APPENDIX V

UNDERGROUND STORAGE OF ARSENIC BEARING MATERIALS

1995 Progress Report

Water Licence N1L2-0043

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1.0 INTRODUCTION

One of the conditions applicable to the Water Licence granted by the Northwest Territories Water Board (The Board) in 1993 was that an investigation and evaluation of the Arsenic Storage Vaults be undertaken from the standpoints of abandonment and restoration, and that the relevant studies should cover the aspects of rock mechanics; geohydrology; geochemistry; permafrost; and risk assessment. The Board (by letter of April 30, 1993) provided Guidelines for developing the Terms of Reference for these studies. The City of Yellowknife retained the services of HBT Agra Limited to review the Guidelines. HBT Agra Limited responded to the City by letter dated March 4, 1993, and recommended a variety of specific tasks including: 3D modelling of the geology; geothermal regime; heat transfer; and hydrogeology. Terms of Reference for this study were prepared and after initial review by the Board's Technical Advisory Committee (TAC), were submitted in final form on October 21, 1993.

A revised Abandonment and Restoration Plan was submitted in January 1994, and comments arising out of a review of the same were provided by The Board on July 15, 1994. These comments covered a number of subjects including the request that the results of HBT Agra Limited's second review of the Terms of Reference for Arsenic Disposal (submitted to the City of Yellowknife by letter of March 24, 1994) be taken into consideration. The Board's review by letter of May 2, 1995 of the report covering study activities during 1994, expressed concern that the work was not on schedule in respect to various tasks originally planned for 1994 and recommended that Royal Oak Mines Inc seek assistance from professional consultants with the appropriate expertise. Royal Oak Mines Inc accepted this recommendation and engaged Mr. M.A.J. (Fred) Matich of MAJM Corporation Ltd to assist in the preparation for and engagement of professional Consulting Organizations required by the studies. As discussed later in this report, assembly of background factual information has been completed in 1995 into a form that several Consulting Organizations and specialist Contracting Firms with different areas of expertise can work on the study simultaneously in an efficient, well coordinated manner. As indicated in the report, developments during the study have shown that it is desirable, from a practical standpoint, to alter the original schedule for the main tasks without, of course, altering the originally proposed completion date.

2.0 HISTORICAL BACKGROUND

One of the tasks completed in 1995 has been a review of available documentation in company archives and it is timely, therefore, to review briefly the historical background to storage of arsenic in underground vaults at this Mine. It is considered particularly significant to the present studies that the historical background spans an almost 50 year period of continuous operational activity and interaction between the Mine and the pertinent Regulatory Authorities.

Data in the archives indicates that the concept of storing arsenic in underground vaults was proposed for the first time in 1950 by Senior Mine Personnel. The scheme(s) considered at that time were considered viable on the evidence of extensive occurrence of permafrost in the bedrock during mining and confirmation by exploratory core drilling and temperature measurements at the location of the proposed initial vault. The first arsenic storage vault (designated # B2-30) was constructed in 1951 and, as noted in the following Table, was filled in about one year. There is evidence that freezing air was circulated into the empty vault (at least into the 1960's) to reinstate any recession of the permafrost resulting from mining operations, and also into the upper part of vaults already filled to ensure that the surface pillar remained frozen. By 1960, the Mine concluded that any underground opening would be suitable for arsenic storage, " provided not so much that the area is in permafrost, but that the area is free from water flow or seepage". The requirements for locating the vaults within an envelope of permafrost, and also that the vaults should be dry before arsenic storage commenced, were maintained at least until the mid - 1980's. The most recent vaults #14 and #15 are located in an area which is not permafrost, although the design and operating criteria of the vaults being dry at start of arsenic storage and maintained dry thereafter, are still considered by the Mine to be essential objectives.

The Table presented on the next page (page 3) provides information collected from the Mines archives with regards to the dates when each specific vault commenced filling, the approximate dimensions of each vault (length x width x height), and the type of vault. There are primarily two types of vaults in which arsenic is deposited; 1) an old "production" ore stope which was mined out and met the criteria for arsenic disposal and 2) the latest vaults, which have been specifically developed in waste areas away from potential ore deposits. As one can see from the Drawing ARS-96-1, there is a definite rectangular shape to the vaults developed specifically for disposal, while the older vaults have irregular shapes. Each specific stope is identified on the Table as being either a production stope or a developed stope.

Once each area was designated for an arsenic vault, Engineered bulkheads were then constructed in order to isolate each vault from the rest of the mine workings for that specific area. From reviewing the archives, it has become apparent that some of the earlier bulkheads were constructed using wood (timber). It should be noted that these wooden bulkheads were replaced with concrete bulkheads throughout the years. Some of these older vaults have a series of bulkheads surrounding the vault while others (the most recent ones) have only two bulkheads, one on the top and one on the bottom. All of these bulkheads are identified on various drawings in the archives, which have recently been updated for each vault.

SUMMARY OF ARSENIC STORAGE FILLING SCHEME - BY VAULT

Vault	Date Filled	Approx. Dimensions length x width x height	Type of Vault
B 2-30	Oct. 28/51 - Dec. 15/52	76' x 20' x 70'	Production Stope
B 2-33	Dec. 16/52 - Mar. 1/56	105' x 28' x 155'	Production Stope
B 2-34	Mar. 2/56 - Jul. 10/58	108' x 28' x 145'	Production Stope
B 2-35/36	Jul. 11/58 - Mar. 15/62		Production Stope
B 2-35	Aug. 22/88 - Nov. 29/88	105' x 40' x 165'	
B 2-36	Dec. 12/88 - Dec. 30/88	110' x 40' x 146'	
B 2-08	Mar. 16/62 - Dec. 31/64 Jan. 1/72 - Sep. 1/72 Jul. 1/75 - Jul. 31/75 Dec. 17/75 - Jan. 9/76 Mar. 11/86 - Sep. 26/86	170' x 50' x 145'	Production Stope
B 2-12	Jan. 1/65 - Dec. 31/71	140' x 40' x 150'	Production Stopes
B 2-13	Sep. 1/72 - Jun. 14/73	80' x 40' x 110'	
B 2-14		105' x 30' x 80'	
C 2-12	Jun. 14/73 - Jun. 30/75 Aug. 1/75 - Dec. 17/75 Jan. 10/76 - May 21/76 Jun. 1/80 - Jan. 9/82 May 22/85 - Mar. 1/86	200' x 25' x 180'	Production Stope
C - 9	May 21/76 - May 31/80	100' x 40' x 180'	Production Stope
C - 10	Apr. 1/82 - May 22/85	65' x 25' x 180'	Developed Stope
B - 11	Sep. 26/86 - Aug. 22/88 Nov. 30/88 - Dec. 12/88	105' x 40' x 70'	Developed Stope
B - 12	Dec. 30/88 - Jun. 30/95	199' x 42' x 110'	Developed Stope
B - 14	Jun. 30/95 - Present (Nov. 95)	175' x 40' x 60'	Developed Stope

The company archives also indicate that routine inspections of these bulkheads were undertaken by Mine personnel, with the emphasis being on the bulkheads sealing off the vault that was presently being filled. Through these inspections, corrective action was undertaken such as replacing wooden bulkheads with concrete ones.

