Impacts of road salts on wetlands and aquatic ecosystems in Outaouais

Agence de Bassin Versant des 7

Ensure integrated and concerted management of water resources and associated ecosystems

- Prevent water pollution
- Improve health of watercourse and lakes
- Increase resiliency
- Protect wetlands
- Educate and mobilize

Personalized approach by project contributed to Water Management Plan goals

Zone de gestion de l'ABV des 7
Bassin versant de 7 rivières

Agence de bassin versant des 7
819-771-5025 | info@abv7.org

Contribution

To volunteers:

- Ottawa Riverkeeper
- Friends of Gatineau River
- LaPêche Coalition for a Green New Deal

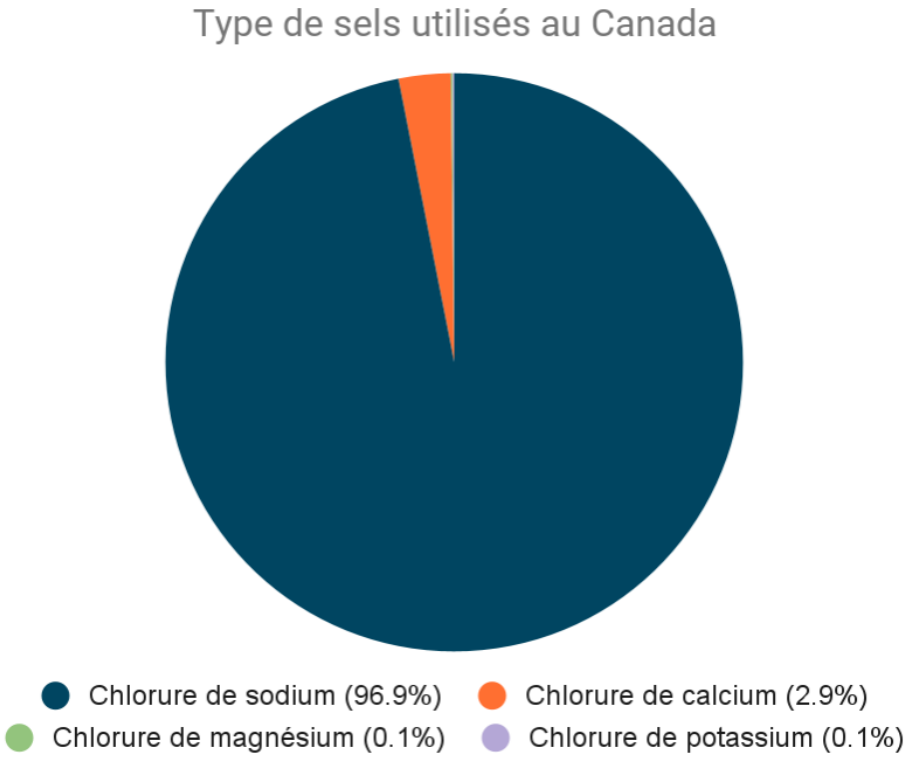
*This project is made possible thanks to a contribution from the **Programme de soutien régional aux enjeux de l'eau**, as part of Plan d'action 2018-2023 de la Stratégie québécoise de l'eau, which deploys concrete measures to protect, use, and manage water and aquatic environments in a way responsible, integrated, and sustainable.*

Project Beginnings

- In winter 2019-2020, Ottawa Riverkeeper sets up a pilot project:
  - Creek monitoring by volunteers
  - Gatineau and Ottawa
  - Conductivity et chlorides
- Finding: several chloride samples above the protection threshold for aquatic life (640 mg/L)
- Winter 2021, this project as part of PSREE:
  - Literature review: trends in Outaouais
  - Literature review: environmental impacts
  - Monitoring of creeks (MRC des Collines et City of Gatineau)
  - Solutions

Source : https://www.ottawariverkeeper.ca

Road Salt Use



In Quebec

1,5 millions of tons de road salts are yearly spreaded.

+ 1 commonly used anti-caking agent: sodium ferrocyanide

+ abrasives : sand, gravel, and litter (sand can be mixed with salt)

Road Salt Use in Outaouais

MRC des Collines

- The 7 municipalities serve in average of 5,000 to 15,000 inhabitants and they maintain an average of 200-km road network. They use less than 2,000 tons of salts.

City de Gatineau

- The City of Gatineau serve more than 250,000 inhabitants et it maintains a 1,900-km road network. It uses about 30,000 tons of salts.

Survey results

- Most of municipalities will subcontract snow removal and road salt spreading service, with contract requirements on the type of products used, the type of equipment used, and the frequency of maintenance.
- The main spreading products used are: sodium chloride (NaCl), calcium chloride (CaCl2), sand, mix of sand/salt, and gravel.
- The number of road salt storage sites considerably varies according to the municipalitie.
- Four municipalities have vulnerable areas for road salt spreading.

