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REPORT ON

TOWN OF FALCONBRIDGE
SOIL SAMPLING PROGRAM
COMPREHENSIVE FALCONBRIDGE SURVEY

Submitted to:

Falconbridge Limited
Sudbury Smelter Business Unit
Falconbridge, Ontario
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EXECUTIVE SUMMARY

Falconbridge Limited (Falconbridge) has initiated a program to assess the environmental significance of metals in soils on lands adjacent to and beyond Falconbridge's smelter located in the City of Greater Sudbury, Ontario. The initial activity of this program consisted of soils collection and analysis, the results of which are provided in this report. Future program activities will include a comprehensive review of all metals data, including those collected over the past 30 years by the Ontario Ministry of the Environment (MOE), an assessment of the degree to which these metals are available for uptake by plants and animals and potentially therefore by local residents, coupled with an active program of community consultation. This program is currently being developed by Falconbridge.

Golder Associates Ltd. (Golder) was retained by Falconbridge to conduct the soils sampling activities and prepare this report. This sampling program was developed with input from the Ministry of the Environment to ensure consistency with previous soils programs conducted within the Sudbury Basin. The MOE identified all procedures relating to sample collection, sample preparation and laboratory analyses. At the request of the MOE, Laurentian University was retained to prepare the soil samples for laboratory analysis and Lakefield Research Ltd. were retained to conduct all chemical analyses. The MOE provided quality assurance of these activities.

Soils were collected from 33 locations chosen as representative of lands owned either by Falconbridge or Inco, public lands within the Town of Falconbridge, and of undisturbed lands within 2 km of the town. Sampled sites included parks, wooded areas, residential yards, a school, playgrounds, grassy areas, vacant lots, gravel lots and grass medians. At each location, soils were collected from approximately 15 to 30 discrete points and then sectioned over 3 depth intervals; from 0 - 5 cm, 5 - 10 cm and 10 - 20 cm. A second set of soil cores was collected at each sample location. Consistent with MOE procedures, this second sample is identified as a 'duplicate'. The general land use at each sample location was noted and the possible use of fertilizer identified. Each sample location was photographed.

All samples were prepared for analysis by Laurentian University, using the same protocol as used previously for samples collected elsewhere in the Sudbury Basin by the MOE. Each sample was completely air dried at room temperature, twigs, stones and aggregated matter were removed and the sample passed through a 20 mm sieve. A portion of the sieved sample was ground to pass through a 355µm sieve and placed in a glass jar.

The prepared samples were then forwarded to the Environmental Analytical Services Division of Lakefield Research Ltd. for analysis. The analytical methodology and the metals parameter list were determined by the MOE, again to be consistent with earlier soils programs completed by the

MOE. Approximately 0.5 g of homogenized sample was acidified, heated in a MARS 5 MAW2 microwave oven, diluted with deionized water, and analysed by Inductively Coupled Plasma Optical Emission Spectrometer. This parameter list consisted of 20 metals including arsenic, cobalt, copper and nickel as well as pH, carbonate, total inorganic carbon and electrical conductivity.

The observed concentrations in soils range up to 297 µg/g for arsenic, 150 µg/g for cobalt, 1,600 µg/g for copper and 1,600 µg/g for nickel. The distribution of metals concentrations does not show a trend with distance from the smelter stack or with depth. The metals concentrations in some duplicate samples also display obvious variations. The data obtained indicate that the metals concentrations in soil vary substantially both laterally and with depth.

The results obtained from this program were compared with the generic soil criteria developed by the Ministry of the Environment in the "Guideline for Use at Contaminated Sites in Ontario" (1997) to provide a preliminary assessment of the significance of the observed metals concentrations. Of the 20 metals analysed, the concentrations of four metals, arsenic, cobalt, copper and nickel exceeded generic soil criteria at some locations. It is to be noted that generic soil criteria were developed for soils with pH values in the range of 5 to 9. The observed pH in soil includes some values in the pH range of 4 and, as such, lies outside the range considered for generic soil criteria development. Site specific soil criteria may therefore need to be developed and applied to assess the environmental significance of metals in soils at Falconbridge. In addition, the Sudbury Basin is underlain by mineralized bedrock and hence local soils contain elevated metals concentrations relative to other areas of Ontario. As such, the background concentration of metals within soils of the Sudbury Basin may also need to be determined as part of this assessment.

