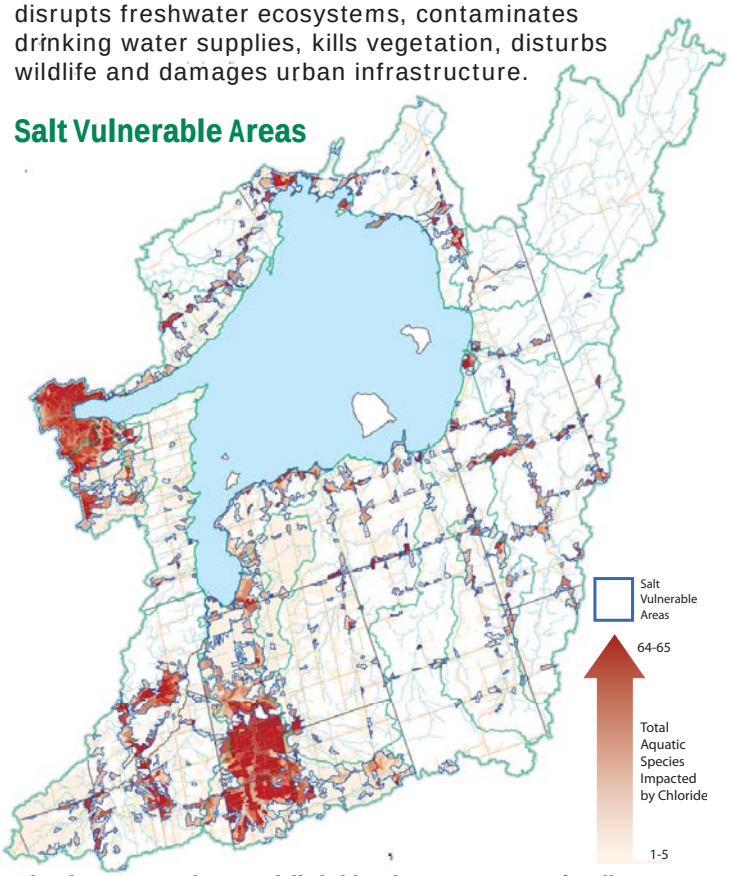
Lake Simcoe Science

Sodium Chloride (Winter Salt)

In this issue, we take a look at an emerging environmental concern in the Lake Simcoe watershed and beyond. Winter salt or sodium chloride is one of the more common de-icers used on roads, highways, parking lots, driveways and sidewalks. It is a relatively cheap and effective way of melting ice at temperatures between 0 and -12 degrees Celsius and is therefore widely used to keep ice and snow from our roads and other hard surfaces, playing an important role in public safety.

The relatively inexpensive price of salt does not take into account its cost to the environment. Excess salt disrupts freshwater ecosystems, contaminates drinking water supplies, kills vegetation, disturbs wildlife and damages urban infrastructure.

Salt Vulnerable Areas



The above map utilizes modelled chloride concentrations for all tributaries to calculate the number of aquatic species that could potentially be affected by chloride concentrations. These vulnerable areas unsurprisingly follow the road network and urban areas, highlighting these as areas in which better salt management and reduced application could have the greatest environmental benefit.

In many circumstances winter salt is over-applied or applied in situations when it's not needed or helpful. The excess winter salt dumped next to the storm drain above will end up flowing into creeks and rivers and then into Lake Simcoe.

Approximately 100,000 tonnes of salt are applied to paved surfaces in the Lake Simcoe watershed each year. This amounts to roughly 500 pounds of salt per person every year. Much of that ends up flowing into watershed creeks and rivers and then into Lake Simcoe.

A growing population and increased urbanization are expanding our reliance on salt to maintain public safety. Unless we make some changes, our reliance on salt will continue to grow and our environment threatened as a result.

The Damaging Effects of Excess Salt

In rivers and streams, excess salt negatively impacts the plants, insects, and fish that live there. Fish maintain a salt and water balance in their bodies by a process called "osmoregulation" which moves water into or out of their cells.

While some fish species live in saltwater and others in freshwater, many are unable to adapt to changes in salinity (salmon and eels are some of the exceptions).

