PART II WELLHEAD PROTECTION PLAN

Public Water Supplier 182001

City of Bayport, Minnesota

Prepared by Matthew Kline

Public Water Supply Profile

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General Information

Unique Well Numbers:
Well #2: 208795
Well #3: 208796
Emergency Well #4: 208797

Public Water Supply ID # 1820001
Size of Population Served: 2,500 (estimated)
County: Washington

Documentation List

Step	Date Performed
Scoping Meeting 2 Held (4720.5340, subp. 1)	December 21, 2018
Scoping 2 Decision Notice Received (4720.5340, subp. 2)	January 28, 2019
Remaining Portion of Plan Submitted to Local Units of Government (LUGs) (4720.5350)	January 8, 2020
Review Comments Considered (4720.5350, subp. 3)	
Public Hearing Conducted (4720.5350, subp.4)	
Remaining Portion WHP Plan Submitted (4720.5360, subp. 1)	
Final WHP Plan Review Received (4720.5360, subp. 4)	

Executive Summary

The Wellhead and Source Water Protection Plan (the Plan) for the City of Bayport (the City) addresses the two municipal supply wells and one emergency supply well operated by the City. The City's original Wellhead Protection Plan was approved by the Minnesota Department of Health in 2010. This Plan amendment was prepared in accordance with the applicable portions of the State of Minnesota Wellhead Protection Rules (Minnesota Rules 4720.5200 through 4720.5590 check).

The City's municipal water supply system includes two primary water supply wells: Wells 2 (208795) and 3 (208796), and one emergency well: Well 4 (208797). Wells 2 and 4 are open only to the Tunnel City Group. Well 3 is open to the Tunnel City Group and the Wonewoc Group. Primary wells 2 and 3 are considered highly vulnerable to contamination due to the presence of tritium and the continued presence of trichloroethylene (TCE).

This Plan amendment consists of two parts. In Part 1 of the Plan amendment, wellhead protection areas (WHPAs) for the City's water supply wells were delineated as were the associated drinking water supply management areas (DWSMAs). A single combined DWSMA was delineated for Bayport Wells 2 and 3. Given the emergency only status of Well 4, a DWSMA was not delineated. As shown in Figure 1, the majority of the single DWSMA is contained within the Bayport City limits, except for a small 40-acre section in Baytown Township that is in the northwest corner of the DWSMA.

The vulnerability of the DWSMA was derived from geologic sensitivity ratings of the city wells and the presence of tritium. Based on this information, MDH has assigned a high vulnerability rating to the DWSMA. The complete Part 1 of the plan can be found in Appendix B.

This document comprises Part 2 of the Plan amendment and addresses the following information:

- Data elements and their assessments;
- Impacts of changes on the public water supply;
- Issues, problems and opportunities;
- Wellhead protection goals, objectives, and action plans;
- Program evaluation; and
- Alternative water supply and/or contingency strategy.

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Chapter One

Data Elements/Assessment

I. Required Data Elements and Assessments

A. Physical Environment Data Elements

1. Soils

The characteristics of soils within the DWSMA apply to this plan because there appears to be a direct hydraulic connection between surface waters and the aquifers serving this water supply system, particularly due to the highly vulnerable rating 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. Figure 2 depicts the soil types within the DWSMA. A total of 15 different soil types were identified within the DWSMA. The associated physical soil properties for each soil type are reported in Appendix C. As a whole, these soils can be characterized as outwash silt and sand material deposited by glacial occurrences. These types of sandy soils provide high infiltration rates but do not support significant runoff as a contributing factor to aquifer recharge in the WHPA.

A major bluff that remains from the last glacial period bisects the city along with a portion of the DWSMA. Given the bluff terrain the potential for soil erosion exits where this feature occurs, however, there are currently no identified erosion areas within the City of Bayport or the DWSMA likely due to the infiltration rates of the soils found in the area.

2. Geology

The hydrologic setting for the Tunnel City Wonewoc Aquifer is fully described in the WHP Part 1 report (Appendix B). Given the type of deposits above the bedrock and the lack of a confining layer within or above the bedrock, the DWSMA vulnerability was rated high. These conditions along with the presence of tritium in both Wells 2 and 3, also contributed to the high vulnerability rating for both wells. These ratings also reflect uncertainty about the pathway for young water reaching the wells. Highly vulnerable aquifers are prone to a variety of contaminant threats, including storage tanks, abandoned wells, recharge areas within the DWSMA, etc. that can provide conduits for contaminants to quickly reach the city's aquifers.

3. Water Resources

The City DWSMA is located entirely within the Middle St. Croix Watershed which encompasses approximately 19.8 square miles. This watershed is part of the St. Croix River Basin. Water within this basin flows overland through the watershed from west to east towards the St. Croix River, which then flows north to south.

The Perro Creek Subwatershed, a subsidiary watershed of the Middle St. Croix Watershed, encompasses a major portion of the City's DMWSA. This entire subwatershed directly discharges to the main channel of Perro Creek, a 1.8 mile urban stream that receives drainage from 324 acres of land within Bayport. Perro Creek is fed by Perro Pond which is a shallow spring fed water body that receives drainage from 340 acres of neighboring subwatersheds within the City's of Oak Park Heights and Stillwater.

Perro Creek currently exceeds water quality standards for Total Suspended Solids (TSS), E. Coli, lead, and copper. The creek is listed as an impaired water by the State of Minnesota while also contributing to the Lake St. Croix impairment and TMDL for total phosphorous due to its discharge into the St. Croix River.

Connectivity between the city wells and this surface water feature is considered in Part 1 of the WHP Plan. Strategies to verify the surface-groundwater interaction will be considered in the implementation section of this plan.

Information on the Middle St. Croix Watershed is available through the Middle St. Croix Water Management Organization. Information on the watershed, subwatersheds, and corresponding plans that includes boundaries, flow directions and mapping is available at: http://www.mscwmo.org/.

Floodplain mapping was reviewed to determine proximity to the DWSMA and the need to incorporate management into Part 2 of the WHP plan. With the delegation of Well #4 to emergency status, there are no wells located within the floodplain.

B. Land Use Data Elements

1. Land Use

The City of Bayport is located in Washington County on the outer edge of the seven-county metropolitan area. The total area of the DWSMA (220 acres) encompasses a portion on the northwest side of the City along with a small area of Baytown Township (40 acres). Specific parcel data within the DWSMA can be accessed through the Washington County GIS system.

The primary land use within the DWSMA is single family residential dwellings, along with a significant amount of open space which includes Barker's Alps Park, conservation prairie land, and the aforementioned acreage within Baytown Township. A smaller area of the DWSMA is made up of the downtown commercial district and Andersen Elementary School, which is located in the northeast portion of the DWSMA.

The undeveloped area within Baytown Township consists of an old farmstead and open space. Baytown and Bayport have an orderly annexation agreement for this piece of land, however, if this land would be developed under Baytown ordinances, the properties would have residential wells and subsurface sewage treatment systems

instead of City water and sewer. This would increase the number of potential contaminant features within the DWSMA. Given the current and future types of land use within the DWSMA located in Bayport, the current and future impact to the aquifer and wells will be minimal. See Figures 3 and 4 for existing and future land use within Bayport and Figure 5 for a land cover map.

2. Potential Contaminant Source Inventory

Existing land uses and potential sources of contamination located within the DWSMA were reviewed by the WHP team. The Potential Contaminant Source Inventory (PCSI) was created utilizing county and state databases (Minnesota Well Index, MPCA What's in My Neighborhood website, County SSTS inventory), combined with staff knowledge, ground work, and staff research to identify the contaminant sources. Table 1 identifies all of the known potential contaminant sources within the DWSMA. Figure 6 shows the locations within the DWSMA. The City of Bayport conducted a PCSI Inventory in 2012 and is using current data from a variety of sources listed above for any new inventory since then. The inventory is limited to the new DWSMA formulated during the Part 1 process of the WHP process. A listing of parcels identified as having potential contaminant sources is shown in Appendix D.

According to the Part I findings, monitoring of the City's water supply wells indicated tritium has been detected in Wells 2 and 3. These results suggest a connection between the wells and land use activities. This will be explored further in monitoring strategies to determine potential surface water signatures within the City wells.

The potential contaminant sources within the DWSMA as currently configured are relatively minimal as show in Table 1. An overview of all potential sources is as follows:

Subsurface sewage treatment systems have been identified as being used by two residential properties within the DWSMA. Both systems have been reviewed through the Washington County SSTS system and are compliant.

There are four underground storage tanks that have been removed, located on two different sites. Each site has been listed as an MPCA spill site. Both sites have been remediated and closed by the MPCA. Neither site impacted groundwater in the area.

There are two identified above ground storage tanks per the MPCA site location map. One tank is currently active and still in use according to the MPCA who is responsible for the regulation of such components. The other tank has been removed. The owners of the active above ground storage tank will be notified about the City's Wellhead Protection Plan and DWSMA. The notification will include information on how leaks can affect the City's drinking water along with the best practices of using and maintaining an above ground storage tank.

There is a total of six documented wells within the DWSMA, including two active domestic wells, two public water supply wells, and two unknown wells. The City will

explore opportunities to determine if other wells exist and pursue ways to seal any unknown/unused wells.

Finally, there are two inactive and one active hazardous waste generators within the DWSMA. The active generator is a small dental business and is identified by the Washington County Public Health Department as low-level waste generator.

Of special note, in the summer of 2018 the City inspected what could be considered an abandoned cesspool at 775 3rd Ave. N. which is in the vicinity of an old farmstead that became residential housing in the 1960's. No contaminated material was detected within the concrete structure and the structure was abandoned per MN Statutes regarding septic system abandonment.

3. Inner Wellhead Management Zone

Existing land uses, management, and local land use controls within the Inner Well Management Zone (IWMZ/200' radius around the public water supply well) and the immediate one-year time of travel area as shown in Figure 7 was reviewed by the WHP team during the development of this plan. This is done to identify land use issues and related potential contaminants which may have the most immediate impact upon the public water supply wells.

A copy of the IWMZ forms and measures that have been identified are included in Appendix E of this plan. The WHP team discussed the importance of ongoing monitoring of land use changes and potential contaminants near the public water supply wells and awareness of State Well Code isolation distances and the need to maintain these setback requirements.

4. Public Utility Services

In regards to public utilities, the management of the DWSMA shall consider the following data elements:

- Transportation routes or corridors
- Gas Utility Pipelines
- Storm sewers, sanitary sewers, and public water supply systems
- Construction, maintenance, and use of public water supply and other wells

Ground transportation corridors provide a potential source of contamination due to accidental spills and discharges. Transportation corridors located within the DWSMA are shown in Figure 8 and include County Highways 14 and 21 and State Hwy MN 95. The City has been designated as an MS4 community and with that comes the requirement to monitor for illicit discharges and spills within the community. The presence of these transportation corridors will be managed by proactively working with local emergency management entities to make them aware of the DWSMA and consider DWSMA protection should any spills occur. All spills will be reported to the State Duty Officer per state requirements.

Gas utility pipeline mapping was reviewed and determined that there are no gas pipelines that intersect the DWSMA.

Stormwater from the Inspiration Development located on the west side of the DWSMA encompasses an "infiltration treatment train system" that would flow to Perro Pond and eventually Perro Creek if the system overflowed. The stormwater system for the remaining portions of the DWSMA also flow to Perro Creek. Figure 9 shows the complete stormwater system.

The stormwater system located outside of the Inspiration Development is primarily composed of open ditches, culverts, and on road drainage. There are two water bodies within Bayport that would be considered Public Water systems.

1. Perro Creek – A small creek that bisects Bayport and flows through the DWSMA. This water body is not listed as a Public Waterway per DNR mapping data.
2. Lake St Croix – A major water body making up the eastern boundary of Bayport that lies outside of the DWSMA.

Figure 10 and 11 depicts the City sewer and water system within the DWSMA. Water and wastewater lines should have negligible impact on groundwater quality.

The DNR Water Supply Plan on file with the City addresses options for back up water supplies and emergency preparedness in the event of a catastrophe, such as a hazardous release that may impact the public water supply. See Appendix H for the DNR Water Supply Plan Approval Letter. The full report can be requested at Bayport City Hall for viewing.

Public water supply wells within the DWMSA have been constructed to meet current state well code specifications. The two domestic wells also meet current standards. Part I has indicated that these entities do not provide a pathway for contaminants to enter the aquifer. There are two unknown wells within the DWSMA that would require more research to determine the location, construction, current usage, and potential for abandonment. At this time, it is unknown as to the potential contamination threat that these wells pose or if they exist.

C. Water Quantity Data

1. Surface Water Quantity

Water chemistry collected to date from the City wells suggests that the drainage feature, specifically Perro Pond/Creek, is not likely a significant source of recharge to the wells. The lack of nitrate and the chloride/bromide ratio in Well #3 does not suggest a strong connection between the well and the stormwater drainage feature(s). However, Part I of the plan indicates that data is somewhat inconclusive and the City should incorporate further testing into their Wellhead Protection Plan. Upon verification that these drainage features have an influence on the City water supply, the City will work with MDH and the wellhead protection team on management strategies for the potential impact.

2. Groundwater Quantity Data

The amount of groundwater in the source water aquifers within the DWSMA are not necessarily the issue as much as the limitation on the system. This can be seen in the stability of the ground water levels over time within the aquifer as identified by well drawdown data which indicates adequate groundwater capacity for the near future.

The current capacity of the water supply system was studied in 2017 in the form of a water distribution system model. Major components of the study include:

- The water system is limited, due to the capacity of the air stripper to treat TCE contaminated water. Max capacity is 1,000 gallons per minute.
- At current levels, the water system has an adequate capacity to provide water to all current customers.

Other factors affecting the groundwater quantity are as follows:

- No interference from other well types are known within the DWSMA.
- Summer usage is above recommended DNR levels which could influence the ability to supply water and fire flow during summer months.
- City wells are aging or becoming unusable. Well #4 has increasing levels of TCE and is located within the floodplain causing it to become relegated to an emergency only well.

D. Water Quality Data

1. Surface Water Quality Data

As discussed in the surface water quantity data section, Part I of the plan indicates that data concerning the influence of surface water on the City wells within the DWSMA is somewhat inconclusive. Given this scenario, surface water quality data will be discussed within this plan.

Perro Creek originates from Perro Pond which is located in Oak Park Heights and fed by stormwater runoff and springs. The creek bisects a portion of the DWSMA as it winds its way through the City. It receives a significant amount of stormwater runoff as it moves through the City due to its usage as the primary stormwater connector to the St. Croix River.

Perro Creek has been tested extensively by the Middle St. Croix Water Management Organization (MSCWMO) over a number of years. The surface water quality data can be found in Appendix F. The creek is currently listed as an impaired water for suspended solids and will be listed in the near future for E. Coli bacteria. Current testing by the MSCWMO is attempting to determine the primary contributor of the E.coli bacteria, human or animal. The creek also sees a significant amount of phosphorous load. The City is continually working with the MSCWMO on management strategies and projects to identify and reduce these contaminants. Additional surface water quality testing has been recommended in Part I of the WHP.

2. Groundwater Quality Data

This data element applies to this plan as existing data from isotopic and chemical analyses indicates that the aquifers used by the City are recharged quickly. A review of the chemical levels and data can be found in Part I of the WHP along with a synopsis on the reasoning for the high vulnerability rating for the DWSMA and wells.

In 1987, trichloroethylene (TCE), a chemical solvent often used in degreasing metal parts, was found in groundwater in Baytown Township just west of the City of Bayport. Beginning in 2003, TCE was detected in Bayport's municipal Well #2 (208795), and by 2005, increased above the maximum contaminant level (MCL) of 5 µg/l. Since then, TCE levels have steadily risen in Wells #2 (208795), #3 (208796), and #4 (208797). In 2007, an air stripping treatment system was installed to treat the water pumped at Bayport's municipal Well #2. Well #3 was connected to the treatment system in 2016. Wells #2 and #3 are now the primary water supply wells and the treated water from them contains no detectable TCE.

MDH continues to monitor the TCE levels on a quarterly basis. Current and past levels can be found in Appendix G. Monitoring for other potential east metro contaminants is ongoing per MDH recommendations, but at this time, there are no other groundwater contaminations in the vicinity. Additional groundwater quality testing has been recommended in Part I of the WHP Plan.

Chapter Two
Impact of Changes on Public Water Supply Wells

I. Changes Identified In:

A. Physical Environment

Currently, significant or large-scale changes in the physical environment that might affect the DWSMA is not anticipated in the next 10 years. Any changes are expected to be the result of residential development/redevelopment of properties or localized infrastructure changes. Such changes are not anticipated to result in land uses different than what is currently found elsewhere within the DWSMA. Any minor changes to the physical environment will likely not affect the management strategies for the Bayport DWSMA presented in the WHP amendment.

B. Land Use

The majority of the DWSMA falls within the boundaries of the City of Bayport. A significant amount of residential development has occurred within the DWSMA over the past 10 years, which has resulted in Bayport becoming close to build-out. No significant changes in land use are expected within the DWSMA in the next 10 years within Bayport.

Of note, the City of Bayport has an orderly annexation agreement with Baytown Township for approximately 40 acres of land that is in the northwest corner of the DWSMA. This land is

primarily undeveloped with an old farmstead and several residential properties located on the site. The area is zoned as residential which would match the land usage in the surrounding areas of the DWSMA and this designation is unlikely to change over the next 10 years. However, if developed under Baytown zoning restrictions, the properties would utilize well and septic systems for water and sewer needs. This would obviously increase the number of potential contaminant sources within the DWSMA.

C. Surface Water

Perro Creek is the primary surface water located within the DWSMA. While flow changes to the creek are not likely to occur, the City has the ability to bypass flow from Perro Pond through a state installed overflow system. If a surficial connection between Perro Creek flow and the City's wells is found to exist, the city may consider permanently bypassing flow to reduce the affect that the creek has on the water supply system.

In the interim, the City is partnering with the Middle St. Croix Watershed Management Organization (MSCWMO) to identify nutrient sources and treat stormwater before it enters Perro Creek. Current testing includes determining the type and source of E. Coli bacteria within the creek. A current cooperative project includes a bio-infiltration basin to remove nutrients that are being carried by stormwater runoff from City streets within the DWSMA. The City will continue to partner with the MSCWMO to improve surface water quality within the City and DWSMA.

D. Groundwater

The City of Bayport is experiencing the final expansion of residential development within the current City limits and the area covered by our joint powers agreement with Baytown Township for public water supply within a number of developments. See Figures 10 and 12 for an overview of the extent of the Bayport water supply system. There remains a minimal number of home sites available along with the orderly annexation area that would also provide a minimal number of residential home sites. The possibility of providing water services to a greater number of Baytown developments in the future depends on the number and size of development requests. According to water modeling within the 2017 Water Distribution System Model, our current water system is capable of supplying water for a full build out of Bayport, the current water supplied developments in Baytown, and a limited amount of potential future developments within Baytown. Recent discussions have already taken place to supply water to a future development that is in the planning stages. The Minnesota Department of Health supports these connections due to the decreased need for residential wells within the well advisory area.

Bayport water supplies are limited due to the capacity of the air stripper unit that treats TCE in our groundwater. Further requests for City supplied water beyond capabilities will potentially require more storage, another well, and further treatment capabilities.

II. Impact of Changes

A. Water Use

Water use for the Bayport water supply system has remained relatively stable for the past five years. The City has seen an increase in residential housing units in the same time period but has also implemented conservation water rates, along with instituting a watering ban. In the past year, the City has made a conscious effort to enforce the watering ban during high periods of water usage. Overall water usage is projected to slowly increase and then stabilize in the coming years primarily due to the limited number of residential connections still available in Bayport and Baytown developments. This does not take into account the connection of additional developments within Baytown Township.

As discussed in the groundwater section of the changes identified, the City of Bayport has a joint powers agreement to provide water to certain developments within Baytown Township. If new developments within the township desire to connect, the City determines if the water system is adequate for the increased demand. Eventually, the water system will reach its capacity and would no longer be able to accept water requests from future developments. An increase to capacity would require the drilling of another well, increasing the capacity of the air stripper (depending on the well's water source), and increasing the capacity of the upper zone water tower. Depending on groundwater contamination issues within Baytown Township and the need to provide treated water to residents, the City could work with MDH, MPCA, Baytown Township, and future developers to make these changes, depending on funding and the desire of Bayport and Baytown to support such an endeavor.

B. Influence of Existing Water and Land Government Programs and Regulations

As noted above, to conserve valuable water resources and address drought impacts, the City has controls on outdoor water usage. The City also provides water conservation information on the website and has a tiered billing structure for water use. These programs are designed to assist residents and businesses with water conservation strategies through incentives and educational information.

County and City ordinances, MPCA's storage tank permitting program, Washington County hazardous waste generator permitting program, state Well Management and Drinking Water Supply Programs, state subsurface sewage treatment system (SSTS) rules, and state rules regarding chemical handling and storage will be relied upon for assistance in regulating the installation of new wells, proper operation and maintenance of SSTS, proper maintenance and operation of storage tanks, proper storage of chemicals, and proper handling of hazardous wastes. In addition, Bayport is aware of and supports the Washington County well sealing program. Bayport believes that the current level of regulations and oversight by various governmental entities are adequate to address these issues.

Land use control and land disturbing activities outside of the City of Bayport will be governed by the local unit of government with jurisdiction in a particular area (minimal area within Baytown

Township). These controls within the City of Bayport have already been developed to minimize the effect stormwater and land use activities have on the water system.

The City of Bayport will continue to rely on federal, state, county and local agencies and regulations and programs to handle issues outside and inside of the City's boundaries regarding water conservation, water appropriations, and well drilling. The City will look to the MDH and DNR for continued regulation of the installation of wells and proper sealing and abandonment of old wells. The programs identified above have proven to be effective. The City will cooperate with the identified agencies, to the extent practicable, as issues arise in the future.

C. Administrative, Technical, and Financial Considerations

The City expects to have adequate resources available over a multi-year period to manage their source water aquifers within their DWSMAs. Funds to support ongoing wellhead and source water protection efforts will come from the City's water utilities budget. Wellhead and source water protection activities will be evaluated periodically her MDH requirements and any changes in the focus of the tasks will also be evaluated to determine if additional funding will be necessary to accommodate the changes. When appropriate and to assist in funding activities, the City may apply for grants from the MDH Source Water Protection Grant Program to fund implementation of management activities described later in this Plan.

For this WHPP to be effective, the City will need to keep the public aware of the issues affecting the public water supply through public educational programs. Therefore, the wellhead and source water protection actions described later in this Plan will include public education. Routine administrative duties will be directed or performed by the Wellhead Protection Manager. Specific tasks and strategies will be performed by the Wellhead Protection Manager or delegated by the manager to City staff or outside resources.

Chapter Three
Issues, Problems, and Opportunities

I. Issues, Problems, and Opportunities

A. Identification of Issues, Problems, and Opportunities

The City of Bayport has identified water and land use issues, problems, and opportunities related to: 1) the aquifer used by the city water supply wells; 2) the quality of the well water and surface water; or 3) land or water use within the DWSMA.

The City assessed: 1) input from public meetings and written comments that it received; 2) the data elements and recommendations by MDH during the scoping meetings; and 3) the status and adequacy of the City's official controls and plans on land use and water uses, as well as those of local, state, and federal government programs. The results of this effort are presented in the following table which defines the nature and magnitude of contaminant source management issues in the City's DWSMA. Identifying the issues, problems, and opportunities, as well as resource needs, enables the city to: 1) take advantage of opportunities that may be

available to make effective use of existing resources; 2) set meaningful priorities for source management; and 3) solicit support for implementing specific source management strategies.

B. Comments Received

There have been several occasions for local governments, state agencies, and the general public to identify issues and comment on the City's WHP plan. At the beginning of the planning process, local units of government were notified that the City was going to develop its WHP plan and were given the opportunity to identify issues, as well as to comment on content. A public information meeting was held to review the results of the delineation of the WHP area, DWSMA, and the vulnerability assessments. Also, a public hearing was held before the completed WHP plan was sent to MDH for state agency review and approval. No issues were identified during comment periods.

Table 2
Issues, Problems, and Opportunities

Issue	Problem	Opportunity
Need for additional monitoring of Perro Pond, Perro Creek, and City wells	Current data elements indicate a connection between the surface water sources of Perro Pond and Creek and the City water supply is unlikely, however the data is inconclusive and should be verified with increased testing	Monitoring and testing for certain chemicals as recommended in the Scoping 2 meeting should verify that a connection does/doesn't exist
Implementation of surface water sampling	Further study potential connection of surface and drinking water, contingent on available funding	Work with MDH on implementation and funding source
Collect groundwater samples from Wells 2 and 3	Further study potential connection of surface and drinking water, contingent on available funding	Work with MDH on implementation and funding source
Aging wells, Increased Water Usage, Potential need for alternative water supply	All City wells are greater than 50 years old Limited Capacity of the Air Stripper Unit (1,000 gpm) Potential Need to Abandon Well #4 (Floodplain, TCE level increasing)	Plan for the installation of future wells Drill test wells to identify groundwater that is free from TCE and within an area that has a confining layer if this exists within Bayport
Spill response to major transportation corridors within the DWSMA (CTY RD 14 and 21, MN 95), of special note, a portion of MN 95 lies within the IWMZ	The City relies upon outside agencies for spill response. The City has limited resources to effectively mitigate these occurrences.	City staff will become trained in illicit discharge detection and will work with MNDOT and local agencies for spill response

Potential for storage tanks, hazardous waste, etc to leak and impact city wells	Potential for leakage from known and unknown PSCI sites	Provide educational materials to storage tank sites and hazardous waste generators to minimize leak potential, educate staff to identify all related potential contaminant sources.
Well Security	Wells #2, #3, and #4 lack alarm security systems	Opportunities are available for grants to help implement security measures for water supply systems
Monitoring Groundwater Levels	Well #2 lacks any type of monitoring equipment. Well #3 has a level transducer but does not automatically record daily levels.	Per the DNR Water Supply Plan, the City will implement groundwater level monitoring to better understand potential level fluctuations due to usage
Emergency Power Supply	The City water supply system has one generator for emergency power situations. To operate the entire system, three generators are required.	The City will explore grant opportunities to help fund the purchase of two generators for full operation of the water supply system
Existing groundwater contamination	Potential known/unknown chemicals/contamination that already exists within the groundwater system	Work with MDH to continuously monitor groundwater to better understand all potential and existing contaminants that may affect the City's drinking water supply

C. Data Elements

Beginning with the delineation of WHPA and DWSMA (Part 1 of the WHP Plan) and continuing in this document, the required data elements have been addressed. Local and regional information was used in compiling and assessing the data elements. Bayport intends to continue collecting data from the municipal wells as well as other applicable information from public data sources as it becomes available during the life of this plan. At a minimum, this Plan will be revised/updated in 10 years as required by the Wellhead Protection Rules, or as directed by the MDH.

D. Local, State, and Federal Programs and Regulations

The State of Minnesota and local units of government currently enforce land use ordinances, zoning laws, sewer ordinances, well permitting regulations, and groundwater appropriation permit regulations. Bayport will work to promote the use of best management practices for potential contaminant source properties within the DWSMA. It is anticipated that local issues will be adequately addressed through the existing processes and adoption of best management practices.

Chapter Four
Wellhead Protection Goals

Goals define the overall purpose for the WHP plan, as well as the end points for implementing objectives and their corresponding actions. The WHP team identified the following goals after considering the impacts that: 1) changing land and water uses have presented to drinking water quality over time; and 2) future changes that need to be addressed to protect the community's drinking water:

- Maintain a safe and adequate drinking water supply for community residents.
- Prevent contaminants from reaching levels that present a risk to people's health.
- Create public awareness and general knowledge about the importance of WHP for maintaining an adequate and safe drinking water supply.
- Continue to collect data to support future wellhead and source water protection efforts.

Chapter Five
Objectives and Plans of Action

I. Objectives and Plans of Action

Objectives provide the focus for ensuring that the goals of the WHP plan are met and that priority is given to specific actions that support multiple outcomes of plan implementation. Both the objectives and the wellhead protection measures (actions) that support them are based on assessing: 1) the data elements; 2) the potential contaminant source inventory; 3) the impacts that changes in land and water use present; and 4) issues, problems, and opportunities in reference to administrative, financial, and technical considerations.

A. Objectives

The following objectives have been identified to support the goals of the WHP plan for the City of Bayport.

A. Provide the residents and businesses with educational materials and other resources to assist property owners with drinking water protection issues such as conservation, storage tank and hazardous waste spill prevention, private well use, maintenance and sealing assistance of wells, and SSTS maintenance.
B. Increase the knowledge base regarding the quantity of water available – maintain adequate drinking water supply.
C. Gather new information and data on potential contaminants.
D. Manage potential contaminants.
E. Ensure emergency preparedness of local agencies.
F. Create awareness among LGU's about the importance of protection of the drinking water supply aquifer.

G. Maintain communications with MDH and other agencies able to assist with implementation of this plan.
H. Collect additional data to substantiate information contained within this Plan, and to provide more detail for future Plan amendments.
I. Conduct regular evaluations of Plan implementation and effectiveness.

