

Wellhead Protection Plan Part II

*Inventory of Potential Contaminant Sources
Plan of Action to Manage Potential Contaminant Sources
Alternate Water Supply and Contingency Strategy*

*Grand Rapids Public Utilities
Public Water Supplier 1310011*

*Grand Rapids, Minnesota
January 2016*

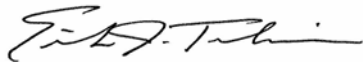


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Grand Rapids Public Utilities
Public Water Supplier 1310011

Grand Rapids, Minnesota
January 2016

Source Water Solutions, LLC

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



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Documentation List

<u>STEP</u>	<u>DATE PERFORMED</u>
Scoping Decision Notice Received (MN Rules Section 4720.5340, subp. 2)	March 18, 2015
Remaining Portion of Plan Submitted to Local Units of Government (LGUs) (MN Rules Section 4720.5350, subp. 1 & 2)	November 12, 2015
Reviews Received From Local Units of Government (MN Rules Section 4720.5350, subp. 2)	January 11, 2016
Reviews Considered (MN Rules Section 4720.5350, subp. 3)	January 11-15, 2016
Public Hearing Conducted (MN Rules Section 4720.5350, subp. 4)	January 20, 2016
Remaining Portion Wellhead Protection Plan Submitted (MN Rules Section 4720.5360, subp. 1)	February 1, 2016
Approved Review Notice Received	April 29, 2016
Provide Notice to LGUs of Plan Approval	May 24, 2016
Begin Plan Implementation	May 25, 2016

Executive Summary

The original Part II Wellhead Protection Plan for Grand Rapids Public Utilities was completed in December 2005 and approved by the Minnesota Department of Health (MDH) in March 2006. Per MN Rule 4720.5570, a public water supplier must review and amend a wellhead protection plan every ten years from the date of the last approval of a plan by the department (MDH). Therefore, the ten-year life of this plan has nearly expired, necessitating an amendment to the plan. The Part I portion of the City's wellhead protection plan update was approved in December 2014. This portion of the wellhead and source water protection plan update (Part II Wellhead Protection Plan Update) for Grand Rapids Public Utilities (GRPUC) includes:

- an assessment of applicable data elements,
- the results of the potential contaminant source inventory,
- management strategies for the potential contaminant sources,
- the GRPUC Water Emergency and Conservation Plan, and
- an Evaluation Plan for the GRPUC Wellhead Protection Program.

Part I of the Wellhead Protection Plan Update presented the delineation of the wellhead protection area (WHPA) and the drinking water supply management area (DWSMA) and included the vulnerability assessments for the City's wells and source water aquifers within the DWSMA. Part I of the Wellhead Protection Plan Update was submitted to the Minnesota Department of Health (MDH) and approved. The boundaries of the WHPA and DWSMA and the vulnerability of the source water aquifers are presented in **Figure 1**. An electronic copy of Part I Update of the GRPUC Wellhead Protection Plan is provided as **Appendix A**.

The GRPUC public water supply system currently uses and relies upon two source water aquifers – a shallow glacial outwash aquifer and the deeper, Biwabik Iron Formation bedrock aquifer. Municipal Wells 1, 3, 4 and 6 are open to the shallow glacial outwash aquifer. Well 2 is open to the Biwabik Iron Formation bedrock aquifer. Based on the local geologic conditions, the DWSMA has been delineated with areas of low, moderate, and high vulnerability (**Figure 1**). Due to evidence showing a surface water-groundwater connection, the MDH delineated an additional area of high vulnerability identified as the Surface Water Contribution Area (SWCA). Potential contaminant source information, and those potential sources required to be identified based upon the DWSMA vulnerability, were presented during the Second Scoping Meeting held with MDH staff on February 11, 2015. At this meeting, the requirements for the content of the Part II Plan were outlined and discussed in detail.

The information and data contained in Sections 1.0 – 4.0 of this portion of the Wellhead Protection Plan Update (hereafter referred to as Part II Update) support the approaches taken to address potential contamination sources that have been identified as potentially affecting the aquifer used for the public water supply. The reader is encouraged to concentrate attention on Sections 1.0 – 5.0 in order to better understand why the particular management strategies are included in Section 6.0.

Section 1.0 provides background for the GRPUC municipal water supply wells and wellhead protection planning update process thus far.

In Section 2.0, the required data elements indicated by the MDH in the *Scoping 2 Decision Notice* are addressed, as well as the data's degree of reliability. Pertinent data elements include information

about the geology, water quality, and water quantity. The data elements and information supplied in Part I of the Plan Update were the basis for the assessment that the aquifers providing drinking water to Grand Rapids are vulnerable to certain land uses and activities, and other wells that penetrate the same aquifers.

Section 3.0 addresses the possible impacts that changes in the physical environment, land use, and water resources have on the public water supply. No significant changes are anticipated in the city within the next ten-year period, and City staff has evaluated the support necessary to implement this Plan.

Section 4.0 establishes priorities and assigns risk to potential contaminant sources identified in the DWSMA.

Section 5.0 addresses the problems and opportunities concerning land use issues relating to the aquifers, well water, and the DWSMA. The vulnerability status of the aquifers and wells, and the quality of water currently produced by the municipal wells result in the following concerns: 1) preventing groundwater contamination to the source water aquifers from existing and future land uses, 2) other wells located within the DWSMA that could become pathways for contamination to enter the aquifers, 3) the extent of surface water contribution to the source water aquifers, and 4) the pumping effects of high-capacity wells that may alter the boundaries of the delineated WHPAs or reduce the hydraulic head in the aquifers.

The drinking water protection goals that the City would like to achieve with this Plan are listed in Section 6.0. In essence, the overall goals of this Plan are to 1) prevent contamination of the source water aquifers, 2) maintain or improve the current drinking water quality, 3) continue to increase public awareness of groundwater protection methods and issues, 4) continue to collect data to support future efforts in wellhead protection planning, and 5) cooperatively manage the surface water bodies within the DWSMA and the source water aquifers with other local government units to assure sustainable water supplies of all users in the future.

Section 7.0 identifies the objectives and action plans for managing the potential sources of contamination. Actions aimed toward educating the general public about groundwater issues, gathering information about other wells, and collecting data relevant to wellhead and source water protection planning are the general focus.

Section 7.5 contains a guide to evaluate the implementation of the identified management strategies of Sections 7.0-7.4. The wellhead protection program for GRPUC will be evaluated on an annual basis prior to its budgeting process.

Section 8.0 identifies the GRPUC's emergency/contingency water plan is included to address the possibility that the water supply system is interrupted due to either emergency situations or drought. Section 8.0 references the GRPUC *Water Emergency and Conservation Plan* approved by the Department of Natural Resources and is scheduled to be updated by October 18, 2018.

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Glossary of Terms

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

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

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

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

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

Surface Water Contribution Area (SWCA). In a conjunctive delineation, the geographic area that may provide recharge to the aquifer within the well capture zone, attributed to: 1) the presence of a surface hydraulic feature; and 2) the runoff of precipitation or meltwater.

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

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

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

Acronyms

CWI - County Well Index

DNR - Minnesota Department of Natural Resources

EPA - United States Environmental Protection Agency

MDA - Minnesota Department of Agriculture

MDH - Minnesota Department of Health

MGS - Minnesota Geological Survey

MnDOT - Minnesota Department of Transportation

MPCA - Minnesota Pollution Control Agency

PCSI – Potential Contaminant Source Inventory

PEAG- Animikie Group (Biwabik Iron Formation Bedrock Aquifer)

QBAA- Quaternary Buried Artesian Aquifer

SWCD - Soil and Water Conservation District

UMN - University of Minnesota

USDA - United States Department of Agriculture

USGS - United States Geological Survey

1.0 Project History and Background

Wellhead Protection is designed to protect public water supply wells. States are required to have wellhead protection programs under the provisions of the 1986 amendments to the federal Safe Drinking Water Act. The Minnesota Department of Health (MDH) administers the state wellhead protection rule, Minnesota Rules, Chapter 4720.5100 – 4720.5590, that sets standards for wellhead protection planning. Grand Rapids Public Utilities (GRPUC) has completed this Part 2 portion of the Wellhead Protection (WHP) Plan Update, in accordance with Minnesota Rules Chapter 4720.5300. The GRPUC has identified a WHP Manager to oversee the development of the plan.

The Wellhead Protection Area (WHPA) is the region that supplies groundwater to the GRPUC municipal wells. The area around it, which is to be protected and managed, is defined as the Drinking Water Supply Management Area (DWSMA). These areas were delineated in Part 1 of the Wellhead Protection Plan Update (**Appendix A**). Geographic landmarks, such as roads and property lines, were used to map the boundaries of the DWSMA so that it is readily identifiable. The location of the DWSMA, relative to other communities, is shown on **Figure 1**. The well vulnerabilities, WHPA, DWSMA, and DWSMA vulnerabilities were approved by the MDH in December 2014 and are also shown on **Figure 1**. Due to evidence of a surface water-groundwater connection in the highly vulnerable portion of the DWSMA, the MDH has identified a Surface Water Contribution Area (SWCA). This area is also depicted in **Figure 1**. The GRPUC utilizes five municipal wells. Well information is summarized in **Table 1** below.

Well Name	Unique Number	Use/Status ¹	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/Reconstructed	Well Vulnerability	Aquifer
Well 1	228870	P	12	118	176	1938	Vulnerable	QBAA
Well 2	228873	P	24 x 16	215	573	1951	Vulnerable	PEAG
Well 3	228862	P	16	116	176	1961	Vulnerable	QBAA
Well 4	127276	P	16	117	157	1977	Vulnerable	QBAA
Well 6	161444	P	24 x 16	100	140	1984	Vulnerable	QBUA

Note: 1. Primary (P)

1.1 Wellhead Protection Area Delineation Criteria

The criteria listed below were used to delineate the GRPUC's WHPA. Please refer to Part I of this Plan Update (**Appendix A**) for detailed documentation regarding how the following criteria were applied in determining the boundaries of the WHPA:

Time of Travel - 20 years

Flow Boundaries - based on geologic information

Daily Volume - provided by the City

Groundwater Flow Field - delineation method was computer modeling

Aquifer Transmissivity - determined from aquifer pumping tests

Based on the local geologic conditions, the DWSMA has been delineated with areas of low to high vulnerability. Based upon water chemistry results and the appearance of surface water contribution to the aquifers, a surface water vulnerability classification was determined by the MDH (**Figure 1**). Consequently, the potential sources of contamination to the source water aquifers include all land uses and other wells that penetrate the aquifer. This information was presented during the Second Scoping Meeting held with MDH staff on February 11, 2015, when the necessary requirements for the content of Part II were outlined and discussed in detail.

2.0 Identification and Assessment of Required Data Elements

The following sections identify the required data elements as outlined in Minnesota Rules Chapter 4720.5200, as well as an assessment of the present and future implications of the data elements. The required data elements were outlined in the Minnesota Department of Health (MDH) Second Scoping Decision Notice dated March 18, 2015 (**Appendix B**). They include data, covering the following topics:

- Physical Environment
- Land Use
- Water Quantity
- Water Quality

2.1 Physical Environment Data Elements

The following sections describe the physical features evaluated for this report.

2.1.1 Precipitation

This data element specifically relates to the highly vulnerable areas of the DWSMA and SWCA because there appears to be a direct hydraulic connection between surface waters and the highly vulnerable portions of the DWSMA. **Table 2** summarizes the last 5 years of total precipitation near Grand Rapids at the Grand Rapids FRS LAB (USC00213303) gage station. The locations of rain gages are depicted in **Figure 8**. Precipitation plays a direct role in recharging the aquifers. The GRPUC does not have any control over precipitation rates or volumes, however, if precipitation decreases, so does natural recharge to the aquifers.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
2010	1.04	0.28	0.78	1.12	2.91	5.23	5.86	4.84	3.93	2.48	1.37	1.87	31.71
2011	1.07	0.27	0.45	3.18	2.60	6.41	3.20	5.55	0.89	1.98	0.81	0.20	26.61
2012	0.56	0.96	1.16	4.22	6.91	7.68	5.62	2.07	0.48	1.33	1.23	0.98	33.20
2013	1.55	1.23	1.91	2.62	2.46	3.41	4.19	2.33	1.13	3.40	0.58	2.02	26.83
2014	0.68	1.60	1.13	2.77	3.89	8.18	2.26	3.29	1.88	1.56	0.70	0.66	28.60

Notes: All values are in inches. Data obtained from MN Climatology Working Group for Grand Rapids FRS LAB station(USC00213303) State Climatology Office - DNR Waters, phone: 651-296-4214, web: <http://climate.umn.edu>.

2.1.2 Geology

The wellhead team considered the local geology when determining the potential contaminant source inventory and assigning risk to potential land uses. This data element is required for, and was presented in, the first part of the Wellhead Protection Plan (please refer to **Appendices A and B**). The subsurface data used in the Part I report and the determination of subsurface stratigraphic relationships were derived from the use of public –domain well records and local and regional geologic studies and publications. The geologic conditions present below the City of Grand Rapids are not anticipated to change during the life of this plan. During the assignment of DWSMA vulnerability in Part I (**Appendix A**), the geologic conditions were assessed in more detail. The areas of high vulnerability have geologic conditions that provide a low level of protection to the GRPUC’s water supply. The areas of low to moderate vulnerability have

geologic conditions that provide a higher level of protection to the City’s water supply. **Figure 1** depicts the zones of SWCA and DWSMA vulnerability.

2.1.3 Soils

The characteristics of the soils within the DWSMA apply to this Plan because there appears to be a hydraulic connection between surface waters and the aquifers serving this water supply system, particularly within the SWCA and highly-vulnerable areas of the DWSMA. Soils with higher permeabilities will allow potential contaminants to migrate faster into the subsurface, and have a higher risk of impacting vulnerable source water aquifers. Soils information was obtained from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database. **Figure 4** depicts the soil types within the DWSMA. The associated physical soil properties for each soil type are provided in **Table 3**. The wellhead team is not aware of any eroding lands causing sedimentation problems.

Table 3 DWSMA Soil Properties				
Map Unit Name (Soil Type)	Ponding Frequency	Drainage Classification	Geologic Depositional Environment	Taxonomy Classification
Aquents, sandy	0-14%	Very poorly drained	beaches	Aquents
Mooselake and Lupton mucky peats	75-100%	Very poorly drained	swamps	Euic, frigid Typic Haplosaprists
Talmoon silt loam	75-100%	Very poorly drained	depressions on moraines	Fine-loamy, mixed, superactive, frigid Mollic Endoaqualfs
Cowhorn loamy very fine sand	0-14%	Somewhat poorly drained	outwash plains	Coarse-loamy, mixed, superactive, nonacid, frigid Aeric Endoaquepts
Borosaprists, depressional	75-100%	Very poorly drained	bogs	Haplosaprists
Cathro muck	75-100%	Very poorly drained	depressions on moraines	Loamy, mixed, euic, frigid Terric Haplosaprists
Zimmerman loamy fine sand, 1 to 8 percent slopes	0-14%	Excessively drained	outwash plains	Mixed, frigid Lamellic Udipsamments
Shooker very fine sandy loam	0-14%	Poorly drained	flats on moraines	Fine-loamy, mixed, superactive, frigid Typic Endoaqualfs
Menahga-Itasca complex, 10 to 25 percent slopes	0-14%	Excessively drained	moraines	Mixed, frigid Typic Udipsamments
Itasca silt loam, 1 to 10 percent slopes	0-14%	Well drained	moraines	Coarse-loamy, mixed, superactive, frigid Haplic Glossudalfs
Itasca-Goodland silt loams, 12 to 25 percent slopes	0-14%	Well drained	moraines	Coarse-loamy, mixed, superactive, frigid Haplic Glossudalfs
Goodland silt loam, 1 to 10 percent slopes	0-14%	Well drained	moraines	Coarse-loamy, mixed, superactive, frigid Haplic Glossudalfs
Greenwood peat	75-100%	Very poorly drained	bogs	Dysic, frigid Typic Haplohemists
Water	0-14%	NA	NA	NA
Udorthents, nearly level to rolling	0-14%	Well drained	NA	Udorthents

Map Unit Name (Soil Type)	Ponding Frequency	Drainage Classification	Geologic Depositional Environment	Taxonomy Classification
Itasca-Goodland silt loams, 2 to 12 percent slopes	0-14%	Well drained	moraines	Coarse-loamy, mixed, superactive, frigid Haplic Glossudalfs

2.1.4 Water Resources

Generally, this data element applies to this Plan because there is a direct hydraulic connection between surface waters and the source water aquifers serving this water supply system within the highly vulnerable areas of the DWSMA. In addition, this data applies as it relates to future groundwater uses that may influence the ability of the aquifer to yield water to the public water supply. It was determined in the Part I WHPP that the surface water features surrounding Grand Rapids may influence the WHPAs and DWSMAs of the municipal well.

The City of Grand Rapids and its municipal wells are located within the Mississippi River-Headwaters and Mississippi River – Grand Rapids major watersheds. The City’s wells lie within the Split Hand Creek-Mississippi River minor watershed. Watershed boundaries, public waters and drainage ditches, and wetland boundaries are depicted in **Figure 8**. Floodplains were also considered as part of this Plan Amendment.

Seven lakes, consisting of 412 acres of surface area, exist within the GRPUC DWSMA. The Mississippi River also flows through the DWSMA. Five named lakes exist within the DWSMA. The shoreland classification for each lake within the GRPUC DWSMA is provided in **Table 4**.

General information describing the groundwater resources and the GRPUC’s public water supply system was presented in the Original Part I of the Plan provided in **Appendix B**, the Part I Update (**Appendix A**) and the *Source Water Assessment (SWA)* found in **Appendix F** of this Plan.

Lake Name	City	Lake Size (Acres)	Shoreland Classification
Ice	Grand Rapids	39.0	Recreational Development
McKinney	Grand Rapids	105.6	Recreational Development
Blandin Reservoir	Grand Rapids	95.0	General Development
Forest	Grand Rapids	37.3	Recreational Development
Hale	Grand Rapids	130.4	Recreational Development
Mississippi River	Grand Rapids	4.5	Natural Environment

*Source: MN Dept. of Natural Resources

2.2 Land Use Data Elements

2.2.1 City Zoning and Land Use

Figure 1 depicts the political boundaries as well as the parcels and Township/Range/Sections located within and around the DWSMA. **Table 5** summarizes the present Grand Rapids land use classifications for the GRPUC DWSMA. **Figure 5** shows the present land use within the City of Grand Rapids. This data was taken from the City’s 2011 Comprehensive Plan. A small portion of

the GRPUC DWSMA extends beyond the Grand Rapids city limits in to Cohasset to the west. The portion of the DWSMA that used to extend north into Grand Rapids Township, has been annexed by the City of Grand Rapids since the original WHPP was developed, however there will still be a need for collaboration between the GRPUC, the City of Grand Rapids, Cohasset, and other local stakeholder groups to effectively protect the City’s drinking water resources.

Land use information and the extent and limits of the WHPA and DWSMA will be helpful to decision-makers in future planning efforts, by considering groundwater quality issues and wellhead and source water protection.

Future land use has also been assessed as part of the GRPUC’s WHPP Update. **Figure 6** depicts Grand Rapids future land use as defined in the City’s 2011 Comprehensive Plan.

Table 6 summarizes the current zoning districts within the GRPUC DWSMA. **Figure 7** depicts the current zoning districts within the City of Grand Rapids. The City of Grand Rapids zoning is discussed further in Section 5 when assessing risk and prioritizing actions and strategies.

Table 5 DWSMA Land Use Summary	
Land Use Classification	Percent of Land Area In DWSMA
Commercial	5.2%
Forestry	2.1%
Industrial	17.5%
Institutional	4.2%
Mining and Extractive	39.4%
Open Water	15.3%
Public Lands	0.6%
Residential	1.1%
Residential - Multifamily	2.0%
Residential - Seasonal	5.0%
Right-of-Way	0.5%
Tax Forfeit - Vacant	3.1%
Transportation and Utilities	3.6%
Unknown	0.0%
Vacant or Undeveloped	0.2%

*Source: City of Grand Rapids

Table 6 Grand Rapids Zoning Districts (2015)					
Zoning District	Percent of Land Area In DWSMA	Zoning District	Percent of Land Area In DWSMA	Zoning District	Percent of Land Area In DWSMA
Central Business	0.6%	One and Two-Family Residence	3.0%	Shoreland Industrial Park	2.5%
Conservancy	3.1%	One-Family Residence	8.5%	Shoreland Limited Business	0.1%
General Business	3.9%	One-Family Residence (Small Lot)	0.0%	Shoreland Multi-Family Residence	0.8%
Industrial Park	18.2%	Public Use	5.6%	Shoreland One and Two-Family Residence	1.7%
Limited Business	0.5%	Recreational Commercial	2.1%	Shoreland One-Family Residence	3.1%

Zoning District	Zoning District	Zoning District	Zoning District	Zoning District	Zoning District
Medical	0.4%	Rural Residential	22.2%	Shoreland Public Use	2.2%
Mining Overlay District	6.0%	Scenic By-Way Commercial Overlay District	0.6%	Shoreland Rural Residential	6.7%
Multi-Family Residence (High Density)	0.6%	Shoreland General Business	1.0%	Urban Overlay	3.6%
Multi-Family Residence (Medium Density)	1.5%	Shoreland General Industrial Park	1.7%	Shoreland Industrial Park	2.5%

*Source: City of Grand Rapids

Since there are areas within the DWSMA where the source water aquifers have been classified as moderate and highly vulnerable, most land uses have also been considered as part of the potential contaminant source inventory (please refer to Section 1.1.2.3) and are discussed in more detail in Section 5 . The City of Grand Rapids and the GRPUC have also considered the presence and use of other wells within the DWSMA when developing this Plan.

2.2.2 Public Utility Services

Records of well construction and maintenance apply to this portion of the plan due to the information available regarding the wells and the quality and quantity of the water supplying this system. This information was provided in Part I of the Plan and was used to support the development of Section 6 of this Plan, which details a water emergency and conservation plan for this system. The wellhead team considered well construction as part of the Plan Amendment.

Oil and gas pipelines are depicted in **Figure 11** and their location was considered as part of the Plan Amendment and potential contaminant source inventory. It was noted however, that the GIS dataset received by the Office of Pipeline Safety does not appear to line up accurately to the aerial photographs.

Transportation corridors, and the storm water management system (ditches, culverts, channels, retention ponds, etc) for Grand Rapids, are depicted in the **Figure 9** and the location of the GRPUC water and sanitary sewer systems in **Figure 10**.

2.3 Water Quantity Data Elements

2.3.1 Surface Water Quantity

This data element applies to this Plan because there appears to be a hydraulic connection between surface waters and the aquifers serving this water supply system, specifically in the high vulnerability portions of the DWSMA. The Mississippi River, widening into Blandin Reservoir in Grand Rapids, crosses the southern portion of the DWSMA. It flows primarily thorough the low vulnerability portion, but does cross over the moderately vulnerable area. McKinney, Hale, Ice and Forest Lakes are located within highly vulnerable portions of the DWSMA. The southern portion of Forest Lake is located in the moderately vulnerable portion of the DWSMA (see **Figure 8**). USGS gaging station 5211000 is located on the Mississippi River at the outlet of Blandin Reservoir. The following stream flow data was available for the period of record (8/13/1964 through 9/8/2015):

High: 4,400 ft³/s

Low: 58.9 ft³/s

Mean: 1,243.4 ft³/s

There are currently two active surface water appropriation permits approved by the DNR located within the City's DWSMA. One is for industrial processing and the other is for power generation. More information is provided in **Table 7**.

The wellhead team considered water bodies with high water marks as part of this plan amendment.

Table 7 Active Surface Water Appropriation Permits

Permittee	Permit Number	Use Name	Category	Resource Name	2011*	2010*	2009*	2008*	2007*	2006*
Blandin Paper Company	1975-2147	Paper Pulp Processing	Industrial Processing	Mississippi River	4,091	5,077	4,562	4,387	4,388	3,713
Blandin Paper Company	1975-2147	Steam Power Cooling (once through)	Power Generation	Mississippi River	2,161	2,512	2564.9	2,702	2,425	2,362

*Volumes are in million gallons per year. Most Recent Data Available Provided. MN DNR SWUDS database.

2.3.2 Groundwater Quantity

Groundwater levels in the source water aquifers appear stable and adequate for the amounts that the GRPUC is currently permitted to withdraw under the water appropriation program administered by the Minnesota Department of Natural Resources (MNDNR).

An Appropriation Permit is required for any person or business that uses more than 10,000 gallons of water per day or 1,000,000 gallons per year. The permits are cataloged in the State Water Use Data System and provides water use data prior to 2012. Water use data for years 2012 to present is available from the MNDNR Permitting and Reporting System (MPARS). These databases were queried for Part I of the Plan to identify high-capacity wells that could potentially influence or impact the local groundwater flow fields and the City's municipal wells. There are 4 additional high-capacity well located within the DWSMA. High yield wells located near the City of Grand Rapids are shown in **Figure 1**. **Table 8** below identifies water appropriation permitted wells. There are currently no high-capacity wells within the DWSMA from which well interference complaints with the GRPUC wells have been documented.

At this time it appears that the source water aquifers used by the public water supply system are sufficient and adequate in quantity and capacity to provide water to Grand Rapids residents during the life of this Plan and into the future. At this time, there are no indications that the performance of source water aquifers are decreasing or degrading in general.

The wellhead team took in to account any additional environmental boreholes, unique well numbers, aquifer measured, years of record and average monthly levels as it developed the PCSI.

Table 8 Annual Volume of Water Discharged from Nearby High Capacity Wells

Unique No	Permit Number	Use	Appropriated Volume*	Aquifer	2013	2012	2011	2010	2009
249403	1975-2189	Public Supply	5,000,000*	QBAA	904,462	1,430,400	1,111,600	899,200	1,176,900
249421	1975-2189	Public Supply	5,000,000*	QBAA	420,441	1,176,660	1,135,820	898,700	1,144,850
486651	1975-2189	Irrigation	5,000,000*	QBAA	144,475	382,909	1,149,600	1,660,100	783,500
486652	1975-2189	Irrigation	5,000,000*	QBAA	0	128,600	30,800	51,200	187,700

Source: MN DNR MPARS Database and MDH

Note: Total appropriated volume for Permit #1975-2189 is 20,000,000 gallons per year

2.4 Water Quality Data Elements

2.4.1 Surface Water Quality

This data element applies to the highly vulnerable areas of the DWSMA because there appears to be a hydraulic connection between surface waters and the aquifers serving this water supply system. Seven lakes exist within the GRPUC DWSMA. The Mississippi River also flows through the low and moderate portion of the DWSMA. Two lakes are un-named shallow lakes. Five named lakes exist within the City’s DWSMA. Blandin Reservoir, part of the Mississippi River located within the low and moderate portions of the DWSMA, has been identified by the MPCA as an impaired water body.

McKinney, Hale, Ice and Forest Lakes are located within highly vulnerable portions of the DWSMA. The southern portion of Forest Lake is located in the moderately vulnerable portion of the DWSMA. No water bodies within the highly vulnerable portions of the DWSMA have been identified as an impaired water body by the MPCA.

A query of MPCA water quality monitoring station data identified seventeen (17) surface water quality sampling points located within the GRPUC DWSMA. Of those 17, seven (7) are located within the highly vulnerable portions of the DWSMA. Surface water sampling locations are depicted on **Figure 8**. The sampling dates, intervals, and analytes vary for each site based upon each sampling event and location purpose. Available historic surface water quality data for those sites located within the highly vulnerable portion of the DWSMA is provided as **Appendix D**.

2.4.2 Groundwater Quality

The quality of groundwater in the source water aquifers within the DWSMA must be evaluated and assessed for this Plan. Groundwater contamination and undesirable groundwater quality will directly impact the public water supply system.

The overall quality of groundwater in Grand Rapids is good and quite similar for all the aquifers. No contaminants were detected at levels that violated federal drinking water standards. Some were detected in trace amounts that were below legal limits.

Samples from the GRPUC wells and public water supply system are routinely collected and analyzed by the MDH as required under the Minnesota Public Water Supply Program and the federal Safe Drinking Water Act. The samples are tested for microorganisms, inorganic compounds, metals, organic and synthetic chemicals, pesticides, herbicides, and radioactive pollutants. The GRPUC is required by the federal government to publish and distribute an annual *Drinking Water Consumer Confidence Report* to all citizens using its public water supply system.

Trace amounts of regulated substances detected in the GRPUC's public water supply. The water in the GRPUC supply system currently meets or exceeds all state and federal requirements and limits for these and all other regulated compounds and chemicals.

The GRPUC Consumer Confidence Report (**2014 Water Quality Report**) is available on the GRPUC's website at: <http://www.grpuc.org/>. A copy of the **2014 Water Quality Report** is also provided in **Appendix E**.

Isotopic data was reviewed in Part I of the Plan Amendment. Samples from the Municipal Wells and Hale, McKinney, and Crystal Lake are presented and plotted in **Appendix A**.

The wellhead team is not aware of any groundwater tracer studies conducted in the area. The groundwater team considered site studies and property audits identifying contamination as well as existing reports to the MDA and MPCA regarding spills and releases when conducting the potential contaminant source inventory.

3.0 Impact of Land and Water Use Changes on the Public Water Supply Wells

The City of Grand Rapids estimates that the following changes to the physical environment, land use, surface water, and groundwater may occur over the 10-year period that the WHP is in effect. This is needed to determine whether new potential sources of contamination may be introduced in the future and to identify future actions for addressing these anticipated sources. Land and water use changes may introduce new contamination sources or result in changes to groundwater use and quality. The anticipated changes may occur within the jurisdictional authority of the City, although some may not. The sections below describe the anticipated changes to the physical environment, land use, and surface water or groundwater in relationship to the 1) influence that existing governmental land and water programs and regulations may have on the anticipated change, and 2) administrative, technical, and financial considerations of the Public Water Supplier and property owners within the DWSMA.

3.1 Changes Identified in the Physical Environment

Large-scale changes in the physical environment within the DWSMA are not anticipated during the 10-year period that this Plan is in effect. The hydrogeologic conditions of the source water aquifers are such that changes in physical environment could have some effect on the source water aquifers within the DWSMA.

3.2 Changes Identified in Land Use

The GRPUC and City of Grand Rapids are unable to effectively control land use changes beyond its own municipal boundaries and will be dependent upon neighboring communities and government units to assist in protecting the source water aquifers used by the GRPUC. As stated in Section 2.2.1, there will be a great need for collaboration, between the GRPUC and the City of Grand Rapids and with neighboring communities and LGUs.

Due to the extent of the DWSMA, it is likely that land uses will be altered within the DWSMA over the 10 year life of this Plan. Expansion of and new development in Grand Rapids in the next 10 years, as well as re-development of existing properties, is likely to occur. A Future Land use Map is provided as **Figure 6**. The information was obtained from the City of Grand Rapids and was used to update the City's Comprehensive Plan. The Comprehensive Plan states that:

“The Future Land Use map is a snapshot of the preferred mix of land uses at a point 20 years in the future.”

Therefore the map is what the City expects land use look like in 2021, assuming the vision and goals of the Comprehensive Plan are met.

A small portion, approximately 13 acres, of the DWSMA extends outside the Grand Rapids political boundary into the City of Cohasset. The GRPUC and City of Grand Rapids will cooperate and collaborate with Cohasset and other local government units to develop and implement wellhead and source water protection policies and strategies.

Since the development of the original WHPP, the City of Grand Rapids has annexed a portion of Grand Rapids Township. There have been some zoning and land use changes since the original plan. The City of Grand Rapids most recent zoned land use is presented in **Figure 7**.

3.3 Changes Identified in Surface Water

There appears to be a hydraulic connection between surface waters and the aquifers used by the GRPUC as a drinking water source in the highly vulnerable areas of the DWSMA. Therefore,

changes to the conditions of surface waters may have an impact on the quality or quantity of the public water supply.

As described in previous sections, there are a number of lakes located within the GRPUC's DWSMA. **Figure 8** shows the spatial relationship between the surface water features and DWSMA vulnerability zones. McKinney, Hale, Ice and Forest Lakes are the major surface water bodies located within highly vulnerable portions of the DWSMA. Any changes in surface water use or quality will follow the goals and objectives defined in the City of Grand Rapids Comprehensive Plan. The Plan states that:

“Future land use choices should consider the impact of development choices on water quality and quantity. Crystal, McKinney and Hale lakes are located within city drinking water recharge areas. The Blandin Reservoir and Mississippi River through the city are listed as impaired waters for excess mercury by the Minnesota Pollution Control Agency. Horseshoe Lake was listed in 2010 as impaired for excess nutrients and a Total Maximum Daily Load (TMDL) analysis will occur at some point in the future. Excess nutrients, however, typically come from residential turf management, storm water runoff, and agricultural practices which can be influenced by local land use choices.”

3.4 Changes Identified in Groundwater Conditions

With its existing public water supply system, the GRPUC provides good quality and sufficient quantity of water to its customers. Current groundwater withdrawals do not appear to be having a negative impact on the groundwater supply. Large changes in groundwater use are not expected over the life of this plan.

3.5 Expected Changes in Water Use

The GRPUC does not anticipate that its water use will increase significantly during the life of this Plan. New high-capacity wells or changes to existing Water Appropriation Permits near the municipal wells could impact the performance of the wells, decrease the capacities of source water aquifers, and/or alter the groundwater flow fields and WHPA.

3.6 Influence of Existing Water and Land Use Government Programs and Regulations

The Minnesota Pollution Control Agency (MPCA) is the government agency responsible for regulating and overseeing most of the potential contaminant sources related to the environment such as hazardous waste generators, underground and aboveground storage tanks, spills, leaking underground storage tank sites, voluntary investigation and cleanup sites, dumps, Superfund Sites, etc. The Minnesota Department of Agriculture (MDA) is responsible for regulating facilities, spills, and releases related to agriculture-based chemicals and substances (i.e. manufacturers, retailers, or users of pesticides, herbicides, fertilizers, etc.). The GRPUC will continue to rely on these State agencies and their programs and policies to enforce existing State regulations. In addition, the GRPUC and City will continue to work with Itasca County Soil and Water Conservation District, its programs and policies related to wetland management. The Minnesota Technical Assistance Program is another resource the GRPUC and City can utilize to assist in preventing pollution and reducing waste from local businesses.

The City of Grand Rapids has adopted many Public Infrastructure and Natural Infrastructure Goals and Priorities in their Comprehensive Plan that align well with the Objectives and Goals in this Wellhead Protection Plan. Some examples include:

- Create a wellhead protection overlay for drinking water wells that identifies and limits land uses that put drinking water systems at risk within the high vulnerability areas. The Wellhead Protection Management area, identified in the Wellhead Management Plan defines an area where the City should adhere to best management practices for protection of groundwater.
- Consider setting standards to mitigate risks to drinking water supply in all vulnerability areas. Recognize and address the development and land use implications of the Drinking Water Vulnerability Areas when reviewing development proposals. **Table 11** will be used to determine risk based upon land use classification and DWSMA Vulnerability. Consider a formal process for mitigating risk for development in the Drinking Water High Vulnerability area.
- Consider demand-side management programs to sustain Grand Rapids' drinking water supply sources.
- Participate in regulatory processes to address impaired waters and continue to incorporate a range of best management practices in new developments and in public rights-of-way during street and trail construction.
- Continue to engage the public in dialogue on public utility planning and service assessment. Develop an outreach/education strategy to promote better understanding of improvement projects and their relationship to quality of life and the greater good of the community.
- Maintain awareness of new wastewater treatment technology, including systems applicable in rural areas of the City.
- Identify potential environmental and natural resource conflicts concerning new facilities or upgrades to existing facilities prior to design phase. Consider criteria that identify and recognize environmental constraints, as described in the natural infrastructure section.
- Define the natural system infrastructure within future development and re-development areas. Rural development design standards must take into consideration septic system best management practices, private wells water source, trees and vegetation removal, and water quantity and quality for natural infrastructure protection.

It is important that the above stated goals be adhered to, specifically to the surface water bodies located in the high vulnerability areas of the DWSMA.

3.7 Administrative, Technical, and Financial Considerations

For this Plan to be effective:

1. The GRPUC will need to identify and document potential sources of contamination to prevent contamination of its source water aquifers.
2. The GRPUC will need to continue to raise public awareness of the issues affecting its drinking water supply through public educational programs.

3. Administrative duties will remain with the Wellhead Protection Manager, who will report to the GRPUC, coordinate the implementation of wellhead protection management action plans, and conduct regular meetings.
4. Support of wellhead and source water protection activities will be provided by funds from the GRPUC water operating fund. Other sources of funding or in-kind services to help achieve the goals set forth in this Plan's Section 4.0 include:
 - a. MDH wellhead implementation grants;
 - b. the MPCA and MDA and their environmental contamination prevention and cleanup programs;
 - c. the MDH Drinking Water Protection Section in monitoring the quality of the public water supply system;
 - d. the MDH Well Management assisting with determining the correct measures for sealing unused wells, constructing new wells, and requiring the sealing of unused wells if this becomes necessary; and
 - e. the MDH Drinking Water Protection Section and the Minnesota Rural Water Association providing technical assistance during the wellhead protection implementation phase.

The costs of implementing wellhead and source water protection activities will be evaluated on an annual basis to determine whether the original cost estimates match the scope of the management practices identified in this part of the Plan. The GRPUC will discuss changes in Plan implementation costs with MDH to determine the availability of state or federal funding for offsetting increased costs of plan implementation.

4.0 Establishing Priorities and Assigning Risk to Potential Contaminant Sources

The management strategies selected and documented in Section 7.0 of this Plan focus on land use activities that have the highest potential to impact the vulnerable aquifers the GRPUC is using for its drinking water supply.

4.1 Potential Contaminant Source Identification and Verification Process

Since portions of the GRPUC DWSMA (and MDH identified SWCA) have been classified as highly vulnerable to contamination and assigned a high priority of protection, a comprehensive potential contaminant source inventory was completed for this Plan Update. In order to conduct a Potential Contaminant Source Inventory (PCSI) for the City DWSMA, information obtained from the MPCA, MDH, MDA, the City of Grand Rapids, the GRPUC and Itasca County were used as starting points. Sanborn Fire Maps for years 1897, 1904, 1908, 1913, 1922, and 1928 were also reviewed.

A PCSI meeting was held with personnel from Grand Rapids Public Utilities, the City of Grand Rapids, and Source Water Solutions to evaluate the status of contaminant sources. Those present at the meeting also brought forth additional potential contaminant sources, which are addressed in this report. An update to the City's Inner Wellhead Management Zone (IWMZ) Inventory is included as **Appendix H**.

The DWSMA vulnerability classification determines the type of land uses and contaminant sources that need to be inventoried. The GIS point datasets, when addresses were available, were geocoded and moved to the appropriate address location. These datasets were pared down based upon the vulnerability of the DWSMA where the site address had been matched. The new locations were then manually cross checked to the address of the nearby parcels in the Itasca County parcel polygon dataset. If they matched, the point was manually moved inside the appropriate parcel polygon. A spatial join was then conducted to match the point to the appropriate Parcel Identification Number (PIN). The site records that returned a populated PIN field were added to the verified dataset.

The verified shapefile attribute table was then updated with Potential Contaminant Source (PCS) and Material Codes.

4.2 Potential Contaminant Source Inventory Results

Table 9 summarizes the potential contaminant sites identified within the GRPUC DWSMA. **Figure 11** depicts the locations of these sites.

Tables summarizing the potential contaminant source information related to the identified land uses and activities within the DWSMA are provided in **Appendix G**. The addresses affiliated with these sites have been cross-referenced with Parcel Identification Numbers where feasible to verify the locations of the potential contaminant sources. The MPCA database contains a single record for a site location. If that location has multiple activities associated with it, the record is denoted as "multiple activities". For the sites located within the GRPUC DWSMA, those records were expanded to include all activities.

Table 9 DWSMA Potential Contaminant Source Inventory Summary		
High Risk Sites	Total in DWSMA	Total in ERA (1 yr.)
Wells	200*	7
Leak Sites	16 Closed	0
Registered Storage Tank Sites	10 Active 2 Inactive	1 Active
Pipelines	3 Active	0
State Assessment Site	1 Active	0
Voluntary Investigation and Cleanup (VIC) Sites	1 Closed	0
Solid Waste Site	1 Closed 1 Unknown	0
Individual Sewage Treatment Systems (Septic Systems)	115 Active	0
Medium Risk Sites	Total in DWSMA	Total in ERA (1 yr.)
Small to Minimal Quantity Hazardous Waste Generator Permits	3 Active 2 Inactive	2 Active
Agricultural Spill (Emergency)	10 Closed	0
Agricultural Chemical Storage Site	1 Active	0
Construction Stormwater Permits	1 Active 1 Inactive	0

*Denotes total number of wells including municipal wells and the wells located in the ERA.

Section 7, of this Plan, details management strategies proposed to address the potential sources of groundwater contamination.

The GRPUC has elected to address the potential contaminant sources based upon risk, in the following prioritized order.

1. High-risk potential sources of contamination within the SWCA and ERA.
2. Medium-risk potential sources of contamination within the SWCA and ERA.
3. High-risk potential sources of contamination within the highly vulnerable areas of the DWSMA.
4. Medium-risk potential sources of contamination within highly vulnerable areas of the DWSMA.
5. High-risk potential sources of contamination within moderately vulnerable areas of the DWSMA.
6. Medium-risk potential sources of contamination within the DWSMA.

5.0 Land Use Issues, Problems, and Opportunities

The GRPUC has identified water and land use issues, problems and opportunities related to:

- the aquifers used by the City water supply wells,
- the quality of the well water, or
- land or water use within the DWSMA.

The GRPUC will assess input from public meetings and written comments it receives, the data elements identified by MDH during the scoping meetings, and the status and adequacy of the City’s official controls and plans on land and water uses, in addition to those of local, state, and federal government programs. Identifying issues, problems and opportunities, including resource needs, enables the GRPUC to take advantage of opportunities that may be available to make effective use of existing resources, set meaningful priorities for source management, and solicit support for implementing specific source management strategies.

The GRPUC has elected to address the land uses based upon risk, in the following prioritized order.

1. High-risk potential of contamination within the SWCA and ERA.
2. Medium-risk potential of contamination within the SWCA and ERA.
3. High-risk potential of contamination within the highly vulnerable areas of the DWSMA.
4. Medium-risk potential of contamination within highly vulnerable areas of the DWSMA.
5. High-risk potential of contamination within moderately vulnerable areas of the DWSMA.
6. Medium-risk potential of contamination within the DWSMA.

How these land uses will be addressed is discussed in further detail in Section 7.0.

5.1 Issues, Problems, and Opportunities Related to the Aquifer

The source water aquifers could be adversely affected by many land use activities and potential contaminant sources in highly vulnerable areas, as well as other wells that penetrate the same aquifers.

Table 10 identifies Grand Rapids zoned land use types and the potential risk each land use may pose to the City’s aquifer. **Table 11** identifies the percent of current zoned land use based upon DWSMA vulnerability classification and risk for contamination.

Table 10 Existing Land Use in Grand Rapids	
Land Use	Potential Risk to Aquifer
Commercial	Moderate to High Risk (potential spills, surface water runoff)
Forestry	Low Risk (fertilizer runoff to surface waters)
Industrial	High to Moderate Risk (potential spills, surface water runoff)
Institutional	Moderate to High Risk (potential spills, surface water runoff)
Mining and Extractive	High to Moderate Risk (potential spills, surface water runoff)
Open Water	Moderate to High Risk (seepage to groundwater)
Public Lands	Low Risk (fertilizer runoff to surface waters)

Land Use	Potential Risk to Aquifer
Residential	Low to Moderate Risk (lawn fertilizers, surface water runoff)
Residential - Multifamily	Low Risk (lawn fertilizers, surface water runoff)
Residential - Seasonal	Low to Moderate Risk (lawn fertilizers, surface water runoff)
Right-of-Way	Moderate to High Risk (potential spills, surface water runoff)
Tax Forfeit - Vacant	Moderate to High Risk (potential contaminant sources, surface water runoff)
Transportation and Utilities	Moderate to High Risk (potential spills, surface water runoff)
Unknown	Moderate to High Risk (potential contaminant sources, surface water runoff)
Vacant or Undeveloped	Low Risk (fertilizer runoff to surface waters)

Land use	SWCD High Vulnerability	DWSMA High Vulnerability	DWSMA Moderate Vulnerability	DWSMA Low Vulnerability
One-Family Residence	9.5%	11.0%	22.5%	25.9%
Multi-Family Residence (Medium Density)	1.7%	1.9%	1.5%	0.0%
Multi-Family Residence (High Density)	0.7%	0.0%	0.0%	1.8%
Limited Business	0.0%	0.0%	1.2%	1.4%
Industrial Park	20.4%	23.5%	0.0%	0.0%
Shoreland General Industrial Park	0.0%	0.0%	4.5%	5.2%
Conservancy	3.4%	3.9%	8.1%	3.1%
Shoreland General Business	0.0%	1.3%	2.7%	9.2%
One and Two-Family Residence	3.4%	3.9%	7.9%	0.0%
Shoreland Public Use	2.5%	2.9%	5.9%	6.8%
Central Business	0.0%	0.0%	1.5%	1.7%
Shoreland Industrial Park	0.0%	0.0%	6.6%	0.0%
Medical	0.0%	0.0%	0.0%	1.3%
General Business	0.0%	0.0%	10.2%	11.8%
Shoreland One-Family Residence	3.4%	4.0%	8.1%	9.4%
Shoreland One and Two-Family Residence	1.9%	2.2%	4.5%	5.2%
Shoreland Multi-Family Residence	0.9%	1.0%	0.0%	0.0%
Shoreland Limited Business	0.0%	0.0%	0.0%	0.3%
Shoreland Rural Residential	7.5%	8.6%	0.0%	0.0%
Recreational Commercial	2.3%	0.0%	0.0%	0.0%
Rural Residential	24.9%	28.7%	0.0%	0.0%
Public Use	6.2%	7.2%	14.7%	17.0%
Mining Overlay District	6.7%	0.0%	0.0%	0.0%
Urban Overlay	4.0%	0.0%	0.0%	0.0%
Scenic By-Way Commercial Overlay District	0.7%	0.0%	0.0%	0.0%
One-Family Residence (Small Lot)	0.0%	0.0%	0.0%	0.05%

Risk for Contamination	Highest	High	Moderate	Low	Minimal
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5.1.1 Wells

There were 200 wells identified within the DWSMA. These wells were identified by merging the MDH county well database with a verified private well database that the GRPUC currently maintains and removing the common well records. The CWI dataset contains 99 wells located within the GRPUC DWSMA. The City maintained a database containing 197 verified well locations within the DWSMA. The CWI identified three additional wells that were not in the City's database.

Wells were identified as the highest risk potential contaminant sources for the City's source water aquifers. Based upon a comparison of MDH Unique Well IDs assigned to the CWI and City's datasets, the data sets were combined.

5.1.2 Leak and Spill Sites

Leak Sites are classified in this Plan as high risks for groundwater contamination. As discussed in the previous section, these sites have had a storage tank release its contents into or onto the ground. There were 16 closed leak sites identified within the vulnerable portion of the DWSMA and SWCA. Although the leak sites have been "cleaned" and "closed" by the MPCA, some of these sites may still have remaining soil and/or groundwater contamination.

5.1.3 Tank Sites

Underground and aboveground storage tanks used to store large quantities of liquid chemicals and potentially hazardous substances are classified in this plan as high risks for groundwater contamination. These storage tanks include residential fuel oil tanks. If leaking or ruptured, these tanks could release large quantities of chemicals into the subsurface, which could eventually enter the source water aquifers and public water supply wells. There were 10 active and 2 inactive registered tank sites identified within the vulnerable portion of the DWSMA and SWCA.

5.1.4 Petroleum Brownfield Sites

Petroleum brownfield sites, like leak sites pose a threat to groundwater supplies. Although many have been "cleaned" and "closed" by the MPCA, some of these sites may still have remaining soil and/or groundwater contamination. No Brownfields sites were identified in the DWSMA.

5.1.5 Superfund (CERCLIS) Sites

Contamination migrating from identified superfund sites may impact groundwater supplies. No superfund sites were identified within the DWSMA.

5.1.6 State Assessment Sites

State Assessment sites are places the MPCA has investigated due to suspected contamination. They are assessed to determine if they pose a risk to human health or the environment. If so, they are referred to a cleanup program. Contamination migrating from identified state assessment sites may impact groundwater supplies. One active state assessment sites was identified within the vulnerable portion of the DWSMA.

5.1.7 Voluntary Investigation & Cleanup (VIC) Sites

Like the leak and petroleum brownfield sites above, VIC sites pose a contamination threat to groundwater supplies. Although the VIC site located within the vulnerable portion of the

DWSMA has been “closed” by the MPCA, the site may still have remaining soil and/or groundwater contamination.

5.1.8 Solid Waste Sites

Closed solid waste sites pose a threat to groundwater and are identified in this plan as posing a high risk for groundwater contamination. One closed solid waste site and one unknown status solid waste site was identified in the vulnerable portion of the DWSMA.

5.1.9 Agchem Facilities

Agchem facilities are businesses, facilities, or properties that manufacture, use, sell, or store large quantities of chemicals, solvents, and substances for agricultural purposes. These types of sites are considered moderate risks for groundwater contamination. One AgChem Facility was identified within the vulnerable portion of the DWSMA.

5.1.10 Hazardous Waste Generators

Hazardous waste generators are facilities or businesses registered and regulated by the State that generate a specified amount of hazardous waste per month. These types of sites are typically considered to be medium risks for groundwater contamination. There were 5 hazardous waste generators identified within the vulnerable portion of the DWSMA and SWCA.

5.1.11 Individual Sewage Treatment Systems (Septic Systems)

There were 115 properties identified as having an individual sewage treatment system within the highly vulnerable portion of the DWSMA and SWCA. Leachate not properly treated discharged can potentially contaminate groundwater. A failed drain field can provide direct contamination to groundwater.

5.1.12 Petroleum Pipeline

Three liquid fuel lines owned by Lakehead Pipeline Co are located in the highly vulnerable portion of the DWSMA. Spills and releases from pipelines are a concern where they are present.

5.1.13 Other Sites

Surface water discharge permits were included in the potential contaminant source inventory as there appears to be a connection between surface and groundwater in some areas of the DWSMA. It is important to recognize that surface water discharge to water bodies, specifically those in the high vulnerability areas, pose a potential threat to groundwater supplies.

In conducting the Potential Contaminant Source Inventory, a table top exercise was held at the Grand Rapids Public Utilities main office building to gather local information to refine and augment the inventory of contamination concerns. Participants included City staff familiar with the City’s current and past land use. During the course of that meeting, it appeared that the State databases were very complete and comprehensive. Two additional sites were identified during the PCSI verification meeting. The location of multiple sites identified in the MPCA database were found to be incorrect and were moved to the proper locations.

5.2 Issues, Problems, and Opportunities Related to The Well Water

This Plan is primarily concerned with potential contaminant sources near the public water supply wells and within the DWSMA that pose a high risk for causing groundwater contamination that could viably impact the source water aquifer and/or public water supply wells. Based on the potential contaminant source inventory, these types of sites, facilities, land

uses, or activities include: leak sites, tank sites, small to minimal quantity hazardous generator, Voluntary Investigation & Cleanup (VIC) sites, municipal and private wells, two solid waste sites, three pipelines, and one state assessment site.

The placement of additional high-capacity wells, increased pumping from existing wells, or significant changes in current groundwater appropriations within the DWSMA may have an impact on groundwater availability to all users, or increased risk that contamination may enter the part of the aquifer used by the public water supply wells.

5.3 Issues, Problems, and Opportunities Related to The Drinking Water Supply Management Area

Several potential contaminant sources were identified within the City's DWSMA. Some of these sources are within areas of the DWSMA where the source water aquifers have been determined to have a high vulnerability to contamination. The GRPUC and the City will need to rely on state agencies such as the MPCA and MDA to regulate and manage many of these land uses.

A principal concern of the GRPUC is to ensure consistent and long-term management of water wells, environmental boreholes, and observation wells within the DWSMA. The public water supply has limited legal capabilities to regulate well construction and sealing in the areas of the DWSMA beyond its legal authority. Changes in land use that increase pumping of the aquifers used by the public water supply wells need to be assessed for possible impacts on water availability and quality. Finally, the GRPUC has no regulatory authority over water appropriations and must rely on the MNDNR to address issues and concerns related to pumping.

5.4 Problems and Opportunities Disclosed at Public Meetings and in Written Comment

Per Minnesota Rule 4720.5350, the City is required to submit a copy of the WHPP to:

- Local units of government wholly or partly within the wellhead protection area,
- The regional development commission, if any, and
- Watershed districts and watershed management organizations wholly or partly within the wellhead protection area.

No comments were received during the Public Hearing or LGU review.

5.5 Problems and Opportunities Regarding Existing Data Elements

For this Plan, the GRPUC has attempted to identify and specifically locate as many potential contaminant sources as possible and feasible given the current level of information, and available resources. However, some potential contaminant sources may exist within the DWSMA that have not yet been identified or accurately located. Over time the GRPUC will continue to comprehensively review and catalog potential threats to its public water supply wells and source water aquifers for future updates to this Plan.

The GRPUC plans to utilize public education opportunities, both existing and proposed to address preventing contamination of the source water aquifers by potential sources of contamination. Additionally, the GRPUC will work in cooperation with local and regional governmental agencies to utilize existing programs when currently available and applicable.

The GRPUC has and will continue to set a high priority on well sealing for existing wells that are unused or not properly maintained. Specifically, the GRPUC will work with the MDH to 1) identify proposed wells that may present these additional concerns, 2) ensure new wells are

properly constructed, 3) determine whether an alternative aquifer could be used, and 4) identify water-use and conservation requirements that the MNDNR may specify with their water appropriations permit.

GRPUC intends to continue to focus its data collection efforts on the following activities throughout the ten-year life of this Plan:

1. Collect more detailed information on all potential sources of contamination within the DWSMA and maintain and update this information in a database.
2. The MDH and/or the Minnesota Rural Water Association will assist the GRPUC in evaluating and prioritizing the potential sources of contamination within the DWSMA and assist in implementing the management strategies in this Plan.
3. The GRPUC will work with the MPCA to identify sites and facilities that could viably contaminate groundwater and evaluate the likelihood and risk of impacting the source water aquifers or public water supply wells.
4. The GRPUC will work with MDH to identify new wells that are constructed within the DWSMA and to verify their locations.
5. The GRPUC will inform MDH when any public water supply well is repaired so that information regarding well construction, static water level, and pumping capacity can be verified or updated.
6. The GRPUC and MDH will inform each other of additional high-capacity wells that are to be constructed within the DWSMA or within a mile of its boundary. MDH will determine with the MNDNR whether the applicant for a water appropriations permit needs to conduct an aquifer test to evaluate the long-term pumping impacts on the GRPUC water supply wells.
7. If the GRPUC decides to abandon Well 5, the MDH will be informed so that the Minnesota Geological Survey can be notified and determine whether it can perform a borehole geophysical survey of the well prior to sealing.

5.6 Status and Adequacy of Official Controls, Plans, and Other Local, State, and Federal Programs on Water Use and Land Use

There are many tools available through regulating and governmental agencies that may be used to achieve the wellhead and source water protection planning goals identified in this Plan. Existing state and local governmental units and their responsibilities, available to GRPUC include:

- wellhead and source water protection – *MDH and MN Rural Water Association*
- well construction – *MDH*
- well sealing – *MDH*
- groundwater appropriation permits – *MNDNR*
- public water supply quality – *MDH*
- setbacks for specific contaminant sources from a well – *MDH and local governments through updated zoning regulations,*

- petroleum pipelines - *Office of Pipeline Safety and the MPCA*
- land use controls – *local governments (City of Grand Rapids, City of Cohasset)*
- hazardous waste generator regulation – *MPCA*
- storage tank regulation – *MPCA*
- leaking storage tank sites – *MPCA*
- agchem facilities regulation – *MDA*
- hazardous waste recycling and management – *MPCA*
- natural resources protection – *Itasca County and MNDNR*
- environmental enforcement and education – *MPCA and Itasca County*
- environmental education - *MPCA*
- free, non-regulatory, confidential environmental assistance - *MPCA Small Business Assistance Program*
- environmental waste reduction and education – *MPCA Office of Environmental Assistance*
- clean shops program (public entities) – *The Western Lake Superior Sanitary District and Itasca County*
- technical assistance with pollution prevention - *MN Technical Assistance Program*
- technical assistance for members - *MN Waste Wise (MN Chamber of Commerce)*
- hazardous waste disposal for very small quantity generators - *Itasca County*
- county solid waste and recycling education/enforcement – *Itasca County*

The GRPUC is confident that local issues may be adequately addressed through existing policies and processes. These processes include:

- existing and proposed public education programs,
- use of best management practices for storage tanks, hazardous waste management, well maintenance, and water conservation,
- open lines of communication with residents and landowners within the DWSMA,
- testing/monitoring of important or appropriate private or existing monitoring wells.

The availability of cost-share funds to assist with the sealing of identified unused/unsealed wells within the DWSMA will be further investigated with the MDH and Itasca County.

6.0 Wellhead Protection Goals

Due to the regional and local geologic setting, the GRPUC DWSMA was divided into three vulnerability designations: high, moderate, and low. As stated previously, due to the appearance of a surface water-groundwater connection, the MDH identified a Surface Water Contribution Area (SWCA). The SWCA was identified as a highly vulnerable area. As such, this Plan focuses on addressing and managing potential sources of surface water and groundwater contamination and other wells based upon the SWCA and DWSMA vulnerability zones. Additional information regarding how these designations were determined can be found in the GRPUC Part I Wellhead Plan Update (**Appendix A**).

The GRPUC public water supply system has enjoyed a sufficient water supply in the past, and proposes through the implementation of this Plan to continue to manage risk and assess threats to its water supply, change water consumption behavior, plan for emergencies while continue to supply safe, potable water for its customers into the future.

The overall goals of this Plan are to 1) prevent contamination of the source water aquifers, and 2) manage the source water aquifers cooperatively with other local government units to assure sustainable water supplies for all users in the future.

The GRPUC identified the following goals to be achieved with the action items contained in this Plan:

- Provide an adequate water supply and maintain the current level of water quality, which meets or exceeds all state and federal standards.
- Educate public officials, landowners and the general public about the importance of wellhead protection to protect the public drinking water supply.
- Develop, with appropriate First Response and State and Local Organizations, an emergency response plan for addressing spills within the 1-yr capture zone (Emergency Response Area).
- Continue to evaluate and efficiently employ technological advancements in providing water services, as well as monitor source water aquifers for water quality and quantity (water levels).
- Provide ongoing collection of data (i.e. water quality and quantity) to support future wellhead protection efforts.
- Continue general public awareness of groundwater issues and emphasize water conservation.
- Assess the impact on the source water aquifer from existing and planned wells within the DWSMA.
- Address risk based priority actions regarding identification and inventory of wells within the DWSMA.
- Address risk based priority actions relating to management of tanks sites within the DWSMA.
- Address risk based priority actions relating to management of small quantity hazardous waste generators.

7.0 Objectives and Plans of Action

Below are four primary objectives of this Plan.

1. Develop and Continually Update a Central Database of Potential Contaminant Sources to Document and Catalog Sites and Land Uses that Pose a Threat to the GRPUC Groundwater Supply.
2. Continue to Educate and Work with the Public and Businesses on Wellhead and Groundwater Protection to Create a Better Collective Understanding of How Behaviors May Affect the Quality and Quantity of the City's Water Supply.
3. Continue to Collect Water Quality, Quantity, and Hydrogeological Data to Better Understand the Source of the City's Water Supply.
4. Work Cooperatively and Collaboratively with Other City Departments and Local Governmental Units to Better Understand the Groundwater System as a Whole and Accomplish the Above Listed Objectives.

7.1 Documentation and Cataloging of Sites that Pose a Contamination Risk to the City's Wells

7.1.1 Development of Comprehensive Wellhead Protection Database

The GRPUC will utilize the information collected for this Plan to expand their current database of potential sources of groundwater contamination within the DWSMA that fits its existing needs and data infrastructure. The GRPUC will continue to identify new sources of potential contaminant source data, working with agencies identified in Section 5.6, and incorporate that data into its own database structure.

This database will be comprised of a detailed inventory of all land uses, existing and abandoned wells, and documented sites with contamination in the DWSMA based on the uses identified in the MDH PCSI Code definitions and DWSMA Vulnerability Classification.

The GRPUC will continue to add information to the database as additional potential contaminant sites are identified through working with various local and state government agencies. All current and future information collected for the database will be compatible with GIS mapping software. The PCSI will also be updated with additional information as gathered through other actions identified below.

The development of an electronic PCS contact database will also be part of this task. The GRPUC will work to develop a system of collecting PCS owner information (i.e. emails, websites, and additional pertinent contact information). This will streamline, make more efficient and reduce the cost to notify the public and businesses of education activities. Also included in this database will be contact information for cooperative and collaborative partners identified in tasks described in the following sections as well as appropriate state and local agency staff. As staff changes occur, the database will be updated to reflect the most recent available information.

- Source of Action
GRPUC, City of Grand Rapids, MN
- Cooperators
Local and state agencies including Itasca County, MN DNR, MPCA, MDH, MN Department of Agriculture, and the USGS. Other cooperators may include surrounding municipalities and LGUs.
- Time Frame
Initiated in 2015 and ongoing thereafter.
- Estimated Cost
Approximately 8 hours of staff time per year.
- Goal(s) Achieved
By the completion of this task, the GRPUC and the City will have a useful tool to track, catalog, and document: a) releases of compounds potentially threatening the public water supply, b) cleanup activities should a release occur, c) well sealings/abandonments and installations, d) installation and/or removal of storage tanks containing hazardous materials/substances, e) changes in land uses and activities within the DWSMA, f) locations of hazardous wastes and materials that could impact the public water supply, g) contact information of PCS owners, h) contact information for wellhead

cooperators. This information will also be valuable in drafting new or revised future regulations relating to specific land uses/activities in the DWSMA, as deemed necessary.

7.1.2

Identify and Document Sites with Documented Environmental Contamination

As the PCS database continually develops, and sites are identified that the GRPUC or City wishes to document further, the GRPUC and City will develop, create, and keep active files on each of these sites. As a starting point, this will be completed for the 16 leak sites, the State assessment site, the VIC sites, and solid waste sites. The MPCA, or possibly surrounding municipalities, will likely be the source of these files. Reports can be requested electronically if they exist, or scanned from hard copy reports. These electronic files will be tied to the PCSI database so that information can be easily accessed through the database.

- Source of Action
GRPUC Wellhead Protection Manager, Grand Rapids City Staff
- Cooperators
MPCA staff, Itasca County, LGUs.
- Time Frame
The MPCA will be initially contacted in 2016 and then annually thereafter.
- Estimated Cost
There may be document duplication costs for copying or requesting electronic MPCA document files. It is expected that this task will require approximately 8 - 16 hours of staff time per year.
- Goal(s) Achieved
Obtaining information regarding environmentally contaminated sites within the DWSMA will foster communication with the MPCA and inform them of the vulnerability of the source water aquifers in Grand Rapids. By connecting these documents directly to the PCSI database, accessing the reports and documents will be streamlined and more efficient.

7.1.3 Land Management of the City's Inner Wellhead Management Zone (IWMZ)

The GRPUC and City will regularly inspect potential contaminant sources identified within the IWMZ. Any PCSs identified in need of attention (i.e. sewer lines) will be prioritized for repair or replacement in a manner consistent with City's practice for infrastructure improvements.

- Source of Action

The GRPUC and City of Grand Rapids

- Cooperators

None

- Time Frame

Inspections to begin in 2016 and conducted annually thereafter

- Estimated Cost

This task is expected to require approximately 2 hours of staff time per year

- Goal(s) Achieved

This action will assist the GRPUC in identifying any potential leaks within the IWMZ. Releases within the IWMZ have a high potential of reaching the City's water wells and identifying any potential leaks early will help protect the GRPUC's water supply.

7.1.4 Inventory of the City's Inner Wellhead Management Zone (IWMZ)

The GRPUC and the MDH will update the potential contaminant source inventory within the IWMZ.

- Source of Action

The GRPUC and City of Grand Rapids

- Cooperators

MDH

- Time Frame

Inventory will be updated in year 6 of the plan.

- Estimated Cost

This task is expected to require approximately 2 hours of staff time per year

- Goal(s) Achieved

This action will assist the GRPUC in identifying any changes within the IWMZ.

7.1.5

Abandonment of Well #5

GRPUC's Well 5 (Unique ID 161423) has not been in use since 1990. The GRPUC will consider abandoning Well 5, per MDH guidance, to remove a potential contaminant source from the moderately vulnerable portion of the DWSMA. The pump has been pulled from the well and the cap is currently welded shut. The City is still maintaining the well in case their needs change, however if they determine that Well 5 is no longer needed, the GRPUC will move forward with the sealing of Well 5.

- Source of Action
GRPUC Wellhead Protection Manager, GRPUC
- Cooperators
MDH, Itasca County
- Time Frame
When the GRPUC makes a decision on abandonment, well sealing quotes will be received and the well will be abandoned.
- Estimated Cost
The cost of well sealing will be determined when quotes are received. GRPUC will explore funding options with Itasca County and/or MDH.
- Goal(s) Achieved
This action will assist with the goal of eliminating potential pollutant sources to the vulnerable source water aquifers used for public water supplies. The number of wells in the DWSMA will be reduced.

7.1.6

Sewer Line Relocation

A sewer line may need to be replaced and relocated to maintain setback distances from Wells 4 and 6 when 4th Ave. and 13th St. road improvements are made. It is anticipated that the road improvements will be completed in 2017. The existing line is a clay tile line and the replacement and relocation of this line will reduce the likelihood of contamination of the water supply from a sewer line leak.

- Source of Action
GRPUC, City of Grand Rapids
- Cooperators
MDH, MnDOT, Itasca County
- Time Frame
Expected completion in 2017
- Estimated Cost
The cost of the sewer line replacement and relocation will be determined when the project goes out to bid.
- Goal(s) Achieved
The existing line is likely a clay tile line and the replacement and relocation of this line will reduce the likelihood of contamination of the water supply from a sewer line leak.

7.2 Public Education Tasks

7.2.1 Well Owner Education

The City of Grand Rapids has a large number of private well owners. To better educate well owners about their wells, utilizing the electronic contact information portion of the PCSI Database, the GRPUC will email MDH, MRWA and/or other applicable pamphlets and brochures related to operating and maintaining wells to all identified well owners located in the DWSMA. The documents will also be made available at the GRPUC's main office and/or on the GRPUC and City's websites. An online questionnaire will be developed and a link to that questionnaire will be included in the water bill. As citizens complete the questionnaires, updated owner, well location, and status information will be gained and will be incorporated and continually updated into the PCSI database. The MDH will be responsible for providing new well owners all applicable information and documents.

Over the life of this plan, the GRPUC will continue to develop an efficient electronic method to distribute information to well owners.

- Source of Action
GRPUC
- Cooperators
MDH; well owners within the DWSMA
- Time Frame
To begin in 2016 and ongoing thereafter
- Estimated Cost
The documents and materials will be provided, free of charge, from the MDH or MRWA. The staff time required for this task will be incorporated through other existing city programs, projects, and budgets.
- Goal(s) Achieved
This action will assist the GRPUC in identifying, verifying, cataloging, and educating well owners in the DWSMA about proper use and maintenance of wells. Proper operation and maintenance of wells will reduce the potential risk that these wells will become direct pathways for contamination of the source water aquifers.

7.2.2

Publishing the Drinking Water Consumer Confidence Report

GRPUC will continue distributing the *Drinking Water Consumer Confidence Report* to all users of the Grand Rapids public water supply via the City's website, newsletter, and local paper. Over 7,000 copies currently go out to customers. Supplemental information will continue to be included to inform the reader on conservation tips and/or well sealing information. The report provides information regarding the city's public water supply system and its water quality.

- Source of Action
GRPUC
- Cooperators
None
- Time Frame
Ongoing, annually distributed as required by federal regulations.
- Estimated Cost
No new or additional costs are expected for this activity. The staff time and costs associated with this task are already allocated through existing city programs, projects, and budgets.
- Goal(s) Achieved
The general public will be more aware of the federal water quality requirements for public water supply systems, and the overall water quality of the city's public water supply.

7.2.3

Presenting Wellhead Protection and Water Conservation Information at Various Events

GRPUC will continue to provide wellhead protection and water conservation information at the City's Annual Water Summit, Itasca County Fair and during Water Day plant tours. The GRPUC will also continue to sponsor the 5th Grade Poster Contest in Grand Rapids. Water conservation and wellhead protection handouts will be provided at these events to promote wellhead protection and water conservation.

- Source of Action
GRPUC
- Cooperators
Itasca County, Local Elementary Schools, City of Grand Rapids
- Time Frame
Annually
- Estimated Cost
No new or additional costs are expected for this activity. The staff time and costs associated with this task are already allocated through existing city programs, projects, and budgets.
- Goal(s) Achieved
The general public will be made more aware of the wellhead protection plan purpose, the wellhead protection area, what they can do to protect their water supply, and water conservation techniques.

7.2.4

Public Education for Owners or Users of Underground and Aboveground Storage Tanks

The GRPUC proposes to send reminder notices regarding state and federal regulations and the importance of early leak detection to owners and users of new and existing storage tanks located within the DWSMA. An online questionnaire will be developed and a link to that questionnaire will be distributed through direct mailing. A request will be made to fuel oil suppliers to include a similar notice with their fuel oil bill. As citizens and businesses complete the questionnaires, updated owner, tank location, and status information will be gained and will be incorporated and continually updated into the PCSI database.

To better educate tank owners about wellhead protection and the role they can play in protecting the water supply, utilizing the electronic contact information portion of the PCSI Database, the GRPUC will email MPCA pamphlets and brochures related to operating and maintaining tanks to all identified tank owners located in the DWSMA. The documents will also be made available at the GRPUC's main office and on the GRPUC and City's websites.

- Source of Action
GRPUC
- Cooperators
City Planning and Fire Departments; MPCA; storage tank owners; fuel oil suppliers
- Time Frame
To begin in 2016 and three times over the plan life.
- Estimated Cost
It is assumed that the pamphlets and informational brochures will be provided by the MPCA free of charge. This task is projected to require approximately 8 hours of staff time per year.
- Goal(s) Achieved
This action will assist the GRPUC in identifying, verifying, cataloging, and educating storage tank owners and users that they are located within an environmentally sensitive area. Helping to ensure that they are meeting applicable regulations will help prevent or minimize the number and severity of petroleum product releases from storage tanks.

7.2.5

Educate Owners of Properties that Generate Hazardous Wastes or Use Hazardous Materials and Chemicals

Due to the number of small to minimal quantity hazardous waste generators within the DWSMA, the GRPUC intends to contact the MPCA, the state agency responsible for regulating and permitting hazardous waste generators, on an annual basis to inquire about the status of hazardous waste users and generators located within the DWSMA. This information will be incorporated into the GRPUC's PCSI Database. As contact information is added to the database, the GRPUC will also send out information electronically to owners of these properties to educate them about Wellhead Protection and inform them of the hazardous waste drop-off events that are offered.

- Source of Action
GRPUC, City of Grand Rapids
- Cooperators
MPCA; businesses and residents that use or generate hazardous wastes, materials, or chemicals.
- Time Frame
Annual contact with the MPCA and education efforts are ongoing. The development of an email database and incorporation of this into the PCSI will begin in 2016 and continue on an annual basis.
- Estimated Cost
This task is expected to require approximately 16 hours of staff time per year.
- Goal(s) Achieved
This action will assist the GRPUC in identifying, verifying, cataloging, and educating hazardous waste generators. It will help to ensure that improper handling and/or storage of wastes is not being conducted within the DWSMA. Education of site owners will remind them that their behavior can reduce the potential impacts to the upper source water aquifers.

7.2.6

Educate Owners of Properties that Generate, Use, Store, Apply, or Sell Agricultural-Related Chemicals

GRPUC proposes to send a letter to the facilities located within the DWSMA that use, handle, store, generate, apply or sell large quantities of chemicals used for agricultural purposes (fertilizers, pesticides, herbicides, etc.). The letter will inform the parties that their facility or property is located within the DWSMA, and the source water aquifers are vulnerable to contamination from land surface activities. In addition, as part of the GRPUC Environmental Outreach Program, the letter will provide information about the Minnesota Technical Assistance Program (MNTAP), a non-profit organization that assists businesses in proper waste handling and management. Applicable brochures and information pamphlets available through the MPCA will also be included in the letters.

- Source of Action
GRPUC and City Engineering Department
- Cooperators
MNTAP, owners, managers, and employees of facilities or businesses that use, store, generate, or sell agricultural chemicals.
- Time Frame
First letters to be sent in 2016, and three times over the life of the plan.
- Estimated Cost
No new or additional costs are anticipated for this action. This task is expected to require four hours of staff time per year.
- Goal(s) Achieved
Informing these businesses and facilities of the vulnerability of the source water aquifers in their locale will encourage cooperation with applicable regulations, and may prevent accidental spills and releases of agricultural chemicals onto the ground and into the subsurface.

7.2.8 Informational New Releases

The GRPUC and City of Grand Rapids will continue to post wellhead and water related information on its website and Facebook page. Information will include articles and information related to wellhead and source water protection, as well as potential contaminant source management such as wells, hazardous waste disposal, turf management, and others. The GRPUC will combine efforts with the policies, goals, and actions outlined in the City of Grand Rapids Comprehensive Plan and applicable Itasca County management plans.

- Source of Action
GRPUC
- Cooperators
City staff; MDH; Itasca County
- Time Frame
To begin in 2016 and at a minimum, annually thereafter.
- Estimated Cost
No new or additional costs are anticipated for this task. The staff time and costs associated with completing this action are already allocated through other city programs, projects, and budgets.
- Goals Achieved
The general public and property owners in the DWSMA as well as citywide, will become more aware of the GRPUC wellhead and source water protection program, groundwater protection principles, and steps that everyone can take to protect the City's public water supply. It will also inform citizens of the ongoing collaborative efforts of local and state agencies and governmental units.

7.3 Coordination and Collaborative Tasks

7.3.1 Incorporate Wellhead and Source Water Protection into the City's Planning Process

The City will include a review of this Wellhead and Source Water Protection Plan as part of their normal zoning and land use planning processes. Copies of the Plan will be distributed to the City's Planner.

The previous version of the GRPUC WHPP has been identified in the City of Grand Rapids 2011 Comprehensive Plan. The City has also been proactive and enrolled in the MPCA Green Step Cities program which identifies conservation measures that can help a community become more sustainable. The City of Grand Rapids was also awarded a Blue Star Award for its storm water management practices. All of these projects deal with cross cutting water management issues in one form or another. The GRPUC and the City of Grand Rapids will continue to identify these management issues and identify wellhead protection in future projects when appropriate.

In addition, to further protect the DWSMA and wells through potentially limiting storage of chemicals and permitting for proposed land uses, the City will evaluate the feasibility of creating an Overlay Zoning District corresponding to the DWSMA, and will review this document and its goals and objectives to identify any conflicts with the City's Comprehensive Plan. Any formal proposal for an Overlay District will include a description of its purpose, aims, goals, and types of control, and will need to be approved by the City.

- Source of Action
GRPUC, Grand Rapids Engineering & Public Works and Planning Departments, MPCA
- Cooperators
GRPUC, Grand Rapids Planning Commission, and Grand Rapids City Council
- Time Frame
Based upon the City's schedule and capacity, they hope to evaluate the feasibility of creating an Overlay Zoning District by 2019.
- Estimated Cost
No new or additional costs are anticipated. The staff time and costs associated with this task are already allocated through existing city programs, projects, and budgets.
- Goal(s) Achieved
Wellhead and source water protection efforts will be extended and incorporated into future planning and projects for the City. Potential pollution risks to the public water supply system will be reduced.

7.3.2

Coordination Regarding Chemical Application to Lakes Within DWSMA

GRPUC will continue its dialogue with MN DNR staff regarding the use of chemicals and herbicides on the lakes within the DWSMA. Since these lakes appear to be hydrologically connected to the source water aquifers, chemicals used on the lakes to control or remove milfoil and purple loosestrife or other applications could impact the aquifer. GRPUC will work with the MN DNR and will request that chemical treatments be minimized or ceased. As needed meetings will be held between GRPUC, MDH, and MN DNR staff.

- Source of Action
GRPUC Wellhead Protection Manager
- Cooperators
Minnesota Department of Natural Resources
- Time Frame
Beginning upon approval of this Plan in 2015 and ongoing as necessary.
- Estimated Costs
No new or additional costs are anticipated for this action. This task is expected to require 8 hours of GRPUC staff time per year.
- Goal(s) Achieved
Minimizing or stopping the use or application of chemicals on the local lakes will reduce the likelihood of contaminating the source water aquifers.

7.3.3 Coordination with Oil Pipeline Owners

The GRPUC will continue to communicate with the MPCA, Office of Pipeline Safety, and Pipeline Owner(s) and be notified of any release by the pipeline(s) located in the northern, highly vulnerable portion of the DWSMA. The GRPUC would like to further discuss a coordinated emergency response to releases and additional pipeline controls to better protect the DWSMA from spills. The meeting will include representatives of the GRPUC, City of Grand Rapids, MPCA, MDH, Office of Pipeline Safety, and the pipeline owner(s).

The accuracy of the GIS pipeline location data made available from the Office of Pipeline Safety has been in question. The GRPUC will request accurate GIS pipeline data from the Pipeline Owner or Office of Pipeline Safety to more accurately locate this important potential contaminant source.

- Source of Action
GRPUC Wellhead Protection Manager
- Cooperators
MPCA, Office of Pipeline Safety, Pipeline Owner(s), MDH
- Time Frame
Initial contact will be made in 2016 and dialogue will occur as needed thereafter
- Estimated Cost
This task is expected to require approximately 8 hours of staff time per year. No other costs are expected.
- Goal(s) Achieved
GRPUC will be notified of past, present, and future releases from the pipeline. The pipeline will better understand the potential threat/impacts of the pipelines to the source water aquifers.

7.3.4 Promoting the Sealing of Unused, Poorly-Maintained, Damaged, or Abandoned Wells

The GRPUC will continue to promote any well sealing or cost-sharing programs available through the MDH or Itasca County that may assist or reimburse the costs and administration of sealing unused, poorly-maintained, damaged or abandoned private wells located within the DWSMA.

The GRPUC will meet with the City of Grand Rapids to discuss the development of an ordinance requiring private well owners within the water service area to connect to the public water supply.

- Source of Action
GRPUC
- Cooperators
MDH, Itasca County, Surrounding LGUs
- Time Frame
Beginning in 2016 and ongoing thereafter
- Estimated Cost
This task is expected to require approximately 16 hours of staff time per year. The GRPUC will consider participating in available, existing cost-sharing programs through MDH and/or Itasca County, and/or reimbursing a portion of the well sealing costs to local residents.
- Goal(s) Achieved
This action will assist with the goal of eliminating potential pollutant sources to the vulnerable source water aquifers used for public water supplies. The number of wells in the DWSMA will be reduced.

7.3.5

Identify New High-Capacity Wells and Changes to Appropriations of Existing High-Capacity Wells

GRPUC staff and MDH staff in the Source Water Protection Unit will set up a line of communication with the appropriate MNDNR Appropriations Program personnel to identify any new, high-capacity wells proposed within the DWSMA. They will also identify any significant changes to existing Water Appropriation Permits for existing high-capacity wells. Any new high-capacity wells or changes to current Appropriation Permits will be evaluated by MDH staff to determine whether the proposed pumping will change the boundaries of the City's WHPA and corresponding DWSMA. If a change is identified, the GRPUC, MDH and MNDNR staff will meet with the well owner(s) to inform them of the potential impacts the new or existing wells may have on the City's wellhead and source water protection efforts, and discuss responsibility for changes to the WHP Plan, that may be necessary.

- Source of Action
GRPUC, MDH, MN DNR
- Cooperators
Well owners, property/business owners, and local residents
- Time Frame
Beginning at the time the Wellhead Protection Plan is approved and ongoing thereafter
- Estimated Cost
No new or additional costs are anticipated. The staff time and costs associated with this task are already allocated through existing programs, projects, and budgets.
- Goal(s) Achieved
This action will assist the GRPUC in identifying new wells proposed to be constructed in the DWSMA, and determine whether the changes from pumping of new or existing wells will affect the GRPUC Wellhead Protection Plan. This action will also provide opportunities to bring well owners into wellhead and source water protection educational programs.

7.3.6 Identification and Documentation of Septic Systems Located Within the Vulnerable DWSMA

The GRPUC intends to contact Itasca County Environmental Services, the local agency responsible for regulating and permitting septic systems, on an annual basis to inquire about the status of septic systems located within the DWSMA. Any changes and non-compliant systems will be updated and reflected in the potential contaminant source inventory database.

If a septic system is no longer in compliance with state and county regulations, the owner will be required to connect to City sewer if available.

- Source of Action
Grand Rapids Public Utilities, City of Grand Rapids
- Cooperators
Itasca County, septic system owners.
- Time Frame
To begin in 2016 and conducted annually thereafter.
- Estimated Cost
This task is expected to require approximately 4 hours of staff time per year.
- Goal(s) Achieved
The annual review of septic systems will help the GRPUC and the City document additional septic systems, which if failing, can act as a contaminant source within DWSMA. Potential impacts to the surficial source water aquifer will be minimized or averted.

7.3.7

Management of Potential Impacts Along Transportation Corridors within the DWSMA

The GRPUC will notify Mn/DOT, Itasca County Emergency Management, Grand Rapids Fire Department, local hazardous material teams, and other appropriate emergency response agencies of the main transportation corridors located within the DWSMA. They will inform them of the potential impact that an accident that results in a spill of any kind may have on the water supply system and work with them to determine a notification/emergency response system in case of a large spill along a transportation corridor within the DWSMA. Included in this notification will be a map depicting the DWSMA and the location of the major transportation corridors within the DWSMA.

The GRPUC will also work with Mn/DOT, MPCA, Itasca County, the City of Grand Rapids and other appropriate stakeholders to determine a best management practice (BMP) regarding snow and ice management on roads and salt storage within the City's DWSMA, specifically those located in the highly vulnerable SWCA.

The City will look in to sending snow plow drivers to MPCA salt application training.

GRPUC will coordinate with the City of Grand Rapids to schedule early street sweeping in the Spring before the first rainfall. This will help prevent salt and sediment from entering the storm water system.

- Source of Action

The GRPUC and City of Grand Rapids

- Cooperators

Mn/DOT; Local emergency response agencies; Itasca County

- Time Frame

The notification will be sent in 2016 and meetings will occur as necessary after. Attendance of salt application training will be reviewed by year 5 of the plan. Street sweeping coordination will begin in 2016 and occur annually thereafter.

- Estimated Cost

This task is expected to require approximately 2 to 4 hours of staff time per occurrence.

- Goal(s) Achieved

This action will require the notification of emergency responders as to the contribution areas (DWSMA) to the City's wells and aid in efficient response and clean-up in case of a large spill along transportation corridors.

This will also help to determine a BMP regarding snow and ice management which would help protect surface water from contamination of road salt, potentially impacting the City's water supply.

7.3.8 Management of Storm Water within the DWSMA

The GRPUC will work closely with the City of Grand Rapids to effectively manage storm water within the DWSMA, specifically within the highly vulnerable SWCA. The City of Grand Rapids will continue to manage storm water as outlined in their Storm Water Pollution Prevention Plan (SWPPP) and Municipal Separate Storm Sewer Systems (MS4) as outlined in the City's Storm Water Permit. The goals and policies identified in these documents align with those of the State, County, and Watershed Management District jurisdictions. As the City updates its Storm Water Pollution Prevention Plan (SWPPP) and Municipal Separate Storm Sewer Systems (MS4) it will incorporate the objectives and goals outlined regarding wellhead protection.

- Source of Action
GRPUC, City of Grand Rapids
- Cooperators
MPCA; Itasca County; Itasca County Soil and Water conservation District.
- Time Frame
To begin in 2016 and conducted annually thereafter. Any necessary changes to MS4 or SWPP will be completed when the permits are updated.
- Estimated Cost
No new or additional costs are anticipated for this task. The staff time and costs associated with completing this action will be allocated through other city programs, projects, and budgets.
- Goal(s) Achieved
This action will align the goals of both storm water management and wellhead protection. Due to the aquifer conditions in which the City obtains its water supply, the need to effectively manage storm water is necessary to protect the City's public water supply.

7.4

Additional Data Collection

7.4.1

Geologic and Hydrogeological Studies and Isotope Data Gathering

GRPUC intends to obtain additional geologic and hydrogeologic information and data regarding the Grand Rapids area. Specifically, the GRPUC will contact MDH in year six (6) and work with the MDH to have samples collected from municipal wells open to different bedrock aquifers and Hale, McKinney and Crystal Lakes within the DWSMA to be tested for tritium and stable isotopes or other parameters as determined by the MDH. GRPUC will also cooperate and collaborate with various groups conducting geologic or hydrogeological studies as feasible and applicable.

- Source of Action
Grand Rapids Public Utilities Wellhead Protection Manager
- Cooperators
Agencies or groups conducting geologic or hydrogeological studies, well drilling companies, and others.
- Time Frame
Assessment monitoring in year 6 of this plan.
- Estimated Cost
No new or additional costs are anticipated for this task. The city staff time and costs associated with this activity are already allocated through existing city programs, projects, and budgets. MDH will provide sample bottles and cover analytical costs.
- Goal(s) Achieved
By obtaining additional geologic and hydrogeological information specifically focused on the Grand Rapids area, more accurate data will be available to delineate future, revised WHPA and DWSMA for the existing and proposed municipal wells. The additional isotope analyses will provide updated information on the vulnerability of the aquifers to land surface activities and connection to the surface waters within the DWSMA. This information will be valuable for future, required updates to this Plan. Updated and more accurate vulnerability assessments will also result.

7.4.2 Well Locating

Aquifer data for the Quaternary aquifer serving Wells 1 (228870), 3 (228862), 4 (127276) and 6 (161444) is spotty in some areas, particularly in the northern and northwestern portion of the DWSMA. If wells are constructed within one mile of the City's municipal boundary or DWSMA, their locations should be verified. The City will contact MDH for assistance for an evaluation of whether there are wells within the area to locate.

- Source of Action
Grand Rapids Public Utilities Wellhead Protection Manager
- Cooperators
MDH, well drilling companies, and others.
- Time Frame
GRPUC will contact in year 5 of this plan.
- Estimated Cost
No new or additional costs are anticipated for this task. The city staff time and costs associated with this activity are already allocated through existing city programs, projects, and budgets.
- Goal(s) Achieved
By obtaining additional geologic and hydrogeological information specifically focused on the Grand Rapids area, more accurate data will be available to delineate future, revised WHPA and DWSMA for the existing and proposed municipal wells. This information will be valuable for future, required updates to this Plan.

7.4.3 Flow Logging of Well 2 (228873)

The actual fracture flow horizons for GRPUC's Well 2 have not been measured or defined via down hole flow or chemistry logging. This measurement can be done in cooperation with MDH during routine pump maintenance, as the pump needs to be pulled from the well prior to logging and sampling.

- Source of Action
GRPUC
- Cooperators
MDH, well drilling companies, and others.
- Time Frame
During routine maintenance of Well 2 as the opportunity presents itself.
- Estimated Cost
No new or additional costs are anticipated for this task. The city staff time and costs associated with this activity are already allocated through existing city programs, projects, and budgets.
- Goal(s) Achieved
By obtaining additional geologic and hydrogeological information specifically focused on the Grand Rapids area, more accurate data will be available to delineate future, revised WHPA and DWSMA for the existing and proposed municipal wells. Doing so could help to better define the fracture flow capture area of Well 2 for future amendments. This information will be valuable for future, required updates to this Plan.

7.5 Annual Evaluation Program

The success of the GRPUC Wellhead Protection program must be routinely evaluated in order to determine whether the Plan is actually accomplishing the intentions of the Utility.

Some of the goals of annual evaluations are to:

- Track the implementation of the objectives identified in Section 3.0 of this Plan
- Determine the effectiveness of specific management strategies regarding the protection of the public water supply
- Identify possible changes to these strategies which may improve their effectiveness
- Determine the adequacy of financial resources and staff availability to carry out the management strategies planned for the coming year.

In order to meet these evaluation goals, the following activities will be implemented:

1. Continue to cooperate with the MDH in the water quality monitoring of the water supply system to determine whether the management strategies are having a positive effect and to identify water quality problems that may arise that must be addressed.
2. Request members of the Public Utilities staff, City staff, the governing authority, and the Wellhead Protection Manager travel through the DWSMA on a regular basis to identify any changes in land use or potential contaminant source management practices which may adversely impact the public water supply.
3. One annual meeting will occur, to review the results of each strategy implemented during the previous plan year and to identify and discuss strategies to be implemented in the coming year.
4. An annual report will be written to the GRPUC regarding progress in implementing the wellhead protection management objectives of this Plan. The annual reports will be compiled and used to review the overall progress in implementing source management strategies every 2 ½ years and when the Wellhead Protection Plan is updated. A copy of the report will be sent to the MDH Source Water Protection Unit in St. Paul and another copy will be placed in the GRPUC wellhead and source water protection file. An annual accomplishment report will also be posted on the GRPUC website.

