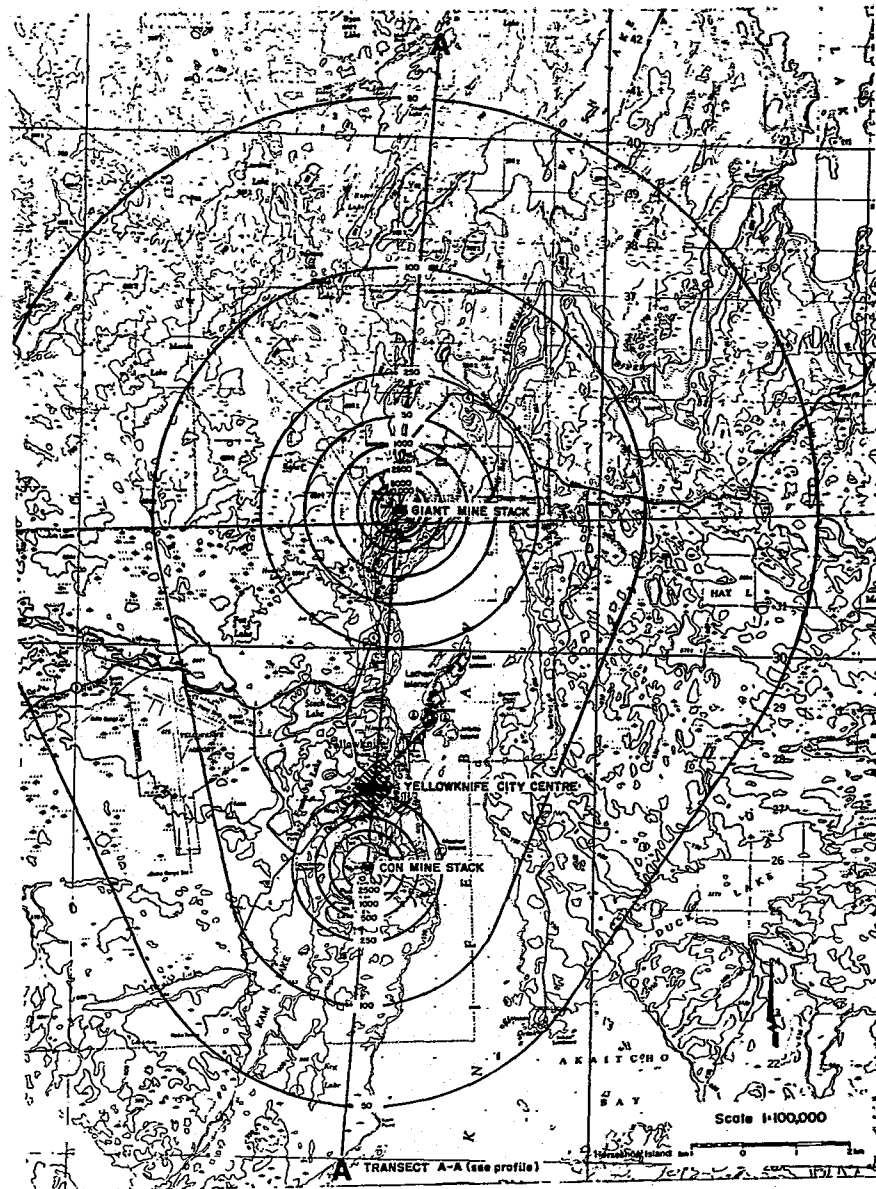


Figure 5.



Source: (13)

and lichen from Cominco Mines was 1/3 that due to the Giant Mine, rather than the 1/6 expected by comparing airborne emissions. It was concluded that mobilization of arsenic from the arsenic ponds at Con Mine was probable. The arsenic concentrations identified in that study are shown in Figure 4 and, by use of isocons, in Figure 5. During the same study, samples were also analysed for chromium, manganese, tellurium, vanadium, beryllium, tin, copper, zinc, nickel, aluminium, iron, potassium, sodium, calcium, magnesium, phosphorus, strontium, titanium, gold, silver, and silicon. However, these elements were found to be present at levels not significantly higher than the normal values to be expected. Levels of uranium, boron, and molybdenum were below the level at which they could be detected (13).

