40-8914

Hecla Mining Company

July 1, 1988

CERTIFIED MAIL - -
RETURN RECEIPT REQUESTED

Mr. R. Dale Smith, Director
Uranium Recovery Field Office
U.S. Nuclear Regulatory Commission, Region IV
P.O. Box 25325
Denver, CO 80225

Re: Johnny M Mine - Submittal of Site Survey and Soil Testing Plan

Dear Mr. Smith:

Enclosed please find the "Site Survey and Soil Testing Report for the Johnny M Mine" prepared in accordance with the submittal entitled "Work Plan for Site Surveys and Cleanup" dated October 16, 1987, and referenced in Condition No. 10 of Source Material License SUA-1482. We appreciate the extension of the June 16, 1988 deadline for submittal of the Report from June 16, 1988 to July 7, 1988 by Mr. Peter Garcia of your staff.

By submitting this Report, Hecla is not waiving any rights it may have to contest the NRC's authority to impose license conditions on Hecla with respect to the Johnny M site, or to contest the NRC's authority or procedures for unilaterally "reissuing" or amending, in an entirely new form, the New Mexico Radioactive Materials License which has governed reclamation obligations at this site in the past. We are hopeful, in turn, that the results set forth in the enclosed Report will provide a basis for final reclamation of the site on terms acceptable to all of us.

Thank you for your attention to this matter. Based upon the results set forth in the Report, we will be preparing a cleanup action plan or stabilization plan for the Johnny M site. We look forward to working closely with NRC throughout this process. Please do not hesitate to call if we may be of assistance to you or your staff.

Sincerely,

Colleen D. Kelley

Colleen D. Kelley
Senior Environmental Engineer

CDK:ld

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6500 Mineral Drive • Box C-8000 • Coeur d'Alene, Idaho 83814-1931 • (208) 769-4100 • TELEX 328478

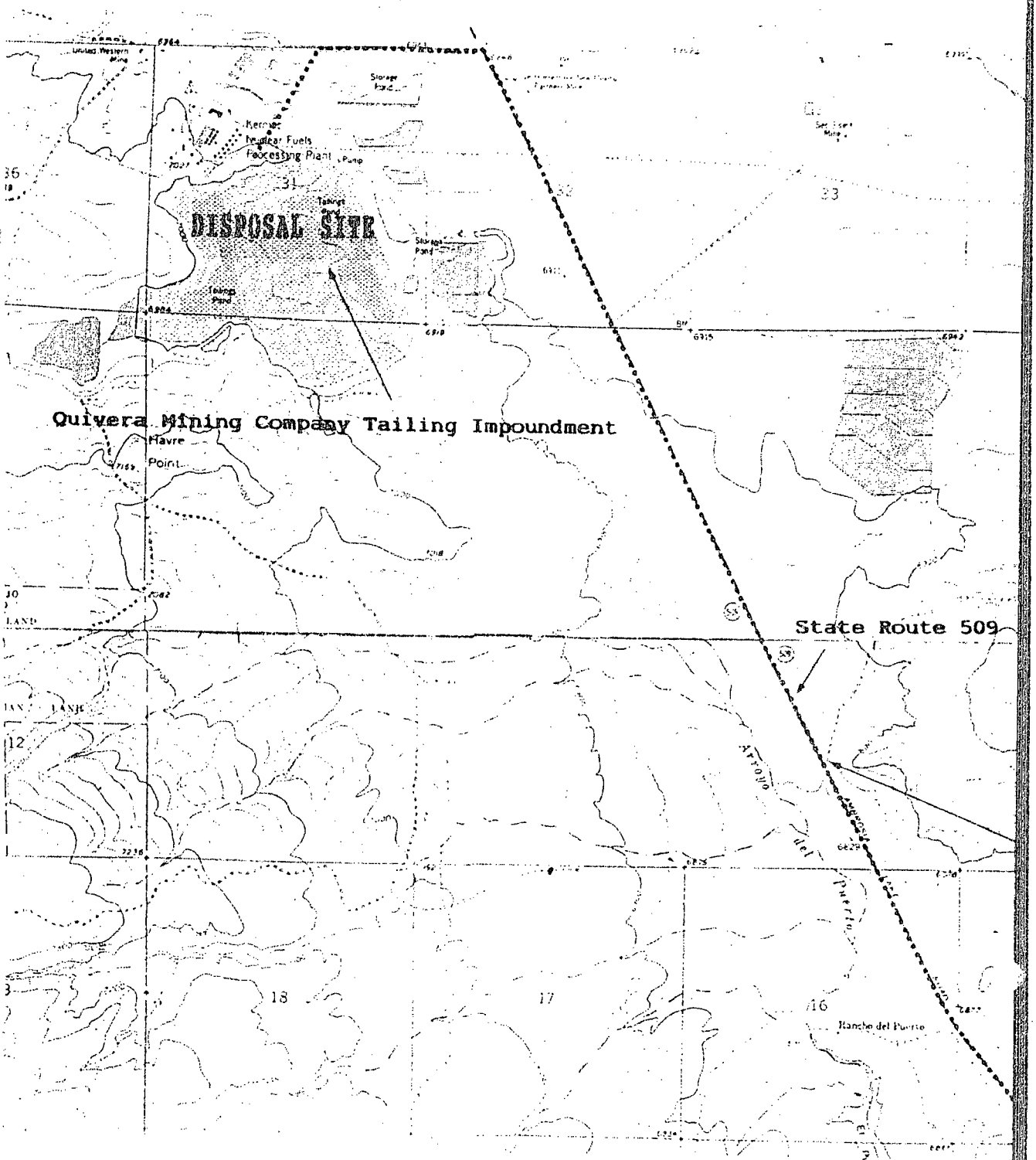
DISPOSAL SITE
Quivera Mining Company Tailing Impoundment
State Route 509
Havre
Point
Kerr-McGee Nuclear Fuels Processing Plant
Storage Pond
Tailings Pond
Arroyo del Puerto
Rancho del Puerto
31
32
33
18
17
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FIGURE 3