- Source of Action
GRPUC Wellhead Protection Manager
- Cooperators
City of Grand Rapids, Surrounding LGUs, MDH
- Time Frame
Annually beginning in 2016
- Estimated Cost
8 Hours of staff time is expected for this task.
- Goal(s) Achieved
By reviewing the WHP Program on an annual basis, the wellhead protection manager can evaluate what is working, what is not, what changes need to be made, etc.

8.0 Alternative Water Supply and Contingency Strategy

Grand Rapids has an Emergency Response Plan, which was submitted and approved by the MNDNR, Division of Waters, Appropriation Permit Program in April 2004 and will be updated by October 5, 2018. This approved Plan contains the required elements of the Minnesota Wellhead Protection Rule and is accepted as an equivalent to an Alternative Water Supply/Contingency Plan as defined in 4720.5280. Implementation of the Plan has begun with the aid and assistance of local emergency management agencies. A copy of the Plan and the MNDNR approval letter are provided in Appendix G.

9.0 Selected References

ARDC. 2005. South Central Itasca County Wastewater Management Plan. South Central Itasca County Wastewater Management Scoping Project. Prepared by Arrowhead Regional Development Commission. Facilitated by South Central Itasca County Intergovernmental Planning Board.

Grand Rapids Public Utilities. 2005. Part II Wellhead Protection Plan. Prepared by SEH.

CR Planning, et. al. 2011. Grand Rapids Comprehensive Plan. Adopted July 25, 2011. Amended July 27, 2015.

Fetter, C.W. 1988. Applied Hydrogeology, Merrill Publishing Company, Columbus, OH.

Geologic Sensitivity Project Workgroup. 1991. Criteria and Guidelines for Assessing Geologic Sensitivity of Ground Water Resources in Minnesota. Minnesota Department of Natural Resources, Division of Waters, St. Paul, MN.

Itasca County SWCD. 2012. Itasca County Local Water Management Plan 2012-2017 Update. Prepared by: Itasca County Soil and Water Conservation District and Itasca County Water Plan Implementation Committee. BWSR Approved April 2012.

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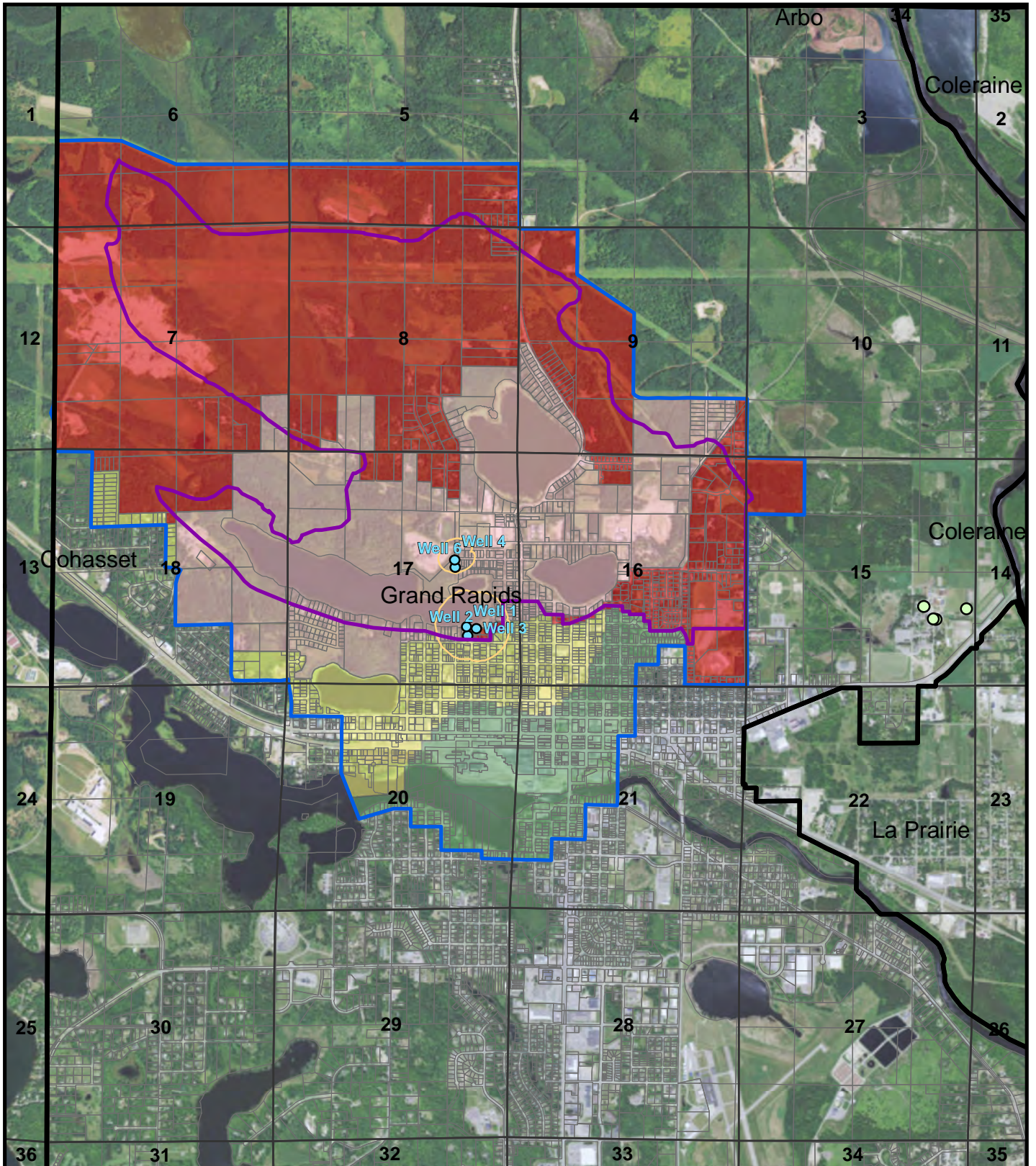
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Jirsa, M.A.; Setterholm, D.R.; Bloomgren, B.A.; Lively, R.S.. (2002). M-126 Bedrock topographic and depth to bedrock maps of the Western Half of the Mesabi Iron Range, Northern Minnesota. Minnesota Geological Survey. Retrieved from the University of Minnesota Digital Conservancy, <http://purl.umn.edu/57182>.

Meyer, G.N.; Jirsa, M.A.; Jennings, C.E.. (2005). M-131 Aggregate resource potential of Itasca County, Minnesota. Minnesota Geological Survey. Retrieved from the University of Minnesota Digital Conservancy, <http://purl.umn.edu/57186>.

Figures



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Legend

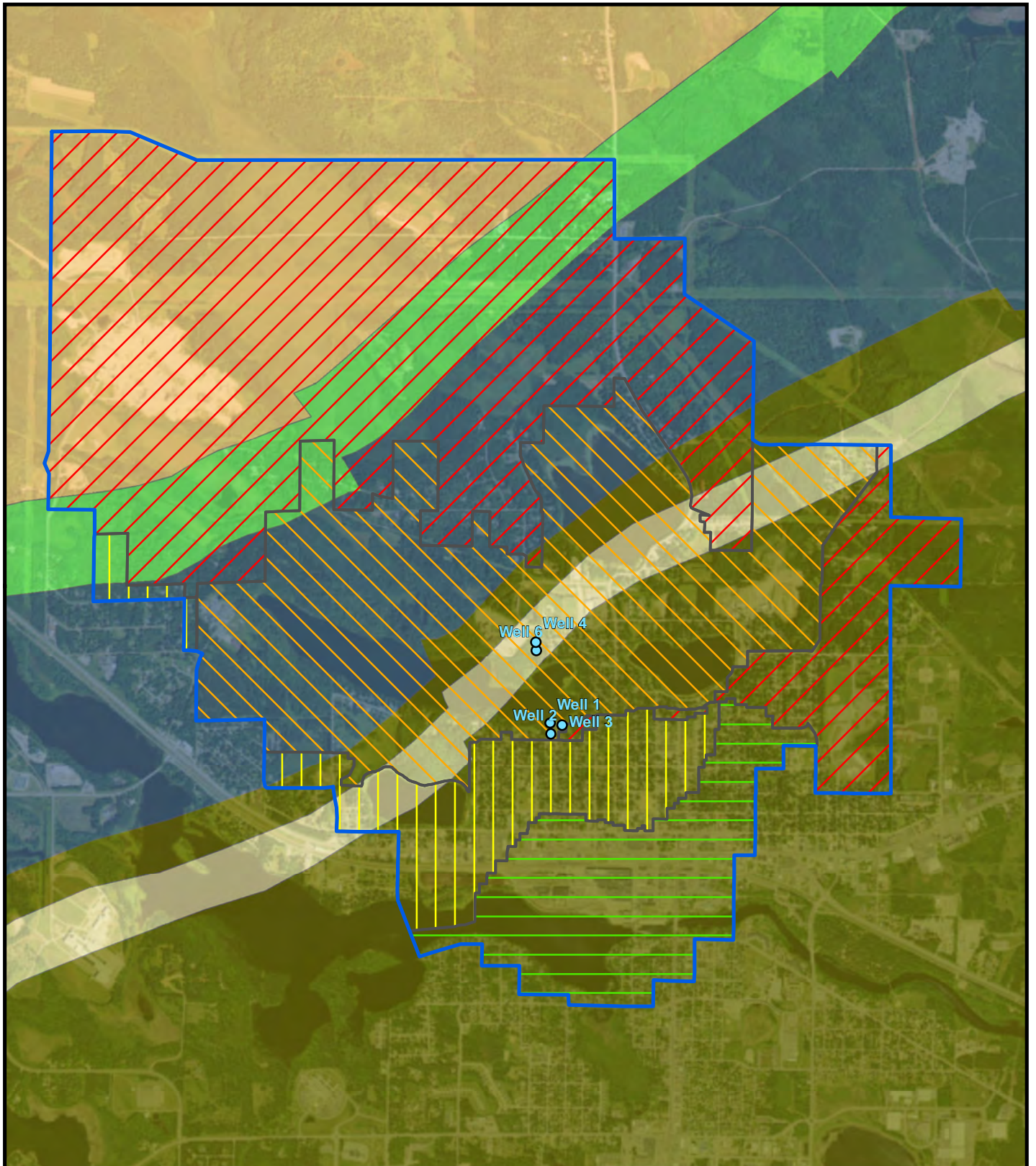
- Surface Water Contribution Area (SWCA)
- Drinking Water Supply Management Area (DWSMA)
- 1 Year Groundwater Capture Zone
- Parcels
- T55N/R25
- Municipal Wells
- High Yield Wells

- DWSMA Vulnerability**
- SWCA High
 - GW High
 - GW Low
 - GW Moderate



0 750 1,500 3,000 4,500 Feet

Figure 1
 Drinking Water Supply Management Area (DWSMA) Vulnerability
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Legend

- Municipal Wells
- Drinking Water Supply Management Area (DWSMA)
- Bedrock Formation**
- Bwabik Iron Formation
- Pokegama Quartzite
- Tonalite to granodiorite
- Virginia Formation mudstone
- Virginia Formation siderite

DWSMA Vulnerability

- SWCA High
- GW High
- GW Moderate
- GW Low

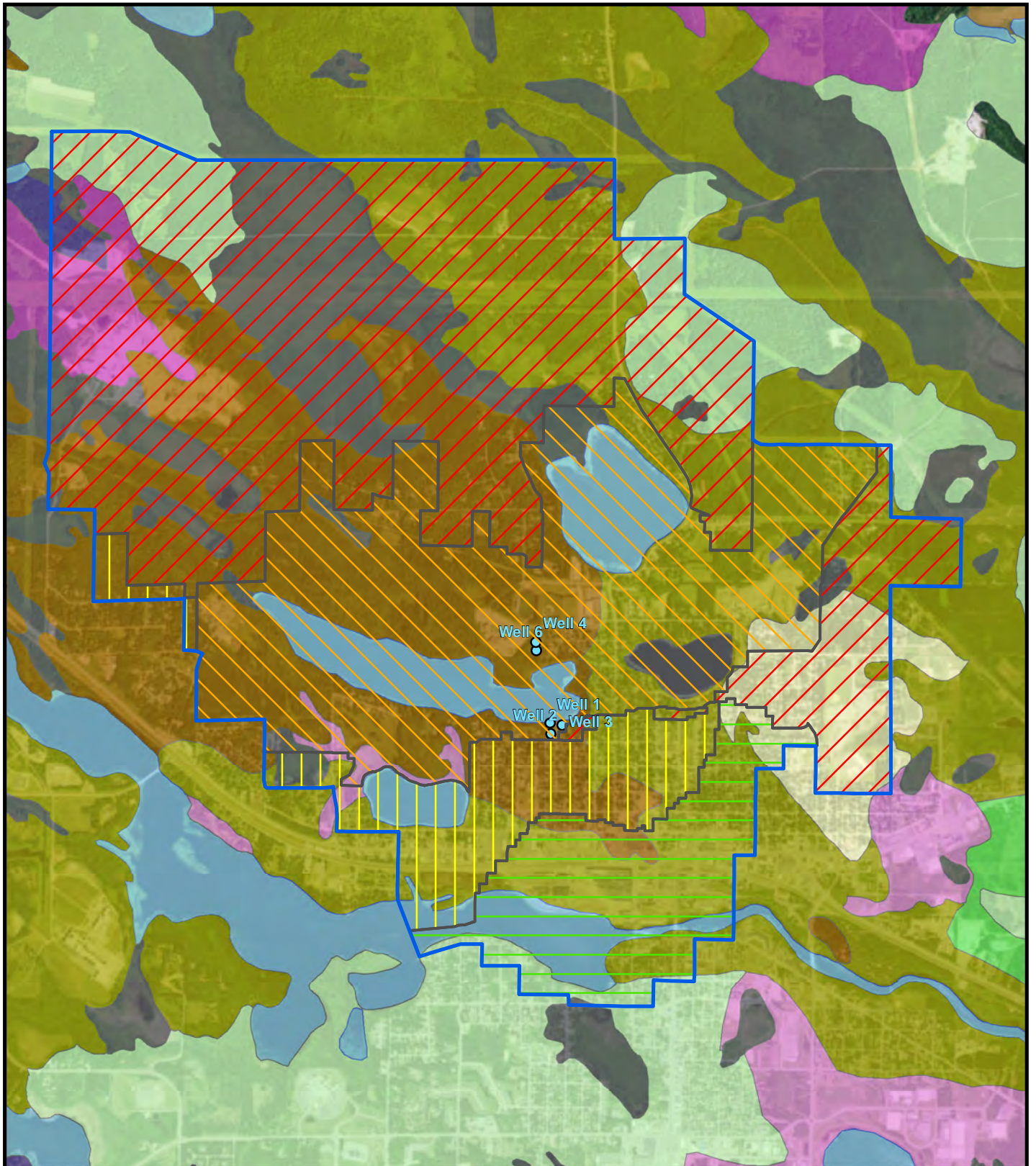
Data Source: (Jirsa, et al. 2002, MDH 2015)



Figure 2

Bedrock
 Geology

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Legend

- Municipal Wells
- Description**
- Dump Mound, Unknown Content
- Dump Mound, Medium Grained Rock
- Peat
- Deltaic Sediment
- Lacustrine Sand and Silt
- Ice Contact Sediment: Rainy lobe

- Ice Contact Till: Rainy Lobe
- Till over Rainy Lobe Deposits
- Washed Till over Rainy Lobe Deposit
- Till (Koochiching Lobe)
- Washed Till (Koochiching Lobe)
- Bedrock Outcrop
- Water Body
- DWSMA

- DWSMA Vulnerability
- SWCA High
- GW High
- GW Moderate
- GW Low



Data Source:
 (Meyer, et al. 2005, MDH 2015)

0 750 1,500 3,000
 Feet

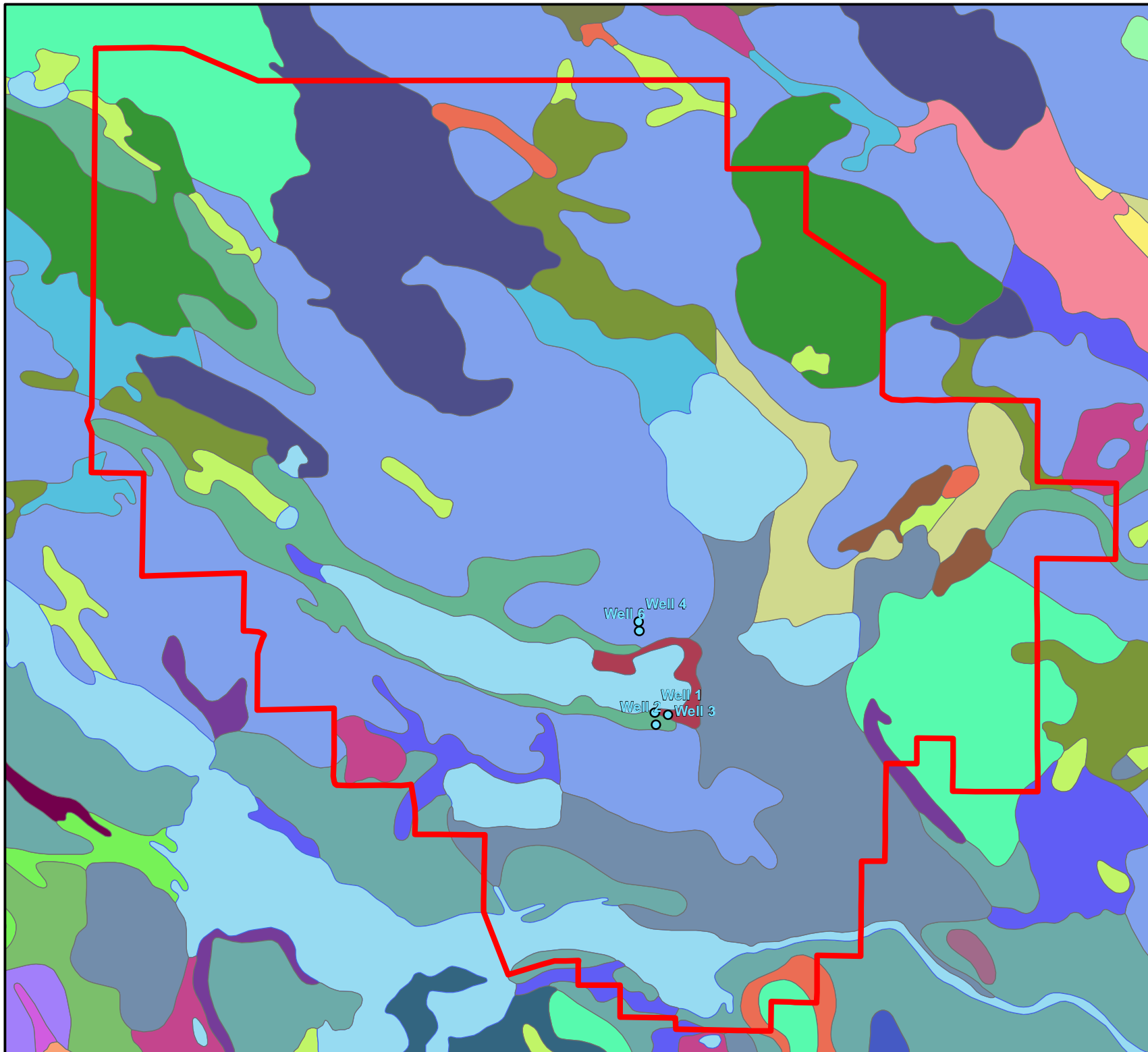
Figure 3

Surficial
 Geology

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 Update

Figure 4

Soils



Legend

Municipal Wells

DWSMA

Soils

Map Unit Name

- Aquents, sandy
- Borosaprists, depressional
- Cathro muck
- Cowhom loamy very fine sand
- Cromwell fine sandy loam, 1 to 10 percent slopes
- Dumps, mine
- Goodland silt loam, 1 to 10 percent slopes
- Greenwood peat
- Histosols, ponded
- Indus and Brickton soils
- Itasca silt loam, 1 to 10 percent slopes
- Itasca-Goodland silt loams, 12 to 25 percent slopes
- Itasca-Goodland silt loams, 2 to 12 percent slopes
- Mahtomedi and Emmert soils, 12 to 50 percent slopes
- Menahga and Graycalm soils, 0 to 8 percent slopes
- Menahga loamy sand, 10 to 30 percent slopes
- Menahga-Itasca complex, 1 to 10 percent slopes
- Menahga-Itasca complex, 10 to 25 percent slopes
- Moselake and Lupton mucky peats
- Morph very fine sandy loam
- Pits, mine
- Rifle mucky peat
- Rosy very fine sandy loam, 0 to 6 percent slopes
- Sandwich loamy fine sand
- Seelyville-Bowstring association
- Shooker very fine sandy loam
- Slickens
- Talmoon silt loam
- Tawas muck
- Taylor and Dalbo silt loams, 0 to 6 percent slopes
- Udortherns, nearly level to rolling
- Udortherns, very steep
- Zimmerman loamy fine sand, 1 to 8 percent slopes
- Water

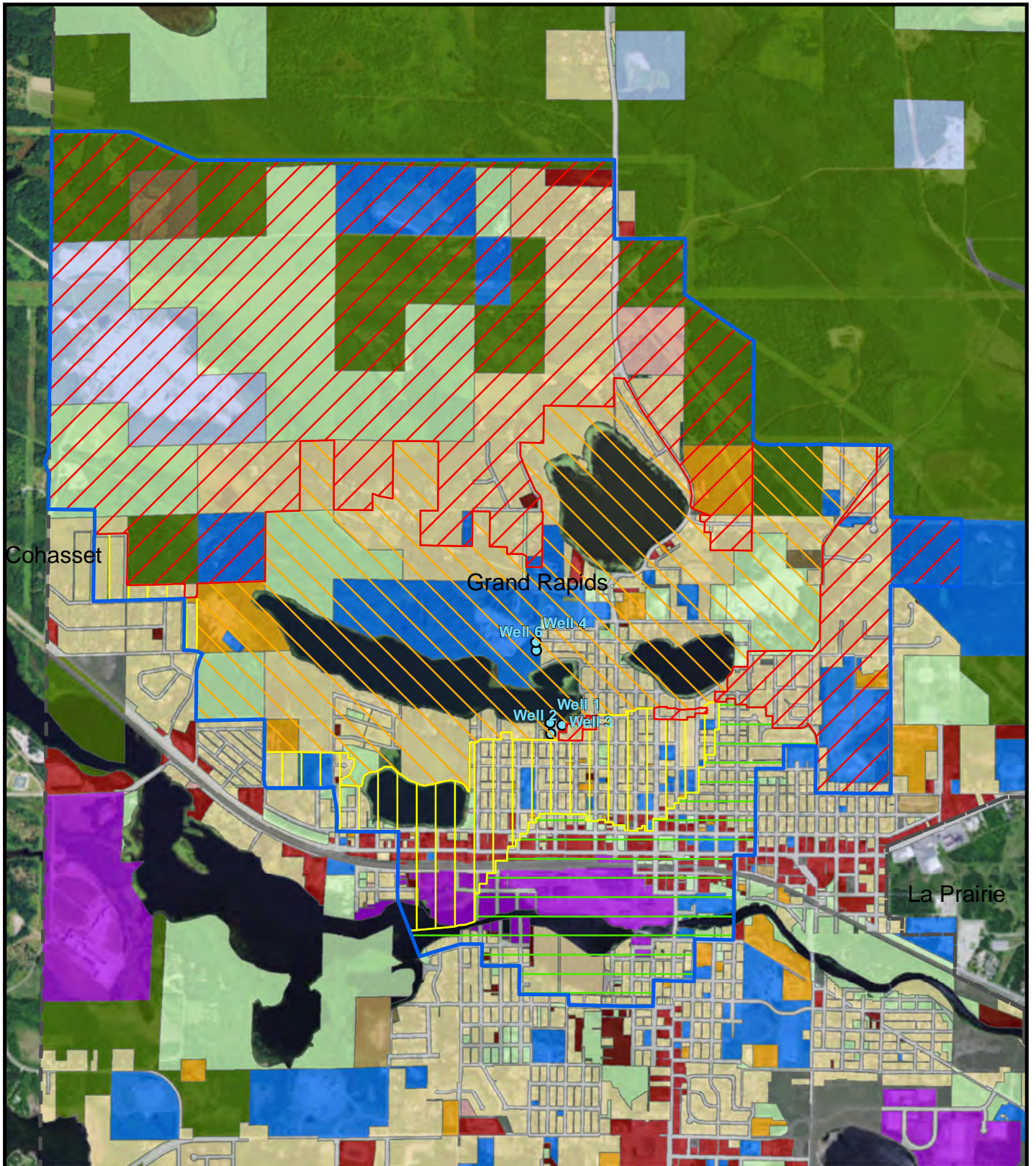
Source: NRCD, MDH



0 500 1,000 2,000 3,000 Feet



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Legend

Land Use

- Residential
- Residential - Multifamily
- Manufactured Home Park
- Residential - Seasonal
- Commercial
- Industrial
- Forestry
- Agriculture
- Institutional
- Public Lands
- Mining and Extractive
- Transportation and Utilities
- Vacant or Undeveloped
- Tax Forfeit - Vacant
- Right-of-Way
- Unknown

DWSMA Vulnerability

- DWSMA
- Municipal Wells
- SWCA High
- GW High
- GW Moderate
- GW Low



Data Source:
 City of Grand Rapids,
 MDH

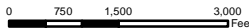
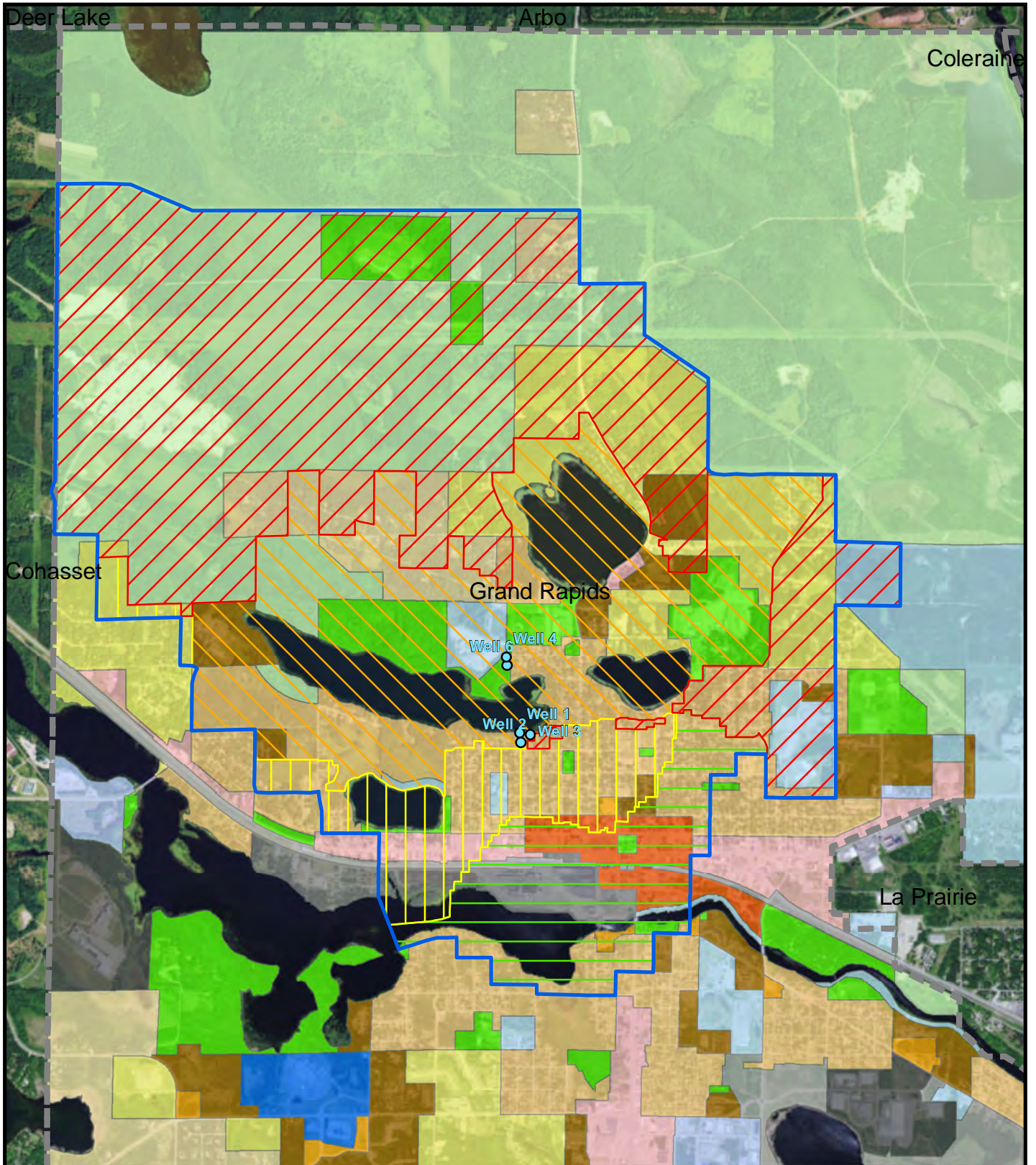


Figure 5

Existing
 Land Use

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Legend

- | | |
|---|---|
| <ul style="list-style-type: none"> Municipal Wells DWSMA DWSMA Vulnerability SWCA High GW High GW Moderate GW Low | <p>Land Use</p> <ul style="list-style-type: none"> Highway Commercial Downtown Mixed Use Neighborhood Mixed Use Industrial - Traditional Industrial Park Business Park Institutional/Civic Medical Campus Parks & Recreation Resource Management Rural Residential Suburban Residential Traditional Neighborhood Multi-Family Residential Transportation & Utilities |
|---|---|



Data Source:
 City of Grand Rapids,
 MDH

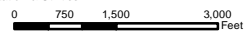
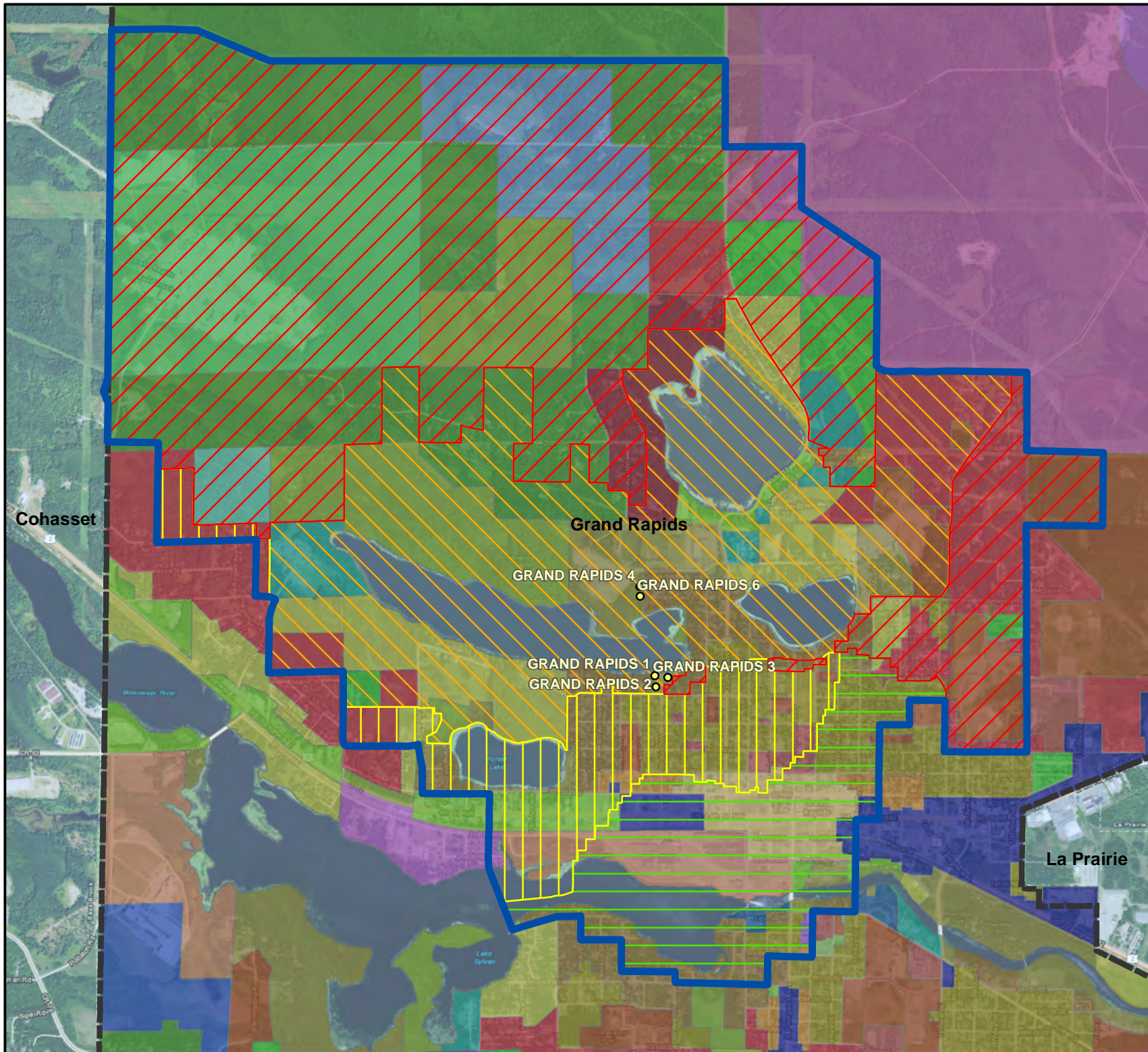


Figure 6

Future
 Land Use

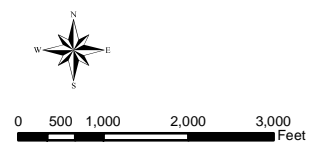
GRPUC
 Wellhead Protection Plan
 Update

Figure 7
Existing Zoning

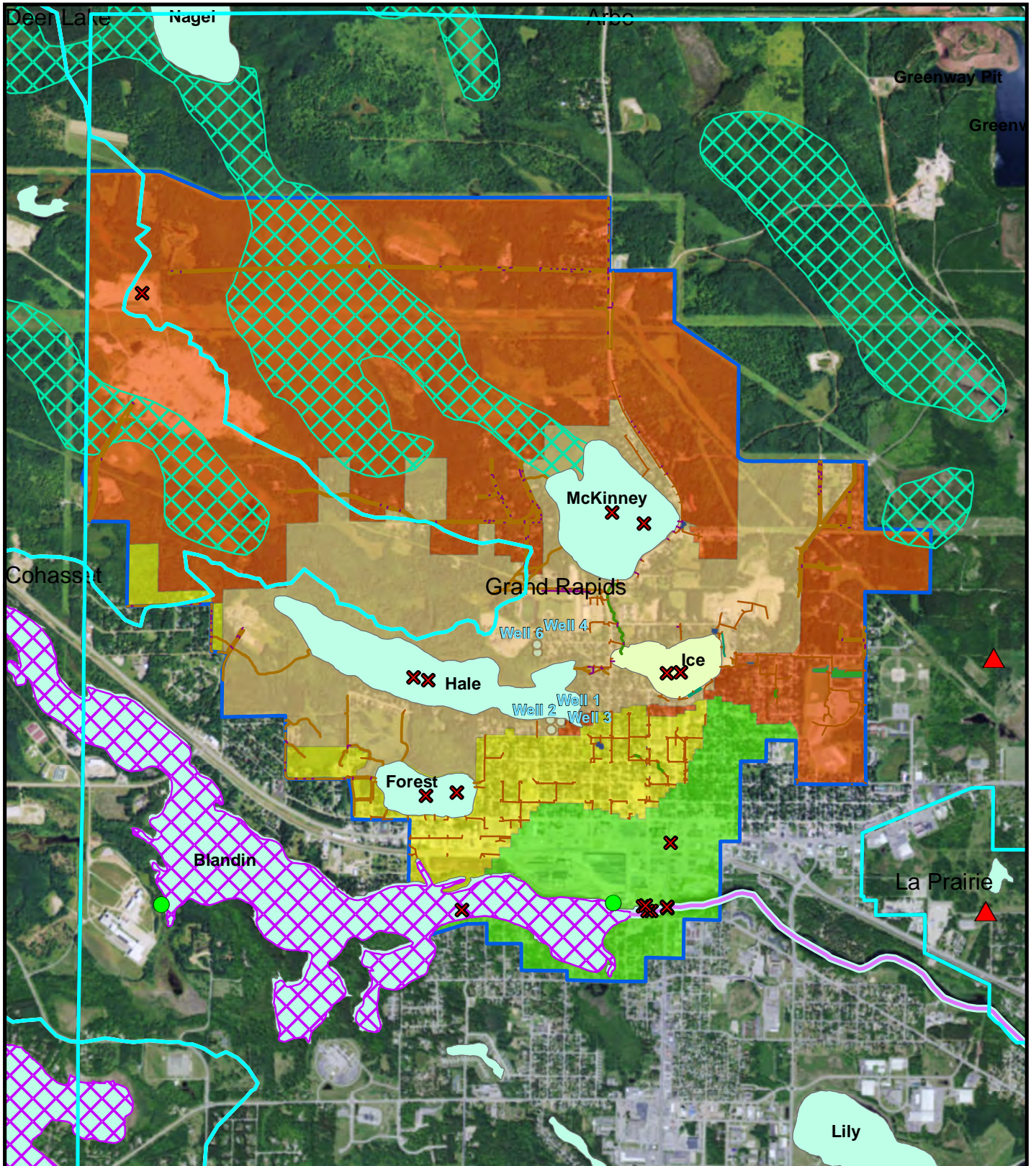


- Legend**
- Municipal Wells
 - DWSMA
 - Municipal Boundary
 - DWSMA Vulnerability
 - SWCA High
 - GW High
 - GW Moderate
 - GW Low
 - Zoning**
 - Agricultural
 - Airport
 - Business Park
 - Central Business
 - Conservancy
 - General Business
 - General Industrial
 - Industrial Park
 - Limited Business
 - Medical
 - Mining Overlay District
 - Multi-Family Residence (High Density)
 - Multi-Family Residence (Medium Density)
 - One and Two-Family Residence
 - One-Family Residence
 - One-Family Residence (Small Lot)
 - Planned Unit Development
 - Public Use
 - Recreational Commercial
 - Rural Residential
 - Scenic By-Way Commercial Overlay District
 - Shoreland Business Park
 - Shoreland General Business
 - Shoreland General Industrial Park
 - Shoreland Industrial Park
 - Shoreland Limited Business
 - Shoreland Medical
 - Shoreland Multi-Family Residence (High Density)
 - Shoreland Multi-Family Residence
 - Shoreland One and Two-Family Residence
 - Shoreland One-Family Residence
 - Shoreland Public Use
 - Shoreland Recreational Commercial
 - Shoreland Rural Residential
 - Urban Overlay

Source: City of Grand Rapids, MDH



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Legend

- Surface Water Withdrawal Permit
- ▲ PrecipStations_MN
- Drainage Ditch Type**
 - Channel
 - Culvert
 - Open Ditch
- X Surface Water Sample Station
- Impaired Water Body**
 - HgF
- Public Water**
 - Basin
 - Wetland
 - Major Watershed Boundary
 - Wetlands
- DWSMA
- DWSMA Vulnerability**
 - SWCA High
 - GW High
 - GW Moderate
 - GW Low
 - Municipal Wells



Data Source:
 City of Grand Rapids,
 MDH, MPCA, DNR
 and U of MN.

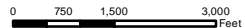
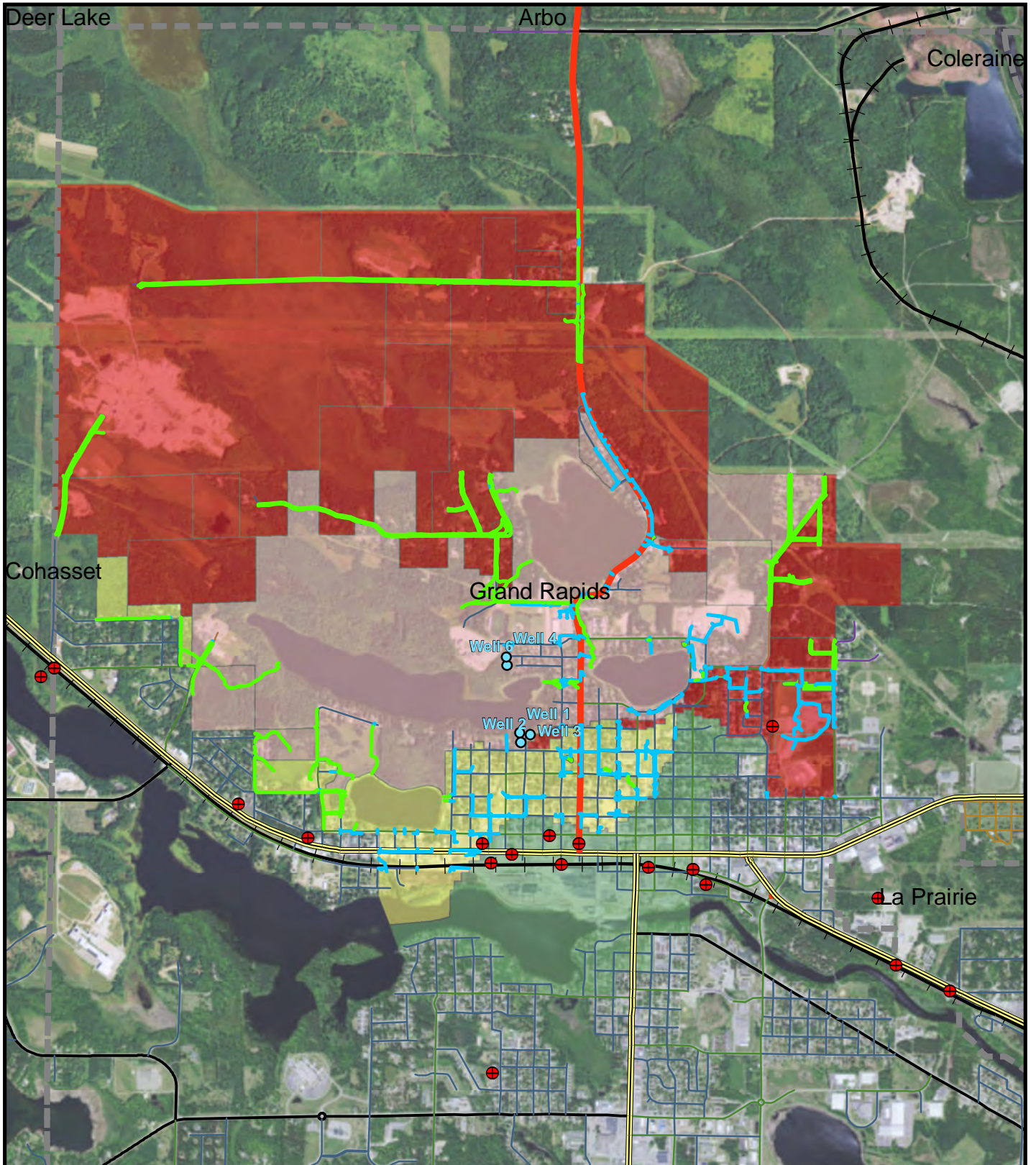


Figure 8

Water Resources

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Legend

Road Type

- US Hwy
- MN Hwy
- County State Aid Hwy
- Municipal State Aid Hwy
- County Rd
- Twp Rd
- Municipal Street
- Ramp
- Uncategorized
- Railroad Crossings
- Municipal Wells
- Stormwater Ditch
- Stormwater Pipe
- railroads
- Stormwater BMP



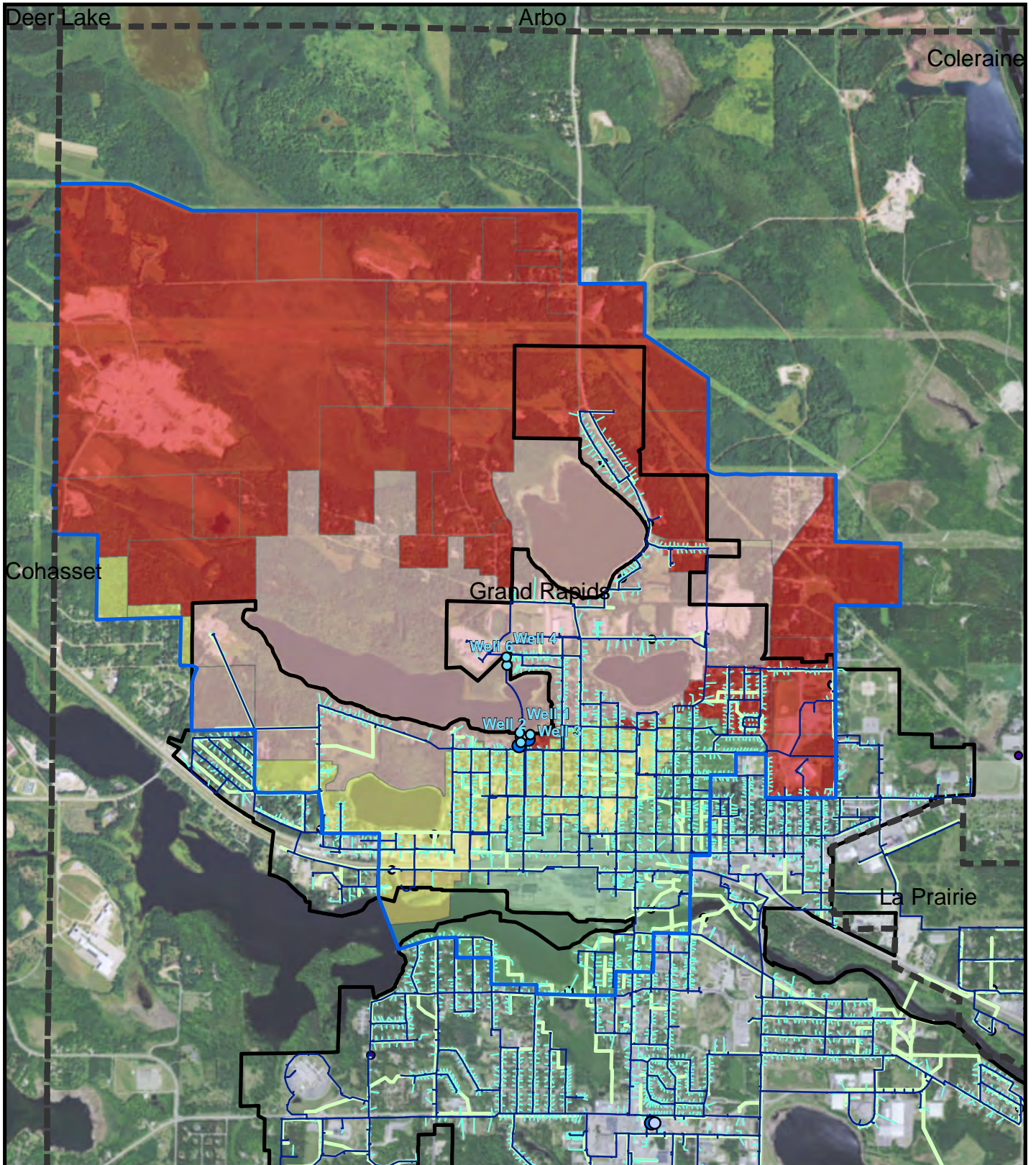
Data Source:
 City of Grand Rapids,
 Mn/DOT, MDH

0 750 1,500 3,000
 Feet

Figure 9

Storm Water and
 Transportation
 Systems

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 Update



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Legend

- | | |
|------------------------|---------------------------|
| Water Structure | Sanitary Service Boundary |
| Pumpstation | Sanitary Line |
| Water Tank | Lift Station |
| Water Main Line | DWSMA |
| Water Service Line | Municipal Wells |



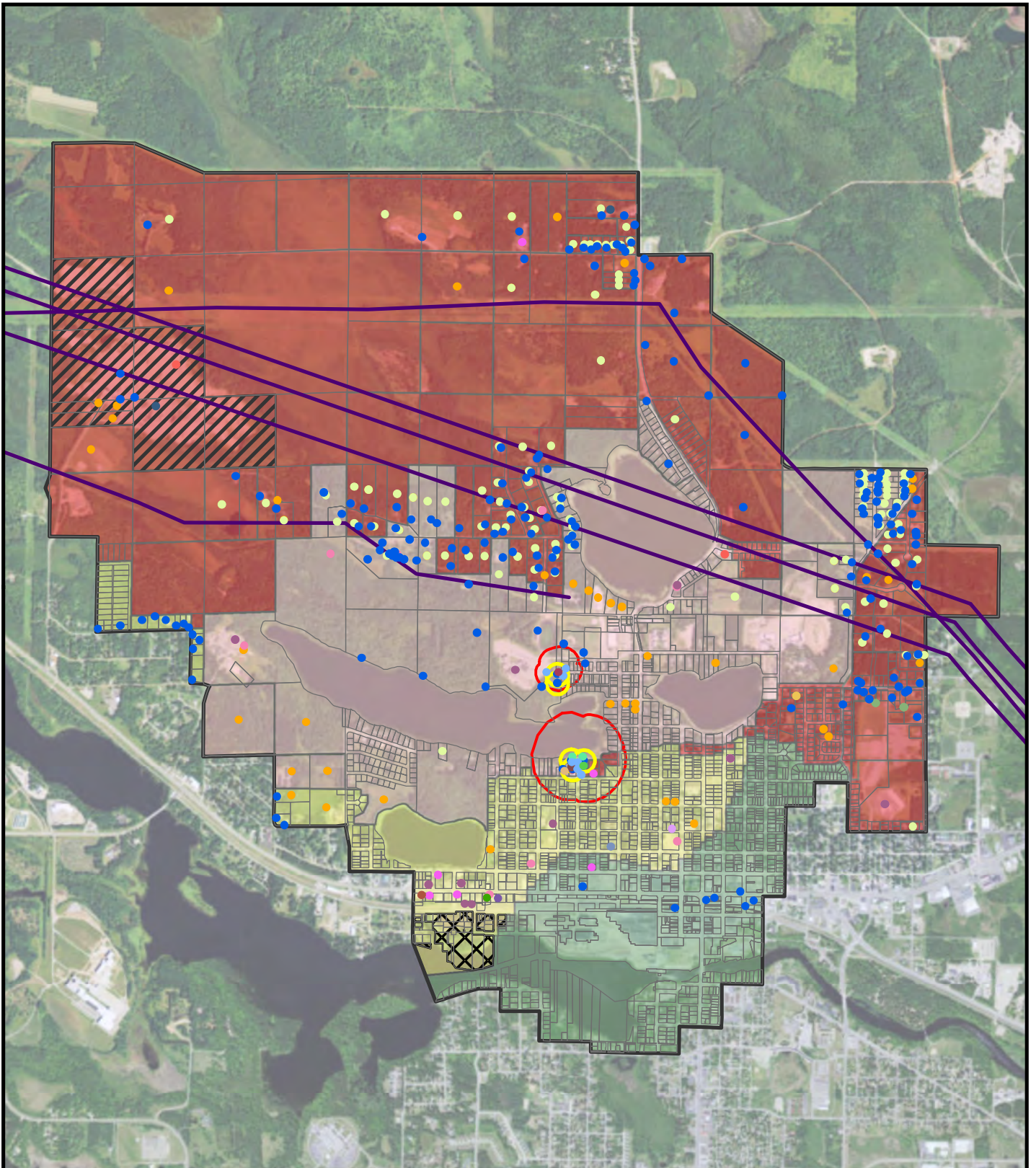
Data Source:
 City of Grand Rapids,
 Mn/DOT, MDH

0 750 1,500 3,000
 Feet

Figure 10

Water and
 Sanitary Sewer
 Systems

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Legend

- | | | | |
|----------------------------|--------------------------------------|-----------------------------|---|
| Emergency Response Area | Agricultural Chemical Storage Site | ISTS (Septic System) | State Assessment Site |
| WMZ | Cistern or Reservoir | Leak Site | Stormwater Detention |
| DWSMA Vulnerability | Construction Stormwater Permit | Livory | Stormwater Infiltration |
| SNCA High | Ditch Inlet/Outlet | Ordinary High Water Mark | Tank Site |
| GW High | Floor Drain | Petroleum Tank | Unused, unsealed well or boring |
| GW Low | Hazardous Waste, Small to Minimal QG | Residential Fuel Tank | Voluntary Investigation & Cleanup (VIC) |
| GW Moderate | AST | Sewer | Well |
| Pipeline | | Solid Waste, Permit By Rule | |
| Land Use | | | |
| Industrial | | | |
| Mining and Extractive | | | |

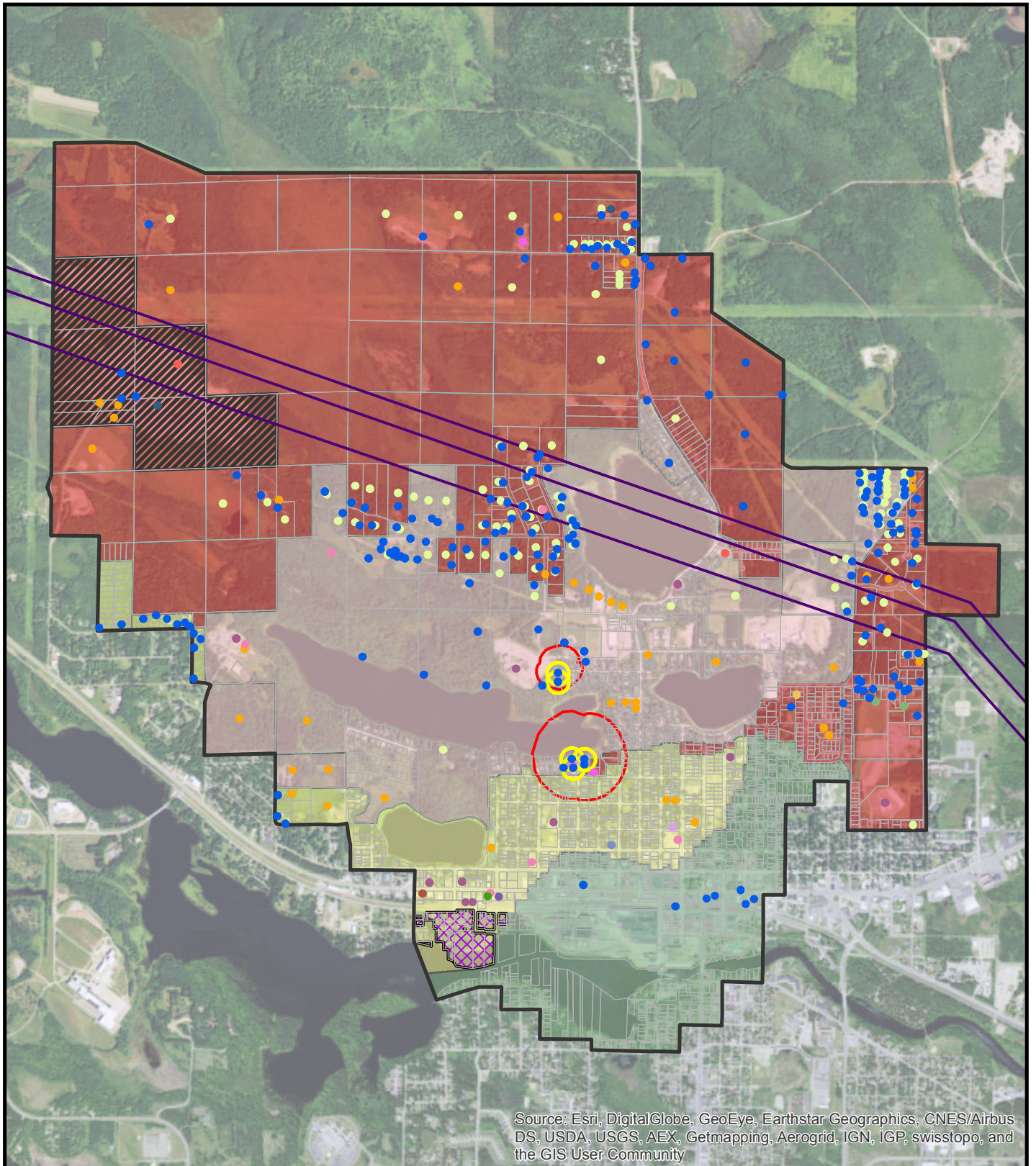



0 750 1,500 3,000 Feet

Figure 11

Potential Contaminant Source Locations

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




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Legend

<p>Pipeline</p> <ul style="list-style-type: none"> — Liquid Fuel IMMZ Emergency Response Area <p>DWSMA Vulnerability</p> <ul style="list-style-type: none"> SWCA High GW High GW Low GW Moderate <p>Land Use</p> <ul style="list-style-type: none"> Industrial Mining and Extractive 	<p>Activity</p> <ul style="list-style-type: none"> ● Agricultural Chemical Storage Site ● Cistern or Reservoir ● Construction Stormwater Permit ● Ditch Inlet/Outlet ● Floor Drain ● Hazardous Waste, Small to Minimal QG ● AST ● ISTS (Septic System) ● Leak Site ● Livery ● Ordinary High Water Mark ● Petroleum Tank ● Residential Fuel Tank ● Sewer ● Solid Waste, Permit By Rule ● State Assessment Site ● Stormwater Detention ● Stormwater Infiltration ● Tank Site ● Unused, unsealed well or boring ● Voluntary Investigation & Cleanup (VC) ● Well
---	---



0 750 1,500 3,000 Feet

Figure 11
Potential Contaminant Source Locations

GRPUC
Wellhead Protection Plan Update

Appendix A

GRPUC Part I Wellhead Protection Plan Update

Grand Rapids Public Utility Wellhead Protection Plan Amendment Part 1
November 2014
Erik Tomlinson, PG: Source Water Solutions, LLC

Introduction

This summary documents the amended delineation of the wellhead protection area (WHPA), drinking water supply management area (DWSMA), emergency response areas (ERAs), and the vulnerability assessments for the Grand Rapids Public Utility drinking water supply wells and DWSMA. These were initially prepared in December of 2003 and must now be amended as the GRPUC's wellhead plan has nearly expired.

Protection Area Boundaries

The DWSMA and WHPA remain unchanged; however, the ERAs have changed slightly (**Figure 1**). The changes in the ERAs reflect that the total water use has decreased since the previous delineation.

The existing WHPA now represents an equivalent of 21 years of capture for Wells 1, 3, 4 and 6. A time of travel for Well 2 has also been re-assessed based on the reduced pumping volume. The existing fracture flow capture zone now reflects a volume of 31 years. The existing WHPA, fracture flow delineation, surface water contribution area (SWCA) and DWSMA for the Grand Rapids wells are shown on **Figure 1**.

Due to the changes in water demand and flow to those wells, it was necessary to re-delineate and update the Emergency Response Areas (ERAs) for Grand Rapids Wells 1, 3, 4, and 6. The ERA for the Quaternary wells is defined as a 1-year zone of capture. A fracture flow delineation with a six month calculated fixed radius combined with a six month up-gradient extension was also re-calculated for Well 2. The updated ERAs (for the Quaternary wells and Well 2) are shown on **Figure 1**.

Vulnerability Assessments and Management Implications

The vulnerability of the DWSMA has remained unchanged and ranges from low to highly vulnerable (**Figure 2**). No new information led to a change in well vulnerability and all of the water supply wells continue to be considered vulnerable. The low to high vulnerability of the DWSMA suggests that wells, contaminated sites, and various other activities and land uses pose a potential threat to the water supply wells. The remainder of the city's wellhead protection plan will outline strategies for effectively managing these activities within the DWSMA.

Documentation

MDH rule criteria and guidelines were used to assess the adequacy of the existing delineations and vulnerability assessments and evaluate the impact of newer data. The results of this assessment showed that a full update of the Part 1 plan is not necessary and instead this brief synopsis is adequate to amend the Part 1 plan. The documentation of this assessment is available from MDH upon request.

**Grand Rapids Public Utility Wellhead Protection Plan Amendment Part 1
November 2014**

**Erik J. Tomlinson, PG (MN License # 46739)
Source Water Solutions, LLC**

This summary documents the amended delineation of the wellhead protection area (WHPA), drinking water supply management area (DWSMA), emergency response area (ERA), and the vulnerability assessments for the Grand Rapids Public Utility drinking water supply wells (PWS ID: 1310011). The amended plan covers the wells listed in **Table 1**. The delineation was performed in accordance with rules (Minnesota Rules 4720.5100 to 4720.5590) for preparing and implementing wellhead protection measures for public water supply wells. The rules are administered by the Minnesota Department of Health (MDH).

**Table 1
Public Water Supply Well Information**

Well Name	Unique Number	Use/Status¹	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/Reconstructed	Well Vulnerability	Aquifer
Well 1	228870	P	12	118	176	1938	Vulnerable	QBAA
Well 2	228873	P	24 x 16	215	573	1951	Vulnerable	PEAG
Well 3	228862	P	16	116	176	1961	Vulnerable	QBAA
Well 4	127276	P	16	117	157	1977	Vulnerable	QBAA
Well 6	161444	P	24 x 16	100	140	1984	Vulnerable	QBUA

Note: 1. Primary (P)

The WHPA and DWSMA delineations and well and DWSMA vulnerability assessments for the City's wells was initially prepared in December 2003 by Hydrogeologic Modeling Services, Inc. in the Wellhead Protection Plan Part I for the City of Grand Rapids Public Utilities Commission. The second part of the city's Wellhead Protection Plan was completed in December 2005 and approved in March 2006. The ten-year life of this plan has nearly expired, necessitating an amendment to the plan.

The MDH has developed guidance for amending wellhead protection plans for settings where no appreciable changes in WHPA delineation criteria have occurred over the ten-year life of a plan. This has been done to facilitate the continuance of wellhead protection efforts and limit the administrative burden for public water suppliers. Given the circumstances listed below, and additional documentation available at MDH (Grand Rapids Public Utilities Commission Plan Amendment Worksheet (EZ worksheet)), a full update of the Part 1 plan is not considered necessary and this summary of the hydrogeologic conditions is considered adequate to bring the Part 1 plan up to date.

WHPA delineation – The existing local MODFLOW model used for the original Part I Plan was updated for the Quaternary wells (Wells 1, 3, 4, and 6) as outlined below. Due to the vulnerability of the

Quaternary aquifer to surface pollution, a conjunctive delineation was required for those wells. In addition, a fracture flow analysis was required for Well 2. The delineation criteria were addressed as follows:

Flow boundaries: There have been no new published sources of hydrogeologic data developed since the previous Part 1 report to suggest that flow boundaries need to be reassessed. Also, there are no additional high capacity groundwater users in the area. Nearby high capacity water users which require state water appropriation permits were included in the model and are provided in **Table 2**.

Table 2
Annual Volume of Water Discharged from Nearby High Capacity Wells

Unique No	2013	2012	2011	2010	2009	Maximum, gallons (2009-2013)	Maximum, m3/day
249403	904,462	1,430,400	1,111,600	899,200	1,176,900	1,430,400	14.83
249421	420,441	1,176,660	1,135,820	898,700	1,144,850	1,176,660	12.20
486651	144,475	382,909	1,149,600	1,660,100	783,500	1,660,100	17.22
486652	0	128,600	30,800	51,200	187,700	187,700	1.947

Daily volume of water pumped: A significant decrease in annual pumping volume for Wells 1, 2, and 4 has been documented (**Table 3**). A slight decrease in annual pumping volume for the system has been documented for Well 6. A substantial increase in pumping at Well 3 has occurred since the original Plan was developed. This increased pumping at Well 3, coupled with the decreased pumping at the other wells (Wells 1, 2, 4, and 6), still provided a significant decrease in the cumulative 10-yr capture zone for the City's wells.

Table 3
Annual Volume of Water Discharged from Water Supply Wells

Local Well ID	Unique No.	2009	2010	2011	2012	2013	Highest annual rate from previous 5 years	Pumping Amount Used in Previous Delineation	% Change
Well 1	228870	82,800,000	145,100,000	105,900,000	106,436,640	89,501,250	145,100,000	182,750,400	-21
Well 2	228873	184,000,000	172,600,000	152,800,000	168,283,824	106,072,260	184,000,000	288,373,217	-36
Well 3	228862	144,100,000	56,000,000	101,900,000	90,353,000	107,959,000	144,100,000	20,838,000	+86
Well 4	127276	47,700,000	51,700,000	27,800,000	27,302,000	65,183,000	65,183,000	254,006,000	-74
Well 6	161444	11,100,000	26,100,000	34,000,000	21,437,000	47,403,000	47,403,000	52,411,000	-10

(Expressed as gallons. **Bolding** indicates greatest pumping volume. Red indicates proportional decrease in pumping volume)

Groundwater flow field: All additional information generated since the first delineation is consistent with the initial directions of groundwater flow.

Aquifer transmissivity: There has been no change in the representative aquifer transmissivity values. The aquifer test plans for each aquifer were re-approved on October 31, 2014.

Time of travel: The time of travel for each well has been re-assessed based on the reduced pumping volume. The existing WHPA now represents an equivalent of 21 years of capture for Wells 1, 3, 4 and 6. A time of travel for Well 2 has also been re-assessed based on the reduced pumping volume. The existing fracture flow capture zone now reflects a volume of 31 years. The existing WHPA, fracture flow delineation, surface water contribution area (SWCA) and DWSMA for the Grand Rapids wells are shown on **Figure 1**.

Due to the changes in water demand and flow to those wells, it was necessary to re-delineate and update the Emergency Response Areas (ERAs) for Grand Rapids Wells 1, 3, 4, and 6. The ERA for the QWTA wells is defined as a 1-yr. zone of capture. A fracture flow delineation with a six month fixed radius combined with a six month up-gradient volume was also re-calculated for Well 2. The updated ERAs (for the Quaternary wells and Well 2) are shown on **Figure 1**.

Well and DWSMA vulnerability - The vulnerabilities of the wells are considered to be vulnerable, as shown in **Table 1**, with no change in vulnerability status from the original WHPP. There was no additional information available that warrant a change in DWSMA vulnerability from the original Plan. The DWSMA has areas of low, moderate, and high vulnerability. (See **Figure 2**)

Other pertinent facts:

- No change in well construction or use/status (**Table 1**).
- Well locations have not changed.
- All additional information generated since the first delineation is consistent with the initial hydrogeologic setting, vulnerability assessment, and directions of groundwater flow.
- The original delineation model still runs. (MODFLOW)
- The original model uncertainty analysis is consistent with current standards.
- A new Data Element Assessment (**Table 4**) has been generated to address any uncertainties with regard to data sources used for the delineation.

In summary, the existing DWSMA, WHPA, and updated ERAs for GRPUC's wells (**Figure 1**) as well as the existing DWSMA vulnerability (**Figure 2**) are protective and meet WHP rule requirements. The MDH and Grand Rapids Public Utilities Commission will review the circumstances again by 2024 to ensure that these areas continue to be protective.

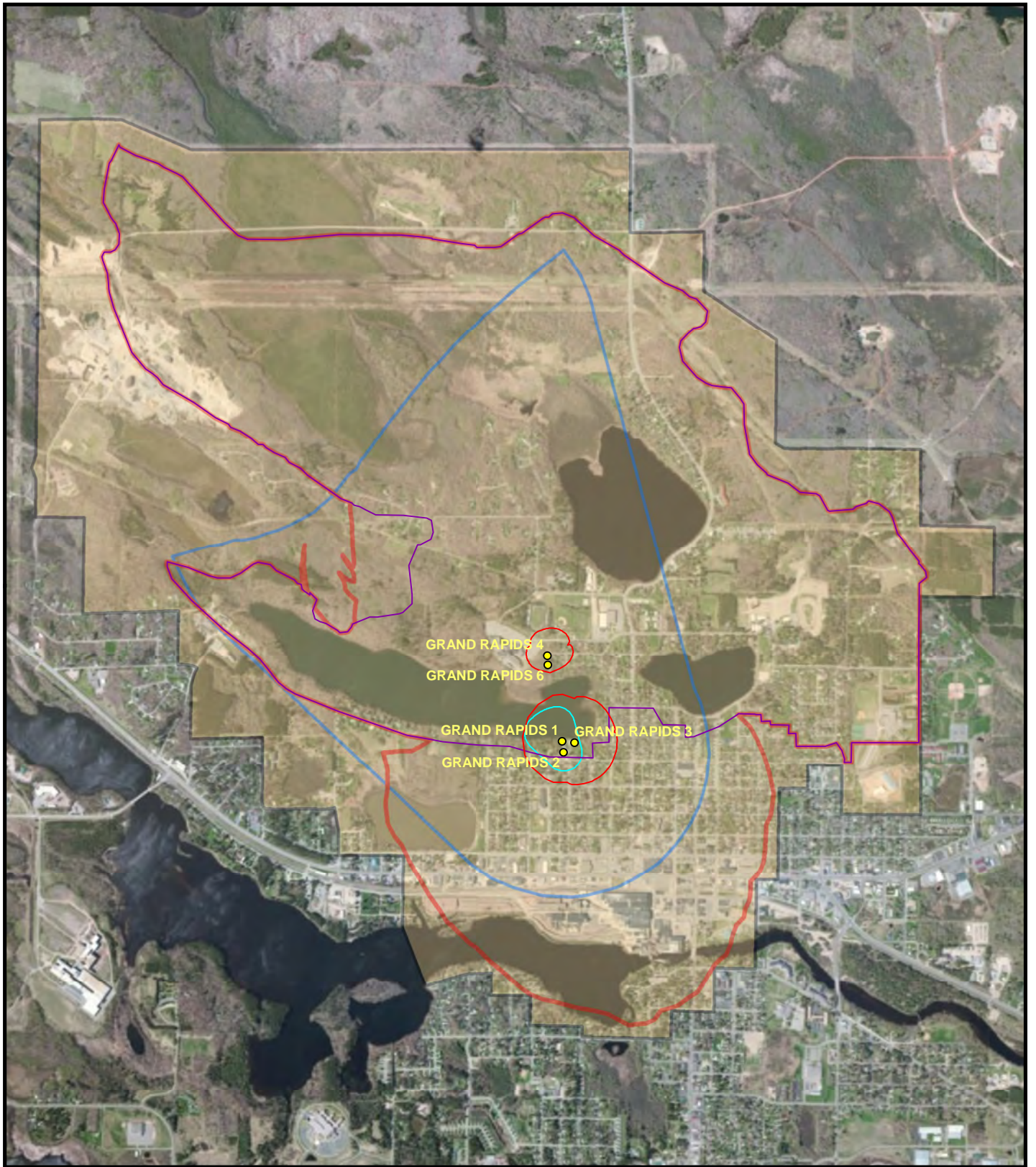
Table 4
Assessment of Data Elements

Data Element	Present and Future Implications				Data Source
	Use of the Well (s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	
Precipitation	L	L	L	L	MN Climatology Office
Geology					
Maps and geologic descriptions	M	H	H	H	MGS, USGS
Subsurface data	M	H	H	H	MGS, MDH
Borehole geophysics	M	H	H	H	None Available
Surface geophysics	L	L	L	L	None Available
Maps and soil descriptions	L	L	L	L	NRCS
Eroding lands					
Water Resources					
Watershed units	L	M	M	M	DNR
List of public waters	L	L	M	M	DNR
Shoreland classifications					
Wetlands map	L	L	M	M	DNR
Floodplain map					
Land Use					
Parcel boundaries map	L	H	L	L	Itasca County
Political boundaries map	L	H	L	L	MnGEO
PLS map	L	H	L	L	MnGEO
Land use map and inventory					
Comprehensive land use map					
Zoning map					
Public Utility Services					
Transportation routes and corridors	L	H	M	M	MnGEO
Storm/sanitary sewers and PWS system map	M	H	M	M	GRPUC, City of Grand Rapids
Oil and gas pipelines map					
Public drainage systems map or list	M	H	H	H	GRPUC, City of Grand Rapids
Records of well construction, maintenance, and use	H	H	H	H	GRPUC, CWI, MDH
Surface Water Quantity					
Stream flow data	L	L	L	L	None Available
Ordinary high water mark data	L	L	L	L	None Available
Permitted withdrawals	L	L	L	L	DNR
Protected levels/flows	L	L	L	L	DNR
Water use conflicts	M	M	M	M	DNR

Data Element	Present and Future Implications				Data Source
	Use of the Well (s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	
Groundwater Quantity					
Permitted withdrawals	H	H	H	H	DNR
Groundwater use conflicts	H	H	H	H	DNR
Water levels	H	H	H	H	MDH, City
Surface Water Quality					
Stream and lake water quality management classification					
Monitoring data summary	M	M	M	M	None Available
Groundwater Quality					
Monitoring data	H	H	H	H	MPCA, MDH
Isotopic data	H	H	H	H	MDH
Tracer studies	H	H	H	H	None Available
Contamination site data	M	M	M	M	MPCA
Property audit data from contamination sites					
MPCA and MDA spills/release reports	M	M	M	M	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



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Legend

WHPAs

- ▬ Grand Rapids QWTA
- ▬ Grand Rapids 2 (Fracture Flow)
- GRPUC Wells
- ▬ QWTA ERA
- ▬ Well 2 ERA
- ▬ DWSMA
- ▬ Surface Water Contribution Area

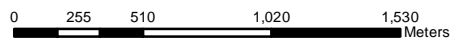
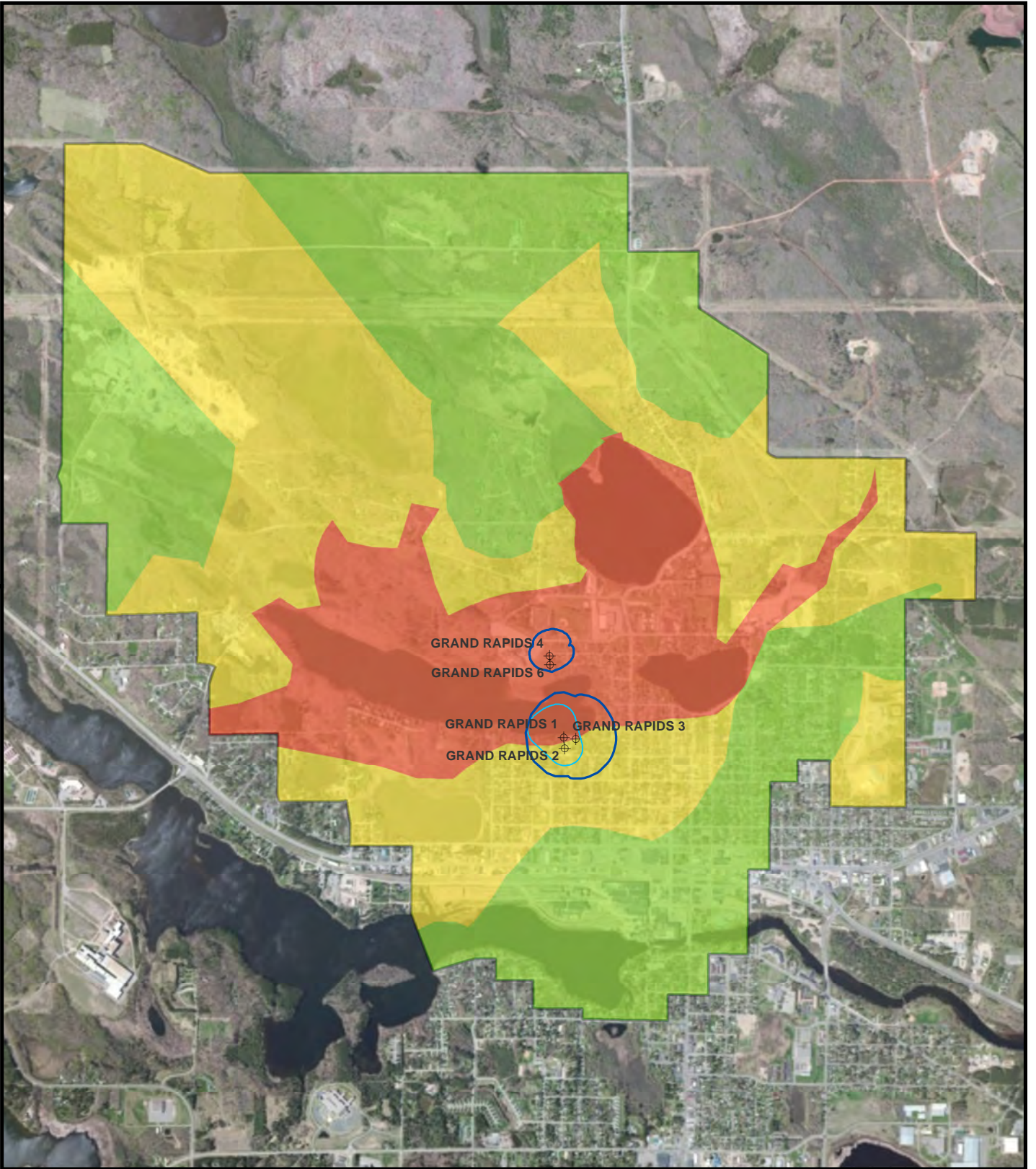


Figure 1
 Wellhead Protection Area and Drinking Water Supply Management Area
 GRPUC Wellhead Protection Plan Update



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Legend

DWSMA Vulnerability

- High
- Moderate
- Low

⊕ GRPUC Wells

▭ QWTA ERA

▭ Well 2 ERA



0 270 540 1,080 1,620 Meters

Figure 2

DWSMA
 Vulnerability

GRPUC
 Wellhead Protection Plan
 Update

**Well 2 Fracture Flow
Emergency Response Area (ERA) Calculation**

Well# = 228873
GRAND RAPIDS 2
X = 459,291.000, Y = 5,232,207.000

6 Month Pumping Volume (182 days)

Pumping Volume (Q):	1,907.00 m ³ /day	67,345.07 cu.ft./day	349.845 gal./min.	503,776.10 gal./day
Water Producing Zone Thickness (L):	109 m	357.612 ft.		
Effective Porosity (n):	0.1			
Original (CFR) Radius:	100.675 m	330.299 ft.		

1st Bearing from Well = 323° from North.

2nd Bearing from Well = 335° from North.

Wellhead Protection (WHP) Plan Amendment Worksheet Delineation of the WHPA and DWSMA and Vulnerability Assessments

Step 1 – Has there been any change in well status for this system since the last WHP plan? Status changes include construction of new wells, reconstruction of existing wells, change in usage for existing wells (e.g., primary versus emergency), adjustments in location of existing wells, and changes in well vulnerability. Use Table 1 to evaluate.

Table 1 - Water Supply Well Information

Local Well ID	Unique Number	Use / Status ¹	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer	Well Vulnerability	Location change? (Y/N)	If well is new, is it in the ERA?
Well 1	228870	P	12	118	176	1938	QBAA	Vulnerable	N	NA
Well 2	228873	P	24 x 16	215	573	1951	PEAG	Vulnerable	N	NA
Well 3	228862	P	16	116	176	1961	QBAA	Vulnerable	N	NA
Well 4	127276	P	16	117	157	1977	QBAA	Vulnerable	N	NA
Well 6	161444	P	24 x 16	100	140	1984	QBUA	Vulnerable	N	NA

Note: 1. Primary (P), Emergency Backup (E), Seasonal Use (S) Use ~~strike-out~~ to identify wells that are no longer included in the amended wellhead protection plan. **Use bolding to note changes to 1) use/status and vulnerability, 2) well location and 3) identify wells that have been added since the current plan was approved.**

Step 2 - What changes have occurred to the amount pumped from each PWS well?

Table 2 - Annual Volume of Water Discharged from Water Supply Wells

Local Well ID	Unique No.	2009	2010	2011	2012	2013	Highest annual rate from previous 5 years	Pumping Amount Used in Previous Delineation
Well 1	228870	82,800,000	145,100,000	105,900,000	106,436,640	89,501,250	145,100,000	182,750,400
Well 2	228873	184,000,000	172,600,000	152,800,000	168,283,824	106,072,260	184,000,000	288,373,217
Well 3	228862	144,100,000	56,000,000	101,900,000	90,353,000	107,959,000	144,100,000	20,838,000
Well 4	127276	47,700,000	51,700,000	27,800,000	27,302,000	65,183,000	65,183,000	254,006,000
Well 6	161444	11,100,000	26,100,000	34,000,000	21,437,000	47,403,000	47,403,000	52,411,000

(Expressed as gallons. **Bolding indicates greatest pumping volume.**)

Step 3 – Other than changes to the city wells identified above, what information is new since the previous delineation?

- Chemistry – compare data for select parameters (or standard vulnerability suite) for user-specified or standardized time periods (ex., 8 years preceding previous delineation compared with everything since then). Standard suite can be tritium, stable isotopes and assessment monitoring suite. This may include city wells and a search of the entire DWSMA or DWSMA plus buffer. **Sampling history and results for the sampling locations identified in Table 3 are provided in Appendix A.**

Table 3 – Updated Chemistry Information

Unique Number	Sample Location Name	Isotope Data/GW Class	New detection of SDWA contaminants	Previous contaminants no longer detected	Geologic Sensitivity	Depth	Aquifer
228870	Grand Rapids Well 1	B4	Bromide, and Sulfate data were not available in original WHPP. Updated Oxygen-18 and Deuterium were not available.	See Appendix A.	Vulnerable	176	QBAA
228873	Grand Rapids Well 2	B4	Alkalinity, Bromide, Ammonia, Sulfate, Nitrate, and TOC data were not available in original WHPP	See Appendix A.	Vulnerable	573	PEAG
228862	Grand Rapids Well 3	B4	Alkalinity, Bromide, Ammonia, Sulfate and TOC data were not available in original WHPP	See Appendix A.	Vulnerable	176	QBAA
127276	Grand Rapids Well 4	B4	Alkalinity, Bromide, Ammonia, Sulfate and TOC data were not available in original WHPP	See Appendix A.	Vulnerable	157	QBAA
161444	Grand Rapids Well 6	B4	Alkalinity, Bromide, Ammonia, Sulfate and TOC data were not available in original WHPP	See Appendix A.	Vulnerable	140	QBUA
SWS 209	Hale Lake	NA	Alkalinity, Bromide, Nitrate, Ammonia, Sulfate and TOC data were not available in original WHPP	See Appendix A.	NA	NA	NA
SWS 211	McKinney Lake	NA	Alkalinity, Bromide, Nitrate, Ammonia, Sulfate and TOC data were not available in original WHPP	See Appendix A.	NA	NA	NA
SWS 340	Crystal Lake	NA	Alkalinity, Bromide, Nitrate, Ammonia, Sulfate and TOC data were not available in original WHPP	See Appendix A.	NA	NA	NA

- Geology/Boundary Conditions – identify if any of the following are new since the last Part 1 approval date:
 - a. County Geologic Atlas
NO
 - b. Wells, from:
 - i. CWI (located and unlocated) within 1 mile of DWSMA (tabular listing with depth/aquifer info for quick assessment).
NO

ii. Wells DB (disclosures, maintenance permits) listed by TRS.
NO

iii. PCSI
The original PCSI identified 106 wells within the DWSMA. The quality of available well location data has improved since the original WHPP was developed. More accurate well data is available in the MDH CWI.

c. Recharge info (compare USGS (Delin & Falteisek, 2007) pub date to old Part 1 date). **Due to the confined nature of the aquifers used by the GRPUC wells, no recharge was used in the original model.**

d. Soils map. **NO**

- Other Pumping Wells - What changes have occurred regarding other high-capacity wells (i.e., wells not from amending PWS)?

Table 4 - Annual Volume of Water Discharged from Other High-Capacity Wells

Unique No.	2013	2012	2011	2010	2009	Maximum, gallons (2009-2013)	Pumping Amount Used in Previous Delineation	% Change
249403	904,462	1,430,400	1,111,600	899,200	1,176,900	1,430,400	1,803,297	-20.7%
249421	420,441	1,176,660	1,135,820	898,700	1,144,850	1,176,660	1,600,788	-26.5%
486651	144,475	382,909	1,149,600	1,660,100	783,500	1,660,100	2,796,557	-40.6%
486652	0	128,600	30,800	51,200	187,700	187,700	1,803,297	-89.6%

(Expressed as gallons. **Bolding indicates greatest pumping volume**).

Step 4 - Using the information assembled in the previous steps, is there information documenting either 1) new hydrogeologic flow boundaries or 2) changes to the hydrogeologic flow boundaries that were included in the current WHPA delineation that are significant enough to require re-delineating the WHPA?

No

Step 5 – Has there been a change in the ambient groundwater flow field, either due to hydrologic conditions, addition of new data or re-interpretation of old data?

No

Step 6 – Does the previous WHPA delineation need to be modified to include either or both of the following? (*check as needed*)

Fracture flow delineation component (*For example, has borehole geophysical work identified specific flow horizons in a fractured aquifer, or were secondary porosity conditions not addressed in the previous delineation according to the current standards?)*

Surface water contribution area (*For example, has monitoring data showed that a suspected hydrologic feature is not functioning as a flow boundary or was the need for a conjunctive delineation not considered in the previous delineation?)*

If either are checked, describe why this additional work is necessary for the plan amendment.

Both a fracture flow delineation and SWCA were completed when the original WHPP was developed. Both are considered adequate and conservative for the current MDH guidance.

Step 7 – Are there any new aquifer test or specific capacity data that will result in a new representative transmissivity value?

Yes. An aquifer test plan was developed for Well 2. However, the current reference transmissivity value for the Quaternary aquifer is still valid.

Step 8 – Was uncertainty adequately addressed in the original WHPA delineation? For example, was variability in aquifer transmissivity and groundwater flowfield addressed explicitly? The latter must include +/- 10% if uniform flow approach was used.

Yes, no changes are needed to address uncertainty.

Step 9A – What was the original ToT? 10 years

Step 9B -- Is there an opportunity to adjust the delineation ToT to maintain the same DWSMA geometry?

Yes. A series of reverse particle tracking scenarios were run to identify the maximum ToT that could be calculated while remaining within the original DWSMA delineation. The maximum ToT based upon the updated pumping volumes for the Quaternary wells was identified as 21 years. The maximum ToT for Well 2 was identified as 31 years.

Step 10 - Do any of the previous steps indicate the need to redefine the WHPA?

No.

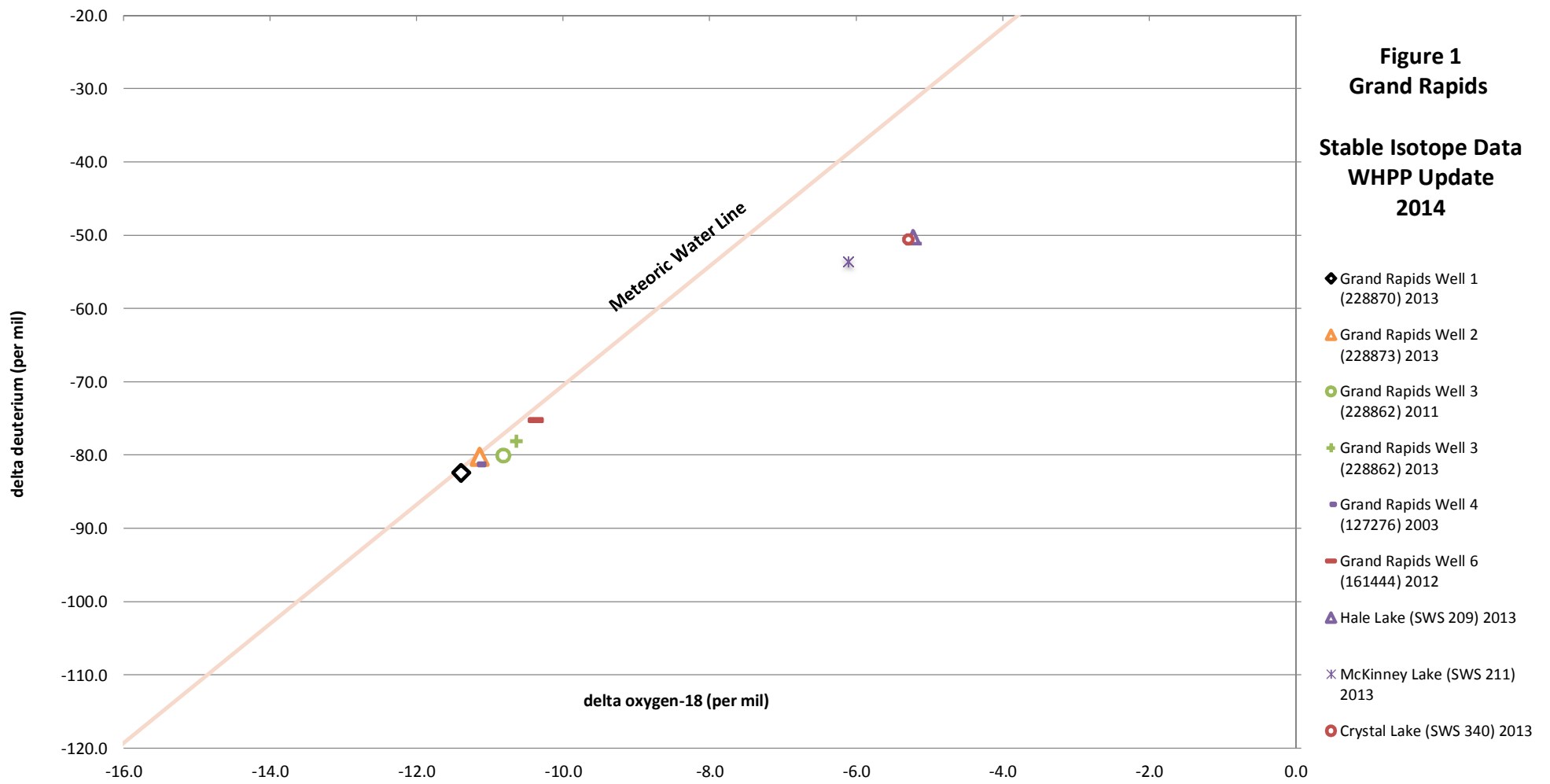
Step 11 – Is the WHPA delineation method that was used for the current plan still adequate to address modifications that have been identified in any of the previous steps?

