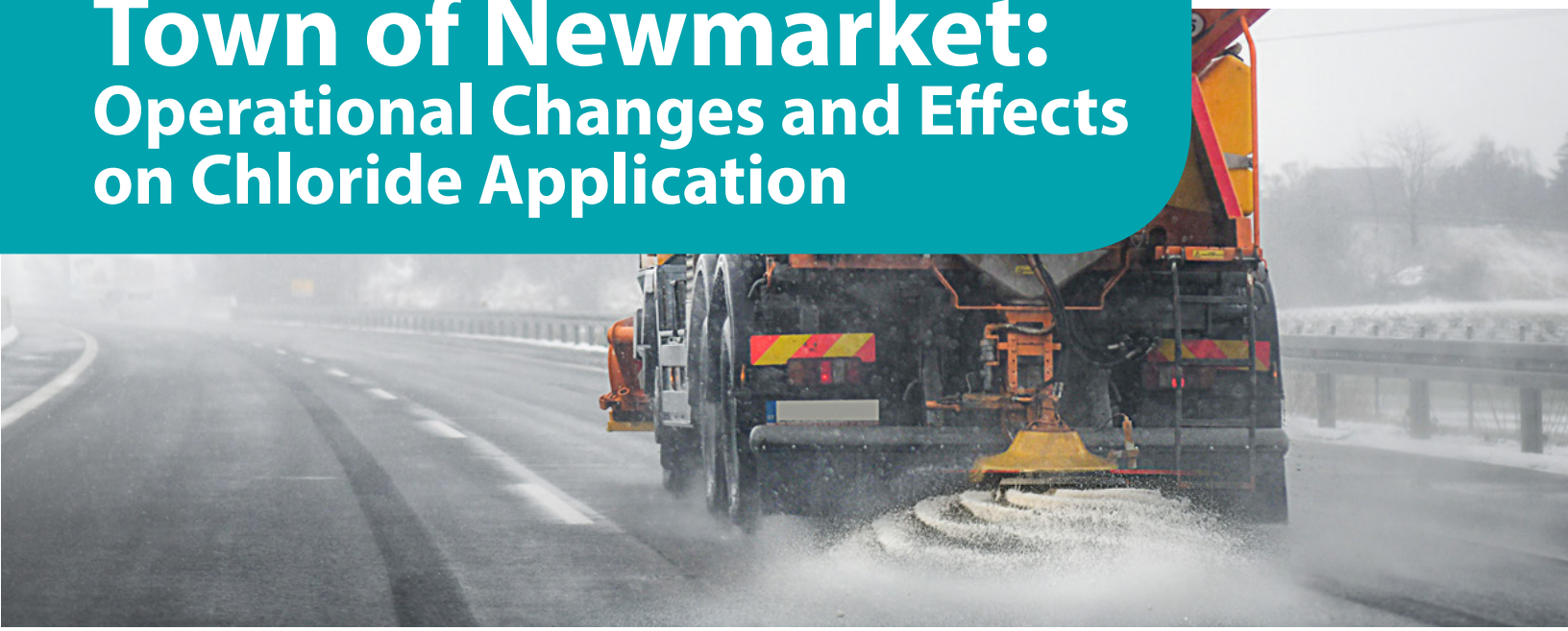
Sustainable Technologies
EVALUATION PROGRAM

TECHNICAL BRIEF

Town of Newmarket:
Operational Changes and Effects on Chloride Application



Municipal salt application for road safety in the winter months is among the highest sources of chloride in the Lake Simcoe watershed (Figure 1), and in southern Ontario in general. In recent years, several municipalities in the watershed have been working to refine their practices and apply less material to roadways. This is being undertaken for several reasons:

- The recognition of the environmental impact of large volumes of chloride entering our aquatic systems
- The desire to remove sand from the mix, as sand clogs waterways and stormwater infrastructure (where it requires removal) and adds to operational costs.
- The exploration of new, potentially more effective materials, such as treated salt products (e.g. Thawrox®).
- A desire to find the optimal application rate to ensure safety, while reducing the amount of material applied.
- Optimization of winter maintenance budgets; costs are lower if less material is applied and spring cleanup costs are reduced.