As part of extensive studies carried out by the Mine in the 1980's relative to possible recovery and sale of the arsenic, one detailed geotechnical type exploratory borehole was put down from surface into each of vault #'s B2-08, B2-30, B2-33, B2-34, B2-35, B2-36, and C-9, in 1981. The results are of important relevance to the present studies and will be supplemented this year, as discussed later.

Over the last 45 years of arsenic disposal, fifteen vaults have been used for disposal with the sixteenth currently under construction. These vaults are primarily located in four specific groupings. The geological setting of these groupings as well as their locations with respect to such features as Baker Creek, mined out-open pits, the mine shaft and the mill are presented in the attached surface map Drawing No. ARS- 96-1. Another longitudinal map of the underground is included - Drawing No. ARS-96-2 which visualizes the relationship of each vault in elevation compared to the underground workings of the rest of the mine.

The four sets of groupings represent the various years in which disposal took place. The first set of groupings include the earliest vaults used and hence the location of these vaults are in the direct vicinity below the baghouse and roaster stack. This grouping is composed of the "oldest" vaults and includes #'s B2-30, B2-33, B2-34, B2-35, and B2-36. The second grouping is located just north/east of the mill under or adjacent to the B1 Pit and is composed of vault #'s B 2-08, B-2-12, B-2-13, and B 2-14 The third grouping consists of vault #'s 9, 10 and C 2-12 and is located south of the mill. The final and fourth grouping includes the "most recent" vaults, #'s 11, 12, 14, and 15. The location of these vaults is east of the mill on the opposite side of Baker Creek under a large a hill (outcrop).

3.0 PRESENT DISPOSAL METHODOLOGY:

As indicated in the previous section, fourteen vaults have already been filled with Arsenic Trioxide. At time of this writing, the fifteenth vault (# 14) is operational while a sixteenth vault (# 15) is under development.

In brief, the following disposal methodology for collection, transportation, and storage is in use at the present:

The roaster fumes are drawn through the baghouse filter media. An average of 12 - 15 tons of material is recovered in the baghouse each operating day. The cleaned baghouse tail gas is drawn to the acid brick stack and released to the atmosphere. The baghouse dust collected has a typical analysis of 85 to 95 wt% arsenic trioxide (As_2O_3) to wt% iron (Fe), to 0.7% antimony (Sb) and 0.10 - 0.15 oz of gold/ton of dust.

Transportation of the arsenic dust is by pneumatic stowage - pumping the material through a standard 4" diameter steel pipe (schedule 20 pipe) from the Cottrell Building to the particular arsenic vault being filled. The pipes are run underground in specially driven drifts used for this purpose only. These distribution drifts are isolated from the general mine workings. The pipes enter the vault through the top access of the engineered design concrete bulkhead, where the pipes have been sealed into the bulkhead during the pouring of the concrete bulkhead. In most cases there is more than one line entering the vault at various lengths (the current vault has three lines) The longest line into the vault is utilized first, filling the back of the vault towards the front. As the vault fills, the lines are switched to each shorter line.

The air used to transport the dust into the stope via the 4" lines is returned by a parallel 6" diameter pipe and is vented back into the baghouse inlet flue. The system is therefore a completely closed system. No dust loss occurs during the transportation as the only place for the dust to fall out of the transportation air bed is inside the vault being filled. The capability also exists to pump directly into the vault from surface via reamed longhole drill-holes or diamond drill holes as the case may be. These grouted in dump points are for emergency dumping by the vacuum truck should failure occur in the pneumatic stowage system.

The most recent vaults (#11, #12, #14 & #15) are situated in waste rock to avoid interference from present and projected future mining activities. They are shown in plan location and elevation on Drawing Nos. ARS-96-1 and ARS-96-2, attached.

The present disposal methodology is controlled by dedicated Mine Personnel and written operational and safety procedures.

Presently operational vault # 14 has experienced evidence of seepage from the bedrock in the area of the lower concrete bulkhead, and the situation is being investigated preparatory to applying corrective measures. The Mines Inspection Branch is being kept informed. Some local seepage from the bedrock has also been detected during the development of the next vault (#15) and this is similarly under investigation. An inspection of the inside of #14 arsenic vault was undertaken by the Mine Foreman and by other members from Royal Oak's Engineering Department prior to commencement of filling. At that time, there was no evidence of moisture inside the vault.

A regular monitoring program (inspections) of this vault are carried out by the Mine Foreman. This involves checking the distribution piping throughout the drift as well as inspecting the bulkhead. Records of these inspections are produced by the Mine Foreman.

During 1995 and into 1996, inspections of the various vaults/bulkheads were conducted by the Environmental Superintendent and the Mine Foreman to provide confirmation on which bulkheads were accessible and which were not. In order to conduct these inspections, valuable information was obtained from a former Mine Foreman who had conducted inspections of these various vaults over the past 25 years.

From the inspections conducted, a better understanding has been obtained on which vaults are accessible and ones that are presently not accessible. There was a total of 11 vaults in which we observed in 1995 either the upper or the lower bulkheads. These vaults are as follows:

#9	#11	B 2-08	B 2-36
#10	#12	B 2-33	#15 (under construction)
C 2-12	#14	B 2-35	

Note: The upper bulkheads of vaults #'s B 2-12, B 2-13, B 2-14 were accessed in 1994.

The remaining 5 vaults #'s B 2-12, B2-13, B 2-14 , B- 2-34, and B 2-30 were not able to accessed in 1995. However, plans are in place in 1996 to gain access to these areas. It has already been determined that the access to #'s B 2-30 and B 2-34 are through surface raises that have been covered over to restrict access. Mine personnel are quite confident that these two vaults can be inspected once these two openings can be accessed this spring/summer, when the snow disappears.

In discussions with mine personnel and with the former Mine Foreman it appears that the remaining three vaults #'s B 2-12, B 2-13, B 2-14 have been isolated from the rest of the workings when a section of B1 Pit collapsed in the 1980's. Royal Oak will make every effort possible to access these vaults in 1996. Should it be necessary, mining will be carried out in order to create access to these vaults. Prior to any mining being conducted to access these areas, inspection holes into the vaults will be drilled in 1996 in order that the status of these vaults can be verified using a borehole camera.

