YELLOWKNIFE AREA AIR QUALITY MONITORING

1996 DATA

The Department of Resources, Wildlife and Economic Development monitors air quality in the Yellowknife area. Dust levels have been monitored in Yellowknife since 1974. Acid rain has been monitored at the Snare Rapids hydro-electric site since 1989. Sulphur dioxide (SO_2) has been monitored in Yellowknife since 1992.

WHAT WERE THE RESULTS FROM YELLOWKNIFE DUST SAMPLING?

Dust samples are taken in downtown Yellowknife on the roof of a two story building. Every six days a sample is collected over a 24-hour period using a high volume air sampler. A measured volume of air is drawn through a filter to collect the suspended particulate (dust). The filters are sent to Environment Canada's National Air Pollution Sampling (NAPS) laboratory in Ottawa for analysis. Dust is measured as the weight of Total Suspended Particulate (TSP) collected on the filter divided by the volume of air drawn. Lead, arsenic and sulphate levels in the collected dust are also determined.

Forty-nine high-volume air samples were collected in downtown Yellowknife during 1996. The following table summarizes the results obtained over the year including the highest and lowest levels measured over 24-hour sample periods and the annual average (geometric mean) for each parameter.

1996 Yellowknife Air Quality Data

	TSP	Sulphate	Lead	Arsenic
highest (24-hr.)	428	4.5	0.06	0.195
lowest (24-hr.)	15	0.31	0.00	0.002
Annual Geometric Mean	55	1.1	0.01	0.008

Note: all units in micrograms per cubic metre of air (µg/m^3).

Each parameter is discussed in greater detail on the following pages.

Total Suspended Particulate

Total Suspended Particulate (TSP) is a general term for dust that includes a wide variety of solid and liquid particles that float in the air. In Yellowknife, the greatest source of TSP is dust from roads, especially in the spring. Forest fires, mining activities and combustion products from vehicles, heating and electricity generation also contribute to TSP levels.

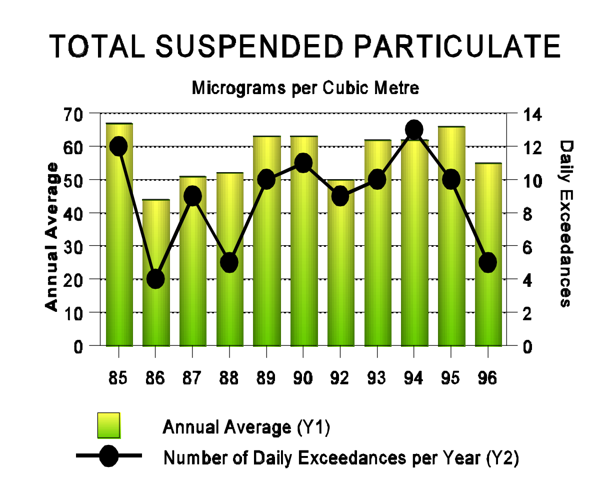

Figure 1

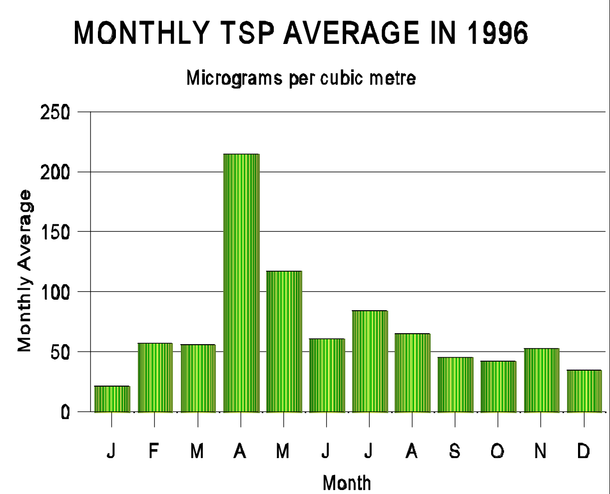

Figure 2

An air quality guideline under the Northwest Territories' *Environmental Protection Act* sets standards for TSP levels in ambient air. The NWT 24-hour (daily) TSP standard is 120 micrograms per cubic metre (µg/m^3) and the annual average (geometric mean) standard is 60 µg/m^3. These standards are set to provide general protection against effects to human and environmental health.

The bars in Figure 1 track the annual average TSP levels measured since 1985. In 1996, the annual average measured 55 µg/m^3, a level which is below the NWT annual standard and the lowest level recorded since 1992.

