Demolition and Decontamination of Wet and Dry Mill Buildings

Heritage Minerals, Inc.

Prepared For:

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Heritage Minerals, Inc.

ENERCON Services, Inc. (ENERCON) is pleased to provide this report on final decommissioning activities conducted at the Heritage Mineral Inc. (HMI) facility located in Lakehurst, NJ. ENERCON was retained to manage and oversee final decommissioning and decontamination (D&D) activities at the HMI facility in accordance with the March 10, 2003 plan and schedule for final D&D activities and modifications resulting from a follow-up phone conversation with NRC on April 9, 2003. These activities have been performed to support termination of NRC License SMB-1541. The D&D plan and schedule of March 10, 2003 (attached) and follow-up letter to NRC dated May 6, 2003 (attached) detail two specific items: removal of fugitive licensable source material pockets in and around the footprint of the former monazite pile and final D&D of the wet and dry process mill buildings. ENERCON performed soil removal activities to address the fugitive licensable pockets of source material in April 2003. The attached report titled "Removal of Fugitive Licensable Soil" (ENERCON, 2003) was submitted on behalf of HMI to NRC Region 1 on June 12, 2003 detailing these activities. This report details all other decommissioning activities at the HMI site including the second phase of D&D activities, final D&D of the wet and dry process mill buildings, and items resulting from NRC's final confirmatory survey of the site following D&D of the mill buildings.

Project Overview

D&D of the wet and dry process mill buildings began in May 2003. Both mill buildings were demolished and all building materials from the demolition and the mill pads were cleaned to achieve appropriate release criteria. Radiological surveys were performed on building materials to ensure the release criteria were met. These materials were transported offsite for disposal or recycling. At the completion of the project approximately 1,800 tons of steel were recycled offsite.

At project completion, HMI excavated, loaded and disposed a total of 226 shipments and 4,246 tons of soils representing three separate removal efforts. This includes the excavation of the monazite pile in 2001 where Radiation Science, Inc (RSI) excavated and disposed of 3,385 tons of monazite and the May 2003 and Dec 2004/Jan 2005 efforts directed by ENERCON where a total of 860 tons of soils were excavated and disposed. All shipments of soil have been sent to International Uranium Corporation (IUC) in White Mesa, UT. The estimated radiological activity of all soil removed from the HMI site is 3.2 Curies of Total Thorium.

Project Organization

This project has been completed for HMI, licensee and owner of the HMI site, by ENERCON. ENERCON provided health physics (HP) technicians and equipment as well as other expertise to the project. This included data collection, compilation, analysis, and reporting; consultations with regulatory officials; documentation of activities; and guidance of remediation efforts. D&D support has been supplied by Neumeyer Environmental Services (NES) and Mazza and Son's, Inc.(Mazza) Various other companies provided limited or specialized support during this project.

Project History

The site was originally owned and operated by ASARCO, Inc. between 1973 and 1982. ASARCO's operation consisted of hydraulic mining of sand deposits containing heavy minerals and processing those sands to extract the titanium mineral ilmenite. This process consisted of a wet mill separation where the heavy minerals, which accounted for 5% of the sand deposits, were concentrated using Humphreys spiral separators and a dry mill operation consisting of high tension electrostatic separators and high intensity magnetic separators which further refined the ilmenite product. Tailings from the dry mill contained the residual heavy minerals following extraction of the titanium mineral product. This process was continued until 1982 when deteriorating market conditions caused ASARCO to stop active operations and place the site on standby status.

In 1986, the property was sold to HMI. For the first year of ownership, HMI leased the facilities to Mineral Recovery, Inc. who ran pilot tests and initial plant break-in for recovery of zircon and additional titanium minerals from the dry mill tailings left by ASARCO operations. Mineral recovery operated the plant for almost a year. In August 1987, HMI took over the operation and continued reprocessing the dry mill tailings to extract the zircon and residual titanium minerals. In January 1989, HMI was cited by the NRC for possession of monazite sands, which contained licensable quantities of source material, i.e., thorium and uranium. At this time, HMI began stockpiling all licensable materials in what became known as the monazite pile and applied to

NRC for a license in March 1989. HMI ceased production in 1990. HMI's license issued on January 2, 1991, specifies the following requirements for license termination: removal off all licensable material from the monazite pile and cleaning of the plant buildings and equipment to the unrestricted release criteria specified in Option 1 of the Branch Technical Position (BTP), 46 Federal Register 52061 (October 23, 1981).

Since that time, numerous phases of decommissioning have been undertaken at the HMI site in support of license termination. HMI contracted with RSI to remove licensable materials from the monazite pile and to decommission the wet and dry mill buildings. In 2001, RSI shipped approximately 3,385 tons of soil from the monazite pile to IUC. RSI also decontaminated and performed final status surveys of both process mill buildings. RSI submitted a final status survey report on the site to NRC in December of 2001. Following submission of RSI's final status survey report, NRC contracted ORISE to perform verification sampling and surveys of the monazite pile and process mill buildings. The attached ORISE report dated March 2002 concluded that licensable soils remained in and around the monazite pile footprint. ORISE also concluded some portions of the mill buildings did not meet the unrestricted release criteria specified in the decommissioning plan. At this time, NRC informed HMI that additional decommissioning activities would be necessary at the site.

In February 2003, HMI retained SENES Consultants Limited (SENES) to provide radiological advice on final decommissioning activities. It was at this time that HMI decided demolition of the wet and dry mill buildings would be the most cost effective decommissioning alternative due to difficulties involved in decontaminating the buildings in place. In the attached March 10, 2003 letter entitled "Overview of Radiological Procedures Concerning the Decommissioning and Decontamination (D&D) of the HMI Lakehurst, NJ Site", SENES recommended a plan and schedule describing HMI's approach to conduct final D&D activities. NRC Region 1 personnel and HMI representatives agreed that the strategies discussed in this letter in conjunction with HMI's approved decommissioning plan would be an appropriate approach to final D&D activities. In follow up conversation on April 9, 2003 between NRC Region 1 personnel and HMI representatives, the D&D approach was finalized. This time HMI retained ENERCON to manage and oversee HMI's final D&D activities.

Project Description

Building demolition

D&D of the wet and dry mill buildings began on May 12th, 2003. Each building consisted of iron and steel process equipment installed within a steel enclosure. The wet mill was demolished first using a Komatsu shear. The shear dismantled and sized the process equipment and internal structures of the wet mill into small manageable pieces. Once the process equipment and internal structures were demolished, the building shell was sheared and pulled down and cut into moveable pieces. As indicated by RSI and ORISE, most of the residual contamination was located in areas of the building which were inaccessible to survey and previous decontamination efforts due to building and equipment geometry. Thus, the dismantling and cutting allowed access to previously inaccessible locations for more thorough decontamination and survey efforts.

After the wet mill was demolished, the shear demolished the dry mill building. To minimize dust generation, the building was wet down using a fire hose while demolition proceeded. Air monitors were set up downwind of the building during demolition to monitor air quality. No significant airborne activity was measured during the dry mill demolition.

Decontamination and Survey

Following demolition, the decontamination process began using power washers and fire-hoses supplied by NES. Pieces of steel were moved using a grappler or wheel loader to the power washing station located on the southwest corner of the wet mill concrete pad. The steel was thoroughly washed to remove all loose sand and dust. Following decontamination, steel was moved to the concrete pad adjacent HMI's equipment building for final survey. Health Physics staff performed final status surveys of the material, which included static beta measurements, smears and exposure measurements. Clean steel materials, meeting the release criteria, were stockpiled on the hill north of the equipment building. These pieces were loaded in trucks and sent to Mercer Group, International in Trenton, NJ to be reprocessed for transportation to a local steel recycling facility. In addition to site release surveys, all shipments of steel successfully passed through a portal monitor at the recycling facility.

Some pieces of process equipment failed to meet release criteria following washing. These failures were due to either accumulations of elevated sand in inaccessible locations or lubricated process equipment, which retained elevated materials in the lubricant. These pieces were stockpiled to undergo more aggressive decontamination efforts. These methods included torch cutting to open inaccessible areas and hot water pressure washing to dissolve and remove contaminated grease. Additionally, HMI purchased a hydraulic spreader, commonly known as the "jaws of life", to open certain pieces of steel, specifically launders, that had become pinched during the demolition. Following utilization of these decontamination methods, all steel, once washed again, met the criteria for unrestricted release.

Following removal of all large steel pieces, a large magnet was used to remove the small pieces of steel left on and around the concrete mill pads. These steel pieces were too small to be picked up with the grappler or wheel loader and most were partially lodged and embedded in sand on and around the concrete pads. The magnet, operated by Mazza, piled these remaining pieces of steel on the concrete pad areas where they could be washed and surveyed. All remaining small steel pieces were released from site using this process.

The final activity associated with the building D&D was cleaning both the wet and dry mill concrete pads to meet unrestricted release criteria. Following the steel decontamination process, residual process sand was left on each mill pad. All sand from both mill pads was collected and stockpiled on a lined area south of the dry mill. The wet mill contained the largest amount of residual sand resulting from the launder decontamination and excavation of numerous sumps and holes located throughout the wet mill. Following bulk sand removal, both concrete mill pads were extensively powerwashed to remove any remaining sand. Sampled data from soil samples taken from the sand stockpile averages 25-27 pCi/g total thorium, below the licensable level of 116 pCi/g but above 10 pCi/g.

Following all D&D activities, a 30-point survey was completed on each concrete mill pad. Results from each survey are attached.

Final Survey Procedures

Radiological surveys of the HMI wet and dry mill building steel equipment and structural pieces provided accurate and concise data to support the license termination process. The radiological survey objectives were to confirm that building materials and process equipment met the surface activity criteria specified in HMI's material license. These values, based on thorium in equilibrium with it's daughter products, are 1,000 dpm / 100 cm^2 average fixed beta, 3,000 dpm / 100 cm^2 maximum fixed beta, and 200 dpm / 100 cm^2 removable beta.

Survey procedure

All release surveys were performed with Ludlum Model 2221 rate-meter coupled with a 43-68 gas-proportional detector probe. Survey procedure included a scan of the material followed by a one minute count and wipe sample taken at the area of highest scan reading. Daily background checks were performed on each Model 2221, recorded and used to determine a daily cutoff for each meter. After a piece or pieces of steel materials were surveyed and shown to meet the release criteria, they were marked with the survey number using green paint and photographed. Steel pieces, which failed release criteria, were marked with red paint and stockpiled south of the dry mill pad. Steel survey data is attached.

Steel stockpiled south of the dry mill pad required more aggressive efforts to remove residual sand. After torch cutting separated clean portions from contaminated, all contaminated pieces were washed with a hot water pressure washer and biodegradable degreaser to remove contaminated grease. The hot water spraying was repeated until all pieces met release criteria. The survey data for these pieces is included with the dry mill survey data under survey unit "Post Decon".

Instrumentation - Radiation Detection Equipment

Radiation detection equipment was selected based on the project requirements. Equipment used throughout the project included gas proportional probes, Sodium Iodide (NaI) scintillation probes, Micro-rem meters and scintillation counters for smears and air samples. All equipment was calibrated at a frequency specified by the manufacturer. All instrumentation was source checked daily on-site and daily background values and efficiencies were utilized. Instruments were selected based on those that would provide an adequate response to radiation and demonstrate compliance with the accepted release criteria.

Minimum Detectable Activity

Minimum detectable activity (MDA) was calculated for each model. The MDA was calculated using formulae contained within Section 5.5.3 of NUREG/CR-5849. The typical background rate and typical detector efficiency used in the MDA calculation was based on an average of the daily background and daily efficiency checks recorded for the instruments in use from May through September 2003. Table 1 shows the instrument models selected and summarizes the typical background counts in counts per minute (cpm), typical detector efficiency, and the average MDA for each instrument model. Other objectives in selecting instruments include special features such as digital displays to provide a more accurate reading than conventional analog displays.

Table 1
Summary of Project Instrumentation

Ludlum Instrument Model	Typical Background Rate	Typical Efficiency %	Average MDA (above background)
2221 (Scaler)	254 cpm	26.0	296 dpm/100 cm^2
2221 (Ratemeter)	254 cpm	26.0	553 dpm/100 cm^2
2221 (Scan)	254 cpm	26.0	2936 dpm/100cm^2
19 (Ratemeter)	4 µR/hr	N/A	Background
2929 (Scaler)	45 cpm	27.5	17 dpm/100 cm^2

Instrument Calibration

Qualified personnel calibrated all field survey instruments. At a minimum, the survey instruments were calibrated before the initial use to verify the annual calibration by the manufacturer or annually based on a previously known calibration date. ENERCON holds calibration information and certificates for the calibration sources. After calibration, an initial source count was performed in the field at a reproducible location for each instrument using the check sources.

Pre-Operational Checks

Background readings for counting instruments were conducted daily prior to use. Each day that an instrument was used, it received an operational check that consisted of a background reading (observed cpm for ratemeters or 10-minute static count for scalers) and a count of a known check source (observed cpm for ratemeters and 1-minute static count for scalers). Any instrument that used a DC battery also received a daily battery check before operation. If a battery check failed, an equivalent size battery was installed and the instrument rechecked before operation. An instrument that approached its calibration due date or fell outside of the ±20 percent of the established initial source check was re-calibrated. Any inappropriate response resulted in the instrument being taken out of service and sent to the qualified vendor for calibration and/or maintenance.

Minimum Detectable Activity Calculation

A representative portion of the daily background and efficiency checks for each instrument in use from May to September 2003 was evaluated for the purpose of establishing MDA values applicable to an instrument model. Data from each individual instrument in service during this time frame was utilized to ensure its representation in the data calculations. Data was grouped by instrument model and summarized using Microsoft Excel© 97. The formula and/or functions used in the spreadsheet are detailed in the following sections.

MDA

Scaler instruments:

$$MDA = \frac{2.71 + 4.65\sqrt{B_r * t}}{t * E * \frac{A}{100}}$$

Ratemeter instruments:

$$MDA = \frac{4.65\sqrt{B_r / 2t_c}}{E * \frac{A}{100}}$$

Scanning instruments:

$$MDA = \frac{3 * B_r}{E * \frac{A}{100}}$$

Where:

MDA = minimum detectable activity level in disintegrations/minute/detector area

B_r = Background rate in counts per unit time (cpm)

t = Count time (scaler) or time constant (ratemeter) in minutes

E = Detector efficiency in counts per disintegration

A = Effective detector area in cm^2

The MDA for static measurements on carbon steel given in NUREG 1507 is 275 cpm. The MDA calculated using averaged field measurements for each instrument is 260 cpm.

Instrument Efficiency

The efficiency of the detection capabilities for each instrument group was calculated by dividing the source count rate by the calibrated dpm value of the available Tech (Tc)-99 calibration source and determining an average of that efficiency value using the MS Excel© function "AVERAGE". Instrument efficiency calculations was performed and recorded daily.

Instrument Models

Ludlum Model 12 with 44-9 Geiger Mueller Tube Detector

This is a ratemeter instrument with a 15 cm^2 Geiger-Mueller tube detector that was used for general contamination detection only and was not used for any release surveys due to its limited alpha detection capabilities. The MDA calculations were based upon beta-gamma background and efficiency data.

Ludlum Model 2221 with 43-68 Gas Proportional Detector

This is a scaler/ratemeter instrument and gas proportional detector and a 100 cm^2 probe area that was used for all types of surveys.

Ludlum Model 2929 with 43-10-1 Scintillation Detector

This is a scaler instrument used for counting wipe samples. While capable of discriminating between alpha and beta contamination, only beta contamination readings were recorded.

Ludlum Model 19 μR Meter

This is a ratemeter instrument that was used for exposure rate surveys of work areas, waste materials, and containers. It was generally accepted that the MDA of this instrument is equivalent to its background readings.

Repairs and Maintenance

An outside vendor that was certified by the instrument manufacturer or the instrument manufacturer performed repairs on the instruments. Periodic maintenance was performed by the technicians as recommended by the manufacturer. Instruments were stored in a secure location away from radioactive contamination.

Operational Documentation

Instrument performance, calibration, and maintenance records were maintained as part of the project files.

Radiation Protection Activities

Personnel exposure to radiation and radioactive material was maintained within the applicable legal limits, and every effort was made to keep personnel exposures ALARA. The administration of the radiation protection program for the project included the following:

- Radiation exposure control
- Radiation/contamination evaluations
- Radiation detection instrumentation
- Emergency procedures
- Protective equipment and clothing
- Radiation worker indoctrination and training programs

Radiation Exposure Control

The nuclear industry standard of ALARA was the driving factor behind all work controls established for the HMI project. ALARA dictates that the radiation exposure to any individual be kept at a minimum, and designates certain steps be taken to maintain exposure ALARA.

Each decontamination worker and HP technician was issued a TLD for the purpose of tracking and documenting radiation exposure during their tenure at the HMI site. Reports of all TLD data are maintained confidentially at the ENERCON office in Murrysville, Pennsylvania.

Radiation and Contamination Evaluations

Radiation and contamination evaluations were performed by the HP staff monitor work areas and to ensure that sand did not migrate to unaffected areas of the site radiation measurements along major traffic routes around the site. Air samples were collected during work periods where any dust was generated during demolition and decontamination activities.

Emergency Procedures

Emergency procedures were focused on responding to problems with building operations such as electrical power, public utilities, or telephone service. No accident or emergencies occurred during the project duration.

Protective Equipment and Clothing

Protective equipment and clothing was used throughout the remediation project to protect the workers and HP staff.

Radiation Worker Training Program

Project personnel received training regarding:

- Radiation and Radioactive Materials
- Radiation Protection
- Safety
- Emergency Response
- Security

In addition, the site HP technicians reviewed all project procedures. The senior HP technician onsite reviewed this information with visitors and temporary workers who were not onsite at the beginning of the project for the site safety training.

Decontamination Methods

A variety of safe and effective decontamination methods were used to clean the mill building materials. The decontamination techniques employed are widely used in the decommissioning industry and do not pose unusual, or significant, health and safety concerns. Personal protection used during the decontamination activities were in accordance with the "Health and Safety Plan, Remediation Activities" manual. All of the steel was cleaned with cold water power washers and fire-hoses. Hot water pressure washers and biodegradable degreaser were used to remove contamination on greased bearings and oily components. Torch cutting was used to open inaccessible areas of equipment as well as to reduce isolated spots of contamination. Grinding was also used to remove contaminated rust from steel equipment.

Background analysis

Background levels were investigated during previous characterization and decommissioning efforts. Daily background checks were performed on each meter used to record field measurements. These backgrounds were subtracted from the gross field measurements to determine if a piece of clean or contaminated. Daily background and efficiency for all meters used on this project are attached. Background soil levels in pCi/g were previously analyzed by SENES.

Data Interpretation

The data attached includes all survey data from the project. Data have been converted to units dpm (surface activity), μR/hr (exposure rates), and pCi/g (soil concentrations) following the guidance of NUREG/CR-5849. All surface activity measurements have been adjusted for natural background.

Records

Original survey and sample data records are maintained at ENERCON's Murrysville, Pennsylvania office.

Data Analysis

The survey data for all steel equipment and structural components is attached. All steel was cleaned until it met release criteria, therefore, as expected, all static measurements are below 1000 net dpm/100 cm^2 as specified in HMI's decommissioning plan. Additionally, all removable measurements are below 200 net dpm/100 cm^2. All radiation measurements were representative of background levels at the survey area. Data interpretation of the surveys performed on each of the wet and dry mill concrete pads show each pad is below release criteria and demonstrated that once the sands were removed from the concrete pads, the pads were clean and showed no elevated surface activity.

ORISE Confirmatory Survey

As these final cleanup efforts were completed, NRC contracted ORISE to perform confirmatory surveys of the site to ensure release criteria were met for both phases of work, the D&D of the process mill buildings and the removal of fugitive licensable ground material products. ORISE personnel completed this survey the week of September 9th, 2003 under the guidance of NRC Region 1 personnel. ORISE performed confirmatory sampling of previous licensable source material locations excavated by ENERCON in April 2003. ORISE also performed a gamma walkover survey of areas surrounding the wet and dry mill pads and areas in and around the former monazite pile. The ORISE survey confirmed that building demolition and building pad cleanups were complete.

During the survey, areas exhibiting elevated activity were flagged. Soil samples from these locations were collected and analyzed by both ENERCON and ORISE. Analytical results indicated that pockets of fugitive licensable materials were present in a few select locations. These locations include areas in and around the former monazite pile, and two locations north of the wet mill pad. Figure 1 and attached table present the location of each sample point possessing licensable material. These remaining locations of fugitive licensable source material are addressed in the attached report, "Final Removal of Fugitive Licensable Soil – 2005"

Project Conclusion

Analysis of the data provided in these reports and previous site decommissioning reports support the conclusion that activities undertaken at the HMI site have successfully met the decommissioning objectives for the HMI site. In summary, both the wet and dry mill building have been demolished, cleaned and disposed offsite. The monazite pile has been excavated and disposed at a licensed facility. All remaining pockets of fugitive licensable source materials and residual sands from both mill demolitions have been excavated and disposed offsite at a licensed facility. All of these efforts have been performed under the guidance of NRC Region 1 personnel using HMI's approved decommissioning plans and procedures.

List of Attachments

March 10, 2003 Letter "Overview of Radiological Procedures Concerning the Decommissioning and Decontamination (D&D) of the Heritage Minerals Inc. (HMI) Lakehurst, NJ Site"

Letter to NRC May 6, 2003

ENERCON Final Removal of Fugitive Licensable Soil Report – 2005

- ORISE Report December 2003
- Letter to NRC June 30, 2004
- NRC letter to HMI November 17, 2004
- Photographs of Fugitive Licensable Material Locations
- Diagram of Sampling Locations Under Stockpile

ORISE Report March 2002

Survey Data for Steel

Survey Data Wet and Dry Mill Pads

Table, Laboratory Data Confirming Removal of Locations Identified by ORISE and ENERCON

Figure 1, Location of Fugitive Licensable Material Identified by ORISE and Enercon (Red Area Map)

Removal of Fugitive Licensable Soil Report June 12, 2003

March 10, 2003 Letter
"Overview of Radiological Procedures
Concerning the Decommissioning and Decontamination (D&D)
of the Heritage Minerals Inc. (HMI)
Lakehurst, NJ Site"

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10 March 2003

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Re: Overview of Radiological Procedures Concerning the Decommissioning and Decontamination (D&D) of the Heritage Minerals Inc. (HMI) Lakehurst, NJ Site

Dear Mr. Thompson:

On Friday, 7 February 2003, I met with you and Ms. Edele Hovnanian at the HMI site in Lakehurst, New Jersey. At that time, we also met with Mr. Dominic Mazza, the demolition/salvage contractor for HMI and Mr. Craig Gordon, the Nuclear Regulatory Commission (NRC) Region I Project Manager for the HMI site.

In addition to general discussions concerning the history of the HMI mill site and previous efforts to decommission the mill, we also had general discussions concerning the need to proceed expeditiously with the decommissioning of the mill buildings and any equipment that had been used to process the heavy mineral feeds. We also had a "walking tour" of the wet mill and dry mill. Finally, in addition to discussing potential approaches to completing the mill decommissioning, we also briefly discussed the need to remove "pockets" of soil identified through the November 2002 "*Characterization Survey for Heritage Minerals, Inc.*" (Radiation Science, Inc. (RSI) 2002) as soils containing *licensable* source material.

Subsequent to our "walking tour" of the mill buildings, SENES was retained on 18 February 2003 to provide radiological advice to HMI in support of D&D activities at the HMI site. In particular, SENES was asked to develop a plan for carrying out radiological surveys in support of mill demolition/salvage and removal of the remaining soils identified to contain *licensable* levels of source material. This letter report provides a description of our proposed approach for the radiological surveys..

BACKGROUND

Previous Site Surveys and Characterization

Significant work has already been done on the HMI site regarding the degree and extent of radiological characterization of the site. This work includes the RSI surveys documented in the RSI Final Status Survey Plan (FSSP) (December 2002 and reported in the Final Site Survey), and the verification confirmatory survey conducted by ORISE (2002). In addition to the FSSP, the Final Site Survey (FSS) and the ORISE report, we have also reviewed a detailed operational history of the site (Thompson 2002) and various plans and photographs of the mills that were provided to us by Mr. John Lord of HMI. (Appendix A is a catalogue of photographs of the mill taken in February 2003.) These photographs illustrate the complexity of the mill decommissioning and the need for a practical approach to decommissioning and supporting radiological surveys.

Figure 1 is a plan of the site showing the location of the mills and other site features (from Thompson 2002). Figure 2 shows the results of the radiological characterization survey carried out for HMI, showing the location of the soils containing *licensable* source material levels (RSI, November 2002).

The following key observations arising from our review of the available information and from discussions with NRC provide some background to our proposed radiological survey plan described in the following sections of this letter report.

We also had the opportunity to participate in two (2) followup telephone discussions with NRC staff in which outstanding issues and potential alternatives for moving forward were discussed.

(1) <u>"Time is of the essence"</u> Both NRC and HMI want the mill buildings (and contents) decommissioned as soon as practicable and, certainly, by the end of 2003.

Trespassers, according to HMI, frequent the lakes created through the mining of the heavy minerals. Given the potential concerns of trespassers during the summer months, it seems desirable, if possible, to demolish the mill buildings and decontaminate the site prior to the summer vacation period, if NRC approval of the proposed procedures is granted expeditiously.

(2) <u>Beta/Gamma Scan</u> As we understand the issue, RSI relied primarily on alpha contamination survey methodologies for the FSS. Since alpha radiation can be masked by oil, dirt, rust etc., ORISE, in their verification survey, relied on beta/gamma survey to identify areas exceeding NRC criteria for unrestricted release.

There appears to be an issue concerning the sensitivity of the beta/gamma survey instruments used by ORISE as part of their verification survey to low energy gamma radiation. In our opinion, the beta/gamma survey meters are more sensitive to low energy gamma than is currently acknowledged by the NRC. However, beta/gamma surveys of surface contamination can be carried out more rapidly than alpha contamination surveys and, therefore, we are proposing beta/gamma scans as the survey method for scanning material arising from mill demolition and assessing compliance with NRC's criteria for unrestricted release.

(3) Materials Failing to Meet NRC's Unrestricted Release Criteria Based on past experience, it is anticipated that some portion of the materials arising from the demolition of the mill and salvage of equipment in the mill may not be easily decontaminated to NRC criteria. One possible example is rubber-lined equipment. In such cases, we have assumed that it is HMI's option to pursue more aggressive decontamination procedures or to send such materials off-site for disposal at an approved facility.

(4) Soils Containing Licensable Source Materials As noted above, some "pockets" of *licensable* source material remain in areas south and east of the dry mill building. These materials will be excavated and transported off-site for processing and disposal at an appropriate facility.

We understand from our discussions that the soils containing more than 500 ppm (0.05% by weight) of uranium and/or thorium are to be removed, and our proposed survey plan has been based on proposed radiological characterization to this level.

(5) Nature of Contamination In developing the proposed radiological survey plan, it is important to understand that the source of the radiation/radioactivity are uranium and thorium decay chain radionuclides naturally occurring in the heavy minerals processed at the HMI site. The heavy mineral sands were "mined" by dredging operations, which created the existing lakes. The heavy minerals were then separated from the sands in which they occurred by physical processes including gravity separation, electrostatic and electromagnetic methods. This leads to two important observations:

i) the heavy mineral sands have never been chemically processed and can reasonably be assumed to be in secular-equilibrium; and

ii) the uranium and thorium series radionuclides in the heavy minerals are naturally occurring and are indistinguishable in type from those present in natural background, the only distinction being the level of the radioactivity. Thus, some confounding from natural background levels of uranium and thorium series radionuclides can be expected.

A. Issue Addressed in Procedure

Based on our previous discussions, the following topics are addressed in this plan:

- Radiological Health and Safety Manual.
- Laydown and washdown areas.
- Milling equipment survey and demolition waste management.
- Mill metal structures, stairways, mezzanines and conduits surveys and demolition waste management.
- Laboratory metal structures surveys and demolition waste management.
- Mill and laboratory masonary walls and concrete floors waste management.
- Exterior soils in licensed areas, (i.e., 10 metres around wet and dry mill buildings and monazite pile survey and waste management).
- Miscellaneous wood and furniture, fixtures, etc., surveys, demolition and waste management.
- Post-demolition documentation and reporting requirements for NRC.

The proposed procedures are outlined in Section B below. Figure 3 is a flow chart illustrating the various activities currently anticipated in the mill decommissioning. Our proposed radiological survey plan is developed with this flow of activities in mind.

B. Procedures

B.1 HEALTH AND SAFETY MANUAL

A manual on procedures for worker health and safety and contamination control will be prepared for the radioactive aspects of the demolition process by the contracted radiation surveyor. The manual will follow Federal Regulations and Policies concerning protection of worker health in dealing with radioactive materials (e.g. 10CFR20 and other applicable standards) with respect to the nature of the radioactive materials and concentrations that are associated with the HMI decommissioning project. It is anticipated that the existing worker change building would be incorporated in the proposed program. A short introduction (1 hour) to potential radiological hazards would be provided to all site workers.

The worker health and safety procedures for the straight demolition work are those that would be anticipated in any construction project of this nature and are carried in the demolition contractor's mandate.

B.2 CLEAN AND CONTAMINATED LAYDOWN AREAS

B.2.1 Clean Equipment and Building Structure Laydown Area

The clean equipment and building structure laydown area will be utilized for storage of equipment and building metal components deemed suitable for unrestricted release. All clean equipment and building material pieces will be appropriately identified as such before removal from the demolition site to the clean area.

B.2.2 Contaminated Equipment and Building Structure Laydown Area

The contaminated equipment and building structure laydown area is designed for storage of equipment and building material deemed as not being economical to decontaminate beyond the power washing effort described below or equipment and building material requiring detailed evaluation before further decontamination efforts are attempted. All contaminated equipment and building material pieces will be identified with an appropriate tag (or alternative method acceptable to the NRC) before being removed to the contaminated laydown area. All equipment and building materials deemed uneconomical to decontaminate will be appropriately packaged and shipped to an appropriate site for disposal.

B.3.0 EQUIPMENT AND BUILDING MATERIAL DECONTAMINATION WASHDOWN AREA

It is proposed that the existing floors of the dry and wet mill buildings will be utilized as decontamination washdown areas. The existing sump in the wet mill building and a sump-equivalent in the dry mill building will be utilized to retain runoff and sediments. Sump pump liquid discharge will be retained in holding tanks and analyzed for radioactive species before off-site discharge. Sediment will be retained in rolloff type containers and treated as waste until appropriate analyses determine whether it is suitable for unrestricted release.

An area around the sump and sump-equivalent will be designated for washdown with appropriate bulkheads to contain and direct runoff.

B.4.0 SURVEY PROTOCOLS

B.4.1 Equipment and Building Materials

Equipment and building material survey protocols will be based on NUREG-5849 (NRC 1992) procedures and generally use the beta scans and beta surface activity measurements technique documented therein. Equipment comparable to that used by ORISE (e.g. beta/gamma pancake detectors, gas proportional counters) with the capability/sensitivity to assess compliance with the NRC criteria for surface contamination levels (NRC Reg. Guide 1.86) will be employed. The specific equipment to be used (manufacturer, model) will be specified by an experienced radiation survey subcontractor (not yet determined) who will be engaged by HMI to undertake this work. A survey manual documenting the equipment to be used, calibration procedures, conversion factors, background allowances and protocols for surface scanning and surface activity measurements etc. will be prepared prior to undertaking the demolition of the equipment and building materials deemed affected.

In consideration of this plan, it is important to note that according to our understanding, attempts have already been made to decontaminate mill surfaces and equipment and, in some cases, failed the ORISE verification survey. Thus, it seems very likely that power washing will not remove all of the remaining contamination. Therefore, it would be expected that parts of a unit may pass the beta evaluation while other parts would not pass. From an operations point of view, it may be desirable to let the demolition contractor shear the materials and use beta/gamma scan for each <18" x 5' piece (piece sizing proposed by demolition contractor). That way some pieces of equipment will pass and others pieces will have to be subjected to more aggressive decontamination or discarded as waste. Subject to safety issues, it appears that the beta/gamma survey for the sheared pieces of equipment units, stairways, catwalks, mezzanines etc. can be carried out within the shelter of mill buildings considerations. It is clear that the beta/gamma of the building metal structural components and sheathing will be carried out in the open.

We understand from discussions with Mr. Gordon that NRC has found that some portions of the mill buildings are clean or unaffected. Thus, we propose that such elements be identified as such jointly by the radiological survey contractor to HMI and NRC and that NRC allow expedited removal of such equipment without further need for decontamination or surveys.

B.4.2 Procedure for Removal of Soils Containing Licensable Source Material

The D&D of the site under NRC guidelines requires the removal of NRC-*licensable* source material that has already been identified in previous surveys (i.e. soils exceeding a concentration of 0.05% (500 ppm) of combined uranium and thorium). (We understand that further characterization may be needed to satisfy State requirements once the NRC license is terminated.) Materials containing uranium and thorium, including naturally occurring soils, emit gamma radiation in proportion to the concentrations of uranium and thorium. The proposed procedure will entail the excavation of the NRC-*licensable* source material down to gamma exposure levels that will ensure that no soils exceeding *licensable* concentrations will remain.

Based on the approximate relationships for soils of 0.6 μR/h at 1 m distance per ppm of natural uranium and 0.3 μR/h per ppm of natural thorium (with each decay series in radioactive equilibrium; e.g., *see* NCRP (1987), Report No. 94), 500 ppm soil concentrations correspond to exposure rates of approximately 300 μR/h and 150 μR/h for uranium and thorium, respectively. Exposure rates for smaller quantities of soil at these concentrations would vary depending on the geometry (source-detector relationship) of the situation. However, the exposure rates corresponding to the 0.05% *licensable* limit are substantially above background exposure rates of 3 to 7 μR/h, or general site exposure rates of 15 to 30 μR/h (ORISE 2002). Therefore, excavation and removal of soils at the locations where *licensable* quantities have been identified down to a near-contact total exposure rate of 60 μR/h or less (twice the ORISE site background), would indicate that soils above *licensable* concentrations have likely been removed. NaI-based survey meters (or equivalent) that are sensitive to μR/h exposure rates would be used for this purpose. Alternatively, portable gamma spectroscopy meters that measure soil concentrations of uranium and thorium directly in units of ppm (when placed in contact with the soil) will be used in the field for this purpose.

To verify that compliance with the 0.05% (500 ppm) limit has been met using this procedure, soil samples from the excavated areas will be obtained and subsequently analyzed in the laboratory for total uranium and thorium. Locations showing residual concentrations exceeding 0.05% (500 ppm) (U + Th) will be further excavated until supplementary soil sampling and analyses confirm that the 0.05% (500 ppm) limit has been met.

B.5.0 DEMOLITION PROCEDURE FOR EQUIPMENT AND MILL BUILDING AND LABORATORY STRUCTURE

For present purposes, it is assumed that the demolition of the wet and dry mill buildings and equipment will proceed in the following manner.

B.5.1 Mill Equipment

i) With NRC input, equipment in and around both mills that has been determined from previous surveys to be unaffected with respect to radioactivity will be appropriately identified and marked. Following this, the unaffected equipment will be sheared into the size fraction (<18" x 5') proposed by the demolition contractor and moved to the clean laydown area.

ii) In a systematic manner and according to its demolition safety plan, the demolition contractor will proceed to remove the affected equipment from both mills. The equipment will be sheared into the size fraction noted above (<18" x 5') and the entire surface of each piece beta scanned using the survey procedures described above. Where anomalous readings that could indicate exceedence of average and/or maximum activity limits are obtained, the piece will be tagged and set aside for detailed survey. Pieces passing the beta scan will be so identified and moved to the clean area. Depending on the economics, the pieces not passing the detailed survey will either be moved to the power wash area for further decontamination and a further detailed survey and/or moved to the waste laydown area for disposal as radioactive waste. Those pieces receiving further decontamination and passing the survey procedure will be sent to the clean area.

A flow chart of the process is attached (Figure 3).

B.5.2 Building Structures and Service Conduits

Once the equipment is removed, the mill buildings will be dismantled according to the contractor's structure demolition plan. The metal structural members, exterior cladding, stairways, piping, conduits etc. from these facilities will be removed and sheared into the size

Letter to NRC
May 6, 2003

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May 6, 2003

Mr. Ronald R. Bellamy, Chief
Decommissioning Laboratory Branch
Division of Nuclear Materials Safety
Region I
United States Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Dear Mr. Bellamy:

On January 8, 2003, representatives of Heritage Minerals, Inc. (HMI) and the Nuclear Regulatory Commission's (NRC's) Region I office met in King of Prussia, PA to discuss potential options for completing final decommissioning and decontamination (D&D) activities at HMI's site in Lakehurst, NJ (the "HMI site"). Then, on January 17, 2003, NRC Region I issued a letter requesting that HMI provide a proposed plan and schedule for final D&D activities at the HMI site within 60 days. Pursuant to this request, on March 10, 2003, HMI and its radiological contractor, SENES Consultants, Ltd., submitted a proposed plan and schedule describing the manner in which HMI proposed to conduct final D&D activities at the HMI site in accordance with NRC regulations and HMI's approved D&D plan. On April 9, 2003, representatives of HMI and NRC Region I participated in a telephone conference during which the March 10, 2003 proposed plan and schedule submitted by HMI were discussed. As a result of this telephone conference, modifications to portions of the March 10, 2003 proposed plan and schedule were agreed to by HMI and NRC representatives, which are memorialized in this letter. It was also agreed that HMI should move forward with final D&D activities as soon as possible. HMI hereby provides NRC with this modified plan and schedule which proposes that final D&D activities commence immediately. Indeed, as of the date of this letter, soil sampling and removal has begun at the site.

First, HMI reaffirms that the demolition and decontamination of the wet and dry mill buildings will be done in accordance with the parameters set forth in HMI's March 10, 2003 proposed plan and schedule. HMI has retained a second radiological contractor, Enercon Services, Inc. (ENERCON), located in Murrysville, PA, to manage all decontamination activities associated with the final D&D of the wet and dry mill buildings. HMI plans to provide NRC Region I representatives with regular updates on the mobilization of ENERCON's personnel to the HMI site.

Second, with respect to the fugitive *licensable* source material "pockets" inside the footprint of the former monazite pile storage area, HMI proposes to modify its March 10, 2003 plan and schedule in the following manner. HMI proposes to excavate and ship off-site the fugitive *licensable* source material from the "pockets" identified in the April 10, 2002 ORISE report and the characterization report prepared by Radiation Science, Inc. (RSI) which was submitted to NRC in November, 2002. After removal of the fugitive *licensable* source material in these "pockets," the soils at the bottom of these "pockets" will meet the NRC Branch Technical Position (BTP) standard of 10 pCi/g for total uranium and 10 pCi/g for total thorium as delineated in HMI's approved decommissioning plan. ENERCON will sample the excavated areas after the fugitive *licensable* source material is removed from these "pockets" to ensure that soil concentrations meet the BTP standard.

With respect to the remainder of the surface soils within the monazite pile storage area, HMI asserts that the BTP standard is no longer relevant since all of the *licensed* source material and all collateral surface contamination therefrom have been removed to satisfy the BTP standard. Remaining surface contamination, which was already present prior to the placement of the monazite-rich *product* in the monazite pile storage area, is the result of pre-NRC licensing operations. In support of this assertion, HMI submits the following:

a. Initially, HMI placed 1,400 tons of *licensed* monazite-rich *product* within the confines of the monazite pile storage area prior to complete shutdown of mineral processing operations. This *product* was in drums or under tarpaulins in a fenced-in area. HMI contracted with Environmental Rail Solutions (ERS) to remove and ship all 1,400 tons of monazite-rich *product* to International Uranium (USA) Corporation's (IUSA's) NRC-licensed uranium mill in Blanding, Utah for processing and disposal. During the removal of the *licensed* monazite-rich *product*, the ERS manager, David Ardito, observed that there was a distinct color difference between the monazite-rich *product* and the underlying soils at the HMI site.[1] After the monazite-rich *product* was removed, pursuant to directions from RSI personnel on-site, ERS removed additional soils which, although not having the same color as the *licensed* monazite-rich *product*, nevertheless registered elevated levels of radionuclides and packaged such soils for shipment to IUSA. As a result, approximately 2,630 tons of *licensed* monazite-rich *product and* additional *unlicensed soils* containing monazite were shipped to IUSA. Even assuming that typically contaminated soil removal operations will generate 10-20% more material for removal (i.e., 1,600 tons), a simple *mass balance* calculation suggests that HMI removed a significant amount of material in excess of the *licensed* monazite-rich product placed in the monazite pile storage area by HMI.

b. In order to assess the possible reasons for this significant differential, HMI prepared a Process History which was submitted to NRC in December, 2002. This Process History demonstrates that the soils beneath the former monazite pile storage area

[1] *See* Letter from David Ardito, Environmental Rail Solutions, to Anthony J. Thompson, Counsel to HMI (March 21, 2003)

contained elevated levels of radionuclides before any *licensed* monazite-rich *product* was placed there. These soils were placed on the ground south of the dry mill building, including in the area which would later become the monazite pile storage area, as a result of milling activities over the 13 year operating history of the mills which involved moving millions of tons of material around the site, by slurry, by front-end loaders and graders, as well as by the Mill Shutdown Avoidance Procedures performed by both ASARCO and HMI prior to NRC licensing. With respect to the latter, as explained in the Process History, when any one component of the *dry* mill process malfunctioned or required repair or replacement, both ASARCO and HMI would shut down that portion of the process and feed any in-process material through holes in the wall of the *dry* mill onto the ground and store such material there until it could be re-introduced into the milling circuits or placed in the waste piles by front-end loader. The remaining soils were graded and regraded onto and into the surface and subsurface soils. As a result of this practice, soils containing elevated levels of radionuclides were left in the areas south of the dry mill, including within the footprint of the monazite pile storage area, before any *licensed* monazite-rich product was placed within that footprint.

c. Further, HMI asserts that none of the radioactivity remaining in soils within the footprint of the monazite pile storage area could have been caused by the *licensed* monazite-rich *product* placed there as a result of NRC-licensed activities because the monazite contained in the heavy mineral fraction processed at the HMI site is insoluble and could not have leached into the surface and subsurface soils on which the *licensed* monazite-rich *product* was placed. SENES has prepared a short report, which is attached to this letter, describing the insolubility of these heavy minerals, including the fact that it is very difficult to mobilize these heavy minerals in acid solutions and, for all practical purposes, impossible for them to be mobilized in the natural environment by infiltrating precipitation. Finally, given that no chemicals were used in heavy mineral fraction processing at the HMI site, which could change the natural insolubility of the heavy minerals, no *licensed* monazite-rich *product* placed in the monazite pile storage area by HMI leached into the surface and subsurface soils on which this *product* was placed.

Therefore, based on the mass-balance differential between the amount of *licensed* monazite-rich *product* placed in the monazite pile storage area and the amount of material excavated and sent to IUSA from the monazite pile storage area, the distinguishing color differential between the *licensed* monazite-rich *product* and the underlying soils in the monazite pile storage area reported by Mr. Ardito, the Process History of the HMI site, and the SENES' report regarding the insolubility of the heavy mineral fraction processed, HMI asserts that, after removal of the fugitive *licensable* source material from the "pockets" and satisfaction of the BTP standard in such "pockets," no further remedial action is necessary within the monazite pile storage area and adjacent grids.

Third, with respect to the fugitive *licensable* source material "pockets" south of the dry mill building and outside the footprint of the former monazite pile identified in the aforementioned ORISE and RSI Reports, HMI proposes to modify its March 10, 2003 plan and schedule to allow for the removal of these fugitive *licensable* source material "pockets" so that soil concentrations at the bottom of these "pockets" satisfy the NRC BTP standard of 10 pCi/g for total uranium and 10 pCi/g for total thorium as delineated in HMI's approved decommissioning plan.

As stated above, HMI has commenced final D&D activities at the HMI site in accordance with its March 10, 2003 plan and schedule and the modifications to that plan and schedule set forth herein. HMI requests that NRC review these proposed modifications and, if NRC finds these modifications acceptable, issue written approval, for the record, as soon as possible. Please feel free to contact me at (202) 496-0780 if you have any questions. Thank you for your time in this matter.

Sincerely,

Anthony J. Thompson, Esq.
COUNSEL TO HMI

Enclosures

ENERCON Final Removal of Fugitive Licensable Soil Report – 2005

Final Removal of Fugitive Licensable Soil - 2005
Heritage Minerals, Inc.