#### (c) Snow

We pointed out earlier that arsenic deposition rates in the Yellowknife area have been determined to be approximately 10 pounds per square mile per month. This figure has been confirmed by surveys of snow quality in and around Yellowknife (17). Since snow remains on the ground throughout the entire winter season, arsenic levels would be expected to build up as a result of continuing deposition. Since the greatest significance of snow, in terms of human exposure, would be as a source of drinking water, arsenic levels can be compared to the maximum permissible level of 0.05 milligrams per litre or ppm specified in the Canadian Drinking Water Standard for arsenic.

A snow survey conducted in 1975 (17) found that 96% of all scoop snow samples exceeded the Canadian standard. In the case of core samples of snow, 85% of the samples exceeded the maximum standard. Average concentrations for each varied between 0.17 and 0.52 milligrams per litre. In addition, snow melt usually contains undissolved particles which have been shown to contain very high concentrations of arsenic which would increase the risk.

Exceedingly high levels of arsenic would be expected to build up in the snow in the vicinity of the Giant Smelter, since deposition rates as high as 564 pounds per square mile per month have been measured inside the Giant property (Figure 6). This situation has been confirmed by measurements recorded during several different surveys (8) ranging as high as 8.6 - 11.4 ppm.

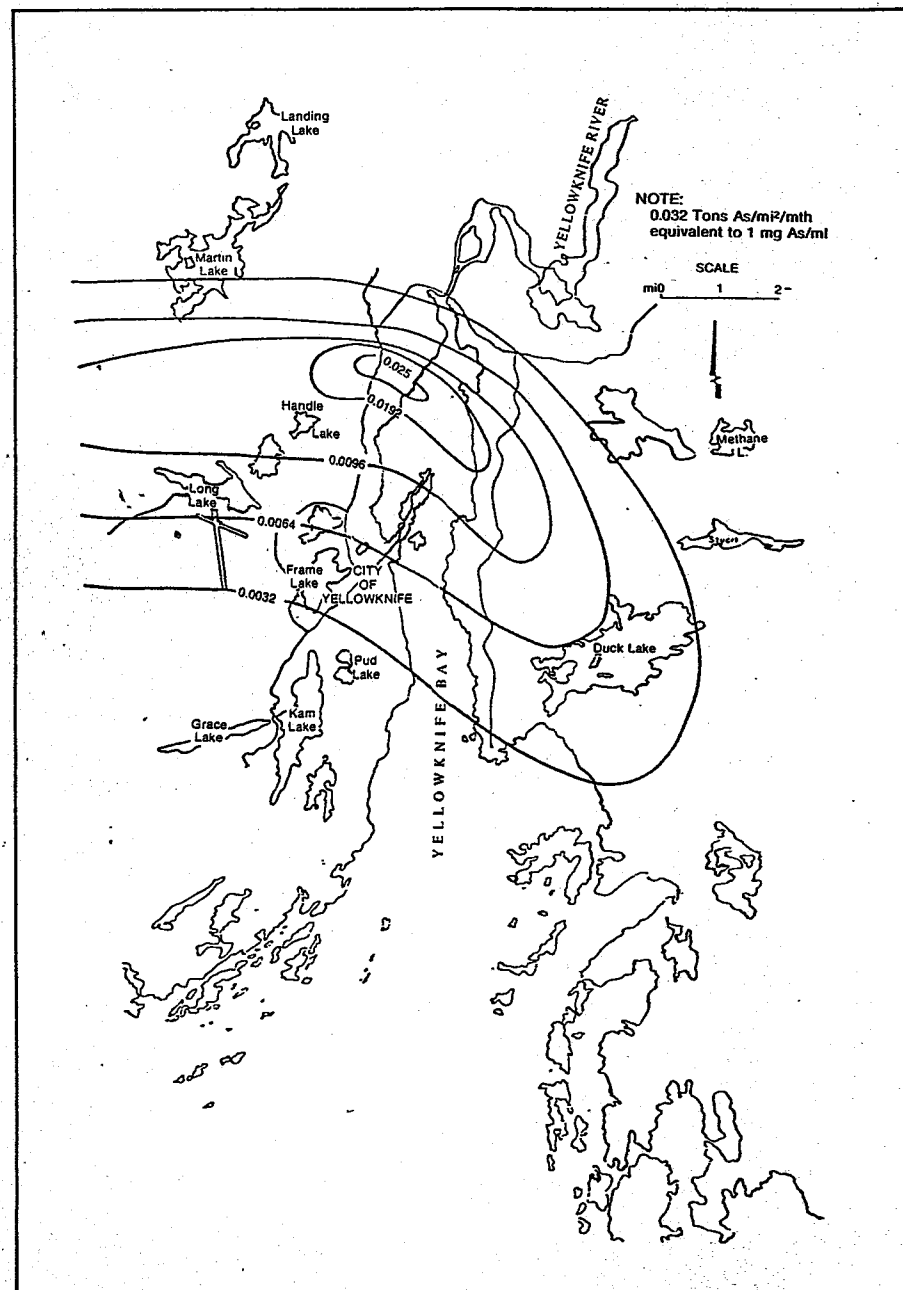
The Task Force concludes that the use of snow as a source of drinking water could constitute a serious health hazard.