Litterature review: uses in the region

A large portion of road salts will end up to the environment:

→ Literature review: mainly by spreading

Salt Storage sites

https://www.transports.gouv.qc.ca

Spreading

https://www.ec.gc.ca/sels-salts/default.asp?lang=Fr&n=BBF5DB7F-1&wbdisable=false

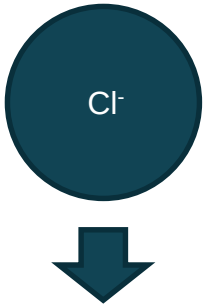
Wasted snow storage sites

https://journalmetro.com/local/mercier-anjou/2238249/lhiver-tire-a-sa-fin-on-visite-le-depot-a-neige-danjou/

Litterature review: potential impacts

Becoming of road salts in the environment

- Into the environment, salt dissociates:



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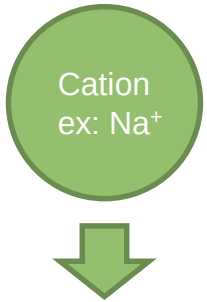


The cations:
- sodium (Na^+)
- sulphates (SO_4^{2-})
- calcium (Ca^{2+})
- magnesium (Mg^{2+})
- potassium (K^+)

Anion of Chloride = **Conservative**

- Follows water cycle, without loss and delay
- Little influenced by chemical and biological reactions
- Concentration of chloride varies according to rain, evaporation and addition of chlorides

Corresponding cation = **No-conservative**

- Quantity directed by exchange processes, reactions, complexation with environment elements.
- Tend to be retained by soil and mobilized by vegetation

Becoming of road salts in the environment

- In the environment, road salts dissociate:

Sodium Ferrocyanide

- Persistent, but not very toxic
- Under certain conditions can form cyanides
- Cyanide ions can dissipate and volatilize
- Effects of ferrocyanides depend on the balance between photolyze et volatilization
- According to some models, it could have effects on some aquatic organisms

Becoming of road salt in the environment

- The chloride follows water cycle and can influence chemical and biologicial reactions into the environment.
- The concentration of chlorides can vary according to rain, evaporation, and addition of road salts.
- The other components of road salts tend to be retained by the soil or vegetation.

Environmental effects of road salts - examples

Surface water

- In high concentrations, road salts can affect the lake mixing process, for example small lakes won't have the turnover during fall and spring.
- Toxic effects on benthos: **Release of heavy metals, complexation of metals with chlorides.**
- Influenced by sodium ions (Na+): several species well adapted to salinity variations, but some are sensitive (e.g., freshwater bacteria, invertebrates, microorganisms, etc.)

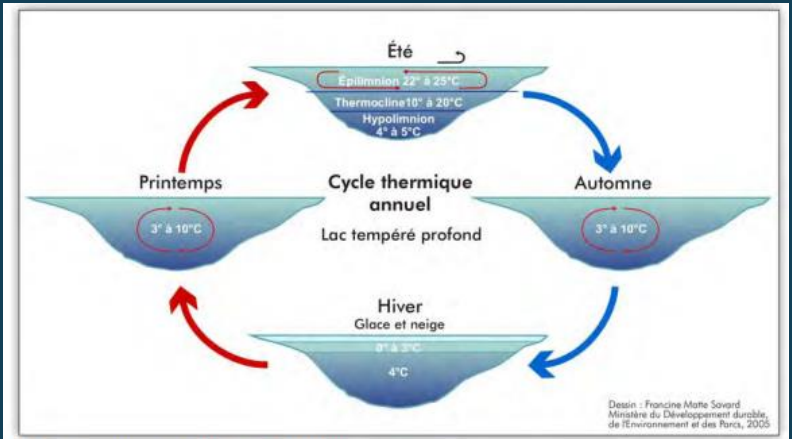


Illustration : Francine Matte-Savard, MDDEP

Environmental effects of road salts - examples

Underground water

- Sources de contamination in underground water tables, including drinking water

Soil

- Effects on soil characteristics : permeability, osmotic potentiel, land stability (erosion)
- Biotic effects: osmotic stress, nutrient mobilization, decomposition process