This report is an addendum to the attached Report dated June 12, 2003, "Removal of Fugitive Licensable Soil" (ENERCON, 2003). That report, submitted on behalf of Heritage Minerals, Inc. (HMI) to the Nuclear Regulatory Commission (NRC) Region 1, detailed the removal of soils containing licensable source material identified by ORISE in January 2002. ORISE performed a second site confirmatory survey in September 2003 and identified additional pockets of fugitive licensable source material at the HMI site in their report dated December 2003 (attached). This report details the removal and disposal of these remaining fugitive licensable soils at the HMI site.

Objective

Following the site confirmatory survey conducted by ORISE in Sept 2003, additional pockets of fugitive licensable materials were identified at the site. Licensable soils at the HMI site are defined as soils possessing greater the 116 pCi/g total thorium. As required by HMI's license, removal of these materials was necessary before HMI could request license termination. Additionally, NRC requested disposal of all residual sand generated during the mill demolition. This sand, approximately 300 tons, was located in a stockpile south of the dry mill pad. HMI's final site decommissioning objective was to remove and dispose of these soils at IUC. The remediation objectives remained consistent with requirements set forth in the attached May 6, 2003 letter to NRC, which stated, fugitive licensable soils will be excavated until the soils at the bottoms of the excavations satisfy the NRC Branch Technical Position (BTP) standard of 10 pCi/g total Thorium and 10 pCi/g total Uranium as delineated in HMI's approved decommissioning plan.

Summary of Activities – Final Survey

In order to ensure this remediation effort would be the final effort, it was necessary to perform one final gamma survey to precisely locate all remaining fugitive licensable soils and to define limits of the NRC licensed area (now called the Red Area). The Red Area was determined based on historical site activities, physical site boundaries and survey results. The area of this walkover included all areas around the wet and dry mill pads, areas in and around the monazite pile, areas where historical site traffic occurred and areas where ORISE located licensable materials. Figure 1 presents the Red Area boundary and the survey results from the walkover. The walkover was completed using a Ludlum Model 2221 ratemeter and 44-10 probe linked to a Trimble ProXR GPS unit. The highest locations corresponded to those located by ORISE during the September 2003 confirmatory survey. During this survey, ENERCON physically marked the boundaries of all licensable areas.

Summary of Activities – Final Remediation

In a letter to NRC dated June 30, 2004 (attached), HMI provided NRC with the results of the GPS walkover survey and proposed boundaries of the Red Area. HMI proposed final site remediation activities to include removal and disposition of the remaining licensable fugitive source material pockets (i.e., soil volumes defined by a *surface footprint* of sands with total thorium and uranium activities in excess of 116 pCi/g. NRC responded with a letter dated November 17, 2004 (attached) agreeing to the proposed boundaries of the Red Area. NRC stated in addition to the removal of these remaining licensable source material pockets, HMI should remove the stockpile to fulfill all decommissioning requirements and allow HMI to request license termination. HMI agreed to expand its final plan to include the removal of the stockpile and began the final site remediation and soil disposal on December 13, 2004.

This remediation was conducted in the same manner as the soil remediation in May 2003. NRC Region 1 personnel provided regulatory oversight of this process. Nine separate areas were identified by the ORISE and ENERCON gamma walkover surveys. Each identified area was excavated until analytical results confirmed the soils at the bottom of each excavation within the boundaries of the surface foot psi below 10 pCi/g total Thorium. When scan results indicated the excavation was complete, ENERCON and NRC jointly sampled each excavation bottom. This joint sampling provided final status survey data and confirmatory regulatory data. HMI sample data from each excavation is provided in Table 1. All analytical results are below 10 pCi/g total Thorium indicating the remediation objectives were achieved. Photographs of each excavation are attached and are marked to include each sample location and corresponding analytical result. All excavated soils from the nine areas were stockpiled with soils generated during the wet and dry mill demolition on a lined area south of the dry mill pad. Together, these soils were loaded and shipped to IUC in White Mesa, Utah for disposal. The last shipment of soil was sent to IUC on January 13, 2005. Following removal of the stockpile, four confirmatory soil samples were taken by ENERCON and NRC from the soils beneath the stockpile liner. Each result, shown in Table 2, is below 10 pCi/g total Thorium. A diagram of the stockpile footprint and sampling locations with analytical results is attached.

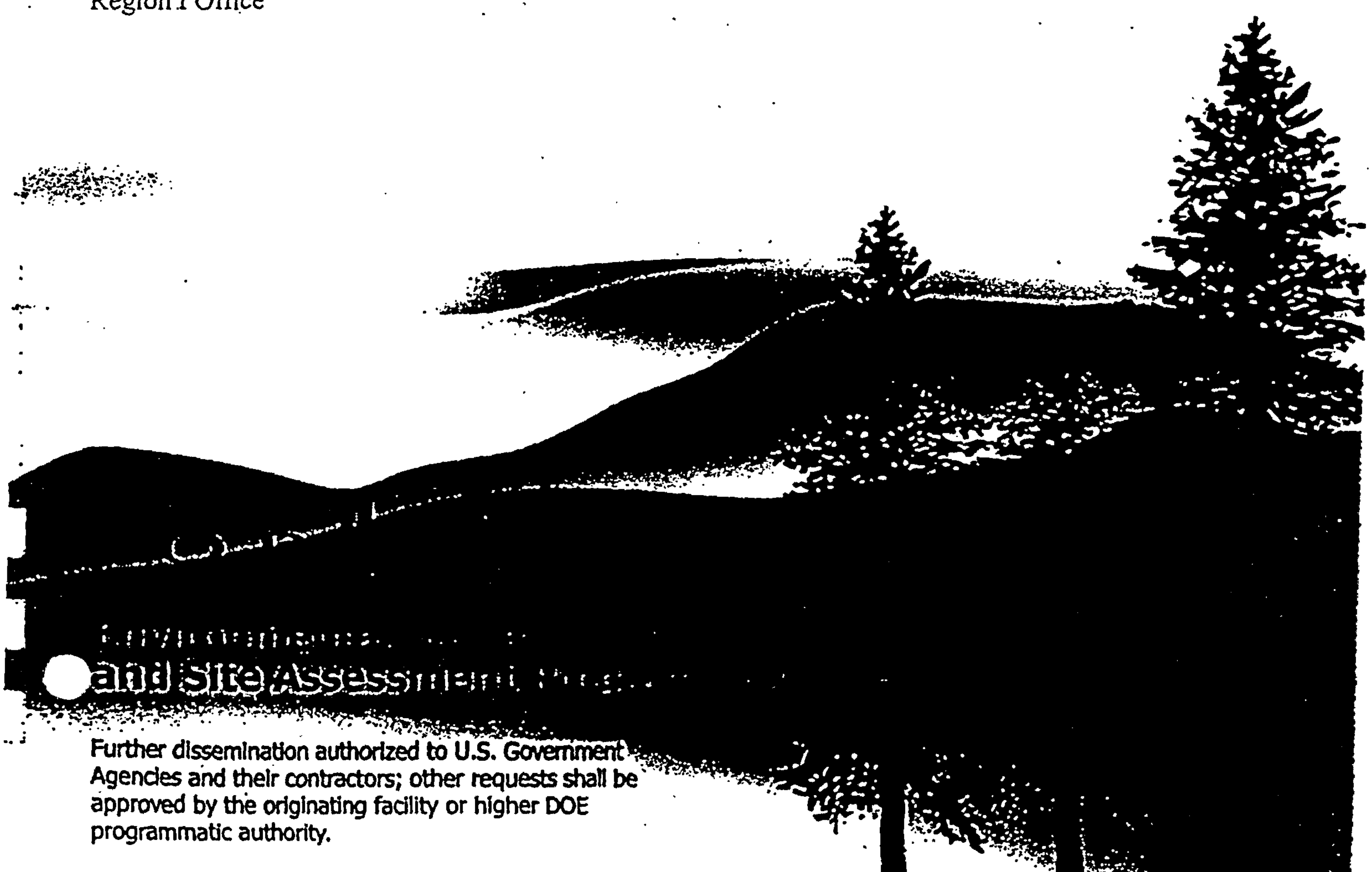
This remediation resulted in the disposal of 543 tons of soil, approximately 300 tons from the mill demolition and 240 tons from the final soil excavations. To date, 4,236 tons of soils from 226 shipments have been removed from the HMI site. The estimated activity in these shipments is 3.2 curies of total Thorium.

ORISE Report
December 2003

CONFIRMATORY SURVEY OF PORTIONS OF THE HERITAGE MINERALS, INC., FACILITY LAKEHURST, NEW JERSEY PHASE 2

J. R. MORTON AND W. C. ADAMS

Prepared for the
U.S. Nuclear Regulatory Commission
Division of Waste Management
Region I Office



The Oak Ridge Institute for Science and Education (ORISE) is a U.S. Department of Energy facility focusing on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists. ORISE is managed by Oak Ridge Associated Universities. Established in 1946, ORAU is a consortium of 86 colleges and universities.

ORISE 03-1581

CONFIRMATORY SURVEY OF PORTIONS OF THE HERITAGE MINERALS, INC., FACILITY LAKEHURST, NEW JERSEY PHASE 2

Prepared by

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FINAL REPORT

DECEMBER 2003

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CONFIRMATORY SURVEY
OF PORTIONS OF THE
HERITAGE MINERALS, INC., FACILITY
LAKEHURST, NEW JERSEY
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ABBREVIATIONS AND ACRONYMS

ε_i	instrument efficiency
ε_s	surface efficiency
ε_{total}	total efficiency
b_i	background counts in the observation interval
μR/h	microroentgen per hour
μrem/h	microrem per hour
BKG	background
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
DOE	Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EML	Environmental Measurements Laboratory
ENERCON	ENERCON Services, Inc.
ESSAP	Environmental Survey and Site Assessment Program
FSS	final status survey
ha	hectare
HMI	Heritage Minerals, Inc.
ISO	International Standards Organization
ITP	Intercomparison Testing Program
JHA	job hazard analysis
keV	kiloelectron volts
kg	kilogram
km	kilometer
m	meter
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MeV	million electron volts
min	minute
NaI	sodium iodide
NIST	National Institute of Standards and Technology
NORM	naturally occurring radioactive material
NRC	Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
RA	remedial action
RSI	Radiation Sciences, Inc.
s	second

CONFIRMATORY SURVEY
OF PORTIONS OF THE
HERITAGE MINERALS, INC., FACILITY
LAKEHURST, NEW JERSEY
PHASE 2

INTRODUCTION AND SITE HISTORY

From 1973 to 1982, the Heritage Minerals, Inc. site was operated by ASARCO, Incorporated. ASARCO's operations consisted of hydraulic mining (dredging) of sand deposits and processing these sands to extract the titanium mineral, ilmenite. ASARCO's process involved bringing in raw materials and pumping the materials to a land-based processing plant where the heavy metals were concentrated using spiral separators. The Wet Mill Tailings were pumped back to a dredge pond as backfill. The heavy metals which followed a different path, were dewatered and then fed onto a conveyor belt and heated until completely dried. The heated material was then conveyed to the Dry Mill where the ilmenite was removed and placed in storage bins for shipping to customers. The non-conductor minerals, referred to as the Dry Mill Tailings, containing virtually all of the monazite material, were then mixed with water and pumped to a storage area east of the mill. ASARCO discontinued all operations at the site in 1982 and the property was sold to Heritage Minerals, Inc. (HMI) in 1986 (RSI 1997).

When HMI began operations, the Dry Mill Tailings, containing the monazite, were reprocessed through the mill to produce market-grade zircon with some monazite impurities. The remaining product, containing the majority of the monazite, was then combined with the other tailings to make up the plant tailings which were then pumped to a storage area (RSI 1997).

In March 1990, HMI decided that sufficient zircon and titanium products remained in the plant tailings to warrant a second round of processing known as Phase II of the operation. This phase involved the isolation of the monazite-rich tailings which were then stored in an area southeast of the Dry Mill known as the Monazite Pile. In August 1990, after about 200,000 tons of tailings were processed through the plant, HMI decided to terminate all operations due to the economic turndown which resulted in a reduced demand for plant products (RSI 1997).

The reprocessing of the 200,000 tons of plant tailings resulted in producing about 150,000 tons of tailings that were relatively monazite free. These tailings were stored separately from the

Monazite Pile. As a result, approximately 1,400 tons of monazite-rich product were generated and were stored in the Monazite Pile. The Monazite Pile and the plant buildings were under control of the U.S. Nuclear Regulatory Commission (NRC) according to terms of License No. SMB-1541 because of the thorium and uranium concentrations within the monazite.

After the plant shutdown in August 1990 a gamma survey was performed within both mills and on selected pieces of equipment which were known to have been in contact with the monazite-containing product. Direct measurements were also performed on selected pieces of equipment (wet tables, dryer, and dry magnets). These survey activities were performed in January 1991 (RSI 1997).

Radiation Sciences, Inc. (RSI), the previous decommissioning contractor to HMI, performed a survey of the natural background levels of uranium and thorium within the soils and measured background exposure rates in 1996 (RSI 1996). This information was used to correct final survey soil sample and exposure rate data. RSI then performed decommissioning of the Wet and Dry Mills and the Monazite Pile and provided the results of their final status surveys (FSS) to the NRC in December 2001 (RSI 2001).

At the request of the NRC, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed confirmatory survey activities at the site in December 2001. The results of those activities indicated the surface activity levels in the Wet and Dry Mills and soil radionuclide concentrations in the Monazite Pile and other soil areas were in excess of the guideline levels (ORISE 2002). As a result, the NRC determined that further decommissioning activities were warranted.

HMI committed to the removal of all licensable quantities of source material prior to license termination and calculated a soil concentration for licensable material at 116 pCi/g of total thorium. "Fugitive" licensable material was then defined as any licensable material found outside of the Monazite Pile area; hence, the trench area was considered a fugitive materials area.

The new site decommissioning contractor, ENERCON Services, Inc. (ENERCON), performed further remediation activities in the Monazite Pile area and a trench area that was identified during the previous ESSAP confirmatory survey activities. The Monazite Pile and the trench areas were remediated to less than 10 pCi/g for total thorium and 10 pCi/g for total uranium. Approximately 300 additional tons of contaminated soils were removed from the site, the excavated areas were backfilled with clean sand, and ENERCON issued a report on their field activities documenting their decommissioning efforts for the soil contamination (ENERCON 2003). Final surveys of materials located outside these areas indicated that all licensable material was removed (ENERCON 2003).

ENERCON also remediated and dismantled the Wet and Dry Mills and disposed of the buildings' construction components so that only the slabs remained. Some support buildings, however, are still being used for equipment storage and office space.

The NRC's Division of Waste Management and Region I requested that the ESSAP of ORISE perform radiological confirmatory survey activities on various land areas and the remaining Wet and Dry Mill slabs of the HMI facility in Lakehurst, New Jersey.

SITE DESCRIPTION

HMI is located in Lakehurst, New Jersey and is approximately 50 kilometers [km (30 miles)] southeast of downtown Trenton, New Jersey (Figures 1 and 2). The HMI facility once consisted of two large milling buildings known as the Wet and Dry Mills and other support and laboratory buildings occupying approximately 2,800 hectares [ha (7,000 acres)]. With the dismantling of the mills, the two concrete pads still remain (Figure 3). The remaining buildings on the property are the Maintenance, Warehouse, Main Office, and Change House buildings. The site is bounded on the north and west by Route 70, the east by Route 37 and to the south by two residential areas and Pinewald Keswick Road.

OBJECTIVES

The objectives of the radiological confirmatory survey were to provide independent contractor field data reviews and radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's field activities relative to established guidelines. Information was gathered and survey data were collected to evaluate the facility's current radiological status as reported by the licensee.

DOCUMENT REVIEW

ESSAP reviewed the final survey data and used the information gathered from that review to plan the confirmatory survey activities (ENERCON 2003).

PROCEDURES

ESSAP personnel visited the HMI facility during the period of September 8 through 10, 2003 and performed visual inspections and independent measurements and sampling of portions of the site. Survey activities were conducted in accordance with a site-specific survey plan and the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2003a, b and c). Survey activities included alpha plus beta and gamma surface scans, direct measurements, soil sampling, and exposure rate measurements.

REFERENCE SYSTEM

Measurements and sampling locations were referenced on ESSAP maps generated from the previous survey activities (ORISE 2002).

SURFACE SCANS

Surface scans for alpha plus beta and gamma radiation were performed on 20% of the concrete pads where the mills once stood. Particular attention was given to openings, cracks, and joints in the pads where material may have accumulated. Gamma scans were conducted over 100% of accessible soil surfaces within and in the immediate vicinity of the Monazite Pile and trench areas, including the re-excavated locations within the trench and Monazite Pile where ENERCON had already backfilled their final depth sampling locations. Gamma scans were also performed over approximately 50% of the soil areas surrounding the former mill facilities. Scans were performed using gas proportional and NaI scintillation detectors coupled to ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation detected by surface scans were marked for further investigation—to include additional surface scans, as deemed necessary to delineate contamination boundaries and for possible soil sampling.

SURFACE ACTIVITY MEASUREMENTS

Construction material specific backgrounds were collected and used to correct gross surface activity measurements. Direct measurements of alpha and beta surface activity were performed at a total of ten locations on each concrete pad (Figures 4 and 5). All of the direct measurements were performed using gas proportional detectors coupled to ratemeter-scalers.

SOIL SAMPLING

Thirty-eight soil samples were collected from the entire NRC-licensed materials area including the Monazite Pile and trench excavations and from existing penetrations in the Wet Mill Pad and from ENERCON—bored locations in the Dry Mill Pad (Figures 4 through 6). Surface (0 to 15 cm) soil samples were collected at the locations of maximum elevated direct radiation identified by surface scans around the remainder of the site. Subsurface soil samples were collected if elevated radiation was suspected to be present below the initial 15 centimeters of exposed soils. Three additional samples were collected from the waste soil pile located south of the former Dry Mill (Figure 6). The waste pile consisted of the recovered wash water and sand from the Wet Mill Pad which was used as the staging area during the remediation of the Wet and Dry Mill building structures and process equipment components. Background soil samples were collected from six locations within a 0.5 to 10 km radius of the site during the previous ESSAP survey activities (Figure 7).

EXPOSURE RATE MEASUREMENTS

Site exposure rates were measured at each soil sample location at one meter above the surface using a micro-rem meter. Background exposure rate measurements were collected from the six previous background soil sampling locations (Figure 7).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2003d). Soil samples were analyzed by gamma spectroscopy and results reported in units of picocuries per gram (pCi/g). The radionuclides of interest were uranium and thorium; however, spectra were reviewed for other identifiable photopeaks. Direct measurement data were converted to units of disintegrations per minute per one hundred square centimeters (dpm/100 cm^2). Exposure rates were reported in microroentgens per hour (μR/h). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B.

FINDINGS AND RESULTS

SURFACE SCANS

Gamma scans conducted over the concrete pads and soil areas identified multiple locations of elevated gamma radiation. Seven locations of elevated alpha plus beta activity were detected during scans of the Dry and Wet Mill pads.

SURFACE ACTIVITY MEASUREMENTS

Results of total alpha and total beta surface activity levels for the concrete pads are summarized in Table 1. Initial total activity levels for the Wet Mill ranged from -9 to 640 dpm/100 cm^2 for alpha and from -94 to 6,700 dpm/100 cm^2 for beta. Initial total activity levels for the Dry Mill ranged from -9 to 130 dpm/100 cm^2 for alpha and from -53 to 2,400 dpm/100 cm^2 for beta. ENERCON was notified of the elevated beta readings and chose to perform additional remedial actions (RA) while ESSAP was still on-site. After post-RA activities, beta activity levels ranged from -94 to 3,400 dpm/100 cm^2 and -53 to 1,100 dpm/100 cm^2 for the Wet and Dry Mills, respectively.

EXPOSURE RATE MEASUREMENTS

Site and background exposure rates are summarized in Table 2. Site exposure rates ranged from 8 to 130 μR/h. Background exposure rates ranged from 3 to 7 μR/h and averaged 4 μR/h (ORISE 2002).

RADIONICLIDE CONCENTRATIONS IN SOIL

Radionuclide concentrations in soil samples are also summarized in Table 2. The radionuclide concentrations for individual samples ranged as follows: -1.5 to 190 pCi/g for total uranium and

0.65 to 775 pCi/g for total thorium. Radionuclide concentrations in background samples ranged as follows: 0.5 to 2.3 pCi/g for total uranium and 0.3 to 1.0 pCi/g for total thorium.

COMPARISON OF RESULTS WITH GUIDELINES

The primary contaminants at this site are thorium and uranium. The applicable NRC guidelines at HMI for natural thorium and natural uranium total surface activity levels are (NRC 1987):

Natural Uranium

5,000 α dpm/100 cm^2, averaged over a 1 m^2 area

15,000 α dpm/100 cm^2, total, maximum in a 100 cm^2 area

Natural Thorium

1,000 dpm/100 cm^2, averaged over a 1 m^2 area

3,000 dpm/100 cm^2, total, maximum in a 100 cm^2 area

ESSAP used the more restrictive guidelines for thorium contamination. Natural thorium emits both alpha and beta radiations, therefore, either alpha or beta radiation may be measured for determining the residual activity of the thorium contaminant. As interpreted by the NRC, the average 1,000 dpm/100 cm^2 and maximum 3,000 dpm/100 cm^2 guideline should apply independently to both alpha and beta measurements for surface contamination involving natural thorium (NRC 1992). ESSAP's experience has shown that beta measurements typically provide a more accurate evaluation of thorium contamination on structural surfaces due to problems inherent in measuring alpha contamination on rough, porous, and/or dirty surfaces. For the thorium series in secular equilibrium, the activity level providing 1,000 alpha dpm/100 cm^2 would result in about 670 beta dpm/100 cm^2. Therefore, a beta activity measurement that is greater than 670 dpm/100 cm^2 was considered to have exceeded the average alpha activity guideline for thorium while a beta activity measurement of 2,000 dpm/100 cm^2 corresponded to the maximum alpha guideline for thorium. Of the 20 initial direct measurements that were performed for beta activity, seven locations exceeded the maximum activity (>2,000 dpm/100 cm^2 for beta) and two locations exceeded the average activity (>670 dpm/100 cm^2 for beta). These locations were reported to ENERCON. Prior to the end of the confirmatory survey, further decontamination activities performed by ENERCON lowered the radioactivity levels to where only one measurement location exceeded the maximum and two exceeded the average guideline. Due to time constraints, these areas were not remediated immediately, but were pointed out to ENERCON and remediated appropriately at a later date.

The exterior exposure rate guideline is 10 μR/h above background with the average site background being 4 μR/h (NRC 1991). Thirty-three of the 41 on-site exposure rates exceeded this guideline.

The soil remediation guidelines are as follows (NRC 1981 and 1983):

Radionuclide	Soil Concentration Above Background (pCi/g)
Total uranium in excavated areas	10
Total thorium in excavated areas	10

For areas where fugitive thorium source material was found, HMI committed to removal of material above the licensable concentration of 116 pCi/g.

Of the 41 surface and subsurface soil samples that were collected from the Heritage site, 34 exceeded the guideline of 10 pCi/g for total uranium. There were 17 soil samples collected from the Monazite Pile and trench areas of which 15 exceeded the total thorium guideline of 10 pCi/g. The three samples collected from the waste pile each had total uranium and thorium concentrations greater than 10 pCi/g. Twenty-one soil samples were collected from the "fugitive" areas (surrounding land areas and beneath the Wet and Dry Mill pads) of which six exceeded the licensable quantity concentration of 116 pCi/g for total thorium.

SUMMARY

The Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education performed confirmatory survey activities on portions of the HMI site in Lakehurst, N.J. during the period of September 8 through 10, 2003. Areas included in the scope of the survey were the Wet and Dry Mill concrete pads and the soil areas surrounding the mill operations, including the former Monazite Pile and the trench of licensable material that was discovered during previous ESSAP confirmatory surveys (ORISE 2002). Survey activities included a review of the final survey report and performance of independent gamma and alpha

plus beta scans, direct surface activity measurements, exposure rate measurements, and soil sampling.

The results of the confirmatory activities indicated that some surface activity levels on the concrete pads still exceeded the applicable NRC guidelines. However, the decommissioning contractor, ENERCON, demonstrated the ability to further remediate those areas to levels within the guidelines, as the residual contamination appeared to be easily removable. However, ESSAP is concerned that the surrounding soils are easily redistributed and may recontaminate the pads.

The exterior exposure rate guideline is 10 μR/h above background with the average site background being 4 μR/h (NRC 1991). Thirty-three of the 41 on-site exposure rates exceeded this guideline.

The soil sample results for the Monazite Pile and the trench areas indicated that residual contamination remained well above the applicable NRC unrestricted release guideline level for both total uranium and total thorium at 10 pCi/g each. The soil data also indicated that elevated concentrations were present at various subsurface depths (greater than 15 cm).

The soil sample results for the areas surrounding the Monazite Pile and trench areas (the "fugitive" materials area) indicated that residual contamination remained well above the NRC criteria and licensee's commitments for this area. Of particular concern is that the licensee has claimed that the area surrounding the former mill buildings contains naturally occurring radioactive materials (NORM) at high concentrations; therefore, the background concentrations of uranium and thorium are elevated above typical backgrounds. However, this does not appear to be the case as soil samples collected from beneath the previously unbroken Dry Mill Pad indicated radionuclide concentrations that were equivalent to the off-site background soil concentrations determined during the previous ESSAP survey activities (ORISE 2002). In contrast, the samples collected from the Wet Mill Pad were from previously exposed soil areas in the pad where processing equipment had been located.