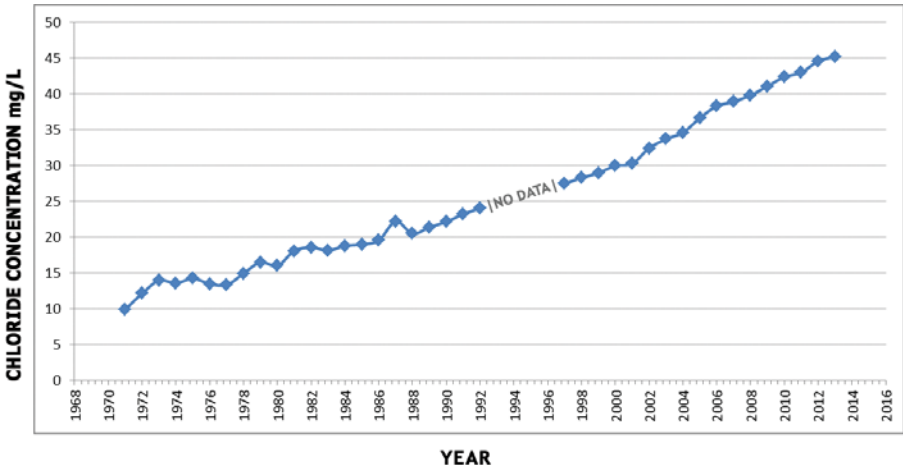
Did You Know...

Chloride levels have been found to be steadily increasing across the Lake Simcoe watershed.

When a freshwater fish is placed in a salty environment, their cells lose water trying to balance against a higher salt content, become dehydrated, and cause organ failure (think of a marathon runner or cyclist who doesn't drink enough during a hot summer race). Sudden or prolonged exposure to saltwater can kill our freshwater fish!

Saltwater fish are adapted to the high salt content, but can become over hydrated and die if placed in freshwater. At the same time long term low level exposure to higher than normal salt levels can also impact aquatic organisms by affecting developmental processes or interfering with key life cycle stages.

Lake Simcoe - Average Annual Chloride Concentration



Graph shows chloride concentrations in Lake Simcoe from 1971 to present. Concentrations can be seen to be increasing at a fairly constant rate of 0.7 mg/L per year. At this rate, concentrations will exceed the chronic exposure guideline by the year 2120.

On land, salt damages roadside vegetation and stunts or deforms the growth of trees. In urban areas, these are the same trees that are carefully planted and maintained for their benefits: stormwater management, pollution reduction, aesthetic value, and others. Accumulations of salt along the sides of roads also attract animals, increasing incidences of collisions.

How much is too much?

The Canadian government has established water quality guidelines that define the levels at which chloride effects aquatic life. There are two different guidelines: a level for chronic exposure and another for acute exposure. Chronic or long-term exposure is a maximum of 120 milligrams of chloride per litre of water. The exposure limit for acute or short-term exposure is 640 milligrams of chloride per litre of water. Severe effects to aquatic life can be expected in as little as 24 hours when the acute exposure is exceeded. By comparison, isolated lakes that are not affected by chloride register as little as 7 milligrams per litre.

Salt Chronic Exposure Guideline

120 milligrams of chloride per liter of water (120 mg/L)

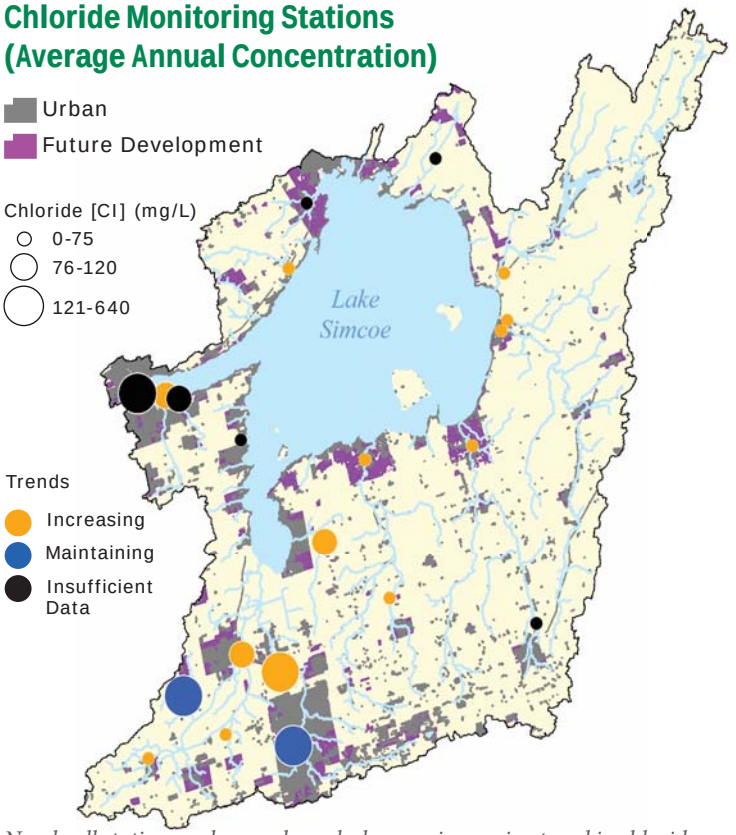
Salt Acute Exposure Guideline

640 milligrams of chloride per litre of water (640 mg/L)