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Falconbridge Limited (Falconbridge) to undertake a soil sampling program within and adjacent to the Town of Falconbridge, located in the City of Greater Sudbury, Ontario (Figure 1). The objective of this program was to determine metals concentrations in surficial soils on lands adjacent to and beyond Falconbridge's Smelter site. This program is an initial step (first phase) in a soil sampling program that will in future, include areas further afield and also on the Falconbridge Smelter site. To ensure consistency with the many soil sampling programs conducted within the Sudbury Basin, the MOE hosted a workshop to present the soil sampling methodology. Golder attended this workshop and the sample methods employed herein, follow those prescribed by the MOE. The methodology for sample preparation, undertaken by Laurentian University, follows the procedure set out by the MOE. The metals parameters list included in the laboratory analytical program is consistent with the parameter list developed by the MOE for earlier soil sampling programs in the Sudbury Basin.

This soil sampling program comprises the initial activity in a program currently being developed by Falconbridge to assess the environmental significance of metals in soils. This program likely will include:

- detailed historical review of smelter operations and metals releases;
- review of historical sampling programs (air, soil, water, vegetation, etc.) conducted by various groups (Falconbridge, Inco, Ministry of the Environment, etc.) in the Sudbury Basin;
- determination of probable background concentrations for metals of concern applicable to the Sudbury Basin;
- further sampling of soils and vegetation;
- speciation analysis for metals of concern;
- assessment of bioavailability to plants, animals and humans; and
- a human health and ecological risk assessment.

This report provides the factual results of the analyses of soil samples collected by Golder from within and adjacent to the Town of Falconbridge.

1.1 Background

Since 1971, soil sampling programs have been conducted by the Ministry of the Environment (MOE) and Inco Limited (Inco) to determine the concentrations of metals in soils and vegetation across the Sudbury Basin. These data are understood to have been developed to assess the effects of operation of the Inco 'Superstack' that was constructed in 1972. It is understood that the MOE will be publishing a report in the fall of 2001 that will include the results of all their soil sampling programs to date.

Although soil sampling has been conducted over a period of 30 years, the MOE recognize that numerous gaps still remain to be addressed. Therefore, the MOE, with Falconbridge and Inco, have jointly developed a soil sampling program to address some of these gaps. This program is to be implemented in the summer and fall of 2001 and consists of the following:

- The MOE will collect soil samples from all schools, parks and beaches across the Sudbury Area and at selected residential properties in areas closest to the smelter sites.
- Falconbridge and Inco will each collect soil samples in remote areas and conduct studies to determine background concentrations of metals of concern in soils.
- Falconbridge will collect soil samples within and adjacent to the Town of Falconbridge, the results of which are provided in this report.

Mining activities have been conducted at the site by Falconbridge beginning in 1929 and smelting activities commenced in 1930. The Town of Falconbridge was developed immediately west of the smelter to serve the local workforce. Over the years, a variety of activities have been conducted on the Falconbridge site including: exploration, mining, milling, smelting and disposal of waste products from the mineral processing (i.e., tailings, pyrrhotite concentrate and slag). Mining was discontinued with the closing of the East Mine in 1990. Ore milling and concentrating began in 1932 and continued until 1988. Smelting operations are ongoing.

2.0 SAMPLING AND ANALYTICAL PROGRAM

The following sections describe the methodology used by Golder for the collection of soil samples, the subsequent processing of these samples by Laurentian University (Laurentian) and the laboratory analysis of the samples by Lakefield Resources Ltd. (Lakefield). Soil sampling was conducted between July 9th and July 12th and on July 27th, 2001.

All field work was supervised and carried out by staff of Golder's Environmental Group. Falconbridge personnel facilitated access to the sampling sites.

2.1 Sampling Site Selection

Soil sampling sites were selected based on discussions between Golder and Falconbridge and a reconnaissance of the area. For purposes of ensuring access, sampling sites were limited to properties owned by Falconbridge and Inco, as well as municipal and crown lands. In areas outside of the Town of Falconbridge, sample sites were selected at a distance of more than 100 metres of roadways, railway and power right-of-ways.