FIGURES

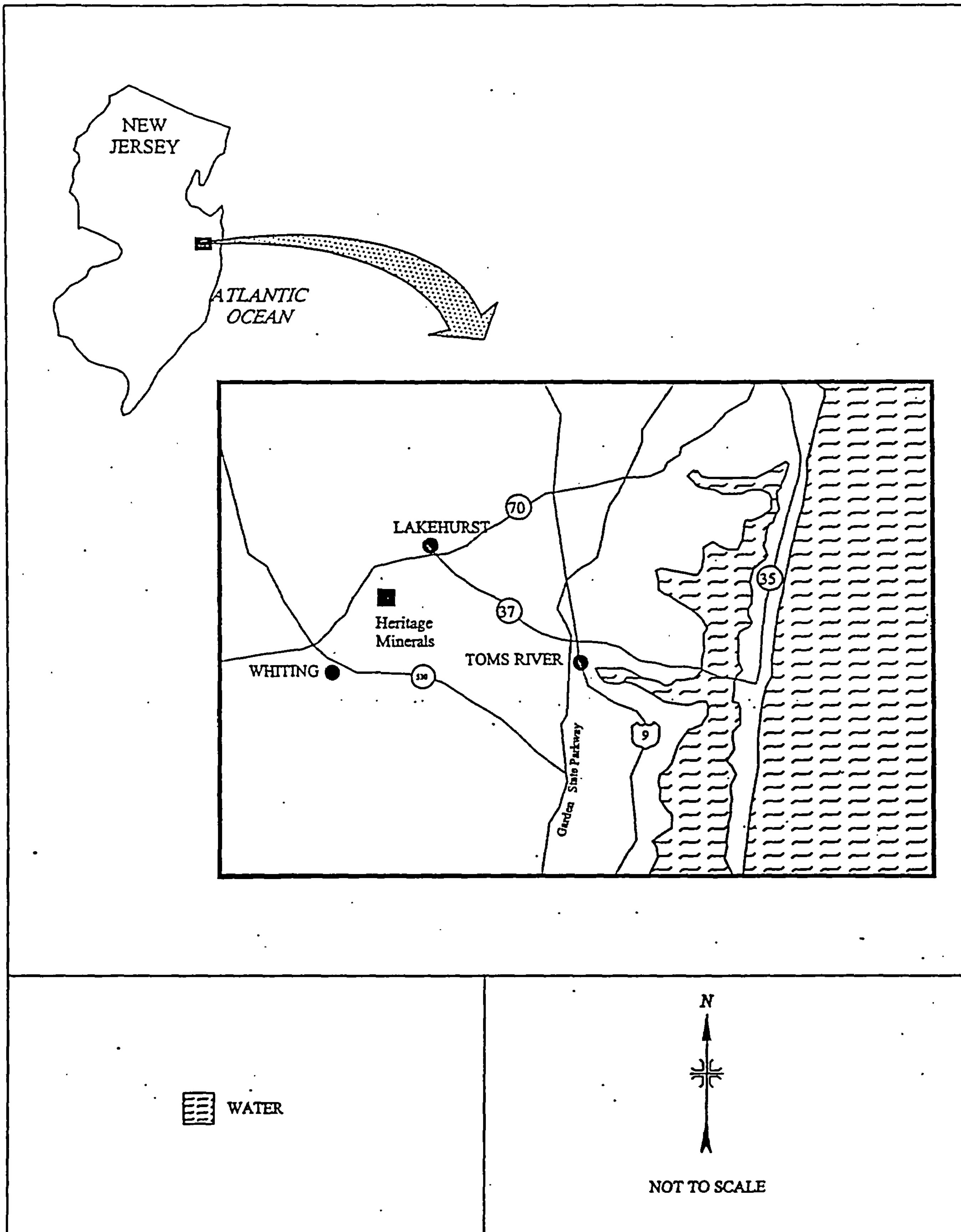

FIGURE 1: Location of the Heritage Minerals Site - Lakehurst, New Jersey

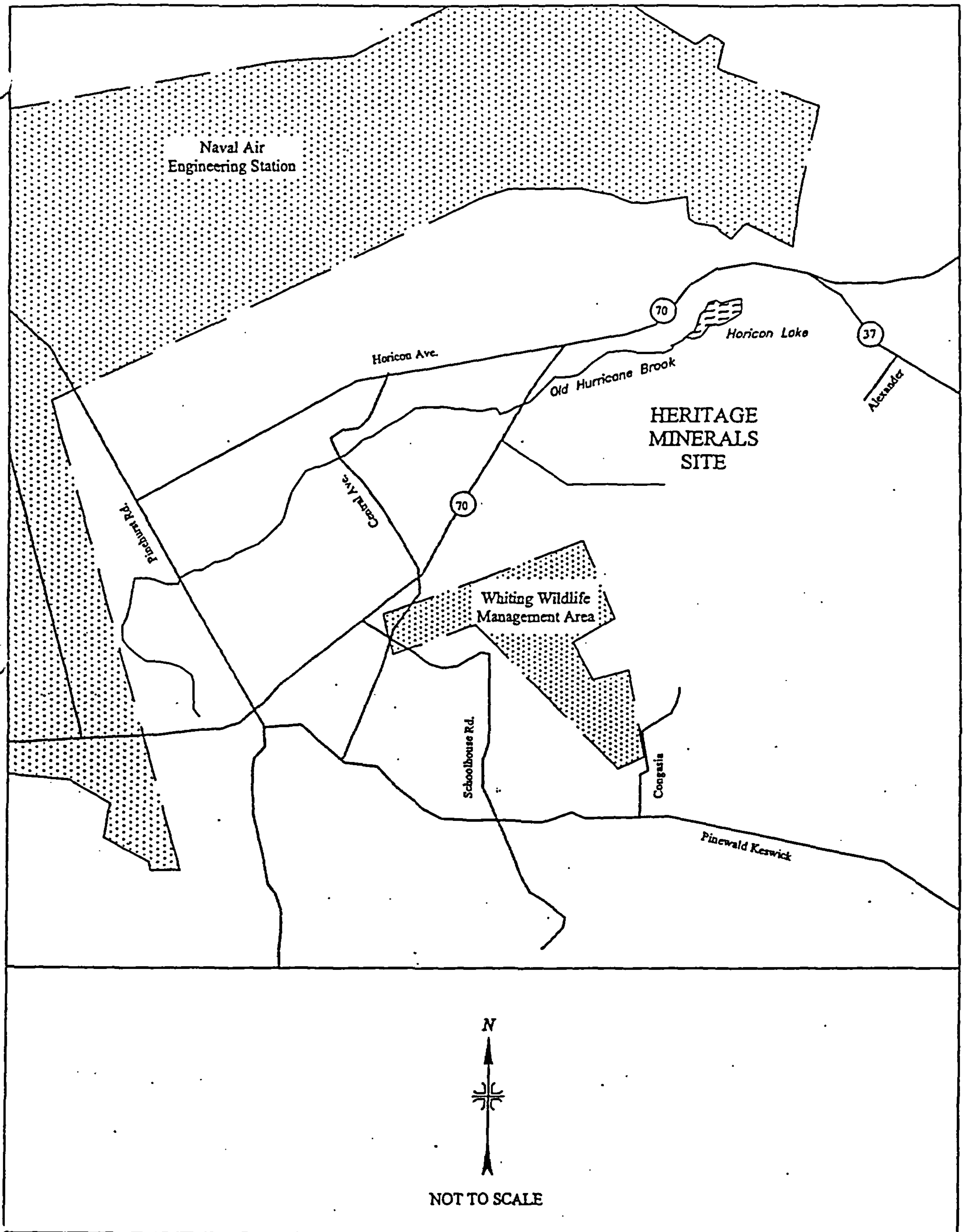

FIGURE 2: Heritage Minerals Site, Lakehurst, New Jersey

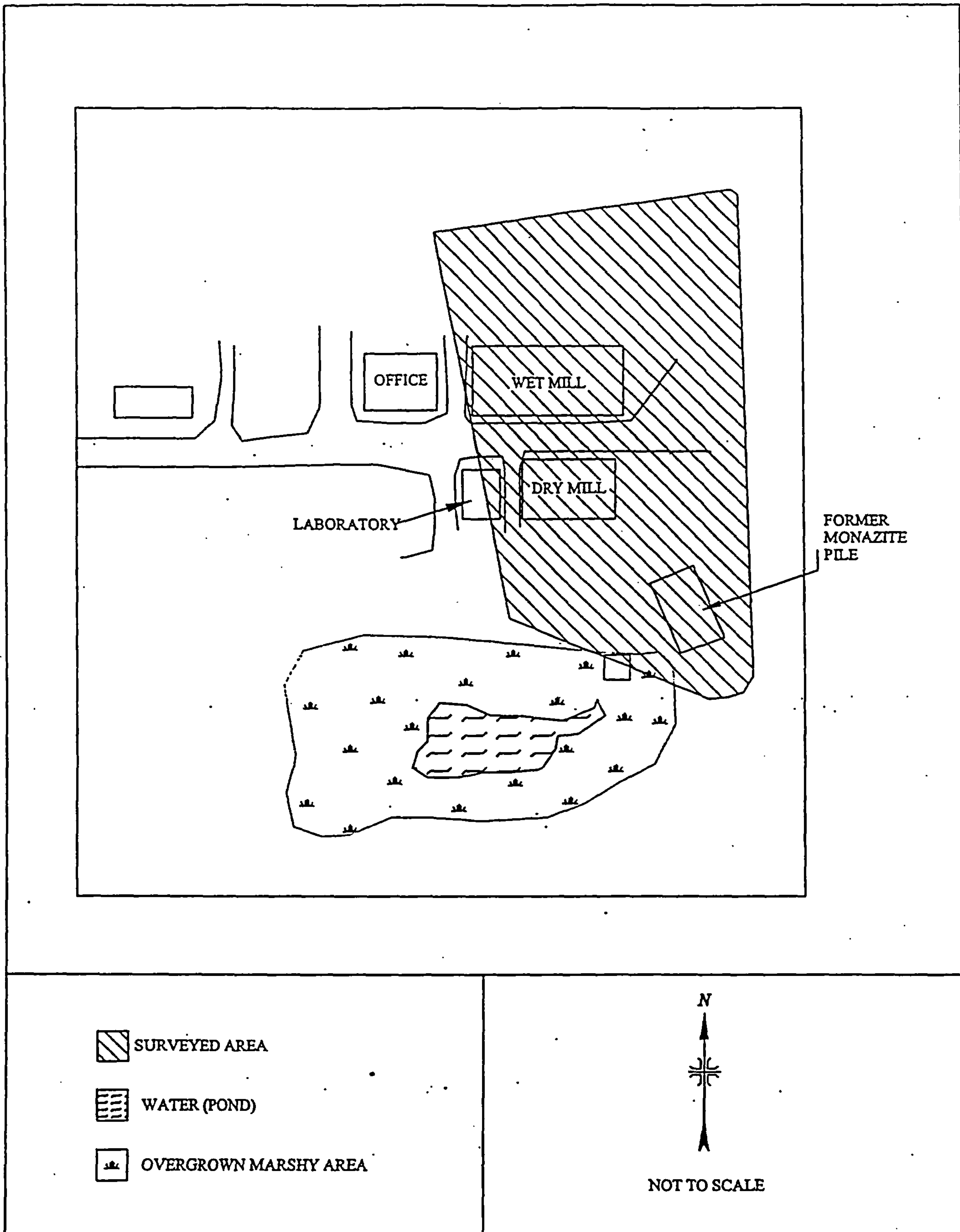

FIGURE 3: Heritage Minerals Site - Surveyed Area

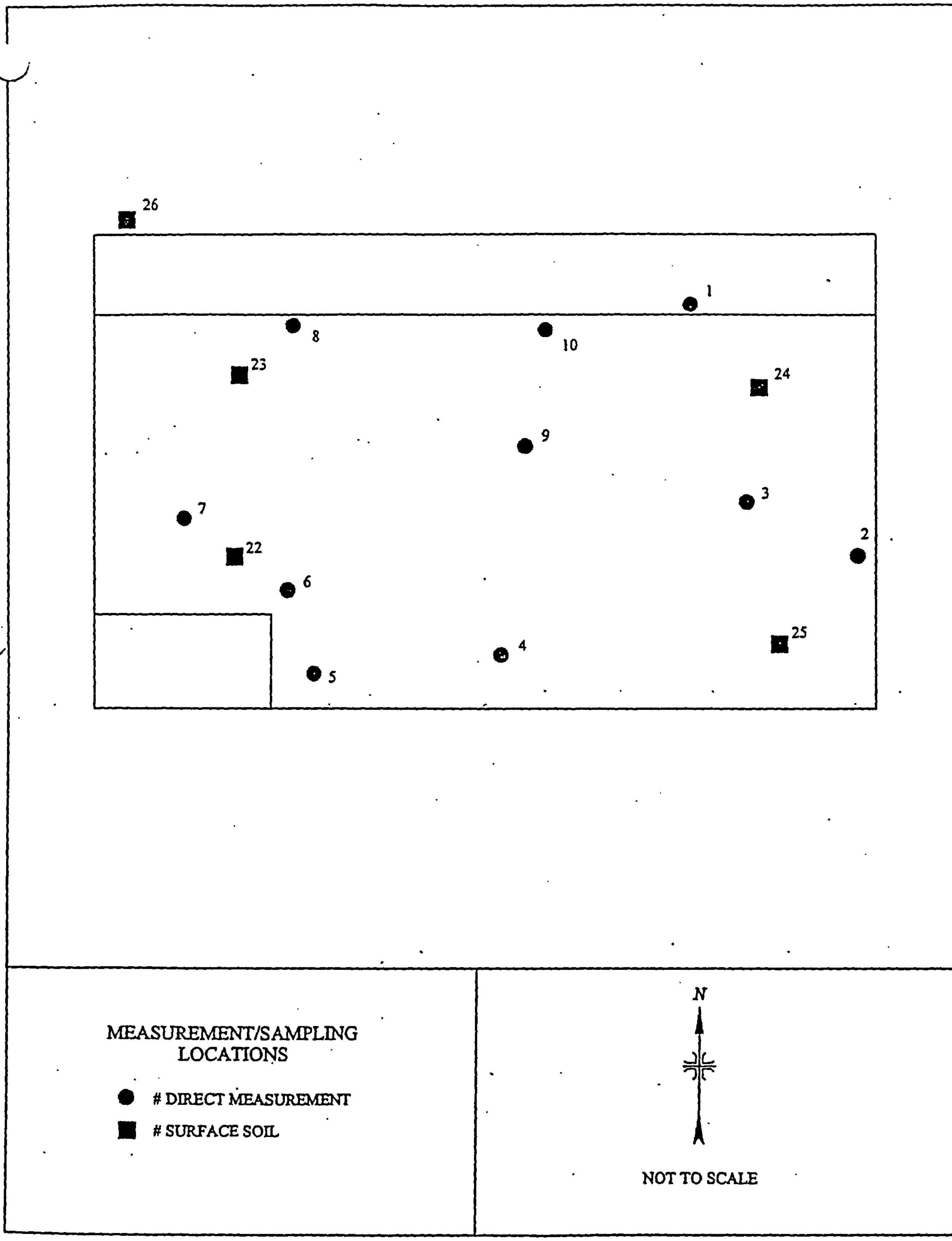

FIGURE 4: Dry Mill Pad - Measurement and Sampling Locations

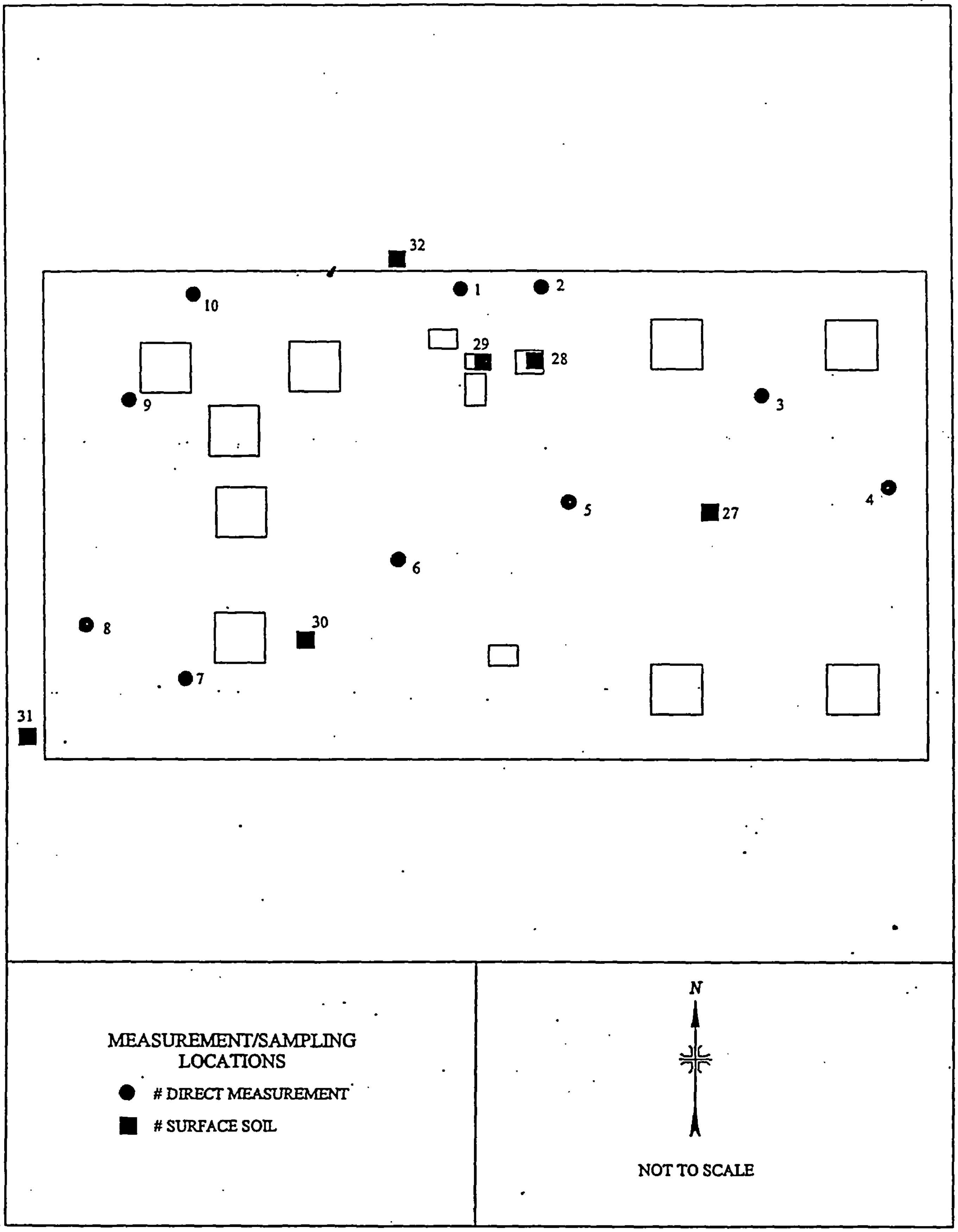

FIGURE 5: Wet Mill Pad - Measurement and Sampling Locations

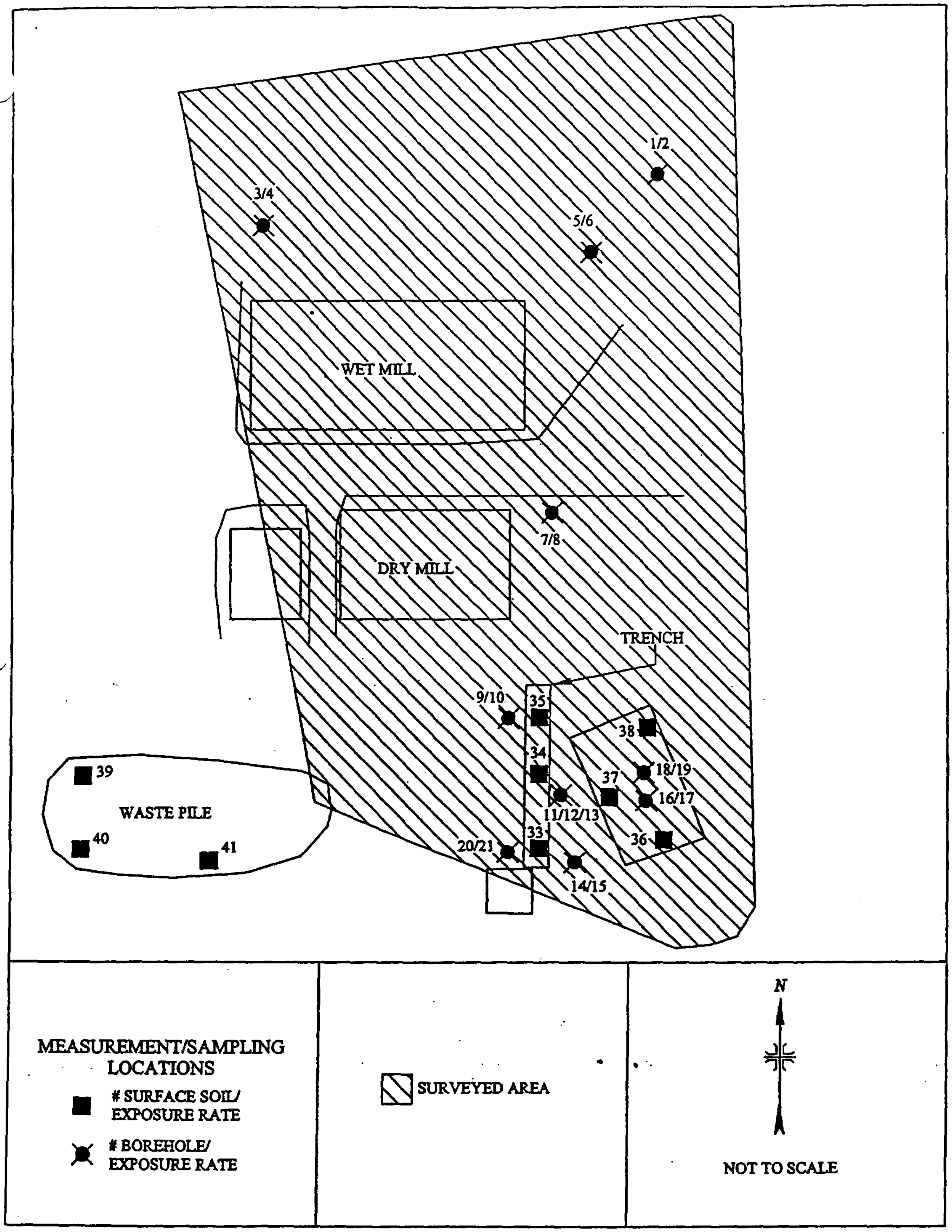

FIGURE 6: Land Area Surveys - Measurement and Sampling Locations

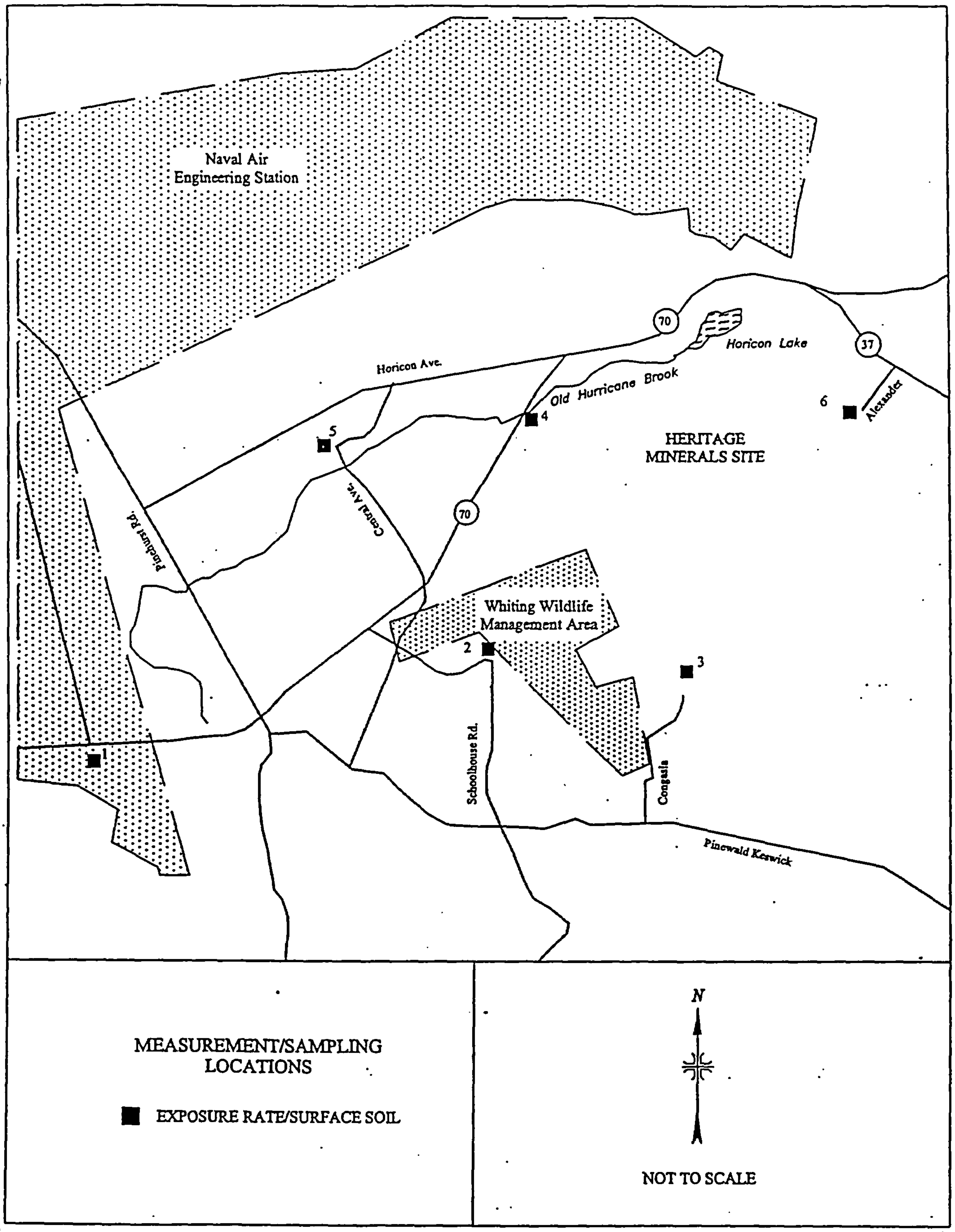

FIGURE 7: Background Measurement and Sampling Locations

TABLES

TABLE 1

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS, INC.
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm^2)	
	Alpha	Beta
Wet Mill		
Location 1	410	4,000
Post RA, Location 1	150	380
Location 2	640	6,700
Post RA, Location 2	110	-42
Location 3	360	3,400
Location 4	-9	3,400
Post RA, Location 4	NA	310
Location 5	-9	560
Location 6	-9	-94
Location 7	130	11
Location 8	79	15
Location 9	-9	-49
Location 10	-9	960
Dry Mill		
Location 1	-9	2,400
Post RA, Location 1	-9	-11
Location 2	130	2,200
Post RA, Location 2	26	-30
Location 3	-9	2,100
Post RA, Location 3	-9	380
Location 4	-9	11
Location 5	-9	-53
Location 6	-9	38
Location 7	88	1,100
Location 8	110	160
Location 9	71	120
Location 10	44	220

[a]Refer to Figures 4 and 5.

TABLE 2

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
HERITAGE MINERALS, INC.
LAKEHURST, NEW JERSEY

Sample ID[a]	Depth (cm)	Exposure Rate @ 1m (μR/h)	Radionuclide Concentrations (pCi/g)					
			U-238	U-235	Total U[b]	Th-228	Th-232	Total Th[c]
Samples from the Monazite Pile Area								
16	15	22	19 ± 14[d]	0.11 ± 0.78	38 ± 20	71.5 ± 4.7	70.4 ± 5.7	141.9 ± 7.4
17	30	22	26 ± 19	-0.38 ± 0.87	51 ± 26	77.5 ± 4.9	77.6 ± 6.4	155.1 ± 8.1
18	15	23	31 ± 11	1.21 ± 0.63	63 ± 16	77.1 ± 4.9	76.8 ± 6.2	153.9 ± 7.9
19	30	23	10.1 ± 7.0	0.21 ± 0.49	20 ± 10	26.6 ± 1.8	25.5 ± 2.2	52.1 ± 2.8
36	100	17	-0.6 ± 1.2	0.02 ± 0.07	-1.3 ± 1.8	0.50 ± 0.05	0.49 ± 0.10	0.98 ± 0.11
37	100	18	0.8 ± 1.2	0.04 ± 0.07	1.7 ± 1.7	1.04 ± 0.08	1.08 ± 0.14	2.12 ± 0.16
38	100	19	2.8 ± 3.8	0.21 ± 0.24	5.9 ± 5.4	5.47 ± 0.39	5.21 ± 0.60	10.67 ± 0.71
Samples from the Trench Area								
9	15	33	38 ± 10	1.65 ± 0.64	78 ± 14	34.7 ± 2.2	35.4 ± 2.9	70.1 ± 3.7
10	30	33	36 ± 14	2.11 ± 0.89	74 ± 20	41.5 ± 2.7	42.8 ± 3.5	84.3 ± 4.5
11	15	54	25 ± 12	1.63 ± 0.91	52 ± 16	57.4 ± 3.7	58.7 ± 4.9	116.1 ± 6.1
12	30	54	42 ± 13	1.66 ± 0.60	85 ± 19	61.2 ± 3.9	61.3 ± 5.0	122.5 ± 6.3
13	45	54	35 ± 13	1.43 ± 0.81	71 ± 18	33.0 ± 2.2	33.3 ± 2.8	66.3 ± 3.6
14	15	26	28 ± 24	1.28 ± 0.89	58 ± 34	80.0 ± 5.1	79.6 ± 6.5	159.6 ± 8.3
15	30	26	36 ± 12	0.96 ± 0.74	73 ± 18	77.9 ± 4.9	77.1 ± 6.2	155.0 ± 7.9
33	15	22	16.8 ± 6.1	0.26 ± 0.28	33.8 ± 8.7	16.4 ± 1.1	15.9 ± 1.4	32.4 ± 1.7
34	15	18	18 ± 10	0.41 ± 0.50	37 ± 14	19.0 ± 1.2	19.3 ± 1.7	38.3 ± 2.1
35	15	33	28 ± 11	1.73 ± 0.63	58 ± 16	32.4 ± 2.1	34.6 ± 2.8	67.0 ± 3.5
Samples from the Waste Pile[e]								
39	15	40	9.7 ± 7.9	0.67 ± 0.42	20 ± 11	13.78 ± 0.92	13.5 ± 1.3	27.3 ± 1.6
40	15	37	6.1 ± 4.9	0.44 ± 0.32	12.7 ± 6.9	10.26 ± 0.68	9.75 ± 0.90	20.0 ± 1.1
41	15	25	15.9 ± 7.1	0.69 ± 0.50	32 ± 10	13.27 ± 0.91	12.9 ± 1.2	26.1 ± 1.5

TABLE 2 (continued)

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
HERITAGE MINERALS, INC.
LAKEHURST, NEW JERSEY

Sample ID[a]	Depth (cm)	Exposure Rate @ 1m (µR/h)	Radionuclide Concentrations (pCi/g)					
			U-238	U-235	Total U[b]	Th-228	Th-232	Total Th[c]
Samples from Other Areas								
1	15	92	67 ± 24	1.2 ± 1.3	136 ± 34	175 ± 11	175 ± 14	350 ± 18
2	30	92	34 ± 11	1.10 ± 0.89	69 ± 16	48.2 ± 3.2	48.8 ± 4.0	97.0 ± 5.1
3	15	40	40 ± 15	1.44 ± 0.83	81 ± 22	89.5 ± 5.7	90.9 ± 7.3	180.3 ± 9.3
4	30	40	45 ± 21	1.8 ± 1.0	93 ± 30	109.5 ± 7.2	109.7± 8.8	219 ± 11
5	15	47	52 ± 22	2.07 ± 0.93	107 ± 30	44.0 ± 2.8	45.2 ± 3.8	89.2 ± 4.7
6	30	47	11.5 ± 8.0	0.69 ± 0.51	24 ± 11	15.8 ± 1.0	15.9 ± 1.4	31.8 ± 1.7
7	15	45	16 ± 13	1.06 ± 0.70	34 ± 18	49.7 ± 3.3	50.0 ± 4.1	99.7 ± 5.3
8	30	45	82 ± 32	3.0 ± 1.8	166 ± 45	381 ± 24	395 ± 32	775 ± 40
20	15	130	94 ± 24	2.22 ± 0.82	190 ± 34	83.8 ± 5.3	93.6 ± 7.6	177.4 ± 9.3
21	30	130	75 ± 14	3.44 ± 0.78	154 ± 20	56.7 ± 3.6	61.3 ± 5.0	118.1 ± 6.1
Samples from Underneath and Immediately Adjacent to the Dry Mill Pad								
22	15	11	1.0 ± 1.0	0.05 ± 0.05	2.0 ± 1.4	0.29 ± 0.04	0.37 ± 0.09	0.66 ± 0.10
23	15	8	-0.8 ± 1.0	0.04 ± 0.06	-1.5 ± 1.4	0.29 ± 0.04	0.36 ± 0.08	0.65 ± 0.09
24	15	13	0.6 ± 1.2	-0.03 ± 0.06	1.2 ± 1.7	0.53 ± 0.05	0.46 ± 0.09	0.98 ± 0.10
25	15	13	0.7 ± 1.4	-0.02 ± 0.07	1.4 ± 1.9	0.47 ± 0.05	0.53 ± 0.10	1.00 ± 0.11
26	15	26	15.0 ± 8.0	1.07 ± 0.59	32 ± 12	13.38 ± 0.89	13.1 ± 1.3	26.5 ± 1.5
Samples from Underneath and Immediately Adjacent to the Wet Mill Pad								
27	15	11	28 ± 10	1.24 ± 0.56	58 ± 14	17.2 ± 1.1	17.7 ± 1.5	34.9 ± 1.9
28	15	11	7.4 ± 4.8	0.19 ± 0.27	15.0 ± 6.8	6.56 ± 0.45	5.77 ± 0.63	12.32± 0.77
29	15	11	32 ± 13	1.25 ± 0.77	65 ± 19	22.0 ± 1.4	21.5 ± 2.0	43.5 ± 2.5
30	15	9	25.5 ± 9.2	0.48 ± 0.40	52 ± 13	14.37 ± 0.94	14.8 ± 1.3	29.2 ± 1.6
31	15	15	35 ± 12	2.04 ± 0.67	72 ± 17	37.1 ± 2.4	39.1 ± 3.2	76.2 ± 4.0
32	15	23	27 ± 13	2.26 ± 0.81	57 ± 18	32.0 ± 2.1	32.8 ± 2.8	64.8 ± 3.5

TABLE 2 (continued)

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
HERITAGE MINERALS, INC.
LAKEHURST, NEW JERSEY

Sample ID[a]	Depth (cm)	Exposure Rate @ 1m (µR/h)	Radionuclide Concentrations (pCi/g)					
			U-238	U-235	Total U[b]	Th-228	Th-232	Total Th[c]
Background Samples								
1	15	3	0.2 ± 0.2	0.1 ± 0.0	0.5	0.3 ± 0.0	0.3 ± 0.1	0.6
2	15	3	0.3 ± 0.2	0.0 ± 0.0	0.6	0.1 ± 0.0	0.2 ± 0.1	0.3
3	15	5	0.5 ± 0.3	0.0 ± 0.0	1.0	0.3 ± 0.0	0.3 ± 0.1	0.6
4	15	4	0.3 ± 0.4	0.0 ± 0.1	0.6	0.3 ± 0.0	0.3 ± 0.1	0.6
5	15	7	0.4 ± 0.4	0.0 ± 0.1	0.8	0.3 ± 0.0	0.3 ± 0.1	0.6
6	15	4	1.1 ± 0.4	0.1 ± 0.1	2.3	0.5 ± 0.0	0.5 ± 0.1	1.0

[a]Refer to Figures 4 through 7.
[b]Total uranium concentrations were calculated by multiplying the U-238 concentration result by two and adding the U-235 concentration.
[c]Total thorium concentrations were calculated by adding the Th-228 and Th-232 concentrations.
[d]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[e]The waste pile consisted of the recovered sand and wash water from the remediation activities on the building structure construction materials and process equipment that was performed on the Wet Mill Pad.

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APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the author or his employer.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

<u>Alpha Plus Beta</u>

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

<u>Gamma</u>

Eberline Pulse Ratemeter Model PRM-6
(Eberline, Santa Fe, NM)
coupled to
Victoreen NaI Scintillation Detector Model 489-55, Crystal: 3.2 cm x 3.8 cm
(Victoreen, Cleveland, OH)

DIRECT MEASUREMENT INSTRUMENT/DETECTOR COMBINATIONS

<u>Alpha</u>

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

<u>Beta</u>

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

<u>Gamma (Exposure Rate)</u>

Bicron Micro-Rem Meter
(Bicron Corporation, Newburg, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(EG&G ORTEC, Oak Ridge, TN)
used in conjunction with:
Lead Shield Model SPG-16-K8
(Nuclear Data)
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

High Purity Extended Range Intrinsic Detectors
Tennelec Model No: ERVDS30-25195
(Canberra, Meriden, CT)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

The proposed survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current job hazard analyses (JHAs). All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available, standards of an industry-recognized organization were used.

Analytical and field survey activities were conducted in accordance with procedures from the following documents of the Environmental Survey and Site Assessment Program:

- Survey Procedures Manual, (February 2003)
- Laboratory Procedures Manual, (February 2003)
- Quality Assurance Manual, (April 2003)

The procedures contained in these manuals were developed to meet the requirements of Department of Energy (DOE) Order 414.1A and the U.S. Nuclear Regulatory Commission *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards* and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in MAPEP, NRIP, ITP, and EML Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

Detectors used for assessing surface activity were calibrated in accordance with ISO-7503[1] recommendations. The total beta efficiency (ε_{total}) was determined for each instrument/detector combination and consisted of the product of the 2π instrument efficiency (ε_i) and surface efficiency (ε_s): $\varepsilon_{total} = \varepsilon_i \times \varepsilon_s$.

The alpha calibration ε_i was 0.36 for the gas proportional detectors calibrated to Th-230 and the beta calibration ε_i was 0.42 for the gas proportional detectors calibrated to Tl-204. The beta calibration source was selected based on the beta energy distribution of the radionuclide. ISO-7503[1] recommends an ε_s of 0.25 for alpha emitters and beta emitters with a maximum energy of less than 0.4 MeV (400 keV) and an ε_s of 0.5 for maximum beta energies greater than 0.4 MeV. Since the maximum beta energy for the HMI radionuclides of concern was greater than 0.4 MeV, an ε_s of 0.5 was used to calculate ε_{total}. The total alpha and beta efficiencies for the gas proportional detectors were 0.09 and 0.21, respectively.

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the detectors slowly over the surface; the distance between the detector and the surface was maintained at a minimum—nominally about 1 cm. A NaI scintillation detector was used to scan for elevated gamma radiation on the concrete pad and soil surfaces. The concrete pad surface was also scanned using small area (126 cm^2) hand-held gas proportional detectors. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Scan minimum detectable concentrations (MDCs) were estimated using the calculational approach described in NUREG-1507.[2] The scan MDC is a function of many variables, including the background level. Typical beta background levels on concrete surfaces range from 250 to 450 cpm for the hand-held gas proportional detectors. Additional parameters selected for the calculation of scan MDCs included a three-second observation interval for the gas proportional

[1]International Standard. ISO 7503-1, Evaluation of Surface Contamination - Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters. August 1, 1988.
[2]NUREG-1507. Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. US Nuclear Regulatory Commission. Washington, DC; June 1998.

detectors, a specified level of performance at the first scanning stage of 95% true positive rate and 25% false positive rate, which yields a d' value of 2.32 (NUREG-1507, Table 6.1), and a surveyor efficiency of 0.5. The instrument efficiency (ε_i) for the hand-held gas proportional detector calibrated to Tl-204 was 0.42. To illustrate an example for the hand-held gas proportional detector, the minimum detectable count rate (MDCR) and scan MDC for beta activity can be calculated as follows:

b_i = (250 cpm)(3 s)(1 min/60 s) = 12.5 counts,
MDCR = (2.32)(12.5 counts)$^{1/2}$ [(60 s/min)/(3 s)] = 164 cpm,
$MDCR_{surveyor}$ = 164/(0.5)$^{1/2}$ = 232 cpm

The scan MDC is calculated assuming a source efficiency (ε_s) of 0.5 (for Tl-204):

$$ScanMDC = \frac{MDCR_{surveyor}}{(\varepsilon_s)(\varepsilon_i)} dpm/100cm^2$$

For the given background range, the estimated scan MDC ranged 1,100 to 1,430 dpm/100 cm^2 for the hand-held gas proportional detectors.

The scan MDC for the NaI scintillation detector for uranium and thorium were obtained directly from NUREG-1507. The scan MDCs were 115 and 28.3 pCi/g, respectively, for total uranium and total thorium (includes sum of all radionuclides in the uranium and thorium decay series).

Surface Activity Measurements

Measurements of total alpha and total beta surface activity levels were performed using hand-held gas proportional detectors with portable ratemeter-scalers. Count rates (cpm), which were integrated over one minute with the detector held in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the net count rate by the total static efficiency ($\varepsilon_i \times \varepsilon_s$) and correcting for the physical area of the detector.

Surface activity measurements were performed on unpainted concrete. The background count rate for the gas proportional detector was 1 cpm for alpha activity. To distinguish between the beta background that naturally occurs in concrete and the high ambient gamma background that was present on the site during the beta activity measurements, unshielded and shielded beta activity measurements were performed at each background direct measurement location on concrete surfaces having no known radiological history. A Plexiglas™ shield of enough thickness to block the beta particles from the natural uranium and natural thorium series was used to determine the gamma count rate associated with the unshielded count rates. The background count rate for concrete surfaces was 303 cpm unshielded and 221 cpm shielded. These material-specific background count rates represented the net beta activity difference between unshielded and shielded beta direct measurements performed in the background reference area for the HMI site. The material-specific background beta count rate difference (reference material count rate) of 82 cpm was then subtracted from the net count rate determined from the concrete pad unshielded and shielded direct measurements to provide a true beta-only direct measurement on the concrete pad surfaces.

The following equation was used to determine the net beta count rate when correcting for ambient gamma background differences:

$$N = (R_{u,su} - R_{s,su}) - R_{rm}$$

where:

N	=	net beta count rate
$R_{u,su}$	=	unshielded survey unit count rate
$R_{s,su}$	=	shielded survey unit count rate
R_{rm}	=	reference material gross count rate

The background material unshielded gross count rates were used to calculate beta surface activity when shielded measurements were not performed in the survey area.

The static beta MDC—calculated using the background material unshielded average count rate—was 320 dpm/100 cm^2 using the gas proportional detectors calibrated to Tl-204. The physical surface area assessed by the gas proportional detector used was 126 cm^2

The static alpha MDC was 67 dpm/100 cm^2 using the gas portional detectors calibrated to Th-230. The physical surface area assessed by the gas proportional detector used was 126 cm^2.

Exposure Rate Measurements

Measurements of dose equivalent rates (μrem/h) were performed at 1 m above the surface using a Bicron microrem meter. Although the instrument displays data in μrem/h, the μrem/h to μR/h conversion is essentially unity.

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

RADIOLOGICAL ANALYSIS

Gamma Spectroscopy

Samples of soil and residues were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in a 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All photopeaks associated with the radionuclides of concern were reviewed for consistency of activity. Photopeaks used for determining the activities of radionuclides of concern and the typical associated MDCs for a one-hour count time were:

Radionuclide	Photopeak	MDC soil (pCi/g)
Th-228	0.583 MeV from Tl-208*	0.05
	(or 0.239 MeV from Pb-212*)	0.02
Th-232	0.911 MeV from Ac-228*	0.05
U-235	0.143 MeV (or 0.186 MeV)	0.06
U-238	1.001 MeV from Pa-234 m*	1.74

*Secular equilibrium assumed. The Pa-234m photopeak was used in lieu of the Th-234

(63 keV) photopeak due to the attenuation of the low-energy gammas due to the high Z material associated with the samples.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the total propagated uncertainties for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels.

Detection limits, referred to as minimum detectable concentration (MDC), were based on 3 plus 4.65 times the standard deviation of the background count $[3 + (4.65\sqrt{BKG})]$. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

APPENDIX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

AND

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

APPENDIX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces or premises, equipment, or scrap which are likely to be contaminated, but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement, shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to special circumstances such as razing of buildings, transfer from premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term

storage or standby status. Such requests must:

a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

a. Identify the premises.

b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 1
ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm βγ/100 cm^2	15,000 dpm βγ/100 cm^2	1,000 dpm βγ/100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal Register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document establishes guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) above background for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	---	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	–	40	200
Depleted Uranium:				
Soluble	35	100	---	1,000
Insoluble	35	300	---	3,000
Enriched Uranium:				
Soluble	30	100	---	1,000
Insoluble	30	250	---	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

Letter to NRC
June 30, 2004

Law Offices of Anthony J. Thompson, P.C.

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June 30, 2004

United States Nuclear Regulatory Commission
Region I Office
Attn: Mr. Ronald Bellamy
475 Allendale Road
King of Prussia, PA 19406

Dear Mr. Bellamy:

By this letter, Heritage Minerals, Inc. (HMI) is providing the Nuclear Regulatory Commission's (NRC's) Region I office with a comprehensive update on the status of final decommissioning and decontamination (D&D) activities at the HMI site in Lakehurst, New Jersey. In addition, HMI is proposing a disposition pathway for all remaining materials at the site so that cost and time-efficient license termination can be achieved.

I. STATUS UPDATE AND PROPOSED DISPOSITION PLAN

As of the date of this letter, HMI has completed demolition of the wet and dry mill site buildings and has decontaminated the remaining resulting scrap materials to satisfy applicable NRC release guidance for *unrestricted use.* Such scrap materials have been removed from the HMI site. As a result of the demolition and decontamination process, HMI has accumulated approximately 300-400 tons of sands that were removed from the wet and dry mill buildings and from scrap materials during decontamination (i.e., by power washing). These sands were accumulated and stockpiled in one area of the HMI site (hereinafter "stockpile area"), and a disposition pathway for such materials needs to be determined.

HMI proposes that the disposition of these stockpiled sands be addressed along with other waste sands at the site (e.g., the so-called Blue/Grey Area), which NRC has determined are subject to the State of New Jersey's jurisdiction. As indicated in the Process History prepared by HMI, the wet and dry mill site buildings were used by site operators, including HMI, to remove saleable titanium mineral products (i.e., ilmenite, rutile, leucoxene, and zircon) from the heavy mineral fraction of the sands mined at the site. For a period of time just prior to the shutdown of active milling operations, HMI installed a monazite removal circuit at the end of the dry mill process to remove the monazite component of the heavy mineral fraction as a potentially saleable product.

HMI's production of a monazite stream in the dry mill led NRC to license the wet and dry mill buildings and the monazite storage pile, although HMI ceased all active processing operations prior to NRC issuing HMI's license.

When HMI determined that its active mineral processing operation was no longer economically viable and active mineral processing operations were terminated, any waste sands that did not reach the Blue Area for disposal remained within the wet and dry mill infrastructure (e.g., pipes, bucket elevators, tanks) and on the surface of equipment until HMI demolished and decontaminated the mill buildings and their infrastructure. During demolition and decontamination of these buildings, sands removed from various portions of the wet and dry mill buildings were placed in the aforementioned stockpile area. HMI's D&D contractor, ENERCON Services, performed a characterization survey of the materials in the stockpile area and determined that the stockpile sands have radiological characteristics similar to the Blue Area waste sands (i.e., 24-27 pCi/g total thorium and 24-25 pCi/g total uranium, which are well below NRC *licensable* source material levels).[1]

At no time were HMI's *wet* mill processing operations ever devoted to the concentration of a potential monazite product. HMI's wet mill utilized specific gravity mechanisms (i.e., Humphrey's spirals, shaker tables) to separate the heavy mineral fraction, which included titanium series minerals and accompanying monazite, from the lighter minerals in the mined sands. Sands containing the heavy mineral fraction eventually were sent from the wet mill to the dry mill for further processing, while the wet mill tailings were sent directly to a stockpile as "clean" material. While it appears that, at times, *licensable* levels of source material were present at the shaker tables, as a general proposition, wet mill processing *did not* create *licensable* source material.[2] Indeed, the dry mill "feed" material created in the wet mill and sent to the dry mill for processing was not *licensable* source material. As a result, since the vast majority of the sands processed in the wet mill exited as "clean" material or as dry mill feed, and concentrations of *licensable* source material were only present sporadically at some of the shaker tables, the in-process sands removed from the wet mill during demolition should not require NRC regulatory oversight.

The in-process sands removed from the *dry* mill building during demolition and decontamination, including any monazite faction, were either destined for disposal in the Blue Area as tailings or would have been contained in the saleable product, neither of which were *licensable* source material. As shown in the Process History, although *licensable* source material concentrations were created in various places in the dry mill circuits (mostly in magnetic circuits), neither the saleable product nor the wastes destined for the Blue Area contained *licensable* source material concentrations. The dry mill utilized only one circuit to concentrate monazite for a few months. Thus, the vast

[1] *See* Attachment A.
[2] Indeed, HMI's wet mill processing operations only used approximately 30 percent of the wet mill building's equipment during active processing operations.

majority of the sands removed from the dry mill during demolition and decontamination either were in a process that had not reached the monazite removal circuit or waste material that never made it to the Blue Area. In total, approximately 95 percent of the sands processed in the dry mill were removed as non-*licensable* saleable product or disposed of as tailings in the Blue Area. Had HMI's processing operations continued, after NRC licensing, the vast majority of the stockpiled sands that ultimately were removed from the dry mill building during demolition and decontamination would have been destined to be non-*licensable,* saleable product (if it was within the removal circuits themselves) or tailings for disposal in the Blue Area. Therefore, since the stockpiled sands do not exceed *licensable* source material levels, such sands should not be a matter requiring NRC regulatory oversight.

With the above-discussed factors in mind, HMI proposes that the stockpiled sands be addressed with the Blue Area as part of the final disposition plan to be developed with the State of New Jersey in accordance with its *Soil Remediation Standards for Radioactive Materials* (*Soil Remediation Standards*)[3] and performed under the Administrative Consent Order (ACO)[4] executed on November 19, 1993, with the New Jersey Department of Environmental Protection (NJDEP). This disposition pathway can be considered analogous to the option proposed by NRC Staff in the recent Transfer of Source Material Proposed Rule, which was to be created because "transfers [of "unimportant quantities" of such material] could potentially result in scenarios where exposure limits in 10 CFR Part 20 could be exceeded."[5] *See* 67 Fed. Reg. 55175, 55176 (August 28, 2002). This Proposed Rule would have allowed licensees to apply to NRC for permission to transfer waste materials below *licensable* source material levels to entities such as landfills and Resource Conservation and Recovery Act (RCRA) Subtitle C sites for final disposition if the transferring entity could demonstrate that no threat to public health and safety would exist as a result of that particular disposition pathway. Indeed, the Proposed Rule stated, "if the [transfer] approval request is for transfer for the purpose of direct disposal in an appropriate facility (*e.g.*, a RCRA Subtitle C facility authorized for such material or other disposal facilities having in place the appropriate State or EPA permits), the request for transfer would normally be approved if the dose to a member of the general public is unlikely to exceed 0.25 mSv/yr (25 mrem/yr)." *Id.* By analogy, had NRC Staff's Proposed Rule been approved by the Commission, HMI could have applied to NRC for permission to transfer jurisdiction over the stockpiled sands to the State of New Jersey which would require disposition of the stockpiled sands (and

---

[3] *See* State of New Jersey, *Soil Remediation Standards for Radioactive Materials*, N.J.A.C. 7:28-12.1 *et seq.* (2000).

[4] *See* Administrative Consent Order (ACO), Heritage Minerals, Inc. Site, Berkeley and Manchester Townships, ¶ 19 (November, 1993) ("The Department intends and Respondents agree that the scope of the investigation and cleanup required by this Administrative Consent Order will include all contaminants at the above referenced Site, and all contaminants which are emanating from or which have emanated from the Site.")

[5] The Commission declined to adopt this Proposed Rule, because NRC Staff failed to present an adequate health and safety basis for its promulgation.

other contaminated sands in all areas of the site contaminated by processing, including the so-called Red Area after release by NRC) in accordance with the aforementioned *Soil Remediation Standards*. Since HMI currently is bound by the above-noted ACO to "investigate and clean up" all contaminants at the site, including radionuclides, which will require it to satisfy New Jersey's 15 mrem/year standard to release the property for *unrestricted* use, including the planned construction of residential dwellings at the site, or perhaps other uses under a *restricted release* scenario, the proposed disposition pathway will have the same effect as approving removal to a State-permitted disposal facility. In addition, HMI is prepared to submit a written commitment to NRC that it will satisfy New Jersey's site release standards. Thus, transfer of the stockpile to New Jersey's jurisdiction along with other contaminated materials at the site should be accepted by NRC Staff as adequately protective of public health and safety.

II. PROPOSED ACTION PLAN

In order to achieve final site closure and license termination, HMI proposes that the following action plan be reviewed and accepted by NRC. Previously, the removal of all *fugitive licensable* source material from the NRC-licensed portion of the HMI site was effectuated in accordance with the May 6, 2003, letter submitted by HMI and approved by NRC. This letter required the excavation of *fugitive licensable* source material pockets (i.e., soil volumes defined by a surface footprint of sands with total thorium and uranium activities in excess of 116 pCi/g), until sampling confirmed that the sands *at the bottom* of the excavation area within the boundaries of the surface footprint were below 10 pCi/g total uranium and 10 pCi/g total thorium. Removal of these *fugitive licensable* source material pockets from excavation areas was completed by ENERCON in accordance with the May 6, 2003 letter. ENERCON's June 26, 2003 report, which was submitted to NRC, demonstrates that such excavation areas meet the requirements as delineated in the May 6, 2003 letter.

Later, on September 9, 2003, NRC's remediation contractor, the Oak Ridge Institutes for Science and Engineering (ORISE), conducted confirmatory sampling at the site and discovered additional *fugitive licensable* source material pockets. Each sample location was staked by ENERCON. Upon receipt and comparison of all ENERCON/ORISE sample data, ENERCON personnel returned to HMI's site to delineate, quantify, and record the GPS location of *licensable* source material. ENERCON personnel delineated and quantified those areas on October 1, 2003, using a Ludlum Model 44-10 sodium iodide instrument with lead columnator to locate each sample point. The area around each location was scanned to determine the surface footprint of *licensable* source material. Each location was augered on all sides and scanned vertically to determine the depth of *licensable* source material. These dimensions were used to estimate a volume of approximately 67 cubic yards of *licensable* source material destined for removal to International Uranium (USA) Corporation (IUSA) for processing as an alternate feed material.

As a result of this discovery and the continued discussions between HMI and NRC regarding the existence of a so-called "Red Area," HMI hereby submits a proposed NRC site boundary which is to encompass the entire NRC-licensed portion of the HMI site and which, technically, will separate the site areas covered by NRC's jurisdiction from those covered by New Jersey's jurisdiction prior to license termination. HMI has included within this *proposed final* NRC site boundary the *fugitive licensable* source material pockets identified by ORISE, the wet and dry mill building pads, the footprint of the former monazite pile storage area, and a reasonable buffer zone surrounding such locations as detailed in Attachment B. This proposed NRC-licensed area is based on a recent 100% gamma/GPS walkover survey of the so-called "Red Area." The area inside this proposed NRC site boundary was covered in a continuous gamma/GPS walkover survey that collected 18,280 readings. Locations exceeding 180,000 counts are shown and the larger ORISE-identified spots exceeding this count number are visible on the attached map. Other ORISE-identified spots are so small that they could not be seen on the scale of this map, so a "dot" was added to demonstrate that the exact locations of such spots are locatable for final disposition.

If this proposed site boundary is acceptable to NRC, ENERCON will address any remaining *fugitive licensable* source material pockets, including excavation of such material, placement of such material into appropriate shipping containers, and transportation of such material to IUSA's NRC-licensed uranium mill for final disposition. At the conclusion of any final excavation and removal of materials from the HMI site, no backfill will be placed in the areas where excavation occurs until necessary verification samples are completed. HMI requests that NRC be present to conduct split-sampling simultaneously with ENERCON's sampling prior to any later attempts to perform confirmatory sampling so that backfill does not fall back into the sampling location. After NRC and ENERCON complete their split sampling, HMI requests that both parties conduct a simultaneous "walkover" of the "Red Area" to verify that all *licensable* source material has been removed. ENERCON will provide a final report detailing the tasks completed, listing the results of all sampling, and providing a survey map of the final walk-over survey. Additionally, as noted above, HMI proposes that disposition of the stockpiled sands from demolition and decontamination of the wet and dry mill buildings be addressed with the Blue/Grey Area waste sands under the NJDEP ACO and the State of New Jersey's *Soil Remediation Standards*.

For your information, HMI is also attaching a map of the Radiation Science, Inc. (RSI) "background" sampling locations and a report prepared for HMI by SENES Consultants, Ltd. for submission to NJDEP as part of discussions with New Jersey regarding ultimate disposition of the *non*-NRC-licensed radionuclides in soils at the site (*See* Attachments C & D). If accepted by NRC, completion of the above-discussed tasks under its NRC license should result in the completion of HMI's obligations and the termination of its NRC license.

Thank you for your time and consideration in this matter, and please feel free to contact me at (202) 496-0780 if you have any questions.

Respectfully Submitted,

Tony

Anthony J. Thompson, Esq

ATTACHMENT A

ATTACHMENT A

STOCKPILE SAMPLES

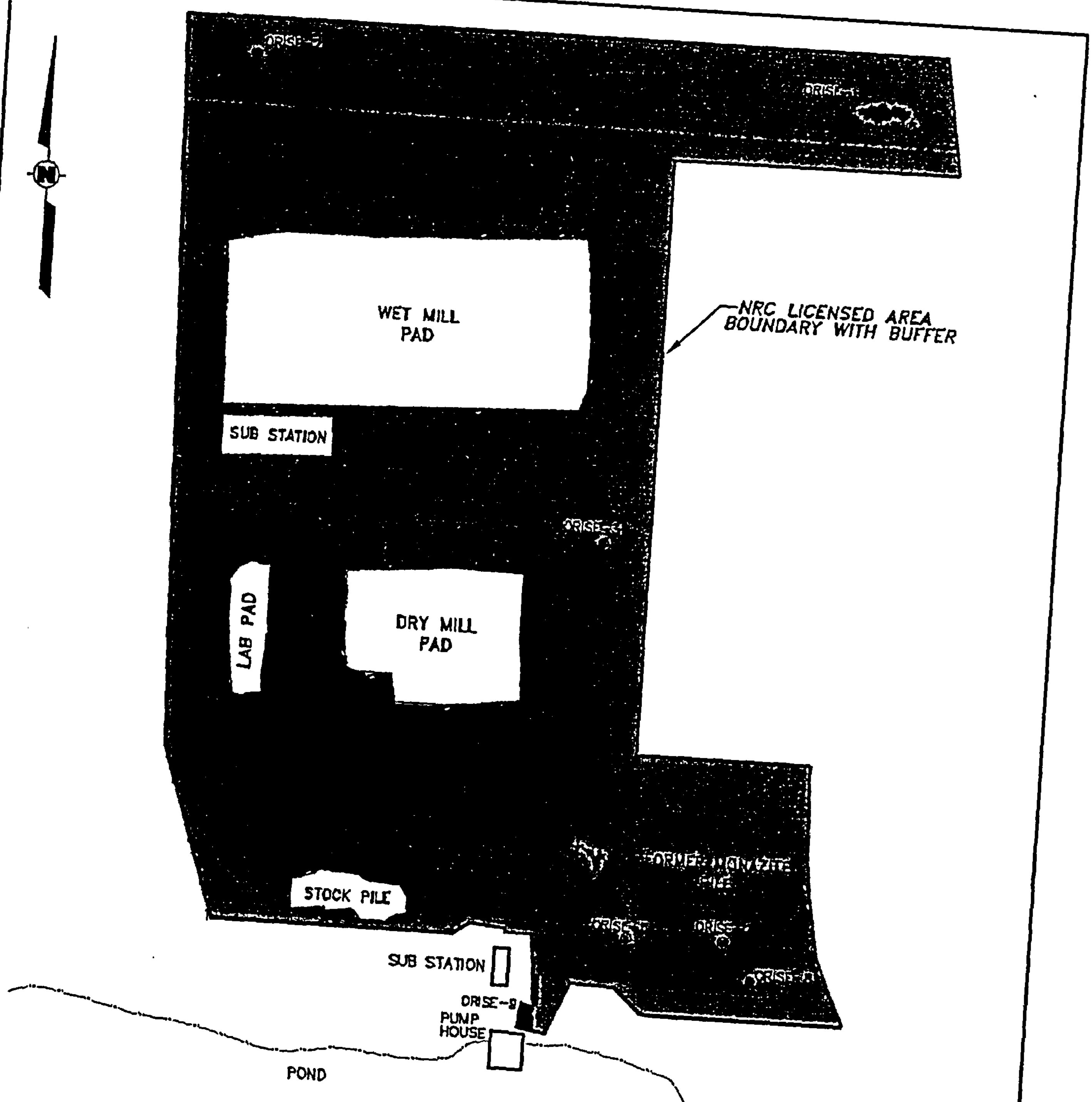
Sampled by	Total Thorium (pCi/g)	Total Uranium (pCi/g)
ENERCON SERVICES	27.7	25.9
ENERCON SERVICES	24.7	24.7
ORISE	27.3	20.0
ORISE	20.0	12.7
ORISE	26.1	32.0

Based on these five samples, the average thorium/uranium concentrations in the sands in the stockpile are approximately 25 pCi/g total thorium and 23 pCi/g total uranium.

Blue Area material concentrations reported by HMI in licensee submittals is approximately 120 parts per million of total uranium and thorium combined. When correlated based on activity, the blue area material as described by HMI should be approximately 21 pCi/g total thorium and 21 pCi/g uranium. These values show good correlation with the stockpile values and verify that the stockpile is consistent with the blue area material.

ATTACHMENT B

DRAWING NUMBER 99281A13



GAMMA SCAN SCALE

Color	Range Beg.	Range End
■	0.00	180000.00
■	180000.00	600000.00

FIGURE 1

NRC LICENSED AREA BOUNDARY WITH BUFFER

HERITAGE MINERALS
LAKEHURST, NEW JERSEY

PREPARED FOR
ENERCON SERVICES, INC.
MURRYSVILLE, PENNSYLVANIA

CUMMINGS RITER CONSULTANTS, INC.

DRAWING NUMBER 99281A13

REVISION	DATE	DESCRIPTION

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"SAMPLE LOCATION FOR PHASE I & II OF BACKROUND DETERMIATION HERITAGE MINERIALS INC."
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ATTACHMENT D

PATHWAYS ANALYSIS AND SITE-SPECIFIC OPTIONS FOR ASARCO/HMI SITE

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EXECUTIVE SUMMARY

The Heritage Minerals, Inc. (HMI) site in New Jersey contains naturally occurring levels of radionuclides that are slightly elevated compared to background levels due to the past processing of heavy mineral sands containing naturally occurring levels of radionuclides. The physical processing of these minerals has resulted in technologically enhanced naturally occurring radioactive material (TENORM) on the site that potentially exceeds New Jersey Department of the Environment (NJDEP) criteria for unrestricted property use.

This report discusses potential site-specific options for addressing those areas with slightly elevated levels of naturally occurring radionuclides at the HMI site to satisfy NJDEP site use criteria including radioactive dose, indoor radon levels and protection of groundwater. Detailed engineering planning and cost estimates have not been developed for these options; however, the technical feasibility, regulatory precedents, and radioactive dose implications for each approach are discussed.