B. WHP Measures and Action Plan

Based upon this information, the WHP team has identified WHP measures that will be implemented by the City over the 10-year period that its WHP plan is in effect. The objective that each measure supports is noted as well as: 1) the lead party and any cooperators; 2) the anticipated cost for implementing the measure; and 3) the timeframe in which the measure will be implemented.

The following categories are used to further clarify the focus that each WHP measure provides, in addition to helping organize the measures listed in the action plan:

- Public Education and Outreach
- Well, Potential Contaminant Source, and IWMZ Management
- Land Use and Planning Management
- WHP Coordination, Reporting, and Evaluation

C. Establishing Priorities

WHP measures reflect the administrative, financial, and technical requirements needed to address the risk to water quality or quantity presented by each type of potential contamination source. Not all of these measures can be implemented at the same time, so the WHP team assigned priority to each. A number of factors must be considered when WHP action items are selected and prioritized (part 4720.5250, subpart 3):

- Contamination of the public water supply wells by substances that exceed federal drinking water standards
- Quantifiable levels of contamination resulting from human activity
- The location of potential contaminant sources relative to the wells
- The number of each potential contaminant source identified and the nature of the potential contaminant associated with each source
- The capability of the geologic material to absorb a contaminant
- The effectiveness of existing controls
- The time required to get cooperation from other agencies and cooperators
- The resources needed: staff, money, time, legal, and technical

The following Table 3 lists each measure that will be implemented over the 10-year period that the City's WHP Plan is in effect, including the priority assigned to each measure. It is difficult to foresee and plan for the future. The City will use its planning and management capabilities within this Plan to respond to any new/unknown source water protection issues that may impact the quality or quantity of its drinking water in the future.

Table 3: Wellhead Protection Measures and Action Plan															
Measure	Priority	Measure	Objective Addressed	City Measure Unless Cooperator Noted	Cost	Implementation Time Frame									
						2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Public Education and Outreach															
1	High	The City of Bayport will notify the residents and businesses in Bayport that the City has an approved wellhead protection plan and share with them the general themes included in the plan. The City will share this information through their city newsletter and/or on the website.	A		Staff Time	X									
2	Medium	The City of Bayport will provide WHP educational materials and a copy of the WHP plan on the City's website and update the page annually. Materials will address general WHP principles and practice and provide best management practices for tanks, private wells and other potential contaminant sources.	A		Staff Time	X	X	X	X	X	X	X	X	X	X
3	Medium	Educate the public on water conservation practices they can implement to reduce water use. Enforce city ordinance regarding water conservation.	A		Staff Time	Ongoing									
4	Medium	Provide information to SSTS owners about proper operation, maintenance, management plans, and regulations related to septic systems.													
Well, Contaminant Source, and IWMZ Management															

5	High	Update potential contaminant source database periodically as tanks are removed and sites are closed or land owners or land use changes. This will also help with the next plan amendment.	D	MDH MPCA	Staff Time					X					X
6	High	Coordinate with MDH, DNR, and Washington County on potential new wells drilled (Well Advisory Area) and SSTS systems installed within the DWSMA. Applies to potential Baytown Township development.	D	MDH DNR Washington County	Staff Time	Ongoing									
7	High	Ongoing research, location, and assessment of unknown wells located within the DWSMA	D	MDH	Staff Time	Ongoing									
8	High	If unused well(s) are located, work with property owner to properly seal well(s). This may include seeking grant funding	D	MDH Landowners Washington County	$1,000 Per Well	Ongoing									
9	High	Educate city staff on procedures and observations for illicit discharge, accidents, spills, and clean-up efforts that may occur in transportation corridors of the DWSMA. Coordinate with MNDOT if such occurrences happen.	D	MNDOT	Staff Time	Ongoing									
10	High	Purchase and install security system components for all well houses if need is determined and funding available.	E		$10,000 per location				X						

11	High	Work with MDH Hydrologist to prepare a monitoring plan for Perro Pond, Perro Creek, and City wells to better characterize whether these stormwater features are recharging the aquifer serving the city wells. Monitoring efforts should include a year-long program of quarterly sampling of parameters such as the stable isotopes of oxygen and hydrogen, total organic carbon, chloride, bromide, nitrate, ammonia, sulfate, arsenic, and field parameters such as temperature and conductivity.	H	MDH	Staff Time					X					
12	High	Work with MDH to implement the surface water monitoring plan per Scoping 2 Notice specifications and Measure #10.	H	MDH	Staff Time						X	X			
13	High	Work with MDH to collect groundwater samples from Wells #2 and #3 for analysis of chloride, bromide, sulfate, nitrate + nitrite as N, ammonia, and tritium. Monitoring will be dependent on funding from MDH and if the subsequent sampling in Measure #11 has occurred.	H	MDH	Staff Time						X	X			
14	High	Prepare a summary of the results and meet with the wellhead team to discuss how the results might be incorporated into wellhead planning and/or whether additional monitoring is needed.	H	MDH	Staff Time							X			

15	Medium	Research potential locations for new city well site. Drill test wells to determine water composition and preferred location with confining layer within the bedrock. Work depends on need and funding availability.	B, E	MDH MN DOC Consultant	Unknown	If need is determined									
16	High	Work with MN Department of Corrections/Stillwater Prison on a permanent interconnection for emergency water supplies for both water supply systems.	E	MN DOC	$70,000			X							
17	High	Purchase and install a groundwater level transducer in Well #2 to track static and drawdown water levels. Set up the SCADA system to record water levels from Wells #2 and #3 on an hourly basis.	B, H		$4,000		X								
18	High	Purchase two generators for emergency power and install at the air stripper unit and booster pump station.	E		$100,000		X								
19	High	Provide information to property owners with active storage tanks describing what WHP is. Provide information regarding proper containment areas for above and below ground tanks and spill response and clean-up.	D, E		Staff Time		X								
20	High	Review land use changes within the IWMZ to determine compliance with zoning and ordinance regulations and well setback requirements.	E, F		Staff Time	Ongoing									

21	Low	Provide information to Hazardous Waste generators located within the DWSMA.	D, E		Staff Time		X								
22	High	Continue partnership with MSCWMO in cooperative effort to improve water quality within the DWSMA and Bayport as a whole.	C, D	MSCWMO	Staff Time	Ongoing									
Land Use and Planning															
23	High	Create a cross-connection control plan.	D, E		Staff Time							X			
24	High	Work with Baytown Township, developers, DNR, MDH, and MPCA to better understand the need to supply water to Baytown residents and/or new developments.	F, G	Baytown Township DNR MDH MPCA	Staff Time	Ongoing									
25	High	Continue to develop and maintain a line of communication between the City and Baytown Township in order to remain abreast of any land use changes which are pending within the City's DWSMA. Review the orderly annexation agreement with Baytown Township for the area that lies within the DWSMA.	E, F	Baytown Township	Staff Time	Ongoing									
WHP Coordination, Reporting, and Evaluation															
26	High	Annually review the WHP plan. Consider funding needs and pursuit of SWP Grant funds to help implement activities identified in the WHP Plan.	I		Staff Time	X	X	X	X	X	X	X	X	X	X

27	High	Maintain a “WHP folder” that contains documentation of WHP activities you have completed and a date that it was done. Identify each activity with the number of the measure contained in this table.	I		Staff Time	X	X	X	X	X	X	X	X	X	X
28	High	Complete and Evaluation Report every 2.5 years that evaluates the “progress of plan of action and the impact of any contaminant release on the aquifer supplying the public water supply well” MN WHP Rule 4720.5270. Submit copy to MDH.	G, I		Staff Time			X			X			X	

Chapter Six
Evaluation Program

I. Evaluation

Plan evaluation is specified under Objective I and provides the mechanism for determining whether WHP action items are achieving the intended result or whether they need to be modified to address changing administrative, technical, or financial resource conditions within the DWSMA. Evaluation is used to support plan implementation and is required under Minnesota Rules, part 4720.5270, and prior to amending the City's WHP plan. The City has identified the following procedures that it will use to evaluate the success of implementing its WHP plan:

- Changes in land use and other development within the DWSMA will be monitored on an ongoing basis.
- It is recommended that the WHP team meets annually, although at a minimum they will meet every 2.5 years and develop a report which assesses the status of plan implementation and to identify issues that impact the implementation of action steps throughout the DWSMA.
- A written report will be completed every 2.5 years and presented to the Bayport City Council stating progress in implementation of objectives. This report will be placed on file at the Bayport Public Works Department and a copy of the evaluation will be sent to the MN Department of Health.

Chapter Seven
Alternative Water Supply/Contingency Strategy

I. DNR Water Supply Plan

The WHP plan must include a contingency strategy that addresses the disruption of the water supply that is caused either by contamination or mechanical failure. The City has a DNR approved Water Supply Plan that fulfills this requirement and is on file at the Public Works Department. See Appendix H for the DNR Approval Letter for the Water Supply Plan.

Appendix A

January 28, 2019

Mr. Matthew Kline, Public Works Director
City of Bayport
294 Third Street North
Bayport, Minnesota 55003

Subject: Scoping 2 Decision Notice and Meeting Summary – Name of Bayport – PWSID 1820001

Dear Mr. Kline,

This letter provides notice of the results of a scoping meeting held with you on December 21, 2018, at Bayport Public Works Building regarding wellhead protection (WHP) planning. During the meeting, we discussed the 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. We also discussed a summary of planning issues and recommendations that were identified during the Part 1 WHP Plan development process which should be considered for inclusion in your Part 2 WHP Plan.

The city of Bayport has met the requirements to distribute copies of the first part of the WHP plan to local units of government and hold an informational meeting for the public. The city of Bayport will have until May 20, 2020, to complete its WHP plan.

MDH understands the city of Bayport staff will be developing a draft of the remainder of the WHP plan. I will be contacting you to review the progress of the development of Part 2 of your plan. Upon request, the Technical Assistance Planner can provide a glossary of terminology, identification of information sources for the required Data Elements, and other technical assistance documents. If you have any questions regarding the enclosed notice, contact me by email at john.freitag@state.mn.us or by phone at 651-201-4669.

Sincerely,

John Freitag, Planner
Source Water Protection Unit
Environment Health Division
P.O. Box 64975
St. Paul, Minnesota 55164-0975

JF:ds-b

Enclosures: Scoping 2 Decision Notice, PCSI Requirements, WHP Planning Issues Summary

cc: Lucas Martin, MDH Engineer, Metro Office
Adam Bell, City Administrator, City of Bayport
Luke Stuewe, Minnesota Department of Agriculture

Date: January 28, 2019

Name of Public Water Supply: City of Bayport

PWSID: 1820001

Name of the Wellhead Protection Manager: Matthew Kline, Public Works Director

Address: 294 Third Street North

City: Bayport

Zip: 55003

Phone: 651-275-4410

Primary Unique Well Numbers: 208795 (Well #2), 208796 (Well #3)

DWSMA Vulnerability: ☐ Low ☐Moderate ☒ High

The purpose for the second scoping meeting, as required by Minnesota Rules, part 4720.5340, is to discuss the information necessary for preparing Part 2 of a Wellhead Protection Plan. The Part 1 Plan identifies the area that provides the source of drinking water for the public water supply (PWS) and assesses how vulnerable that area is to contamination. The PWS can utilize that information to develop land use and management practices that protects their groundwater resource from contamination.

The wellhead rule (Minnesota Rules, part 4720.5340) refers to the information required for wellhead planning as data elements. This notice lists the data elements that are stated in Minnesota Rules, part 4750.5400 and are selected for the PWS because of the vulnerability of the drinking water supply management area (DWSMA) as determined in Part 1.

Scoping 2 Data Elements Needed for the Part 2

Data Elements are pieces of information in the form of a map, a list, records, tables and inventories. Where appropriate, they should be reviewed and assessed in terms of their present and/or 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 DWSMA. It is important to discuss the relevance of the data elements to management of the DWSMA. Check the technical assistance comments for guidance on reviewing the data elements and conducting these assessments. Clearly identify in the plan which data elements are associated with which tables/figures. If a data element does not exist, state that in the narrative.

Submit –

The following information MUST be submitted in the Part 2 by including it in the plan narrative and/or appendix. An asterisk* with red text indicates information that MUST be contained in the Part 2.

- ☐ *A map that indicates the vulnerability and includes the DWSMA, WHP Area, and Emergency Response Area must be included in the Part 2. This map with vulnerability is a product of the Part 1 and provides a basis for planning activities in Part 2. SWP Planner can provide the DWSMA figure.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT –

Soils

- ☐ *Existing maps of the soils and a description of soil infiltration characteristics.
- ☐ *A description or an existing map of known eroding lands that are causing sedimentation problems.

Technical Assistance Comments: Infiltration characteristics and active erosion sites, along with land cover/land use and potential contaminant source information, should be assessed to determine the potential for the transport of contaminants into vulnerable areas of a DWSMA. The review of soils, infiltration, and erosion characteristics may identify opportunities for management strategies or targeted practices that reduce contaminant migration into groundwater.

DATA ELEMENTS ABOUT THE LAND USE –

Land Use

- ☐ *An existing map of political boundaries.
- ☐ *An existing map of public land surveys including township, range, and section.

Technical Assistance Comments: A map or maps showing updated political boundaries and township, range, section with labels is required for determining land use authorities for the land within the DWSMA. DWSMA figure map provided by SWP Planner will also contain political boundaries with township, range, and section. Determine and discuss how the various land use authorities may affect the management of the DWSMA.

- A map and an inventory of the current and historical agricultural, residential, commercial, industrial, recreational, and institutional land uses and potential contaminant sources.
  - ☐ *The Potential Contaminant Source Inventory (PCSI) data in both a table and a map format must be created and included in the Part 2. Include potential contaminant sources as listed on the PCSI attachment provided for each existing vulnerability within the DWSMA.
    - If DWSMA contains moderate and/or high vulnerability inventory all wells.
    - The inventory should include your community wells but not include any wells that are known to have been sealed according to the Minnesota Well Code (MN Rules 4725).
  - ☐ *A land use/land cover map and table. SWP Planner can provide a land cover map and data/table from federal sources. This data set should be used unless an alternative electronic data set that is more current and detailed is available. Assess and discuss changes in land use that could impact management of the DWSMA.
  - ☐ *An inventory of the Inner Wellhead Management Zone (IWMZ). A recent IWMZ inventory (within six years) for each primary well with management recommendations on the MDH form, or a table that summarizes the number and type of contaminant sources with the management recommendations must be included. Incorporate or reference the recommendation(s) from the IWMZ into the Part 2. IWMZ will be completed by the SWP Planner with assistance from the PWS staff. A copy will be provided to the PWS.

Technical Assistance Comments: This section encompasses the Potential Contaminant Source Inventory known as the PCSI. See the Scoping 2 Decision Notice Potential Contaminant Source Inventory Requirement Attachment(s) and endorsement procedures/fact sheets for further information. Utilize the PCSI geodatabase attribute template provided by SWP Planner. Management strategies must be developed for potential sources of contamination that pose a risk to the drinking water supply.

- ☐ *An existing comprehensive land-use map.
- ☐ *An existing zoning map.

Technical Assistance Comments: This information can indicate areas in the DWSMA where growth or the addition of potential contaminant sources is likely to occur. Furthermore, the review of local zoning and comprehensive land-use maps facilitates the evaluation of the degree of compatibility current and future land uses have with the PWS goals of protecting the drinking water wells and aquifer.

DATA ELEMENTS ABOUT THE LAND USE –

Public Utility Services

☐ *An existing map of transportation routes or corridors.

Technical Assistance Comments: Highway and railroad corridors can be used to move hazardous materials. These corridors should be evaluated to determine the level of risk they pose for spills in the DWSMA, considering their proximity to the wells, the local topography, and geologic conditions.

☐ *An existing map of storm sewers, sanitary sewers, and public water supply systems.

Technical Assistance Comments: Storm sewer systems and sanitary systems can be sources of contamination. Storm sewers are generally considered a public utility element designed to convey storm water runoff and use constructed features such as pipes and ponds. Evaluate the integrity and condition (age, type of material, any investigative work, etc.) of these systems in the DWSMA, noting the location of the water supply system and public water supply wells in relation to these potential contaminant sources. It is not necessary to include a map of your public water supply system in the Part 2 if you believe it would pose a threat to the security of your system.

☐ *An existing map of the gas and oil pipelines used by gas and oil suppliers.

Technical Assistance Comments: Petroleum pipelines can be sources of contamination (excluding liquefied natural gas pipelines). If possible, describe what is generally known about the condition of these pipelines in the DWSMA, and the readiness of the PWS to respond to an emergency. It is not necessary to include a map in the Part 2 if you believe it would pose a security threat.

☐ *An existing map or list of public drainage systems.

Technical Assistance Comments: Public drainage systems can help mobilize and transport contaminants. Use the Department of Natural Resources Buffer Protection Map and/or other available maps of ditches that have been publically recorded (county/judicial ditches). These public drainage systems should be assessed to determine the level of risk they pose in the DWSMA. Identify land uses that could contribute contaminants to the public drainage system and identify any ongoing remediation activities.

Required to be discussed in the plan-

The following information (if existing) MUST be reviewed and discussed in the development of the Part 2. The Part 2 narrative must contain a description identifying whether/how the information may influence the management of the DWSMA. The data element may be located in the public domain. While the map or document reviewed is not required to be included in the Part 2, the source of the data element must be provided in the plan narrative by indicating a web address or reference to its location.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT –

Water Resources

- An existing map of the boundaries and flow directions of major watershed units and minor watershed units.

Technical Assistance Comments: Identify/list the major and minor watershed(s) in the Part 2 in order to become aware of local water planning efforts such as One Watershed One Plan (1W1P), Watershed Restoration and Protection Strategies (WRAPS), and/or Groundwater Restoration and Protection Strategies (GRAPS).

- An existing map showing those areas delineated as floodplain by existing local ordinances.

Technical Assistance Comments: Assess and describe any issues and management needed due to proximity to floodplain. Public water supply wells located in the floodplain should be evaluated to determine if they are meeting the flood protection requirements of the MN Well Code 4725.5850. Consider utilizing the sanitary survey report to identify potential issues with public water supply wells in floodplains.

DATA ELEMENTS ABOUT THE LAND USE –

Land Use

- An existing map of parcel boundaries.

Technical Assistance Comments: Parcel boundaries may have been used for delineation of the DWSMA in Part 1. In Part 2, parcel identification information must be included or linked and must be used for education or targeting activities or practices in addressing potential contaminants. In the narrative, indicate if parcel data is available from the public domain (i.e. county GIS or associated website such as Beacon).

Part 1 -

The following information was reviewed and assessed in Part 1. The Part 1 should be used as a data source for the Part 2. The technical assistance comments provide the requirements for how this information must be discussed and/or included in the Part 2. Include relevant excerpts or summaries from the Part 1 where indicated. Or if the Part 1 is included in the appendix that can be referenced.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT –

- 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.
- Existing records of the geologic materials penetrated by wells, borings, exploration test holes, or excavations, including those submitted to the department.
- Existing borehole geophysical records from wells, borings, and exploration test holes.
- Existing surface geophysical studies.

Technical Assistance Comments: Provide a summary in the plan narrative (few sentences/paragraph) of the Description of the Hydrologic Setting from Part 1. Provide the conclusions regarding the Well and DWSMA Vulnerabilities related to the geologic conditions and how these conditions influence the management of the DWSMA.

DATA ELEMENTS ABOUT THE LAND USE –

Public Utility Services

- An existing record of construction, maintenance, and use of the public water supply well and other wells within the DWSMA.

Technical Assistance Comments: Well construction records indicate what is known about the well(s) and can indicate if the well(s) have structural integrity or groundwater protection issues. Briefly summarize in the plan narrative what is discussed about each well from the Assessment of Well Vulnerability in Part 1.

DATA ELEMENTS ABOUT WATER QUANTITY –

Surface Water Quantity

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

Technical Assistance Comments: Provide a summary from Part 1 in the plan narrative about the interactions between surface water features and the groundwater and if there are water use or pumping conflicts. Contact MDH hydro if need additional technical assistance.

Groundwater Quantity

- An existing list of wells covered by state appropriation permits, including amounts of water appropriated, type of use, and aquifer source.
- An existing description of known well interference problems and water use conflicts.
- An existing list of state environmental bore holes, including unique well number, aquifer measured, years of record, and average monthly levels.

Technical Assistance Comments: This information, if known, was incorporated into the Part 1 and was used to assist in determining hydrologic boundary conditions and area static water levels. In Part 2, information about Department of Natural Resources appropriation permit holders and any known well interference problems or water use conflicts must be discussed, including how this information could affect the management of the DWSMA.

DATA ELEMENTS ABOUT WATER QUALITY –

Groundwater Quality

- An existing summary of water quality data, including: 1. bacteriological contamination indicators; 2. inorganic chemicals; and 3. organic chemicals.
- An existing list of water chemistry and isotopic data from wells, springs, or other groundwater sampling points.
- An existing report of groundwater tracer studies.

Technical Assistance Comments: This information, if known, was incorporated into the Part 1. Provide a summary of the assessment of well vulnerability and/or any relevant chemistry and isotopic composition data available from PWS wells and other wells/sources.

- An existing site study and well water analysis of known areas of groundwater contamination.
- An existing property audit identifying contamination.
- An existing report to the Minnesota Department of Agriculture and the Minnesota Pollution Control Agency of contaminant spills and releases.

Technical Assistance Comments: This information, if known, was incorporated into the Part 1. Discuss whether there are groundwater contamination areas that could pose a risk to the public water supply well(s) now or in the future. Include any relevant data and how this information may affect the management of the DWSMA.

Revised: 04/2018

To obtain this information in a different format, call: 651-201-4570. Printed on recycled paper.

City of Bayport Scoping 2 Meeting

Wellhead Protection (WHP) Planning Issues Summary

NOTE: 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.

Drinking Water Protection Issues Identified to Date:

MDH recommends that the city develop a monitoring plan for additional sampling of both the stormwater feature and the wells over the course of several seasons. (See recommendations below for more detail)

Legacy Trichloroethene (TCE) contamination is an ongoing issue. (See Water Quality below for more detail)

Water Quality Detections and Implications:

In 1987, TCE, a chemical solvent often used for degreasing metal parts, was found in the groundwater in Baytown Township, west of the city of Bayport. Beginning in 2003, TCE has been detected in Bayport's municipal Well #2 (208795) and by 2005 increased above the maximum contaminant level (MCL) of 5µg/L. Since then, TCE has been detected at low levels in Bayport Wells 3 (208796) and 4 (208797). In 2007, an air stripping treatment system was installed to treat the water pumped at Bayport's municipal Well #2. Well #3 was connected to the treatment system in 2016. Wells 2 and 3 are now the primary water supply wells and the treated water from them contains no detectable TCE.

Old Municipal Well Information:

- The Minnesota Department of Health has compiled historical information for use in the planning process.

Sanborn Maps:

☒ Sanborn Maps are not available for this area.

Recommended WHP Measures:

1. Additional monitoring of the Prison Stormwater Pond, Perro Creek, and the city wells should help to better characterize whether the stormwater drainage feature is recharging the aquifer serving the city wells. Monitoring efforts should include a year-long program of quarterly sampling of parameters such as the stable isotopes of oxygen and hydrogen, total organic carbon, chloride, bromide, nitrate, ammonia, sulfate, arsenic and field parameters such as temperature and conductivity.

Implementation of the monitoring plan should be made, contingent on available funding. It is recommended that the city consider a step-wise approach to the monitoring measures, for example:

- Contact MDH hydrologist by year five for assistance with preparing a monitoring plan that identifies sampling locations and parameters, timeframes and roles.
- Implement the monitoring plan over four quarters by year six and seven.
- Prepare a summary of the results, and meet with the wellhead team to discuss how the results might be incorporated into wellhead planning and/or whether additional monitoring is needed.

2. Collect groundwater samples from Well #2 (208795) and Well #3 (208796) for analysis of chloride, bromide, sulfate, nitrate + nitrite as N, ammonia, and tritium. Timeframe: at year six. Responsibilities: the city of Bayport staff to schedule with MDH; sample collection and analysis done by MDH; contingent upon funding from MDH. The full monitoring package may be unnecessary depending on whether the city implements the quarterly monitoring plan related to the stormwater features.

3. New Wells: Both of the city's primary wells are more than 50 years old. Pending available funding, the city may want to include a measure in their plan for drilling test wells to plan for the eventual replacement of one or more of their older wells. If new wells are being considered, installing them in an area with a thicker or more competent layer of clay-rich till or shale may provide the city with natural protection against man-made contaminants at the land surface.

Other: None

Appendix B

Hydrogeologic Assessment of the Drinking Water Source and Wells for the City of Bayport

DELINEATIONS – WELLHEAD PROTECTION AREA AND DRINKING WATER SUPPLY MANAGEMENT AREA

VULNERABILITY ASSESSMENTS – WELLS AND DRINKING WATER SUPPLY MANAGEMENT AREA

August 20, 2018

Hydrogeologic Assessment of the Drinking Water Source and Wells for the City of Bayport

Public Water Supply ID: 1820001

City of Bayport
294 North Third Street
Bayport, Minnesota 55003
651-275-4410
mkline@ci.bayport.mn.us
http://www.ci.bayport.mn.us/

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I hereby certify that this plan, specification or report 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.

Signature: _____ Date: _____

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Glossary of Terms

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

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

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

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

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

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

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

FSA - Farm Security Administration

MDA - Minnesota Department of Agriculture

MDH - Minnesota Department of Health

MGS - Minnesota Geological Survey

MnDOT - Minnesota Department of Transportation

MnGEO - Minnesota Geospatial Information Office

MODFLOW - Three-Dimensional Finite-Difference Groundwater Model

MPCA - Minnesota Pollution Control Agency

NRCS - Natural Resource Conservation Service

SWCD - Soil and Water Conservation District

UMN - University of Minnesota

USDA - United States Department of Agriculture

USGS - United States Geological Survey

Summary

Protection Areas - The recharge area for the wells is known as the wellhead protection area, or WHPA, and represents the area that contributes water to the city's wells within a 10-year time period. The area that contributes water within a one-year time period is known as the emergency response area, or ERA. Practical reasons require the designation of a management area that fully envelops the wellhead protection area, called the drinking water supply management area, or DWSMA. Each of these areas is shown in Figure 1.

Geology and Groundwater Flow – The city of Bayport has two primary bedrock wells and one emergency bedrock well: Well #2 (Unique No.208795), Well #3 (Unique No. 208796), and Well #4 (Unique No. 208797). Wells 2 (208795) and 4 (208797) are open only to the Tunnel City Group (CTCG Aquifer). Well #3 (208796) is open to the Tunnel City Group and to the Wonewoc Group (CTCW Aquifer). The city's aquifers are between approximately 129 and 260 feet below the ground surface (Table 1). Regionally, groundwater flow is to the east, discharging into the St. Croix River.

Well Vulnerability - The vulnerability of each well was assessed based on 1) well construction details, especially conformance with standards required by the state well code, 2) the geologic sensitivity of the aquifers, and 3) past monitoring results. The well construction information for Wells 2 (208795) and 3 (208796) indicates compliance with the current State Well Code specifications (Minnesota Rules, part 4725). Primary Wells 2 (208795) and 3 (208796) are both considered vulnerable to contamination due to tritium being detected in the well water (Table 2). Detectable tritium and the continued presence of TCE indicates the presence of young (post-1953) water.

DWSMA Vulnerability - The vulnerability of the city's aquifer throughout the DWSMA is based on the geologic sensitivity ratings of wells and their monitoring data (Table 2). Based on this information MDH has assigned a high vulnerability to the DWSMA. This suggests that water and contaminants may travel from the land surface to the city's aquifers within a time span of years to decades. The high vulnerability areas are based on the relative lack of continuous layers of confining materials (e.g. clay or shale) that could impede vertical infiltration of contaminants. This rating reflects also uncertainty about the pathway for young water reaching the wells. Highly vulnerable aquifers are prone to a variety of contaminant threats, including chemical storage tanks and abandoned wells that can provide conduits for contaminants to quickly reach the city's aquifers.

Water Quality Concerns – Under the Safe Drinking Water Act, the Environmental Protection Agency (EPA) established national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. US EPA has identified chemicals that occur in drinking water with a frequency and at levels that may pose a threat to public health, and has defined maximum allowable levels in the city's water supply.

In 1987, Trichloroethene (TCE), a chemical solvent often used for degreasing metal parts, was found in the groundwater in Baytown Township, west of the city of Bayport . Beginning in 2003, TCE has been detected in Bayport's municipal Well #2 (208795) and by 2005 increased above the maximum contaminant level (MCL) of 5µg/L. Since then, TCE has been detected at low levels in Bayport Wells 3 (208796) and 4 (208797). In 2007, an air stripping treatment system was installed to treat the water pumped at Bayport's municipal Well #2. Well #3 was connected to the treatment system in 2016. Wells 2 and 3 are now the primary water supply wells and the treated water from them contains no detectable TCE.

Recommendations - The Recommendations section of this report outlines actions that could improve future delineations and vulnerability assessments and should be considered for inclusion as management strategies in the city's wellhead protection plan. These activities include water quality monitoring to investigate the connection between surface water and water pumped at the well.

