REPORT ON

POTENTIAL CoC IDENTIFICATION USING EMISSION INVENTORIES AND DISPERSION MODELLING OF INCO AND ALGOMA OPERATIONS

VALE INCO LIMITED
PORT COLBORNE
COMMUNITY BASED
RISK ASSESSMENT

PROJECT NO. ONT34648

REPORT ON

POTENTIAL CoC IDENTIFICATION USING EMISSION INVENTORIES AND DISPERSION MODELLING OF INCO AND ALGOMA OPERATIONS

PREPARED FOR

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PROJECT NO. ONT34648

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EXECUTIVE SUMMARY

Jacques Whitford Limited (JWL) was retained by Vale Inco Limited (Inco) to conduct a Community Based Risk Assessment (CBRA) for the City of Port Colborne. The CBRA was undertaken in accordance with a Technical Scope of Work (JWL, 2000) prepared in consultation with a Public Liaison Committee. The Technical Scope of Work (TSOW) required that a number of scientific studies and investigations be undertaken to obtain the community specific information necessary to complete the CBRA. One of these studies was to conduct various investigations for the identification and evaluation of potential chemicals of concern (CoC) based on CBRA Condition Numbers 1, 2 and 3 as outlined in the TSOW.

This report presents the results and findings of an emission inventory and dispersion modelling study to address CBRA Conditions 1, 2 and 3.

Inco had operated the Port Colborne Nickel Refinery (PCNR) in the City of Port Colborne since 1918. Historical operations at the refinery released particulate/metals emissions into the atmosphere that caused regional contamination of the soil. Algoma operated an iron foundry in Port Colborne from 1913 to 1977. The foundry was located to the south-west of the Inco refinery and its operations also emitted particulate and metals to the atmosphere.

Emissions Inventory

Emissions inventories of particulate matter, nickel, and iron, were developed utilising available operating records and standardised methodologies and techniques specified by United States Environmental Protection Agency (US EPA) and the Ontario Ministry of Environment (MOE). Speciation data for other CoCs was unavailable for the Algoma operation, therefore only these three contaminants were examined in the inventory. The emissions inventories were developed using available information, which was scarce for Algoma operations and some early Inco operations. In these cases, emissions estimation techniques that were consistent between the two facilities were used. The total particulate matter emissions are presented in Figures I-1 and I-2. These figures show the estimated annual emissions of particulate matter (PM) and the cumulative PM emissions over the operating lives of each facility. These figures show that Algoma was estimated to be a slightly greater emitter of particulate matter than Inco.

The estimated annual air emissions of nickel from Inco are presented in Figure I-3. The estimated annual air emissions of iron from Inco and Algoma are presented in Figure I-4. Annual iron emissions from Inco to the air were estimated to be less than 1% of the Algoma emissions.

Speciation data for other potential CoC's were unavailable for Algoma therefore comparisons between the two facilities could not be made. However, the relative magnitude of PM air emissions from each facility is expected to be an indicator of the relative environmental impact of each facility for other CoCs.

It should be noted that the two emissions inventories developed for Inco and Algoma are estimates of the emissions from each facility (based on available data and including emissions factors that typically are conservative). However, as the same emissions inventory techniques were used for both facilities, the relative magnitude of emissions between the two facilities is expected to be representative of reality. Given the relative scarcity of emissions data for historical operations for either facility, it is expected that the emissions estimates provided in this report are within a factor of 2-3 of actual emissions.

Meteorological Analysis

A five-year meteorological data set was assembled using the Inco onsite meteorological tower, Environment Canada data for the Port Colborne area and US National Centre of Atmospheric Research data for Niagara Falls and Buffalo. The meteorological analysis shows the predominant wind direction to be blowing from the southwest (14.2% of the time) while winds blow from the east about 1.3% of the time. Based on the relative positions of the Algoma facility located to the south-west of the Rodney Street area and the Inco facility located to the east of the Rodney Street area, it is expected that Algoma emissions would impact more frequently on the Rodney Street area than that from Inco emissions.

Deposition Modelling

Predicted contaminant depositions over Port Colborne were based on a five-year data set of hourly meteorological data for the region. Since many of the areas of interest for the study fall within an area where the wake effects of buildings are expected to influence dispersion and deposition, the US EPA dispersion model ISC-PRIME was used in the analysis. The meteorology of a region tends to historically be relatively consistent, therefore the five-year meteorological data set was used to represent the meteorological conditions experienced by Port Colborne in previous decades. Using this approach, total deposition during the operating life of each facility was calculated over a 7-km by 7-km domain covering the Port Colborne area for each contaminant addressed in the emissions inventory. The spatial variation in total contaminant depositions due to Inco alone, Algoma alone and both concomitantly were predicted using ISC-PRIME and presented graphically in contour plots.

The dispersion/deposition modelling analysis predicted the following:

- Algoma particulate matter (PM) emissions resulted in significantly higher PM depositions in the Rodney Street area (and over Port Colborne in general) than those from Inco. In the Rodney Street area, PM depositions due to Algoma were predicted to be between 11-12 times greater than those from Inco.
- Emissions of nickel by Inco resulted in significantly higher nickel depositions to the northeast of the refinery than in the Rodney Street area.
- Algoma was responsible for the majority of the iron deposition in the Port Colborne area. Algoma emissions resulted in significantly greater iron depositions in the Rodney Street area than those from Inco.

Figure 1-1 Comparison of Estimated Annual PM Emissions from Inco and Algoma over the Operating Life of Each Facility

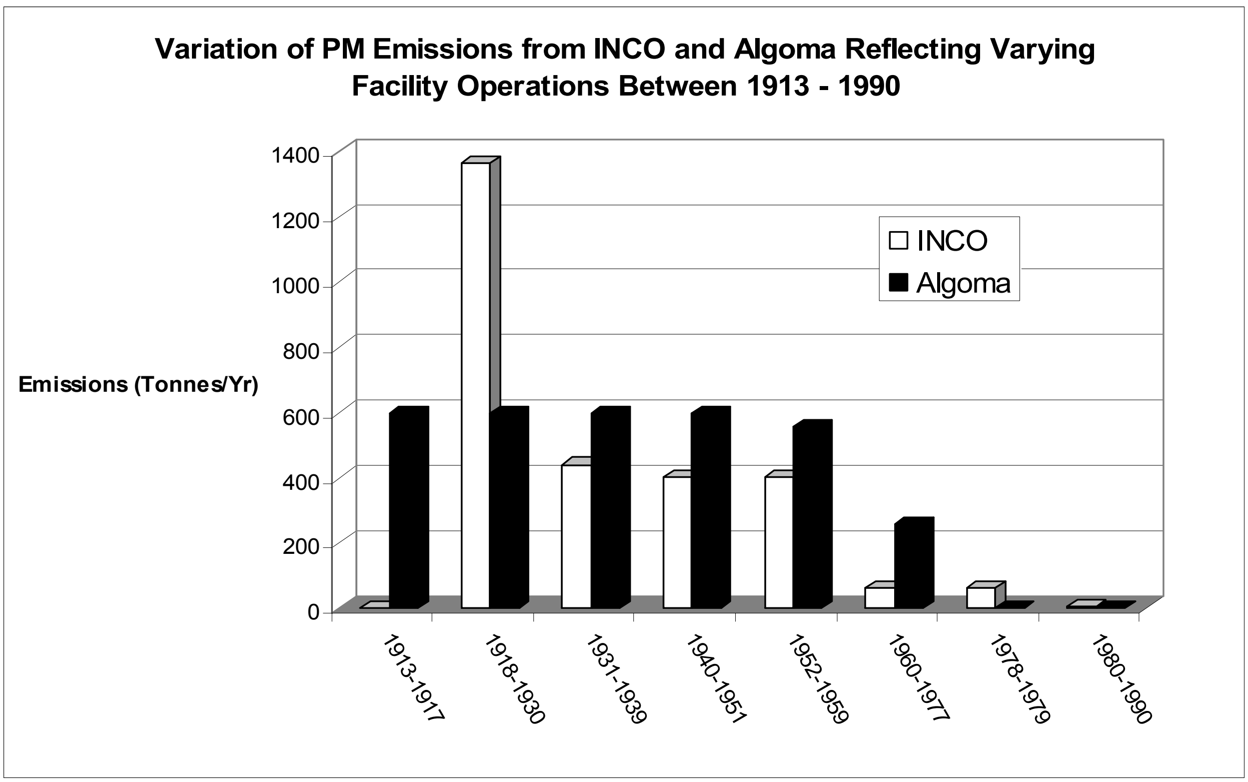


Figure 1-2 Comparison of Cumulative PM Emissions from Inco and Algoma Emissions over the Operating Life of Each Facility

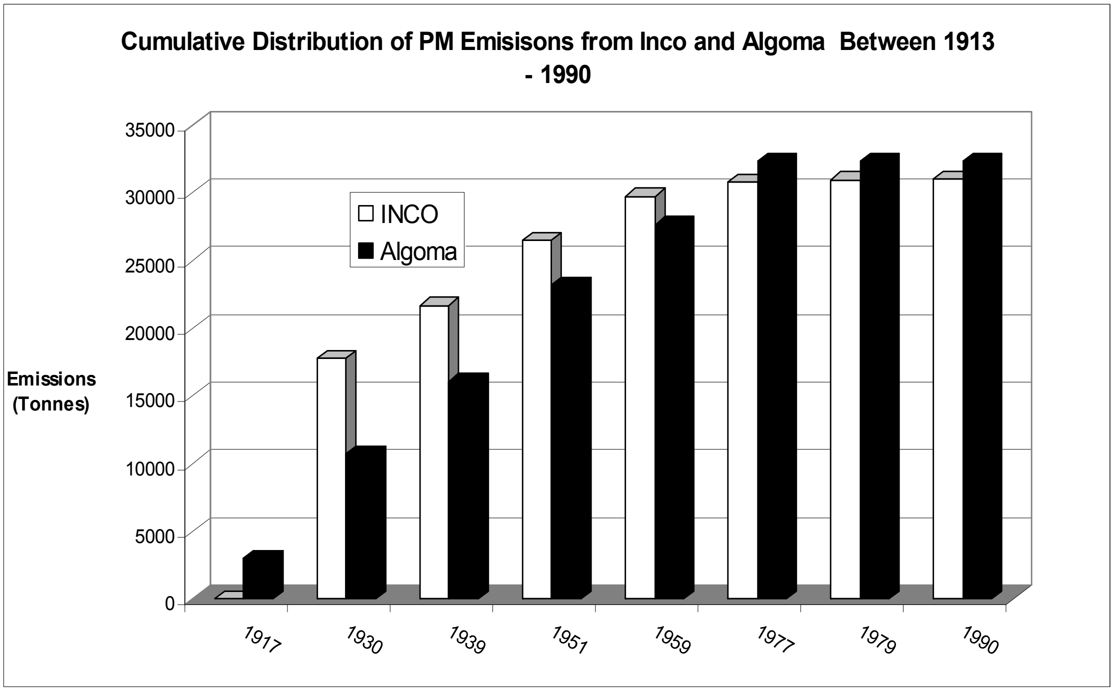


Figure 1-3 Variation of Estimated Inco Nickel Emissions Due to Variations in Facility Operations

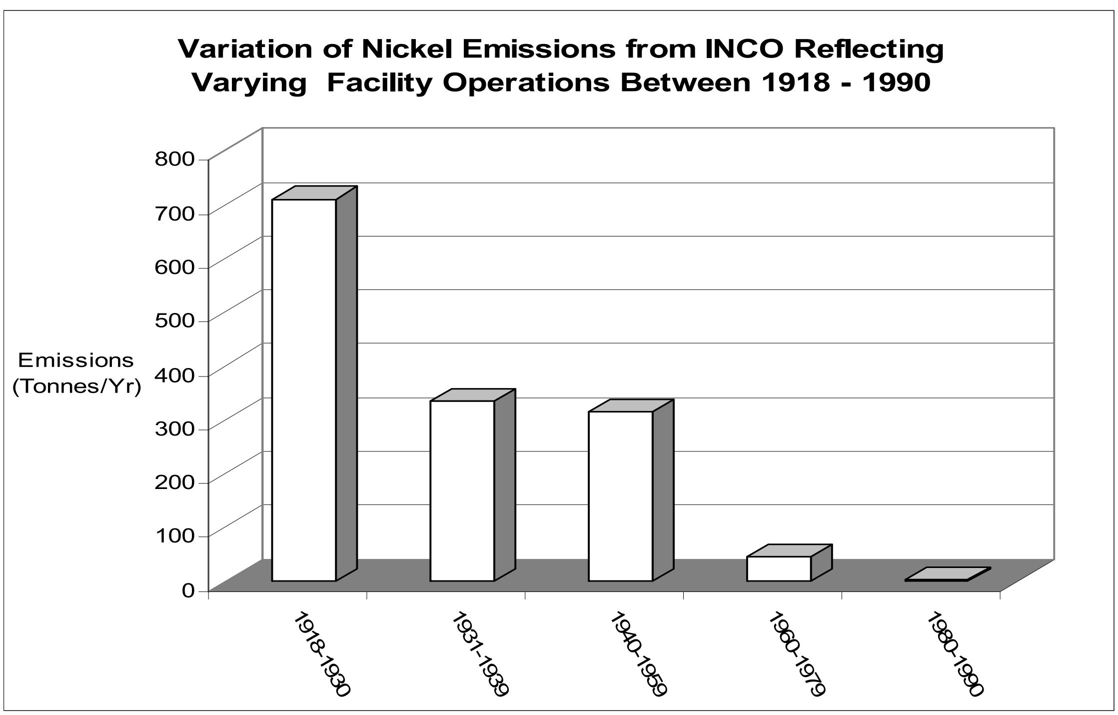
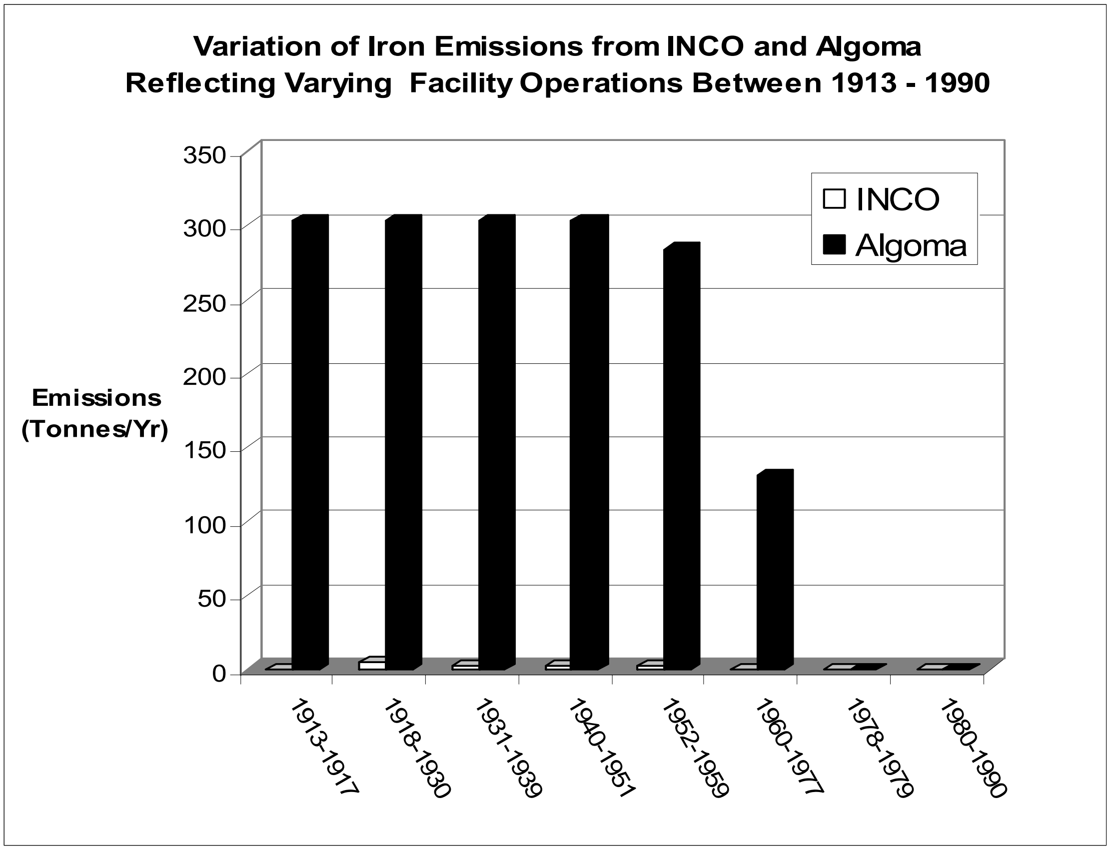


Figure 1-4 Estimated Annual Iron Emissions (Metric Tonnes/Year) from Inco and Algoma Due to Variations in Facility Operations



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1. INTRODUCTION

Vale Inco Limited (Inco) operated a nickel refinery in the City of Port Colborne from 1918 to 1984. Nearby, the former Algoma Steel and former Canada Blast Furnace had operated a steel plant that reportedly sintered and smelted iron ore to form pig iron from the early 1910's to 1977, located approximately 500 m southwest and upwind of the Inco refinery. Historical operations at the Inco refinery and the former steel plant released particulate emissions that subsequently resulted in atmospheric deposition of these particulates on Port Colborne soils surrounding the Inco refinery and the former steel plant.

Jacques Whitford Limited (JWL) was retained by Inco to carry out a Community Based Risk Assessment (CBRA) for the City of Port Colborne. The CBRA was undertaken in accordance with a Technical Scope of Work (JWL, 2000) prepared in consultation with a Public Liaison Committee (PLC). The Technical Scope of Work (TSOW) required that a number of scientific studies and investigations be undertaken to obtain the community specific information necessary to complete the CBRA. One of these studies was to conduct various investigations for the identification and evaluation of potential chemicals of concern (CoC) based on CBRA Condition Numbers 1, 2 and 3 as outlined in the TSOW and summarized below.

The definition for a CoC within this CBRA is a chemical found in Port Colborne soils originating from an industrial source(s) where all of the following Conditions are met:

Condition 1) Chemicals that were historically used or generated by the industrial source(s) or its processes, **and**

Condition 2) Chemicals that are present at a community level at concentrations greater than MOE generic effects-based guidelines (Table 'A' Generic Guidelines (MOE, 1997)), **and**

Condition 3) Chemicals whose presence in soil show a scientific linkage to the historical operations of that industrial source(s).

INCO is the proponent of the CBRA. Only chemicals that meet all three of the above stated CBRA COC conditions and had originated from INCO's historical operations were considered COCs for the CBRA.

This report presents the results and findings of an emission inventory and dispersion modelling study in finding scientific linkages between measured surface soil chemical concentrations in samples taken from Port Colborne and the two potential industrial sources, as either from Inco or its neighbouring former steel plant, Algoma. This study was done to address CBRA Condition Numbers 1, 2 and 3.

In 2001, a draft report was released, entitled "*Potential CoC Identification using an Emissions Inventory and Dispersion Modelling*" and dated November 23, 2001. The report under this cover represents the final report regarding emission inventories and dispersion modelling of the Inco and Algoma operations.

Other CoC evaluation reports for this CBRA have been prepared documenting other studies that relate from soil mapping and establishing empirical relationships, to statistical analyses which were conducted to address CBRA Condition Numbers 2 and 3, respectively; details of those studies are found in the following documents:

- JWL report entitled *"Potential CoC Identification using Soil Chemical Concentration Data in Exceedance of MOE Generic Guideline"* Jacques Whitford Limited. March 28, 2008.
- JWL report entitled *"Potential CoC Identification using Statistical Analyses"* dated March 28, 2008.

This report provides estimates of the variation of emissions of the following constituents and major contaminant indicators from each facility (over the course of their operations) based on available operating and background records:

- Particulate Matter (PM) for both Algoma and Inco;
- Nickel for Inco; and,
- Iron for Algoma and Inco.

The emissions inventories for each facility were developed utilising standardised methodologies and techniques specified by United States Environmental Protection Agency (US EPA) and the Ontario Ministry of Environment (MOE).

Estimates of the relative deposition of the contaminants from each facility (over the course of their operations) were estimated using the US EPA Industrial Source Complex – PRIME (ISC-PRIME) atmospheric dispersion model. A meteorological data set, consisting of five years of local, hourly wind data (which is expected to be representative of the historical meteorology of the region) were used to calculate contaminant depositions over the surrounding area. This meteorological data was used to represent atmospheric conditions over the entire 90-year period of the dispersion modelling.

The following sections detail the emissions estimation and dispersion modelling methodologies, results and conclusions of the study.

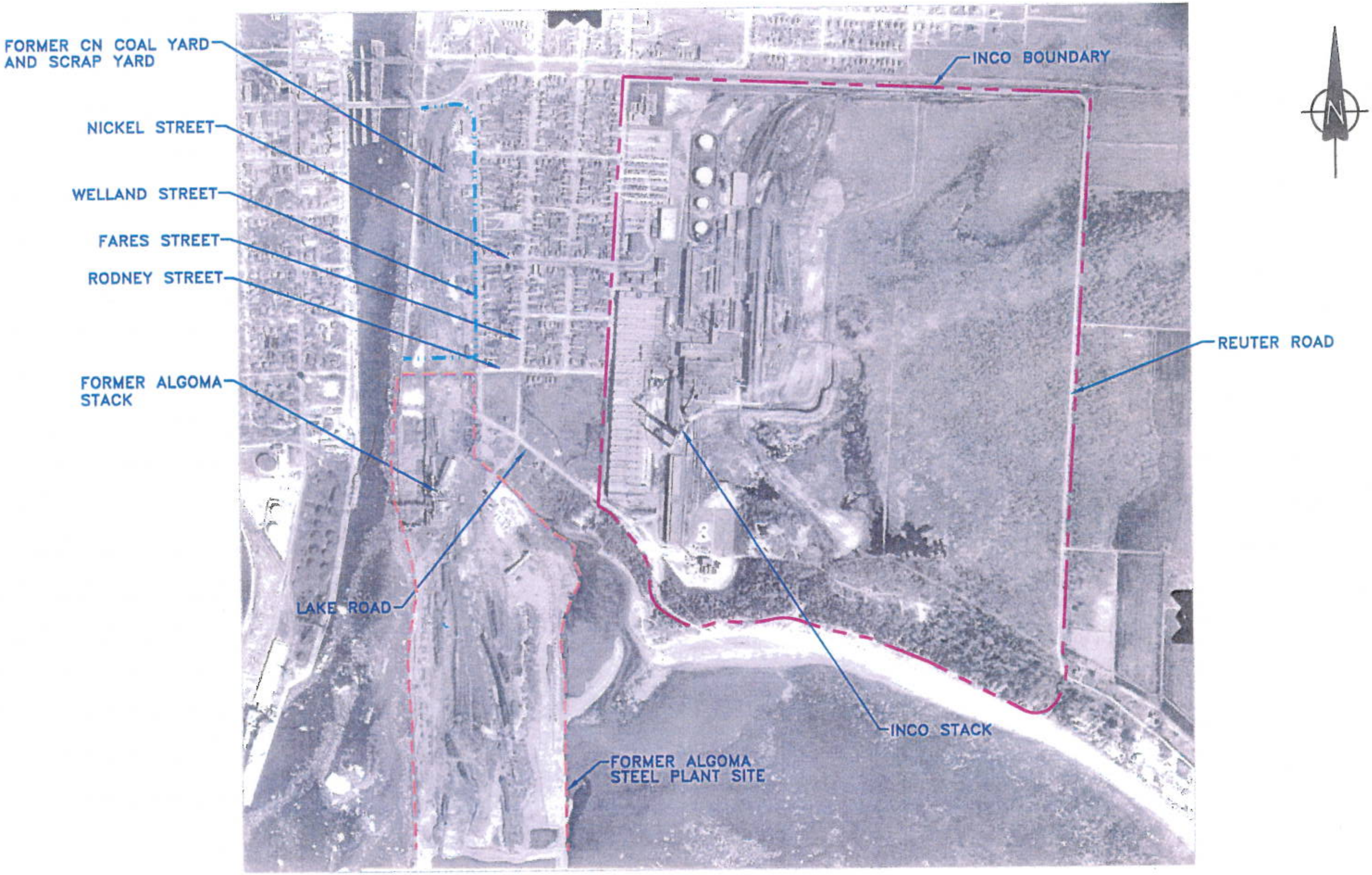
2. OVERVIEW OF INCO AND ALGOMA HISTORICAL OPERATIONS

2.1 General Description Of The Study Area

The area of concern for the current study included the existing Inco Port Colborne facility, and the region between Inco and the Welland Canal. Along the Canal once was the site of the Canadian Furnace Company/Algoma Steel Corporation Limited plant. Previous historical reviews and site assessments have confirmed that this area of concern has been an area of industrial activity since the early 1900s (Jacques Whitford Limited, 2008a). Residential areas have comingled with the refinery and steel plant since and even before the early 1900's.

Although there is evidence of other existing and historical industrial activity in addition to the Inco and Algoma facilities within the study area, the current study focused on potential historic air emissions from these two facilities exclusively.

An aerial photograph of the current study area (circa 1959), showing both the existing Inco site and the former Algoma facility is provided in Figure 2-1.



N.T.S

AERIAL PHOTO (1959) OF THE STUDY AREA
SHOWING THE INCO AND ALGOMA FACILITIES

Job No.: ONT34648		Fig. No.: 2-1
Date: 01/11/23	Dwn. by: PC	Appd: GC

Jacques Whitford

34648-AERIAL 2

2.2 International Nickel Company

The International Nickel Company Port Colborne refinery has been in existence at its current location since the early 1900's. The facility was first operational in 1918 as a branch refinery, with the primary operations being carried out in Bayonne, New Jersey. Since that time the facility has undergone a large number of process, operational and equipment changes. Initial operations were conducted using the Orford process for the high temperature extraction of copper-nickel matte supplied from the Copper Cliff mine. This process separated nickel "bottoms" and copper "tops", which were passed to additional on-site operations. The nickel "bottoms" from the Orford process underwent leaching, roasting, reducing and fire refining to produce nickel ingots. The copper "tops" were reduced to produce blister copper for further refining off-site. The primary operations for these processes including calcining furnaces for roasting, mechanical separation, grinding and crushing, and sintering to reduce the sulphur content of the nickel and copper products.

In the 1930's, the Orford process was discontinued and transferred to the facility in Copper Cliff. The Port Colborne facility focused on coal fired reverberatory furnaces and calcining furnaces to reduce the Orford bottoms received from Copper Cliff to produce the nickel products. In the mid 1920's, electro-refining operations were introduced, which allowed for the production of nickel in electrolytic tanks, removing the need for fire refining. Over time, the proportion of fire refining conducted by the facility was gradually reduced in favour of an increased emphasis on electro-refining. Unlike fire refining operations, electrolytic refining, being a low temperature electrochemical process, has a negligible potential to result in any significant air emissions. The electro-refining of nickel was ceased in 1984.

Additional processes introduced to the Port Colborne facility included precious metal refining for the recovery of trace precious metals, and the introduction of electro-refining for cobalt. Current operations consist primarily of cobalt refining and precious metal refining.

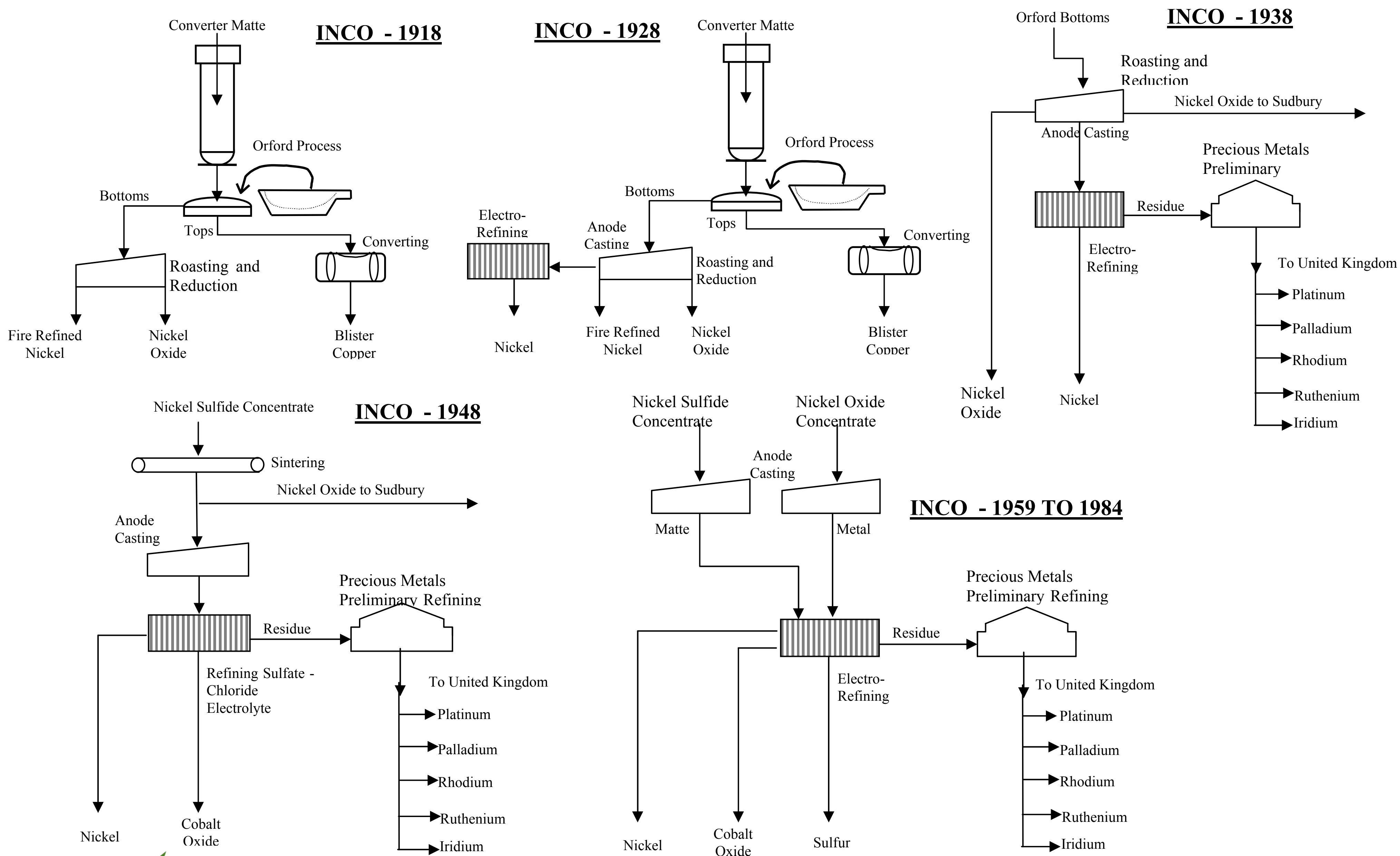
Figure 2-2 provides a photograph of the Inco Port Colborne facility in the background and the neighbouring Algoma Steel facility in the foreground from a period in the 1950's. The residential area situated between these two facilities in Figure 2-2 is later on in this text referred to as the Rodney Street Area. The following schematics in Figure 2-3 provide a series of process flow diagrams for the facility ranging from 1918 through to 1968.

Figure 2-2 Inco - Port Colborne

(Courtesy of the Port Colborne Historical Museum) circa 1950's

Figure 2-3 Historic Operations at Inco – Process Schematics

Ref.:Renzoni, L.S. "Extractive Metallurgy at International Nickel - A Half Century of Progress" Feb, 1969 (Modified – Jacques Whitford 2001)



Within the refinery there were historically processes that generated air emissions and others that had negligible air emissions. An example of the later is electro-refining – a process which allowed for the production of nickel in electrolytic tanks, removing the need for fire refining. Unlike fire refining operations, electrolytic refining, being a low temperature, wet, electrochemical process, had a negligible potential to result in any significant air emissions. Other processes with negligible air emissions included precious metal refining for the recovery of trace precious metals and electro-refining of cobalt.

The processes of concern with regards to the potential for the generation of air emissions are discussed briefly in the following sections.

Orford Process

The original Orford process operations consisted of three cupola furnaces (two for nickel, one for copper), three copper reverberatory furnaces, three copper converter stands and two slag reverberatory furnaces. All of these operations were conducted in the original Number 1 building (see Figure 6-2) located at the east end of the property. The combined air emissions from these operations were routed through two common plenums to a Cottrell precipitator that discharged to a 350-foot stack (source B1-01 in Figure 6-2). The Cottrell precipitator was shut down in December 1920. Significant material handling operations, matte and coal storage as well as fugitive losses from the furnaces were associated with these processes.

Calcining Furnaces

The calcining furnaces were part of the copper-nickel separation leaching operations conducted to selectively remove the nickel and copper as oxides. Incoming material was ground, crushed and partially roasted on the upper deck of the calcining hearth furnace. The partially roasted material was subsequently mixed with salt for chloridizing the copper and nickel and transferred to a series of leaching tanks. At this stage, the majority of the copper has been removed, and left over material is impure nickel oxide. Subsequent roasting at high temperatures (1,200°C) and additional leaching resulted in a nickel oxide material, with an approximate composition of 77.5% nickel, 0.1% copper, 0.25% iron and 0.008% sulphur.

Air emissions from the grinding, material handling and calcining operations were routed through an underground flue to a large dust chamber for the inertial separation of particulate matter before being exhausted to the atmosphere through a dedicated 350 foot exhaust stack (source DC01 in Figure 6-2).

Sintering

Sintering operations were intended primarily as desulphurization, with the sulphur content being reduced from approximately 25% to 0.4%. The incoming matte and nickel oxide materials were crushed through a series of jaw crushers and cone crushers, prior to high temperature roasting to reduce sulphur. Some of the resulting sinter was further refined on-site, while some was shipped as a market product. The air emissions were exhausted through the same underground flue/ dust chamber as used for the calcining furnace emissions.

Nickel Reverberatory Furnaces

The crude oxide, or sinter, was further processed on-site using a series of reverberatory type anode furnaces. These operations consisted of high temperate reduction of the nickel oxide to produce impure nickel metal, which was cast into nickel ingots or nickel shot for electrolytic nickel production.

2.3 Algoma Steel/Canadian Furnace Company

The property adjacent to the canal was the site of an iron smelter, which operated from 1911 until 1977. Originally operated as the Canadian Furnace Company Limited, the site was purchased by Algoma Steel Corporation Limited in 1950 and operated as the Canadian Furnace Division until the facility ceased operation and was subsequently demolished.

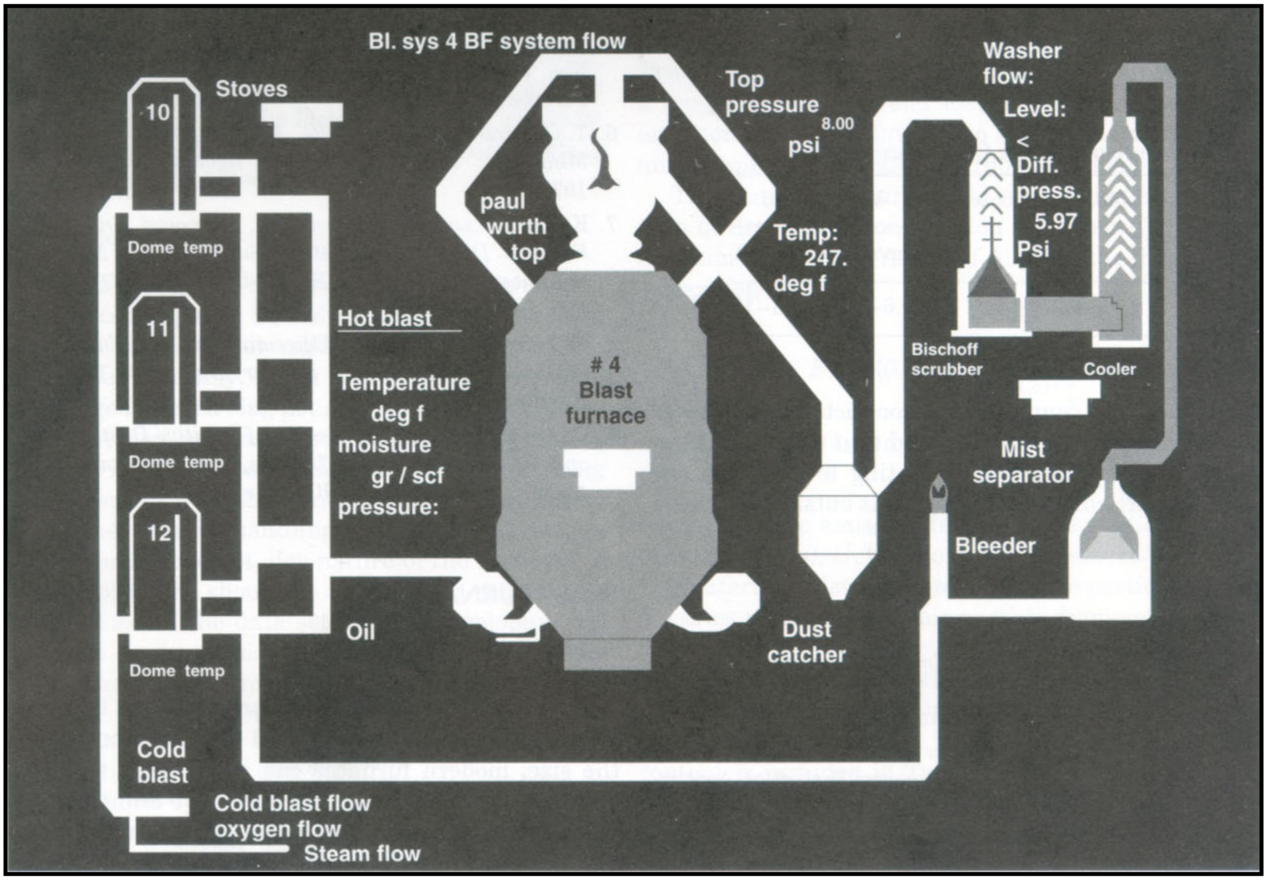
The Canadian Furnace/Algoma facility manufactured pig iron used for the fabrication of other steel products. Pig iron is manufactured from sintered iron ore in a blast furnace and reduced with hot gas. The manufacture of one tonne of iron requires approximately 1.4 tonnes of iron bearing material, 0.65 tonnes of coke, 0.25 tonnes of limestone or dolomite, and 2 tonnes of air. The resulting by-products include 0.4 tonnes of waste slag and 3.5 tonnes of blast furnace gas containing dust particulate.

Iron ore is mixed with waste materials and melted and agglomerated into sinter for subsequent charging to a blast furnace. Sintering consists of high temperature (1300 to 1480 °C) treatment of the ore, to provide surface melting and agglomeration of the finer particles into larger clumps. The fused sinter is crushed and screened to provide a material of a suitable size for the blast furnace.

The blast furnace consists of a large refractory lined chamber, which is charged with sinter, ore and flux (typically limestone or dolomite) and fired with coke. The mixed material is chemically reduced with hot gas to provide molten iron and slag. The molten iron and slag collect at the base of the furnace and are removed through different holes in the base of the furnace hearth. Between each metal pour, the taphole is plugged with clay. Tapping involves breaking open the clay plug to allow the molten iron and slag to pour down a series of runners to the casting machine for the manufacture of iron ingots, or pigs. Waste gas from the furnace is collected, treated to remove most of the particulate, and recycled as fuel to fire the stoves, which in turn provide the heated air for use in the blast furnace. A schematic of the blast furnace is provided in Figure 2-4.

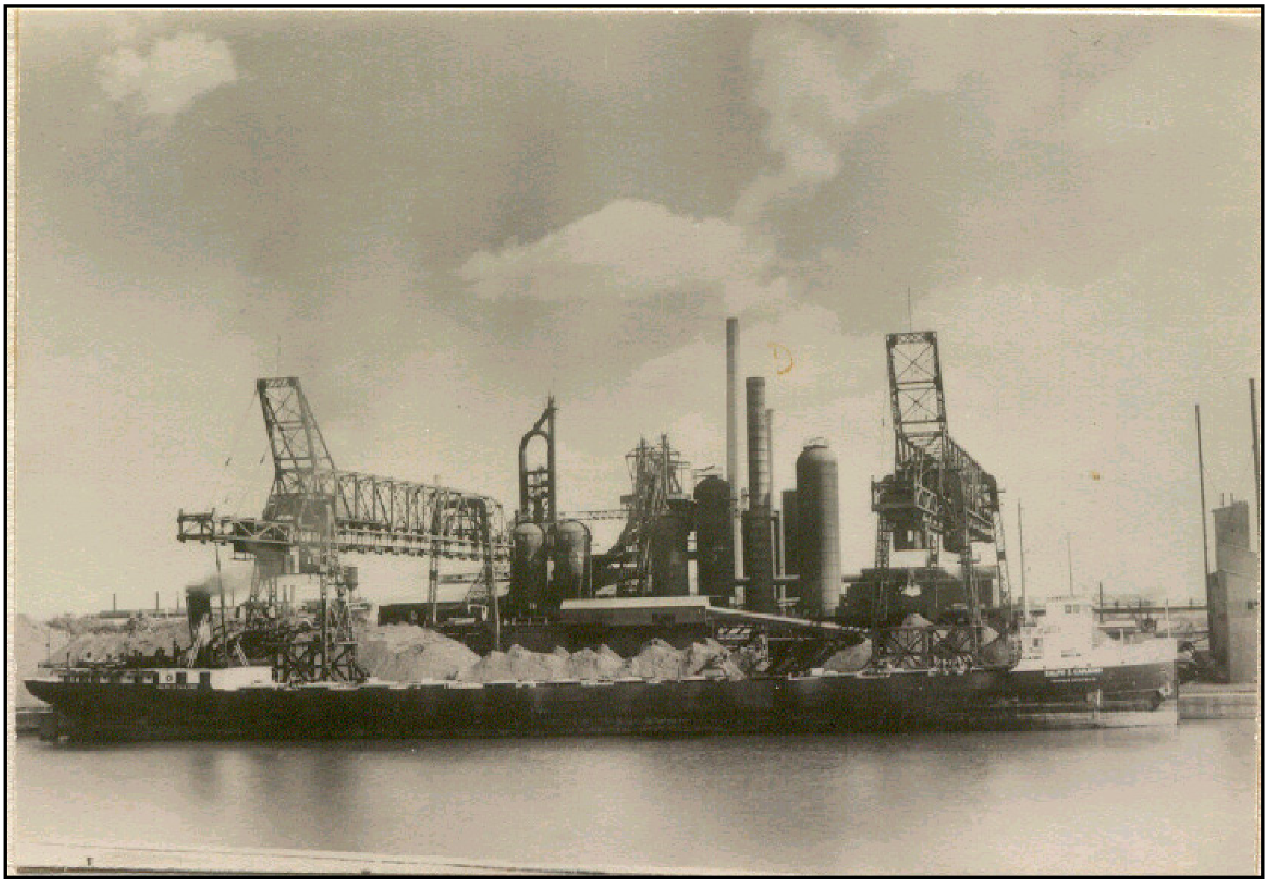
The facility originally consisted of two blast furnaces, with a total of five stoves providing the reducing air. Molten iron was poured into pig iron ingots using a link belt single strand pig casting machine. A single Greenawalt sintering plant was used for the conversion of raw iron ore into process sinter for charging into the blast furnaces. The gas cleaning system for the facility consisted of a dust catcher cyclone and a wet scrubber. A second double strand pig casting machine was added in 1960 to accommodate an increase in production of pig iron. By 1964, one of the blast furnaces was taken out of commission and the overall production capacity of the facility reduced. By 1977, the facility had ceased operation and was subsequently demolished. Materials, including ore, coke and slag, were stored in open stockpiles between the facility and the edge of the canal. An historic photograph of the site is provided in the Figure 2-5.

