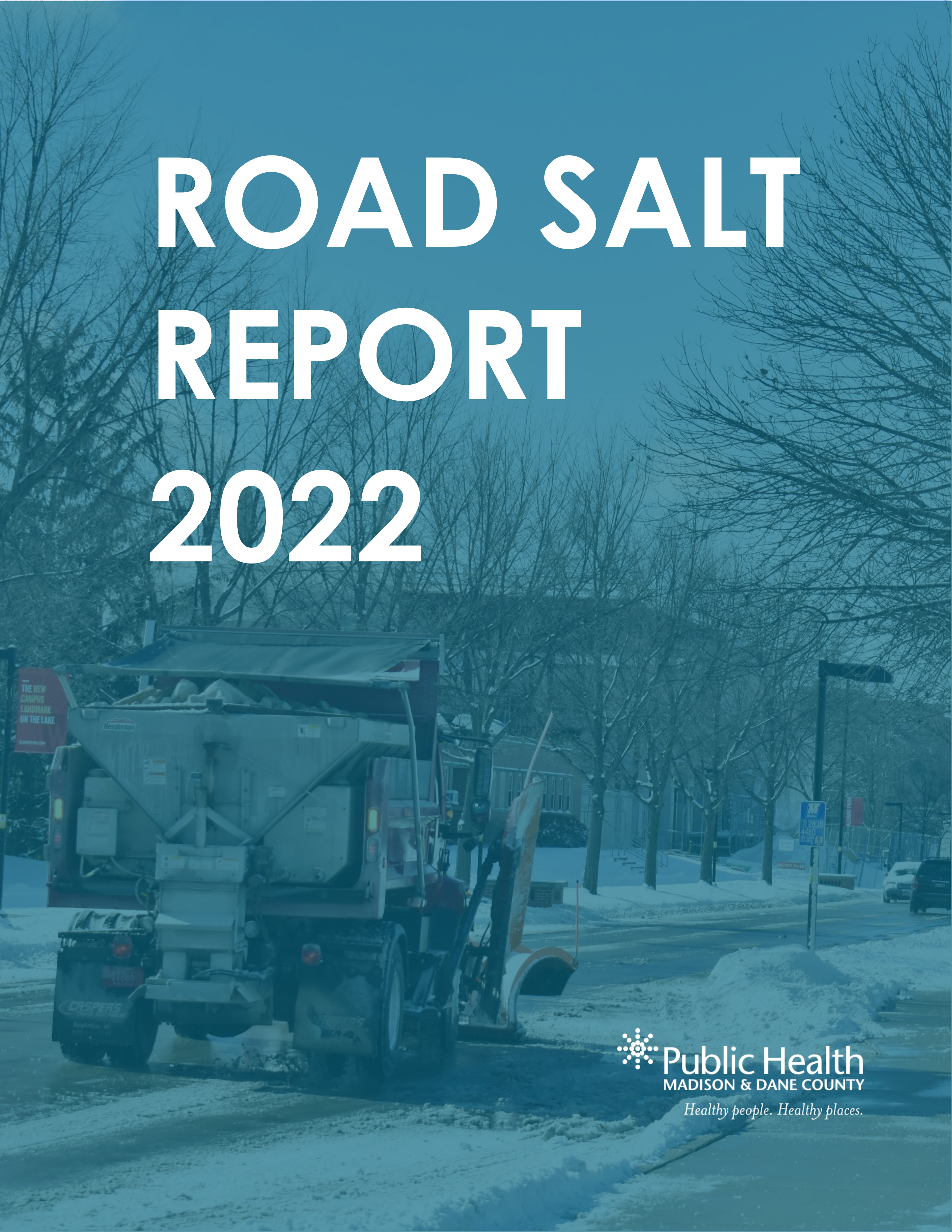
ROAD SALT REPORT 2022



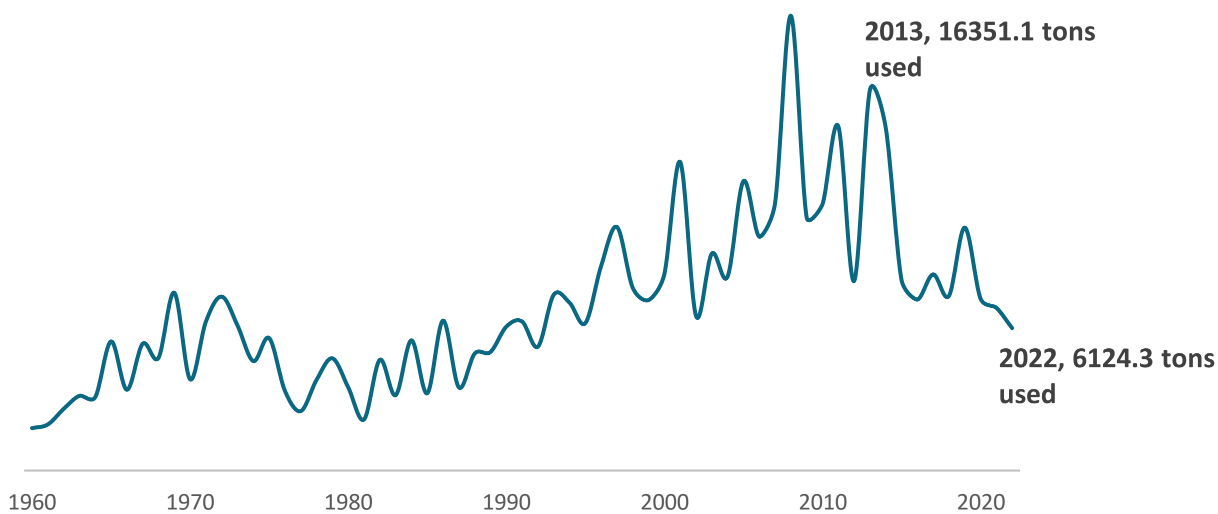
Public Health
MADISON & DANE COUNTY
Healthy people. Healthy places.

KEY TAKEAWAYS

Madison's salt use has decreased

Total annual road salt use has been reduced since 2015 (see graph below). Relatively mild winters have played a role, but the Streets Department has also taken advantage of changes in traffic patterns due to COVID. Salt routes serving schools were eliminated during virtual classes. Even though per-mile application rates increased, the reduction in service resulted in a decrease in total salt use.

The number of tons of salt the City of Madison uses has decreased in the past decade.



Source: City of Madison Streets Division. Data from 1960-2022.

