

DNR Analysis: Current Groundwater Use Is Sustainable But Does Affect White Bear Lake

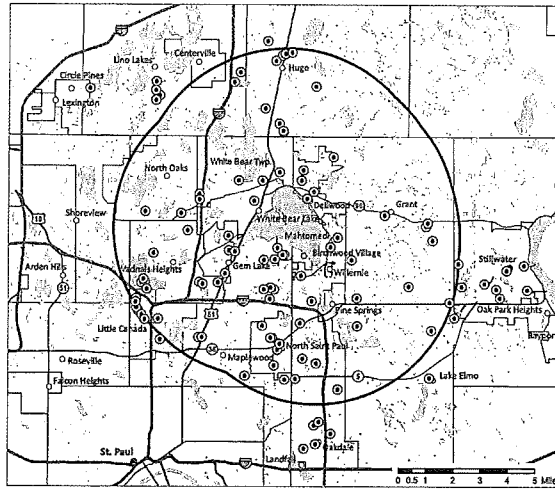
WHY WE'RE PUBLISHING THIS

Water levels in White Bear Lake have been the subject of public debate for over a century, with people thinking they are sometimes too high and sometimes too low. Most recently, a 2012 lawsuit by the White Bear Lake Restoration Association and White Bear Lake Homeowners Association charged that the Minnesota Department of Natural Resources (DNR) was allowing communities and businesses in the area to use too much groundwater, leading to unacceptably low lake levels that harmed White Bear Lake and violated Minnesota's water sustainability standard. In August 2017, the Ramsey County District Court ruled in favor of the associations and ordered DNR to make several modifications to existing permits and conduct additional analysis to determine whether further changes are needed. This publication presents the results of that analysis in a public newspaper, as required by the court.

Figure 1 shows the long-term water level record for White Bear Lake. The fact that water levels on White Bear have fluctuated considerably over time is well-established, as is the fact that the lake is connected to its underlying aquifers. What has been less clear is the relative impact of groundwater use on lake levels, compared with precipitation and evaporation. Building on previous work by the US Geological Survey and a nationally recognized groundwater modeling firm, DNR has developed a new groundwater flow model, completed in August 2018, that allows us to distinguish weather effects from groundwater use and helps us understand the impact of individual permits. To develop the model, DNR consulted other agencies and experts, and used the best available data on water use, precipitation, and evaporation.

KEY FINDINGS

Using a state-of-the-science groundwater flow model and the best available data, DNR's major



Community served by public supply wells within buffer Water
 Analyzed permit installations White Bear Lake 5-mile buffer

Figure 2. This map shows the approximate location of the permits that were included for this analysis, along with the 5-mile radius around White Bear Lake. The yellow areas indicate the communities that are served by water supplies with at least one well within the five-mile radius and that are thus subject to the court's order. Unshaded areas either do not have public water supply wells or the wells are located entirely outside of the 5-mile radius.

findings from its analysis of permits that include wells within 5-miles of White Bear Lake (Figure 2) are:

1. Groundwater use has been declining (Figure 3)
2. Current groundwater use complies with Minnesota's sustainability standard (see inset at top of next page)
3. Current groundwater use has contributed to water levels falling below the recently established protective elevation for White Bear Lake (established in 2016 to protect recreational uses)
4. Temporary irrigation bans within nearby cities would not have a significant effect on water levels in White Bear Lake

What we analyzed

The Ramsey County District Court ordered DNR to review all existing groundwater appropriation permits within five miles of White Bear Lake, both individually and cumulatively, to ensure they meet the state sustainability standard (see inset at top of next page). The court also ordered DNR to assess the sustainability of an unprecedented scenario in which all of the permittees within 5-miles of White Bear Lake pump at their maximum permitted rates. Groundwater is used to supply drinking water—as well as water for businesses, irrigation, and other uses—in the five-mile area.

To conduct this analysis, DNR established a 5-mile radius around White Bear Lake and identified 44 groundwater permits within that area (Figure 2). It is important to note that communities often have multiple wells under a single groundwater appropriation permit. For purposes of this analysis, if a community had wells both within and outside the 5-mile radius, DNR considered all of their wells and their total water use in this analysis. Approximately 500,000 people are served by community water supplies subject to the court's order. See Figure 2 for a depiction of the communities affected and approximate location of all permits that were analyzed. Further details regarding how we conducted our analysis are provided in the Analysis section.

