



ROY R. CELLAN  
Corporate Manager  
Reclamation

ENVIRONMENTAL, HEALTH, SAFETY  
AND GOVERNMENT AFFAIRS

February 21, 2002

UPS Next Day 1Z 875 261 01 1002 230 6

Mr. Melvyn N. Leach, Branch Chief  
U.S. Nuclear Regulatory Commission  
Fuel Cycle Licensing Branch, NMSS  
Mail Stop T-8A33  
Two White Flint North  
11545 Rockville Pike  
Rockville, MD 20852

**RE: Docket No. 40-8903  
License No. SUA-1471  
Semi-Annual Environmental Monitoring Report  
Period - July through December 2001**

Dear Mr. Leach:

Pursuant to US Nuclear Regulatory Commission Regulation 10 CFR 40.85 and Part 20, Homestake Mining Company of California hereby submits two (2) copies of their semi-annual report for the second half of 2001 (July - December) for the Homestake Grants Project.

The content of the attached semi-annual report follows the general theme used for previously submitted reports. Pursuant to License Condition No. 15 of Amendment 31, the ground water data included with the report represents the results received from the point of compliance (POC) wells and the background P for this time period.

It should be noted that the Semi-Annual report for the period of **January through June 2001** reported TLD, Attachment 3, the heading is mislabeled "mrem/qr" when it should have been labeled "mrem/6 mo." The actual reported exposure rate for January through June 2001 was based on a 6-month reporting from the vendor so the numbers were right but the heading was mislabeled. We are sorry for any confusion related to this oversight.

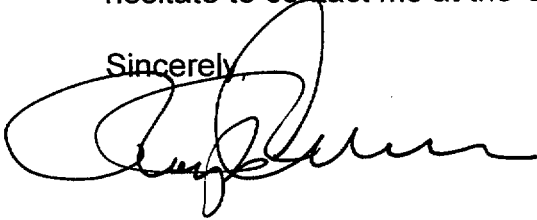
In October of 2001 Homestake Mining Company began the construction of a 300-gpm expansion of the RO water treatment plant at the Grants site. The expansion will allow the processing of 600-gpm of ground water while producing about 470-gpm of RO

Mr. Melvyn N. Leach, Branch Chief  
February 21, 2002  
Page 2 of 2

product water for reinjection. The plant expansion is scheduled to be completed early in the first quarter of 2002.

If you or your staff has any questions or comments regarding this report, please do not hesitate to contact me at the Grants site (505) 287-4456.

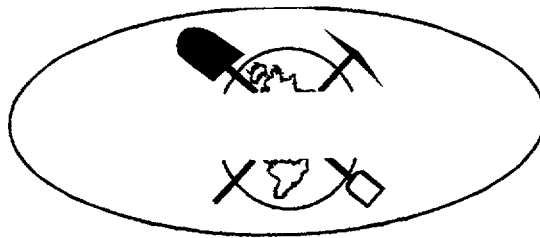
Sincerely,

A handwritten signature in black ink, appearing to be 'Melvyn N. Leach', written over the word 'Sincerely,'.

Enclosure

xc: Mr. Blair Spilzberg, Chief, Decommissioning Branch, w/enclosure  
Mr. Alan Cox, wo/enclosure  
Mr. George Hoffman, Hydro Engineering, w/enclosure  
Mr. Mark Purcell, EPA, w/enclosure

**HOMESTAKE MINING COMPANY  
OF  
CALIFORNIA  
GRANTS PROJECT**



**SEMI-ANNUAL ENVIRONMENTAL  
REPORT**

**JULY – DECEMBER**

**2001**

**State of New Mexico DP-200  
U.S. Nuclear Regulatory Commission License SUA-1471**

## **TABLE OF CONTENTS**

1.0	INTRODUCTION.....	1
2.0	ENVIRONMENTAL MONITORING PROGRAMS .....	1
2.1	Air Particulate Monitoring .....	2
2.2	Radon Gas Monitoring.....	2
3.0	WATER QUALITY MONITORING .....	2
4.0	DIRECT RADIATION .....	3
5.0	SURFACE CONTAMINATION.....	3
5.1	Personnel Skin and Clothing.....	3
5.2	Survey of Equipment Prior to Release for Unrestricted Use.....	3
6.0	LOWER LIMIT OF DETECTION .....	3
7.0	ANNUAL STATUS REPORT FOR TAILINGS AND EVAPORATION POND EMBANKMENTS .....	5
8.0	DATA SUMMARY AND CONCLUSIONS.....	5

## **TABLES**

Table 1 - Environmental Monitoring Program Excluding Groundwater Monitoring
Table 2 –Groundwater Monitoring Program (8-99)
Water Quality - Point of Compliance and Background
Table 2.1.1 - Water Quality Analyses for Well D1
Table 2.1.2 - Water Quality Analyses for Well S4
Table 2.1.3 - Water Quality Analyses for Well X
Table 2.1.4 - Water Quality Analyses for Background Well P
Table 3 - Occupational Monitoring Program

## **FIGURES**

Figure 1 - Monitoring & Sampling Locations
--

## **ATTACHMENTS**

Attachment 1 – High Volume Air Sampling Results
Attachment 2 - Radon Gas Monitoring Results
Attachment 3 - Environmental Gamma Radiation Results
Attachment 4 - Annual Effective Dose Equivalent to Individuals of the Public
Attachment 5 - 2001 Annual Status Report for the Large and Small Tailings Embankments

## 1.0 INTRODUCTION

This Semi-Annual Environmental Monitoring Report summarizes effluent monitoring data recorded for Homestake Mining Company of California - Grants Project (Homestake) from July through December 2001. The submittal of this report to the appropriate Nuclear Regulatory Commission (NRC) Regional Office and State of New Mexico within 60 days after January 1, and July 1 for each year of operation is required for all uranium mill facilities pursuant to 10 CFR Part 40.65. The monitoring data and the report format has been selected by Homestake representatives to satisfy the requirements of 10 CFR Part 40.65.

Homestake's monitoring and surveillance program for radioactive effluent releases have been designed to ensure the project compliance with 10 CFR Part 40, and Part 20 U.S. NRC Standards for Protection Against Radiation and closely approximates programs as described in NRC's Regulatory Guide 4.14, Radiological Effluent and Environmental Monitoring at Uranium Mills. Some effluent monitoring activities differ from those presented in the Regulatory Guide 4.14 as required by Homestake's Radioactive Materials License (SUA-1471).

Recontouring reclamation activities began in September 1993 and mill demolition commenced in late October 1993 and was completed December 10, 1995. A mill decommissioning completion report was submitted in February 1996 and approved by the NRC on January 28, 1999. The large tailings pile has been recontoured and covered with interim cover on the top and radon barrier on the outslopes. Bedding and erosion protection was placed on outslopes. Soil verification of the removal of off-pile contaminated soil is complete; the completion report submitted December 18, 1995 and approved by the NRC on January 29, 1999. In addition, a decommissioning report for the mine ion-exchange (IX) plant was completed and approved on December 22, 1997.

During the reporting period Homestake operated a water treatment plant or reverse osmosis (RO) plant. For the operating period from July through December, the RO plant processed an average 295-gpm while producing an average of 252-gpm of product water that was used for re-injection.

Homestake's groundwater monitoring program, as outlined in license Condition No. 35, continued as an ongoing program during this period. The requirements set forth in Condition No. 35 include the reporting of both radiological and non-radiological water quality parameters for specified wells, as well as the documentation of water injection and collection volumes of the groundwater cleanup system. The performance review of the corrective action program is submitted annually as a separate document and contains the groundwater monitoring information for January 1 through December 31 of each year. In order to meet NRC's requirement for semi-annual reporting, groundwater-monitoring data for the point-of-compliance (POC) wells and background well P is included in this report. It should be noted that while these POC wells will eventually be used to demonstrate groundwater restoration, they are not representative of off-site effluent levels.

