Kimley»Horn

TECHNICAL MEMORANDUM

To:	Greg Johnson, PE, MCES
From:	Uma Vempati, PE, Kimley-Horn Ron Leaf, PE, Kimley-Horn
CC:	Mat Cox, PE, Kimley-Horn
Date:	April 21, 2025
Subject:	White Bear Lake Comprehensive Plan: Study No. 8 Stormwater Collection and Infiltration to Raise Groundwater Elevations (Initial Evaluation)

INTRODUCTION

The purpose of this technical memorandum is to provide an initial evaluation for collecting and infiltrating stormwater to raise groundwater elevations and augment White Bear Lake. This work is part of Metropolitan Council's (Met Council) White Bear Lake Area Comprehensive Plan Work Group efforts to ensure communities in the White Bear Lake area have access to sufficient drinking water to allow for municipal growth while ensuring the sustainability of surface and groundwater resources.

Study 8 is one of a wide range of water sustainability and conservation methods being evaluated through the Met Council work group efforts. The study is identified as an initial evaluation to reflect that it is a screening level analysis, intended to understand the potential benefits as well as the challenges, issues, and concerns associated with the approach. Depending on the results of this initial evaluation and the extent of identified potential benefits, challenges, and issues, a more detailed analysis may be completed in a second study phase if the work group decides to proceed with further evaluation.

The scope of work for this initial evaluation for Study No. 8 includes:

1. Review typical contaminants that are detected in stormwater ponds and the regulatory requirements that may not allow these contaminants to be discharged into the groundwater aquifer without adequate treatment. Review if this practice is being done or allowed in other areas of Minnesota besides small scale rain infiltration ponds.

2. Identify the potential challenges, issues, and concerns with stormwater collection and infiltration to raise groundwater elevations. Determine issues and concerns related to:
    - Stormwater pond contaminants (metals, nutrients, etc.) and practices to prevent these contaminants from entering groundwater aquifers
    - Drought conditions
    - Treating stormwater for multiple contaminants

DATA COLLECTION AND REVIEW

The following section describes the data collection and review process for existing stormwater ponds and infiltration features within a 2-mile radius of White Bear Lake. The Minnesota DNR Hydrography Dataset from the Minnesota Geospatial Commons was used as a starting point for determining the existing stormwater ponds within a 2-mile radius of White Bear Lake. Upon initial review, the dataset was found to have limited detail to identify specific stormwater features (including infiltration features).

The project team subsequently contacted two of the cities bordering the lake and the Rice Creek Watershed District (RCWD) to request available stormwater treatment facility data. RCWD had no storm treatment system feature data. Both cities provided access to their data. These datasets consisted of a mix of lake/ponds/wetland and infiltration features. The datasets were generally not coded to a level of detail to specifically identify only infiltration features, except for one of the cities for which the storm treatment features consisted entirely of rain gardens.

TYPICAL STORMWATER CONTAMINANTS

Table 1 below summarizes common stormwater pollutants, concerns and corresponding typical mitigation strategies. The Minnesota Stormwater Manual provides a more complete summary of concentrations of pollutants found in stormwater runoff for several different land uses and provides some basic information related to mobility, toxicity, potential risks to groundwater and other properties of each contaminant. The Stormwater Manual also provides some limited information on the concentrations of a small set of pollutants found within storm water ponds. Data is fairly consistent between the two datasets.

All of the pollutants found in typical storm water runoff, and therefore also in storm water treatment facilities, including infiltration systems would be either infiltrated or discharged to the drainage system through the basin overflow structure.

Table 1. Stormwater Contaminants, Concerns and Mitigation Strategies

Pollutant	Sources	Potential Concerns	Mitigation Strategies
Nutrients (N, P)	Sediment, organic debris, fertilizer, animal feces, combined sewer overflows	Low to moderate risk for N due to high mobility to groundwater, although low concentrations.	Anoxic zone for denitrification
Organic Matter	Organic debris (leaves, twigs, etc.)	Low oxygen and odors in surface waters	Infiltration
Suspended Sediment	Paved surfaces, bare soil, construction, stockpiles	Clogging intakes, increased maintenance	Sedimentation, Infiltration
Chlorides	De-icing and water softening chemicals	Corrosive to pipes, toxic to plants and fish. High groundwater risk.	No cost effective treatment
Pathogens	Animal feces, insects, sewage, waste	Risk to human health	Increase temperature, low soil Ph, finer clay soils
Metals	Vehicle exhaust, roofing materials, vehicle repair drainage	Toxic to plants and fish. Zinc poses a minor potential risk to groundwater.	Infiltration
Organic Chemicals (pesticides, petroleum chemicals)	Drainage of sources of organics	Human/animal health risk, toxic to plants and fish	Microbial degradation