Sample locations were selected to provide for spatial coverage and representation of different terrain types including disturbed and native (undisturbed) areas. A total of thirty-three sites were sampled, including parks (3 sites), wooded areas (14 sites), residential yards (3 sites), schools (1 site), playgrounds (2 sites), grassy areas (4 sites), vacant lots (3 sites), gravel lots (1 site) and grass medians (2 sites). Sampling sites were numbered GSS-1 through GSS-33 and are shown on Figure 2. Table 1 lists the UTM coordinates of each sampling site. Photographs of each sampling site are included in Appendix A. It should be noted that sample sites GSS-3 and GSS-33 were located in a former tailings deposition area (Ballpark Tailings) that has been reclaimed and developed into sports fields and playground areas.

2.2 Soil Sampling

Soil samples were collected according to standard protocol in the MOE publication "*Field Investigation Manual, Part 1, General Methodology*" (MOE, May 1993). In addition, a sampling clinic was conducted by the MOE on June 20, 2001, and attended by Golder, Laurentian and MOE sampling crews to ensure consistency in sampling methodologies for all soil sampling activities to be completed in this program.

At each sampling site, an appropriate sample location was determined. In residential areas, samples were collected from the least disturbed areas. Disturbed areas and structures that could compromise the results were avoided. These included septic systems, metal walls, painted walls, peeling paint, hydro lines, chain link fences, sidewalks, driveways, walkways and roads. The

approximate age of the home and potential use of fertilizers was noted. In parks and schoolyards, well-worn areas of most exposure and a representative area of large fields were sampled. Areas of fill, woodchips, fences and painted lines on fields were avoided.

In wooded areas, sampling was conducted in a 10 m circle of soil, scraping away duff (leaf/grass litter) with a boot or hand. Wet areas, dense moss and lichen cover, or areas all under one tree type were avoided.

Once an appropriate sample location was chosen at a sampling site, the UTM (Universal Transverse Mercator, Canada Mean NAD 27) coordinates were taken with a GPS unit (Garmin GPS 12XL) and recorded on station description forms provided by the MOE. On the form, the sample name and location were recorded, a sketch of the area and the sample location drawn and sample labels for the lab (provided by MOE) were recorded. The station description forms are included in Appendix B. Each site was also photographed.

Soil cores were collected using either of two stainless steel augers: an Oakfield Soil Sampler with a footjack and a larger diameter Star Quality Soil Sampler. The augers were cleaned with distilled water and brushes and flushed with sample soil between sample locations. Soil was cored by pushing the auger into the soil to 20 cm or the maximum attainable depth, rotating to the right to break off the core, enlarging the hole slightly and removing the auger from the soil taking care to maintain the bottom of the sample. At each sampling site, a digital photo of a representative core in the auger with a label and scale was taken (Appendix A) and a written description of a representative core obtained. According to MOE procedure, a large "W" pattern was walked and cores collected along this pattern until a full sample was obtained. A full sample was considered to be 30 Oakfield cores or 15 of the larger diameter cores. In sites where gravel fill was encountered and where coring was difficult, samples were collected by digging a pit with a stainless steel trowel and collecting depth samples from the sides of the pit with the trowel, as per MOE protocol.

Duplicate samples (see Section 2.5) were collected during a second pass over each sampling site where an additional 30 small soil cores or 15 larger soil cores were collected. These samples are identified as 'duplicates' to agree with MOE protocols for this program. It is to be noted that the 'duplicate' sample is not a split from the first sample, but rather a separate sample, or replicate, collected from the same area.

Each core was sectioned according to MOE depth protocol: from 0 to 5 cm depth, from 5 to 10 cm depth and from 10 to 20 cm depth. Cores were sectioned using a stainless steel spatula. Each depth interval was placed in a plastic bag, which included lab labels provided by MOE. Original samples were labelled with even numbers and duplicate samples with odd numbers, as per MOE protocol. If a full section was not collected (e.g., the total soil depth was less than 20 cm), the

portion available was collected and a note was made. The bags were tied shut and stored at room temperature until shipped for processing.

2.3 Sample Preparation

Soil samples were processed at Laurentian. Soils were processed according to Standard Operating Procedure by the Ontario Ministry of the Environment Standards Development Branch/ Laboratory Services Branch (Appendix C). Soils were laid out on plastic trays and completely air dried at room temperature. The fully dried samples were disaggregated and twigs, rocks and stones removed. The remaining soil was passed through a 20 mm sieve (Number 10 mesh) and any material not passing through the sieve discarded. A sub-sample of the portion less than 2.0 mm was ground with a mortar and pestle or mechanical grinder until it passed through a 355 um sieve (Number 45 mesh). The sieve and mortar and pestle were cleaned between samples. The portion of soil smaller than 355 µm was stored in a 125 mL glass jar until analysis.

