



**Royal Oak
Mines Inc.**

Head Office
2000-1000-1000-1000
Vancouver, B.C.
V6C 3K7

TEL (604) 682-8330
FAX (604) 682-4286

February 16, 1994

Air Quality Specialist
Environmental Protection Division,
Northwest Territories Department of Renewable Resources,
600, 5102 - 50 Avenue,
Yellowknife, N.W.T.
X1A 3S8

Attn: Mr. Emery Paquin

(403) 873-7654

Dear Mr. Paquin:

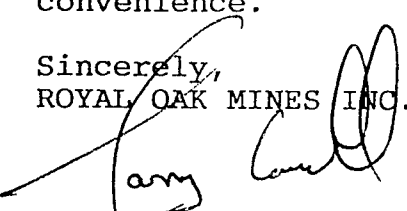
Re: Draft Guideline respecting Ambient Air Quality Criteria for Sulphur Dioxide and Total Suspended Particulate in the Northwest Territories Issued for Comment by The N.W.T. Department of Renewable Resources.

On January 05, 1994 the N.W.T. Department of Renewable Resources issued a Draft Guideline Respecting Ambient Air Quality Criteria for Sulphur Dioxide and Total Suspended Particulate in the Northwest Territories. The following submission is offered by Royal Oak Mines Inc. in response to the proposed guideline.

The primary focus of this presentation deals with the impact the proposed ambient air quality standard for sulphur dioxide would have on the Giant mine.

We appreciate the opportunity to participate in this process and welcome any questions regarding this presentation. If you have any further questions or wish any clarification on our comments please feel free to contact the undersigned at your convenience.

Sincerely,
ROYAL OAK MINES INC.



Larry Connell
Manager of Environmental & Metallurgical Services

Royal Oak Mines Inc. - N.W.T. Division

The Giant Mine

N.W.T Department of Renewable Resources
Proposed Guideline Respecting Air Quality
Criteria for Sulphur Dioxide
and Total Suspended Particulate in the
Northwest Territories

Stakeholder Comments

February 16, 1994

Comment on The Proposed Guideline Respecting Ambient Air Quality Criteria For Sulphur Dioxide and Total Suspended Particulate in the Northwest Territories

Summary

The Northwest Territories Department of Renewable Resources is planning to establish, under the N.W.T. Environmental Protection Act, an ambient air quality guideline for sulphur dioxide. The proposed criteria is 50% lower than the level recommended by the Federal Provincial Advisory Committee on Air Quality as being adequate to ensure ongoing protection of the environment. The proposed N.W.T. standard would be lower than most other jurisdictions in North America including California. Royal Oak views this issue very seriously as it will have a very significant impact on the future economic viability of the Giant mine.

Other provincial jurisdictions have established ambient air quality guidelines for sulphur dioxide at levels close to the Federal maximum acceptable level. In these provinces special exemptions have been granted to existing plants that emit sulphur dioxide. There is general recognition that imposition of tight new standards would render the gas treatment facilities at these facilities obsolete and that requiring replacement of the plants would have disastrous economic impact on the respective communities.

Continuous air monitoring carried out in Yellowknife by Environment Canada in 1973, 1974, 1975, 1990 and 1992 indicates that there are episodic periods of short duration representing less than 0.7% of the time when the proposed air quality standard is exceeded as a result of sulphur dioxide emissions from the Giant roaster stack. The process used to remove arsenic from the gas results in a cool gas exit temperature which results in a short radius dispersion pattern from the Giant stack. Most environmental impacts resulting from the Giant stack emission fall within a one kilometre radius of the stack. There is evidence of some impact up to 4 kilometres from the stack in a northerly direction. The land area impacted since the mine entered production is relatively small especially when compared to the area impacted by urban development of the City of Yellowknife.

