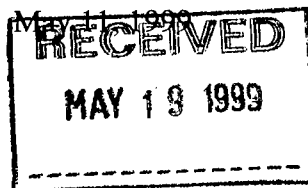
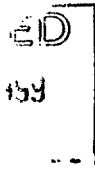




Northwest  
Territories

Resources, Wildlife and Economic Development

Environmental Protection Service  
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To Whom It May Concern:

**Yellowknife Area Air Quality Monitoring – 1997 Data**

Attached please find a copy of the 1997 data report on Yellowknife area air quality. Air quality data reports are prepared annually by the Department of Resources, Wildlife and Economic Development to provide public information on the results of the monitoring activities that we regularly carry out.

If you have any questions please contact me at (867) 873-7654.

Sincerely,

Jim Sparling  
Air Quality Programs Coordinator

Attachment



**Yellowknife Area Air Quality Monitoring  
1997 Data  
Executive Summary**

Air quality is monitored by the Department of Resources, Wildlife and Economic Development in the Yellowknife area. The 1997 Data Report provides information on levels and trends for dust, arsenic, lead, sulphate, sulphur dioxide and acid rain.

Highlights of the report include:

- improved dust conditions in Yellowknife
- lower arsenic levels
- sulphur dioxide monitoring in N'dilo

Dust conditions in Yellowknife are better than in the early 1990's. This improvement in air quality is considered to be largely due to the efforts by the City of Yellowknife to clean roads throughout the summer and the on-going paving of graveled areas.

There is no northern air quality standard for arsenic. Levels are based on the Ontario standard. Arsenic levels during 1997 remained well below the Ontario standard.

Lead levels are also measured against the Ontario standard. Lead was detected in 43 of the 55 dust samples taken in 1997. All were well below the Ontario standard. Potential sources for lead in the air include aviation gas, which continues to contain lead, and the burning of wood that has been coated with lead-based paint.

Sulphur dioxide levels for 1997 and 1998 are included in the report for downtown Yellowknife and for N'dilo, where a sulphur dioxide analyzer was installed in July of 1997. On several occasions levels in Yellowknife measured above the NWT standard. However, the annual average of the level of sulphur dioxide in the air was below the standard. Levels in N'dilo are within the same range as Yellowknife. Fluctuations in sulphur dioxide levels are likely due to differences in weather and wind directions.



## YELLOWKNIFE AREA AIR QUALITY MONITORING

### 1997 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 ( $\text{SO}_2$ ) has been monitored in Yellowknife since 1992 and a second sulphur dioxide analyzer was installed in N'dilo in 1997. In this report, 1998 data is included for dust and sulphur dioxide. Laboratory data for the other pollutants from 1998 samples was otherwise not available when this report was prepared.

#### 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.

Fifty five high-volume air samples were collected in downtown Yellowknife during 1997. 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.

**1997 Yellowknife Air Quality Data**

	TSP		Sulphate	Lead	Arsenic
	1997	1998			
highest (24-hr.)	539	897	3.3	0.03	0.063
lowest (24-hr.)	12	8	0.4	0.01	0.002
Annual Average	52	58	1.0	0.02	0.005