After processing, samples were shipped by Laurentian to Lakefield for chemical analysis.

2.4 Laboratory Analysis

The prepared soil samples were analysed at the Environmental Analytical Services Division of Lakefield according to Method #9-2-37 (June 2000). The sample was mixed thoroughly to ensure sub-samples would be homogenous. Between 0.5 and 0.505 g of the sample was weighed into a Teflon sleeve and was treated with 5 ml each of concentrated HNO_3 and HCl. The vessels were placed in a MARS 5 MAW2 Microwave Oven, put through a heat cycle and allowed to cool to less than 60^{o}C. The contents were poured into 50 ml volumetric flasks and diluted to volume with deionized water. Chemical analysis was by Inductively-Coupled Plasma-Optical Emission Spectrometer (ICP-OES).

2.5 Quality Assurance/Quality Control

Several quality assurance / quality control measures were followed in both the field and laboratory programs of this study.

In the field, a second sample was taken at each soil sampling site. According to MOE procedure, two separate passes were made over a large “W” pattern and 30 smaller cores or 15 larger cores collected during each pass. The soils from each pass were stored and managed separately. The soil from the second pass was considered as the ‘duplicate’ sample, and the samples were sectioned and stored separately from the original. It is to be noted that the duplicate sample is not a sub-sample of the original but rather a second sample from the same site.

The original and duplicate samples were analysed separately and concentrations compared. The minimum, maximum, and mean differences in duplicate concentrations were calculated. Table 2 summarizes the duplicate analysis for each depth interval. The concentration of some duplicates was exactly the same, and the mean difference between duplicate concentrations was generally low. The mean difference between duplicates decreases with depth in the soil profile.

The samples were analysed at Lakefield, which is certified by the Standards Council of Canada (accredited ISO/IEC Guide 25 level) and the Canadian Association of Environmental Analytical Laboratories. The calibration and testing activities at Lakefield follow the requirements of the ISO/IEC 900 series standards. According to the Lakefield Research Analytical Services Description of Quality Control and Accreditation (Appendix D), quality control measures include duplicate samples, spiked blanks, spiked replicates, reagent/instrument blanks, preparation control samples, certified reference material analysis and instrument control samples. Lakefield indicates that at least 20% of samples analysed are quality control samples.

3.0 INVESTIGATIVE RESULTS

3.1 Physical Characteristics

The soils in the Sudbury area are glacially-derived, sandy and loamy classification, and vary greatly in texture and organic matter content across the area (Dudka et al., 1995). The soils sampled in and around the Town of Falconbridge varied in structure, texture, colour and profile thickness from one site to the next. Also some general differences were observed between soil cores in disturbed sites and those collected from undisturbed wooded or grassy sites. Soils sampled at disturbed sites (in parks, residential yards, schools, gravel lots, vacant lots and grass medians) tended to be more difficult to core which resulted in a shallower average sample depth than soils sampled in wooded or grassy sites. Soil cores from developed sites were generally less than 20 cm in total thickness and, as a result, the 10 to 20 cm increment was often not a full sample. Cores in these areas were also compacted and horizons were more consolidated than those observed at undisturbed wooded/grassy areas.

Soil cores generally consisted of a dark brown, thin organic matter cover (average ~3 cm thick) underlain by light to dark brown, fine- to medium-textured sandy horizons. Gravel fill and pebbles and cobbles were encountered more often in developed sites than in wooded sites. Soil cores from wooded sites generally contained thicker organic horizons (average ~5 cm) were underlain by sand horizons with an observed higher fraction of organic material than that at developed sites. In wooded and grassy sites, the average grain size was finer and a lighter grey, silty horizon was sometimes encountered relative to developed sites. Detailed soil core descriptions are included in Table 2 and a photograph of a typical core at each site is included in Appendix A.

3.2 Chemical Characteristics

All soil samples were analysed for total inorganic carbon, carbonate, soil pH, conductivity, and trace metals including aluminium, arsenic, barium, beryllium, cadmium, calcium, cobalt, copper, chromium, iron, magnesium, manganese, molybdenum, nickel, lead, strontium, vanadium, zinc, antimony and selenium. The chemical results are provided in Table 4.

