Appendix A

OAKVILLE

2025-2030
Salt Management Plan

Appendix A

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APPENDICES

Commitment

This Salt management Plan was adopted by the Town of Oakville on the date indicated below and applies to all employees and contractors involved in Winter Maintenance Operations for the Town of Oakville.

Reviewed by		
Name	**Signature**	**Date**
Jose A. Herrera P. Eng., M. Eng. *Manager, Works Operations*		November 4, 2024
Approved by:		
Name	**Signature**	**Date**
Sam Inchasi P. Eng., MBA, PMP *Director, Roads & Works Operations*		November 4, 2024
Date Adopted		

1.0 INTRODUCTION

Road salts (primarily sodium chloride) are the preferred deicing/anti-icing chemicals for maintaining winter safety because of the cost, effectiveness and ease of handling. The amount of salt used is a function of the level of service policies and budgets, the transportation system, snow fighting strategies and techniques and weather conditions. Excessive use of salt can have environmental impacts.

A Salt Management Plan provides the means through which an organization commits to implementing salt best management practices as it fulfills its obligation to provide safe, efficient and cost-effective transportation systems.

1.1 Purpose of Salt Management Plan

This Plan sets out a framework for Town of Oakville to continuously seek improvement in the management of road salt used in our winter maintenance operations. This Plan demonstrates our commitment to reducing the environmental effects of excessive salt use, consistent with Environment and Climate Change Canada's (ECCC) stated objectives. As recognized by ECCC, any modifications to winter maintenance activities must be carried out in a way that provides roadway safety and user mobility consistent with the weather conditions experienced during the snow and ice control season.

This Plan shows the management practices Town of Oakville uses to protect the environment from the negative impacts of road salts. This Plan includes all areas where road salt is used such as roads, sidewalks, parking lots and pathways. The Plan applies to all winter maintenance personnel – both staff and hired resources/contractors.

1.2 Legislative and Policy Context

1.2.1 Code of Practice for the Environmental Management of Road Salts

Environment and Climate Change Canada (ECCC) released a "Code of Practice for the Environmental Management of Road Salts" (Environment and Climate Change Canada, 2022). As part of the Code of Practice, we have prepared a Salt Management Plan (SMP) and report our progress yearly. The Code of Practice includes a recommendation for SMP content, as summarized in Table 1. These and other recommendations from the Code are included in Appendix B.

Table 1 Content Recommendations from the Code of Practice for the Environmental Management of Road Salts

Recommendation for Salt Management Plan content from the Code of Practice for the Environmental Management of Road Salts	Relevant Section in this SMP
Provide a statement recognizing the role of a salt management plan in achieving improved environmental protection without compromising road safety;	Section 1: Introduction

Recommendation for Salt Management Plan content from the Code of Practice for the Environmental Management of Road Salts	Relevant Section in this SMP
Provide a commitment or endorsement of the plan at the highest level in the organization;	Section: 2.4 Commitment
Identify activities or operations through which road salts may be released to the environment and goals to achieve reduction of the negative environmental impacts of these releases;	Section: 3 Road Salt Use and Releases
Assess current practices against recommended best management practices, including those contained in the TAC Syntheses of Best Practices;	Section 4.4 Operational Practices
Contain documentation of all policies and procedures applicable to the salt management plan;	Section 4.0 Operational Practices
Include communication activities necessary to inform the organization and the public of the salt management plan and related policies and procedures;	Section 4.2 Communication Activities
Contain a training program for all personnel when managing or performing winter maintenance activities involving the use of road salts;	Section 4.3 Training Program
Provide response procedures to react to uncontrolled releases of road salts that could result in environmental impacts;	Section 4.4 Operational Practices
Ensure monitoring of actions to measure the plan's effectiveness;	Section 4.6 Monitoring of Actions, and Section 4.7 Plan Review and Update
Include record-keeping as described in section 15 of this Code;	Section 4.5 Record Keeping
Include a procedure for yearly review of the plan by the organization with continual improvement of salt management practices and the salt management plan as better management practices become known and progress is achieved; and	Section 4.7 Plan Review and Update
Establish and implement corrective actions to address deficiencies identified in the operations of the organization to which the plan applies.	Section 4.7 Plan Review and Update

1.2.2 Source Water Protection

The Ontario *Clean Water Act, 2006* was enacted to ensure clean, safe, and sustainable drinking water for Ontarians by protecting sources of municipal drinking water including our lakes, rivers, and well water. The prescribed threats to drinking water sources are set out in Section 1.1 (1) paragraph 2 of *Ontario Regulation 287/07*. They include:

- the application of road salt,
- the handling and storage of road salt, and
- the storage of snow.

Source Protection Plans were developed to provide policy direction for prescribed threats in a geographical area. Complementary to that, the Ministry of Environment, Conservation and Parks

developed a list of management measures within the Risk Management Measures Catalogue to help provide ways to manage prescribed threats.

1.2.2.1 Source Water Protection Plans

The purpose of the Source Protection Plans (SPPs) is to protect existing and future drinking water sources. To address prescribed threats, an SSP contains policies that are either:

- Legally binding and may be clearly shown as such or use words such as “must conform with”, “must comply with”, “have regard to”, and
- Recommend: non-legally binding (e.g., strategic and monitoring).

The policies within an SPP are linked to types of vulnerable areas. Types of vulnerable areas and the acronyms used in the polices that are relevant to road salt (i.e., water quality threat) are shown in Table 1.

Table 2. Description of Source Water Protection Vulnerable Areas

Acronym	Description
WHPA	Wellhead Protection Areas (WHPA) are areas on the land around a municipal well, the size of which is determined by how quickly water travels underground to the well: • WHPA-A - The standard 100-metre radius circle around each municipal well • WHPA-B represents the 2-year time of travel • WHPA-C represents the 5-year time of travel • WHPA-D represents the 25-year time of travel, and • WHPA-E represents municipal wells that are under the direct influence of surface water.
IPZs	Intake Protection Zones (IPZs) are the area on the water and land surrounding a municipal surface water intake. The size of each zone is determined by how quickly water flows to the intake, in hours. There are three categories of IPZs; • IPZ-1 is a one-kilometre circle around the intake • IPZ-2 is the area where water can reach the intake in a specified time, determined by the SPP • IPZ-3 is delineated if modelling demonstrates that a spill outside IPZ-1 and -2 could impact water quality.
HVA	Highly Vulnerable Aquifers are those that are particularly susceptible to contamination because of its location near the ground’s surface or where the types of materials in the ground around it are highly permeable.
SGRA	Significant Groundwater Recharge Areas (SGRA) are areas on the landscape where water can seep easily into the ground and flow to an aquifer.

For the Town, the following Source Protection Plans apply:

- The Halton-Hamilton Source Protection Plan (HH-SPP)
- Credit Valley-Toronto and Region-Central Lake Ontario (CTC) Source Protection Region (CTC-SPP)

The SPP policies relevant to the application of road salt, the handling and storage of road salt, and the storage of snow are described in Appendix B and the locations of vulnerable areas are shown in Appendix C.

1.2.2.2 The Risk Management Measures Catalogue

The Risk Management Measures Catalogue provides a source of management measures to effectively manage prescribed threats. As described in detail in Appendix B, there are the following:

- 12 measures for the application of road salt
- 18 measures for the handling and storage of road salt, and
- 9 measures for the storage of snow.

1.2.3 Guidelines on Snow Disposal and De-icing Operations in Ontario

The Ontario Ministry of Environment Conservation and Parks (MECP) is concerned about the amount of chloride introduced to the environment from deicing operations be kept to a minimum. To that concern, the Ministry developed guidelines on snow disposal and de-icing operations to address environmental concerns. Recommendations from this guideline are included in Appendix A.

Update of the Salt Management Plan

For this update, we have:

- Developed a comprehensive list of current requirements, polices, guidelines and leading practices for salt management.
- Compared our current practices against this list.
- Documented where we are consistent with current requirements, polices, guidelines and leading practices for salt management, and identified opportunities for improvement.
- Developed short-and long-term goals for continuous improvement that allows us to continue to provide the public with the safe and efficient transportation systems they expect, while minimizing effects of road salt use on the environment.
- Identified actions, training, monitoring, and reporting activities to support the goals and this Plan.

This approach is based on the following principles for Salt Management Plans (Transportation Association of Canada, 2013):

- It is activity based, with each activity being assessed against requirements, established standards and leading practices to determine how they can be carried out with minimal environmental impact.
- Current operations are reviewed and compared with requirements and industries leading practices, and improvements are made to the operations to meet requirements and improve practices as feasible are implemented as required.
- Required actions are documented in policies and procedures and communicated throughout the organization – including contractors hired to assist with winter maintenance operations.
- Activities are recorded, monitored, audited and reported periodically to assess progress and identify areas for further improvement.
- Gaps between actions and desired outcomes are identified and corrective actions are developed and implemented, with necessary modifications being made to policies and procedures and appropriate training.

This Plan is dynamic. It allows the Town to phase in new approaches and technologies in a way that is responsive to fiscal demands and the needs to ensure that roadway safety is not compromised.

2.0 POLICY, SCOPE AND COMMITMENT

2.1 Policy

We recognize the role of our salt management plan in achieving improved environmental protection without compromising road safety. Within our overall policy context, the following is the Town's policy on the use and management of road salt.

- To comply with all applicable federal and provincial legislation regarding the storage and use of snow and ice control products.
- To use road salt in an environmentally responsible manner, and minimize the negative environmental effects of handling, storage and application of road salt on the environment, without compromising safety of all road users.
- The Town of Oakville will minimize the negative impacts of road salt to the natural and built environment by continuously identifying and implementing cost-effective technologies and practices.

Our salt management principles are:

- Safe travel within our Right of Ways and the safe use of municipally owned parking lots is a top priority.
- The use of road salt is essential to maintaining safety during winter weather conditions. The use of road salts as part of the Winter Operations approach allows the Town to meet its service level

on snow removal as required under legislation, and is key at fending off liabilities to the Town and ultimately ensures the protection of public safety.

- We will strive to reduce the amount of salt released to the environment through effective salt management practices.
- We will show leadership locally, provincially and nationally in the area of road salt management by leading by example and sharing our knowledge and experiences with others.
- We will provide the necessary training and encouragement to our winter maintenance personnel to allow them to be fully contributing partners in achieving an environmentally sound and safe winter maintenance program.
- Performance will be tracked and reported through appropriate internal reporting processes and public outreach methods.

2.2 Scope

This Salt Management Plan applies to roads, sidewalks, bicycle lanes, multiuse paths, and municipal parking lots.

2.3 Goals

Our goal is to reduce the negative environmental impacts of salt release include having:

- Policies that help reduce the need for road salt, including Level of Service and related policies
- Infrastructure planning and design approaches that minimize the need for road salt.
- Winter maintenance operations that return safe travelling conditions within approved Levels of Service and legislated requirements while optimizing road salt use.
- Secure handling and storages of solid road salt, liquid salt (e.g., brine), and abrasives (e.g., sand) including spill prevention and response, good housekeeping (e.g., washing of equipment).
- Appropriate snow storage and disposal.
- Process to reduce other losses of road salt (e.g., washing of equipment).

3.0 ROAD SALT USE AND RELEASES

Road salt may be released to the environment through a variety of activities and operations. The following is a list of the main activities and operations undertaken by winter maintenance through which road salts may be released to the environment:

- Handling and storage of solid road salt as solid salt, liquid salt (brine), and mixed into abrasives (most commonly sand), referred to as “sweetened” abrasives
- Application of road salt as solid and bine and/or sweetened abrasives to roads, paths, sidewalks and municipal parking lots
- Snow storage and disposal
- Uncontrolled releases from:

- leaching of road salt piles
- leaching of sweetened abrasive piles
- spills, and
- equipment washing.

4.0 SALT VULNERABLE AREAS

The location of wellhead protection areas, issue contributing areas, and intake protection zones is included in Appendix C. At this time, no other Salt Vulnerable Areas (SVA) have been identified.

The Town's approach is to optimize road salt at all locations, this includes using technologies (like direct liquid application for anti-icing) to optimize the use of road salt, monitoring salt use, locating new patrol yards or snow disposal sites outside of vulnerable areas and considering location and protection of vulnerable areas in the design of new roads and/or upgrading of existing roads.

5.0 ROAD SALT MANAGEMENT PROCEDURES

This section includes our procedures to manage road salt. They include:

- roles and responsibilities
- communication activities
- training
- response to uncontrolled releases to road salts
- operational practices
- record-keeping
- monitoring of actions
- plan review, corrective action and best practices update
- continuous improvement targets

5.1 Roles and Responsibilities

Roles and responsibilities are assigned with respect to winter maintenance activities and road salt management. Roles and responsibilities are documented in each employee's job specification.

5.2 Communication Activities

We are committed to informing all levels of our organization and the public with respect to road salt management including this plan and related policies and procedures. We see this as critical in securing and maintaining support for meeting our roads salt management goals.

We will undertake communications with internal staff, council and the public as necessary and appropriate to gather support for the salt management plan.

5.3 Training Program

Appropriate and on-going training is a cornerstone of managing our road salt. All staff and contractors involved in winter maintenance will have training appropriate to their responsibilities and activities. Appendix A.2 contains a description of current training practices.

5.4 Response to Uncontrolled Releases of Road Salts

Uncontrolled releases of road salts can impact the natural and built environments. As such, we will have a spill response procedure (see Appendix B for details) for uncontrolled releases of road salt in the maintenance yard.

5.5 Operational Practices and Review

Practices are the methods, materials, and equipment we use in our winter maintenance program to reduce road salt in the environment. The practices are included in Appendix B. The sections titles and a description of the practices are shown below.

The Salt Management Plan will be reviewed yearly for:

- consistency with corporate and winter maintenance policies and procedures,
- tracking progress towards continuous improvement targets, and
- Incorporating feedback.

Operational enhancements will be taken as needed to address issues and opportunities identified.

A comprehensive review and update will occur as needed (typically 5 to 7 years). This will include a re-evaluation of continuous improvement goals and targets and an update of best practices. The results of the review are provided in Appendix B.

Appendix Section		Description of Practices
B.1	GENERAL INFORMATION	General information about the town.
B.2	SALT MANAGEMENT PLAN (SMP)	Salt Management Plan (SMP) sets out the plan for ensuring that the management of road salt used in winter maintenance operations is implemented and continuously improved.
B.3	INFRASTRUCTURE PLANNING, DESIGN AND MAINTENANCE	Infrastructure that includes considerations for snowfighting during planning and design will likely reduce the need for de-icing and anti-icing and overall reduction in salt use.

Appendix Section		Description of Practices
B.4	DRIFT CONTROL	Blowing snow is the primary cause of icy roads in wind-exposed areas—melting extracts diurnal solar radiant heat stored in the pavement and substratum, and the quantity of snow blowing across a road can be hundreds of times greater than direct snowfall. As such, a significant amount of winter maintenance activity is devoted to controlling drifting snow. If mitigation measures can lower the potential for snow and ice accumulation, the winter maintenance demands will be correspondingly lower and the need for road salt application will be reduced.
B.5	LEVEL OF SERVICE (LOS)	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. The amount of salt use will depend on the LOS, most directly the winter road path or sidewalk condition maintained both during and post storm (which relates to road class) and time to achieve the condition.
	5.1 Roads	
	5.2 Bicycle and Multiuse Trails (MUT)	
	5.3 Sidewalks	
B.6	ROUTE REVIEW	The LOS establish priorities and leads to determining the amount and type of equipment assigned to routes to cover all service areas during storm conditions. Duplication of service due to inefficient routes leads to redundant salt use and premature plowing of previously salted roads. Well-designed snowplow routes result in snow and ice control service that is both more effective, because roads are cleared more rapidly.
B.7	FORECASTING OF CONDITIONS	Good snow and ice control decision-making (and thus salt management) depends on consistently accurate and timely weather information.
B.8	STORM RESPONSE AND DECISION SUPPORT	Snow and ice control decisions that are clearly understood and supported leads to optimal use of salt.
B.9	APPLICATION RATES	The types of materials should be optimized to support the winter event response decisions in order to meet the LOS in a manner that is responsive to equipment available, fiscal demands and safety.
	9.1 Solids	
	9.2 Liquids	
	9.1 Abrasives	
B.10	SALT VULNERABLE AREAS	Salt vulnerable areas those that sensitive to salt.
B.11	EQUIPMENT	Equipment and controls on the equipment have an effect on the use of salt.
B.12	MONITORING AND RECORD KEEPING	To improve salt use, assessments of the practices and procedures based on established measures are needed.
B.13	MATERIALS STORAGE & HANDLING FACILITIES	If not properly stored, salt can be lost to the environment in large quantities because of exposure to precipitation and wind.
B.14	SNOW REMOVAL, STORAGE AND DISPOSAL	Snow disposal sites can release salt-impacted water. Therefore, proper site selection and design can minimize these impacts.

Appendix Section		Description of Practices
B.15	TRAINING	To achieve effective implementation of a salt management program, people require proper and appropriate training.
B.16	ENGAGEMENT, REPORTING AND OUTREACH	An informed council, public and media are more likely to become effective partners in achieving the goals of the Salt Management Plan.
B.17	PARKING LOTS AND PRIVATE INFRASTRUCTURE	Parking lots and other private infrastructure has become recognized a significant source of salt to the environment.

5.6 Record-keeping

The Town understand the importance of record keeping not only for salt management but also for winter maintenance overall. We will keep records as needed to meet the needs of winter maintenance in general and evaluate salt management as needed. Our record keeping will be consistent with the policy and procedures for the Town of Oakville.

5.7 Monitoring of Actions

Practices will be monitored as needed or specified to evaluate their effectiveness with respect to meeting the overall goal of reducing the impacts of road salt to the natural and build environments.

5.8 Plan Review and Update

The Salt Management Plan will be reviewed yearly for:

- consistency with corporate and winter maintenance policies and procedures,
- tracking progress towards continuous improvement targets, and
- Incorporating feedback.

Operational enhancements will be taken as needed to address issues and opportunities identified.

A comprehensive review and update will occur as needed (typically 5 to 7 years). This will include a re-evaluation of continuous improvement goals and targets and an update of best practices.

5.9 Continuous Improvement Objective

Salt management objectives are to continuously improve the salt management plan. Objectives are determined by reviewing exiting salt management practices against current industry leading practices. Where gaps exist, leading practices are reviewed against considerations such as safety implications, practicality, and cost-effectiveness. Where appropriate, objectives to improve practices are determined and reviewed by senior management. Targets, associated milestones, and performance measures, are included in Appendix A.

6.0 BIBLIOGRAPHY

Adams, T. M., Danijarsa, M., Martinelli, T., Stanuch, G., & Vonderohe, A. (2003). Performance Measures For Winter Operations . *TRB 2003 Annual Meeting CD-ROM.*

Alberta Infratructure and Transportation. (2007). *Bridge Inspection and Maintenance System Level 2 Inspection Manual (Release 1.1).* Edmonton: Government of the Province of Alberta.

Bergström , A. (2002). *Winter Maintenance and Cycleways.* Stockholm: Royal Institute of Technology.

Blackburn and Associates. (2014). *Establishing Effective Salt and Anti-icing Application Rates.* Clear Roads.

Boyce, B., Pisano , P., & Guevara, G. N. (2019, October 28). *7B.1 FHWA Road Weather Managment Program Integrated Mobile Observations (IMO) Project*. Retrieved from American Meteorological Society: https://ams.confex.com/ams/95Annual/webprogram/Paper270297.html

City o Guelph. (2016). *Private Salt Managment Plans in the City of Guelph, Guidance Document for Proponents.* Retrieved from https://guelph.ca/wp-content/uploads/SWP_SaltManagementGuidance.pdf

Cluett , C., & Jenq, J. (2007). *A Case Study of the Maintenance Decision Support System (MDSS) in Maine.*

CTC Source Protection Committee. (2015). *Approved Source Protection Plan: CTC Source Protection Region.*

Dowds, J., Sullivan, J., Novak, D., & Scott, D. (2016). *Identifying Best Practices for Snowplow Route Optimization .* St. Paul: Clear Roads Pooled Fund .

Drobot, S., Mahoney, W., Schuler, E., Wiener, G., Chapman, M., Pisano, P. A., . . . Stern, A. D. (Undated). *INTELLIDRIVE ROAD WEATHER RESEARCH & DEVELOPMENT .*

Environment and Climate Change Canada. (2019, 11 28). *Performance indicators and national targets for environmental management of road salts: table 1*. Retrieved from Canadian Environmental Protection Act Registry: publications: https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/performance-indicators-national-targets-road-salts/table-1.html

Environment and Climate Change Canada. (2022). *Code of Practice for the Environmental Management of Road Salts o.* Ottawa: Environment and Climate Change Canada.

Fay, L., Akin, M., Shi, X., & Veneziano, D. (2013). *Revised Chapter 8, Winter Operations and Salt, Sand and Chemical Management, of the Final Report on NCHRP 25-25(04) .* American Association of State Highway and Transportation Officials (AASHTO) .

FHWA. (1996). *Manual of Practice for an Effective Anti-icing program.*

FHWA. (2019, October 30). *Road Weather Management Program* . Retrieved from U.S Department of Transportation : https://ops.fhwa.dot.gov/weather/mitigating_impacts/surveillance.htm

Government of Alberta . (2020, 11 15). *De-icing salts applied to a ramp*. Retrieved from RETROactive: https://albertashistoricplaces.com/2013/01/03/salt-and-sidewalks-putting-it-on-ice/de-icing-salts-applied-to-a-ramp/

Halton Hamilton Source Protection. (2022). *Source Protection Plans for the Halton Region Source Protection Area and the Hamilton Region Source Protection Area.*

Horizon Landscape Company. (2020, Nov 19). *Horizon Landscape Company*. Retrieved from HOW TO PREVENT SALT DAMAGE: https://horizonlandscape.com/prevent-salt-damage/

How Much Does It Cost to Repair Concrete Driveway? (2020, Nov 13). Retrieved from Fixr: https://www.fixr.com/costs/concrete-driveway-repair#:~:text=It%20also%20resolves%20cosmetic%20issues,that%20measures%20250%20square%20feet.

Iowa DOT. (Undated). *Post Storm Review.*

Komorowski. (2019, 11 01). Retrieved from Enabling Winter Cycling in Montreal : http://www.tcat.ca/wp-content/uploads/2015/10/Komorowski-1.pdf

Lee , M.-S., & Nelson, D. (2018). *Utilization of AVL/GPS Technology: Case Studies.* Clear Roads .

Levelton Consultants Limited . (2007). *Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts (NCHRP REPORT 577).* TRANSPORTATION RESEARCH BOARD.

Lukezich, D. (2017). *Using Automated Vehicle Location to Monitor Road Salt Application into Ground Water.* Unpublished.

Marchetti, M., Chapman, L., Khalifa, A., & Buès, M. (2014). New Role of Thermal Mapping in Winter Maintenance with Principal Components Analysis. *Advances in Meteorology*, 11.

Ministry of Environment. (2011). *Guidelines on Snow Disposal and De-icing Operations in Ontario.* MOECC.

Ministry of Environment Conservation and Parks. (2019, October 31). *Risk Management Measures Catalogue*. Retrieved from Source Water Protection: http://www.trcagauging.ca/RMMCatalogue/Default.aspx

Ministry of Environment, Conservation and Parks. (2022). *Risk Management Measures Catalogue.* Retrieved from Ministry of Environment, Conservation and Parks: https://files.ontario.ca/moe_mapping/downloads/4Other/Risk_Management_Measures_Catalogue_2022.xlsx

Minnesota Department of Transportation. (2011). *2010 - 2011 Annual Winter Maintenance Report .*

Mn/DOT. (2005). *Minnesota Snow and Ice Conrol: Field Handbook for Snowplow Operators.* Minnesota Local Road Research Board (LRRB).

National Academies of Sciences, Engineering, and Medicine. (2009). *Performance Measures for Snow and Ice Control Operations: Supplemental Material.* The National Academies Press.

NDDOT. (undated). *Anti-icing Fact-sheet.*

Nevada DOT. (2014). *Maintenance Decision Support System: Pilot Study and Cost Benefit Analysis (Phase 2).*

Nova Scotia Transportation and Infrastructure Renewal . (2008). NIGHT ICING POTENTIAL PROJECT - Thermal Mapping . *Transporation Association of Canada Annual Conference* , (p. 5).

OGRA. (2018). *Good Practices for Winter Maintenance in Salt Vulnerable Areas.*

Ontario Road Salt Management Group and Ontario Good Roads Association. (2015). *Automated Vehicle Location (AVL) Adoption by Ontario Municipalities Survey Results.* Retrieved from https://www.ogra.org/images/eBlast/Weekly/images/AVLSurvey/AVL%20Survey%20Ver007.pdf

Potter, A. S., Gallagher, M. R., & Bayer, C. W. (2016). *Synthesis on Global Positioning Systems/Automatic Vehicle Location Equipment Used for Winter Maintenance.* Clear Roads.

Region of Waterloo. (2020, Nov 12). *Water protection: winter salt management*. Retrieved from Engage Region of Waterloo : https://www.engagewr.ca/saltingshift/widgets/24760/photos/7105

Smithson, L. D. (2012). Optimized and Sustainable Winter Operations in Canada and the United States . *2012 Conference of the Transportation Association of Canada .* Fredericton.