Source : https://ici.radio-canada.ca/nouvelle/518145/uqtr-etude-puits-contamines

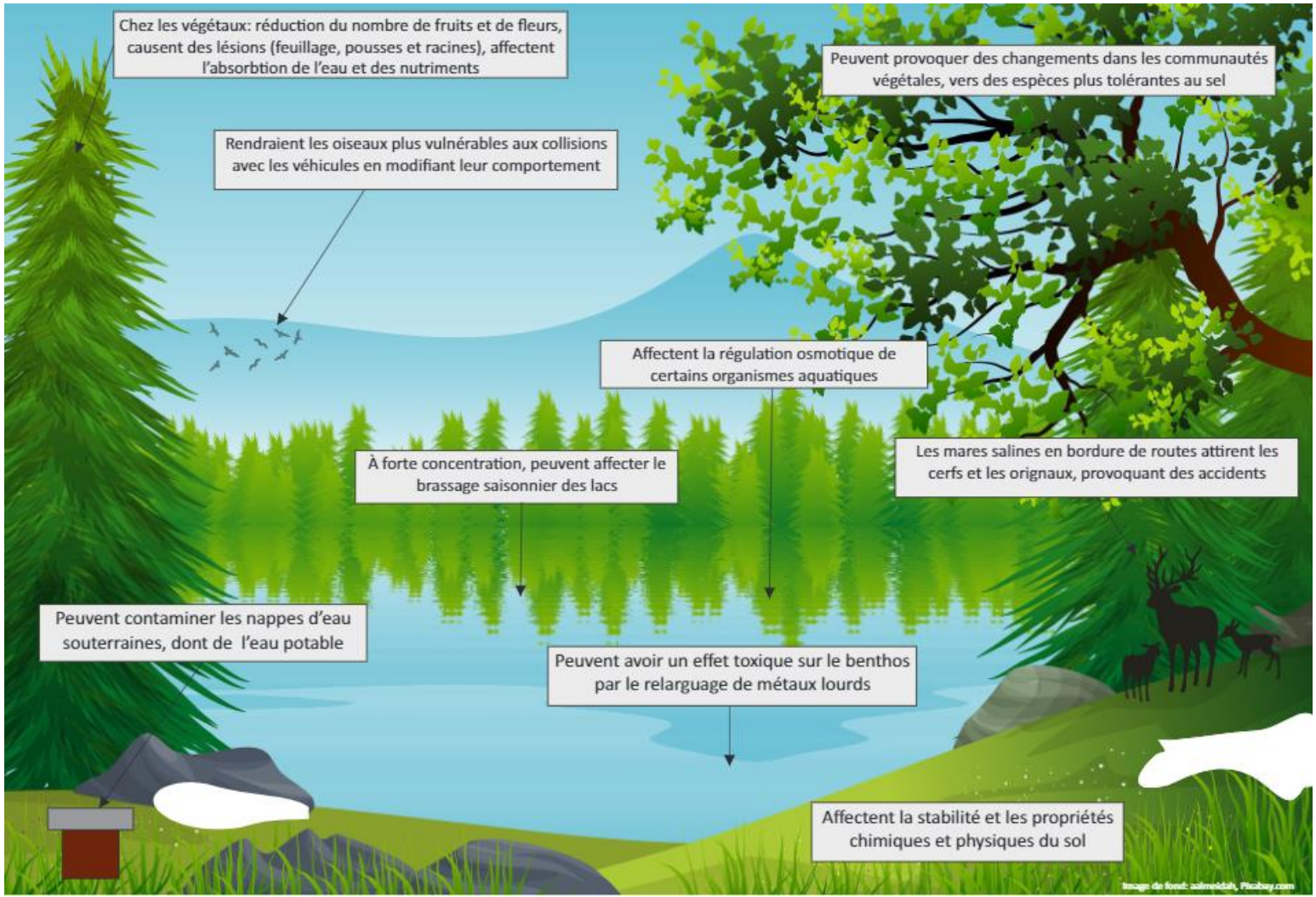
Environmental effects of road salts - examples

Flora

- **Negative effects increasing the plant vulnerability to insects, diseases, and abiotic stress** (reduction of nomber of flowers and fruits, presence of lesions in leaves and roots, decrease of growth, etc.)
- Effects on water and nutrient absorption
- Change of vegetal communities favoring species tolerant to salt: **bulrush et commun reed**

Fauna

- **Effects on animal behaviours and number of road collisions**:
  - Moose and white-tailed deers attracted to roadside salt ponds
  - Birds are also affected


Chez les végétaux: réduction du nombre de fruits et de fleurs, causent des lésions (feuillage, pousses et racines), affectent l'absorbtion de l'eau et des nutriments
Peuvent provoquer des changements dans les communautés végétales, vers des espèces plus tolérantes au sel
Rendraient les oiseaux plus vulnérables aux collisions avec les véhicules en modifiant leur comportement
Affectent la régulation osmotique de certains organismes aquatiques
Les mares salines en bordure de routes attirent les cerfs et les orignaux, provoquant des accidents
À forte concentration, peuvent affecter le brassage saisonnier des lacs
Peuvent contaminer les nappes d'eau souterraines, dont de l'eau potable
Peuvent avoir un effet toxique sur le benthos par le relarguage de métaux lourds
Affectent la stabilité et les propriétés chimiques et physiques du sol
Image de fond: aalmeidah, Pixabay.com

And the abrasives?

They also have environmental impacts

- Decrease of water quality: ↓ transparency, ↑ turbidity
- Silting up watercourse
- Clogging of fish spawning grounds

Sampling

Conductivity measurement

- The conductivity is the water ability to conduct electricity.
- It can be affected by the presence of chlorides

Monitoring campaign

- When conductivity measurements exceed the treshold of (1015 uS/cm), sampling were sampled to confirm the concentration of chlorides in the creeks.

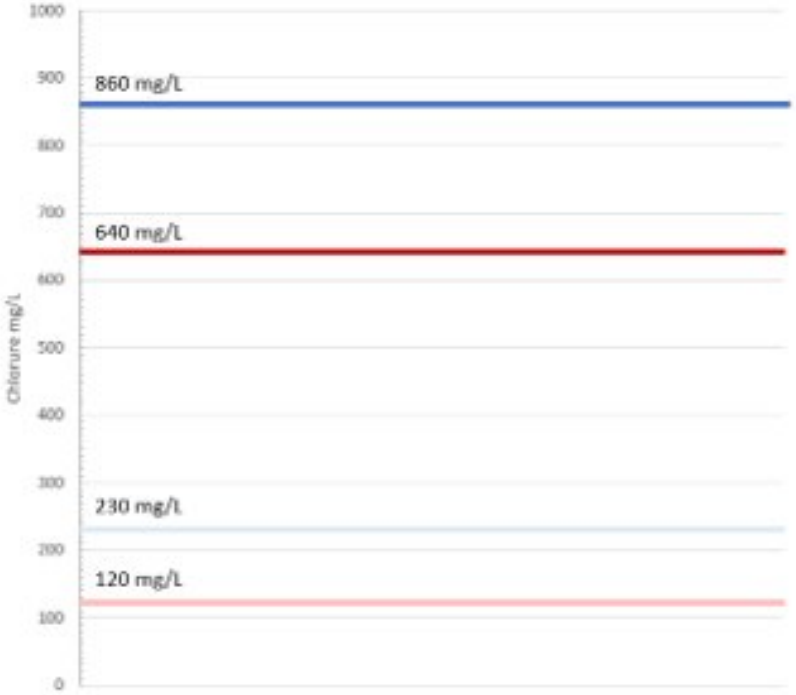
Sampling

What is the conductivity?