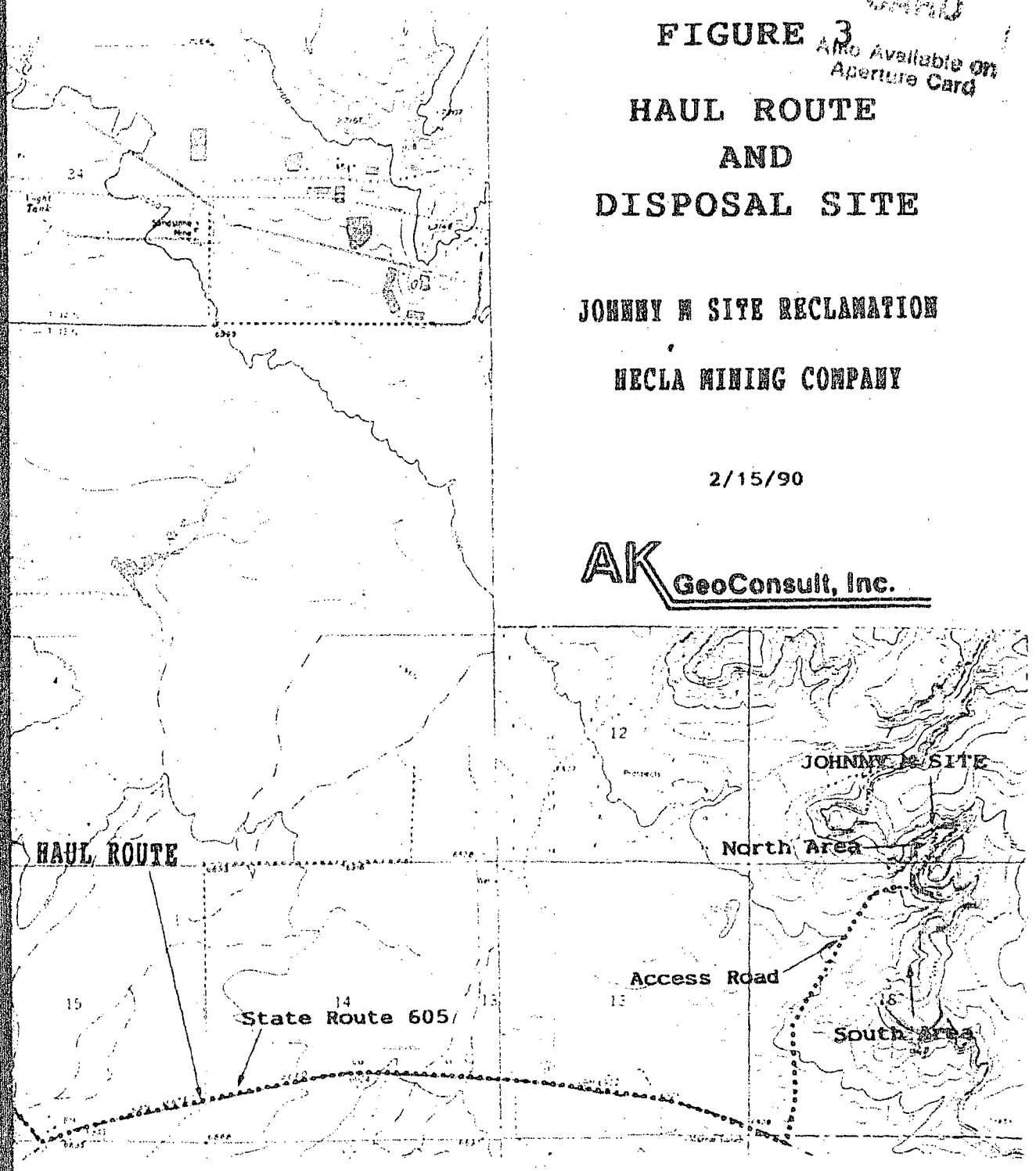
HAUL ROUTE AND DISPOSAL SITE

JOHNNY M SITE RECLAMATION

HECLA MINING COMPANY

2/15/90

AK GeoConsult, Inc.



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REPORT OF INVESTIGATION

JOHNNY M MINE SITE

HECLA MINING COMPANY

PREPARED BY:

Alan Kuhn, Ph.D

Lyda W. Hersloff, Ph.D.

Gene Jenkins

REPORT OF INVESTIGATION

JOHNNY M MINE SITE

Hecla Mining Company

In accordance with the submittal entitled "work plan for site surveys and cleanup" made between Hecla Mining Company and the USNRC, a site gamma survey and soil testing program were conducted at the Johnny M Mine site. These surveys were conducted to determine the vertical and horizontal extent of contamination, as well as the source of contamination.

The Johnny M Mine site evaluated was divided into two areas, north and south. Within each area, a licensed surveyor had laid out a 100 foot square grid. In addition, in the south area, a 16-line radial survey pattern was established for points beyond the grid area. Within each area, a gamma survey was conducted with measurements being taken at each of the grid locations. These gamma surveys were conducted using a Ludlum 125 micrometer. The meter was calibrated at Colorado State University prior to the surveys using a Radium-226 source and a pressurized ionization chamber.

Concurrent with the gamma survey, soil samples were collected at 10 grid locations in both the north and south areas. The locations for soil sampling were determined based on the gamma measurements and are representative of the range of gamma measurements found in each area. Where

possible, soil samples were collected to a depth of 3 feet at intervals of 6 inches. The soils were analyzed by Hazen Research in Golden, CO for Radium-226 (Ra-226), Natural Uranium (U_3O_8), percent moisture, and pH. Eighteen of the soil samples were randomly selected for quality control and analyzed by Accu Laboratories for Ra-226 and Unat as well as for Thorium-230 (Th-230) and Thorium-234 (Th-234).