Figure 2-4 Schematic of a Typical Blast Furnace



Reference: AWMA, Air Pollution Engineering Manual, 2nd Edition, 2000.

Figure 2-5 Algoma Steel/Canadian Furnace Company



Picture of former steel plant upwind of the Inco refinery (Courtesy of the Port Colborne Historical Museum) circa 1950's

3. HISTORIC AIR EMISSION INVENTORY

3.1 Overview of Inventory and Applicability

3.1.1 Overview

A series of air emission inventories were developed to cover the historic operating periods of the Inco and Algoma Port Colborne facilities. The inventories were developed following the protocols of an Emission Summary and Dispersion Modelling Report as stipulated in the Ontario Ministry of the Environment guideline document *Procedure for Preparing an Emission Summary and Dispersion Modelling Report*, dated June 1998.

In order to account for the changes in equipment, production methods and manufactured materials over the course of the historic operating periods of the facilities, a series of separate inventories were compiled for each facility. Each air emission inventory scenario was designed to cover a period of years where the operating conditions were relatively consistent for each facility.

The design of the inventory scenarios included the following considerations:

- Major modifications to facility operations and processing equipment;
- Major changes to production levels and/or types of materials produced; and
- Availability of reliable information sources.

For each scenario, an air emission inventory was developed for a representative year of operations. The estimated air emissions for the representative year were taken to be indicative of the emissions for each year of that scenario period.

3.1.2 Applicability

The air emission inventories developed under this study were intended to explore the historic air emissions of selected metals from operations at the Inco and Algoma facilities. As a consequence, the current inventories were only focused on the principle sources of metals emissions from the facilities, based on the available information regarding historic operations. These inventories should not be considered as rigorous attempts to fully characterise the total air emissions profile of all potential contaminants over the operational history of the facilities.

Further, the development of rigorous emission inventories for historic operations was constrained by the availability of detailed, reliable operating information for the facilities; in particular the early operating years. Given that one of the intended objectives of this study was the comparison of the relative air emissions from the two facilities, priority was given to ensuring that processes from both facilities were examined in a consistent manner and that similar emission estimation approaches were used. This was especially important in instances where detailed site-specific information was not generally available.

3.2 Information Sources

Three primary categories of information were used for the preparation of the inventories: site specific information, previous inventory work, and engineering estimates. The specific information resources used are cited in the following sections. The full references for published information sources are provided in the References Section at the end of this document.

3.2.1 Site Specific Information

Site specific information resources used for this study include the following:

Inco References:

- Historic site plans for the facility, including:
  - Document No. 70-052-B-00470, Port Colborne General Arrangement of Plant, May 30, 1919.
  - Document No. 70-052-B-00492, Port Colborne Refinery, Plant Layout, April 3, 1935.
  - Document No. 70-052-B-00463, Port Colborne Nickel Refinery, site plan, October 27, 1958.
  - Document No. 70-052-B-00464, Port Colborne Nickel Refinery, September 23, 1974.
  - Document No. 70-052-B-00462, Port Colborne Nickel Refinery, Insurance Plan, October 10, 1984.
  - Document No. 70-052-B-31633, Port Colborne Refinery, Source Data Manager Base Drawing Site Plan, November 17, 1999.
- Inco Internal Memorandum. WHMIS Speciation of Port Colborne Cottrell Dust. December 7, 1988;
- Inco Internal Memorandum. Historic Samples from PCNR. May 28, 1986;

- Inco "Metals Practice Sheets" spreadsheet: Production-Receipts.xls, November 30, 2000;
- Inco internal report, "Appendix I : History of Operations";
- Inco internal report, Figures 1-6, and Port Colborne Refinery Simplified Flow Diagram; and
- Inco internal report, "Port Colborne Nickel Refinery" with attachment "Port Colborne Nickel Refinery Flow Chart".

Algoma References:

- Algoma Ore Division. Mine Closure Plan November 1, 1994.
- Directory of Iron and Steel Works of the United States and Canada, American Iron and Steel Institute. Editions 26, 28, 29 and 30. 1951, 1957, 1960 and 1964; and
- Port Colborne Historical Museum, Inco Photograph of Algoma/Canada Furnace Limited "Where Victoria Pig Iron is Produced".

3.2.2 Previous Emission Inventories

Additional background data for this study was taken from previous emission inventory work relating to the Inco facility.

Inco References:

- Inco internal report, "Stacks Query", 8/10/01.

3.2.3 Engineering Estimates

Given the paucity of rigorous, well documented air emission sampling data for either facility, and to maintain consistency with the estimation techniques between the two facilities, the emission estimates were developed based on industry recognised mass balance and engineering estimation techniques. The following literature sources provided guidance on estimation procedures and techniques in addition to emission factors and calculation algorithms:

- Buonicore, A.J., W.T. Davis eds. 1992. Air Pollution Engineering Manual. Air & Waste Management Association. Van Nostrand Reinhold;
- Ontario Ministry of the Environment. 1998. Procedure for Preparing an Emission Summary and Dispersion Modelling Report; and
- U.S. Environmental Protection Agency (1983). Compilation of Air Pollutant Emission Factors, Supplement No.14 AP-42.

3.3 Emission Estimation Approaches and Data Quality

3.3.1 Format of Emission Estimates

Each of the emission estimates have been expressed according to the following generic equation:

$$ER \quad = \quad AR \ x \ EF \ x \ (1 - CE)$$

Where:

ER	=	Emission rate, expressed in units of tonnes per year or grams per second;
AR	=	Activity Rate of the process in question, typically represented by the associated material throughput or production rate;
EF	=	Emission Factor, expressed in units of mass of contaminant emitted per unit activity rate of the associated process; and
CE	=	Control Efficiency associated with the process in question, where appropriate.

3.3.2 Averaging Period

Emission factors were calculated according to a variety of process specific information, such as control/collection system efficiencies, published emission factors, and operating rates of the associated process. The emission rates were calculated based on annual material throughput data to give an averaging period expressed over an annual basis. As no reliable data were available regarding historic operating hours per year for the various processes, the short term emission rates (expressed as grams per second, hourly average basis) were scaled from the annual data using the assumption of continuous operation.

This approach was taken to ensure that the inventories reflected a reasonably conservative assessment, and that both facilities were treated on a consistent basis.

3.3.3 Data Quality

The emission estimates developed under this study have been assigned a data quality rating based on the estimation methodology and information resource used. The terminology's used for describing the emission estimation technique and the resulting data quality have been based on the Ontario Ministry of the Environment guideline document *Procedure for Preparing an Emission Summary and Dispersion Modelling Report*, dated June 1998. The following reference terminologies in Table 3-1 have been used for this study:

Table 3-1 Emission Estimation Methods

Reference	Estimation Method	Data Quality
USEPA EF	Emission factor published by the U.S. EPA in Report AP-42, Fifth Addition	A, B, C, D or E
EPA/INCO EF	Emission factor published by U.S. EPA, modified by additional site specific data from INCO	A, B, C, D or E
EPA/AL EF	Emission factor published by U.S. EPA, modified by additional site specific data from Algoma	A, B, C, D or E
AWMA EF	Emission factor developed based on information published by the Air & Waste Management Association	A, B, C, D or E
EC	Emission estimate derived from process data, manufacturer's specifications or other Engineering Calculation	Conservative (Con)

The U.S. EPA AP-42 Emission Factors are given data quality ratings of A through E, with A representing estimates with the highest level of confidence (direct source measurements, validated by multiple testing) and E representing the lowest level of confidence (few tests with inconsistent results).

Table 3-2 Data Quality Ratings

Data Quality Rating	Reliability	Basis
A	Excellent	Derived from sound, validated source tests from many randomly chosen facilities from a specific source category population. Minimal variability in data.
B	Above Average	Derived from sound, validated source tests from a reasonable number of facilities from a specific source category population. Industries tested may not represent a random sample. Minimal variability in data.
C	Average	Derived from generally sound and/or new source testing methodologies from a reasonable number of facilities. Industries tested may not represent a random sample. Minimal variability in data.
D	Below Average	Derived from generally sound and/or new source testing methodologies from a small number of facilities. There is evidence that the industries tested do not represent a random sample. Some variability evident in data.
E	Poor	Derived from new and/or generally unacceptable source testing methodologies. There is evidence that the industries tested do not represent a random sample. Variability evident in data.

In several cases, emission factors were taken from published references and further modified using site specific information. In these instances, the data quality rating given for that emission factor was reduced by one letter grade to account for the potential reduction in accuracy of the modified estimate.

3.4 Inventory Methodology

3.4.1 Inventory Scenarios

Given the available information resources, the historic operations for the two facilities were separated according to the following operating periods:

Table 3-3 Inco Air Emission Inventory Scenarios

Scenario	Operating Years	Reference Year	Operational Highlights
1	1918 - 1930	1928	Orford Process and electro-refining, Cu and Ni only
2	1931 - 1938	1938	Orford Process ceased, electro-refining and precious metals refining
3	1939 - 1959	1958	Electro-refining upgrades, sintering ceased
4	1960 - 1979	1968	New Cottrell ESP start-up.
5	1980 - 1990	1983	Electro Co refining start-up in 1983

In the period from 1991 to 2001,a negligible quantity of nickel was emitted from the Inco facility (based on Inco's NPRI submissions to Environment Canada). Therefore emissions during this period were not included in the dispersion modelling.

The primary data references for development of the Inco scenarios were:

- Historic facility site plans;
- Inco "Metals Practice Sheets" spreadsheet; and
- Inco internal report, "Appendix I: History of Operations" and historic Port Colborne Refinery process flow diagrams.

Table 3-4 Algoma Air Emission Inventory Scenarios

Scenario	Operating Years	Reference Year	Operational Highlights
1	1913 - 1951	1951	Pig Iron and Ferroalloy[1] production, two blast furnaces
2	1952 - 1959	1957	Pig Iron production only, two blast furnaces
3	1960 - 1977	1960	Pig Iron production only, one blast furnace

[1]Ferroalloy production accounted for only 4.4% of the total facility production levels, based on the literature reference for 1951.

The primary data references for development of the Algoma scenarios were:

- Directory of Iron and Steel Works of the United States and Canada, American Iron and Steel Institute. Editions 26, 28, 29 and 30. 1951, 1957, 1960 and 1964.

3.4.2 Emission Inventory Design

The design of each of the air emission inventories was based on the following:

- Availability of a direct historic reference for each emission source included in the inventory;
- Availability of a direct, validated emission estimation technique for each identified emission source type;
- Availability of a direct, site specific reference regarding trace metal composition for each identified emission source type; and
- Consistency of emission estimation techniques for similar processes between each scenario and between the two facilities.

This approach was used to ensure that all data used for the inventories were traceable to a reference document, based on validated emission estimation techniques and consistent between the two facilities. This allowed the comparison of historic air emissions from the two facilities to be conducted on a consistent basis.

Using this basis, the inventories were developed according to the following methodology:

- Emission estimates were developed for the principle process operations referenced in the historic documentation, and included furnaces, material handling (crushing/grinding) and material storage stockpiles;
- The standard U.S. EPA emission factors for total particulate matter were used for the appropriate process for all emission sources to provide a baseline "template" particulate emission inventory for each scenario; and
- Site specific trace metal composition data were used for various materials (such as raw ores, coal, slag, and material from dust collection systems) and applied to the template particulate emission inventory to produce each specific trace metal emission inventory.

3.4.3 Emission Estimation Methodologies

The following emission estimation methodologies were used to develop baseline particulate matter air emission estimates for each of the operational scenarios.

Several simplifying assumptions were made during the development of the air emission inventories:

- Fugitive air emissions relating to specific processes were assigned to a single emission point from the roof of the associated building;
- Material loading/unloading emissions were assigned to the same locations as the material stockpiles (if applicable); and
- Minor emissions sources and processes with negligible potential to emit the trace metals of concern for this study were not included in the inventories.

3.4.4 Inco Process Emissions

The primary process operations of concern from the Inco facility were:

- Cupola furnaces;
- Reverberatory furnaces;
- Calcining furnaces;
- Electric furnaces;
- Ball mills / material grinding;
- Foundry additives production
- Sintering; and
- Nickel refining furnaces.

Air emissions from electro refining and precious metals refining were not included in the inventories as these processes were negligible contributors of the trace metals of concern for this study.

The U.S. EPA compilation of air pollutant emission factors does not specifically include data for particulate emissions from nickel refining. Emission factors were therefore taken from analogous processes, including general ore handling/grinding operations and similar furnaces from the iron and steel manufacturing data compilation.

Cupola Furnaces

Emissions from the matte and nickel cupola furnaces, as well as the copper tops holding furnace, operated during the early historical period (1918-1930) were estimated based on cupola furnace emission factors for gray iron foundries. As these emissions were routed to the old Cottrell electrostatic precipitator, which was assumed not to function, the uncontrolled emission factor (EF) was used.

$$ER = AR \times EF$$

Where:	ER	=	Emission Rate
	AR	=	total tonnes of metal produced
	EF	=	Emission factor for uncontrolled cupola furnace
		=	6.9 kg / Mg

Source: U.S. EPA Report AP-42, Section 12.10. Data quality rating E.

Copper Reverberatory Furnaces / Converters

Emissions from the copper reverberatory furnaces and converters, operated during the early historical period (1918-1930) were estimated based on reverberatory furnace/converter emission factors for primary copper smelters. As these emissions were routed to the old Cottrell electrostatic precipitator (which was assumed not to function), the uncontrolled emission factor was used.

$$ER = AR \times EF$$

Where:	AR	=	total tonnes of metal produced
	EF	=	Emission factor for an uncontrolled copper reverberatory furnace
		=	25 kg / Mg
	EF	=	Emission factor for an uncontrolled copper converter
		=	18 kg / Mg

Source: U.S. EPA Report AP-42, Section 12.3. Data quality rating B.

Calcining Furnaces/Slag Reverb Furnaces

Emissions from the calcining furnaces were estimated using the reverberatory furnace emission factors for gray iron foundries. The uncontrolled emission factor was used, as these emissions were routed through the dust chamber.

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for uncontrolled reverberatory furnace

= 1.1 kg / Mg

Source: U.S. EPA Report AP-42, Section 12.10. Data quality rating E.

Electric (Anode) Furnaces

Emissions from the electric (anode) furnaces (as well as the electric slag furnace and FAP) were estimated using the electric arc furnace emission factors for gray iron foundries. The uncontrolled emission factor was used until multiclone dust collectors were installed (starting in 1938).

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for uncontrolled electric arc furnace

= 6.3 kg / Mg

= 1.89 kg/Mg for furnace with multiclone (assumed 70% control efficiency)

= 0.315 kg/Mg for the FAP Baghouse (assuming 95% baghouse control efficiency)

Source: U.S. EPA Report AP-42, Section 12.10. Data quality rating C for uncontrolled and D for controlled.

Nickel Refining Furnaces

Emissions from the nickel refining furnaces were estimated using the open-hearth furnace emission factors for iron and steel making. The uncontrolled emission factor was used for the older, uncontrolled, furnace emissions, and a control efficiency of 70% was assumed for emissions after installation of a multi-clone dust collector.

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for open hearth furnace

= 10.5 kg / Mg for uncontrolled and 3.15 kg/Mg for controlled

Source: U.S. EPA Report AP-42, Section 12.5. Data quality rating D for uncontrolled and E for controlled.

Process Fugitives from Furnaces

Process fugitive emissions from furnace operations were estimated using the emission factor for roof monitor emissions resulting from open hearth furnace operations in iron and steel making.

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for roof monitor above open hearth furnace

= 0.084 kg / Mg

Source: U.S. EPA Report AP-42, Section 12.5. Data quality rating C.

Ball Mills/Material Grinding

Emissions from the mechanical grinding of ores (ball mills, krupp mills, and jaw crushing) were estimated using the emission factors for lead bearing ore crushing and grinding.

$$ER = AR \times EF \times (100 - CE) / 100$$

Where: AR = total tonnes of metal produced

EF = Emission factor for copper ore crushing and grinding

= 3.2 kg / Mg

CE = estimated control efficiency

= 70% for cyclone control; 95% for baghouse control

Source: U.S. EPA Report AP-42, Section 12.18.

Data quality rating B for emission factor. Reduced to C for estimated control efficiencies.

Sintering

Sintering emissions were estimated for the windbox exhaust and sinter discharge. The uncontrolled emission factors were used, as these emissions were routed through the dust chamber.

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for sintering windbox exhaust + Sinter discharge

= 5.56 + 3.4 = 8.96 kg / Mg

Source: U.S. EPA Report AP-42, Section 12.5. Data quality rating B.

Old Cottrell Precipitator Emissions

The old Cottrell precipitator handled the emissions from the cupola furnaces, reverberatory furnaces and converters located in building 1 (see Figure 6-2) under the first operational scenario (1918-1930) and the combined emissions from the sources were routed to the single 500-foot Cottrell precipitator exhaust stack. The Cottrell precipitator was shut down in December 1920 after only three years of operation. Anecdotal data suggests that this equipment may have only had minimal effectiveness, therefore a control efficiency of 0% (no control) was applied to these emissions.

New Cottrell Precipitator Emissions

The new Cottrell electrostatic precipitator (ESP) was installed in 1960 and controlled the emissions from all nickel refining furnaces in the #4 building (see Figure 6-5), and supplemented the cyclone/multiclone dust collectors installed on several of the furnaces during 1938-1939. A control efficiency of 99 percent for the multiclone/ESP control system was applied to the uncontrolled emissions estimates for these sources.

Dust Chamber Emissions

Several processes were tied into a common exhaust plenum and routed to a large settling chamber for particulate removal, prior to exhaust to the atmosphere through a large dedicated exhaust stack. For purposes of this evaluation, the following sources from buildings 2 and 3 (see Figure 6-2) were considered to exhaust through the dust chamber system:

- Calcining furnaces;
- Electric furnaces; and
- Sinter machine.

An estimated emission control efficiency was applied to the combined emissions from these processes. For the purpose of this evaluation, the dust chamber was assumed to operate as a moderately efficient inertial separator, and was assigned a particulate removal efficiency of 70%. The dust chamber exhaust was initially emitted through a 350-foot stack. The stack was replaced in 1936 with a 500-foot stack.

3.4.5 Algoma Process Emissions

The primary process operations of concern from the Algoma facility were:

- Blast Furnaces;
- Pig Iron Casting; and
- Sintering

Blast Furnaces

Emissions from blast furnace operations included fugitive losses, tapping and the combustion of blast furnace gas for operation of the blast furnace stoves.

For fugitive blast furnace emissions and emissions from tapping, the following expression was used:

$$ER = AR \times EF$$

Where: AR = total tonnes of metal charged to blast furnace

EF = Emission factor for uncontrolled roof monitors and tapping.

= 0.3 kg/Mg for roof monitors and 0.15 kg/Mg for tapping

Source: U.S. EPA Report AP-42, Section 12.5.

Data quality rating B for both roof monitors and tapping.

For blast furnace gas combustion, the amount of blast furnace gas generated was estimated based on an estimate of 2,000 cubic meters of gas generated per tonne of metal produced, with an energy value of 3.7 MJ/m^3.

Source: AWMA Air Pollution Engineering Manual, 1992. p. 651

The current AP-42 emission factor for blast furnace gas combustion assumes a control efficiency of over 99% as current technology for these emissions includes a cyclone/wet scrubber followed by a high efficiency wet scrubber or ESP. It was expected that emissions control technology during the turn of the century operations of the mill would not be able to account for a 99% control efficiency therefore the AP-42 emission factor was weighted to represent 80%, 90% and 95% control efficiency for Scenarios 1 to 3 respectively. The corresponding particulate matter emission estimate from blast furnace gas combustion was:

$$ER = AR \times EF$$

Where: AR = Energy value of total blast furnace gas combusted (MJ)

EF = Emission factor for blast furnace gas combustion.

= 0.0003 kg/MJ (Scenario 1 with 80% control efficiency)

= 0.00015 kg/MJ (Scenario 2 with 90% control efficiency)

= 0.000075 kg/MJ (Scenario 3 with 95% control efficiency)

Source: U.S. EPA Report AP-42, Section 12.5. Data quality rating D reduced to E for assumed control efficiencies.

Pig Iron Casting

Emissions from the casting of pig iron were estimated using the emission factor for torpedo cars during hot metal desulphurization:

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for a single torpedo car

= 0.55 kg/Mg

Source: U.S. EPA Report AP-42, Section 12.5. Data quality rating D.

Sintering

Sintering emissions were estimated for both the windbox and discharge (breaker and hot screens). The emission factors for uncontrolled sintering were used with an estimated control efficiency of 80% (Scenarios 1 and 2) and 90% (Scenario 3).

$$ER = AR \times EF$$

Where: AR = total tonnes of metal produced

EF = Emission factor for sintering windbox and discharge

= 1.12 kg/Mg for windbox and 0.68 kg/Mg for discharge with 80% control efficiency. (Scenarios 1 and 2)

= 0.556 kg/Mg for windbox and 0.34 kg/Mg for discharge with 80% control efficiency. (Scenario 3)

Source: U.S. EPA Report AP-42, Section 12.5.

Data quality rating of C for windbox and B for discharge with estimated control efficiencies.

3.4.6 On-Site Material Handling

The material handling activities on-site can be categorised as either batch or continuous operations, depending upon how these activities are conducted on-site. Both types of operation are covered by a general emission factor equation.

The general emission factor equation is:

$$EF = \frac{k \ x\ 0.0016\,(U/2.2)^{1.3}}{(M/2)^{1.4}}$$

Where: EF = emission factor, kg/tonne of material handled

k = particle size multiplier

U = mean wind speed, m/s

M = material moisture content, %

The equation is considered to have a quality rating of A for material silt contents in the range of 0.44% to 19%. For silt contents outside of this range, the quality rating is considered to be reduced to B.

Source: U.S. EPA Report AP-42, Section 13.2.4. 1995.

The corresponding material emission rates is determined by:

$$Emission\ Rate = EF \times SE$$

Where:
- EF = general emission factor, kg/tonne of material handled
- SE = source extent or mass of material handled, tonnes per year

For this assessment, a mean wind speed value of 4.5 m/s was used for all calculations. The default material moisture content values from US EPA AP-42 Section 13.2.4 were used for ore, coal/coke and slag. The values used were 6.6%, 7.8% and 0.9% respectively.

3.4.7 Wind Scavenging (Erosion)

Air emissions resulting from wind scavenging or erosion are associated with the on-site stockpiles of coal, ore and slag. Emissions are only generated due to the action of wind across the surface of the materials, and are independent of the emissions generated by loading, unloading or other material handling operations.

Erosion emissions from the material stockpiles are separated into active and inactive emissions. Wind erosion from the active areas of the stockpiles tends to be greater due to the mechanical action on the surface of the material. Inactive piles typically develop a surface crust, reducing the amount of free material available for wind transport.

The emission factor for wind erosion may be expressed as:

$$EF \quad = k \times N \times [58(u - u_t)^2 + 25(u-u_t)]$$

Where: EF = Emission factor, g/m2

k = Particle size multiplier (1.0 for total particulate)

N = Number of times the surface material is disturbed in a given time period

u = Friction velocity, m/s

ut = Threshold friction velocity, m/s

Source: U.S. EPA Report AP-42, Section 13.2.5. 1995.

To determine the corresponding erosion emission rate for a given unit of time:

Emission Rate = EF x Surface area of exposed material

Estimates of the size of the various material stockpiles were made based on visual observations of the historic site plans, fire insurance plans and aerial photographs. For this assessment, the following assumed values were used:

Table 3-5 Surface Areas of Material Stockpiles

Stockpile	Inco Facility (M^2)	Algoma Facility (M^2)
Primary Feed	-	11,387
Coal/coke	12,110	5,287
Slag	12,110	3,254

It should be noted that this emission estimation methodology generates erosion emission rates that vary with wind speed. To calculate an annual average emission rate, a median wind speed value was employed based on an analysis of the local meteorological data set. For this assessment, a value of 78 km/hour was used for both the Inco and Algoma sites.

When using this equation for dispersion modelling over a specific time period, the value of N (the number of times the surface material is disturbed) is used to differentiate between active and inactive areas of the surface materials. Active areas are disturbed more frequently than inactive areas, and consequently have a higher value of N, which generates higher emissions. For this assessment, it was assumed that the material stockpiles underwent a major disturbance once every two weeks over the course of the year, to yield a value of 26 for N. This assumed value was applied to both the Inco and Algoma sites for consistency.

The friction velocity can be calculated for any observed wind speed value by converting the observed value to the corresponding "fastest mile of wind", and then applying a factor of 0.053 for relatively flat, exposed areas.

Using an observed hourly average wind speed of 78 km/hr, the corresponding friction velocity may be calculated as:

$$u = \frac{78 \;\; km/hr \;\; x \;\; 1.24 \;\; x \;\; 0.053 \;\; x \;\; 1000 \;\; m/km}{3600 \;\; s/hr}$$

$$= 1.42 \;\; m/s$$

Where the factor of 1.24 was determined from the logarithmic relationship between hourly mean velocity and "fastest mile" velocity.

The threshold friction velocity stipulates the minimum wind speed required to scavenge particulate matter into the air, and can be estimated from the dry aggregate structure of the surface material. A threshold friction velocity of 1.33 m/s, with a corresponding surface roughness height of 0.3 cm was used for this assessment.

3.5 Metal Compostion Data

Development of the specific metals emission inventories for each of the scenarios involved the application of a composition factor for the specific metal in question to the baseline particulate emission inventories. The following composition data were used for PCNR emissions:

Table 3-6 Metal Composition Data for Inco

Material	Nickel Content (%)	Iron Content (%)
Matte	41.8	0.32
Sinter	74.2	0.81
Green/Black Nickel Oxide	77.0	0.39
Coal/Coke	0.0004	0.0303
Slag	0.478	5.34
Cottrell Precipitator Dust	75.1	0.89

Speciation factors for the matte were taken as the maximum metal content of either Coniston or Copper Cliffe Bessemer matte (analysis of 1930-40 era matte) presented in an Inco memo to J.S. Warner from V.J. Zatka, May 1986. Speciation factors for the Green/Black nickel oxide and sinter were also taken as the maximum metal content of analysis of green NiO (1953) and black NiO (1953), and sinter (1940 and 1950) respectively, presented in the same memo. Metal speciation of the slag was taken from analysis of the Refold slag conducted in 1991. Speciation factors for the new Cottrell Precipitator were taken from analysis of inlet dust to the electro-static precipitator (ESP) presented in an Inco memo from W. Gibbs to A. Mansion, December 1977.

There were no specific data available regarding the trace metal content of the ores and materials used historically at the Algoma facility. For the purposes of this evaluation, an iron content value of 35% was used for the Algoma ore and 51% for the Algoma sinter. These values were listed in "Survey of the Canadian Iron Ore Industry during 1957".

3.6 Facility Activity Data

Activity data for the Inco facility for each of the historical emissions scenarios considered were developed from Inco records of annual material production and raw material receipts by averaging the data over each time period. The average activity data for each emissions scenario are presented in Table 3-7.

Table 3-7 Average Activity Data (tonnes/year) for each Inco Emission Scenario

	1918-1930	1931-1939	1940-1959	1960-1979	1980-1990
Product					
Green in	323.7	796.6	237.6	124.4	0.0
Black in	9127.7	1943.1	1778.7	121.2	0.0
Sinter	4994.0	37846.8	43757.4	0.0	0.0
Converter Cu	12870.8	2830.1	0.0	0.0	0.0
In Anodes	7362.5	42960.3	92539.1	64776.6	9039.1
Wrought In	8465.5	2734.1	4268.2	2998.2	0.0
Secondary Anodes	127.1	736.8	2685.0	2725.2	0.0
Reduced In	312.8	1897.3	3925.9	1676.7	0.0
Sulfide Anodes	0.0	0.0	1892.1	8368.4	0.0
FAP	0.0	0.0	0.0	1959.9	2076.1
Utility Nickel	0.0	0.0	0.0	1737.2	18647.8
Receipts					
Bessemer matte (CC+Conis)	39154.3	6364.5	0.0	72.7	0.0
Orford Sulphide - CC	0.0	52066.3	44332.0	0.0	0.0
Sulphide Conc (MEP)	0.0	0.0	9471.0	2637.6	0.0
SEP -CC Sinter	0.0	0.0	32532.1	6283.3	0.0
MZP - Sec Metallics	0.0	0.0	1147.8	1922.2	0.0
Ni Oxide FEP	0.0	0.0	126.6	43205.6	0.0
MRP Sulphide Conc	0.0	0.0	631.9	176.9	0.0
MNP Sulphide Conc	0.0	0.0	1983.5	0.0	0.0
RGP Sinter 95	0.0	0.0	0.0	1703.8	0.0

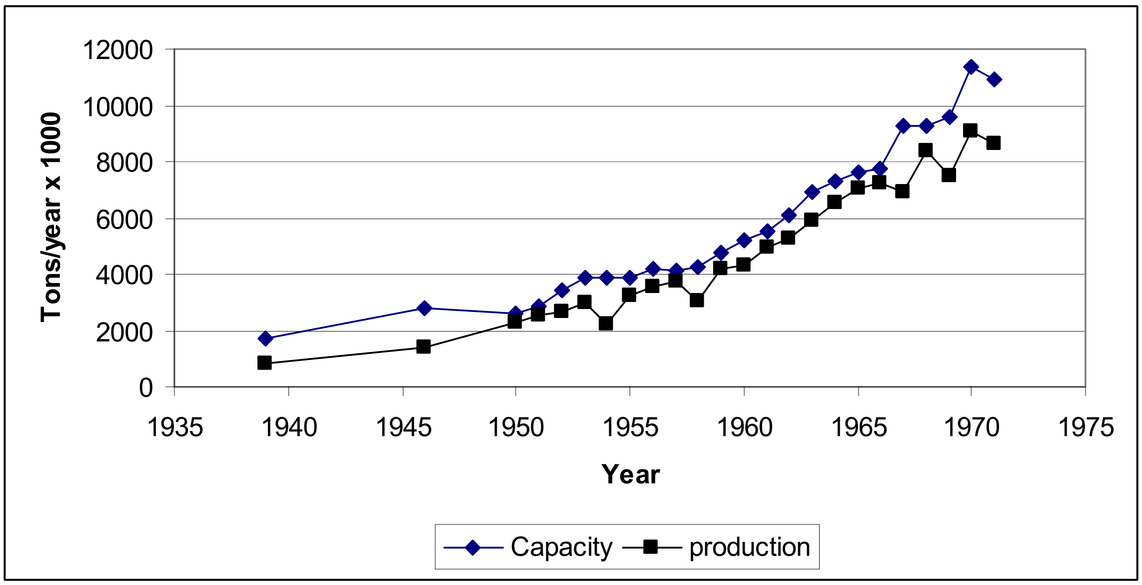
Specific activity data for the Algoma mill were unavailable so emissions were calculated based on the mill capacity during each scenario and an estimate of the actual average production during each emission scenario. Production and capacity data for the mill were available for four years from the Survey of the Canadian Iron Ore Industry, published by the Department of Mines and Technical Surveys. These data are presented in Table 3-8.

Table 3-8 Production and Capacity Data for the Canada Furnace/Algoma Mill

Year	Capacity (tonnes x 1000)	Production (tonnes x 1000)	% of Capacity
1958	197	81.4	41
1960	187	85	46
1968	236	115	49
1970	236	220	93

It should be noted that these data show that the Algoma mill was typically not operating at capacity. Of the four years of available data, the mill was operating at less than 50% capacity for three years and at close to full-capacity for one year. For the purpose of the Algoma emission inventory, it was assumed that the Algoma mill was operating at 50% capacity for all emissions scenarios. This is expected to be a conservative assumption (i.e. underestimate Algoma emissions) based on historical data of Canadian pig iron production. Figure 3-1 presents the historical variation of Canadian pig iron production and plant capacity between 1939 and 1971. During this time, production from the industry as a whole averaged about 80% of plant capacity.

Figure 3-1 Historical Variation in Canadian Pig Iron Production (1939-1971)



3.7 Air Emission Inventory

3.7.1 Summary of Emission Points

Tables 3-9 to 3-16 summarise the full set of emission sources used in the air emission inventories for all scenarios.

Table 3-9 Air Emission Sources – Inco Scenario 1 (1918-1930)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts
	Building 1 -			
	Jaw Crushing	28,891	tonnes product/yr.	Green/Black Ni,Sinter (crushed twice)
	Cupola Furnace 1 - Bessemer Matte	39,154	tonnes product/yr.	Bessemer Matte
	Cupola Furnace 2- Nickel	14,445	tonnes product/yr.	Green/Black Ni,Sinter
	Tops Holding Furnace - Copper	12,871	tonnes product/yr.	Converter Cu
	Copper Reverb Furnaces 1 to 3	12,871	tonnes product/yr.	Converter Cu
	Copper Converter Stands 1 to 3	12,871	tonnes product/yr.	Converter Cu
	Slag Reverb Furnaces 1 and 2	44,969	tonnes product/yr.	58/50.8 * Bessemer Matte
B1-02	Process Fugitives, Raw Material Handling	39,154	tonnes matte/yr.	Bessemer Matte
B1-03	Process Fugitives, Converters	12,871	tonnes product/yr.	Converter Cu
B1-04	Process Fugitives, Reverb	12,871	tonnes product/yr.	Converter Cu
B1-05	Process Fugitives, Cupola	54,633	tonnes product/yr.	2*(Green/Black Ni,Sinter)+Converter Cu
B1-05	Process Fugitive - intermediate material handling	27,316	tonnes product/yr.	G/B NiO, Sinter, Converter Cu
	Building 2			
B2-01	Exhaust Stack - Ball Mills 1 and 2 (with cyclone)	14,445	tonnes product/yr.	G/B NiO, Sinter
B2-03	Process Fugitives, Material Handling	14,445	tonnes product/yr.	G/B NiO, Sinter
	Building 3			
	Mechanical Calcining Furnaces 1 to 5	9,451	tonnes product/yr.	G/B NiO
	Hand Rabbled Calcining Furnaces 1 to 5	9,451	tonnes product/yr.	G/B NiO
	Anode Furnaces 8 and 9	127	tonnes product/yr.	Secondary Anodes
	Sinter Machines 1 to 4	4,994	tonnes product/yr.	Ni sinter
B3-02	Process Fugitives, Mechanical	9,451	tonnes product/yr.	G/B NiO
B3-03	Process Fugitives, Hand Rabbled	9,451	tonnes product/yr.	G/B NiO
	Process Fugitives, Sintering	4,994	tonnes product/yr.	Sinter
	Building 4			
B4-01	Nickel Refining Furnaces 1 and 2	7,914	tonnes product/yr.	1/2 of Wrought Ni+Anodes
B4-02	Nickel Refining Furnaces 3 and 4	7,914	tonnes product/yr.	1/2 of Wrought Ni+Anodes
B4-03	Process Fugitives, Nickel Refining	15,828	tonnes product/yr.	Wrought Ni+Anodes
	Material Handling Emissions			
MH-01	Matte loading/unloading	39,154	tonnes matte/yr.	Bessemer matte
MH-02	Coke/Coal loading/unloading	22,566.92	tonnes coke/yr.	Bessemer matte *(.65/1.4)
MH-03	Slag loading / unloading	13,887.33	tonnes slag/yr.	Bessemer matte *(.4/1.4)
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg. 1
WS-02	Coke/Coal Storage Pile	-	square meters	Stored in Bins in Bldg. 1
WS-03	Slag Storage Pile	12,110	square meters	

Table 3-10 Air Emission Sources – Inco Scenario 2 (1931-1938)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts
	Building 1			
B1-02	Process Fugitives, Material Handling	6,364	tonnes product/yr.	Bessemer matte
B1-06	Slimes Dryer Exhaust	1,289	tonnes product/yr.	3% of anode production
	Building 2			
B2-01	Ball Mills 1 to 4 (with cyclone)	40,587	tonnes product/yr.	G/B NiO+Sinter
B2-02	Krup Mills 1 to 3 (with baghouse)	40,587	tonnes product/yr.	G/B NiO+Sinter
	Process Fugitives, Material Handling	81,173	tonnes product/yr.	2*(G/B NiO+Sinter)
	Process Fugitives, Material handling	52,066	tonnes product/yr.	oreford sulphide
	Process Fugitives, Material Conveying	52,066	tonnes product/yr.	oreford sulphide
	Building 3			
	Mechanical Calcining Furnaces 1 to 5	2,740	tonnes product/yr.	G/B NiO
	Hand Rabbled Calcining Furnaces 1 to 5	2,740	tonnes product/yr.	G/B NiO
	secondary anodes	737	tonnes product/yr.	secondary anodes
	Sinter Machines 1 to 7	37,847	tonnes product/yr.	sinter Ni
B3-01	Exhaust Stack			
B3-02	Process Fugitives, Mechanical	2,740	tonnes product/yr.	G/B NiO
B3-03	Process Fugitives, Hand Rabbled	2,740	tonnes product/yr.	G/B NiO
B3-04	Process Fugitives, Sintering	37,847	tonnes product/yr.	sinter Ni
B3-05	Process Fugitives, Secondary Anode Furnaces	737	tonnes product/yr.	secondary anodes
B3-06	Process Fugitives, Calciner Annex	2,740	tonnes product/yr.	G/B NiO
	Building 4			
B4-01	Nickel Refining Furnaces (with multiclones)	2,734	tonnes product/yr.	wrought Ni production
B4-03	Process Fugitives, Nickel Refining	2,734	tonnes product/yr.	wrought Ni production
B4-02	Anode Furnace 1	4,773	tonnes product/yr.	1/9 of anode production
B4-04	Anode Furnaces 2/3	9,547	tonnes product/yr.	2/9 of anode production
B4-05	Anode Furnace 4	4,773	tonnes product/yr.	1/9 of anode production
B4-06	Anode Furnace 5/6	9,547	tonnes product/yr.	2/9 of anode production
B4-07	Anode Furnace 7	4,773	tonnes product/yr.	1/9 of anode production
B4-08	Anode Furnace 8/9	9,547	tonnes product/yr.	2/9 of anode production
B4-10	Process Fugitives, Anode Nickel Refining	42,960	tonnes product/yr.	anode production
	Material Handling Emissions			
MH-01	Matte loading/unloading	6,364	tonnes ore/yr.	bessemer matte
MH-02	Coke/Coal loading/unloading	4,226.94	tonnes coke/yr.	bessemer matte *(.65/1.4)
MH-03	Slag loading/unloading	2,601.20	tonnes slag/yr.	bessemer matte *(.4/1.4)
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1
WS-02	Coke/Coal Storage Pile	12,110	square meters	
WS-03	Slag Storage Pile	12,110	square meters	

Table 3-11 Air Emission Sources – Inco Scenario 3 (1939-1959)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts
	Building 1			
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte
B1-06	Slimes Dryer Exhaust	2,776	tonnes product/yr.	3% of anode production
B1-04	Electric Slag furnace (installed 1941)	2,776	tonnes product/yr.	3% of anode production
	Building 2			
B2-01	Ball Mills 1 to 4 (cyclone)	45,774	tonnes product/yr.	G/B NiO, Sinter
B2-02	Krup Mills 1 to 4 (baghouse)	45,774	tonnes product/yr.	G/B NiO, Sinter
	Process Fugitives, Material Handling	91,547	tonnes product/yr.	2*(G/B NiO, Sinter)
	Process Fugitives, Material handling	90,225	tonnes product/yr.	oreford sulphide+other receipts
	Process Fugitives, Material Conveying	90,225	tonnes product/yr.	oreford sulphide+other receipts
	Building 3			
	Mechanical Calcining Furnaces 1 to 5	2,016	tonnes product/yr.	G/B NiO
	Hand Rabbled Calcining Furnaces 1 to 5	2,016	tonnes product/yr.	G/B NiO
	Sulphide Anode Furnace - installed 1956	1,892	tonnes product/yr.	sulphide anode production
	Sinter Machines 1 to 7	43,757	tonnes product/yr.	sinter Ni
B3-02	Process Fugitives, Mechanical	2,016	tonnes product/yr.	G/B NiO
B3-03	Process Fugitives, Hand Rabbled	2,016	tonnes product/yr.	G/B NiO
B3-04	Process Fugitives, Sintering	43,757	tonnes product/yr.	sinter Ni
B3-05	Process Fugitives, Anode Furnaces	1,892	tonnes product/yr.	sulphide anode production
B3-06	Process Fugitives, Calciner Annex	2,016	tonnes product/yr.	G/B NiO
	Building 4			
B4-01	Nickel Refining Furnaces (with multiclones)	4,268	tonnes product/yr.	wrought Ni production
B4-03	Process fugitives, nickel refining	4,268	tonnes product/yr.	wrought Ni production
B4-02	Anode Furnace 1 (with multiclone)	10,282	tonnes product/yr.	1/9 of anode production
B4-04	Anode Furnace 2/3 (with multiclone)	20,564	tonnes product/yr.	2/9 of anode production
B4-05	Anode Furnace 4 (with multiclone)	10,282	tonnes product/yr.	1/9 of anode production
B4-06	Anode Furnace 5/6 (with multiclone)	20,564	tonnes product/yr.	2/9 of anode production
B4-07	Anode Furnace 7 (with multiclone)	10,282	tonnes product/yr.	1/9 of anode production
B4-08	Anode Furnace 8/9 (with multiclone)	20,564	tonnes product/yr.	2/9 of anode production
B4-10	Process Fugitives, Anode Nickel Refining	92,539	tonnes product/yr.	anode production
	Building 5			
B5-01	Secondary anodes (with wet collector)	2,685	tonnes product/yr.	secondary anodes
B5-01	Rod Milling	-	tonnes product/yr.	RGP Sinter 95
	Material Handling Emissions			
MH-01	Matte loading/unloading	-	tonnes Matte/yr.	bessemer matte
MH-02	Coke/Coal loading/unloading	936.12	tonnes coke/yr.	bessemer matte *(.65/1.4)
MH-03	Slag loading / unloading	576.07	tonnes slag/yr.	bessemer matte *(.4/1.4)
WS-02	Coke/Coal Storage Pile	12,110	square meters	
WS-03	Slag Storage Pile	12,110	square meters	