The proposed guideline is targeted specifically at the Giant mine in Yellowknife and comes in response to an action filed under the Environmental Rights Act by a special interest group. This guideline sets the scene for the passage of future regulation or control orders directed at requiring Royal Oak to reduce sulphur dioxide emissions from the Giant mine. Such regulation will render the existing gas cleaning facilities obsolete. Replacement of the processing equipment would cost in excess of \$30 million which cannot be financed by the remaining ore reserve base at the Giant mine. Consequently this course of action could lead to the premature closure of the Giant mine.

Royal Oak takes the proposed guideline very seriously. We recommend that The N.W.T. adopt the existing two tier ambient air quality standard recommended by the Federal Provincial Advisory Committee on Air Quality Objectives. This would allow tighter regulation of new sources of sulphur dioxide while allowing some recognition of the difficulties faced by facilities already in production who cannot afford replacement of their equipment.

Comment on The Proposed Guideline Respecting Ambient Air Quality Criteria For Sulphur Dioxide and Total Suspended Particulate in the Northwest Territories

The Northwest Territories Department of Renewable Resources has circulated a proposed guideline establishing ambient air quality criteria for sulphur dioxide and total suspended particulate in the Northwest Territories requesting stakeholder comment. Royal Oak Mines Inc. as owner and operator of the Giant mine in Yellowknife has a primary interest in this subject and offers the following submission in response to the proposed guidelines.

1.0. Sulphur Dioxide Ambient Air Quality Criteria

1.1. Federal Ambient Air Quality Objective for Sulphur Dioxide

In 1978 the Canadian Federal Government published, under the Clean Air Act, national ambient air quality objectives for carbon monoxide, suspended particulate matter, sulphur dioxide, oxidants (ozone) and nitrogen dioxide. These air quality objectives were recommended by the Federal Provincial Advisory Committee on Air Quality (FPACAQ). In 1987 the FPACAQ reviewed the national ambient air quality objectives for sulphur dioxide and based on a review of the scientific literature recommended the following ambient air quality objective:

	Average Concentration [$\mu\text{g}/\text{M}^3$ (ppm)]* over a Continuous Period		
	<u>1 Hour</u>	<u>24 Hours</u>	<u>1 Year</u>
Maximum Desirable Level	450 (0.17)	150 (0.06)	30 (0.01)
Maximum Acceptable Level	900 (0.34)	300 (0.11)	60 (0.02)

Factor used to convert $\mu\text{g}/\text{M}^3$ (@25° C and 101 kPa) to ppm was
 $1 \mu\text{g}/\text{M}^3 = 3.82 \times 10^{-4}$ ppm SO_2 .

The following definitions were used by the FPACAQ in setting numerical values for the highest concentration levels in the desirable and acceptable ranges:

The Maximum Acceptable Level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being.

The Maximum Desirable Level is the long term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country, and for the continuing development of control technology.

The FPACAQ wrote in their report: "The maximum acceptable level will be of most concern to control agencies in their day-to-day operations. It is intended to provide adequate protection to receptors and guidance for long term planning. When this level is exceeded, control action is indicated. At levels below the maximum desirable level, the pollutant would have little or no effect."

1.2. Canadian Provincial Air Quality Objectives

Nine of the ten Canadian provinces have since established their own ambient air quality objectives for sulphur dioxide. These objectives are presented in Table 1.

Table 1: Provincial Ambient Air Quality Objectives for Sulphur Dioxide	Sulphur Dioxide ug/m3		
	Annual	24 Hour	1 Hour
Canada - Tolerable		800	
- Acceptable	60	300	900
- Desirable	30	150	450
British Columbia	49.2	255.6	884.9
Alberta	30	150	450
Saskatchewan	30	150	450
Manitoba	60	300	900
Ontario	55	275	690
Quebec	52.2	289.1	1315.2
New Brunswick	59.1	295.6	886.9
Nova Scotia	-	-	-
Prince Edward Island	60	300	900
Newfoundland	55	274.8	824.5
Yukon	-	-	-
N.W.T. (Proposed)	30	150	450
Alaska	79	360.2	1283 (3 Hr)
U.S.A.	80	365	1300 (3 Hr)

In six provinces, all east of Saskatchewan, the ambient air quality objective for sulphur dioxide has been established at or close to the Federal maximum acceptable level.