- Ability of water to conduct electricity
- General measurement of water quality
- Affected by the presence of dissolved inorganic solids, including chlorides
- Influenced above all by the geology, although strong variations of conductivity compared to normal can be an indicator of contamination in the watercourse.

Sampling

Criteria for aquatic life protection - Chlorides



Acute effect = in the short term

Chronic effect = in the long term

Sampling

- **Ottawa Riverkeeper, Friends of Gatineau River, LaPêche Coalition for a Green New Deal et ABV des 7**
- Measurement of conductivity to evalute the chloride level in water

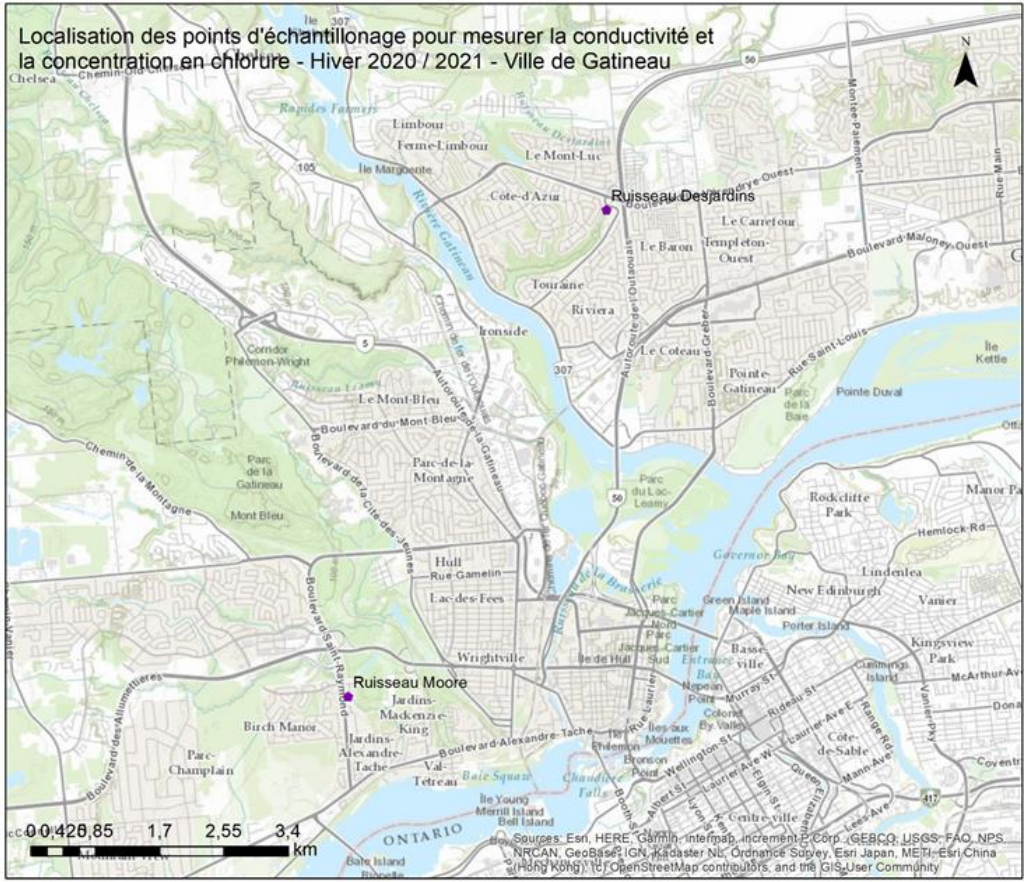
Trigger Event

- Snow + 2cm
- Melting episode

Measurement of conductivity

-1015µs/cm	
1015 et 3200µs/cm	Chloride sampling Monitoring up to 4 days
+3200µs/cm	Chloride sampling

