Pollution Pollution Mapping for Mission Industrial Area and South St Boniface in Winnipeg, Canada.

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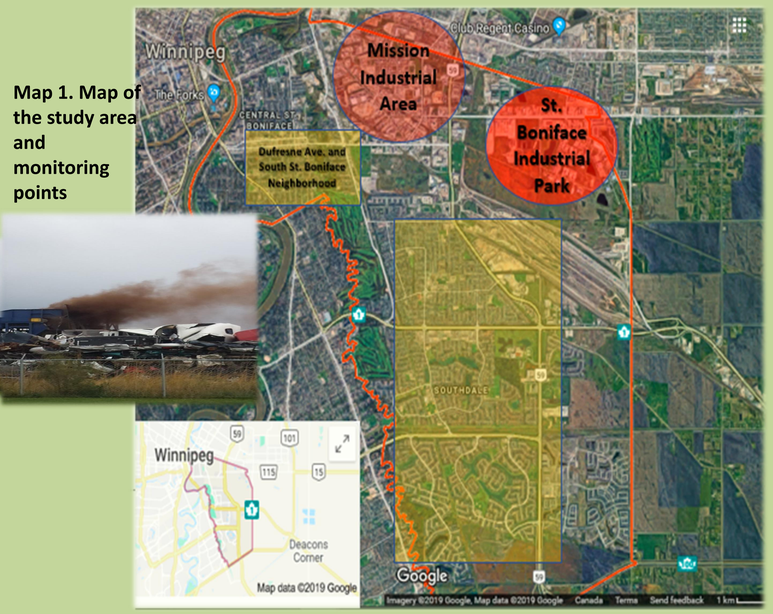
Introduction

- South St. Boniface is a neighborhood less than one kilometer from a shredder at the scrap metal recycling facility of Industrial Metals Inc., in the Mission Industrial Area of Winnipeg . See Map 1 for location.
- Emissions such as metal particulate, volatile organic smell, smoke and fires (Fig. 3 & 5) have been frequently reported to regulatory agencies by residents of South St. Boniface.
- Scrap metal recycling technologies (notably metal shredder and electric arc furnace) emit air pollutants including respirable fine particulate matter ($PM_{2.5}$) and heavy metals (OSHA, 2008).
- Sustained human exposure to air pollutants and noise pose adverse human health risks especially in children and other vulnerable populations (Ana et al., 2009; D'Amato et al., 2015).
- $PM_{2.5}$ is inhaled deep into the thoracic and lungs region, increasing the risk of lung cancer and other cardiovascular and respiratory diseases (Bell et al., 2007; IARC, 2013).



Map 1. Map of the study area and monitoring points

Methods and Materials

Monitored 3 different types of pollution at Industrial Metals Inc. fenceline, residential area and school, with monitoring sites as shown in Figure 2:

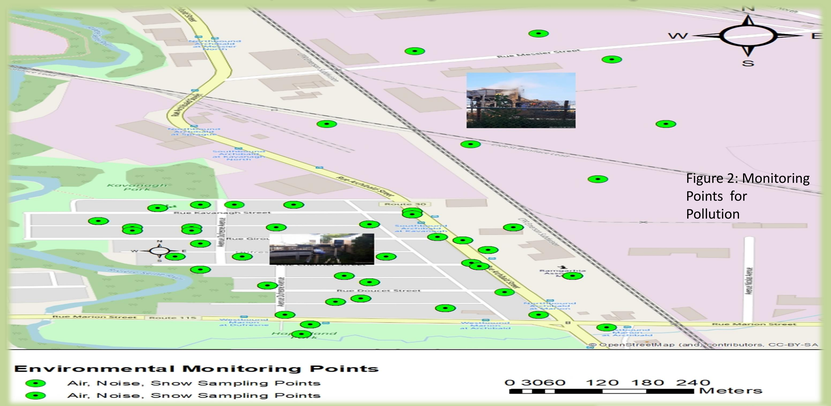


Figure 2: Monitoring Points for Pollution

1. PM2.5 using Dylos laser particle counter.
   - 8 hours air sampling near industry fence line during peak operation for 3 to 5 x weekly over 6 months (May to Oct., 2018).
     - Analyzed upwind and downwind when air sampling.