	Average Concentration [$\mu\text{g}/\text{M}^3$ (ppm)]*		
	over a Continuous Period		
	<u>1 Hour</u>	<u>24 Hours</u>	<u>1 Year</u>
Max Acceptable Level	900 (0.34)	300 (0.11)	60 (0.02)

In four provinces the level was set just below the federal guideline although the difference is negligible. Nova Scotia has not established any provincial standard and consequently uses the Federal objective.

British Columbia also established a provincial standard just below the federal maximum acceptable sulphur dioxide level however this was recently lowered to the federal maximum desirable level.

Alberta and Saskatchewan have established provincial ambient air quality standards equal to the federal maximum desirable level (1 Hr - $450 \mu\text{g}/\text{m}^3$) for sulphur dioxide.

Ambient air quality objectives for sulphur dioxide have been consistently set higher in provinces where both population and industry are more prevalent. This same pattern also holds for the United States where the ambient air quality objective for sulphur dioxide both federally and for the majority of the individual states is higher than the Canadian maximum acceptable level.

While the provinces have established their own ambient air quality objectives for sulphur dioxide, most of the major sources of sulphur dioxide emissions in Canada are being regulated under regulations or guidelines that establish industry specific standards that are higher than the provincial objectives listed in Table 1. This is primarily due to two factors:

- The ability to achieve the provincial ambient air quality criteria for sulphur dioxide is limited by the availability and efficiency of state of the art technology to reduce sulphur dioxide emissions.
- The cost of installing and implementing sulphur dioxide emission control technology at plants that were constructed prior to the introduction of the current federal and provincial standards for ambient air quality is high. Implementation of a new standard may render the emission control equipment at any industrial facility obsolete necessitating total replacement or major upgrading. Existing mine operations with finite ore reserves would be incapable of financially supporting major equipment replacement projects, estimated to be in excess of \$30 million over their life.

In most of these situations the province will employ the provincial standard for ambient air quality for sulphur dioxide to establish operating licenses for any new source of sulphur dioxide emissions prior to the facility being constructed. However, in these same provinces, exemptions are often granted to specific industrial sites that were in operation prior to the new standard being promulgated. There is general acknowledgement that imposing the new standards on these plants without an extended period of adjustment would have significant negative impact on the future viability of the operation.

In Ontario the Ministry of Environment & Energy (MOEE) established the following ambient air quality standard for sulphur dioxide:

	Sulphur Dioxide	
	<u>ug/m³</u>	<u>PPM</u>
1/2 Hour Avg	838	0.32
1 Hour Avg	690	0.25

In Sudbury a special exemption was issued to both the Falconbridge and INCO smelters as they could not meet the provincial standard, despite the fact that both smelters have recently undergone multi-million dollar upgrades to improve both cost effectiveness and environmental performance. The MOEE negotiated a control order with Falconbridge establishing the following air quality standard to be met at a continuous monitor located in the nearest populated area:

	Sulphur Dioxide	
	<u>ug/m³</u>	<u>PPM</u>
1 Hour Rolling Avg	1,309	0.50

This exemption was scientifically justified on the basis of maintaining sulphur dioxide levels below those expected to result in damage to the specific types of vegetation surrounding the smelter site. The Falconbridge smelter operations are reduced whenever the ambient air quality standard of a 1 hour rolling average of 0.50 ppm sulphur dioxide is reached at the continuous monitor in the adjacent townsite. The INCO operation in Sudbury has a similar exemption to that of Falconbridge.