South Dakota DOT. (2017). *Winter Highway Maintenance Plan 2017-2018.*

SRF Consulting Group, Inc. (2019). *16-03: Standards and Guidance for Using Mobile Sensor Technology to Assess Winter Road Conditions.* Clear Roads.

TAC. (2013). *Salt Managment Guide.*

Toronto and Region Conservation Authority. (2019). *Procurement Guidance for Parking Lot Snow and Ice Management.*

Transportation Association of Canada . (2013a). *Syntheses of Best Practices Road Salt Management 1.0 – SALT MANAGEMENT PLANS.*

Transportation Association of Canada. (2013). *Syntheses of Best Practices Road Salt Managment: 1.0 - Salt Management Plans.* Transportation Association of Canada.

Transportation Research Board. (2010). *Pooled Fund Study Project TPF-5(054) - Second Quarter Report .*

Xianming, S., Strong, C., Larson, R. E., Kack, D. W., Cuelho, E. V., El Ferradi , N., . . . Fay, L. E. (2006). *Vehicle-Based Technologies for Winter Maintenance: Project No. 20-7(200) .* National Cooperative Highway Research Program.

Xu, G., Shi, X., Sturges, L., Chapman, M., Albrecht, C., & Bergner, D. (2017). *Snow Removal Performance Metrics.* Minnesota Department of Transportation.

Ye, Z., Strong, C., Fay, L., & Shi , X. (2009). *Cost Benefits of Weather Information for Winter Road Maintenance.* Iowa Department of Transportation.

Zhang, K., Luo, Y., Xie , W., & Wu, J. (2020). Evaluation of road performance and adhesive characteristic of asphalt binder in salt erosion environment. *Materials Today Communications 25 (2020) 101593*(25).

APPENDIX A - CONTINUOUS IMPROVEMENT OBJECTIVES

Appendix A

Opportunities	Target Group/Goal and Commitments	Timing
INFRASTRUCTURE PLANNING, DESIGN AND MAINTENANCE		
Continue winter maintenance functional groups pertaining to the planning and design of roads and bike paths (on-road and segregated/multiuse paths) to incorporate maintenance insights that can reduce road salts.	Transportation and Engineering, Planning & Development Group, and Roads and Works.	Already in practice
LEVEL OF SERVICE: ROADS		
Monitoring of LOS attainment so that it is not being achieved but not consistently and significantly overachieved. See section Monitoring and Program Review and Engagement. Consider installing IRT's on plow trucks.	Roads and Works	2026-2027 (pending budget approvals)
FORECASTING OF CONDITIONS		
Develop procedures for consistent use of spreader and calibration of Infrared thermometers (IRT) supported by training. Calibration records should be maintained.	Roads and Works	Already implemented for Spreader Calibration, and IRT calibration SOP by 2025.
ROUTE REVIEW		
To optimize the use of spreaders and plows by efficient routing, the town is planning to re-optimize routes.	Roads and Works	2025-2026
Consider pilot of mobile weather information systems (MWIS) with regional partners.	Roads and Works	2026-2027 (pending budget approvals)
STORM RESPONSE AND DECISION SUPPORT		
Look to expand anti-icing program / DLA.	Roads and Works	2026-2027. Pending upgrade to brine-tanks to allow brine blending.

Appendix A

Opportunities	Target Group/Goal and Commitments	Timing
Create a decision support tool with several application rates and/or investigate and pilot a tool for region-wide application, that could include sidewalks and bus stops. Consider implementation of a Maintenance Decision Support System (MDSS).	Roads and Works	Decision support tool with several application rates in progress (80% complete). MDSS: 2026-2027 (pending budget approvals)
APPLICATION OF SOLIDS		
Review the benefits of using pre-treated salt use following other Regional testing, e.g., Thawrox - calcium chloride with magnesium chloride and a viscosity modifier) or pre-wetting salt piles with calcium chloride or other liquids, and if effective, will it achieve an overall reduction in chloride loading.	Roads and Works	Ongoing, target finalized review by 2027, Town has been using thawrox (Type II treated salt). town to consider other alternatives and analyze cost benefits, if it can reduce salt usage.
APPLICATION OF ABRASIVES		
Consider reducing salt added to abrasives in BIA. Research suggest that it is not effective. Consider investigating anti-icing (DLA) or other approaches to have the right amount of salt at the right time.	Roads and Works	2026-2027 Town to focus on MDSS tool or guidelines to standardize process.
SALT VULNERABLE AREAS		
EQUIPMENT		
The town to continue undertaking trials of effective cutting edges (typically rubber encased carbide blades), such as the Joma blade and report the findings to other municipalities in Halton Region.	Roads and Works	2025-2026 Town currently trialing Nordik Move, and new Combi specified for 2026 requires cutting edges to be Blackcat Joma.

Opportunities	Target Group/Goal and Commitments	Timing
		Town to quantify findings to share results after 2025-2026 winter season.
Consider increasing pre-wetting as part of operations, standardize process and expand on its capabilities/use. The town should consider investigating pre-treated materials as an option to supplement the pre-wettting.	Roads and Works	2025-2026.
MONITORING AND REPORTING		
Consider leveraging winter operations information and data. Vehicle information Via GEOTAB and ERSI are available, more active feedback, such as salt use per km for could be developed but resources are lacking. The town should consider hiring specialists to review and provide analysis for winter operations, if budget allows.	Works Operations	2025-2027 completion (pending budget approvals)
MATERIAL STORAGE AND HANDLING		
Requirement: The town should determine if any storage yards would be a significant drinking water threat and undertake either prohibiting handling and storage or creating a specific risk management plan.	Works Operations	2026-2027, goal for risk management plan and assessment at the town salt storage facilities.
Develop a "Good Housekeeping" standard operating procedures for sites that includes: spill response and clean-up; routine condition assessment; procedures for delivery including avoiding deliveries in the rain; etc.	Works Operations	Town already has housekeeping standards developed, to review and update by 2026.
SNOW REMOVAL		
Requirement: The town should confirm that snow storage locations are, or would be, a significant	Works Operations	Current approved town snow storage locations meet requirements. The

Opportunities	Target Group/Goal and Commitments	Timing
drinking water threat. And if they are then either prohibit storage or create a risk management plan as required.		town is looking for a North snow storage facility, recommendation to be followed when suitable location is identified.
The town should consider undertaking Environmental Assessment Municipal Class EA should be undertaken for any new snow storage facilities that considers avoiding WHPAs.	Works Operations	Supplementary additional ECA's to be reviewed and budgeted as required. These shall also be part of the North snow storage facility assessments.
ENGAGEMENT AND REPORTING		
Requirement: The town is to deliver education and outreach materials and programs where the application, handling and storage of road salt is, or would be, a significant drinking water threat, targeted to small businesses, commercial and industrial sectors.	Communications and Works Operations	2025-2026 – Town operations to work with communications on the creation of outreach material and programs for the general public.
TRAINING		
Develop standardized training program for inhouse personnel to enhance knowledge about winter operations.	Roads and Works	Training programs already in place. Operations will be reviewing and creating new winter related training material, including guidelines by 2025-2026.
PARKING LOTS AND PRIVATE INFRASTRUCTURE		
Requirement: The town is to determine where zoning restrictions on parking lots is applicable and create prohibitions as per Source Water Protection Plans.	Development Engineering, Works Operation & Environmental Management (part of Transportation and Engineering)	Town to consider for the future revisions to the SMP due to the large size in scope and resources required to deliver this recommendation.
ENVIRONMENTAL RECOMMENDATIONS		
Carry out assessment for abandoned or unused wells should be identified and decommissioned especially if facility in wellhead protection area (WHPA).	Works Operations & Transportation and Engineering.	Feasibility to be reviewed and to be updated in yearly SMP reviews.

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Opportunities	Target Group/Goal and Commitments	Timing
Town to review the SMP recommendations pertaining environmental and incorporate into the town Environmental Management Plan for items that are feasible and applicable to the town.	Works Operations & Transportation and Engineering.	Feasibility to be reviewed and to be updated in yearly SMP reviews.

APPENDIX B - WINTER MAINTENANCE INFORMATION, SALT MANAGEMENT PRACTICES

Appendix Section		Description of Practices
B.1	GENERAL INFORMATION	General information about the town.
B.2	SALT MANAGEMENT PLAN (SMP)	Salt Management Plan (SMP) sets out the plan for ensuring that the management of road salt used in winter maintenance operations is implemented and continuously improved.
B.3	INFRASTRUCTURE PLANNING, DESIGN AND MAINTENANCE	Infrastructure that includes considerations for snowfighting during planning and design will likely reduce the need for de-icing and anti-icing and overall reduction in salt use.
B.4	DRIFT CONTROL	Blowing snow is the primary cause of icy roads in wind-exposed areas—melting extracts diurnal solar radiant heat stored in the pavement and substratum, and the quantity of snow blowing across a road can be hundreds of times greater than direct snowfall. As such, a significant amount of winter maintenance activity is devoted to controlling drifting snow. If mitigation measures can lower the potential for snow and ice accumulation, the winter maintenance demands will be correspondingly lower and the need for road salt application will be reduced.
B.5	LEVEL OF SERVICE (LOS)	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. The amount of salt use will depend on the LOS, most directly the winter road path or sidewalk condition maintained both during and post storm (which relates to road class) and time to achieve the condition.
	5.1 Roads	
	5.2 Bicycle and Multiuse Trails (MUT)	
	5.3 Sidewalks	
B.6	ROUTE REVIEW	The LOS establish priorities and leads to determining the amount and type of equipment assigned to routes to cover all service areas during storm conditions. Duplication of service due to inefficient routes leads to redundant salt use and premature plowing of previously salted roads. Well-designed snowplow routes result in snow and ice control service that is both more effective, because roads are cleared more rapidly.

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Appendix Section		Description of Practices
B.7	FORECASTING OF CONDITIONS	Good snow and ice control decision-making (and thus salt management) depends on consistently accurate and timely weather information.
B.8	STORM RESPONSE AND DECISION SUPPORT	Snow and ice control decisions that are clearly understood and supported leads to optimal use of salt.
B.9	APPLICATION RATES	The types of materials should be optimized to support the winter event response decisions in order to meet the LOS in a manner that is responsive to equipment available, fiscal demands and safety.
	9.1 Solids	
	9.2 Liquids	
	9.1 Abrasives	
B.10	SALT VULNERABLE AREAS	Salt vulnerable areas those that sensitive to salt.
B.11	EQUIPMENT	Equipment and controls on the equipment have an effect on the use of salt.
B.12	MONITORING AND RECORD KEEPING	To improve salt use, assessments of the practices and procedures based on established measures are needed.
B.13	MATERIALS STORAGE & HANDLING FACILITIES	If not properly stored, salt can be lost to the environment in large quantities because of exposure to precipitation and wind.
B.14	SNOW REMOVAL, STORAGE AND DISPOSAL	Snow disposal sites can release salt-impacted water. Therefore, proper site selection and design can minimize these impacts.
B.15	TRAINING	To achieve effective implementation of a salt management program, people require proper and appropriate training.
B.16	ENGAGEMENT, REPORTING AND OUTREACH	An informed council, public and media are more likely to become effective partners in achieving the goals of the Salt Management Plan.
B.17	PARKING LOTS AND PRIVATE INFRASTRUCTURE	Parking lots and other private infrastructure has become recognized a significant source of salt to the environment.

1 GENERAL INFORMATION	
As of 2024	**Town of Oakville**
Population	233,700
Lane kilometers of total roads under winter control	2000* lane km
Lane kilometers of city roads under winter control	1649* lane km
Lane kilometers of Regional Roads maintained	351* lane km
Lane kilometers of bicycle paths / MUP within the control of winter operations	65 lane km of cycle lanes, 260 kilometres of on-road bike lanes and off-road cycling paths*
Kilometers of sidewalks within the control of winter operations	1100*
Parking lots within the control of winter operations	+/- 100*
Other	Approximately 2000 transit stops 2025 onwards

*Information to be confirmed and updated in 2025 with a full analysis

Appendix A

1. SALT MANAGEMENT PLAN (SMP)					
Objective	Develop and maintain a salt management plan				
Rationale	Rationale: Salt Management Plan (SMP) sets out the plan for ensuring that the management of road salt used in winter maintenance operations is implemented and continuously improved.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Conditions	**Gap and Opportunity for Improvement**
QL001: Optimize road salt application efficiency. The operator should prepare a salt management plan that brings all aspects of salt management into a comprehensive system, provide personnel training on the usage of the most effective road salt application, and consider timing and application methods such as anti-icing or pre-treatment.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)	Effectiveness: high	No significant barriers	Met	None
CODE-1: The salt management plan should: provide a statement recognizing the role of a salt management plan in achieving improved environmental protection without compromising road safety	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb	A SMP is a critical for an organization to commit to and implement salt management. Impact: High		Met	None
19-MECC: One of the immediate concerns of the Ministry in this matter is that the amount of chloride introduced to the environment from deicing operations be kept to a minimum.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)				
11-MECC: The Ministry encourages the sensible and conservative use of sodium chloride and other de-icing compounds.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)				
CODE-2: The salt management plan should: provide a commitment or endorsement of the plan at the highest level in the organization	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			In Progress	2024 SMP could be approved at the highest level. Roads and Works to present SMP report to Commissioner in November 22 and Council on December 16, 2024.
CODE-3: The salt management plan should: identify activities or operations through which road salts may be released to the environment and goals to achieve reduction of the negative environmental impacts of these releases	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-4: The salt management plan should: assess current practices against recommended best management practices, including those contained in the TAC Syntheses of Best Practices	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	Town is also incorporating best practices from MTO, NCHRP and FHWA.
CODE-5: The salt management plan should: contain documentation of all policies and procedures applicable to the salt management plan	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Conditions	Gap and Opportunity for Improvement
CODE-6: The salt management plan should: include communication activities necessary to inform the organization and the public of the salt management plan and related policies and procedures	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-7: The salt management plan should: contain a training program for all personnel when managing or performing winter maintenance activities involving the use of road salts	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-8: The salt management plan should: provide response procedures to react to uncontrolled releases of road salts that could result in environmental impacts	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-9: The salt management plan should: ensure monitoring of actions to measure the plan's effectiveness	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-10: The salt management plan should: include record-keeping as described in the Record Keeping section of this Code of Practice	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-11: The salt management plan should: include a procedure for yearly review of the plan by the organization with continual improvement of salt management practices and the salt management plan as better management practices become known and progress is achieved and	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-12: The salt management plan should: establish and implement corrective actions to address deficiencies identified in the operations of the organization to which the plan applies	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to using the most recent advancements in the application of winter maintenance anti-icing and de-icing materials, winter maintenance equipment, and road weather information and other decision support systems. As well, the training of personnel and the monitoring of the effectiveness of road salt application techniques should be considered	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Conditions	Gap and Opportunity for Improvement
CODE-18: An organization that meets the criteria of the application section should prepare a salt management plan within one year after publication of this Code in the Canada Gazette. It is recommended that implementation of the plan begins in the financial period or fiscal year immediately following the preparation of the plan	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-19: It is recommended that organizations hiring agents or contractors ensure that those agents or contractors comply with any measures in the salt management plan related to their work	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-20: An organization that meets the criteria of the application section should provide to the Minister of the Environment notification of intent to prepare a salt management plan within 6 months after publication of this Code in the Canada Gazette or within 6 months of becoming subject to this Code, whichever is later	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			TBD	None
CODE-22: An organization that meets the criteria of the application section should: (b) keep records of all data reported, copies of the salt management plan, plan revisions, training records, and any yearly review reports, including those that contain corrective action	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-23: An organization that meets the criteria of the application section should: retain the information referred to in paragraph (b) for 7 years and d. make the information referred to in paragraph (b) available to the Minister of the Environment upon request	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-24: Review of progress and need for further action	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-25: In order to monitor the effectiveness of this Code, organizations will be invited to cooperate with the Minister of the Environment in the preparation of progress reports on the development and implementation of salt management plans.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-26: Five years after publication of this Code in the Canada Gazette, organizations will be invited to cooperate with the Minister of the Environment and to participate in an evaluation of progress achieved towards prevention and reduction of the negative impacts of road salts on the environment through the implementation of this Code.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Conditions	Gap and Opportunity for Improvement
CODE-27: The review will consider the level of implementation of best management practices, such as those found in the TAC Syntheses of Best Practices, the progress accomplished towards preventing or reducing the negative impacts of road salts on the Canadian environment and road safety monitoring data.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-28: This review will help determine if other steps or programs are needed to further prevent or reduce negative impacts of road salts on the environment.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-29: The environmental impact indicators listed in Annex A should be considered during the development and implementation of the salt management plan.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
CODE-31: The data gathering and reporting provisions in Annex C of this Code should be considered during the development and implementation of the salt management plan.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			Met	None
EC Target 2) Annual review of salt management plan: Salt Management Plan is to be reviewed annually	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)			Met	None
Salt Management Plan should be updated regularly (5 years)	Syntheses of Best Practices Road Salt Management Transportation Association of Canada 1.0 – SALT MANAGEMENT PLANS (Transportation Association of Canada , 2013a)			Met	Salt Management Plan is updated approximately every 5-7 years.
QL001: Optimize road salt application efficiency. The operator should prepare a salt management plan that brings all aspects of salt management into a comprehensive system, provide personnel training on the usage of the most effective road salt application, and consider timing and application methods such as anti-icing or pre-treatment.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)			Met	None
QL002: Prepare salt management plan. A salt management plan needs to be developed and implemented locally by each road authority according to Environmental Canada Syntheses of Best Practices containing: salt management policy and objectives, situational analysis, documentation system, proposed approaches, training plan, monitoring, record keeping, reporting and analysis, and management review.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)			Met	None

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3 INFRASTRUCTURE PLANNING, DESIGN AND MAINTENANCE					
Objective	Consider winter maintenance (particularly the need for de-icing and anti-icing) during the design of new or improved road, sidewalk and cycling infrastructure, including considerations on optimizing maintenance operations that will optimize or reduce the use of salts.				
Rationale	Infrastructure that includes considerations for snowfighting during the design will likely reduce the need for de-icing and anti-icing and reduce salt use.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
QL004[a]: Implement road design that minimizes salt application, de-icing, and snow storage requirements. Drifting can be controlled by the erection of drift control devices such as snow fence and snow ridges.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)	An increase in the roadway and bridge designers' awareness of techniques, configurations, and design parameters will reduce the amount of snow and ice accumulation, which can lead to reduced salt application. Impact: Low to medium depending on project-specific conditions.	Institutional - typically the barriers are siloed work for transportation planning and operations	The winter maintenance operations functional group is invited to planning and design sessions both for the Town and for the Region. This is important to ensure SMP requirements are followed and suggestions provided to designers for consideration. As infrastructure changes (road diets, cycling lanes etc.) there is increasing challenges to winter maintenance such snow storage. For cycling lanes, adjacent (non-segregated) have the same LOS as the road, but off-road cycling lanes can have different LOS under the maintenance standards, etc.	The Town has good practices in place where Designs are being reviewed by operations, this aligns with the recommended practices of: -winter maintenance functional groups involvement in site plan approvals, and the planning and design of roads and bike paths (on- road and segregated/MUP) broadening the SMP that other functional teams (e.g., planning) have a role its development and implementation. -prioritizing segregated cycling lanes over on-road cycling lanes Areas to consider on reviewing: - Consider reviewing parking policy to remove parked cars and allow for more effective plowing, reducing salt needs.
QL004[b]: Implement road design that minimizes salt application, de-icing, and snow storage requirements. Conduct training on design techniques and criteria that improves salt application performance, plan and design roadways to minimize the crossing through source water protection areas, and set design technical standards and guidelines that improves salt application.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
QL004[c]: Implement road design that minimizes salt application, de-icing, and snow storage requirements. Enhance the usage of new technologies for salt application management such as Road Weather Information System (RWIS), and Fixed Automated Spray Technology (FAST), and develop industry standards that improve salt application performance	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
QL134: Apply environmental considerations for roadway and bridge design, operation and maintenance: minimize paved areas. Minimizing paved areas as much as possible. Considering the environment and source water protection during road and/or bridge design, operation and maintenance will minimize adverse environmental impacts.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
QL138: Apply environmental considerations for roadway and bridge design, operation and maintenance: site bridges. Site new bridges away from vulnerable areas (WHPA, IPZ, HVA, SGRA) to minimize impacts on the drinking water sources.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
QL163: Setbacks for land application: separation distance from waterways. Regulating the separation distance to waterways will manage the risk of contamination reaching source water through these pathways. Surface water features (lakes, streams, rivers, ponds, canals, ditches, etc.) man made or natural, including seasonal or intermittently flooded areas should also be identified on a map with the associated separation distance.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
The planning and design of new or improvement to roads / bicycle lanes (protected or adjacent) should consider ways to: reduce snow drifting, reduce water / refreeze ice accumulations; accommodate snow storage, access for snow removal vehicles for protected or shared-use paths, etc.	Salt Management Guide (TAC, 2012) Cebe, J. (2014) Winter Bike Lane Maintenance: A Review of National and International Best Practices (Updated 2/14) PERSPECTIVES IN PLANNING Volume 2, Number 1				
Good pavement design can help improve the performance of the winter chemicals that are applied	Synthesis of Practice 5.0 PAVEMENT AND SALT MANAGEMENT (TAC, 2013)	Improving the performance of the winter chemicals that are applied, leads to reduced usage for the same or better level of service. Low to medium impact depending on pavement design.	Institutional - typically the barriers are siloed work for road/ pavement design and operations.		
QL544: Minimizing the Impact of Road salt on Water Quality - Pavement Design. Good pavement design can help improve road salt performance, minimize usage for the same or better level of service and safety, and thus reduce environmental impact.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
QL541: Minimizing the Impact of Road salt on Water Quality - Proper Drainage Planning and Design. The minimization of salt related impacts should be one objective of any management strategy formulated for roadway drainage systems. Proper drainage planning and design can reduce the potential impacts on salt vulnerable areas by isolating or diverting the drainage from vulnerable areas. Measures as for example the listed below when used in combination with other policies and guidelines for drainage design, may assist in the responsible drainage management strategy: - Establishment of buffer zones and filter strips on the sides of roadways to prevent direct spray and runoff from reaching sensitive surface waters and vegetation. - Construction of drainage systems that direct salt laden runoff away from sensitive areas. When local ground water quality is a concern, catch basins, drainpipes, lined ditches, and impervious berms beneath the roadside are all effective for directing salt away from the problem areas. This is more cost-effective in urban areas. - Limiting salt application to specific areas that need it the most such as steep inclines, bus routes and main thoroughfares. - Changing Driver Behaviour by increasing public awareness of the potentially harmful effects of de-icing chemicals on the environment and to secure the public's cooperation in reducing the need for application of salt on roads by lowering speed limits under icy conditions. In some places where the environment is very sensitive to human activity and important to the public, lower speed limits and other driving restrictions have been imposed. Unfortunately, the range of potential impacts from salt-laden runoff offers considerable challenges to the designer. There are a number of practices that can aid in the management of runoff, however each practice may mitigate some types of impacts while accentuating others. For example, promoting rapid conveyance of runoff to a receiving watercourse will reduce the potential for impairment of potable groundwater while increasing potential impacts on aquatic environment.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)	Impact: medium effectiveness	These may not be practical in many road planning and design projects		
QL581: Site Assessment and In-Situ Remediation for Releases of Salt to Land. In general in-situ remediation of salt contaminated soil involves: 1) Replacement of sodium on the soil particles with calcium; and 2) Subsequent removal of salts, including sodium, in the soil solution by leaching with natural precipitation or irrigation. This step may involve collection and proper disposal of leachate. Proper collection and disposal of leachate must be part of the remediation where there is potential for causing further adverse effects.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)	Impact: high effectiveness	Recent changes to the soil management (O.Reg. 406/19) means that remediation of such soils from winter maintenance is much less likely		