4.0 PROJECT ORGANIZATION

The work prior to 1995 involved only personnel from the Mine together with contracting services for specialized tasks such as drilling, for installation of thermistors, and for measurement of ground temperatures. During 1995, there was an increased involvement of Mine Personnel particularly at a senior level including the Mine Manager; the Superintendent of Environmental Services; the Acting Chief Engineer, the Chief Geologist; and the Mine Foreman. In addition, a former underground Mine Foreman was involved for his expertise in developing the historical background and in reviewing the data from the archives.

During 1995, the first independent consultants were retained including Ms. Serena Domvile - Principal Scientist, Seacor Environmental Inc (to produce a guideline document on arsenic) and Mr. M.A.J. Matich an independent Consulting Engineer, in an overall technical review and advisory capacity. The need for additional specialized expertise in fields such as rock mechanics, hydrogeology; permafrost, environmental sciences, and risk assessment, was recognized by both the Northwest Territories Water Board and by Royal Oak Mines Inc. Accordingly, during 1995 statements of qualifications and experience were solicited and received from organizations who are collectively recognized in all of these fields of expertise, including EBA Engineering Consultants Ltd; Klohn-Crippen Consultants Ltd; and Golder Associates Ltd. A proposal was also solicited from Ferguson, Simek Clark, Consulting Engineers, for the structural reviews of the bulkheads on all of the vaults. Consideration has also been given to the outside contracting services which will be required to supplement the various field investigations such as drilling, coring, sampling, testing, monitoring instrument installation; inspection by borehole camera etc; and possibly also GPR (Ground Penetrating Radar) and seismic surveys.

As discussed later, an important element of the studies carried out in 1995 was the assembly of background information into a form which will enable the involvement of all outside consultants and contractors to take place in an efficient, well coordinated, intensive manner. The necessary preparatory work has been completed and it is planned to engage consultants and specialized contracting services from among the candidate organizations to supplement in-house expertise and kick off this detailed consultant-oriented phase of the studies within the next month. Mine Personnel will still be provided in an overall management and coordination role as well as for direct input in areas such as environmental, geology, mining, and arsenic disposal operations.

5.0 STATUS OF STUDIES:

As already indicated, an important element of the studies completed to date, has been the review of background data from the company archives, personnel interviews, and the published technical literature. This data will be commented on below where appropriate, and under the same headings as used in the previous report.

As a general statement, the priorities for the work in this category carried out in 1995, were given to (a) the assembly of factual data on geology and topographic features of the mine area including open pits and water bodies as well as details of the vaults and other associated below-ground construction, for use in producing the required 3D models, and (b) understanding the construction, filling, and post-construction performance of the vaults.

One of the major tasks undertaken falls into a separate category, namely the production of a comprehensive "Guideline Document on Arsenic" in draft form by Seacor Environmental Engineering Inc.

Progress during the year on other tasks may be summarized as follows:

5.1 - <u>Physical Stability</u>:

Work in this category involved (I) inspection visits to vaults already discussed, (ii) assembly of geological data for the overall mine area and the immediate environs of individual vaults or groups of vaults, (iii) production of detailed drawings for all of the vaults showing details in plan and cross-section, etc. in a form suitable as reference in the development of 3D models required; and (iv) exploratory core drilling and geological assessment of the area of vault #15 currently under construction, as well as local areas of vault #14. Many of the drawings which have been produced were displayed during the presentation to the TAC on December 14, 1995.

There is no evidence in the available data base of any instability in any of the vaults during or subsequent to construction.

The following brief description of the general and detailed findings is presented to assist the reader in respect to the geological setting of the Mine area and the vaults.

The general surface geology of the Mine area is depicted on Drawing No. ARS-96-1.

The Yellowknife volcanic-sedimentary belt extends north from Great Slave Lake for a distance of over 50 kms. The belt consists of a homoclinal, steep easterly to vertically dipping succession of mafic to intermediate volcanic rocks with minor volcaniclastic and sedimentary rocks.

The Giant Mine is located within the Archean age Kam group which consists of variably metamorphosed massive, pillowed and variolitic tholeiitic basalts, intermediate to mafic tuffs, and interflow sediments which have been intruded by gabbroic and diabasic dykes of various ages. The rocks have undergone middle greenschist to middle amphibolite facies metamorphism.

Two prominent fault trends exist within the Giant Mine; 060°, and 160°. The 160 faults are prominent faults with variable easterly dips and are characterized by clay fault gouge and breccia. The sense of movement on these faults is sinistral. The 060 faults are generally characterized by having little or no clay gouge or breccia and may appear as thin hairline fractures. The sense of motion on these faults is dextral, they dip to the west. Faults with the aforementioned trends may occur as major faults or appear as lesser faults. Water seepage into the mine generally occurs along major fault zones.

Joints are numerous in the Giant Mine, but in general they mirror the trends of the two major fault patterns. Occasionally, at the intersection of the two joint trends, a red staining occurs on the joint planes. The staining suggests the joints were open to the surface and allowed the passage of ground water.

Geological setting of vaults #'s 11, 12, 14, and 15 lie within the Townsite formation. The host lithology of the storage vaults is a mostly massive chloritized greenstone varying in composition from dacite to basalt. Structural data was collected from the #14 and #15 vault areas.

A strong north trending fault with several intersecting and associated 060° and 160° faults is present in both the upper and lower sills of the #14 vault. A strong 000/75°W trending fault and an associated 050° fault were mapped in the lower sill of the #15 vault. The faults observed in the lower sill were tight, with no evidence of water seepage.

A detailed program of core drilling has been carried out on storage vault #14 and #15 (under construction). Reports have been generated and findings have been discussed elsewhere which will be presented to the Mines Inspection Branch.

The lower #15 Arsenic vault sill was mapped for structural features such as faults, joints, mineralization and alteration. Five AQTK diamond drill holes were collared from within this lower sill to assess the rock competency around the vault, and to locate any major structural features near the vault. The Rock Quality Description (RQD), a modified CSIR Rock Mass Rating (RMR') and modified NGI Q' (Tunnelling Quality Index) were determined from this diamond drill core.

Five diamond drill holes were drilled from the lower sill of the #15 vault to determine the lithology(s) around this vault and to locate any major faults between the #15 and #14 vaults. The drilling south of the #15 vault was to more determine if the Townsite fault is as shown on the preliminary general geology map. The drill hole did not locate the Townsite fault within 100 feet of the end of the vault.

The two holes drilled west of #15 vault indicated the lithology to be a massive volcanic with a relatively good RMR' ranging from a low of 67 to a high of 83. The two holes drilled east between the #15 and #14 vaults indicated there are two bands of chlorite schist within a variably brecciated mafic volcanic rock. The chlorite schist unit nearest the #14 vault returned the lowest CSIR Rock Mass Rating (RMR) values, the average is approximately 61. The second chlorite schist unit nearer the #15 vault returned RMR' values ranging from 66 to 75.