REGULATORY CONSIDERATIONS FOR INFILTRATION

The primary regulatory mechanism currently in place to protect groundwater sources from negative impacts from stormwater infiltration is the NPDES Permit program administered by the Minnesota Pollution Control Agency (MPCA). Provisions in both the NPDES Construction Stormwater (CSW) General Permit and the MS4 Permit program (implemented by permitted cities and counties in this area) have requirements that address infiltration practices. Some of the local watershed organizations have parallel requirements on the requirements and prohibitions for infiltration.

Section 16 of the NPDES CSW Permit contains several specific criteria for where infiltration systems can be used and where they are prohibited from being used. Due to the extent of public and private wells in the area surrounding White Bear Lake, one of the most applicable provisions is Section 16.19, copied in the screen clip below from the CSW Permit. Section 20.9 in the MS4 General Permit has very similar language that requires MS4 permittees to implement official controls to apply these requirements and prohibitions for projects within their jurisdiction.

16.19	This permit prohibits permittees from constructing infiltration systems within a Drinking Water Supply Management Area (DWSMA) as defined in Minn. R. 4720.5100, subp. 13, if the system will be located: a. in an Emergency Response Area (ERA) within a DWSMA classified as having high or very high vulnerability as defined by the Minnesota Department of Health; or b. in an ERA within a DWSMA classified as moderate vulnerability unless a regulated MS4 Permittee performed or approved a higher level of engineering review sufficient to provide a functioning treatment system and to prevent adverse impacts to groundwater; or c. outside of an ERA within a DWSMA classified as having high or very high vulnerability, unless a regulated MS4 Permittee performed or approved a higher level of engineering review sufficient to provide a functioning treatment system and to prevent adverse impacts to groundwater.

Exhibit 1 shows the extents of DWSMA zone designations within the 2-mile boundary from White Bear Lake, as well as the distribution of wells throughout the area. Table 2 shows the portion of land area that is covered by each DWSMA zone within the area. Much of the area north and west of the lake has no specific restrictions or prohibitions on infiltration of stormwater. In the southern and eastern portions of the 2-mile boundary surrounding the lake there is a mix of high and medium vulnerability areas. The areas designated as high vulnerability account for roughly 20% of the area within the 2-mile boundary.

Table 2. DWSMAs in the 2-Mile Boundary

DWSMA Vulnerability Category	Surface Area (Acres)	Portion of 2-Mile Boundary
None	11,245	51%
Low	823	4%
Moderate	5,537	25%
High	4,382	20%
Very High	0.0	0%
Emergency Response Area	0.0	0%
Totals	**21,987**	**100.0%**

1. Surface area values include area of White Bear Lake.

Infiltration in the areas designated as high vulnerability would require a higher level of engineering review as defined by the local permitting authority. Typical higher-level reviews may include a closer look at the potential pollutants that may be present in the contributing drainage area (gas stations, industrial facilities, etc.) as well as looking at the travel time between the basin and any sensitive receptors (i.e., individual wells in the area).

Other groundwater protection measures in place in Minnesota include:

- Minnesota has a Groundwater Protection Rule, which is based on the Minnesota Nitrogen Fertilizer Management Plan, that outlines the state strategy for preventing contamination and responding to elevated nitrate from fertilizer in groundwater. This rule would not apply to the infiltration of stormwater.
- Class V injection wells are regulated by the US EPA Region 5 UIC in Minnesota. Regulations apply to large capacity cesspools and motor vehicle waste disposal wells in Wellhead Protection Areas. Large capacity septic systems also require an inventory and permitting process. Based on our experience designing and permitting infiltration systems for decades this regulation has generally not applied to the typical stormwater features that would be used for infiltration.

Overall, the requirements and regulations applicable to infiltrating stormwater in Minnesota are fairly consistent. While new development and redevelopment projects (including linear projects) are the major triggers for constructing new infiltration facilities, some watershed organizations and local governments also pursue and implement stand-alone facilities. While the construction of these facilities may contribute to groundwater recharge, the primary intent of the facilities is to treat stormwater and little to no efforts are made through the permitting processes to quantify the benefits of groundwater recharge. Exhibit 2 shows the distribution of hydrologic soil groups (HSG) throughout the study area, with an estimated 28% being classified as the total HSG A and B soils, which are highly suitable for infiltration. An additional 40% of the area is classified as “Other”, which is generally urban land that was not specifically classified. A portion of this area may also be suitable for infiltration.

