



ROY R. CELLAN  
CORPORATE MANAGER  
RECLAMATION

ENVIRONMENTAL, HEALTH, SAFETY  
AND GOVERNMENT AFFAIRS

February 24, 2000

UPS Next Day Air: 1Z 875 261 01 1000 027 7

Mr. John Surmeier, Branch Chief  
Uranium Recovery and Low Level Waste Branch  
Division of Waste Management MS 7E-47  
Office of Nuclear Material Safety and Safeguards  
11545 Rockville Pike  
Rockville, MD 20555

RE: Docket No. 40-8903  
License No. SUA-1471  
Semi-Annual Environmental Monitoring Report  
Period - July through December 1999

Dear Mr. Surmeier:

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 1999 (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.

During the first half of 1999 Homestake Mining Company constructed a water treatment plant. The plant is designed to process the waters collected from the ground water aquifer and make a product that is suitable for re-injection. The testing phase was started during the second half of 1999. Early tests indicated a need to make significant modifications to the pre-treatment portion of the plant. Design and final construction of the pre-treatment modifications will be complete in March 2000. On-going testing of the reverse osmosis systems and portions of the pre-treatment systems was conducted during the second half of 1999 and first quarter of 2000. The plant will be in full operation sometime in the second quarter of 2000.

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

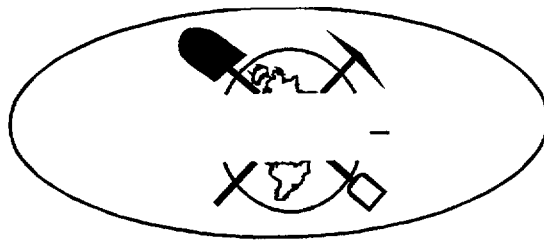
Sincerely,

A handwritten signature in black ink, appearing to read "Ray Surmeier". The signature is fluid and cursive, with the first name "Ray" being more prominent and the last name "Surmeier" following in a similar style.

Enclosure

xc: Mr. Blair Spilzberg, Chief, Decommissioning Branch, w/enclosure  
Mr. Harold F. Barnes, Director EHSG&A, SFO, w/enclosure  
Mr George Hoffman, Hydro Engineering, w/enclosure  
File HMC Grants

**HOMESTAKE MINING COMPANY  
OF  
CALIFORNIA  
GRANTS PROJECT**



**SEMI-ANNUAL ENVIRONMENTAL  
REPORT**

**JULY - DECEMBER  
1999**

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

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## 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 1999. The submittal of this report to the appropriate Nuclear Regulatory Commission (NRC) Regional Office and New Mexico state agency 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 have 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, with 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 this reporting period Homestake Mining Company has constructed a water treatment plant. This plant is designed to process the waters collected from the ground water aquifer and make a product that is suitable for re-injection. The plant experienced some design problems in the pre-treatment portion of the plant, forcing delay of the start-up and testing phase of the operation. This plant began the start-up and testing phase in December 1999 and is expected to be operating sometime in the first quarter of 2000.

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 are included in the semi-annual environmental monitoring reports. 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.

Due to a calculation error, previously reported effluent concentration values for the high volume samples collected during the first and second quarters of 1999 were incorrect. The correct values were recalculated and are included in Attachment 1.

### **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 (8-97) 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 are included in this Semi-Annual Environmental Report. These data are reported in Tables 2.1.1-2.1.9.

The Groundwater Monitoring Table 2 (8-97) was reviewed in 1999. As a result, a new Table 2 was developed, approved by the NMED on October 13, 1999, and submitted for approval by the NRC on September 29, 1999. The new table represents a reduction in the monitoring program without compromising the intent of the overall monitoring program.

The water quality of these 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 dosimeters (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 Eberline Instrument Co.). 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:

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

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  $2 E 09$  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 1999 is included at 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. Individual effluent monitoring program results are more fully discussed in the following paragraphs.

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 (8-97)**

TABLE 2 – Groundwater Monitoring Program (8-97)

Well Number	Parameters to be Monitored	Frequency of Monitoring
#1 & #2 Deepwell	C	Quarterly
#1 & #2 Deepwell	D	Annually
All Active Injection Wells	Rate & Monthly Total	Monthly
Broadview Acres SUB1, SUB3, 453	A	Semi-Annually
Broadview Acres SUB2	A (except water level)	Semi-Annually
Broadview Acres SUB1, SUB2, SUB3, 434, 446, 453	B (except water level)	Annually
Felice Acres 490, 492, 493, 494	A	Semi-Annually
Felice Acres 490, 492, 493, 494	B	Annually
Murray Acres 802, 844	A	Semi-Annually
Murray Acres 802, 804, 820, 844, WCW	B(no water level in 804)	Annually
Pleasant Valley 688, 835, 846	A (no water level in 835)	Semi-Annually
Pleasant Valley 688, 835, 846	B (no water level in 835)	Annually
Regional 905, 910, 917, 920, 942	B (except water level)	Annually
Site Monitoring Wells B, CW2, CW3, CW4R, PM, WR7, WR11, X, Y	A	Quarterly
Site Monitoring Wells B, CW2, CW3, CW4R, PM, WR7, WR11, X, Y	B & F	Semi-annually
Secondary Site Monitoring Wells BC, B1, BP, D1, DC, DM, DZ, F, FB, I, K2, KM, KZ, M4, MO, N, O, S, SO, SV, T, W, WR5, WR9	A	Semi-annually
Secondary Site Monitoring Wells GH, CW2-1	Water Level Only	Semi-annually

TABLE 2 – Groundwater Monitoring Program (8-97)

Well Number	Parameters to be Monitored	Frequency of Monitoring
Secondary Site Monitoring Wells BC, B1, BP, CW9, D1, DC, DM, DZ, F, FB, I, K2, KM, KZ, M4, MO, N, ND, O, S, SO, SV, S2, T, W, WR9, WR5	B	Annually
Secondary Site Monitoring Wells 931, 934	B	Semi-Annually
Secondary Site Monitoring Well NC	A B	Quarterly Semi-Annually
Secondary Site Monitoring Wells 929, 933, 945, CW40	B (no water level in 933 or 945)	Semi-Annually
All Active Collection Wells	E	Monthly
All Active Collection Wells	B	Annually
All Active Collection Wells	Collection rate, water level and total volume for week	Weekly
Reversal Wells B, BA, KZ, KF, SO, SP, S1, S2	Water Level	Weekly
E Coll Pond, W Coll Pond	B (W Coll Pond - no water level )	Quarterly
E Coll Pond, W Coll Pond	F	Semi-annually
DQ, M5, S3, S4	B	Quarterly
DQ, M5, S3, S4	F	Semi-annually
Background Wells P, P1, P2	B F	Quarterly Semi-annually
Background Wells DD, Q, R	B & F	Annually

A = Water Level, SO<sub>4</sub>, U-Nat, Se, TDS

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-Nat, Se, Mo, Ra-226

C = SO<sub>4</sub>, TDS

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-Nat, Filtered Ra-226

E = Water Level, SO<sub>4</sub>, U-Nat, TDS

F = V, Ra-228, Th-230

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





# ENERGY LABORATORIES, INC.

SHIPPING: 2393 SALT CREEK HIGHWAY • CASPER, WY 82601

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

E-mail: energy@trib.com • FAX: (307) 234-1639

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

Billings • Casper • Gillette  
Helena • Rapid City

## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

BP	BP
08-17-99/1029	11-03-99/10:41
Water	Water
32391-003	34277-1
September 12, 1999	December 9, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	EPA-200.7	mg/L	1.0	192	230
Magnesium	EPA-200.7	mg/L	1.0	52.3	61.9
Sodium	EPA-200.7	mg/L	1.0	352	404
Potassium	EPA-200.7	mg/L	1.0	5.4	4.4
Carbonate	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	516	475
Sulfate	EPA-200.7	mg/L	1.0	846	961
Chloride	EPA-200.7	mg/L	1.0	198	195
Nitrate as N	EPA-353.2	mg/L	0.10	2.63	3.52