The available geological information collected for vault #'s B2-30, B2-33, B2-35, B2-36, #9, and #10 indicates that they were cut in the massive to pillowed tholeiitic flows.

Historical data indicates that vault #B2-30 is located within an amygdaloidal, variolitic greenstone (basalt) unit. There are narrow bands of chlorite schist around and within the area of the vault. A narrow brecciated unit was located by diamond drill holes drilled through the vault area. Two vertical drill holes from surface confirm the lithologies present in the area. Also noted were the limits of the permafrost. According to the drill holes, the permafrost extended below the 5910 elevation. This vault was located in permafrost entirely below the 5910 elevation.

Vault #'s B2-08, B2-12, B2-13, B2-14 and C2-12 were high grade ore stopes prior to being selected for arsenic storage vaults. The ore mineralization is generally recognizable as broad zones of silicification and/or quartz-carbonate veining with disseminated sulphide mineralization. This mineralization is hosted by a shear zone where the lithology varies from a chlorite sericite schist to a sericite schist. These vaults lie entirely within the sericite schist shear zone.

5.2 Technical Options For Decommissioning:

In its previous submissions to The Board, Royal Oak Mines Inc has indicated that there are, on presently available evidence several technically viable options for decommissioning of the vaults. The Company is still of this view. However, it believes that identification of the candidate options, and the rationale behind their selection, would best be made later in this study with the benefit of additional factual data which is planned to be developed as this study progresses, and relevant analysis using this data.

5.3 Permafrost Conditions:

In reviewing the historical background information, documentation from the initial stages of mining there is evidence of zones of permafrost throughout various areas of the mine. This evidence led in early stages of planning, to disposing of the arsenic underground in secure vaults in a complete permafrost envelope.

As a first step in the present investigation of the state of permafrost in the mine area, six (6) drill holes were drilled in June 1994. These holes are identified as the following

ID No.	Location Description
Hole A-1	Hill overlooking UBC Pit
Hole A-2	Along-side road towards UBC Pit
Hole A-3	Northeast of Roaster Building
Hole A-4	Between B1 Pit and Baker Creek
Hole A-5	Between Ingraham Trail and B1 Pit
Hole A-6	Between A shaft and C Shaft

Five of these holes are located in the vicinity of the active and inactive arsenic storage areas. One hole was drilled between the A shaft and C Shaft in an area that was not influenced by active mining conditions. A map identifying the locations of the these holes was provided in last years report submitted January 25, 1995.

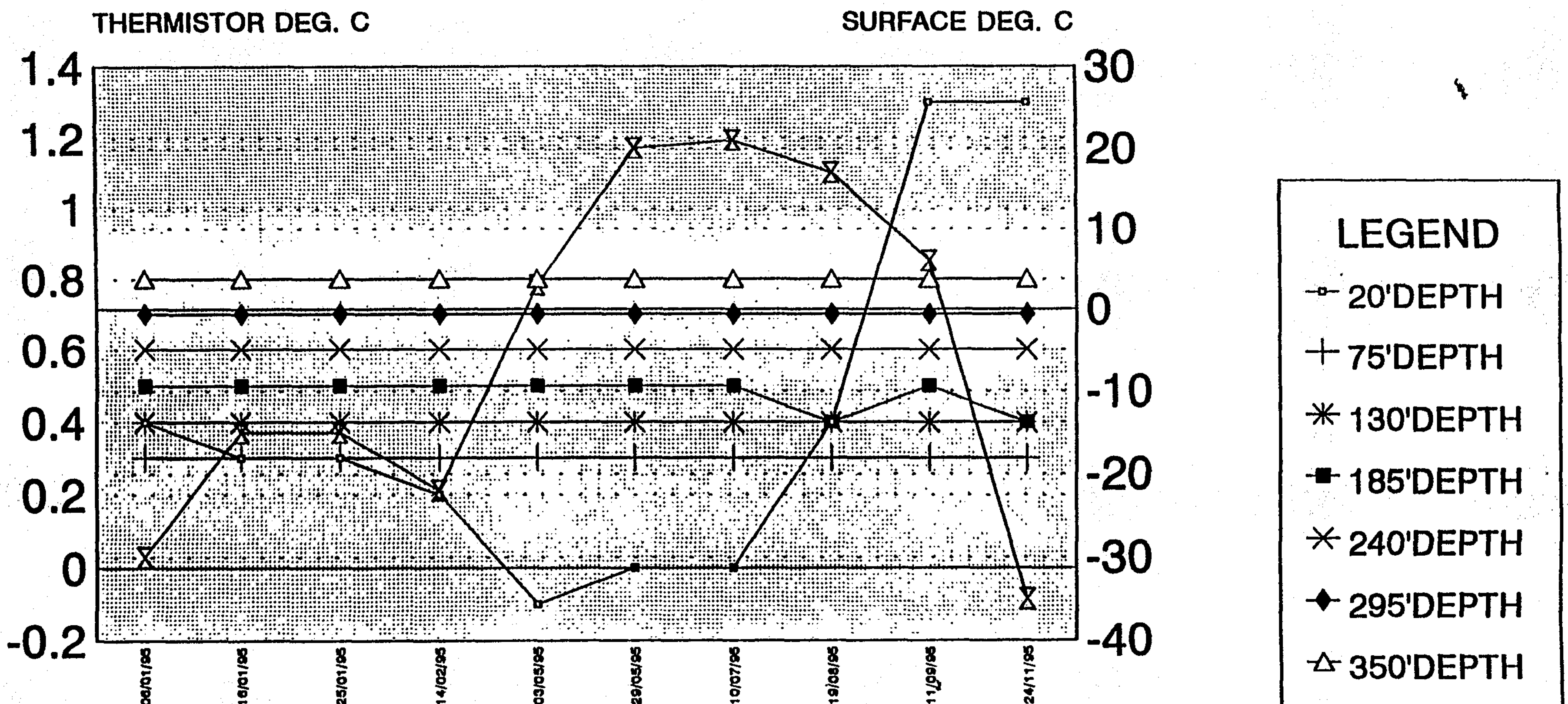
In each of these holes, a string of thermistors were installed to monitor the rock temperatures at various depths. The strings read temperatures at surface, at 20 foot depths below surface and then at 55 foot intervals down until the bottom of each hole. The 350 foot depth was used as this is lowest point of any arsenic vault.

The instrumentation was read one per week in 1994 and proved to be very consistent week to week, therefore the results in 1994 were averaged for each month. The results for the 1994 season were provided in the report submitted January 25, 1995.

During 1995, readings were made at various times throughout the year, taking into account the various seasons winter, spring, summer, and fall. The results are presented on the attached graphs.

The results suggests that the <u>current</u> pattern of occurrence of permafrost may not be wide spread across the whole mine property. The data obtained to date is subject to review based on additional work in this category planned for 1996 and 1997. Which is planned to include thermistor installations closer to individual vaults and particularly those where there was evidence of permafrost during mining and filling with arsenic.