2. Snow samples (Elik et al., 2001).
   - Sampled accumulated undisturbed snowpack compared to background levels.
   - Analyzed by Inductively Coupled Plasma-Mass Spectrometry for metals analysis (Voica et al., 2012) for concentrations and then applying contamination factor (*cf*) and pollution load index (PLI)
   - $cf = \frac{\text{mean conc.of heavy metals from the study area}}{mean\ conc.\ of\ background\ sample}$ ---- (1)

$$PLI = \sqrt[n]{cfi * cf2 * cf3 * cf4 * cf4 * cf5 * cf6 * cf7 * cf8}$$ ---------- (2)

3. Noise level measurement using A-weighted (dBA) to assess the loudness and human ear's threshold limit using digital Sound Level Meter

4. Analysis by SPSS, spatial interpolation and Kriging interpolation maps.

Chart 1: Contamination factor (Cf) of heavy metals in snow samples in South St. Boniface Area

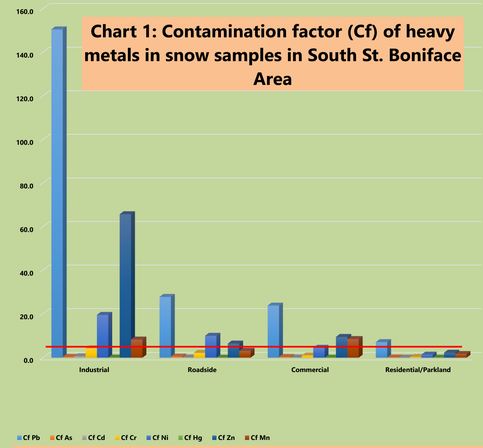
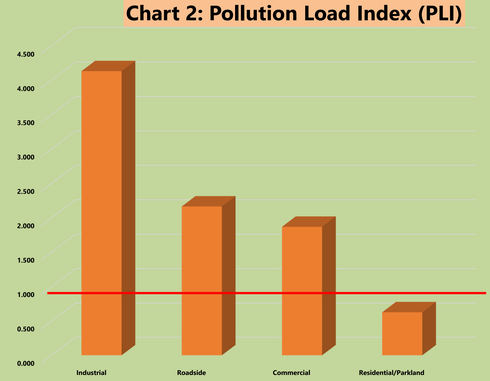
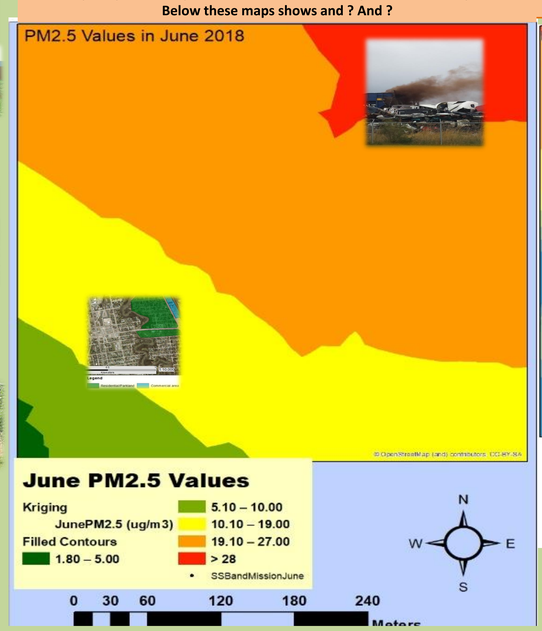