Yes.

Step 12 - Do the existing DWSMA boundaries need to be re-defined?

No, the existing DWSMA will stay the same at the GRPUC's discretion. Based upon the change in pumping, however, the ERAs have been re-defined.

Congratulations – you may use the EZ amendment form to document the amended Part 1 and file this worksheet to document the basis for using it.



Appendix B

Original GRPUC Part 1 WHPP

Wellhead Protection Plan Part I:

***Delineations of Wellhead Protection Areas and
Drinking Water Supply Management Areas, and
Well and Aquifer Vulnerability Assessments***

***Prepared for
The City of Grand Rapids, Minnesota
Public Utilities Commission***

December, 2003



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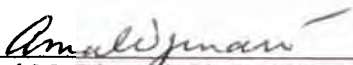


City of Grand Rapids Wellhead Protection Plan: Part 1

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



 Amal M. Djerrari, Ph.D., P.E., CGWP

Date: 12/1/2003 Reg. No. 20369

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Executive Summary

This report documents the delineation of the wellhead protection areas and drinking water supply management area for Grand Rapids Public Utilities Commission (GRPUC), Public Water Supply ID No. 1310011. The delineation was performed in accordance with Minnesota Rules 4720.5100 to 4720.5580 for preparing and implementing wellhead protection measures for public water supply wells. The rules are administered by the Minnesota Department of Health (MDH).

The City of Grand Rapids obtains its drinking water supply from five public water supply wells (Well 1, [228870], Well 3 [228862], Well 4 [127276], Well 6 [161444], and Well 2 [228873], Figures 1 and 2). All wells are completed in the glaciofluvial outwash aquifer except for Well 2, a bedrock well completed in the Biwabik Iron Formation.

The wellhead protection area (WHPA) for the city's glacial outwash wells was delineated using a multi-aquifer groundwater flow model that uses the numerical code MODFLOW. This model was developed by the U.S. Geological Survey (USGS) for the MDH for the purpose of generating source water assessments in the Grand Rapids area. The WHPA generated by the model was modified to include the boundaries of the surface watershed for lakes Hale, Crystal and McKinney. Stable isotope data suggest that water from these lakes may be a minor but measurable component of recharge for Wells Nos. 3, 4 and 6.

A separate approach was required to delineate the WHPA for Well 2 because the aquifer used by this well is dominated by fracture flow and is not considered equivalent to a porous-media aquifer such as the glacial outwash used by the city's other wells. The WHPA for Well 2 was delineated by the MDH using a calculated radius based on the well pumping rate, open interval and aquifer porosity. The radius was then extrapolated up-gradient to the northern limits of the Biwabik Iron Formation.

The drinking water supply management area (DWSMA) was determined by overlaying the boundaries of the WHPA on a map showing political and property parcel boundaries, drainage features, roadways, and section boundaries. The DWSMA was delineated using these features as boundaries. Figure 13 shows the boundary of the WHPA for all wells. Figure 15 shows the boundaries of the DWSMA.

All of Grand Rapids Public Utilities wells have been determined by the MDH to be vulnerable to contamination. This determination was based on evaluation of well construction, well usage, water

chemistry of samples from the well, and geologic protection. The primary reason that the wells are considered vulnerable is the presence of young water, as indicated by the detection of tritium in excess of 1 tritium unit (TU) in samples from Wells 1, 2, 3, and 6. This indicates that local land uses have the potential to affect groundwater quality. The vulnerability status of the wells matches the high vulnerability status of the DWSMA in the immediate vicinity of the wells. The map of vulnerability within the DWSMA is shown in Figure 20.

1.0 Introduction

This report documents the delineation of the wellhead protection areas and drinking water supply management area for the Grand Rapids Public Utilities Commission, Public Water Supply ID No. 1310011. The delineation was performed in accordance with rules (Minnesota Rules 4720.5100 to 4720.5580) for preparing and implementing wellhead protection measures for public water supply wells. The rules are administered by the Minnesota Department of Health (MDH).

This report summarizes the delineation of Wellhead Protection Areas (WHPAs) and Drinking Water Supply Management Areas (DWSMAs) for the City of Grand Rapids, Minnesota. The City of Grand Rapids obtains its water from five public water supply wells (Well 1 [228870], Well 3 [228862], Well 4 [127276], Well 6 [161444], and Well 2 [228873], Figures 1 and 2).

All wells are completed in the glacial deposits aquifer except for Well 2, a bedrock well completed in the Biwabik Iron Formation. Well logs for the city wells are provided in Appendix A.

2.0 Criteria for Wellhead Protection Area Delineation

The MDH has established criteria to insure accurate delineations of WHPAs. These criteria are listed below.

2.1 Time of Travel

A minimum, ten-year time of travel criteria must be used to determine a wellhead protection area that would provide sufficient reaction time to remediate potential health impacts in the event of contamination of the aquifer. A time of travel of ten years was considered in this study.

2.2 Aquifer Transmissivity

The aquifer transmissivity of the glaciofluvial outwash aquifer was estimated from data collected during aquifer testing performed by SEH in Well 6 on May 14, 15, and 16, 2003. A report on the test is included in Appendix B. The representative transmissivity for the glaciofluvial outwash aquifer was estimated by SEH to be 156,700 ft²/day (14,558 m²/day). This value in fact is representative of the aquifer near Wells 4 and 6. The average thickness of the outwash aquifer is 115 ft (35 m) at Well 4, yielding an average hydraulic conductivity value of 1,363 ft/day (416 m/day).

The representative transmissivity for the glaciofluvial outwash aquifer near Well 1 is inferred from the SEH pump test to be 20,790 ft²/day (1,931 m²/day [Appendix B, Table 1]). The average thickness of the outwash aquifer is 84 ft (25.6 m) at Well 1, yielding an average hydraulic conductivity value of 247.5 ft/day (75.4 m/day).

The maximum transmissivity for the glaciofluvial outwash aquifer near Well 6 was estimated by SEH to be 276,600 ft²/day (25,697 m²/day) at Well 4, yielding a maximum hydraulic conductivity value of 2,405 ft/day (738 m/day).

All three values were used in the WHPA delineation for Wells Nos. 1, 3, 4 and 6. The maximum hydraulic conductivity of 738 m/day was used for a small area around Wells 4 and 6 and was applied throughout Layers 2 to 6 within this small area. This was done to simulate the presence of a thick deposit of sand and gravel, most likely an ice-contact feature, that appears to interconnect models layers 2 through 6 in that area.

The representative values of 416 m/day and 75.4 m/day were used for larger areas around Wells 4 and 6 and Wells 1 and 3, respectively (Figure 10). These representative values were applied only to layers 4 and 6 of the model. Outside the areas discussed above, the hydraulic conductivities of Layers 4 and 6 were kept at their calibrated values from the regional model, i.e. 30 and 32 m/day, respectively (Figure 10, and Jones, 2003).

No attempt was made to quantify the transmissivity of the Biwabik Iron Formation, because this parameter is not useful for describing flow through fractures or conduits and because of the rapid change in the extent of secondary porosity within this unit. The MDH is currently in the process of revising its approach to WHPA delineation in fractured aquifers and will likely make significant revisions to this criterion for fractured aquifers in future rule revisions.

2.3 Daily Volume of Water Pumped

The daily volume of water pumped from each of Grand Rapids municipal wells and used for the WHPA delineation was calculated based on historical pumping records and projected 2008 pumping needs obtained from the City of Grand Rapids.

Historical pumping data was acquired from the City of Grand Rapids or from the Minnesota Department of Natural Resources (MNDNR). The largest annual withdrawal for the period 1998-2002 was 599.1 million gallons in 2001 (Table 1).

Based on the projected growth, TKDA (2003) estimated that the population served in 2008 would be approximately 9,800. Using the average per capita consumption rates for the period of record 1991 through 2001 (i.e., 194 gallons per day per capita), the total Year 2008 average water needs are estimated to be 693.9 million gallons per year (MGY) or an average daily pumping rate of 1.9 million gallons per day (MGD). The allocation of this yearly total to each well was based on the average allocations for the period 1998 through 2002 (Table 2).

Table 1 summarizes the historical and projected annual withdrawals at the City of Grand Rapids municipal wells. The pumping rate used to determine each well's WHPA delineation is also provided in Table 1. This pumping rate is either the historical maximum rate for the period 1998-2002 or the projected rate for 2008, whichever is greater.

2.4 Flow Boundaries

To accurately delineate the WHPAs, it is necessary to assess the effects that nearby wells, rivers, lakes, and variations in geologic conditions may have on groundwater flow directions and velocities. The WHPAs for the city wells screened in the glaciofluvial outwash aquifer were delineated using a regional groundwater flow model developed by the USGS.

The model takes into account regional flow boundaries (i.e., aquifer limit, rivers, lakes, and aquifer recharge), spatial variations in aquifer properties, and the effect of high capacity wells. The model is based on the following hydrogeologic and groundwater flow conceptual models.

2.4.1 Conceptual Hydrogeologic Model

2.4.1.1 Physical Setting

Grand Rapids is located at the west end of the Mesabi Iron Range, Itasca County, in north-central Minnesota. The mean annual temperature (1961- 90) at Grand Rapids, Minnesota is 38.6 °F, and the mean annual precipitation is 27.54 inches (Perry Jones, 2002). January is the coldest month and July is the warmest month. February is the driest month and June is the wettest month. Mean January temperature is 3.8 °F, and mean July temperature is 67.4 °F. Mean February precipitation is 0.54 in., and mean June precipitation is 4.11 in. Land-surface altitude near Grand Rapids ranges from 1,255 ft along the Mississippi River to 1,550 ft along the Giants Range, northeast of Grand Rapids. The Giants Range is a linear ridge composed of Precambrian granitic and undifferentiated metasedimentary rocks that trend northeast to southwest, northeast of Grand Rapids. This range is the major topographic high with land-surface altitude along its crest varying from 1,400 to 1,550 ft near Grand Rapids.

Surface drainage and groundwater flow near Grand Rapids is generally to the south-southeast, toward local lakes, the Prairie River, and the Mississippi River (Oakes, 1970). East of Grand Rapids, the Prairie River flows into the Mississippi River. The Mississippi River flows through Grand Rapids to the southeast.

2.4.1.1 Geological and Hydrogeological Setting

Glacial drift covers much of the Grand Rapids area. Three major morainal till units and associated glaciofluvial outwash deposits cover the Grand Rapids area. These were formed during the Wisconsin glaciation ice advances (Winter, 1971).

The stratigraphically lowest till unit, the basal till, is a dark-greenish and brownish-gray till that is sandy, silty, clayey, and calcareous (Winter, 1971). The middle boulder and upper surficial till units are found throughout the area. The boulder till ranges widely in color from gray to yellow, and consists of sands and silts, with abundant cobbles and boulders (Winter, 1971). This till tends to be the thickest unit in the study area. The surficial till is brown in color; sandy, silty, and calcareous; and is generally less than 30 ft thick in the area.

Glaciofluvial outwash deposits lie stratigraphically between surficial and boulder tills, and often lie between the boulder and basal till or bedrock (Winter, 1973a). These outwash deposits consist largely of sands, gravels, and boulders. Glaciofluvial outwash deposits between the surficial and boulder tills are the most continuous outwash deposits in the Grand Rapids area (Winter, 1973a). These outwash deposits consist of fine-grained sands throughout much of the area, but are highly transmissive, coarse-grained sands, gravels, and boulders at locations near the City of Grand Rapids wells. The glaciofluvial outwash sediments found below the boulder till are fairly continuous in the Grand Rapids area.

A middle Precambrian series of metasediments termed the Animikie Group, of which the Biwabik Iron Formation is the most economically important, underlies the drift in the Grand Rapids area (Oakes, 1970). The Biwabik Iron Formation is the uppermost bedrock unit throughout most of the study area and is the dominant bedrock aquifer along the Mesabi Iron Range because of the combination of fracturing and solution-weathering that have occurred locally in its subcrop area. These same factors have accounted for the development of so-called “natural ores”, portions of the iron formation where magnetite has been oxidized to hematite thereby enriching the iron content. Natural ore mines dominated production on the Mesabi Range through the 1950’s, after which most natural ore inventories were depleted and mining activity focused on the relatively unaltered iron formation or “taconite”. Two relatively small natural ore mines are located in the Grand Rapids area, the Tioga No. 2 Mine and the Greenway Mine, however neither mine has been productive for many years and there is currently no active taconite mining occurring in the Grand Rapids area.

The Biwabik Iron Formation is comprised primarily of chert and iron minerals that were deposited as marine chemical sediments. It is sandwiched conformably between the underlying Pokegama Quartzite and the overlying Virginia Formation, which is dominantly composed of argillite, siltstone and fine-grained greywacke. These underlying and overlying units generally have not been fractured or weathered to the extent of the Biwabik Iron Formation and are generally considered confining units for the Biwabik Iron Formation, at least on a regional scale. All three units are early

Proterozoic in age. The Biwabik Iron Formation, Pokegama Quartzite and Virginia Formation strike to the northeast at approximately 50 degrees and dip from 5 to 15 degrees to the southeast. They rest on late Archean-aged granitic rocks of the Giants Range batholith, which forms the northeast-trending topographic high located at the north end of the study area.

The Biwabik Iron Formation has a thickness of approximately 350 - 500 feet in the Grand Rapids area (Oakes, 1970). The formation has been subdivided into four members throughout most of the Mesabi Range based primarily on textural differences. These are, from top to bottom, 1) upper slaty; 2) upper cherty; 3) lower slaty; and 4) lower cherty (White, 1954). The slaty members are more thinly bedded and fissile than the cherty members, which tend to be massive and granular. In the westernmost Mesabi Range, basically from the Grand Rapids area to around Birch Lake in eastern Cass County, only two members are distinguishable, these being an upper slaty member underlain by a cherty member (Morey, 1972). Additional differences noted between the westernmost Mesabi Range and the more easterly reaches include 1) a trend towards more carbonate-facies iron formation, 2) decreasing formation thickness and iron content, and 3) interfingering with the overlying Virginia Formation, which locally is rich in iron carbonate (Morey, 1972). Grand Rapids Well 2 is apparently open through both the Virginia Formation and the upper slaty and upper cherty members of the Biwabik Iron Formation (Cotter and others, 1965).

The Biwabik Iron Formation is thought to have little primary porosity, and groundwater flow through this unit is thought to be controlled by faults, joints (both high-angle and bedding-plane), zones of solution-weathering and man-made mining structures such as drifts and shafts. No specific faults or joint trends have been mapped in Biwabik Iron Formation in the Grand Rapids area, and the dominant mines on this part of the Mesabi Range, such as the Canisteo Mine near Coleraine, are the flat-lying type, suggesting that bedding planes may be the dominant flow paths in this area (Morey, 1972). Other evidence of geologic structure in the Grand Rapids area can be derived from bedrock structural contour mapping (Figure 21). Such mapping suggests the presence of a bedrock valley trending approximately 155 degrees through the area of the Grand Rapids well field. While the presence of this structure is somewhat uncertain because of the limited density of borehole data in the area, it is suggestive of a zone of weakness in the Biwabik Iron Formation that may have resulted from high-angle faulting or fracturing. To summarize, it is likely that groundwater flow through the Biwabik Iron Formation in the Grand Rapids area is controlled by bedding plan joints, which dip from 5 to 15 degrees in a southeasterly direction (approximately 150 degrees), and by high-angle joints that strike approximately 155 degrees.

2.4.2 Groundwater Flow Conceptual Model

Groundwater flow in the upper groundwater flow system consists of three surficial aquifers separated by the three tills units (the upper, the middle and the basal till units). These glacial sediments are underlain by bedrock, including the Biwabik Iron Formation aquifer. The surficial aquifers are recharged by infiltration that enters the system either through precipitation or by interaction with surface water features (lakes and streams). Buried glacial aquifers and the Biwabik Iron Formation are recharged by leakage through glacial tills that separate these aquifers from one another. Groundwater discharge from the system is through pumping and to the Mississippi River and the Prairie River, east of Grand Rapids.

Present groundwater withdrawals are mainly from glaciofluvial outwash aquifers through municipal, small industrial and domestic wells. The City of Grand Rapids obtains two thirds its water from four public water supply completed in the glaciofluvial outwash sediments, and one third from Well 2, a bedrock well completed in the Biwabik Iron Formation (Table 2). Domestic wells near Grand Rapids extract water mostly from glaciofluvial outwash aquifers, with few households using the Biwabik Iron Formation for a source of water.

2.4.3 Other Groundwater Withdrawals

An assessment of well interferences from other wells was conducted by including high capacity wells from the DNR Water Appropriation Permit database and the CWI database. Their effect is taken into account in the model in the delineation of the WHPAs of the City of Grand Rapids glaciofluvial wells. No high-capacity wells other than Grand Rapids Well 2 were identified as drawing from the Biwabik Iron Formation aquifer in the Grand Rapids area.

2.5 Groundwater Flow Field

For this study, the ambient direction of groundwater flow in the glaciofluvial aquifers was estimated, based on a piezometric map from the U.S. Geological Survey Hydrologic Investigation Atlas HA-322 (Oakes, 1970). Groundwater in the glaciofluvial outwash aquifers is generally to the southeast in the City of Grand Rapids area, but is locally very affected by pumping at high capacity wells.

The groundwater flow field for the Biwabik Iron Formation is not known with certainty because of the lack of wells with water level data in this area. It is assumed that the groundwater flow field for this aquifer is similar to that for the overlying glaciofluvial aquifers, which is predominantly southeasterly towards the Grand Rapids well field.

2.6 Method Used to Delineate Wellhead Protection Areas

The City of Grand Rapids has four wells in the glaciofluvial outwash aquifers and one well (Well 2) in the Biwabik iron formation. Two different approaches were used for each of these geological settings because of the fundamental differences in groundwater flow characteristics between porous media and fracture flow aquifers. The delineation for Well 2 was performed by the MDH. The following sections describe the delineation approach for each geologic setting.

2.6.1 Glaciofluvial Outwash Wells

The USGS in collaboration with the MDH developed a three-dimensional groundwater flow model for the glaciofluvial outwash aquifers to be used for the Source Water Protection Areas assessment.

The model covers approximately 115 square miles and was built using the USGS modular groundwater flow model MODFLOW 96 (Figure 3). MODFLOW 96 is a three-dimensional, finite difference, groundwater flow model that simulates groundwater flow in multiple aquifers (Harbaugh and McDonald, 1996).

The model was constructed based on the conceptual model of the hydrogeology of the area. The conceptual model assumed that the upper groundwater flow system consists of three glaciofluvial aquifers separated by three tills units (the upper, the middle and the basal till units). The aquifers are recharged by infiltration that enters the system either through precipitation or by recharge from near surface water features (lakes) through their interaction with the groundwater. Ground water discharge from the system is through pumping and to the Mississippi River and the Prairie River, east of Grand Rapids.

The USGS model has six layers representing from top to bottom:

- The Upper surficial Till (Layer 1)
- The Upper glaciofluvial deposit (Layer 2)
- The Middle Till (Layer3)
- The Middle glaciofluvial deposit (Layer 4)
- The Basal Till (Later 5), and

- **The Lower glaciofluvial Outwash Deposit (Layer 6)**

Lakes, perennial rivers, and perennial wetlands were included in the model to capture the surface water groundwater interactions. The model was calibrated to hydraulic heads and flows in specific stretches of the river system (Jones, 2003).

To delineate the wellhead protection areas for the City of Grand Rapids outwash wells, a local telescopic model populated with the regional calibrated parameters and infiltration was constructed. The local model has a variable-spacing grid that ranges from 5m around the city wells to 500 m near the boundary of the model (Figure 4). The calibrated USGS coverages representing the calibrated hydraulic conductivities, infiltration, and the model boundary conditions were applied to the local model.

The local model is a replica of the regional model at a smaller scale so that more refinement in the cell sizes can be performed. This refinement was necessary to accurately compute the WHPA areas. Because the local model does not extend to natural boundary conditions, hydraulic heads were specified at the boundaries (Figure 5). The regional model provided the head at the head-specified cells along the boundaries of the local model.

After construction, the local model calibration was verified with that of the regional model. The hydraulic heads computed at different locations in Layers 4 and 6, by the local and the regional models were compared in terms of:

- spatial distributions of errors between the two models (Figures 6 and 8), and
- Graphs of correlations between the two hydraulic heads computations (Figures 7 and 9).

As shown on these figures, the reconstructed local model is an accurate replica of the regional model.

The telescopic model, however, resulted in more cells going dry than the regional model. A dry cell is a cell for which the computed hydraulic head lies below the bottom elevation of the cell. Most of the dry cells occur in Layers 2, 3 and to a lesser extent in Layer 4, near Wells 4 and 6. This was the result of both using a finer grid, which resulted in larger values of computed drawdown near the wells, as well as allowing a direct hydraulic connection between Layers 2, 3, 4, 5, and 6 by applying the maximum hydraulic conductivity for all these layers within the small area around Wells 4 and 6. The computation in a dry cell in itself does not necessarily result in a modeling error. In the present case, it is only an artifact of the layering approach which tries to represent a unique hydrogeologic

unit near Wells 4 and 6 into five separate model layers. The model attempts to compute the same hydraulic head in all five layers in that area. This results in hydraulic heads in Layers 2 and 3 and to some extent in Layer 4 to drop below the bottom elevations of those respective layers near the pumping wells. The dry cells near Wells 4 and 6, however, are not expected to greatly affect the delineated wellhead protection area. By drying out cells above the pumping wells and thus not allowing more water leakage through those cells from the upper layers, more water is taken laterally. The model estimates a wider and therefore more conservative wellhead protection area.

The calibrated local model was then used to delineate the wellhead protection areas. However prior to its use in the delineations, changes were incorporated to the reconstructed local model to better capture the hydrogeologic setting near the City of Grand Rapids well field. These changes included:

- A modification of the base elevation of Layer 6 based on the descriptions in the well logs,
- A modified extent of the Middle and Lower glaciofluvial outwash deposits, based on shapefiles provided by Jim Walsh of the MDH (Figure 10).
- The conductances of lakebed sediments for Hale Lake and Crystal Lake were reduced by a factor of 10 so that surface water entering the city wells reflects the MDH assessment of the surface water/ground water interactions near the city wells, i.e., the contribution from lakes represents less than 10 percent of the groundwater pumped at the wells (Appendices C and D).
- Three local areas of modified horizontal conductivities were included in the model to reflect the transmissivity of the outwash aquifer in layer 6 near the City of Grand Rapids wells. The maximum hydraulic conductivity of 738 m/day was used for a small area around Wells 4 and 6 and was applied throughout Layers 2 to 6 within this small area. This was done to simulate the presence of a thick deposit of sand and gravel, most likely an ice-contact feature, that appears to interconnect model layers 2 through 6 in that area. The representative values of 416 m/day and 75.4 m/day were used for larger areas around Wells 4 and 6 and Wells 1 and 3, respectively (Figure 10). These representative values were applied only to layers 4 and 6 of the model. Outside the areas discussed above, the hydraulic conductivities of Layers 4 and 6 were kept at their calibrated values in the regional model, i.e. 30 and 32 m/day, respectively (Figure 10, and Jones, 2003).
- The pumping rates from Table 1 were used for the City of Grand Rapids well.

The delineation was performed by backtracking particles from the wells to a 10-year time of travel using the particle tracking MODPATH code. A series of 200 particles (100 from the upper 5 percent of the total Lower Outwash thickness and 100 from the bottom 5 percent) were launched at each well. A porosity of 25 percent was used for the outwash aquifers. Results of the WHPA delineation are shown on Figure 11 for the GRPUC outwash wells.

2.6.2 Biwabik Iron Formation Well 2

Traditional WHPA delineation approaches based on analytical or numerical models that simulate the flow of groundwater flow through porous media are not applicable to the Biwabik Iron Formation aquifer because it is presumably dominated by fracture or conduit flow. Instead, the WHPA for Grand Rapids Well 2 was delineated by 1) calculating a radius around the well to represent an inner protection zone, and 2) extrapolating that radius upgradient to the northern boundary of the aquifer (Figure 22). A more thorough discussion of this delineation approach is summarized in Appendix F. The WHPA delineation for Well 2 is shown on Figure 12.

2.6.3 Surface Watershed Component of the WHPA

The stable isotope data suggested that a small but measurable component of lake water may be present at Wells 3, 4 and 6 (Appendices C and D). This result was also confirmed by the groundwater model which computed groundwater travel path that originate from Hale, Crystal and McKinney Lakes. Thus, the final WHPA for the glaciofluvial aquifers should include not only the model-generated capture zone, but a surface watershed delineation for the Hale, Crystal and McKinney Lake chain. The surface watershed delineation was provided by GRPUC and is depicted in Figure 11.

2.6.4 Conjunctive Wellhead Protection Area

The final wellhead protection areas for the City of Grand Rapids wells is constructed as a composite of the imprints of the glaciofluvial outwash aquifers WHPA, the Biwabik Iron Formation well 2 WHPA, and the surface watershed delineation for the Hale, Crystal and McKinney chain. The conjunctive wellhead protection area is depicted in Figure 13.

2.7 Uncertainty Analysis

2.7.1 Glaciofluvial Outwash Aquifer Wells

The groundwater flow model was constructed to simulate the flow conditions in the complex hydrogeologic setting of the Grand Rapids area.

The pumping test conducted by SEH yielded a wide range in the hydraulic conductivity of the outwash, demonstrating the complexity of the local hydrogeologic setting and the uncertainty in this parameter. To minimize the impact of this uncertainty, two large areas (that represent the average hydraulic conductivities near the northern and southern wells) and one small are (that represent the maximum estimated hydraulic conductivity near the northern wells) were included in the model.

Despite this precaution, uncertainty remains on the actual hydraulic characteristics of the aquifer. To assess the impact of this uncertainty on the computed WHPA, a sensitivity of the shape of the WHPA was performed by modifying the horizontal and vertical hydraulic conductivities of the large areas by – 50 percent and + 50 percent. The first sensitivity analysis scenario used a hydraulic conductivity equal to 0.5 times the value used in the base case. The second sensitivity analysis scenario used a hydraulic conductivity equal to 1.5 times the value used in the base case.

The changes in the delineated WHPA due to these variations are depicted in Figure 14. As expected a smaller horizontal hydraulic conductivity yields a smaller WHPA. However, the WHPA is fairly insensitive to an increase in hydraulic conductivity. This is partially explained by the fact that within the ten years time of travel during which the particles are tracked, most of the particles reach the boundaries of the model (i.e., either the surrounding lakes or the wetlands). Thus, increasing the hydraulic conductivity results in the particles reaching those boundaries earlier, but does not change the size of the WHPA. This insensitivity of the WHPA to an increase in hydraulic conductivity seems to be also the result of a decrease in hydraulic gradient which offsets the increase in hydraulic conductivity in the travel time computation, yielding mainly an unchanged travel time. Finally, the WHPA is fairly insensitive to changes to the vertical hydraulic conductivity.

2.7.2 Biwabik Iron Formation Well 2

The WHPA delineation for Grand Rapids Well 2 is sensitive to the porosity and aquifer thickness used in the fixed radius calculation, and to the directions of dip and dominant fracture orientation that were used in the extension of the radius. In the case of the dip and fracture orientation, this uncertainty has been accounted for by adding and subtracting 10 degrees from the dominant

direction. In the case of the fixed radius calculation, a conservative aquifer thickness was used instead of using the entire open interval for Well 2. The value used for porosity is considered an average value for fractured aquifers based on textbook references. If a very low porosity value of near 0.01 were employed, typical of plutonic or metamorphic rocks with little to no primary porosity, then the calculated radius would increase by approximately a factor of 3.

2.7.3 Conclusions and Recommendations for Future Improvements

The WHPAs were delineated using conservative pumping rate assumptions. Maximum observed or projected pumping rates were used for each city well as if the wells were continuously pumping at these maximum rates. These pumping conditions rarely occur simultaneously or, if they occur simultaneously, will only prevail for a limited amount of time (i.e., generally for hours or at the maximum days at a time). The WHPA delineations rules call for the use of these maximum pumping conditions as if they exist continuously during the whole 10-yr period on which the delineation is based. The assumption that these extreme pumping conditions exist simultaneously and on a continuous basis, provides for an additional safety factor that is built in the WHPA delineation process to offset the uncertainty that always exists when natural hydrogeological settings and processes are modeled.

However, as with all WHPAs, this delineation is based on the best information available at the time and should be re-evaluated as new information becomes available. Specific recommendations for future improvements to these delineations include:

- Future improvement of outwash aquifer model should include revisiting the model layer elevations. Rather than generating the model from an already interpolated surface (as was the case in this study where the regional model layer elevations were used to compute the telescopic model layer elevations), it is recommended that the telescopic model layer elevations be regenerated directly from the original scatter points developed by the MDH.
- Furthermore, we would recommend correcting the thickness of Layer 6 to allow for the full transmissivity around Wells 4 and 6, rather than creating a localized zone around Wells 4 and 6 where Layers 2, 3, 4, 5, and 6 are hydraulically connected. This will minimized the occurrence and the number of dry cells and provide an overall more stable model.
- Refinement of the glacio-fluvial outwash aquifer model is needed in the area of the DWSMA, northwest of Well 4 and 6. No wells or boring log information exists for that area, mostly

because most of it appears to consist of a swamp. When revisiting the model, it is important to check for new wells, borings, or geophysical studies in that area to refine the conceptual model.

- If any new wells, test wells or borings are to be constructed for the city into the Biwabik Iron Formation, special directions should be given to the well contractor regarding the need for detailed geologic logs with identification of specific water-producing horizons as accurately as possible. Well cuttings should be collected at 5-foot intervals for later analysis of stratigraphic contacts and aquifer properties. The Minnesota Geological Survey should be contacted for proper well cuttings collection procedures.
- If Well 2 is to undergo maintenance involving removal of its pump, arrangements should be made to have the well tested using down-hole methods that might determine specific flow horizons within the aquifer. Such methods might include flow meters and temperature or water quality probes.
- Finally, the installation of other high-capacity wells in the Biwabik Iron Formation in the Grand Rapids area, or increased discharge from the city's wells over the rate used in this delineation, must be evaluated to determine if a revision of the WHPA or DWSMA is required.

3.0 DWSMA Delineation

The WHPA and the DWSMA developed for the Grand Rapids Public Utilities wells fall within the Grand Rapids city limits. The Drinking Water Supply Management Area (DWSMA) was constructed using roads and parcel boundaries within the city limits, and roads, lakes, and section lines outside of the city limits. The DWSMA was drafted with the assistance from staff from Grand Rapids Public Utilities and is depicted in Figure 15.

4.0 Vulnerability Assessments

This section documents the vulnerability assessments of the wells and drinking water supply management area for the public water supply system operated by Grand Rapids Public Utilities. This assessment was performed in accordance with rules (Minnesota Rule 4720.5210) for preparing and implementing wellhead protection measures for public water supply wells.

The vulnerability of all GRPUC wells was determined by the MDH by evaluating available information on: (1) geology, (2) well construction, and (3) chemical and isotopic composition of the well water. The results from this evaluation were compared with the criteria in Minnesota Rule 4720.5550.

The vulnerability of the drinking water supply management area for the City of Grand Rapids was determined by evaluating available information on the lateral continuity of protective geologic materials overlying the aquifer.

4.1 Well Vulnerability Assessment

The MDH has developed a database of community and non-community, non-transient, public water supply wells in Minnesota. This database stores information pertinent to well vulnerability and rates the vulnerability of individual wells. A score is calculated for each well based on the factors cited above. Higher scores correlate to a greater perceived vulnerability. A numeric cutoff (40 and below) is used to identify vulnerable from non-vulnerable wells (MDH, 1997). Vulnerable wells are also identified based on the presence of contamination, such as nitrate-nitrogen in excess of 10 mg/l, or young (post-1953) water, as indicated by the presence of 1 tritium unit or greater. A well vulnerability assessment was performed by the MDH for the City of Grand Rapids wells and is described below. Printouts from the MDH vulnerability database are provided in Appendix E.

All wells were determined to be vulnerable based on results of tritium analyses performed on samples collected on June 14, 2000. Values of 24.3, 10.4, 24.6, and 17.7 tritium units were observed in Wells 1, 2, 3, and 6, respectively. The tritium results indicate the water from those wells, and presumably water in the aquifer in the vicinity of the wells, entered the ground after 1953. Wells that produce water without tritium are generally not considered susceptible to anthropogenic contamination (Alexander and Alexander, 1989).

The determination for Well 4 was based on its ratings of 50, and on tritium data at the other city wells.

Wells Nos. 4 and 6 meet all elements of the current well construction code. Wells Nos. 1, 2 and 3 lack documentation showing that the annular space between the well casing and the borehole is grouted. Although this requirement was not in place at the time these wells were drilled, it has been added subsequently.

4.2 Drinking Water Supply Management Area Vulnerability Assessment

4.2.1 Glaciofluvial Outwash Aquifer

The glaciofluvial outwash aquifer was evaluated for its vulnerability to contamination throughout the extent of the DWSMA on the basis of geologic logs from wells in the area, chemical and isotopic data described in this report, as well as geomorphic features in the area.

A map of clay content in the first 100 feet of soil was constructed based on information from geologic logs. This map is depicted in Figure 16. The content of clay was also analyzed for 20-foot intervals for two cross sections that run east-west and north-south and pass through the City of Grand Rapids wells (Figure 17). The locations of the two cross sections are presented in Figure 16.

The vulnerability ratings of the glaciofluvial aquifer within the DWSMA reflects the likelihood that water and any associated contamination can reach the aquifer(s) in question within a given time period via vertical infiltration. This was done in accordance with the Department of Natural Resources (DNR) guidance for assessing geologic sensitivity (DNR, 1991) as recommended by MDH for vulnerability assessments in DWSMAs:

- A vulnerability rating of very high suggests travel times that may range from hours to months. This rating is reserved for situations where the aquifer in question has no overlying protection and the water table is relatively close to the land surface (20 feet or less) unless age-dating or tracer studies can be used to document the presence of very young recharge in other geologic settings. No such areas exist within the Grand Rapids DWSMA.
- A vulnerability rating of high suggests travel times on the order of weeks to years. This rating is applied where the aquifer has little to no effective geologic protection and the water table is greater than 20 feet from the land surface. Overlying clay is generally not be present

unless it is either very thin (less than 10 feet) or is restricted to the uppermost 10 feet where it likely compromised by weathering and secondary porosity. If it extends below 10 feet, it is described as weathered (e.g., yellow) in drillers logs. If the shallow clay or till is unsaturated, it is further reason for presuming that it is relatively permeable and a rating of high can be assigned. This rating can also be applied in other settings if age-dating or tracer studies can be used to document the presence of very young recharge in other geologic settings. The high vulnerability area for Grand Rapids is restricted to the extent of the ice contact deposits that run from the large gravel pit located in the northwestern portion of the DWSMA to the area of the northern city well field (Oakes, 1970). This area of ice contact deposits, depicted in Figure 16, seems to consist largely of coarse sediment, with some patchy clay or till. The clay or till seem restricted to the upper 30 feet or so and where present is apparently unsaturated, such as at Wells 4 and 6. This is supported by the aquifer test results that suggest an unconfined drawdown signature. Thus, relatively rapid recharge can be expected to layers 2 and 4 in this area, as well as layer 6 in the immediate are of Wells 4 and 6, consistent with the groundwater model.

- A vulnerability rating of moderate implies travel times on the order of years to decades. This rating is applicable where overlying geologic protection is present, but either is not very thick (less than 10 feet of un-weathered clay), contains lithologies other than just clay or shale (e.g., sand, boulders, sandy clay, etc.), may be discontinuous, or wells finished in the underlying aquifer show the presence of relatively young water based on methods such as tritium analysis. This is the classic leaky aquifer system, which is representative of much of the Grand Rapids glaciofluvial aquifer system. South of Hale Lake, the well logs for the city wells seem to indicate the presence of relatively continuous water-saturated clay-rich till overlying the layer 4 aquifer. Where driller's logs describe only clay overlying the aquifers, it is relatively thin. Otherwise, sandy or bouldery clay is common. Young water is indicated by the presence of tritium. This area surrounding the ice contact deposits, and much of the remainder of the DWSMA, is well-represented by a vulnerability rating of moderate.

In addition, the high vulnerability rating was downgraded to moderate for those portions of the ice contact deposits between the gravel pit and the outer limit of the WHPA because those areas have been added to the DWSMA based on the surface water criteria rather than based on the groundwater travel times which are greater than 10 years.

- A vulnerability rating low implies travel times of decades to a century. This rating is applied only where overlying geologic protection is well documented, laterally continuous and either of significant thickness or very low intrinsic permeability (e.g., clay or shale not including significant amounts of other lithologies). Tritium will most likely not be present in these settings, or if present is likely at very low levels. Areas indicated as low vulnerability show a relatively great thickness of either clay or clay-rich till that is water saturated. No tritium data exist to counter this rating. A low rating was also assigned to any part of the DWSMA that is not underlain by aquifer material in layers 2, 4 or 6, consistent with the groundwater model. Those portions fall outside of the boundaries of the aquifers. The vulnerability map of the glaciofluvial aquifer is shown in Figure 18.

4.2.2 Biwabik Iron Formation Well 2

The Biwabik Iron Formation aquifer was evaluated for its vulnerability to contamination throughout the extent of the DWSMA on the basis of 1) geologic maps of the area, 2) geologic logs from wells in the area, and 3) the chemical and isotopic data described in this report.

The Biwabik Iron Formation is recharged by leakage from the overlying glacial sediments, except where it has been exposed by mining. For that reason, the vulnerability of the Biwabik Iron Formation is directly related to the vulnerability of the glacial aquifers that overlie it. However, it is not identical to the vulnerability of the overlying glaciofluvial aquifers. The geologic record for Well 2 suggests that a basal till, identified as “hardpan” in the driller’s log, is present between the deepest glaciofluvial aquifer (model layer 6) and the top of the iron formation. Assuming this unit is laterally persistent, as suggested by Winter (1973), it can be inferred that it provides an extra level of protection to the Biwabik Iron Formation. Therefore, the vulnerability of the Biwabik Iron Formation was determined by downgrading the vulnerability assessment determined for the overlying glaciofluvial aquifers by one vulnerability rating. For example, those areas determined to be highly vulnerable for the glaciofluvial aquifers were determined to be moderately vulnerable for the Biwabik Iron Formation.

This approach of assigning vulnerability to the Biwabik Iron Formation is relatively conservative because it does not take into account the presence of any overlying Cretaceous sedimentary deposits or the Virginia Formation. However, the presence of tritium at 10.4 TU in a water sample from Well 2 taken in 1991 is strongly suggestive that the Biwabik Iron Formation is recharged over a relatively short time period, certainly no greater than several decades, and that overlying geologic protection must be limited in its effectiveness or lateral continuity. In particular, it is likely that the Virginia

Formation is a relatively ineffective aquitard in the Grand Rapids area. Lithologic descriptions of the Virginia Formation for the western Mesabi Range suggest that this unit interfingers with the Biwabik Iron Formation and has a relatively high iron content in the form of ferruginous chert (Morey, 1972). These factors suggest that the Virginia Formation may not be as effective a confining unit in the Grand Rapids area as it may be in more easterly portions of the Mesabi Range. In addition, Grand Rapids Well 2 is open to both the Virginia and Biwabik Formations. This type of well construction may maximize water yield but locally minimizes any geologic protection that might be afforded by the Virginia Formation.

4.2.3 Conjunctive Vulnerability within the DWSMA

The conjunctive vulnerability assessment of the glaciofluvial aquifer, the Biwabik iron formation, and the surface watershed for the Hale, Crystal and McKinney Lake chain was constructed by refining the individual assessment in light of the vulnerability assessment of the overlying units.

This was done using the following guidelines:

- All areas of the surface watershed were rated with the ratings of the glaciofluvial outwash aquifer. As noted above, the high vulnerability rating was downgraded to moderate for those portions of the ice contact deposits located outside of the WHPA because those areas have groundwater travel times greater than 10 years.
- Where the Biwabik Iron Formation well WHPA was overlain by the glaciofluvial outwash wells, the overall vulnerability was that of the glaciofluvial outwash aquifer.

The conjunctive vulnerability of the DWSMA is depicted in Figure 20. The GRPUC wells are all located within an area of high vulnerability status. These ratings are in concordance with the well vulnerability rating.

5.0 Supporting Data Files

Project-specific data files included on the compact disk are listed on Table 3. All coordinates in the modeling files are based on UTM NAD 83 datum. Elevations are in meters above mean sea level (meters, MSL). Time units are days. Length units are meters.

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Tables

Table 1

Summary of Historical and Projected Groundwater Withdrawal

Well Name	Unique Number	Total Annual Withdrawal (gal/yr)					Projected 2008 Withdrawal (gal/yr)	Withdrawal used in WHPA (gal/yr)	WHPA Withdrawal Instantaneous Pumping Rate (m ³ /day)
		1998	1999	2000	2001	2002			
Well 1	228870	108,582,120	182,750,400	130,198,500	101,411,520	51,707,160	138,770,180	182,750,400	1,894.0
Well 2	228873	257,753,880	240,777,000	246,650,040	256,632,480	184,214,400	288,373,217	288,373,217	2,988.7
Well 3	228862	1,278,000	4,211,000	2,671,000	3,121,000	20,638,000	7,996,365	20,638,000	213.9
Well 4	127276	133,920,000	127,218,000	173,075,000	185,541,000	254,006,000	213,671,578	254,006,000	2,632.5
Well 6	161444	35,497,000	27,147,000	43,324,000	52,411,000	28,138,000	45,126,660.27	52,411,000	543.2
Totals		537,031,000	582,103,400	595,918,540	599,117,000	538,703,560	693,938,000	798,178,617	8,272.2

Table 3
Files included on the Compact Disks

Files Path	File Name	File Description
Modeling Project - Model Files CD		
Calibrated Regional Model		
\Regional Model	GRmodel_amd.mat	
\Regional Model	GRmodel_amd.map	
\Regional Model	GRmodel_amd.ini	
\Regional Model	GRmodel_amd.2dg	
\Regional Model	GRmodel_amd.xy	
\Regional Model	GRmodel_amd.plt	
\Regional Model	GRmodel_amd2g.dat	
\Regional Model	GRmodel_amd3g.dat	
\Regional Model	GRmodel_amd2s.dat	
\Regional Model	GRmodel-9_amd.mfs	
\Regional Model	GRmodel-9_amd.mfn	
\Regional Model	GRmodel-9_amd.bas	
\Regional Model	GRmodel-9_amd.bcf	
\Regional Model	GRmodel-9_amd.oc	
\Regional Model	GRmodel-9_amd.pcg	
\Regional Model	GRmodel-9_amd.riv	
\Regional Model	GRmodel-9_amd.wel	
\Regional Model	GRmodel-9_amd.ghb	
\Regional Model	GRmodel-9_amd.rch	
\Regional Model	GRmodel-9_amd.lyr	
\Regional Model	GRmodel-9_amd.pme	
\Regional Model	GRmodel-9_amd.ppa	
\Regional Model	GRmodel-9_amd.ppo	
\Regional Model	GRmodel-9_amd.pli	
\Regional Model	GRmodel-9_amd.pma	
\Regional Model	GRmodel-9 hed	
\Regional Model	GRmodel-9.drw	
\Regional Model	GRmodel-9mf.dat	
\Regional Model	GRmodel-942803.ept	
\Regional Model	GRmodel-942803.pth	
\Regional Model	GRmodel_amd.gpr	GMS Project File
\Regional Model	GRmodel-940mf.dat	
Local Model		
\Local model verification	GR USGS-Local model verification.mat	
\Local model verification	GR USGS-Local model verification.map	
\Local model verification	GR USGS-Local model verification.ini	
\Local model verification	GR USGS-Local model verification.2dg	
\Local model verification	GR USGS-Local model verification.xy	
\Local model verification	GR USGS-Local model verification.plt	
\Local model verification	GR USGS-Local model verification2g.dat	
\Local model verification	GR USGS-Local model verification3g.dat	
\Local model verification	GR USGS-Local model verification2s.dat	
\Local model verification	LocQUSGS2.mfs	
\Local model verification	LocQUSGS2.mfn	
\Local model verification	LocQUSGS2.bas	
\Local model verification	LocQUSGS2.bcf	
\Local model verification	LocQUSGS2.oc	
\Local model verification	LocQUSGS2.pcg	
\Local model verification	LocQUSGS2.riv	
\Local model verification	LocQUSGS2.wel	
\Local model verification	LocQUSGS2.ghb	
\Local model verification	LocQUSGS2.lyr	
\Local model verification	LocQUSGS2.hed	
\Local model verification	LocQUSGS2.drw	
\Local model verification	GR USGS-Local model verification.gpr	GMS Project File
\Local model verification	LocQUSGS2mf.dat	

Table 3
Files included on the Compact Disks

Files Path	File Name	File Description
Sensitivity Analysis		
\Sensitivity	WHPA-sens.mat	
\Sensitivity	WHPA-sens.map	
\Sensitivity	WHPA-sens.ini	
\Sensitivity	WHPA-sens.2dg	
\Sensitivity	WHPA-sens.xy	
\Sensitivity	WHPA-sens2g.dat	
\Sensitivity	WHPA-sens3g.dat	
\Sensitivity	WHPA-sens2s.dat	
\Sensitivity	WHPA8 KHP50.mfs	
\Sensitivity	WHPA8 KHP50.mfn	
\Sensitivity	WHPA8 KHP50.bas	
\Sensitivity	WHPA8 KHP50.bcf	
\Sensitivity	WHPA8 KHP50.oc	
\Sensitivity	WHPA8 KHP50.pcg	
\Sensitivity	WHPA8 KHP50.riv	
\Sensitivity	WHPA8 KHP50.wel	
\Sensitivity	WHPA8 KHP50.ghb	
\Sensitivity	WHPA8 KHP50.lyr	
\Sensitivity	WHPA8 hed	
\Sensitivity	WHPA8 drw	
\Sensitivity	WHPA8mf.dat	
\Sensitivity	WHPA8 5yrs.rsp	
\Sensitivity	WHPA8 5yrs.nam	
\Sensitivity	WHPA8 5yrs.mdf	
\Sensitivity	WHPA8 5yrs.loc	
\Sensitivity	WHPA8 5yrs.tim	
\Sensitivity	WHPA8 5yrs.pth	
\Sensitivity	WHPA8 5yrs.ept	
\Sensitivity	WHPA8 1yr.pth	
\Sensitivity	WHPA8 10yrs.pth	
\Sensitivity	WHPA840mf.dat	
\Sensitivity	WHPA8 KHP50.hed	
\Sensitivity	WHPA8 KHP50.rsp	
\Sensitivity	WHPA8 KHP50.nam	
\Sensitivity	WHPA8 KHP50.mdf	
\Sensitivity	WHPA8 KHP50.loc	
\Sensitivity	WHPA8 KHP50.tim	
\Sensitivity	WHPA-sens.gpr	
\Sensitivity	WHPA-sensb.gpr	
\Sensitivity	sensitivity.bat	
\Sensitivity	WHPA8 KVP50.wel	
\Sensitivity	WHPA8 KVP50.tim	
\Sensitivity	WHPA8 KVP50.sum	
\Sensitivity	WHPA8 KVP50.rsp	
\Sensitivity	WHPA8 KVP50.riv	
\Sensitivity	WHPA8 KVP50.pth	
\Sensitivity	WHPA8 KVP50.pcg	
\Sensitivity	WHPA8 KVP50.oc	
\Sensitivity	WHPA8 KVP50.nam	
\Sensitivity	WHPA8 KVP50.mfs	
\Sensitivity	WHPA8 KVP50.mfn	
\Sensitivity	WHPA8 KVP50.mdf	
\Sensitivity	WHPA8 KVP50.lyr	
\Sensitivity	WHPA8 KVP50.loc	
\Sensitivity	WHPA8 KVP50.hed	

Table 3
Files included on the Compact Disks

Files Path	File Name	File Description
\Sensitivity	WHPA8 KVP50.ghb	
\Sensitivity	WHPA8 KVP50.ept	
\Sensitivity	WHPA8 KVP50.bcf	
\Sensitivity	WHPA8 KVP50.bas	
\Sensitivity	WHPA8 KVM50.wel	
\Sensitivity	WHPA8 KVM50.tim	
\Sensitivity	WHPA8 KVM50.sum	
\Sensitivity	WHPA8 KVM50.rsp	
\Sensitivity	WHPA8 KVM50.riv	
\Sensitivity	WHPA8 KVM50.pth	
\Sensitivity	WHPA8 KVM50.pcg	
\Sensitivity	WHPA8 KVM50.oc	
\Sensitivity	WHPA8 KVM50.nam	
\Sensitivity	WHPA8 KVM50.mfs	
\Sensitivity	WHPA8 KVM50.mfn	
\Sensitivity	WHPA8 KVM50.mdf	
\Sensitivity	WHPA8 KVM50.lyr	
\Sensitivity	WHPA8 KVM50.loc	
\Sensitivity	WHPA8 KVM50.hed	
\Sensitivity	WHPA8 KVM50.ghb	
\Sensitivity	WHPA8 KVM50.ept	
\Sensitivity	WHPA8 KVM50.bcf	
\Sensitivity	WHPA8 KVM50.bas	
\Sensitivity	WHPA8 KHP50.sum	
\Sensitivity	WHPA8 KHP50.pth	
\Sensitivity	WHPA8 KHP50.ept	
\Sensitivity	WHPA8 KHM50.wel	
\Sensitivity	WHPA8 KHM50.tim	
\Sensitivity	WHPA8 KHM50.sum	
\Sensitivity	WHPA8 KHM50.rsp	
\Sensitivity	WHPA8 KHM50.riv	
\Sensitivity	WHPA8 KHM50.pth	
\Sensitivity	WHPA8 KHM50.pcg	
\Sensitivity	WHPA8 KHM50.oc	
\Sensitivity	WHPA8 KHM50.nam	
\Sensitivity	WHPA8 KHM50.mfs	
\Sensitivity	WHPA8 KHM50.mfn	
\Sensitivity	WHPA8 KHM50.mdf	
\Sensitivity	WHPA8 KHM50.lyr	
\Sensitivity	WHPA8 KHM50.loc	
\Sensitivity	WHPA8 KHM50.hed	
\Sensitivity	WHPA8 KHM50.ghb	
\Sensitivity	WHPA8 KHM50.ept	
\Sensitivity	WHPA8 KHM50.bcf	
\Sensitivity	WHPA8 KHM50.bas	
\Sensitivity	WHPA 8 KV P50.dxf	
\Sensitivity	WHPA 8 KV M50.dxf	
\Sensitivity	WHPA 8 KH P50.dxf	
\Sensitivity	WHPA 8 KH M50.dxf	
\Sensitivity	WHPA 6 KV P50.dxf	
\Sensitivity	WHPA 6 KV M50.dxf	
\Sensitivity	WHPA 6 KH P50.dxf	
\Sensitivity	WHPA 6 KH M50.dxf	

Table 3
Files included on the Compact Disks

Files Path	File Name	File Description
Wellhead Protection Area Delineation Model		
I\WHPA	WHPA8 10yrs.rsp	MODPATH Response File
I\WHPA	WHPA8.xy	
I\WHPA	WHPA8 10yrs.ept	
I\WHPA	WHPA8 10yrs.loc	
I\WHPA	WHPA8 10yrs.mdf	
I\WHPA	WHPA8 10yrs.nam	
I\WHPA	WHPA8 10yrs.pth	
I\WHPA	WHPA8.wel	
I\WHPA	WHPA8 10yrs.sum	
I\WHPA	WHPA8 10yrs.tim	
I\WHPA	WHPA8 10yrs.pth.bt	
I\WHPA	WHPA8 1yr.ept	
I\WHPA	WHPA8 1yr.loc	
I\WHPA	WHPA8 1yr.mdf	
I\WHPA	WHPA8 1yr.nam	
I\WHPA	WHPA8 1yr.pth	
I\WHPA	WHPA8 1yr.rsp	
I\WHPA	WHPA8 1yr.sum	
I\WHPA	WHPA8 1yr.tim	
I\WHPA	WHPA8 5yrs.ept	
I\WHPA	WHPA8 5yrs.loc	
I\WHPA	WHPA8 5yrs.mdf	
I\WHPA	WHPA8 5yrs.nam	
I\WHPA	WHPA8 5yrs.pth	
I\WHPA	WHPA8 5yrs.rsp	
I\WHPA	WHPA8 5yrs.sum	
I\WHPA	WHPA8 5yrs.tim	
I\WHPA	WHPA82g.dat	
I\WHPA	WHPA82s.dat	
I\WHPA	WHPA83g.dat	
I\WHPA	WHPA8mf.dat	
I\WHPA	WHPA8.2dg	
I\WHPA	WHPA8.bas	
I\WHPA	WHPA8.bcf	
I\WHPA	WHPA8.drw	
I\WHPA	WHPA8.ept	
I\WHPA	WHPA8.ghb	
I\WHPA	WHPA 8 Pathlines.dxf	
I\WHPA	WHPA8.hed	
I\WHPA	WHPA8.ini	
I\WHPA	WHPA8.loc	
I\WHPA	WHPA8.lyr	
I\WHPA	WHPA8.map	
I\WHPA	WHPA8.mat	
I\WHPA	WHPA8.mdf	
I\WHPA	WHPA8.mfn	
I\WHPA	WHPA8.nam	
I\WHPA	WHPA8.oc	
I\WHPA	WHPA8.pcg	
I\WHPA	WHPA8.pth	
I\WHPA	WHPA8.riv	
I\WHPA	WHPA8.rsp	
I\WHPA	WHPA8.sum	
I\WHPA	WHPA8.tim	
I\WHPA	WHPA8.mfs	
I\WHPA	WHPA8.gpr	

Table 3
Files included on the Compact Disks

Files Path	File Name	File Description
Arcview Project - GIS CD		
Root Directory	standard gis report figures grand rapids WHPA.apr	Arcview Project file
lgis\shape\utm83\base	city_of_grand_rapids.shp	
lgis\shape\utm83\boundary	parcels1.shp	
lgis\shape\utm83\boundary	roads1.shp	
lgis\shape\utm83\geology	cwi_wells_used_in_sand_content_map.shp	
lgis\shape\utm83\hydro	lakes.shp	
lgis\shape\utm83\hydro	streams.shp	
lgis\shape\utm83\model	active_domain2shp.shp	
lgis\shape\utm83\model	wetlands_gms_polys.shp	
lgis\shape\utm83\model\jfwalsh	grand_rapids_city_wells.shp	
lgis\shape\utm83\vulnerability	high_vul.shp	
lgis\shape\utm83\vulnerability	vulnerability_conjunctive_13b.shp	Conjunctive Vulnerability
lgis\shape\utm83\vulnerability	vulnerability_outwash_polys.shp	Outwash Vulnerability
lgis\shape\utm83\wells	cwi_wells_near_grand_rapids.shp	
lgis\drgs	bovey.tif	
lgis\drgs	cohasset_east.tif	
lgis\drgs	grand_rapids.tif	
lgis\drgs	la_prairie.tif	
lgis\shape\utm83\whpa	city_of_grand_rapids_alone.shp	
lgis\shape\utm83\whpa	dwsma.shp	DWSMA
lgis\shape\utm83\whpa	emergency_management_zone_polys.shp	Emergency Management Zone
lgis\shape\utm83\whpa	geologic_x_sections_location_vulnerability.shp	
lgis\shape\utm83\whpa	kh_11_whpa_model_polys.shp	
lgis\shape\utm83\whpa	kh_12_whpa_model_polys.shp	
lgis\shape\utm83\whpa	kh_13_whpa_model_polys.shp	
lgis\shape\utm83\whpa	kh_14_whpa_model_polys.shp	
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lgis\shape\utm83\whpa	kh_16_whpa_model_polys.shp	
lgis\shape\utm83\whpa	lakes_within_whpa.shp	
lgis\shape\utm83\whpa	local_model_grid_frame_poly.shp	
lgis\shape\utm83\whpa	q_average_gms_wells_located_mdh_and_grpuc.shp	
lgis\shape\utm83\whpa	q_whpa_gms_wells_located_mdh_and_grpuc.shp	
lgis\shape\utm83\whpa	sens_khm50.shp	
lgis\shape\utm83\whpa	sens_khp50.shp	
lgis\shape\utm83\whpa	sens_kvm50.shp	
lgis\shape\utm83\whpa	sens_kvp50.shp	
lgis\shape\utm83\whpa	up_watershed_polys.shp	
lgis\shape\utm83\whpa	up_wshed_utm.shp	
lgis\shape\utm83\whpa	well_2_whpa.shp	Well 2 WHPA
lgis\shape\utm83\whpa	whpa_conjunctive_delineation_2_polys.shp	
lgis\shape\utm83\whpa	whpa_delineation_whpa8_polys.shp	Outwash WHPA
lgis\shape\utm83\whpa	whpa_t_10yrs_arc.shp	
lgis\shape\utm83\whpa	whpa8_10yrs_point.shp	
lgis\shape\utm83\whpa	whpa8-10-yrs_flow_line.shp	
lgis\shape\utm83\whpa	whpa8-10yrs-whpa_polys2.shp	Outwash WHPA (combined)

Figures

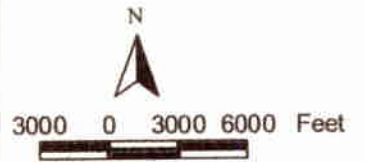
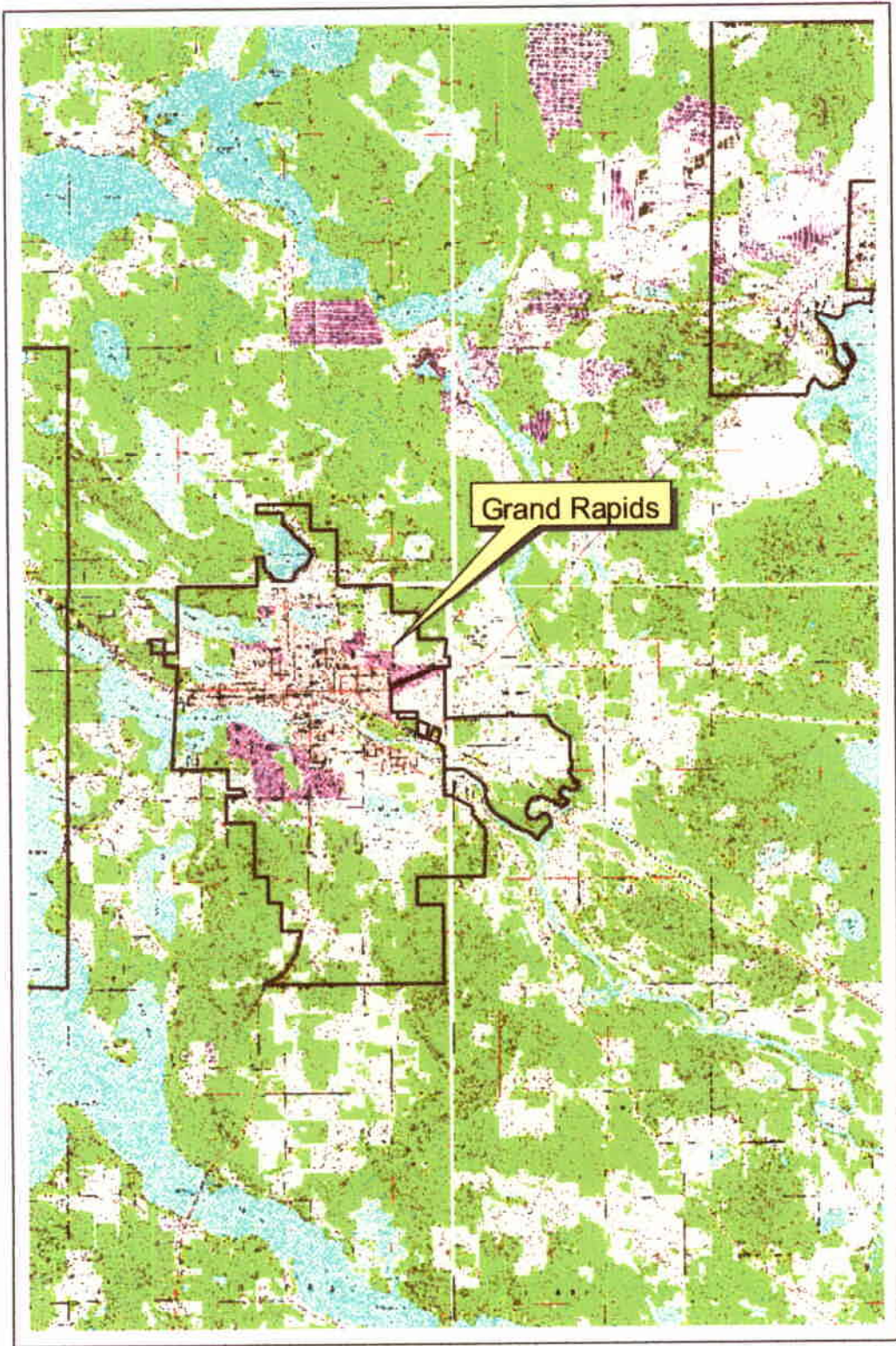
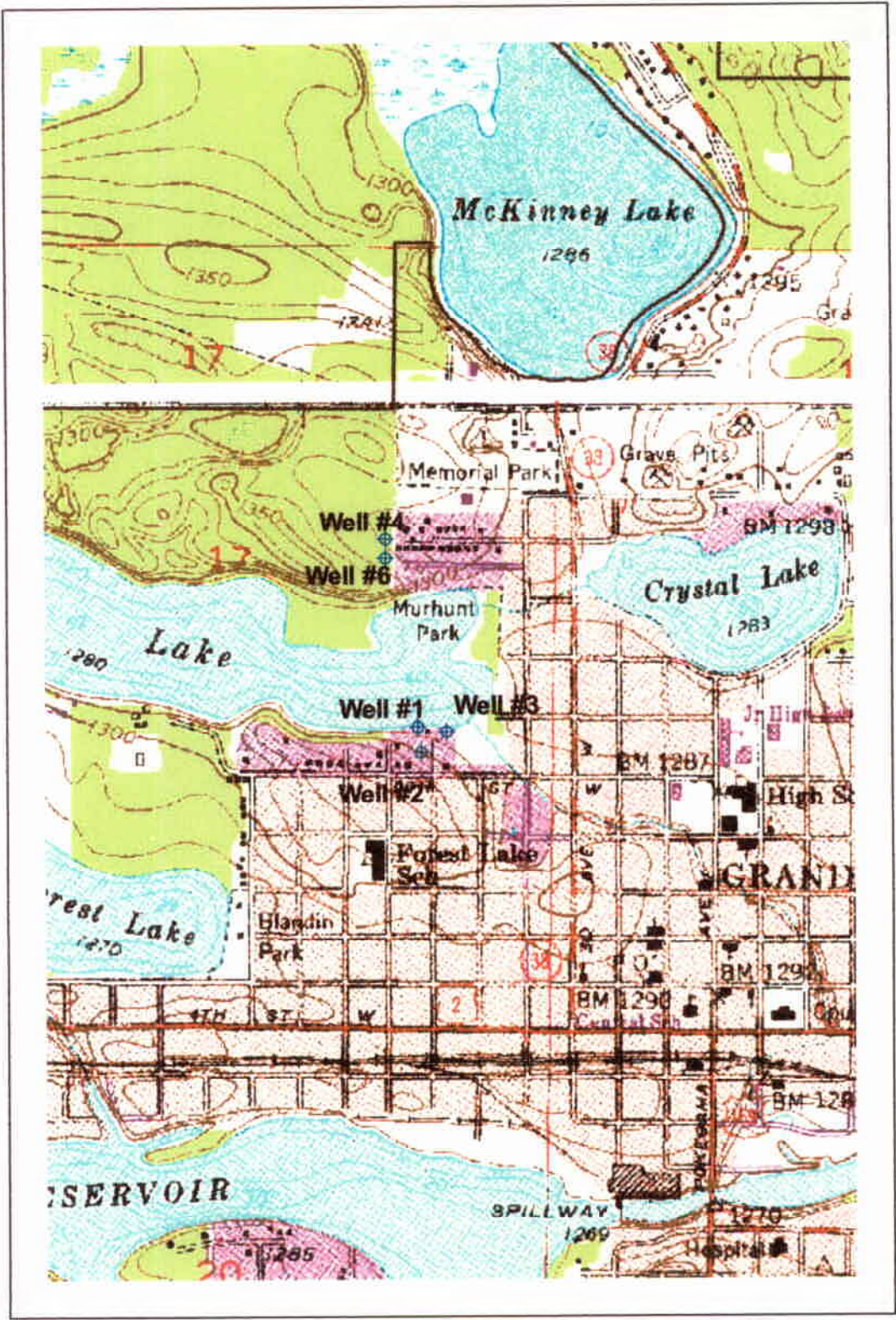


Figure 1
Site Location Map
(City of Grand Rapids)



View1: Well Field

City of Grand Rapids Wells

- ◆ Bwabik Iron Formation
- ◆ Glacial Deposits

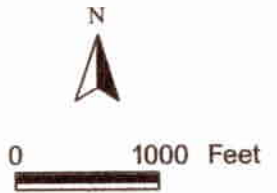
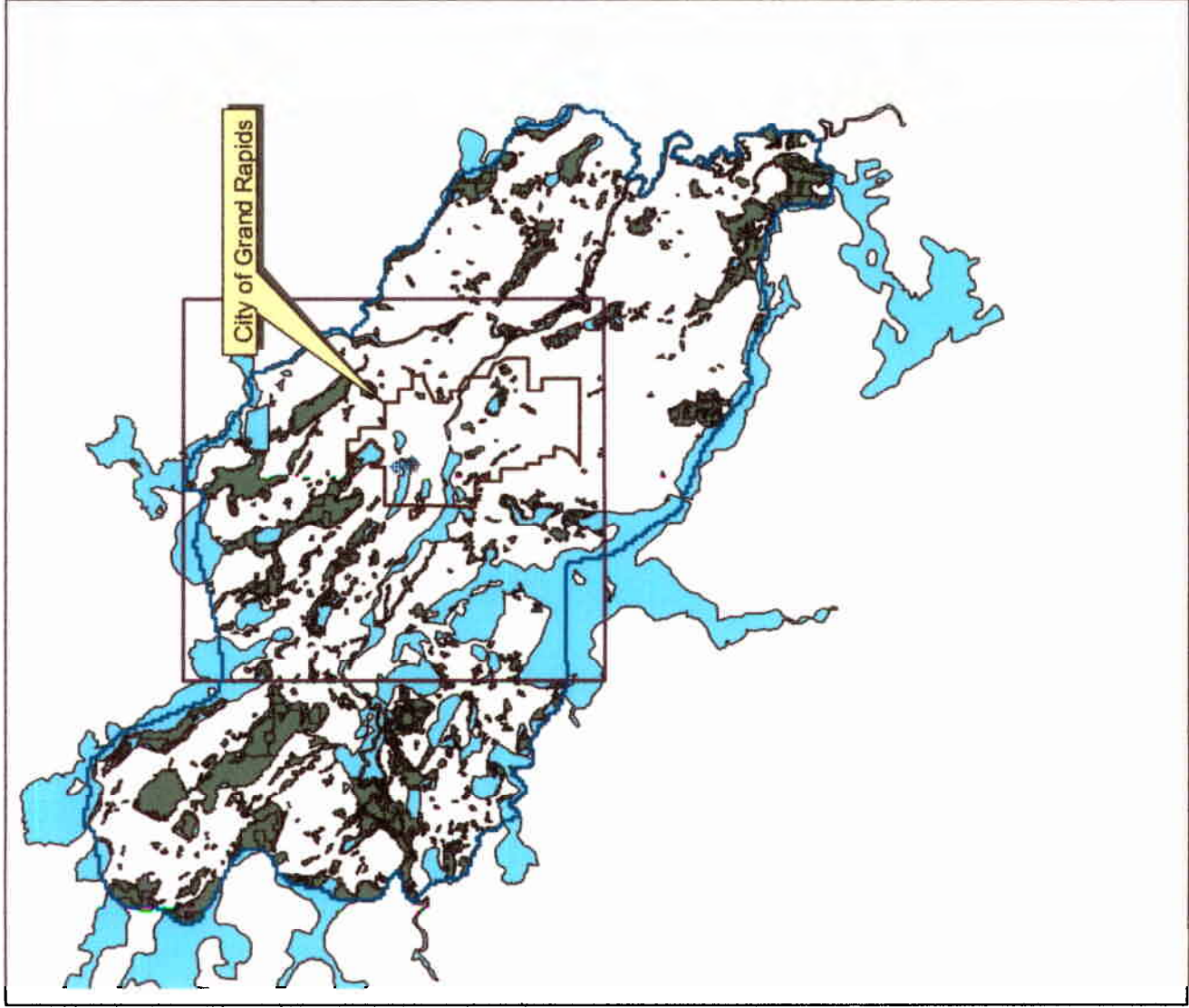


Figure 2
WELL FIELD
(City of Grand Rapids)



View 3: USGS MODFLOW Regional Model







-  MODFLOW Active Domain - USGS Regional Model
-  Local Model Extent
- City of Grand Rapids Wells**
 -  Blwabik Iron Formation Well
 -  Glacio-Fluvial Outwash Well
-  Wetlands
-  Rivers and Lakes



Figure 3
USGS Regional MODFLOW Model Extent
(City of Grand Rapids)

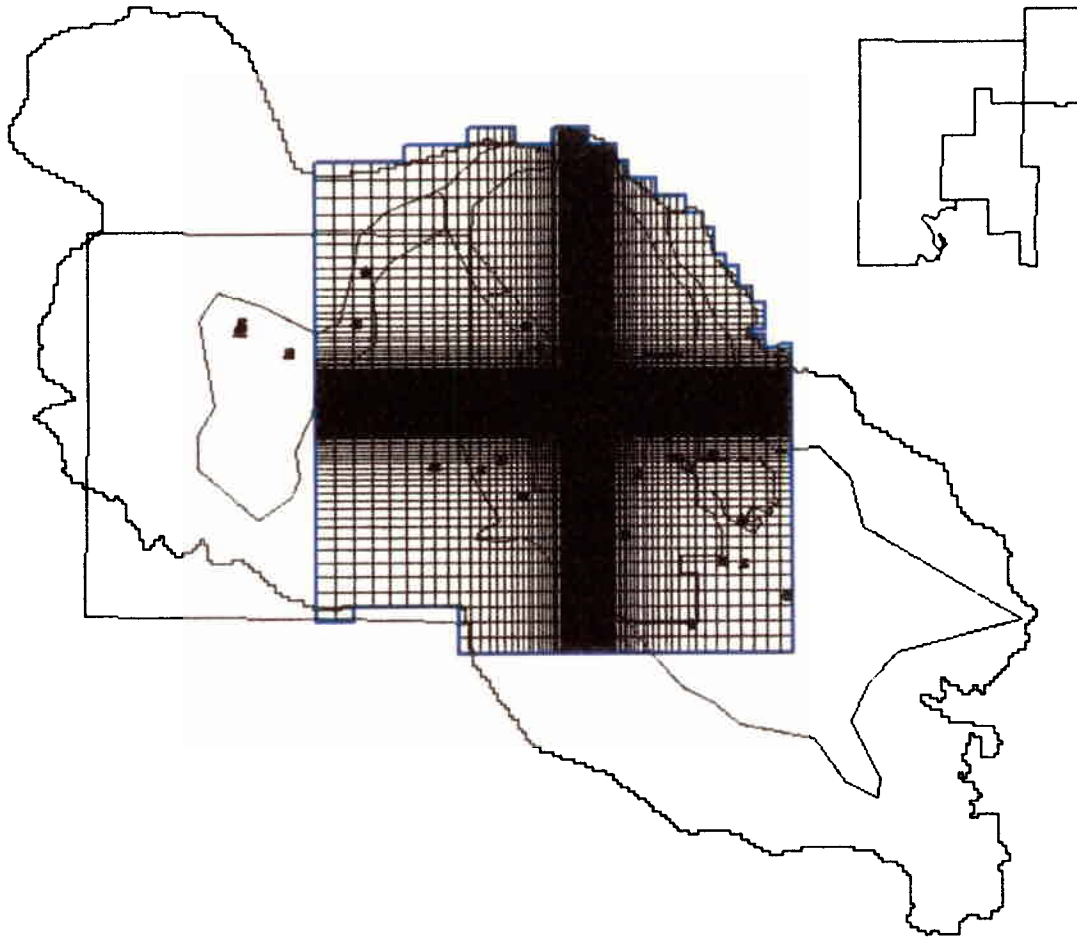


Figure 4
MODFLOW FINITE DIFFERENCE ACTIVE GRID
LOCAL MODEL
City of Grand Rapids

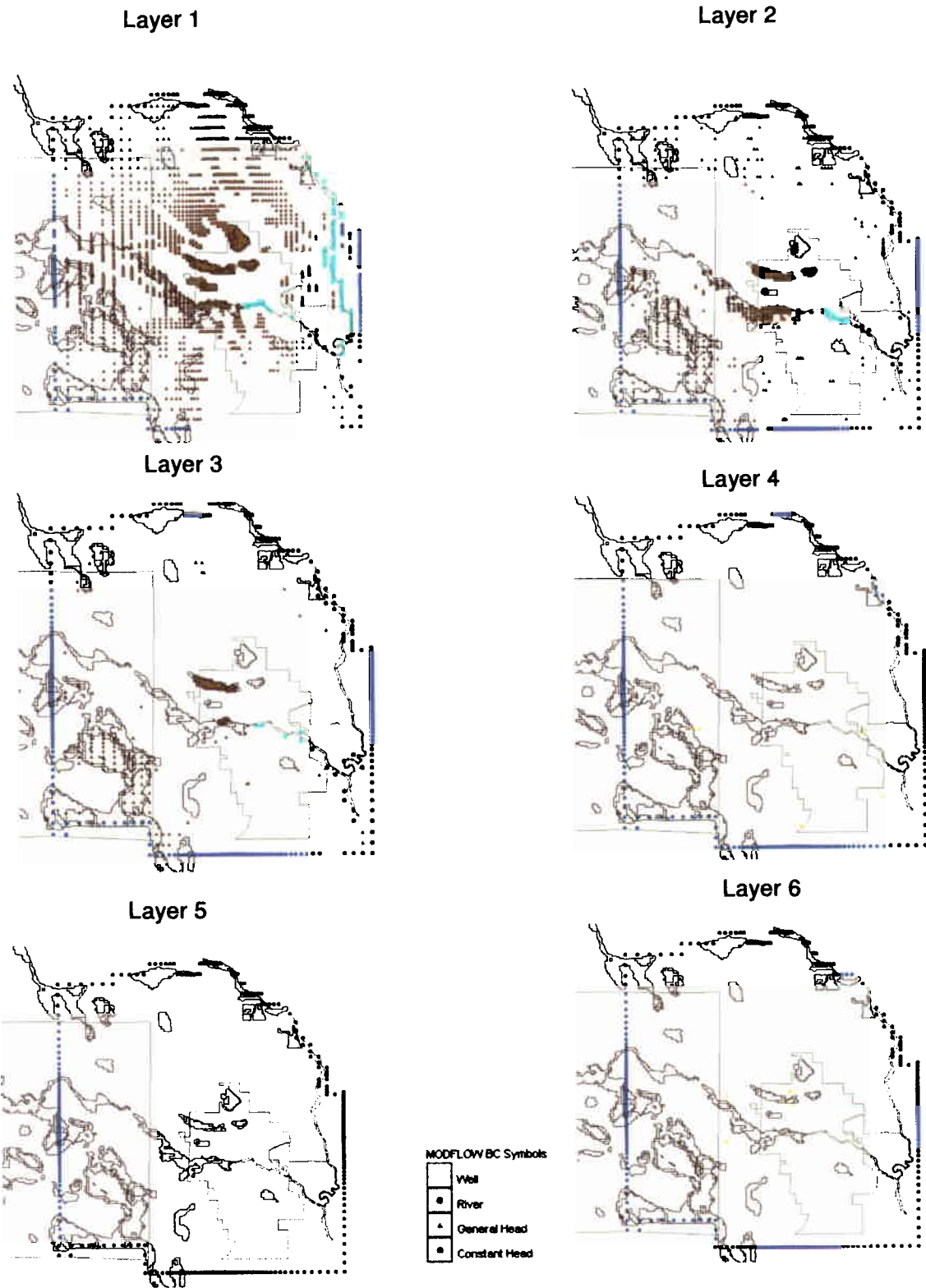


Figure 5
 MODFLOW BOUNDARY CONDITIONS
 LOCAL MODEL
 City of Grand Rapids

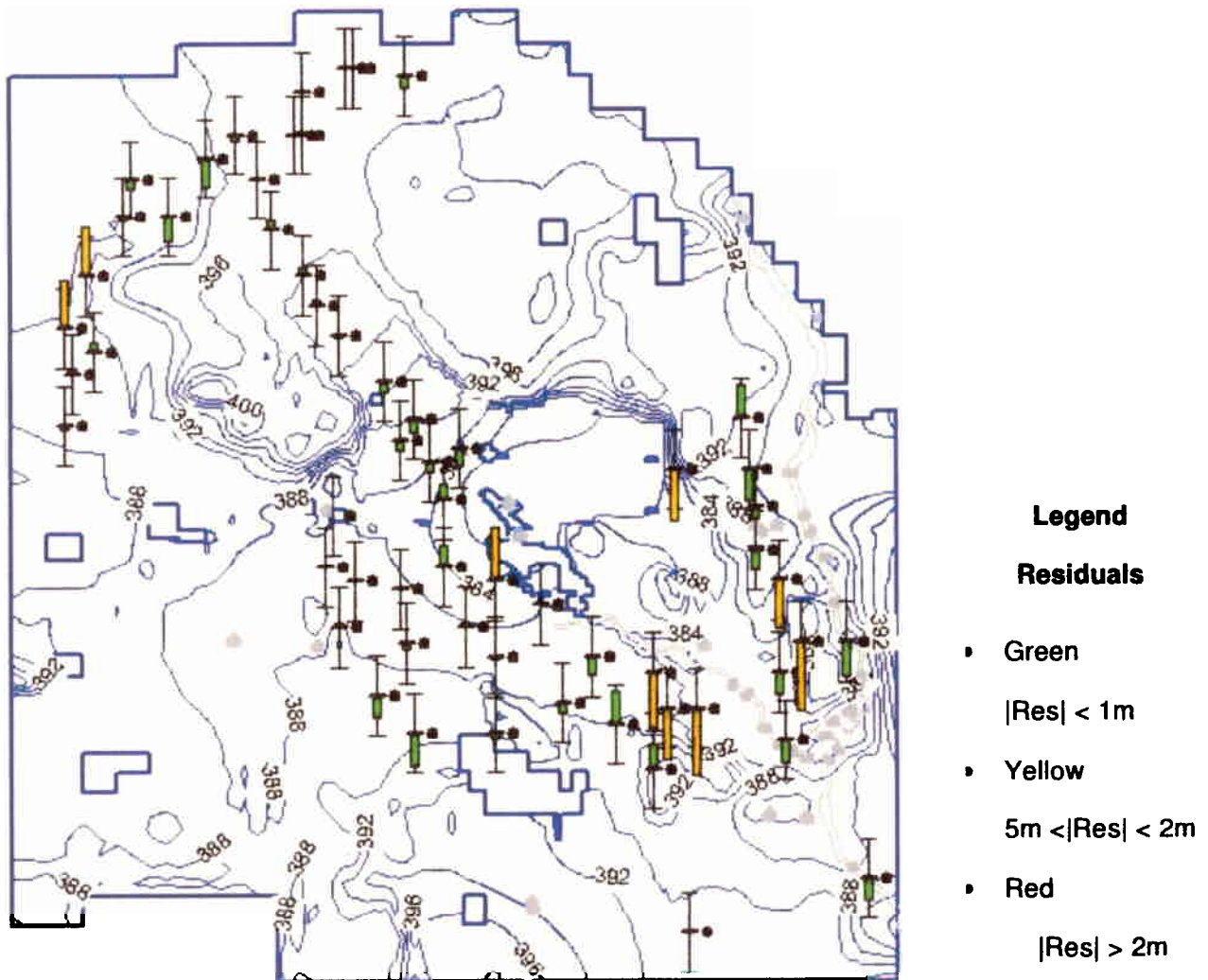
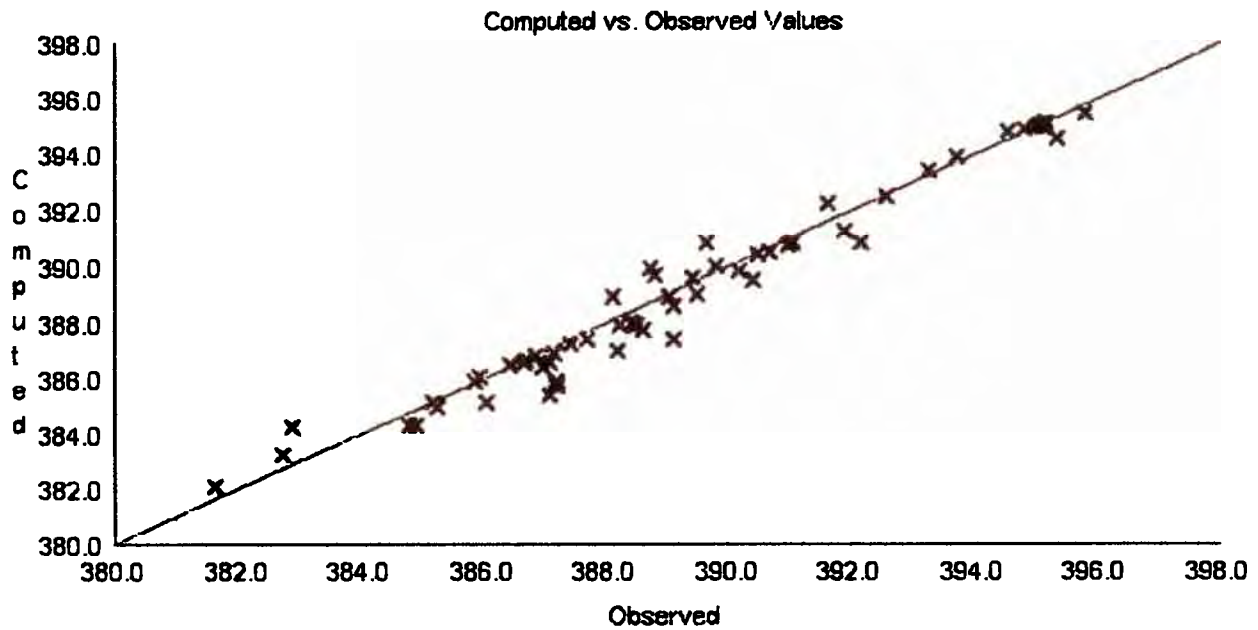


Figure 6
 SPATIAL DISTRIBUTIONS OF RESIDUALS IN LAYER 4
 COMPARISON BETWEEN REGIONAL AND LOCAL MODELS
 COMPUTED HEADS
 City of Grand Rapids



Error Summary

Solution / Data set: LocQUSGS2 / LocQUSGS2_Heads

Observed measurement: Head

Mean error: -0.18

Mean abs. error: 0.47

Root mean sq. error: 0.66

Figure 7
HYDRAULIC HEADS COMPUTED BY LOCAL MODEL VS.
COMPUTED BY REGIONAL MODEL
LAYER 4
City of Grand Rapids

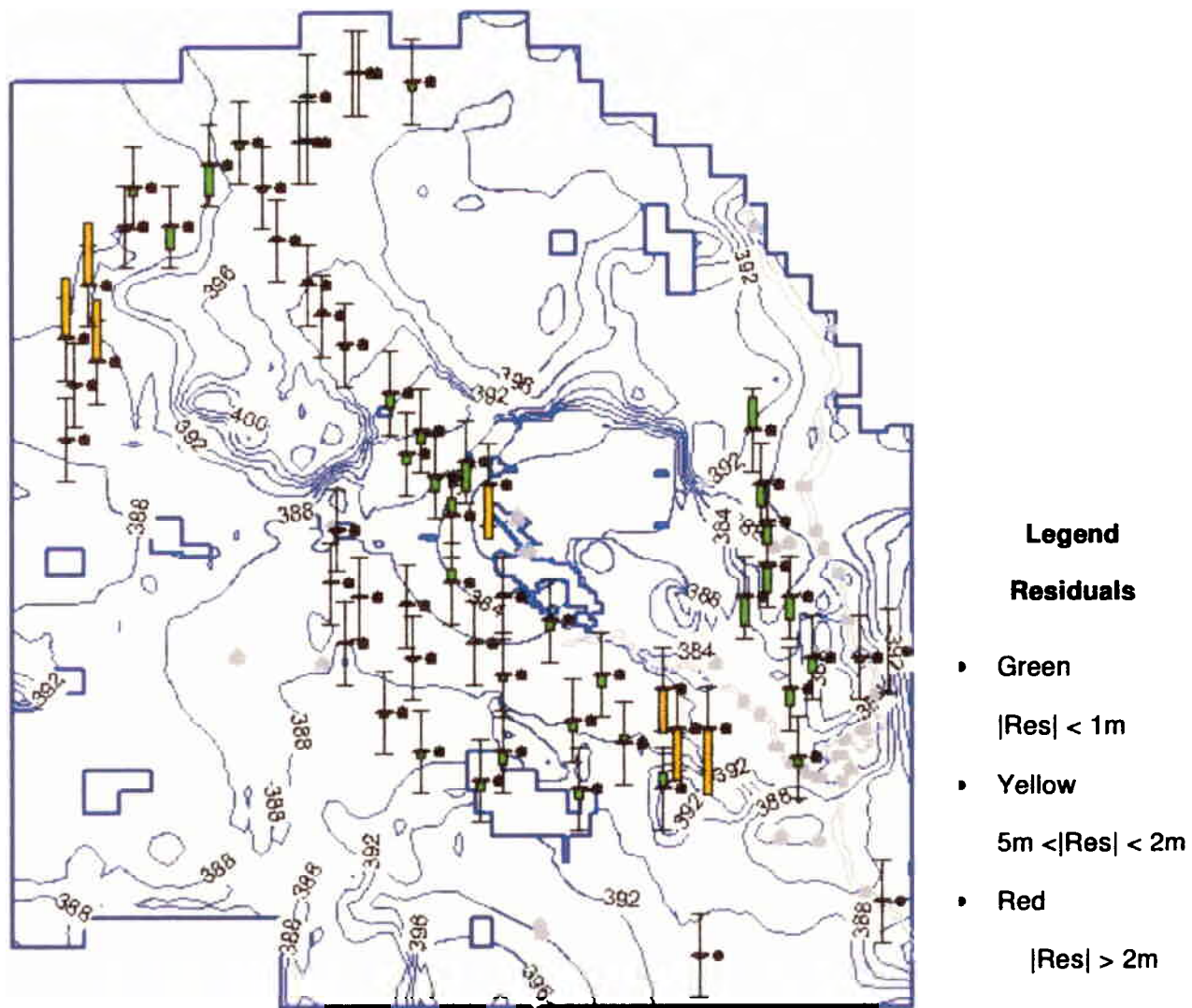
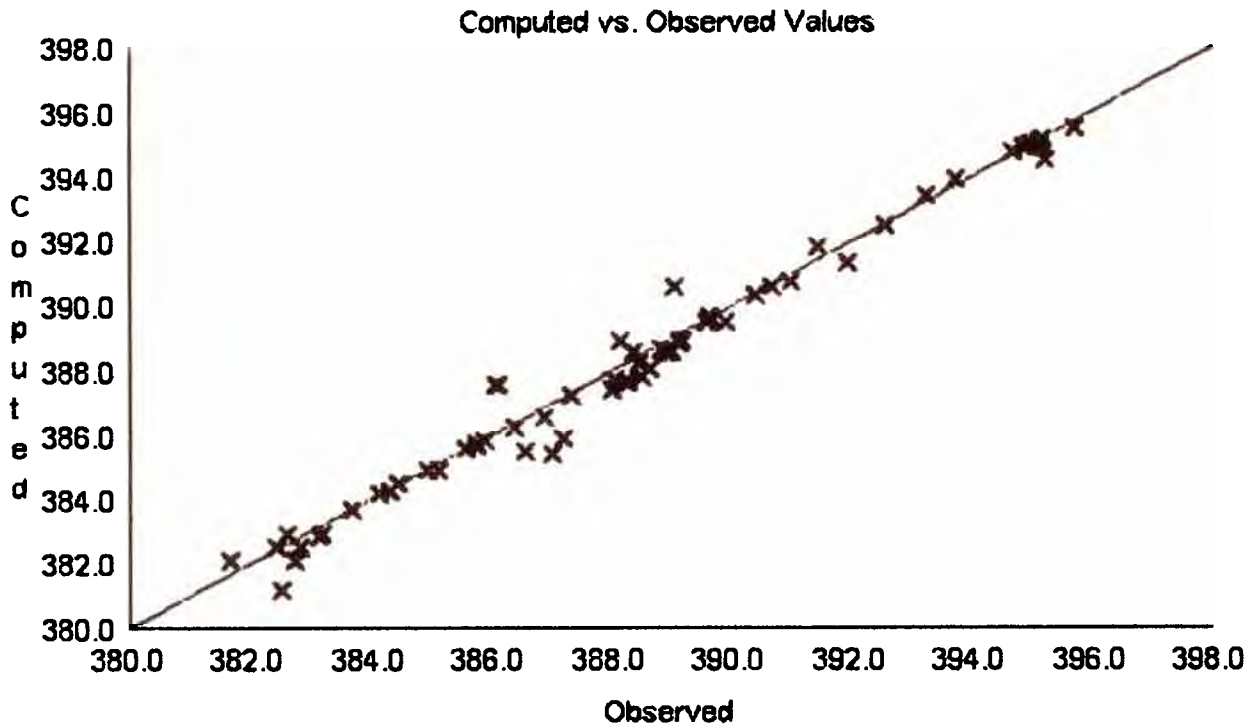