Chloride levels are still rising in our lakes

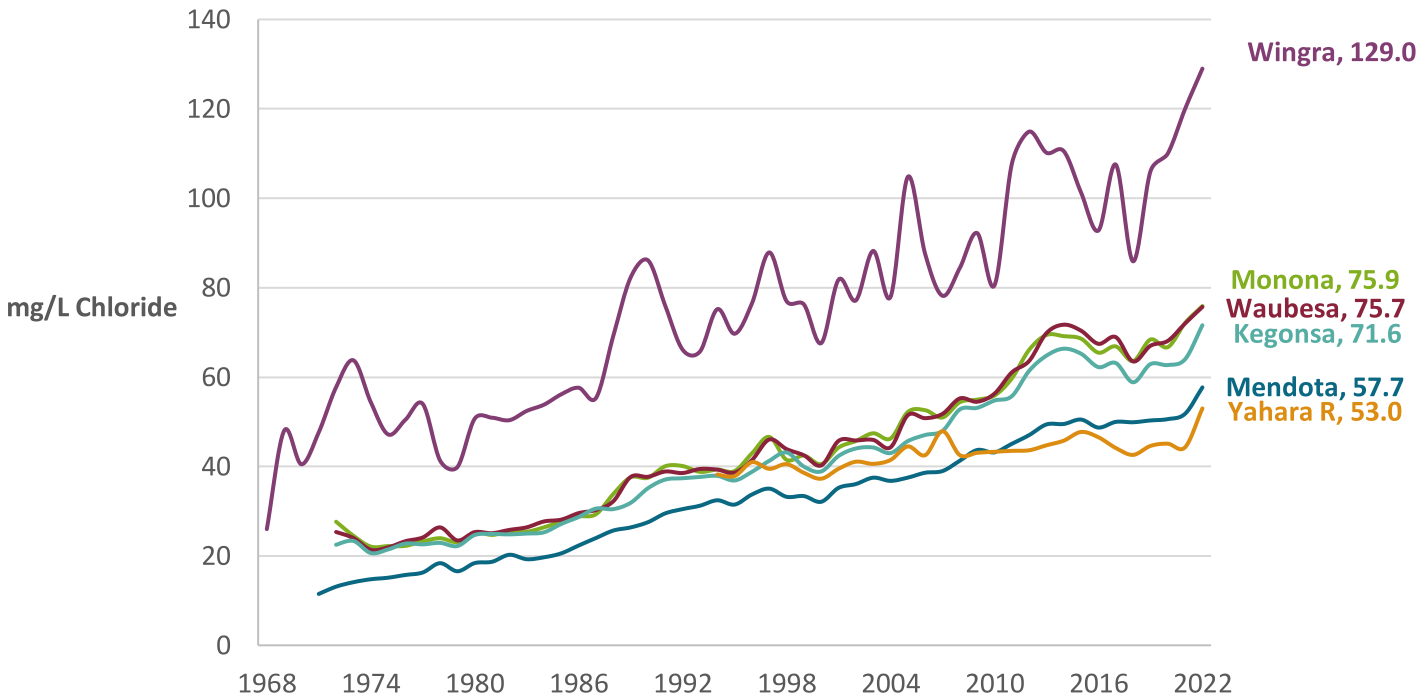
Average road salt use over the past three years is 25% lower than the previous three years, and 20% lower than the long-term average. However, lake chloride concentrations show Lake Wingra chloride has increased by 17%, while the other Yahara lakes have all increased by about 7% (see graph below).

Chloride levels are still rising because chloride does not easily leave lakes. The salt that we used in the past leaves a legacy; it sticks around, continuing to affect our water. So, even with less salt being used, we continue to see chloride levels rise in our lakes.

Weather also plays a role. Lake chloride concentrations rise during hot, dry summers as lake water evaporates and there is less rainfall to dilute the water. During extended periods of dry weather, Lake Wingra receives flow from the Nakoma Road and Big Springs with a high chloride concentration, which makes Lake Wingra more affected by fluctuating weather.

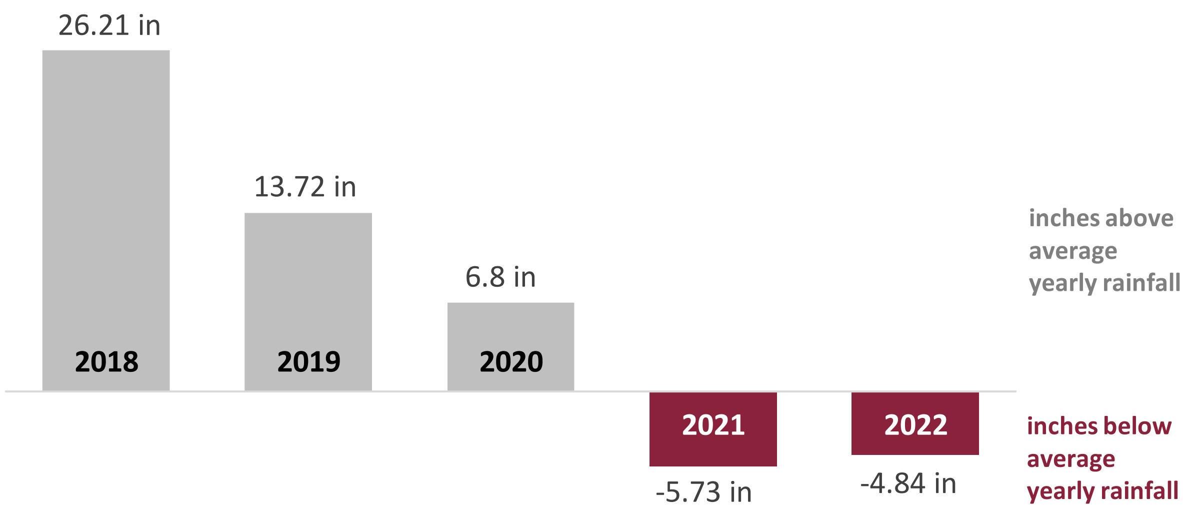
It is important to remember that aside from Madison, there are eight townships, two villages, three cities, Dane County, and a multitude of private applicators contributing chloride to the watershed. Although most agencies strive to minimize salt use to reduce cost, priorities and application rates vary.