Manitoba has established the following ambient air quality objective for sulphur dioxide:

	Sulphur Dioxide	
	<u>ug/m³</u>	<u>PPM</u>
1 Hour Avg	900	0.34
24 Hour Avg	300	0.11
Annual	60	0.02

Sulphur dioxide emissions at both the Hudson Bay Mining & Smelting operations in Flin Flon and the INCO smelting operations in Thompson are regulated under a special Provincial Act. This act establishes an emission level and provides a schedule for staged reduction of these emissions. At the Hudson Bay Mining & Smelting operations the act provides for a 25% reduction in emissions in 1994 as indicated by the following:

	Sulphur Dioxide	
	Emission Levels	
	Tonnes x 1000	
	<u>Daily</u>	<u>Annually</u>
1993	30 KT	293 KT
1994	23 KT	220 KT

To place things in perspective the emission of sulphur dioxide from the Giant Mine roaster is as follows:

0.040 KT 13 KT

The Hudson Bay Mining & Smelting operations are not able to consistently meet the provincial ambient air quality guideline for sulphur dioxide. The company is currently upgrading the facility to both reduce operating costs and achieve the new environmental standards.

1.3. Air Quality Monitoring in Yellowknife

Environment Canada monitored sulphur dioxide levels in Yellowknife on a continuous basis during the period of 1973 through 1975. During the study period, sulphur dioxide concentrations in ambient air around Yellowknife did not exceed the annual arithmetic mean Maximum Desirable national air quality objective of 0.01 ppm (30 ug/m³). One hour ambient air quality concentrations occasionally exceeded the one hour Maximum Desirable objective of 0.17 ppm (450 ug/m³) but rarely exceeded the one hour Maximum Acceptable objective of 0.34 ppm (900 ug/m³).

<u>Year</u>	<u>Percent of Time Ambient Air Quality Exceeded the Maximum Desirable Level of 450 ug/m³ sulphur dioxide in Yellowknife</u>
1973	0.12%
1974	0.25%
1975	0.48%

In October of 1990, Environment Canada reported the following frequency distribution for hourly average sulphur dioxide concentrations in Yellowknife:

<u>Concentration of SO2 (ppm)</u>	<u>Number of Hours</u>	<u>Percent</u>	<u>Cumulative Percentage</u>	<u>Concentration SO2 (ug/m3)</u>
0	479	97.96	97.96	0
0.01 - 0.02	6	1.23	99.19	30 - 60
0.03 - 0.06	2	0.41	99.60	60 - 150
0.07 - 0.17	2	0.41	100.01	150 - 450
0.18 - 0.34	0	0	100.01	450 - 900
0.35 +	0	0	100.01	900 +

Environment Canada again monitored sulphur dioxide levels in Yellowknife during the period of August through November of 1992. The 24 hour Maximum Desirable national air quality objective of 0.06 ppm (150 ug/m³) was exceeded once. The one hour Maximum Desirable objective of 0.17 ppm (450 ug/m³) was exceeded 0.68% of the time.

The following conclusions can be drawn from the continuous air quality monitoring data collected by Environment Canada in the City of Yellowknife:

- A) Ambient air concentrations of sulphur dioxide when averaged over a one year period were below the 0.01 ppm (30 ug/m³) standard proposed by the N.W.T. Department of Renewable Resources during the study period.
- B) Ambient air concentrations of sulphur dioxide when averaged over 24 hour periods exceeded the 0.06 ppm (150 ug/m³) standard proposed by the N.W.T. Department of Renewable Resources 0.06% of the time during the 1992 study period. The federal maximum acceptable standard for a 24 hour period of 0.11 ppm (300 ug/m³) was not exceeded during the 1992 study period in Yellowknife.

- C) Ambient air concentrations of sulphur dioxide when averaged over 1 hour periods exceeded the 0.17 ppm (450 ug/m³) standard proposed by the N.W.T. Department of Renewable Resources 0.68% of the time during the 1992 study period. The federal maximum acceptable standard for a 1 hour period of 0.34 ppm (900 ug/m³) was exceeded 0.17% of the time during the 1992 study period in Yellowknife.

In the previous Environment Canada study the 1 hour standard of 0.17 ppm (450 ug/m³) proposed by the N.W.T. Department of Renewable Resources was exceeded as follows:

<u>1973</u>	<u>1974</u>	<u>1975</u>
0.12%	0.25%	0.48%

During the 1992 study the 1 hour federal acceptable standard of 0.34 ppm (900 ug/m³) was exceeded on four occasions. On one of these occasions (September 26th) the highest 1 hour level recorded during the study period was observed (1,516 ug/m³) during a period when the wind was blowing from the south. Consequently this level cannot be attributed to the Giant roaster stack.