Figure 8
SPATIAL DISTRIBUTIONS OF RESIDUALS IN LAYER 6
COMPARISON BETWEEN REGIONAL AND LOCAL MODELS
COMPUTED HEADS
City of Grand Rapids



Error Summary

Solution / Data set: LocQUSGS2 / LocQUSGS2_Heads

Observed measurement: Head

Mean error: -0.13

Mean abs. error: 0.36

Root mean sq. error: 0.55

Figure 9
HYDRAULIC HEADS COMPUTED BY LOCAL MODEL VS.
COMPUTED BY REGIONAL MODEL
LAYER 6
City of Grand Rapids

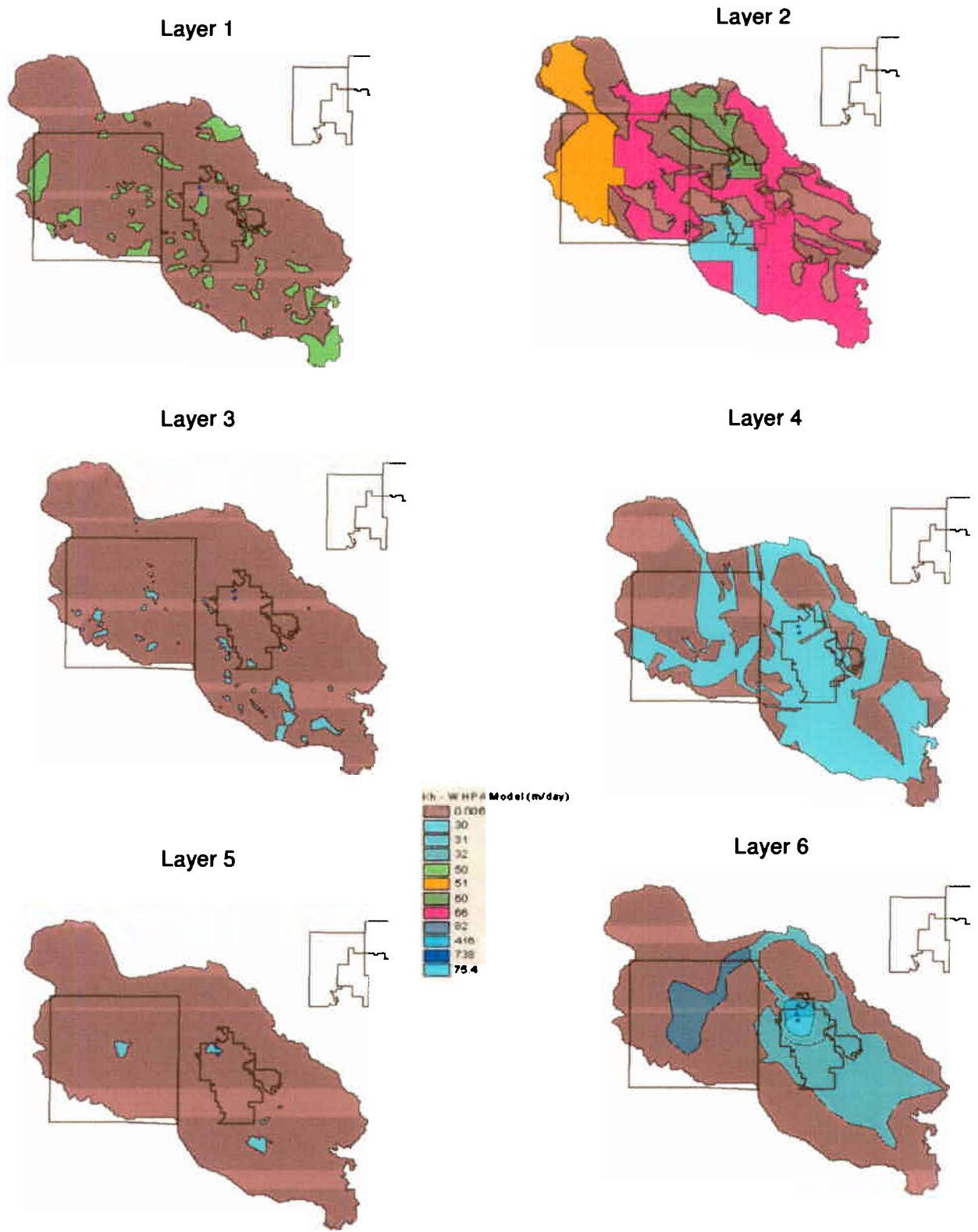


Figure 10
 HYDRAULIC CONDUCTIVITY ZONES
 WHPA LOCAL MODEL
 City of Grand Rapids

View11: WHPA 1, 5 & 10-yr TT

City of Grand Rapids Wells

- ◆ Blwabik Iron Formation Well
- ◆ Glacio-Fluvial Outwash Well

Wellhead Protection Area - Outwash Wells

- 10-yr Time of Travel
- 5-yr Time of Travel
- 1-yr TT - Emergency Management Zone

Groundwater Flow Lines

- Well 1
- Well 3
- Well 4
- Well 6

Hale, Crystal and Mc Kinney lakes Watershed

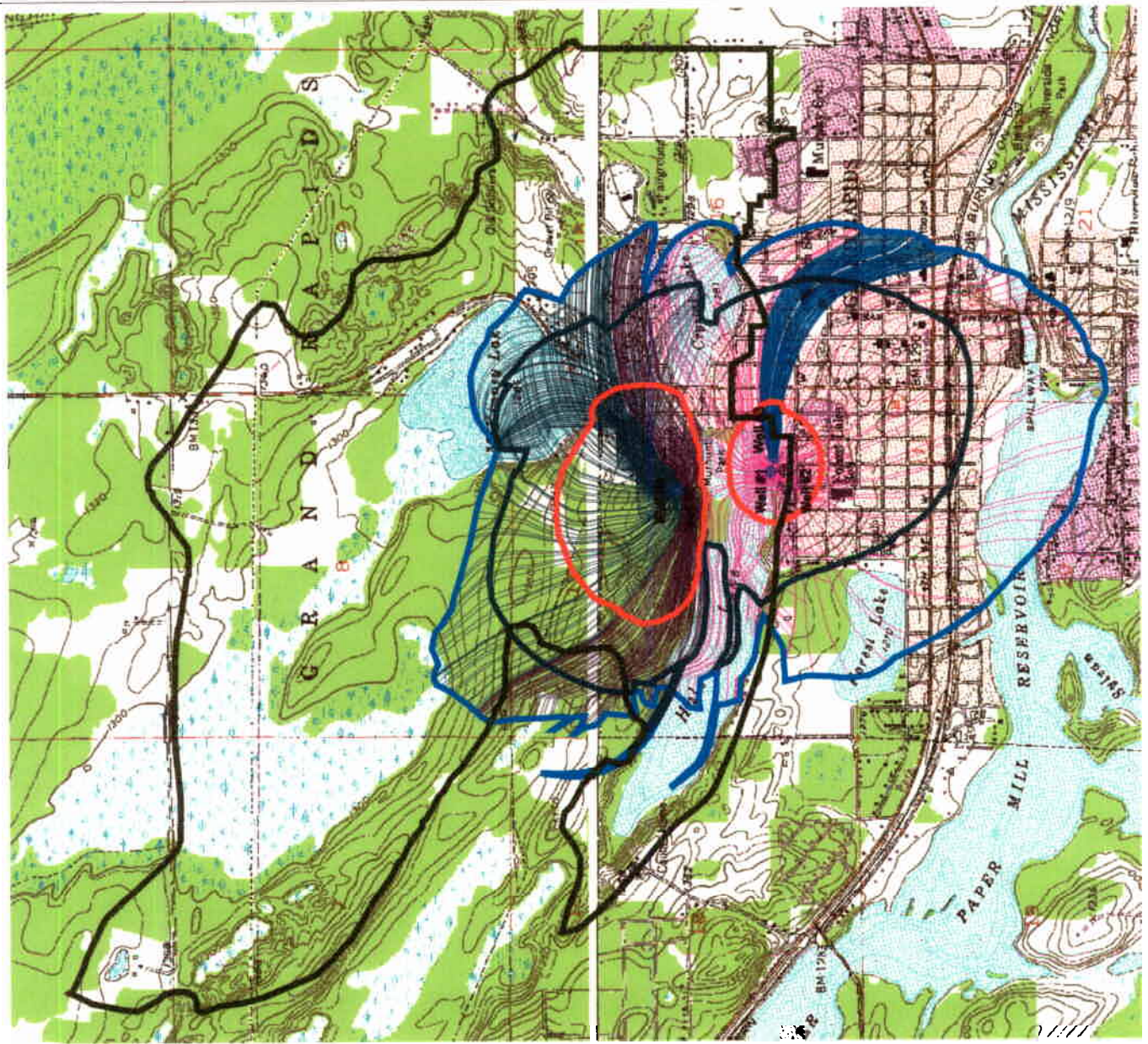


Figure 11

WHPA DELINEATION GLACIO-FLUVIAL OUTWASH WELLS 1, 3, 4 & 6 (City of Grand Rapids)

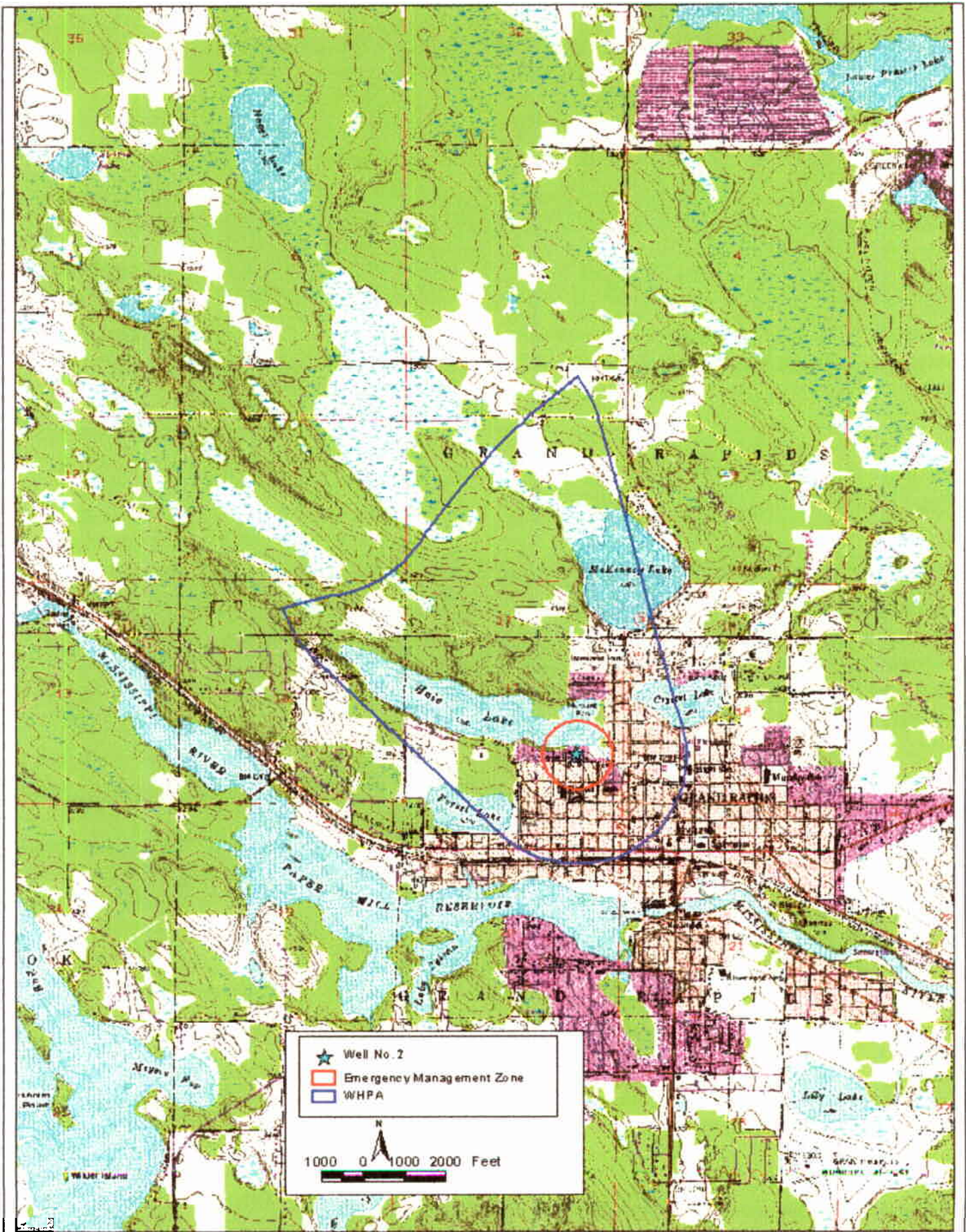


Figure 12. WHPA delineation for Grand Rapids Well No. 2.

View13: WHPA - Conjunctive Delineation

- City of Grand Rapids Wells
 - ◆ Basalt Iron Formation Well 2
 - ◆ Grand Outwash Deposits
- Emergency Management Zone
 - 1-yr Time of Travel
 - 10-yr Time of Travel
- WHPA - Conjunctive Delineation
 - WHPA
- Wellhead Protection Area - Outwash Wells
 - 10-yr Time of Travel
- Hale, Crystal and Mc Kinney lakes Watershed
 - Watershed
- Wellhead Protection Area - Well 2
 - 10-yr Time of Travel

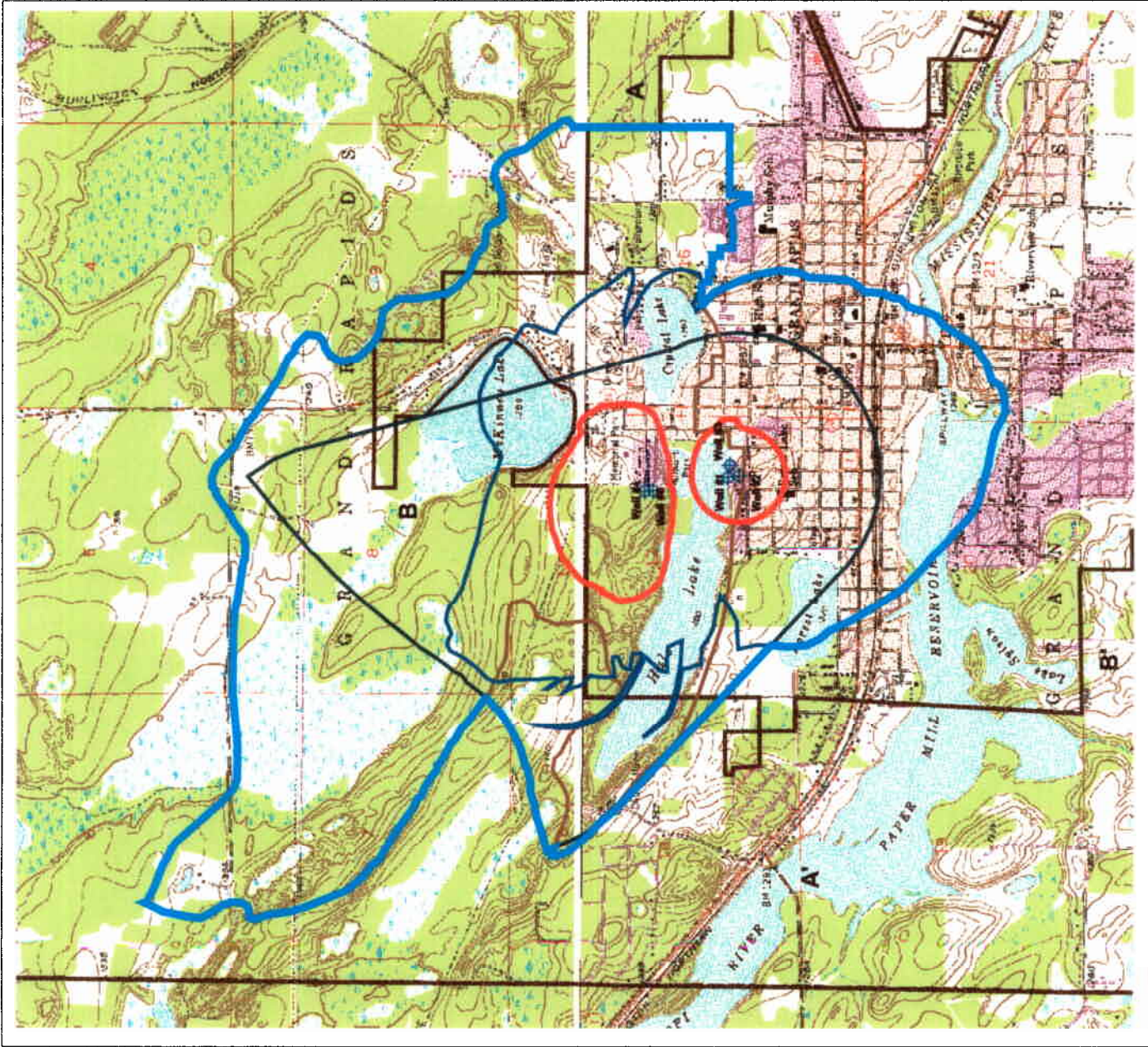


Figure 13
WHPA
CONJUNCTIVE DELINEATION
(City of Grand Rapids)

View 13: Sensitivity Analysis to Kh and Kv

City of Grand Rapids Wells

- Bunkin Iron Formation Well
- Oude-Fluist Oudesch Well

Wellhead Protection Area - Oudesch Wells

- 10-yr Time of Travel
- 5-yr Time of Travel
- 1-yr Time of Travel

WHPA - KH minus 50 %
 WHPA - KH plus 50 %
 WHPA - KV minus 50 %
 WHPA - KV plus 50 %

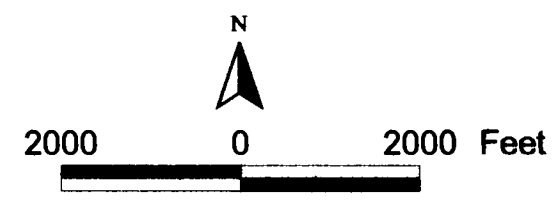
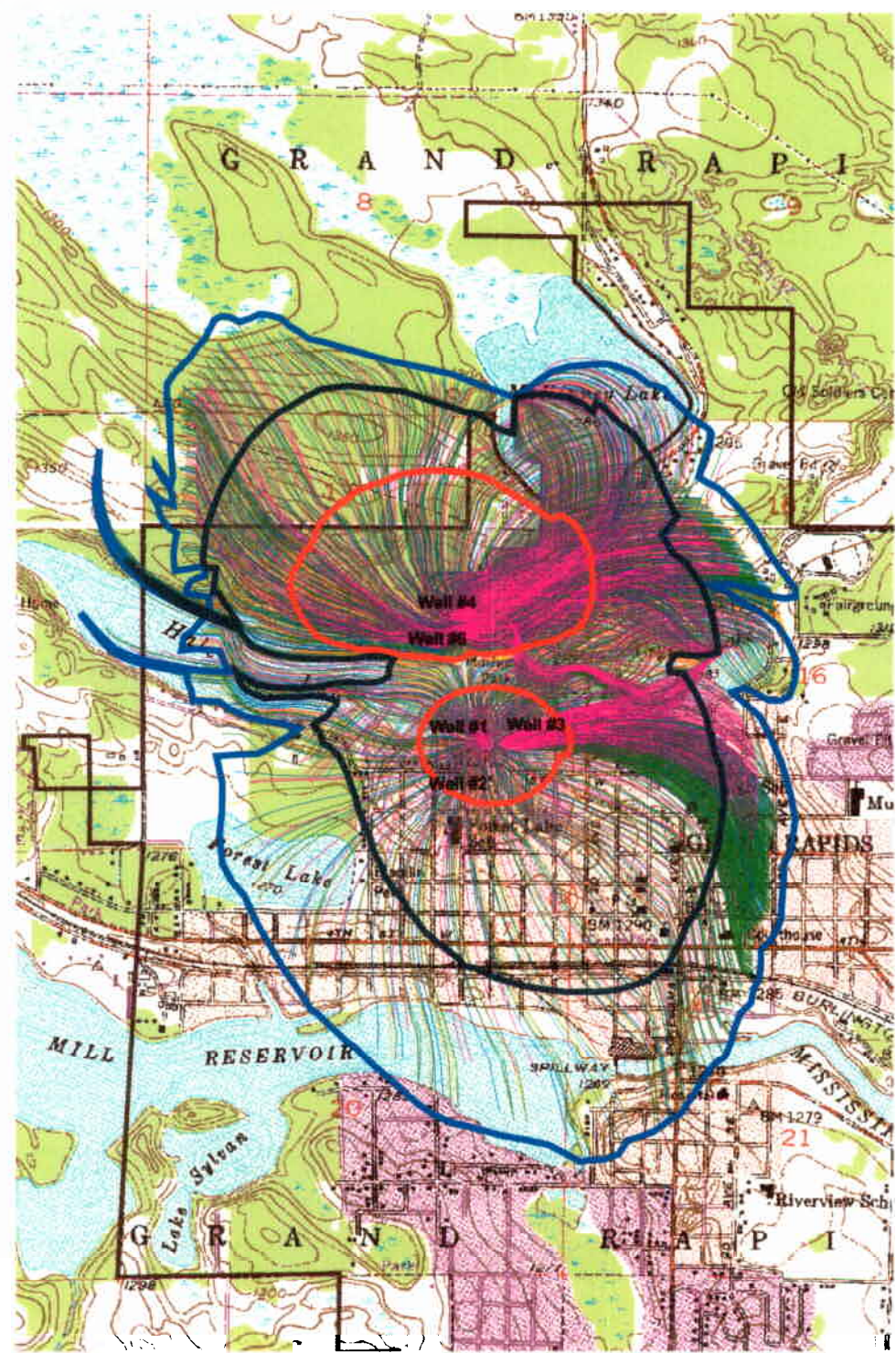


Figure 14
SENSITIVITY OF WHPA DELINEATION
TO UNCERTAINTY IN THE HORIZONTAL
AND VERTICAL HYDRAULIC CONDUCTIVITIES
(City of Grand Rapids)

View 15: DWSMA

- DWSMA
 - Feature not yet classified
 - Municipal boundary
 - PLSS Section line
 - Pipeline
 - Property line
 - ROW closure line
 - RR closure line
 - Street ROW
 - Water closure line
- WHPA - Conjunctive Delineation
 - WHPA
- City of Grand Rapids Wells
 - Shwabik Iron Formation Well 2
 - Glacial Outwash Deposits
- Emergency Management Zone
 - 1-yr Time of Travel

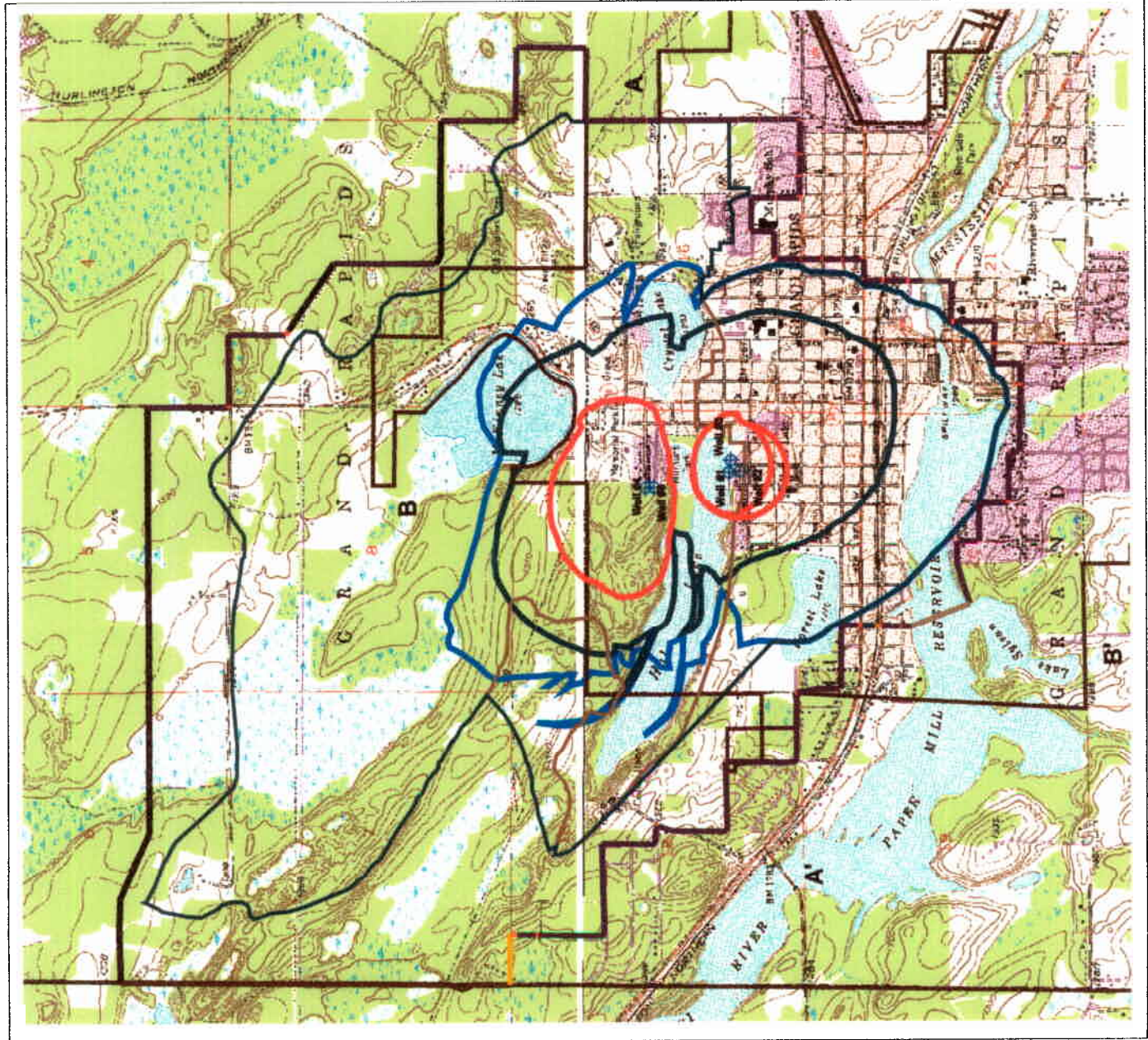


Figure 15
DWSMA
(City of Grand Rapids)

View 16: Map of Clay Content in Upper 100 ft

City of Grand Rapids Wells

- Bwabik Iron Formation
- Glacial Deposits

CWI Wells Used in Clay Content Map

- CWI Well

Cross Sections

- A-A'
- B-B'

DWSMA

- Feature not yet classified
- Municipal boundary
- PLSS Section line
- Pipeline
- Property line
- ROW closure line
- RR closure line
- Street ROW
- Water closure line
- Ice Contact Deposits

Clay Content (in Percent) in Upper 100 ft

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- No Data



2000 0 2000 Feet

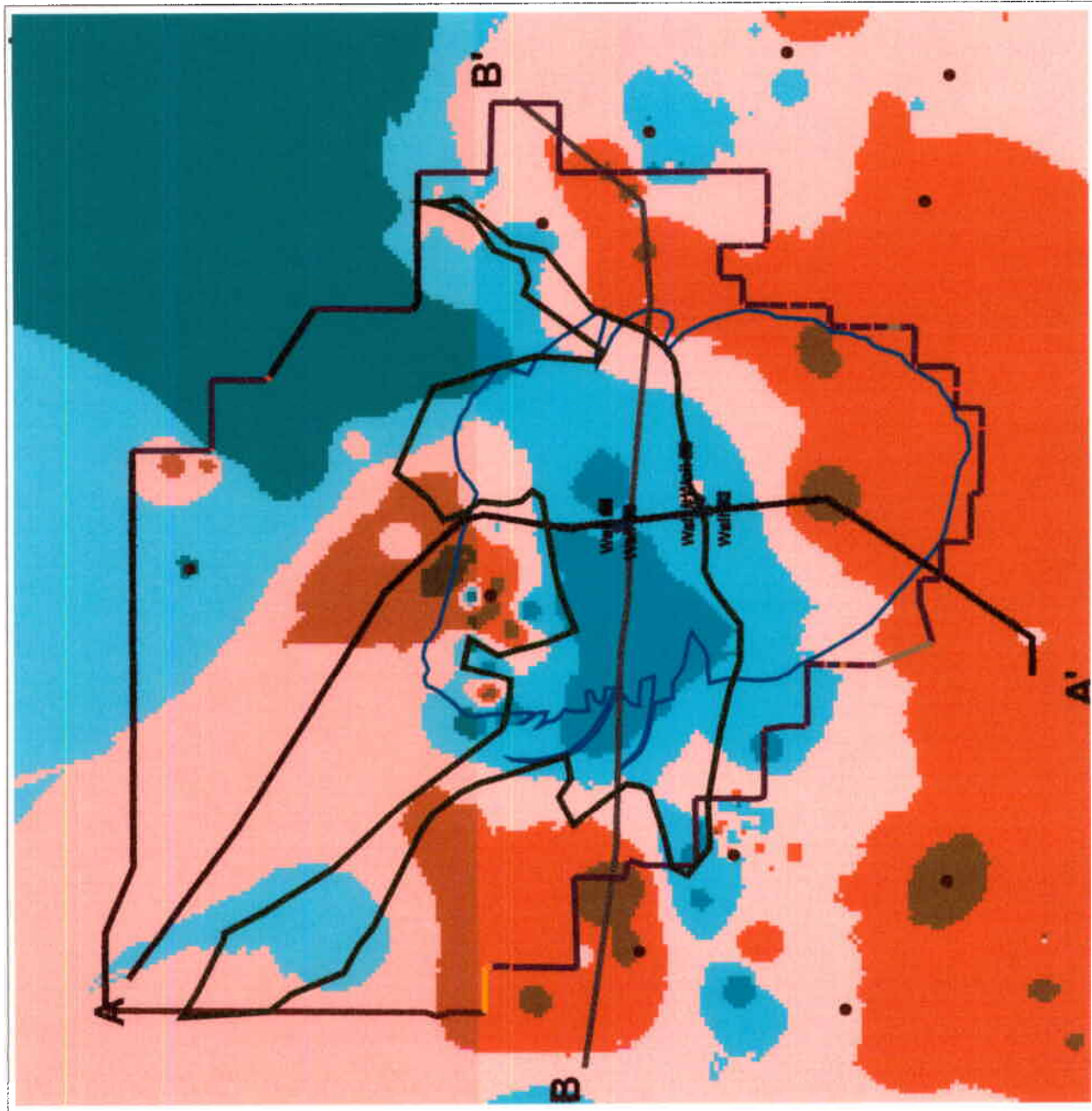


FIGURE 16
MAP OF CLAY CONTENT IN UPPER 100 FT
(City of Grand Rapids)

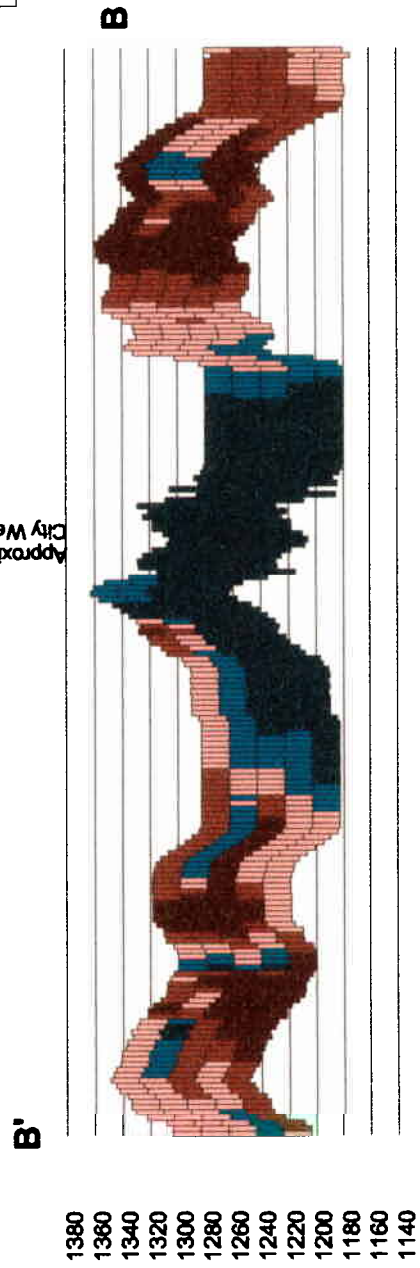
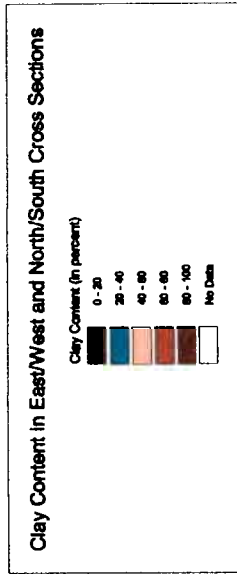
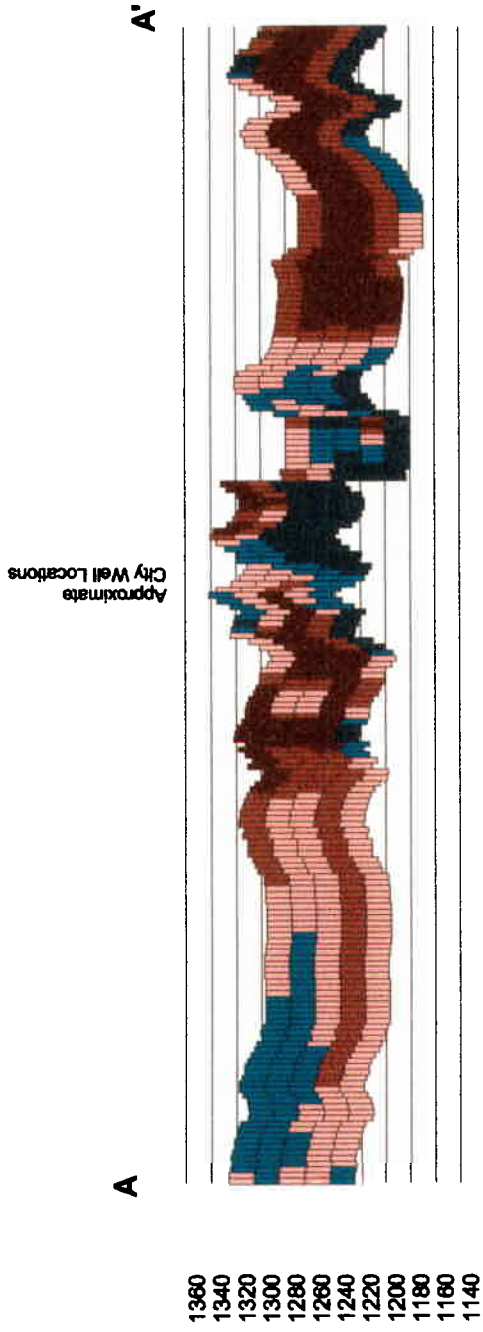
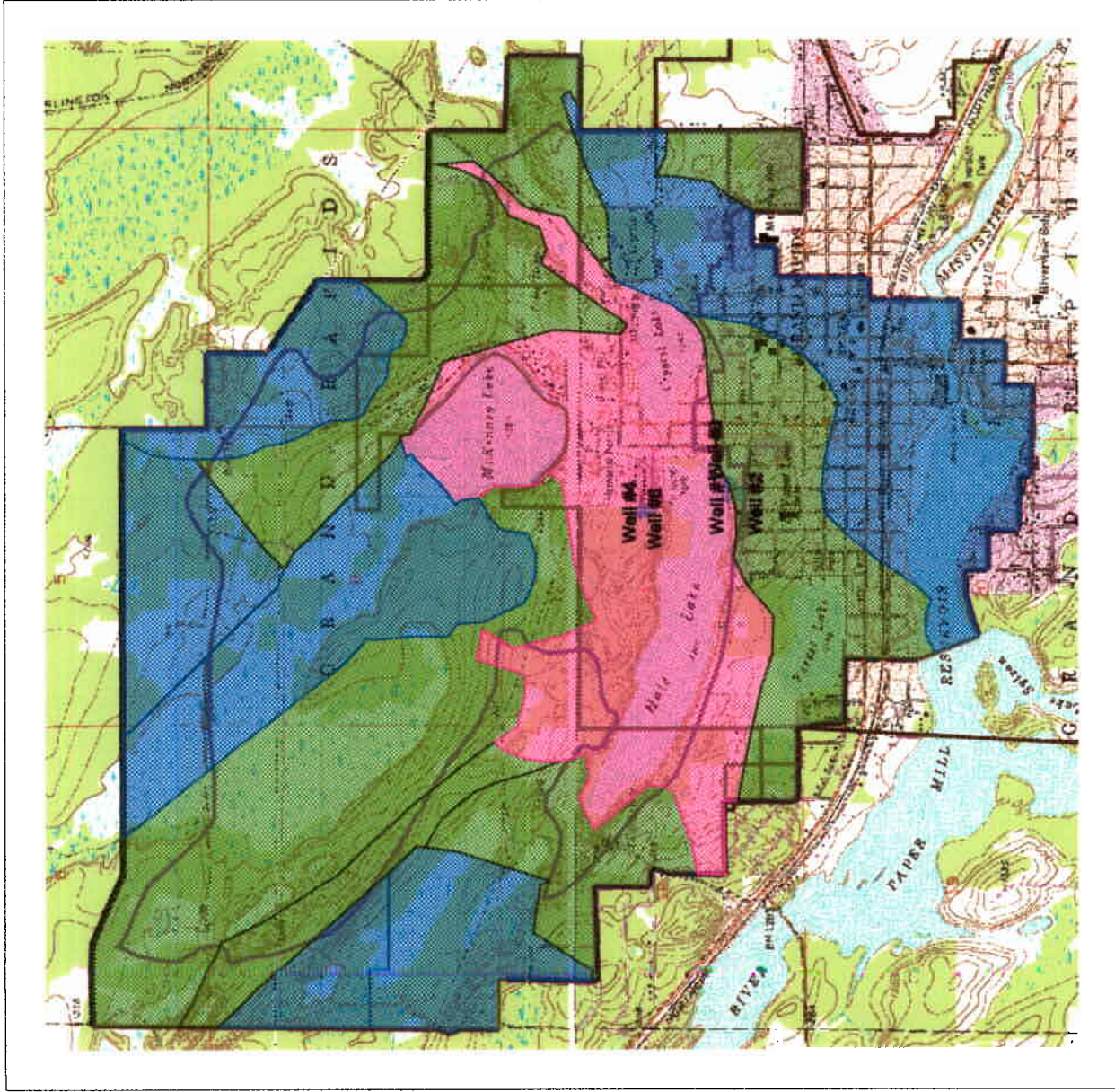


FIGURE 17
CLAY CONTENT IN EAST/WEST
AND NORTH/SOUTH CROSS SECTIONS
 (City of Grand Rapids)



View: Figure 18 - Glaciofluvial Aquifer Vulnerability

DWSMA

- Feature not yet classified
- Municipal boundary
- PLSS Section line
- Property line
- Property line
- ROW closure line
- RR closure line
- Small ROW
- Water closure line

City of Grand Rapids Wells

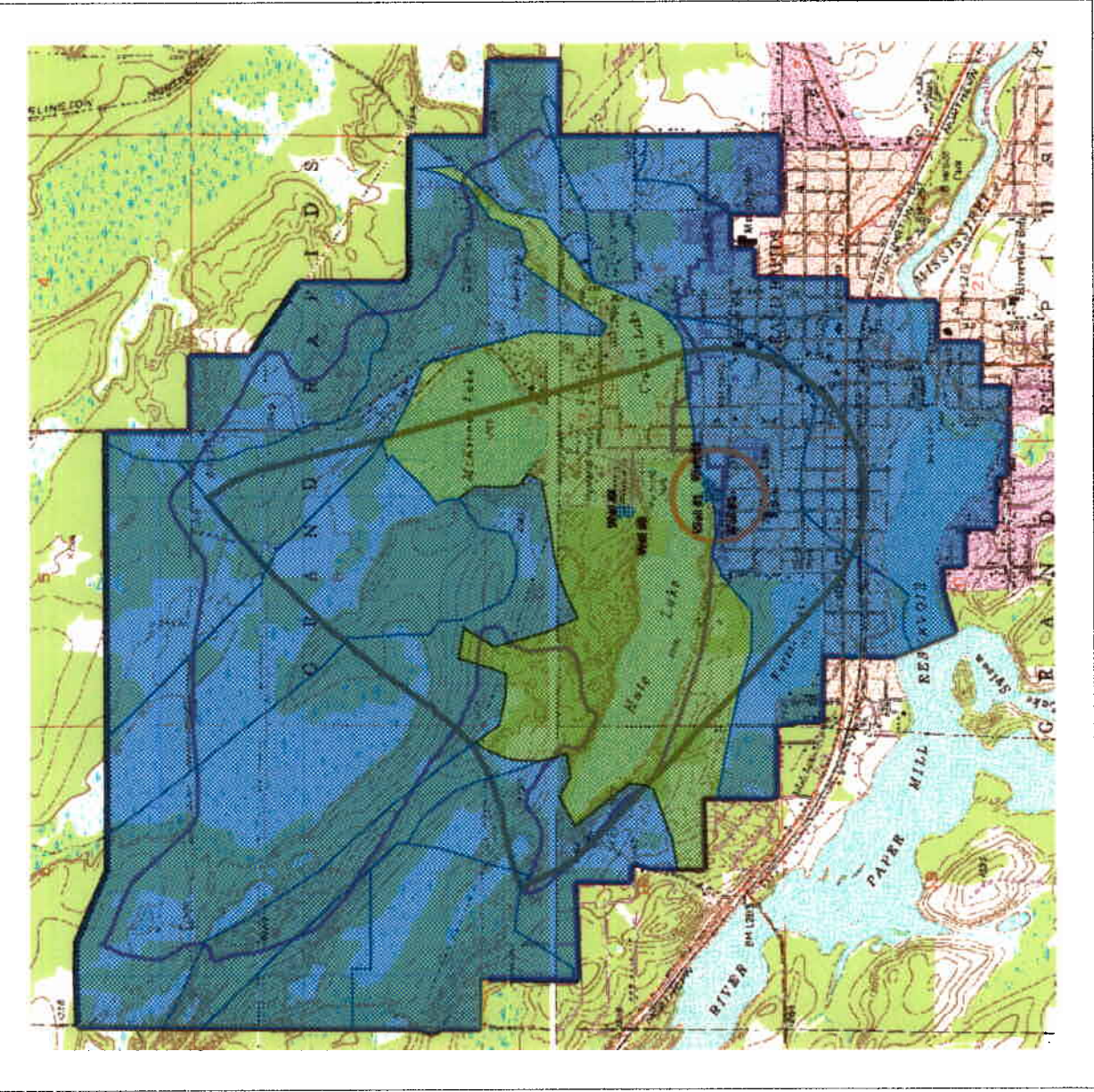
- Wellhead
- Wellhead

Vulnerability: Glaciofluvial Aquifer

- High
- Moderate
- Low



FIGURE 18
GLACIOFLUVIAL AQUIFER VULNERABILITY
 (City of Grand Rapids)



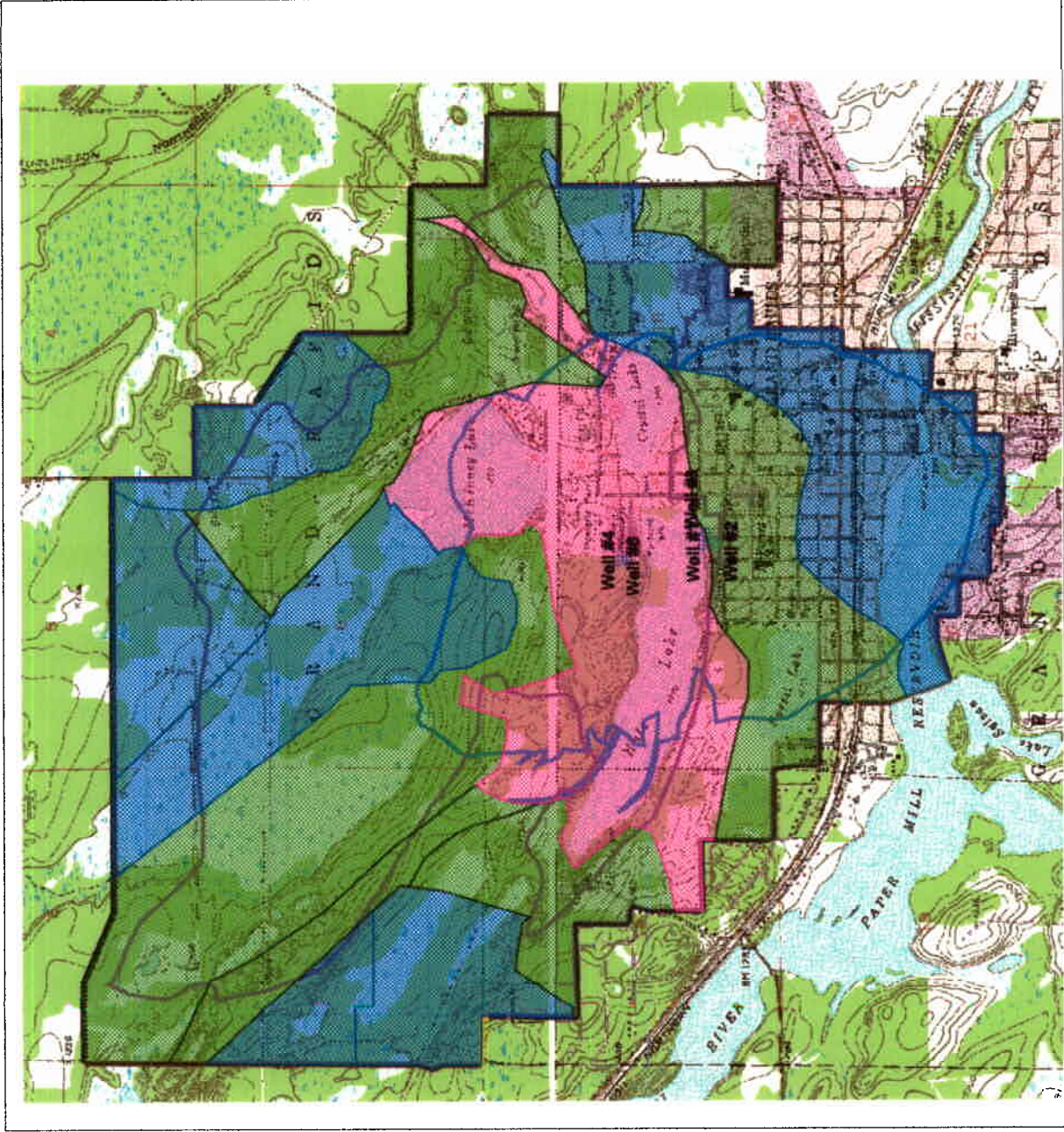
View: Figure 19 - Biwabik Iron Formation Vulnerability

- DWSMA
- Feature not yet classified
 - Municipal boundary
 - PLBS Section line
 - Pipeline
 - Property line
 - ROW closure line
 - RR closure line
 - Street ROW
 - Water closure line
- City of Grand Rapids Wells
- Biwabik Iron Formation
 - Glacial Deposits
 - Well 2 WHPA
 - Emergency Management Zone
- Biwabik Iron Formation Vulnerability
- High
 - Moderate
 - Low



2000 0 2000 Feet

FIGURE 19
BEDROCK AQUIFER VULNERABILITY
(City of Grand Rapids)



View: Figure 20 - DWSMA Conjunctive Vulnerability

- City of Grand Rapids Wells
- ◆ Bleebit Iron Formation
- ◆ Glacial Deposits
- DWSMA
- Feature not yet classified
- Municipal boundary
- PLSS Section line
- Pipeline
- Property line
- ROW closure line
- RR closure line
- Street ROW
- Water closure line
- DWSMA Conjunctive Vulnerability
- High
- Moderate
- Low



FIGURE 20
DWSMA CONJUNCTIVE VULNERABILITY
(City of Grand Rapids)

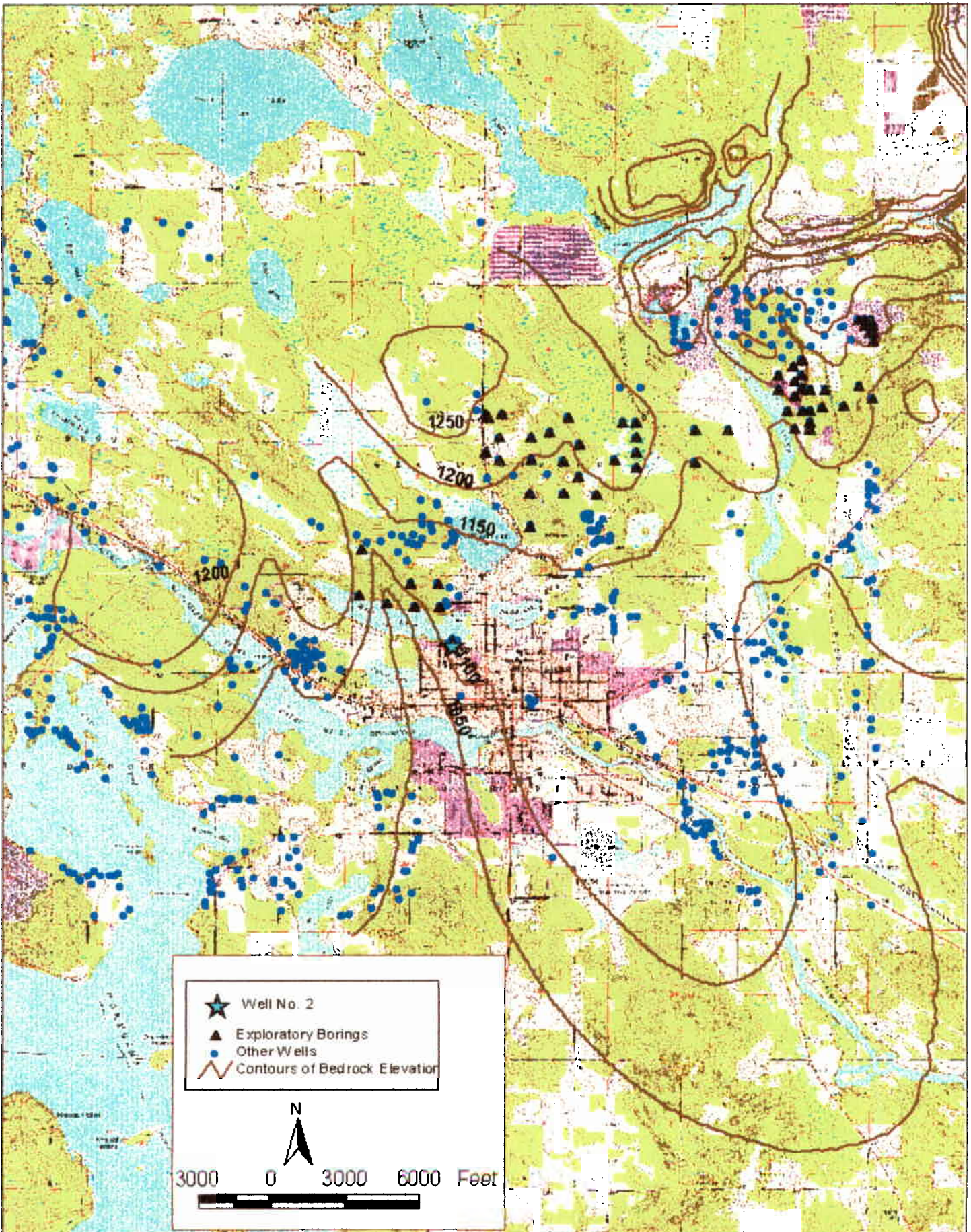


Figure 21. Bedrock topography map of Grand Rapids area.

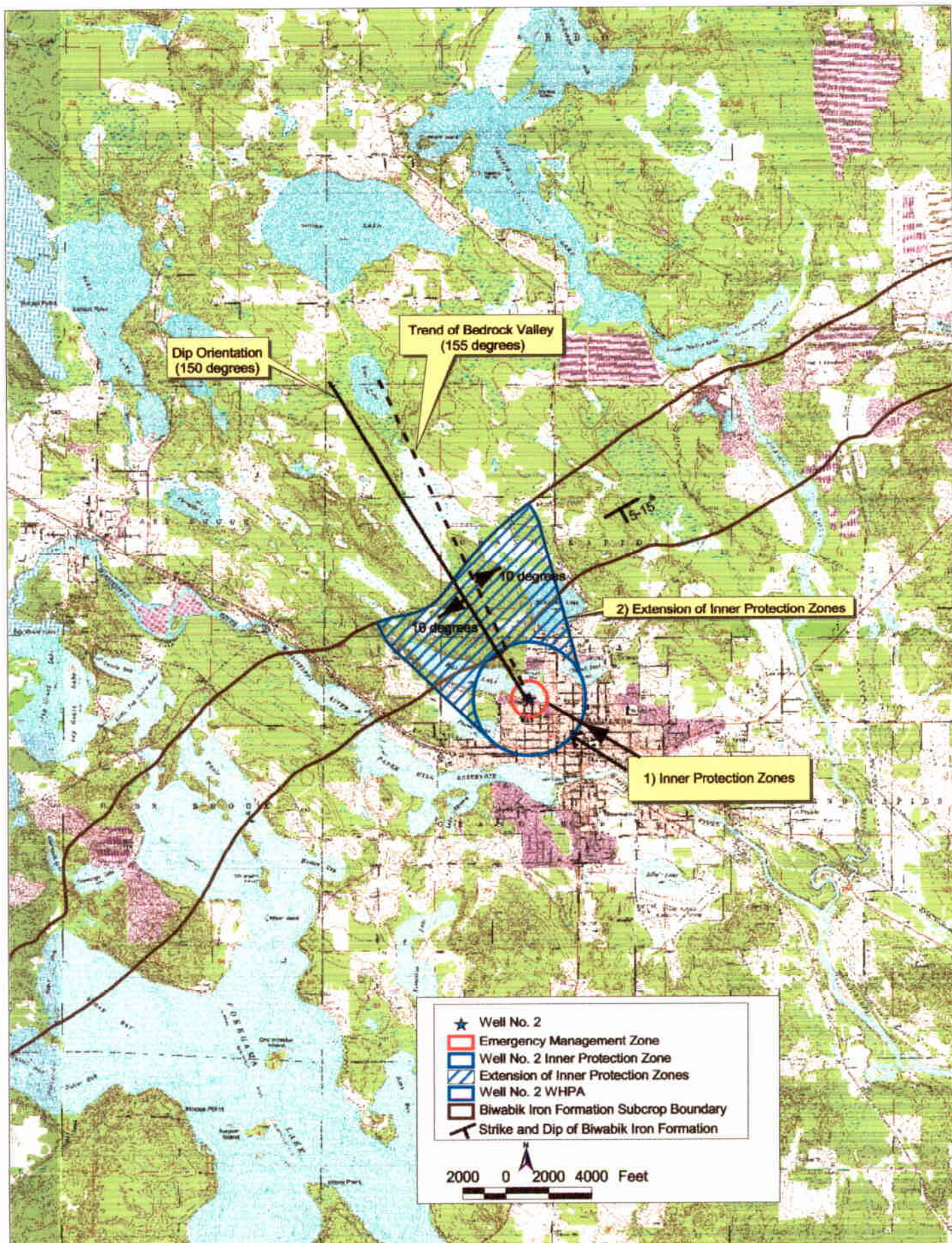


Figure 22. Procedure used to delineate WHPA for Well No. 2.

Appendices

Appendix A
Well Logs and Well Construction Reports

Unique No. 00228870	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD <i>Minnesota Statutes Chapter 1031</i>	Update Date 2002/03/29																																																																						
County Name Itasca		Entry Date 1992/08/03																																																																						
Township Name Township Range Dir Section Subsection 55 25 W 17 DDB	Well Depth 176 ft. Depth Completed 176 ft. Date Well Completed 1938/08/00																																																																							
Well Name GRAND RAPIDS #1	Drilling Method																																																																							
Well Owner's Name VILLAGE OF GRAND RAPIDS GRAND RAPIDS MN	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.																																																																						
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>GEOLOGICAL MATERIAL</th> <th>COLOR</th> <th>HARDNESS</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr><td>FILL</td><td></td><td></td><td>0</td><td>5</td></tr> <tr><td>SANDY CLAY</td><td></td><td></td><td>5</td><td>20</td></tr> <tr><td>SAND & CLAY</td><td></td><td></td><td>20</td><td>60</td></tr> <tr><td>CLAY</td><td></td><td></td><td>60</td><td>78</td></tr> <tr><td>CLAY & SAND</td><td></td><td></td><td>78</td><td>80</td></tr> <tr><td>SAND</td><td></td><td></td><td>80</td><td>106</td></tr> <tr><td>SAND COARSE</td><td></td><td></td><td>106</td><td>110</td></tr> <tr><td>SAND</td><td></td><td></td><td>110</td><td>120</td></tr> <tr><td>SAND & GRAVEL</td><td></td><td></td><td>120</td><td>130</td></tr> <tr><td>QUICK SAND</td><td></td><td></td><td>130</td><td>143</td></tr> <tr><td>FINE SAND</td><td></td><td></td><td>143</td><td>160</td></tr> <tr><td>SAND & GRAVEL</td><td></td><td></td><td>160</td><td>167</td></tr> <tr><td>SAND</td><td></td><td></td><td>167</td><td>176</td></tr> </tbody> </table>	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	FILL			0	5	SANDY CLAY			5	20	SAND & CLAY			20	60	CLAY			60	78	CLAY & SAND			78	80	SAND			80	106	SAND COARSE			106	110	SAND			110	120	SAND & GRAVEL			120	130	QUICK SAND			130	143	FINE SAND			143	160	SAND & GRAVEL			160	167	SAND			167	176	Use Community Supply (municipal)	
	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO																																																																			
	FILL			0	5																																																																			
	SANDY CLAY			5	20																																																																			
	SAND & CLAY			20	60																																																																			
	CLAY			60	78																																																																			
	CLAY & SAND			78	80																																																																			
	SAND			80	106																																																																			
	SAND COARSE			106	110																																																																			
	SAND			110	120																																																																			
SAND & GRAVEL			120	130																																																																				
QUICK SAND			130	143																																																																				
FINE SAND			143	160																																																																				
SAND & GRAVEL			160	167																																																																				
SAND			167	176																																																																				
	Casing Drive Shoe? <input type="checkbox"/> Yes <input type="checkbox"/> N	Hole Diameter																																																																						
	Screen Make	Open Hole From ft. to ft. Type																																																																						
	Static Water Level 10 ft. from Land surface Date 1938/08/00																																																																							
	PUMPING LEVEL (below land surface) ft. after hrs. pumping g.p.m.																																																																							
	Well Head Completion Pitless adapter mfr Model Casing Protection <input type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade(Environmental Wells and Borings ONLY)																																																																							
	Grouting Information Well grouted? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																							
	Nearest Known Source of Contamination ft. direction type Well disinfected upon completion? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																							
	Pump <input type="checkbox"/> Not Installed Date Installed Mfr name Model HP Volts Drop Pipe Length ft. Capacity g.p.m. Type																																																																							
	Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																							
	Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																							
USGS Quad Grand Rapids Elevation 1280 Aquifer: Alt Id: 1310011S01	Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. License Business Name Name of Driller MCCARTHY WELL																																																																							

Report Copy

Unique No. 00228870	MINNESOTA DEPARTMENT OF HEALTH				Update Date 2002/03/29			
County Name Itasca	WELL AND BORING RECORD				Entry Date 1992/08/03			
<i>Minnesota Statutes Chapter 1031</i>								
Township Name	Township	Range	Dir	Section	Subsection	Well Depth	Depth Completed	Date Well Completed
	55	25	W	17	DDB	176 ft.	176 ft.	1938/08/00
Well Name	GRAND RAPIDS #1			Lic. Or Reg. No.		Name of Driller	MCCARTHY WELL	
USGS Quad	Grand Rapi	Elevation	1280	Aquifer		Alternative Id	1310011S01	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
FILL			0	5		FILL		
	FILL = Fill							
SANDY CLAY			5	20		CLAY	SAND	
	CLAY = Clay			SAND = Sand				
SAND & CLAY			20	60		SAND	CLAY	
	SAND = Sand			CLAY = Clay				
CLAY			60	78		CLAY		
	CLAY = Clay							
CLAY & SAND			78	80		CLAY	SAND	
	CLAY = Clay			SAND = Sand				
SAND			80	106		SAND		
	SAND = Sand							
SAND COARSE			106	110		SAND		
	SAND = Sand							
SAND			110	120		SAND		
	SAND = Sand							
SAND & GRAVEL			120	130		SAND	GRVL	
	SAND = Sand			GRVL = Gravel				
QUICK SAND			130	143		SAND		
	SAND = Sand							
FINE SAND			143	160		SAND		
	SAND = Sand							
SAND & GRAVEL			160	167		SAND	GRVL	
	SAND = Sand			GRVL = Gravel				
SAND			167	176		SAND		
	SAND = Sand							

Township Name Township Range Dir Section Subsection 55 25 W 17	Well Depth 573 ft.	Depth Completed 573 ft.	Date Well Completed 1951/00/00
---	-----------------------	----------------------------	-----------------------------------

Well Name GRAND RAPIDS #2	Drilling Method
---------------------------	-----------------

Well Owner's Name VILLAGE OF GRAND RAPIDS GRAND RAPIDS MN	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No	From ft. to ft.
--	----------------	---	-----------------

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	Use Community Supply (municipal)
---------------------	-------	----------	------	----	----------------------------------

GRAVEL & CLAY			0	10	Casing Drive Shoe? <input type="checkbox"/> Yes <input type="checkbox"/> N	Hole Diameter
SAND & CLAY			10	30		

CLAY	BLUE		30	45	Casing Diameter	Weight(lbs/ft)
SAND			45	55		

CLAY	BLUE		55	60	24 in. to 166 ft	Screen N	Open Hole From ft. to ft.
SAND, FINE			60	100	16 in. to 215 ft		

CLAY	BLUE		100	166	Make	Type
SAND & GRAVEL			166	183		

"HARDPAN"			183	214	Static Water Level 32 ft. from Land surface	Date 1951/00/00
-----------	--	--	-----	-----	---	-----------------

TACONITE			214	573	PUMPING LEVEL (below land surface)	
					ft. after	hrs. pumping g.p.m.

Well Head Completion	Pitless adapter mfr			Model
	Casing Protection			<input type="checkbox"/> 12 in. above grade
	<input type="checkbox"/> At-grade(Environmental Wells and Borings ONLY)			

Grouting Information	Well grouted? <input type="checkbox"/> Yes <input type="checkbox"/> No		
Nearest Known Source of Contamination			
	ft.	direction	type
	Well disinfected upon completion? <input type="checkbox"/> Yes <input type="checkbox"/> No		

Pump <input type="checkbox"/> Not Installed	Date Installed		
Mfr name			
Model	HP		Volts

Drop Pipe Length	ft.	Capacity	g.p.m.
Type	T		
Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No			

USGS Quad Grand Rapids	Elevation 1290
Aquifer:	Alt Id: 1310011S02

Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No	Well CONTRACTOR CERTIFICATION Lic. Or Reg. No.
	License Business Name
	Name of Driller KEYS WELL

Report Copy

Unique No. 00228873	MINNESOTA DEPARTMENT OF HEALTH				Update Date 2002/03/29			
County Name Itasca	WELL AND BORING RECORD				Entry Date 1992/08/03			
<i>Minnesota Statutes Chapter 1031</i>								
Township Name	Township	Range	Dir	Section	Subsection	Well Depth	Depth Completed	Date Well Completed
	55	25	W	17		573 ft.	573 ft.	1951/00/00
Well Name	GRAND RAPIDS #2			Lic. Or Reg. No.		Name of Driller	KEYS WELL	
USGS Quad	Grand Rapi	Elevation	1290	Aquifer		Alternative Id	1310011S02	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
GRAVEL & CLAY			0	10		GRVL	CLAY	
	GRVL = Gravel			CLAY = Clay				
SAND & CLAY			10	30		SAND	CLAY	
	SAND = Sand			CLAY = Clay				
CLAY	BLUE		30	45		CLAY		
	CLAY = Clay							
SAND			45	55		SAND		
	SAND = Sand							
CLAY	BLUE		55	60		CLAY		
	CLAY = Clay							
SAND, FINE			60	100		SAND		
	SAND = Sand							
CLAY	BLUE		100	166		CLAY		
	CLAY = Clay							
SAND & GRAVEL			166	183		SAND	GRVL	
	SAND = Sand			GRVL = Gravel				
"HARDPAN"			183	214				
TACONITE			214	573		IRFM		
	IRFM = Iron Formation							

Unique No. 00228862

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD

Update Date 2002/03/29

County Name Itasca

Minnesota Statutes Chapter 1031

Entry Date 1992/08/03

Township Name Township Range Dir Section Subsection
55 25 W 17 DOB

Well Depth Depth Completed Date Well Completed
179 ft. 179 ft. 1961/11/00

Well Name GRAND RAPIDS #3

Drilling Method

Well Owner's Name VILLAGE OF GRAND RAPIDS

Drilling Fluid

Well Hydrofractured? Yes No
From ft. to ft.

GRAND RAPIDS MN

Use Community Supply (municipal)

Casing Drive Shoe? Yes N Hole Diameter

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
FILL, LAKE DEPOSITS			0	7
SAND, GRAVEL, BOULDERS			7	18
TILL, CLAY, CALC, SANDY	GRAY		18	85
TILL, SOME W/BOOBLES			85	90
SAND, COARSE, GRAVEL,			90	95
SAND, GRAVEL, CLAY			95	101
TILL, SANDY, PEBBLY, NON LT GR			101	107
SAND, GRAVEL SOME CLA	GRAY		107	113
SAND, COARSE, GRAVEL			113	138
SAND, COARSE, CLAY ST.	RED		138	146
SAND, GRAVEL, CALC.			146	179

Screen Open Hole From ft. to ft.
Make Type

Static Water Level 10 ft. from Land surface Date 1961/11/00

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 name
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.

License Business Name

Name of Driller LAYNE WELL

USGS Quad Grand Rapids
Aquifer:

Elevation 1280
Alt Id: 1310011S03

Report Copy

Unique No. 00228862	MINNESOTA DEPARTMENT OF HEALTH					Update Date 2002/03/29		
County Name Itasca	WELL AND BORING RECORD					Entry Date 1992/08/03		
<i>Minnesota Statutes Chapter 1031</i>								
Township Name	Township	Range	Dir	Section	Subsection	Well Depth	Depth Completed	Date Well Completed
	55	25	W	17	DDB	179 ft.	179 ft.	1961/11/00
Well Name	GRAND RAPIDS #3			Lic. Or Reg. No.		Name of Driller	LAYNE WELL	
USGS Quad	Grand Rapi	Elevation	1280	Aquifer		Alternative Id	1310011S03	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
FILL, LAKE DEPOSITS			0	7		FILL		
	FILL = Fill							
SAND, GRAVEL, BOULDERS NON-CALC			7	18		SAND	GRVL	BLDR
	SAND = Sand			GRVL = Gravel			BLDR = Boulder	
TILL, CLAY, CALC, SANDY	GRAY		18	85		CLAY	SAND	
	CLAY = Clay			SAND = Sand				
TILL, SOME W/BOOBLES & BOULDERS			85	90		CLAY	SAND	BLDR
	CLAY = Clay			SAND = Sand			BLDR = Boulder	
SAND, COARSE, GRAVEL, CALC.			90	95		SAND	GRVL	
	SAND = Sand			GRVL = Gravel				
SAND, GRAVEL, CLAY			95	101		SAND	GRVL	CLAY
	SAND = Sand			GRVL = Gravel			CLAY = Clay	
TILL, SANDY, PEBBLY, NON-CALC.	LT GREY		101	107		CLAY	SAND	PEBL
	CLAY = Clay			SAND = Sand			PEBL = Pebbles	
SAND, GRAVEL SOME CLAY ST.	GRAY		107	113		SAND	GRVL	CLAY
	SAND = Sand			GRVL = Gravel			CLAY = Clay	
SAND, COARSE, GRAVEL			113	138		SAND	GRVL	
	SAND = Sand			GRVL = Gravel				
SAND, COARSE, CLAY ST. NON-CALC.	RED		138	146		SAND	CLAY	
	SAND = Sand			CLAY = Clay				
SAND, GRAVEL, CALC.			146	179		SAND	GRVL	
	SAND = Sand			GRVL = Gravel				

Unique No. 00127276	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD <i>Minnesota Statutes Chapter 1031</i>	Update Date 2002/03/29
County Name Itasca		Entry Date 1992/08/03
Township Name Township Range Dir Section Subsection 55 25 W 17	Well Depth 157 ft. Depth Completed 157 ft. Date Well Completed 1977/07/20	
Well Name GRAND RAPIDS #4	Drilling Method Cable Tool	
Well Owner's Name CITY OF GRAND RAPIDS CITY HALL GRAND RAPIDS MN 55744-	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.
	Use Municipal	
	Casing Drive Shoe? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N	Hole Diameter
	Casing Diameter 16 in. to 117 ft. Weight(lbs/ft) 62.58	
GEOLOGICAL MATERIAL COLOR HARDNESS FROM TO		
DRIFT, W/BOULDERS BROW 0 40		
SAND & GRAVEL BROW 40 88		
SAND & GRAVEL GRAY 88 155		
SAND & CLAY RED 155 157		
	Screen Y	Open Hole From ft. to ft.
	Make JOHNSON TELESCOPE Type	
	Diameter Slot Length Set Fitting	
	16 40 40 117 ft. to 157 ft	
	Static Water Level 40 ft. from Land surface	Date 1977/07/19
	PUMPING LEVEL (below land surface) 47 ft. after 2 hrs. pumping 1670 g.p.m.	
	Well Head Completion Pitless adapter mfr Model Casing Protection <input checked="" type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade(Environmental Wells and Borings ONLY)	
	Grouting Information Well grouted? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Material From To (ft.) Amount(yds/bags) G 0 50 100 S	
	Nearest Known Source of Contamination 500 ft. direction S type O Well disinfected upon completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
	Pump <input type="checkbox"/> Not Installed Date Installed Mfr name PEERLESS Model 12LB HP 75 Volts 460 Drop Pipe Length 100 ft. Capacity E+03 g.p.m Type T	
REMARKS, ELEVATION, SOURCE OF DATA, etc.	Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No	
75' WEST OF END OF 13TH ST. WEST, GRAND RAPIDS M.G.S. NO. 1314.	Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No	
USGS Quad Grand Rapids Elevation 1326 Aquifer: Alt Id: 1310011S04	Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 62012 License Business Name Name of Driller <u>SAMPSON, C.</u>	

Report Copy

Unique No. 00127276	MINNESOTA DEPARTMENT OF HEALTH				Update Date 2002/03/29			
County Name Itasca	WELL AND BORING RECORD				Entry Date 1992/08/03			
<i>Minnesota Statutes Chapter 1031</i>								
Township Name	Township	Range	Dir	Section	Subsection	Well Depth	Depth Completed	Date Well Completed
	55	25	W	17		157 ft.	157 ft.	1977/07/20
Well Name	GRAND RAPIDS #4			Lic. Or Reg. No.	62012	Name of Driller	SAMPSON, C.	
USGS Quad	Grand Rapi	Elevation	1326	Aquifer		Alternative Id	1310011S04	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
DRIFT, W/BOULDERS	BROWN		0	40		CLAY	BLDR	
	CLAY = Clay						BLDR = Boulder	
SAND & GRAVEL	BROWN		40	88		SAND	GRVL	
	SAND = Sand						GRVL = Gravel	
SAND & GRAVEL	GRAY		88	155		SAND	GRVL	
	SAND = Sand						GRVL = Gravel	
SAND & CLAY	RED		155	157		SAND	CLAY	
	SAND = Sand						CLAY = Clay	

Unique No. 00161444	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD <i>Minnesota Statutes Chapter 1031</i>	Update Date 2002/03/29
County Name Itasca		Entry Date 1992/08/03
Township Name Township Range Dir Section Subsection 55 25 W 17	Well Depth 140 ft. Depth Completed 140 ft. Date Well Completed 1984/12/18	
Well Name GRAND RAPIDS #6	Drilling Method Cable Tool	
Contact's Name CITY OF GRAND RAPIDS CITY HALL GRAND RAPIDS MN 55744	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.
	Use Municipal	
	Casing Drive Shoe? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N	Hole Diameter
GEOLOGICAL MATERIAL COLOR HARDNESS FROM TO	Casing Diameter Weight(lbs/ft)	
CLAY & BOULDERS BROW HARD 0 34	24 in. to 50 ft 94.62	
SAND BROW SOFT 34 43	16 in. to 100 ft 62.58	
SAND W/ROCKS BROW HARD 43 47		
SAND BROW SOFT 47 49		
SAND W/ROCKS BROW MEDIUM 49 65		
SAND BROW MEDIUM 65 68		
SAND W/ROCKS BROW MEDIUM 68 98		
SAND & GRAVEL BROW MEDIUM 98 140		
	Screen Y	Open Hole From ft. to ft.
	Make JOHNSON	Type L
	Diameter Slot Length Set	Fitting
	14.5 40 140 ft. to 100 ft	
	Static Water Level 43 ft. from Land surface	Date 1984/12/11
	PUMPING LEVEL (below land surface) 49.2 ft. after 20 hrs. pumping 1200 g.p.m.	
	Well Head Completion Pitless adapter mfr Model Casing Protection <input checked="" type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade(Environmental Wells and Borings ONLY)	
	Grouting Information Well grouted? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Material From To (ft.) Amount(yds/bags) G 0 50 4 Y	
	Nearest Known Source of Contamination 300 ft. direction N type SDF Well disinfected upon completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
	Pump <input type="checkbox"/> Not Installed Date Installed Mfr name DYRON JACKSON Model 12MOH HP 100 Volts 480 Drop Pipe Length 70 ft. Capacity E+03 g.p.m Type T	
REMARKS, ELEVATION, SOURCE OF DATA, etc.	Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No	
M.G.S. NO. 2126.	Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No	
USGS Quad Grand Rapids Elevation 1330	Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27058	
Aquifer: Alt Id: 1310011S06	License Business Name Name of Driller <u>MARTIE D.</u>	

Report Copy

Unique No. 00161444	MINNESOTA DEPARTMENT OF HEALTH						Update Date 2002/03/29	
County Name Itasca	WELL AND BORING RECORD						Entry Date 1992/08/03	
<i>Minnesota Statutes Chapter 1031</i>								
Township Name	Township	Range	Dir	Section	Subsection	Well Depth	Depth Completed	Date Well Completed
	55	25	W	17		140 ft.	140 ft.	1984/12/18
Well Name	GRAND RAPIDS #6			Lic. Or Reg. No.	27058	Name of Driller	MARTHIE, D.	
USGS Quad	Grand Rapi	Elevation	1330	Aquifer		Alternative Id	1310011S06	

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	STRAT	LITH PRIM	LITH SEC	LITH MINOR
CLAY & BOULDERS	BROWN	HARD	0	34		CLAY	BLDR	
	CLAY = Clay		BLDR = Boulder					
SAND	BROWN	SOFT	34	43		SAND		
	SAND = Sand							
SAND W/ROCKS	BROWN	HARD	43	47		SAND	BLDR	
	SAND = Sand		BLDR = Boulder					
SAND	BROWN	SOFT	47	49		SAND		
	SAND = Sand							
SAND W/ROCKS	BROWN	MEDIUM	49	65		SAND	BLDR	
	SAND = Sand		BLDR = Boulder					
SAND	BROWN	MEDIUM	65	68		SAND		
	SAND = Sand							
SAND W/ROCKS	BROWN	MEDIUM	68	98		SAND	BLDR	
	SAND = Sand		BLDR = Boulder					
SAND & GRAVEL	BROWN	MEDIUM	98	140		SAND	GRVL	
	SAND = Sand		GRVL = Gravel					

Appendix B
Aquifer Test Report



TO: Dennis Doyle, Grand Rapids Public Utilities Commission

FROM: Craig L. Kurtz, PG

DATE: May 29, 2003

RE: Aquifer Pumping Test
SEH No. A-GRAPU0308.00 SP

This Technical Memorandum summarizes the aquifer pumping test conducted for the Grand Rapids Public Utilities Commission (GRPUC). The test was performed in accordance with the Minnesota Department of Health (MDH) Wellhead Protection Rules (MN Rules Chapter 4720.5320 and 4720.5520), and the April 28, 2003 Aquifer Test Plan submitted to and approved by MDH staff.

Test Description

The test was performed on May 14, 15, and 16, 2003 and consisted of a 24-hour background phase, a 24-hour pumping phase, and a 24-hour recovery phase. Municipal Well 6 (MN Unique Well Number 161444) was used as the pumping well, and Municipal Wells 1 (MN Unique Well Number 228870) and 4 (MN Unique Number 127276) were used as the observation wells to record groundwater drawdown. Municipal Well 6, the pumping well, was also used to record groundwater drawdown. Access to the casing of Municipal Well 3 was not feasible; therefore, it could not be utilized as an observation well. Well records for the municipal wells are attached to this technical memorandum.

Municipal Wells 1, 3, 4, and 6 are open to the buried sand and gravel aquifer. Municipal Well 2 is open to the bedrock aquifer and was therefore not monitored during the test. The approximate distances from Municipal Well 6 to Municipal Wells 1 and 4 are 1,406 and 161 feet respectively. Municipal Wells 4 and 6 are located north of Hale Lake, and Municipal Wells 1, 2, and 3 are located south of Hale Lake. Municipal Well 6 is approximately 412 feet from the lake's shoreline.

Electronic pressure transducers and data loggers were utilized to monitor and record the groundwater levels and drawdown in the three wells. Groundwater level readings were recorded logarithmically in Municipal Wells 4 and 6, and every one minute in Municipal Well 1. At the beginning of the test, the approximate depths of static groundwater in Municipal Wells 1, 4 and 6 were 13.90, 39.55, and 47.50 feet below the access port of the casings respectively.

Prior to the pumping phase of the test, all five municipal wells were not pumped for at least 24 hours. The groundwater level recording equipment was installed in Municipal Wells 1, 4, and 6 on May 14, 2003. The 24-hour pumping phase of the test was started at 10:00 a.m. on May 15,

2003 and ended at 10:00 a.m. on May 16, 2003. During this phase, only Municipal Well 6 was pumped; the other four municipal wells were not used. The pumping rate of Municipal Well 6 ranged from 1,693 to 1,898 gallons per minute (gpm) based on data from the well's totalizer. The average pumping rate over the entire pumping phase of the test was 1,827 gpm. The pumping rates of the well during the test as recorded from totalizer are attached. After the pump of Municipal Well 6 was shut off, the recovery phase of the test lasted 24 hours from 10:00 a.m. on May 15 to 10:00 a.m. May 17, 2003. None of the five municipal wells were pumped during this phase of the test.

Groundwater level data collected during the test has been provided on a disk with this Technical Memorandum. The electronic pressure transducer in Municipal Well 6 appears to have malfunctioned during the test. Therefore, the data from the pumping well does not appear usable in the analysis of the aquifer. The maximum groundwater drawdown observed in the observation wells were 0.596 feet in Municipal Well 4, and 0.489 feet in Municipal Well 1.

Data Analysis

The groundwater level data from Municipal Wells 1 and 4 were analyzed using AQTESOLV® software. The analysis consisted of matching the groundwater level data to an appropriate type-curve, resulting in a calculated estimate of the transmissivity and storativity of the aquifer. Time-drawdown graphs for the data collected from the municipal wells are attached.

Based on the information from the well records of the municipal wells, Hale Lake may be in hydraulic connection to the buried sand and gravel aquifer. To determine whether Hale Lake significantly influenced the aquifer pumping test, an image well solution was also incorporated into the analysis of the data from Municipal Well 4. Time-drawdown graphs using an image well on the data collected from Municipal Well 4 are attached.

Results

It appears that the aquifer is unconfined, based on the best type-curve match to the data and information from the well records. Solutions for leaky and confined aquifers did not match the data as accurately. The Neuman (1974) delayed gravity response solution was used to calculate a transmissivity, specific yield, and storativity for the aquifer. The Neuman type-curve, using an image well, appears to best match the recovery data from Municipal Well 4. However, the image well solution does not match the pumping phase data as well as the Neuman type-curve without an image well. The transmissivity, specific yield, and storativity estimates are summarized in Table 1 below.

Table 1 – Pumping Test Analysis Results

Data Set	Transmissivity (ft ² /day) – Neuman 1974 Solution	Storativity	Specific Yield
Well 4 Pumping and Recovery Data	276,600	0.00072	0.0871
Well 4 Recovery Data Only	235,500	0.000488	0.1473
Well 1 Pumping and Recovery Data	20,790	0.009420	0.0094
Well 1 Recovery Data Only	70,030	0.014300	0.0143
Wells 1 & 4 Pumping and Recovery Data	306,800	0.000206	0.0002
Well 4 Pumping and Recovery Data with Image Well	156,700	0.000856	0.3097
Well 4 Recovery Data Only with Image Well	152,800	0.000576	0.3260

Conclusions

It appears that the Neuman (1974) unconfined solution best represents and explains the hydrogeologic conditions of the buried sand and gravel source water aquifer used for the Grand Rapids, Minnesota public water supply. The representative transmissivity, specific yield, and storativity for the aquifer in the vicinity of Municipal Wells 4 and 6 are estimated to be 156,700 ft²/day, 0.31, and 0.00085 respectively. In the vicinity of Municipal Wells 1 and 3, the aquifer may be under leaky or confined hydrologic conditions. Therefore, the transmissivity of the buried sand and gravel aquifer south of Hale Lake may be less than in areas north of the lake. Where the aquifer is unconfined, the hydrologic effects of surface waters near the municipal wells should be evaluated and incorporated into the analysis when modeling the groundwater system.

clk/CLK/pjk/ea

- Attachments - Well Records
 Pumping Rate Summary
 Time-Drawdown Graphs
- Enclosure - Groundwater level data

c: Bob Beaver, PE, SEH Inc.

