Rochester Public Utilities Wellhead Protection Plan Amendment

Part I:

Delineation of the Wellhead Protection Area (WHPA), Drinking Water Supply Management Area (DWSMA), and Assessments of Well and DWSMA Vulnerability

Prepared for

Rochester Public Utilities

July 2017

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Prepared for

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July 2017

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July 2017

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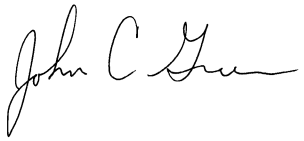
Certification

I hereby certify that this plan, document, or 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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Public Water Supply Profile

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General Information

UNIQUE WELL NUMBER(S) 220666, 220833, 222525, 222528, 220822, 222527, 220681, 220662, 220625, 220818, 220660, 220819, 220675, 147451, 224212, 180567, 161425, 239761, 434041, 506819, 220627, 463536, 601335, 601336, 676687, 698933, 733087, 773386, 796431, 220628, 228168, 220629

SIZE OF POPULATION SERVED 112,742 (2013 estimate)

COUNTY Olmsted

1.0 Introduction

Rochester Public Utilities (RPU) operates the municipal water supply system for the City of Rochester. In compliance with the Minnesota Wellhead Protection Rules (MN Rules 4720.5100 through 4720.5590), wellhead protection areas (WHPAs) and Drinking Water Supply Management Areas (DWSMAs) were delineated for Rochester in 2004 (Osweiler and Blum, 2004). Minnesota Rule 4720.5570 states that wellhead protection plans must be reviewed and amended at least every ten years. In addition, the Minnesota Department of Health (MDH) has instituted requirements for inclusion of fracture-flow analysis in the delineation of WHPAs since the last delineation of the Rochester's WHPAs and DWSMAs.

As required by Minnesota Rule 4720.5570, new WHPAs and new DWSMAs have been delineated for Rochester. This report summarizes work completed to update the delineation of the Rochester WHPAs and DWSMAs in compliance with the Minnesota Wellhead Protection Rules and to meet the current MDH requirements. Data elements used in preparation of the report are presented in Table 1.

RPU currently operates 32 municipal water supply wells (Figure 1). These 32 wells pump from a total of five different aquifers: Shakopee aquifer, Jordan aquifer, Tunnel City aquifer, Wonewoc aquifer, and Mt. Simon aquifer (Table 2). Table 2 summarizes construction, use, and vulnerability information for the RPU water supply wells. Well logs for RPU's wells are presented in Appendix A.

2.0 Criteria for Wellhead Protection Area Delineation

The following criteria were used to ensure accurate delineation of the WHPAs.

2.1 Time of Travel

A minimum 10-year groundwater time of travel criterion must be used to delineate a WHPA (MN Rule 4720.5510) so there is sufficient reaction time to respond to potential health impacts in the event of contamination of the aquifer. A groundwater time of travel of ten years was considered in this study. As required by the Wellhead Protection Rules, the one-year groundwater time of travel was also determined for each well addressed in this study.

2.2 Aquifer Transmissivity

As discussed in Section 2.5 below, the United States Geological Survey (USGS) developed a groundwater model for Olmsted County. The Olmsted County model extends vertically to the base of the Jordan Sandstone. At the November 21, 2014 Pre-Delineation Meeting it was determined that the Olmsted County groundwater model would be used with no changes to hydraulic conductivity or transmissivity for the baseline delineation of WHPAs for the RPU water supply wells that are open to the Shakopee and Jordan aquifers. See Appendix B for a summary of pumping test results for the Prairie du Chien Group and Jordan Sandstone and a comparison to transmissivity ranges in the Olmsted County groundwater model.

As shown in Table 2, a portion of the open intervals in ten of RPU's water supply wells are in the aquifers below the Jordan aquifer. Transmissivities for the combined Tunnel City and Wonewoc aquifers and the Mt. Simon aquifer were the same as those used by Osweiler and Blum (2004) for RPU's previous WHPA delineations (Appendix B).

2.3 Daily Volume of Water Pumped

Annual pumping data for the RPU water supply wells for the period 2009 through 2013 are summarized in Table 3. As indicated in Table 2, RPU Well 41 was not constructed until 2014. The greatest total annual withdrawal for 2009-2013 was 4,824,823,139 gallons in 2012. Projected 2019 total demand is based on a linear projection of historical pumping from RPU (2013) and Olmsted County water systems #1 and #2. As noted in Table 3, RPU provided information on projected pumping of Well 41. The projected 2019 percentages of total pumping for Wells 20, 23, 27, and 30 were reduced from their 2009-2013 averages by 0.3 to 1.3 percent to compensate for the projected pumping from Well 41. The projected 2019 total annual withdrawal is 5,433,500,000 gallons. The maximum projected 2019 pumping from each well was estimated based on the percentage of the total volume that each well pumped from 2009-2013 (with the modifications for Wells 20, 23, 27, and 30) and the 2019 projected demand. The pumping rate used in the models for each RPU water supply well for the WHPA delineation was either the historical maximum for the period 2009-2013 or the maximum projected for 2019, whichever was greater. Table 3 summarizes the pumping rates used in the models for delineation of the WHPAs. Non-revenue water (the difference between the total volume pumped annually by RPU's wells and the total amount billed to users) averaged approximately 6% during the period 2006-2015 (RPU, 2016).

2.4 Conceptual Hydrogeologic Model

The conceptual hydrogeologic model is a schematic description of how water enters, flows, and leaves the groundwater system. Its purpose is to define the major sources and sinks of water, the division or lumping of lithostratigraphic units into aquifers and aquitards, the direction of groundwater flow, the interflow of groundwater between aquifers, and the interflow of water between surface waters and groundwater. The conceptual hydrogeologic model is scale-dependent (i.e., local conditions may not be identical to regional conditions). The following sections provide a brief discussion of the conceptual hydrogeologic model for the Rochester area. A more detailed discussion of the conceptual model is presented n Barr (2014).

2.4.1 Geologic Setting and Generalized Hydrostratigraphy

All of the sedimentary rocks comprising aquifers and aquitards in the Rochester area were deposited during the Paleozoic Era when large epicontinental seas flooded much of the North American craton. The Hollandale Embayment, a shallow shelf that extended from southeastern Minnesota and western Wisconsin southward to Iowa and Illinois was most important in controlling the depositional environment of sediments as water levels fluctuated within the shallow sea. Transgressions (rising of sea level over time) and regressions (a dropping of sea level over time) resulted in the deposition of sediments that became the sequences of limestone, shale, and sandstone that are present today. After formation of these sedimentary bedrock sequences, a long period of erosion occurred, resulting in large bedrock valleys and the removal and/or dissection of bedrock units. Subsequent glaciations during the Quaternary Period resulted in additional erosion of bedrock formations and deposition of glacial sediments. A map of the bedrock geology is shown on Figure 1.

The different sedimentary rocks (referred to as lithostratigraphic units) are generally distinguishable and mappable over large areas. Figure 2 shows lithostratigraphic units found in Olmsted County. Lithostratigraphic units are lumped or split into hydrostratigraphic units depending on their ability to transmit water. Some lithostratigraphic units, or parts thereof, transmit water easily and are referred to as aquifers. Others do not transmit water easily, especially in the vertical direction, and are referred to as confining units or aquitards (Figure 2). The aquifers in the Rochester area include the following hydrostratigraphic units:

- Galena aquifer
- St. Peter aquifer
- Shakopee aquifer
- Jordan aquifer
- Tunnel City aquifer
- Wonewoc aquifer
- Mt. Simon aquifer

Relative to WHPA delineations, the aquifers of interest are the Shakopee, Jordan, Tunnel City, Wonewoc, and Mt. Simon.

The aquitards in the Rochester area include the following hydrostratigraphic units:

- Decorah, Platteville, and Glenwood confining units
- Oneota confining unit
- Jordan confining unit
- St. Lawrence confining unit
- Tunnel City confining unit
- Eau Claire confining unit
- Precambrian confining unit

Cross sections showing the hydrostratigraphic units down to the Mt. Simon aquifer in the Rochester area are shown on Figures 3 through 5. Cross section locations are shown on Figure 1.

2.4.2 Groundwater Flow Directions

Groundwater flows from zones of high piezometric head to zones of low piezometric head. As shown on plate 5 (Bedrock Hydrogeology) of the Olmsted County Geologic Atlas (Kanivetsky, 1988), in the Rochester area groundwater flow in the St. Peter, Shakopee, and Jordan aquifers is from a groundwater divide located west, south, and east of the City toward the South Fork Zumbro River, which is the main natural groundwater discharge zone for much of the region.

Regionally, groundwater flow in the deeper Tunnel City, Wonewoc, and Mt. Simon aquifers is towards the east-northeast where the Mississippi River is the main groundwater discharge zone (e.g., Delin and Woodward, 1984; Young, 1992). Conceptually there may be some groundwater flow from the Tunnel City aquifer upward toward the South Fork Zumbro River and wells open to the Jordan aquifer but data are not sufficient to definitively identify such a condition. Locally, around high capacity wells or well fields, smaller cones of depression may also develop in the aquifers, resulting in local groundwater-flow paths directed toward high-capacity wells.

2.4.3 Recharge/Leakage

Recharge to the Galena aquifer in the Rochester area occurs primarily via relatively slow infiltration of precipitation through unconsolidated sediments and rapid infiltration via karst features. Rates of recharge are not well documented, and likely are highly variable due to karst conditions. The cross sectional model of Lindgren (2001) used a recharge rate of 7.0 in/yr for the Galena aquifer.

The most studied source of water for the St. Peter aquifer in the Rochester area is focused areal recharge occurring along the edge of the Decorah, Platteville, and Glenwood confining units (i.e., the Decorah edge). Recharge rates along the Decorah edge have been estimated to range from 1.9 in/yr to 25.5 in/yr (Lindgren, 2001) and are highly dependent on local conditions. Most areas where the St. Peter Sandstone is the uppermost bedrock in the vicinity of Rochester correspond to locations of focused areal recharge along the Decorah edge. However, where the St. Peter Sandstone is the uppermost bedrock and not subject to focused recharge due to the Decorah edge, recharge rates have been estimated at 4.8 to 6.2 inches per year (Lindgen, 2001). In areas where the St. Peter Sandstone is not the uppermost bedrock

unit leakage through the overlying Glenwood confining unit away from the Decorah edge has been estimated to range from 0.1 in/yr to 2 in/yr (Delin, 1991; Lindgren, 2001).

Recharge to the Shakopee aquifer occurs via three main processes: leakage from the overlying St. Peter aquifer, areal recharge where the Shakopee Formation is the uppermost bedrock unit, and seepage from surface water features. The amount of leakage from the overlying St. Peter aquifer is unknown. In the Minneapolis-St. Paul metropolitan area a basal shaley member in the St. Peter Sandstone has been identified from boring and gamma logs (Mossler, 2008). This shaley member is regarded as an aquitard. Tipping and Runkel (2008) note that this basal shaley member of the St. Peter Sandstone is not present in Olmsted County. However, Lindgren (2001) identified water level differences between the St. Peter aquifer and the Shakopee aquifer of as much as 7.2 feet that were measured in a well nest, indicating that the basal portion of the St. Peter Sandstone may impede groundwater flow and act as a confining unit. Therefore, Lindgren (2001) included a basal St. Peter confining unit in his cross sectional groundwater flow model. Using data presented by Lindgren (2001), the cross sectional model estimates seepage through the basal St. Peter at 1.8 in/yr. However, at this time it is unknown if this rate is applicable at a regional scale. Areal recharge to the Shakopee aquifer is estimated to range from 4.8 in/yr to 6.2 in/yr (Lindgren, 2001; Delin, 1991).

Delin (1991) found that most river reaches in the Rochester area are gaining (i.e., groundwater flows into the stream). However, it was concluded that at least three reaches of the South Fork of the Zumbro River and one reach of Bear Creek are likely losing reaches (i.e., river water seeping into the groundwater system). A detailed analysis of a 600 foot-long reach along the South Fork Zumbro River north of U.S. Highway 14 concluded the River was losing 1.2 ft^3/sec to the underlying Shakopee aquifer in July, 1988 (Delin, 1991). Much of this losing reach has been attributed to pumping from RPU Well 11. However, water chemistry information indicates that the amount of water originating from the River that enters the well is minimal, and no nitrate or pesticides from the River have been detected in Well 11. Much of the capture area for Well 11 is believed to be under and on the other side of the River due to the presence of volatile organic chemicals in the well water that are known to have been spilled on the other side of the River from Well 11 (Osweiler and Blum, 2004).

The Prairie du Chien is exposed in the bed of Silver Creek indicating the potential for a high degree of connection between the aquifer system and the Creek. A stream gaging study for Silver Creek near Well 27 was conducted by the MDH in 2002 (Osweiler and Blum, 2004). Results from the study indicated a significant loss of stream flow in the creek while Well 27 was pumping. The USGS did some additional follow-up study along Silver Creek near Well 27 in 2008 and 2010 (USGS, 2011). Results from the USGS study indicated that during most of the year Silver Creek is a gaining stream near Well 27. However, during some periods, particularly in the late summer and fall, some reaches do become losing. Water quality and isotopic analyses show no indication that groundwater pumped from Well 27 is sourced from Silver Creek (e.g., Blum, 2016a). It is possible that pumping effects could result in a reach of Silver Creek becoming a losing stream for a portion of the year without water captured by Well 27 being sourced from the Creek.

Recharge to the Jordan aquifer occurs primarily via leakage through overlying or underlying confining units. Leakage downward through the overlying Oneota confining unit most certainly occurs. Also potentially important, but not well quantified, is vertical upward leakage through the St. Lawrence and Jordan confining units. Due to lowered hydraulic head in the Jordan aquifer resulting from large pumping stresses, the potential may exist for upward vertical leakage from below, particularly near high capacity wells. The extent and magnitude of such potential upward leakage in the Rochester area is unknown.

Recharge to the Tunnel City, Wonewoc, and Mt. Simon aquifers occurs via leakage through overlying confining units. The amount of leakage between units has not been quantified. Similar to the Jordan aquifer, leakage may occur upward through underlying confining units near high capacity wells. However, pumping stresses on these aquifers are much less than on the Jordan aquifer and upward leakage is likely not as potentially significant.

2.4.4 Groundwater Discharge

Various measurements of groundwater discharge to streams have been made in the Rochester area. Delin (1991) measured a total net groundwater discharge along 25 miles of the South Fork Zumbro River of 16 ft^3/sec. The study noted, however, that along 7 miles of the South Fork Zumbro River there was a measured loss from the River to the aquifer of 11 ft^3/sec. The groundwater flow model developed by Delin (1991) and updated by Lindgren (1997) estimated net groundwater discharge along the same 25 miles of the South Fork Zumbro River between 17 ft^3/sec and 20 ft^3/sec. The net groundwater discharge along six miles of Bear Creek was measured at 5 ft^3/sec by Delin (1991) and the net groundwater discharge along six miles of Cascade Creek was measured at 2 ft^3/sec.

It is noted that much of the available data regarding groundwater discharge to streams was collected prior to major flood control projects in the Rochester area. These projects straightened and deepened channels in addition to constructing flood walls and other control structures. The effect of these modifications on groundwater discharge to streams is unknown.

2.4.5 Flow Boundaries

Groundwater flow boundaries in the vicinity of Rochester include the South Fork Zumbro River and tributaries, which flow through the City. High capacity wells act as local flow boundaries while operating.

2.5 Groundwater Models

Most of RPU's wells are open to the Jordan aquifer or the Jordan aquifer and portions of the Prairie du Chien Group (Shakopee aquifer and/or Oneota confining unit). RPU wells 12, 17 18, 19, 20, 21, 22, 24, and 25 are open to the Jordan, Tunnel City, and Wonewoc aquifers. Well 20 is also open from the Jordan aquifer to the Mt. Simon aquifer.

To accurately delineate the WHPAs, it is necessary to assess how nearby wells, rivers, lakes, and variations in geologic conditions affect groundwater flow directions and velocities in the aquifer. The USGS constructed a groundwater flow model for Olmsted County for RPU using the finite difference code MODFLOW-NWT (Niswonger et al., 2011). MODFLOW-NWT is public domain software that is available

from the United States Geological Survey. The Jordan aquifer is the lowermost hydrostratigraphic unit included in this groundwater model.

At the November 21, 2014 Pre-Delineation Meeting with MDH staff it was decided that the pre-release version of the Olmsted County model would be used for porous media capture zone delineations in the Shakopee and Jordan aquifers (with minor modifications that are identified in section 2.5.2 below). The pre- and post-processor Groundwater Vistas (version 6) (ESI, 2011) was used to create the model data files and evaluate the model results.

As noted above, the open intervals for RPU Wells 12, 17 18, 19, 20, 21, 22, 24, and 25 extend below the Jordan aquifer into the Tunnel City and Wonewoc aquifers. The open interval in Well 20 extends into the Mt. Simon aquifer. At the November 21, 2014 Pre-Delineation Meeting with MDH staff it was decided that an analytic element model such as MLAEM (Strack, 1998) would be used for capture zone delineations for the portions of these wells open in the Tunnel City, Wonewoc, and Mt. Simon aquifers.

2.5.1 MODFLOW Model

The Olmsted County groundwater model developed by the USGS consists of eight layers. The model domain extends slightly beyond the Olmsted County limits as shown in Appendix C. As shown in Appendix C, the hydrostratigraphic units are simulated in the eight model layers as follows:

- Layer 1 – Quaternary sediments
- Layer 2 – Galena aquifer
- Layer 3 – Decorah, Platteville, and Glenwood confining unit
- Layer 4 – St. Peter aquifer
- Layer 5 – Upper Shakopee aquifer
- Layer 6 – Lower Shakopee aquifer
- Layer 7 – Oneota confining unit
- Layer 8 – Jordan aquifer

A cross section through the model domain and the hydraulic conductivity ranges in the model layers are shown in Appendix C.

2.5.1.1 Boundary Conditions

As shown in Appendix C, the model domain boundary consists of constant head cells. Documentation from the USGS indicating how the boundary heads were defined was not available at the time this report was prepared but they appear to be consistent with available hydraulic head data from the County Well Index (CWI). The USGS used MODFLOW's SFR2 package to simulate streams in the model domain. Recharge is distributed on model layer 1 as shown in Appendix C.

2.5.1.2 Model Parameters

Recharge for the model as estimated during the model calibration process conducted by the USGS is shown in Appendix C. Recharge values range between 5.9 and 10.6 in/yr, which is within the expected range for the Rochester area.

The distribution of hydraulic conductivity values in the model was defined using a series of pilot points (Doherty, 2003). The range of hydraulic conductivity values for each hydrostratigraphic unit is shown in Appendix C. Per the discussion at the November 21, 2014 Pre-Delineation Meeting with MDH staff, no additional model calibration was performed.

2.5.2 Model Modifications

Per the discussion at the November 21, 2014 Pre-Delineation Meeting with MDH staff, the following modifications were made to the pre-release version of the Olmsted County groundwater model to facilitate the WHPA delineations in the Shakopee and Jordan aquifers:

- Pumping rates for all RPU wells were updated to projected future rates shown in Table 3. Aquifer transmissivities in the model were used to determine how pumping was distributed in multi-aquifer wells.
- Model boundaries represented with the Stream Flow Routing Package (SFR2) were converted to the River Package (RIV) to facilitate model grid refinement.
- The model grid was refined to 12.5 meters by 12.5 meters around the RPU wells.

MODFLOW files for the Olmsted County groundwater model are provided in Appendix G.

2.6 MLAEM Model

Model layers 4 and 5 of the southern province of Metro Model 1 (Seaberg, 2000, Hansen and Seaberg, 2000) were modified as described in the next section for the delineations in the aquifers below the Jordan aquifer.

The Tunnel City and Wonewoc aquifers are combined in layer 4 of Metro Model 1. Model layer 5 of Metro Model 1 simulates the Mt. Simon aquifer. The groundwater flow direction in the Tunnel City, Wonewoc, and Mt. Simon aquifers in the vicinity of Rochester is generally to the northeast. The regional discharge area for these aquifers is the Mississippi River. Locally, discharge from the aquifers occurs via high capacity wells. In some areas of southeastern Minnesota (but not in the vicinity of Rochester) springs emerge from the Tunnel City Group.

It is assumed that the St. Lawrence confining unit hydraulically separates the Tunnel City aquifer from the overlying Jordan aquifer and that RPU wells penetrating the St. Lawrence confining unit draw essentially no water from the unit. It is further assumed that the Eau Claire confining unit hydraulically separates the Wonewoc aquifer from the Mt. Simon aquifer and that Well 20 draws essentially no water from the Eau Claire confining unit.

2.6.1 Model Modifications

The following modifications were made to Layers 4 and 5 of Metro Model 1 in order to facilitate WHPA delineations for the RPU wells:

- RPU wells 12, 17, 18 19, 20, 21, 22, 24, and 25 were added to the model. Pumping rates in model layers 4 and 5 were apportioned based on the transmissivities of the aquifers as shown in Appendix C. No high capacity wells in the Tunnel City, Wonewoc, or Mt. Simon aquifers other than the RPU wells open to these aquifers were identified in the vicinity of Rochester.
- A curvilinear element with a fixed head was added southwest of Rochester to help define the hydraulic gradient in layer 4. Hydraulic gradient shown in Delin and Woodward (1984) and Ruhl et al. (1982) were used to guide the selection of the location and elevation for the curvilinear element.
- Hydraulic conductivities in Layers 4 and 5 were adjusted to be consistent with the aquifer transmissivities shown in Table 4.
- VAREL strengths on the top of layer 4 were adjusted so that head and hydraulic gradient in layer 4 in the vicinity of Rochester were consistent with available information (e.g., Delin and Woodward, 1984).
- Model uncertainties were addressed by varying the hydraulic conductivities of model Layers 4 and 5. Following the approach described by Osweiler and Blum (2004), the hydraulic conductivity of Layer 4 was varied $\pm$50% and the hydraulic conductivity of Layer 5 was varied $\pm$10%.

2.7 Groundwater Flow Fields

The groundwater flow fields used for delineation of the WHPAs were determined by the groundwater flow models. In the Shakopee and Jordan aquifers, the modeled flow fields indicate that groundwater flow in these aquifers in the vicinity of Rochester is generally toward the central part of the City and the South Fork Zumbro River (see Appendix C). In the combined Tunnel City and Wonewoc aquifers and in the Mt. Simon aquifer the modeled groundwater flow fields indicate the flow directions in the vicinity of Rochester are generally to the northeast toward the regional discharge zone at the Mississippi River (see Appendix C). These modeled flow directions are consistent with available data.

3.0 Delineation of the Wellhead Protection Areas

At the Pre-Delineation meeting it was determined that delineation of the WHPAs for the RPU wells must include the evaluation of both porous media flow and fracture flow. Therefore, porous media capture zones were determined for all RPU wells and fractured media flow delineations were developed for the RPU wells open in the Shakopee aquifer and/or Jordan aquifer. The porous media and fractured media capture zones were combined to delineate the composite WHPA.

3.1 Porous Media Flow Evaluation

The groundwater flow models discussed above in Section 2 were used for the evaluation of porous media groundwater flow in the vicinity of Rochester.

3.1.1 Shakopee and Jordan Aquifer Delineations

Most of RPU's wells are open to the Jordan aquifer or the Jordan aquifer and portions of the Prairie du Chien Group (Shakopee aquifer and/or Oneota confining unit). Delineation of the porous media capture zones for these wells is described below.

3.1.1.1 Porous Media Flow Delineations

The pre-release version of the Olmsted County groundwater model, modified as discussed above in section 2.5.2, was used to delineate 1-year and 10-year porous media flow capture zones for the RPU wells open in the Shakopee and Jordan aquifers.

The porous media capture zones for the RPU wells were delineated using the software program MODPATH (Pollock, 1994) with the modeled groundwater flow field. A minimum of 50 particles were tracked from each well. The particles were released from at least 5 vertical points along the open section of each aquifer supplying a well. These particles were tracked backwards in time for 1 year and 10 years.

Porosity values used for the porous media evaluation were as follows (Norvitch et al., 1974; Schwartz and Zhang, 2003):

- Quaternary sediments = 0.25
- St. Peter aquifer = 0.283
- Prairie du Chien Group = 0.056 (both the Shakopee aquifer and Oneota confining unit)
- Jordan aquifer = 0.2

The porous media capture zones for the RPU wells open in the Shakopee and Jordan aquifers were delineated using the software program MODPATH (Version 5) with the modeled groundwater flow fields.

Sensitivity Analysis

Multiple particle tracking simulations were conducted to account for uncertainty of the horizontal hydraulic conductivity of the Jordan aquifer and the vertical hydraulic conductivity of the Oneota

confining unit. In addition to the base model run, particle tracking simulations were conducted for each of the following:

- Decrease the horizontal hydraulic conductivity of the Jordan aquifer by a factor of eight
- Decrease the vertical hydraulic conductivity of the Oneota by a factor of two
- Increase the vertical hydraulic conductivity of the Oneota by a factor of two
- Decrease the vertical hydraulic conductivity of the Oneota by a factor of ten
- Increase the vertical hydraulic conductivity on the Oneota by a factor of ten

For each of these simulations, particle tracking was done for 1-year and 10-year times of travel. The particles traces from the base model run and the sensitivity simulations were combined to produce composite 1-year and 10-year porous media times of travel particle trace maps for the RPU wells open in the Shakopee and/or Jordan aquifer (Appendix C).

3.1.1.2 Fracture Flow Evaluation

Fractured media flow delineations were developed for the RPU wells open in the Shakopee aquifer and/or Jordan aquifer. These delineations were prepared by MDH staff (Blum, 2016b) following procedures developed by the MDH (2011) and provided to RPU. Delineation of the 1-year groundwater time of travel zone around each affected RPU well was done using the calculated fixed radius technique (Appendix D). Delineation of the 10-year groundwater time of travel zone around each affected RPU well included the calculated fixed radius with upgradient extensions and extensions based on lineament orientations (Appendix D). The procedures followed for the fracture flow evaluation are documented in Appendix D.

3.1.2 Delineations for Lower Aquifers

RPU wells 12, 17 18, 19, 20, 21, 22, 24, and 25 are open to the Tunnel City and Wonewoc aquifers. Well 20 is also open to the Mt. Simon aquifer. Groundwater flow in these aquifers is considered to be according to porous media principles. The WHPAs for these wells in the aquifers below the Jordan aquifer were delineated using the analytical element code MLAEM (Strack, 1998). The Minnesota Pollution Control Agency (MPCA) used MLAEM to develop Metro Model 1 for the Minneapolis-St. Paul metropolitan area (Seaberg, 2000; Hansen and Seaberg, 2000). Layers 4 and 5 of Metro Model 1 include the Rochester area. The Tunnel City and Wonewoc aquifers are combined in model layer 4 and model layer 5 simulates the Mt. Simon aquifer.

Groundwater capture zones for 1-year and 10-year groundwater times of travel were delineated around each well in layers 4 and 5 by tracing 30 particles backward in time from each well in each model layer, as appropriate. Composite groundwater time of travel zones around each well were delineated by combining the base and uncertainty analysis results. The composite particle tracking maps for 1-year and 10-year groundwater time of travel around the RPU wells in the combined Tunnel City and Wonewoc aquifers and the Mt. Simon aquifer are shown in Appendix C.

3.2 WHPA Delineations

The 10-year fracture flow capture zones and composite 10-year porous media capture zones were combined to define the WHPAs. There are three main WHPAs due to spacing of the RPU wells. In addition, there are small WHPAs around Wells 24, 72, 73, and 77. The Emergency Response Area (ERA) is delineated for each well by the combined 1-year fracture flow capture zones and composite 1-year porous media capture zones. The WHPAs and ERAs are shown on Figure 6.

3.3 Conjunctive Delineation

As discussed below in section 6.0, there are areas in the DWSMA in which aquifer vulnerability of the Shakopee aquifer (i.e., the uppermost aquifer from which the RPU wells pump) is classified as High. However, based on an evaluation of groundwater chemistry data (Blum, 2016a), the MDH determined that available information does not indicate a direct link between surface water and any of the RPU wells located in areas where vulnerability of the Shakopee aquifer is classified as High. Therefore, inclusion of a conjunctive delineation (i.e., a surface water catchment area) in the DWSMA was not necessary.

4.0 Delineation of the Drinking Water Supply Management Areas

The Rochester DWSMAs encompass the WHPAs with boundaries that correspond to geographically identifiable features (e.g., roads, parcel boundaries, quarter-quarter section lines). The majority of the DWSMA boundaries are defined by quarter-quarter sections. The Northwestern DWSMA extends beyond the Rochester city limits into Cascade and Kalmar Townships. The Central DWSMA extends beyond the Rochester city limits into Cascade, Haverhill, Marion, and Rochester Townships. The Southeastern DWSMA extends beyond the Rochester city limits into Marion Township. The Well 24 DWSMA is entirely within the Rochester city limits. The Well 72 DWSMA and the Well 77 DWSAMA are entirely within Marion Township. The Well 73 DWSMA extends beyond the Rochester city limits into Rochester Township. The Rochester DWSMAs are shown on Figure 7. Per the discussion at the November 21, 2014 Pre-Delineation Meeting, the MDH is not requiring 1:24,000 scale maps of the DWSMAs.

5.0 Well Vulnerability Assessment

MDH evaluated the vulnerability of the RPU municipal wells to contamination from contaminants released at the surface. The evaluation parameters include geology, well construction, pumping rate, and water quality. RPU Wells 20, 21, 23, 24, 25, 40, 72, 73, and 77 are classified as "Not Vulnerable" and the remaining RPU wells are classified as "Vulnerable." The well vulnerability classification for each of the RPU wells is shown in Table 2. Copies of the MDH well vulnerability scoring sheets for the RPU wells are presented in Appendix E.

6.0 Drinking Water Supply Management Area Vulnerability Assessment

The standard approach to evaluating and classifying aquifer vulnerability within a DWSMA per MDH guidance (see MDH, 1997) is based on an assessment of geologic sensitivity and groundwater quality data (see Appendix F). The Prairie du Chien Group (composed of the Shakopee Formation and Oneota Dolomite) are fractured/karsted in southeastern Minnesota, including in the Rochester area. As a result, there is uncertainty in the groundwater flow directions and velocities in the Shakopee aquifer, particularly in areas where the Shakopee Formation is the uppermost bedrock unit. Therefore, after discussions with MDH staff, it was determined that an approach that is more conservative than the standard approach to classifying aquifer vulnerability within the RPU DWSMAs was warranted in order to be more protective of the source water aquifers. The more conservative approach places less weight on the water chemistry of samples from individual wells.

The more conservative approach for classifying aquifer vulnerability (Blum, 2017) consists of the following:

- Classifying aquifer vulnerability as High in areas where the Shakopee Formation or the St. Peter Sandstone is the uppermost bedrock unit and there is not a significant fraction of clay-rich sediments overlying the bedrock. This covers the majority of the area within the DWSMAs.
- Classifying aquifer vulnerability as Moderate in areas where the Decorah Edge units (i.e., Glenwood Formation, Platteville Formation, and Decorah Shale) are the uppermost bedrock units.
- Classifying the aquifer vulnerability as Low in areas where Galena Group units (Cummingsville Formation and Prosser Limestone) are the uppermost bedrock units.

These criteria were generally applied using quarter-quarter sections (i.e, tracts 40 acres in size). The aquifer vulnerability distribution within the DWSMAs determined following this approach is shown on Figure 7.

7.0 Recommendations

Groundwater and surface water quality data obtained by the MDH (Blum, 2016a) was used to assess the potential connection between surface water bodies and RPU wells. The analytical data included stable isotopes of water along with nitrate, nitrite, ammonia, chloride, and bromide. Based on the available data, it was not clear in some cases if a connection between an RPU well and surface water exists. It is recommended that RPU work with MDH to develop a plan to collect additional water quality data with the objective of reducing, or eliminating, uncertainties regarding potential connections between RPU wells and surface water. The data could be used to improve the groundwater model used in the WHPA delineations and to support improved assessments of well vulnerability.

It is also noted that RPU is working with Minnesota Department of Natural Resources staff to develop a program for groundwater and surface water monitoring in the Rochester area. It is recommended that RPU provide updates to MDH staff regarding the development of the monitoring program and/or involve MDH staff in the discussions.

8.0 Supporting Data Files

The groundwater model files and GIS files are included in Appendix G. (Appendix G can be found in the "Part1" folder on the CD.)

The groundwater model can be reviewed using MODFLOW-NWT (Niswonger et al., 2011). MODPATH files can be reviewed using MODPATH Version 5.

All coordinates in the modeling files are based on UTM NAD 83 Zone 15 N datum. Elevations are in meters above mean sea level (m MSL). Time units are days. Length units are meters.

The GIS files have been named according to the MDH conventions. Shapefiles are in UTM NAD83 Zone 15 N datum.

9.0 References

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Tables

Table 1

Assessment of Data Elements
Rochester Public Utilities WHPP Amendment

Data Element	Present and Future Implications				Data Source
	Use of the Wells	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in [illegible]	
Precipitation	M	L	M	M	Minnesota Climatology Working Group
Geology					
Maps and geologic descriptions	M	H	H	H	MGS, CWI
Subsurface data	M	H	H	H	MGS, MDH, CWI
Borehole geophysics	M	M	M	M	MGS
Surface geophysics	L	L	L	L	Not Available
Maps and soil descriptions	L	M	M	M	MGS, NRCS
Eroding lands					
Water Resources					
Watershed units	L	L	L	L	DNR
List of public waters	L	L	L	L	DNR
Shoreland classifications					
Wetlands map					
Floodplain map					
Land Use					
Parcel boundaries map	L	L	L	L	Olmsted County
Political boundaries map	L	L	L	L	MNGEO
PLS map	L	H	L	L	DNR
Land use map and inventory					
Comprehensive land use map					
Zoning map					
Public Utility Services					
Transportation routes and corridors	L	L	L	L	MNDOT
Storm/sanitary sewers and PWS system map	L	L	L	L	RPU, City of Rochester
Oil and gas pipelines map					

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

CWI – Minnesota County Well Index
DNR – Minnesota Department of Natural Resources
MNGEO - Minnesota Geospatial Information Office
MDH – Minnesota Department of Health
MNDOT – Minnesota Department of Transportation
MPCA – Minnesota Pollution Control Agency
NRCS – Natural Resources Conservation Service
SSURGO – Soil Survey Geographic Database
USGS – United States Geological Survey

Table 1

Assessment of Data Elements
Rochester Public Utilities WHPP Amendment

Data Element	Present and Future Implications				Data Source
	Use of the Wells	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in [illegible]	
Public drainage systems map/list	L	L	L	L	City of Rochester
Records of well construction, maintenance, and use	H	H	M	L	RPU, CWI, MDH files
Surface Water Quantity					
Stream flow data	L	L	L	L	DNR
Ordinary high water mark data	L	L	L	L	DNR
Permitted withdrawals	L	L	L	L	DNR
Protected levels/flows	L	L	L	L	DNR
Water use conflicts	L	L	L	L	DNR
Groundwater Quantity					
Permitted withdrawals	H	H	H	H	DNR, RPU
Groundwater use conflicts	L	L	L	L	DNR
Water levels	H	H	H	H	CWI, MDH
Surface Water Quality					
Stream and lake water quality management classification					
Monitoring data summary	L	M	L	L	MDH
Groundwater Quality					
Monitoring data	H	H	H	H	MDH
Isotopic data	H	H	H	H	MDH
Tracer studies	L	L	L	L	Not Available
Contamination site data	L	L	M	M	MPCA, MDH
Property audit data from contamination sites					
MPCA and MDA spills/release reports	L	L	L	L	MDA, MPCA

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

CWI – Minnesota County Well Index
DNR – Minnesota Department of Natural Resources
MNGEO - Minnesota Geospatial Information Office
MDH – Minnesota Department of Health
MNDOT – Minnesota Department of Transportation
MPCA – Minnesota Pollution Control Agency
NRCS – Natural Resources Conservation Service
SSURGO – Soil Survey Geographic Database
USGS – United States Geological Survey

Table 2

RPU Water Supply Wells
Rochester Public Utilities WHPP Amendment

Unique Number	Local Well ID	Use[1]	Year Completed	Casing Diameter (in)	Casing Depth (ft)	Well Depth (ft)	Aquifer[2]	Well Vulnerability[3]
220666	11	P	1948	20	140	455	OPSH – CJDN	High
220833	12	P	1960	14	307	752	CJDW	High
222525	13	P	1954	24x20	141	442	OPSH – CJDN	High
222528	15	P	1957	30x24	154	432	OPSH – CJDN	High
220822	17	P	1960	24x16	429	904	CJDW	Medium
222527	18	P	1963	30x24	343	806	CJDW	Medium
220681	19	P	1962	30x24	343	881	CJDW	Medium
220662	20	P	1964	30x24	306	912	CJMS	Medium
220625	21	P	1965	30x24	458	981	CJDW	Low
220818	22	P	1966	30x24	344	730	CJDW	Medium
220660	23	P	1967	30x24	326	436	OPSH-CJDN	Low
220819	24	P	1968	24	309	685	CJDW	Low
220675	25	P	1969	30x24	345	850	CJDW	Low
147451	26	P	1978	30x24	364	624	OPSH – CJDN	High
224212	27	P	1979	30x24	345	448	CJDN	Medium
180567	28	P	1981	30x24	305	389	CJDN	High
161425	29	P	1982	30x24	422	519	CJDN	Medium
239761	30	P	1984	36x24	319	402	CJDN	Medium
434041	31	P	1987	36x24	462	530	CJDN	Medium
506819	32	P	1989	36x24	453	540	CJDN	High
220627	33	P	1958	24x16	509	605	CJDN	Medium
463536	34	P	1991	36x24	369	465	CJDN	Medium
601335	35	P	1999	36x30x24	369	457	CJDN	Medium
601336	36	P	2000	30x24	397	478	CJDN	Medium
676687	37	P	2003	30x24	393	501	CJDN	Medium
698933	38	P	2004	30x24	374	467	CJDN	Medium
733087	39	P	2006	30x24	365	458	CJDN	Medium
773386	40	P	2010	30x24	460	640	OPSH – CJDN	Low
796431	41	P	2014	30x24	360	470	CJDN	Low
220628	72	P	1968	10x6	375	460	CJDN	Low
228168	73	P	1965	16x10	575	675	CJDN	Medium
220629	77	P	1964	12x8	369	450	CJDN	Low

[1] P=Primary water supply well
[2] Aquifer codes: CJDN = Jordan; OPSH – CJDN = Shakopee – Jordan; CJDW = Jordan – Tunnel City – Wonewoc; CJMS = Jordan – Tunnel City –Wonewoc – Mt. Simon
[3] Well vulnerability from Table 4 in Blum (2016)

Table 3
Annual and Projected Pumping Rates for RPU Wells
Rochester Public Utilities WHPP Amendment

2009 - 2013 Annual Pumping Data

Unique Number	Well Name	Total Annual Withdrawal (gal/yr)				
		2009	2010	2011	2012	2013
220666	11	191,803,000	167,695,000	165,884,000	229,389,000	111,057,000
220833	12	1,500,000	1,918,000	1,901,000	494,000	257,000
222525	13	203,006,000	201,011,000	135,849,000	102,568,000	114,899,000
222528	15	19,411,000	24,214,000	39,186,000	34,006,000	74,385,000
220827	16	0	0	0	0	0
220822	17	235,986,000	237,476,000	198,307,000	133,904,000	126,352,000
222527	18	157,186,000	127,732,000	61,035,000	142,445,000	120,884,000
220681	19	25,556,000	19,471,000	28,934,000	25,200,000	21,892,000
220662	20	56,239,000	53,947,000	89,395,000	87,096,000	23,170,000
220625	21	93,614,000	86,588,000	92,199,000	92,107,000	101,030,000
220818	22	254,267,000	211,738,000	175,787,000	206,448,000	160,210,000
220660	23	50,425,000	45,303,000	28,863,000	112,629,000	116,310,000
220819	24	43,479,000	33,538,000	29,995,000	28,748,000	25,426,000
220675	25	215,937,000	337,250,000	310,992,000	158,654,000	131,511,000
147451	26	148,058,000	156,300,730	119,257,000	128,100,000	130,258,000
224212	27	444,421,000	390,941,000	388,429,000	284,333,000	296,747,000
180567	28	196,722,000	262,369,000	348,229,000	380,483,000	421,974,000
161425	29	165,073,000	209,563,000	153,846,000	174,710,000	166,656,000
239761	30	350,746,000	199,927,000	259,270,000	446,886,000	319,984,000
434041	31	288,029,000	191,438,000	285,774,000	291,969,000	269,016,000
506819	32	141,846,000	39,827,000	97,629,000	84,281,000	111,078,000
220627	33	11,612,000	11,198,000	9,282,000	19,199,000	9,735,000
463536	34	191,586,000	129,757,000	152,437,000	191,575,000	197,142,000
601335	35	204,753,000	266,288,000	167,348,000	251,162,000	298,979,000
601336	36	457,984,000	564,113,000	548,132,000	486,436,760	503,027,000
676687	37	151,536,000	224,639,000	153,004,000	204,960,000	137,683,000
698933	38	129,221,000	42,242,000	206,240,000	232,607,000	103,065,000
733087	39	183,176,000	156,556,000	120,750,000	174,684,000	294,920,000
773386	40	0	0	33,433,000	101,175,000	79,130,000
219560	Airport (71)	53,178,000	63,768,000	43,541,000	3,380,000	0
220628	Sandy Slopes (72)	3,437,061	3,278,782	3,264,796	3,722,273	3,032,468
228168	Merrihills (73)	3,119,109	2,501,630	2,693,500	3,788,506	3,071,060
220776	Osjor Estates (76)	0	0	0	0	0
220629	Meadowbrook (77)	4,097,200	3,414,000	3,900,000	4,175,400	3,410,900
220687	Lenwood (78)	0	0	0	3,508,200	0
	Totals	**4,677,003,370**	**4,466,002,142**	**4,454,786,296**	**4,824,823,139**	**4,476,291,428**

Source: Rochester Public Utilities

Table 3 (cont.)
Annual and Projected Pumping Rates for RPU Wells
Rochester Public Utilities WHPP Amendment

2009 - 2013 Percent of Annual Withdrawal

Unique Number	Well Name	Percent Annual Withdrawal					Average Annual % of Withdrawal
		2009	2010	2011	2012	2013	
220666	11	4.1%	3.8%	3.7%	4.8%	2.5%	3.8%
220833	12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
222525	13	4.3%	4.5%	3.0%	2.1%	2.6%	3.3%
222528	15	0.4%	0.5%	0.9%	0.7%	1.7%	0.8%
220827	16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
220822	17	5.0%	5.3%	4.5%	2.8%	2.8%	4.1%
222527	18	3.4%	2.9%	1.4%	3.0%	2.7%	2.6%
220681	19	0.5%	0.4%	0.6%	0.5%	0.5%	0.5%
220662	20	1.2%	1.2%	2.0%	1.8%	0.5%	1.3%
220625	21	2.0%	1.9%	2.1%	1.9%	2.3%	2.0%
220818	22	5.4%	4.7%	3.9%	4.3%	3.6%	4.4%
220660	23	1.1%	1.0%	0.6%	2.3%	2.6%	1.5%
220819	24	0.9%	0.8%	0.7%	0.6%	0.6%	0.7%
220675	25	4.6%	7.6%	7.0%	3.3%	2.9%	5.1%
147451	26	3.2%	3.5%	2.7%	2.7%	2.9%	3.0%
224212	27	9.5%	8.8%	8.7%	5.9%	6.6%	7.9%
180567	28	4.2%	5.9%	7.8%	7.9%	9.4%	7.0%
161425	29	3.5%	4.7%	3.5%	3.6%	3.7%	3.8%
239761	30	7.5%	4.5%	5.8%	9.3%	7.1%	6.8%
434041	31	6.2%	4.3%	6.4%	6.1%	6.0%	5.8%
506819	32	3.0%	0.9%	2.2%	1.7%	2.5%	2.1%
220627	33	0.2%	0.3%	0.2%	0.4%	0.2%	0.3%
463536	34	4.1%	2.9%	3.4%	4.0%	4.4%	3.8%
601335	35	4.4%	6.0%	3.8%	5.2%	6.7%	5.2%
601336	36	9.8%	12.6%	12.3%	10.1%	11.2%	11.2%
676687	37	3.2%	5.0%	3.4%	4.2%	3.1%	3.8%
698933	38	2.8%	0.9%	4.6%	4.8%	2.3%	3.1%
733087	39	3.9%	3.5%	2.7%	3.6%	6.6%	4.1%
773386	40	0.0%	0.0%	0.8%	2.1%	1.8%	0.9%
219560	Airport (71)	1.1%	1.4%	1.0%	0.1%	0.0%	0.7%
220628	Sandy Slopes (72)	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
228168	Merrihills (73)	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
220776	Osjor Estates (76)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
220629	Meadowbrook (77)	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
220687	Lenwood (78)	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%

Table 3 (cont.)
Annual and Projected Pumping Rates for RPU Wells
Rochester Public Utilities WHPP Amendment

Projected Pumping for Capture Zone Delineations

Unique Number	Well Name	Projected 2019 Total[1] (gal/yr)	% of 2019 Total Projected Water Use Well[2,7]	Projected 2019 Well Pumpage Based on %[3] (gal/yr)	Maximum Total Pumping for Model Input[4] (gal/yr)	Maximum Total Pumping for Model Input[4] (gal/day)	Maximum Total Pumping for Model Input[4] (m^3/day)
220666	11		3.7%	201,320,342	229,389,000	628,463	2,379
220833	12		0.0%	1,430,288	1,918,000	5,255	20
222525	13		3.3%	177,444,638	203,006,000	556,181	2,105
222528	15		0.8%	44,976,620	74,385,000	203,795	771
220827	16		0.0%	0	0	0	0
220822	17		4.0%	218,415,266	237,476,000	650,619	2,463
222527	18		2.6%	141,709,719	157,186,000	430,647	1,630
220681	19		0.5%	28,282,980	28,934,000	79,271	300
220662	20		1.0%	53,616,983	89,395,000	244,918	927
220625	21		2.0%	108,884,203	108,884,203	298,313	1,129
220818	22		4.3%	235,203,346	254,267,000	696,622	2,637
220660	23		1.1%	62,102,987	116,310,000	318,658	1,206
220819	24		0.7%	37,640,108	43,479,000	119,121	451
220675	25		5.0%	271,521,047	337,250,000	923,973	3,497
147451	26		2.9%	159,509,999	159,509,999	437,014	1,654
224212	27		6.6%	357,626,121	444,421,000	1,217,592	4,609
180567	28		6.9%	376,754,896	421,974,000	1,156,093	4,376
161461	29		3.7%	203,508,802	210,341,013	576,277	2,181
239761	30		5.5%	301,011,620	446,886,000	1,224,345	4,634
434041	31		5.7%	309,456,297	309,456,297	847,825	3,209
506819	32		2.0%	110,685,814	141,846,000	388,619	1,471
220627	33		0.3%	14,153,725	19,199,000	52,600	199
463536	34		3.7%	201,142,873	201,142,873	551,076	2,086
601335	35		5.1%	278,005,292	298,979,000	819,121	3,100
601336	36		11.0%	599,707,295	599,707,295	1,643,034	6,219
676687	37		3.7%	203,604,520	224,639,000	615,449	2,329
698933	38		3.0%	165,442,300	232,607,000	637,279	2,412
733087	39		4.0%	217,655,285	294,920,000	808,000	3,058
773386	40		0.9%	49,382,878	164,943,000	451,899	1,710
796431	41		4.6%	252,000,000	252,000,000	690,411	2,613
219560	Airport (71)		0.7%	38,651,790	NA[5]	NA[5]	NA[5]
220628	Sandy Slopes (72)		0.1%	3,906,419	3,906,419	10,703	41
228168	Merrihills (73)		0.1%	3,534,175	3,788,506	10,379	39
220776	Osjor Estates (76)		0.0%	0	0	0	0
220629	Meadowbrook (77)		0.1%	4,433,361	4,433,361	12,146	46
220687	Lenwood (78)		0.0%	778,013	NA[6]	NA[6]	NA[6]
	Totals	**5,433,500,000**	**100%**	**5,433,500,000**	**6,316,578,966**	**17,305,696**	**65,502**

[1] Projected pumping based linear projection of historical pumping from RPU 2012 Engineering and Operations Report and Average from County Water System #1 and #2 which will be pumped by Well 41 in the future.

[2] Percentages for wells based on historical use.

[3] Estimated per well pumpage based on 2019 projected withdrawal and estimated percent of total pumped by each well

[4] For each well, the greater of the estimated pumpage based on projected 2019 withdrawal and actual annual pumpage for 2009 through 2013.

[5] Airport (71) no longer used. Pumping from Well 71 assigned to Well 40 per RPU.

[6] Lenwood (78) no longer used. Pumping from Well 78 assigned to Well 29 per RPU.

[7] Well 41 pumping projection provided by RPU. Pumping from Well 41 anticipated to reducing pupming in Wells, 20, 23, 27 and 30. Rates adjusted acordingly.

* Actual simulated pumping adjusted based on estimated withdrawl from Jordan aquifer. Lower aquifer units not simulated in Olmsted County MODFLOW model.

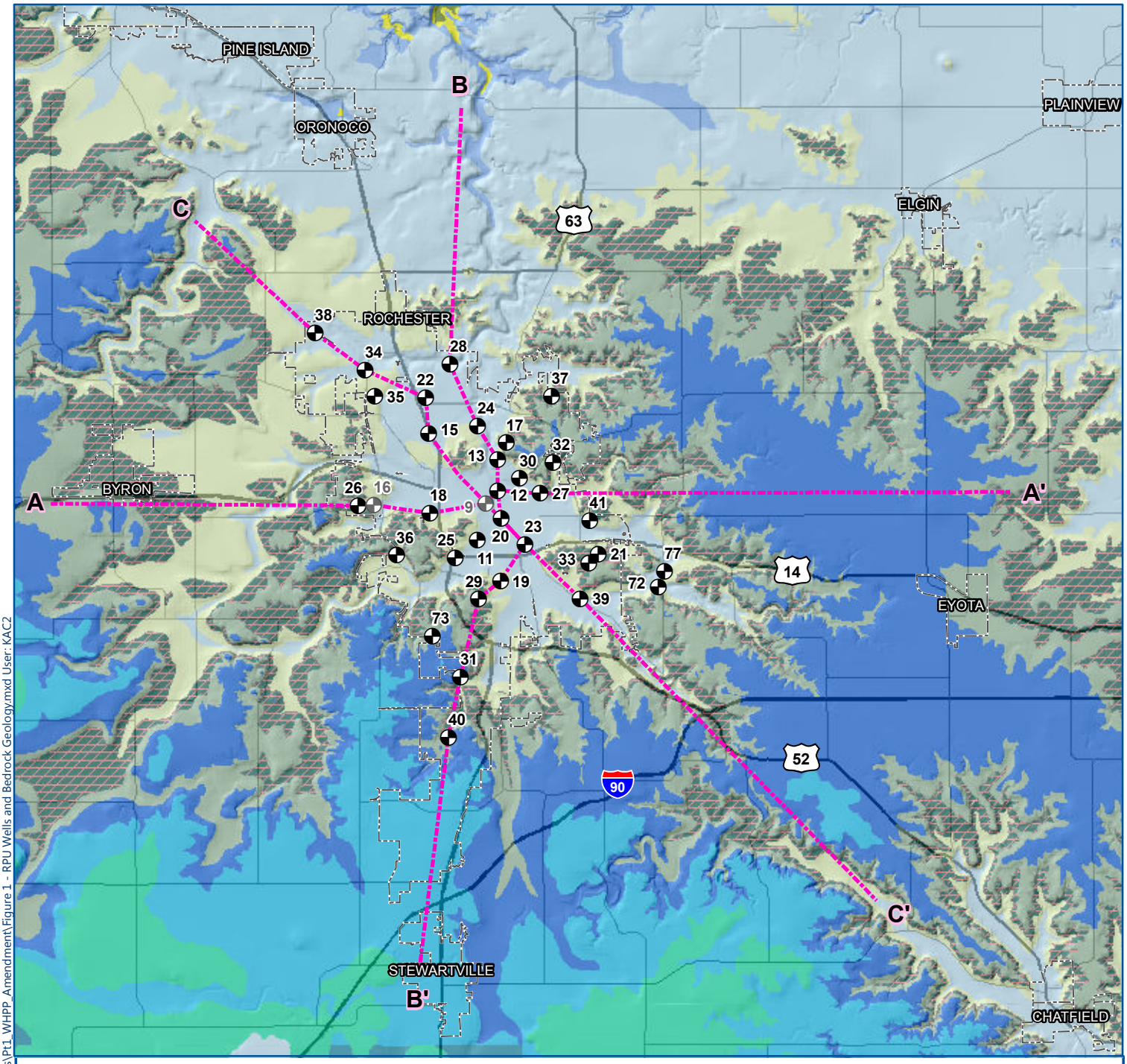
Table 4

Pumping Rate Distribution for RPU Wells Below the Jordan Aquifer
Rochester Public Utilities WHPP Amendment

Well	OPDC Open Length (m)	Model OPDC K (Oneota) (m/day)	Model CJDN Thickness (m)	CJDN K (m/day)	Open OPDC T (m^2/day)	CJDN T (m^2/day)	CTCW T (m^2/day)	CMTS T (m^2/day)	Fraction Q_t from OPDC	Fraction Q_t from CJDN	Fraction Q_t from CTCW	Fraction Q_t from CMTS	Q_t for WHPA Delineation (m^3/day)	Q from OPDC (m^3/day)	Q from CJDN (m^3/day)	Q from CTCW (m^3/day)	Q from CMTS (m^3/day)
12			28.956	16.05		464.7438	11.15	256.4		0.977	0.023		20.0		19.53	0.46859	
17	1.8	0.29	28.956	15.89	0.52	460.11084	11.15	256.4	0.001	0.975	0.024		2463.0	2.73	2402.06	58.20994	
18			28.956	16.08		465.61248	11.15	256.4		0.977	0.023		1630.0		1591.88	38.12060	
19			28.956	16.3		471.9828	11.15	256.4		0.977	0.023		300.0		293.12	6.92452	
20	24.7	0.29	28.956	16.14	7.16	467.34984	11.15	256.4	0.010	0.630	0.015	0.35	927.0	8.95	583.83	13.92902	320.30490
21			28.956	16.17		468.21852	11.15	256.4		0.977	0.023		1129.1		1102.85	26.26293	
22	17.1	0.29	28.956	16.68	4.96	482.98608	11.15	256.4	0.010	0.968	0.022		2636.7	26.20	2551.61	58.90533	
24			28.956	15.81		457.79436	11.15	256.4		0.976	0.024		450.9		440.15	10.72028	
25	19.8	0.29	28.956	16.21	5.74	469.37676	11.15	256.4	0.012	0.965	0.0229		3497.2	41.30	3375.75	80.19060	

OPDC Prairie du Chien Group (Shakopee aquifer and/or Oneota confining unit
CJDN Jordan aquifer
CTCW Combined Tunnel City and Wonewoc aquifers
CMTS Mt. Simon aquifer
CTCW transmissivity from Osweiler and Blum (2004)
CMTS transmissivity from Osweiler and Blum (2004)
Q_t Total pumping rate for the well
Q Pumping rate from the well applied to the indicated aquifer

Figures



RPU Supply Wells

Inactive RPU Supply Wells

Hydrogeologic Cross Section

Municipal Boundary

Bedrock Geology

Maquoketa and Dubuque Fms.

Stewartville Fm.

Prosser Fm.

Cummingsville Fm.

Decorah Shale, Platteville and Glenwood Fms.

St. Peter Sandstone

Shakopee Fm.