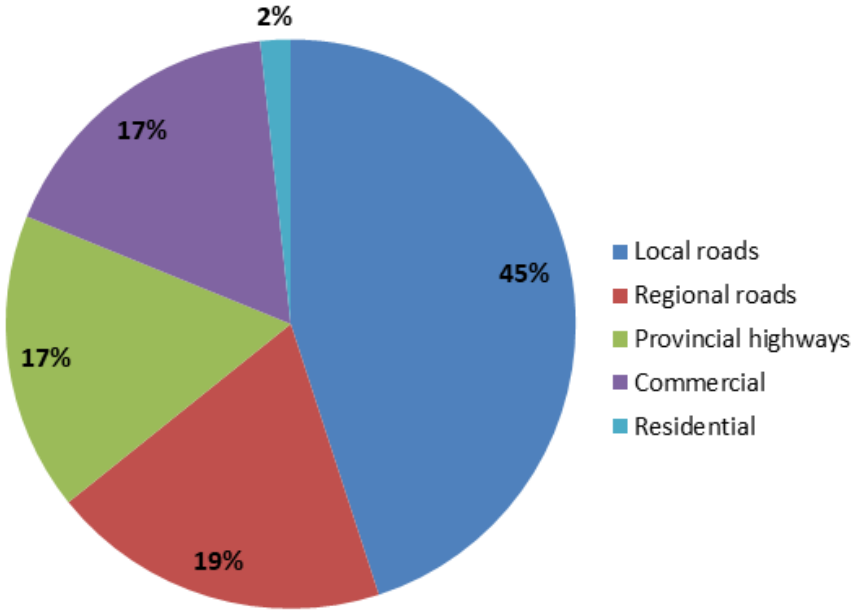


Figure: 1 Sources of salt in the Lake Simcoe watershed(2015).

The Town of Newmarket, in York Region, is one of the Lake Simcoe municipalities that has been working to refine its practices. Until the 2016/2017 winter season, the Town used a mix of salt and sand, like many municipalities in the area (an exploration of salt vs. sand can be found in this Technical Bulletin). From 1995 to 2015, the Town used a ratio

of approximately 60:40 salt to sand. Staff had begun to recognize the environmental issues and financial impact of the inclusion of sand in the mix, and in the 2016/17 winter season, the amount of sand in the was reduced to 50%, and Thawrox®, a salt product coated with magnesium chloride and other materials to enhance its performance, was used in place of traditional rock salt (a comparison of various winter maintenance materials can be found in the Alternatives to Salt technical brief). Following a pilot project in the 2017/18 season where 100% Thawrox® was used on all roads, the Town switched permanently to the use of 100% Thawrox®. This bulletin will explore the evolution of the Town's practices, and how these have affected annual material use, costs, and road safety, as well as the factors that are influencing event response and material application.

As noted above, the Town used a mix of sand and salt in a ratio of approximately 60% sand, 40% salt (with some variation from year to year) during the period from 1995 to the 2015/2016 season. Recognizing that perhaps this mix wasn't the most effective for ensuring road safety, and acknowledging the operational issues associated with sand use and environmental impacts of chlorides from road salt, staff at the Town made the decision to adjust their ratios and eventually change their materials fully to Thawrox®, a treated salt product. Treated salt products are typically made from rock salt (sodium chloride), which are coated with additives to improve their performance (e.g. magnesium chloride, beet juice, or an acetate deicer). The benefits of using treated salt vs. the sand/salt mix or straight rock salt include:

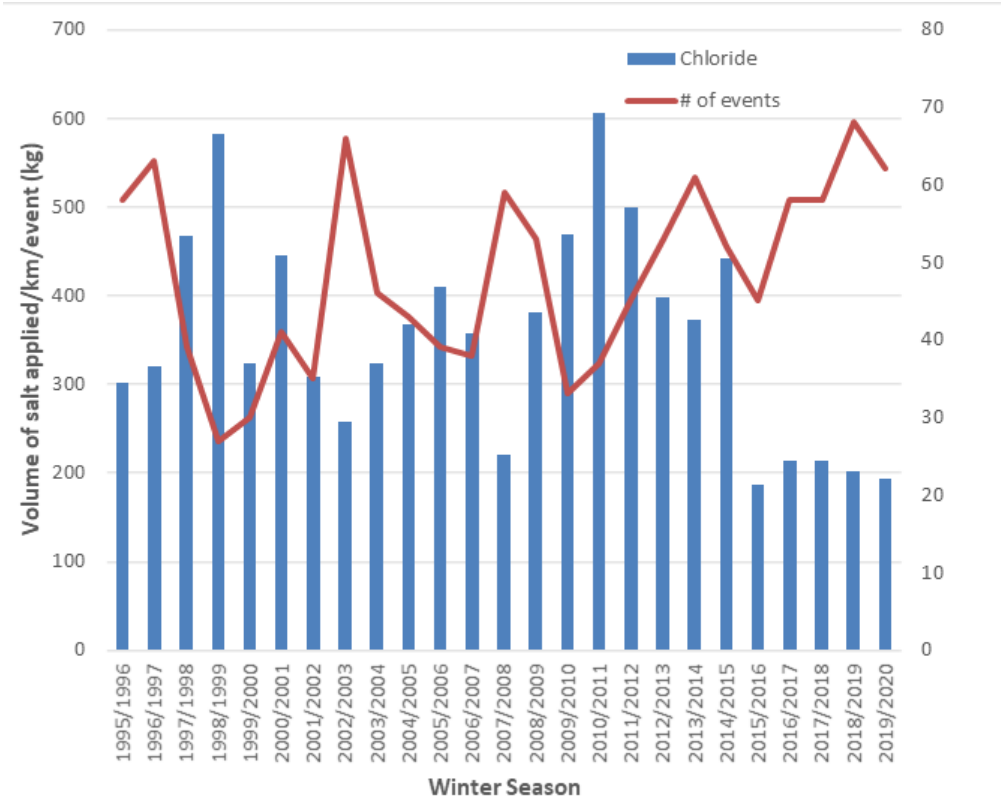
- The product is more likely to stick to the road, enhancing its effectiveness.
- Because of the coating, it begins brining action quickly, melting ice and preventing its adhesion to the road.
- There is a residual effect, which means that additional applications can be spaced out further or eliminated altogether, depending on the severity and duration of the event.
- Its effective temperature is lower than that of straight salt (e.g.-15°C vs -7°C for Thawrox®).
- Some contain corrosion inhibitors.
- It can be applied at a lower rate than the either the sand/salt mix or straight salt.

The application rate for each event is shown in Figure 2. For comparison between seasons, the chart also includes the number of events the Town responded to in each season.

As is evident from the graph, the overall volume of material applied has decreased since the Town moved to reduce the amount of sand in the mix in the 2015/2016 season, and its removal of sand entirely and shift to Thawrox® in the 2017/2018 season. They were able to further decrease their material usage by reducing the rate at which they apply Thawrox®, while still ensuring that roads remained safe. These changes resulted in a 46% decrease in the amount of chloride applied during each event. It can also be noted from the graph that the number of events the Town is treating each here has been increasing over the past several years. This will be discussed later in this case study.

Many practitioners are concerned about the higher costs of treated salt product. Fortunately, this additional cost is offset by the product features, particularly the lower application rate and residual action. The chart below displays the per kilometre cost difference for traditional rock salt and treated salt for each event,

Figure 2: The volume of chloride (salt or Thawrox®) applied and the number of events responded to for 1995-2020.



at the application rates used by the Town before and after they changed their practices and eliminated sand from the mix. Note that the traditional salt rate only includes the salt component, and not the sand that it was mixed with (which would be an additional cost).

Material	Cost/tonne ($)	Volume applied/km/event (T)	Cost/km/event ($)
Salt	100	0.39	39
Thawrox®*	125	0.21	26.25

The Town currently treats 312 km of roads. This equates to a per event cost of $12,168 with the sand/salt mix, and $8,190 with Thawrox.