Non-Metals					
Total Dissolved Solids @ 180°C	SM 2540-C	mg/L	10.0	2140	2280
pH	SM 4500-H-B	std. units	0.10	7.71	7.71

Trace Metals					
Chromium	EPA-200.7	mg/L	0.05	< 0.05	< 0.05
Molybdenum	EPA-200.7	mg/L	0.03	0.39	0.41
Selenium	EPA-200.8	mg/L	0.005	0.201	0.247
Vanadium	EPA-200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric					
Uranium	EPA-200.8	mg/L	0.0003	0.950	1.04
*Uranium Precision ±				0.086	0.094
Uranium		µCi/mL	2.0E-10	6.4E-07	7.0E-07
*Uranium Precision ±				5.8E-08	6.3E-08
Radium 226	EPA-903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±				0.2	0.2
Radium 226		µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±				2.0E-10	2.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±				1.0	1.3
Radium 228		µCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.0E-09	1.3E-09
Thorium 230	EPA-907.0	pCi/L	0.2	< 0.2	0.2
Thorium Error Estimate ±				0.2	0.2
Thorium 230		µCi/mL	2.0E-10	< 2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10	2.0E-10

Quality Assurance Data			Target Range		
Anion	-	meq		31.88	33.59
Cation	-	meq		29.40	34.34
WYDEQ A/C Balance	-	%	-5 - +5	-4.05	1.11
Calc TDS	-	mg/L		1916	2110
TDS A/C Balance	-	dec. %	0.80 - 1.20	1.12	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.

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**COMPLETE ANALYTICAL SERVICES**

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34277R00001

**Table 2.1.2 - Water Quality Analyses for Well D1**



Billings • Casper • Gillette • Rapid City

# ENERGY LABORATORIES, INC.

SHIPPING: 2393 SALT CREEK HIGHWAY • CASPER, WY 82601

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

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WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY						
Sample ID:						
Sample Date/Time:						
Sample Matrix:						
Laboratory ID:						
Report Date:						
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">DI</td></tr> <tr><td style="text-align: center;">08-17-99/0957</td></tr> <tr><td style="text-align: center;">Water</td></tr> <tr><td style="text-align: center;">32391-004</td></tr> <tr><td style="text-align: center;">September 12, 1999</td></tr> </table>	DI	08-17-99/0957	Water	32391-004	September 12, 1999
DI						
08-17-99/0957						
Water						
32391-004						
September 12, 1999						

Major Ions		Method	Units	"Lower Limit of Detection"	Results
Calcium	Ca	EPA-200.7	mg/L	1.0	215
Magnesium	Mg	EPA-200.7	mg/L	1.0	49.6
Sodium	Na	EPA-200.7	mg/L	1.0	380
Potassium	K	EPA-200.7	mg/L	1.0	5.6
Carbonate	CO <sub>3</sub>	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	HCO <sub>3</sub>	SM 2320-B	mg/L	1.0	459
Sulfate	SO <sub>4</sub>	EPA-200.7	mg/L	1.0	990
Chloride	Cl	EPA-200.7	mg/L	0.10	197
Nitrate as N	NO <sub>3</sub>	EPA-353.2	mg/L	0.10	3.78

Non-Metals					
Total Dissolved Solids @ 180°C	TDS	SM 2540-C	mg/L	2.0	2350
pH		SM 4500-H-B	std. units	0.10	7.75

Trace Metals					
Chromium	Cr	EPA-200.7	mg/L	0.05	< 0.05
Copper	Cu	EPA-200.7	mg/L	0.01	< 0.01
Molybdenum	Mo	EPA-200.7	mg/L	0.03	0.82
Selenium	Se	EPA-200.8	mg/L	0.005	0.386
Vanadium	V	EPA-200.8	mg/L	0.01	< 0.01

Radiometric					
Uranium	<sup>238</sup> U	EPA-200.8	mg/L	0.0003	1.92
*Uranium Precision ±					0.173
Uranium	<sup>235</sup> U		µCi/mL	2.0E-10	1.3E-06
*Uranium Precision ±					1.2E-07
Radium 226	<sup>226</sup> Ra	EPA-903.0	pCi/L	0.2	0.2
Radium Error Estimate ±					0.2
Radium 226	<sup>226</sup> Ra		µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±					2.0E-10
Radium 228	<sup>228</sup> Ra	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±					1.0
Radium 228	<sup>228</sup> Ra		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±					1.0E-09
Thorium 230	<sup>230</sup> Th	EPA-907.0	pCi/L	0.2	< 0.2
Thorium Error Estimate ±					0.2
Thorium 230	<sup>230</sup> Th		µCi/mL	2.0E-10	< 2.0E-10
Thorium Error Estimate ±					2.0E-10

Quality Assurance Data			Target Range	
Anion	-	meq		34.00
Cation	-	meq		31.55
WYDEQ A/C Balance	-	%	-5 - +5	-3.74
Calc TDS	-	mg/L		2084
TDS A/C Balance	-	dec. %	0.80 - 1.20	1.13

\*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.

Log in No. 99-32391  
 08-17-99 06:22:09



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# ENERGY LABORATORIES, INC.

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E-mail: energy@trib.com • FAX: (307) 234-1639  
PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

D1
11-04-99/10:29
Water
34310-1
December 11, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results
Calcium	EPA-200.7	mg/L	1.0	231
Magnesium	EPA-200.7	mg/L	1.0	53.1
Sodium	EPA-200.7	mg/L	1.0	418
Potassium	EPA-200.7	mg/L	1.0	4.4
Carbonate	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	474
Sulfate	EPA-200.7	mg/L	1.0	950
Chloride	EPA-200.7	mg/L	0.10	197
Nitrate + Nitrite as N	EPA-353.2	mg/L	0.10	4.10

Non-Metals				
Total Dissolved Solids @ 180°C	SM 2540-C Mod.	mg/L	10.0	2270
pH	SM 4500-H-B	std. units	0.10	7.73

Trace Metals				
Chromium	EPA-200.7	mg/L	0.05	< 0.05
Molybdenum	EPA-200.8	mg/L	0.03	0.96
Selenium	EPA-200.8	mg/L	0.005	0.274
Vanadium	EPA-200.8	mg/L	0.01	< 0.01

Radiometric				
Uranium	EPA-200.8	mg/L	0.0003	1.86
*Uranium Precision ±				0.167
Uranium		µCi/mL	2.0E-10	1.3E-06
*Uranium Precision ±				1.1E-07
Radium 226	EPA-903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±				0.2
Radium 226		µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±				2.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±				1.2
Radium 228		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.2E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.2
Thorium Error Estimate ±				0.2
Thorium 230		µCi/mL	2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10

Quality Assurance Data		Target Range	
Anion	meq		33.44
Cation	meq		34.26
WYDEQ A/C Balance	%	-5 - +5	1.22
Calc TDS	mg/L		2110
TDS A/C Balance	dec. %	0.80 - 1.20	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.