Lake and river chloride concentrations have gradually increased for decades.



Source: Public Health Madison & Dane County monthly monitoring data

In 2021 and 2022, Madison received **several less inches of rainwater** than average.



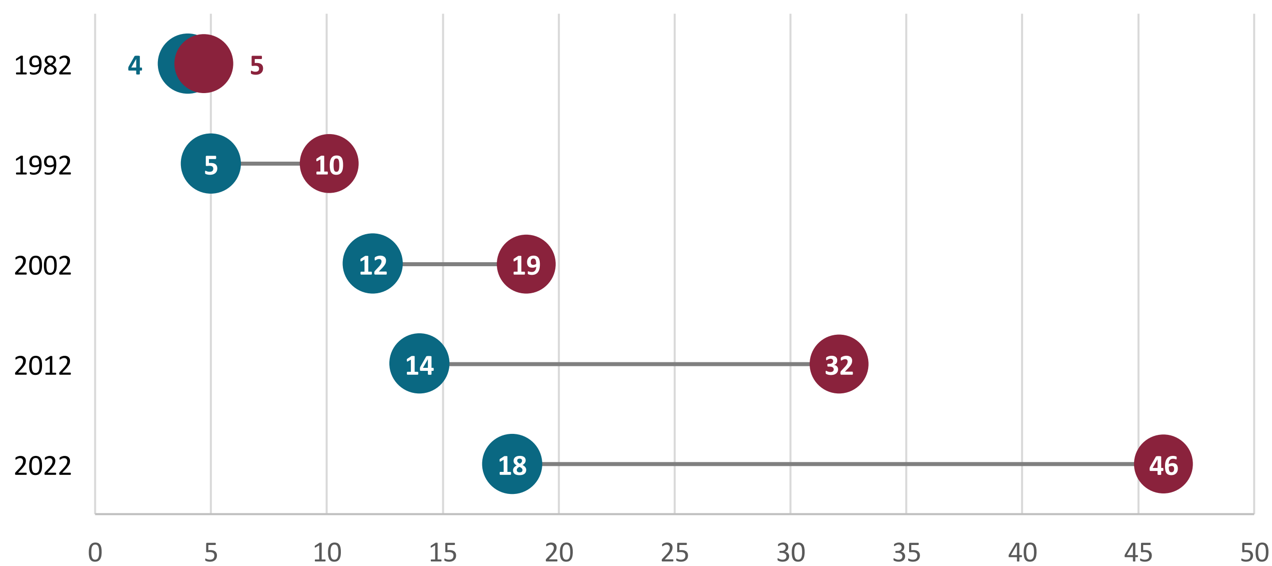
Source: National Oceanic and Atmospheric Administration

Road salt profoundly affects small surface waters. Our chloride monitoring has documented acutely toxic levels in several small urban waterways. The sampling protocol we use captures base flow contaminant concentrations, not peak levels, so maximum chloride concentrations may be even higher. These waters are also likely receiving other inputs (chemicals) that affect their water quality as well.