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4 DRIFT CONTROL					
Objective	To reduce snow accumulation on roadways and problems associated with drifting and blowing snow.				
Rationale	Blowing snow is the primary cause of icy roads in wind-exposed areas—melting extracts diurnal solar radiant heat stored in the pavement and substratum, and the quantity of snow blowing across a road can be hundreds of times greater than direct snowfall. As such, a significant amount of winter maintenance activity is devoted to controlling drifting snow. If mitigation measures can lower the potential for snow and ice accumulation, the winter maintenance demands will be correspondingly lower and the need for road salt application will be reduced.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
Document snow drift prone areas and design mitigation measures for drift-free roads	Syntheses of Best Practices Road Salt Management: 3.0 – ROAD, BRIDGE AND FACILITY DESIGN (TAC 2013); Controlling Blowing and Drifting Snow with Snow Fences and Road Design (Table, 2003) Salt Management Guide (TAC, 2013)	Blowing snow is the primary cause of icy roads in wind-exposed areas—melting extracts diurnal solar radiant heat stored in the pavement and substratum, and the quantity of snow blowing across a road can be hundreds of times greater than direct snowfall. As such, a significant amount of winter maintenance activity is devoted to controlling drifting snow. If mitigation measures can lower the potential for snow and ice accumulation, the winter maintenance demands will be correspondingly lower and the need for road salt application will be reduced. Medium to large impact for drift-prone roads	Cost for permanent solutions can be expensive, especially if land acquisition is needed. Ability to use land outside of Right-of-Way	As development in the Town has grown, snow difting and the need for snow fence has declined to the point where is it no longer an issue. As part of Winter Operations cleanup, the Town benches snowbanks as to provide measures of drift control by packing the snow, and at the same time increasing snow storage capacity. This is in addition to snow removal operations after large Winter Events, which prevents snowbanks from drifting back into the roadway.	None
QL522: Snow Storage: Drift Control Strategies - Snow Fences. Install snow fences to contain the snow to the roadsides and keep it from blowing onto roadways and parking lots. • Consider the volume of snow that needs to be contained on the roadsides. Both capacity and height should be considered when selecting the proper fence. • Doubling the fence height will increase snow storage capacity up to four times. • Fences four-eight feet in height should be used depending on the amount of snow being blown onto the roadway. An eight-foot-tall fence can contain up to 40 tons of snow. In areas where extreme amounts of blowing snow occur, higher fences up to 12 feet may be needed. • Snow fences too close to the road can increase the amount of snow on the road! The distance between fences and the road should be at least 35 times the height of the fence. • Although fences should be perpendicular to the prevailing wind direction, the angle can vary by as much as 25 degrees without affecting performance. • Porosity refers to the open area of a fence. A porosity of 40-50 percent is recommended to maintain the largest drifts. • A bottom gap should be left when installing the fence that is 10-15 percent of the fence height. A gap between the bottom of the fence and the ground increases the height and capacity of a snow fence and reduces the amount of snow deposited close to the fence.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
QL523: Snow Storage: Drift Control Strategies - Living Vegetative Snow Fences. Living snow fences, using vegetation to trap and contain snow to roadsides. • Trees and shrubs suitable for drift control should have relatively dense foliage that extends to ground level. Coniferous species are recommended for their dense foliage, fast-growing nature and resistance to drought, road salt, frost, and disease. The best spacing for coniferous trees is approximately eight feet with rows spaced 8-10 feet apart. Three rows are recommended to reduce the possibility of gaps forming when trees die. • A strip of tall grasses 12 feet wide will actually trap the snow and hold it. Native grasses are an attractive addition to farmsteads and field borders because they remain upright during the winter and provide wildlife with excellent cover for the winter and nesting habitat in the spring	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				

Appendix A

5.1 Level of Service: Roads					
Objective	To ensure that a Level of Service (LOS) policy is set and that any revisions are approved by senior management and communicated to winter maintenance personnel. The LOS policy must be clear, functional and understandable to operations personnel and the layperson (e.g. public and politicians). It should make it clear what is to be achieved and what will not be achieved (e.g. there may not be continuous bare pavement conditions throughout a storm). The LOS must meet the minimum described in O. Reg. 239/02 Minimum Maintenance Standards for Municipal Highways, as amended.				
Rationale	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. The amount of salt use will depend on the LOS, most directly the winter road condition maintained both during and post storm (which relates to road class) and time to achieve the condition. Municipalities may see "LOS-creep" where LOS is continually raised exceed the prescribed / approved LOS in response to public complaints / desire for higher LOS, particularly in the face of increased traffic.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
An LOS policy should be specified	Salt Management Guide (TAC, 2013)	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. High Impact	Compliance with the MMSMH, and metering LOS and expectations of public.	The Town has Winter Services Levels Ver 3.0 Dec 2021 Service level based on road classification, in general: - Primary Roads including Regional Roads - 2.5 cm plowing, bare pavement 4-6 hours. - Secondary Roads and Priority (e.g. transit stop roads): 5.0 cm plowing, bare pavement 6-12 hours. - Residential Roads: Do not get salted, snowpack condition, 7.5cm plowing trigger, abrasives applied (Sand/salt). - Sidewalk follow similar principle. Monitoring done on paper records.	Monitoring of LOS attainment so that it is not being achieved but not consistently and significantly overachieved. See section Monitoring and Program Review and Engagement.
14- MECC: Apply de-icing chemicals on main thoroughfares and critical sections of roadways only. 20- MECC: Salt only main thoroughfares and critical sections of other roadways, such as inclines, intersections, crosswalks, etc.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Directly effects total amount of materials used. Impact: High	Compliance with the MMSMH, and metering LOS and expectations of public.		.
The LOS policy should specify pavement conditions that is to be maintained: - During a storm: Generally bare and wet ; Accumulations of loose snow or slush below MMS prescribed depth; Accumulations of loose snow or slush on a snow packed pavement or unpaved surface below MMS prescribed depth. - Post storm: Bare pavement; Centre-bare; Snow packed	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011) Salt Management Guide (TAC, 2013) A Guideline for Developing a Level of Service Policy (OGRA, 2014)	Bare pavement typically requires more salt to obtain than centre-bare, which requires more road salt than snow-packed . In urban areas, snowpack or "white-road" condition might serve these areas perfectly well, with plowing to prevent impassable conditions and occasional sanding to address slippery conditions when necessary. This end condition within the LOS would use far less salt than a bare pavement condition assuming appropriate mobility and safety are met. Impact: High to Low depending on the conditions specified.	Agencies may find that with freezing rain / sleet followed by flash freezes that more salt is needed to address unsafe conditions than if bare pavement was maintained. This specific event consideration may be appropriate to add to decision support (see below). Caution, changing of the conditions to be met both during and post storm needs to consider safety, public expectations and should include support of elected public policy-makers.		
The LOS policy should be adhered to as specified. LOS creep can occur where public expectations / complaints move the LOS higher (e.g., less time) from the stated LOS, requiring more salt use. This has several components: council endorsement of LOS and public education.	Salt Management Guide (TAC, 2013)	Municipalities may exceed the prescribed / approved LOS in response to public complaints / desire for higher LOS, particularly in the face of increased traffic.	Caution, changing of the conditions to be met both during and post storm needs to consider safety, public expectations and should include support of elected public policy-makers.		
The LOS (MMSMH) is based primarily on highway speeds and ADT. The municipality could lower the speed of roads during the winter season or during events to change their classification and reduce the LOS. For example, RWIS information could be used to control variable-message speed limit signs under adverse winter weather conditions.	Winter Highway Maintenance, A Look Forward TRB A3C09: Committee on Winter Maintenance (Nixon, undated):	Experiments using this technology are being conducted in Nevada, and results to date suggest considerable success (Nixon (undated) Winter Highway Maintenance; A Look Forward). In Finland, the effects of seasonally changing speed limits from 100 km/h to 80 km/h during winter on selected roads was studied, and all accidents decreased by 14%. Finland continues to have reduced winter speed limits. While not done to reduce salt use, it does suggest that reducing speed limits is viable. Impact: Moderate to high depending on speeds specified and changes to road class.	Caution, changing of the conditions to be met for the winter needs to consider safety, public expectations and should include support of elected public policy-makers.	The Town has reduces speeds from 50- 40km and there are speed cameras, including automated speed enforcement.	The Town could undertake a review of the reduced speed limits within the MMSMH framework and see if opportunity for salt reduction.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
MTQ has the concept of a "winter ecoroad", which is a road that is subject to an alternative maintenance approach during the winter season, in order to reduce the environmental impacts of de-icing salt on one or more zones sensitive to road salts.	Winter Ecoroads: Frame of Reference for the Establishment of a Winter Ecoroad (Quebec, 2013)	This maintenance approach priorities plowing and the use of abrasives at critical points of the network to ensure road safety. However, in some circumstances, the use of road salts remains the recommended method, particularly when the pavement is icy, and at critical locations, such as on slopes, on curves and at stops. The Ecoroad approach is implemented under three principles: primacy of road safety; community support; and reduce the environmental impacts of road salts on sensitive areas. Impact: moderate to high impact, depending on locations.	Caution, changing of the conditions to be met for the winter needs to consider safety, public expectations and should include support of elected public policy-makers.	Not considered	Consider reviewing the Ecoroads program within the MMSMH framework, especially for Salt Vulnerable Areas.

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5.2 Level of Service (Bicycle and MUT)	
Objective	To ensure that a Level of Service (LOS) policy is set and that any revisions are approved by senior management and communicated to winter maintenance personnel. The LOS policy must be clear, functional and understandable to operations personnel and the layperson (e.g. public and politicians). It should make it clear what is to be achieved and what will not be achieved (e.g. there may not be continuous bare pavement conditions throughout a storm). The LOS must meet the minimum described in O.Reg 239/02 Minimum Maintenance Standards for Municipal Highways, as amended. Under O.Reg. 239/02, "bicycle lane" means: (a) a portion of a roadway that has been designated by pavement markings or signage for the preferential or exclusive use of cyclists, or (b) a portion of a roadway that has been designated for the exclusive use of cyclists by signage and a physical or marked buffer A multi-use path is a two-way path that is horizontally and vertically separated from the travelled portion of the roadway by a curb and buffer; multi-use paths are shared by cyclists and pedestrians. In-boulevard multi-use paths are distinct from multi-use trails, which run in a dedicated corridor separate from the road right-of-way (Ontario Traffic Manual – Book 18 – Cycling Facilities, Ontario Ministry of Transportation (2021).
Rationale	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. The amount of salt use will depend on the LOS, most directly the winter road condition maintained both during and post storm (which relates to road class) and time to achieve the condition. Municipalities may see "LOS-creep" where LOS is continually raised exceed the prescribed / approved LOS in response to public complaints / desire for higher LOS, particularly in the face of increased traffic.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Keep only selected bicycle lanes open in the winter.	Enabling Winter Cycling in Montreal Street Design and Maintenance Practices (Komorowski, 2019)	Moderate to Low impact depending on number of km affected.	The MMSMH appears to not allow facilities to be closed during the winter.	The Town has Winter Services Levels Ver 3.0 Dec 2021 that includes Bike Lanes. The Town has protected bicycle lanes (e.g. Speers Road) and various on the road non protected bicycle lanes. A multi-use path are not plowed if there is sidewalk beside it; unless signed meeting the definition of bicycle lane.	Consider developing a decision support or guideline on material application for sidewalk including trialling out new technologies or materials.
QL541: Minimizing the Impact of Road salt on Water Quality - Proper Drainage Planning and Design. Limiting salt application to specific areas	Risk Management Measures Catalogue (2019)	Impact: Moderate effectiveness	Compliance with the MMSMH, and meeting LOS and expectations of public.		
An LOS policy should be specified for bicycle facilities.	Salt Management Guide (TAC, 2013)	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. Moderate to Low impact with respect to bicycle facilities	Agencies may find that with freezing rain / sleet followed by flash freezes that more salt is needed to address unsafe conditions than if bare pavement was maintained. This specific event consideration may be appropriate to add to decision support (see below). Caution, changing of the conditions to be met both during and post storm needs to consider safety, public expectations and should include support of elected public policy-makers.		
The LOS policy should specify pavement conditions that is to be maintained: - During a storm: Generally bare and wet; Accumulations of loose snow or slush below MMS prescribed depth; Accumulations of loose snow or slush on a snow packed pavement or unpaved surface below MMS prescribed depth. Post storm: Bare pavement; Centre-bare; Snow packed	Salt Management Guide (TAC, 2013) A Guideline for Developing a Level of Service Policy (OGRA, Ontario Good Roads Association)	High impact, depending on the conditions specified.	Caution, changing of the conditions to be met both during and post storm needs to consider safety, public expectations and should include support of elected public policy-makers.		Research suggests that anti-icing activities may be more important for bicycle lanes, and could be considered for bicycle facilities, with equipment that can apply material on the bicycle lanes.
The LOS policy should be adhered to as specified. LOS creep can occur where public expectations / complaints move the LOS higher (e.g., less time) from the stated LOS, requiring more salt use. This has several components: monitoring LOS attainment, council endorsement of the set LOS, and public education.	Salt Management Guide (TAC, 2013)	Municipalities may exceed the prescribed / approved LOS in response to public complaints / desire for higher LOS, particularly in the face of increased traffic.	Caution, changing of the conditions to be met both during and post storm needs to consider safety, public expectations and should include support of elected public policy-makers.		Monitoring of Cycling LOS attainment so that it is not being achieved but not consistently and significantly overachieved. See section Monitoring and Program Review and Engagement

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5.3 Level of Service: Sidewalks	
Objective	To ensure that a Level of Service (LOS) policy is set and that any revisions are approved by senior management and communicated to winter maintenance personnel. The LOS policy must be clear, functional and understandable to operations personnel and the layperson (e.g. public and politicians). It should make it clear what is to be achieved and what will not be achieved (e.g. there may not be continuous bare pavement conditions throughout a storm). The LOS must meet the minimum described in O.Reg. 366/18 Minimum Maintenance Standards for Municipal Highways.
Rationale	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. The amount of salt use will depend on the LOS, most directly the winter road condition maintained both during and post storm (which relates to road class) and time to achieve the condition. Municipalities may see "LOS-creep" where LOS is continually raised exceed the prescribed / approved LOS in response to public complaints / desire for higher LOS, particularly in the face of increased traffic.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
An LOS policy should be specified	Salt Management Guide (TAC, 2013)	The prescribed / approved LOS is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. Moderate to Low impact with respect to bicycle facilities	None	The Town has Winter Services Levels Ver 3.0 Dec 2021. Sand is used on sidewalks except in BIA's where salt is used.	Expands upon the information in the Winter Services Levels in a guidance / policy document of sidewalks - See Section 8 storm response for decision support tool that could be an option for side walks.
				The Town clears over 2000 bus stops. The service level set by the Town requires for bus stops to be cleared if snow exceeds five centimeters in depth and once the roads have been cleared. Current LOS: Priority is that primary and secondary road transit stops are cleared first, and transit stop clearing is generally completed within 48 hours after the end of the storm. However, when we have a heavy snowfall, or back to back snowfall, it will take longer to clear all stops.	Expands upon the information in the Winter Services Levels in a guidance / policy document of transit bus clearing - See Section 8 storm response for decision support tool that could be an option for bus stops.

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6 ROUTE REVIEW					
Objective	To optimize the use of spreaders and plows by efficient routing in accordance with the LOS expectations.				
Rationale	The LOS establish priorities and leads to determining the amount and type of equipment assigned to routes to cover all service areas during storm conditions. Duplication of service due to inefficient routes leads to redundant salt use and premature plowing of previously salted roads. Well-designed snowplow routes result in snow and ice control service that is both more effective, because roads are cleared more rapidly.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
Routes should be reviewed yearly and at least after any changes to the LOS, fleet size or mix, or when roads are added to / removed from inventory.	Salt Management Guide (TAC, 2013)	Moderate to Low impact, but has optimization benefits.	None	Routes are reviewed, as needed , as the Town expands and adds new development areas for road, sidewalk and transit stops. Town operations group are notified of new road, sidewalk, bicycle lane maintenance areas typically in the fall for both Regional, assumed subdivissions and non assumed subdivissions, which result in the Town adding these areas to pre-existing routes. - All Town routes have their own maps, separated by zones and equipment type, as well as road classification. There are maps for sidewalk, transit stops, roadway and windrow removal program locations.	Consider reviewing annually and updating routing if after changes to the LOS, winter maintenance fleet size or mix, or when roads are added to / removed from inventory.
There are an increasing number of computerized tools to facilitate the routing process, but these tools are not yet widely used by winter maintenance practitioners. From multiple route optimization projects, route length reductions were reported on the order of 5% to 10%, with reductions as high as 50% reported in one case. These projects show that route optimization tools are powerful in improving routing efficiency when coupled with expert judgment in the route design process.	Identifying Best Practices for Snowplow Route Optimization (Dowds, Sullivan, Novak, & Scott, 2016)	Moderate to Low impact, but has optimization benefits.	Cost of tools can be significant	The last review was by an external service provider in 2017. Town is starting the process to analyze the current groth of the Town and modify its equipment complement to deliver effective service and reduce salt usage. Currently, the exercise has been completed for the upcoming 2025-2026 new Town sidewalk contract, as Contracts renew, the same exercise shall follow.	None

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7 FORECASTING OF CONDITIONS	
Objective	To provide timely and accurate weather and pavement information to assist in snow and ice control decision-making.
Rationale	Good snow and ice control decision-making (and thus salt management) depends on consistently accurate and timely weather information. All weather monitoring must be performed at a frequency which enables a winter event response which complies with the MMSMH. Research suggests that most accurate weather sources should be used for winter maintenance within budget limits and other constraints. Pavement temperature is the primary piece of information necessary for determining if frost or ice will form, or snow will accumulate on the pavement. It can fluctuate significantly depending upon the time of day, degree of cloud cover, subsurface conditions (e.g., frost penetration, moisture presence, thermal retention properties, etc.) and type of pavement. Therefore ongoing monitoring of pavement temperatures is important for good snow and ice control decision-making. Salt use optimization is achieved by more accurate deployment of equipment and application of chemicals.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
From October 1 to April 30, the standard is to monitor the weather once every shift or three times per calendar day, whichever is more frequent, at intervals determined by the municipality. Weather monitoring includes both current and that forecasted to occur in the next 24 hours.	O. Reg. 366/18: Minimum Maintenance Standards for Municipal Highways (MMSMH)	Good snow and ice control decision-making (and thus salt management) depends on consistently accurate and timely weather information. Impact: Moderate	None	Reviewed 3 times per day or once per shift minimum: •The Town receives weather updates from the region on a daily basis showing the existing and forecasted conditions of the Regions ARWIS stations. •During the winter months, the Town has road patrollers that monitor road conditions, 24/7/365.	None
Use of weather forecasts and Value Added Meteorological Service (VAMS) to improve decision making and storm response. A subscription to a VAMS provider allows customized weather forecasts four times a day that are specific to your area as well as give you the information you need to adjust the application rates of road salt to meet local pavement and weather conditions.	Salt Management Guide (TAC, 2013), Good Practices for Winter Maintenance in Salt Vulnerable Areas (ORGA, 2018)		Costs for VAMS	Information from Regional VAMS provider. Town has access to additional weather information provided by Conservation Halton	Consider highway camera (Ontario 511 website) to see what weather conditions are coming. Consider Town installing cameras to monitor road conditions (subject to budget approvals), and centralize the monitoring during Winter Events. Consider providing view access to any existing cameras to monitor road conditions.
Use of RWIS to improve understanding of pavement temperature forecasts and trends can improve the accuracy of decision-making.	Salt Management Guide (TAC, 2013)		None	Use 4 RWIS from Region	None
Vehicle-mounted RWIS systems (mobile weather information systems or MWIS): can include pavement freeze point sensor and a friction measuring device.	Standards and Guidance for Using Mobile Sensor Technology to Assess Winter Road Conditions (May 2019) Surveillance, Monitoring and Prediction (FHWA, 2019)		Cost for MWIS	Not used	Consider pilot of mobile weather information systems (MWIS) with regional partners. Consider procuring and implementing a mobile detector, such as the Vaisala MD30 on winter patrol vehicles to have mobile weather data.
Infrared thermometers (IRT) can be used to determine the current surface temperatures.	Salt Management Guide (TAC, 2013), Good Practices for Winter Maintenance in Salt Vulnerable Areas (ORGA, 2018)	Good snow and ice control decision-making (and thus salt management) depends on understanding the pavement characteristics. Impact: High to Moderate	None	IRT on every patroller truck	Have IRT on every salter
For the IRT, there should be procedures on their operation, recording keeping and calibration, plus training.	Salt Management Guide (TAC, 2013)		None	Town is calibrating IRT's as of 2024, including development of procedure and documentation, using the current Ministry standard and procedure as the baseline.	Develop procedures for consistent use and calibration of Infrared thermometers supported by training. Calibration records should be maintained.
Thermal Mapping is a technique to generate road-condition forecasts for entire routes based on particular points and mobile sensors.	None		Costs	None	None

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Non-Invasive Sensors (Mini-RWIS): Non-invasive road weather sensor units are mounted several meters above the surface and measures surface conditions such as: wetness, ice, snow, or frost, water film heights, ice percentage in water, freeze point temperature. Through these measurements, a friction coefficient on the road can be generated. This produces real-time friction level of the road surface that can be used in decisions to plow and/or apply materials and, if used properly, can prevent over application.	Syntheses of Best Practices Road Salt Management 9.0 – WINTER MAINTENANCE EQUIPMENT AND TECHNOLOGIES (TAC, 2013)		Costs, data compatibility	Non-Invasive sensors not considered	Consider pilot of non-invasive sensors (Mini-RWIS) with regional partners. Review potential use of a MDSS (Maintenance decision support system) which may require Mini ARWIS to assist in how much salt we use or need to use.
Road surface traction measurement: Moisture, snow and ice degrade surface friction producing slippery conditions. Road salts and, sometimes, abrasives like sand, are applied to improve traction, increasing the coefficient of friction. Decisions about material application can be improved by having better information about the current friction level of the surface:					
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to: road weather information	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb		None	Reviewed 3 times per day or once per shift minimum	None

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8 STORM RESPONSE AND DECISION SUPPORT	
Objective	To understand a forecasted storm event and implement a consistent and effective snow and ice control response that includes preventative actions as well as contingencies for emergency or unusual conditions in order to meet the LOS.
Rationale	Snow and ice control decisions that are not clearly supported by procedures (including handling unusual and emergency conditions), leads to a less than optimal use of salt , usually more. At its most complex, these decision support procedures become expert systems. Maintenance Decision Support System (MDSS) is, in its most general terms, an automated tool for providing decision support to winter road maintenance managers. In a broader sense, MDSS is a multi-layered, information system that provides forecasts, predictions, reports on observed weather and road conditions. There are benefits and issues expressed regarding MDSS programs. A case study of New Hampshire's five previous winters showed that, had MDSS been used, 23% less salt could have provided the same level of service. (2010 Transportation Pooled Fund Study TPF-5(054) Maintenance Decision Support System). Trail stakeholders were interviewed and they generally had a positive view of the MDSS (Western Transportation Institute and Tiers, Inc. 2010).

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Anti-icing is the proactive winter maintenance practice of adding road salt or other chemicals to the road prior to the winter event. It has been shown to improve level of service (LOS); reduce the need for products, abrasives or plowing; and associated cost savings and safety and mobility benefits. Direct liquid application (DLA) has emerged as the most commonly used proactive winter maintenance practice.	Salt Management Guide (TAC, 2013), Good Practices for Winter Maintenance in Salt Vulnerable Areas (ORGA, 2018), others	Generally speaking, anti-icing is an effective practice at reducing application of winter maintenance products relative to other practices, such as deicing, because lower application rates can be used. Impact: High to Moderate	Cost of additional equipment, lack of experience / expertise in using anti-icing approaches, public concern.	The Town uses DLA on regional roads and primary roads. DLA is effective for frost on bridge decks and for snow storms, it allows for additional de-icing salts to active faster. During core winter months, salt residual from operations means the Town will not require to apply DLA on roads. Town is piloting DLA on secondary roads for effectiveness on snow removal.	Look to expand anti-icing program / DLA Explore alternative DLA materials such as enhanced brines or other liquids on a trial basis.
QL539: Minimizing the Impact of Road salt on Water Quality - Anti-icing. Anti-icing is the timely application of chemical freezing point depressants to roadways before snow and ice accumulate. This prevents the formation of a bond between slippery snow and ice and the roadway, thereby facilitating mechanical removal.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
Decision Support is a tool to help analyze the various information (weather conditions, pavement temperature, equipment etc.) in order to come to optimal response decisions. Expert Guides can take different forms and have different levels of sophistication. Examples of Expert Guides in common use include: decision trees that document successful experiences that can be repeated or a Table with headings such as: temperature range, type of precipitation, road condition, activity (plow, sand, salt), and recommended treatment (beginning, during, end of storm). This should include roads, cycle lanes, MUT, and sidewalks.	Salt Management Guide (TAC, 2013), Maintenance Decision Support System (FHWA, 2019)	Generally speaking, Decision support and the more elaborate MDSS programs are effective at reducing salt use as it allows agencies to better customize responses to winter events and optimize material use. Impact: High effectiveness	None	Town operations is developing a winter operations (and salt) application guideline for roads for decision support. Estimating a 2025 completion for roads which will then be monitored and fine tuned over the subsequent seasons. Guideline shall streamline our operations providing a decision support whose main goal is to optimize salt usage.	Create a decision support tool to include MDSS (Software) in future years with several application rates and/or investigate and pilot a tool for region-wide application, that could include sidewalks and bus stops.
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to using ... decision support systems.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb				
QL535: Minimizing the Impact of Road salt on Water Quality - Reduce Salt Use. Application guidelines: -To prevent over-application, established amounts of salt per unit area for specific temperature ranges and timing, with respect to snowfalls, should be calculated. -Crews should be well trained to adhere to the standards and ensure that application rates are consistent. -There should be regular reviews and adjustments to the materials and amounts applied as conditions dictate.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
QL535: Minimizing the Impact of Road salt on Water Quality - Reduce Salt Use. Application guidelines: -Consider sanding - Rely on plowing: in general, mechanical removal should be used in preference to salting where both methods are shown to be equally effective, economical and practical.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)	Depending on conditions, prioritizing plowing and use of abrasives (sanding) help reduce salt use. Impact: High effectiveness	Cost to implement and maintain the system, could be significant data acquisition costs and issues	Plowing and use of abrasives (e.g., residential streets) are prioritized.	None

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
MDSS (a computerized expert system) is an innovation that was developed and investigated in the early 2000s. There are benefits and issues expressed regarding MDSS programs.	Salt Management Guide (TAC, 2013), Maintenance Decision Support System (FHWA, 2019)	Generally speaking, decision support and the more elaborate MDSS programs are effective at reducing salt use as it allows agencies to better customize responses to winter events and optimize material use. Impact: High effectiveness	Cost to implement and maintain the system, could be significant data acquisition costs and issues	Not Considered	See item #17 recommendations on Town to consider a MDSS tool subject to budget approval process.