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



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## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

DQ	DQ
08-17-99/1144	11-04-99/14:04
Water	Water
32391-001	34310-7
September 12, 1999	December 11, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	EPA-200.7	mg/L	1.0	348	358
Magnesium	EPA-200.7	mg/L	1.0	155	157
Sodium	EPA-200.7	mg/L	1.0	5370	5290
Potassium	EPA-200.7	mg/L	1.0	30.8	14.5
Carbonate	SM 2320-B	mg/L	1.0	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	2770	2620
Sulfate	EPA-200.7	mg/L	1.0	9500	8410
Chloride	EPA-200.7	mg/L	0.10	1160	1090
Nitrate + Nitrite as N	EPA-353.2	mg/L	0.10	41.9	43.5

Non-Metals					
Total Dissolved Solids @ 180°C	SM 2540-C Mod	mg/L	10.0	20300	18800
pH	SM 4500-H-B	std. units	0.10	7.99	7.97

Trace Metals					
Chromium	EPA-200.7	mg/L	0.05	-	< 0.05
Molybdenum	EPA-200.7	mg/L	0.03	92.0	83.3
Selenium	EPA-200.7	mg/L	0.005	3.16	3.76
Vanadium	EPA-200.7	mg/L	0.01	0.02	< 0.01

Radiometric					
Uranium	EPA-200.7	mg/L	1.0	41.4	46.0
*Uranium Precision ±				3.73	4.140
Uranium		µCi/mL	2.0E-10	2.8E-05	3.1E-05
*Uranium Precision ±				2.5E-06	2.8E-06
Radium 226	EPA-903.0	pCi/L	0.2	1.8	4.6
Radium Error Estimate ±				0.2	0.6
Radium 226		µCi/mL	2.0E-10	1.8E-09	4.6E-09
Radium Error Estimate ±				2.0E-10	6.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	1.0	< 1.0
Radium Error Estimate ±				0.9	1.2
Radium 228		µCi/mL	1.0E-09	1.0E-09	< 1.0E-09
Radium Error Estimate ±				9.0E-10	1.2E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.2	0.2
Thorium Error Estimate ±				0.2	0.2
Thorium 230		µCi/mL	2.0E-10	2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10	2.0E-10

Quality Assurance Data			Target Range		
Anion		meq		279.03	252.00
Cation		meq		264.58	261.36
WYDEQ A/C Balance		%	-5 - +5	-2.66	1.82
Calc TDS		mg/L		18135	16823
TDS A/C Balance		dec. %	0.80 - 1.20	1.12	1.12

\*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.

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**Table 2.1.4 - Water Quality Analyses for Well M5**



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## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

M5	M5
08-17-99/1108	11-04-99/11:33
Water	Water
32391-002	34310-5
September 12, 1999	December 11, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	EPA-200.7	mg/L	1.0	256	264
Magnesium	EPA-200.7	mg/L	1.0	54.8	56.7
Sodium	EPA-200.7	mg/L	1.0	357	355
Potassium	EPA-200.7	mg/L	1.0	5.3	4.5
Carbonate	SM 2320-B	mg/L	1.0	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	344	343
Sulfate	EPA-200.7	mg/L	1.0	1140	1050
Chloride	EPA-200.7	mg/L	0.10	188	191
Nitrate + Nitrite as N	EPA-353.2	mg/L	0.10	7.4	5.72

Non-Metals					
Total Dissolved Solids @ 180°C	SM 2540-C Mod	mg/L	10.0	2530	2370
pH	SM 4500-H-B	std. units	0.10	7.75	7.88

Trace Metals					
Chromium	EPA-200.7	mg/L	0.05	-	< 0.05
Molybdenum	EPA-200.8	mg/L	0.03	1.57	1.59
Selenium	EPA-200.8	mg/L	0.005	0.62	0.547
Vanadium	EPA-200.8	mg/L	0.01	0.01	< 0.01

Radiometric					
Uranium	EPA-200.8	mg/L	0.0003	2.50	2.03
*Uranium Precision ±				0.225	0.183
Uranium		µCi/mL	2.0E-10	1.7E-06	1.4E-06
*Uranium Precision ±				1.5E-07	1.2E-07
Radium 226	EPA-903.0	pCi/L	0.2	0.4	< 0.2
Radium Error Estimate ±				0.3	0.2
Radium 226		µCi/mL	2.0E-10	4.0E-10	< 2.0E-10
Radium Error Estimate ±				3.0E-10	2.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	1.0	< 1.0
Radium Error Estimate ±				0.9	1.2
Radium 228		µCi/mL	1.0E-09	1.0E-09	< 1.0E-09
Radium Error Estimate ±				9.0E-10	1.2E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.2	0.2
Thorium Error Estimate ±				0.2	0.2
Thorium 230		µCi/mL	2.0E-10	2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10	2.0E-10

Quality Assurance Data		Target Range			
Anion	meq			35.25	33.32
Cation	meq			33.02	33.48
WYDEQ A/C Balance	%	-5 - +5		-3.26	0.23
Calc TDS	mg/L			2207	2119
TDS A/C Balance	dec. %	0.80 - 1.20		1.15	1.12

\*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.

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**Table 2.1.5 - Water Quality Analyses for Well S3**



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

## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

S3	S3
08-18-99/0951	11-04-99/13:31
Water	Water
32443-002	34310-3
September 16, 1999	December 11, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	EPA-200.7	mg/L	1.0	276	215
Magnesium	EPA-200.7	mg/L	1.0	72.0	57.2
Sodium	EPA-200.7	mg/L	1.0	984	861
Potassium	EPA-200.7	mg/L	1.0	8.0	6.3
Carbonate	SM 2320-B	mg/L	1.0	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	672	678
Sulfate	EPA-200.7	mg/L	1.0	2000	1650
Chloride	EPA-200.7	mg/L	0.10	305	221
Nitrate + Nitrite as N	EPA-353.2	mg/L	0.10	4.27	2.50

Non-Metals					
Total Dissolved Solids @ 180°C	SM 2540-C Mod	mg/L	10.0	4550	3660
pH	SM 4500-H-B	std. units	0.10	7.86	7.72

Trace Metals					
Chromium	EPA-200.7	mg/L	0.05	-	< 0.05
Molybdenum	EPA-200.7	mg/L	0.03	9.63	9.74
Selenium	EPA-200.8	mg/L	0.005	0.506	0.204
Vanadium	EPA-200.8	mg/L	0.01	0.01	< 0.01

Radiometric					
Uranium	EPA-200.7	mg/L	1.0	10.7	11.1
*Uranium Precision ±				0.963	0.999
Uranium		µCi/mL	2.0E-10	7.2E-06	7.5E-06
*Uranium Precision ±				6.5E-07	6.8E-07
Radium 226	EPA-903.0	pCi/L	0.2	0.2	< 0.2
Radium Error Estimate ±				0.2	0.2
Radium 226		µCi/mL	2.0E-10	2.0E-10	< 2.0E-10
Radium Error Estimate ±				2.0E-10	2.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	1.0	< 1.0
Radium Error Estimate ±				1.3	1.1
Radium 228		µCi/mL	1.0E-09	1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.3E-09	1.1E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.4	0.2
Thorium Error Estimate ±				0.3	0.2
Thorium 230		µCi/mL	2.0E-10	4.0E-10	2.0E-10
Thorium Error Estimate ±				3.0E-10	2.0E-10

Quality Assurance Data		Target Range			
Anion	meq			61.61	51.93
Cation	meq			62.79	53.11
WYDEQ A/C Balance	%	-5 - +5		0.94	1.13
Calc TDS	mg/L			4001	3362
TDS A/C Balance	dec. %	0.80 - 1.20		1.14	1.09

\*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.