The line in Figure 1 shows the number of times during the year that the NWT 24-hour standard was exceeded. In 1996, 5 of 49 TSP samples exceeded the 24-hour standard. These exceedances all occurred in April and May. Figure 2 shows the average TSP level for every month.

Yellowknife dust conditions in 1996 were considerably better than in previous years. This improvement in air quality is considered to be largely due to efforts by the City of Yellowknife to clean grit and gravel from roads following the spring melt and throughout the summer as well as ongoing paving of graveled areas.

Dust (TSP) levels in Yellowknife cannot be entirely defined on the basis of measurements made at the single monitoring station. The dust levels reported here were measured at the downtown monitoring station but, based on complaints received and observations, dust affects large portions of the city.

Arsenic

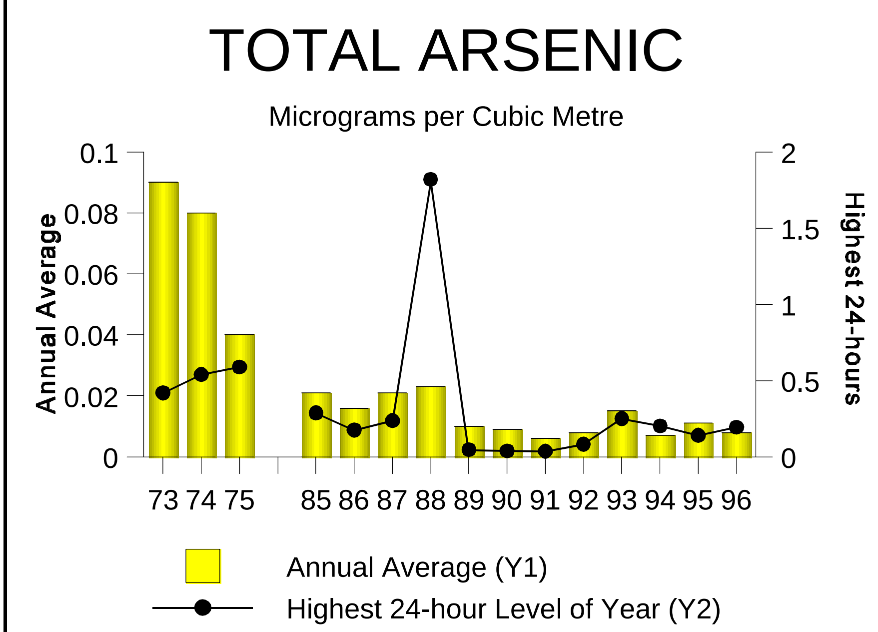

Figure 3

The bars in Figure 3 show that in 1996, the annual average (geometric mean) for total arsenic in Yellowknife air was 0.008 µg/m^3. The line in Figure 3 shows the highest total arsenic level measured over a 24-hour period. In 1996, the highest 24-hour level measured was 0.195 µg/m^3. The lowest 24-hour level was 0.002 µg/m^3.

There is no NWT air quality standard for arsenic. One form, arsenic trioxide, is now known to be a human carcinogen. Before carcinogenic properties of arsenic were recognized, Ontario had developed a standard of 0.3 µg/m^3 over 24-hours for total arsenic based on general toxicity. It is now known that the health risk for humans is greatest at higher levels but arsenic is a "non-threshold" carcinogen and even levels below 0.3 µg/m^3 present a small risk of causing cancer.

Since 1985, total arsenic levels in Yellowknife over a 24-hour period have only risen above the Ontario standard twice. Both of those exceedances were in 1988 and coincided with pollution control equipment malfunctions at the Royal Oak Giant Yellowknife Gold Mine, located about 5 kilometres north of Yellowknife.

In March of 1994 a survey was conducted in the Yellowknife area to determine total arsenic levels in snow. This survey confirmed results from previous surveys conducted in 1975 and 1986 that showed that the Giant Mine remains the most significant source of arsenic in the Yellowknife area.

Lead

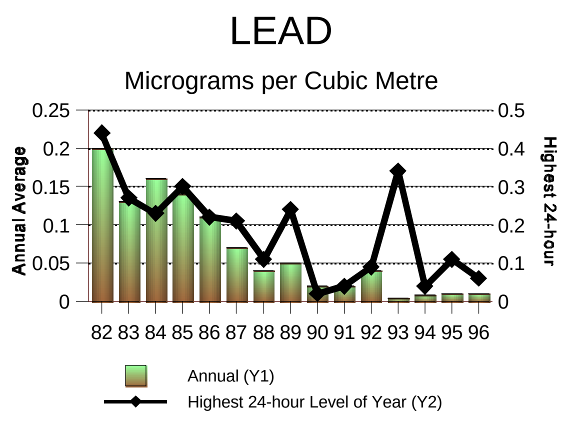

Figure 4

Lead was detected in 37 of the 49 samples taken in 1996. The highest 24-hour sample measured 0.06 µg/m^3, well below the Ontario standard of 5.0 µg/m^3. The annual average (geometric mean) lead level in 1996 was 0.01 µg/m^3.