9.1 SOLIDS (rates)

Municipal* Application Rates					Town of Oakville				
Identifier	**Rate*** **	**Units**	**Pre-Wet Rate**	**Comments**	**Identifier**	**Rate**	**Units**	**Pre-Wet Rate**	**Comments**
Anti-icing					**Anti-icing**				
	N/A	N/A	N/A	Not typically used		N/A	N/A	N/A	Not used for anti-icing
Anti-icing					**Plowing**				
					Single Spinner (2 lane km) Application Rate for either only left or right spinner operation, to apply salt on 2 lanes per km only with one spinner at the rate shown below.				
	N/A	N/A	N/A	Not typically used	Always	130	kg/2lane km*	N/A	Plowing operations carried out on primary and secondary roads with combination spreaders salt while plowing, this is to allow bare pavement to be achieved and prevent further snowfall from bonding with the road which would prevent us from meeting standard.
De-icing					**De-icing**				
					Single Spinner (2 lane km) Application Rate for either only left or right spinner operation, to apply salt on 2 lanes per km.				
Frost Rate	50-70	kg/2lane km	20 - 25%**	Brine pre-wet	Town uses DLA for Frost, not direct salt application, reducing in cost reduction as DLA rate is lower.				Town does not use a light rate, for frost, Town uses DLA.
Light	70-105	kg/2lane km	20 - 25%	Brine pre-wet	Low A	100	kg/2lane km*	20%	Town application rates to be supported by a suggested application rate guideline for various types of wintry precipitation and temperatures. Following 407 ETR developed rates tailored to the Town and adjusted based on MTO and FHWA developed practices, including that of integrating use of Type II salts.
					Low B	130			
Medium	130-154	kg/2lane km	20 - 25%	Brine pre-wet	Medium	150	kg/2lane km*	20%	
Heavy	200	kg/2lane km	20 - 25%	Brine pre-wet	High	200	kg/2lane km*	20%	

* Based on Peer and comparable municipalities with similar climate supplement with values from guidance documents and others because the municipal data set is weak due to lack of current information and lack of confidence in some of the values reported.

** Test results show that using a pre-wet ratio of 20% results in higher friction values while consuming less amount of material on highways. (Usman; Fu; Kaur; Perchanok and McClintock, 2018)

*** Field research has documented equal or improved performance of 20% less pre-wetted salt compared to dry salt (Pre-wetting and Anti-icing — Techniques for Winter Road Maintenance, Wisconsin Transportation Bulletin (Wisconsin Transportation Information Center, 2005)

*In 2024, the Town has modified all its salt application rates. This is to support the 2024 Town application rate guideline and decision support for the team. This will substantially reduce salt usage as staff will be able to rely on this guideline when they are deploying winter operations, as opposed to prior practices, where it was based on individual personal judgement and preferences.

Appendix A

9.1 MATERIALS - SOLIDS					
Objective	To provide the right material, right amount, at the right time and in the right place to optimize material use with respect to safety, cost, equipment available and protection of the natural and built environments.				
Rationale	The types and phases materials should be optimized to support the winter event response decisions in order to meet the LOS in a manner that is responsive to equipment available, fiscal demands and safety.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
EC Target 6) Adopting either increasing pre-wetting capacity or using pre-treated salts 75% of vehicles equipped for pre-wetting, or 100% use of pre-treated materials. QL536: Minimizing the Impact of Road salt on Water Quality - Pre-Wetting Salt. Pre-wetting salt decreases the amount of road salt or sand required without decreases in levels of service.	Performance indicators and national targets for environmental management of road salts (ECCC, 2019) Salt Management Guide (TAC, 2013) Risk Management Measures Catalogue (2019)	Pre-wetting has shown to increase the performance of solid products or abrasives and their longevity on the roadway surface, thereby reducing the amount of materials required. Studies suggest that pre-wetting salt reduce salt loss by up to 30%: Pre-treated material is now offered on the market as a cost-effective alternative that can provide similar results. Impact: High Effectiveness	Costs of additional equipment Time to full tanks during event Education and training in its use Maintained of equipment	Town already using pre-treated salt, currently using Thawrox which is a magnesium chloride coating on regular salt, allowing it to be more effective at low temperatures, resulting in less volume required to melt equivalent amount of snow than it would be by using regular salt. In 2025, the combination spreader truck specifications will be revised to include pre-wet systems with variable application up to 30% and if possible (budgetary constraint) up to 2,200 litre tank holding capacity. As the fleet renews, the Town will pursue consistenty in its pre-wet usage, as current fleet is limited.	A review of the benefits of using pre-treated salt (e.g., Thawrox - calcium cloride with magnesium chloride and a viscosity modifier) and if effective, will it achieve an overall reduction in chloride loading.
QL536: Minimizing the Impact of Road salt on Water Quality - Pre-Wetting Salt. Pre-wetting decreases the amount of road salt or sand required without decreases in levels of service. A variety of liquids may be used for pre-wetting road salt. These include sodium chloride, calcium chloride, magnesium chloride, potassium acetate, and calcium magnesium acetate in brine solutions. Water can also be an effective pre-wetting agent provided that the temperature is relatively high.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
Using the right amount of salt (i.e., only the amount need to effectively meet the LOS / safety goals) is key to reducing the amount of salt introduced into the environment. 12-MECC: Reduce de-icing chemical application rates to the minimum amount necessary to successfully perform the job.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	The LOS sets the performance requirements and the application rates should be tuned to meet the LOS based on the winter event without over-achieving. Impact: High Effectiveness	Safety is paramount and drives the desire to apply materials at a rate to overachieve the LOS.	See Section 12 Monitoring and Reporting for review of determining LOS has been met.	
Having multiple application rates for solids allows better matching of salt application to conditions and thus optimizes salt use.	Salt Management Guide (TAC, 2013)	Coupled with decision support tools, multiple application rates can optimize salt use. Impact: Moderate to High depending on rates used	Education and training on using multiple rates, should have a decision support to maximize benefit.	The rates are set by the Town. Application rates in Section 9.1. Town is working on the decision support guideline to support application rates.	Based on peers and research (see Section 9.1), a review of the existing rates for opportunties / benefit of having another rate and reducing existing rates, especially when combined with decision support tool (Section 8).
Depending on their composition and how they are used, alternatives to road salt (NaCl) can reduce or replace the use of road salt.	Salt Management Guide (TAC, 2013)	Impact: High effectiveness	Cost: alternatives to sodium chloride (road salt) are more expensive (can be 10s to 100 times more expensive) Alternatives have environmental impacts as well. For example CMA can contribute to biochemical oxygen demand, and KA has been known to impact asphalt and concrete pavements. Alternatives have different properties that may require alternative equipment for use, different operational / environmental considerations for effectiveness etc.	Town currently uses Type II treated Salt (Thawrox) for temperatures below -15C, but has not standardized a process on its use and rates. The initial standardization on a pilot project to use thawrox at lower amounts as opposed to regular salt is being undertaken, to pilot in the 2024-2025 season.	Consider leading or participating in a review and/or pilot test of using various pre-treated salt (e.g., Thawrox - calcium cloride with magnesium chloride and a viscosity modifier) that includes determining if it will result in an overall reduction in chloride loading. A cost benefit anaylis could be undertaken eventually to justify increase in budget on alternate salts to decrease the volume applied on the road vs cost.
QL540: Road Salt Alternatives - Other Alternatives to Sodium Chloride. Several freezing point depressants are available for road de-icing as alternatives to NaCl. Their efficiency as de-icers, and their relative effects on the environment need to be reviewed on an individual basis. Calcium Chloride (Ca Cl2), Calcium Magnesium Acetate (CMA) (see QL533 for description), Magnesium Chloride (MgCl2), Potassium Acetate (see QL534 for description), Potassium Chloride (KCl) Sodium Salts of Carboxylic Acids. Regular reviews of products available in the market and discussion with other communities regarding alternative de-icers are recommended. Clear Roads has developed procedures for considering low chloride or no-chloride alternatives. These include Determining the Toxicity of Deicing Materials (December 2013). Determining Effectiveness of Deicing Materials and Procedures (December 2009) and Development of Standardized Test Procedures for Evaluating Deicing Chemicals (March 2010)	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to using the most recent advancements in the application of winter maintenance anti-icing and de-icing materials.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb				
17-MECC: Certain chemical substances such as nitrates and phosphates (for example, urea) and organic substances such as methanol, alcohol, or ethylene glycol present particular hazards to the aquatic environment and should not be used in bulk as deicers except in special circumstances.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Not applicable	Not applicable	Not used	None

9.2 LIQUIDS (rates)								
	Municipal* Application Rates				Town of Oakville			
	Range	Rate	Units	Comments	Identifier	Rate	Units	Comments
Pre-wet								
Brine		33-50	L/tonne	Wisconsin Transportation Bulletin No. 22 Pre-wetting and Anti-icing — Techniques for Winter Road Maintenance (2005)	Standard	20%	L/tonne	To start 2025-2026 season
MgCl2 blends		20-60	L/tonne	For example, ProMelt Ultra: made from a refined corn carbohydrate derivative blended with magnesium chloride, Promelt Meg (30% MgCl2):				
Other								
Anti-Icing (DLA)								
Brine	Low	37-56	L/ln-km	Rates are weather and pavement temperature dependent (from Blackburn and Associates, 2014)	Low	60	L/ln-km	Frost
	Average	67	L/ln-km		Medium	80	L/ln-km	Light Snow
	High	82-117	L/ln-km		High	100	L/ln-km	Moderate Snow
MgCl2 blends		40-70	L/ln-km	Promelt Meg (30% MgCl2): Manufactures recommendations: 40 - 70 litres per lane kilometre are typical, up to 90 litres per lane kilometre max Some users found MgCl2 too humidity and temperature dependent, and slippery				
Other								

* Based on comparable municipalities with similar climate supplement with values from guidance documents and others because the municipal data set is weak due to lack of current information and lack of confidence in some of the values reported.

Appendix A

9.2 MATERIALS - LIQUIDS					
Objective	To provide the right material, right amount, at the right time and in the right place to optimize material use with respect to safety, cost, equipment available and protection of the natural and built environments.				
Rationale	The types and phases materials should be optimized to support the winter event response decisions in order to meet the LOS in a manner that is responsive to equipment available, fiscal demands and safety.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
Using the right amount of salt (i.e., only the amount need to effectively meet the LOS / safety goals) is key to reducing the amount of salt introduced into the environment. 12-MECC: Reduce de-icing chemical application rates to the minimum amount necessary to successfully perform the job.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	The LOS sets the performance requirements and the application rates should be tuned to meet the LOS based on the winter event without over-achieving. Impact: High Effectiveness	Safety is paramount and drives the desire to apply materials at a rate to overachieve the LOS.	Anti-icing with in-house produced brine is conducted on regional and primary roads when needed, mostly when frost is forecasted on elevated surfaces. Typically during the core winter months, the salt residual may be enough to have that additional anti-icing layer on the pavement. Anti-icing is applied on an as required basis, typically 1 day prior frost is forecasted. Town will continue DLA practices of anti-icing in the next seasons, focusing on secondary and even explore DLA on residential roads as a trial.	Opportunities to expand anti-icing program to secondary roads and perhaps sidewalks. It should be piloted to determine if advantageous.
Having multiple application rates allows better matching of salt application to conditions and thus optimizes salt use.	Salt Management Guide (TAC, 2013)	Coupled with decision support tools, multiple application rates can optimize salt use. Impact: Moderate to High depending on rates used	Education and training on using multiple rates, should have a decision support to maximize benefit.		
Anti-icing (often via direct liquid application or DLA) has emerged as the most commonly used proactive winter maintenance practice.	Salt Management Guide (TAC, 2013)	It has been shown to improve level of service (LOS); reduce the need for products, abrasives or plowing; and associated cost savings and safety and mobility benefits. Generally speaking, anti-icing is an effective practice at reducing application of winter maintenance products relative to other practices, such as deicing, because lower application rates can be used. Impact: High effectiveness	Purchase and storage of liquid chemicals, cost of specialized equipment, training in use of anti-icing strategy		

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Depending on their composition and how they are used, alternatives to road salt (NaCl) can reduce or replace the use of road salt.	Salt Management Guide (TAC, 2013)	Impact: High effectiveness	Cost: alternatives to sodium chloride (road salt) are more expensive (can be 10s to 100 times more expensive) Alternatives have environmental impacts as well. For example CMA can contribute to biochemical oxygen demand, and KA has been known to impact asphalt and concrete pavements. Alternatives have different properties that may require alternative equipment for use, different operational / environmental considerations for effectiveness etc.	None, given in-house brine production. As the Town replaces the brine tanks, agitators to be installed for the Town to try using blended brines (e.g. pro melt) which are additives added to regular salt brine, which allows the brine to be used at temperatures below -8C for pre-wetting and anti-icing. Town has tried alternatives such as beet juice, some to no success due to clogging of equipment. Town will be actively looking to explore other alternatives, especially those beneficial for lower temperatures below -8C, where regular salt brine is not effective.	None
QL540: Road Salt Alternatives - Other Alternatives to Sodium Chloride. Several freezing point depressants are available for road de-icing as alternatives to NaCl. Their efficiency as de-icers, and their relative effects on the environment need to be reviewed on an individual basis. Calcium Chloride (Ca Cl2), Calcium Magnesium Acetate (CMA) (see QL533 for description), Magnesium Chloride (MgCl2), Potassium Acetate (see QL534 for description). Potassium Chloride (KCl) Sodium Salts of Carboxylic Acids. Regular reviews of products available in the market and discussion with other communities regarding alternative de-icers are recommended.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
17-MECC: Certain chemical substances such as nitrates and phosphates (for example, urea) and organic substances such as methanol, alcohol, or ethylene glycol present particular hazards to the aquatic environment and should not be used in bulk as deicers except in special circumstances.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)				
18-MECC: Certain rock salt additives are environmentally hazardous. Rust inhibitors (e.g.. hexavelant chromium) can impair water quality and should not be used. Ferric ferrocyanide, commonly added as an anti-caking agent, has not proven hazardous in the small quantities found in road salt.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)				
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to using the most recent advancements in the application of winter maintenance anti-icing and de-icing materials	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb				

Appendix A

9.3 MATERIALS - ABRASIVES					
Objective	To optimize the amount of salt in sand/salt blends required to ensure the abrasives function effectively in snow and ice control.				
Rationale	High amounts of salt in sand/salt blends can result in excessive salt entering the environment for the task, and there are some indications that sand may reduce the effectiveness of salt.				
				Town of Oakville	
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Current Practice**	**Gap and Opportunity for Improvement**
15-MECC: Where salt/sand mixtures are applied, incorporate into the admixture only enough salt to achieve the desired results. For most applications, only enough salt should be added to abrasives to keep the abrasives free flowing under freezing conditions (3 to 5%).	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Research suggests that abrasive /mixes with a high percentage of salt for a combination of melting and traction, tends to result in salt overapplication.	Historical practices may be hard to change	Sand is used on residential roads, under snow packed road condition. Sand is also used for residential sidewalks. However, depending on service level and for safety, due to large volume of pedestrian traffic, the BIA's are salted.	Consider reducing salt added to abrasives. Consider investigating anti-icing (DLA) or other approaches to have the right amount of salt at the right time

Appendix A

10 SALT VULNERABLE AREAS					
Objective	To determine if any vulnerable areas are potentially impacted by the use of salt.				
Rationale	Salt vulnerable areas may require unique solutions that may require the use of other strategies/methods or more expensive de-icers to maintain sensitive areas.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
EC Target 7) Salt Vulnerable Areas are identified and an action plan is prepared to prioritize areas where best available techniques economically achievable are considered. Completed by 2024	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)	To improve progress in identifying, monitoring and protecting areas that may be particularly sensitive to road salts. Impact: Low to medium overall but high in specific areas	No standard approach for SVA has been developed. Experience shows that it is difficult to differentiate areas because of data availability, level of detail etc. Can be very impractical to have winter maintenance approaches that are different for lengths of roads or areas.	The Town considers the Salt Vulnerable Areas (SVA) identified in the relevant Source Protection Plans. No other SVAs identified.	Consider the need to expand Salt Vulnerable Area to include other areas such as listed in MECC's Code of practice for the environmental management of road salts
QL546: Minimizing the Impact of Road salt on Water Quality - Identification of Salt-Sensitive Areas. Identification of salt-sensitive areas, ecosystems, waterbodies and aquifers which require special reductions in the application of salt on relevant stretches of roadway. Alternative chemicals, more efficient use of salt, reliance on abrasives and changes to the road surface are possible means of achieving such a reduction. Salt vulnerable areas need to be identified and the potential for salt impacted drainage to affect these vulnerable areas must be assessed. Special design modifications to traditional stormwater management measures may be warranted to protect these salt vulnerable areas. Measures may include clay or geosynthetic liners in conveyance ditches and ponds, infiltration ponds where appropriate, or use of storm sewers to transport drainage past vulnerable areas. Salt vulnerable areas could include: - areas draining into bodies of water with low dilution, low volume or salt sensitive species; - areas adjacent to salt sensitive vegetation and agricultural operations; - areas draining into a source of drinking water (surface water and groundwater); and - areas associated with groundwater recharge zones or shallow water table, with medium to high permeability soils. The assessment of alternative sites should consider the potential chloride loadings to salt vulnerable areas and whether or not these loadings could have any adverse effects. Sites that have the potential to adversely affect vulnerable areas even after applying best management practices should be eliminated from further consideration.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
16-MECC: Consider special protective measures when de-icing chemicals are applied to places in proximity to very salt-sensitive areas (e.g., orchards, parks).	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)				
QL546: Minimizing the Impact of Road salt on Water Quality - Identification of Salt-Sensitive Areas. Identification of salt-sensitive areas, ecosystems, waterbodies and aquifers which require special reductions in the application of salt on relevant stretches of roadway.	Risk Management Measures Catalogue (2019)				
CODE-30: The guidance for identifying vulnerable areas provided in Annex B should be considered during the development and implementation of the salt management plan.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb				
CODE-32: Additional salt management measures in vulnerable areas may include: [1] using technologies that further optimize the use of road salts; [2] using environmentally, technically and economically feasible alternatives to road salts; [3] increasing monitoring and measuring of chlorides and/or their impacts; [4] locating patrol yards and snow disposal sites outside of vulnerable areas; [5] considering location and protection of vulnerable areas in the design of new roads and/or upgrading of existing roads.	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb			The Town's approach is to optimize the application of road salt at all locations, this includes using technologies like direct liquid application for anti-icing. For salt use monitoring, see Section 12. The locating of new patrol yards or snow disposal sites will be outside of vulnerable areas. See Section 2 for input into design of new roads and/or upgrading of existing roads.	None
T-34-C: Application, and handling and storage of road salt Legal Effect: Part a - Must comply with - legally binding. List (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Existing and Future Where the existing and future application, or handling and storage of road salt would be a significant drinking water threat in a wellhead protection area, intake protection zone or issue contributing area: a. the City of Hamilton, Regional Municipality of Halton, Town of Milton, Town of Halton Hills, Town of Oakville, City of Burlington shall continue their established, related education and outreach programs. In addition, within two years of the date that the updated Source Protection Plan comes into effect, the City of Hamilton and the Region of Halton, in collaboration with the City of Burlington and Towns of Milton, Halton Hills and Oakville in Halton Region, are requested to develop and implement education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices. It is recommended that the key messages be the efficient use of road salts and the use of alternatives to help address newly identified threats. b. the City of Hamilton and the Region of Halton shall document the nature of any new or existing education and outreach program established regarding the application, and handling and storage of road salt, the number of persons contacted, and the location of the participants and report this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	Wellhead protection area, intake protection zone or issue contributing area are identified in the Salt Management Plan.	Requirement, Determine where the existing and future application, or handling and storage of road salt would be a significant drinking water threat in a wellhead protection area, intake protection zone or issue contributing area. See Section 16 for education and outreach programs

Appendix A

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
T-32-C: Application, and handling and storage of road salt Legal Effect: Must conform with – legally binding; Parts a and b, (parts c and d are monitoring policies). Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future Where the future handling and storage of road salt would be a significant drinking water threat: a. within a wellhead protection area and issue contributing area, the Region of Halton, Town of Milton, Town of Halton Hills, and the City of Hamilton shall prohibit through Planning Act tools salt storage facilities with greater than 5,000 tonnes of capacity. b. within an issue contributing area a risk management official shall establish risk management plans with persons proposing to construct salt storage facilities of 5,000 tonnes or less. The implementation of these risk management plans shall be overseen by a risk management inspector. c. the risk management official shall document in their annual report, in accordance with section 65 of Ontario Regulation 287/07, action taken regarding risk management plans for the handling and storage of road salt and submit this report to the Source Protection Authority by February 1 of each year. d. the municipal planning authority shall provide copies of their planning documents to the Source Protection Authority when they have been amended to conform with the policies to prohibit the salt storage and handling facilities.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	N/A	N/A
T-53-C: Application, and handling and storage of road salt and Storage of snow Legal Effect: Parts a and b Must conform with - legally binding. (Part d is a monitoring policy) Where Policy Applies: see Figures 2 to 11. When Policy Applies: Future To facilitate the effective implementation of policies for significant drinking water threats and assist in municipal decision-making, a. the municipal planning authorities are requested to require proponents to disclose whether any of the following activities are expected to occur on the property where they would be significant drinking water threats, proposed storage location, where applicable, as well as the substances utilized or stored and their volume: v. the application, or handling and storage of road salt vi. the storage of snow b. the City of Hamilton, the Region of Halton, and the County of Wellington are requested to require a full disclosure report as part of a complete application under the Planning Act. c. Repealed. d. the municipal planning authority shall report to the Source Protection Authority by February 1 of each year on actions taken to amend municipal documents/processes to require disclosure of threat activities and the number of disclosure reports that were received in the previous year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	Snow stockpile comes to Central Operations yard. Town is planning to find a location in North Oakville for a future snow storage yard.	Consider requiring proponents to disclose details of any proposed application, handling or storage of road salt, or snow storage where they would be significant drinking water threats
T-35-C: Application, and handling and storage of road salt Legal Effect: Part a - Must comply with - legally binding.(Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Existing and Future Where the existing and future application, or handling and storage of road salt would be significant drinking water threats, a. within two years of the date that the Source Protection Plan comes into effect, the municipalities shall amend their salt management plans to identify the location of wellhead protection areas, issue contributing areas, and intake protection zones and to enhance best management practices in these areas. b. the municipalities shall advise the Source Protection Authority of the revision to the salt management plans when completed and provide a status update by February 1 of each year until completed.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	The Salt Management Plan identifies the location of wellhead protection areas, issue contributing areas, and intake protection zones. The Town's approach is to optimize the application of road salt at all locations, this includes using technologies like direct liquid application for anti-icing.	Consider advising the Source Protection Authority of the revision to the Salt Management Plan
T-49-S Application, and handling and storage of road salt Legal Effect: Part a - Strategic - non-legally binding. (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future To raise awareness of mapped drinking water sources and seek collaboration on the use of best practices for the application of road salt where this activity would be a future significant, moderate or low threat on private properties, a. de-icing contractors are requested to develop and/or amend their salt management plans for private properties to identify the location of wellhead protection areas and intake protection zones, and to use best management practices to protect drinking water sources within these areas. b. the Halton Region and Hamilton Region Conservation Authorities shall request the Smart About Salt organization and Ministry of Transportation Ontario to consult with private de-icing contractors to determine if their salt management plans identify the location of vulnerable areas for drinking water source protection and report on this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	N/A	N/A
T-61-S Application, and handling and storage of road salt Legal Effect: Part a - non-legally binding. (Part b is a monitoring policy) Where Policy Applies: See Figures 12, 13, 14, 15. • Moderate threats: WHPA-A -V. score 10; WHPA-B – V. score 10, 8; WHPA-C – V. score 8; WHPA-E - V. score 9, 8.1; IPZ-1 – V. score 7. • Low threats: WHPA-A -V. score 10; WHPA-B – V. score 10, 8, 6; WHPA-C – V. score 8, 6; WHPA-D – V. score 6; WHPA-E - V. score 8.1; IPZ-1 – V. score 7, 6; IPZ-2- V. score 6.3, 5.4, HVA – V. score 6WHPA-A & B – V. score 10; WHPA-E – V. score 9 When Policy Applies: Existing and Future Where the existing and future application, or handling and storage of road salt would be moderate or low drinking water threats: a. within two years of the date that the Source Protection Plan comes into effect, the municipalities shall amend their salt management plans to identify the location of wellhead protection areas, issue contributing areas, and intake protection zones and to enhance best management practices in these areas. b. the municipalities shall advise the Source Protection Authority of the revision to the salt management plans when completed and provide a status update by February 1 of each year until completed.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	The Salt Management Plan identifies the location of wellhead protection areas, issue contributing areas, and intake protection zones. The Town's approach is to optimize the application of road salt at all locations, this includes using technologies like direct liquid application for anti-icing.	The Town could advise the Source Protection Authority of the revision to the Salt Management Plan