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**Table 2.1.6 - Water Quality Analyses for Well S4**



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## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

S4	S4
08-18-99/1025	11-04-99/12:51
Water	Water
32456-001	34310-4
September 18, 1999	December 11, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	EPA-200.7	mg/L	1.0	526	465
Magnesium	EPA-200.7	mg/L	1.0	139	100
Sodium	EPA-200.7	mg/L	1.0	605	580
Potassium	EPA-200.7	mg/L	1.0	8.2	7.8
Carbonate	SM 2320-B	mg/L	1.0	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	579	528
Sulfate	EPA-200.7	mg/L	1.0	2290	1940
Chloride	EPA-200.7	mg/L	0.10	201	181
Nitrate + Nitrite as N	EPA-353.2	mg/L	0.10	0.10	< 0.10

Non-Metals					
Total Dissolved Solids @ 180°C	SM 2540-C Mod	mg/L	10.0	4340	4040
pH	SM 4500-H-B	std. units	0.10	7.82	7.77

Trace Metals					
Chromium	EPA-200.7	mg/L	0.05	-	< 0.05
Molybdenum	EPA-200.8	mg/L	0.03	0.29	0.39
Selenium	EPA-200.8	mg/L	0.005	0.036	0.030
Vanadium	EPA-200.8	mg/L	0.01	0.01	< 0.01

Radiometric					
Uranium	EPA-200.7	mg/L	1.0	8.5	6.4
*Uranium Precision ±				0.7650	0.576
Uranium		µCi/mL	2.0E-10	5.8E-06	4.3E-06
*Uranium Precision ±				5.2E-07	3.9E-07
Radium 226	EPA-903.0	pCi/L	0.2	1.1	1.0
Radium Error Estimate ±				0.2	0.4
Radium 226		µCi/mL	2.0E-10	1.1E-09	1.0E-09
Radium Error Estimate ±				2.0E-10	4.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	1.0	< 1.0
Radium Error Estimate ±				1.3	1.1
Radium 228		µCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.3E-09	1.1E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.2	0.2
Thorium Error Estimate ±				0.2	0.2
Thorium 230		µCi/mL	2.0E-10	< 2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10	2.0E-10

Quality Assurance Data		Target Range	
Anion	meq		62.90 , 54.21
Cation	meq		64.40 57.00
WYDEQ A/C Balance	%	-5 - +5	1.17 2.51
Calc TDS	mg/L		4060 3539
TDS A/C Balance	dec. %	0.80 - 1.20	1.07 1.14

\*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.

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34310R00004

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**Table 2.1.7 - Water Quality Analyses for Well X**



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WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY	
Sample ID:	X
Sample Date/Time:	08-11-99/0951
Sample Matrix:	Water
Laboratory ID:	32239-001
Report Date:	August 16, 1999

Major Ions		Method	Units	"Lower Limit of Detection"	Results
Calcium	Ca	EPA-200.7	mg/L	1.0	168
Magnesium	Mg	EPA-200.7	mg/L	1.0	49.8
Sodium	Na	EPA-200.7	mg/L	1.0	378
Potassium	K	EPA-200.7	mg/L	1.0	7.0
Carbonate	CO <sub>3</sub>	EPA-310.1	mg/L	1.0	< 1.0
Bicarbonate	HCO <sub>3</sub>	EPA-310.1	mg/L	1.0	591
Sulfate	SO <sub>4</sub>	EPA-200.7	mg/L	1.0	651
Chloride	Cl	EPA-200.7	mg/L	0.10	194
Nitrate as N	NO <sub>3</sub>	EPA-353.2	mg/L	0.10	1.87

Non-Metals					
Total Dissolved Solids @ 180°C	TDS	EPA-160.1	mg/L	2.0	1910
pH		EPA-150.1	std. units	0.10	7.53

Trace Metals					
Chromium	Cr	EPA-200.7	mg/L	0.05	< 0.05
Copper	Cu	EPA-200.7	mg/L	0.01	0.02
Molybdenum	Mo	EPA-200.7	mg/L	0.03	0.91
Selenium	Se	EPA-200.8	mg/L	0.005	0.048
Vanadium	V	EPA-200.8	mg/L	0.01	0.05

Radiometric					
Uranium	<sup>238</sup> U	EPA-200.8	mg/L	0.0003	0.676
*Uranium Precision ±					0.061
Uranium	<sup>235</sup> U		µCi/mL	2.0E-10	4.6E-07
*Uranium Precision ±					4.1E-08
Radium 226	<sup>226</sup> Ra	EPA-903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±					0.2
Radium 226	<sup>226</sup> Ra		µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±					2.0E-10
Radium 228	<sup>228</sup> Ra	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±					0.9
Radium 228	<sup>228</sup> Ra		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±					9.0E-10
Thorium 230	<sup>230</sup> Th	EPA-907.0	pCi/L	0.2	0.2
Thorium Error Estimate ±					0.2
Thorium 230	<sup>230</sup> Th		µCi/mL	2.0E-10	2.0E-10
Thorium Error Estimate ±					2.0E-10

Quality Assurance Data		Target Range	
Anion	meq		28.88
Cation	meq		29.16
WYDEQ A/C Balance	%	-5 - +5	0.49
Calc TDS	mg/L		1753
TDS A/C Balance	dec. %	0.80 - 1.20	1.09

\*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.



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# ENERGY LABORATORIES, INC.

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

## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

X
10-12-99/15:37
Water
33779-001
November 18, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results
Calcium	EPA-200.7	mg/L	1.0	162
Magnesium	EPA-200.7	mg/L	1.0	47.9
Sodium	EPA-200.7	mg/L	1.0	399
Potassium	EPA-200.7	mg/L	1.0	5.6
Carbonate	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	600
Sulfate	EPA-200.7	mg/L	1.0	694
Chloride	EPA-200.7	mg/L	0.10	201
Nitrate as N	EPA-353.2	mg/L	0.10	1.84

Non-Metals				
Total Dissolved Solids @ 180°C	SM 2540-C	mg/L	10.0	1950
pH	SM 4500-H-B	std. units	0.10	7.95

Trace Metals				
Chromium, total	EPA-200.8	mg/L	0.05	< 0.05
Molybdenum	EPA-200.8	mg/L	0.03	1.62
Selenium	EPA-200.8	mg/L	0.005	0.123
Vanadium	EPA-200.8	mg/L	0.01	0.04

Radiometric				
Uranium	EPA-200.8	mg/L	0.0003	0.932
*Uranium Precision ±				0.084
Uranium		µCi/mL	2.0E-10	6.3E-07
*Uranium Precision ±				5.7E-08
Radium 226	EPA-903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±				0.2
Radium 226		µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±				2.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±				1.0
Radium 228		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.0E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.2
Thorium Error Estimate ±				0.2
Thorium 230		µCi/mL	2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10

Quality Assurance Data		Target Range	
Anion	-	meq	30.12
Cation	-	meq	29.58
WYDEQ A/C Balance	-	%	-5 - +5
Calc TDS	-	mg/L	1819
TDS A/C Balance	-	dec. %	0.80 - 1.20

\*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.