The periods during which the proposed ambient air quality standard for sulphur dioxide has been exceeded in Yellowknife are both infrequent and short in duration. Generally they correspond with periods when strong winds out of the north blow the gas exiting the Giant roaster stack directly into town.

The lead candle and diffusion plate data reported by the N.W.T. Department of Renewable Resources indicates that sulphur dioxide released from the Giant roaster stack impacts an area in close proximity to the stack (generally within a 1,000 to 2,000 meter radius) and consequently does not have a large impact on populated areas. This short radius of impact is a result of the cool temperature of the gases exiting the stack. The low temperature of the gas results in low exit velocities and consequently leads to a short radius dispersion pattern. The gas cleaning process employed to remove arsenic from the roaster off gas results in the cool temperature of the gas as it exits the stack.

1.4. Air Quality in Other Canadian Centres

Sulphur dioxide levels in ambient air in Canada are monitored by Environment Canada through the National Air Pollution Surveillance (NAPS) Network. A typical selected set of results for January 1990 is presented as Table 2.

The data is presented to put the Yellowknife experience in perspective. In many of Canada's smaller communities where the resource sector plays a key role, ambient air levels of sulphur dioxide periodically exceed the 1 hour proposed standard of 0.17 ppm (450 ug/m³). As in Yellowknife these periods are generally less than 1% of the time. The same pattern is also true for the 24 hour proposed standard of 0.06 ppm (150 ug/m³).

Table 2: Sulphur Dioxide Levels in Ambient Air in Selected Canadian Centres

Source: Environment Canada - NAPS Network - January 1990

January 1990	Location of Sampler	# of Hourly Samples	Monthly Mean PPM SO ₂	Frequency Distribution of 1 Hour Samples (PPM SO ₂)				Frequency Distribution of 24 Hour Samples (PPM SO ₂)			
				70%	95%	99%	Max	70%	95%	99%	Max
Quebec											
Montreal	Pointe aux Trembles	743	0.023	0.03	0.06	0.10	0.15	0.03	0.04	0.05	0.05
Quebec City	Rue des Sables	686	0.049	0.01	0.28	0.73	0.95	0.08	0.16	0.30	0.31
Arvida	Powell & Hoopes	707	0.033	0.03	0.14	0.17	0.24	0.05	0.09	0.09	0.11
Shawinigan	Frigon & Laval	711	0.024	0.02	0.11	0.23	0.30	0.03	0.07	0.08	0.09
Bale Comeau	39 Ave Mance	500	0.015	0.00	0.09	0.22	0.26	0.02	0.06	0.08	0.09
Rouyn	Hotel de Ville	684	0.003	0.00	0.01	0.10	0.20	0.00	0.02	0.05	0.05
Ontario											
Sudbury	Ash Street	744	0.012	0.01	0.05	0.09	0.32	0.02	0.03	0.04	0.04
Sudbury	Kennedy Street	744	0.016	0.01	0.07	0.20	0.86	0.02	0.05	0.09	0.09
Sudbury	Science Centre North	744	0.007	0.01	0.03	0.08	0.44	0.01	0.02	0.04	0.04
Cornwall	Bedford & Third	741	0.008	0.01	0.04	0.07	0.26	0.01	0.02	0.03	0.03
Sarnia	Front St @ CN Tracks	713	0.023	0.02	0.10	0.16	0.22	0.02	0.07	0.11	0.11
Toronto	Lawrence & Kennedy	744	0.008	0.01	0.02	0.03	0.03	0.01	0.02	0.02	0.02

Environmental standards across Canada are being revised at an ever increasing rate often outpacing the ability of technology to achieve compliance with the new standards. The standards are often imposed with no assessment of the socioeconomic consequences or benefits. The implementation of new standards can often render the environmental control facilities at an existing resource processing facility obsolete. The problem is not unique to Yellowknife. A mechanism must be in place to weigh the environmental benefits against the cost of compliance with the new standard, particularly when dealing with existing facilities. Imposing new sulphur dioxide emission control standards that effectively render the gas cleaning equipment obsolete at the Giant mine could also leave the operation economically unviable given the status of the mine's remaining reserve base and the high cost (estimated in excess of \$30 million) of modifying the ore processing facility. These factors should be weighed against the value of the environmental benefits that may be recognized.