Table 1 - Water Supply Well Information

Local Well ID	Unique Number	Use / Status	Case Diameter (inches)	Case Depth (feet)	Well Depth (feet)	Date Constructed / Reconstructed	Aquifer	Well Vulnerability
Well #2	208795	Primary	20 x 16	193	315	1947	CSLT - St. Lawrence-Tunnel City	Vulnerable
Well #3	208796	Primary	12 x 8	129	296	1952	CTCW - Tunnel City-Wonewoc	Vulnerable
Well 4	208797	Emergency	24	136	260	1964	CTCG - Tunnel City Group	Vulnerable

Table 2 - Isotope and Water Quality Results

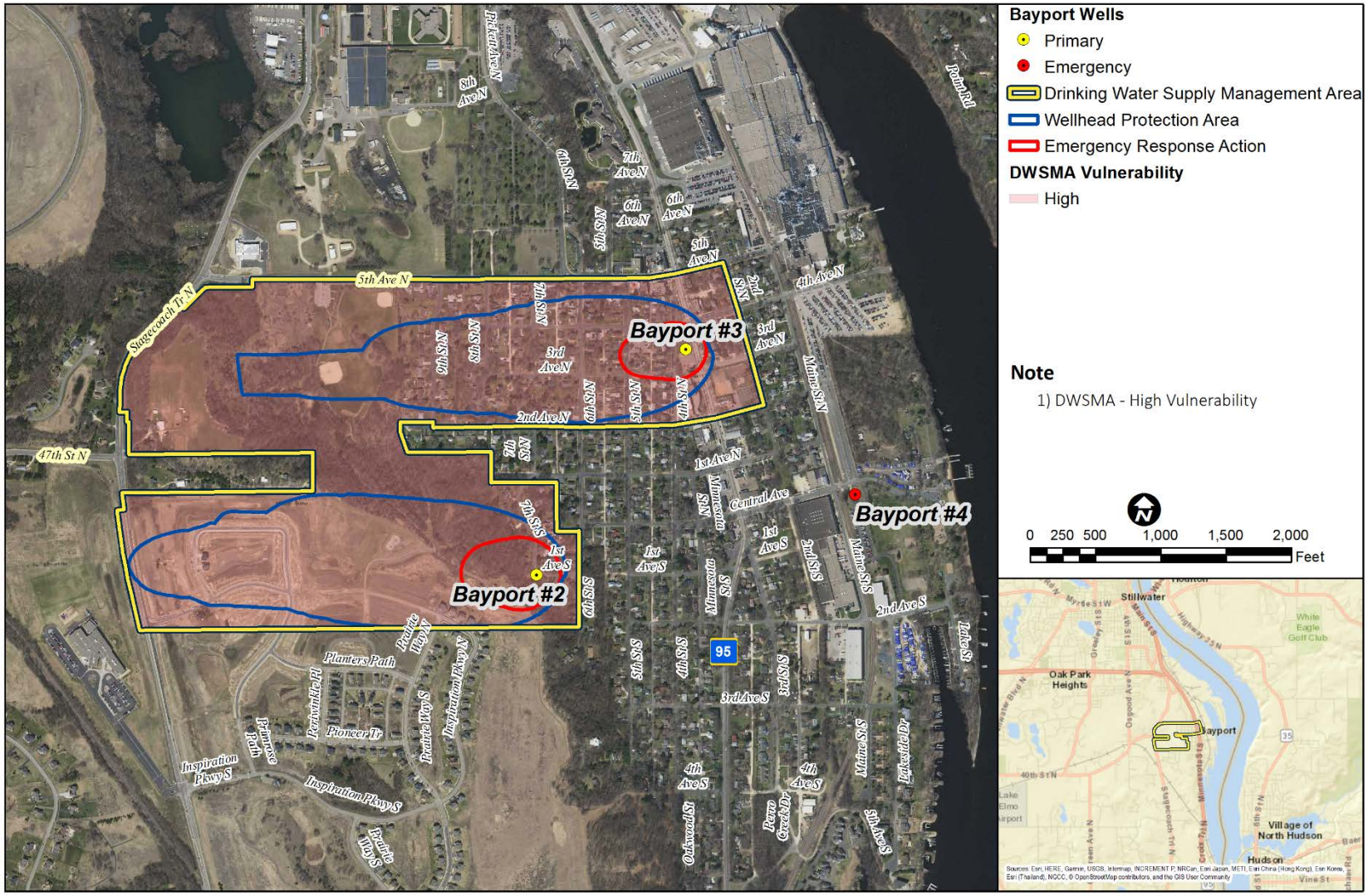
Sample Date is February 13, 2017 *(unless otherwise indicated)*

Sampling Point	Tritium (TU)	Nitrate + Nitrite (mg/L)	Ammonia Nitrogen (mg/L)	Chloride (mg/L)	Bromide (mg/L)	Cl/Br	Arsenic (ug/L)
Well # 2 (208795)	3.8	2.2	<0.05 *(7/24/2012)*	15.50 *(7/24/2012)*	0.0237 *(7/24/2012)*	654 *(7/24/2012)*	2.38 *(7/24/2012)*
Well # 3 (208796)	2.28	< 0.05	<0.05 *(7/24/2012)*	5.74 *(7/24/2012)*	0.0145 *(7/24/2012)*	396 *(7/24/2012)*	1.46 *(1/10/2018)*

2

Washington County
Minnesota

Figure 1
Drinking Water Supply Management Area and Vulnerability
City of Bayport



Technical Report

Discussion

This document describes the amendments to Part 1 of the wellhead protection (WHP) plan for the city of Bayport (PWSID 1820001). The purpose for amending the plan is to address the changes that have occurred since the plan was last approved, in order to update the WHP measures that are needed to protect public drinking water. In addition, the locations of the city's wells were adjusted for greater accuracy. The work was performed in accordance with the Minnesota Wellhead Protection Rule, parts 4720.5100 to 4720.5590.

This report presents delineations of the wellhead protection area (WHPA) and drinking water supply management area (DWSMA), and the vulnerability assessments for the public water supply wells and DWSMA. Figure 1 shows the boundaries for the WHPA and the DWSMA. Figure 1 also shows the emergency response area (ERA), which is defined by a one-year time of travel. An inner wellhead management zone (IWMZ), which is the area within a 200-foot radius around the well, serves as the wellhead protection area for emergency wells and is not displayed in this report. Definitions of rule-specific terms used are provided in the "Glossary of Terms."

In addition, this report documents the technical information required to prepare this portion of the WHP plan in accordance with the Minnesota Wellhead Protection Rule. Additional technical information is available from MDH.

Table 1 lists all the wells in the public water supply system. Only wells listed as primary are required to be included in the WHP plan.

The Assessment of the Data Elements

MDH staff met with representatives of the city of Bayport on July 25, 2017, for a scoping meeting that identified the data elements required to prepare Part I of the WHP plan. Appendix A presents the assessment of these data elements relative to the present and future implications of planning items specified in Minnesota Rules, part 4720.5210.

General Descriptions

Description of the Water Supply System

The city of Bayport obtains its drinking water supply from two primary wells. Table 1 summarizes information regarding them.

Description of the Hydrogeologic Setting

The hydrologic setting for the Tunnel City/Wonewoc Aquifer is described in the 2007 WHPA Part 1 report (Djerrari, 2007). Depth to bedrock in Baytown Township, west of the city, ranges from 0 to 50 feet, but in the western and southwestern portions of Bayport, depth to bedrock ranges from 200 to 300 feet. The logs for the three Bayport municipal wells indicate depth to bedrock of 115 to 170 feet. In Baytown Township glacial deposits above the bedrock consist of till and outwash deposits, with local areas of lacustrine sand and silt. In western Bayport, the unconsolidated deposits above the bedrock are comprised of upper terrace deposits consisting of sands and gravels (Appendix B, Figures 3 and 6). Lower terrace deposits are present in most of the city, east of the bluff, in the floodplain areas. These deposits also consist of sand, gravelly-sand, and gravel (Appendix B, Figures 3 and 6).

The uppermost bedrock in most of Bayport is the Tunnel City Group (formerly known as the Franconia Formation), a very fine-grained glauconitic sandstone. Typically, 165 feet thick, this formation ranges from 150 to 180 feet thick in the Bayport area, according to local well logs. In the western part of Bayport and into Baytown Township, the uppermost bedrock formations become progressively younger and include the St. Lawrence Formation, the Jordan Sandstone, the Prairie du Chien Group, and thin remnants of the St. Peter Sandstone.

Below the Tunnel City Group are the Wonewoc Sandstones. The Wonewoc Sandstones consist of silty, fine- to coarse-grained, poorly sorted, quartzose sandstone at the top, underlain by the better sorted, fine- to medium-grained sandstone. The Wonewoc Sandstones average 50- 60 feet in thickness. Bayport Wells 2 (208795) and 4 (208797) are open only to the Tunnel City Group (CTCG Aquifer). Bayport Well #3 (208796) is open to the Tunnel City Group and to the Wonewoc Formation (CTCW aquifer). The city's aquifers are between approximately 115 and 296 feet below the ground surface (Table 1).

The distribution of the aquifer and its stratigraphic relationships with adjacent geologic materials are shown in the geologic cross-sections developed in the original Part 1 plan (Djerrari, 2007), and included in Appendix B. The geological maps and studies used to further define local hydrogeologic conditions are provided in the “Selected References” section of this report.

A description of the hydrogeologic setting for the aquifers used to supply drinking water is presented in Table 3.

Table 3 - Description of the Local Hydrogeologic Setting

Tunnel City/Wonewoc Aquifer	Aquifer Material	Sandstone	City Well Logs
	Primary Porosity	0.2	Typical of aquifer material.
	Aquifer Thickness	180	City Well Logs
	Stratigraphic Top Elevation	565 - 590 AMSL	City Well Logs
	Stratigraphic Bottom Elevation	409 AMSL	City Well Logs
	Hydraulic Confinement	Confined	City Well Logs
	Transmissivity (T)	Reference Value/Range 3,780 ft^2/day (1,890 - 5,670 ft^2/day)	The transmissivity of the Tunnel City/Wonewoc Aquifer was determined by multiplying the hydraulic conductivity by the aquifer thickness.
	Hydraulic Conductivity (K)	Reference Value/Range 21 ft/day (10.5 – 31.5 ft/day)	The reference value for the transmissivity of the Tunnel City Aquifer was determined from a pump test at Bayport Well #2. The Wonewoc formation was assumed to have the same hydraulic properties. The range of Kh was assumed to be +/- 50 percent.
	Groundwater Flow Field	Flow to the east toward the St Croix River. Hydraulic Gradient: 1.4×10^{-1}	Measured from model results.

Delineation of the Wellhead Protection Area

Delineation Criteria

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

Table 4 - Description of WHPA Delineation Criteria

Criterion	Descriptor	How the Criterion was Addressed
Flow Boundary	Mississippi, Rum, and St. Croix Rivers	The rivers provided boundary conditions to the regional model that extended to these natural boundaries. The head specified boundaries for the local model were set at the head computed by the regional groundwater model.
Flow Boundary	Other High-Capacity Wells (Table 6)	The pumping amounts were determined based on the averaged 2011 - 2015 pumping volumes. The pumping amounts of these high-capacity wells were included in the methods used for the delineation. In addition, other high capacity wells located beyond the two-mile radius were included in the model.
Daily Volume of Water Pumped	See Table 5	Pumping information was obtained from the DNR Groundwater Appropriations Permit 1964-0526 and from the public water supply system. The annual pumped volumes were converted to a daily volume pumped by the well.
Groundwater Flow Field	Flow to the east Hydraulic Gradient: 1.4×10^{-1} ft/foot	The model calibration process addressed the relationship between the calculated versus observed groundwater flow field.
Aquifer Transmissivity	Reference Value: 3,780 ft^2/day	The aquifer test plan was approved on January 17, 2018, and T was determined from a pump test conducted in 2004 at Well #2. Uncertainty regarding aquifer transmissivity was addressed as described in the "Addressing Model Uncertainty" section.
Time of Travel	10 years	The public water supplier selected a 10-year time of travel.

Pumping data was obtained from the DNR Permit and Reporting System (MPARS) for the public water supply's Appropriations Permit Number 1964-0526. These values, confirmed by the public water supplier, were used to identify the maximum volume of water pumped annually by each well over the previous five-year period, as shown in Table 5. An estimate of the pumping for the next five years is also shown. The maximum daily volume of discharge used as an input parameter in the model was calculated by dividing the greatest annual pumping volume by 365 days.

In addition to the wells used by the public water supplier, Table 6 shows other high-capacity wells included in the delineation to account for their pumping impacts on the capture areas for the public water supply wells. Pumping data for these high-capacity wells was obtained from the DNR MPARS database.

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

Well Name	Unique Number	2012	2013	2014	2015	2016	Annual Volume of Water Pumped[1] (gallons)	Daily Volume (cubic meters)
Well #2	**208795**	40,318,000	47,717,000	**48,224,000**	40,571,000	37,650,000	48,224,000	500.1
Well #3	**208796**	23,126,000	6,209,000	23,551,000	22,769,000	**44,811,000**	44,811,000	464.7

[1]Expressed as gallons. Bolding indicates greatest annual pumping volume

Table 6 - Other Permitted High-Capacity Wells

Unique Number	Well Name	DNR Permit Number	Aquifer	Use	Annual Volume of Water Pumped[1, 2]	Daily Volume (cubic meters)
208790	Andersen Corporation	1960-0269	CFRNCMTS	Non-metallic Processing (rubber, plastic, glass, concrete)	126.7368	1314
208791	MN Dept of Corrections - Stillwater	1986-6042	CMTS	Commercial/Institutional Water Supply	75	778
767106	MN Dept of Corrections - Stillwater	1986-6042	CMTS	Commercial/Institutional Water Supply	75	778
231885	Xcel Energy	1964-0866	CMTSPMHN	Commercial/Institutional Water Supply; Thermoelectric Power Generation - Non Cooling	33.782388	350
737150	Bryan Rock Products, Inc.	2007-0667	QWTA	Sand and Gravel Washing	26.533504	275
112245	Andersen Corporation	1960-0269	CFRNCMTS	Non-metallic Processing (rubber, plastic, glass, concrete)	0	0
225915	Xcel Energy	1964-0866	CMTSPMHN	Commercial/Institutional Water Supply; Thermoelectric Power Generation - Non Cooling	23.73864	246
478570	Andersen Corporation	1987-6323	QWTA	Pollution Containment	16.8121	174
767106	MN Dept of Corrections - Stillwater	1986-6042	CWOC	Commercial/Institutional Water Supply	60.381	626

[1]Expressed as million gallons per year

Method Used to Delineate the Wellhead Protection Area

The WHPA for the city of Bayport's wells was determined using the software code MODFLOW (McDonald and Harbaugh, 1988; Harbaugh et al., 2000; Harbaugh, 2005). The groundwater capture zone delineations were completed using an existing regional MODFLOW Model, MetroModel 3.0, provided by the Metropolitan Council (Metropolitan Council, 2014). MODFLOW is a 3D, cell-centered, finite difference, saturated flow model developed by the USGS (Harbaugh et al., 2005).

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

A local-scale model centered on Bayport was extracted from the regional seven-county model. The local model and all of the modeling for this amendment was completed using GMS (Aquaveo, 2015), a pre- and post- processor for MODFLOW. The heads computed from the regional model provide some of the boundary conditions for the local model as specified heads. The size of the domain and the general flow-field characteristics of the model were based on the results of the original delineation.

The local model domain was divided into a three-dimensional, non-uniform grid. The model has 244 rows, 262 columns, and nine layers. The details of the MetroModel were translated to the local-scale model using GMS. Finer grid spacing (~3m in the area of the city wells) was applied in the local model with telescopic mesh refinement used in the area of the site where the city wells are located. This refinement was required for an accurate computation of the particle flow paths for determining the WHPA delineation.

Prior to its use in the delineations, the following modifications were incorporated in the refined model:

- Local areas of modified horizontal conductivity were included in the model to reflect the Tunnel City/Wonewoc aquifer property in the Bayport area.
- The pumping rates from Table 5 were assigned to the Bayport wells.
- The pumping rates from Table 6 were assigned to the permitted high-capacity wells located within two-miles of the city wells.

The delineation was performed by backtracking particles from the wells to a 10-year time of travel using the particle tracking MODPATH Code (Pollock, 1994). A series of 50 particles were launched at each well. A porosity of 0.20 was used for the Tunnel City/Wonewoc Aquifer.

Representative aquifer parameters were used in the base case model scenario. Additional modeling scenarios using MODFLOW were then simulated using reasonable estimations of parameters to demonstrate model sensitivity and to reflect uncertainty conditions.

The combined output of all model results were composited to create the final WHPA (Figure 1).

Results of Model Calibration and Sensitivity Analysis

Model calibration is a procedure that compares the results of a model based on estimated input values to measured or known values. This procedure can be used to define model validity over a range of input values, or it helps determine the level of confidence with which model results may be used. As a matter of practice, groundwater flow models are usually calibrated using water elevation and/or flux. The sensitivity analysis quantifies the differences in model results produced by the natural variability of a particular parameter. Uncertainty analysis addresses the effects of poor data quality (lack of local detailed information or deficiencies in the data) on the model results. Together, sensitivity and uncertainty analyses are commonly used to evaluate the effects that natural variability and uncertainties in the hydrogeologic data have on the size and shape of the capture zones. In regards to the WHPA delineation, these analyses are used to document that the delineation is optimal, conservative, and protective of public health based on existing information.

Model Calibration

A qualitative evaluation of the calibration can be made by comparing the simulated potentiometric surface (Figure 2) with observed water level targets obtained from the CWI database. Upon review the calibrated flow model generally captures the major features of the groundwater flow system along with the elevation, shape, magnitude, and gradient of the CWI database observed flow field.

A quantitative measure by which to evaluate the success obtained during calibration is to compare the root mean square of the residuals errors (RMSE) and the maximum observed head difference of the calibration dataset. The calibration dataset included water level information from wells completed in the Tunnel City/Wonewoc Aquifer. The RMSE of the model prediction errors represented less than 8.1 percent of the total change in the measured heads across the model domain, which is within an acceptable range for a calibrated model (Appendic C). It is noted that this error is less than the calibration target of 15 percent (Barr Engineering Company, 2008).

Sensitivity Analysis

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

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

  How Addressed and Results – The pumping rate is based on the results presented in Table 5 and, therefore, is not considered a variable factor that will influence the delineation of the WHPA. The modeled pumping rate is based on the largest annual pumping during the last five years of record, as shown in Table 5, and therefore the sensitivity of the delineation to this parameter is minimal when compared with the other parameters discussed below.

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

  How Addressed and Results – General flow direction was determined based upon static water levels of similarly screened wells in the area of the model. Overall, the sensitivity of the WHPA to the direction of groundwater flow should not be significant, given the current knowledge of the hydraulic head distribution in the aquifer.

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

  How Addressed and Results – The ambient groundwater flow field that is defined in Figure 2 provides the basis for determining the extent to which each model run reflects the conceptual understanding of the orientation of the capture area for a well. The regional model was calibrated to hydraulic heads, and the local refined model calibration was verified for heads measured in observation wells completed in the Tunnel City/Wonewoc Aquifer. The sensitivity of the WHPA to the direction of groundwater flow should not be significant, given the current knowledge of hydraulic head distribution in the aquifer.

- The **horizontal hydraulic conductivity** influences the size and shape of the capture zone.

  How Addressed and Results – Initial hydraulic conductivity was calculated from specific capacity and aquifer test. In the base-case scenario, the hydraulic conductivity of the Tunnel City/Wonewoc Aquifer was estimated from a pumping test conducted at Bayport Tunnel City Well #2 (208795). No pumping test was conducted for the Wonewoc formation. It was assumed that the Tunnel City and the Wonewoc share the same hudraulic properties. To account for this uncertainty, two additional model runs were performed wherein the hydraulic conductivity was decreased/increased by 50 percent. The impact on the the size of the capture zone are depicted in Figure 3.

- The **aquifer porosity** influences the size and shape of the capture zone.

  How Addressed and Results – Decreasing the porosity causes a linear, proportional increase in the areal extent of the capture zone. A literature value of 20 percent was used for the delineation and this value was not varied (Fetter, 2001).

- The **aquifer thickness** influences the size and shape of the capture zone.

  How Addressed and Results – Final aquifer thicknesses used in this model were the result of a multi-step statistical analysis. A cross-sectional analysis was done to determine the thicknesses of the aquifer at well points throughout the modeled extent. Layer thicknesses were interpolated between wells and unrealistic values were identified and disposed of at all steps by comparing with adjacent well data, where available, and by using hydrogeologic judgment. As a result the model layering closely follows the overall stratigraphy through the area surrounding the city of Bayport's wells.

Addressing Model Uncertainty

Using computer models to simulate groundwater flow involves representing a complicated natural system in a simplified manner. Local geologic conditions may vary within the capture areas of the public water supply wells, but the amount of existing information needed to accurately define this degree of variability is often not available for portions of the WHPA. In addition, the current capabilities of groundwater flow models may not be sufficient to represent the natural flow system exactly. However, the results are valid within a range defined by the reasonable variation of input parameters for this delineation setting.

The steps employed for this delineation to address model uncertainty were:

1. Pumping Rate – For each well, a maximum historical (five-year) pumping rate or an engineering estimate of future pumping, whichever is greater (Minnesota Rules, part 4720.5510, subpart 4).
2. Aquifer Hydraulic Conductivity – Hydraulic conductivity was adjusted plus and minus 50 percent.

Capture areas were developed for a range of hydraulic conductivities and times of travel of one and 10 years (Figure 3). The WHPA for the Bayport wells consists of a composite of the porous media aquifer delineations (Figure 4). This provides a conservative approach to addressing model uncertainty and produces a WHPA that is expected to protect public health.

Conjunctive Delineation

A surface water contribution area (SWCA) was not included in the original delineation so the need for a conjunctive delineation was assessed as part of this amendment. Surface water drains from the bluffs, easterly to the urban areas in the valley and is then directed by open ditches and storm sewers to Perro Creek and ultimately into the St. Croix River (Figure 4).

Because there are no retention ponds, except at the Prison, surface water is generally discharged directly to the river. Dense vegetation along the bluffs helps minimize heavy runoff. Surface water for the newer area of the city, the Inspiration Development, is collected by storm sewers or open ditches, and directed into retention ponds The development has an elaborate "storm water treatment train" system of ponding and infiltration that retains and treats runoff prior to discharge to the CSAH 21 ditch. This ditch ultimately drains to the Prison Pond and is discharged into Perro Creek and the St. Croix River.

From the Prison stormwater pond, Perro Creek drains southeast and across the capture zone of Well #3 before discharging into the St. Croix River (Figure 4). Since the vulnerability of the WHPA is high, there is a potential for stormwater or surface water to infiltrate into the aquifer serving the Bayport wells. However, water chemistry collected to date from the city wells suggests that the drainage feature is not likely a significant source of recharge to the wells. The lack of nitrate and the chloride/bromide ratio in Well #3 (Table 2) does not suggest a strong connection between the well and the stormwater drainage feature. The available data is inconclusive and does confirm nor exclude a connection stormwater/well water. A SWCA may become necessary, but we do not currently have the data to support that judgement. Therefore, to conserve resources, we are deferring the decision until the next amendment, and will collect the necessary data in the meantime. We recommend that the city develop a monitoring plan for additional sampling of both the stormwater feature and the wells over the course of several seasons. The preparation and implementation of the monitoring plan should be included as measures in their Part 2 wellhead protection plan. The purpose of the plan is to better assess the relationship between potential recharge by the drainage feature and the aquifer used by the city wells, if any.

A conjunctive SWCA was also assessed relative to the potential of overland runoff from topographically higher elevation areas to the highly vulnerable WHPA. In this setting, a SWCA was determined to be unnecessary because the area soils are primarily comprised of outwash silts and sands. These types of sandy soils generally do not support significant runoff. From this assessment, it was determined that runoff is not a significant contributor to aquifer recharge in the WHPA.

Delineation of the Drinking Water Supply Management Area

The boundaries of the DWSMA were defined by the city of Bayport using the following features (Figure 1):

- Center-lines of highways, streets, roads, or railroad rights-of-ways.
- Public Land Survey coordinates.
- Property or fence lines.
- Center-lines of public drainage system.;

Vulnerability Assessments

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

Assessment of Well Vulnerability

The vulnerability assessments for each well used by the city of Bayport are listed in Table 1 and are based upon the following conditions:

1. Well construction meets current State Well Code specifications (Minnesota Rules, part 4725), meaning that the well itself should not provide a pathway for contaminants to enter the aquifer used by the public water supplier.
2. The geologic conditions at the well site do not include a cover of clay-rich geologic materials over the aquifer, that could otherwise retard or prevent the vertical movement of contaminants.
3. In 1987, Trichloroethene (TCE), a chemical solvent often used for degreasing metal parts, was found in the groundwater in Baytown Township, west of the city of Bayport. Beginning in 2003, TCE has been detected in Bayport's municipal Well #2 (208795) and by 2005 increased above the maximum contaminant level (MCL) of 5µg/L. Since then, TCE has been detected at low levels in Bayport Wells 3 (208796) and 4 (208797). In 2007, an air stripping treatment system was installed to treat the water pumped at Bayport's municipal Well #2. Well #3 was connected to the treatment system in 2016. Wells 2 and 3 are now the primary water supply wells and the treated water from them contains no detectable TCE.
   None of the other human-caused contaminants regulated under the federal Safe Drinking Water Act have been detected at levels indicating that the well itself serves to draw contaminants into the aquifer as a result of pumping; and
4. Water samples were collected from Well #2 (208795) and Well #3 (208796) in 2017 and were analyzed for tritium and nitrate. Tritium or nitrate was detected in the samples (Table 2), confirming the vulnerable nature of the wells (Alexander and Alexander, 1989).

Assessment of Drinking Water Supply Management Area Vulnerability

The vulnerability of groundwater underlying the land parcels located within the groundwater contribution area for Bayport, shown in Figure 4, was evaluated primarily on:

1. Isotopic and water chemistry data from wells located within the DWSMA indicate that the aquifer contains water that has detectable levels of tritium or human-caused contamination.
2. Review of the geologic logs contained in the CWI database, geological maps, and reports indicate that the aquifer exhibits a high geologic sensitivity throughout the DWSMA and is not isolated from the direct vertical recharge of surface water.

The original analysis of aquifer vulnerability from the original Part 1 Wellhead Protection Plan is mostly retained. Appendix B contains the geologic cross-sections prepared for the original plan that indicated aquifer vulnerability. These cross-sections were based on data from well logs located in and around the original DWSMA. Since the revised WHPA is smaller in size, these cross-sections still provide adequate coverage across the new groundwater contribution area.

Given the information currently available, it is prudent to assign a high vulnerability rating to the DWSMA, in accordance with the Minnesota Wellhead Protection Rule (parts 4720.5100 to 4720.5590) (Figure 4).

Recommendations

The following recommendations have been generated to inform the next amendment of the city of Bayport's Wellhead Protection Plan.

1. Additional monitoring of the Prison Stormwater Pond, Perro Creek, and the city wells should help to better characterize whether the stormwater drainage feature is recharging the aquifer serving the city wells. Monitoring efforts should include a year-long program of quarterly sampling of parameters such as the stable isotopes of oxygen and hydrogen, total organic carbon, chloride, bromide, nitrate, ammonia, sulfate, arsenic and field parameters such as temperature and conductivity.

   Implementation of the monitoring plan should be made contingent on available funding. It is recommended that the city consider a step-wise approach to the monitoring measures, for example:

   - Contact the MDH hydrologist by year five for assistance with preparing a monitoring plan that identifies sampling locations and parameters, timeframes and roles.
   - Implement the monitoring plan over four quarters by year six and seven.
   - Prepare a summary of the results, and meet with the wellhead team to discuss how the results might be incorporated into wellhead planning and/or whether additional monitoring is needed.

2. Collect groundwater samples from Well #2 (208795) and Well #3 (208796) for analysis of chloride, bromide, sulfate, nitrate + nitrite as N, ammonia, and tritium. Timeframe: at year six. Responsibilities: the city of Bayport staff to schedule with MDH; sample collection and analysis done by MDH; contingent upon funding from MDH. The full monitoring package may be unnecessary depending on whether the city implements the quarterly monitoring plan related to the stormwater features.

3. New Wells: Both of the city's primary wells are more than 50 years old. Pending available funding, the city may want to include a measure in their plan for drilling test wells to plan for the eventual replacement of one or more of their older wells. If new wells are being considered, installing them in an area with a thicker or more competent layer of clay-rich till or shale may provide the city with natural protection against man-made contaminants at the land surface.