**Note:** all units in micrograms per cubic metre of air ( $\mu\text{g}/\text{m}^3$ ).

## 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.

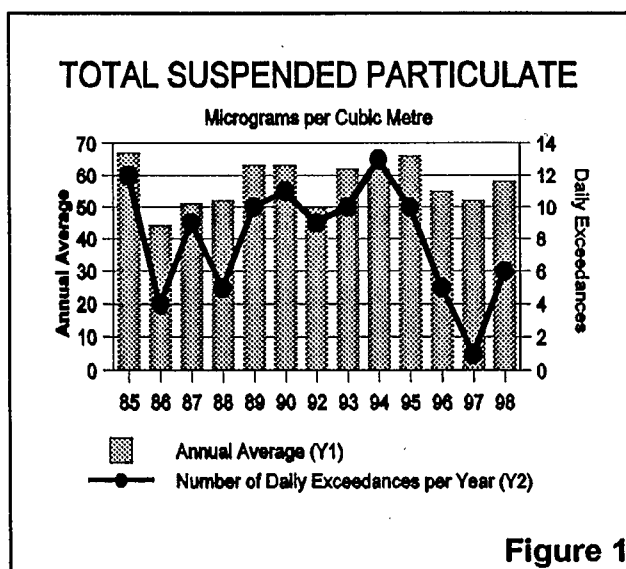


Figure 1

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 ( $\mu\text{g}/\text{m}^3$ ) and the standard for the annual average is 60  $\mu\text{g}/\text{m}^3$  (geometric mean). These standards are set to provide general protection against effects to human and environmental health.

The bars in Figure 1 track annual average TSP levels measured since 1985. In 1997, the annual average was 52  $\mu\text{g}/\text{m}^3$ , the lowest annual average since 1992 but in 1998 rose to 58  $\mu\text{g}/\text{m}^3$ . Levels in both years were below the NWT annual standard.

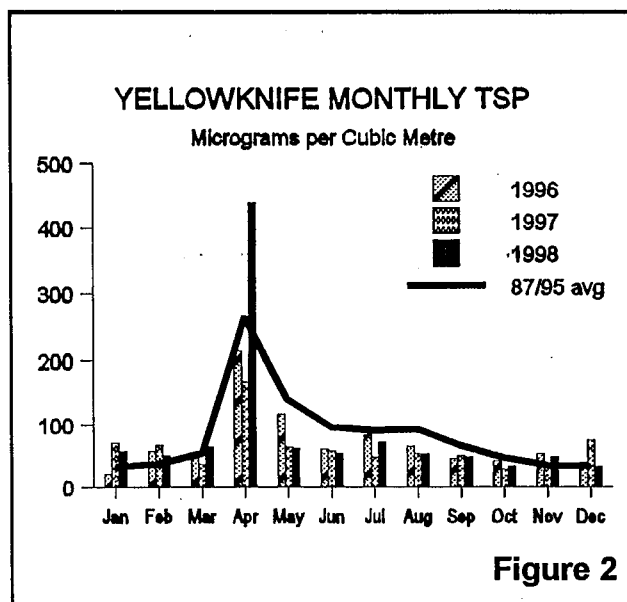


Figure 2

The line in Figure 1 shows the number of times during the year that the NWT 24-hour standard was exceeded. In 1997, only 1 of 55 TSP samples exceeded the 24-hour standard and in 1998, 6 of the 55 samples exceeded the 24-hour standard. Exceedances of the standard most often occur in April. Figure 2 shows the average TSP level for every month.

Yellowknife dust conditions are better than in the early 1990's. This improvement in air quality is considered to be largely due to efforts by the City of Yellowknife to clean roads 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 many parts of Yellowknife.