Results – City of Gatineau



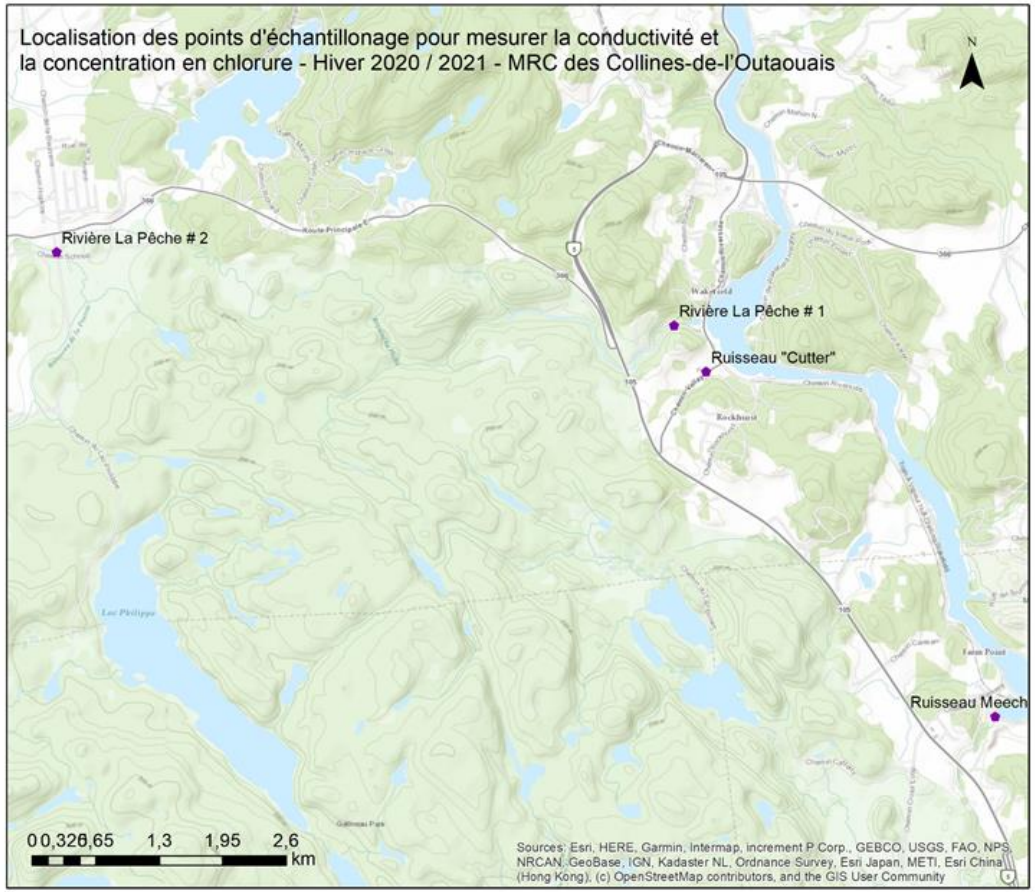
→ 6 sites

→ On tributaries of Gatineau and Ottawa rivers.

→ Targeted approach:

- Site may have an impact with road salts
- Urban environment or close to a major road