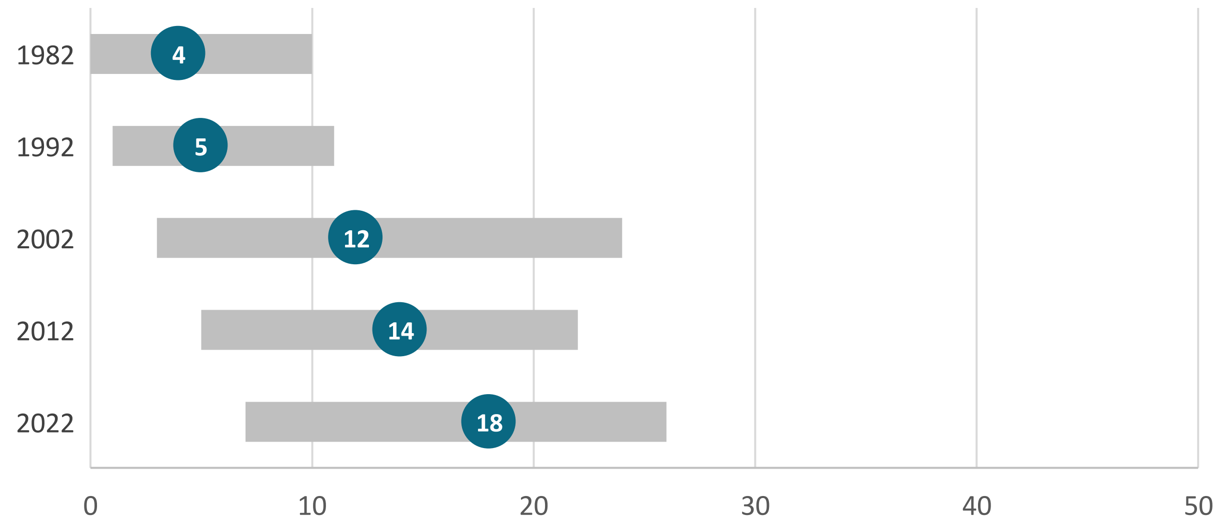
Chloride levels in Madison wells continue to increase

In addition to impacting surface waters, road salt applications also contaminate groundwater. Shallow groundwater is affected first, and this is reflected in the chloride levels in Madison's drinking water. Chloride levels continue to increase in some City wells that draw water from both the upper and lower aquifers, especially those near main thoroughfares. The figure below compares past chloride concentrations in deeply cased wells, which draw water from the lower aquifer, and wells with short casings, which draw water from both the upper and lower aquifers.

Median chloride levels (mg/l) have increased more in **upper & lower aquifer wells** than in **lower aquifer wells**.

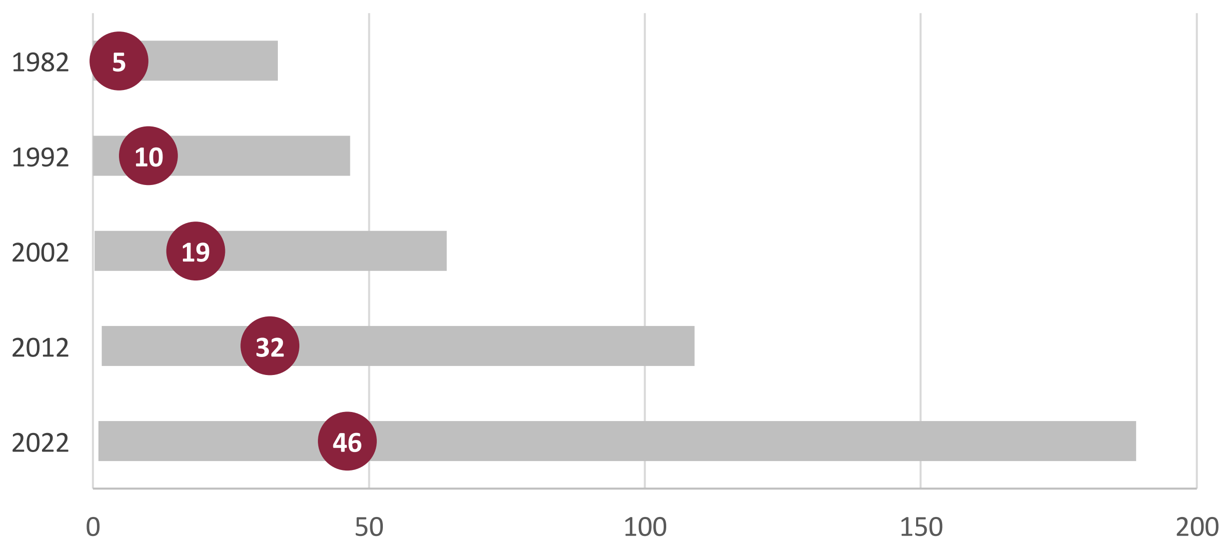


Chloride levels in **lower aquifer wells** have increased slightly, with a fairly narrow **range of results.**