Based on previous studies undertaken by the MOE, metals of particular concern in the Sudbury area are arsenic (As), copper (Cu) and nickel (Ni). In addition, as discussed in Section 3.2.1, the observed concentrations of cobalt appear to be a concern. Table 5 lists the Arsenic, Cobalt, Copper and Nickel concentrations for the three depth intervals and duplicates, at each sampling site. For the purposes of this study, duplicate samples were treated separately and concentrations were not averaged.

Spatial variations in soil concentrations at the three depth intervals for the four metals of concern are presented on Figures 3 – 50. These maps were produced using the Golden Software Surfer 7 software package (contour maps, kriging grid method). These maps are statistical approximations of the spatial distribution of the different parameters. These maps should only be used as an interpretative tool to provide information on approximate areas and/or patterns of metals concentrations and cannot be used to infer parameter concentrations at locations not directly sampled. Soil concentrations are only known with certainty at those sites for which soil was actually sampled and chemically analysed. The mapping of concentrations is significantly affected by the spatial distribution of the sampling sites and the software used to generate the contours. The reliability of the contours diminishes at the edges of the map as well as in large areas where there are no or very few samples.

Variations in soil concentrations with depth for the four metals of concern at each sampling point are presented graphically on Figures 51 – 58.

3.2.1 Regulatory Criteria

Generic soil and groundwater remediation criteria for various land uses are presented in the MOE document "Guideline for Use at Contaminated Sites in Ontario, February, 1997" and can be used for comparison purposes. These generic soil criteria were developed to encompass a wide variety of soil conditions and environmental variables, so that the Ministry can be certain that these soil criteria are protective of human and ecological health throughout the province.

The Ontario Ministry of the Environment Guideline document also allows for the development of site-specific criteria using specific site information. These criteria are developed through a site-specific risk assessment and offer the same level of protection as the generic criteria. The generic soil criteria were developed to be applicable in cases where soil pH ranges from 5 to 9. The data in this report indicate that surface soil pH ranges from approximately 4 to 7. As a result, the generic criteria will not be applicable to some portions of the Study area and it may be necessary to develop site-specific criteria that reflect local environmental conditions for this Study area.

For comparison purposes, the analytical results were compared to the criteria for coarse grained soils where groundwater is used for drinking water supplies (Table A of the above Guideline document). Results for arsenic, cobalt, copper and nickel were observed to exceed these criteria at several locations. In addition, the criteria for lead was exceeded at two locations (GSS-10 and GSS-19) and the criteria for chromium was exceeded at one location (GSS-31). As noted above, for the observed pH conditions, these criteria are not everywhere applicable and site-specific criteria may need to be developed.

3.2.2 Metals of Concern

The surface soil criteria for residential and parkland use presented in the MOE document "Guideline for Use at Contaminated Sites in Ontario, February, 1997" are exceeded for arsenic, cobalt, copper, and nickel at locations in the Town of Falconbridge. The maximum, minimum and mean concentrations for these metals are listed below.

Depth	Minimum	Maximum	Mean
Arsenic:			
0 - 5 cm	5	220	33 (n=66)
5 - 10 cm	5	280	26 (n=65)
10 - 20 cm	5	297	18 (n=63)
Cobalt:			
0 - 5 cm	5.5	120	22 (n=66)
5 - 10 cm	1.9	150	12 (n=65)
10 - 20 cm	2.2	75	9.5 (n=64)
Copper:			
0 - 5 cm	46	1600	322 (n=66)
5 - 10 cm	15	1200	180 (n=65)
10 - 20 cm	9.5	800	111 (n=63)
Nickel:			
0 - 5 cm	60	1600	316 (n=66)
5 - 10 cm	22	850	157 (n=65)
10 - 20 cm	17	980	103 (n=64)

The areas of high and low metal concentrations correlate between these metals. In general, high copper, cobalt, nickel, and arsenic concentrations occur in the same areas (GSS-33, GSS-10, GSS-21, GSS-24, and GSS-7). Low concentrations of all metals are seen along Longyear Road from Falconbridge to Garson and in the central section of town.