Oneota Dolomite

Jordan Sandstone

St. Lawrence Fm

Bedrock Geology: Runkel and Others, 2013

N

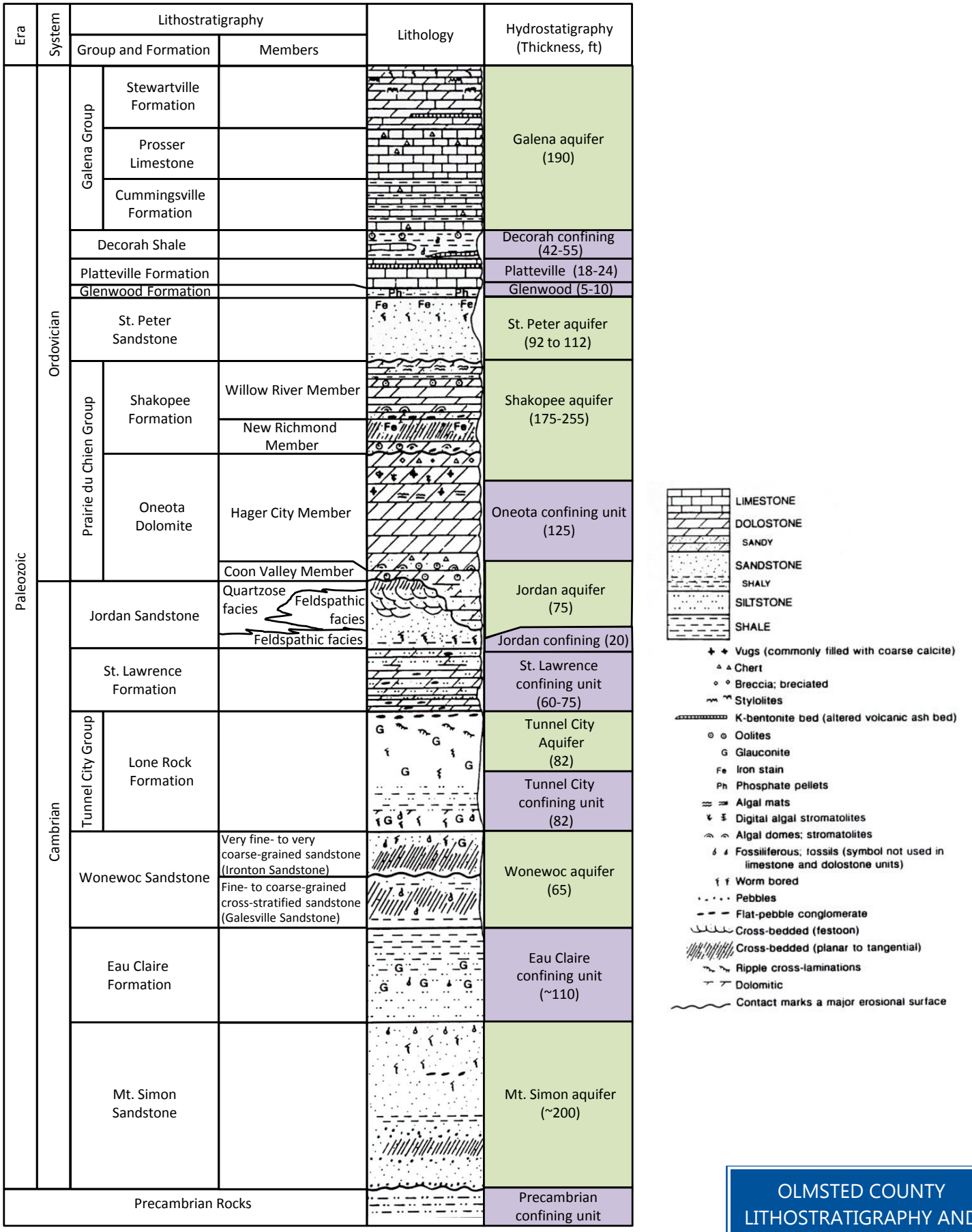
0 3.5 7

Miles

BARR

RPU WELLS AND BEDROCK GEOLOGY
RPU WHPP Amendment
Rochester Public Utilities

FIGURE 1



Modified from Tipping and Runkel (2008); Runkel (1996)

OLMSTED COUNTY
LITHOSTRATIGRAPHY AND HYDROSTRATIGRAPHY
RPU WHPP Amendment
Rochester Public Utilities

FIGURE 2

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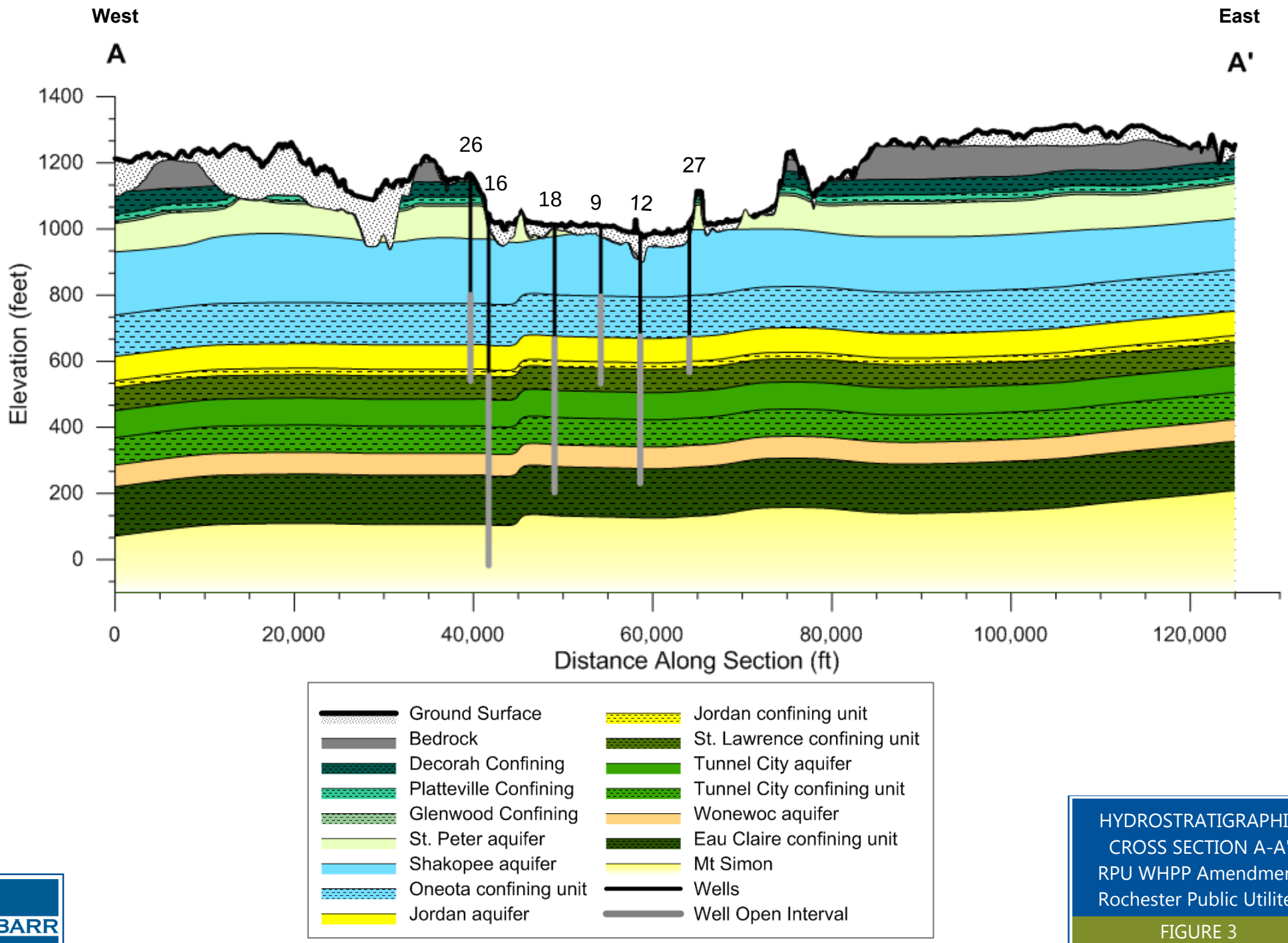

BARR

HYDROSTRATIGRAPHIC CROSS SECTION A-A'
RPU WHPP Amendment
Rochester Public Utilites

FIGURE 3

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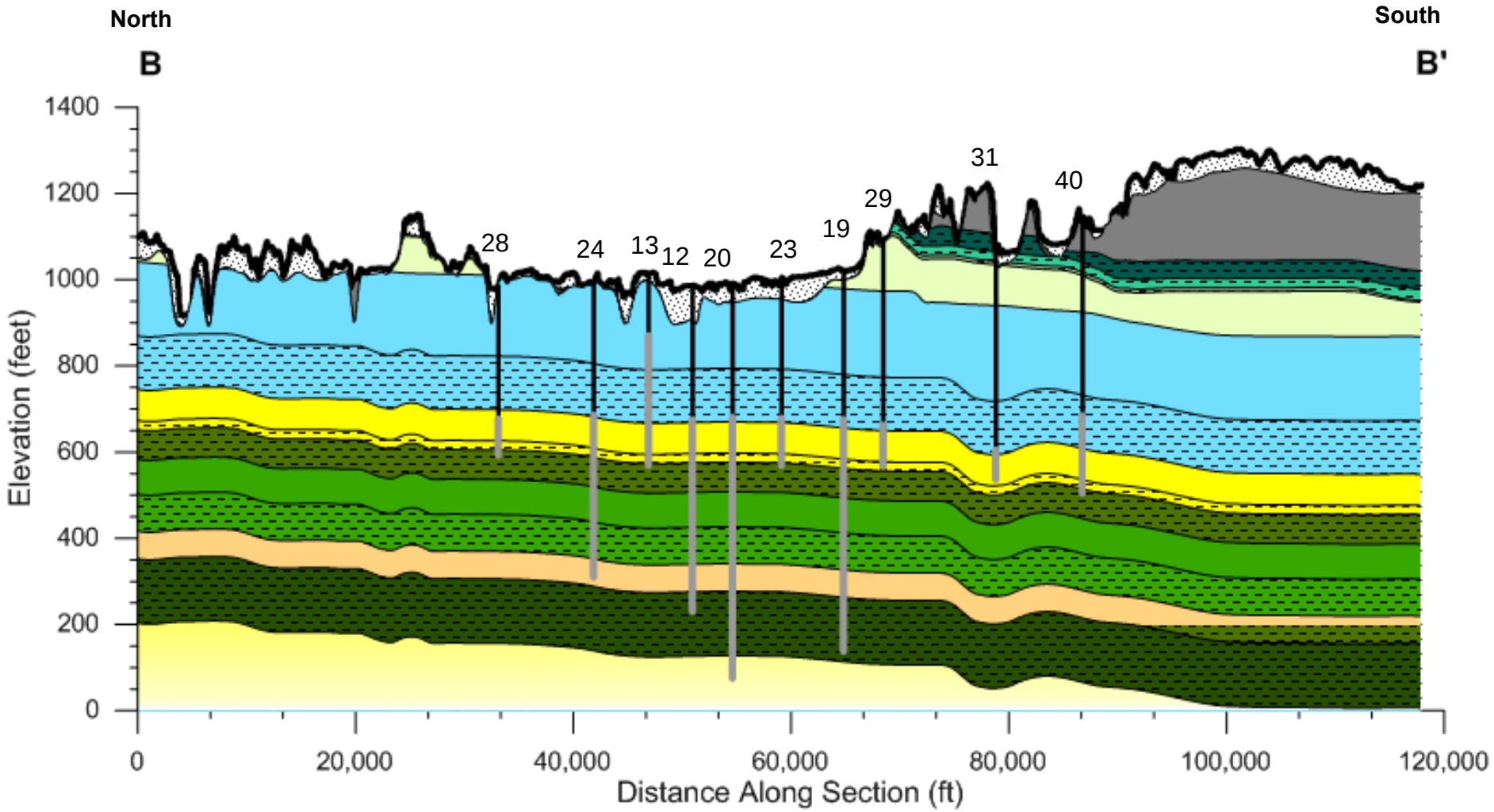
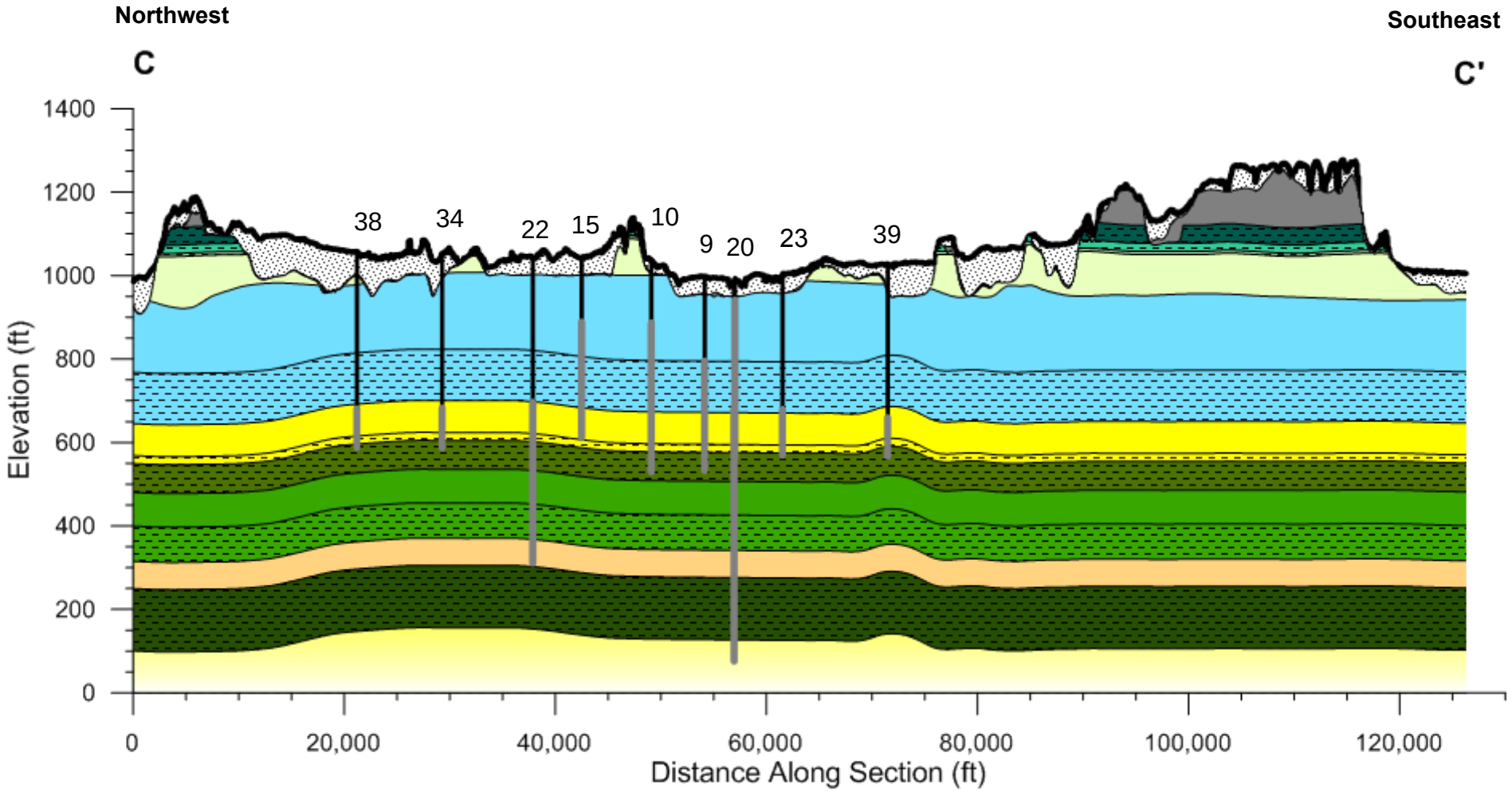


BARR

HYDROSTRATIGRAPHIC CROSS SECTION B-B'
RPU WHPP Amendment
Rochester Public Utilites

FIGURE 4

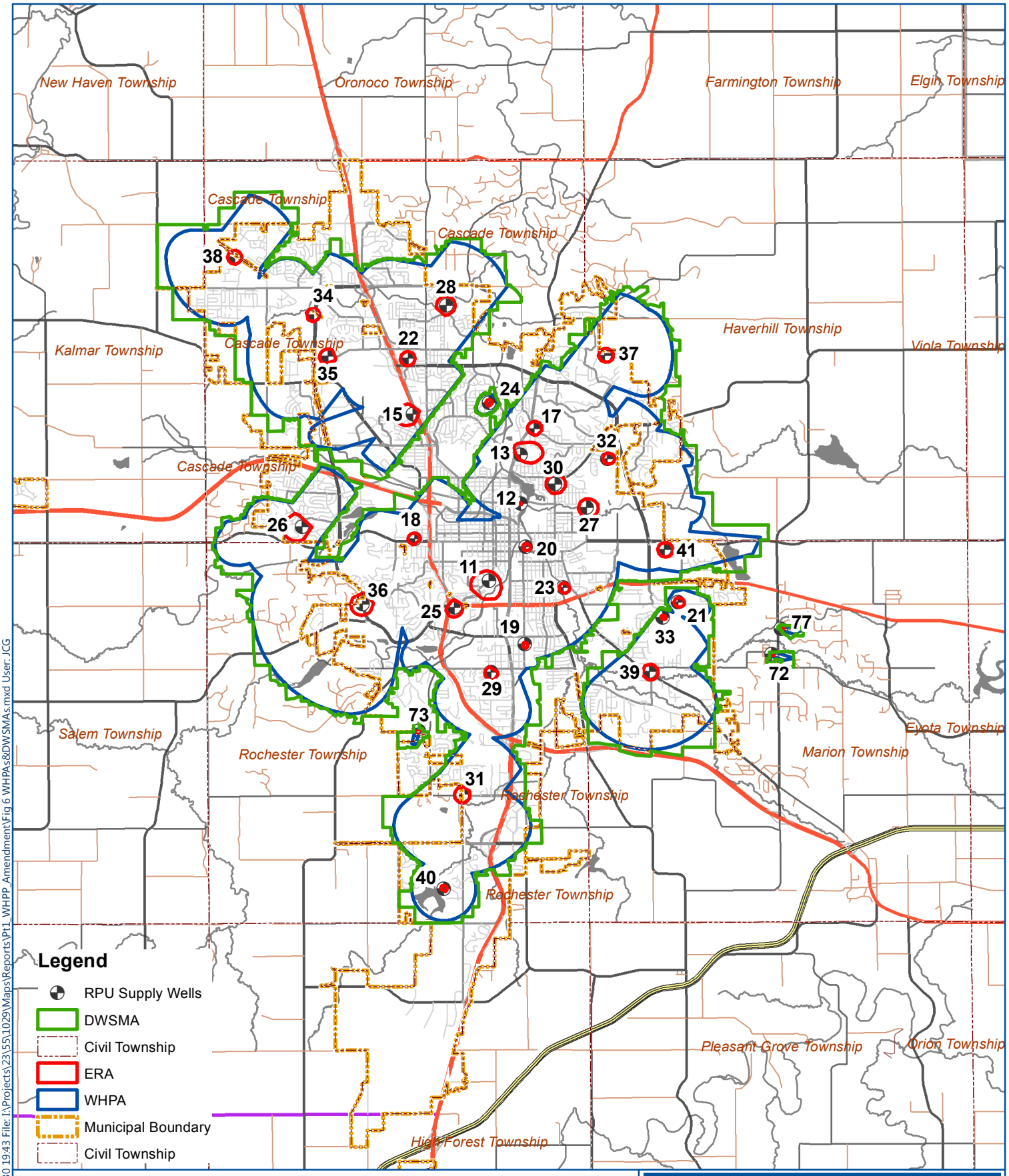
P:\Mpls\23 MN\55\23551029 RPU Water Source Sustain Eval\23551029.11 WHPP Amendment\WorkFiles\Report\Figures\Fig05 Cross Section C-C.pdf



BARR

HYDROSTRATIGRAPHIC CROSS SECTION C-C'
RPU WHPP Amendment
Rochester Public Utilites

FIGURE 5


New Haven Township
Oronoco Township
Farmington Township
Elgin Township
Cascade Township
Cascade Township
Kalmar Township
Cascade Township
Haverhill Township
Viola Township
Cascade Township
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77
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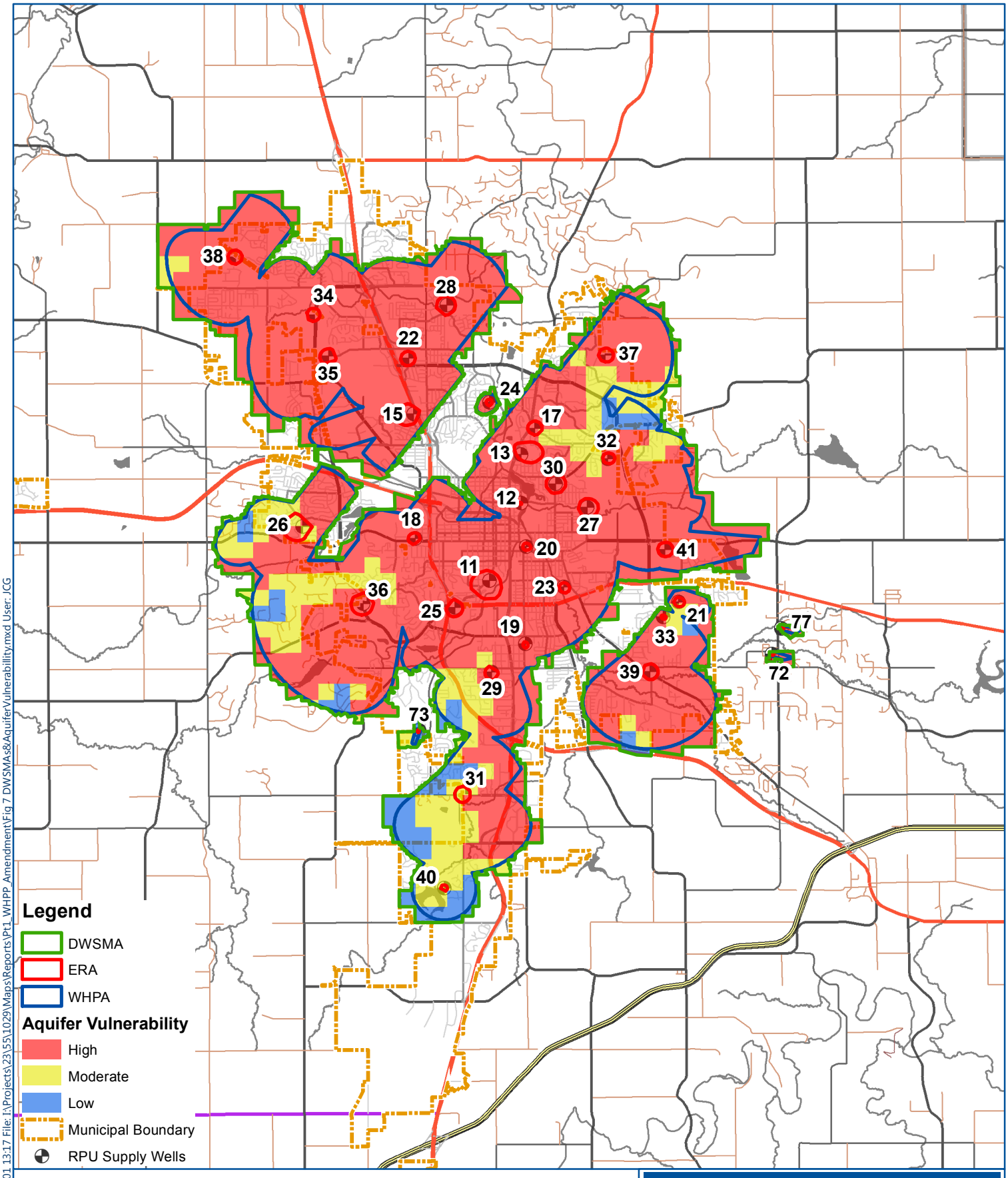
72
29
73
Salem Township
Rochester Township
Eyota Township
Marion Township
31
Rochester Township
40
Rochester Township
Pleasant Grove Township
Orion Township
Haverhill Township
Legend
RPU Supply Wells
DWSMA
Civil Township
ERA
WHPA
Municipal Boundary
Civil Township
N
1 0.5 0 1 2
Miles
BARR
WHPAs and DWSMAs
RPU WHPP Amendment
Rochester Public Utilities
FIGURE 6
Barr Footer: ArcGIS 10.4.1, 2017-04-30 19:43 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig 6 WHPAs&DWSMAs.mxd User: JCG



DWSMAs AND AQUIFER VULNERABILITY
RPU WHPP Amendment
Rochester Public Utilities

FIGURE 7

Appendix A

Well Construction Records

Unique No. 00220666

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2008/06/23

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	2	CAADCD

Well Name ROCHESTER 11

Well Owner's Name ROCHESTER 11

ROCHESTER MN 55901

Contact's Name CITY OF ROCHESTER

ROCHESTER MN 55901

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
CLAY	YELLO		0	7
SAND & GRAVEL			7	15
LIME	WHITE	V.HARD	15	23
LIME	PINK	M.HARD	23	108
SAND & ROCK		SOFT	108	119
LIME		HARD	119	130
LIME		SOFT	130	170
LIME		V.HARD	170	176
LIME, BROKEN AND NOT V			176	290
LIME	BLUE	HARD	290	318
SAND ROCK		SOFT	318	380
SAND ROCK		HARD	380	385
SAND ROCK		HARD	385	395
ALT. LAYERS OF SAND, LIM			395	397
ALT. LAYERS OF SAND, LIM			397	455

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED BY MGS 12-23-1987.

USGS Quad Rochester Elevation 999

Aquifer: OPCJ Alt Id: 79-5076

Report Copy

Well Depth 455 ft. Depth Completed 455 ft. Date Well Completed 1948/05/00

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Casing Diameter 20 in. t 140 ft

Weight(lbs/ft)

Hole Diameter 0 in. t 455 ft

Screen N

Make

Type

Open Hole From 140 ft. to 455 ft.

Static Water Level 19 ft. from Land surface Date 1948/05/00

PUMPING LEVEL (below land surface)

163 ft. after 8 hrs. pumping 1052 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 125 Volts

Drop Pipe Length 190 ft. Capacity g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller THEIN, P.

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220666 **Update Date** 2008/06/23

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	2	CAADCD	455	ft.	455	ft.	1948/05/00

Well Name ROCHESTER 11 **Lic. Or Reg. No.** 55079 **Name of Driller** THEIN, P.

USGS Quad Rochester **Elevation** 999 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
CLAY QCUY = Clay	YELLOW CLAY = Clay		0	7	QCUY	CLAY		
SAND & GRAVEL QHUU = Sand & larger	SAND = Sand		7	15	QHUU	SAND	GRVL GRVL = Gravel	
LIME QBUU = Boulder or boulders	WHITE BLDR = Boulder	V.HARD	15	23	QBUU	BLDR		
LIME OPDC = Prairie Du Chien Group	PINK DLMT = Dolomite	M.HARD	23	108	OPDC	DLMT		
SAND & ROCK OPDC = Prairie Du Chien Group	SNDS = Sandstone	SOFT	108	119	OPDC	SNDS	DLMT DLMT = Dolomite	
LIME OPDC = Prairie Du Chien Group	DLMT = Dolomite	HARD	119	130	OPDC	DLMT		
LIME OPDC = Prairie Du Chien Group	DLMT = Dolomite	SOFT	130	170	OPDC	DLMT		
LIME OPDC = Prairie Du Chien Group	DLMT = Dolomite	V.HARD	170	176	OPDC	DLMT		
LIME, BROKEN AND NOT VERY HARD OPDC = Prairie Du Chien Group	DLMT = Dolomite		176	290	OPDC	DLMT		
LIME OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite	HARD	290	318	OPDC	DLMT		
SAND ROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite	SOFT	318	380	OPDC	DLMT	SNDS SNDS = Sandstone	
SAND ROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite	HARD	380	385	OPDC	DLMT	SNDS SNDS = Sandstone	
SAND ROCK CJDN = Jordan	SNDS = Sandstone	HARD	385	395	CJDN	SNDS		
ALT. LAYERS OF SAND, LIME & SHALE CJDN = Jordan	SNDS = Sandstone		395	397	CJDN	SNDS	SHLE SHLE = Shale	

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220666 **Update Date** 2008/06/23

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	2	CAADCD	455	ft.	455	ft.	1948/05/00

Well Name ROCHESTER 11 **Lic. Or Reg. No.** 55079 **Name of Driller** THEIN, P.

USGS Quad Rochester **Elevation** 999 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
ALT. LAYERS OF SAND, LIME & SHALE			397	455	CSTL	SLSN	DLMT	SHLE

CSTL = St.Lawrence SLSN = Siltstone DLMT = Dolomite SHLE = Shale

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220833 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	35	ADDADB

Well Name ROCHESTER 12

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Well Owner's Name ROCHESTER 12

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
SAND FILL			0	20
SAND & GRAVEL			20	51
LIMEROCK			51	72
SAND & LIME	YELLO		72	80
LIMESTONE	BLUE	HARD	80	91
LIMESTONE	BLUE	HARD	91	93
LIMESTONE		HARD	93	260
LIMESTONE	BLUE	HARD	260	288
SANDSTONE		HARD	288	391
LIMEROCK		HARD	391	401
LIMEROCK & SANDSTONE			401	464
LIMEROCK			464	495
LIMESTONE & SHALE			495	497
SHALE	BLU/G		497	525
LIMESTONE & SHALE			525	565
LIMESTONE			565	580
SHALE		HARD	580	590
LIMESTONE		HARD	590	650
SANDSTONE			650	680
SHALE			680	689
SHALE & SANDROCK			689	700
SANDROCK			700	705
SHALE			705	715
SHALE & SANDSTONE			715	725
SANDSTONE			725	735
SHALE			735	752

REMARKS, ELEVATION, SOURCE OF DATA, etc.

PCA GWQ-118.

USGS Quad Rochester Elevation 984

Aquifer: MTPL Alt Id: 79-5076

Report Com...

Well Depth 752 ft. **Depth Completed** 752 ft. **Date Well Completed** 1960/00/00

Drilling Method

Drilling Fluid Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N **Hole Diameter**

Casing Diameter 14 in. t **Weight(lbs/ft)** 307 ft

Screen N **Open Hole** From 307 ft. to 752 ft.

Make Type

Static Water Level 42 ft. from Land surface Date 1969/00/00

PUMPING LEVEL (below land surface)

214 ft. after hrs. pumping 700 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 34050

License Business Name

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220833 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	35	ADDADB	752	ft.	752	ft.	1960/00/00

Well Name ROCHESTER 12 **Lic. Or Reg. No.** 34050 **Name of Driller**

USGS Quad Rochester **Elevation** 984 **Aquifer** MTPL **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SAND FILL RMMF = Man-made fill	SAND = Sand		0	20	RMMF	SAND FILL = Fill	FILL	
SAND & GRAVEL QHUU = Sand & larger	SAND = Sand		20	51	QHUU	SAND GRVL = Gravel	GRVL	
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		51	72	OPDC	DLMT		
SAND & LIME OPDC = Prairie Du Chien Group	YELLOW SNDS = Sandstone		72	80	OPDC	SNDS DLMT = Dolomite	DLMT	
LIMESTONE OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite	HARD	80	91	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite	HARD	91	93	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite	HARD	93	260	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite	HARD	260	288	OPDC	DLMT		
SANDSTONE CJDN = Jordan	SNDS = Sandstone	HARD	288	391	CJDN	SNDS		
LIMEROCK CSTL = St.Lawrence	DLMT = Dolomite	HARD	391	401	CSTL	DLMT		
LIMEROCK & SANDSTONE CSTL = St.Lawrence	SNDS = Sandstone		401	464	CSTL	SNDS DLMT = Dolomite	DLMT	
LIMEROCK CSTL = St.Lawrence	DLMT = Dolomite		464	495	CSTL	DLMT		
LIMESTONE & SHALE CFRN = Franconia	DLMT = Dolomite		495	497	CFRN	DLMT SHLE = Shale	SHLE	
SHALE CFRN = Franconia	BLU/GRN SHLE = Shale		497	525	CFRN	SHLE		

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220833 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	35	ADDADB	752	ft.	752	ft.	1960/00/00

Well Name ROCHESTER 12 **Lic. Or Reg. No.** 34050 **Name of Driller**

USGS Quad Rochester **Elevation** 984 **Aquifer** MTPL **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
LIMESTONE & SHALE CFRN = Franconia	DLMT = Dolomite		525	565	CFRN	DLMT	SHLE	SHLE = Shale
LIMESTONE CFRN = Franconia	DLMT = Dolomite		565	580	CFRN	DLMT		
SHALE CFRN = Franconia	SHLE = Shale	HARD	580	590	CFRN	SHLE		
LIMESTONE CFRN = Franconia	DLMT = Dolomite	HARD	590	650	CFRN	DLMT		
SANDSTONE CIGL = Ironton-Galesville	SNDS = Sandstone		650	680	CIGL	SNDS		
SHALE CIGL = Ironton-Galesville	SHLE = Shale		680	689	CIGL	SHLE		
SHALE & SANDROCK CIGL = Ironton-Galesville	SHLE = Shale		689	700	CIGL	SHLE	SNDS	SNDS = Sandstone
SANDROCK CIGL = Ironton-Galesville	SNDS = Sandstone		700	705	CIGL	SNDS		
SHALE CECR = Eau Claire	SHLE = Shale		705	715	CECR	SHLE		
SHALE & SANDSTONE CECR = Eau Claire	SHLE = Shale		715	725	CECR	SHLE	SNDS	SNDS = Sandstone
SANDSTONE CECR = Eau Claire	SNDS = Sandstone		725	735	CECR	SNDS		
SHALE CECR = Eau Claire	SHLE = Shale		735	752	CECR	SHLE		

Unique No. 00222525

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/12

Entry Date 1991/08/24

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	26	DADAAC

Well Depth 442 ft. | Depth Completed 442 ft. | Date Well Completed 1954/03/04

Well Name ROCHESTER 13

Drilling Method Cable Tool

Well Owner's Name ROCHESTER 13

ROCHESTER MN

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter

Casing Diameter Weight(lbs/ft)

24 in. t 19 ft

20 in. t 141 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DIRT	BLACK		0	1
CLAY			1	6
LIMEROCK			6	100
SANDROCK			100	110
LIMEROCK			110	124
SANDROCK			124	130
LIMEROCK			130	320
SANDSTONE			320	346
SANDSTONE			346	410
SANDSTONE			410	430
LIMEROCK			430	442

Screen N

Open Hole From 141 ft. to 442 ft.

Make

Type

Static Water Level 40 ft. from Land surface Date 1954/03/04

PUMPING LEVEL (below land surface)

146 ft. after hrs. pumping 1000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 62012

License Business Name

Name of Driller

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 3-19-1984. M.G.S. NO. 6.

GWQ NO. 119.

USGS Quad Rochester Elevation 1013.1

Aquifer: OPCJ Alt Id: 79-5076

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00222525 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1991/08/24

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	26	DADAAC	442	ft.	442	ft.	1954/03/04

Well Name ROCHESTER 13 **Lic. Or Reg. No.** 62012 **Name of Driller**

USGS Quad Rochester **Elevation** 1013.1 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DIRT	BLACK		0	1	RUUK	SOIL	ORGD	
RUUK = Recent Deposit	SOIL = Soil				ORGD = Organic Deposits			
CLAY			1	6	QCUU	CLAY		
QCUU = Clay	CLAY = Clay							
LIMEROCK			6	100	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDROCK			100	110	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIMEROCK			110	124	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDROCK			124	130	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIMEROCK			130	320	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE			320	346	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				SNDS = Sandstone			
SANDSTONE			346	410	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SANDSTONE			410	430	CSTL	SLSN	SHLE	DLMT
CSTL = St.Lawrence	SLSN = Siltstone				SHLE = Shale		DLMT = Dolomite	
LIMEROCK			430	442	CSTL	DLMT	SLSN	SHLE
CSTL = St.Lawrence	DLMT = Dolomite				SLSN = Siltstone		SHLE = Shale	

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00222528 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	27	BABBAB

Well Name ROCHESTER 15

Well Owner's Name ROCHESTER 15

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	36
DRIFT			36	40
LIMESTONE			40	78
LIMESTONE		HARD	78	90
LIMESTONE & SANDSTONE			90	105
LIMESTONE & SANDSTONE			105	140
LIMESTONE		HARD	140	155
LIMESTONE & SANDSTONE			155	185
LIMESTONE		HARD	185	192
LIMESTONE	GRAY	HARD	192	235
LIMESTONE	BLUE	HARD	235	300
LIMESTONE		HARD	300	318
LIMESTONE	BLUE	HARD	318	340
LIMESTONE & SHALE & SA			340	360
SANDSTONE			360	430
LIMESTONE			430	432

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 2-6-1995.

USGS Quad Rochester Elevation 1044.5

Aquifer: OPCJ Alt Id: 79-5076

Report Copy

Well Depth 432 ft. **Depth Completed** 432 ft. **Date Well Completed** 1957/00/00

Drilling Method Cable Tool

Drilling Fluid Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N **Hole Diameter**

Casing Diameter **Weight(lbs/ft)**

30 in. t 41 ft

24 in. t 154 ft

Screen N **Open Hole** From 154 ft. to 432 ft.

Make Type

Static Water Level ft. from Date

PUMPING LEVEL (below land surface)

ft. after hrs. pumping g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27010

License Business Name

Name of Driller

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00222528 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	27	BABBAB	432	ft.	432	ft.	1957/00/00

Well Name ROCHESTER 15 **Lic. Or Reg. No.** 27010 **Name of Driller**

USGS Quad Rochester **Elevation** 1044.5 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SANDSTONE			360	430	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
LIMESTONE			430	432	CSTL	DLMT	SLSN	SHLE
CSTL = St.Lawrence	DLMT = Dolomite		SLSN = Siltstone				SHLE = Shale	

Unique No. 00220822

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/12

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	25	BBDDCC

Well Depth 904 ft. **Depth Completed** 904 ft. **Date Well Completed** 1960/02/01

Well Name ROCHESTER 17

Drilling Method Cable Tool

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Well Owner's Name ROCHESTER 17

ROCHESTER MN

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

Casing Diameter **Weight(lbs/ft)**

24 in. t 102 ft

16 in. t 429 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
SANDSTONE			0	106
SANDSTONE & LIMEROCK			106	109
LIMEROCK			109	160
LIMEROCK & SANDROCK			160	167
LIMEROCK			167	197
LIMEROCK, SMALL CREVIC			197	203
LIMEROCK & SANDROCK &			203	209
SANDROCK			209	218
LIMEROCK			218	263
LIMEROCK & SOME SANDR			263	435
SANDROCK			435	504
LIMEROCK			504	520
SHALE			520	524
LIMEROCK		HARD	524	554
SANDROCK			554	558
LIMEROCK & SHALE & SAN			558	595
LIMEROCK & SHALE			595	628
SHALE & SANDROCK			628	648
LIMEROCK & STICKY SHAL			648	652
LIMEROCK & SANDROCK &			652	852
SHALE		HARD	852	871
SHALE & SANDROCK			871	904

Screen N **Open Hole** From 429 ft. to 904 ft.

Make Type

Static Water Level 136 ft. from Land surface Date 1960/01/22

PUMPING LEVEL (below land surface)

292 ft. after 29.25 hrs. pumping 1000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Rochester Elevation 1102.7

Aquifer: OPCG Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27058

License Business Name

Name of Driller

Report Copy

HE-01205-06 (Rev. 9/96)

Unique No. 00220822

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/12

County Name Olmsted

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	25	BBDDCC	904	ft.	904	ft.	1960/02/01

Well Name ROCHESTER 17 Lic. Or Reg. No. 27058 Name of Driller

USGS Quad Rochester Elevation 1102.7 Aquifer OPCG Alternative Id 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SANDSTONE OSTP = St.Peter	SNDS = Sandstone		0	106	OSTP	SNDS		
SANDSTONE & LIMEROCK OSTP = St.Peter	SNDS = Sandstone		106	109	OSTP	SNDS	DLMT	
						DLMT = Dolomite		
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		109	160	OPDC	DLMT		
LIMEROCK & SANDROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		160	167	OPDC	DLMT	SNDS	
						SNDS = Sandstone		
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		167	197	OPDC	DLMT		
IMEROCK, SMALL CREVICES OPDC = Prairie Du Chien Group	DLMT = Dolomite		197	203	OPDC	DLMT	CRVC	
						CRVC = Crevice		
LIMEROCK & SANDROCK & SHALE OPDC = Prairie Du Chien Group	DLMT = Dolomite		203	209	OPDC	DLMT	SNDS	SHLE
						SNDS = Sandstone	SHLE = Shale	
SANDROCK OPDC = Prairie Du Chien Group	SNDS = Sandstone		209	218	OPDC	SNDS		
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		218	263	OPDC	DLMT		
LIMEROCK & SOME SANDROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		263	435	OPDC	DLMT	SNDS	
						SNDS = Sandstone		
SANDROCK CJDN = Jordan	SNDS = Sandstone		435	504	CJDN	SNDS		
LIMEROCK CSTL = St.Lawrence	DLMT = Dolomite		504	520	CSTL	DLMT		
SHALE CSTL = St.Lawrence	SHLE = Shale		520	524	CSTL	SHLE		
LIMEROCK CSTL = St.Lawrence	DLMT = Dolomite	HARD	524	554	CSTL	DLMT		

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220822 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	25	BBDDCC	904	ft.	904	ft.	1960/02/01

Well Name ROCHESTER 17 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Rochester **Elevation** 1102.7 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SANDROCK			554	558	CFRN	SNDS		
CFRN = Franconia	SNDS = Sandstone							
LIMEROCK & SHALE & SANDROCK			558	595	CFRN	DLMT	SHLE	SNDS
CFRN = Franconia	DLMT = Dolomite		SHLE = Shale			SNDS = Sandstone		
LIMEROCK & SHALE			595	628	CFRN	DLMT	SHLE	
CFRN = Franconia	DLMT = Dolomite		SHLE = Shale					
SHALE & SANDROCK			628	648	CFRN	SHLE	SNDS	
CFRN = Franconia	SHLE = Shale		SNDS = Sandstone					
LIMEROCK & STICKY SHALE			648	652	CFRN	DLMT	SHLE	
CFRN = Franconia	DLMT = Dolomite		SHLE = Shale					
LIMEROCK & SANDROCK & SHALE			652	852	CIGL	DLMT	SNDS	SHLE
CIGL = Ironton-Galesville	DLMT = Dolomite		SNDS = Sandstone			SHLE = Shale		
SHALE		HARD	852	871	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							
SHALE & SANDROCK			871	904	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale		SNDS = Sandstone					

Unique No. 00222527

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/12

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	34	CDCCAD

Well Name ROCHESTER 18

Well Owner's Name ROCHESTER 18

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DIRT	BLACK		0	4
SANDROCK			4	30
LIMEROCK & SANDROCK			30	35
LIMEROCK			35	40
LIMEROCK & SANDROCK			40	49
LIMEROCK		SOFT	49	72
LIMEROCK & SANDROCK			72	100
LIMEROCK		HARD	100	166
LIMEROCK & SANDROCK			166	199
LIMEROCK			199	315
LIMEROCK & SANDROCK			315	326
SANDROCK			326	408
LIMEROCK & SANDROCK			408	441
LIMEROCK & SHALE			441	576
SHALE			576	690
SHALE & SANDROCK			690	705
SANDROCK			705	725
SHALE & SANDROCK			725	735
SHALE			735	806

USGS Quad Rochester Elevation 1010.6

Aquifer: CJIG Alt Id: 79-5076

Report Copy

Well Depth 806 ft. Depth Completed 806 ft. Date Well Completed 1963/03/05

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Casing Diameter Weight(lbs/ft)

30 in. t 31 ft

24 in. t 343 ft

Hole Diameter

in. t 806 ft

in. t 312 ft

Screen N

Make Type

Open Hole From 343 ft. to 806 ft.

Static Water Level 16 ft. from Land surface Date 1963/03/05

PUMPING LEVEL (below land surface)

225 ft. after hrs. pumping 2000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27058

License Business Name

Name of Driller

HE-01205-06 (Rev. 9/96)

Unique No. 00222527

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/12

County Name Olmsted

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	34	CDCCAD	806	ft.	806	ft.	1963/03/05

Well Name ROCHESTER 18 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Rochester **Elevation** 1010.6 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DIRT	BLACK		0	4	RUUK	SOIL	ORGD	
RUUK = Recent Deposit	SOIL = Soil		ORGD = Organic Deposits					
SANDROCK			4	30	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
LIMEROCK & SANDROCK			30	35	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK			35	40	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK & SANDROCK			40	49	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite		SNDS = Sandstone					
LIMEROCK		SOFT	49	72	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK & SANDROCK			72	100	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite		SNDS = Sandstone					
LIMEROCK		HARD	100	166	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK & SANDROCK			166	199	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite		SNDS = Sandstone					
LIMEROCK			199	315	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK & SANDROCK			315	326	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite		SNDS = Sandstone					
SANDROCK			326	408	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
LIMEROCK & SANDROCK			408	441	CSTL	DLMT	SNDS	
CSTL = St.Lawrence	DLMT = Dolomite		SNDS = Sandstone					
LIMEROCK & SHALE			441	576	CSLF	DLMT	SHLE	
CSLF = St.Lawrence-Franconia	DLMT = Dolomite		SHLE = Shale					

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00222527 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	34	CDCCAD	806	ft.	806	ft.	1963/03/05

Well Name ROCHESTER 18 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Rochester **Elevation** 1010.6 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SHALE			576	690	CFRN	SHLE		
CFRN = Franconia	SHLE = Shale							
SHALE & SANDROCK			690	705	CIGL	SHLE	SNDS	
CIGL = Ironton-Galesville	SHLE = Shale		SNDS = Sandstone					
SANDROCK			705	725	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
SHALE & SANDROCK			725	735	CIGL	SHLE	SNDS	
CIGL = Ironton-Galesville	SHLE = Shale		SNDS = Sandstone					
SHALE			735	806	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							

Unique No. 00220681

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	12	CBBCCD

Well Name ROCHESTER 19

Well Depth 881 ft. | Depth Completed 881 ft. | Date Well Completed 1962/09/14

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Well Owner's Name ROCHESTER 19
17TH SE ST
ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter
in. t 27 ft
in. t 881 ft

Casing Diameter Weight(lbs/ft)
30 in. t 27 ft
24 in. t 343 ft

Screen N

Open Hole From 343 ft. to 881 ft.

Make Type

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
ST. PETER SANDSTONE			0	10
SANDSTONE		HARD	10	13
SANDSTONE			13	26
LIMEROCK SHAKOPEE<		V.HARD	26	52
SANDROCK LITE BROWN			52	57
LIME & SANDROCK			57	63
LIMEROCK			63	103
LIMEROCK		V.HARD	103	129
SANDROCK	WHITE	M.HARD	129	139
LIMEROCK		HARD	139	162
LIMEROCK		MEDIUM	162	190
SOME SAND ROCK			190	195
LIMEROCK		M.HARD	195	205
LIMEROCK		M.HARD	205	245
LIMEROCK		M.HARD	245	295
LIMEROCK		M.HARD	295	321
SANDROCK & SHALE JOR			321	338
SANDROCK & SHALE			338	345
SANDROCK			345	354
SANDROCK			354	420
SANDROCK & SHALE			420	425
LIMEROCK			425	435
LIMEROCK & SHALE			435	450
LIMEROCK & SHALE			450	493
LIMEROCK & SHALE			493	520
LIMEROCK & SHALE & SAN			520	538
LIMEROCK & SHALE & SAN			538	576
SHALE & SANDROCK-MINO			576	597
SHALE & SANDROCK-MINO			597	620
STICKY SHALE & SANDROC			620	630
STICKY SHALE & SANDROC			630	685
SANDROCK DRESBACK		HARD	685	705

Static Water Level 27 ft. from Land surface Date 1962/09/14

PUMPING LEVEL (below land surface)
189.42 ft. after hrs. pumping 2000 g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection ☐ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)
		345	

Nearest Known Source of Contamination
ft. direction type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Mfr nam
Model HP Volts

SANDROCK SOME SHALE	HARD	705	720
SANDROCK SOME SHALE	HARD	720	754
SHALE, LAYERS OF SANDR GREE		754	765
SHALE, LAYERS OF SANDR GREE		765	780
STICKY SHALE		780	785
STICKY SHALE		785	808
STICKY SHALE, LITTLE SAN		808	813
STICKY SHALE & SANDROC		813	824
STICKY SHALE & SANDROC		824	830
STICKY SHALE & SANDROC PNK/B		830	839
STICKY SHALE & SANDROC PNK/B		839	855
STICKY SHALE & SANDROC		855	881

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Simpson Elevation 1020.6

Aquifer: CJIG Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27058

License Business Name

Name of Driller

Report Copy

HE-01205-06 (Rev. 9/96)

Unique No. 00220681

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/10

County Name Olmsted

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	12	CBBCCD	881	ft.	881	ft.	1962/09/14

Well Name ROCHESTER 19 Lic. Or Reg. No. 27058 Name of Driller

USGS Quad Simpson Elevation 1020.6 Aquifer CJIG Alternative Id 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
ST. PETER SANDSTONE			0	10	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
SANDSTONE		HARD	10	13	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
SANDSTONE			13	26	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
LIMEROCK SHAKOPEE<		V.HARD	26	52	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDROCK LITE BROWN			52	57	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIME & SANDROCK			57	63	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK			63	103	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK		V.HARD	103	129	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDROCK	WHITE	M.HARD	129	139	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIMEROCK		HARD	139	162	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK		MEDIUM	162	190	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SOME SAND ROCK			190	195	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIMEROCK		M.HARD	195	205	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK		M.HARD	205	245	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							

Unique No. 00220681

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	12	CBBCCD	881	ft.	881	ft.	1962/09/14

Well Name ROCHESTER 19 Lic. Or Reg. No. 27058 Name of Driller

USGS Quad Simpson Elevation 1020.6 Aquifer CJIG Alternative Id 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite	M.HARD	245	295	OPDC	DLMT		
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite	M.HARD	295	321	OPDC	DLMT		
SANDROCK & SHALE JORDAN CJDN = Jordan	SNDS = Sandstone		321	338	CJDN	SNDS		
SANDROCK & SHALE CJDN = Jordan	SNDS = Sandstone		338	345	CJDN	SNDS		
SANDROCK CJDN = Jordan	SNDS = Sandstone		345	354	CJDN	SNDS		
SANDROCK CJDN = Jordan	SNDS = Sandstone		354	420	CJDN	SNDS		
SANDROCK & SHALE CJDN = Jordan	SNDS = Sandstone		420	425	CJDN	SNDS		
LIMEROCK CSTL = St.Lawrence	DLMT = Dolomite		425	435	CSTL	DLMT		
LIMEROCK & SHALE CSTL = St.Lawrence	DLMT = Dolomite		435	450	CSTL	DLMT	SHLE	
							SHLE = Shale	
LIMEROCK & SHALE CSTL = St.Lawrence	DLMT = Dolomite		450	493	CSTL	DLMT	SHLE	
							SHLE = Shale	
LIMEROCK & SHALE CSTL = St.Lawrence	DLMT = Dolomite		493	520	CSTL	DLMT	SHLE	
							SHLE = Shale	
LIMEROCK & SHALE & SANDROCK CSTL = St.Lawrence	DLMT = Dolomite		520	538	CSTL	DLMT	SHLE	SNDS
							SHLE = Shale	SNDS = Sandstone
LIMEROCK & SHALE & SANDROCK CSTL = St.Lawrence	DLMT = Dolomite		538	576	CSTL	DLMT	SHLE	SNDS
							SHLE = Shale	SNDS = Sandstone
SHALE & SANDROCK-MINOR CFRN = Franconia	SHLE = Shale		576	597	CFRN	SHLE	SNDS	
							SNDS = Sandstone	

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220681 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	12	CBBCCD	881	ft.	881	ft.	1962/09/14

Well Name ROCHESTER 19 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Simpson **Elevation** 1020.6 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SHALE & SANDROCK-MINOR			597	620	CFRN	SHLE	SNDS	
CFRN = Franconia	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE & SANDROCK-MINOR			620	630	CFRN	SHLE	SNDS	
CFRN = Franconia	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE & SANDROCK-MINO			630	685	CFRN	SHLE	SNDS	
CFRN = Franconia	SHLE = Shale				SNDS = Sandstone			
SANDROCK DRESBACK		HARD	685	705	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
SANDROCK SOME SHALE		HARD	705	720	CIGL	SNDS	SHLE	
CIGL = Ironton-Galesville	SNDS = Sandstone				SHLE = Shale			
SANDROCK SOME SHALE		HARD	720	754	CIGL	SNDS	SHLE	
CIGL = Ironton-Galesville	SNDS = Sandstone				SHLE = Shale			
SHALE, LAYERS OF SANDROCK	GREEN		754	765	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
SHALE, LAYERS OF SANDROCK	GREEN		765	780	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE			780	785	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							
STICKY SHALE			785	808	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							
STICKY SHALE, LITTLE SANDROCK			808	813	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE & SANDROCK			813	824	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE & SANDROCK			824	830	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE & SANDROCK	PNK/BRN		830	839	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220681 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	12	CBBCCD	881	ft.	881	ft.	1962/09/14

Well Name ROCHESTER 19 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Simpson **Elevation** 1020.6 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
STICKY SHALE & SANDROCK	PNK/BRN		839	855	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE & SANDROCK			855	881	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			

Unique No. 00220662

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	1	BBBCAC

Well Name ROCHESTER 20

Well Owner's Name ROCHESTER 20

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
FILL			0	7
DRIFT			7	70
LIMESTONE			70	296
JORDAN SANDSTONE			296	366
LIMESTONE			366	367
JORDAN SANDSTONE			367	387
JORDAN SANDSTONE			387	412
JORDAN SANDSTONE			412	424
SHALE & LIMESTONE			424	487
SHALE & LIMESTONE			487	658
SANDSTONE			658	684
LIMESTONE			684	686
SAND & SHALE			686	717
DARK STICKY CLAY			717	726
SAND		HARD	726	734
CLAY			734	740
CLAY			740	786
SHALE	GREE		786	826
SAND & CLAY			826	838
SHALE			838	869
SANDROCK			869	912

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 8-1-1995.

USGS Quad Rochester Elevation 989

Aquifer: OPCM Alt Id: 79-5076

Report Copy

Well Depth 912 ft. Depth Completed 912 ft. Date Well Completed 1964/03/20

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☑ Yes ☐ N

Hole Diameter in. t 912 ft

Casing Diameter			Weight(lbs/ft)
30	in. t	70 ft	118.65
24	in. t	306 ft	94.62

Screen N

Open Hole From 306 ft. to 912 ft.

Make Type

Static Water Level 48 ft. from Land surface Date 1969/00/00

PUMPING LEVEL (below land surface)

252 ft. after hrs. pumping 848 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 150 Volts

Drop Pipe Length 280 ft. Capacity Ξ+03 g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 96460

License Business Name

Name of Driller

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220662 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	1	BBBCAC	912	ft.	912	ft.	1964/03/20

Well Name ROCHESTER 20 **Lic. Or Reg. No.** 96460 **Name of Driller**

USGS Quad Rochester **Elevation** 989 **Aquifer** OPCM **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
FILL RMMF = Man-made fill	FILL = Fill		0	7	RMMF	FILL		
DRIFT QUUU = Unknown deposit type	DRFT = Drift		7	70	QUUU	DRFT		
LIMESTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite		70	296	OPDC	DLMT		
JORDAN SANDSTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite		296	366	OPDC	DLMT	SNDS SNDS = Sandstone	
LIMESTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite		366	367	OPDC	DLMT		
IORDAN SANDSTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite		367	387	OPDC	DLMT	SNDS SNDS = Sandstone	
JORDAN SANDSTONE CJDN = Jordan	SNDS = Sandstone		387	412	CJDN	SNDS		
JORDAN SANDSTONE CSTL = St.Lawrence	SLSN = Siltstone		412	424	CSTL	SLSN	SHLE SHLE = Shale	DLMT DLMT = Dolomite
SHALE & LIMESTONE CSTL = St.Lawrence	SLSN = Siltstone		424	487	CSTL	SLSN	SHLE SHLE = Shale	DLMT DLMT = Dolomite
SHALE & LIMESTONE CFRN = Franconia	SNDS = Sandstone		487	658	CFRN	SNDS	SHLE SHLE = Shale	DLMT DLMT = Dolomite
SANDSTONE CIGL = Ironton-Galesville	SNDS = Sandstone		658	684	CIGL	SNDS		
LIMESTONE CIGL = Ironton-Galesville	SNDS = Sandstone		684	686	CIGL	SNDS		
SAND & SHALE CIGL = Ironton-Galesville	SNDS = Sandstone		686	717	CIGL	SNDS	SHLE SHLE = Shale	
DARK STICKY CLAY CIGL = Ironton-Galesville	SHLE = Shale		717	726	CIGL	SHLE		

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220662 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	1	BBBCAC	912	ft.	912	ft.	1964/03/20

Well Name ROCHESTER 20 **Lic. Or Reg. No.** 96460 **Name of Driller**

USGS Quad Rochester **Elevation** 989 **Aquifer** OPCM **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SAND		HARD	726	734	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
CLAY			734	740	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
CLAY			740	786	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
SHALE	GREEN		786	826	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							
SAND & CLAY			826	838	CECR	SNDS	SHLE	
CECR = Eau Claire	SNDS = Sandstone				SHLE = Shale			
SHALE			838	869	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							
SANDROCK			869	912	CMTS	SNDS		
CMTS = Mt.Simon	SNDS = Sandstone							

Unique No. 00220625

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/09

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	106	13	W	5	CDDDBD

Well Depth 981 ft. **Depth Completed** 981 ft. **Date Well Completed** 1965/10/04

Well Name ROCHESTER 21

Drilling Method

Well Owner's Name ROCHESTER 21

ROCHESTER MN 55901

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Contact's Name CITY OF ROCHESTER

ROCHESTER MN 55901

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

Casing Diameter **Weight(lbs/ft)**

30 in. t 152 ft

24 in. t 458 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
SHALE	GREE		0	18
LIMESTONE	BLUE		18	46
ST. PETER SANDSTONE	YELLO		46	144
LIMESTONE	BLUE		144	163
SANDSTONE (ROOT VALLE	YELLO		163	174
LIMESTONE	BROW		174	184
LIMESTONE	BLUE		184	188
SANDSTONE	YELLO		188	196
LIMESTONE	YELLO	HARD	196	250
LIMESTONE	GRAY		250	345
LIMESTONE	BROW		345	350
LIMESTONE	YELLO		350	392
LIMESTONE	BLUE		392	445
SANDSTONE			445	455
SANDSTONE & LIMESTONE	WHITE		455	480
SANDSTONE (FINE)	WHITE		480	548
LIGHT GRAY TO DARK LIME	GRAY		548	634
SANDY SHALE	GREE		634	653
SHALE & LIMESTONE	GREE		653	698
SHALE & SANDSTONE	BLU/G		698	710
STICKY SHALE	GRAY	HARD	710	728
STICKY SHALE & SANDSTO	GRAY	HARD	728	760
STICKY SHALE & SANDSTO	GREE	HARD	760	798
SHALE & SANDSTONE	GRAY		798	842
SHALE & SANDSTONE	GREE		842	858
STICKY SHALE & SANDSTO	GREE		858	876
SHALE	GRAY		876	885
SANDSTONE			885	888
SHALE & SANDSTONE	GRAY		888	902
CLAY & LIMEROCK	GRAY		902	910
SHALE	GREE		910	925
CLAY	BROW		925	934

Screen N **Open Hole** From 458 ft. to 981 ft.

Make Type

Static Water Level 163 ft. from Land surface Date 1965/10/04

PUMPING LEVEL (below land surface)

227 ft. after hrs. pumping 380 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 75 Volts

SHALE	GRAY	934	936
CLAY	BROW	936	943
STICKY SHALE	GREE	943	981
STICKY CLAY	GRAY	981	981

Drop Pipe Length 250 ft. Capacity E+03 g.p.m

Type S

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Rochester Elevation 1136.5

Aquifer: CJIG Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220625 **Update Date** 2009/02/09

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	5	CDDDBD	981	ft.	981	ft.	1965/10/04

Well Name ROCHESTER 21 **Lic. Or Reg. No.** 55079 **Name of Driller**

USGS Quad Rochester **Elevation** 1136.5 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SHALE ODCR = Decorah	GREEN SHLE = Shale		0	18	ODCR	SHLE		
LIMESTONE OPGW = Platteville-Glenwood	BLUE LMSN = Limestone		18	46	OPGW	LMSN	SHLE SHLE = Shale	
ST. PETER SANDSTONE OSTP = St.Peter	YELLOW SNDS = Sandstone		46	144	OSTP	SNDS		
LIMESTONE OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite		144	163	OPDC	DLMT		
SANDSTONE (ROOT VALLEY) OPDC = Prairie Du Chien Group	YELLOW SNDS = Sandstone		163	174	OPDC	SNDS		
LIMESTONE OPDC = Prairie Du Chien Group	BROWN DLMT = Dolomite		174	184	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite		184	188	OPDC	DLMT		
SANDSTONE OPDC = Prairie Du Chien Group	YELLOW SNDS = Sandstone		188	196	OPDC	SNDS		
LIMESTONE OPDC = Prairie Du Chien Group	YELLOW DLMT = Dolomite	HARD	196	250	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	GRAY DLMT = Dolomite		250	345	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	BROWN DLMT = Dolomite		345	350	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	YELLOW DLMT = Dolomite		350	392	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	BLUE DLMT = Dolomite		392	445	OPDC	DLMT		
SANDSTONE CJDN = Jordan	SNDS = Sandstone		445	455	CJDN	SNDS		

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220625 **Update Date** 2009/02/09

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	5	CDDDBD	981	ft.	981	ft.	1965/10/04

Well Name ROCHESTER 21 **Lic. Or Reg. No.** 55079 **Name of Driller**

USGS Quad Rochester **Elevation** 1136.5 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SANDSTONE & LIMESTONE CJDN = Jordan	WHITE SNDS = Sandstone		455	480	CJDN	SNDS	DLMT	
SANDSTONE (FINE) CJDN = Jordan	WHITE SNDS = Sandstone		480	548	CJDN	SNDS		
LIGHT GRAY TO DARK LIMESTONE CSTL = St.Lawrence	GRAY DLMT = Dolomite		548	634	CSTL	DLMT	SLSN SLSN = Siltstone	SHLE SHLE = Shale
SANDY SHALE CFRN = Franconia	GREEN SHLE = Shale		634	653	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SHALE & LIMESTONE CFRN = Franconia	GREEN SHLE = Shale		653	698	CFRN	SHLE	DLMT DLMT = Dolomite	SNDS SNDS = Sandstone
SHALE & SANDSTONE CFRN = Franconia	BLU/GRY SHLE = Shale		698	710	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
STICKY SHALE CFRN = Franconia	GRAY SHLE = Shale	HARD	710	728	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
STICKY SHALE & SANDSTONE CFRN = Franconia	GRAY SHLE = Shale	HARD	728	760	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
STICKY SHALE & SANDSTONE CFRN = Franconia	GREEN SHLE = Shale	HARD	760	798	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SHALE & SANDSTONE CIGL = Ironton-Galesville	GRAY SHLE = Shale		798	842	CIGL	SHLE	SNDS SNDS = Sandstone	
SHALE & SANDSTONE CIGL = Ironton-Galesville	GREEN SHLE = Shale		842	858	CIGL	SHLE	SNDS SNDS = Sandstone	
STICKY SHALE & SANDSTONE CECR = Eau Claire	GREEN SHLE = Shale		858	876	CECR	SHLE	SNDS SNDS = Sandstone	
SHALE CECR = Eau Claire	GRAY SHLE = Shale		876	885	CECR	SHLE		
SANDSTONE CECR = Eau Claire	SNDS = Sandstone		885	888	CECR	SNDS		

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220625 **Update Date** 2009/02/09

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	5	CDDDBD	981	ft.	981	ft.	1965/10/04

Well Name ROCHESTER 21 **Lic. Or Reg. No.** 55079 **Name of Driller**

USGS Quad Rochester **Elevation** 1136.5 **Aquifer** CJIG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SHALE & SANDSTONE	GRAY		888	902	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
CLAY & LIMEROCK	GRAY		902	910	CECR	SHLE	DLMT	
CECR = Eau Claire	SHLE = Shale				DLMT = Dolomite			
SHALE	GREEN		910	925	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
CLAY	BROWN		925	934	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
SHALE	GRAY		934	936	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
CLAY	BROWN		936	943	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY SHALE	GREEN		943	981	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			
STICKY CLAY	GRAY		981	981	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale				SNDS = Sandstone			

Unique No. 00220818

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2011/09/19

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	22	BBDAAC

Well Name ROCHESTER 22

Well Owner's Name ROCHESTER 22

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	32
LIMESTONE			32	135
LIMESTONE & SEAMS OF S			135	140
LIMESTONE			140	172
LIMESTONE & SOME SAND			172	205
LIMESTONE			205	327
LIMESTONE & SHALE			327	337
SANDSTONE	WHITE		337	355
SHALEY SANDSTONE			355	360
SANDSTONE		HARD	360	395
SANDSTONE		SOFT	395	400
SANDSTONE			400	412
SHALEY SANDSTONE			412	435
LIMESTONE			435	511
SHALE & LIMESTONE			511	515
LIMESTONE		HARD	515	523
SHALE & LIMESTONE			523	532
SHALE	GREE		532	535
LIMESTONE & GREEN SHA			535	564
SANDROCK			564	570
STICKY SHALE			570	581
LIMESTONE		HARD	581	583
SHALE			583	585
SHALE & FINE SAND SEAM			585	601
SANDSTONE	BROW		601	608
STICKY SHALE & SANDSTO			608	617
SHALE & SANDSTONE & LI			617	624
SHALE	GREE		624	626
SHALE & LIMESTONE			626	662
SANDSTONE & SHALE			662	710
SHALE			710	711
SANDSTONE			711	726

Well Depth 730 ft. **Depth Completed** 730 ft. **Date Well Completed** 1966/07/21

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

Casing Diameter **Weight(lbs/ft)**

30 in. t 34 ft

24 in. t 344 ft

Screen N

Make Type

Open Hole From 344 ft. to 730 ft.

Static Water Level 66 ft. from Land surface Date 1966/07/21

PUMPING LEVEL (below land surface)

286 ft. after hrs. pumping 1336 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 150 Volts

SHALE	726	730

REMARKS, ELEVATION, SOURCE OF DATA, etc.

M.G.S. NO. 330.

OLD P.A. 66-1056.

USGS Quad Rochester Elevation 1042

Aquifer: OPCG Alt Id: 79-5076

Report Copy

Drop Pipe Length ft. Capacity g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27118

License Business Name

Name of Driller BRADFORD, A.

Unique No. 00220818

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2011/09/19

County Name Olmsted

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	22	BBDAAC	730	ft.	730	ft.	1966/07/21

Well Name ROCHESTER 22 Lic. Or Reg. No. 27118 Name of Driller BRADFORD, A.