Well Records

Unique No. 00228870	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD Minnesota Statutes Chapter 1031		Update Date 2002/03/29																																																																						
County Name Itasca			Entry Date 1992/08/03																																																																						
Township Name Township Range Dir Section Subsection 55 25 W 17 DDB	Well Depth 176 ft.	Depth Completed 176 ft.	Date Well Completed 1938/08/00																																																																						
Well Name GRAND RAPIDS #1	Drilling Method																																																																								
Well Owner's Name VILLAGE OF GRAND RAPIDS GRAND RAPIDS MN	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.																																																																							
<table border="1"> <thead> <tr> <th>GEOLOGICAL MATERIAL</th> <th>COLOR</th> <th>HARDNESS</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr> <td>FILL</td> <td></td> <td></td> <td>0</td> <td>5</td> </tr> <tr> <td>SANDY CLAY</td> <td></td> <td></td> <td>5</td> <td>20</td> </tr> <tr> <td>SAND & CLAY</td> <td></td> <td></td> <td>20</td> <td>60</td> </tr> <tr> <td>CLAY</td> <td></td> <td></td> <td>60</td> <td>78</td> </tr> <tr> <td>CLAY & SAND</td> <td></td> <td></td> <td>78</td> <td>80</td> </tr> <tr> <td>SAND</td> <td></td> <td></td> <td>80</td> <td>106</td> </tr> <tr> <td>SAND COARSE</td> <td></td> <td></td> <td>106</td> <td>110</td> </tr> <tr> <td>SAND</td> <td></td> <td></td> <td>110</td> <td>120</td> </tr> <tr> <td>SAND & GRAVEL</td> <td></td> <td></td> <td>120</td> <td>130</td> </tr> <tr> <td>QUICK SAND</td> <td></td> <td></td> <td>130</td> <td>143</td> </tr> <tr> <td>FINE SAND</td> <td></td> <td></td> <td>143</td> <td>160</td> </tr> <tr> <td>SAND & GRAVEL</td> <td></td> <td></td> <td>160</td> <td>167</td> </tr> <tr> <td>SAND</td> <td></td> <td></td> <td>167</td> <td>176</td> </tr> </tbody> </table>	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	FILL			0	5	SANDY CLAY			5	20	SAND & CLAY			20	60	CLAY			60	78	CLAY & SAND			78	80	SAND			80	106	SAND COARSE			106	110	SAND			110	120	SAND & GRAVEL			120	130	QUICK SAND			130	143	FINE SAND			143	160	SAND & GRAVEL			160	167	SAND			167	176	Use Community Supply (municipal)	Casing Drive Shoe? <input type="checkbox"/> Yes <input type="checkbox"/> N Hole Diameter	
	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO																																																																				
	FILL			0	5																																																																				
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	PUMPING LEVEL (below land surface) ft. after hrs. pumping g.p.m.																																																																								
	Well Head Completion Pitless adapter mfr Model Casing Protection <input type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade (Environmental Wells and Borings ONLY)																																																																								
	Grouting Information Well grouted? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																								
	Nearest Known Source of Contamination ft. direction type Well disinfected upon completion? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																								
	Pump <input type="checkbox"/> Not Installed Date Installed Mfr name Model HP Volts Drop Pipe Length ft. Capacity g.p.m. Type																																																																								
	Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																								
	Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																								
USGS Quad Grand Rapids Elevation 1280 Aquifer: AR Id: 1310011S01	Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. License Business Name Name of Driller MCCARTHY WELL																																																																								

Report Copy

Unique No. 00228873	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD <i>Minnesota Statutes Chapter 1031</i>		Update Date 2002/03/29																																																							
County Name Itasca			Entry Date 1992/08/03																																																							
Township Name Township Range Dir Section Subsection 55 25 W 17	Well Depth 573 ft.	Depth Completed 573 ft.	Date Well Completed 1951/00/00																																																							
Well Name GRAND RAPIDS #2	Drilling Method																																																									
Well Owner's Name VILLAGE OF GRAND RAPIDS GRAND RAPIDS MN	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.																																																								
<table border="1"> <thead> <tr> <th>GEOLOGICAL MATERIAL</th> <th>COLOR</th> <th>HARDNESS</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr> <td>GRAVEL & CLAY</td> <td></td> <td></td> <td>0</td> <td>10</td> </tr> <tr> <td>SAND & CLAY</td> <td></td> <td></td> <td>10</td> <td>30</td> </tr> <tr> <td>CLAY</td> <td>BLUE</td> <td></td> <td>30</td> <td>45</td> </tr> <tr> <td>SAND</td> <td></td> <td></td> <td>45</td> <td>55</td> </tr> <tr> <td>CLAY</td> <td>BLUE</td> <td></td> <td>55</td> <td>80</td> </tr> <tr> <td>SAND, FINE</td> <td></td> <td></td> <td>80</td> <td>100</td> </tr> <tr> <td>CLAY</td> <td>BLUE</td> <td></td> <td>100</td> <td>188</td> </tr> <tr> <td>SAND & GRAVEL</td> <td></td> <td></td> <td>188</td> <td>183</td> </tr> <tr> <td>"HARDPAN"</td> <td></td> <td></td> <td>183</td> <td>214</td> </tr> <tr> <td>TACONITE</td> <td></td> <td></td> <td>214</td> <td>573</td> </tr> </tbody> </table>	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	GRAVEL & CLAY			0	10	SAND & CLAY			10	30	CLAY	BLUE		30	45	SAND			45	55	CLAY	BLUE		55	80	SAND, FINE			80	100	CLAY	BLUE		100	188	SAND & GRAVEL			188	183	"HARDPAN"			183	214	TACONITE			214	573	Use Community Supply (municipal)	Casing Drive Shoe? <input type="checkbox"/> Yes <input type="checkbox"/> N Hole Diameter	
	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO																																																					
	GRAVEL & CLAY			0	10																																																					
	SAND & CLAY			10	30																																																					
	CLAY	BLUE		30	45																																																					
	SAND			45	55																																																					
	CLAY	BLUE		55	80																																																					
	SAND, FINE			80	100																																																					
	CLAY	BLUE		100	188																																																					
	SAND & GRAVEL			188	183																																																					
"HARDPAN"			183	214																																																						
TACONITE			214	573																																																						
	Casing Diameter 24 in. to 166 ft.	Weight(lbs/ft) 16 in. to 215 ft.																																																								
	Screen N	Open Hole From ft. to ft.																																																								
	Make	Type																																																								
	Static Water Level 32 ft. from Land surface	Date 1951/00/00																																																								
	PUMPING LEVEL (below land surface) ft. after hrs. pumping g.p.m.																																																									
	Well Head Completion Pitless adapter mfr Model Casing Protection <input type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade(Environmental Wells and Borings ONLY)																																																									
	Grouting Information Well grouted? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																									
	Nearest Known Source of Contamination ft. direction type Well disinfected upon completion? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																									
	Pump <input type="checkbox"/> Not Installed Date Installed Mfr name Model HP Volts Drop Pipe Length ft. Capacity g.p.m. Type T																																																									
	Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																									
	Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																									
USGS Quad Grand Rapids Elevation 1290 Aquifer: Alt Id: 1310011S02	Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. License Business Name Name of Driller KEYS WELL																																																									

Report Copy

Unique No. 00228862		MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD <i>Minnesota Statutes Chapter 1031</i>			Update Date 2002/03/29																																																													
County Name Itasca					Entry Date 1992/08/03																																																													
Township Name Township Range Dir Section Subsection			Well Depth	Depth Completed	Date Well Completed																																																													
55 25 W 17 DDB			179 ft.	179 ft.	1961/11/00																																																													
Well Name GRAND RAPIDS #3			Drilling Method																																																															
Well Owner's Name VILLAGE OF GRAND RAPIDS			Drilling Fluid		Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																													
GRAND RAPIDS MN			From		ft. to ft.																																																													
<table border="1"> <thead> <tr> <th>GEOLOGICAL MATERIAL</th> <th>COLOR</th> <th>HARDNESS</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr> <td>FILL, LAKE DEPOSITS</td> <td></td> <td></td> <td>0</td> <td>7</td> </tr> <tr> <td>SAND, GRAVEL, BOULDERS</td> <td></td> <td></td> <td>7</td> <td>18</td> </tr> <tr> <td>TILL, CLAY, CALC, SANDY</td> <td>GREY</td> <td></td> <td>18</td> <td>85</td> </tr> <tr> <td>TILL, SOME W/BOOBLES</td> <td></td> <td></td> <td>85</td> <td>90</td> </tr> <tr> <td>SAND, COARSE, GRAVEL,</td> <td></td> <td></td> <td>90</td> <td>95</td> </tr> <tr> <td>SAND, GRAVEL, CLAY</td> <td></td> <td></td> <td>95</td> <td>101</td> </tr> <tr> <td>TILL, SANDY, PEBBLY, NON</td> <td>LT GR</td> <td></td> <td>101</td> <td>107</td> </tr> <tr> <td>SAND, GRAVEL SOME CLA</td> <td>GREY</td> <td></td> <td>107</td> <td>113</td> </tr> <tr> <td>SAND, COARSE, GRAVEL</td> <td></td> <td></td> <td>113</td> <td>138</td> </tr> <tr> <td>SAND, COARSE, CLAY ST.</td> <td>RED</td> <td></td> <td>138</td> <td>146</td> </tr> <tr> <td>SAND, GRAVEL, CALC.</td> <td></td> <td></td> <td>146</td> <td>179</td> </tr> </tbody> </table>			GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	FILL, LAKE DEPOSITS			0	7	SAND, GRAVEL, BOULDERS			7	18	TILL, CLAY, CALC, SANDY	GREY		18	85	TILL, SOME W/BOOBLES			85	90	SAND, COARSE, GRAVEL,			90	95	SAND, GRAVEL, CLAY			95	101	TILL, SANDY, PEBBLY, NON	LT GR		101	107	SAND, GRAVEL SOME CLA	GREY		107	113	SAND, COARSE, GRAVEL			113	138	SAND, COARSE, CLAY ST.	RED		138	146	SAND, GRAVEL, CALC.			146	179	Use Community Supply (municipal)			
			GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO																																																											
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			SAND, GRAVEL, BOULDERS			7	18																																																											
			TILL, CLAY, CALC, SANDY	GREY		18	85																																																											
			TILL, SOME W/BOOBLES			85	90																																																											
			SAND, COARSE, GRAVEL,			90	95																																																											
			SAND, GRAVEL, CLAY			95	101																																																											
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Casing		Drive Shoe? <input type="checkbox"/> Yes <input type="checkbox"/> N		Hole Diameter																																																														
Screen		Open Hole		From ft. to ft.																																																														
Make		Type																																																																
Static Water Level			10 ft. from Land surface		Date 1961/11/00																																																													
PUMPING LEVEL (below land surface)																																																																		
		ft. after		hrs. pumping		g.p.m.																																																												
Well Head Completion																																																																		
Pitless adapter mfr			Model																																																															
Casing Protection			<input type="checkbox"/> 12 in. above grade																																																															
<input type="checkbox"/> At-grade (Environmental Wells and Borings ONLY)																																																																		
Grouting Information			Well grouted?		<input type="checkbox"/> Yes <input type="checkbox"/> No																																																													
Nearest Known Source of Contamination																																																																		
		ft.		direction		type																																																												
Well disinfected upon completion?			<input type="checkbox"/> Yes <input type="checkbox"/> No																																																															
Pump <input type="checkbox"/> Not Installed			Date Installed																																																															
Mfr name			Model		HP Volts																																																													
Drop Pipe Length			ft.		Capacity g.p.m.																																																													
Type																																																																		
Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																		
Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No																																																																		
USGS Quad Grand Rapids			Elevation 1280																																																															
Aquifer:			Alt Id: 1310011S03																																																															
Report Copy																																																																		
Well CONTRACTOR CERTIFICATION			Lic. Or Reg. No.																																																															
License Business Name																																																																		
Name of Driller			LAYNE WELL																																																															

Unique No. 00127276	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD Minnesota Statutes Chapter 1031		Update Date 2002/03/29																									
County Name Itasca			Entry Date 1992/08/03																									
Township Name Township Range Dir Section Subsection 55 25 W 17	Well Depth 157 ft.	Depth Completed 157 ft.	Date Well Completed 1977/07/20																									
Well Name GRAND RAPIDS #4	Drilling Method Cable Tool																											
Well Owner's Name CITY OF GRAND RAPIDS CITY HALL GRAND RAPIDS MN 55744-	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.																										
<table border="1"> <thead> <tr> <th>GEOLOGICAL MATERIAL</th> <th>COLOR</th> <th>HARDNESS</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr> <td>DRIFT, W/BOULDERS</td> <td>BROW</td> <td></td> <td>0</td> <td>40</td> </tr> <tr> <td>SAND & GRAVEL</td> <td>BROW</td> <td></td> <td>40</td> <td>88</td> </tr> <tr> <td>SAND & GRAVEL</td> <td>GRAY</td> <td></td> <td>88</td> <td>155</td> </tr> <tr> <td>SAND & CLAY</td> <td>RED</td> <td></td> <td>155</td> <td>157</td> </tr> </tbody> </table>	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO	DRIFT, W/BOULDERS	BROW		0	40	SAND & GRAVEL	BROW		40	88	SAND & GRAVEL	GRAY		88	155	SAND & CLAY	RED		155	157	Use Municipal		
	GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO																							
	DRIFT, W/BOULDERS	BROW		0	40																							
	SAND & GRAVEL	BROW		40	88																							
	SAND & GRAVEL	GRAY		88	155																							
	SAND & CLAY	RED		155	157																							
	Casing Drive Shoe? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N	Hole Diameter																										
	Casing Diameter 16 in. to 117 ft.	Weight(lbs/ft) 62.58																										
	Screen Y	Open Hole From ft. to ft.																										
	Make JOHNSON TELESCOPE	Type																										
Diameter Slot Length Set	Fitting																											
16 40 40 117 ft. to 157 ft.																												
Static Water Level 40 ft. from Land surface	Date 1977/07/19																											
PUMPING LEVEL (below land surface) 47 ft. after 2 hrs. pumping 1670 g.p.m.																												
Well Head Completion Pitless adapter mfr Model Casing Protection <input checked="" type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade(Environmental Wells and Borings ONLY)																												
Grouting Information Well grouted? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Material From To (ft.) Amount(yds/bags) G 0 50 100 S																												
Nearest Known Source of Contamination 500 ft. direction S type O Well disinfected upon completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No																												
Pump <input type="checkbox"/> Not Installed Date Installed Mfr name PEERLESS Model 12LB HP 75 Volts 460 Drop Pipe Length 100 ft. Capacity E+03 g.p.m. Type T																												
Any not in use and not sealed well(s) on property? <input type="checkbox"/> Yes <input type="checkbox"/> No																												
Was a variance granted from the MDH for this Well? <input type="checkbox"/> Yes <input type="checkbox"/> No																												
Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 62012 License Business Name Name of Driller SAMPSON, C.																												
REMARKS, ELEVATION, SOURCE OF DATA, etc. 75' WEST OF END OF 13TH ST. WEST, GRAND RAPIDS M.G.S. NO. 1314. USGS Quad Grand Rapids Elevation 1326 Aquifer: Alt Id: 1310011S04																												

Report Copy

Unique No. 00161444	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING RECORD Minnesota Statutes Chapter 1031		Update Date 2002/03/29
County Name Itasca			Entry Date 1992/08/03
Township Name Township Range Dir Section Subsection 55 25 W 17	Well Depth 140 ft.	Depth Completed 140 ft.	Date Well Completed 1984/12/18
Well Name GRAND RAPIDS #8	Drilling Method Cable Tool		
Contact's Name CITY OF GRAND RAPIDS CITY HALL GRAND RAPIDS MN 55744	Drilling Fluid	Well Hydrofractured? <input type="checkbox"/> Yes <input type="checkbox"/> No From ft. to ft.	
	Use Municipal		
	Casing Drive Shoe? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N	Hole Diameter	
GEOLOGICAL MATERIAL COLOR HARDNESS FROM TO	Casing Diameter	Weight(lbs/ft)	
CLAY & BOULDERS BROW HARD 0 34	24 in. to 50 ft	94.62	
SAND BROW SOFT 34 43	16 in. to 100 ft	82.58	
SAND W/ROCKS BROW HARD 43 47			
SAND BROW SOFT 47 49			
SAND W/ROCKS BROW MEDIUM 49 65			
SAND BROW MEDIUM 65 68			
SAND W/ROCKS BROW MEDIUM 68 98			
SAND & GRAVEL BROW MEDIUM 98 140			
	Screen Y	Open Hole From ft. to ft.	
	Make JOHNSON	Type L	
	Diameter Slot Length Set	Fitting	
	14.5 40 140 ft. to 100 ft		
	Static Water Level 43 ft. from Land surface	Date 1984/12/11	
	PUMPING LEVEL (below land surface) 49.2 ft. after 20 hrs. pumping 1200 g.p.m.		
	Well Head Completion Pitless adapter mfr Model Casing Protection <input checked="" type="checkbox"/> 12 in. above grade <input type="checkbox"/> At-grade (Environmental Wells and Borings ONLY)		
	Grouting Information Well grouted? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Material From To (ft.) Amount(yds/bags) G 0 50 4 Y		
	Nearest Known Source of Contamination 300 ft. direction N type SDF Well disinfected upon completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
	Pump <input type="checkbox"/> Not Installed Date Installed Mfr name DYRON JACKSON Model 12MOH HP 100 Volts 480 Drop Pipe Length 70 ft. Capacity E+03 g.p.m. Type T		
REMARKS, ELEVATION, SOURCE OF DATA, etc. M.G.S. NO. 2126.			
USGS Quad Grand Rapids	Elevation 1330		
Aquifer:	Alt Id: 1310011S06		
Report Copy			
Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27053		Name of Driller MARTHE, D.	

Pumping Rate Summary

**Grand Rapids, MN Aquifer Pumping Test
Pumping Rate Data - Municipal Well 6**

Elapsed Time (minutes)	Totalizer Reading	Calculated Discharge (gpm)
0	141714740	0
7	141726590	1693
12	141735300	1742
15	141740810	1837
20	141750300	1898
25	141759100	1760
30	141768260	1832
35	141777400	1828
40	141786560	1832
45	141795700	1828
50	141804850	1830
55	141814020	1834
60	141823160	1828
120	141933000	1831
180	142042700	1828
360	142371410	1826
720	143026280	1819
1440	144345752	1833

Total Water Pumped (gallons): 2,631,012

Average Discharge Rate: 1827 gpm

Time-Drawdown Graphs

Grand Rapids Aquifer Pumping Test (May 2003) - Well 4 Pumping and Recovery Data

Prepared By:

SEH Inc.

Project:

A-GRAPU0308.00

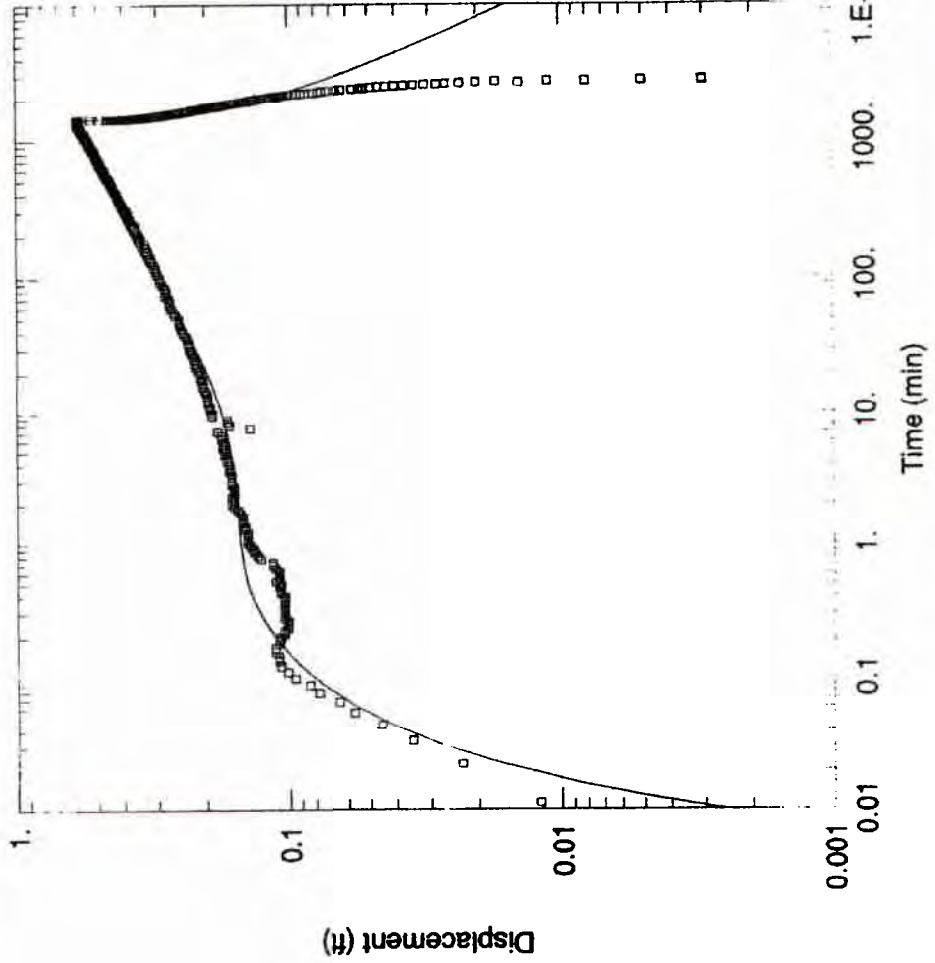
Prepared For:

Grand Rapids Public Utilities

Location:

Grand Rapids, MN

Data Set: X:\FJ\Grapu\030800\pumptest\well4.aqt
 Date: 05/28/03 Time: 10:00:44



SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 2.766E+05 ft²/day

S = 0.0007196

Sy = 0.08709

β = 0.1109

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 6	578.1	7615

Observation Wells

Well Name	X (ft)	Y (ft)
Well 4	571.5	7776



Grand Rapids Aquifer Pumping Test (May 2003) - Well 4 Recovery Data

Prepared By:

Prepared For:

SEH Inc.

Grand Rapids Public Utilities

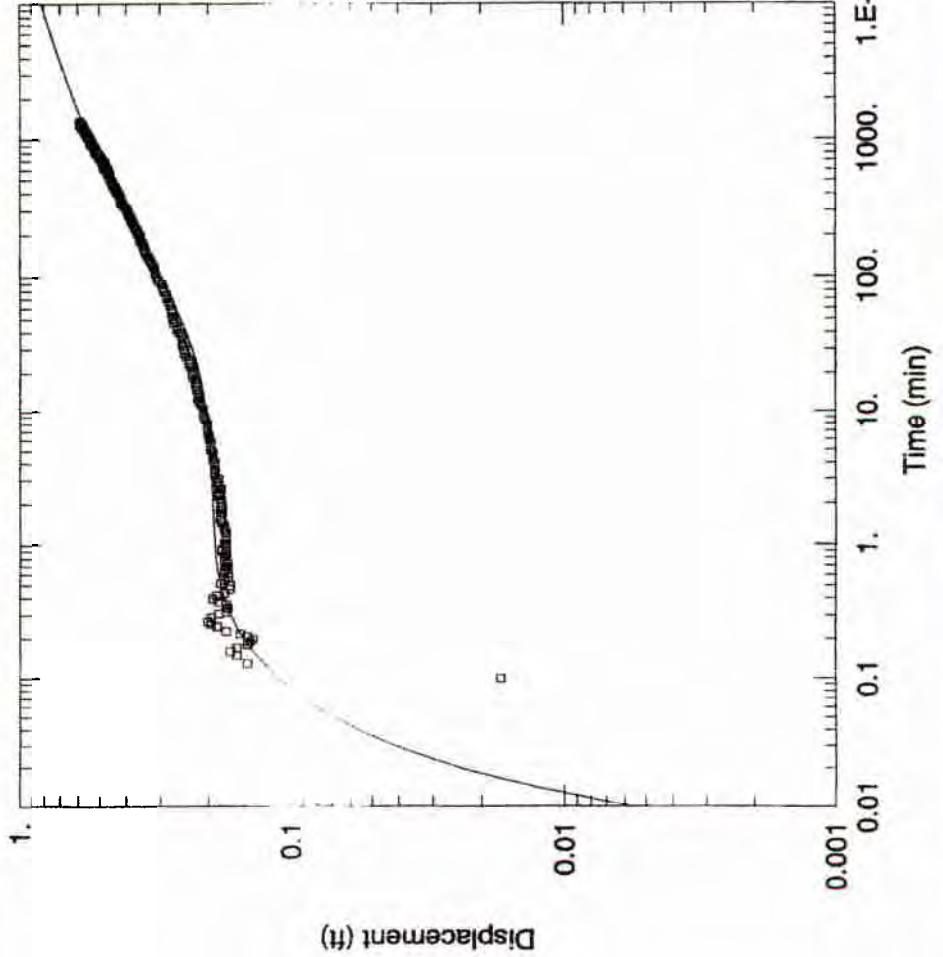
Project:

Location:

A-GRAPU0308.00

Grand Rapids, MN

Data Set: X:\...\well4recovery.aqt
 Date: 05/28/03 Time: 09:59:06



SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 2.355E+05 ft²/day

S = 0.0004861

Sy = 0.1473

B = 0.0932

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 6	578.1	7615

Observation Wells

Well Name	X (ft)	Y (ft)
Well 4	571.5	7776



Grand Rapids Aquifer Pumping Test (May 2003) - Well 1 Pumping and Recovery Data

Prepared By:

Prepared For:

SEH Inc.

Grand Rapids Public Utilities

Project:

Location:

A-GRAPU0308.00

Grand Rapids, MN

Data Set: X:\FJ\Grapu\030800\pumptest\well1.aqt
 Date: 05/28/03 Time: 10:00:12

SOLUTION

Aquifer Model: Unconfined
 Solution Method: Neuman
 $T = 2.079E+04 \text{ ft}^2/\text{day}$
 $S = 0.009417$
 $Sy = 0.5$
 $\beta = 1.098$

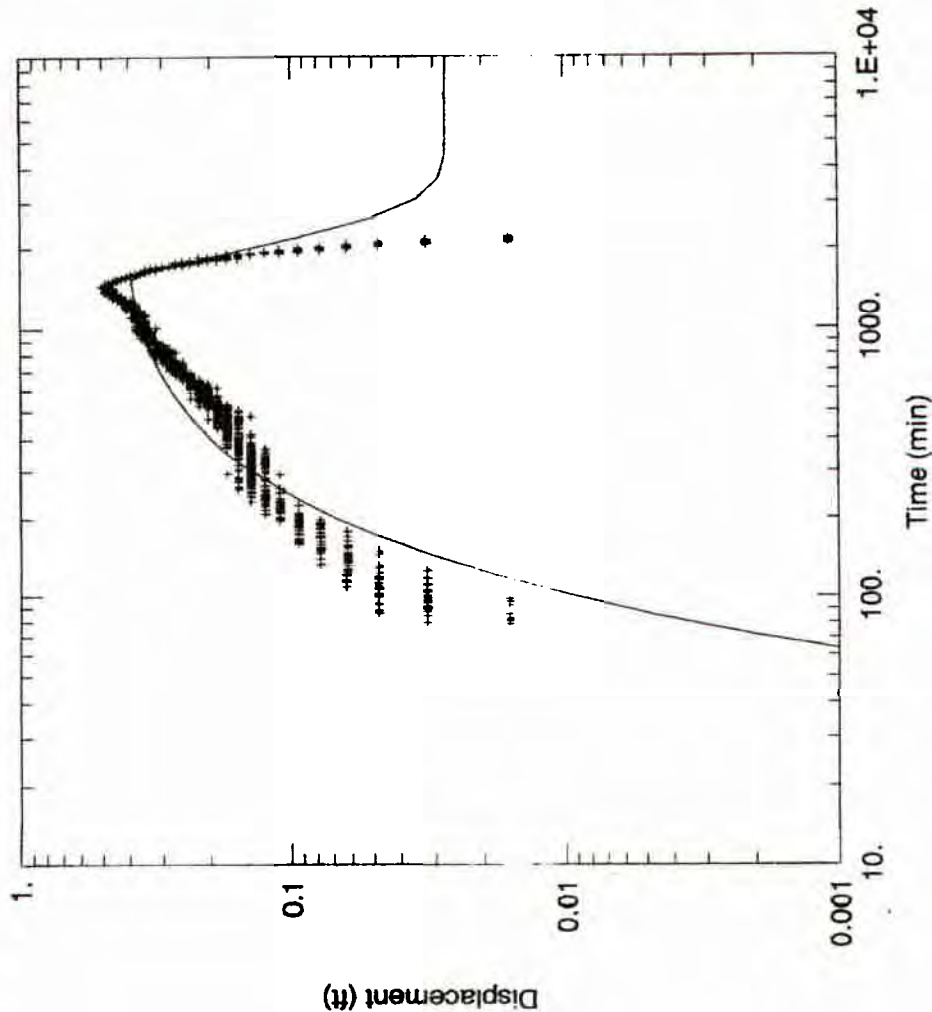
AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells		
Well Name	X (ft)	Y (ft)
Well 6	578.1	7615

Observation Wells		
Well Name	X (ft)	Y (ft)
+ Well 1	840.5	6234



Grand Rapids Aquifer Pumping Test (May 2003) - Well 1 Recovery Data

Prepared By:

Prepared For:

SEH Inc.

Grand Rapids Public Utilities

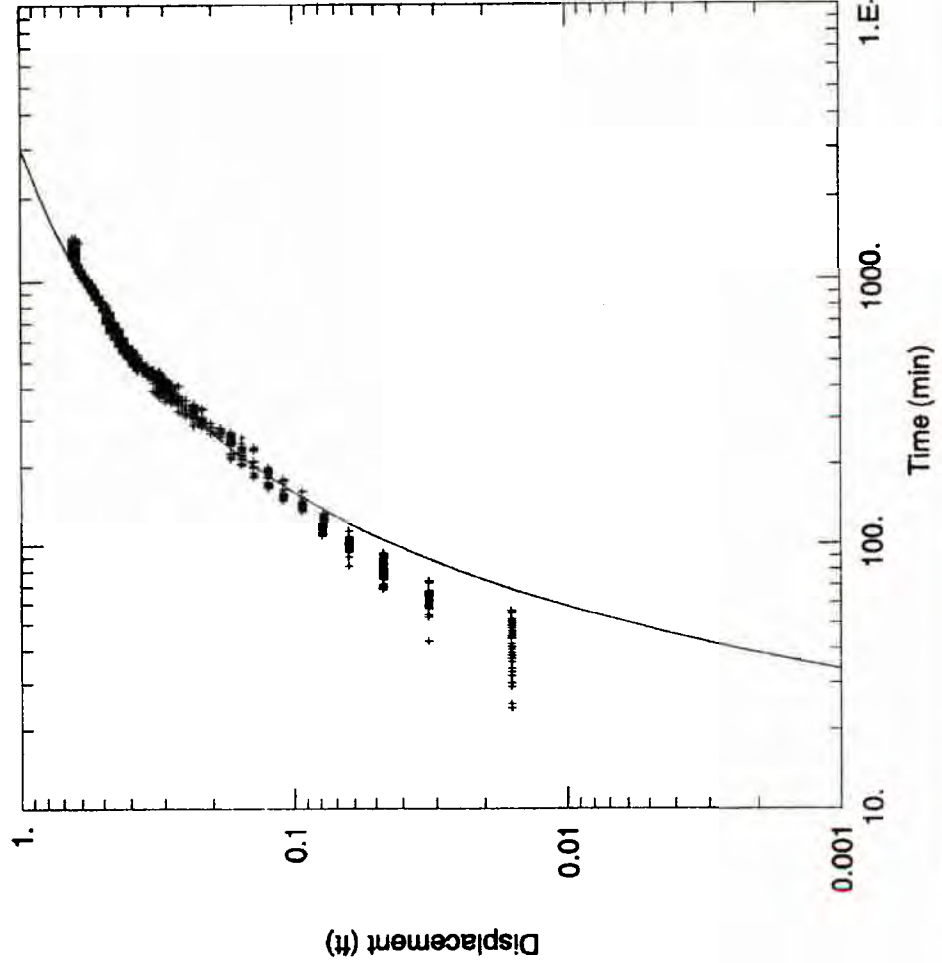
Project:

Location:

A-GRAPU0308.00

Grand Rapids, MN

Data Set: X:\...well1recovery.aqt
 Date: 05/28/03 Time: 10:34:27



SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 7.003E+04 ft²/day

S = 0.01432

Sy = 0.001

β = 1.E-10

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 6	578.1	7615

Observation Wells

Well Name	X (ft)	Y (ft)
+ Well 1	840.5	6234



Grand Rapids Aquifer Pumping Test (May 2003) - Wells 1 and 4 Data

Prepared By:

SEH Inc.

Project:

A-GRAPU0308.00

Prepared For:

Grand Rapids Public Utilities

Location:

Grand Rapids, MN

Data Set: X:\...wells1and4.aqt
 Date: 05/28/03 Time: 10:01:15

SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 3.068E+05 ft²/day

S = 0.0002059

Sy = 0.009376

Kz/Kr = 0.02139

AQUIFER DATA

Saturated Thickness: 100. ft

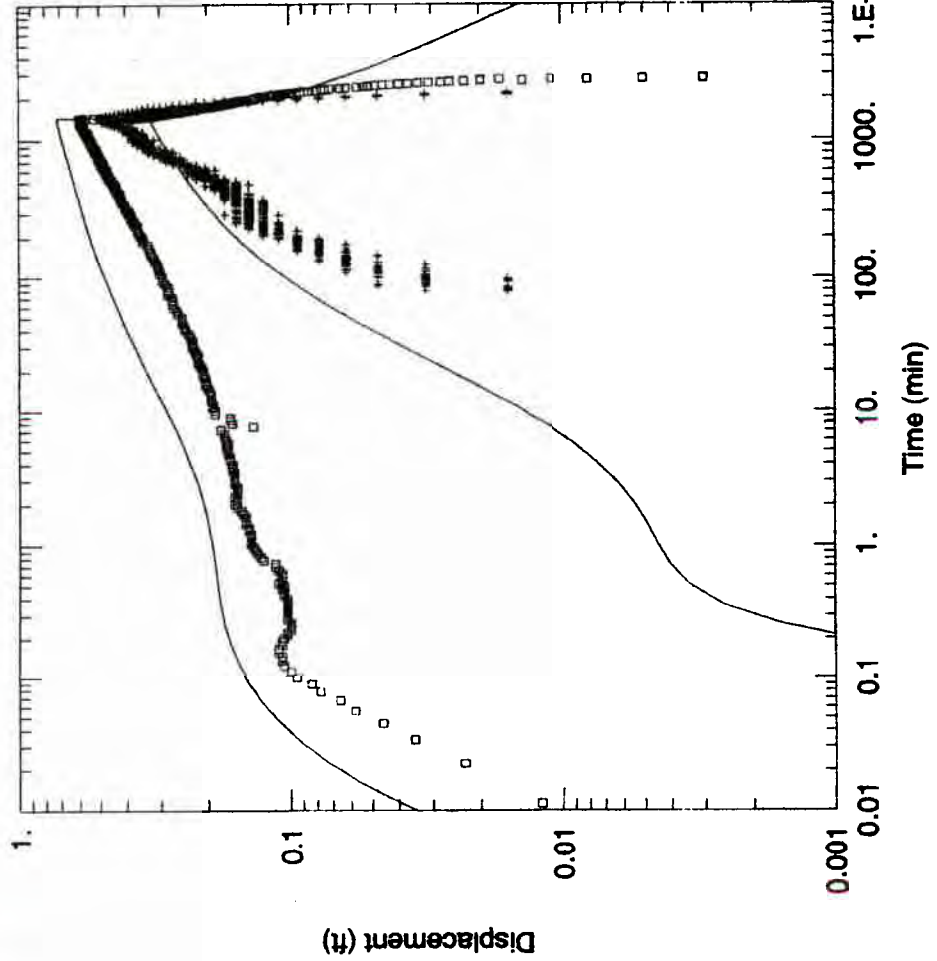
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 6	578.1	7615

Observation Wells

Well Name	X (ft)	Y (ft)
Well 4	571.5	7776
Well 1	840.5	6234



Time-Drawdown Graphs w/ Image Well

Grand Rapids Aquifer Pumping Test (May 2003) - Well 4 Pumping and Recovery Data

Prepared By:

Prepared For:

SEH Inc.

Grand Rapids Public Utilities

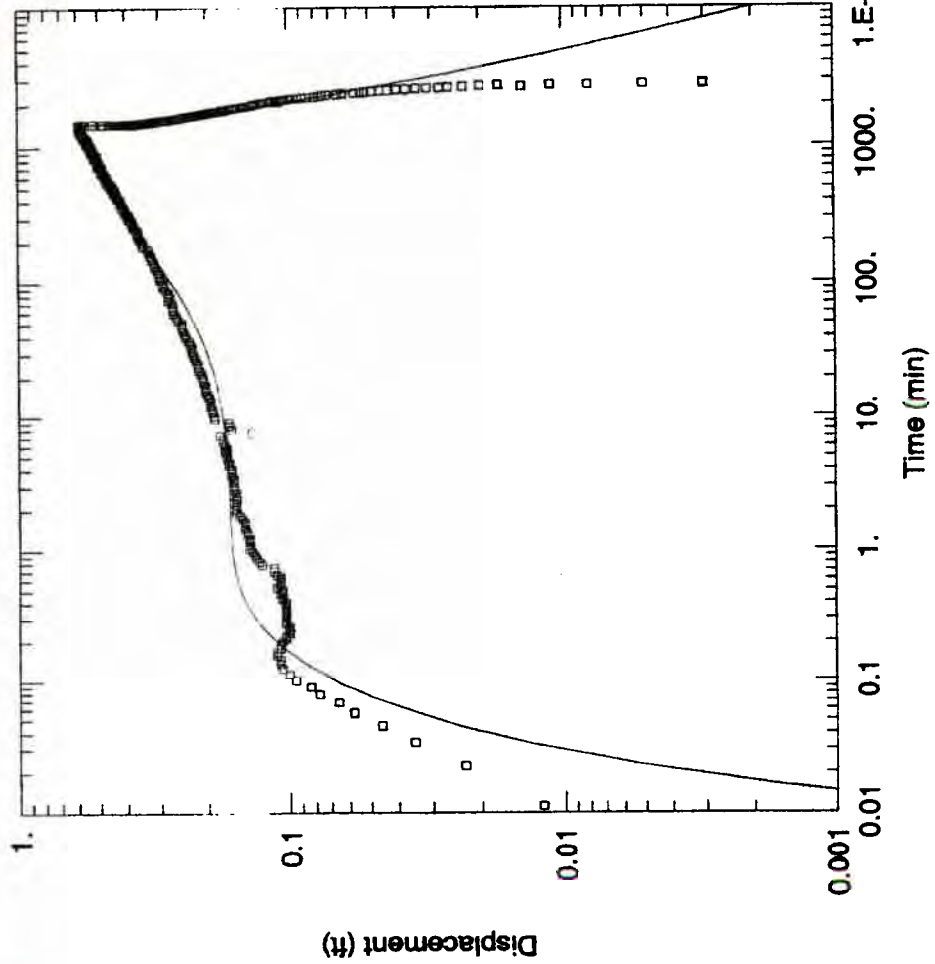
Project:

Location:

A-GRAPU0308.00

Grand Rapids, MN

Data Set: X:\FJ\Grapu\030800\pumptest\well4.aqt
 Date: 05/28/03 Time: 14:52:57



SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 1.567E+05 ft²/day

S = 0.0008564

Sy = 0.3097

β = 0.2616

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 6	578.1	7615
Image	578.1	6791

Observation Wells

Well Name	X (ft)	Y (ft)
Well 4	571.5	7776



Appendix C
Laboratory Results of Surface Water and
Groundwater Samples

Minnesota Department Of Health – Environmental Laboratory

Final Report - Client Copy - Report Of Analytical Results

Program: **HC**
 Program Name: **COMM WATER SUPPLIES (SAN.)**

Date Received: **22-MAY-2003**
 Date Generated: **30-MAY-2003**
 Request Page: **1 of 2**
 Date Reported: **JUN 02 2003**

Samples: 200312415 - 200312418

<u>PWS No</u>	<u>Site ID</u>	<u>Facility Name</u>	<u>City</u>
1310011	1310011	GRAND RAPIDS	GRAND RAPIDS
<u>Collect Dt</u>	<u>Coll Time</u>	<u>Coll ID</u>	<u>Collector Name</u>
20-MAY-2003	1200	2606	Walsh Jim
<u>Field Blank</u>	<u>Type</u>	<u>QTR</u>	<u>Field Res</u>
-	-	-	-
		<u>PO4 Res</u>	<u>Trip Blank</u>
		-	-

Sample No: **200312415** Receiving Comments: -

<u>Field No</u>	<u>LocID</u>	<u>Sampling Point</u>
228870	-	WELL NO. 1

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	15	1.0	mg/L	29-MAY-2003

Sample No: **200312416** Receiving Comments: -

<u>Field No</u>	<u>LocID</u>	<u>Sampling Point</u>
228873	-	WELL NO. 2

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	14	1.0	mg/L	29-MAY-2003

Sample No: **200312417** Receiving Comments: -

<u>Field No</u>	<u>LocID</u>	<u>Sampling Point</u>
228862	-	WELL NO. 3

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	40	1.0	mg/L	29-MAY-2003

B

Minnesota Department Of Health – Environmental Laboratory

Final Report - Client Copy - Report Of Analytical Results

Program: **HC**
 Program Name: **COMM WATER SUPPLIES (SAN.)**

Date Received: **22-MAY-2003**
 Date Generated: **30-MAY-2003**
 Request Page: **2 of 2**
 Date Reported:

Samples: 200312415 - 200312418

<u>PWS No</u>	<u>Site ID</u>	<u>Facility Name</u>	<u>City</u>
1310011	1310011	GRAND RAPIDS	GRAND RAPIDS
<u>Collect Dt</u>	<u>Coll Time</u>	<u>Coll ID</u>	<u>Collector Name</u>
20-MAY-2003	1200	2606	Walsh Jim
<u>Field Blank</u>	<u>Type</u>	<u>QTR</u>	<u>Field Res</u>
-	-	-	-
		<u>PO4 Res</u>	<u>Trip Blank</u>
		-	-

Sample No: **200312418** Receiving Comments: -

<u>Field No</u>	<u>LocID</u>	<u>Sampling Point</u>
127276	-	WELL NO. 4

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	13	1.0	mg/L	29-MAY-2003

Minnesota Department Of Health – Environmental Laboratory

Final Report - Client Copy - Report Of Analytical Results

Program: **HC**
 Program Name: **COMM WATER SUPPLIES (SAN.)**

Date Received: **22-MAY-2003**
 Date Generated: **30-MAY-2003**
 Request Page: **1 of 1**
 Date Reported: **JUN 02 2003**

Samples: 200312419 - 200312419

<u>PWS No</u>	<u>Site ID</u>	<u>Facility Name</u>	<u>City</u>
1310011	1310011	GRAND RAPIDS	GRAND RAPIDS
<u>Collect Dt</u>	<u>Coll Time</u>	<u>Coll ID</u>	<u>Collector Name</u>
20-MAY-2003	1200	2606	Walsh Jim
<u>Field Blank</u>	<u>Type</u>	<u>QTR</u>	<u>Field Res</u>
-	-	-	-
		<u>PO4 Res</u>	<u>Trip Blank</u>
		-	-

Sample No: **200312419** Receiving Comments: -

<u>Field No</u>	<u>LocID</u>	<u>Sampling Point</u>
161444	-	WELL NO. 6

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	12	1.0	mg/L	29-MAY-2003

ADD Issue Date Verification

Tuesday 03-JUN-2003 at 08:52 AM

FONDRK1

AMP	ISSUE_DT
200309461	03-JUN-03
200309462	03-JUN-03
200309463	03-JUN-03
200309464	03-JUN-03
200309503	03-JUN-03
200309504	03-JUN-03
200309505	03-JUN-03
200309700	03-JUN-03
200309701	03-JUN-03
200309702	03-JUN-03
200309703	03-JUN-03
200309704	03-JUN-03
200309705	03-JUN-03
200309813	03-JUN-03
200309814	03-JUN-03
200309815	03-JUN-03
200309816	03-JUN-03
200309817	03-JUN-03
200310008	03-JUN-03
200310009	03-JUN-03
200310010	03-JUN-03
200310075	03-JUN-03
200310258	03-JUN-03
200310259	03-JUN-03
200310260	03-JUN-03
200310261	03-JUN-03
200310262	03-JUN-03
200310275	03-JUN-03
200310276	03-JUN-03
200310328	03-JUN-03
200310329	03-JUN-03
200310330	03-JUN-03
200310529	03-JUN-03
200310604	03-JUN-03
200310605	03-JUN-03
200310631	03-JUN-03
200310632	03-JUN-03
200310633	03-JUN-03
200310634	03-JUN-03
200310685	03-JUN-03
200310686	03-JUN-03
200310687	03-JUN-03
200310688	03-JUN-03
200310689	03-JUN-03
200310690	03-JUN-03
200310691	03-JUN-03
200310692	03-JUN-03
200310693	03-JUN-03
200310694	03-JUN-03
200310695	03-JUN-03
200310702	03-JUN-03
200310703	03-JUN-03
200310704	03-JUN-03

6/13/03 KFF

ADD Issue Date Verification

Tuesday 03-JUN-2003 at 08:52 AM

FONDRK1

AMP	ISSUE_DT
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200310705	03-JUN-03
200310706	03-JUN-03
200310707	03-JUN-03
200310708	03-JUN-03
200310709	03-JUN-03
200310710	03-JUN-03
200310711	03-JUN-03
200310755	03-JUN-03
200310782	03-JUN-03
200310790	03-JUN-03
200310791	03-JUN-03
200310792	03-JUN-03
200310793	03-JUN-03
200310819	03-JUN-03
200312412	03-JUN-03
200312413	03-JUN-03
200312414	03-JUN-03

Minnesota Department Of Health – Environmental Laboratory

Final Report - Client Copy - Report Of Analytical Results

Program: IB
 Program Name: SOURCE WATER PROTECTION

Date Received: 22-MAY-2003
 Date Generated: 30-MAY-2003
 Request Page: 1 of 1
 Date Reported: JUN 03 2003

Samples: 200312412 - 200312414

PWS No	Site ID	Facility Name	City
-	-	-	GRAND RAPIDS
Collect Dt	Coll Time	Coll ID	Collector Name
20-MAY-2003	1200	2606	Walsh Jim
Field Blank	Type	QTR	Field Res
-	-	-	-
PO4 Res	Trip Blank		
-	-		

Sample No: 200312412 Receiving Comments: -

Field No	LocID	Sampling Point
HALE LAKE	-	-

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	9.4	1.0	mg/L	29-MAY-2003

Sample No: 200312413 Receiving Comments: -

Field No	LocID	Sampling Point
ICE LAKE	-	-

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	13	1.0	mg/L	29-MAY-2003

Sample No: 200312414 Receiving Comments: -

Field No	LocID	Sampling Point
MCKINNEY L	-	-

***** SAMPLE RESULTS *****

Unit: BACTICHEM	Result	Rept Level	Units	Analysis Date
23 Chloride, Total	5.5	1.0	mg/L	29-MAY-2003

Appendix D
MDH's Assessment of Surface
Water/Groundwater Interaction

Appendix D

Isotopic and Chemical Analysis of Water Samples from Grand Rapids for Wellhead Protection Area Delineation

06/30/03

Water samples from Hale, Crystal and McKinney Lakes and the city of Grand Rapids municipal wells and were taken on May 20, 2003 and analyzed for chloride and the stable isotopes of oxygen and hydrogen. The purpose of the sampling was to gain insight into the relative importance of nearby lakes as a source of recharge to the Grand Rapids wells. Chloride analyses were conducted at the Minnesota Department of Health Laboratory whereas the stable isotope analyses were provided by the Environmental Isotope Laboratory at the University of Waterloo. Analytical results are presented in the following table:

Sample Source	Sample Number	Oxygen-18 (per mil, relative to SMOW)	Deuterium (per mil, relative to SMOW)	Chloride (mg/l)
Hale Lake	31-3610520	-5.8	-56.24	9.4
Crystal (Ice) Lake	ICE0520	-5.35	-51.98	13
McKinney Lake	31-0370520	-5.17	-50.97	5.5
Grand Rapids Well 1	2288700520	-11.39	-82.42	15
Grand Rapids Well 2	2288730520	-11.3	-81.77	14
Grand Rapids	2288620520	-11.01	-81.11	40

Well 3				
Grand Rapids Well 4	1272760520	-11.15	-81.26	13
Grand Rapids Well 6	1614440520	-11.03	-80.22	12

Stable Isotope Analysis: The well water samples form a tight cluster of points that are near the global meteoric water line (Figure 1). Although none of the city well samples plot exactly on the line, the samples from Wells Nos. 1 and 2 plot within the limits of analytical uncertainty of this line, whereas the samples from Wells Nos. 3, 4 and 6 plot only slightly off. This indicates that these water samples were composed primarily of recharge that entered the aquifer without undergoing significant evaporation. On the other hand, the lake water samples plot well off the global meteoric water line, indicating the effects of evaporation on these water bodies. Lakes McKinney and Crystal are very similar in isotopic composition and distinct from Hale Lake, which has somewhat less of an evaporative signature.

It appears clear from the isotopic data that these lakes are not significant flow boundaries to the city wells and that water from these lakes constitute at most approximately 10% of the water from Wells 3, 4 and 6, and even less (or perhaps none) at Wells 1 and 2.

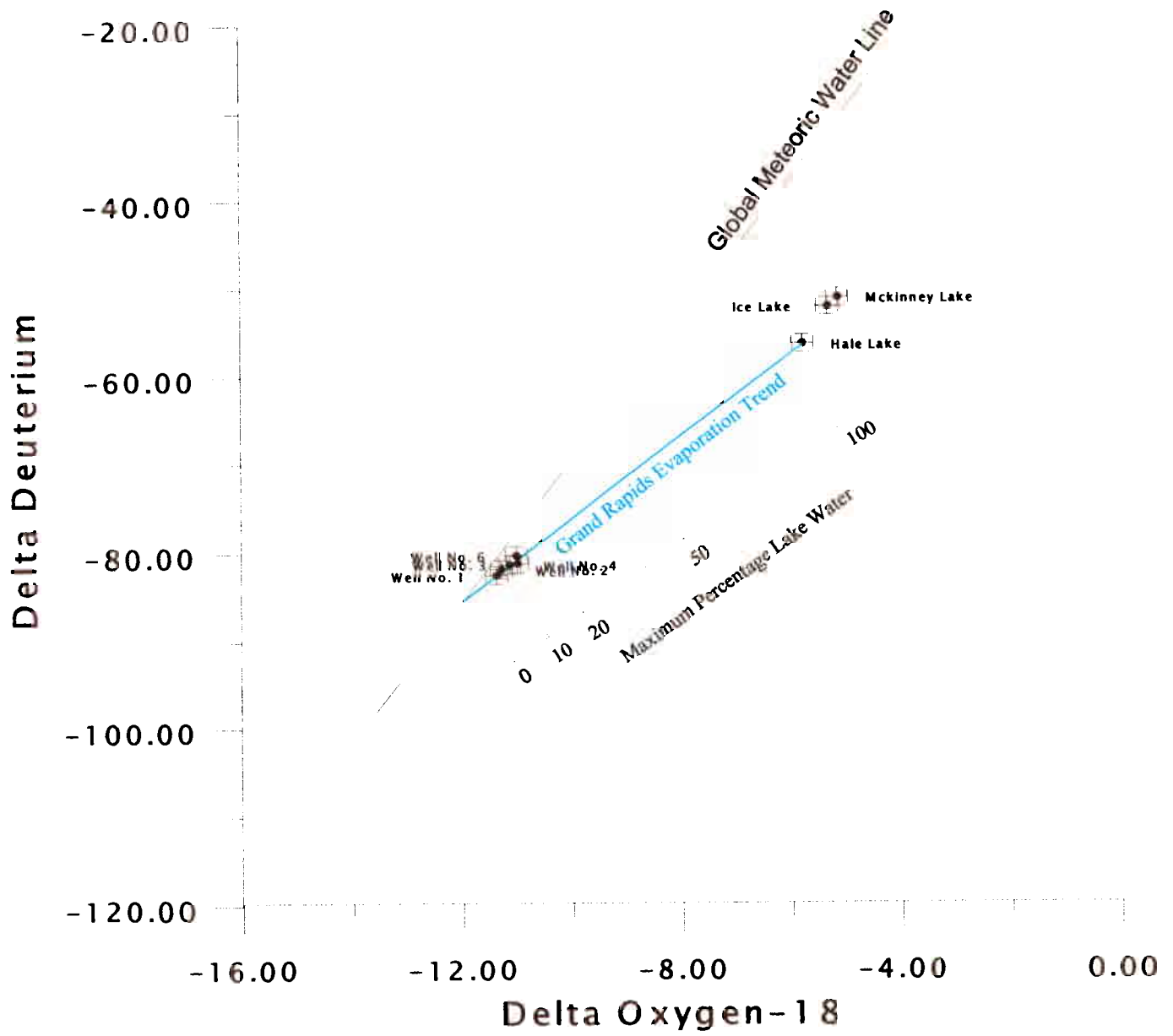


Figure 1. Stable isotope results for Grand Rapids

Chloride Analysis: With the exception of the result from Well 3, the chloride values are relatively uniform, and therefore are not very useful for estimating the importance of the lakes as a source of recharge to the city wells. The value recorded for Well 3 is much greater than that recorded from nearby Well 1 and from the lake water samples. This must indicate that 1) the source of the chloride at this well is something other than the lakes, and 2) it must be a fairly localized occurrence. Assuming this source is located at or near the land surface, the presence of such elevated chloride values at depth in this buried aquifer attests to the leaky nature of the confining units. Common sources of chloride include roadway de-icing salts, potash fertilizer and septic effluent.

Conclusions:

- 1) Isotopic analysis of water samples proved useful and showed that Hale, Crystal and McKinney Lakes were not major sources of recharge to the Grand Rapids city wells. Little to no evidence of lake impact was found at Wells Nos. 1 and 2, and a maximum of approximately 10% lake water could be accounted for at Wells Nos. 3, 4, and 6.
- 2) Chloride was not a useful discriminator because the well and lake water samples were similar. An exception was the sample from Well No.3, which apparently was impacted by a nearby point-source of chloride.

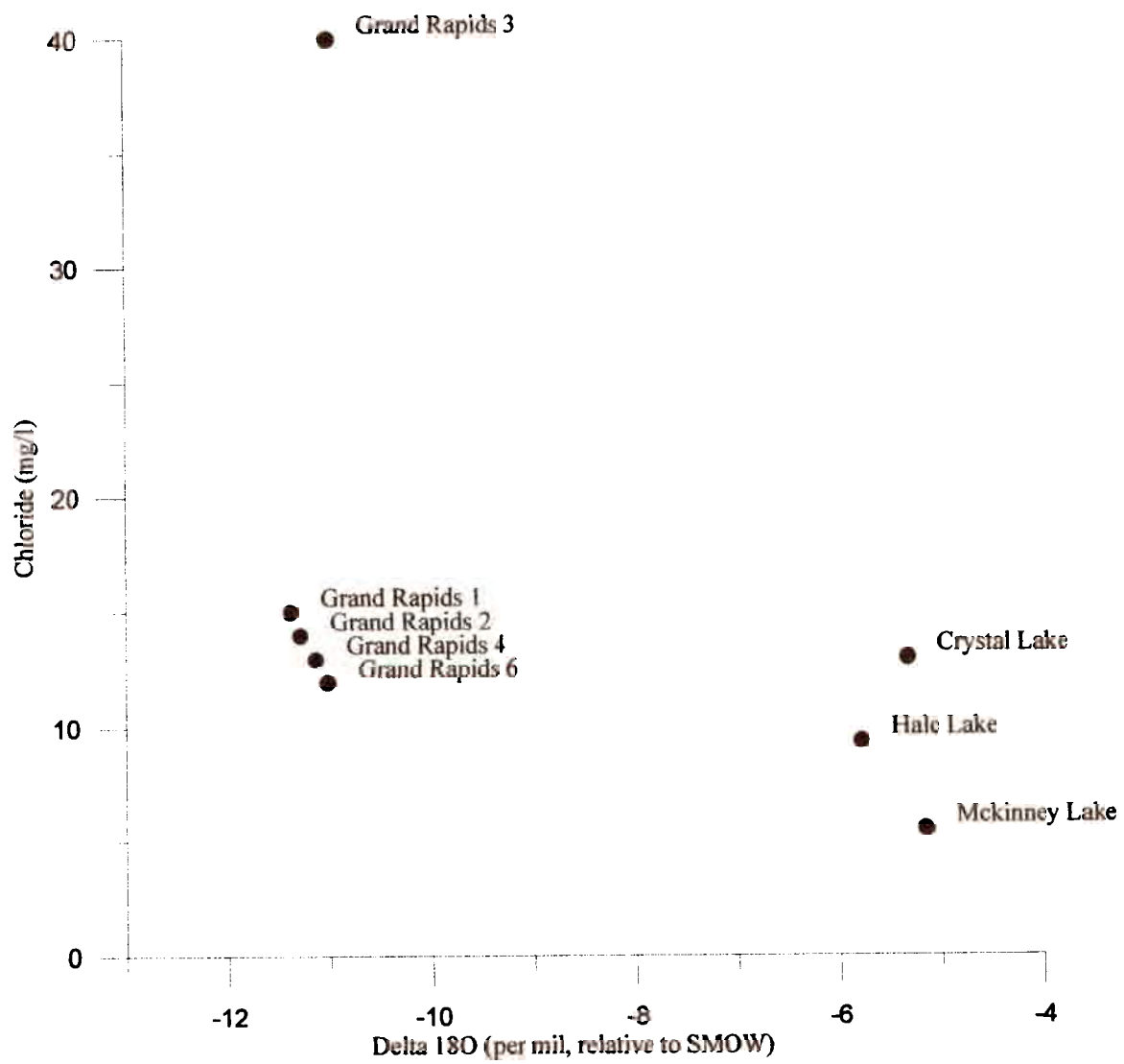


Figure 2. Relationship between chloride and oxygen-18 at Grand Rapids

Appendix E
MDH's Well Vulnerability Assessment Reports

Printouts from MDH Vulnerability Database for City of Grand Rapids Wells

PWSID : 1310011
SYSTEM NAME: Grand Rapids
WELL NAME : Well #1

TIER : 1
WHP RANK : 3
UNIQUE WELL #: 00228870

COUNTY: Itasca TOWNSHIP NUMBER: 55 RANGE: 25 SECTION: 17 QUARTERS: DDB

CRITERIA	DESCRIPTION	POINTS
Aquifer Name	QUAT. BURIED ARTES. AQUIFER	
DNR Geologic Sensitivity Rating: L	Score: 3	20
Geologic Data From	Well Record	
Year Constructed	1938	
Construction Method	Cable Tool/Bored	0
Casing Depth	118	10
Well Depth	176	
Casing grouted into borehole?	Unknown	0
Cement grout between casings?	Unknown	5
All casings extend to land surface?	Unknown	5
Gravel-packed casings?	Unknown	0
Wood or masonry casing?	No	0
Holes or cracks in casing?	Unknown	0
Isolation distance violations?	Unknown	0
Pumping Rate:	800	10
Non-THMS VOCs detected?	Unknown	0
Pesticides detected?	Unknown	0
Maximum nitrate detected	<1.0 02/01/1972	0
Maximum tritium detected	24.3 06/14/2000	vulnerable
Carbon-14 age	Unknown	0
Wellhead Protection Score		50
Wellhead Protection Vulnerability Rating:		VULNERABLE

COMMENTS

□

PWSID : 1310011
SYSTEM NAME: Grand Rapids
WELL NAME : Well #2

TIER : 1
WHP RANK : 3
UNIQUE WELL #: 00228873

COUNTY: Itasca TOWNSHIP NUMBER: 55 RANGE: 25 SECTION: 17 QUARTERS: DDBB

CRITERIA	DESCRIPTION	POINTS
-----	-----	-----
Aquifer Name :	BIWABIK IRON-FORMATION	
DNR Geologic Sensitivity Rating: VL L	Score: 10	10
Geologic Data From :	Well Record	
Year Constructed :	1951	
Construction Method :	Rotary/Drilled	0
Casing Depth :	382	5
Well Depth :	572	
Casing grouted into borehole?	Unknown	5
Cement grout between casings?	Unknown	5
All casings extend to land surface?	Unknown	5
Gravel-packed casings?	Unknown	0
Wood or masonry casing?	No	0
Holes or cracks in casing?	Unknown	0
Isolation distance violations?	Unknown	0
Pumping Rate:	750	10
Non-THMS VOCs detected?	Unknown	0
Pesticides detected?	Unknown	0
Maximum nitrate detected :	0.1	0
Maximum tritium detected :	10.4	vulnerable
Carbon-14 age :	Modern	0

Wellhead Protection Score : 40
Wellhead Protection Vulnerability Rating: VULNERABLE

COMMENTS

□

PWSID : 1310011
SYSTEM NAME: Grand Rapids
WELL NAME : Well #3

TIER : 1
WHP RANK : 3
UNIQUE WELL #: 00228862

COUNTY: Itasca TOWNSHIP NUMBER: 55 RANGE: 25 SECTION: 17 QUARTERS: BDD

CRITERIA	DESCRIPTION	POINTS
Aquifer Name	QUAT. BURIED ARTES. AQUIFER	
DNR Geologic Sensitivity Rating: VL L	Score: 7	15
Geologic Data From	Well Record	
Year Constructed	1964	
Construction Method	Rotary/Drilled	0
Casing Depth	120	10
Well Depth	180	
Casing grouted into borehole?	Unknown	5
Cement grout between casings?	Unknown	5
All casings extend to land surface?	Unknown	5
Gravel-packed casings?	Unknown	0
Wood or masonry casing?	No	0
Holes or cracks in casing?	Unknown	0
Isolation distance violations?	Unknown	0
Pumping Rate:	870	10
Non-THMS VOCs detected?	Unknown	0
Pesticides detected?	No	0
Maximum nitrate detected	<1.0 08/01/1972	0
Maximum tritium detected	24.6 06/14/2000	vulnerable
Carbon-14 age	Unknown	0
Wellhead Protection Score		50
Wellhead Protection Vulnerability Rating:		VULNERABLE

COMMENTS

□

PWSID : 1310011
SYSTEM NAME: Grand Rapids
WELL NAME : Well #4

TIER : 1
WHP RANK : 3
UNIQUE WELL #: 00127276

COUNTY: Itasca TOWNSHIP NUMBER: 55 RANGE: 25 SECTION: 17 QUARTERS:

CRITERIA	DESCRIPTION	POINTS
Aquifer Name	QUAT. BURIED ARTES. AQUIFER	
DNR Geologic Sensitivity Rating: L L	Score: 1	20
Geologic Data From	Well Record	
Year Constructed	1977	
Construction Method	Cable Tool/Bored	0
Casing Depth	117	10
Well Depth	157	
Casing grouted into borehole?	Yes	0
Cement grout between casings?	Not Applicable	0
All casings extend to land surface?	Yes	0
Gravel-packed casings?	No	0
Wood or masonry casing?	No	0
Holes or cracks in casing?	Unknown	0
Isolation distance violations?	Unknown	0
Pumping Rate:	1200	20
Non-THMS VOCs detected?	Unknown	0
Pesticides detected?	Unknown	0
Maximum nitrate detected	<0.4 12/01/1978	0
Maximum tritium detected	Unknown	0
Carbon-14 age	Unknown	0

Wellhead Protection Score : 50
Wellhead Protection Vulnerability Rating: VULNERABLE
Assessed By: WALSHJ1

COMMENTS

L-1 INFERRED FROM 0-40' INTERVAL OF OTHER CITY WELLS. This well is assumed to be vulnerable based on presence of tritium at other city wells.□

PWSID : 1310011
SYSTEM NAME: Grand Rapids
WELL NAME : Well #6

TIER : 1
WHP RANK : 3
UNIQUE WELL #: 00161444

COUNTY: Itasca TOWNSHIP NUMBER: 55 RANGE: 25 SECTION: 17 QUARTERS:

CRITERIA	DESCRIPTION	POINTS
Aquifer Name	QUAT. WATER TABLE AQUIFER	
DNR Geologic Sensitivity Rating: L	Score: 2	20
Geologic Data From	Well Record	
Year Constructed	1984	
Construction Method	Cable Tool/Bored	0
Casing Depth	100	10
Well Depth	140	
Casing grouted into borehole?	Yes	0
Cement grout between casings?	Unknown	5
All casings extend to land surface?	Yes	0
Gravel-packed casings?	No	0
Wood or masonry casing?	No	0
Holes or cracks in casing?	Unknown	0
Isolation distance violations?	Unknown	0
Pumping Rate:	1800	20
Non-THMS VOCs detected?	Unknown	0
Pesticides detected?	Unknown	0
Maximum nitrate detected	<0.4 11/01/1985	0
Maximum tritium detected	17.7 06/14/2000	vulnerable
Carbon-14 age	Unknown	0
Wellhead Protection Score		55
Wellhead Protection Vulnerability Rating:		VULNERABLE

COMMENTS

Appendix F
WHPA Delineation Procedure for Well 2

Appendix F

Delineation of WHPA for Well 2

Traditional WHPA delineation approaches based on analytical or numerical models that simulate the flow of groundwater through porous media are not applicable to the Biwabik Iron Formation Aquifer because it is presumably dominated by fracture or conduit flow. Instead, the WHPA for Grand Rapids Well 2 was delineated by 1) calculating a radius around the well to represent an inner protection zone, and 2) extrapolating that radius upgradient to the northern boundary of the aquifer (Figure 22).

1) Inner Protection Zone Calculation – An inner protection zone was calculated for Grand Rapids Well 2 using the following equation:

$$r = \sqrt{\frac{Q}{(n)(L)(\pi)}}$$

Where r is the radius around the well, Q is the volume of water pumped by the well over a given time period, n is the effective porosity, and L is the combined thickness of the water-producing horizons in the aquifer.

In this instance, an effective porosity of 0.1 was assumed based on literature references for fractured aquifers (Fetter, 1988). The term Q was derived from the daily volume of water pumped (Table 1), and radii were calculated for both one-year and ten-year time periods. Ideally, the L term would be based on the thickness of water-producing horizons identified in the construction record for the well. In this instance, the well construction record for Well 2 does not specify which portions of the aquifer were productive. In order to estimate this thickness, well log data from Keewatin, Minnesota were extrapolated. At Keewatin, construction records for City Wells Nos. 1 and 2 and the National Steel Pellet Company Main Well suggest that 25 to 80 percent of the open interval in the Biwabik Iron Formation may be capable of transmitting water based on driller's descriptions of oxidized zones within the formation. The mean value for this range was approximately 50 percent. In order to render a relatively conservative WHPA for Grand Rapids Well No.2, the uncased interval of the well (358 feet) was divided by 2 to represent the average value from Keewatin, and then this figure was used to represent L in the equation.

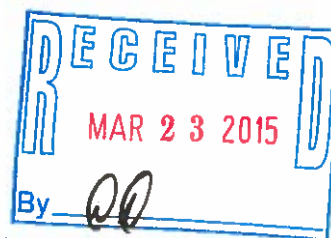
The radii that are produced by this calculation are a relatively crude measure of the potential volume of aquifer that might be needed to supply water to this well over one and ten-year time periods. Despite the shortcomings of this approach, it is necessary to provide some measure of protection to the immediate area around the well to account for uncertainty regarding the hydrogeologic factors controlling flow through the Biwabik Iron Formation.

2) Extrapolation of Calculated Radius – Available potentiometric and geologic data suggest that groundwater flow in the Biwabik Iron Formation is predominantly to the southeast towards Well 2. Predominant geologic controls on groundwater flow direction include 1) the dip orientation of the formation, which is approximately 150 degrees, and 2) the strike orientation of high-angle fractures or faults, which is inferred to be approximately 155 degrees along an apparent bedrock valley that trends past the Grand Rapids well field to the northern boundary of the Biwabik Iron Formation (Figure 19). These controls on groundwater flow were factored in by projecting the calculated ten-year radius for Well 2 both up-dip (330 degrees) and up-structure (335 degrees) to the northern extent of the Biwabik Iron Formation. These projections were then re-done at plus and minus ten degrees from the dominant directions to accommodate measurement uncertainty (Figure 22).

Appendix C

MDH Second Scoping Decision Notice

March 18, 2015



Protecting, maintaining and improving the health of all Minnesotans

Mr. Dennis Doyle
Water/Wastewater Collection Manager
Grand Rapids Public Utilities
P.O. Box 658
Grand Rapids, Minnesota 55744-0658

Dear Mr. Doyle:

Subject: Scoping 2 Decision Notice and Meeting Summary – Grand Rapids Public Utilities – PWSID 1310011

This letter provides notice of the results of the second scoping meeting I held with you, Anthony Ward, PUC General Manager, and Julie Kennedy, City Engineer (city of Grand Rapids), and Eric Tomlinson, Consultant (Sourcewater Solutions) on February 11, 2015, at Grand Rapids Public Utilities facility regarding Part II of your wellhead protection (WHP) plan. During the meeting, we discussed data elements that must be compiled and assessed to prepare the part of the WHP plan related to the management of potential contaminants in the approved drinking water supply management area. The enclosed Scoping 2 Decision Notice lists the data elements discussed at the meeting. The data elements must be compiled and assessed in terms of their present and future implications on the 1) use of the well(s), 2) quality and quantity of water supplying the public water supply wells(s), and 3) land and groundwater uses in the drinking water supply management areas. We also discussed a summary of planning issues identified during the Part I WHP Plan development process which should be considered for inclusion in your Part II WHP Plan.

The Grand Rapids Public Utilities has met the requirements to distribute copies of the first part of the WHP plan to local units of government. The Grand Rapids Public Utilities will have until November 30, 2015, to complete its WHP plan.

If a data element is marked on the enclosed notice as a data element that must be used and it does not exist, it is helpful if your plan notes this. MDH understands a consultant will be working with you to develop a draft of the remainder of the WHP plan. I will be contacting you to review the progress of the development of Part II of your plan. If you have any questions regarding the enclosed notice, contact me by email at chris.parthun@state.mn.us or by phone at (218) 308-2109.

Sincerely,

A handwritten signature in black ink that reads "Chris Parthun".

Christopher Parthun, Planner
Environmental Health Division
705 5th Street NW, Suite A
Bemidji, Minnesota 56601

CP:ds-b

Enclosures

cc: Michael Luhrsen, MDH Engineer, Duluth District Office
Tom Pagel, City Administrator, City of Grand Rapids
Ron Struss, Minnesota Department of Agriculture
Eric Tomlinson, Sourcewater Solutions

General Information: 651-201-5000 • Toll-free: 888-345-0823 • www.health.state.mn.us

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SCOPING 2 DECISION NOTICE

Variable Vulnerable DWSMA

Remainder of the Wellhead Protection Plan

Name of Public Water Supply:		Date:
Grand Rapids Public Utilities PWSID 1310011		March 18, 2015
Name of the Wellhead Protection Manager:		
Dennis Doyle		
Address:	City:	Zip:
P.O. Box 658	Grand Rapids	55744-0658
Unique Well Numbers:		Phone:
228870 (Well 1), 228873 (Well 2), 338862 (Well 3), 127276 (Well 4), 161444 (Well 6)		(218) 326-7192

Instructions for Completing the Scoping 2 Form

N	R	S	N = Not required. If this box is checked, this data element is NOT necessary for your wellhead protection plan because it is not needed or it has been included in the first scoping decision notice. Please go to the next data element.
X			

N	R	S	R = Required for the remainder of the plan. If this box is checked, this data MUST be used for the "remainder of the plan."
	X		

N	R	S	S = Submit to MDH. If this box is checked, this data element MUST be included in your wellhead protection plan and submitted to MDH. If there is NO check mark in the "S" box but there is an "X" in the "R" box, this data element MUST be included in your plan, but should NOT be submitted to MDH. This box will only be checked if MDH does not have access to this data element. This will help to reduce the cost by reducing the amount of paper and time to reproduce the data element.
		X	

Note: Any data elements required in the first scoping decision notice must also be used to complete the remainder of the wellhead protection plan.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT

PRECIPITATION			
N	R	S	An existing map or list of local precipitation gauging stations.
	X	X	
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing table showing the average monthly and annual precipitation in inches for the preceding five years.
	X	X	
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
GEOLOGY			
N	R	S	An existing geologic map and a description of the geology, including aquifers, confining layers, recharge areas, discharge areas, sensitive areas as defined in Minnesota Statutes, section 103H.005, subdivision 13, and groundwater flow characteristics.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about these data elements.			
N	R	S	Existing records of the geologic materials penetrated by wells, borings, exploration test holes, or excavations, including those submitted to the department.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about these data elements.			
N	R	S	Existing borehole geophysical records from wells, borings, and exploration test holes.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect the geology of the areas.			
N	R	S	Existing surface geophysical studies.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect the geology of the areas.			
SOILS			
N	R	S	Existing maps of the soils and a description of soil infiltration characteristics.
	X	X	
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	A description or an existing map of known eroding lands that are causing sedimentation problems.
	X	X	
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			

WATER RESOURCES			
N	R	S	An existing map of the boundaries and flow directions of major watershed units and minor watershed units.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map and a list of public waters as defined in Minnesota Statutes, section 103G.005, subdivision 15, and public drainage ditches.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	The shoreland classifications of the public waters listed under subitem (2), pursuant to part 6120.3000 and Minnesota Statutes, sections 103F.201 to 103F.221.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map of wetlands regulated under Chapter 8420 and Minnesota Statutes, section 103G.221 to 103G.2373.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map showing those areas delineated as floodplain by existing local ordinances.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			

DATA ELEMENTS ABOUT THE LAND USE

LAND USE			
N	R	S	An existing map of parcel boundaries.
	X	X	
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map of political boundaries.
	X	X	
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map of public land surveys including township, range, and section.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			

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

Technical Assistance Comments: The inventory, mapping and management of land uses and potential sources of contamination for all the Drinking Water Supply Management Area(s) must reflect what is known about these data elements, as follows:

Moderate and Highly Vulnerability

- 1) All potential contaminant sources and facility designations as listed on the attachments
- 2) a land use/land cover map and table
- 3) an inventory of the Inner Wellhead Management Zone (IWMZ).

Low Vulnerability

- 1) All potential contaminant sources and facility designations as listed on the attachment [inventory wells 50 feet in depth of the bottom of the well and deeper) and wells of undocumented or unknown depths for the potential contaminant source inventory]
- 2) a land use/land cover map and table
- 3) an inventory of the Inner Wellhead Management Zone (IWMZ).

Source Water Contribution Areas (SWCA) - As listed on the attachment. (An Amended DWSMA Vulnerability Figure for the city of Grand Rapids is attached for reference to identify this SWCA.)

As a starting point, MDH will provide a 2006 land cover map and table from federal data bases. This data set must be used unless an alternative electronic data set that is more current and detailed is available.

Management strategies must be developed for all land uses and potential sources of contamination.

	R	S	An existing comprehensive land-use map.
	X	X	

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

N	R	S	Existing zoning map.
	X	X	

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

PUBLIC UTILITY SERVICES

N	R	S	An existing map of transportation routes or corridors.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map of storm sewers, sanitary sewers, and public water supply systems.
	X	X	
Technical Assistance Comments: It is not necessary to include a map of your public water supply system in your plan if you feel it would pose a threat to the security of your system. An existing map of the storm sewers and sanitary sewers in the Drinking Water Supply Management Area(s) must be included in the wellhead protection plan and must also be submitted to the MDH as part of the approval.			
N	R	S	An existing map of the gas and oil pipelines used by gas and oil suppliers.
	X	X	
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing map or list of public drainage systems.
	X	X	
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing record of construction, maintenance, and use of the public water supply well and other wells within the drinking water supply management area.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about these data elements.			

DATA ELEMENTS ABOUT WATER QUANTITY

SURFACE WATER QUANTITY

N	R	S	An existing description of high, mean, and low flows on streams.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing list of lakes where the state has established ordinary high water marks.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing list of permitted withdrawals from lakes and streams, including source, use, and amounts withdrawn.
	X		
Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing list of lakes and streams for which state protected levels or flows have been established.
	X		

Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

N	R	S	An existing description of known water-use conflicts, including those caused by groundwater pumping.
	X	X	

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

GROUNDWATER QUANTITY

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

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

N	R	S	An existing description of known well interference problems and water-use conflicts.
	X	X	

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

N	R	S	An existing list of state environmental bore holes, including unique well number, aquifer measured, years of record, and average monthly levels.
	X		

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

DATA ELEMENTS ABOUT WATER QUALITY

SURFACE WATER QUALITY

N	R	S	An existing map or list of the state water quality management classification for each stream and lake.
	X		

Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

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

Technical Assistance Comments: The management of the vulnerable parts of the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

GROUNDWATER QUALITY

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

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

N	R	S	An existing list of water chemistry and isotopic data from wells, springs, or other groundwater sampling points.
	X		

Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.

N	R	S	An existing report of groundwater tracer studies.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing site study and well water analysis of known areas of groundwater contamination.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about these data elements.			
N	R	S	An existing property audit identifying contamination.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			
N	R	S	An existing report to the Minnesota Department of Agriculture and the Minnesota Pollution Control Agency of contaminant spills and releases.
	X		
Technical Assistance Comments: The management of all the Drinking Water Supply Management Area(s) must reflect what is known about this data element.			

**Grand Rapids Public Utilities
Scoping 2 Meeting
Wellhead Protection (WHP) Planning Issues Summary**

Drinking Water Protection Issues Identified to Date:

From the amended Part 1:

The vulnerabilities of the wells are considered to be vulnerable, with no change in vulnerability status from the original WHPP. There was no additional information available that warrant a change in DWSMA vulnerability from the original Plan. The DWSMA has areas of low, moderate, and high vulnerability, and a Surface Water Contribution Area has been specifically identified.

Other pertinent facts:

- No change in well construction or use/status.
- Well locations have not changed.
- All additional information generated since the first delineation is consistent with the initial hydrogeologic setting, vulnerability assessment, and directions of groundwater flow.
- The original delineation model still runs. (MODFLOW)
- The original model uncertainty analysis is consistent with current standards.
- A new Data Element Assessment has been generated to address any uncertainties with regard to data sources used for the delineation.

In summary, the existing DWSMA, WHPA, and updated ERAs for Grand Rapids Public Utilities' wells, as well as the existing DWSMA vulnerability are protective and meet WHP rule requirements.

Water Quality Detections and Implications:

Place/Sample Name	Date Taken	3H Result	Br (mg/L)	Cl (mg/L)	Cl/Br
Grand Rapids (1310011)					
Grand Rapids Well 3 (228862)	3/29/2011	11.1	0.0287	45.2	1575
Grand Rapids Well 2 (228873)	3/29/2011	2.3	0.0196	7.74	395
Grand Rapids Well 1 (228870)	7/13/2012		0.0181	12.4	685
Grand Rapids Well 2 (228873)	7/13/2012		0.0221	7.06	319
Grand Rapids Well 6 (161444)	7/13/2012		0.0500	22	440
Grand Rapids Well 6 (161444)	8/9/2013	6.7	0.0216	24.1	1116
Grand Rapids Well 3 (228862)	8/9/2013	10.0	0.0314	45.5	1449
Grand Rapids Well 2 (228873)	8/9/2013	4.6	0.0183	5.63	308
Hale Lake (SWS 209)	8/9/2013		0.0050	13.1	2620
McKinney Lake (SWS 211)	8/9/2013		0.0100	9.22	922
Crystal Lake (SWS 340)	8/9/2013		0.0050	20.2	4040

Table 3 – Updated Chemistry Information – indicates that the Isotope Data/GW Class for Wells 1, 2, 3, 4, and 6 are ranked as a B4:

Subcategory B4 - Post-1953 Impacted Non-Pathogen - groundwater is receiving a component of recharge over a time period of several decades, but pathogenic organisms are absent. Other contaminants may be present, such as volatile organic compounds or fuel degradates.

Br (mg/l) < 0.2
Cl (mg/l) > 10
Cl/Br 250- <5000
Tritium > 0.8

Old Municipal Well Information:

- Old Municipal Well Report was used in original plan and is on file

Sanborn Maps:

- Sanborn Maps are available for this area (1897-1942)
- Sanborn Maps are not available for this area.

Recommended WHP Measures:

1. **Flow Logging of Well 2 (228873):** The actual fracture flow horizons for the city’s bedrock well (Well 2) have not been measured or defined via downhole flow or chemistry logging. Doing so could help to better define the fracture flow capture area for future amendments. This measurement can be done in cooperation with MDH during routine pump maintenance, as the pump needs to be pulled from the well prior to logging and sampling.
2. **Well Locating:** Aquifer data for the Quaternary aquifer serving Wells 1 (228870), 3 (228862), 4 (127276) and 6 (161444) is spotty in some areas, particularly in the northern and northwestern portions of the DWSMA. If wells are constructed within one mile of the city’s municipal boundary or DWSMA, their locations should be verified. The city could contact MDH for assistance in year five for an evaluation of whether there are wells within that area to locate.
3. **Water Sampling:** Assessment monitoring package during year six, include the primary wells, in particular the Quaternary wells, and Hale, McKinney and Crystal Lakes, as well as the Mississippi River. MDH can provide sample bottles and cover analytical costs. The city may need to collect the samples and ship them to MDH.

Other:

This document is intended to be a summary of issues identified to date and is not intended to replace the required data elements identified in the Scoping 2 Decision Notice nor is it intended to be an exhaustive list of all potential drinking water issues.

Potential Contaminant Source Inventory Requirements

Grand Rapids Highly Vulnerable Surface Water DWSMA

The following current and historical potential contaminant sources and related codes, materials and related codes, and facility designation and related codes are required to be included in the potential contaminant source inventory. Each potential contaminant source identified must be assigned a facility designation and related code. In cases where a materials identification is required, a materials designation and code must be assigned.

<u>Potential Contaminant Sources (PCS)</u>	<u>PCS Codes</u>	<u>Material Codes</u>	<u>Comments / Caveats</u>
Above-Ground Storage Tank	AST		Outdoor, spills and runoff
Chemicals		C000	
Fertilizers		A050	
Fuels, gases, and oils		F000	
Hazardous substances		C001	
Solvents and coatings		S000	
Waste		W000	
Animal Feedlot	AFL		Aboveground storage and runoff
Ash Disposal Site	ASHD		Runoff and flooding potential
Drainage Ditch	DITCH		Runoff movement through any public or other drainage ditch system toward lake or streams
Hazardous Waste Generator	HWG		Particularly for aboveground storage
Hazardous Waste Handler	HWH		Aboveground storage and runoff, spills
Individual Sewage Treatment System	ISTS		May not be a concern in Grand Rapids, as this would mostly be a GW threat and would be covered in the most highly vulnerable areas by the High GW area. May be an issue with faulty or old systems during flooding and high runoff into nearby ditching

<u>Potential Contaminant Sources (PCS)</u>	<u>Material</u>	<u>PCS Codes</u>	<u>Material Codes</u>	<u>Comments / Caveats</u>
Land Application		LAPP		Runoff and flooding potential
Agricultural chemicals			C010	
Chemicals (unspecified)			C000	
Fertilizers			A050	
Minerals and metals (unspecified)			M000	
Waste (used unless one of the materials listed below apply)			W000	
Solid waste			W100	
Animal manure			W520	
Large Capacity Cesspool (potential Class V)		CVLCC		Runoff and flooding potential
Large Capacity Waste Water Disposal Site (potential Class V)		CVWWD		Runoff and flooding potential
Pit (aggregate)		PIT		Runoff and flooding potential
Potential Contamination Site ¹		PCS		Likely to be highly plume- and site-dependent, driven by how much of a surface water issue the contaminant is
Sludge Disposal Site		SLDG		Not sure if this is an issue in GR either
Solid Waste Management Site		SWMS		Aboveground storage runoff issues
Spills		SPL		Aboveground, runoff and ponding at surface
Storage or Preparation Area		STOR		Aboveground, runoff potential
Agricultural chemicals			C010	
Chemicals (include RMP facilities here)			C000	
Fertilizers			A050	
Fuels, gases, and oils			F000	
Hazardous substances (include TRIS)			C001	

<u>Potential Contaminant Sources (PCS)</u>	<u>PCS Codes</u>	<u>Material Codes</u>	<u>Comments / Caveats</u>
<u>Material</u> facilities here)			
Road salt		C020	
Solvents and coatings		S000	
Pressure-treated wood		C220	
Waste (used unless one of the materials listed below apply)		W000	
Solid waste		W100	
Animal manure		W520	
Waste oils		W700	
Motor vehicle waste		W710	
Tires		W120	
Stormwater Basin	SWB		Runoff out of basins during storm events could reach lakes. Also could be area of focused recharge to aquifer.
Stormwater Outlet	SROUT		
Suspected Contaminant of Concern	SCC		These would be inventoried in a groundwater high or moderate vuln area, but should be inventoried anywhere there's a potential for travel via runoff events.
Chemical		C000	
Food, agricultural, and consumer products		A000	
Fuels, gases, and oils		F000	
Materials and minerals		M000	
Pathogens		P000	
Solvents and coatings		S000	
Waste		W000	
Wastewater Disposal Site ²	WWDS		If site discharge would likely interact with stormwater runoff

Potential Contaminant Sources (PCS)
Material **PCS** **Material**
Codes **Codes** **Codes**
Comments / Caveats

Wastewater Stabilization Pond	WSP		Flooding risk
Wastewater Treatment Pond	WWTD		Not likely an issue in GR unless a new wastewater plant were necessary on the north side of the Mississippi river.

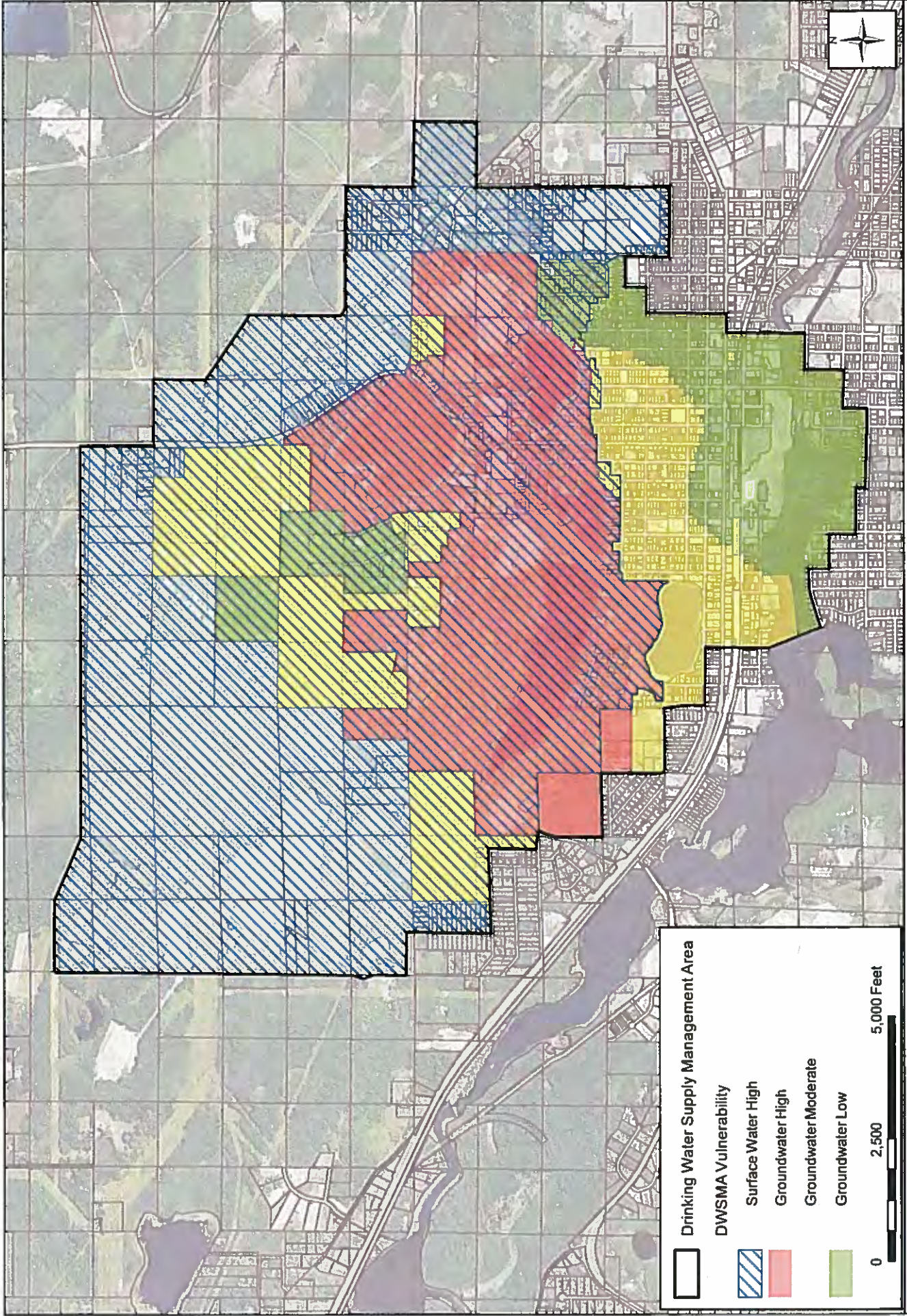
Footnotes:

¹Potential Contamination Sites (PCS) include the following:

- Brownfields (BMS)*
- Delisted State Superfund Sites (DPLP)*
- Federal Superfund Sites (NPL)*
- Hazardous Waste Investigative/cleanup (HWIC)*
- No Further Remedial Action Planned (NFRAP)*
- State Superfund Sites (PLP)*
- Suspected Hazardous Waste Site (CERCL)*
- Voluntary Investigative Cleanup (VIC)*
- State Assessment Site (SAS)*

²Wastewater Disposal Sites (WWDS) include the following:

- National Pollutant Discharge Elimination System (NDPES)*
- State Disposal System Permit (SDS)*



Amended DWSMA Vulnerability
City of Grand Rapids



**Scoping 2 Decision Notice Attachment
Potential Contaminant Source Inventory Requirements**

Non-Vulnerable DWSMA

The following current and historical potential contaminant sources and related codes, and facility designation and related codes must be included in the potential contaminant source inventory. Each potential contaminant source identified must be assigned a facility designation and related code.

<u>Potential Contaminant Sources (PCS)</u>	<u>PCS Codes</u>
Large Capacity Cesspool (potential Class V)	CVLCC
Large Capacity Waste Water Disposal Site (potential Class V)	CVWWD
Motor Vehicle Waste Disposal Well (potential Class V)	CVMVW
Wells	WEL

List of Designated Facilities and Codes

Residential

Residential Category Description: includes all establishments offering residence or accommodation, such as homes, apartments, housing for the elderly, hotels, and motels.

Facility Codes and Designations

1000: All Establishments Offering Residence

Commercial

Commercial Category Description: includes establishments typically associated with commercial land use. Examples include: general sales and service; retail sales and service; automobile sales and service; finance and insurance; business, professional, scientific and technical services; food services, and personal services.

Facility Codes and Designations

2000: General Sales and Service

Industrial

Industrial Category Description: includes manufacturing establishments located in plants, factories or mills and employs power-driven machines and materials handling equipment. Many manufacturing establishments process products of agriculture, forestry, fishing, mining or quarrying.

Facility Codes and Designations

3000: Manufacturing and Wholesale Trade

Transportation, Communication and Utilities

Transportation, Communication, and Utilities Category Description: a catch-all category that includes transportation, communication and utilities for essential facilities.

Facility Codes and Designations

4000: Transportation, Communication, Information, and Utilities

Arts, Entertainment and Recreation

Arts, Entertainment, and Recreation Category Description: includes establishments that provide services for cultural, entertainment, and recreational activities such as live performances, events, exhibits intended for public viewing and historical sites.

Facility Codes and Designations

5000: Arts, Entertainment, and Recreation

Education, Public Administration, Health Care, and other Institutions

Institutional Category Description: a catch-all category that includes education, public administration, health care, and other institutions. Examples include schools of all types, governmental buildings, military installations, public safety facilities, medical clinics and hospitals, other health and human services facilities, religious institutions, and death care services.

Facility Codes and Designations

6000: Education, Public Administration, Health Care, and Other Institutions

Construction

Construction Category Description: includes establishments that build structures or perform additions, alterations, reconstruction, installation and repairs. Examples include excavation contractors, carpentry, concrete contractors, painters, electricians, painters, highway and street construction, and sewer and well drilling.

Facility Codes and Designations

7000: Construction-Related Businesses

Mining and Extractive Uses

Mining and Extractive Uses Category Description: includes establishments that extract natural mineral solids, liquid materials, and gases.

Facility Codes and Designations

8000: Mining and Extraction Establishments

Agriculture and Forestry

Agricultural and Forestry Category Description: includes establishments that grow crops, raise animals, harvest timber and harvest fish and other animals from farms, ranches, or natural habitats.

Facility Codes and Designations

9000: Agriculture, Forestry, Fishing, and Hunting

Scoping 2 Decision Notice Attachment
Potential Contaminant Source Inventory Requirements

Moderately Vulnerable DWSMA

The following current and historical potential contaminant sources and related codes, materials and related codes, and facility designation and related codes are required to be included in the potential contaminant source inventory. Each potential contaminant source identified must be assigned a facility designation and related code. In cases where a materials identification is required a materials designation and code must be assigned.

