

Summary of Findings: Lead Concentrations in Soil in Winnipeg Neighbourhoods

The Province of Manitoba, as represented by the Ministers of Health, Seniors and Active Living and Sustainable Development, commissioned an independent review of the potential health risks associated with lead in soils throughout the City of Winnipeg. This review was completed by a team led by Intrinsic Corp., in association with Habitat Health Impact Consulting, which included certified toxicologists, risk assessors, and a medical doctor. It included an evaluation of the benefits of conducting further investigations and provided recommendations regarding risk management and communication related to lead in soils.

The work was completed between May and November 2019 and was divided into five tasks:

- **Task 1:** Review of available soil data for Winnipeg neighbourhoods.
- **Task 2:** Review of current and historical sources of lead in Winnipeg.
- **Task 3:** Review of approaches used by Canadian and Western jurisdictions for assessing and managing lead in soil.
- **Task 4:** Assessment of health risks associated with the lead concentrations measured in Winnipeg soils.
- **Task 5:** Recommendations for further assessment of risks and possible risk management options.



Summaries of the activities completed under each Task along with the key findings are presented below.

Task 1: Review of Available Soil Data for Winnipeg Neighbourhoods

Since the mid-1970s, the Province of Manitoba has completed several studies to measure the level of lead in Winnipeg soils. The focus was on the most recent studies completed by the Province, as well as a study conducted by the University of Manitoba for the neighbourhood of St. Boniface. All of the reported soil results were compared with the current health-based guideline for residential soils available from the Canadian Council for Ministers of the Environment. Consideration was given to the number of samples within each neighbourhood, the sample depth, the number of soil samples above the residential guideline, and the relative proportion of samples in each neighbourhood with soil concentrations above the residential guideline.

Key Findings of Task 1

- The studies conducted by the Province have shown that concentrations of lead in soil in Winnipeg have decreased over time.
- Concentrations of lead in soil were lower in samples collected from the most recent investigations, however, these samples were collected from deeper depths (up to 10 cm) rather than from soils near the surface. Higher concentrations of lead may be found in soils closer to the surface, and people are more likely to come into contact with these soils.
- Only the University of Manitoba's St. Boniface study included samples from private residences. All of the recent samples collected by the Province were from public spaces such as boulevards, schools, and parks.
- Ten (10) neighbourhoods were identified as being of potential concern since one or more of the soil samples collected from these areas contained lead concentrations above the residential soil quality

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guideline. These neighbourhoods include: Centennial, Daniel McIntyre, Glenelm/Chalmers, North Point Douglas, River/Osborne, Sargent Park, St. Boniface, West End, Weston, Wolseley/Minto.

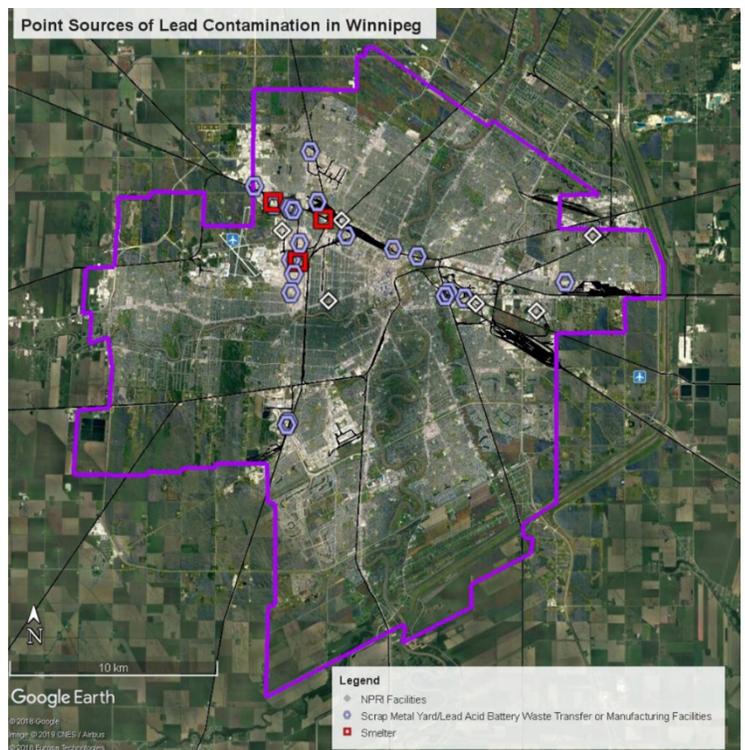
- A very small number of soil samples were collected from some of these neighbourhoods and others throughout Winnipeg. As a result, lead concentrations in some of these areas may not be well understood. It is also possible that other neighbourhoods not included in these studies may have soil lead concentrations at levels of potential concern.