Table 3-12 Air Emission Sources – Inco Scenario 4 (1960-1979)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts
	Building 1			
B1-02	Process Fugitives, Material Handling	73	tonnes material/yr.	bessemer mate
B1-06	Slimes Dryer Exhaust (wet scrubber 1961)	1,943	tonnes product/yr.	3% of Anode Production
B1-04	Electric Slag Furnace	1,943	tonnes product/yr.	3% of anode production
	Building 2			
B2-10	Exhaust Stack FAP (with Baghouse)	1,960	tonnes product/yr.	FAP
	Process Fugitives, Material Handling	1,960	tonnes product/yr.	FAP
B2-01	Ball Mills 1-4 (with cyclone)	245.63	tonnes product/yr.	Shut down in 1964
B2-02	Krup Mills 1-4 (with baghouse)	245.63	tonnes product/yr.	G/B NiO + sinter
	Process Fugitives, Material Handling	246	tonnes product/yr.	G/B NiO + sinter
	Process Fugitives, Material handling	55,929	tonnes product/yr.	oreford sulphide+other receipts
	Process Fugitives, Material Conveying	55,929	tonnes product/yr.	oreford sulphide+other receipts
B2-03	Process Fugitives (Total)			
	Building 3			
	Mechanical Calcining Furnaces 1 to 5 (ran until 1963)	246	tonnes product/yr.	G/B NiO
	Hand Rabbled Calcining Furnaces 1 to 5	246	tonnes product/yr.	G/B NiO
	Sulphide Anode Furnace - installed 1956 - shut down in 1974	8,368	tonnes product/yr.	sulphide anode production
DC-01	**Dust Chamber Exhaust Stack (Bldg 3)**			
B3-02	Process Fugitives, Mechanical	246	tonnes product/yr.	G/B NiO
B3-03	Process Fugitives, Hand Rabbled	246	tonnes product/yr.	G/B NiO
B3-05	Process Fugitives, Anode Furnaces	8,368	tonnes product/yr.	sulphide anode production
B3-06	Process Fugitives, Calciner Annex	246	tonnes product/yr.	G/B NiO
	Building 4			
B4-01	Nickel Refining Furnace (with multiclone)	2,998	tonnes product/yr.	wrought Ni production
B4-03	Process Fugitives, Nickel Refining	2,998	tonnes product/yr.	wrought Ni production
B4-10	Process Fugitives, Anode Nickel Refining	64,777	tonnes product/yr.	anode production
CP-01	Anode furnace+ cyclone+Cottrell Precipitator Stack 1	21,592	tonnes product/yr.	1/3 of anode production
CP-02	Anode furnace+ cyclone+Cottrell Precipitator Stack 2	21,592	tonnes product/yr.	1/3 of anode production
CP-03	Anode furnace+ cyclone+Cottrell Precipitator Stack 3	21,592	tonnes product/yr.	1/3 of anode production
	Building 5			
B5-01	Secondary anodes (with wet collector)	2,725	tonnes product/yr.	secondary anodes
B5-01	Rod Milling	1,704	tonnes product/yr.	RGP Sinter 95
	Material Handling Emissions			
MH-01	Matte loading/unloading	73	tonnes ore/yr.	bessemer matte
MH-02	Coke/Coal loading/unloading	147.80	tonnes coke/yr.	bessemer matte *(.65/1.4)
MH-03	Slag loading/unloading	90.95	tonnes slag/yr.	bessemer matte *(.4/1.4)
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1
WS-02	Coke/Coal Storage Pile	12,110	square meters	
WS-03	Slag Storage Pile	12,110	square meters	

Table 3-13 Air Emission Sources – Inco Scenario 5 (1980-1990)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts
	Building 1			
B1-02	Process Fugitives, Material Handling	-	tonnes material/yr.	bessemer matte
B1-06	Slimes Dryer Exhaust (with wet scrubber)	271	tonnes product/yr.	3% of Anode Production
	Building 2			
B2-10	Exhaust Stack FAP Baghouse	2,076	tonnes product/yr.	FAP
	Process Fugitives, Material Handling	2,076	tonnes product/yr.	FAP
	Building 4			
B4-10	Process Fugitives, Anode Nickel Refining	9,039	tonnes product/yr.	anode production
CP-01	utility furnaces+ cyclone+Cottrell Precipitator Stack 1	9,229	tonnes product/yr.	1/3(anode production+ utility Ni)
CP-02	utility furnaces+ cyclone+Cottrell Precipitator Stack 2	9,229	tonnes product/yr.	1/3(anode production+ utility Ni)
CP-03	utility furnaces+ cyclone+Cottrell Precipitator Stack 3	9,229	tonnes product/yr.	1/3(anode production+ utility Ni)

Table 3-14 Air Emission Sources – Algoma Scenario 1 (1913-1951)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units
BF1-01	No 1 BF Roof Monitor	88,625	tonnes product/yr.
BF1-02	No 1 BF Tapping	88,625	tonnes product/yr.
BF1-03	No 1 BF Stoves (3)	655,825,000	MJ/yr.
BF2-01	No 2 BF Roof Monitor	29,700	tonnes product/yr.
BF2-02	No 2 BF Tapping	29,700	tonnes product/yr.
BF2-03	No 2 BF Stoves	219,780,000	MJ/yr.
PC1-01	Pig Casting Machine	118,325	tonnes product/yr.
S1-01	Sintering Plant - Windbox	118,325	tonnes sinter/yr.
S2-02	Sintering Plant - Discharge	118,325	tonnes sinter/yr.
	Material Handling Emissions		
MH-01	Ore loading/unloading x 2	165,655	tonnes ore/yr.
MH-02	Coke loading/unloading x 2	76,911	tonnes coke/yr.
MH-03	Slag loading / unloading	47,330	tonnes slag/yr.
WS-01	Ore Storage Pile	11387	square meters
WS-02	Coke Storage Pile	5287	square meters
WS-03	Slag Storage Pile	3254	square meters

Table 3-15 Air Emission Sources – Algoma Scenario 2 (1952-1959)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units
BF1-01	No 1 BF Roof Monitor	104,500	tonnes product/yr.
BF1-02	No 1 BF Tapping	104,500	tonnes product/yr.
BF1-03	No 1 BF Stoves (3)	773,300,000	MJ/year
BF2-01	No 2 BF Roof Monitor	37,741	tonnes product/yr.
BF2-02	No 2 BF Tapping	37,741	tonnes product/yr.
BF2-03	No 2 BF Stoves	279,283,400	MJ/yr.
PC1-01	Pig Casting Machine	142,241	tonnes product/yr.
S1-01	Sintering Plant - Windbox	142,241	tonnes sinter/yr.
S2-02	Sintering Plant - Discharge	142,241	tonnes sinter/yr.
	Material Handling Emissions		
MH-01	Ore loading/unloading	199,137	tonnes ore/yr.
MH-02	Coke loading/unloading	92,457	tonnes coke/yr.
MH-03	Slag loading / unloading	56,896	tonnes slag/yr.
WS-01	Ore Storage Pile	11387	square meters
WS-02	Coke Storage Pile	5287	square meters
WS-03	Slag Storage Pile	3254	square meters

Table 3-16 Air Emission Sources – Algoma Scenario 3 (1960-1977)

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units
BF1-01	No 1 BF Roof Monitor	104,500	tonnes product/yr.
BF1-02	No 1 BF Tapping	104,500	tonnes product/yr.
BF1-03	No 1 BF Stoves (5)	773,300,000	MJ / year
PC1-01	Pig Casting Machine	104,500	tonnes product/yr.
S1-01	Sintering Plant - Windbox	104,500	tonnes sinter/yr.
S2-02	Sintering Plant - Discharge	104,500	tonnes sinter/yr.
	Material Handling Emissions		
MH-01	Ore loading/unloading	146,300	tonnes ore/yr.
MH-02	Coke loading/unloading	67,925	tonnes coke/yr.
MH-03	Slag loading / unloading	41,800	tonnes slag/yr.
WS-01	Ore Storage Pile	11387	square meters
WS-02	Coke Storage Pile	5287	square meters
WS-03	Slag Storage Pile	3254	square meters

3.7.2 Inventory Summary

Tables 3-17 and 3-18 provide summaries of the estimated annual emissions for each scenario. The detailed emission inventory data are provided in Appendices A to E.

Table 3-17 Summary of Annual Emissions – Inco Scenarios

Scenario	Particulate Matter (Tonnes Per Year)	Nickel (Tonnes Per Year)	Iron (Tonnes Per Year)
1	1365	710	4.8
2	441	335	2.2
3	402	314	2.2
4	60.8	45	0.3
5	3.19	2	0.02

Table 3-18 Summary of Annual Emissions – Algoma Scenarios

Scenario	Particulate Matter (Tonnes Per Year)	Iron (Tonnes Per Year)
1	595	303
2	557	284
3	258	131

Nickel emissions from the Inco PCNR for the period from 1991 to 2001 were determined from the facilities NPRI reports to Environment Canada and averaged about 0.58 tonnes/year of nickel. These emissions are very small compared to the emissions estimated for the operating scenarios between 1918 to 1990.

3.8 Summary of Estimated INCO and Algoma Emissions Over the Operating Life of the Facilities

Utilising the emissions inventories for the various operating scenarios presented in the preceding sections, total emissions were determined. Total facility emissions of each contaminant were calculated by summing the estimated annual emissions of PM, iron and nickel for all years that the facility was operating (1918-1990 for Inco and 1913-1977 for Algoma) and are presented in Table 3-19.

Table 3-19 Summary of Estimated Total Contaminant Emissions from Inco and Algoma

Contaminant	Algoma Emissions (Tonnes)	Inco Emissions (Tonnes)
Particulate Matter	32,327	30,990
Iron	16,477	132
Nickel	N/A	19,459

The total PM emissions are presented in Figures 3-2 and 3-3. These figures show the annual PM emissions rates (tonnes/year) and the cumulative PM release to the atmosphere from each facility. These figures show that Algoma was estimated to be a slightly larger PM emitter than was Inco (by about 4%).

The estimated annual air emissions of nickel from Inco are presented in Figure 3-4. Air emissions of nickel from Inco were highest during the 1918-1930 period with significantly decreased emissions from that point on. During this period, which encompassed nickel production with the Orford process, emissions of nickel to the air were about twice as high as any other period during the operation of the facility.

The estimated annual air emissions of iron from Inco and Algoma are presented in Figure 3-5. Air emissions of iron from Algoma were estimated to be highest during the early operations of the mill. Annual iron emissions from Inco to the air were estimated to be less than 1% of the Algoma emissions.

In the period from 1991 to 2001, nickel emissions from the Inco facility were estimated (from Inco NPRI submissions) to be 5.8 tonnes or about 0.03% of the total historical nickel emissions. Due to the negligible quantity of nickel emitted from the Inco facility between 1991 and 2001, these emissions were not included in the dispersion modelling.

Figure 3-2 Comparison of Estimated Annual PM Emisisons from Inco and over the Operating Life of Each Facility

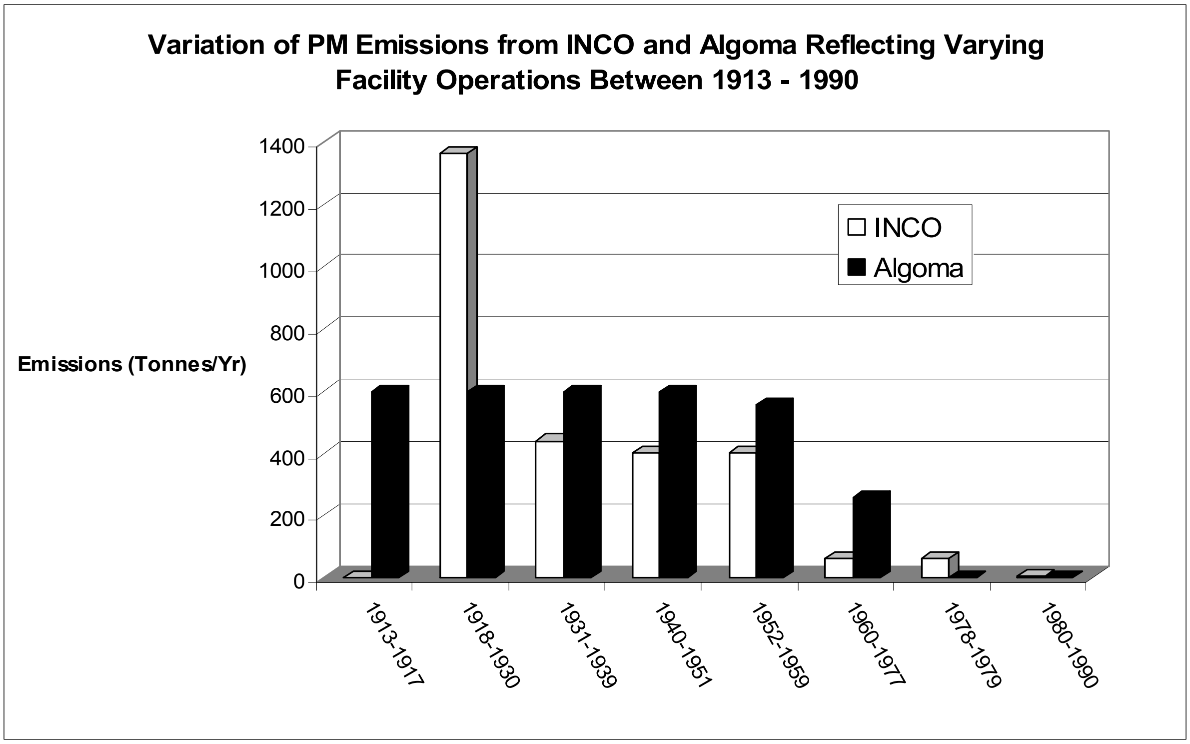


Figure 3-3 Comparison of Cumulative Estimated PM Emissions from Inco and Algoma over the Operating Life of Each Facility

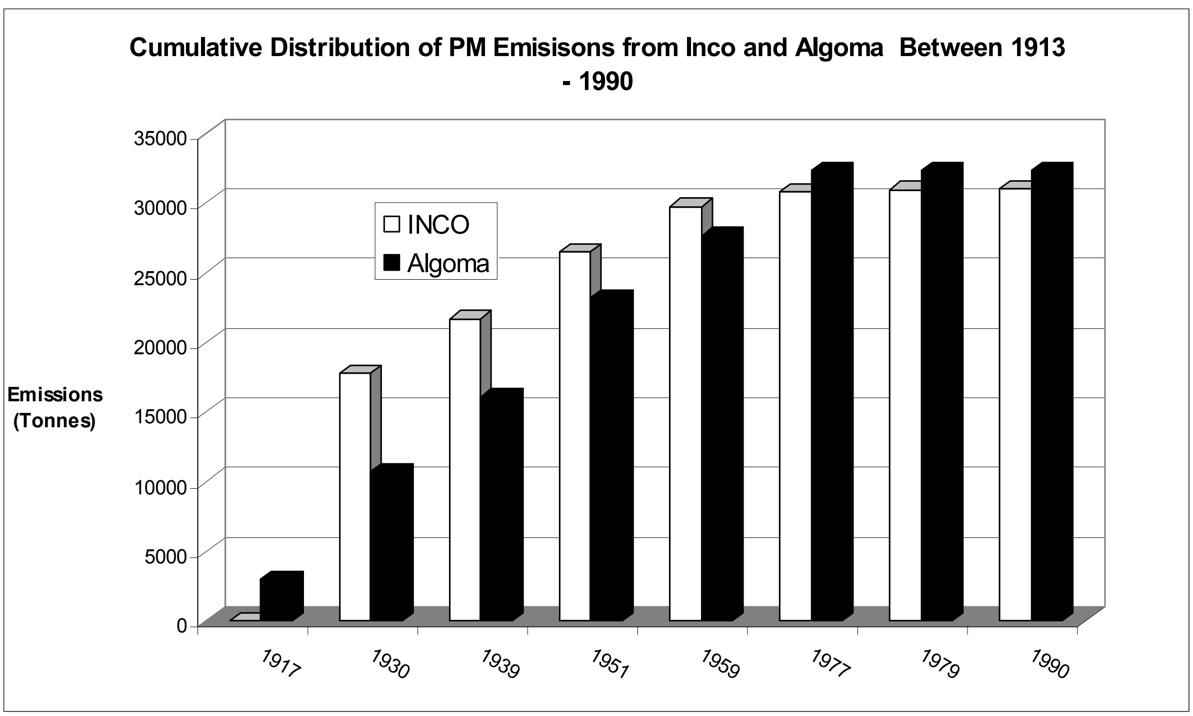


Figure 3-4 Variation of Estimated Inco Nickel Emissions Due to Variations in Facility Operations

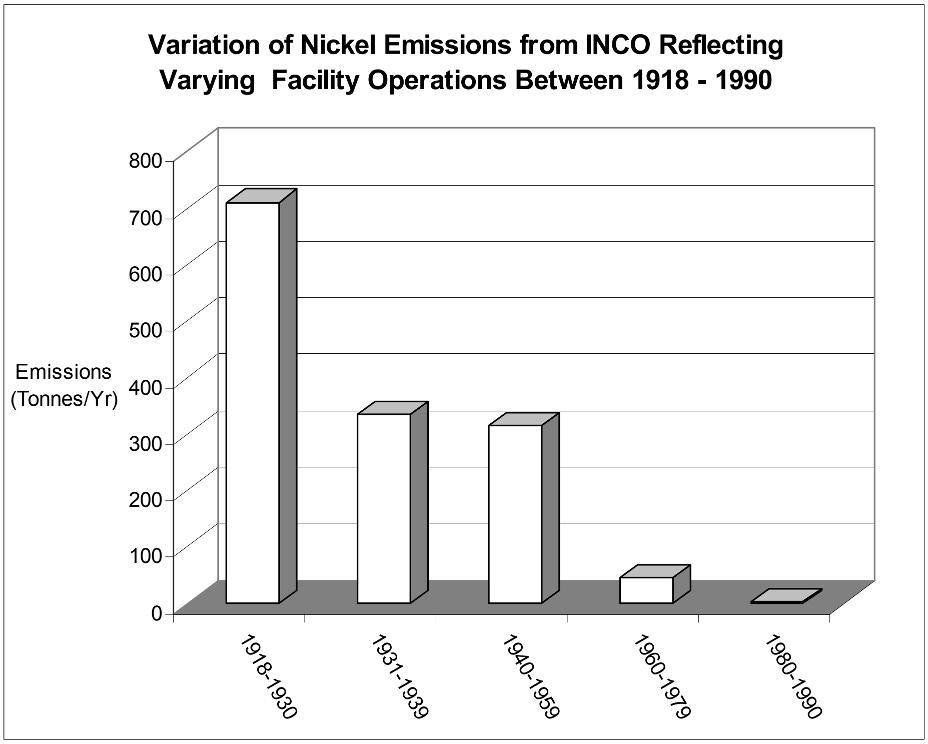
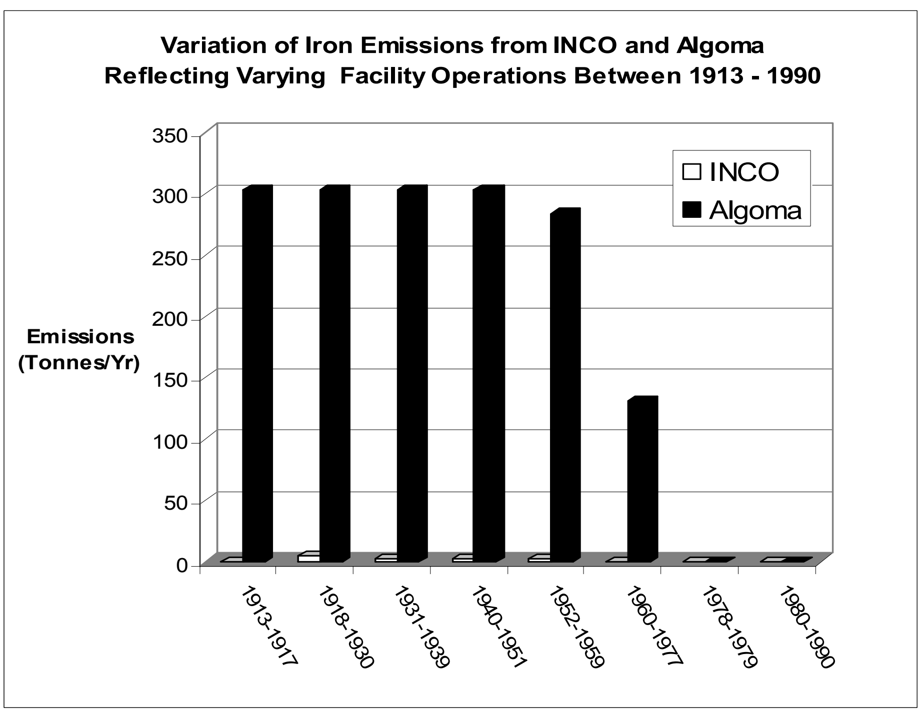


Figure 3-5 Variations of Estimated Iron Emissions from Inco and Algoma Due to Variations in Facility Operations



4. METEOROLOGY OF THE REGION

4.1 Local Meteorology

The local meteorology of the region must be known to evaluate the atmospheric dispersion and transport of emissions released by a plant. Data required to predict the dispersion and transport includes wind velocities and direction; temperature; atmospheric stability; and mixing layer depth. Wind and temperature data are readily available from meteorological stations, but atmospheric stability and mixing layer depth are calculated from additional raw meteorological data including; cloud cover, snow cover and solar radiation. Raw hourly meteorological data for 1996-2000 from the Environment Canada, Atmospheric Environment Service was used in the analysis as were twice daily, upper air sounding data from the US National Centre of Atmospheric Research. These data were merged with Port Colborne station data obtained from Atmospheric Environment Service. Table 2-1 presents the stations and parameters obtained.

Table 4-1 Meteorological Stations

Type Of Station	**Upper Air**	**Surface Station**	Surface Station
Station Name	Buffalo, NY	Niagara Falls, NY	Inco On-Site Met Station
Location	78.73°W 42.56°N	78.95°W, 43.1°N	79.14°W, 42.53°N
Years	Jan. 96 – Dec. 00	Jan. 00 – Dec. 200	Jan. 96 – Dec. 00
Parameters	Pressure Altitude Temperature Wind Direction and Speed Relative Humidity	Cloud Cover Snow Cover Relative Humidity	Wind Speed and direction Temperature

The air pollution potential is defined as the meteorological conditions which, given the existence of emissions, would be conducive to poor air quality. Conditions that allow for the accumulation of pollutants denote high air pollution potential. Parameters from which the dispersion of pollutants may be evaluated include; the duration of light wind speeds, atmospheric stability and mixing layer depths.

Meteorological conditions, which may lead to high ground level concentrations from elevated point sources, are, typically, either convective atmospheric stability with light winds or neutral conditions with high wind speeds. High concentrations from low elevated sources or virtual sources are typically due to stable conditions with light winds. The merged raw data for the area were used to calculate the hourly heat flux, Monin-Obukhov length (a stability parameter), mixing layer depth, surface friction velocity and convective velocities with the aid of the AERMET meteorological pre-processor.

4.2 Geophysical Data

In addition to meteorological data, site geophysical data are also required to characterise the dispersion region of the area. These parameters include surface roughness, Bowen ratio and Albedo. Table 4-2 presents these selected parameters for the area, following the guidelines as described in AERMET (1998). The facilities are located very close to Lake Ontario to the south, with urban conditions to the north-west and agricultural conditions to the north-east and east. These surface conditions are reflected in Table 4-2 below.

Table 4-2 Site Characteristics Around Port Colborne

Month	ESE To W Lake Surface Characteristics			W To NNE Urban Surface Characteristics			NNE To ESE Cultivated Land Surface Characteristics		
	Albedo	Bowen Ratio	Surface Roughness (m)	Albedo	Bowen Ratio	Surface Roughness (m)	Albedo	Bowen Ratio	Surface Roughness (m)
Jan	0.2	1.5	0.0001	0.25	1.5	0.5	0.6	1.5	0.01
Feb	0.2	1.5	0.0001	0.25	1.5	0.5	0.6	1.5	0.01
Mar	0.12	0.1	0.0001	0.14	1.0	0.5	0.14	0.3	0.03
April	0.12	0.1	0.0001	0.14	1.0	0.5	0.14	0.3	0.03
May	0.12	0.1	0.0001	0.14	1.0	0.5	0.14	0.3	0.03
June	0.1	0.1	0.0001	0.16	2.0	1.0	0.2	0.5	0.2
July	0.1	0.1	0.0001	0.16	2.0	1.0	0.2	0.5	0.2
Aug	0.1	0.1	0.0001	0.16	2.0	1.0	0.2	0.5	0.2
Sept	0.14	0.1	0.0001	0.18	2.0	1.0	0.18	0.7	0.05
Oct	0.14	0.1	0.0001	0.18	2.0	1.0	0.18	0.7	0.05
Nov	0.14	0.1	0.0001	0.18	2.0	1.0	0.18	0.7	0.05
Dec	0.2	1.5	0.0001	0.35	1.5	0.5	0.6	1.5	0.01

4.3 Atmospheric Stability

The stability of the atmosphere is defined as its tendency to resist or enhance vertical motion. Three states of atmospheric stability are distinguished: convective, neutral and stable, depending on the vertical temperature profile or lapse rate. Vertical dispersion of pollutants is greatest under convective atmospheric conditions when the temperature decreases with height at a rate greater than the adiabatic lapse rate of 0.98EC/100 m. An air parcel, which is forced to rise in a convective atmosphere, will cool adiabatically, and hence remain warmer than the surrounding air and continue to rise. The air pollution potential is generally lowest under convective conditions.

In a neutral atmosphere, the temperature lapse rate is equal to the adiabatic lapse rate of 0.98EC/100 m. A rising air parcel in a neutral atmosphere will remain at the same level once the force causing it to rise has been removed. Horizontal dispersion will dominate over vertical dispersion under neutral conditions.

Vertical dispersion of pollutants is least effective in a stable atmosphere when the temperature lapse rate is less than the adiabatic lapse rate of 0.98EC/100 m. An air parcel forced to rise under such conditions will become cooler than the surrounding air and tend to sink back down to its original level, once the force causing it to rise has been removed. Light winds frequently accompany stable conditions, reducing horizontal dispersion and increasing the air pollution potential.

In the case of an elevated temperature inversion (increase in temperature with height) above a neutral or convective layer, the base of the inversion effectively forms a lid - leading to a build-up of pollutants beneath the lid. Surface based inversions are most common during the early morning hours following radiative cooling of the earth's surface during clear nights.

One method for obtaining an estimate of atmospheric stability using routinely observed data (wind speed and a net radiation index) is a STAR (STability ARray) analysis. Six stability classes are defined according to the scheme developed by Pasquill and Smith (1983). The definition of these stability classes (A-F) is shown in Table 4-3.

Table 4-3 Definition of Stability Classification

Surface Wind Speed (m/s)	Daytime Insolation			Night-Time Conditions	
	Strong	Moderat e	Slight	Thin Overcast Or 4/8 Cloudiness	3/8 Cloudiness
<2	A	A-B	B	-	-
2	A-B	B	C	E	F
4	B	B-C	C	D	E
6	C	C-D	D	D	D
>6	C	D	D	D	D

AERMET calculates the hourly surface heat flux and subsequently determines the surface friction velocity (u_*) and the Monin-Obukhov (L) through an iterative procedure using surface layer similarity for each hour. These hourly values (u_* and L) were subsequently used to generate P-G dispersion classification following the method developed by Golder (1972) as shown in Figure 4-1. Here, the Monin-Obovkov lengths along with the surface roughness conditions were used to classify the atmospheric conditions.

The seasonal distribution of atmospheric stability for Port Colborne for 1996-2000 is presented in Table 4-4. For this data set, neutral conditions occur much more frequently than convective and stable conditions during the year. Highly convective conditions occur with a higher frequency during the summer than other seasons, which can be attributed to increased solar radiation and the absence of snow cover. High frequency of neutral conditions in Port Colborne is attributable to the generally high wind speeds (with infrequent calms) in the area, which tends to force atmospheric conditions to neutral (i.e. mechanically dominated turbulence) conditions.

Table 4-4 Season Distribution of Atmospheric Stability for Port Colborne (1996-2000)

Season	Highly Convective	Moderately Convective	Neutral	Stable
Winter	1.02	0.62	16.35	7.89
Spring	2.26	2.42	12.99	8.30
Summer	3.95	3.20	9.02	6.70
Fall	1.66	1.38	15.19	7.06
Annual	8.9	7.6	53.5	29.9

Figure 4-1 Relationship between Monin-Obukhov Length and Pasquill-Gifford Stability

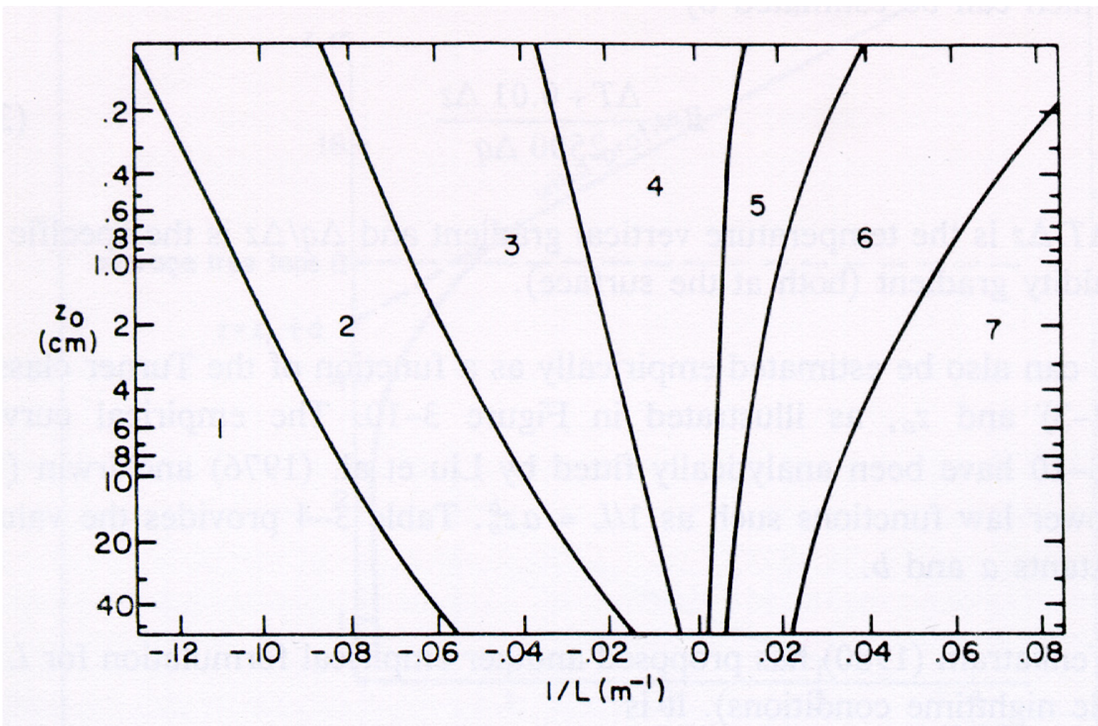
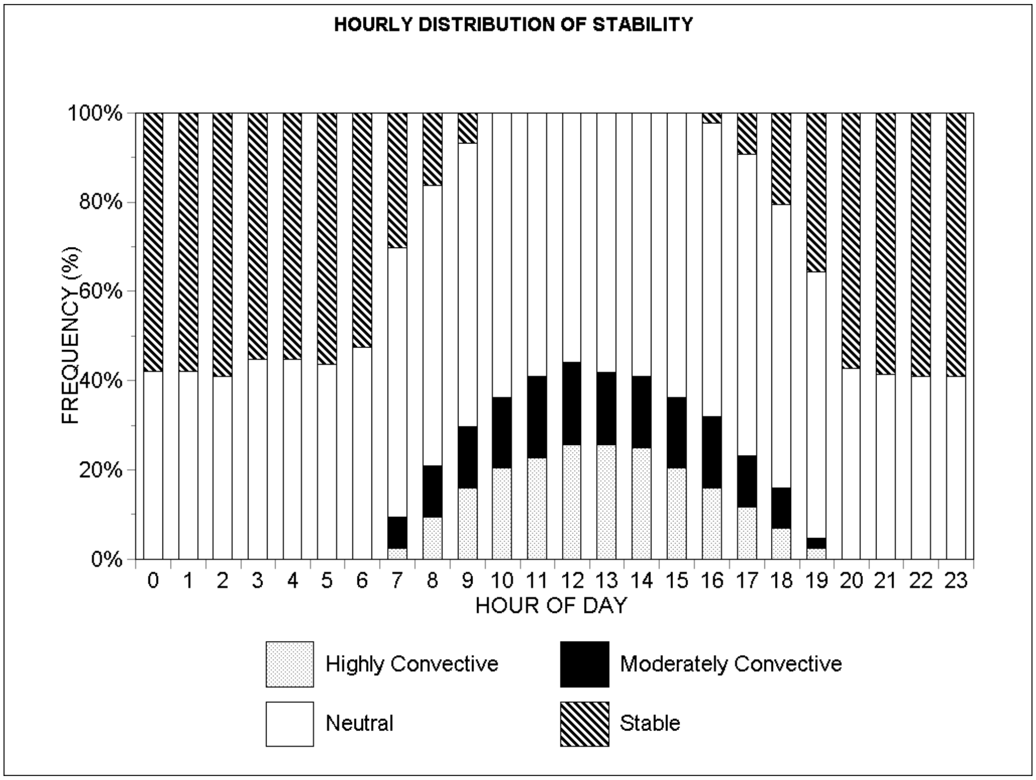


Figure 4-2 Atmospheric Stability Conditions

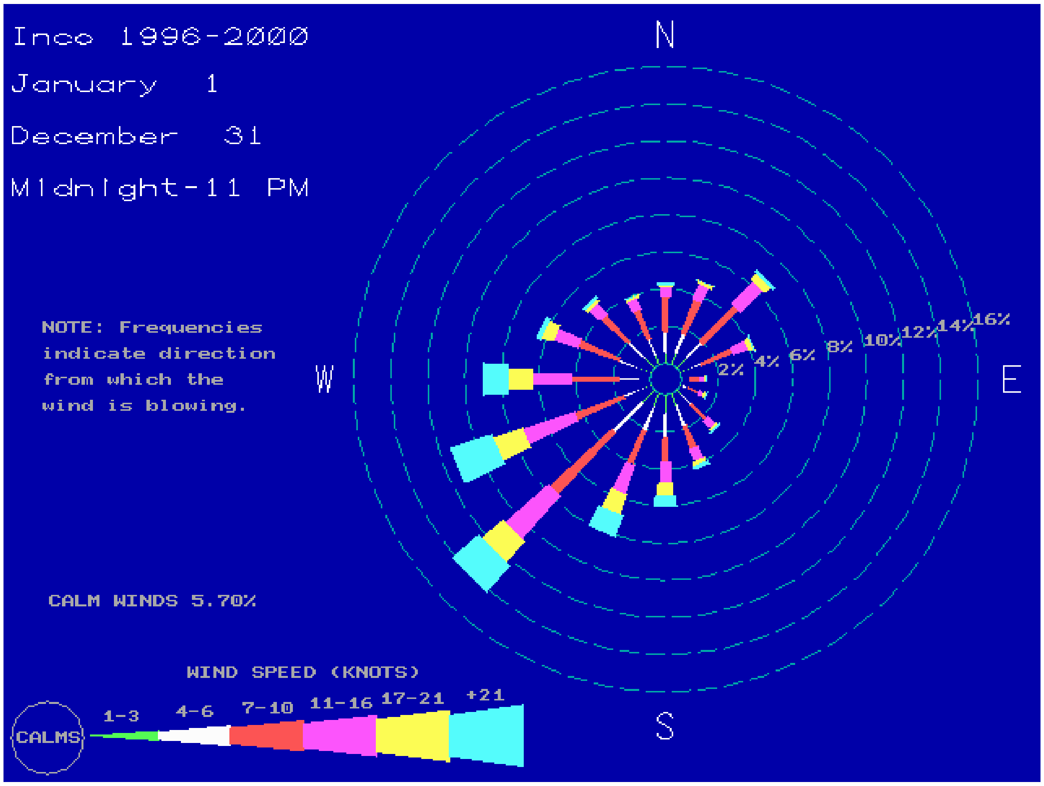


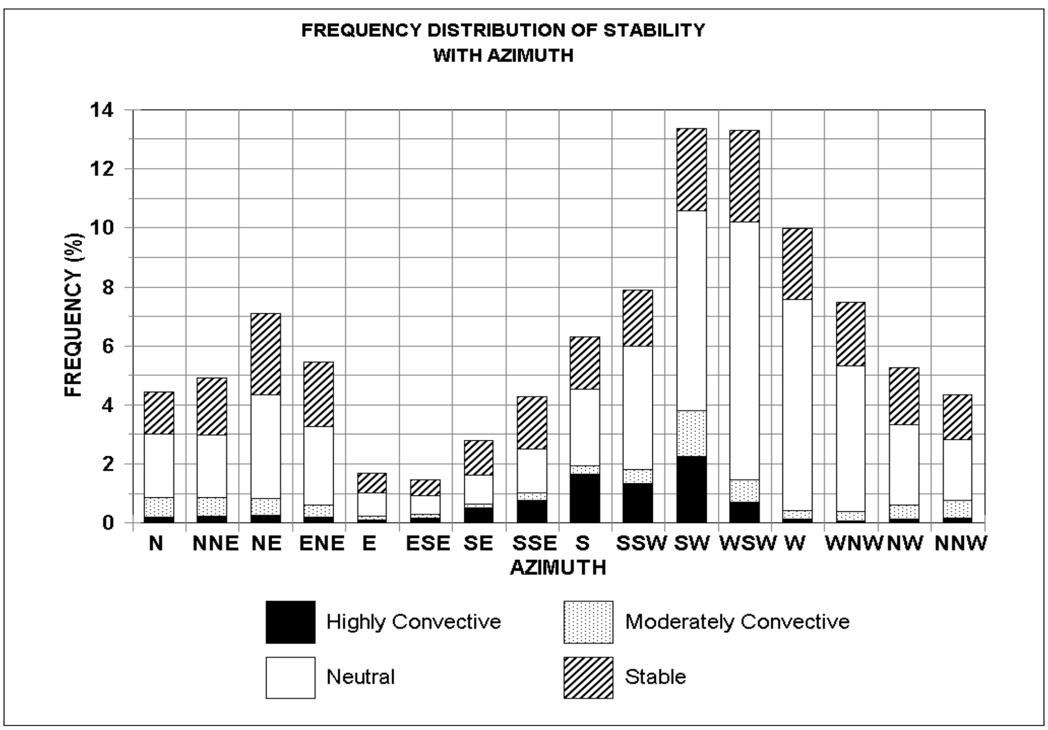
The diurnal variation of atmospheric stability with hour of day is presented in Figure 4-2, where time is given in local time. The occurrence of convective conditions is limited to between 7:00 LST and 19:00 LST, with the most frequent occurring around 12:00 LST. Stable conditions have a similar trend, with a higher frequency during the night-time than during the daytime, which is consistent with the decreased surface insolation during this period.

4.4 Wind Speed and Direction

The annual average joint frequency distribution of wind speed and direction for the Port Colborne area is presented in Figure 4-3. The dominant winds are from south-western to westerly directions. The predominant wind direction is winds blowing from the southwest (14.2% of the time) while the least frequent direction is winds blowing from the east (1.3% of the time). Very low wind speeds occur infrequently. The directional preference of stability is also presented in Figure 4-3. Stable conditions occur primarily with winds from northeast or southwesterly directions while neutral conditions occur most frequently with winds from the southwest.

Figure 4-3 Wind Rose and Stability Conditions





It should be noted that Figure 4-2 indicates that stable atmospheric conditions occur only during the night-time, as would be expected (due to the lack of solar insolation during this time). The stability data presented in Figure 4-3 therefore indicates that the night-time stable conditions are as likely to occur from southwesterly directions (blowing to the northeast) as stable winds from the north-east (blowing to the sourthwest). Figure 4-3 also indicates that stable wind conditions (which, coupled with low wind speeds often produce the highest ground level concentrations for low level emissions sources) blow less frequently from the east to the west (i.e. from the Inco facility over the Rodney Street area) than in any other direction.

4.5 Mixing Layer Heights

The mixing layer height is a parameter used to define the effective depth of the atmosphere (measured from the surface) through which contaminants are dispersed or effectively mixed. Heat transfer from the surface to the atmosphere generates convection and vertical mixing. The mixing height represents the location of an elevated temperature inversion (increase in temperature with height) above a neutral or convective boundary layer. The base of the inversion effectively forms a lid restricting dispersion. Pollutants can build-up in this boundary layer if there is a strong inversion and the plume becomes contained beneath the inversion base. Surface based inversions are most common during the early morning hours following radiative cooling of the earth's surface during clear nights.

Analysis of Canadian and northern United States upper air station data have been prepared by SENES (1996). For the Port Colborne area, Buffalo data were used to estimate the morning and afternoon maximum mixing heights. The data indicates a high frequency of low mixing heights during the summer months with a minimum of 524 m. (Table 4-5).

The AERMET meteorological pre-processor estimates convective and mechanically generated mixing layer heights using surface data parameters and upper air soundings. During stable conditions, when $L > 0$, the mechanical mixing height is computed. During unstable conditions, defined when $L < 0$, both the convective and mechanical mixing heights are computed. As long as no data are missing to make the computations, this procedure yields a continuous record of mechanical mixing heights while the record for convective mixing heights is restricted to daytime hours of upward heat flux.