Results - Outaouais



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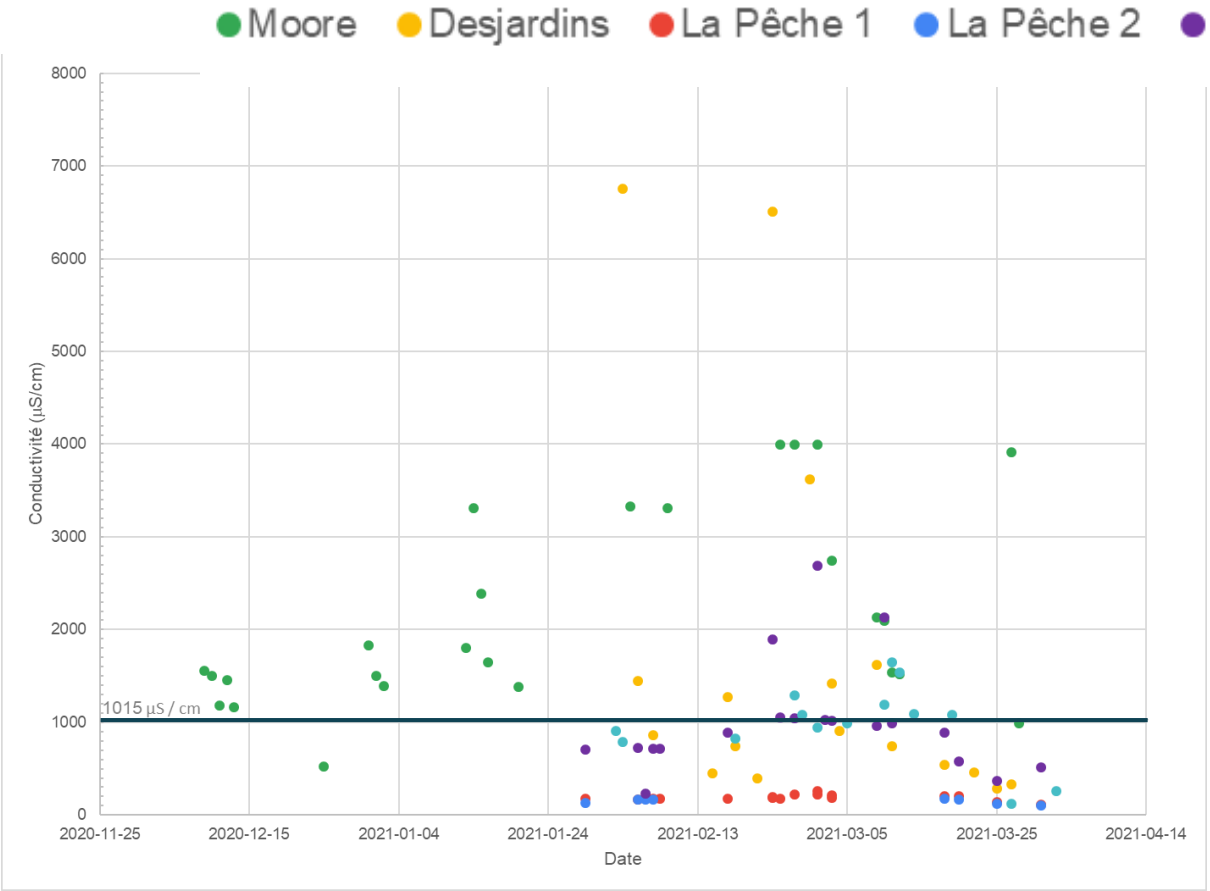
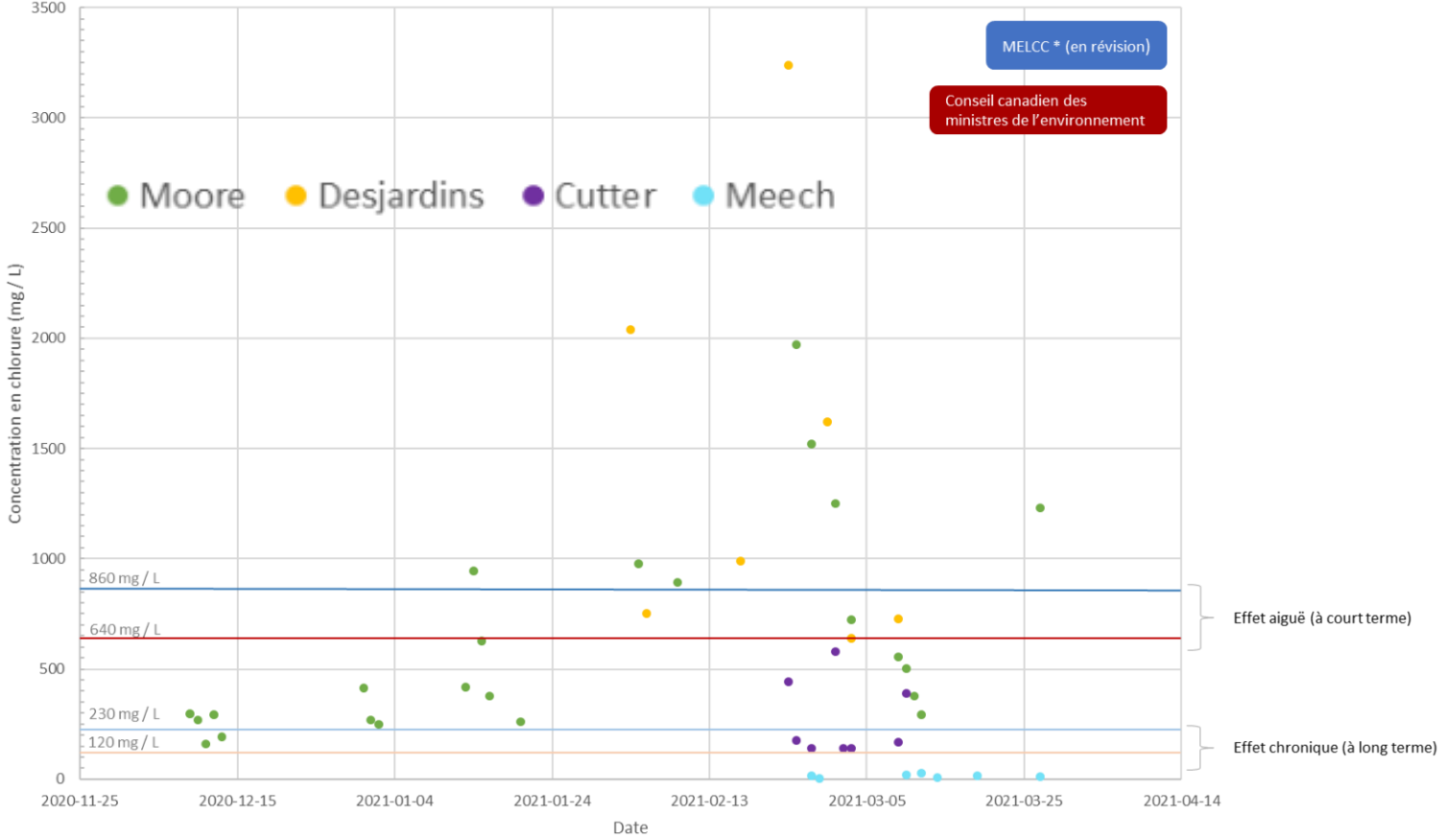


Résultats - Outaouais



Results - Outaouais

Tableau 4 : Nombre d'échantillons analysés pour en déterminer la concentration en chlorure, ainsi que le nombre d'échantillons parmi ceux-ci dépassant les critères de qualité de l'eau pour la protection de la vie aquatique du Conseil canadien des ministres de l'environnement et du MELCC pour les effets chroniques (long terme) et aigus (court terme).

Cours d'eau	Nombre d'échantillons analysés	Nombre d'échantillons dont la concentration en chlorure est supérieure aux critères de qualité de l'eau pour la protection de la vie aquatique			
		Conseil canadien des ministres de l'environnement		MELCC (en révision)	
		Exposition longue durée (120 mg/L)	Exposition courte durée (640 mg / L)	Effets chroniques (230 mg / L)	Effets aigus (860 mg / L)
Desjardins	7	7	6	7	4
Moore	24	24	8	22	7
Meech	7	0	0	0	0
Cutter	8	8	0	3	0
Total	**46**	**39**	**14**	**32**	**11**

Road Salt Management Plan

What is it?

- This is a document by which a municipality commits to a better use of road salts.
- To decrease their environmental impacts and costs while ensuring the safety and efficiency of its transport network.

Road Salt Management Plan

What is it?