The TENORM nature of the radionuclides and the physical characteristics of the heavy minerals containing naturally occurring radionuclides provide a basis for site-specific options. A critical factor is the chemical characteristics of heavy minerals that results in radioactive equilibrium within the minerals, low radon emanation compared to normal soils, and insolubility with respect to ingestion or leaching to groundwater. These aspects support the derivation of site-specific derived concentration guideline levels (DCGLs) that are less restrictive than the default values provided by NJDEP.

The existing site characterization data, derived from an NJDEP-approved plan, have been used to estimate the volumes and radionuclide concentrations in materials to be addressed. Additionally, a review of site-specific background characterization studies indicates that background concentrations likely were underestimated in the past.

Two site-specific options have been considered. The first option is consolidation of the material with slightly elevated concentrations to one area with State enforced institutional controls allowing only recreational uses. Radiological doses under this first option would be considerably lower than State criteria and would meet dose criteria if the institutional control were to fail. The second option would be to return the slightly elevated material to its original location by placing the material at the bottom of the lakes originally created by on-site dredging/mining of the ore. In effect, this second option returns the TENORM material to its place in nature. Under both site-specific options, the planned development area meets the NJDEP requirements for unrestricted release.

The second option, specifically the return of the TENORM material to its original place in nature, is the preferred option due to lower radiological dose, no requirement for institutional controls, and a lack of technical complexity.

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1.0 INTRODUCTION

The Heritage Minerals, Inc. (HMI) site in New Jersey contains naturally occurring radionuclide levels that are slightly elevated compared to natural background levels due to the past processing of heavy mineral sands containing naturally occurring levels of radionuclides. The purely physical processing of these heavy mineral sands has resulted in the presence of technologically enhanced naturally occurring radioactive material (TENORM) at the HMI site that potentially may exceed New Jersey Department of Environmental Protection (NJDEP) criteria for unrestricted property use.

Existing HMI site characterization data, based on an NJDEP approved plan, have been used to estimate the volume of materials containing slightly elevated levels of radionuclides. Additionally, a review of site-specific background characterization studies indicates that background concentrations at the HMI site likely were underestimated in the past.

Two potential site-specific options that have been considered are consolidation of the TENORM material to one area with State enforced institutional controls (i.e. deed restrictions) allowing only recreational use (i.e. *limited* restricted use) thereby allowing the development area to satisfy NJDEP unrestricted site use criteria and returning the TENORM material to the bottom of the lakes created by the original dredging/mining of the original ore. In effect, this later option returns the TENORM material to its place in nature. Under both site-specific options, the planned development area meets the NJDEP requirements for unrestricted site use.

This report focuses on potential site-specific options for those areas of the HMI site containing the TENORM material, and it will discuss how these options will satisfy NJDEP unrestricted site use criteria including criteria for radiation dose, indoor radon levels and groundwater protection. Detailed engineering planning and cost estimates have not yet been developed for these options; however, the technical feasibility, regulatory precedents, and radioactive dose implications for each approach will be discussed.

The general outline of the report is as follows:

- Chapter 2 provides a brief historical description of the HMI site and processing operations, including some discussion of TENORM material and secular equilibrium relative to the heavy mineral fraction.

- Chapter 3 discusses the development of alternate concentration guideline values based on site-specific conditions; specifically, the physical and chemical characteristics of the heavy minerals fraction which results in ingestion, including groundwater pathways, being irrelevant to a dose assessment due to the insolubility of and the low radon emanation from heavy minerals, the latter of which substantially reduces potential indoor radon doses. Derived Concentration Guideline Levels (DCGLs) based only on external gamma exposure and inhalation are developed for the natural uranium and thorium series for a representative range of remediation scenarios.

- Chapter 4 discusses the site-specific radiological characterization, including background characterization data for the HMI site, primarily from the MTRAP characterization study (CDM 1998). Volumes of TENORM material to be addressed from the areas of concern (AOCs) are estimated for the site-specific options.

- Chapter 5 describes the two site-specific options for the AOCs with different requirements for institutional controls.

- Chapter 6 summarizes the report findings and suggests areas for possible refinement.

2.0 SITE HISTORY

In 1957, ASARCO, Inc. (ASARCO) explored the area around what is now the HMI site for deposits of titanium-bearing heavy minerals, which were reportedly to be found in Ocean County's underlying sedimentary formations. At that time, ASARCO optioned approximately 20,000 acres of land in Manchester Township and, in 1960, after three years of exploration, ASARCO purchased approximately 9,000 acres for mineral recovery of which 7,000 acres currently remain under HMI's control.

After purchasing these 9,000 acres of land in 1960, ASARCO placed the site on standby status until 1968. In 1968, ASARCO began the design and construction phases for its mineral recovery plant. The design and construction phases lasted about five years until 1973 when ASARCO's mineral recovery operations commenced.

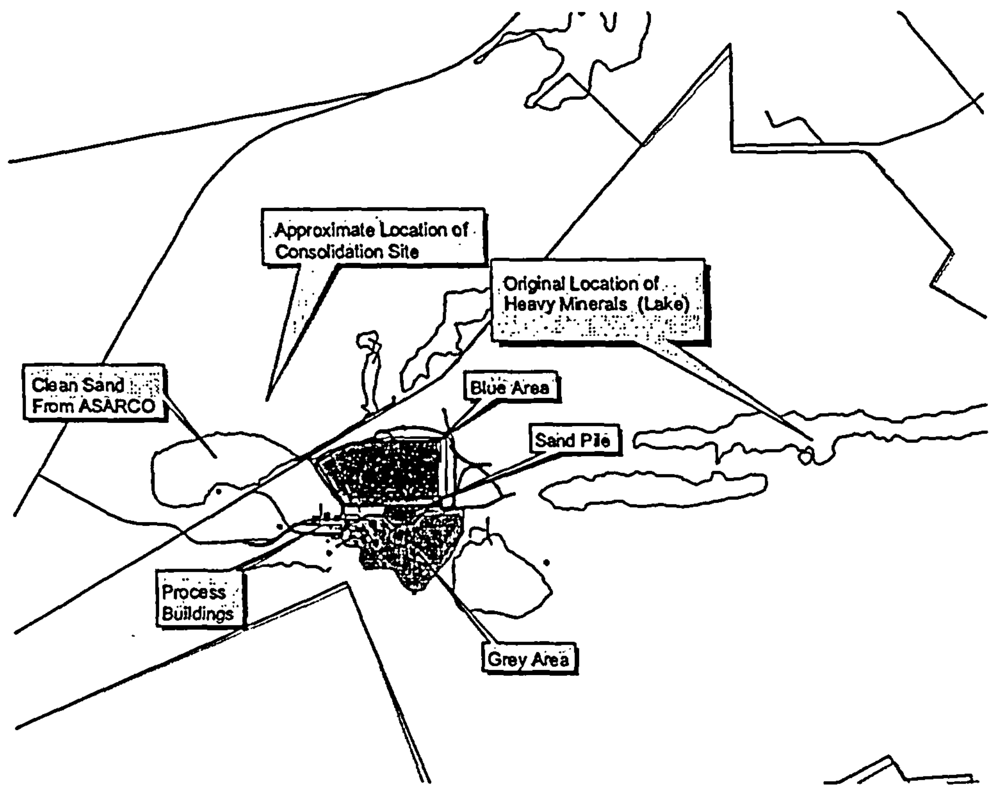
The plant facilities designed and constructed by ASARCO are situated in the center of the mined area of the property. The wet mill building is a three-story steel structure erected on a 229' X 99' concrete slab, and the dry mill building is also a three-story steel structure erected on a 120' X 95' concrete slab. Additional buildings at the HMI site include the laboratory, the service building, the warehouse, the change house, the compressor house, and the main office building.

Since mineral recovery operations began in 1973, the HMI site has been owned and/or operated by four (4) different companies, ASARCO, Humphrey's Gold, Mineral Recovery, Inc. (MRI) and HMI. Each company utilized the same general mineral recovery process with some variations depending on which heavy mineral each company sought to recover. One consistent factor in the mineral recovery processes used at the HMI site is the absence of any chemicals. Mineral recovery operations only utilized gravity and electrostatic and electro-magnetic processes to separate and recovery heavy minerals from the dredged/mined sands. These processing operations will be discussed in greater detail below.

2.1 SITE LOCATION

The HMI site is located in Lakehurst, NJ, (located in Manchester Township, Ocean County) approximately 75 miles south of New York City in the New Jersey Coastal Plain. The plant entrance is located at Mile Marker 41 on New Jersey State Highway No. 70 and 12 miles west of the Garden State Parkway. This area is characterized by fine to coarse sandy soils, gravels, and clays that geologically were formed by an estuary. Figure 2.1 shows the general property outline along with areas that were involved in the processing of heavy minerals at the site. A brief discussion of these areas and the process history are included in the following sections.

FIGURE 2.1
SCHEMATIC SITE MAP



2.2 Site Process Activity

2.2.1 ASARCO Mineral Recovery for Ilmenite

ASARCO's mineral recovery operations began in 1973 and continued until March of 1982 and were primarily focused on the recovery of the titanium mineral ilmenite. Its mineral recovery operations consisted of hydraulic mining (dredging) of sand deposits on-site which were identified as containing economic levels of ilmenite. These sand deposits also contained a variety of titanium-bearing minerals such as leucoxene and rutile as well as other heavy minerals including zircon, kyanite, sillimenite and monazite.

ASARCO's mining (dredging) operations involved the removal of topsoil overlying the areas where recoverable ilmenite was located and stockpiling such topsoil for future use during site reclamation. Dredging operations were conducted to a maximum depth of approximately 80 feet and broke sand deposits into recoverable sizes which were removed from the ore zone as a slurry. The dredge was advanced through the mining zone in a walking-type advance at a rate of 100 feet per week creating a path approximately 120 feet wide. About 12.3 million yd^3 of sand containing heavy minerals was extracted during the dredging/mining stage with a nominal grade of 5% heavy minerals. The end result of this dredging/mining activity was the lakes currently at the HMI site which are approximately 80 feet deep: the majority of heavy minerals and the accompanying naturally occurring radionuclides that were extracted at the HMI site were originally present at the bottom of these lakes.

The dredged/mined ore was then fed to the wet mill where it was screened for oversized materials, which were rejected from the process and returned to the dredge pond or stockpiled as clean gravel. The remaining dredged material was introduced to a concentrating circuit containing Humphrey spirals where ilmenite (heavy minerals) was separated from silica sands (lighter minerals) by gravity. The lighter silica sands were returned to the dredge pond as backfill, and the heavy mineral concentrate was fed to a final finisher for further concentrating. The resulting wet mill heavy mineral concentrate, which contained approximately 95 percent of the heavy minerals originally dredged, including ilmenite and monazite, was then stored on the ground east of the wet mill to de-water. The de-watered concentrate was then moved using front-end loaders to the dry mill feed hopper for insertion into the dry mill process. Any residual material left on the ground east of the wet mill was graded and re-graded on the surface and into the subsurface to maintain level ground for future storage and de-watering of wet mill concentrates. Spills of material also occurred during the loading of heavy mineral concentrates from the wet mill process prior to insertion into the dry mill process. This occurred because front-end loaders were used to transport wet mill concentrates from the wet mill storage area to the dry mill.

It is crucial to note that the dry mill process used by ASARCO was composed of various units including conveyor belts, bucket elevators, and a series of electrostatic and electromagnetic separators in an *integrated* mineral recovery process. The proper operation of the dry mill required that, depending on their location in the dry mill circuit(s), the various electrostatic and electromagnetic separators be calibrated to the ore grade at that point in the process to maximize mineral recovery. Thus, the dry mill process relied heavily on the continuous and simultaneous operation of these units.

When any one component of any dry mill unit required repair or replacement, the dry mill could not produce a final ilmenite product. In order to avoid total dry mill shutdown, which would have cost approximately $120,000 per hour, ASARCO initiated a procedure ("Mill Shutdown Avoidance Procedure) of continuing to run the dry mill while replacing any malfunctioning components. To do this, the dry mill process was essentially "short-circuited" and the in-process feed material was conveyed through portals cut in the dry mill's walls onto the ground south of the dry mill for future re-insertion into the dry mill process.

This Mill Shutdown Avoidance Procedure resulted in feed materials from various stages of the dry mill process, which contained various concentrations of heavy mineral being piled on the east and south sides of the dry mill. This material was used for general site grading and, depending on the process stage, contained slightly elevated levels of radionuclides in varying concentrations.

In summary, slightly elevated radionuclide levels arising from ASARCO operations primarily comprise the heavy mineral fraction stockpiled on the Grey Area with some slightly elevated naturally occurring radionuclides in the sediments at the bottom of the settling ponds located in the Blue Area and in other areas arising from spills or process upsets in the ASARCO plant.

2.2.2 Humphrey's Gold Mineral Recovery Operations

In April of 1982, ASARCO leased the HMI site to Humphrey's Gold for the purpose of conducting a plant-scale pilot test using the tailings from ASARCO's ilmenite recovery operations to determine if a commercial grade zircon product could be economically produced. ASARCO's lease with Humphrey's Gold was to last six (6) months, although Humphrey's Gold performed pilot tests for only one (1) month. ASARCO was not directly involved in Humphrey's Gold's pilot tests.

With the exception of limiting the amount of feed materials introduced into the dry mill process, Humphrey's Gold utilized the ASARCO mineral recovery processes in the same manner as ASARCO. However, the greatly reduced volume of feed material introduced into the dry mill process resulted in such feed materials being unsuitable for processing. Thus, Humphrey's Gold's mineral recovery operations lasted only one (1) month. Tailings and any product generated from Humphrey's Gold mineral recovery operations were pumped to the northeast section of the Grey Area for stockpiling.

2.2.3 Mineral Recovery, Inc. Mineral Recovery Operations

In 1986, HMI purchased the site from ASARCO and leased the plant facilities to MRI. When MRI began mineral recovery operations at the HMI site, it sought to recover zircon, leucoxene, and rutile from the tailings created by ASARCO. In order to engage in such activity, MRI altered the ASARCO dry mill process to include additional mechanisms allowing for further separation of heavy minerals so that zircon, leucoxene, and rutile recovery could be maximized.

MRI started mineral recovery operations in October of 1986 and continued such operations until August of 1987 when HMI assumed the management and control of the site.

2.2.4 Heritage Minerals Inc. Mineral Recovery Operations

After MRI's lease was terminated in August of 1987, HMI assumed control of the site and commenced operations to process ASARCO's tailings in the Grey Area for the recovery of zircon, leucoxene, and rutile.

The dry mill process employed by HMI was fundamentally similar to that used by ASARCO during its mineral recovery operations. However, since HMI was attempting to recover zircon as its main product and leucoxene and rutile as byproducts, the HMI dry mill process did contain some variations from the ASARCO dry mill process.

HMI conducted mineral recovery operations in two separate phases. During Phase I, the dry mill process was divided into two distinct process circuits, the Leucoxene and Zircon Circuits. HMI processed the remaining tailings created by ASARCO to recover their zircon, leucoxene and rutile content. Tailings from HMI's Phase I operations were stockpiled in the Blue Area.

When the dry mill tailings created by ASARCO were depleted by HMI's Phase I mineral recovery operations, HMIs Phase II mineral recovery operations were initiated. Initially, HMI conducted tests to determine whether sufficient amounts of zircon and leucoxene remained in the Blue Area tailings to warrant reprocessing them for zircon and leucoxene recovery. After these tests were concluded, HMI determined that there were sufficient quantities of zircon and leucoxene available for reprocessing. At this point, HMI began to reprocess the Blue Area tailings using the same wet and dry mill processes described above.

HMI used the same Mill Shutdown Avoidance procedures as ASARCO during its mineral recovery operations and placed heavy mineral concentrates on the ground south and east of the dry mill when a component of the dry mill process malfunctioned. While it attempted to return this stockpiled material to the dry mill process, HMI was unable to do so because the material's heavy mineral concentrations were too high to meet the ore grade calibrations of the dry mill process. This resulted in stockpiled materials being graded and re-graded on the surface and into the subsurface east and south of the dry mill building.

2.2.5 Areas of Concern

On the basis of process history, there are four areas of concern (AOC) relative to slightly elevated levels of naturally occurring radionuclides. The first area is the Grey Area where heavy mineral tailings from the original ASARCO operations were placed. Although these tailings were re-processed by HMI for zircon recovery, there may be residual ASARCO tailings remaining in the Grey Area as well as materials arising from surface grading of overflow materials.

The second AOC is the Blue Area where the tailings from HMI mineral recovery operations for zircon were placed. These tailings would generally have higher levels of naturally occurring radionuclides than the original tailings in the Grey Area. The Blue Area also contains the sediments from the bottom of the settling ponds used during ASARCO's mineral recovery operations.

The third AOC is the Sand Pile which contains tailings produced during the recovery of monazite from tailings in the Blue Area. The levels of naturally occurring radionuclides in this material are generally expected to be lower than that of materials located in the Grey or the Blue Area.

The final AOC is the "Mill Vicinity" area where slightly elevated levels of naturally occurring radionuclides are present due to the use of overflow materials from the milling process for site grading.

2.3 TENORM

The slightly elevated levels of naturally occurring radionuclides at the HMI site can be considered to be TENORM since the radionuclides were naturally present in the ore mined on the property. Radionuclides were not introduced into the materials nor were radionuclides brought onto the site from outside sources. The slightly elevated radionuclide concentrations are the result of the physical separation of heavy minerals containing naturally occurring radionuclides without the use of chemicals.

The TENORM material is present in varying concentrations in soils at the HMI site depending on the relevant process history. In some cases, the concentrations of radionuclides were sufficiently high that the materials were classified as *licensable* source material by the Nuclear Regulatory Commission (NRC). This classification was applied to the monazite pile that was shipped off site. The monazite fraction of the heavy mineral sands contains most of the naturally occurring radionuclides present in the soils at the site.

2.4 Heavy Minerals and Equilibrium in the Natural Decay Series

Naturally occurring radionuclide concentrations in heavy minerals typically are in secular equilibrium (Paschoa *et al* 1993, Kerrigan and O'Connor 1990). Process knowledge of the site indicates that, since no chemical separation (i.e. chemical processing which might result in chemical changes to the minerals including dissolution of radionuclides in the heavy mineral fraction) of the heavy minerals occurred, **in our opinion, it is reasonable to assume (secular) equilibrium within the uranium-238 and thorium-232 decay chains.**

3.0 ALTERNATE CONCENTRATION CRITERIA

NJDEP provides "default" DCGLs for radionuclide concentrations at sites; however, alternate DCGLs can be proposed based on relevant site-specific information. This chapter describes the technical basis for alternate DCGLs at this site based in large part on the insolubility of heavy minerals due to the absence of any chemical processing. The insolubility of the heavy minerals renders the groundwater and ingestion dose pathways irrelevant and their physical structure results in the radon emanation coefficient from the heavy mineral fraction being much lower than from typical soils. The radioactive equilibrium in the heavy mineral fraction means that only *one* radionuclide from each of the natural uranium and natural thorium series need be considered in establishing DCGLs.

In general terms, the intended use of the development site will be residential slab-on-grade construction for a retirement community. Other areas of the HMI site are intended for use as open areas (e.g., no residential or commercial development).

3.1 NJDEP PATHWAYS ANALYSIS AND DEFAULT CONCENTRATION GUIDELINES

NJDEP has established unrestricted use standards for sites containing elevated levels of radionuclides (NJDEP 2000). The primary standards include a total effective dose equivalent from intake and external radiation dose of 15 millirem per year (mrem/y) above background, an incremental indoor radon concentration of less than 3.0 picocuries per litre (pCi/L) and groundwater radionuclide concentrations which satisfy the relevant New Jersey Groundwater Quality Standards (7:28-12.9(a)).

3.1.1 NJDEP Pathways Model

The NJDEP regulations provide for calculation of alternate DCGLs where site-specific physical factors, waste-specific factors or design factors may make use of such alternatives which are more appropriate than the "default" DCGLs (7:28-12.9(c)). A pathways analysis may be conducted with a computer model acceptable to NJDEP (7:28-12.9(h)). NJDEP has created a spreadsheet, *NJRaSoRS5.xls*, that is considered acceptable for calculating alternate DCGLs, and this spreadsheet has been utilized in the present assessment.

3.2 SITE-SPECIFIC CONSIDERATIONS FOR DERIVATION OF ALTERNATIVE CONCENTRATION GUIDELINES

NJDEP has indicated that alternate DCGLs can be pursued. At the HMI site, the major site-specific consideration is the chemical and physical characteristics of heavy minerals.

3.2.1 Physical/Chemical Properties of Heavy Mineral Fraction

The heavy mineral fraction which contains virtually all of the naturally occurring radionuclides contains very stable compounds such that the radionuclides are unavailable for transport through the environment (e.g. leaching to groundwater or chemical uptake by vegetation). In a similar manner, the release of radon from the heavy mineral fraction is much lower than the release of radon from typical soils. These physical and chemical characteristics of the heavy mineral fraction are the critical considerations in the derivation of alternate guideline values

<u>Solubility/Bioavailability</u>

The heavy minerals at the HMI site are of a type(s) which are stable chemically and physically such that the contained radionuclides do not leave the mineral structure under normal environmental conditions after their initial formation. Heavy minerals, such as zircon, are so stable that materials containing these minerals can be dated more than 2 billion years into the past based on the relationship between the activities of uranium and lead radionuclides within the zircon. These types of heavy minerals like these are even resistant to chemical breakdown in hydrochloric acid and often require the more aggressive hydrofluoric acid to dissolve minerals and release radionuclides. These heavy minerals are therefore considered stable under environmental conditions and are not available for chemical uptake by vegetation or leaching to groundwater. This is consistent with the NRC's statement that heavy minerals at the site are stable and that water samples show no increase in radioactive contamination (NRC 1993). Recent groundwater measurements at the site show radionuclide concentrations at background levels and, therefore, it can be concluded that the dissolution of radionuclides is not occurring (CDM 1998).

The insolubility of heavy minerals results in secular equilibrium of the radioactive decay series with the radionuclides remaining within the matrix. Thorium series equilibrium was investigated in a typical Western Australian monazite, and it was concluded that secular equilibrium could be assumed when estimating individual radionuclide activity in monazite from the gross alpha activity (Kerrigan and O'Connor, 1990).

Radon Emanation Coefficient

The radon emanation coefficient is the proportion (fraction) of radon atoms that are created from the radioactive decay of radium within the mineral grain that escape into interstitial spaces. These radon atoms then become available for diffusion through the soil and potentially for entry into buildings. Radon emanation in soils have been reported at 0.25 (Megumi and Mamro, 1974) and averaging 0.23 from a range of 0.02 to 0.83 (UNSCEAR, 1993). Radon emanation coefficients for heavy minerals like those at the HMI site are much lower due to their physical structure. Radon emanation coefficients from zircon were reported to be 0.017 ranging from 0.0017 to 0.048 in 28 samples from Finland and 0.031 ranging from 0.002 to 0.12 in 29 other samples (Barretto 1975). Emanation coefficients of Rn-220 from monazite have been reported as 0.0002 for dry samples (Kerrigan 1990), 0.002 (Barretto 1975) and 0.0036 (as reported by Kerrigan 1990). Radon emanation rates from uncovered ores were in most cases lower than the emanation rate from soils (Harrington 1993).

The literature indicates that radon emanation coefficients from such heavy minerals fractions are about a factor of 10 or more lower than the radon emanation coefficient for typical soils. It follows that the indoor radon concentrations potentially attributable to radionuclides in the heavy minerals located at the HMI site would be at least 10 times lower than the corresponding indoor radon concentrations from typical soils with the same radium concentration. The NJDEP pathways analysis for radon uses a factor of 1.5 pCi/L per pCi/g to relate indoor radon concentrations to soil concentrations. On the basis of lower radon emanation coefficients for the heavy minerals fraction, a factor of 0.15 pCi/L per pCi/g would provide a conservative estimate of the indoor radon concentration arising from heavy minerals and has been used in this assessment. This is consistent with findings that low levels of radon are present where heavy minerals are processed (Hewson 1990, Johnston 1991, Koperski 1993).

3.2.2 Land Use Scenarios

Residential structures will be constructed in the development area with lot sizes ranging up to approximately 71 ft by 110 ft. The lot sizes for residences built under failure of institutional control scenario are unknown. For this analysis, we have assumed that the lot size is the same, 10890 ft^2, as the NJDEP default values.

3.3 ALTERNATE DCGLs FOR HERITAGE SITE SOILS

Alternate DCGLs have been calculated for HMI site soils based on two site-specific conditions:

1. First, the chemical and physical characteristics of the radionuclides are such that they are not mobile in the environment and, therefore, the intake pathways (groundwater, soil ingestion, and crop ingestion) are not applicable at this site.
2. The radon emanation factor for heavy minerals is much lower than the default value used by NJDEP.

3.3.1 NJDEP Default Dose Factors

Dose factors (mrem per pCi/g) were calculated using the NJDEP pathways model for various selected vertical extents of contamination (VE) and depths of uncontaminated surface soil (USS). Radionuclides within each of the natural uranium series and thorium series were considered to have the same activity (i.e. to be in equilibrium) due to the physical and chemical nature of the heavy mineral fraction. The natural U-235 series was assumed to have 5% of the activity of U-238 (While NJDEP usually does not consider U-235 in its analysis, we have considered it here for completeness).

The dose factors were summed to provide a single dose factor for the uranium and thorium decay series. Table 3.1 shows the dose factors from the external radiation and inhalation pathways along with the dose factors for all pathways that are usually considered by NJDEP provided in brackets. In general, the dose factors (per pCi/g) for thorium are slightly higher than the dose factors for uranium primarily due to the higher external radiation dose from the thorium series compared to the uranium series. The dose factors from the thorium series range from 9.8 mrem per pCi/g for basement construction with 9 ft vertical extent of contamination (VE) and 0 ft uncontaminated surface soil (USS) to 0.8 mrem per pCi/g for slab-on-grade construction with 1 ft VE and 3 ft USS. Obviously, the dose factor depends on construction type, the vertical extent of contamination, and the thickness of uncontaminated surface soil.

TABLE 3.1
DOSE FACTORS (mrem per pCi/g) FROM EXTERNAL GAMMA RADIATION AND INHALATION FOR RESIDENTIAL SCENARIO BASED ON NJDEP DEFAULT ANALYSIS

		Vertical Extent of Contamination (VE)		
Construction Type	**Natural Decay Series**	**1 ft VE**	**5 ft VE**	**9 ft VE**
0 ft of uncontaminated surface soil (USS)				
Basement	Thorium	5.9 (6.9)	7.8 (9.2)	9.8 (11.2)
	Uranium	4.1 (6.6)	5.4 (10.0)	6.9 (12.8)
Slab-on-Grade	Thorium	6.6 (7.4)	6.6 (8.0)	6.6 (8.0)
	Uranium	4.6 (6.7)	4.6 (9.2)	4.6 (10.5)
1 ft of uncontaminated surface soil (USS)				
Basement	Thorium	1.2 (1.7)	6.2 (7.4)	9.8 (11.2)
	Uranium	0.9 (2.3)	4.3 (8.6)	6.9 (12.8)
Slab-on-Grade	Thorium	1.9 (2.4)	4.2 (5.6)	4.2 (5.6)
	Uranium	1.4 (2.8)	2.9 (7.6)	2.9 (8.8)
2 ft of uncontaminated surface soil (USS)				
Basement	Thorium	1.2 (1.7)	6.2 (7.1)	8.6 (9.6)
	Uranium	0.9 (2.3)	4.3 (7.9)	6.0 (11.1)
Slab-on-Grade	Thorium	0.9 (1.3)	2.4 (3.3)	2.4 (3.3)
	Uranium	0.6 (2.0)	1.7 (5.4)	1.7 (6.7)
3 ft of uncontaminated surface soil (USS)				
Basement	Thorium	1.2 (1.4)	6.2 (6.7)	7.4 (7.9)
	Uranium	0.9 (1.8)	4.3 (7.2)	5.2 (9.4)
Slab-on-Grade	Thorium	0.8 (1.2)	1.5 (2.0)	1.5 (2.0)
	Uranium	0.5 (1.9)	1.1 (3.9)	1.1 (5.2)

Notes:
Dose Factors are summed over the natural decay series radionuclides assuming equilibrium.
Number in brackets is Dose factor including all Pathways.
Uranium series includes U-235 decay series radionuclides at 5% of U-238 series.

Table 3.1 includes, in parentheses, the dose factors if the ingestion pathways were included for comparison purposes.

3.3.2 Alternate DCGLs

Alternate DCGLs for the natural uranium and natural thorium series have been estimated by dividing the 15 mrem standard by the dose factor for the decay series with the ingestion pathways excluded (due to the insolubility of the heavy minerals). Table 3.2 shows the DCGLs for basement and slab-on-grade residential construction. As expected, due to the higher gamma radiation emissions from thorium, the DCGLs for the thorium series are lower than the DCGLs for uranium series. The DCGLs range from 1.5 pCi/g to19.6 pCi/g for the thorium series. The numbers in parentheses are the DCGLS using NJDEP default pathways parameters.

TABLE 3.2
DCGL (pCi/g) FOR RESIDENTIAL SCENARIO
BASED ON NJDEP DEFAULT ANALYSIS OF EXTERNAL RADIATION AND INHALATION PATHWAYS

		Vertical Extent of Contamination (VE)		
Construction Type	**Natural Decay Series**	**1 ft VE**	**5 ft VE**	**9 ft VE**
0 ft of uncontaminated surface soil USS)				
Basement	Thorium	2.5 (2.2)	1.9 (1.6)	1.5 (1.3)
	Uranium	3.6 (2.3)	2.8 (1.5)	2.2 (1.2)
Slab-on-Grade	Thorium	2.3 (2.0)	2.3 (1.9)	2.3 (1.9)
	Uranium	3.2 (2.2)	3.2 (1.6)	3.2 (1.4)
1 ft of uncontaminated surface soil (USS)				
Basement	Thorium	12.1 (9.0)	2.4 (2.0)	1.5 (1.3)
	Uranium	17.3 (6.7)	3.5 (1.7)	2.2 (1.2)
Slab-on-Grade	Thorium	7.8 (6.3)	3.6 (2.7)	3.6 (2.7)
	Uranium	11.1 (5.4)	5.1 (2.0)	5.1 (1.7)
2 ft of uncontaminated surface soil (USS)				
Basement	Thorium	12.1 (9.0)	2.4 (2.1)	1.7 (1.6)
	Uranium	17.3 (6.7)	3.5 (1.9)	2.5 (1.4)
Slab-on-Grade	Thorium	17.2 (11.4)	6.3 (4.5)	6.3 (4.5)
	Uranium	24.6 (7.4)	9.0 (2.8)	9.0 (2.2)
3 ft of uncontaminated surface soil (USS)				
Basement	Thorium	12.1 (10.5)	2.4 (2.2)	2.0 (1.9)
	Uranium	17.3 (8.4)	3.5 (2.1)	2.9 (1.6)
Slab-on-Grade	Thorium	19.6 (12.8)	9.9 (7.4)	9.9 (7.4)
	Uranium	28.0 (8.0)	14.1 (3.8)	14.1 (2.9)

Note:
Numbers in brackets are the DCGL with NJDEP default pathways parameters.

3.3.3 Alternate Concentrations Limits for Loss-of-Control

Table 3.3 shows the soil concentrations corresponding to a dose of 100 mrem/y and are applicable for loss of control scenarios. The concentrations have been determined by dividing the dose factors into the allowable 100 mrem/y. Again the concentrations for all NJDEP pathways (with default values) are provided in parentheses.

TABLE 3.3
DCGL(pCi/g) FOR LOSS OF CONTROL SCENARIO
BASED ON NJDEP DEFAULT ANALYSIS OF EXTERNAL RADIATION AND INHALATION PATHWAYS

Construction Type	Natural Decay Series	1 ft VE	5 ft VE	9 ft VE
0 ft of uncontaminated surface soil (USS)				
Basement	Thorium	16.8 (14.5)	12.9 (10.9)	10.2 (8.9)
	Uranium	24.3 (15.2)	18.5 (10.0)	14.5 (7.8)
Slab-on-Grade	Thorium	15.0 (13.5)	15.0 (12.4)	15.0 (12.4)
	Uranium	21.6 (15.0)	21.6 (10.8)	21.6 (9.5)
1 ft of uncontaminated surface soil (USS)				
Basement	Thorium	80.6 (59.7)	16.1 (13.5)	10.2 (8.9)
	Uranium	115.5 (44.4)	23.1 (11.6)	14.5 (7.8)
Slab-on-Grade	Thorium	52.2 (42.3)	23.9 (17.9)	23.9 (17.9)
	Uranium	74.0 (36.1)	34.1 (13.2)	34.1 (11.3)
2 ft of uncontaminated surface soil (USS)				
Basement	Thorium	80.6 (59.7)	16.1 (14.1)	11.6 (10.5)
	Uranium	115.5 (44.4)	23.1 (12.6)	16.6 (9.0)
Slab-on-Grade	Thorium	114.7 (76.0)	42.0 (30.0)	42.0 (30.0)
	Uranium	163.9 (49.3)	60.0 (18.5)	60.0 (14.9)
3 ft of uncontaminated surface soil (USS)				
Basement	Thorium	80.6 (70.1)	16.1 (14.9)	13.6 (12.7)
	Uranium	115.5 (56.3)	23.1 (13.8)	19.4 (10.7)
Slab-on-Grade	Thorium	130.4 (85.1)	65.7 (49.3)	65.7 (49.3)
	Uranium	186.6 (53.1)	94.0 (25.5)	94.0 (19.2)

<u>Notes:</u>
Natural series in equilibrium.
Number in brackets is concentration with 100 mrem/y based on all Pathways.
Uranium series includes U-235 decay series radionuclides at 5% of U-238 series.

4.0 SITE CHARACTERIZATION DATA

Site-specific characterization studies of the HMI site have been conducted, the most comprehensive of which is the Mine Tailings Radioactivity Assessment Plan (MTRAP) (CDM 1998). The MTRAP data provide information on estimated activity in borehole samples along with surface and downhole measurements of gamma radiation levels. These measurements are used to estimate the volume of materials that would exceed the site-specific DCGLs for potential site-specific options considered for this site.

4.1 RADIOLOGICAL CHARACTERIZATION STUDIES

Radionuclide concentrations can be measured using various laboratory and field methods. The concentrations of individual radionuclides can be measured in soil samples using laboratory methods that measure the energy and number of particles given off during radioactive decay. Field instrumentation is also available (e.g. field gamma spectroscopy) to quantify radionuclide concentrations; however, simple gamma radiation rate meters have proven effective as surrogates for radionuclide concentrations due to presence of radionuclides in the uranium and thorium decay series that produce an amount of gamma radiation that is easily and precisely measured by field instrumentation. Site-specific relationships can be developed between the count rate in these gamma radiation detectors and laboratory analyses of radionuclide concentrations in soil samples. This approach provides the opportunity of cost-effective, comprehensive and real-time estimates of radionuclide concentrations for natural uranium and thorium decay series that are in, or near, equilibrium.

4.2 EXISTING RADIOLOGICAL CHARACTERIZATION DATA

4.2.1 Pre-MTRAP Radiological Data

Historic radiological data collected for the site have previously been reviewed (SENES 1995). The data comprises gamma radiation surveys, including a grided survey of the Blue and Grey Areas, soil samples, and some water quality samples.

4.2.2 Prior Background Characterization

A background characterization study was conducted according to NUREG-5849 guidance as requested by NJDEP (RSI 1996). Ten initial locations were selected where surface gamma radiation levels were measured and soil samples were analyzed for Ra-226 and Th-232 activities. An additional 22 locations were sampled to meet the NUREG-5849 requirement that the mean value should be known within 20% of the mean value. The mean background concentrations reported from this study were 0.31 and 0.25 for U-238 and Th-232, respectively for a total activity of 0.56 pCi/g (U-238 + Th-238). The mean gamma radiation levels on the surface were reported at 3 μR/h (2.84 μR/h prior to rounding).

Site characterization approaches have evolved substantially since that time, specifically, in the case where multiple radionuclides are naturally present, variable, and at levels comparable to the clean-up criteria. NJDEP has requested that NUREG-1575 (i.e. MARSSIM) be referred to develop background (letter to Picco received 30 December 1998). More recently, the NJDEP has stated that NUREG-1505 may be necessary in situations where background is variable and at levels comparable to the cleanup criteria.

4.3 MTRAP CHARACTERIZATION

A radiological characterization of the site condition in 1997 has been reported by Camp Dresser & McKee (CDM, 1998). The overall approach was to establish a grid of boreholes across the site with collection of soil samples at 1 foot depth increments. A calibration between gamma radiation measurements from a flux box and radionuclide concentrations from a sub-sample of the collected samples was developed and used to estimate the sum of U-238 (Ra-226) and Th-232 activities

Volumes of contaminated material were estimated based on downhole gamma radiation logging measurements and stratigraphic observations. An overall average activity concentration of 7 pCi/g for U-238 (Ra-226) plus Th-232 was reported.

4.3.1 Summary of MTRAP Measurements

A 200 foot by 200 foot grid was established over the 126 acre area of interest and gamma radiation levels were measured at each grid intersection using NaI detectors at a height of 1 m above the surface. The gamma radiation levels ranged between 6 and 305 μR/h with a mean gamma radiation level of 38 μR/h (CDM 1998).

Subsurface characterization comprised continuous soil sampling and down-hole gamma radiation measurements at 126 boreholes advanced at selected grid locations. Soil samples were collected and the total activity of U-238 (Ra-226) and Th-232 was estimated using the gamma flux box method. The average of all estimated concentrations was about 7 pCi/g; however, there was no specific reporting of estimated activity by area of concern. Profiles of gamma radiation levels and lithography by depth were provided for selected transects of the sites.

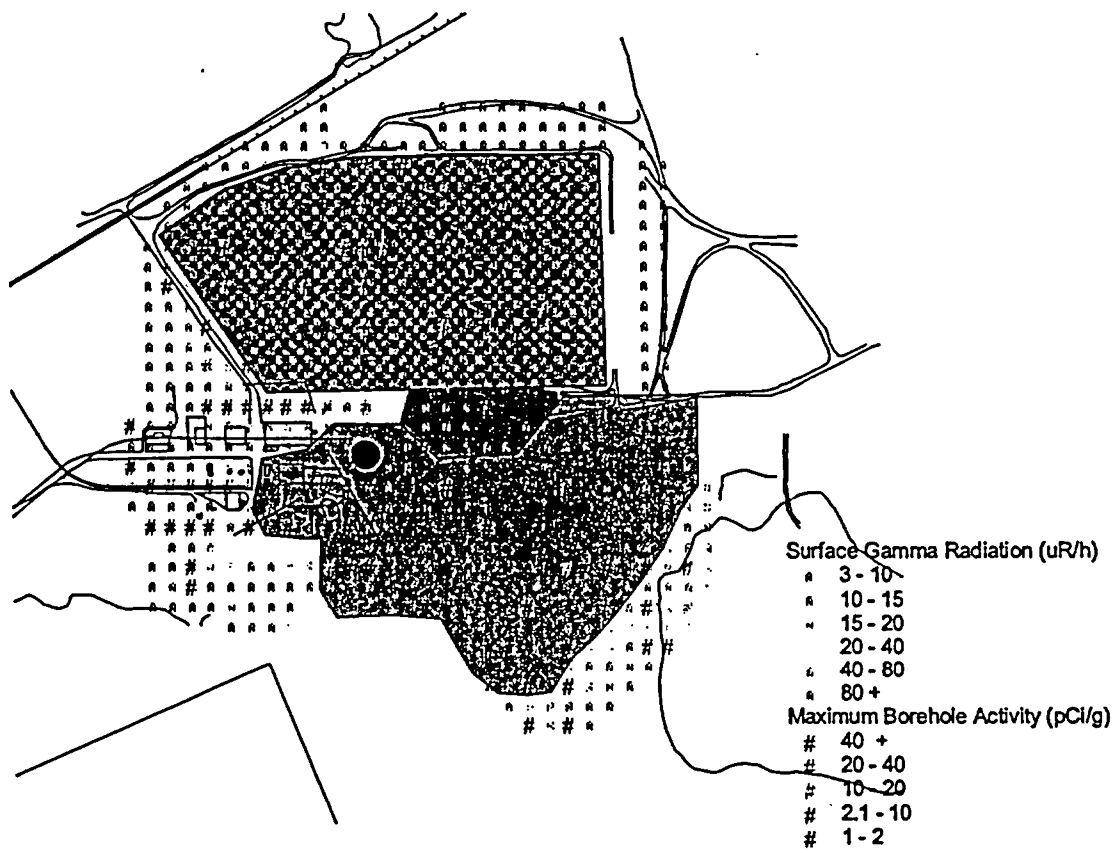
Table 4.1 summarizes the radionuclide levels measured in each area for the three main types of measurement; specifically, the surface gamma radiation measurements, the estimated (using the gamma box method) activity in borehole samples and the measured gamma radiation level down the boreholes reported as counts per minute (cpm). The data were not electronically available at the time of this report and have been manually extracted by SENES from the MTRAP report. The table includes a summary of measured (by laboratory) activities; however, these samples tended to be selected from areas of higher levels of naturally occurring radionuclides and are, therefore, not representative of the overall pattern of activity in the AOCs.

TABLE 4.1
SUMMARY OF MTRAP RADIOLOGICAL MEASUREMENTS

Parameter	Number of Obs	Mean	Median	90th Perc.	Maximum
All MTRAP measurements					
Activity (Est.) pCi/g	941	7.0	6.7	6.7	100.2
Activity (Mea.) pCi/g	72	24.4	19.2	57.0	99.0
Gamma (Borehole.) cpm	1779	7907	3394	19594	21E4
Gamma (Surface) µR/h	820	40	26	94	305
Blue Area					
Activity (Est.) pCi/g	390	9.4	6.7	16.1	100.2
Activity (Mea.) pCi/g	45	29.5	23.7	59.0	99.0
Gamma (Borehole.) cpm	679	12168	6694	26618	21E4
Gamma (Surface) µR/h	268	71	69	121	200
Grey Area					
Activity (Est.) pCi/g	234	5.8	6.7	6.7	72.2
Activity (Mea.) pCi/g	16	18.0	14.8	39.0	67.0
Gamma (Borehole.) cpm	455	5216	1742	13667	138E3
Gamma (Surface) µR/h	236	32	24	54	305
Sand Pile					
Activity (Est.) pCi/g	107	2.9	2.0	6.7	6.7
Activity (Mea.) pCi/g	1	5.5	5.5	5.5	5.5
Gamma (Borehole.) cpm	178	10134	9817	13460	18125
Gamma (Surface) µR/h	19	38	34	60	86
Mill Vicinity					
Activity (Est.) pCi/g	208	5.8	6.7	6.7	25.4
Activity (Mea.) pCi/g	10	13.5	14.2	21.3	23.0
Gamma (Borehole.) cpm	457	3505	1687	8480	29317
Gamma (Surface.) µR/h	241	18	14	36	90

Figure 4.1 shows an overview of the MTRAP radiological data along with an outline of the AOCs. The figure shows the surface gamma radiation levels and the maximum estimated activity in each of the boreholes. It is visually apparent the highest surface gamma radiation levels and borehole activity occurs in the western half of the Blue Area.

FIGURE 4.1
MTRAP MEASUREMENTS



4.3.2 Comments on Methods Used in the MTRAP Program

CDM used a calibration curve relating gamma radiation levels measured from a sample of soil placed in a controlled geometry to the radionuclide concentrations measured using laboratory gamma spectroscopy. Not all radionuclides in the uranium and thorium decay series were measured and the relationship was based on the sum of activities of one radionuclide from the uranium series and one radionuclide from the thorium decay series. This implies an assumption of equilibrium conditions in the decay series which, as previously discussed, is appropriate for the site. This approach, denoted as the "gamma box" method was used to characterize soil samples from homogeneous depth horizons in the boreholes. A number of samples with radionuclide analyses were used in developing the calibration curve and additional samples were analyzed in the laboratory for verification purposes.

The gamma box method is relatively imprecise for measurements at low levels of radionuclides; however, the gamma box method is useful for the screening level assessments of the extent and magnitude of radioactive materials and for assessing the feasibility of site-specific options. The downhole borehole gamma measurements provide a more precise characterization of radionuclide concentrations compared with the "gamma box" method since a much larger volume of soil and amount of radioactivity is being measured compared to the small volume in the "gamma box."