Cloride levels (mg/l) in **upper & lower aquifer wells** have increased more, with **a broader range of results.**

Some wells have more chloride than others, but all are below EPA limits.



Data from three graphs supplied by Madison Water Utility

Updated March 2023

Public Health MADISON & DANE COUNTY
Healthy people. Healthy places.

BACKGROUND AND HISTORY

Why do we use road salt?

History of salt use in Wisconsin

- Since the 1950s, the Wisconsin Department of Transportation (DOT) has used rock salt as a deicer on state highways. By 1956, the DOT had implemented a "bare pavement" policy for state highways.
- The bare pavement policy created a demand from motorists for increased road maintenance that persists to this day.
- Salt use reduction efforts began at both the state and city level in 1973. At the same time, the Madison Common Council directed Public Health Madison & Dane County to monitor the effects of road salt on the Yahara Lakes and submit an annual report.

How road salt works

- Vehicles driving on snow-covered roads leads to ice forming on the pavement. Plowing is usually not enough to prevent the layer of ice from forming.
- Deicers are used to prevent or remove ice. Deicers work by getting lowering the freezing point of water. The deicer ions get in the way of ice forming a solid structure, keeping it liquid for longer.
- Road salt is usually made up of sodium and chloride. When road salt is applied, it melts and splits into two parts: sodium ions and chloride ions.
- The sodium ions become a part of the soil. Chloride ions end up washed away by rainwater into our lakes or groundwater.
- As a result, chloride concentration in our water resources continues to grow with each salt application.
- The only ways to mitigate chloride are through rainwater diluting it in lakes and groundwater, or by salty water flowing out of lakes or groundwater.

Why chloride is harmful

- Chloride in surface waters is toxic to aquatic life. Heavier, salt-laden water can also accumulate at the bottom of lakes and cause a condition known as meromixis, where water near the bottom does not circulate during seasonal turnover.
    - The Wisconsin Department of Natural Resources (DNR) has set the chronic toxicity criterion for chloride to 395 mg/L. This maximum 4-day concentration ensures adequate protection of aquatic life if not exceeded more than once every 3 years.
- Chloride affects the taste and drinkability of our water. The Environmental Protection Agency (EPA) has set a secondary standard for chloride in drinking water at 250 mg/L. Secondary standards are advisory for aesthetic considerations. There is no health-based standard for chloride in drinking water.

- Chloride also increases the corrosiveness of water, which damages bridges, concrete roadways and structures, and automobiles. The results can be disastrous:
    - In 2015, the National Highway Traffic and Safety Administration found 2008 and earlier vehicles could experience unexpected brake failure due to corrosion caused by road salt.
    - The Algo Centre Mall in northern Ontario collapsed from corrosion to steel supports caused by salt water from a leaky roof top parking lot.
    - Road salt was a contributing factor in the lead contamination of drinking water in Flint, Michigan.
    - The former Highway 19 Bridge over the Yahara River grew noticeably more corroded over a six-year span (see photos below). An accounting of the cost of damages caused by road salt would be extensive and difficult to estimate.

Corrosion of former Highway 19 Yahara River Bridge. March of 2013 on left, December of 2019 on right. Stalactites form at the largest fracture every winter and slowly dissolve over the remainder of the year.

Deicers are important for public safety, and we don't have great alternatives

- Even though road salt damages our infrastructure, water resources, and our environment, it is widely considered cheap and effective. Wisconsin experiences many freeze-thaw cycles throughout the winter season, which can cause dangerously slick roadways. Thus, some level of anti-icing/deicing road maintenance is necessary to keep roads passable for emergency equipment and commerce.