1.5. Impact of Giant Roaster Emissions on Local Vegetation

Scientific data collected in 1990 and 1991 indicate that vegetation to the north of the Giant roaster stack to a distance of approximately 4 kilometres is affected to some degree by sulphur dioxide emissions. In 1990 drought conditions combined with the sulphur dioxide acted to prematurely yellow leaves in the area of impact. In 1991 when drought was not as great a contributor the problem was less pronounced and the area of influence was observed to be closer to the stack. The silver birch trees are more sensitive to the sulphur dioxide than other species.

The area of vegetation impacted by the sulphur dioxide emissions from the Giant roaster since the mine came into operation in 1948 is relatively small when compared to the area impacted by the urban growth of the City of Yellowknife.

1.6. The Giant Mine

Royal Oak Mines Inc. owns and operates the Giant mine, which is located 4 km to the north of the City of Yellowknife. The Giant mine first went into production in May of 1948.

The Giant ore body is a refractory gold deposit where the contained gold is locked within the matrix of an arsenic sulphide mineral called arsenopyrite. Direct leaching of this ore yields very low gold recoveries (approximately 25%). It was recognized from the mine's inception that the arsenopyrite mineral matrix would have to be broken down and the contained sulphur and arsenic removed to enable the contained gold to be extracted. An Edwards Hearth type roaster was constructed at Giant in the late 1940's to accomplish this task. This initial roaster was upgraded several times and eventually replaced by a Dorr Oliver style two stage fluid bed roaster.

The gold bearing minerals, namely arsenopyrite and pyrite are recovered by a process called flotation. The process selectively recovers the sulphide gold bearing minerals (arsenopyrite and pyrite) in a concentrate, where 90 to 95% of the gold contained in the ore is recovered in a concentrate which represents only 15% of the weight of ore processed. The remaining 85% of the weight containing 5 to 10% of the gold is rejected as a waste product called tailings.

The sulphide concentrate is roasted at an elevated temperature (935° F) in a two stage fluid bed roaster. The arsenic contained in the concentrate is removed in the first stage as arsenic trioxide which exits in the form of a gas at the elevated temperatures at which the roaster operates. The fuel required to achieve the elevated temperature is provided by oxidizing the sulphur contained in the concentrate. The sulphur is burned off exiting the roaster vessel as a sulphur dioxide gas (SO₂). The first stage roaster is operated under mild reducing conditions (an oxygen deficiency) to ensure that the arsenic is not over oxidized to arsenic pentoxide. In the second stage of the roaster the remaining sulphur is oxidized to gaseous sulphur dioxide.

The roaster calcine, which is the roasted concentrate after removal of the arsenic and sulphur, consists of a matrix of iron oxides (principally magnetite and hematite) and gold. The calcine is water quenched, reground and processed through the cyanide leach circuit for gold recovery.

The gas streams from both the first and second stage roasters are passed through a series of cyclones designed to remove coarse calcine dust entrained in the gas stream. The hot gas is then passed through an electrostatic precipitator where an electrical charge is imparted to the very fine particles of calcine dust entrained in the gas stream. The charged particles of dust are recovered on electrodes with the opposite charge. The dust recovered in the electrostatic precipitator is processed for extraction of the contained gold.

