Background
Water Degradation
- Population growth has caused intense urbanization in many cities and towns causing changes in land-use features and a water quality.
- Urbanization causes an increase in impervious surface which has shown to cause problems such as water degradation from sedimentation, erosion, loss of habitat and fish populations.

Road Salt Usage
- Urbanization has caused a greater concern for public safety during cold climates, due to icy roads.
- Environment Canada has determined that road salts can be toxic to plants, animals and the aquatic environment. (Images)

Chloride in Stormwater Ponds
- The application of road salt is seen in creeks, rivers and lakes. It has been documented to already have negative impacts on aquatic ecology.
- Previous research indicated that during winter months chloride loadings would occur at the bottom of the pond.
- Stormwater ponds that cause chloride to collect in the winter months may have serious toxic effects to benthic organisms causing an alteration in ecosystems and food webs within the pond.

Methodology

Research Aim & Objectives
The main objective of the study is to assess whether stormwater ponds have an impact on chloride concentrations from road salt and natural sources. The research included the following objectives:
- Measuring chloride and total suspended solids at the inlet and outlet of five stormwater ponds to determine the efficiency of each pond
- Characterizing features surrounding 5 stormwater ponds which will include design, vegetation, geographic location and inlet and outlet structures
- Compare water quality samples over three sampling periods with stormwater pond features and weather conditions
- Make recommendations to improve functionality and design of future stormwater ponds based on findings, in order to control the amount of chloride being released into downstream creeks and water bodies

Results & Discussion
Design
Design features analyzed during individual pond analysis can be seen in Table 1.

Table 1: Design Elements of the Sampled Ponds

<table>
<thead>
<tr>
<th>Pond</th>
<th>Location</th>
<th>Design Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV14</td>
<td>Lover's Creek</td>
<td>Gate, Berm, Inlet &amp; Outlet</td>
</tr>
<tr>
<td>BK4</td>
<td>Bunker's Creek</td>
<td>Inlet, Outlet, Berm</td>
</tr>
<tr>
<td>KD1</td>
<td>Kidd's Creek</td>
<td>Inlet, Outlet, Berm</td>
</tr>
<tr>
<td>GR5</td>
<td>Georgian Creek</td>
<td>Inlet, Outlet, Berm</td>
</tr>
<tr>
<td>HW5</td>
<td>Hickedt Creek</td>
<td>Inlet, Outlet, Berm</td>
</tr>
</tbody>
</table>

Vegetation
Types of vegetation documented were not identified based on specific species but rather family. Table 2 shows vegetation based on vegetative zones seen in Figure 6.

Table 2: Vegetative Zones Elements of the Sampled Ponds

<table>
<thead>
<tr>
<th>Pond</th>
<th>Location</th>
<th>Vegetative Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV14</td>
<td>Lover's Creek</td>
<td>Elderberry, Dogwood, Sedges, Willow, Poplar, Cattail, Maple, Pine</td>
</tr>
<tr>
<td>BK4</td>
<td>Bunker's Creek</td>
<td>Elderberry, Dogwood, Sedges, Willow, Poplar, Cattail, Maple, Pine</td>
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</tbody>
</table>

Chloride & TSS
TSS and chloride was averaged for all the inlets and outlets over the three sampling events. The results can be seen in Figure 9.

Chloride removal rates were mainly positive although had negative removal rates on June 17 for LV14 and HW5, indicating that something within these ponds is causing a greater amount of chloride to be released to the water shed than values estimated within the pond.

Conclusion & Recommendations
- Research indicated that there is an impact on stormwater ponds based on chloride emissions, although it was not determined whether the results are solely related to road salt.
- Further investigation would be required to understand if design features and vegetation actually have an impact on these results.
- During high rainfall events man-made detention ponds had elevated chloride concentrations at the outlet compared to the inlet.

Recomendations to the research include:
1) Samples should be taken over a longer period of time, allowing to include seasonal variation
2) Samples should be taken over various weather events, differing amount of rainfall and sunshine
3) Vegetation and design features should be better assessed to determine if these are having an impact.