Background Evaluation

Ten background gamma measurements and five surface soil samples were collected from both the north and south areas. For each area, the background survey was conducted at locations above the areas being investigated. Specifically, background soil samples and gamma measurements for the north area were collected in the basal portions of the canyon walls and on the canyon ridge above the northwest of the canyon floor while those for the south area were collected along the bench cut and the basal portion of the mesa slope to the north and east of the area. For all background soil samples, an attempt was made to collect soils representative of the natural area and the range of gamma measurements.

The average uncorrected background gamma exposure rate for the north area was 30.0±3.7 uR/hr; however, there was significant rock shine along the ledge above the north area. The corrected gamma exposure is 15 ± 1.0 uR/hr in the surface 0-15cm of soil. The average background Ra-226 soil concentration in the north area was 1.4 ± 0.3 pCi/g. This

background concentration was determined using only 4 of the 6 samples taken since the Ra/U ratios of NB1 and NB5 were not consistent with normal baseline ratio's.

The average background gamma exposure rate for the south area was 17.0 ± 0.6 uR/hr. Since there was no evidence of rock shine along the mesa slope of the south area, there was no correction to the gamma readings. The average background Radium-226 soil concentration for the south area was 1.1 ± 0.1 pCi/g in the surface (0-15cm) soil interval based on 3 of the 5 samples collected, again because of discrepancies in the Ra/U and Ra/Th-234 ratios.

Gamma Measurements

The gamma measurement procedure used, where shine was expected, consisted of a total of 4 readings at each location. To correct for shine, a one quarter inch sheet of lead 12 inches square was used. The readings then included 2 readings at 1 meter height, one with and one without lead, and 2 readings at 5cm height, one with and one without lead. The difference between the readings at 5 cm with and without lead is the delta reading due to shine from adjacent rock or other sources. Tables 1 and 2 give the uncorrected and corrected gamma exposure rates at 1 meter at those locations where soil samples were also collected for the north and south areas. The corrected readings are approximately 53

percent of the uncorrected readings with a certainty of at least 98 percent. Using all of the field readings where shine was evaluated (n=57), the correlation indicated a 98 percent accuracy. The field gamma readings are plotted on the attached Figures 1 and 2 with the corrected values being in parentheses.

Correlation Between Gamma Measurements and Soil Ra-226 Concentrations

Table 3 and 4 give the gamma exposure rates and the corresponding Ra-226 surface (0-15cm) soil concentrations for the north and south areas respectively. The regression equation for the north area between the uncorrected gamma measurements at 1 meter and the surface soil Ra-226 concentration is:

Ra-226, pCi/g = 0.55 uR/hr - 9.34

When compared to the regulations in 10CFR40 establishing an average Ra-226 soil concentration in the surface 15cm of 5 pCi/g above background and given the average background Ra-226 in the north area of 1.4 pCi/g, then the above equation predicts the corresponding uncorrected total gamma reading equivalent to 6.4 pCi/g Ra-226 to be 29 uR/hr, with an accuracy of 93 percent.

The same regression for the south area is (Table 4):

Ra-226, pCi/g = 1.00 uR/hr - 21.34

The above equation for the south area, given the background Ra-226 surface soil concentration of 1.1 pCi/g, predicts a

corresponding gamma exposure rate of 27 uR/hr with an accuracy of 98 percent.

The linear correlations between the corrected gamma values and the soil concentrations are equivalent in accuracy to the uncorrected gamma measurements in predicting the surface soil Ra-226 concentrations. This is confirmed by the 99% accuracy predicted by the regression between corrected gamma readings and uncorrected gamma readings, and indicates that the field measurements taken during reclamation can be used directly to determine Ra-226 soil concentration without the need for shine correction.