## 2.0 ENVIRONMENTAL MONITORING PROGRAMS

The monitoring requirements for the site are summarized in Tables 1, 2, and 3. Details of the monitoring program are discussed in the following sections:

## **2.1 Air Particulate Monitoring**

Homestake continuously samples total suspended particulate at six locations around the reclamation site (see Figure 1). Those locations identified as HMC-1, HMC-2 and HMC-3 are areas at the property boundary expected to have the highest predictable concentrations of airborne radioactive particulate. The predominant wind direction is from the Southwest; accordingly, HMC-1, HMC-2 and HMC-3 are generally located down wind from Homestake's reclamation activities. The location identified at HMC-6 represents background conditions, and is located due west of the large tailings pile at the western most side of the property boundary. Locations HMC-4 and HMC-5 represent the sites of the nearest residences. The results are presented in Attachment 1.

Homestake uses a Sierra Instruments Model #305-200 High Volume Air Sampler (or equivalent) to continuously sample the ambient air of the locations shown in Figure 1. The samples are collected on 8-inch by 10-inch Whatman glass fiber filters (or equivalent), which are changed weekly or more frequently as required by dust loading. Energy Laboratories, Inc analyzes the collected samples quarterly for Natural Uranium, Radium-226, and Thorium-230.

## **2.2 Radon Gas Monitoring**

Radon gas concentrations are monitored on a continuous basis at the eight locations identified in Figure 1. The background station for radon gas is HMC #16, located Northwest of the site. Landauer Corporation's track-etch passive radon monitors (PRM), or the equivalent, are used to continuously monitor radon gas at each sampling location. Semi-annually Homestake personnel place new alpha particle sensitive detectors at monitoring locations and the exposed detectors are retrieved and returned to Landauer Corporation for analysis. The technique by which the PRM detectors measure radon gas concentrations consists of exposing an alpha-particle sensitive plastic detector, which is mounted in a plastic container, to ambient air. The decay of radon gas contained in the ambient air causes imprint tracks on the alpha-sensitive detector that can then be counted at a later time. The radon gas concentration can subsequently be calculated by determining the number of tracks per unit area of the detector. A filter is placed over the container opening to inhibit the entrance of any alpha-emitting dust particles. The results are presented in Attachment 2.

## **3.0 WATER QUALITY MONITORING**

Table 2 (8-99) outlines the sampling frequency and parameters monitored. Additionally, the volumes of water injected and recovered as part of the ground-water cleanup program is monitored on a weekly frequency and the values are documented. A performance review report is submitted by March 31 of each year according to License Condition 35E. In order to comply with 10 CFR 40.65, the groundwater monitoring data for the POC wells and background well P is included in this report. The data is reported in Tables 2.1.1-2.1.4.

The water quality of the POC wells is currently being restored and therefore the reported levels are not representative of effluent from the site. The concentration levels are therefore not compared to 10 CFR 20 effluent limits. A hydraulic barrier forces the water in the aquifer near these POC wells to move in the direction of the collection wells where the water is withdrawn and treated.

#### **4.0 DIRECT RADIATION**

Gamma exposure rates are continuously monitored through the use of thermoluminescent dosimeter (TLD) badges placed at each of the seven locations identified in Figure 1. HMC #16 is considered the background location for direct radiation. The data is reported in Attachment 3.

Gamma exposure rates are continuously monitored through the use of thermo luminescent dosimeter (TLD) at each of the seven locations identified in Figure 1. Each TLD badge consists of five LiF chips selected for uniform response and placed in a plastic holder. The plastic provides adequate protection from weather for these badges to be used out-of-doors. The TLD's are exchanged semi-annually and analyzed by an approved independent laboratory (currently Landauer Inc.). The integrated levels of direct environmental radiation are recorded for each of the seven locations. HMC #16 is considered the background location for direct radiation. The data are reported in Attachment 3.

#### **5.0 SURFACE CONTAMINATION**

The Occupational Monitoring Program requirements are summarized in Table 3. The aspects related to contamination control are discussed briefly below.

##### **5.1 Personnel Skin and Clothing**

The monitoring of personnel for alpha contamination is required as part of all radiation work permits using standard operating procedures. No releases of personnel or clothing above administrative limits were reported during this reporting period.

##### **5.2 Survey of Equipment Prior to Release for Unrestricted Use**

Equipment surveys are required for all equipment that is to be removed from contaminated areas as specified in radiation work permits. Standard Operating Procedures are used for these surveys. No releases of contaminated material above NRC release criteria were reported.

#### **6.0 LOWER LIMIT OF DETECTION**

Homestake representatives have calculated the Lower Limit of Detection (LLD) for each measurement system, where applicable; to more accurately evaluate concentrations of radioactive material measured in the environment surrounding the mill site. The lower limit of detection is defined in the U.S. Nuclear Regulatory Guide 4.14 as the smallest concentration of radioactive material sampled that has a 95% probability of being detected, with only a 5% probability that a blank sample will yield a response interpreted to mean that radioactive material is present. Since the LLD is a function of sample volume, counting efficiency, radiochemical yield, etc., it varies for different sampling and analysis procedures.

For the individual measurement systems for which Homestake has calculated LLDs, the following formula was utilized:

$$LLD = \frac{4.66 S_b}{3.7 E 4 V Y \exp(-\lambda \Delta t)}$$

Where:

LLD is the lower limit of detection (microCuries per milliliter);  
 $S_b$  is the standard deviation of the instrument background counting rate (counts per second);  
 $3.7 E 4$  is the number of disintegrations per second per microCurie;  
 $E$  is the counting efficiency (counts per disintegration);  
 $V$  is the sample volume (milliliters);  
 $Y$  is the fractional radiochemical yield (when applicable);  
 $\lambda$  is the radioactive decay constant for the particular radionuclide; and;  
 $\Delta t$  is the elapsed time between sample collection and counting

The value of  $S_b$  used in the calculation of the LLD for a particular measurement system will be based on the actual observed variance of the instrument background counting rate. The laboratory has been instructed to report the LLD for each measurement considering all of the parameters associated with the measurement system and the sample size.

The vendor laboratory that performed the analyses reported herein has documented that the LLD for air and water samples will meet or exceed the requirements in Regulatory Guide 4.14. This assumes a minimum water sample size of 1 liter and an air sample volume of 2 E09 ml. Landauer, Inc reports the LLD for radon-222. The LLDs for the constituents are:

Ra-226, Th-230 in air	1 E-16 $\mu$ Ci/ml
Rn-222 in air	30 pCi(d/l)
U-nat in air	1 E-16 $\mu$ Ci/ml
U-nat in water	2 E-10 $\mu$ Ci/ml
Ra-226, Th-230 in water	2 E-9 $\mu$ Ci/ml
Ra-228 in water	1 E-9 $\mu$ Ci/ml

U-nat is analyzed by a fluorometric method by the current vendor laboratory. In order to determine the LLD, the laboratory has performed the analysis on a blank sample many times and uses the standard deviation of these background measurements to calculate the LLD. This LLD is specified for all analyses as long as the sample size or volume meets the minimum value.



## **7.0 ANNUAL STATUS REPORT FOR TAILINGS AND EVAPORATION POND EMBANKMENTS**

License Condition 12 specifies that periodic inspection of the large and small tailing embankments are made and documented. An annual status report summarizing the monthly inspections for 2001 is included as Attachment No. 5.

