

May 2008

Sudbury Soils Study



metals • health • environment

Human Health Risk Assessment RESULTS



After five years of intensive fieldwork and data analysis, the Technical Committee overseeing the Sudbury Soils Study has completed **Volume 2: Human Health Risk Assessment (HHRA)**. The HHRA assessed the potential impacts to human health related to metal exposures in the environment.

The results of the HHRA report were announced to the public at three community information sessions in the Greater Sudbury area in May 2008.

Conclusions and background information from the HHRA are summarized here for general information. For a more detailed discussion of the results, the complete technical report may be reviewed at all branches of the public library in the Greater Sudbury area, and online at www.sudburysoilsstudy.com.

Conclusions: Human Health Risk Assessment

The main conclusions from the detailed human health risk assessment for the Greater Sudbury study area are summarized as follows:

1. Based on current conditions in the Sudbury area, the study predicted little risk of health effects on Sudbury area residents associated with metals in the environment.
2. There were no unacceptable health risks predicted for exposure to four of the six Chemicals of Concern studied: arsenic, copper, cobalt, and selenium.
3. The risk calculated for typical exposures to lead throughout the Greater Sudbury area are within acceptable benchmarks for protection of human health. However, levels of lead in some soil samples indicate a potential risk for young children in localized areas in Copper Cliff, Coniston, Falconbridge and Sudbury Centre.
 - Lead levels in soils and dust in the Sudbury area are similar to levels in other older urban communities in Ontario.
4. The study calculated a minimal risk of respiratory inflammation from lifetime exposures (70 years) to airborne nickel in two areas: Copper Cliff and the western portion of Sudbury Centre.
 - Respiratory inflammation has been linked to the promotion of respiratory cancer caused by other agents;
 - Based on the conservative assumptions and approaches used in this risk assessment, it is unlikely that any additional respiratory cancers will result from nickel exposure over the 70-year lifespan considered in the risk assessment;
 - Health risks related to nickel inhalation were not identified in the other communities of interest.
5. Anglers, hunters and First Nations people (who may consume more local fish and wild game than the general population) are at no greater risk of health effects due to metal exposures in the environment.

The SARA Group is confident that the study did not underestimate risks to the population of Greater Sudbury. The results of the HHRA will be used as a basis for making risk management decisions in the Greater Sudbury Area.

Study Background

The purpose of this risk assessment was to determine whether the metal levels in the environment pose health risks to residents of the Greater Sudbury area. The study was conducted between 2003 and 2008 and is one of the largest and most comprehensive of its kind in North America.

The Sudbury Soils Study began in 2001 in response to recommendations from the Ontario Ministry of the Environment (MOE) relating to elevated metal levels in Sudbury area soils. The study was commissioned by Vale Inco (formerly Inco Limited) and Xstrata Nickel (formerly Falconbridge Limited).

To administer the study, a multi-stakeholder Technical Committee (TC) was formed, comprised of members from the MOE, the Sudbury & District Health Unit, the City of Greater Sudbury, Vale Inco, Xstrata Nickel and the First Nations & Inuit Health Branch of Health Canada.



Data Collection

The study was undertaken by a group of scientists and independent consultants who joined together to form the Sudbury Area Risk Assessment (SARA) Group. Between 2003 and 2005, more than 14,000 samples of soil, dust, water, air, vegetables, drinking water, fish and food were collected from the study area and analyzed for metal levels.

Communities of Interest

The primary communities of interest identified for this health risk assessment were Copper Cliff, Coniston, Falconbridge, Sudbury Centre and Hanmer. The first four communities were selected based on their proximity to current or historic metal production sites. Hanmer, which is not close to these sites, was selected as a comparison community.

Chemicals of Concern:

The SARA Group used data collected from the study area to evaluate risks to area residents for the following six Chemicals of Concern (COC):

- Arsenic
- Cobalt
- Copper
- Lead
- Nickel
- Selenium

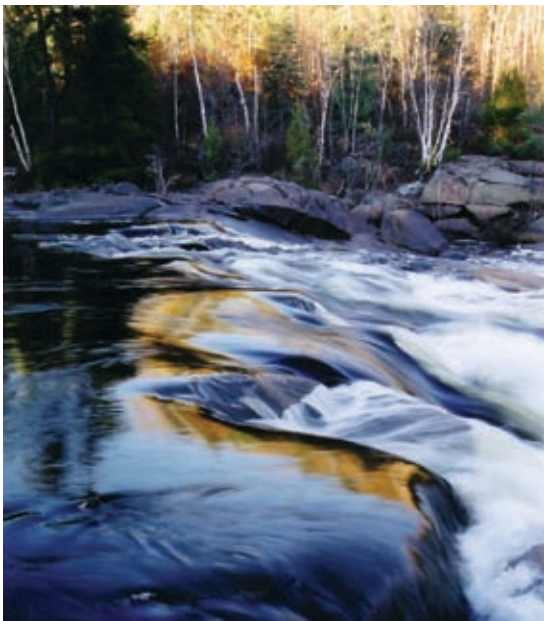
Since these COC are naturally occurring elements that are present in small amounts in food, drinking water, air and soil, most people are exposed to low levels of these substances every day. In small amounts, some COC (cobalt, copper, selenium) are considered essential for good health. However, high doses of any of these elements have the potential to cause health effects under certain conditions.