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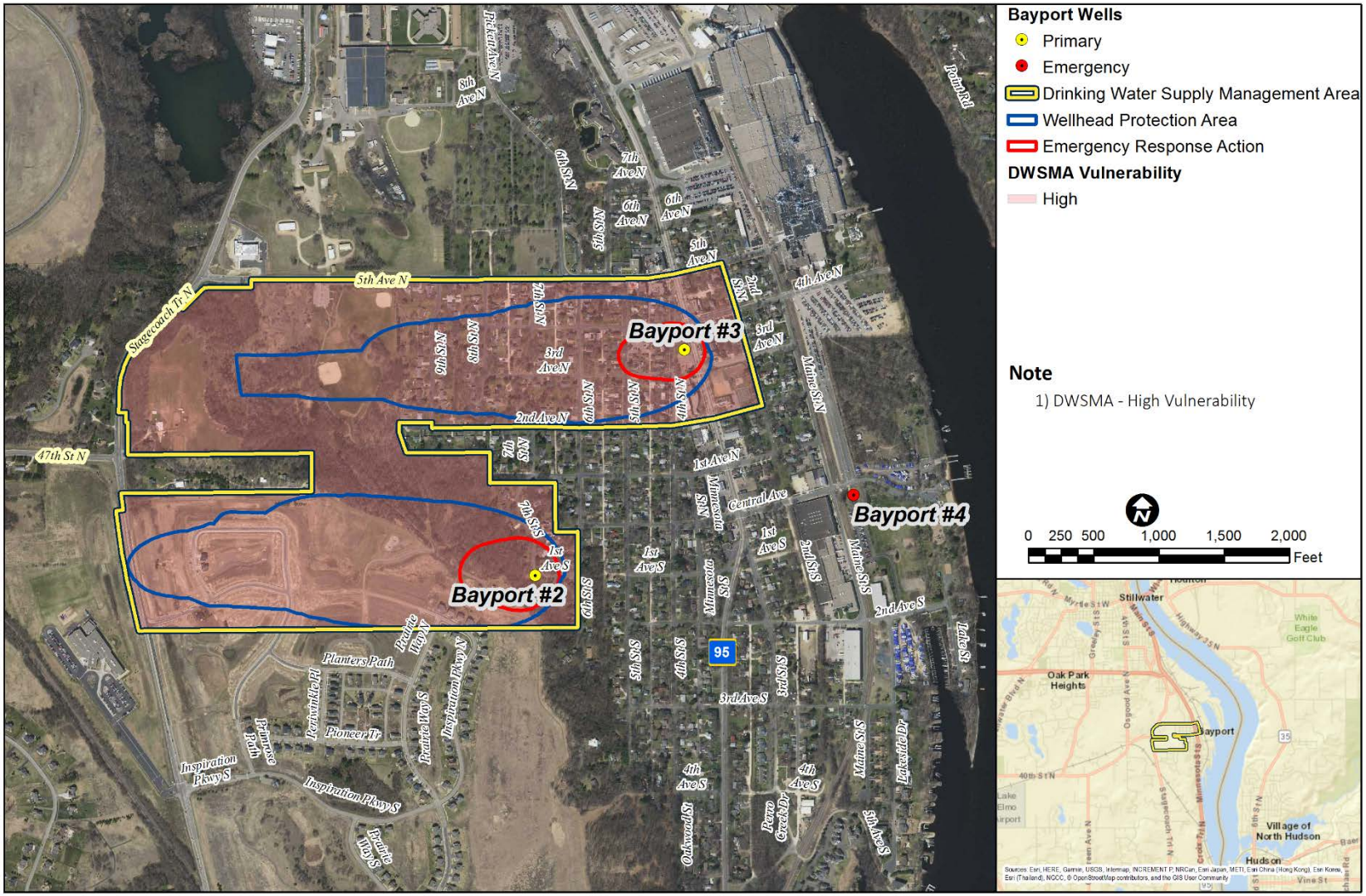
Figures

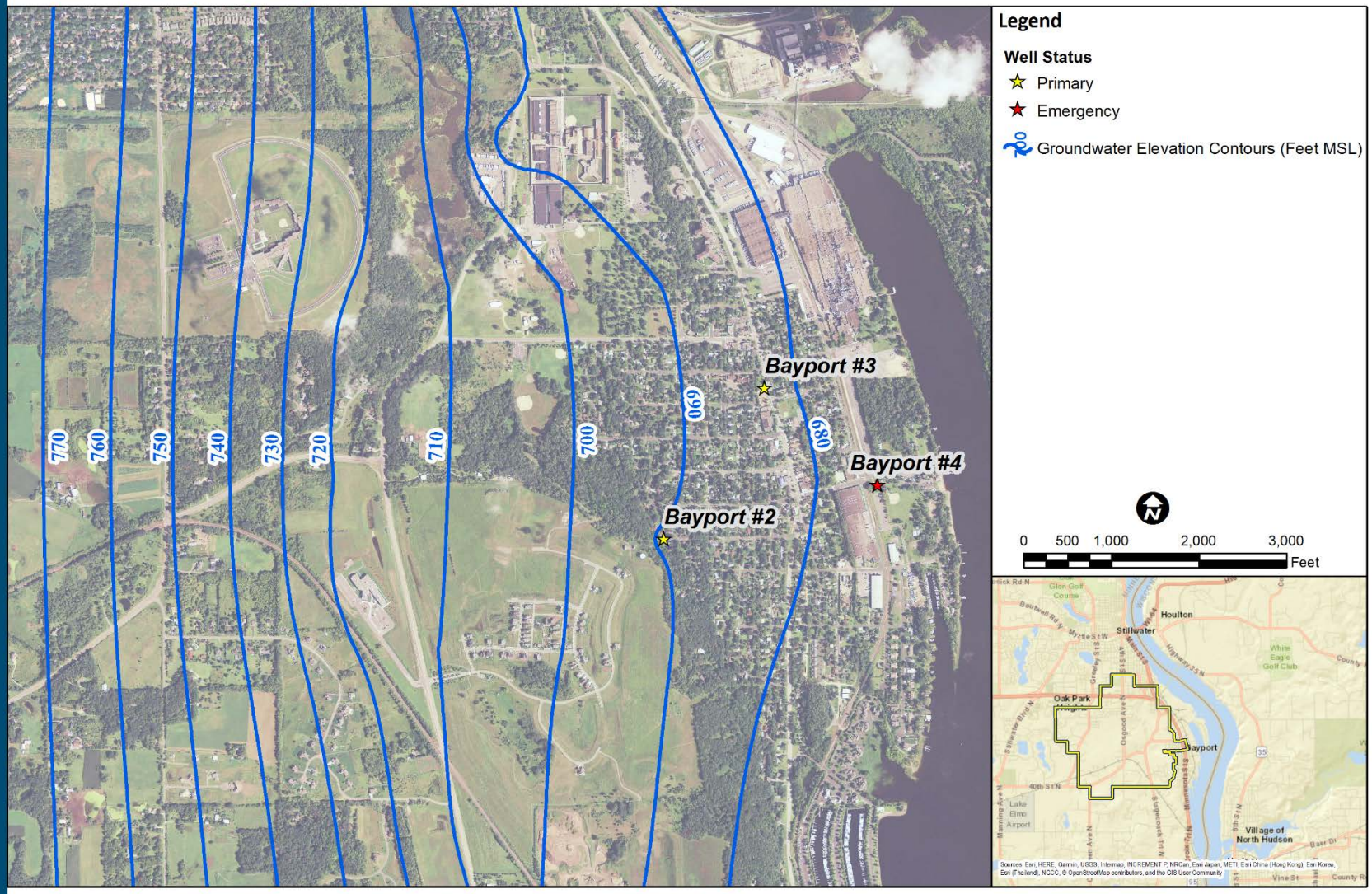
Washington County
Minnesota

Figure 1
Drinking Water Supply Management Area and Vulnerability
City of Bayport



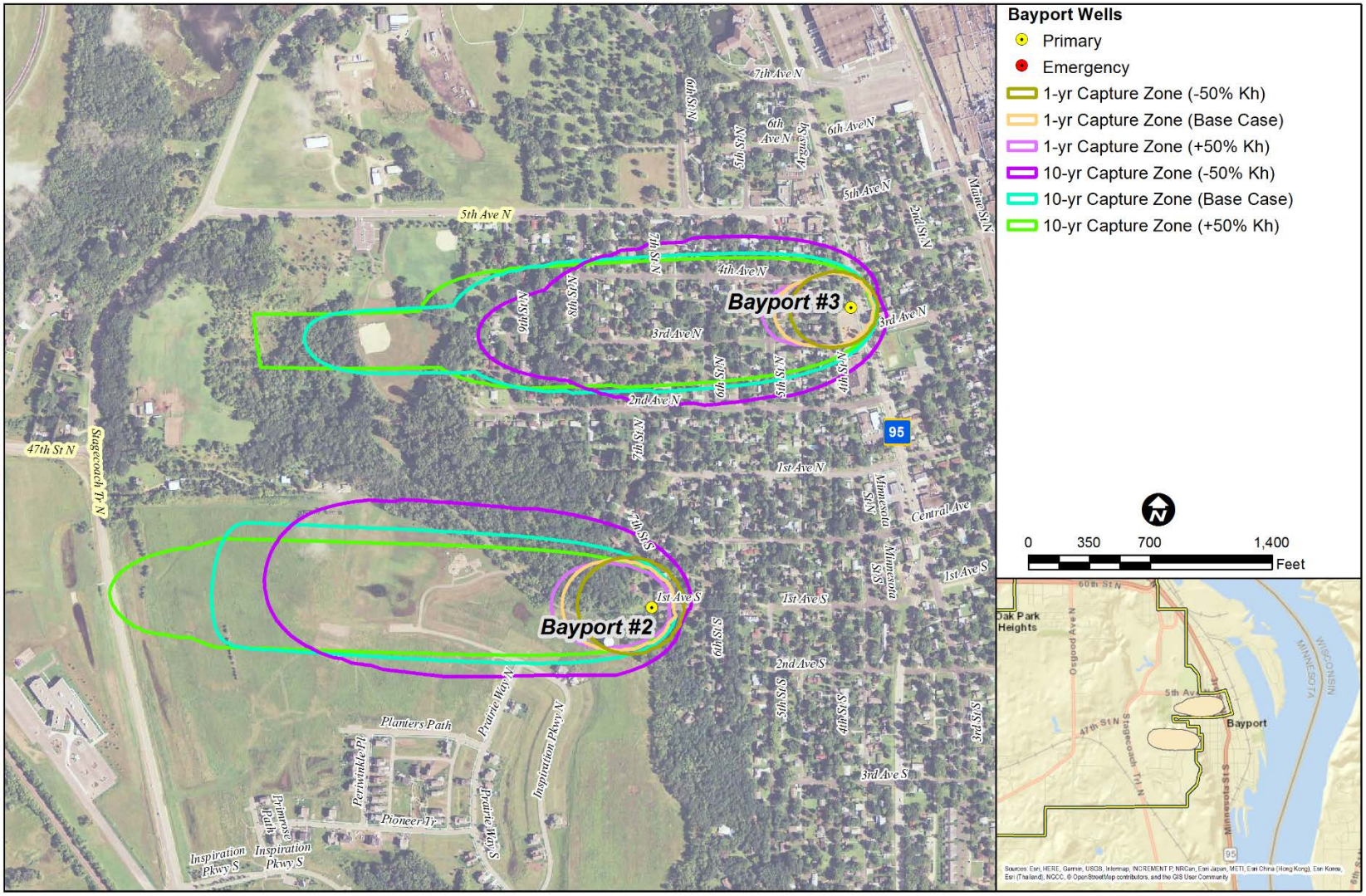
Washington County
Minnesota

Figure 2
Groundwater Elevation Contours
Tunnel City/ Wonewoc Aquifer
Bayport



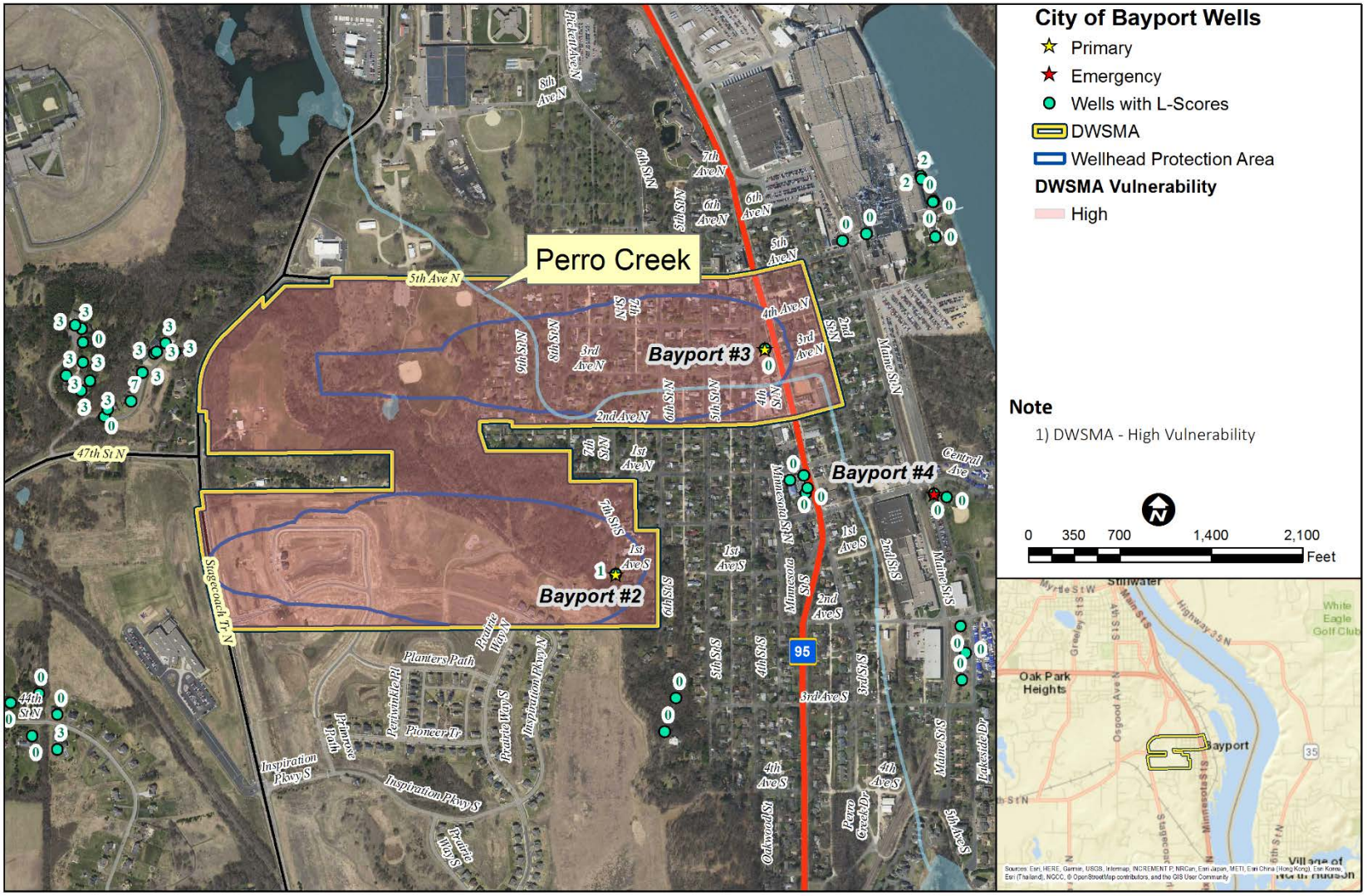
Washington County
Minnesota

Figure 3
Sensitivity of the Capture Zone to Kh
City of Bayport



Washington County
Minnesota

Figure 4
DWSMA Vulnerability
City of Bayport



Appendix A: Data Elements Assessment

Data Type	Data Element	Use of the Well(s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	Data Source
Climate	Precipitation	H	H	H	H	MN Climatology Office, USGS
Geology	Maps and geologic descriptions	M	H	H	H	MGS, DNR, USGS, Consultant Reports
Geology	Subsurface data	M	H	H	H	MGS, MDH, MPCA, DNR, MDA
Geology	Borehole geophysics	M	H	H	H	MGS, Consultant Reports
Geology	Surface geophysics	L	L	L	L	DNR, MPCA, Consultant Reports,
Soils	Maps and soil descriptions	L	H	M	L	NRCS
Soils	Eroding lands					
Water Resources	Watershed units	L	H	L	L	MnGEO, DNR
Water Resources	List of public waters	L	H	L	L	MnGEO, DNR
Water Resources	Shoreland classifications					
Water Resources	Wetlands map	L	H	L	L	USFWS
Water Resources	Floodplain map					
Land Use	Parcel boundaries map	L	H	L	L	Washington County
Land Use	Political boundaries map	L	H	L	L	MnGEO, City
Land Use	Public Land Survey map	L	H	L	L	MnGEO
Land Use	Land use map and inventory					
Land Use	Comprehensive land use map					
Land Use	Zoning map					
Public Utility Services	Transportation routes and corridors	L	L	L	L	MnDOT, MnGEO
Public Utility Services	Storm/sanitary sewers and PWS system map	L	M	L	L	City
Public Utility Services	Oil and gas pipelines map					
Public Utility Services	Public drainage systems map or list	L	H	L	L	MnGEO, DNR
Public Utility Services	Records of well construction, maintenance, and use	H	H	H	H	City, CWI, MDH
Surface Water Quantity	Stream flow data	L	H	H	H	DNR, USGS (no relevant data found)
Surface Water Quantity	Ordinary high water mark data	L	H	L	L	DNR (no relevant data found)

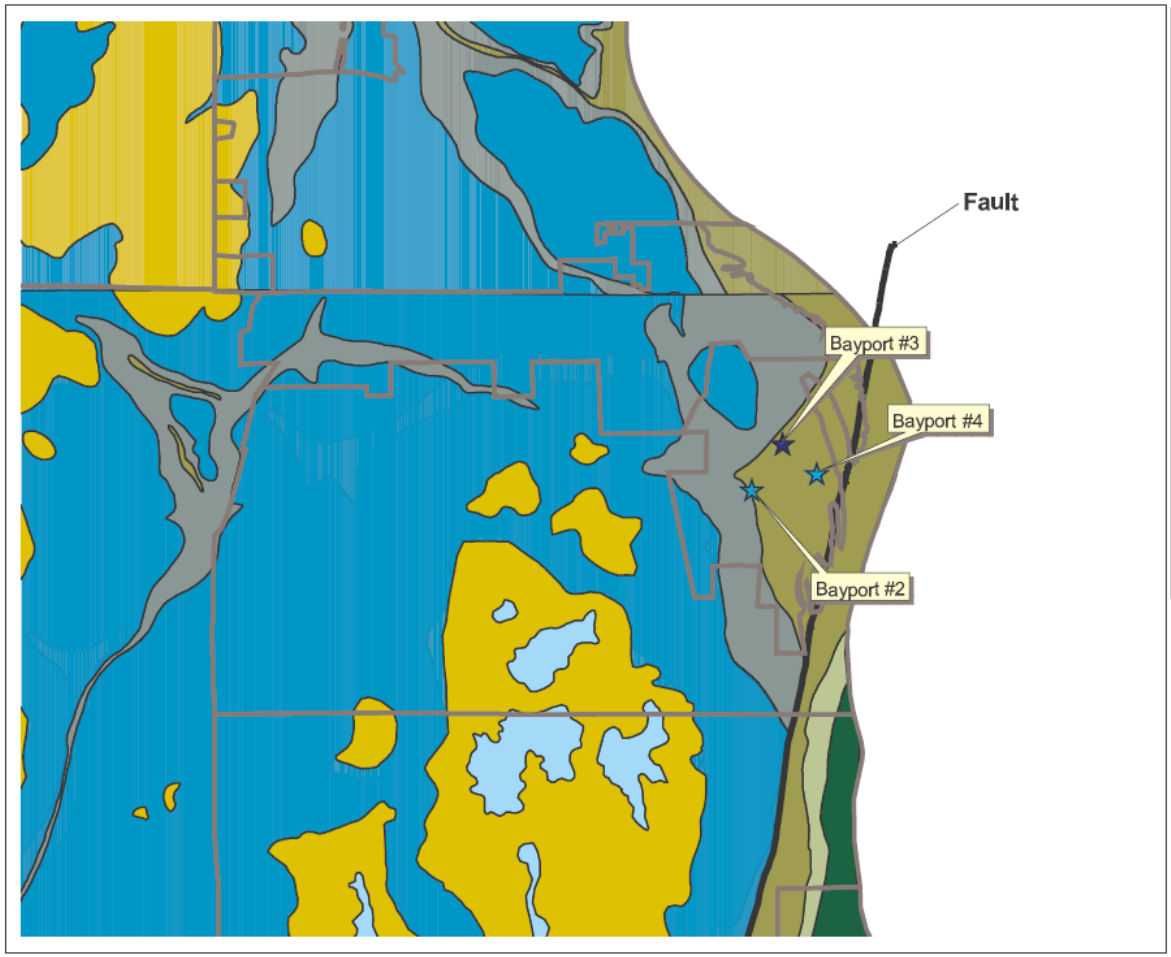
Data Type	Data Element	Use of the Well(s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	Data Source
Surface Water Quantity	Permitted withdrawals	L	H	L	L	DNR
Surface Water Quantity	Protected levels/flows	L	H	L	L	DNR (no relevant data found)
Surface Water Quantity	Water use conflicts	L	H	L	L	DNR (no relevant data found)
Groundwater Quantity	Permitted withdrawals	H	H	H	H	DNR
Groundwater Quantity	Groundwater use conflicts	H	H	H	H	DNR
Groundwater Quantity	Water Levels	H	H	H	H	DNR, MPCA, MDA, MDH, City
Surface Water Quality	Stream and lake water quality management classifications					
Surface Water Quality	Monitoring data summary	L	H	L	L	MDH, MPCA (no relevant data found)
Groundwater Quality	Monitoring data	H	H	H	H	MPCA, MDH, MDA, USGS
Groundwater Quality	Isotopic data	H	H	H	H	MPCA, MDH, MDA, USGS, Washington County, UMN
Groundwater Quality	Tracer studies	H	H	H	H	DNR, MPCA (no relevant data found)
Groundwater Quality	Contamination site data	M	M	M	M	MPCA, MDA
Groundwater Quality	Property audit data from contamination sites					
Groundwater Quality	MPCA and MDA spills/release reports	M	M	M	M	MPCA, MDA

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 this delineation

Acronyms used in this report are listed after the Glossary of Terms.

Appendix B: Bedrock Geology near Wells 2, 3 and 4



View: Figure 4 - Bedrock Geology

City of Bayport Wells
- Franconia-Ironton-Galesville
- Franconia
- Cities

Bedrock Metro MGS (South Wash)
- Decorah
- Plattebille-Glenwood
- St. Peter
- Prairie du Chien Group
- Jordan
- St. Lawrence- Franconia
- Ironton - Galesville
- Eau Claire
- Mt. Simon
- PMRC

N

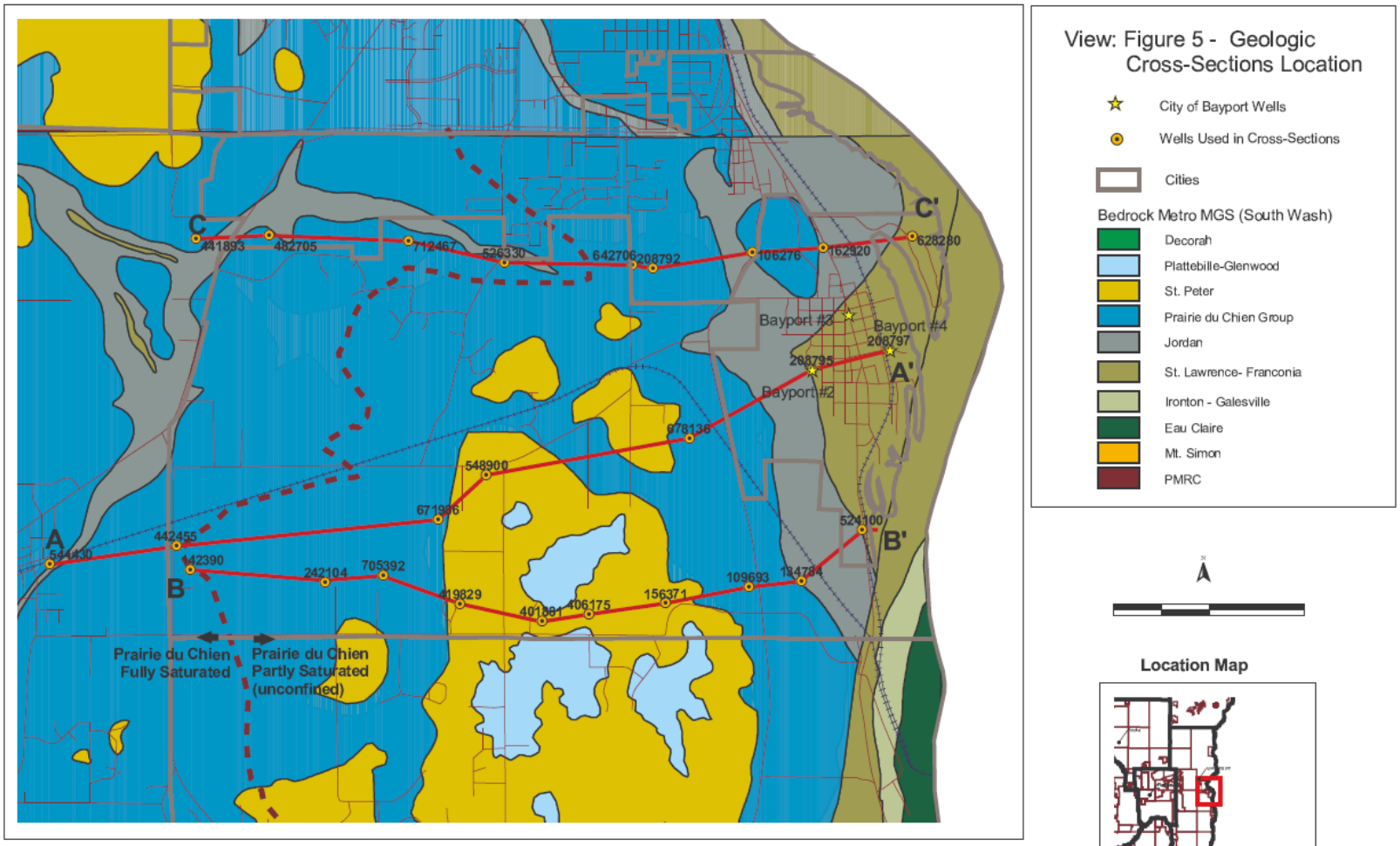
3000 0 3000 Feet

Location Map

The Franconia Formation was renamed the Tunnel City Group. The Ironton-Galesville sandstones were renamed the Wonewoc Sandstones.

MINNESOTA MDH DEPARTMENT of HEALTH

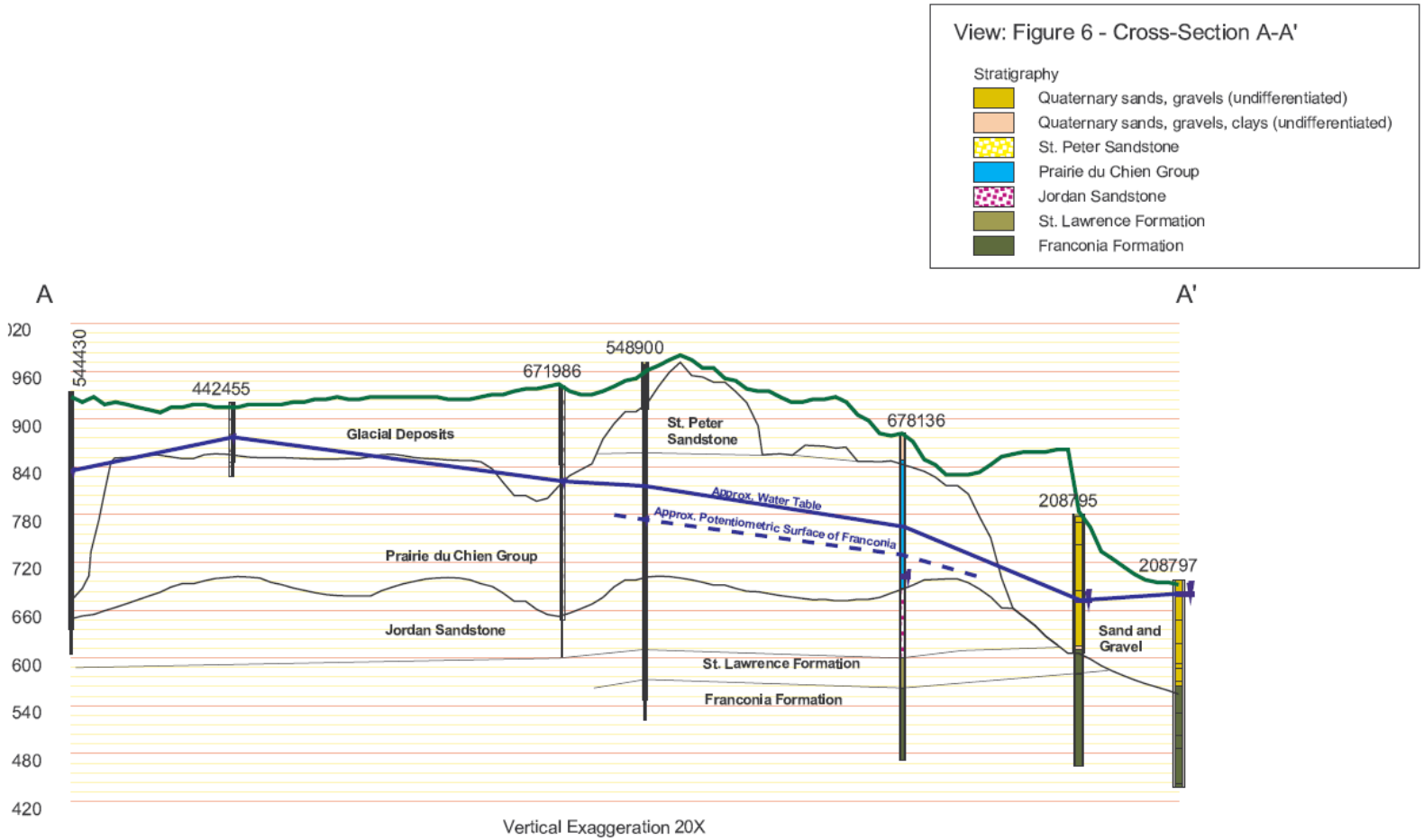
Figure 4
Bedrock Geology
City of Bayport



The Franconia Formation was renamed the Tunnel City Group. The Ironton-Galesville sandstones were renamed the Wonewoc Sandstones.