## **8.0 DATA SUMMARY AND CONCLUSIONS**

The summaries of Homestake's effluent monitoring program included in this submittal contain data for each of the regulated parameters released to unrestricted areas. DP-200, dated November 15, 1995, and 10 CFR Part 40.65 requires that Homestake submit its effluent release monitoring data to the State of New Mexico and the NRC within 60 days of the end of the six-month period ending January 1 and July 1 of each year. Homestake is submitting this report to satisfy the regulatory requirements cited above. Included in this report's attachments are summaries of the results of the effluent monitoring activities conducted by Homestake and pertinent to the required monitoring time period.

The data collected in many of Homestake's effluent monitoring programs can be readily compared to 10 CFR Part 20 values. Homestake has not exceeded 10 CFR Part 20 values in any of their effluents monitored during the period covered by this report. This, of course, does not include the ground water values at the POC wells as discussed earlier. The maximum annual effective dose equivalent to the public has been calculated for the year 2001, based upon the environmental monitoring data. The report, Attachment 4, shows that the effective dose equivalent to the nearest resident is less than the 100-mrem/year NRC limit.

Vegetation and soil samples are no longer required on an annual basis per Amendment 24 to Source Material License.

**Table 1 - Environmental Monitoring Program Excluding  
Groundwater Monitoring**

TABLE 1 - Environmental Monitoring Program Excluding Groundwater Monitoring

Type of Sample	Number	Locations	Method	Frequency	Analytical Parameters
AIR Particulates	3	HMC1, HMC2, HMC3 at or near the site boundary in sectors that have the highest predicted concentrations of radioactive airborne particulates.	Continuous (High Vol.)	Weekly filter change or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230
	2	HMC4, HMC5 at nearest occupied residences	Continuous (High Vol.)	Weekly filter change, or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230
	1	HMC6 background location	Continuous (High Vol.)	Weekly filter change, or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230
Radon Gas	8	Locations described in Air - Particulates & HMC7 on S boundary & HMC16 as a background	Continuous Track-etch	Semi-Annual	Rn-222
DIRECT RADIATION	7	Locations described in Air - Particulates & HMC-16 as a background	Continuous Track-etch	Semi-Annual	Gamma Exposure Rate

**Table 2 – Groundwater Monitoring Program (8-99)**

**TABLE 2 – Groundwater Monitoring Program (8-99)**

<b>Well Number</b>	<b>Parameters to be Monitored</b>	<b>Frequency of Monitoring</b>
<b>#1 &amp; #2 Deepwells</b>	<b>D</b>	<b>Annually</b>
<b>Broadview Acres Wells 446, SUB1, SUB2, SUB3</b>	<b>G</b>	<b>Annually</b>
<b>Felice Acres Wells 490, 492, 493, 494</b>	<b>G</b>	<b>Annually</b>
<b>Murray Acres Wells 802, 844</b>	<b>G</b>	<b>Annually</b>
<b>Pleasant Valley Wells 688, 846</b>	<b>G</b>	<b>Annually</b>
<b>Regional Wells 920, 942</b>	<b>G</b>	<b>Annually</b>
<b>Site Monitoring Wells F, FB, GH, MO, CW2</b>	<b>G</b>	<b>Annually</b>
<b>Collection System Wells</b>	<b>Total Volume</b>	<b>Monthly</b>
<b>Injection System Wells</b>	<b>Total Volume</b>	<b>Monthly</b>
<b>Reversal Wells B, BA, KZ, KF, SO, SP, S1, S2</b>	<b>Water Level</b>	<b>Weekly</b>
<b>Point of Compliance Wells D1, X, S4</b>	<b>B, F</b>	<b>Annually</b>
<b>Background Well P</b>	<b>B</b>	<b>Annually</b>

**B =** Water Level, pH, TDS, SO<sub>4</sub>, Cl, HCO<sub>3</sub>, CO<sub>3</sub>, Na, Ca, Mg, K, NO<sub>3</sub>, U, Se, Mo, Ra-226

**D =** Ca, Mg, K, Na, HCO<sub>3</sub>, CO<sub>3</sub>, Cl, SO<sub>4</sub>, pH, TDS, Al, As, Ba, Cd, Co, Cr, Cu, CN, F, Fe, Pb, Mn, Hg, Mo, Ni, NO<sub>3</sub> as N, Se, Ag, Zn, U, Filtered Ra-226

**F =** V, Ra-228, Th-230

**G =** Water Level, SO<sub>4</sub>, U, Se, TDS, Mo

**Table 2.1.1 - Water Quality Analyses for Well D1**



Billings • Casper • Gillette  
Helena • Rapid City

## ENERGY LABORATORIES, INC.

SHIPPING: 2393 SALT CREEK HIGHWAY • CASPER, WY 82601

MAILING: P.O. BOX 3258 • CASPER, WY 82602

E-mail: casper@energylab.com • FAX: (307) 234-1639

PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

### LABORATORY ANALYSIS REPORT

Client: Homestake Mining Company

Sample ID:  
Sample Date/Time:  
Date Received:  
Sample Matrix:  
Laboratory ID:  
Report Date:

D1	D1
05/30/2001 08:50	05/30/2001 08:49
06/11/2001 10:00	06/11/2001 10:00
Liquid, Water	Liquid, Water
01-33453-1	01-33453-2
July 6, 2001	July 6, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	211	214
Magnesium	2	EPA 200.7	mg/L	1.0	49.1	49.6
Sodium	4	EPA 200.7	mg/L	1.0	329	331
Potassium	3	EPA 200.7	mg/L	1.0	4.2	4.2
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	522	533
Sulfate	8	EPA 200.7	mg/L	1.0	769	772
Chloride	7	EPA 200.7	mg/L	0.10	192	194
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	2.67	2.69

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10	1960	1980
Alkalinity	75	SM 2320-B	mg/L	1.0	428	437
pH	9	SM 4500-H-B	std. units	0.10	7.95	7.71

Trace Metals						
Molybdenum	36	EPA 200.8	mg/L	0.03	0.97	0.98
Selenium	40	EPA 200.8	mg/L	0.005	0.111	0.114
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	1.34	1.37
*Uranium Precision ±	244				0.003	0.003
Uranium, Rad.	113	EPA 200.8	μCi/mL	2.0E-10	9.1E-07	9.3E-07
*Uranium Precision ±	114				1.8E-09	1.9E-09
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±	245				0.3	0.2
Radium 226	256	EPA 903.0	μCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				3.0E-10	2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±	257				1.0	1.0
Radium 228	359	EPA 904.0	μCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±	360				1.0E-09	1.0E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.5	0.4
Thorium Error Estimate ±	248				0.5	0.4
Thorium 230	362	EPA 907.0	μCi/mL	2.0E-10	5.0E-10	4.0E-10
Thorium Error Estimate ±	363				5.0E-10	4.0E-10

Quality Assurance Data			Target Range	
Anion	meq		30.2	30.5
Cation	meq		29.1	29.3
SM A/C Balance	%	-5 - +5	-1.95	-1.97
Calc TDS	mg/L		1828	1844
TDS A/C Balance	dec. %	0.80 - 1.20	1.07	1.07

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

msh: r:\reports\clients\2001\homestake(e)\grants\liquid\d1\33453-2.xls

ENTERED AUG 1 6 2001 TRACKING NO. PAGE NO.