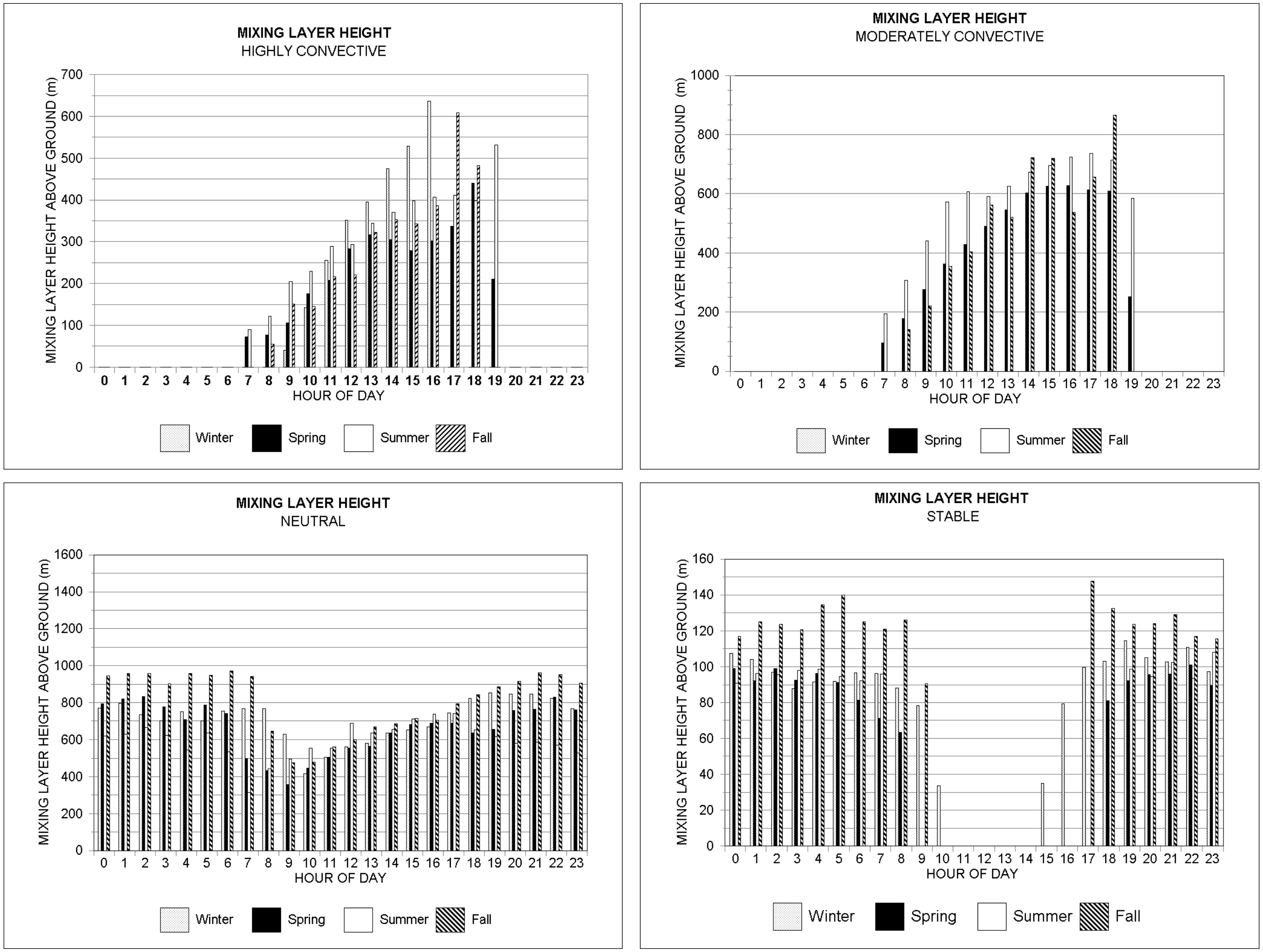
Figure 4-4 presents the height of the mixing layer during convective, neutral and stable conditions with time of day and season. Maximum convective mixing layer heights occur in the summer with a general increase in height from about 7:00 to 18:00 LST and a collapse shortly after, which is consistent with the increased solar radiation during the daytime. Neutral mixing layer heights are typically higher during the fall than other seasons. Neutral conditions are predicted to occur during all hours of the day, while stable conditions occur only during the evening and night-time.

AERMET generally predicts slightly lower mixing layer heights than was shown at Buffalo, NY. This is true for both morning and afternoon mixing heights.

Table 4-5 Mixing Layer Height Variation With Season, Buffalo, NY

	Winter	Spring	Summer	Fall	Annual
Morning Mixing Height (m)	673	656	524	792	730
Afternoon Mixing Heights(m)	571	1230	1432	1056	1137

Figure 4-4 Diurnal Variations of Mixing Layer Heights



5. DISPERSION MODELLING METHODOLOGY

5.1 Approach

Predicted contaminant depositions over Port Colborne were based on hourly meteorological data for the region. Quality checked data from January 1996 to December 2000 were used in the ISC-PRIME dispersion model predictions. Short-term (1 hour average) numerical estimates of the ground-level concentrations resulting from the Inco and Algoma facilities were made for each hour of the five years. The predicted 1-hour average depositions were summed over the length of the meteorological data set to determine the total contaminant deposition for a five-year period, for each emission scenario examined.

Algoma operations were characterised as being relatively constant during three periods (1913 to 1951, 1952-1959, and 1960-1977); therefore contaminant depositions were modelled for these three emissions scenarios. The five-year total depositions predicted from the modelling for each scenario over the modelling domain were then weighted by the ratio of the number of years of operation of that particular scenario to five years to calculate the total expected deposition for that scenario period. The same approach was used for the five operating scenarios modelled for the Inco refinery. This approach takes advantage of the fact that the meteorology of a region tends to historically be relatively consistent (reference). Therefore, it is expected that the five-year meteorological data for 1996-2000 will be representative of the meteorological conditions experienced by Port Colborne in previous decades.

The following sections describe the ISC-PRIME dispersion model used in the deposition modelling, as well as the pre-processors used to develop the input data for the model.

5.2 Description of ISC-PRIME

The Industrial Source Complex Short Term – PRIME model provides options to model emissions from a wide range of sources that might be present at a typical industrial source complex. The basis of the model is the straight-line, steady-state Gaussian plume equation, which is used to model emissions from elevated point sources, emissions from stacks that experience the effects of aerodynamic downwash due to nearby buildings, isolated vents, multiple vents, storage piles, conveyor belts, and the like.

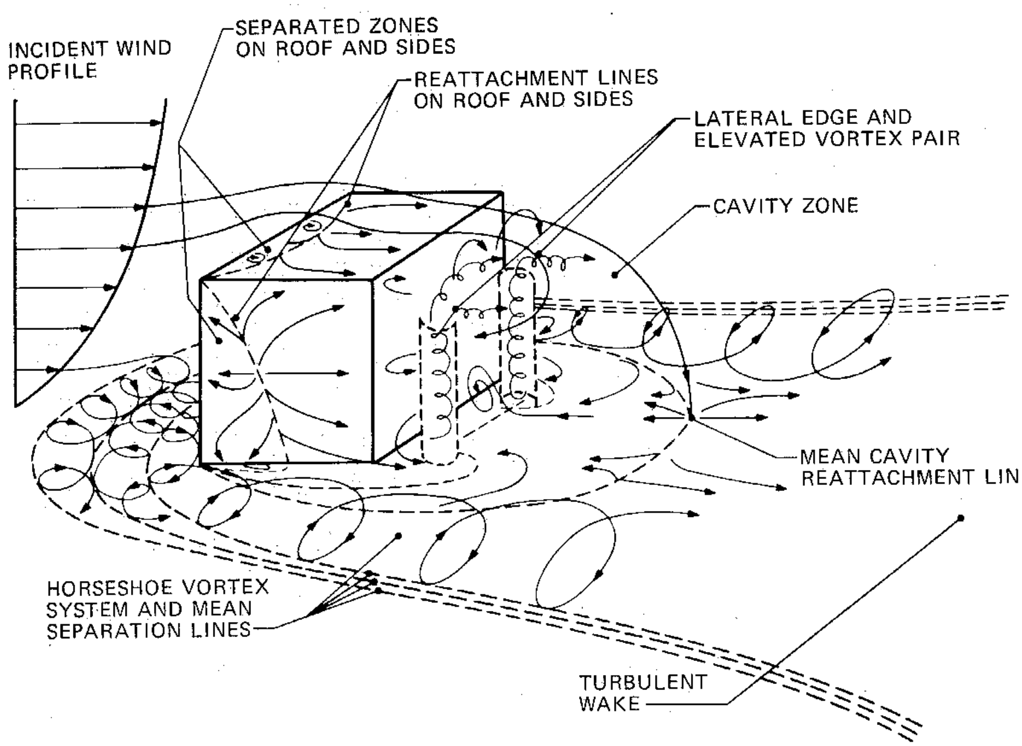
The ISC-PRIME model uses a steady-state Gaussian plume equation to model emissions from point sources, such as stacks and isolated vents and accepts hourly meteorological data records to define the conditions for plume rise, transport, diffusion, and deposition. The model estimates the concentration or deposition value for each source and receptor combination for each hour of input meteorology, and calculates user-selected short-term averages. The model incorporates algorithms to account for the following effects:

- Dispersion from point, area, volume or line sources
- Briggs stack tip downwash
- Buoyancy and momentum plume rise
- Updated building downwash and re-circulation cavity algorithms
- Terrain effects
- Wet and dry deposition with plume depletion
- Pasquill-Gifford or McElroy-Pooler plume widths

ISC-PRIME incorporates the **P**lume **RI**se **M**odel **E**nhancements (PRIME) model, which incorporates two important features of building downwash – enhanced plume dispersion coefficients due to turbulent wake and reduced plume rise caused by a combination of descending streamlines in the lee of the building and increased entrainment in the wake. The PRIME model addresses the entire structure of the wake from the cavity immediately downwind of the building to the far wake (see Figure 5-1). The building cavity can be defined as the region bounded above by the separation streamline originating at the upwind edge of the roof and bounded downwind of the building by the reattachment streamline. The lateral sides of the structure form the side of the ellipsoidal cavity. The wake beyond the cavity is termed the far wake. The dimensions of the downwashing building structure are used to form an ellipsoidal shape that may consist of a rooftop and downwind cavity or a single recirculation cavity.

Further information on ISCPRIME is found in USEPA (1999).

Figure 5-1 Flow Around a Building



5.2.1 Building Wake Effects

Wind direction dependent building information such as width and height were generated with the US EPA BPIP (**B**uilding **P**rofile **I**nput **P**rogram) PRIME. The building processor requires input data defining the co-ordinates of the building corners, the tier heights as well as the source locations on each building (USEPA, 1985). The output file from the building processor becomes part of the input file to ISCPRIME.

BPIPPRIME generates the building height, length, and projected widths of the building tier associated with the greatest height of wake effects for each ten degrees of wind direction for each source. These building heights and projected widths are the same as are used for Good Engineering Practice stack height calculations. Figure 5-2 shows an example of a two tiered building with different tiers controlling the height that is appropriate for use for different wind directions. For an east or west wind the lower tier defines the appropriate height and width, while for a north or south wind the upper tier defines the appropriate values for height and width.

The building downwash/wake algorithms in ISCPRIME are improvements to the Huber-Snyder and Schulman-Scire methods used in the ISCST3 model. For building wake effects, modifications are made to the plume rise of a source as well as the lateral and vertical dispersion or spread of the plume. The principle idea is that significant mechanical turbulence is generated by the flow of the wind around an obstacle causing the height of plume to be reduced as well as the increasing or enhancing the spread of the plume.

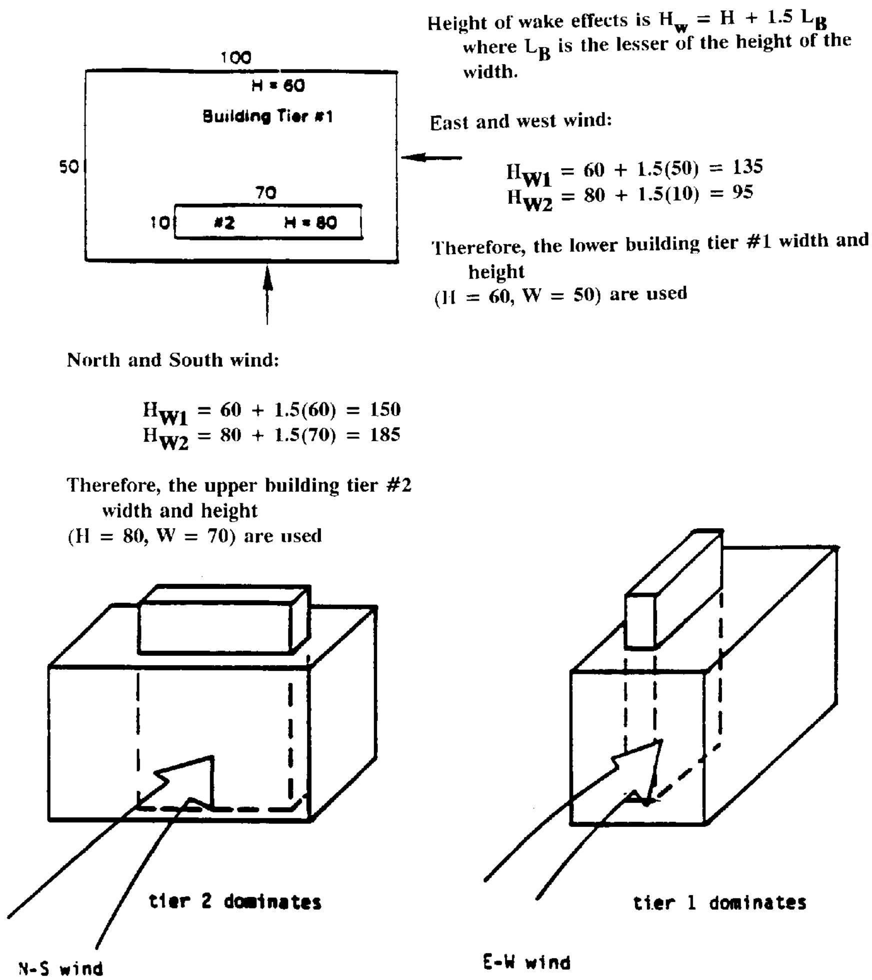
The central approach used in PRIME is to explicitly treat the trajectory of the plume near the building, and to use the position of the plume relative to the building to calculate interactions with the building wake. PRIME calculates the local slope of the mean streamlines as a function of projected building shape, and coupled with a numerical plume rise model, determines the change in plume centreline location with downwind distance. This incorporates the descent of the air containing the plume material, and rise of the plume relative to the streamlines due to buoyancy or momentum effects.

ISC-PRIME dispersion is based on the approach of Weil (1996). Enhanced turbulence intensity and velocity deficit values are calculated within the wake region. These values are a maximum at the lee wall of the building and decay downwind. Ambient turbulence intensity is inferred from the Briggs rural and urban dispersion coefficient formulas. As has been observed in wind-tunnel tests, both the horizontal and vertical dispersion coefficients are enhanced in the building wake. This virtually eliminates the unrealistically large predicted concentrations by ISCST3 during low wind speed, stable conditions which are caused by only enhancing the vertical dispersion coefficient when the stack height is more than 20% higher than the building height.

The ISCST3 model is only valid for the far wake (defined in ISC as beyond the lesser of three building heights or building widths). ISC-PRIME predicts concentrations in both the near and far wakes. The fraction of the plume captured by the near wake is fixed within the near wake following Wilson and Britter (1982). This plume mass is then re-emitted to the far wake as a volume source and added to the uncaptured primary plume. A transition zone between the near and far wakes is used to represent the unsteadiness of the near wake/far wake interface. In the transition zone, the concentrations are calculated as the sum of the uncaptured primary plume contribution plus a combination of the near wake concentration and the volume source concentration.

The wake-effects evaluation procedures were applied to all Inco and Algoma stacks. For regulatory application, a building is considered sufficiently close to a stack to cause wake effects when the distance between the stack and the nearest part of the building is less than or equal to five times the lesser of the height or the projected width of the building.

Figure 5-2 Example of Tiered Building Configuration



5.2.2 Deposition Modelling

Dry deposition of particulate onto the ground was modelled from the two facilities. Dry deposition is the removal of particles or gases due to interception with the ground. Many factors influence dry deposition including; meteorological variables, properties of the depositing pollutant and properties of the intercepting surface. Some of the important properties affecting dry deposition are presented in Table 5-1. The ISC-PRIME dry deposition model is based on the dry deposition model contained in the Acid Deposition and Oxidant Model (ADOM) (USEPA, 1995).

Table 5-1 Factors Affecting Dry Deposition

Micrometeorology variables	Depositing material: Particles	Depositing material: Gases	Surface variables
Aerodynamic roughness	Agglomeration	Chemical activity	Accommodation
Mass transfer	Diameter	Diffusion	Exudates
Particles	Density	Brownian	Trichomes
Gases	Diffusion	Eddy	Pubescence
Heat	Brownian	Partial pressure	Wax
Momentum	Eddy equal to	in equilibrium	Biotic surfaces
Atmospheric stability	Particle	with surface	Canopy growth
Diffusion, effect of	Momentum	Solubility	Dormant
Canopy	Heat		Expanding
Diurnal variation	Effect of canopy on		Senescent
Fetch	Diffusiophoresis		Canopy structure
Flow separation	Electrostatic effects		Areal density
Above canopy	Attraction		Bark
Below canopy	Repulsion		Bole
Friction velocity	Gravitational settling		Leaves
Inversion layer	Hygroscopicity		Porosity
Pollutant concentration	Impaction		Reproductive structure
Relative humidity	Interception		Soils
Seasonal variation	Momentum		Stem
Solar radiation	Physical properties		Type
Surface heating	Resuspension		Electrostatic properties
Temperature	Shape		Leaf, vegetation
Terrain	Size		Boundary layer
Uniform	Solubility		Change at high winds
Nonuniform	Thermophoresis		Flutter
Turbulence			Stomatal resistance
Wind velocity			Nonbiotic surfaces
Zero-plane displacements			pH effects on
Mass transfer			Reaction
Particles			Solubility
Gases			Pollutant penetration and distribution in canopy
Heat			Prior deposition loading
Momentum			Water

5.2.3 ISC-PRIME Options

The ISCPRIME model includes a wide range of options for modelling air quality impacts of various sources. The model is designed to support the US EPA's regulatory modelling programs and has the regulatory modelling options as the default mode of operation for the model. The regulatory default option includes:

- the use of stack-tip downwash,
- buoyancy-induced dispersion,
- final plume rise (except for sources with building downwash),
- a routine for processing averages when calm winds occur,
- default values for wind profile exponents and for the vertical potential temperature gradients, and
- use of upper bound estimates for super-squat buildings having an influence on the lateral dispersion of the plume.

The user may select either rural or urban dispersion parameters, depending on the characteristics of the source location. For the current modelling application, the ISC-PRIME model was executed for an urban environment in the regulatory mode with the exception of missing data. Here, ISC-PRIME was set to skip missing hours and treat that hour the same as a calm (i.e., set concentration to zero). The regulatory default mode would stop all dispersion calculations after encountering a missing data hour. The selection of an urban environment sets ISCPRIME to use the pre-defined temperature and wind speed profiles for an urban area as well as urban dispersion coefficients (i.e., McElroy-Pooler).

The ISC-PRIME urban dispersion option was selected because the model domain of interest is primarily an urban environment, with the lakeshore to the south of the area of interest.

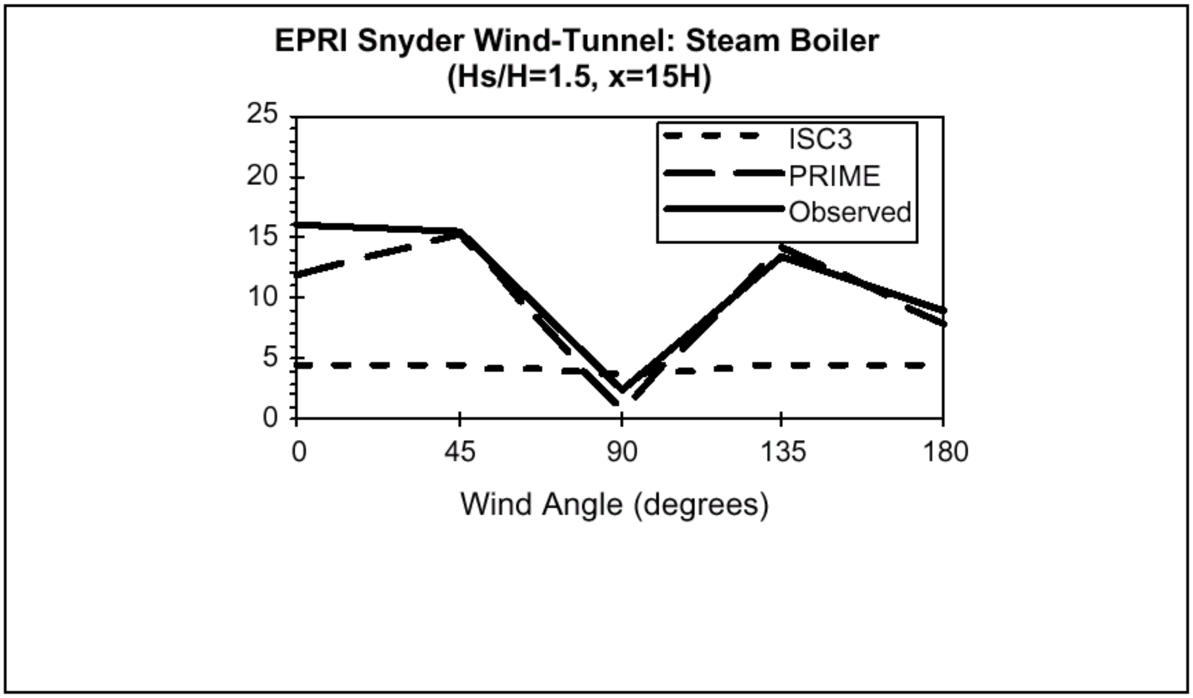
5.2.4 Full Scale Verification of ISC-PRIME

The developers of ISC-PRIME have conducted extensive model verification studies using measured data and model predictions. Examples of some studies are presented to demonstrate the accuracy of the model in predicting ambient concentrations/depositions.

Snyder Wind-Tunnel Data

These data include systematic variations of stack to building height ratios, ratios of exhaust speeds to wind speeds, wind angle, Froude number and stack location for both a generic steam boiler and combustion turbine. Figure 5-3 shows the comparison of PRIME and ISCST3 to data for a steam boiler with stack to building height ratio of 1.5 at 15 building heights downwind for 5 different wind angles to the building face. The building width is twice the height and 2.5 times the length with a direction of zero degrees defined as perpendicular to the wider horizontal dimension.

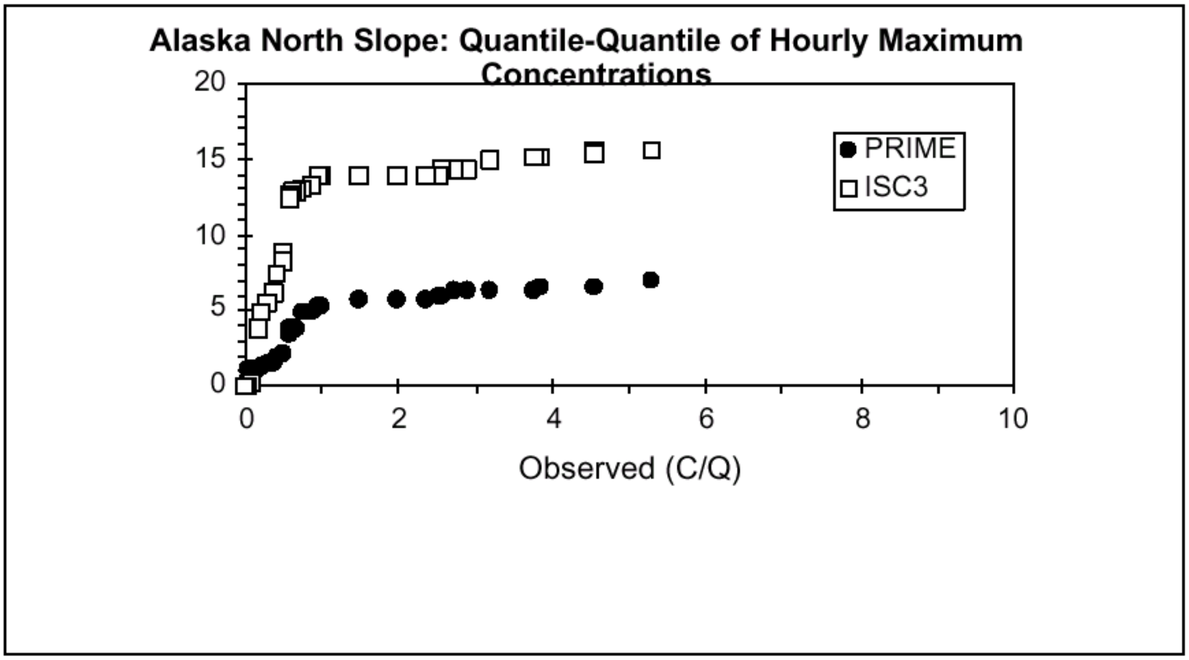
Figure 5-3 Snyder Wind Tunnel Study Model Verifications



Alaska North Slope Study

A field study was conducted near Prudhoe Bay (Guenther, Lamb and Allwine, 1989) for a high buoyancy, high momentum combustion turbine with a stack to building height ratio of 1.15. Thirty-eight hours of tracer data and onsite meteorological data were collected during high wind conditions over a 7-day period. Figure 5-4 shows that PRIME produces better agreement than ISC3 for the largest concentrations, but both models over predict (i.e. produce conservative estimates) for the smaller observed values.

Figure 5-4 Alaska North Slope Model Verification Study



5.3 Meteorological Data for Dispersion Modelling

Meteorological data for ISC-PRIME was processed with the most recent release of the AERMET meteorological pre-processor. The major purpose of AERMET is to calculate boundary layer parameters for use by AERMOD.A meteorological interface module, internal to AERMOD, uses these parameters to generate profiles of the needed meteorological variables. In addition, AERMET passes all meteorological observations to AERMOD.

Surface characteristics in the form of albedo, surface roughness and Bowen ratio, plus standard meteorological observations, are input to AERMET.AERMET then calculates the PBL parameters: friction velocity (u_*), Monin-Obukhov length (L), convective velocity scale (w_*), temperature scale (θ_*), CBL height (z_i), SBL height (h), and surface heat flux (H). These parameters are then passed to the meteorological interface module where vertical profiles are calculated, from similarity expressions, for wind speed (u), wind direction, lateral and vertical turbulent fluctuations (σ_v, σ_z), potential temperature gradient ($d\theta/dz$), and potential temperature (θ).

6. DISPERSION MODEL INPUTS

The inputs required to model particulate deposition are presented in this section. These inputs include characteristics of each particulate emission source (e.g. stack height, stack diameter, exit velocity, temperature and contaminant emission rate), building data for the calculation of the effects of structures on dispersing plumes, and a grid of receptors at which particulate/metals depositions were predicted.

6.1 Source Parameters

The particulate emissions inventory and emissions scenarios for each facility are presented in Section 3. The physical parameters of the stacks, volume and area sources are presented in Appendix I for the sources used in the dispersion modelling.

6.2 Building Data

The ISC-PRIME models require direction dependent building information for use in the building wake and building downwash calculations. These data were generated with the US EPA building pre-processor (BPIP-PRIME) using the building data presented in Figures 6-1 to 6-6 for the various building/emissions scenarios. The X, Y co-ordinates and building heights used in the building pre-processing are presented in Appendix J. T he building pre-processor was used to produce direction dependent building widths and heights for each stack for input to the ISC-PRIME model.

The Inco buildings and their primary purposes during each emissions scenario are summarised in Table 6-1 below.

Figure 6-1 Building and Emissions Sources Layout for all Algoma Scenarios (1913-77)

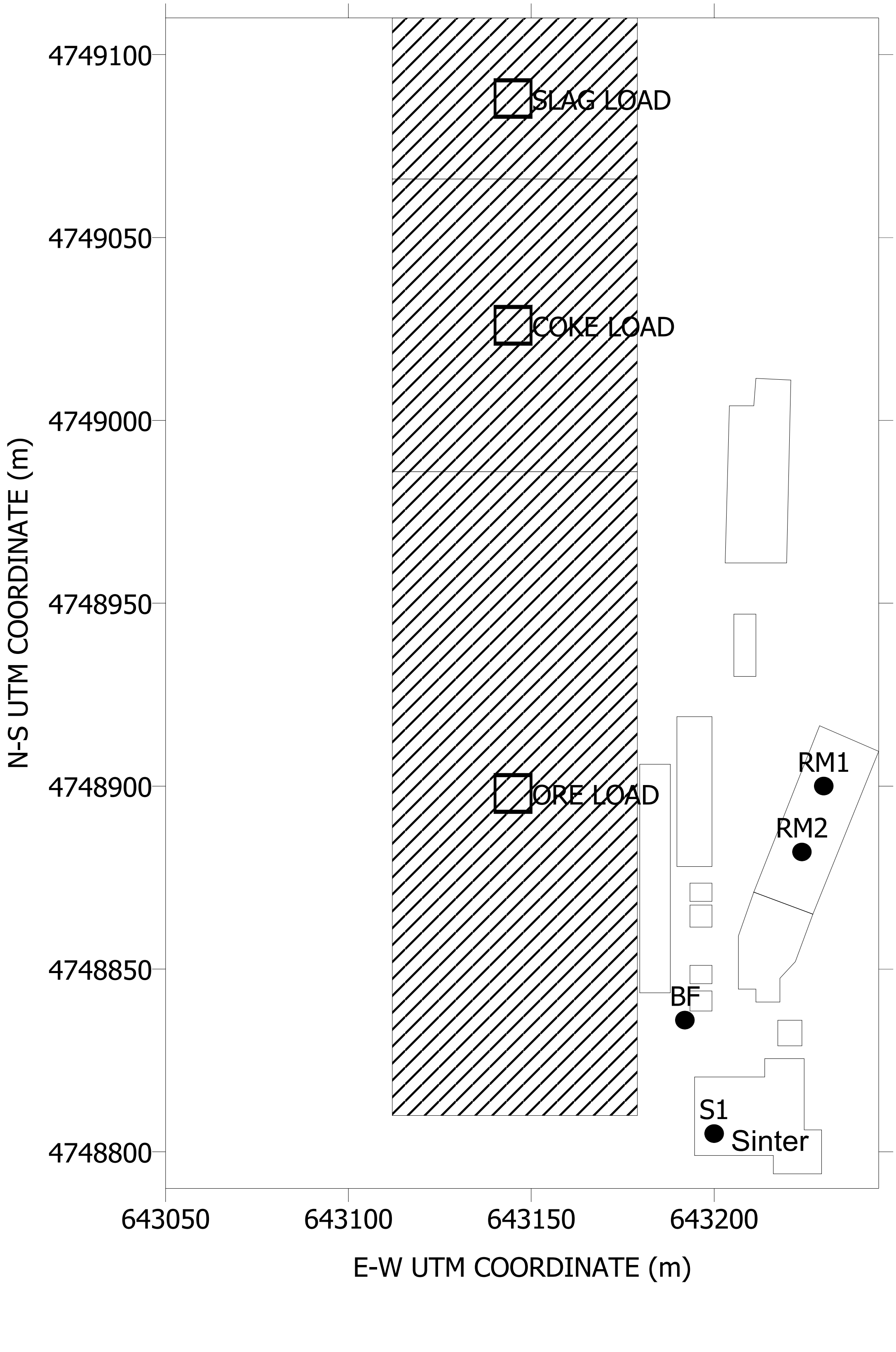


Figure 6-2 Building and Emissions Sources Layout for Inco Scenario 1 (1918-30)

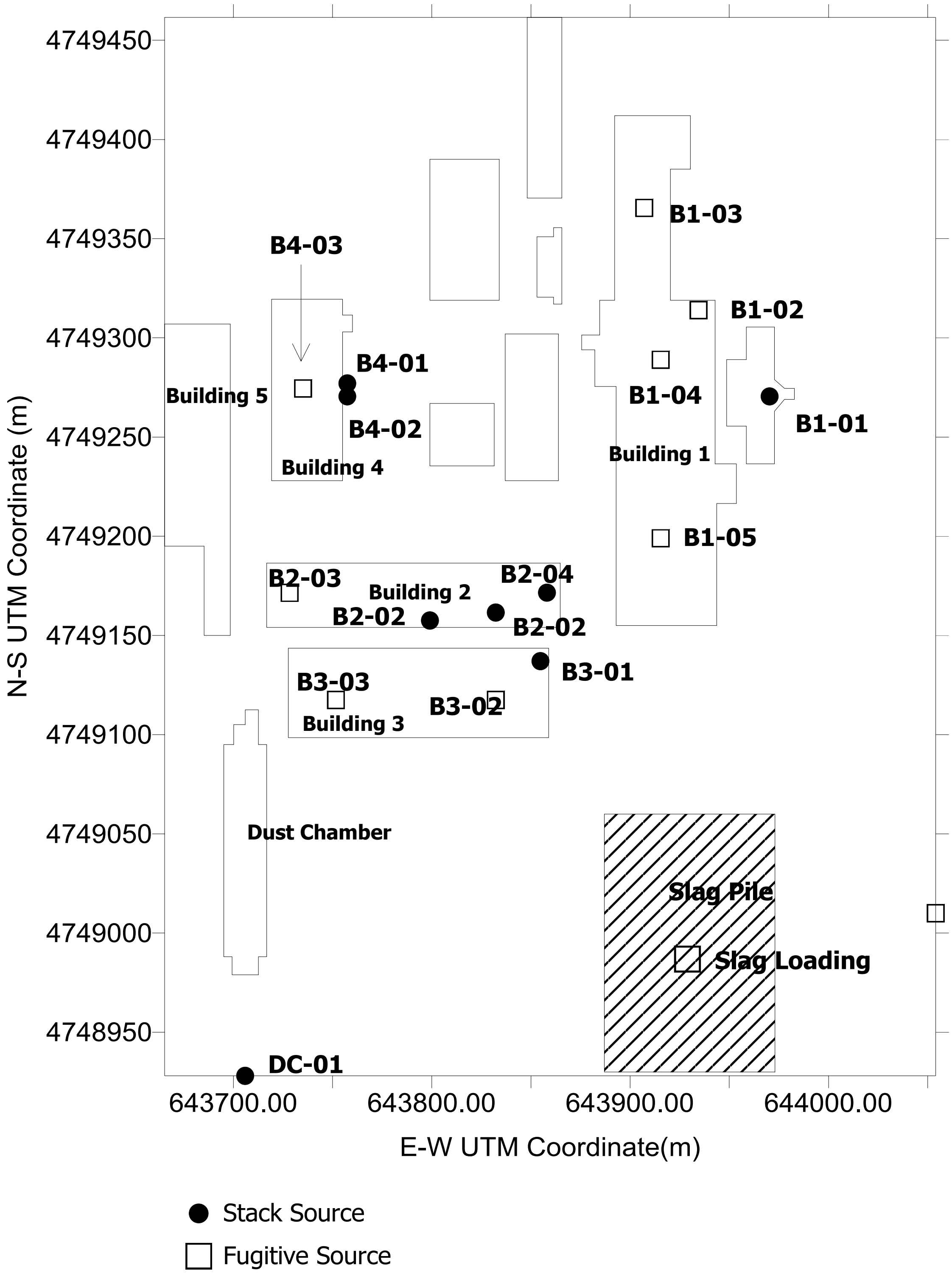


Figure 6-3 Building and Emissions Sources Layout for Inco Scenario 2 (1931-39)

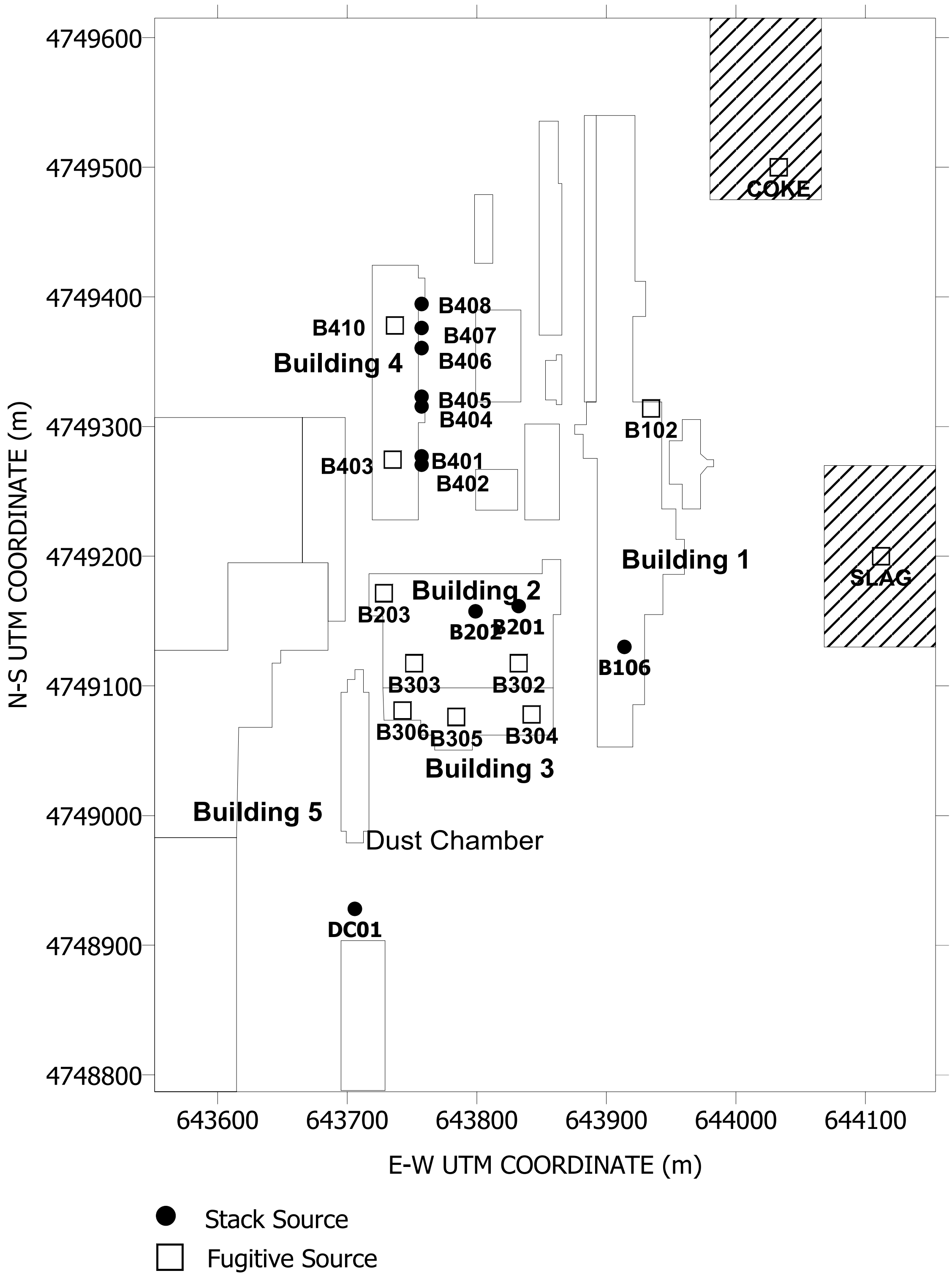


Figure 6-4 Building and Emissions Sources Layout for Inco Scenario 3 (1940-59)

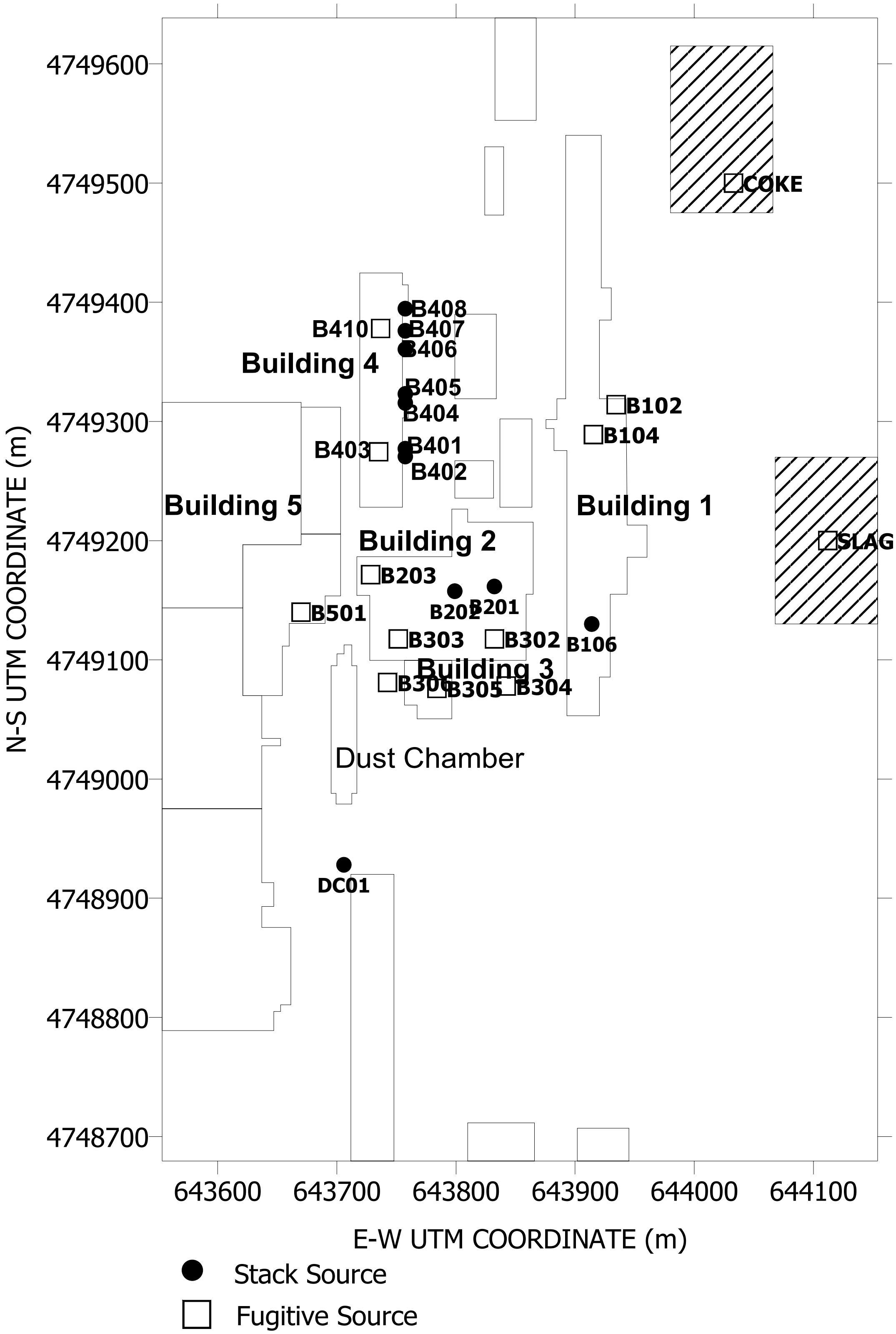


Figure 6-5 Building and Emissions Sources Layout for Inco Scenario 4 (1960-79)