Figure 4 shows the decrease in annual lead levels since 1982. Levels of lead in Yellowknife air have on average declined since leaded gasoline was phased out.

One potential source of lead in the air continues to be burning wood coated with lead-based paint. Such wood should not be burned.

Sulphate and Nitrate

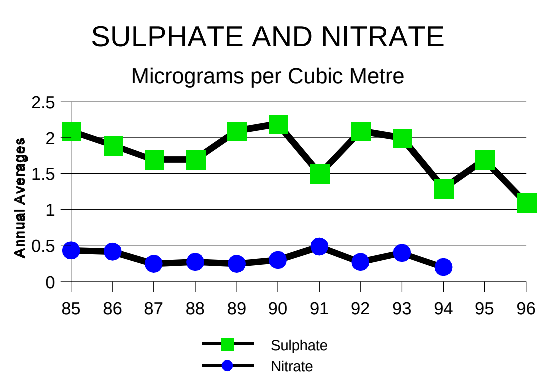

Figure 5

Figure 5 shows that there has been no change in nitrate levels in Yellowknife air while sulphate levels appear to be declining. Levels of these pollutants in Yellowknife are lower than in most Canadian cities. There are no standards for these pollutants in other Canadian jurisdictions.

Sulphate and nitrate particulates are considered to be “secondary pollutants.” Sulphur dioxide and oxides of nitrogen are emitted as gases from combustion sources such as furnaces or vehicle engines. Within about a day these gases react in tiny water droplets and form sulphate and nitrate particulates, which then contribute to smog and acid rain problems.

WHAT WERE THE SULPHUR DIOXIDE LEVELS IN 1996?

Continuous monitoring for sulphur dioxide (SO_2) is conducted in downtown Yellowknife. Previous studies have shown that the Giant Mine gold roaster north of Yellowknife is the largest single source in the area and that the highest levels of SO_2 in the Yellowknife area are measured downwind from the mine.

An air quality guideline under the Northwest Territories' *Environmental Protection Act* sets a standard for acceptable levels of SO_2 in ambient air. The hourly standard for SO_2 is 450 micrograms per cubic metre (µg/m^3), the 24-hour (daily) standard is 150 µg/m^3 and the annual standard is 30 µg/m^3.

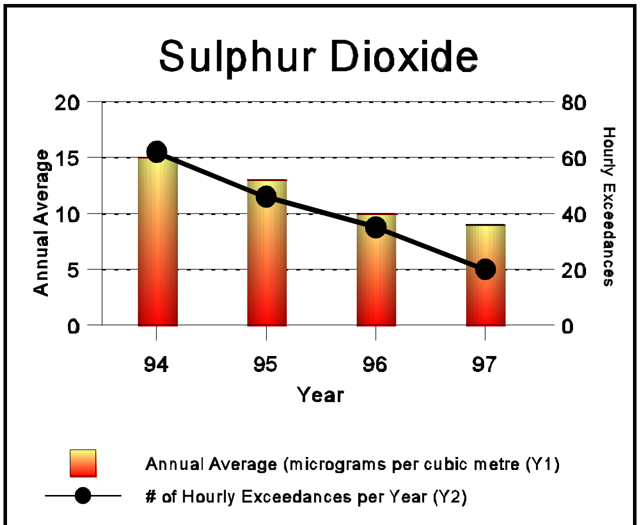

Figure 6

In 1996, Yellowknife SO_2 levels exceeded the NWT hourly standard on 35 occasions at the downtown monitoring site. For two of these occasions, the hourly level measured above 900 µg/m^3, the levels above which impacts on human health from exposure to SO_2 are considered to begin. The 24-hour standard was exceeded two times. The annual average was 10 µg/m^3, a level which is below the NWT standard.

Figure 6 shows the decrease in SO_2 levels measured in Yellowknife air between 1994 to 1997 (1997 data for SO_2 is available early because no laboratory analysis is required). The bars track the annual average which went from 15 µg/m^3 of SO_2 in 1994 to 9 µg/m^3 of SO_2 in 1997. The number of exceedances of the NWT hourly standard shown by the line in Figure 6 dropped from 62 in 1994 to 20 in 1997.