USGS Quad Rochester Elevation 1042 Aquifer OPCG Alternative Id 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT			0	32	QUUU	DRFT		
QUUU = Unknown deposit type	DRFT = Drift							
LIMESTONE			32	135	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE & SEAMS OF SANDSTONE			135	140	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SNDS = Sandstone		
LIMESTONE			140	172	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE & SOME SANDSTONE LAYER			172	205	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SNDS = Sandstone		
LIMESTONE			205	327	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE & SHALE			327	337	OPDC	DLMT	SHLE	
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SHLE = Shale		
SANDSTONE	WHITE		337	355	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SNDS = Sandstone		
SHALEY SANDSTONE			355	360	OPDC	DLMT	SNDS	SHLE
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SNDS = Sandstone	SHLE = Shale	
SANDSTONE		HARD	360	395	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SNDS = Sandstone		
SANDSTONE		SOFT	395	400	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite					SNDS = Sandstone		
SANDSTONE			400	412	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SHALEY SANDSTONE			412	435	CJDN	SNDS	SHLE	
CJDN = Jordan	SNDS = Sandstone					SHLE = Shale		
LIMESTONE			435	511	CSTL	DLMT	SLSN	SHLE
CSTL = St.Lawrence	DLMT = Dolomite					SLSN = Siltstone	SHLE = Shale	

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220818 **Update Date** 2011/09/19

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	22	BBDAAC	730	ft.	730	ft.	1966/07/21

Well Name ROCHESTER 22 **Lic. Or Reg. No.** 27118 **Name of Driller** BRADFORD, A.

USGS Quad Rochester **Elevation** 1042 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SHALE & LIMESTONE CFRN = Franconia	SHLE = Shale		511	515	CFRN	SHLE	DLMT DLMT = Dolomite	
LIMESTONE CFRN = Franconia	DLMT = Dolomite	HARD	515	523	CFRN	DLMT	SHLE SHLE = Shale	SNDS SNDS = Sandstone
SHALE & LIMESTONE CFRN = Franconia	SHLE = Shale		523	532	CFRN	SHLE	DLMT DLMT = Dolomite	SNDS SNDS = Sandstone
SHALE CFRN = Franconia	GREEN SHLE = Shale		532	535	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
LIMESTONE & GREEN SHALE CFRN = Franconia	DLMT = Dolomite		535	564	CFRN	DLMT	SHLE SHLE = Shale	SNDS SNDS = Sandstone
SANDROCK CFRN = Franconia	SNDS = Sandstone		564	570	CFRN	SNDS	SHLE SHLE = Shale	DLMT DLMT = Dolomite
STICKY SHALE CFRN = Franconia	SHLE = Shale		570	581	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
LIMESTONE CFRN = Franconia	DLMT = Dolomite	HARD	581	583	CFRN	DLMT	SHLE SHLE = Shale	DLMT DLMT = Dolomite
SHALE CFRN = Franconia	SHLE = Shale		583	585	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SHALE & FINE SAND SEAMS CFRN = Franconia	SHLE = Shale		585	601	CFRN	SHLE	SNDS SNDS = Sandstone	
SANDSTONE CFRN = Franconia	BROWN SNDS = Sandstone		601	608	CFRN	SNDS	SHLE SHLE = Shale	DLMT DLMT = Dolomite
STICKY SHALE & SANDSTONE CFRN = Franconia	SHLE = Shale		608	617	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SHALE & SANDSTONE & LIMESTONE CFRN = Franconia	SHLE = Shale		617	624	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SHALE CFRN = Franconia	GREEN SHLE = Shale		624	626	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220818 **Update Date** 2011/09/19

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	22	BBDAAC	730	ft.	730	ft.	1966/07/21

Well Name ROCHESTER 22 **Lic. Or Reg. No.** 27118 **Name of Driller** BRADFORD, A.

USGS Quad Rochester **Elevation** 1042 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SHALE & LIMESTONE			626	662	CFRN	SHLE	DLMT	SNDS
CFRN = Franconia	SHLE = Shale		DLMT = Dolomite			SNDS = Sandstone		
SANDSTONE & SHALE			662	710	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
SHALE			710	711	CIGL	SHLE		
CIGL = Ironton-Galesville	SHLE = Shale							
SANDSTONE			711	726	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
SHALE			726	730	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale		SNDS = Sandstone					

Unique No. 00220660

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	1	DBDCCB

Well Depth	Depth Completed	Date Well Completed
806 ft.	806 ft.	1967/02/10

Well Name ROCHESTER 23

Drilling Method Cable Tool

Well Owner's Name ROCHESTER 23

ROCHESTER MN

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	20
SHAKOPEE			20	47
SANDSTONE & SHALE		SOFT	47	58
SHAKOPEE-ONEOTA			58	312
SANDY SHALE	GREE		312	325
SANDSTONE			325	398
SANDSTONE			398	436
SHALEY LIMESTONE			436	440
SHALEY LIMESTONE			440	512
SHALE	GREE		512	532
SANDSTONE, SHALE LAYE			532	640
SHALE			640	644
SANDSTONE			644	662
SHALE			662	672
SANDSTONE			672	677
SHALE			677	682
SANDSTONE			682	707
SANDSTONE & SHALE LAY			707	730
SHALE FROM SANDSTONE			730	751
SHALE			751	806

Casing Diameter **Weight(lbs/ft)**

30 in. t 24 ft

24 in. t 326 ft

Screen N

Open Hole From 326 ft. to 806 ft.

Make Type

Static Water Level 16 ft. from Land surface Date 1967/02/10

PUMPING LEVEL (below land surface)

217 ft. after hrs. pumping 1529 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 150 Volts

Drop Pipe Length 220 ft. Capacity Ξ+03 g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 3-19-1984 & 7-25-1995.

THE LOG HAS EXTENSIVE PUMP TEST DATA.

USGS Quad Rochester Elevation 1006.8

Aquifer: OPCG Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27118

License Business Name

Name of Driller BRADFORD, A.

Report Copy

HE-01205-06 (Rev. 9/96)

Unique No. 00220660

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	1	DBDCCB	806	ft.	806	ft.	1967/02/10

Well Name ROCHESTER 23 **Lic. Or Reg. No.** 27118 **Name of Driller** BRADFORD, A.

USGS Quad Rochester **Elevation** 1006.8 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT QUUU = Unknown deposit type	DRFT = Drift		0	20	QUUU	DRFT		
SHAKOPEE OPDC = Prairie Du Chien Group	DLMT = Dolomite		20	47	OPDC	DLMT		
SANDSTONE & SHALE OPDC = Prairie Du Chien Group	SNDS = Sandstone	SOFT	47	58	OPDC	SNDS	SHLE	
SHAKOPEE-ONEOTA OPDC = Prairie Du Chien Group	DLMT = Dolomite		58	312	OPDC	DLMT		
SANDY SHALE OPDC = Prairie Du Chien Group	GREEN SHLE = Shale		312	325	OPDC	SHLE	DLMT	
SANDSTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite		325	398	OPDC	DLMT	SNDS	
SANDSTONE CJDN = Jordan	SNDS = Sandstone		398	436	CJDN	SNDS		
SHALEY LIMESTONE CJDN = Jordan	SNDS = Sandstone		436	440	CJDN	SNDS		
SHALEY LIMESTONE CSLF = St.Lawrence-Franconia	DLMT = Dolomite		440	512	CSLF	DLMT	SHLE SHLE = Shale	SNDS SNDS = Sandstone
SHALE CSLF = St.Lawrence-Franconia	GREEN SHLE = Shale		512	532	CSLF	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SANDSTONE, SHALE LAYERS CFRN = Franconia	SNDS = Sandstone		532	640	CFRN	SNDS	SHLE SHLE = Shale	DLMT DLMT = Dolomite
SHALE CFRN = Franconia	SHLE = Shale		640	644	CFRN	SHLE	SNDS SNDS = Sandstone	DLMT DLMT = Dolomite
SANDSTONE CIGL = Ironton-Galesville	SNDS = Sandstone		644	662	CIGL	SNDS		
SHALE CIGL = Ironton-Galesville	SNDS = Sandstone		662	672	CIGL	SNDS	SHLE SHLE = Shale	

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220660 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	1	DBDCCB	806	ft.	806	ft.	1967/02/10

Well Name ROCHESTER 23 **Lic. Or Reg. No.** 27118 **Name of Driller** BRADFORD, A.

USGS Quad Rochester **Elevation** 1006.8 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SANDSTONE			672	677	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
SHALE			677	682	CIGL	SNDS	SHLE	
CIGL = Ironton-Galesville	SNDS = Sandstone		SHLE = Shale					
SANDSTONE			682	707	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
SANDSTONE & SHALE LAYERS			707	730	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale		SNDS = Sandstone					
SHALE FROM SANDSTONE LENSES			730	751	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale		SNDS = Sandstone					
SHALE			751	806	CECR	SHLE		
CECR = Eau Claire	SHLE = Shale							

Unique No. 00220819

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/12

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	23	CDADAC

Well Name ROCHESTER 24

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Well Owner's Name ROCHESTER 24

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	4
LIMEROCK		HARD	4	28
LIMEROCK W/CREVICES			28	44
LIMEROCK & SANDSTONE			44	54
LIMEROCK		HARD	54	75
LIMEROCK CREVICES			75	80
LIMEROCK			80	87
SANDROCK			87	92
LIMEROCK CREVICES			92	103
LIMEROCK & SANDROCK			103	108
LIMEROCK			108	122
LIMEROCK CREVICES			122	145
LIMEROCK			145	211
LIMEROCK CREVICED			211	248
LIMEROCK & SHALE			248	280
LIMEROCK & SANDROCK			280	300
SANDROCK			300	390
LIMEROCK			390	395
LIMEROCK & SHALE			395	484
SANDROCK & SHALE			484	499
SHALE			499	503
SANDROCK			503	505
SHALE & SANDROCK			505	548
STICKY SHALE			548	558
SANDROCK & SHALE			558	563
SHALE			563	568
LIMEROCK & SANDROCK			568	574
LIMEROCK & SANDROCK &			574	588
LIMEROCK & SHALE			588	593
LIMEROCK & SANDROCK &			593	600
SHALE	BROW		600	603
SHALE & LIMEROCK	GREE		603	618

Well Depth 685 ft. Depth Completed 685 ft. Date Well Completed 1968/05/07

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter

Casing Diameter 24 in. t Weight(lbs/ft) 309 ft

Screen N

Open Hole From 309 ft. to 685 ft.

Make Type

Static Water Level 36 ft. from Land surface Date 1968/05/07

PUMPING LEVEL (below land surface)

242 ft. after 24 hrs. pumping 1200 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 200 Volts

SANDROCK & SHALE	618	642
SANDROCK	642	678
STICKY SHALE	678	685

REMARKS, ELEVATION, SOURCE OF DATA, etc.

OLD P.A. 69-0030.

Drop Pipe Length ft. Capacity g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Rochester Elevation 997

Aquifer: OPCG Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 96460

License Business Name

Name of Driller

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220819 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	23	CDADAC	685	ft.	685	ft.	1968/05/07

Well Name ROCHESTER 24 **Lic. Or Reg. No.** 96460 **Name of Driller**

USGS Quad Rochester **Elevation** 997 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT			0	4	QUUU	DRFT		
QUUU = Unknown deposit type	DRFT = Drift							
LIMEROCK		HARD	4	28	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK W/CREVICES			28	44	OPDC	DLMT	CRVC	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				CRVC = Crevice			
LIMEROCK & SANDSTONE			44	54	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				SNDS = Sandstone			
LIMEROCK		HARD	54	75	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK CREVICES			75	80	OPDC	DLMT	CRVC	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				CRVC = Crevice			
LIMEROCK			80	87	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDROCK			87	92	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIMEROCK CREVICES			92	103	OPDC	DLMT	CRVC	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				CRVC = Crevice			
LIMEROCK & SANDROCK			103	108	OPDC	DLMT	SNDS	CRVC
OPDC = Prairie Du Chien Group	DLMT = Dolomite				SNDS = Sandstone		CRVC = Crevice	
LIMEROCK			108	122	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK CREVICES			122	145	OPDC	DLMT	CRVC	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				CRVC = Crevice			
LIMEROCK			145	211	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK CREVICED			211	248	OPDC	DLMT	CRVC	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				CRVC = Crevice			

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220819 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	23	CDADAC	685	ft.	685	ft.	1968/05/07

Well Name ROCHESTER 24 **Lic. Or Reg. No.** 96460 **Name of Driller**

USGS Quad Rochester **Elevation** 997 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
LIMEROCK & SHALE OPDC = Prairie Du Chien Group	DLMT = Dolomite		248	280	OPDC	DLMT	SHLE	SHLE = Shale
LIMEROCK & SANDROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		280	300	OPDC	DLMT	SNDS	SNDS = Sandstone
SANDROCK CJDN = Jordan	SNDS = Sandstone		300	390	CJDN	SNDS		
LIMEROCK CSTL = St.Lawrence	DLMT = Dolomite		390	395	CSTL	DLMT	SLSN	SLSN = Siltstone
LIMEROCK & SHALE CSTL = St.Lawrence	DLMT = Dolomite		395	484	CSTL	DLMT	SLSN	SLSN = Siltstone
SANDROCK & SHALE CFRN = Franconia	SNDS = Sandstone		484	499	CFRN	SNDS	SHLE	DLMT SHLE = Shale DLMT = Dolomite
SHALE CFRN = Franconia	SHLE = Shale		499	503	CFRN	SHLE	SNDS	DLMT SNDS = Sandstone DLMT = Dolomite
SANDROCK CFRN = Franconia	SNDS = Sandstone		503	505	CFRN	SNDS	SHLE	SHLE = Shale
SHALE & SANDROCK CFRN = Franconia	SHLE = Shale		505	548	CFRN	SHLE	SNDS	DLMT SNDS = Sandstone DLMT = Dolomite
STICKY SHALE CFRN = Franconia	SHLE = Shale		548	558	CFRN	SHLE	SNDS	DLMT SNDS = Sandstone DLMT = Dolomite
SANDROCK & SHALE CFRN = Franconia	SNDS = Sandstone		558	563	CFRN	SNDS	SHLE	DLMT SHLE = Shale DLMT = Dolomite
SHALE CFRN = Franconia	SHLE = Shale		563	568	CFRN	SHLE	SNDS	SNDS = Sandstone
LIMEROCK & SANDROCK CFRN = Franconia	DLMT = Dolomite		568	574	CFRN	DLMT	SNDS	SHLE SNDS = Sandstone SHLE = Shale
LIMEROCK & SANDROCK & SHALE CFRN = Franconia	DLMT = Dolomite		574	588	CFRN	DLMT	SNDS	SHLE SNDS = Sandstone SHLE = Shale

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220819 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	23	CDADAC	685	ft.	685	ft.	1968/05/07

Well Name ROCHESTER 24 **Lic. Or Reg. No.** 96460 **Name of Driller**

USGS Quad Rochester **Elevation** 997 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
LIMEROCK & SHALE			588	593	CFRN	DLMT	SHLE	SNDS
CFRN = Franconia	DLMT = Dolomite		SHLE = Shale				SNDS = Sandstone	
LIMEROCK & SANDROCK & SHALE			593	600	CFRN	DLMT	SNDS	SHLE
CFRN = Franconia	DLMT = Dolomite		SNDS = Sandstone				SHLE = Shale	
SHALE	BROWN		600	603	CFRN	SHLE	SNDS	DLMT
CFRN = Franconia	SHLE = Shale		SNDS = Sandstone				DLMT = Dolomite	
SHALE & LIMEROCK	GREEN		603	618	CFRN	SHLE	DLMT	SNDS
CFRN = Franconia	SHLE = Shale		DLMT = Dolomite				SNDS = Sandstone	
SANDROCK & SHALE			618	642	CIGL	SNDS	SHLE	
CIGL = Ironton-Galesville	SNDS = Sandstone		SHLE = Shale					
SANDROCK			642	678	CIGL	SNDS		
CIGL = Ironton-Galesville	SNDS = Sandstone							
STICKY SHALE			678	685	CECR	SHLE	SNDS	
CECR = Eau Claire	SHLE = Shale		SNDS = Sandstone					

Unique No. 00220675

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	10	AAABDB

Well Name ROCHESTER 25

Well Owner's Name ROCHESTER 25

ROCHESTER MN

Contact's Name CITY OF ROCHESTER
4000 EAST RIVER NE RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	65
LIMEROCK			65	129
ROOT VALLEY SANDROCK			129	135
DOLOMITE			135	339
SANDROCK (JORDAN)			339	410
SANDROCK (JORDAN)			410	425
SANDROCK (JORDAN)			425	449
SHALE (ST. LAWRENCE)			449	690
SANDROCK & SHALE			690	765
SANDROCK & SHALE			765	770
SHALE			770	793
SANDROCK & SHALE			793	803
SHALE			803	850

REMARKS, ELEVATION, SOURCE OF DATA, etc.

M.G.S. NO. 652. OLD P.A. NO. 69-0031.

USGS Quad Rochester Elevation 1009.6

Aquifer: OPCG Alt Id: 79-5076

Report Copy

Well Depth 850 ft. Depth Completed 850 ft. Date Well Completed 1969/01/10

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Casing Diameter	Weight(lbs/ft)
30 in. t 65.5 ft	
24 in. t 345 ft	

Hole Diameter

0 in. t 281 ft

0 in. t 850 ft

Screen N

Open Hole From 345 ft. to 850 ft.

Make Type

Static Water Level 14 ft. from Land surface Date 1969/01/10

PUMPING LEVEL (below land surface)

210 ft. after 9 hrs. pumping 2000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	345	800	S

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 150 Volts

Drop Pipe Length ft. Capacity g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 62012

License Business Name

Name of Driller O'BRIEN, F.

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220675 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	10	AAABDB	850	ft.	850	ft.	1969/01/10

Well Name ROCHESTER 25 **Lic. Or Reg. No.** 62012 **Name of Driller** O'BRIEN, F.

USGS Quad Rochester **Elevation** 1009.6 **Aquifer** OPCG **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT QUUU = Unknown deposit type	DRFT = Drift		0	65	QUUU	DRFT		
LIMEROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		65	129	OPDC	DLMT		
ROOT VALLEY SANDROCK OPDC = Prairie Du Chien Group	SNDS = Sandstone		129	135	OPDC	SNDS		
DOLOMITE OPDC = Prairie Du Chien Group	DLMT = Dolomite		135	339	OPDC	DLMT		
SANDROCK (JORDAN) OPDC = Prairie Du Chien Group	DLMT = Dolomite		339	410	OPDC	DLMT	SNDS = Sandstone	
SANDROCK (JORDAN) CJDN = Jordan	SNDS = Sandstone		410	425	CJDN	SNDS		
SANDROCK (JORDAN) CSTL = St.Lawrence	SLSN = Siltstone		425	449	CSTL	SLSN	DLMT = Dolomite	SHLE = Shale
SHALE (ST. LAWRENCE) CSLF = St.Lawrence-Franconia	SHLE = Shale		449	690	CSLF	SHLE	SNDS = Sandstone	DLMT = Dolomite
SANDROCK & SHALE CIGL = Ironton-Galesville	SNDS = Sandstone		690	765	CIGL	SNDS	SHLE = Shale	
SANDROCK & SHALE CECR = Eau Claire	SHLE = Shale		765	770	CECR	SHLE	SNDS = Sandstone	
SHALE CECR = Eau Claire	SHLE = Shale		770	793	CECR	SHLE		
SANDROCK & SHALE CECR = Eau Claire	SNDS = Sandstone		793	803	CECR	SNDS	SHLE = Shale	
SHALE CECR = Eau Claire	SHLE = Shale		803	850	CECR	SHLE		

Unique No. 00147451

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/12

Entry Date 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	32	DCBBBA

Well Depth 624 ft. | Depth Completed 624 ft. | Date Well Completed 1978/04/28

Well Name ROCHESTER 26

Drilling Method Cable Tool

Well Owner's Name ROCHESTER 26

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☑ Yes ☐ N

Casing Diameter				Weight(lbs/ft)
30	in. t	83	ft	118.65
24	in. t	364	ft	94.62

Hole Diameter

0 in. t 624 ft

0 in. t 364 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	13
BROKEN PLATTEVILLE RO			13	20
BROKEN PLATTEVILLE RO			20	73
BROKEN PLATTEVILLE RO			73	82
PLATTEVILLE ROCK			82	90
PLATTEVILLE ROCK			90	96
PLATTEVILLE ROCK			96	99
ST. PETER SANDSTONE			99	194
ST. PETER SANDSTONE			194	200
SHAKOPEE ROCK			200	402
ONEOTA			402	530
JORDAN SANDSTONE			530	613
JORDAN SANDSTONE			613	620
ST. LAWRENCE			620	624

Screen N

Make

Type

Open Hole From 364 ft. to 624 ft.

Static Water Level 155 ft. from Land surface Date 1978/04/28

PUMPING LEVEL (below land surface)

252 ft. after 8 hrs. pumping 1250 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	364	1140	S

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 12-23-1987. M.G.S. NO. 1361.

USGS Quad Douglas Elevation 1166

Aquifer: OPCJ Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27010

License Business Name

Name of Driller HOLLEN, G.

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00147451 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1989/12/28

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	32	DCBBBA	624	ft.	624	ft.	1978/04/28

Well Name ROCHESTER 26 **Lic. Or Reg. No.** 27010 **Name of Driller** HOLLEN, G.

USGS Quad Douglas **Elevation** 1166 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT QUUU = Unknown deposit type	DRFT = Drift		0	13	QUUU	DRFT		
BROKEN PLATTEVILLE ROCK & SHALE OGAL = Galena	LMSN = Limestone		13	20	OGAL	LMSN	SHLE	SHLE = Shale
BROKEN PLATTEVILLE ROCK & SHALE ODCR = Decorah	SHLE = Shale		20	73	ODCR	SHLE		
BROKEN PLATTEVILLE ROCK & SHALE OPVL = Platteville	LMSN = Limestone		73	82	OPVL	LMSN		
PLATTEVILLE ROCK OPVL = Platteville	LMSN = Limestone		82	90	OPVL	LMSN		
PLATTEVILLE ROCK OGWD = Glenwood	SHLE = Shale		90	96	OGWD	SHLE		
PLATTEVILLE ROCK OSTP = St.Peter	SNDS = Sandstone		96	99	OSTP	SNDS		
ST. PETER SANDSTONE OSTP = St.Peter	SNDS = Sandstone		99	194	OSTP	SNDS		
ST. PETER SANDSTONE OPDC = Prairie Du Chien Group	DLMT = Dolomite		194	200	OPDC	DLMT		
SHAKOPEE ROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		200	402	OPDC	DLMT		
ONEOTA OPDC = Prairie Du Chien Group	DLMT = Dolomite		402	530	OPDC	DLMT		
JORDAN SANDSTONE CJDN = Jordan	SNDS = Sandstone		530	613	CJDN	SNDS		
JORDAN SANDSTONE CSTL = St.Lawrence	SLSN = Siltstone		613	620	CSTL	SLSN	SHLE SHLE = Shale	DLMT DLMT = Dolomite
ST. LAWRENCE CSTL = St.Lawrence	SLSN = Siltstone		620	624	CSTL	SLSN	DLMT DLMT = Dolomite	SHLE SHLE = Shale

Unique No. 00224212

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	107	13	W	31	BCCCCB

Well Name ROCHESTER 27

Well Depth 448 ft. | Depth Completed 448 ft. | Date Well Completed 1979/12/14

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Well Owner's Name ROCHESTER 27

ROCHESTER MN

Contact's Name ROCHESTER PUBLIC UTILITIES
4000 EAST RIVER RD
ROCHESTER MN 55904

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter

Casing Diameter Weight(lbs/ft)

30 in. t 32 ft

24 in. t 345 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
GLACIAL DRIFT			0	32
SHAKOPEE DOLOMITE			32	135
ROOT VALLEY SANDSTON			135	153
SHAKOPEE DOLOMITE			153	247
ONEOTA DOLOMITE			247	320
SHALE	BLUE		320	331
JORDAN SANDSTONE			331	395
JORDAN SANDSTONE			395	428
ST. LAWRENCE			428	448

Screen N

Open Hole From 345 ft. to 448 ft.

Make Type

Static Water Level 25 ft. from Land surface Date 1979/12/14

PUMPING LEVEL (below land surface)

ft. after hrs. pumping g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	345	42	Y

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 3-7-1997. M.G.S. NO. 1546.

USGS Quad Rochester Elevation 1016

Aquifer: OPCJ Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27010

License Business Name

Name of Driller HOLLEN, G.

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00224212 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	13	W	31	BCCCCB	448	ft.	448	ft.	1979/12/14

Well Name ROCHESTER 27 **Lic. Or Reg. No.** 27010 **Name of Driller** HOLLEN, G.

USGS Quad Rochester **Elevation** 1016 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
GLACIAL DRIFT			0	32	QUUU	SOIL	CLAY	SAND
QUUU = Unknown deposit type	SOIL = Soil		CLAY = Clay				SAND = Sand	
SHAKOPEE DOLOMITE			32	135	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
ROOT VALLEY SANDSTONE			135	153	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
SHAKOPEE DOLOMITE			153	247	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
ONEOTA DOLOMITE			247	320	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SHALE	BLUE		320	331	OPDC	SHLE		
OPDC = Prairie Du Chien Group	SHLE = Shale							
JORDAN SANDSTONE			331	395	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite		SNDS = Sandstone					
JORDAN SANDSTONE			395	428	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
ST. LAWRENCE			428	448	CSTL	DLMT	SLSN	SHLE
CSTL = St.Lawrence	DLMT = Dolomite		SLSN = Siltstone				SHLE = Shale	

Unique No. 00180567

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	15	ADBDBB

Well Depth 389 ft. | Depth Completed 389 ft. | Date Well Completed 1981/08/04

Well Name ROCHESTER 28

Drilling Method Cable Tool

Well Owner's Name ROCHESTER 28

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter

Casing Diameter Weight(lbs/ft)

30 in. t 39 ft

24 in. t 305 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
MUD			0	24
SANDSTONE	TAN		24	28
LIMESTONE	TAN		28	48
LIMESTONE	BROW	MEDIUM	48	52
LIMESTONE	BROW	HARD	52	60
LIMESTONE	TAN	MEDIUM	60	115
LIMESTONE	TAN	HARD	115	175
LIMESTONE	BROW		175	187
LIMESTONE	TAN		187	191
LIMESTONE	GRAY	HARD	191	211
LIMESTONE	TAN		211	257
LIMESTONE	GRAY		257	285
SANDSTONE	GRAY		285	351
LIMESTONE	GRAY		351	360
SANDSTONE	GRAY		360	385
ST. LAWRENCE	GRAY		385	389

Screen N

Open Hole From 305 ft. to 389 ft.

Make Type

Static Water Level 15 ft. from Land surface Date 1981/07/27

PUMPING LEVEL (below land surface)

199.5 ft. after 4 hrs. pumping 1580 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G		38	Y	

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Rochester Elevation 984

Aquifer: CJDN Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller THEIN, D.

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00180567 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	15	ADBDBB	389	ft.	389	ft.	1981/08/04

Well Name ROCHESTER 28 **Lic. Or Reg. No.** 55079 **Name of Driller** THEIN, D.

USGS Quad Rochester **Elevation** 984 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
MUD			0	24	QUUU	MUDD		
QUUU = Unknown deposit type	MUDD = Mud							
SANDSTONE	TAN		24	28	OPDC	SNDS	DLMT	
OPDC = Prairie Du Chien Group	SNDS = Sandstone				DLMT = Dolomite			
LIMESTONE	TAN		28	48	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	BROWN	MEDIUM	48	52	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	BROWN	HARD	52	60	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	TAN	MEDIUM	60	115	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	TAN	HARD	115	175	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	BROWN		175	187	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	TAN		187	191	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	GRAY	HARD	191	211	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	TAN		211	257	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	GRAY		257	285	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE	GRAY		285	351	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
LIMESTONE	GRAY		351	360	CJDN	SNDS	DLMT	
CJDN = Jordan	SNDS = Sandstone				DLMT = Dolomite			

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00180567 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	15	ADBDBB	389	ft.	389	ft.	1981/08/04

Well Name ROCHESTER 28 **Lic. Or Reg. No.** 55079 **Name of Driller** THEIN, D.

USGS Quad Rochester **Elevation** 984 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SANDSTONE	GRAY		360	385	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
ST. LAWRENCE	GRAY		385	389	CSTL	SLSN	DLMT	
CSTL = St.Lawrence	SLSN = Siltstone				DLMT = Dolomite			

Unique No. 00161425

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2008/06/23

Entry Date 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	14	BAADAB

Well Name ROCHESTER 29

Well Owner's Name ROCHESTER 29

ROCHESTER MN 55903

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	18
ST. PETER SANDROCK			18	106
SHAKOPEE-ONEOTA			106	408
JORDAN SANDROCK			408	425
JORDAN SANDROCK			425	514
ST. LAWRENCE			514	519

REMARKS, ELEVATION, SOURCE OF DATA, etc.

72 YARDS OF GROUT WERE USED IN GROUTING IN THE CASINGS.

GAMMA LOGGED 8-24-1995. M.G.S. NO. 2014.

USGS Quad Simpson Elevation 1087

Aquifer: CJDN Alt Id: 79-5076

Report Copy

Well Depth	Depth Completed	Date Well Completed
519 ft.	519 ft.	1982/10/25

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Casing Diameter			Weight(lbs/ft)
30	in. t	106 ft	118.65
24	in. t	422 ft	94.62

Hole Diameter

0 in. t 422 ft

0 in. t 519 ft

Screen N

Make Type

Open Hole From 422 ft. to 519 ft.

Static Water Level 89 ft. from Land surface Date 1982/10/18

PUMPING LEVEL (below land surface)

159 ft. after 10 hrs. pumping 1500 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)
G	0	106	0
G	0	422	

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27058

License Business Name

Name of Driller

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00161425 **Update Date** 2008/06/23

County Name Olmsted **Entry Date** 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	14	BAADAB	519	ft.	519	ft.	1982/10/25

Well Name ROCHESTER 29 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Simpson **Elevation** 1087 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT QUUU = Unknown deposit type	DRFT = Drift		0	18	QUUU	DRFT		
ST. PETER SANDROCK OSTP = St.Peter	SNDS = Sandstone		18	106	OSTP	SNDS		
SHAKOPEE-ONEOTA OPDC = Prairie Du Chien Group	DLMT = Dolomite		106	408	OPDC	DLMT		
JORDAN SANDROCK OPDC = Prairie Du Chien Group	DLMT = Dolomite		408	425	OPDC	DLMT		
JORDAN SANDROCK CJDN = Jordan	SNDS = Sandstone		425	514	CJDN	SNDS		
ST. LAWRENCE CSTL = St.Lawrence	SLSN = Siltstone		514	519	CSTL	SLSN	DLMT DLMT = Dolomite	SHLE SHLE = Shale

Unique No. 00239761

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/12

Entry Date 1992/04/03

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	36	ABBCCD

Well Depth 402 ft. **Depth Completed** 402 ft. **Date Well Completed** 1984/03/26

Well Name ROCHESTER 30

Drilling Method Cable Tool

Well Owner's Name ROCHESTER 30

ROCHESTER MN 55903

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Use Community Supply (municipal)

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	5
SAND & SHALE			5	48
SAND & SHALE			48	58
LIMEROCK			58	91
SANDSTONE			91	108
LIMEROCK			108	305
SANDROCK			305	360
SANDROCK			360	400
SHALE			400	402

Casing **Drive Shoe?** ☐ Yes ☐ N

Casing Diameter **Weight(lbs/ft)**

36 in. t 64 ft

24 in. t 319 ft

Hole Diameter

0 in. t 402 ft

0 in. t 319 ft

Screen N

Make Type

Open Hole From 319 ft. to 402 ft.

Static Water Level 30 ft. from Land surface Date 1984/03/26

PUMPING LEVEL (below land surface)

174 ft. after 8 hrs. pumping 1800 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	319	1019	S

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 6-8-1994. M.G.S. NO. 2170.

USGS Quad Rochester Elevation 1006

Aquifer: CJDN Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 62012

License Business Name

Name of Driller HANSON, D.

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00239761 **Update Date** 2009/02/12

County Name Olmsted **Entry Date** 1992/04/03

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	36	ABBCCD	402	ft.	402	ft.	1984/03/26

Well Name ROCHESTER 30 **Lic. Or Reg. No.** 62012 **Name of Driller** HANSON, D.

USGS Quad Rochester **Elevation** 1006 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT			0	5	QUUU	DRFT		
QUUU = Unknown deposit type	DRFT = Drift							
SAND & SHALE			5	48	QLUU	SAND	CLAY	
QLUU = Clay & sand	SAND = Sand		CLAY = Clay					
SAND & SHALE			48	58	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMEROCK			58	91	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE			91	108	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
LIMEROCK			108	305	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDROCK			305	360	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite		SNDS = Sandstone					
SANDROCK			360	400	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SHALE			400	402	CSTL	SLSN	DLMT	SNDS
CSTL = St.Lawrence	SLSN = Siltstone		DLMT = Dolomite				SNDS = Sandstone	

Unique No. 00434041

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	23	CCCCCB

Well Depth 555 ft. | Depth Completed 530 ft. | Date Well Completed 1987/10/13

Well Name ROCHESTER 31

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Well Owner's Name ROCHESTER 31
40TH ST
ROCHESTER MN 55903

Use Community Supply (municipal)

Contact's Name ROCHESTER PUBLIC UTILITIES

ROCHESTER MN 55903

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
SAND, GRAVEL & COBBLES	BROW	SOFT	0	27
SANDSTONE	BROW	SOFT	27	54
SANDSTONE	GRAY	SOFT	54	125
DOLOMITE	GRAY	HARD	125	435
SANDSTONE	WHITE	SOFT	435	490
SANDSTONE	WHITE	SOFT	490	550
SANDSTONE	WHITE	SOFT	550	555

Casing — Drive Shoe? ☑ Yes ☐ N

Casing Diameter			Weight(lbs/ft)
36 in. t	54 ft		142.68
24 in. t	462 ft		94.62

Hole Diameter

0 in. t	462 ft
in. t	530 ft
0 in. t	126 ft

Screen N

Make Type

Open Hole From 462 ft. to 530 ft.

Static Water Level 38 ft. from Land surface Date 1987/10/06

PUMPING LEVEL (below land surface)

100.5 ft. after 8 hrs. pumping 1500 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	461.5	54	Y

Nearest Known Source of Contamination

225 ft. direction S type BOW

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 5-13-1999. M.G.S. NO. 2829.

USGS Quad Simpson Elevation 1068.5

Aquifer: CJDN Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27058

License Business Name

Name of Driller

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00434041 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	23	CCCCCB	555	ft.	530	ft.	1987/10/13

Well Name ROCHESTER 31 **Lic. Or Reg. No.** 27058 **Name of Driller**

USGS Quad Simpson **Elevation** 1068.5 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SAND, GRAVEL & COBBLES	BROWN	SOFT	0	27	QHUB	SAND	GRVL	COBL
QHUB = Sand & larger	SAND = Sand				GRVL = Gravel		COBL = Cobble	
SANDSTONE	BROWN	SOFT	27	54	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
SANDSTONE	GRAY	SOFT	54	125	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
DOLOMITE	GRAY	HARD	125	435	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE	WHITE	SOFT	435	490	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				SNDS = Sandstone			
SANDSTONE	WHITE	SOFT	490	550	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SANDSTONE	WHITE	SOFT	550	555	CSTL	SLSN	SHLE	
CSTL = St.Lawrence	SLSN = Siltstone				SHLE = Shale			

Unique No. 00506819

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date 1992/08/17

County Name Olmsted

Township Name	Township	Range	Dir	Section	Subsection
	107	13	W	30	CACDBD

Well Depth 540 ft. | Depth Completed 540 ft. | Date Well Completed 1989/12/15

Well Name ROCHESTER 32

Drilling Method Non-specified Rotary

Well Owner's Name ROCHESTER 32

ROCHESTER MN 55904

Drilling Fluid

Other

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Contact's Name ROCHESTER PUBLIC UTILITIES
4000 EAST RIVER RD
ROCHESTER MN 55904

Use Community Supply (municipal)

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	5
DECORAH	GREE	MEDIUM	5	10
PLATTEVILLE	GRAY	MEDIUM	10	28
GLENWOOD	BLUE	MEDIUM	28	33
ST. PETER	BROW	MEDIUM	33	135
SHAKOPEE	BROW	MEDIUM	135	235
ROOT VALLEY	GRAY	MEDIUM	235	240
ONEOTA	BROW	MEDIUM	240	433
JORDAN	GRAY	MEDIUM	433	470
JORDAN	GRAY	MEDIUM	470	540

Casing — Drive Shoe? ☐ Yes ☑ N

Casing Diameter	Weight(lbs/ft)
36 in. t 11 ft	
24 in. t 453 ft	

Hole Diameter

0 in. t 540 ft

0 in. t 453 ft

Screen N

Make

Type

Open Hole From 453 ft. to 540 ft.

Static Water Level 141 ft. from Land surface Date 1989/12/11

PUMPING LEVEL (below land surface)

334.75 ft. after 24 hrs. pumping 1015 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	1	453	59	Y

Nearest Known Source of Contamination

50 ft. direction type SDF

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

CORNER OF PARKWOOD HILLS DR. AND 22ND AVE.

GAMMA LOGGED BY B.A. LEISCH & ASSOC.

USGS Quad Rochester Elevation 1129.4

Aquifer: CJDN Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller VANHOUTEN, D.

Report Copy

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00506819 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	13	W	30	CACDBD	540	ft.	540	ft.	1989/12/15

Well Name ROCHESTER 32 **Lic. Or Reg. No.** 55079 **Name of Driller** VANHOUTEN, D.

USGS Quad Rochester **Elevation** 1129.4 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT QUUU = Unknown deposit type	DRFT = Drift		0	5	QUUU	DRFT		
DECORAH ODCR = Decorah	GREEN SHLE = Shale	MEDIUM	5	10	ODCR	SHLE		
PLATTEVILLE OPVL = Platteville	GRAY LMSN = Limestone	MEDIUM	10	28	OPVL	LMSN		
GLENWOOD OGWD = Glenwood	BLUE SHLE = Shale	MEDIUM	28	33	OGWD	SHLE		
ST. PETER OSTP = St.Peter	BROWN SNDS = Sandstone	MEDIUM	33	135	OSTP	SNDS		
SHAKOPEE OPDC = Prairie Du Chien Group	BROWN DLMT = Dolomite	MEDIUM	135	235	OPDC	DLMT		
ROOT VALLEY OPDC = Prairie Du Chien Group	GRAY SNDS = Sandstone	MEDIUM	235	240	OPDC	SNDS		
ONEOTA OPDC = Prairie Du Chien Group	BROWN DLMT = Dolomite	MEDIUM	240	433	OPDC	DLMT		
JORDAN OPDC = Prairie Du Chien Group	GRAY DLMT = Dolomite	MEDIUM	433	470	OPDC	DLMT	SNDS SNDS = Sandstone	
JORDAN CJDN = Jordan	GRAY SNDS = Sandstone	MEDIUM	470	540	CJDN	SNDS		

Unique No. 00220627

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/09

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	106	13	W	8	BBDDBD

Well Depth 605 ft. **Depth Completed** 605 ft. **Date Well Completed** 1958/00/00

Well Name ROCHESTER 33

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Well Owner's Name ROCHESTER 33

ROCHESTER MN

Contact's Name CITY OF ROCHESTER

ROCHESTER MN

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

Casing Diameter **Weight(lbs/ft)**

24 in. t 54 ft

16 in. t 509 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	2
DECORAH SHALE			2	60
PLATTVILLE FORMATIONS			60	101
ST. PETER SAND			101	203
SHAKOPEE DOLOMITE			203	325
ROOT VALLEY SAND			325	340
ONEOTA DOLOMITE			340	499
JORDAN SAND			499	605

Screen N **Open Hole** From 509 ft. to 605 ft.

Make Type

Static Water Level 166 ft. from Land surface Date /19/58

PUMPING LEVEL (below land surface)

186 ft. after hrs. pumping 210 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)
	0	509	

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity 210 g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

CO-OP POWER ASSN. DRILLED BY THEIN WELL CO.

ROSE HARBOR WELL.

USGS Quad Rochester Elevation 1192

Aquifer: CJDN Alt Id: 38734108400

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller

Report Copy

HE-01205-06 (Rev. 9/96)

Unique No. 00220627

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/09

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	8	BBDDBD	605	ft.	605	ft.	1958/00/00

Well Name ROCHESTER 33 Lic. Or Reg. No. 55079 Name of Driller

USGS Quad Rochester Elevation 1192 Aquifer CJDN Alternative Id 38734108400

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT QUUU = Unknown deposit type	DRFT = Drift		0	2	QUUU	DRFT		
DECORAH SHALE ODCR = Decorah	SHLE = Shale		2	60	ODCR	SHLE		
PLATTVILLE FORMATIONS OPVL = Platteville	LMSN = Limestone		60	101	OPVL	LMSN		
ST. PETER SAND OSTP = St.Peter	SNDS = Sandstone		101	203	OSTP	SNDS		
SHAKOPEE DOLOMITE OPDC = Prairie Du Chien Group	DLMT = Dolomite		203	325	OPDC	DLMT		
ROOT VALLEY SAND OPDC = Prairie Du Chien Group	SNDS = Sandstone		325	340	OPDC	SNDS		
ONEOTA DOLOMITE OPDC = Prairie Du Chien Group	DLMT = Dolomite		340	499	OPDC	DLMT		
JORDAN SAND CJDN = Jordan	SNDS = Sandstone		499	605	CJDN	SNDS		

Unique No. 00463536

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	17	ACDDAB

Well Name ROCHESTER 34

Well Owner's Name ROCHESTER 34

ROCHESTER MN 55902

Contact's Name ROCHESTER PUBLIC UTILITIES
4000 EAST RIVER NE RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT	GRAY	SOFT	0	75
DRIFT	GRAY	SOFT	75	86
ST. PETER	BROW	MEDIUM	86	125
SHAKOPEE	BROW	HARD	125	177
ROOT VALLEY	BROW	MEDIUM	177	180
ONEOTA	GRAY	HARD	180	350
JORDAN	GRAY	MEDIUM	350	420
JORDAN	GRAY	SOFT	420	460
JORDAN	GRAY	MEDIUM	460	465

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED BY B.A. LEISCH & ASSOC. M.G.S. NO. 3365.

GOLF COURSE ON 41ST AND 55TH ST.

USGS Quad Douglas Elevation 1053.2

Aquifer: CJDN Alt Id: 3365

Report Copy

Well Depth 465 ft. Depth Completed 465 ft. Date Well Completed 1991/05/22

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☑ Yes ☐ N

Casing Diameter				Weight(lbs/ft)
36	in. t	86	ft	142.6
24	in. t	369	ft	94.6

Hole Diameter

0	in. t	197	ft
0	in. t	465	ft
0	in. t	369	ft

Screen N

Open Hole From 369 ft. to 465 ft.

Make Type

Static Water Level 50 ft. from Land surface Date 1991/05/16

PUMPING LEVEL (below land surface)

324.5 ft. after 8 hrs. pumping 1250 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	369	56	Y

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 62012

License Business Name

Name of Driller GALVIN, M.

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00463536 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 1992/08/17

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	17	ACDDAB	465	ft.	465	ft.	1991/05/22

Well Name ROCHESTER 34 **Lic. Or Reg. No.** 62012 **Name of Driller** GALVIN, M.

USGS Quad Douglas **Elevation** 1053.2 **Aquifer** CJDN **Alternative Id** 3365

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT	GRAY	SOFT	0	75	QUUG	DRFT		
QUUG = Unknown deposit type	DRFT = Drift							
DRIFT	GRAY	SOFT	75	86	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				SNDS = Sandstone			
ST. PETER	BROWN	MEDIUM	86	125	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SHAKOPEE	BROWN	HARD	125	177	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
ROOT VALLEY	BROWN	MEDIUM	177	180	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = Sandstone							
ONEOTA	GRAY	HARD	180	350	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
JORDAN	GRAY	MEDIUM	350	420	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite				SNDS = Sandstone			
JORDAN	GRAY	SOFT	420	460	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
JORDAN	GRAY	MEDIUM	460	465	CSTL	SLSN	DLMT	SHLE
CSTL = St.Lawrence	SLSN = Siltstone				DLMT = Dolomite		SHLE = Shale	

Unique No. 00601335

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date 1999/08/20

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	20	AAADCA

Well Name ROCHESTER 35

Well Owner's Name ROCHESTER 35

ROCHESTER MN 55906

Contact's Name ROCHESTER 35
4000 EAST RIVER NE RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT	BROW	SOFT	0	15
SAND & GRAVEL	BROW	SOFT	15	24
SHALE & GRAVEL	GRAY	SOFT	24	27
SHALE & GRAVEL	GRAY	SOFT	27	40
PRAIRIE DU CHIEN	BROW	MEDIUM	40	351
JORDAN	GRAY	MEDIUM	351	362
JORDAN	GRAY	MEDIUM	362	443
JORDAN	GRAY	MEDIUM	443	457

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 4-13-1999.

USGS Quad Douglas Elevation 1054.5

Aquifer: CJDN Alt Id: 79-5076

Report Copy

Well Depth 457 ft. Depth Completed 457 ft. Date Well Completed 1999/06/29

Drilling Method Non-specified Rotary

Drilling Fluid Well Hydrofractured? ☐ Yes ☐ No From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☑ Yes ☐ N

Casing Diameter				Weight(lbs/ft)
36	in. t	39	ft	142.7
30	in. t	65	ft	118.6
24	in. t	369	ft	94.62

Hole Diameter

in. t 40 ft

in. t 65 ft

in. t 369 ft

Screen N Open Hole From 369 ft. to 457 ft.

Make Type

Static Water Level 53 ft. from Land surface Date 1999/06/29

PUMPING LEVEL (below land surface)

154.5 ft. after 28 hrs. pumping 2000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	369	31	Y

Nearest Known Source of Contamination

50 ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller VAN HOUTEN, D

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00601335 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 1999/08/20

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	20	AAADCA	457	ft.	457	ft.	1999/06/29

Well Name ROCHESTER 35 **Lic. Or Reg. No.** 55079 **Name of Driller** VAN HOUTEN, D

USGS Quad Douglas **Elevation** 1054.5 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT	BROWN	SOFT	0	15	QUUB	DRFT		
QUUB = Unknown deposit type	DRFT = Drift							
SAND & GRAVEL	BROWN	SOFT	15	24	QHUB	SAND	GRVL	
QHUB = Sand & larger	SAND = Sand				GRVL = Gravel			
SHALE & GRAVEL	GRAY	SOFT	24	27	QPUG	CLAY	GRVL	
QPUG = Pebbly sand/silt/clay	CLAY = Clay				GRVL = Gravel			
SHALE & GRAVEL	GRAY	SOFT	27	40	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
PRAIRIE DU CHIEN	BROWN	MEDIUM	40	351	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
JORDAN	GRAY	MEDIUM	351	362	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
JORDAN	GRAY	MEDIUM	362	443	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
JORDAN	GRAY	MEDIUM	443	457	CSTL	SLSN	SNDS	
CSTL = St.Lawrence	SLSN = Siltstone				SNDS = Sandstone			

Unique No. 00601336

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/10

Entry Date 2000/10/09

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	4	CDDDDB

Well Name ROCHESTER 36

Well Owner's Name ROCHESTER 36
WEST CIRCLE DR
ROCHESTER MN 55902

Contact's Name ROCHESTER PUBLIC UTILITIES
4000 EAST RIVER NE RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT	GRAY	MEDIUM	0	52
CLAY & GRAVEL			52	77
LIMESTONE	BROW	MEDIUM	77	373
LIMESTONE	GRAY	MEDIUM	373	384
SANDSTONE	GRAY	MEDIUM	384	475
LIMESTONE	BLUE	MEDIUM	475	478

USGS Quad Douglas Elevation 1044.4
Aquifer: CJDN Alt Id: 79-5076

Report Copy

Well Depth 478 ft. **Depth Completed** 478 ft. **Date Well Completed** 2000/08/07

Drilling Method Non-specified Rotary

Drilling Fluid Foam Well Hydrofractured? ☐ Yes ☑ No From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Casing Diameter			Weight(lbs/ft)
30	in. t	79 ft	
24	in. t	397 ft	

Hole Diameter

in. t	79	ft
in. t	397	ft
in. t	478	ft

Screen N **Open Hole** From 397 ft. to 478 ft.

Make Type

Static Water Level 38 ft. from Land surface Date 2000/08/04

PUMPING LEVEL (below land surface)
106 ft. after 20 hrs. pumping 2030 g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection ☐ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	397	37	Y
P	0	397	5	Y

Nearest Known Source of Contamination
50 ft. direction type
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N
Mfr nam
Model HP Volts
Drop Pipe Length ft. Capacity g.p.m
Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079
License Business Name
Name of Driller VANHOUTEN, D.

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00601336 **Update Date** 2009/02/10

County Name Olmsted **Entry Date** 2000/10/09

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	4	CDDDDB	478	ft.	478	ft.	2000/08/07

Well Name ROCHESTER 36 **Lic. Or Reg. No.** 55079 **Name of Driller** VANHOUTEN, D.

USGS Quad Douglas **Elevation** 1044.4 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT	GRAY	MEDIUM	0	52	QUUG	DRFT		
QUUG = Unknown deposit type	DRFT = Drift							
CLAY & GRAVEL			52	77	QPUU	CLAY	GRAN	
QPUU = Pebbly sand/silt/clay	CLAY = Clay				GRAN = Granite			
LIMESTONE	BROWN	MEDIUM	77	373	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	GRAY	MEDIUM	373	384	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE	GRAY	MEDIUM	384	475	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
LIMESTONE	BLUE	MEDIUM	475	478	CSTL	DLMT	SLSN	
CSTL = St.Lawrence	DLMT = Dolomite				SLSN = Siltstone			

Unique No. 00676687

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date / / 0

Township Name	Township	Range	Dir	Section	Subsection
	107	13	W	19	BABCAA

Well Name ROCHESTER 37

Well Owner's Name ROCHESTER 37

ROCHESTER MN

Contact's Name ROCHESTER PUBLIC UTILITES
4000 EAST RIVER NE RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
BLACK DIRT	BLACK	MEDIUM	0	5
CLAY & SAND	BROW	MEDIUM	5	15
SAND	BROW	MEDIUM	15	23
SAND	BROW	MEDIUM	23	24
SANDSTONE	BROW	MEDIUM	24	90
LIMESTONE	BROW	MEDIUM	90	92
LIMESTONE	BROW	MEDIUM	92	350
LIMESTONE	GRAY	MEDIUM	350	380
SANDSTONE	GRAY	MEDIUM	380	401
SANDSTONE	GRAY	MEDIUM	401	501

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 9-11-2003.

USGS Quad Rochester Elevation 1084.9

Aquifer: OPCJ Alt Id: 79-5076

Report Copy

Well Depth 501 ft. Depth Completed 501 ft. Date Well Completed 2003/09/25

Drilling Method Non-specified Rotary

Drilling Fluid: Foam

Well Hydrofractured? ☐ Yes ☑ No From ft. to ft.

Use Community Supply (municipal)

Casing — Drive Shoe? ☑ Yes ☐ N

Casing Diameter — Weight(lbs/ft)
30 in. t 27 ft
24 in. t 393 ft

Hole Diameter
in. t 393 ft
in. t 501 ft
in. t 27 ft

Screen N

Open Hole From 393 ft. to 501 ft.

Make Type

Static Water Level 95 ft. from Land surface Date 2003/09/22

PUMPING LEVEL (below land surface)
266 ft. after 24 hrs. pumping 2000 g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection Y ☑ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	27	3	Y
G	0	393	47	Y

Nearest Known Source of Contamination
50 ft. direction type
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N
Mfr nam
Model HP Volts
Drop Pipe Length ft. Capacity g.p.m
Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079
License Business Name
Name of Driller VANHOUTEN, D.

Unique No. 00676687

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date / / 0

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	13	W	19	BABCAA	501	ft.	501	ft.	2003/09/25

Well Name ROCHESTER 37 **Lic. Or Reg. No.** 55079 **Name of Driller** VANHOUTEN, D.

USGS Quad Rochester **Elevation** 1084.9 **Aquifer** OPCJ **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
BLACK DIRT	BLACK	MEDIUM	0	5	RUUK	SOIL	ORGD	
RUUK = Recent Deposit	SOIL = Soil			ORGD = Organic Deposits				
CLAY & SAND	BROWN	MEDIUM	5	15	QLUB	CLAY	SAND	
QLUB = Clay & sand	CLAY = Clay			SAND = Sand				
SAND	BROWN	MEDIUM	15	23	QFUB	SAND		
QFUB = Sand	SAND = Sand							
SAND	BROWN	MEDIUM	23	24	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
SANDSTONE	BROWN	MEDIUM	24	90	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
LIMESTONE	BROWN	MEDIUM	90	92	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
LIMESTONE	BROWN	MEDIUM	92	350	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
LIMESTONE	GRAY	MEDIUM	350	380	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE	GRAY	MEDIUM	380	401	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE	GRAY	MEDIUM	401	501	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00698933 **Update Date** 2009/02/11

County Name Olmsted **Entry Date** 2005/07/05

Township Name	Township	Range	Dir	Section	Subsection
	107	14	W	7	CAAAAA

Well Name ROCHESTER 38

Well Owner's Name ROCHESTER 38

ROCHESTER MN 55906

Contact's Name CITY OF ROCHESTER
4000 EAST RIVER NE RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DIRT	BLACK	MEDIUM	0	3
CLAY	BROW	MEDIUM	3	10
SAND GRAVEL	BROW	MEDIUM	10	20
CLAY & GRAVEL	BROW	MEDIUM	20	25
SAND & GRAVEL	BLUE	MEDIUM	25	32
SHALE & GRAVEL	BLUE	HARD	32	40
SHALE	GREE	MEDIUM	40	47
SHALE & GRAVEL	BLUE	MEDIUM	47	55
LIMESTONE	BRN/G	MEDIUM	55	360
SANDSTONE	GRAY		360	370
SANDSTONE	BROW	SOFT	370	380
SAND	BROW	MEDIUM	380	390
SANDSTONE	BRN/T	MEDIUM	390	455
SANDSTONE	GRAY	HARD	455	467

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 3-25-2004 BY THEIN WELL CO.

GAMMA LOGGED 4-17-2007.

GAMMA & MULTI TOOL LOGGED 5-4-2007.

WELL WAS BLASTED WITH 150 LBS. OF EXPLOSIVES AT 400, 410, AND 420 FEET.

ABOUT 150 YARDS OF MATERIAL WAS AIR LIFTED OUT OF THE WELL.

Well Depth 467 ft. **Depth Completed** 467 ft. **Date Well Completed** 2004/10/18

Drilling Method Non-specified Rotary

Drilling Fluid Foam

Well Hydrofractured? ☐ Yes ☑ No

From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☑ N

Casing Diameter	Weight(lbs/ft)
30 in. t 55 ft	
24 in. t 374 ft	

Hole Diameter

in. t 55 ft
in. t 374 ft
in. t 467 ft

Screen N **Open Hole** From 374 ft. to 467 ft.

Make Type

Static Water Level 42 ft. from Land surface Date 2005/03/24

PUMPING LEVEL (below land surface)

331 ft. after 24 hrs. pumping 1000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	55	5	Y
G	0	374	28	Y
P	55	360	14	Y

Nearest Known Source of Contamination

50 ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

USGS Quad Douglas
Aquifer: CJDN

Elevation 1056.3
Alt Id: 79-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079
License Business Name
Name of Driller SANDERS, T.

Report Copy

HE-01205-06 (Rev. 9/96)

Unique No. 00698933

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2009/02/11

Entry Date 2005/07/05

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	107	14	W	7	CAAAAA	467	ft.	467	ft.	2004/10/18

Well Name ROCHESTER 38 **Lic. Or Reg. No.** 55079 **Name of Driller** SANDERS, T.

USGS Quad Douglas **Elevation** 1056.3 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DIRT	BLACK	MEDIUM	0	3	RUUK	SOIL	ORGD	
RUUK = Recent Deposit	SOIL = Soil			ORGD = Organic Deposits				
CLAY	BROWN	MEDIUM	3	10	QCUB	CLAY		
QCUB = Clay	CLAY = Clay							
SAND GRAVEL	BROWN	MEDIUM	10	20	QHUB	SAND	GRVL	
QHUB = Sand & larger	SAND = Sand			GRVL = Gravel				
CLAY & GRAVEL	BROWN	MEDIUM	20	25	QPUB	CLAY	GRVL	
QPUB = Pebbly sand/silt/clay	CLAY = Clay			GRVL = Gravel				
SAND & GRAVEL	BLUE	MEDIUM	25	32	QHUG	SAND	GRVL	
QHUG = Sand & larger	SAND = Sand			GRVL = Gravel				
SHALE & GRAVEL	BLUE	HARD	32	40	QPUG	CLAY	GRVL	
QPUG = Pebbly sand/silt/clay	CLAY = Clay			GRVL = Gravel				
SHALE	GREEN	MEDIUM	40	47	QCUL	CLAY		
QCUL = Clay	CLAY = Clay							
SHALE & GRAVEL	BLUE	MEDIUM	47	55	QPUG	CLAY	GRVL	
QPUG = Pebbly sand/silt/clay	CLAY = Clay			GRVL = Gravel				
LIMESTONE	BRN/GRY	MEDIUM	55	360	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SANDSTONE	GRAY		360	370	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SANDSTONE	BROWN	SOFT	370	380	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SAND	BROWN	MEDIUM	380	390	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SANDSTONE	BRN/TAN	MEDIUM	390	455	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
SANDSTONE	GRAY	HARD	455	467	CSTL	SLSN	DLMT	
CSTL = St.Lawrence	SLSN = Siltstone			DLMT = Dolomite				

Unique No. 00733087

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2009/02/09

Entry Date 2005/12/20

Township Name	Township	Range	Dir	Section	Subsection
	106	13	W	18	AAADAA

Well Name ROCHESTER 39

Well Owner's Name ROCHESTER 39

ROCHESTER MN 55904

Contact's Name CITY OF ROCHESTER
201 FOURTH SE ST
ROCHESTER MN 55904

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
SAND & GRAVEL	BROW	MEDIUM	0	35
SAND & GRAVEL	TAN	SFT-MED	35	46
LIMESTONE & CLAY	BROW	MEDIUM	46	49
LIMESTONE	GRAY	MEDIUM	49	57
LIMESTONE	BROW	MEDIUM	57	228
LIMESTONE	GRAY	MEDIUM	228	326
LIMESTONE	BROW	MEDIUM	326	330
LIMESTONE	GRAY	MEDIUM	330	353
SANDSTONE	GRAY	SFT-MED	353	363
SANDSTONE	GRAY	MEDIUM	363	452
LIMESTONE	GRAY	MEDIUM	452	455
LIMESTONE	GRAY	MEDIUM	455	458

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 10-12-2006. LOGGED BY JIM TRAEN.

DRILLERS DON VANHOUTEN, ROGER KURTH, AND DAVID DOWELL

USGS Quad Simpson Elevation 1026

Aquifer: CJDN Alt Id: 79-5076

Report Copy

Well Depth 458 ft. **Depth Completed** 458 ft. **Date Well Completed** 2006/08/21

Drilling Method Air Rotary

Drilling Fluid Foam

Well Hydrofractured? ☐ Yes ☑ No From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☑ Yes ☐ N

Casing Diameter	Weight(lbs/ft)	
30 in. t	50 ft	
24 in. t	365 ft	

Hole Diameter

in. t	363 ft
in. t	458 ft
in. t	49 ft

Screen N **Open Hole** From 363 ft. to 458 ft.

Make Type

Static Water Level 6.8 ft. from Land surface Date 2006/06/06

PUMPING LEVEL (below land surface)

136.5 ft. after 24 hrs. pumping 2000 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G		50	9.5	Y
G		365	21	Y

Nearest Known Source of Contamination

50 ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☑ Not Installed Date Installed N

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 55079

License Business Name

Name of Driller DON/ROGER

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00733087 **Update Date** 2009/02/09

County Name Olmsted **Entry Date** 2005/12/20

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	18	AAADAA	458	ft.	458	ft.	2006/08/21

Well Name ROCHESTER 39 **Lic. Or Reg. No.** 55079 **Name of Driller** DON/ROGER

USGS Quad Simpson **Elevation** 1026 **Aquifer** CJDN **Alternative Id** 79-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
SAND & GRAVEL QHUB = Sand & larger	BROWN SAND = Sand	MEDIUM	0	35	QHUB GRVL = Gravel	SAND	GRVL	
SAND & GRAVEL QHUB = Sand & larger	TAN SAND = Sand	SFT-MED	35	46	QHUB GRVL = Gravel	SAND	GRVL	
LIMESTONE & CLAY QPUB = Pebbly sand/silt/clay	BROWN CLAY = Clay	MEDIUM	46	49	QPUB COBL = Cobble	CLAY	COBL	
LIMESTONE OPDC = Prairie Du Chien Group	GRAY DACT = Dacite	MEDIUM	49	57	OPDC	DACT		
LIMESTONE OPDC = Prairie Du Chien Group	BROWN DLMT = Dolomite	MEDIUM	57	228	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	GRAY DLMT = Dolomite	MEDIUM	228	326	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	BROWN DLMT = Dolomite	MEDIUM	326	330	OPDC	DLMT		
LIMESTONE OPDC = Prairie Du Chien Group	GRAY DLMT = Dolomite	MEDIUM	330	353	OPDC	DLMT		
SANDSTONE CJDN = Jordan	GRAY SNDS = Sandstone	SFT-MED	353	363	CJDN	SNDS		
SANDSTONE CJDN = Jordan	GRAY SNDS = Sandstone	MEDIUM	363	452	CJDN	SNDS		
LIMESTONE CJDN = Jordan	GRAY SNDS = Sandstone	MEDIUM	452	455	CJDN	SNDS		
LIMESTONE CSTL = St.Lawrence	GRAY DLMT = Dolomite	MEDIUM	455	458	CSTL SLSN = Siltstone	DLMT	SLSN	

Unique No. 00773386

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2011/09/19

Entry Date 2009/12/04

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	34	ACDDBC

Well Depth 640 ft. **Depth Completed** 640 ft. **Date Well Completed** 2010/09/30

Well Name ROCHESTER 40

Drilling Method Cable Tool

Well Owner's Name ROCHESTER 40
1355 LONE PINE SW DR
ROCHESTER MN

Drilling Fluid Additive (+ Bentonite)

Well Hydrofractured? ☐ Yes ☑ No
From ft. to ft.