CHANGE IN PRACTICE - IMPACT ON COLLISION RATE

When a municipality looks at changing their winter maintenance practices, safety is obviously of the utmost importance. An increase in the collision rate during the winter would indicate that the change has been ineffective or that they have been too aggressive in their efforts to reduce the amount of material applied. In the case of the Town of Newmarket, the available data (see Figure 3) do not show an appreciable difference in winter collision rates between the period prior to when the practices were changed, and after. In fact, collision rates appear to show a decrease; additional data for years following the move to Thawrox®, when they are available, will show whether trend is significant.

BENEFITS OF CHANGING PRACTICE

The shift in the ratio of sand to salt, and eventual elimination of sand from the winter maintenance mix and shift to a treated salt product has had significant benefits for the Town of Newmarket. Newmarket, along with several other Lake Simcoe municipalities, have also switched to treated salt products and have generally reported having good results.

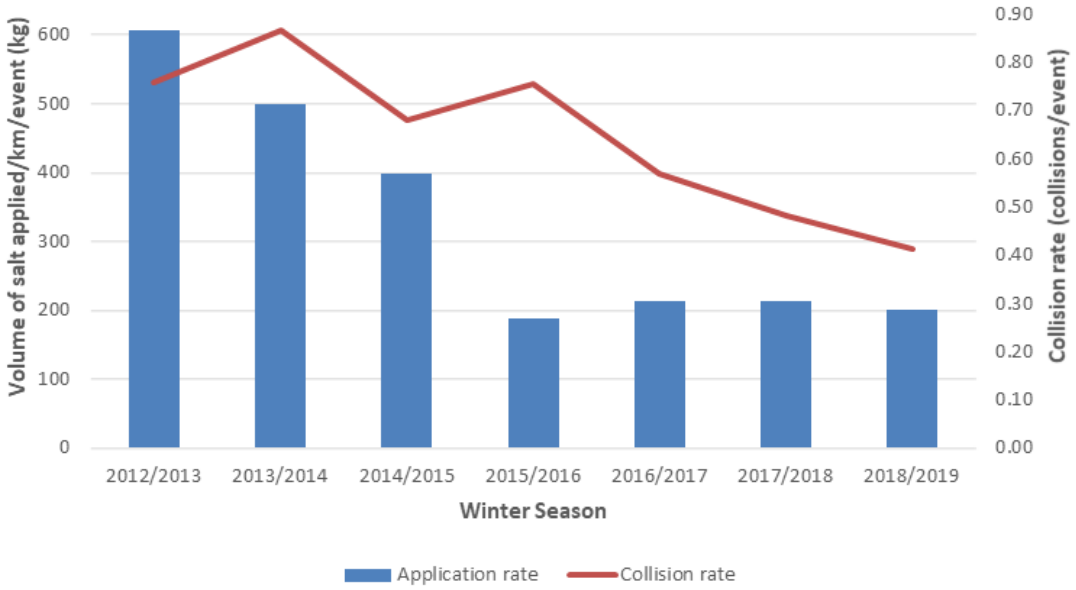


Figure 3: The seasonal (November-April) collision rate compared with the volume of salt applied per kilometre per event.

As noted in the Sand vs. Salt Technical Bulletin, there are many benefits of removing sand from the winter maintenance mix. Chief among them is a reduction in the amount of deadheading, or refill, trips, which reduces the fuel consumption. Town staff have noted that since the switch to straight Thawrox®, deadheading trips have mostly been eliminated, except for a few of the longer routes. This trip reduction has resulted in a decrease in the amount of fuel used by the plows each season. The Town benefits from the cost savings from the reduced fuel use, which has dropped by 200 L/event on average since the change. Over a season, this equates to a cost savings of approximately $15,000 (assuming 60 trips/season and a gas price of $1.30/L). Additional benefits include the lower number of person hours spent on deadheading trips, and a reduction in the carbon footprint of their winter maintenance activities each year. In the 2014-2015 season, the maintenance of roads during the winter was associated with 1.56 T of CO2 being released during each event; this decreased to 1.03 T in the 2018-2019 season, a 34% reduction (ICBE, 2020). Figure 4 shows the fuel consumption for each event against the percentage of sand in the mix. It appears that the switch from salt to Thawrox®, with its lower application rate and residual action, has enhanced the benefit of removing sand from the mix. The caveat to this is the increased number of events that the Town is responding to each year; which would of course increase the fuel use. However, this increase will be less than it would be if a sand/salt mix were still being used.