For this assessment, an estimate of this relationship has been developed based on soil horizons where the activity has been determined in the laboratory using gamma spectroscopy analysis and where downhole gamma radiation levels have been measured. From summarization of the MTRAP data, the average activity in these soil horizons was 25.4 pCi/g (U-238 + Th-232) and the average gamma radiation level from the borehole measurements was 27560 cpm. This implies an overall factor of 0.00092 pCi/g per cpm between borehole gamma radiation levels and activity concentration in the soil e.g.

$$\left(\frac{25.4\ pCi/g}{27560\ cpm}\right)$$

Note that use of this factor will overestimate activity levels at near background conditions due to the presence of naturally occurring potassium which typically contributes about 40% of the gamma radiation exposure rate from natural soils. For present purposes, we conservatively assume that natural potassium contributes 500 cpm to borehole gamma radiation levels. The predictive equation than becomes:

$$\text{Total Activity} = 0.00092 * (\text{CPM} - 500)$$

The equation predicts a total (U-238+ Th-232) activity concentration of 1.4 pCi/g at a count rate of 2000 cpm.

4.4 ALTERNATIVE BACKGROUND CHARACTERIZATION

4.4.1 MTRAP Study

The MTRAP assessment noted that the existing site-specific background characterization study at that time reported a mean gamma exposure level of 3 μR/h, but a consultant at the time (Max

El Tawil) had noted that the background survey did not reflect areas with naturally occurring heavy mineral sands (CDM 1998). Surface gamma radiation surveys in un-mined areas known to contain heavy minerals ranged from 5 to 7 μR/h. Additional background measurements that were collected indicated surface gamma radiation levels of 4 to 5 μR/h in one undisturbed area with natural heavy minerals and about 2 μR/h in areas without heavy mineral content. Based on the larger survey considered by El Tawil, background gamma exposure rates in areas with heavy mineral content range up to 7 μR/h or more than 2.5 times the mean exposure rates (2.8 μR/h) in the original background study. This suggests that the original site-specific background study may have underestimated the activity concentration and a more appropriate estimate of background activity (U-238 + Th-232) might be about 1.5 pCi/g (i.e. 2.5 times 0.56 pCi/g).

The MTRAP assessment used a downhole gamma radiation level of 1500 to 2000 cpm to define the vertical extent of tailings implying that this was considered the background radiation level of sub-surface soils. Using the general relationship between borehole gamma radiation levels and measured activity in the MTRAP program, this would correspond to background activity concentrations in the range of 0.9 to 1.4 pCi/g. This range of concentrations is somewhat higher than the previous background characterization and generally consistent with a potential background concentration of 1.5 pCi/g based on the surface gamma radiation measurements.

4.4.2 Background Derived From Mineral Exploration

Mineral exploration activities included an extensive borehole program to catalogue naturally occurring mineral deposits on parts of the site. The concentrations were estimated by 5-foot depth increments, and a general relationship of increasing radioactivity with increasing heavy mineral fraction was discovered. Therefore, increasing TiO_2 concentration provides a basis for quantifying natural variability in Th-232 and Ra-226 concentrations.

A regression relationship was developed based on gamma spectroscopy of soil samples and corresponding TiO_2 concentrations (SENES 1995b). The data included downhole gamma radiation measurements ranging from 1007 cpm with 1.13% TiO_2 to 2197 cpm with 3.46% TiO_2 in type "E" soils corresponding roughly to an increasing of 500 cpm per %increase in TiO_2 above 1%. For the same content, gamma radiation levels tended to be higher in finer soils: for example, the gamma radiation level for a 1.82% TiO_2 in sample from "D" soil was 2462 cpm. These measurements indicated downhole gamma radiation levels ranging above 2000 cpm in undisturbed background locations. This level is comparable to that used to define the depth of tailings in this assessment.

Bulk Estimate of Mined Material

As a crude approximation, the heavy mineral fraction at the HMI site contains about 50% TiO_2 so that the relationship with gamma radiation is about 250 cpm per % heavy minerals (i.e. heavy minerals at the site are approximately 50% TiO_2). The original ore dredged/mined from the site was nominally 5% heavy minerals; thereby implying an average gamma radiation level on the order of 3000 cpm for these materials (2000 cpm (background) + 5 x 250 cpm). Using the relationship in the MTRAP data, the average background activity concentration in the dredged/mined materials was on the order of 2 pCi/g (U-238 + Th-232). However, the use of this approach to background characterization may not be preferable since most of the radioactivity was originally located at a depth of 80 feet below the surface.

It is of note that the gamma radiation in the natural deposit previously located at the bottom of the present day lakes would be about 25000 cpm corresponding to pure heavy minerals (e.g. 250 cpm per % times 100%).

4.4.3 Formal Background Characterization

NJDEP has suggested that a formal background study based on MARSSIM technology may be required for this site. The MTRAP assessment was approved by NJDEP before the development of MARSSIM and, given the thorough understanding of the radioactivity to heavy mineral fraction ratio and their natural stability, the thorough process history knowledge, and the relatively homogeneous nature of the disposition in the soils in the various defined areas of the site, such a detailed and expensive site characterization appears unnecessary and perhaps would impose an unfair "back-fitting" requirement.

In our opinion, the existing characterization is adequate for planning the remediation approaches. A MARSSIM-type survey would be conducted as part of the verification survey once remediation has been completed.

4.5 VOLUME OF MATERIAL REQUIRING EXCAVATION

The volume of contamination depends on background concentrations developed for the site and the intended uses. In this section, we develop volume estimates for a range of background concentrations and for various DCGLs considered for the property.

4.5.1 DCGLs and Background Concentrations

The MTRAP characterization program was based on estimates of total (i.e. Th-232 + U-238) activity in the soils and measurements of gamma radiation levels. These measurements do not discriminate between Th-232 and U-238 or the individual radionuclides within the decay series. As discussed earlier, it has been considered reasonable to expect that radionuclides within the natural uranium and natural thorium decay series will have similar (i.e. in equilibrium), activity levels.

Examination of the site-specific DCGLs in the preceding chapter suggests that the DCGLs for uranium are generally higher than those for the thorium series and, hence, a DCGL for combined uranium and thorium set equal to the thorium DCGL will be conservative (i.e. protective of health) while removing the need to assess individual series concentrations. **As a result, a single DCGL for total activity is used in this report and is set equal to the DCGL for the thorium series.**

Background Concentration

It is likely that the original site-specific background concentrations of 0.56 pCi/g (U-238 + Th-232) underestimates the actual natural background concentration for locations where heavy minerals have been mined. A formal survey following current protocols has not yet been conducted to develop a more realistic (i.e. higher) background characterization. A more formal site-specific background characterization would be expected to support a background activity concentration on the order of 1.5 pCi/g (U-238 + Th-232) based on a simple analyses of gamma radiation levels measured on undisturbed areas of the HMI site containing heavy minerals. A background value of 1.5 pCi/g has been used for consideration of remediation options in this report.

At this time, a formal study to more fully define background is not necessary but could be considered if the potential cost implications of remediating what might actually be natural background levels is found to be excessive in subsequent engineering and cost studies.

DCGLs for Consideration

The "fail-safe" limiting concentration for the site is based on a 100 mrem/y dose under loss of control scenario. We consider the most pessimistic scenario to be where a basement home is built in a 9 ft (effectively infinite) thickness of elevated material with no uncontaminated surface soil. The Th-232 concentration corresponding to 100 mrem/y would be 10.2 pCi/g (see Table 3.3). This value when used for total activity would be a conservative (i.e. protective) DCGL for total activity since the U-238 DCGL for this scenario would be 14.5 pCi/g.

The DCGLs corresponding to the 15 mrem/a dose criterion are dependent on institutional (e.g. land use) controls established for the relevant portions of the site and the vertical extent of elevated concentrations.

The intended use for the development area of the site is for retirement residences and the goal is to meet NJDEP criteria for unrestricted release in the development area. For the receiving area of the site where the TENORM material would be placed and mixed, restrictions enforced by the State of New Jersey for "parkland only" status in perpetuity will be considered as an institutional control. The DCGLs for total incremental activity of Th-232 and U-238 are then given by Table 4.2 for 5 ft and 9ft vertical extent with no uncontaminated surface soil (USS). The DCGL for recreational use are based on NJDEP default values and an occupancy factor of 50 h/y (Yu *et al.* 2001). The dose factor for recreational uses is 0.106 mrem/y per pCi/g.

TABLE 4.2
REMEDIATION DCGLS

Restriction	5 ft (VE)	9 ft (VE)
Loss-of-Control (at consolidation site)	12.9	10.2
Recreational Use (at consolidation site)	141	141
Unrestricted Use (at development site)	1.9	1.5

The table indicates that the incremental concentration over a vertical extent of 5 feet can not exceed 12.9 pCi/g in order to meet the 100 mrem/y "fail-safe" criterion for loss-of-control and must be 1.9 pCi/g to meet the unrestricted release criterion. Five feet is the approximate depth of material after remediation.

4.5.2 Estimated Volumes

<u>Note</u>: *This section should not be interpreted as a formal estimate of volumes intended to support a detailed engineering and cost assessment but rather a preliminary estimate of potential volumes of soil and tailings to be remediated. These preliminary estimates are provided to assist in the preliminary evaluation of the feasibility of various remedial approaches.*

The MTRAP data has been analyzed to determine the volume of material that exceeds the DCGLs for the options considered for the site. The volumes have been estimated using the downhole data to determine the depth of material above the DCGL, the volume of this material and the average activity in the material.

In the MTRAP assessment, the vertical extent of contamination was based on the depth where down-hole gamma radiation levels were in the range of 1,500 to 2,000 cpm (CDM, 1998). Using this cutoff level of (about) 2000 cpm, based on an estimate of site-specific background radiation levels, the volumes of above-background radioactivity were calculated. For the site-specific options discussed in this report, it is not the volume of material that is "above background" which is of concern; rather, *it is the volume of material that exceeds "background" plus the DCGL.* In order to estimate these volumes using the downhole gamma radiation level it is necessary to relate activity concentrations to downhole gamma radiation levels.

The volumes of interest are calculated based on the sum of background and DCGL activity. Using the factor of 0.00092 pCi/g per cpm previously described in this report, the gamma radiation levels corresponding to activity concentrations of interest can be calculated. Table 4.3 indicates that the borehole gamma radiation levels would vary from 4196 to 16152 cpm for the dose scenario considered for the site.

TABLE 4.3
CALCULATED BOREHOLE GAMMA RADIATION LEVELS (cpm) CORRESPONDING TO REMEDIATION GOALS

DCGL (U-238 + Th-232)	Borehole Gamma Radiation Level (cpm)
1.9 (unrestricted release) for development area	4196
12.9 (loss of control) for consolidation area	16152

Notes:
Based on 5 ft Vertical Extent and 1.5 pCi/g background level.
DCGL is incremental activity above background
Borehole gamma radiation level includes background contribution.

The volumes requiring remediation for each DCGLs is based on the deepest depth in a borehole where the corresponding gamma radiation level is exceeded. Note that, in some cases, the radioactivity in a soil horizon above this level may be lower than the corresponding gamma radiation level. The depth from each borehole is then used to estimate the volume in each area of concern based on interpolation of depths from the boreholes.

Table 4.4 summarizes these volumes including the volume of material where the downhole gamma radiation level exceeds 2000 cpm for comparison against the volume estimates from the MTRAP assessment. The total volume of "above-background" material is estimated at about 930,000 yd^3 which is comparable to the MTRAP estimate of 1 million cubic yards. The volume of material that exceeds a DCGL for 5 ft vertical extent (1.9 pCi/g above background) is 690,000 yd^3 with a bounding estimate of about 310,000 yd^3 for the "fail-safe" loss-of-control scenario.

TABLE 4.4
ESTIMATED REMEDIATION VOLUMES

Area of Concern	Acreage (acres)	Average Depth (ft)	Volume (yd^3)	Average Activity (pCi/g)
Clean-up to Background (1.5 pCi/g)				
Blue Area	41.2	6.3	420,069	10.9
Grey Area	43.7	3.1	216,934	6.8
Sand Pile	4.8	15.4	119,850	8.8
Mill Vicinity	38.2	2.8	173,003	4.6
TOTAL	127.9	4.5	929,856	7.5
Lost of Control (100 mrem/y or 12.9 pCi/g)				
Blue Area	36.4	3.1	182,458	21.7
Grey Area	41.6	0.8	55,990	22.6
Sand Pile	4.8	4.1	31,615	11.0
Mill Vicinity	22.4	1.2	43,019	18.8
TOTAL	105.2	1.8	313,082	21.2
Unrestricted Release (1.9 pCi/g above background)				
Blue Area	40.9	5.1	335,220	13.7
Grey Area	43.7	2.1	149,441	9.3
Sand Pile	4.8	14.7	114,655	9.3
Mill Vicinity	28.1	2.0	91,243	8.3
TOTAL	117.5	3.6	690,558	10.6

Note:
Activity estimates include background concentrations

5.0 SITE-SPECIFIC OPTIONS

This chapter describes remediation approaches considered for the Heritage site and a qualitative evaluation of the options. The approaches are technically feasible and meet NJDEP dose criteria; however the engineering and other costs for the approaches are not known at this time.

5.1 GOALS

The goal of remediation is to reduce the levels of naturally occurring radionuclides at the site in a cost-effective manner that is protective of human health during remediation and into the future. After remediation, the site will meet NJDEP release criteria of 15 mrem/y (100 mrem/y for loss-of-control), less than 3 pCi/L incremental indoor radon and NJDEP groundwater criteria.

The intended use on the development area of the site is residential with open space uses on other areas of the HMI site. A goal is to provide site conditions suitable for these uses with no dependency on engineering controls and only minimal dependence on State imposed institutional controls.

5.2 POTENTIAL SITE-SPECIFIC OPTIONS

Two potential site-specific options have been considered for TENORM materials that exceed the DCGL for unrestricted release. Both options would leave the development area of the site suitable for unrestricted property use. These are:

- "Consolidation": Mixing and consolidating the materials containing slightly elevated levels of radionuclides onto another area of the site leaving the original location in a condition suitable for unrestricted release. These lands would be owned by one or more government entities which will have power to enforce the land use restrictions. State enforced restrictions on use would prevent construction in the consolidation area and concentrations in the material would be such that loss of State enforced institutional control would result in doses less than (<) 100 mrem/y.

- "Restoration": The material with slightly elevated levels of radionuclides would be placed on the bottom of the lakes created by dredging/mining of the original ore. This approach is consistent with returning the site to its original condition since the majority of the heavy minerals were located in a high-grade vein of ore at the bottom of these man-made lakes. The original site location would have been suitable for unrestricted property use.

5.3 AREAS AVAILABLE FOR SITE-SPECIFIC OPTIONS

The intended use of the development area is for residential slab-on-grade development. The site-specific options require that the DCGLs and dose criteria are met. Table 5.1 conceptualizes the approaches, target activity concentrations and institutional and engineering controls required for each option.

TABLE 5.1
CONCEPTUAL APPROACH TO REMEDIATION

	Intended Development Area (AOCs)	Receiving Area
Consolidation	Meets unrestricted release (1.9 pCi/g above background)	Meet dose criteria through institutional control and meet loss of control criteria (e.g. <12.9 pCi/g above background)
Restoration	Meets unrestricted release (1.9 pCi/g above background)	No controls : a return to original site condition

The receiving area across the railway tracks from the processing facility (shown schematically on Figure 2.1) is considered a potential consolidation site where materials with slightly elevated radionuclide concentrations could be consolidated and then subjected to State imposed institutional controls restricting land use to recreational open space. For example, the elevated material could be removed from the AOCs to concentrations levels appropriate for unrestricted release (i.e. 1.9 pCi/g above background). The 690,000 yd^3 of elevated material having an average concentration of 10.9 pCi/g activity (including 1.5 pCi/g background) would be consolidated (see Table 4.4 for volume and activity estimates). The concentration in the consolidated material would be lower than the concentration corresponding to 100 mrem/y in a loss-of-control scenario. Doses under the recreational use scenario would be considerably lower, 1 mrem/y, than the 15 mrem/y criterion.

The elevated material could be removed from the AOCs and placed in the bottom of the lakes where the heavy minerals were originally removed. The larger lake is on the order of 88 acres in area. Placement of all 690,000 yd^3 of material would result in a layer that was about 5 ft thick at the bottom of the 80 ft deep lake leaving a nominal water cover of about 75 feet.

5.4 EVALUATION OF SITE-SPECIFIC OPTIONS

This section outlines the considerations for evaluating the two site-specific options.

5.4.1 Technical Feasibility

The technical feasibility of the site-specific options relates to the effectiveness in meeting NJDEP unrestricted use criteria, the applicability to site conditions, and the complexity of the approach. Locations are available at the HMI site to address the TENORM material, but the complexity of the approach and the effectiveness of the options will vary.

Although the materials are relatively homogenous with respect to the source and composition, the depth and amount of mixing with sands with lower levels of naturally occurring radionuclides varies somewhat across the site. This means that options involving consolidation or mixing (under the TENORM approach) would need to consider the concentrations at a scale of individual residential lot size. While moving or mixing of soil inherently will act to average out these variations, efforts would be required during remediation and verification sampling to ensure the design concentrations were met.

In principle, placement of the TENORM material back into the bottom of the lakes would be the simplest option involving the re-pulping of the material and using a slurry approach to pump and place the materials back into the lake. This would be, in effect, a reversal of the mining procedure and would provide a significant degree of mixing.

5.4.2 Radiological Considerations

Radiological implications from radon and groundwater concerns are rendered irrelevant due to the chemical and physical characteristics of the heavy minerals. Radiological doses arise from external gamma radiation exposures and inhalation.

The radiological implications of simply mixing the materials and consolidating based on a TENORM strategy would result in an estimated dose of 1 mrem/y, which is substantially below the 15 mrem/y dose criteria under the recreational use scenario while limiting doses to 100 mrem/y under a loss-of-control scenario.

Placement of all the TENORM material into the bottom of lakes would reduce the incremental radiation dose to zero since the radioactivity in the TENORM material would be returned to its original place in nature. There would be no external gamma radiation from this material or inhalation due to its isolation, and the material is insoluble so no radioactive dose from groundwater or the ingestion pathway would arise from this option. This should not be considered an engineering control or institutional control since the material has been returned to its original place in nature essentially in the same form and with a lower concentration of heavy minerals, including monazite and its contained naturally occurring radionuclides. The levels of naturally occurring radionuclides in this location will actually be lower than concentrations present prior to dredging/mining activities.

5.4.3 Regulatory and Public Acceptance

These site-specific options are desirable in that the material is TENORM and was not brought onto the site.

There may be some resistance to the option of returning the material to the bottom of the lakes where it originated due to sensitivity of the public regarding perceived groundwater contamination. The insolubility of these materials and lack of elevated radionuclide concentrations in groundwater even though heavy minerals are present in the local area indicate that this is not a scientific or technical issue.

5.4.4 Costs

Based on our assessment, both site-specific options discussed above are likely able to the meet the NJDEP criteria; however, the cost implications of these options may vary substantially. In order to arrive at a final proposal, it is recommended that engineering cost estimates be developed for each site-specific option, including the costs for characterization and final status survey requirements.

5.5 SUMMARY

Table 5.2 summarizes the two site-specific options. The restoration option involving the placement of the TENORM materials at the bottom of the lakes appears to be the preferred approach from a radiological dose, a technical feasibility, and a potential site impact standpoint.

TABLE 5.2
COMPARISON OF REMEDIATION OPTIONS

	Controls Required	Radiation Dose	Site Impact
Consolidation	Institutional Control (recreational use)	<15 mrem/a	Only Institutional controls for Open Space Area
Restoration (Placement in Lake Bottom)	None	Nil	Nil

6.0 DISCUSSION/CONCLUSIONS/RECOMMENDATIONS

6.1 SUMMARY OF PRELIMINARY INVESTIGATIONS

The materials containing slightly elevated levels of naturally occurring radionuclides at the HMI site is TENORM arising from the dredging/mining and processing of heavy mineral sands containing naturally occurring radionuclides. The material has physical and chemical characteristics that are site-specific relative to consideration for DCGLs and site-specific options.

- The U-238 and Th-232 decay series are considered to be in secular equilibrium due to the insolubility of heavy minerals and the lack of chemical processes during mining activities.

- Radon emanation from heavy minerals is much lower than from ordinary materials. With a conservative estimate of 90% lower, a site-specific relationship of 0.15 pC/L per pCi/g can be used rather than the default NJDEP value of 1.5 pCi/L per pCi/g. Radon is not a concern when addressing the TENORM material at the HMI site.

Site-specific DCGLs were calculated for this site based on the physical and chemical properties of heavy minerals; specifically, the insolubility of heavy minerals in natural environments.

- Doses from the groundwater and ingestion pathways are rendered irrelevant based on the insolubility of heavy minerals (a site-specific factor).

- A DCGL for total (U-238 plus Th-232) activity can be used for this site with the DCGL based on Th-232 activity. This is conservative since U-238 has a higher, albeit similar, DCGL compared with Th-232 and facilitates the use of total activity for planning and implementation of a site-specific option.

Preliminary volume and activity estimates have been determined using downhole gamma radiation readings measured as part of the MTRAP program rather than using the gamma flux box measurements. Using these volume estimates, two general site-specific options were considered including: i) above-ground consolidation using institutional controls; and, ii) restoration through placement in the lake bottom where the majority of the heavy mineral materials were originally located.

A qualitative assessment identifies placement in the bottom of the lakes as the preferred approach due to lower radiological dose, no requirement for institutional or engineering controls and lack of technical complexity.

6.2 STEPS FORWARD

The unit costs for the above-mentioned site-specific options should be evaluated in order to compare their cost-effectiveness and to determine the sensitivity of cost to background levels. For example, options such as placement of elevated material in the lake bottom may be less sensitive to background levels than options involving consolidation and mixing.

The existing site-specific background characterization likely underestimates background radioactivity levels that are appropriate for this site and a value of 1.5 pCi/g (U-238 plus Th-232) has been used in this report.

Final verification and, potentially, refinements to these site-specific options may require a MARSSIM-like approach to reflect the natural variation in radioactivity present at sites, like the HMI site, that contain heavy minerals.

The relationship between downhole gamma radiation levels and activity concentrations should be formalized since this provides a more precise estimate of *in situ*, and present, activity concentrations than the gamma box method.

Final verification studies would likely be designed with a MARSSIM-like approach to provide confidence in a cost-effective and scientifically defensible manner that the proposed site-specific option(s) actually accomplishes the intended objective.

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APPENDIX A

SUPPORTING QUALIFICATIONS

DOUGLAS B. CHAMBERS

Vice-President, Director of Radioactivity and Risk Studies

EDUCATION

B.Sc. (Honours), Physics, 1968, University of Waterloo (University of Waterloo Tuition Scholarship)
Ph.D., Physics, 1973, McMaster University (National Research Council Science Scholarship)
Two Sessions at the Advanced School for Statistical Mechanics and Thermodynamics, University of Texas, Austin, 1970 and 1971
Air Pollution Diffusion, U.S. EPA, Research Triangle Park, 1974
Annual Health Physics Course, Chalk River Nuclear Laboratories, 1974
Observations on Human Populations, School of Hygiene, University of Toronto, 1979

PROFESSIONAL AFFILIATIONS

Advisory Committee on Radiation Protection (1993 to 2002 - committee advises the Canadian Nuclear Safety Commission on matters concerning radiation protection)
American Nuclear Society
Canadian Standards Association, Member of Technical Committee on Environmental Radiation Protection (1978 to 1994, Chairman 1987 to 1994)
Canadian Standards Association, Member of Technical Committee on Risk Analysis (1989 to present)
Canadian Radiation Protection Association
Health Physics Society (U.S.)
Society for Risk Analysis (U.S.)
U.S. National Council on Radiation Protection and Measurements, Scientific Committee 85 on Risk of Lung Cancer from Radon (1991 to date)
United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), Member 1998 to date, Canadian delegation
Consultant to UNSCEAR for preparation of "Sources-to-Effect Assessment of Radon in Homes and Workplaces".

AWARDS

1997 W.B. Lewis Award (Canadian Nuclear Association) for achievements in environmental radioactivity.

2002 Health Physics Society.
Morgan Lecturer
"Perspectives on Radioactive Waste Management in Canada. Joint Midyear Meeting. Orlando, February 2002.

EXPERIENCE

1980 to date - SENES Consultants Limited
Vice-President and Director of Risk and Radioactivity Studies. Technical responsibilities include management and technical direction of multi-disciplinary studies including: human health risk assessments; radioactivity exposure evaluations; environment impact assessments; environmental pathways and dose assessments; air dispersion modelling studies of radon and dense/reactive gases; ecological risk assessments; mine waste management; geochemical modelling assessments; low-level radioactive waste management; and risk (cost) - benefit analyses.

Dr. Chambers has contributed to the development of, and made extensive use of the methods of uncertainty analysis for: exposure pathways analysis; dose reconstruction and epidemiological investigations; risk assessments; and application of environmental statistics. While at SENES, Dr. Chambers has directed or contributed to more than 300 projects, examples of which are given below.

Human Health Risk Assessment - Numerous studies including: risks from exposure to radon; investigations into harmonization of cancer and non-cancer risk; integrating quality of life issues in cost-benefit analyses; studies of the effect of uncertainty in exposure (dose) on the feasibility of epidemiological investigations, pharmacokinetic modelling and toxicological assessments of uranium, arsenic and other toxins; and evaluation of the risks associated with nickel in soils at contaminated sites proximate to nickel production facilities.

Risk assessments performed under Dr. Chambers' direction include evaluation of risks from: naturally occurring radioactivity in phosphogypsum arising from use in agriculture and road construction; radioactivity, and various metals in drinking water; reuse of industrial contaminated sites; incineration of municipal wastes and accidental release of chlorine from waste water treatment facilities. Other projects include: LNG storage facility; blood mercury levels and water level regulation in respect to low-head hydro projects; release of volatile organics from waste water treatment plant; risks for alternative uses of sewage sludge; and exposure to fugitive dust emissions from mining, municipal, radioactive and hazardous waste management activities.

Ecological Risk Assessment - Dr. Chambers has played a key role in the development of ecological risk assessment methodologies for mining regions in northern Saskatchewan and northern Ontario, and in support of decontamination planning for contaminated industrial sites. Dr. Chambers also completed an ecological risk assessment for the use of slag from refining operations as construction fill. He has directed numerous risk assessments for industrial contaminated sites.

Environmental Assessment – Numerous, assessments including: the preparation of an environmental impact statement for the decommissioning of uranium tailings facilities in Ontario and northern Saskatchewan, the United States and elsewhere; and a risk (cost) - benefit analysis for the reclamation of an *in situ* leach property in Texas. Dr. Chambers has also contributed to environmental assessments of nuclear power plants, thermal power plants and other industrial and mining facilities.

Facility Risk Assessment – Dr. Chambers has been involved in numerous facility risk assessments involving petrochemicals, ammonia, uranium hexafluroide, and chlorine amongst others. He has supervised a number of transportation risk studies involving petrochemicals, acids, radioactive waste, sludge and ore slurry. He has also been involved in a health and safety risk analysis for oxygen and nitrogen pipelines. These projects have been conducted in Ontario, British Columbia, Saskatchewan, South Africa and Trinidad.

Geochemical Modelling and Assessment - Dr. Chambers is active in the development and application of geochemical models for evaluation of management options for mine waste rock and tailings. He was a senior scientist in a multi-disciplinary study team assisting the Federal German Environment Ministry with the decommissioning of uranium mining and processing sites in Saxonia and Thüringia, where geochemical modelling was employed to perform a comparative evaluation of rehabilitation options for multiple surface waste rock heaps, including evaluation of specific criteria for relocation of waste rock to a large open pit mine, and geochemical simulation of the backfilled pit as well as the flooding of the entire mining area. Other geochemical assessments include evaluation of alternatives for reducing acid generation of mine waste heaps in South Africa.

Radioactivity - Director or senior health physics advisor for numerous studies pertaining to radiation protection including: dose reconstruction and epidemiologic analyses of persons exposed to elevated radon progeny concentrations including residents of Port Hope Ontario and uranium miners of Beaverlodge, Port Radium and Colorado Plateau; reconstruction of environmental exposures and doses from radioactive contaminated sites, decommissioning of uranium and thorium facilities; review of thorium metabolism data; and uranium biokinetic models; development of decommissioning criteria and guidelines; assessment of the potential risks from naturally occurring radioactivity (NORM);dose assessment and the development of health and safety practices for uranium mine workers; and the application of the ALARA optimization principal.

Remedial Actions and Decommissioning - Directed and participated in numerous decommissioning and remedial action programs for NORM (naturally occurring radioactive material) wastes and low-level radioactive waste (LLRW) management sites, uranium mining facilities in Canada, United States and overseas. Dr. Chambers directed conceptual design studies for disposal of LLRW in near-surface facilities and engineered underground caverns. He also directed a study to investigate the technical and economic feasibility of a commercial LLRW facility in Canada.

Air Quality Assessment - Provided technical direction to atmospheric dispersion studies involving dense/reactive gases such as ammonia, chlorine, anhydrous hydrogen fluoride and N_2/O_2 and uranium hexafluoride releases. Dr. Chambers developed a detailed physical/chemical model for the release, atmospheric transport and deposition of uranium hexafluoride for an accident at a uranium hexafluoride facility in Gore Oklahoma. He has carried out numerous site-specific modelling studies of thermal power stations, numerical air quality modelling for complex terrain, calibration/verification studies, and development of long-range transport models.

1973-1980 - James F. MacLaren Limited

General Manager, Nuclear Projects Division from 1977 to 1980. Responsible for the development of the firm's capabilities in environmental radioactivity and radiation protection. Project Manager for the Air Environment Division from 1973 to 1977.

Environmental specialist on matters pertaining to the air environment and/or radioactivity on numerous environmental impact assessments across Canada and internationally.

Specialist input to the development, implementation and interpretation of results from air quality and meteorological surveys, air dispersion analyses and noise assessments at several types of industrial projects at locations across Canada. Developed a meteorological control system for large oil fired power plant in New Brunswick.

Project scientists for the development of national inventory of sources, emissions and environmental fate of mercury, lead and beryllium and asbestos.

TECHNICAL PAPERS AND PRESENTATIONS

More than 100 technical papers, reports publications and presentations (list available upon request). He has also presented seminars and workshops on a variety of topics, in Canada, the United States, Europe, South America and Africa.

RONALD H. STAGER

Senior Environmental Statistician/Engineer

Education

M.Math, Statistics, 1987, University of Waterloo
B.Sc.(Eng), Agricultural Engineering, 1979,
University of Guelph

Member of Professional Engineers of Ontario

Experience

1989-date - SENES Consultants Limited

Senior Environmental engineer and statistician specializing in environmental statistics, risk assessment, radiation studies, solid waste quantification and characterization, and dispersion modelling.

Environmental Statistics - Provides technical advice on statistical analysis and database management for a large variety of environmental studies. Major contributor to several projects requiring specialized statistical analyses of environmental data. Provides clients and professional journals with scientific peer review for environmental sampling plans, statistical methodology, and data quality.

Development and testing of statistical methods for predicting source strength and spatial location of contaminants using non-intrusive measurements for an ongoing internationally-funded scientific program.

Performed multivariate analyses on several environmental data sets including precipitation chemistry, radioactivity, soil sampling of polyaromatic hydrocarbons, background surface water quality, effluent discharges, and solid waste composition data. Fit nonlinear statistical leachate models to test cell data.

Managed and analyzed relational databases with more than 100,000 records and analyzed datasets with more than one million observations. Modified geographic information system (GIS) data files for enhanced graphical presentation. Applied GIS methodology and geostatistical techniques to risk assessments and site characterizations. Developed spatial statistics approaches for detection of small elevations above temporally and spatially variable background levels.

Produced probability distributions for use in probabilistic analyses. Acquired data, reviewed data quality, selected empirical models, and provided mathematical fits to data. Developed and enhanced methodologies for the incorporation of below detection limit observations.

Risk Assessment - Programmed computer models to predict health effects resulting from exposure to biological microbes, chemicals and radionuclides. Developed and evaluated bio-kinetic models to relate excretion to likely intake of contaminants. Developed life table models to quantify the social and health impacts of risk.

Developed a computerized interface between air dispersion models and database files containing source characteristics, geographic attributes, population data, emission profiles and meteorological data and incorporate pathways algorithms to estimate dose and risk.

Radiological Characterization and Remediation

Designed, implemented and interpreted radiological characterization programs in support of remediation plans for properties contaminated with radioactivity um. These programs used automated collection of gamma radiation data incorporating GPS-based systems with database management and automated analysis and mapping using GIS (Arcview) software. Designed remediation programs and verification surveys.

Provided comments and assessed implications of draft Multi-agency Radiation Survey and Site Investigation Manual (MARSSIM) for a mining association and advised private companies on implementation strategies. Developed statistical methods to improve the detection limits for measurement of radon, detection of discrete and diffuse sources of contamination and an automated system to separate soils on the basis of radiological contamination levels.

Reviewed occupational exposure measurements to assess the implications of new regulations on uranium fuel cycle operations and lead researcher for retrospective analyses of exposures for a major epidemiological study. Provided external review of environmental radiation monitoring programs. Conducted pathways modelling for development of allowable releases from nuclear facilities.

Solid Waste Characterization and Quantification - Major contributor to a study of waste generated in a major metropolitan municipality. This project involved a statistical sample selection from defined sectors of waste generation and the projection of sample results to totals for the municipality. Waste generation rates for more than 20 sectors and more than 40 types of waste were calculated.

Participant in studies of packaging wastes, paper wastes and solid waste incineration. Investigated and compared methodologies of quantification and characterization of solid waste with respect to monitoring compliance with reduction guidelines.

Dispersion Modelling - Participated in several studies to model the effluent plumes arising from releases to receiving waters. These projects included both river and lake discharges from municipal and mining effluent treatment facilities. Assessed the compliance of modelled plumes with respect to water quality objectives for the local jurisdiction. Provided conceptual design on the placement and outlet configuration for proposed developments. Assessed the assimilative capacity of receiving waters for a number of projects.

Conducted sensitivity analyses on the effects of uncertainty in emission characteristics and meteorological conditions on predicted concentrations from air dispersion models. Performed probabilistic analyses to estimate deposition arising from an accidental release. Related predicted airborne deposition patterns to observed soil concentrations.

1987-1989 - ACN Nielsen Company of Canada

Research statistician participating in electronic measurement of television viewing. Responsible for the selection and maintenance of a national sample of households, the calculation of universe estimates, and statistical analyses. Specific duties included; supervision of enumeration and recruitment procedures utilized by field staff, documentation of methodologies for audit requirements, presentation of survey techniques to industry technical committees and field personnel in information and training seminars, and liaison with Statistics Canada for acquisition of electronic data from census, household facilities, and labor force surveys in raw form as well as special analyses.

1983 - Coquitlam River Salmonid Enhancement Project

Provided engineering and supervisory support for an enhancement program on a depleted salmonid river system. Consultation with governmental experts and project team members included investigation and recommendations for control of sediment pollution sources; hydrological characterization of river system; design and supervision of habitat enhancements through flow control structures and placement of gravel for spawning beds; and supervision of the fabrication and operation of traps for biological sampling of salmonid populations.

1981-1982 - Canadian Bio Resources Engineering

Engineer-in-Training participating in environmental studies, water and sewer services, soil and drainage studies, and computer analyses.

Investigated the effects of construction of the proposed B.C. Hydro Site C dam on downstream water quality. Collected meteorological data for the site, programmed a computer model and conducted a sensitivity analysis on the effect of reservoir operation and meteorological parameters. Validated the model with pre- and post-construction data from a similar existing reservoir.

Participant in a study of the transport of diffuse source contaminants in the Okanagan Basin. Data on the depth of aquifers and soil types in study area were collected and a complete survey of agricultural, municipal, and industrial sources of contaminants in the basin was performed. A computer model was developed to predict the quantity of contaminants reaching receiving waters. Sensitivity analyses, model validation, and documentation were also completed.

Design and supervision of water supply and sewer services. Prepared innovative site-specific designs in order to comply with environmental concerns including constructed septic fields and peak-averaging systems. Managed projects requiring design specifications, permit compliance, tendering of bids, and supervision of work. Designed and applied for permits for the modification of natural habitat for the development of recreational areas. Designed drainage and soil placement for playing fields.

1980 - Schlumberger of Canada Limited

Junior Engineer responsible for maintenance and operation of data logging equipment in the petroleum industry in northwestern Alberta. Interpreted radioactivity and sonic well logs as well as performed production services.

Technical Papers and Presentations

Author of journal articles, technical papers and presentations on development of statistical methodology for characterization studies, risk from occupational exposures, data quality improvement, and the effect of uncertainty on epidemiological studies.

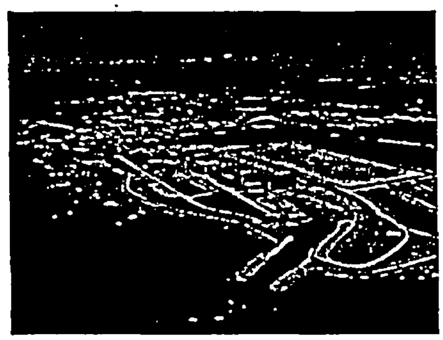
SENES Consultants Limited

SELECTED RADIOACTIVITY EXPERIENCE

SENES, an acronym for Specialists in Energy, Nuclear and Environmental Sciences, is a wholly Canadian-owned company incorporated in Ontario in 1980. SENES provides leading-edge environmental services for industrial, commercial, governmental, and public interest groups on a broad spectrum of projects. Since formation in 1980, SENES has participated in over 3,000 projects throughout North America, as well as in the Caribbean, South America, Australia, Asia, Africa and Europe. SENES has its main office in the Greater Toronto Area (Richmond Hill) with branch offices in Ottawa, Ontario and Vancouver, British Columbia. SENES has established four other companies including: Decommissioning Consulting Services Limited in Richmond Hill; SENES Oak Ridge Inc., Center for Risk Analysis in Tennessee, U.S.A.; SENES Chile; and SENES India - to provide additional services in selected specialized areas. Clients can take advantage of the working relationships among SENES and its affiliated companies to access the outstanding technical and scientific capabilities offered by each company.

SENES provides environmental services across a wide range of sectors, and specializes in work related to radioactivity. Since the firms inception, SENES has carried out more than 1500 radiation related projects, ranging from personal service efforts including the provision of individual expert support and advice or peer review, through to full scale multi-discipline development and cleanup projects. In the course of these projects our clients have included uranium mining companies, uranium refineries, fuel fabrication facilities, nuclear power plants laboratories, numerous industrial clients, industry associations and federal and international agencies and regulators. To these clients, SENES provides expertise in:

- health physics;
- environmental assessment;
- air and water quality assessment and modelling;
- environmental audits and liability assessments;
- radioactive and hazardous waste management;
- development of remedial action plans;
- decommissioning and closure; and
- human health and ecological risk assessment and management.



The focus of this selective summary is to provide a cross section of typical projects illustrating our experience on issues related to radioactivity.

- Ecological Risk Assessment
- Risk Assessment
- Closeout, Decommissioning and Reclamation
- Environmental Assessment
- NORM
- Radiological Surveys

We would be pleased to answer any enquiries and can be contacted at the address below. Additional information is available through visiting our web site at http://www.senes.on.ca

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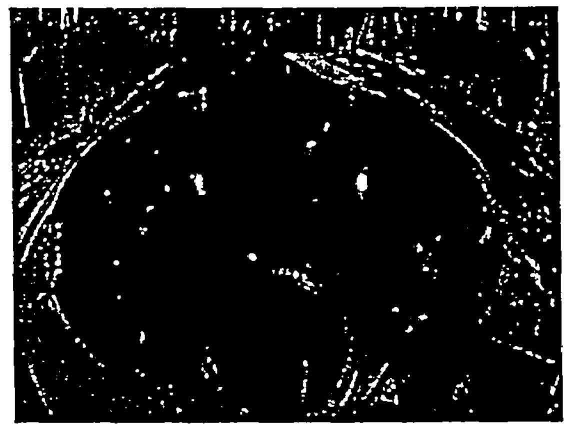
ECOLOGICAL RISK ASSESSMENT

PICKERING NUCLEAR GENERATING STATION ECOLOGICAL RISK ASSESSMENT

Building on a previous "Environmental Review" of the Pickering Nuclear Generating Station (PNGS) conducted by SENES, a Tier I Ecological Risk Assessment was undertaken. Relevant information was extracted from the Environmental Review report and the various findings were integrated using ERA methodology to identify key effects and potential risks of PNGS operations on ecosystem components of concern at the PN site. The study, which focused on the ecological effects of both radioactive and chemical contaminants, considered the diverse urban, industrial and natural environment of the PNGS site. Following from the Tier I assessment, SENES marshalled an international, multi-disciplinary team for the PNGS Tier II. Study components identified during Tier I as requiring additional examination were examined including: obtaining additional data; modelling groundwater and surface water interaction; studying contaminant levels in indicator organisms; and refining the environmental compartment modelling.
(Ontario Power Generation)

BLIND RIVER AND PORT HOPE ECOLOGICAL RISK ASSESSMENT

A multi-tiered assessment was completed as part of an environmental effects monitoring study at the Cameco Port Hope and Blind River facilities. Environmental media considered included: air, surface water, sediment, groundwater and soil. Air modeling of current emissions was used to estimate air concentrations at locations of maximum exposure and to study the long-term impacts of deposition from air on soil concentrations. Pathways analysis, exposure assessment (including food chain effects) and risk analysis were completed. Aquatic and terrestrial non-human biota were assessed. *(Cameco Corporation)*



BRUCE NUCLEAR GENERATING STATION ECOLOGICAL RISK ASSESSMENT

An ecological risk assessment was carried out in support of an environmental assessment of the proposed expansion of the Radioactive Waste Operations Site 2 (RWOS2) at the Bruce Nuclear Power Development. Ecological receptors included fish, amphibians, benthic invertebrates, aquatic plants, terrestrial plants, terrestrial invertebrates, birds and mammals. The assessment considered only radiation dose from anthropogenic radiation sources. The Tier 1 assessment indicated that some receptors had screening indices greater than 1 and therefore a Tier 2 analysis was carried out. The Tier 2 analysis found that the doses to all receptors were acceptable. *(Ontario Power Generation)*

PORT RADIUM MINE– SITE, HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT, DECOMMISSIONING PLANNING

SENES carried out a series of initiatives over several years in association with the assessment of potential environmental and human health concerns surrounding the Port Radium mine, located on the north-eastern shore of Great Bear Lake approximately 4 degrees south of the Arctic

Circle. Activities included participation in an Experts Workshop with the community of Déline to establish a framework for collaborative efforts between the Government of Canada and the Dene Nation, and conducting several site assessments carried out for the Department of Indian Affairs and Northern Development (DIAND) and the Canadian Déline Uranium Table (CDUT) to identify the environmental status and conditions at the site.

The preliminary site efforts included compilation and review of existing data, interviews with former operators and related parties, and design and implementation of a winter field program to gather site-specific information. The winter program, carried out in association with the community of Déline collected water, waste rock, and tailings samples, set radiation monitors, and gathered site wide gamma radiation measurements. Results of the program were combined in a report that identified site conditions, provided a discussion of potential hazards and risks, summarized existing information and data gaps, commented on potential decommissioning requirements, and presented action recommendations to support the development of future full-scale site assessment of potential human health or ecological risks.

Subsequently, as a first part of a Three Year Action Plan developed by the CDUT, SENES was retained to carry out a more detailed site assessment program to further refine the assessment of potential human health and environmental issues. . The project included additional characterization and delineation of contaminant sources, further definition of site conditions and pathways through a field program that included water sampling, tailings and waste rock sampling, geophysical (ground penetrating radar) measurements, air sampling, radiation measurements and monitoring, local biota sampling, and surveying of site topographic features for future mapping. A site-specific risk assessment framework was used to guide the development of a quantitative screening level human health and ecological risk assessment for the site and decommissioning options and alternatives were identified and assessed for future consideration. As with the first program, the project was carried out in association with the community of Déline. Based on the findings of these programs SENES developed a quantitative human health and ecological risk assessment for the site and several decommissioning options for consideration by DIAND and the CDUT.