Use Community Supply (municipal)

Contact's Name CITY OF ROCHESTER
4000 EAST RIVER RD
ROCHESTER MN 55906

Casing **Drive Shoe?** ☑ Yes ☐ N

Casing Diameter				Weight(lbs/ft)
30	in. t	31	ft	118.65
24	in. t	460	ft	94.62

Hole Diameter

in. t	560	ft	
in. t	640	ft	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
BLACK DIRT	BLACK	SOFT	0	3
GALENA BUFF		V.HARD	3	28
GALENA	LT. GR	HARD	28	39
GALENA BUFF		HARD	39	62
DECORAH	BLU/G	M.HARD	62	105
PLATTEVILLE	GRAY	M.HARD	105	107
PLATTEVILLE	GRAY	M.HARD	107	127
PLATTEVILLE	GRAY	M.HARD	127	135
ST. PETER SANDSTONE	LT. GR		135	233
PRAIRIE DU CHIEN	GRAY	HARD	233	263
PRAIRIE DU CHIEN NEW RI	WHT/T	HARD	263	269
ONEOTA	TAN/G	HARD	269	271
NEW RICHMOND	TAN	HARD	271	315
ONEOTA BUFF		HARD	315	505
ONEOTA/SHAKOPEE BUFF		HARD	505	541
JORDON	GRAY	MEDIUM	541	634
ST. LAWRENCE OFF WHITE		HARD	634	640

Screen N **Open Hole** From 460 ft. to 640 ft.

Make Type

Static Water Level 117 ft. from Land surface Date 2010/09/12

PUMPING LEVEL (below land surface)
154.25 ft. after 5 hrs. pumping 1850 g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection Y ☑ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G		25	60	S
G	25	460	65	Y

Nearest Known Source of Contamination
75 ft. direction SW type SEW
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed
Mfr nam GOULDS
Model 12CHC-8 HP 250 Volts 460
Drop Pipe Length 200 ft. Capacity g.p.m
Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 6-1-2010. M.G.S. NO. 5000. LOGGED BY JIM TRAEN.

ELEVATION: 1,146.5 FT, SIMPSON QUAD 28-B

DOUG ROVANG, P.E. (507) 280-1605

ROGER E. RENNER, MGWC

CASING PROTECTION=PUMPHOUSE

PUMP CAPACITY=1,500@419TDH

USGS Quad Simpson
Aquifer: OPCJ

Elevation 1146.5
Alt Id: 75-5076

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 1431
License Business Name
Name of Driller COLBURN, S.

Report Copy

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00773386 **Update Date** 2011/09/19

County Name Olmsted **Entry Date** 2009/12/04

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	34	ACDDBC	640	ft.	640	ft.	2010/09/30

Well Name ROCHESTER 40 **Lic. Or Reg. No.** 1431 **Name of Driller** COLBURN, S.

USGS Quad Simpson **Elevation** 1146.5 **Aquifer** OPCJ **Alternative Id** 75-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
BLACK DIRT	BLACK	SOFT	0	3	RUUK	SOIL	ORGD	
RUUK = Recent Deposit	SOIL = Soil			ORGD = Organic Deposits				
GALENA BUFF		V.HARD	3	28	OGCM	LMSN		
OGCM = Galena/Cummingsville Mbr	LMSN = Limestone							
GALENA	LT. GRY	HARD	28	39	OGCM	LMSN		
OGCM = Galena/Cummingsville Mbr	LMSN = Limestone							
GALENA BUFF		HARD	39	62	OGCM	LMSN	SHLE	
OGCM = Galena/Cummingsville Mbr	LMSN = Limestone			SHLE = Shale				
DECORAH	BLU/GRN	M.HARD	62	105	ODCR	SHLE		
ODCR = Decorah	SHLE = Shale							
PLATTEVILLE	GRAY	M.HARD	105	107	ODCR	SHLE		
ODCR = Decorah	SHLE = Shale							
PLATTEVILLE	GRAY	M.HARD	107	127	OPVL	LMSN		
OPVL = Platteville	LMSN = Limestone							
PLATTEVILLE	GRAY	M.HARD	127	135	OGWD	SHLE		
OGWD = Glenwood	SHLE = Shale							
ST. PETER SANDSTONE	LT. GRY		135	233	OSTP	SNDS		
OSTP = St.Peter	SNDS = Sandstone							
PRAIRIE DU CHIEN	GRAY	HARD	233	263	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
PRAIRIE DU CHIEN NEW RICHMOND	WHT/TAN	HARD	263	269	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
ONEOTA	TAN/GRY	HARD	269	271	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
NEW RICHMOND	TAN	HARD	271	315	OPDC	DLMT	SNDS	
OPDC = Prairie Du Chien Group	DLMT = Dolomite			SNDS = Sandstone				
ONEOTA BUFF		HARD	315	505	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00773386 **Update Date** 2011/09/19

County Name Olmsted **Entry Date** 2009/12/04

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	14	W	34	ACDDBC	640	ft.	640	ft.	2010/09/30

Well Name ROCHESTER 40 **Lic. Or Reg. No.** 1431 **Name of Driller** COLBURN, S.

USGS Quad Simpson **Elevation** 1146.5 **Aquifer** OPCJ **Alternative Id** 75-5076

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
ONEOTA/SHAKOPEE BUFF		HARD	505	541	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
JORDON	GRAY	MEDIUM	541	634	CJDN	SNDS		
CJDN = Jordan	SNDS = Sandstone							
ST. LAWRENCE OFF WHITE		HARD	634	640	CSTL	SLSN	SLSN	
CSTL = St.Lawrence	SLSN = Siltstone						SLSN = Siltstone	

Unique No. 00796431

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2015/04/16

Entry Date 2013/09/18

Township Name	Township	Range	Dir	Section	Subsection
	106	13	W	5	BACBBB

Well Name ROCHESTER 41

Well Owner's Name ROCHESTER 41
3303 RIDGELINE DR
ROCHESTER MN 55906

Contact's Name ROCHESTER PUBLIC UTILITIES
4000 EAST RIVER RD
ROCHESTER MN 55906

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT	BROW	SOFT	0	8
ST. PETER SANDSTONE	WHITE	SOFT	8	58
DOLOMITE PDC.	GRAY	V.HARD	58	303
SHALE	WHITE	HARD	303	326
DOLOMITE	GRAY	HARD	326	337
DOLOMITE/SANDSTONE	GRY/W	HARD	337	356
DOLOMITE/SANDSTONE	GRY/W	HARD	356	357
JORDAN SANDSTONE	GRY/W	HARD	357	463
ST. LAWRENCE	GRAY	HARD	463	470

REMARKS, ELEVATION, SOURCE OF DATA, etc.

GAMMA LOGGED 2-5-2014. M.G.S. NO.5374. LOGGED BY JIM TRAEN

VARIANCE TN# 5043.

USGS Quad Rochester Elevation 1058

Aquifer: CJDN Alt Id: 5374

Report Copy

Well Depth 470 ft. **Depth Completed** 470 ft. **Date Well Completed** 2014/06/06

Drilling Method Cable Tool

Drilling Fluid Bentonite

Well Hydrofractured? ☐ Yes ☑ No From ft. to ft.

Use community supply(municipal)

Casing **Drive Shoe?** ☑ Yes ☐ N

Casing Diameter				Weight(lbs/ft)
30	in. t	58	ft	118.65
24	in. t	360	ft	94.62

Hole Diameter

in. t 360 ft

in. t 470 ft

Screen N

Make Type

Open Hole From 360 ft. to 470 ft.

Static Water Level 32 ft. from Land surface Date 2014/05/12

PUMPING LEVEL (below land surface)

135.65 ft. after 2.5 hrs. pumping 1850 g.p.m.

Well Head Completion

Pitless adapter mfr PUMP HOUSE Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G		360	39	Y

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☑ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 1431

License Business Name

Name of Driller COLBURN, S.

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00796431 **Update Date** 2015/04/16

County Name Olmsted **Entry Date** 2013/09/18

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	5	BACBBB	470	ft.	470	ft.	2014/06/06

Well Name ROCHESTER 41 **Lic. Or Reg. No.** 1431 **Name of Driller** COLBURN, S.

USGS Quad Rochester **Elevation** 1058 **Aquifer** CJDN **Alternative Id** 5374

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT	BROWN	SOFT	0	8	QUUB	DRFT		
QUUB = Quat. deposit-brown	DRFT = Drift							
ST. PETER SANDSTONE	WHITE	SOFT	8	58	OSTP	SNDS		
OSTP = St.Peter Sandstone	SNDS = sandstone							
DOLOMITE PDC.	GRAY	V.HARD	58	303	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
SHALE	WHITE	HARD	303	326	OPDC	SHLE		
OPDC = Prairie Du Chien Group	SHLE = shale							
DOLOMITE	GRAY	HARD	326	337	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
DOLOMITE/SANDSTONE	GRY/WHT	HARD	337	356	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
DOLOMITE/SANDSTONE	GRY/WHT	HARD	356	357	CJDN	SNDS		
CJDN = Jordan Sandstone	SNDS = sandstone							
JORDAN SANDSTONE	GRY/WHT	HARD	357	463	CJDN	SNDS		
CJDN = Jordan Sandstone	SNDS = sandstone							
ST. LAWRENCE	GRAY	HARD	463	470	CSTL	SLSN	DLMT	
CSTL = St.Lawrence Formation	SLSN = siltstone					DLMT = Dolomite		

Unique No. 00220628

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2014/03/10

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	106	13	W	9	DDABCA

Well Name SANDY SLOPES

Well Owner's Name SANDY SLOPES ROCHESTER 72

ROCHESTER MN 55901

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT & SAND			0	20
ST. PETER	YELLO	SOFT	20	52
SHAKOPEE-ONEOTA LIMES		MED-HRD	52	360
JORDAN	TAN	SFT-MED	360	460

USGS Quad Simpson Elevation 1062

Aquifer: CJDN Alt Id: 578

Report Copy

Well Depth 460 ft. Depth Completed 460 ft. Date Well Completed 1968/03/14

Drilling Method Non-specified Rotary

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use community supply(municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Casing Diameter			Weight(lbs/ft)
10	in. t	52 ft	
6	in. t	375 ft	

Hole Diameter

in. t 460 ft

Screen N

Make Type

Open Hole From 375 ft. to 460 ft.

Static Water Level 100 ft. from Land surface Date 1968/03/14

PUMPING LEVEL (below land surface)

ft. after hrs. pumping g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	375	13	Y

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP 15 Volts

Drop Pipe Length ft. Capacity g.p.m

Type S

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 20065

License Business Name

Name of Driller

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220628 | **Update Date** 2014/03/10

County Name Olmsted | **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	9	DDABCA	460	ft.	460	ft.	1968/03/14

Well Name SANDY SLOPES | **Lic. Or Reg. No.** 20065 | **Name of Driller**

USGS Quad Simpson | **Elevation** 1062 | **Aquifer** CJDN | **Alternative Id** 578

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT & SAND			0	20	QFUU	SAND		
QFUU = sand	SAND = sand							
ST. PETER	YELLOW	SOFT	20	52	OSTP	SNDS		
OSTP = St.Peter Sandstone	SNDS = sandstone							
SHAKOPEE-ONEOTA LIMESTONE		MED-HRD	52	360	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
JORDAN	TAN	SFT-MED	360	460	CJDN	SNDS		
CJDN = Jordan Sandstone	SNDS = sandstone							

Unique No. 00228168

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2016/02/29

Entry Date 1988/01/25

County Name Olmsted

Township Name	Township	Range	Dir	Section	Subsection
	106	14	W	15	CDCDCD

Well Name MERRIHILLS 1

Well Owner's Name CITY OF ROCHESTER

ROCHESTER 73

ROCHESTER MN

Well Depth	Depth Completed	Date Well Completed
675 ft.	675 ft.	1965/01/00

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use community supply(municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter

Casing Diameter	Weight(lbs/ft)
16 in. t ft	
10 in. t 575 ft	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
NO RECORD			0	40
LIME			40	100
LIME			100	175
ST PETER			175	275
PRAIRIE DU CHIEN			275	575
JORDAN			575	675

Screen N

Open Hole From 575 ft. to 675 ft.

Make Type

Static Water Level 192 ft. from Land surface Date 1965/00/00

PUMPING LEVEL (below land surface)

275 ft. after hrs. pumping 300 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr nam

Model HP Volts

Drop Pipe Length ft. Capacity g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Simpson Elevation 1209

Aquifer: CJDN Alt Id: 385

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 23124

License Business Name

Name of Driller

Report Copy

Unique No. 00220629

County Name Olmsted

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2014/10/30

Entry Date 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection
	106	13	W	10	BCCBAA

Well Name MEADOWBROOK ADD.1

Contact's Name MEADOWBROOK ADD.
ROCHESTER 77

ROCHESTER MN 55901

Well Depth	Depth Completed	Date Well Completed
450 ft.	450 ft.	1964/10/21

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No
From ft. to ft.

Use community supply(municipal)

Casing Drive Shoe? ☑ Yes ☐ N

Casing Diameter	Weight(lbs/ft)
12 in. t 60 ft	
8 in. t 369 ft	

Hole Diameter
0 in. t 450 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	60
LIMESTONE			60	74
ROOT VALLEY SANDSTON			74	80
LIMESTONE			80	350
JORDAN SANDSTONE			350	450

Screen N

Make Type

Open Hole From 369 ft. to 450 ft.

Static Water Level 17 ft. from Land surface Date 1964/10/09

PUMPING LEVEL (below land surface)
133 ft. after 24 hrs. pumping 325 g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection ☐ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)

Nearest Known Source of Contamination
ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Mfr nam
Model HP Volts
Drop Pipe Length ft. Capacity g.p.m
Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

USGS Quad Rochester Elevation 1063
Aquifer: CJDN Alt Id: 68-101

Report Copy

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 96460
License Business Name
Name of Driller MUELLER BROS.

HE-01205-06 (Rev. 9/96)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Unique No. 00220629 **Update Date** 2014/10/30

County Name Olmsted **Entry Date** 1988/01/25

Township Name	Township	Range	Dir	Section	Subsection	Well Depth		Depth Completed		Date Well Completed
	106	13	W	10	BCCBAA	450	ft.	450	ft.	1964/10/21

Well Name MEADOWBROOK ADD.1 **Lic. Or Reg. No.** 96460 **Name of Driller** MUELLER BROS.

USGS Quad Rochester **Elevation** 1063 **Aquifer** CJDN **Alternative Id** 68-101

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT			0	60	QUUU	DRFT		
QUUU = Quaternary deposit	DRFT = Drift							
LIMESTONE			60	74	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
ROOT VALLEY SANDSTONE			74	80	OPDC	SNDS		
OPDC = Prairie Du Chien Group	SNDS = sandstone							
LIMESTONE			80	350	OPDC	DLMT		
OPDC = Prairie Du Chien Group	DLMT = Dolomite							
JORDAN SANDSTONE			350	450	CJDN	SNDS		
CJDN = Jordan Sandstone	SNDS = sandstone							

Appendix B

Aquifer Transmissivity Information

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:	1550010	PWS Name:	Rochester Public Utilities

Contact Information for Person Completing this Form

Name:	John Greer, PG
Address:	4300 MarketPointe Drive
	Suite 200
City, State, Zip:	Minneapolis, MN 55435
Phone, Fax, e-mail:	952-832-2691, 952-832-2601, jgreer@barr.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: John Greer	Prof. License: 30347	Date: 7/12/2016

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:	Prairie du Chien	☑ Confined	☐ Unconfined	☐ Fractured Rock

See Attachment 1

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

220666	220818	239761			
222525	220660	434041			
222528	220819	506819			
220822	220675	773386			
220681	147451				
220662	161425				

Reviewed by:	**Approved:** ◉ Yes ○ No	**Approval Date:** 7/13/16

Attachment 1

Prairie du Chien Aquifer and Jordan Aquifer Transmissivities

The Minnesota Department of Health (MDH) has on file aquifer test results for 31 Rochester Public Utilities (RPU) water supply wells conducted during the period 1980-2014. The wells for which the MDH has aquifer test results are: 220831, 220830, 220666, 220833, 222525, 222526, 222528, 220822, 222527, 220681, 220662, 220625, 220818, 220660, 220675, 147451, 224212, 180567, 161425, 239761, 434041, 506819, 220627, 463536, 601335, 601336, 676687, 698933, 733087, 773386, 796431. In addition, the MDH has on file results of an aquifer test conducted in 1989 on well 228150. MDH provided a summary of the aquifer test results (Table 1) to RPU and Barr Engineering to support preparation of the DAP-ATP forms for the RPU Part 1 Wellhead Protection Plan amendment.

At the November 21, 2014 Pre-Delineation Meeting, the MDH agreed that the Olmsted County groundwater model prepared by the United States Geological Survey (USGS) would be used for delineation of new porous media groundwater time of travel zones for RPU wells pumping from the Prairie du Chien Group (OPDC) and Jordan Sandstone (CJDN). The model, as calibrated by the USGS, includes variable hydraulic conductivity distributions in both the OPDC and the CJDN. At the Pre-Delineation Meeting it was also agreed that modification of hydraulic conductivity/transmissivity distributions in the Olmsted County groundwater model would be limited to sensitivity analysis model runs.

The aquifer test results summary was reviewed and the results compared to the transmissivities of the OPDC and CJDN in the Olmsted County model. Since many of the RPU wells are open to both the OPDC and CJDN the following procedure was followed to determine the maximum, minimum, and geometric mean transmissivities for the OPDC from the aquifer test results for test results from wells that are open to both the OPDC and the CJDN:

- The horizontal hydraulic conductivity (K_x) for the Jordan was calculated using the test results for RPU Wells 28, 33, 35, 37, 38, 39, and 41 and the Jordan thicknesses shown in the stratigraphy descriptions for these wells prepared by the Minnesota Geological Survey (MGS) that are in the Minnesota Well Index (MWI) database. If the stratigraphy descriptions do not show that the well penetrates into the St. Lawrence Formation it was assumed the thickness of the CJDN at the well is equal to the thickness of CJDN penetrated by the well. The geometric mean of the CJDN K_x values was then calculated.
- The geometric mean K_x of the CJDN was then used to calculate the transmissivity (T) for the CJDN at each of the OPDC-CJDN wells by multiplying the geometric mean CJDN K_x by the CJDN thickness at each of the wells as determined from the stratigraphy descriptions.
- The CJDN T for each of the OPDC-CJDN wells was then subtracted from the corresponding OPDC-CJDN T determined from aquifer tests to get a T for the OPDC at each well.

After completing these calculations, the geometric mean T for the OPDC was calculated and the maximum and minimum T for the OPDC were determined. The maximum and minimum T for the CJDN were obtained from the test results for the RPU wells open to only the CJDN (RPU Wells 28, 33, 35, 37, 38, 39, and 41).

The following table shows the T ranges for the OPDC and CJDN based on the aquifer test results and as implemented in the Olmsted County groundwater model (note: model layers 5 , 6, and 7 define the OPDC in the model and layer 8 defines the CJDN).

Formation	Pumping Test Results			Groundwater Model		
	Minimum T (ft^2/day)	Maximum T (ft^2/day)	Geometric Mean T (ft^2/day)	Minimum T (ft^2/day)	Maximum T (ft^2/day)	Geometric Mean T (ft^2/day)
OPDC	99	8,970	962	396.7	10,342.3	7,156.1
CJDN	270	4,010	917	1,027.0	5,164.9	4,843.6

Based on the Pre-Delineation Meeting discussions, the sensitivity analysis will include the following adjustments to hydraulic conductivity values:

- One run of the Olmsted County groundwater model with all the K_x values in the CJDN (model layer 8) divided by a factor of 8.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) divided by a factor of 2.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) multiplied by a factor of 2.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) divided by a factor of 10.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) multiplied by a factor of 10.0.

Table 1

Aquifer Test Results Summary
(source: Minnesota Department of Health)

Tests						Methods and Results - Transmissivity is in units of ft^2/day																Representative Properties		
Tester	Test Year	Test Number	Unique	Well Name	Aquifer***	Q/s	early-Cooperj acob	late-Cooper Jacob	early-T/t'	late-T/t'	early-Agarwal	late-Agarwal	Walton	r/B [d- less]	S [d-less]	Theis	dGlee	Hantush-Jacob	L [feet]	Theis t/r^2	Theis t/r^2-adjusted	T [ft^2/day]	S [d-less]	L [feet]
Historic tests																								
Liesch	1980	254	220831	RPU 09	PdC-Jordan		231	779	821	412			600		1.00E-03							600	1.00E-03	
Liesch	1980	253	220830	RPU 10	PdC-Jordan		963	4171					1230		5.90E-04							1230	5.90E-04	
Liesch	1980	239	220666	RPU 11	PdC-Jordan				543	3329			1670									1670		
Liesch	1980	481	220833	RPU-12	Jordan - Wonewoc		1912	3824	432	1524												1912		
Liesch	1980	247	222525	RPU 13	PdC-Jordan		1939	5909					2060									2060		
Liesch	1980	249	222526	RPU 14	PdC-Jordan		234	3342	234	1952			650		2.60E-03							650	2.60E-03	
Liesch	1980	248	222528	RPU 15	PdC-Jordan		321	3350	2473				1180									1180		
Liesch	1995	487	222528	RPU 15	PdC-Jordan	2750	1083			2807					1.00E-04							1083	1.00E-04	
Liesch	1980	246	220822	RPU 17	PdC - Wonewoc		481	5187	4064	5187												4064		
Liesch	1980	252	222527	RPU 18	Jordan - Wonewoc		860	3957	1024	2500												1024		
Liesch	1980	241	220681	RPU 19	Jordan - Wonewoc		575	4652	842	3917												842		
Liesch	1980	237	220662	RPU 20	PdC - Mt. Simon		709	1471														1471		
Liesch	1980	236	220625	RPU 21	Jordan - Wonewoc		936	3075														936		
Liesch	1980	482	220818	RPU-22	PdC - Wonewoc		281	3676														281		
Liesch	1995	488	220818	RPU-22	PdC - Wonewoc	990	294			1872					5.00E-04							294	5.00E-04	
Liesch	1980	238	220660	RPU 23	PdC-Jordan		495	2460					2260									2260		
Liesch	1980	240	220675	RPU 25	PdC - Wonewoc		655	2527														655		
Liesch	1978	251	147451	RPU 26	PdC-Jordan				3209	2774												2774		
Liesch	1980	243	224212	RPU 27	PdC-Jordan		869	2112														869		
Liesch	1981	484	180567	RPU-28	Jordan		749	1471					1360									749		
Liesch	1995	489	180567	RPU-28	Jordan	1710	762			1738					1.00E-04							762	1.00E-04	
Liesch	1982	242	161425	RPU 29	PdC-Jordan		2513	4586					2300									2300		
Liesch	1984	255	239761	RPU 30	PdC-Jordan		2540	9358		8957			2840									2840		
Liesch	1995	490	434041	RPU-31	PdC-Jordan	6150									1.00E-04							6150	1.00E-04	
RPU	1995	491	463536	RPU-34	PdC-Jordan	1100	294			4278					6.00E-04							1100	6.00E-04	
Recent tests																								
RPU	2012	2179	220666	RPU-11	PdC-Jordan						510	2000	410	0.15	3.30E-04							410	3.30E-04	
RPU	2012	2182	222528	RPU-15	PdC-Jordan						480	1900	750	0.1	3.00E-04							750	3.00E-04	
RPU	2014	2183	220822	RPU-17	PdC - Wonewoc						1360	2870	650	0.1	1.90E-04							650	1.90E-04	
RPU	2012	2184	222527	RPU-18	Jordan - Wonewoc						140	1480	130	0.2	4.20E-04							130	4.20E-04	
RPU	2012	2189	220681	RPU-19	Jordan - Wonewoc						290	2660	220	0.15	1.20E-04				2200*			220	1.20E-04	2200
RPU	2012	2194	220818	RPU-22	PdC - Wonewoc						130	1600	180	0.15	7.80E-04							180	7.80E-04	
RPU	2012	2195	220660	RPU-23	PdC-Jordan						190	1390	250	0.15	1.10E-03							250	1.10E-03	
RPU	2012	2196	220675	RPU-25	PdC - Wonewoc						310	2010	360	0.15	7.00E-04							360	7.00E-04	
RPU	2014	2547	224212	RPU-27	PdC-Jordan						1170	5900	760	0.15	2.80E-03							760	2.80E-03	
RPU	2012	2198	180567	RPU-28	Jordan						700	2400	470	0.15	3.60E-04							470	3.60E-04	
RPU	2014	2219	161425	RPU-29	PdC-Jordan						2330	3740	1450	0.15	1.60E-03							1450	1.60E-03	
RPU	2012	2200	239761	RPU-30	PdC-Jordan						1080	2060	540	0.15	2.90E-04							540	2.90E-04	
RPU	2012	2204	434041	RPU-31	PdC-Jordan						2510		1510	0.15	1.63E-03							1510	1.63E-03	
RPU	2012	2206	506819	RPU-32	PdC-Jordan						320	1500	230	0.15	1.50E-04							230	1.50E-04	
RPU	2014	2207	220627	RPU-33	Jordan						1150	2580	480	0.15	2.30E-05							480	2.30E-05	
RPU	2014	2210	463536	RPU-34	PdC-Jordan						290	2130	250	0.15	3.00E-04							250	3.00E-04	
RPU	2012	2211	601335	RPU-35	Jordan						1890	3490	1080	0.15	5.20E-04							1080	5.20E-04	
RPU	2014	2216	601336	RPU-36	PdC-Jordan						1590	3640	1850	0.15	3.00E-03							1850	3.00E-03	
Barr Eng. Co.	2015	2546	676687	RPU-37	Jordan								4010	2.57	1.70E-04							4010	1.70E-04	
RPU	2014	2217	698933	RPU-38	Jordan						310	1180	270	0.15	6.00E-04							270	6.00E-04	
RPU	2014	2218	733087	RPU-39	Jordan						1110	4370	990	0.15	4.10E-03							990	4.10E-03	
E.H. Renner	2010	2485	773386	RPU-40	PdC-Jordan	8720		11020			8340		6430	0.005	4.00E-04	25700	9435	9950	7000	12900	7860	8500	4.00E-04	7000
E.H. Renner	2014	2484	796431	RPU-41	Jordan						1940				7.70E-05	1540	3086	3050	6000	4630	3090	3090	7.70E-05	6000
USGS	1989	2409	228150	Stauffer C	h Prairie du Chien										1.00E-04	8970**						8970	1.10E-04	

* from a chloride mixing-model, based on steady-state ambient & pumping induced leakage

** Anisotropic T; this is the maximum T - orientation ~ N95oE, minimum T was 1790 ft^2/day - orientation ~ N5oE

*** PdC = Prairie du Chien Group; Jordan = Jordan Sandstone

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:	1550010	PWS Name:	Rochester Public Utilities

Contact Information for Person Completing this Form

Name:	John Greer, PG
Address:	4300 MarketPointe Drive
	Suite 200
City, State, Zip:	Minneapolis, MN 55435
Phone, Fax, e-mail:	952-832-2691, 952-832-2601, jgreer@barr.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: John Greer	Prof. License: 30347	Date: 7/12/2016

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:	Jordan	☑ Confined	☐ Unconfined	☐ Fractured Rock

See Attachment 1

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					
220666	220681	220675	434041	676687	228168
220833	220662	147451	506819	698933	220629
222525	220625	224212	220627	733087	
222528	220818	180567	463536	773386	
220822	220660	161425	601335	796431	
222527	220819	239761	601336	220628	

Reviewed by:	**Approved:** ◉ Yes ○ No	**Approval Date:** 7/13/16

Attachment 1

Prairie du Chien Aquifer and Jordan Aquifer Transmissivities

The Minnesota Department of Health (MDH) has on file aquifer test results for 31 Rochester Public Utilities (RPU) water supply wells conducted during the period 1980-2014. The wells for which the MDH has aquifer test results are: 220831, 220830, 220666, 220833, 222525, 222526, 222528, 220822, 222527, 220681, 220662, 220625, 220818, 220660, 220675, 147451, 224212, 180567, 161425, 239761, 434041, 506819, 220627, 463536, 601335, 601336, 676687, 698933, 733087, 773386, 796431. In addition, the MDH has on file results of an aquifer test conducted in 1989 on well 228150. MDH provided a summary of the aquifer test results (Table 1) to RPU and Barr Engineering to support preparation of the DAP-ATP forms for the RPU Part 1 Wellhead Protection Plan amendment.

At the November 21, 2014 Pre-Delineation Meeting, the MDH agreed that the Olmsted County groundwater model prepared by the United States Geological Survey (USGS) would be used for delineation of new porous media groundwater time of travel zones for RPU wells pumping from the Prairie du Chien Group (OPDC) and Jordan Sandstone (CJDN). The model, as calibrated by the USGS, includes variable hydraulic conductivity distributions in both the OPDC and the CJDN. At the Pre-Delineation Meeting it was also agreed that modification of hydraulic conductivity/transmissivity distributions in the Olmsted County groundwater model would be limited to sensitivity analysis model runs.

The aquifer test results summary was reviewed and the results compared to the transmissivities of the OPDC and CJDN in the Olmsted County model. Since many of the RPU wells are open to both the OPDC and CJDN the following procedure was followed to determine the maximum, minimum, and geometric mean transmissivities for the OPDC from the aquifer test results for test results from wells that are open to both the OPDC and the CJDN:

- The horizontal hydraulic conductivity (K_x) for the Jordan was calculated using the test results for RPU Wells 28, 33, 35, 37, 38, 39, and 41 and the Jordan thicknesses shown in the stratigraphy descriptions for these wells prepared by the Minnesota Geological Survey (MGS) that are in the Minnesota Well Index (MWI) database. If the stratigraphy descriptions do not show that the well penetrates into the St. Lawrence Formation it was assumed the thickness of the CJDN at the well is equal to the thickness of CJDN penetrated by the well. The geometric mean of the CJDN K_x values was then calculated.
- The geometric mean K_x of the CJDN was then used to calculate the transmissivity (T) for the CJDN at each of the OPDC-CJDN wells by multiplying the geometric mean CJDN K_x by the CJDN thickness at each of the wells as determined from the stratigraphy descriptions.
- The CJDN T for each of the OPDC-CJDN wells was then subtracted from the corresponding OPDC-CJDN T determined from aquifer tests to get a T for the OPDC at each well.

After completing these calculations, the geometric mean T for the OPDC was calculated and the maximum and minimum T for the OPDC were determined. The maximum and minimum T for the CJDN were obtained from the test results for the RPU wells open to only the CJDN (RPU Wells 28, 33, 35, 37, 38, 39, and 41).

The following table shows the T ranges for the OPDC and CJDN based on the aquifer test results and as implemented in the Olmsted County groundwater model (note: model layers 5 , 6, and 7 define the OPDC in the model and layer 8 defines the CJDN).

Formation	Pumping Test Results			Groundwater Model		
	Minimum T (ft^2/day)	Maximum T (ft^2/day)	Geometric Mean T (ft^2/day)	Minimum T (ft^2/day)	Maximum T (ft^2/day)	Geometric Mean T (ft^2/day)
OPDC	99	8,970	962	396.7	10,342.3	7,156.1
CJDN	270	4,010	917	1,027.0	5,164.9	4,843.6

Based on the Pre-Delineation Meeting discussions, the sensitivity analysis will include the following adjustments to hydraulic conductivity values:

- One run of the Olmsted County groundwater model with all the K_x values in the CJDN (model layer 8) divided by a factor of 8.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) divided by a factor of 2.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) multiplied by a factor of 2.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) divided by a factor of 10.0.
- One run of the Olmsted County groundwater model with all the K_z values in the Oneota confining unit (model layer 7) multiplied by a factor of 10.0.

Table 1

Aquifer Test Results Summary
(source: Minnesota Department of Health)

Tests						Methods and Results - Transmissivity is in units of ft^2/day																Representative Properties		
Tester	Test Year	Test Number	Unique	Well Name	Aquifer***	Q/s	early-CooperJacob	late-Cooper Jacob	early-T/t'	late-T/t'	early-Agarwal	late-Agarwal	Walton	r/B [d- less]	S [d-less]	Theis	deGlee	Hantush-Jacob	L [feet]	Theis t/r^2	Theis t/r^2-adjusted	T [ft^2/day]	S [d-less]	L [feet]
Historic tests																								
Liesch	1980	254	220831	RPU 09	PdC-Jordan		231	779	821	412			600		1.00E-03							600	1.00E-03	
Liesch	1980	253	220830	RPU 10	PdC-Jordan		963	4171					1230		5.90E-04							1230	5.90E-04	
Liesch	1980	239	220666	RPU 11	PdC-Jordan				543	3329			1670									1670		
Liesch	1980	481	220833	RPU-12	Jordan - Wonewoc		1912	3824	432	1524												1912		
Liesch	1980	247	222525	RPU 13	PdC-Jordan		1939	5909					2060									2060		
Liesch	1980	249	222526	RPU 14	PdC-Jordan		234	3342	234	1952			650		2.60E-03							650	2.60E-03	
Liesch	1980	248	222528	RPU 15	PdC-Jordan		321	3350	2473				1180									1180		
Liesch	1995	487	222528	RPU 15	PdC-Jordan	2750	1083			2807					1.00E-04							1083	1.00E-04	
Liesch	1980	246	220822	RPU 17	PdC - Wonewoc		481	5187	4064	5187												4064		
Liesch	1980	252	222527	RPU 18	Jordan - Wonewoc		860	3957	1024	2500												1024		
Liesch	1980	241	220681	RPU 19	Jordan - Wonewoc		575	4652	842	3917												842		
Liesch	1980	237	220662	RPU 20	PdC - Mt. Simon		709	1471														1471		
Liesch	1980	236	220625	RPU 21	Jordan - Wonewoc		936	3075														936		
Liesch	1980	482	220818	RPU-22	PdC - Wonewoc		281	3676														281		
Liesch	1995	488	220818	RPU-22	PdC - Wonewoc	990	294			1872					5.00E-04							294	5.00E-04	
Liesch	1980	238	220660	RPU 23	PdC-Jordan		495	2460					2260									2260		
Liesch	1980	240	220675	RPU 25	PdC - Wonewoc		655	2527														655		
Liesch	1978	251	147451	RPU 26	PdC-Jordan				3209	2774												2774		
Liesch	1980	243	224212	RPU 27	PdC-Jordan		869	2112														869		
Liesch	1981	484	180567	RPU-28	Jordan		749	1471					1360									749		
Liesch	1995	489	180567	RPU-28	Jordan	1710	762			1738					1.00E-04							762	1.00E-04	
Liesch	1982	242	161425	RPU 29	PdC-Jordan		2513	4586					2300									2300		
Liesch	1984	255	239761	RPU 30	PdC-Jordan		2540	9358		8957			2840									2840		
Liesch	1995	490	434041	RPU-31	PdC-Jordan	6150									1.00E-04							6150	1.00E-04	
RPU	1995	491	463536	RPU-34	PdC-Jordan	1100	294			4278					6.00E-04							1100	6.00E-04	
Recent tests																								
RPU	2012	2179	220666	RPU-11	PdC-Jordan						510	2000	410	0.15	3.30E-04							410	3.30E-04	
RPU	2012	2182	222528	RPU-15	PdC-Jordan						480	1900	750	0.1	3.00E-04							750	3.00E-04	
RPU	2014	2183	220822	RPU-17	PdC - Wonewoc						1360	2870	650	0.1	1.90E-04							650	1.90E-04	
RPU	2012	2184	222527	RPU-18	Jordan - Wonewoc						140	1480	130	0.2	4.20E-04							130	4.20E-04	
RPU	2012	2189	220681	RPU-19	Jordan - Wonewoc						290	2660	220	0.15	1.20E-04				2200*			220	1.20E-04	2200
RPU	2012	2194	220818	RPU-22	PdC - Wonewoc						130	1600	180	0.15	7.80E-04							180	7.80E-04	
RPU	2012	2195	220660	RPU-23	PdC-Jordan						190	1390	250	0.15	1.10E-03							250	1.10E-03	
RPU	2012	2196	220675	RPU-25	PdC - Wonewoc						310	2010	360	0.15	7.00E-04							360	7.00E-04	
RPU	2014	2547	224212	RPU-27	PdC-Jordan						1170	5900	760	0.15	2.80E-03							760	2.80E-03	
RPU	2012	2198	180567	RPU-28	Jordan						700	2400	470	0.15	3.60E-04							470	3.60E-04	
RPU	2014	2219	161425	RPU-29	PdC-Jordan						2330	3740	1450	0.15	1.60E-03							1450	1.60E-03	
RPU	2012	2200	239761	RPU-30	PdC-Jordan						1080	2060	540	0.15	2.90E-04							540	2.90E-04	
RPU	2012	2204	434041	RPU-31	PdC-Jordan						2510		1510	0.15	1.63E-03							1510	1.63E-03	
RPU	2012	2206	506819	RPU-32	PdC-Jordan						320	1500	230	0.15	1.50E-04							230	1.50E-04	
RPU	2014	2207	220627	RPU-33	Jordan						1150	2580	480	0.15	2.30E-05							480	2.30E-05	
RPU	2014	2210	463536	RPU-34	PdC-Jordan						290	2130	250	0.15	3.00E-04							250	3.00E-04	
RPU	2012	2211	601335	RPU-35	Jordan						1890	3490	1080	0.15	5.20E-04							1080	5.20E-04	
RPU	2014	2216	601336	RPU-36	PdC-Jordan						1590	3640	1850	0.15	3.00E-03							1850	3.00E-03	
Barr Eng. Co.	2015	2546	676687	RPU-37	Jordan								4010	2.57	1.70E-04							4010	1.70E-04	
RPU	2014	2217	698933	RPU-38	Jordan						310	1180	270	0.15	6.00E-04							270	6.00E-04	
RPU	2014	2218	733087	RPU-39	Jordan						1110	4370	990	0.15	4.10E-03							990	4.10E-03	
E.H. Renner	2010	2485	773386	RPU-40	PdC-Jordan	8720		11020			8340		6430	0.005	4.00E-04	25700	9435	9950	7000	12900	7860	8500	4.00E-04	7000
E.H. Renner	2014	2484	796431	RPU-41	Jordan						1940				7.70E-05	1540	3086	3050	6000	4630	3090	3090	7.70E-05	6000
USGS	1989	2409	228150	Stauffer C	h Prairie du Chien										1.00E-04	8970**						8970	1.10E-04	

* from a chloride mixing-model, based on steady-state ambient & pumping induced leakage

** Anisotropic T; this is the maximum T - orientation ~ N95oE, minimum T was 1790 ft^2/day - orientation ~ N5oE

*** PdC = Prairie du Chien Group; Jordan = Jordan Sandstone

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:	1550010	PWS Name:	Rochester Public Utilities

Contact Information for Person Completing this Form

Name:	John Greer, PG
Address:	4300 MarketPointe Drive
	Suite 200
City, State, Zip:	Minneapolis, MN 55435
Phone, Fax, e-mail:	952-832-2691, 952-832-2601, jgreer@barr.com

Aquifer Properties Determination Methods

- ☐ 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: John Greer	Prof. License: 30347	Date: 7/13/2016

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:	Tunnel City-Wonewoc	☑ Confined	☐ Unconfined	☐ Fractured Rock

Osweiler and Blum (2004) provide a transmissivity of 120 ft**2/day (11.15 m**2/day) for the aquifer that was taken from the literature. This value will be used as the base case transmissivity for the wellhead protection area delineations. The sensitivity/uncertainty evaluation will consist of modifying the base case transmissivity by +/-50%.

Reference:

Osweiler T. and J. Blum, 2004. Part 1 of the Wellhead Protection Plan for the City of Rochester, Minnesota - Including: the Wellhead Protection Area Delinetion, Drinking Water Supply Management Area Delineation, and Vulnerability Assessment, June 2004.

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

220833	220818				
220822	220819				
222527	220675				
220681					
220662					
220625					

Reviewed by:	**Approved:** ◉ Yes ○ No	**Approval Date:** 7/13/16

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:	1550010	PWS Name:	Rochester Public Utilities

Contact Information for Person Completing this Form

Name:	John Greer, PG
Address:	4300 MarketPointe Drive
	Suite 200
City, State, Zip:	Minneapolis, MN 55435
Phone, Fax, e-mail:	952-832-2691, 952-832-2601, jgreer@barr.com

Aquifer Properties Determination Methods

☐ 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: John Greer	Prof. License: 30347	Date: 7/13/2016

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	☑ Confined	☐ Unconfined	☐ Fractured Rock

Osweiler and Blum (2004) provide a transmissivity of 2,760 ft**2/day (256.4 m**2/day) for the aquifer that was taken from the literature. This value will be used as the base case transmissivity for the wellhead protection area delineations. The sensitivity/uncertainty evaluation will consist of modifying the base case transmissivity by +/-10%.

Reference:

Osweiler T. and J. Blum, 2004. Part 1 of the Wellhead Protection Plan for the City of Rochester, Minnesota - Including: the Wellhead Protection Area Delinetion, Drinking Water Supply Management Area Delineation, and Vulnerability Assessment, June 2004.

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.

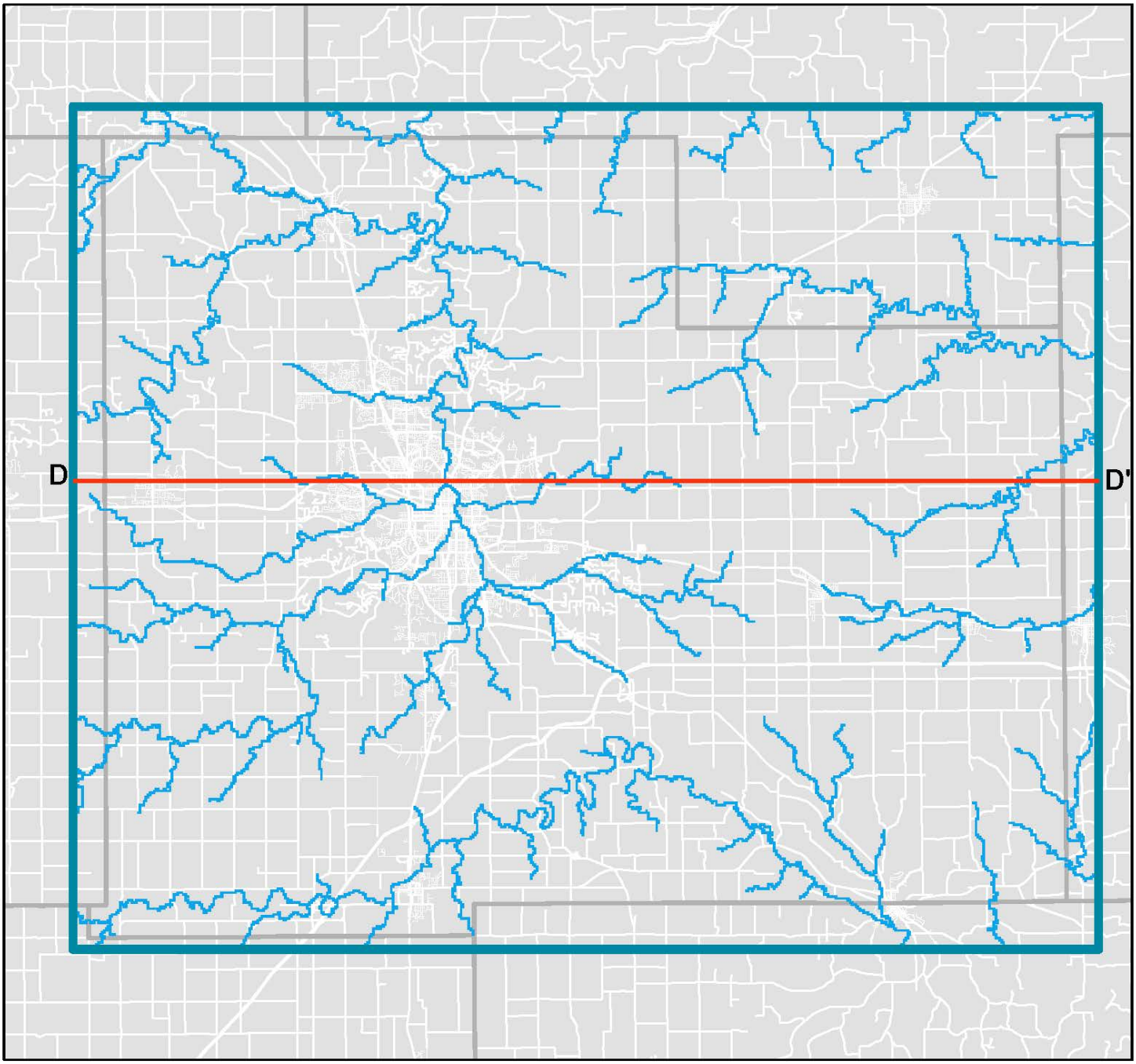
List the unique number of each public water supply well to which this DAP-ATP Form applies

220662					

Reviewed by:	**Approved:** ◉ Yes ○ No	**Approval Date:** 7/13/16

Appendix C

Porous Media Groundwater Modeling



Reference Map

Model Cross Section

Streams

Constant Head Boundary

County Boundaries

N

Miles

0 5

Kilometers

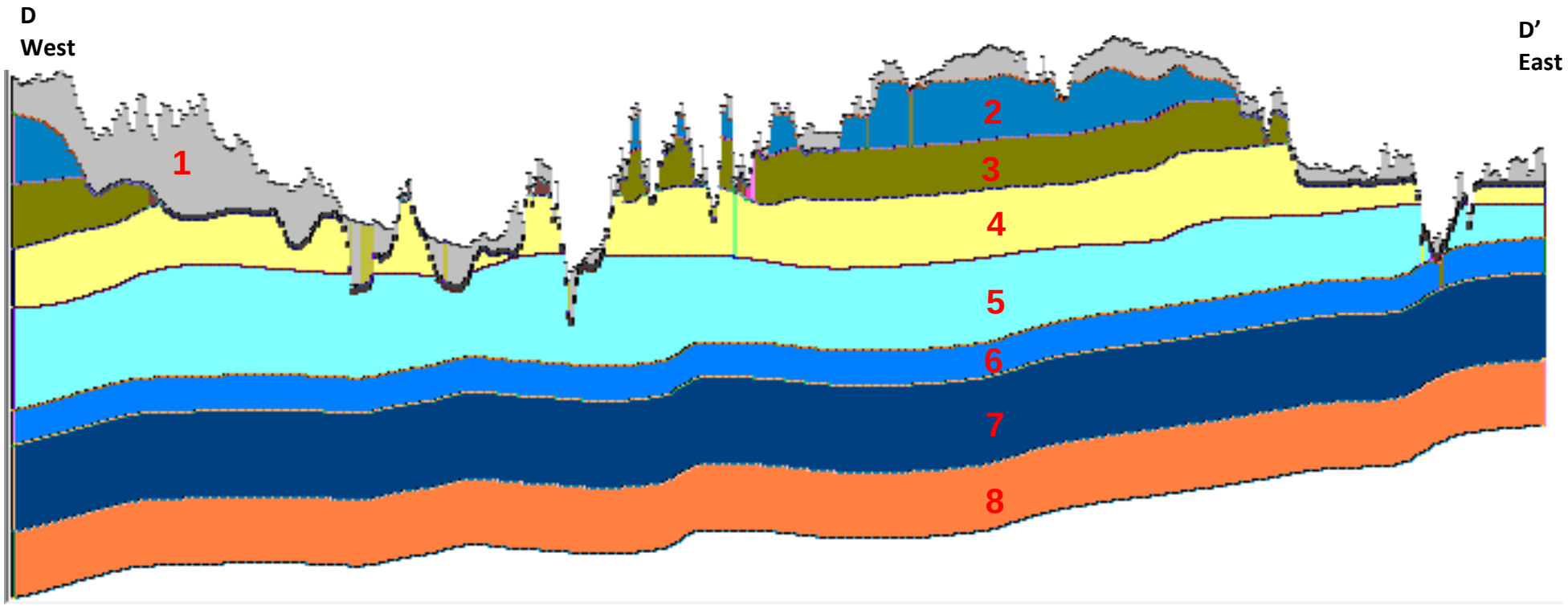
0 10

MODFLOW MODEL DOMAIN AND BOUNDARIES
RPU WHPP Amendment
Rochester Public Unitilies

FIGURE C-1

BARR

Barr Footer: P:\Mpls\23 MN\55\23551029 RPU Water Source Sustain Eval\23551029.11 WHPP Amendment\WorkFiles\Report\Figures\FigC-1 - Groundwater Model Domain and Boundaries.pdf



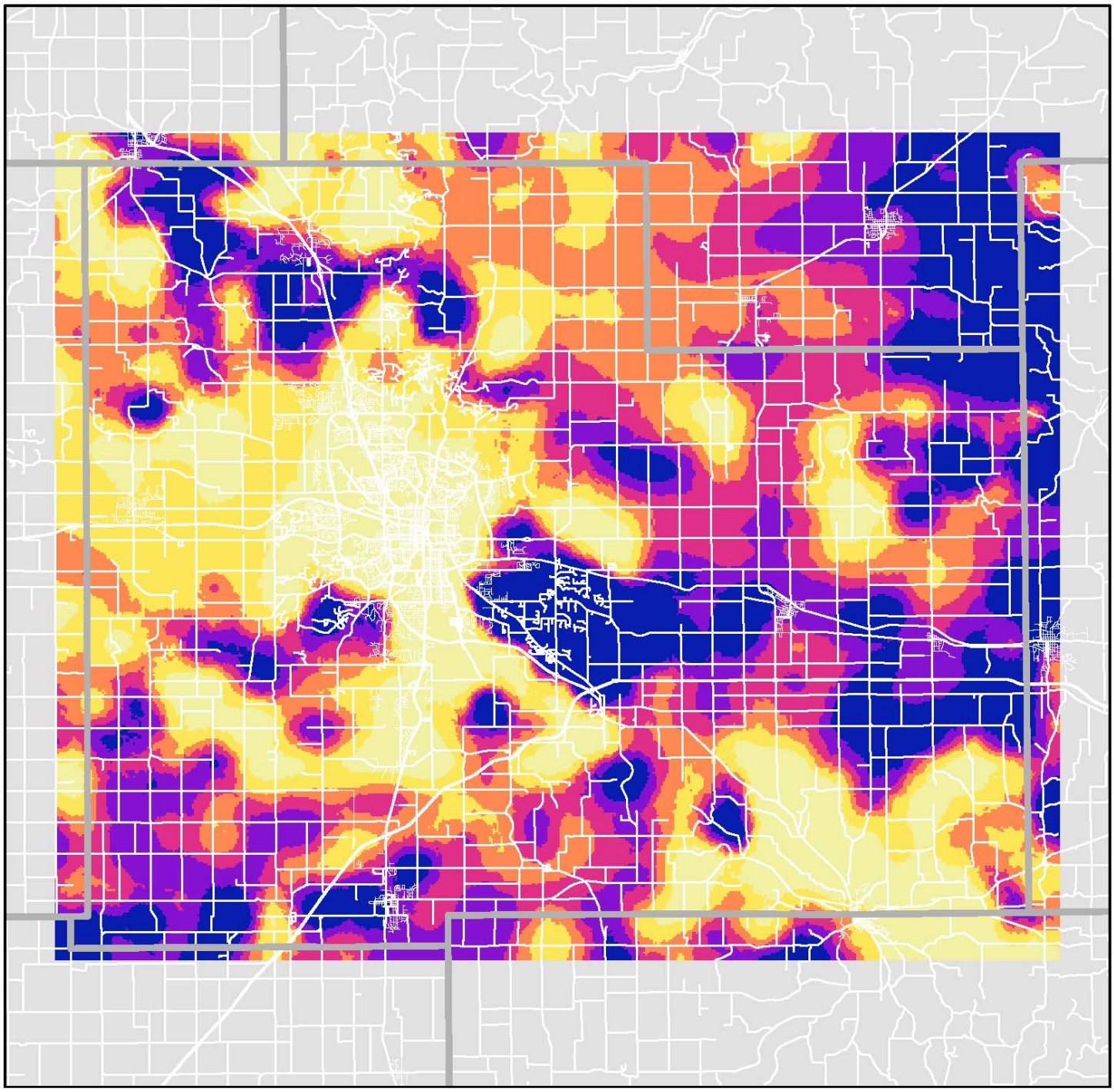
Layer	Hydrostratigraphic Unit	K_x Range (m/day)	K_z Range (m/day)
1	Quaternary Sediments	2.4 to 3.6	0.06 to 0.15
2	Galena aquifer	2.8 to 6.4	0.01 to 0.09
3	Decorah, Platteville, & Glenwood confining unit	4.0×10^{-3} to 1.9	1.3×10^{-6} to 0.03
4	St Peter aquifer	10.9 to 12.6	0.08 to 0.09
5	Upper Shakopee aquifer	12.5 to 15.5	0.15 to 0.19
6	Lower Shakopee aquifer	12.4 to 14.2	0.16 to 0.21
7	Oneota confining unit	0.29 to 0.30	5.6×10^{-3} to 6.5×10^{-3}
8	Jordan aquifer	14.6 to 16.6	0.73 to 0.83

GROUNDWATER MODEL LAYERING AND HYDRAULIC CONDUCTIVITY RANGES

RPU WHPP Amdendment
Rochester Public Utilities

FIGURE C-2

BARR



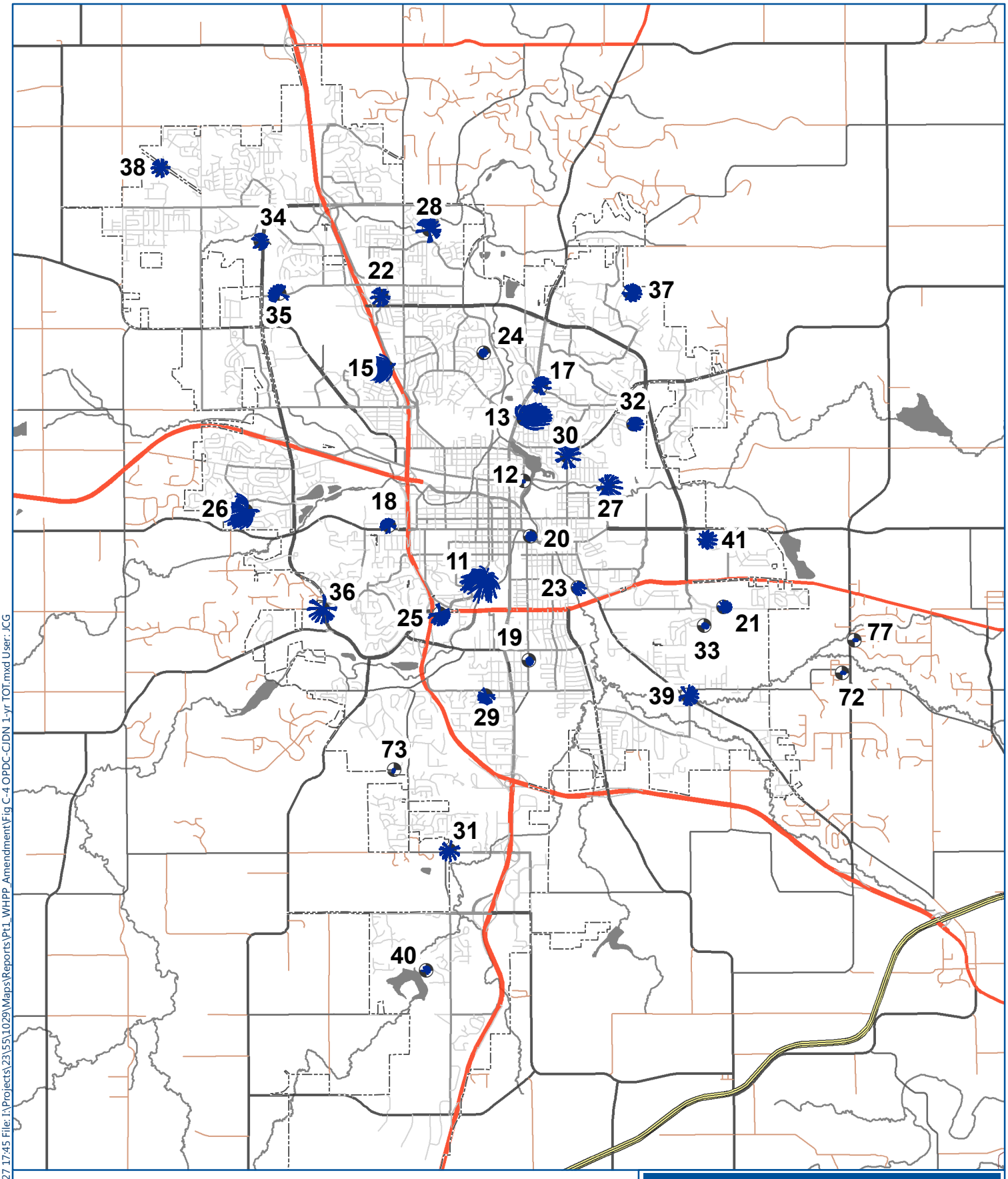
Model Recharge (in/yr)

- 5.86
- 7.83
- 7.85
- 8.03
- 8.32
- 10.56

N

GROUNDWTER MODEL
RECHARGE DISTRIBUTION
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-3



Legend

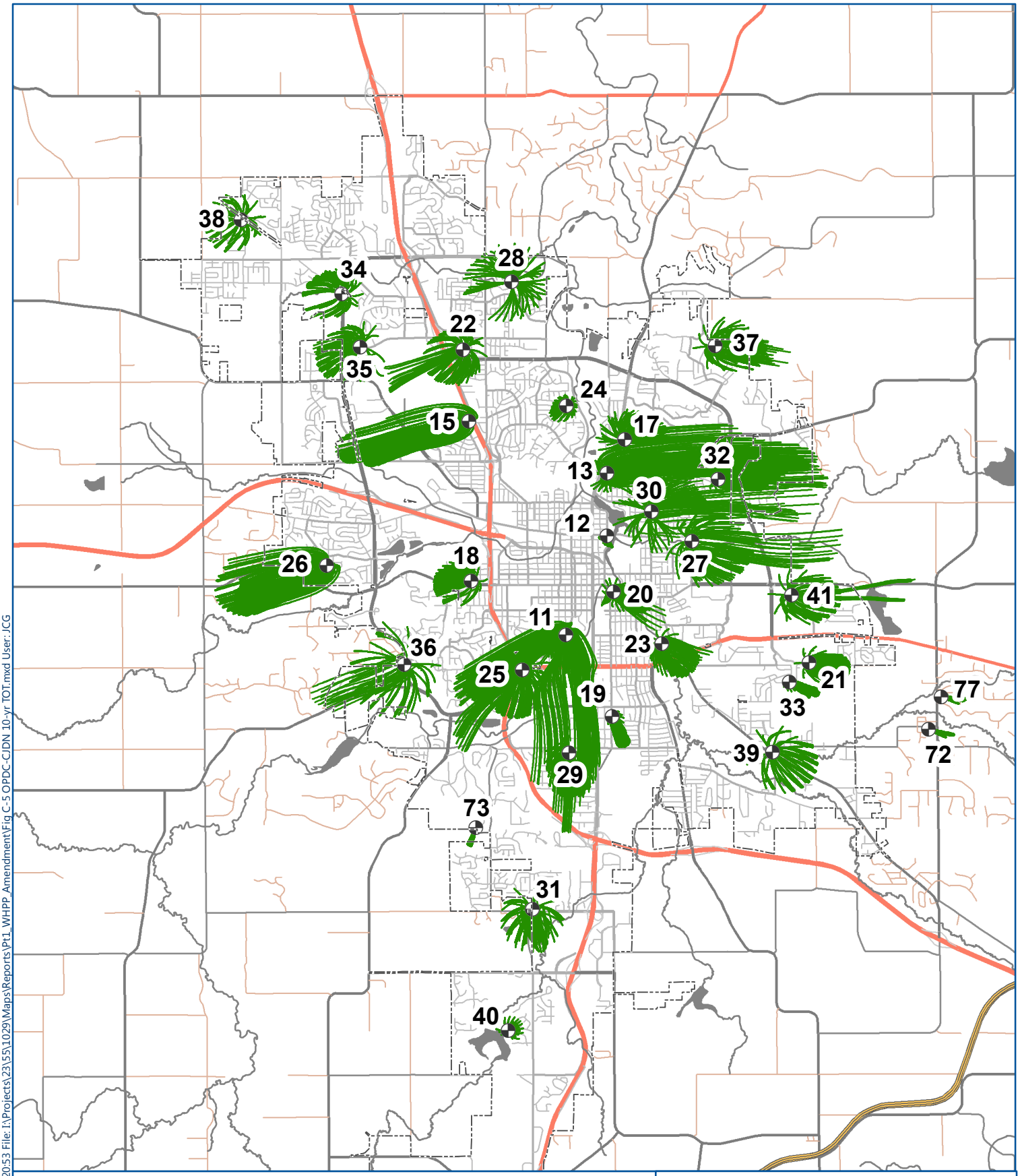
- 1-yr TOT Flow Paths
- Municipal Boundary
- RPU Supply Wells

1 0.5 0 1 2 Miles

BARR

COMPOSITE 1-YR GROUNDWATER TIME OF TRAVEL FLOW PATHS FOR SHAKOPEE AND JORDAN AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-4