Where to go for more information

This publication summarizes DNR's analysis and findings at a high level. Additional information on our groundwater flow model and our full technical analysis are available at:

www.mndnr.gov/gwmp/wbl/index.html

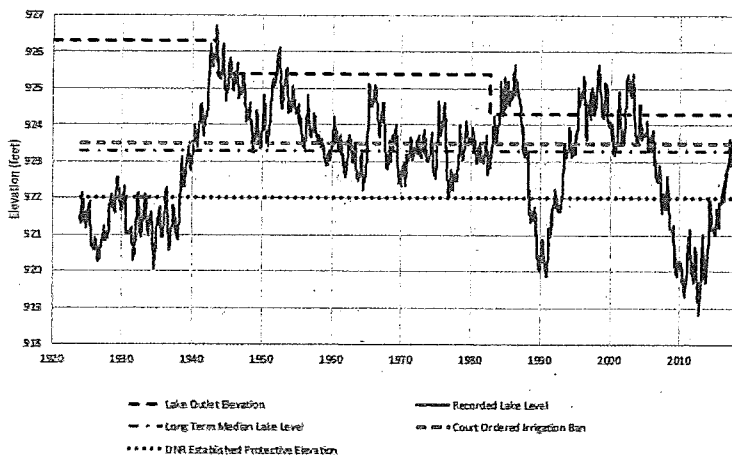


Figure 1. This graph illustrates that water levels have fluctuated widely in White Bear Lake over the last ninety years. The graph also shows historic lake levels relative to several key elevations, including the lake's outlet, which has varied over time and is currently 924.3 feet; the long-term median lake level of 923.3 feet; the court's residential irrigation ban trigger of 923.5 feet; and the protective elevation of 922.0 feet that DNR established in 2016.

Minnesota Statute 103G.287, Subd. 5. Sustainability standard.

The commissioner [of the DNR] may issue water-use permits for appropriation from groundwater only if the commissioner determines that the groundwater use is sustainable to supply the needs of future generations and the proposed use will not harm ecosystems, degrade water, or reduce water levels beyond the reach of public water supply and private domestic wells constructed according to Minnesota Rules, chapter 4725.

ANALYSIS SUPPORTING OUR FINDINGS

To comply with the court order, DNR analyzed three groundwater use scenarios, using the groundwater flow model to predict aquifer and lake levels resulting from changes in groundwater use when other factors (precipitation and evaporation) are held constant. To make our modeling as real world as possible, we applied each scenario to actual conditions beginning in 1988, allowing us to capture both wet and dry periods and compare model results with actual observed lake levels over the same period. However, because of lag times between changes in groundwater use and impacts to White Bear Lake, the model requires a "warm-up" period. For the timeframe we modeled, the long-term impacts of the three scenarios we modeled are most clearly evident from 2002 forward.

The three scenarios modeled are:

- **No Groundwater Use** - no permitted groundwater use in the area starting in 1988. This scenario provides a reference for comparison.
- **Existing Groundwater Use** - all reported use within five miles of White Bear Lake during the last ten years, projected back to 1988. The total amount of groundwater used over the past ten years is less than the amount used in the 1980s and 1990s. This decrease is reflected in the projected water levels (Figure 4 next page), and better allows us to assess the sustainability of current use.
- **Maximum Groundwater Use** - this scenario considered all permits as using the absolute maximum allowable groundwater from 1988 forward. This has never actually happened and is not expected to occur, but is something the court directed DNR to evaluate.

The analysis evaluated all of the permits both individually and collectively under these three scenarios. Figure 4 illustrates the results of lake level modeling under these scenarios.

Sustainability Criteria

DNR's analysis indicates that groundwater use in the area meets the state sustainability standard (see inset at the top of this page). Specifically this means:

- Groundwater use does not harm the White Bear Lake ecosystem
- Groundwater use does not jeopardize groundwater supplies for future generations or adversely impact private domestic wells

- Groundwater use does not degrade water quality in White Bear Lake

Note that Minnesota's sustainability standard does not address recreational use. However, DNR has established a protective elevation based on recreational use considerations, which is discussed separately in this publication.

- Groundwater Use does not Harm the White Bear Lake Ecosystem

Under all of the scenarios considered, the groundwater use does not harm the White Bear Lake ecosystem. Each scenario results in different water levels that fluctuate to varying degrees, which creates changes in the types and abundance of aquatic vegetation, a key measure of ecosystem health. However, those changes do not cross thresholds that would result in a degraded biological community.

According to the model, in the "No Groundwater Use" scenario, water levels in the lake would have been higher than the observed water levels over the past 15 years (Figure 4). Sustained high water levels in the lake would have reduced the overall amount of near shore area that supports emergent plants (e.g. bulrush) compared to other scenarios, with minimal change in the amount of submerged vegetation.

In the "Existing Groundwater Use" scenario, water levels would have been up to about one foot or more higher on average than observed water levels (Figure 4). Water levels would still have declined during periods of less than normal rainfall. Periodic lower water levels do, however, benefit the lake ecosystem because of increased emergent plant growth near the shoreline. Periodic exposure during low water is needed to germinate some types of plant seeds. These plants help reduce shoreline erosion and provide important fish and wildlife habitat, especially when water levels rise, as they have in recent years.