Source of Residual Radioactivity

The soil sampling program included analyses for Radium-226 concentrations as well as for Uranium, Thorium-230 (Th-230) and Thorium-234 (Th-234). The ratios of the Uranium and Thorium-234 concentrations to the concentrations of other radionuclides in the U-238 decay chain, are used to indicate whether the Ra-226 in soil is due to natural terrestrial radioactivity or to mill tailings. If the Ra-226 in soil is due to uranium mill tailings, the activity ratio between Ra-226 and Uranium (Ra/U) should be statistically greater than that determined at the background locations. Further, the activity of Th-234, the 24-day half-life daughter of U-238, should be much lower than those of Th-230, and Ra-226 which are left in the tailings after

much of the uranium has been extracted. If the Ra-226 soil concentration is due to natural U-238, the activities of Th-234, Th-230, and Ra-226 should be similar. Therefore, if the ratios of Th-234 to Th-230 and Ra-226 in the north and south areas are much lower than those seen in background samples. These soil samples can be identified as containing mill tailings.

Except for analytical error and preferential leaching, the Ra-226 and Th-230 concentrations should be approximately equivalent regardless of whether the source is tailings, uranium ore or natural material. The Ra-226/Th-230 ratios are listed in Table 5 and were used to establish the confidence interval associated with equilibrium. To reduce the effect of analytical differences, the Ra-226 and Th-230 concentrations are those reported by the same laboratory (Accu Labs). The mean ratio is approximately 1.0 with a standard error of 0.32. The 95% confidence interval for the mean Ra-226/Th-230 ratio of 1.0, including analytical error, is 0.6 - 1.4. Based on this 95% confidence interval of the mean Ra-226/Th-230 ratio indicating equilibrium, then the Ra-226/U-238 and Ra-226/Th-234 ratios in the north and south areas significantly greater than 1.4 would indicate the presence of tailings.

The Ra-226/Th-234 ratios are listed in Table 6. From Table 6, the ratio in the north area of B-8, 0-6", indicates a significant deviation from equilibrium suggesting the

presence of tailings. This is also confirmed when evaluating the Ra-226/U-238 ratios in the north area as given in Table 7. From these ratios, it appears that the part of the north area containing residual tailings is bounded to the NE by B-8, to the NW by B-6, to the SW by D-6 and to the SE by D-8. The remaining area although elevated in gamma measurements is probably residual ore material.

The Ra-226/Th-234 ratios for the south area are also given in Table 6. These ratios indicate the presence of tailings material in S-16 (0-6", 30-36"), V-14 (0-6"), and SB1 (0-6"). This is confirmed by the Ra-226/U-238 ratios given in Table 8 where the ratios greatly exceed the equilibrium 95% confidence limit of 1.4. The part of the south area which appears to contain tailings material, based on the Ra-226/Th-234 and Ra-226/U-238 ratios, extends from T-14 to the west and south including S-11, T-14, T-13, T-11, U-13 and V-13. There also appears to be residual tailings around S-16.

The attached soil sampling report and computer plots illustrate the residual radioactivity as a function of depth. The goal was to sample to a depth of three feet at each location; however, rock was encountered much closer to the surface than expected especially in the north area. The attached figures (1A and 1B) for the south area, show a definite trend of decreasing Ra-226 concentration with

increasing depth of soil at most locations. A trend is not as readily apparent for the north area since samples at most locations could not be collected to the total depth of 3 feet.

IMS INC
environmental scientists and engineers

Soil Sampling at the Johnny M Mine

Methods

After gamma measurements were taken at each grid point, ten points were selected in each area for soils sampling. The points were selected to represent a range of surface gamma values. In the South Area, the points chosen for sampling were R–12, S–11, S–16, T–11, T–13, T–14, U–12, U–13, V–12, and V–14. In the North Area, the points chosen were B–8, C–4, C–6, C–7, C–8, D–5, D–8, E–4, F–2 and F–5. At each sample location, samples at 15-cm depth intervals were collected using a 7.5-cm soil auger from the surface down to 90 cm. At two locations in the South Area and nine locations in the North Area, bedrock, rock fragments or other obstructions prevented sampling down to 90 cm. Four locations in the North Area were sampled only to a depth of 30 cm.