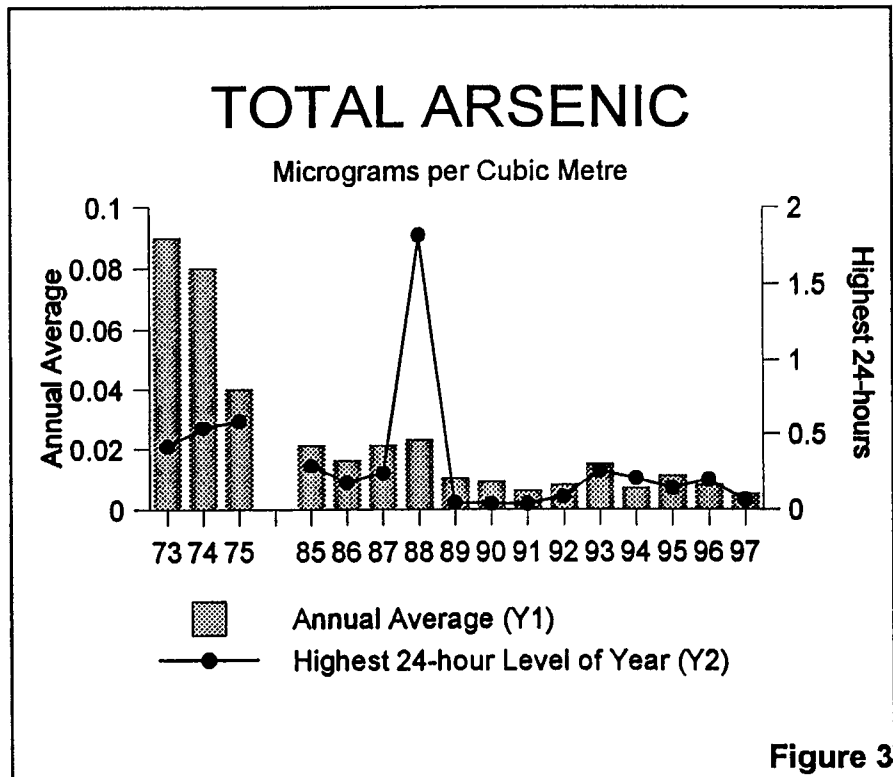
## Arsenic

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  $0.3 \mu\text{g}/\text{m}^3$  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  $0.3 \mu\text{g}/\text{m}^3$  present a risk of causing cancer.

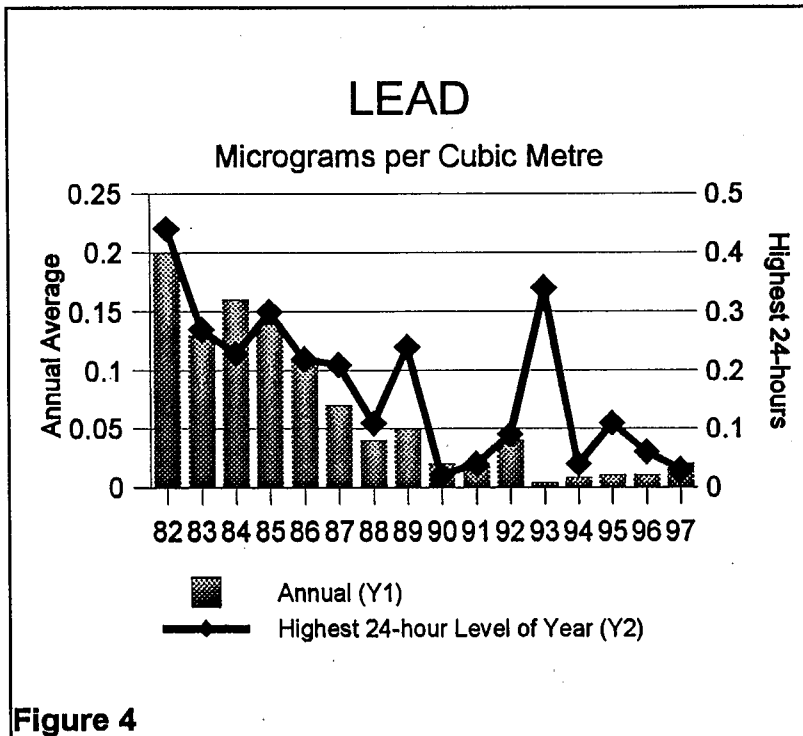
The bars in Figure 3 show that in 1997, the annual average (geometric mean) for total arsenic in Yellowknife air was  $0.005 \mu\text{g}/\text{m}^3$ . The line shows the highest total arsenic level measured over a 24-hour period. The highest 24-hour level measured in 1997 was  $0.063 \mu\text{g}/\text{m}^3$  and the lowest was  $0.002 \mu\text{g}/\text{m}^3$ .

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.



**Figure 3**

**Lead****Figure 4**

Lead was detected in 43 of the 55 samples taken in 1997. The highest 24-hour sample measured  $0.03 \mu\text{g}/\text{m}^3$ , well below the Ontario standard of  $5.0 \mu\text{g}/\text{m}^3$ . The annual average (geometric mean) lead level in 1997 was  $0.02 \mu\text{g}/\text{m}^3$ .