Legend

- Municipal Boundary
- RPU Supply Wells
- 10-yr TOT Flow Paths

N

0 0.5 1 2 3

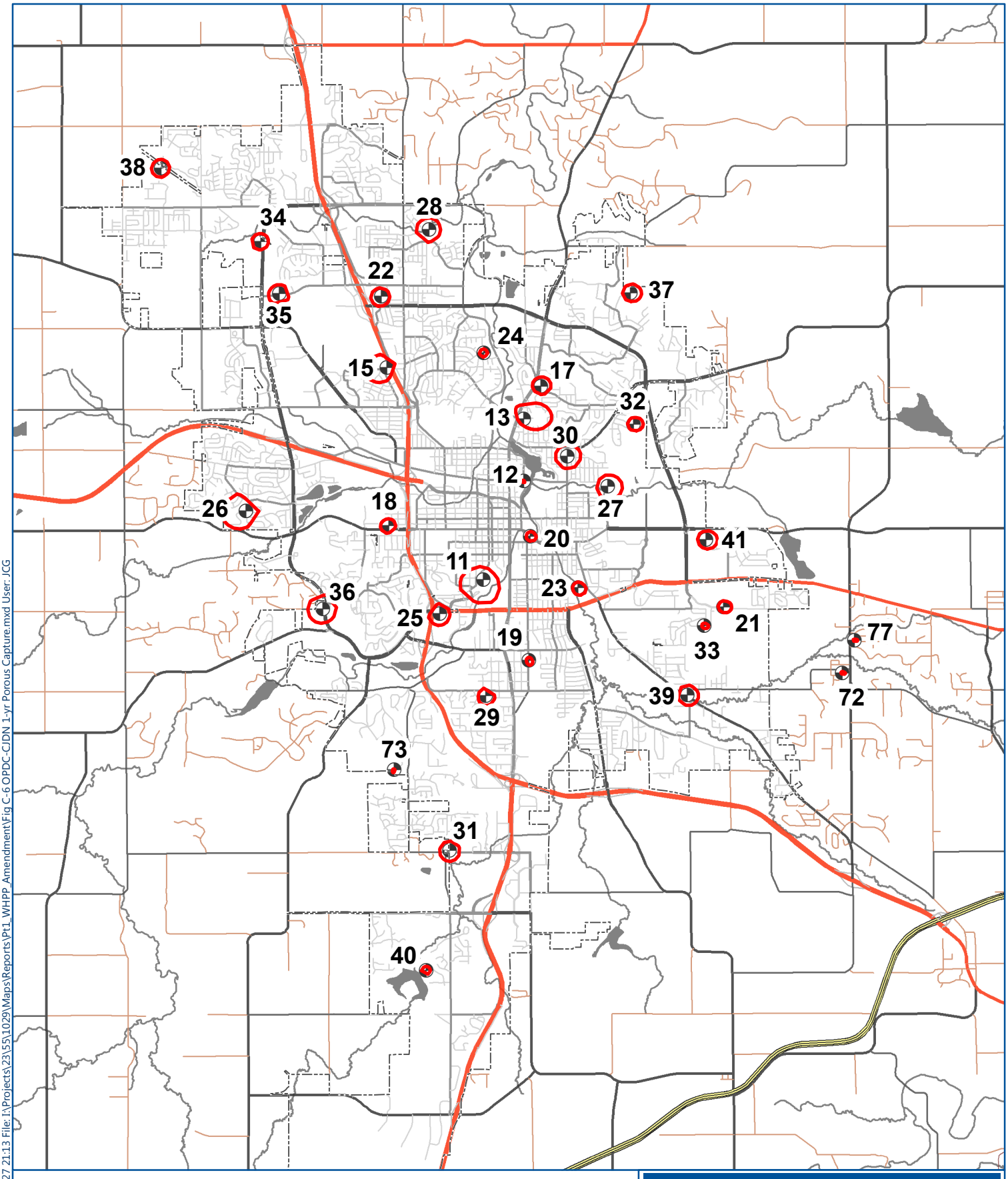
Miles

BARR

COMPOSITE 10-YR TIME OF TRAVEL FLOW PATHS FOR SHAKOPEE AND JORDAN AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-5

Barr Footer: ArcGIS 10.4.1, 2017-04-27 20:53 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig C-5 OPDC-CJDN 10-yr TOT.mxd User: JCG



Legend

- 1-yr Porous Media Capture Zone
- Municipal Boundary
- RPU Supply Wells

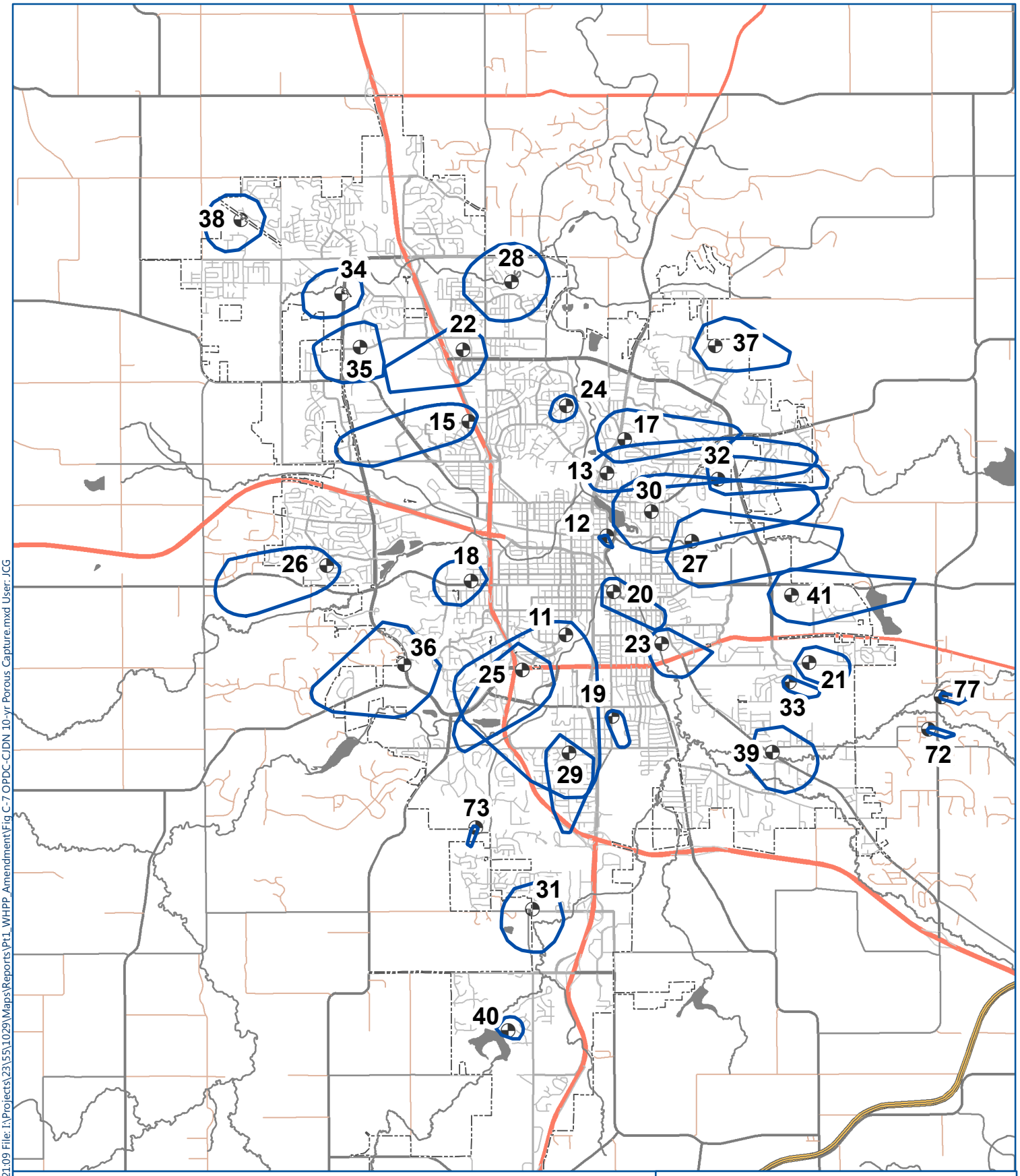
1 0.5 0 1 2 Miles

BARR

COMPOSITE 1-YR POROUS MEDIA CAPTURE ZONES FOR SHAKOPEE AND JORDAN AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-6

Barr Footer: ArcGIS 10.4.1, 2017-04-27 21:13 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig C-6 OPDC-CIDN 1-yr Porous Capture.mxd User: JCG



Legend

- 10-yr Porous Media Capture Zone
- Municipal Boundary
- RPU Supply Wells

N

0 0.5 1 2 3

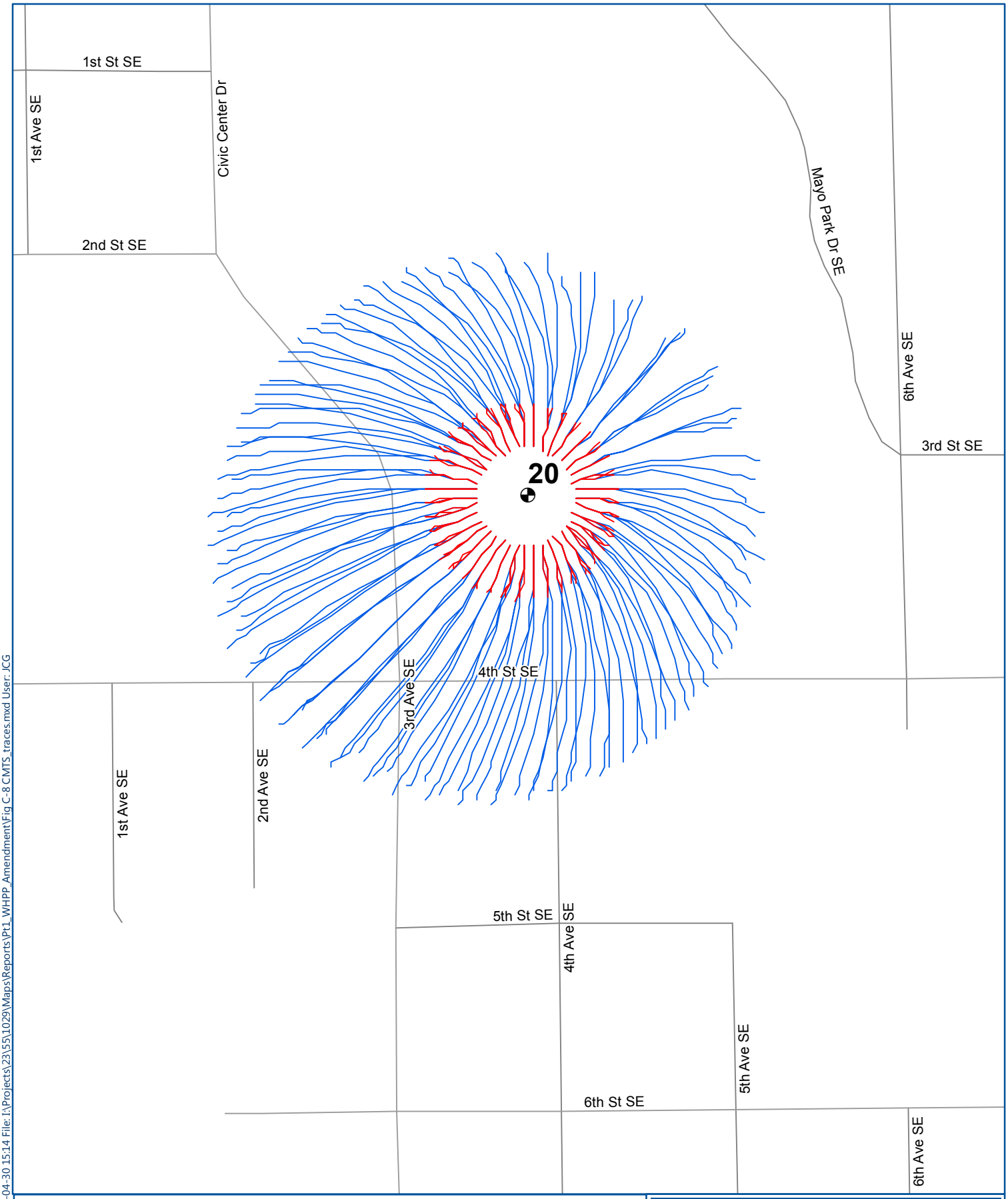
Miles

BARR

COMPOSITE 10-YR POROUS MEDIA CAPTURE ZONES FOR SHAKOPEE AND JORDAN AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-7

Barr Footer: ArcGIS 10.4.1, 2017-04-27 21:09 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig C-7 OPDC-CUDN 10-yr Porous Capture.mxd User: JCG



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

0 50 100 200 300 400

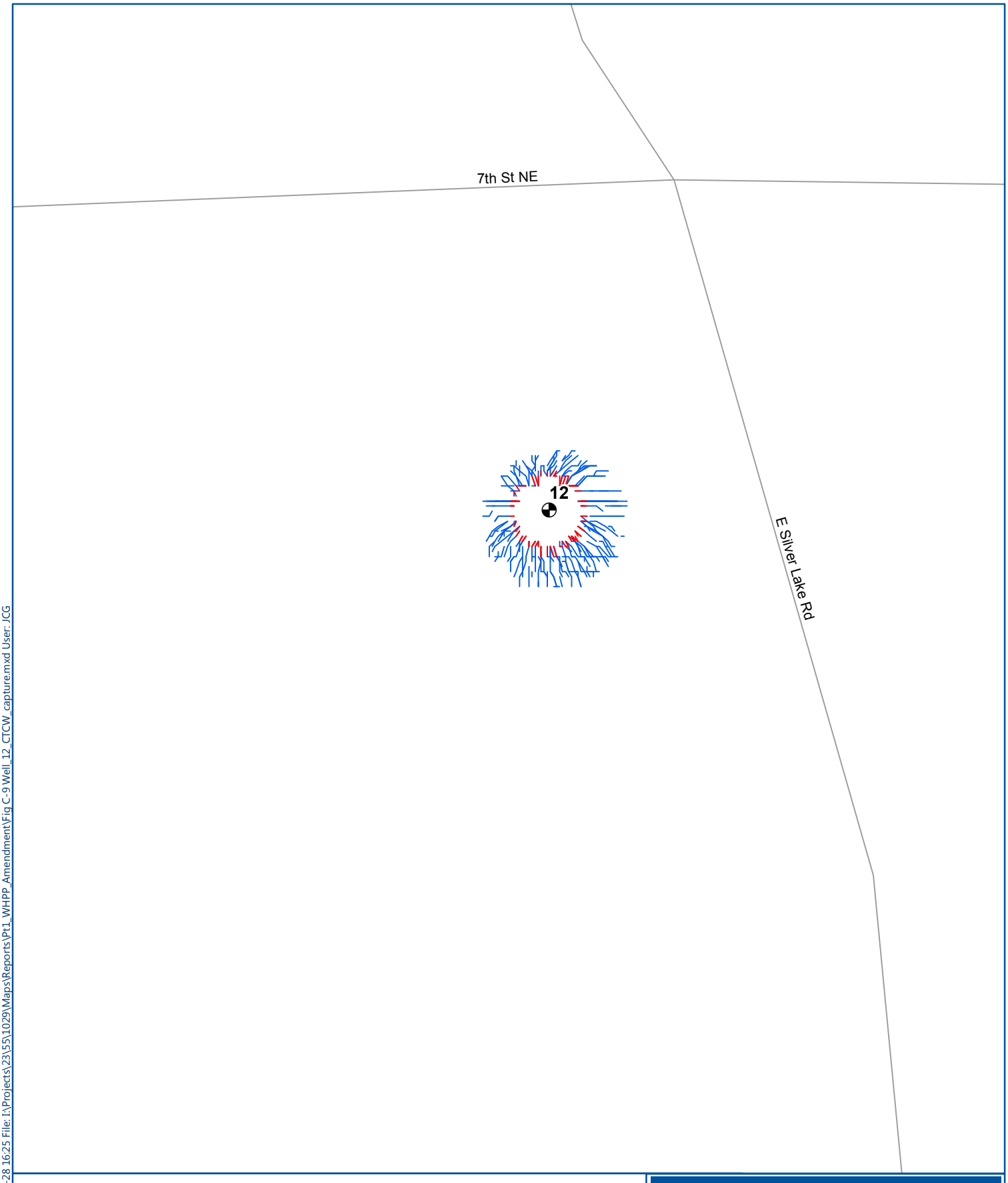
Feet

BARR

WELL 20 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: MT. SIMON AQUIFER
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-8

Barr Footer: ArcGIS 10.4.1, 2017-04-30 15:14 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig C-8 CMTS_traces.mxd User: JCG



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

25 12.5 0 25 50

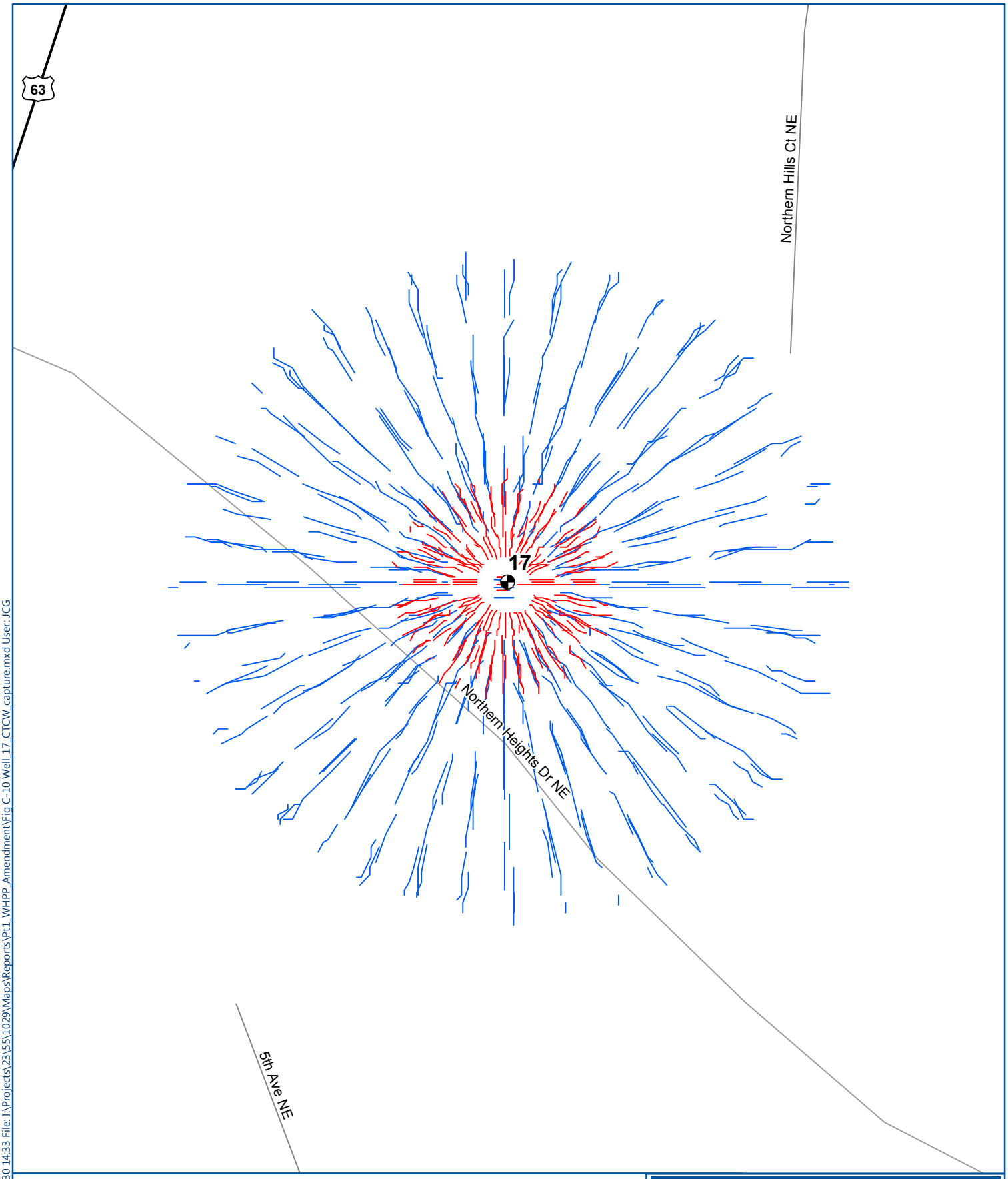
Feet

WELL 12 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS

RPU WHPP Amendment

Rochester Public Utilities

FIGURE C-9



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

50 25 0 50 100

Feet

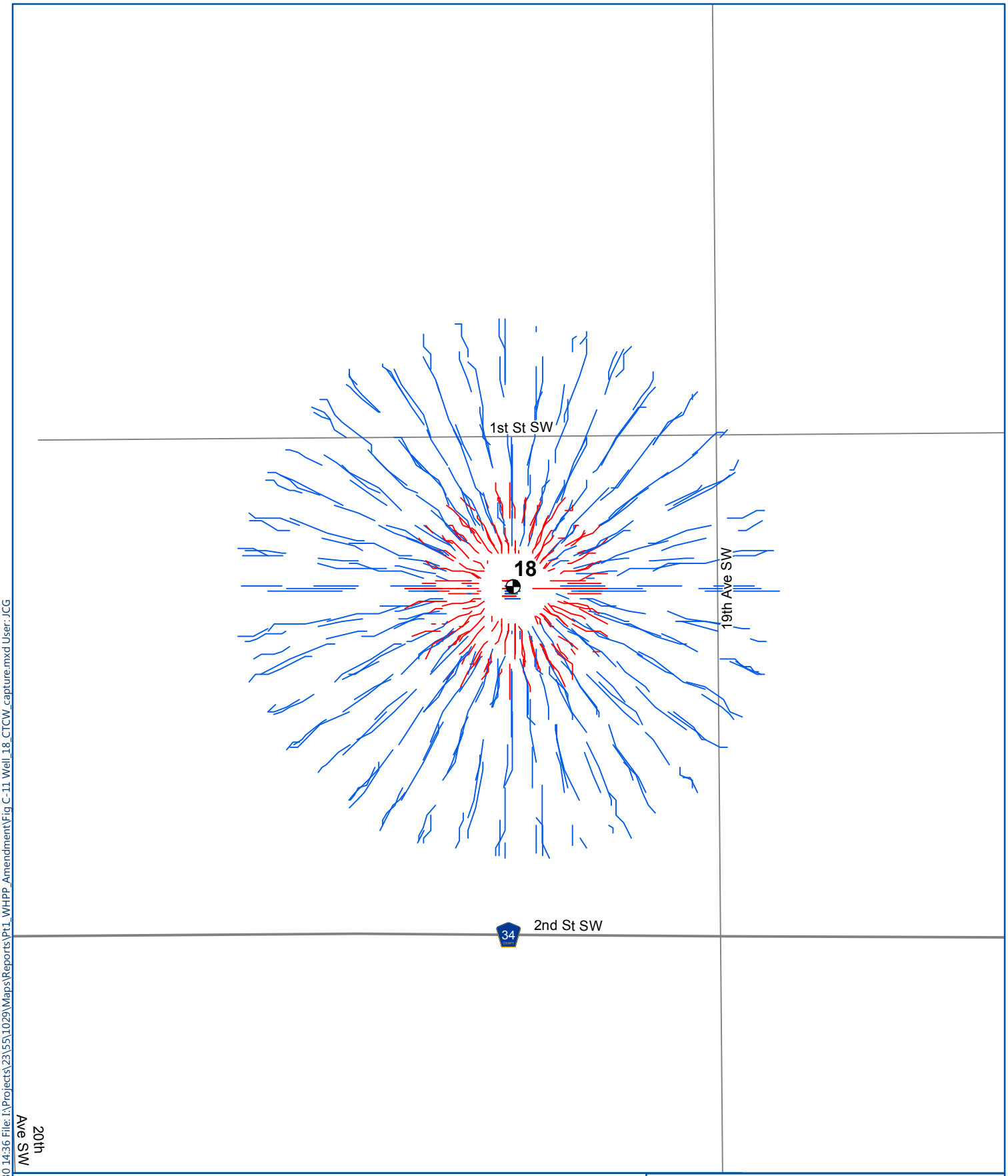
BARR

WELL 17 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS

RPU WHPP Amendment

Rochester Public Utilities

FIGURE C-10



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

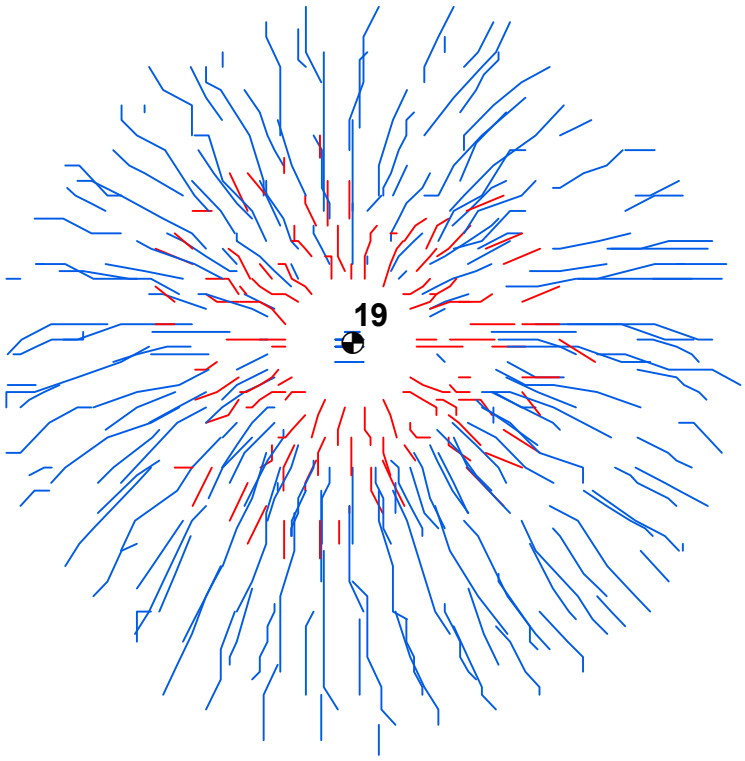
N

50 25 0 50 100

Feet

WELL 18 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-11



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

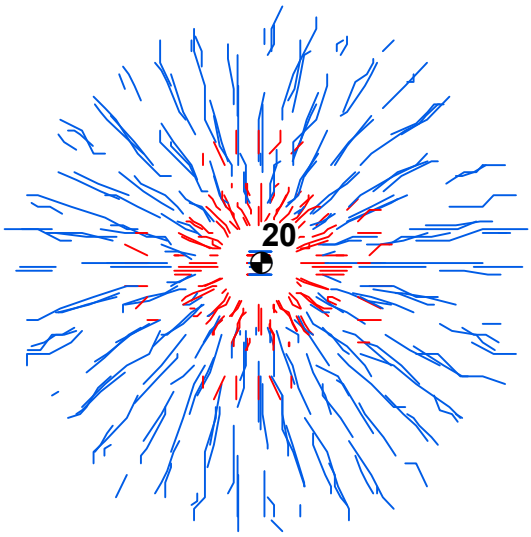
25 12.5 0 25 50

Feet

BARR

WELL 19 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-12



3rd Ave SE

4th St SE

4th Ave SE

Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

50 25 0 50 100

Feet

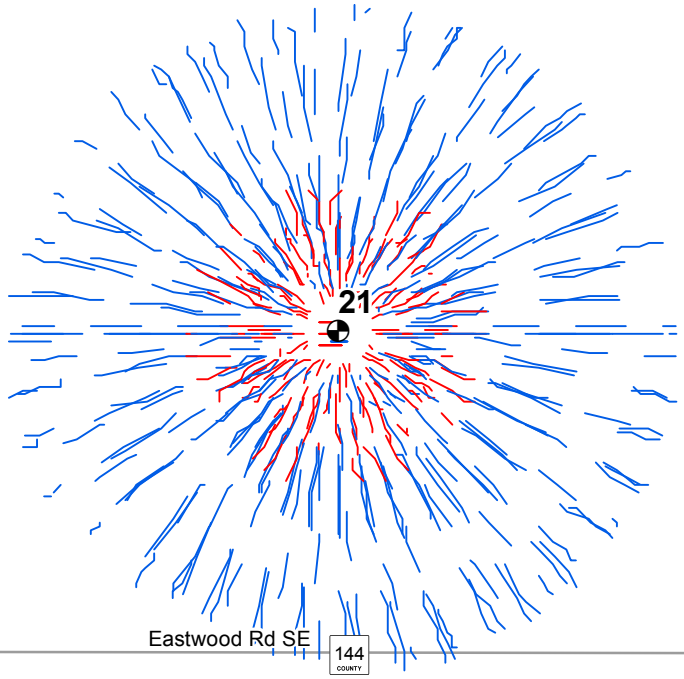
BARR

WELL 20 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS

RPU WHPP Amendment

Rochester Public Utilities

FIGURE C-13



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

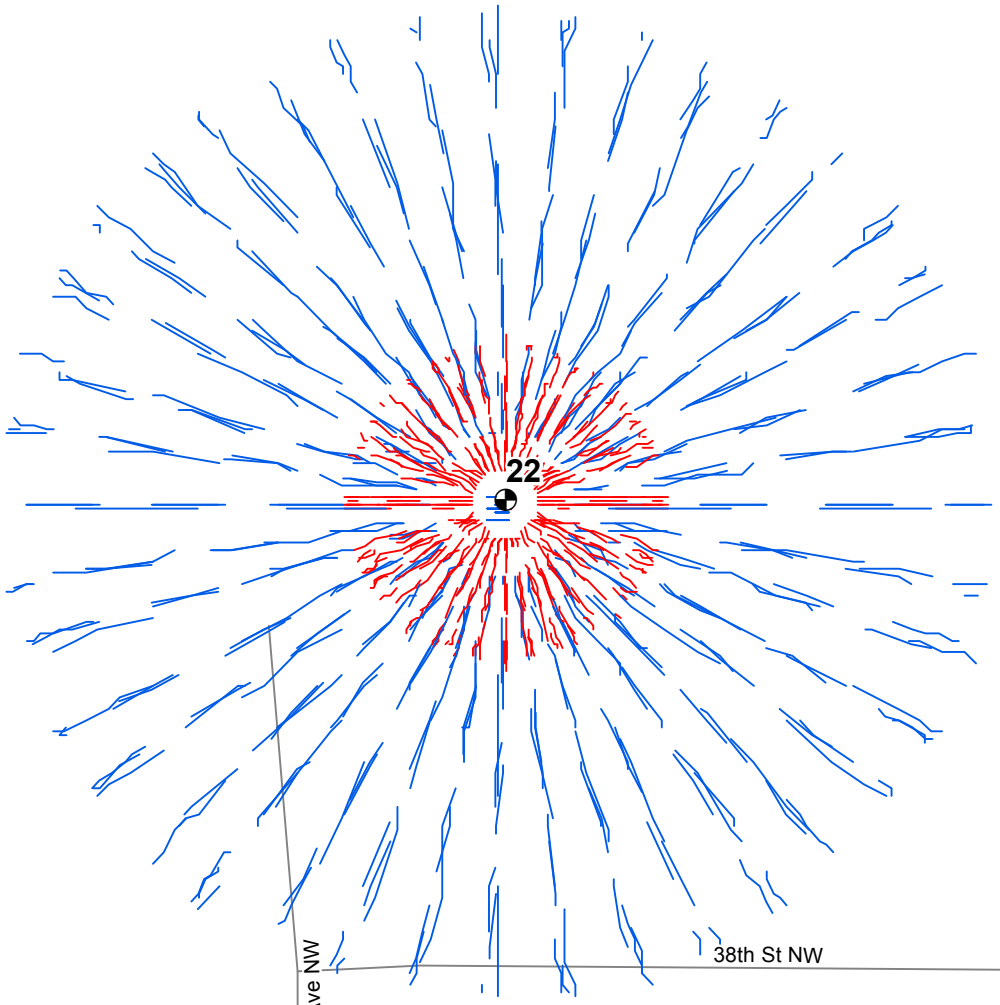
50 25 0 50 100

Feet

BARR

WELL 21 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-14



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

50 25 0 50 100

Feet

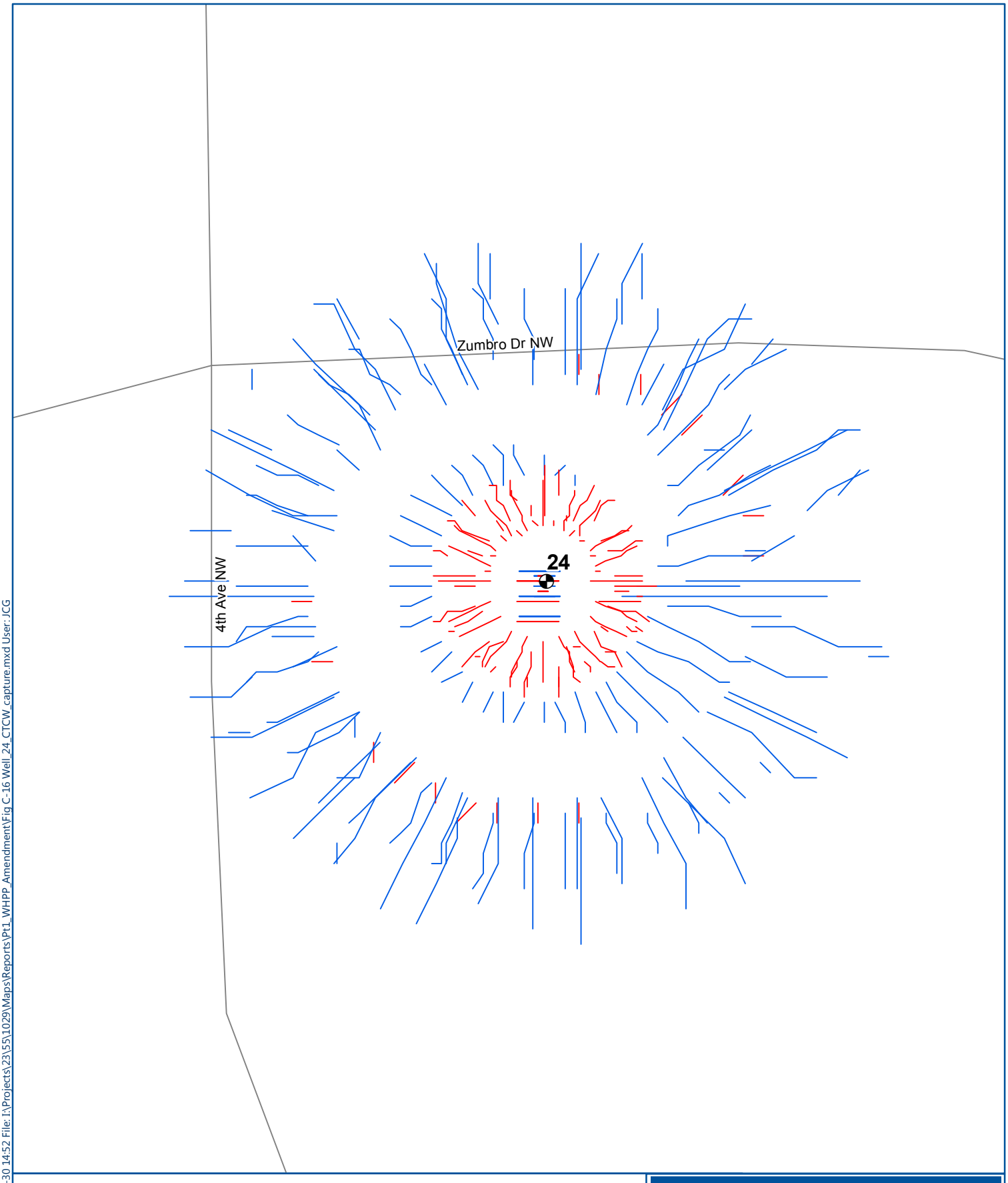
BARR

WELL 22 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS

RPU WHPP Amendment

Rochester Public Utilities

FIGURE C-15



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

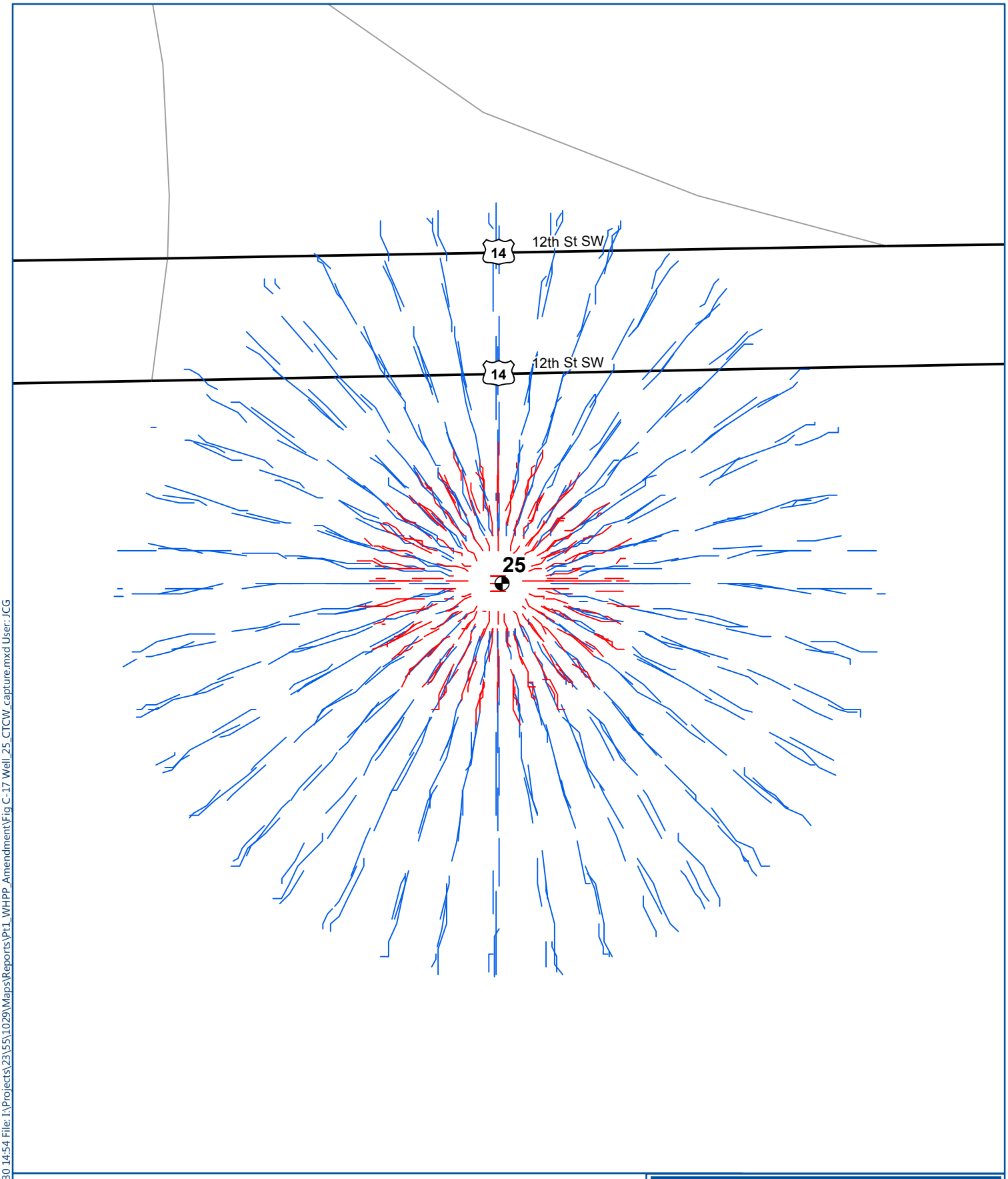
25 12.5 0 25 50

Feet

BARR

WELL 24 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-16



Legend

- RPU Supply Wells
- 1-yr TOT Particle Track
- 10-yr TOT Particle Track

N

50 25 0 50 100

Feet

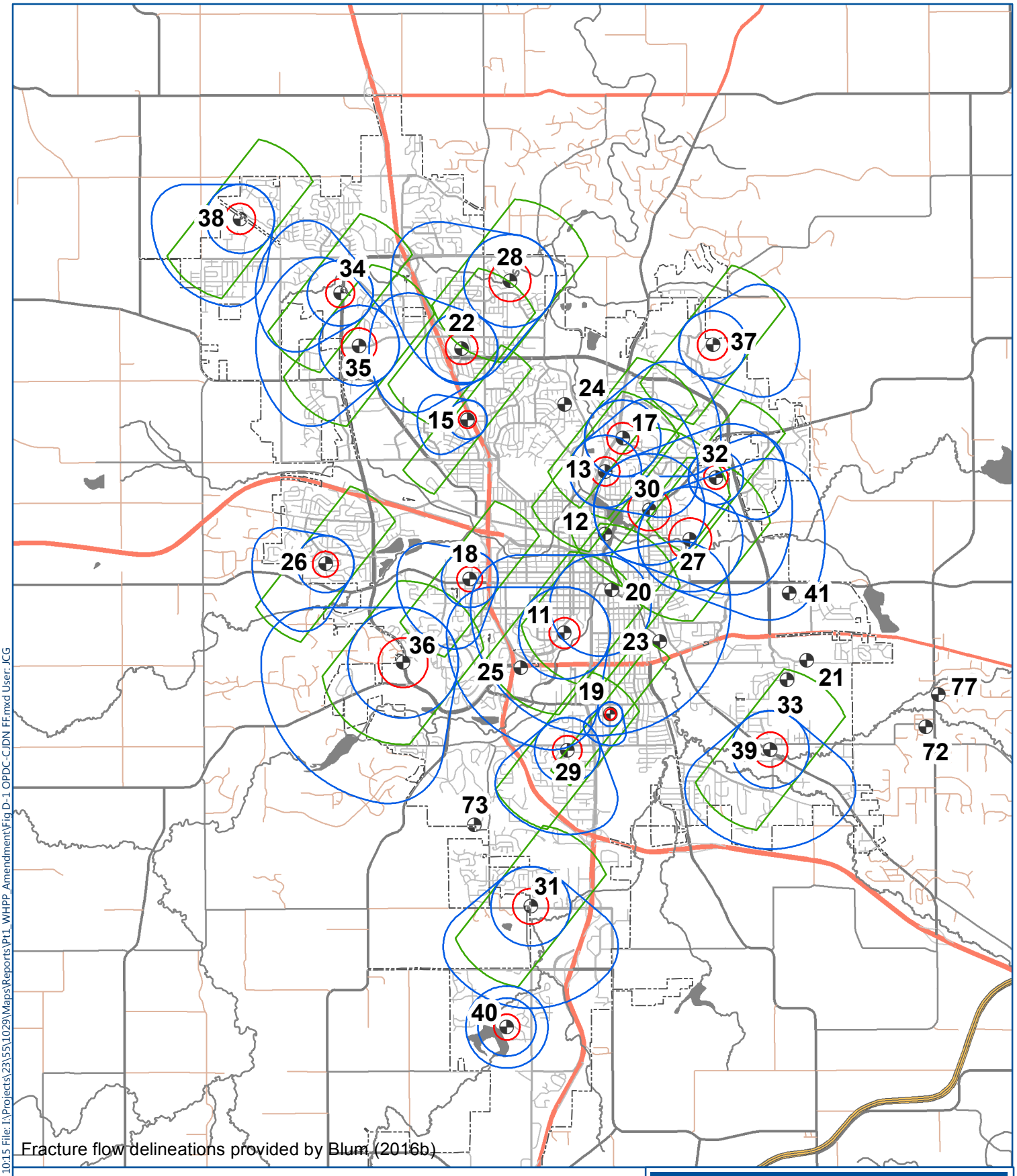
BARR

WELL 25 1-YR AND 10-YR COMPOSITE CAPTURE ZONES: TUNNEL CITY AND WONEWOC AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE C-17

Appendix D

Fracture Flow Evaluation



Fracture flow delineations provided by Blum (2016b).

Legend

- RPU Supply Wells
- CFR and UGExtensions
- 1-yr TOT Zone
- LineamentExtensions
- Municipal Boundary

DRAFT

N

0 0.5 1 2 3

Miles

BARR

FRACTURE FLOW 1-YR AND 10-YR TIME OF TRAVEL ZONE COMOPONENTS: SHAKOPEE AND JORDAN AQUIFERS
RPU WHPP Amendment
Rochester Public Utilities

FIGURE D-1

Barr Footer: ArcGIS 10.4.1, 2017-05-04 10:15 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig D-1 OPDC-CJDN FF.mxd User: JCG

Memo

Minnesota Department of Health

Date: June 3, 2016

To: Rochester Public Utility WHP Project File (PWSID: 1550010)

From: Justin Blum

Subject: Fractured Rock Delineation Procedure for the Amendment of the Rochester Wellhead Protection Plan

---

Detailed assessment of hydrogeologic conditions in southeastern Minnesota; and, particularly within the Rochester Basin has contributed greatly to the understanding of a complex hydrogeologic flow system from the 1980's. That information was the foundation of the initial wellhead protection plan for Rochester. Continuing that work, several studies have been published by the MGS and USGS over the last ten years to support the re-delineation of Rochester's Wellhead Protection Area (WHPA). All of the technical work that Rochester Public Utilities has supported by over the years has benefited scientific understanding as well as protected the quality of drinking water for the community

During this time, changes also have occurred from a regulatory perspective. Policy and guidance for delineation of wellhead protection areas in fractured and solution weathered bedrock have been published by the MDH. (MDH. 2011) These conditions apply to the hydrogeologic setting in Rochester.

Even though the concept of a calculated fixed radius is quite simple, the procedure for delineating the fracture-flow capture area is not straightforward. To help support RPU's efforts to protect drinking water, the MDH is providing the portion of the delineation based on the fracture-flow analysis, attached. In part, this is to support Rochester's complete revision of the porous-media flow model that is required to amend the WHPA and to meet the schedule for completing the amendment process in this complex setting.

Fracture-flow Delineation Procedure

1. Identify Overlapping CFR areas

Table 1. Summary of Overlap Calculations

Page No.	Name	Overlaps with	Unique	Q	Revised Q	Remarks
Central Rochester (downtown area) to southwest overlap chain						
3	Mayo	--	220664	3993	4049	Franklin Heating Plant, two wells – assume all pumping from one
		St. Mary's	231890	1085	1100	
4	AMPI-1,2,&3	--	233030	3388	4009	Assume all AMPI pumping at closest OPCJ well
		W-20	220662	621	--	Completely enclosed –see note 1.
5	AMPI-1,2,&3	--	233030	4009	5198	
		Mayo	220664	4049	5250	
6	AMPI-1,2,&3	--	233030	5198	5207	
		Seneca Foods	242118	631	632	
7	W-11	--	220666	2659	4177	Overlap with two other wells, area of overlap is 0.64 of W-11 CFR
		Mayo	220664	5250		
		AMPI-1,2,&3	233030	5207		
9	W-11	--	220666	4177	4,282	
		Seneca Foods	242118	632	648	
10	W-36	--	601336	6219	6,275	
		Golf Course	227828	175	177	assume all pumping from closest well
Eastern Rochester to Galena Plateau Overlap Chain						
11	13	--	222525	2105	2,448	
		17	220822	2463	2,865	

Page No.	Name	Overlaps with	Unique	Q	Revised Q	Remarks
12	30	--	239761	4634	5,038	
		13	222525	2,448	2,661	
13	27	--	224212	4609	5,459	
		30	239761	5,038	5,966	
14	27	--	224212	5,459	5,608	
		32	506819	1,511	1471	
15	32	--	506819	1,511	1,532	
		30	239761	5,965	6,048	
16	30	--	239761	6,048	6290	
		17	220822	2,865	2979	
	Northwest Overlap Chain					
17	34		463536	2086	2,205	
		35	601335	3100	3,277	
18	35		601335	3277	3,429	
		IBM	220817	352	368	

1. **RPU 20**

RPU 20 is a multi-aquifer well, PdC-MtSimon. Water chemistry information exists to inform a mixing-model. The chloride concentration of W-20 is 8 ppm. Similarly situated wells; W-11, 15, 30, & 32 show chloride concentrations in the range of 11.7 to 14.8 ppm. If a representative minimum concentration in the PdC-Jordan is 12 ppm in the central Rochester area, then approximately 0.67 of the water produced from W-20 is originating from the PdC-Jordan. The pumping volume of W-20 is adjusted to reflect this proportion; from 927 to 621 m^3/day.

Central Rochester (downtown area) to southwest overlap chain

Unique Well# = 231890
ST MARY'S HOSPITAL
X = 541,627.000, Y = 4,874,255.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	1,085.000	m3/day	38,316.413	cu.ft./day	199.046	gal./min.	286,626.676	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	454.592	m	1,491.442	ft.				
New Radius:	457.745	m	1,501.787	ft.				
New Pumping Volume (Q): *	1,100.103	m3/day	38,849.759	cu.ft./day	201.817	gal./min.	290,616.384	gal./day

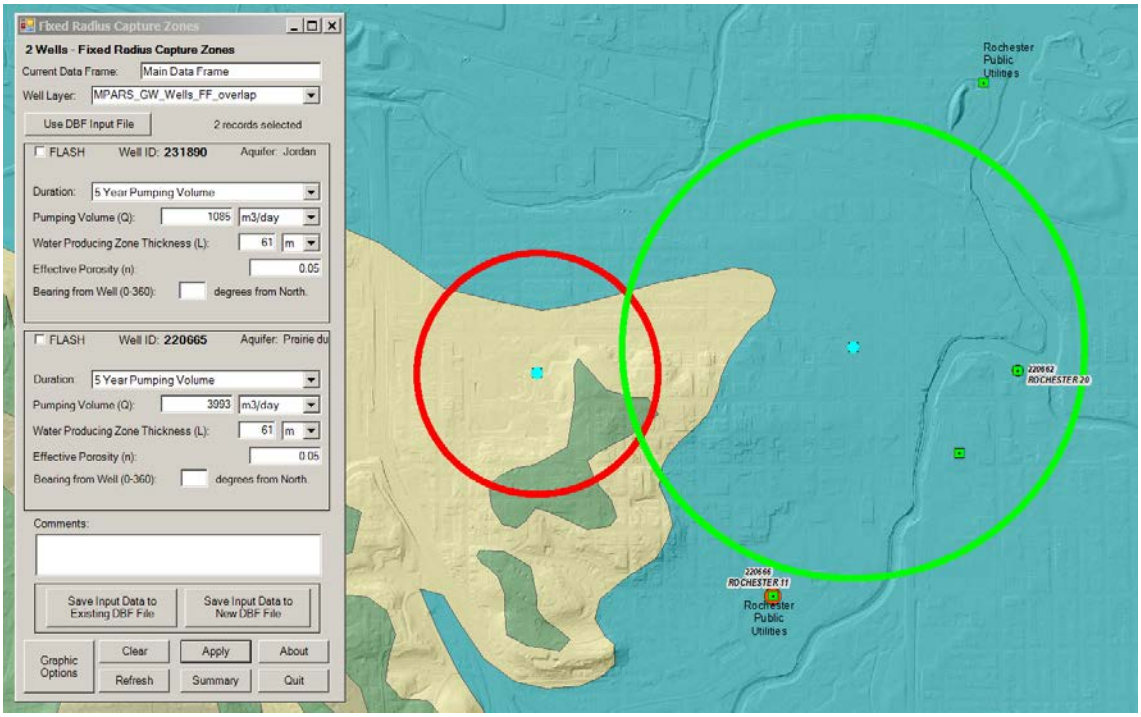
Unique Well# = 220665
FRANKLIN HEATING STATION (KAHLER CORPORATION)
X = 542,829.000, Y = 4,874,354.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	3,993.000	m3/day	141,011.462	cu.ft./day	732.527	gal./min.	1,054,839.001	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	872.080	m	2,861.154	ft.				
New Radius:	878.128	m	2,880.998	ft.				
New Pumping Volume (Q): *	4,048.581	m3/day	142,974.276	cu.ft./day	742.724	gal./min.	1,069,521.865	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well# 231890:	649,221.311	m2	6,988,153.275	sq.ft.
New (CFR) Area for Well# 231890:	658,258.168	m2	7,085,425.091	sq.ft.
Original (CFR) Area for Well# 220665:	2,389,254.098	m2	25,717,692.189	sq.ft.
New (CFR) Area for Well# 220665:	2,422,511.395	m2	26,075,670.403	sq.ft.
Overlap Area to Well# 231890:	9,036.856	m2	97,271.816	sq.ft.
Overlap Area to Well# 220665:	33,257.297	m2	357,978.214	sq.ft.
Total Overlap Area: 42,294.153	m2	455,250.030	sq.ft.	



AMPI - Unique Well = 233030
X = 543,233.000, Y = 4,873,952.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	3,388.000	m3/day	119,646.089	cu.ft./day	621.538	gal./min.	895,014.910	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	803.301	m	2,635.502	ft.				
New Radius: 873.825	m	2,866.881	ft.					
New Pumping Volume (Q): *	**4,009**.000	m3/day	141,576.497	cu.ft./day	735.462	gal./min.	1,059,065.753	gal./day

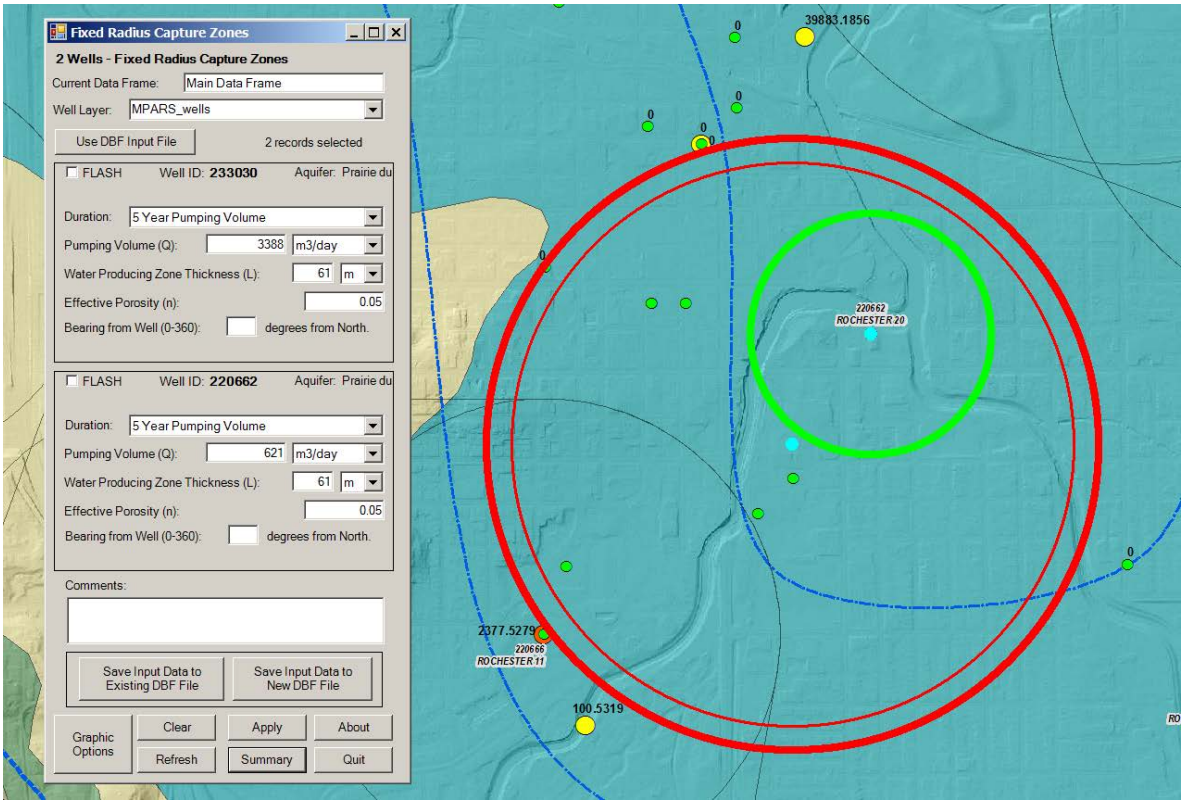
W20 - Unique Well = 220662
X = 543,456.000, Y = 4,874,267.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	621.000	m3/day	21,930.408	cu.ft./day	113.924	gal./min.	164,050.844	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	343.916	m	1,128.333	ft.				
New Radius: 343.916	m	1,128.333	ft.					
New Pumping Volume (Q): *	621.000	m3/day	21,930.408	cu.ft./day	113.924	gal./min.	164,050.844	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 233030:	2,027,245.902	m2	21,821,072.161	sq.ft.
New (CFR) Area for Well 233030:	2,398,827.869	m2	25,820,743.298	sq.ft.
Original (CFR) Area for Well 220662:	371,581.967	m2	3,999,671.137	sq.ft.
New (CFR) Area for Well 220662:	371,581.967	m2	3,999,671.137	sq.ft.

Overlap Area to Well 233030:	371,581.967	m2	3,999,671.137	sq.ft.
Overlap Area to Well 220662:	0.000	m2	0.000	sq.ft.
Total Overlap Area:	371,581.967	m2	3,999,671.137	sq.ft.