COMPLETE ANALYTICAL SERVICES

33453R00003

**Table 2.1.2 - Water Quality Analyses for Well X**





### LABORATORY ANALYSIS REPORT

Client: Homestake Mining Company

Sample ID:

Sample Date/Time:

Date/Time Received:

Sample Matrix:

Laboratory ID:

Report Date:

Revised Report Date:

X	X
10/17/2000 14:04	07/25/2001 08:17
10/19/2000 10:00	07/31/2001 10:00
Liquid, Water	Liquid, Water
00-36916-3	C01070307-1
November 21, 2000	August 23, 2001
-	September 12, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	128	57.6
Magnesium	2	EPA 200.7	mg/L	1.0	36.1	16.3
Sodium	4	EPA 200.7	mg/L	1.0	92.4	68.6
Potassium	3	EPA 200.7	mg/L	1.0	3.8	2.6
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	254	312
Sulfate	8	EPA 200.7	mg/L	1.0	277	63.0
Chloride	7	EPA 200.7	mg/L	0.10	109	32.3
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	2.07	1.20

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10	915	427
Alkalinity	75	SM 2320-B	mg/L	1.0	208	256
pH	9	SM 4500-H-B	std. units	0.01	7.85	8.10

Trace Metals						
Chromium	27	EPA 200.7	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	0.30	0.15
Selenium	40	EPA 200.8	mg/L	0.005	0.017	< 0.005
Vanadium	42	EPA 200.8	mg/L	0.01	0.02	0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	0.096	0.045
*Uranium Precision ±	244				0.009	0.000
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	6.5E-08	3.0E-08
*Uranium Precision ±	114				5.9E-09	3.4E-10
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±	245				0.3	0.1
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				3.0E-10	1.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	1.3
Radium Error Estimate ±	257				0.8	1.0
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	< 1.0E-09	1.3E-09
Radium Error Estimate ±	360				8.0E-10	1.0E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	< 0.2	< 0.2
Thorium Error Estimate ±	248				0.2	0.2
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Thorium Error Estimate ±	363				2.0E-10	2.0E-10

Quality Assurance Data			Target Range	
Anion	meq		13.2	7.46
Cation	meq		13.5	7.29
SM A/C Balance	%	-5 - +5	1.26	-1.15
Calc TDS	mg/L		783	403
TDS A/C Balance	dec. %	0.80 - 1.20	1.17	1.06

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

**Table 2.1.3 - Water Quality Analyses for Well S4**

### LABORATORY ANALYSIS REPORT

**Client:** Homestake Mining Company

**Sample ID:**

**Sample Date/Time:**

**Date/Time Received:**

**Sample Matrix:**

**Laboratory ID:**

**Report Date:**

S4	S4
12/06/2000 11:11	07/23/2001 15:00
12/11/2000 10:30	07/31/2001 10:00
Liquid, Water	Liquid, Water
00-38137-5	C01080027-004
January 9, 2001	September 11, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	419	410
Magnesium	2	EPA 200.7	mg/L	1.0	87.6	86.0
Sodium	4	EPA 200.7	mg/L	1.0	478	530
Potassium	3	EPA 200.7	mg/L	1.0	7.2	6.5
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	476	426
Sulfate	8	EPA 200.7	mg/L	1.0	1750	1700
Chloride	7	EPA 200.7	mg/L	0.10	165	150
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	0.11	< 0.10

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10	3660	3280
Alkalinity	75	SM 2320-B	mg/L	1.0	391	350
pH	9	SM 4500-H-B	std. units	0.01	7.67	7.90

Trace Metals						
Molybdenum	36	EPA 200.8	mg/L	0.03	0.67	0.54
Selenium	40	EPA 200.8	mg/L	0.005	0.042	0.013
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	4.13	2.90
*Uranium Precision ±	244				0.372	0.067
Uranium, Rad.	113	EPA 200.8	μCi/mL	2.0E-10	2.8E-06	2.0E-06
*Uranium Precision ±	114				2.5E-07	4.5E-08
Radium 226	45	EPA 903.0	pCi/L	0.2	0.9	0.7
Radium Error Estimate	245				0.2	0.3
Radium 226	256	EPA 903.0	μCi/mL	2.0E-10	9.0E-10	7.0E-10
Radium Error Estimate	258				2.0E-10	3.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	2.9	< 1.0
Radium Error Estimate	257				1.1	0.8
Radium 228	359	EPA 904.0	μCi/mL	1.0E-09	2.9E-09	< 1.0E-09
Radium Error Estimate	360				1.1E-09	8.0E-10
Thorium 230	48	EPA 907.0	pCi/L	0.2	< 0.2	< 0.2
Thorium Error Estimate	248				0.3	0.1
Thorium 230	362	EPA 907.0	μCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Thorium Error Estimate	363				3.0E-10	1.0E-10

Quality Assurance Data			Target Range	
Anion	meq		49.0	46.7
Cation	meq		49.2	50.9
SM A/C Balance	%	-5 - +5	0.27	4.32
Calc TDS	mg/L		3146	3097
TDS A/C Balance	dec. %	0.80 - 1.20	1.16	1.06

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

**Table 2.1.4 - Water Quality Analyses for Background Well P**

## LABORATORY ANALYSIS REPORT

Client: Homestake Mining Company

Sample ID:

Sample Date/Time:

Date/Time Received:

Sample Matrix:

Laboratory ID:

Report Date:

P	P
11/28/2000 09:03	07/23/2001 12:02
12/07/2000 10:30	07/31/2001 10:00
Liquid, Water	Liquid, Water
00-38065-3	C01080046-1
January 12, 2001	August 23, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	214	238
Magnesium	2	EPA 200.7	mg/L	1.0	45.2	51.2
Sodium	4	EPA 200.7	mg/L	1.0	231	239
Potassium	3	EPA 200.7	mg/L	1.0	4.9	5.0
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	256	243
Sulfate	8	EPA 200.7	mg/L	1.0	910	983
Chloride	7	EPA 200.7	mg/L	1.0	49.0	53.8
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	6.85	8.40

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10	1790	1870
Alkalinity	75	SM 2320-B	mg/L	1.0	210	199
pH	9	SM 4500-H-B	std. units	0.01	7.71	7.90

Trace Metals						
Molybdenum	36	EPA 200.8	mg/L	0.03	< 0.03	< 0.03
Selenium	40	EPA 200.8	mg/L	0.005	0.137	0.170

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	0.029	0.030
*Uranium Precision ±	244				0.003	0.0007
Uranium, Rad.	113	EPA 200.8	μCi/mL	2.0E-10	1.9E-08	2.0E-08
*Uranium Precision ±	114				1.7E-09	4.7E-10
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	0.4
Radium Error Estimate ±	245				0.2	0.3
Radium 226	256	EPA 903.0	μCi/mL	2.0E-10	< 2.0E-10	4.0E-10
Radium Error Estimate ±	258				2.0E-10	3.0E-10

Quality Assurance Data			Target Range	
Anion	meq		25.1	26.6
Cation	meq		24.6	26.7
SM A/C Balance	%	-5 - +5	-0.85	0.14
Calc TDS	mg/L		1613	1730
TDS A/C Balance	dec. %	0.80 - 1.20	1.11	1.08

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

### **Table 3 - Occupational Monitoring Program**

**Table 3 - Occupational Monitoring Program**

Type of Sample	Number	Locations	Method	Frequency	Analytical Parameters
Lapel Personal Air Sample	As required by RWP	As required by RWP (2 L/min or eq.)	HP-1	As required by RWP	Alpha, U-Nat
Lapel Personal Air Sampler Calibration	As required by RWP	N/A	HP-1	As required by RWP	Flow rate
Release of Equip.	As required by RWP	Potentially Contaminated Equipment and Materials	HP-4	As required by RWP	Alpha, beta gamma
ALARA	N/A	As required by RPA	HP-6	N/A	As required by RPA
Respiratory Protection Protection	As required by RWP	As required by RWP	HP-7	N/A	N/A
Bioassay	As required by RWP	As required by RWP	HP-8 after mill decommissioning; termination	Baseline, Semi-annual	U-Nat in urine
Instrument Calibration	Variable	Radiation Detection Instruments in use	HP-10	6 months or less	N/A
Personnel Gamma (TLD)	Variable	Personnel	HP-11	Quarterly	Gamma
Personnel Contam.	As required by RWP	As required by RWP	HP-12	As required by RWP	Alpha
Radiation Protection Training	As required	Mill Site taught by RPA (certified individual) subjects as per Reg Guide 8.31	HP-14 for people working with groundwater or physical work with tailings sand/slimes	Initial & annual refresher	Training Class & Written Test