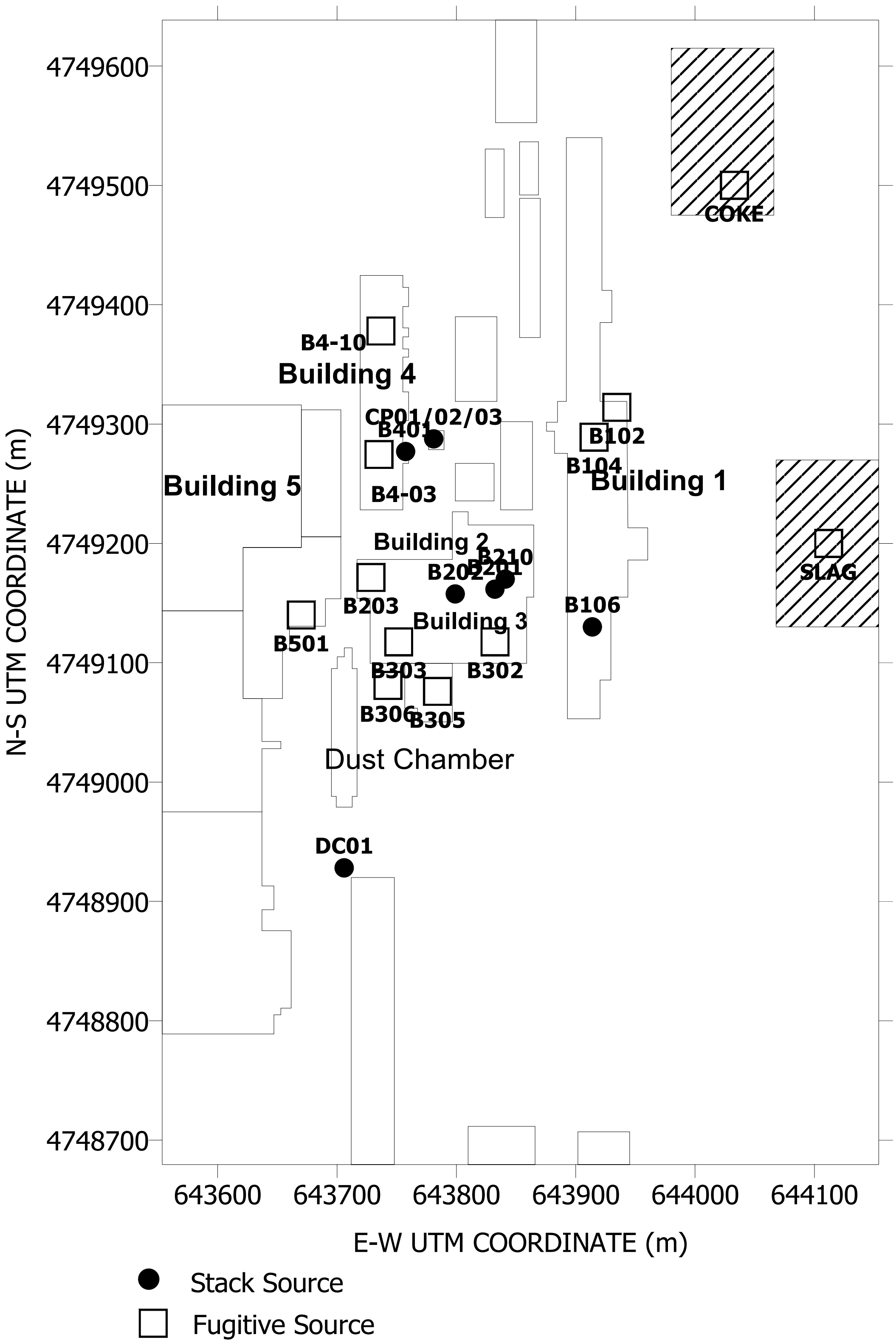


Figure 6-6 Building and Emissions Sources Layout for Inco Scenario 5 (1980-90)

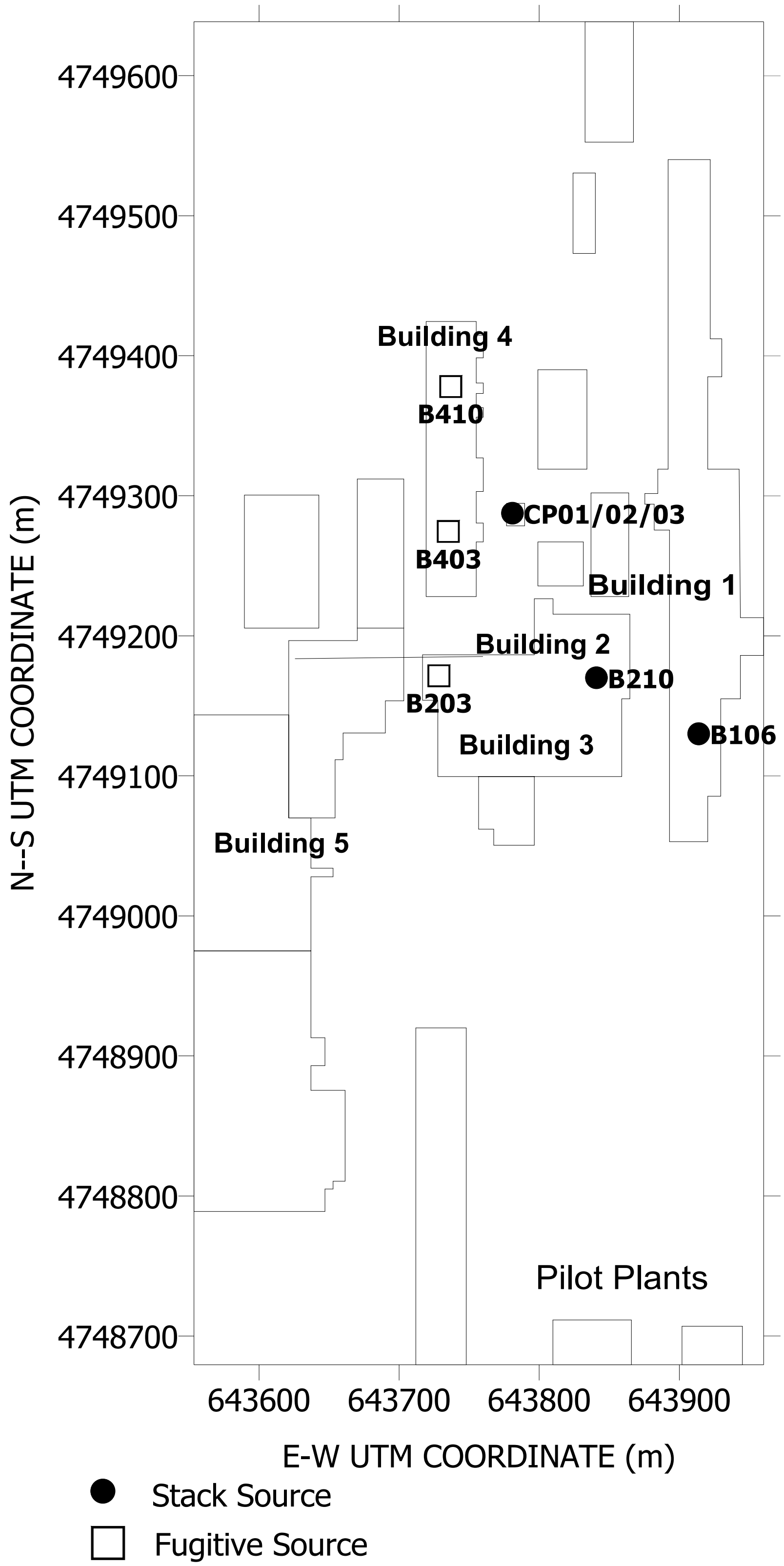


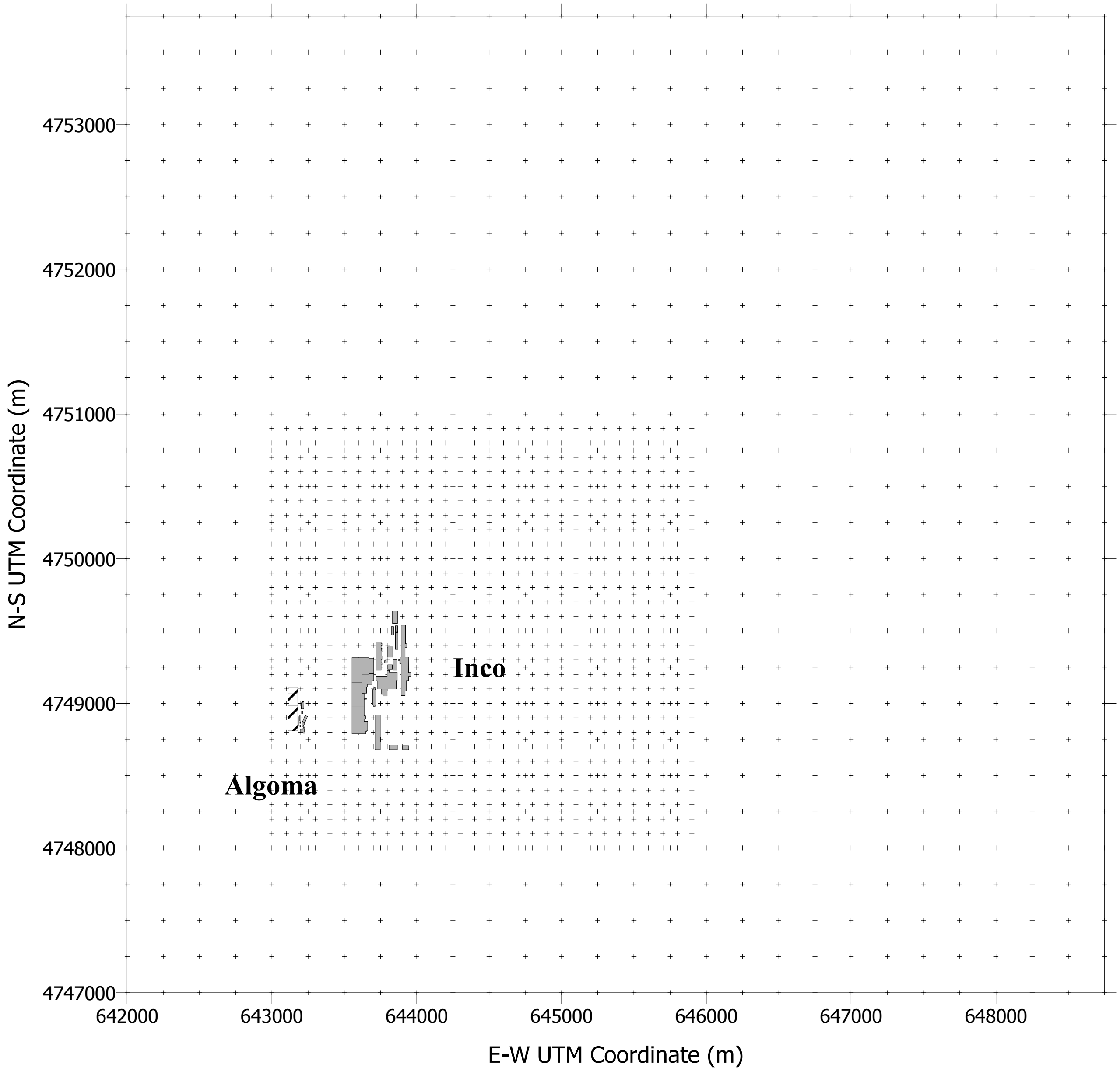
Table 6-1 Summary of Inco Buildings for each Emission Scenario.

Scenario	Building 1	Building 2	Building 3	Building 4	Building 5
1 (1918-30)	Orford Process	Leaching	Calcining and Sintering	Nickel Refining	Not Built
2 (1931-38)	Raw material storage/ slimes drying/nickel precipitation	Leaching	Calcining and Sintering	Nickel Refining	Electro Refinery
3 (1939-59)	Raw material storage/ slimes drying/nickel precipitation	Leaching	Calcining and Sintering	Nickel Refining	Electro Refinery
4 (1960-79)	Raw material storage/ slimes drying/nickel precipitation	Leaching and Foundry Additives Production	Storage	Anode Casting	Electro Refinery
5 (1980–90)	Raw material storage/ slimes drying/nickel precipitation	Leaching and Foundry Additives Production	Storage	Utility Nickel Production	Electro Refinery

6.3 Receptor Grid

Ground level concentrations were calculated over a 7-km by 7-km grid with varying grid spacing. The locations of the receptors used in the analysis are presented in Figure 6-7.

Figure 6-7 Receptor Grid Used in Analysis



7. RESULTS OF ISC-PRIME ANALYSIS

The following sections present the results of the dispersion modelling of Inco and Algoma emissions of the various potential CoCs addressed in this study. Dispersion modelling results for iron and nickel (calculated in grams of contaminant per square metre) were converted to ppm (by mass) in the soil assuming that all the metal would be contained in the top 5-cm of the soil and the density of the soil in the Port Colborne area is 1500 kg/m^3.

7.1 Particulate Matter (PM) Depositions

Isopleths of predicted total PM depositions due to emissions from Inco and Algoma individually (over the operating lifespan of each facility) are presented in Figures 7-1 and Figure 7-2, respectively. The results of the dispersion/deposition modelling predict that Algoma emissions resulted in significantly higher PM depositions than those from Inco. Although Inco is estimated to have only slightly smaller overall PM emissions (about 4% smaller over the lifespans of the facilities), much of these emissions occur from taller stacks than those at Algoma. Higher stack heights allow for greater dilution of the plume before it reaches ground, thus reducing PM concentrations and depositions. In addition, the larger buildings in the Inco complex also serve to pre-dilute the contaminant plumes (due to their wake effects), thus lowering the contaminant concentrations in the plumes and therefore their depositions.

In the Rodney Street area, PM depositions due to Algoma were predicted to be between 11-12 times greater than from Inco. The predominant wind direction in the Port Colborne area is from the south-west (14.2% of the time, see Table 4-5), therefore Algoma emissions will be most frequently carried over the Rodney Street area. Inco is located to the east of Rodney Street and winds blowing Inco emissions over Rodney Street (winds blowing from the east) occur less frequently (1.3% of the time). Therefore emissions from Inco will impact the Rodney Street area less frequently than emissions from Algoma.

A plot of the total PM depositions due to emissions from both facilities collectively is presented in Figure 7-3.

Figure 7-1 Contours of Total Predicted PM Depositions (g/m²) due to Inco

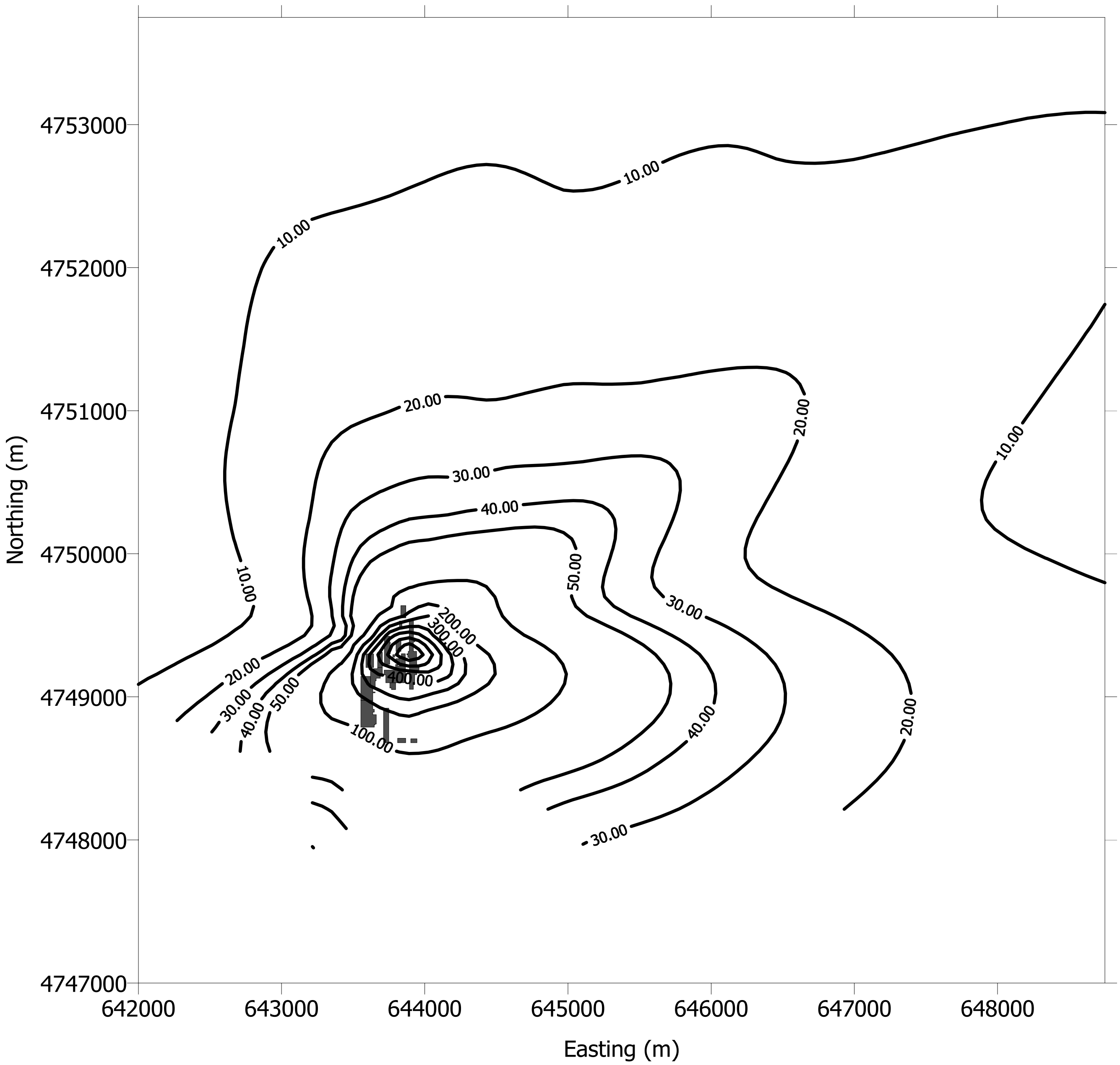


Figure 7-2 Contours of Total Predicted PM Deposition (g/m²) due to Algoma

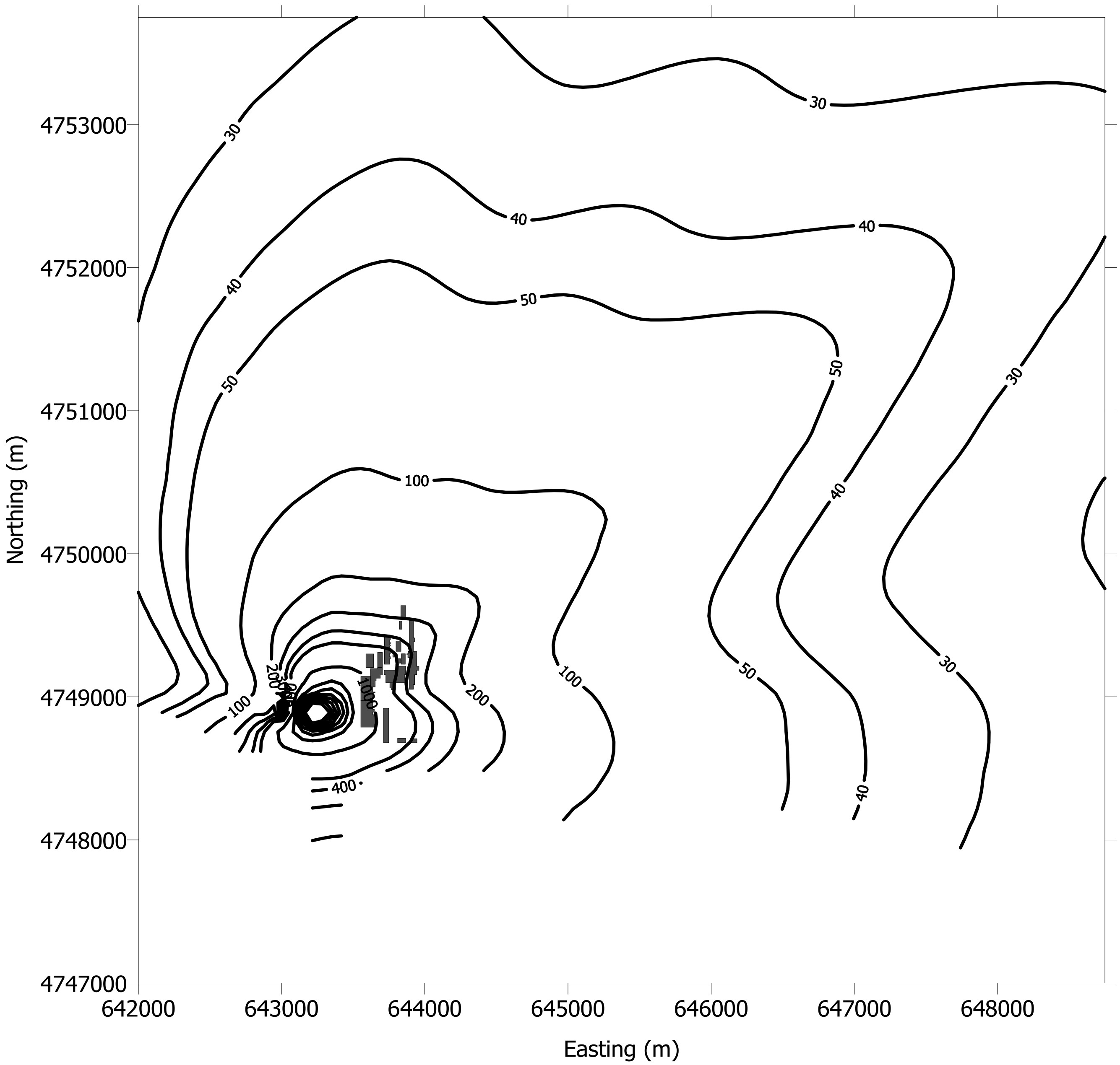
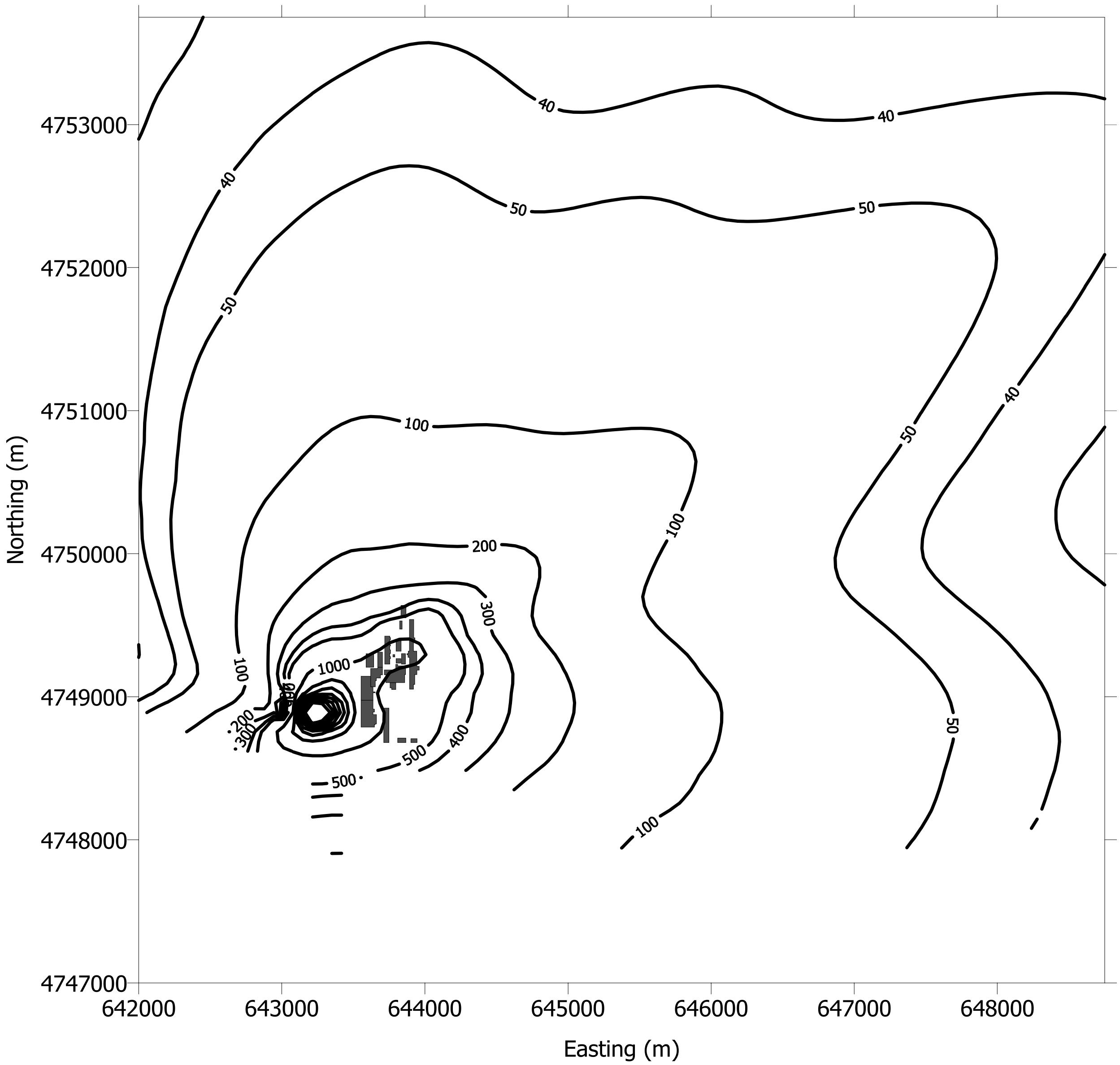


Figure 7-3 Contours of Total Predicted PM Depositions (g/m^2) due to both Sources



7.2 Nickel (Ni) Depositions

Isopleths of predicted total nickel deposition due to emissions from Inco (over the operating lifespan of the refinery) is presented in Figures 7-4. The results of the dispersion/deposition modelling predict that Inco emissions resulted in significantly higher nickel depositions to the north-east of the refinery than in the Rodney Street area. It should be noted that the model predictions presented in these figures show the total deposition of nickel on the ground surface and do not address how the nickel is carried/adsorbed into the soil.

7.2.1 Sensitivity Analysis of Inco Nickel Emissions Inventory

A simple sensitivity analysis of the Inco nickel emissions inventory and deposition modelling was conducted. The estimated Inco nickel emissions were increased by factors of two and three and the predicted nickel deposition contours for the original, doubled and tripled nickel emissions were compared to the measured nickel concentrations in the Port Colborne soil. The results of this analysis are presented in Figure 7-5. In this figure, the predicted 200 and 1000 ppm contours for the original, doubled and tripled nickel emissions are presented as solid, dashed and dot-dashed lines respectively. The 200 and 1000-ppm contours measured in the Port Colborne soil are presented as dashed green lines in this figure. The dispersion model predictions match the measured soil concentrations when the nickel emissions are increased by between 2-3 times the original inventory. It should be noted that dispersion models are typically accurate within a factor of two of actual measurements. This suggests that the Inco nickel emission inventory may be underestimated by no more than a factor of 2-3.

As similar emissions estimation methodologies and dispersion modelling were conducted for both the Inco and Algoma facilities, it would be expected that any uncertainty in the Algoma emissions inventory would be of a similar magnitude.

Figure 7-4 Contours of Total Predicted Nickel Depositions (ppm) due to Inco

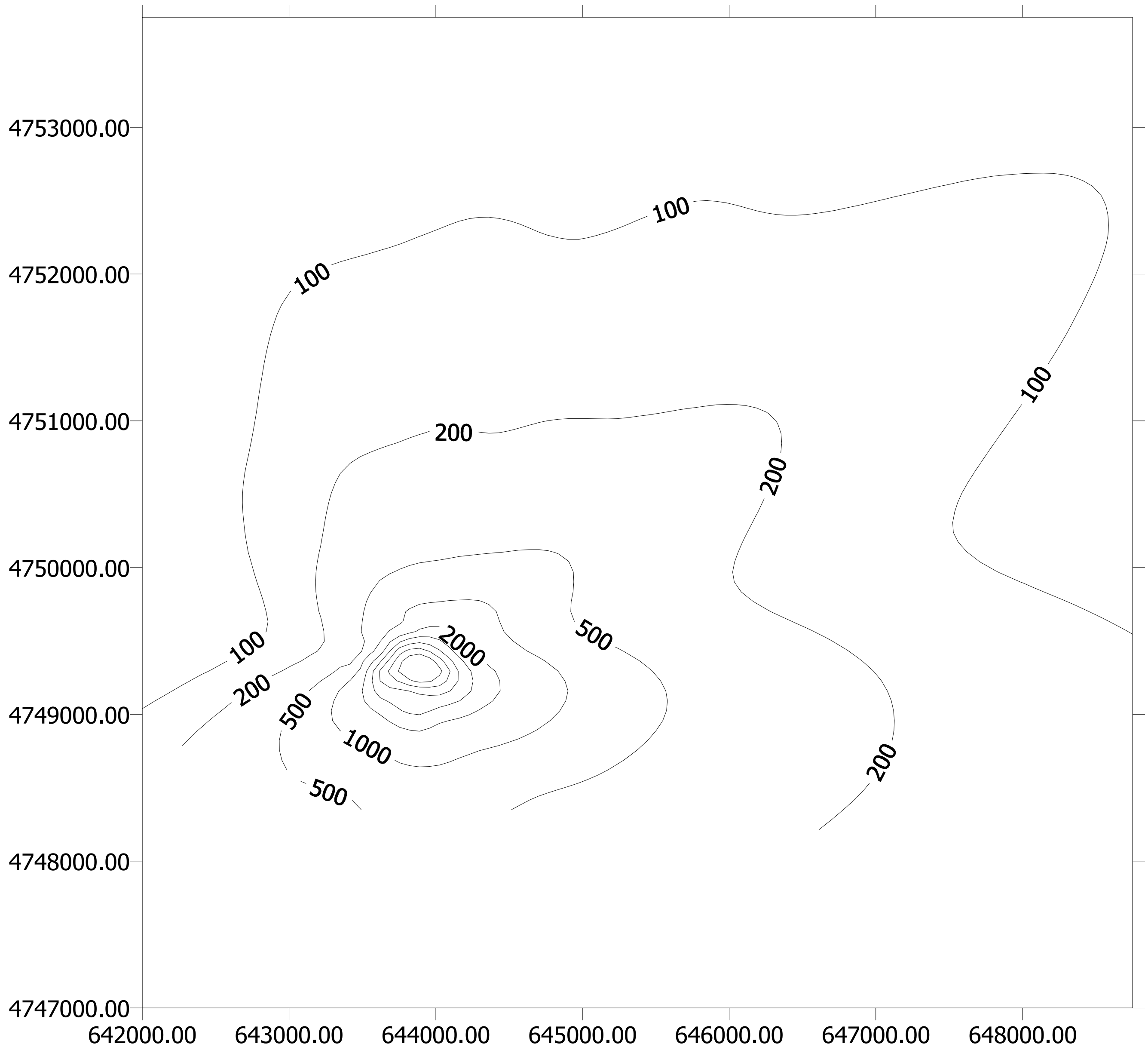
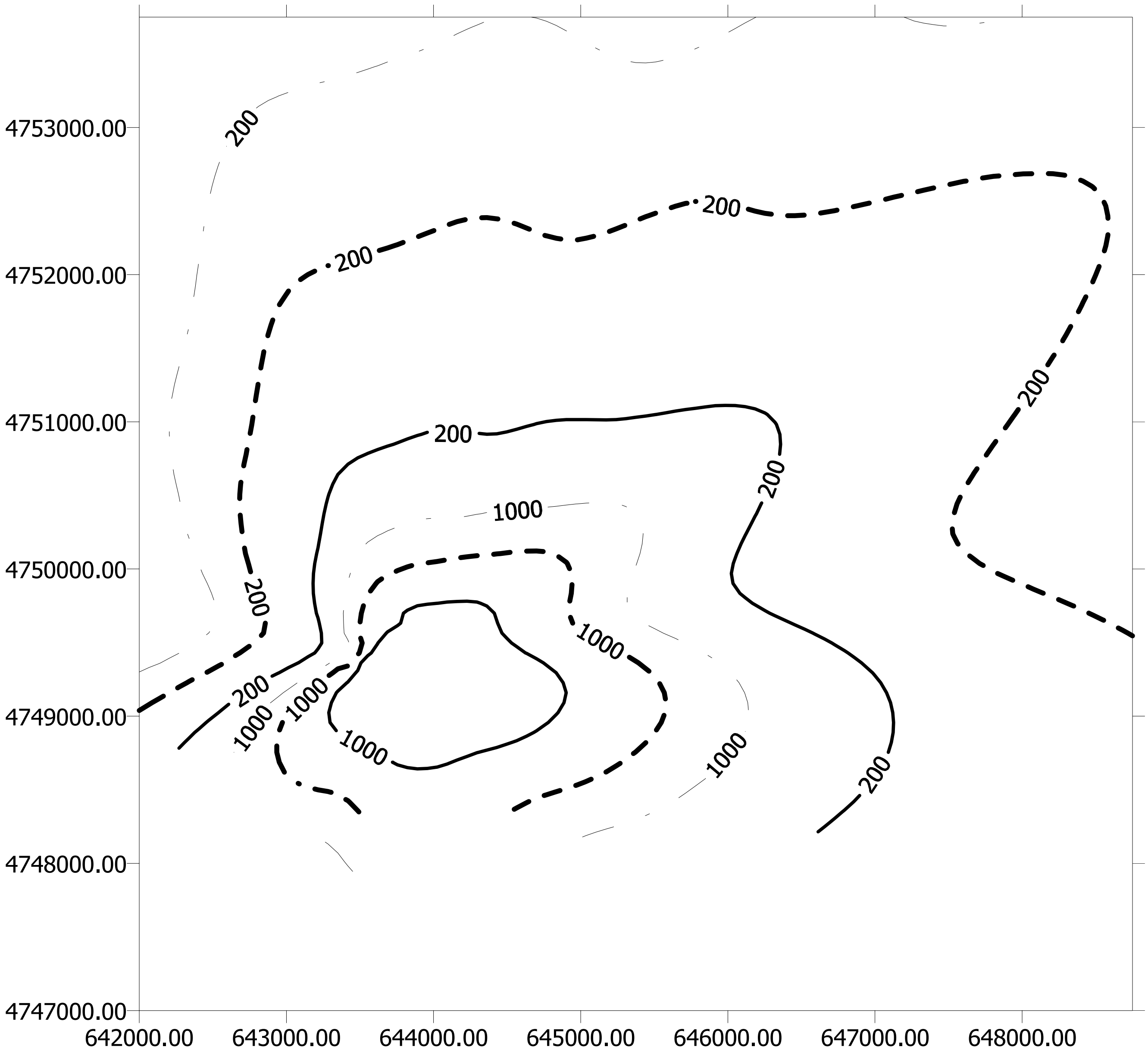


Figure 7-5 Comparison of Predicted Nickel Depositions for the Inco Inventory Increased by Factors of 2 and 3.



7.3 Iron (Fe) Depositions

Isopleths of predicted total iron deposition due to emissions from Algoma and Inco (over the operating lifespan of each facility) is presented in Figures 7-6 and 7-7 respectively. The results of the dispersion/deposition modelling predict that Algoma emissions resulted in significantly greater iron depositions in the Rodney Street area than did Inco (about 8,959 ppm from Algoma versus 6 ppm from Inco). It should be noted that the model predictions presented in these figures show the total deposition of iron on the ground surface and do not address how the iron is carried/adsorbed into the soil. A plot of the total deposition due to both Inco and Algoma emissions is presented in Figure 7-8.

Figure 7-6 Contours of Total Predicted Iron Deposition (ppm) due to Algoma

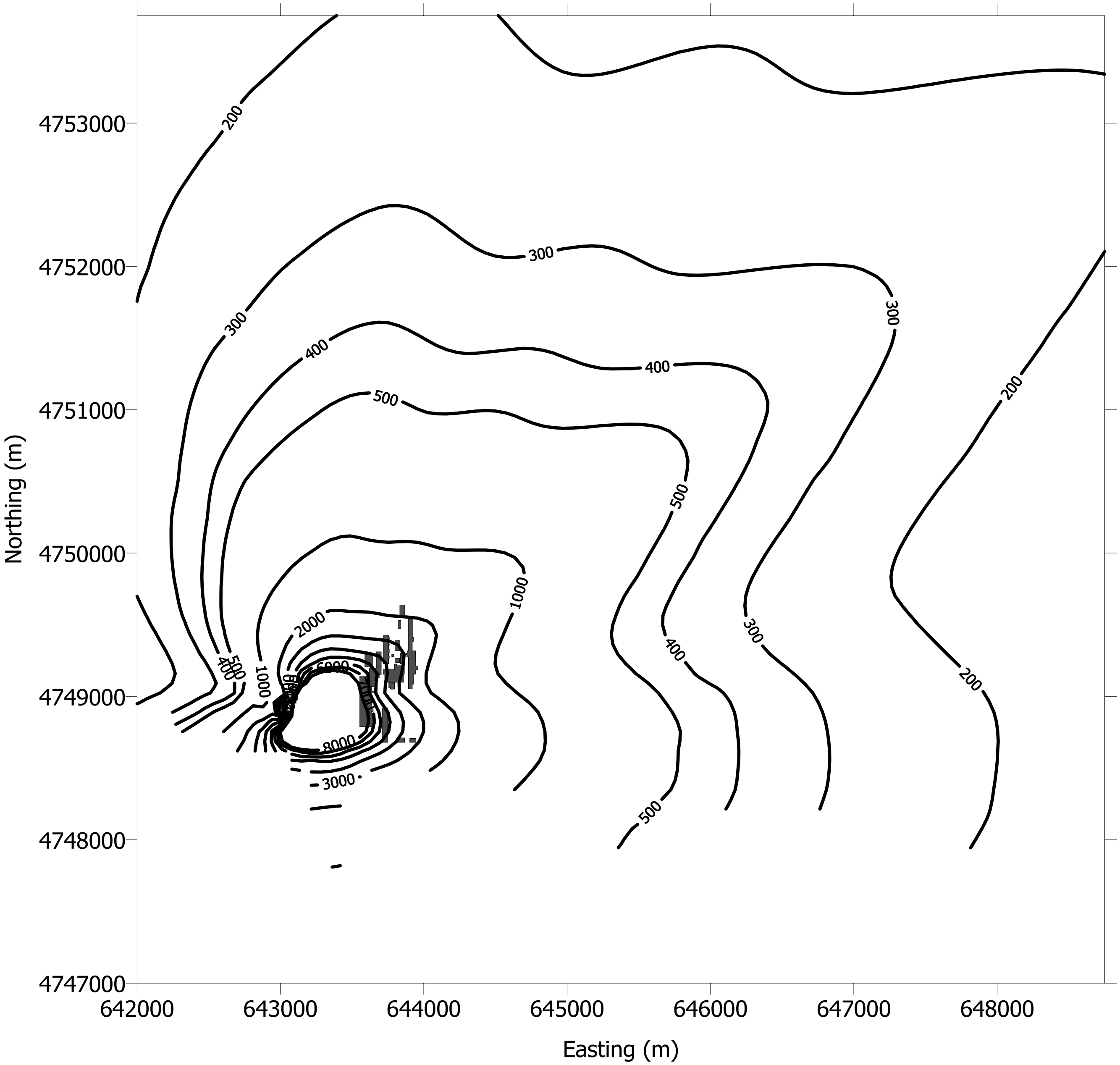


Figure 7-7 Contours of Total Predicted Iron Deposition (ppm) due to Inco

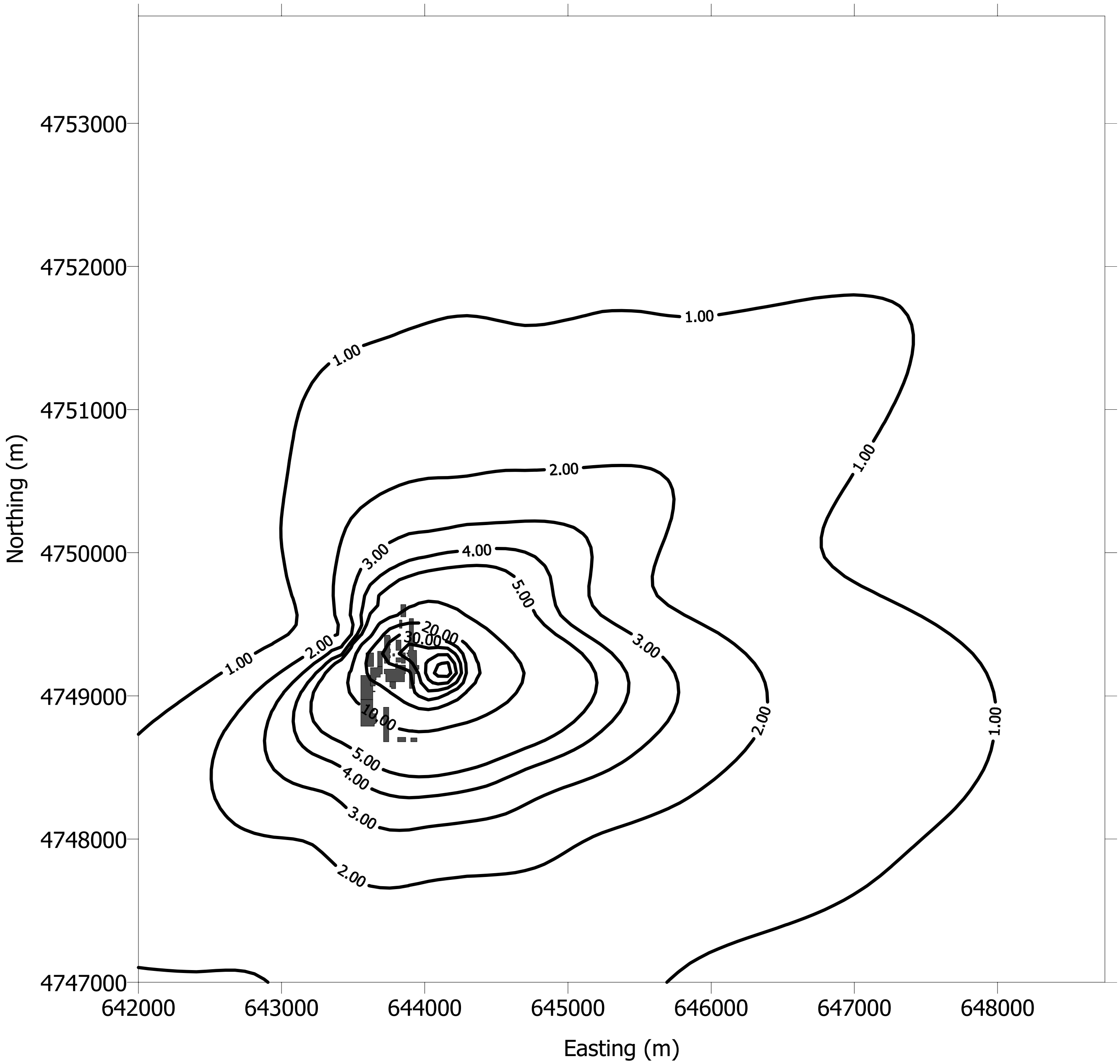
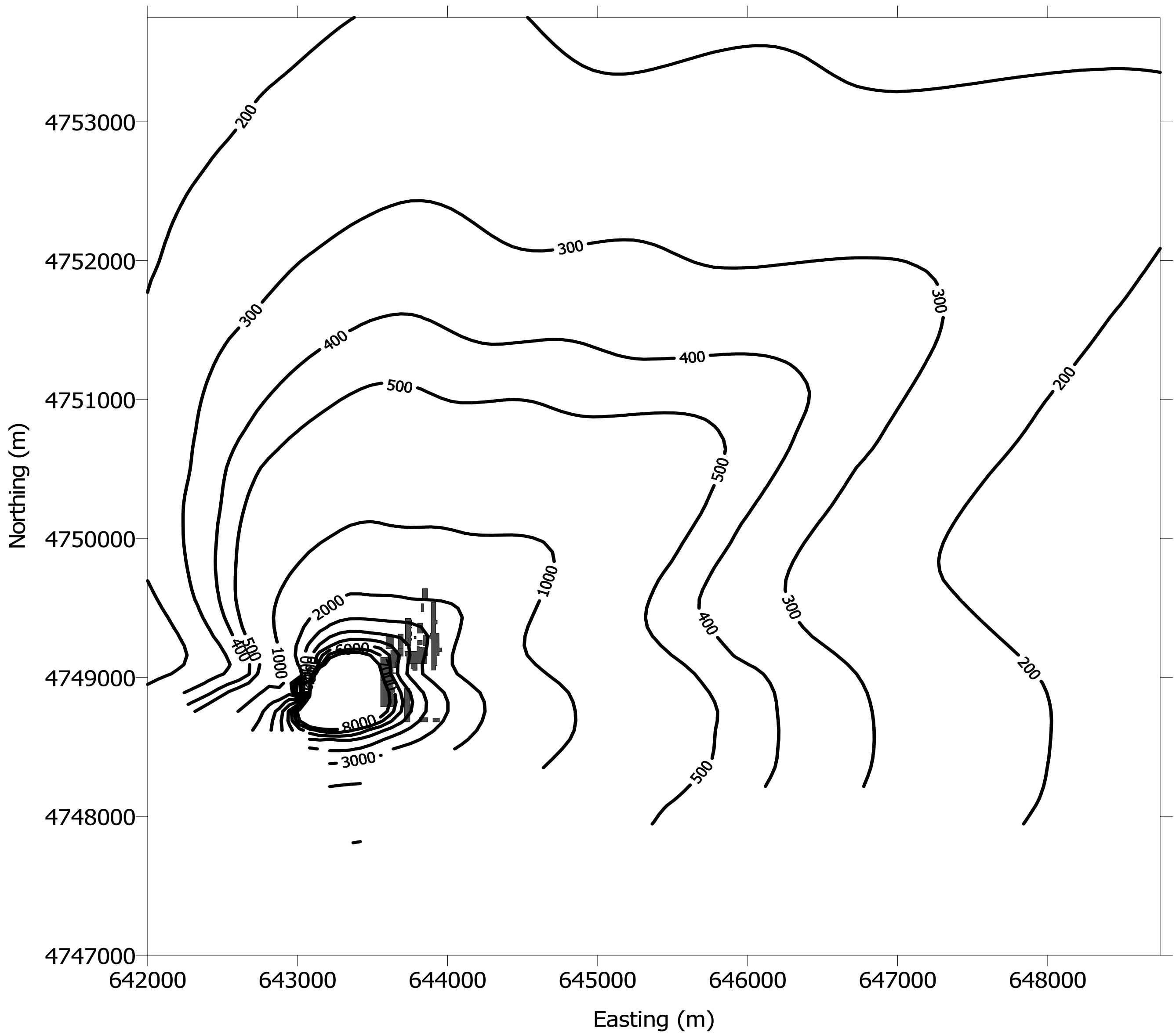


Figure 7-8 Contours of Total Predicted Iron Deposition (ppm) due to Inco and Algoma Combined



8. CONCLUSIONS

Jacques Whitford Limited (Jacques Whitford) conducted an emission inventory and dispersion modelling study of historical emissions of contaminants from the Inco and Algoma facilities in the City of Port Colborne, Ontario. The following summarises the main findings and conclusions of the study.