MINNESOTA MDH DEPARTMENT of HEALTH

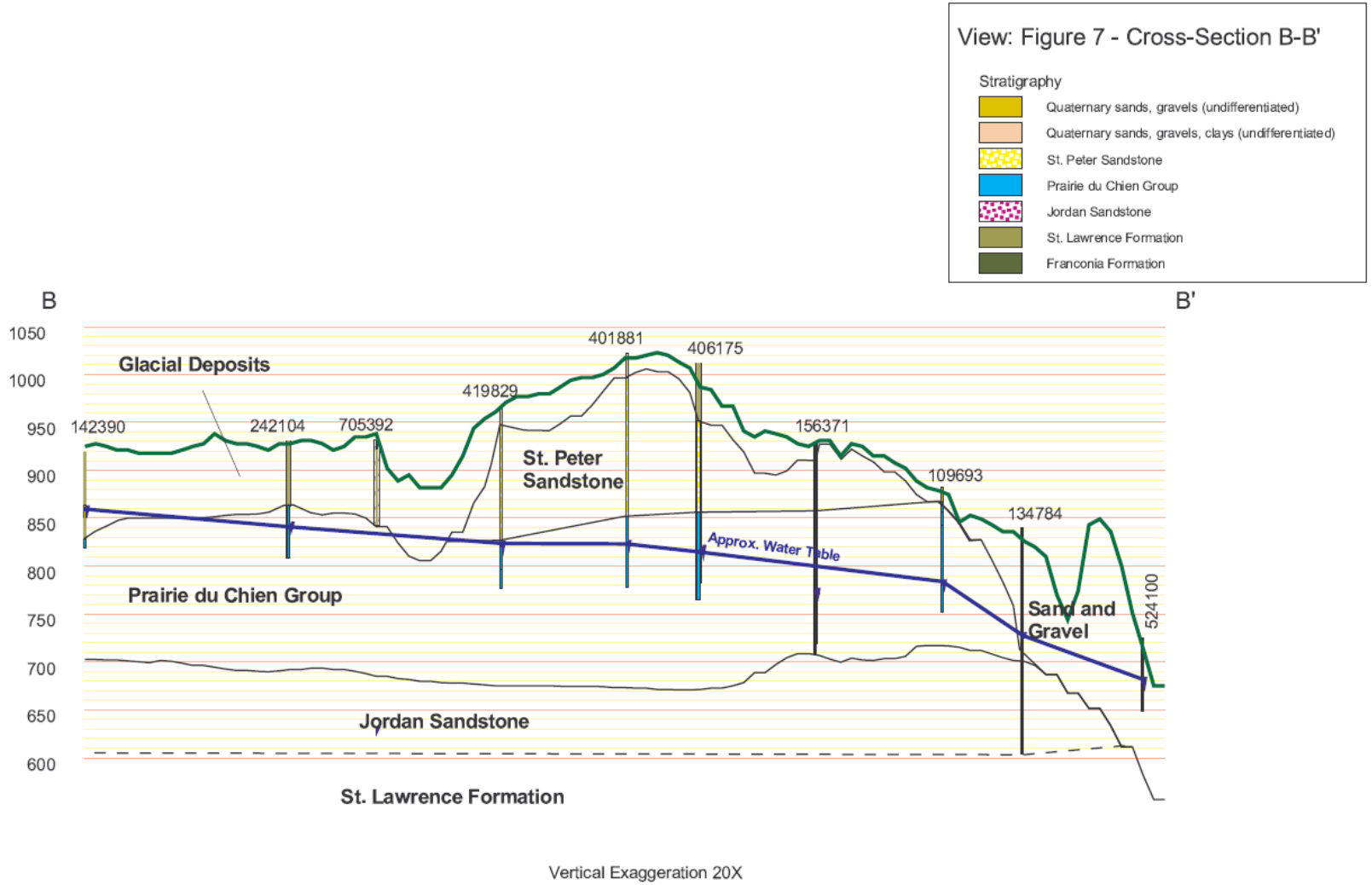
Figure 5
Geologic Cross-Sections Locations
City of Bayport



The Franconia Formation was renamed the Tunnel City Group. The Ironton-Galesville sandstones were renamed the Wonewoc Sandstones.

MINNESOTA MDH DEPARTMENT OF HEALTH

Figure 6
Geologic Cross-Section A-A'
City of Bayport



The Franconia Formation was renamed the Tunnel City Group. The Ironton-Galesville sandstones were renamed the Wonewoc Sandstones.

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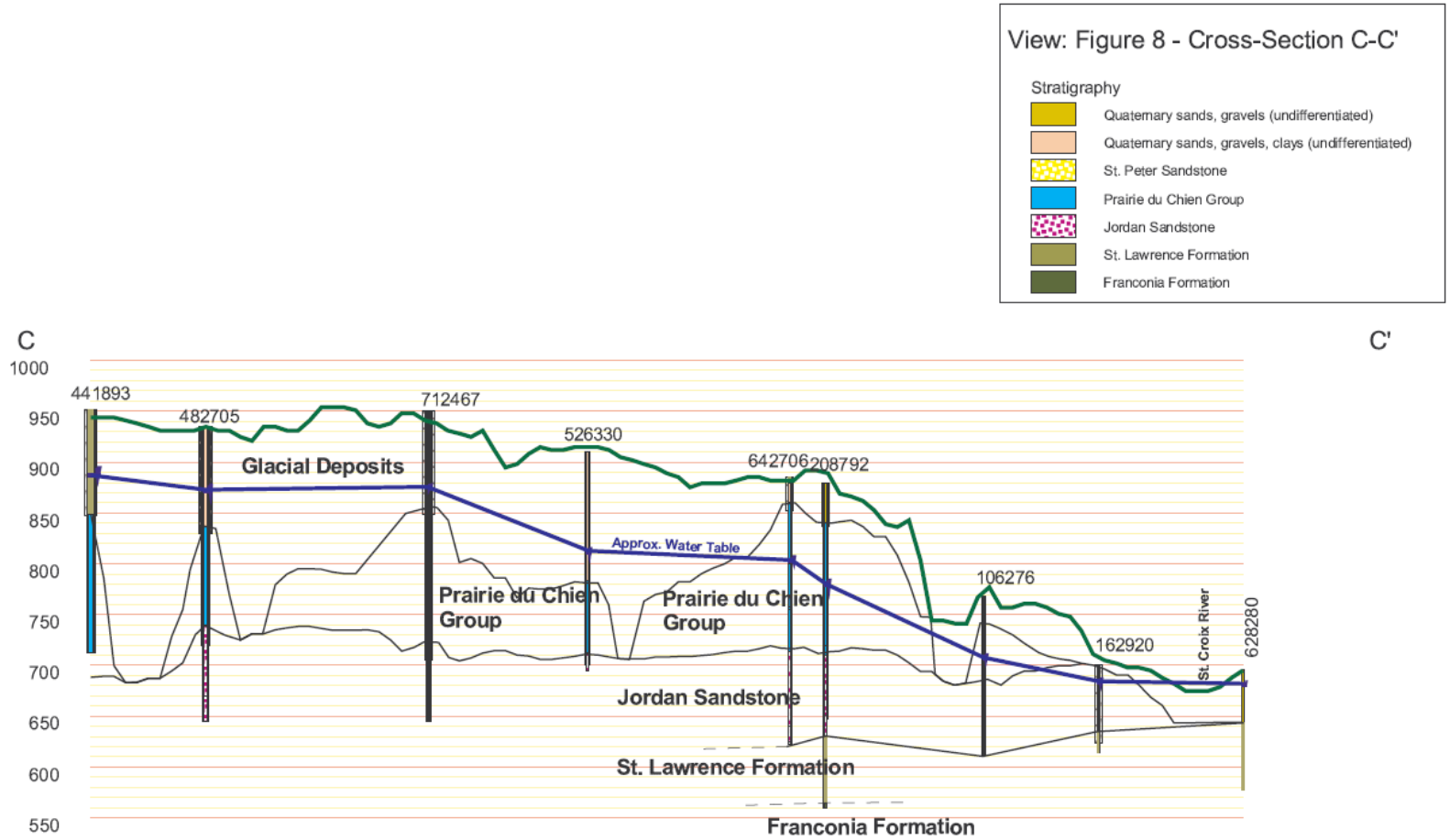
Figure 7
Geologic Cross-Section B-B'
City of Bayport



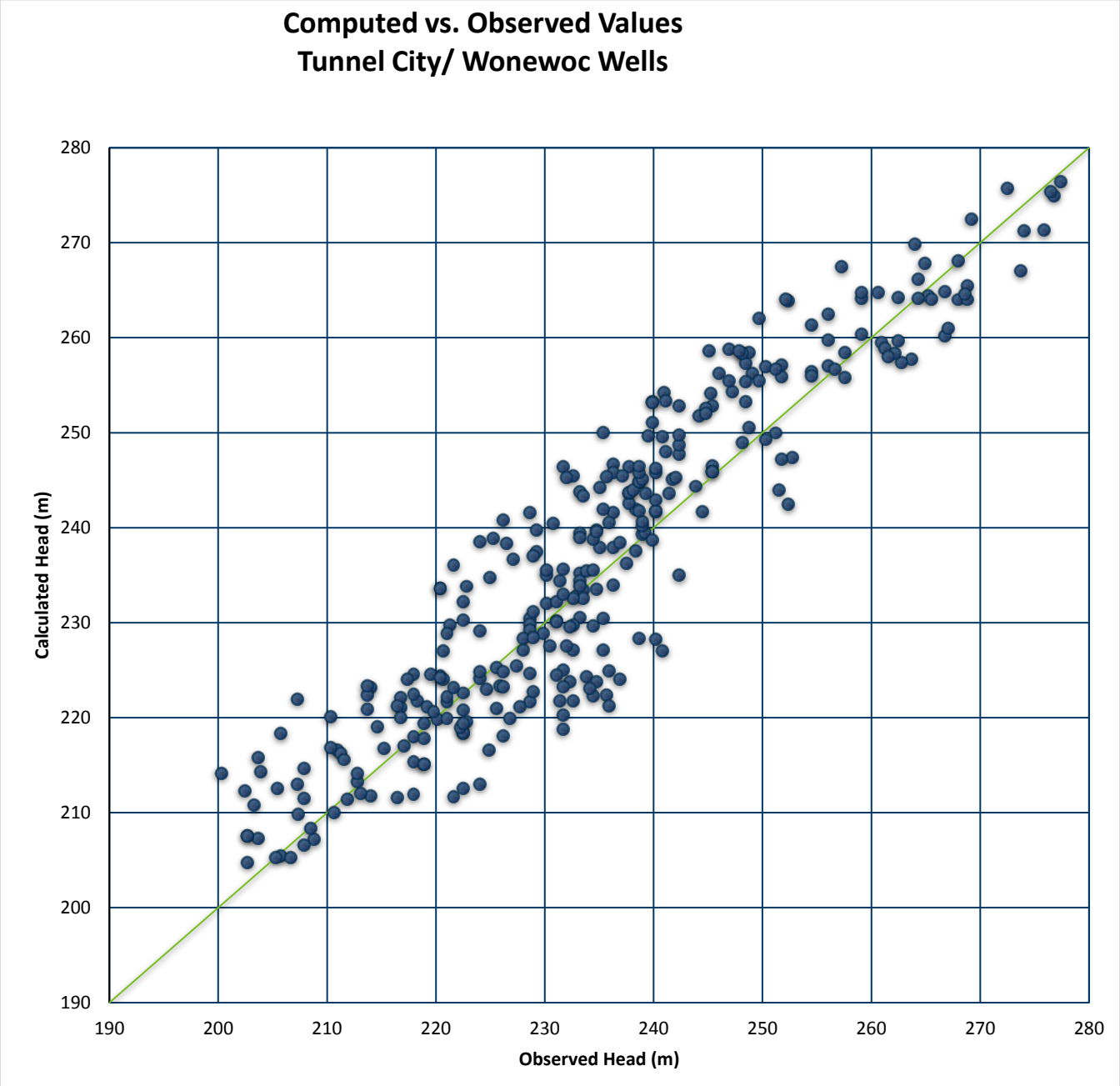
The Franconia Formation was renamed the Tunnel City Group. The Ironton-Galesville sandstones were renamed the Wonewoc Sandstones.

Vertical Exaggeration 20X

MINNESOTA MDH DEPARTMENT OF HEALTH

Figure 8
Geologic Cross-Section C-C'
City of Bayport

Appendix C: Calibrated Model Results



Mean Residual (m)	-2.17
Root Mean Squared Residual (m)	6.79
Normalized RMS	8.3%

Appendix C

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
12C—Emmert gravelly loamy coarse sand, 3 to 12 percent slopes														
Emmert	0-6	-80-	-17-	1- 3- 5	1.45-1.53 -1.60	141.00-141.00- 141.00	0.06-0.08-0. 10	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.05	.15	5	2	134
	6-60	-92-	- 6-	1- 2- 3	1.55-1.70 -1.80	141.00-141.00- 141.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
Chetek	—	—	—	—	—	—	—	—	—					
Kingsley	—	—	—	—	—	—	—	—	—					

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
49—Antigo silt loam, 0 to 2 percent slopes														
Antigo	0-9	10-20- 40	50-70- 80	5-10- 17	1.25-1.40 -1.55	4.23-9.17-14.11	0.17-0.23-0. 24	0.4- 1.0- 1.9	1.0- 3.0- 7.0	.49	.49	3	5	56
	9-12	10-20- 40	50-72- 80	5- 8- 15	1.35-1.50 -1.55	4.23-9.17-14.11	0.17-0.21-0. 22	0.3- 0.7- 1.5	0.5- 0.8- 1.0	.55	.55			
	12-19	10-20- 40	50-67- 80	8-13- 20	1.45-1.50 -1.65	4.23-9.17-14.11	0.17-0.21-0. 22	0.5- 0.9- 1.5	0.3- 0.5- 0.8	.55	.55			
	19-28	10-22- 40	50-58- 80	10-20- 27	1.45-1.50 -1.65	4.23-9.17-14.11	0.17-0.21-0. 22	0.6- 1.5- 2.6	0.3- 0.5- 0.8	.43	.43			
	28-31	30-40- 65	30-43- 50	5-17- 20	1.55-1.60 -1.70	4.23-9.17-14.11	0.07-0.15-0. 19	0.2- 1.1- 1.5	0.1- 0.3- 0.5	.37	.37			
	31-33	35-60- 75	15-28- 50	5-12- 18	1.55-1.65 -1.70	4.23-9.17-14.11	0.07-0.08-0. 19	0.2- 0.6- 1.4	0.1- 0.3- 0.5	.10	.28			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	33-79	90-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-14 1.14	0.02-0.04-0. 06	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Billyboy	0-9	10-20- 40	50-70- 80	5-10- 17	1.25-1.40 -1.55	4.23-9.17-14.11	0.18-0.23-0. 24	0.4- 1.0- 1.9	1.0- 3.0- 7.0	.49	.49	3	5	56
	9-11	10-20- 40	50-72- 80	5- 8- 17	1.35-1.50 -1.55	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.7- 1.7	0.5- 0.8- 1.0	.55	.55			
	11-20	10-20- 40	50-67- 80	5-13- 17	1.45-1.50 -1.65	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.9- 1.3	0.3- 0.5- 0.8	.55	.55			
	20-26	35-40- 65	30-43- 50	5-17- 20	1.55-1.60 -1.70	4.23-9.17-14.11	0.07-0.16-0. 19	0.2- 1.2- 1.5	0.1- 0.3- 0.5	.37	.37			
	26-30	35-60- 75	15-28- 50	5-12- 17	1.55-1.60 -1.70	4.23-9.17-14.11	0.07-0.11-0. 19	0.2- 0.8- 1.3	0.1- 0.3- 0.5	.28	.28			
	30-35	80-82- 90	5-11- 15	5- 7- 10	1.55-1.65 -1.70	42.34-91.74-14 1.14	0.02-0.07-0. 10	0.2- 0.4- 0.7	0.0- 0.1- 0.3	.05	.10			
	35-79	90-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-14 1.14	0.02-0.04-0. 06	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Sconsin	0-9	5-30- 40	50-60- 88	7-10- 15	1.25-1.40 -1.55	4.23-9.17-14.11	0.18-0.23-0. 24	0.6- 1.0- 1.6	1.0- 3.0- 7.0	.43	.43	3	5	56
	9-12	5-32- 40	50-60- 88	5- 8- 12	1.35-1.50 -1.55	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.7- 1.2	0.5- 0.8- 1.0	.55	.55			
	12-17	5-31- 40	50-60- 88	5- 9- 15	1.45-1.50 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.1	0.3- 0.5- 0.8	.55	.55			
	17-18	5-31- 40	50-60- 88	5- 9- 15	1.45-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.5	0.3- 0.5- 0.8	.64	.64			
	18-27	5-35- 40	50-55- 88	5-10- 15	1.45-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.1	0.1- 0.3- 0.5	.64	.64			
	27-34	35-50- 80	10-37- 50	7-13- 19	1.55-1.60 -1.70	4.23-9.17-14.11	0.06-0.17-0. 19	0.2- 0.9- 1.4	0.1- 0.3- 0.5	.43	.43			
	34-38	35-66- 80	10-23- 50	6-11- 15	1.80-1.90 -2.00	0.07-0.24-0.42	0.04-0.07-0. 14	0.2- 0.7- 1.1	0.0- 0.0- 0.3	.32	.32			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	38-79	85-94-100	0- 4- 10	0- 2- 5	1.65-1.70-1.80	42.34-91.74-141.14	0.01-0.04-0.07	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Rosholt	0-8	35-55- 70	20-37- 60	4- 8- 12	1.35-1.50-1.55	4.23-23.29-42.34	0.10-0.14-0.24	0.3- 0.7- 1.3	1.0- 3.0- 7.0	.28	.28	3	3	86
	8-13	35-55- 70	20-37- 60	4- 8- 12	1.55-1.65-1.75	4.23-23.29-42.34	0.08-0.12-0.22	0.2- 0.7- 1.2	0.5- 0.8- 1.0	.37	.37			
	13-20	35-54- 70	20-35- 50	5-11- 18	1.55-1.65-1.75	4.23-23.29-42.34	0.07-0.12-0.19	0.3- 0.9- 1.9	0.3- 0.5- 0.8	.32	.32			
	20-28	35-58- 80	10-28- 50	5-14- 20	1.55-1.65-1.75	4.23-23.29-42.34	0.07-0.12-0.19	0.3- 1.2- 2.4	0.3- 0.5- 0.8	.24	.24			
	28-34	75-82- 90	0-10- 20	4- 8- 12	1.55-1.70-1.75	42.34-91.74-141.14	0.02-0.06-0.10	0.1- 0.5- 1.1	0.1- 0.3- 0.5	.05	.10			
	34-79	88-94- 99	0- 4- 10	0- 2- 5	1.55-1.70-1.80	42.34-91.74-423.34	0.02-0.04-0.06	0.0- 0.1- 0.4	0.0- 0.1- 0.3	.02	.02			
Brill	0-7	5-12- 20	65-77- 85	8-11- 15	1.25-1.35-1.55	4.23-9.17-14.11	0.18-0.23-0.24	0.5- 0.8- 1.2	1.0- 3.0- 7.0	.49	.49	3	5	56
	7-11	5-12- 20	65-77- 85	8-11- 15	1.35-1.45-1.55	4.23-9.17-14.11	0.18-0.21-0.22	0.6- 1.0- 1.5	0.5- 0.8- 1.0	.55	.55			
	11-19	5-13- 20	60-70- 85	8-17- 23	1.45-1.50-1.65	4.23-9.17-14.11	0.18-0.21-0.22	0.5- 1.2- 1.9	0.3- 0.5- 0.8	.55	.55			
	19-34	5-15- 25	50-63- 70	15-22- 27	1.45-1.50-1.65	4.23-9.17-14.11	0.18-0.20-0.22	1.0- 1.7- 2.5	0.1- 0.3- 0.5	.49	.49			
	34-38	35-50- 60	25-37- 50	5-13- 20	1.55-1.65-1.70	4.23-9.17-14.11	0.06-0.15-0.19	0.2- 0.8- 1.5	0.1- 0.3- 0.5	.37	.37			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	38-79	90-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-14 1.14	0.02-0.04-0. 06	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Ossmer	0-9	5-22- 40	50-68- 88	7-10- 15	1.00-1.35 -1.50	4.23-9.17-14.11	0.18-0.23-0. 24	0.5- 0.7- 1.2	1.5- 3.0- 8.0	.49	.49	3	5	56
	9-11	5-23- 40	50-69- 88	5- 8- 12	1.35-1.50 -1.60	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.7- 1.5	0.5- 1.3- 3.0	.55	.55			
	11-16	5-22- 40	50-69- 88	5- 9- 15	1.40-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.1	0.3- 0.5- 1.0	.55	.55			
	16-26	5-22- 40	50-62- 88	7-16- 20	1.40-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.4- 1.2- 1.5	0.1- 0.3- 0.5	.55	.55			
	26-34	35-50- 80	10-37- 50	7-13- 19	1.45-1.60 -1.70	4.23-9.17-14.11	0.06-0.17-0. 19	0.3- 0.9- 1.4	0.1- 0.2- 0.5	.37	.37			
	34-38	35-57- 80	10-31- 50	7-12- 16	1.45-1.60 -1.70	4.23-9.17-14.11	0.06-0.10-0. 19	0.3- 0.8- 1.2	0.1- 0.2- 0.3	.32	.32			
	38-79	85-94-10 0	0- 4- 10	0- 2- 5	1.65-1.70 -1.80	42.34-91.74-14 1.14	0.01-0.04-0. 07	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
49B—Antigo silt loam, 2 to 6 percent slopes														
Antigo	0-9	10-20- 40	50-70- 80	5-10- 17	1.25-1.40 -1.55	4.23-9.17-14.11	0.17-0.23-0. 24	0.4- 1.0- 1.9	1.0- 3.0- 7.0	.49	.49	3	5	56
	9-12	10-20- 40	50-72- 80	5- 8- 15	1.35-1.50 -1.55	4.23-9.17-14.11	0.17-0.21-0. 22	0.3- 0.7- 1.5	0.5- 0.8- 1.0	.55	.55			
	12-19	10-20- 40	50-67- 80	8-13- 20	1.45-1.50 -1.65	4.23-9.17-14.11	0.17-0.21-0. 22	0.5- 0.9- 1.5	0.3- 0.5- 0.8	.55	.55			
	19-28	10-22- 40	50-58- 80	10-20- 27	1.45-1.50 -1.65	4.23-9.17-14.11	0.17-0.21-0. 22	0.6- 1.5- 2.6	0.3- 0.5- 0.8	.43	.43			
	28-31	30-40- 65	30-43- 50	5-17- 20	1.55-1.60 -1.70	4.23-9.17-14.11	0.07-0.15-0. 19	0.2- 1.1- 1.5	0.1- 0.3- 0.5	.37	.37			
	31-33	35-60- 75	15-28- 50	5-12- 18	1.55-1.65 -1.70	4.23-9.17-14.11	0.07-0.08-0. 19	0.2- 0.6- 1.4	0.1- 0.3- 0.5	.10	.28			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	33-79	90-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-14 1.14	0.02-0.04-0. 06	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Billyboy	0-9	10-20- 40	50-70- 80	5-10- 17	1.25-1.40 -1.55	4.23-9.17-14.11	0.18-0.23-0. 24	0.4- 1.0- 1.9	1.0- 3.0- 7.0	.49	.49	3	5	56
	9-11	10-20- 40	50-72- 80	5- 8- 17	1.35-1.50 -1.55	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.7- 1.7	0.5- 0.8- 1.0	.55	.55			
	11-20	10-20- 40	50-67- 80	5-13- 17	1.45-1.50 -1.65	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.9- 1.3	0.3- 0.5- 0.8	.55	.55			
	20-26	35-40- 65	30-43- 50	5-17- 20	1.55-1.60 -1.70	4.23-9.17-14.11	0.07-0.16-0. 19	0.2- 1.2- 1.5	0.1- 0.3- 0.5	.37	.37			
	26-30	35-60- 75	15-28- 50	5-12- 17	1.55-1.60 -1.70	4.23-9.17-14.11	0.07-0.11-0. 19	0.2- 0.8- 1.3	0.1- 0.3- 0.5	.28	.28			
	30-35	80-82- 90	5-11- 15	5- 7- 10	1.55-1.65 -1.70	42.34-91.74-14 1.14	0.02-0.07-0. 10	0.2- 0.4- 0.7	0.0- 0.1- 0.3	.05	.10			
	35-79	90-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-14 1.14	0.02-0.04-0. 06	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Rosholt	0-8	35-55- 70	20-37- 60	4- 8- 12	1.35-1.50 -1.55	4.23-23.29-42.3 4	0.10-0.14-0. 24	0.3- 0.7- 1.3	1.0- 3.0- 7.0	.28	.28	3	3	86
	8-13	35-55- 70	20-37- 60	4- 8- 12	1.55-1.65 -1.75	4.23-23.29-42.3 4	0.08-0.12-0. 22	0.2- 0.7- 1.2	0.5- 0.8- 1.0	.37	.37			
	13-20	35-54- 70	20-35- 50	5-11- 18	1.55-1.65 -1.75	4.23-23.29-42.3 4	0.07-0.12-0. 19	0.3- 0.9- 1.9	0.3- 0.5- 0.8	.32	.32			
	20-28	35-58- 80	10-28- 50	5-14- 20	1.55-1.65 -1.75	4.23-23.29-42.3 4	0.07-0.12-0. 19	0.3- 1.2- 2.4	0.3- 0.5- 0.8	.24	.24			
	28-34	75-82- 90	0-10- 20	4- 8- 12	1.55-1.70 -1.75	42.34-91.74-14 1.14	0.02-0.06-0. 10	0.1- 0.5- 1.1	0.1- 0.3- 0.5	.05	.10			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	34-79	88-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-42 3.34	0.02-0.04-0. 06	0.0- 0.1- 0.4	0.0- 0.1- 0.3	.02	.02			
Sconsin	0-9	5-30- 40	50-60- 88	7-10- 15	1.25-1.40 -1.55	4.23-9.17-14.11	0.18-0.23-0. 24	0.6- 1.0- 1.6	1.0- 3.0- 7.0	.43	.43	3	5	56
	9-12	5-32- 40	50-60- 88	5- 8- 12	1.35-1.50 -1.55	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.7- 1.2	0.5- 0.8- 1.0	.55	.55			
	12-17	5-31- 40	50-60- 88	5- 9- 15	1.45-1.50 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.1	0.3- 0.5- 0.8	.55	.55			
	17-18	5-31- 40	50-60- 88	5- 9- 15	1.45-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.5	0.3- 0.5- 0.8	.64	.64			
	18-27	5-35- 40	50-55- 88	5-10- 15	1.45-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.1	0.1- 0.3- 0.5	.64	.64			
	27-34	35-50- 80	10-37- 50	7-13- 19	1.55-1.60 -1.70	4.23-9.17-14.11	0.06-0.17-0. 19	0.2- 0.9- 1.4	0.1- 0.3- 0.5	.43	.43			
	34-38	35-66- 80	10-23- 50	6-11- 15	1.80-1.90 -2.00	0.07-0.24-0.42	0.04-0.07-0. 14	0.2- 0.7- 1.1	0.0- 0.0- 0.3	.32	.32			
	38-79	85-94-10 0	0- 4- 10	0- 2- 5	1.65-1.70 -1.80	42.34-91.74-14 1.14	0.01-0.04-0. 07	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Brill	0-7	5-12- 20	65-77- 85	8-11- 15	1.25-1.35 -1.55	4.23-9.17-14.11	0.18-0.23-0. 24	0.5- 0.8- 1.2	1.0- 3.0- 7.0	.49	.49	3	5	56
	7-11	5-12- 20	65-77- 85	8-11- 15	1.35-1.45 -1.55	4.23-9.17-14.11	0.18-0.21-0. 22	0.6- 1.0- 1.5	0.5- 0.8- 1.0	.55	.55			
	11-19	5-13- 20	60-70- 85	8-17- 23	1.45-1.50 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.5- 1.2- 1.9	0.3- 0.5- 0.8	.55	.55			
	19-34	5-15- 25	50-63- 70	15-22- 27	1.45-1.50 -1.65	4.23-9.17-14.11	0.18-0.20-0. 22	1.0- 1.7- 2.5	0.1- 0.3- 0.5	.49	.49			
	34-38	35-50- 60	25-37- 50	5-13- 20	1.55-1.65 -1.70	4.23-9.17-14.11	0.06-0.15-0. 19	0.2- 0.8- 1.5	0.1- 0.3- 0.5	.37	.37			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	38-79	90-94- 99	0- 4- 10	0- 2- 5	1.55-1.70 -1.80	42.34-91.74-14 1.14	0.02-0.04-0. 06	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
Ossmer	0-9	5-22- 40	50-68- 88	7-10- 15	1.00-1.35 -1.50	4.23-9.17-14.11	0.18-0.23-0. 24	0.5- 0.7- 1.2	1.5- 3.0- 8.0	.49	.49	3	5	56
	9-11	5-23- 40	50-69- 88	5- 8- 12	1.35-1.50 -1.60	4.23-9.17-14.11	0.18-0.21-0. 24	0.3- 0.7- 1.5	0.5- 1.3- 3.0	.55	.55			
	11-16	5-22- 40	50-69- 88	5- 9- 15	1.40-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.3- 0.7- 1.1	0.3- 0.5- 1.0	.55	.55			
	16-26	5-22- 40	50-62- 88	7-16- 20	1.40-1.55 -1.65	4.23-9.17-14.11	0.18-0.21-0. 22	0.4- 1.2- 1.5	0.1- 0.3- 0.5	.55	.55			
	26-34	35-50- 80	10-37- 50	7-13- 19	1.45-1.60 -1.70	4.23-9.17-14.11	0.06-0.17-0. 19	0.3- 0.9- 1.4	0.1- 0.2- 0.5	.37	.37			
	34-38	35-57- 80	10-31- 50	7-12- 16	1.45-1.60 -1.70	4.23-9.17-14.11	0.06-0.10-0. 19	0.3- 0.8- 1.2	0.1- 0.2- 0.3	.32	.32			
	38-79	85-94-10 0	0- 4- 10	0- 2- 5	1.65-1.70 -1.80	42.34-91.74-14 1.14	0.01-0.04-0. 07	0.0- 0.1- 0.3	0.0- 0.1- 0.3	.02	.02			
120—Brill silt loam														
Brill	0-3	-14-	-71-	10-15- 20	1.30-1.40 -1.45	4.00-9.00-14.00	0.20-0.22-0. 24	0.0- 1.5- 2.9	2.0- 3.0- 4.0	.37	.37	3	5	56
	3-11	-14-	-72-	8-14- 20	1.35-1.45 -1.55	4.00-9.00-14.00	0.16-0.19-0. 22	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.55	.55			
	11-14	-14-	-71-	10-15- 20	1.40-1.48 -1.55	4.00-9.00-14.00	0.16-0.19-0. 22	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.55	.55			
	14-35	-10-	-68-	18-23- 27	1.50-1.55 -1.60	4.00-9.00-14.00	0.16-0.19-0. 22	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.49	.49			
	35-60	-95-	- 2-	1- 4- 6	1.55-1.68 -1.80	42.00-92.00-14 1.00	0.01-0.04-0. 07	0.0- 1.5- 2.9	0.0- 0.0- 0.5	.05	.05			
Antigo	—	—	—	—	—	—	—	—	—					
Barronett	—	—	—	—	—	—	—	—	—					