HP-# = Homestake procedure number; RPA = Radiation Protection Administrator; RWP =

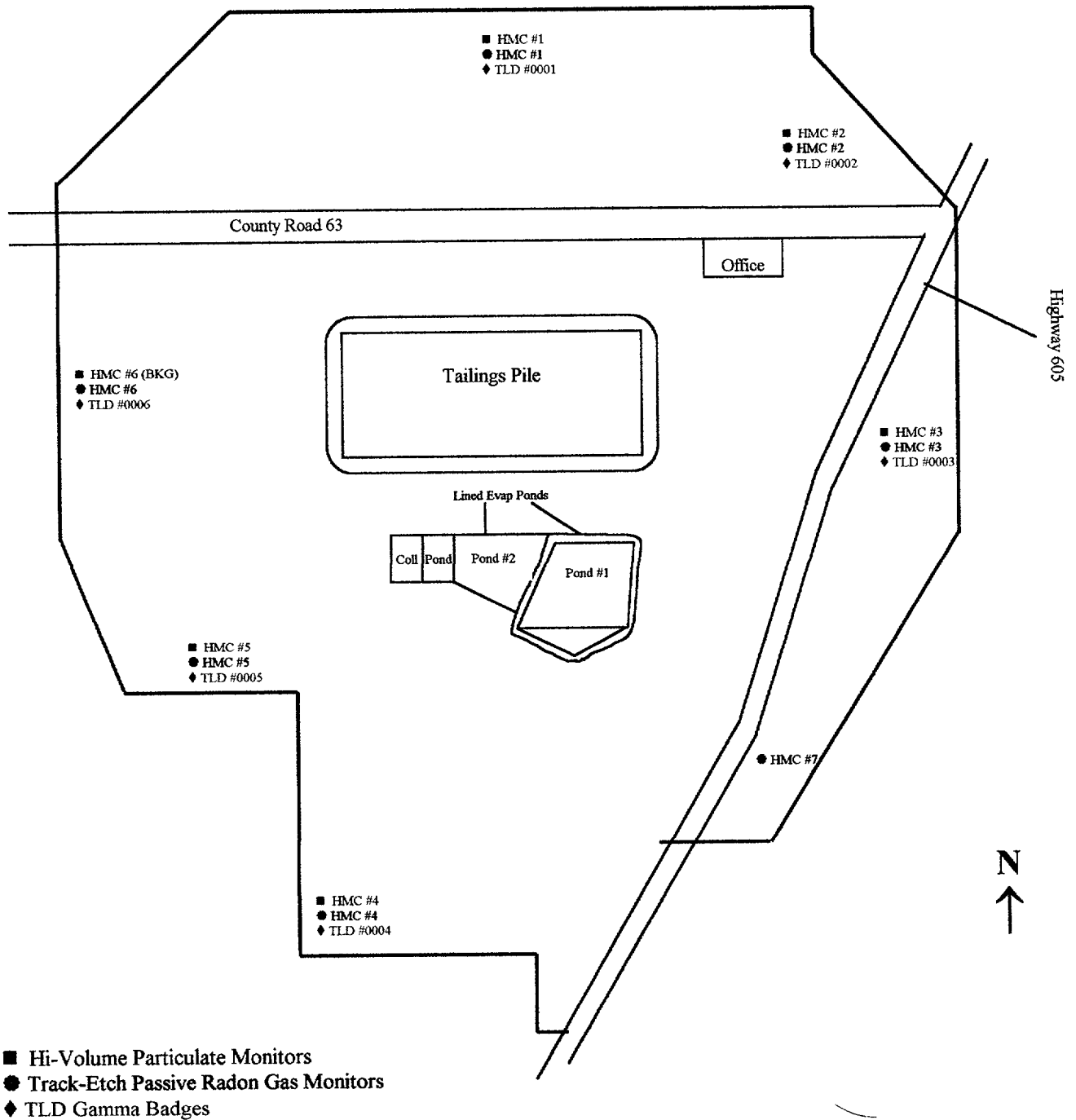
Radiation Work Permit; TLD = Thermoluminescent Dosimeter

## **Figure 1 – Monitoring & Sampling Locations**



# HOMESTAKE MINING COMPANY GRANTS PROJECT Monitoring & Sampling Locations

- HMC #0016 (BKG)
- ◆ TLD #0016 (BKG)



**FIGURE 1**

## **Attachment 1 – High Volume Air Sampling Results**



## HIGH VOLUME AIR ANALYSIS REPORT

CLIENT:

HOMESTAKE MINING - GRANTS, NEW MEXICO

REPORT DATE:

November 11, 2001

DATE SAMPLED:

3rd Quarter 2001

EPA Method		200.8	903.0		907.0	
Laboratory Number	Sample I.D.	Uranium-nat pCi/filt.	Radium 226 pCi/filt. +/-		Thorium 230 pCi/filt. +/-	
C01100018-001A	HMC 1	243	4.0	0.4	3.6	1.7
C01100018-002A	HMC 2	192	4.9	0.4	4.9	0.4
C01100018-003A	HMC 3	665	3.6	0.4	<0.2	N/A
C01100018-004A	HMC 4	640	3.0	0.9	3.0	0.9
C01100018-005A	HMC 5	985	1.9	0.9	<0.2	N/A
C01100018-006A	HMC 6	230	4.2	0.4	1.7	0.9
C01100018-007A	HMC 7	0.640	<0.4	N/A	<0.4	0.0
LLD	pCi/filter	0.4	0.4		0.4	



### HIGH VOLUME AIR ANALYSIS REPORT

CLIENT:

HOMESTAKE MINING - GRANTS, NEW MEXICO

REPORT DATE:

January 15, 2002

DATE SAMPLED:

4th Quarter 2001

EPA Method		200.8	903.0		907.0	
Laboratory Number	Sample I.D.	Uranium-nat pCi/filt.	Radium 226 pCi/filt. +/-		Thorium 230 pCi/filt. +/-	
C01120827-001A	HMC 1	98.8	1.7	0.9	2.6	0.9
C01120827-002A	HMC 2	41.1	<0.4	N/A	2.5	1.1
C01120827-003A	HMC 3	321	6.2	0.4	8.7	2.6
C01120827-004A	HMC 4	299	1.7	0.9	3.4	1.3
C01120827-005A	HMC 5	498	2.6	0.4	1.9	0.9
C01120827-006A	HMC 6	121	6.0	0.4	4.3	1.5
C01120827-007A	HMC 7	0.51	<0.4	N/A	<0.4	0.0
LLD	pCi/filter	0.4	0.4		0.4	



HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 15, 2002

SAMPLE ID: HMC 1

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
01-31995-1 First Quarter 2001 Air Volume in mLs 1.50E+11	<sup>nat</sup> U	1.71E-16	N/A	1.00E-16	9.00E-14	1.90E-01
	<sup>230</sup> Th	< 1.00E-16	1.01E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	1.26E-17	1.00E-16	9.00E-13	< 1.11E-02
01-33054-1 Second Quarter 2001 Air Volume in mLs 7.44E+10	<sup>nat</sup> U	1.41E-15	N/A	1.00E-16	9.00E-14	1.57E+00
	<sup>230</sup> Th	< 1.00E-16	2.03E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	1.07E-16	1.52E-17	1.00E-16	9.00E-13	1.19E-02
C01100018-001A Third Quarter 2001 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	1.69E-15	N/A	1.00E-16	9.00E-14	1.88E+00
	<sup>230</sup> Th	< 1.00E-16	1.18E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.63E-18	1.00E-16	9.00E-13	< 1.11E-02
C01120827-001A Fourth Quarter 2001 Air Volume in mLs 1.36E+11	<sup>nat</sup> U	7.26E-16	N/A	1.00E-16	9.00E-14	8.07E-01
	<sup>230</sup> Th	< 1.00E-16	6.95E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.95E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

lmh: r:\reports\clients2001\homestake(e)\air\4q2001.xls

TRACKING NO. PAGE NO.