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33779R00001

**Table 2.1.8 - Water Quality Analyses for Well Y**





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WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY					
Sample ID:					Y
Sample Date/Time:					08-11-99/0947
Sample Matrix:					Water
Laboratory ID:					32239-002
Report Date:					August 16, 1999

Major Ions		Method	Units	"Lower Limit of Detection"	Results
Calcium	Ca	EPA-200.7	mg/L	1.0	266
Magnesium	Mg	EPA-200.7	mg/L	1.0	67.4
Sodium	Na	EPA-200.7	mg/L	1.0	882
Potassium	K	EPA-200.7	mg/L	1.0	11.4
Carbonate	CO <sub>3</sub>	EPA-310.1	mg/L	1.0	< 1.0
Bicarbonate	HCO <sub>3</sub>	EPA-310.1	mg/L	1.0	640
Sulfate	SO <sub>4</sub>	EPA-200.7	mg/L	1.0	1680
Chloride	Cl	EPA-200.7	mg/L	0.10	394
Nitrate as N	NO <sub>3</sub>	EPA-353.2	mg/L	0.10	4.79

Non-Metals		Method	Units	"Lower Limit of Detection"	Results
Total Dissolved Solids @ 180°C	TDS	EPA-160.1	mg/L	2.0	4110
pH		EPA-150.1	std. units	0.10	7.58

Trace Metals		Method	Units	"Lower Limit of Detection"	Results
Chromium	Cr	EPA-200.7	mg/L	0.05	< 0.05
Copper	Cu	EPA-200.7	mg/L	0.01	< 0.01
Molybdenum	Mo	EPA-200.7	mg/L	0.03	11.6
Selenium	Se	EPA-200.7	mg/L	0.10	1.36
Vanadium	V	EPA-200.8	mg/L	0.01	0.01

Radiometric		Method	Units	"Lower Limit of Detection"	Results
Uranium	<sup>238</sup> U	EPA-200.7	mg/L	1.0	7.10
*Uranium Precision ±					0.639
Uranium	<sup>235</sup> U		µCi/mL	2.0E-10	4.8E-06
*Uranium Precision ±					4.3E-07
Radium 226	<sup>226</sup> Ra	EPA-903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±					0.2
Radium 226	<sup>226</sup> Ra		µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±					2.0E-10
Radium 228	<sup>228</sup> Ra	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±					1.0
Radium 228	<sup>228</sup> Ra		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±					1.0E-09
Thorium 230	<sup>230</sup> Th	EPA-907.0	pCi/L	0.2	0.2
Thorium Error Estimate ±					0.2
Thorium 230	<sup>230</sup> Th		µCi/mL	2.0E-10	2.0E-10
Thorium Error Estimate ±					2.0E-10

Quality Assurance Data			Target Range	
Anion		meq		56.97
Cation		meq		57.56
WYDEQ A/C Balance		%	-5 - +5	0.52
Calc TDS		mg/L		3643
TDS A/C Balance		dec. %	0.80 - 1.20	1.13

\*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.

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# ENERGY LABORATORIES, INC.

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

## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

Y
10-12-99/15:00
Water
33779-002
November 18, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results
Calcium	EPA-200.7	mg/L	1.0	255
Magnesium	EPA-200.7	mg/L	1.0	65.5
Sodium	EPA-200.7	mg/L	1.0	790
Potassium	EPA-200.7	mg/L	1.0	8.1
Carbonate	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	627
Sulfate	EPA-200.7	mg/L	1.0	1630
Chloride	EPA-200.7	mg/L	0.10	347
Nitrate as N	EPA-353.2	mg/L	0.10	4.26

Non-Metals				
Total Dissolved Solids @ 180°C	SM 2540-C	mg/L	10.0	3820
pH	SM 4500-H-B	std. units	0.10	7.65

Trace Metals				
Chromium, total	EPA-200.8	mg/L	0.05	< 0.05
Molybdenum	EPA-200.7	mg/L	0.03	10.9
Selenium	EPA-200.8	mg/L	0.005	1.58
Vanadium	EPA-200.8	mg/L	0.01	< 0.01

Radiometric				
Uranium	EPA-200.8	mg/L	0.0003	5.58
*Uranium Precision ±				0.502
Uranium		µCi/mL	2.0E-10	3.8E-06
*Uranium Precision ±				3.4E-07
Radium 226	EPA-903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±				0.2
Radium 226		µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±				2.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±				1.0
Radium 228		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.0E-09
Thorium 230	EPA-907.0	pCi/L	0.2	< 0.2
Thorium Error Estimate ±				0.2
Thorium 230		µCi/mL	2.0E-10	< 2.0E-10
Thorium Error Estimate ±				2.0E-10

Quality Assurance Data			Target Range	
Anion	-	meq		54.35
Cation	-	meq		52.76
WYDEQ A/C Balance	-	%	-5 - +5	-1.48
Calc TDS	-	mg/L		3429
TDS A/C Balance	-	dec. %	0.80 - 1.20	1.11

\*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.

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**Table 2.1.9- Water Quality Analyses for Background Well P**



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## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

P
09-15-99/1249
Water
33193-003
October 15, 1999

Major Ions		Method	Units	"Lower Limit of Detection"	Results
Calcium	Ca	EPA-200.7	mg/L	1.0	216
Magnesium	Mg	EPA-200.7	mg/L	1.0	47.2
Sodium	Na	EPA-200.7	mg/L	1.0	239
Potassium	K	EPA-200.7	mg/L	1.0	4.6
Carbonate	CO <sub>3</sub>	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	HCO <sub>3</sub>	SM 2320-B	mg/L	1.0	241
Sulfate	SO <sub>4</sub>	EPA-200.7	mg/L	1.0	964
Chloride	Cl	EPA-200.7	mg/L	1.0	47.9
Nitrate as N	NO <sub>3</sub>	EPA-353.2	mg/L	0.10	9.65

Non-Metals					
Total Dissolved Solids @ 180°C	TDS	SM 2540-C	mg/L	10.0	1840
pH		SM 4500-H-B	std. units	0.10	7.68

Trace Metals					
Molybdenum	Mo	EPA-200.8	mg/L	0.03	< 0.03
Selenium	Se	EPA-200.8	mg/L	0.005	0.189

Radiometric					
Uranium	<sup>Nat</sup> U	EPA-200.8	mg/L	0.0003	0.036
*Uranium Precision ±					0.003
Uranium	<sup>Nat</sup> U		µCi/mL	2.0E-10	2.4E-08
*Uranium Precision ±					2.2E-09
Radium 226	<sup>226</sup> Ra	EPA-903.0	pCi/L	0.2	0.4
Radium Error Estimate ±					0.2
Radium 226	<sup>226</sup> Ra		µCi/mL	2.0E-10	4.0E-10
Radium Error Estimate ±					2.0E-10

Quality Assurance Data			Target Range	
Anion	-	meq		26.11
Cation	-	meq		25.24
WYDEQ A/C Balance	-	%	-5 - +5	-1.68
Calc TDS	-	mg/L		1683
TDS A/C Balance	-	dec. %	0.80 - 1.20	1.09

\*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.

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## WATER ANALYSIS REPORT HOMESTAKE MINING COMPANY

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

P
11-04-99/14:52
Water
34310-2
December 11, 1999

Major Ions	Method	Units	"Lower Limit of Detection"	Results
Calcium	EPA-200.7	mg/L	1.0	231
Magnesium	EPA-200.7	mg/L	1.0	49.6
Sodium	EPA-200.7	mg/L	1.0	257
Potassium	EPA-200.7	mg/L	1.0	5.4
Carbonate	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	SM 2320-B	mg/L	1.0	247
Sulfate	EPA-200.7	mg/L	1.0	938
Chloride	EPA-200.7	mg/L	0.10	54.6
Nitrate + Nitrite as N	EPA-353.2	mg/L	0.10	8.88

Non-Metals				
Total Dissolved Solids @ 180°C	SM 2540-C Mod.	mg/L	10.0	1800
pH	SM 4500-H-B	std. units	0.10	7.73

Trace Metals				
Chromium	EPA-200.7	mg/L	0.05	< 0.05
Molybdenum	EPA-200.8	mg/L	0.03	< 0.03
Selenium	EPA-200.8	mg/L	0.005	0.174
Vanadium	EPA-200.8	mg/L	0.01	< 0.01

Radiometric				
Uranium	EPA-200.8	mg/L	0.0003	0.032
*Uranium Precision ±				0.003
Uranium		µCi/mL	2.0E-10	2.2E-08
*Uranium Precision ±				2.0E-09
Radium 226	EPA-903.0	pCi/L	0.2	0.5
Radium Error Estimate ±				0.3
Radium 226		µCi/mL	2.0E-10	5.0E-10
Radium Error Estimate ±				3.0E-10
Radium 228	EPA-904.0	pCi/L	1.0	< 1.0
Radium Error Estimate ±				1.1
Radium 228		µCi/mL	1.0E-09	< 1.0E-09
Radium Error Estimate ±				1.1E-09
Thorium 230	EPA-907.0	pCi/L	0.2	0.2
Thorium Error Estimate ±				0.2
Thorium 230		µCi/mL	2.0E-10	2.0E-10
Thorium Error Estimate ±				2.0E-10

Quality Assurance Data		Target Range	
Anion	meq		25.80
Cation	meq		27.00
WYDEQ A/C Balance	%	-5 - +5	2.27
Calc TDS	mg/L		1699
TDS A/C Balance	dec. %	0.80 - 1.20	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.

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**COMPLETE ANALYTICAL SERVICES**

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**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	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 =

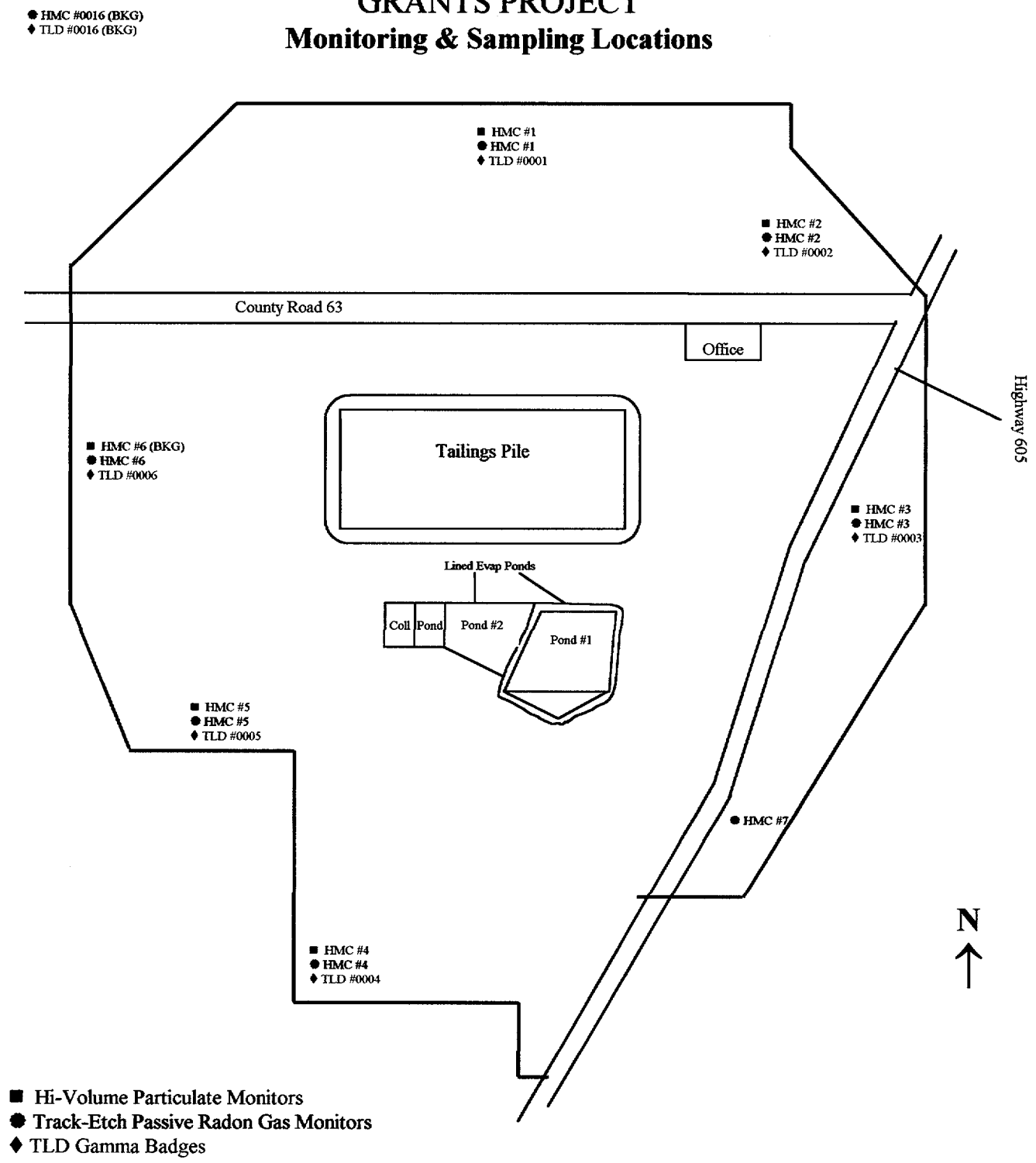
Radiation Work Permit; TLD = Thermoluminescent Dosimeter

**Figure 1 – Monitoring & Sampling Locations**



# HOMESTAKE MINING COMPANY GRANTS PROJECT

## Monitoring & Sampling Locations



**FIGURE 1**

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



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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 30, 2000

SAMPLE ID: HMC 1

Quarter/Date Sampled Air Volume	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
99-23471 First Quarter 1999 Air Volume in mLs 1.59E+11	<sup>nat</sup> U	1.22E-16	N/A	1.00E-16	9.00E-14	1.36E-01
	<sup>230</sup> Th	< 1.00E-16	9.51E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.38E-18	1.00E-16	9.00E-13	< 1.11E-02
99-32084 Second Quarter 1999 Air Volume in mLs 1.42E+11	<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	1.06E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	1.14E-16	1.20E-17	1.00E-16	9.00E-13	1.27E-02
33242-001 Third Quarter 1999 Air Volume in mLs 1.39E+11	<sup>nat</sup> U	3.23E-15	N/A	1.00E-16	9.00E-14	3.59E+00
	<sup>230</sup> Th	< 1.00E-16	6.80E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	1.22E-17	1.00E-16	9.00E-13	< 1.11E-02
35281-1 Fourth Quarter 1999 Air Volume in mLs 1.43E+11	<sup>nat</sup> U	8.84E-16	N/A	1.00E-16	9.00E-14	9.82E-01
	<sup>230</sup> Th	< 1.00E-16	9.25E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.61E-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