ROYAL OAK MINES - GIANT MINE
ARSENIC STOPE THERMISTOR HOLE #1

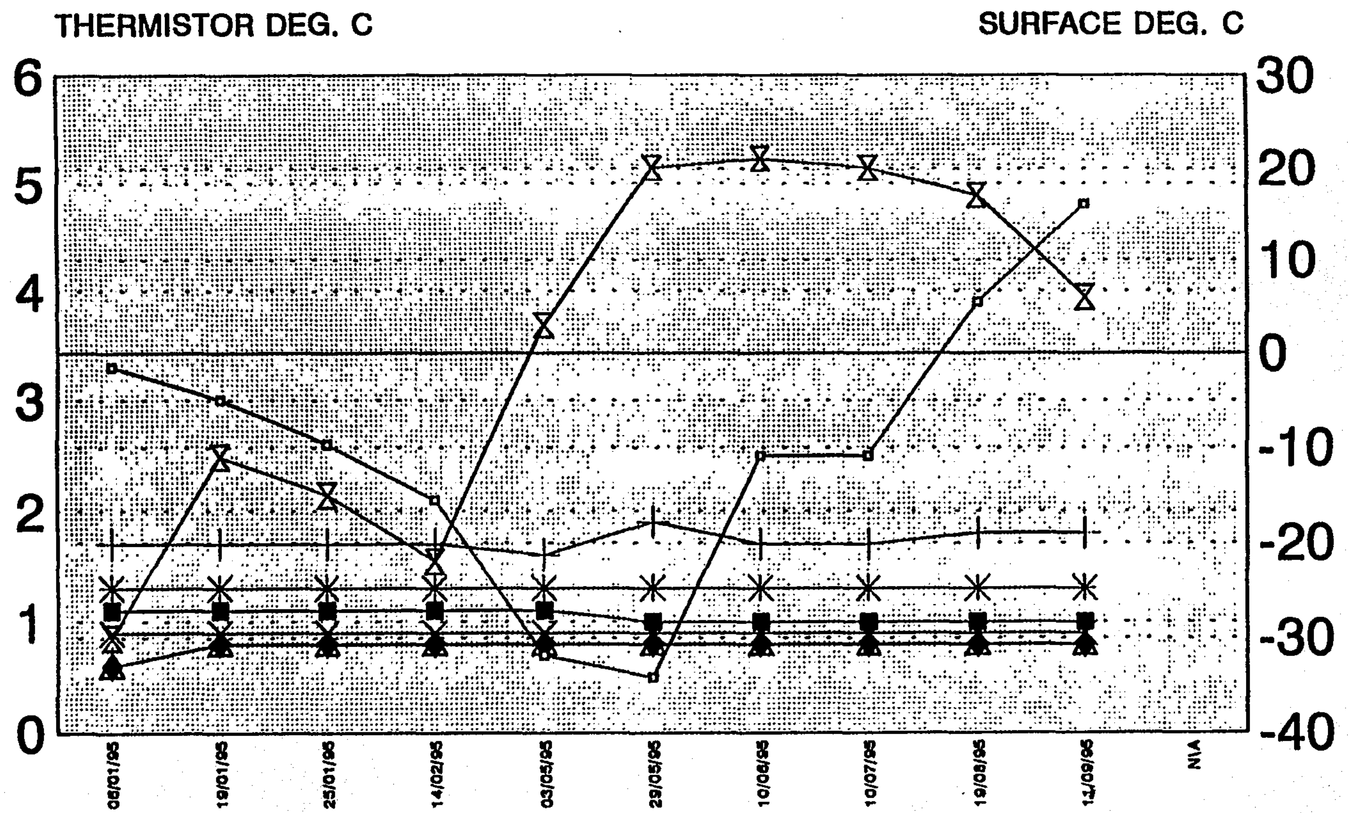


	08/01/95	16/01/95	25/01/95	14/02/95	03/05/95	29/05/95	10/07/95	19/08/95	11/09/95	24/11/95
20'DEPTH	0.4	0.3	0.3	0.2	-0.1	0	0	0.4	1.3	1.3
75'DEPTH	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
130'DEPTH	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
185'DEPTH	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.4
240'DEPTH	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
295'DEPTH	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
350'DEPTH	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
SUR. TEMP	-30	-15	-15	-22	3	20	21	17	6	-35