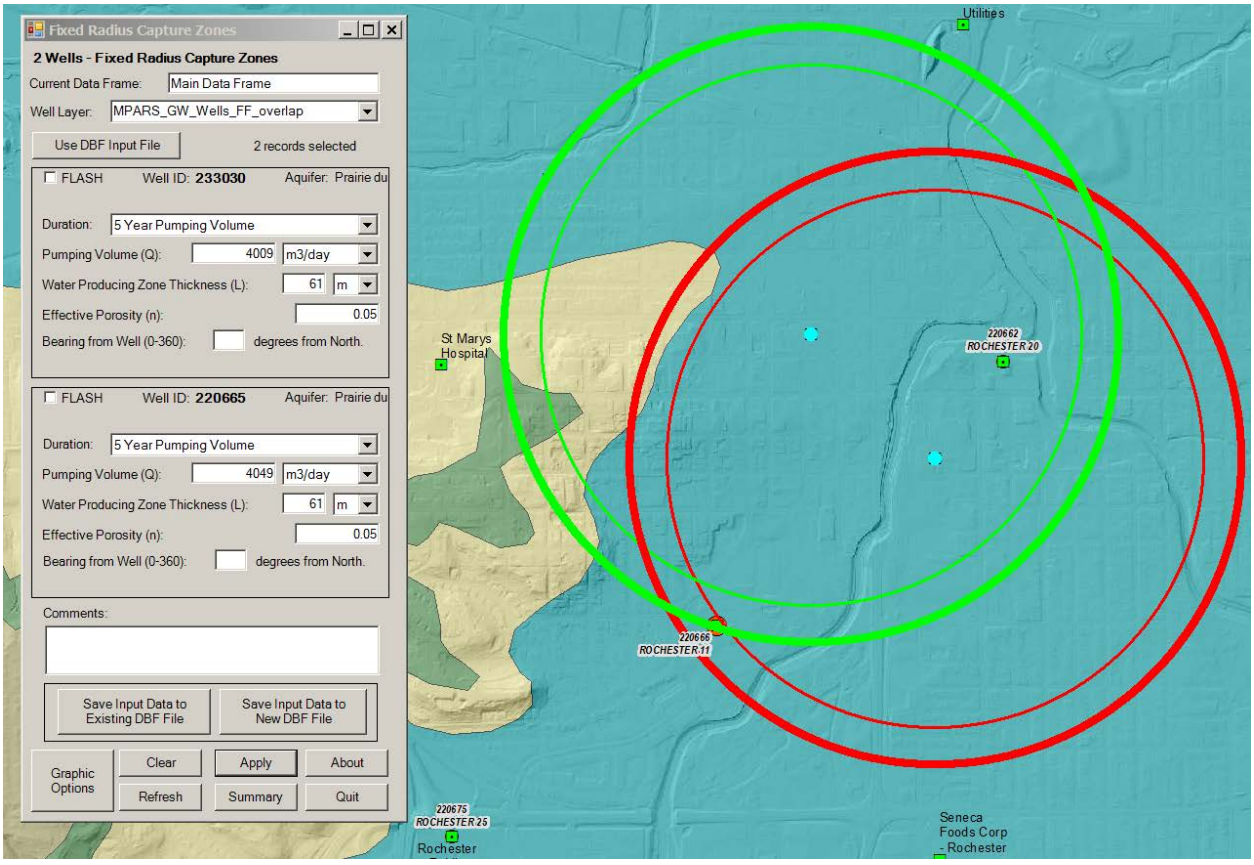


Unique Well# = 233030
A.M.P.I. NO.3
X = 543,233.000, Y = 4,873,952.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	4,009.000	m3/day	141,576.497	cu.ft./day	735.462	gal./min.	1,059,065.753	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	873.825	m	2,866.881	ft.				
New Radius:	995.016	m	3,264.487	ft.				
New Pumping Volume (Q): *	5,198.124	m3/day	183,570.018	cu.ft./day	953.610	gal./min.	1,373,199.107	gal./day

Unique Well# = 220665
FRANKLIN HEATING STATION (KAHLER CORPORATION)
X = 542,829.000, Y = 4,874,354.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	4,049.000	m3/day	142,989.083	cu.ft./day	742.800	gal./min.	1,069,632.635	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	878.174	m	2,881.148	ft.				
New Radius:	999.967	m	3,280.732	ft.				
New Pumping Volume (Q): *	5,249.989	m3/day	185,401.597	cu.ft./day	963.125	gal./min.	1,386,900.270	gal./day

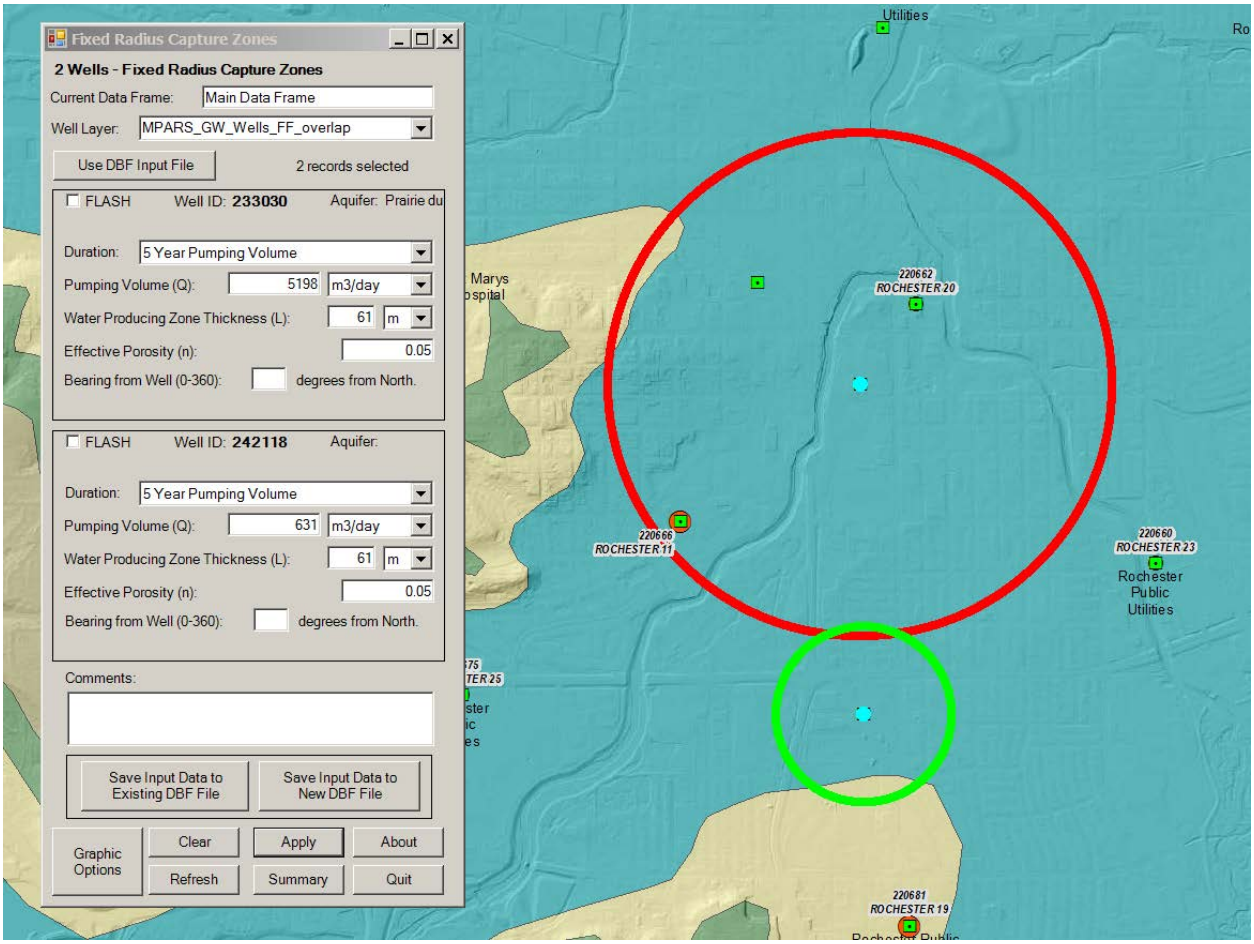


Unique Well# = 233030
A.M.P.I. NO.3
X = 543,233.000, Y = 4,873,952.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	5,198.000	m3/day	183,565.635	cu.ft./day	953.588	gal./min.	1,373,166.322	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	995.004	m	3,264.448	ft.				
New Radius:	995.911	m	3,267.425	ft.				
New Pumping Volume (Q): *	5,207.486	m3/day	183,900.636	cu.ft./day	955.328	gal./min.	1,375,672.307	gal./day

Unique Well# = 242118
SENECA FOODS
X = 543,247.000, Y = 4,872,646.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	631.000	m3/day	22,283.554	cu.ft./day	115.759	gal./min.	166,692.564	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	346.674	m	1,138.382	ft.				
New Radius:	346.990	m	1,138.419	ft.				
New Pumping Volume (Q): *	632.152	m3/day	22,324.221	cu.ft./day	115.970	gal./min.	166,996.773	gal./day



Well# = 220666
X = 542,524.000, Y = 4,873,410.000

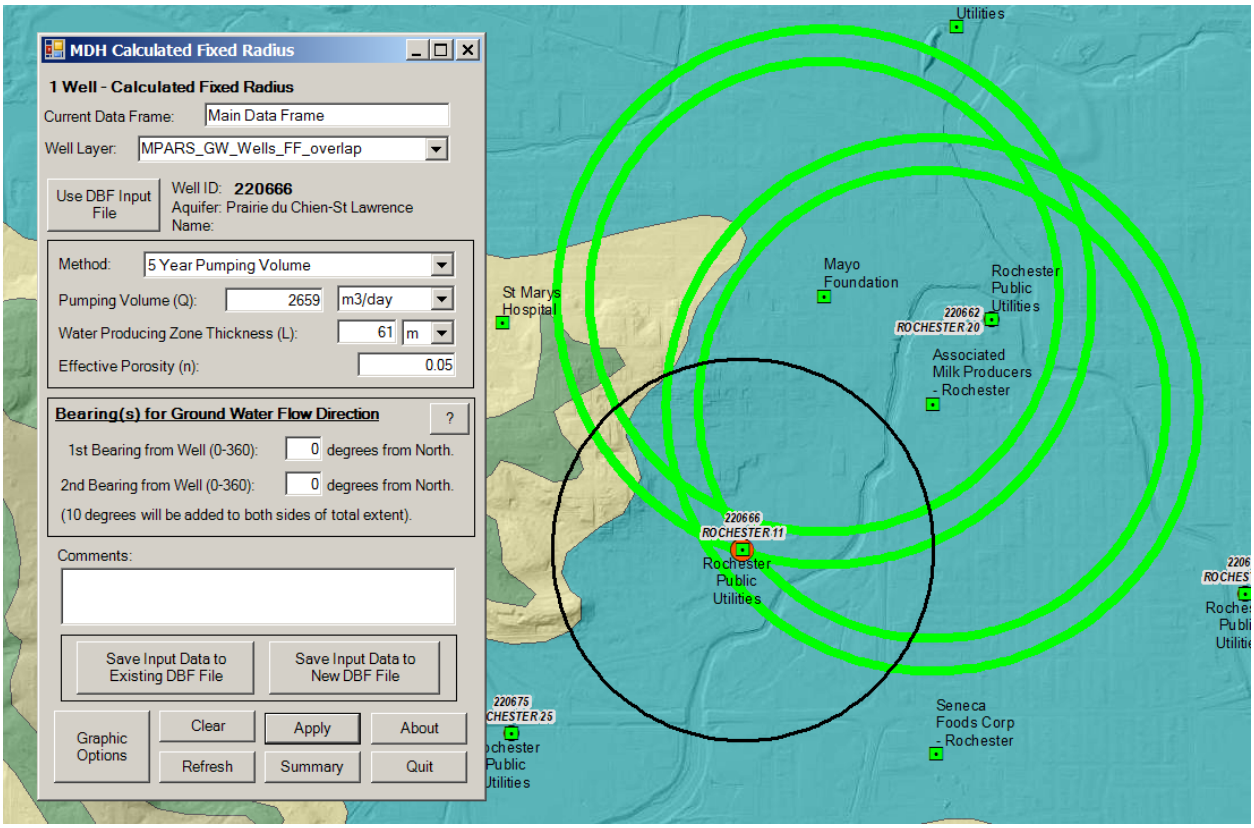
5 Year Pumping Volume (1825 days)

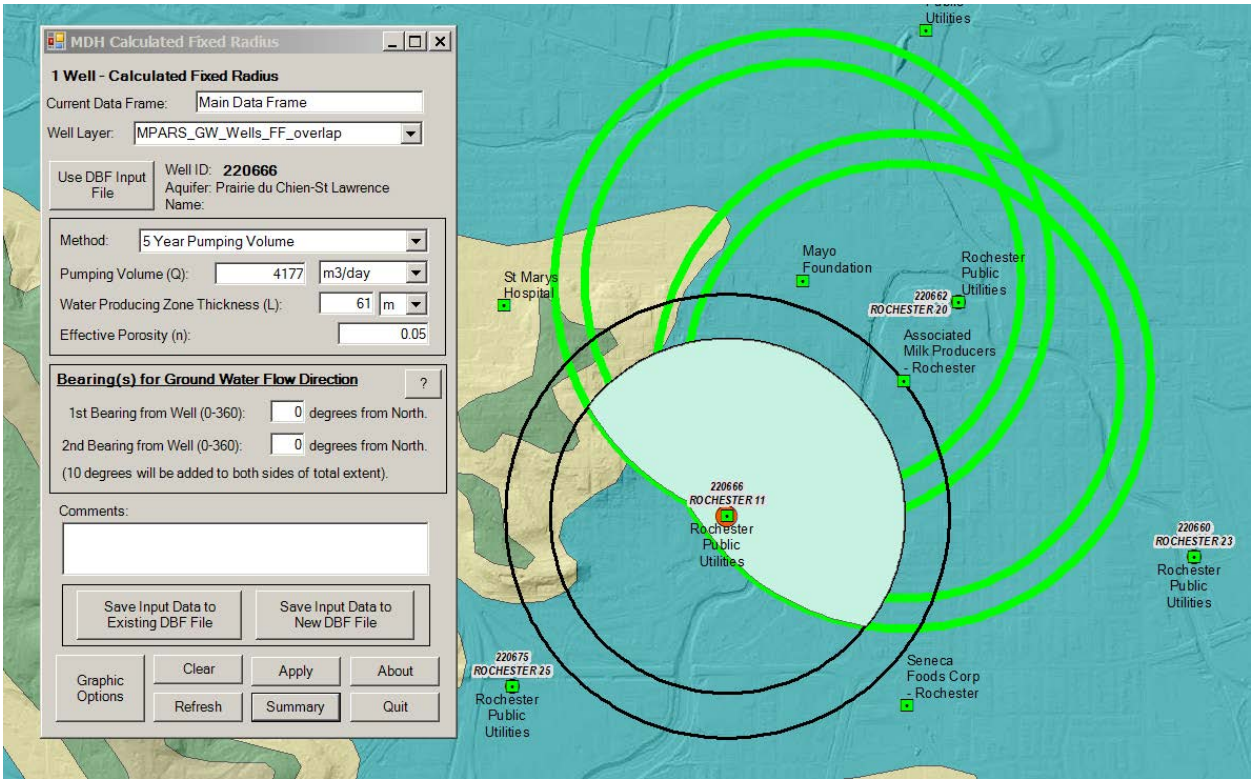
Pumping Volume (Q):	2,659.000	m3/day	93,901.697	cu.ft./day	487.801	gal./min.	702,433.484	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	711.649	m	2,334.806	ft.				

Well# = 220666
X = 542,524.000, Y = 4,873,410.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	4,177.000	m3/day	147,509.361	cu.ft./day	766.282	gal./min.	1,103,446.658	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	891.947	m	2,926.334	ft.				



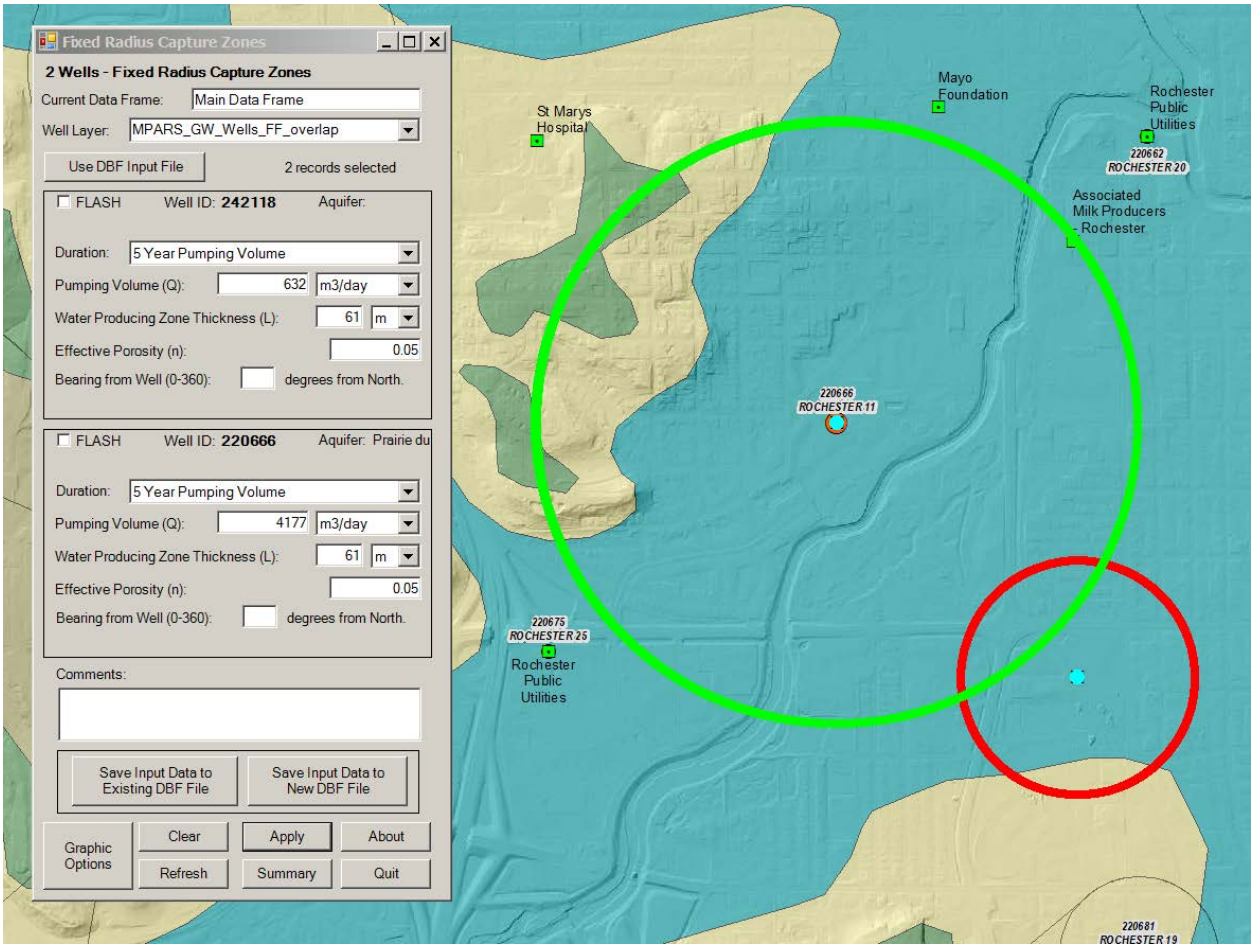

MDH Calculated Fixed Radius
1 Well - Calculated Fixed Radius
Current Data Frame:
Main Data Frame
Well Layer:
MPARS_GW_Wells_FF_overlap
Use DBF Input File
Well ID: 220666
Aquifer: Prairie du Chien-St Lawrence
Name:
Method:
5 Year Pumping Volume
Pumping Volume (Q):
4177
m3/day
Water Producing Zone Thickness (L):
61
m
Effective Porosity (n):
0.05
Bearing(s) for Ground Water Flow Direction
?
1st Bearing from Well (0-360):
0
degrees from North.
2nd Bearing from Well (0-360):
0
degrees from North.
(10 degrees will be added to both sides of total extent).
Comments:
Save Input Data to Existing DBF File
Save Input Data to New DBF File
Graphic Options
Clear
Apply
About
Refresh
Summary
Quit
St Marys Hospital
Mayo Foundation
Rochester Public Utilities
220662
ROCHESTER 20
Associated Milk Producers - Rochester
220666
ROCHESTER 11
Rochester Public Utilities
220660
ROCHESTER 23
Rochester Public Utilities
220675
ROCHESTER 25
Rochester Public Utilities
Seneca Foods Corp - Rochester

Unique Well# = 242118
X = 543,247.000, Y = 4,872,646.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	632.000	m3/day	22,318.869	cu.ft./day	115.942	gal./min.	166,956.736	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	346.949	m	1,138.283	ft.				
New Radius: 351.294	m	1,152.538	ft.					
New Pumping Volume (Q): *	647.929	m3/day	22,881.386	cu.ft./day	118.864	gal./min.	171,164.656	gal./day

Unique Well# = 220666
X = 542,524.000, Y = 4,873,410.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	4,177.000	m3/day	147,509.361	cu.ft./day	766.282	gal./min.	1,103,446.658	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	891.947	m	2,926.334	ft.				
New Radius: 903.117	m	2,962.981	ft.					
New Pumping Volume (Q): *	4,282.276	m3/day	151,227.135	cu.ft./day	785.596	gal./min.	1,131,257.541	gal./day



W36 - Unique Well = 601336
X = 539,345.000, Y = 4,872,825.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	6,219.000	m3/day	219,621.909	cu.ft./day	1,140.893	gal./min.	1,642,885.987	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	1,088.346	m	3,570.688	ft.				
New Radius:	1,093.195	m	3,586.597	ft.				
New Pumping Volume (Q): *	6,274.539	m3/day	221,583.249	cu.ft./day	1,151.082	gal./min.	1,657,557.828	gal./day

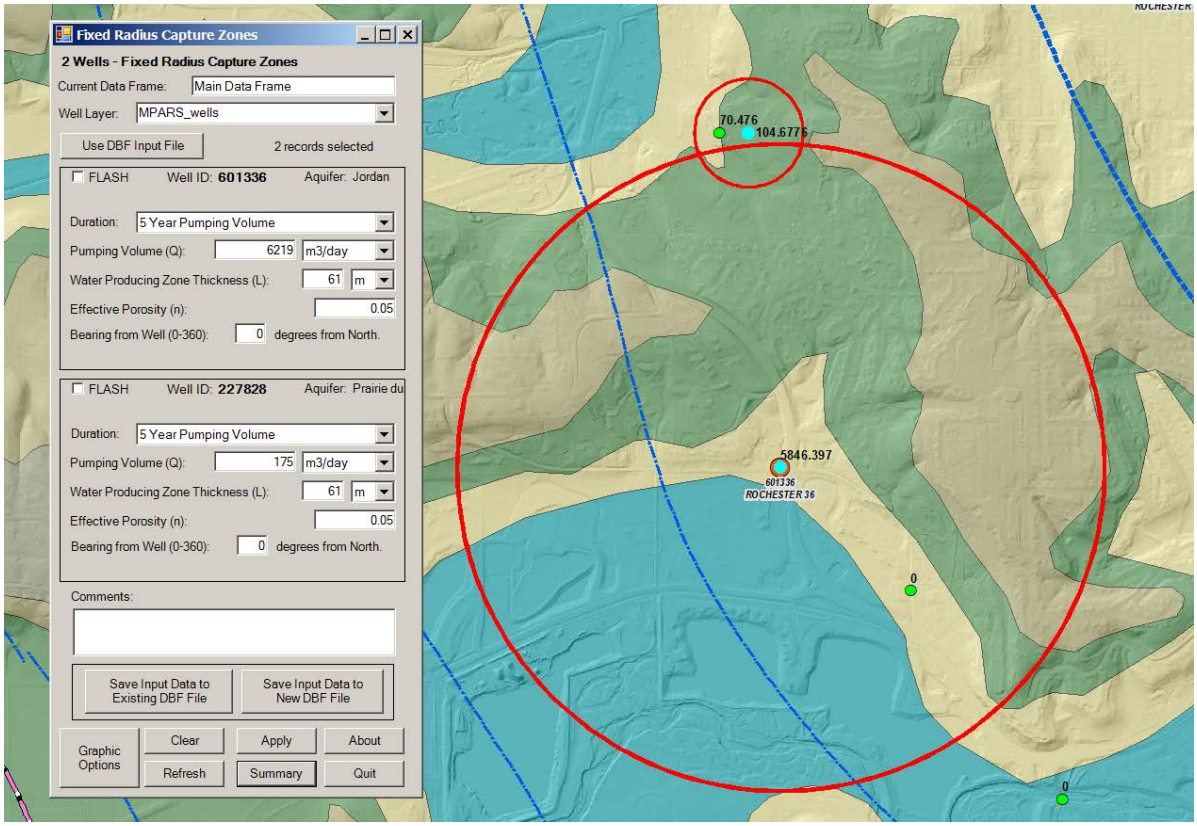
Golf Course - Unique Well = 227828
X = 539,237.000, Y = 4,873,954.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	175.000	m3/day	6,180.067	cu.ft./day	32.104	gal./min.	46,230.109	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	182.568	m	598.978	ft.				
New Radius:	183.382	m	601.646	ft.				
New Pumping Volume (Q): *	176.563	m3/day	6,235.258	cu.ft./day	32.391	gal./min.	46,642.968	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 601336:	3,721,204.918	m2	40,054,677.617	sq.ft.
New (CFR) Area for Well 601336:	3,754,437.248	m2	40,412,387.089	sq.ft.
Original (CFR) Area for Well 227828:	104,713.115	m2	1,127,121.496	sq.ft.
New (CFR) Area for Well 227828:	105,648.258	m2	1,137,187.287	sq.ft.

Overlap Area to Well 601336:	33,232.330	m2	357,709.472	sq.ft.
Overlap Area to Well 227828:	935.144	m2	10,065.792	sq.ft.
Total Overlap Area:	34,167.473	m2	367,775.264	sq.ft.



Eastern Rochester to Galena Plateau Overlap Chain

W13 - Unique Well = 222525
X = 543,326.913, Y = 4,876,592.958

5 Year Pumping Volume (1825 days)									
Pumping Volume (Q):	2,105.000	m3/day	74,337.372		cu.ft./day	386.168	gal./min.	556,082.168	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.					
Effective Porosity (n):	0.05								
Original (CFR) Radius:	633.188	m	2,077.388	ft.					
New Radius:	682.867	m	2,240.378	ft.					
New Pumping Volume (Q): *	2,448.270	m3/day	86,459.830		cu.ft./day	449.142	gal./min.	646,764.448	gal./day

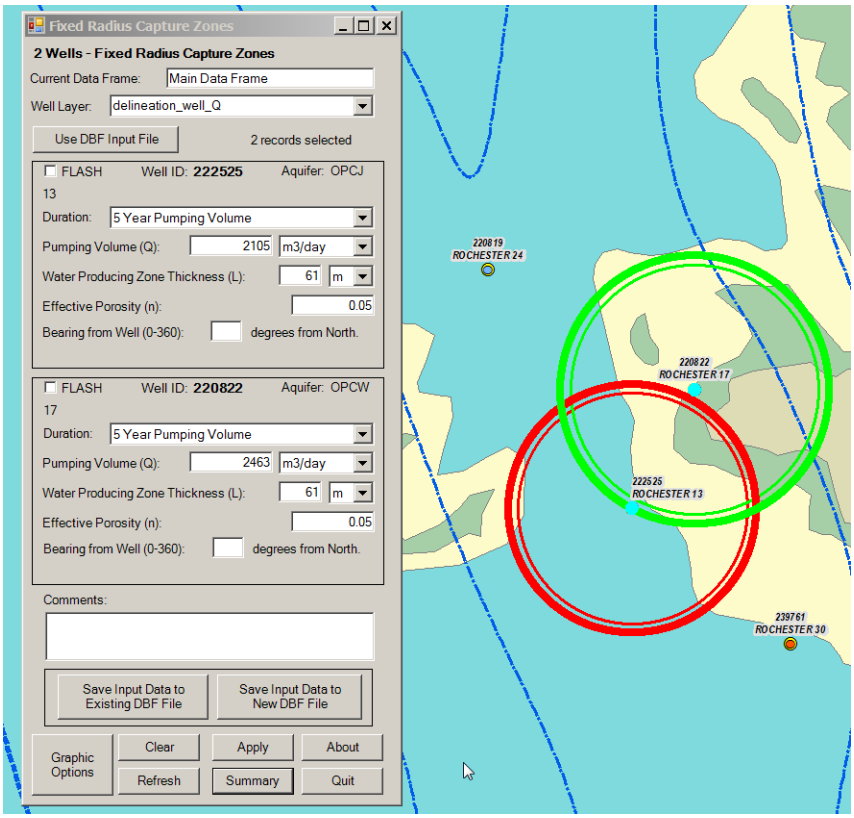
W17 - Unique Well = 220822
X = 543,668.305, Y = 4,877,246.128

5 Year Pumping Volume (1825 days)									
Pumping Volume (Q):	2,463.000	m3/day	86,980.023		cu.ft./day	451.844	gal./min.	650,655.762	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.					
Effective Porosity (n):	0.05								
Original (CFR) Radius:	684.918	m	2,247.107	ft.					
New Radius:	738.656	m	2,423.413	ft.					
New Pumping Volume (Q): *	2,864.650	m3/day	101,164.162		cu.ft./day	525.528	gal./min.	756,760.492	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 222525:	1,259,549.180	m2	13,557,661.422	sq.ft.
New (CFR) Area for Well 222525:	1,464,948.307	m2	15,768,557.082	sq.ft.
Original (CFR) Area for Well 220822:	1,473,762.295	m2	15,863,429.968	sq.ft.
New (CFR) Area for Well 220822:	1,714,093.910	m2	18,450,335.436	sq.ft.

Overlap Area to Well 222525:	205,399.127	m2	2,210,895.660	sq.ft.
Overlap Area to Well 220822:	240,331.615	m2	2,586,905.468	sq.ft.
Total Overlap Area:	445,730.742	m2	4,797,801.129	sq.ft.



W30 - Unique Well = 239761
X = 544,196.781, Y = 4,875,846.240

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	4,634.000	m3/day	163,648.163	cu.ft./day	850.120	gal./min.	1,224,173.285	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	939.474	m	3,082.263	ft.				
New Radius:	979.550	m	3,213.746	ft.				
New Pumping Volume (Q): *	5,037.786	m3/day	177,907.729	cu.ft./day	924.196	gal./min.	1,330,842.244	gal./day

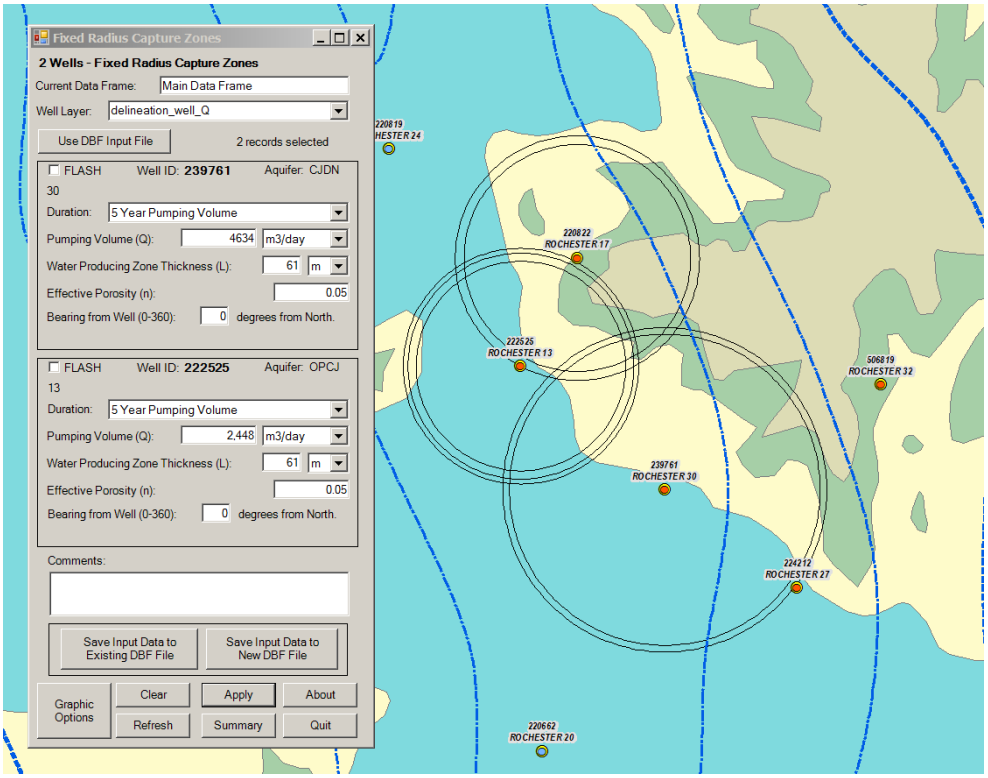
W13 - Unique Well = 222525
X = 543,326.913, Y = 4,876,592.958

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	2,448.000	m3/day	86,450.303	cu.ft./day	449.092	gal./min.	646,693.181	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	682.830	m	2,240.254	ft.				
New Radius:	711.958	m	2,335.819	ft.				
New Pumping Volume (Q): *	2,661.308	m3/day	93,983.194	cu.ft./day	488.224	gal./min.	703,043.119	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 239761:	2,772,803.279	m2	29,846,177.211	sq.ft.
New (CFR) Area for Well 239761:	3,014,412.895	m2	32,446,838.963	sq.ft.
Original (CFR) Area for Well 222525:	1,464,786.885	m2	15,766,819.554	sq.ft.
New (CFR) Area for Well 222525:	1,592,421.832	m2	17,140,669.353	sq.ft.

Overlap Area to Well 239761:	241,609.617	m2	2,600,661.752	sq.ft.
Overlap Area to Well 222525:	127,634.946	m2	1,373,849.799	sq.ft.
Total Overlap Area:	369,244.563	m2	3,974,511.551	sq.ft.



W27 - Unique Well = 224212
X = 544,999.429, Y = 4,875,255.762

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	4,609.000	m3/day	162,765.297	cu.ft./day	845.534	gal./min.	1,217,568.984	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	936.936	m	3,073.937	ft.				
New Radius:	1,019.663	m	3,345.350	ft.				
New Pumping Volume (Q): *	5,458.833	m3/day	192,776.870	cu.ft./day	1,001.438	gal./min.	1,442,071.148	gal./day

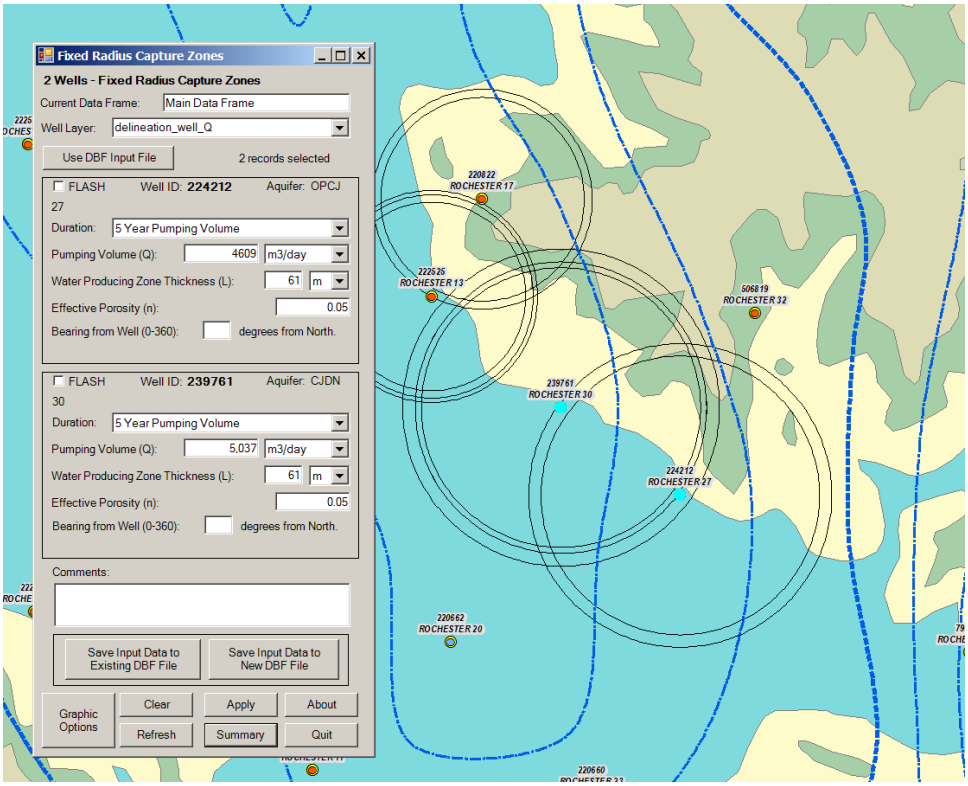
W30 - Unique Well = 239761
X = 544,196.781, Y = 4,875,846.240

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	5,037.000	m3/day	177,879.974	cu.ft./day	924.052	gal./min.	1,330,634.622	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	979.473	m	3,213.495	ft.				
New Radius:	1,065.956	m	3,497.230	ft.				
New Pumping Volume (Q): *	5,965.750	m3/day	210,678.476	cu.ft./day	1,094.434	gal./min.	1,575,984.459	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 224212:	2,757,844.262	m2	29,685,159.855	sq.ft.
New (CFR) Area for Well 224212:	3,266,350.977	m2	35,158,675.278	sq.ft.
Original (CFR) Area for Well 239761:	3,013,942.623	m2	32,441,776.999	sq.ft.
New (CFR) Area for Well 239761:	3,569,670.182	m2	38,423,572.874	sq.ft.

Overlap Area to Well 224212:	508,506.714	m2	5,473,515.423	sq.ft.
Overlap Area to Well 239761:	555,727.559	m2	5,981,795.874	sq.ft.
Total Overlap Area:	1,064,234.274	m2	11,455,311.297	sq.ft.



W27 - Unique Well = 224212
X = 544,999.429, Y = 4,875,255.762

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	5,458.000	m3/day	192,747.448	cu.ft./day	1,001.285	gal./min.	1,441,851.056	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	1,019.585	m	3,345.095	ft.				
New Radius:	1,033.517	m	3,390.803	ft.				
New Pumping Volume (Q): *	5,608.179	m3/day	198,050.977	cu.ft./day	1,028.836	gal./min.	1,481,524.207	gal./day

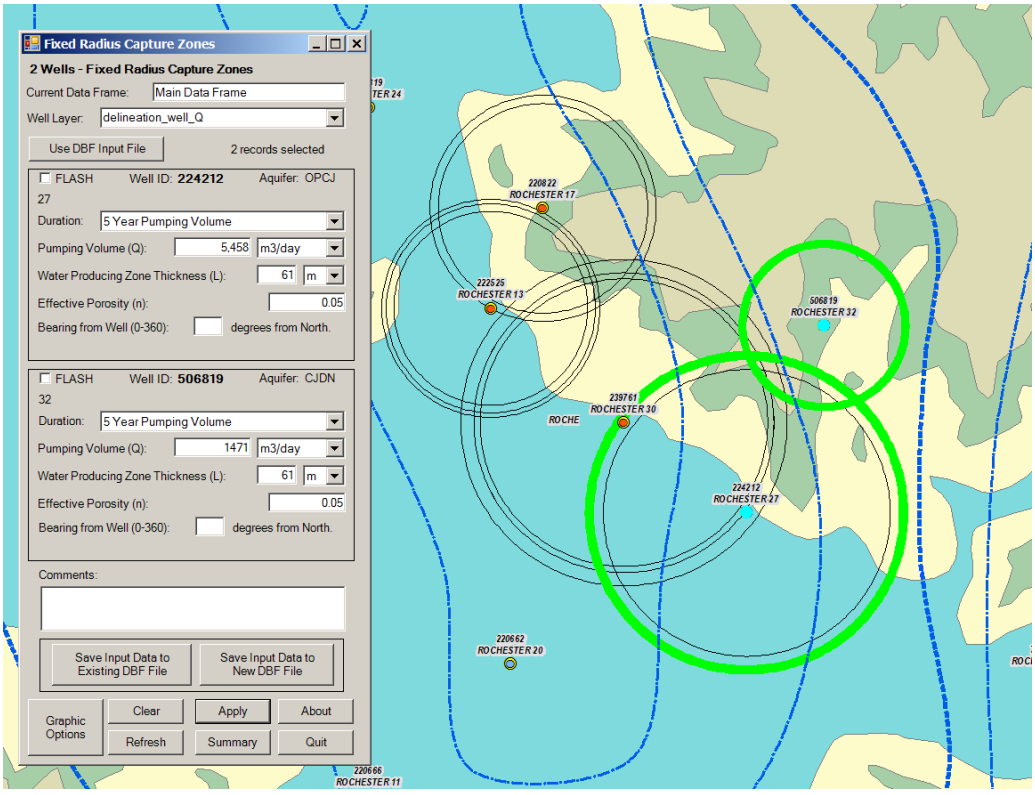
W32 - Unique Well = 506819
X = 545,506.000, Y = 4,876,480.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	1,471.000	m3/day	51,947.874	cu.ft./day	269.859	gal./min.	388,597.087	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	529.313	m	1,736.593	ft.				
New Radius:	536.546	m	1,760.322	ft.				
New Pumping Volume (Q): *	1,511.475	m3/day	53,377.242	cu.ft./day	277.284	gal./min.	399,289.503	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 224212:	3,265,852.459	m2	35,153,309.284	sq.ft.
New (CFR) Area for Well 224212:	3,355,713.793	m2	36,120,567.692	sq.ft.
Original (CFR) Area for Well 506819:	880,188.525	m2	9,474,261.260	sq.ft.
New (CFR) Area for Well 506819:	904,407.290	m2	9,734,949.629	sq.ft.

Overlap Area to Well 224212:	89,861.334	m2	967,258.408	sq.ft.
Overlap Area to Well 506819:	24,218.765	m2	260,688.369	sq.ft.
Total Overlap Area:	114,080.099	m2	1,227,946.777	sq.ft.



W32 - Unique Well = 506819
X = 545,506.000, Y = 4,876,480.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	1,511.000	m3/day	53,360.461	cu.ft./day	277.197	gal./min.	399,163.969	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	536.462	m	1,760.045	ft.				
New Radius:	540.205	m	1,772.325	ft.				
New Pumping Volume (Q): *	1,532.158	m3/day	54,107.645	cu.ft./day	281.079	gal./min.	404,753.298	gal./day

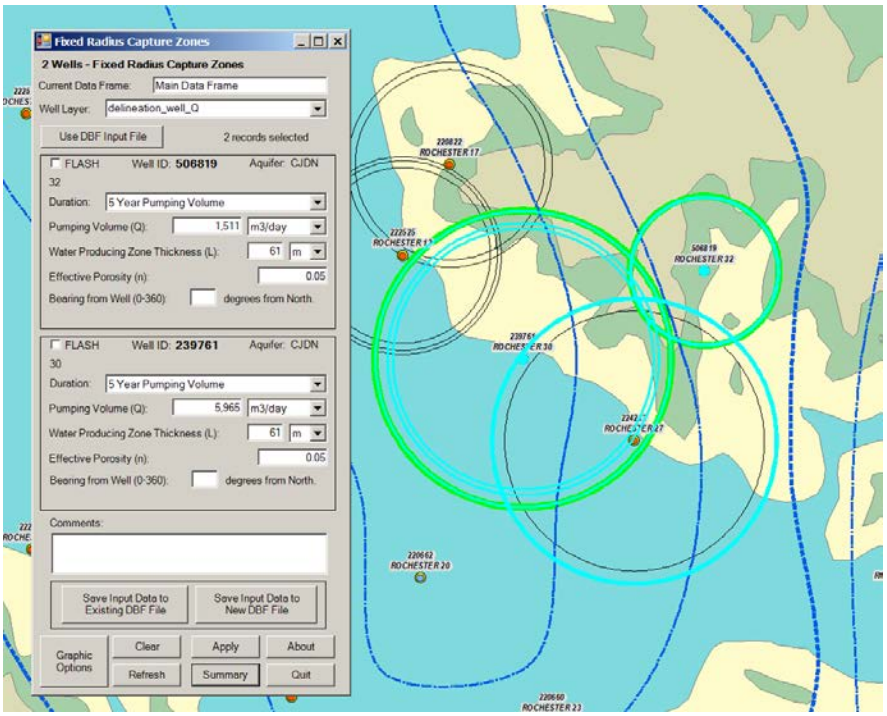
W30 - Unique Well = 239761
X = 544,196.781, Y = 4,875,846.240

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	5,965.000	m3/day	210,651.984	cu.ft./day	1,094.296	gal./min.	1,575,786.286	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	1,065.889	m	3,497.010	ft.				
New Radius:	1,073.325	m	3,521.408	ft.				
New Pumping Volume (Q): *	6,048.525	m3/day	213,601.657	cu.ft./day	1,109.619	gal./min.	1,597,851.370	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 506819:	904,122.951	m2	9,731,889.030	sq.ft.
New (CFR) Area for Well 506819:	916,783.011	m2	9,868,160.651	sq.ft.
Original (CFR) Area for Well 239761:	3,569,221.311	m2	38,418,741.275	sq.ft.
New (CFR) Area for Well 239761:	3,619,199.642	m2	38,956,703.032	sq.ft.

Overlap Area to Well 506819:	12,660.060	m2	136,271.620	sq.ft.
Overlap Area to Well 239761:	49,978.331	m2	537,961.757	sq.ft.
Total Overlap Area:	62,638.391	m2	674,233.377	sq.ft.



W30 - Unique Well = 239761
X = 544,196.781, Y = 4,875,846.240

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	6,048.000	m3/day	213,583.101	cu.ft./day	1,109.523	gal./min.	1,597,712.566	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	1,073.279	m	3,521.255	ft.				
New Radius:	1,094.624	m	3,591.286	ft.				
New Pumping Volume (Q): *	6,290.959	m3/day	222,163.104	cu.ft./day	1,154.094	gal./min.	1,661,895.445	gal./day

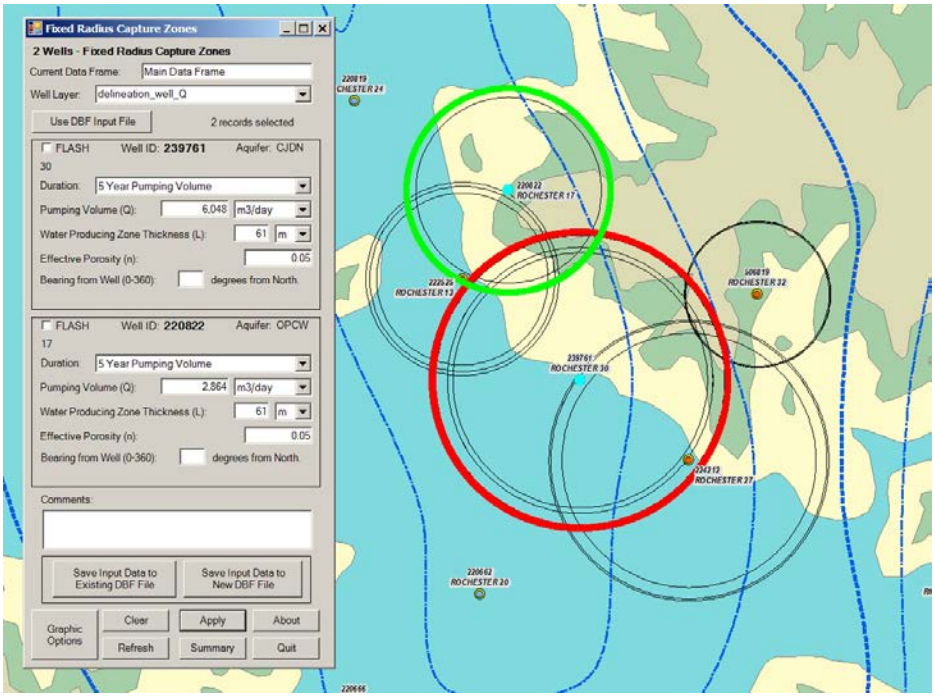
W17 - Unique Well = 220822
X = 543,668.305, Y = 4,877,246.128

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	2,864.000	m3/day	101,141.204	cu.ft./day	525.409	gal./min.	756,588.755	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	738.572	m	2,423.138	ft.				
New Radius:	753.261	m	2,471.330	ft.				
New Pumping Volume (Q): *	2,979.052	m3/day	105,204.221	cu.ft./day	546.515	gal./min.	786,982.235	gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 239761:	3,618,885.246	m2	38,953,318.898	sq.ft.
New (CFR) Area for Well 239761:	3,764,262.130	m2	40,518,141.140	sq.ft.
Original (CFR) Area for Well 220822:	1,713,704.918	m2	18,446,148.367	sq.ft.
New (CFR) Area for Well 220822:	1,782,547.411	m2	19,187,162.074	sq.ft.

Overlap Area to Well 239761:	145,376.884	m2	1,564,822.241	sq.ft.
Overlap Area to Well 220822:	68,842.493	m2	741,013.707	sq.ft.
Total Overlap Area:	214,219.377	m2	2,305,835.948	sq.ft.



Northwest Overlap Chain

W34 - Unique Well = 463536
X = 538,107.303, Y = 4,880,106.038

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	2,086.000	m3/day	73,666.394		cu.ft./day	382.683	gal./min.	551,062.899 gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	630.324	m	2,067.992	ft.				
New Radius:	648.064	m	2,126.195	ft.				
New Pumping Volume (Q): *	2,205.072	m3/day	77,871.398		cu.ft./day	404.527	gal./min.	582,518.512 gal./day

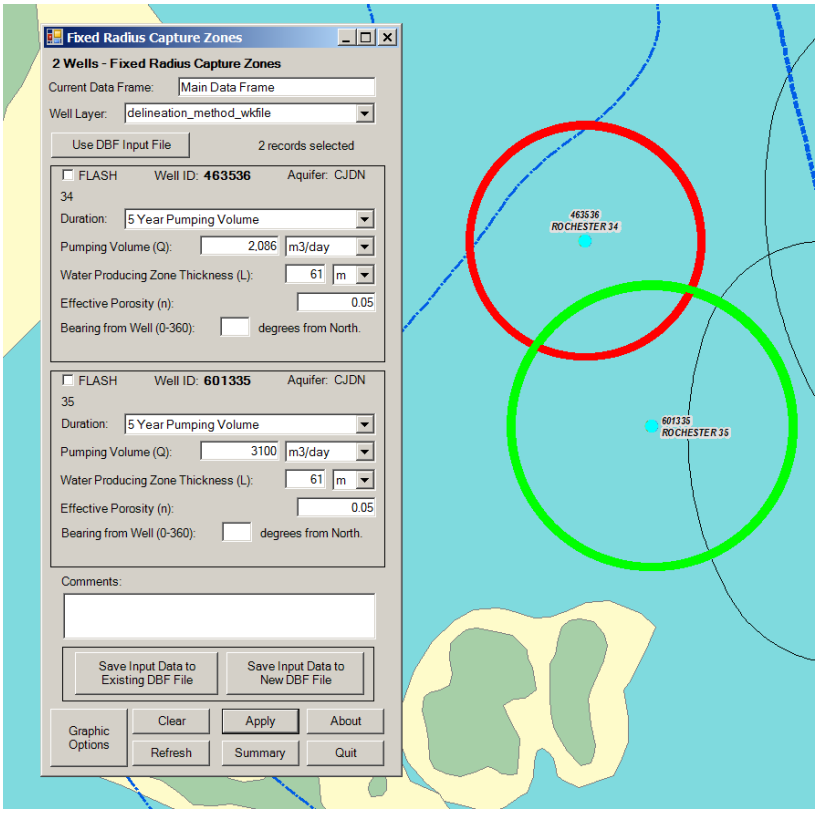
W35 - Unique Well = 601335
X = 538,478.488, Y = 4,879,073.242

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	3,100.000	m3/day	109,475.465		cu.ft./day	568.704	gal./min.	818,933.359 gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	768.400	m	2,520.998	ft.				
New Radius:	790.027	m	2,591.951	ft.				
New Pumping Volume (Q): *	3,276.953	m3/day	115,724.512		cu.ft./day	601.166	gal./min.	865,679.477 gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 463536:	1,248,180.328	m2	13,435,288.231	sq.ft.
New (CFR) Area for Well 463536:	1,319,428.597	m2	14,202,197.480	sq.ft.
Original (CFR) Area for Well 601335:	1,854,918.033	m2	19,966,152.213	sq.ft.
New (CFR) Area for Well 601335:	1,960,799.929	m2	21,105,854.357	sq.ft.

Overlap Area to Well 463536:	71,248.270	m2	766,909.249	sq.ft.
Overlap Area to Well 601335:	105,881.896	m2	1,139,702.144	sq.ft.
Total Overlap Area:	177,130.166	m2	1,906,611.393	sq.ft.



IBM - Unique Well = 220817
X = 539,043.000, Y = 4,878,530.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	352.000	m3/day	12,430.763		cu.ft./day	64.575	gal./min.	92,988.562 gal./day
Water Producing Zone Thickness (L):		61.000	m	200.131	ft.			
Effective Porosity (n):		0.05						
Original (CFR) Radius:		258.927	m	849.499	ft.			
New Radius:	264.895	m	869.078	ft.				
New Pumping Volume (Q): *	368.412	m3/day	13,010.351		cu.ft./day	67.586	gal./min.	97,324.188 gal./day

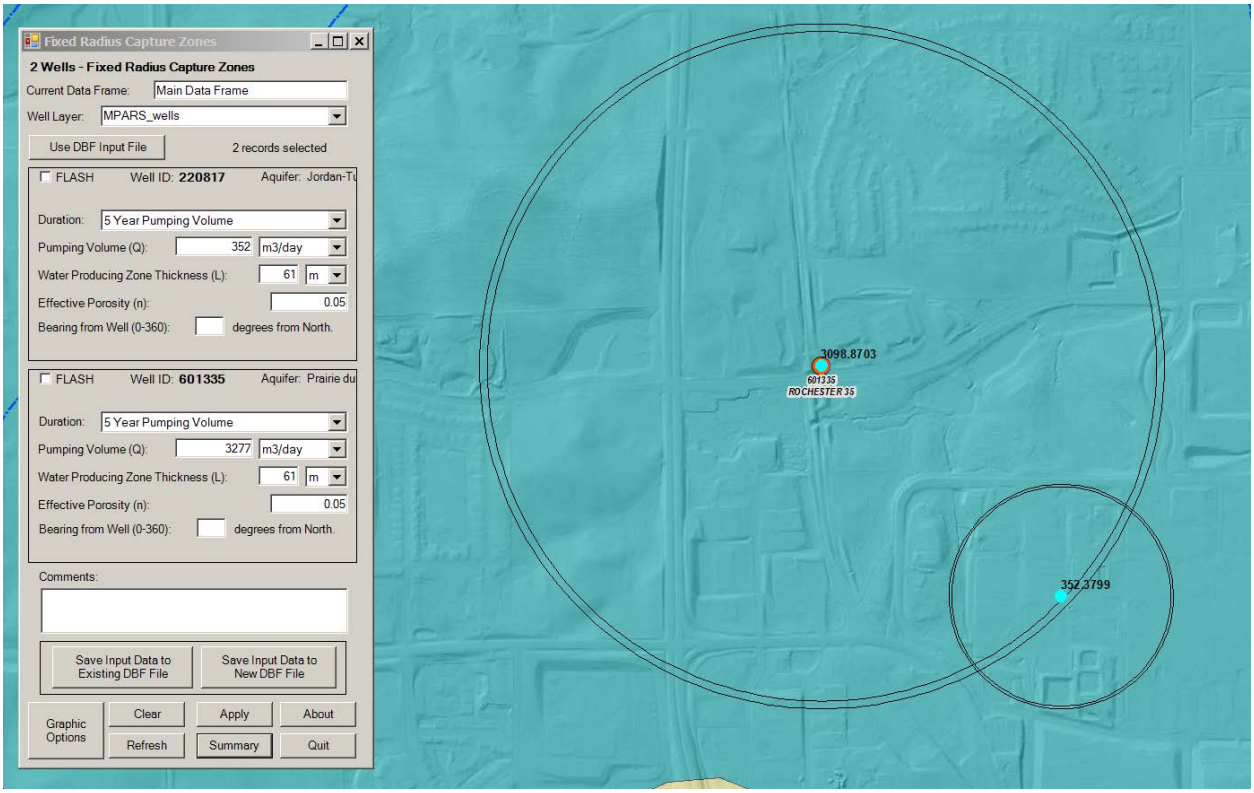
RPU 35 - Unique Well = 601335
X = 538,478.000, Y = 4,879,073.000

5 Year Pumping Volume (1825 days)								
Pumping Volume (Q):	3,277.000	m3/day	115,726.161		cu.ft./day	601.175	gal./min.	865,691.812 gal./day
Water Producing Zone Thickness (L):		61.000	m	200.131	ft.			
Effective Porosity (n):		0.05						
Original (CFR) Radius:		790.032	m	2,591.969	ft.			
New Radius:	808.240	m	2,651.707	ft.				
New Pumping Volume (Q): *	3,429.791	m3/day	121,121.936		cu.ft./day	629.205	gal./min.	906,055.012 gal./day

OVERLAP SUMMARY INFORMATION

Original (CFR) Area for Well 220817:	210,622.951	m2	2,267,124.380	sq.ft.
New (CFR) Area for Well 220817:	220,443.324	m2	2,372,829.891	sq.ft.
Original (CFR) Area for Well 601335:	1,960,827.869	m2	21,106,155.098	sq.ft.
New (CFR) Area for Well 601335:	2,052,252.192	m2	22,090,237.367	sq.ft.

Overlap Area to Well 220817:	9,820.373	m2	105,705.511	sq.ft.
Overlap Area to Well 601335:	91,424.323	m2	984,082.269	sq.ft.
Total Overlap Area:	101,244.696	m2	1,089,787.780	sq.ft.

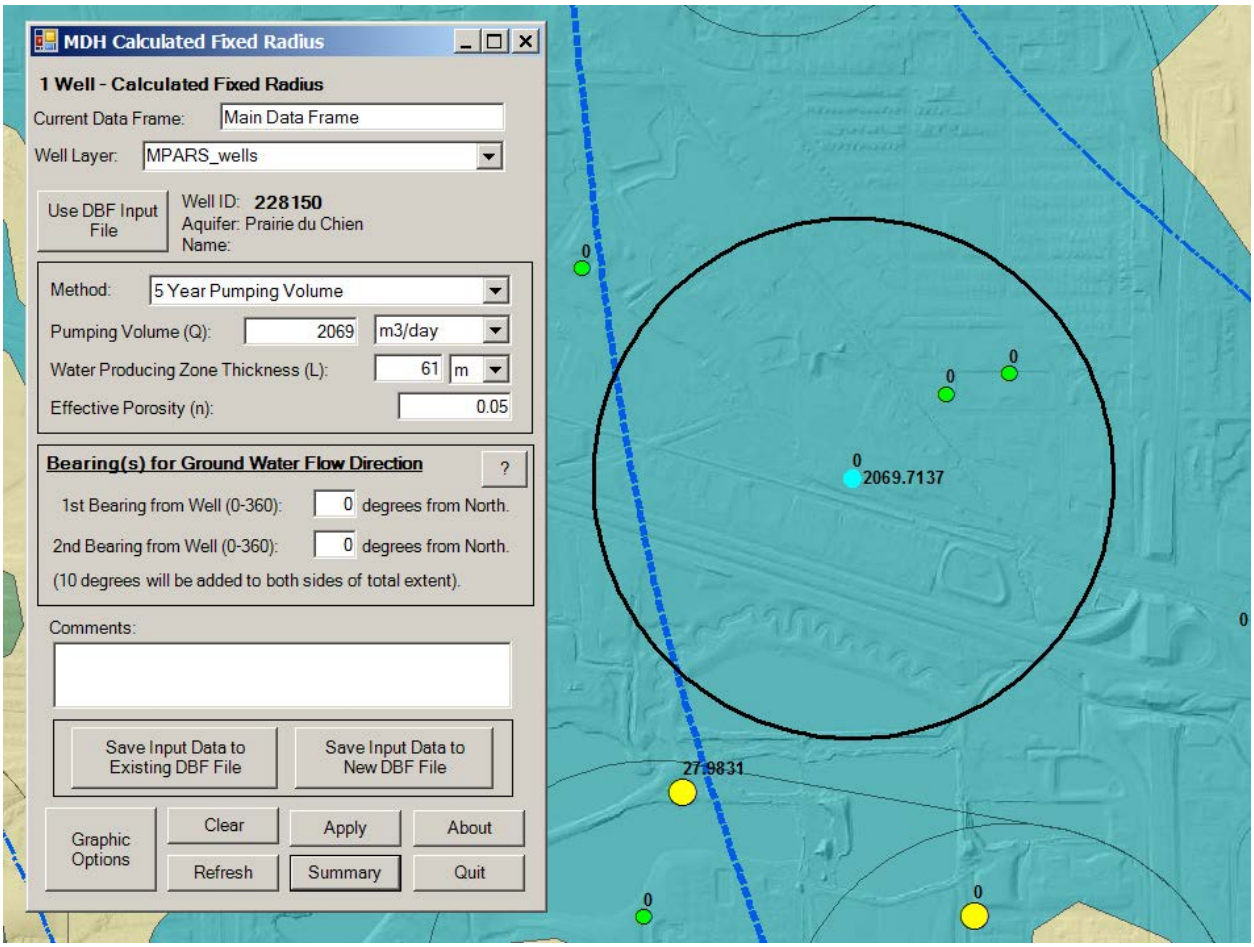


Overlap Test for other high capacity wells

Well = 228150
Stauffer Chemical
X = 540,273.000, Y = 4,875,863.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,069.000	m3/day	73,066.044	cu.ft./day	379.564	gal./min.	546,571.974	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	627.750	m	2,059.548	ft.				



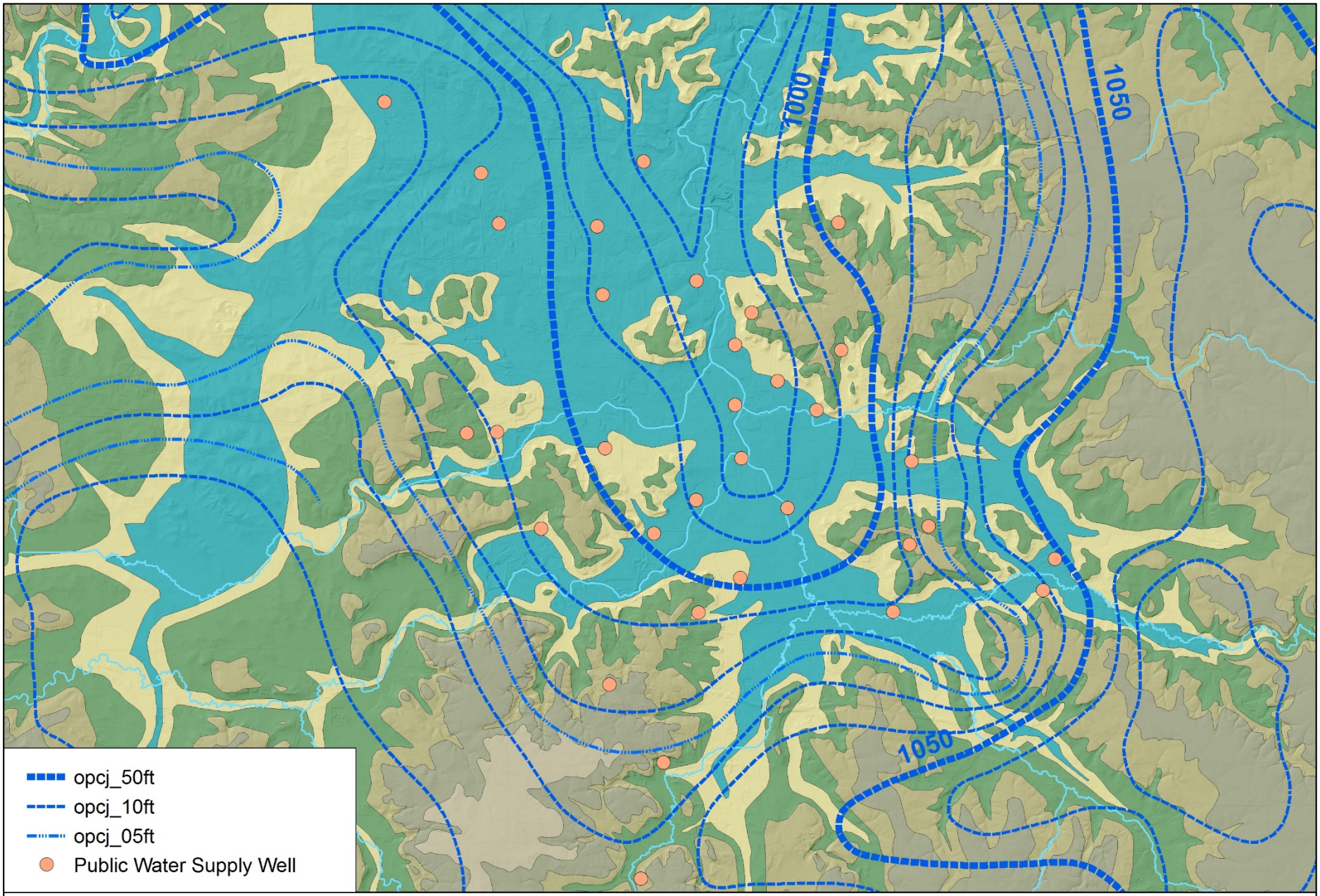
No overlap found.