Emission Inventories

Emissions inventories of particulate matter (Inco and Algoma), nickel (Inco), and iron (Inco and Algoma) were developed utilising available operating records and standardised methodologies and techniques specified by United States Environmental Protection Agency (US EPA) and the Ontario Ministry of Environment (MOE). The total estimated emissions of each contaminant are presented in Table 8.1. Inco was estimated to be a slightly smaller emitter of particulate matter than was Algoma.

Algoma was estimated to be the predominant emitter of iron (about 99% of all iron was estimated to be emitted from Algoma). Other than iron, speciation data for potential CoC's were unavailable for Algoma; therefore comparisons between the two facilities for other potential CoCs could not be made. However, the relative magnitude of PM air emissions from each facility is expected to be an indicator of the relative environmental impact of each facility for other contaminants. The estimated PM emissions between Inco and Algoma were within 4% of one another; therefore Algoma also may have emitted other potential CoCs.

Table 8-1 Summary of Estimated Total Contaminant Emissions from Inco and Algoma

Contaminant	Algoma Emissions (Tonnes)	Inco Emissions (Tonnes)
Particulate Matter	32,327	30,990
Iron	16,477	132
Nickel	N/A	19,459

It should be noted that the two emissions inventories developed for Inco and Algoma are estimates of the emissions from each facility (based on available data and emissions factors that typically are conservative). However, as the same emissions inventory techniques were used for both facilities, the relative magnitude of emissions between the two facilities is expected to be representative of reality.

Meteorological Analysis

A five-year meteorological data set was assembled using the Inco onsite meteorological tower, Environment Canada data for the Port Colborne area and US National Centre of Atmospheric Research data for Niagara Falls and Buffalo. The meteorological analysis shows the predominant wind direction to be blowing from the south-west (14.2% of the time) while winds blow from the east about 1.3% of the time. The Algoma facility was located to the south-west of the Rodney Street area while the Inco facility is located to the east, therefore it is expected that Algoma emissions would impact on the Rodney Street area more frequently than Inco emissions.

Deposition Modelling

Predicted contaminant depositions over Port Colborne were based on a five-year data set of hourly meteorological data for the region. Since many of the areas of interest for the study fall within an area where the wake effects of buildings are expected to influence dispersion and deposition, the US EPA dispersion ISC-PRIME was used in the analysis. The meteorology of a region tends to historically be relatively consistent, therefore the five-year meteorological data set was used to represent the meteorological conditions experienced by Port Colborne in previous decades. Using this approach, total deposition during the operating life of each facility was calculated over a 7-km by 7-km domain covering the Port Colborne area for each contaminant addressed in the emissions inventory.

The dispersion/deposition modelling analysis predicted the following:

- Algoma particulate matter (PM) emissions resulted in significantly higher PM depositions in the Rodney Street area and Port Colborne as a whole than those from Inco. In the Rodney Street area, PM depositions due to Algoma were predicted to be between 11-12 times greater than those from Inco.
- Emissions of nickel by Inco resulted in significantly higher nickel depositions to the north-east of the refinery than in the Rodney Street area.
- Algoma was responsible for the majority of the iron deposition in the Port Colborne area. Algoma emissions resulted in significantly greater iron depositions in the Rodney Street area than those from Inco.

Yours very truly,

JACQUES WHITFORD ENVIRONMENT LTD.

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APPENDIX A

PM EMISSIONS INVENTORY FOR ALGOMA

Algoma - Port Colborne **Scenario: 1**
Air Emission Inventory **Base Year: 1951**

Source ID	Source Description	Production Activity Rate	AR Units	Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density	
	Process Emissions												
BF1-01	No 1 BF Roof Monitor	88,625	tonnes product / year	0.3	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	27	0.84	1	1	
BF1-02	No 1 BF Tapping	88,625	tonnes product / year	0.15	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	13	0.42	1	1	
BF1-03	No 1 BF Stoves (3)	655,825,000	MJ / year	0.0003	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	197	6.24	1	1	
BF2-01	No 2 BF Roof Monitor	29,700	tonnes product / year	0.3	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	9	0.28	1	1	
BF2-02	No 2 BF Tapping	29,700	tonnes product / year	0.15	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	4.5	0.14	1	1	
BF2-03	No 2 BF Stoves	219,780,000	MJ / year	0.0003	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	65.9	2.09	1	1	
PC1-01	Pig Casting Machine	118,325	tonnes product / year	0.55	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	65	2.06	2	1	
S1-01	Sintering Plant - Windbox	118,325	tonnes sinter / year	1.112	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	132	4.17	3	1	
S2-02	Sintering Plant - Discharge	118,325	tonnes sinter / year	0.68	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	80	2.55	3	1	
	Material Handling Emissions												
MH-01	Ore loading/unloading x 2	165,655	tonnes ore / year	0.00113	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.19	0.0059	9	1	
MH-02	Coke loading/unloading x 2	76,911	tonnes coke / year	0.00089	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.069	0.0022	9	3	
MH-03	Slag loading / unloading	47,330	tonnes slag / year	0.0092	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.43	0.014	9	1	
WS-01	Ore Storage Pile	11387	square meters	0.077	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.87	0.03	10		2.42635E-06
WS-02	Coke Storage Pile	5287	square meters	0.077	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.40	0.01	10		2.42635E-06
WS-03	Slag Storage Pile	3254	square meters	0.077	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.25	0.01	10		2.42635E-06
	Plant Capacity	50	%										
								Totals:	**595.3**	**18.9**			

Wind Erosion Parameters

Wind Speed (@20.1 m)	89.8	km/hr
Disturbances per Year	26	

Algoma - Port Colborne | **Scenario:** 2
Air Emission Inventory | **Base Year:** 1957

Source ID	Source Description	Production Activity Rate	AR Units	Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density
	Process Emissions											
BF1-01	No 1 BF Roof Monitor	104,500	tonnes product / year	0.3	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	31	0.99	1	1
BF1-02	No 1 BF Tapping	104,500	tonnes product / year	0.15	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	16	0.50	1	1
BF1-03	No 1 BF Stoves (3)	773,300,000	MJ / year	0.00015	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	116	3.68	1	1
BF2-01	No 2 BF Roof Monitor	37,741	tonnes product / year	0.3	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	11	0.36	1	1
BF2-02	No 2 BF Tapping	37,741	tonnes product / year	0.15	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	5.7	0.18	1	1
BF2-03	No 2 BF Stoves	279,283,400	MJ / year	0.00015	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	41.9	1.33	1	1
PC1-01	Pig Casting Machine	142,241	tonnes product / year	0.55	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	78	2.48	2	1
S1-01	Sintering Plant - Windbox	142,241	tonnes sinter / year	1.112	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	158	5.02	3	1
S2-02	Sintering Plant - Discharge	142,241	tonnes sinter / year	0.68	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	97	3.07	3	1
	Material Handling Emissions											
MH-01	Ore loading/unloading	199,137	tonnes ore / year	0.00113	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.22	0.0071	9	1
MH-02	Coke loading/unloading	92,457	tonnes coke / year	0.00089	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.083	0.0026	9	3
MH-03	Slag loading / unloading	56,896	tonnes slag / year	0.0092	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.52	0.017	9	1
WS-01	Ore Storage Pile	11387	square meters	0.077	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.87	0.03	10	1
WS-02	Coke Storage Pile	5287	square meters	0.077	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.40	0.01	10	3
WS-03	Slag Storage Pile	3254	square meters	0.077	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.25	0.01	10	1
	Plant Capacity	50	%									
								Totals:	**557.38**	**17.67**		

Wind Erosion Parameters

Wind Speed	89.8	km/hr
Disturbances per Year	26	

Algoma - Port Colborne | **Scenario:** 3
Air Emission Inventory | **Base Year:** 1960

Source ID	Source Description	Production		Contaminant - Total Particulate					Emission Rate		PSD	PSD
	Process Emissions	**Activity Rate**	**AR Units**	**Emission Factor**	**EF Units**	**Methodology**	**Data Quality**	**Reference**	**ER (Mg/yr)**	**ER (g/s)**	**Category**	**Density**
BF1-01	No 1 BF Roof Monitor	104,500	tonnes product / year	0.3	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	31	0.99	1	1
BF1-02	No 1 BF Tapping	104,500	tonnes product / year	0.15	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	16	0.50	1	1
BF1-03	No 1 BF Stoves (5)	773,300,000	MJ / year	0.000075	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	58	1.84	1	1
PC1-01	Pig Casting Machine	104,500	tonnes product / year	0.55	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	57	1.82	2	1
S1-01	Sintering Plant - Windbox	104,500	tonnes sinter / year	0.556	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	58	1.84	3	1
S2-02	Sintering Plant - Discharge	104,500	tonnes sinter / year	0.34	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	36	1.13	3	1
	Material Handling Emissions											
MH-01	Ore loading/unloading	146,300	tonnes ore / year	0.00113	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.17	0.0052	9	1
MH-02	Coke loading/unloading	67,925	tonnes coke / year	0.00089	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.061	0.0019	9	3
MH-03	Slag loading / unloading	41,800	tonnes slag / year	0.0092	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.38	0.012	9	1
WS-01	Ore Storage Pile	11387	square meters	0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.87	0.03	10	1
WS-02	Coke Storage Pile	5287	square meters	0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.40	0.01	10	3
WS-03	Slag Storage Pile	3254	square meters	0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.40	0.01	10	1
	Plant Capacity	50	%					**Totals:**	**258.41**	**8.19**		

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

APPENDIX B

PM EMISSIONS INVENTORY FOR INCO

Inco - Port Colborne | **Scenario:** 1
Air Emission Inventory | **Base Year:** 1928

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density	
	Building 1													
	Jaw Crushing	28,891	tonnes product/ year	Green/Black Ni,Sinter (crushed twice)	3.20E+00	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18					
	Cupola Furnace 1 - Bessemer Matte	39,154	tonnes product/ year	Bessemmer Matte	6.90E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10					
	Cupola Furnace 2- Nickel	14,445	tonnes product/ year	Green/Black Ni,Sinter	6.90E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10					
	Tops Holding Furnace - Copper	12,871	tonnes product / year	Converter Cu	6.90E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10					
	Copper Reverb Furnaces 1 to 3	12,871	tonnes product / year	Converter Cu	2.50E+01	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10					
	Copper Converter Stands 1 to 3	12,871	tonnes product / year	Converter Cu	1.80E+01	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10					
	Slag Reverb Furnaces 1 and 2	44,969	tonnes product / year	58/50.8 * Bessemer Matte	1.10E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10					
B1-01	Cottrell ESP Exhaust Stack (assumed ESP not working)									1154.009	3.659E+01	4	8	
B1-02	Process Fugitives, Raw Material Handling	39,154	tonnes matte / year	Bessemer Matte	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.022	7.005E-04	9	3	
B1-03	Process Fugitives, Converters	12,871	tonnes product / year	Converter Cu	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5 (roof monito	1.081	3.428E-02	4	8	
B1-04	Process Fugitives, Reverb	12,871	tonnes product / year	Converter Cu	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5 (roof monito	1.081	3.428E-02	4	8	
B1-05	Process Fugitives, Cupola	54,633	tonnes product / year	2*(Green/Black Ni,Sinter)+Converter Cu	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5 (roof monito	4.589	1.455E-01	4	8	
B1-05	Process Fugitive - intermediate material handling	27,316	tonnes product / year	G/B NiO, Sinter, Converter Cu	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.015	4.887E-04	9	3	
	Building 2													
B2-01	Exhaust Stack - Ball Mills 1 and 2 (with cyclone)	14,445	tonnes product / year	G/B NiO, Sinter	9.60E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	13.868	4.397E-01	9	3	
B2-03	Process Fugitives, Material Handling	14,445	tonnes product / year	G/B NiO , Sinter	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.008	2.585E-04	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5	9,451	tonnes product / year	G/B NiO	1.10E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.10					
	Hand Rabbled Calcining Furnaces 1 to 5	9,451	tonnes product / year	G/B NiO	1.10E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.10					
	Anode Furnaces 8 and 9	127	tonnes product / year	Secondary Anodes	6.30E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
	Sinter Machines 1 to 4	4,994	tonnes product / year	Ni sinter	8.96E+00	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5					
B3-02	Process Fugitives, Mechanical	9,451	tonnes product / year	G/B NiO	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.794	2.517E-02	9	3	
B3-03	Process Fugitives, Hand Rabbled	9,451	tonnes product / year	G/B NiO	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.794	2.517E-02	9	3	
	Process Fugitives, Sintering	4,994	tonnes product / year	Sinter	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.419	1.330E-02	9	3	
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				7.00E+01	% Reduction	EC	Conservative	AWMA 1992	19.902	6.311E-01	6	8	
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnaces 1 and 2	7,914	tonnes product / year	1/2 of Wrought Ni+Anodes	1.05E+01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	83.097	2.635E+00	5	8	
B4-02	Nickel Refining Furnaces 3 and 4	7,914	tonnes product / year	1/2 of Wrought Ni+Anodes	1.05E+01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	83.097	2.635E+00	5	8	
B4-03	Process Fugitives, Nickel Refining	15,828	tonnes product / year	Wrought Ni+Anodes	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	1.330	4.216E-02	5	8	
	Material Handling Emissions													
MH-01	Matte loading/unloading	39,154	tonnes matte/ year	bessemer matte	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.022	7.005E-04	9	3	
MH-02	Coke/Coal loading/unloading	22,566.92	tonnes coke / year	bessemer matte *(.65/1.4)	4.47E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.010	3.196E-04	9	2	
MH-03	Slag loading / unloading	13,887.33	tonnes slag / year	bessemer matte *(.4/1.4)	9.18E-03	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.127	4.043E-03	9	8	
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	7.61E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3	#DIV/0!
WS-02	Coke/Coal Storage Pile	-	square meters	Stored in Bins in Bldg 1	7.61E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	2	#DIV/0!
WS-03	Slag Storage Pile	12,110	square meters		7.61E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	8	2.4122E-06
									Total	**1365.187**	**4.329E+01**			

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Product	**1918-1930**
Green Ni	323.72
Black Ni	9,127.69
Sinter	4,994.03
Converter Cu	12,870.82
Ni Anodes	7,362.46
Wrought Ni	8,465.48
Secondary Anodes	127.08
Reduced Ni	312.81
Sulphide Anodes	0.00
FAP	0
Receipts	
Bessemer matte (CC+Conis)	39154.25939
Orford Sulphide - CC	0
Sulphide Conc (MEP)	0
SEP -CC Sinter	0
MZP - Sec Metallics	0
Ni Oxide FEP	0
MRP Sulphide Conc	0
MNP Sulphide Conc	0
RGP Sinter 95	0

Inco - Port Colborne | **Scenario:** 2
Air Emission Inventory | **Base Year:** 1939

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density
	Building 1												
B1-02	Process Fugitives, Material Handling	6,364	tonnes material / year	bessemer matte	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.004	1.139E-04	9	3
B1-06	Slimes Dryer Exhaust	1,289	tonnes product / year	3% of anode production	1.10000	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	1.418	4.495E-02	5	3
	Building 2												
B2-01	Ball Mills 1 to 4 (with cyclone)	40,587	tonnes product / year	G/B NiO+Sinter	0.96	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	38.963	1.236E+00	9	3
B2-02	Krup Mills 1 to 3 (with baghouse)	40,587	tonnes product / year	G/B NiO+Sinter	0.16	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	6.494	2.059E-01	9	3
	Process Fugitives, Material Handling	81,173	tonnes product / year	2*(G/B NiO+Sinter)	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4				
	Process Fugitives, Material handling	52,066	tonnes product / year	oreford sulphide	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4				
	Process Fugitives, Material Conveying	52,066	tonnes product / year	oreford sulphide	0.01300	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5				
B2-03	Building 3 - total process fugitives									0.752	2.385E-02		
	Building 3												
	Mechanical Calcining Furnaces 1 to 5	2,740	tonnes product / year	G/B NiO	1.1	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5				
	Hand Rabbled Calcining Furnaces 1 to 5	2,740	tonnes product / year	G/B NiO	1.1	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5				
	secondary anodes	737	tonnes product / year	secondary anodes	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10				
	Sinter Machines 1 to 7	37,847	tonnes product / year	sinter Ni	8.96	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5				
B3-01	Exhaust Stack												
B3-02	Process Fugitives, Mechanical	2,740	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.230	7.298E-03	9	3
B3-03	Process Fugitives, Hand Rabbled	2,740	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.230	7.298E-03	9	3
B3-04	Process Fugitives, Sintering	37,847	tonnes product / year	sinter Ni	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	3.179	1.008E-01	9	3
B3-05	Process Fugitives, Secondary Anode Furnaces	737	tonnes product / year	secondary anodes	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.062	1.963E-03	9	3
B3-06	Process Fugitives, Calciner Annexx	2,740	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.230	7.298E-03	9	3
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				70	% Reduction	EC	Conservative	AWMA 1992	104.933	3.327E+00	6	8
PH-01	Power house												
	Building 4												
B4-01	Nickel Refining Furnaces (with multiclones)	2,734	tonnes product / year	wrought Ni production	3.15	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	8.612	2.731E-01	6	8
B4-03	Process Fugitives, Nickel Refining	2,734	tonnes product / year	wrought Ni production	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.230	7.283E-03	5	8
B4-02	Anode Furnace 1	4,773	tonnes product / year	1/9 of anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	30.072	9.536E-01	9	3
B4-04	Anode Furnaces 2/3	9,547	tonnes product / year	2/9 of anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	60.144	1.907E+00	9	3
B4-05	Anode Furnace 4	4,773	tonnes product / year	1/9 of anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	30.072	9.536E-01	9	3
B4-06	Anode Furnace 5/6	9,547	tonnes product / year	2/9 of anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	60.144	1.907E+00	9	3
B4-07	Anode Furnace 7	4,773	tonnes product / year	1/9 of anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	30.072	9.536E-01	9	3
B4-08	Anode Furnace 8/9	9,547	tonnes product / year	2/9 of anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	60.144	1.907E+00	9	3
B4-10	Process Fugitives, Anode Nickel Refining	42,960	tonnes product / year	anode production	0.084	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	3.609	1.144E-01	9	3
	Material Handling Emissions												
MH-01	Matte loading/unloading	6,364	tonnes ore / year	bessemer matte	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.004	1.139E-04	9	3
MH-02	Coke/Coal loading/unloading	4,226.94	tonnes coke / year	bessemer matte *(.65/1.4)	0.00045	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.002	5.986E-05	9	2
MH-03	Slag loading / unloading	2,601.20	tonnes slag / year	bessemer matte *(.4/1.4)	0.0092	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.024	7.573E-04	9	8
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3
WS-02	Coke/Coal Storage Pile	12,110	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	2
WS-03	Slag Storage Pile	12,110	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	8
									Total	**441.467**	**1.400E+01**		

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Product	**1931-1939**
Green Ni	796.6
Black Ni	1943.1
Sinter	37846.8
Converter Cu	2830.1
Ni Anodes	42960.3
Wrought Ni	2734.1
Secondary Anodes	736.8
Reduced Ni	1897.3
Sulphide Anodes	0.0
FAP	0.0

Receipts

Bessemer matte (CC+Conis	6364.5
Orford Sulphide - CC	52066.3
Sulphide Conc (MEP)	0.0
SEP -CC Sinter	0.0
MZP - Sec Metallics	0.0
Ni Oxide FEP	0.0
MRP Sulphide Conc	0.0
MNP Sulphide Conc	0.0
RGP Sinter 95	0.0

Inco - Port Colborne **Scenario: 3**
Air Emission Inventory **Base Year: 1957**

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density		
	Building 1														
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00	9	3		
B1-06	Slimes Dryer Exhaust	2,776	tonnes product / year	3% of anode production	1.10E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	3.054	9.684E-02	5	3		
B1-04	Electric Slag furnace (installed 1941)	2,776	tonnes product / year	3% of anode production	6.30E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	17.490	5.546E-01	5	3		
	Building 2														
B2-01	Ball Mills 1 to 4 (cyclone)	45,774	tonnes product / year	G/B NiO, Sinter	9.60E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	43.943	1.393E+00	9	3		
B2-02	Krup Mills 1 to 4 (baghouse)	45,774	tonnes product / year	G/B NiO, Sinter	1.60E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	7.324	2.322E-01	9	3		
	Process Fugitives, Material Handling	91,547	tonnes product / year	2*(G/B NiO, Sinter)	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4						
	Process Fugitives, Material handling	90,225	tonnes product / year	oreford sulphide+other receipts	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4						
	Process Fugitives, Material Conveying	90,225	tonnes product / year	oreford sulphide+other receipts	0.01300	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5						
B2-03	Process Fugitives (total)									1.275	4.045E-02	9	3		
	Building 3														
	Mechanical Calcining Furnaces 1 to 5	2,016	tonnes product / year	G/B NiO	1.10E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.5						
	Hand Rabbled Calcining Furnaces 1 to 5	2,016	tonnes product / year	G/B NiO	1.10E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5						
	Sulphide Anode Furnace - installed 1956	1,892	tonnes product / year	sulphide anode production	6.30E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10						
	Sinter Machines 1 to 7	43,757	tonnes product / year	sinter Ni	8.96E+00	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5						
B3-02	Process Fugitives, Mechanical	2,016	tonnes product / year	G/B NiO	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.169	5.371E-03	9	3		
B3-03	Process Fugitives, Hand Rabbled	2,016	tonnes product / year	G/B NiO	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.169	5.371E-03	9	3		
B3-04	Process Fugitives, Sintering	43,757	tonnes product / year	sinter Ni	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	3.676	1.166E-01	9	3		
B3-05	Process Fugitives, Anode Furnaces	1,892	tonnes product / year	sulphide anode production	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.159	5.040E-03	9	3		
B3-06	Process Fugitives, Calciner Annexx	2,016	tonnes product / year	G/B NiO	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.169	5.371E-03	9	3		
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				7.00E+01	% Reduction EC		Conservative	AWMA 1992	122.527	3.885E+00	6	8		
PH-01	Power house														
	Building 4														
B4-01	Nickel Refining Furnaces (with multiclones)	4,268	tonnes product / year	wrought Ni production	3.15E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	13.445	4.263E-01	6	8		
B4-03	Process fugitives, nickel refining	4,268	tonnes product / year	wrought Ni production	8.40E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.359	1.137E-02	6	8		
B4-02	Anode Furnace 1 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	1.89E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	19.433	6.162E-01	9	3	started putting multiclones on anodde furnaces in 1937	
B4-04	Anode Furnace 2/3 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	1.89E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	38.866	1.232E+00	9	3		
B4-05	Anode Furnace 4 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	1.89E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	19.433	6.162E-01	9	3		
B4-06	Anode Furnace 5/6 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	1.89E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	38.866	1.232E+00	9	3		
B4-07	Anode Furnace 7 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	1.89E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	19.433	6.162E-01	9	3		
B4-08	Anode Furnace 8/9 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	1.89E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	38.866	1.232E+00	9	3		
B4-10	Process Fugitives, Anode Nickel Refining	92,539	tonnes product / year	anode production	8.40E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	7.773	2.465E-01	9	3		
	Building 5														
B5-01	Secondary anodes (with wet collector)	2,685	tonnes product / year	secondary anodes	1.26E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	3.383	1.073E-01	9	3		
B5-01	Rod Milling	-	tonnes product / year	RGP Sinter 95	3.20E+00	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	0.000E+00	9	3		
	Material Handling Emissions														
MH-01	Matte loading/unloading	-	tonnes Matte / year	bessemer matte	5.64E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00	9	3		
MH-02	Coke/Coal loading/unloading	936.12	tonnes coke / year	bessemer matte *(.65/1.4)	4.47E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.326E-05	9	2		
MH-03	Slag loading / unloading	576.07	tonnes slag / year	bessemer matte *(.4/1.4)	9.18E-03	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.005	1.677E-04	9	8		G/M2
WS-01	Matte Storage	-	square meters	Pile located inside building x	7.61E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3		#DIV/0!
WS-02	Coke/Coal Storage Pile	12,110	square meters		7.61E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	2		2.4122E-06
WS-03	Slag Storage Pile	12,110	square meters		7.61E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	8		2.4122E-06
									Total	**401.661**	**1.274E+01**				

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Product	**1940-1959**
Green Ni	**237.5954587**
Black Ni	**1778.662125**
Sinter	**43757.38025**
Converter Cu	**0**
Ni Anodes	**92539.05018**
Wrought Ni	**4268.1703**
Secondary Anodes	**2685.020981**
Reduced Ni	**3925.875477**
Sulphide Anodes	**1892.103724**
FAP	**0**
Receipts	
Bessemer matte (CC+(	**0**
Orford Sulphide - CC	**44331.99464**
Sulphide Conc (MEP)	**9470.98842**
SEP -CC Sinter	**32532.06274**
MZP - Sec Metallics	**1147.767075**
Ni Oxide FEP	**126.5809037**
MRP Sulphide Conc	**631.9093324**
MNP Sulphide Conc	**1983.528542**
RGP Sinter 95	**0**

Inco - Port Colborne **Scenario: 4**
Air Emission Inventory **Base Year: 1968**

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units		Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density	
	Building 1													
B1-02	Process Fugitives, Material Handling	73	tonnes material / year	bessemer mate	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.301E-06	9	3	
B1-06	Slimes Dryer Exhaust (wet scrubber 1961)	1,943	tonnes product / year	3% of Anode Production	0.11000	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.214	6.778E-03	5	3	
B1-04	Electric Slag Furnace	1,943	tonnes product / year	3% of anode production	6.30E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	12.243	3.882E-01	5	3	
	Building 2													
B2-10	Exhaust Stack FAP (with Baghouse)	1,960	tonnes product / year	FAP	0.31500	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.10	0.617	1.958E-02	5	3	
	Process Fugitives, Material Handling	1,960	tonnes product / year	FAP	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
B2-01	Ball Mills 1-4 (with cyclone)	245.63	tonnes product / year	Shut down in 1964	9.60E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.236	7.477E-03	9	3	
B2-02	Krup Mills 1-4 (with baghouse)	245.63	tonnes product / year	G/B NiO + sinter	1.60E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.039	1.246E-03	9	3	
	Process Fugitives, Material Handling	246	tonnes product / year	G/B NiO + sinter	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material handling	55,929	tonnes product / year	oreford sulphide+other receipts	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material Conveying	55,929	tonnes product / year	oreford sulphide+other receipts	0.01300	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
B2-03	Process Fugitives (Total)									0.760	2.410E-02	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5 (ran until 1963)	246	tonnes product / year	G/B NiO	1.1	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Hand Rabbled Calcining Furnaces 1 to 5	246	tonnes product / year	G/B NiO	1.1	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Sulphide Anode Furnace - installed 1956 - shut down in 1974	8,368	tonnes product / year	sulphide anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
DC-01	Dust Chamber Exhaust Stack (Bldg 3)				70	% Reduction	EC	Conservative	AWMA 1992	15.978	5.067E-01	6	8	
B3-02	Process Fugitives, Mechanical	246	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.021	6.543E-04	9	3	
B3-03	Process Fugitives, Hand Rabbled	246	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.021	6.543E-04	9	3	
B3-05	Process Fugitives, Anode Furnaces	8,368	tonnes product / year	sulphide anode production	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.703	2.229E-02	9	3	
B3-06	Process Fugitives, Calciner Annexx	246	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.021	6.543E-04	9	3	
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnace (with multiclone)	2,998	tonnes product / year	wrought Ni production	3.15	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	9.444	2.995E-01	6	8	
B4-03	Process Fugitives, Nickel Refining	2,998	tonnes product / year	wrought Ni production	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.252	7.986E-03	6	8	
B4-10	Process Fugitives, Anode Nickel Refining	64,777	tonnes product / year	anode production	0.084	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	5.441	1.725E-01	9	3	
CP-01	Anode furnace+ cyclone+Cottrell Precipitator Stack 1	21,592	tonnes product / year	1/3 of anode production	0.063	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	1.360	4.314E-02	7	8	
CP-02	Anode furnace+ cyclone+Cottrell Precipitator Stack 2	21,592	tonnes product / year	1/3 of anode production	0.063	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	1.360	4.314E-02	7	8	
CP-03	Anode furnace+ cyclone+Cottrell Precipitator Stack 3	21,592	tonnes product / year	1/3 of anode production	0.063	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	1.360	4.314E-02	7	8	
	Building 5													
B5-01	Secondary anodes (with wer collector)	2,725	tonnes product / year	secondary anodes	1.26	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	3.434	1.089E-01	9	3	
B5-01	Rod Milling	1,704	tonnes product / year	RGP Sinter 95	3.20E+00	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	5.452	1.729E-01	9	3	
	Material Handling Emissions													
MH-01	Matte loading/unloading	73	tonnes ore / year	bessemer matte	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.301E-06	9	3	
MH-02	Coke/Coal loading/unloading	147.80	tonnes coke / year	bessemer matte *(.65/1.4)	0.00045	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	2.093E-06	9	2	
MH-03	Slag loading / unloading	90.95	tonnes slag / year	bessemer matte *(.4/1.4)	0.0092	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.001	2.648E-05	9	8	G/M2
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3	#DIV/0!
WS-02	Coke/Coal Storage Pile	12,110	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	2	2.4122E-06
WS-03	Slag Storage Pile	12,110	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.921	2.921E-02	10	8	2.4122E-06
									Total	**60.800**	**1.928E+00**			

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Product	1960-1979
Green Ni	124.4018392
Black Ni	121.2290191
Sinter	0
Converter Cu	0
Ni Anodes	64776.61583
Wrought Ni	2998.240804
Secondary Anodes	2725.216031
Reduced Ni	1676.738556
Sulphide Anodes	8368.387761
FAP	1959.922684
utility nickel	1737.194414
Receipts	
Bessemer matte (CC+Conis)	72.70663034
Orford Sulphide - CC	0
Sulphide Conc (MEP)	2637.620958
SEP -CC Sinter	6283.299977
MZP - Sec Metallics	1922.231517
Ni Oxide FEP	43205.55611
MRP Sulphide Conc	176.913624
MNP Sulphide Conc	0
RGP Sinter 95	1703.841667

Inco - Port Colborne
Air Emission Inventory

Scenario: 5
Base Year: 1983

Source ID	Source Description / Process Emissions	Production Activity Rate	AR Units		Contaminant - Total Particulate Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	PSD Category	PSD Density	
	Building 1													
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00	9	3	
B1-06	Slimes Dryer Exhaust (with wet scrubber)	271	tonnes product / year	3% of Anode Production	0.11000	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.030	9.459E-04	5	3	
	Building 2													
B2-10	Exhaust Stack FAP Baghouse	2,076	tonnes product / year	FAP	0.31500	kg / Mg	US EPA EF	US EPA D	AP-42, S 13.2.5	0.654	2.074E-02	8	3	
	Process Fugitives, Material Handling	2,076	tonnes product / year	FAP	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material handling	-	tonnes product / year	oreford sulphide+other receipts	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material Conveying	-	tonnes product / year	oreford sulphide+other receipts	0.01300	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
B2-03	Process Fugitives (Total)									0.001	3.714E-05	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5	-	tonnes product / year	G/B NiO	1.1	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Hand Rabbled Calcining Furnaces 1 to 5	-	tonnes product / year	G/B NiO	1.1	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Sulphide Anode Furnace - installed 1956	-	tonnes product / year	sulphide anode production	6.3	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
DC-01	Dust Chamber Exhaust Stack (Bldg 3)				70	% Reduction	EC	Conservative	AWMA 1992	0.000	0.000E+00	6	8	
B3-02	Process Fugitives, Mechanical	-	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00	9	3	
B3-03	Process Fugitives, Hand Rabbled	-	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00	9	3	
B3-05	Process Fugitives, Anode Furnaces	-	tonnes product / year	sulphide anode production	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00	9	3	
B3-06	Process Fugitives, Calciner Annexx	-	tonnes product / year	G/B NiO	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00	9	3	
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnace (with multiclone)	-	tonnes product / year	wrought Ni production	3.15	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.000	0.000E+00	6	8	
B4-03	Process Fugitives, Nickel Refining	-	tonnes product / year	wrought Ni production	0.084	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00	6	8	
B4-10	Process Fugitives, Anode Nickel Refining	9,039	tonnes product / year	anode production	0.084	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.759	2.408E-02	9	3	
CP-01	utility furnaces+ cyclone+Cottrell Precipitator Stack 1	9,229	tonnes product / year	1/3 (anode production+utility Ni)	0.063	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.581	1.844E-02	7	8	
CP-02	utility furnaces+ cyclone+Cottrell Precipitator Stack 2	9,229	tonnes product / year	1/3 (anode production+utility Ni)	0.063	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.581	1.844E-02	7	8	
CP-03	utility furnaces+ cyclone+Cottrell Precipitator Stack 3	9,229	tonnes product / year	1/3 (anode production+utility Ni)	0.063	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.581	1.844E-02	7	8	
	Building 5													
B5-01	Secondary anodes (with wet collector)	-	tonnes product / year	secondary anodes	1.26	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.000	0.000E+00	9	3	
	Rod Milling (with baghouse 1971)	-	tonnes product / year	RGP Sinter 95	1.60E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	0.000E+00	9	3	
	Material Handling Emissions													
MH-01	Matte loading/unloading	-	tonnes matte / year	bessemer matte	0.00056	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00	9	3	
MH-02	Coke/Coal loading/unloading	-	tonnes coke / year	bessemer matte *(.65/1.4)	0.00045	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00	9	2	
MH-03	Slag loading / unloading	-	tonnes slag / year	bessemer matte *(.4/1.4)	0.0092	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	0.000E+00	9	8	G/M2
WS-01	Matte Storage	-	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3	#DIV/0!
WS-02	Coke/Coal Storage Pile	-	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	2	#DIV/0!
WS-03	Slag Storage Pile	-	square meters		0.076	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	8	#DIV/0!
									Total	**3.189**	**1.011E-01**			

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Product	1980-1990
Green Ni	0
Black Ni	0
Sinter	0
Converter Cu	0
Ni Anodes	9039.101973
Wrought Ni	0
Secondary Anodes	0
Reduced Ni	0
Sulphide Anodes	0
FAP	2076.058913
utility Nickel	18647.8
Receipts	
Bessemer matte (CC+Conis)	0
Orford Sulphide - CC	0
Sulphide Conc (MEP)	0
SEP -CC Sinter	0
MZP - Sec Metallics	0
Ni Oxide FEP	0
MRP Sulphide Conc	0
MNP Sulphide Conc	0
RGP Sinter 95	0

APPENDIX C

NICKEL EMISSIONS INVENTORY FOR INCO

Inco - Port Colborne **Scenario:** 1
Air Emission Inventory **Base Year:** 1928

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Nickel Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	
	Building 1											
	Jaw Crushing	28,891	tonnes product/ year	Green/Black Ni,Sinter (crushed twice)	2.46E+00	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4			
	Cupola Furnace 1 - Bessemer Matte	39,154	tonnes product/ year	Bessemmer Matte	2.88E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Cupola Furnace 2- Nickel	14,445	tonnes product/ year	Green/Black Ni,Sinter	5.31E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Tops Holding Furnace - Copper	12,871	tonnes product / year	Converter Cu	2.88E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Copper Reverb Furnaces 1 to 3	12,871	tonnes product / year	Converter Cu	1.05E+01	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Copper Converter Stands 1 to 3	12,871	tonnes product / year	Converter Cu	7.52E+00	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Slag Reverb Furnaces 1 and 2	44,969	tonnes product / year	58/50.8 * Bessemer Matte	4.60E-01	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
B1-01	Cottrell ESP Exhaust Stack (assumed ESP not working)									550.003	1.744E+01	
B1-02	Process Fugitives, Raw Material Handling	39,154	tonnes matte / year	Bessemer Matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.009	2.928E-04	
B1-03	Process Fugitives, Converters	12,871	tonnes product / year	Converter Cu	3.51E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.452	1.433E-02	
B1-04	Process Fugitives, Reverb	12,871	tonnes product / year	Converter Cu	3.51E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.452	1.433E-02	
B1-05	Process Fugitives, Cupola	54,633	tonnes product / year	2*(Green/Black Ni,Sinter)+Converter Cu	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	3.534	1.121E-01	
B1-05	Process Fugitive - intermediate material handling	27,316	tonnes product / year	G/B NiO, Sinter, Converter Cu	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.012	3.763E-04	
	Building 2											
B2-01	Exhaust Stack - Ball Mills 1 and 2	14,445	tonnes product / year	G/B NiO, Sinter	7.39E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	10.678	3.386E-01	
B2-03	Process Fugitives, Material Handling	14,445	tonnes product / year	G/B NiO , Sinter	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.006	1.990E-04	
	Building 3											
	Mechanical Calcining Furnaces 1 to 5	9,451	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5			
	Hand Rabbled Calcining Furnaces 1 to 5	9,451	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5			
	Anode Furnaces 8 and 9	127	tonnes product / year	Secondary Anodes	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10			
	Sinter Machines 1 to 4	4,994	tonnes product / year	Ni sinter	6.65E+00	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5			
B3-02	Process Fugitives, Mechanical	9,451	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.611	1.938E-02	
B3-03	Process Fugitives, Hand Rabbled	9,451	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.611	1.938E-02	
	Sinter Machines 1 to 4	4,994	tonnes product / year	Ni sinter	6.23E-02	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	0.311	9.870E-03	
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				7.00E+01	% Reduction	EC	Conservative	AWMA 1992	14.949	4.740E-01	
PH-01	Power house											
	Building 4											
B4-01	Nickel Refining Furnaces 1 and 2	7,914	tonnes product / year	1/2 of Wrought Ni+Anodes	8.09E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	63.984	2.029E+00	
B4-02	Nickel Refining Furnaces 3 and 4	7,914	tonnes product / year	1/2 of Wrought Ni+Anodes	8.09E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	63.984	2.029E+00	
B4-03	Process Fugitives, Nickel Refining	15,828	tonnes product / year	Wrought Ni+Anodes	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	1.024	3.246E-02	
	Material Handling Emissions											
MH-01	Ore loading/unloading	39,154	tonnes matte/ year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.009	2.928E-04	
MH-02	Coke/Coal loading/unloading	22,567	tonnes coke / year	bessemer matte *(.65/1.4)	1.79E-09	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.278E-09	
MH-03	Slag loading / unloading	13,887	tonnes slag / year	bessemer matte *(.4/1.4)	4.39E-05	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.001	1.933E-05	
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	3.18E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	#DIV/0!
WS-02	Coke/Coal Storage Pile	-	square meters	Stored in Bins in Bldg 1	3.04E-07	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	#DIV/0!
WS-03	Slag Storage Pile	12,110	square meters		3.64E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.004	1.396E-04	1.15303E-08
									Total	**710.636**	**2.253E+01**	