DATE

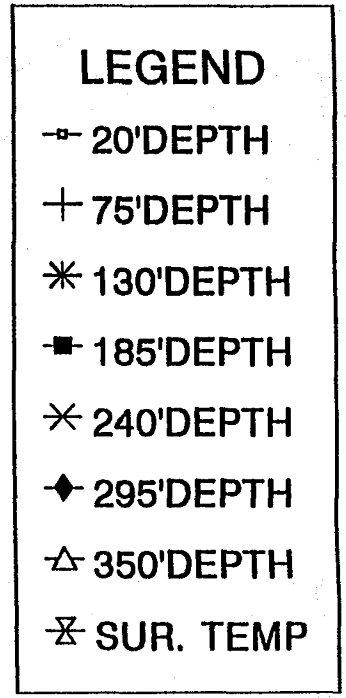
ROYAL OAK MINES - GIANT MINE

ARSENIC STOPE THERMISTOR HOLE #2

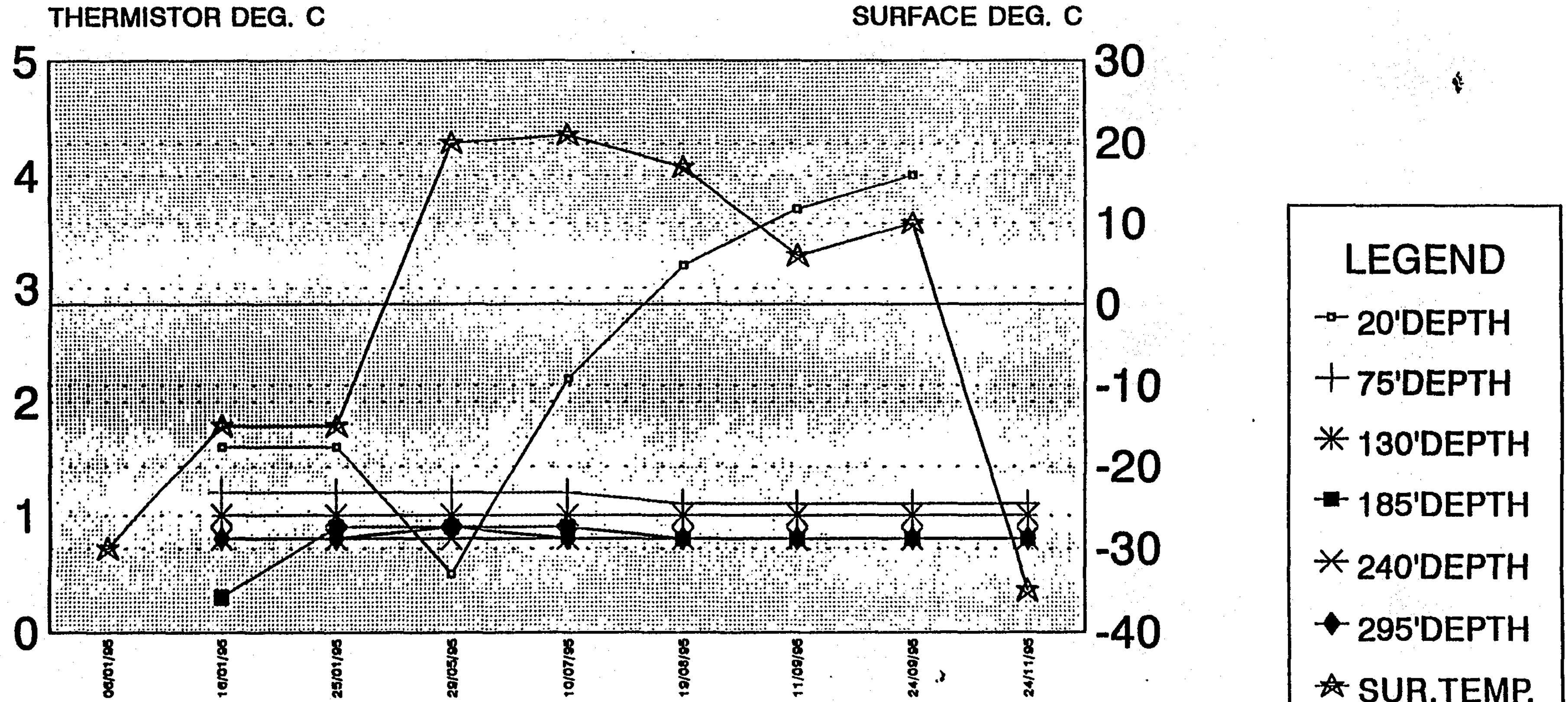


20'DEPTH	3.3	3	2.6	2.1	0.7	0.5	2.5	2.5	3.9	4.8
75'DEPTH	1.7	1.7	1.7	1.7	1.6	1.9	1.7	1.7	1.8	1.8
130'DEPTH	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
185'DEPTH	1.1	1.1	1.1	1.1	1.1	1	1	1	1	1
240'DEPTH	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
295'DEPTH	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
350'DEPTH	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
SUR. TEMP	-30	-11	-15	-22	3	20	21	20	17	6

DATE



ROYAL OAK MINES - GIANT MINE
ARSENIC STOPE THERMISTOR HOLE #3

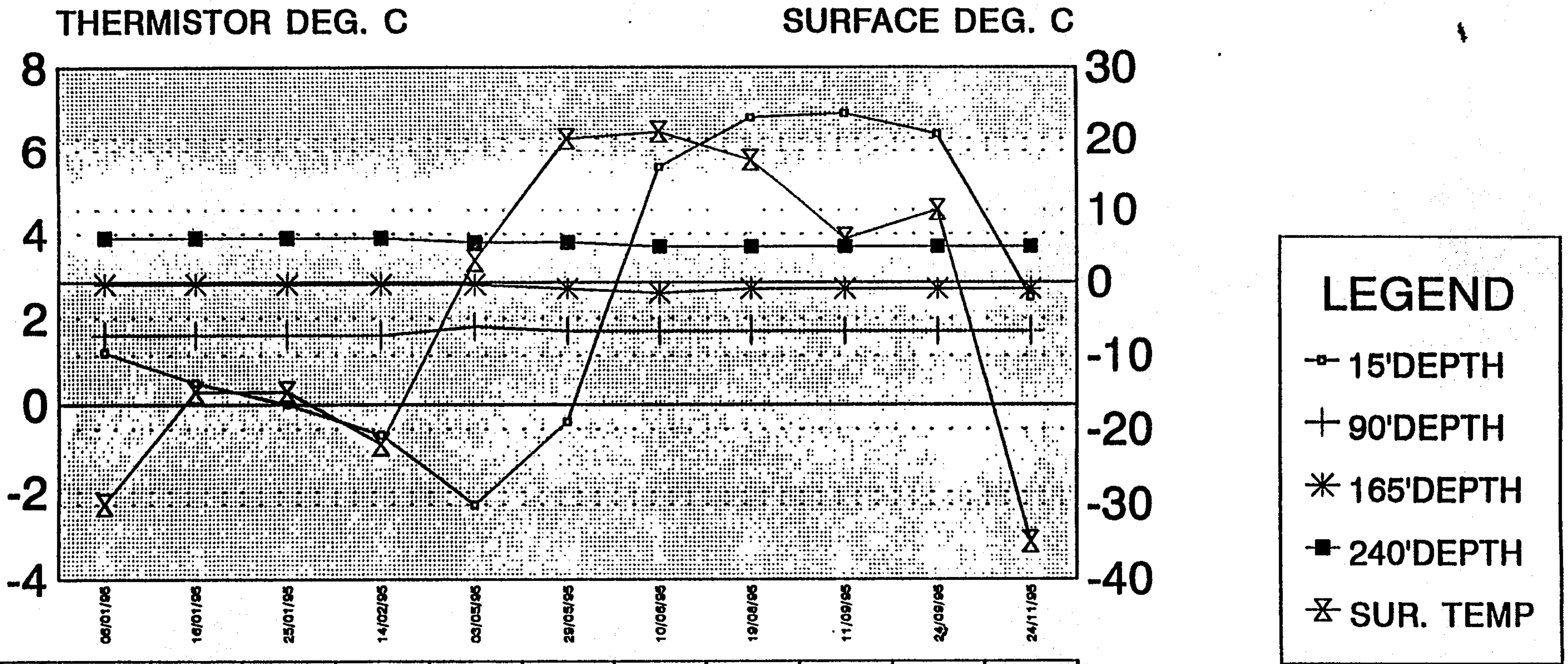


	06/01/95	16/01/95	25/01/95	29/05/95	10/07/95	19/08/95	11/09/95	24/09/95	24/11/95
20'DEPTH		1.6	1.6	0.5	2.2	3.2	3.7	4	
75'DEPTH		1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1
130'DEPTH		1	1	1	1	1	1	1	1
185'DEPTH		0.3	0.9	0.9	0.9	0.8	0.8	0.8	0.8
240'DEPTH		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
295'DEPTH		0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8
350'DEPTH		1	1	1	1	1	1	1	1
SUR.TEMP.	-30	-15	-15	20	21	17	6	10	-35