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
151—Burkhardt sandy loam, 0 to 3 percent slopes														
Burkhardt	0-13	-67-	-24-	5- 9- 13	1.35-1.45 -1.55	14.00-28.00-42. 00	0.11-0.14-0. 15	0.0- 1.5- 2.9	2.0- 2.5- 3.0	.24	.24	2	3	86
	13-16	-67-	-20-	8-13- 18	1.55-1.60 -1.65	14.00-28.00-42. 00	0.10-0.13-0. 19	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.24	.24			
	16-60	-92-	- 6-	1- 2- 6	1.50-1.65 -1.80	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
Dickman	—	—	—	—	—	—	—	—	—					
Hubbard	—	—	—	—	—	—	—	—	—					
Sparta	—	—	—	—	—	—	—	—	—					
151B—Burkhardt sandy loam, 3 to 9 percent slopes														
Burkhardt	0-13	-67-	-24-	5- 9- 13	1.35-1.45 -1.55	14.00-28.00-42. 00	0.11-0.14-0. 15	0.0- 1.5- 2.9	2.0- 2.5- 3.0	.24	.24	2	3	86
	13-16	-67-	-20-	8-13- 18	1.55-1.60 -1.65	14.00-28.00-42. 00	0.10-0.13-0. 19	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.24	.24			
	16-60	-92-	- 6-	1- 2- 6	1.50-1.65 -1.80	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
Dickman	—	—	—	—	—	—	—	—	—					
Hubbard	—	—	—	—	—	—	—	—	—					
Sparta	—	—	—	—	—	—	—	—	—					

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
155C—Chetek sandy loam, 6 to 12 percent slopes														
Chetek	0-8	-68-	-23-	5- 9- 12	1.35-1.53 -1.55	4.00-28.00-42.0 0	0.10-0.13-0. 15	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.20	.20	2	3	86
	8-14	-45-	-43-	7-12- 17	1.40-1.55 -1.60	4.00-28.00-42.0 0	0.09-0.14-0. 19	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.43	.43			
	14-19	-67-	-19-	9-14- 18	1.50-1.55 -1.60	4.00-28.00-42.0 0	0.08-0.11-0. 13	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.10	.24			
	19-60	-92-	- 6-	1- 2- 3	1.60-1.70 -1.80	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.0- 0.5	.02	.02			
Kingsley	—	—	—	—	—	—	—	—	—					
Poskin	—	—	—	—	—	—	—	—	—					
454B—Mahtomedi loamy sand, 0 to 6 percent slopes														
Mahtomedi	0-8	-83-	- 9-	2- 9- 15	1.40-1.50 -1.60	42.00-92.00-14 1.00	0.10-0.11-0. 12	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.10	.10	5	2	134
	8-30	-91-	- 4-	0- 5- 10	1.55-1.60 -1.75	42.00-92.00-14 1.00	0.05-0.06-0. 07	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
	30-60	-94-	- 1-	0- 5- 10	1.55-1.60 -1.75	42.00-92.00-14 1.00	0.04-0.07-0. 09	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
Antigo	—	—	—	—	—	—	—	—	—					
Brill	—	—	—	—	—	—	—	—	—					
Demontreville	—	—	—	—	—	—	—	—	—					
Kingsley	—	—	—	—	—	—	—	—	—					

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
454F—Mahtomedi loamy sand, 25 to 40 percent slopes														
Mahtomedi	0-3	-83-	- 9-	2- 9- 15	1.40-1.50 -1.60	42.00-92.00-141.00	0.10-0.11-0.12	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.10	.10	5	2	134
	3-23	-91-	- 4-	0- 5- 10	1.55-1.60 -1.75	42.00-92.00-141.00	0.05-0.06-0.07	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
	23-60	-94-	- 1-	0- 5- 10	1.55-1.60 -1.75	42.00-92.00-141.00	0.04-0.07-0.09	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
Demontreville	—	—	—	—	—	—	—	—	—					
Kingsley	—	—	—	—	—	—	—	—	—					
507—Poskin silt loam														
Poskin	0-13	-14-	-71-	13-15- 17	1.35-1.45 -1.55	4.00-9.00-14.00	0.21-0.23-0.24	0.0- 1.5- 2.9	2.0- 3.0- 4.0	.43	.43	3	5	56
	13-28	- 7-	-70-	18-23- 27	1.40-1.53 -1.60	4.00-9.00-14.00	0.17-0.20-0.22	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.49	.49			
	28-33	-46-	-46-	2- 9- 15	1.50-1.60 -1.65	4.00-23.00-42.00	0.05-0.14-0.22	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.64	.64			
	33-60	-92-	- 7-	0- 2- 3	1.60-1.70 -1.80	42.00-92.00-141.00	0.02-0.05-0.07	0.0- 1.5- 2.9	0.0- 0.0- 0.5	.02	.02			
Antigo	—	—	—	—	—	—	—	—	—					
Barronett, sandy substratum	—	—	—	—	—	—	—	—	—					
Brill	—	—	—	—	—	—	—	—	—					
Rosholt	—	—	—	—	—	—	—	—	—					

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
857—Urban land-Waukegan complex, 0 to 3 percent slopes														
Urban land	—	—	—	—	—	—	—	—	—					
Waukegan	0-10	-10-	-68-	18-23- 27	1.35-1.45 -1.55	4.00-9.00-14.00	0.22-0.23-0. 24	0.0- 1.5- 2.9	2.0- 3.5- 5.0	.37	.37	3	6	48
	10-24	-10-	-68-	18-23- 27	1.45-1.45 -1.55	4.00-9.00-14.00	0.20-0.21-0. 22	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.49	.49			
	24-60	-91-	- 4-	1- 6- 10	1.55-1.60 -1.70	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			
858—Urban land-Chetek complex, 0 to 3 percent slopes														
Urban land	—	—	—	—	—	—	—	—	—					
Chetek	0-6	-68-	-23-	5- 9- 12	1.35-1.53 -1.55	4.00-28.00-42.0 0	0.10-0.13-0. 15	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.20	.20	3	3	86
	6-20	-67-	-19-	9-14- 18	1.50-1.55 -1.60	4.00-28.00-42.0 0	0.08-0.11-0. 13	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.10	.24			
	20-60	-92-	- 6-	1- 2- 3	1.60-1.70 -1.80	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.0- 0.5	.02	.02			

Physical Soil Properties–Washington County, Minnesota														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
858C—Urban land-Chetek complex, 3 to 15 percent slopes														
Urban land	—	—	—	—	—	—	—	—	—					
Chetek	0-6	-68-	-23-	5- 9- 12	1.35-1.53 -1.55	4.00-28.00-42.0 0	0.10-0.13-0. 15	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.20	.20	2	3	86
	6-18	-67-	-19-	9-14- 18	1.50-1.55 -1.60	4.00-28.00-42.0 0	0.08-0.11-0. 13	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.10	.24			
	18-60	-92-	- 6-	1- 2- 3	1.60-1.70 -1.80	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.0- 0.5	.02	.02			
1040—Udorthents														
Udorthents	—	—	—	—	—	—	—	—	—					
1820F—Mahtomedi variant-Rock outcrop complex, 25 to 60 percent slopes														
Mahtomedi	0-3	-67-	-23-	5-10- 15	1.42-1.51 -1.60	14.00-28.00-42. 00	0.13-0.15-0. 17	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.20	.20	5	3	86
	3-32	-79-	-16-	0- 5- 10	1.48-1.57 -1.65	42.00-92.00-14 1.00	0.09-0.10-0. 11	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.24	.24			
	32-42	-97-	- 2-	0- 2- 3	1.50-1.63 -1.75	42.00-92.00-14 1.00	0.05-0.06-0. 07	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.05	.05			
	42-60	—	—	—	—	1.00-3.00-4.00	—	—	—					
Rock outcrop	—	—	—	—	—	—	—	—	—					

Data Source Information

Soil Survey Area: Washington County, Minnesota
Survey Area Data: Version 15, Sep 16, 2019

Appendix D

Appendix D - Potential Contaminant Sources - Parcel Listing

PCSI ID	PIN	Program ID	Name	Address	City	Zip Code	PCS_C	MAT_C	Total	Activity	Status_C	Comments
1	1002920110013	10713	Meisters Garage	397 5th Ave No	Bayport	55003	LUST	F000	4	Leaking Underground Storage Tank	Removed	3 underground tanks removed, 1 above ground tank removed
2	1002920110013	18361	Meisters Garage	397 5th Ave No	Bayport	55003	AST	F000	1	Above-ground Storage Tank	Active	1 used oil above ground tank active
3	1002920110013	MND981533854	Meisters Garage	397 5th Ave No	Bayport	55003	HWG		1	Hazardous Waste, Small	Active	
4	1002920110111	MND116901570	Bay Dental Care	363 5th Ave No	Bayport	55003	HWG		1	Hazardous Waste, Small	Active	
5	1002920110023	MNR000012153	Niles Construction	507 6th St No	Bayport	55003	HWG		1	Hazardous Waste, Small	Inactive	
6	1102920220052	MNR000062471	Andersen Elementary School	309 4th St No	Bayport	55003	HWG		1	Hazardous Waste, Small	Inactive	
7	1102920220089	TS0126041	Weller Residence	464 4th St No	Bayport	55003	LUST	F000	1	Leaking Underground Storage Tank	Inactive	Tank Removed, Site Closed
8			Unlocated Well	Andersen Elementary	Bayport	55003	WEL		1	Unlocated Well	Unknown	Well not verified
9			Unlocated Well	City of Bayport	Bayport	55003	WEL		1	Unlocated Well	Unknown	Well not verified, not a city well
10	1002920210004	273700	Anderson/Bradley Residence	4745 Stagecoach Trail	Baytown Township	55082	WEL		1	Well	Active	
11	1002920210004		Anderson/Bradley Residence	4746 Stagecoach Trail	Baytown Township	55083	SSTS		1	Septic System	Active	
12	1002920210001	832178	Federowski Residence	15385 50th St No	Baytown Township	55082	WEL		1	Well	Active	
13	1002920210001		Federowski Residence	15386 50th St No	Baytown Township	55083	SSTS		1	Septic System	Active	

Appendix E

Environmental Health Division
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) - POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1820001	**COMMUNITY**
NAME	Bayport	
ADDRESS	Bayport Water Superintendent, 294 North Third Street, Bayport, MN 55003	

FACILITY (WELL) INFORMATION

NAME	Well #2	**IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?**
FACILITY ID	S01	☐ YES (Please attach a copy)
UNIQUE WELL NO.	208795	☐ NO ☐ UNDETERMINED
COUNTY	Washington	

PWS ID / FACILITY ID	1820001 S01	**UNIQUE WELL NO.**	208795

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		

PWS ID / FACILITY ID	1820001 S01	UNIQUE WELL NO.	208795

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				
*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		
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		N		
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	166	N
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	98	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.		N		
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		Y	20	Y
*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		

PWS ID / FACILITY ID	1820001 S01	UNIQUE WELL NO.	208795

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				
*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		
PT1	Petroleum tank or container, 1100 gal. or more, without safeguards	150	150		N		
PT2	Petroleum tank or container, 1100 gal. or more, with safeguards	100	100		N		
PT3	Petroleum tank or container, buried, between 56 and 1100 gal.	50	50		N		
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		N		
PU1	Pit or unfilled space more than four feet in depth	20	20		N		
PC1	Pollutant or contaminant that may drain into the soil	50	50	100	N		
SP1	Swimming pool, in-ground	20	20		N		
*VH1	Vertical heat exchanger, horizontal piping conforming to rule	50	10		N		
*VH2	Vertical heat exchanger (vertical) piping, conforming to rule	50	35		N		
*WR1	Wastewater rapid infiltration basin, municipal or industrial	300	300	600	N		
*WA1	Wastewater spray irrigation area, municipal or industrial	150	150	300	N		
*WS1	Wastewater stabilization pond, industrial	150	150	300	N		
*WS2	Wastewater stabilization pond, municipal, 500 or more gal./acre/day of leakage	300	300	600	N		
*WS3	Wastewater stabilization pond, municipal, less than 500 gal./acre/day of leakage	150	150	300	N		
*WT1	Wastewater treatment unit tanks, vessels and components (Package plant)	100	100		N		
*WT2	Water treatment backwash disposal area	50	50	100	N		
Additional Sources (If there is more than one source listed above, please indicate here).							
Potential Contamination Sources and Codes Based on Previous Versions of this Form							
	none found within 200' of this well.						

* New potential contaminant source.

[1] A sensitive well has less than 50 feet of watertight casing, and which is not cased below a confining layer or confining materials of at least 10' in thickness.

[2] These sources, known as Class V underground injection wells, are regulated by the federal U.S. Environmental Protection Agency.

[3] These sources are classified as illegal by Minnesota Rules, Chapter 4725.

[4] Isolation distance is determined by average flow per day or if a facility handles infectious or pathological wastes.

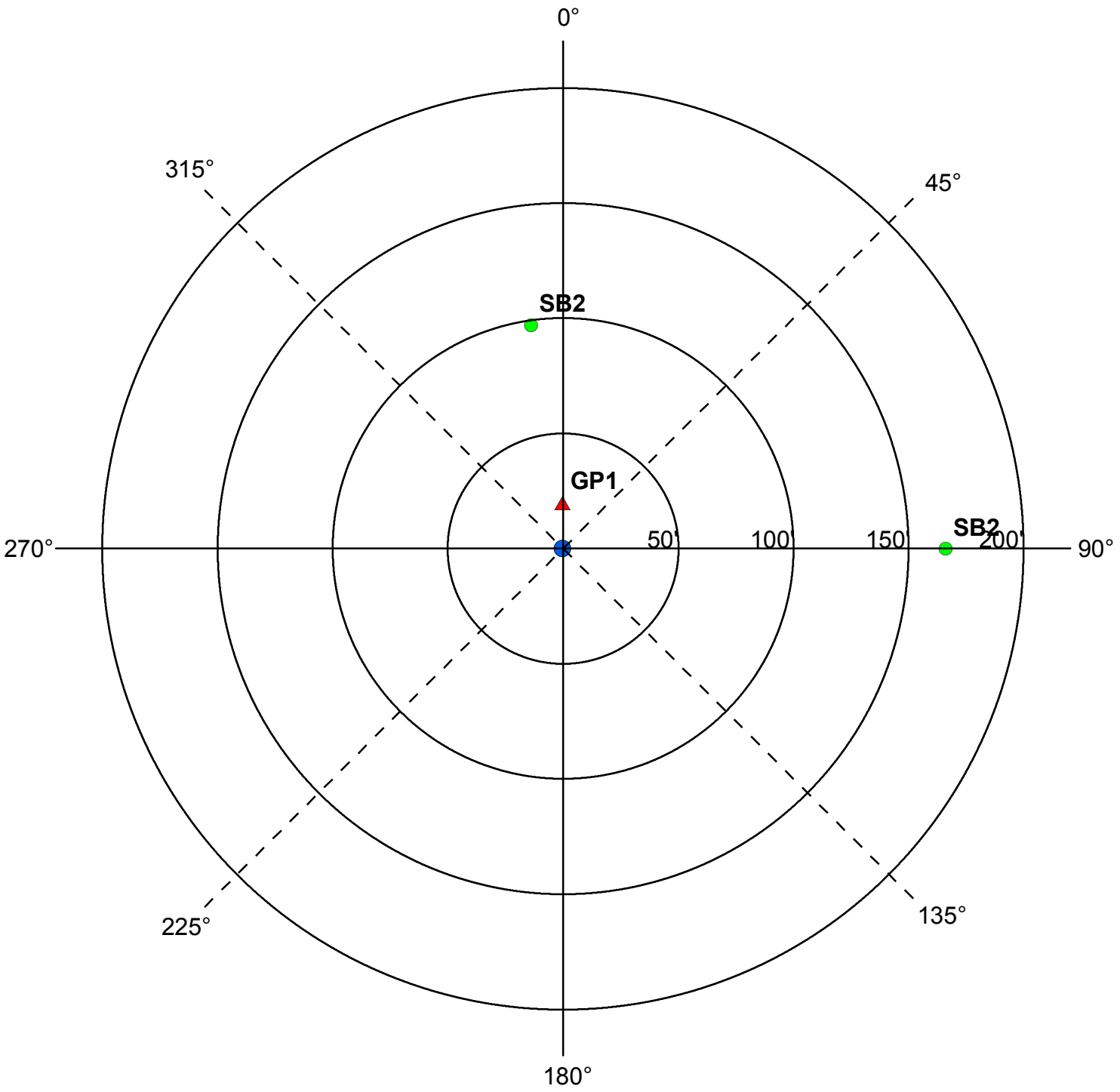
[5] A community public water-supply well must be a minimum of 50 feet from a petroleum tank or container, unless the tank or container is used for emergency pumping and is located in a room or building separate from the community well; and is of double-wall construction with leak detection between walls; or is protected with secondary containment.

This form is based on the new isolation distances in Minnesota Rules, Chapter 4725, related to wells and borings adopted August 4, 2008, and Minnesota Rules, Chapter 4720, related to wellhead protection.

PWS ID / FACILITY ID	1820001 S01	UNIQUE WELL NO.	208795

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	Martin, Lucas	DATE	7 - 11 - 2017

PWS ID / FACILITY ID	1820001 S01	UNIQUE WELL NO.	208795

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED

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

Environmental Health Division
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) - POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1820001	**COMMUNITY**
NAME	Bayport	
ADDRESS	Bayport Water Superintendent, 294 North Third Street, Bayport, MN 55003	

FACILITY (WELL) INFORMATION

NAME	Well #3	**IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?**
FACILITY ID	S02	☐ YES (Please attach a copy)
UNIQUE WELL NO.	208796	☐ NO ☐ UNDETERMINED
COUNTY	Washington	

PWS ID / FACILITY ID	1820001 S02	**UNIQUE WELL NO.**	208796

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		

PWS ID / FACILITY ID	1820001 S02	UNIQUE WELL NO.	208796

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				
*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		
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		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		Y	85	Y
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		Y	65	Y
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.		N		
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		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	1820001 S02	UNIQUE WELL NO.	208796

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				
*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		
PT1	Petroleum tank or container, 1100 gal. or more, without safeguards	150	150		N		
PT2	Petroleum tank or container, 1100 gal. or more, with safeguards	100	100		N		
PT3	Petroleum tank or container, buried, between 56 and 1100 gal.	50	50		N		
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		N		
PU1	Pit or unfilled space more than four feet in depth	20	20		N		
PC1	Pollutant or contaminant that may drain into the soil	50	50	100	N		
SP1	Swimming pool, in-ground	20	20		N		
*VH1	Vertical heat exchanger, horizontal piping conforming to rule	50	10		N		
*VH2	Vertical heat exchanger (vertical) piping, conforming to rule	50	35		N		
*WR1	Wastewater rapid infiltration basin, municipal or industrial	300	300	600	N		
*WA1	Wastewater spray irrigation area, municipal or industrial	150	150	300	N		
*WS1	Wastewater stabilization pond, industrial	150	150	300	N		
*WS2	Wastewater stabilization pond, municipal, 500 or more gal./acre/day of leakage	300	300	600	N		
*WS3	Wastewater stabilization pond, municipal, less than 500 gal./acre/day of leakage	150	150	300	N		
*WT1	Wastewater treatment unit tanks, vessels and components (Package plant)	100	100		N		
*WT2	Water treatment backwash disposal area	50	50	100	N		

Additional Sources (If there is more than one source listed above, please indicate here).

Potential Contamination Sources and Codes Based on Previous Versions of this Form

none found within 200' of this well.

* New potential contaminant source.

[1] A sensitive well has less than 50 feet of watertight casing, and which is not cased below a confining layer or confining materials of at least 10' in thickness.

[2] These sources, known as Class V underground injection wells, are regulated by the federal U.S. Environmental Protection Agency.

[3] These sources are classified as illegal by Minnesota Rules, Chapter 4725.

[4] Isolation distance is determined by average flow per day or if a facility handles infectious or pathological wastes.

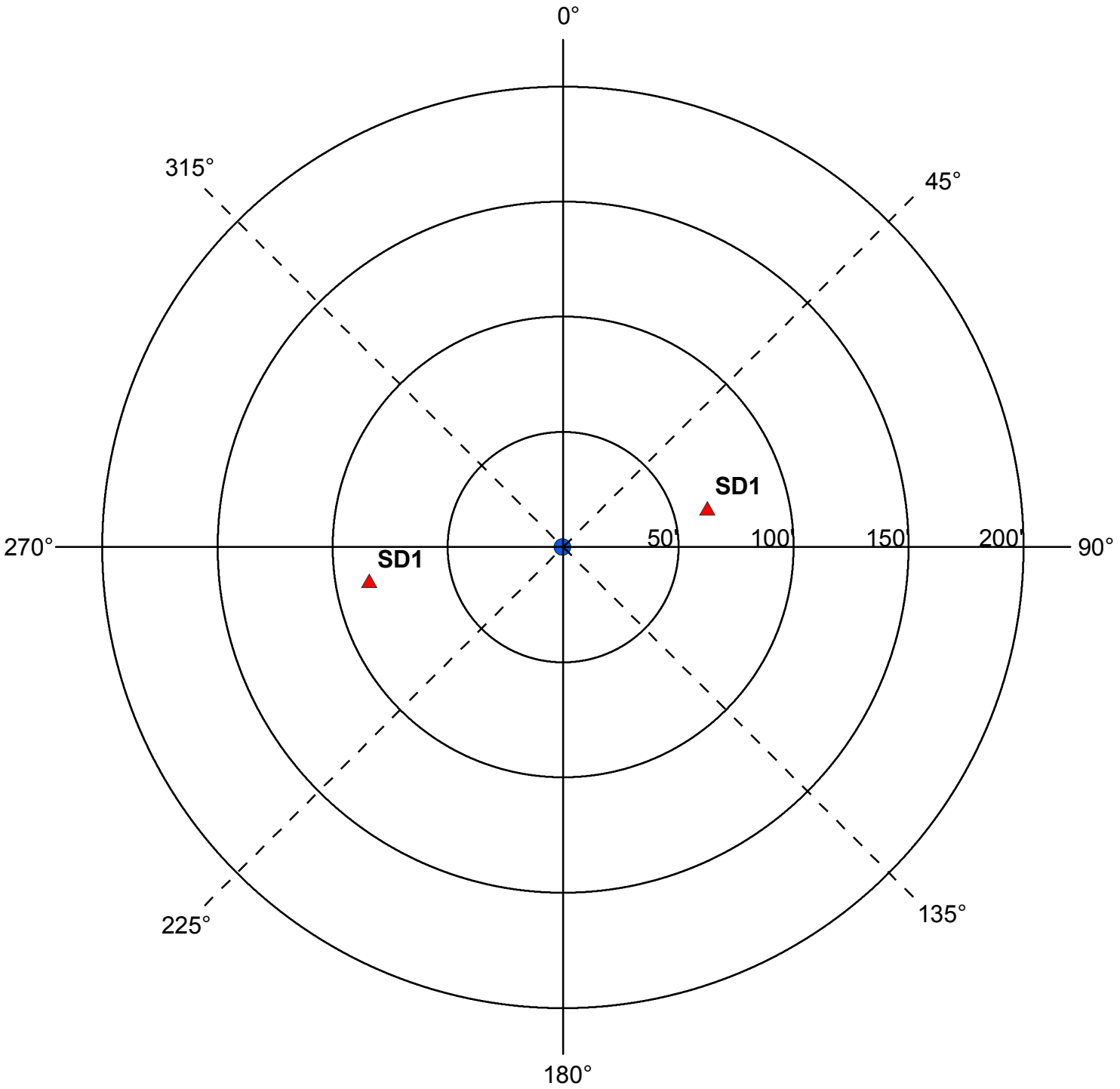
[5] A community public water-supply well must be a minimum of 50 feet from a petroleum tank or container, unless the tank or container is used for emergency pumping and is located in a room or building separate from the community well; and is of double-wall construction with leak detection between walls; or is protected with secondary containment.

This form is based on the new isolation distances in Minnesota Rules, Chapter 4725, related to wells and borings adopted August 4, 2008, and Minnesota Rules, Chapter 4720, related to wellhead protection.