Beyond using infiltration facilities for stormwater treatment function, we are aware of only one other project area in Minnesota that is currently evaluating infiltration options with the primary intent to recharge groundwater. The DNR is working on a water use conflict project in central Minnesota that is exploring options that would import groundwater from outside the zone of influence of a stream system and infiltrate that water through surface impoundments or underground drain fields back into the groundwater.

CHALLENGES, ISSUES, AND CONCERNS

There are number of potential challenges associated with infiltrating stormwater to an extent where the approach could have a positive impact on raising groundwater elevations. The following sections present a few of the more significant challenges.

STORMWATER POND CONTAMINANTS

Typical contaminants were presented in Table 1. In general, there are no major issues with infiltrating stormwater, provided the review and design process follows established criteria and regulations to minimize the transport of stormwater pollutants into the groundwater.

The benefits of infiltration over pumping stored stormwater are that particulate pollutants including metals and suspended solids are generally removed through the process of infiltration. Dissolved pollutants are

not easily removed directly through infiltration and may be able to reach the groundwater table. Although some dissolved pollutants are removed through natural attenuation as they move through the sub-surface, other mitigation strategies may be needed to effectively treat stormwater before reaching groundwater, depending on the specific pollutant and expect concentrations. The NPDES CSW includes a provision that requires pretreatment of runoff to the maximum extent practicable prior to routing stormwater to an infiltration system. Pre-treatment through stormwater wet ponds is often used to treat such pollutants. In addition to wet ponds, typical pretreatment systems include vegetated filter strips, sediment forebays, sump manholes with baffle plates and a variety of proprietary structural manhole devices. Underlaying soil conditions below the infiltration basin also have a large effect on the transport of pollutants and removal capacity prior to reaching groundwater sources.

DROUGHT CONDITION CONSIDERATIONS

Similar to the discussion in the Technical Memorandum for Study 1, there is no additional water falling on the ground that could be infiltrated or otherwise contribute surface runoff to the lake within the surface watershed drainage boundary of Rice Creek Watershed District. Outside of the surface drainage boundary, much of the surrounding areas already contribute infiltrated water to the northeast metro area regional groundwater system.

During drought conditions there are no significant challenges with infiltration systems, except during the initial plant establishment period. In severe drought conditions, the effectiveness of infiltration systems may be further reduced as the initial rainfall events would first need to restore the soil profile to field capacity before the excess stormwater volume would begin to infiltrate. The need for additional infiltration of stormwater to recharge the aquifer and help maintain elevations in White Bear Lake would likely be at its greatest during drought conditions when less stormwater would be available around the lake to infiltrate into the aquifer. Therefore, drought conditions could have a significant impact on the rates of stormwater infiltration that would be needed to raise groundwater elevations during these conditions.