Transparent Process

To ensure that all stakeholders were given fair and equal access to the process, an Independent Process Observer was assigned to represent the interests of the community.

A Public Advisory Committee (PAC) facilitated community involvement and promoted the flow of information between the study partners and the public.

An Independent Scientific Advisor provided input to the TC to ensure that reliable scientific principles and methodologies were used to conduct the study.

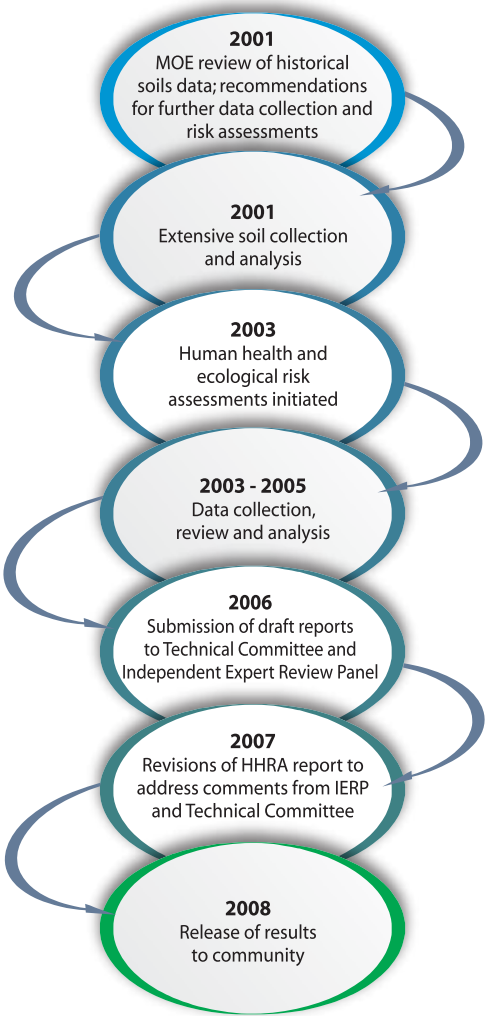


Expert Peer Review Panel

A draft of the HHRA report was thoroughly reviewed by an Independent Expert Review Panel (IERP) comprised of six leading North American scientists who specialize in human health, toxicology, metal speciation, and risk assessment. Following a comprehensive review of the HHRA draft report, the IERP offered the following concluding comments:

- The panel found this to be a very comprehensive assessment. They were especially pleased to see the extent of sampling done in the community, for example soil, air, dust, water and local foods.
- The assessment appropriately considered all sensitive groups of the population and the possible ways that people in Sudbury might be exposed.
- The panel found the overall approach to be appropriate and provided specific technical recommendations for revisions to improve the scientific soundness of the results. The panel also made suggestions to improve the clarity of the report.

Based on the sampling results, and feedback from the IERP process, the SARA Group is confident that the HHRA presents sound conclusions based on the best available scientific information.

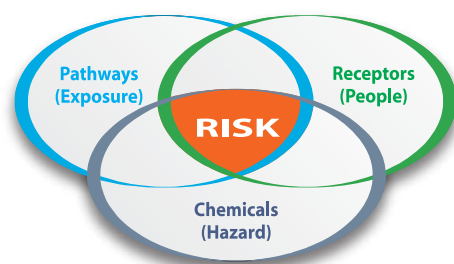


Chronology of Events
for the Sudbury Soils Study

What is a Human Health Risk Assessment?

The term *risk* refers to the chance or likelihood that a particular event will occur. Human health risk assessment (HHRA) uses mathematical models to calculate the theoretical risk that a given population will experience adverse health effects from exposure to particular chemicals in the environment.

Although they are based on real environmental data, the risk predictions are theoretical because they are calculated using conservative models and assumptions about the population and their exposure to chemicals in the environment. The models used in HHRA are considered to be conservative because they tend to overestimate rather than underestimate potential risks, in the interest of protecting human health.