Appendix A

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
T-37-C Storage of snow Legal Effect: Part a - Must conform with - legally binding. (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future Where the future storage of snow would be a significant drinking water threat: a. in a wellhead protection area and issue contributing area, the Region of Halton, the Towns of Milton and Halton Hills and the City of Hamilton shall prohibit through Planning Act tools snow storage facilities that are at or above grade at greater than one hectare in size or, below grade, at or greater than 0.01 hectare in size. b. the Region of Halton, the Towns of Milton and Halton Hills and the City of Hamilton shall provide copies of their planning documents to the Source Protection Authority when they have been amended to conform with the policy to prohibit snow storage facilities of these sizes.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	N/A	N/A
T-39-C Storage of snow Legal Effect: Part a - Must conform with - legally binding. (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future Where the future storage of snow would be a significant drinking water threat in an issue contributing area: a. the municipal planning authority shall require at site plan approval that best management practices for site design to protect drinking water sources be included to manage snow storage and the associated melt water at snow storage facilities at or above grade between 0.01 and 1 hectare in size. b. the municipal planning authority shall document the number of new site plan applications reviewed, and the conditions imposed for the management of snow storage and melt water runoff and report this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	See Section 14 Snow Removal	See Section 14 Snow Removal
T-53-C a Storage of snow Legal effect: Parts a and b Must conform with - legally binding. (Part d is a monitoring policy) Where Policy Applies: see Figures 2 to 11 When Policy Applies: Future To facilitate the effective implementation of policies for significant drinking water threats and assist in municipal decision-making, a. the municipal planning authorities are requested to require proponents to disclose whether any of the following activities are expected to occur on the property where they would be significant drinking water threats, proposed storage location, where applicable, as well as the substances utilized or stored and their volume: v. the application, or handling and storage of road salt vi. the storage of snow b. the City of Hamilton, the Region of Halton, and the County of Wellington are requested to require a full disclosure report as part of a complete application under the Planning Act. d. the municipal planning authority shall report to the Source Protection Authority by February 1 of each year on actions taken to amend municipal documents/processes to require disclosure of threat activities and the number of disclosure reports that were received in the previous year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	See Section 17 Parking Lots and Private Infrastructure	See Section 17 Parking Lots and Private Infrastructure
T-49-S Application, and handling and storage of road salt Legal Effect: Part a - Strategic - non-legally binding. (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future To raise awareness of mapped drinking water sources and seek collaboration on the use of best practices for the application of road salt where this activity would be a future significant, moderate or low threat on private properties, a. de-icing contractors are requested to develop and/or amend their salt management plans for private properties to identify the location of wellhead protection areas and intake protection zones, and to use best management practices to protect drinking water sources within these areas. b. the Halton Region and Hamilton Region Conservation Authorities shall request the Smart About Salt organization and Ministry of Transportation Ontario to consult with private de-icing contractors to determine if their salt management plans identify the location of vulnerable areas for drinking water source protection and report on this information to the Source Protection Authority by February 1 of each year.	N/A	N/A	N/A	See Section 17 Parking Lots and Private Infrastructure	See Section 17 Parking Lots and Private Infrastructure
T-60-S: Storage of snow Legal Effect: non-legally binding Where Policy Applies: see Figures 12 to 15 • Moderate threats: WHPA-A -V. score 10; WHPA-B – V. score 10, 8; WHPA-C – V. score 8; WHPA-E - V. score 9, 8.1; IPZ-1 – V. score 7. • Low threats: WHPA-A -V. score 10; WHPA-B – V. score 10, 8, 6; WHPA-C – V. score 8, 6; WHPA-D – V. score 6; WHPA-E - V. score 8.1; IPZ-1 – V. score 7, 6; IPZ-2- V. score 6.3, 5.4, HVA – V. score 6, When Policy Applies: Existing and Future Where the existing and future application, or handling and storage of road salt would be a moderate or low drinking water threat in a wellhead protection area, intake protection zone or issue contributing area, a, the City of Hamilton, Regional Municipality of Halton shall continue their established, related education and outreach programs, In addition, within two years of the date that the Source Protection Plan comes into effect, the City of Hamilton and the Region of Halton, in collaboration with the City of Burlington and Towns of Milton, Halton Hills and Oakville in Halton Region, are requested to develop and implement education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices. It is recommended that the key messages be the efficient use of road salts and the use of alternatives. b. the City of Hamilton and the Region of Halton shall document the nature of any new or existing education and outreach program established regarding the application, and handling and storage of road salt, the number of persons contacted, and the location of the participants and report this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	Moderate and Low threats are identified in the Salt Management Plan.	See Section 16 for education and outreach programs
SAL-1 Application of Road Salt (Unassumed Roads and Private Parking Lots) Part IV, s.58: For unassumed roads and private parking lots with greater than 200 square metres, the application of road salt is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is, or would be significant, in any of the following areas: WHPA-A (existing, future); or WHPA-B (VS = 10) (existing, future); or WHPA-E (VS ≥ 9) (existing, future); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Without limiting other requirements, risk management plans shall include a goal to minimize salt usage through alternative measures, while maintaining roadway safety for users.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 17 Parking Lots and Private	See Section 17 Parking Lots and Private

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
SAL-2 Application of Road Salt (Public Roads) Part IV, s.58: For public roads, the application of road salt is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is, or would be significant, in any of the following areas: WHPA-A (existing, future); or WHPA-B (VS = 10) (existing, future); or WHPA-E (VS ≥ 9) (existing, future); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Without limiting other requirements, risk management plans shall include provisions for: a) the reduction of salt usage through best management practices such as alternative de- icer materials (with lower sodium and chloride) and/or contemporary technology; and b) the use of trained individuals in the application of road salt (could include technicians and technologists and others responsible for salt management plans, winter maintenance supervisors, patrollers, equipment operators, mechanics, and contract employees).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	The Town's Salt Management Plan address the reduction of salt usage through best management practices and the use of trained individuals.	The Town can confirm with CTC that the salt management plan is suitable as the risk management plan
SAL-3 Application of Road Salt Land Use Planning: Where the application of road salt to roads and parking lots would be a significant drinking water threat, the planning approval authority shall: 1) Prohibit the establishment of new parking lots with greater than 2000 square metres in: WHPA-A not in an Issue Contributing Area for Sodium or Chloride (future); 2) Prohibit the establishment of new parking lots with greater than 200 square metres in: WHPA-A in an Issue Contributing Area for Sodium or Chloride (future); and 3) Require a salt management plan, which includes a reduction in the future use of salt, as part of a complete application for development which includes new roads and parking lots where the application of road salt is significant in any of the following areas: WHPA-B (VS = 10) (future); or WHPA-E (VS ≥ 9) (future); or the remainder of an Issue Contributing Area for Sodium or Chloride (future). Such plans should include but not be limited to mitigation measures regarding design of parking lots, roadways and sidewalks to minimize the need for repeat application of road salt such as reducing ponding in parking areas; and directing stormwater discharge outside of vulnerable areas where possible.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 17 Parking Lots and Private Infrastructure	See Section 17 Parking Lots and Private Infrastructure
SAL-7 Handling and Storage of Road Salt Part IV, s.57, s.58: Where the handling and storage of road salt is, or would be, a significant drinking water threat (excluding incidental quantities for personal use), the following actions shall be taken: 1) The handling and storage of road salt is designated for the purpose of s.57 under the Clean Water Act, and is therefore prohibited where the threat would be significant in any of the following areas: WHPA-A (future); or WHPA-B (VS = 10) (future); or WHPA-E (VS ≥ 9) (future); or the remainder of an Issue Contributing Area for Sodium or Chloride (future). 2) The handling and storage of road salt is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is significant in any of the following areas: WHPA-A (existing); or WHPA-B (VS = 10) (existing); or WHPA-E (VS ≥ 9) (existing); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 13 Materials Storage and Handling	See Section 13 Materials Storage and Handling
SAL-8 Application of Road Salt, Handling and Storage of Road Salt Education and Outreach: The municipality shall deliver education and outreach materials and programs where the application, handling and storage of road salt is, or would be, a significant drinking water threat, targeted towards: a) owners/tenants of residences and small businesses where the application, handling and storage of road salt (existing, future) is, or would be, a significant drinking water threat about the impact of salt on municipal drinking water and what they can do to reduce their use of salt to ensure that the activity ceases to be, or does not become, a significant drinking water threat; and b) commercial and industrial sectors to address the importance of source protection planning and the impacts of road salt on drinking water sources, with the key message being responsible salt storage and application, and the use of contemporary technology; in any of the following areas: WHPA-A (existing, future); or WHPA-B (VS = 10) (existing, future); or WHPA-E (VS ≥ 9) (existing, future); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Where appropriate education and outreach materials prepared by the Ministry of the Environment, Conservation and Parks are available, the municipality shall deliver those materials.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 16 for education and outreach programs	See Section 16 for education and outreach programs
SAL-9 Application of Road Salt, Handling and Storage of Road Salt Monitoring: Where the application, handling and storage of road salt (existing, future) is, or would be, a significant drinking water threat in an Issue Contributing Area for Sodium or Chloride the following actions shall be taken: a) the responsible Source Protection Authority, in partnership with affected municipalities, shall conduct an investigation on the source and nature of sodium or chloride threats, contingent on funding; b) the municipality shall undertake monthly sampling of sodium and chloride levels in raw water at affected wells and report the results to the Source Protection Authority; and c) the Source Protection Authority in partnership with affected municipalities shall assess the information for any increasing trends and advise the Source Protection Committee on the need for new source protection plan policies to be developed to prevent future drinking water Issues.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 12 Monitoring	See Section 12 Monitoring
SAL-10 Moderate/ Low Threats Application of Road Salt Land Use Planning: Where the application of road salt would be a moderate or low drinking water threat, the planning approval authority is encouraged to require a salt management plan, which includes a reduction in the future use of salt, as part of a complete application for development which includes new roads and parking lots in any of the following areas: WHPA-A (VS = 10) (existing, future); or WHPA-B (VS ≤ 10) (future); or WHPA-C (future); or WHPA-D (future); or WHPA-E (VS ≥ 4.5 and <9) (future); or HVA (future). Such plans should include, but not be limited to, mitigation measures regarding design of parking lots, roadways and sidewalks to minimize the need for repeat application of road salt such as reducing ponding in parking areas, directing stormwater discharge outside of vulnerable areas where possible, and provisions to hire certified contractors.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 17 Parking Lots and Private Infrastructure	See Section 17 Parking Lots and Private Infrastructure
SAL-12 Application of Road Salt (Moderate/ Low Threats) Specify Action: Where the application of road salt on unassumed roads and private parking lots with greater than 200 square metres is, or would be, a moderate or low drinking water threat in any of the following areas: WHPA-A (VS = 10) (existing, future); or WHPA-B (VS ≤ 10) (existing, future); or WHPA-C (existing, future); or WHPA-D (existing, future); or WHPA-E (VS ≥ 4.5 and <9) (existing, future); or HVA (existing, future). The municipality is encouraged to: a) require implementation of a salt management plan which includes the goal to minimize salt usage through alternative measures, while maintaining public safety; and b) require the use of trained individuals in the application of road salt (could include technicians and technologists and others responsible for salt management plans, winter maintenance supervisors, patrollers, equipment operators, mechanics, and contract employees).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 17 Parking Lots and Private Infrastructure	See Section 17 Parking Lots and Private Infrastructure
SAL-13 Application of Road Salt, Handling and Storage of Road Salt (Moderate/ Low Threats) Specify Action: Where the application, handling and storage of road salt is, or would be, a moderate or low drinking water threat, the municipality is requested to report the results of its sodium and chloride monitoring conducted under the Safe Drinking Water Act and any other monitoring programs annually to the Source Protection Authority. The Source Protection Authority shall assess the information for any increasing trends and advise the Source Protection Committee on the need for new source protection plan policies to be developed to prevent future drinking water Issues, in any of the following areas: WHPA-A (VS = 10) (existing, future); or WHPA-B (VS ≤ 10) (existing, future); or WHPA-C (existing, future); or WHPA-D (existing, future); or WHPA-E (VS ≥ 4.5 and <9) (existing, future); or HVA (existing, future).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 12 Monitoring	See Section 12 Monitoring

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
SNO-1 Storage of Snow Part IV, s.57, s.58: Where the storage of snow is, or would be, a significant drinking water threat, the following actions shall be taken: 1) The storage of snow is designated for the purpose of s.57 under the Clean Water Act, and is therefore prohibited where the threat is, or would be significant, in any of the following areas: WHPA-A (existing, future 2) The storage of snow is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is significant in any of the following areas: WHPA-B (VS = 10) (existing, future); or, WHPA-E (VS ≥ 9) (existing, future); or, The remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Without limiting other requirements, risk management plans shall include appropriate terms and conditions to ensure the storage of snow, and associated runoff, ceases to be a significant drinking water threat. Notwithstanding the above, emergency snow storage may be permitted outside of WHPA- A as determined by the risk management official and the municipality responsible for snow storage in the absence of a Risk Management Plan.)	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	See Section 14 Snow Removal	See Section 14 Snow Removal
HR-CW-1.5 Education and Outreach Programs Policies: Halton Region, in collaboration with other bodies where desirable, may develop and implement education and outreach programs directed at any, or all, significant threat activities prescribed under the Clean Water Act, 2006 where such programs are deemed necessary and/or appropriate by Halton Region and subject to available funding. Such programs may include, but not necessarily be limited to, increasing awareness and understanding of drinking water threats and promotion of best management practices.	Grand River Source Protection Plan (Grand River Conservation Authority, 2021)	Source Water Protection	None	Not Applicable	Not Applicable
HR-CW-1.9 Annual Reporting Policies: Where the Halton Region and Town of Milton are required to amend their Official Plan and/or Zoning By-laws as a result of policies in this plan, they shall provide notice to the Source Protection Authority within 30 days of the amendment(s) coming into effect.	Grand River Source Protection Plan (Grand River Conservation Authority, 2021)	Source Water Protection	None	Not Applicable	Not Applicable
HR-MC-8.1 The Handling and Storage of Road Salt: The Region of Halton and the Town of Milton shall amend their Official Plans to prohibit future salt storage and handling facilities with a capacity greater than 5,000 tonnes of road salt where this activity would be a significant drinking water threat, to ensure these activities never become significant drinking water threats.	Grand River Source Protection Plan (Grand River Conservation Authority, 2021)	Source Water Protection	None	Not Applicable	Not Applicable
HR-MC-9.1 The Storage of Snow: The Region of Halton and Town of Milton shall include policies in their Official Plan requiring all future development to be designed and maintained based on best management practices regarding snow storage including the provision of designated snow storage areas and the management of associated melt water to ensure this activity never becomes a significant drinking water threat.	Grand River Source Protection Plan (Grand River Conservation Authority, 2021)	Source Water Protection	None	Not Applicable	Not Applicable

Appendix A

11 EQUIPMENT					
Objective	Understanding of the equipment your organization owns, rents, leases or contracts, for use in your winter maintenance operations.				
Rationale	Equipment and controls on the equipment have an effect on the use of salt.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to using the most recent advancements in: winter maintenance equipment	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb	Depends upon the equipment	Cost of equipment, and training for proper use.	All equipment is tracked using AVL and salt data, including contractors. Town equipment uses the latest and most recents spreader systems and controllers, that allow for automatic salt volume spreading adjustements based on speed, including variable pre-wet capabilities in the trucks ordered for 2025 onwards. Town is actively exploring new technologies to assess/implement.	See below
QL537: Minimizing the Impact of Road salt on Water Quality - Advanced Equipment. There are an enormous variety of tools that can be used to increase efficiency and safety and to reduce costs, some are: - Special snow ploughs: Several specialized snow ploughs are available that are effective for removing specific types of snow and ice for operating under different road, highway and street conditions. Some examples of different ploughs are: one-way front ploughs, reversible ploughs, four-way articulated ploughs, underbody ploughs, and side wings. Materials used for blade edges include synthetic polymers, rubber, steel and carbide inserts. Remote monitors: These transmit information about roadway conditions and thus may facilitate timely and appropriate winter maintenance measures. Such monitors are only a component of an integrated road (or street) weather information system. In addition to real-time pavement temperature, dew point, humidity, air temperature, wind velocity and direction and the amount of de-icing chemical on the pavement; they may have processing and display capacities to assist maintenance managers choose the best maintenance measures. Such integrated systems are used by highway and urban maintenance staff alike. Pavement temperature monitors: These are very useful and much less expensive than fully integrated remote monitors. Pavement temperature is the main factor in the formation, development and breaking of a bond between fallen or compacted precipitation and the road surface as well as the effectiveness of chemical treatment. Remote monitors that lie beneath the road surface can indicate pavement temperatures, in particular trouble spots, near or on a bridge for instance, so that action can be taken immediately when there is the risk of dangerous conditions. Automatic de-icer spray systems: These are available for trouble spots such as bridge decks; a high pressure nozzle and sprayer are embedded in the roadway itself and activated remotely or automatically when sensors indicate there is a need. Infrared pavement temperature monitors: These can be fitted to trucks or	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)	See below for tools and equipment	N/A	Town is considering testing additional cutting edges. Town has specialized attachments on trial for the cutting edges on plows. We currently have the nordik move booster which adjsusts the cutting edges to the road and the carbide blades are encased in rubber, ploww roads better as it creates a squeege effect, reducing salt usage due to better road clearing. The new 2025 combination truck ordered by the Town was specified to include Joma Blackcat blades. New Truck specs conform to highway specifications similar to ones used on freeways, with larger pre-wet tanks, rubber cutting edges and increased horsepower/torque as to allow enchanced snow clearing capabilities, reducing amounts of plowing rounds and optimizing salt usage due to increased road surface clearing capabilities. Town considering trialling a wide wing, in discussions with vendor for a potential trial in 2025.	[1] Town could undertake trials for the Joma blade. [2] The Town could report the findings of Joma blade trial to other municipalities in Halton Region Consider following organizations like Clear Roads, and TRB who are continually evaluating equipment and have methodologies to test equipment and results for opportunities to improve performance. It would be beneficial to attend technology innovation shows where the latest winter technology is showcased periodically every couple of years.
EC Target 6) Adopting either increasing pre-wetting capacity or using pre-treated salts 75% of vehicles equipped for pre-wetting, or 100% use of pre-treated materials	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)	To encourage use of advanced salt application. Several studies show significant reductions in salt use with the introduction of new technologies including pre-wetting. Further, pre-treated material is now offered on the market as a cost-effective alternative that can provide similar results. Impact: High	Additional costs of equipment. Additional technical expertise needed in both using new equipment and integrating it into maintenance practices	Most of the Town and contracted spreaders have pre-wetting capability. Town will start aiming to pilot 20% pre-wet application, to start 2025-2026 season as to allow proper time to set up and trial.	Consider investigating pre-treated materials as an option to optimize salt use either replacing or augment pre-wetting. See Section 9.1.

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Equip all spreaders with electronic spreader controls that can be accurately calibrated, regulated to ground speed with reporting capabilities to better track route times and salt application locations, and generate salt-use data in order to optimize salt	Salt Management Guide (TAC, 2013)	Groundspeed oriented electronic controllers on salt spreaders help to ensure that salt is applied at the proper rate regardless of the speed of the truck being used to spread the salt, and that salt stops discharging when the truck is stopped. Adoption and use of technologies are expected to increase and become a core practice for all organizations. Impact: High	Additional costs of equipment. Additional technical expertise needed in both using new equipment and integrating it into maintenance practices	All spreaders have electronic spreader controls: some Dickie Johns and some Rexroth) with AVL/GPS and reporting capabilities. All vehicles including sidewalk vehicles have Geotab - auto generated - staff too at AVL data - contractors are handed maps and colour coded on paper. Check AVL data to confirm contractor. Town is planning on hiring a fleet specialists to review and analysis for winter operations	Explore systems that integrate AVL and reporting, for Winter Operations management.
EC Target 5) 95% of spreaders are equipped with groundspeed electronic controllers	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)				
13-MECC: Employ rate-controlled distribution equipment which applies the de-icing chemical at the proper rate, regardless of the vehicle's speed.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)				
QL538: Minimizing the Impact of Road salt on Water Quality - Spreaders. Having an efficient and precise spreading mechanism is one very effective way to mitigate the impact of road salt on the environment.	Risk Management Measures Catalogue (Ministry of Environment, Conservation and Parks, 2022)				
Use AVL/GPS technologies with reporting capabilities to better track route times and salt application locations.	Salt Management Guide (TAC, 2013) Synthesis on Global Positioning Systems/Automatic Vehicle Location Equipment Used for Winter Maintenance (Potter, Gallagher, & Bayer, 2016)				
All spreaders are calibrated at least at the start of each season and when repaired as per manufacturer's instruction including using actual volume testing.	Salt Management Guide (TAC, 2013)	Correctly calibrated spreaders are essential for being able to apply the material at the selected application rate, avoiding overapplication. Impact: High	Additional costs for calibration. Inhouse expertise is needed or have to get outside people.	For the 2024 season, Town has developed its own calibration standard, based off of the MTO Calibration requirements. Including documentation which shall help verify calibrations and set a standard to be followed by Town and Contractors performing road plowing and spreading operations.	None
Other sensors could be added to spreaders, such as: - on-board freezing point and ice-presence - salinity / residual chloride	Vehicle-Based Technologies for Winter Maintenance: The State of the Practice (Xianming, et al., 2006)	Allows for more accurate application rates. Install sensors to provide information to drivers and/or can be integrated to automatic spreader controls to apply the right amount of chemicals in the right place. Impact: Moderate to High	Vehicle based sensors have not been well-established, or widely deployed for field use. While studies suggest that they are generally reliable, implementation issues (such as need to clean the sensor heads regularly) as still under development.	Not used	The Town could consider following test results by other organizations.
Mobile Data Collector (MDC) A MDC is a controller in combo units that receives input from the operator, spreader controller, GPS and plow blade sensors. Weather forecasting and chemical application recommendations are then provided back to the controller using a Maintenance Decision Support System (MDSS), which includes local and regional weather radar information.	Vehicle-Based Technologies for Winter Maintenance: The State of the Practice (Xianming, et al., 2006)	Having the most current information on road and weather conditions improve the overall efficiency of our operation, thus, reduces the amount of applied materials, and decrease overall costs.	Costs, user acceptance, and need for advanced training have been identified as barriers. Integration is critical for communications, user interface, and hardware/software expandability and compatibility.	Not used	The Town could consider following test results by other organizations.
Consider specialized plows and plow blades to improve removal of snow and ice such as flexible cutting edge placed in front that adjusts to the contours of the roadway,	Salt Management Guide (TAC, 2013)	More effective removal of snow and ice, reduce the need for de-icing chemicals. Impact: Moderate	Costs, durability, and need for training have been identified as barriers.	Town is considering testing Joma blades and other types of blades. New 2025 plows will have Joma Blackcat cutting edges/blades. We currently have a nordik move system which performs similarly to the Joma blades.	[1] Town could undertake trials for the Joma blade. [2] he Town could report the findings of Joma blade trial to other municipalities in Halton Region Consider following organizations like Clear Roads, and TRB who are continually evaluating equipment and have methodologies to test equipment and results for opportunities to improve performance.
Fixed Automated Spray Technology (FAST) are stand-alone system that automatically sprays an anti-icing chemical onto the road surface. It remotely senses the potential of frost or ice formation on pavement via atmospheric and pavement data from RWIS or an Environmental Sensor System (ESS).	Salt Management Guide (TAC, 2013)	Localized application (such as bridges) but users report a reduction in chemical application at these location, especially effective if non-chloride anticiers are used. Can be considered for SVAs. However, all agency report a positive Benefit/Cost when used in appropriate locations. Impact: Moderate	Costs and reliability (need for maintenance) have been identified as barriers.	Town never considered due to the large investment and maintenance that such systems require. Taking into consideration the bridges the Town has along its corridor may not be as beneficial. Halton Regional Roads have the large bridges along the Town corridor and may be beneficial for them to explore.	The Town could consider if fixed anti-icing system would be beneficial at certain locations to reduce chloride loadings (e.g., a bridges in an SVA) .