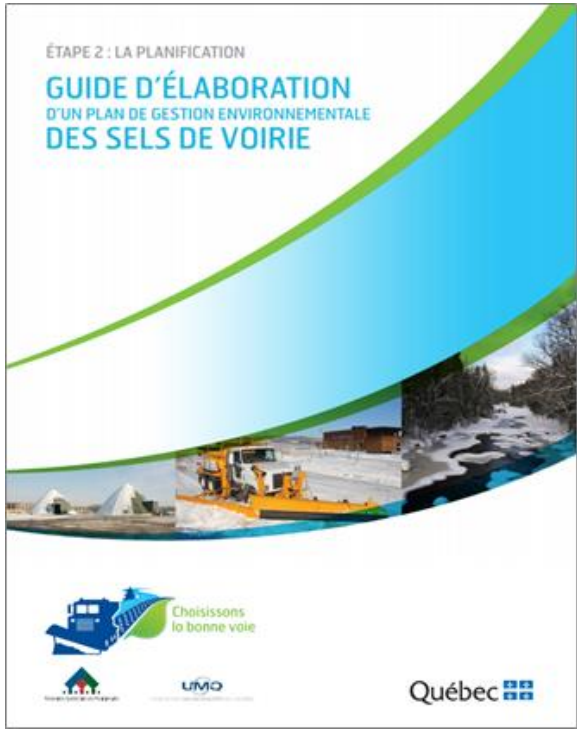
- It inventories the activities associated with road salts.
- It takes corrective measures to minimize environmental impacts.
- Its must be adapted to each municipality according to its own factors (e.g., budget, transport network configuration, etc.)

Available tools for help

Stratégie québécoise pour une gestion environnementale des sels de voirie – MTQ (in French only)

- Encourage administrators to set up a road salt management plan
- Suggest a process in 5 steps
- Informations, reference tools, and trainings

www.selsdevoirie.gouv.qc.ca



Available tools for help

Code of practice : road salts environmental management - Environment et Climate Change Canada

- For organization using more than 500 tons of road salts or with sensitive areas
- 2 recommendations:
  → Create a road salts management plan
  → Adopt best management practices

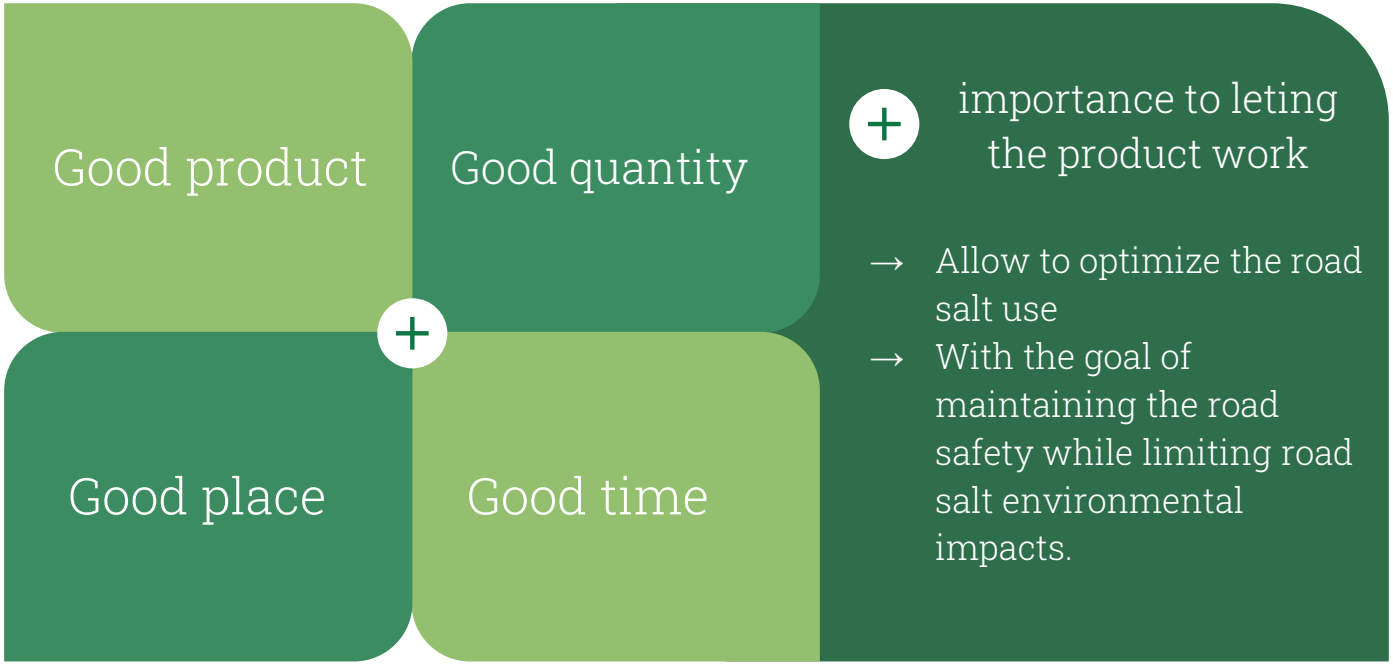
https://www.canada.ca/en/environment-climate-change/services/pollutants/road-salts/code-practice-environmental-management.html

Training - Smart About Salt Council (SASC)

- None-Profit Organization
  - Mandate: reduce the impact of road salt spreading in freshwater
- Training and Certification Programs (French and English)
- For municipalities and contractors
- Inscrease the safety of users while reducing the quantity of spreaded salts
- Online trainings offered for now

smart about salt
Winter Salt Management Program
http://www.smartaboutsalt.com/

The concept of 4 “G” - Solutions



Solutions

Trainings

- In the beginning of each season, training or upgrade for operators:
  - Theorical principles of road salt use
  - Pratical aspects of the use of equipment and their accessories
- If resources allow, designate a responsible for winter road maintenance and operation with the following requirements:
  - At least 3 years of experience in winter road O&M
  - Have completed a training
  - Familiar with the road salt management plan

Solutions

Meteo monitoring

- Specific information on weather and road conditions can help in decision-making. For examples:
  - Suscription to local weather services
  - Road weather stations
  - Portable thermometers installed on trucks (measurement of ambiant air temperature and of the roadway)

Solutions

Equipment calibration

- Regardless of the spreader used, the spread rate should be always accurate.
- Calibration should be done twice a year (beginning of and half of the season) and after each vehicle repair.