Arsenic

The concentrations of arsenic in soil varies spatially. The highest surface (0 – 5 cm) soil Arsenic concentration within the Town of Falconbridge is observed at GSS-10 (220 µg/g). GSS-10 was collected from a vacant lot next to #5 Morlock Street. GSS-32, collected from the Parkinson Street playground adjacent to GSS-10, shows an arsenic concentration approximately 10 times lower (24 µg/g). Concentrations were also high at GSS-33 (160 µg/g), the playground at the Lindsley Street ballfield. Three sites on the edge of town, GSS-7, GSS-13 and GSS-24, also show high concentrations of arsenic (210, 193 and 144 µg/g, respectively). GSS-7 is from a wooded area at the end of Lindsley Street, GSS-13 is from a grassy area off a dirt road from Lakeshore Street and GSS-24 is from a wooded area off Longyear Street. The arsenic

concentration from most of the samples collected within the town is below 100 µg/g. In general, surface soil arsenic concentrations are lower in town than just outside town. Concentrations on Longyear Road to Garson are also lower (between 5 and 74 µg/g).

The highest intermediate (5 – 10 cm) soil arsenic concentration is just outside the Town of Falconbridge, at GSS-7 (280 µg/g), and is also high at GSS-13 (160 µg/g). Within the Town of Falconbridge, the highest intermediate soil concentration is at GSS-10 (190 µg/g). Most arsenic concentrations in soil collected from sites within the town are below 50 µg/g. In general, intermediate soil arsenic concentrations are lower in town than just outside town. The higher concentrations just outside town grade to lower concentrations on Longyear Road toward Garson (between 5 and 41 µg/g).

The highest deep (10 – 20 cm) soil arsenic concentration is just outside the Town of Falconbridge, at GSS-7 (297 µg/g) and is also high at GSS-13 (190 µg/g). Within the Town of Falconbridge, the highest deep soil concentration is at GSS-10 (160 µg/g). In general, deep soil arsenic concentrations are lower in town than just outside town. Most town soil concentrations fall below 50 µg/g. Concentrations along Longyear Road toward Garson are also lower (between 5 and 16 µg/g).

Arsenic concentrations generally decrease or do not change significantly with depth in the soil profile. Exceptions to this trend include significant increases in already high concentrations with depth at GSS-7 and GSS-13, and an increase from low to higher concentrations with depth at GSS-1, GSS-4, GSS-9 and GSS-19. GSS-1 is from a park at Lindsley Street and Parkinson Street, GSS-4 is from the backyard of the lodge on Edison Street, GSS-9 is from a grassy area at Lakeshore Street and Morlock Street and GSS-19 is from a gravel lot at the Edison Street fire hall.

Cobalt

The concentration of cobalt in soils varies spatially. The highest surface (0 – 5 cm) soil cobalt concentration is in the Town of Falconbridge at GSS-9 (120 µg/g), a grassy area at Lakeshore and Morlock Streets. Cobalt concentration is also elevated at GSS-21 (76 µg/g), the grassy area between the church and rink at Mott and Franklin Streets. Most sites in town have concentrations below 60 µg/g, with many below 40 µg/g. In general, surface soil cobalt concentrations are lower in the centre of town and increase to the town edge. Concentrations further from town, on Longyear Road to Garson, are also lower (between 5 and 16 µg/g).

The highest intermediate (5 – 10 cm) soil cobalt concentration is in the Town of Falconbridge at GSS-9 (150 µg/g), a grassy area at Lakeshore and Morlock Streets. With the exception of GSS-9,

most sites in town have concentrations that are low, with many below 21 µg/g. Concentrations on Longyear Road toward Garson are lower (between 1.9 and 7.6 µg/g).

The highest deep (10 – 20 cm) soil cobalt concentration is within the Town of Falconbridge at GSS-11 (75 µg/g), the vacant lot next to #33 Rix Street, and is also high at GSS-12 (57 µg/g), the vacant lot at Lakeshore and MacDonnell Streets. In general, deep (10 – 20 cm) soil cobalt concentrations are lower in the north end of town than the south. With the exception of GSS-12 and GSS-11, sites in town have concentrations below 40 µg/g, with many below 21 µg/g. Concentrations along Longyear Road toward Garson are low (between 2.2 and 5.1 µg/g).

Cobalt concentrations generally decrease or do not change significantly with depth in the soil profile. Exceptions to this trend include increases at GSS-1 and GSS-11.