Product	1918-1930
Green Ni	323.72
Black Ni	9,127.69
Sinter	4,994.03
Converter Cu	12,870.82
Converter Cu	12,870.82
Anodes	17,669.90
Wrought Ni	8,465.48
Secondary Anodes	127.08
Reduced Ni	371.40
Receipts	
Bessemer matte	33,076.87

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Speciation Factor	Factor	Reference
Copper Cliff Matte	4.18E-01	Inco Memo, May 1986
Sinter	7.42E-01	Inco Memo, May 1986
Nickel Oxide	7.70E-01	Inco Memo, May 1986
Coal/Coke	4.00E-06	Algoma Coal
slag	0.00478	

Inco - Port Colborne **Scenario:** **2**
Air Emission Inventory **Base Year:** **1939**

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Nickel Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)
	Building 1										
B1-02	Process Fugitives, Material Handling	6,364	tonnes material / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.002	4.760E-05
B1-06	Slimes Dryer Exhaust	1,289	tonnes product / year	3% of anode production	1.10E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	1.418	4.495E-02
	Building 2										
B2-01	Ball Mills 1 to 4	40,587	tonnes product / year	G/B NiO+Sinter	7.39E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	30.002	9.513E-01
B2-02	Krup Mills 1 to 3	40,587	tonnes product / year	G/B NiO+Sinter	1.23E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	5.000	1.586E-01
	Process Fugitives, Material Handling	81,173	tonnes product / year	2*(G/B NiO+Sinter)	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4		
B2-04	Material transfer	52,066	tonnes product / year	oreford sulphide	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4		
B2-04	Conveying	52,066	tonnes product / year	oreford sulphide	1.00E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
B2-03	Building 3 - total process fugitives									0.579	1.836E-02
	Building 3										
	Mechanical Calcining Furnaces 1 to 5	2,740	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
	Hand Rabbled Calcining Furnaces 1 to 5	2,740	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
	secondary anodes	737	tonnes product / year	secondary anodes	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10		
	Sinter Machines 1 to 7	37,847	tonnes product / year	sinter Ni	6.65E+00	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5		
B3-01	Exhaust Stack										
B3-02	Process Fugitives, Mechanical	2,740	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.177	5.619E-03
B3-03	Process Fugitives, Hand Rabbled	2,740	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.177	5.619E-03
B3-04	Process Fugitives, Sintering	37,847	tonnes product / year	sinter Ni	6.23E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	2.359	7.480E-02
B3-05	Process Fugitives, Anode Furnaces	737	tonnes product / year	secondary anodes	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.048	1.511E-03
B3-06	Process Fugitives, Calciner Annexx	2,740	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.177	5.619E-03
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				70 % Reduction EC			Conservative	AWMA 1992	77.950	2.472E+00
PH-01	Power house										
	Building 4										
B4-01	Nickel Refining Furnace 1	2,734	tonnes product / year	wrought Ni production	2.43E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	6.632	2.103E-01
B4-03	Process Fugitives, Nickel Refining	2,734	tonnes product / year	wrought Ni production	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.177	5.608E-03
B4-02	Anode Furnace 1	4,773	tonnes product / year	1/9 of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	23.156	7.343E-01
B4-04	Anode Furnaces 2/3	9,547	tonnes product / year	2/9 of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	46.311	1.469E+00
B4-05	Anode Furnace 4	4,773	tonnes product / year	1/9 of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	23.156	7.343E-01
B4-06	Anode Furnace 5/6	9,547	tonnes product / year	2/9 of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	46.311	1.469E+00
B4-07	Anode Furnace 7	4,773	tonnes product / year	1/9 of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	23.156	7.343E-01
B4-08	Anode Furnace 8/9	9,547	tonnes product / year	2/9 of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	46.311	1.469E+00
B4-10	Process Fugitives, Anode Nickel Refining	42,960	tonnes product / year	anode production	6.47E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	2.779	8.811E-02
	Material Handling Emissions										
MH-01	Ore loading/unloading	6,364	tonnes ore / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.002	4.760E-05
MH-02	Coke/Coal loading/unloading	4,227	tonnes coke / year	bessemer matte *(.65/1.4)	1.79E-09	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	2.394E-10
MH-03	Slag loading / unloading	2,601	tonnes slag / year	bessemer matte *(.4/1.4)	4.39E-05	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	3.620E-06
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	3.18E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00
WS-02	Coke/Coal Storage Pile	12,110	square meters		3.04E-07	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	1.168E-07
WS-03	Slag Storage Pile	12,110	square meters		3.64E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.004	1.396E-04
									Total	**335.882**	**1.065E+01**

Speciation Factor	Factor	Reference
Copper Cliff Matte	4.18E-01	Inco Memo, May 1986
Sinter	7.42E-01	Inco Memo, May 1986
Nickel Oxide	7.70E-01	Inco Memo, May 1986
Coal/Coke	4.00E-06	Algoma Coal
slag	0.00478	

Product	**1931-1939**
Green Ni	796.65
Black Ni	1,943.06
Sinter	37,846.84
Converter Cu	2,830.11
Anodes	42,960.30
Wrought Ni	2,734.08
Secondary Anodes	736.78
Reduced Ni	2,046.56
Receipts	
Bessemer matte	5,818.08

Inco - Port Colborne | **Scenario:** 3
Air Emission Inventory | **Base Year:** 1957

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Nickel Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)
	Building 1										
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00
B1-06	Slimes Dryer Exhaust	2,776	tonnes product / year	3% of anode production	8.47E-01	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	2.351	7.456E-02
B1-04	Electric Slag furnace (installed 1941)	2,776	tonnes product / year	3% of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	13.467	4.270E-01
	Building 2										
B2-01	Ball Mills 1 to 4	45,774	tonnes product / year	G/B NiO, Sinter	7.39E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	33.836	1.073E+00
B2-02	Krup Mills 1 to 4	45,774	tonnes product / year	G/B NiO, Sinter	1.23E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	5.639	1.788E-01
	Process Fugitives, Material Handling	91,547	tonnes product / year	2*(G/B NiO, Sinter)	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4		
	Process Fugitives, Material handling	90,225	tonnes product / year	oreford sulphide+other receipts	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4		
	Process Fugitives, Material Conveying	90,225	tonnes product / year	oreford sulphide+other receipts	5.43E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
B2-03	Process Fugitives (total)									0.551	1.748E-02
	Building 3										
	Mechanical Calcining Furnaces 1 to 5	2,016	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
	Hand Rabbled Calcining Furnaces 1 to 5	2,016	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
	Anode Furnaces 8 and 9	1,892	tonnes product / year	sulphide anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10		
	Sinter Machines 1 to 7	43,757	tonnes product / year	sinter Ni	6.65E+00	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5		
B3-01	Exhaust Stack										
B3-02	Process Fugitives, Mechanical	2,016	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.130	4.135E-03
B3-03	Process Fugitives, Hand Rabbled	2,016	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.130	4.135E-03
B3-04	Process Fugitives, Sintering	43,757	tonnes product / year	sinter Ni	6.23E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	2.727	8.648E-02
B3-05	Process Fugitives, Anode Furnaces	1,892	tonnes product / year	sulphide anode production	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.122	3.881E-03
B3-06	Process Fugitives, Calciner Annexx	2,016	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.130	4.135E-03
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				70	% Reduction	EC	Conservative	AWMA 1992	101.203	3.209E+00
PH-01	Power house										
	Building 4										
B4-01	Nickel Refining Furnace 1	4,268	tonnes product / year	wrought Ni production	2.43E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	10.352	3.283E-01
B4-03	Process fugitives, nickel refining	4,268	tonnes product / year	wrought Ni production	6.47E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.276	8.754E-03
B4-02	Process Fugitives, Nickel Refining	10,282	tonnes product / year	1/9 of anode production	1.46E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	14.964	4.745E-01
B4-04	Anode Furnace 2/3 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	1.46E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	29.927	9.490E-01
B4-05	Anode Furnace 4 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	1.46E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	14.964	4.745E-01
B4-06	Anode Furnace 5/6 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	1.46E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	29.927	9.490E-01
B4-07	Anode Furnace 7 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	1.46E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	14.964	4.745E-01
B4-08	Anode Furnace 8/9 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	1.46E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	29.927	9.490E-01
	Process Fugitives, Anode Nickel Refining	92,539	tonnes product / year	anode production	6.47E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	5.985	1.898E-01
	Building 5										
B5-01	Secondary anodes	2,685	tonnes product / year	secondary anodes	9.70E-01	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	2.605	8.260E-02
B5-01	Rod Milling	-	tonnes product / year	RGP Sinter 95	2.37E+00	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	0.000E+00
	Material Handling Emissions										
MH-01	Matte loading/unloading	-	tonnes ore / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00
MH-02	Coke/Coal loading/unloading	936	tonnes coke / year	bessemer matte *(.65/1.4)	1.79E-09	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	5.302E-11
MH-03	Slag loading / unloading	576	tonnes slag / year	bessemer matte *(.4/1.4)	4.39E-05	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	8.016E-07
WS-01	Matte Storage	-	square meters	Pile located inside building x	3.18E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00
WS-02	Coke/Coal Storage Pile	12,110	square meters		3.04E-07	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	1.168E-07
WS-03	Slag Storage Pile	12,110	square meters		3.64E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.004	1.396E-04
									Total	**314.184**	**9.963E+00**

Speciation Factor	Factor	Reference
Ore (Copper Cliff Matte)	4.18E-01	Inco Memo, May 1986
Sinter	7.42E-01	Inco Memo, May 1986
Nickel Oxide	7.70E-01	Inco Memo, May 1986
Coal/Coke	4.00E-06	Algoma Coal
Slag	0.00478	

Product	1940-1959
Green Ni	237.60
Black Ni	1,778.66
Sinter	43,757.38
Converter Cu	0.00
Anodes	92,539.05
Wrought Ni	4,268.17
Secondary Ano	2,685.02
Reduced Ni	3,999.61

Receipts

Bessemer matt	0.00

Inco - Port Colborne **Scenario:** **4**
Air Emission Inventory **Base Year:** **1968**

Source ID	Source Description / Process Emissions	Production Activity Rate	AR Units		Contaminant - Nickel Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)			
	Building 1													
B1-02	Process Fugitives, Material Handling	73	tonnes material / year	bessemer mate	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	5.438E-07			
B1-06	Slimes Dryer Exhaust	1,943	tonnes product / year	3% of Anode Production	8.47E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.165	5.219E-03			
B1-04	Electric Slag Furnace	1,943	tonnes product / year	3% of anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	9.427	2.989E-01	5	3	
	Building 2													
B2-10	Exhaust Stack FAP Baghouse	1,960	tonnes product / year	FAP	2.43E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 13.2.5	0.475	1.507E-02	8	3	
	Process Fugitives, Material Handling	1,960	tonnes product / year	FAP	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
B2-01	Ball Mills 1-4	246	tonnes product / year	Shut down in 1964	7.39E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.182	5.758E-03			
b2-02	Krup Mills 1-4	246	tonnes product / year	G/B NiO + sinter	1.23E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.030	9.596E-04			
	Process Fugitives, Material Handling	246	tonnes product / year	G/B NiO + sinter	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material handling	55,929	tonnes product / year	oreford sulphide+other receipt	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material Conveying	55,929	tonnes product / year	oreford sulphide+other receipt	1.00E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
B2-03	Process Fugitives (Total)									0.585	1.855E-02	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5	246	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Hand Rabbled Calcining Furnaces 1 to 5	246	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Sulphide Anode Furnace - installed 1956 - shut down in 1974	8,368	tonnes product / year	sulphide anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
DC-01	Dust Chamber Exhaust Stack (Bldg 3)				70	% Reduction	EC	Conservative	AWMA 1992	12.303	3.901E-01			
B3-02	Process Fugitives, Mechanical	246	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.016	5.038E-04	9	3	
B3-03	Process Fugitives, Hand Rabbled	246	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.016	5.038E-04	9	3	
B3-05	Process Fugitives, Anode Furnaces	8,368	tonnes product / year	sulphide anode production	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.541	1.716E-02	9	3	
B3-06	Process Fugitives, Calciner Annexx	246	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.016	5.038E-04	9	3	
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnace 1	2,998	tonnes product / year	wrought Ni production	2.43E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	7.272	2.306E-01	6	8	
B4-03	Process Fugitives, Nickel Refining	2,998	tonnes product / year	wrought Ni production	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.194	6.149E-03	6	8	
B4-10	Process Fugitives, Anode Nickel Refining	64,777	tonnes product / year	anode production	6.47E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	4.190	1.329E-01	9	3	
CP-01	Anode furnace+ cyclone+Cottrell Precipitator Stack	21,592	tonnes product / year	1/3 of anode production	4.73E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.6	1.022	3.239E-02			
CP-02	Anode furnace+ cyclone+Cottrell Precipitator Stack	21,592	tonnes product / year	1/3 of anode production	4.73E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.7	1.022	3.239E-02			
CP-03	Anode furnace+ cyclone+Cottrell Precipitator Stack	21,592	tonnes product / year	1/3 of anode production	4.73E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.8	1.022	3.239E-02			
	Building 5													
B5-01	Secondary anodes (with wer collector)	2,725	tonnes product / year	secondary anodes	9.70E-01	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	2.644	8.384E-02	9	3	
B5-01	Rod Milling	1,704	tonnes product / year	RGP Sinter 95	2.37E+00	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	4.046	1.283E-01	9	3	
	Material Handling Emissions													
MH-01	Matte loading/unloading	73	tonnes ore / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	5.438E-07	9	3	
MH-02	Coke/Coal loading/unloading	148	tonnes coke / year	bessemer matte *(.65/1.4)	1.79E-09	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	8.372E-12	9	2	
MH-03	Slag loading / unloading	91	tonnes slag / year	bessemer matte *(.4/1.4)	4.39E-05	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	1.266E-07	9	8	G/M2
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	3.18E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3	#DIV/0!
WS-02	Coke/Coal Storage Pile	12,110	square meters		3.04E-07	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	1.168E-07	10	2	9.6488E-12
WS-03	Slag Storage Pile	12,110	square meters		3.64E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.004	1.396E-04	10	8	1.153E-08
									Total	**45.171**	**1.432E+00**			

Speciation Factor	Factor	Reference
Ore (Copper Cliff Matte)	4.18E-01	Inco Memo, May 1986
Sinter	7.42E-01	Inco Memo, May 1986
Nickel Oxide	7.70E-01	Inco Memo, May 1986
Coal/Coke	4.00E-06	Algoma Coal
Cottrell Precip Dust	7.51E-01	MOE Report, Feb 1978
slag	0.00478	

Product	1960-1979
Green Ni	124.4018392
Black Ni	121.2290191
Sinter	0
Converter Cu	0
Ni Anodes	64776.61583
Wrought Ni	2998.240804
Secondary Anodes	2725.216031
Reduced Ni	1676.738556
Sulphide Anodes	8368.387761
FAP	0

Receipts

Bessemer matte (CC+Conis)	72.70663034
Orford Sulphide - CC	0
Sulphide Conc (MEP)	2637.620958
SEP -CC Sinter	6283.299977
MZP - Sec Metallics	1922.231517
Ni Oxide FEP	43205.55611
MRP Sulphide Conc	176.913624
MNP Sulphide Conc	0
RGP Sinter 95	1703.841667

Inco - Port Colborne | **Scenario:** 5
Air Emission Inventory | **Base Year:** 1983

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Contaminant - Nickel	Emission Factor	EF Units	Methodology	Data Quality	Emission Rate Reference	ER (Mg/yr)	ER (g/s)			
	Building 1													
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
B1-06	Slimes Dryer Exhaust	271	tonnes product / year	3% of Anode Production	8.47E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.023	7.283E-04			
	Building 2													
B2-10	Exhaust Stack FAP Baghouse	2,076	tonnes product / year	FAP	2.43E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 13.2.5	0.504	1.597E-02	8	3	
	Process Fugitives, Material Handling	2,076	tonnes product / year	FAP	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material handling	-	tonnes product / year	oreford sulphide+other receipts	4.34E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material Conveying	-	tonnes product / year	oreford sulphide+other receipts	1.00E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
B2-03	Process Fugitives (Total)									0.001	2.860E-05	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5	-	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Hand Rabbled Calcining Furnaces 1 to 5	-	tonnes product / year	G/B NiO	8.47E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Sulphide Anode Furnace - installed 1956 (Anode Furnaces 8 and 9 dimantled in 1941)	-	tonnes product / year	sulphide anode production	4.85E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
DC-01	Dust Chamber Exhaust Stack (Bldg 3)	-			70	% Reduction	EC	Conservative	AWMA 1992	0.000	0.000E+00			
B3-02	Process Fugitives, Mechanical	-	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B3-03	Process Fugitives, Hand Rabbled	-	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B3-05	Process Fugitives, Anode Furnaces	-	tonnes product / year	sulphide anode production	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B3-06	Process Fugitives, Calciner Annexx	-	tonnes product / year	G/B NiO	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnace 1	-	tonnes product / year	wrought Ni production	2.43E+00	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.000	0.000E+00			
B4-03	Process Fugitives, Nickel Refining	-	tonnes product / year	wrought Ni production	6.47E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B4-10	Process Fugitives, Anode Nickel Refining	9,039	tonnes product / year	anode production	6.47E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.585	1.854E-02			
CP-01	Cottrell Precipitator Stack 1	9,229	tonnes product / year	1/3 (anode production+utility Ni)	4.73E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.437	1.385E-02			
CP-02	Cottrell Precipitator Stack 2	9,229	tonnes product / year	1/3 (anode production+utility Ni)	4.73E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.437	1.385E-02			
CP-03	Cottrell Precipitator Stack 3	9,229	tonnes product / year	1/3 (anode production+utility Ni)	4.73E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.437	1.385E-02			
	Building 5													
B5-01	Secondary anodes (with wet collector)	-	tonnes product / year	secondary anodes	9.70E-01	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.000	0.000E+00			
	Rod Milling	-	tonnes product / year	RGP Sinter 95	1.19E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	0.000E+00	9	3	
	Material Handling Emissions													
MH-01	Matte loading/unloading	-	tonnes matte / year	bessemer matte	2.36E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
MH-02	Coke/Coal loading/unloading	-	tonnes coke / year	bessemer matte *(.65/1.4)	1.79E-09	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
MH-03	Slag loading / unloading	-	tonnes slag / year	bessemer matte *(.4/1.4)	4.39E-05	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	0.000E+00			G/M2
WS-01	Matte Storage	-	square meters		3.18E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
WS-02	Coke/Coal Storage Pile	-	square meters		3.04E-07	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
WS-03	Slag Storage Pile	-	square meters		3.64E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
									Total	**2.422**	**7.680E-02**			

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Speciation Factor	**Factor**	**Reference**
Ore (Copper Cliff Matte)	4.18E-01	Inco Memo, May 1986
Sinter	7.42E-01	Inco Memo, May 1986
Nickel Oxide	7.70E-01	Inco Memo, May 1986
Coal/Coke	4.00E-06	Algoma Coal
Cottrell Precip Dust	7.51E-01	MOE Report, Feb 1978
slag	0.00478	

APPENDIX D

IRON EMISSIONS INVENTORY FOR INCO

Inco - Port Colborne
Air Emission Inventory

Scenario: 1
Base Year: 1928

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Iron Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)	
	Building 1											
	Jaw Crushing	28,891	tonnes ore/ year	Green/Black Ni,Sinter (crushed twice)	1.25E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4			
	Cupola Furnace 1 - Bessemer Matte	39,154	tonnes product/ year	Bessemmer Matte	2.21E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Cupola Furnace 2- Nickel	14,445	tonnes product/ year	Green/Black Ni,Sinter	2.69E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Tops Holding Furnace - Copper	12,871	tonnes product / year	Converter Cu	2.21E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Copper Reverb Furnaces 1 to 3	12,871	tonnes product / year	Converter Cu	8.00E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Copper Converter Stands 1 to 3	12,871	tonnes product / year	Converter Cu	5.76E-02	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
	Slag Reverb Furnaces 1 and 2	44,969	tonnes product / year	58/50.8 * Bessemer Matte	3.52E-03	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10			
B1-01	Cottrell ESP Exhaust Stack (assumed ESP not working)									3.827	1.214E-01	
B1-02	Process Fugitives, Raw Material Handling	39,154	tonnes matte / year	Bessemer Matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	2.242E-06	
B1-03	Process Fugitives, Converters	12,871	tonnes product / year	Converter Cu	2.69E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.003	1.097E-04	
B1-04	Process Fugitives, Reverb	12,871	tonnes product / year	Converter Cu	2.69E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.003	1.097E-04	
B1-05	Process Fugitives, Cupola	54,633	tonnes product / year	2*(Green/Black Ni,Sinter)+Converter Cu	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.018	5.675E-04	
B1-05	Process Fugitive - intermediate material handling	27,316	tonnes product / year	G/B NiO, Sinter, Converter Cu	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.906E-06	
	Building 2											
B2-01	Exhaust Stack - Ball Mills 1 and 2	14,445	tonnes product / year	G/B NiO, Sinter	3.74E-03	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.054	1.715E-03	
B2-03	Process Fugitives, Material Handling	14,445	tonnes product / year	G/B NiO , Sinter	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.008E-06	
	Building 3											
	Mechanical Calcining Furnaces 1 to 5	9,451	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5			
	Hand Rabbled Calcining Furnaces 1 to 5	9,451	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5			
	Anode Furnaces 1 and 2	127	tonnes product / year	Secondary Anodes	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10			
	Sinter Machines 1 to 4	4,994	tonnes product / year	Ni sinter	7.26E-02	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5			
B3-02	Process Fugitives, Mechanical	9,451	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.003	9.818E-05	
B3-03	Process Fugitives, Hand Rabbled	9,451	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.003	9.818E-05	
	Sinter Machines 1 to 4	4,994	tonnes product / year	Ni sinter	6.80E-04	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	0.003	1.077E-04	
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				7.00E+01	% Reduction	EC	Conservative	AWMA 1992	0.134	4.249E-03	
PH-01	Power house											
	Building 4											
B4-01	Nickel Refining Furnaces 1 and 2	7,914	tonnes product / year	1/2 of Wrought Ni+Anodes	4.10E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.324	1.028E-02	
B4-02	Nickel Refining Furnaces 3 and 4	7,914	tonnes product / year	1/2 of Wrought Ni+Anodes	4.10E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.324	1.028E-02	
B4-03	Process Fugitives, Nickel Refining	15,828	tonnes product / year	Wrought Ni+Anodes	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.005	1.644E-04	
	Material Handling Emissions											
MH-01	Ore loading/unloading	39,154	tonnes matte/ year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	2.242E-06	
MH-02	Coke/Coal loading/unloading	22,567	tonnes coke / year	bessemer matte *(.65/1.4)	1.35E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	9.683E-08	
MH-03	Slag loading / unloading	13,887	tonnes slag / year	bessemer matte *(.4/1.4)	4.90E-04	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.007	2.157E-04	
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	2.43E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	#DIV/0!
WS-02	Coke/Coal Storage Pile	-	square meters	Stored in Bins in Bldg 1	2.30E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	#DIV/0!
WS-03	Slag Storage Pile	12,110	square meters		4.06E-03	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.049	1.558E-03	1.28691E-07
									Total	**4.759**	**1.509E-01**	

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Speciation Factor	**Factor**	**Reference**
Copper Cliff Matte	3.20E-03	Inco Memo, May 1986
Sinter	8.10E-03	Inco Memo, May 1986
Nickel Oxide	3.90E-03	Inco Memo, May 1986
Coal/Coke	3.03E-04	Algoma Coal
slag	0.05335	

Product	**1918-1930**
Green Ni	323.72
Black Ni	9,127.69
Sinter	4,994.03
Converter Cu	12,870.82
Converter Cu	12,870.82
Anodes	17,669.90
Wrought Ni	8,465.48
Secondary Anodes	127.08
Reduced Ni	371.40
Receipts	
Bessemer matte	33,076.87

Inco - Port Colborne **Scenario:** **2**
Air Emission Inventory **Base Year:** **1939**

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Iron Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)
	Building 1										
B1-02	Process Fugitives, Material Handling	6,364	tonnes material / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	3.644E-07
B1-06	Slimes Dryer Exhaust	1,289	tonnes product / year	3% of anode production	1.10E+00	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	1.418	4.495E-02
	Building 2										
B2-01	Ball Mills 1 to 4	40,587	tonnes product / year	G/B NiO+Sinter	3.74E-03	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.152	4.818E-03
B2-02	Krup Mills 1 to 3	40,587	tonnes product / year	G/B NiO+Sinter	6.24E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.025	8.031E-04
	Process Fugitives, Material Handling	81,173	tonnes product / year	2*(G/B NiO+Sinter)	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4		
B2-04	Material transfer	52,066	tonnes product / year	oreford sulphide	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4		
B2-04	Conveying	52,066	tonnes product / year	oreford sulphide	5.07E-05	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
B2-03	Building 3 - total process fugitives									0.003	9.300E-05
	Building 3										
	Mechanical Calcining Furnaces 1 to 5	2,740	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
	Hand Rabbled Calcining Furnaces 1 to 5	2,740	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5		
	secondary anodes	737	tonnes product / year	secondary anodes	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10		
	Sinter Machines 1 to 7	37,847	tonnes product / year	sinter Ni	7.26E-02	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5		
B3-01	Exhaust Stack										
B3-02	Process Fugitives, Mechanical	2,740	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.846E-05
B3-03	Process Fugitives, Hand Rabbled	2,740	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.846E-05
B3-04	Process Fugitives, Sintering	37,847	tonnes product / year	sinter Ni	6.80E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.026	8.166E-04
B3-05	Process Fugitives, Anode Furnaces	737	tonnes product / year	secondary anodes	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	7.654E-06
B3-06	Process Fugitives, Calciner Annexx	2,740	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.846E-05
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				70 %	Reduction EC		Conservative	AWMA 1992	0.837	2.653E-02
PH-01	Power house										
	Building 4										
B4-01	Nickel Refining Furnace 1	2,734	tonnes product / year	wrought Ni production	1.23E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.034	1.065E-03
B4-03	Process Fugitives, Nickel Refining	2,734	tonnes product / year	wrought Ni production	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.840E-05
B4-02	Anode Furnace 1	4,773	tonnes product / year	1/9 of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.117	3.719E-03
B4-04	Anode Furnaces 2/3	9,547	tonnes product / year	2/9 of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.235	7.438E-03
B4-05	Anode Furnace 4	4,773	tonnes product / year	1/9 of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.117	3.719E-03
B4-06	Anode Furnace 5/6	9,547	tonnes product / year	2/9 of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.235	7.438E-03
B4-07	Anode Furnace 7	4,773	tonnes product / year	1/9 of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.117	3.719E-03
B4-08	Anode Furnace 8/9	9,547	tonnes product / year	2/9 of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.235	7.438E-03
B4-10	Process Fugitives, Anode Nickel Refining	42,960	tonnes product / year	anode production	3.28E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.014	4.463E-04
	Material Handling Emissions										
MH-01	Ore loading/unloading	6,364	tonnes ore / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	3.644E-07
MH-02	Coke/Coal loading/unloading	4,227	tonnes coke / year	bessemer matte *(.65/1.4)	1.35E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	1.814E-08
MH-03	Slag loading / unloading	2,601	tonnes slag / year	bessemer matte *(.4/1.4)	4.90E-04	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.001	4.040E-05
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	2.43E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00
WS-02	Coke/Coal Storage Pile	12,110	square meters		2.30E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	8.851E-06
WS-03	Slag Storage Pile	12,110	square meters		4.06E-03	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.049	1.558E-03
									Total	**3.618**	**1.147E-01**

Speciation Factor	Factor	Reference
Copper Cliff Matte	3.20E-03	Inco Memo, May 1986
Sinter	8.10E-03	Inco Memo, May 1986
Nickel Oxide	3.90E-03	Inco Memo, May 1986
Coal/Coke	3.03E-04	Algoma Coal
slag	0.05335	

Product	1931-1939
Green Ni	796.65
Black Ni	1,943.06
Sinter	37,846.84
Converter Cu	2,830.11
Anodes	42,960.30
Wrought Ni	2,734.08
Secondary Anodes	736.78
Reduced Ni	2,046.56
Receipts	
Bessemer matte	5,818.08

Inco - Port Colborne
Air Emission Inventory

Scenario: 3
Base Year: 1957

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units	Activity Rate Products/receipts	Contaminant - Iron Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)			
	Building 1													
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
B1-06	Slimes Dryer Exhaust	2,776	tonnes product / year	3% of anode production	4.29E-03	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.012	3.777E-04			
B1-04	Electric Slag furnace (installed 1941)	2,776	tonnes product / year	3% of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.068	2.163E-03	5	3	
	Building 2													
B2-01	Ball Mills 1 to 4	45,774	tonnes product / year	G/B NiO, Sinter	3.74E-03	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.171	5.434E-03			
B2-02	Krup Mills 1 to 4	45,774	tonnes product / year	G/B NiO, Sinter	6.24E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.029	9.057E-04			
	Process Fugitives, Material Handling	91,547	tonnes product / year	2*(G/B NiO, Sinter)	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material handling	90,225	tonnes product / year	oreford sulphide+other receipts	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material Conveying	90,225	tonnes product / year	oreford sulphide+other receipts	4.16E-05	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
B2-03	Process Fugitives (total)									0.004	1.306E-04	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5	2,016	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Hand Rabbled Calcining Furnaces 1 to 5	2,016	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Anode Furnaces 8 and 9	1,892	tonnes product / year	sulphide anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
	Sinter Machines 1 to 7	43,757	tonnes product / year	sinter Ni	7.26E-02	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5					
B3-01	Exhaust Stack													
B3-02	Process Fugitives, Mechanical	2,016	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.095E-05			
B3-03	Process Fugitives, Hand Rabbled	2,016	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.095E-05			
B3-04	Process Fugitives, Sintering	43,757	tonnes product / year	sinter Ni	6.80E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.030	9.441E-04			
B3-05	Process Fugitives, Anode Furnaces	1,892	tonnes product / year	sulphide anode production	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	1.966E-05			
B3-06	Process Fugitives, Calciner Annexx	2,016	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	2.095E-05			
DC-01	Dust Chamber Exhaust Stack (Bldgs 2 and 3)				70 % Reduction EC			Conservative	AWMA 1992	1.023	3.245E-02			
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnace 1	4,268	tonnes product / year	wrought Ni production	1.23E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.052	1.663E-03			
B4-03	Process fugitives, nickel refining	4,268	tonnes product / year	wrought Ni production	3.28E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.001	4.434E-05			
B4-02	Process Fugitives, Nickel Refining	10,282	tonnes product / year	1/9 of anode production	7.37E-03	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.076	2.403E-03			
B4-04	Anode Furnace 2/3 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	7.37E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.152	4.807E-03			
B4-05	Anode Furnace 4 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	7.37E-03	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.076	2.403E-03			
B4-06	Anode Furnace 5/6 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	7.37E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.152	4.807E-03			
B4-07	Anode Furnace 7 (with multiclone)	10,282	tonnes product / year	1/9 of anode production	7.37E-03	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.076	2.403E-03			
B4-08	Anode Furnace 8/9 (with multiclone)	20,564	tonnes product / year	2/9 of anode production	7.37E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.152	4.807E-03			
	Process Fugitives, Anode Nickel Refining	92,539	tonnes product / year	anode production	3.28E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.030	9.613E-04			
	Building 5													
B5-01	Secondary anodes	2,685	tonnes product / year	secondary anodes	4.91E-03	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.013	4.184E-04			
B5-01	Rod Milling	-	tonnes product / year	RGP Sinter 95	2.59E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	0.000E+00	9	3	
	Material Handling Emissions													
MH-01	Matte loading/unloading	-	tonnes ore / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
MH-02	Coke/Coal loading/unloading	936	tonnes coke / year	bessemer matte *(.65/1.4)	1.35E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	4.017E-09			
MH-03	Slag loading / unloading	576	tonnes slag / year	bessemer matte *(.4/1.4)	4.90E-04	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	8.947E-06			G/M2
WS-01	Matte Storage	-	square meters	Pile located inside building x	2.43E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
WS-02	Coke/Coal Storage Pile	12,110	square meters		2.30E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	8.851E-06			7.30898E-10
WS-03	Slag Storage Pile	12,110	square meters		4.06E-03	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.049	1.558E-03			1.28691E-07
									Total	**2.169**	**6.878E-02**			

Speciation Factor	Factor	Reference
Ore (Copper Cliff Matte)	3.20E-03	Inco Memo, May 1986
Sinter	8.10E-03	Inco Memo, May 1986
Nickel Oxide	3.90E-03	Inco Memo, May 1986
Coal/Coke	3.03E-04	Algoma Coal
Slag	0.05335	

Product	**1940-1959**
Green Ni	237.60
Black Ni	1,778.66
Sinter	43,757.38
Converter Cu	0.00
Anodes	92,539.05
Wrought Ni	4,268.17
Secondary Ano	2,685.02
Reduced Ni	3,999.61
Receipts	
Bessemer matt	0.00

Inco - Port Colborne | **Scenario:** 4
Air Emission Inventory | **Base Year:** 1968

Source ID	Source Description Process Emissions	Production Activity Rate	AR Units		Contaminant - Iron Emission Factor	EF Units	Methodology	Data Quality	Reference	Emission Rate ER (Mg/yr)	ER (g/s)				
	Building 1														
B1-02	Process Fugitives, Material Handling	73	tonnes material / year	bessemer mate	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	4.163E-09				
B1-06	Slimes Dryer Exhaust	1,943	tonnes product / year	3% of Anode Production	4.29E-04	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.001	2.644E-05				
B1-04	Electric Slag Furnace	1,943	tonnes product / year	3% of anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.048	1.514E-03	5	3		
	Building 2														
B2-10	Exhaust Stack FAP Baghouse	1,960	tonnes product / year	FAP	1.23E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 13.2.5	0.002	7.635E-05	8	3		
	Process Fugitives, Material Handling	1,960	tonnes product / year	FAP	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4						
B2-01	Ball Mills 1-4	246	tonnes product / year	Shut down in 1964	3.74E-03	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.001	2.916E-05				
b2-02	Krup Mills 1-4	246	tonnes product / year	G/B NiO + sinter	6.24E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	4.860E-06				
	Process Fugitives, Material Handling	246	tonnes product / year	G/B NiO + sinter	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4						
	Process Fugitives, Material handling	55,929	tonnes product / year	oreford sulphide+other receipt	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4						
	Process Fugitives, Material Conveying	55,929	tonnes product / year	oreford sulphide+other receipt	5.07E-05	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5						
B2-03	Process Fugitives (Total)									0.003	9.397E-05	9	3		
	Building 3														
	Mechanical Calcining Furnaces 1 to 5	246	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5						
	Hand Rabbled Calcining Furnaces 1 to 5	246	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5						
	Sulphide Anode Furnace - installed 1956 - shut down in 1974	8,368	tonnes product / year	sulphide anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10						
DC-01	Dust Chamber Exhaust Stack (Bldg 3)				70	% Reduction	EC	Conservative	AWMA 1992	0.062	1.976E-03				
B3-02	Process Fugitives, Mechanical	246	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	2.552E-06	9	3		
B3-03	Process Fugitives, Hand Rabbled	246	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	2.552E-06	9	3		
B3-05	Process Fugitives, Anode Furnaces	8,368	tonnes product / year	sulphide anode production	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.003	8.693E-05	9	3		
B3-06	Process Fugitives, Calciner Annexx	246	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	2.552E-06	9	3		
PH-01	Power house														
	Building 4														
B4-01	Nickel Refining Furnace 1	2,998	tonnes product / year	wrought Ni production	1.23E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.037	1.168E-03	6	8		
B4-03	Process Fugitives, Nickel Refining	2,998	tonnes product / year	wrought Ni production	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.001	3.115E-05	6	8		
B4-10	Process Fugitives, Anode Nickel Refining	64,777	tonnes product / year	anode production	3.28E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.021	6.729E-04	9	3		
CP-01	Anode furnace+ cyclone+Cottrell Precipitator Stack	21,592	tonnes product / year	1/3 of anode production	5.61E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.6	0.012	3.839E-04				
CP-02	Anode furnace+ cyclone+Cottrell Precipitator Stack	21,592	tonnes product / year	1/3 of anode production	5.61E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.7	0.012	3.839E-04				
CP-03	Anode furnace+ cyclone+Cottrell Precipitator Stack	21,592	tonnes product / year	1/3 of anode production	5.61E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.8	0.012	3.839E-04				
	Building 5														
B5-01	Secondary anodes (with wer collector)	2,725	tonnes product / year	secondary anodes	4.91E-03	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.013	4.246E-04	9	3		
B5-01	Rod Milling	1,704	tonnes product / year	RGP Sinter 95	2.59E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.044	1.400E-03	9	3		
	Material Handling Emissions														
MH-01	Matte loading/unloading	73	tonnes ore / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	4.163E-09	9	3		
MH-02	Coke/Coal loading/unloading	148	tonnes coke / year	bessemer matte *(.65/1.4)	1.35E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	6.342E-10	9	2		
MH-03	Slag loading / unloading	91	tonnes slag / year	bessemer matte *(.4/1.4)	4.90E-04	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	1.413E-06	9	8	G/M2	
WS-01	Matte Storage	-	square meters	Stored in Bins in Bldg 1	2.43E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00	10	3		#DIV/0!
WS-02	Coke/Coal Storage Pile	12,110	square meters		2.30E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	8.851E-06	10	2		7.309E-10
WS-03	Slag Storage Pile	12,110	square meters		4.06E-03	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.049	1.558E-03	10	8		1.2869E-07
									Total	**0.323**	**1.023E-02**				

Speciation Factor	Factor	Reference
Ore (Copper Cliff Matte)	3.20E-03	Inco Memo, May 1986
Sinter	8.10E-03	Inco Memo, May 1986
Nickel Oxide	3.90E-03	Inco Memo, May 1986
Coal/Coke	3.03E-04	Algoma Coal
Cottrell Precip Dust	0.0089	MOE Report, Feb 1978
slag	0.05335	

Product	1960-1979
Green Ni	124.4018392
Black Ni	121.2290191
Sinter	0
Converter Cu	0
Ni Anodes	64776.61583
Wrought Ni	2998.240804
Secondary Anodes	2725.216031
Reduced Ni	1676.738556
Sulphide Anodes	8368.387761
FAP	0

Receipts

Bessemer matte (CC+Conis)	72.70663034
Orford Sulphide - CC	0
Sulphide Conc (MEP)	2637.620958
SEP -CC Sinter	6283.299977
MZP - Sec Metallics	1922.231517
Ni Oxide FEP	43205.55611
MRP Sulphide Conc	176.913624
MNP Sulphide Conc	0
RGP Sinter 95	1703.841667

Inco - Port Colborne | **Scenario:** 5
Air Emission Inventory | **Base Year:** 1983

Source ID	Source Description / Process Emissions	Production Activity Rate	AR Units	Contaminant - Iron	Emission Factor	EF Units	Methodology	Data Quality	Emission Rate Reference	ER (Mg/yr)	ER (g/s)			
	Building 1													
B1-02	Process Fugitives, Material Handling	-	tonnes material / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
B1-06	Slimes Dryer Exhaust	271	tonnes product / year	3% of Anode Production	4.29E-04	kg / Mg	US EPA EF	US EPA E	AP-42, S 12.10	0.000	3.689E-06			
	Building 2													
B2-10	Exhaust Stack FAP Baghouse	2,076	tonnes product / year	FAP	1.23E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 13.2.5	0.003	8.087E-05	8	3	
	Process Fugitives, Material Handling	2,076	tonnes product / year	FAP	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material handling	-	tonnes product / year	oreford sulphide+other receipts	2.20E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4					
	Process Fugitives, Material Conveying	-	tonnes product / year	oreford sulphide+other receipts	5.07E-05	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
B2-03	Process Fugitives (Total)									0.000	1.449E-07	9	3	
	Building 3													
	Mechanical Calcining Furnaces 1 to 5	-	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Hand Rabbled Calcining Furnaces 1 to 5	-	tonnes product / year	G/B NiO	4.29E-03	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5					
	Sulphide Anode Furnace - installed 1956 (Anode Furnaces 8 and 9 dimantled in 1941)	-	tonnes product / year	sulphide anode production	2.46E-02	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10					
DC-01	Dust Chamber Exhaust Stack (Bldg 3)	-			70	% Reduction	EC	Conservative	AWMA 1992	0.000	0.000E+00			
B3-02	Process Fugitives, Mechanical	-	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B3-03	Process Fugitives, Hand Rabbled	-	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B3-05	Process Fugitives, Anode Furnaces	-	tonnes product / year	sulphide anode production	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B3-06	Process Fugitives, Calciner Annexx	-	tonnes product / year	G/B NiO	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
PH-01	Power house													
	Building 4													
B4-01	Nickel Refining Furnace 1	-	tonnes product / year	wrought Ni production	1.23E-02	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.000	0.000E+00			
B4-03	Process Fugitives, Nickel Refining	-	tonnes product / year	wrought Ni production	3.28E-04	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.5	0.000	0.000E+00			
B4-10	Process Fugitives, Anode Nickel Refining	9,039	tonnes product / year	anode production	3.28E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.003	9.390E-05			
CP-01	Cottrell Precipitator Stack 1	9,229	tonnes product / year	1/3 (anode production+utility Ni)	5.61E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.005	1.641E-04			
CP-02	Cottrell Precipitator Stack 2	9,229	tonnes product / year	1/3 (anode production+utility Ni)	5.61E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.005	1.641E-04			
CP-03	Cottrell Precipitator Stack 3	9,229	tonnes product / year	1/3 (anode production+utility Ni)	5.61E-04	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	0.005	1.641E-04			
	Building 5													
B5-01	Secondary anodes (with wet collector)	-	tonnes product / year	secondary anodes	4.91E-03	kg / Mg	US EPA EF	US EPA C	AP-42, S 12.10	0.000	0.000E+00			
	Rod Milling	-	tonnes product / year	RGP Sinter 95	1.30E-03	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.18	0.000	0.000E+00	9	3	
	Material Handling Emissions													
MH-01	Matte loading/unloading	-	tonnes matte / year	bessemer matte	1.81E-06	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
MH-02	Coke/Coal loading/unloading	-	tonnes coke / year	bessemer matte *(.65/1.4)	1.35E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	0.000	0.000E+00			
MH-03	Slag loading / unloading	-	tonnes slag / year	bessemer matte *(.4/1.4)	4.90E-04	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	0.000	0.000E+00			G/M2
WS-01	Matte Storage	-	square meters		2.43E-04	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
WS-02	Coke/Coal Storage Pile	-	square meters		2.30E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
WS-03	Slag Storage Pile	-	square meters		4.06E-03	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	0.000	0.000E+00			#DIV/0!
									Total	**0.021**	**6.709E-04**			