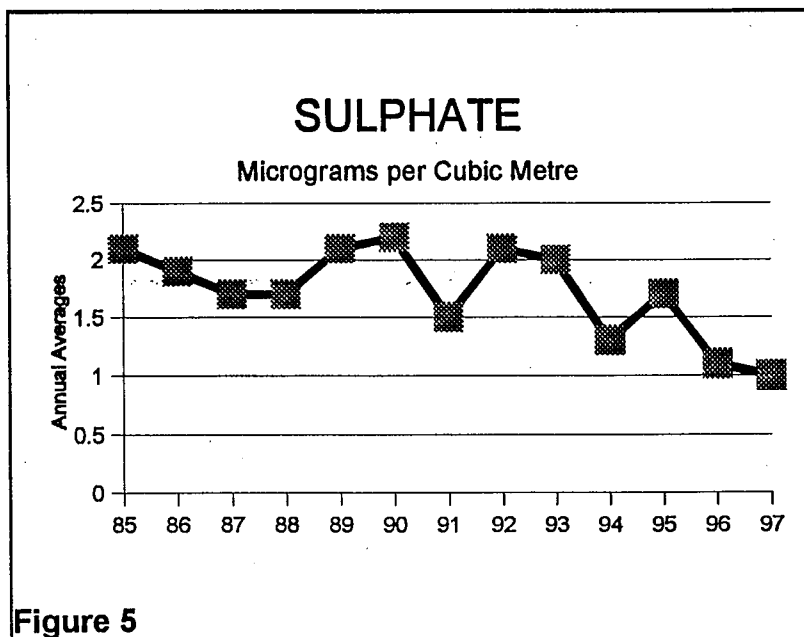
Figure 4 shows the annual lead levels since 1982. Levels of lead in Yellowknife air declined after leaded gasoline was phased out in 1986.

Aviation gas continues to contain lead. Another potential source of lead in the air is burning wood that has been coated with lead-based paint. Painted and treated wood should not be burned.

**Sulphate**

Figure 5 shows that sulphate levels in Yellowknife air appear to be declining. Levels of this pollutant in Yellowknife are lower than in most Canadian cities. There is no standard for sulphate in other Canadian jurisdictions.

Sulphate is considered to be a "secondary" pollutant. Sulphur dioxide is a gas from combustion sources such as furnaces or vehicle engines and gold roasting. Within about a day this gas reacts in tiny water droplets and forms sulphate particulates which contribute to smog and acid rain problems.

**Figure 5**

## WHAT WERE THE SULPHUR DIOXIDE LEVELS IN 1997 AND 1998?

Continuous monitoring for sulphur dioxide ( $\text{SO}_2$ ) is conducted in downtown Yellowknife and since 1997 at a site in N'dilo. 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  $\text{SO}_2$  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  $\text{SO}_2$  in ambient air. The hourly standard for  $\text{SO}_2$  is 450 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ), a level at which effects on vegetation begin to occur. The 24-hour (daily) standard is 150  $\mu\text{g}/\text{m}^3$  and the annual standard is 30  $\mu\text{g}/\text{m}^3$ . 1998 data for  $\text{SO}_2$  is provided in this report because no laboratory analysis is required.

In 1997, Yellowknife  $\text{SO}_2$  levels exceeded the NWT hourly standard on 21 occasions at the downtown monitoring site. For three of these occasions, the hourly level measured above 900  $\mu\text{g}/\text{m}^3$ , the levels above which impacts on human health from exposure to  $\text{SO}_2$  are considered to begin. There were no 24-hour standard exceedances in 1997. The annual average was 9  $\mu\text{g}/\text{m}^3$ , a level which is below the NWT standard.

In 1998, downtown Yellowknife  $\text{SO}_2$  levels exceeded the NWT hourly standard on 45 occasions and nine of these were above 900  $\mu\text{g}/\text{m}^3$ . There were two 24-hour standard exceedances in 1998. The annual average was 14  $\mu\text{g}/\text{m}^3$ , a level which is below the NWT standard.