DATE

ROYAL OAK MINES - GIANT MINE

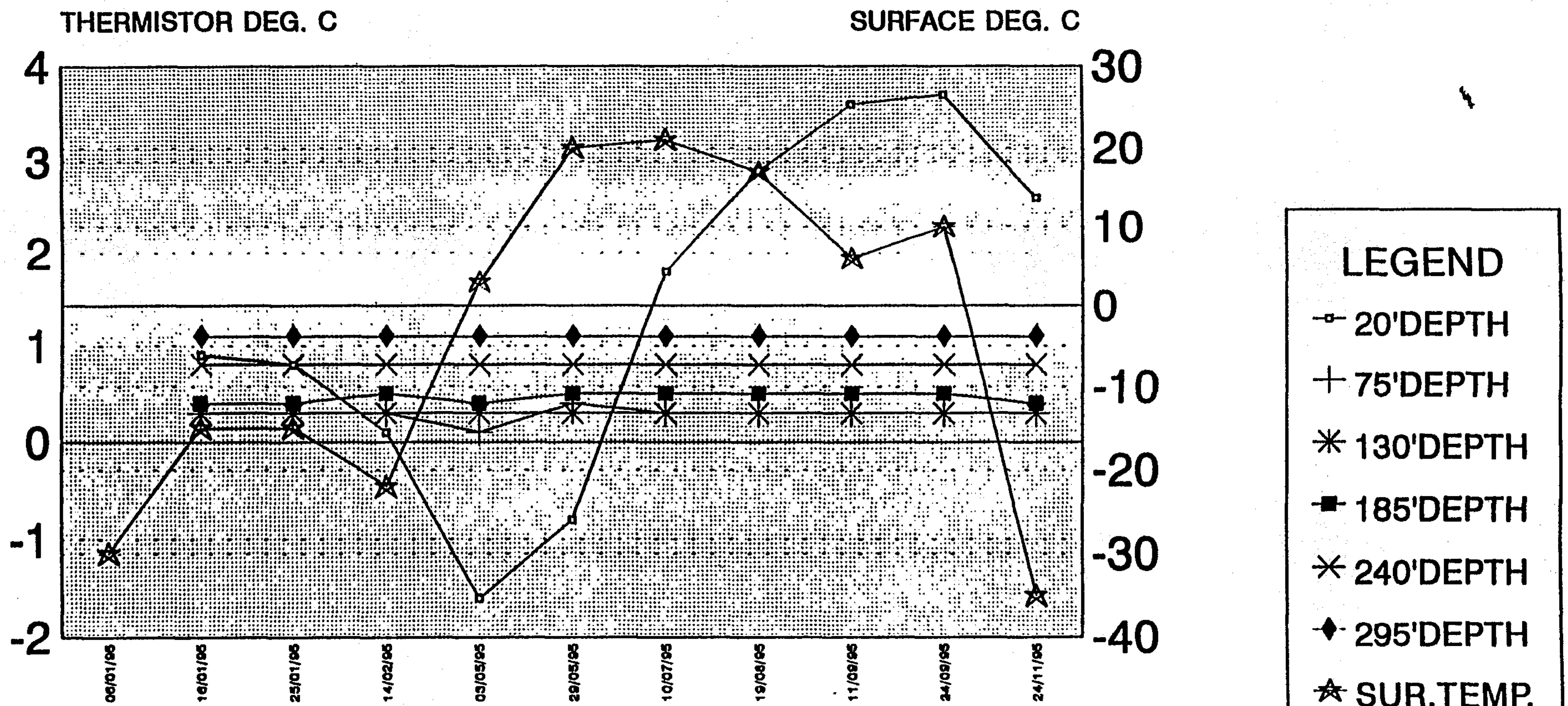
ARSENIC STOPE THERMISTOR HOLE #4



	06/01/95	16/01/95	25/01/95	14/02/95	03/05/95	29/05/95	10/06/95	19/08/95	11/09/95	24/09/95	24/11/95
15'DEPTH	1.2	0.5	0	-0.7	-2.3	-0.4	5.6	6.8	6.9	6.4	2.5
90'DEPTH	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7
165'DEPTH	2.8	2.8	2.8	2.8	2.8	2.7	2.6	2.7	2.7	2.7	2.7
240'DEPTH	3.9	3.9	3.9	3.9	3.8	3.8	3.7	3.7	3.7	3.7	3.7
000'DEPTH	0.6										
000'DEPTH	0.7										
000'DEPTH	0.9										
SUR. TEMP	-30	-15	-15	-22	5	20	21	17	6	10	-35

DATE

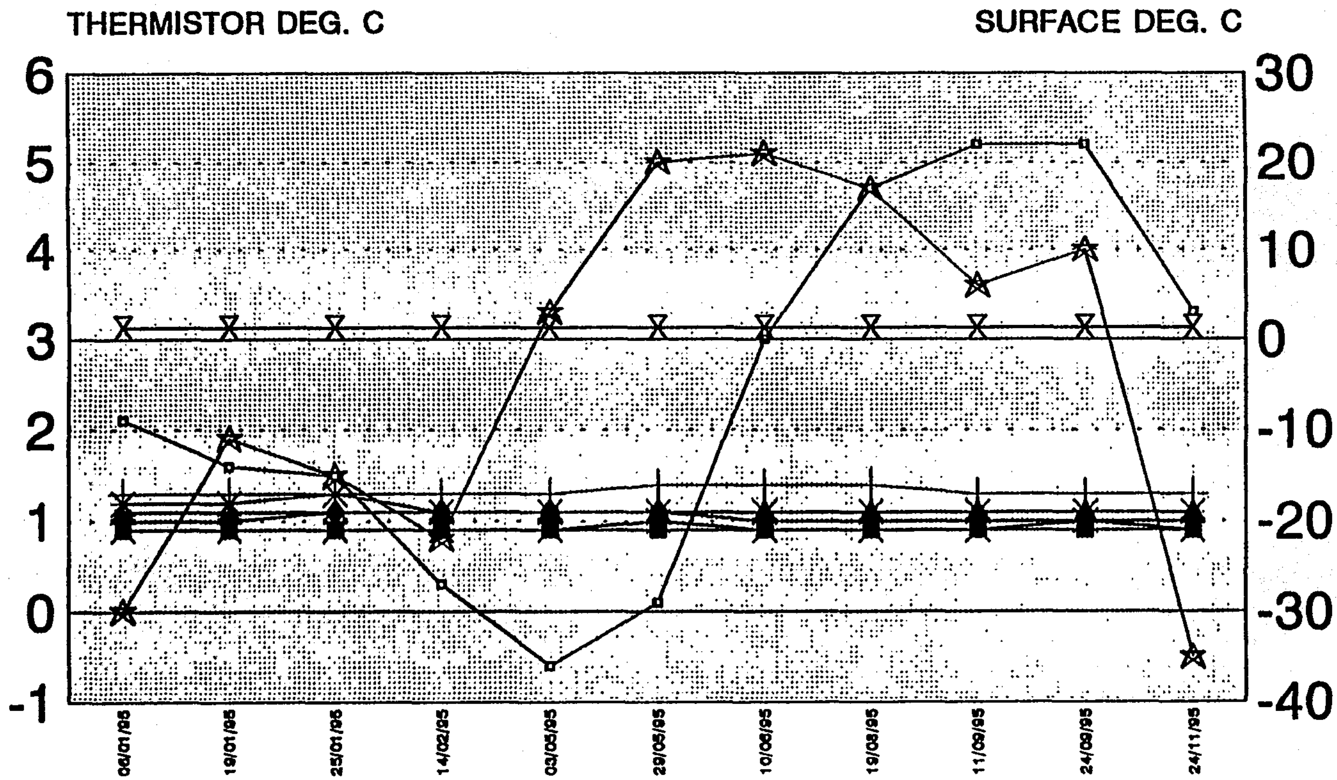
ROYAL OAK MINES - GIANT MINE
ARSENIC STOPE THERMISTOR HOLE #5