The gas stream exiting the electrostatic precipitator is cooled from 850 to 200° F by mixing the hot gas with large volumes of ambient air in a contained mixing chamber. At the cooler temperatures the arsenic trioxide condenses from the gaseous phase into a solid (powder form). The cooled gas stream is passed through a series of baghouses where the arsenic trioxide is filtered from the gas stream. The effectiveness of the baghouse in recovering the arsenic trioxide from the gas stream is greater than 99%. The arsenic trioxide is pneumatically transferred from the baghouse to a rock storage vault located underground in the permafrost. The filtered gas exiting the baghouse is drawn through a fan and discharged to the atmosphere through a 45 meter high stack.

As indicated previously the gas cleaning process used to recover arsenic trioxide from the roaster off gas stream results in a relatively cool gas temperature at the exit of the baghouse. Consequently the gas exits the stack at relatively low velocities resulting in a short radius dispersion pattern. Heating the gas would improve dispersion characteristics, spreading the sulphur dioxide over a larger radius but would not reduce the total loading of sulphur dioxide released to the environment.

The amount of sulphur dioxide released from the Giant roaster stack historically averaged 30 to 35 short tons per day (10 to 12 KT per year). In 1992 sulphur dioxide emissions averaged 41.4 short tons per day (13 KT per year) reflecting an increase in mine production rates. The higher rate of sulphur dioxide emissions reported by the N.W.T. Department of Renewable Resources (50 to 65 metric tonnes per day) is incorrect and results from the inclusion of an incorrect stack sampling test result reported by Western Research. This test was conducted in August of 1991 under contract to Renewable Resources and reported a gas flow almost double that of the plant's maximum capacity. The result was not verified in a second test conducted in October of 1991.

The Giant roaster off gas cleaning facilities were designed in the 1950's to comply with emission standards of the day. The facility was upgraded in the 1970's to meet new standards for arsenic trioxide emissions. The imposition of new standards requiring that sulphur dioxide emissions be reduced would most probably render the facility obsolete. The addition of gas scrubbing equipment or an acid plant are neither economically nor technically feasible due to the gas cleaning process already in place to recover arsenic trioxide from the roaster off gas.

Large volumes of ambient air used to cool the hot gas exiting the electrostatic precipitator enables arsenic trioxide to be recovered from the gas stream. This process results in a very dilute concentration of sulphur dioxide in the gas leaving the stack. The low concentration technically precludes the production of sulphuric acid. Even if sulphuric acid could be produced, the problem of transporting or disposing the acid becomes insurmountable given the remote location of Yellowknife. Scrubbing the gas to remove sulphur dioxide would require massive volumes of limestone which is not available north of Great Slave Lake and would present a new environmental problem in the disposal of the large volumes of sulphate precipitates that would be formed.

At this late date in the mine life, it is doubtful whether the remaining ore reserve would be large enough to finance the installation of a replacement technology such as pressure oxidation (cost estimated to be in excess of \$30 million). Consequently imposition of any regulation that would require sulphur dioxide emission control equipment be installed at the Giant mine would have a major impact on the continued viability of the mine.

1.7. The Proposed Ambient Air Quality Standard for Sulphur Dioxide

An investigation of arsenic and sulphur dioxide emissions from the roaster stack at the Giant mine was undertaken by the N.W.T. Department of Renewable Resources after a request for such an investigation was filed with the Government of the Northwest Territories under the N.W.T. Environmental Rights Act on April 22, 1991. The complaint under the Environmental Rights Act was filed by two Yellowknife residents both of whom are well known local environmental activists who routinely oppose the presence of the Giant mine in Yellowknife.

This pressure has prompted the Department of Renewable Resources to introduce the proposed guideline for ambient air quality levels for sulphur dioxide in the Northwest Territories. The guideline establishes the framework for subsequent regulations targeted at controlling emissions from the roaster stack at the Giant mine. Consequently the issue is taken very seriously.