PWS ID / FACILITY ID	1820001 S02	UNIQUE WELL NO.	208796

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	Martin, Lucas	DATE	7 - 11 - 2017

PWS ID / FACILITY ID	1820001 S02	UNIQUE WELL NO.	208796

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED

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

Environmental Health Division
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) - POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1820001	**COMMUNITY**
NAME	Bayport	
ADDRESS	Bayport Water Superintendent, 294 North Third Street, Bayport, MN 55003	

FACILITY (WELL) INFORMATION

NAME	Well #4	**IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?**
FACILITY ID	S03	☐ **YES** (Please attach a copy)
UNIQUE WELL NO.	208797	☐ **NO** ☐ **UNDETERMINED**
COUNTY	Washington	

PWS ID / FACILITY ID	1820001 S03	**UNIQUE WELL NO.**	208797

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		

PWS ID / FACILITY ID	1820001 S03	UNIQUE WELL NO.	208797

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				
*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		
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		N		
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	66	Y
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	165	Y
*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.		N		
UUW	Unused, unsealed well or boring	50	50		Y	138	
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		

PWS ID / FACILITY ID	1820001 S03	UNIQUE WELL NO.	208797

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				
*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		
PT1	Petroleum tank or container, 1100 gal. or more, without safeguards	150	150		N		
PT2	Petroleum tank or container, 1100 gal. or more, with safeguards	100	100		N		
PT3	Petroleum tank or container, buried, between 56 and 1100 gal.	50	50		N		
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		N		
PU1	Pit or unfilled space more than four feet in depth	20	20		N		
PC1	Pollutant or contaminant that may drain into the soil	50	50	100	N		
SP1	Swimming pool, in-ground	20	20		N		
*VH1	Vertical heat exchanger, horizontal piping conforming to rule	50	10		N		
*VH2	Vertical heat exchanger (vertical) piping, conforming to rule	50	35		N		
*WR1	Wastewater rapid infiltration basin, municipal or industrial	300	300	600	N		
*WA1	Wastewater spray irrigation area, municipal or industrial	150	150	300	N		
*WS1	Wastewater stabilization pond, industrial	150	150	300	N		
*WS2	Wastewater stabilization pond, municipal, 500 or more gal./acre/day of leakage	300	300	600	N		
*WS3	Wastewater stabilization pond, municipal, less than 500 gal./acre/day of leakage	150	150	300	N		
*WT1	Wastewater treatment unit tanks, vessels and components (Package plant)	100	100		N		
*WT2	Water treatment backwash disposal area	50	50	100	N		

Additional Sources (If there is more than one source listed above, please indicate here).

Potential Contamination Sources and Codes Based on Previous Versions of this Form

none found within 200' of this well.

* New potential contaminant source.

[1] A sensitive well has less than 50 feet of watertight casing, and which is not cased below a confining layer or confining materials of at least 10' in thickness.

[2] These sources, known as Class V underground injection wells, are regulated by the federal U.S. Environmental Protection Agency.

[3] These sources are classified as illegal by Minnesota Rules, Chapter 4725.

[4] Isolation distance is determined by average flow per day or if a facility handles infectious or pathological wastes.

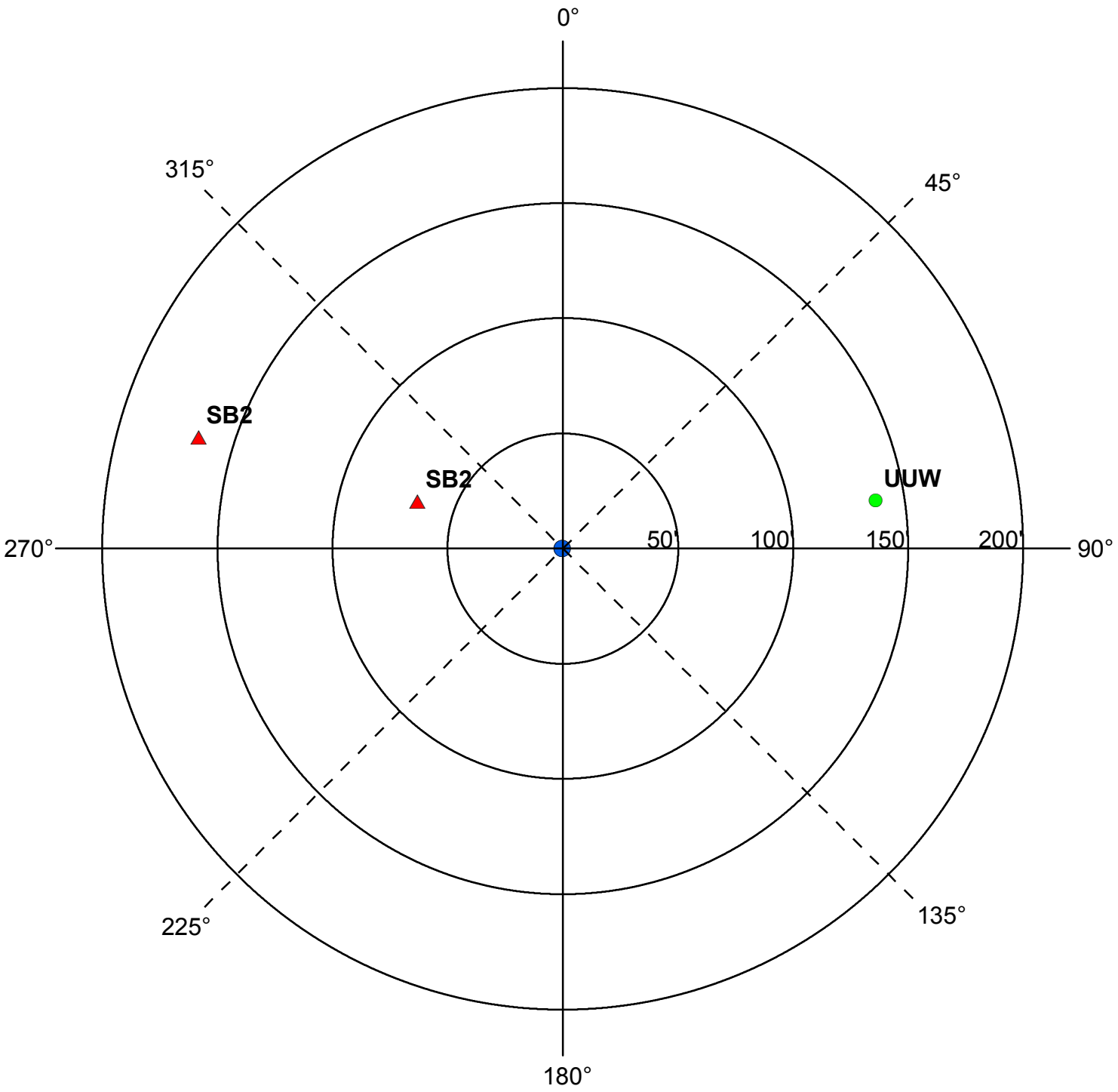
[5] A community public water-supply well must be a minimum of 50 feet from a petroleum tank or container, unless the tank or container is used for emergency pumping and is located in a room or building separate from the community well; and is of double-wall construction with leak detection between walls; or is protected with secondary containment.

This form is based on the new isolation distances in Minnesota Rules, Chapter 4725, related to wells and borings adopted August 4, 2008, and Minnesota Rules, Chapter 4720, related to wellhead protection.

PWS ID / FACILITY ID	1820001 S03	UNIQUE WELL NO.	208797

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	Martin, Lucas	DATE	7 - 11 - 2017

PWS ID / FACILITY ID	1820001 S03	UNIQUE WELL NO.	208797

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED

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

Appendix F

B. PERRO CREEK MONITORING

The goal of monitoring Perro Creek in 2016-2017 was to identify where the greatest contribution of nutrients and sediment to the Saint Croix River was occurring. Monitoring continued in 2018 to further refine previous observations. In 2018 base and storm grab samples were collected at the Perro Creek at the Diversion Structure site, and analyzed for Total Phosphorus (TP), Total Kjeldhal Nitrogen (TKN), Total Suspended Solids (TSS) and *E. coli*. Samples were collected and analyzed for *E. coli* at Perro Creek at the Perro Pond Outlet, Perro Creek at 5th Avenue, Perro Creek at 9th Street, Perro Creek at 8th Street, Perro Creek at 6th Street, Perro Creek at 4th Street, Perro Creek at St. Croix Trail Downstream, Perro Creek at Central Avenue, and Perro Creek at 3rd Avenue. Monitoring will continue at these sites in 2019.

In 2018 Perro Creek at the Diversion Structure had lower average results than 2017. The average phosphorus concentration was 0.065 mg/L with a range of 0.020-0.252 mg/L, lower than the average phosphorus concentration in 2017 of 0.069 mg/L. The average TSS concentration was 9.4 mg/L; lower than 20 mg/L in 2017. Perro Creek at the Diversion Structure TSS results had a range of 1-31 mg/L, which was a lower range than 1-76 mg/L in 2017 (Table 7 and Table 8).

The equipment at Perro Creek at the Diversion Structure was installed further downstream in 2018 to a more stable site. The area velocity sensor was moved from its location in 2017 due to challenges that prevented accurate estimation of discharge, including channel obstructions such as debris. The frequency of manipulations of the creek also caused issues with collecting accurate data, as they caused sediment deposition, which constantly changed the shape and depth of the channel. The frequent occurrence of obstructions from various sources impacted the consistency and quality of logged data. The 2018 location remedied these issues by moving the probe into the 3.5 ft culvert downstream from the v-notch weir at the diversion structure. The new location was less impacted by debris and succeeded in collecting more consistent data. Additional monitoring is planned for 2019 to further refine these observations

DRAFT

There were notable differences in *E. coli* results between sites along Perro Creek in 2018. Sample results seem to indicate that there is an increased prevalence of *E. coli* downstream of the 8th street monitoring location. It should be noted that between the Perro at 8th Street site and the next site, Perro at 6th Street, there is a known decommissioned cesspool. This cesspool was filled in during the summer of 2018 and may be a contributing source of *E. coli* to Perro Creek. After 6th Street *E. coli* results generally increase moving downstream, with a few exceptions. Half of the sampling events indicate a drop in *E. coli* occurs at two sites, Perro Creek at the Diversion Structure and Perro Creek at Central Ave. The drop in *E. coli* results at these two sites may suggest that there is an additional source of water diluting the *E. coli* along this portion of Perro Creek.

E. coli results are calculated by estimating the most probable number of *E. coli* organisms in a stream. The primary source of *E. coli* is human and animal waste. *E.coli* can cause diarrhea and abdominal cramps and is considered life-threatening for vulnerable populations such as children, and the elderly, making high *E. coli* presence a concern for human health. *E. coli* results were high for all sites during the storm event on 9/20/2018, with eight of the ten sites exceeding the standard testing limit of 2,420 most probable number of organisms (MPN) per 100/ml. These samples were further tested in the lab as a diluted sample with results varying from 17,500-54,600 MPN per 100/ml. The highest individual *E. coli* result occurred at the Perro Creek at the St. Croix Trail Downstream site on 9/20/2018 (Table 9). According to the MPCA standards, Perro Creek is exceeding impairment standards at 6th Street in June and September (Table 10). Impairment standards are based on MPCA protocol which includes the last ten years of data and requires at least 5 samples in a calendar month to calculate the geometric mean (average).

DRAFT

Table 7. Perro Creek 2018 Total Suspended Solids (TSS) and Total Phosphorus (TP)

Site	Estimated Discharge (CFS)	Total Estimated Flow (ac-ft)	Proportion of Total Flow	Average Phosphorus Concentration (mg/L)	Phosphorus Range (mg/L)	Average TSS Concentration (mg/L)	TSS Range (mg/L)	TP Load (lbs.)	TSS Load (lbs.)
Perro at Diversion Structure Overflow 5/17-10/29	2,365,007	54.32	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Perro at Diversion Structure Base 5/17-10/29*	6,905,082	158.60	0.9408	0.036	0.020-0.058	4	1-16	15.518	1724.23
Perro at Diversion Structure Storm 5/17-10/29*	434,571	9.98	0.0592	0.124	0.047-0.252	20	8-31	3.364	549.35

*Nonlogged period of 6/29-8/9 excluded

Table 8. Perro Creek 2018 Water Quality Results

Date	Perro Creek at the Diversion Structure			
	Sample Type	TP (mg/L)	TSS (mg/L)	TKN (mg/L)
5/22/2018	Base	~0.038	3	0.39
6/6/2018	Storm	0.252	21	2.00
6/18/2018	Base	~0.026	3	0.45
6/25/2018	Base	0.058	16	0.58
7/13/2018	Storm	~0.047	8	0.72
7/23/2018	Base	~0.043	~1	0.30
8/1/2018	Base	~0.045	~1	0.34
8/24/2018	Storm	0.105	31	0.62
9/5/2018	Base	~0.039	4	0.43
9/20/2018	Storm	0.090	21	0.80
9/27/2018	Base	~0.022	3	0.29
10/16/2018	Base	<0.020	<1	0.16

DRAFT

Table 9. Perro Creek 2018 *E. coli* Results

Site	*E. coli* Results					
	5/22/2018	6/19/2018	7/19/2018	8/29/2018	9/20/2018	10/16/2018
Perro at Perro Pond Outlet	15	42	17	9	>2420	7
Perro at 5th Ave	45	56	80	21	1733	18
Perro at 9th Street	48	65	28	16	1733	8
Perro at 8th Street	49	127	133	37	>2420	27
Perro at 6th Street	58	488	153	59	>2420	125
Perro at 4th Street	50	548	261	73	>2420	186
Perro at St. Croix Trail Downstream	64	579	579	66	>2420	299
Perro at Diversion Structure	50	>2420	517	88	>2420	205
Perro at Central Ave	55	1986	276	66	>2420	249
Perro at 3rd Ave	228	>2420	548	79	>2420	101

Table 10. Monthly Geometric Means of *E. Coli* Latest Ten Years

Monthly Geometric Means for *E. coli* (#/100 mL)

Site	April	May	June	July	August	September	October
Perro at Perro Pond Outlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at 5th Ave	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at 9th Street	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at 8th Street	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at 6th Street	Insufficient Data	68	181	120	102	283	Insufficient Data
Perro at 4th Street	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at St. Croix Trail Downstream	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at Diversion Structure	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at Central Ave	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Perro at 3rd Ave	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data

Exceeds geometric mean of 126 #/100mL from not less than 5 samples in a calendar month

10% of samples taken in the last 10 years exceed 1,260 #/100mL (Doesn't necessarily exceed geometric mean standard)

*Based on MPCA protocol: "*Not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies only between April 1 and October 31.*"

emphasis being placed on water entering Brick Pond. Continued monitoring at the Greeley Street catchment will help monitor the impact of BMPs installed in the Greeley Street catchment.

Loading estimates indicate the next priority would be the Lake Street catchment, which showed the highest average and discrete phosphorus concentrations. However, reducing the discharge and/or the phosphorus concentration at any of the four catchments identified as high contributors should have a significant impact on improving the water quality in Lily Lake. Therefore, it is recommended that these results be used in conjunction with implementation factors of stormwater management practices for targeting improvements to the catchments.

C. STREAMS

Monitoring of Perro Creek started in 2016 to determine where the greatest contribution of nutrients and sediment to the St. Croix River was occurring. This investigation continued in 2018. Based on past consistently low TP and TSS results monitoring at the Perro Pond Outlet was discontinued in 2018. Under current conditions it can be assumed that Perro Pond would not be a significant source of nutrient loading to the St. Croix River, and therefore not benefit significantly from retrofits. Monitoring at Perro Creek at the Diversion Structure continued in 2018. The average total phosphorus result was 0.065 mg/L, lower than 0.069 mg/L in 2017.

Perro Creek *E. coli* results are low at both sites prior to the creek entering the City of Bayport. Results increase substantially from the Perro Creek at 5th Ave site to the Perro Creek at 3rd Ave site, indicating that there may be sources contributing *E. coli* to the creek somewhere in the City of Bayport. *E. coli* results do not increase at all sites moving downstream as expected. The *E. coli* results increase significantly after the Perro Creek at 8th Street Site. This site is located upstream from a decommissioned cesspool, which may be a source of *E. coli*. Additionally there is a drop in *E. coli* results around the Perro Creek at the Diversion Structure and Perro Creek at Central Ave sites. This indicates that a source of groundwater, or piped drinking water, may be contributing to Perro Creek upstream of these sites and diluting *E. coli*. Perro Creek crosses under Andersen Elementary School upstream of these sites. Any potential groundwater or piped drinking water contributions from this stretch are unknown to the WCD. Monitoring will continue in 2019 to further investigate the source of *E. coli* entering Perro Creek.

Appendix G

Bayport Trichloroethene (TCE) Results

	Well #2	Well #3	Well #4	Treatment Plant
Date Collected	**Result (ug/L)**	**Result (ug/L)**	**Result (ug/L)**	**Result (ug/L)**
1/4/2007	4.9	0.5	0.4	
3/5/2007		0.7	0.4	
4/24/2007	6.2	0.5	0.3	No Detect
9/4/2007	6.2	0.7	0.5	No Detect
11/7/2007	7.3	0.8	0.8	No Detect
1/17/2008	7.8	1.2	0.9	No Detect
4/17/2008	8.9	1.1	0.9	No Detect
7/22/2008	7.4	1.6	1.0	No Detect
11/20/2008	6.2	0.9	0.8	No Detect
2/3/2009	7.8	1.3	0.7	No Detect
4/23/2009	8.2	2.1	1.4	No Detect
8/28/2009	8.7	1.9	1.1	No Detect
12/2/2009	7.3	1.8	1.2	No Detect
2/9/2010	8.7	2.3	1.5	No Detect
4/13/2010	7.6	1.8	1.5	No Detect
8/11/2010	6.2	1.5	1.1	No Detect
10/7/2010	4.4	2.2	1.1	No Detect
1/11/2011	5.8	2.2	1.9	No Detect
4/11/2011	5.0	2.3	1.5	No Detect
7/22/2011	7.8	2.4	1.5	No Detect
10/12/2011	8.4	3.0	1.9	No Detect
1/19/2012	8.3	3.2	2.4	No Detect
5/3/2012	9.0	3.1	2.5	No Detect
7/24/2012	8.3	3.7	2.4	No Detect
10/18/2012	8.1	3.1	2.1	No Detect
1/29/2013	8.2	3.2	1.9	No Detect
4/8/2013	7.7	2.8	2.3	No Detect
7/11/2013	8.1		1.7	No Detect
12/30/2013	7.1	3.3	1.4	No Detect
2/11/2014	8.6	3.7	1.8	No Detect
4/22/2014	6.5	2.3	1.2	No Detect
7/23/2014	7.7	4.2	2.4	No Detect
11/4/2014	7.4	3.8	2.2	No Detect
1/12/2015	7.5	3.6	2.3	No Detect
5/6/2015	6.8	3.4	2.2	No Detect
7/21/2015	8.1	4.1	2.5	No Detect
11/19/2015	8.3	3.8	2.2	No Detect
2/18/2016	8.9	4.0	2.2	No Detect
5/17/2016		3.8	2.9	No Detect
7/12/2016	7.8	3.7		No Detect
11/9/2016	7.6	3.8		No Detect
1/24/2017	8.2	4.3		No Detect
4/19/2017	8.2	4.2		No Detect
7/11/2017	8.5	3.4	3.5	No Detect
10/12/2017	8.7	4.7		No Detect
1/10/2018	7.4	4.3		No Detect
4/18/2018	7.5	4.1		No Detect
7/17/2018	8.4	2.7	3.3	0.28
10/25/2018		3.7		No Detect
1/16/2019	6.9	3.8		No Detect
5/9/2019	7.4	4.3		No Detect

Note: Maximum Contaminant Level for TCE = 5.4 ug/L.

Updated: 7/15/19

Appendix H

DEPARTMENT OF NATURAL RESOURCES

Minnesota Department of Natural Resources
Ecological and Water Resources
1200 Warner Road
St. Paul, MN 55106

January 31, 2019

City of Bayport
Matt Kline, Public Works Director
294 North 3rd Street
Bayport, MN 55003

RE: Water Supply Plan Approval, City of Bayport, Appropriation Permit No. 1964-0526

Dear Mr. Kline:

The Department of Natural Resources (DNR) has completed our review of the revised City of Bayport water supply plan for the public water supply system that is authorized under DNR Water Appropriation Permit 1964-0526. After reviewing your thoughtful and thorough revisions, I am pleased to advise you that in accordance with Minnesota Statutes, Section 103G.291, Subdivision 3, and on behalf of the Commissioner of the DNR, I hereby **approve your water supply plan.** We encourage the City of Bayport to complete the attached "Certification of Adoption" form. Please upload the form to the MPARS-Water Supply Plan tab as soon as the City officially adopts the plan.

The approval of the City of Bayport water supply plan is not a pre-approval of either proposed wells or the proposed future volumes that are indicated in Table 7. The City of Bayport has noted the uncertain future of well #4. A DNR "Well Construction – Preliminary Assessment" will be required for new well proposals, and after the construction of new a well, DNR Water Appropriation Permit 1964-0526 will need to be amended to reflect the existence of the well. The application for the "Well Construction – Preliminary Assessment" should not be submitted until the time period in which the well will be needed is less than one year to enable the most current geologic information to be used for the assessment.

Attached to this letter is a copy of a Water Supply Plan Review checklist containing remaining comments from both the DNR and the Metropolitan Council. These comments should be used to improve the City of Bayport water supply plan and improve the management of the City of Bayport water supply system. In addition, we will look forward to the receiving the City of Bayport' new Critical Water Deficiency Ordinance within six months of the approval of the City of Bayport water supply plan.

The DNR approves the changes to Appendix 2 that indicate that SCADA will be installed in well #4 in the near future and in Well #2 within ten-years. Bayport has also indicated that the measuring points of the transducers will be surveyed and that hourly water level information will be collected from the wells that will be submitted to the DNR on a quarterly basis at: gwlevelcoor.dnr@state.mn.us using a template that can be obtained from the groundwater level coordinator.

In addition to the comments above, the City of Bayport should also note the comments on the approved City of Bayport water supply plan from the Metropolitan Council that were sent to the City of Bayport during December, 2019.

Thank you for your efforts in planning for the future of the City of Bayport water supply and for conserving the water resources of the State of Minnesota. If you have any questions or need additional assistance with the City's water appropriation permit, please contact DNR Hydrologist Sara Mielke at 651-259-5879, or Sara.Mielke@state.mn.us or me at (651) 259 – 5877.

Sincerely,

Joseph D. Richter

Joe Richter
District Appropriations Hydrologist
Minnesota Department of Natural Resources

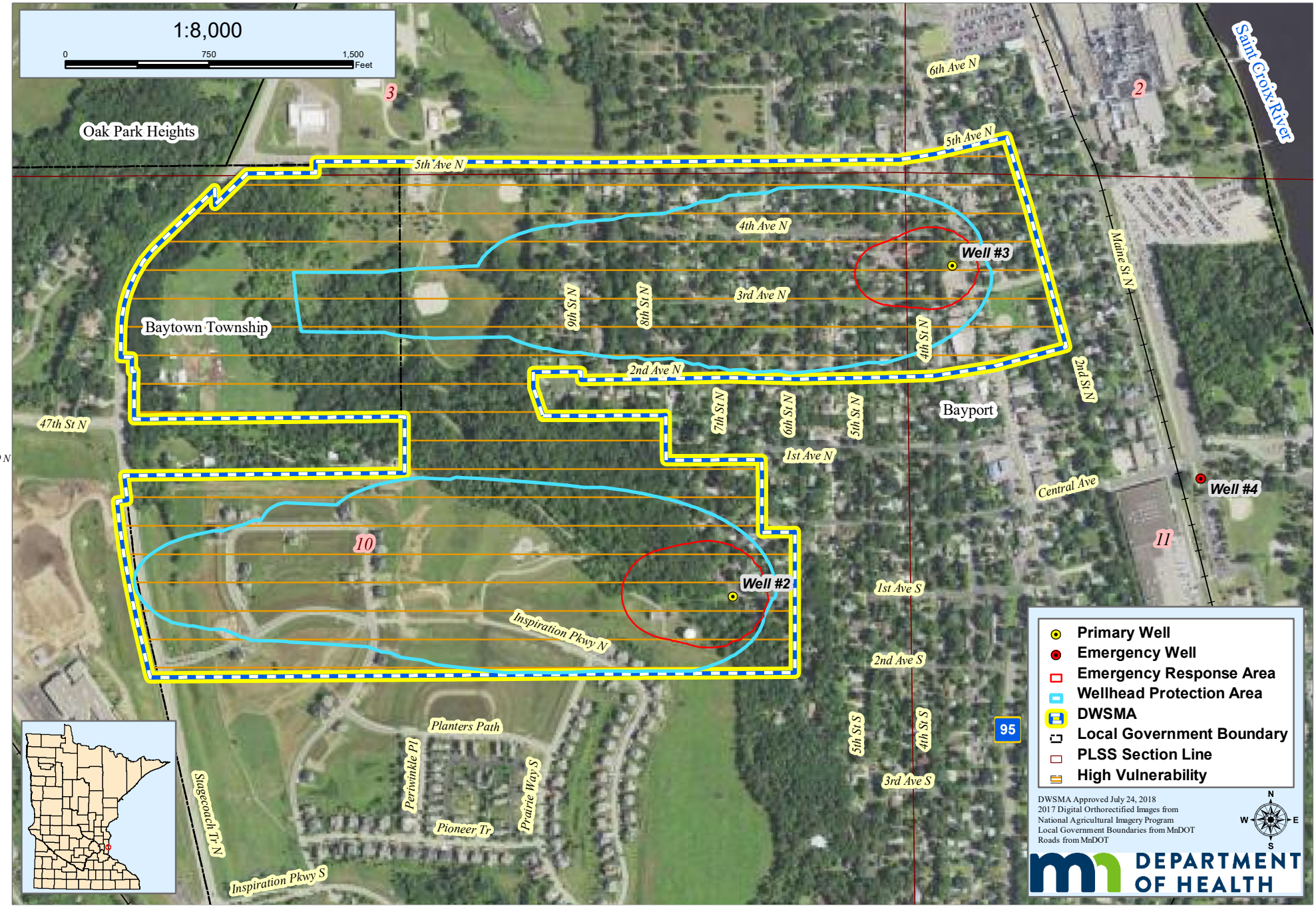
CC: Raya Esmaeili, Metropolitan Council Reviews Coordinator
Ali Elhassan, Metropolitan Council
Carmelita Nelson, DNR Water Supply Plan Coordinator
Jeanne Daniels, EWR South District Manager
Jenifer Soresen, EWR Area Hydrologist

Figures 1-12

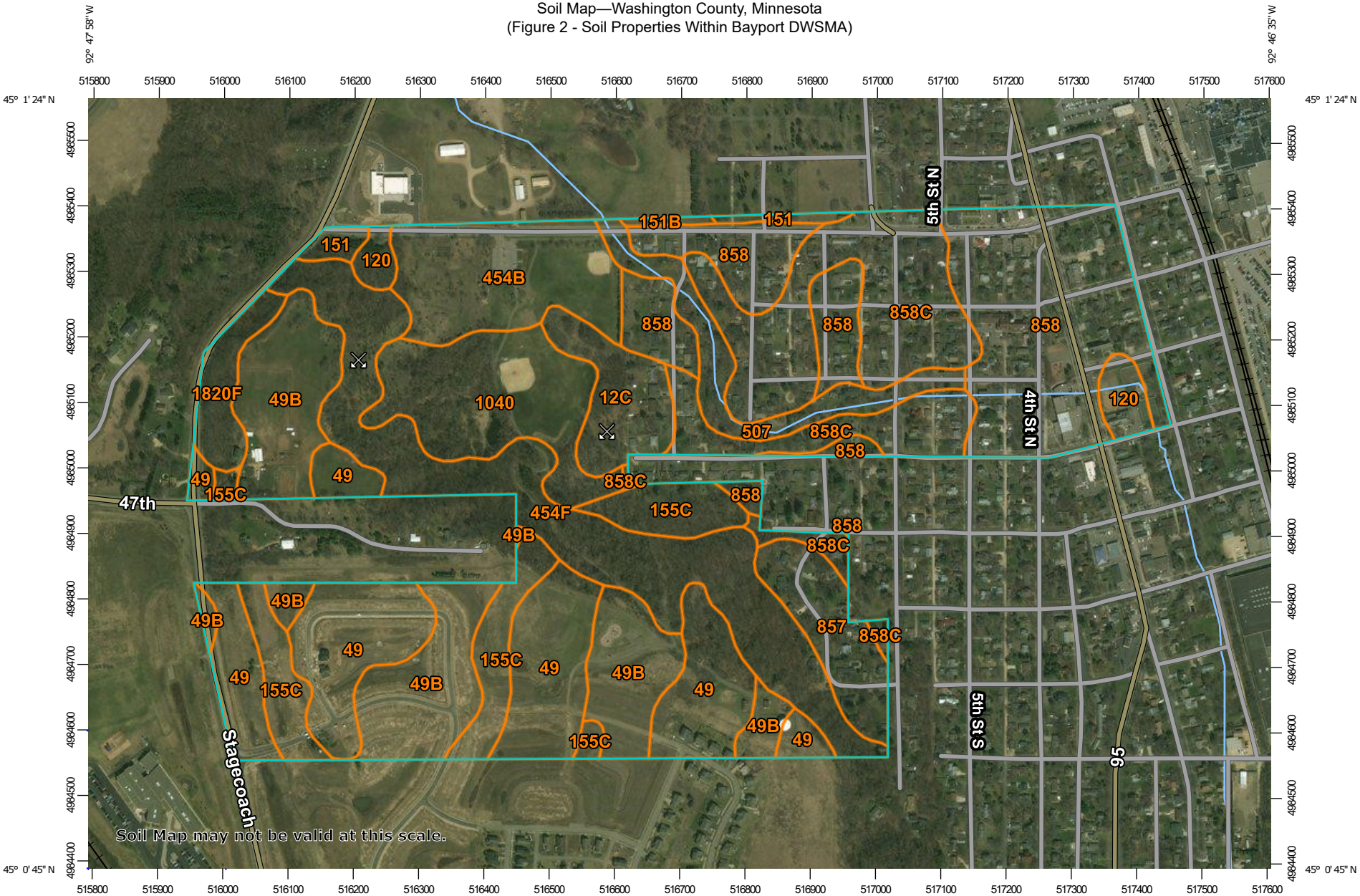
Bayport
Washington County
Minnesota

Minnesota Department of Health
Environmental Health
Source Water Protection Unit

Figure 1
Bayport Drinking Water Supply Management Area (DWSMA) MN-01075 - High Vulnerability