Chloride Levels Increasing

LSRCA scientists monitor chloride levels at 21 different locations on the tributaries of Lake Simcoe and an additional 17 stations in the lake itself. What they're finding is a long-term trend towards increasing chloride levels at most stations. The result is an increase in lake concentrations of approximately 0.7 mg/L per year. The average concentration in 2013 was 45.24 mg/L. At this rate, with the current level of development, our lake will exceed the chronic chloride guideline by the year 2120. While that seems a long way off, it means there is time to make changes that will protect the lake for future generations.

Chloride Monitoring Stations (Average Annual Concentration)



Nearly all stations, urban and rural, show an increasing trend in chloride concentrations over the long term, indicating the wide spread increase in winter salt application. Encouragingly, some stations are showing a slowing of this trend in the short-term data.

We need to change our salt management and application practices today to prevent this from happening.

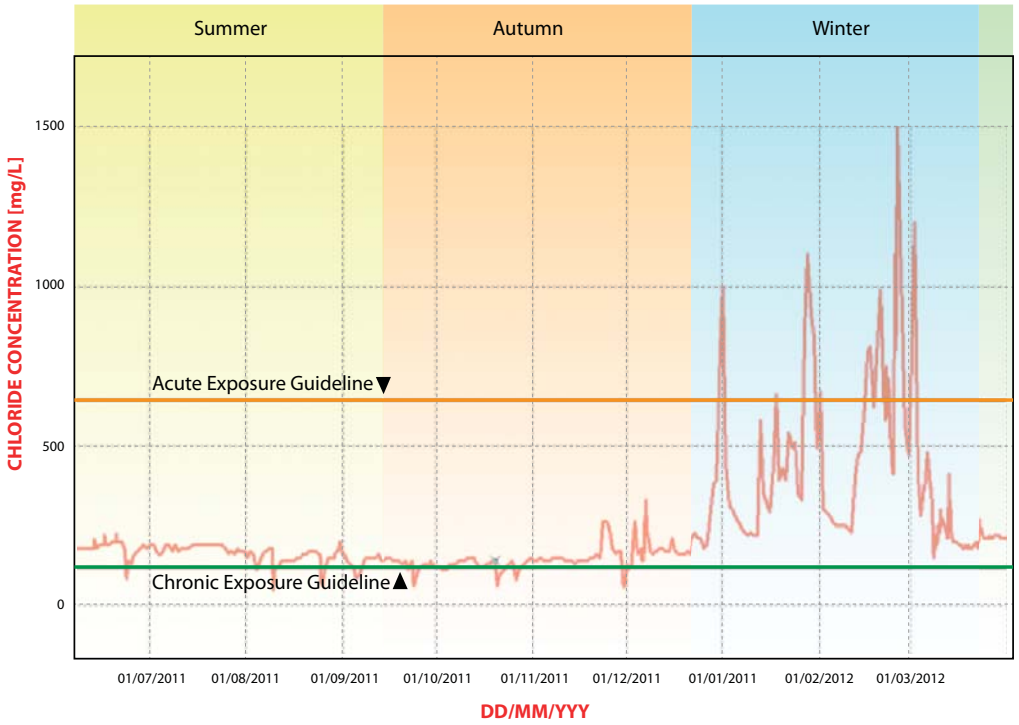
Even more pressing are the chloride concentrations recorded in our urban creeks and rivers. Our data shows that we exceed the chronic guidelines in urban areas such as Newmarket, Aurora and Barrie. We're exceeding the acute guidelines at four stations (2009-2013): Hewitts Creek, Hotchkiss Creek, Lovers Creek (Barrie), and East Holland River (Newmarket & Aurora). The highest and most disturbing concentration was 6,120 milligrams per litre recorded at Hotchkiss Creek in February 2013.

In the last 5 years periodic sampling has recorded 17 exceedances of the acute guideline at Hotchkiss Creek. However, continuous chloride sampling at Holland Landing recorded 44 exceedances of the acute guideline in one winter (figure below).