ECOLOGICAL RISK ASSESSMENT OF URANIUM MINING IN NORTHERN SASKATCHEWAN

In the first phase of this two phase study, a screening level ecological risk analysis was performed to examine the potential risks posed by uranium mining in the McArthur River region in northern Saskatchewan. The probable responses of populations of eight aquatic and seven terrestrial "valued ecosystem components" (VECs) were evaluated in relation to expected exposures to twenty-three potential contaminants (including radionuclides, metals and other physical and chemical parameters). The results of the screening level assessment were used to: (1) identify the contaminants that appear to pose no direct threat to the VECs of interest; and (2) point out the combinations of populations and contaminants that should possibly by examined in greater detail because of the potential for ecological impact. In the second phase of this study, a more detailed assessment was performed for caribou and wolf exposure to seven potential contaminants (including radionuclides and metals). A detailed computer simulation employing environmental transfer and uptake models and quantitative uncertainty analysis was performed. *(Cameco Corporation)*

Human Health and Ecological Risk Analysis for the Clinch River Environmental Restoration Program

In the Remedial Investigation/Feasibility Study for the Clinch River/Poplar Creek Operable Unit, SENES participated in the human health risk assessment for this major Superfund site. The studies involved risk assessments and remedial investigations of the off-site release of contaminants from the Oak Ridge Facilities, including the Oak Ridge National Laboratory, the former Gaseous Diffusion Plant (K-25), and the Weapons Production Plant (Y-12). *SENES* was responsible for reviewing the entire report and providing advice for the conduct of the human health risk assessment. In addition, SENES conducted the uncertainty analysis for the human health risk assessment and was responsible for the radiological dose calculations for the terrestrial and aquatic biota and for predicting the ecological effects from the calculated doses. Human health and ecological risk assessments were conducted for the contaminants of concern, including both organic compounds and heavy metals. This project involved QA/QC for the collection and analysis of data. (*Lockheed Martin Energy Systems*)

Conceptual Risk Assessment for Rhone River, France

As part of a public review process, expert reviews of a series of detailed radioecological monitoring reports were undertaken for a French government nuclear agency and a local commission of the "département du Gard". The rigour of conclusions and supporting arguments provided in the reports, as well as the adequacy of the sampling program undertaken and the methodology taken were reviewed and evaluated.

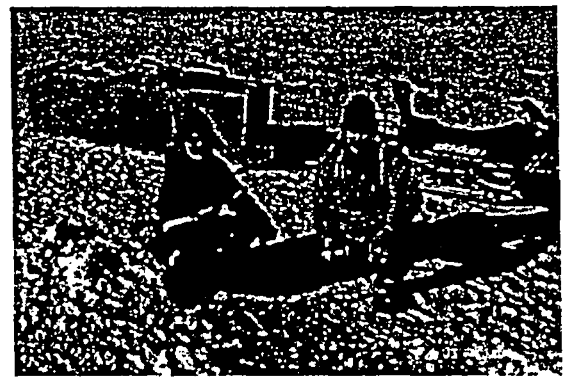
The reports consist of results and interpretations of radioecological monitoring programs on the levels of various artificial radionuclides encountered in aquatic and terrestrial compartments released from a large nuclear complex located in the southern part of France. This nuclear complex includes: a fuel reprocessing facility, a fast-breeder reactor (phénix), military related reactors, as well as other nuclear supporting facilities. The reports include various measurements of fission products (e.g., ^{137}Cs, ^{134}Cs, ^{106}Rh+Ru), activation products (e.g., ^{60}Co, ^{58}Co, ^{54}Mn), transuranics (e.g. ^{241}Am, $^{239/240}Pu$, ^{238}Pu), and tritium in aquatic indicators (surface and underground water, aquatic vegetation, fish species and sediments) and terrestrial indicators (soil and terrestrial vegetation), but also in some food chain products (milk, wine, grapes and fish). One of these reports specifically addressed levels of tritium in leaves resulting from atmospheric emissions of tritium.

Ecological Risk Assessment of High Level Nuclear Wastes

A review of Canada's nuclear waste disposal concept, as developed by Atomic Energy of Canada Limited (AECL), was conducted on behalf of Environment Canada on aspects related to the natural environment. Independent ecological risk assessment calculations were performed for both the pre-closure and the post-closure phases of the disposal concept. Scoping calculations were carried out to evaluate the impacts of habitat loss and radiation dose rates within a synthetic reference environment representing a hypothetical location in the Canadian Shield. Population level endpoints were considered for both moose and brook trout. The results indicated that radiation effects associated with normal facility operation would not be measurable at the population level. *(Environment Canada)*

Human Health and Ecological Risk Assessment for Decommissioning a Uranium Mine

This study involved predicting the release of radionuclides from the flooded tailings using the Uranium Tailings Assessment Program (UTAP.3w). The UTAP model, developed by SENES, contains a comprehensive source term that models the long term geochemical reactions within a sulphidic uranium mill tailings environment. The detailed probabilistic modelling of radionuclides and metals through the environment and the potential uptake by humans and aquatic and terrestrial receptors was evaluated using the INTAKE model. INTAKE an in-house model also developed by SENES, for simulating environmental transfer and risk. Ecological receptors were selected from each trophic level for the assessment. Potential exposures were then compared to the applicable toxicity data and the possible combinations of receptors and contaminants of concern were identified. *(Rio Algom Ltd.)*



RISK ASSESSMENT

AGRICULTURAL AND ROAD CONSTRUCTION USES OF PHOSPHOGYPSUM CONTAINING RA-226

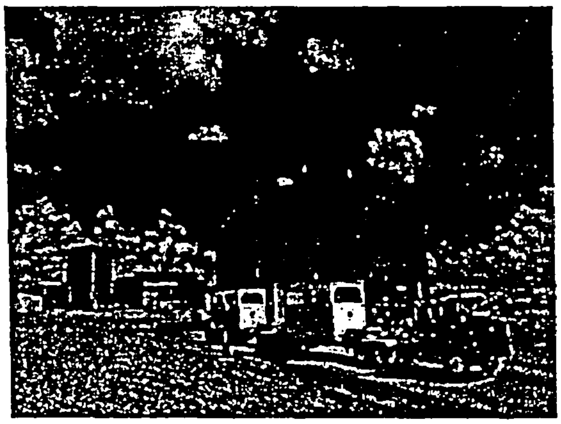
SENES prepared a dose and risk assessment of potential impacts on workers and members of the public from agricultural and road construction uses of phosphogypsum (a by-product of phosphate production for fertilizer) in Florida. Phosphogypsum from central Florida contains an average of 26 pCi/g Ra-226 and some of its uses are prohibited by the United States Environmental Protection Agency. Screening calculations of several exposure pathways (external gamma radiation, radon progeny, inhalation of dust, and ingestion of dust, garden produce and animal products) were made to identify those pathways which resulted in the highest risk and required detailed assessment. Probabilistic methods were used to more accurately estimate the distributions of potential dose and lifetime risk from exposures to external gamma radiation and radon progeny and to compare them to regulatory criteria. (*Florida Institute of Phosphate Research*)

NATIONAL URANIUM TAILINGS PROGRAM (NUTP)

In the 1980s, SENES undertook the study for the NUTP to assess the role of bacteria in the oxidation of pyritic uranium tailings. The study included a critical evaluation of the literature to identify deficiencies and to make recommendations for additional work. Factors which affect the rate of bacteria-assisted oxidation of pyritic material include: the geochemistry and reactivity of the pyritic material; the amount of pyrite present in the waste material and the exposed surface area of the pyritic component; the availability of oxygen which is the principal electron acceptor; the availability of carbon dioxide which is the sole source of carbon for the strictly chemolithotrophic bacteria of interest; the pH of the leach solution (e.g. tailings porewater); the temperature of the leach solution (e.g. tailings porewater); and presence (or absence) of organic inhibitors. Of the above factors, oxygen has been frequently identified as the rate limiting reactant in tailings. The implications of close-out concepts to limit oxygen accessibility to the tailings were also evaluated. *(Energy Mines and Resources Canada; now Natural Resources Canada)*

HUMAN HEALTH RISK ASSESSMENTS FOR URANIUM MINING

Human health risk assessments were performed to examine the potential exposures of nearby residents to radionuclides due to uranium mining in northern Saskatchewan and northern Ontario and to background sources of radiation. Environmental pathways analysis were performed to assess radionuclide movement through the environment to humans. The INTAKE model used for this assessment, developed through and applied to numerous previous projects and applications spanning more than a decade, traditionally evaluates incremental doses. The model was adapted to allow for the evaluation of background exposures and total doses (i.e. including background levels of radiation). The INTAKE model is set up within a probabilistic framework incorporating uncertainty and natural variability of model parameters into the calculations. *(Amok/Cluff Mining, Cameco Corporation, Denison Mines Limited, Minatco Limited, Midwest Joint Venture, Rio Algom Limited)*



ACLs FOR URANIUM TAILINGS PILE

Homestake Mining Company of California was decommissioning its uranium tailings pile at Grants, New Mexico. After corrective actions have been terminated, uranium, selenium and molybdenum concentrations in groundwater were expected to exceed drinking water criteria. Therefore, Homestake applied for alternate concentration limits (ACLs) for these three metals in groundwater to the Nuclear Regulatory Commission. In support of the application, Homestake prepared a risk assessment that described the expected movement of the metals from the tailings pile into the surrounding groundwater, the potential exposures to nearby residents from ingestion of drinking water and from irrigation of foodstuffs and the potential toxic impact. The assessment also addressed alternate corrective actions, corresponding alternate concentration limits and demonstrated that the recommended limits were as low as reasonable achievable considering other social and economic factors. SENES played a key role in organizing the structure of the assessment and in developing details of the pathways, exposure and toxicity analyses. *(Homestake Mining Company of California)*

EVALUATION OF UF_6 RELEASES

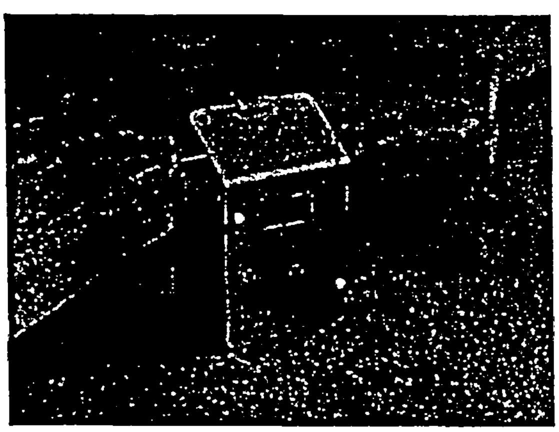
SENES evaluated the usefulness and effectiveness of currently existing models for analyzing accidental releases of uranium hexafluoride (UF_6) from fuel cycle facilities. The NRC requires licensees to conduct an Integrated Safety Analysis (ISA), to develop an Emergency Response Plan (ERP) and, in the event of an accidental release of UF_6, to conduct a Post-Accident Analysis (PAA) to evaluate both the severity of the accidental release and potential health impacts on the local population. Models specifically developed for UF_6 and those developed for the treatment of dense gases that are potentially applicable to UF_6 release, reaction and dispersion were examined. Both screening-level and detailed public-domain models were evaluated. Evaluation involved assessment of model components; applicability to ISA, ERP, and PAA; and user interface and QAQC. Within the component evaluation process, a models treatment of source term, thermodynamics, and atmospheric dispersion were evaluated and comparisons among model predictions and with actual observations were conducted. (U.S. *Nuclear Regulatory Commission*)

RADON DECAY PRODUCT EXPOSURES TO UNDERGROUND WORKERS AT THE ELDORADO BEAVERLODGE URANIUM MINE

As part of a three-phase project, SENES re-evaluated the exposures to radon decay products of uranium miners at the Beaverlodge mine in northern Saskatchewan. The first phase of the study examined the available data and assessed the reliability of previous estimates of both radon decay product levels (WL) in the mine and the radon decay product exposures (WLM) of the men who worked in the mine. The re-evaluated exposure were, on average, lower than the exposure estimates previously used in epidemiological analyses; however, a large amount of uncertainty in individual employee exposures was evident based on a high spatial variability in radon decay product levels throughout the mine. The second phase involved a detailed investigation of the Beaverlodge records to further improve the estimates of the exposures of a case control group. Exposure rates specific to the area and the time when the individuals worked, rather than mine-wide estimates, were assigned to individuals. In the third phase, an algorithm was developed to estimate exposures of the entire cohort to radon decay products based on occupation and employment duration information previously compiled by the original investigators. The uncertainties in exposures using the cohort algorithm were estimated. *(Atomic Energy Control Board of Canada)*

RE-EVALUATION OF RADON DECAY PRODUCT EXPOSURES TO UNDERGROUND WORKERS AT THE PORT RADIUM MINE

Radon decay product (RDP) concentrations and exposures (WLM) to underground employees in a case-control group from the Port Radium uranium mine were re-evaluated. The re-evaluation was based on a detailed review of mine data for the period 1942-1960, a review of published literature and interviews with selected number of former Port Radium employees familiar with mine operations, ventilation and radiation protection at Port Radium. *(Atomic Energy Control Board of Canada)*



FEASIBILITY STUDY INTO THE RE-EVALUATION OF EXPOSURE DATA FOR THE COLORADO PLATEAU URANIUM MINER COHORT STUDY

The Colorado Plateau cohort of uranium miners is an extremely valuable resource in that it currently provides one of the strongest bases for risk estimation for groups exposed to radon daughters. Although there is no known systematic bias with regard to the magnitude of the exposures estimated with this cohort, the uncertainties in exposures are very large, particularly those exposures associated with the early years of uranium mining. These large uncertainties could affect the epidemiological analyses of this cohort.

In 1995, SENES conducted a preliminary feasibility study into the re-evaluation of exposure data for the Colorado Plateau cohort. Data on mine workplace conditions was examined with respect to variability within mines, among mines, by mining district and by state. A small test cohort of miners was selected from the larger cohort to determine the potential for reconstruction of exposures, and to determine any possible bias introduced in the earlier exposure estimates. All other available information was also reviewed to determine any possible bias in earlier estimates. *(National Mining Association, Washington DC)*

UNCERTAINTY ANALYSIS FOR DOSE RECONSTRUCTION MODELS

The goal of this study was to provide Center for Disease Control in Atlanta (CDC) with an objective evaluation of. a variety of quantitative and qualitative methods for uncertainty analysis, with special consideration for the application of these methods to dose reconstruction models. Specific efforts will focus on the definition of those situations that require quantitative uncertainty analysis and the evaluation of different approaches for these analyses. Methods for uncertainty analysis will be evaluated for their applicability to different types and sizes of models. Ease and cost effectiveness of use, clarity of interpretation, and defensibility of the final result will also be considered. The ultimate goal of the project is the application of quantitative uncertainty analysis to specific case studies of interest to CDC. In this project, formal working relations have been established with other scientists who are internationally renowned for their pioneering work in the use of quantitative uncertainty analysis in radiological and chemical risk assessment. SENES (Toronto) developed methods for screening epidemiological feasibility and dose-response analysis taking uncertainty in dose into account. (*Centers for Disease Control, Atlanta*)

SENES has performed hundreds of risk assessments which examine the potential risks to people and the environment for both radioactive and non-radioactive hazards. Examples include the evaluation of risks from drinking water (chemical and pathogens) and the development of a risk based decision model for selecting the preferred water management alternative, risk assessment and risk management for industrial contaminated sites, risks from LNG storage facilities and risks from accidental releases of UF_6, anhydrous HF, anhydrous ammonia and other agents. Consideration of the sources and effects of uncertainty are important considerations.

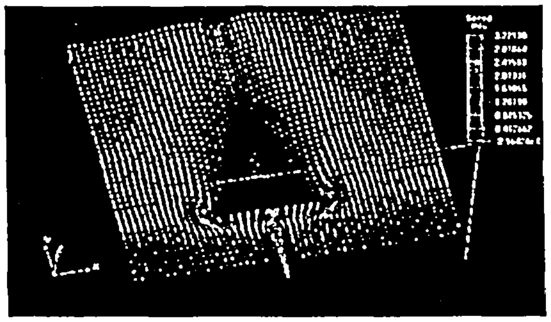
WEST CHICAGO LITIGATION SUPPORT

In 1931, the Lindsay Light and Chemical Company established a thorium extraction facility in West Chicago, Illinois. Later operations included the recovery of rare-earth elements also present in the ores. Solid wastes containing uranium and thorium series radioactivity were stored on-site. In 1967, ownership of the ore processing site passed to Kerr-McGee Chemical Corporation. Seven years later in 1974, Kerr-McGee terminated operations and planned: the decommissioning of the site; the termination of the licence from the Illinois Department of Nuclear Safety (IDNS); and the return of the site to unrestricted use. Subsequently, throughout Kerr-McGee's decommissioning activities, various lawsuits have been initiated alleging that radiation and radioactivity associated with the West Chicago site has had a deleterious effect on people living in the proximate area.

On behalf of Kerr-McGee counsel, SENES undertook detailed analysis of possible radiation doses to plaintiffs in various lawsuits. The SENES dose reconstructions played a key role in resolving the lawsuits. *(Covington and Burling)*

ACCIDENTAL RELEASES OF UF6 – SEQUOYAH FUELS CORPORATION

On 4 January 1986, there was an accident at the Sequoyah Fuels Corporation facility at Gore Oklahoma that led to the rupture of a 14 ton cylinder of uranium hexafluoride (UF6), SENES used available data to carry out a post accident analysis of chemical concentrations of UF6, UO2F2 and HF. The starting point for the analysis was the development of a time dependent, thermodynamic based model for the release of UF6. Since UF6 is reactive with water, the analysis also developed thermodynamic models for converting UF6 release into UO2F2 and HF. The air dispersion analysis took account of building configurations and local weather. Measured concentrations in soil and vegetation were used to calibrate the model, which predicted time dependent concentrations of UF6, UO2F2 and HF in the air at various downwind locations. All of the models were embedded in a Monte Carlo framework. The predicted concentrations compare dwell to available data. *(Kerr-McGee)*



CLOSEOUT, DECOMMISSIONING AND RECLAMATION

SOIL RELOCATION PROJECT

A detailed environmental screening assessment was carried out for the proposed relocation of approximately 200,000 tonnes of contaminated soils and sediment from several major areas within the Town of Port Hope, Ontario (e.g. three ravines, the municipal garbage dump, a small dam, the harbour, and four open areas). The actual removal operation was postponed pending the establishment of a permanent disposal site. *(Low-Level Radioactive Waste Management Office)*

STANLEIGH URANIUM MINE

SENES also prepared a Comprehensive Study Report under the Canadian Environmental Assessment Act for the decommissioning of the Stanleigh mine, mill and waste management area. The report includes project alternatives, the decommissioning plan, an assessment of all decommissioning activities, the predicted environmental effects of these activities, mitigative measures, follow-up (monitoring) program, and the public consultation activities. SENES was also responsible for the development of the public consultation program and assisted the client in implementing the program. *(Rio Algom Limited)*

AGNEW LAKE URANIUM MINE

Assistance was provided to Agnew Lake Mines in the acquisition of approval from the Atomic Energy Control Board to allow its decommissioning license to lapse. SENES completed a pathways analysis for the site and co-ordinated and submitted the final monitoring summary report for the five-year transition monitoring phase. SENES also provided testimony before a hearing in support of Agnew Lake's application which was approved. Ownership of the property now resides with the Province of Ontario. *(Kerr Addison Mines Limited)*

ATLAS TAILINGS PILE RECLAMATION

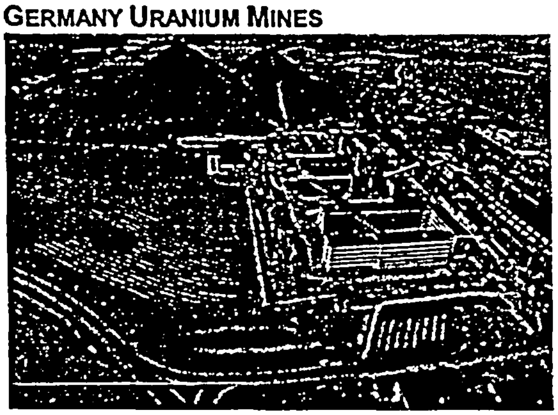
SENES undertook a comparative screening level risk assessment of the proposed on-site reclamation plan and an alternative off-site reclamation option for this 10.5 million ton uranium tailings pile situated near Moab, Utah. The project included review of planned activities and assessments of associated radiological and non-radiological risks to the environment, public, and reclamation workers along with a comparison to the "no action" base case. In its EIS assessment, U.S. NRC staff concurred with the results of the SENES risk analysis.

SENES also reviewed the U.S. NRC regulatory and decision making framework, a review of Title I and Title II reclamation precedents and costs, carried out probabilistic cost estimate sensitivity analyses, and assisted Atlas and national counsel in development and presentation of public information and in producing comprehensive responses to U.S. NRC's DEIS. *(Atlas Corporation)*

BEAVERLODGE URANIUM MINE

An engineering feasibility study was undertaken by SENES to assess the engineering requirements and the environmental and cost implications of several potential reclamation concepts for the ultimate close-out of the Beaverlodge uranium mine/mill facility in northern Saskatchewan. Reclamation concepts were developed for each component of the mine/mill facility including the tailings areas, tailings spills, waste rock piles, mine water sludges, mines, mill and ancillary facilities. Detailed pathways analyses were subsequently undertaken for selected reclamation options. Site-specific radiation measures, an evaluation of eating habits specific to the area, and a literature search of critical pathways parameters (e.g. water to fish transfer factors) were used to estimate the potential radiation exposures resulting from several reclamation options. A water quality model was developed mainly to simulate uranium and radium-226 levels over an extended timeframe for input to the pathways analysis. The mine was successfully decommissioned and reclaimed. The Province of Saskatchewan and Eldorado Resources (now Cameco) have jointly participated in monitoring the transition years. The facility has performed as expected and negotiations are ongoing for transfer of the property back to the Crown. *(Eldorado Resources Limited)*

GERMANY URANIUM MINES



SENES headed a team of Canadian consultants retained to advise the German Environment Ministry (BMU) on the decommissioning of Wismut's uranium mining facilities in Saxony and Thüringea. The Wismut sites are only part of a larger problem that includes 2,000 nearby historic and abandoned waste sites. SENES, in addition to co-ordinating project activities, has direct responsibility for environmental issues including, but not limited to, evaluation of decommissioning criteria and the assessment of decommissioning plans proposed by Wismut. Acid mine drainage, the release of toxic metals and radionuclides to the environment, ecological and human health risks are among the areas of concern. *(German Environment Ministry)*

RABBIT LAKE URANIUM MINE

To assess the impact of a waste rock pile and open pit, laboratory scale leaching studies were designed and evaluated to determine the acid generation potential and the leachability of metals and radionuclides from the mine wastes. The project involved the development of a water quality model to assess reclamation strategies for the B Zone open pit and waste rock pile developed adjacent to Collins Bay on Wollaston Lake. The model simulated metal and radionuclide leaching from waste rock, mineralized waste and exposed ore and evaluated the potential benefits of reclamation alternatives. Pathways analyses to estimate the radiation exposure of local residents in the Wollaston Lake area of northern Saskatchewan were also prepared. *(Cameco Corporation)*

SITING TASK FORCE

The Siting Task Force (STF) on Low-Level radioactive Waste Management was established by the federal government in 1989 to implement a Co-operative Siting Process to site a facility for the long-term management of the Port Hope Areas wastes. SENES was retained by the Siting Task Force Secretariat to provide consultative services on various aspects of the project including: characterization of the Port Hope Area hazardous wastes (both low-level radioactive and chemical contaminants); assistance in the development of cleanup criteria applicable to the various waste sites; design and implementation of a field sampling program to upgrade existing waste characterization data and better delineate waste occurrences at the Port Granby and Welcome Waste Management Facilities (WMFs); input to the design of remedial action plans for the major waste occurrences; assessment of potential transportation of options for the transport of approximately 1 million cubic metres of wastes to the candidate disposal sites at Deep River and Port Hope, Ontario; and co-ordination of project issues to ensure compliance with federal environmental assessment requirements. (*Siting Task Force on Low-Level Radioactive Waste Management Phase 4*)

CLEAN-UP OF LOW-LEVEL RADIOACTIVE WASTE

Pre-development radiation surveys conducted by SENES on vacant land in the Malvern area of Metropolitan Toronto identified four piles of soil containing low-level radioactive material. The source of the radioactivity was found to be radium contained in small pieces of plastic tubing. A remedial program was designed and implemented to separate the pieces of tubing from the bulk soil, and to concentrate the major portion of the radioactive inventory. Computer-assisted radiation detectors were used to test the soil and identify the presence of tubing pieces. Approximately 2,500 cubic metres of soil were processed and close to 20,000 pieces of tubing were recovered and shipped off-site to a licensed waste management facility. SENES personnel were involved in all aspects of the project including pre-development radiation surveys, identification of contamination, design of the soil processing operation, preparation of an environmental review of the proposed clean-up operation following the Federal Environmental Assessment Review Office (FEARO) protocol, operation of a public information office, operation of the soil processing system, and participation in the Malvern Remedial Action Committee established by the Federal and Provincial governments to develop appropriate management plans for the waste. *(Low-Level Radioactive Waste Management Office)*

WEST CHICAGO THORIUM PLANT (KRESS CREEK)

Over the years, some of the wastes containing radioactive contamination were transported, presumably through a storm sewer, from the thorium extraction facility in West Chicago to Kress Creek, a tributary of the West Branch of the Dupage River, and caused thorium contamination along the banks of the Creek and the River. SENES analysed the available radiological data and prepared an assessment of the existing radiological conditions along Kress Creek. Representative dose calculations from radon and thoron progeny and from ingestion of vegetables grown in contaminated soil were made. The report focussed on responses to questions from the Nuclear Regulatory Commission. *(Kerr-McGee)*

RADIOLOGICAL ASSESSMENT AND DECOMMISSIONING

In preparation for decommissioning the West Chicago site, Kerr-McGee constructed facilities to provide for control of emissions to the environment and to facilitate retrieval, processing and loading for transport of the contaminated materials. SENES prepared a screening level impact assessment of the potential radiological impacts from contaminated dust, and radon and thoron progeny to on-site workers and the members of the public potentially exposed during preparatory work. The resuspension of contaminated dust by the wind and by earth-moving equipment was estimated using EPA models that incorporated site-specific parameters such as wind-speed, moisture content and exposed area. The exhalation of radon and thoron from exposed waste and their release from pore spaces during waste removal were calculated using factors recommended by EPA and NRC. The atmospheric dispersion of radon, thoron, their progeny and particulate radioactivity were estimated at nearby residences by modelling atmospheric dispersion using local weather data and the ISCLT model recognized by the United States Environmental Protection Agency. Similarly, after the construction of support facilities and removal of contaminated tailings to disposal (Phase I) SENES prepared a screening level impact assessment of the potential radiological impacts associated with the work. *(Kerr-McGee)*

MOAB RECLAMATION TRUST

As part of the bankruptcy agreement, the Moab Reclamation Trust (Atlas, NRC and the State of Utah) administered by PricewaterhouseCoopers LLB, was established to provide interim administration of the NRC Source Material License for the Atlas Mill and tailings site located on the Colorado River, near Moab, Utah. In carrying out its License requirements the Trust initiated several studies and actions in support of the approved decommissioning plan for the site SENES was retained by the Trust to provide strategic and long-term environmental planning advice on proposed environmental programs for the site including water quality assessments, engineering plans for dewatering and earthworks, and proposed radiation monitoring programs. SENES also carried out a comprehensive independent review and assessment of ALARA reports to NRC for the period from 1995 to 2000, and developed an application for exemption from the 100mrem/yr limit pursuant to 10 CFR Part 20 - 1301(c) from NRC in support of the proposed decommissioning works. The application included complete technical analysis of radioactivity issues associated with proposed decommissioning works and the potential effects on the nearest resident. The NRC approval of the application was the first such approval provided by NRC and is a precedent for the industry.

ENVIRONMENTAL ASSESSMENT

SENES has performed numerous environmental impact assessments for mining, industrial and governmental clients. SENES personnel prepared the first EIS under the Federal Environmental Assessment Review Process (for the Point Lepreau NGS) and have been active in the Federal process since then. SENES have also performed or participated in numerous EIS in Saskatchewan and Ontario and in essentially all of the environmental assessments performed for uranium mining and processing in Canada. A few examples are given below.

DECOMMISSIONING OF URANIUM MINES - ELLIOT LAKE AREA, ONTARIO

SENES has participated in many investigations over a period of 20 years aimed at the development of decommissioning plans for several uranium mines, mills, and associated waste management areas located in the Elliot Lake region of northern Ontario. This work has progressed through reviews of options, preparation of environmental and radiological pathways analyses, presentation of the decommissioning proposals to the Atomic Energy Control Board (AECB) and preparation of environmental screening reports for submission to the AECB in accordance with the former federal EARP process. All decommissioning activities and their attendant environmental impacts were identified; specific ameliorative and mitigative actions were recommended as required. Two comprehensive Environmental Impact Statements (EIS) of the waste management areas were prepared to comply with panel guidelines; assistance was provided to Rio Algom Limited and Denison Mines Limited in preparation for hearings under EARP. The EIS's were approved by the environmental assessment panel. Most recently, SENES prepared a Comprehensive Study Report under the Canadian Environmental Assessment Act for the decommissioning of another mine, mill and waste management area, and was also responsible for the development of the public consultation program. The report was approved and licences to decommission have been issued. *(Rio Algom Limited/Denison Mines Limited)*

McARTHUR RIVER

In Phase 1 of this two phase study, an exposure assessment was performed to examine the potential exposures to radionuclides due to uranium mining in the McArthur River region of northern Saskatchewan and to background sources of radiation. An environmental pathways analysis was performed to assess radionuclide movement through the environment to humans. The INTAKE model used for this assessment, developed through and applied to numerous previous projects and applications spanning more than a decade, traditionally evaluates incremental doses. The model was adapted to allow for the evaluation of background exposures and total doses (i.e. including background levels of radiation). The SENES INTAKE model is set up within a probabilistic framework incorporating uncertainty and natural variability of model parameters into the calculations. In the second phase, human health risks due to radiation doses and exposures to heavy metals via airborne and

aqueous emissions were estimated. In Phase II, detailed human health risk assessments and ecological risk assessments were performed. *(Cameco Corporation)*

HIGH-GRADE URANIUM DEPOSIT TEST MINE, SASKATCHEWAN

An environmental impact assessment was prepared for a proposed underground, high-grade uranium mine. A test mine was to be used to evaluate sub-surface conditions and the mining technologies to be used. The assessment included a review of the environmental data for the mine site and vicinity, identification of possible impacts and mitigative measures, and development of a monitoring program to be followed during mine operation. From inception to licence approval, the project was completed within a year. *(Midwest Joint Venture)*

URANIUM MINING

In addition to such EIS studies, SENES has performed numerous studies in support of mining high grade uranium properties in northern Saskatchewan. Many of these have a radiological focus, including:

- Assessment of worker exposures at the Cluff Lake uranium mine relative to new AECB regulations;
- Development of the radiation protection section of COGEMA's application for the JEB mill;
- Review of the radiation protection aspects of the basic design for the proposed JEB mill expansion (based on the proposed Cigar Lake mill design) and development of the radiation protection design manual for the JEB mill expansion;
- Participation in a feasibility study on workplace radiation protection for the McArthur River project;
- Completion of a detailed gamma survey at the Key Lake mill and a related assessment of worker exposures and shielding requirements for two milling scenarios (i.e. increase of the mill ore grade from about 2 $\%U_3O_8$ to 4 to 20 $\%U_3O_8$) in support of the feasibility study just mentioned above;
- Participation in development of alternatives for test mining at Cigar Lake and associated radiological evaluation (with Pierre Zettwoog);
- Participation in a feasibility study for mining of Eagle Point deposit and associated radiological evaluation;
- Analysis of implications of proposed new AECB regulations on mining in Ontario and Saskatchewan. *(Rio Algom and Uranium Saskatchewan)*

These studies required: the evaluation of various mine/mill environments, shielding alternatives, mining/milling and ore handling methods, upset scenarios and related contingency measures; the characterization of various radioactive source terms; and the optimization (ALARA) of proposed and existing mining/milling installations and activities at the feasibility, conceptual and detailed engineering levels.

CUMULATIVE EFFECTS ASSESSMENT FOR THE BRUCE NUCLEAR GENERATING STATION, ONTARIO

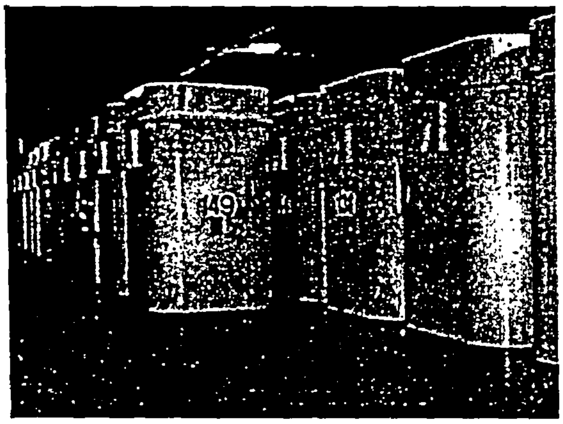
SENES and Gartner Lee Limited prepared a cumulative effects assessment as part of Ontario Hydro's Comprehensive Study Report for a Used Fuel Dry Storage Facility (UFDSF) at the Bruce site in accordance with the requirements of the Canadian Environmental Assessment Act and the draft Cumulative Effects Guide (1997) prepared by the Canadian Environmental Assessment Agency. The intent of the cumulative effects assessment was to assess environmental effects of the project over a large regional area as well as the longer time period into the past and the future. The cumulative effects of the UFDSF on key environmental factors and Valued Ecosystem Components were evaluated, giving consideration to: existing operations (Bruce B, RWOS 1 and 2, Douglas Point); ancillary facilities (the steam plant and central maintenance facilities); and, proposed projects (RWOS 2 upgrade, including incineration, additional inground container storage facilities, waste removal from RWOS 1, heavy water plant decommissioning and steam plant replacement). Assessment also considered the cumulative effects resulting from the restart of Bruce A, and the eventual plant shut down and safe storage of Bruce A and B. *(Ontario Hydro)*

ENVIRONMENTAL REVIEW OF PICKERING NUCLEAR GENERATING STATION, ONTARIO

SENES and Gartner Lee Limited conducted a comprehensive review of the effects of the Pickering Nuclear Generating Station (PNGS) on the biophysical environment surrounding the station. This review was required by the Atomic Energy Control Board as a condition for renewing Ontario Hydro's licence to operate the Pickering Nuclear Station. The review dealt with the biophysical effects of PNGS and the preparation of an environmental action plan. Of particular interest was the analysis of the effects of radioactive and non-radioactive emissions on Valued Ecosystem Components (VECs) such as groundwater, Lake Ontario surface and drinking water, air, inshore and lake-wide fish populations and adjacent marshes and bays. The review involved setting up, meeting with, and having material reviewed by a Community Working Group (CWG). Screening studies were prepared to determine possible effects and a priority system for a ten-point program to address the issues.
Elements of that program included, among others, actions to improve data gathering and monitoring, specific actions to address VECs, recommendations for the introduction of Statistical Process Control and Facility Risk Management techniques and the development of five-year environmental actions plans. *(Ontario Hydro)*

DARLINGTON USED FUEL DRY STORAGE ENVIRONMENTAL ASSESSMENT (DUFDS)

Power Generation Inc. (OPG) is proposing to develop the a Used Fuel Dry Storage facility at the Darlington Nuclear Generating Station property to store fuel, that has been previously cooled at least ten years under water, in dry storage containers. SENES was part of a multi-disciplinary team of environmental consulting firms to carry out the environmental assessment for the twenty-two month project that includes the preparation of an EA study report and all necessary supporting materials meeting the requirements of CEAA, for submission to the Canadian Nuclear Safety Commission. SENES involvement in the environmental assessment includes review of atmospheric and noise environments, socio-economics, radiation and radioactivity, risk and hazard assessment, and cumulative effects assessments. *(Ontario Power Generation Nuclear)*



LEPREAU NUCLEAR GENERATING STATION, NEW BRUNSWICK

Scientific and project management services were provided during the preparation of the site selection study for the first nuclear generating station in the Atlantic provinces. Subsequently, the EIA for the selected site at Point Lepreau, New Brunswick was prepared. Field monitoring programs were designed and implemented and major contributions made on various aspects of atmospheric dispersion, radioactivity, and cooling water discharge. Expert testimony was provided at federal and provincial hearings. Similar contributions were provided for the environmental assessment of a second reactor proposed for Lepreau. *(New Brunswick Electric Power Commission)*

PICKERING WASTE MANAGEMENT FACILITY PHASE II ENVIRONMENTAL ASSESSMENT (PWMF II EA)

Ontario Power Generation Inc. (OPG) proposes to develop the second phase of the Pickering Used Fuel Dry Storage (PUFDS) at the Pickering Nuclear Generating Station property in dry storage containers. As another part of the PWMF II, OPG plans to develop a Retube Components Storage Facility (RCSF) for future retubing of Pickering Nuclear Generating Station B in dry storage modules. SENES was retained to lead a multi-disciplinary team of environmental consulting firms to carry out the environmental assessment for the sixteen-month project that includes the preparation of an EA study report and all necessary supporting materials meeting the requirements of CEAA, for submission to the Canadian Nuclear Safety Commission. Other project areas include the provision of assistance with the selection of facility locations, and the identification environmental implications of associated with alternative sites. The environmental assessment includes review of atmospheric, aquatic and terrestrial environments; geology and seismicity; land use and sustainability; socio-economic, physical and cultural resources; radiation and radioactivity, risk and hazard assessment; cumulative effects assessments; and public consultation. *(Ontario Power Generation Nuclear)*

TECHNICAL REVIEW ON EIA OF ROMANIAN POWER REACTOR

SENES was retained by Export Development Canada (EDC) to conduct a review of Atomic Energy of Canada Limited's Environmental Impact Assessment (EIA) of Romania's Cernavoda Nuclear Power Plant – Unit 2. The review involved a three step process following the procedures outlined by EDC and involved comparison with Canadian and International practices. The review concluded that the EIA meets the requirements of EDC and is consistent with EA professional practice in Canada.

COMPREHENSIVE STUDY REPORT FOR WHITESHELL LABORATORIES DECOMMISSIONING, MANITOBA

The closure of research programs and operations at the Atomic Energy of Canada Limited (AECL) Whiteshell Laboratories required a change in the nature of the Atomic Energy Control Board (AECB) licence to reflect the transition from Site Operations to Site Decommissioning. The AECB determined that the decommissioning of the laboratories required a Comprehensive Study environmental assessment under the Canadian Environmental Assessment Act (CEAA). Decommissioning of the WR-1 nuclear reactor, was included in the project scope. SENES was retained by AECL to lead a multi-disciplinary team of environmental experts to prepare the Comprehensive Study Report for the proposed project. The study included an assessment of cumulative environmental effects. *(Atomic Energy Canada Limited)*

NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

SENES has successfully undertaken over 100 projects involving NORM. A partial listing of these projects which illustrates the wide scope of services related to NORM assessments is provided below.

NORM IN THE OIL/GAS INDUSTRY

The U.S. Environmental Protection Agency (EPA) prepared a preliminary risk assessment of management and disposal options for oil field wastes and piping contaminated with NORM in the state of Louisiana. SENES carried out a critical review of the EPA report which focussed on the validity of EPA's assumptions and the consistency of the assessment methodology with recognized risk assessment practices. *(American Petroleum Institute)*

Elevated levels of radium in produced water are adventitiously extracted from some oil wells, typically those associated with marine deposits. Radiation survey protocols used by the oil companies and the variability of radium concentrations provide for only small isolated areas of activity concentrations at less than 30 pCi/g in pipe scale and sludge. SENES used an estimated distribution of radium concentration in waste, and probabilistic methods for calculating potential doses from external gamma radiation and indoor radon to users of remediated oil field sites returned to unrestricted public access. *(American Petroleum Institute)*

REVIEW/DEVELOPMENT OF REGULATIONS

The U.S. Environmental Protection Agency (EPA) prepared a waste characterization and preliminary risk assessment of diffuse NORM mining wastes (i.e. large volumes of waste containing natural radioactivity at concentrations above background levels). A critical review of the EPA report focussed on the methodology used by EPA and the selection of models and parameter values used in the dose and risk assessment. *(American Mining Congress, now the National Mining Association)* The purpose of this study was to assist in the development of information on radon-222 in drinking water. Environmental levels and the pathways of exposure to humans were critically examined. The most recent dosimetric models on ingestion risk were reviewed while the inhalation risk was based on water-to-air transfer factors for various typical water uses and the best available epidemiological studies on the risks of exposure to radon and its progeny. A dynamic indoor air quality model was used to assist in the estimation of exposures. Several alternative rationales for the development of a risk-based guideline were presented. *(Health and Welfare Canada)*

The U.S. EPA introduced regulations requiring the reporting of the release of naturally occurring radionuclides in excess of reportable quantities (RQ) and supported the regulation with a Technical Background Document (TBD). SENES carried out a critical review of the radionuclide pathways and dose and risk models described and used by EPA in the TBD to establish the criteria levels (RQs). The review focussed on estimates of potential dose and risk resulting from releases of radon-222. *(American Mining Congress, now the National Mining Association)*

PHOSPHOGYPSUM (PG)

Phosphogypsum (PG), a by-product of the production of phosphate fertilizers, can contain several times the normal background concentrations of uranium series radionuclides, and may represent a radiation hazard under certain exposure scenarios.