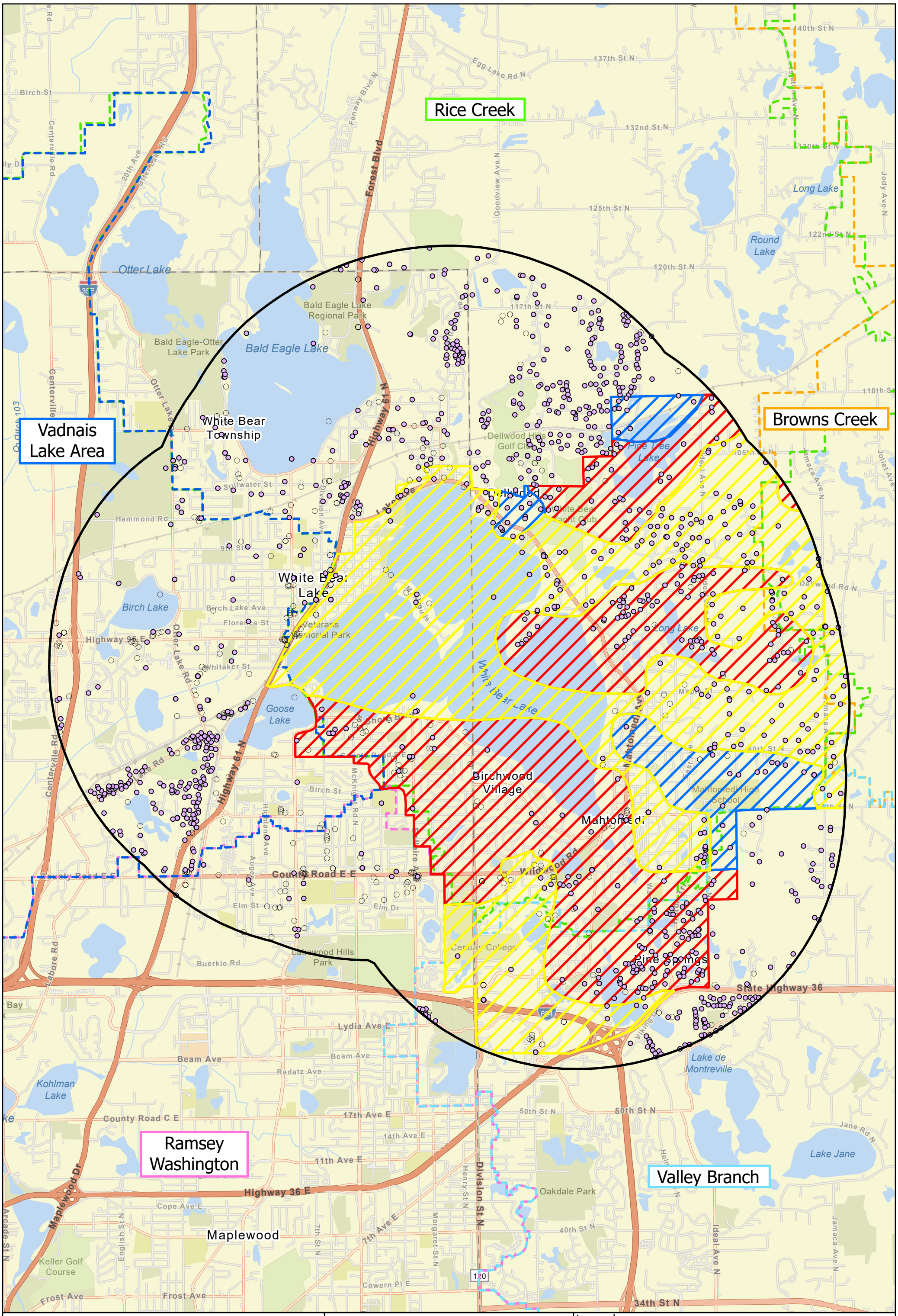
TREATING FOR MULTIPLE CONTAMINANTS

Overall, infiltration systems treat the range of contaminants found in stormwater very well. Two exceptions as noted in the Minnesota Stormwater Manual and summarized in Table 1 are chlorides and zinc. Zinc is generally found at lower levels in stormwater and represents a minor risk to groundwater. Chlorides are typically found in stormwater in winter and early spring from the use of road salt and deicing solutions. Best management practices for reducing chlorides in stormwater centers around reduction in use of road salt and proper storage to limit contamination.

CONCLUSIONS

The combination of current regulations and related to infiltration system and extent of soil conditions throughout the surrounding area pose no major issues or challenges toward additional infiltration practices being implemented in the area to help recharge groundwater. However, quantifying the benefits of creating new infiltration systems focused on recharging groundwater levels appears to be substantial challenge, especially considering that the rainfall that falls on much of the surrounding area is already contributing to the lake via surface water conveyances or through infiltration to the groundwater. In addition, drought conditions could have a significant impact on stormwater infiltration rates that would be needed to raise groundwater elevations to provide additional supply capacity for groundwater wells and help maintain water elevations in White Bear Lake.

Exhibits:



N

0 0.38 0.75 1.5 Miles

Metropolitan Council, MetroGIS, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/ NASA, USGS, EPA, NPS, USDA, USFWS