Task 2: Review of Current and Historical Sources of Lead in Winnipeg

The studies describing lead concentrations in soils throughout Winnipeg were reviewed to understand the current and historical sources of contamination and to help further identify areas of potential concern. In addition, several other resources were searched, including the National Pollutant Release Inventory managed by Environment and Climate Change Canada and the Manitoba Environmental Assessment and Licensing Public Registry. A literature review was also completed in order to identify known sources of lead emissions in urban areas, and to identify potential “hot-spots” for lead in soils.

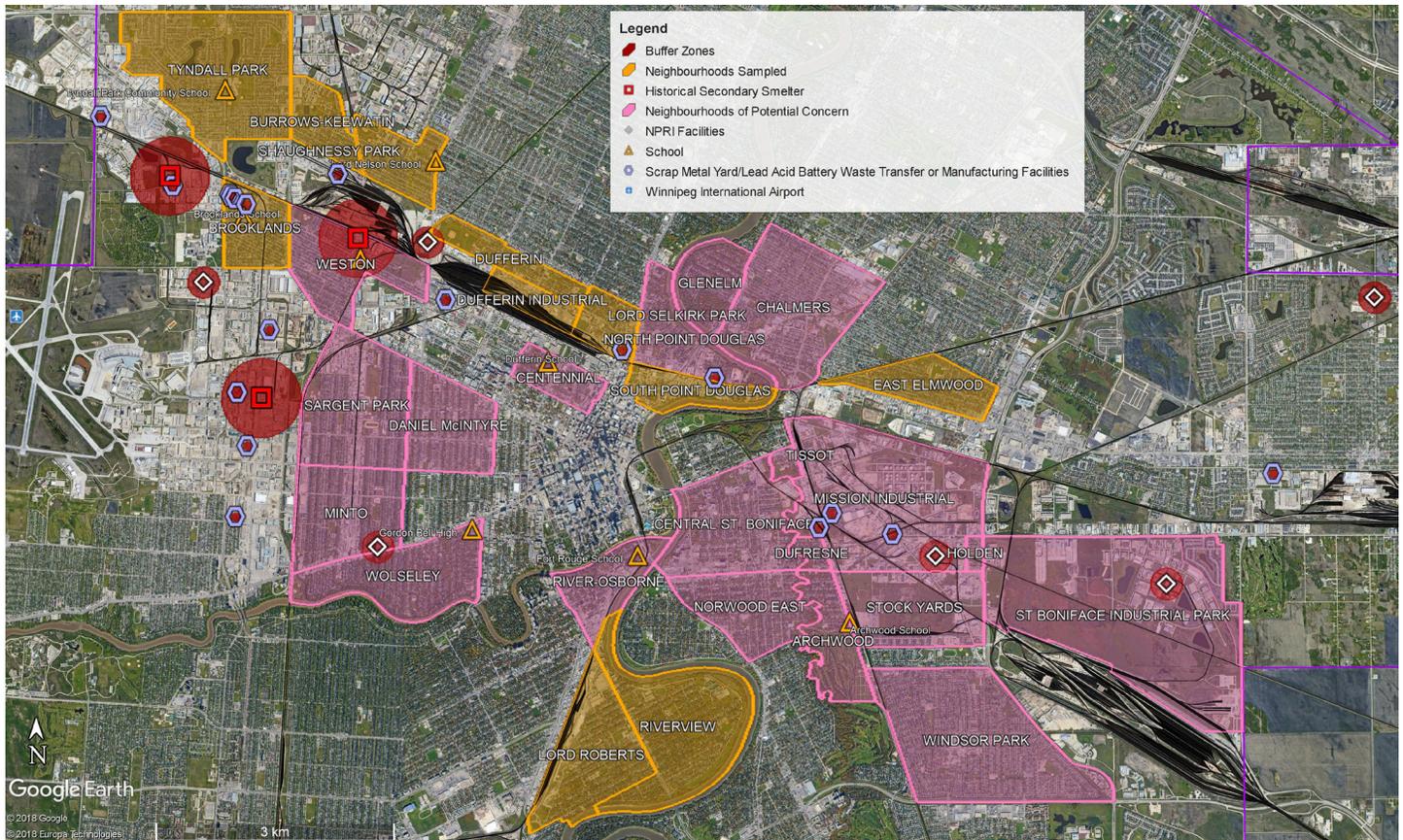
Key Findings for Task 2:

- Areas within the central area of Winnipeg appear to have been most affected by vehicle emissions related to the historical use of leaded-fuels, particularly areas within 100 metres of busy roads.
- Elevated soil concentrations are also associated with emissions from three (3) historical lead smelters that were located within the western area of Winnipeg. These smelters are no longer in operation.
- Other potential industrial sources include foundries, battery manufacturing or waste disposal sites, scrap processing, auto wrecking operations, an oil refinery, and other manufacturing operations.
- Non-industrial sources of lead in soil include the presence of lead-based paints on the inside and outside of buildings (including homes) and the historical use of coal for combustion. These could affect all older neighbourhoods of the City.
- Given that the smelters are no longer operating and leaded fuels have been phased-out, the main sources of lead emissions in Winnipeg are no longer present.



Potential Lead Emission Sources in Winnipeg. Red squares indicate previous smelter operations, and the other colours indicate emission sources identified from the National Pollutant Release Inventory (NPRI) and Manitoba databases.

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Neighbourhoods in Winnipeg included in the soil surveys (orange) and those identified as being of potential concern (pink) based on concentrations of lead in soil. Potential sources of lead emissions are also shown with surrounding buffer zones (in red) indicating the areas that may have been impacted by emissions from commercial and industrial operations.

Task 3: Review of Approaches used by Canadian and Western Jurisdictions for Addressing Lead in Soil

A review was completed to identify information about the current levels of exposure to lead in Canada and other areas, the current state of knowledge about lead and the health effects that it may cause, and how regulatory agencies in Canada and other parts of the world manage lead in soils. As part of this review, the various strategies that have been used to reduce lead exposure were also considered.

Key Findings of Task 3:

- Blood lead levels in children and adults have been declining since the 1970s in Canada and the United States.
- In Canada, for children aged 3 to 11 years, the average blood lead level in 2016-2017 was about 0.55 microgram per decilitre ($\mu\text{g}/\text{dL}$). No specific blood lead levels are available for children in Winnipeg or Manitoba as a whole.

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- Children aged 7 years and under are the most sensitive to the effects of lead because their nervous system is still developing. These effects are not reversible, and include effects on learning, behaviour, and intelligence.
- In adults, long-term lead exposure can contribute to high blood pressure, heart disease, kidney problems, and reproductive effects.
- The understanding of the toxicity of lead suggests that previous approaches for evaluating lead based on the concept of a 'safe' level of exposure are not sufficiently protective of health effects.
- The Canadian residential soil quality guideline of 140 µg/g (or ppm) is based on pre-2000 science. As a result, comparing soil concentrations to this guideline may not provide an adequate level of protection for young children.
- Currently, no Province or Territory in Canada requires blood lead testing to be completed. When sampling is completed by family doctors or public health agencies, there is no requirement for tracking or sharing information between medical professionals, except in Quebec.
- Published studies indicate that in areas where soil lead contamination is related to airborne emissions, reducing or eliminating lead emissions may be the most effective way to reduce blood lead levels in children.
- Since the primary sources of lead emissions in Winnipeg are no longer present, there is uncertainty regarding the levels of exposure experienced by children throughout the City related to historical lead contamination in soil.

Task 4: Assessment of Health Risks Associated with the Lead Concentrations in Winnipeg Soils

Given that a number of neighbourhoods were identified as being of potential concern based on concentrations of lead measured in soil and the known current and historical sources of lead, further effort was needed to evaluate potential exposure and risks. Understanding the relationship between soil concentrations and exposure in children is important to assess potential risks and to develop environmental guidelines. Multiple lines of evidence were used to evaluate risks for the neighbourhoods of potential concern. This included a review of recent studies published in the scientific literature for similar urban areas world-wide that included assessments of lead in soils, and the use of soil data to predict blood lead levels in children in Winnipeg.

Since blood lead measurements are not available for Winnipeg children, a predictive model was used to estimate blood lead levels based on the measured lead concentrations in the Winnipeg soils. This model (the **Integrated Exposure Uptake Biokinetic** or **IEUBK** model) was developed by the United States Environmental Protection Agency.

The model considered the measured soil lead concentrations for each neighbourhood, in addition to environmental lead exposures from air, food, dust, and water. The estimated blood lead levels were then compared to levels measured in other urban areas and to levels that are considered to be acceptable for preventing significant health effects.

A blood lead level of 2 µg/dL was selected as a "level of concern" for comparison to the blood lead levels predicted by the model for each neighbourhood. Blood lead levels below 1-2 µg/dL are associated with a very low level of risk for a population.

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To provide an understanding of other potential factors that may affect children and may make them more vulnerable to the effects of lead, available socio-economic and health status information for the identified neighbourhoods in Winnipeg were also considered.



Key Findings of Task 4:

- There are notable differences in the lead levels in soils of the Winnipeg neighbourhoods.
- The soil concentrations in the neighbourhoods of North Point Douglas and Weston are similar or higher than concentrations found in many urban areas in North America and other parts of the world where lead has been identified as a potential concern. The lead concentrations in other Winnipeg neighbourhoods were generally much lower than in these areas.

- The predicted average blood lead levels for children (inclusive of ages 0-7 years) in North Point Douglas and Weston were above the level of concern of 2 $\mu\text{g}/\text{dL}$.
- In Daniel McIntyre, the predicted blood lead levels for children within the ages of 6 months to 4 years were also above 2 $\mu\text{g}/\text{dL}$.
- Children are the most sensitive to the effects of lead, and these predicted blood lead levels are at levels of potential concern to health.
- The predicted average blood lead levels for all 10 of the selected Winnipeg neighbourhoods were also higher than what has been reported for Canadian children (on average less than 1 $\mu\text{g}/\text{dL}$).
- Some areas in Winnipeg are known to contain homes with leaded pipes and plumbing. It is possible that exposure to lead from tap water has been underestimated for some children.
- Overall, the results of the modelling indicates that the potential for children's blood lead levels to exceed a level of concern are relatively low for many of the neighbourhoods for which soil lead results are available, particularly given that most of these areas do not have a significant active source of lead emissions.
- There is a greater potential for children to have elevated blood lead levels in the neighbourhoods of North Point Douglas and Weston as a result of the frequency of elevated soil lead concentrations in these areas.
- A review of several studies where both soil concentrations and blood lead levels were measured indicates that the relationship between soil lead concentrations and blood lead levels in children are highly variable from one community to another. While some studies have shown that blood lead levels increase gradually over a large range of soil concentrations, others indicate that blood lead levels increase more sharply at lower soil concentrations, followed by a more gradual increase at higher concentrations. Overall, there is uncertainty in using the results of other studies to predict blood lead levels in Winnipeg.
- The areas of North Point Douglas, Weston, Daniel McIntyre, and Centennial all share similar characteristics, including lower income, lower rates of employment, lower levels of education, higher

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proportion of visible minority residents, and lower ratings for several indicators of health when compared to the rest of the Winnipeg. Children living in these areas may be more vulnerable to the effects of lead.

- St. Boniface was the only neighbourhood where soil samples were collected from homes – samples for all other neighbourhoods were from public places like boulevards, parks or schools. As a result, there is some uncertainty in using these soil results to assess risks in these neighbourhoods.

Task 5: Recommendations for Further Assessment of Risks and Proposed Risk Management Options

To aid the Province in identifying potential actions to address health concerns related to lead in Winnipeg soils, a review of options was conducted as part of Task 5.

Key Findings of Task 5:

- Given that the current soil guideline is not based on the most recent scientific understanding of lead toxicity, preliminary calculations were made for a clean-up guideline for Winnipeg. This resulted in a range in potential guideline values. The current Canadian lead guideline falls within this range.
- Based on the information available to describe lead levels in soils throughout Winnipeg, the completion of a detailed human health risk assessment (HHRA) is unlikely to provide significant further insight into the interpretation of potential risks unless more data is collected.
- Several potential risk management and remediation options are available for lead. Each option is associated with various benefits and challenges and should be considered on a site-by-site basis.
- Since the primary sources of lead contamination for Winnipeg soils have been eliminated (leaded fuels, secondary lead smelters), further reductions in sources of emissions would likely be limited to isolated commercial and industrial operations.
- There is enough information to show that soil contamination in certain neighbourhoods represents a potential concern. Blood lead monitoring is recommended to assess risks and the potential need for further soil sampling or risk management.
- For the neighbourhoods of Weston and North Point Douglas, the available soil data indicates that there is a higher chance that children living in these areas will have elevated blood lead levels. For these neighbourhoods, the combination of elevated soil concentrations and lower socioeconomic status creates greater concern for health risks. Biomonitoring in these areas will help to determine if similar studies are needed for other areas of Winnipeg.

Overall Recommendations Made to the Province of Manitoba

Based on the review of the available information as part of Tasks 1 to 5, the following recommendations were provided to the Province:

Recommendation 1: Community Outreach and Education

It is recommended that the Province, in collaboration with key stakeholders, develop an overall lead awareness communications and outreach program. Initiatives might include a publicly available website or social media platform that provides regular updates and shares information. As part of the lead awareness campaign, training and information should be given to parents and caregivers of young children, as well as daycares, community centres, and preschools.

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Recommendation 2: Biomonitoring and Paired Environmental Sampling Study

To provide a measure of actual lead exposures, it is recommended that a biomonitoring study be completed for certain neighbourhoods, with a focus on children under the age of 7.

A biomonitoring study involves the collection of a biological sample by medical professionals to assess how much of a chemical a person has in their body. For lead, blood is used to obtain a picture of lead exposure over the past 30 days. If any children with higher blood lead levels are identified, the need for medical evaluation and treatment, and household-focused or community-focused strategies for reducing lead exposures can be developed. Areas of particular interest include:

- **Point Douglas Community Health Area¹**, specifically North Point Douglas, South Point Douglas², and neighbourhoods to the west and north that have not been sampled for lead to date; and,
- **Inkster Community Health Area¹** (specifically Weston, as well as Burrows Keewatin which has not been sampled to date).