Wind Erosion Parameters

Wind Speed	78.1	km/hr
Disturbances per Year	26	

Speciation Factor	Factor	Reference
Ore (Copper Cliff Matte)	3.20E-03	Inco Memo, May 1986
Sinter	8.10E-03	Inco Memo, May 1986
Nickel Oxide	3.90E-03	Inco Memo, May 1986
Coal/Coke	3.03E-04	Algoma Coal
Cottrell Precip Dust	0.0089	MOE Report, Feb 1978
slag	0.05335	

APPENDIX E

IRON EMISSIONS INVENTORY FOR ALGOMA

Algoma - Port Colborne **Scenario:** **1**
Air Emission Inventory **Base Year:** **1951**

Source ID	Source Description	Production		Contaminant - Iron					Emission Rate		
	Process Emissions	**Activity Rate**	**AR Units**	**Emission Factor**	**EF Units**	**Methodology**	**Data Quality**	**Reference**	**ER (Mg/yr)**	**ER (g/s)**	
BF1-01	No 1 BF Roof Monitor	88,625	tonnes product / year	1.53E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	1.36E+01	4.30E-01	
BF1-02	No 1 BF Tapping	88,625	tonnes product / year	7.65E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	6.78E+00	2.15E-01	
BF1-03	No 1 BF Stoves (3)	655,825,000	MJ / year	1.53E-04	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	1.00E+02	3.18E+00	
BF2-01	No 2 BF Roof Monitor	29,700	tonnes product / year	1.53E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	4.54E+00	1.44E-01	
BF2-02	No 2 BF Tapping	29,700	tonnes product / year	7.65E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	2.27E+00	7.20E-02	
BF2-03	No 2 BF Stoves	219,780,000	MJ / year	1.53E-04	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	3.36E+01	1.07E+00	
PC1-01	Pig Casting Machine	118,325	tonnes product / year	2.81E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	3.32E+01	1.05E+00	
S1-01	Sintering Plant - Windbox	118,325	tonnes sinter / year	5.67E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	6.71E+01	2.13E+00	
S2-02	Sintering Plant - Discharge	118,325	tonnes sinter / year	3.47E-01	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	4.10E+01	1.30E+00	
	Material Handling Emissions										
MH-01	Ore loading/unloading	165,655	tonnes ore / year	3.95E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	6.54E-02	2.07E-03	
MH-02	Coke loading/unloading	76,911	tonnes coke / year	2.71E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	2.08E-05	6.60E-07	
MH-03	Slag loading / unloading	47,330	tonnes slag / year	4.68E-03	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	2.22E-01	7.03E-03	
WS-01	Ore Storage Pile	11387	square meters	2.68E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	3.05E-01	9.67E-03	8.49221E-07
WS-02	Coke Storage Pile	5287	square meters	2.32E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	1.23E-04	3.89E-06	7.35183E-10
WS-03	Slag Storage Pile	3254	square meters	3.90E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	1.27E-01	4.03E-03	1.23744E-06
								Totals:	**3.03E+02**	**9.61E+00**	

Speciation Fraction:

Ore	3.50E-01
Sinter	5.10E-01
Coal	3.03E-04

Algoma - Port Colborne **Scenario: 2**
Air Emission Inventory **Base Year: 1957**

Source ID	Source Description	Production		Contaminant - Iron					Emission Rate		
	Process Emissions	**Activity Rate**	**AR Units**	**Emission Factor**	**EF Units**	**Methodology**	**Data Quality**	**Reference**	**ER (Mg/yr)**	**ER (g/s)**	
BF1-01	No 1 BF Roof Monitor	104,500	tonnes product / year	1.53E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	1.60E+01	5.07E-01	
BF1-02	No 1 BF Tapping	104,500	tonnes product / year	7.65E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	7.99E+00	2.53E-01	
BF1-03	No 1 BF Stoves (3)	773,300,000	MJ / year	7.65E-05	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	5.92E+01	1.88E+00	
BF2-01	No 2 BF Roof Monitor	37,741	tonnes product / year	1.53E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	5.77E+00	1.83E-01	
BF2-02	No 2 BF Tapping	37,741	tonnes product / year	7.65E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	2.89E+00	9.16E-02	
BF2-03	No 2 BF Stoves	279,283,400	MJ / year	7.65E-05	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	2.14E+01	6.77E-01	
PC1-01	Pig Casting Machine	142,241	tonnes product / year	2.81E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	3.99E+01	1.27E+00	
S1-01	Sintering Plant - Windbox	142,241	tonnes sinter / year	5.67E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	8.07E+01	2.56E+00	
S2-02	Sintering Plant - Discharge	142,241	tonnes sinter / year	3.47E-01	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	4.93E+01	1.56E+00	
	Material Handling Emissions										
MH-01	Ore loading/unloading	199,137	tonnes ore / year	3.95E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	7.87E-02	2.49E-03	
MH-02	Coke loading/unloading	92,457	tonnes coke / year	2.71E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	2.50E-05	7.93E-07	
MH-03	Slag loading / unloading	56,896	tonnes slag / year	4.68E-03	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	2.66E-01	8.45E-03	
WS-01	Ore Storage Pile	11,387	square meters	2.68E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	3.05E-01	9.67E-03	8.49E-07
WS-02	Coke Storage Pile	5,287	square meters	2.32E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	1.23E-04	3.89E-06	7.35E-10
WS-03	Slag Storage Pile	3,254	square meters	3.90E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	1.27E-01	4.03E-03	1.24E-06
								Totals:	**2.84E+02**	**9.00E+00**	

Speciation Fraction:

Ore	3.50E-01
Sinter	5.10E-01
Coal	3.03E-04

Algoma - Port Colborne **Scenario: 3**
Air Emission Inventory **Base Year: 1960**

Source ID	Source Description	Production		Contaminant - Iron					Emission Rate		
	Process Emissions	**Activity Rate**	**AR Units**	**Emission Factor**	**EF Units**	**Methodology**	**Data Quality**	**Reference**	**ER (Mg/yr)**	**ER (g/s)**	
BF1-01	No 1 BF Roof Monitor	104,500	tonnes product / year	1.53E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	1.60E+01	5.07E-01	
BF1-02	No 1 BF Tapping	104,500	tonnes product / year	7.65E-02	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	7.99E+00	2.53E-01	
BF1-03	No 1 BF Stoves (5)	773,300,000	MJ / year	3.83E-05	kg / MJ	US EPA EF	US EPA D	AP-42, S 12.5	2.96E+01	9.38E-01	
PC1-01	Pig Casting Machine	104,500	tonnes product / year	2.81E-01	kg / Mg	US EPA EF	US EPA D	AP-42, S 12.5	2.93E+01	9.29E-01	
S1-01	Sintering Plant - Windbox	104,500	tonnes sinter / year	2.84E-01	kg / Mg	US EPA EF	US EPA B	AP-42, S 12.5	2.96E+01	9.40E-01	
S2-02	Sintering Plant - Discharge	104,500	tonnes sinter / year	1.73E-01	kg / Mg	US EPA EF	US EPA A	AP-42, S 12.5	1.81E+01	5.75E-01	
	Material Handling Emissions										
MH-01	Ore loading/unloading	146,300	tonnes ore / year	3.95E-04	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	5.78E-02	1.83E-03	
MH-02	Coke loading/unloading	67,925	tonnes coke / year	2.71E-07	kg / Mg	US EPA EF	US EPA B	AP-42, S 13.2.4	1.84E-05	5.83E-07	
MH-03	Slag loading / unloading	41,800	tonnes slag / year	4.68E-03	kg / Mg	US EPA EF	US EPA A	AP-42, S 13.2.4	1.96E-01	6.21E-03	
WS-01	Ore Storage Pile	11,387	square meters	2.66E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	3.03E-01	9.61E-03	8.44E-07
WS-02	Coke Storage Pile	5,287	square meters	2.30E-05	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	1.22E-04	3.86E-06	7.31E-10
WS-03	Slag Storage Pile	3,254	square meters	3.88E-02	kg / m2	US EPA EF	Conservative	AP-42, S 13.2.5	2.05E-01	4.00E-03	1.23E-06
								Totals:	**1.31E+02**	**4.16E+00**	

Speciation Fraction:

Ore	3.50E-01
Sinter	5.10E-01
Coal	3.03E-04
	78.1

APPENDIX F

STACK PARAMETERS FOR ALL EMISSIONS SCENARIOS

Algoma - Scenarios 1-3

Source	Type	X-Coord(m)	Y-Coord (m)	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
S1	POINT	643200	4748805	40	600	5	3
BF	POINT	643192	4748836	35	500	5	3
RM1	POINT	643230	4748900	14	293	0.1	1
RM2	POINT	643224	4748882	14	293	0.1	1
ORE	AREA	643112	4748810				
COK	AREA	643112	4748986				
SLA	AREA	643112	4749066				
OREL	AREA	643145	4748898				
COKL	AREA	643145	4749026				
SLAL	AREA	643145	4749088				

Inco - Scenario 1

Source	Type	X-Coord(m)	Y-Coord (m)	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
B101	POINT	643970.3	4749270.6	106.68	293	5	6
B102	POINT	643934.5	4749313.8	19.45	293	0.1	1
B103	POINT	643907.1	4749365.3	19.45	293	0.1	1
B104	POINT	643915.4	4749288.8	19.45	293	0.1	1
B105	POINT	643915.4	4749199.1	19.45	293	0.1	1
B201	POINT	643832.3	4749161.7	18.9	293	5	0.61
B202	POINT	643799.1	4749157.6	17.68	293	5	0.76
B203	POINT	643728.4	4749171.7	14.39	293	0.1	1
B204	POINT	643858.1	4749171.7	14.39	293	0.1	1
B301	POINT	643854.8	4749136.8	21.03	303.15	30.4	1.32
B302	POINT	643832.3	4749117.7	14.39	293	0.1	1
B303	POINT	643751.7	4749117.7	14.39	293	0.1	1
B401	POINT	643757.5	4749277.2	30.48	440	5	1.9
B402	POINT	643757.5	4749270.6	30.48	440	5	1.9
B403	POINT	643735.1	4749274.7	15.49	293	0.1	1
DC01	POINT	643706	4748928.2	106.7	334.8	0.71	6
SLA	AREA	644001	4748950				
OREL	AREA	643907.1	4749365.3				
COKL	AREA	643907.1	4749365.3				
SLAL	AREA	644054	4749010				

Inco - Scenario 2

Source	Type	X-Coord(m)	Y-Coord (m)	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
B102	POINT	643934.5	4749313.8	19.45	293	0.1	1
B106	POINT	643914	4749130	19.45	293	0.1	1
B201	POINT	643832.3	4749161.7	18.9	293	5	0.61
B202	POINT	643799.1	4749157.6	17.68	293	5	0.76
B203	POINT	643728.4	4749171.7	14.39	293	0.1	1
B302	POINT	643832.3	4749117.7	14.39	293	0.1	1
B303	POINT	643751.7	4749117.7	14.39	293	0.1	1
B304	POINT	643842.3	4749077.8	14.39	293	0.1	1
B305	POINT	643784.1	4749076.1	14.39	293	0.1	1
B306	POINT	643742.6	4749081.1	14.39	293	0.1	1
B401	POINT	643757.5	4749277.2	30.48	440	5	1.9
B402	POINT	643757.5	4749270.6	30.48	440	5	1.9
B403	POINT	643735.1	4749274.7	15.49	293	0.1	1
B404	POINT	643757.5	4749315.4	18.3	440	5	1.9
B405	POINT	643757.5	4749322.9	18.3	440	5	1.9
B406	POINT	643757.5	4749360.3	18.3	440	5	1.9
B407	POINT	643757.5	4749376.1	18.3	440	5	1.9
B408	POINT	643757.5	4749394.4	18.3	440	5	1.9
B410	POINT	643736.8	4749377.8	15.49	293	0.1	1
DC01	POINT	643706	4748928.2	153.4	334.8	0.71	6
COK	AREA	643982	4749480				
SLA	AREA	644068	4749130				
OREL	AREA	643907.1	4749365.3				
COKL	area	644021	4749540				
SLAL	area	644110	4749200				

Inco - Scenario 3

Source	Type	X-Coord(m)	Y-Coord (m)	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
B102	POINT	643934.5	4749313.8	19.45	293	0.1	1
B104	POINT	643915.4	4749288.8	19.45	293	0.1	1
B106	POINT	643914	4749130	19.45	293	0.1	1
B201	POINT	643832.3	4749161.7	18.9	293	5	0.61
B202	POINT	643799.1	4749157.6	17.68	293	5	0.76
B203	POINT	643728.4	4749171.7	14.39	293	0.1	1
B302	POINT	643832.3	4749117.7	14.39	293	0.1	1
B303	POINT	643751.7	4749117.7	14.39	293	0.1	1
B304	POINT	643842.3	4749077.8	14.39	293	0.1	1
B305	POINT	643784.1	4749076.1	14.39	293	0.1	1
B306	POINT	643742.6	4749081.1	14.39	293	0.1	1
B401	POINT	643757.5	4749277.2	30.48	440	5	1.9
B402	POINT	643757.5	4749270.6	30.48	440	5	1.9
B403	POINT	643735.1	4749274.7	15.49	293	0.1	1
B404	POINT	643757.5	4749315.4	18.3	440	5	1.9
B405	POINT	643757.5	4749322.9	18.3	440	5	1.9
B406	POINT	643757.5	4749360.3	18.3	440	5	1.9
B407	POINT	643757.5	4749376.1	18.3	440	5	1.9
B408	POINT	643757.5	4749394.4	18.3	440	5	1.9
B410	POINT	643736.8	4749377.8	15.49	293	0.1	1
B501	POINT	643670	4749140	15.5	293	0.1	1
DC01	POINT	643706	4748928.2	153.4	334.8	0.71	6
COK	AREA	643982	4749480				
SLA	AREA	644068	4749130				
OREL	AREA	643907.1	4749365.3				
COKL	area	644021	4749540				
SLAL	area	644110	4749200				

Inco - Scenario 4

Source	Type	X-Coord(m)	Y-Coord (m)	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
B102	POINT	643934.5	4749313.8	19.45	293	0.1	1
B104	POINT	643915.4	4749288.8	19.45	293	0.1	1
B106	POINT	643914	4749130	19.45	293	0.1	1
B201	POINT	643832.3	4749161.7	18.9	293	5	0.61
B202	POINT	643799.1	4749157.6	17.68	293	5	0.76
B203	POINT	643728.4	4749171.7	14.39	293	0.1	1
B210	POINT	643841	4749170	18.9	293	25.9	1.32
B302	POINT	643832.3	4749117.7	14.39	293	0.1	1
B303	POINT	643751.7	4749117.7	14.39	293	0.1	1
B305	POINT	643784.1	4749076.1	14.39	293	0.1	1
B306	POINT	643742.6	4749081.1	14.39	293	0.1	1
B401	POINT	643757.5	4749277.2	30.48	440	5	1.9
B403	POINT	643735.1	4749274.7	15.49	293	0.1	1
B410	POINT	643736.8	4749377.8	15.49	293	0.1	1
B501	POINT	643670	4749140	15.5	293	0.1	1
DC01	POINT	643706	4748928.2	153.4	334.8	0.71	6
CP01	POINT	643781	4749291.7	23.6	444.3	22.8	0.91
CP02	POINT	643781	4749287.4	23.6	444.3	22.8	0.91
CP03	POINT	643781	4749283	23.6	444.3	22.8	0.91
COK	AREA	643982	4749480				
SLA	AREA	644068	4749130				
OREL	AREA	643907.1	4749365.3				
COKL	area	644021	4749540				
SLAL	area	644110	4749200				

Inco - Scenario 5

Source	Type	X-Coord(m)	Y-Coord (m)	Height (m)	Temp (K)	Vel (m/s)	Diameter (m)
B102	POINT	643934.5	4749313.8	19.45	293	0.1	1
B106	POINT	643914	4749130	19.45	293	0.1	1
B203	POINT	643728.4	4749171.7	14.39	293	0.1	1
B210	POINT	643841	4749170	18.9	293	25.9	1.32
B301	POINT	643854.8	4749136.8	21.03	303	30.4	1.32
B403	POINT	643735.1	4749274.7	15.49	293	0.1	1
B410	POINT	643736.8	4749377.8	15.49	293	0.1	1
CP01	POINT	643781	4749291.7	23.6	444.3	22.8	0.91
CP02	POINT	643781	4749287.4	23.6	444.3	22.8	0.91
CP03	POINT	643781	4749283	23.6	444.3	22.8	0.91

APPENDIX G

BUILDING DATA FOR ALL EMISSIONS SCENARIOS

```
"Algoma buildings - Scenarios
1-3"
'ST'
'METERS' 1.00
'UTMN' 0
11
'Blowing engine room' 1 0
10 8.6
643194.6 4748799
643216.2 4748799
643216.2 4748794.2
643229.4 4748794.2
643229.4 4748806.2
643224.6 4748806.2
643224.6 4748825.4
643213.8 4748825.4
643213.8 4748820.6
643194.6 4748820.6
'Ore Bins' 1 0
4 3.6
643179.6 4748843.4
643188 4748843.4
643188 4748905.8
643179.6 4748905.8
'Engine House' 1 0
4 12.9
643189.8 4748919
643199.4 4748919
643199.4 4748878.2
643189.8 4748878.2
'Steel Furnace' 2 0
9 14.4
643211.4 4748841
643218 4748841
643218 4748847.6
643222.2 4748851.8
643227 4748865
643210.8 4748871
643206.6 4748859
643206.6 4748844.6
643211.4 4748844.6
4 14
643227 4748865
643245 4748909.4
643228.8 4748916.6
643210.8 4748871
'General Store' 1 0
6 5.7
643203 4748961
643204.2 4749004.2
643210.8 4749004.2
643211.4 4749011.4
643221 4749010.8
643219.8 4748961
'Locomotive shed' 1 0
4 11.5
 643205.4 4748929.8
 643205.4 4748947.2
 643211.4 4748947.2
 643211.4 4748929.8
'Steel Blower1' 1 0
4 27.4
 643193.4 4748838.6
 643193.4 4748844
 643199.4 4748844
 643199.4 4748838.6
'Steel Blower2' 1 0
4 27.4
643193.4 4748845.8
643193.4 4748850.8
643199.4 4748850.8
643199.4 4748845.8
'Steel Blower3' 1 0
4 27.4
643193.4 4748861.4
643193.4 4748867.4
643199.4 4748867.4
643199.4 4748861.4
'Steel Blower4' 1 0
4 27.4
643193.4 4748868.6
643193.4 4748873.4
643199.4 4748873.4
643199.4 4748868.6
'Steel Tank' 1 0
4 27.4
43217.4 4748836.2
43224 4748836.2
43224 4748829
43217.4 4748829
4
'S1' 0 35 643200 4748805
'BF' 0 40  643192 4748836
'RM1' 0 14 643230 4748900
'RM2' 0 14 643224 4748882
```

```
'INCO Scenario 1'
'ST'
'METERS' 1.00
'UTMN' 0.
12
'No 1 Warehouse',1,0
6,13.11
643685.228  4749150.1
643698.524  4749150.1
643698.524  4749307.1
643665.284  4749307.1
643665.284  4749194.9
643685.228  4749194.9
'Dust chamber',1,0
14,10.82
643699.355  4748978.9
643712.651  4748978.9
643712.651  4748988.0
643716.806  4748988.0
643716.806  4749095.2
643712.651  4749095.2
643712.651  4749112.7
643706.003  4749112.7
643706.003  4749105.2
643700.186  4749105.2
643700.186  4749095.2
643695.2    4749095.2
643695.2    4748988.0
643699.355  4748988.0
'Power house',1,0
4,15
643799.075  4749235.7
643831.484  4749235.7
643831.484  4749267.2
643799.075  4749267.2
'Leaching',1,0
4,14.39
643716.806  4749154.2
643864.724  4749154.2
643864.724  4749186.6
643716.806  4749186.6
'Calcining',1,0
4,14.39
643727.609  4749098.5
643858.907  4749098.5
643858.907  4749143.4
643727.609  4749143.4
'store house',1,0
4,7.32
643837.01   4749228.2
643863.893  4749228.2
643863.893  4749302.1
643837.01   4749302.1
'MB&E',1,0
4,10.21
643799.075  4749318.8
643833.977  4749318.8
643833.977  4749390.2
643799.075  4749390.2
'Change B',1,0
8,4.85
643853.09 4749320.4
643861.4 4749320.4
643861.4 4749317.1
643865.555 4749317.1
643865.555 4749355.3
643861.4 4749355.3
643861.4 4749351.2
643853.09 4749351.2
'Sulphide',1,0
20,19.45
643892.978 4749155.1
643943.669 4749155.1
643943.669 4749216.6
643953.641 4749216.6
643953.641 4749236.5
643942.838 4749236.5
643942.838 4749318.8
643920.401 4749318.8
643920.401 4749385.2
643930.373 4749385.2
643930.373 4749411.8
643892.147 4749411.8
643892.147 4749318.8
643884.668 4749318.8
643884.668 4749301.3
643875.527 4749301.3
643875.527 4749293.8
643882.175 4749293.8
643882.175 4749275.6
643892.978 4749275.6
'cottrel',1,0
14, 20
643958.627 4749236.5
643972.754 4749236.5
643972.754 4749263.1
643977.74 4749268.9
643982.726 4749268.9
643982.726 4749274.7
643977.74 4749274.7
643972.754 4749278.9
643972.754 4749305.5
643958.627 4749305.5
643958.627 4749288.8
643948.655 4749288.8
643948.655 4749255.6
643958.627 4749255.6
'Nickel',1,0
12,15.97
643719.299 4749228.2
643755.032 4749228.2
643755.032 4749267.2
643760.018 4749267.2
643760.018 4749280.5
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643755.032 4749280.5
643755.032 4749303.0
643760.018 4749303.0
643760.018 4749311.3
643755.032 4749311.3
643755.032 4749319.6
643719.299 4749319.6
'Carpenter',1,0
4,  7.62
643848.104 4749370.3
643865.555 4749370.3
643865.555 4749461.7
643848.104 4749461.7
18
'B1-01' 0 106.68 643970.261
4749270.6
'B1-02' 0 19.45  643934.528
4749313.8
'B1-03' 0 19.45  643907.105
4749365.3
'B1-04' 0 19.45  643915.415
4749288.8
'B1-05' 0 19.45  643915.415
4749199.1
'B2-01' 0 18.9   643832.315
4749161.7
'B2-02' 0 17.68  643799.075
4749157.6
'B2-03' 0 14.39  643728.44
4749171.7
'B2-04' 0 14.39  643858.076
4749171.7
'B3-01' 0 21.03  643854.752
4749136.8
'B3-02' 0 14.39  643832.315
4749117.7
'B3-03' 0 14.39  643751.708
4749117.7
'PH-01' 0 53.34  643810.709
4749230.7
'B4-01' 0 30.48  643757.525
4749277.2
'B4-02' 0 30.48  643757.525
4749270.6
'B4-03' 0 15.49  643735.088
4749274.7
'B5-01' 0 13.11  643670.27
4749199.1
'DC-01' 0 153.4  643706.003
4748928.2
```

```
'INCO Scenario 2'
'ST'
'METERS' 1.00
'UTMN' 0.
13
'Warehouse',4,0
4, 12.8
643551.437 4748786.9
643614.593 4748786.9
643614.593 4748983.0
643551.437 4748983.0
12, 17.07
643551.437 4748983.0
643614.593 4748983.0
643616.255 4749067.8
643642.016 4749067.8
643642.016 4749117.7
643648.664 4749117.7
643648.664 4749127.6
643685.228 4749127.6
643685.228 4749194.9
643607.945 4749194.9
643607.945 4749127.6
643551.437 4749127.6
6, 13.1
643685.228 4749150.1
643698.524 4749150.1
643698.524 4749307.1
643665.284 4749307.1
643665.284 4749194.9
643685.228 4749194.9
6,11.64
643551.437 4749127.6
643607.945 4749127.6
643607.945 4749194.9
643665.284 4749194.9
643665.284 4749307.1
643551.437 4749307.1
'No 2 warehouse',1,0
4,  11.67
643695.2 4748787.8
643729.271 4748787.8
643729.271 4748903.3
643695.2 4748903.3
'Dust chamber',1,0
14,  10.82
 643699.355 4748978.9
 643712.651 4748978.9
 643712.651 4748988.0
 643716.806 4748988.0
643716.806 4749095.2
643712.651 4749095.2
643712.651 4749112.7
643706.003 4749112.7
643706.003 4749105.2
643700.186 4749105.2
643700.186 4749095.2
643695.2 4749095.2
 643695.2 4748988.0
643699.355 4748988.0
'Power house',1,0
4,  15
643799.075 4749235.7
643831.484 4749235.7
643831.484 4749267.2
643799.075 4749267.2
'Leaching tier 1',2,0
10,  12.03
643728.44 4749073.6
643756.694 4749073.6
643756.694 4749062.0
643767.497 4749062.0
643767.497 4749050.4
643796.582 4749050.4
643796.582 4749062.0
643858.907 4749062.0
643858.907 4749098.5
643727.609 4749098.5
10, 14.39
643858.907 4749098.5
643858.907 4749155.1
643864.724 4749155.1
643864.724 4749197.4
643850.597 4749197.4
643850.597 4749186.6
643716.806 4749186.6
643716.806 4749154.2
643727.609 4749154.2
643727.609 4749098.5
'store house',1,0
4,   7.32
643837.01 4749228.2
643863.893 4749228.2
643863.893 4749302.1
643837.01  4749302.1
'MB&E',1,0
4,  10.21
643799.075 4749318.8
643833.977 4749318.8
643833.977 4749390.2
643799.075 4749390.2
'Change B',1,0
8,  4.85
643853.09 4749320.4
643861.4 4749320.4
643861.4 4749317.1
643865.555 4749317.1
643865.555 4749355.3
643861.4 4749355.3
643861.4 4749351.2
643853.09 4749351.2
'C&C shops',1,0
6,  7.62
643848.104 4749370.3
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643865.555 4749370.3
643865.555 4749487.5
643863.062 4749487.5
643863.062 4749535.7
643848.104 4749535.7
'Brick',1,0
4,   5.33
643798.244 4749426.0
643812.371 4749426.0
643812.371 4749479.1
643798.244 4749479.1
'Sulphide',2,0
28,  19.45
643892.978 4749052.8
643920.401 4749052.8
643920.401 4749085.3
643929.542 4749085.3
643929.542 4749155.1
643943.669 4749155.1
643943.669 4749185.8
643960.289 4749185.8
643960.289 4749213.2
643953.641 4749213.2
643953.641 4749236.5
643942.838 4749236.5
643942.838 4749318.8
643920.401 4749318.8
643920.401 4749385.2
643930.373 4749385.2
643930.373 4749411.8
643922.063 4749411.8
643922.063 4749539.8
643892.147 4749539.8
643892.147 4749318.8
643884.668 4749318.8
643884.668 4749301.3
643875.527 4749301.3
643875.527 4749293.8
643882.175 4749293.8
643882.175 4749275.6
643892.978 4749275.6
4,13.78
643892.147 4749539.8
643883.006 4749539.8
643883.006 4749318.8
643892.147 4749318.8
'cottrel',1,0
14,  20
643958.627 4749236.5
643972.754 4749236.5
643972.754 4749263.1
643977.74 4749268.9
643982.726 4749268.9
643982.726 4749274.7
643977.74 4749274.7
643972.754 4749278.9
643972.754 4749305.5
643958.627 4749305.5
643958.627 4749288.8
643948.655 4749288.8
643948.655 4749255.6
643958.627 4749255.6
'Nickel',1,0
24,  15.97
643719.3 4749228.2
643755.0 4749228.2
643755.0 4749267.2
643760.0 4749267.2
643760.0 4749280.5
643755.0 4749280.5
643755.0 4749303.0
643760.0 4749303.0
643760.0 4749327.1
643755.0 4749327.1
643755.0 4749356.2
643760.0 4749356.2
643760.0 4749362.8
643755.0 4749362.8
643755.0 4749372.8
643760.0 4749372.8
643760.0 4749380.3
643755.0 4749380.3
643755.0 4749398.5
643760.0 4749398.5
643760.0 4749414.3
643755.0 4749414.3
643755.0 4749424.3
643719.3 4749424.3
24
'B102'  0 19.450 643934.528
4749313.8
'B106' 0  19.45 643914.0
4749130.0
'B201' 0 18.9 643832.315
4749161.7
'B2-02' 0 17.68 643799.075
4749157.6
'B2-03' 0 14.39 643728.44
4749171.7
'B2-04' 0 14.39 643858.076
4749171.7
'B3-01' 0 21.03 643854.752
4749136.8
'B3-02' 0 14.39 643832.315
4749117.7
'B3-03' 0 14.39 643751.708
4749117.7
'B3-04' 0 14.39 643832.315
4749077.8
'B3-05' 0 14.39 643784.117
4749076.1
'B3-06' 0 14.39 643742.567
4749081.1
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'PH-01' 0 53.34 643810.709
4749230.7
'B4-01' 0 30.48 643757.525
4749277.2
'B4-02' 0 30.48 643757.525
4749270.6
'B4-03' 0 15.49 643735.088
4749274.7
'B4-04' 0 18.29 643757.525
4749315.4
'B4-05' 0 18.29 643757.525
4749322.9
'B4-06' 0 18.29 643757.525
4749360.3
'B4-07' 0 18.29 643757.525
4749376.1
'B4-08' 0 18.29 643757.525
4749394.4
'B4-10' 0 18.29 643736.75
4749377.8
'B5-02' 0 13.11 643688.552
4749145.9
'DC-01' 0 153.4 643706.003
4748928.2

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'INCO Scenario 3'
'ST'
'METERS' 1.00
'UTMN' 0.
13
'Power house',1,0
4,  15
643799.075 4749235.7
643831.484 4749235.7
643831.484 4749267.2
643799.075 4749267.2
'Dust chamber',1,0
14,  10.82
643699.355 4748978.9
643712.651 4748978.9
643712.651 4748988.0
643716.806 4748988.0
643716.806 4749095.2
643712.651 4749095.2
643712.651 4749112.7
643706.003 4749112.7
643706.003 4749105.2
643700.186 4749105.2
643700.186 4749095.2
643695.2 4749095.2
643695.2 4748988.0
643699.355 4748988.0
'store house',1,0
4,   7.32
643837.01   4749228.2
643863.893  4749228.2
643863.893  4749302.1
643837.01   4749302.1
'MB&E',1,0
4,  10.21
 643799.075 4749318.8
 643833.977 4749318.8
643833.977 4749390.2
643799.075 4749390.2
'Nickel',1,0
24,  15.97
643719.299 4749228.2
643755.032 4749228.2
643755.032 4749267.2
643760.018 4749267.2
643760.018 4749280.5
643755.032 4749280.5
643755.032 4749303.0
643760.018 4749303.0
643760.018 4749327.1
643755.032 4749327.1
643755.032 4749356.2
643760.018 4749356.2
643760.018 4749362.8
643755.032 4749362.8
643755.032 4749372.8
643760.018 4749372.8
643760.018 4749380.3
643755.032 4749380.3
643755.032 4749398.5
643760.018 4749398.5
643760.018 4749414.3
643755.032 4749414.3
643755.032 4749424.3
643719.299 4749424.3
'Leaching tier 1',2,0
6,  12.04
643756.694 4749062.0
643767.497 4749062.0
643767.497 4749050.4
643796.582 4749050.4
643796.582 4749099.4
643756.694 4749099.4
12, 14.39
643858.907 4749099.4
643858.907 4749155.1
643864.724 4749155.1
643864.724 4749215.7
643809.878 4749215.7
643809.878 4749226.5
643796.582 4749226.5
643796.582 4749186.6
643716.806 4749186.6
643716.806 4749154.2
643727.609 4749154.2
643727.609 4749099.4
'Sulphide',1,0
26,  19.45
643892.978 4749052.8
643920.401 4749052.8
643920.401 4749085.3
643929.542 4749085.3
643929.542 4749155.1
643943.669 4749155.1
643943.669 4749185.8
643960.289 4749185.8
643960.289 4749213.2
643943.669 4749213.2
643942.838 4749318.8
643920.401 4749318.8
643920.401 4749385.2
643930.373 4749385.2
643930.373 4749411.8
643922.063 4749411.8
643922.063 4749539.8
643892.147 4749539.8
643892.147 4749318.8
643884.668 4749318.8
643884.668 4749301.3
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643875.527 4749293.8
643882.175 4749293.8
643882.175 4749275.6
643892.978 4749275.6
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'Hevment',1,0
4,  5.55
643832.84 4749552.3
643867.4 4749552.3
643867.4 4749638.7
643832.84 4749638.7
'No 60',1,0
4,  6.25
643824.2 4749473.1
643840.04 4749473.1
643840.04 4749530.7
643824.2 4749530.7
'RS3',1,0
4,  20.57
 643901.96 4748679.7
 643945.16 4748679.7
 643945.16 4748707.0
 643901.96 4748707.0
'RS2',1,0
4,  13.56
 643809.8 4748711.4
 643865.96 4748679.7
 643865.96 4748711.4
 643809.8 4748679.7
'E&W',1,0
4,  12.28
 643711.88 4748679.7
 643747.88 4748679.7
 643747.88 4748920.2
 643711.88 4748920.2
'electroR T1',5,0
14,  12.8
 643553.48 4748789.1
 643647.08 4748789.1
 643647.08 4748805.0
 643652.84 4748805.0
 643652.84 4748810.7
 643661.48 4748810.7
 643661.48 4748875.5
 643637 4748875.5
 643637 4748892.8
 643647.08 4748892.8
 643647.08 4748913.0
 643637 4748913.0
643637 4748974.9
643553.48 4748974.9
10,17.07
643553.48 4748974.9
643637 4748974.9
643637 4749028.2
643652.84 4749028.2
643652.84 4749033.9
643637 4749033.9
643637 4749069.9
643621.16 4749069.9
643621.16 4749143.4
643553.48 4749143.4
12,15.54
643621.16 4749069.9
643654.28 4749069.9
643654.28 4749111.7
643660.04 4749111.7
643660.04 4749130.4
643690.28 4749130.4
643690.28 4749153.4
643703.24 4749153.4
643703.24 4749205.3
643670.12 4749205.3
643670.12 4749196.6
643621.16 4749196.6
6,10
643553.48 4749143.4
643621.16 4749143.4
643621.16 4749196.6
643670.12 4749196.6
643670.12 4749316.2
643553.48 4749316.2
4,13.11
643670.12 4749205.3
643703.24 4749205.3
643703.24 4749311.8
643670.12 4749311.8
22
'B102'  0 19.450 643934.528
4749313.8
'B106' 0  19.45 643914.0
4749130.0
'B201' 0 18.9 643832.315
4749161.7
'B202' 0 17.68 643799.075
4749157.6
'B203' 0 14.39 643728.44
4749171.7
'B302' 0 14.39 643832.315
4749117.7
'B303' 0 14.39 643751.708
4749117.7
'B304' 0 14.39 643832.315
4749077.8
'B305' 0 14.39 643784.117
4749076.1
'B306' 0 14.39 643742.567
4749081.1
'B401' 0 30.48 643757.525
4749277.2
'B402' 0 30.48 643757.525
4749270.6
'B403' 0 15.49 643735.088
4749274.7
'B404' 0 18.29 643757.525
4749315.4
'B405' 0 18.29 643757.525
4749322.9
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'B406' 0 18.29 643757.525
4749360.3
'B407' 0 18.29 643757.525
4749376.1
'B408' 0 18.29 643757.525
4749394.4
'B410' 0 18.29 643736.75
4749377.8
'DC01' 0 153.4 643706.003
4748928.2
'B501' 0 15.5  643670.0
4749140.0
'B104' 0 19.45  643915.415
4749288.8
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'INCO Scenario 4'
'ST'
'METERS' 1.00
'UTMN' 0.
16
'Power house',1,0
4,  15
643799.075 4749235.7
643831.484 4749235.7
643831.484 4749267.2
643799.075 4749267.2
'Dust chamber',1,0
14,  10.82
643699.355 4748978.9
643712.651 4748978.9
643712.651 4748988.0
643716.806 4748988.0
643716.806 4749095.2
643712.651 4749095.2
643712.651 4749112.7
643706.003 4749112.7
643706.003 4749105.2
643700.186 4749105.2
643700.186 4749095.2
643695.2 4749095.2
643695.2 4748988.0
643699.355 4748988.0
'store house',1,0
4,   7.32
643837.01  4749228.2
643863.893 4749228.2
643863.893 4749302.1
643837.01  4749302.1
'MB&E',1,0
4,  10.21
643799.075 4749318.8
643833.977 4749318.8
643833.977 4749390.2
643799.075 4749390.2
'Nickel',1,0
24,  15.97
643719.299 4749228.2
643755.032 4749228.2
643755.032 4749267.2
643760.018 4749267.2
643760.018 4749280.5
643755.032 4749280.5
643755.032 4749303.0
643760.018 4749303.0
643760.018 4749327.1
643755.032 4749327.1
643755.032 4749356.2
643760.018 4749356.2
643760.018 4749362.8
643755.032 4749362.8
643755.032 4749372.8
643760.018 4749372.8
643760.018 4749380.3
643755.032 4749380.3
643755.032 4749398.5
643760.018 4749398.5
643760.018 4749414.3
643755.032 4749414.3
643755.032 4749424.3
643719.299 4749424.3
'Leaching tier 1',2,0
6, 12.04
643756.694 4749062.0
643767.497 4749062.0
643767.497 4749050.4
643796.582 4749050.4
643796.582 4749099.4
643756.694 4749099.4
12, 14.39
643858.907 4749099.4
643858.907 4749155.1
643864.724 4749155.1
643864.724 4749215.7
643809.878 4749215.7
643809.878 4749226.5
643796.582 4749226.5
643796.582 4749186.6
643716.806 4749186.6
643716.806 4749154.2
643727.609 4749154.2
643727.609 4749099.4
'Sulphide',1,0
26,  19.45
643892.978 4749052.8
643920.401 4749052.8
643920.401 4749085.3
643929.542 4749085.3
643929.542 4749155.1
643943.669 4749155.1
643943.669 4749185.8
643960.289 4749185.8
643960.289 4749213.2
643943.669 4749213.2
643942.838 4749318.8
643920.401 4749318.8
643920.401 4749385.2
643930.373 4749385.2
643930.373 4749411.8
643922.063 4749411.8
643922.063 4749539.8
643892.147 4749539.8
643892.147 4749318.8
643884.668 4749318.8
643884.668 4749301.3
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643875.527 4749293.8
643882.175 4749293.8
643882.175 4749275.6
643892.978 4749275.6
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643867.4 4749552.3
643867.4 4749638.7
643832.84 4749638.7
'No 60',1,0
4,  6.25
643824.2 4749473.1
643840.04 4749473.1
643840.04 4749530.7
643824.2 4749530.7
'RS3',1,0
4,  20.57
643901.96 4748679.7
643945.16 4748679.7
643945.16 4748707.0
643901.96 4748707.0
'RS2' ,1,0
4, 13.56
643809.8 4748679.7
643865.96 4748679.7
643865.96 4748711.4
643809.8 4748711.4
'E&W',1,0
4,  12.28
643711.88 4748679.7
643747.88 4748679.7
643747.88 4748920.2
643711.88 4748920.2
'electroR T1',5,0
14,  12.8
643553.48 4748789.1
643647.08 4748789.1
643647.08 4748805.0
643652.84 4748805.0
643652.84 4748810.7
643661.48 4748810.7
643661.48 4748875.5
643637 4748875.5
643637 4748892.8
643647.08 4748892.8
643647.08 4748913.0
643637 4748913.0
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643553.48 4748974.9
10,17.07
643553.48 4748974.9
643637 4748974.9
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643652.84 4749028.2
643652.84 4749033.9
643637 4749033.9
643637 4749069.9
643621.16 4749069.9
643621.16 4749143.4
643553.48 4749143.4
12, 15.54
643621.16 4749069.9
643654.28 4749069.9
643654.28 4749111.7
643660.04 4749111.7
643660.04 4749130.4
643690.28 4749130.4
643690.28 4749153.4
643703.24 4749153.4
643703.24 4749205.3
643670.12 4749205.3
643670.12 4749196.6
643621.16 4749196.6
6,10
643553.48 4749143.4
643621.16 4749143.4
643621.16 4749196.6
643670.12 4749196.6
643670.12 4749316.2
643553.48 4749316.2
4,13.11
643670.12 4749205.3
643703.24 4749205.3
643703.24 4749311.8
643670.12 4749311.8
'No7 Carpenter',1,0
4,  7.62
643853 4749372.3
643870.28 4749372.3
643870.28 4749489.0
643853 4749489.0
'No 46 Storage',1,0
4,  5.94
643853 4749491.8
643868.84 4749491.8
643868.84 4749536.5
643853 4749536.5
'Sm Cot B',1,0
4,  6
643776.68 4749278.7
643789.64 4749278.7
643789.64 4749294.6
643776.68 4749294.6
14
'B102'  0 19.45 643934.528
4749313.8
'B106' 0  19.45 643914.0
4749130.0
'B203' 0 14.39 643728.44
4749171.7
'B301' 0 21.03 643854.752
4749136.8
'B403' 0 15.49 643735.088
4749274.7
'B410' 0 18.29 643736.75
4749377.8
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'CP01' 0 23.62 643781
4749291.7
'CP02' 0 23.62 643781
4749287.4
'CP03' 0 23.62 643781
4749283.0
'DC01' 0 153.4 643706.003
4748928.2
'B901' 0 11.89 643795.4
4749058.4
'B501' 0 15.5  643670.0
4749140.0
'B104' 0 19.45  643915.415
4749288.8
'B210' 0 18.9   634841.0
4749170.0
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'INCO Scenario 5'
'ST'
'METERS' 1.00
'UTMN' 0.
14
"Power house",1,0
4,15
643799.075  4749235.7
643831.484  4749235.7
643831.484  4749267.2
643799.075  4749267.2
"store house",1,0
4,7.32
643837.01   4749228.2
643863.893  4749228.2
643863.893  4749302.1
643837.01   4749302.1
"MB&E",1,0
4,10.21
643799.075  4749318.8
643833.977  4749318.8
643833.977  4749390.2
643799.075  4749390.2
"Nickel",1,0
24,15.97
643719.299  4749228.2
643755.032  4749228.2
643755.032  4749267.2
643760.018  4749267.2
643760.018  4749280.5
643755.032  4749280.5
643755.032  4749303.0
643760.018  4749303.0
643760.018  4749327.1
643755.032  4749327.1
643755.032  4749356.2
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