2. Revised Discharge Values Used for Fractured Rock Delineation

Name	Unique	Q [m^3/day]	Revised Q for Fractured Rock Delineation	Remarks
11	220666	2379	4,282	
13	222525	2105	2,661	
15	222528	771	--	
17	220822	2463	2979	
18	222527	1630	--	
19	220681	300	--	
20	220662	927	621	Apportioned to OPCJ
22	220818	2637	--	
26	147451	1654	--	
27	224212	4609	5,608	
28	180567	4376	--	
29	161461	2181	--	
30	239761	4634	6290	
31	434041	3209	--	
32	506819	1471	1,532	
34	463536	2086	2,205	
35	601335	3100	3,429	
36	601336	6219	6275	
37	676687	2329	--	
38	698933	2412	--	
39	733087	3058	--	
40	773386	1710	--	

3. Assess gradient and direction of flow

An upgradient extension oriented along directions of groundwater flow is required if the ratio of the specific discharge to the well discharge is less than 3000. In the case of wells within the Rochester Basin, the gradient is sufficiently large that nearly all wells are required to include this type of extension. Well 40 is located close to the groundwater divide (an area of low gradient) and has sufficient protective geologic cover that a circular extension is appropriate, The following figure shows the groundwater elevation contours in the fractured rock aquifer system based on water levels reported on driller's records, MDNR observation wells and information in RPU's files.



MDH Minnesota Department *of* Health

O:\DwpSwp\Project\SE_District\55_olms\10010_RPU\14Part1A\GIS\wells_flowdirection.mxd (27 May 2016)

0 5,000 10,000 20,000 Feet

N

Groundwater Elevaton - PdC-Jordan Aquifer System
Wellhead Protection Plan Amendment
Rochester Public Utilities

4. Calculate CFR and Upgradient Extension (UGE)

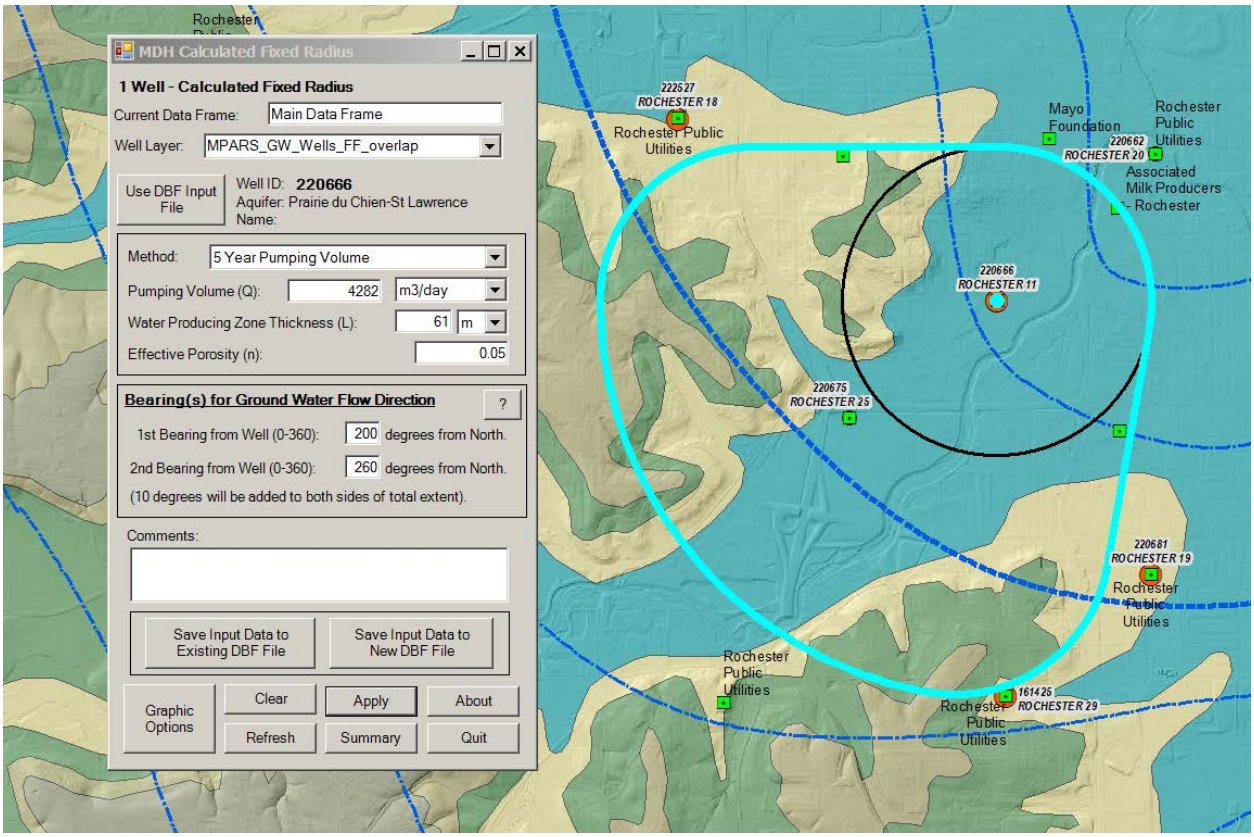
Well = 220666
11
X = 542,524.000, Y = 4,873,410.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	4,282.000	m3/day	151,217.401	cu.ft./day	785.545	gal./min.	1,131,184.723	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	903.088	m	2,962.886	ft.				

1st Bearing from Well = 200° from North.

2nd Bearing from Well = 260° from North.



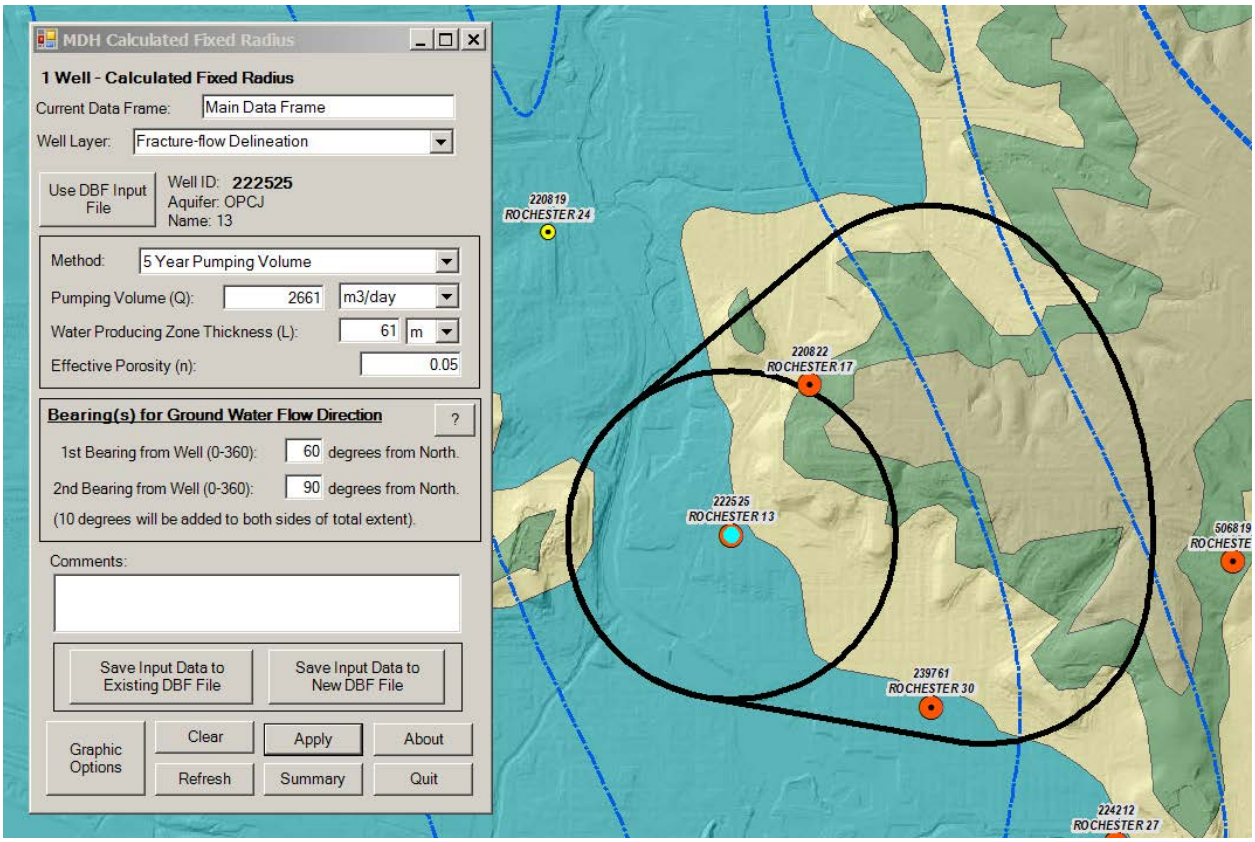
Well# = 222525
13
X = 543,326.913, Y = 4,876,592.958

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,661.000	m3/day	93,972.327	cu.ft./day	488.168	gal./min.	702,961.828	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	711.916	m	2,335.684	ft.				

1st Bearing from Well = 60° from North.

2nd Bearing from Well = 90° from North.



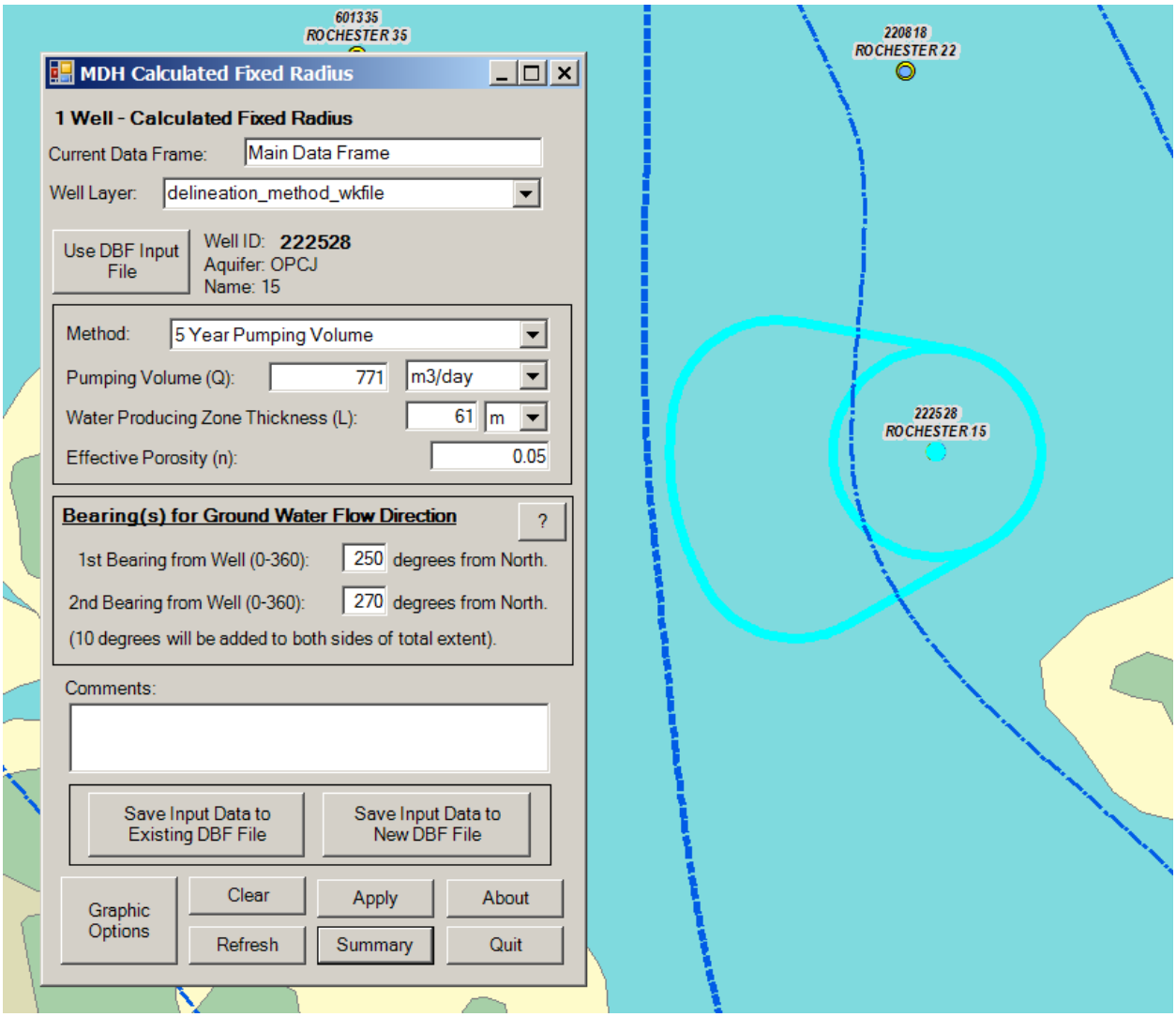
Well = 222528
15
X = 540,612.304, Y = 4,877,613.953

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	771.000	m3/day	27,227.608	cu.ft./day	141.442	gal./min.	203,676.652	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	383.207	m	1,257.242	ft.				

1st Bearing from Well = 250° from North.

2nd Bearing from Well = 270° from North.



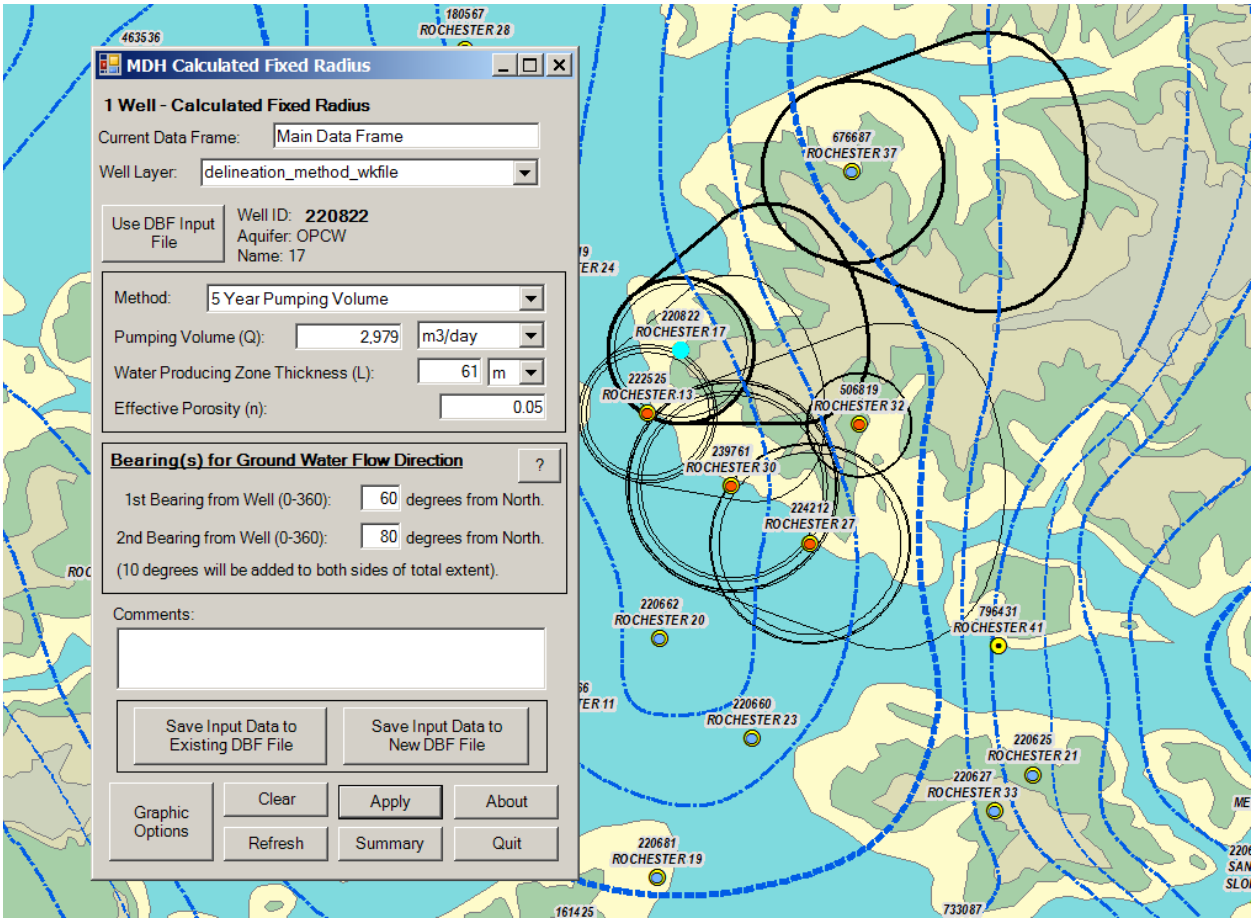
Well = 220822
17
X = 543,668.305, Y = 4,877,246.128

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,979.000	m3/day	105,202.391	cu.ft./day	546.506	gal./min.	786,968.541	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	753.255	m	2,471.308	ft.				

1st Bearing from Well = 60° from North.

2nd Bearing from Well = 80° from North.



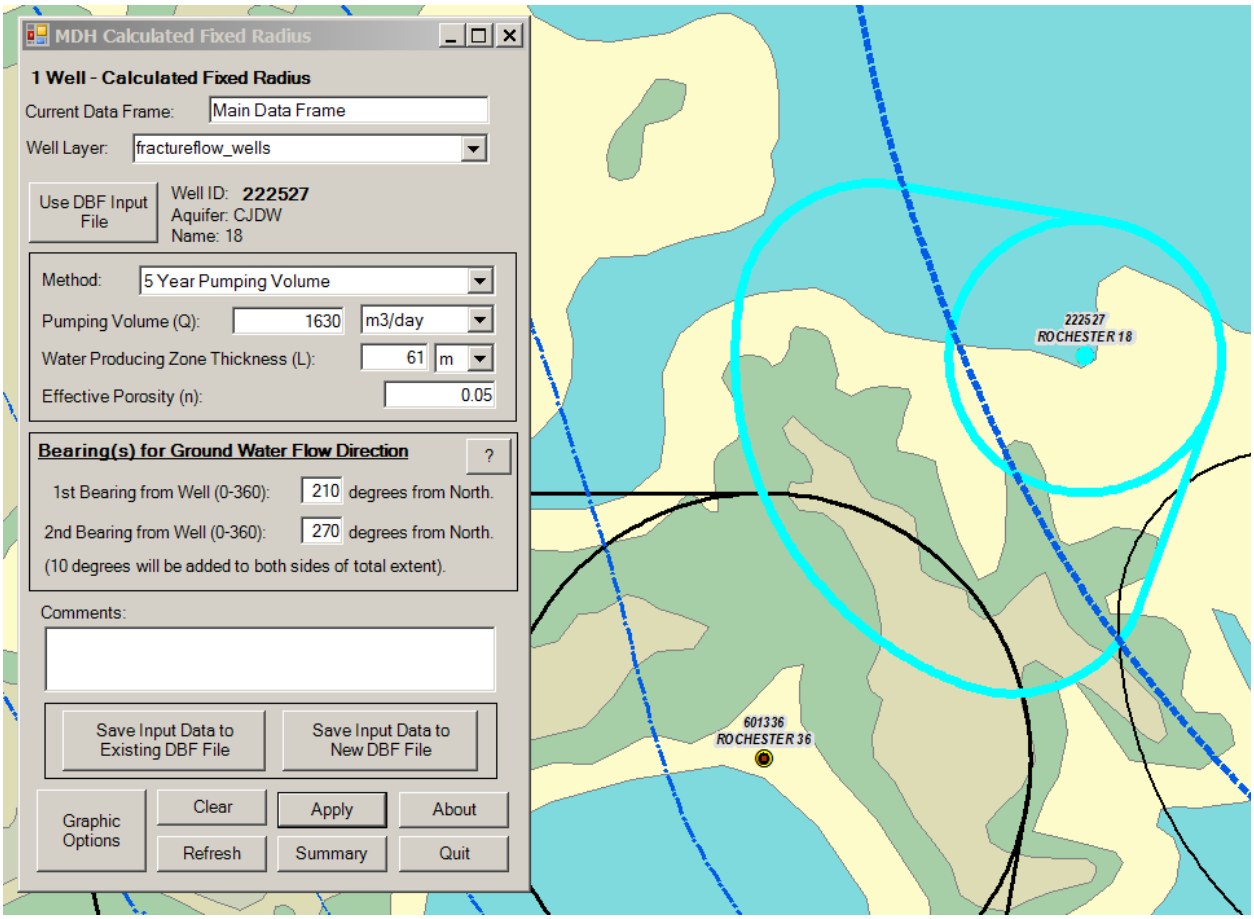
Well = 222527
18
X = 540,656.524, Y = 4,874,472.806

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	1,630.000	m3/day	57,562.906	cu.ft./day	299.028	gal./min.	430,600.444	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	557.186	m	1,828.039	ft.				

1st Bearing from Well = 210° from North.

2nd Bearing from Well = 270° from North



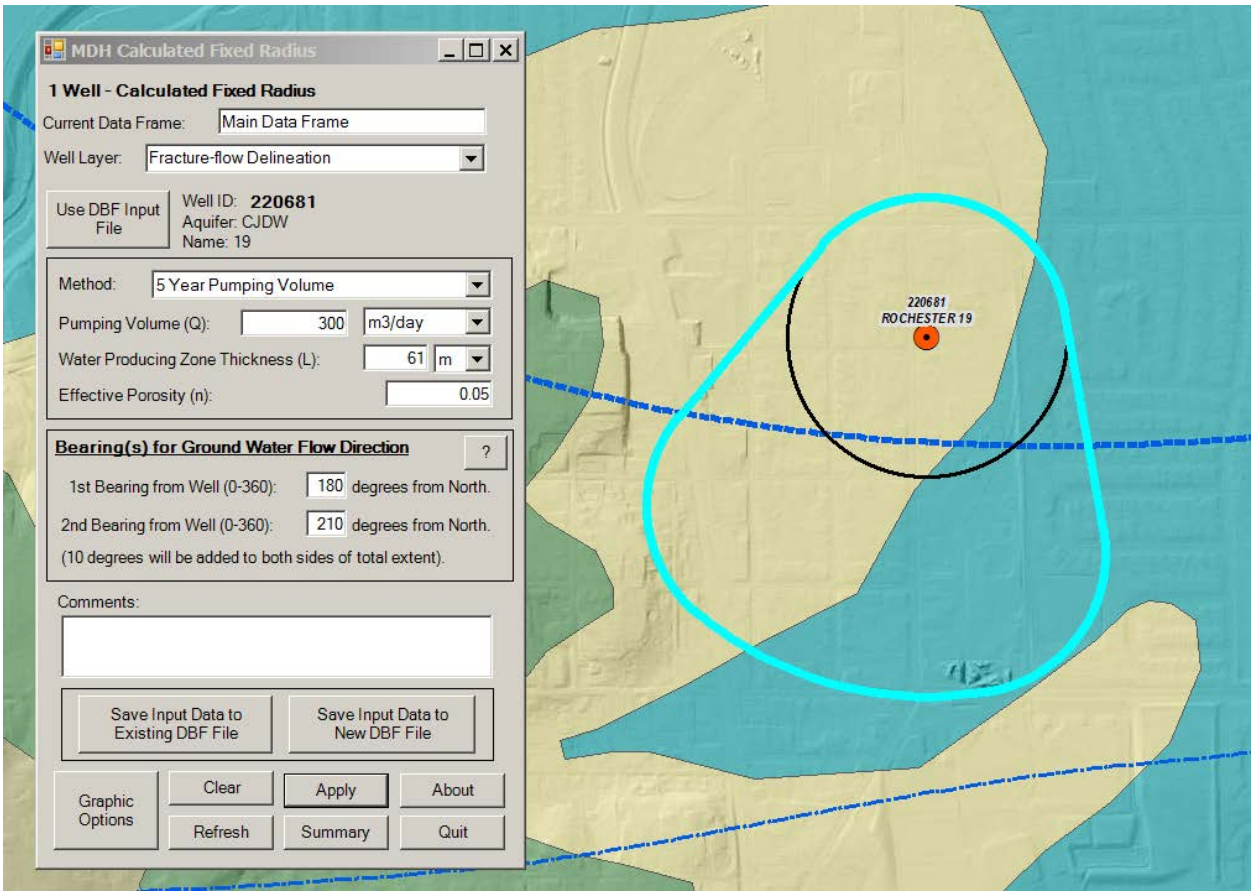
Well# = 220681
19
X = 543,429.830, Y = 4,871,810.793

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	300.000	m3/day	10,594.400	cu.ft./day	55.036	gal./min.	79,251.615	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	239.038	m	784.246	ft.				

1st Bearing from Well = 180° from North.

2nd Bearing from Well = 210° from North.



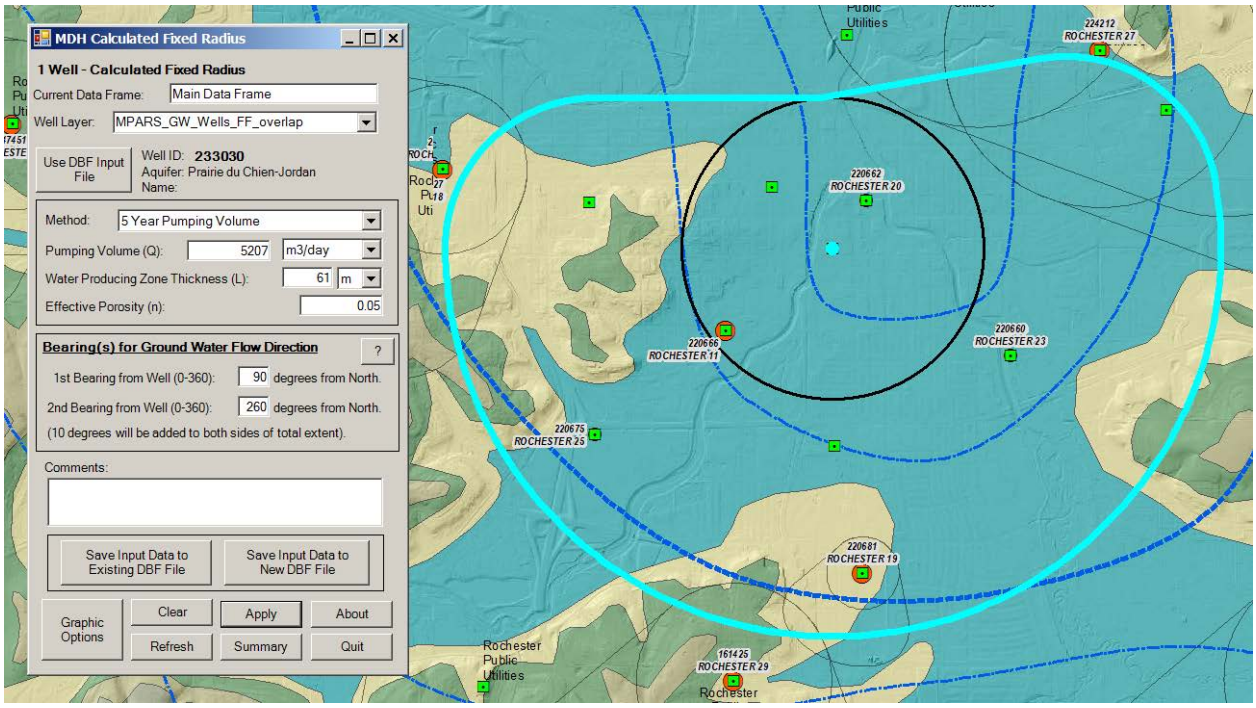
Well = 233030
AMPI & W20
X = 543,233.000, Y = 4,873,952.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	5,207.000	m3/day	183,883.467	cu.ft./day	955.239	gal./min.	1,375,543.871	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	995.865	m	3,267.273	ft.				

1st Bearing from Well = 90° from North.

2nd Bearing from Well = 260° from North.



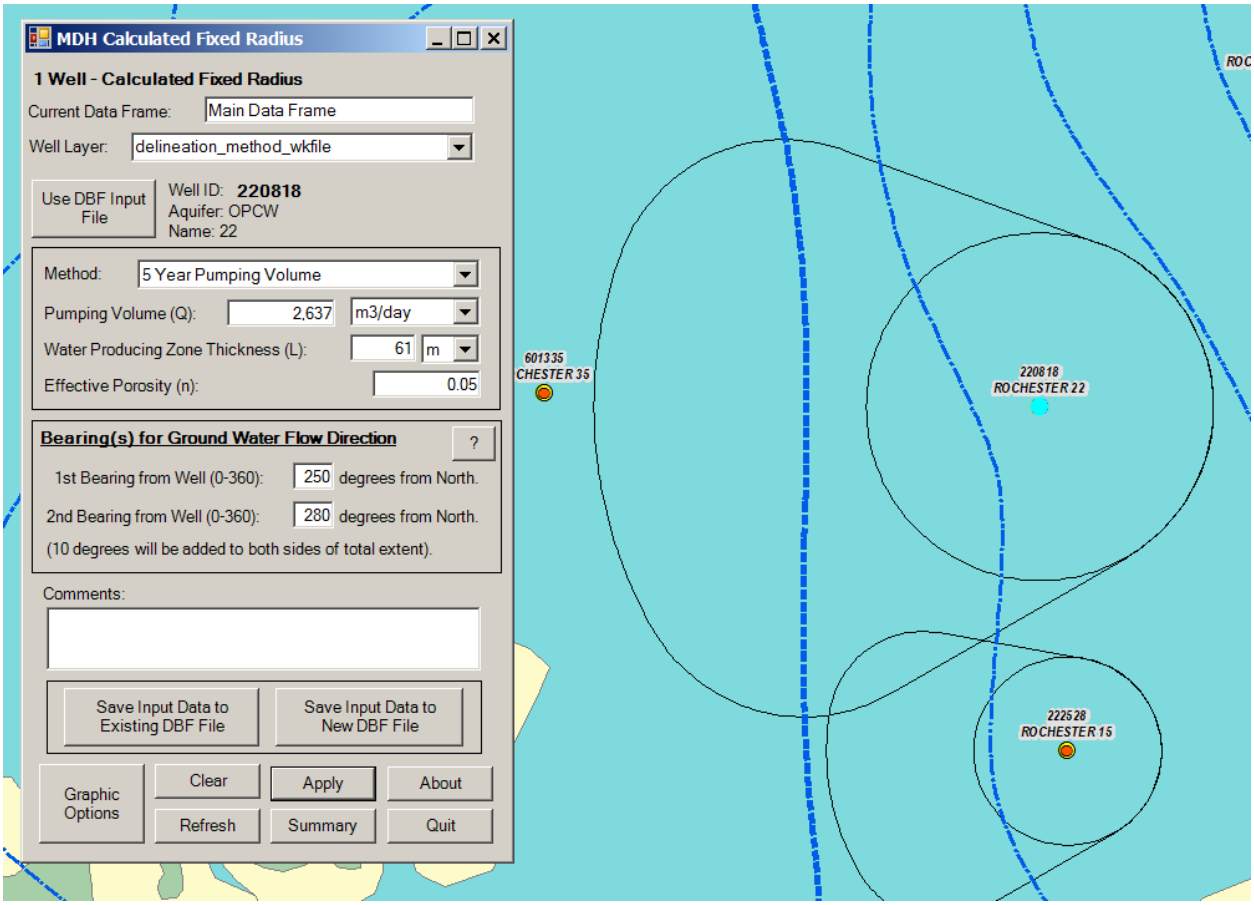
Well = 220818
22
X = 540,498.879, Y = 4,879,018.207

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,637.000	m3/day	93,124.775	cu.ft./day	483.765	gal./min.	696,621.699	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	708.699	m	2,325.127	ft.				

1st Bearing from Well = 250° from North.

2nd Bearing from Well = 280° from North



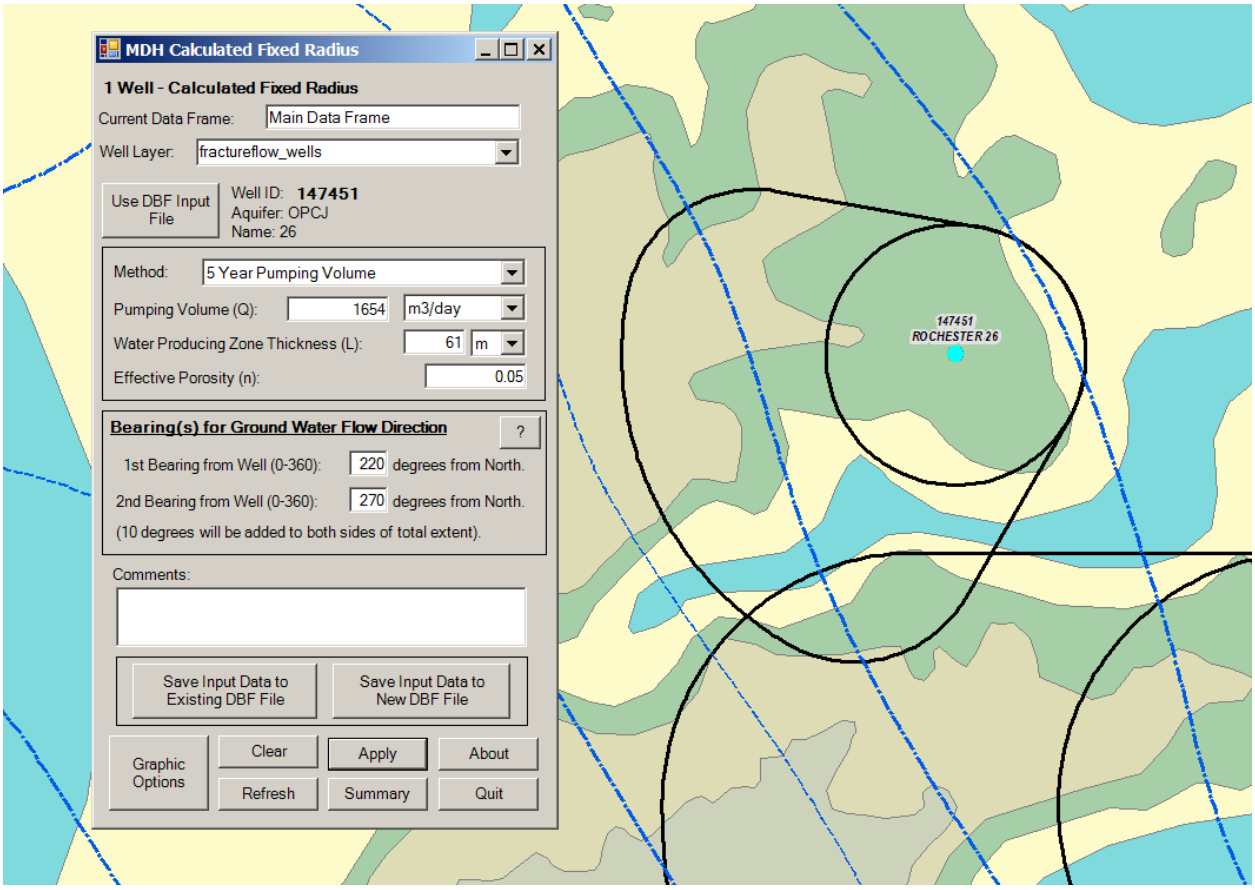
Well = 147451
26
X = 537,815.665, Y = 4,874,767.328

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	1,654.000	m3/day	58,410.458	cu.ft./day	303.431	gal./min.	436,940.573	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	561.273	m	1,841.448	ft.				

1st Bearing from Well = 220° from North.

2nd Bearing from Well = 270° from North.



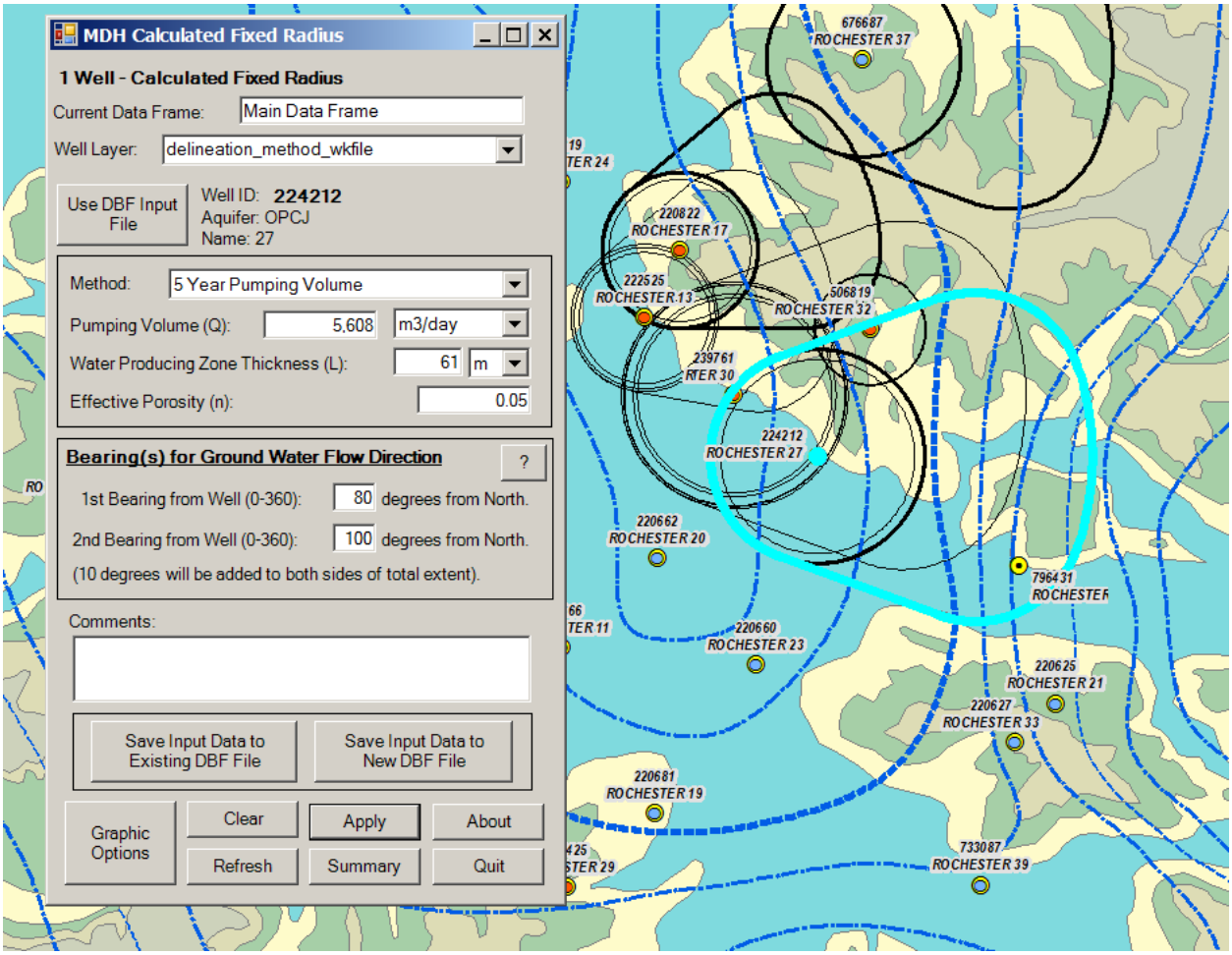
Well = 224212
27
X = 544,999.429, Y = 4,875,255.762

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	5,608.000	m3/day	198,044.648	cu.ft./day	1,028.803	gal./min.	1,481,476.863	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	1,033.500	m	3,390.749	ft.				

1st Bearing from Well = 80° from North.

2nd Bearing from Well = 100° from North.



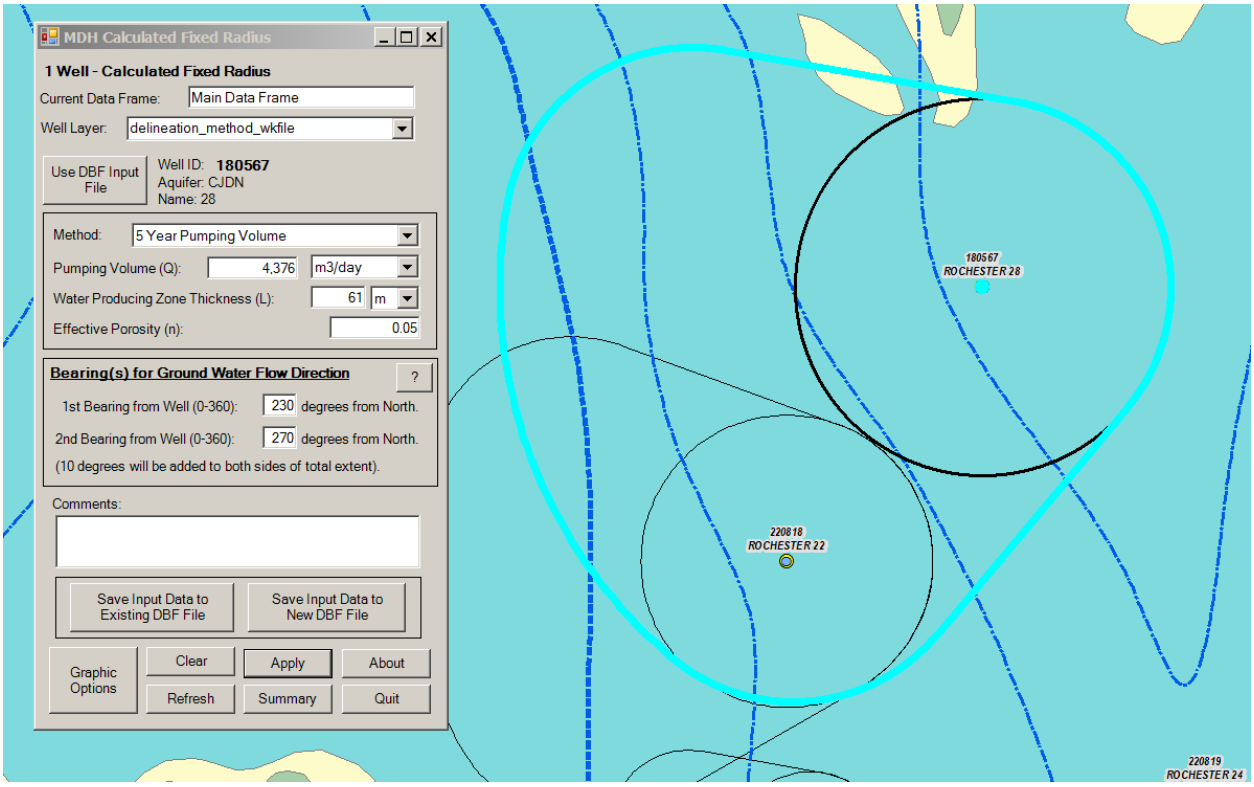
Well = 180567
28
X = 541,451.405, Y = 4,880,347.964

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	4,376.000	m3/day	154,536.979	cu.ft./day	802.790	gal./min.	1,156,016.896	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	912.946	m	2,995.231	ft.				

1st Bearing from Well = 230° from North.

2nd Bearing from Well = 270° from North.



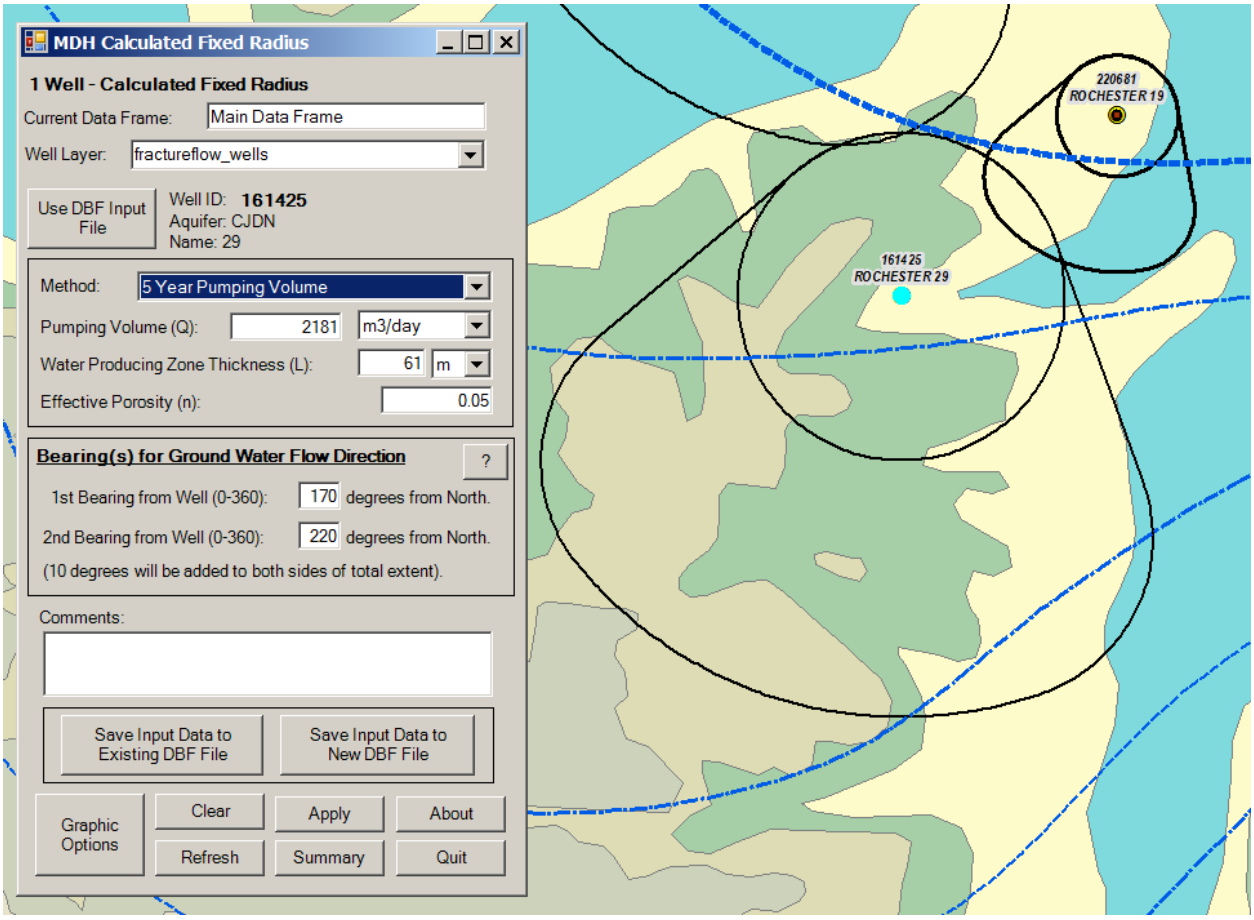
Well = 161425
29
X = 542,578.838, Y = 4,871,099.755

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,181.000	m3/day	77,021.287	cu.ft./day	400.111	gal./min.	576,159.244	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	644.517	m	2,114.557	ft.				

1st Bearing from Well = 170° from North.

2nd Bearing from Well = 220° from North.



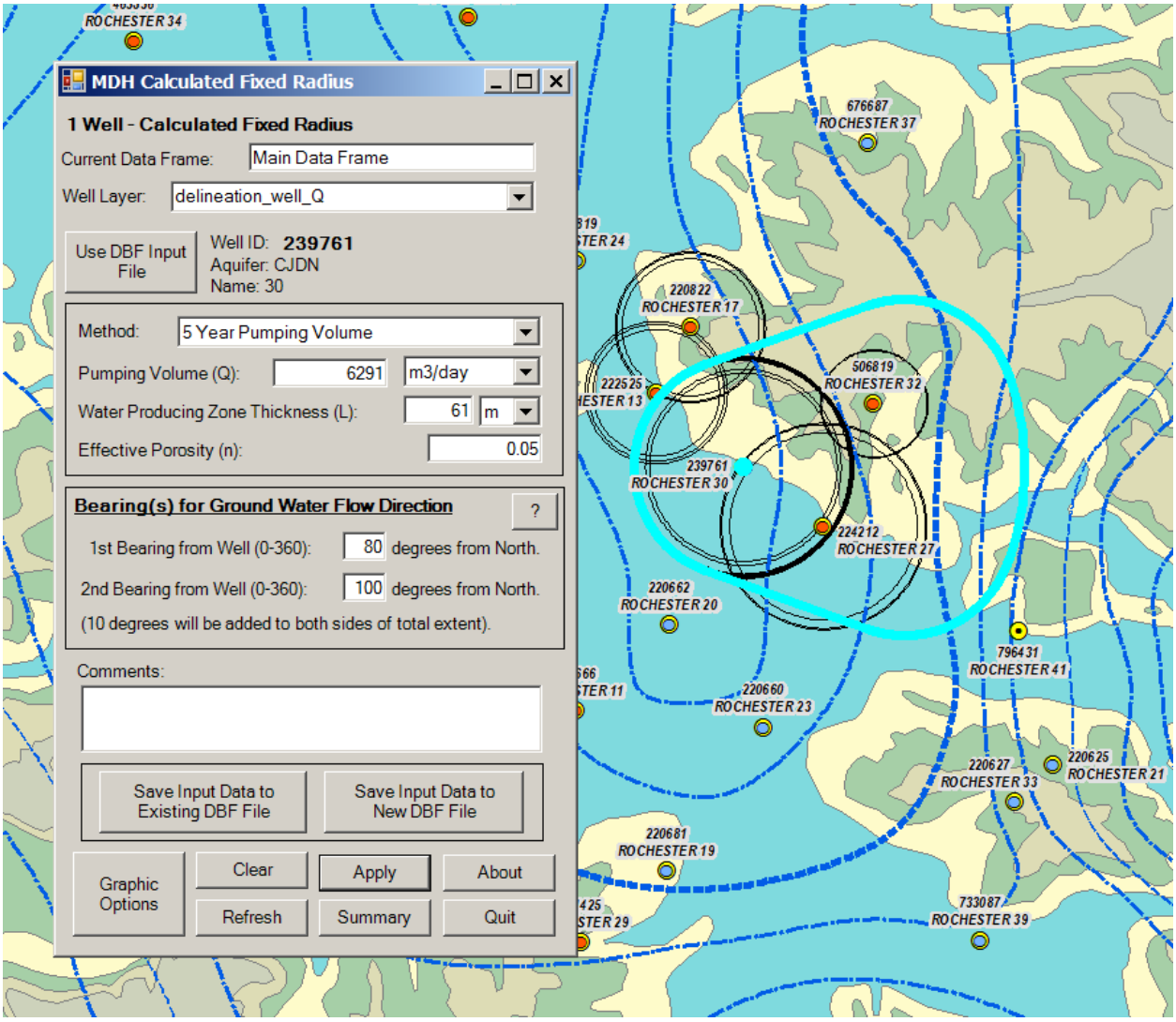
Well = 239761
30
X = 544,196.781, Y = 4,875,846.240

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	6,291.000	m3/day	222,164.565	cu.ft./day	1,154.102	gal./min.	1,661,906.374 gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.			
Effective Porosity (n):	0.05						
Original (CFR) Radius:	1,094.628	m	3,591.298	ft.			

1st Bearing from Well = 80° from North.

2nd Bearing from Well = 100° from North.



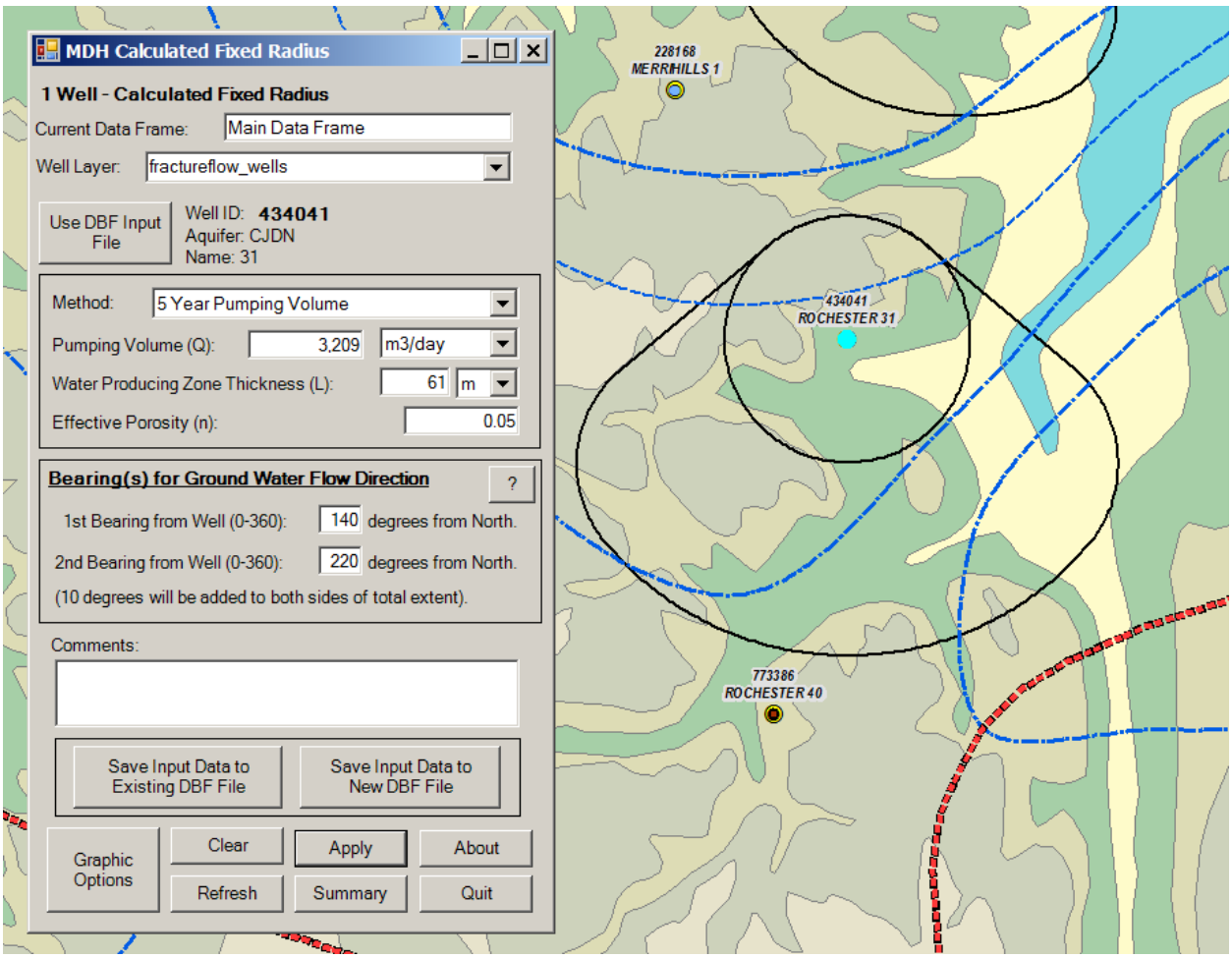
Well = 434041
31
X = 541,857.244, Y = 4,868,027.849

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	3,209.000	m3/day	113,324.764	cu.ft./day	588.700	gal./min.	847,728.112	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	781.792	m	2,564.936	ft.				

1st Bearing from Well = 140° from North.

2nd Bearing from Well = 220° from North.



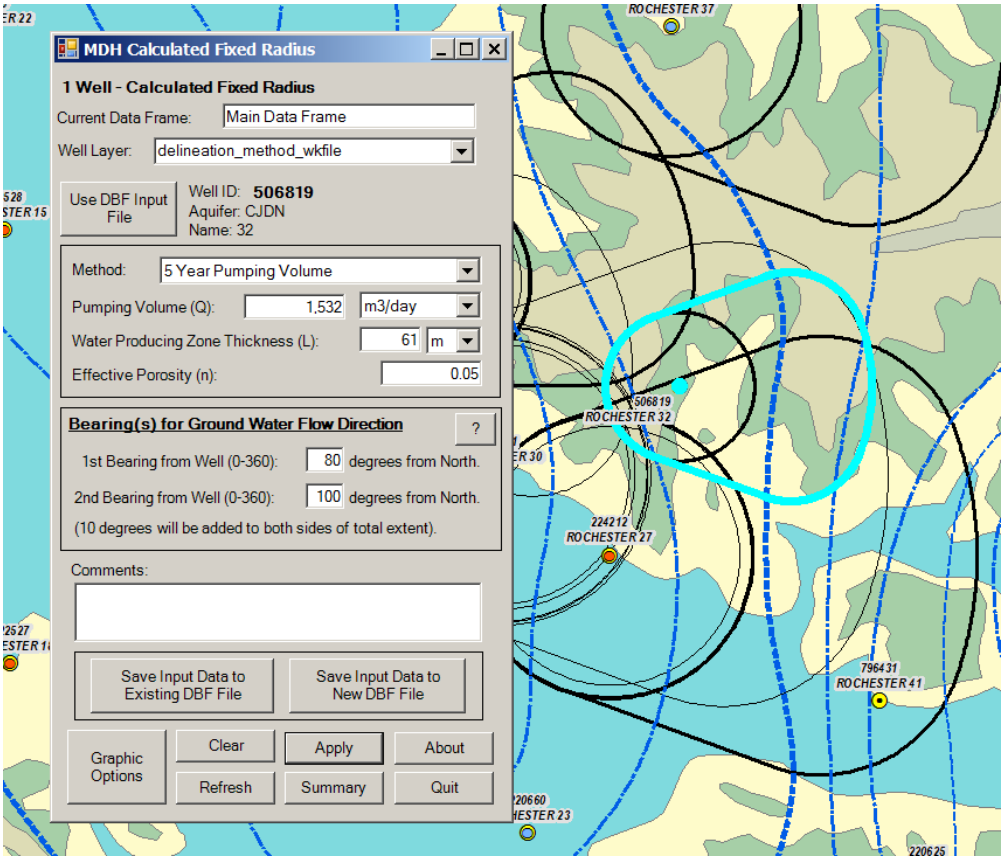
Well = 506819
32
X = 545,506.000, Y = 4,876,480.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	1,532.000	m3/day	54,102.069	cu.ft./day	281.050	gal./min.	404,711.583	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	540.177	m	1,772.234	ft.				

1st Bearing from Well = 80° from North.

2nd Bearing from Well = 100° from North.



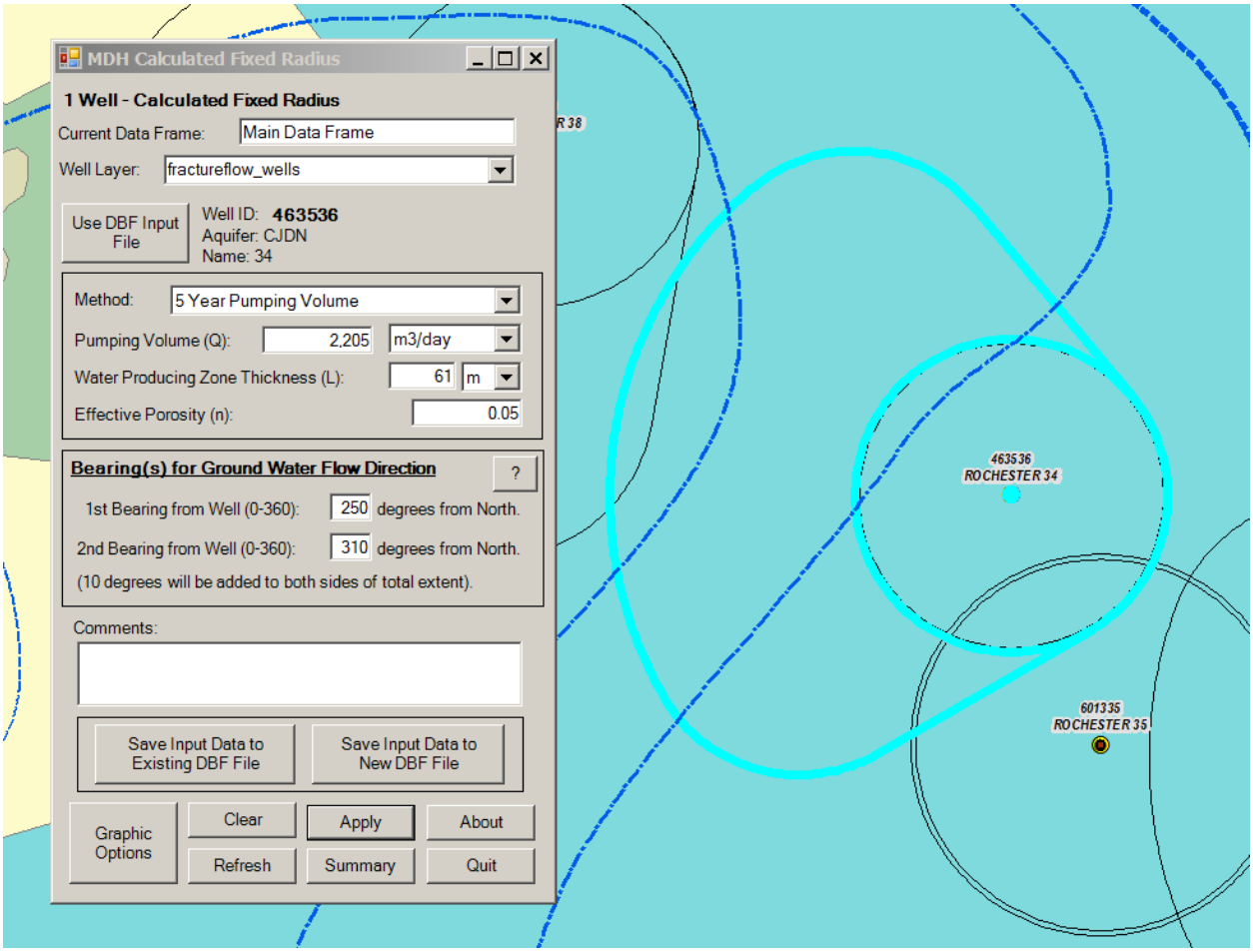
Well = 463536
34
X = 538,107.303, Y = 4,880,106.038

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,205.000	m3/day	77,868.839	cu.ft./day	404.513	gal./min.	582,499.373	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	648.054	m	2,126.160	ft.				

1st Bearing from Well = 250° from North.

2nd Bearing from Well = 310° from North.