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

## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 30, 2000

SAMPLE ID: HMC 2

Quarter/Date Sampled Air Volume	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
99-23472 First Quarter 1999 Air Volume in mLs 1.59E+11	<sup>nat</sup> U	1.13E-16	N/A	1.00E-16	9.00E-14	1.25E-01
	<sup>230</sup> Th	< 1.00E-16	1.07E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.38E-18	1.00E-16	9.00E-13	< 1.11E-02
99-32085 Second Quarter 1999 Air Volume in mLs 1.43E+11	<sup>nat</sup> U	1.68E-15	N/A	1.00E-16	9.00E-14	1.87E+00
	<sup>230</sup> Th	< 1.00E-16	1.06E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	1.18E-16	1.19E-17	1.00E-16	9.00E-13	1.31E-02
33242-002 Third Quarter 1999 Air Volume in mLs 1.41E+11	<sup>nat</sup> U	1.72E-15	N/A	1.00E-16	9.00E-14	1.92E+00
	<sup>230</sup> Th	< 1.00E-16	9.38E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	9.38E-18	1.00E-16	9.00E-13	< 1.11E-02
35281-2 Fourth Quarter 1999 Air Volume in mLs 1.43E+11	<sup>nat</sup> U	4.75E-16	N/A	1.00E-16	9.00E-14	5.28E-01
	<sup>230</sup> Th	< 1.00E-16	1.06E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	9.25E-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

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# ENERGY LABORATORIES, INC.

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

## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 30, 2000

SAMPLE ID: HMC 3

Quarter/Date Sampled Air Volume	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
99-23473 First Quarter 1999 Air Volume in mLs 1.59E+11	<sup>nat</sup> U	1.17E-16	N/A	1.00E-16	9.00E-14	1.30E-01
	<sup>230</sup> Th	< 1.00E-16	1.07E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.38E-18	1.00E-16	9.00E-13	< 1.11E-02
99-32086 Second Quarter 1999 Air Volume in mLs 1.41E+11	<sup>nat</sup> U	4.85E-15	N/A	1.00E-16	9.00E-14	5.39E+00
	<sup>230</sup> Th	< 1.00E-16	1.47E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.68E-18	1.00E-16	9.00E-13	< 1.11E-02
33242-003 Third Quarter 1999 Air Volume in mLs 1.43E+11	<sup>nat</sup> U	4.17E-15	N/A	1.00E-16	9.00E-14	4.63E+00
	<sup>230</sup> Th	< 1.00E-16	7.93E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	1.19E-17	1.00E-16	9.00E-13	< 1.11E-02
35281-3 Fourth Quarter 1999 Air Volume in mLs 1.41E+11	<sup>nat</sup> U	1.53E-15	N/A	1.00E-16	9.00E-14	1.70E+00
	<sup>230</sup> Th	< 1.00E-16	9.38E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.70E-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

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 30, 2000

SAMPLE ID: HMC 4

Quarter/Date Sampled Air Volume	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
99-23474 First Quarter 1999 Air Volume in mLs 1.57E+11	<sup>nat</sup> U	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	<sup>230</sup> Th	< 1.00E-16	7.22E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.41E-18	1.00E-16	9.00E-13	< 1.11E-02
99-32087 Second Quarter 1999 Air Volume in mLs 1.41E+11	<sup>nat</sup> U	3.63E-15	N/A	1.00E-16	9.00E-14	4.04E+00
	<sup>230</sup> Th	< 1.00E-16	1.61E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	1.18E-16	1.21E-17	1.00E-16	9.00E-13	1.31E-02
33242-004 Third Quarter 1999 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	7.32E-15	N/A	1.00E-16	9.00E-14	8.14E+00
	<sup>230</sup> Th	< 1.00E-16	1.31E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	9.19E-18	1.00E-16	9.00E-13	< 1.11E-02
35281-4 Fourth Quarter 1999 Air Volume in mLs 1.41E+11	<sup>nat</sup> U	8.30E-15	N/A	1.00E-16	9.00E-14	9.22E+00
	<sup>230</sup> Th	< 1.00E-16	9.38E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.70E-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

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 30, 2000

SAMPLE ID: HMC 5

Quarter/Date Sampled	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
99-23475	<sup>nat</sup> U	1.43E-16	N/A	1.00E-16	9.00E-14	1.58E-01
First Quarter 1999	<sup>230</sup> Th	< 1.00E-16	7.61E-18	1.00E-16	2.00E-14	< 5.00E-01
Air Volume in mLs 1.49E+11	<sup>226</sup> Ra	< 1.00E-16	6.34E-18	1.00E-16	9.00E-13	< 1.11E-02
99-32088	<sup>nat</sup> U	1.11E-14	N/A	1.00E-16	9.00E-14	1.23E+01
Second Quarter 1999	<sup>230</sup> Th	< 1.00E-16	1.20E-17	1.00E-16	2.00E-14	< 5.00E-01
Air Volume in mLs 1.42E+11	<sup>226</sup> Ra	2.09E-15	8.65E-17	1.00E-16	9.00E-13	2.32E-01
33242-005	<sup>nat</sup> U	1.94E-14	N/A	1.00E-16	9.00E-14	2.16E+01
Third Quarter 1999	<sup>230</sup> Th	< 1.00E-16	1.17E-17	1.00E-16	2.00E-14	< 5.00E-01
Air Volume in mLs 1.45E+11	<sup>226</sup> Ra	< 1.00E-16	1.30E-17	1.00E-16	9.00E-13	< 1.11E-02
35281-5	<sup>nat</sup> U	2.08E-14	N/A	1.00E-16	9.00E-14	2.31E+01
Fourth Quarter 1999	<sup>230</sup> Th	< 1.00E-16	1.09E-17	1.00E-16	2.00E-14	< 5.00E-01
Air Volume in mLs 1.39E+11	<sup>226</sup> Ra	< 1.00E-16	6.80E-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

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 30, 2000

SAMPLE ID: HMC 6

Quarter/Date Sampled Air Volume	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
99-23476 First Quarter 1999 Air Volume in mLs 1.58E+11	<sup>nat</sup> U	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	<sup>230</sup> Th	< 1.00E-16	7.18E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.39E-18	1.00E-16	9.00E-13	< 1.11E-02
99-32090 Second Quarter 1999 Air Volume in mLs 1.43E+11	<sup>nat</sup> U	1.48E-15	N/A	1.00E-16	9.00E-14	1.64E+00
	<sup>230</sup> Th	< 1.00E-16	1.19E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.64E-18	1.00E-16	9.00E-13	< 1.11E-02
33242-006 Third Quarter 1999 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	2.73E-15	N/A	1.00E-16	9.00E-14	3.03E+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	1.31E-17	1.00E-16	9.00E-13	< 1.11E-02
35281-6 Fourth Quarter 1999 Air Volume in mLs 1.43E+11	<sup>nat</sup> U	2.00E-15	N/A	1.00E-16	9.00E-14	2.22E+00
	<sup>230</sup> Th	< 1.00E-16	9.25E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.61E-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

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COMPLETE ANALYTICAL SERVICES





# RADIOCHEMICAL QUALITY ASSURANCE REPORT - HOMESTAKE MINING CORPORATION

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

33242-001-007
Air Filter
3rd Quarter 1999
09-27-99
October 28, 1999

	Method	Relative Percent Difference <sup>1</sup>	Spike Recovery (Percent) <sup>2</sup>	LCS Recovery (Percent)	Method Blank $\mu\text{Ci/mL}$	Date Analyzed	Analyst
Laboratory #: Uranium:	200.8	0.53	103	-	<1.00E-16	10-17-99	TS
Laboratory #: Radium-226:	903.0	6.3	75	80	<1.00E-16	10-19-99	RS
Laboratory #: Thorium-230:	907.0	17.9	95	105	<1.00E-16	10-25-99	PH

- (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.