Encouragingly, 10 stations recorded no exceedances of the chronic guideline from 2009–2013. These stations are located in primarily rural or naturalized catchments, highlighting the fact that chloride is an urban issue.

This data supports the need to look at more careful management and application practices in places such as Barrie, where Hotchkiss Creek is located, as well as our other urban areas such as Aurora, Newmarket and Orillia.

Holland Landing Station - Daily Chloride Concentrations (July 2011-April 2012)



The majority of the summer and autumn chloride concentrations can be seen to exceed the chronic guideline, while winter concentrations can be seen to be greatly elevated, exceeding the acute guideline on 44 occasions at the Holland Landing station (downstream of Aurora and Newmarket).

What Are the Salt Alternatives?

This is unfortunately the biggest problem. There are no cost-effective alternatives to salt. Other options also contain chloride (calcium chloride, magnesium chloride, potassium chloride) or nitrogen (urea based de-icers) and are therefore also environmentally problematic. The one alternative product, calcium magnesium acetate, is very expensive (by several orders of magnitude) for frequent use in the harsh Canadian winters.

Unless we do something, Lake Simcoe will exceed the government guidelines for chronic exposure to chloride in water by the year 2120.

Being Smart About The Salt We Use

Since there are few cost effective alternatives to using salt, the key is reduction, adopting best management practices and applying the right material, at the right time and in the right amount.

We've learned that, in many circumstances, salt is over-applied, or applied in situations when it's not needed or helpful.

All municipalities in the Lake Simcoe watershed have developed "Salt Management Plans" to help navigate the balance between environmental protection and public safety. In collaboration with municipalities, we are identifying areas where the greatest impacts to aquatic habitats are occurring, and that might require special consideration for effective salt management.

Much of the salt that finds its way to our watercourses is actually applied in parking lots and building entrances, rather than on roads. The Smart About Salt® program is a training and certification program for private contractors, developed by the Region of Waterloo. Smart About Salt® training has been offered to snow plow operators and owners of large parking lots in the Lake Simcoe watershed, to help provide them the tools and understanding they need to find the appropriate balance between public safety and environmental protection.

A shovel is your best bet for keeping your driveway and walkways clear. Wearing sturdy winter boots help protect you from slips and falls.

Contractors who have gone through the course typically reduce their salt use by 25 to 30 percent. This is good for the environment and also good for their budgets because they use less salt yet maintain the same level of public safety.

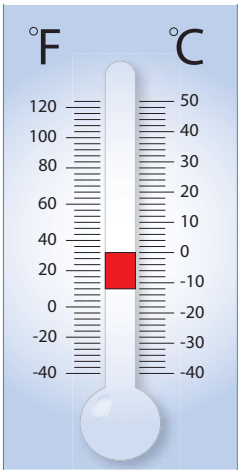
smart about salt®
Winter Salt Management Program

What You Can Do

It's possible to stay safe this winter and minimize the impact of salt on the environment.

Part of the reason municipalities, business owners, employers, property managers, and people generally, use so much salt is their concern for public safety. A lot of salt gets applied when it may not be necessary. We can all help by paying closer attention to our winter habits:

1. Wear sturdy footwear appropriate for the weather to help protect yourself from slips and falls when outdoors.
2. Put snow tires on your vehicle. It will help keep you safe on the roads.
3. At home, make sure any downspouts are pointed away from hardened areas so that water isn't draining onto your walkways or driveways.
4. A shovel is your best bet for keeping your driveway and walkways clear.
5. If you need more traction on your sidewalk or in front of your door, use sand or kitty litter.
6. Winter salt use is most effective between 0˚C and -12˚C. Above or below these temperatures consider alternatives such as shoveling snow and ice or using sand or kitty litter for traction.
7. Ask your local businesses if their contractors are Smart About Salt® trained. If they aren't, have them contact us as we're working with local municipalities and others to coordinate training.



Winter Salt's effectiveness is between 0°C and -12°C

Read previous issues of Lake Simcoe Science Newsletters online at www.lsrca.on.ca/sciencenewsletter

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Member of Conservation ONTARIO Natural Champions

Established in 1951, the Lake Simcoe Region Conservation Authority provides leadership in the restoration and protection of the environmental health and quality of Lake Simcoe and the surrounding watershed with our community, municipal and other government partners.
To learn more visit www.LSRCA.on.ca. Alternative formats of this publication are available upon request.