Copper

The concentration of copper in soils varies spatially. The highest surface (0 – 5 cm) soil copper concentration is within the Town of Falconbridge at GSS-33 (1,600 µg/g), the playground at the Lindsley Street ballfield. Copper concentrations are also high at GSS-10 (1,400 µg/g), the vacant lot next to #5 Morlock Street and GSS-21 (1500 µg/g), the grassy area between the church and rink near Mott and Franklin Streets. A site on the edge of town, GSS-24, also shows high concentrations (1,200 µg/g). In general, surface (0 – 5 cm) soil copper concentrations are lower on the east side of town and increase to the west. Concentrations further from town, on Longyear Road to Garson, are lower (between 49 and 470 µg/g).

The highest intermediate (5 – 10 cm) soil copper concentration is within the Town of Falconbridge, at GSS-10 (1,200 µg/g). One site on the edge of town, the wooded area GSS-7, also shows high concentrations (1,100 µg/g). In general, intermediate soil copper concentrations are lower in town than just outside town. Most sites in town have concentrations below 500 µg/g. The higher concentrations just outside town grade to lower concentrations on Longyear Road toward Garson (between 15 and 200 µg/g).

The highest deep (10 – 20 cm) soil copper concentration is just outside the Town of Falconbridge, at GSS-7 (800 µg/g). Within the Town of Falconbridge, the highest deep soil concentration is at GSS-1 (650 µg/g), the park at Lindsley and Parkinson Streets and GSS-10 (530 µg/g), the vacant lot next to #5 Morlock Street. In general, deep soil copper concentrations are lower in town than just outside town. Most sites in town have concentrations below 500 µg/g, with many below 225 µg/g. Concentrations along Longyear Road toward Garson are low (9 to 110 µg/g).

Copper concentrations generally decrease or do not change significantly with depth in the soil profile. The exception to this trend is a significant increase at GSS-1 with depth.

Nickel

The concentration of nickel in soils varies spatially. The highest surface (0 – 5 cm) soil nickel concentration is on the edge of Town of Falconbridge at GSS-21 (1,600 µg/g), a grassy area between the United Church and Memorial Rink off Lindsley Street. Within the Town of Falconbridge, the highest concentration is at GSS-33 (1,200 µg/g), the playground at the Lindsley Street ballfield, with additional high concentrations at GSS-14 (1200 µg/g), #6 Cobalt Street and GSS-10 (960 µg/g), a vacant lot next to #5 Morlock Street. On the edge of town, GSS-24 shows high nickel concentrations (820 µg/g). Most sites in town have samples that are below 1,000 µg/g, with many below 500 µg/g. In general, surface soil nickel concentrations are lower on the east side of town and increase to the west. Concentrations further from town, on Longyear Road to Garson, are lower (160 to 280 µg/g).

The highest intermediate (5 – 10 cm) soil nickel concentration is within the Town of Falconbridge at GSS-10 (850 µg/g), the vacant lot next to #5 Morlock Street and an elevated concentration is also present at GSS-33 (750 µg/g), the playground at the Lindsley Street ballfield. Concentrations are also high on the edge of town at GSS-21 (580 µg/g). In general, intermediate soil nickel concentrations are higher surrounding these sites, and lower with increasing distance from the sites. Many sites in town have concentrations below 500 µg/g. Concentrations on Longyear Road toward Garson are lower (22 to 140 µg/g).

The highest deep (10 – 20 cm) soil nickel concentration is within the Town of Falconbridge at GSS-10 (980 µg/g), the vacant lot next to #5 Morlock Street and at GSS-12 (700 µg/g), the vacant lot at Lakeshore and MacDonnell Streets. In general, deep soil nickel concentrations are lower in the north end of town than the south. Most sites in town have concentrations below 500 µg/g. Concentrations along Longyear Road toward Garson are low (17 to 54 µg/g).

Nickel concentrations generally decrease or do not change significantly with depth in the soil profile. Exceptions to this trend include increases at GSS-1 and GSS-12.

4.0 CLOSURE

We trust that this is sufficient for your current needs. We are prepared to review the contents of this report at your convenience.

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APPENDIX A

FIELD PHOTOGRAPHS
SAMPLING SITES AND TYPICAL SOIL CORES

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STATION DESCRIPTION FORMS

APPENDIX C

SOIL PROCESSING STANDARD OPERATING PROCEDURE

APPENDIX D

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