The U.S. EPA prepared a waste characterization and preliminary risk assessment of emissions from storage piles and selected uses of PG. SENES carried out a critical review of the EPA report which focussed on EPA's methodology, the selection of models, and estimated doses and risks. *(The Fertilizer Institute)*

The U.S. Environmental Protection Agency prohibits by regulation the use of phosphogypsum containing radium-226 in excess of 10 pCi/g for road construction on the basis of their generic risk assessment and estimate of potential doses and risks to workers and members of the public. SENES followed EPA's methodology and exposure pathways as closely as possible and estimated potential doses and risks to workers and members of the public from the use of phosphogypsum from stacks in Florida in a short experimental section of road. SENES demonstrated that potential lifetime risks were below the limit considered presumptively safe by EPA (<10^{-4}), and that the risk from phosphogypsum in the road was no greater than the corresponding risk should the phosphogypsum be left in the stacks. *(Florida Institute of Phosphate Research (FIPR))*

This study examined the potential environmental and health concerns of PG stacks in Canada. The scope of the study included operating and decommissioned stacks, as well the use and mis-use of PG. Potential generic concerns relative to groundwater in the area of the stacks, as well the emission of radon and NORM-contaminated dust, were examined. Data from comparable PG sites in the United States were also reviewed in the study. Potential uses for PG that were studied included PG in non-residential construction and as a soil amendment. *(Environment Canada, Alberta Environment, Ontario Ministry of the Environment)*

The South African Council for Nuclear Safety (CNS) issued a guideline (LG-1032) which outlines the requirements for the assessment of radiation hazards to members of the public from mining and mineral processing facilities. SENES carried out the first assessment of this kind using the new CNS standard on the Kynoch Fertiliser plants at Potchestroom, Chloorkop and Phalaborwa. Thorium series radioactivity is present at higher than normal concentrations in the phosphate ore processed at the plant. A structured and comprehensive approach to the assessment involves the collection and review of existing data, the identification of critical receptors, screening level dose assessments, identification of additional sampling requirements, conduct of measurement programs and modelling exercises, and comparison of predicted potential doses and risks to nearby members of the public to regulatory standards. *(Kynoch Fertiliser (Pty) Ltd.)*

PG from a fertilizer plant in South Africa was treated off-site and used by others without restriction in the manufacture of cement, which was shipped throughout the country. Feedstock to the fertilizer plant and the PG contained higher concentrations of NORM than found in surrounding soils. The Council for Nuclear Safety, the Nuclear regulatory agency, licensed the operation of the fertilizer plant and required that a risk assessment of potential exposures to workers and the public be carried out. SENES characterized the source of radioactivity in the PG and developed potential exposure pathways to workers and members of the public based on site-specific and generic data concerning the use of the PG. *(Kynoch Fertiliser (Pty) Limited)*

Construction of a proposed residential development in the vicinity of PG stacks in Calgary, Alberta was limited by a buffer zone that prohibited construction in the area. As part of an overall assessment of airborne emissions from the stacks, SENES evaluated the potential radiation exposures to future residents as a function of distance from the ponds. Partially as a result of this analysis, the buffer zone was reduced allowing the development to proceed. *(Douglasdale Estates)*

SENES prepared a series of annual air quality monitoring reports on airborne radioactive emissions associated with PG stacks in Calgary, Alberta, as well as provided on-going advice on the monitoring itself. *(Western Co-operative Fertilizers Limited)*

As part of the decommissioning plan for a phosphate fertilizer plant near Sarnia, Ontario, a radiation survey of the site and equipment was undertaken. Both external gamma measurements and contamination checks of equipment scheduled for potential re-use were undertaken, and compared to relevant release criteria for radioactive materials. (*ICI Canada Inc.*)

With the closure of the production activities at a phosphate fertilizer plant in Calgary, Alberta, SENES was retained to undertake a risk assessment of the preliminary site decommissioning plans which included three scenarios: current conditions, post-dewatering the stacks during reclamation, and post-reclamation. *(Western Co-operative Fertilizers Limited)*

ELEMENTAL PHOSPHORUS REFINERIES

A number of the major issues arising from an extensive decommissioning plan proposed for an elemental phosphorus refinery were NORM-related, namely, the short and long-term environmental implications of the proposed undertaking, and the potential occupational and public radiation exposures. Working in conjunction with the proponents, the potential exposures were evaluated, and presented in a number of meetings with both regulators and the public. Part of the analysis involved the selection of a radiation dose reference limit for workers who were not covered by any existing legislation on NORM-derived exposures. The analysis was accepted by the authorities and the involved citizenry allowing the decommissioning to proceed. (*Albright & Wilson Americas*)

Calcium silicate (phosphate "slag") is a hard ceramic-like material produced as a by-product in the production of elemental phosphorus from phosphate ore. The phosphate ore contains a low concentration of naturally occurring uranium which is retained in the silicates. The silicates have excellent properties as aggregate material. This study examined the potential radiation exposures and associated risks that might result from various proposed uses of the silicates, such as in roads, and parking lots. The risks were compared to levels of risks encountered through normal daily activities. *(Albright & Wilson Americas)*

As input to a risk assessment of an operating elemental phosphorus refinery in Soda Springs, Idaho, Classified as a Superfund site by the U.S. EPA, SENES performed a detailed analysis of the emission rates and dispersion of several types of air emissions from the refinery, including heavy metals, fluoride and NORM (naturally occurring radioactive materials). As a result of this analysis, which demonstrated that previous emissions and predicted air concentrations had been greatly overestimated, the air exposure pathway was relegated to a "non issue" in the final assessment of the refinery. (*The Monsanto Company*)

As part of an ongoing health and safety program, SENES was retained to assess the potential radiation exposures to workers from airborne radioactivity at an elemental phosphorus refinery in Newfoundland. A monitoring program using both persona and area monitoring devices, in combination with task-time analyses, was undertaken to estimate exposures to the radioactive dust. While the estimated exposures were within permissible levels for non-radiation workers or members of the public, recommendations to further lower potential exposures were made. (*ERCO Industries Limited, now Albright & Wilson Americas*)

During major maintenance and rebuilding of production furnaces at an electrothermal elemental phosphorus refinery in Newfoundland, a monitoring program was undertaken to assess the radiation exposures of workers. Gamma radiation exposures, total and respirable dust levels, radon concentrations and surface contamination levels were measured. Elevated beta radiation levels due to strongly affixed contamination (lead-210 and decay progeny) were measured on the interior furnace walls (carbon blocks) near the reaction zones in the furnaces. Total exposures were below permissible levels for non-radiation workers or members of the public. (*ERCO Industries Limited, now Albright & Wilson Americas*)

MANAGEMENT OF NORM WASTES

This study focussed on discrete sources of NORM wastes produced in Canada (as opposed to diffuse sources such as phosphogypsum), generally characterized by elevated, low volume non-uniform concentrations of NORM, such as pipe scale from oil and gas facilities and filters from phosphate fertilizer production. Estimates of the volumes and generation rates of various waste types, identification of regulatory issues, and descriptions of current management practices were provided. The results of this study were to be used by the client in conjunction with the results of other studies to review and update the requirements for the management of low-level radioactive wastes in Canada. (*Low-Level Radioactive Waste Management Office*)

On behalf of the International Atomic Energy Agency (IAEA) and as part of an international team, SENES provided expert advice to the Government of Jordan on the environmental implications of NORM wastes produced by the phosphate industry. Several phosphate mining and fertilizer production facilities throughout Jordan were visited, and a summary report was prepared through the IAEA discussing potential environmental concerns and presenting suggestions for subsequent monitoring and analysis to be undertaken under the direction of the Jordanian government. (*International Atomic Energy Agency*)

Some of the heavy mineral ores and concentrates used in the production of titanium oxide contain NORM. SENES provided advice to two clients on the environmental and occupational implications of the resultant NORM-contaminated wastes, particularly in reference to the existing and proposed provincial regulations on the disposal of hazardous wastes. (*KRONOS Canada, Trioxide Canada*)

To assist in the management of NORM wastes from a titanium oxide producer that were classified as hazardous under Quebec regulations because of their radioactivity, the environmental and occupational implications of disposal in an industrial landfill were examined. The analysis examined task-time estimates for likely disposal scenarios, and considered potential exposure to gamma, radon and airborne dust. In the absence of applicable radiation exposure limits for non-nuclear workers, the estimated exposures were compared to a reference limit generally applicable to members of the public. (*KRONOS Canada*)

SENES carried out a critical review of a risk assessment prepared for the decommissioning of a site containing thorium contaminated slag in Surrey, British Columbia. (*Low-level Radioactive Waste Management Office*)

NORM AT RARE EARTH FACILITIES

Naturally occurring thorium series radionuclides contaminate a site in West Chicago resulting from past operations of a rare earth facility. One of the remedial activities planned during the cleanup involved washing and drying large volumes of soil to remove radioactivity. Radon gas would be released during these operations. SENES carried out an assessment of the magnitude of the release and the potential increase in normal background levels of radon in the vicinity. *(Kerr-McGee Chemical Corporation)*

Natural thorium contamination existed along the banks of a creek in a residential area of Chicago, due to past operations of a rare earth extraction facility. The U.S. Nuclear Regulatory Commission (NRC) ordered the present owners to show cause why the contaminated materials should not be cleaned up according to Environmental Protection Agency Standards that had originally been developed for uranium-bearing wastes. In response to the NRC, a study was carried out focussing on potential radiation pathways of exposure and the applicability of EPA standards. *(Kerr-McGee Chemical Corporation)*

NORM waste from a rare earth processing plant in New Jersey lay beneath an area proposed for residential development. SENES assessed the potential radiation exposures to residents should homes be built in the area, and developed statistical techniques to facilitate these predictions. *(Confidential Client)*

NORM IN MINING

A large smelter processing both ore and scrap metal and other materials for recycling had detected the presence of NORM in some special feeds and ingredients. Because of the potential implications of the NORM, SENES was retained to undertake a radiological survey of the smelter in order to assess any potential immediate hazards to workers. In addition, information on the radioactivity concentrations in the material to be processed at the smelter was reviewed, and potential occupational doses and risks were assessed. The findings were presented to both management and worker representatives. The results and recommendations of the study were used by the company as a basis for updating the smelter policy on NORM. *(Confidential client)*

The potential problems associated with mining the Sarfartoq niobium deposit in West Greenland and the studies which would be required prior to the development of a mine were evaluated. This study was undertaken for the Mineral Resources Administration (MRA) for Greenland, based in Copenhagen, Denmark. The evaluation focussed on the potential environmental and safety problems associated with the radioactive constituents present in the Sarfartoq ore; it was largely based on a review of the proposed MRA study program and matters discussed at meetings with representatives from the Danish/Greenlandic Authorities in Copenhagen. (*Mineral Resources Administration for Greenland*)

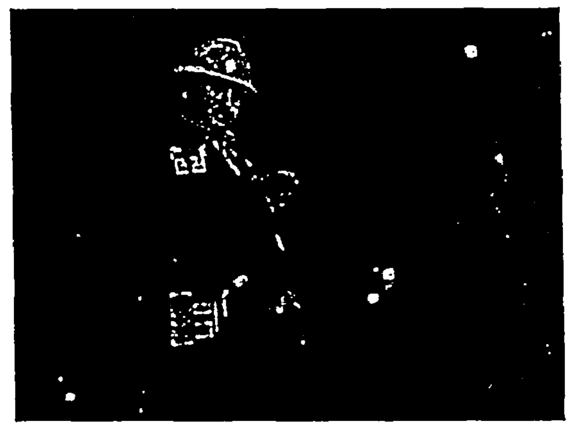
Niobium concentrate was found to contain elevated levels of NORM radionuclides from both the thorium and uranium series. Advice on transportation regulations and packaging requirements, including export requirements, were provided to the supplier for both domestic and international shipments. The supplier's clients were also advised on the regulatory and exposure implications of the NORM shipments. (*Cambior*)

Elevated levels of thorium-series radionuclides were present in deposits of beryllium ore scheduled for potential mining. The environmental and occupational implications of the NORM were assessed and presented to regulatory authorities as part of an overall review of the potential development. (*Hecla Resources*)

Iscor Mining are developing a mining and processing operation in KwaZulu-Natal province of South Africa to recover ilmenite from local surface deposits and produce titanium and high-purity iron.

The concentrations of naturally occurring uranium and thorium series radionuclides in the surface deposits are in excess of the criteria that require licensing by the national regulatory agency, the Council on Nuclear Safety (CNS). On behalf of Iscor, SENES prepared background and environmental assessments and submitted them to the CNS to demonstrate that potential radiological doses to members of the public from the proposed operations would be within regulatory limits. (*Iscor Mining*)

The radiological implications of the NORM to the operations of a tin smelter in Mexico where the tin was exported were evaluated. The evaluation was based on radiation measurements taken during a site visit to the smelter, a review of the potential occupational and environmental impacts of smelter operations, and an assessment of compliance with existing legislative requirements. (*Confidential Client*)



ABRASIVES

Abrasives and other ceramic materials were manufactured at a plant in southern Ontario using raw materials that contained higher than normal concentrations of uranium and thorium series radioactivity. Dust collection systems on the plant stacks removed most of the particulate emissions from the exhaust. SENES used measured dust emission rates, atmospheric dispersion models and environmental pathways models to estimate the radiological dose to members of the public in the vicinity of the plant from incidental radioactivity. *(Norton Advanced Ceramics of Canada Inc.)*

RADIOLOGICAL SURVEYS

SENES has performed numerous radiation monitoring studies for open areas, homes, buildings and industrial facilities. Many of these studies are confidential due to the sensitive nature of the work. and therefore cannot be described in open literature. A few examples are provided below.

IN-SITU LEACH IRRIGATION AREA

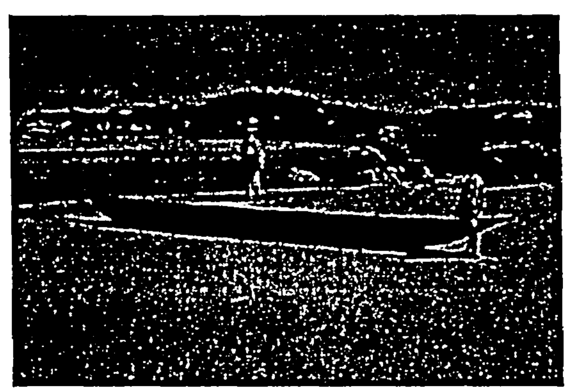
SENES provided a gamma radiation survey of more than 170 acres of in-situ uranium leach properties. Several 2" by 2" sodium iodide (NaI) detectors were mounted on a four-wheel drive vehicle and the gamma radiation levels were automatically merged with a real-time differential GPS providing co-ordinates at sub-metre accuracy. Gamma radiation levels were updated each second and, typically, 60 gamma radiation measurements were collected for each 100 m^2 surveyed. The gamma radiation measurements were summarized and presented as gamma radiation contour maps, as AutoCAD drawings and as summary tables. A relationship was developed between the depth profile of soil Ra-226 concentrations and the gamma radiation measurements. The relationship was used to estimate the volumes of material exceeding relevant criteria, and therefore requiring remediation, and to minimize the number of soil samples required to demonstrate compliance with the criteria. *(Everest Exploration Inc., Texas USA)*

PHOSPHATE SLAG

Phosphate slag had been used for a number of years in the construction of highways and streets, railroads, public parking areas, and as backfill in some residential areas of Quebec. Such uses were subsequently prohibited because of the NORM in slag. In this study, the resultant exposures were estimated using both measurement data and theoretical estimates based on the radiological characteristics of the slag and postulated exposure scenarios. The results were presented and discussed with public health officials who, in a subsequent study, generally agreed with the analysis in that they recommended that remediation efforts were not required because of the estimated magnitude of the risks and exposures relative to background levels. *(Albright & Wilson Americas)*

ENVIRONMENTAL BASELINE MONITORING FOR A DEVELOPING MINE IN MADAGASCAR

SENES undertook an intensive three-week baseline environmental monitoring program for a potential mine in southern Madagascar. The mining company required an evaluation of the existing radioactivity, air quality and noise and environments in the local communities that may be affected by the development. As part of the environmental monitoring program, gamma radiation exposure rate levels were measured at selected sites throughout the study area to document existing levels of gross gamma radiation from terrestrial sources. The purpose of this component of the monitoring program was to determine gamma radiation levels that could be used for future estimates of potential radiation exposure rates. In addition to the gamma surveys, radon and thoron samples were collected within the study area



NIOBIUM WASTE

A program of surface and subsurface gamma measurements and soil and water sampling was carried out to delineate the extent of niobium wastes containing elevated levels of natural thorium at an industrial site in Surrey, British Columbia. Through these investigations, the extent of contamination was defined, the extent of the ground water transport was assessed, and the possibility of reducing the waste volume by segregating the contaminated material from non-contaminated soils was examined. The results of this program formed the basis for the design of the remedial work. *(Low-Level Radioactive Waste Management Office)*

RADIOLOGICAL CONDITIONS PERTAINING TO LOW-LEVEL SOIL CONTAMINATION, TORONTO

Summaries of radiological survey data were prepared to assist owners and tenants in their evaluation of an offer by the Ontario Ministry of Housing to purchase their homes. The Government of Ontario had offered to purchase properties in the residential subdivision in Metro Toronto where owners and Ontario Housing Commission tenants were concerned about the presence of low-level radioactive contamination in soil on their properties. Advice on the radiological conditions was provided to both the homeowners and the Ministry of Housing. *(Ontario Ministry of Housing)*

CLEAN UP OF LLRW FROM A SANITARY LANDFILL SITE

Surface soils at a sanitary landfill site were found to contain naturally occurring LLRW from a phosphate fertilizer plant. Radiation levels were measured across the site prior to the design and supervision of a program to remove the contaminated material. Radiation levels were again measured once remediation was complete to ensure that it had been effective. *(Canadian Industries Limited)*

MONITORING OF AIRBORNE PB-212:

Design of a monitoring program to U.S. Environmental Protection Agency (EPA) standards to measure thoron decay products (Pb-212) emitted during remediation of a site contaminated with natural thorium in West Chicago, Illinois. *(Kerr-McGee Chemical Corporation)*

NRC letter to HMI
November 17, 2004

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

November 17, 2004

Docket No. 04008980 License No. SMB-1541

Edele Hovnanian
President
Heritage Minerals, Inc.
One Hovchild Plaza
4000 Route 66
Tinton Falls, NJ 07753

SUBJECT: HERITAGE MINERALS, INC. (HMI)

Dear Ms. Hovnanian:

This is in reference to the letter dated June 30, 2004, providing a decommissioning and decontamination status update for the Heritage Minerals, Incorporated (HMI) site in Lakehurst, New Jersey. This letter also requested approval of 1) a proposed "Red Area" boundary delineating the area subject to NRC requirements for license termination, and 2) disposition of stockpiled waste materials from the decontamination of site mill structures and equipment as "blue area" material to be managed by the State of New Jersey. NRC response to these requests is listed below.

1) We agree with formally delineating the area within the HMI site that would be subject to NRC jurisdiction for the purpose of decommissioning. Based on independent measurements, NRC staff determined that the proposed boundary is acceptable. Any material located within this bounded area, even if outside of the footprint of the former monazite pile, that contains a concentration of thorium in excess of the unimportant quantity limits in 10 CFR 40.13(a) (116 pCi/g), must be remediated to below 10 pCi/g. However, any material within the bounded area that is less than 116 pCi/g of thorium, will be treated as an unimportant quantity which does not require further remediation.

2) NRC staff has determined that, while the stockpiled waste material may currently have a source material concentration of less than 0.05% by weight (the criteria for determining an 'unimportant quantity'), the material is licensed material with low concentrations of source material from licensed activities. This determination is based on the following:

   a) Although you assert the material did not result from licensed operations, it did originate from the decontamination of buildings and equipment involved in licensed operations (i.e. the wet and dry mills), and must therefore be considered licensed material.

b) You indicated that the material is below the unimportant quantity limit in 10 CFR 40.13(a), therefore the State of New Jersey should manage it in addition to the material in the "Blue" and "Gray" areas. This request is inconsistent with the concept of establishing a boundary for the NRC-licensed area, which includes the mill process buildings. Additionally, you provided no indication that the State of New Jersey is willing to assume responsibility for this material after the NRC license is terminated.

Based on the above summary, the NRC staff has concluded that HMI's proposed action plan to delineate a jurisdictional boundary for final remediation is acceptable. However, the proposal for disposition of the stockpiled material is not authorized. The stockpiled material must be managed in the same manner as other residual radioactivity that was associated with licensed operations at the site (i.e. the material must be removed and transferred to a licensed recipient authorized to receive the material). Additionally, the area underneath the stockpiled material is subject to the same cleanup criteria approved in item 1 above (i.e. any material that contains a concentration of 116 pCi/gm of thorium or more must be remediated to below 10 pCi/gm).

After remediation is completed, NRC staff will perform confirmatory measurements, and you may request an amendment to terminate the license. Amendment of the license will be subject to the associated hearing rights required by 10 CFR Part 2.

Thank you for your continued cooperation on this matter.

Sincerely,

Original signed by Ronald R. Bellamy

Ronald R. Bellamy
Chief, Decommissioning Branch
Division of Nuclear Materials Safety

cc:
Jill Lipoti, Assistant Director, NJDEP
Anthony J. Thompson, Attorney at Law

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DATE	11/15/04		11/15/04		11/15/04		11/17/04	
OFFICE	ORA/RI							
NAME	Kfarrar KLF							
DATE	11/16/04							

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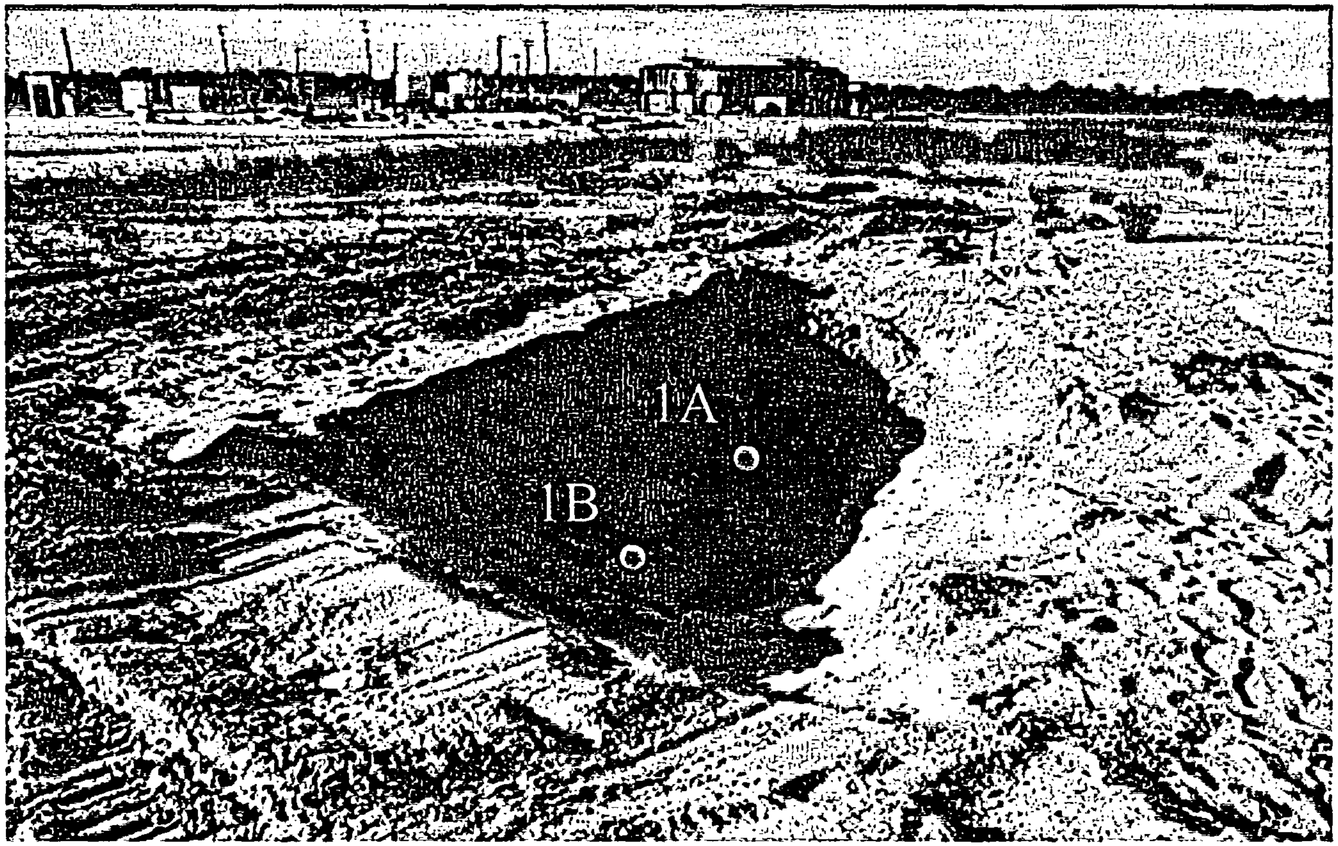
Photographs of Fugitive Licensable Material Locations

ORISE 1



Location of ORISE Sample Location 1. Sample 1A = 1.18 pCi/g Total Thorium and 4.06 pCi/g Total Uranium;
Sample 1B = 1.09 pCi/g Total Thorium and 6.26 pCi/g Total Uranium

ORISE 2

Location of ORISE Sample Location 2. Sample 2 = 0.06 pCi/g Total Thorium and Non-Detect for Total Uranium

ORISE 3

Location of ORISE Sample Location 3. Sample 3 = 0.89 pCi/g Total Thorium and 0.34 pCi/g Total Uranium

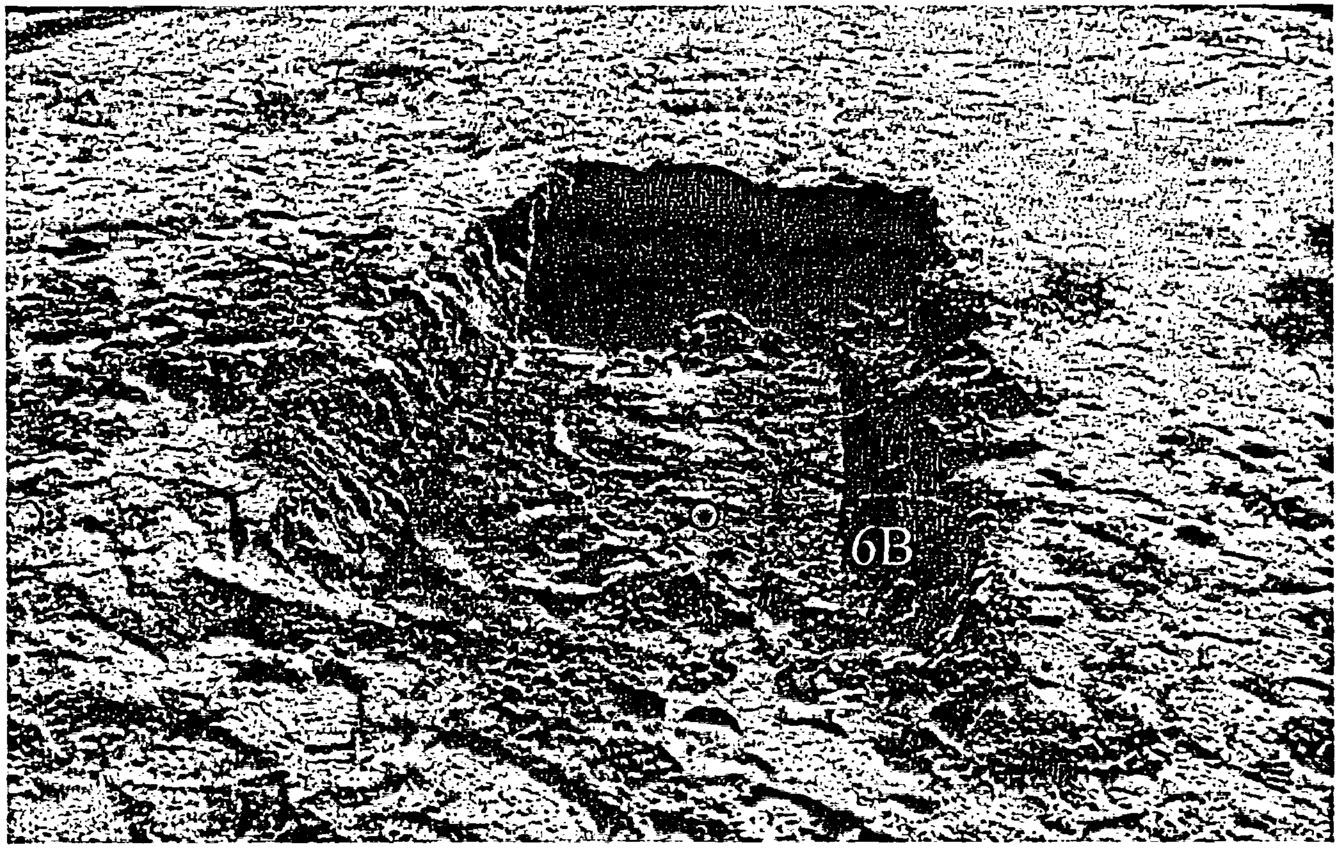
ORISE 4 / 5

Location of ORISE Sample Locations 4 and 5. Sample 4 = Non-Detect for Total Thorium and 6.24 pCi/g Total Uranium; Sample 5 = 0.37 pCi/g Total Thorium and 3.84 pCi/g Total Uranium

ORISE 6A

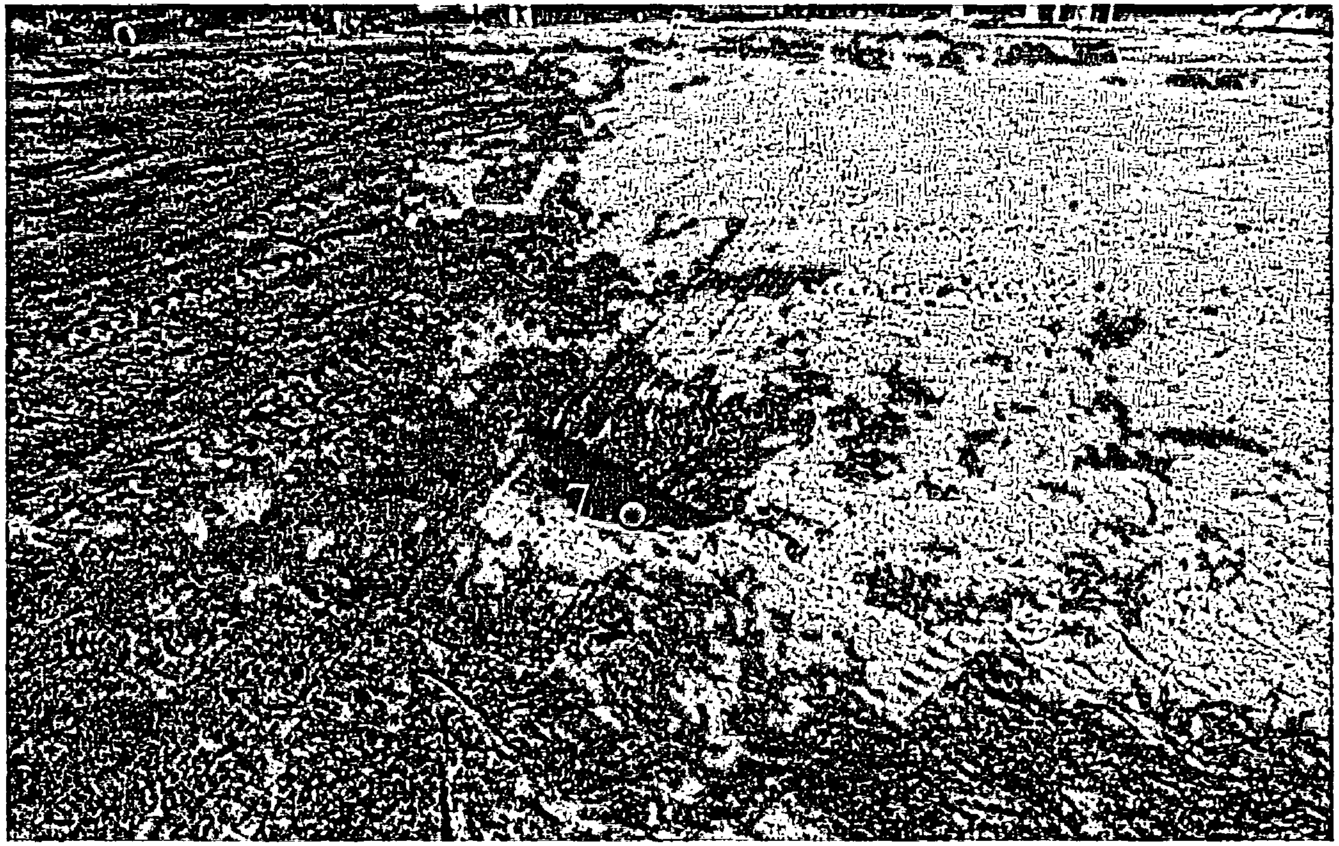
Location of ORISE Sample Location 6A. Sample 6A = 0.07 pCi/g Total Thorium and Non-Detect for Total Uranium

ORISE 6B



Location of ORISE Sample Location 6B. Sample6B = 1.79 pCi/g Total Thorium and 7.62 pCi/g Total Uranium

ORISE 7



Location of ORISE Sample Location 7. Sample 7 = 2.0 pCi/g Total Thorium and Non-Detect for Total Uranium

ORISE 8

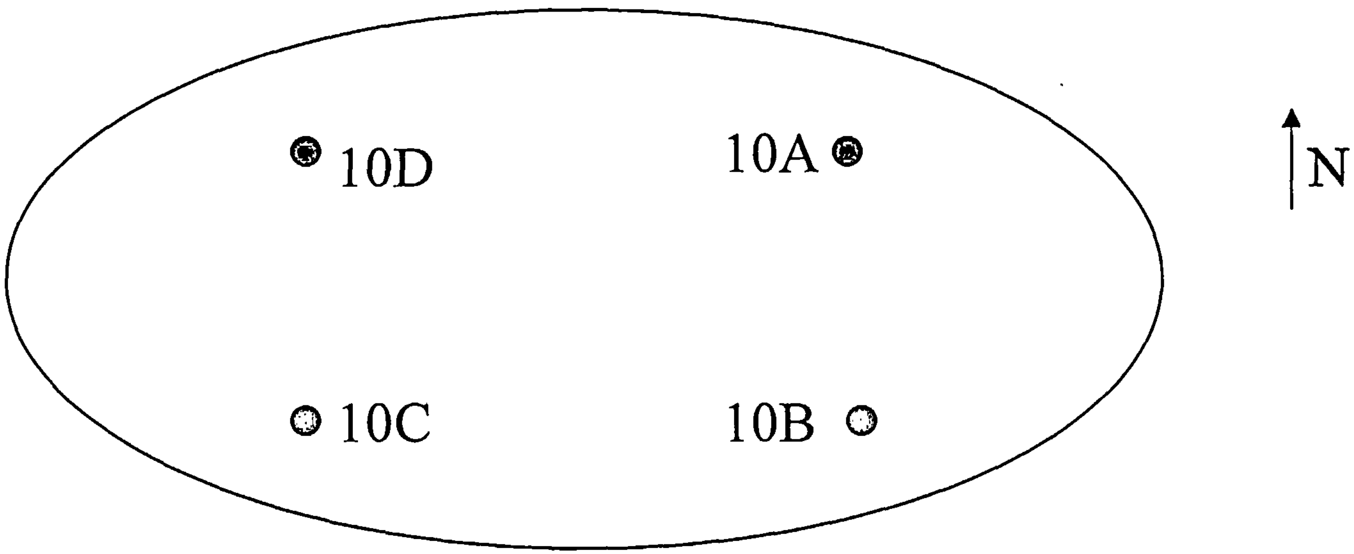
Location of ORISE Sample Location 8. Sample 1A = 6.59 pCi/g Total Thorium and 5.37 pCi/g Total Uranium

ORISE 9

Location of ORISE Sample Location 9. Sample 9A = Non-Detect for Total Thorium and 3.79 pCi/g for Total Uranium; Sample 9B = 0.40 pCi/g Total Thorium and 6.74 pCi/g Total Uranium; Sample 9C = 0.12 pCi/g Total Thorium and 1.60 pCi/g Total Uranium

Diagram of Sampling Locations Under Stockpile

STOCKPILE FOOTPRINT



Stockpile footprint Sample Location 10. Sample 10A = 0.59 pCi/g Total Thorium and 5.08 pCi/g Total Uranium; Sample 10B = 1.86 pCi/g Total Thorium and 8.66 pCi/g Total Uranium; Sample 10C = 0.70 pCi/g Total Thorium and 5.16 pCi/g Total Uranium; Sample 10D = 1.45pCi/g Total Thorium and 7.64 pCi/g Total Uranium

ORISE Report
March 2002

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

April 10, 2002

Docket No. 04008980 License No. SMB-1541

John F. Lord
Site Manager
Heritage Minerals, Inc.
One Hovchild Plaza
4000 Route 66
Tinton Falls, NJ 07753

SUBJECT: ORISE CONFIRMATORY SURVEY REPORT

Dear Mr. Lord:

Our February 14, 2002, letter to you provided preliminary results from the December 2001 confirmatory survey performed by our contractor, the Oak Ridge Institute for Science and Education (ORISE). The survey results showed that remediated areas identified in your Final Status Survey did not meet the NRC's guidelines for unrestricted release. As discussed with you during our February 26, 2002, site visit, we are concerned about residual contamination remaining in the pile area and on surface structures in mill buildings. We are also in receipt of your March 26, 2002, response to our February 14, 2002, letter in which you acknowledge that additional contamination remains in these areas.

Enclosed is the final ORISE report which includes an analysis of your Final Status Survey and measurements of selected areas around the site. We request a response to the issues raised in the section of the report entitled, "Findings and Results". The response should propose a work plan and schedule to ensure contaminated material is adequately removed from designated areas. Attention should be given to finalizing remediation activities for licensed material within the monazite pile and in mill buildings to meet NRC unrestricted release guidelines.

Your March 26, 2002, letter provided additional detail about activities in the mills and disposal of material in the pile area from previous operations. In order to complete the remediation of licensed material, you indicated that process history information will be developed to further characterize areas in question so that site locations of HMI-generated contamination can be properly identified. We believe that historical information will be beneficial in assessing the amount of licensed residual material remaining onsite. Please notify us of the results of your investigation when completed.

Concerns raised in your March 26, 2002, letter over jurisdiction of material and your revised sampling plan are under NRC review. Information about the procedures used by ORISE for radiological surveys and laboratory analysis may be found in their technical manual at http://www.orau.gov/essap/techman.htm.

Note that since site decommissioning is currently incomplete, we are reviewing the timeliness of remediation efforts following decommissioning plan approval on October 19, 1999, as they relate to the requirements of 10 CFR 40.42(h). Your request for exemption or extension to these requirements does not provide sufficient information to determine whether NRC action is necessary. If you wish to pursue an exemption for an alternate schedule, you must provide the required information specified in 10 CFR 40.42(h)(2)(i).

You also indicate that HMI is investigating the feasibility of dismantling the wet and dry mills. We believe it would be beneficial to meet and discuss possible proposals for near-term activities for the mills, and also the pile area, which address the required remediations prior to license termination. As you discussed with Craig Gordon, the meeting will be held on April 23, 2002, in the Region I office at 10:00 a.m.

Should you have any questions about the ORISE report, please contact me or Craig Gordon. Thank you for your cooperation.

Sincerely,

Ronald R. Bellamy, Chief
Decommissioning and Laboratory Branch
Division of Nuclear Materials Safety

Enclosure: ORISE Confirmatory Survey Report

cc: Anthony J. Thompson, Esquire
Nancy Stanley, NJDEP
The Honorable Michael Fressola, Mayor, Manchester Twp.

ORISE 2002-0420

CONFIRMATORY SURVEY OF PORTIONS OF THE HERITAGE MINERALS INCORPORATED FACILITY LAKEHURST, NEW JERSEY (DOCKET NO. 040-08980; RFTA NO. 01-012)

Prepared by

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Prepared for the

U.S. Nuclear Regulatory Commission
Region I Office

FINAL REPORT

MARCH 2002

This report is based on work performed under an Interagency Agreement (NRC Fin. No. J5403) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC05-00OR22750 with the U.S. Department of Energy.

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HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY
(DOCKET NO. 040-08980; RFTA NO. 01-012)

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ACKNOWLEDGMENTS

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ABBREVIATIONS AND ACRONYMS

ϵ_i	instrument efficiency
ϵ_s	surface efficiency
µrem/h	microrem per hour
µR/h	microroentgens per hour
b_i	background counts in observation interval
BKG	background
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
dpm	disintegrations per minute
dpm/100 cm^2	disintegrations per minute per one hundred square centimeters
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
FSS	final status survey
GM	Geiger-Mueller
ha	hectares
HMI	Heritage Minerals, Inc.
ITP	Intercomparison Testing Program
kg	kilogram
km	kilometer
m	meter
mm	millimeter
m^2	square meter
MAPEP	Mixed Analyte Performance Evaluation Program
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MeV	mega electron volts
MRI	Mineral Recovery, Inc.
NaI	sodium iodide
NIST	National Institute of Science and Technology
NRC	Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
RSI	Radiation Science, Inc.
SU	survey unit
ZnS	zinc sulfide

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INTRODUCTION AND SITE HISTORY

From 1973 to 1982, the Heritage Minerals, Inc. site was operated by ASARCO, Incorporated. ASARCO's operations consisted of the hydraulic mining (dredging) of sand deposits and the processing of these sands to extract the titanium mineral, ilmenite. The deposits contained approximately 95% silica (common sand) and 5% heavy minerals. There are many mineral constituents in the deposits that are heavier than silica; ilmenite is the predominant heavy mineral, followed by zircon, kyanite, sillimanite, rutile, staurolite, tourmaline and monazite. The monazite contains thorium and uranium causing the deposits to be radioactive.

ASARCO's process involved creating a pond for the dredge. The raw material was then brought in and placed in the dredge pond where the dredge sand was pumped to a screening barge where large roots, clay balls, and gravel were removed from the sand. The screened sand was pumped in slurry form to a land based processing plant where the heavy metals were concentrated using spiral separators in a Wet Mill. The Wet Mill tailings, consisting of silica sand and water, were pumped back to the dredge pond as backfill. The heavy metals followed a different path and were dewatered and stockpiled outside the Wet Mill. ASARCO then used water to wash away the fine clay which coated the mineral particles. Excess wash water and suspended clay were decanted off using large holding tanks before pumping out the sand. Clay-laden water was pumped to a series of large-area settling ponds on the north side of the Wet Mill. It should be noted that the monazite concentration was increased by the ratio of 24:1 as a result of going through the Wet Mill and concentrating the heavy minerals down from 1,200 tons to 50 tons.

The heavy mineral concentrate was then allowed to drain before it was transferred to a storage silo. The material was then fed onto a conveyor belt and dumped into an oil-fired rotary dryer where the sands were heated to 300 °F and completely dried. The heated sand was then conveyed to the Dry Mill which contains high-tension electrostatic separators and high-intensity magnetic separators.

The high tension separators removed the ilmenite which is electrically conductive while the other heavy minerals remaining in the concentrate are non-conductors. The ilmenite was then placed in storage bins for shipping to customers while the non-conductor minerals, referred to as the Dry Mill tailings, contained virtually all of the monazite material at a ratio of 2.5:1. These tailings were then mixed with water and pumped to a storage area east of the mill. ASARCO had planned to process the Dry Mill tailings at a later date for the extraction and sale of the zircon and monazite; however, deteriorating market conditions caused ASARCO to discontinue all operations at the site in 1982 and the property was sold to Heritage Minerals, Inc. (HMI) in 1986 (RSI 1997).

After the property was purchased by HMI, the plant facilities were leased to Mineral Recovery, Inc. (MRI). MRI performed laboratory tests for the recovery of zircon and additional titanium minerals left behind by ASARCO; the monazite was to remain as part of the Dry Mill tailings. MRI began plant operations in October 1986 and continued until August 1987 when their lease expired. HMI then took over operation of the mill until August 1990, when all production was stopped (RSI 1997).

It was during the period when HMI began operations that the Dry Mill tailings, containing the monazite, were reprocessed through the mills. The Dry Mill tailings, now referred to as the New Feed for the zircon plant, were mixed with water and pumped to the Wet Mill. The slurry was then processed through Humphreys spirals to remove any remaining silica sand and some of the aluminum minerals. Practically all of the monazite makes it through this process. The tailings were then collected in a holding tank (sump) and pumped to the area north of the Wet Mill where it was dewatered and dried in the rotary dryer. The product was then fed to the Dry Mill where titanium minerals were separated using the high tension machines. The remaining material, containing the zircon and monazite, was reslurried with water and pumped back to the Wet Mill where the material was fed into a hydraulic classifier and then into shaking tables to remove remaining aluminum minerals. The table concentrate was then dewatered on a vacuum filter and dried and heated in a second oil-fired rotary dryer. The material was then conveyed over to the Dry Mill and processed through the zircon circuit to remove the zircon (and monazite). Another process produced market-grade zircon with some monazite impurities. The remaining product, containing the majority of the monazite was then processed through the wet mill where it was combined with the spiral tailings and table tailings to make up the plant tailings which were then pumped to a storage area (RSI 1997).

In March, 1990, HMI decided that sufficient zircon and titanium products remained in the plant tailings to warrant a second round of processing known as Phase II of the operation. HMI incorporated some minor variations to the above mentioned process during Phase II operations. One of these changes, which was dictated by the U.S. Nuclear Regulatory Commission (NRC) during the licensing process, involved isolating the monazite-rich tailings. The new procedure had the mill tailings being stored in an area southeast of the Dry Mill known as the Monazite Pile. In August 1990, after about 200,000 tons of tailings were processed through the plant, HMI decided to terminate all operations due to the economic turndown which resulted in a reduced demand for plant products (RSI 1997).

The reprocessing of the 200,000 tons of plant tailings resulted in the production of about 150,000 tons of tailings that were relatively monazite free. These tailings were stored separately from the Monazite Pile. As a result, approximately 1,400 tons of monazite-rich product were generated and were stored in the Monazite Pile. The Monazite Pile and the plant buildings are under control of the NRC according to terms of License No. SMB-1541 because of the thorium and uranium concentrations.

After the plant shutdown in August 1990, both mills were subjected to a thorough cleaning and decommissioning. All the equipment in the Wet Mill which was used in the project was washed down with high-pressure water hoses and nozzles until no sand was visible on or around the equipment. The sand and water collected in the sumps and pumps were drained on the concrete floor and the sand was collected and transported to the Monazite Pile using shovels and wheelbarrows. Because of the electrical equipment present in the Dry Mill, water was not used to clean the equipment. Instead, high pressure air hoses were used to blow down the sand and dust from the equipment, structural steel, walls, and other surfaces (RSI 1997).

After the plant cleanup, a gamma survey was performed within the plant building and on selected pieces of equipment which were known to have been in contact with the monazite-containing product. Direct measurements were also performed on selected pieces of equipment (wet tables, dryer, and dry magnets). These survey activities were performed in January 1991 (RSI 1997).

Radiation Science, Inc. (RSI), the health physics contractor to HMI, performed a survey of the natural background levels of uranium and thorium within the soils and background exposure rates in 1996 (RSI 1996). This information was used to correct final survey soil sample and exposure rate data.

Currently, the site has been decommissioned with some support buildings still being used for equipment storage and repair. The Wet and Dry Mill equipment is non-operational but both buildings contain millions of dollars worth of heavy equipment including tanks, elevators, high tension separators, piping, and hundreds of tons of heavy equipment and structural supports.

RSI used two classifications to distinguish survey units for final surveys—these included Affected and Unaffected areas. NUREG/CR-5849 was used by RSI as the governing document for releasing the Wet and Dry Mills (NRC 1992a). The major radiological contaminants of concern for the Wet and Dry Mills are thorium and uranium (and associated decay products).

The NRC Division of Waste Management requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform radiological confirmatory survey activities on various portions of the HMI facility in Lakehurst, New Jersey.

SITE DESCRIPTION

HMI is located in Lakehurst, New Jersey and is approximately 50 kilometers [km (30 miles)] southeast of downtown Trenton, New Jersey (Figure 1). The HMI facility consists of two large milling buildings known as the Wet and Dry Mills and other support (warehouse and office areas) and laboratory buildings occupying approximately 2,800 hectares [ha (7,000 acres)]. The site is bounded on the north and west by Route 70, the east by Route 37 and to the south by two residential areas and Pinewald Keswick Road (Figure 2).