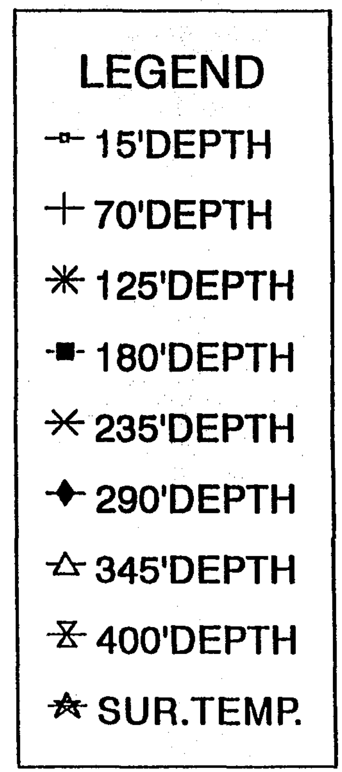


20'DEPTH		0.9	0.8	0.1	-1.6	-0.8	1.8	2.9	3.6	3.7	2.6
75'DEPTH		0.3	0.3	0.3	0.1	0.4	0.3	0.3	0.3	0.3	0.3
130'DEPTH		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
185'DEPTH		0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.4
240'DEPTH		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
295'DEPTH		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
350'DEPTH		1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
SUR.TEMP.	-30	-15	-15	-22	3	20	21	17	6	10	-35

DATE

ROYAL OAK MINES - GIANT MINE
ARSENIC STOPE THERMISTOR HOLE #6





	06/01/95	19/01/95	25/01/95	14/02/95	03/05/95	29/05/95	10/06/95	19/08/95	11/09/95	24/09/95	24/11/95
15'DEPTH	2.1	1.6	1.5	0.3	-0.6	0.1	3	4.7	5.2	5.2	3.3
70'DEPTH	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.3	1.3	1.3
125'DEPTH	1.2	1.2	1.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
180'DEPTH	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
235'DEPTH	0.9	0.9	0.9	0.9	0.9	1	0.9	0.9	0.9	1	0.9
290'DEPTH	1	1	1.1	1.1	1.1	1.1	1	1	1	1	1
345'DEPTH	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
400'DEPTH	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
SUR.TEMP.	-30	-11	-15	-22	3	20	21	17	6	10	-35

DATE

5.4 Hydrological Considerations:

As already indicated, a "Guideline Document on Arsenic" was commissioned in 1995, for use as reference during the various aspects of the overall studies.

During 1995, a preliminary evaluation was made of the probable original pattern of groundwater flows based on evidence of surface water occurrence in terms of location, elevation, flows, etc. A similar evaluation was made of probable changes to groundwater flow patterns produced by the underground mining operations and surface features such as open pits, relocation of existing water courses, and the like. It was intended that this data would be used as background in planning the more definitive studies of hydrogeological conditions scheduled for 1996, as discussed later.

5.5 Risk Assessment:

During 1995, an examination of historical data and present operations was made to identify sources of potential risk, and data was generated to provide a better understanding of the geochemistry of arsenic trioxide. Potential risks which were identified included possible effects from Baker Creek under flood; presence of open pits and other surface features in the vicinity of the vaults; possible seepage from old unplugged exploration drill holes; and the like. The main thrust of the work was to assist in management of such risks through inspection and monitoring procedures.

As in the case of the development of technical options for decommissioning mentioned earlier, the Company considers that a comprehensive risk assessment would best be made with the benefit of the additional factual data and analysis which are planned for implementation in the next phases of this overall study.

6.0 1996 STUDY PROGRAM:

As already indicated, the work has progressed to the stage where input from supplementary consulting Organizations and individuals with recognized expertise in the various specialized fields required, can be brought to bear in a coordinated, efficient manner. All of the areas of expertise will require supplemental field investigation activities (such as drilling, testing, monitoring, and surveillance, etc), and therefore the priority in 1996 will be to carry out the bulk of the necessary field investigatory type work. In as much as the specifics of the field programs have to be developed with input from Mine personnel and Specialists concerned, the first task which will be assigned to the Consultants selected, is the input to the joint development of an overall program of field work.

It is envisioned that field drilling and testing will be carried out for geotechnical; geological; rock mechanics; hydrogeological; permafrost; environmental; structural (bulkhead review); inspection (holes into existing vaults); purposes. The work involved should obviously be coordinated to the best advantage. It is similarly envisioned that monitoring, instrumentation and wells and other such facilities together with laboratory testing, will be involved collectively in most, (if not all) of the above components of the study.

Execution of the field program would be carried out to the extent practical by Mine forces and facilities supplemented as required by a Contracting Organization/s. The work will be under full-time technical supervision, with review as required by the Specialists involved.

The main objectives of the work planned for the balance of 1996 are (I) to complete the acquisition of the necessary data for use in preparation of the various required 3D models, (ii) carry out initial analysis and evaluations based on the data obtained, (iii) finalize a plan of action for the work required to complete this study in 1997, and (iv) continuation of inspection and monitoring activities.

In as much as the specifics of the additional supplementary Consulting and Contracting services which will be engaged, and the investigatory programs which will be carried out, will be determined in the immediate future, it is proposed to inform The Board of the actions taken in this regard through a presentation meeting of the type involved in December, 1995, assuming of course that this is acceptable to the Board and the Technical Advisory Committee.

7.0 GENERAL:

It is hoped that the above is in sufficient detail for The Board's purposes at present. Further details can be provided should this be required. Kindly note that, in any event, it is our plan to request the opportunity to make another presentation to the TAC late in 1996, along similar lines to the presentation made in December, 1995.