Potential Contaminant Sources (PCS)

PCS Codes

<u>Material</u>	<u>Material Codes</u>
Above-Ground Storage Tank - Greater than 1100 gallons	AST
Chemicals	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances	C001
Solvents and coatings	S000
Waste	W000
Agricultural Drainage Well (potential Class V)	ADW
Disposal Well (potential Class V)	DISWLL
Industrial Drainage Well (potential Class V)	INDW
Large Capacity Cesspool (potential Class V)	CVLCC
Large Capacity Waste Water Disposal Site (potential Class V)	CVWWD
Leaking Underground Storage Tank	LUST
Misc. Injection Well (potential Class V)	INJWLL
Motor Vehicle Waste Disposal Well (potential Class V)	CVMVW
Pipeline Facility	PLFAC
Potential Contamination Site ¹	PCS
Recharge Well (potential Class V)	RWLL
Reinjection Well (potential Class V)	RIWLL
Solid Waste Management Site	SWMS
Special Drainage Well (potential Class V)	SPDW
Spills	SPL
Storage or Preparation Area	STOR
Chemicals (include RMP facilities here)	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances (include TRIS facilities here)	C001
Solvents and coatings	S000
Waste	W000
Stormwater Injection Well (potential Class V)	SWI

Potential Contaminant Sources (PCS)

PCS Codes

<u>Material</u>	<u>Material Codes</u>
Suspected Contaminant of Concern	SCC
Chemical	C000
Food, agricultural, and consumer products	A000
Fuels, gases, and oils	F000
Materials and minerals	M000
Pathogens	P000
Solvents and coatings	S000
Waste	W000
Underground Storage Tank	UST
Chemicals	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances	C001
Solvents and coatings	S000
Waste	W000
Wells	WEL

Footnotes:

¹Potential Contamination Sites (PCS) include the following:

- Brownfields (BMS)*
- Delisted State Superfund Sites (DPLP)*
- Federal Superfund Sites (NPL)*
- Hazardous Waste Investigative/cleanup (HWIC)*
- No Further Remedial Action Planned (NFRAP)*
- State Superfund Sites (PLP)*
- Suspected Hazardous Waste Site (CERCL)*
- Voluntary Investigative Cleanup (VIC)*

List of Facility Designations and Codes**Residential**

Residential Category Description: includes all establishments offering residence or accommodation, such as homes, apartments, housing for the elderly, hotels, and motels.

Facility Codes and Designations

- 1100:** Private Household (used unless one of the facility designations listed below apply)
 - 1100-01:** Residence
 - 1100-02:** Apartment or condominium
 - 1100-03:** Mobile home park
- 1200:** Housing Services for Special Needs
- 1300:** Hotels, Motels, or Other Accommodation Services

Commercial

Commercial Category Description: includes establishments typically associated with commercial land use. Examples include: general sales and service; retail sales and service; automobile sales and service; finance and insurance; business, professional, scientific and technical services; food services, and personal services.

Facility Codes and Designations

- 2000:** General Sales and Service (used unless one of the facility designations listed below apply)
 - 2100:** Retail sales or service
 - 2110:** Automobile sales or service establishment
 - 2110-01:** Automotive/vehicle repair
 - 2110-02:** Car wash
 - 2114:** Boat or marine craft dealer
 - 2114-01:** Boat services/repair/refinishing
 - 2116:** Gasoline services
 - 2120:** Heavy consumer goods, sales, or service establishments
 - 2120-01:** Furniture repair/refinishing
 - 2122:** Hardware stores and home centers
 - 2123:** Lawn and garden supply establishments
 - 2124:** Department stores, warehouse clubs or superstores
 - 2126:** Lumber yards and building materials
 - 2130:** Durable consumer goods, sales, or service

Industrial

Industrial Category Description: includes manufacturing establishments located in plants, factories or mills and employs power-driven machines and materials handling equipment. Many manufacturing establishments process products of agriculture, forestry, fishing, mining or quarrying.

Facility Codes and Designations

3000: Manufacturing and Wholesale Trade

Transportation, Communication and Utilities

Transportation, Communication, and Utilities Category Description: a catch-all category that includes transportation, communication, and utilities for essential facilities.

Facility Codes and Designations

4000: Transportation, Communication, Information, and Utilities

4345: Sanitary landfill (disposal)

4346: Waste treatment and disposal

4346-01: Salvage yard

4346-06: Dump

4346-07: State closed landfill

Arts, Entertainment and Recreation

Arts, Entertainment and Recreation Category Description: includes establishments that provide services for cultural, entertainment, and recreational activities such as live performances, events, exhibits intended for public viewing, and historical sites.

Facility Codes and Designations

5000: Arts, Entertainment and Recreation

Education, Public Administration, Health Care and other Institutions

Institutional Category Description: a catch-all category that includes education, public administration, health care, and other institutions. Examples include schools of all types, governmental buildings, military installations, public safety facilities, medical clinics and hospitals, other health and human services facilities, religious institutions, and death care services.

Facility Codes and Designations

6000: Education, Public Administration, Health Care, and Other Institutions

Construction

Construction Category Description: includes establishments that build structures or perform additions, alterations, reconstruction, installation and repairs. Examples include excavation contractors, carpentry, concrete contractors, painters, electricians, painters, highway and street construction, and sewer and well drilling.

Facility Codes and Designations

7000: Construction-Related Businesses

Mining and Extractive Uses

Mining and Extractive Uses Category Description: includes establishments that extract natural mineral solids, liquid materials, and gases.

Facility Codes and Designations

8000: Mining and Extraction Establishments

Agriculture and Forestry

Agricultural and Forestry Category description: includes establishments that grow crops, raise animals, harvest timber and harvest fish and other animals from farms, ranches, or natural habitats.

Facility Codes and Designations

9000: Agriculture, Forestry, Fishing, and Hunting

Scoping 2 Decision Notice Attachment
Potential Contaminant Source Inventory Requirements

Highly and Very Highly Vulnerable DWSMA

The following current and historical potential contaminant sources and related codes, materials and related codes, and facility designation and related codes are required to be included in the potential contaminant source inventory. Each potential contaminant source identified must be assigned a facility designation and related code. In cases where a materials identification is required, a materials designation and code must be assigned.

<u>Potential Contaminant Sources (PCS)</u>	<u>PCS Codes</u>
<u>Material</u>	<u>Material Codes</u>
Above-Ground Storage Tank	AST
Chemicals	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances	C001
Solvents and coatings	S000
Waste	W000
Agricultural Drainage Well (potential Class V)	ADW
Animal Burial Site	ABS
Animal Feedlot	AFL
Ash Disposal Site	ASHD
Disposal Well (potential Class V)	DISWLL
Grave(s)	GRV
Hazardous Waste Generator	HWG
Hazardous Waste Handler	HWH
Individual Sewage Treatment System	ISTS
Industrial Drainage Well (potential Class V)	INDW
Large Capacity Cesspool (potential Class V)	CVLCC
Large Capacity Waste Water Disposal Site (potential Class V)	CVWWD
Leaking Underground Storage Tank	LUST
Misc. Injection Well (potential Class V)	INJWLL
Motor Vehicle Waste Disposal Well (potential Class V)	CVMVW
Nuclear Reactor	NR
Pipeline Facility	PLFAC
Pit (aggregate)	PIT
Potential Contamination Site ¹	PCS
Recharge Well (potential Class V)	RWLL
Reinjection Well (potential Class V)	RIWLL

Potential Contaminant Sources (PCS)

PCS Codes

Material

Material Codes

Sludge Disposal Site	SLDG
Solid Waste Management Site	SWMS
Special Drainage Well (potential Class V)	SPDW
Spills	SPL
Storage or Preparation Area	STOR
Agricultural chemicals	C010
Chemicals (include RMP facilities here)	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances (include TRIS facilities here)	C001
Road salt	C020
Solvents and coatings	S000
Pressure-treated wood	C220
Waste (used unless one of the materials listed below apply)	W000
Solid waste	W100
Animal manure	W520
Waste oils	W700
Motor vehicle waste	W710
Tires	W120
Stormwater Basin	SWB
Stormwater Injection Well (potential Class V)	SWI
Stormwater Outlet	SROUT
Suspected Contaminant of Concern	SCC
Chemical	C000
Food, agricultural, and consumer products	A000
Fuels, gases, and oils	F000
Materials and minerals	M000
Pathogens	P000
Solvents and coatings	S000
Waste	W000
Underground Storage Tank	UST
Chemicals	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances	C001
Solvents and coatings	S000
Waste	W000
Waste - Metro Area	IWS
Wastewater Disposal Site ²	WWDS
Wastewater Stabilization Pond	WSP
Wastewater Treatment Pond	WWTD
Wells	WEL

Footnotes:

¹Potential Contamination Sites (PCS) include the following:

- Brownfields (BMS)*
- Delisted State Superfund Sites (DPLP)*
- Federal Superfund Sites (NPL)*
- Hazardous Waste Investigative/cleanup (HWIC)*
- No Further Remedial Action Planned (NFRAP)*
- State Superfund Sites (PLP)*
- Suspected Hazardous Waste Site (CERCL)*
- Voluntary Investigative Cleanup (VIC)*
- State Assessment Site (SAS)*

²Wastewater Disposal Sites (WWDS) include the following:

- National Pollutant Discharge Elimination System (NDPES)*
- State Disposal System Permit (SDS)*

List of Facility Designations and Codes**Residential**

Residential Category Description: includes all establishments offering residence or accommodation, such as homes, apartments, housing for the elderly, hotels, and motels.

Facility Codes and Designations

- 1100:** Private Household (used unless one of the facility designations listed below apply)
 - 1100-01:** Residence
 - 1100-02:** Apartment or condominium
 - 1100-03:** Mobile home park
- 1200:** Housing Services for Special Needs
- 1300:** Hotels, Motels, or Other Accommodation Services

Commercial

Commercial Category Description: includes establishments typically associated with commercial land use. Examples include: general sales and service; retail sales and service; automobile sales and service; finance and insurance; business, professional, scientific and technical services; food services, and personal services.

Facility Codes and Designations

2000: General Sales and Service (used unless one of the facility designations listed below apply)

2100: Retail sales or service

2110: Automobile sales or service establishment

2110-01: Automotive/vehicle repair

2110-02: Car wash

2114: Boat or marine craft dealer

2114-01: Boat services/repair/refinishing

2116: Gasoline services

2120: Heavy consumer goods, sales, or service establishments

2120-01: Furniture repair/refinishing

2122: Hardware stores and home centers

2123: Lawn and garden supply establishments

2124: Department stores, warehouse clubs or superstores

2126: Lumber yards and building materials

2130: Durable consumer goods, sales, or service

2130-01: Paint stores

2200: Financial and insurance establishments

2300: Rental, leasing, and storage establishments

2400: Professional, scientific and technical services and general business

2416: Research and development establishments (scientific, etc.)

2417: Advertising, media and photography services

2417-01: Photographic services

2451: Extermination and pest control establishments - non-agriculture

2452: Janitorial

2453: Landscaping

2454: Carpet and upholstery cleaning

2455: Packing and crating services

2500: Food Services

2600: Personal Services

2600-01 Dry cleaners

2600-02 Laundromat

2700: Pet and animal services (except veterinary)

Industrial

Industrial Category Description: includes manufacturing establishments located in plants, factories or mills and employs power-driven machines and materials handling equipment. Many manufacturing establishments process products of agriculture, forestry, fishing, mining or quarrying.

Facility Codes and Designations

- 3000:** Manufacturing and Wholesale Trade (used unless one of the facility designations listed below apply)
 - 3110** Food and beverages
 - 3110-01:** Food processing plant
 - 3110-02:** Rendering plant
 - 3120:** Tobacco manufacturing establishment
 - 3130:** Textiles
 - 3140:** Leather and allied products
 - 3210:** Wood products establishment
 - 3210-01:** Wood preserving plant
 - 3210-02:** Sawmill
 - 3220:** Paper and printing materials
 - 3220-01:** Printing
 - 3220-02:** Paper mill
 - 3230:** Furniture manufacturing
 - 3310:** Petroleum and coal products
 - 3310-01:** Petroleum refining/processing
 - 3310-02:** Asphalt production
 - 3320:** Chemical manufacturing/processing plant
 - 3320-01:** Plastics/synthetics manufacturing
 - 3330:** Nonmetallic mineral products
 - 3330-01:** Cement/concrete plants
 - 3340:** Primary metal manufacturing
 - 3340-01:** Foundry/metal plating
 - 3340-02:** Electroplaters
 - 3350:** Machinery manufacturing
 - 3360:** Electrical/electronic products manufacturing
 - 3370:** Transportation, automobile manufacturing
 - 3410:** Jewelry and silverware manufacturing
 - 3420:** Dolls, toys, games and musical instruments manufacturing
 - 3440:** Sign manufacturing
 - 3600:** Warehouse

Transportation, Communication and Utilities

Transportation, Communication, and Utilities Category Description: a catch-all category that includes transportation, communication, and utilities for essential facilities.

Facility Codes and Designations

- 4000:** Transportation, Communication, Information, and Utilities (used unless one of the facility designations listed below apply)
- 4110:** Air transportation establishments
- 4120:** Rail transportation establishments
- 4130:** Road, ground, passenger, and transit
- 4140:** Fleet/trucking/bus terminals
- 4150:** Marine and water transportation
- 4160:** Courier and messenger services
- 4170:** Postal service establishments
- 4180:** Pipeline transportation
- 4200:** Communications and information establishments
- 4310:** Electric power plant
 - 4310-01:** Power substation
- 4311:** Hydroelectric power plant
- 4312:** Fossil power plant
- 4313:** Nuclear power plant
- 4314:** Alternative energy sources
- 4320:** Natural gas, petroleum, fuels, etc. establishments
- 4330:** Water, steam, air conditioning supply establishments
- 4340:** Sewer, solid waste, and related services
 - 4340-01:** Wastewater treatment plant
- 4341:** Hazardous waste collection facility
- 4342:** Hazardous waste treatment and disposal
- 4343:** Solid waste collection services
- 4344:** Solid waste combustor or incinerator
- 4345:** Sanitary landfill (disposal)
- 4346:** Waste treatment and disposal
 - 4346-01:** Salvage yard
 - 4346-02:** Demolition debris landfill
 - 4346-03:** Composting site
 - 4346-04:** Recycling site
 - 4346-05:** Transfer station
 - 4346-06:** Dump
 - 4346-07:** State closed landfill
- 4347:** Septic hauler

Arts, Entertainment and Recreation

Arts, Entertainment and Recreation Category Description: includes establishments that provide services for cultural, entertainment, and recreational activities such as live performances, events, exhibits intended for public viewing, and historical sites.

Facility Codes and Designations

- 5000:** Arts, Entertainment and Recreation (used unless one of the codes listed below apply)
- 5100:** Performing arts or supporting establishment
 - 5130:** Racetrack establishment
 - 5140:** Fairgrounds
 - 5140-02:** Stadium
 - 5200:** Museums and other special purpose recreational establishments
 - 5230:** Zoo
 - 5231:** Garden
 - 5233:** Arboretum
 - 5300:** Amusement, sports, or recreation establishment
 - 5360:** Marina or yachting club facility operators
 - 5370:** Golf courses
 - 5400:** Camp, camping, and related establishments
 - 5500:** Natural and other recreational parks

Education, Public Administration, Health Care and other Institutions

Institutional Category Description: a catch-all category that includes education, public administration, health care, and other institutions. Examples include schools of all types, governmental buildings, military installations, public safety facilities, medical clinics and hospitals, other health and human services facilities, religious institutions, and death care services.

Facility Codes and Designations

- 6000:** Education, Public Administration, Health Care, and Other Institutions (used unless one of the facility designations listed below apply)
- 6100:** Schools
 - 6200:** Public administration establishments
 - 6310:** Military installation and national security facilities
 - 6320:** Space research and technology services
 - 6400:** Public safety facilities
 - 6500:** Health and human services facilities
 - 6511:** Clinics
 - 6530:** Hospitals
 - 6600:** Religious institutions
 - 6710:** Funeral homes and services
 - 6720:** Cremation and other services
 - 6720-01:** Cemetery

Construction

Construction Category Description: includes establishments that build structures or perform additions, alterations, reconstruction, installation and repairs. Examples include excavation contractors, carpentry, concrete contractors, painters, electricians, painters, highway and street construction, and sewer and well drilling.

Facility Codes and Designations

7000: Construction-Related Businesses

Mining and Extractive Uses

Mining and Extractive Uses Category Description: includes establishments that extract natural mineral solids, liquid materials, and gases.

Facility Codes and Designations

8000: Mining and Extraction Establishments

Agriculture and Forestry

Agricultural and Forestry Category description: includes establishments that grow crops, raise animals, harvest timber and harvest fish and other animals from farms, ranches, or natural habitats.

Facility Codes and Designations

9000: Agriculture, Forestry, Fishing, and Hunting (used unless one of the facility designations listed below apply)

9000-01: Farm

9000-02: Crop production

9130-01: Orchard

9130-02: Vineyard

9140: Greenhouse, nursery, and floriculture

9154: Hay

9220: Spraying, dusting, and other related services

9300: Animal production, including slaughter

9360: Fish hatcheries, fisheries, and aquaculture

9400: Forestry and logging

Appendix D

Soil Properties

**Appendix D
Soil Properties**

Map Unit Key	Map Unit Name	Ponding Frequency	Drainage Class	Potential Erosion Hazard	Hydric Classification	Geomorphic Description
398419	Aquents, sandy	0-14%	Very poorly drained	Not rated	Unknown	beaches
398482	Borosapristis, depressional	75-100%	Very poorly drained	Slight	All hydric	bogs
398442	Cathro muck	75-100%	Very poorly drained	Slight	All hydric	depressions on moraines
398446	Cowhorn loamy very fine sand	0-14%	Somewhat poorly drained	Slight	Not hydric	outwash plains
398448	Goodland silt loam, 1 to 10 percent slopes	0-14%	Well drained	Moderate	Not hydric	moraines
398443	Greenwood peat	75-100%	Very poorly drained	Slight	All hydric	bogs
398449	Itasca silt loam, 1 to 10 percent slopes	0-14%	Well drained	Moderate	Not hydric	moraines
398479	Itasca-Goodland silt loams, 12 to 25 percent slopes	0-14%	Well drained	Severe	Not hydric	moraines
398478	Itasca-Goodland silt loams, 2 to 12 percent slopes	0-14%	Well drained	Moderate	Not hydric	moraines
398475	Menahga and Graycalm soils, 0 to 8 percent slopes	0-14%	Somewhat excessively drained	Slight	Not hydric	outwash plains
398439	Menahga loamy sand, 10 to 30 percent slopes	0-14%	Excessively drained	Severe	Not hydric	outwash plains
398474	Menahga-Itasca complex, 10 to 25 percent slopes	0-14%	Excessively drained	Severe	Not hydric	moraines
398466	Moselake and Lupton mucky peats	75-100%	Very poorly drained	Slight	All hydric	swamps
398465	Shooker very fine sandy loam	0-14%	Poorly drained	Slight	All hydric	flats on moraines
398460	Talmoon silt loam	75-100%	Very poorly drained	Slight	All hydric	depressions on moraines
398422	Udorthents, nearly level to rolling	0-14%	Well drained	Moderate	Not hydric	not available
398426	Zimmerman loamy fine sand, 1 to 8 percent slopes	0-14%	Excessively drained	Moderate	Not hydric	outwash plains

Appendix E

Surface Water Quality

analysisDate	collectingOrg	comments	gltt	parameter	result	resultUnit	sampleDate	sampleDesc	sampleFractionType	sampleType	stationid	stationName	testMethodId	testMethodName
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Alkalinity, total as CaCO3	140 mg/L		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	FLD	Field measurement/observation, generic method	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Apparent color	45 PCU		9/2/1981 m	Dissolved	Sample	31-0533-00-101	BLANDIN	LEG_P0080	COLOR (PLATINUM-COBALT UNITS)	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	pH	7.9 None		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	LEG_P00403	PH, LAB, STANDARD UNITS SU	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Organic Nitrogen as N	0.78 mg/L		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	LEG_P00605	NITROGEN, ORGANIC, TOTAL (MG/L AS N)	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Ammonia-nitrogen as N	0.1 mg/L		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	LEG_P00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Kjeldahl nitrogen as N	0.8 mg/L		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	LEG_P00625	NITROGEN, KJELDAHL, TOTAL (MG/L AS N)	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.03 mg/L		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	LEG_P00630	NITRATE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Phosphorus as P	0.038 mg/L		9/2/1981 m	Total	Sample	31-0533-00-101	BLANDIN	LEG_P00665	PHOSPHORUS, TOTAL (MG/L AS P)	
1/1/1901	MPCA Lake Monitoring Program Project	(null)	(null)	Chlorophyll a, corrected for pheophytin	4.63 ug/L		9/2/1981 m	Non-filter	Sample	31-0533-00-101	BLANDIN	LEG_P32211	CHLOROPHYLL a-UG/L SPECTROPHOTOMETRIC ACID. METH.	
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.8 mg/L		9/2/1981 m	Total	FMO	31-0533-00-101	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification	
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	51.06%		9/2/1981 m	Total	FMO	31-0533-00-101	BLANDIN	FIL	Field measurement/observation, generic method	
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Depth, Secchi disk depth	1.6 m		9/2/1981 m	Total	FMO	31-0533-00-101	BLANDIN	FLD	Field measurement/observation, generic method	
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C		9/2/1981 m	Total	FMO	31-0533-00-101	BLANDIN	FLD	Field measurement/observation, generic method	
10/1/2005	Citizen Lake Monitoring Program	(null)	(null)	Depth, Secchi disk depth	3.05 m		10/1/2005 m	Total	FMO	31-0533-00-201	BLANDIN	FLD	Field measurement/observation, generic method	
8/19/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	1A,CLEAR	None	8/19/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
8/19/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1 VERY GOOD	None	8/19/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
8/19/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HSLC	None	8/19/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
8/19/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm		8/19/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HMOC	None	6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Dissolved oxygen (DO)	7.14 mg/L		6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	pH	7.65 None		6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Specific conductance	237 uS/cm		6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	None	6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1 VERY GOOD	None	6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Temperature, water	18.46 deg C		6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/18/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm		6/18/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
8/11/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm		8/11/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
5/27/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HSLC	None	5/27/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
9/3/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	1A,CLEAR	None	9/3/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
9/3/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1 VERY GOOD	None	9/3/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
9/3/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	NSLC	None	9/3/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
5/27/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	None	5/27/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
5/27/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1 VERY GOOD	None	5/27/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
9/2/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm		9/2/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
5/27/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	95 cm		5/27/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
6/4/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	None	6/4/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/4/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	2 GOOD	None	6/4/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/4/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HSLC	None	6/4/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
6/4/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm		6/4/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Dissolved oxygen (DO)	6.89 mg/L		7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	pH	7.6 None		7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Specific conductance	280 uS/cm		7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	None	7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1 VERY GOOD	None	7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HMOC	None	7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Temperature, water	24.81 deg C		7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/24/2014	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm		7/24/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
8/11/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	None	8/11/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
8/11/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1 VERY GOOD	None	8/11/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
8/11/2014	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HMOC	None	8/11/2014 (null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.CFLD		Field measurement/observation, generic method	
7/29/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.64 mg/L		7/24/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Total Kjeldahl Nitrogen by Colorimetry	
7/29/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L		7/24/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Nitrate-Nitrite Nitrogen by Colorimetry	
8/14/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Pheophytin a	1.98 ug/L		7/24/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/14/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Chlorophyll a, corrected for pheophytin	2.14 ug/L		7/24/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/13/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Phosphorus as P	0.024 mg/L		7/24/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.45000-P-I (F)		In-line UV/Perulfate Digestion and Flow Injection Analysis for Total Phosphorus (F)	
9/4/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Pheophytin a	1.29 ug/L		8/19/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
9/4/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Phosphorus as P	0.016 mg/L		8/19/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.45000-P-I (F)		In-line UV/Perulfate Digestion and Flow Injection Analysis for Total Phosphorus (F)	
8/22/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.07 mg/L		8/19/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	353.2	Nitrate-Nitrite Nitrogen by Colorimetry	
9/9/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Pheophytin a	0.88 ug/L		8/19/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
9/9/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Chlorophyll a, corrected for pheophytin	1.94 ug/L		8/19/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/26/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Kjeldahl nitrogen as N	2.64 mg/L		8/19/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Total Kjeldahl Nitrogen by Colorimetry	
9/3/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Chlorophyll a, corrected for pheophytin	2.09 ug/L		8/11/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/19/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.69 mg/L		8/11/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Total Kjeldahl Nitrogen by Colorimetry	
8/19/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L		8/11/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Nitrate-Nitrite Nitrogen by Colorimetry	
7/25/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Phosphorus as P	0.018 mg/L		7/24/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.45000-P-I (F)		In-line UV/Perulfate Digestion and Flow Injection Analysis for Total Phosphorus (F)	
7/15/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.84 mg/L		7/7/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Total Kjeldahl Nitrogen by Colorimetry	
7/29/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Phosphorus as P	0.021 mg/L		7/7/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.45000-P-I (F)		In-line UV/Perulfate Digestion and Flow Injection Analysis for Total Phosphorus (F)	
7/18/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Pheophytin a	2.33 ug/L		7/7/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
7/18/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Chlorophyll a, corrected for pheophytin	2.18 ug/L		7/7/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
7/14/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L		7/7/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	353.2	Nitrate-Nitrite Nitrogen by Colorimetry	
7/10/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Pheophytin a	0.86 ug/L		6/18/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
7/10/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Chlorophyll a, corrected for pheophytin	2.4 ug/L		6/18/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
7/1/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.93 mg/L		6/18/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	351.2	Total Kjeldahl Nitrogen by Colorimetry	
6/27/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L		6/18/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C	353.2	Nitrate-Nitrite Nitrogen by Colorimetry	
6/17/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Phosphorus as P	0.022 mg/L		6/18/2014 (null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.45000-P-I (F)		In-line UV/Perulfate Digestion and Flow Injection Analysis for Total Phosphorus (F)	
6/17/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Pheophytin a	2 ug/L		6/4/2014 (null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
6/17/2014	Effluent Limit Permit Monitoring	Lab sample tem	(null)	Chlorophyll a, corrected for pheophytin	5.61 ug/L		6/4/2014 (null)	Non-filter						

analysisDate	collectingOrg	comments	gltt	parameter	result	resultUnit	sampleDate	sampleDesc	sampleFractionType	sampleType	stationid	stationName	testMethodId	testMethodName	
6/26/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	HMOC	(null)	6/26/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/26/2013	Effluent Limit Permit Monitoring	(null)	(null)	Temperature, water	25.1 deg C	(null)	6/26/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/26/2013	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm	(null)	6/26/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	14.CLEAR	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Dissolved oxygen (DO)	8.61 mg/L	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	pH	7.76 None	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Specific conductance	258 uS/cm	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	2.GOOD	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	NMOC	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Temperature, water	16.76 deg C	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm	(null)	6/11/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	14.CLEAR	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Dissolved oxygen (DO)	6.99 mg/L	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	pH	7.72 None	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Specific conductance	268 uS/cm	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream recreational suitability (choice list)	1.VERY GOOD	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Stream condition (text)	NSLC	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Temperature, water	25.18 deg C	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD		Field measurement/observation, generic method	
7/17/2013	Effluent Limit Permit Monitoring	(null)	(null)	Transparency, tube with disk	100 cm	(null)	7/17/2013	(null)	Total	FMO	S007-333	MISSISSIPPI RIVER 1.LFLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
8/13/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	1.2 mg/L	(null)	7/17/2013	(null)	Suspended	Sample	S007-333	MISSISSIPPI RIVER 1.L		160.4 Volatile Residue	
8/9/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	1.6 mg/L	(null)	7/17/2013	(null)	Suspended	Sample	S007-333	MISSISSIPPI RIVER 1.C2540-D		Total Suspended Solids in Water	
8/28/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	1.22 ug/L	(null)	7/17/2013	(null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/28/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Chlorophyll a, corrected for pheophytin	2.59 ug/L	7/17/2013	(null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/15/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Hardness, Ca, Mg as CaCO3	140 mg/L	7/17/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C2340B		Hardness by Calculation	
8/15/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Sulfate as SO4	1.71 mg/L	7/17/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography	
8/13/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Chloride	3.83 mg/L	7/17/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		350.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography	
8/7/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Ammonia-nitrogen as N	0.05 mg/L	7/17/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		350.1 Ammonia Nitrogen by Colorimetry	
8/2/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Kjeldahl nitrogen as N	0.73 mg/L	7/17/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		351.2 Total Kjeldahl Nitrogen by Colorimetry	
8/2/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	7/17/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		353.2 Nitrate-Nitrite Nitrogen by Colorimetry	
8/7/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Ammonia-nitrogen as N	0.05 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		350.1 Ammonia Nitrogen by Colorimetry	
7/24/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Total suspended solids	3.6 mg/L	7/10/2013	(null)	Suspended	Sample	S007-333	MISSISSIPPI RIVER 1.C2540-D		Total Suspended Solids in Water	
7/31/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Sulfate as SO4	2.01 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography	
7/31/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Chloride	3.76 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography	
7/26/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Pheophytin a	1.41 ug/L	7/10/2013	(null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
7/26/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Chlorophyll a, corrected for pheophytin	2.07 ug/L	7/10/2013	(null)	Non-filter	Sample	S007-333	MISSISSIPPI RIVER 1.C10200-H		Chlorophyll a-b-c Determination	
8/2/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Volatile suspended solids	2.4 mg/L	7/10/2013	(null)	Suspended	Sample	S007-333	MISSISSIPPI RIVER 1.C		160.4 Volatile Residue	
8/5/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Hardness, Ca, Mg as CaCO3	150 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C2340B		Hardness by Calculation	
7/26/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Kjeldahl nitrogen as N	0.82 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		351.2 Total Kjeldahl Nitrogen by Colorimetry	
7/25/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		353.2 Nitrate-Nitrite Nitrogen by Colorimetry	
7/16/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Biochemical oxygen demand, standard conditions	1.2 mg/L	7/10/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C5210-B		5-Day Biochemical Oxygen Demand	
6/25/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Hardness, Ca, Mg as CaCO3	110 mg/L	5/22/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C2340B		Hardness by Calculation	
6/12/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Sulfate as SO4	3.33 mg/L	5/22/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography	
6/12/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Chloride	3.92 mg/L	5/22/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography	
6/11/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Volatile suspended solids	2 mg/L	5/22/2013	(null)	Suspended	Sample	S007-333	MISSISSIPPI RIVER 1.C		160.4 Volatile Residue	
6/6/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Total suspended solids	4 mg/L	5/22/2013	(null)	Suspended	Sample	S007-333	MISSISSIPPI RIVER 1.C2540-D		Total Suspended Solids in Water	
6/30/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Ammonia-nitrogen as N	0.05 mg/L	5/22/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		350.1 Ammonia Nitrogen by Colorimetry	
6/18/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Kjeldahl nitrogen as N	1.04 mg/L	5/22/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		351.2 Total Kjeldahl Nitrogen by Colorimetry	
6/6/2013	Effluent Limit Permit Monitoring	(null)	(null)	Lab sample tem (null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	5/22/2013	(null)	Total	Sample	S007-333	MISSISSIPPI RIVER 1.C		353.2 Nitrate-Nitrite Nitrogen by Colorimetry	
5/6/2014	MPCA Stream Monitoring Program Project	(null)	(null)	Flow	1480 cfs	(null)	5/6/2014	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-DAIL	Stream Flow, Hydrsta Daily Value, Computed from Established Rating Curve		
8/2/2011	MPCA Stream Monitoring Program Project	(null)	(null)	Flow	1880 cfs	(null)	8/2/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-DAIL	Stream Flow, Hydrsta Daily Value, Computed from Established Rating Curve		
6/13/2009	MPCA Stream Monitoring Program Project	(null)	(null)	Flow	2320 cfs	(null)	6/13/2009	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-UNT	Stream Flow, Hydrsta Daily Value, Computed from Established Rating Curve		
1/21/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Total suspended solids	1.2 mg/L	1/13/2015	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-DAIL		Total Suspended Solids in Water	
1/27/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	1/13/2015	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH		353.2 Nitrate-Nitrite Nitrogen by Colorimetry	
1/23/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Volatile suspended solids	2 mg/L	1/13/2015	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH		160.4 Volatile Residue	
1/14/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Turbidity	1.2 NTU	1/13/2015	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH 2130-B		Nephelometric Method	
1/25/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Kjeldahl nitrogen as N	0.83 mg/L	1/13/2015	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH		351.2 Total Kjeldahl Nitrogen by Colorimetry	
1/14/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Orthophosphate as P	0.005 mg/L	1/13/2015	(null)	Dissolved	Sample	S003-656	MISSISSIPPI R AT 7TH 4500-P-F		Phosphorus in Water by Colorimetry- Automated Ascorbic Acid Metho	
1/14/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Phosphorus as P	0.008 mg/L	1/13/2015	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH 4500-P-F		In-line UV/Perulfate Digestion and Flow Injection Analysis for Total Phosphorus (F)	
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Dissolved oxygen (DO)	13.2 mg/L	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method	
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	pH	8.26 None	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method	
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Specific conductance	423 uS/cm	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method	
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	(null)	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Stream recreational suitability (choice list)	1.VERY GOOD	(null)	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Stream condition (text)	N	None	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Temperature, water	0.05 deg C	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method	
1/13/2015	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Flow	938 cfs	1/13/2015	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-DAIL	Stream Flow, Hydrsta Daily Value, Computed from Established Rating Curve		
12/30/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Transparency, tube with disk	100 cm	12/30/2014	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD SECCHI TUBE		Secchi Transparency Tube, 100 cm	
12/30/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO	(null)	12/30/2014	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method
12/30/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Stream recreational suitability (choice list)	1.VERY GOOD	(null)	12/30/2014	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method
12/30/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Stream condition (text)	N	None	12/30/2014	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD		Field measurement/observation, generic method
12/30/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Flow	1120 cfs	12/30/2014	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-DAIL	Stream Flow, Hydrsta Daily Value, Computed from Established Rating Curve		
12/8/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Volatile suspended solids	2.4 mg/L	11/25/2014	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH		160.4 Volatile Residue	
11/26/2014	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Lab sample tem (null)	Turbidity	1.9 NTU	11/25/2014	(null)	Total	Sample	S003-656	MISSISSIPPI R AT			

analysisDate	collectingOrg	comments	gltt	parameter	result	resultUnit	sampleDate	sampleDeg	sampleFractionType	sampleType	stationid	stationName	testMethodId	testMethodName
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Dissolved oxygen (DO)	11.87 mg/L	mg/L	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO (null)	(null)	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream recreational suitability (choice list)	1.VERY GD (null)	(null)	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
5/11/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Volatile suspended solids	1.6 mg/L	mg/L	4/21/2011	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH	FMO	160.4 Volatile Residue
4/22/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	1.9 NTU	NTU	4/21/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH 2130-B	FMO	Nephelometric Method
5/6/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	2.1 mg/L	mg/L	4/21/2011	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH 2540-D	FMO	Total Suspended Solids in Water
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	pH	7.87 None	(null)	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Specific conductance	220 uS/cm	uS/cm	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream condition (text)	H	(null)	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
5/6/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	4/21/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	FMO	353.2 Nitrate-Nitrite Nitrogen by Colorimetry
4/22/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Orthophosphate as P	0.007 mg/L	mg/L	4/21/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	FMO	365.1 Phosphorus by Colorimetry
5/3/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Phosphorus as P	0.028 mg/L	mg/L	4/21/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	FMO	365.1 Phosphorus by Colorimetry
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Flow	1860 cfs	cfs	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-DAIL	FMO	Stream Flow, Hydrsta Daily Value, Computed from Established Rating Curve
4/21/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Turbidity	1.7 FNU	FNU	4/21/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD TURB	FMO	Turbidity, Nephelometric Method
4/5/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	3.2 mg/L	mg/L	3/29/2011	(null)	Suspended	QC-FR	S003-656	MISSISSIPPI R AT 7TH 2540-D	QC-FR	Total Suspended Solids in Water
4/19/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Kjeldahl nitrogen as N	0.72 mg/L	mg/L	3/29/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	351.2 Total Kjeldahl Nitrogen by Colorimetry
4/5/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Volatile suspended solids	1.0 mg/L	mg/L	3/29/2011	(null)	Suspended	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	160.4 Volatile Residue
4/1/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	2.8 NTU	NTU	3/29/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH 2130-B	QC-FR	Nephelometric Method
4/8/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	3/29/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	353.2 Nitrate-Nitrite Nitrogen by Colorimetry
4/19/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	3/29/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	353.2 Nitrate-Nitrite Nitrogen by Colorimetry
4/1/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Orthophosphate as P	0.006 mg/L	mg/L	3/29/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	365.1 Phosphorus by Colorimetry
4/11/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Phosphorus as P	0.029 mg/L	mg/L	3/29/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	365.1 Phosphorus by Colorimetry
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Dissolved oxygen (DO)	10.46 mg/L	mg/L	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
4/1/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Orthophosphate as P	0.007 mg/L	mg/L	3/29/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	365.1 Phosphorus by Colorimetry
4/5/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Volatile suspended solids	1.6 mg/L	mg/L	3/29/2011	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	160.4 Volatile Residue
4/5/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	1.6 NTU	NTU	3/29/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH 2130-B	Sample	Nephelometric Method
4/5/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	3.6 mg/L	mg/L	3/29/2011	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH 2540-D	Sample	Total Suspended Solids in Water
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Specific conductance	344 uS/cm	uS/cm	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO (null)	(null)	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream recreational suitability (choice list)	1.VERY GD (null)	(null)	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Temperature, water	2.89 deg C	deg C	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Flow	1740 cfs	cfs	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-UNF	FMO	Stream Flow, Hydrsta Unit Value, Computed from Established Rating Curve
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Transparency, tube with disk	100 cm	cm	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD TTUBE100	FMO	Transparency Tube, 100 cm
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Turbidity	1.3 FNU	FNU	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD TURB	FMO	Turbidity, Nephelometric Method
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	pH	7.51 None	(null)	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
3/29/2011	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream condition (text)	N	(null)	3/29/2011	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
8/2/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Volatile suspended solids	1 mg/L	mg/L	7/17/2012	(null)	Suspended	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	160.4 Volatile Residue
7/20/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	7/17/2012	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	353.2 Nitrate-Nitrite Nitrogen by Colorimetry
7/24/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Phaeophytin a	2.63 ug/L	ug/L	7/17/2012	(null)	Non-filter	QC-FR	S003-656	MISSISSIPPI R AT 7TH 10200-H	QC-FR	Chlorophyll a-b-c Determination
7/24/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Chlorophyll a, corrected for phaeophytin	1.32 ug/L	ug/L	7/17/2012	(null)	Non-filter	QC-FR	S003-656	MISSISSIPPI R AT 7TH 10200-H	QC-FR	Chlorophyll a-b-c Determination
7/24/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	1.6 NTU	NTU	7/17/2012	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH 2130-B	QC-FR	Nephelometric Method
7/13/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	1.2 mg/L	mg/L	7/17/2012	(null)	Suspended	QC-FR	S003-656	MISSISSIPPI R AT 7TH 2540-D	QC-FR	Total Suspended Solids in Water
7/27/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.95 mg/L	mg/L	7/17/2012	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	351.2 Total Kjeldahl Nitrogen by Colorimetry
7/18/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Orthophosphate as P	0.022 mg/L	mg/L	7/17/2012	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	365.1 Phosphorus by Colorimetry
7/18/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	1.8 NTU	NTU	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH 2130-B	FMO	Nephelometric Method
7/24/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Phaeophytin a	0.8 ug/L	ug/L	7/17/2012	(null)	Non-filter	Sample	S003-656	MISSISSIPPI R AT 7TH 10200-H	Sample	Chlorophyll a-b-c Determination
7/24/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Chlorophyll a, corrected for phaeophytin	2.08 ug/L	ug/L	7/17/2012	(null)	Non-filter	Sample	S003-656	MISSISSIPPI R AT 7TH 10200-H	Sample	Chlorophyll a-b-c Determination
8/2/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Volatile suspended solids	1.2 mg/L	mg/L	7/17/2012	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	160.4 Volatile Residue
7/31/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	1.2 mg/L	mg/L	7/17/2012	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH 2540-D	Sample	Total Suspended Solids in Water
7/13/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.95 mg/L	mg/L	7/17/2012	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	351.2 Total Kjeldahl Nitrogen by Colorimetry
7/20/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	7/17/2012	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	353.2 Nitrate-Nitrite Nitrogen by Colorimetry
7/18/2012	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Orthophosphate as P	0.023 mg/L	mg/L	7/17/2012	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	365.1 Phosphorus by Colorimetry
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Dissolved oxygen (DO)	6.03 mg/L	mg/L	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	pH	7.48 None	(null)	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Specific conductance	264 uS/cm	uS/cm	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream Physical Appearance, Minnesota (choice list)	18.TEA-CO (null)	(null)	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream recreational suitability (choice list)	1.VERY GD (null)	(null)	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Stream condition (text)	H	(null)	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Temperature, water	25.45 deg C	deg C	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD	FMO	Field measurement/observation, generic method
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Flow	1730 cfs	cfs	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD STR FLOW H-UNF	FMO	Stream Flow, Hydrsta Unit Value, Computed from Established Rating Curve
7/17/2012	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Transparency, tube with disk	100 cm	cm	7/17/2012	(null)	Total	FMO	S003-656	MISSISSIPPI R AT 7TH FLD TTUBE100	FMO	Transparency Tube, 100 cm
3/1/1901	Major Watershed Pollutant Load Monitoring Network	(null)	(null)	Chlorophyll a, corrected for phaeophytin	4 ug/L	ug/L	6/8/2011	(null)	Non-filter	Sample	S003-656	MISSISSIPPI R AT 7TH 10200-H	Sample	Chlorophyll a-b-c Determination
5/1/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Volatile suspended solids	5 mg/L	mg/L	4/21/2011	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	160.4 Volatile Residue
4/22/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	2.6 NTU	NTU	4/21/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH 2130-B	QC-FR	Nephelometric Method
5/6/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	2 mg/L	mg/L	4/21/2011	(null)	Suspended	QC-FR	S003-656	MISSISSIPPI R AT 7TH 2540-D	QC-FR	Total Suspended Solids in Water
4/29/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.89 mg/L	mg/L	4/21/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	351.2 Total Kjeldahl Nitrogen by Colorimetry
5/3/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Phosphorus as P	0.029 mg/L	mg/L	4/21/2011	(null)	Total	QC-FR	S003-656	MISSISSIPPI R AT 7TH	QC-FR	365.1 Phosphorus by Colorimetry
6/21/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.84 mg/L	mg/L	6/8/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	351.2 Total Kjeldahl Nitrogen by Colorimetry
6/28/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Phosphorus as P	0.03 mg/L	mg/L	6/8/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	365.1 Phosphorus by Colorimetry
6/28/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Volatile suspended solids	2.4 mg/L	mg/L	6/8/2011	(null)	Suspended	Sample	S003-656	MISSISSIPPI R AT 7TH	Sample	160.4 Volatile Residue
6/9/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Turbidity	1.8 NTU	NTU	6/8/2011	(null)	Total	Sample	S003-656	MISSISSIPPI R AT 7TH 2130-B	Sample	Nephelometric Method
6/15/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem	(null)	Total suspended solids	2.4 mg/L	mg/L	6/8/2011	(null)	Suspended	Sample</				

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9/6/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem (null)		Organic carbon	9 mg/L	g/L	8/23/2011 (null)	Dissolved		Sample	MS03-656	MISSISSIPPI R AT 77H 5310-C		Total Organic Carbon in Water- Ultraviolet Oxidation Method
9/15/2011	Major Watershed Pollutant Load Monitoring Network	Lab sample tem (null)		Organic carbon	9.3 mg/L	g/L	8/23/2011 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 5310-C		Total Organic Carbon in Water- Ultraviolet Oxidation Method
6/13/2009	Upper Mississippi River Blackberry to Vermillion TMDL (null)	(null)		pH	7.93	None	6/13/2009 (null)	Total		FMO	MS03-656	MISSISSIPPI R AT 77H FLD		Field measurement/observation, generic method
12/7/2010	Major Watershed Pollutant Load Monitoring Network	Lab sample tem (null)		Turbidity	4.6	NTRU	12/6/2010 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2130-B		Nephelometric Method
12/13/2010	Major Watershed Pollutant Load Monitoring Network	Lab sample tem (null)		Total suspended solids	2.6	mg/L	12/6/2010 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-D		Total Suspended Solids in Water
12/10/2010	Major Watershed Pollutant Load Monitoring Network	Lab sample tem (null)		Kjeldahl nitrogen as N	0.28	mg/L	12/6/2010 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
12/10/2010	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <		Inorganic nitrogen (nitrate and nitrite) as N	0.05	mg/L	12/6/2010 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
12/7/2010	Major Watershed Pollutant Load Monitoring Network	Lab sample tem <		Orthophosphate as P	0.005	mg/L	12/6/2010 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
12/17/2010	Major Watershed Pollutant Load Monitoring Network	Lab sample tem (null)		Phosphorus as P	0.012	mg/L	12/6/2010 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
12/6/2010	Major Watershed Pollutant Load Monitoring Network	(null)		pH	7.95	None	12/6/2010 (null)	Total		FMO	MS03-656	MISSISSIPPI R AT 77H FLD		Field measurement/observation, generic method
12/6/2010	Major Watershed Pollutant Load Monitoring Network	(null)		Specific conductance	300	µmhos/cm	12/6/2010 (null)	Total		FMO	MS03-656	MISSISSIPPI R AT 77H FLD		Field measurement/observation, generic method
12/6/2010	Major Watershed Pollutant Load Monitoring Network	(null)		Temperature, water	0	deg C	12/6/2010 (null)	Total		FMO	MS03-656	MISSISSIPPI R AT 77H FLD		Field measurement/observation, generic method
1/1/1901	Major Watershed Pollutant Load Monitoring Network	(null)		Chlorophyll a, corrected for pheophytin	6	µg/L	9/13/2011 (null)	Non-filter		QC-FR	MS03-656	MISSISSIPPI R AT 77H 10200-H		Chlorophyll a-b-c Determination
1/1/1901	Major Watershed Pollutant Load Monitoring Network	(null)		Chlorophyll a, corrected for pheophytin	6	µg/L	9/13/2011 (null)	Non-filter		Sample	MS03-656	MISSISSIPPI R AT 77H 10200-H		Chlorophyll a-b-c Determination
1/1/1901	Major Watershed Pollutant Load Monitoring Network	(null)		Chlorophyll a, corrected for pheophytin	6	µg/L	8/23/2011 (null)	Non-filter		QC-FR	MS03-656	MISSISSIPPI R AT 77H 10200-H		Chlorophyll a-b-c Determination
1/1/1901	Major Watershed Pollutant Load Monitoring Network	(null)		Chlorophyll a, corrected for pheophytin	4	µg/L	8/21/2011 (null)	Non-filter		Sample	MS03-656	MISSISSIPPI R AT 77H 10200-H		Chlorophyll a-b-c Determination
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Turbidity	4.4	NTRU	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2130-B		Nephelometric Method
4/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total suspended solids	9.6	mg/L	4/14/2009 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-D		Total Suspended Solids in Water
4/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total solids	180	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-B		Total Solids Dried 103-105C in Water
4/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total volatile solids	52	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	160.4	Volatile Residue
5/6/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Sulfate as SO4	3.87	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	300.1	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
5/6/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Chloride	3.57	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	300.1	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
4/23/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Ammonia-nitrogen as N	0.05	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	350.1	Ammonia Nitrogen by Colorimetry
4/23/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Kjeldahl nitrogen as N	0.16	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
4/23/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Inorganic nitrogen (nitrate and nitrite) as N	0.045	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
5/5/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Phosphorus as P	0.045	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Orthophosphate as P	0.006	mg/L	4/14/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H QC10-115-01-1-A	160.4	Orthophosphate, Total, by QuikChem method 10-115-01-1-A
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total volatile solids	90	mg/L	4/17/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	160.4	Volatile Residue
4/22/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Sulfate as SO4	8.66	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 300(A)		Inorganic Anions by Ion Chromatography
4/22/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Chloride	3.52	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	300	Determination of Inorganic Anions by Ion Chromatography
4/23/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Ammonia-nitrogen as N	0.05	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	350.1	Ammonia Nitrogen by Colorimetry
4/23/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Kjeldahl nitrogen as N	0.65	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Inorganic nitrogen (nitrate and nitrite) as N	0.03	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
4/24/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Phosphorus as P	0.033	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
4/9/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Orthophosphate as P	0.006	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H QC10-115-01-1-A	160.4	Orthophosphate, Total, by QuikChem method 10-115-01-1-A
4/11/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Sulfate as SO4	10.6	mg/L	4/17/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 300(A)		Inorganic Anions by Ion Chromatography
4/9/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Turbidity	3.4	NTRU	4/17/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2130-B		Nephelometric Method
4/14/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total solids	210	mg/L	4/7/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-B		Total Solids Dried 103-105C in Water
4/14/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total suspended solids	4.8	mg/L	4/7/2009 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-D		Total Suspended Solids in Water
4/2/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total volatile solids	72	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	160.4	Volatile Residue
4/2/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Turbidity	4.4	NTRU	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2130-B		Nephelometric Method
4/2/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total solids	190	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-B		Total Solids Dried 103-105C in Water
4/7/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total suspended solids	4	mg/L	4/1/2009 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-D		Total Suspended Solids in Water
4/11/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Chloride	14.2	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	300	Determination of Inorganic Anions by Ion Chromatography
4/23/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Ammonia-nitrogen as N	0.06	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	350.1	Ammonia Nitrogen by Colorimetry
4/12/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Kjeldahl nitrogen as N	0.2	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
4/10/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Inorganic nitrogen (nitrate and nitrite) as N	0.14	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
4/17/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Phosphorus as P	0.043	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
4/2/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Orthophosphate as P	0.005	mg/L	4/1/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H QC10-115-01-1-A	160.4	Orthophosphate, Total, by QuikChem method 10-115-01-1-A
8/7/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Kjeldahl nitrogen as N	0.53	mg/L	7/29/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
8/7/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Turbidity	1	NTRU	7/29/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2130-B		Nephelometric Method
8/3/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total suspended solids	2	mg/L	7/29/2009 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-D		Total Suspended Solids in Water
8/3/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Volatile suspended solids	1	mg/L	7/29/2009 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-E		Fixed and Volatile Solids in Water
7/13/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Inorganic nitrogen (nitrate and nitrite) as N	0.05	mg/L	7/29/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
7/13/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Phosphorus as P	0.007	mg/L	7/29/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
7/8/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Orthophosphate as P	0.007	mg/L	7/29/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H QC10-115-01-1-A	160.4	Orthophosphate, Total, by QuikChem method 10-115-01-1-A
6/29/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total suspended solids	2.4	mg/L	6/23/2009 (null)	Suspended		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-D		Total Suspended Solids in Water
6/29/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total volatile solids	87	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	160.4	Volatile Residue
6/24/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Turbidity	1.8	NTRU	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2130-B		Nephelometric Method
6/29/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Total solids	200	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H 2540-B		Total Solids Dried 103-105C in Water
7/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Sulfate as SO4	6.09	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	300.1	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
7/20/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Chloride	3.75	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	300.1	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
7/1/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Ammonia-nitrogen as N	0.05	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	350.1	Ammonia Nitrogen by Colorimetry
6/17/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Kjeldahl nitrogen as N	0.75	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
6/24/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Inorganic nitrogen (nitrate and nitrite) as N	0.05	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
7/13/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Phosphorus as P	0.03	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
6/24/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Orthophosphate as P	0.009	mg/L	6/23/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H QC10-115-01-1-A	160.4	Orthophosphate, Total, by QuikChem method 10-115-01-1-A
1/1/1901	Upper Mississippi Information Access Initiative	(null)		Escherichia coli	9	MPN/100m	6/13/2009 (null)	Total		Sample	MS03-656	MISSISSIPPI R AT 77H Colliert		Coliform/E. coli Enzyme substrate test, ONPG-MUG Test
6/25/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Kjeldahl nitrogen as N	0.6	mg/L	6/11/2009 (null)	Total		QC-FR	MS03-656	MISSISSIPPI R AT 77H	351.2	Total Kjeldahl Nitrogen by Colorimetry
6/19/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Inorganic nitrogen (nitrate and nitrite) as N	0.05	mg/L	6/11/2009 (null)	Total		QC-FR	MS03-656	MISSISSIPPI R AT 77H	351.2	Nitrate-Nitrite Nitrogen by Colorimetry
7/7/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)		Phosphorus as P	0.019	mg/L	6/11/2009 (null)	Total		QC-FR	MS03-656	MISSISSIPPI R AT 77H	365.1	Phosphorus by Colorimetry
6/12/2009	Upper Mississippi Information Access Initiative	Lab sample tem <		Orthophosphate as P	0.005	mg/L	6/11/2009 (null)	Total		QC-FR	MS03-656	MISSISSIPPI R AT 77H QC10-115-01-1-A	160.4	Orthophosphate, Total, by QuikChem method 10-115-01-1-A
6/17/2009	Upper													

analysisDate	collectingOrg	comments	gltt	parameter	result	resultUnit	sampleDate	sampleDesc	sampleFractionType	sampleType	stationID	stationName	testMethodID	testMethodName
4/3/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	9.47 mg/L	mg/L	4/3/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
4/3/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	4.5 deg C	deg C	4/3/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
8/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.09 None	None	8/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
8/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	292 uS/cm	uS/cm	8/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
8/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	21.3 deg C	deg C	8/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/19/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.12 None	None	7/19/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/19/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	272 uS/cm	uS/cm	7/19/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
6/27/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	55.4023 %	%	6/27/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
6/27/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	6.82 None	None	6/27/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
5/18/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	6.56 mg/L	mg/L	5/18/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
5/18/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	285 uS/cm	uS/cm	5/18/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
5/18/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	15.8 deg C	deg C	5/18/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/13/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	11.76 mg/L	mg/L	4/13/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
4/13/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	94.08 %	%	4/13/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/13/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	6.64 None	None	4/13/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/13/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	279 uS/cm	uS/cm	4/13/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/13/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	5.7 deg C	deg C	4/13/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
3/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	7.4 mg/L	mg/L	3/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
3/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	54.8148 %	%	3/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
3/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.37 None	None	3/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
3/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	323 uS/cm	uS/cm	3/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
3/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	2.6 deg C	deg C	3/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
10/19/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	8.72 mg/L	mg/L	10/19/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
10/19/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	71.4754 %	%	10/19/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
10/19/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.28 None	None	10/19/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
10/19/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	311 uS/cm	uS/cm	10/19/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
10/19/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	7.2 deg C	deg C	10/19/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
9/21/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	7.58 mg/L	mg/L	9/21/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
9/21/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	70.1852 %	%	9/21/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
9/21/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.61 None	None	9/21/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
9/21/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	276 uS/cm	uS/cm	9/21/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
9/21/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	12.3 deg C	deg C	9/21/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/27/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	6.58 mg/L	mg/L	7/27/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
7/27/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.37 None	None	7/27/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/27/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	261 uS/cm	uS/cm	7/27/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/27/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	20.9 deg C	deg C	7/27/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
2/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	8.44 mg/L	mg/L	2/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
2/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	6.88 None	None	2/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
2/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	-0.4 deg C	deg C	2/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
3/31/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Volatile suspended solids	1.2 mg/L	mg/L	3/25/2009 (null)	Suspended	Sample	Sample	S002-635	MISSISSIPPI USH16:2540-E		Fixed and Volatile Solids in Water
7/23/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	pH	7.13 None	None	7/23/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
5/10/1996	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	84.8646 %	%	5/10/1996 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/2/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	73.0844 %	%	4/2/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
5/18/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	65.6 %	%	5/18/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
2/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	57.8082 %	%	2/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/12/1996	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	65.5072 %	%	4/12/1996 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/22/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	154.3 %	%	4/22/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
9/25/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	79.0991 %	%	9/25/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/3/1995	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	253 uS/cm	uS/cm	4/3/1995 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
8/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	5.3 mg/L	mg/L	8/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
7/19/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	5.9 mg/L	mg/L	7/19/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
6/27/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	23.5 deg C	deg C	6/27/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
6/27/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen (DO)	4.82 mg/L	mg/L	6/27/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:DO WINKLER		Dissolved Oxygen, Iodometric Method with Azide Modification
6/27/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Temperature, water	23.5 deg C	deg C	6/27/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
8/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	58.8889 %	%	8/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/19/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	57.4714 %	%	7/19/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
6/27/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	240 uS/cm	uS/cm	6/27/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
2/22/1994	Mississippi Headwaters Riverwatch Program	(null)	(null)	Specific conductance	310 uS/cm	uS/cm	2/22/1994 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
7/27/1993	Mississippi Headwaters Riverwatch Program	(null)	(null)	Dissolved oxygen saturation	73.1111 %	%	7/27/1993 (null)	Total	FMO	FMO	S002-635	MISSISSIPPI USH16:FLD		Field measurement/observation, generic method
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Magnesium	15 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:200.71W		Metals in Water by ICP-AES
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Calcium	34 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:200.71W		Metals in Water by ICP-AES
4/15/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Hardness, Ca, Mg as CaCO3	147 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:2340B		Hardness by Calculation
3/31/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Total suspended solids	4 mg/L	mg/L	3/25/2009 (null)	Suspended	Sample	Sample	S002-635	MISSISSIPPI USH16:2540-D		Total Suspended Solids in Water
4/10/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Chloride	4.93 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:	300	Determination of Inorganic Anions by Ion Chromatography
4/10/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Turbidity	2.5 None	None	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:ELC, P00076		TURBIDITY JACK TURBIDIMETER, FORM 229 TURB UNIT
1/1/1901	Mississippi Headwaters Riverwatch Program	(null)	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.2 mg/L	mg/L	5/8/1991 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:ELC, P00630		NITRATE PLUS NITRATE, TOTAL 1.2 MG/L AS N
4/10/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Sulfate as SO4	7.22 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:300A		Inorganic Anions by Ion Chromatography
4/7/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Kjeldahl nitrogen as N	0.66 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:	351.2	Total Kjeldahl Nitrogen by Colorimetry
4/2/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.06 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:	353.2	Nitrate-Nitrite Nitrogen by Colorimetry
4/7/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Phosphorus as P	0.045 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:	365.1	Phosphorus by Colorimetry
3/26/2009	Upper Mississippi Information Access Initiative	Lab sample tem	(null)	Orthophosphate as P	0.009 mg/L	mg/L	3/25/2009 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:QC10-115-01-1-A		Orthophosphate, Total, by QuikChem method 10-115-01-1-A
11/14/2008	Attkin - Big Sandy River Turbidity TMDL	Lab sample tem	(null)	Turbidity	1.9 NTU	NTU	11/13/2008 (null)	Total	Sample	Sample	S002-635	MISSISSIPPI USH16:2130-B		Nephelometric Method
11/17/2008	Attkin - Big Sandy River Turbidity TMDL	Lab sample tem	(null)	Total suspended solids	1.6 mg/L	mg/L	11/13/2008 (null)	Suspended	Sample	Sample	S002-635	MISSISSIPPI USH16:2540-D		Total Suspended Solids in Water
10/31/2008	Attkin - Big Sandy River Turbidity TMDL	Lab sample tem	(null)	Turbidity	1.7 NTU	NTU	10/30/2008 (null)							

analysisDate	collectingOrg	comments	gltt	parameter	result	resultUnit	sampleDate	sampleDesc	sampleFractionType	sampleType	stationid	stationName	testMethodId	testMethodName
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	3.79 ug/L	ug/L	8/1/2001 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for pheophytin	17.89 ug/L	ug/L	8/1/2001 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.112 mg/L	mg/L	3/4/1999 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4110-B	Anion in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.019 mg/L	mg/L	3/4/1999 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.014 mg/L	mg/L	3/4/1999 m		Total	Sample	31-0370-00-100	MCKINNEY	4500-P-E	Phosphorus in Water by Colorimetry-Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.026 mg/L	mg/L	3/4/1999 m		Total	Sample	31-0370-00-100	MCKINNEY	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.008 mg/L	mg/L	9/15/1998 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4110-B	Anion in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.029 mg/L	mg/L	9/15/1998 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.059 mg/L	mg/L	9/15/1998 m		Total	Sample	31-0370-00-100	MCKINNEY	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	0.92 ug/L	ug/L	9/15/1998 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for pheophytin	7.63 ug/L	ug/L	9/15/1998 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.013 mg/L	mg/L	7/15/1998 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4110-B	Anion in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.18 mg/L	mg/L	7/15/1998 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.137 mg/L	mg/L	7/15/1998 m		Total	Sample	31-0370-00-100	MCKINNEY	4500-P-E	Phosphorus in Water by Colorimetry-Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.708 mg/L	mg/L	7/15/1998 m		Total	Sample	31-0370-00-100	MCKINNEY	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.015 mg/L	mg/L	7/15/1998 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4110-B	Anion in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.099 mg/L	mg/L	7/15/1998 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.019 mg/L	mg/L	7/15/1998 m		Total	Sample	31-0370-00-100	MCKINNEY	4500-P-E	Phosphorus in Water by Colorimetry-Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.629 mg/L	mg/L	7/15/1998 m		Total	Sample	31-0370-00-100	MCKINNEY	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	1.64 ug/L	ug/L	7/15/1998 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for pheophytin	2.1 ug/L	ug/L	7/15/1998 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.013 mg/L	mg/L	3/4/1999 m		Total	Sample	31-0370-00-100	MCKINNEY	4500-P-E	Phosphorus in Water by Colorimetry-Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	True color	60 PCU	PCU	3/4/1999 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	2120-B	Color in Water by Visual Comparison
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.183 mg/L	mg/L	3/4/1999 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4110-B	Anion in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.005 mg/L	mg/L	3/4/1999 m		Dissolved	Sample	31-0370-00-100	MCKINNEY	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.051 mg/L	mg/L	3/4/1999 m		Total	Sample	31-0370-00-100	MCKINNEY	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	0.5 ug/L	ug/L	3/4/1999 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for pheophytin	0.6 ug/L	ug/L	3/4/1999 m		Non-filter	Sample	31-0370-00-100	MCKINNEY	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
9/5/2010	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	2.10W ALG(null)		9/5/2010 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/15/2008	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.03 m	m	7/15/2008 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/23/2009	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.42 m	m	8/23/2009 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/3/2009	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.57 m	m	7/3/2009 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/20/2014	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	2.10W ALG(null)		8/20/2014 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/20/2014	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	3.FAIR (null)		8/20/2014 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/20/2014	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.2 m	m	8/20/2014 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/30/2012	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	3.MED ALG(null)		8/30/2012 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/30/2012	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	3.FAIR (null)		8/30/2012 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/30/2012	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.7 m	m	8/30/2012 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
9/5/2010	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	2.GOOD (null)		9/5/2010 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
9/5/2010	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.4 m	m	9/5/2010 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/17/2010	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4 m	m	7/17/2010 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/17/2010	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1.CLEAR (null)		7/17/2010 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/17/2010	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	2.GOOD (null)		7/17/2010 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.0386 mg/L	mg/L	7/31/1996 m		Total	Sample	31-0372-00-201	UNNAMED (ICE)	FLD	Phosphorus in Water by Colorimetry-Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for pheophytin	2 ug/L	ug/L	7/31/1996 m		Non-filter	Sample	31-0372-00-201	UNNAMED (ICE)	LEG_P32211	CHLOROPHYLL A UG/L SPECTROPHOTOMETRIC ACID METH.
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	1.42 ug/L	ug/L	7/31/1996 m		Non-filter	Sample	31-0372-00-201	UNNAMED (ICE)	LEG_P32218	PHAEOPHYTIN A UG/L SPECTROPHOTOMETRIC ACID METH.
6/6/2006	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.64 m	m	6/6/2006 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/10/2005	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.88 m	m	7/10/2005 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/10/2005	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.40 m	m	7/10/2005 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/6/2007	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.64 m	m	7/6/2007 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
11/3/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.75 m	m	11/3/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
10/21/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.05 m	m	10/21/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
10/21/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.26 m	m	10/21/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
10/4/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.29 m	m	9/10/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
8/11/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.51 m	m	8/11/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/26/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.01 m	m	7/26/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
7/7/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.29 m	m	7/7/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
6/17/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.2 m	m	6/17/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
6/17/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.99 m	m	6/22/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
6/17/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.69 m	m	6/17/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
6/3/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.39 m	m	6/3/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
5/21/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.89 m	m	5/21/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
4/20/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	4.79 m	m	4/10/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
4/16/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.11 m	m	4/16/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
4/13/1999	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.41 m	m	4/13/1999 m		Total	FMO	31-0372-00-201	UNNAMED (ICE)	FLD	Field measurement/observation, generic method
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Alkalinity, total as CaCO3	140 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0533-00-102	BLANDIN	LEG_P00080	Field measurement/observation, generic method
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Apparent color	50 PCU	PCU	9/2/1981 m		Dissolved	Sample	31-0533-00-102	BLANDIN	LEG_P00080	COLOR PLATINUM-COBALT UNITS
1/1/1901	MPCA Lake Monitoring Program Project		(null)	pH	7.9 None	None	9/2/1981 m		Total	Sample	31-0533-00-102	BLANDIN	LEG_P00403	PH, LAB, STANDARD UNITS SU
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Organic Nitrogen as N	0.79 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0533-00-102	BLANDIN	LEG_P00605	NITROGEN, ORGANIC, TOTAL (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Ammonia-nitrogen as N	0.1 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0533-00-102	BLANDIN	LEG_P00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Kjeldahl Nitrogen as N	0.89 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0533-00-102	BLANDIN	LEG_P00625	NITROGEN, KJELDAHL, TOTAL (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.03 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0533-00-102	BLANDIN	LEG_P00630	NITRATE PLUS NITRITE, TOTAL 1 DET. (MG/L AS N)</

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1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Phosphorus as P	0.02 mg/L	mg/L	8/4/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Organic carbon	12.6 mg/L	mg/L	8/4/2010	m	Dissolved	Sample	31-0376-00-201	HORSEHOE	5310-C	Total Organic Carbon in Water- Ultraviolet Oxidation Method
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	True color	12 PCU	PCU	8/4/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	TB_253	Measurement of Water Color
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Nutrient-nitrogen as N	0.94 mg/L	mg/L	8/4/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	TN SEC-DER SPEC	Nitrate and Organic N Analyses with Second-Derivative Spectroscopy
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Organic carbon	12.7 mg/L	mg/L	7/12/2010	m	Dissolved	Sample	31-0376-00-201	HORSEHOE	5310-C	Total Organic Carbon in Water- Ultraviolet Oxidation Method
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Alkalinity, total as CaCO3	71.5 mg/L	mg/L	8/4/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	2320	Alkalinity in Water by Titration
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Chlorophyll a, corrected for pheophytin	5.25 ug/L	ug/L	8/4/2010	m	Non-filter	Sample	31-0376-00-201	HORSEHOE	445	In-Vitro Determination of Chlorophyll
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Chlorophyll a, corrected for pheophytin	<		7/12/2010	m	Non-filter	Sample	31-0376-00-201	HORSEHOE	445	In-Vitro Determination of Chlorophyll
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Phosphorus as P	0.026 mg/L	mg/L	7/12/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Alkalinity, total as CaCO3	67 mg/L	mg/L	7/12/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	2320	Alkalinity in Water by Titration
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	True color	11.2 mg/L	mg/L	7/12/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	TB_253	Measurement of Water Color
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Nutrient-nitrogen as N	1.03 mg/L	mg/L	7/12/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	TN SEC-DER SPEC	Nitrate and Organic N Analyses with Second-Derivative Spectroscopy
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Alkalinity, total as CaCO3	69.9 mg/L	mg/L	6/29/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	2320	Alkalinity in Water by Titration
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Chlorophyll a, corrected for pheophytin	6.73 ug/L	ug/L	6/29/2010	m	Non-filter	Sample	31-0376-00-201	HORSEHOE	445	In-Vitro Determination of Chlorophyll
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Phosphorus as P	0.017 mg/L	mg/L	6/29/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Organic carbon	13.4 mg/L	mg/L	6/29/2010	m	Dissolved	Sample	31-0376-00-201	HORSEHOE	5310-C	Total Organic Carbon in Water- Ultraviolet Oxidation Method
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	True color	12.17 PCU	PCU	6/29/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	TB_253	Measurement of Water Color
1/1/1901	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Nutrient-nitrogen as N	0.79 mg/L	mg/L	6/29/2010	m	Total	Sample	31-0376-00-201	HORSEHOE	TN SEC-DER SPEC	Nitrate and Organic N Analyses with Second-Derivative Spectroscopy
7/12/2010	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Depth, Secchi disk depth	2.1 m	m	7/12/2010	m	Total	FMO	31-0376-00-201	HORSEHOE	FLO	Field measurement/observation, generic method
1/29/2010	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Depth, Secchi disk depth	2.1 m	m	6/29/2010	m	Total	FMO	31-0376-00-201	HORSEHOE	FLO	Field measurement/observation, generic method
8/16/2010	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Depth, Secchi disk depth	1.4 m	m	8/16/2010	m	Total	FMO	31-0376-00-201	HORSEHOE	FLO	Field measurement/observation, generic method
8/4/2010	1st WQ Inventory of Itasca County Lakes.	2010. Asses (null)	(null)	Depth, Secchi disk depth	1.6 m	m	8/4/2010	m	Total	FMO	31-0376-00-201	HORSEHOE	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.6 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	48.9361 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C	deg C	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.6 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C	deg C	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.6 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C	deg C	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.8 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	51.0638 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.8 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	51.0638 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C	deg C	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.8 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	51.0638 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C	deg C	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.8 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	51.0638 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Temperature, water	19.5 deg C	deg C	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.6 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	48.9361 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	48.9361 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen (DO)	4.6 mg/L	mg/L	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	DO WINKLER	Dissolved Oxygen, Iodometric Method with Azide Modification
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	48.9361 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
9/2/1981	MPCA Lake Monitoring Program Project	(null)	(null)	Dissolved oxygen saturation	51.0638 %	%	9/2/1981	m	Total	FMO	31-0533-00-100	BLANDIN	FLO	Field measurement/observation, generic method
5/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total volatile solids	6.6 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	160.4	Volatile Residue
5/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Turbidity	5.1 NTU	NTU	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. 2130-B		Nephelometric Method
5/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total solids	130 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. 2540-B		Total Solids Dried 103-105°C in Water
5/20/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total suspended solids	10 mg/L	mg/L	5/13/2009 (null)		Suspended	Sample	5005-499	PRAIRIE AT US-2, 2. 2540-D		Total Suspended Solids in Water
5/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Sulfate as SO4	4.07 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	300.1	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
5/21/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Chloride	2.8 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	300.1	Determination of Inorganic Anions in Drinking Water by Ion Chromatography
5/20/2009	Upper Mississippi Information Access Initiative	Lab sample tem <	(null)	Ammonia-nitrogen as N	0.05 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	350.1	Ammonia Nitrogen by Colorimetry
5/26/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Kjeldahl nitrogen as N	0.64 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	351.2	Total Kjeldahl Nitrogen by Colorimetry
5/20/2009	Upper Mississippi Information Access Initiative	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	353.2	Nitrate-Nitrite Nitrogen by Colorimetry
5/20/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Phosphorus as P	0.029 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	365.1	Phosphorus by Colorimetry
5/14/2009	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Orthophosphate as P	0.008 mg/L	mg/L	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. QC10-115-01-1-A		Orthophosphate, Total, by QuikChem method 10-115-01-1-A
1/1/1901	Upper Mississippi Information Access Initiative	(null)	(null)	Escherichia coli	3 MPN/100n	MPN/100n	5/13/2009 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. Colliert		Coliform/E. coli Enzyme substrate test; ONPG-MUG Test
1/1/1901	Upper Mississippi Information Access Initiative	(null)	(null)	Escherichia coli	11 MPN/100n	MPN/100n	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. Colliert		Coliform/E. coli Enzyme substrate test; ONPG-MUG Test
8/26/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total suspended solids	1.6 mg/L	mg/L	8/20/2008 (null)		Suspended	Sample	5005-499	PRAIRIE AT US-2, 2. 2540-D		Total Suspended Solids in Water
8/25/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total volatile solids	8/20/2008 (null)		8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	160.4	Volatile Residue
8/21/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Turbidity	1.4 NTU	NTU	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. 2130-B		Nephelometric Method
8/25/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total solids	160 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. 2540-B		Total Solids Dried 103-105°C in Water
9/11/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Sulfate as SO4	10.6 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. 300(A)		Inorganic Anions by Ion Chromatography
9/11/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Chloride	3.6 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	325.2	Chloride by Colorimetric Analysis II
9/11/2008	Upper Mississippi Information Access Initiative	Lab sample tem <	(null)	Ammonia-nitrogen as N	0.05 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	350.1	Ammonia Nitrogen by Colorimetry
8/26/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Kjeldahl nitrogen as N	0.59 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	351.2	Total Kjeldahl Nitrogen by Colorimetry
8/26/2008	Upper Mississippi Information Access Initiative	Lab sample tem <	(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.05 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	353.2	Nitrate-Nitrite Nitrogen by Colorimetry
9/15/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Phosphorus as P	0.021 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	365.1	Phosphorus by Colorimetry
9/21/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Orthophosphate as P	0.005 mg/L	mg/L	8/20/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2. QC10-115-01-1-A		Orthophosphate, Total, by QuikChem method 10-115-01-1-A
7/28/2008	Upper Mississippi Information Access Initiative	Lab sample tem (null)	(null)	Total volatile solids	65 mg/L	mg/L	7/23/2008 (null)		Total	Sample	5005-499	PRAIRIE AT US-2, 2.	160.4	Volatile Residue

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1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.006 mg/L	mg/L	7/16/1998 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.1 mg/L	mg/L	7/16/1998 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	0.5 ug/L	ug/L	7/16/1998 m		Non-filter	Sample	31-0373-00-201	HALE	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for phaeophytin	0.52 ug/L	ug/L	7/16/1998 m		Non-filter	Sample	31-0373-00-201	HALE	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.429 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.014 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4110-B	Anions in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.005 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.025 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.013 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4110-B	Anions in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.015 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4110-B	Anions in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.005 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.008 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.311 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.013 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4110-B	Anions in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.005 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.005 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.307 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.013 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4110-B	Anions in Water by Ion Chromatography
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.005 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.32 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	1.48 ug/L	ug/L	6/17/1998 m		Non-filter	Sample	31-0373-00-201	HALE	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for phaeophytin	1.51 ug/L	ug/L	6/17/1998 m		Non-filter	Sample	31-0373-00-201	HALE	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.07861 mg/L	mg/L	7/26/1996 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	True color	10 PCU	PCU	9/2/1981 m		Dissolved	Sample	31-0373-00-201	HALE	2120-B	Color in Water by Visual Comparison
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Gran acid neutralizing capacity	102 mg/L	mg/L	10/23/2002 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Titration
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.216 mg/L	mg/L	9/28/2000 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	3.694 mg/L	mg/L	9/28/2000 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.022 mg/L	mg/L	9/28/2000 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.652 mg/L	mg/L	9/28/2000 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phaeophytin a	2.9 ug/L	ug/L	9/28/2000 m		Non-filter	Sample	31-0373-00-201	HALE	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Chlorophyll a, corrected for phaeophytin	12.3 ug/L	ug/L	9/28/2000 m		Non-filter	Sample	31-0373-00-201	HALE	ASTM D3731-87	Chlorophyll-a and Phaeophytin-a
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Alkalinity, total as CaCO3	140 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Apparent color	10 PCU	PCU	9/2/1981 m		Dissolved	Sample	31-0373-00-201	HALE	LEG_P00080	COLOR (PLATINUM-COBALT UNITS)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	pH	8.2 None	None	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	LEG_P00403	PH, LAB, STANDARD UNITS SU
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Organic Nitrogen as N	0.58 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	LEG_P00605	NITROGEN, ORGANIC, TOTAL (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Ammonia-nitrogen as N	0.06 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	LEG_P00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Kjeldahl nitrogen as N	0.54 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	LEG_P00625	NITROGEN, KJELDAHL, TOTAL (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Inorganic nitrogen (nitrate and nitrite) as N	0.01 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	LEG_P00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Phosphorus as P	0.029 mg/L	mg/L	9/2/1981 m		Total	Sample	31-0373-00-201	HALE	LEG_P00665	PHOSPHORUS, TOTAL (MG/L AS P)
1/1/1901	MPCA Lake Monitoring Program Project		(null)	Chlorophyll a, corrected for phaeophytin	3.31 ug/L	ug/L	9/2/1981 m		Non-filter	Sample	31-0373-00-201	HALE	LEG_P32211	CHLOROPHYLL A UG/L SPECTROPHOTOMETRIC ACID. METH.
8/20/2001	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	8/20/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Ammonia-nitrogen as N	0.005 mg/L	mg/L	6/17/1998 m		Dissolved	Sample	31-0373-00-201	HALE	4500-NH3(H)	Ammonia in Water - Flow Injection Analysis
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Phosphorus as P	0.022 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	4500-P-E	Phosphorus in Water by Colorimetry- Ascorbic Acid Method
1/1/1901	Itasca County Lake Assessment (includes Jessie L CWP)(null)		(null)	Nutrient-nitrogen as N	0.406 mg/L	mg/L	6/17/1998 m		Total	Sample	31-0373-00-201	HALE	APHA 4500-NORGD	Nitrogen, Total, by Block Digestion and Flow Injection Analysis (APHA 21st Ed)
7/2/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	7/2/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
5/27/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	2.LOW ALG(null)	(null)	5/27/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
7/2/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	7/2/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
7/2/2002	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	6.1 m	m	7/2/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/27/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	6/27/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/23/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	6/23/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
8/1/2001	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	8/1/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
8/20/2001	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	8/20/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/27/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	6/27/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/23/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	6/23/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
9/12/2001	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	9/12/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/14/2002	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	6.4 m	m	6/14/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/23/2002	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.18 m	m	6/23/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/14/2002	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	3.66 m	m	6/14/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/4/2002	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.9 m	m	6/4/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
9/12/2001	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.74 m	m	9/12/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
9/12/2001	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.49 m	m	9/12/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
9/2/2001	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	5.03 m	m	9/2/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
5/27/2002	Citizen Lake Monitoring Program		(null)	Depth, Secchi disk depth	2.59 m	m	5/27/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/14/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	6/14/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
5/21/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	2.LOW ALG(null)	(null)	5/21/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/14/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	6/14/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/4/2002	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	2.LOW ALG(null)	(null)	6/4/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
6/4/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	2.GOOD (null)	(null)	6/4/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
5/21/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	2.GOOD (null)	(null)	5/21/2002 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
9/2/2001	Citizen Lake Monitoring Program		(null)	Lake physical appearance (choice list)	1. CLEAR (null)	(null)	9/2/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
9/2/2001	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	1.VERY GO (null)	(null)	9/2/2001 m		Total	FMO	31-0373-00-201	HALE	FLD	Field measurement/observation, generic method
5/27/2002	Citizen Lake Monitoring Program		(null)	Lake recreational suitability (choice list)	2.GOOD (null)	(null)	5/27/2002 m		Total	FMO	31-0373-0			

Appendix F

GRPUC 2014 Water Report

City of Grand Rapids
2014 Drinking Water Report

The City of Grand Rapids is issuing the results of monitoring done on its drinking water for the period from January 1 to December 31, 2014. The purpose of this report is to advance consumers' understanding of drinking water and heighten awareness of the need to protect precious water resources.

Source of Water

The City of Grand Rapids provides drinking water to its residents from a groundwater source: five wells ranging from 140 to 572 feet deep, that draw water from the Quaternary Buried Artesian, Animikie Group, and Quaternary Buried Unconfined aquifers.

The Minnesota Department of Health has made a determination as to how vulnerable our systems' source(s) of water may be to future contamination incidents. If you wish to obtain the entire source water assessment regarding your drinking water, please call 651-201-4700 or 1-800-818-9318 (and press 5) during normal business hours. Also, you can view it on line at www.health.state.mn.us/divs/eh/water/swp/swa.

Call 218-326-7024 if you have questions about the City of Grand Rapids drinking water or would like information about opportunities for public participation in decisions that may affect the quality of the water.

Results of Monitoring

No contaminants were detected at levels that violated federal drinking water standards. However, some contaminants were detected in trace amounts that were below legal limits. The table that follows shows the contaminants that were detected in trace amounts last year. (Some contaminants are sampled less frequently than once a year; as a result, not all contaminants were sampled for in 2014. If any of these contaminants were detected the last time they were sampled for, they are included in the table along with the date that the detection occurred.)

Key to abbreviations:

MCLG—Maximum Contaminant Level Goal: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

MCL—Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

AL—Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirement which a water system must follow.

90th Percentile Level—This is the value obtained after disregarding 10 percent of the samples taken that had the highest levels. (For example, in a situation in which 10 samples were taken, the 90th percentile level is determined by disregarding the highest result, which represents 10 percent of the samples.)

Note: In situations in which only 5 samples are taken, the average of the two with the highest levels is taken to determine the 90th percentile level.

ppm—Parts per million, which can also be expressed as milligrams per liter (mg/l).

ppb—Parts per billion, which can also be expressed as micrograms per liter (µg/l).

N/A—Not Applicable (does not apply).

Contaminant (units)	MCLG	MCL	Level Found		Typical Source of Contaminant
			Range (2014)	Average/ Result*	
Barium (ppm)	2	2	N/A	.04	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits.
Fluoride (ppm)	4	4	1.1-1.5	1.3	State of Minnesota requires all municipal water systems to add fluoride to the drinking water to promote strong teeth; Erosion of natural deposits; Discharge from fertilizer and aluminum factories.
Nitrate (as Nitrogen) (ppm)	10.4	10.4	N/A	.38	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.
Total Coliform Bacteria	0 present	>1 present	N/A	1♥	Naturally present in the environment.

*This is the value used to determine compliance with federal standards. It sometimes is the highest value detected and sometimes is an average of all the detected values. If it is an average, it may contain sampling results from the previous year.

♥Follow-up sampling showed no contamination present.

Contaminant (units)	MCLG	AL	90% Level	# sites over AL	Typical Source of Contaminant
Copper (ppm) (08/28/2012)	1.3	1.3	1.03	0 out of 20	Corrosion of household plumbing systems; Erosion of natural deposits.
Lead (ppb) (08/28/2012)	0	15	3.8	0 out of 20	Corrosion of household plumbing systems; Erosion of natural deposits.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. City of Grand Rapids is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at <http://www.epa.gov/safewater/lead>.

Monitoring may have been done for additional contaminants that do not have MCLs established for them and are not required to be monitored under the Safe Drinking Water Act. Results may be available by calling 651-201-4700 or 1-800-818-9318 during normal business hours.

Compliance with National Primary Drinking Water Regulations

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.

Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the U. S. Environmental Protection Agency (EPA) prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Food and Drug Administration regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 18004264791.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline at 18004264791.

Appendix G

Source Water Assessment Sheets



<http://www.health.state.mn.us/index.html>

Minnesota Department of Health

ID Number: 1310011

Facility Contact: Dennis Doyle
(218) 326-7192
Grand Rapids
Grand Rapids Water Superintendent
P.O. Box 658
Grand Rapids, MN 55744

MDH Contact: Chris Parthun
(218) 308-2109
705 Fifth Street, Suite A
Bemidji, MN 56601
Chris.Parthun@state.mn.us

Status of the Source Water Protection Plan:

The water supply system is preparing a protection plan for the wellhead protection area(s) that have been approved by the Minnesota Department of Health under provisions of Minnesota Rules Chapter 4720.

Source Water Protection Area: - Click [Map1 \(http://www.health.state.mn.us/jpg/swp00770.pdf\)](http://www.health.state.mn.us/jpg/swp00770.pdf) to view SWPA map(s).

Yes - A Source Water Protection Area has been designated for this well.

Description of the source water: - The water supply for Grand Rapids is obtained from 5 primary wells. Well depth (in feet), well status, aquifer(s) used, and sensitivity of the source(s) of drinking water are listed in the following table.

Unique Well No	Well ID	Depth	Well Use	Aquifer	Aquifer Sensitivity	*Well Sensitivity	SWPA
00127276	Well #4	157	Primary	Glacial Deposits	High	See (2)	Yes
00161444	Well #6	140	Primary	Glacial Deposits	High	See (2)	Yes
00228870	Well #1	176	Primary	Glacial Deposits	High	See (2)	Yes
00228873	Well #2	572	Primary	Bedrock	High	See (2)	Yes
00228862	Well #3	176	Primary	Glacial Deposits	High	See (2)	Yes

Well construction assessment: - The water wells used by the Grand Rapids meet current standards for construction and maintenance. These factors do not contribute to the susceptibility of the source water to contamination.

Well Sensitivity: - Well sensitivity refers to the integrity of the well due to its construction and maintenance. It is based on the results of the well construction assessment. It can be one of the following:

- (1) The well is susceptible to contamination because it does not meet current construction standards or no information about well construction is available, regardless of aquifer sensitivity.
- (2) The well is not susceptible because it meets well construction standards and does not present a pathway for contamination to readily enter the water supply.

Aquifer Sensitivity: - Aquifer sensitivity refers to the degree of geological protection afforded the aquifer(s) used by the public water supply.

High - The aquifer is considered to exhibit a high sensitivity to contamination because of the local geological setting.

Source Water Susceptibility: - Source water susceptibility refers to the likelihood that a contaminant will reach the source of drinking water. It reflects the results of assessing well sensitivity, aquifer sensitivity, and water quality data.

Medium - The lateral extent of fine-grained materials between the land surface and the source of drinking water does not appear to be persistent throughout the source water protection area.

High - The source water is considered to be susceptible because of the tritium content of the well water in glacial deposits.

Contaminants of concern: - The following statement summarizes the potential contaminants for which a source of drinking water may be at risk:

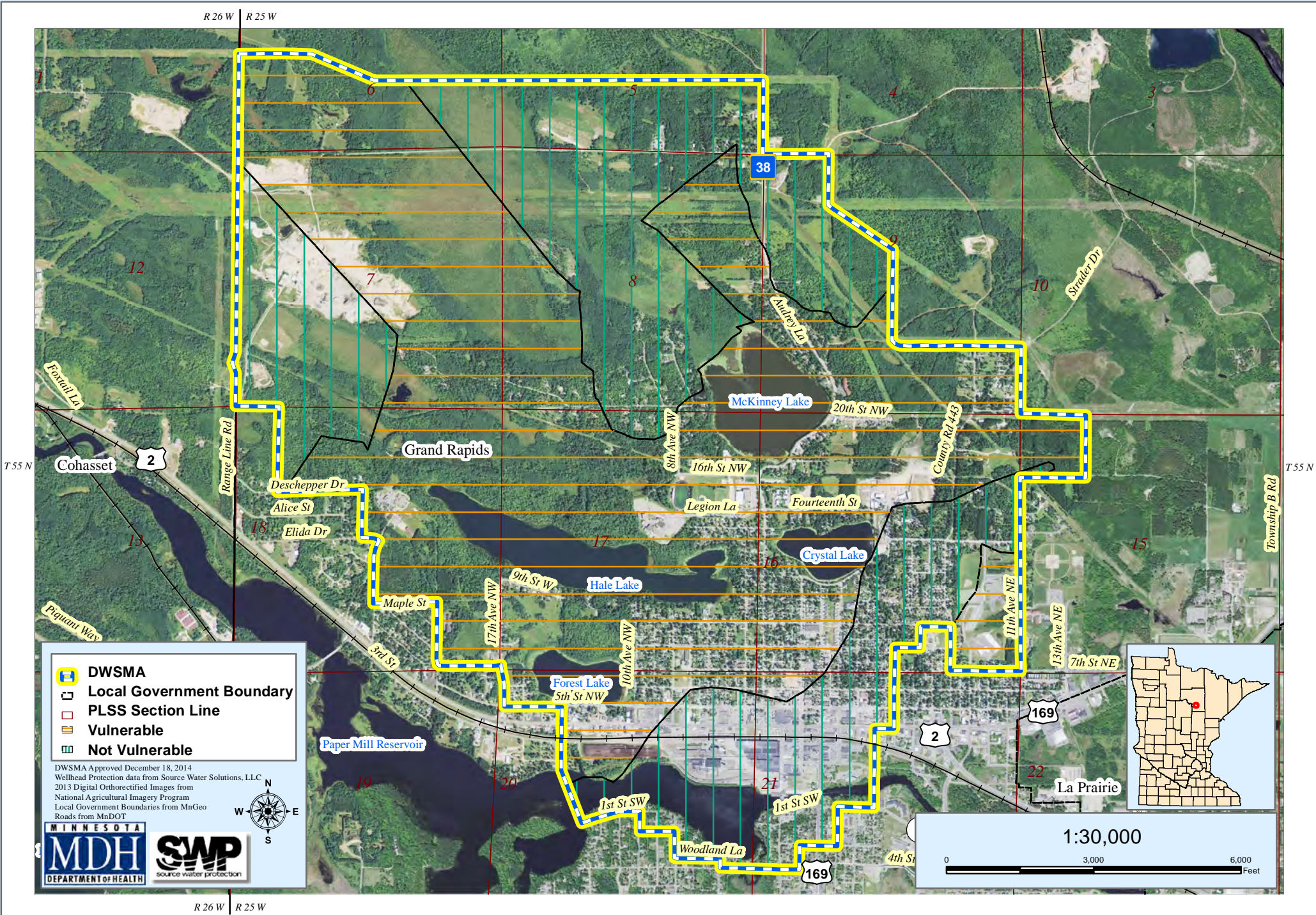
One or more contaminants regulated under the federal Safe Drinking Water Act for this public water supply system have been detected in the source water. However, the water supplied to users meets state and federal drinking water standards for potability. For further information, please contact the MDH representative listed at the beginning of this assessment.