Combination
of Factors
Contributing
to Health Risk

The presence of a hazard (or COC) does not necessarily mean there is a health risk. Three factors must be present in order for a potential risk to be present: exposure, a receptor and a chemical.

Sudbury Studies

Extensive survey and sampling programs were undertaken from 2003 through 2005 to gather Sudbury-specific data needed to complete the HHRA. The collection of this information helped to ensure that the risk predictions were as accurate as possible for area residents. Taking a site-specific approach to risk assessment allows scientists to account for local conditions, such as geology, weather patterns, metal concentrations and other naturally occurring influences in the environment.

The Sudbury-specific studies included:

- Year-long air monitoring program at 10 sites around Sudbury,
- Food consumption survey to determine eating habits (local foods) of area residents,
- Survey of COC levels in vegetables from more than 60 local gardens (and local wild blueberries),
- Survey of COC levels in sport fish from eight local lakes,
- Measurement of metal levels in drinking water from approximately 100 area wells and lakes,
- Survey of COC levels in indoor dust from 90 homes and 8 schools,
- Study of relative bioaccessibility of COC levels in Sudbury soils and dust, and
- Speciation study to determine the chemical form of the COC in Sudbury soil, dust and air.

Details on each of these individual studies are provided in the full HHRA technical report.

Understanding the Results

To provide a consistent framework of relative risks reported in this study, we have adopted terminology suggested by recognized experts in the field of risk communication. The terms associated with different levels of numerical risk are described below:

- **High:** fairly regular events occurring at a rate greater than 1 in 100. They may also be described as frequent, serious or significant.
- **Moderate:** a risk of between 1 in 1,000 and 1 in 100. This would apply to a wide range of medical procedures and environmental events.
- **Low:** a predicted increased risk of between 1 in 10,000 and 1 in 1,000. Other words that might be used include reasonable, tolerable and small.
- **Very Low:** a risk between 1 in 100,000 and 1 in 10,000.
- **Minimal:** a risk is in the range of 1 in 1 million to 1 in 100,000. The conduct of normal life is not generally affected as long as reasonable precautions are taken to minimize exposure. Some policy makers consider a probability of anything lower than 1 in 100,000 as acceptable.
- **Negligible:** an adverse event occurring in less than 1 per 1 million episodes. While still important to identify and monitor, such a risk would be of little concern for normal living. Other words that could be used in this context are remote or insignificant.

In all cases in the Sudbury HHRA, risks are considered to be in the negligible and minimal range. These definitions may be useful in understanding the relative risks expressed in the conclusions of this report.

Results Summary

The HHRA study results show that little or negligible risk is predicted for arsenic, cobalt, copper and selenium in each of the communities of interest. No unacceptable risk was predicted for lead under typical exposure conditions; however, lead was identified as a concern for toddlers in some areas.

Minimal health risks due to nickel in air were identified in two of the communities of interest.

No significant differences were observed between risk predictions for the general population and the hunter/angler/First Nations subpopulations. This confirms that the consumption of local food from hunting and fishing activities did not significantly increase exposures to the COC.

These results are discussed in more detail below.

Arsenic

The study concluded that Sudbury area residents are at no greater risk to arsenic than other Ontario or Canadian residents. In the study area, between 58-76% of the arsenic exposure comes from supermarket foods. Since Ontario supermarket foods come from

common sources, these exposures are similar for all residents across the province. No further actions are considered necessary.

Cobalt

Health risks are considered negligible for cobalt in all of the communities of interest. No further action is required.

Copper

Health risks are considered negligible for copper in all of the communities of interest. No further action is required.

Selenium

As with arsenic, the major source (approximately 80%) of selenium exposure comes from consuming supermarket foods. Based on the weight of evidence, the HHRA results indicate that study area residents are at no greater risk from selenium exposure than residents in other areas of the province. No further action is required.

Lead

In most areas of Greater Sudbury, health risks are considered negligible for lead in the environment. No additional action is considered necessary for most areas.

Minimal risks were identified in very localized areas in Coniston, Copper Cliff, Falconbridge, and Sudbury Centre, due to levels of lead found in some samples of soil and indoor dust.

Understanding the Results

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These risks are primarily a concern for young children, who are considered the most sensitive to lead exposure.

It is important to note that there are several sources of lead in the Sudbury environment. The major source of lead exposure (about 50%) for residents is supermarket foods, while direct soil exposure accounts for about 10% (or less) of total exposure.