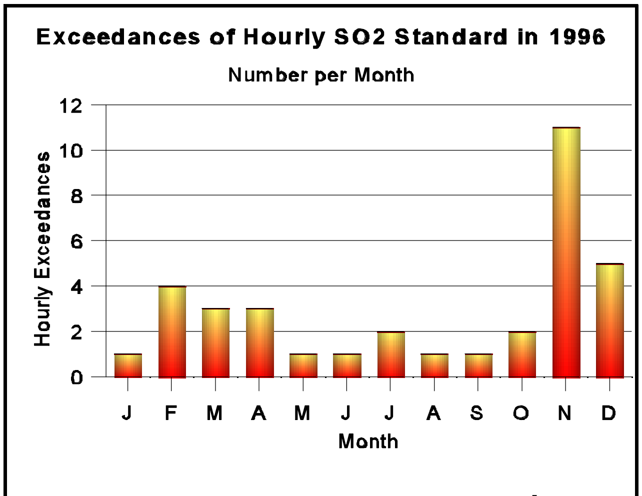

Figure 7

The decrease in measured SO_2 levels is likely due to a combination of factors such as the amount of SO_2 emitted from the Giant Mine and differences in the weather over the years. Further work is being undertaken to understand this change.

Figure 7 shows the seasonal variation in the number of times the NWT hourly standard was exceeded each month. There is more observable vegetation damage and higher SO_2 levels to the north of the mine than in downtown Yellowknife where measurements are made because during the summer growing season, winds from the south are more frequent.

ARE ACID RAIN LEVELS STILL LOW?

Precipitation monitoring to measure acid rain in the Yellowknife area started in 1989. The Department of Resources, Wildlife and Economic Development operates a Canadian Air and Precipitation Monitoring (CAPMoN) station at the Northwest Territories Power Corporation's Snare Rapids hydro site, 150 kilometres northwest of Yellowknife. Rain and snow samples are collected on a daily basis and sent to Environment Canada's CAPMoN laboratory in Toronto for analysis.

Acidity in precipitation is measured in pH units, with lower values indicating greater acidity. Sulphate and nitrate ions are naturally present at low levels in rain and snow while higher levels from industrial pollution are the primary cause of acid rain. Calcium and magnesium ions generally come from natural sources and act to neutralize acidity in precipitation.

Monitoring for pH and other compounds at the Snare Rapids hydro site in 1996 indicated negligible acid rain content. The average pH at Snare Rapids in 1996 was 5.08. This is consistent with pH levels detected in past years and is considered to be a typical background level associated with unpolluted areas. Annual sulphate deposition at Snare Rapids in 1996 was 1.36 kilograms per hectare per year (kg/ha/yr). Although, as shown in Figure 8 this is an increase over previous years, it is well below 7 kg/ha/yr, the level considered to protect sensitive ecosystems in the Northwest Territories. In the parts of eastern Canada where acid rain is a serious environmental problem, sulphate deposition is in excess of 20 kg/ha/yr. Nitrate deposition at Snare Rapids is similarly low compared to eastern Canada.

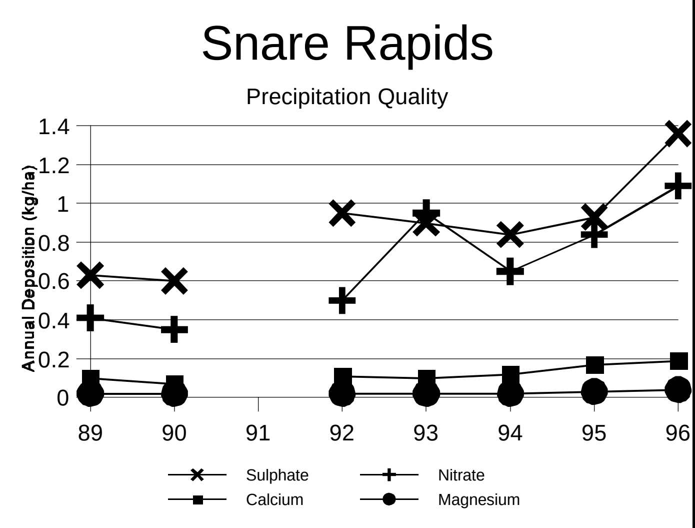

Figure 8

Figure 8 shows the deposition rates of some of the ions measured in Snare Rapids precipitation since 1989. While calcium and magnesium deposition rates have remained constant, there has been an increase in both sulphate and nitrate rates. The 1996 sulphate and nitrate deposition rates are well below levels that could cause an environmental effect in sensitive ecosystems. The deposition rates of these ions will continue to be monitored in future years.

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