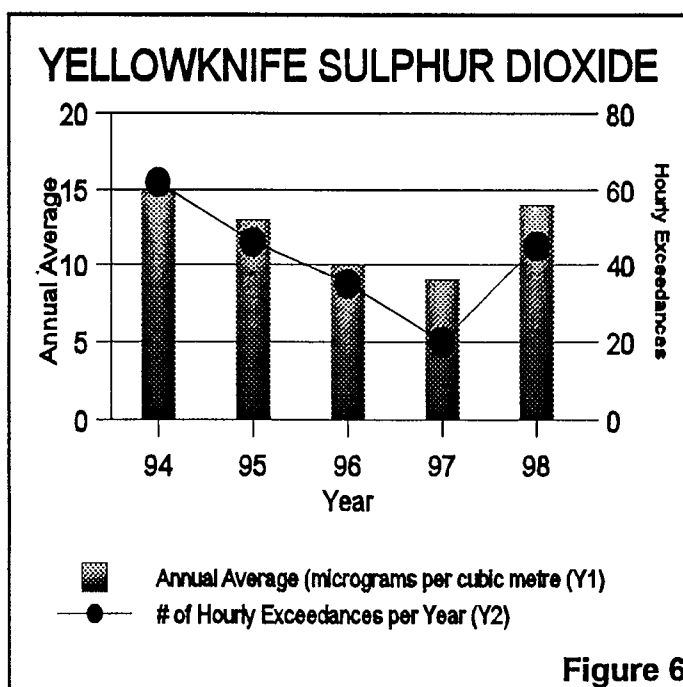


Figure 6

Figure 6 shows the general trends in  $\text{SO}_2$  levels measured in downtown Yellowknife air between 1994 to 1998. The bars track the annual average and the line shows the number of times in each year that the NWT hourly standard was exceeded.

Emissions of sulphur dioxide from the Giant Mine do vary somewhat but not enough to account for the changes in levels measured in downtown Yellowknife. The fluctuations in measured  $\text{SO}_2$  levels are likely due to differences in the weather and wind directions over the years.

During the summer growing season, frequent winds from the south carry

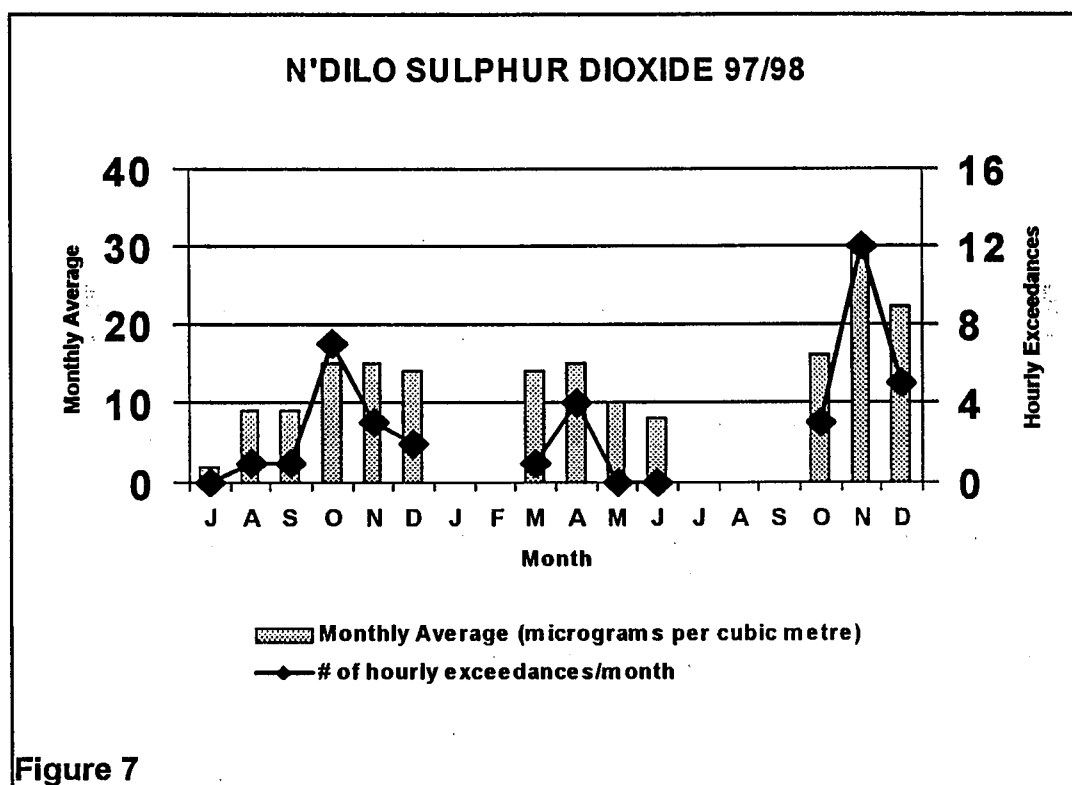
higher  $\text{SO}_2$  levels to the north of the mine. Vegetation damage caused by these pollution levels has been observed up to five kilometres north of the mine.