- Chloride salts of calcium and magnesium were some of the first alternative deicers used. While they both work at lower temperatures than sodium chloride (rock salt), they still contribute chlorides to the environment. Also, they are not as efficient as sodium chloride, and don't lower the freezing point of water as much.
- Calcium magnesium acetate (CMA) is another alternative that has seen limited use for a long time. It is much less corrosive than chloride salts, but it reduces oxygen levels in water. It also has a higher effective minimum temperature.
- Other less corrosive alternatives have been developed. These are usually a combination of a chloride salt and an organic, phosphate, or metal constituent that add oxygen demand, nutrients, or metals to the environment along with a lower level of chloride than straight chloride salts.

Sodium chloride remains the most commonly used deicer. If deicers are necessary for safe roads, and if road salt is the best option, then reducing the harmful effects of deicing can only be achieved by reducing the amount applied.

How does Madison use road salt?

History of Madison's salt use

- Interstate highway system procedures set a standard that influence state, county, and municipal actions.
    - By the early 1950s, highway deicing with rock salt had begun as the preferred treatment.
    - As highway safety became prioritized, the Wisconsin Department of Transportation (DOT) adopted a "bare pavement" policy for state highways.
    - Increases in fuel costs in 1973 led to the bare pavement policy being changed and salting being reduced. Later in the 1970s, the DOT further reduced salt use for environmental reasons.
    - This was next addressed in 2002 when the DOT clarified the expectations of the bare pavement policy. The name was also changed to Passable Roadway – During a Winter Storm guideline.
- Over this 60-year time span, winter road maintenance in Madison followed a course similar to the DOT's (see table below). City salt applications began in 1959. A study conducted by the Rivers and Lakes Commission in 1962 revealed high chloride in roadside ditches following melt water flows, but overall road salt impacts were minimal. Yet chloride levels in Lake Wingra were increasing at an alarming rate, compelling the Rivers and Lakes Commission to request a 50% reduction in road salt use in the Lake Wingra basin for the winter of 1973-74. By 1977, the salt reduction program was extended to the entire city.
- A primary strategy for meeting the salt reduction goal was segmented salting. This practice involved applying salt on every other block. Traffic was supposed to carry salt residue to the untreated roadway. However, carry-over was minimal and the process resulted in increased ice formation. It was discontinued in 1980 due to strong opposition to city-wide salt reduction.

Decade	Actions
1970s: beginning to reduce salt	• 1973: Wingra watershed salt reduction • 1977: City-wide salt reduction • 1977: Salt application rate set at 50 lbs./mile • 1977: Segmented salting begins
1980s	• 1980: Segmented salting discontinued
1990s:	• 1992: Salt spreader calibration • 1999: Computerized spreader calibration • 1999: 100% beet juice tested
2000s: **Testing alternatives**	• 2000: Calcium magnesium acetate tested • 2002: Coal ash tested as an abrasive • 2004: Calcium chloride pre-wetting agent • 2007: 23% Salt brine pre-wetting agent • 2008: Ice slicer tested
2010s: Becoming salt wise	• 2010: Anti-icing with salt brine • 2010: Auger inserts with fixed tailgates • 2010: Salt crusher at tailgate • 2011: Geomelt 70/30 anti-icing agent tested • 2014: Wisconsin Salt Wise Partnership formed • 2016: Additional brine truck added to fleet • 2016: City/private salt applicator training
2020s: **Adding brine and BRT**	• 2020: Added brine capacity • 2020: Reduced salt miles due to reduced Metro routes (due to COVID) • 2021: Added brine capacity • 2022: Added brine capacity • 2022: Reduced salt miles due to segments not meeting guidelines • 2023: Added brine capacity • 2023: Reworking salt system due to bus rapid transit (BRT)

For more information

This report was prepared by:

Rick Wenta, Environmental Protection Lead Worker
rwenta@publichealthmdc.com

Updated March 2023

Public Health
MADISON & DANE COUNTY
Healthy people. Healthy places.