Each sample was placed in a clean, polyethylene bag, labeled and sealed. Eighteen samples were split for quality control evaluation. Following sampling splitting, all samples were delivered to a laboratory for analysis. Samples were analyzed for percent moisture, pH, uranium, and radium-226. In addition to these analyses, the split samples were analyzed for thorium.

Results

A total of 98 samples were collected: 55 from the South Area, 33 from the North Area, and ten background samples. Analytical results for the South Area, North Area and background samples are shown in Tables 1, 2, and 3, respectively.

South Area. Figures 1A and 1B show radium-226 concentrations with depth for the South Area samples. Lowest radium-226 concentrations occur at R–12. At most sampled locations, radium-226 concentrations tend to be higher closer to the soil surface. At six locations radium-226 concentrations below 15 cm do not exceed 6 pCi/g, and at one other location radium-226 concentrations do not exceed 16 pCi/g below 15 cm. At two locations, S-11 and T-14, radium-226 concentrations are above 50 pCi/g to a depth of 45 cm. At these two locations, radium-226 concentrations decrease to less than 16 pCi/g below 45 cm.

Values for pH range from 5.2 to 8.8. There is no apparent correlation between pH and radium-226 concentrations.

North Area. Figures 2A and 2B show radium-226 concentrations with depth for the North Area samples. Highest radium-226 concentration occur at the 15-to-30 cm sample at F-2. The lowest radium-226 concentration level is at F–5.

The trend of decreasing radium-226 concentrations with increasing depth is not as readily apparent for the North Area as it is in the South Area. This may be at least in part due to the limited number of samples obtained from the North Area from depths below 45 cm. At six of the ten locations, radium-226 concentrations are higher in the 15-to-30 cm interval than in the 0-to-15 cm interval. Two other locations exhibit little change in radium-226 concentrations between these two intervals. Of the four locations sampled to more than 45 cm, one (C–7) shows little change with depth. At two locations, D–8 and F–5, radium-226 concentrations generally decrease with depth, and are less than 16 pCi/g below 30 cm. At location C–4, radium concentrations vary erratically with depth.

Table 1. Laboratory results—South Area.

Site no.	Depth to top of sample increment (cm)	Radium 226 (pCi/g)	Uranium as U308 (%)	pH
R-12	0	0.7 ±0.5	<0.001	8.7
R-12	15	0.5 ±0.4	<0.001	8.2
R-12	30	0.2 ±0.3	<0.001	8.1
R-12	45	0.5 ±0.4	<0.001	8.1
R-12	60	0.4 ±0.4	<0.001	8.5
R-12	75	0.6 ±0.4	<0.001	8.8
S-11	0	91 ±5	0.009	8.3
S-11	15	95 ±5	0.009	8.4
S-11	30	45 ±3	0.005	8.4
S-11	45	15 ±2	0.001	8.3
S-11	60	3.2 ±0.9	<0.001	7.2
S-11	75	1.1 ±0.5	<0.001	6.8
S-16	0	16 ±2	0.001	8.1
S-16	15	39 ±3	0.001	8.0
S-16	30	65 ±4	0.003	8.1
S-16	45	9.0 ±1.5	0.001	8.1
S-16	60	83 ±5	0.003	8.2
S-16	75	100 ±5	0.006	8.1
T-11	0	190 ±10	0.015	8.0
T-11	15	5.8 ±1.3	0.001	7.5
T-11	30	3.0 ±0.9	<0.001	6.6
T-11	45	2.8 ±0.9	0.001	6.8
T-11	60	2.1 ±0.8	<0.001	6.3
T-11	75	2.8 ±0.9	<0.001	7.3
T-13	0	34 ±3	0.001	7.4
T-13	15	3.2 ±0.9	0.001	5.9
T-13	30	1.5 ±0.6	<0.001	7.0
T-14	0	63 ±4	0.002	8.2
T-14	15	86 ±5	0.005	8.0
T-14	30	59 ±4	0.002	8.3
T-14	45	5.0 ±1.1	<0.001	8.1