651-201-5000 Phone
888-345-0823 Toll-free

Information on this website is available in alternative formats to individuals with disabilities upon request.

Updated

Grand Rapids Drinking Water Supply Management Area (DWSMA) MN-00770 - Variable Vulnerability



Appendix H

Potential Contaminant Inventory Tables

Appendix I

Inner Wellhead Management Zone (IWMZ) Inventory

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) -
 POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1310011	COMMUNITY
NAME	Grand Rapids	
ADDRESS	Grand Rapids Water Superintendent, P.O. Box 658, Grand Rapids, MN 55744	

FACILITY (WELL) INFORMATION

NAME	Well #1	IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE? <input type="checkbox"/> YES (Please attach a copy) <input type="checkbox"/> NO <input type="checkbox"/> UNDETERMINED
FACILITY ID	S01	
UNIQUE WELL NO.	228870	
COUNTY	Itasca	

PWS ID / FACILITY ID	1310011 S01	UNIQUE WELL NO.	228870
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)			LOCATION		
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				

Agricultural Related

*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well ² (Class V well - illegal ³)	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		

SSTS Related

AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well) ²	50/300/150 ⁴	50/300/150 ⁴	100/600/300 ⁴	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		Y	148	N**
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal) ²	75	75	150	N		
MVW	Motor vehicle waste disposal (Class V well - illegal) ²	illegal	illegal		N		

PWS ID / FACILITY ID	1310011 S01	UNIQUE WELL NO.	228870
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	78	N**
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	142	N**
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		N		
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		

Land Application

SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
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Solid Waste Related

COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		

Storm Water Related

SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well ² (Class V well - illegal ³)	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		

Wells and Borings

*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	201	
UUW	Unused, unsealed well or boring	50	50		N		

General

*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		Y	167	N**
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well) ²	illegal ³	illegal ³		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		
OH1	Ordinary high water level of a stream, river, pond, lake, reservoir, or drainage ditch (holds water six months or more)	50	35		Y	200	N**

PWS ID / FACILITY ID

1310011 S01

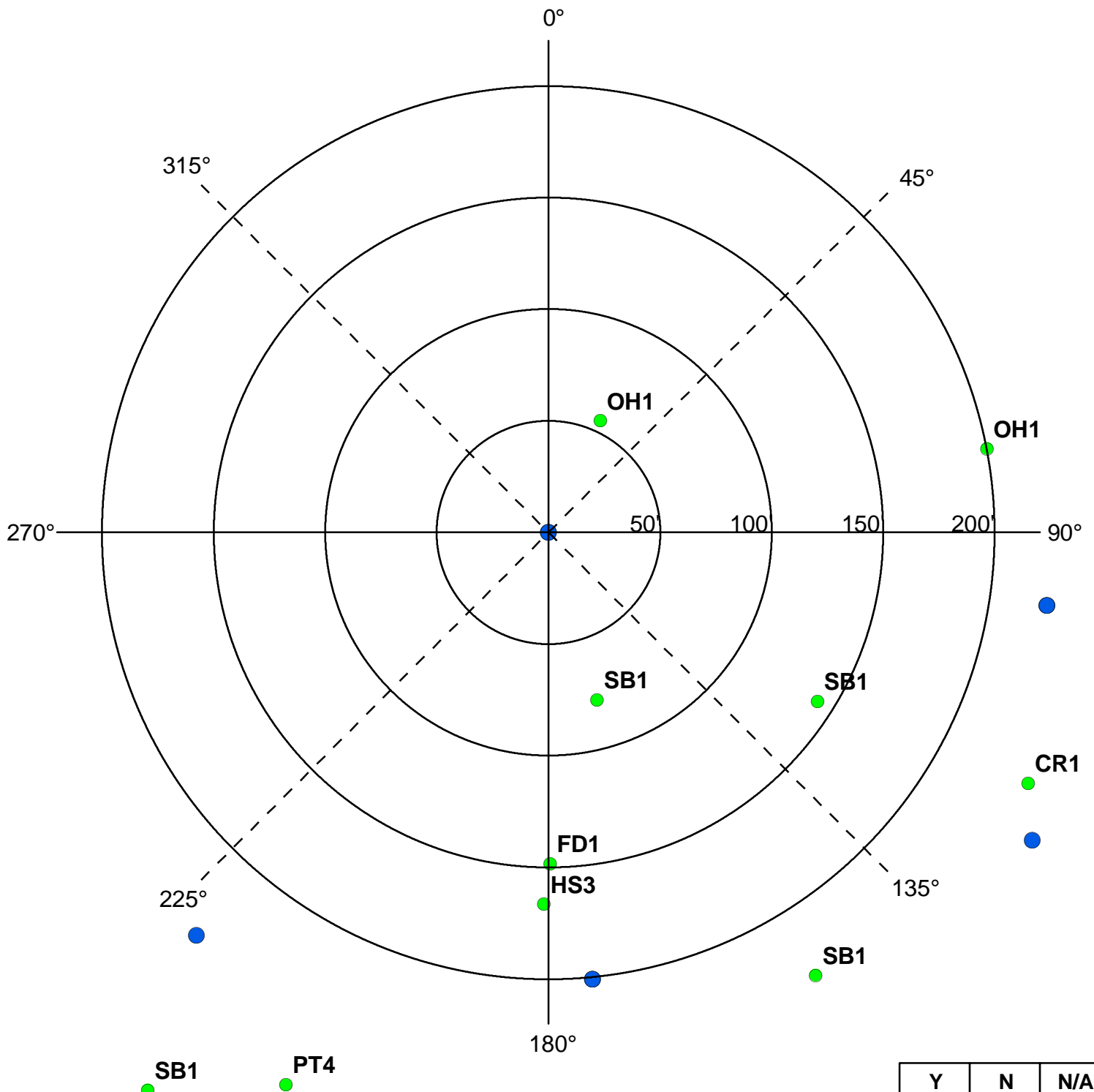
UNIQUE WELL NO.

228870

SETBACK DISTANCES

All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



	Y	N	N/A
Were the isolation distances maintained for the new sources of contamination?	X		
Is the system monitoring existing nonconforming sources of contamination?	X		

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR

Parthun, Christopher

DATE

11 - 3 - 2015

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		

COMMENTS
<p>HS3 consists of standard water treatment chemicals.</p>

For further information, please contact:

**Minnesota Department of Health
 Drinking Water Protection Section
 Source Water Protection Unit
 P.O. Box 64975
 St. Paul, Minnesota 55164-0975**

**Section Receptionist: 651-201-4700
 Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000**

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) -
 POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1310011	COMMUNITY
NAME	Grand Rapids	
ADDRESS	Grand Rapids Water Superintendent, P.O. Box 658, Grand Rapids, MN 55744	

FACILITY (WELL) INFORMATION

NAME	Well #2	IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE? <input type="checkbox"/> YES (Please attach a copy) <input type="checkbox"/> NO <input type="checkbox"/> UNDETERMINED
FACILITY ID	S02	
UNIQUE WELL NO.	228873	
COUNTY	Itasca	

PWS ID / FACILITY ID	1310011 S02	UNIQUE WELL NO.	228873
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)			LOCATION		
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				

Agricultural Related

*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well ² (Class V well - illegal ³)	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		

SSTS Related

AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well) ²	50/300/150 ⁴	50/300/150 ⁴	100/600/300 ⁴	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		Y	50	N
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal) ²	75	75	150	N		
MVW	Motor vehicle waste disposal (Class V well - illegal) ²	illegal	illegal		N		

PWS ID / FACILITY ID	1310011 S02	UNIQUE WELL NO.	228873
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	125	N
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	160	N
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	185	N
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	100	N
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	145	N
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		

Land Application

SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
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Solid Waste Related

COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		

Storm Water Related

SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well ² (Class V well - illegal ³)	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		

Wells and Borings

*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	201	
WEL	Operating well	record dist.	record dist.		Y	178	
UUW	Unused, unsealed well or boring	50	50		N		

General

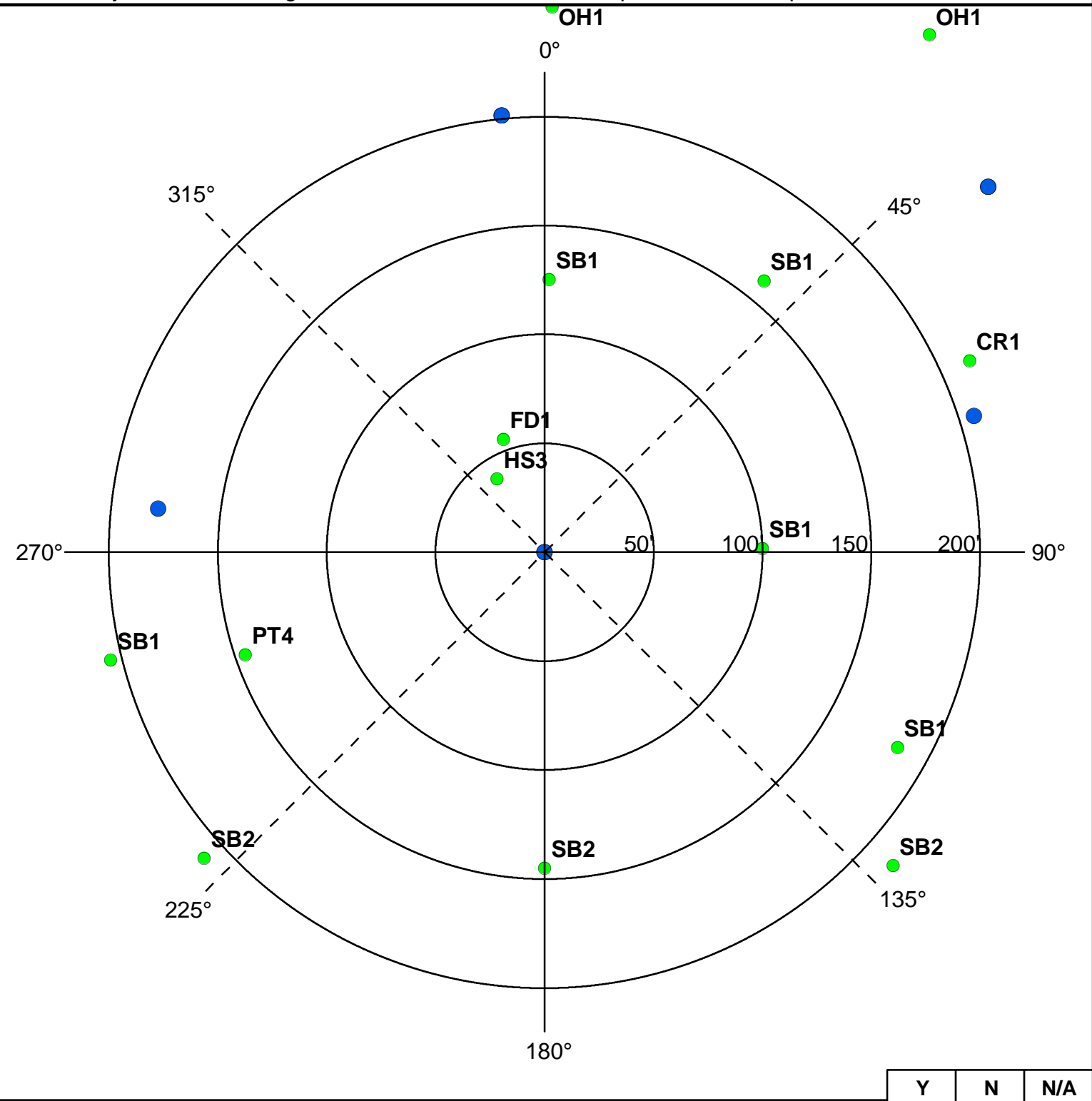
*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		Y	40	N
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		

PWS ID / FACILITY ID 1310011 S02

UNIQUE WELL NO. 228873

SETBACK DISTANCES All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



	Y	N	N/A
Were the isolation distances maintained for the new sources of contamination?	X		
Is the system monitoring existing nonconforming sources of contamination?	X		

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR Parthun, Christopher DATE 11 - 3 - 2015

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Determine status of test well unique number 228871 drilled in 1954 located westerly of Grand Rapids Well #2 approximately 180 feet.		
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		
Tanks and secondary containments should be inspected on a regular basis for leak or spill detection. See: http://www.pca.state.mn.us/index.php/waste/waste-and-cleanup/waste-management/index.html for information, or call the Minnesota Pollution Control Agency at 1-800-657-3864.		

COMMENTS
<p>HS3 consists of standard water treatment chemicals.</p> <p>PT4 is the fuel storage tank for the emergency generator.</p>

<p>For further information, please contact:</p> <p>Minnesota Department of Health Drinking Water Protection Section Source Water Protection Unit P.O. Box 64975 St. Paul, Minnesota 55164-0975</p> <p>Section Receptionist: 651-201-4700 Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000</p>

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) -
 POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1310011	COMMUNITY
NAME	Grand Rapids	
ADDRESS	Grand Rapids Water Superintendent, P.O. Box 658, Grand Rapids, MN 55744	

FACILITY (WELL) INFORMATION

NAME	Well #3	IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE? <input type="checkbox"/> YES (Please attach a copy) <input type="checkbox"/> NO <input type="checkbox"/> UNDETERMINED
FACILITY ID	S03	
UNIQUE WELL NO.	228862	
COUNTY	Itasca	

PWS ID / FACILITY ID	1310011 S03	UNIQUE WELL NO.	228862
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				

Agricultural Related

*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well ² (Class V well - illegal ³)	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		

SSTS Related

AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well) ²	50/300/150 ⁴	50/300/150 ⁴	100/600/300 ⁴	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		N		
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal) ²	75	75	150	N		
MVW	Motor vehicle waste disposal (Class V well - illegal) ²	illegal	illegal		N		

PWS ID / FACILITY ID	1310011 S03	UNIQUE WELL NO.	228862
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	195	N**
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	111	N**
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		N		
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		

Land Application

SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
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Solid Waste Related

COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		

Storm Water Related

SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well ² (Class V well - illegal ³)	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		

Wells and Borings

*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	105	
UUW	Unused, unsealed well or boring	50	50		N		

General

*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		Y	80	N
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		N		
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well) ²	illegal ³	illegal ³		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		
OH1	Ordinary high water level of a stream, river, pond, lake, reservoir, or drainage ditch (holds water six months or more)	50	35		Y	75	N

PWS ID / FACILITY ID

1310011 S03

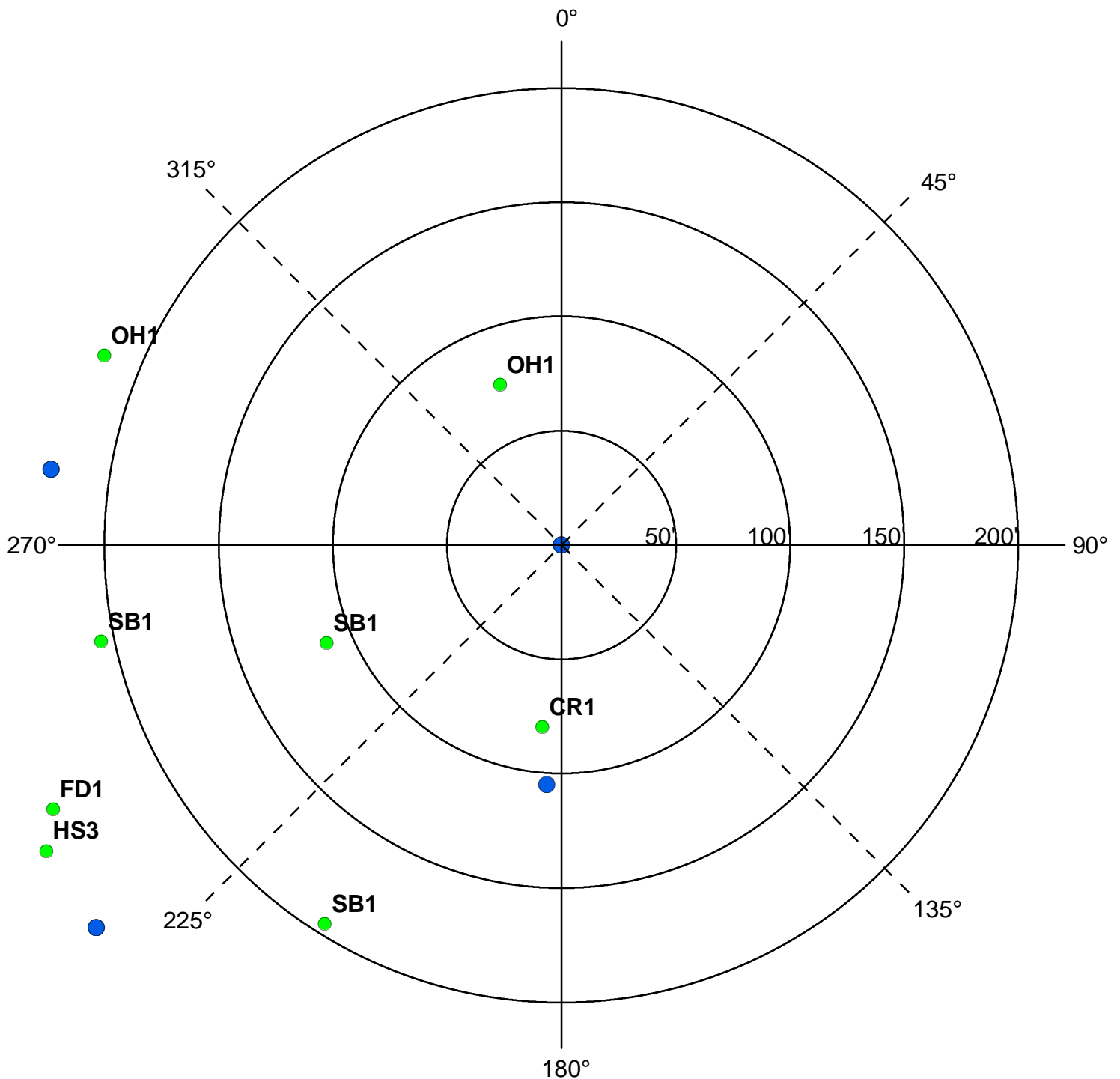
UNIQUE WELL NO.

228862

SETBACK DISTANCES

All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



	Y	N	N/A
Were the isolation distances maintained for the new sources of contamination?	X		
Is the system monitoring existing nonconforming sources of contamination?			X

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR

Parthun, Christopher

DATE

11 - 3 - 2105

PWS ID / FACILITY ID	1310011 S03	UNIQUE WELL NO.	228862
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RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Determine status of test well unique number 228872 drilled in 1960 to depth of 208 feet. Located south of Grand Rapids Well #3 approximately 100 feet.		
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		

COMMENTS

For further information, please contact:

**Minnesota Department of Health
Drinking Water Protection Section
Source Water Protection Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975**

**Section Receptionist: 651-201-4700
Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000**

**INNER WELLHEAD MANAGEMENT ZONE (IWMZ) -
 POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT**

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1310011	COMMUNITY
NAME	Grand Rapids	
ADDRESS	Grand Rapids Water Superintendent, P.O. Box 658, Grand Rapids, MN 55744	

FACILITY (WELL) INFORMATION

NAME	Well #4	IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE? <input type="checkbox"/> YES (Please attach a copy) <input type="checkbox"/> NO <input type="checkbox"/> UNDETERMINED
FACILITY ID	S04	
UNIQUE WELL NO.	127276	
COUNTY	Itasca	

PWS ID / FACILITY ID	1310011 S04	UNIQUE WELL NO.	127276
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				

Agricultural Related

*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well ² (Class V well - illegal ³)	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		

SSTS Related

AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well) ²	50/300/150 ⁴	50/300/150 ⁴	100/600/300 ⁴	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		N		
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal) ²	75	75	150	N		
MVW	Motor vehicle waste disposal (Class V well - illegal) ²	illegal	illegal		N		

PWS ID / FACILITY ID	1310011 S04	UNIQUE WELL NO.	127276
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	200	N
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	190	N
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	115	N
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	50	N
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		
Land Application							
SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
Solid Waste Related							
COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		
Storm Water Related							
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well ² (Class V well - illegal ³)	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		
Wells and Borings							
*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	161	
UUW	Unused, unsealed well or boring	50	50		Y	35	N
General							
*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		N		
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well) ²	illegal ³	illegal ³		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		

PWS ID / FACILITY ID

1310011 S04

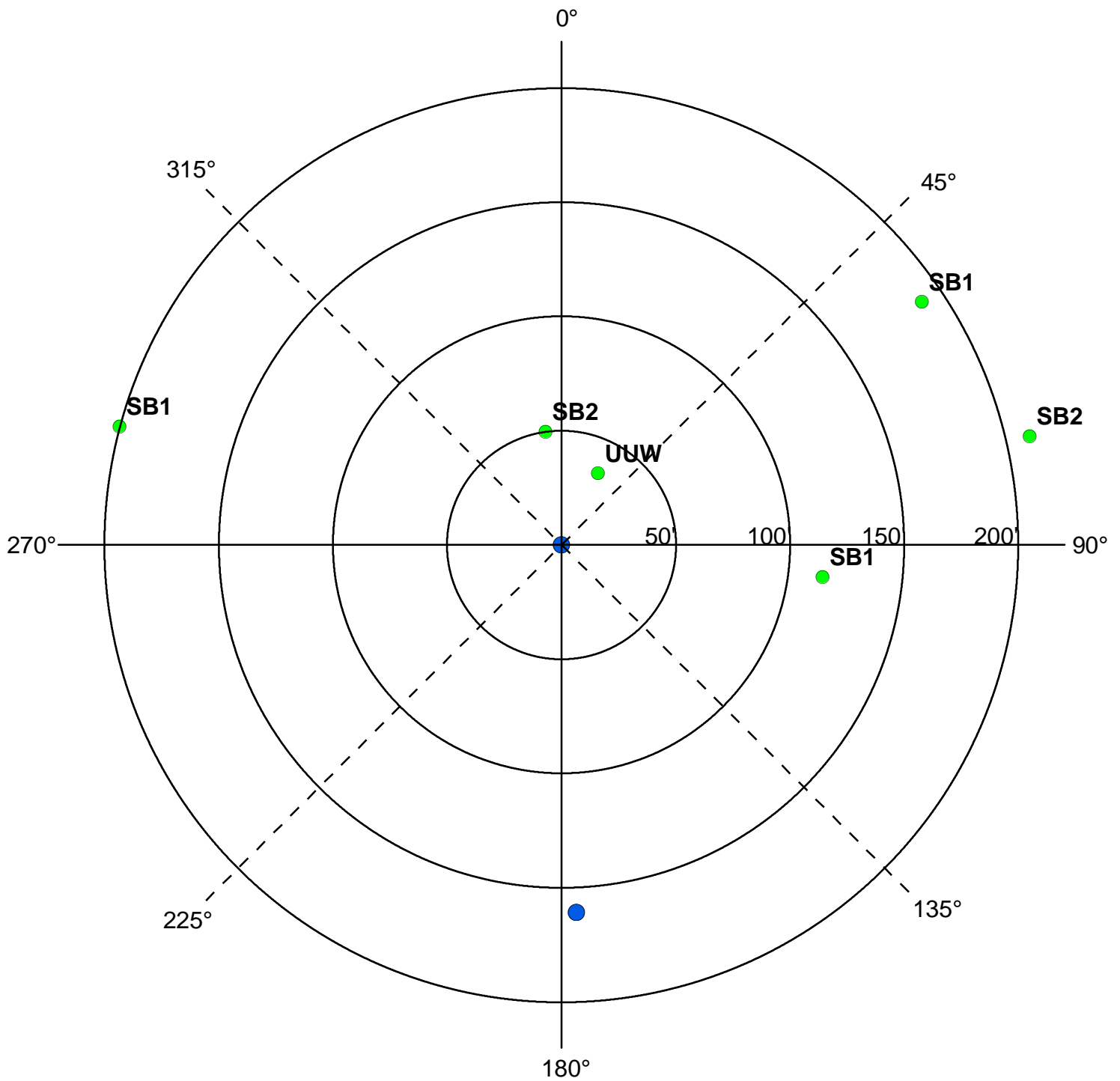
UNIQUE WELL NO.

127276

SETBACK DISTANCES

All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



	Y	N	N/A
Were the isolation distances maintained for the new sources of contamination?	X		
Is the system monitoring existing nonconforming sources of contamination?			X

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR

Parthun, Christopher

DATE

11 - 3 - 2015

PWS ID / FACILITY ID	1310011 S04	UNIQUE WELL NO.	127276
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RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Investigate the unconfirmed UUW located approximately 35 feet NE of the well, and report the results to your MDH Planner.		
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		

COMMENTS
Status and designation of UUW is unconfirmed.

For further information, please contact:

**Minnesota Department of Health
Drinking Water Protection Section
Source Water Protection Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975**

**Section Receptionist: 651-201-4700
Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000**

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) -
 POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1310011	COMMUNITY
NAME	Grand Rapids	
ADDRESS	Grand Rapids Water Superintendent, P.O. Box 658, Grand Rapids, MN 55744	

FACILITY (WELL) INFORMATION

NAME	Well #6	IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE? <input type="checkbox"/> YES (Please attach a copy) <input type="checkbox"/> NO <input type="checkbox"/> UNDETERMINED
FACILITY ID	S06	
UNIQUE WELL NO.	161444	
COUNTY	Itasca	

PWS ID / FACILITY ID	1310011 S06	UNIQUE WELL NO.	161444
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)			LOCATION		
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				

Agricultural Related

*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well ² (Class V well - illegal ³)	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		

SSTS Related

AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well) ²	50/300/150 ⁴	50/300/150 ⁴	100/600/300 ⁴	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		N		
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal) ²	75	75	150	N		
MVW	Motor vehicle waste disposal (Class V well - illegal) ²	illegal	illegal		N		

PWS ID / FACILITY ID	1310011	S06	UNIQUE WELL NO.	161444
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PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well ¹	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	182	N**
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		N		
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		
Land Application							
SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
Solid Waste Related							
COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		
Storm Water Related							
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well ² (Class V well - illegal ³)	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		
Wells and Borings							
*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	161	
UUW	Unused, unsealed well or boring	50	50		Y	192	N**
General							
*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		N		
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well) ²	illegal ³	illegal ³		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		
OH1	Ordinary high water level of a stream, river, pond, lake, reservoir, or drainage ditch (holds water six months or more)	50	35		N		
*PP1	Petroleum buried piping	50	50		N		
*PP2	Petroleum or crude oil pipeline to a refinery or distribution center	100	100		N		

PWS ID / FACILITY ID

1310011 S06

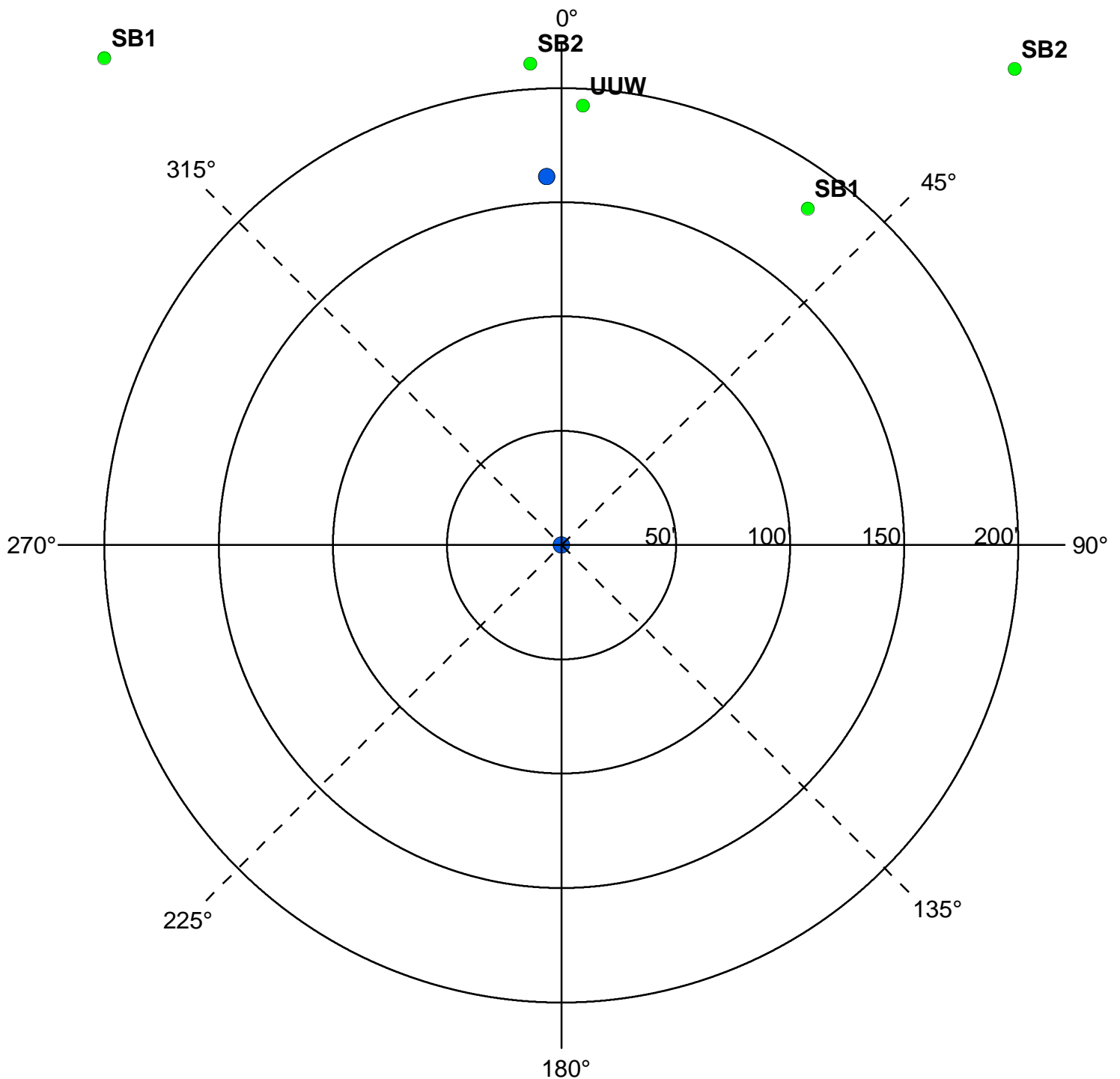
UNIQUE WELL NO.

161444

SETBACK DISTANCES

All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



	Y	N	N/A
Were the isolation distances maintained for the new sources of contamination?	X		
Is the system monitoring existing nonconforming sources of contamination?			X

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR

Parthun, Christopher

DATE

11 - 3 - 2015

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Investigate the unconfirmed UUW located approximately 180 feet N of the well, and report the results to your MDH Planner.		
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		

COMMENTS

Status and designation of UUW is unconfirmed.

For further information, please contact:

**Minnesota Department of Health
 Drinking Water Protection Section
 Source Water Protection Unit
 P.O. Box 64975
 St. Paul, Minnesota 55164-0975**

**Section Receptionist: 651-201-4700
 Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000**

Appendix J

GRPUC Water Supply Plan and Water Emergency and Conservation Plan

**WATER EMERGENCY AND CONSERVATION PLAN FOR
THE CITY OF GRAND RAPIDS WATER SYSTEM**

Prepared For

CITY OF GRAND RAPIDS PUBLIC UTILITIES COMMISSION
GRAND RAPIDS, MN

May 2007

Progressive Consulting Engineers, Inc (PCE)

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ABBREVIATIONS

The following abbreviations are used in the Grand Rapids Emergency Management and Conservation Plan:

AWWA	American Water Works Association
CIP	Capital Improvement Plan
CWI	County Well Index
DNR	Department of Natural Resources
DWSMA	Drinking Water Supply Management Area
GD	Glacial Drift
gpcd	Gallons Per Capita Per Day
GPCD	Gallons Per Capita Demand
GPD	Gallons Per Day
GPM	Gallons Per Minute
GRPUC	Grand Rapids Public Utilities Commission
HP	Horse Power
H ₂ SiF ₆	Hydrofluorosilicic Acid
KMnO ₄	Potassium Permanganate
MDH	Minnesota Department of Health
MG	Million Gallon
MGD	Million Gallons Per Day
MGY	Million Gallons Per Year
MNDNR	Minnesota Department of Natural Resources
MSL	Mean Seal Level
SCADA	Supervisory Control And Data Acquisition
Sub	Submersible
SDWA	Safe Drinking Water Act
USEPA	United States Environmental Protection Agency
VT	Vertical Turbine
WECP	Water Emergency and Conservation Plan
WHP	Wellhead Protection
WTP	Water Treatment Plant
WWTP	Waste Water Treatment Plant

DEFINITIONS

The following definitions applies to the City of Grand Rapids Water Emergency and Conservation Plan:

Residential	Water used for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Also called domestic water use.
Commercial	Water used by motels, hotels, restaurants, office buildings, commercial facilities, and institutions, both civilian and military.
Industrial	Water used for thermoelectric power (electric utility generation) and other industrial uses such as steel, chemical and allied products, paper and allied products, mining, and petroleum refining.
Institutional	Hospitals, nursing homes, day care centers, and other facilities that uses water for essential domestic requirements. This includes public facilities and public metered uses.
Irrigation	Artificial application of water on lands to assist in growing crops and pastures or maintaining recreational lands such as parks and golf courses.
Others	This includes the water used for the internal system maintenance such as maintenance in winter water run, hydrant flushing, water wagon, street sweeper, flooding ice rinks, etc. It also includes water provided to the interdepartmental-metered connections such as fire, water/sewer, wastewater treatment plant, etc.

Unaccounted

Unaccounted for water is the volume of water withdrawn from all water sources minus the volume of water sold. (Backwash water is figured into this amount.)

Wholesale Deliveries

Bulk water sales to other public water suppliers.

NOTE: Non-essential water uses defined by the Minnesota Statutes 103G.291, includes lawn sprinkling, vehicle washing, golf course, park irrigation and other non-essential uses. Some of the categories listed above will also include non-essential uses of water because it is not possible for water suppliers to separate these uses from individual accounts.

DNR Water Appropriation Permit Number(s)	1986-2076
Name of Water Supplier	City of Grand Rapids Public Utilities Commission
Address	500 SE 4 TH Street, P.O. Box 658 Grand Rapids, MN 55744
Contact Person	Dennis Doyle
Title	WTP Manager
Phone Number	218-326-7192
E-Mail Address	dmdoyle@grpuc.org

EXECUTIVE SUMMARY

All public water suppliers in Minnesota that supply water to more than 1,000 people are required to submit their water emergency and conservation plan to the Department of Natural Resources (DNR) every 10 years. The first plan was submitted and approved in 1996 and the second generation of plans is due in the year 2006 and 2007. The City of Grand Rapids has to update their water emergency and conservation plan consistent with the new guidelines and submit to the DNR by October 15, 2007.

In February 2007, Grand Rapids Public Utility Commission (GRPUC) selected Progressive Consulting Engineers, Inc (PCE) to complete the water emergency and conservation plan. The plan is prepared according to the DNR requirements and guidelines provided on the DNR website. The plan satisfies the contingency requirements of wellhead and source water protection plans, State Drinking Water Revolving Fund application requirements and certain comprehensive plan requirements for the City of Grand Rapids.

This report is the result of joint efforts of the City of Grand Rapids staff and the Progressive Consulting Engineers staff. The City of Grand Rapids staff has provided great support and cooperation in finalizing this Plan. The cooperation and assistance of the City of Grand Rapids staff is gratefully acknowledged.

This report includes the water supply system description and evaluation, emergency response procedures and water conservation planning for the City of Grand Rapids.

CHAPTER 1

INTRODUCTION

All public water suppliers in Minnesota that serve water to more than 1,000 people must have a Water Emergency and Conservation Plan (WECP) approved by the Department of Natural Resources (DNR). According to the Minnesota Statutes 103G.291, it should be updated and submitted to the DNR for approval every 10 years. The first plans were submitted and reviewed in 1996. The second generation of WECP has to be submitted by the year 2006 and 2007 based on the priority date set by the DNR. The City of Grand Rapids has to submit their WECP by October 15, 2007.

The second generation of WECP accomplishes the following:

- Identifies the improvements and additions needed in the water treatment plant to provide safe and sufficient drinking water to the growing community.
- Establishes the emergency programs required to mitigate any significant water emergency or disaster affecting the City.
- Identifies the policies and procedures made by the City to conserve water and to educate people to use water wisely and efficiently.
- Satisfies contingency plan requirements for the wellhead and source water protection plans, State Drinking Water Revolving Fund application requirements and certain comprehensive plan requirements for the communities in the Twin Cities Metropolitan Area.

The format of second generation of WECP is prepared by the DNR and is available on http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/eandc_plan.html.

The guidelines are divided into four parts as described below:

Part I - addresses the current status of demands and supplies. It reviews the existing water supply system, evaluates the adequacy of the resources to sustain current and projected demands of the City and identifies proposed improvements over the next ten years to meet the growing needs of the City in the form of capital improvement plan (CIP).

Part II – addresses the emergency response procedures. It includes guidelines for the emergency response procedures and the actions needed for effective emergency responses.

Part III – addresses the planning and measures for water conservation. This section describes the programs and long-term conservation measures that are intended to reduce the demand of water, improve the efficiency in use and reduces the losses and waste of water.

Part IV – relates to the comprehensive plan requirements that applies only to the communities in seven-county Twin Cities Metropolitan Area.

CHAPTER 2

WATER SUPPLY SYSTEM DESCRIPTION AND EVALUATION

The City of Grand Rapids is located in Itasca County, in northern Minnesota's Iron Range. It is located 75 miles west of Duluth and 200 miles north of Twin Cities. The water service to the City of Grand Rapids began in 1930s. Currently, the City is providing water to about 9,500 people.

The first step in any water supply analysis is to review the current status of demand and supply. The information provided below gives details about the historic and current water demand for the City of Grand Rapids and also discusses the City's existing water treatment facility. Information contained in this part can be used in the development of emergency response procedures and conservation plan later in the report.

A Analysis of Water Demand

The section below summarizes the historic water use for the City of Grand Rapids from the year 1996 to 2006.

2.A.1 The Summary of Historic Water Use

Historic water use data for the past 10 years are summarized in Table 1-1 and 1-2. Figure 1 shows the variation in pumpage, residential usage and serviced population for the last 10 years.

The figure shows fairly constant serviced population and residential water usage with slight variation in the annual water use. As the City of Grand Rapids provides large quantity of water to its commercial customers (see details in next section), variation in annual usage is due to changes in the water demand by the commercial customers. Variation in annual usage can also be due to variation in water used for the internal service maintenance by the Grand Rapids Public Utilities.

2.A.2 Water Demand

Water Use by Category

Categorical water usage can provide insight into consumption trends and patterns within the City. Changes in the amount of water used within a particular category can result in

fundamental changes in daily and yearly demand patterns seen by the system. The pattern for annual water sales data by customer categories for the last 10 years are presented in Table 1-3 and Figure 2. The customer categories for the City of Grand Rapids is discussed below:

Residential – Residential water use measures the amount of water used by the residential customers. The usage can be bathing, washing, cooking, lawn irrigation, etc. Total residential water use within the City has been steady over the period of last 10 years (see figure 2). The residential per capita usage has also remained fairly constant. The residential per capita usage is shown in Table 1-3. The reason for constant residential per capita usage can be attributed to a steady population with established use patterns along with smaller more mature landscape and tree cover requiring less irrigation needs.

Commercial - Commercial customers are the largest water users for the City of Grand Rapids. Figure 3 shows the % distribution of water use by customer category for the year 2006. 55% of total water sold, is attributed to the commercial customers whereas the residential customers use only 26% of annual water sold.

Industrial – Industrial customers account for about 6% of the total water use in the year 2006. Until year 2000, City did not have a separate category for industrial customers. The water use by the industrial customers was included in the commercial customers category. Now, Grand Rapids has two separate categories for their commercial and industrial customers.

Institutional – The Public Utilities Commission does not have a separate institutional category. The water used by the institutional customers is included in the commercial customer usage.

Other – Other category for the City of Grand Rapids includes the water used for internal system maintenance such as maintenance in winter water run, hydrant flushing, water wagon, street sweeping, flooding ice rinks, etc. It also includes water used by the interdepartmental meter connections such as fire, water/sewer, wastewater treatment plant (WWTP), etc.

Unaccounted Water

Every water system has a loss of water either due to leakage or other unmetered uses. Due to water loss, water pumped to the system will always be greater than the water sold.

Figure 4 shows the water sales and production data for the last 10 years. The difference between the water pumped and the water sold is the unaccounted water. The unaccounted water is shown in Table 1-2. Table shows increased unaccounted water use for the year 2006. The unaccounted water for the year 2006 was about 13% which is higher than 10% limit set by the American Water Works Association (AWWA). One potential source of error would be the meters in need of repairs or calibration. The City will make an ongoing effort to identify and address any sources of error in their water accounting tools and procedures.

Average and Maximum Day Demand

The average day demand is the average amount of water used per day by the City of Grand Rapids. It is usually calculated as the annual water use/365 days. The maximum day demand is the maximum amount of water used in one day. Table 1-4 and Figure 5 shows the variation in average day and maximum day demand for the City of Grand Rapids. The average day demand for the City of Grand Rapids has remained fairly constant over the period of last 10 years whereas the maximum day demand has varied a lot. The variation in maximum day demand is due to the changing demand of large commercial customers. This variation depends on the manufacturing process involved in the industries and commercial establishments with the possible exception of large restaurants, hotels, car washes, etc.

2.A.3 Per Capita Day Demand

Table 1-1, 1-3 and figure 6 shows the total and residential per capita demand for the City of Grand Rapids over the period of last 10 years. The figure shows that the residential per capita day demand has remained constant over the period of last 10 years whereas total per capita day demand is decreasing since the last couple of years. The average total per capita day demand for the City of Grand Rapids has reduced to about 6 gpcd since the year 2001.

2.A.4 Large Volume Customers

Large volume customers are the customers that use more than 10,000 gallons per day (GPD) of water. Table 2 shows the list of large volume customers for the City of Grand Rapids for the year 2005. Blandin Paper Co. and the City of La Prairie are the largest water users that use about 16% and 7% of total annual water sold by the City. The other large customers include Grand Rapids Wastewater Treatment Plant (WWTP) (primary

and secondary), Itasca Community College, Grand Itasca Clinic and Hospitals, Itasca County Court House, Pine Ridge Apartments, Grand Village and YMCA.

B Treatment and Storage Capacity

The City of Grand Rapids system consists of six wells (five active and one inactive), three elevated storage tanks, one ground storage tank, a treatment plant and a system of trunk and lateral watermains ranging in size from 4 to 12 inches. Geographically, the system supplies water to a majority of the developed City and covers approximately 115 feet of vertical elevation. The existing treatment and storage facility is discussed in detail below.

2.B.1 Water Treatment Facility

The City of Grand Rapids has one water treatment plant (WTP) with the capacity of 3.6 million gallons per day (MGD). The raw water entering the plant is aerated, filtered and softened. About 30-35 % of filtered water is softened and blended with bypassed filtered water before it is sent to the distribution system. Treatment also includes fluoridation for dental prophylaxis with the addition of hydrofluorosilicic acid and the provision for disinfection by chlorination if needed.

Iron and Manganese – is removed by aeration (natural air) and chemical oxidation method and the particulate minerals are removed by gravity filtration.

Softening – Treatment plant uses ion-exchange process to soften its water supply. Only a portion of water is passed through the zeolite softeners. Since this process reduces the hardness essentially to zero, a portion of the filtered unsoftened water is by-passed around the softeners to leave some hardness or alkalinity in the water. In this process, the softened water and the filtered water are blended to reduce the raw water hardness of about 220 mg/L to approximately 120 mg/L prior to discharge to the distribution system.

Disinfection - The City of Grand Rapids does not provide disinfection to its distributed finished water, as allowed by the current regulatory standards for ground water supplies. The City does, however, have the facilities in-place and has the ability to disinfect their water with gaseous chlorine, should the need arise.

Fluoridation - Fluoride addition is mandatory and is added in accordance to the Minnesota Department of health (MDH) rules. The City injects hydrofluorosilicic acid to met the MDH fluoridation requirements of 0.9-1.5 mg/L.

Filtration – is done by greensand gravity filtration.

Oxidation – is done by potassium permanganate.

The entire water treatment process is summarized in Table 3-A.

2.B.2 Storage Capacity

Water storage facility serves several purposes in a water system, including the capacity to meet peak demands that exceed the capacity of supply sources. They also help to maintain constant system pressure and provide water during the emergency conditions such as power outages, supply facility breakdowns and fire-fighting needs.

The City of Grand Rapids has the total storage capacity of 2.0 million gallons (MG). Currently, the City has three elevated towers and one ground storage reservoir with capacities of 0.5 MG each. The description of storage capacity is summarized in Table 3-B. The elevated tank No. 3 has been recently added to serve the high-pressure service area in the southern part of the City. The ground storage reservoir (clearwell) is located at the water treatment plant. The details of water storage for the City of Grand Rapids is summarized in Table 3-B.

The average day demand for the City of Grand Rapids since last 5 years is 1.26 MG and the storage capacity is 2.0 MG. This shows that the City has sufficient water storage.

C Water Source

The City of Grand Rapids relies solely on groundwater. The City does not have an appropriation permit to use surface water as a source. The ground water source is discussed in detail below.

2.C.1 Groundwater Source

At present, the City has a total of six wells. Five wells are active, whereas, one well is inactive. The detail of wells including capacity, date of implementation, location, and construction data are shown in Table 4-B. The total capacity of well is 4,931 gallons per minute (GPM) whereas the firm capacity is 3,036 GPM. The firm capacity is the total capacity with the largest well out of service. The existing 3,036 GPM of firm capacity is

roughly two times the 2006 peak day demand of 1791 GPM. The copies of well records and well maintenance information are provided in Appendix A of the report.

Wells No. 1, 2, 3, 4 and 6 provides water to the distribution system whereas Well No. 5 has been temporarily capped off due to elevated iron concentrations. Well No. 2 lies in Biwabik/Pokegama formation whereas all other wells lie in the Glacial Drift (GD) formation. According to the Minnesota Geological Survey, the City of Grand Rapids lies atop the Biwabik-Iron formation aquifer and a Glacial Drift aquifer. The Glacial Drift aquifer is highly susceptible to pollution. The Biwabik-Iron aquifer lies 500 feet below ground, which makes it less prone to pollution.

2.C.2 Wholesale or Retail Interconnection

The City of Grand Rapids currently provides wholesale water to the City of La Prairie. The City provides about 0.04 MG of water everyday to the City of La Prairie. See Table 4-D.

The City of Grand Rapids is also working on identifying the City of Cohasset and Harris Township as potential recipients for extension of its water utility services in the near future.

2.C.3 Emergency Interconnection

The City of Grand Rapids currently has no emergency interconnection with other neighboring suppliers or private sources that can be used to supply water on an emergency or occasional basis.

D Demand Projections

2.D.1 Population Projection

Population is one of the most important factors that have high impact on the water use. It is a dynamic quantity, affected by many variables such as land use and socio-economic trends, and hence very difficult to estimate the future population with a high degree of accuracy. Table 5 shows the population projection for the City of Grand Rapids. The details of projection are provided below.

Population Served

Comprehensive water study report prepared by TKDA in the year 2003 has projected the total population served by the system. As the City is providing water to the City of La Prairie, the total population of La Prairie is also included in the population of Grand Rapids. The data of projected serviced population (as discussed in Table 5) is taken from the comprehensive water study report. The graph of historical and projected population served by the system as given in the TKDA report is attached in Appendix B for reference.

Total Population

Based on the last 10 years data, the average population served by the City of Grand Rapids water system is about 97%. To project the total population of the City, it is assumed that the % population served by the City will remain 97% for the next 10 years. Total population is then projected using the following formula:

$$TotalPopulation = \frac{PopulationServed}{\%PopulationServed}$$

The total population projected by the end of year 2016 is approximately 11,808 with population served of about 11,500.

2.D.2 Demand Projection

The future water system demands can be calculated based on the per capita demand of the City. TKDA has used per capita demand for the projection of future demands in the comprehensive water study report prepared for the City of Grand Rapids in 2003. The information provided in this report is used for the demand projections.

Average Day

The average day and the peak day demand for the year 2010, 2015 and 2020 is projected in comprehensive water study report by TKDA. Based on the information given in that report, the average day demand for the rest of the year is extrapolated. See Table 5.

Maximum Day

Peaking factor, the ratio of the maximum day demand to the average day demand, is projected by TKDA. The graph showing the projection by TKDA is attached in Appendix C for reference. Information provided on the graph is used in the table for the projection of the maximum day demand.

Maximum Hour

For the projection of maximum hour demand, it is assumed that the maximum hour demand is twice the maximum day demand.

Table 5 shows the ten-year demand projections for the City of Grand Rapids.

E Resource Sustainability

Sustainable water use is very important to provide water for the needs of society now and in future without unacceptable social, economic or environmental consequences. Resource sustainability can be evaluated using the water level data and an evaluation of impacts on natural resources.

2.E.1 Monitoring Wells

According to the DNR, records of water levels should be maintained for all production wells and the source water reservoirs/basins. The City of Grand Rapids has all the active wells used for producing the water. The City monitors their wells every year using a level meter. Table 6-A shows the list of the wells that are measured annually by the City of Grand Rapids.

2.E.2 Water Level Data

The seasonal and long-term trend of water source provides the information about the impact of water withdrawal on the ground water aquifer. Table 6-B shows the drawdown data for all the wells since the year 1996 to 2006. The City does not have all the water level data for the past 10 years. The water level data for the last 3 years are shown in the Table 6-B.

For proper management of the aquifer resources, the City should pump at the rates that allows for long-term recharge of the aquifer being pumped from. Short-term changes in the water levels due to wet and dry years are to be expected. Figure 7 shows the trends of water level data (drawdown data) for each of the five wells. The trend shows the behavior of ground water sustainability in the aquifer at present and in the future.

2.E.3 Natural Resource Impact

There is no natural resource features such as calcareous fens, wetlands, trout streams, rivers or surface water basins that are or could be influenced by water withdrawals from the municipal production wells that are known to the City. According to the City's

wellhead protection (WHP) plan II, there are currently no other high-capacity wells within the drinking water supply management area (DWSMA) from which well interference complaints with the City's wells have been documented.

Since there are no such complaints about natural resource impact, the City of Grand Rapids Community Development Department has not implemented any resource protection thresholds or measures for mitigating such impacts. The measures would be developed in the future if the need arise.

2.E.4 Sustainability

Sustainable use of water resource requires balancing the use of resource among competing uses including environmental uses. To assess the long-term viability of a particular ground-water use, it is necessary to consider both the amount of water in circulation as well as the desires of the community to accept or limit economic, social, and environmental impacts.

Working towards sustainability requires monitoring and analyzing the water use trends, addressing the demands collectively, using water efficiently; and above all recognizing water's value to our neighborhoods, communities, economy, environment, and continued existence on this planet.

Flow in the upper groundwater flow system consists of three superficial aquifers separated by the three till units (the upper, the middle and the basal till units). These glacial sediments are underlain by bedrock, including the Biwabik Iron Formation aquifer. The superficial aquifers are recharged by the infiltration that enters the system either through precipitation or by interaction with the surface water features (lakes and streams). Buried glacial aquifers and the Biwabik Iron formation are recharged by the leakage through the glacial tills that separate these aquifers from one another. Groundwater discharge from the system is through pumping, the Mississippi River and the Prairie River, East of Grand Rapids.

Present groundwater withdrawals are mainly from glaciofluvial outwash aquifers through the municipal, small industrial and domestic wells. The City of Grand Rapids obtains two thirds of its water from four public water supplies completed in the glaciofluvial outwash sediments, and one third from Well No. 2, a bedrock well completed in the Biwabik Iron Formation. Domestic wells near Grand Rapids extract water mostly from the glaciofluvial outwash aquifers, with few households using the Biwabik Iron Formation for a source of water.

An assessment of well interferences from other wells was conducted by including the high capacity wells from the DNR Water Appropriation Permit Database and the County Well Index (CWI) database. The City has prepared a wellhead protection plan that was delineated using multi-aquifer groundwater flow model that uses the numerical code of MODEFLOW in the year 2003. No high capacity wells other than Grand Rapids Well No. 2 were identified as drawing from the Biwabik Iron Formation aquifer in the Grand Rapids area. The aquifers of Grand Rapids usually appear to be adequate for satisfying the future needs of the city.

The groundwater level in the source water aquifer appears to be stable and adequate for the amount of water that Grand Rapids is currently permitted to withdraw under the water appropriation program administered by the Minnesota Department of Natural Resources (MNDNR). According to the Grand Rapids WHP plan part II prepared in 2005, there appears to be sufficient groundwater quantity at this time, based upon existing pumping capacity and the performance of the wells completed in the aquifers used by the City.

Source Water Protection Plans

The purpose of Source Water Protection is to help prevent contaminants from entering public drinking water sources. There are three primary parts to the Minnesota's Source Water Protection Program: Wellhead Protection, Source Water Assessments, and Protection of Surface Water intakes. Every city needs to prepare source water protection plan under the federal safe drinking water act (SDWA).

For, the City of Grand Rapids, all the five wells have been determined to be vulnerable to contamination from land surface activities based on the chemistry of the groundwater suggesting the presence of young water. The City of Grand Rapids has adopted their Wellhead Protection Plan part I in December 2003 and part II in November 2005. The WHP plan was approved on March 9, 2006. The City will make every effort to reduce the contamination and protect the ground water from becoming contaminated.

F Capital Improvement Plan

Capital improvement plan (CIP) is the short and long term financial planning tool to address the community needs in the future for improving the distribution system and to provide sufficient and safe drinking water to the community.

2.F.1 Adequacy of Existing Water System to Meet the Current and Projected Demands

The existing water system is capable of handling the current demands of the City but few changes and additions will be required in future to meet the needs of growing population. The improvements needed are discussed below:

Water Production Facilities

Five operating wells that provide water to the City of Grand Rapids have a total pumping capacity of 4,931 GPM with the firm well capacity of 3,036 GPM. The table below shows the future raw water firm pumping capacity, needed, in order to supply water for the maximum day demand

Year	Firm Well Capacity (GPM)	Maximum Day Water Demand (GPM)	Firm Capacity Needed
2010	3,036	1,884	0
2020	3,036	2,219	0

As the estimated maximum day water demand is less than the existing firm well capacity, no additional well will be needed in future until the year 2020 to meet the demand of the growing community. The existing wells are capable of providing the current and the future needs of the City.

Water Treatment

The City of Grand Rapids' WTP is designed to treat 2,100 GPM and has been operated acceptably up to 2,500 GPM for short duration. To account for filter back wash cycle, the 24-hour rated capacity is reduced to 1,925 GPM. But as the maximum day demand may reach the existing treatment capacity by 2020, expansion of treatment plant will be required in the future.

Water Storage Facilities

The City of Grand Rapids has 1,500,000 gallons of elevated water storage, and 500,000 gallons in ground (clearwell) storage available to the system. Since the high service pumps essential for conveying the ground storage water to the system, do not have an on-site back-up source of power, even a major power failure could render this storage volume unavailable to the system. The elevated storage would continue to supply water

until the tank is empty. Hence the existing ground storage capacity cannot be included in the existing storage capacity leaving the system storage capacity of only 1,500,000 gallons. Approximately 2.2 MG of storage will be needed to meet 2020 storage needs. This is 0.7 MG greater than the existing elevated capacity. Hence an additional 0.5-1.0 MG of water storage would be required by the City to meet the 2020 demand.

The alternative to constructing a new elevated tank is to provide a source of back-up power which can continuously provide power to the system during an electrical outage.

Water Distribution System

The City has certain water mains which has a diameter less than 6-inches. The City needs to replace these mains with a 6-inch or larger diameter. Also to serve better under pressured existing and future customers with satisfactory water pressure, the hydraulic grade line of the low pressure system needs to be raised to approximately 1,470 feet above mean sea level (MSL) through the replacement or relocation of the existing low pressure system elevated storage tank.

The improvements needed in the future as discussed above is summarized in a CIP prepared by TKDA and is attached in Appendix D. It also includes the estimated project cost in 2002-dollar amount.

2.F.2 Water Source Alternatives

The City of Grand Rapids has adopted a joint resolution for the orderly annexation of the township of Grand Rapids and is expected to undergo expansion of the water system over the next 15 years due to the growth. In addition, the City of Grand Rapids is considering providing water to the City of Cohasset to the west, Harris Township to the south, and could someday provide service to the Potlatch Mill located south of the river and adjacent to the Cohasset border.

2.F.3 Preventive Maintenance

Long-term preventive measures will help to reduce the risk of emergency situations. The City of Grand Rapids is in process of taking the following preventive maintenance measures.

1. The City has an average of 10.4% of unaccounted water for the last 10 years, which is higher than 10% limit set by AWWA. This might be due to leakage or other un-metered uses. As the distribution system continues to age, watermain leaks may become more prominent. The City has performed system wide leak detection in 1996 and a meter change-out program is currently in place. The City might need to continue meter change-out program and if needed, additional leak detection efforts should be implemented to reduce the un-accounted for water use.
2. The existing distribution system has nearly 10,000 feet of 4-inch watermains serving the City of Grand Rapids. The City needs to replace the small diameter mains by 6-inch or larger diameter mains. This will help the City to maintain sufficient pressure in their system.

CHAPTER 3

EMERGENCY RESPONSE PROCEDURES

This section will serve as the City of Grand Rapids Water System Emergency Plan. Copies of this section along with multiple copies of the "Emergency Reporting Information" form will be made readily accessible to all the appropriate personnel. The purpose of this plan is to prepare a detailed description of procedures to follow in the event of a disruption of normal water service. The disruption could be natural or manmade, and could affect the entire water system or only parts of the system. Since this plan cannot address all the potential disasters, the intention is to give the water utility staff, guidelines to quickly restore normal water service with a minimum disruption, and to minimize any potential health and safety risks. This plan should be coordinated with the emergency plans of other cities and regional entities: Police, Fire, Public Works, etc.

The City of Grand Rapids has submitted their emergency response plan to the United States Environmental Protection Agency (USEPA) in the year 2004. The information about the completed Federal Emergency Response Plan is provided below:

Emergency Response Plan	Contact Person	Contact Number
Emergency Response Lead	Dennis Doyle	218-326-7192
Alternate Emergency Response Lead	Anthony Ward	218-320-7024
Emergency Response Plan Certification Date	April 2004	

The emergency telephone list of the key utilities and the community personnel, contractors and suppliers is attached in Appendix E.

D Allocation and Demand Reduction Procedures

Every city should have a plan that includes the procedure to address the gradual decrease in water supply as well as emergencies and a sudden loss of water due to line breaks, power failures etc. Along with the implementation of other water emergency measures, demand reduction measures should also be implemented.

According to the Minnesota Statutes 103G.261, during the period of limited water supplies, all water suppliers are required to allocate their water based on priorities. During emergency, the allocation should distribute water equitably within each water use priority and the customer category. Non-essential use of water is the lowest use priority

and should be the first water use subjected to allocation restrictions. Quick responses to restrict the non-essential use of water during the periods of limited supplies will help protect the domestic and the economic use of water.

3.D.1 Water Demand Allocation Priorities According to The Minnesota Statutes

When there is not enough water for everyone, Minnesota law sets general priorities for which the users can appropriate water of the state. These priorities from highest to lowest are as follows:

First Priority: Domestic water supply excluding industrial and commercial uses of municipal water supply, and use for power production that meets contingency requirements.

Note: Domestic use is defined (MN Rules 6115.0630, Subp.9) as the use for general household purposes and human needs such as cooking, cleaning, drinking, washing, and waste disposal, and uses for on-farm livestock watering excluding commercial livestock operations that use more than 10,000 gallons per day (GPD) or one million gallons per year (MGY) of water.

Second Priority: Water use involving consumption of less than 10,000 GPD.

Third Priority: Agricultural irrigation and processing of agricultural products (exceeding 10,000 GPD).

Fourth Priority: Power production in excess of the use provided for in the contingency plan under first priority.

Fifth Priority: Uses, other than agricultural irrigation, processing of agricultural products, and power production (exceeding 10,000 GPD).

Sixth Priority: Non-essential uses. These uses are defined by the Minnesota Statutes 103G.291 as lawn sprinkling, vehicle washing, golf course and park irrigation, and other non-essential uses.

3.D.2 Procedure for Water Use Priorities and Demand Reduction Potential for The City of Grand Rapids

Each city needs to develop their own water use priorities based on their customer categories. The local allocation priorities will need to address water used for human needs at residential and other different types of facilities such as hotels, office buildings and manufacturing plants.

A simplified means of viewing water use groups is that the demands associated with the higher priority water use groups must be met prior to the allocation of water to the subsequent lower priority groups. The foremost priority for the City of Grand Rapids is to provide water for the human needs at hospitals, nursing homes and similar types of facilities. The other local priorities set by the City of Grand Rapids are discussed in detail below:

First priority – The first priority for the City of Grand Rapids will be to provide water for the domestic use. Domestic use is usually the residential usage excluding the water used for the non-essential purposes such as lawn sprinkling, car washing, etc.

The average residential demand (excluding the non-essential use) for the City of Grand Rapids for the year 2005 was about 0.322 million gallons per day (MGD). Assuming that the domestic use is typically the winter demand (when the non-essential use such as lawn sprinkling is negligible), the average residential demand is calculated using the average of the residential demand for the winter months (January, February and March).

The demand reduction potential is the demand that the City can restrict during an emergency. The demand reduction potential for the first priority group would be 0.07 MGD. The demand reduction potential is calculated by subtracting the winter demands (January, February and March) from the average of summer demands (July and August). Theoretically, all demands in excess of 1st priority water demands can be subjected to restrictions and therefore represents the potential water use reductions.

Second Priority - When there is more than enough water to meet the City of Grand Rapids 1st priority demands, water can be allocated to the 2nd priority water use group. The second priority water use group includes the non-domestic usages (agricultural, commercial, and industrial) of less than 10,000 GPD. This quantity will be approximated as the summation of commercial, industrial and institutional uses. The 2005 average day demand for the non-domestic use was 0.35 MGD and the demand potential reduction was

0.093 MGD. The average day demand of this group excludes the excess of 10,000 gallons of water used by the large volume customers.

Third Priority - When there is more than enough water to meet the Grand Rapids' 1st and 2nd priority demands, water could be allocated to the 3rd priority uses. The third priority water use group includes agricultural irrigation and agricultural products processing with usage in excess of 10,000 GPD. No such usage was identified for the City of Grand Rapids at present.

Fourth Priority - The fourth priority water use group is the water used for producing power in excess of contingency power requirements. No such use exists for the City of Grand Rapids.

Fifth Priority - When there is more than enough water to meet the Grand Rapids' priority 1, 2, 3, and 4 demands, water could be allocated to the 5th priority uses. The fifth priority water use group includes commercial and industrial use in excess of 10,000 GPD. The average day demand for the year 2005 for such group was 0.47 MGD whereas the total potential reduction was 0.47 MGD. For this group, it is assumed that the entire water supply can be restricted during the emergency as large volume customers are also included in the second priority group with limited supply of water.

Sixth Priority - When there is more than enough water to meet the Grand Rapids' priority 1, 2, 3, 4, and 5 demands, water could be allocated to the 6th priority use. The sixth priority water use group includes non-essential usage such as sprinkling and car washing and internal system maintenance such as hydrant flushing, street sweeping, etc. The total potential reduction in demand for a restriction on the 6th priority use is strongly dependent on the season of the year.

The average day demand for the non-essential usage includes water used for lawn sprinkling and water used for the internal system maintenance (other category for the City of Grand Rapids). The average day demand for the year 2005 was about 0.079 MGD. The water used for non-essential purposes is the first water usage on which the restrictions can be imposed. Hence the demand reduction potential for this category would be 0.079 MGD.

In an emergency, sprinkling bans could be easily instituted. It should be noted that the difference between the winter and the summer usage may be due in part to increases the domestic consumption (i.e. ingestion and showers) during warmer months. Thus, expecting that a restriction of priority six usages will reduce the summer use to the

cumulative winter demand associated with priorities 1 through 5 may be overly optimistic for the City of Grand Rapids. During a very high sprinkling period it would be reasonable to expect that a total sprinkling ban would reduce the cumulative demand by about 30%. This is based on the assumption that the vast majority of the difference between the average summer quarter use and the peak day use is due to non-essential usage (sprinkling and car washing). Much less reduction would be expected in association with an odd/even sprinkling ban instituted during a high volume sprinkling month. In fact, some people may even use more water for sprinkling, due to the perception that they (their lawn) might otherwise be deprived. It will be conservatively assumed that on average people will continue to sprinkle 75% as much as they would otherwise. In other words, on their day to water they will water half again as much as they would if there was not an odd/even ban in effect. It will again be assumed that the difference between the maximum day demand and the average demand during a sprinkling/summer month constitutes the maximum amount of non-essential use. For these assumptions, the potential demand reduction associated with an odd/even sprinkling ban is 7.75% $[(1 - 0.75)(30\%) = 7.75\%]$ during a period of high sprinkling use. An odd/even ban would also be expected to decrease the peak day demand for the period in which the ban was in place, because there should be less simultaneous sprinkling.

Tables 8 lists the water use priorities for the City of Grand Rapids based on their customer categories. It also includes the average day demand and the demand reduction potential for each category.

3.D.3 Short-Term Demand Reduction Procedures

The primary focus of any short-term demand reduction procedure is to develop the emergency measure for the summer months. It also provides the measures used in the emergencies during other times of the year such as an emergency due to water main breaks, power outage, well contamination, etc.

The City of Grand Rapids will develop water related ordinances that allow Public Utilities Commission, an adequate flexibility to implement short-term reduction measures. In particular, the Public Utilities Commission will be empowered to develop and enforce emergency specific resolutions for the purpose of short-term demand reductions. This will include the authority to enact emergency and user-category specific water rates (i.e. double or triple normal water rates), impose fines for violations, or discontinue water service to non-compliant customers. A list of standard reduction measures and their associated actions is summarized below.

Voluntary Reduction Measures: Public service announcements, “bill stuffers”, fliers, notices in local newspaper, announcements on the City’s website.

Sprinkling Bans: Odd/even ban or a total ban in an extreme emergency.

Water Allocation Restrictions: Based on the severity of emergency and the water use priorities defined in the previous section.

The above measures are progressively more stringent and are to be used as the length or severity of an emergency warrants. Triggers for each of the short-term demand reduction measures are outlined in the next section.

Triggers for Implementing Plan Components

The critical factor in the Grand Rapids water system is the well/pump supply capacity. The capacity with the largest working/usable well out of service is defined as the well firm capacity. Demand reduction measures are to be used to ensure that the pumpage demand does not exceed the well firm capacity. Thus, a reasonable trigger for the City of Grand Rapids is the percent of the well firm capacity posed by current or anticipated pumpage demands [i.e. (anticipated pumpage demand/well firm capacity)*100]. Note that the well firm capacity may change based on the type of emergency; for example, if a well or wells is rendered inoperable or unusable due to the emergency at hand. The current well firm capacity is 4.4 MGD.

Table 9 lists short-term demand reduction measures and their associated triggers. The triggers are based on the maximum potential demand reductions estimated in the above section. The triggers are provided as guidelines, and the listed demand reduction measures can definitely be implemented prior to these triggers if deemed appropriate by experienced City water personnel. In the event of an extreme or unusual emergency, a meeting should be called and organized in order to identify appropriate emergency response measures.

The customers would be informed regarding the emergency procedures and responses they may need to implement through the bill stuffers, fliers, advertisements on television, radio and website and through public announcements.

E Enforcement

Enforcement should become more stringent as an emergency progresses. Since the odd/even sprinkling bans have not been practiced by the City of Grand Rapids, the City will have to develop water related ordinances which will allow the Public Utilities Commission to implement odd/even sprinkling bans and more stringent conservation measures as deemed necessary. Odd/even sprinkling bans can be enforced by the water operation and maintenance department and the police department as complaints are called in. Total sprinkling bans and other allocation eliminations can be monitored by the water utility staff and enforced as needed by the police department.

The City ordinances should allow enforcement to include fines, other penalties such as adjusted billing rates, and the cutting off of water supplies to offending customers. Customers can be notified of the penalties using bill stuffers and/or public announcements in the event of a total sprinkling ban or more stringent water conservation measures.

Authority to Implement Water Emergency Response

During the emergency, GRPUC General Manager or Utility Manager, Anthony Ward will have the authority to implement water use restrictions and response plan. In case of emergency, if the Utility Manager is not available, his designated representative, water treatment plant Manager, Dennis Doyle will have the authority to implement a water emergency response action.

CHAPTER 4

WATER CONSERVATION PLAN

Water conservation is an important part of water resource management and it helps the City to satisfy the ever-increasing demands being placed on the water resource. The purpose of this plan is to describe the City's approach to water conservation. The City of Grand Rapids' goals of conservation in a water supply are detailed below.

A Goals of Conservation

Conservation measures can be used to reduce the demand for water, improve the efficiency of water use, and reduces the loss and waste of water. In some cases, conservation of water can actually be an alternative to developing additional source of water to meet peak demands for the non-essential water use.

Reducing the peak water use is the ultimate objective of the conservation. Thus, conservation is a more general and long-term approach which works towards the same objective as the short-term demand reduction measures (discussed in Chapter 3). Reducing the peak water use will delay or reduce the additional source development and water storage requirements. Conservation is most easily measured by the reductions in unaccounted water, and the residential and overall per capita water usage.

Unaccounted Water

The average volume of unaccounted water for the City of Grand Rapids since the year 2002 is 41,400,000 gallons which is about 8.9% of total water use. The unaccounted use of water when the first generation of WECP was submitted was about 16% and now it has reduced to 8.9% since the last 5 years. It is now under the 10% limit set by AWWA.

The City has conducted system wide leak detection in 1996 and the meter change-out program is currently in place to reduce the unaccounted water use. The City of Grand Rapids will continue to carry out such programs in the future whenever the need arises.

Residential Gallons Per Capita Demand

As discussed before, residential gallons per capita demand (GPCD) is one of the most important factors which helps in conserving the water for the future use. The average

residential usage for the City of Grand Rapids for the last 5 years was 39.6 gallons per capita per day (gpcd). The average residential use for the Twin Cities Metropolitan Area in the year 2002 was 75 gpcd. The average GPCD for the City of Grand Rapids is much lower, almost half the average of Twin Cities Metropolitan Area. Figure 6 shows that the annual residential per capita demand for the City of Grand Rapids has remained almost constant since the last 10 years and the City will make ongoing efforts to reduce this average or at least keep this average constant in the future. The progress towards this goal will be reviewed regularly.

Total Per Capita Demand

Figure 6 shows the trend of per capita demand for the City of Grand Rapids. The graph shows the decrease in the total per capita demand since last 5 years and this shows the efforts of the City in conserving water.

Peak Demands

The average of maximum day to average day ratio for the City of Grand Rapids for the last 5 years was about 2.27 which is below 2.6 ratio suggested in the DNR guidelines.

B Water Conservation Programs

Short-term conservation measures are the programs that are available for use in an emergency and long-term measures are the programs that improve the water use efficiencies.

Short-term conservation measures are discussed in the Water System Emergency Plan and will not be readdressed in this section. The specific measures for facilitating conservation as recommended by the DNR includes: 1) Metering 2) Water Audits 3) Leak Detection, and Repair 4) Conservation-Oriented Water Rates 5) Regulations 6) Education and Information Programs and 7) Retrofitting Programs. These seven long-term conservation measures are discussed, as they relates to the City of Grand Rapids, in the following subsections.

4.B.1 Metering

The American Water Works Association (AWWA) recommends that every water utility should meter all the water taken into the system and all the water distributed from its

system at its customer's point of service. An effective metering program relies upon periodic performance testing, repair, repair and maintenance of all the meters. AWWA also recommends that the utilities should conduct regular water audits to ensure accountability.

All Grand Rapids water system users are metered and all meters are read monthly. The goal for the City of Grand Rapids is that no private users will be added to the system without a meter. If wasteful uses of water are identified, adjusting the rate structure may be the best means of encouraging more efficient use of water. At large or corporate facilities, the City could provide separate meters for sprinkling and charge a higher rate for water used in association with those meters. Meters could be tested and recalibrated periodically, and repaired (or replaced) as needed. Table 10-A&B shows the metering details for the City of Grand Rapids.

4.B.2 Unaccounted

Unaccounted-for water is the difference between the volume of water that goes in to the system and the volume of water that is sold. Losses are typically due to water main leakage and breaks; hydrant flushing to remove iron and manganese precipitates in water mains, and other unbilled usage. AWWA recommends a goal of 10% or less for unaccounted water use. To reduce and keep track of the unaccounted water, AWWA recommends doing regular water audits for the system.

The Grand Rapids system does water audits every year to identify, quantify and verify water and revenue losses. Water audits for residences and businesses is the way to help educate customers about their water uses and encourage further conservation of water. The City would continue performing water audits for their customers and will consider providing them with information on home water audits and/or providing water audit services kits.

The City will review their monthly customer water use data to identify large increases in the volumes and hence potential leakage. This will better enable the City to assess the condition of their water system. Customers with high water losses could then be targeted for home water audits or repair programs such as "Waters Off". "Waters Off" program is the program used in Minneapolis-St. Paul area in which the City monitors water bills of elderly and lower income water customers. Water audits are used to determine if

customers with high volume water use have leaking fixtures, etc. that need to be repaired. The United Association of Plumbers Local 15 and Local 34, the Minnesota Mechanical Contractors and the Plumbing Service Industry Council sponsors and donate time and material to fix leaking appliances and retrofit old fixtures in the homes of elderly and low-income water customers.

The City of Grand Rapids performs leak detection and surveys periodically as needed. The last leak detection survey was done on July 7, 1996. The City will continue to keep annual records of their unaccounted-for water usage. Leak detection efforts would then be concentrated in those areas of the distribution system where there is a greater percent of unaccounted water. When a particular leaky pipe is discovered, it would be repaired or replaced. The rate structure would be adjusted to include costs associated with leak detection and repair activities.

4.B.3 Conservation Water Rates

The City of Grand Rapids is billing their water customers every month in terms of the gallons of water used. At present, the City is using a declining block rate structure to pay for the true cost of supplying, treating, and delivering the water including maintenance, billing, and all planned water system capital improvements. Declining block is the term used when the rate per unit decreases as water use increases.

The City of Grand Rapids evaluates their water rates structure every 5 years. A new rate study was conducted recently in August 2006. For the purpose of conservation, flat rate structure was proposed but the City opted to maintain the declining block rate structure (five step rate for water) and just adjust the rates at this time rather than converting the system to flat rate for water use. As per the new rate proposed, the developed commodity rate has been adjusted for the outside-city customers based on the existing rates whereas the fixed costs were not changed. For inside-city customers, both commodity and fixed cost will remain the same. The newer rate is not implemented as of yet into the system. The current rate structure is included in Appendix F.

Currently, the City bills users outside the city limits at a higher rate (about 8% higher) than those within the City limits. According to the new rate structure developed, the City also plans to continue this practice but with higher rate factor. With the new proposed

rates in place, outside-city customers will pay roughly 1.08 times higher than the inside-city rates.

The present water rates do not generate enough revenue for a perpetual water supply for the GRPUC customers and hence it is recommended that the City should review these rates annually and small increases be considered to compensate for deficiencies in revenue. Often times, the industries can reduce their total water use by recycling used water instead of sending it straight to the sewer (i.e. using spent cooling water as wash water). Thus, in the future, the City would consider adjusting their sewer charges to promote conservation amongst their commercial/industrial users. The City would continue to update their water rate structure at least every five years.

Additionally, the City of Grand Rapids considers the development of emergency specific rates (i.e., double or triple the normal rates) to be a useful means of restraining use during an emergency. The City should also consider adopting a seasonal rate to reduce their non-essential uses and peak demands.

4.B.4 Regulation

According to the DNR, every city should implement regulations and ordinance for short-term and long-term reduction in demand and improvements for water use efficiencies. As summer lawn metering creates large demands on local water facilities, the DNR strongly recommends considering adopting a restrictive ordinance that bans all lawn watering between 10:00 A.M. to 6:00 P.M. for the entire summer. This will help to reduce long-term water use and improve efficiency application. Studies on lawn watering indicate that much of the water applied during this time period is wasted, as it is lost to evaporation. The City of Grand Rapids has no such lawn water restrictions, as the residential per capita day demand is very low. The City will consider implementing such lawn watering restrictions in future to reduce the needs of watering restrictions and expansion of their water system.

Associated State and Federal Plumbing Codes require that all new homes and retrofits of the existing homes utilize water efficient fixtures. These are the primary regulations which will help ensure long-term improvements in water use efficiencies. As discussed in Chapter 3, the City will develop resolutions/ordinances that allow the Public Utilities Commission, an adequate flexibility to implement short-term reduction measures. The

Public Utilities Commission will take steps deemed necessary to discourage ongoing wasteful use of water.

4.B.5 Education and Information Programs

Customers should be provided information on how to improve water use efficiencies. The City of Grand Rapids currently provides the annual drinking water report and the consumer confidence report to all of their customers. Grand Rapids also educate their people by sending “bill stuffers” (available from AWWA) and fliers, school curriculums on water resources (National Drinking Water Week), and direct mailings to encourage voluntary water reduction measures. Sample copy of educational materials as used by the City of Grand Rapids for the last couple of years are attached in Appendix G.

The City also educates people to change their water use habits which would facilitate conservations. This includes taking short showers, using less bath water, turning faucets off while brushing teeth, only running dishwashers when they are full, etc.

In some areas of the country, landscaping changes can substantially reduce watering requirements. It is not believed that substantial conservation results are possible through landscaping efforts in Grand Rapids.

In the past, the City has used both bill stuffers and articles in the local newspaper to educate their customers. Because the City already has a very low residential per capita water usage, residential bill stuffers and school programs will not be implemented for water conservation related education until the need arises. During the sprinkling bans and the emergency periods, public service announcements will be issued in the local newspaper; in addition, special mailings may be issued to inform relevant customers.

4.B.6 Retrofitting Programs

As mentioned in the previous section, the passage of the Energy Policy Act in 1992 resulted in uniform efficiency standards for virtually all-household fixtures manufactured after January 1994. Thus, even without any formal program for water fixture replacement, it is expected that the City’s per capita water usage will continue to decline. This will occur as residents, by their own free will, replace old water fixtures with post-1994 fixtures. Amy Vickers, the principal author of the water efficiency standards for

plumbing fixtures in the Energy Policy Act, made the following estimation in August 1993 AWWA Journal article:

“Based on the combination of fixtures of different ages now in use, the average 2.63-person household uses about 121 gal/day for toilets, showerheads, and faucets. This will probably drop to about 55 gal/day by 2026 as the pre-1994 generation of fixtures is replaced by the post-1994 stock.”

Actual water reduction in a given house will depend on the number of persons in the household, individual water use habits, and the number and type of water fixtures used in the household. A greater rate of reduction in residential per capita water use could be achieved through the implementation of a mandated water fixture retrofit program. The costs associated with a mandated fixture replacement program could be incorporated into the City’s water rate structure. However, both costs and benefits should be carefully assessed prior to the implementation of any such program.

The City would also consider adopting an ordinance that requires all the new buildings and facility constructions requiring a City permit (i.e. a remodeling permit) to retrofit with water efficient fixtures as a condition of the permit if the need arise. At this time the City does not plan to implement such program.

CHAPTER 5

SUMMARY OF WATER EMERGENCY AND CONSERVATION PLAN

Chapter 5 summarizes the water emergency and conservation plan for the City of Grand Rapids as required by the DNR. Goals, policies and recommended actions for the City of Grand Rapids are addressed below:

A Goals

1. Promote sustainable use of the City's municipal water supply source.
2. Protect the health and economic well being of the City's citizens by providing safe and dependable water service at a reasonable cost.
3. Operate the City's water service so that it is economically self-sufficient and so that the rates and reserves allow for an appropriate infrastructure replacement schedule.
4. Protect the quality and quantity of groundwater resources and promote groundwater recharge.

B Policies

1. Coordinate with the appropriate state and regional agencies to ensure the sustainable use of the Glacial Drift and Biwabik/Pokegemon aquifer from which the City is withdrawing water.
2. Remain in compliance with State and Federal Drinking Water Standards.
3. Frequently monitor the water use to ensure that the existing wells are adequate to meet the current and future demands of the City.
4. Encourage water conservation to reduce the need of additional water supply wells.
5. Continue to plan for short-term and long-term system needs to insure rate stability and the economic self-sustainability of the City's water supply system.
6. Encourage all property owners to connect to the City's municipal water supply system.

7. Encourage proper capping and sealing of all unused wells to protect the groundwater quality.
8. Monitor and reinforce the security of the water source and its physical infrastructure.

C Recommended Actions

1. The GRPUC will continue to analyze its water production and distribution system on a regular basis and will provide system upgrades or component replacements as well as routine maintenance projects as necessary.
2. The GRPUC will continue to employ the following water conservation measures:
 - Voluntary Reduction Measures
 - Sprinkling Bans
 - Water Allocation Restrictions
3. The GRPUC will continue to follow the enforcement procedures for water conservation measures that are specified in the City ordinance.
4. The GRPUC will continue to maintain drawdown records as part of the long-range maintenance of well water levels to insure sustainable aquifer use.
5. To ensure the integrity of the public water supply, the PUC will continue implementing a systematic replacement of cast-iron and other outdated constriction materials used for watermain construction as the opportunities arise through street construction and other infrastructure improvement projects.
6. The City should continue its operation and maintenance activities which includes seasonal water main flushing, hydrant and valve inspection and exercising, annual well column, pump, line shaft and motor inspection and repair when appropriate.

CERTIFICATION OF ADOPTION

WATER EMERGENCY AND CONSERVATION PLAN

City or Water System Name: City of Grand Rapids, MN

Name of Person Authorized to Sign
Certification on Behalf of the System: Anthony Ward

Title: General Manager

Address: Grand Rapids Public Utility Commission,
P.O. Box 658, 500 SE 4th Street,
Grand Rapids, MN 55744

Telephone: 218-326-7188

Fax: 218-326-7499

Email: atward@grpuc.org

I certify that the Water Emergency and Conservation Plan approved by the Department of Natural Resources has been adopted by the Public Utilities Commission that has authority over water supply services.

Signed:

Date:

TABLES

**Table 1-1
Summary of Historic Water Use
Grand Rapids, MN**

Year	Total Population	Serviced Population	Total Service Connections	Total Water Pumped (MG)*	Total Water Sold (MG)*	Total Gallons Per Capita per Day (gpcd)**
1996	8387	8,163	2,841	513.2	432.3	172.2
1997	8,383	8,163	2,834	577.7	478.1	193.9
1998	8,378	8,434	2,905	547.7	458.9	177.9
1999	8,374	8,434	2,880	582.8	446.6	189.3
2000	8,369	8,434	2,976	609.8	471.2	198.1
2001	8,425	8,434	2,979	603.5	443.6	196.0
2002	8,525	8,434	3,061	570.9	440.2	185.4
2003	8,725	8,434	3,088	516.1	422.7	167.6
2004	9,025	7,764	3,113	509.4	409.6	179.7
2005	9,300	8,478	3,322	528.0	426.3	170.6
2006	9,500	8,543	3,286	509.5	403.8	163.4
					Average	181.3

* Total water pumped and sold data are from annual Audit report provided by the City

**Total Gallons per Capita per Day = total water withdrawal/population served/365 days.

Table 1-2
Summary of Production and Distribution Statistics
Grand Rapids, MN

Year	Total Water Pumped (MG)	Total Water Used in Processing (MG)	Total Water into the System (MG)	Total Water Sold (MG)	Unaccounted Water (MG)	% of Unaccounted Water
1996	513.2	2.9	510.3	432.3	78.0	15.3
1997	577.7	27.5	550.2	478.1	72.1	13.1
1998	547.7	50.1	497.6	458.9	38.7	7.8
1999	582.8	79.2	503.6	446.6	57.0	11.3
2000	609.8	88.8	520.9	471.2	49.7	9.5
2001	603.5	96.7	506.8	443.6	63.2	12.5
2002	570.9	74.8	496.0	440.2	55.9	11.3
2003	516.1	69.3	446.7	422.7	24.0	5.4
2004	509.4	65.8	443.6	409.6	34.0	7.7
2005	528.0	68.6	459.4	426.3	33.1	7.2
2006	509.5	45.5	464.0	403.8	60.2	13.0
					Average	10.4

Average percent unaccounted water for the last 5 years =

8.9 %

**Table 1-3
Historic Water Use Data Based on Customer Category
Grand Rapids, MN**

Year	Population Served	Annual Water Sold (MG)						Residential Usage Per Capita Per Day (gpcd)**
		Residential	Commercial	Industrial	Other	Unaccounted	Wholesale Deliveries*	
1996	8,163	121.9	281.9	Under Commercial	21.91	78.0	N/A	40.9
1997	8,163	120.1	296.3	Under Commercial	41.5	72.1	N/A	40.3
1998	8,434	121.0	333.4	Under Commercial	35.1	38.7	N/A	39.3
1999	8,434	118.8	300.3	Under Commercial	27.5	57.0	N/A	38.6
2000	8,434	120.6	315.4	Under Commercial	0.0	49.7	N/A	39.2
2001	8,434	118.7	283.0	38.4	0.1	63.2	N/A	38.6
2002	8,434	119.0	278.1	40.5	2.6	55.9	N/A	38.6
2003	8,434	120.2	266.3	23.2	79.3	24.0	N/A	39.0
2004	7,764	118.5	265.2	25.6	0.3	34.0	N/A	41.8
2005	8,478	122.7	276.5	24.1	2.9	33.1	12.7	39.7
2006	8,543	121.2	255.5	26.2	0.9	60.2	N/A	38.9
							Average	39.5

The average of annual unaccounted water for the last 5 years = 41.4
The average residential GPCD use for the last 5 years = 39.6

Note:

* Wholesale deliveries is the bulk water sales to other public water suppliers. The data is not available.

** Residential usage per capita per day = total residential sales in gallons/population served/365 days.

N/A - Not Available

**Table 1-4
Summary of Historic Demands
Grand Rapids, MN**

Year	Demand (MGD)		
	Average Day P_{AvgDay}^*	Maximum Day P_{MaxDay}	P_{MaxDay}/P_{AvgDay}
1996	1.40	1.86	1.33
1997	1.51	2.09	1.39
1998	1.36	2.09	1.53
1999	1.38	2.13	1.55
2000	1.43	1.94	1.36
2001	1.39	2.86	2.06
2002	1.36	3.58	2.63
2003	1.22	2.31	1.89
2004	1.22	2.13	1.75
2005	1.26	3.84	3.05
2006	1.27	2.58	2.03
		Average	1.87

The average of maximum day to average day ratio for the last 5 years = 2.27

* The average day demand is the annual production of water/365 days.

Table 2
Large Volume Users for the Year 2005
Grand Rapids, MN

Name of Large Volume Customers	Usage for 2005		Total Annual Use (GPY)	% Annual Use
	(GPD)	(GPY)*		
Blandin Paper Co.	220,697	67,092,000	426,324,000	16%
City of LaPrairie	93,523	28,431,000		7%
Grand Rapids WWTP Primary Plant	46,974	14,280,000		3%
Grand Itasca Clinic and H	34,875	10,602,000		2%
Itasca Community College	33,681	10,239,000		2%
Grand Rapids WWTP Secondary Plant	26,711	8,120,000		2%
Itasca County Court Hou	26,566	8,076,000		2%
Pine Ridge Apartments	20,230	6,150,000		1%
City of Grand Rapids	18,599	5,654,000		1%
Grand Village	18,457	5,611,000		1%
Housing and Redevelopment Authority	18,000	5,472,000		1%
YMCA	17,520	5,326,000		1%
Sawmill Inn	17,477	5,313,000		1%
School District 318	14,730	4,478,000		1%
Manor House	12,309	3,742,000		1%

Large Volume customers are the customers that uses more than 10,000 GPD of water.

* The GPY data is for the year 2005-2006 and for the 10 months period as provided by the Grand Rapids Public Utilities Commission.