Appendix A

12 MONITORING AND RECORD KEEPING					
Objective	To optimize the use of road salt by reviewing winter maintenance activities during and post storm event, and at the end of season.				
Rationale	Accurate monitoring of weather, environmental conditions (like surface temperature), and winter maintenance activities, will support and improve snow and ice control decisions, leading to efficient use of salt. To improve salt management, a strategic-level, post-season assessment of the practices and procedures based on established measures should be undertaken by senior management/council and at the supervisor (program) level. Annual measures should be compared to the previous year's results or to some other benchmark set by the municipality. The LOS policy document should include the frequency and format of reporting as well as a list of the performance measures to be used. As well, existing available and new approaches and technologies should be reviewed on a continual basis and to recommend pilot studies on the preferred technologies and winter maintenance methodologies.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
CODE-17: Salt Application: The objective is the reduction of the negative impacts of road salts by delivering the right amount of road salts in the right place at the right time. In pursuing this objective, consideration should be given to monitoring of the effectiveness of road salt application techniques	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb	To review salt management successes, standard metrics (key performance indicators.) need to be established for and targets established. These could include salt use per event, total salt use per road class, salt loadings per area (such as SVA), time taken to reach end condition (as specified in LOS policy), measured friction levels.	Staff resources, trained personnel's availability to undertake analysis.	The Geotab information connects to ERSI (GIS) and provides real time metrics. Looking for more active feedback, such as salt use per km for better tracking. However, lacking recourses to review and analysis data to full potential. Town currently uses paper to track route metrics.	The Town should consider hiring an specialists to review and analysis for winter operations, if budget allows.
Set and implement a procedure to retrieve and review weather and equipment generated data on a during event, storm, and year end basis	Salt Management Guide (TAC, 2013)	Review of weather, environmental conditions (like surface temperature), and winter maintenance activities, will support and improve snow and ice control decisions, leading to efficient use of salt. Impact: High		There are standard performance measures the Town looks at (like time to complete route). However, lacking recourses to review and analysis data to develop additional performance measures.	The Town should consider hiring an specialists to review and analysis for winter operations, if budget allows.
Develop standard metrics to measures road salt use	Snow Removal Performance Metrics (Xu, et al., 2017)	Standard performance measures will help all agencies develop and implement a consistent and comparable performance review program. Measures should be developed at the senior management/council (strategic level), at the supervisor (program) level and front line staff (service) level. Annual measures should be compared to the previous year's results or to some other benchmark set by the municipality. Impact: High to Moderate	Costs to have staff work to develop standard metrics.		
Develop Weather Severity Index to compare road salt use, season to season.	Snow Removal Performance Metrics (Xu, et al., 2017)		Costs to have staff work to develop standard metrics.	Something the Town has in its plans to review and get insights, most likely to be able to be accomplished when a AVL/data-analysis technician is dedicated to focus on Winter metrics.	Consider developing standard metrics and a weather severity index to allow annual comparisons
Review during event					
Undertake patrolling as per MMSMH	O. Reg. 366/18: Minimum Maintenance Standards for Municipal Highways	Patrolling information can be used to optimizing salt use including commenting on if the LOS is being significantly over-achieved	None	The Town has a map room (continuously staffed during season) with smart boards where the GeoTab data is checked and tracked. Updates are done throughout the shift with respect to what is done and condition, data dispatched to Comms Centre for public. Always someone in map room. Look at moving to digital - then can have active feedback - start see per- event - salt use / km - more better tracking. Communications from contractors: they will provide loads per shift but does not count. Town is currently assessing options on live monitoring solutions (e.g. Deloitte and WSP). Town also has dedicated winter patrol every day of the week.	Consider adding details to road patrol information that specifically addressed optimizing salt use including commenting on if the LOS is being significantly over-achieved. Opportunity: A Municipality is using a mobile survey app (CrowdSingal) that is relatively inexpensive and customizable. At the end of shift, drivers' complete several questions to update supervisors on status, and includes information on weather information, material use, road conditions. The app aggregates and presents the data, allowing outliers to be identified.
Equipment-mounted, RWIS integrated, or stand-alone sensors provide information about the current friction level of the road surface.	Salt Management Guide (TAC, 2013); Quantifying Salt Concentration on Pavement (Cui, Fay, and Shi, 2015)	Friction, residual chloride / salinity, ice detection and other sensors are becoming more common on roads as they are shown to be reliable and accurately report road surface conditions	Cost of equipment, licencing fees, staff resources, trained personnel's availability to undertake analysis.	None	Consider tracking advances in mobile sensors with regional partners.
Review during season					
Periodically compare salt usage by route to identify and address any inconsistencies	Salt Management Guide (TAC, 2013)	Periodic in season reviews of material use, application rates selected, etc. can deviations from the other equipment and patterns to identify units that out of calibrations, drivers who are not adhering to the application rules, etc. A generic term used for management application, a Salt Dashboard collects and analyzes data and provide a "dashboard" of information to managers with respect to salt usage (e.g., Iowa DOT).	Integrating technologies from various manufacturers into a cohesive, smooth operational system is challenging. Few turnkey options exist and integrating sensor, camera, data collection and GPS presents a number of technical challenges. Obtaining full organizational and financial support from agency management may be challenging as well as the need to piloting system with vendors and operators to identify objectives for use, providing operators with training that emphasizes the technologies' operational and safety benefits, and supervisors in using the system data for adjustments to maintenance and resource-allocation strategies.	Town has approval to hire a fleet technician, est. 2025.	The Town should consider hiring an specialists to review and analysis for winter operations, if budget allows. Specialist to review and analysis for winter operations and explore solutions that could provide data analysis or live metrics for operations. Town to consider winter software or solutions to quantify operational metrics (e.g. material use, route completion). Addition of AVL technician could support this initiative.

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Reviewing and Comparing Seasons					
Set standard performance metrics	Salt Management Guide (TAC, 2013); Quantifying Salt Concentration on Pavement (Cui, Fay, and Shi, 2015)	To review salt management successes, standard metrics (key performance indicators.) need to be established for and targets established. These could include salt use per event, total salt use per road class, salt loadings per area (such as SVA), time taken to reach end condition (as specified in LOS policy), measured friction levels.	None	Limited ~~review~~	Consider development of a list of metrics that can be used to review salt use performance between seasons to identify opportunities for improvement. The metrics review should include information currently collected, gaps between information needed, and ways to standardize the information.
Develop Winter Servite Index	Salt Management Guide (TAC, 2013)	To evaluate salt use between seasons and agencies, the variability of winter events and maintenance practices needs to be addressed. To account for and normalizes the variables for consistency, a winter severity indexes (WSI) are used.	None	None	Consider developing a Winter Severity Index that can be used to review salt use performance between seasons and identify opportunities for improvement. It may be possible to develop a single WSI for the region.
Track your material use. (loader / scales) to confirm use	Salt Management Guide (TAC, 2013)	Loader-Mounted electronic weighing equipment or truck scale, and liquid meters are all methods to confirm the amount of material loaded. This can be used to confirm amounts spread on the specific route and can help look for overuse, deficiencies, calibration errors etc.	Cost of additional equipment.	Loader has a scale to weigh salt but not recorded or reviewed Biggest limiting factor is having personnel available to operate scale houses in Central Ops, and north ops does not have a scale.	Town should have a process by which load weights are recorded and reviewed
Conduct a year-end review	Salt Management Guide (TAC, 2013)	Lessons can be learned from a review of winter maintenance operation. Improvements in policy, operations, and even in equipment, can be identified and implemented through a post-season assessment of the practices, procedures and treatments used. It is important that all levels of the organization be involved in these evaluations from senior managers, to front line supervisors, to equipment operators. As part of the post-season assessment, staff will need to compare this year's results using a series of performance measures. Impact: Low to Moderate	None	Town does winter planning and review of major events in the spring. Town is developing its 2025 Winter Plan which will also be used to describe how the Town delivers winter operations through its corridor. Meant to be a document mostly use for lawsuit defense and also training for new town supervisory/management staff	Consider formalizing the year-end review to identify lessons learned and continual improvement
Year-end reconciliation of materials used for salt, abrasives and liquid to identify losses	Transportation Association of Canada (2003)	Year-end reconciliation are import as they allow road authorities to: determine loss of salt from storage facilities, and inconsistencies between actual total material use and total materials use reported.	None	Post- season year end reconciliation is done	Consider look to improve on this existing data collection to improve salt optimization. Explore doing salt pile surveys at end of season.
EC Target 1) Submission of annual reports	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)		None	Reporting is submitted	None
21-MECC: Accurate records of salt application should be maintained, including: the type of deicing agent employed (e.g.. sodium chloride, calcium chloride, etc.), the rate of application, the frequency of application, and road areas covered.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	This information would aid the Ministry in determination of total chloride loading to a basin from road salt application, as well as providing the municipal authority with quantitative data on the use of deicing materials.	None	Records are kept	None
SAL-9 Application of Road Salt, Handling and Storage of Road Salt Monitoring: Where the application, handling and storage of road salt (existing, future) is, or would be, a significant drinking water threat in an Issue Contributing Area for Sodium or Chloride the following actions shall be taken: a) the responsible Source Protection Authority, in partnership with affected municipalities, shall conduct an investigation on the source and nature of sodium or chloride threats, contingent on funding; b) the municipality shall undertake monthly sampling of sodium and chloride levels in raw water at affected wells and report the results to the Source Protection Authority; and c) the Source Protection Authority in partnership with affected municipalities shall assess the information for any increasing trends and advise the Source Protection Committee on the need for new source protection plan policies to be developed to prevent future drinking water Issues.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	None	None
SAL-13 Application of Road Salt, Handling and Storage of Road Salt (Moderate/ Low Threats) Specify Action: Where the application, handling and storage of road salt is, or would be, a moderate or low drinking water threat, the municipality is requested to report the results of its sodium and chloride monitoring conducted under the Safe Drinking Water Act and any other monitoring programs annually to the Source Protection Authority. The Source Protection Authority shall assess the information for any increasing trends and advise the Source Protection Committee on the need for new source protection plan policies to be developed to prevent future drinking water Issues, in any of the following areas: WHPA-A (VS = 10) (existing, future); or WHPA-B (VS ≤ 10) (existing, future); or WHPA-C (existing, future); or WHPA-D (existing, future); or WHPA-E (VS ≥ 4.5 and <9) (existing, future); or HVA (existing, future).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	None	None

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13 MATERIALS STORAGE & HANDLING FACILITIES					
Objective	To ensure that salt and the salt in blended abrasives do not dissolve into water (such as rain or stormwater) and leave the site into the environment during delivery and storage.				
Rationale	If not properly stored, snow and ice control chemicals can be lost to the environment in large quantities because of exposure to precipitation and wind. This loss can be costly due to the actual loss of salt, and can lead to environmental damage, Many road organizations have incurred large costs to clean up salt contamination from maintenance yards where materials have been poorly stored and handled.				
				Town of Oakville	
Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Current Practice	Gap and Opportunity for Improvement
SAL-7 Handling and Storage of Road Salt Part IV, s.57, s.58: Where the handling and storage of road salt is, or would be, a significant drinking water threat (excluding incidental quantities for personal use), the following actions shall be taken: 1) The handling and storage of road salt is designated for the purpose of s.57 under the Clean Water Act, and is therefore prohibited where the threat would be significant in any of the following areas: WHPA-A (future); or WHPA-B (VS = 10) (future); or WHPA-E (VS ≥ 9) (future); or the remainder of an Issue Contributing Area for Sodium or Chloride (future). 2) The handling and storage of road salt is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is significant in any of the following areas: WHPA-A (existing); or WHPA-B (VS = 10) (existing); or WHPA-E (VS ≥ 9) (existing); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	Central, North and South East Operations salt storage are covered, paved with contained drainage systems. Additional assessments will be carried out based on the SMP recommendations.	The Town should determine if any storage yards would be a significant drinking water threat and undertake either prohibiting handling and storage or creating a specific risk management plan
QL005: Apply best environmental management practices to design and operation of road maintenance yards.	Risk Management Measures Catalogue (2019)	Improved operational standards for road maintenance yards can enhance their environment design and operation, and thereby prevent off-site environmental impacts. Impact: High Effectiveness	N/A	Following leading practice. Town to assess recommendations from the SMP and continually improve.	Develop a "Good Housekeeping standard operating procedures' that includes : spill and contaminant reporting; routine condition assessment for salt storage facilities; procedures for delivery including rainy weather, storage of delivery records; and for conducting an year-end reconciliation of bulk material use been done for salt, sand and liquid to determine if there are losses to the environment.
EC Target 3) Road Salts are stored under a permanent roof and on impermeable pads 100% of road salts stored under a permanent roof and on impermeable pads	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)	Research shows that loss of salt from storage and handling can be a significant source to the environment. Implementing leading practices (e.g., impervious surfaces, stored inside, etc.) for salt storage facilities is needed to minimize loss of sodium chloride to the environment including groundwater. Impact: High Effectiveness	Cost	North Operations in full compliance, additional upgrades to be recommended when Central and South East Depot are upgraded to conform with leading practices.	Consider assessing existing depots for continues improvements and upgrades.
QL121: Employ a multi-barrier approach to designing salt storage facilities: impervious liners.	Risk Management Measures Catalogue (2019)		Cost		
22-MECC: De-icing chemicals or sand/salt stockpiles shall always be protected from precipitation or surface runoff. The Ministry recommends that permanent storage structures be installed wherever possible.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)		Cost		
24-MECC: Permanent storage structures afford the best protection and we urge the installation of such structures wherever possible.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)		Cost		
CODE-15: Salt Storage: The objective is the prevention or control of releases from existing and new sites. In pursuing this objective, the following practices should be considered: coverage of salt piles and blended salt-sand piles, handling practices that avoid uncontrolled releases, drainage management, wash water collection and treatment, training of personnel, and monitoring of the effectiveness of the facility	Code of practice for the environmental management of road salts (Environment and Climate Change Canada, Date modified: 2022-08-02) https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html#annexb		Cost		
ABRASIVES					
EC Target 4) Treated abrasives are covered 75% of the tonnes of treated abrasives are covered	Performance indicators and national targets for environmental management of road salts (ECCC, 2019)	Research shows that loss of salt from abrasive storage and handling can be a significant source to the environment. Following leading practices for salt storage facilities are needed to minimize loss of sodium chloride to the surface and groundwater systems. Impact:	Cost	Following leading practice	None
For abrasives blended on-site, exposure to the elements should be minimized	Salt Management Guide (TAC, 2013)				
LIQUIDS					
Liquid tanks should be on impervious bases with spill protection and barriers to prevent vehicle collisions	Salt Management Guide (TAC, 2013)	Leak and spill prevention measures and equipment include alarm system & automatic valves to prevent brine and and/other chemicals storage tanks from being overfilled and the containment and collection of spills and storm runoff. Impact: High Effectiveness	Costs for leak and spill prevention measures (e.g., secondary containment) and alarms	North Operations liquid tanks fully contained. Central Operations upgrades are part of the planned capital expansion work for brine tanks when Central Operations yard gets rehabilitated.	If not present, include appropriate spill prevention measures to liquid tanks from being overfilled and contain spills, leak prevention etc. Consider developing a "Good Housekeeping standard operating procedures' that includes: spill and contaminant reporting and response
QL103: Leak and spill prevention measures and equipment: alarm system and automatic valves.	Risk Management Measures Catalogue (2019)			QL103: Leak and spill prevention measures and equipment: alarm system and automatic valves.	

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
HANDLING AND GOOD HOUSEKEEPING					
Solid materials unloaded outside should be brought under cover as soon as possible following delivery, with delivery in favourable weather	Salt Management Guide (TAC, 2013)	Research shows that loss of salt from storage and handling can be a significant source to the environment.	Logistics	We have general Good Housekeeping procedure. Town has some SOP's but not all required to conform with SMP recommendations.	Enhance "Good Housekeeping" standard operating procedures that includes: spill and contaminant reporting and response for stormwater management systems; routine condition assessment for salt storage facilities; procedures for delivery including avoiding deliveries in the rain , storage of delivery records; and for conducting an year-end reconciliation of bulk material use been done for salt, sand and liquid to determine if there are losses to the environment.
Good Housekeeping standard operating procedures should be written that include: Material delivery and mixing (abrasives), storage, spreader loading / unloading, liquid storage and handling, vehicle washing, and training.	Salt Management Guide (TAC, 2013)				
QL025: Spill and contaminant reporting and response for stormwater management systems.	Risk Management Measures Catalogue (2019)	Spill reporting and response should be designed to prevent contaminants from spills in reaching the storm water conveyance systems. Impact: Medium Effectiveness	Cost, training		
QL074: Application of preventative maintenance.	Risk Management Measures Catalogue (2019)	The long-term operation, preventative maintenance, and monitoring of the source containment system to ensure that all structures are in good working condition so as to minimize the risk of structure failure leading to a leak or spill. Impact: High Effectiveness	Cost, training		
QL078: Adoption of routine monitoring programs for salt storage facilities.	Risk Management Measures Catalogue (2019)	Routine monitoring programs for salt storage facilities to identify spill and facility failure occurrences shortly after they occur, and lead to faster remediation, and fewer impacts to the environment. Impact: Low Effectiveness	Cost (staff time), training	None	Enhance the "Good Housekeeping standard operating procedures' that includes: routine monitoring program.
Record delivery records and end-of-season residuals for salt, sand and liquid to determine any losses and conduct a year-end reconciliation of bulk material use been done for salt, sand and liquid.	Salt Management Guide (TAC, 2013)	To determine losses, a year-end reconciliation of bulk material use should be done for salt, sand and liquid. Impact: High	Cost (staff time), training	Following leading practice	Consider developing a "Good Housekeeping standard operating procedures' that includes: how to handle delivery record, determine end-of-season residuals for salt, sand and liquid, and how to review to determine any losses.
SPILLS					
Have response plan for road and yard spills of deicing / anti-icing materials	Salt Management Guide (TAC, 2013)	Spills can be a significant source of salt to the environment.		Following leading practice, Town has SOP on spills but not one specifically focused on de-icing and anti-icing materials	Consider developing a "Good Housekeeping standard operating procedures' that includes: spill and contaminant reporting and response
Run mock emergencies to test response	Salt Management Guide (TAC, 2013)	Spills can be a significant source of salt to the environment.		None	Consider running mock emergencies to test response
SITE CONTAMINATION					
QL581: Site Assessment and In-Situ Remediation for Releases of Salt to Land.	Risk Management Measures Catalogue (2019)	Salt movement and assessment, and remediation procedures of salt-contaminated sites can avoid or mitigate adverse effects on the environment. Impact: High Effectiveness	Cost of remediation	None at this time	If off-site contamination is a concern (e.g., nearby drinking water wells), consider an electromagnetic or other investigations of salt impacts of current and old storage sties could be undertaken to determine impacts and remediation of salt-impacts soils and groundwater
QL125: Decommissioning of abandoned wells. Wells that are no longer needed or are not in use should be promptly decommissioned in accordance with Ontario Regulation 903.	Risk Management Measures Catalogue (2019)	Wells that are no longer needed or are not in use should be promptly decommissioned in accordance with Ontario Regulation 903. Impact: High Effectiveness	Cost of decommissioning	None at this time.	Abandoned or unused wells should be identified and decommissioned especially if facility in wellhead protection area (WHPA).

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Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
NEW FACILITIES					
Building allows all salt delivery and handling (including blending of abrasives) to occur inside.	Salt Management Guide (TAC, 2013)	Rain will release salt-ladened water to the environment. Impact: High Effectiveness	Logistics	Following leading practice	None
QL077: Employ innovative construction materials and methods for salt storage facilities.	Risk Management Measures Catalogue (2019)	Salt storage structures are subject to chloride corrosion, which can be resisted through use of innovative construction materials such as plastic-reinforced concrete. Impact: High Effectiveness	Cost	Following leading practice	None
QL183: Establish buffer zone - chemical storage.	Risk Management Measures Catalogue (2019)	A contaminant protection zone is established to ensure the location of chemical storage facilities are a minimum distance away from a water body or watercourse, and the tank is not located over any existing piping or drainage system. Impact: Medium Effectiveness	None	Following leading practice	None
QL163: Setbacks for land application: separation distance from waterways.	Risk Management Measures Catalogue (2019)	Regulating the separation distance to waterways will manage the risk of contamination reaching source water through these pathways. Impact: High Effectiveness	None	Following leading practice	None
QL541: Minimizing the Impact of Road salt on Water Quality - Proper Drainage Planning and Design.	Risk Management Measures Catalogue (2019)	Limiting salt application to specific areas, buffer zones, drainage systems that direct salt laden runoff away from sensitive areas and increasing public awareness are ways to reduce impact of road salt to the environment. Impact: Medium Effectiveness	Cost	Following leading practice	None
QL123: Employ a multi-barrier approach to designing salt storage facilities: low vulnerability siting.	Risk Management Measures Catalogue (2019)	Siting of salt storage facilities in low vulnerability areas to reduce the risk to groundwater and/or surface water drinking water systems. Impact: High Effectiveness	Cost	Following leading practice	None
QL163: Setbacks for land application: separation distance from waterways.	Risk Management Measures Catalogue (2019)	Regulating the separation distance to waterways will manage the risk of contamination reaching source water through these pathways. Impact: High Effectiveness	None	No new storage facilities planned at this time.	None
Stormwater					
QL606: Management of Contaminated Stormwater Runoff at Salt Storages Facilities.	Risk Management Measures Catalogue (2019)	Additional management strategies to reduce the volume of salt-contaminated stormwater runoff generated at each facility and/or runoff treatment for salt removal are approaches applied to reduce spill of contaminated runoff. Impact: High Effectiveness	Cost of undertaking studies, implementing / retrofitting mitigation measures, which may require additional lands.	New facilitates - Following leading practice	For existing facilities: undertake a review of the leading practices and develop an site improvement plan, based on surface and groundwater monitoring results (if undertaken) For new facilities: Environmental Assessment Municipal Class EA should be undertaken for any new snow storage facilities that considers all of these factors.
QL122: Employ a multi-barrier approach to designing salt storage facilities: stormwater management.	Risk Management Measures Catalogue (2019)	Implement stormwater management for salt storage facilities to minimize runoff. Impact: High Effectiveness			
QL562: Stormwater and Combined Sewer Systems Management Modelling.	Risk Management Measures Catalogue (2019)	Stormwater management models are used throughout the world for planning, performance analysis and control design related to stormwater runoff, combined sewers, sanitary sewers, and other drainage systems. Impact: High Effectiveness			
QL017: Stormwater management: grassed channel/wet swales.	Risk Management Measures Catalogue (2019)	Swales are natural depressions or wide shallow channels used to convey and treat storm water. There are two basic design variations, grassed channels and wet swales. Both are commonly referred to as biofiltration swales. Impact: Medium Effectiveness			
QL073: Backflow prevention.	Risk Management Measures Catalogue (2019)	A backflow prevention device is a device which prevents water from watercourses being drawn in to a system if pressure is lost. These devices are implemented where storage tank systems are linked to a watercourse. Impact: Medium Effectiveness			
QL153: Runoff Collection and Diversion Systems.	Risk Management Measures Catalogue (2019)	Collection, storage and diversion systems isolate runoff from on-site contaminant sources, preventing pollutants from contaminating storm water runoff and water sources. Impact: High Effectiveness			
QL227: Control Water Inflow to Waste Disposal and Chemical Storage Sites.	Risk Management Measures Catalogue (2019)	Reduction of inflow of both surface runoff and groundwater to the waste disposal or chemical storage areas where leaching and erosion can occur would reduce the potential risk to adjacent watercourses. Impact: Medium Effectiveness			
QL024: Monitor and maintain stormwater management structures.	Risk Management Measures Catalogue (2019)	Stormwater management structures are commonly used for controlling storm water runoff, removing contaminants, and recharging groundwater. Impact: Medium Effectiveness			
QL153: Runoff Collection and Diversion Systems.	Risk Management Measures Catalogue (2019)	Collection, storage and diversion systems isolate runoff from on-site contaminant sources, preventing pollutants from contaminating storm water runoff and water sources. Impact: High Effectiveness			
QL227: Control Water Inflow to Waste Disposal and Chemical Storage Sites.	Risk Management Measures Catalogue (2019)	Reduction of inflow of both surface runoff and groundwater to the waste disposal or chemical storage areas where leaching and erosion can occur would reduce the potential risk to adjacent watercourses. Impact: Medium Effectiveness			
QL524: Snow Storages: Oil-Grit Separators.	Risk Management Measures Catalogue (2019)	Upon entering the separator, the meltwater is diverted into a 'treatment chamber' where petroleum products and finer sediments are captured and separated. Impact: High Effectiveness			
Wash water -Vehicles (especially spreaders) should be washed at a location where the wash water can be properly diluted, disposed, or recycled/reused.	Salt Management Guide (TAC, 2013)	Where on-site brine production is carried out, wash water may be passed through an oil/water separator and used in brine production. Otherwise, wash water should be disposed of to sewers (sanitary and storm) and will need to conform to system requirements. Direct discharge to surface water is the least preferred of these approaches and needs to be in compliance with legislation.			