Automatic spreading controllers

- Adjust the quantity of product applied according to the speed of the truck.
- When coupled with a positioning system, they allow precise assessment of the amount of salt spreaded.

Solutions

Quality scratching

- The blades with carbide parts suitable for the road effectively remove the snow and reduce the use of salt.

Pre-humidification

- Apply a liquid to pre-humidify the salts
- Avoid dispersion, increase melting capacity, allows to reduce the amount of salt applied.
- Can be done during spreading on board of truck or at the storage site when stalking salt.

Solutions

Anti-icing

- Preventive use of melting products to prevent snow or ice adhering to the road
- Product applied to the roadway 3 to 24 hours before the onset of a storm
- Based on the use of road weather data

Direct spreading of liquid

- Application of liquid de-icer on the pavement
- Cause immediate melting

Solutions

Strategic use of new equipment

- New equipment should be used to more sensitive areas or requiring more salt spreading.

Planning of spreading routes

- Prevent from road sections being traited twice.

Automatic Location of vehicles

- Better monitoring of road salt spreading, location of vehicles, and the workflow

Solutions

Snow guards and windbreaks made from plants or rigid materials (sensitive areas)

- On portions of roads subject to snow accumulation
- Must be installed some distance from the road

Storage of salts and waste snow elimination

- Can contribute to the road salt dissemination in the environment.
- In Quebec, these activities are governed by the *Règlement sur la gestion de la neige, des sels de voirie et des abrasifs* in force since December 31, 2020.

Quartiers blancs - Ville de Saguenay - 2008

- In 2013, the City of Saguenay has 27 *white districts* and it plans to broaden the concept into its whole territory.

Projected Annual Savings: 1,000,000 $

- Spreading abrasive that melts over a short distance, when essential
- Selected according to a flat and homogeneous land outside of downtown in concertation with the stakeholders (councilors et citizens)
- Signage installation
- Spreading rate from 450 to 250 kg/km, spreading length from 30 to 15 m before the stops.

Source: https://www.neomedia.com/saguenay-lac-st-jean/actualites/societe/264270/de-nouveaux-quartiers-blancs-a-saguenay-en-2015

Eco routes d'hiver - MTQ

- Alternative maintenance method: use of abrasive and intensification of stratching
- Road salt only used on iced pavement or critical locations (slopes, curves, and stops).
- 3 principles: Road safety, Social acceptability, and Protection of sensitive areas
- Low-Flow Regional Roads (< 500 vehicles / day)
- **In 2020, the Ministry of Transports Québec (MTQ) designated 22 road sections in Québec as « écoroutes d'hiver ».**

Signalisation à installer pour l'implantation d'une écoroute d'hiver

City de Sherbrooke – Vivre avec l'hiver - 2017

- **Management Plan** based on: Safety of users, Conservation of resources, and Protection of the environment
- **Winter Viability Committee**: recommend to the City the O&M of snow removal and salt spreading service

- Trainings for managers: assesssment and monitoring of amount of salts according to winter events
- Trucks equipped with a spreading controller
- Abrasive spreading for road sections along Magog lake
- Blowing snow on the edge when possible to reduce trips to waste snow dumps
- Deployment of GPS system to optimize the spreading route in real time (monitoring of amount of salts and abrasive spreaded)

Municipality of Chelsea – strategic spreading - 2017

- **Operation of snow removal**: + 5 cm on the ground or when pavement is slippery.
- Since 2019, **only abrasives are spreaded** in the curves, intersections, slopes or when required. This is done on a length of 30 m before and after curves, slopes, and intersections.
- A mix of salts and sand is spreaded on the whole width of principal road.
- Crushed stones or sand are spreaded on the width of secondary roads.

Resolution adopted in 2017 for a district, then another resolution in 2018 to enforce these measures to the whole municipal territory

Conclusion

- Road salts have impacts in the environment.
- It is important to takomg measures to reduce its impact as well as making road safe for users.
- ABV des 7 offers support in the management of road salts.

Thank you!

Speaker:

- Jean-François Ouellet, ABV des 7

Authors of the study:

- Michèle Labelle, Gabrielle Fortin et Théo Jean

To volunteers:

- Garde-Rivière des Outaouais
- Amis de la rivière Gatineau
- LaPêche Coalition for a Green New Deal

To participating municipalities: Gatineau, Val-des-Monts, Chelsea, Cantley, Ange-Gardien, La Pêche, Notre-Dame-de-Salette et Pontiac.

This project is made possible thanks to a contribution from the Programme de soutien régional aux enjeux de l'eau, as part of Plan d'action 2018-2023 de la Stratégie québécoise de l'eau, which deploys concrete measures to protect, use, and manage water and aquatic environments in a way responsible, integrated, and sustainable.

Questions and comments