## N'dilo Sulphur Dioxide

In July 1997 a sulphur dioxide analyzer was installed in N'dilo which is about 2.5 kms northeast of the downtown Yellowknife monitoring site. Figure 7 illustrates the sulphur dioxide data collected in N'dilo in 1997 and 1998.

N'dilo SO<sub>2</sub> levels in 1997 (July to December), exceeded the NWT hourly standard on 14 occasions. Two of these exceedances were above 900 µg/m<sup>3</sup>. There were no 24-hour exceedances and the average over the period when data is available was 12 µg/m<sup>3</sup>, a level that is below the NWT annual standard.

Data was not collected for several months in 1998 due to analyzer maintenance. During the remaining seven months, SO<sub>2</sub> levels exceeded the NWT hourly standard on 25 occasions. Three of these exceedances measured above 900 µg/m<sup>3</sup>. The 24-hour standard was exceeded twice. The average over the period when data is available was 17 µg/m<sup>3</sup>, a level which is below the NWT annual standard.



Sulphur dioxide levels in N'dilo are within the same range as levels detected in downtown Yellowknife even though the N'dilo site is half the distance from the Giant Mine roaster stack. N'dilo is directly across Yellowknife Bay of Great Slave Lake from the roaster stack. This proximity to the lake seems to have an effect on how the sulphur dioxide travels, probably because of air currents over water. During open water months, levels of sulphur dioxide have been low even when the wind is blowing directly towards N'dilo.



## ARE ACID RAIN LEVELS STILL LOW? Note: 1997 data was not available when this report was prepared.

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.

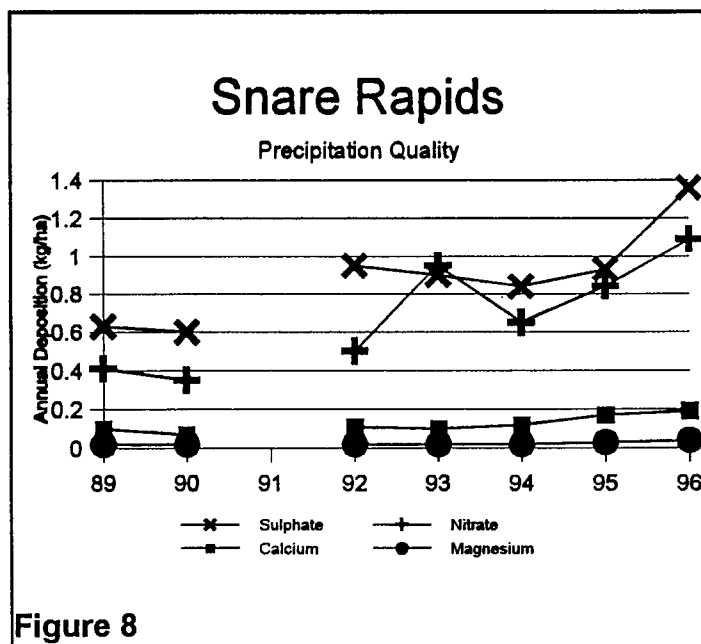


Figure 8 shows the deposition rates of some of the ions measured in Snare Rapids precipitation since 1989. While calcium and magnesium deposition rates have remained constant, there has been an increase in both sulphate and nitrate rates. The 1996 sulphate and nitrate deposition rates are well below 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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