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
Monitoring Programs					
QL258: Sampling and Monitoring Programs (Surface Water and Groundwater).	Risk Management Measures Catalogue (2019)	Surface water and groundwater monitoring and inspection programs provide evidence of contamination caused by malfunctions, deterioration, operator error, leaks, spills or runoff. Impact: Medium Effectiveness	Costs for studies to determine and implement monitoring, maintenance of units monitoring	Town does monitoring along creeks for surface water in various locations.	If off-site contamination is a concern (e.g., nearby drinking water wells), consider an electromagnetic or other investigations of salt impacts of current and old storage sties could be undertaken to determine impacts and remediation of salt-impacts soils and groundwater.
QL166: Pollution prevention assessment.	Risk Management Measures Catalogue (2019)	Conducting a pollution prevention assessment involves collecting process information, setting pollution prevention targets, and developing, screening, and selecting pollution prevention option for further study. Impact: High Effectiveness	Costs for studies, and would be tied to chloride monitoring	Not Applicable: This would only be considered with respect to remediations	
QL057: In-Situ Contaminated Site remediation: phytoextraction.	Risk Management Measures Catalogue (2019)	Phytoremediation is the use of green plants to remove, contain, or otherwise render harmless environmental contaminants. Impact: Medium Effectiveness		Not Applicable: This would only be considered with respect to remediations	None

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14 SNOW REMOVAL, STORAGE AND DISPOSAL	
Objective	To ensure snow removal and disposal operations are done efficiently and in an environmental responsible manner.
Rationale	A review of disposal operations can lead to adopting methods that are the least harmful to the environment. Environmental issues associated with snow disposal sites include: meltwater quality, litter, dust, aesthetics, and noise. Snow disposal sites can impact the environment in many ways. Therefore, proper site selection can minimize these impacts. Criteria should include soil permeability, distance from major water course, vegetation characteristics, ecologically sensitive sites, critical wildlife habitat, operational needs (e.g. haul distances) etc.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
QL581: Site Assessment and In-Situ Remediation for Releases of Salt to Land.	Risk Management Measures Catalogue (2019)	Salt movement and assessment, and remediation procedures of salt-contaminated sites can avoid or mitigate adverse effects on the environment. Impact: High Effectiveness	Cost of remediation	Town following prior SMP recommended practices, to consider new recommendations pending budget approvals.	If off-site contamination is a concern (e.g., nearby drinking water wells), consider an electromagnetic or other investigations of salt impacts of current and old snow storage sties could be undertaken to determine impacts and remediation of salt-impacts soils and groundwater
QL125: Decommissioning of abandoned wells. Wells that are no longer needed or are not in use should be promptly decommissioned in accordance with Ontario Regulation 903.	Risk Management Measures Catalogue (2019)	Wells that are no longer needed or are not in use should be promptly decommissioned in accordance with Ontario Regulation 903. Impact: High Effectiveness	Cost of decommissioning	See section 13, monitoring wells.	Abandoned or unused wells should be identified and decommissioned especially if facility in wellhead protection area (WHPA).
1-MECC: Direct disposal of snow to watercourses or ice-covered lakes and rivers shall be eliminated wherever possible.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.	None	Town disposes of snow at proper approved disposal sites.	None
2-MECC: Disposal on properly selected land sites, is considered, in most cases, the best solution	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.	None	Town uses officially approved disposal sites when there is no sufficient snow storage along the corridor, mostly during large winter events.	None
3-MECC: Certain conditions may arise where direct dumping may be the only practical alternative. The Ministry advises municipalities to fully evaluate all alternatives to direct disposal before considering this option	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.	None		
4-MECC: Disposal on an approved land site is considered in most cases the best solution, but if land sites are limited or unavailable, we urge that mechanical melters be used in conjunction with a settling chamber or other innovative disposal and treatment systems be evaluated before reverting to direct disposal.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.	None	Not applicable	None
5-MECC: If special circumstances preclude the disposal of snow on land sites or by other satisfactory means, Ministry approval from the Regional Technical Support Manager is required prior to dumping directly to a watercourse.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.	None	Not applicable	None

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
6-MECC: While most soluble salts will ultimately reach surface or ground waters in the vicinity of the disposal site, the rate of discharge may be averaged out over time, avoiding a concentrated input as is experienced with direct disposal.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.	Cost of undertaking studies, implementing mitigation measures, which may require additional lands.	The Town is considering a second snow storage in the north, proper EA process to follow.	The Town should consider undertaking Environmental Assessment Municipal Class EA should be undertaken for any new snow storage facilities that considers all of these factors including avoid WHPAs.
All snow disposal sites should be evaluated by the Ontario Ministry of the Environment. Contact the Regional Office.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.			
7-MECC: The site should preferably be remote from surface watercourses. The construction of berms and dykes may be required to prevent direct drainage to a watercourse. No guidelines provided on the distances required. The following example is provided: average land slopes of less than 3% in permeable soils, a site location with a runoff distance to a watercourse of more that 600 feet would be acceptable without dyking, or with a minimum of dyking.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.			
8-MECC: The quantity of snow which can be stock-piled at a particular site should be assessed in relation to estimated runoff rates and quality, the dilution capacity of the watercourse to which the melt will discharge, and downstream water uses.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.			
9-MECC: Use of ground water immediately down-gradient of a possible site should be determined as part of the site evaluation process.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. Hydrogeologic investigations should be conducted to determine the potential for ground water pollution from contaminants in the snow. Wherever possible, land disposal sites should be located in areas where an impervious strata will prevent the migration of soluble contaminants to the ground water aquifer of in areas of ground water outflow. Recharge areas may be suitable if, in the opinion of the hydrogeologist, the aquifer supplying potable water is not liable to be impaired. No salt use reduction.			
10-MECC: All snow disposal sites should be evaluated by the Ontario Ministry of the Environment. Contact the Regional Office.	Guidelines on Snow Disposal and De-icing Operations in Ontario (MOECC, 2011)	Avoid direct impacts. No salt use reduction.			
QL541: Minimizing the Impact of Road salt on Water Quality - Proper Drainage Planning and Design.	Risk Management Measures Catalogue (2019)	Limiting salt application to specific areas, buffer zones, drainage systems that direct salt laden runoff away from sensitive areas and increasing public awareness are ways to reduce impact of road salt to the environment. Impact: Medium Effectiveness			
QL542: Minimizing the Impact of Road salt on Water Quality - No Snow Dumping.	Risk Management Measures Catalogue (2019)	Practices which lessen the impacts of snow to water and sediment quality. Impact: Medium Effectiveness			
QL562: Stormwater and Combined Sewer Systems Management Modelling.	Risk Management Measures Catalogue (2019)	Stormwater management models are used throughout the world for planning, performance analysis and control design related to stormwater runoff, combined sewers, sanitary sewers, and other drainage systems. Impact: High Effectiveness			
QL003: Snow storage and disposal practices: Site Sampling, Monitoring and Assessment.	Risk Management Measures Catalogue (2019)	Stored snow can be contaminated by salt, ice control chemicals, oil, grease, heavy metals from vehicles, litter and debris and airborne pollutants. This snow must be handled, stored and disposed in an appropriate manner to protect the water source. Impact: High Effectiveness			
QL017: Stormwater management: grassed channel/wet swales.	Risk Management Measures Catalogue (2019)	Swales are natural depressions or wide shallow channels used to convey and treat storm water. There are two basic design variations, grassed channels and wet swales. Both are commonly referred to as biofiltration swales. Impact: Medium Effectiveness			
QL024: Monitor and maintain stormwater management structures.	Risk Management Measures Catalogue (2019)	Stormwater management structures are commonly used for controlling storm water runoff, removing contaminants, and recharging groundwater. Impact: Medium Effectiveness			
QL057: In-Situ Contaminated Site remediation: phytoextraction.	Risk Management Measures Catalogue (2019)	Phytoremediation is the use of green plants to remove, contain, or otherwise render harmless environmental contaminants. Impact: Medium Effectiveness			

Appendix A

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
QL073: Backflow prevention.	Risk Management Measures Catalogue (2019)	A backflow prevention device is a device which prevents water from watercourses being drawn in to a system if pressure is lost. These devices are implemented where storage tank systems are linked to a watercourse. Impact: Medium Effectiveness			
QL119: Restrict snow and salt disposal and storage within source protection areas. Avoiding the salt and snow disposal and storage within vulnerable areas to mitigate the drinking water threat.	Risk Management Measures Catalogue (2019)	Avoid placing the snow disposal and storage within vulnerable areas to mitigate the drinking water threat. Impact: High Effectiveness			
QL153: Runoff Collection and Diversion Systems.	Risk Management Measures Catalogue (2019)	Collection, storage and diversion systems isolate runoff from on-site contaminant sources, preventing pollutants from contaminating storm water runoff and water sources. Impact: High Effectiveness			
QL163: Setbacks for land application: separation distance from waterways.	Risk Management Measures Catalogue (2019)	Regulating the separation distance to waterways will manage the risk of contamination reaching source water through these pathways. Impact: High Effectiveness			
QL166: Pollution prevention assessment.	Risk Management Measures Catalogue (2019)	Conducting a pollution prevention assessment involves collecting process information, setting pollution prevention targets, and developing, screening, and selecting pollution prevention option for further study. Impact: High Effectiveness			
QL227: Control Water Inflow to Waste Disposal and Chemical Storage Sites.	Risk Management Measures Catalogue (2019)	Reduction of inflow of both surface runoff and groundwater to the waste disposal or chemical storage areas where leaching and erosion can occur would reduce the potential risk to adjacent watercourses. Impact: Medium Effectiveness			
QL520: Snow Storage and/or Disposal Site Selection.	Risk Management Measures Catalogue (2019)	If a separate storage or disposal site is necessary to collect and maintain large piles of snow off-site, a variety of factors should be considered when choosing an appropriate site. Impact: High Effectiveness			
QL524: Snow Storages: Oil-Grit Separators.	Risk Management Measures Catalogue (2019)	Upon entering the Oil-Grit separator, the meltwater is diverted into a 'treatment chamber' where petroleum products and finer sediments are captured and separated. Impact: High Effectiveness			
QL074: Application of preventative maintenance.	Risk Management Measures Catalogue (2019)	The long-term operation, preventative maintenance, and monitoring of the source containment system to ensure that all structures are in good working condition so as to minimize the risk of structure failure leading to a leak or spill. Impact: High Effectiveness	Cost of undertaking monitoring.	Town has proper approved and contained snow disposal sites, whose permit outlines our requirements. General site inspections are carried through the year, including cleanup of oil grit separator/filtering systems.	An inspection and monitoring plan should be developed for snow disposal site. The need fors monitoring of surface water and groundwater should be evaluated and if warranted included.
QL258: Sampling and Monitoring Programs (Surface Water and Groundwater).	Risk Management Measures Catalogue (2019)	Surface water and groundwater monitoring and inspection programs provide evidence of contamination caused by malfunctions, deterioration, operator error, leaks, spills or runoff. Impact: Medium Effectiveness			
QL521: Snow Storage and/or Disposal Site Operation and Maintenance.	Risk Management Measures Catalogue (2019)	Once a site for snow storage is selected, it should be properly maintained throughout the season, and appropriately restored once the season has ended Impact: High Effectiveness			
QL519: Plowing operations of large areas: Managing Snow Piles. Guidelines to minimize the environmental impact from the snow melt of large piles.	Risk Management Measures Catalogue (2019)	Guidelines to minimize the environmental impact from the snow melt of large piles. Impact: Medium Effectiveness	None	No guidelines	If warranted, consider developing guidelines to minimize the environmental impact from the snow melt of large piles
T-39-C Storage of snow Legal Effect: Part a - Must conform with - legally binding. (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future Where the future storage of snow would be a significant drinking water threat in an issue contributing area: a. the municipal planning authority shall require at site plan approval that best management practices for site design to protect drinking water sources be included to manage snow storage and the associated melt water at snow storage facilities at or above grade between 0.01 and 1 hectare in size. b. the municipal planning authority shall document the number of new site plan applications reviewed, and the conditions imposed for the management of snow storage and melt water runoff and report this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Requirement	None	The Town is considering a second snow storage in the north to follow leading practice. Existing snow storage facility in Central Operations in compliance with leading practices.	[1] The town will require for site plan approval , where the future storage of snow would be a significant drinking water threat in an issue contributing area, best management practices for site design to protect drinking water sources be included to manage snow storage and the associated melt water at snow storage facilities at or above grade between 0.01 and 1 hectare in size. This could include requiring a Snow Storage and Salt Management Plan - see City of Guelph's PRIVATE SALT MANAGEMENT PLANS for an example of requirements. [2] The town should have a process for documenting the number of new site plan applications reviewed, and the conditions imposed for the management of snow storage and melt water runoff, and report this information to the Source Protection Authority by February 1 of each year.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
SNO-1 Storage of Snow Part IV, s.57, s.58: Where the storage of snow is, or would be, a significant drinking water threat, the following actions shall be taken: 1) The storage of snow is designated for the purpose of s.57 under the Clean Water Act, and is therefore prohibited where the threat is, or would be significant, in any of the following areas: WHPA-A (existing, future 2) The storage of snow is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is significant in any of the following areas: WHPA-B (VS = 10) (existing, future); or, WHPA-E (VS ≥ 9) (existing, future); or, The remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Without limiting other requirements, risk management plans shall include appropriate terms and conditions to ensure the storage of snow, and associated runoff, ceases to be a significant drinking water threat. Notwithstanding the above, emergency snow storage may be permitted outside of WHPA- A as determined by the risk management official and the municipality responsible for snow storage in the absence of a Risk Management Plan.)	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	N/A	The Town should confirm that snow storage locations are, or would be, a significant drinking water threat. And if they are then either prohibit storage or create a risk management plan as required.

Appendix A

15 TRAINING	
Objective	To ensure that all in-house and sub-contracted staff, management, supervisors, patrollers and operators, have appropriate awareness of / training in salt management practices.
Rationale	To achieve effective implementation of a salt management program, those people charged with delivering the snow and ice control program must understand the rationale behind the measures being implemented as well as what is expected of them. This can only come through a thorough education / training program, including annual refreshers.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
QL545: Minimizing the Impact of Road salt on Water Quality - Training of Road Maintenance Staff.	Risk Management Measures Catalogue (2019)	Road authorities should have a comprehensive training program that demonstrates the purpose and value of new procedures and ensures that personnel are competent to carry out their duties. Impact: Medium Effectiveness	Developing training materials, costs for staff	Town is developing its own Winter Operations Training Guide, used to train all its personnel carrying out winter operations. The Town will train all personnel inhouse that do road patrol and decision making. All new supervisors are sent to the Good Roads Snow School and equivalent courses. Town personnel may attend winter related conferences to bring the knowledge and insights back to the Town. Town does winter plow driver training (inhouse or external). Town develops and maintains operational SOP's which get updated every 3 years. We used the SOP's to train personnel. Town does yearly winter orientation with team and contractors including discussions on salt usage and best practices as per Town SMP.	Consider expanding knowledge base and localize it specifically for Town operations, this shall allow consistency with training material, service level requirements suited for the Town operations.
The organization must promote a culture that supports learning.	Syntheses of Best Practices Road Salt Management: 2.0 – TRAINING				
The organization needs to identify training needs as they relate to the SMP.					
The training program should be planned, organized and scheduled.					
A monitoring system in place to confirm the desired learning transfer has occurred / effectiveness of the training.					
Training should include: aware of the need to conform with all SMP procedures and requirements and what they specifically need to do to do so; the SMP policy and why improved performance is beneficial; and the consequences of not following these procedures and requirements.					
Records of training / awareness should be maintained.					
Using expert instruction to ensure that the information is factual, topical, current, and relevant.					

Appendix A

16 ENGAGEMENT, REPORTING AND OUTREACH	
Objective	To communicate effectively with councils, the public, and the media about Level of Service the importance of road salt to maintaining safe roadways during the winter season and about what the agency is doing to improve salt management
Rationale	An informed council, public and media are more likely to become effective partners in achieving the goals of the Salt Management Plan.

Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
A Communication Plan for the Winter Maintenance program been developed that incudes salt management The PUBLIC should be kept informed about the actions being taken by to manage road salt use and the Agency's winter maintenance program	Salt Management Guide (TAC, 2013)	An informed council, public and media are more likely to become effective partners in achieving the salt optimizaiotn goals , incuding any changes to LOS: Impact: High	Sensitivity of Municipalities in what is communicated and how to the public, including competing messaging and public being overwhelmed	Website: general information with online plow tracker. General information describing the Town's service levels for road, sidewalk, and transit stop operations. Town does not have a detailed explanation on bicycle facilities and bicycle lanes yet. Town personnel assist councilors upon request on drafting winter operations/related communications to their constituents. Town website has plenty of resources to educate the public on the Town winter practices, see section TC-34C (below)	Consider develop and implement education and outreach program(s) for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices. It is recommended that the key messages be the efficient use of road salts and the use of alternatives to help address newly identified threats. For example, see Waterloo Region https://www.regionofwaterloo.ca/en/living-here/winter-maintenance-for-commercial-properties.aspx#Literature
Source Protection Authority updated yearly				Not provided	Consider updating Source Protection Authority yearly with information as per non-binding requirements
COUNCIL should been annually informed about the actions being taken by the AGENCY to manage road salt use and the Agency's winter maintenance program.				Not a current practice	Consider workshops for council with walk through and event from 3 days out to 3 days past the event presenting – Maps, contracts, LOS, classifications, Agreements, etc.
T-34-C: Application, and handling and storage of road salt Legal Effect: Part a - Must comply with - legally binding. List (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Existing and Future Where the existing and future application, or handling and storage of road salt would be a significant drinking water threat in a wellhead protection area, intake protection zone or issue contributing area: a. the City of Hamilton, Regional Municipality of Halton, Town of Milton, Town of Halton Hills, Town of Oakville, City of Burlington shall continue their established, related education and outreach programs. In addition, within two years of the date that the updated Source Protection Plan comes into effect, the City of Hamilton and the Region of Halton, in collaboration with the City of Burlington and Towns of Milton, Halton Hills and Oakville in Halton Region, are requested to develop and implement education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices. It is recommended that the key messages be the efficient use of road salts and the use of alternatives to help address newly identified threats. b. the City of Hamilton and the Region of Halton shall document the nature of any new or existing education and outreach program established regarding the application, and handling and storage of road salt, the number of persons contacted, and the location of the participants and report this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Required	None	Education to public on a formal setting take place formally on the Town website, through communications and social media and throuch Councilor communications to their constituents (when requested by each individual councilor). This typically pertains only to service level and operations. Town has published SMP online (currently the 2018) on the website.	Develop and implement education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices. It is recommended that the key messages be the efficient use of road salts and the use of alternatives to help address newly identified threats.

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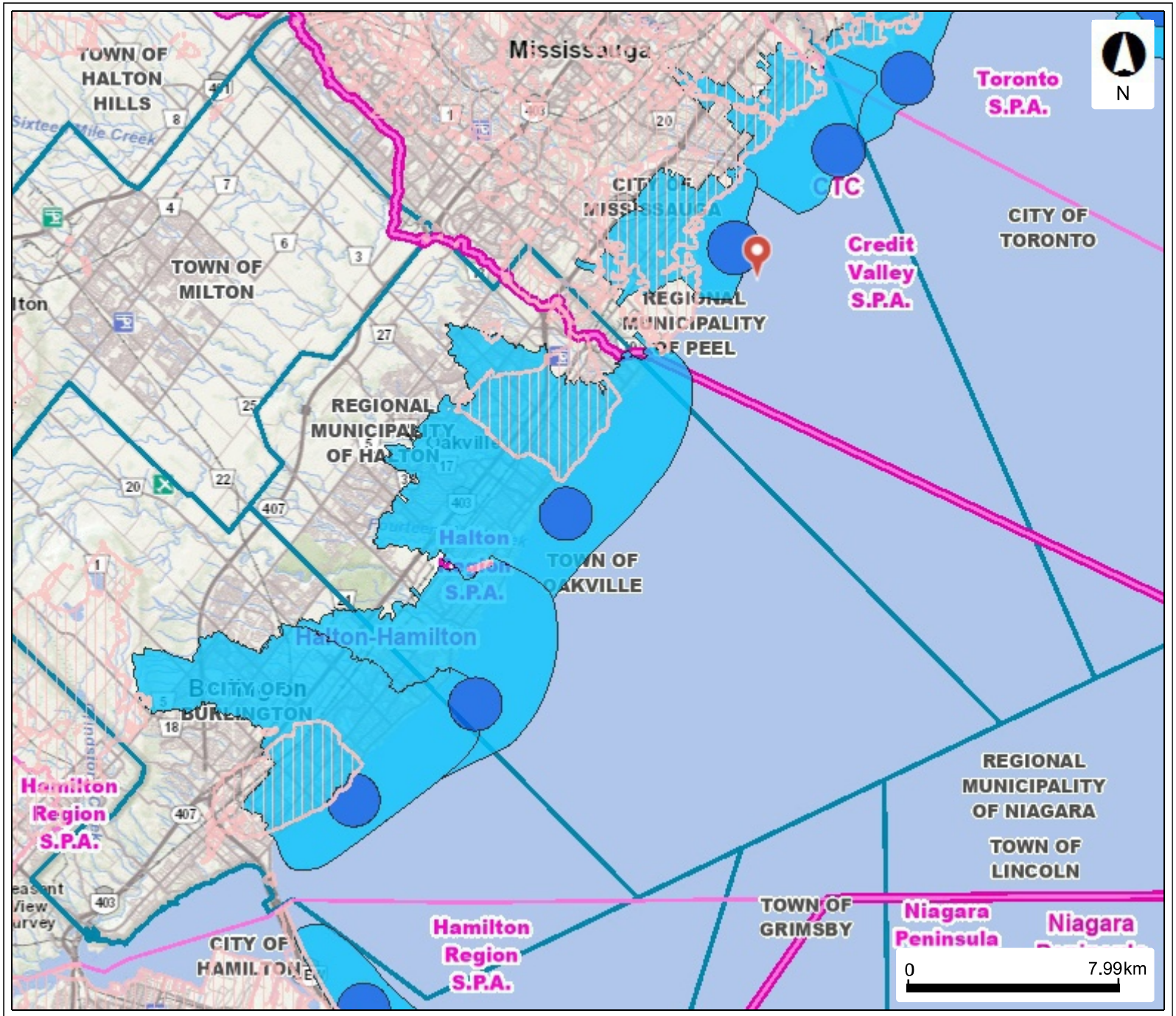
Leading Practice	References	Rationale and Impact on Salt Use Reduction	Barriers	Town of Oakville	
				Current Practice	Gap and Opportunity for Improvement
SAL-8 Application of Road Salt, Handling and Storage of Road Salt Education and Outreach: The municipality shall deliver education and outreach materials and programs where the application, handling and storage of road salt is, or would be, a significant drinking water threat, targeted towards: a) owners/tenants of residences and small businesses where the application, handling and storage of road salt (existing, future) is, or would be, a significant drinking water threat about the impact of salt on municipal drinking water and what they can do to reduce their use of salt to ensure that the activity ceases to be, or does not become, a significant drinking water threat; and b) commercial and industrial sectors to address the importance of source protection planning and the impacts of road salt on drinking water sources, with the key message being responsible salt storage and application, and the use of contemporary technology; in any of the following areas: WHPA-A (existing, future); or WHPA-B (VS = 10) (existing, future); or WHPA-E (VS ≥ 9) (existing, future); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Where appropriate education and outreach materials prepared by the Ministry of the Environment, Conservation and Parks are available, the municipality shall deliver those materials.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	Moderate and Low threats are identified in the Salt Management Plan.	Collaborate with Halton Region on education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices
T-60-S: Storage of snow Legal Effect: non-legally binding Where Policy Applies: see Figures 12 to 15 • Moderate threats: WHPA-A -V. score 10; WHPA-B – V. score 10, 8; WHPA-C – V. score 8; WHPA-E - V. score 9, 8.1; IPZ-1 – V. score 7. • Low threats: WHPA-A -V. score 10; WHPA-B – V. score 10, 8, 6; WHPA-C – V. score 8, 6; WHPA-D – V. score 6; WHPA-E - V. score 8.1; IPZ-1 – V. score 7, 6; IPZ-2- V. score 6.3, 5.4, HVA – V. score 6. When Policy Applies: Existing and Future Where the existing and future application, or handling and storage of road salt would be a moderate or low drinking water threat in a wellhead protection area, intake protection zone or issue contributing area, a. the City of Hamilton, Regional Municipality of Halton shall continue their established, related education and outreach programs. In addition, within two years of the date that the Source Protection Plan comes into effect, the City of Hamilton and the Region of Halton, in collaboration with the City of Burlington and Towns of Milton, Halton Hills and Oakville in Halton Region, are requested to develop and implement education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices. It is recommended that the key messages be the efficient use of road salts and the use of alternatives. b. the City of Hamilton and the Region of Halton shall document the nature of any new or existing education and outreach program established regarding the application, and handling and storage of road salt, the number of persons contacted, and the location of the participants and report this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	Moderate and Low threats are identified in the Salt Management Plan.	Collaborate with Halton Region on education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices; owners/tenants of residences and small businesses, commercial and industrial, where the application, handling and storage of road salt (existing, future) is, or would be, a significant drinking water threat about the impact of salt on municipal drinking water and what they can do to reduce their use of salt to ensure that the activity ceases to be, or does not become, a significant drinking water threat
HR-CW-1.5 Education and Outreach Programs Policies: Halton Region, in collaboration with other bodies where desirable, may develop and implement education and outreach programs directed at any, or all, significant threat activities prescribed under the Clean Water Act, 2006 where such programs are deemed necessary and/or appropriate by Halton Region and subject to available funding. Such programs may include, but not necessarily be limited to, increasing awareness and understanding of drinking water threats and promotion of best management practices.	Grand River Source Protection Plan (Grand River Conservation Authority, 2021)	Source Water Protection	None	Not Applicable	Consider collaborating with Halton Region on education and outreach programs for the private and public sector, as well as the general public, about the impacts of road salt on drinking water sources and the use of best management practices
HR-CW-1.9 Annual Reporting Policies: Where the Halton Region and Town of Milton are required to amend their Official Plan and/or Zoning By-laws as a result of policies in this plan, they shall provide notice to the Source Protection Authority within 30 days of the amendment(s) coming into effect.	Grand River Source Protection Plan (Grand River Conservation Authority, 2021)	Source Water Protection	None	Not Applicable	Not Applicable