In the "Maximum Groundwater Use" scenario, water levels in the lake would have been lower than the observed water levels (Figure 4). Lower water levels would increase emergent vegetation in the nearshore area, while decreasing the areal extent of submerged aquatic vegetation. However, the decrease in submerged vegetation would be less than the amount allowed under Minnesota law.

- Groundwater use does not jeopardize groundwater supplies or impact private domestic wells

According to the model, water levels in each of the groundwater use scenarios would be more than adequate to reliably pump groundwater over many years, known as safe yield. This means that groundwater supplies for future generations would not be jeopardized. Given these modeled aquifer levels and past experience, we also don't anticipate problems with domestic wells under any of the scenarios.

- Groundwater use does not degrade water quality

Based on past water levels and measurements of water clarity and phosphorous, there are no discernible impacts on water quality from the groundwater use simulated in these scenarios.

Individual Permits

Because the existing groundwater use permits do not cumulatively violate the state's sustainability standard, it follows that none of them individually violate the standard. However, groundwater use does demonstrably affect lake levels, and DNR's groundwater flow model allows us to better understand the relative impact of individual permits on lake levels. Key factors determining an individual permit's impact on White Bear Lake include distance of the well(s) from the lake and the volume of water used. Of the 44 permits analyzed, permits held by these ten entities contribute most substantially to the water level impacts.

- White Bear Lake
- White Bear Township
- Mahtomedi
- Vadnais Heights
- Oakdale
- North St. Paul
- Saputo Dairy Foods
- Hugo
- Stillwater
- Lino Lakes

Again, it is important to underscore that none of these permits is violating the state's sustainability standard. However, to the extent that adjustments may be warranted to support recreational uses (see Protective Elevation discussion), these permits would have the greatest impact.

DNR Analysis continued on next page

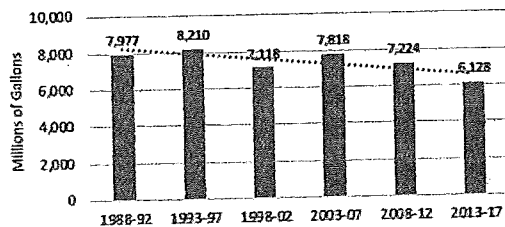


Figure 3. This graph illustrates that groundwater use has been declining over the last ten years. Annual average use was calculated in 5-year increments, beginning in 1988, which marks the start of consistent use reporting. The volume of water includes wells that are outside of the 5 mile radius when a community has wells both inside and outside of the radius.

DNR Analysis continued

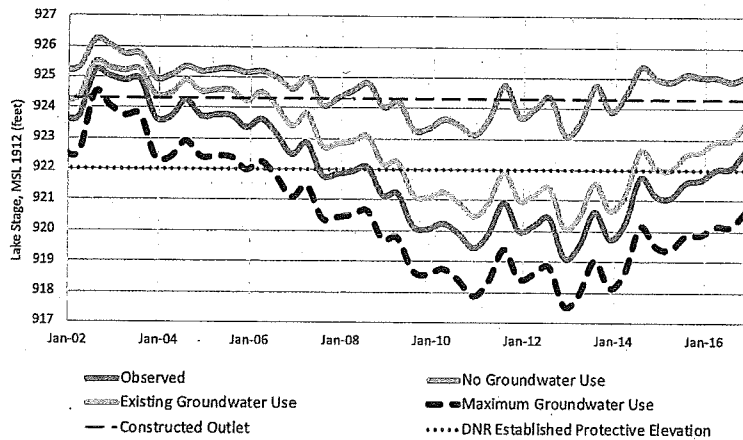


Figure 4. This graph is one of the key outputs from the groundwater flow model and illustrates the predicted water levels for White Bear Lake under different groundwater use scenarios within the 5-mile radius of the lake. The lines have the same general shape, because water level fluctuations are driven primarily by rainfall and evaporation. However the differences among the lines reflect the relative impact of different levels of groundwater use on lake levels.

GROUNDWATER USE AND THE WHITE BEAR LAKE PROTECTIVE ELEVATION

In 2016, DNR established a protective elevation of 922.0 feet for White Bear Lake. State law provides for setting protective elevations for lakes that are subject to direct surface water appropriations, with the goal of limiting (not eliminating) adverse impacts to the lake from the appropriation. The protective elevation established for White Bear Lake was the first time DNR developed a protective elevation to help manage groundwater, rather than surface water, appropriations.

In setting the protective elevation for White Bear Lake, DNR considered multiple factors, including the lake's historic range, aquatic vegetation, fisheries, water quality, recreational uses, and the area and slope of the lakebed.