Soil Map—Washington County, Minnesota
(Figure 2 - Soil Properties Within Bayport DWSMA)



Map Scale: 1:8,280 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Minnesota
Survey Area Data: Version 15, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

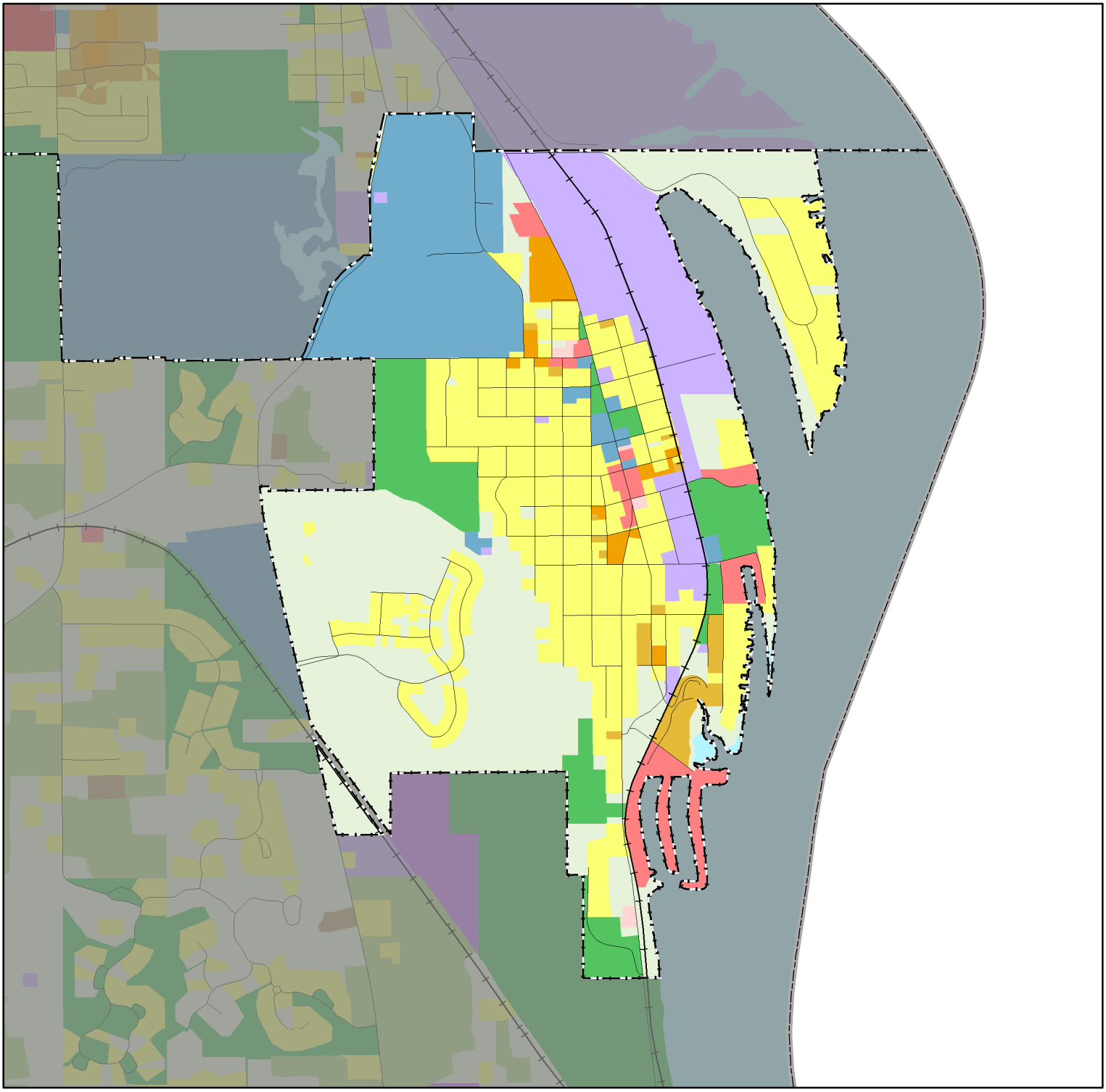
Date(s) aerial images were photographed: Oct 4, 2010—Jun 6, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
12C	Emmert gravelly loamy coarse sand, 3 to 12 percent slopes	6.7	3.0%
49	Antigo silt loam, 0 to 2 percent slopes	31.7	14.4%
49B	Antigo silt loam, 2 to 6 percent slopes	27.8	12.6%
120	Brill silt loam	3.2	1.4%
151	Burkhardt sandy loam, 0 to 3 percent slopes	1.7	0.8%
151B	Burkhardt sandy loam, 3 to 9 percent slopes	0.4	0.2%
155C	Chetek sandy loam, 6 to 12 percent slopes	12.9	5.8%
454B	Mahtomedi loamy sand, 0 to 6 percent slopes	13.6	6.2%
454F	Mahtomedi loamy sand, 25 to 40 percent slopes	26.4	12.0%
507	Poskin silt loam	7.0	3.2%
857	Urban land-Waukegan complex, 0 to 3 percent slopes	7.0	3.2%
858	Urban land-Chetek complex, 0 to 3 percent slopes	36.7	16.7%
858C	Urban land-Chetek complex, 3 to 15 percent slopes	26.5	12.0%
1040	Udorthents	14.6	6.6%
1820F	Mahtomedi variant-Rock outcrop complex, 25 to 60 percent slopes	3.9	1.8%
Totals for Area of Interest		**220.1**	**100.0%**

Figure 3 - 2016 Land Use Map



Approximately 1 inch = 0.337 miles

2016 Land Use Classes

Single Family Residential
- Farmstead
- Seasonal / Vacation
- Single Family, Detached
- Single Family, Attached

Multifamily Residential
- Multifamily
- Manufactured Housing Park

Commercial
- Retail and Other Commercial
- Office

Mixed Use
- Mixed-Use Residential
- Mixed-Use Industrial
- Mixed-Use Commercial

Institutional
- Institutional

Industrial
- Industrial and Utility
- Extractive

Park and Recreation
- Park, Recreation, or Preserve
- Golf

Agricultural
- Agricultural Activities

Other
- Undeveloped
- Open Water

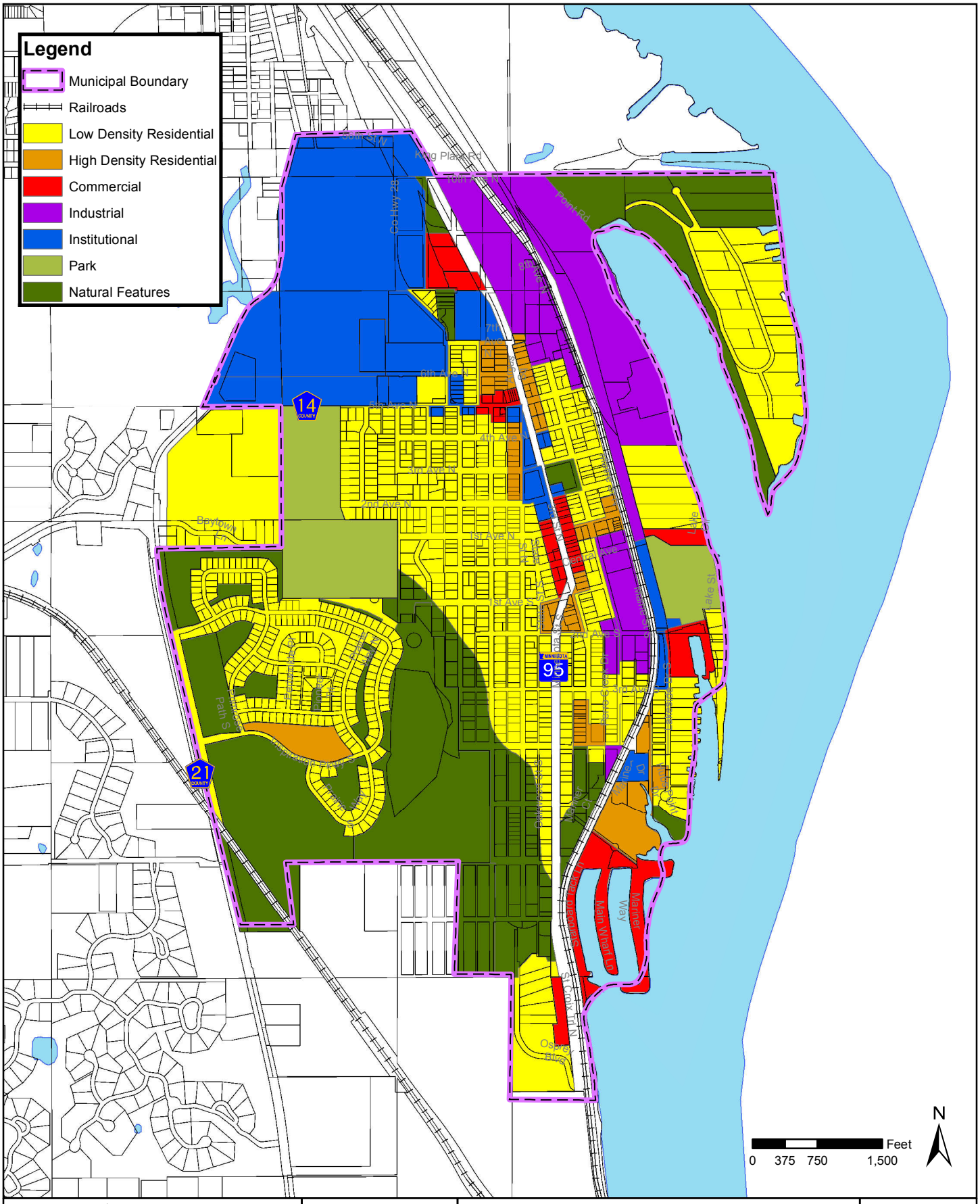
Transportation
- Major Highway
- Major Railway
- Airport or Airstrip

Land Use Data Sources: 2016 State of Minnesota Aerial Imagery • 2010 Generalized Land Use Delineations • NCompass Technologies Road Centerline Data
2016 Parcel Data from all Seven Metropolitan Counties • Internet Resources • Field Checks • Community Feedback

County Boundary --- April 2016
City and Township Boundaries --- April 2016
Roads --- NCompass, April 2016
Railway --- MNDOT, 2001

Map Printed March 2018

METROPOLITAN COUNCIL



Path: \\sehnn\projects\AE\B\Baypo\144027\5-final-dsgn\51-drawings\90-GIS\MapsandData\Fig 6 Future Land Use.mxd

SEH

3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (888) 908-8166
TF: (800) 325-2055
www.sehinc.com

Project: BAYPO 144027
Print Date: 5/16/2018

Map by: thastings
Projection: NAD_1983_HARN _Adj_MN_Washington_Feet
Source: City of Bayport
SEH File, Bayport CAD, Washington County

Figure 4 - Future Land Use Map

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

Bayport
Washington County
Minnesota

Minnesota Department of Health
Environmental Health
Source Water Protection Unit

Figure 5
Bayport Drinking Water Supply Management Area (DWSMA) MN-01075 - Land Cover 2011

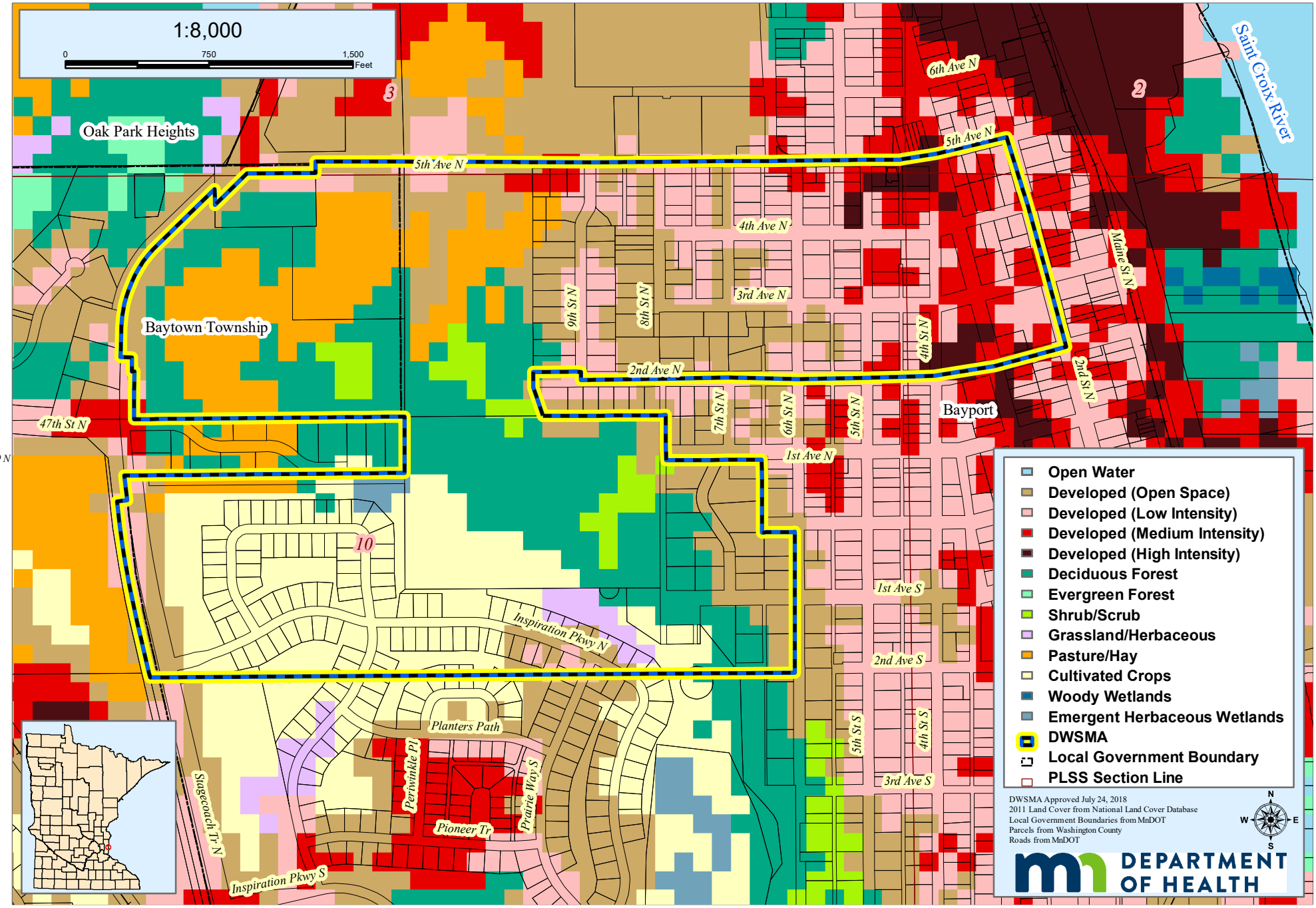
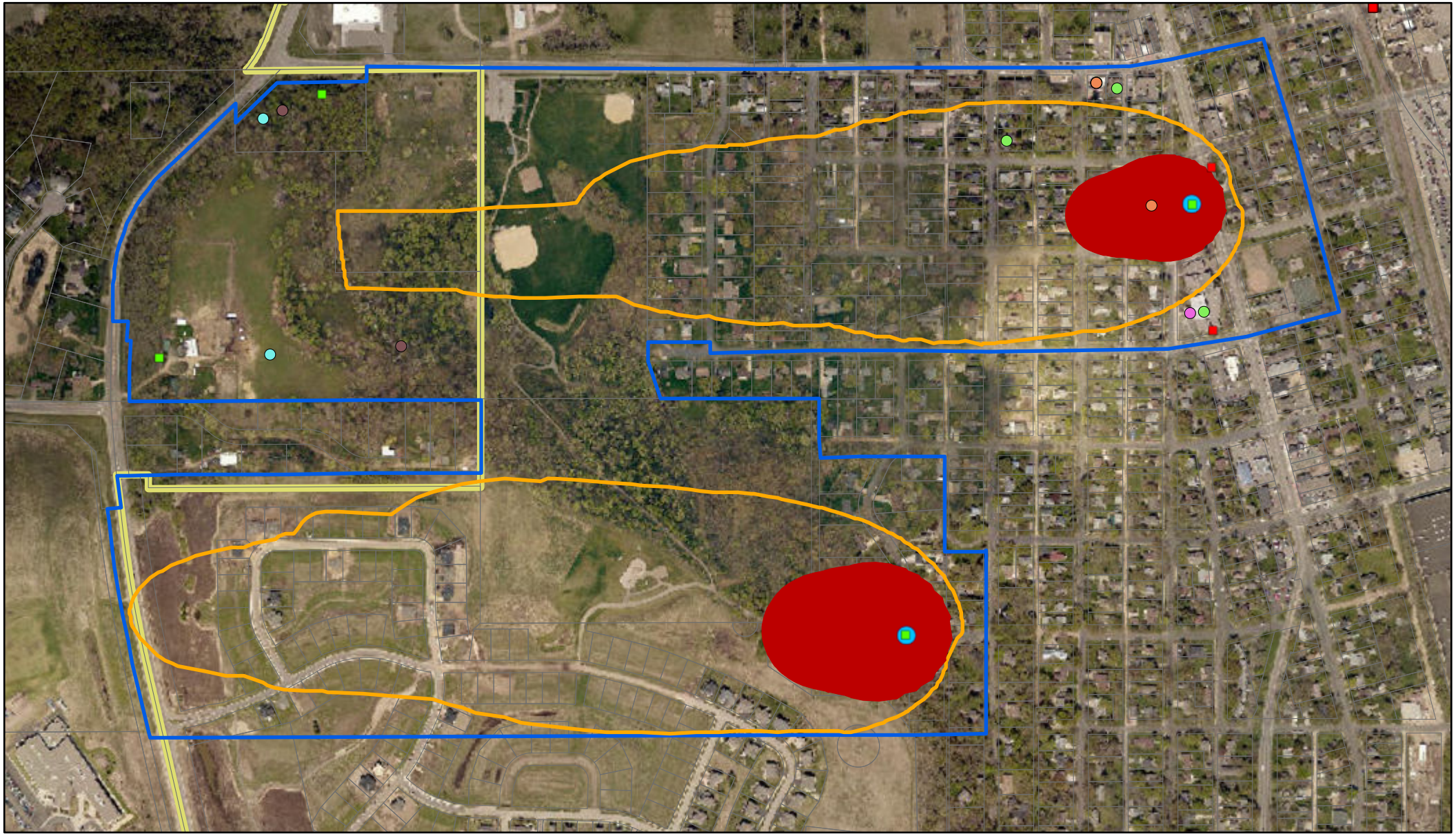


Figure 6 - Potential Contaminant Source Inventory Map



1/7/2020, 2:27:59 PM

WHP - Potential Contaminant Source Inventory 2020

- Above-ground Storage Tank
- Hazardous Waste, Small
- Leaking Underground Storage Tank
- Septic System
- Unlocated Well
- Well
- WHP - Located Wells
- WHP - Unlocated Wells
- WHP - Public Water Supply Sources
- WHP - Emergency Response Area
- WHP - Wellhead Protection Area

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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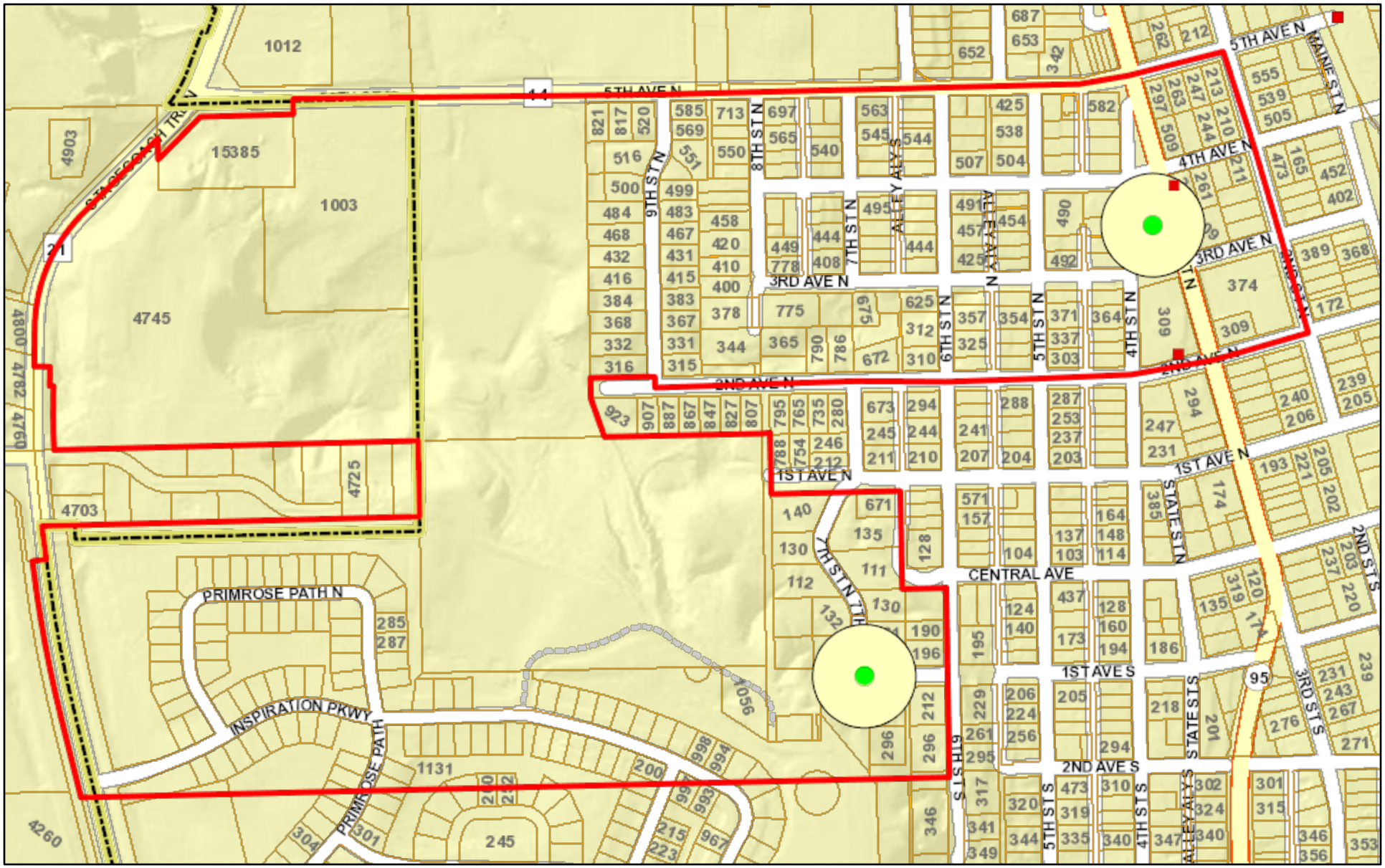
Washington County, MN, Esri Canada, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA |

Figure 7 - Inner Wellhead Management Zone Map



October 16, 2019

- Public Water Supply Sources
- Inner Wellhead Management Zone
- Drinking Water Supply Management Area
- Unlocated Wells
- City Boundary
- TaxParcel

1:6,400

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

City of Bayport, SEH, Washington County, Washington County

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Washington County | City of Bayport, SEH, Washington County |

Figure 8 - Major Transportation Corridor Map

10/16/2019, 4:18:13 PM

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,

Web AppBuilder for ArcGIS

Washington County | Washington County, MN, Esri Canada, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA |

Figure 9 - Storm Sewer System Map

May 30, 2019

1:17,090

0 0.125 0.25 0.5 mi

0 0.225 0.45 0.9 km

Storm Clean Out

Storm Other

Storm Culvert

Storm Gravity Main

Active

Abandoned

City Boundary

City of Bayport, SEH, Washington County
Washington County

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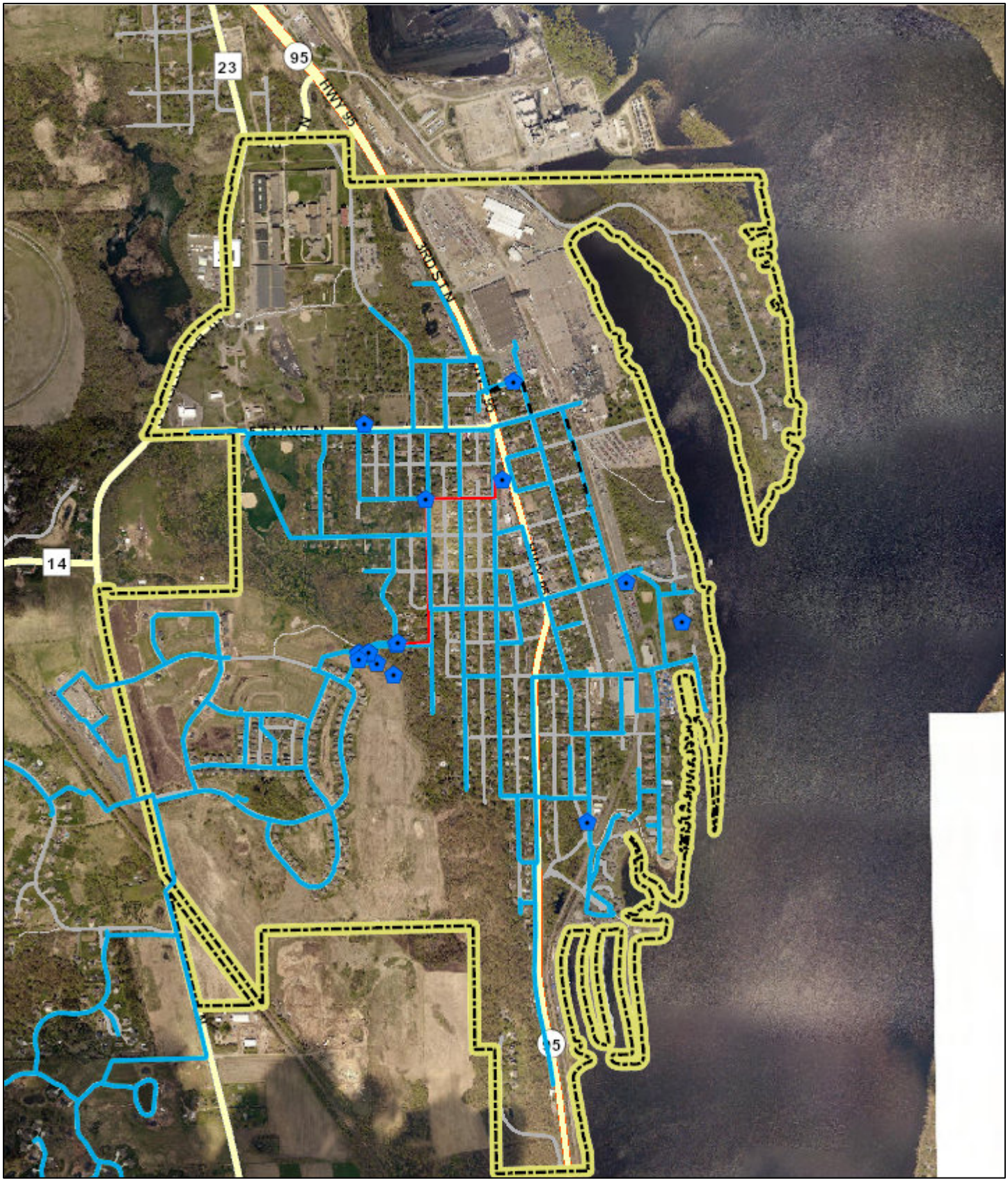
Washington County | City of Bayport, SEH, Washington County |

Figure 10 - Water System Map



May 30, 2019

1:17,090

0 0.125 0.25 0.5 mi

0 0.225 0.45 0.9 km

Water Network Structure

City Boundary

Water Main

Active

Raw Water

Abandoned

City of Bayport, SEH, Washington County
Washington County

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Washington County | City of Bayport, SEH, Washington County |

Figure 11 - Sanitary Sewer System Map

May 30, 2019

1:17,090

0 0.125 0.25 0.5 mi

0 0.225 0.45 0.9 km

Sanitary Network Structure

- Lift Station
- Dry Well

Sanitary Gravity Main

- Active
- Abandoned

- Sanitary Pressurized Main
- City Boundary

City of Bayport, SEH, Washington County
Washington County

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Washington County | City of Bayport, SEH, Washington County |

Figure 12 - Baytown Water Connections

10/18/2019, 2:47:50 PM

1:19,286

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Washington County

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Washington County | USDA FSA, DigitalGlobe, GeoEye, CNES/Airbus DS | Esri, HERE, Garmin, iPC |