12827R000003



### HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 15, 2002

SAMPLE ID: HMC 2

Quarter/Date Sampled Volume	Air	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
01-31995-2 First Quarter 2001 Air Volume in mLs 1.51E+11		$^{238}\text{U}$	1.12E-16	N/A	1.00E-16	9.00E-14	1.24E-01
		$^{230}\text{Th}$	< 1.00E-16	1.00E-17	1.00E-16	2.00E-14	< 5.00E-01
		$^{226}\text{Ra}$	< 1.00E-16	5.01E-18	1.00E-16	9.00E-13	< 1.11E-02
01-33054-2 Second Quarter 2001 Air Volume in mLs 8.45E+10		$^{238}\text{U}$	1.21E-15	N/A	1.00E-16	9.00E-14	1.34E+00
		$^{230}\text{Th}$	< 1.00E-16	2.01E-17	1.00E-16	2.00E-14	< 5.00E-01
		$^{226}\text{Ra}$	< 1.00E-16	1.12E-17	1.00E-16	9.00E-13	< 1.11E-02
C01100018-002A Third Quarter 2001 Air Volume in mLs 1.49E+11		$^{238}\text{U}$	1.29E-15	N/A	1.00E-16	9.00E-14	1.43E+00
		$^{230}\text{Th}$	< 1.00E-16	0.00E+00	1.00E-16	2.00E-14	< 5.00E-01
		$^{226}\text{Ra}$	< 1.00E-16	2.54E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-002A Fourth Quarter 2001 Air Volume in mLs 1.43E+11		$^{238}\text{U}$	2.87E-16	N/A	1.00E-16	9.00E-14	3.19E-01
		$^{230}\text{Th}$	< 1.00E-16	7.93E-18	1.00E-16	2.00E-14	< 5.00E-01
		$^{226}\text{Ra}$	< 1.00E-16	0.00E+00	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

lmh: r:\reports\clients2001\homestake(e)\air\4q2001.xls



HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 15, 2002

SAMPLE ID: HMC 3

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
01-31995-3 First Quarter 2001 Air Volume in mLs 1.60E+11	<sup>nat</sup> U	3.52E-16	N/A	1.00E-16	9.00E-14	3.91E-01
	<sup>230</sup> Th	< 1.00E-16	0.00E+00	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	9.45E-18	1.00E-16	9.00E-13	< 1.11E-02
01-33054-3 Second Quarter 2001 Air Volume in mLs 8.59E+10	<sup>nat</sup> U	7.55E-15	N/A	1.00E-16	9.00E-14	8.39E+00
	<sup>230</sup> Th	< 1.00E-16	1.98E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	8.80E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-003A Third Quarter 2001 Air Volume in mLs 1.47E+11	<sup>nat</sup> U	4.53E-15	N/A	1.00E-16	9.00E-14	5.03E+00
	<sup>230</sup> Th	< 1.00E-16	7.71E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.57E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-003A Fourth Quarter 2001 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	2.23E-15	N/A	1.00E-16	9.00E-14	2.48E+00
	<sup>230</sup> Th	< 1.00E-16	1.84E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.63E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration



HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 15, 2002

SAMPLE ID: HMC 4

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
01-31995-4 First Quarter 2001 Air Volume in mLs 1.58E+11	$^{\text{nat}}\text{U}$	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	$^{230}\text{Th}$	< 1.00E-16	9.57E-18	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	9.57E-18	1.00E-16	9.00E-13	< 1.11E-02
01-33054-4 Second Quarter 2001 Air Volume in mLs 8.38E+10	$^{\text{nat}}\text{U}$	3.36E-15	N/A	1.00E-16	9.00E-14	3.73E+00
	$^{230}\text{Th}$	< 1.00E-16	1.13E-17	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	9.02E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-004A Third Quarter 2001 Air Volume in mLs 1.46E+11	$^{\text{nat}}\text{U}$	4.38E-15	N/A	1.00E-16	9.00E-14	4.87E+00
	$^{230}\text{Th}$	< 1.00E-16	7.77E-18	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	6.47E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-004A Fourth Quarter 2001 Air Volume in mLs 1.46E+11	$^{\text{nat}}\text{U}$	2.04E-15	N/A	1.00E-16	9.00E-14	2.27E+00
	$^{230}\text{Th}$	< 1.00E-16	9.06E-18	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	0.00E+00	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration





# HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 15, 2002

SAMPLE ID: HMC 5

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
01-31995-5 First Quarter 2001 Air Volume in mLs 1.49E+11	$^{238}\text{U}$	1.49E-16	N/A	1.00E-16	9.00E-14	1.66E-01
	$^{230}\text{Th}$	< 1.00E-16	0.00E+00	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	1.01E-17	1.00E-16	9.00E-13	< 1.11E-02
01-33054-5 Second Quarter 2001 Air Volume in mLs 7.62E+10	$^{238}\text{U}$	2.94E-15	N/A	1.00E-16	9.00E-14	3.27E+00
	$^{230}\text{Th}$	< 1.00E-16	1.74E-17	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	9.92E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-005A Third Quarter 2001 Air Volume in mLs 1.41E+11	$^{238}\text{U}$	6.99E-15	N/A	1.00E-16	9.00E-14	7.76E+00
	$^{230}\text{Th}$	< 1.00E-16	1.34E-17	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	6.70E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-005A Fourth Quarter 2001 Air Volume in mLs 1.41E+11	$^{238}\text{U}$	3.53E-15	N/A	1.00E-16	9.00E-14	3.92E+00
	$^{230}\text{Th}$	< 1.00E-16	6.70E-18	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	2.68E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration



# HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 15, 2002

SAMPLE ID: HMC 6

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
01-31995-6 First Quarter 2001 Air Volume in mLs 1.47E+11	$^{\text{nat}}\text{U}$	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	$^{230}\text{Th}$	< 1.00E-16	1.29E-17	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	1.29E-17	1.00E-16	9.00E-13	< 1.11E-02
01-33054-6 Second Quarter 2001 Air Volume in mLs 7.56E+10	$^{\text{nat}}\text{U}$	9.82E-16	N/A	1.00E-16	9.00E-14	1.09E+00
	$^{230}\text{Th}$	< 1.00E-16	1.25E-17	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	1.00E-17	1.00E-16	9.00E-13	< 1.11E-02
C01100018-006A Third Quarter 2001 Air Volume in mLs 1.22E+11	$^{\text{nat}}\text{U}$	1.89E-15	N/A	1.00E-16	9.00E-14	2.10E+00
	$^{230}\text{Th}$	< 1.00E-16	7.75E-18	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	3.10E-18	1.00E-16	9.00E-13	< 1.11E-02
C01100018-006A Fourth Quarter 2001 Air Volume in mLs 1.44E+11	$^{\text{nat}}\text{U}$	8.41E-16	N/A	1.00E-16	9.00E-14	9.35E-01
	$^{230}\text{Th}$	< 1.00E-16	1.05E-17	1.00E-16	2.00E-14	< 5.00E-01
	$^{226}\text{Ra}$	< 1.00E-16	2.63E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration



QUALITY ASSURANCE REPORT  
HOMESTAKE MINING CORPORATION

Laboratory ID Range:

Sample Matrix:

Sample Date:

Date Received:

Report Date:

C01100018-001A-007A

Air Filter

3rd Quarter 2001

10/01/2001

November 11, 2001

	Method	Relative Percent Difference <sup>1</sup>	Spike Recovery (Percent) <sup>2</sup>	LCS Recovery (Percent)	Method Blank pCi/Filter	Date Analyzed	Analyst
Laboratory #:	C01100018-004A		C01100018-004A				
Uranium:	6020	1.78	108	-	<0.4	10/31/2001	ts
Laboratory #:	C01090758-010A		C01090758-015A		RA-279		
Radium 226:	903.0	2.4	90	109	<0.4	10/25/2001	rs
Laboratory #:	C01100018-007A		C01100018-007A		AS-100		
Thorium 230:	907.0	10.01	98	97	<0.4	10/25/2001	ph
Digestion:	Volume		Units		Batch		
	SW3050	1.89	Liter		323	10/16/2001	rcb

(1) These values are an assessment of analytical precision. The acceptance range is 0-20% for sample results above 10 times the reporting limit. This range is not applicable to samples with results below 10 times the reporting limit.

(2) These values are an assessment of analytical accuracy. They are a percent recovery of the spike addition. ELI performs a matrix spike on 10 percent of all samples for each analytical method.

lmh: r:\reports\clients2001\homestake(e)\air\3q2001.xls

TRACKING NO. PAGE NO.

10018R00008

**QUALITY ASSURANCE REPORT  
HOMESTAKE MINING CORPORATION**

Laboratory ID Range:  
Sample Matrix:  
Sample Date:  
Date Received:  
Report Date:

C01120827-001A-007A
Air Filter
4th Quarter 2001
12/31/2001
January 15, 2002

	<u>Method</u>	<u>Relative Percent Difference<sup>1</sup></u>	<u>Spike Recovery (Percent)<sup>2</sup></u>	<u>LCS Recovery (Percent)</u>	<u>Method Blank pCi/Filter</u>	<u>Date Analyzed</u>	<u>Analyst</u>
Laboratory #:	C02010107-001A		C02010107-001A				
Uranium:	6020	3.7	105	-	<0.4	01/09/2002	ts
Laboratory #:	C01110426-001A		C01110426-001A		RA-352		
Radium 226:	903.0	9.3	97	110	<0.4	01/02/2002	rs
Laboratory #:	AS117SPIKE		AS117MB		AS-117		
Thorium 230:	907.0	4.0	115	117	<0.4	01/02/2002	pch
Digestion:	<u>Volume</u>		<u>Units</u>		<u>Batch</u>		
	SW3050	1.89	Liters		745	12/31/2001	rcb

(1) These values are an assessment of analytical precision. The acceptance range is 0-20% for sample results above 10 times the reporting limit. This range is not applicable to samples with results below 10 times the reporting limit.

(2) These values are an assessment of analytical accuracy. They are a percent recovery of the spike addition. ELI performs a matrix spike on 10 percent of all samples for each analytical method.

lmh: r:\reports\clients2001\homestake(e)\air\4q2001.xls

## **Attachment 2 - Radon Gas Monitoring Results**

Attachment 2 - Radon Gas Monitoring Results  
Track-Etch Passive Survey

Location	Monitoring Period	Rn Concentration ( $\mu\text{Ci/ml}$ )	Error Estimate ( $\mu\text{Ci/ml}$ )	% Limit* (%)	LLD ( $\mu\text{Ci/ml}$ )
Hi-Vol #1 N Outer Perimeter	6/29/2001 - 12/28/2001	1.1E-09	2.6E-10	11	1.6E-10
Hi-Vol #2 NE Outer Perimeter	6/29/2001 - 12/28/2001	1.3E-09	2.9E-10	13	1.6E-10
Hi-Vol #3 E Outer Perimeter	6/29/2001 - 12/28/2001	7.0E-10	1.9E-10	7	1.6E-10
Hi-Vol #4 S Outer Perimeter	6/29/2001 - 12/28/2001	1.4E-09	2.9E-10	14	1.6E-10
Hi-Vol #5 N of Nearest Residence	6/29/2001 - 12/28/2001	1.4E-09	3.0E-10	14	1.6E-10
Hi-Vol #6 W of Outer Perimeter	6/29/2001 - 12/28/2001	1.1E-09	2.7E-10	11	1.6E-10
HMC #7 S Boundary	6/29/2001 - 12/28/2001	1.1E-09	2.7E-10	11	1.6E-10
HMC #16 Background	6/29/2001 - 12/28/2001	1.1E-09	2.8E-10	11	1.6E-10

\*Limit of 1E-8  $\mu\text{Ci/ml}$  for radon-222 with daughters removed as given in 10 CFR20, Appendix B, Table 2

## **Attachment 3 - Environmental Gamma Radiation Results**

Attachment 3 - Environmental Gamma Radiation Results  
TLD Perimeter Survey

Direct Radiation Measurements

Location	Monitoring Period	Exposure Rate (mrem/6 mo)	Error (mrem/6 mo)*
Hi-Vol #1 N Outer Perimeter	07/01/2001 - 12/31/2001	17	1.7
Hi-Vol #2 NE Outer Perimeter	07/01/2001 - 12/31/2001	16	1.6
Hi-Vol #3 E Outer Perimeter	07/01/2001 - 12/31/2001	20	2.0
Hi-Vol #4 S Outer Perimeter	07/01/2001 - 12/31/2001	16	1.6
Hi-Vol #5 N of Nearest Residence	07/01/2001 - 12/31/2001	30	2.9
Hi-Vol #6 W of Outer Perimeter	07/01/2001 - 12/31/2001	20	2.0
#16 Background	07/01/2001 - 12/31/2001	18	1.8

\*Error is 1.96 std. dev.



**Attachment 4 - Annual Effective Dose Equivalent to  
Individuals of the Public**

## Annual Effective Dose Equivalent to Individuals of the Public

### 1.0 Introduction

There were very few activities in 2001 at the Grants Uranium Mill Site other than those associated with the groundwater restoration program. All off-pile tailings were consolidated with the tailings in 1995 and covered with a soil cover. All tailings currently have either an interim or permanent cover.

The 10 CFR 20.1301 radiation dose limit for individual members of the public from NRC-licensed facilities is specified as a total effective dose equivalent (TEDE) of 100 mrem/year. A licensee may request permission from the NRC to operate a facility up to a maximum of 500 mrem/year. Compliance may be demonstrated by calculations or measurements showing that the individual likely to receive the maximum dose from the facility does not exceed the limit, or by comparing the concentrations at the site perimeter to those specified in Table 2 of Appendix B to 10 CFR Part 20. Radiation from external sources for individuals in the unrestricted area may not deliver a dose equivalent of 0.002 rem in any hour or 0.050 rem in one year.

HMC has submitted environmental monitoring reports as required by 10 CFR 40.65 and License No. SUA-1471. The data from these reports along with data from background monitoring stations have been used in this dose assessment.

