De-icing Salts and Street Tree Performance in Structural Soil Cells

This document provides a synopsis of an investigation on the movement of de-icing salts in structural soil cells and their impact on the vitality of trees planted along the Martin Goodman Trail on Queen's Quay Boulevard, Toronto, Canada.

Background & Objectives - In 2017, the UFRED group of Ryerson University investigated the seasonal variation of soil salinity caused by de-icing salt application and the associated process of salts removal, on the condition of the Queen's Quay trees, with the objective of advancing design, planting, and maintenance practices of trees planted in soil cells.

Site Description – Queen's Quay revitalization, finalized in 2015, involved the planting of 154 London Planetrees and Sycamore trees in structural soil cells (Silva Cells®) along the Martin Goodman Multi-Purpose Trail (Fig 1).

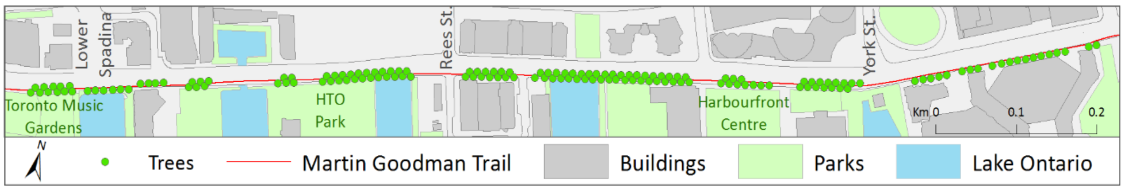

Fig 1: Tree-planting sites and surrounding environment at Queen's Quay Boulevard, Toronto

Fig 2: Types of data collected

Data Collection & Analysis – This research quantified multiple variables related to tree vitality (Fig 2) using a standard sampling procedure (Fig 3). We focused on two aspects: 1) evaluating the movement of de-icing salts through the immediate soil environment of the trees and the effect of Spring flushing (2017); and 2) evaluating the growing conditions and their relationship with tree health. This involved doing site surveys, collecting soil samples, using soil data loggers, and using GIS to model shadow patterns. These data were analysed with the objective of characterising the movement of de-icing salts in the soils and identifying factors influencing tree performance.

Results - The salinity and alkalinity levels found at the selected sites were on average higher than the values suggested before negative effects are expected on trees (Fig 4). The concentrations, however, ranged seasonally, sharply rising over the winter and gradually decreasing through spring. Our results also indicate that there was no long-term accumulation of de-icing salts during one season. In addition, soil salinity levels were higher at deeper depths, and the fluctuations of salinity coincide with variation in moisture and precipitation events (Fig 5). This means that the passive irrigation system stimulated the downward movement, or flushing, of salts. Additionally, elevated soil salinity and alkalinity were related to diminishing soil nutrient levels (Fig 6). Trees that displayed a good canopy condition in 2017 had higher nutrients and higher daily exposure sunlight in March. Proximity to the building-side of the trail was associated with higher salinity levels.

Type of Data	*Sources of Data*	*Details of Sampling*	*Dates of Collection*
Soils	Soil samples	57 samples distributed along all tree plantings	December 2016 March 2017 May 2017
	Soil data loggers	4 loggers next to living trees distributed along site	Continuously April-June 2017 (72 days)
Trees	Field assessments	154 trees	June 2016 June 2017

Fig 3: Examples of data collected and sampling procedures

Soil chemistry variable	*Results*	*Standard*
pH	8.7	< 6.7
Electro-conductivity	0.4 dS/m	< 0.5dS/m
Organic Matter	2.97%	4 – 15%
Calcium	4398.8ppm	1000-4000ppm
Magnesium	101.4ppm	100 – 300ppm
Sodium	452.1ppm	< 260ppm

Fig 4: Soil chemitry average results and standard values

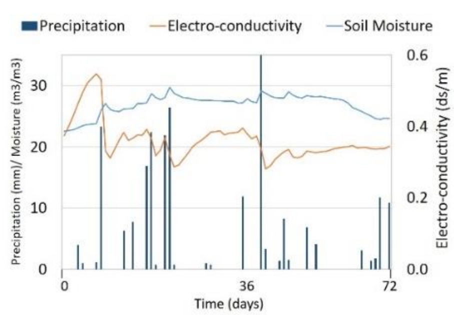

Fig 5: Daily mean soil moisture and soil salinity (electro-conductivity), and daily precipitation from April 12 to June 22

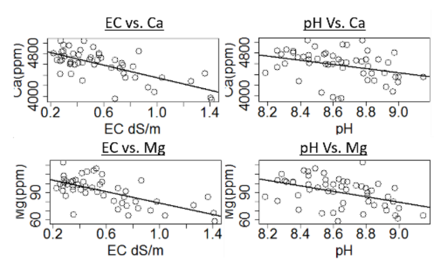

Fig 6: Associations between salinity, alkalinity, and selected nutrients

Recommendations - (1) Incorporate system elements into structural soil cells enabling saturation soil cells to assist salt movement; (2) Educate building managers/retailers about de-icing salt application; (3) Minimize tree planting of trees in areas with little direct sunlight; (4) Select shade and salt tolerant species; and (5) Monitor soil salinity levels on a long-term basis.

Partners: