Manitoba Sustainable Development

Winnipeg Soil Survey
Fall 2018

Environmental Compliance and Enforcement Branch
January 2019

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Executive Summary

In October 2018, Manitoba Sustainable Development Environmental Compliance and Enforcement Branch conducted a soil survey to assess lead concentrations in soil in the City of Winnipeg. The 2018 survey collected samples from locations sampled in 2007 and 2008 by the Province. The 2018 survey collected samples from locations sampled in 2007 and 2008 by the Province. The lead levels from the earlier study were previously reported to the public.

Past studies were conducted to ascertain the impact of smelter activity on the surrounding environment and to evaluate lead levels in the soil over time. Characterization of the soil indicated that lead was mainly accumulating as a result of proximity to high traffic areas and the historic use of leaded fuels.

The Canadian Council of Ministers of the Environment (CCME) human health guideline for lead in soil (residential/parkland) is 140 mg/kg which is based on the soil ingestion pathway. The survey identified that levels of lead exceeding this guideline remain in the surface soil at Weston School, Westview Park, in areas of North Point Douglas and one sample obtained from Glenelm/Chalmers. All exceedances had been previously identified in studies and surveys conducted prior to 2018.

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I. Introduction

The Province of Manitoba conducted a series of studies in Winnipeg in late 1970s and in 1980s to investigate lead (Pb) concentrations in soils from boulevards, schoolyards, and parks and playgrounds in the inner city. The Terrestrial Standards and Studies Section of Manitoba Environment initiated these studies due to the concerns expressed over the elevated lead in blood levels detected in students at the Weston School (Jones, 1985; Krawchuk, 1980).

During earlier studies, soil lead levels at some sites exceeded 2600 mg/kg, which was the applicable action criterion adopted from Ontario Guidelines at the time (Jones, D. C. 1985). As a result, remediation measures, such as removal and replacement of contaminated soil, were undertaken at several sites in Winnipeg in 1982 and 1983 (Jones, D. C. and D. L. Wotton, 1982; Jones, D. C. and D. L. Wotton, 1983a). In 1999, the CCME updated the Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. The residential/parkland soil quality guideline for lead was established at 140 mg/kg (CCME, 1999). These CCME guidelines are a generic benchmark to evaluate the need for further investigation or remediation with respect to the specific land use (CCME 1996).

A further study conducted in 2007-2008 by provincial environmental staff indicated that lead levels exceeding the CCME guidelines in soils were primarily found in older neighborhoods in Winnipeg and were localized in areas of high vehicle traffic. Weston School also still exhibited exceedances above the applicable guidelines for lead in soil.

Previous studies have attributed lead contamination in soil to leaded gasoline from vehicle exhaust, and note that widespread use of leaded fuels was phased out in the late 1980s (Wotton, D.L. and Doern, F.E., 1983; Manitoba Conservation, 2010). In 1990, the Government of Canada imposed a limit on the concentration of lead in gasoline produced, sold and purchased under the Canadian Environmental Protection Act's Gasoline Regulation (SOR/90-247).

In 2017, the University of Manitoba, Manitoba Sustainable Development and Public Health evaluated the results of soil sampling conducted by the university in the fall of 2017 in the St. Boniface area. Results showed that some soils contained levels of lead exceeding the CCME guideline. Based on these more recent results, the Minister of Sustainable Development requested that previous studies be replicated to test whether surface lead levels are increasing, stable or decreasing over time.

Manitoba Sustainable Development's Environmental Compliance and Enforcement Branch (ECE) conducted a more comprehensive study in October 2018 to replicate the 2007-2008 study. In total, 127

locations were sampled in October 2018, including residential boulevards in Wolseley/Minto, Riverview/Lord Roberts, Glenelm/Chalmers and North Point Douglas. A number of parks, playgrounds and schoolyards, including some areas in St. Boniface were also sampled.

Background

Lead (Pb) is a naturally occurring element found in rock and soil, yet widespread anthropogenic use has resulted in its ubiquitous presence in the environment (Health Canada, 2013a). Natural levels of lead in soil reflect the mineralogy of the soil parent (geological) material. Soils and sediments act as primary environmental sinks for lead compounds. Lead is an odourless, bluish-grey, lustrous metal that is malleable, ductile, and resistant to chemical corrosion (Health Canada, 2013b). Given its historical dispersive uses, lead is found in virtually all surface soils around the globe, where it can remain indefinitely as a result of its non-volatility and low soil mobility. Due to its tendency to strongly adsorb to soils, lead is generally retained in the upper soil layers, and its deposition is regarded as irreversible and permanent unless it is removed through remediation (ATSDR 2007 as quoted in Health Canada, 2013a).

National Air Pollution Surveillance (NAPS) data demonstrated that ambient air lead concentrations in Canada have declined significantly following the introduction of unleaded gasoline in Canada in 1975 and the prohibition of leaded gasoline for use in on-road vehicles in the 1990s (Health Canada 2013a). Other primary anthropogenic sources of lead include releases from the mining and smelting of lead ores, as well as other ores in which lead is a by-product or contaminant, processing, use, recycling, or disposal (WHO 1995 and ATSDR 2007 as quoted in Health Canada, 2013a). Electrical utilities also release lead into the environment in flue gas from the burning of fuels such as coal, in which lead is a contaminant (ATSDR 2007 as quoted in Health Canada, 2013a).

Environmental lead concentrations are extensively measured and reported by national, provincial, and municipal initiatives across Canada. Lead is found in all environmental media in Canada, as well as in food and drinking water. Levels of lead in most environmental media have declined significantly over the past few decades. (Health Canada, 2013a).

II. Previous Studies

Several studies were conducted by the Province of Manitoba and for academic purposes in the late 1970s and the 1980s to investigate soil lead concentrations in the City of Winnipeg and other rural communities in Manitoba. The summary of available reports of previous studies are as follows:

1. A Survey of Lead Accumulation in Tree Foliage and Surface Soil of the Winnipeg Area Report No. MS79-4 (Wotton, D. L. 1979)

   A survey of urban tree foliage and surface soil was conducted to determine lead concentrations in areas of varying traffic density, in areas adjacent to secondary lead smelters and in the immediate area of Lord Nelson and Weston Elementary Schools within the City of Winnipeg in 1979. It was found that variability among tree species in the absorption and accumulation of lead in leaf tissue existed. Lead accumulation from urban traffic in the Winnipeg area resulted in lead concentrations which ranged from 17.6 to 43.4 µg/g in tree foliage and 132.5 to 1085.0 µg/g in surface soils for areas of low and high traffic volume respectively. The survey also found that lead concentration in tree foliage and surface soil from sampling locations in close proximity to the secondary smelters was frequently tenfold the lead concentrations found to accumulate from normal motor vehicle emissions in the Winnipeg area.

2. A Survey of Soil Lead Levels in the City of Winnipeg (Krawchuk, B.P. 1980)

   A survey of soil was carried out in the city of Winnipeg during the period of September 1978 to September 1979. Seventy-five (75) sites, ranging from residential to heavily trafficked arteries to industrial areas were sampled on a seasonal basis. The survey found lead concentrations in soil levels greater than 1000 µg/g near major arteries, at busy intersections and in areas surrounding secondary lead smelters, while residential area soils had levels of less than 500 µg/g. The study concluded that higher lead levels are generally found along the traffic routes or around lead smelting industries. The report found that in the Weston area 15 sites yielded an average lead level of 725 ± 745 µg/g soil with a range of 90 to 2820 µg/g soil. The report further stated that elevated lead levels existed in the soil around the three smelters in the city, indicating that the pollution control devices mounted in the plants were not removing all the lead from the air or were not working at all in some cases. During the Weston School hearing it was revealed that Canada Metals Ltd. had suffered a stack knock-down resulting in uncontrolled emission from the plant into the atmosphere.

3. Lead Particulate Analysis in Air and Soil of The City of Winnipeg 1982 Report No. 83-3 (Wotton, D.L. and Doern, F.E. 1983)

   A collaborative study between the Environmental Management Division of the Manitoba Department of Environment and Workplace Safety and Health, the Canadian Bronze Company Limited and Atomic Energy of Canada (Pinawa) was launched in 1982 to investigate a procedure that would distinguish between the forms of lead particles originating from various sources. This study aimed to provide a better understanding of lead deposition following the remedial actions carried out in the Weston area in 1981 and 1982. Atomic Energy of Canada conducted analysis with scanning electron microscope (SEM) and energy dispersive x-ray spectrometry (EDX) to characterise lead particles from air samples at eighteen locations throughout the city, in addition to soil sampling and analysis at all sampling locations. The study concluded that the major source of lead deposition around Weston School was likely from motor vehicle exhaust rather than smelter emissions.

4. Lead Distribution in Winnipeg as Reflected by City Area Dogs Report No. 83-10 (Kucera, E 1983)

   A study of lead in blood of dogs was carried out in 1981. Since studies carried out by the Province of Manitoba had identified concerns of elevated levels of lead in the air, soil and vegetation, and there was no data on blood lead concentration of a cross section of Winnipeg population, dogs were used as bio-monitors of lead and as a low cost alternative to large-scale surveys of humans in this study. 480 blood samples were analysed and 95% of the samples were found to have lead concentrations of less than 8.0µg/100ml. The findings of the study indicated that traffic contributed a significant portion of total inhaled lead and concluded that the levels found did not cause any dangerous accumulation in dogs.

5. A survey of Lead in Soil from Seven Schools and Three Residential Areas of Winnipeg, 1983 – Report No. 83-15 (Jones, D.C. and Wotton, D.L. 1983)

   The Environmental Management Division (Terrestrial Standards and Studies Section) of the Manitoba Department of Environment and Workplace Safety and Health initiated a survey in 1983 to determine the lead levels in soil, dust and particulate debris from paved playgrounds at seven (7) schools and to determine lead in soil levels from three (3) residential areas in the City of Winnipeg. These sites were selected for their similarities to the Weston school and Weston area in proximity to major traffic thoroughfares and with respect to age and development. The seven schools selected were Lord Nelson Elementary, Dufferin Elementary, Sacre-Coeur Elementary, Gordon Bell, Fort Rouge Elementary, Archwood Elementary and Norberry Elementary. The three

(3) communities selected were Elmwood, Riverview and Wolseley. The survey found that the lead levels at the school playgrounds and residential boulevards were within acceptable limits (2600 µg/g) at that time.

6. A Survey of Lead-in-Soil from Seven Rural Communities in Manitoba, 1984 Report No. 86-2 (Jones, D. C. 1986)

   The Environmental Management Division (Terrestrial Standards and Studies Section) of the Manitoba Department of Environment and Workplace Safety and Health initiated a survey in 1984 of lead in soil concentrations in Selkirk, Steinbach, Portage la Prairie, Brandon, Dauphin, Swan River and The Pas. The samples were collected in areas representative of various traffic flow volumes. The lead in soil concentrations found in the communities were 31 µg/g to 439 µg/g in Selkirk; 138 µg/g to 338 µg/g in Steinbach; 52 µg/g to 346 µg/g in Portage la Prairie; 10 µg/g to 610 µg/g in Brandon; 53 µg/g to 504 µg/g in Dauphin; 26 µg/g to 226 µg/g in Swan River; and 21 µg/g to 357 µg/g in The Pas. The survey concluded that the ranges in lead concentrations for the seven (7) communities were consistent with other lead in soil studies conducted in Winnipeg, Thompson and Flin Flon. The survey also noted that there was a slight trend of increased lead concentrations at sites adjacent to major traffic thoroughfares.

7. A Survey of Lead-in-Soil Concentrations at Seven Tot Lots in The City of Winnipeg – Report No. 86-3 (Jones, D. C. 1986)

   The Environmental Management Division (Terrestrial Standards and Studies Section) of the Manitoba Department of Environment and Workplace Safety and Health initiated a survey in June 1984 to evaluate lead in soil concentrations of seven (7) Winnipeg tot lots which were in close proximity to major traffic routes. It was found that lead concentrations in sod and soil samples were well below the acceptable limits of 2600 µg/g at that time. The lead concentrations ranged from 15 µg/g to 740 µg/g. Further, it was generally found that lead concentrations were highest in tot lots immediately adjacent to high traffic volume thoroughfares.

8. A Synopsis of the Lead Program at Weston Elementary School in the City of Winnipeg Report No. 85-3 (Jones, D. C. 1985)

   The report provides background of the lead issues at Weston School and brief details of cleanup operations in 1981 and 1983. This report also recommended further investigation be undertaken to study the relationship of automobile exhaust emission to lead levels in soils.

9. Manitoba Conservation, 2010. Sampling Report: Surface Soil Lead Levels in Winnipeg, Manitoba: 2007 & 2008, Report No. 2009-03. May 2011, Winnipeg MB 34 pp.

   The Habitat Management and Ecosystem Monitoring Section of Manitoba Conservation sampled soil in 2007 at sites that had been previously sampled during the 1980s in order to determine whether lead concentrations had changed appreciably over time. A total of 45 samples were collected from six (6) playgrounds, 97 samples from seven (7) schoolyards, and 77 samples from boulevards in four (4) residential areas. Most sample sites were in older, inner city neighbourhoods in central Winnipeg. The survey concluded that the lead concentrations in most of the sod, soil, and aggregate samples collected in 2007 were usually lower than those recorded in the 1980s. Lead levels in sod and soil at a number of sites exceeded the CCME guideline of 140 µg/g; these included sod and soil samples collected from the Weston Elementary School sports field, grass-covered areas in a number of playgrounds, and from the boulevard along Sutherland Avenue in North Point Douglas.

   In response to the 2007 soil survey, a second survey was conducted in 2008, focusing on collecting and analyzing surface soil, sand, pea gravel and other surface aggregate material from City of Winnipeg playgrounds and sports fields in the vicinity of potential past and present point sources of lead. Only one (1) of the 90 samples collected from playgrounds and sports fields in 2008 had a lead concentration above the CCME guideline; this was from a grassed area in a playground bordered by Logan Avenue. Based on 2008 results, it was concluded that lead levels at playgrounds and sports fields in the vicinity of potential point sources in the inner-city were lower than the CCME Residential/Parkland soil quality guideline for the protection of human health of 140 µg/g.

Weston School

The issue of lead contamination in soil at Weston School became known when some children were found to have elevated blood lead levels during 1976 and 1979. It was suspected that the lead levels might have been caused by Canadian Bronze, a secondary smelter situated in close proximity to the Weston School (Jones, D.C. 1985).

One of the initial studies was a survey of urban tree foliage and surface soil undertaken in 1979 to determine lead concentrations in areas of varying traffic density, in areas adjacent to secondary lead smelters, and in the immediate areas of Lord Nelson and Weston Elementary Schools within the City of Winnipeg. Lead concentrations in tree foliage and surface soil from sampling locations in close proximity to the secondary lead smelters frequently measured tenfold the values found to accumulate from normal motor vehicle emissions in the Winnipeg area. Levels of lead concentration around both elementary schools was high and a gradient of decreasing concentration was found as distance increased from major emission sources (Wotton 1979).

Additional lead in air, soil and vegetation surveys were conducted during the summer of 1980 at Weston and Lord Nelson Schools and in the immediate vicinity of the three (3) secondary lead smelters (Wotton and Bezak 1980 as reported in Jones, D.C. 1985). The air monitoring results were similar to those found in 1979. The soil and vegetation surveys found a gradient of lead accumulation decreasing sharply with increasing distance from high traffic volume streets. Lead accumulation levels were similar to those found in 1979.

An intensive soil survey was carried out in April 1981 to further evaluate the extent and level of lead contamination in the area surrounding the smelter (Wotton 1981b as reported in Jones, D.C. 1985). This survey delineated areas where there was a higher probability that children might be exposed to unacceptable levels of lead in soil. Sixty-eight residences, 1400 meters of boulevard and the playgrounds of Weston School were singled out for further intensive study.

Another survey was carried out in July 1981 and the report that followed recommended that particulate debris with lead levels in excess of the guideline should be removed from the paved play area at the north side of Weston School (Wotton 1981c as reported in Jones, D.C. 1985). Initial clean up was carried out in 1981 using a dry vacuuming procedure and approximately 1.0 tonnes of debris was removed and disposed of at Brady Road Landfill of City of Winnipeg. Following the initial cleanup operation, monitoring of lead levels at Weston School continued and samples taken in 1982 and 1983 showed lead levels above the

guidelines adopted at that time in the newly accumulated migrant dust. As a result, another cleanup operation was carried out in June 1983 and approximately 1.36 tonnes of debris were removed and disposed of at the Brady Road landfill (Jones, D.C. 1985).

In 1982, an attempt was made by the Province to characterize individual lead particles and a research project was carried out in collaboration with Atomic Energy of Canada Limited and Canadian Bronze Company Limited. The report "Lead Particulate Analysis in Air and Soil of the City of Winnipeg 1982" was released by the Department of Environment and Workplace Safety and Health in June 1983 (Wotton and Doern 1983b). One major conclusion of the report was that automobile exhaust from Logan Avenue, a major traffic artery, appeared to be the primary source of lead at Weston Elementary School.

Since it appeared that Weston School had a unique problem with respect to lead levels, it was suspected that paint chips containing lead may have been contributing to the high lead levels found at Weston School (Jones, D.C. 1985). The report recommended remedial action to minimize the accumulation of lead contaminated particulate debris on paved school play areas. In the summer of 1984, all painted surfaces on the north and west side of the school were scraped and repainted to reduce the lead contribution due to sloughing of lead paint. In September 1984, the entire frontal paved area adjacent to Logan Avenue as well as the paved west side along Quelch Street was removed and replaced with new soil, sod, trees and shrubs (Jones, D.C. 1985).

According to the available records, the next study on Weston School was conducted by the Habitat Management and Ecosystem Monitoring Section of the Wildlife and Ecosystem Protection Branch of Manitoba Conservation in 2007. Sampling occurred at 21 locations and it was found that the Weston School playground continued to contain lead levels above the guidelines (Manitoba Conservation, 2010).

III. Methodology and Project Scope

A. Sample Location Selection

The 2018 survey focused on areas sampled during previous studies to assess the current levels of residual lead in soil. These areas included four (4) residential areas, namely Wolseley/Minto Riverview/Lord Roberts, Glenelm/Chalmers and North Point Douglas, and 18 schools and 32 parks and playgrounds in the City of Winnipeg. The list of schools sampled are given in Table A.1 and list of Parks and Playgrounds are presented in Table A.2 of Appendix A.

Some alterations were made from previous studies' locations due to changes in landscape, hardscape or land use. Pre-sampling ground-truthing determined which sites were no longer in existence or practical for sampling. Specifically, Habitat Park was no longer in existence, but was sampled in 2008, and samples were only collected along the edges of the schoolyard at Gordon Bell High School as the majority of the yard is now paved. Point Douglas Park and several schools were added to the 2018 sampling survey, as well; although not sampled in 2008, the schools were mentioned in the study for their proximity to the smelters and other sampled sites (Manitoba Conservation, 2010). Additionally, at the request of the Winnipeg School Division samples were collected at Norquay School and at a second sample site at Dufferin Elementary. All sampling locations and respective global positioning system coordinates are tabulated in Table B.1 and shown in Maps B.1 to B.8 in Appendix B.

B. Sample Protocol

Previous studies that focused on investigating the lead content in surface soil employed various sampling techniques. The 2017 study conducted by the University of Manitoba's Department of Soil Science in the St. Boniface Industrial area involved sampling 0 to 7.5 cm depth and utilized composite samples (Personal communication with Prof. F. Zvomuya). During the survey of soil lead levels in the City of Winnipeg in 1980 (Krawchuk, B. P. 1980), discrete samples of the top 2 cm of soil and a subsurface sample from a depth of 2 to 4 cm were collected. Soil sampling conducted by the Province in 2007 and 2008 (Manitoba Conservation, 2010) used a variety of sampling methods collecting from the top 2.5 cm layer and 5 cm underlying soil layer, and used both discrete sampling as well as composite sampling methods.

Thus, in 2018 it was decided to closely follow similar methodology employed by the University of Manitoba in their 2017 St. Boniface soil study and other available technical documents

(CCME, 2016a; CCME, 2016b; EPA, 1995). Composite sampling was utilized to obtain a representative sample of surface soil from each sampling location. Each composite sample consisted of ten (10) discrete soil subsamples. Discrete samples were obtained by collecting soil to a depth of 7.5 cm using a 2 cm diameter Oakfield soil sampler (Appendix C).

One composite sample was obtained from each selected sampling location noted above. In order to obtain a composite sample in each playground and schoolyard, discrete subsamples were collected at appropriate intervals along an "X" pattern to ensure distribution of subsamples over the entire sampling location. All subsampling locations were geo-referenced with GPS.

Composite samples obtained from the residential boulevards were collected from discrete subsamples taken within 15 cm of the curb and 60 cm apart from each other. Samples collected from a North-South directional street were collected from the southeast corner of the intersection and the east side of the street. For East-West directional streets, samples were collected from the southeast corner and south side of the street.

Sampling design at Weston Elementary School followed the same sampling grid pattern employed in the 2007 Soil Survey. Composite samples were obtained from each of the 21 sample locations previously sampled in 2007. Each composite sample consisted of five (5) discrete samples taken 30 cm from each other at each point. An additional composite sample was obtained along an "X" pattern in the area in southeast corner of the schoolyard, which was not sampled during the 2007 study.

A field duplicate sample was obtained for every tenth sample collected by a sampling team; the homogenised sample was divided in two (2) and placed in a separate, labelled sample bag as a quality control and quality assurance measure. GPS coordinates were recorded in decimal points in UTM NAD83. Photographs were taken to supplement the observations made at each sampling location. Sample collection logs were completed for each sampling location.

GPS or site mapping information from previous studies was not available during development of the current survey protocol; when necessary, estimations were made regarding sample locations.

C. Sample Collection

A new pair of clean, disposable, non-powdered nitrile gloves was used for collecting each composite sample. The Oakfield Soil sampler, ruler and other equipment that came in contact with the sample were cleaned between each composite sample collection using distilled water and

lead-free wet wipes. Before sampling, the sampling area was cleared of any surface debris such as twigs, stones or leaf litter. Then the Oakfield soil sampler was placed on the designated sample point in an upright position and the tube was pushed into soil to a depth of 10 cm and a slight twisting motion to the right only was used to break off the core. The sampler was then carefully removed from the ground turning to the right while retaining the soil core in the tool. The top 7.5 cm of core was measured and carefully removed from the sampler tube and placed directly into the sample collection bag. All subsamples from a sampling location were placed into the same sample bag and thoroughly mixed within the bag. Sample bags were labelled with the corresponding sample identification number, sample date and time, and initials of the sample collector. Photographs showing sampling procedures are given in Appendix D.

D. Sample Preservation and Laboratory Information

Sample bags were placed immediately into a cooler with ice or an ice pack prior to and during transport to the analytical laboratory. At the end of each sampling day, the soil samples along with Chain of Custody forms were handed over to ALS Laboratories for sample preparation, processing and analysis. ALS Laboratory is a CALA (Canadian Association for Laboratory Accreditation) accredited private analytical laboratory. The CALA provides accreditation that ensures laboratories are competent to carry out environmental testing performed to support environmental monitoring programs and regulations. Soil samples were dried, disaggregated and sieved (2 mm) in the laboratory and analysis was carried out following EPA 200.2/6020A method. Strong Acid Leachable Metals in the <2 mm fraction were solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis was performed by Collision/Reaction Cell Inductively Coupled Plasma Mass Spectrometry (ICPMS).

E. Sampling Teams

Six (6) teams of two (2) ECE staff were created. Each team was comprised of a lead person from either the Winnipeg, Steinbach or Selkirk office, and a second team member from the Selkirk, Gimli, Lac du Bonnet, Steinbach, Ste. Anne or Portage la Prairie office. The team leads remained in place for the duration of the sampling period, whereas the second team members varied so as to allow for more participation and experience from nearby offices while mitigating impacts to regional program delivery. Five (5) teams were each assigned one (1) of the four (4) residential areas or to the Northwest Industrial Area. Each residential area included sampling of boulevards, schools, parks and playgrounds in a specific neighbourhood, while the Northwest Industrial Area

was comprised of parks, playgrounds and schools. These five (5) teams collected samples from residential boulevards, parks and playgrounds from October 9 to 11, 2018. The sixth team was brought in as all teams came together on October 19, 2018 to sample all of the schools on an in-service day to minimize disruption to students.

F. Sampling Data

For each sampling location, a sample log was recorded on a form that was created for the project (Appendix E). There were two (2) variations of the form: one (1) for boulevards, and one (1) for schools, parks and playgrounds which included an additional section to record the GPS coordinates for each subsample location. Subsample GPS coordinates were not recorded for the boulevards as the subsample points were 60 cm apart and therefore no significant change in GPS coordinates would be noted as the GPS units used had an accuracy of +/- 3 m.

Each Sample Team Lead recorded the sample time, location, GPS coordinates, number of subsamples collected and weather description. Additionally, the log was used to record other site information under the following categories:

- *Soil Description*: A general description of the soil sampled was recorded (e.g. soil texture, composition, colour, moisture). Any variations in composition among the subsamples were also noted. Each team was provided with a soil classification card to assist in that regard.
- *Site Description/Additional Observations*: Particulars about the site location (type of site, location of sampling point along boulevard) and site influences were noted. Site influences were things that could have a potential for impact on sample results. For example, proximity to rail lines, heavy traffic or industrial areas could mean more depositions in the surface soil; having soil and sod recently laid because of construction works along boulevards, or the installation of gardens with imported soil along the boulevards, may likewise mean that historic depositions have been removed from the site.
- *Site Diagram*: A brief sketch was created to illustrate the approximate sample locations with landmarks noted.
- *Photo Descriptions/Additional Notes*: In this section, deviations to the sampling protocol and any additional photos taken beyond what was required as per the protocol were recorded. Examples of typical deviations from the sampling protocol include

when sample points had to be moved due to the sampler hitting a restrictive layer, or when a subsample point was unable to be sampled for some reason. Additional photos were taken when significant soil variations were noted in a subsample.

All data collected from the field log was recorded in a database created for this project. The information collected on these sample logs may assist in the interpretation of the results and in the sample design of future studies.

Two sampling locations (Prince Charles Educational Resource Center and Technical Vocational High School) were incorrectly labelled during the field sampling program. Upon receipt and review of the certificate of analysis, the sample IDs for these sites were identified based on documented sample collection information and later corrected for the purpose of this report.

G. Workplace Health and Safety

Safe work procedures were incorporated into the sampling protocol. These were created in consultation with the Safety, Health and Risk Management Consultant for Sustainable Development. Team leads briefed team members on safe work procedures at the beginning of each sampling day. Sampling teams donned personal protective equipment including high visibility clothing and approved safety footwear. Safety cones were deployed to facilitate traffic flow around the team vehicle/worksite when located along a roadway. Teams were provided procedures and puncture-resistant gloves to deal with sharps that may be encountered on the ground. Each team was also provided an eyewash bottle to treat potential irritants or foreign material that came into contact with workers' eyes in the field.

IV. Analytical Criteria (CCME Guideline)

The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) have been adopted by Manitoba Sustainable Development as the primary standards for lead in soil as required under the Contaminated Sited Remediation Regulation (M.R. 107/97). These guidelines have been developed based on risks to human health and ecological impacts dependent on land use, receptors and pathways.

For the purpose of this study, Manitoba Sustainable Development has determined that the Residential/ Parkland human health guideline of 140 mg/kg (CCME, 1999) is the most applicable criteria.

V. Results

A. Residential

Residential boulevards tested in the 2018 soil survey were grouped into four (4) sub-areas: Wolseley/Minto (Group 1), Riverview/Lord Roberts (Group 2), Glenelm/Chalmers (Group 3), and North Point Douglas (Group 4). Results are summarized below in Table 1.

Table 1. Residential Boulevards - Lead in Soil Survey Results Summary

Residential Sub-area		Wolseley/ Minto	Riverview/ Lord Roberts	Glenelm/ Chalmers	North Point Douglas
No. of Sites Sampled		18	20	17	22
No. of Sites with Guideline Exceedances		0	0	1	9
Lead in soil (mg/kg)	**Mean**	37.0	50.7	57.6	199.8
	Max	105.0	125.0	141.0	885.0
	Min	11.3	14.2	14.2	15.6

Wolseley/Minto

Results of Residential Boulevards of Wolseley/Minto are presented in Table F.1 and illustrated in Map F.1 of Appendix F. No exceedances of applicable criteria were found in the composite samples collected from 18 residential boulevards in the Wolseley/Minto area.

Riverview/Lord Roberts

Results of Residential Boulevards of Riverview/Lord Roberts are presented in Table F.2 and illustrated in in Map F.2 of Appendix F. No exceedances of applicable criteria were found in the composite samples collected from 20 residential boulevards in the Riverview/Lord Roberts area.

Glenelm/Chalmers

Results of Residential Boulevards of Glenelm/Chalmers are presented in Table F.3 and illustrated in Map F.3 of Appendix F. One (1) of 17 residential boulevards tested in the Glenelm/Chalmers area was found to exceed applicable criteria. The composite soil sample collected at Macintosh Ave between Henderson & Brazier was found to contain 141 mg of lead per kg of soil compared to applicable CCME criteria of 140 mg/kg.

North Point Douglas

Results of Residential Boulevards of North Point Douglas are presented in Table F.4 and illustrated in Map F.4 of Appendix F. Nine of the 22 residential boulevards tested in the North Point Douglas area were found to exceed the applicable criteria of 140 mg/kg. These guideline exceedances were found along Stephens Street, Sutherland Avenue, and Syndicate Street as listed in Table 2 below.

Table 2. North Point Douglas Residential Boulevards - Guideline Exceedances

Location	Lead in soil (mg/kg)
Stephens St Middle btn Sutherland & rail line	620
Stephens St Middle btn Sutherland & Rover	204
Stephens St S end near rail line	216
Stephens St SE corner at Sutherland Ave	236
Sutherland Ave S side btn McFarland St & Syndicate	400
Sutherland Ave at SE corner McFarland St	150
Sutherland Ave at SE corner Syndicate St	755
Sutherland Ave at SW corner Stephens St	278
Syndicate St S btn Sutherland & Rover	210

Exceedances of applicable criteria – by a factor of two (2) or more – were found along Sutherland Avenue and Stephens Street. The highest results of 755-885 mg/kg were found on Sutherland Avenue at the southeast corner of Syndicate Street. The lead level in soil along Stephens Street between Sutherland Avenue and the rail line was determined to be four (4) times applicable criteria at 620 mg/kg. Soil in the boulevard along Sutherland Avenue between McFarland Street and Syndicate Street was observed at 400 mg/kg.

B. Parks and Playgrounds

Results of Parks and Playgrounds are presented in Table E.5 and E.6 and illustrated in Maps F.5 to F.6 of Appendix F. Two (2) of 32 parks and playgrounds included in the study were found to contain soil lead levels exceeding applicable criteria as outlined in Table 3 and described further below.

Table 3. Parks and Playgrounds - Lead in Soil Survey Results Summary

No. of Parks and Playgrounds Sampled		32
No. of Parks and Playgrounds with Guideline Exceedances		2
Lead in soil (mg/kg)	**Mean**	72.1
	Max	439
	Min	15.9

Point Douglas Park

The composite soil sample collected at Point Douglas Park was found to contain 141 mg of lead per kg of soil compared to applicable CCME criteria of 140 mg/kg.

Westview Park

The composite soil sample collected at Westview Park was found to significantly exceed applicable criteria at 439 mg/kg of lead.

C. Schools

Results of schools yards are presented in Table F.5 and F.6 and illustrated in Maps F.5 to F.6 of Appendix F. Of the 18 schoolyards sampled, only Weston School was found to contain soil with lead levels exceeding applicable criteria. Results for the sampling program conducted at Weston School are presented separately in Section V.C.1. Table 4 below presents a summary of results for the other 17 schools.

Table 4. Schools* - Lead in Soil Survey Results Summary

No. of Schools Sampled*		17
No. of Schools with Guideline Exceedances*		0
Lead in soil (mg/kg)	**Mean***	50.5
	Max*	97.5
	Min*	11.5

*excluding Weston School

1. Weston School

Results of Weston Elementary School are presented in Table F.7 and illustrated in Maps F.8 of Appendix F. Of the 22 sampling locations at the Weston School yard, 18 were found to exceed the applicable criteria of 140 mg/kg (Table 5).

Table 5. Weston School - Lead in Soil Survey Results Summary

No. of Sites Sampled		22
No. of Sites with Guideline Exceedances		18
Lead in soil (mg/kg)	**Mean**	215.9
	Max	446.0
	Min	96.3

Table 6 presents the results of soil lead testing conducted at Weston School's yard and shows that guideline exceedances were found across the yard.

Exceedances of applicable criteria – by a factor of two (2) or more – were found at four (4) sites in the Weston School yard: WSA2, WSD1, WSE1, WSF1. The maximum lead concentration of 446 mg/kg was found at WSA2 in the northwest corner of the yard near the school tarmac and play structure. Sampling sites WSD1, WSE1, and WSF1 located in the northeast corner of the yard (along the north edge adjacent Logan Avenue) exhibited results of 375, 372 and 342 mg/kg respectively.

Four (4) of the 22 tested sites at Weston School yard were found to contain soil lead levels below applicable criteria: WSA5, WSB1, WSB4, and WSC3. WSB1 is located near the northwest corner adjacent the play structure and Logan Avenue, while the other three sites below criteria (WSA5, WSB4, WSC3) are situated in the southwest quadrant of the yard.

Table 6. Weston School – Soil Survey Results

Location	Lead in soil (mg/kg)*	Location	Lead in soil (mg/kg)*
Composite1	**198.0**	WSC1	**199.0**
WSA1	**271.0**	WSC2	**259.0**
WSA2	**446.0**	WSC3	119.0
WSA3	**224.0**	WSC4	**225.0**
WSA4	**201.0**	WSC5	**171.0**
WSA5	96.3	WSD1	**375.0**
WSB1	114.0	WSD2	**184.0**
WSB2	**239.0**	WSE1	**372.0**
WSB3	**183.0**	WSE2	**151.0**
WSB4	120.0	WSF1	**342.0**
WSB5	**203.0**	WSF2	**180.0**

*Shading indicates exceedance of CCME criteria

The analytical results presented in Manitoba Conservation Report No. 2009-03 (Manitoba Conservation, 2010) are reproduced in Appendix G. Photographs illustrating an overview of sampling locations are provided in Appendix H of this report. All certificates of analysis received have been presented in a separate addendum to this report.

VI. Discussion

Previous studies have concluded that the primary source of the lead contamination was due to pollutants emitted by motorized vehicles rather than industrial sources. The Government of Canada imposed a limit on lead concentrations in gasoline beginning in 1990 but contamination from that time persists.

Residential Areas

A total of 77 samples were collected in residential areas; of these samples, ten (10) exceeded the applicable criteria. Exceedances were observed in only two (2) residential areas that were sampled, both with known historical impacts. Overall lead concentrations in the sampled areas were lower than concentrations recorded in studies from previous years.

North Point Douglas

Concentrations of lead identified in the Point Douglas neighbourhood were found to be consistent with previous studies. All nine (9) sample locations with concentrations of lead exceeding 140 mg/kg in 2018 had exhibited exceedances in previous years' studies. Areas observed with new grass and curbs had significantly lower lead concentrations, suggesting that these areas may have been replenished with new sod and soil. Overall concentrations in the 2018 study were found to be lower than in previous years, and the number of samples exceeding 140 mg/kg was reduced from the previous studies. These exceedances in the past have been mainly attributed to leaded fuels and heavily trafficked areas, with more localized sources possible related to heavy industry (Manitoba Conservation, 2010).

Glenelm/Chalmers

One sample exceeded the applicable criteria by 1 mg/kg. This location has historically exceeded the guideline with concentrations of 260 kg/mg in 1983. In 2007, concentrations were identified below applicable guidelines; however, due to lack of geo-referencing information, the exact sample locations may have varied from year to year. In the remaining samples, concentrations were below applicable guidelines and were observed to typically reduce in value in comparison to previous studies.

Parks and Playgrounds

Two (2) of the 32 parks and playgrounds sampled had concentrations of lead above applicable guidelines. Point Douglas Park exceeded the criteria by 1 mg/kg. Although this park was not sampled in previous studies, the results are consistent with the exceedances observed in the North Point Douglas Residential Area.

Westview Park also had concentrations of lead that exceeded the applicable criteria with a value of 439 mg/kg. Lead concentrations for Westview Park in 1979 were identified to a maximum of 1265 mg/kg and at 368 mg/kg in 2008. Although the lead levels are still exceeding applicable guidelines, the values are lower than levels detected in 1979. Four (4) surrounding parks sampled did not have lead concentrations exceeding 140 mg/kg. Lead levels at this site may be a result of previous use as a landfill.

Schoolyards

Soils at the 17 schools sampled (excluding Weston School) had levels of lead below the CCME human health guideline in a residential parkland area.

Weston School

Lead concentrations of 18 soil samples at Weston School exceeded CCME guidelines; however, overall a significant decrease was observed from the 1981 study. The values in areas sampled during the 2018 survey were typically lower than the concentrations observed in the 2007 study sample areas, with one exception, sample A1, which was above the 2007 levels. Seven (7) surrounding parks were sampled near Weston School; all of these sites had lead concentrations below 140 mg/kg.

Two previous studies have hypothesized that these lead impacts resulted from neighbouring smelter activities (Wotton, D.L 1979 and Krawchuk 1980); however, a collaborative study between the Province of Manitoba, the Canadian Bronze Company Limited and Atomic Energy of Canada (Pinawa) later concluded that microanalysis of the lead sampled in the Weston Area identified a distinct spectral pattern associated with auto exhaust particulate (Wotton, D.L. and Doern, F.E. 1983). It has been noted throughout this report that sample locations were based off of maps and diagrams from previous reports. Differences in lead concentrations between historical levels and 2018 levels may be attributed to soil replacement, a decline in lead deposited on the surface due to legislation banning leaded fuels, gradual movement of metal down the soil profile or other natural factors.

Although the previously contaminated particulate matter from paved areas immediately surrounding Weston School was removed and areas were repaved or remediated (Jones, D. C. 1985), lead concentrations at the school have continued to exceed 140 mg/kg. It is important to note that only areas with concentrations above 2600 mg/kg were previously remediated and that the use of leaded gasoline continued in Canada until 1990.

VII. Conclusion / Recommendations

The 2018 Winnipeg Soil Survey determined that soil lead levels exceed applicable CCME criteria at a number of sampled locations. Minor exceedances were found on Macintosh Avenue in Winnipeg's Glenelm/Chalmers neighbourhood and at Point Douglas Park. The survey found exceedances at Weston School, Westview Park, and in the North Point Douglas neighbourhood along Stephens Street, Sutherland Avenue and Syndicate Street.

It is recommended that further analysis of lead levels found in this report be conducted to determine if there are risks to human health.

VIII. Limitations

This survey is not an exhaustive study of lead in soil in the Winnipeg area. The survey was conducted at sites in inner-city areas to determine whether changes of lead concentrations over time had occurred in locations that had been sampled during the 2007-2008 survey conducted by the Habitat Management and Ecosystem Monitoring Section of Manitoba Conservation. The major limitation is that this current survey is only able to determine the current levels of lead in surface soil in comparison to previous studies. The survey did not attempt to document or investigate the possible sources of pollution during the survey; therefore, conclusions related to the source of lead contamination cannot be drawn from this survey.

Although the 2010 report from Manitoba Conservation stated that geo-referencing took place of all sampling locations from the 2007-2008 Sampling Survey, the details were not available when initiating the 2018 survey. Efforts were made to replicate sampling locations based on the information provided in the 2010 report. It should also be noted that a sampling location from the present survey may not be the exact same sampling location of the previous survey, but is in close proximity of locations identified in the previous survey.

IX. References

ATSDR, 20177. Toxicological profile for Lead. U.S. Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Washington, DC as quoted in Health Canada 2013a.

CCME, 1996. Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada Canadian Council of Ministers of the Environment The National Contaminated Sites Remediation Program, March 1996

CCME, 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: Lead (1999), Canadian Council of Ministers of the Environment, 1999.

CCME, 2016a. Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment - Volume 3 Suggested Operating Procedures (ISBN 978-1-77202-030-4 pdf), Canadian Council of Ministers of the Environment

CCME, 2016b. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment – Volume 1 Guidance Manual (ISBN 978-1-77202-026-7 pdf), Canadian Council of Ministers of the Environment

EPA, 1995. Report on Protocols for dust and soil sampling (EPA 747-R-95-001), March, 1995

Health Canada, 2013a. Final Human Health State of the Science Report on Lead, February, 2013, Ottawa, Ontario

Health Canada, 2013b. Risk Management Strategy for Lead. February, 2013, Ottawa, Ontario

Jones, D. C. 1985. A Synopsis of the Lead Program at Weston Elementary School in the City of Winnipeg. Manitoba Environment and Workplace Safety and Health, Environmental Management Division, Terrestrial Standards and Studies Section. Winnipeg, MB. Report No. 85-3. 21 pp.

Jones, D. C. 1986a. A Survey of Lead-in-Soil Concentrations at Seven Tot Lots in The City of Winnipeg. Manitoba Environment and Workplace Safety and Health, Terrestrial Standards and Studies Section. Winnipeg, MB. Report No. 86-3. 17 pp

Jones, D. C. 1986b. A Survey of Lead-in-Soil Concentrations from Seven Rural Communities in Manitoba, 1984. Department of Environment and Workplace Safety and Health, Environmental Management Division, Terrestrial Standards and Studies Section, Report 86-2. 17 pp.

Jones, D. C. and D. L. Wotton, 1982. Lead Program Report. Soil/Sod Removal and Replacement in the Weston Area of Winnipeg, 1982. Manitoba Environment and Workplace Safety and Health, Environmental Management Division, Terrestrial Standards and Studies. Winnipeg, MB. Report No. 82-3. 9 pp

Jones, D. C. and D. L. Wotton, 1983a. Lead Program Report. Soil/Sod Removal and Replacement in the Weston Area of Winnipeg, 1983. Manitoba Environment and Workplace Safety and Health, Environmental Management Services Branch, Terrestrial Standards and Studies. Winnipeg, MB. Report No. 83-16. 15 pp

Jones, D. C. and D. L. Wotton, 1983b. A Survey of Lead in Soil from Seven Schools and Three Residential Areas of Winnipeg, 1983. Manitoba Environment and Workplace Safety and Health, Environmental Management Services Branch, Terrestrial Standards and Studies Section. Winnipeg, MB. Report No. 83-15. 25 pp

Krawchuk, B. P. 1980. A Survey of Soil Lead Levels in the City of Winnipeg. MSc. Thesis. Department of Chemistry, University of Manitoba. Winnipeg, MB. 148 pp.

Kucera, E. 1983. Lead distribution in Winnipeg as reflected by city area dogs. Department of Environment and Workplace Safety and Health, Environmental Management Division, Terrestrial Standards and Studies Section, Report 83-10. 20 pp.

Manitoba Conservation. 2010. Sampling Report: Surface Soil Lead Levels in Winnipeg, Manitoba: 2007 & 2008. Manitoba Conservation Report No. 2009-03. Winnipeg, MB. 34 pp.

Schwarts, S.M. 1985. Total Suspended Particulate and Lead Concentrations in the Weston School Area of Winnipeg, January 1984-April 1985. Department of Environment Workplace Safety and Health. Environmental Management Division, Air Standards and Studies Section. Report No. 85-3. 36 pp.

WHO, 1995. Inorganic Lead. International Programme on Chemical Safety, Environmental Health Criteria 165. World Health Organization, Geneva, CH

Wotton, D. L. 1979. A Survey of Lead Accumulation in Tree Foliage and Surface Soil of the Winnipeg Area. Manitoba Department of Mines, Natural Resources and Environment, Environmental Research and Development Branch, Department of Mines, Natural Resources and Environment, Report 79-4. 32pp.

Wotton, D. L. and D. Bezak, 1980. Lead Program City of Winnipeg, Interim Progress Report. Environmental management Division, Environmental Services Branch. 15pp.

Wotton, D. L. and F. E. Doern, 1983. Lead Particulate Analysis in Air and Soil of the City of Winnipeg, 1982. Department of Environment Workplace Safety and Health. Environmental Management Division, Environmental Management Services, Terrestrial Standards and Studies Section, Report 83-3. 64pp.

Appendix A

LIST OF SCHOOLS AND PARKS AND PLAYGROUNDS SAMPLED DURING THE SOIL SURVEY 2018

Table A.1: List of Schools sampled during Soil Survey in Fall 2018

	Schools	Sampling Location Number
1	Archwood School	06-008
2	Brooklands School	05-003
3	Cecil Rhodes School	05-005
4	Clifton School	05-007
5	Dufferin Elementary - Daycare	06-026
6	Dufferin Elementary – School field	06-030
7	Fort Rouge Elementary	06-006
8	Garden Grove School	06-012
9	Gordon Bell High School	06-001
10	Lord Nelson Elementary	06-020
11	Norquay School	06-029
12	Prince Charles Educational Resource Centre	05-015
13	R.B. Russell Vocational High School	06-027
14	Shaughnessy Park School	06-017
15	Sisler High School	06-019
16	Technical Vocational High School	05-016
17	Tyndall Park School	06-014
18	Weston Elementary	Various sites (see Table B.1 in Appendix B)

Table A.2: List of Parks and Playgrounds sampled during Soil Survey in Fall 2018

	Parks and Playgrounds	Sampling Location Number
1	Bannatyne Playground	05-001
2	Bluebird Park	05-002
3	Campion Tot Lot	05-004
4	Clifton Community Centre	05-006
5	Eldon Ross Wading Pool	05-008
6	Galmar Playground	05-009
7	McPhillips Athletic Grounds	05-010
8	Pascoe Park Playground	05-011
9	Stanley Knowles Park	05-012
10	Old Exhibition Grounds Sinclair Playground	05-013
11	Weston Park	05-014
12	Weston Memorial Community Centre	05-017
13	Westview Park	05-018
14	Woodsworth Park	05-019
15	Isaac Brock Community Centre	06-002
16	Berwick Soccer/Ball diamond	06-003
17	Hethrington Park	06-004
18	Lord Roberts Community Centre	06-005
19	Hespeler Park	06-007
20	Archibald Tot Lot	06-009
21	Grace Street Tot Lot	06-010
22	Point Douglas Park	06-011
23	Tyndall Park Community Centre	06-013
24	Gainsborough Cove Park	06-015
25	Shaughnessy Community Centre	06-016
26	Northwood Community Centre	06-018
27	Spence Tot Lot	06-021
28	Home Playground	06-022
29	Jacob Penner (Notre Dame Park)	06-023
30	Maryland Tot Lot	06-024
31	North Logan Park	06-025
32	Pioneer Arena Soccer Pitch	06-028

Appendix B

GLOBAL POSITIONING SYSTEM (GPS) COORDINATES OF THE SAMPLING LOCATIONS

Table B.1: GPS Coordinates of the Sampling locations of Soil Survey Fall 2018

Sample Number	Sampling Location	Coordinates[1]	
		Latitude	Longitude
01-001	Garfield St at Portage Ave	049.88405000	-097.17727000
01-002	Garfield St at Westminster Ave	049.88192000	-097.17740000
01-003	Garfield St btn Westminster & Portage	049.88307000	-097.17725000
01-004	Greenwood Pl at Portage Ave	049.88386000	-097.17950000
01-005	Greenwood Pl at Wolseley Ave	049.88024000	-097.17981000
01-006	Greenwood Pl btn Wolseley & Portage	049.88211000	-097.17968000
01-007	Minto St at Portage Ave	049.88414000	-097.18040000
01-008	Minto St at Wolever Ave	049.88684000	-097.18017000
01-009	Minto St btn Portage & Wolever	049.88549000	-097.18028000
01-010	Sherburn St at Portage Ave - north side	049.88467000	-097.17603000
01-011	Sherburn St at Portage Ave - south side	049.88422000	-097.17609000
01-012	Sherburn St at Westminster Ave	049.88187000	-097.17625000
01-013	Sherburn St btn Portage & Wolever	049.88582000	-097.17596000
01-014	Sherburn St at Wolever Ave	049.88668000	-097.17590000
01-015	Sherburn St btn Westminster & Portage	049.88306000	-097.17616000
01-016	Sprague St at Portage Ave	049.88366000	-097.18099000
01-017	Sprague St at Wolseley Ave	049.88069000	-097.18115000
01-018	Sprague St btn Wolseley & Portage	049.88232000	-097.18101000
02-001	Balfour Ave at Hay St	049.86115000	-097.12746000
02-002	Balfour Ave at Osborne St	049.86028000	-097.13029000
02-003	Balfour Ave btn Osborne & Hay	049.86072000	-097.12879000
02-004	Baltimore Ave at Hay St	049.86282000	-097.12878000
02-005	Baltimore Ave at Osborne St	049.86192000	-097.13161000
02-006	Baltimore Ave btn Osborne & Hay	049.86239000	-097.13004000
02-007	Clare Ave at Hay St	049.86030000	-097.12678000
02-008	Clare Ave at Osborne St	049.85937000	-097.12958000

[1] GPS coordinates were recorded in decimal points in UTM NAD83

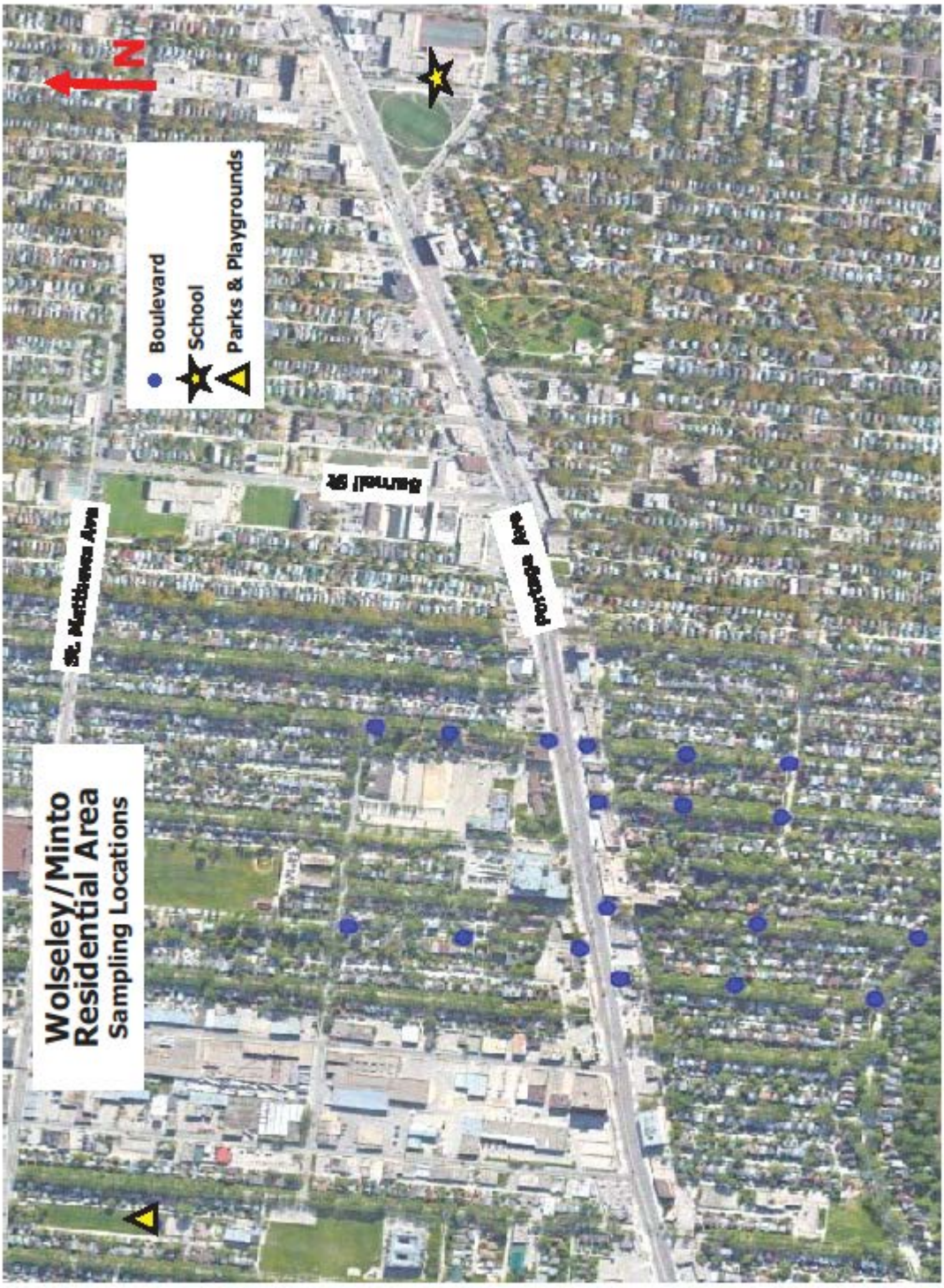
Sample Number	Sampling Location	Coordinates[1]	
		Latitude	Longitude
02-009	Clare Ave btn Osborne & Hay	049.85941000	-097.12810000
02-010	Jubilee Ave at Nassau St	049.85849000	-097.13358000
02-011	Jubilee Ave btn Osborne & Nassau	049.85897000	-097.13223000
02-012	Kylemore Ave at Nassau St	049.86244000	-097.13681000
02-013	Kylemore Ave btn Osborne & Nassau	049.86274000	-097.13506000
02-014	Maplewood Ave at Hay St	049.86449000	-097.13024000
02-015	Maplewood Ave at Osborne St	049.86363000	-097.13308000
02-016	Maplewood btn Osborne & Hay	049.86399000	-097.13165000
02-017	Rathgar Ave at Nassau St	049.86098000	-097.13557000
02-018	Rathgar Ave btn Osborne & Nassau	049.86141000	-097.13433000
02-019	Rosedale Ave at Nassau St	049.85942000	-097.12424000
02-020	Rosedale Ave btn Osborne & Nassau	049.86004000	-097.13261000
03-001	Cobourg Ave at Beatrice St	049.91636000	-097.11945000
03-002	Cobourg Ave at Henderson Hwy	049.91481000	-097.11475000
03-003	Cobourg Ave btn Henderson & Beatrice	049.91571000	-097.11729000
03-004	Hart Ave at Beatrice St	049.91502000	-097.12046000
03-005	Hart Ave at Henderson Hwy	049.91340000	-097.11583000
03-006	Hart Ave btn Henderson & Beatrice	049.91428000	-097.11823000
03-007	Hespeler Ave at Beatrice St	049.91431000	-097.12101000
03-008	Hespeler Ave at Henderson Hwy	049.91232100	-097.11607000
03-009	Hespeler Ave btn Henderson & Beatrice	049.91359000	-097.11853000
03-010	Macintosh Ave at Brazier St	049.91204600	-097.11274200
03-011	Macintosh Ave btn Henderson & Brazier	049.91253000	-097.11417000
03-012	Martin Ave W west of Henderson Hwy	049.91713000	-097.11617000
03-013	Martin Ave W at Beatrice St	049.91787000	-097.11846000
03-014	Martin Ave W at Brazier St	049.91529000	-097.11003000
03-015	Martin Ave W at Henderson Hwy - east blvd	049.91641000	-097.11357000
03-016	Martin Ave W at Henderson Hwy - west blvd	049.91646000	-097.11430000
03-017	Martin Ave W east of Henderson Hwy	049.91588000	-097.11182000

Sample Number	Sampling Location	Coordinates[1]	
		Latitude	Longitude
04-001	Sutherland Ave E btn Stephens & Angus	049.90381000	-097.11772000
04-002	Angus St Middle btn Sutherland & rail line	049.90354000	-097.11736000
04-003	Disraeli St Middle btn Sutherland & Rover	049.90674000	-097.12431000
04-004	Stephens St Middle btn Sutherland & rail line	049.90364000	-097.11832000
04-005	Stephens St Middle btn Sutherland & Rover	049.90491000	-097.11778000
04-006	Syndicate St Middle btn Sutherland & Rover	049.90510000	-097.11874000
04-007	Sutherland Ave NE corner at Disraeli St	049.90569000	-097.12595000
04-008	Syndicate St NE corner at Sutherland Ave	049.90419000	-097.11912000
04-009	Stephens St NW corner at Sutherland Ave	049.90398000	-097.11822400
04-010	Angus St south end near rail line	049.90336000	-097.11749000
04-011	Disraeli St south end btn Sutherland & Rover	049.90572000	-097.12617000
04-012	Stephens St south end near rail line	049.90337000	-097.11840000
04-013	Sutherland Ave south side btn McFarland St & Syndicate	049.90417000	-097.11996000
04-014	Stephens St S btn Sutherland & Rover	049.90396000	-097.11803000
04-015	Syndicate St S btn Sutherland & Rover	049.90419000	-097.11926000
04-016	SE corner of ball park on Disraeli St at Rover Ave	049.90742000	-097.12323000
04-017	Stephens St SE corner at Sutherland Ave	049.90380000	-097.11829000
04-018	Sutherland Ave at SE corner McFarland St	049.90426000	-097.12027000
04-019	Sutherland Ave at SE corner Syndicate St	049.90398000	-097.11917000
04-020	Sutherland Ave at SW corner Stephens St	049.90386100	-097.11829000
04-021	Sutherland Ave east of Angus	049.90371000	-097.11715000
04-022	Sutherland Ave W btn Stephens & Angus	049.90392900	-097.11773400
05-001	Bannatyne Playground	049.91696400	-097.19930300
05-002	Bluebird Park	049.91867800	-097.20418500
05-003	Brooklands School	049.92183000	-097.20229400
05-004	Campion Tot Lot	049.91467800	-097.18791000
05-005	Cecil Rhodes School	049.91609600	-097.19138600
05-006	Clifton Community Centre	049.90133000	-097.18999300

Sample Number	Sampling Location	Coordinates[1]	
		Latitude	Longitude
05-007	Clifton School	049.89813700	-097.18622100
05-008	Eldon Ross Wading Pool	049.92157600	-097.20029100
05-009	Galmar Playground	049.92407700	-097.19762800
05-010	McPhillips Athletic Grounds	049.91647700	-097.17556200
05-011	Pascoe Park Playground	049.91483400	-097.18352200
05-012	Stanley Knowles Park	049.91605400	-097.17604700
05-013	Old Exhibition Grounds Sinclair Playground	049.91863700	-097.16059600
05-014	Weston Park	049.92091300	-097.18970200
05-015	Prince Charles Educational Resource Centre	049.90081800	-097.18068800
05-016	Technical Vocational High School	049.90698400	-097.17874500
05-017	Weston Memorial Community Centre	049.92084000	-097.19196800
05-018	Westview Park	049.90675000	-097.18989100
05-019	Woodsworth Park	049.92870500	-097.20115100
06-001	Gordon Bell High School	049.88648000	-097.16196500
06-002	Isaac Brock Community Centre	049.88885800	-097.18669500
06-003	Berwick Soccer/Ball diamond	049.86034000	-097.14552000
06-004	Hethrington Park	049.86428000	-097.14236000
06-005	Lord Roberts Community Centre	049.85984400	-097.14389900
06-006	Fort Rouge Elementary	049.88411900	-097.13285600
06-007	Hespeler Park	049.91542500	-097.12372600
06-008	Archwood School	049.87544400	-097.09517200
06-009	Archibald Tot Lot	049.89637600	-097.10620700
06-010	Grace Street Tot Lot	049.90218000	-097.11444000
06-011	Point Douglas Park	049.90376200	-097.11443800
06-012	Garden Grove School	049.93993400	-097.21551200
06-013	Tyndall Park Community Centre	049.93793900	-097.20585700
06-014	Tyndall Park School	049.93757700	-097.20646200
06-015	Gainsborough Cove Park	049.93301000	-097.20207700
06-016	Shaughnessy Community Centre	049.93384500	-097.19449600

Sample Number	Sampling Location	Coordinates[1]	
		Latitude	Longitude
06-017	Shaughnessy Park School	049.93297800	-097.19014200
06-018	Northwood Community Centre	049.93059000	-097.17961600
06-019	Sisler High School	049.93093000	-097.17646200
06-020	Lord Nelson Elementary	049.92901200	-097.17001400
06-021	Spence Tot Lot	049.89913100	-097.15378400
06-022	Home Playground	049.89565960	-097.16678000
06-023	Jacob Penner (Notre Dame Park)	049.90015900	-097.16196900
06-024	Maryland Tot Lot	049.89985800	-097.15993400
06-025	North Logan Park	049.90659800	-097.14572500
06-026	Dufferin Elementary-Daycare	049.90637300	-097.14940100
06-027	R.B. Russell Vocational High School	049.91017000	-097.14183500
06-028	Pioneer Arena Soccer Pitch	049.90989900	-097.15675600
06-029	Norquay School	049.90863000	-097.12973000
06-030	Dufferin Elementary-School field	049.90637300	-097.14940100
Composite1	Weston Elementary	049.91713200	-097.18340800
WSA1	Weston Elementary	049.91713200	-097.18340800
WSA2	Weston Elementary	049.91713200	-097.18340800
WSA3	Weston Elementary	049.91713200	-097.18340800
WSA4	Weston Elementary	049.91713200	-097.18340800
WSA5	Weston Elementary	049.91713200	-097.18340800
WSB1	Weston Elementary	049.91713200	-097.18340800
WSB2	Weston Elementary	049.91713200	-097.18340800
WSB3	Weston Elementary	049.91713200	-097.18340800
WSB4	Weston Elementary	049.91713200	-097.18340800
WSB5	Weston Elementary	049.91713200	-097.18340800
WSC1	Weston Elementary	049.91713200	-097.18340800
WSC2	Weston Elementary	049.91713200	-097.18340800
WSC3	Weston Elementary	049.91713200	-097.18340800
WSC4	Weston Elementary	049.91713200	-097.18340800

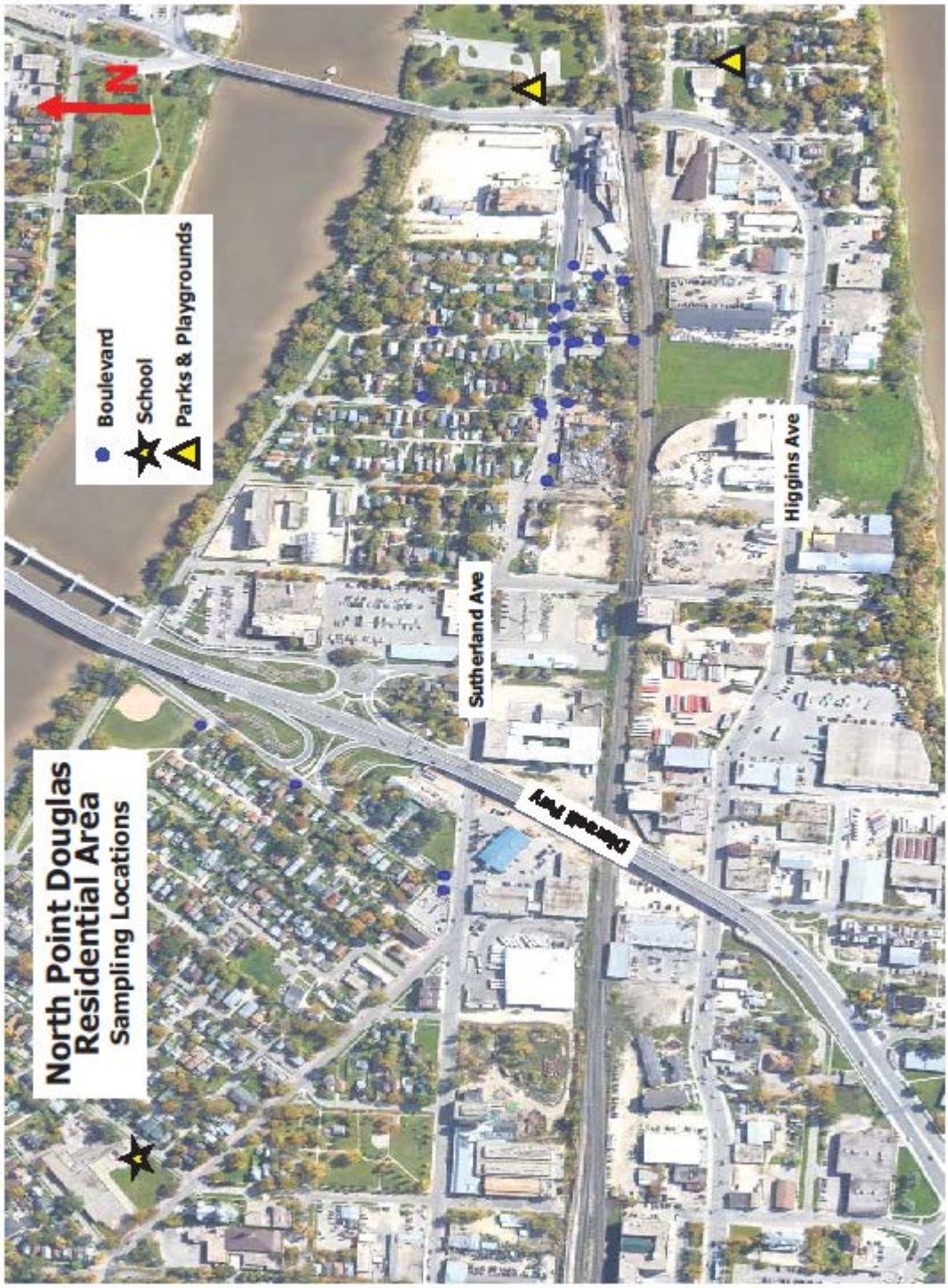
Sample Number	Sampling Location	Coordinates[1]	
		Latitude	Longitude
WSC5	Weston Elementary	049.91713200	-097.18340800
WSD1	Weston Elementary	049.91713200	-097.18340800
WSD2	Weston Elementary	049.91713200	-097.18340800
WSE1	Weston Elementary	049.91713200	-097.18340800
WSE2	Weston Elementary	049.91713200	-097.18340800
WSF1	Weston Elementary	049.91713200	-097.18340800
WSF2	Weston Elementary	049.91713200	-097.18340800



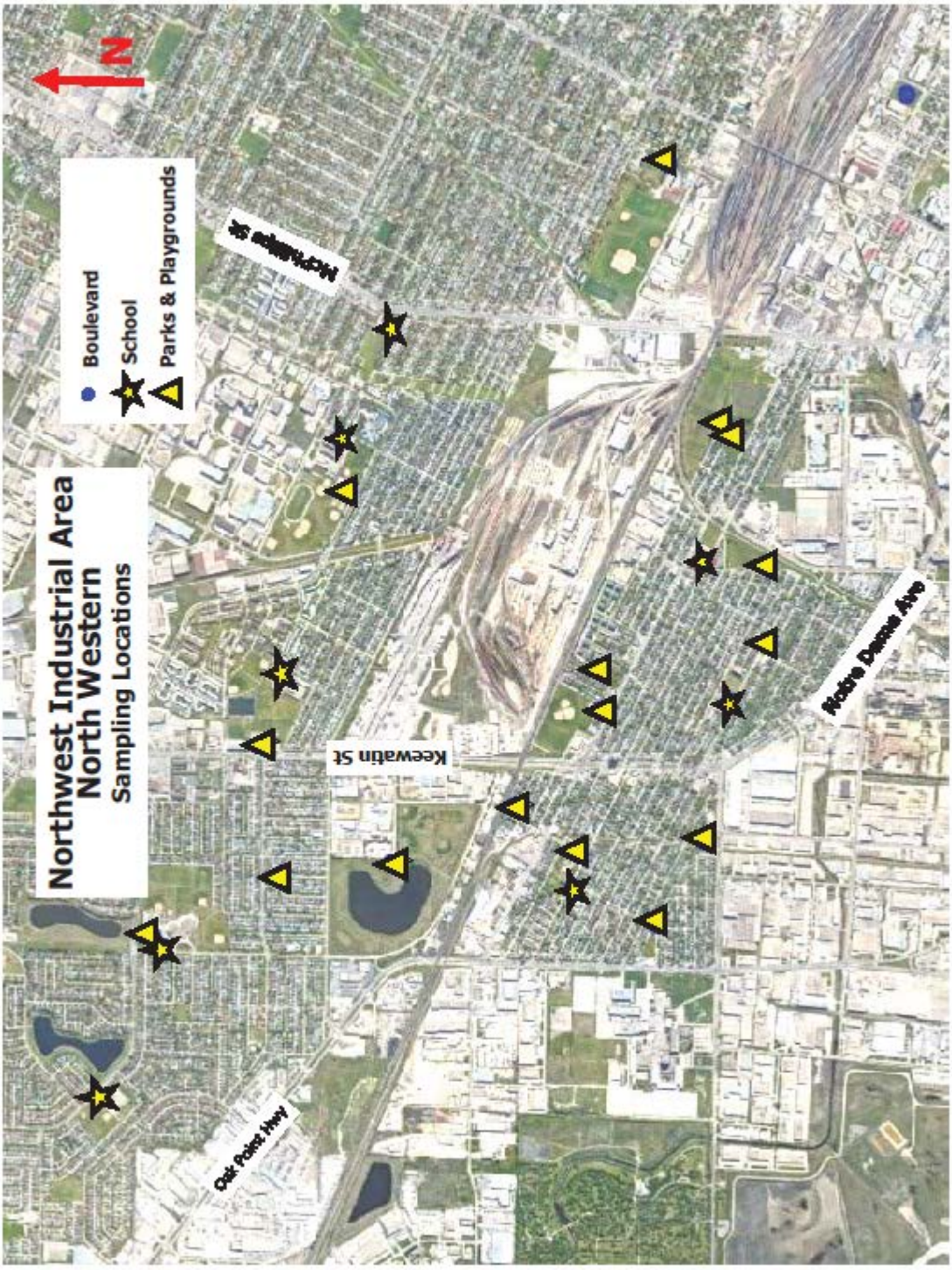
Map B.1: Sampling Locations in Wolseley/ Minto Residential Boulevards

Map B.2: Sampling Locations in Riverview/Lord Roberts Residential Boulevards

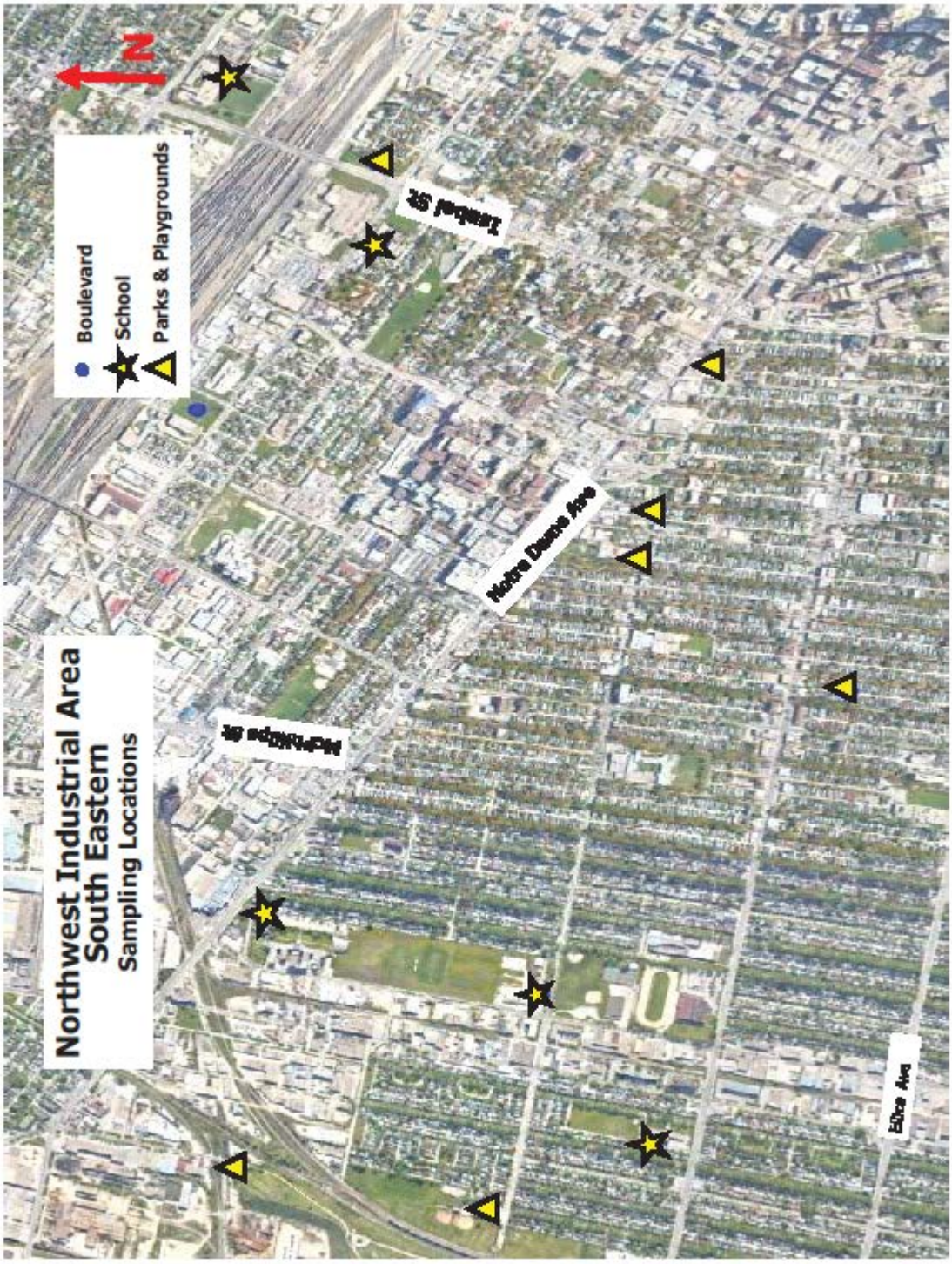
Map B.3: Sampling Locations in Glenelm/Chalmers Residential Boulevards



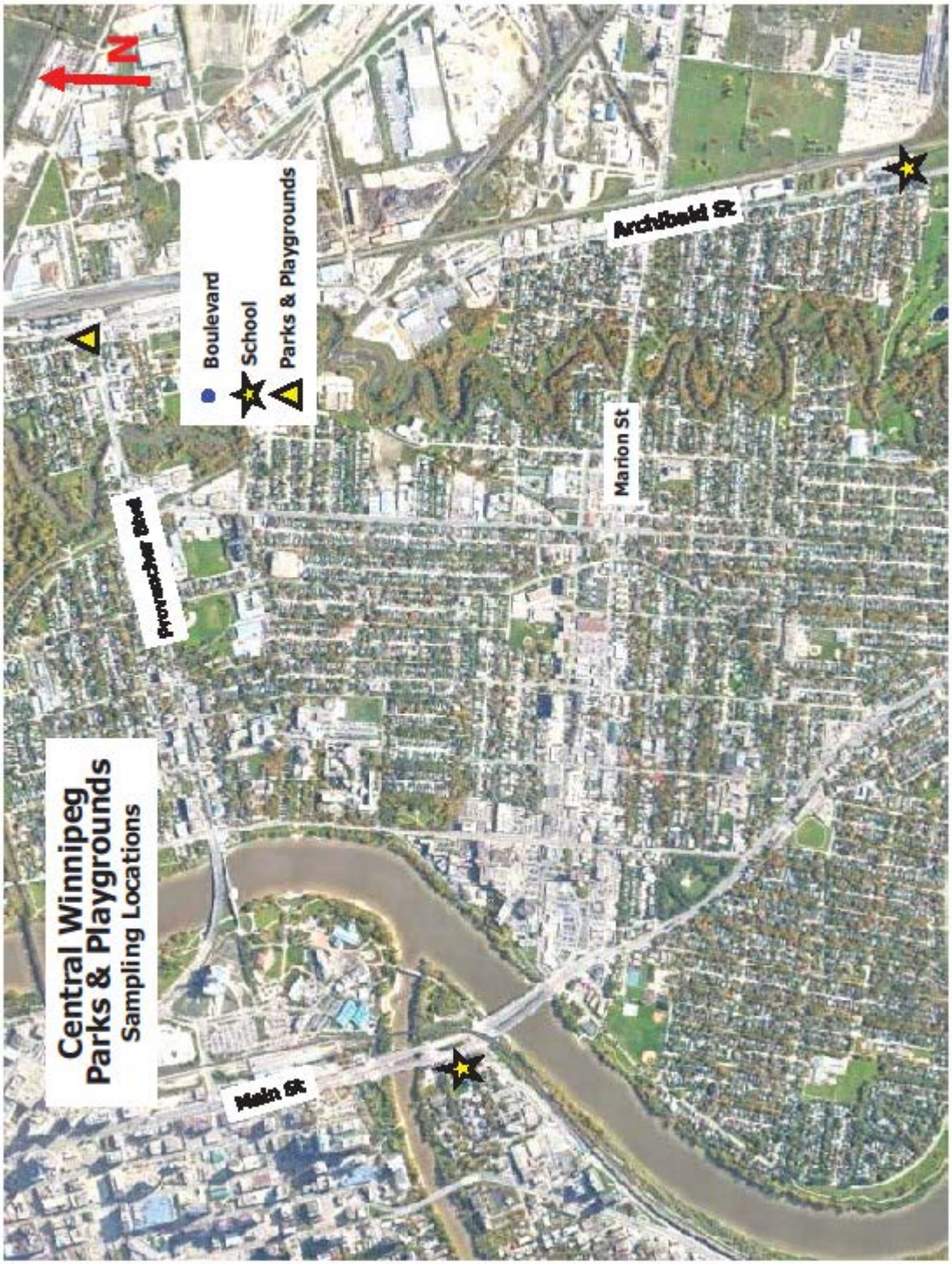
Map B.4: Sampling Locations in North Point Douglas Residential Boulevards



Map B.5: Sampling Locations in Northwest Industrial Area (North Western)



Map B.6: Sampling Locations in Northwest Industrial Area (South Eastern)



Map B.7: Sampling Locations in Parks and Playgrounds (Central Winnipeg)

Map B.8: Sampling Locations in Weston Elementary School

Appendix C

STANDARD OPERATING PROCEDURE:
SOIL SAMPLING FOR LEAD CONTENT IN SURFACE SOIL

STANDARD OPERATING PROCEDURE:
SOIL SAMPLING FOR LEAD CONTENT IN SURFACE SOIL

SCOPE

This standard operating procedure (SOP) provides general direction and guidance for the collection of a representative soil sample for analysis of Lead in surface soil.

Contents of the SOP are adopted from the CCME Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment - Volume 3 Suggested Operating Procedures (ISBN 978-1-77202-030-4 pdf), EPA report on Protocols for dust and soil sampling (EPA 747-R-95-001) and other available technical documents.

APPLICATION

Collection of soil samples for the purposes of testing of lead content in surface soil. The Team Lead is responsible for overseeing the overall soil sampling activities. The Team Lead is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP.

EQUIPMENT, MATERIALS AND SUPPLIES

- *2 cm diameter Oakfield Soil sampler*
- *Nitrile gloves* - clean, non-powdered, disposable
- *Wet wipes* (lead- and alcohol-free wipes such as baby wipes)
- *Buckets with lids* (rinsing and cleaning the equipment)
- *Distilled Water*
- *Paper towels*
- *Laboratory supplied soil sample collection bags*
- *Measuring tape*
- *Ruler* (cleanable, and of adequate length to determine sample depth)
- *Global Positioning System Receiver (GPS)*
- *Camera*
- *Coolers (for sample storage)*
- *Ice packs or ice cubes*
- *Permanent ink marker*
- *Sample collection log and site plan sketch* on which to indicate location of samples
- *Safety gloves - puncture resistant*
- *Chain-of-Custody forms* provided by the laboratory
- *Garbage bags*

SAMPLING DESIGN

Composite sampling methodology is used to obtain a representative sample for surface soil at each sampling location.

Each composite sample will consist of ten (10) discrete soil subsamples.

Each discrete sample will be obtain by collecting soil sample to a depth of 7.5 cm using 2 cm diameter Oakfield soil sampler.

CATEGORIES OF SAMPLE LOCATIONS

Sampling of parks and playgrounds:
One composite sample is required. In order to obtain a composite sample, discrete subsamples must be collected at appropriate intervals along an "X" pattern in each park or playground. All subsample locations need to be geo-referenced with GPS as well as referenced on a site drawing with measurements from structures, distances between sample locations and site features.

Sampling of schoolyards:
One composite sample is required. In order to obtain a composite sample, discrete subsamples must be collected at appropriate intervals along an "X" pattern in each schoolyard. All subsample locations need to be geo-referenced with GPS as well as referenced on a site drawing with measurements from structures, distances between sample locations and site features.

Sampling of residential boulevards:
One composite sample is required. Sampling location must be within 15 cm of the curb and where possible samples should be taken at the curb edge. Subsamples should 0.6 m (2 ft.) apart from each other. In residential boulevards, if sampling location on a N-S street, collect the samples from the SE corner of the intersection and the east side of the street. For E-W streets, collect the samples from the SE corner and south side of the street.

Weston Elementary School
Composite samples will be obtained from 21 sample locations previously sampled in 2007 Soil Survey. Each composite sample will consists of five (5) discrete samples. Subsamples should be no closer to each other than 0.3 m (1 ft.) and no farther than apart than 1.0 m (3 ft.).

QUALITY CONTROL AND QUALITY ASSURANCE (QA/QC)

For every 10th composite sample taken by a team, one field duplicate sample must be obtained. The field duplicate sample will be obtained by splitting the homogenised composite sample and filling a separate sample bag.

PLANNING AND PREPARATION

Conduct a detailed review of site features and health and safety requirements. Based on site features, implement personal health and safety precautions (e.g. traffic cones, visible vest, gloves, respiratory protection, ear and eye protection, *etc*.). For details, please refer the Safe Work Procedure adopted for the soil sampling.

SELECTION OF SAMPLE LOCATION AND COMPLETING THE SAMPLE COLLECTION LOG

Sampling location:
Decide the predetermined location where the composite sample will be collected.

GPS Coordinates:
Obtain the GPS coordinates and enter in the sample collection log. The format for GPS coordinates must be in decimal points in UTM NAD83 (e.g.: 49.909074 / -97.203947)

Photographs:
Supplement the observations with photographs. Use a scale or item of known dimension in the photograph for size comparison purposes if required for any of the photograph.

Sample Collection log:
Complete all the required fields in the sample collection log. Draw a sketch map of the sampling location and mark approximate subsampling points with their identifying markers with measurements from structures, distances between sample locations and site features. Record observations, weather conditions and other required sampling notes. Record any deviations from the standard operating procedure and reasons. Photographs taken should be documented giving brief detail.

SAMPLE COLLECTION

Gloves

Wear a new pair of clean, disposable non-powdered nitrile gloves before collecting each composite sample.

Cleaning of tools

Soil sampler, ruler must be cleaned using distilled water and wet wipe before sampling. [Note: All equipment that comes in contact with the sample should be cleaned between each composite sample collection]

Preparation of Sample container:

Select a sample collection zip lock bag for each composite soil sample from a sample location. Write the following on the sample label with the permanent ink marker:

Company: *MB Sustainable Development*
Sample Location:
Sample ID: *(Format:- Sampling Group 0X- number XX)*
*(for duplicate sample: 0X-XXX**D**)*
Date sampled: (and time) (Format:- *yyyy-mm-dd / hhmm*)
Project/Location: *ECE Winnipeg Soil Survey 2018*
Analysis Required: *Lead*
Sample taken by: *Initials*

Site preparation:

Clean the sampling area of any surface debris (for example twigs, stones, rocks or leaf litter).

Sample collection using a soil sampler

Place the Oakfield soil sampler on the designated sample point in upright position and force the tube into soil to a depth of 10 cm. Using a slight twisting motion to the right only break off core. Carefully remove the tube from the ground by turning to right while retaining the soil core in the tool.

Measure the top 7.5 cm core. Carefully remove the measured 7.5 cm core through the cut out portion of the Sampler tube and place directly into the sample collection bag and tightly seal the bag using the zip lock.

Deposit sample into sample bag

Deposit all subsamples from a sampling location into the same sample bag. Do not expose samples, or sampling equipment to vehicle exhaust or other point sources of contamination.

Mixing of subsamples

Mix the sample in the sample bag itself to homogenise to the extent possible.

Sample storage in the field

Check and make sure the sample bag is correctly labelled and the sample ID number appear correctly on the sampling bag and in the sample collection log. Complete the sampled date / time and write the initials of the sample collector in the label of the sample bag. Soil sampling bags must be placed immediately in a cooler with ice pack or ice.

Obtaining field duplicate samples:

Obtain a field duplicate sample for every 10^{th} sample collected by the sampling team by splitting the homogenised sample and filling in a separate sample bag.

Filling coring holes created by sampling in the field:
Any coring material not used for samples should be placed back in the core hole and rest of the core hole to be filled up with fresh soil.

Complete the Laboratory Chain-of-Custody forms:
Complete the ALS Chain of Custody form by filling the sample identification number, date and time, type of sample, analysis required and other payment and contact details.

Discard used wipes and gloves:
Discard all used gloves and wipes in the garbage bag. (Do not use pockets or trash containers at the nearby residence)

Disposal Procedures:
All residuals and rinse waters generated during the cleaning of equipment on-site will be collected and transported back to the office for disposal. All solid waste to be disposed in the office garbage bins placed in the back parking lot. Discard rinse water appropriately.

TRANSPORT OF SAMPLES

Soil samples intended for laboratory analysis should be stored in appropriate sampling bags and placed immediately in a cooler with ice pack prior to and during transport to the analytical laboratory. Maintain the soil samples at 4^0C in transit.

SUBMISSION TO LABORATORY

At the end of each day, Team Lead will verify that the samples collected are consistent with those logged on the Chain of Custody form(s) and review and augment descriptions, as necessary. The soil samples and Chain of Custody forms should be handed over to designated coordinator for submission to the analytical laboratory.

STORAGE

At the end of each sampling schedule, clean Oakfield sampler and other tools as per the required methods and store in a specified location in the office. Use care when storing materials to avoid contamination.

DOCUMENTATION

Verify the sample collection logs to ensure that all sampling activities and sampling conditions were recorded properly. Each sample collection log must be initialed by the respective Team Lead. Hand over the sample collection logs to the designated coordinator at the end of each sampling schedule.

References:

1. CCME Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment - Volume 3 Suggested Operating Procedures (ISBN 978-1-77202-030-4 pdf)
2. CCME Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment – Volume 1 Guidance Manual (ISBN 978-1-77202-026-7 pdf)
3. EPA report on Protocols for dust and soil sampling (EPA 747-R-95-001), March, 1995
4. Appendix 13.3: Collecting Soil Samples for Lead Determination, US Department of Housing and Urban Development
5. Soil Sampling, Operating procedure, U.S. Environmental Protection Agency, Science and Ecosystem Support Division, Athens, Georgia, SESDPROC-300-R3, August 2014

Appendix D

PHOTOGRAPHS SHOWING SAMPLING PROCEDURES

D.1: SAMPLING PROCESS IN SCHOOLS, PLAYGROUNDS AND PARKS

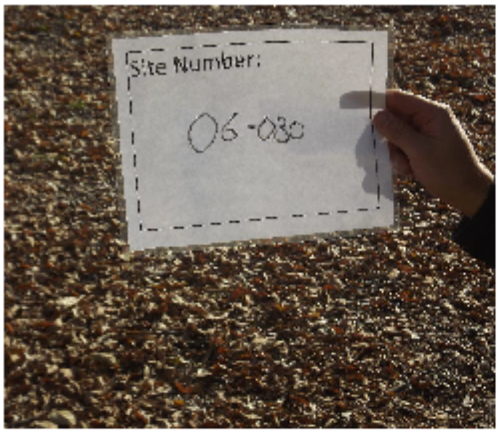


Photo 1 : Sample ID

Photo 2: Sample ID with overview of sampling

Photo 3: Inserting Soil probe to extract sample

Photo 4: Soil probe with sample

Photo 5: Sample and sample bag

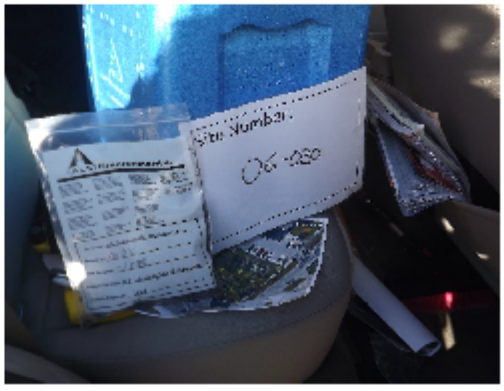


Photo 6: Completed composite sample in bag

D.1: SAMPLING PROCESS IN SCHOOLS, PLAYGROUNDS AND PARKS

Photo 7: Sample bag placed in cooler with ice

Photo 8: Cleaning equipment

D.2: SAMPLING PROCESS IN RESIDENTIAL BOULEVARDS

Photo 9: Boulevard sample points flagged

Photo 10: Using soil probe to extract sample

Photo 11 : Soil sample extracted and sample bag

Photo 12: Composite sample and sample ID card

Photo 13 : Sample placed in cooler

Photo 14: Cleaning equipment

Appendix E

SAMPLE COLLECTION LOG

Manitoba
Sustainable Development

Date/Time _____

Sample Number :	Sample Location:
GPS Coordinates:	
Weather:	

Number of subsamples collected:	Duplicate: Y / N
Soil Description (Soil type, subtypes, consistency, firmness, colour, moisture, plasticity, depths)	
Site Description/Additional observations:	

Site Diagram

Photos Collected	Sampler Initials

Subsample Location	GPS coordinates
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Photo Descriptions/ Additional Notes

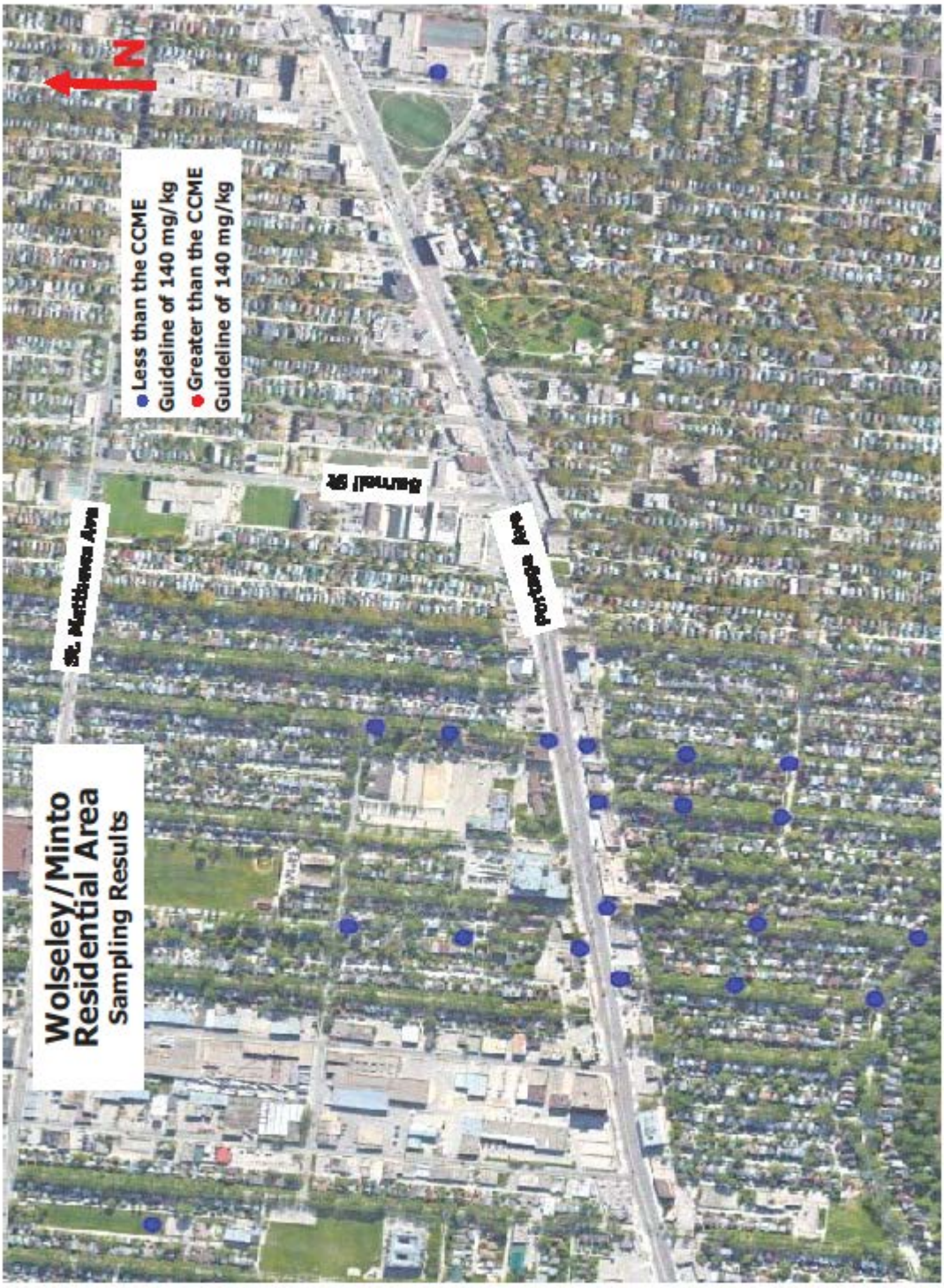
Appendix F

ANALYTICAL DATA –
WINNIPEG SOIL SURVEY 2018

Table F.1: Lead in Soil Survey 2018 - Wolseley/ Minto Residential Boulevards

Sample Number	Date Sampled	Sample Location	Results[1] (mg/kg)
01-001	2018-10-09	Garfield St at Portage Ave	61.7
01-002	2018-10-09	Garfield St at Westminster Ave	22.3
01-003	2018-10-09	Garfield St btn Westminster & Portage	45
01-004	2018-10-09	Greenwood Pl at Portage Ave	28
01-005	2018-10-09	Greenwood Pl at Wolseley Ave	50.7
01-006	2018-10-09	Greenwood Pl btn Wolseley & Portage	46.4
01-007	2018-10-10	Minto St at Portage Ave	18.1
01-008	2018-10-10	Minto St at Wolever Ave	24.3
01-009	2018-10-10	Minto St btn Portage & Wolever	33.5
01-010	2018-10-10	Sherburn St at Portage Ave - north side	48.8
01-011	2018-10-09	Sherburn St at Portage Ave - south side	19.6
01-012	2018-10-09	Sherburn St at Westminster Ave	14.5
01-013	2018-10-10	Sherburn St btn Portage & Wolever	43.2
01-014	2018-10-10	Sherburn St at Wolever Ave	33.1
01-015	2018-10-09	Sherburn St btn Westminster & Portage	11.3
01-016	2018-10-10	Sprague St at Portage Ave	32.4
01-016 D	2018-10-10	Sprague St at Portage Ave	26.3
01-017	2018-10-10	Sprague St at Wolseley Ave	37.9
01-018	2018-10-10	Sprague St btn Wolseley & Portage	105

- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria



Map F.1: Sampling Results in Wolseley/Minto Residential Boulevards

Table F.2: Lead in Soil Survey 2018 - Riverview/Lord Roberts Residential Boulevards

Sample Number	Date Sampled	Sample Location	Results[1] (mg/kg)
02-001	2018-10-09	Balfour Ave at Hay St	26.3
02-002	2018-10-09	Balfour Ave at Osborne St	56.7
02-003	2018-10-09	Balfour Ave btn Osborne & Hay	27.1
02-003 D	2018-10-09	Balfour Ave btn Osborne & Hay	24.4
02-004	2018-10-09	Baltimore Ave at Hay St	36
02-005	2018-10-09	Baltimore Ave at Osborne St	34.3
02-006	2018-10-09	Baltimore Ave btn Osborne & Hay	34.4
02-007	2018-10-09	Clare Ave at Hay St	17.8
02-008	2018-10-09	Clare Ave at Osborne St	26.6
02-009	2018-11-09	Clare Ave btn Osborne & Hay	70.4
02-010	2018-10-10	Jubilee Ave at Nassau St	125
02-011	2018-10-10	Jubilee Ave btn Osborne & Nassau	107
02-011 D	2018-10-10	Jubilee Ave btn Osborne & Nassau	92.7
02-012	2018-10-09	Kylemore Ave at Nassau St	96.9
02-013	2018-10-09	Kylemore Ave btn Osborne & Nassau	57.4
02-014	2018-10-09	Maplewood Ave at Hay St	17.9
02-015	2018-10-09	Maplewood Ave at Osborne St	75.5
02-016	2018-10-09	Maplewood btn Osborne & Hay	24.9
02-017	2018-10-09	Rathgar Ave at Nassau St	110
02-018	2018-10-09	Rathgar Ave btn Osborne & Nassau	25.4
02-019	2018-10-10	Rosedale Ave at Nassau St	14.4
02-020	2018-10-10	Rosedale Ave btn Osborne & Nassau	14.2

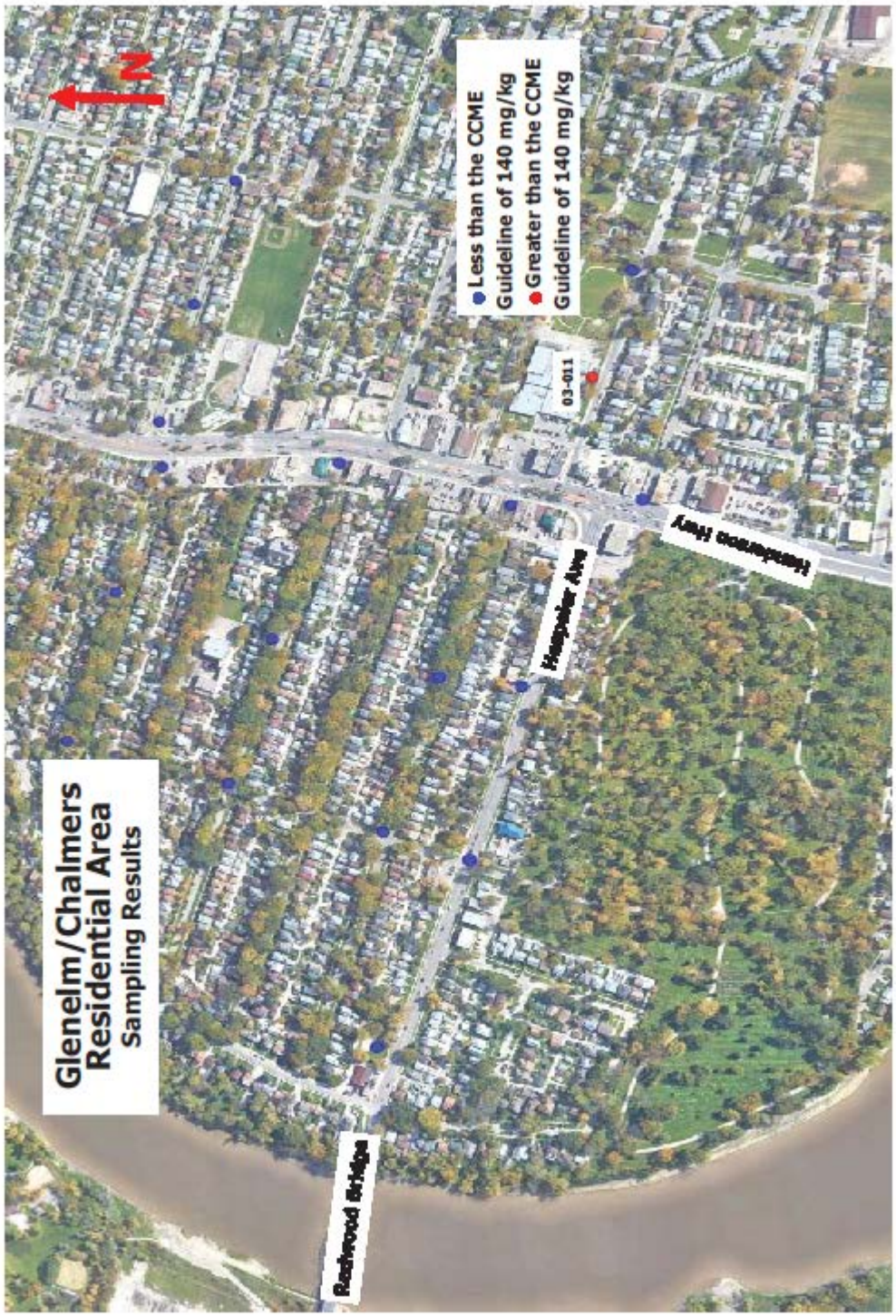
- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria

Map F.2: Sampling Results in Riverview/Lord Roberts Residential Boulevards

Table F.3: Lead in Soil Survey 2018 - Glenelm/Chalmers Residential Boulevards

Sample Number	Date Sampled	Sample Location	Results [1] (mg/kg)
03-001	2018-10-09	Cobourg Ave at Beatrice St	98.8
03-002	2018-10-09	Cobourg Ave at Henderson Hwy	72.5
03-003	2018-10-09	Cobourg Ave btn Henderson & Beatrice	134
03-004	2018-10-09	Hart Ave at Beatrice St	87.4
03-005	2018-10-09	Hart Ave at Henderson Hwy	14.2
03-006	2018-10-09	Hart Ave btn Henderson & Beatrice	27.9
03-007	2018-10-09	Hespeler Ave at Beatrice St	67.5
03-007 D	2018-10-09	Hespeler Ave at Beatrice St	17
03-008	2018-10-10	Hespeler Ave at Henderson Hwy	25.6
03-009	2018-10-09	Hespeler Ave btn Henderson & Beatrice	29.1
03-010	2018-10-10	Macintosh Ave at Brazier St	60.2
03-011	2018-10-10	Macintosh Ave btn Henderson & Brazier	141
03-012	2018-10-09	Martin Ave W west of Henderson Hwy	21.6
03-013	2018-10-09	Martin Ave W at Beatrice St	34.3
03-014	2018-10-10	Martin Ave W at Brazier St	47.7
03-015	2018-10-10	Martin Ave W at Henderson Hwy - east blvd	25.6
03-016	2018-10-09	Martin Ave W at Henderson Hwy - west blvd	43.9
03-017	2018-10-10	Martin Ave W east of Henderson Hwy	87.6

- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria

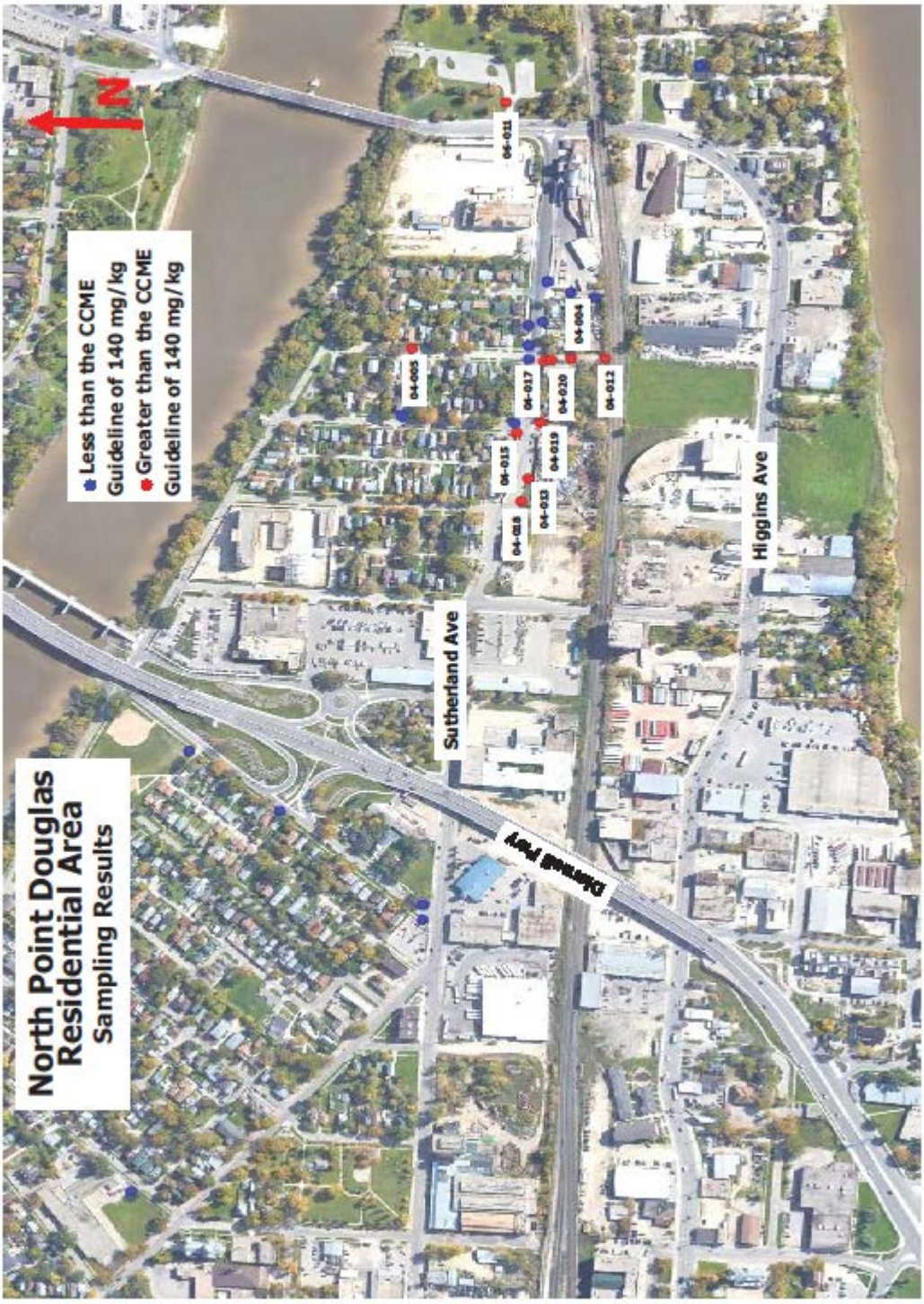


Map F.3: Sampling Results in Glenelm/Chalmers Residential Boulevards

Table F.4: Lead in Soil Survey 2018 - North Point Douglas Residential Boulevards

Sample Number	Date Sampled	Sample Location	Results [1] (mg/kg)
04-001	2018-10-11	Sutherland Ave E btn Stephens & Angus	53.2
04-002	2018-10-09	Angus St Middle btn Sutherland & rail line	22.9
04-003	2018-10-10	Disraeli St Middle btn Sutherland & Rover	15.6
04-004	2018-10-10	Stephens St Middle btn Sutherland & rail line	620
04-005	2018-10-09	Stephens St Middle btn Sutherland & Rover	204
04-006	2018-10-12	Syndicate St Middle btn Sutherland & Rover	87.8
04-007	2018-10-10	Sutherland Ave NE corner at Disraeli St	36.6
04-007 D	2018-10-10	Sutherland Ave NE corner at Disraeli St	69.3
04-008	2018-10-11	Syndicate St NE corner at Sutherland Ave	94.5
04-009	2018-10-11	Stephens St NW corner at Sutherland Ave	99.1
04-010	2018-10-09	Angus St south end near rail line	78.3
04-011	2018-10-10	Disraeli St south end btn Sutherland & Rover	136
04-012	2018-10-10	Stephens St south end near rail line	216
04-013	2018-10-11	Sutherland Ave south side btn McFarland St & Syndicate	400
04-014	2018-10-09	Stephens St S btn Sutherland & Rover	29.9
04-015	2018-10-11	Syndicate St S btn Sutherland & Rover	210
04-016	2018-10-10	SE corner of ball park on Disraeli St at Rover Ave	26.4
04-017	2018-10-11	Stephens St SE corner at Sutherland Ave	236
04-018	2018-10-11	Sutherland Ave at SE corner McFarland St	150
04-018 D	2018-10-11	Sutherland Ave at SE corner McFarland St	168
04-019	2018-10-11	Sutherland Ave at SE corner Syndicate St	755
04-019 D	2018-10-11	Sutherland Ave at SE corner Syndicate St	885
04-020	2018-10-11	Sutherland Ave at SW corner Stephens St	278
04-021	2018-10-09	Sutherland Ave east of Angus	99.1
04-022	2018-10-09	Sutherland Ave W btn Stephens & Angus	25.4

- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria

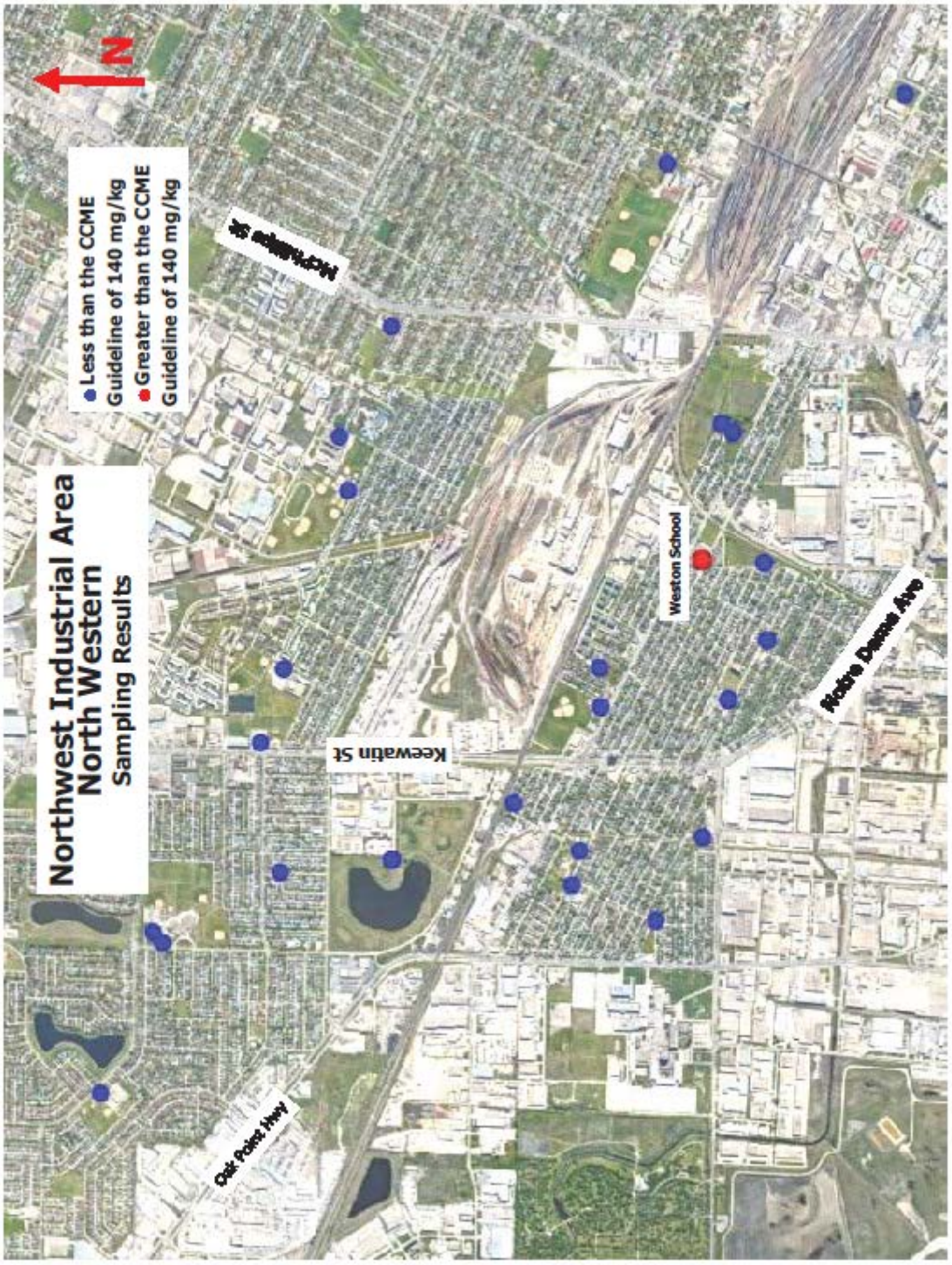


Map F.4: Sampling Results in North Point Douglas Residential Boulevards

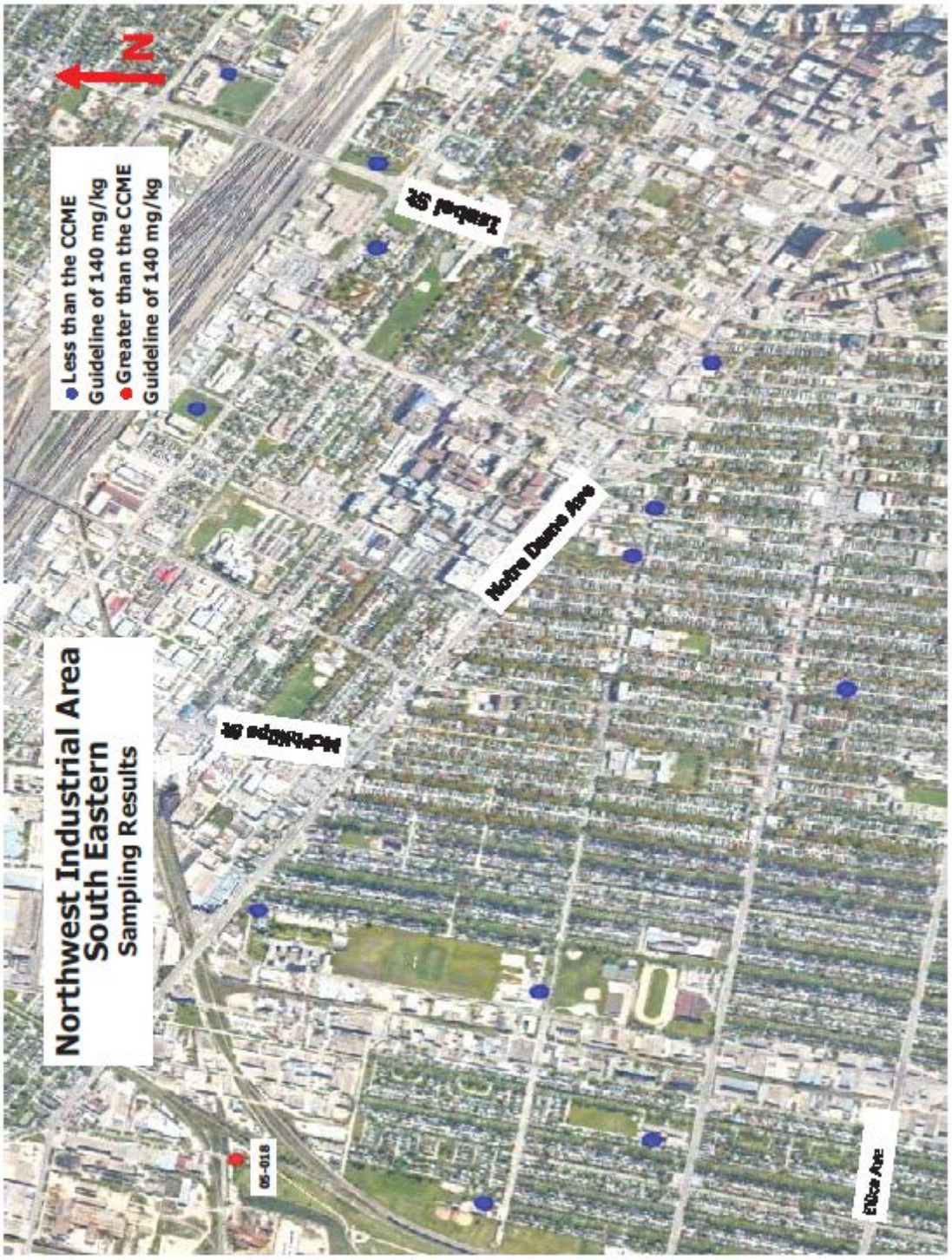
Table F.5: Lead in Soil Survey 2018 - Northwest Industrial Area

Sample Number	Date Sampled	Sample Location	Results [1] (mg/kg)
05-001	2018-10-10	Bannatyne Playground	58.6
05-002	2018-10-09	Bluebird Park	30.2
05-003	2018-10-19	Brooklands School	34.6
05-004	2018-10-09	Campion Tot Lot	72.1
05-005	2018-10-19	Cecil Rhodes School	86.9
05-005 D	2018-10-19	Cecil Rhodes School	85
05-006	2018-10-11	Clifton Community Centre	57.4
05-007	2018-10-19	Clifton School	90.3
05-008	2018-10-10	Eldon Ross Wading Pool	19.2
05-009	2018-10-10	Galmar Playground	95
05-010	2018-10-10	McPhillips Athletic Grounds	32
05-011	2018-10-09	Pascoe Park Playground	82
05-012	2018-10-09	Stanley Knowles Park	91.9
05-013	2018-10-10	Old Exhibition Grounds Sinclair Playground	53.2
05-014	2018-10-09	Weston Park	85.8
05-015 [2]	2018-10-19	Prince Charles Educational Resource Centre	52.4
05-016 [2]	2018-10-19	Technical Vocational High School	55.3
05-017	2018-10-11	Weston Memorial Community Centre	81.7
05-018	2018-10-11	Westview Park	439
05-019	2018-10-10	Woodsworth Park	45.6
05-019 D	2018-10-10	Woodsworth Park	52

- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria
- [2] Sample ID modified correct labelling error in the field sampling program



Map F.5: Sampling Results in Northwest Industrial Area (Northwestern)

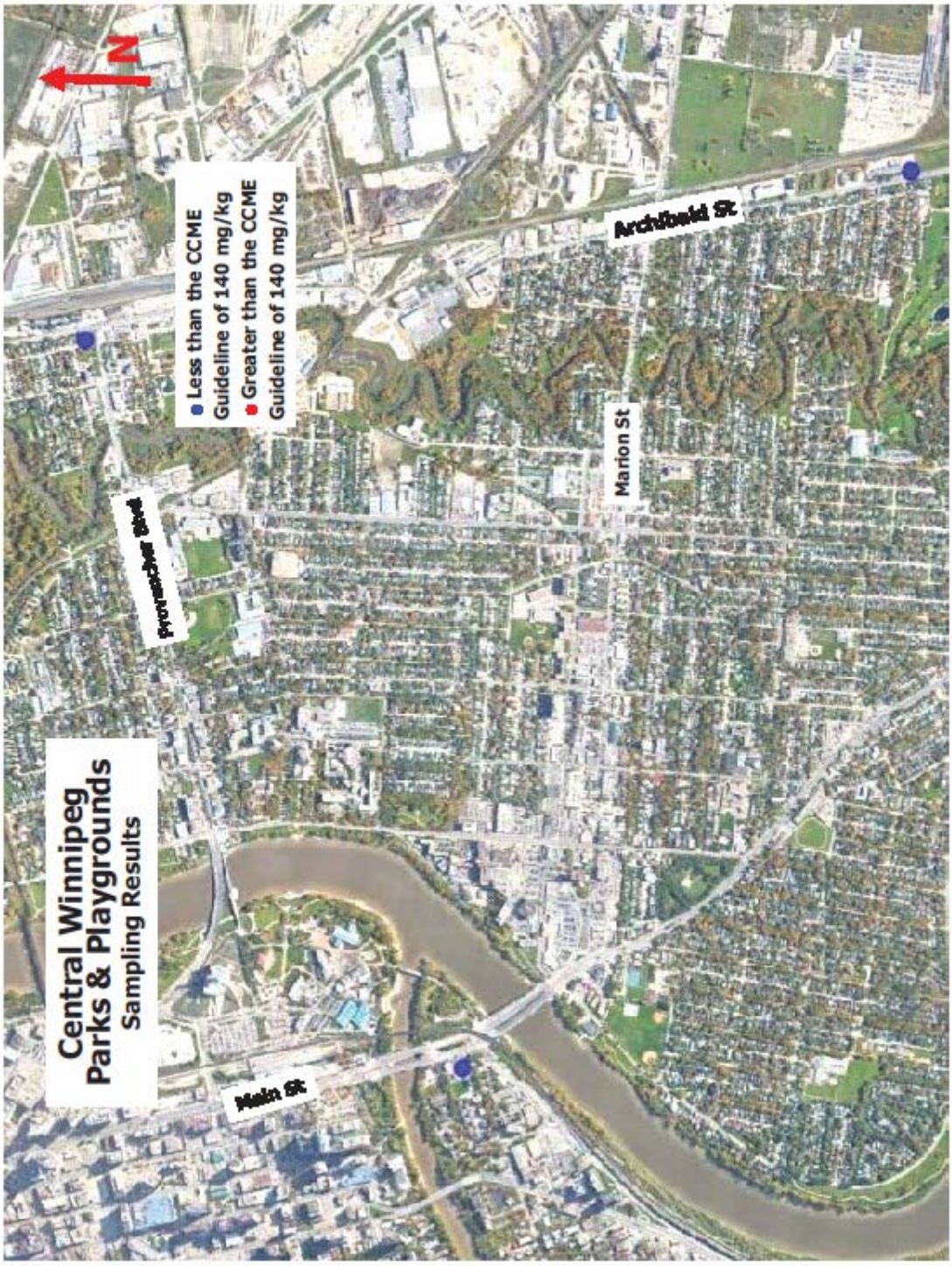


Map F.6: Sampling Results in Northwest Industrial Area (South Eastern)

Table F.6: Lead in Soil Survey – Schools and Parks and Playgrounds

Sample Number	Date Sampled	Sample Location	Results [1] (mg/kg)
06-001	2018-10-19	Gordon Bell High School	58.9
06-002	2018-10-11	Isaac Brock Community Centre	48.1
06-003	2018-10-10	Berwick Soccer/Ball diamond	102
06-004	2018-10-10	Hethrington Park	32.9
06-005	2018-10-10	Lord Roberts Community Centre	21.5
06-006	2018-10-19	Fort Rouge Elementary	14.6
06-007	2018-10-10	Hespeler Park	123
06-008	2018-10-19	Archwood School	18
06-008 D	2018-10-19	Archwood School	19.3
06-009	2018-10-10	Archibald Tot Lot	64
06-010	2018-10-10	Grace Street Tot Lot	119
06-011	2018-10-09	Point Douglas Park	141
06-012	2018-10-19	Garden Grove School	15.1
06-013	2018-10-10	Tyndall Park Community Centre	15.9
06-014	2018-10-19	Tyndall Park School	11.5
06-015	2018-10-10	Gainsborough Cove Park	33
06-016	2018-10-10	Shaughnessy Community Centre	19.8
06-017	2018-10-19	Shaughnessy Park School	36.3
06-018	2018-10-11	Northwood Community Centre	53
06-019	2018-10-19	Sisler High School	30.4
06-020	2018-10-19	Lord Nelson Elementary	75.1
06-021	2018-10-11	Spence Tot Lot	22.7
06-021 D	2018-10-11	Spence Tot Lot	26.6
06-022	2018-10-11	Home Playground	54.4
06-023	2018-10-11	Jacob Penner (Notre Dame Park)	83.1
06-024	2018-10-11	Maryland Tot Lot	136
06-025	2018-10-11	North Logan Park	39.2
06-025 D	2018-10-11	North Logan Park	36.1
06-026	2018-10-19	Dufferin Elementary-Daycare	38.7
06-027	2018-10-19	R.B. Russell Vocational High School	97.5
06-028	2018-10-11	Pioneer Arena Soccer Pitch	56.6
06-029	2018-10-19	Norquay School	79
06-030	2018-10-19	Dufferin Elementary – School field	59.8

- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria



Map F.7: Sampling Results in Schools and Parks and Playgrounds

Table F.7: Lead in Soil Survey 2018 - Weston Elementary School

Sample Number	Date Sampled	Sample Location	Results [1] (mg/kg)
Composite1	2018-10-05	Weston Elementary	198
WSA1	2018-10-05	Weston Elementary	271
WSA2	2018-10-05	Weston Elementary	446
WSA3	2018-10-05	Weston Elementary	224
WSA4	2018-10-05	Weston Elementary	201
WSA5	2018-10-05	Weston Elementary	96.3
WSB1	2018-10-05	Weston Elementary	114
WSB2	2018-10-05	Weston Elementary	239
WSB3	2018-10-05	Weston Elementary	183
WSB4	2018-10-05	Weston Elementary	120
WSB5	2018-10-05	Weston Elementary	203
WSC1	2018-10-05	Weston Elementary	199
WSC1 D	2018-10-05	Weston Elementary	219
WSC2	2018-10-05	Weston Elementary	189
WSC2 D	2018-10-05	Weston Elementary	259
WSC3	2018-10-05	Weston Elementary	119
WSC3 D	2018-10-05	Weston Elementary	117
WSC4	2018-10-05	Weston Elementary	225
WSC5	2018-10-05	Weston Elementary	171
WSD1	2018-10-05	Weston Elementary	375
WSD2	2018-10-05	Weston Elementary	184
WSE1	2018-10-05	Weston Elementary	372
WSE2	2018-10-05	Weston Elementary	151
WSF1	2018-10-05	Weston Elementary	342
WSF2	2018-10-05	Weston Elementary	180

- All samples collected at a depth of 7.5 cm
- "D" indicate the duplicate field sample
- [1] Results compared to The Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) Residential/Parkland Human Health guideline for lead in soil
- Shading indicates exceedance of CCME criteria
- "D" indicate the duplicate field sample

Map F.8: Sampling Results in Weston Elementary School

Appendix G

ANALYTICAL DATA FROM PREVIOUS STUDIES

AS PRESENTED IN

SAMPLING REPORT: SURFACE SOIL LEAD LEVELS IN WINNIPEG, MANIOBA 2007 AND 2008 - REPORT NO. 2009-03

(MANITOBA CONSERVATION, 2010)

Table G.1: Concentration of Lead in sod and soil samples in Wolseley/ Minto Neighbourhoods in 1983 and in 2007

2018 Sample Number	2007 TQ Site	1983 Site Number	Site Description	Pb in Surface Sod Layer (mg/kg)		Pb in top 5 cm of Soil under Sod Layer (mg/kg)	
				Sod 1983	Sod 2007	Soil 1983	Soil 2007
01-001	TQ0861	12	Garfield St. at Portage Ave.	620	54	800	22
01-002	TQ0859	10	Garfield St. at Westminster Ave.	360	42	200	25
01-003	TQ0860	11	Garfield St. btn Westminster & Portage	240	200	220	108
01-004	TQ0856	7	Greenwood Pl. at Portage Ave.	600	65	300	98
01-005	TQ0858	9	Greenwood Pl. at Wolseley Ave.	210	102	170	149
01-006	TQ0857	8	Greenwood Pl. btn Wolseley & Portage	180	28	160	34
01-007	TQ0867	20	Minto St. at Portage Ave.	150	22	30	60
01-008	TQ0869	22	Minto St. at Wolever Ave.	240	31	130	24
01-009	TQ0868	21	Minto St. btn Wolever & Portage	190	22	200	20
01-010	TQ0862	13	Sherburn St. at Portage Ave. (north)	680	92	700	21
01-011	n/s	n/s	Sherburn St. at Portage Ave. (south)	-	-	-	-
01-012	TQ0864	15	Sherburn St. at Westminster Ave.	450	27	320	9
01-013	TQ0866	17	Sherburn St. at Wolever Ave.	380	26	320	32
01-014	TQ0865	16	Sherburn St. btn Wolever & Portage	310	126	260	67
01-015	TQ0863	14	Sherburn St. btn Westminster & Portage	380	19	270	20
01-016	TQ0855	6	Sprague St. at Portage Ave.	800	13	1000	86
01-017	TQ0853	4	Sprague St. at Wolseley Ave.	220	17	160	35
01-018	TQ0854	5	Sprague St. btn Wolseley & Portage	200	82	220	182
			Average concentration of Pb (mg/kg)	**365**	**57**	**321**	**58**

n/s – no sample; *Shading indicates exceedance of CCME criteria

Table G.2: Concentration of Lead in sod and soil samples in Riverview/Lord Roberts Neighbourhoods in 1983 and in 2007

2018 Sample Number	2007 TQ Site	1983 Site Number	Site Description	Pb in Surface Sod Layer (mg/kg)		Pb in top 5 cm of Soil under Sod Layer (mg/kg)	
				Sod 1983	Sod 2007	Soil 1983	Soil 2007
02-001	TQ0841	15	Balfour Ave. at Hay St.	108	9	84	9
02-002	TQ0839	13	Osborne St. at Balfour Ave.	720	95	348	310
02-003	TQ0840	14	Balfour Ave. btn Osborne & Hay	84	73	144	23
02-004	TQ0838	9	Baltimore Rd. at Hay St.	108	23	48	28
02-005	TQ0836	7	Osborne St. at Baltimore Ave.	348	77	72	228
02-006	TQ0837	8	Baltimore Rd. btn Osborne & Hay	60	27	36	45
02-007	TQ0842	16	Hay St. at Clare Ave.	84	33	96	119
02-008	TQ0844	18	Osborne St. at Clare Ave.	816	36	528	45
02-009	TQ0843	17	Clare Ave. btn Osborne & Hay	192	29	456	35
02-010	TQ0846	20	Jubilee Ave. at Nassau St.	276	43	144	47
02-011	TQ0845	19	Jubilee Ave. btn Osborne & Nassau	600	40	640	41
02-012	TQ0851	29	Kylemore Ave. at Nassau St.	132	78	372	280
02-013	TQ0852	30	Kylemore Ave. btn Osborne & Nassau	312	34	216	45
02-014	TQ0835	3	Maplewood Ave. at Hay St.	168	15	108	23
02-015	TQ0833	1	Osborne St. at Maplewood Ave.	1044	109	348	131
02-016	TQ0834	2	Maplewood Ave. btn Osborne & Hay	144	39	84	39
02-017	TQ0849	25	Rathgar Ave. at Nassau St.	240	29	240	76
02-018	TQ0850	26	Rathgar Ave. btn Osborne & Nassau	372	67	252	56
02-019	TQ0847	21	Rosedale Ave. at Nassau St.	384	21	240	13
02-020	TQ0848	22	Rosedale Ave. btn Osborne & Nassau	348	17	288	34
			Average concentration of Pb (mg/kg)	**327**	**45**	**237**	**81**

*Shading indicates exceedance of CCME criteria

Table G.3: Concentration of Lead in sod and soil samples in Glenelm/Chalmers Neighbourhoods in 1983 and in 2007

2018 Sample Number	2007 TQ Site	1983 Site Number	Site Description	Pb in Surface Sod Layer (mg/kg)		Pb in top 5 cm of Soil under Sod Layer (mg/kg)	
				Sod 1983	Sod 2007	Soil 1983	Soil 2007
03-001	TQ0886	7	Cobourg Ave. at Beatrice St.	280	56	290	107
03-002	TQ0888	9	Cobourg Ave. at Henderson Hwy	700	75	480	343
03-003	TQ0887	8	Cobourg Ave. btn Henderson & Beatrice	180	42	140	23
03-004	TQ0889	13	Hart Ave. at Beatrice St.	10	45	90	63
03-005	TQ0891	15	Hart Ave. at Henderson Hwy	70	191	40	369
03-006	TQ0890	14	Hart Ave. btn Henderson & Beatrice	10	49	40	81
03-007	TQ0894	18	Hespeler Ave. at Beatrice St.	980	22	410	22
03-008	TQ0892	16	Hespeler Ave. at Henderson Hwy	1600	34	580	347
03-009	TQ0893	17	Hespeler Ave. btn Henderson & Beatrice	900	30	450	84
03-010	TQ0899	29	McIntosh Ave. at Brazier St.	340	29	450	21
03-011	TQ0898	28	McIntosh Ave. btn Henderson & Brazier	260	32	20	34
03-012	TQ0884	2	Martin Ave. W. west of Henderson Hwy	300	37	370	29
03-013	TQ0883	1	Martin, Ave. W. at Beatrice St.	310	20	310	19
03-014	TQ0897	21	Martin Ave. W. at Brazier St.	30	95	80	114
03-015	TQ0896	20	Martin Ave. W. at Henderson Hwy (east blvd)	420	62	440	160
03-016	TQ0895	19	Martin Ave. W. at Henderson Hwy (west blvd)	710	26	700	24
03-017	TQ0885	3	Martin Ave. W. at Henderson Hwy (east of Henderson Hwy)	660	28	530	20
			Average concentration of Pb (mg/kg)	**456**	**51**	**319**	**109**

*Shading indicates exceedance of CCME criteria

Table G.4: Concentration of Lead in sod and soil samples in North Point Douglas Neighbourhoods in 1988 and in 2007

2018 Sample Number	2007 TQ Site	1988 Site Number	Site Description	Pb in Sod / Soil (mg/kg)	
				Sod/Soil 1988	Sod/Soil 2007
04-001	TQ0914	19	East Sutherland btn Stephens & Angus	4650	104
04-002	TQ0915	24	Middle Angus St. btn Sutherland & rail line	1200	2240
04-003	TQ0921	32	Middle Disraeli St. btn Sutherland & Rover	310	32
04-004	TQ0910	15	Middle Stephens St. btn Sutherland & rail line	770	593
04-005	TQ0907	12	Middle Stephens St. btn Sutherland & Rover	360	105
04-006	TQ0904	6	Middle Syndicate St. btn Sutherland & Rover	290	81
04-007	TQ0919	30	NE corner Sutherland Ave. at Disraeli St.	1110	119
04-008	TQ0906	8	NE corner Syndicate St. at Sutherland Ave.	520	492
04-009	TQ0909	14	NW corner Stephens St. at Sutherland Ave.	82	235
04-010	TQ0916	25	South end Angus St. near rail line	2300	1170
04-011	TQ0920	31	South end Disraeli St. between Sutherland & Rover	353	31
04-012	TQ0911	16	South end Stephens St. near rail line	960	367
04-013	TQ0901	2	South side Sutherland Ave. btn Madeline & Syndicate	2270	800
04-014	TQ0908	13	South Stephens St. btn Sutherland & Rover	240	156
04-015	TQ0905	7	South Syndicate St. btn Sutherland & Rover	440	212
04-016	TQ0922	33	SE corner of ball park on Disraeli btn Sutherland & Rover	510	202
04-017	TQ0912	17	SE corner Stephens St. at Sutherland Ave.	1150	666
04-018	TQ0900	1	SE corner Madeline St. at Sutherland Ave.	550	444
04-019	TQ0902	4	SE corner Syndicate St. at Sutherland Ave.	1500	1120
04-020	TQ0903	5	SW corner Stephens St. at Sutherland Ave.	220	649
04-021	TQ0917	34	Sutherland Ave. east of Angus	480	181
04-022	TQ0913	18	West Sutherland btn Stephens & Angus	3040	605
-	TQ0918	35	Sutherland Ave. east of Angus	260	165
			Average concentration of Pb (mg/kg)	**1024.6**	**468.2**

*Shading indicates exceedance of CCME criteria

Table G.5: Concentration of Lead in sod and soil samples Weston Elementary School sports field in 1981 and in 2007

2018 Sample Number	2007 TQ Site	Historic Site Number	Distance from Logan Ave. fence (m)	Pb in Surface Sod Layer (mg/kg)		Pb in top 5 cm of Soil under Sod Layer (mg/kg)	
				1981	2007	1981	2007
WSA1	TQ0729	A1	0	1700	n/s	450	113
WSA2	TQ0730	A2	15	690	389	190	685
WSA3	TQ0731	A3	30	560	195	370	380
WSA4	TQ0732	A4	46	940	146	190	228
WSA5	TQ0733	A5	61	710	89	60	168
WSB1	TQ0734	B1	0	1300	89	70	126
WSB2	TQ0735	B2	15	820	907	200	583
WSB3	TQ0736	B3	30	650	458	100	420
WSB4	TQ0737	B4	46	580	328	130	235
WSB5	TQ0738	B5	61	670	187	120	355
WSC1	TQ0739	C1	0	1500	183	100	1130
WSC2	TQ0740	C2	15	770	113	190	514
WSC3	TQ0741	C3	30	500	497	160	720
WSC4	TQ0742	C4	46	560	499	130	397
WSC5	TQ0743	C5	61	510	169	70	315
WSD1	TQ0744	D1	0	1500	113	280	839
WSD2	TQ0745	D2	15	1200	815	130	453
WSE1	TQ0746	E1	0	1700	260	260	610
WSE2	TQ0747	E2	15	1100	503	330	629
WSF1	TQ0748	F1	0	1400	212	200	461
WSF2	TQ0749	F2	15	1200	430	310	363

n/s – no sample; *Shading indicates exceedance of CCME criteria

Table G.6: Concentration of Lead in samples collected from sites in Winnipeg School yards in 1983 and in 2007

School yard	2007 TQ Site	Historic site number	Lead concentration (mg/kg)		Type of material sampled in 2007
			1983	2007	
Archwood Elementary	TQ0718	A1	110	5	aggregate particles on paved surface
	TQ0719	A2	360	28	aggregate particles on paved surface
	TQ0720	A3	530	27	aggregate particles on paved surface
	TQ0721	A4	570	31	soil & dust particles on paved surface
	TQ0722	A7	520	26	soil & dust particles on paved surface
	TQ0723	A8	610	32	aggregate particles on paved surface
	TQ0724	A9	530	27	aggregate particles on paved surface
	TQ0725	A10	430	27	aggregate particles on paved surface
	TQ0726	A13	230	24	aggregate particles on paved surface
	TQ0727	A14	130	19	aggregate particles on paved surface
	TQ0728	-	-	6	composite pea gravel sample
Lord Nelson Elementary	TQ0700	LN1	1500	73	mix of sod and soil
	TQ0701	LN2	2300	126	soil
	TQ0702	LN3	1600	15	sod
	TQ0703	LN4	2000	176	soil
	TQ0704	LN5	1250	62	soil & dust particles on paved surface
	TQ0705	LN6	1100	64	soil & dust particles on paved surface
	TQ0706	LN7	1750	66	soil
	TQ0707	LN8	430	131	soil
	TQ0708	LN9	790	51	aggregate particles on paved surface
	TQ0709	LN10	330	78	aggregate particles on paved surface
	TQ0710	LN11	400	85	aggregate particles on paved surface
	TQ0711	LN12	400	15	sod
	TQ0712	LN13	205	51	aggregate particles on paved surface
	TQ0713	LN14	560	99	aggregate particles on paved surface
	TQ0714	LN16	2400	105	soil
Gordon Bell High	TQ0782	GB1	950	129	mix of sod and soil
	TQ0783	GB2	310	74	aggregate particles on paved surface
	TQ0784	GB3	435	114	mix of sod and soil
	TQ0785	GB4	440	72	mix of sod and soil
	TQ0786	GB5	440	85	mix of sod and soil
	TQ0787	GB6	330	86	aggregate particles on concrete surface
	TQ0788	GB7	510	101	aggregate particles on concrete surface
	TQ0789	GB8	1100	96	aggregate particles on concrete surface

School yard	2007 TQ Site	Historic site number	Lead concentration (mg/kg)		Type of material sampled in 2007
			1983	2007	
	TQ0790	GB9	440	151	aggregate particles on concrete surface
	TQ0791	GB11	1900	290	aggregate particles on concrete surface
	TQ0792	GB12	1300	104	mix of sod and soil
	TQ0793	GB13	1050	144	sod
	TQ0794	GB14	1550	140	sod
Dufferin Elementary	TQ0758	D1	1100	185	mix of sod and soil
	TQ0759	D2	1100	228	sod
	TQ0760	D3	1400	48	sod
	TQ0761	D4	980	107	sod
	TQ0762	D5	1050	19	mix of sod and soil
	TQ0763	D6	970	21	mix of sod and soil
	TQ0764	D7	850	25	mix of sod and soil
	TQ0765	D8	610	153	mix of sod and soil
	TQ0766	D10	1200	238	soil & dust particles on paved surface
	TQ0767	D11	930	307	soil & dust particles on paved surface
	TQ0768	D13	n/a	89	soil & dust particles on paved surface
	TQ0769	D14	555	62	soil & dust particles on paved surface
	TQ0770	D15	950	18	soil & dust particles on paved surface
	TQ0771	D16	800	39	soil & dust particles on paved surface
Fort Rouge Elementary	TQ0772	FR5	1850	69	aggregate particles on paved surface
	TQ0773	FR6	900	204	aggregate particles on paved surface
	TQ0774	FR7	1200	43	mix of sod and soil
	TQ0775	FR8	1300	36	mix of sod and soil
	TQ0776	FR9	630	43	mix of sod and soil
	TQ0777	FR10	780	17	sod
	TQ0778	FR11	870	20	sod
	TQ0779	FR12	840	19	sod
	TQ0780	FR13	1010	19	sod
	TQ0781	FR14	830	134	aggregate particles on pavement surface
Weston Elementary	TQ0750	1	2200	92	aggregate particles on concrete surface
	TQ0751	3	3200	99	mix of sod and soil
	TQ0752	5	3800	82	sod
	TQ0753	6	2300	116	sod
	TQ0754	8	2500	86	aggregate particles on concrete surface
	TQ0755	10	4800	102	mix of sod and soil
	TQ0756	12	2800	50	sod

School yard	2007 TQ Site	Historic site number	Lead concentration (mg/kg)		Type of material sampled in 2007
			1983	2007	
	TQ0757	14	2500	46	sod
Tyndall School	TQ0715	-	n/s	125	aggregate particles on paved surface
	TQ0716	-	n/s	3	sand from sand box
	TQ0717	1	60	12	sod
Average concentration of Pb (mg/kg)			**1125**	**82**	

*Shading indicates exceedance of CCME criteria

Table G.7: Concentration of Lead in samples collected from sites in Winnipeg Playgrounds in 1984 and in 2007

Playground	2007 TQ Site	1984 Site Number	Pb in Surface Sod Layer (mg/kg)		Pb in top 5 cm of Soil under Sod Layer (mg/kg)		Pb in Sand-Aggregate Layer (mg/kg)		Comments
			1983	2007	1983	2007	1983	2007	
Archibald Tot Lot	TQ0795	1	190	124	160	241	-	-	sod layer over soil
	TQ0796	2	270	129	165	179	-	-	sod layer over soil
	TQ0797	3	395	143	295	258	-	-	sod layer over soil
	TQ0798	4	-	-	-	-	30	6	sand
	TQ0799	5	195	58	110	57	-	-	sod layer over soil
	TQ0800	6	110	75	150	83	-	-	sod layer over soil
	TQ0801	composite	-	115	-	-	-	-	mainly sod with some sand
Hespeler Park	TQ0803	1	330	94	235	74	-	-	sod layer over soil
	TQ0804	2	no sod	no sod	240	54	-	-	soil only, no sod layer
	TQ0805	3	140	32	120	61	-	-	sod layer over soil
	TQ0806	4	-	-	-	-	35	5	sand,
	TQ0807	5	-	-	-	-	15	3	sand,
	TQ0808	6	200	41	100	51	-	-	sod layer over soil
	TQ0809	7	-	-	-	-	50	13	sand in 1984, pea gravel in 2007
	TQ0810	composite	-	61	-	-	-	-	mainly sod with some sand
Home Playground	TQ0870	5	200	105	170	189	-	-	sod layer over soil
	TQ0871	6	110	36	130	58	-	-	sod layer over soil
	TQ0872	7	80	21	80	30	-	-	sod layer over soil
	TQ0873	8	170	199	160	212	-	-	sod layer over soil
	TQ0874	composite	-	63	-	-	-	-	mainly sod with some sand
Jacob Penner (Notre Dame Park)	TQ0875	1	no sod	no sod	190	140	-	-	soil only, no sod layer
	TQ0876	2	no sod	no sod	30	113	-	-	soil only, no sod layer
	TQ0877	3	100	58	125	93	-	-	sod layer over soil
	TQ0878	4	-	-	-	-	30	81	gravel in 1984, bare soil in 2007
	TQ0879	6	60	50	70	69	-	-	sod layer over soil
	TQ0880	7	60	58	70	90	-	-	sod layer over soil
	TQ0881	8	-	-	-	-	30	3	sand

Playground	2007 TQ Site	1984 Site Number	Pb in Surface Sod Layer (mg/kg)		Pb in top 5 cm of Soil under Sod Layer (mg/kg)		Pb in Sand-Aggregate Layer (mg/kg)		Comments
			1983	2007	1983	2007	1983	2007	
	TQ0882	9	105	101	165	339	-	-	sod layer over soil
Maryland Tot Lot	TQ0822	1	345	207	155	237	-	-	sod layer over soil
	TQ0823	2	310	115	125	156	-	-	sod layer over soil
	TQ0824	3	-	-	-	-	180	115	sand/gravel
	TQ0825	4	-	-	-	-	95	33	sand
	TQ0826	5	-	-	-	-	120	34	sand/gravel
	TQ0827	6	-	-	-	-	50	19	sand
	TQ0828	7	-	-	-	-	30	2	sand
	TQ0829	8	-	-	-	-	170	21	sand
	TQ0830	9	285	341	120	436	-	-	sod layer over soil
	TQ0831	10	155	142	145	268	-	-	sod layer over soil
	TQ0832	composite	-	100	-	-	-	-	mainly sod with some sand
Spence Tot Lot	TQ0811	1	380	113	320	214	-	-	sod layer over soil in 1984, no sod in 2007
	TQ0812	2	245	no sod	300	48	-	-	sod layer over soil
	TQ0813	3	500	18	450	24	-	-	sod layer over soil
	TQ0814	4	-	-	-	-	50	39	sand in 1984 and 2007
	TQ0815	5	-	-	-	-	40	40	sand in 1984 and 2007
	TQ0816	6	360	33	335	30	-	-	sod layer over soil
	TQ0817	7	-	-	-	-	260	35	sandy soil in 1984, sand in 2007
	TQ0818	8	-	-	-	-	230	39	sand/gravel in 1984, sand in 2007
	TQ0819	9	680	712	740	429	-	-	sod layer over soil
	TQ0820	10	600	201	640	320	-	-	sod layer over soil
	TQ0821	composite	-	88	-	-	-	-	mainly sod with some sand

*Shading indicates exceedance of CCME criteria

Table G.8: Results for samples collected during the 2008 sampling program in Winnipeg

Sample Number 2018	Sample Number 2008	Site Description	Pb in Sod / Soil (mg/kg)
			2008
05-001	TQ0967	Bannatyne Playground sod area, Bannatyne Ave.	59.8
05-001	TQ0968	Bannatyne Playground sandbox, Bannatyne Ave.	2.8
05-001	TQ0969	Bannatyne Playground play structure/slide, Bannatyne Ave.	39.3
05-002	TQ0964	Bluebird Park sod area, Oddy St.	48.2
05-002	TQ0965	Bluebird Park play structure, Oddy St.	14
05-004	TQ0953	Campion Tot Lot sod area, William Ave. W	56.2
05-004	TQ0954	Campion Tot Lot W swing, area, William Ave. W	17
05-004	TQ0955	Campion Tot Lot W play structure, William Ave. W	15.6
05-006	TQ1007	Clifton Community Centre N soccer pitch, Wellington Ave. & Strathcona St.	54
05-006	TQ1008	Clifton Community Centre S soccer pitch, Wellington Ave. & Strathcona St.	70.3
05-006	TQ1009	Clifton Community Centre Playground/Pool sod area, Wellington Ave. & Strathcona St.	94.9
05-006	TQ1010	Clifton Community Centre Playground/Pool play structure, Wellington Ave. & Strathcona St.	13.3
05-006	TQ1011	Clifton Community Centre Playground Sandbox, Wellington Ave. & Strathcona St.	2.2
05-006	TQ1012	Clifton Community Centre Playground/Pool S swing area, Wellington Ave, & Strathcona St.	12
05-006	TQ1013	Clifton Community Centre N ball diamond infield, Wellington Ave. & Strathcona St.	3.8
05-006	TQ1014	Clifton Community Centre N ball diamond outfield, Wellington Ave. & Strathcona St.	16.4
05-006	TQ1015	Clifton Community Centre S ball diamond infield, Wellington Ave. & Strathcona St.	3.6
05-006	TQ1016	Clifton Community Centre S ball diamond outfield, Wellington Ave. & Strathcona St.	16.9
05-008	TQ0972	Eldon Ross Wading Pool sod area, Alexander Ave.	33.8
05-008	TQ0973	Eldon Ross Wading Pool sandbox, Alexander Ave.	4
05-009	TQ0970	Galmar Playground sod area, Midmar Ave.	65.2
05-009	TQ0971	Galmar Playground sandbox, Midma, Ave.	19.7
05-010	TQ0941	McPhillips Athletic Grounds west ball diamond infield	15.2
05-010	TQ0942	McPhillips Athletic Grounds west/east ball diamond outfield	89.7
05-010	TQ0943	McPhillips Athletic Grounds east ball diamond infield	9.9
05-010	TQ0944	McPhillips Athletic Grounds soccer pitch	23.7
05-010	TQ0945	McPhillips Athletic Grounds football field	22.7
05-011	TQ0946	Pascoe Park ball diamond infield, Pacific Ave. & Pascoe St.	31.8
05-011	TQ0947	Pascoe Park soccer pitch, Pacific Ave & Pascoe St.	97.7
05-011	TQ0948	Pascoe Park Playground sod area, Jordain St.	62.6
05-011	TQ0949	Pascoe Park Playground play structure, Jordain St.	11.5

Sample Number 2018	Sample Number 2008	Site Description	Pb in Sod / Soil (mg/kg)
			2008
05-011	TQ0950	Pascoe Park Playground S swing area, Jordain St.	9.1
05-011	TQ0951	Pascoe Park Playground teeter totter area, Jordain St.	16.8
05-011	TQ0952	Pascoe Park Playground N swing area, Jordain St.	10.2
05-012	TQ0937	Stanley Knowles Park west sod area, Logan Ave.	**161**
05-012	TQ0938	Stanley Knowles Park east sod area, Logan Ave.	87.8
05-012	TQ0939	Stanley Knowles Park swing area, Logan Ave.	5.9
05-012	TQ0940	Stanley Knowles Park sandbox, Logan Ave.	2.9
05-013	TQ0931	Old Exhibition Grounds Sinclair Playground sod area, Sinclair Ave.	36
05-013	TQ0932	Old Exhibition Grounds Sinclair Playgroun, swing area, Sinclair Ave.	4.2
05-013	TQ0933	Old Exhibition Grounds Sinclair Playground swing, area, Sinclair Ave.	9.9
05-013	TQ0934	Old Exhibition Grounds Sinclair Playground sandbox, Sinclair Ave.	15.1
05-013	TQ0935	Old Exhibition Grounds SW ball diamond outfield	21
05-013	TQ0936	Old Exhibition Grounds SW ball diamond infield	7.7
05-014	TQ0959	Weston Park sod area near Logan Ave.	117
05-014	TQ0960	Weston Park E swing area, Logan Ave.	24.6
05-014	TQ0961	Weston Park sandbox, Logan Ave.	2.2
05-014	TQ0962	Weston Park W swing area, Logan Ave.	25.7
05-014	TQ0963	Weston Park sod/sand play area, Logan Ave.	40.1
05-017	TQ0956	Weston Memorial Community Centre soccer pitch, Logan Ave.	12.6
05-017	TQ0957	Weston Memorial Community Centre football field, Logan Ave.	62.7
05-017	TQ0958	Weston Memorial Community Centre ball diamond infield, Logan Ave.	3.3
05-018	TQ0991	Westview Park south entrance sod area, Empress St. & Wellington	**208**
05-018	TQ0992	Westview Park top of slope, south end sod area	**368**
05-018	TQ0993	Westview Park top of slope, north end sod area	**356**
05-019	TQ0974	Woodsworth Park northwest ball diamond infield, Heckla Ave.	3.4
05-019	TQ0975	Woodsworth Park northwest ball diamond outfield, Heckla Ave.	61.5
05-019	TQ0976	Woodsworth Park soccer pitch, Park Lane Ave.	115
06-002	TQ0990	Isaac Brock Community Centre N soccer pitch, Tefler St. N	23.1
06-003	TQ0983	Berwick soccer pitch, Argue St.	7.3
06-003	TQ0984	Berwick ball diamond infield, Argue St.	4.8
06-003	TQ0985	Berwick ball diamond outfield, Argue St.	55.6
06-004	TQ0986	Hetherington Park sod area, Hetherington Ave. & Daly St. S	21.4
06-004	TQ0987	Hetherington Park play structure, Hetherington Ave. & Daly St. S	3.7

Sample Number 2018	Sample Number 2008	Site Description	Pb in Sod / Soil (mg/kg)
			2008
06-005	TQ0988	Lord Roberts Community Centre ball diamond infield, Kylemore Ave.	4.4
06-005	TQ0989	Lord Roberts Community Centre ball diamond outfield, Kylemore Ave.	9.7
06-010	TQ0923	Grace Playground sod area, Grace St., South Point Douglas	128
06-010	TQ0924	Grace Playground sandbox, Grace, St., South Point Douglas	3.9
06-010	TQ0925	Grace Playground swing area, Grace St., South Point Douglas	27.9
06-013	TQ0977	Tyndall Park Community Centre sod area, Manitoba Ave.	57.2
06-013	TQ0978	Tyndall Park Community Centre sandbox, Manitoba Ave.	3.2
06-013	TQ0979	Tyndall Park Community Centre play structure, Manitoba Ave.	10.8
06-013	TQ1000	Tyndall Park Community Centre SE soccer pitch, backlane N side Tyndall Ave.	54.9
06-013	TQ1001	Tyndall Park Community Centre SW ball diamond infield, King Edward St.	2.5
06-013	TQ1002	Tyndall Park Community Centre SW ball diamond outfield, King Edward St.	21.8
06-013	TQ1003	Tyndall Park Community Centre (Garden Grove) soccer pitch, Burrows Ave.	7.4
06-013	TQ1004	Tyndall Park Community Centre (Garden Grove) ball diamond infield, Burrows Ave.	2.4
06-013	TQ1005	Tyndall Park Community Centre (Garden Grove) Playground play structure, Burrows Ave.	6.8
06-013	TQ1006	Tyndall Park Community Centre (Garden Grove) Playground sandbox, Burrows Ave.	2.9
06-015	TQ0980	Gainsborough Cove Park sod area, Gainsborough Cove	37.5
06-015	TQ0981	Gainsborough Cove Park sandbox, Gainsborough Cove	3
06-015	TQ0982	Gainsborough Cove Park slide, Gainsborough Cove,	4.6
06-016	TQ0994	Shaughnessy Community Centre SW soccer pitch, Tefler St. N	26.2
06-018	TQ0995	Northwood Community Centre ball diamond infield, Burrows Ave.	3.2
06-018	TQ0996	Northwood Community Centre ball diamond outfield, Burrows Ave.	66.8
06-018	TQ0997	Northwood Community Centre Playground play structure, Burrows Ave.	3.8
06-018	TQ0998	Northwood Community Centre Playground sandbox, Burrows Ave.	2.4
06-018	TQ0999	Northwood Community Centre Playground sod area, Burrows Ave.	34.3
06-025	TQ0926	Playground sod area, Logan Ave. & Salter St. (North Logan Park)	40
06-025	TQ0927	Playground swing area, Logan Ave. & Salter St.	8.7
06-028	TQ0930	Pioneer Arena soccer pitch, Logan Ave.	60.3
-	TQ0928	Habitat Playground sod area, b/w Jarvis Ave. & Dufferin	58.7
-	TQ0929	Habitat Playground play structure, b/w Jarvis Ave. & Dufferin	56.7

Appendix H

PHOTOGRAPHS SHOWING AN OVERVIEW OF THE SAMPLING LOCATIONS

Appendix H.1: Parks, Playgrounds and Schools

Photo 1: Spence Tot Lot , 636 Spence St

Photo 2: Home Playground, 772 Sargent Ave

Photo 3: Isaac Brock Community Centre , 715 Telfer St N

Photo 4: Jacob Penner Park, 659 Wellington Ave

Photo 5: Norquay School, 132 Lusted Ave

Photo 6: Archwood School, 800 Archibald St

Appendix H.1: Parks, Playgrounds and Schools

Photo 7: Bannatyne Playground, 1816 Bannatyne Ave N

Photo 8: Bluebird Park, Oddy St

Photo 9: Campion Tot Lot, 1436 William Ave

Photo 10: Pascoe Park, 155 Jordan St

Photo 11: Stanley Knowles Park, 1235 Logan Ave

Photo 12: Weston Park, 299 Lock St

Photo 13: Old Exhibition Grounds, 80 Sinclair St

Photo 14: McPhillips Athletic Grounds, 2015 Bawlf St

Photo 15: Galmar Playground, 1839 Midmar Ave

Photo 16: Woodsworth Park, 1850 Hekla Ave

Photo 17: Eldon Ross Wading Pool, 1887 Pacific Ave

Photo 18: Westview Park, 1265 Empress St

Appendix H.1: Parks, Playgrounds and Schools

Photo 19: Clifton Community Centre, 1315 Strathcona St

Photo 20: Weston Memorial Community Centre, 1625 Logan Ave

Photo 21: Cecil Rhodes School, 1570 Elgin Ave

Photo 22: Fort Rouge Elementary, 115 River Ave

Photo 23: Brooklands School, 1950 Pacific Ave W

Photo 24: Hespeler Park, 25 Hespeler Ave

Appendix H.1: Parks, Playgrounds and Schools

Photo 25: Shaughnessy Community Centre, Manitoba at Keewatin

Photo 26: Shaughnessy Park School, 1641 Manitoba Ave

Photo 27: Northwood Community Centre, 1415 Burrows Ave

Photo 28: Sisler High School, 1360 Redwood Ave

Photo 29: Lord Nelson Elementary, 820 McPhillips St

Photo 30: Maryland Tot Lot, Maryland & Wellington

Appendix H.1: Parks, Playgrounds and Schools

Photo 31: North Logan Park, Logan & Salter

Photo 32: R.B. Russel School, 364 Dufferin Ave

Photo 33: Pioneer Arena, 799 Logan Ave

Photo 34: Dufferin Elementary Garden, 545 Alexander Ave

Photo 35: Dufferin Elementary Field, 545 Alexander Ave

Photo 36: Gordon Bell High School, 3 Borrowman Place

Appendix H.1: Parks, Playgrounds and Schools

Photo 37: Berwick Soccer Pitch, Berwick and Argue St

Photo 38: Lord Roberts Community Centre, 725 Kylemore Ave

Photo 39: Hethrington Park, 615 Hethrington Ave

Photo 40: Tyndall Park Community Centre, 2255 King Edward St

Photo 41: Gainsborough Cove Park, Gainsborough Cove

Photo 42: Clifton School, 1070 Clifton Ave

Appendix H.1: Parks, Playgrounds and Schools

Photo 43: Prince Charles Education Centre, 1075 Wellington Ave

Photo 44: Technical Vocational School, 1555 Wall St

Photo 45: Gardon Grove School, 2340 Burrows Ave

Photo 46: Tyndall Park School 2221 King Edward St

Photo 47: Archibald Tot Lot, Mission & Archibald

Photo 48: Grace St Tot Lot, Grace St & Dewdney

Appendix H.1: Parks, Playgrounds and Schools

Photo 49: Point Douglas Park, Stadacona & Sutherland

Appendix H.2– Photos of Representative Residential Boulevards for Each Neighbourhood Sampled

Photo 1: Wolseley /Minto Neighbourhood

Photo 2: Riverview/Lord Roberts Neighbourhood

Photo 3: Glenelm/Chalmers Neighbourhoods

Photo 4: North Point Douglas Neighbourhood