In specific terms, our concerns with the proposed ambient air quality guideline for sulphur dioxide can be summarized as follows:

- Promulgation of this guideline would establish an air quality standard in the Northwest Territories for sulphur dioxide that is more stringent than most other jurisdictions in Canada and the US (including California and Alaska). Vermont would be the only jurisdiction with a more stringent standard for sulphur dioxide. The ability to attract industrial development to the north would be impaired by this action.
- The air quality limit being proposed for sulphur dioxide is 50% of the Maximum Acceptable national air quality objective established by the Federal Provincial Advisory Committee on Air Quality. The FPACAQ defined the "Maximum Acceptable Air Quality Objective" as being intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being. The FPACAQ reported that the Maximum Acceptable Air Quality Objective should be of most concern to control agencies in their day to day operation as it was intended to provide adequate protection to receptors and guidance for long term planning.
- The proposed guidelines leave no provision for exempting an existing emission source where circumstances warrant it or while alternate control mechanisms are employed.
- The proposed guidelines do not specify the mechanism to be used to monitor ambient air quality but leaves this to the discretion of the Chief Environmental Protection Officer who is free to change the method employed as he sees fit. This power is too broad. The mechanism to be used for measuring ambient air quality should be specified within the guideline. Companies should be protected from constantly having to change measurement equipment and techniques and the related cost. Industry should not have to bear the cost of conducting research or undertaking studies on air quality measuring methods as the Chief Environmental Protection Officer sees fit to impose. The guideline as written would allow this to occur.

1.8. Recommendations

- 1) The N.W.T. should adopt the air quality objective for sulphur dioxide as proposed by the Federal Provincial Advisory Committee on Air Quality. This would entail establishing the following two tier ambient air quality objective:

Average Concentration (ug/m3 (ppm) Over a Continuous Period			
	<u>Annual Avg</u>	<u>24 Hour Avg</u>	<u>1 Hour Avg</u>
Maximum Desirable Level:	30 (0.01)	150 (0.06)	450 (0.17)
Maximum Acceptable Level:	60 (0.02)	300 (0.11)	900 (0.34)

- The maximum desirable level would be used to establish regulations to license and control all new sources of sulphur dioxide emissions within the Northwest Territories.
- The maximum acceptable level would be used to license and control the existing industrial sources of sulphur dioxide emissions within the Northwest Territories.

Special consideration should be given to industrial sites that were in operation before the current guideline was conceived. These industrial sites should not be forced out of business by the imposition of new regulations and standards that render their existing facilities obsolete. The magnitude of the environmental impact from these sites has to be weighed against the benefits provided to the residents of the N.W.T. A two tiered regulation would enable this flexibility while maintaining reasonable protection of the environment.

- 2) The guideline or subsequent regulation should include provision for the Minister of Renewable Resources to issue a special exemption, where appropriate, to any industrial source of sulphur dioxide emission that was in operation prior to promulgation of the new standard. This exemption would include flexibility to negotiate special conditions appropriate to the specific circumstance.
- 3) Monitoring techniques should be established in the guideline and not left to the whim of the Chief Environmental Protection Officer.

2.0. Total Suspended Particulate Ambient Air Quality Criteria

Royal Oak does not have a significant direct stakeholder interest in the proposed establishment of an ambient air quality criteria for Total Suspended Particulate in the Northwest Territories.

On many occasions natural forces such as forest fires and wind borne dust will act to contaminate the air beyond the proposed ambient air quality criteria for total suspended particulate. This will make it difficult to establish regulations that can be consistently enforced to control the level of total suspended particulate within the Northwest Territories.

Why is there need to establish a specific guideline for total suspended particulate in the Northwest Territories given that there already exists a very similar federal guideline? Why not adopt the existing federal guideline?

The background document prepared by the N.W.T. Department of Renewable Resources talks about the combined effects of SO₂ and TSP with reference to coal smoke in the United Kingdom in the 1950's. The document does not elaborate whether this is perceived to be a problem associated with SO₂ emissions from the Giant roaster stack.

Are the proposed guidelines for ambient levels of TSP directed at controlling sulphur dioxide levels from the Giant roaster stack? The largest contributor of TSP contamination within the N.W.T. will result from burning operations associated with the burning of timber slash, from "ice fogs" prevalent in cold winter temperatures in urban centres across the Territory and from wind borne dust common around urban areas during dry summer periods.