These areas include neighbourhoods located near major roadways, with current or historical industrial emission sources, and areas with older housing that may have lead paint. It may also be of value to extend the biomonitoring study into the Downtown area (e.g., Daniel McIntyre) given the limited extent of sampling coverage in this area and its close proximity to potential sources of lead.

Environmental samples such as soil from residential play areas, dust from floors where children play, residential tap water, and household paint, can also be collected from participating households to better understand children's exposures.

Recommendation 3: Weston School and Playgrounds

An action plan is recommended for Weston Elementary School. While several of the suspected sources of lead in the area are no longer operating or relevant, and some soils have been removed and replaced, elevated levels of lead are still present in soil at the Weston school. This might be due to the re-distribution of soils from other nearby properties that have not been assessed and cleaned-up.

As the winter 2019/2020 season has started, access to soils is limited due to snow and frozen ground, so the implementation of immediate risk management measures is not considered necessary. That said, it is recommended that students, parents, and staff are made aware of the potential concerns related to lead in soils on the school grounds and are provided with an overview of the potential future actions.

In order of priority, recommended actions for the Weston school yard and sports field include:

- Promote hand washing and hygiene at the school (as well as to potential park users, including area day cares) through an awareness campaign and the distribution of kits to parents and caregivers regarding handwashing.
- The collection of more surface soil and sod samples following the 2020 Spring thaw at a shallow depth of 0-2.5 cm to characterize current surface soil conditions. Any visibly exposed areas of soil or aggregate should be sampled.

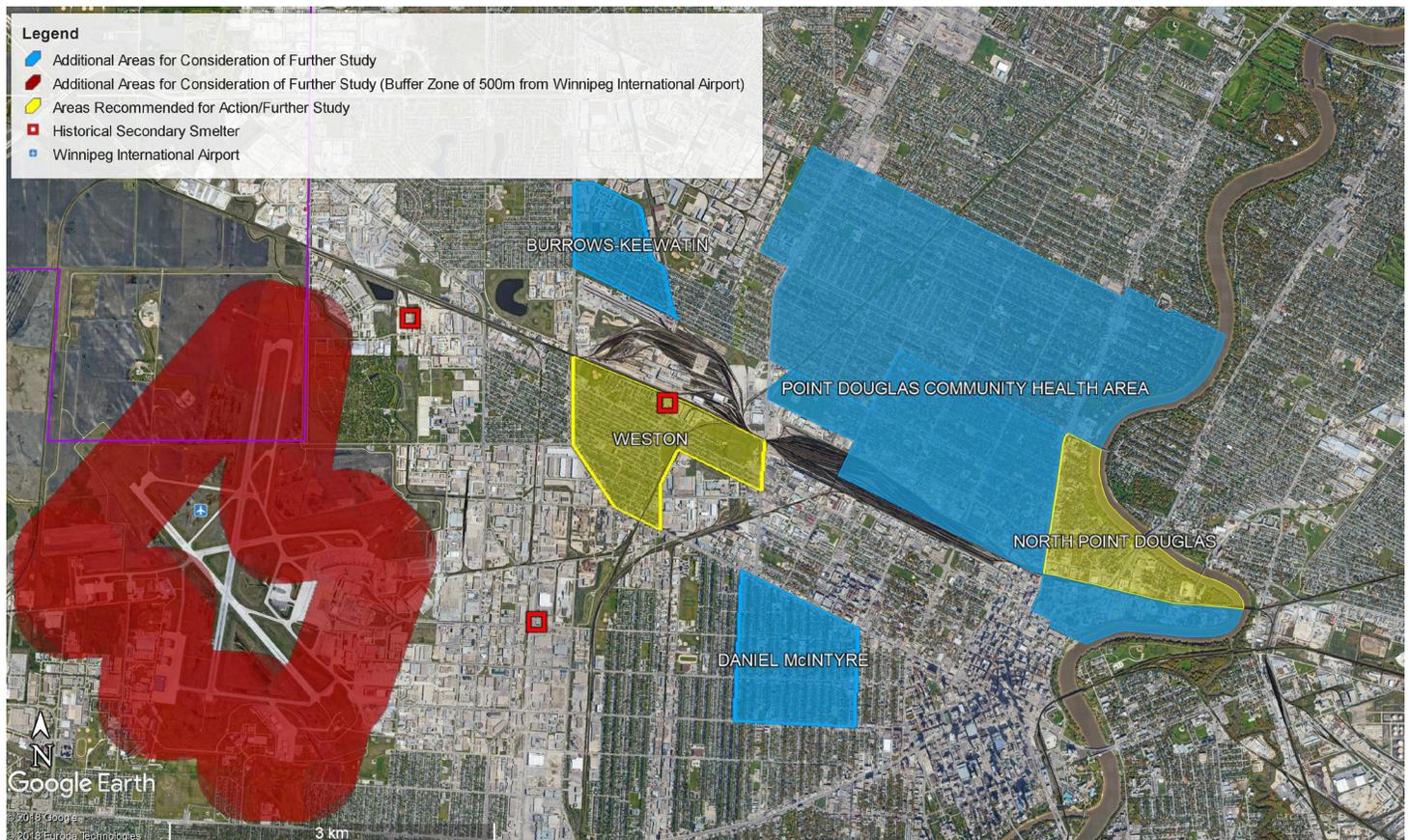
¹ Community Health Area, as defined by the Winnipeg Regional Health Authority:
https://www.wrha.mb.ca/research/cha/files/Maps_WRHAPopulation06.pdf