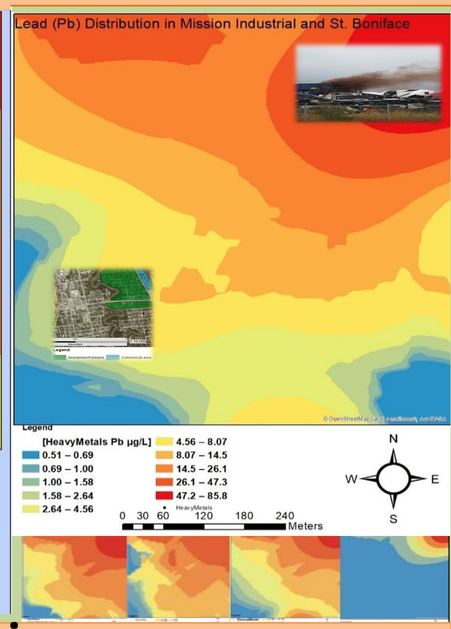
Chart 2: Pollution Load Index (PLI)



Map 2: Spatial Interpolation of PM 2.5 and Heavy Metals in Snowpack
Below these maps shows and ? And ?



Map 3: Kriging interpolation Maps of Heavy Metals



Objectives

This study analyzed different pollution types by levels and spatial analysis near Industrial Metals Inc., a scrap metal recycling plant, and other points in South St. Boniface neighbourhood, for:

1. Particulate matter below 2.5 ug ($PM_{2.5}$) emissions compared to regulatory guidelines and upwind levels.

2. Concentration of metals, including lead, arsenic, zinc, nickel, cadmium, chromium and total mercury in snow samples to analyze applying contamination factor (cf) and pollution load.

3. Noise pollution levels to compare to regulatory guidelines and health thresholds.

Results and Analysis

1. **Respirable fine particulate ($PM_{2.5}$)**
The results for hourly emissions of $PM^{2.5}$ in the industrial area shown in red exceed > 27 µg/m^3 (20.3 to 67.2 µg/m^3) with the orange/yellow areas showing deteriorating air quality with satisfactory in green in Map 2. June is shown in Map 2 but all months sampled have similar results.

2. **Carcinogenic Heavy metals in Snow samples**
Highest levels of Lead (Pb) are shown in Map 3 near Industrial Metals but also for arsenic, zinc, nickel, cadmium, chromium and total mercury in snow samples . The high contamination factor and pollution load high pollution loads in Chart 1 and 2 show higher levels near industry for most heavy metals, particularly for lead.

3. **Noise levels** exceeded 55 dBA standard in the Industrial area as shown with the red on the maps, and episodic exceedances occur in the residential area.

Conclusion

Different pollution types are shown to have elevated levels with higher levels near Mission Industrial and Industrial Metals Inc. with:

1. **Higher Respirable fine particulate ($PM_{2.5}$) occurred near Industries**. $PM_{2.5}$ exceeded Canadian Ambient Air Quality Standard sporadically and hourly but not typically over an 8 hour average at monitoring points near Industrial Metals Inc. However during forest fires in August, $PM_{2.5}$ values in residential and traffic corridor sampling points exceeded the CAAQ standard.

2. Higher levels of heavy metals occurred in snow pack near Industries. Near the shredder at Industrial Metals there were high contamination factors for Lead, Zinc, Nickel and Mercury and high pollution load of carcinogenic heavy metals near Industrial Metals Inc shredder. Short- and long-term exposure to Lead (Pb) in children disrupts brain and nervous system development and high blood pressure and kidney damage in adults.

3. Higher levels of noise near Industries. Noise levels exceed > 55 dBA with hourly measurements >70 dBA pose hearing impairment in the industrial area while the episodic increase in noise levels in the residential area up to 55 dBA and 58.5 dBA reduce welfare and pleasure of residents.

This study recommends regulatory control measures requiring engineering design to prevent particulate, metal and noise pollution by enclosure of the scrap metal shredder.

References

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