#### (d) Potable Water Supplies

##### (i) Yellowknife Municipal Water Supply

The Canadian Drinking Water Standards and Objectives, 1968 (18) specify that the maximum permissible limit for arsenic in drinking water is 0.05 milligrams per litre, and that the acceptable limit is 0.01 milligrams per litre. Before December 1969 the source of water supply for the town of Yellowknife

Figure 6.  
Arsenic Isopleths for Snow Survey, 1975, Yellowknife, Northwest Territories



Source: (17)

was the west side of Yellowknife Bay on Great Slave Lake. Available data during the period 1951-1969 indicate that the average concentration of arsenic in drinking water for the period (0.048 mg/l) was very close to the maximum permissible level, based upon the *Canadian Drinking Water Standards* (6). However, there was a sizable variation in arsenic concentration by month, the highest concentrations being recorded during the spring run-off period of May, June, and July of each year. The average concentration of arsenic in drinking water for the month of June for the period 1951-69 was 0.107 ppm. In summary, the water supply was within acceptable limits during that period less than 16% of the time, and for almost 70% of the time the level of contamination was between 0.01 ppm and 0.05 ppm. Approximately 15% of the time the water supply is estimated to have been above the maximum permissible level of 0.05 ppm (6).

The present source of water supply for the town of Yellowknife was put into service in December 1969. This source of supply is the Yellowknife River north of its confluence with Yellowknife Bay. The existing system also supplies Cominco and the Giant Yellowknife Staff House area. Arsenic concentrations are monitored routinely and have been consistently found to be barely detectable. Short-term introduction of water from Yellowknife Bay into the municipal system, for fire-fighting purposes, would not be sufficient to constitute a health hazard. Routine monitoring for arsenic in drinking water based on the requirements of the *Canadian Drinking Water Standards and Objectives* should, of course, be continued indefinitely, as a normal public health monitoring program.

#### (ii) Giant Yellowknife Water Supply

This water supply is primarily a source for process water for Giant; however, a small portion of the water from this source has been used, up until this year, for drinking and washing purposes, by employees at the mine and smelter. The water supply source is from Back Bay, not far from the Baker Creek outlet. Water is chlorinated prior to use and is monitored routinely for arsenic and coliform bacteria.

Back Bay is the depository for sewage effluent from the town of Yellowknife and for the Baker Creek discharge from the Giant tailings ponds. In addition, it has been suggested that domestic sewage from the Giant plant has overflowed into Baker Creek during power failures. The only treatment provided for this supply is basic chlorination. Monitoring for other heavy metals likely to be present in Back Bay has not been conducted nor has any total chemical quality assessment been made, as required by the *Canadian Drinking Water Standards*. Studies (19) have shown that heavy metals and arsenic have spread well into the Bay from Baker Creek. Sediments contain an average of 1,320 ppm arsenic at a distance of 500 yards from Baker Creek and range up to 2,400 ppm. The levels remain high in Back Bay and an average concentration of 130 ppm has been

recorded at a distance of 3 miles from the mine. Bottom organisms have been killed in a large part of the Bay, with a zone of influence extending about 1.5 miles into Back Bay and 0.7 miles out from the mine. The same study (19) has shown that metal levels in the water in Back Bay are unusually high with arsenic sometimes exceeding 1 ppm at 0.5 miles from the mine.