### 2.0 DOSE ASSESSMENT

The important pathways for assessing the dose to the maximum exposed individual are: inhalation of airborne particulate from the site, exposure to radon generated at the site, and the exposure to direct gamma radiation at the site boundary. The nearest residence is located within 100 yards of the HMC-4 and HMC-5 sampling stations. It is known that the residents have typical lifestyles.

NUREG/CR-5512 recommends default values for the residential scenario. The values for indoor and outdoor occupancy are 200 effective days/year and 71 effective days/year, respectively. This is equivalent to a 75 percent total occupancy factor. This has been used in this analysis for all pathways.

#### 2.1 Inhalation of Radionuclides

The committed effective dose equivalent from inhalation of particulate was calculated for the four principal long-lived radionuclides, U-238, U-234, Th-230, and Ra-226, using the quarterly environmental monitoring data given in the Semi-Annual Environmental Reports for 2000. The sampling location HMC #5 was chosen as the Nearest Residence Location since the total calculated EDE was higher than at the other possible Nearest Residence Location, HMC#4. These stations are located on the southwestern perimeter of the site near existing residences. The use of these data to predict the dose to the nearest resident is very conservative in that the exposure at the residences should be less than that at the site perimeter.

Committed Effective Dose Equivalent per Unit Intake via Inhalation factors were taken from ICRP 30 tables. The values are given below:

<u>Nuclide</u>	<u>CEDE (mrem/<math>\mu</math>Ci)</u>
U-234	13.2E4
U-238	11.8E4
Th-230	32.6E4
Ra-226	8.6E3

Continuous occupancy at a breathing rate of 20,000 liters/day (Table A-1, NUREG-0859) was assumed. The CEDE was calculated for each of the radionuclides at each station. The CEDE at the principal residence for 100 percent occupancy was calculated to be 3.3 mrem/year while that at the background location (HMC#6) was calculated to be 1.1 mrem/y, for a net CEDE at the principal residence of 2.2 mrem/y. The results from these calculations are shown in Table 2-1 and Table 2-2. Considering the 75 percent occupancy factor, this results in a net dose equivalent of 1.7 mrem/year.

## 2.2 Exposure to Radon

The outdoor radon levels in the Grants Uranium Belt are known to be high and variable, depending on the location relative to mine vents, surface ore deposits, and topographical features. The natural background radon concentrations, arising from the calm winds during the evenings and at times from temperature inversions, generally follow the drainage path of the heavy air. The HMC site is situated at the lowest point in the drainage path for radon generated over a very large area to the North, Northwest, and Lobo Canyon to the East. Therefore the natural background levels at the site are expected to be very high and variable over short periods of time due to being in this drainage path.

The radon data for the two monitoring periods are provided in Attachment 2 of the semi-annual monitoring reports. Monitoring Station 16 has been accepted as the radon background location for the site. The nearest residence exposure was chosen as HMC#5. The average of the radon concentration for HMC#5 was 1.7 pCi/l while the average for the background location is 1.1 pCi/l. This results in a net radon concentration at the nearest residence is 0.6 pCi/l.

Since the nearest residence is within a few hundred feet of Monitoring Station HMC #5 and within 3500 feet of the major source of radon, the equilibrium should be low. We have selected 20 percent radon daughter equilibrium as an estimate for use in the calculations. NRC uses continuous exposure to 0.1 pCi/l Rn-222 in full equilibrium with the daughter products as being equivalent to a CEDE of 50 mrem/y (10CFR Part 20, Appendix B). With 20 percent equilibrium, the CEDE would be 100 mrem/pCi/l. Considering the 75 percent occupancy factor, the net radon concentration at the nearest residence therefore results in a calculated CEDE of 45 mrem/y.

## 2.3 Dose from Exposure to Direct Radiation

An estimate of the dose equivalent from direct exposure to radiation sources at the site is obtained from the environmental TLDs placed at the monitoring stations. The Nearest Residence location, HMC#4, was used since it was higher than the alternative location HMC#5 as shown in Attachment 3 at the end of the semiannual reports. The time-weighted-average exposure rate at HMC#5 was 54 mrem/year while the background location, HMC#16, had a time-weighted average exposure rate of 33 mrem/year. Considering the 75 percent occupancy time, the dose equivalent to the nearest resident is 16 mrem/year.

## 2.4 Total Effective Dose Equivalent to the Nearest Resident

The TEDE to the Nearest Resident can be calculated by adding the EDE from inhalation of airborne particulate, the exposure to radon coming from the site, and the dose equivalent from direct gamma radiation. As indicated in the previous sections, there are 1.7 mrem/y from airborne particulate, 45 mrem/y from radon, and 16 mrem/y from direct gamma radiation for a total TEDE of 63 mrem/y. This is within the 100 mrem/year limit.

Table 2-1 Annual Effective Dose at the Nearest Residence from Airborne Particulate

Year: 2001

STATION: HMC #5 Nearest Residence

AIRBORNE CONCENTRATION

	U-nat μCi/ml =====	U-234 μCi/ml =====	U-238 μCi/ml =====	Th-230 μCi/ml =====	Ra-226 μCi/ml =====
1st qtr	1.49E-16	7.26E-17	7.26E-17	1.00E-16	1.00E-16
2nd qtr	2.94E-15	1.43E-15	1.43E-15	1.00E-16	1.00E-16
3rd qtr	6.99E-15	3.41E-15	3.41E-15	1.00E-16	1.00E-16
4th qtr	3.53E-15	1.72E-15	1.72E-15	1.00E-16	1.00E-16
Average	3.40E-15	1.66E-15	1.66E-15	1.00E-16	1.00E-16

ANNUAL EFFECTIVE DOSE EQUIVALENT

U-234 mrem =====	U-238 mrem =====	Th-230 mrem =====	Ra-226 mrem =====	TOTAL mrem =====
1.598	1.428	0.238	0.006	3.3

Table 2-2 Annual Effective Dose at the Site Background Location from Airborne Particulate

Year:2001

STATION: HMC #6 Background

## AIRBORNE CONCENTRATION

	U-nat $\mu\text{Ci/ml}$	U-234 $\mu\text{Ci/ml}$	U-238 $\mu\text{Ci/ml}$	Th-230 $\mu\text{Ci/ml}$	Ra-226 $\mu\text{Ci/ml}$
	=====	=====	=====	=====	=====
1st qtr	1.00E-16	4.87E-17	4.87E-17	1.00E-16	1.00E-16
2nd qtr	9.82E-16	4.79E-16	4.79E-16	1.00E-16	1.00E-16
3rd qtr	1.89E-15	9.21E-16	9.21E-16	1.00E-16	1.00E-16
4th qtr	8.41E-16	4.10E-16	4.10E-16	1.00E-16	1.00E-16
	-----	-----	-----	-----	-----
Average	9.53E-16	4.65E-16	4.65E-16	1.00E-16	1.00E-16

## ANNUAL EFFECTIVE DOSE EQUIVALENT

U-234 mrem	U-238 mrem	Th-230 mrem	Ra-226 mrem	TOTAL mrem
=====	=====	=====	=====	=====
0.448	0.400	0.238	0.006	1.1

**Attachment 5 – 2000 Annual Status Report for the Large  
and Small Tailings Embankments**



INTEROFFICE CORRESPONDENCE

---

**TO:** Roy R. Cellan

**FROM:** Joe Vigil

**DATE:** January 2, 2002

**RE: 2001 Annual Status Report for the Large and Small Tailings Embankments**

Monthly inspections were conducted on the Large and Small Tailings Embankments from January through December. As a result of the inspections, the Large Tailings Embankment required the placement of additional clay in several areas on the top interim cover where rain had caused minor erosion.

The Small Tailings embankments did not require any repair work during the 2001 season.