SW3050 digestion performed on air filters with final volume of 1.89 liters.

Report Approved By: *M. Baiba*

Reviewed By: *R.A. Lachy*  
ELI LABORATORY SUPERVISOR

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**RADIOCHEMICAL QUALITY ASSURANCE REPORT - HOMESTAKE MINING COMPANY**

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

35281-1-7
Air Filter
4th Quarter 1999
12-30-99
January 30, 2000

	<u>Method</u>	<u>Relative Percent Difference</u> <sup>1</sup>	<u>Spike Recovery (Percent)</u> <sup>2</sup>	<u>LCS Recovery (Percent)</u>	<u>Method Blank</u> <u>μCi/mL</u>	<u>Date Analyzed</u>	<u>Analyst</u>
<b>Laboratory #:</b>		35160-1	35160-2				
<b>Uranium:</b>	200.8	0.0	100	-	< 1.00E-16	01-18-00	TS
<b>Laboratory #:</b>		30053-1	30132-1		RA-15		
<b>Radium-226:</b>	903.0	11	89	104	< 1.00E-16	01-21-00	RS
<b>Laboratory #:</b>		35281-4	30101-1		AS-5		
<b>Thorium-230:</b>	907.0	14.1	95	93	< 1.00E-16	01-25-00	PH
<b>Digestion:</b>		<u>Volume</u>	<u>Units</u>				
	SW3050	1.89	Liter			01-03-00	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.

Report Approved By: *[Signature]*

Reviewed By:

*[Signature]*  
REGISTERED QUALITY  
 LABORATORY SUPERVISOR

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**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	6/28/99 - 1/3/2000	2.0E-09	5.0E-10	20	1.6E-10
Hi-Vol #2 NE Outer Perimeter	6/28/99 - 1/3/2000	1.6E-09	3.5E-10	16	1.6E-10
Hi-Vol #3 E Outer Perimeter	6/28/99 - 1/3/2000	1.1E-09	2.8E-10	11	1.6E-10
Hi-Vol #4 S Outer Perimeter	6/28/99 - 1/3/2000	1.7E-09	3.6E-10	17	1.6E-10
Hi-Vol #5 N of Nearest Residence	6/28/99 - 1/3/2000	1.6E-09	3.5E-10	16	1.6E-10
Hi-Vol #6 W of Outer Perimeter	6/28/99 - 1/3/2000	1.7E-09	3.7E-10	17	1.6E-10
HMC #7 S Boundary	6/28/99 - 1/3/2000	1.2E-09	3.0E-10	12	1.6E-10
HMC #16 Background	6/28/99 - 1/3/2000	1.1E-09	2.9E-10	11	1.6E-10

\*Limit of  $1\text{E-}8$   $\mu\text{Ci/ml}$  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/qr)	Error (mrem/qr)*
Hi-Vol #1 N Outer Perimeter	7/1/99 - 1/7/2000	26.0	3.3
Hi-Vol #2 NE Outer Perimeter	7/1/99 - 1/7/2000	27.2	8.1
Hi-Vol #3 E Outer Perimeter	7/1/99 - 1/7/2000	24.7	7.4
Hi-Vol #4 S Outer Perimeter	7/1/99 - 1/7/2000	26.4	5.7
Hi-Vol #5 N of Nearest Residence	7/1/99 - 1/7/2000	12.4	1.2
Hi-Vol #6 W of Outer Perimeter	7/1/99 - 1/7/2000	12.4	1.2
#16 Background	7/1/99 - 1/7/2000	Badge Lost	

\*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 1999 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 are covered by 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 20.0001-20.2401. 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.

#### 2.1 Dose from the 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 1999. The sampling location HMC #5 was chosen as the Nearest Residence Location since the environmental levels were 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/mCi)</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 was calculated to be 11.7 mrem/year while that at the background location (HMC#6) was calculated to be 1.6 mrem/y, for a net CEDE at the principal residence of 10.1 mrem/y. These results from these calculations are shown in Table 2-1 and Table 2-2.

## 2.2 Dose from 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 at the end of this section. Monitoring Station 16 has been accepted as the radon background location for the site. The nearest residence exposure was chosen as HMC#4 since it was higher than the other possible residence location, HMC#5. The time-weighted average of the radon concentration for HMC#4 is 1.59 pCi/l while the time-weighted average for the background location is 1.09 pCi/l. This results in a net radon concentration at the nearest residence is 0.5 pCi/l.

Since the nearest residence is within a few hundred feet of Monitoring Station HMC #4 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. The measured net radon concentration at the nearest residence therefore results in a calculated CEDE of 50 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 this section. The time-weighted-average exposure rate at HMC#4 was 24.7 mrem/quarter while the background location, HMC#16, had a time-weighted average exposure rate of 24.7 mrem/quarter. The TLD for the last half of 1998 for HMC#16 was lost and therefore the data for the first six months of the year was used to determine the annual average exposure rate. With this assumption, the off-site population received no additional dose equivalent above that at the background location.

## 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 10.1 mrem/y from airborne particulate, 50 mrem/y from radon, and 0 mrem/y from direct gamma radiation for a total TEDE of 60 mrem/y. This is within the 100 mrem/year limit.

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

Year:1999

STATION: HMC #6 Background

AIRBORNE CONCENTRATION

	U-nat μCi/ml =====	U-234 μCi/ml =====	U-238 μCi/ml =====	Th-230 μCi/ml =====	Ra-226 μCi/ml =====
1st qtr	1.00E-16	4.87E-17	4.87E-17	1.00E-16	1.00E-16
2nd qtr	1.48E-15	7.21E-16	7.21E-16	1.00E-16	1.00E-16
3rd qtr	2.73E-15	1.33E-15	1.33E-15	1.00E-16	1.00E-16
4th qtr	2.00E-15	9.75E-16	9.75E-16	1.00E-16	1.00E-16
Average	----- 1.58E-15	----- 7.69E-16	----- 7.69E-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 =====
0.741	0.662	0.238	0.006	1.6

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

Year:1999

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	1.43E-16	6.97E-17	6.97E-17	1.00E-16	1.00E-16
2nd qtr	1.11E-14	5.41E-15	5.41E-15	1.00E-16	2.09E-15
3rd qtr	1.94E-14	9.46E-15	9.46E-15	1.00E-16	1.00E-16
4th qtr	2.08E-14	1.01E-14	1.01E-14	1.00E-16	1.00E-16
Average	----- 1.29E-14	----- 6.27E-15	----- 6.27E-15	----- 1.00E-16	----- 5.98E-16

ANNUAL EFFECTIVE DOSE EQUIVALENT

U-234 mrem =====	U-238 mrem =====	Th-230 mrem =====	Ra-226 mrem =====	TOTAL mrem =====
6.040	5.400	0.238	0.037	11.7

**Attachment 5**



## Interoffice Correspondence

---

**TO:** Roy Cellan

**FROM:** Ron Waterland

**DATE:** January 28, 2000

**SUBJECT:** 1999 Annual Status Report for the Large and Small Tailings Embankments

Bob Boyd conducted monthly inspections of the Large and Small Tailings Embankments from January through October 1999. As a result of the inspections some minor maintenance work was periodically schedule and completed. The maintenance for 1999 consisted of minor repair to the interim cover in several places on the top of the Large Tailings. Additional clay was placed in areas on top of the Large Tailings where rain had caused minor erosion.

There was only a minor amount of erosion in areas on the Small Tailings embankments. Work to repair those areas is scheduled for the 2000 summer construction season.