Monitoring of this water supply by Giant Yellowknife mines has shown that average monthly arsenic concentrations have consistently exceeded the maximum acceptable level, with an average concentration for 1976 of 0.03 ppm. Individual monthly maximums have been as high as 0.229 during 1976 and 0.32 during 1975. Although bacteriological monitoring results have consistently indicated the absence of coliforms, there is serious cause for concern. Arsenic concentrations have been variable and approaching maximum permissible levels. The potential hazards associated with the source itself would dictate the rejection of this water supply for purposes of human consumption.

While it is understood that action has already begun in this respect, the Task Force recommends that the use of the Giant Yellowknife water supply as a source of potable water for plant employees be discontinued as soon as possible. The municipal system should be extended to provide employees with water for drinking and washing purposes.

#### (iii) Cominco Water Supply

Available data on water quality for the Cominco water supply from 1951 to 1969 indicate water quality very similar to that of the town of Yellowknife during the same period (6). The Con Mine is currently supplied by the town of Yellowknife water supply system, and as a result, water quality in terms of arsenic concentration is well within acceptable limits.

#### (iv) Snow Melt

As we point out above, the use of snow as a source of drinking water could constitute a serious health hazard. It is important, therefore, that every effort be made to ensure that melted snow is not used as a potable water source in the Yellowknife area.

It is probable that some members of the Indian communities in Latham Island and Detah continue to make use of snow as a potable water source, in spite of the fact that water is routinely made available to the community by tank-truck. In order to deal with this potential problem steps should be taken to: (a) ensure that every member of each community at risk is routinely advised and reminded of the hazard of using melted snow for drinking and cooking purposes and (b) ensure that adequate quantities of potable water are made available to the residents of unserved communities. The provision of public water supplies is a function of local government. The Task Force considers that both Giant Yellowknife and Cominco have a responsibility financially to support such a program.

#### (e) Surface Waters

Arsenic levels in natural surface waters are usually low, ranging from less than 1 ppb to less than 100 ppb†. Nearly 80% of the U.S. waters contain less than 10 ppb. Much higher concentrations ranging upwards from 1 ppm are not infrequently encountered in hot springs and groundwaters in areas of thermal activity, and in well waters and streams draining areas of industrial activity (10). The natural levels of dissolved arsenic in Canadian rivers measured during 1968-74 appear to be low. In most cases, arsenic was undetected by the methods employed which had a sensitivity which varied from 5-13 micrograms per litre. Lakes Superior, Ontario, Huron, and Erie have been found to have levels ranging from 0.25 to approximately 1 microgram per litre (5).

There is a wide variation in arsenic levels in lakes and other surface waters in the Yellowknife area. Most are well within the limits of the *Canadian Drinking Water Standards*. However, some lakes (such as Long Lake, Fault Lake, and Range Lake) have measured levels of arsenic several times the maximum acceptable level recommended for drinking purposes. Measurements taken in February 1975 indicated a concentration of 1.29 ppm in Range Lake, 0.27 in Fault Lake, and 0.135 in Long Lake (8). The arsenic in these cases seems to come from natural sources.

Arsenic levels in Yellowknife Bay are relatively low and generally well within standards (less than 0.005 - 0.02 ppm). Kam Lake has measured levels of arsenic in the 2-3 ppm range (8), apparently due to seepage from the Cominco tailings ponds. Surface water and sea waters are believed to be self-cleaning with respect to arsenic, the element being removed from solution and deposited in the sediments. The latter invariably contain higher concentrations of arsenic than do the waters above. However it is clear that any future use of lakes in the Yellowknife area as possible water-supply sources should be approached with caution. In any such case, arsenic monitoring should be conducted over a period of several months to ensure the acceptability of the water for human consumption.

#### (f) Fish and Shellfish

It has been suggested by some that fish might be an important source of arsenic exposure, since certain species could be subject to exposure to high levels of arsenic in lake water. The allowable limit for arsenic in fish protein, as established by the Department of National Health and Welfare, is 3.5 ppm.

Arsenic in edible parts of fish and fishery products in Canada has been found to vary from an average of 0.25-40.2 ppm for sea-water species and from 0.01-0.62 ppm for freshwater species. It is chiefly the fish living near or at the bottom of the sea (ground fish) which tend to accumulate high amounts of arsenic (flounder, sole, skate, lobster, shrimp). No significant accumulation was

†Parts per billion or micrograms per litre.