We determined that there were no permanent adverse impacts to the lake ecosystem or water quality associated with temporary declines to the lower end of White Bear Lake's historic range. Indeed, there are demonstrable ecosystem benefits to variable lake levels, and declines to the lower end of the range provide an important ecological reset for aquatic vegetation, which in turn supports fish and other organisms.

However, our review of all available information also demonstrated that there were adverse impacts to recreational uses associated with lower lake levels. These adverse impacts included things like dock extensions, the closure of Ramsey County Beach, increased requests to control Eurasian milfoil, reduced access at public ramps and private marinas, and limitations on shore fishing.

In seeking to balance the ecosystem benefits and negative recreational impacts of lake levels at the lower end of White Bear Lake's historic range, DNR established the 922.0 feet protective elevation. The protective elevation is not a fixed level that is maintained, or a minimum level that is guaranteed. Rather, it is a level at or before which DNR will work with permit holders to modify their water use in

order to reduce the likelihood that the lake will fall below the protective elevation for an extended period of time. This does not mean that DNR will shut-off drinking water in order to protect recreational uses of the lake. But it does mean that we will implement reasonable, science-based permit adjustments to support the protective elevation.

Our analysis indicates that water levels under the "Existing Groundwater Use" scenario would have fallen below the lake's protective elevation in 6 of the last 15 years (Figure 4). Observed lake levels fell below the protective elevation in 10 of the last 15 years. The difference between the two scenarios, relative to the protective elevation, is because current groundwater use is lower than historic use and the model applies that change starting in 1988.

The "Maximum Groundwater Use" scenario would result in falling below the protective elevation both more frequently and by a wider margin than the observed lake levels over this same time period. However, as stated previously, pumping at the maximum rate by all permitted users is an unprecedented and unrealistic scenario. The insights gained from this scenario are not particularly useful in managing groundwater appropriation permits.

Importantly, the groundwater flow model provides a new tool in applying the protective elevation. It allows us to calculate the amount of water that can be pumped without causing lake levels to fall below the protective elevation under normal weather conditions. (The protective elevation is not intended to ensure that the lake will not fall below 922.0 under prolonged drought.) It also allows us to identify which permits are having the greatest impacts on lake levels and focus our efforts to implement the protective elevation on those permits.

TEMPORARY IRRIGATION BAN WOULD RESULT IN LITTLE CHANGE TO WATER LEVELS

DNR also simulated how a temporary irrigation ban would affect lake levels. Specifically, we

attempted to model the Ramsey County District Court's ban on residential irrigation when water levels drop below 923.5 feet. To do this we used the "Existing Groundwater Use" scenario and subtracted the estimated volume of water attributable to residential irrigation when the ban would have been in effect between 2002 and 2016. Under this approach, the residential irrigation ban was modeled beginning in 2007, when the existing groundwater use scenario dropped below 923.5 feet, and continued through 2016 as lake levels had not yet reached the court's established level of 924.0 feet for lifting the ban. The model indicates that the irrigation ban would have increased lake levels by about 4.5 inches after ten years. A ban of shorter duration would have less of an impact on lake levels.

The two main reasons for this modest change in lake level have to do with the amount of water pumped and the distance of that pumping from the lake. The communities with wells closest to White Bear Lake use a relatively small amount of water for irrigation, and the communities with higher summer water use are located many miles away from the lake. The model clearly shows it takes many years for pumping effects to fully reach the lake.

The model does demonstrate that permanent and long-term water conservation does benefit lake levels. Temporary restrictions can be extremely important for suppliers to manage peak demand and community water supplies. However, the court's temporary residential irrigation bans would not result in substantial changes to water levels on White Bear Lake.

WHAT'S NEXT

DNR is appealing the Ramsey County District Court's ruling, based on the court's assessment of the science, interpretation of state law, and application of that law to the specific facts of the White Bear Lake case. That matter is pending before the Minnesota Court of Appeals. A ruling in our appeal is not expected until the first half of 2019.

Despite the pending appeal, DNR has continued to work hard to improve our collective understanding of the very complex relationship between groundwater use and water levels on White Bear Lake. Our new groundwater flow model represents a significant advancement of the science and is one of the most sophisticated models available anywhere in the United States for conducting this kind of analysis. Using this new tool, we are committed to working with local communities, businesses and residents to make carefully targeted, well-informed modifications to water use in the area.

DNR's work has been, and must continue to be, informed by the best available science. That science does change and evolve. Based on our analysis, DNR has concluded that existing groundwater use meets Minnesota's sustainability standards, but also contributes to the frequency and degree to which White Bear Lake may fall below the protective elevation that supports recreational uses of the lake. We have initiated discussions with the affected community water suppliers regarding these findings and will be working with them to explore conservation options and alternative water sources that can help ensure White Bear Lake remains a prized recreational asset for area residents and all Minnesotans.