**Table 3-A
Details of Water Treatment
Grand Rapids, MN**

Well No.	1	2	3	4	5	6
Disinfection	None					
Fluoridation	H ₂ SiF ₆					
Oxidation	KMnO ₄					
Softening	Ion Exchange					
Iron and Manganese Removal	Aeration and Chemical Oxidation					

Key to Symbols

H₂SiF₆ - Hydrofluorosilicic Acid (for fluoridation)

KMnO₄ - Potassium Permanganate

**Table 3-B
Details of Storage Facility
Grand Rapids, MN**

	Storage			
Name	Tower No. 1 (North Tank)	Tower No. 2 (South Tank)	Tower No. 3 (New Tank)	Ground Storage (Clearwell)
Location	936 9th St NW	10th St and 2nd Ave SE	Southern Part of the City	WTP
Type	Elevated	Elevated	Elevated	Underground
Volume (MG)	0.5	0.5	0.5	0.5
Overflow Elevation (feet)	1420	1418	1520	1294

**Table 4-B
Details of Ground Water Storage
Grand Rapids, MN**

Total Well Capacity = 4931 gpm
Firm Well Capacity * = 3036 gpm

SERVICE AREAS:						
Pressure Zone						
SUPPLY:						
Well No.	1	2	3	4	5***	6
Location	North of WTP	South of WTP	East of WTP	North of Hale Lake	North of Hale Lake	South of Well no. 4
Capacity (GPM)**	553	600	543	1340	1400	1895
Capacity (MGD)	0.80	0.86	0.78	1.93	2.02	2.73
Year Installed	1938	1951		1977	1985	1984
Unique Well Number	228870	228873	228862	127276	161423	161444
Casing Diameter (inches)	12	16	16	16	16	16
Casing Depth (feet)	118	382	120	117	80	100
Well Depth (feet)	176	573	180	157	135	140
Formation	GD	Biwabik / Pokegama	GD	GD	GD	GD
Static Level (feet)**	18.5	45.5	18.5	39	35	47
Drawdown (feet)**	53.67	149.83	46.2	10.5	9	7.08
Pump Type	Sub	Sub	VT	VT	VT	VT
Motor HP	750	675	850	1100	1575	1200
Status	Active	Active	Active	Active	Inactive	Active

* Firm Well Capacity = Total Well Capacity - Biggest well out of service

** Well Capacity data, static level and drawdown data is from 2006 Their Well Report provided by the City

*** All data for well 5 is from old WECP report.

KEY TO SYMBOLS:

VT - Vertical Turbine

GD - Glacial Drift

Sub - Submercible

Table 4-C
Surface Water Source Details
Grand Rapids, MN

Surface Water Intake ID	Resource Name	Capacity	
		GPM	MGD
-	-	-	-
-	-	-	-

Note: The City of Grand Rapids does not have any surface water source. The City solely relies on the ground water source.

Table 4-D
Wholesale or Retail Interconnections
Grand Rapids, MN

Water Supply System	Capacity		Wholesale or Retail
	GPM	MGD	
City of La Prairie	29.09	0.04	Wholesale

The capacity data is for the year 2006.

**Table 4-E
Emergency Interconnections
Grand Rapids, MN**

Water Supply System	Capacity		Note any Limitations on Use
	GPM	MGD	
-	-	-	-
-	-	-	-

The City of Grand Rapids has no Emergency Interconnection with neighboring suppliers or any other private source.

**Table 5
Future Demand Projections
Grand Rapids, MN**

Year	Total Population	Population Served	% Population Served	Average Day Demand P_{AvgDay} (MGD)	Maximum Day Demand P_{MaxDay} (MGD)	Maximum Hour Demand P_{MaxHr} (MGD)	Projected Demand (MGY)
1997	8,387	8,163	0.97	1.51	1.4	NA	-
1998	8,383	8,434	1.01	1.36	1.53	NA	-
1999	8,378	8,434	1.01	1.38	1.55	NA	-
2000	8,374	8,434	1.01	1.43	1.36	NA	-
2001	8,369	8,434	1.01	1.39	2.06	4.12	-
2002	8,425	8,434	1.00	1.36	2.63	5.27	-
2003	8,525	8,434	0.99	1.22	1.89	3.77	-
2004	8,725	7,764	0.89	1.22	1.75	3.50	-
2005	9,025	8,478	0.94	1.26	3.05	6.10	-
2006	9,300	8,543	0.92	1.27	2.03	4.06	-
2007	9,908	9,650	0.97	1.41	2.21	4.43	513.24
2008	10,052	9,790		1.43	2.26	4.52	520.69
2009	10,165	9,900		1.44	2.31	4.62	526.54
2010	10,268	10,000		1.46	2.35	4.69	531.86
2011	10,422	10,150		1.48	2.41	4.82	539.84
2012	10,653	10,375		1.51	2.48	4.96	551.80
2013	10,966	10,680		1.52	2.51	5.02	554.80
2014	11,295	11,000		1.53	2.56	5.11	558.45
2015	11,603	11,300		1.54	2.58	5.16	560.59
2016	11,808	11,500		1.56	2.64	5.28	570.52
2020	12,183	11,865	1.58	2.77	5.53	577.09	

Note:

The average % population served for the last 10 years is about 97%.

For projection of population from the year 2007-2016, it is assumed that the % population served will remain 97% for the next 10 years.

Average day demand for the year 2010, 2015 and 2020 is projected in Comprehensive Water Study Report by TKDA 2003. Average day demand for the rest of the years is extrapolated based on the year 2010, 2015 and 2020 data. See attached graph in Appendix C.

Maximum day/Average day demand ratio from the year 2007-2020 is used from the Comprehensive Water Study Report prepared by TKDA in 2003.

* P_{MaxHr} is assumed to be twice the P_{MaxDay} demand.

Table 6-A
Well Monitoring Data
Grand Rapids, MN

Unique Well No.	Well No.	Type of Well	Frequency of Measurement	Method of Measurement
		(Production or Observation)	(Daily, Monthly etc.)	(Steel Tape, SCADA, etc)
228870	1	Production	Annually	Level Meter
228873	2	Production	Annually	Level Meter
228862	3	Production	Annually	Level Meter
127276	4	Production	Annually	Level Meter
161423	5	Not in Use	-	-
161444	6	Production	Annually	Level Meter

**Table 6-B
Well Level Data
Grand Rapids, MN**

Year	Draw Down Data (ft)				
	1	2	3	4	6
1996	23.0	41.0	46.2	10.2	7.3
1997	23.1	41.0	46.2	10.2	7.3
1998	23.1	41.5	46.0	10.2	7.3
1999	23.1	41.5	46.2	10.2	7.3
2000					
2001	23.0	41.5	46.2	10.4	7.5
2002				10.4	7.5
2003	44.42	99.92		10.75	7.08
2004	52.83	101		10.75	7.25
2005	44.42	99.92		10.75	7.08
2006	44.42	99.92		10.75	7.08

Year	Water Level Data (ft)				
	1	2	3	4	6
2003	71.83	143.83			54.83
2004	64.58	140.33			54.17
2005	67.5	144		50	54.08
2006	72.17	195.33		49.5	54.08

Well	Static Water Level (ft)		Drawdown (ft)	
	When well constructed	2006	When well constructed	2006
1	10	18.5		53.67
2	8	45.5	25	149.83
3	21	46		46.2
4	39	39	35	10.5
6	43	54.08	6.5	7.08

**Table 7-B
Private Water Source Detail
Grand Rapids, Mn**

Name of Private Water Source	Capacity		Note any Limitations on Use
	GPM	MGD	
-	-	-	-
-	-	-	-

The City of Grand Rapids has no private water source.

Table 8
Water Use Priorities for the Year 2005
Grand Rapids, MN

For Year 2005

Allocation Priorities	Customer Category	Average Day Demand (GPD)	Demand Reduction Potential (GPD)
1	Residential (Domestic use other than non-essential use in lawn sprinkling etc.)	321,778	71,368
2	Commercial, Industrial and Agricultural (water use <10,000 GPD)	353,213	93,423
3	Agricultural Irrigation and Agricultural Processing (water use > 10,000 GPD)	-	-
4	Producing Power in Excess of Contingency Power Requirement	-	-
5	Commercial and Industrial (water use > 10,000 GPD)	470,349	470,349
6	Non-essential (lawn sprinkling, others, etc)	79,436	79,436

* Demand Reduction Potential
 First and Second Priority Group = (Summer Demand)-(Winter Demand)

Table 9
Demand Reduction Procedures
Grand Rapids, MN

Condition	Trigger(s)	Actions
Stage 1 (Mild)	Voluntary Reduction Measures	Always - public service announcements, bill stuffers, notices in local news paper, announcements on the City website. Educating public for water efficient lawn watering practices.
	Restrict lawn watering, vehicle washing, golf course and park irrigation and other non-essential use	People using Municipal water for sprinkling should sprinkle water only between 6:00 a.m. to 11: 00 a.m. and 6:00 p.m. to midnight.
Stage 2 (Moderate)	Odd/Even Sprinkling Ban	When it is anticipated that pumpage demand with voluntary measures may exceed 100% of the firm well capacity [Pumpage Demand w/Voluntary Measures > 4.4 MGD (when all current wells are usable)]
	Suspend lawn watering, vehicle washing, golf course and park irrigation and other non-essential use	Inform public through bill stufferes, fliers, advertisements on television, radio and newspaper, public announcements, etc.
		Enforce violation ticket and penalties for violation and cancel water connection if violation charges increase to certail limit.
Stage 3 (Severe)	Total Sprinkling Ban	When it is anticipated that pumpage demand may exceeds 107.25% of the well firm capacity [Pumpage Demand > 4.7 MGD (when all current wells are usable)]
		When Odd/Even Sprinkling Ban is unable to keep the pumpage demand below 100% of the firm well capacity [Pumpage Demand with Odd/Even Sprinkling Ban > 4.4 MGD (when all current pumps are usable)]
	Providing water as per water use priorities set by the City	Inform public about the emergency and priorities set by the City through various programes, bill stuffers and announcements.
Critical Water Deficiency (M.S.103G.291)	Executive Order by Governor and as provided in above triggers	
	All of the above triggers	

Note: The potential for water availability problems during the onset of drought are almost impossible to predict. Significant increase in demand should be balanced with preventative measures to conserve the supplies in the event of prolonged drought conditions.

**Table 10-A&B
Metering Details
Grand Rapids, MN**

Table 10-A - For Year 2006

Customer Category	No. of Connections	No. of Metered Connections	Meter Testing Schedule (Years)	Average Age/Meter Replacement Schedule (Years)
Residential	2,570	2,570	As Needed	N/A
Institutional	-	-	-	-
Commercial	715	715	As Needed	N/A
Industrial	1	1	As Needed	N/A
Public Facilities	-	-	-	-
Totals	3,286	3,286		

Note:

The City of Grand Rapids has no unmetered system at present.
N/A - Not Available

Table 10-B - For Year 2006

	No. of Metered Connections	Meter Testing Schedule (Years)*	Average Age/Meter Replacement Schedule (Years)
Water Source (Wells/Intakes)	6	Every 10	N/A
Treatment Plants	1	Every 10	N/A

City of Grand Rapids has done their last meter testing 10 years ago.

FIGURES

Figure 1
Variation of Pumpage, Residential Usage and Serviced Population
Grand Rapids, MN

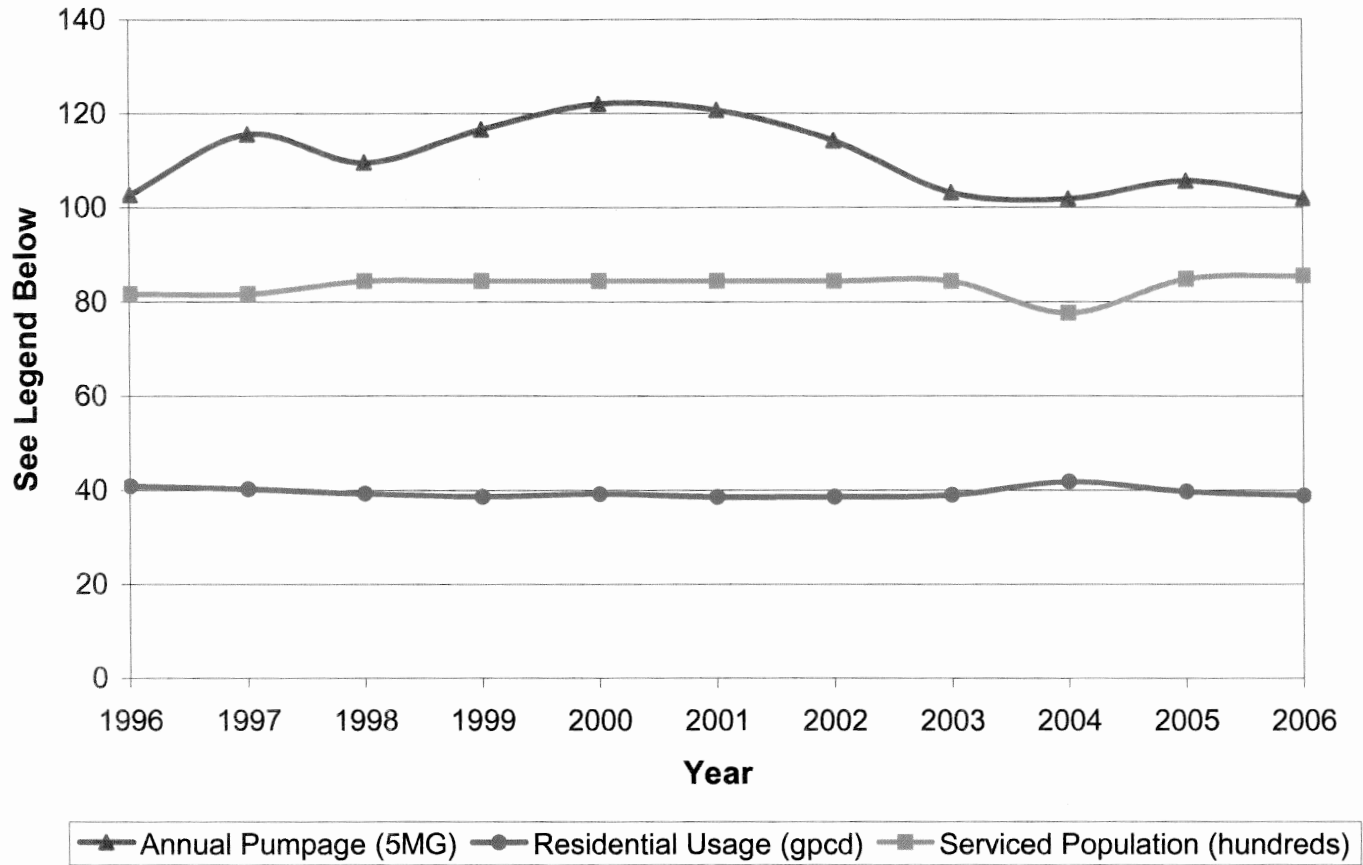


Figure 2
Annual Water Use by Customer Category
Grand Rapids, MN

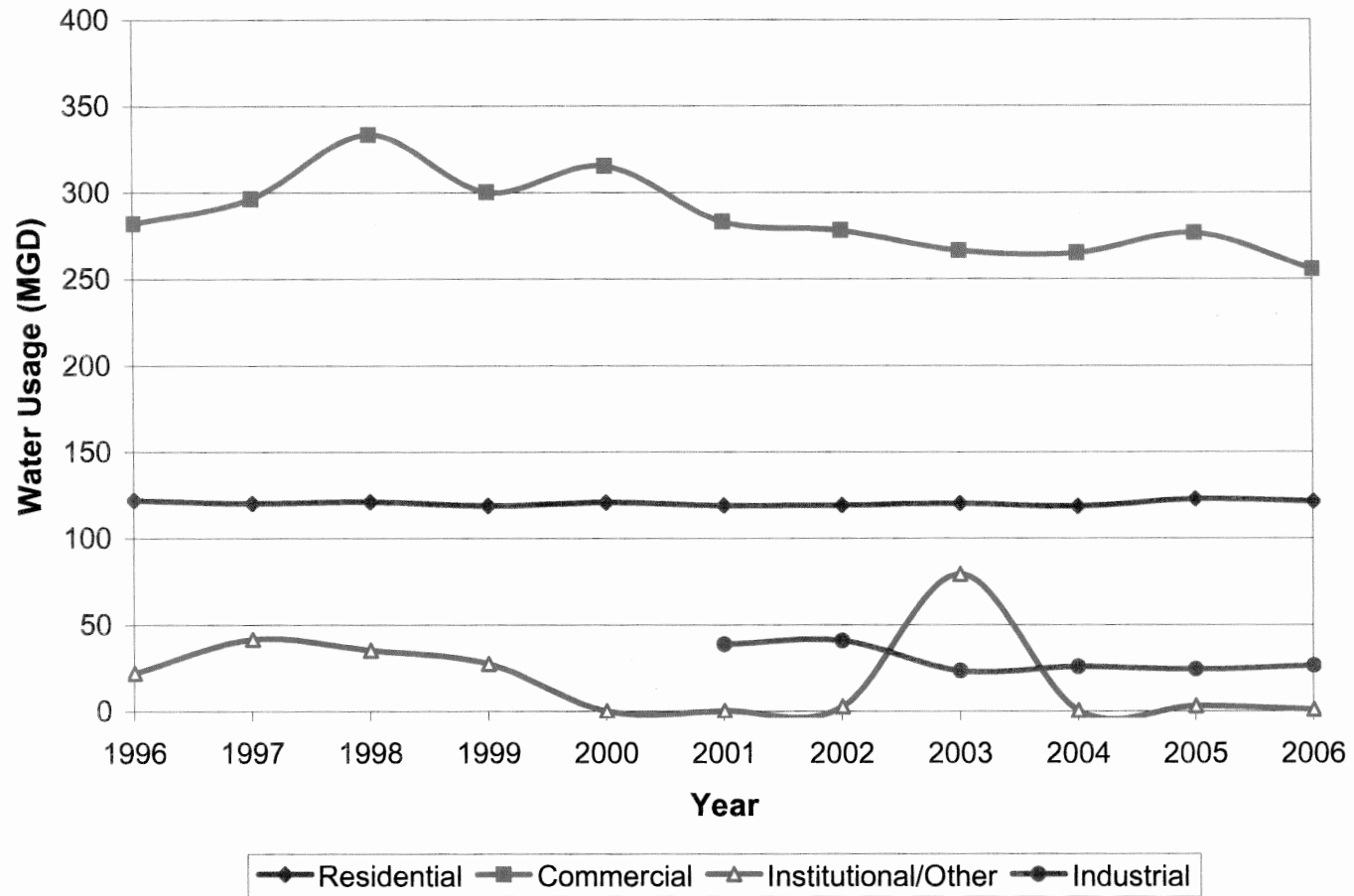


Figure 3
Percentage Water Use by Customer Category for the Year 2006
Grand Rapids, MN

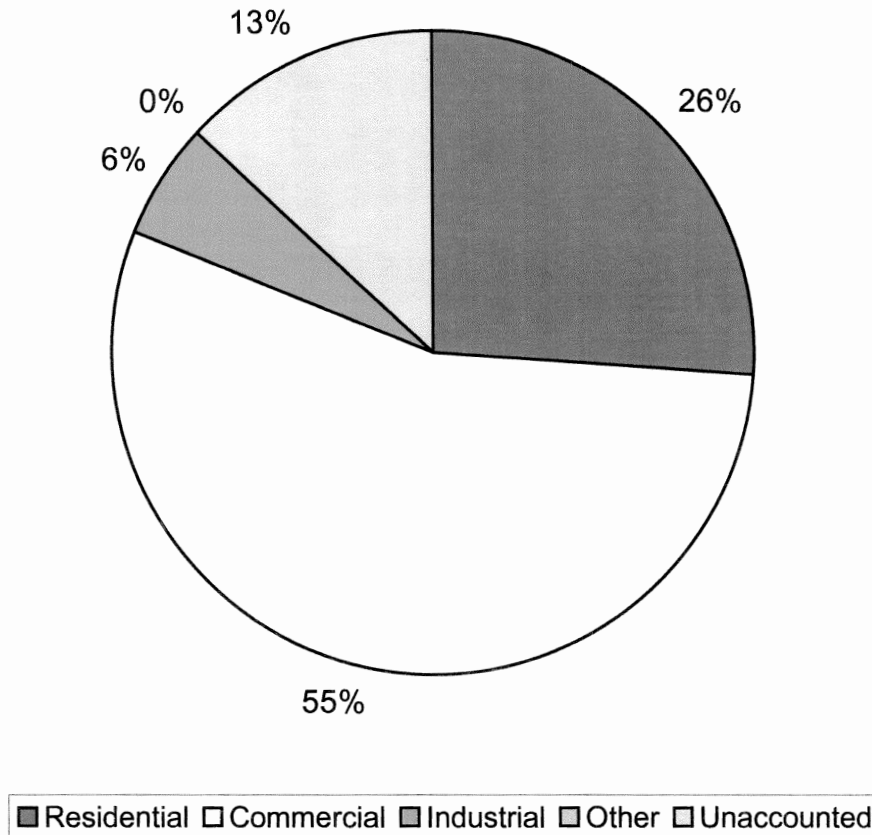


Figure 4
Water Production and Sales
Grand Rapids, MN

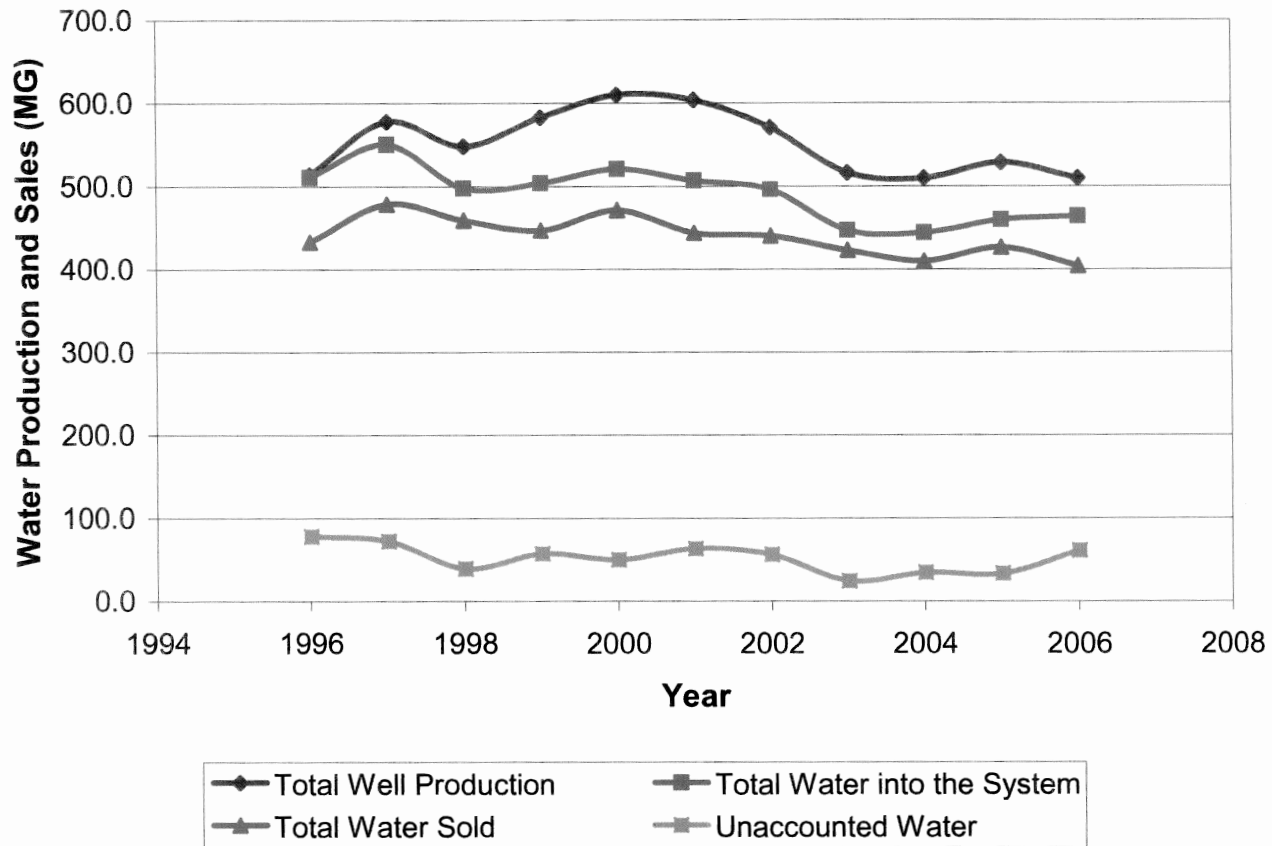


Figure 5
Variation in Average Day and Maximum Day Demand
Grand Rapids, MN

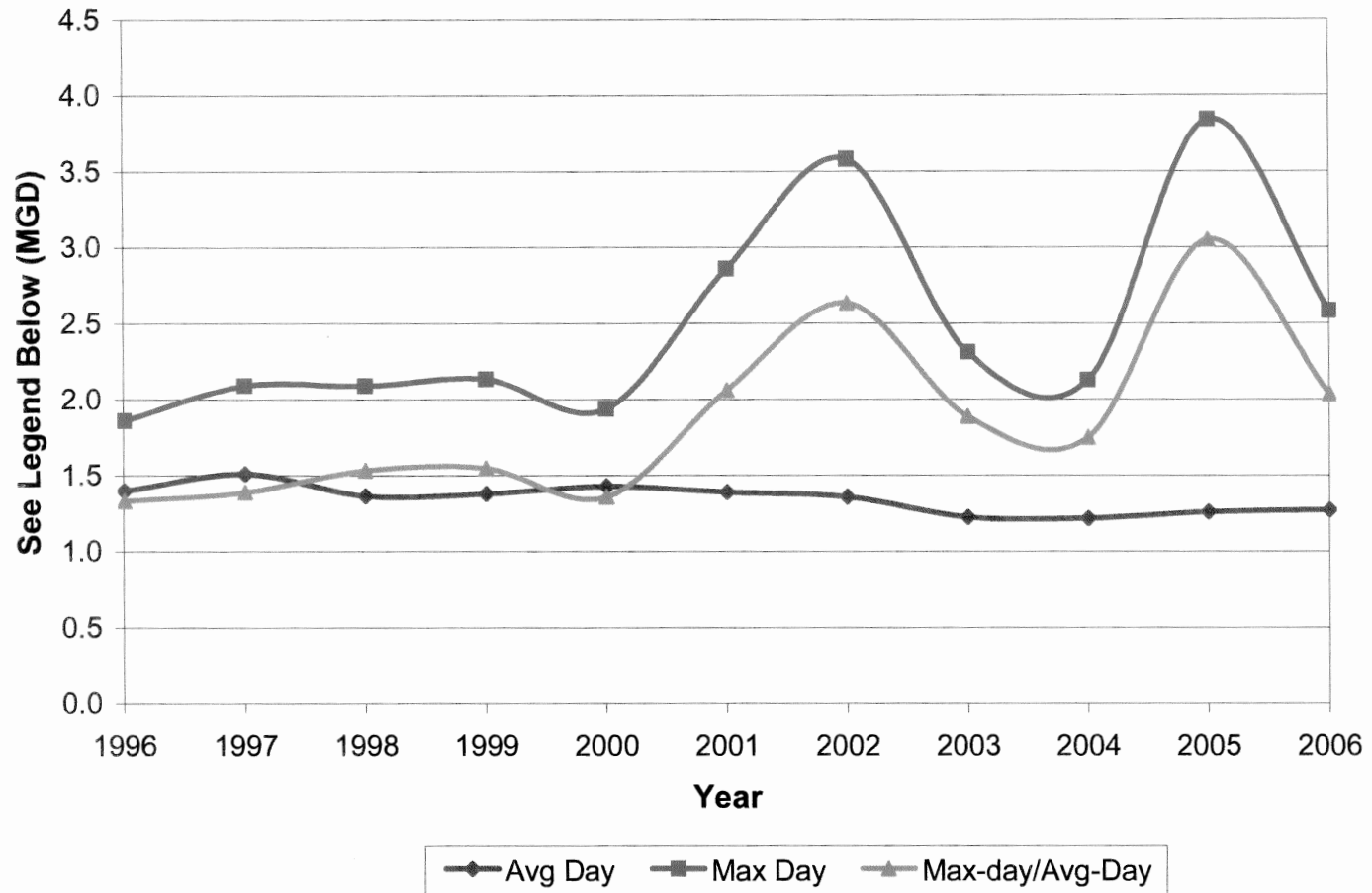


Figure 6
Per Capita Demands
Grand Rapids, MN

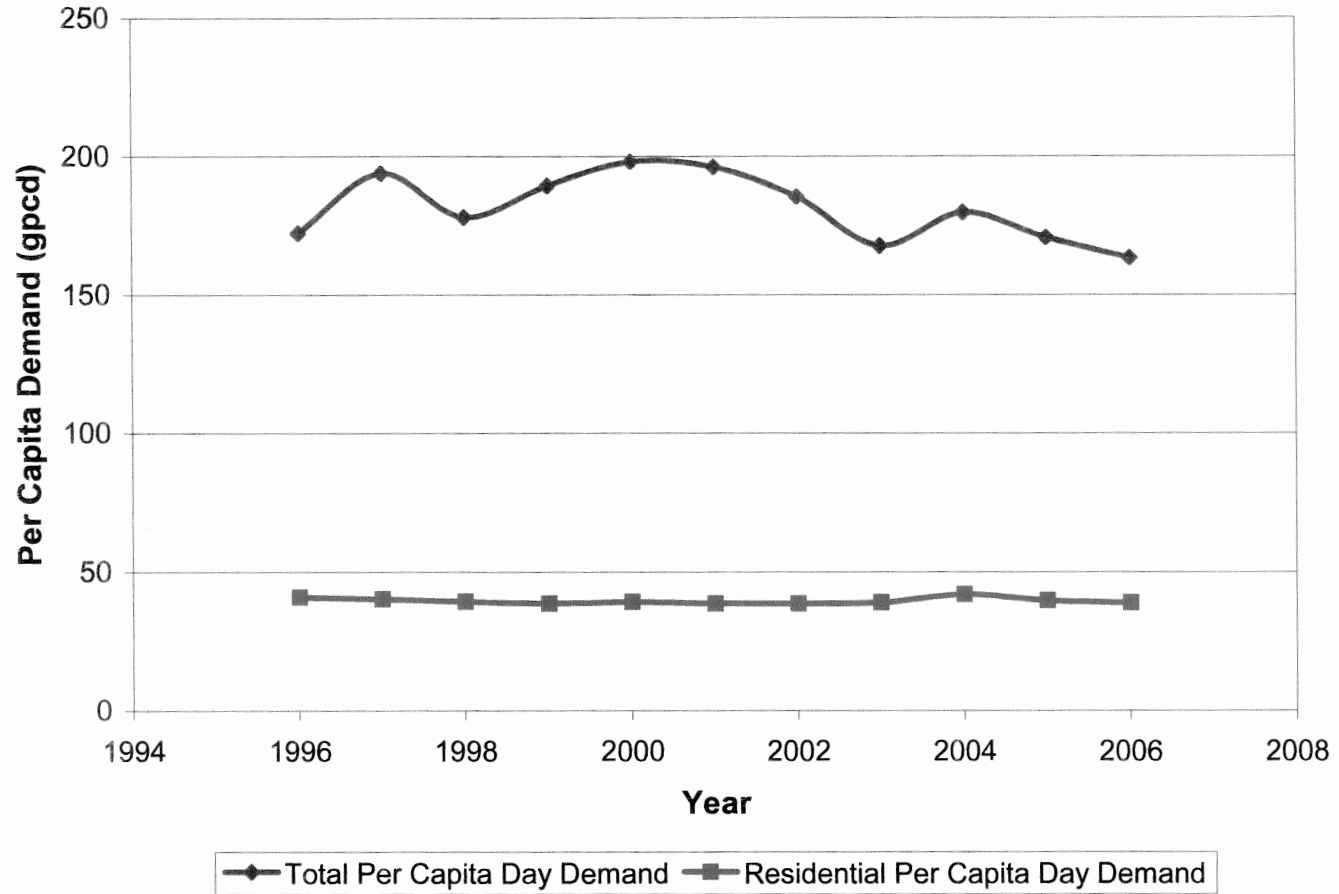
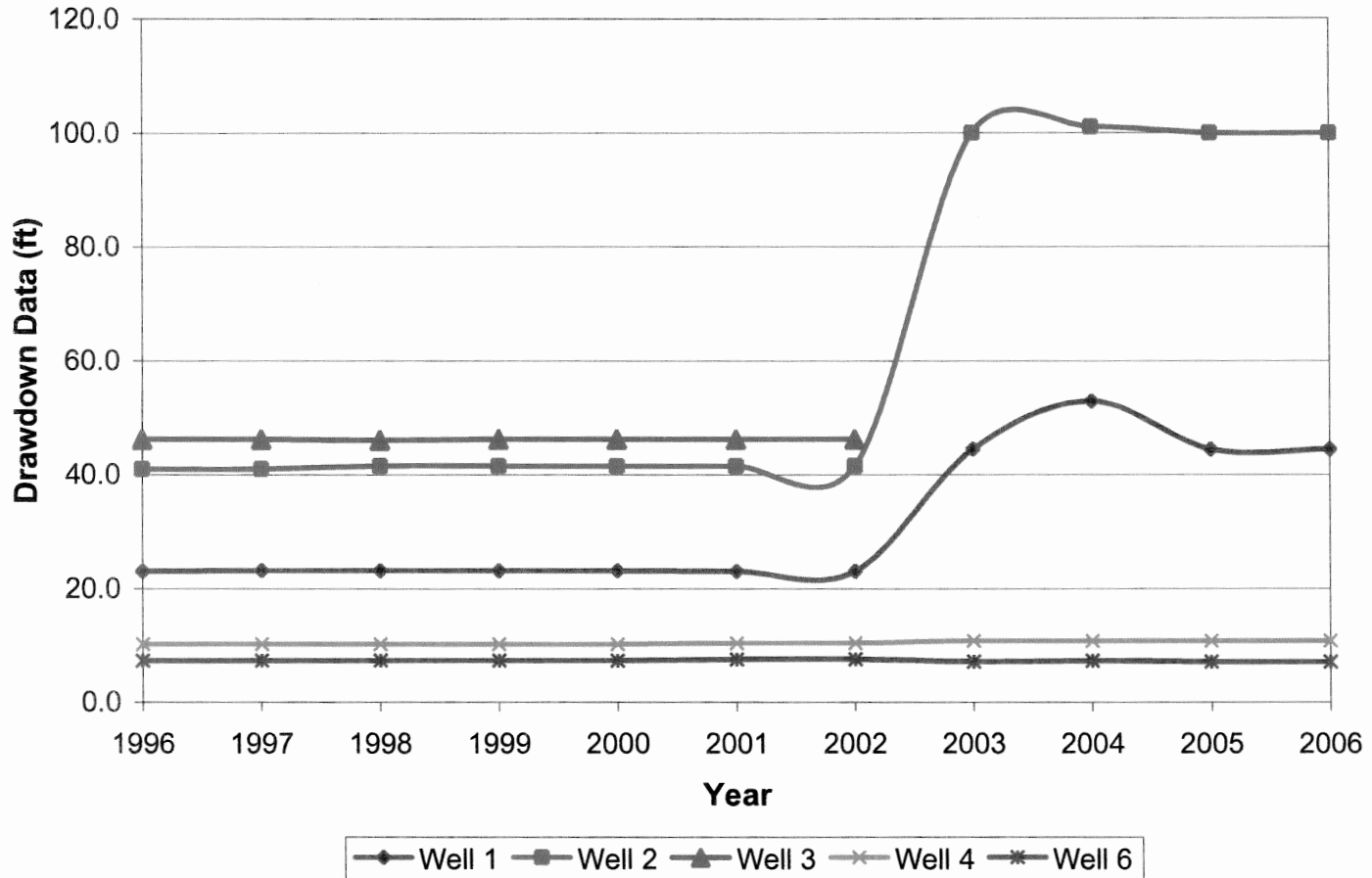
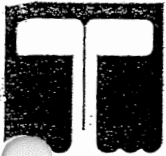


Figure 7
Variations in Well Levels
Grand Rapids, MN



APPENDIX A



THEIN WELL

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July 18, 2003

Dennis Doyle
City of Grand Rapids
P.O. Box 658
Grand Rapids, MN 55744

Dear Dennis:

Enclosed you will find the reports from my recent inspection of your pumps and wells.

On well 3 and 4, I couldn't get the drawdown gauge to go through so cautions are marked on the reports. The next time I'm in the area, I'll try again with a different drawdown gauge.

Well #3 is showing a considerable amount of vibration, mostly at the base. This may be caused by a problem with the pump or line shaft bearings with the vibration being transmitted up the turbine shaft.

I also noticed that there is no pre-lube provision on any of the turbine wells. You may want to add this feature in the future.

If you have any questions, please call me at 866-786-7349, or Will at 800-450-8000.

Sincerely,

THEIN WELL COMPANY

Daniel Crannick
Project Manager



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #2 South of T. Plant Unique #: 228873 Inspection Date: 7-11-2003

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	640	X	
B) Static Water Level (water level when not pumping)	42.83	X	
C) Pumping Water Level	143.83	X	
D) Drawdown (P.W.L. - S.W.L.)	101.00	X	
E) Specific Capacity (G.P.M. / D.D.)	6.34	X	
F) Discharge pressure guage reading	to filter	X	

X	
X	
X	
X	
X	
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage	L1 to L2 462.00	L2 to L3 466.00	L1 to L3 458.00
C) Amperage	L1 82.80	L2 76.60	L3 81.30
D) Winding Resistance	0-0-0		
E) Insulation Resistance	00-00-00		
F) Pump Bowl / TDH Condition			

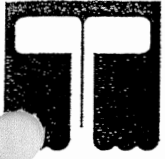
X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan Crannick



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #1 North of Water Unique #: 228870 Inspection Date: 7-11-2003

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	620
B) Static Water Level (water level when not pumping)	19.00
C) Pumping Water Level	71.83
D) Drawdown (P.W.L. - S.W.L.)	52.83
E) Specific Capacity (G.P.M. / D.D.)	11.74
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution
X	
X	
X	
X	
X	
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage L1 to L2 471.00	L2 to L3 477.00	L1 to L3 475.00	
C) Amperage L1 34.60	L2 32.90	L3 35.40	
D) Winding Resistance	0-0-0		
E) Insulation Resistance	00-00-00		
F) Pump Bowl / TDH Condition			

X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan Crannick



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #3 East of filter plant Unique #: 228862 Inspection Date: 7-11-2003

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	820	X	
B) Static Water Level (water level when not pumping)			X
C) Pumping Water Level			X
D) Drawdown (P.W.L. - S.W.L.)			X
E) Specific Capacity (G.P.M. / D.D.)	?		X
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 478.00	L2 to L3 481.00	L1 to L3 474.00	X	
B) Amperage	L1 45.60	L2 38.20	L3 42.80	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed	Y/N			X	
E) Turbine Motor Grease Changed	Y/N			X	
F) Pump Packing - Changed/Added				X	
G) Pump Bowl / TDH Condition					

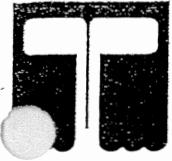
III. General Operation

A) Production Rate of Well		
B) Effect From Other Wells		
C) History of Well		
D) Operating Hours of Well		
E) Other		

Comments

Unable to get drawdown gauge to go through so cautions are marked. There is a good bit of vibration at the pump base, possibly being transmitted up from below. You may want to consider having this checked out in the not too distant future.

Inspected By: Don Crannick



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #4 N. well on N. Unique #: 127276 Inspection Date: 7-11-2003

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	1280
B) Static Water Level (water level when not pumping)	
C) Pumping Water Level	
D) Drawdown (P.W.L. - S.W.L.)	
E) Specific Capacity (G.P.M. / D.D.)	?
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution

X	
	X
	X
	X
	X
X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 491.00	L2 to L3 494.00	L1 to L3 492.00
B) Amperage	L1 59.10	L2 59.40	L3 62.30
C) Electric Motor Bearings			
D) Turbine Motor Oil Changed	Y/N		
E) Turbine Motor Grease Changed	Y/N		
F) Pump Packing - Changed/Added			
G) Pump Bowl / TDH Condition			

X	
X	
X	
X	
X	

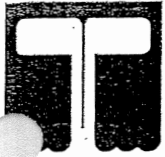
III. General Operation

A) Production Rate of Well
 B) Effect From Other Wells
 C) History of Well
 D) Operating Hours of Well
 E) Other

Comments

Cautions marked because static level and drawdown couldn't be checked. I will come back at a later time to check it.

Inspected By: Dan Crannick



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #6 S. well on N. Unique #: 161444 Inspection Date: 7-11-2003

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	1830	X	
B) Static Water Level (water level when not pumping)	47.58	X	
C) Pumping Water Level	54.83	X	
D) Drawdown (P.W.L. - S.W.L.)	7.25	X	
E) Specific Capacity (G.P.M. / D.D.)	252.41	X	
F) Discharge pressure guage reading	60	X	

X	
X	
X	
X	
X	
X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 487.00	L2 to L3 490.00	L1 to L3 488.00	X	
B) Amperage	L1 103.00	L2 103.00	L3 106.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed	Y/N			X	
E) Turbine Motor Grease Changed	Y/N			X	
F) Pump Packing - Changed/Added				X	
G) Pump Bowl / TDH Condition					

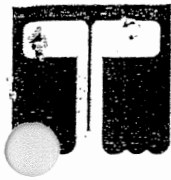
X	
X	
X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

inspected By: Dan Crannick



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August 17, 2005

Mr. Dennis Doyle
City of Grand Rapids
PO Box 658
Grand Rapids, MN 55744

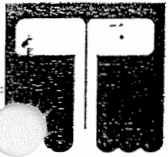
Dear Dennis;

Enclosed you will find the reports from my recent inspection of your pumps and wells. Everything appears to be operating within normal limits.

If you have any questions, please call me or Will at 800-450-8000.

Sincerely,

Daniel Crannick
Project Manager



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #1 North of Water Unique #: 228870 Inspection Date: 8-5-2005

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	651	X	
B) Static Water Level (water level when not pumping)	23.08	X	
C) Pumping Water Level	67.50	X	
D) Drawdown (P.W.L. - S.W.L.)	44.42	X	
E) Specific Capacity (G.P.M. / D.D.)	14.66	X	
F) Discharge pressure guage reading	to filter	X	

X	
X	
X	
X	
X	
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage	L1 to L2 459.00	L2 to L3 459.00	L1 to L3 462.00
C) Amperage	L1 33.00	L2 33.00	L3 34.00
D) Winding Resistance	0-0-0		
E) Insulation Resistance	00-00-00		
F) Pump Bowl / TDH Condition			

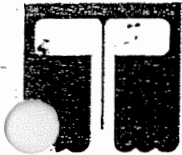
X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan C.



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #2 South of T. Plant Unique #: 228873 Inspection Date: 8-5-2005

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	652
B) Static Water Level (water level when not pumping)	44.08
C) Pumping Water Level	144.00
D) Drawdown (P.W.L. - S.W.L)	99.92
E) Specific Capacity (G.P.M. / D.D.)	6.53
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution
X	
X	
X	
X	
X	
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage	L1 to L2 464.00	L2 to L3 461.00	L1 to L3 460.00
C) Amperage	L1 80.00	L2 78.00	L3 78.00
D) Winding Resistance		0-0-0	
E) Insulation Resistance		00-00-00	
F) Pump Bowl / TDH Condition			

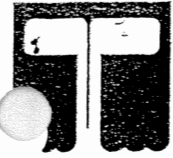
X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dean C.



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #3 East of filter plant Unique #: 228862 Inspection Date: 8-5-2005

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

		Condition	
		Good	Caution
A) Gallons Per Minute	847	X	
B) Static Water Level (water level when not pumping)			X
C) Pumping Water Level			X
D) Drawdown (P.W.L. - S.W.L.)			X
E) Specific Capacity (G.P.M. / D.D.)	?		X
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 462.00	L2 to L3 459.00	L1 to L3 459.00	X	
B) Amperage	L1 44.00	L2 42.00	L3 41.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed Y/N				X	
E) Turbine Motor Grease Changed Y/N				X	
F) Pump Packing - Changed/Added				X	
G) Pump Bowl / TDH Condition					

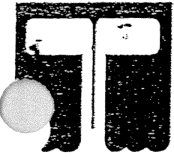
III. General Operation

A) Production Rate of Well		
B) Effect From Other Wells		
C) History of Well		
D) Operating Hours of Well		
E) Other		

Comments

Unable to get drawdown gauge to go through so cautions are marked. There is a good bit of vibration at the pump base, possibly being transmitted up from below.

Inspected By : Dan C.



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #4 N. well on N. Unique #: 127276 Inspection Date: 8-5-2005

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	1323	X	
B) Static Water Level (water level when not pumping)	39.25	X	
C) Pumping Water Level	50.00	X	
D) Drawdown (P.W.L. - S.W.L.)	10.75	X	
E) Specific Capacity (G.P.M. / D.D.)	123.07	X	
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

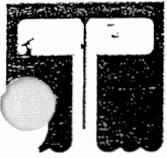
A) Voltage	L1 to L2 488.00	L2 to L3 489.00	L1 to L3 488.00	X	
B) Amperage	L1 63.00	L2 60.00	L3 63.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed Y/N				X	
E) Turbine Motor Grease Changed Y/N				X	
F) Pump Packing - Changed/Added					
G) Pump Bowl / TDH Condition					

III. General Operation

A) Production Rate of Well		
B) Effect From Other Wells		
C) History of Well		
D) Operating Hours of Well		
E) Other		

Comments

Inspected By: Dan C



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #6 S. well on N. Unique #: 161444 Inspection Date: 8-5-2005

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	1892	X	
B) Static Water Level (water level when not pumping)	47.00	X	
C) Pumping Water Level	54.08	X	
D) Drawdown (P.W.L. - S.W.L)	7.08	X	
E) Specific Capacity (G.P.M. / D.D.)	267.23	X	
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

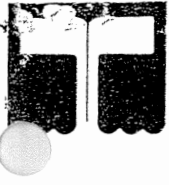
A) Voltage	L1 to L2 487.00	L2 to L3 488.00	L1 to L3 486.00	X	
B) Amperage	L1 105.00	L2 103.00	L3 105.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed Y/N				X	
E) Turbine Motor Grease Changed Y/N				X	
F) Pump Packing - Changed/Added				X	
G) Pump Bowl / TDH Condition					

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan C.



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August 10, 2006

Dennis Doyle
City of Grand Rapids
PO Box 658
Grand Rapids, MN 55744

Dear Dennis;

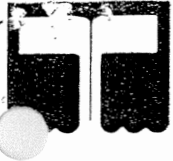
Enclosed you will find the reports from my recent inspection of your pumps and wells. This year's results are mixed at best. The specific capacity of well #1 is down slightly, but well #2 is down about 25% in specific capacity. Well #3 is unknown as we can't get a drawdown gauge to go down this well. Well #3 also shows some vibration at the base but it is no worse than in past years. Wells #4 and #6 seem to perform just fine. I feel that wells 1 and 2 are being over-pumped while the rest of your wells are being under-utilized.

My recommendation for now is to valve wells 1 and 2 back and make up the difference with well 4 or 6. Then, since it has apparently been quite some time, have well #3 pulled for a physical inspection. Well #2 is probably going to need a rehab. The next time I get to that area I will contact Rick and make arrangements to check well #2 again. Both well #4 and #6 produce enough flow so that it shouldn't be a problem for you to meet the demand.

If you have any questions about any of this you can contact me at any time.

Sincerely,

Dan Crannick
Project Manager



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #1 North of Water Unique #: 228870 Inspection Date: 8-4-2006

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	553
B) Static Water Level (water level when not pumping)	18.50
C) Pumping Water Level	72.17
D) Drawdown (P.W.L. - S.W.L.)	53.67
E) Specific Capacity (G.P.M. / D.D.)	10.30
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution
X	
X	
X	
X	
X	
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage	L1 to L2 454.00	L2 to L3 454.00	L1 to L3 457.00
C) Amperage	L1 33.00	L2 35.00	L3 34.00
D) Winding Resistance		0-0-0	
E) Insulation Resistance		00-00-00	
F) Pump Bowl / TDH Condition			

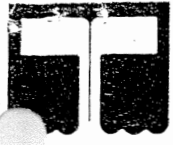
X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan Cronin



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #2 South of T. Plant Unique #: 228873 Inspection Date: 8-4-2006

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	600
B) Static Water Level (water level when not pumping)	45.50
C) Pumping Water Level	195.33
D) Drawdown (P.W.L. - S.W.L)	149.83
E) Specific Capacity (G.P.M. / D.D.)	4.00
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution
X	
X	
	X
	X
	X
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage	L1 to L2 464.00	L2 to L3 461.00	L1 to L3 461.00
C) Amperage	L1 79.00	L2 78.00	L3 78.00
D) Winding Resistance		0-0-0	
E) Insulation Resistance		00-00-00	
F) Pump Bowl / TDH Condition			

X	
X	
X	
X	

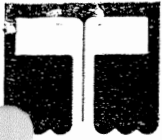
III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Cautions marked because of increase in draw-down and decrease of specific capacity.

Inspected By: Dan Cronin



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #3 East of filter plant Unique #: 228862 Inspection Date: 8-4-2006

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

- A) Gallons Per Minute 543
- B) Static Water Level (water level when not pumping)
- C) Pumping Water Level
- D) Drawdown (P.W.L. - S.W.L.)
- E) Specific Capacity (G.P.M. / D.D.) ?
- F) Discharge pressure guage reading to filter

Condition	
Good	Caution

X	
	X
	X
	X
	X
X	

II. Turbine Pump Operation

- A) Voltage L1 to L2 467.00 L2 to L3 465.00 L1 to L3 464.00
- B) Amperage L1 45.00 L2 43.00 L3 41.00
- C) Electric Motor Bearings
- D) Turbine Motor Oil Changed Y/N
- E) Turbine Motor Grease Changed Y/N
- F) Pump Packing - Changed/Added
- G) Pump Bowl / TDH Condition

X	
X	
X	
X	
X	
X	

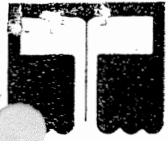
III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Unable to get drawdown gauge to go through so cautions are marked. There is a good bit of vibration at the pump base, possibly being transmitted up from below.

Inspected By: *Dan Cronin*



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #4 N. well on N. Unique #: 127276 Inspection Date: 8-4-2006

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	1340
B) Static Water Level (water level when not pumping)	39.00
C) Pumping Water Level	49.50
D) Drawdown (P.W.L. - S.W.L.)	10.50
E) Specific Capacity (G.P.M. / D.D.)	127.62
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution

X	
X	
X	
X	
X	
X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 492.00	L2 to L3 495.00	L1 to L3 492.00
B) Amperage	L1 63.00	L2 60.00	L3 64.00
C) Electric Motor Bearings			
D) Turbine Motor Oil Changed Y/N			
E) Turbine Motor Grease Changed Y/N			
F) Pump Packing - Changed/Added			
G) Pump Bowl / TDH Condition			

X	
X	
X	
X	

III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan Cronin



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September 2, 2004

Dennis Doyle
City of Grand Rapids
420 N. Pokegama
PO Box 658
Grand Rapids, MN 55744

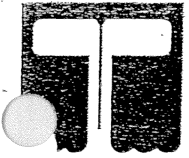
Dear Dennis;

Enclosed you will find the reports from my recent inspection of your pumps and wells.
Everything appears to be operating within normal limits.

If you have any questions, please call me or Will at 800-450-8000.

Sincerely,


Daniel Crannick
Project Manager



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SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #2 South of T. Plant Unique #: 228873 Inspection Date: 8-19-2004

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

A) Gallons Per Minute	661
B) Static Water Level (water level when not pumping)	35.08
C) Pumping Water Level	140.33
D) Drawdown (P.W.L. - S.W.L.)	105.25
E) Specific Capacity (G.P.M. / D.D.)	6.28
F) Discharge pressure guage reading	to filter

Condition	
Good	Caution
X	
X	
X	
X	
X	
X	

II. Submersible Pump Operation

A) Meg / OHMS			
B) Voltage	L1 to L2 463.00	L2 to L3 461.00	L1 to L3 460.00
C) Amperage	L1 81.00	L2 79.00	L3 79.00
D) Winding Resistance		0-0-0	
E) Insulation Resistance		00-00-00	
F) Pump Bowl / TDH Condition			

X	
X	
X	
X	

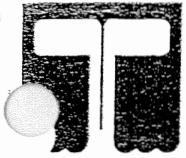
III. General Operation

- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

*60 H.P.
10-28-04
Installed*

Inspected By: *Dan C.*



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TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #4 N. well on N. Unique #: 127276 Inspection Date: 8-19-2004

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	1311	X	
B) Static Water Level (water level when not pumping)			X
C) Pumping Water Level			X
D) Drawdown (P.W.L. - S.W.L)			X
E) Specific Capacity (G.P.M. / D.D.)	?		X
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 495.00	L2 to L3 497.00	L1 to L3 495.00	X	
B) Amperage	L1 60.00	L2 63.00	L3 63.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed Y/N				X	
E) Turbine Motor Grease Changed Y/N				X	
F) Pump Packing - Changed/Added					
G) Pump Bowl / TDH Condition					

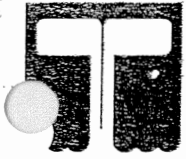
III. General Operation

A) Production Rate of Well		
B) Effect From Other Wells		
C) History of Well		
D) Operating Hours of Well		
E) Other		

Comments

Cautions marked because static level and drawdown couldn't be checked.

Inspected By: Dan C.



THEIN WELL

WELLS ~ PUMPS
SALES ~ SERVICE

P.O. BOX 778, 11355 HWY. 71 NE (ACROSS FROM RINGO LAKE)
SPICER, MINNESOTA 56288 • (320) 796-2111
www.theinwell.com • E-mail: theinwell@tds.net

Since 1893

SUBMERSIBLE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #1 North of Water Unique #: 228870 Inspection Date: 8-19-2004

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and seventeen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	650	X	
B) Static Water Level (water level when not pumping)	15.58	X	
C) Pumping Water Level	64.58	X	
D) Drawdown (P.W.L. - S.W.L.)	49.00	X	
E) Specific Capacity (G.P.M. / D.D.)	13.27	X	
F) Discharge pressure guage reading	to filter	X	

Submersible Pump Operation

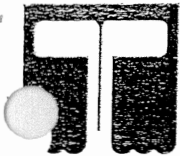
A) Meg / OHMS					
B) Voltage	L1 to L2 454.00	L2 to L3 457.00	L1 to L3 458.00	X	
C) Amperage	L1 33.00	L2 34.00	L3 35.00	X	
D) Winding Resistance		0-0-0		X	
E) Insulation Resistance		00-00-00		X	
F) Pump Bowl / TDH Condition					

III. General Operation

A) Production Rate of Well		
B) Effect From Other Wells		
C) History of Well		
D) Operating Hours of Well		
E) Other		

Comments

Inspected By: Dan C.



THEIN WELL

WELLS ~ PUMPS
SALES ~ SERVICE

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SPICER, MINNESOTA 56288 • (320) 796-2111
www.theinwell.com • E-mail: theinwell@tds.net

Since 1893

TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #3 East of filter plant Unique #: 228862 Inspection Date: 8-19-2004

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

I. Well Efficiency

		Condition	
		Good	Caution
A) Gallons Per Minute	750	X	
B) Static Water Level (water level when not pumping)			X
C) Pumping Water Level			X
D) Drawdown (P.W.L. - S.W.L.)			X
E) Specific Capacity (G.P.M. / D.D.)	?		X
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 460.00	L2 to L3 459.00	L1 to L3 456.00	X	
B) Amperage	L1 44.00	L2 42.00	L3 42.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed Y/N				X	
E) Turbine Motor Grease Changed Y/N				X	
F) Pump Packing - Changed/Added				X	
G) Pump Bowl / TDH Condition					

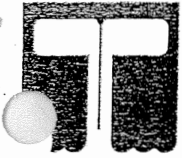
III. General Operation

A) Production Rate of Well		
B) Effect From Other Wells		
C) History of Well		
D) Operating Hours of Well		
E) Other		

Comments

Unable to get drawdown gauge to go through so cautions are marked. There is a good bit of vibration at the pump base, possibly being transmitted up from below.

Inspected By : Dan C.



THEIN WELL

WELLS ~ PUMPS
SALES ~ SERVICE

P.O. BOX 778, 11355 HWY. 71 NE (ACROSS FROM RINGO LAKE)
SPICER, MINNESOTA 56288 • (320) 796-2111
www.theinwell.com • E-mail: theinwell@tds.net

Since 1893

TURBINE PUMP WELL INSPECTION REPORT

Customer: City of Grand Rapids Well Number: #6 S. well on N. Unique #: 161444 Inspection Date: 8-19-2004

Both an early awareness of a reduction in the efficiency of your Well and a good preventive maintenance program are a necessity for you to avoid extensive down time, extreme rehabilitation expenses and a shortened life span for your well. The following three areas and eighteen items pertaining to your Well have been checked and are reported, where possible, as shown below.

Area and Item Inspected

Condition	
Good	Caution

I. Well Efficiency

A) Gallons Per Minute	1852	X	
B) Static Water Level (water level when not pumping)	47.00	X	
C) Pumping Water Level	54.17	X	
D) Drawdown (P.W.L. - S.W.L.)	7.17	X	
E) Specific Capacity (G.P.M. / D.D.)	258.30	X	
F) Discharge pressure guage reading	to filter	X	

II. Turbine Pump Operation

A) Voltage	L1 to L2 493.00	L2 to L3 492.00	L1 to L3 493.00	X	
B) Amperage	L1 104.00	L2 102.00	L3 105.00	X	
C) Electric Motor Bearings				X	
D) Turbine Motor Oil Changed Y/N				X	
E) Turbine Motor Grease Changed Y/N				X	
F) Pump Packing - Changed/Added				X	
G) Pump Bowl / TDH Condition					

III. General Operation

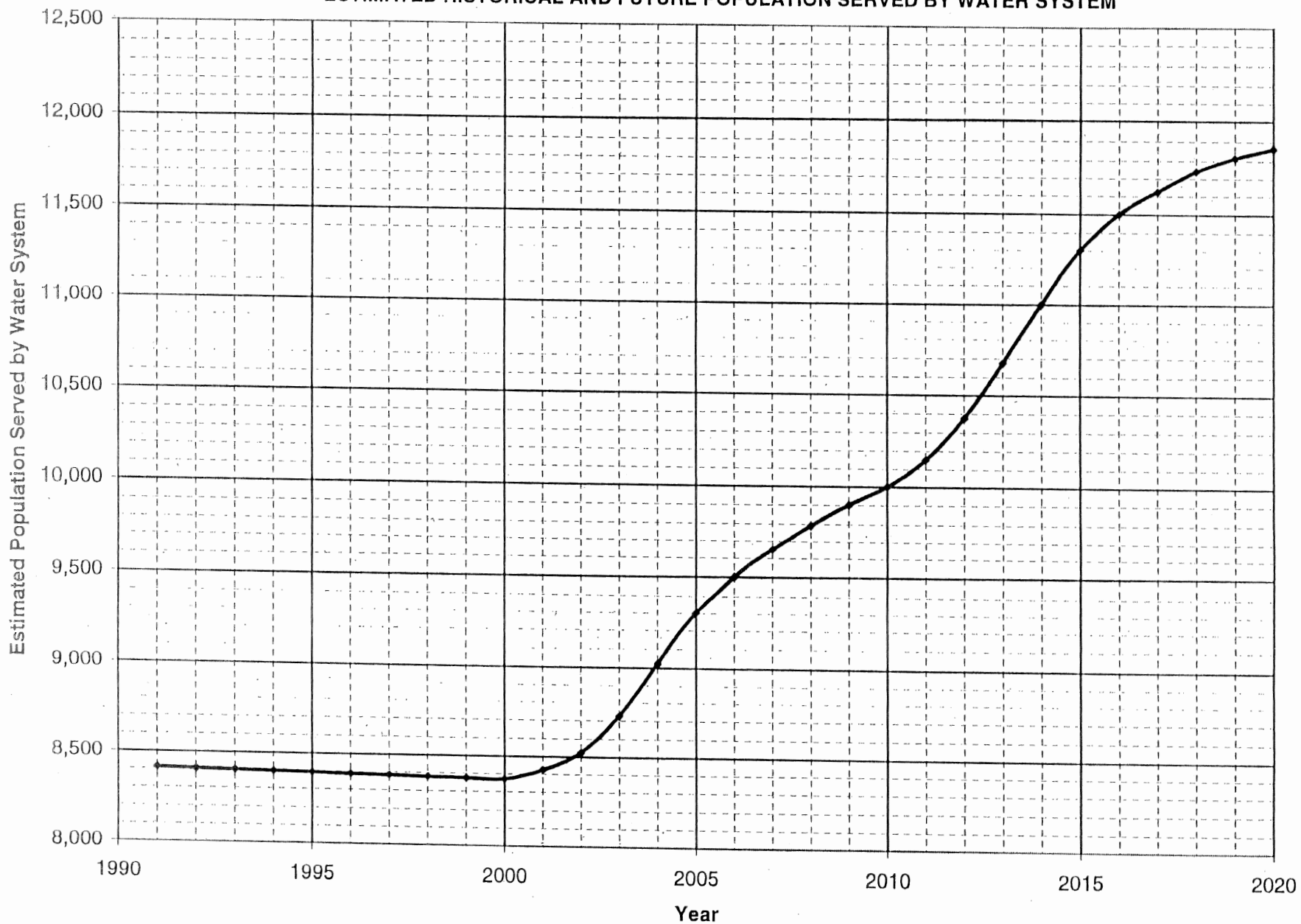
- A) Production Rate of Well
- B) Effect From Other Wells
- C) History of Well
- D) Operating Hours of Well
- E) Other

Comments

Inspected By: Dan C.

APPENDIX B

FIGURE NO. 3
ESTIMATED HISTORICAL AND FUTURE POPULATION SERVED BY WATER SYSTEM

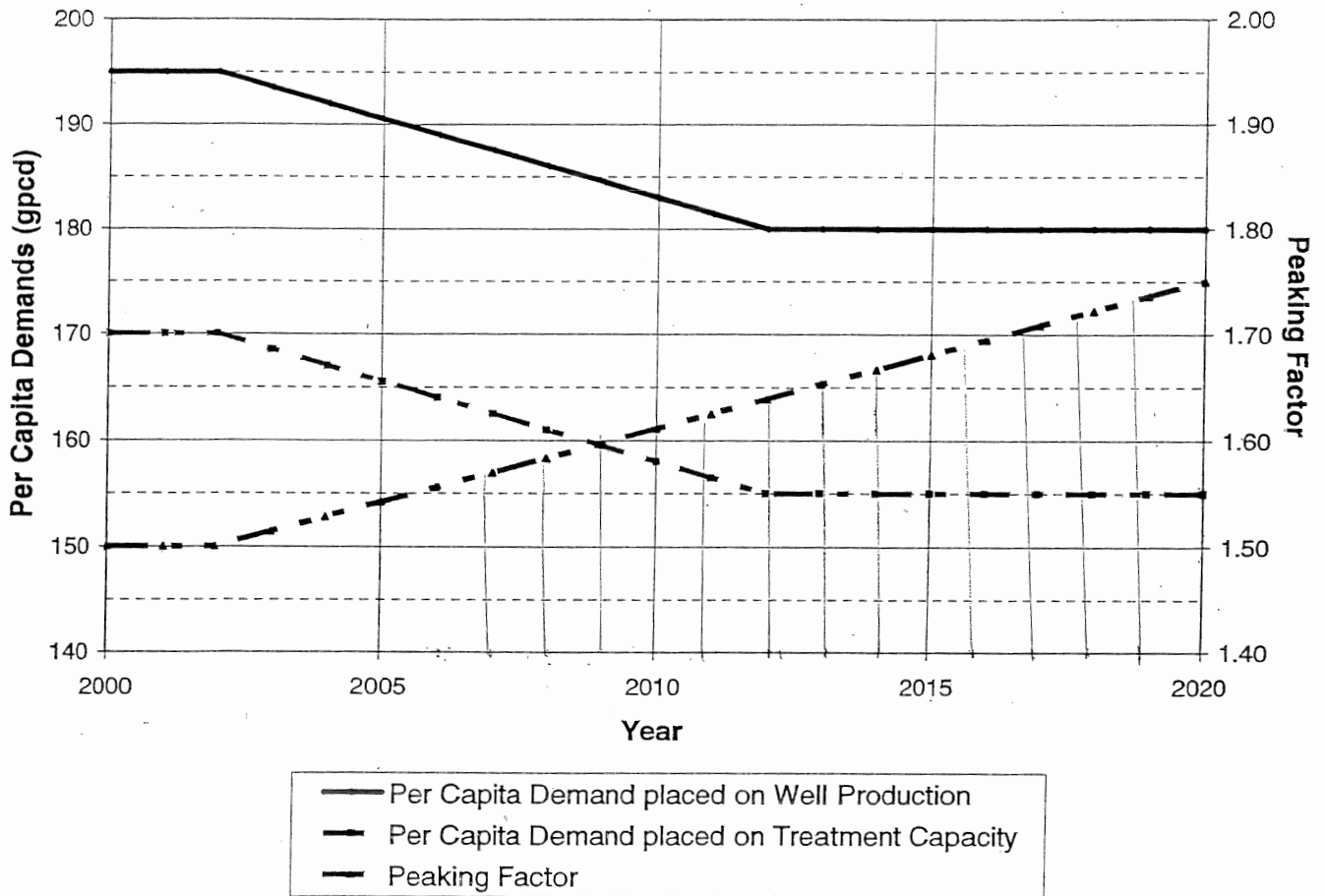


SOURCE - Comprehensive Water System Study Report, TkDA 2003

APPENDIX C

system. Based on these factors, this Study has projected an increase in the peaking factor from 1.5 to 1.75 times the average day demand over the planning period. Again, it must be remembered that these are average values, and the actual value can and will vary each year. Figure No. 9 provides a graphical presentation of the decreasing per capita consumption and increasing peak factor.

**FIGURE NO. 9
PROJECTED PER CAPITA DEMAND**



By projecting population, and establishing anticipated peaking factors and per capita consumption rates, we are able to predict the future consumptive rates that the supply and treatment facilities will be required to satisfy. Table No. 4-14 contains estimates for average and peak day treatment demands through the design period.

SOURCE: Comprehensive water system study Report, TKDA 2003

APPENDIX D

- Provide Source of On-Site Back-up Emergency Power to Existing Production Facilities
- Construction of 0.5 MG Ground Water Storage Tank and Connecting Trunk Watermain
- Construction or Relocation of, Existing 0.5 MG Elevated Water Storage Tank
- Remove/Salvage the Existing 500,000 Gallon Elevated Storage Tanks
- Strengthen Watermain System
- Interim Improvement Plan
- Annexation Area Improvement Plan

**TABLE NO. 6-7
2002-2020 CAPITAL IMPROVEMENT PLAN
MUNICIPAL WATER SYSTEM FACILITIES**

Item No.	Improvement	Implementation Date	Estimated Project Cost
1	Back-up Power Facilities	2003 – 2005	\$ 460,000
2	Highway 2 Trunk Watermain Improvement	200 7 – 200 8	\$3,750,000
3	3rd Avenue/2nd Avenue South Trunk Watermain Improvement w/ 3rd River Crossing (TH2 to Booster Station)	2003 – 2005	\$1,750,000
4	Existing Trunk Watermain Improvements	2003 – 2006	\$ 150,000
5	Construction of 0.5 MG Elevated Storage Tank	2004 – 2006	\$ 725,000
6	Remove/Salvage 500,000 Gallon Storage Tank(s)	2005 – 2008	\$ 135,000
7	Pokegama Road Trunk Watermain Improvement (Booster Station to Completion)	2005 – 2010	\$1,935,000
8	Construction of 0.5 MG Ground Storage Tank	2005 – 2010	\$ 550,000
9	Booster Station	2005 – 2010	\$ 315,000
Total			\$9,770,000

Note: Project Costs are based on Year 2002 (ENR 6500) construction and includes engineering and 4% for legal, administrative, and miscellaneous cost. Capitalized interest resulting from the sale of bonds to finance any of the individual projects; however, is not included.

At the request of the PUC and City staff, four separate interim studies were performed, and are included in Section 8 at the end of the Study. They consist of the new Hospital site along Golf Course Road, pressure enhancement to the Murphy Hill area, Ridgewood Road street and watermain improvements, and fire flow deficiencies in the Grand Rapids

APPENDIX E

Attachment - Appendix E

Emergency Telephone List

Emergency Response Team	Name	Work Telephone	Alternate Telephone
Emergency Response Lead	Dennis Doyle	218-326-7192	218-326-4806
Alternate Emergency Response Lead	Anthony Ward	218-320-7188	218-326-4806
Water Operator	Jay LaTourelle	218-326-7024	218-326-4806
Alternate Water Operator	Jay LaTourelle	218-326-7024	218-326-4806
Public Communications	Anthony Ward	218-320-7188	218-326-4806

State and Local Emergency Response Contacts	Name	Work Telephone	Alternate Telephone
State Incident Duty Officer	Minnesota Duty Officer	800/422-0798 Out State	651-649-5451 Metro
County Emergency Director			
National Guard	Minnesota Duty Officer	800/422-0798 Out State	651-649-5451 Metro
Mayor/Board Chair			
Fire Chief	Dale Rosier	218-326-7639	911
Sheriff	Pat Medure	218-326-7470	
Police Chief	Leigh Surfing	218-326-3464	911
Ambulance			
Hospital	Itasca Medical Center	218-320-3401	911
Doctor or Medical Facility			

State and Local Agencies	Name	Work Telephone	Alternate Telephone
MDH District Engineer			
MDH	Drinking Water Protection	651-201-4700	
State Testing Laboratory	Minnesota Duty Officer	800/422-0798 Out State	651-649-5451 Metro
MPCA	Pollution Control	1-800-657-3864	1-800-422-0798
DNR Area Hydrologist			
County Water Planner			

Utilities	Name	Work Telephone	Alternate Telephone
Electric Company	GR Public Utilities	218-326-7024	218-326-4806
Gas Company	Ferrellgas	1-888-337-7355	
Telephone Company	U.S. Link	1-800-450-4000	
Gopher State One Call	Utility Locations	800-252-1166	651-454-0002
Highway Department			

Mutual Aid Agreements	Name	Work Telephone	Alternate Telephone
Neighboring Water System	City of Cohasset (Mike Stesskal) City of Coleraine	218-328-6225 218-245-2112	218-328-6645 218-245-3385
Emergency Water Connection	-	-	-
Materials			

Technical/Contracted Services/Supplies	Name	Work Telephone	Alternate Telephone
MRWA Technical Services	MN Rural Water Association	800-367-6792	
Well Driller/Repair	Thein Well (Allan Anderson)	320-796-2111	1-800-450-8000
Pump Repair	Thein Well	320-796-2111	1-800-450-8000
Electrician	API Electric (George Pliml)	218-263-3658	218-969-3362
Plumber	Itasca Plumbing (Ken Brown)	218-245-2441	218-245-3480
Backhoe	Casper Construction (Bill Casper)	218-326-9637	

Chemical Feed	Hawkins Chemicals (Jerry Wilson)	715-398-5653	1-800-777-7165
Meter Repair			
Generator	Hawkins Construction	218-326-0309	
Valves	Vessco Inc (Terry Schiro)	952-941-2678	612-805-8917
Pipe & Fittings	National Waterworks	952-937-9666	1-800-782-8112
Water Storage			
Laboratory			
Engineering firm			

Communications	Name	Work Telephone	Alternate Telephone
News Paper	Grand Rapids Herald Review (Twice Weekly)	218-326-6623	
	Duluth News (Daily)	218-423-5281	
	Star Tribune (Daily)	612-673-4000	
Radio Station	Kozy (1320 AM)	218-326-3446	
	KMFY (96.9 FM)	218-326-0307	
School Superintendent	Lloyd Styroll (ISD-318)	218-327-5704	
Property & Casualty Insurance			

Critical Water Users	Name	Work Telephone	Alternate Telephone
Hospital Critical Use:	Itasca Medical Center	218-326-3401	
Nursing Home Critical Use:	Grand Village Nursing Home	218-326-0543	
	Evergreen Terrace	218-326-3431	
	Manor House	318-326-3469	
Public Shelter Critical Use:			

APPENDIX F

GRAND RAPIDS PUBLIC UTILITIES COMMISSION WATER AND WASTEWATER COLLECTION RATES

WATER SERVICE

Applicable **within** the corporate limits of the City of Grand Rapids:

<u>Meter Size</u>	<u>Rate</u>
5/8"-3/4"	\$5.25
1"	7.05
1 1/4"	7.95
1 1/2"	8.90
2"	13.85
3"	50.55
4"	64.15
6"	95.85

Applicable **beyond** the corporate limits of the City of Grand Rapids:

<u>Meter Size</u>	<u>Rate</u>
5/8"-3/4"	\$5.65
1"	7.65
1 1/4"	8.65
1 1/2"	9.65
2"	15.10
3"	55.25
4"	70.10
6"	104.80

Commodity Charges*: Based on water consumption per thousand gallons:

First 10,000 Gallons	\$3.10/1,000
Next 30,000 Gallons	2.83/1,000
Next 210,000 Gallons	2.64/1,000
Next 250,000 Gallons	2.45/1,000

*Charges calculated are on a per month basis

Commodity Charges**: Based on water consumption per thousand gallons:

First 10,000 Gallons	\$3.35/1,000
Next 30,000 Gallons	3.07/1,000
Next 210,000 Gallons	2.85/1,000
Next 250,000 Gallons	2.66/1,000

*Charges calculated are on a per month basis

Adjustments: Plus the applicable proportionate part of any taxes and assessments imposed by any governmental authority which are assessed on the basis of meters or customers, or the price of or revenue from water gallons or service sold, or the volume of water pumped, transmitted, treated or sold.

WASTEWATER COLLECTION & TREATMENT SERVICE

Applicable **within** the corporate limits of the City of Grand Rapids:

Service Charge*:	\$5.88
Collection/Treatment Charge per 1,000 Gallons	\$2.28

*Charges are calculated on a per month basis

Applicable **beyond** the corporate limits of the City of Grand Rapids:

Service Charge*:	\$6.02
Collection/Treatment Charge per 1,000 Gallons	\$2.55

*Charges are calculated on a per month basis

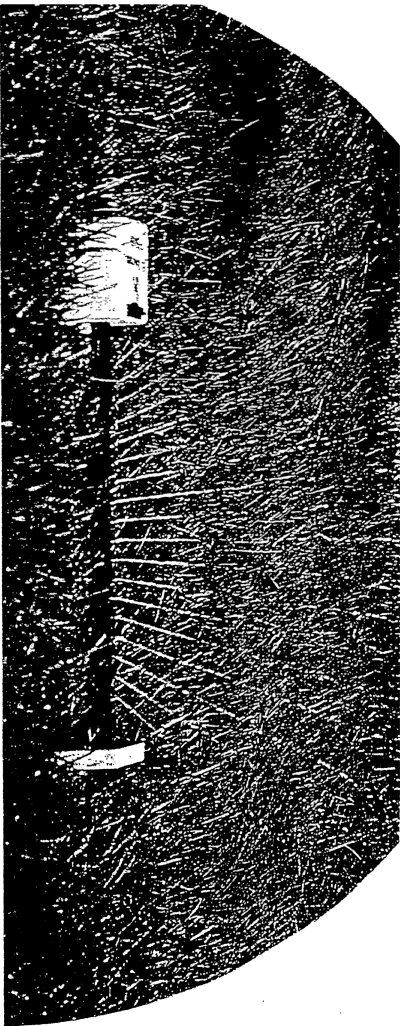
Adjustments: Plus the applicable proportionate part of any taxes and assessments imposed by any governmental authority which are assessed on the basis of meters, services or customers or the price of or revenues from wastewater gallons or services sold, or the volume of wastewater collected, treated or discharged.

Payment: Bills for service are due and payable at the office of the Grand Rapids Public Utilities Commission as per the due date specified on the bill.

Date Adopted: December 19, 2001

Effective Date: February 1, 2002

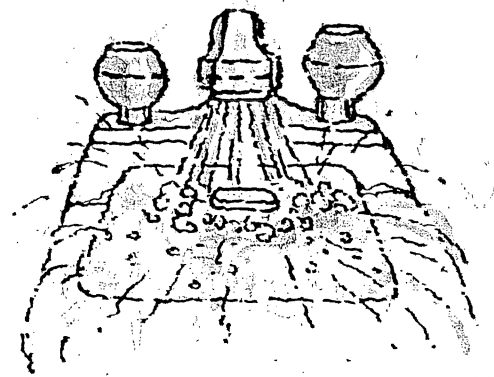
APPENDIX G



By the dawn's early light...

25

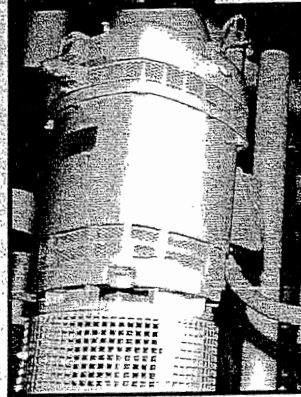
**THINGS YOU
CAN DO TO
PREVENT
WATER WASTE**





**Grand Rapids
Public Utilities
Commission
Drinking Water
Quality Report 2005**

Call Dennis Doyle, Water
Department Manager, or
Anthony Ward GRPUC
General Manager at
218-326-7024 if you have
questions about the Grand
Rapids Public Utilities
Commission's drinking water
or would like information
about opportunities for public
participation in decisions that
may affect the quality of the
water.



Grand Rapids Public Utilities Commission

Drinking Water Quality Report 2004

Call Dennis Doyle, Water
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or would like information
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participation in decisions that
may affect the quality of the
water.



Rapids

Public Utilities

4th annual

DRINKING
WATER

Report

Spring, 2002

Grand Rapids Resident: Grand Rapids Public Utilities is publishing testing results for the city's drinking water for 2001. The purpose of this report is to advance consumers understanding of drinking water and heighten awareness of the need to protect our water resources. The Safe Drinking Water Act ensures your right to-know about where your drinking water comes from and what is in it. The Public Utilities Commission intends that this report will fulfill its obligation to provide residents with current and accurate information about your drinking water.

If you have questions about Grand Rapids drinking water, or if you would like information on opportunities to participate in public meetings where decisions regarding water quality are made, please contact Dennis Doyle at 326-7024 or dmdoyle@grpuc.org.

Making
DRINKING WATER
Safe

Grand Rapids Public Utilities
Box 658
SE 4th Street
Grand Rapids, MN 55744



Resident
City of Grand Rapids
Minnesota 55744

U.S. POSTAGE
PAID
Grand Rapids, MN
Permit No. 16

Information on Water from the EPA

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves natural substances and, in some cases, radioactive material, and can pick up substances resulting from the presence of people and animals. The water is regularly evaluated for the following possible contaminants:

- Viruses and bacteria, which may come from sewage, agriculture and wildlife.
- Salts and metals, which can be naturally occurring or result from runoff, wastewater discharges, or farming.
- Pesticides and herbicides, which may come from agriculture, runoff, and residential uses.
- Synthetic and volatile organic chemicals, which are industrial by-products and can come from gas stations, runoff, and septic systems.
- Radioactive constituents, which can be naturally occurring and result from mining.

In order to ensure that tap water is safe to drink, EPA prescribes regulations that limit the amount of substances in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water that must provide the same protection for public health. *Some people may be more vulnerable to contaminants found in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. Environmental Protection Agency/Centers for Disease Control guidelines on appropriate means to lessen the risk of infection by Cryptosporidium are available from the Safe Drinking Water Hot-Line (800-426-4791).*

Grand Rapids Drinking Water Report

The Grand Rapids Public Utilities Commission is presenting to you the first Water Quality Report on the city's drinking water. The purpose of this report is to summarize the results of monitoring performed on our water during 1998 and to inform our customers about drinking water and the water utility supplying it. Information from the Environmental Protection Agency is also provided for your review. Congress has directed the EPA to require water systems to report annually on drinking water quality. This report fulfills this requirement and will be issued annually.

Did you know?

- The most water used in one day in Grand Rapids – 2.25 million gallons – was on August 11, 1998. The high temperature that day was 81°, the low temperature was 57°.
- Depending on brand and packaging, it would cost from \$40 to \$200 to take a bath in bottled water. In Grand Rapids water, it costs less than \$0.09.
- The city has 1.5 million gallons of storage capacity. A third water tower (500,000 gallon capacity) will be constructed next year.
- A leaky toilet can waste as much as 200 gallons of water per day.

Questions about water or water service?

Call the Public Utilities Commission at
326-7024.

high copper levels can result in liver or kidney damage. People with Wilson's Disease should consult their doctor if they consume water with high copper levels. In response to this issue, the utility performed a corrosion control study to make the water less likely to absorb materials, such as copper, from your plumbing. The pH of the water is now adjusted to lessen its corrosive characteristics. We believe this will decrease the amount of copper measured in distribution system water.

Water Testing

Grand Rapids water is frequently and regularly monitored by the Minnesota Department of Health, independent laboratories, and Public Utilities employees. Testing includes analyses for both regulated and unregulated substances that can effect the water's safety and quality. Regulated substances have had Maximum

EPA. Unregulated substances are not a threat to human health, but can effect the aesthetic qualities of the water. They are assessed using state standards known as Health Risk Limits, or have unenforceable recommended maximums set by the Safe Drinking Water Act. Should there ever be a public health concern regarding your drinking water, the Public Utilities Commission will inform you immediately.

Customer Service

In addition to providing high quality water, the employees of the Public Utilities Commission strive to provide you, the customer, with high quality service on a daily basis. The human and capital investments the community has made in our system have been invaluable and success would be impossible without your help.

Substances Detected in the Grand Rapids Water Supply by MN Department of Health Monitoring

Substance (units)	Highest Level Allowed (MCL)	Highest Level Detected in Grand Rapids Water	Ideal Goal (MCLG if regulated)	Typical Source of Substance
Regulated Substances Controlled Prior to Distribution (if not tested in 1998, last testing date included)				
Barium (ppm) 6/16/94	2.0	0.05	2.0	Natural deposits; drilling and refinery waste
Fluoride (ppm) 12/11/96	4.0	1.3	4.0	State-required additive
Nitrate as Nitrogen (ppm)	10.0	0.22	10.0	Fertilizer, sewage, natural deposits
Nitrite as Nitrogen (ppm)	1.0	0.02	1.0	Fertilizer, sewage, natural deposits
Total Coliform Bacteria	> 1 present	1*	Present in no samples	Naturally present in the environment
Unregulated Substances Detected in Grand Rapids Water				
Sodium (ppm) 12/11/96	---	38	200	Natural deposits
Sulfate (ppm) 1/30/95	---	8.9	250	Natural deposits
Regulated Substances Controlled in the Distribution System				
Substance (units)	Action Level (AL): 90% of sites must be under this value	# of sites over the Action Level	90% of all samples were below this level	Typical Source of Substance
Lead (ppb)	15	0 out of 20 tested	2.0	Home plumbing
Copper (ppm)	1.3	3 out of 20 tested	1.4**	Home plumbing

Key: MCL: Maximum Contaminant Level (the highest level of the contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology). MCLG: Maximum Contaminant Level Goal (the level of contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety). AL: Action Level (the concentration of a contaminant which, if exceeded, triggers treatment or other requirement which a water system must follow. 90% of all samples measures must be below this level). PPB: parts per billion. PPM: parts per million. * = Follow up sampling showed no contamination. ** = We are in exceedance of the action level of copper. See explanation in text.

Water sources. Our water supply originates deep underground from three different geological water formations: the Quarternary Buried Artesian Aquifer, the Biwabik Iron-Formation Aquifer, and the Quarternary Water Table Aquifer. Five wells, ranging in depth from 140 to 372 feet deep, draw water from these sources.

Treatment Plant. The present system of water treatment and distribution had its beginnings in 1985. At that time, the existing treatment plant was reaching the end of its useful life and a study of new water treatment options was commissioned. RCM and Associates developed the study and presented options to the Utility in November, 1985. The firm KBM, Inc. was selected to design the new plant and Max Gray Construction, Inc. was chosen to build the facility. The combined efforts of all parties involved resulted in one of the most sophisticated water treatment facilities in Minnesota going on-line November 14, 1988.

Water Treatment. Although most people don't realize it, city dwellers in the United States enjoy the best drinking water in the world. This is because the water we consume is a manufactured product. Seldom does water come straight from the ground needing no treatment to improve its quality, and our water is not an exception. The following paragraphs describe the treatment processes used to improve our water.

Iron and Manganese Removal. These are minerals common in Minnesota groundwater. While not a threat to health, they can affect the aesthetic qualities of the water. Water with iron concentrations greater than 0.5 parts per million (ppm) can be a nuisance in the home. Grand Rapids wells typically contain 20 to 50 ppm before treatment. Iron can leave rust-colored stains on laundry, porcelain and fixtures. Levels of manganese greater than 0.05 ppm can cause the water to have black spots on ice cubes and cause the water to have a bitter, metallic taste. Our wells contain 0.2 to 0.5 ppm manganese. The treatment plant effectively removes these

Softening. Grand Rapids is one of the few cities in the state that softens water at a centralized softening plant. This saves residents the expense of purchasing and maintaining a home softening system. Prior to treatment, our water is relatively hard at 190 to 250 ppm. After treatment, the water has an average hardness of 100-110 ppm. Softening is beneficial because hard water can leave yellow stains on laundry, cause mineral buildup in plumbing, and increases the amount of soap necessary for cleaning.

Fluoridation. Addition of fluoride is mandated by state law. Fluoride has been proven to reduce tooth decay, especially in children. The concentration is monitored regularly so that optimum levels are maintained.

Corrosion Control. To prevent corrosion in water mains and your plumbing, the pH of the water is adjusted using soda ash. This diminishes the amount of copper that can be absorbed into the water from your plumbing.

Monitoring Report Summary

Grand Rapids water is tested for many different substances so you can be confident of its safety. The table at right lists substances that have been detected in the city water supply. Grand Rapids' water supply tested slightly above the action level for copper. A few other substances were detected at levels well below state and federal standards. According to the EPA, all drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline at (800) 426-4791.

Copper is an essential nutrient, but excess amounts can cause health problems. Its source is home plumbing. Some people who consume too much copper may experience gastrointestinal

APPENDIX H

Calculation for Demand Reduction Potential (DPR)

First Priority

Residual - water usage in thousand gallons (See DPR's water usage data by customer category)

Jan - $10537 + 29 = 10566$

Feb - $9495 + 27 = 9522$

Mar - $8749 + 23 = 8772$

Average = $\frac{9653.33}{3} =$ winter demand

July - $10571 + 29 = 10600$

Aug - $13745 + 30 = 13775$

Average = $\frac{12157.5}{3} \rightarrow$ Summer demand

Demand reduction potential for residual is the base demand during winter months when water use for non-essentials such as lawn watering do not occur.

\therefore Average day demand \pm excluding demand for non-essential use)

= winter demand Feb-Mar-Apr
(28181 + 31)

= $\frac{9653.33 \times 1000}{30} = 321,778$ GPD

Demand reduction potential = (Summer-winter) thousand
= $(1398145) - (321778)$

$\frac{12157.5 \times 1000}{31} = 391,855$ GPD

Commercial - water usage in thousand gallons

Jan - $2038 + 1804 + 2151 + 3906 + 5379 + 4388 + 167 + 266 = 7138$

Feb - $1819 + 1627 + 2060 + 4424 + 4765 + 4365 + 238 + 749 = 20107$

Mar - $1804 + 1468 + 2755 + 4333 + 4390 + 409 + 214 + 449 = 19432$

Average = 56677

June = $2270 + 1785 + 2873 + 4317 + 5773 + 4680 + 169 + 95 + 6 = 21969$

July = $2270 + 1785 + 2873 + 4317 + 5773 + 4680 + 169 + 294 + 31 = 23232$

Aug = $2613 + 2241 + 4808 + 5984 + 6335 + 4950 + 116 + 506 + 50 = 27603$

Average = 72804

Industrial

Jan - 1650

June - 1120

Feb - 1320

July - 1450

Mar - 1180

Aug - 1850

Avg = 1384

Avg = 1474

Second Priority

Commercial

$$\text{Summer demand} = 24268 \times 1000 / 30.67 = 721262$$

$$\text{Winter demand} = 18893 \times 1000 / 30 = 629744.4$$

Industrial

$$\text{Summer demand} = 1474 \times 1000 / 30.67 = 48038.3$$

$$\text{Winter demand} = 1384 \times 1000 / 30 = 46133.3$$

Demand reduction potential =

$$\begin{aligned} & [\text{Comm} + \text{Ind}]_{\text{summer}} - [\text{Comm} + \text{Ind}]_{\text{winter}} \\ & = 769300.3 - 675677.7 \\ & = 93622.6 \end{aligned}$$

Average day demand

$$\begin{aligned} & = [\text{Total Comm} + \text{Ind}] - [\text{Customer using more than 10,000 CRP}] \\ & = 823,562 - [\text{Total (Large customers - 10,000 CRP)}] \\ & = 823,562 - 470,349 \\ & = 353,213 \text{ CRP} \end{aligned}$$



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Fifth Priority

Average day demand =

$$[\text{Total (large customers usage)}] - [\text{Total (large customers usage - 10,000)}]$$

$$= 620349 - 470349$$

$$= 150,000$$

Demand reduction potential = Average day demand

Sixth Priority

Average day demand =

$$[\text{Total other}] + [\text{Total Residential (Sum-winter) demand}]$$

$$= (2.9 \times 1000000 / 365) + (71,368)$$

Demand reduction potential = Average day demand