² Only a few samples were available for South Point Douglas. There is an overall lack of coverage in this area.

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- Before the first lawn maintenance in the spring/summer of 2020, efforts should be taken at the school and local parks to minimize the generation of dust or exposure to underlying soils during landscaping activities (e.g., possibly restrict aeration, leaf blowing in some areas).
- Replacement of sand and gravel in the playground area with a soil barrier and rubberized playground surface material. If a barrier/rubber material is not installed, consideration should be given to regular replacement of sand/gravel over time. Wipe samples can be collected from hard surfaces on an annual or seasonal basis.
- Exposed soil surfaces should be covered in mulch, sod, or groundcover to prevent direct access to soils and the generation of dust.
- Dependent on the findings of future sampling studies, the replacement of grass with artificial turf for the sports field could be considered to provide a physical barrier. Dust control measures must be implemented for the turf during excavation and installation, and proper cleaning following installation.

Several of the above listed mitigation measures could also be proactively taken for the other schools, playgrounds, and recreational areas within the Weston neighbourhood on an as-needed-basis with the overall goal of reducing the potential for soil and outdoor dust exposure for young children.



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Recommendation 4: Blood Lead Reporting and Monitoring

Currently, when a person is identified as having an elevated blood lead level following testing by a family physician, this information is not shared with or tracked by the Province. The Province should consider implementing a reporting system that ensures that any children in the Province that are tested by their family physician or other public health personnel are tracked and receive the necessary follow-up. This will help public health officials identify clusters of children who are potentially at higher risk.

Other Sources of Information Regarding Lead

Province of Manitoba

Environmental Health Information - <https://www.gov.mb.ca/health/publichealth/environmentalhealth/lead.html>

Lead and Gardening Factsheet -

https://www.gov.mb.ca/health/publichealth/environmentalhealth/home_gardens.html

Health Canada

Factsheet on Lead - <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/environmental-contaminants/lead.html>

Drinking Water Guideline - <https://www.canada.ca/en/health-canada/news/2019/03/health-canada-sets-new-guideline-for-lead-in-drinking-water-latest-in-series-of-government-actions-to-protect-canadians-from-exposure-to-lead.html>

United States Agency for Toxic Substances and Disease Registry (ATSDR)

Toxic Substances Portal - <https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=22>

United States Environmental Protection Agency (US EPA)

<https://www.epa.gov/lead>