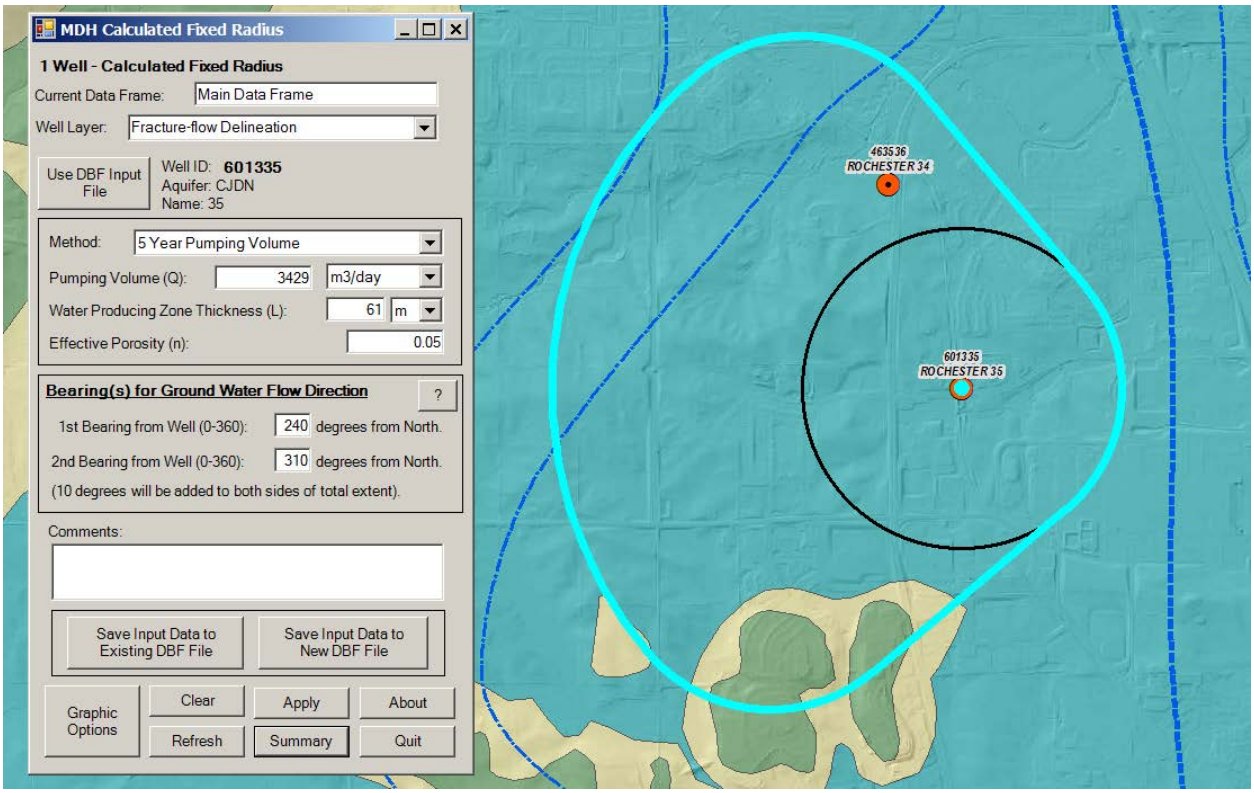
Well# = 601335
35
X = 538,478.488, Y = 4,879,073.242

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	3,429.000	m3/day	121,093.990	cu.ft./day	629.060	gal./min.	905,845.964	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	808.147	m	2,651.401	ft.				

1st Bearing from Well = 240° from North.

2nd Bearing from Well = 310° from North.



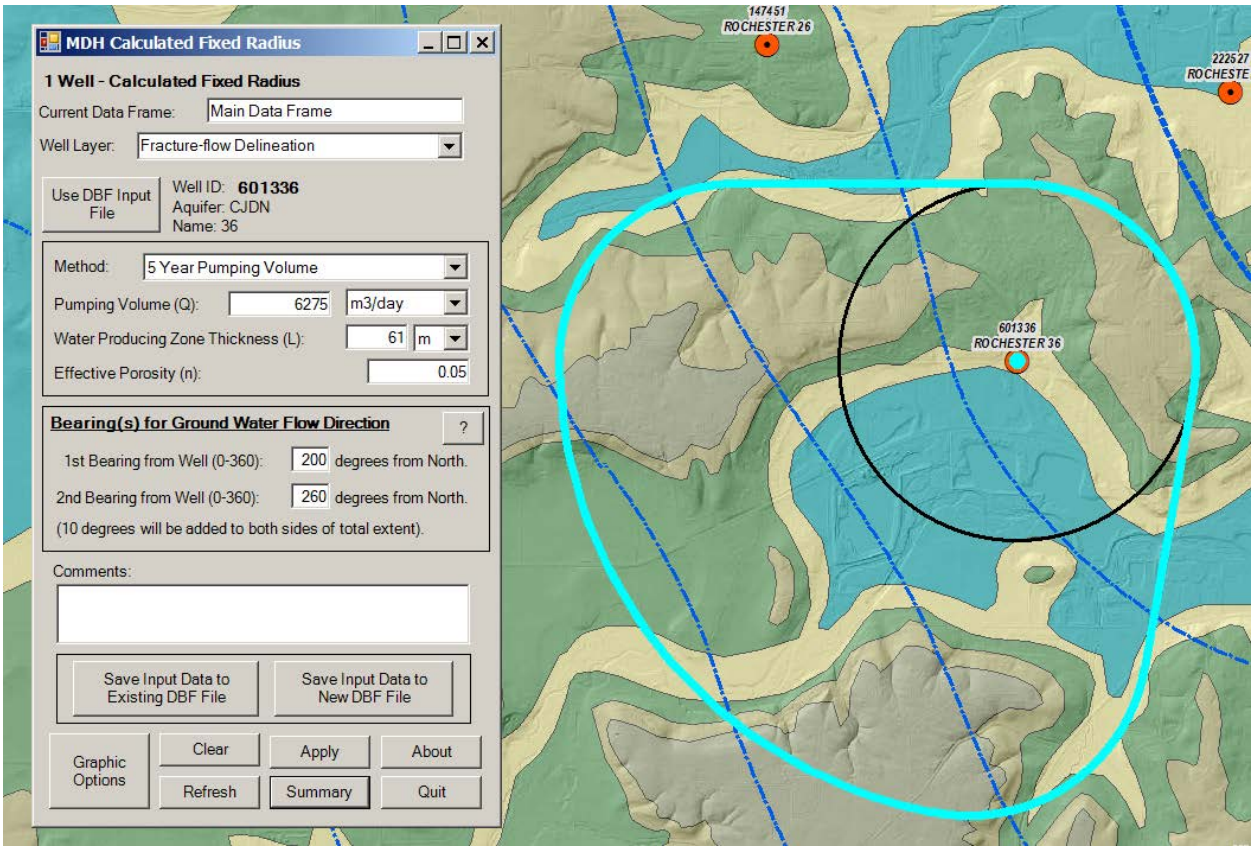
Well# = 601336
36
X = 539,345.000, Y = 4,872,825.000

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	6,275.000	m3/day	221,599.530	cu.ft./day	1,151.166	gal./min.	1,657,679.622	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	1,093.235	m	3,586.728	ft.				

1st Bearing from Well = 200° from North.

2nd Bearing from Well = 260° from North.



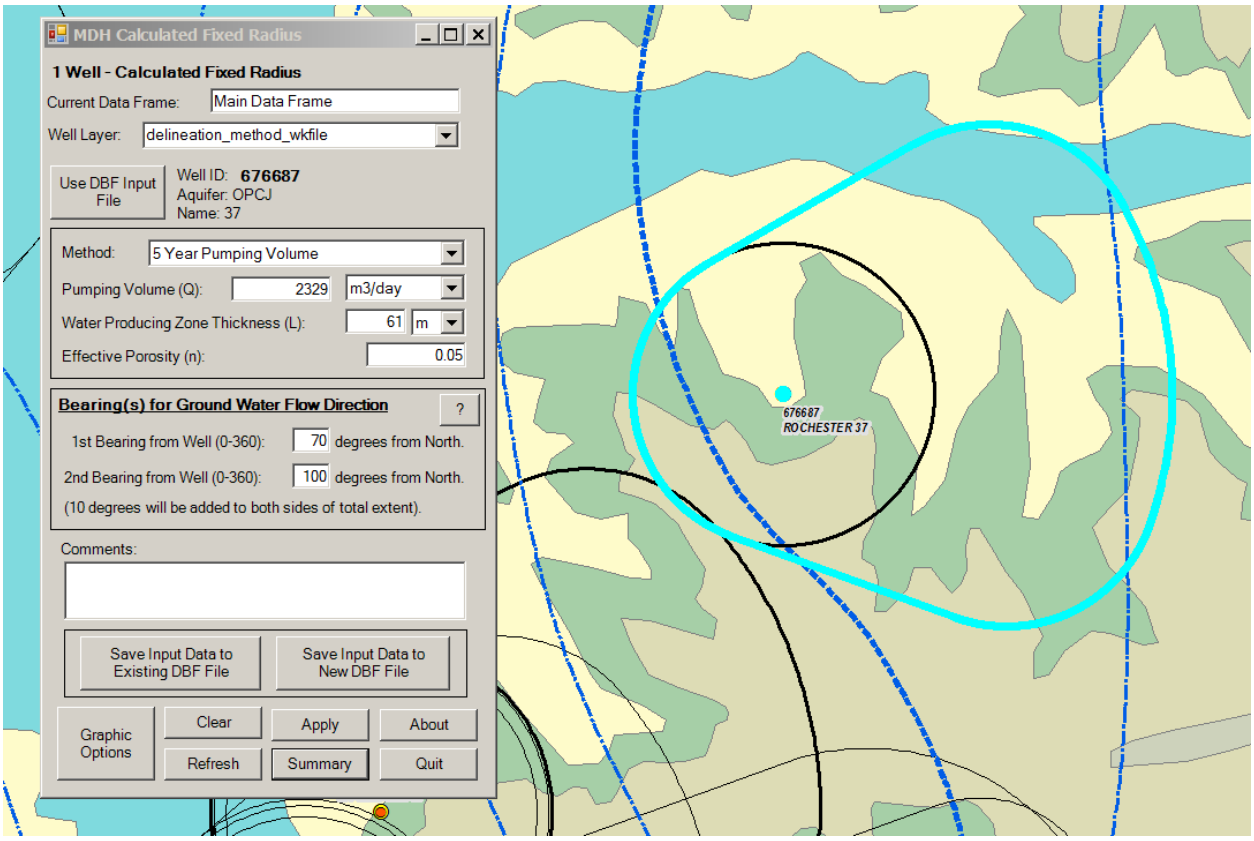
Well = 676687
37
X = 545,441.661, Y = 4,879,087.335

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,329.000	m3/day	82,247.858	cu.ft./day	427.262	gal./min.	615,256.707	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	666.026	m	2,185.125	ft.				

1st Bearing from Well = 70° from North.

2nd Bearing from Well = 100° from North..



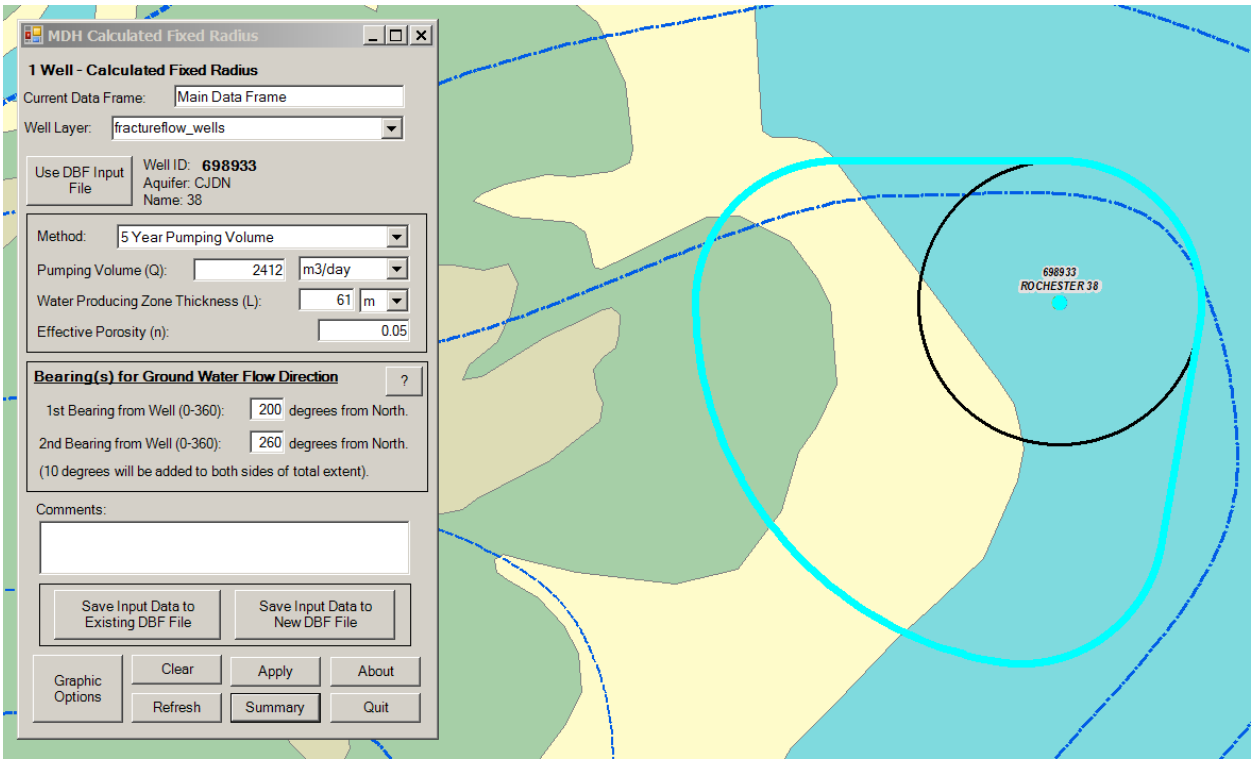
Well = 698933
38
X = 536,134.283, Y = 4,881,569.163

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	2,412.000	m3/day	85,178.975	cu.ft./day	442.488	gal./min.	637,182.988	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	677.790	m	2,223.721	ft.				

1st Bearing from Well = 200° from North.

2nd Bearing from Well = 260° from North..



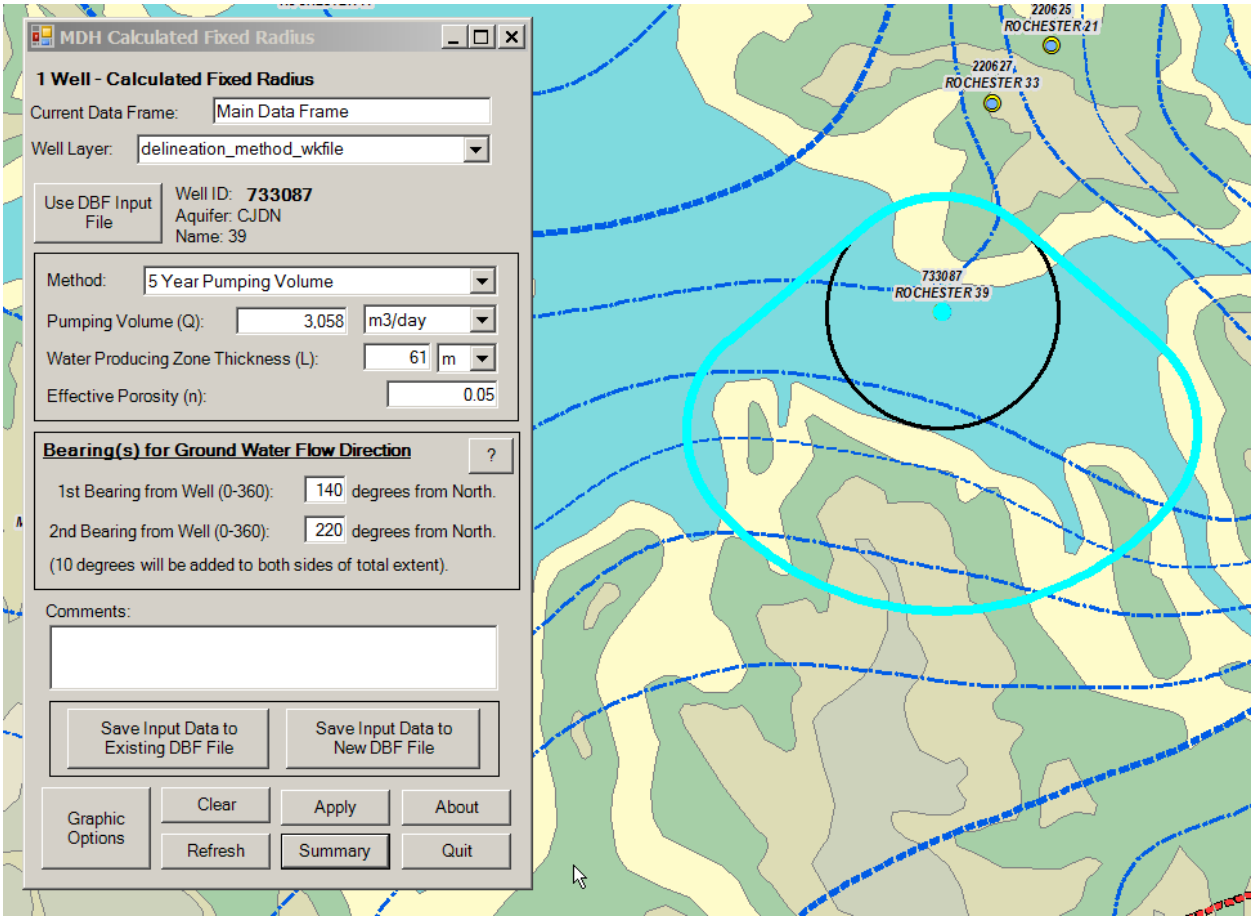
Well = 733087
39
X = 546,575.652, Y = 4,871,115.674

5 Year Pumping Volume (1825 days)

Pumping Volume (Q):	3,058.000	m3/day	107,992.249	cu.ft./day	560.999	gal./min.	807,838.133	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	763.177	m	2,503.862	ft.				

1st Bearing from Well = 140° from North.

2nd Bearing from Well = 220° from North



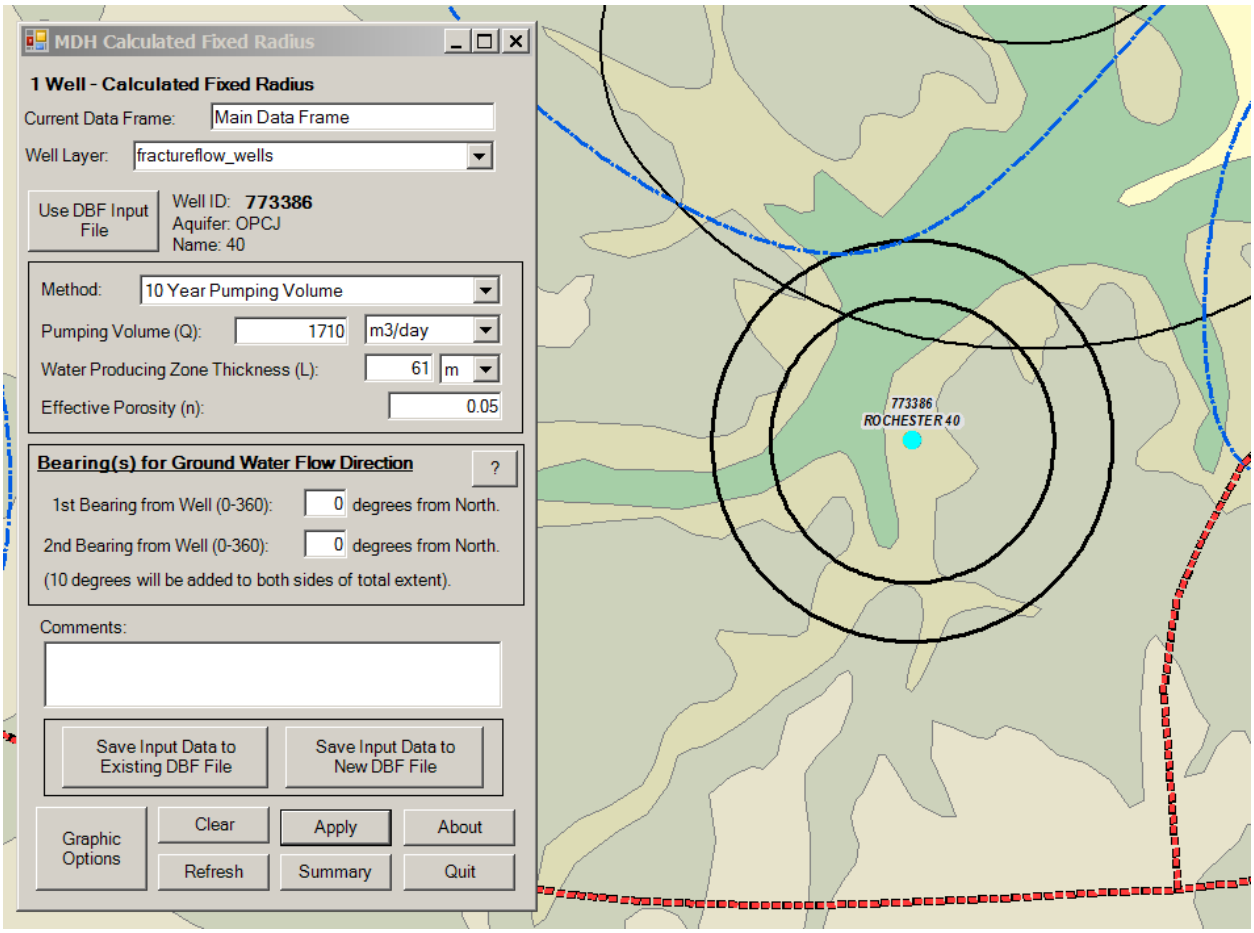
Well = 773386
40
X = 541,389.601, Y = 4,865,648.412

10 Year Pumping Volume (3650 days)

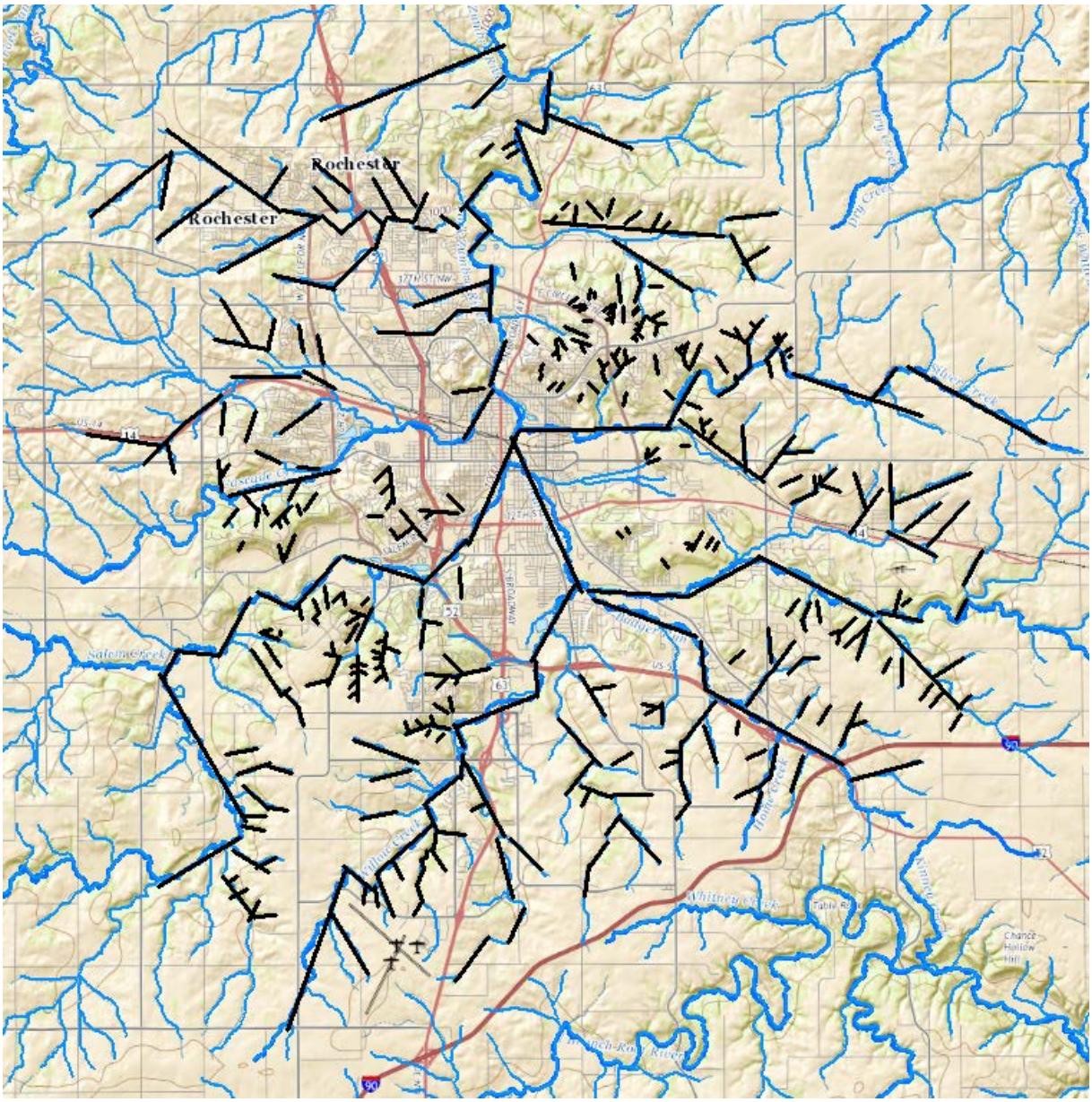
Pumping Volume (Q):	1,710.000	m3/day	60,388.079	cu.ft./day	313.704	gal./min.	451,734.208	gal./day
Water Producing Zone Thickness (L):	61.000	m	200.131	ft.				
Effective Porosity (n):	0.05							
Original (CFR) Radius:	807.086	m	2,647.919	ft.				

1st Bearing from Well = 0° from North.

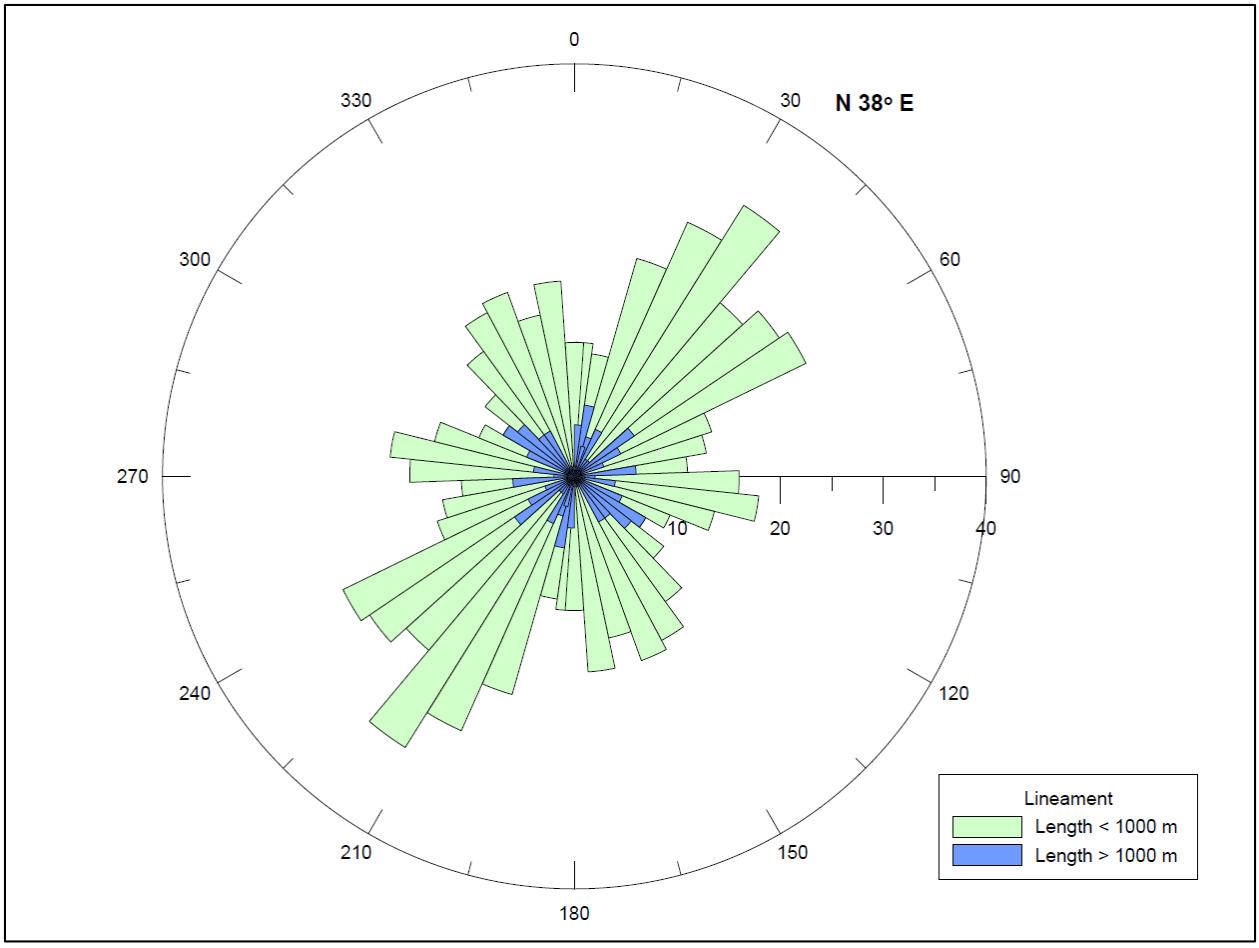
2nd Bearing from Well = 0° from North.



5. Lineament Analysis

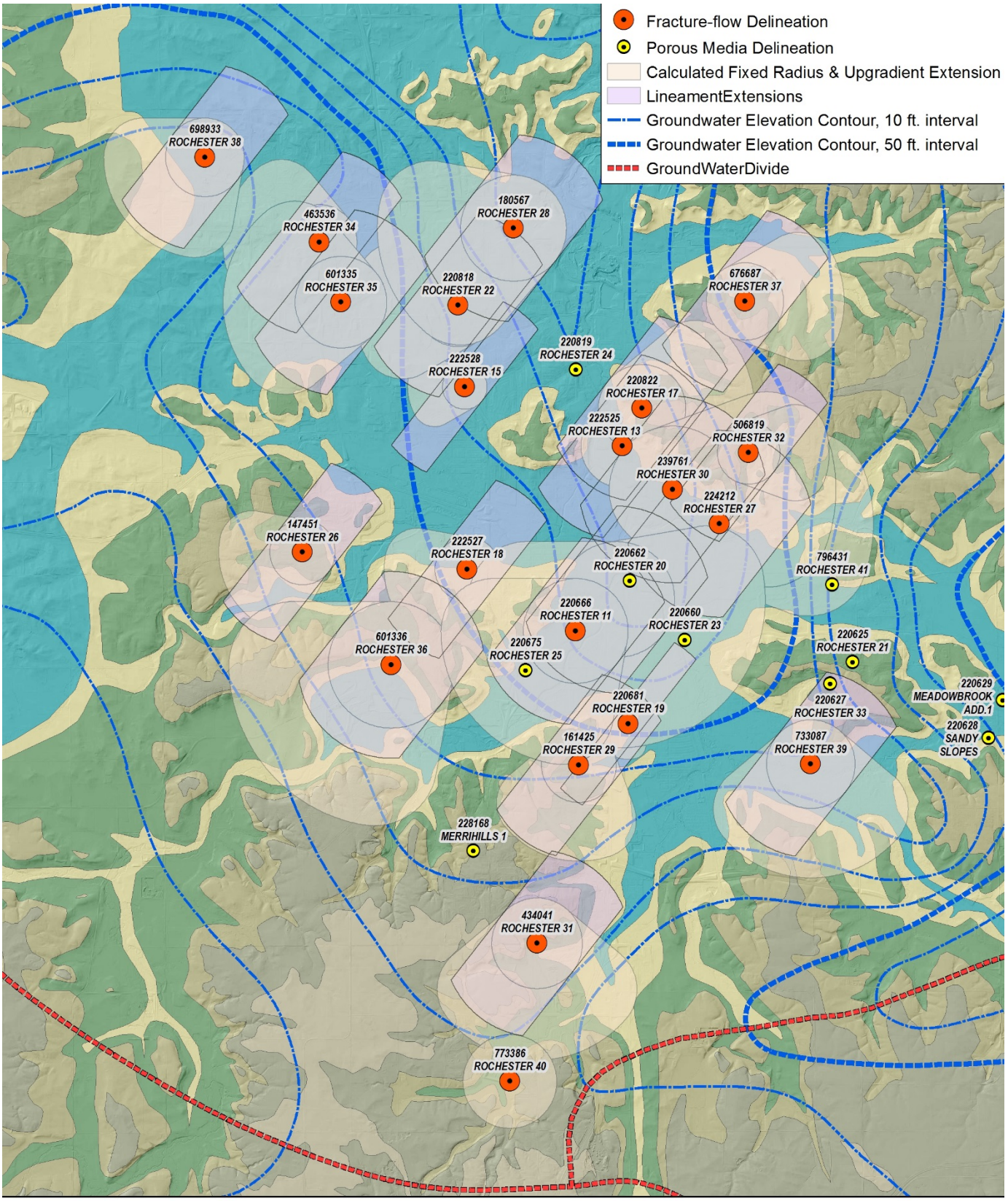


Digitized Lineaments



Rose Diagram of Lineament Angles

Lineament extensions were projected along the predominant direction for one mile using the 5-year CFR. The composite CFR, UGE and Lineament areas are shown in the following figure.


Fracture-flow Delineation
Porous Media Delineation
Calculated Fixed Radius & Upgradient Extension
LineamentExtensions
Groundwater Elevation Contour, 10 ft. interval
Groundwater Elevation Contour, 50 ft. interval
GroundWaterDivide
698933 ROCHESTER 38
463536 ROCHESTER 34
180567 ROCHESTER 28
601335 ROCHESTER 35
220818 ROCHESTER 22
676687 ROCHESTER 37
220819 ROCHESTER 24
222528 ROCHESTER 15
220822 ROCHESTER 17
222525 ROCHESTER 13
506819 ROCHESTER 32
239761 ROCHESTER 30
224212 ROCHESTER 27
147451 ROCHESTER 26
222527 ROCHESTER 18
220662 ROCHESTER 20
796431 ROCHESTER 41
220666 ROCHESTER 11
220660 ROCHESTER 23
601336 ROCHESTER 36
220675 ROCHESTER 25
220625 ROCHESTER 21
220629 MEADOWBROOK ADD 1
220627 ROCHESTER 33
220628 SANDY SLOPES
220681 ROCHESTER 19
161425 ROCHESTER 29
733087 ROCHESTER 39
228168 MERRIHILLS 1
434041 ROCHESTER 31
773386 ROCHESTER 40
MDH Minnesota Department of Health
0 2,500 5,000 10,000
Feet
N
Fractured Rock Delineation
City of Rochester

Appendix E

MDH Well Vulnerability Assessments

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #11 UNIQUE WELL #: 00220666

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 2 QUARTERS: CADA

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1948	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	140	10
Well Depth	:	455	
Casing grouted into borehole?		No	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	:	763	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.09 07/19/2004	0
Maximum tritium detected	:	1.8 03/13/2013	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		20
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
WELL OPEN TO CSTL. Previous tritium result 3.9 TU on 08/08/1990.

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #12 UNIQUE WELL #: 00220833

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 36 QUARTERS: ADDA

CRITERIA		DESCRIPTION		POINTS
Aquifer Name(s)	:	Multiple Aquifer		
DNR Geologic Sensitivity Rating	:	High		0
L Score	:	0		
Geologic Data From	:	Well Record		
Year Constructed	:	1960		
Construction Method	:	Cable Tool/Bored		0
Casing Depth	:	305		5
Well Depth	:	752		
Casing grouted into borehole?		No		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	:	506		10
Pathogen Detected?				0
Surface Water Characteristics?				0
Maximum nitrate detected	:	<.05 09/27/1994		0
Maximum tritium detected	:	2.4 09/18/2013		VULNERABLE
Non-THMS VOCs detected?		cis-1,2-Dichloroethene	05/13/1991	VULNERABLE
Pesticides detected?				0
Carbon 14 age	:	Unknown		0
Wellhead Protection Score	:			15
Wellhead Protection Vulnerability Rating	:			VULNERABLE
Vulnerability Overridden	:			

COMMENTS

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #13 UNIQUE WELL #: 00222525

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 26 QUARTERS: DADA

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	Very high	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1954	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	141	10
Well Depth	:	442	
Casing grouted into borehole?		No	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	:	726	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	1.4 09/14/2009	10
Maximum tritium detected	:	2.5 03/13/2013	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	M	0
Wellhead Protection Score	:		35
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
WELL OPEN TO CSTL

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #15 UNIQUE WELL #: 00222528

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 27 QUARTERS: BABB

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	Medium	25
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1957	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	154	10
Well Depth	:	432	
Casing grouted into borehole?		Unknown	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	:	676	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.26 08/23/2005	0
Maximum tritium detected	:	6.5 04/12/2004	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		50
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
SENSITIVITY OF DRIFT MATERIAL ESTIMATED FROM OLMSTED CO. GEOLOGIC ATLAS

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #17 UNIQUE WELL #: 00220822

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 26 QUARTERS: BCAA

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Galesville	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1960	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	429	0
Well Depth	:	904	
Casing grouted into borehole?		Unknown	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	:	754	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<1 12/01/1973	0
Maximum tritium detected	:	1 03/13/2013	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		15
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #18 UNIQUE WELL #: 00222527

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 34 QUARTERS: DCCA

CRITERIA		DESCRIPTION			POINTS
Aquifer Name(s)	:	Jordan-Galesville			
DNR Geologic Sensitivity Rating	:	Very high			0
L Score	:	0			
Geologic Data From	:	Well Record			
Year Constructed	:	1963			
Construction Method	:	Cable Tool/Bored			0
Casing Depth	:	340			5
Well Depth	:	806			
Casing grouted into borehole?		Unknown			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	:	463			5
Pathogen Detected?					0
Surface Water Characteristics?					0
Maximum nitrate detected	:	<1	12/01/1973		0
Maximum tritium detected	:	1.7	03/13/2013		VULNERABLE
Non-THMS VOCs detected?		Trichloroethene (TCE)		09/27/1990	VULNERABLE
Pesticides detected?					0
Carbon 14 age	:	Unknown			0
Wellhead Protection Score	:				15
Wellhead Protection Vulnerability Rating	:				VULNERABLE
Vulnerability Overridden	:				

COMMENTS
CJDN-CECR

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #19 UNIQUE WELL #: 00220681

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 12 QUARTERS: CBBC

CRITERIA		DESCRIPTION			POINTS
Aquifer Name(s)	:	Jordan-Galesville			
DNR Geologic Sensitivity Rating	:	Very high			0
L Score	:	0			
Geologic Data From	:	Well Record			
Year Constructed	:	1963			
Construction Method	:	Cable Tool/Bored			0
Casing Depth	:	343			5
Well Depth	:	881			
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	:	606			10
Pathogen Detected?					0
Surface Water Characteristics?					0
Maximum nitrate detected	:	<1	12/01/1973		0
Maximum tritium detected	:	1.3	09/10/2013		VULNERABLE
Non-THMS VOCs detected?		1,2-Dichloropropane		09/25/1990	VULNERABLE
Pesticides detected?					0
Carbon 14 age	:	Unknown			0
Wellhead Protection Score	:				15
Wellhead Protection Vulnerability Rating	:				VULNERABLE
Vulnerability Overridden	:				

COMMENTS
CJDN-CECR

625 Robert St. N. St. Paul MN 55155
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MINNESOTA DEPARTMENT OF HEALTH
SECTION OF DRINKING WATER PROTECTION
SWP Vulnerability Rating

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #20 UNIQUE WELL #: 00220662

COUNTY: Olmsted TOWNSHIP NUMBER: 104 RANGE: 14 W SECTION: 1 QUARTERS: BBBC

CRITERIA		DESCRIPTION		POINTS
Aquifer Name(s)	:	Prairie Du Chien-Mt.Simon		
DNR Geologic Sensitivity Rating	:	High		0
L Score	:	0		
Geologic Data From	:	Well Record		
Year Constructed	:	1964		
Construction Method	:	Cable Tool/Bored		0
Casing Depth	:	306		5
Well Depth	:	912		
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?		Unknown		0
Isolation distance violations?				0
Pumping Rate	:	819		10
Pathogen Detected?				NOT VULNERABLE
Surface Water Characteristics?				NOT VULNERABLE
Maximum nitrate detected	:	<1 12/01/1973		NOT VULNERABLE
Maximum tritium detected	:	<.8 09/10/2013		NOT VULNERABLE
Non-THMS VOCs detected?		Tetrachloroethene	09/25/1990	VULNERABLE
Pesticides detected?				0
Carbon 14 age	:	Unknown		0
Wellhead Protection Score	:			15
Wellhead Protection Vulnerability Rating	:			NOT VULNERABLE
Vulnerability Overridden	:			

COMMENTS
CJDN-CMTS

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: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #21 UNIQUE WELL #: 00220625

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 13 W SECTION: 5 QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan-Galesville	
DNR Geologic Sensitivity Rating	:	Very low	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1965	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	458	0
Well Depth	:	981	
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	:	554	10
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<.05 12/09/1993	NOT VULNERABLE
Maximum tritium detected	:	<.8 06/16/2011	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		10
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		

COMMENTS
CJDN-CECR, VL SCORE BASED ON PRESENCE OF ODCR + OGWD. Previous tritium result <0.8 TU (no date noted).

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #22 UNIQUE WELL #: 00220818

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 22 QUARTERS: BBDA

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Galesville	
DNR Geologic Sensitivity Rating	:	Medium	25
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1966	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	344	5
Well Depth	:	730	
Casing grouted into borehole?		No	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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	773	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<1 12/01/1973	0
Maximum tritium detected	:	3.5 06/15/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		40
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS

CJDN-CECR, GEOLOGIC SENSITIVITY OF DRIFT ESTIMATED FROM OLMSTED CO. GEOLOGIC ATLAS. Previous tritium result 9.3 TU (no date noted).

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #23 UNIQUE WELL #: 00220660

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 1 QUARTERS: DBDC

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	Very high	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1967	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	326	5
Well Depth	:	436	
Casing grouted into borehole?		Unknown	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	:	866	10
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<.4 12/01/1973	NOT VULNERABLE
Maximum tritium detected	:	<.8 03/13/2013	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		20
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		Justin Blum 1/30/2012 13:09:05

COMMENTS
origianlly CJDN-CECR, reconstructed 1984 to OPDC-CJDN, Tritium < 0.8 TU, in 1990

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #24 UNIQUE WELL #: 00220819

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 23 QUARTERS: CDAD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Galesville	
DNR Geologic Sensitivity Rating	:	Very high	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1968	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	309	5
Well Depth	:	685	
Casing grouted into borehole?		No	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	:	843	10
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<1 12/01/1973	NOT VULNERABLE
Maximum tritium detected	:	<.8 09/18/2013	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
CJDN-CECR

625 Robert St. N. St. Paul MN 55155
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MINNESOTA DEPARTMENT OF HEALTH
SECTION OF DRINKING WATER PROTECTION
SWP Vulnerability Rating

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #25 UNIQUE WELL #: 00220675

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 10 QUARTERS: AAAB

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Galesville	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1969	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	345	5
Well Depth	:	850	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	951	10
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<1 12/01/1973	NOT VULNERABLE
Maximum tritium detected	:	<.8 06/16/2011	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

CJDN-CECR, GEOLOGIC SENSITIVITY OF DRIFT ESTIMATED FROM OLMSTED CO. GEOLOGIC ATLAS. Previous tritium result <0.8 TU (no date noted).

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #26 UNIQUE WELL #: 00147451

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 32 QUARTERS: CDAA

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	Low	20
L Score	:	1	
Geologic Data From	:	Well Record	
Year Constructed	:	1978	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	364	5
Well Depth	:	624	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	960	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.79 06/12/1996	0
Maximum tritium detected	:	1.3 03/13/2013	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	M	0
Wellhead Protection Score	:		35
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
WELL OPEN TO CSTL, GEOLOGIC SENSITIVITY OF L BASED ON PRESENCE OF OGWD

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #27 UNIQUE WELL #: 00224212

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 13 W SECTION: 31 QUARTERS: BCCD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1979	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	345	5
Well Depth	:	448	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	1280	20
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.05 12/09/1993	0
Maximum tritium detected	:	3.5 06/15/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		25
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS

WELL OPEN TO CSTL, GEOLOGIC SENSITIVITY OF DRIFT ESTIMATED FROM OLSMTED CO. ATLAS AND WELL 220783 IN CWI.
Previous tritium result 9.5 TU (no date noted).

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #28 UNIQUE WELL #: 00180567

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 15 QUARTERS:

CRITERIA		DESCRIPTION		POINTS
Aquifer Name(s)	:	Jordan		
DNR Geologic Sensitivity Rating	:	Medium		25
L Score	:	0		
Geologic Data From	:	Well Record		
Year Constructed	:	1981		
Construction Method	:	Cable Tool/Bored		0
Casing Depth	:	305		5
Well Depth	:	389		
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?		Unknown		0
Isolation distance violations?				0
Pumping Rate	:	974		10
Pathogen Detected?				0
Surface Water Characteristics?				0
Maximum nitrate detected	:	<.05 12/09/1993		0
Maximum tritium detected	:	2.1 06/15/2011		VULNERABLE
Non-THMS VOCs detected?		Trichloroethene (TCE)	09/27/1990	VULNERABLE
Pesticides detected?				0
Carbon 14 age	:	Unknown		0
Wellhead Protection Score	:			40
Wellhead Protection Vulnerability Rating	:			VULNERABLE
Vulnerability Overridden	:			

COMMENTS

MODERATE RATING BASED ON ASSUMPTION THAT MUD DESRCIBED IN LOG IS LOESS OVER TILL OR JUST LOESS. Previous tritium result 3.0 TU (no date noted).

625 Robert St. N. St. Paul MN 55155
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MINNESOTA DEPARTMENT OF HEALTH
SECTION OF DRINKING WATER PROTECTION
SWP Vulnerability Rating

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #29 UNIQUE WELL #: 00161425

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1982	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	422	0
Well Depth	:	519	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	1205	20
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.1 10/20/1986	0
Maximum tritium detected	:	2.1 06/15/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		20
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
Previous tritium result 5.3 TU on 08/08/1990.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #30 UNIQUE WELL #: 00239761

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 36 QUARTERS: ABBC

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1984	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	319	5
Well Depth	:	402	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	904	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.2 10/20/1986	0
Maximum tritium detected	:	3.6 06/15/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		15
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
Previous tritium result 7.4 TU on 10/20/86.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #31 UNIQUE WELL #: 00434041

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 23 QUARTERS: CCC

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1987	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	462	0
Well Depth	:	530	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	1243	20
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.4 09/19/1990	0
Maximum tritium detected	:	3.1 06/17/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		20
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
Previous tritium result 2.5 TU on 08/29/1990..

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #32 UNIQUE WELL #: 00506819

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 13 W SECTION: 30 QUARTERS: AC

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Low	20
L Score	:	1	
Geologic Data From	:	Well Record	
Year Constructed	:	1989	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	453	0
Well Depth	:	540	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	699	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.4 09/19/1990	0
Maximum tritium detected	:	4 06/15/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		30
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
L RATING BASED ON PRESENCE OF OGWD. Previous tritium result 4.4 TU on 08/15/1990.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #33 Rose Harbor UNIQUE WELL #: 00220627

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 13 W SECTION: 8 QUARTERS: BBDD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Very low	15
L Score	:	5	
Geologic Data From	:	Well Record	
Year Constructed	:	1958	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	509	0
Well Depth	:	605	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	336	5
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.09 06/16/2011	0
Maximum tritium detected	:	1.1 06/16/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		20
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
L SCORE DOES NOT REFLECT PRESENCE OF OGWD. Previous tritium result 2.6 TU on 01/01/1990.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #34 UNIQUE WELL #: 00463536

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 17 QUARTERS: ACDD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Low	20
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1991	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	369	5
Well Depth	:	465	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	799	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.4	0
Maximum tritium detected	:	1.8 04/12/2004	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		35
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS

GEOLOGIC SENSITIVITY RATING BASED ON OLMSTED COUNTY ATLAS, DRIFT DESCRIPTION IN WELL RECORD INADEQUATE FOR PROVIDING L SCORE. NITRATE DETECTION LIMIT SHOWN A GUESS, HALVERSON SAYS NO NO3 DETECTED BY CITY.

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

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PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #35 UNIQUE WELL #: 00601335

COUNTY: Olmsted TOWNSHIP NUMBER: 107 RANGE: 14 W SECTION: 20 QUARTERS: AAAD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1999	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	369	5
Well Depth	:	457	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	1315	20
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.39 08/04/2009	0
Maximum tritium detected	:	3.8 04/12/2004	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		25
Wellhead Protection Vulnerability Rating	:		VULNERABLE

Vulnerability Overridden :

COMMENTS

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #36 UNIQUE WELL #: 00601336

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 4 QUARTERS: CD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Medium	25
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	2000	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	397	5
Well Depth	:	478	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	1447	20
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.05 07/19/2004	0
Maximum tritium detected	:	1.24 10/08/2008	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		50
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		Jim Walsh

COMMENTS
Previous tritium result of 2.2 TU on 3/7/2005.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #37 UNIQUE WELL #: 00676687

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	2003	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	393	5
Well Depth	:	501	
Casing grouted into borehole?		Yes	0
Cement grout between casings?		Yes	0
All casings extend to land surface?		Yes	0
Gravel - packed casings?		Yes	20
Wood or masonry casing?		No	0
Holes or cracks in casing?		No	0
Isolation distance violations?			0
Pumping Rate	:	805	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.05 08/23/2005	0
Maximum tritium detected	:	4.7 03/07/2005	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		35
Wellhead Protection Vulnerability Rating	:		VULNERABLE

Vulnerability Overridden :

COMMENTS

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #38 UNIQUE WELL #: 00698933

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Medium	25
L Score	:	2	
Geologic Data From	:	Well Record	
Year Constructed	:	2004	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	374	5
Well Depth	:	467	
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	:	994	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.05 06/26/2006	0
Maximum tritium detected	:	1.9 06/17/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		40
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
Previous tritium result 1.9 TU on 10/08/2008.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #39 UNIQUE WELL #: 00733087

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Very high	0
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	2006	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	365	5
Well Depth	:	458	
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	:	1090	20
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	.38 06/16/2011	0
Maximum tritium detected	:	2.6 06/16/2011	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		25
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
Previous tritium result 3.7 TU on 10/08/2008.

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #40 UNIQUE WELL #: 00773386

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Prairie Du Chien-Jordan	
DNR Geologic Sensitivity Rating	:	Low	15
L Score	:	4	
Geologic Data From	:	Well Record	
Year Constructed	:	2009	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	460	0
Well Depth	:	640	
Casing grouted into borehole?		Not applicable	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?		Yes	20
Isolation distance violations?			0
Pumping Rate	:		0
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<.05 07/17/2012	NOT VULNERABLE
Maximum tritium detected	:	<.8 09/18/2013	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
OPOD - CJDN WELL, Decorah shale present

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #41 UNIQUE WELL #: 00796431

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	VULNERABLE
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	2014	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	366	5
Well Depth	:	470	
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	:		0
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	:		5
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #72 (Sandy Slopes) UNIQUE WELL #: 00220628

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 13 W SECTION: 9 QUARTERS: DDAC

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Other	
Year Constructed	:	1968	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	375	5
Well Depth	:	460	
Casing grouted into borehole?		No	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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	179	5
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	.38 07/17/2008	NOT VULNERABLE
Maximum tritium detected	:	<.8 04/12/2004	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		10
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		

COMMENTS

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Well #73 (Merrihills) UNIQUE WELL #: 00228168

COUNTY: Olmsted TOWNSHIP NUMBER: 106 RANGE: 14 W SECTION: 15 QUARTERS: CDCD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Other	
Year Constructed	:	1965	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	575	0
Well Depth	:	675	
Casing grouted into borehole?		No	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	:	140	5
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<.4 02/06/1990	NOT VULNERABLE
Maximum tritium detected	:	<.8 04/12/2004	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		5
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		

COMMENTS

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

PWSID: 1550010 TIER: 2
SYSTEM NAME: Rochester WHP RANK:
WELL NAME: Meadowbrook Addition Well #77 UNIQUE WELL #: 00220629

COUNTY: Olmsted TOWNSHIP NUMBER: RANGE: SECTION: QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	High	0
L Score	:	0	
Geologic Data From	:	Other	
Year Constructed	:	1964	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	369	5
Well Depth	:	450	
Casing grouted into borehole?		Unknown	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	:	170	5
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<.05 11/25/1994	NOT VULNERABLE
Maximum tritium detected	:	<.8 03/22/2011	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

Appendix F

Alternate Aquifer Vulnerability Assessment

Appendix F

Alternate Aquifer Vulnerability Assessment

F1.0 Vulnerability Assessment

The vulnerabilities of the aquifers within the DWSMAs associated with the RPU water supply wells were evaluated in a manner consistent with MDH guidance for assessing aquifer vulnerability (MDH, 1997) using geologic sensitivities based on L scores computed from boring log data and water quality data for the RPU wells.

The first step in the assessment is to determine the geologic sensitivity rating of the aquifer. The Minnesota Department of Natural Resources (MnDNR) defines geologic sensitivity based on the travel time of water moving vertically from the surface to the aquifer of interest as follows (see MnDNR, 1991):

- Sensitivity = Very High: vertical travel time is hours to months
- Sensitivity = High: vertical travel time is weeks to years
- Sensitivity = Moderate: vertical travel time is years to decades
- Sensitivity = Low: vertical travel time is several decades to a century
- Sensitivity = Very Low: vertical travel time is more than a century

Geologic logs listed in the CWI for wells in the vicinity of the DWSMAs were reviewed and "L scores" based on the thickness of low permeability units at each well location were assigned to each well. (See MnDNR (1991) for a discussion of how to determine L scores). L-scores were determined for a total of 513 wells. A map of the geologic sensitivity within the DWSMA and the L scores used to develop the sensitivity distribution is shown on Figure F-1.

The second step in the assessment is to refine the geologic sensitivity using water quality data from the water supply wells. MDH staff prepared an evaluation of groundwater quality data for the RPU wells (Blum, 2016a). The water quality data presented in the MDH evaluation was used along with the geologic sensitivity information to define the aquifer vulnerability distribution in the DWSMAs shown on Figure F-2.

F2.0 Tritium

Tritium (^3H), a radioactive isotope of hydrogen, has been used extensively to date groundwater. Tritium activities peaked during atmospheric hydrogen bomb testing of the 1950s and 1960s, and values of ^3H in precipitation reached a maximum of approximately 10,000 T.U. (tritium units) in 1963 (Mazor, 2004). Natural production of ^3H in the upper atmosphere introduces approximately 5 T.U. to precipitation each year (Mazor, 2004). Because ^3H has a relatively short half-life of 12.43 years, radioactive decay since the bomb peak has reduced tritium activities to near background levels and ^3H is used mostly for relative age dating today. Groundwater that has little or no detectible ^3H is stated to be "vintage" or pre-bomb. Groundwater with detectable values of ^3H is stated to be "young" or post-bomb. The presence of tritium at concentrations above 1 tritium unit indicates the presence of a significant fraction of post-1954 (i.e.,

recently infiltrated) water in the groundwater sample. As shown in the MDH water quality assessment (Blum, 2016a), the results of sampling conducted during the period March 2011 and November 2014 indicate that tritium was present in all the RPU wells except Wells 21, 23, 24, 25, 26, 40, and 77. Tritium was not detected in Wells 72 or 73 when they were last evaluated in April 2004.

It is recommended that RPU work with the MDH to conduct tritium sampling in the water supply wells at least every ten years in order to have current data available for assessing well and aquifer vulnerability in the future.

F3.0 References

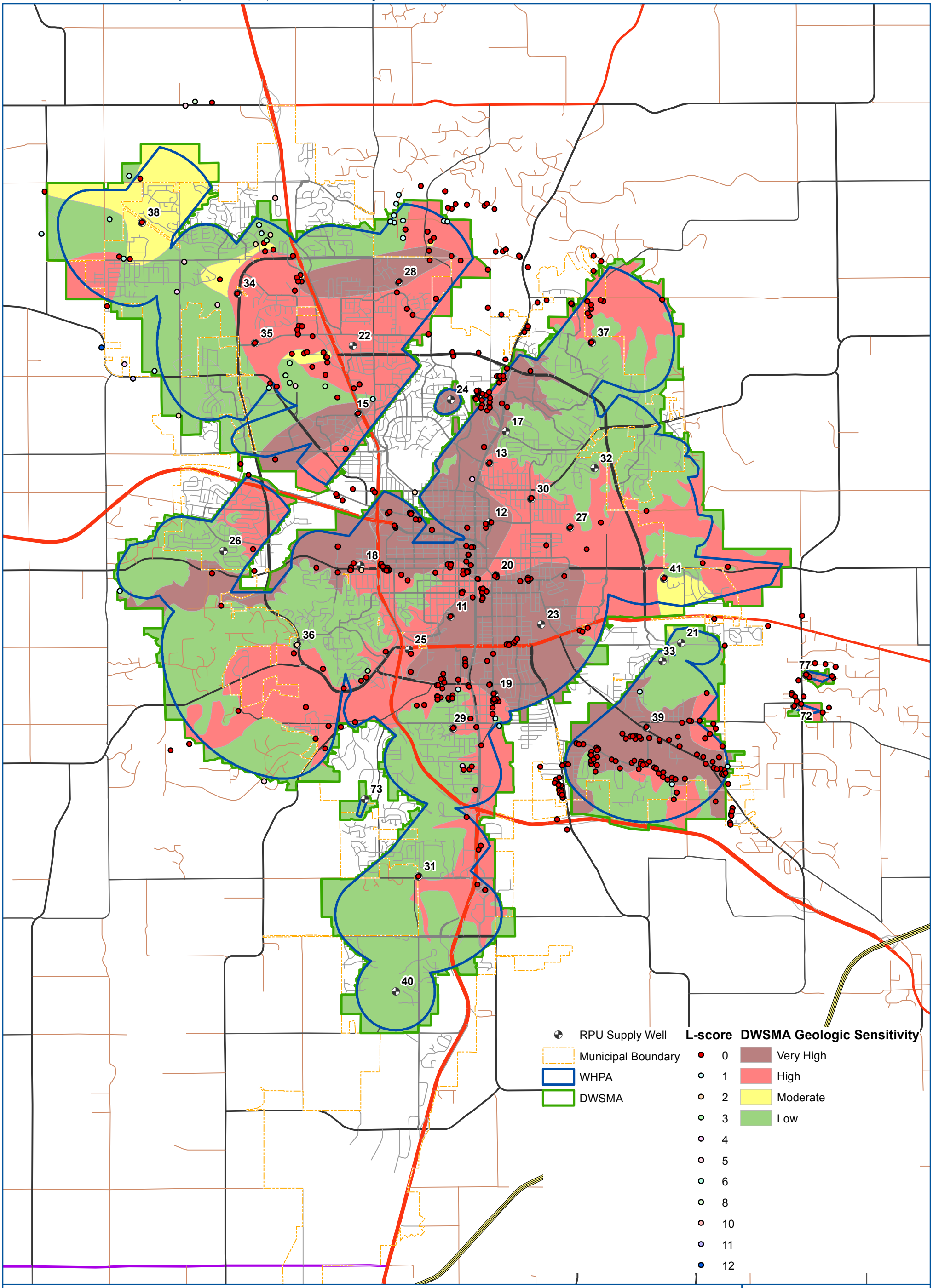
Blum, J., 2016a. Analysis of Water Chemistry Data from Rochester Public Utility (RPU) Wells for Groundwater Residence Time and Possible Human Impacts – to Inform the Vulnerability Assessments for the Rochester Wellhead Protection Plan Amendment, Memo from Justin Blum of Minnesota Department of Health to Rochester Public Utility WHP Project File (PWSID: 1550010), April 8, 2016.

Mazor, E, 2004. Chemical and Isotopic Groundwater Hydrology, 3rd ed., New York: Marcel Dekker Inc.

Minnesota Department of Health (MDH), 1997. *Assessing Well and Aquifer Vulnerability for Wellhead Protection*, 67 p., February 1997

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, 122 p., June 1991.

Barr Footer: ArcGIS 10.4.1, 2017-05-03 16:56 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig F-1 L Scores&GeoSens.mxd User: JCG



BARR

DRAFT

L SCORES AND
GEOLOGIC SENSITIVITY
Rochester WHPP Amendment
Rochester Public Utilities

FIGURE F-1

Barr Footer: ArcGIS 10.4.1, 2017-05-03 17:03 File: I:\Projects\23\55\1029\Maps\Reports\Pt1_WHPP_Amendment\Fig F-2 Std_AqVuln_Assessment.mxd User: JCG

38 34 28 35 22 37 24 15 17 13 32 30 12 27 26 18 20 41 11 23 36 25 21 33 77 19 72 29 39 73 31 40

RPU Supply Well
Municipal Boundary
WHPA
DWSMA

Aquifer Vulnerability
High
Moderate
Low

DRAFT

0 1 2
Miles

DWSMA VULNERABILITY USING STANDARD MDH APPROACH
Rochester WHPP Amendment
Rochester Public Utilities

FIGURE F-2

Appendix G

Groundwater Model Files and GIS Shapefiles