CHALLANGES IN REDUCING CHLORIDE APPLICATION

In the period prior to the operational changes made by the Town (1995-2015), the material application rates (including

only the salt component of the mix) averaged 0.39 T/km/event. Following the changes, the rate dropped to 0.21 T/km/event. Unfortunately, despite the large decrease in the application rate with the changes in practices, the total volume of salt/Thawrox® being applied to Newmarket's roads has not observed the same decline. In fact, the data show a slight increase in total volume applied between these two periods. There are several reasons for this increase, the most notable of which are a longer road network in the Town, as well as an increase in event response. In the period prior to the operational changes, the Town responded to approximately 45 events annually, whereas in the period following the changes, close to 60 events were responded to. The reasons for this increase in response are cited as changing weather conditions due to climate change (e.g. more freezing rain, more freeze-thaw events). In addition, changes to the Minimum Maintenance Standards under the Municipal Act (S.239/02) require that if there is a substantial probability of ice forming on a roadway, that the roadway should be treated to prevent ice formation. As a result, staff are often required to apply material earlier than they normally would, and there is often a need to re-apply during or after the event.

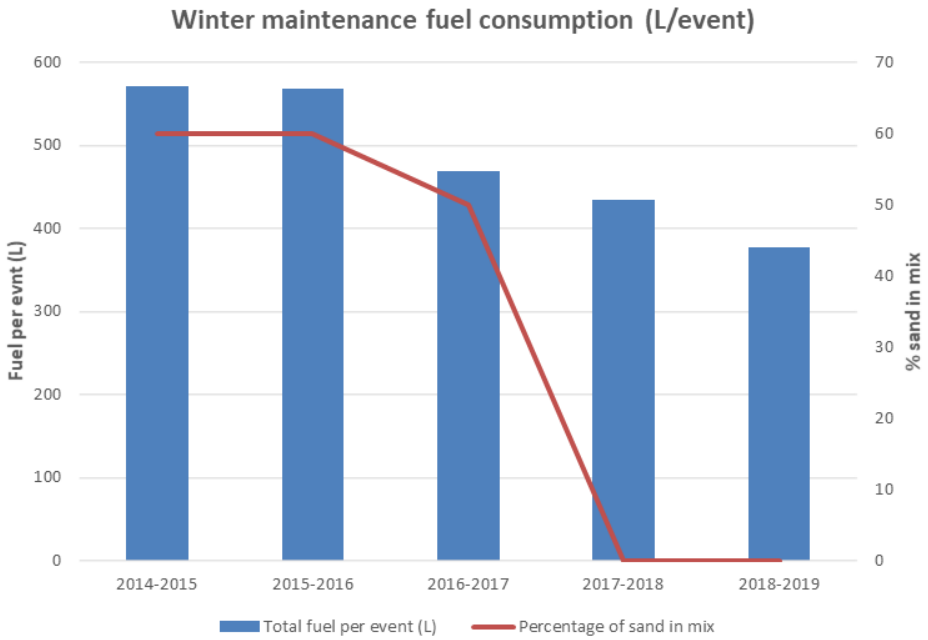


Figure 4: Fuel consumption per event, plotted against the percentage of sand in the mix for each winter season.

The conditions requiring increased event response are complex and may be exacerbated by an ever changing climate and increasing public expectations around road conditions. It is, however, important to note that the volume of salt being applied each season would be much higher if the Town had not made these changes to their practices; there would be 7,300 tonnes being applied instead of 3,900. Further investigation would help in enhancing our understanding of these issues and may shed some light on what could be done to mitigate them.

CONCLUSION

Staff from the Town of Newmarket have done an admirable job in recognizing the financial and environmental impacts associated with their winter maintenance practices, and in re-evaluating their practices and making changes to their program reduce these impacts. Their continued evaluation of current and innovative practices will help to ensure that the Town's residents are safe and financial resources are well used, while minimizing the environmental impact.

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Published 2022. Visit us at sustainabletechnologies.ca to explore our other resources on salt management.

If you are interested in getting involved through any of our engagement opportunities, please contact us at:

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