Appendix A

17 PARKING LOTS AND PRIVATE INFRASTRUCTURE					
Objective	To ensure salt use is optimized at municipal parking lots.				
Rationale	Parking lots and other private infrastructure has become recognized a significant source of salt to the environment.				
Leading Practice	**References**	**Rationale and Impact on Salt Use Reduction**	**Barriers**	**Town of Oakville**	
				Current Practice	**Gap and Opportunity for Improvement**
QL519: Plowing operations of large areas: Managing Snow Piles. Guidelines to minimize the environmental impact from the snow melt of large piles.	Risk Management Measures Catalogue (2019)	Guidelines to minimize the environmental impact from the snow melt of large piles. Impact: Medium Effectiveness	None	Town has various practices for parking lots. Parking lots maintained by Parks and Open space. Roads and Works Operations, and Parks & Open Space operations already discussed collaborating in streamlining guidelines in the future.	Consider developing guidelines to minimize the environmental impact from the snow melt of large piles. Example of a guideline is Region of Waterloo worksheet: https://www.regionofwaterloo.ca/en/living-here/resources/Documents/water/protection/salt/4424429_winter_maintenance_worksheet.pdf
T-49-S Application, and handling and storage of road salt Legal Effect: Part a - Strategic - non-legally binding. (Part b is a monitoring policy) Where Policy Applies: WHPA-A & B – V. score 10; WHPA-E – V. score 9 (see Figures 2 to 11). When Policy Applies: Future To raise awareness of mapped drinking water sources and seek collaboration on the use of best practices for the application of road salt where this activity would be a future significant, moderate or low threat on private properties, a. de-icing contractors are requested to develop and/or amend their salt management plans for private properties to identify the location of wellhead protection areas and intake protection zones, and to use best management practices to protect drinking water sources within these areas. b. the Halton Region and Hamilton Region Conservation Authorities shall request the Smart About Salt organization and Ministry of Transportation Ontario to consult with private de-icing contractors to determine if their salt management plans identify the location of vulnerable areas for drinking water source protection and report on this information to the Source Protection Authority by February 1 of each year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	Limited to Town related contractor compliance only.	Consider promoting that de-icing contractors develop and/or amend their salt management plans for private properties to identify the location of wellhead protection areas and intake protection zones, and to use best management practices to protect drinking water sources within these areas. Also promote Smart About Salt certification for private de-icing contractors or in-house for parking lots.
SAL-1 Application of Road Salt (Unassumed Roads and Private Parking Lots) Part IV, s.58: For unassumed roads and private parking lots with greater than 200 square metres, the application of road salt is designated for the purpose of s.58 under the Clean Water Act, requiring risk management plans, where the threat is, or would be significant, in any of the following areas: WHPA-A (existing, future); or WHPA-B (VS = 10) (existing, future); or WHPA-E (VS ≥ 9) (existing, future); or the remainder of an Issue Contributing Area for Sodium or Chloride (existing, future). Without limiting other requirements, risk management plans shall include a goal to minimize salt usage through alternative measures, while maintaining roadway safety for users.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None	No SMP's are currently required by developers or other parties at this time.	Determine where prohibitions or risk management plan, or salt management plan are applicable for new private parking lots and infrastructure as per Source Water Protection Plans, and implement. Example: City of Guelph's PRIVATE SALT MANAGEMENT PLANS
SAL-3 Application of Road Salt Land Use Planning: Where the application of road salt to roads and parking lots would be a significant drinking water threat, the planning approval authority shall: 1) Prohibit the establishment of new parking lots with greater than 2000 square metres in: WHPA-A not in an Issue Contributing Area for Sodium or Chloride (future); 2) Prohibit the establishment of new parking lots with greater than 200 square metres in: WHPA-A in an Issue Contributing Area for Sodium or Chloride (future); and 3) Require a salt management plan, which includes a reduction in the future use of salt, as part of a complete application for development which includes new roads and parking lots where the application of road salt is significant in any of the following areas: WHPA-B (VS = 10) (future); or WHPA-E (VS ≥ 9) (future); or the remainder of an Issue Contributing Area for Sodium or Chloride (future). Such plans should include but not be limited to mitigation measures regarding design of parking lots, roadways and sidewalks to minimize the need for repeat application of road salt such as reducing ponding in parking areas; and directing stormwater discharge outside of vulnerable areas where possible.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None		
SAL-10 Moderate/ Low Threats Application of Road Salt Land Use Planning: Where the application of road salt would be a moderate or low drinking water threat, the planning approval authority is encouraged to require a salt management plan, which includes a reduction in the future use of salt, as part of a complete application for development which includes new roads and parking lots in any of the following areas: WHPA-A (VS = 10) (existing, future); or WHPA-B (VS ≤ 10) (future); or WHPA-C (future); or WHPA-D (future); or WHPA-E (VS ≥ 4.5 and <9) (future); or HVA (future). Such plans should include, but not be limited to, mitigation measures regarding design of parking lots, roadways and sidewalks to minimize the need for repeat application of road salt such as reducing ponding in parking areas, directing stormwater discharge outside of vulnerable areas where possible, and provisions to hire certified contractors.	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	None		
SAL-12 Application of Road Salt (Moderate/ Low Threats) Specify Action: Where the application of road salt on unassumed roads and private parking lots with greater than 200 square metres is, or would be, a moderate or low drinking water threat in any of the following areas: WHPA-A (VS = 10) (existing, future); or WHPA-B (VS ≤ 10) (existing, future); or WHPA-C (existing, future); or WHPA-D (existing, future); or WHPA-E (VS ≥ 4,5 and <9) (existing, future); or HVA (existing, future), The municipality is encouraged to: a) require implementation of a salt management plan which includes the goal to minimize salt usage through alternative measures, while maintaining public safety; and b) require the use of trained individuals in the application of road salt (could include technicians and technologists and others responsible for salt management plans, winter maintenance supervisors, patrollers, equipment operators, mechanics, and contract employees).	Approved Source Protection Plan: CTC Source Protection Region (CTC Source Protection Committee , 2022)	Source Water Protection	Cost	Town typically maintains most unassumed roads that have occupancy. This allow us to comply with our SMP goals and strategy. This applies to both private developments as well as Regional roads, including construction projects that the Town operations maintains during the winter.	Consider require implementation of a salt management plan on unassumed roads and private parking lots with greater than 200 square metres with the goal to minimize salt usage through leading practices, and use of trained individuals, Example: City of Guelph's PRIVATE SALT MANAGEMENT PLANS
T-53-C a Storage of snow Legal effect: Parts a and b Must conform with - legally binding. (Part d is a monitoring policy) Where Policy Applies: see Figures 2 to 11 When Policy Applies: Future To facilitate the effective implementation of policies for significant drinking water threats and assist in municipal decision-making, a. the municipal planning authorities are requested to require proponents to disclose whether any of the following activities are expected to occur on the property where they would be significant drinking water threats, proposed storage location, where applicable, as well as the substances utilized or stored and their volume: v. the application, or handling and storage of road salt vi. the storage of snow b. the City of Hamilton, the Region of Halton, and the County of Wellington are requested to require a full disclosure report as part of a complete application under the Planning Act, d. the municipal planning authority shall report to the Source Protection Authority by February 1 of each year on actions taken to amend municipal documents/processes to require disclosure of threat activities and the number of disclosure reports that were received in the previous year.	Source Protection Plan for Halton Region Hamilton Region (as approved November 4, 2022)	Source Water Protection	None	None	For the future storage of snow, municipal planning authorities should required property proponents to disclose municipal planning authorities are requested to require proponents to disclose whether any of the following activities are expected to occur on the property where they would be significant drinking water threats, proposed storage location and volumes of road salt and snow

APPENDIX C - SALT VULNERABLE AREAS



Legend

- Issue Contributing Areas
- Highly Vulnerable Aquifers
- WHPA-E
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Intake Protection Zone 2
- Source Protection Areas
- Source Protection Regions
- Municipal Boundaries - Upper Tier
- Municipal Boundaries - Single and Lower Tier

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Appendix A

Ontario

Map Created: 11/4/2024
Map Center: 43.4329 N, -79.65353 W

APPENDIX D – PROCEDURES AND PROGRAMS

Appendix D.1 - Training Program

Town personnel depending on their reporting level shall have the following training:

- OTM Book 7
- Driver training (inhouse) with DZ license when operating heavy equipment.
- Winter orientation, discussing basics of winter phenomena, salt use and its uses. This is an inhouse training session.
- Snow School (Supervisors),
- ARWIS weather training (outsourced by ARWIS provider).
- Patrolling orientation (in-house)
- Additional courses offered in the industry on an as required basis, including conferences.
- Town SOP's pertaining to winter operations:
    - Plowing
    - Sidewalk operations
    - Other snow removal related SOP's including operation of brine equipment, spreader systems, etc.
    - Loader operation for loading material intro trucks.

The Town is also developing the following guides to be used for training, aimed full completion by 2025:

- Town of Oakville Winter Operations Guide
- Winter Plan

Appendix D.2 - Brine Station Operation Procedure

Last Revision Date: November 4, 2024

Appendix A

Corporation of the Town of Oakville

OAKVILLE

Standard Operating Procedure

SOP Name	Brine Station – Central Ops	SOP Number	PRD-OPS-019
Owner/Job Title	Ryan Wood	Department	Roads & Works
Review due date	June 16, 2023	Revised date	March 10, 2022
Endorsed by	Darnell Lambert	Endorsment date	June 16, 2022
Published	June 16, 2022	Total Pages	4

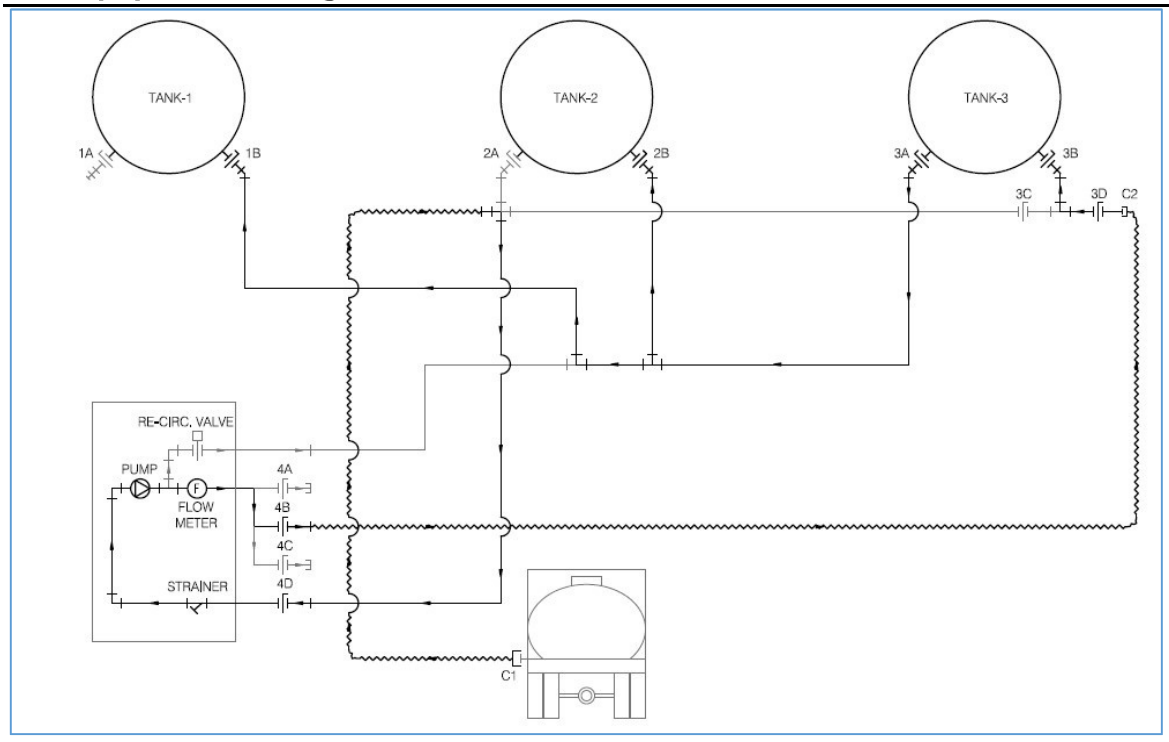
PRD-OPS-

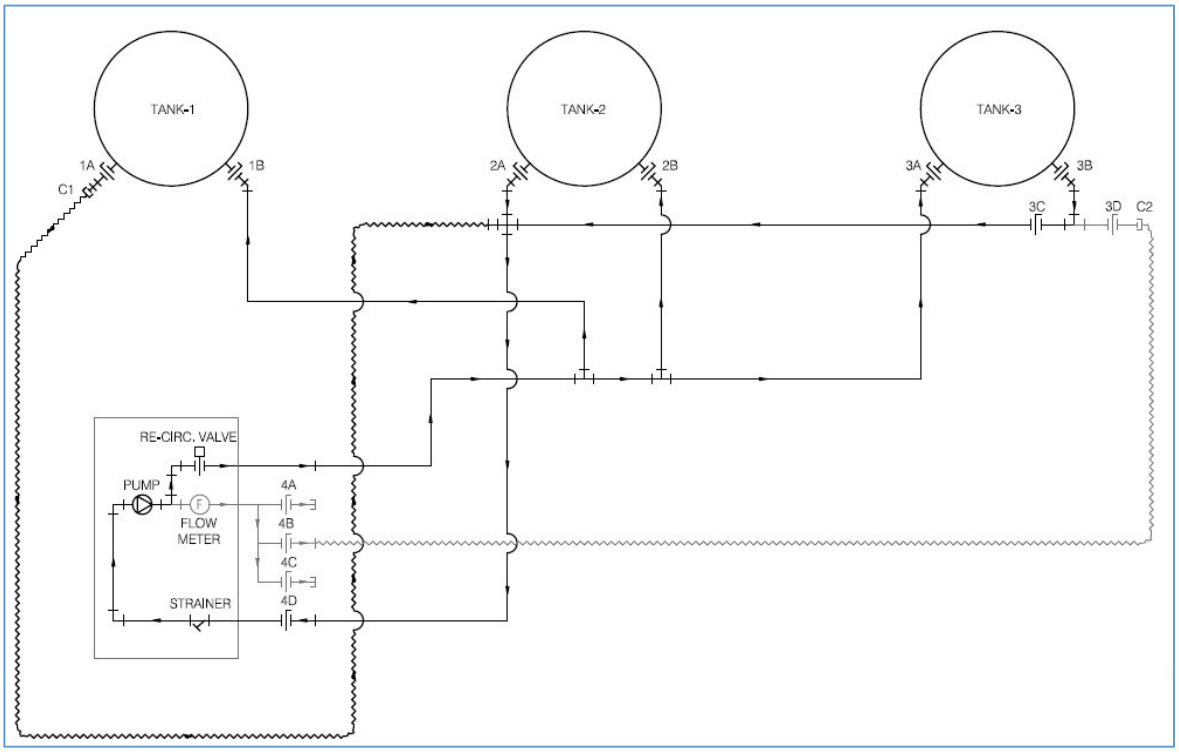
Brine Station-Central Ops

A. Purpose/Scope

Purpose	The purpose of this document is to describe the procedure for using the brine pump system.
Scope	For operators who are filling trucks with brine.

B. Equipment – Images





C. Training/Certification Requirements

Do not use any equipment or perform any Activity unless you have been trained.

List the mandatory requirements applicable to this SOP below.

Documentation	
☐	Criminal Check
☒	Driver's Licence
Training and/or Certificates (list if applicable)	
☒	Select staff will be trained on the Tank Fill, Re-circulation and Truck fill modes**.**
☒	Truck operators may be trained on the Truck Fill mode only.

D. Personal Protective Equipment (PPE)

You must always wear the personal protective equipment required to perfom the task.

Personal Protective Equipment (PPE): Check ☒ all that apply						
☐	☒	☒	☐	☒	☐	☐
Apron	Gloves	Hi-Visibility Apparel	Mask (Disposable)	Safety Footwear	Full Body Harness	Respirator
☐	☒	☐	☐	☒	☒	☐

Face Shield	Hard Hat	Insect Repellant	Mask (Re-usable)	Safety Glasses	Hearing Protection	Sunscreen Sunglasses

E. Procedure

Describe the specfic steps, who is responsible, and actions to be taken in a listed format.
Insert a Hazard symbol ⚠ next to each step to indentify a potential hazard if the steps are not followed as outlined in the document.

1. Inspection and Preinspection

1.1. Do not operate this equipment unless you have been signed off by your Supervisor or designate.

1.2. Only workers who are properly trained, and authorized will operate this equipment.

⚠ 1.3. Prescribed and designated Personal Protective Equipment (PPE) must be worn while operating this equipment or as appropriate for the job.

1.4. Understand the location and use of all controls and safety devices on this equipment.

2. Controls

2.1. Do not operate this equipment unless you have been signed off by your Supervisor or designate.

2.2. For Auto Re-circulation the pump will not start until called for by the low temperature sensor. The low temperature controller is set to -18C.

3. Starting

3.1. Activate the “E-STOP” button by pressing the knob.

3.2. Ensure all valves are closed.

3.3. Ensure the re-circulation valve is closed by setting the selector switch to “FILL”.

3.4. Ensure the re-circulation valve is closed by setting the selector switch to “FILL”.

The procedure outlines the three (3) different modes for the brine re-circulation system.

Tank Fill Mode (See Fig 1, Appendix B)

4. Operating

4.1. Connect delivery hose C2 to valve 3D.

4.2. Connect suction hose to connector C1 at the truck.

4.3. Open truck valve.

4.4. Valves 1A, 2A, 3C, 4A, 4C remain closed.

4.5. Open valves 1B, 2B, 3C, 4A, 4B, 4D.

4.6. Set the pump in manual mode by setting the selector switch to “MANUAL”.

4.7. Disengage the “E-STOP” button by twisting the knob.

4.8. Press the “START” (Green) Button

4.9. When complete, engage the “E-STOP” by pushing the knob.

5. Shut Down

5.1. Shut off truck valve at connector C1.

5.2. Shut off 3D valve.

5.3. Disconnect truck hose at connector C1.

5.4. Return to Truck Fill mode configuration.

Re-Circulation Mode (AUTO or MANUAL) (See Fig 2, Appendix B)

6. Operating

AUTO-RECIRC for periods of no use during cold temps

6.1. Put the pump into Automatic mode by setting the selector switch to "AUTO"

6.2. Disengage the "E-STOP" by twisting the knob.

6.3. The pump will start when called for by the low temperature sensor. The low temperature controller is set to -18°C.

MANUAL RECIRC for off or pre-season use, or as required

6.4 Put the pump into Manual mode by setting the selector switch to "MAN."

6.5 Disengage the "E-STOP" by twisting the knob.

6.6 Press the "START" (Green) Button.

6.7 Run pump for desired time (30-60 min, or as directed).

6.8 When complete, engage the "E-STOP" by pushing the knob.

7 Shut Down

7.1 Return to Truck Fill mode configuration.

Truck Fill Mode (See Fig 3, Appendix B)

8. Operating

8.1 Connect suction hose C1 to valve 1A.
8.2 Connect delivery hose to connector C2 at the truck.
8.3 Open truck valve
8.4 Close valves 1B, 2B, 3A, 3D, 4A, and 4C.
8.5 Open valves 1A, 2A, 3B, 3C, 4B, and 4D.
8.6 Set the pump in manual mode by setting the selector switch to "MANUAL".
8.7 Disengage the "E-STOP" button by twisting the knob.
8.8 Press the "START" (Green) Button.
⚠ 8.9 When complete, engage the "E-STOP" by pushing the knob.

9. Shut Down

9.1 Shut off truck valve at connector C2.

9.2 Shut off 4B valve.

9.3 Disconnect truck hose at connector C2.

10. Maintenance

10.1 Area should be free of litter and debris

10.2 Doors to be closed on Brine Unit after each use

⚠ 10.3 Hoses should be neatly stored whenever possible

F. Related Documents

Reference any other documents that closely align with this procedure.

Related Documentation	SharePoint location or URL
Master SOP Procedures	SharePoint
Flusher Truck SOP	PRD-OPS-146

Appendix D.3 - Internal Facility Spill Procedure

Appendix A

Corporation of the Town of Oakville

OAKVILLE

Standard Operating Procedure

SOP Name	Spills – Operations Facility Internal	SOP Number	PRD-OPS-165
Owner/Job Title	Ryan Wood	Department	Roads and Works
Review due date	July 12, 2023	Revised date	March 10, 2022
Endorsed by	Darnell Lambert	Endorsment date	June 17, 2022
Published	July 12, 2022	Total Pages	3

Spills- Operations Facility Internal

A. Purpose/Scope

Purpose	To control a spill in a safe manner while protecting employees, and the enviroment
Scope	All employees who may encounter a spill

B. Equipment – Images

N/A

C. Training/Certification Requirements

Do not use any equipment or perform any Activity unless you have been trained.

List the mandatory requirements applicable to this SOP below.

Documentation	
☐	Criminal Check
☐	Driver's Licence
Training and/or Certificates (list if applicable)	
☒	Spills Training & Awareness

D. Personal Protective Equipment (PPE)

You must always wear the personal protective equipment required to perfom the task.

Personal Protective Equipment (PPE): Check ☒ all that apply							
 ☐	 ☒	 ☒	 ☒	 ☒	 ☐	 ☒	
Apron	Gloves	Hi-Visibility Apparel	Mask (Disposable)	Safety Footwear	Full Body Harness	Respirator	

 ☒	 ☒	 ☐	 ☐	 ☒	 ☒	 ☐
Face Shield	Hard Hat	Insect Repellant	Mask (Re-usable)	Safety Glasses	Hearing Protection	Sunscreen Sunglasses

E. Procedure

Describe the specfic steps, who is responsible, and actions to be taken in a listed format.
Insert a Hazard symbol ⚠ next to each step to indentify a potential hazard if the steps are not followed as outlined in the document.

1. Inspection and Preinspection

⚠ **1.1** If a spill occurs and the substance is unknown, call 911

2. Controls

The **Supervisor** is responsible for:

2.1 As far as practical, securing the affected area until appropriate cleanup is completed. Overseeing containment and cleanup by the worker.

2.2 Notifying the MOE Spills Action Centre at 1-800-268-6060 if there is a leak or spill > 25L, or when a solid, liquid and/or gaseous material has been released to the outside environment (i.e. outside of a building) and causes or has the potential to cause an adverse effect.

2.3 Arranging for appropriate health care for an injured person, when required.

2.4 Notifying and coordinating the appropriate spills response contractor.

2.5 Reporting, including completion of an Accident/Incident Report, or an Injury Report (when required).

2.6 Providing a copy of the above noted reports to the Joint Health and Safety Committee.

The **Manager** is responsible for:

2.7 Notifying the Director of any spill requiring a call to the MOE Spills Action Centre.

2.8 Arranging for disposal of spilled material in a proper manner.

2.9 Reviewing Accident Injury Report (when required), or an Incident Report.

2.10 Investigating and implementing any necessary action to prevent reoccurrence.

Workers are required to:

⚠ 2.11 Where possible, stop, contain and cleanup any spill in accordance with proper procedures.

2.12 Report all spills to their immediate supervisor as soon as possible after the spill has occurred.

⚠ 2.13 Wherever possible provide all relevant information to their supervisor including location, size and type of spill, and any immediate hazards relating to the spill

3. Starting

4. Operating

⚠ 4.1 Once a spill has occurred, the **worker** shall immediately take steps to secure the area of the spill so that the spill does not place an immediate threat to the health or safety of themselves,their co-workers or the public.

4.2 Where possible the **worker** shall stop the source of the spill.

4.3 The **worker** shall assess the area for any potential hazards and where possible take preventative measures to mitigate the hazards (i.e. if spill material is flammable, turn off any potential ignition sources). When in doubt consult the Material Safety Data Sheets (MSDS) for hazards.

4.4 If a serious hazard exists in which the **worker** is unable to safely secure the area, the **worker** shall immediately contract contact 911 and evacuate any co-workers or public to a safe distance.

4.5 The **worker** shall notify the supervisor as soon as possible after a spill has occurred and make them aware of any potential hazards.

4.6 Where possible the **worker** shall contain the spill and keep from entering any storm or sanitary sewer, roadside ditch, creek, etc.

4.7 The **supervisor** shall ensure that the area of the spill is secure until appropriate clean up is completed and/or investigation has concluded.

4.8 The worker shall clean up spilled material in accordance with the applicable MSDS requirements including wearing the appropriate personal protective equipment (PPE) at all times and shall be done under the direction of the supervisor. Spilled material shall be placed in a secure container for disposal.

4.9 In the event of an emergency, (i.e. large spill of flammable liquid), the Fire **Department** will take appropriate measures to secure and contain the spill until the appropriate cleanup can be completed. The **supervisor** may request assistance from the Fire Department in non-emergency situations should the nature or size of the spill require it.

4.10 In all cases, should the size and/or nature of the spill exceed the capabilities of Town staff to provide appropriate cleanup, the **supervisor** and/or the **Fire Department** shall contact a spills response contractor.

4.11 Where a hazardous material (i.e. diesel fuel) has been discharged to the natural environment (i.e. roadside ditch. drainage course, storm or sanitary sewer) the **supervisor** shall contact the MOE Spills Action Centre at **1- 800-268-6060.**

4.12 The **manager** shall notify the Director when a call to MOE Spills Action Centre is required.

5. Shut Down

5.1 Where required the **Supervisor** is responsible for completing the appropriate ***Accident/Incident Report*** and/or ***Injury Report*** in accordance with the Department reporting procedure.

5.2 The **Supervisor** shall provide a copy of all completed reports to the Joint Health and Safety Committee.

5.3 The **Manager** will be responsible for investigating spills, completing and implementing appropriate measures to avoid reoccurrence where possible.

5.4 The **Manager** shall be responsible to ensure proper disposal of spilled material.

6. Maintenance

6.1. N/A

F. Related Documents

Reference any other documents that closely align with this procedure.

Related Documentation	SharePoint location or URL
Master SOP Procedures	SharePoint