EXHIBIT 1

Study 8 - DWSMAs in the White Bear Lake Area

4/17/2025

Legend

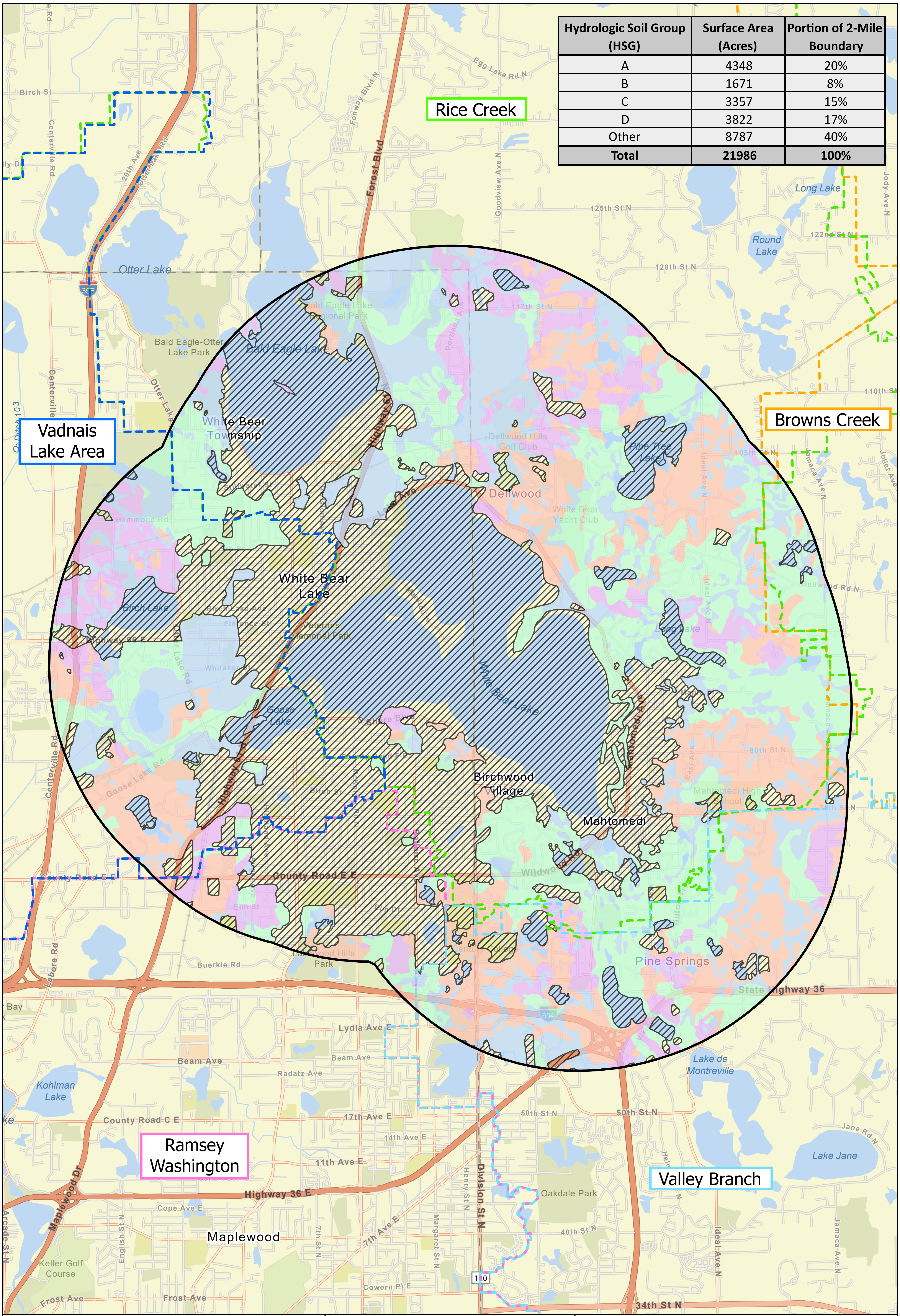
- 2-mile Boundary
- Inactive Well
- Active Well

DWSMA Risk Level

- High
- Low
- Moderate

Watershed Districts

- Browns Creek
- Ramsey-Washington
- Rice Creek
- Vadnais Lake Area
- Valley Branch



Hydrologic Soil Group (HSG)	Surface Area (Acres)	Portion of 2-Mile Boundary
A	4348	20%
B	1671	8%
C	3357	15%
D	3822	17%
Other	8787	40%
Total	**21986**	**100%**

N

0 0.38 0.75 1.5 Miles

Metropolitan Council, MetroGIS, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS

EXHIBIT 1

Study 8 - Hydrologic Soil Group in the White Bear Lake Area

4/17/2025

Legend

- 2-mile Boundary

HSG

- A
- B
- C
- D
- Other

Watershed Districts

- Browns Creek
- Ramsey-Washington
- Rice Creek
- Vadnais Lake Area
- Valley Branch