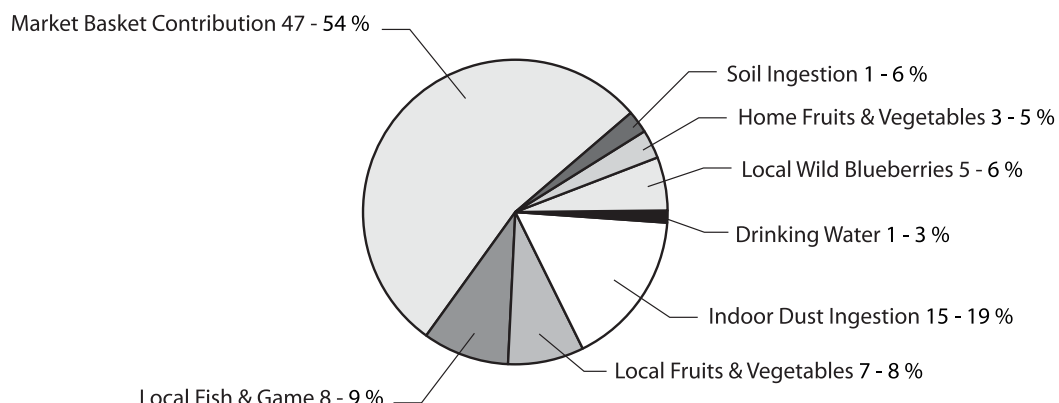
Levels of lead detected in soil in the Sudbury area are similar to levels found in other older urban communities in Ontario that have no industrial sources. In older homes, lead levels can be elevated in dust and soil from historic use of lead-based paints, and in drinking water where lead pipes and solder are present. Therefore, when considering options for reducing lead exposure, it is important to consider all possible sources of lead in the environment.

The study results identify the need for risk management to reduce exposure to lead in localized areas.

Nickel

Two routes of exposure for nickel were analyzed, to address different potential health outcomes:

Sources of Oral/Dermal Lead Exposure to Toddlers in the Study Area



■ Oral/Dermal exposure:

The calculated risks are negligible for oral/dermal exposures to nickel in all communities of interest. These risks are within acceptable benchmarks, and no further action is necessary.

■ Inhalation exposure:

For lifetime exposure to nickel, respiratory inflammation was the primary endpoint (health outcome) associated with nickel inhalation in this study.

Risks were considered negligible for nickel inhalation exposure in Coniston, Falconbridge, and Hanmer, as well as in the typical Ontario resident scenario. These risks are within acceptable benchmarks, and no further action is considered necessary.

Using conservative assumptions, the study calculated a minimal risk of respiratory inflammation from lifetime exposures to airborne nickel in the areas of Copper

Cliff and the western portion of Sudbury Centre. These risks are based on nickel levels measured at two air monitoring stations immediately surrounding Vale Inco's complex at Copper Cliff.

While there is evidence to suggest that respiratory inflammation may promote respiratory cancers that are caused by other agents, the evidence for this relationship comes from animal studies and occupational settings. Exposures in these situations are typically much higher than normally found in the environment.

Based on the analysis conducted for this risk assessment, it is unlikely that any additional respiratory cancers could be detected as a result of nickel exposure over the 70-year lifespan considered in the risk assessment. However, these results identify the need for risk management to reduce exposure to airborne nickel in these localized areas.

Have your say contact us

HHRA Public Comment Period – May 19 to July 31, 2008:

Members of the public are invited to review the HHRA report and submit written comments during the Public Comment Period: May 19, 2008 to July 31, 2008.

The study team will review all comments submitted during this period. To receive a published response, all comments must be relevant to the contents of the HHRA Report, and must be submitted in writing before 11:59 pm on July 31, 2008, accompanied by the name, address and phone number of the individual submitting the comment(s). Responses to relevant public comments will be published as an Appendix to the final HHRA Report.

How to submit your comments on the HHRA:

- By MAIL: Sudbury Soils Study – HHRA Public Comments
c/o Gartner Lee Limited, 512 Woolwich St. Suite 2
Guelph, Ontario N1H 3X7
- By FAX: 1.519.763.1668
- By EMAIL: comments@sudburysoilsstudy.com
- By INTERNET: www.sudburysoilsstudy.com (online comment form provided)

Additional Information

Copies of the full technical report (Volume II Sudbury Area Human Health Risk Assessment) are available for viewing at the offices of the Ontario Ministry of the Environment at 199 Larch Street, Sudbury, and at the public libraries in Greater Sudbury. Electronic copies of the entire technical report and other information regarding the study are available on the website at www.sudburysoilsstudy.com.

A HHRA Summary Report is also available at the above locations, or requests for copies may be made by phone: 1.866.315.0228.

For information on how to reduce your exposure to metals in the environment, contact:

Ontario Ministry of the Environment
1.705.564.3237,

Sudbury & District Health Unit
1.866.522.9200, ext. 240, or

Health Canada
1.705.671.0760.



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