The portion of the facility where the NRC licensed work (monazite milling) was performed was within the two milling buildings and the area known as the Monazite Pile (Figure 3). The mill buildings consist of metal frames and roofs and the siding is corrugated steel. The floor construction varies from area to area and is a combination of poured concrete, brick and bare earth. There are few windows, several garage-type doors, several standard entrances, and several roof ventilator fans. The stairs and upper floor areas are of steel/aluminum deck grating, typical of milling/manufacturing buildings.

The Wet Mill contains the process equipment that was used to extract the product material from the raw materials. The Dry Mill contains the process equipment used to extract the product materials from the Wet Mill process feed. A ten meter square grid system was established by RSI around the Monazite Pile and extended out to ten meters beyond the fenced borders of the pile. The pile has since been removed exposing natural soils below and the grid system is no longer in place.

There are also five other buildings on the site—these are the Laboratory, Maintenance, Warehouse, Main Office, and Change House buildings where monazite-rich products may have been handled. Monazite was also sampled or analyzed in the laboratory, so the Laboratory Building was considered in the survey. However, affected process equipment was repaired in the mill buildings rather than being repaired in the Maintenance Building therefore, this building was not included in the survey activities (RSI 1997).

OBJECTIVES

The objectives of the radiological confirmatory survey were to provide independent contractor field data reviews and radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and final status survey results, relative to established guidelines. Information was gathered to evaluate the facility's current radiological status as reported by the licensee.

DOCUMENT REVIEW

ESSAP reviewed some of the site documentation and the final status survey plan prior to visiting the site and reviewed the final status survey report while on site (RSI 1997 and 2001).

RADIOLOGICAL SURVEY PROCEDURES

ESSAP personnel visited and performed a confirmatory survey of the HMI facility during the period of December 10 through 13, 2001. Survey activities were conducted in accordance with a site-specific survey plan, submitted to and approved by the NRC (ORISE 2001a), and the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2000 and 2001b). Survey activities included gamma, alpha plus beta, and beta surface scans, direct measurements, soil sampling, miscellaneous sampling, and exposure rate measurements. This report summarizes the procedures and results of the survey.

ESSAP used the following radiological survey procedures to conduct confirmatory survey activities on building, equipment, and soil surfaces that are to be released for unrestricted use. Specific survey units (SU) were surveyed based on RSI's two classifications (Affected and Unaffected)—these classifications were based on the potential for radiological contamination; on historical process knowledge; and, on RSI's characterization survey findings. ESSAP performed confirmatory surveys in 17 of the SUs in the Dry and Wet Mills for which RSI has provided data—these SUs were selected based on RSI's final status data.

INTERIOR

ESSAP used the following procedures for the interior surfaces of the Laboratory and Mill Buildings.

Reference System

The complexity of the interior of both buildings posed a challenge to the application of a two-dimensional grid systems as described in Draft NUREG/CR-5849 (NRC 1992a). Therefore, ESSAP used digital pictures created by both ESSAP and RSI to document surface activity measurement locations on equipment surfaces. The floor plan figures provided by RSI were used to document surface activity measurements on floor surfaces.

Surface Scans

Based on the classification of the interior SUs by the licensee, surface scans for alpha plus beta, beta, and gamma radiation were performed at up to 20% of the structural surfaces in affected survey units and at judgmental locations within the structural surfaces in unaffected survey units. Surface scans for alpha plus beta and gamma radiation were performed on up to 100% of the ground floor surfaces of the Dry Mill and the eastern half of the Wet Mill. Particular attention was given to cracks and joints in the structural surfaces where material may have accumulated. Interior scans were performed using gas proportional, ZnS, GM, and NaI scintillation detectors coupled to ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation detected by surface scans were marked for further investigation.

Surface Activity Measurements

Initially, construction material-specific backgrounds were determined in areas of similar construction, but without a history of radioactive material use. Additionally, ambient backgrounds were determined in areas where direct surface activity measurements were performed. These background measurements were used to correct gross surface activity measurements.

Direct measurements of surface activity were performed at a total of 129 locations on equipment and building surfaces (Figures 4 through 21). The majority of the direct measurements were performed using gas proportional detectors—GM and ZnS scintillation detectors were used in areas that were inaccessible to the gas proportional detectors. All detectors were coupled to ratemeter-scalers. Smear samples, for the determination of removable gross alpha and gross beta activity levels, were collected from each accessible direct measurement location.

Exposure Rate Measurements

Interior background exposure rate measurements were performed within the Main Office Building which has similar construction, but no history of radioactive material use. Exposure rates were performed at a total of ten locations within both the Wet Mill and Dry Mill buildings (Figures 21 and

22) and three locations within the Laboratory Building (no figure). Exposure rates were performed at one meter from the surface using a microrem meter.

Residue Sampling

Residue samples were collected from two locations in the Dry Mill and one location in the Wet Mill (Figures 7, 18, and 20).

EXTERIOR

ESSAP used the following procedures for the Monazite Pile and the adjacent areas surrounding the Monazite Pile and the Dry Mill Building.

Reference System

Since the reference system utilized by RSI was no longer in place, ESSAP established a 10 m × 10 m reference grid system for the former Monazite Pile area. An aerial photo and landmarks were used for referencing other exterior locations that were not within the Monazite Pile area.

Surface Scans

Gamma scans were conducted over 100 percent of accessible soil surfaces within and in the immediate vicinity (5 meters) of the Monazite Pile area. Cursory gamma scans were performed at other suspect locations, i.e., near the Dry Mill and in areas between the Dry Mill, Monazite Pile and the pond. Gamma scans were performed using NaI scintillation detectors coupled to ratemeters with audible indicators. Locations of elevated radiation were marked for further investigation.

Exposure Rates

Exterior background exposure rate measurements were performed at six locations within a 0.5 to 10 km radius of the site (Figure 23). Site exposure rates were measured at 23 surface soil sample locations (Figures 24 and 25). Exposure rate measurements were performed at one meter above the surface using a microrem meter.

Soil Sampling

Background soil samples were collected from each external background exposure rate measurement location (Figure 23). Surface (0 to 15 cm) soil samples were collected from 17 locations in three grid blocks within the former Monazite Pile (Figure 24). Four soil samples were collected from each of the selected grid blocks at the points midway between the center and grid block corners of the selected grid blocks. Several soil samples were also collected within these three grid blocks at locations of elevated direct radiation identified by surface scans. Additional soil samples were collected at locations outside the former Monazite Pile at locations of elevated direct radiation identified by surface scans (Figure 25). Subsurface soil samples were collected from ten locations where elevated radiation was suspected to be present below the initial 15 cm of exposed soils (Figures 24 and 25). Samples collected by RSI were also requested for confirmatory analysis.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2001c). Soil and residue samples were analyzed by gamma spectroscopy and results reported in picocuries per gram (pCi/g). The radionuclides of interest are uranium and thorium; however, spectra were reviewed for other identifiable photopeaks. Smears were analyzed for gross alpha and gross beta activity using a low-background gas proportional counter. Direct measurement data and smear data were converted to units of disintegrations per minute per one hundred square centimeters (dpm/100 cm^2). Exposure rates were reported in microroentgens per hour (μR/h). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B.

FINDINGS AND RESULTS

Although the final status survey (FSS) report was not available until ESSAP was on-site, electronic versions of figures and data for surface activity measurements were provided prior to the survey site visit. NRC inspection of licensee documentation for surface scans and samples taken after the pile removal showed soil concentrations to be within unrestricted release guideline values. The confirmatory survey was performed based upon the licensee's indication that remediation activities were completed. The FSS report containing the remaining text and the soil sample data were provided at the time of the survey.

DOCUMENT REVIEW

Review of the FSS report indicated that:

- documentation was described for alpha surface activity measurements only. Prescribed ESSAP survey procedures have been developed based on previous experience which shows that surface activity measurements for thorium and/or uranium should also include consideration for beta activity measurements, due to attenuation problems associated with measuring alpha contamination on rough, porous, or dirty surfaces;
- interpretation of averaging guidelines for soils within the Monazite Pile did not follow NUREG/CR-5849 guidance. Soil samples were collected at a rate of one per 100 square meter grid and averaged over the entire Monazite Pile area (approximately fifteen 10 m × 10 m grid blocks);
- soil backgrounds were typically elevated in the Monazite Pile area and around the Mill buildings. This did not agree with RSI's Report of Site Backgrounds, performed in July 1996, which indicated that the average U-238 and Th-232 background concentrations were 0.31 and 0.25 pCi/g, respectively. The average background level was 3 µrem/h (RSI 1996); and,
- the Monazite Pile was scanned over 100% of the surface area with a NaI probe suspended approximately 2 feet above the surface of the soil. The scanning methodology was not

consistent with NUREG/CR-5849 guidelines which specifies measurements to be taken in closer proximity to the soil surface.

INTERIOR

The results for the Wet and Dry Mills and the Laboratory Building are discussed below.

Surface Scans

Several areas of elevated alpha plus beta and beta activity were detected on the floors and equipment within the Mill Buildings. Most of the activity appeared to be in locations where sand, dust, or debris had gathered. Surface scans also detected alpha plus beta activity within the Laboratory Building.

Surface Activity Measurements

Results of total alpha and alpha plus beta surface activity levels for the interior areas are summarized in Table 1. Total activity levels in the Laboratory Building ranged from 9 to 720 dpm/100 cm^2 for alpha and -240 to 3,500 dpm/100 cm^2 for alpha plus beta. Total activity levels in the Wet Mill ranged from 140 to 2,300 dpm/100 cm^2 for alpha and 810 to 35,000 dpm/100 cm^2 for alpha plus beta. Total activity levels in the Dry Mill ranged from 200 to 2,600 dpm/100 cm^2 for alpha and 73 to 89,000 dpm/100 cm^2 for alpha plus beta. Removable activities for all areas ranged from 0 to 150 dpm/100 cm^2 for alpha and -5 to 730 dpm/100 cm^2 for beta.

Exposure Rate Measurements

The exposure rates for the Laboratory and the Wet and Dry Mills are summarized in Table 2 and ranged from 7 to 17 μR/h. Background exposure rates in the main equipment building ranged from 4 to 8 μR/h and averaged 6 μR/h.

Residue Sampling

Concentrations of radionuclides in site residue samples are summarized in Table 3. The radionuclide concentrations for the three samples were: 120, 870, and 1,400 pCi/g for total uranium and 640, 1,300 and 3,100 pCi/g for total thorium.

EXTERIOR

The results for the Monazite Pile and exterior areas adjacent to the Pile and Mill Buildings are discussed below.

Surface Scans

Gamma scans conducted over the former Monazite Pile and the surrounding areas of the Pile and the Mill Buildings identified multiple locations of elevated direct gamma radiation.

Exposure Rates

Site and background exposure rates are summarized in Table 4. Site exposure rates ranged from 15 to 30 μR/h. Background exposure rates ranged from 3 to 7 μR/h and averaged 4 μR/h.

Soil Sampling

Radionuclide concentrations in site soil samples are summarized in Table 4. The radionuclide concentration for the individual samples ranged as follows: 2.3 to 120 pCi/g for total uranium and 5.6 to 1540 pCi/g for total thorium. The grid block average concentrations for surface samples collected within the three 100 m^2 grid blocks of the former Monazite Pile were 6.9, 29 and 31 pCi/g for total uranium and 15, 75 and 150 pCi/g for total thorium.

Concentrations of radionuclides in background samples are summarized in Table 4 and ranged as follows: 0.5 to 1.0 pCi/g for total uranium and 0.3 to 0.6 pCi/g for total thorium.

Confirmatory Sample Analyses

Three samples that RSI had analyzed at a contracted, off-site laboratory were also analyzed by ESSAP. The analytical results for the comparative evaluation of the RSI archived samples are provided in Table 5 and indicated that the RSI contractor laboratory data were consistent and in agreement with ESSAP's analytical results.

COMPARISON OF RESULTS WITH GUIDELINES

The primary contaminants at this site are thorium and uranium. The applicable NRC guidelines for natural thorium and natural uranium surface activity levels are (NRC 1987):

Natural Uranium

5,000 α dpm/100 cm^2, averaged over a 1 m^2 area

15,000 α dpm/100 cm^2, total, maximum in a 100 cm^2 area

1,000 α dpm/100 cm^2, removable

Natural Thorium

1,000 dpm/100 cm^2, averaged over a 1 m^2 area

3,000 dpm/100 cm^2, total, maximum in a 100 cm^2 area

200 dpm/100 cm^2, removable

Because RSI has elected to use the more restrictive guidelines for thorium contamination, ESSAP used RSI's approach for confirmatory measurements and data comparison. Natural thorium emits both alpha and beta radiations, therefore, either alpha or beta activity may be measured for determining the residual activity of the thorium contaminant. As interpreted by the NRC, the average 1,000 dpm/100 cm^2 and maximum 3,000 dpm/100 cm^2 should apply independently to both alpha and beta measurements for surface contamination involving natural thorium (NRC 1992b). ESSAP's experience has shown that beta measurements typically provide a more accurate evaluation of thorium contamination on structural surfaces due to problems inherent in measuring alpha contamination on rough, porous, and/or dirty surfaces. For the thorium series in secular equilibrium, the activity level providing 1,000 alpha dpm/100 cm^2 would result in about 670 beta dpm/100 cm^2. Therefore, a beta activity measurement that is greater than 670 dpm/100 cm^2 was considered to have exceeded the alpha activity guideline for thorium. However, based on the standard thorium guideline, of the 129 direct measurements that were performed for alpha plus beta activity, 20 exceeded the average guideline and 75 exceeded the maximum. Even with the attenuation of alpha particles due to the heavy dust levels, seven of the 26 alpha direct measurements still exceeded the average guideline—none exceeded the maximum guideline. One smear sample collected from SU42 in the Dry Mill exceeded the removable guideline.

The NRC guideline for exposure rates at one meter above building surfaces is 5 μR/h above background (NRC 1991). Of the 18 exposure rates that were performed in the Laboratory and Mill Buildings, three measurements in the Dry Mill and two in the Wet Mill exceeded this guideline.

The NRC guideline for exposure rates at one meter above the surface for exterior areas is 10 μR/h above background (NRC 1981). All on-site exposure rate measurements exceeded this guideline value with the average background exposure rate of 4 μR/h.

The soil guidelines are as follows (NRC 1981 and 1983):

Radionuclide	Soil Concentration Above Background (pCi/g)
Total uranium	10
Total thorium	10

Of the 34 surface and subsurface soil samples that were collected from the HMI site, 27 exceeded the guideline for total uranium and 32 exceeded the guideline for total thorium. Only two of the samples that were collected did not exceed either guideline.

SUMMARY

The Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education performed confirmatory survey activities of the Wet and Dry Mill Buildings, the Laboratory, the former Monazite Pile, and soil areas adjacent to these areas at the Heritage Minerals Site during the period of December 10 through 13, 2001. Survey activities included a review of the final status survey report and performance of independent gamma and alpha plus beta scans, direct surface activity measurements, exposure rate measurements, and miscellaneous and soil sampling.

The results of the verification activities indicated that surface activity levels and radionuclide concentrations in soil exceeded guideline levels. The majority of surface activity measurements and soil samples collected by ESSAP exceeded the appropriate guidelines. Furthermore, each of the three residue samples collected from the Mill Buildings had total uranium and total thorium levels in excess of 120 and 640 pCi/g, respectively. While elevated radionuclide concentrations were present in surface soil samples, it was apparent that elevated concentrations were also present at various subsurface depths. Scoping surveys of unaffected mill and other exterior areas also showed indication of residual radionuclide contamination.

FIGURES

792-001 (1)

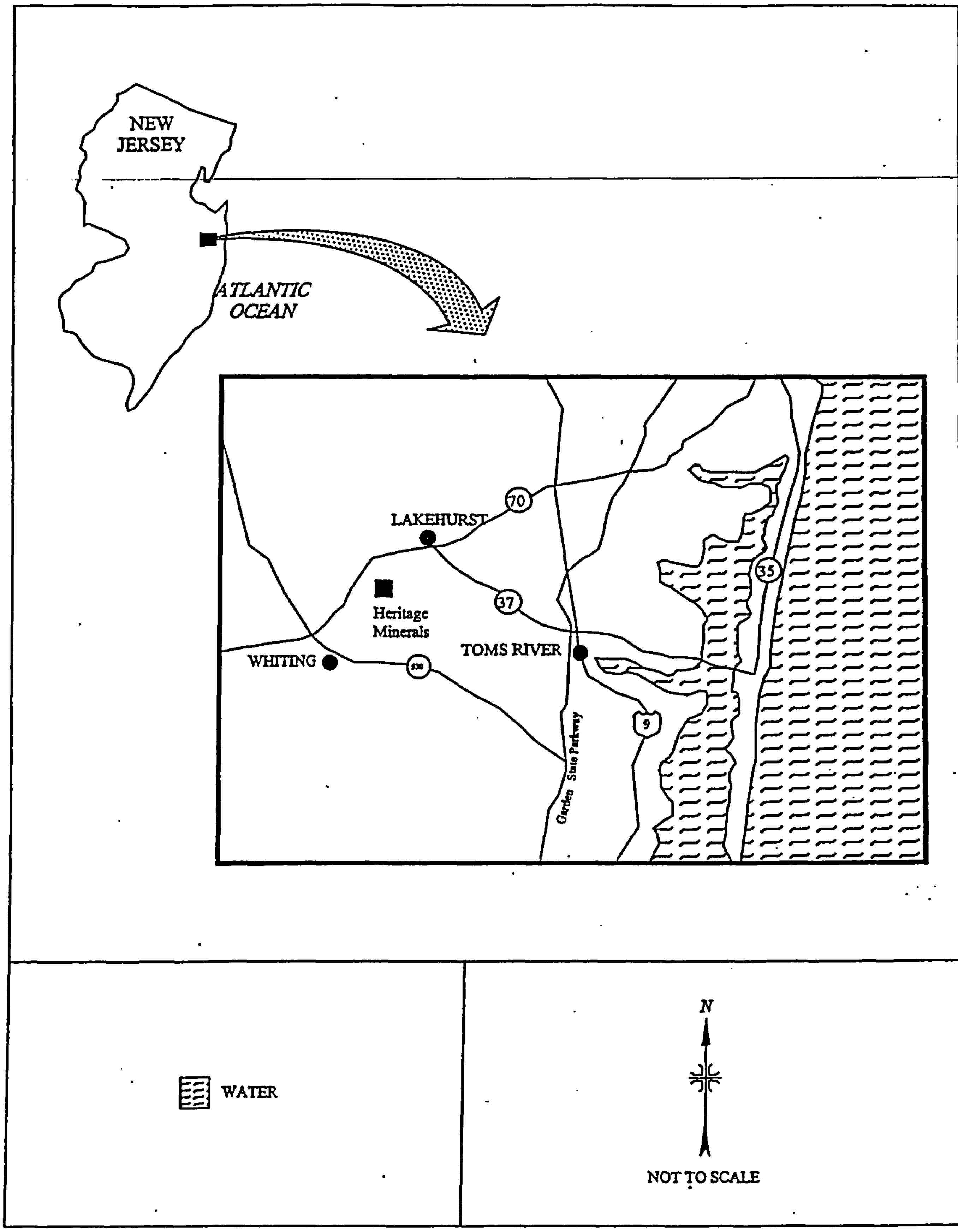


FIGURE 1: Location of the Heritage Minerals Site - Lakehurst, New Jersey

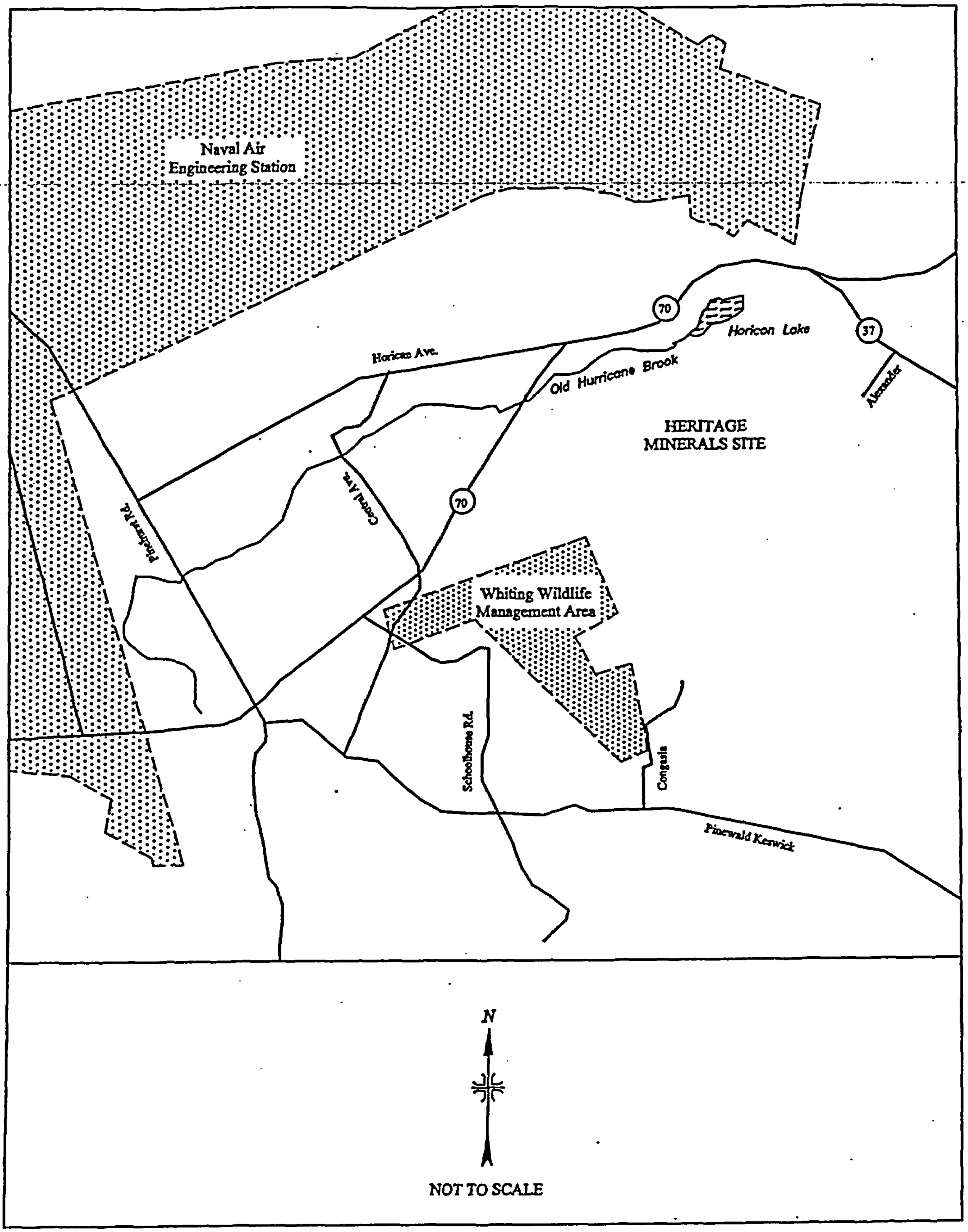


FIGURE 2: Heritage Minerals Site - Lakehurst, New Jersey

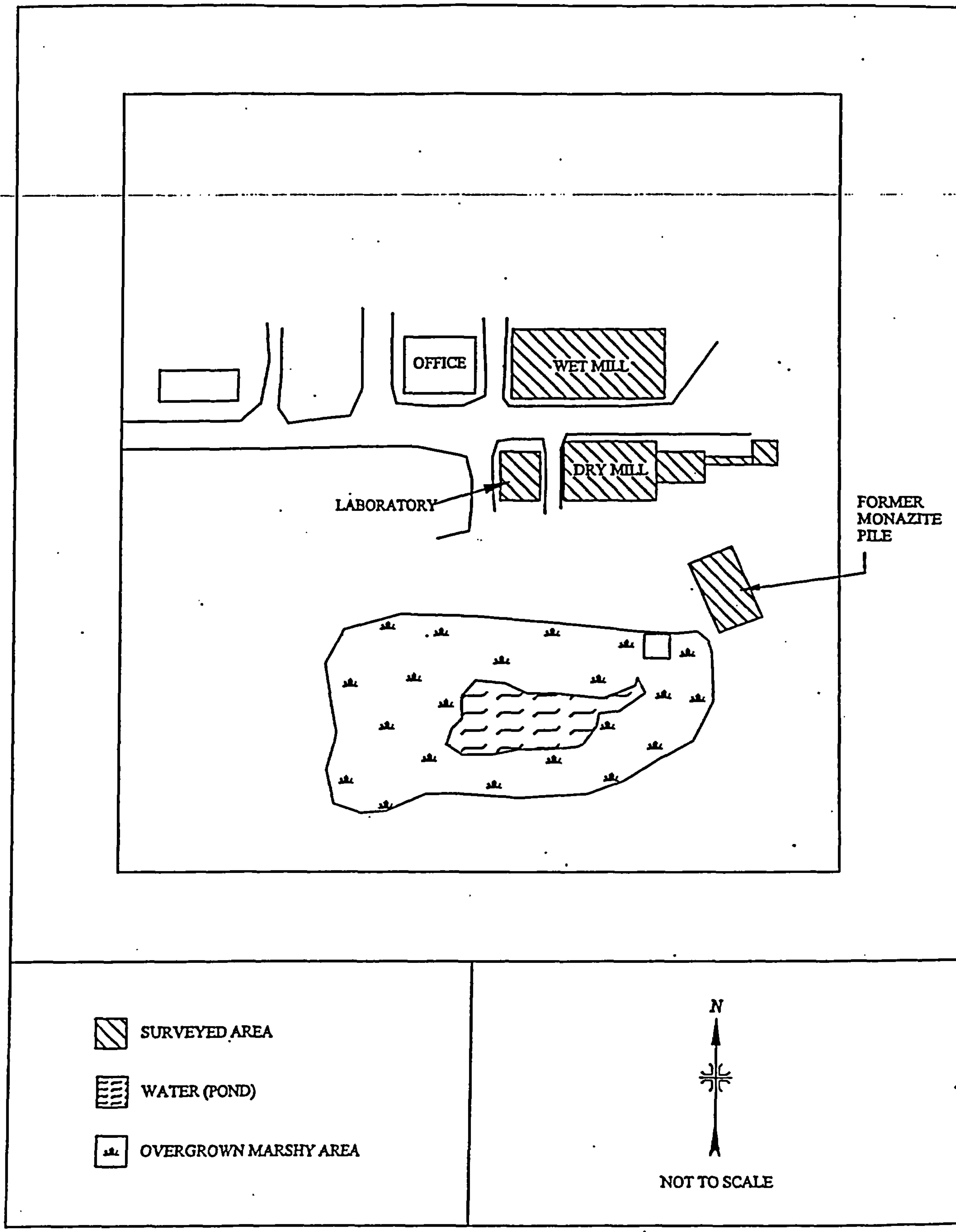
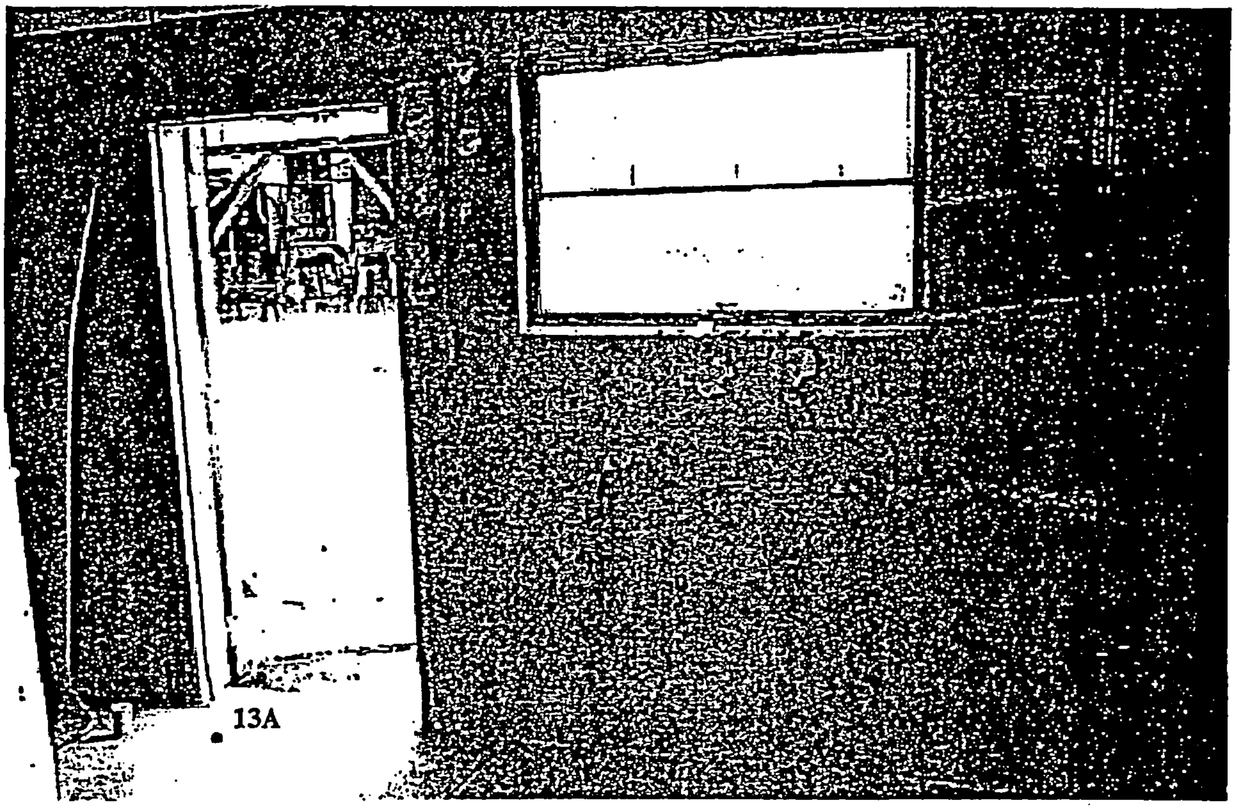
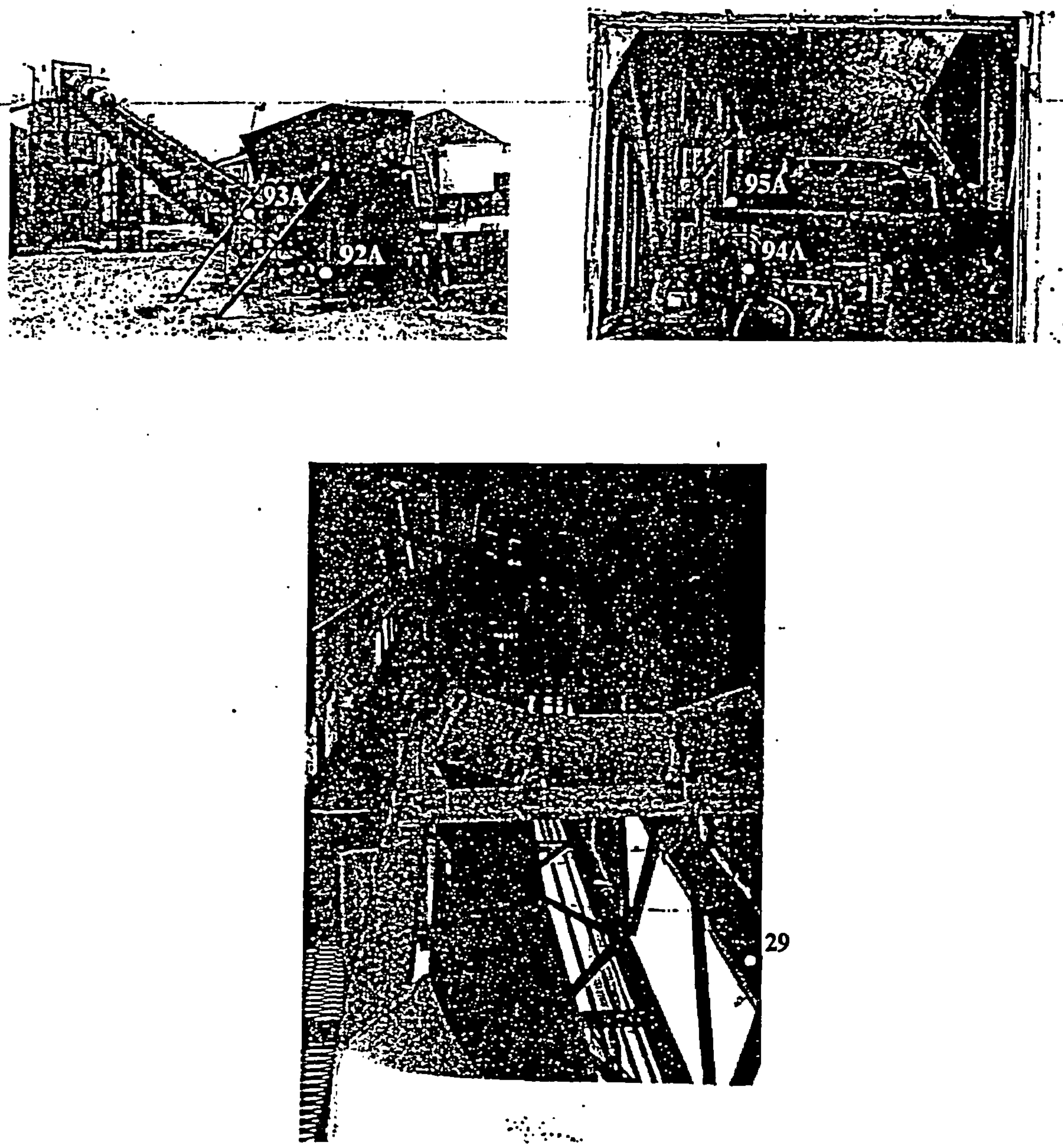


FIGURE 3: Heritage Minerals Site - Location of Surveyed Areas



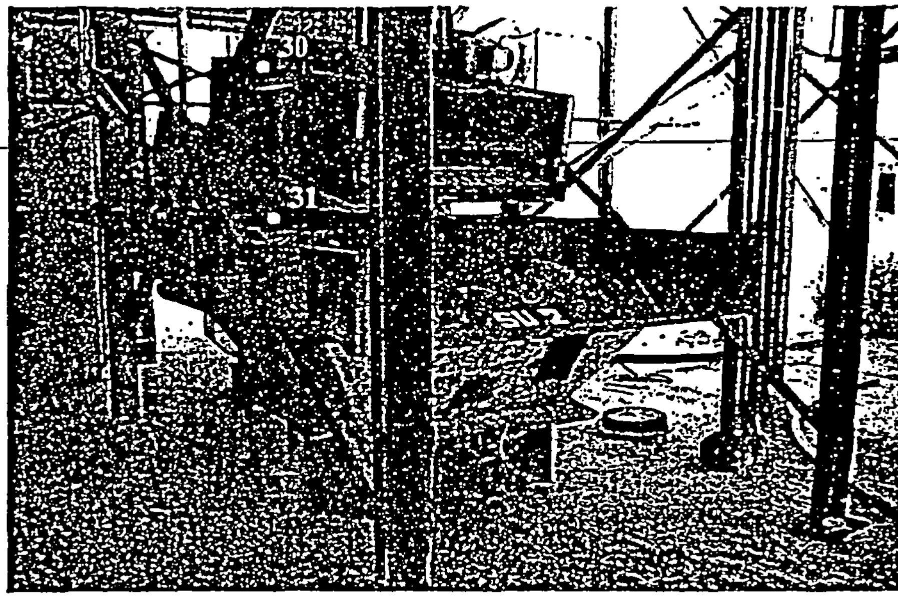
MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

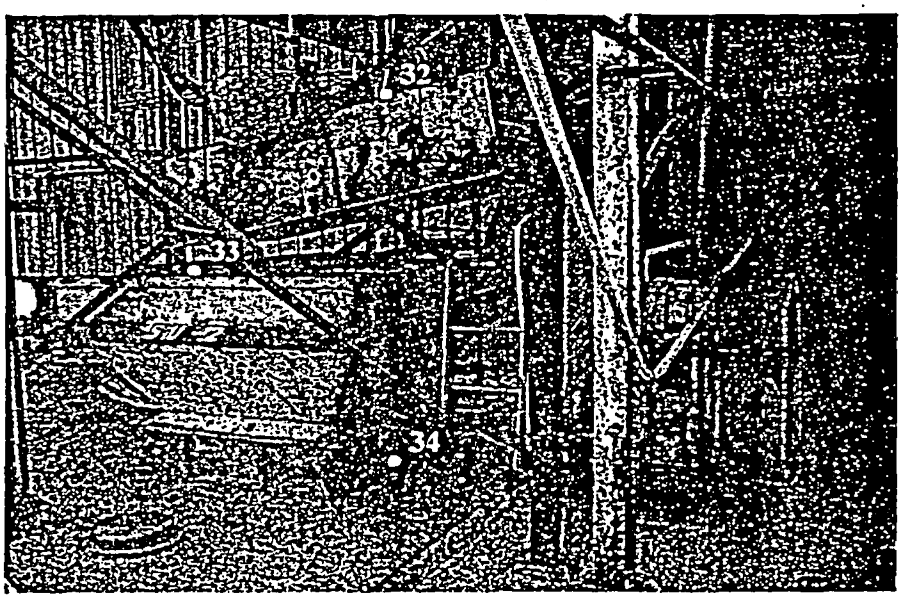
FIGURE 4: Laboratory — Location of Measurement 13A



MEASUREMENT/SAMPLING LOCATIONS	NOT TO SCALE
• # SINGLE POINT	

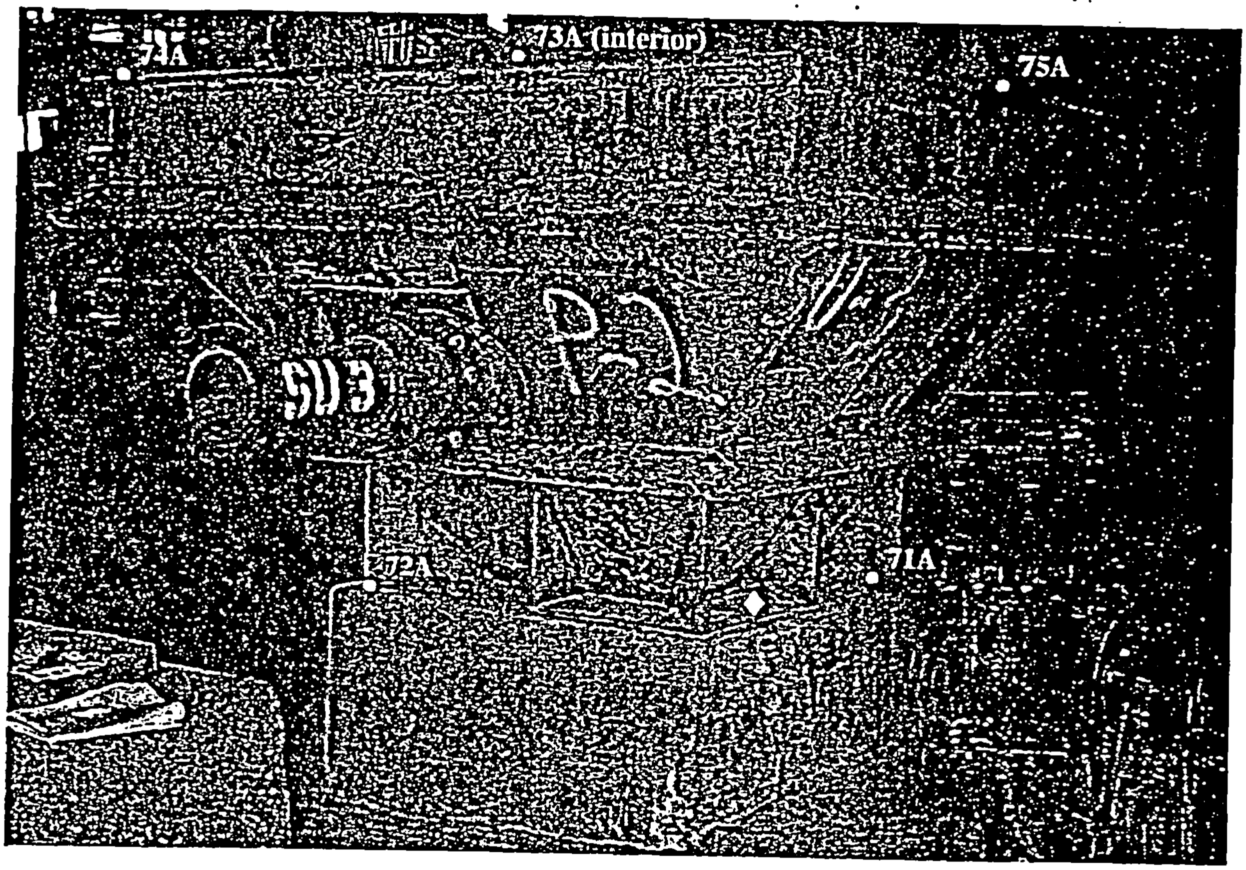
FIGURE 5: Survey Unit 1 — Direct Measurement and Sampling Locations





MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 6: Wet Mill, Survey Unit 2— Direct Measurement and Sampling Locations

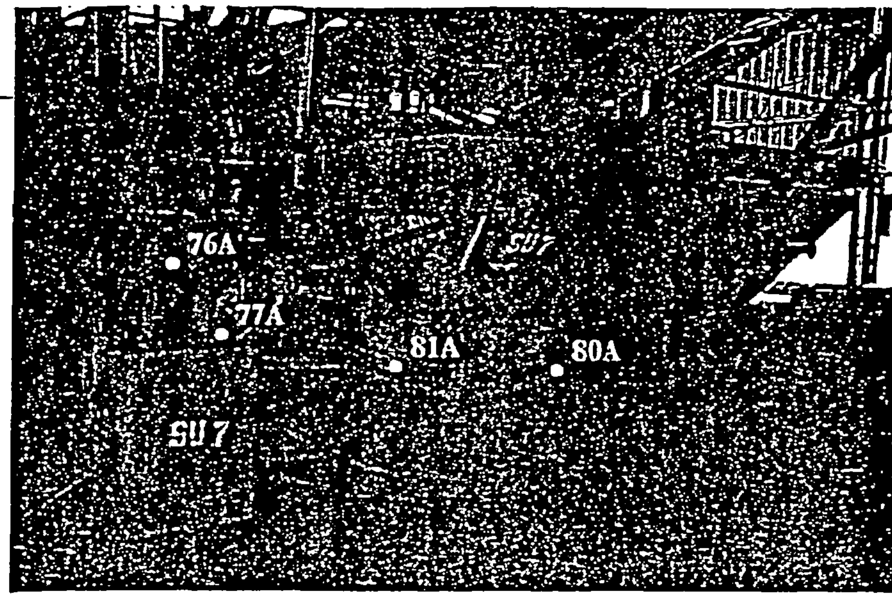


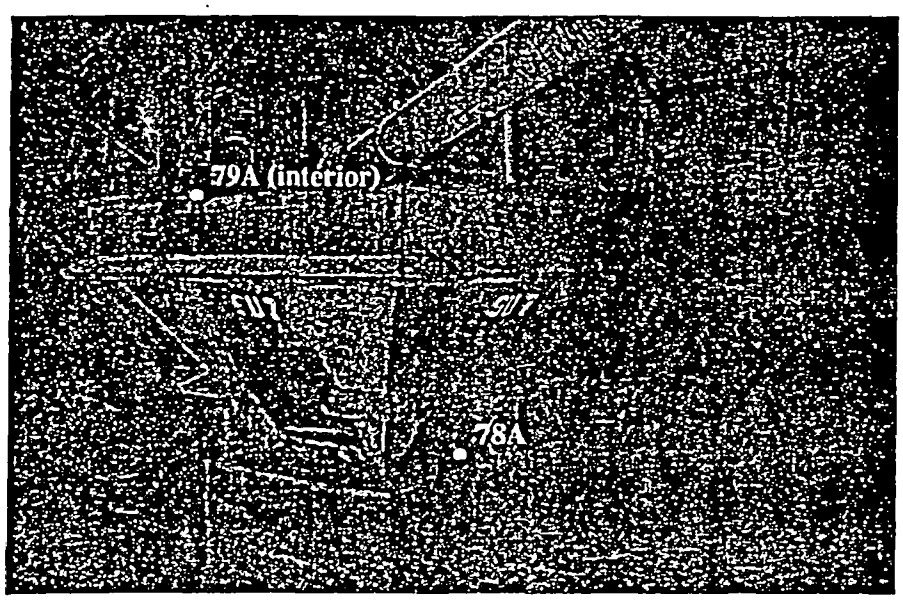
MEASUREMENT/SAMPLING LOCATIONS

- ● # SINGLE POINT
- ♦ RESIDUE SAMPLE

NOT TO SCALE

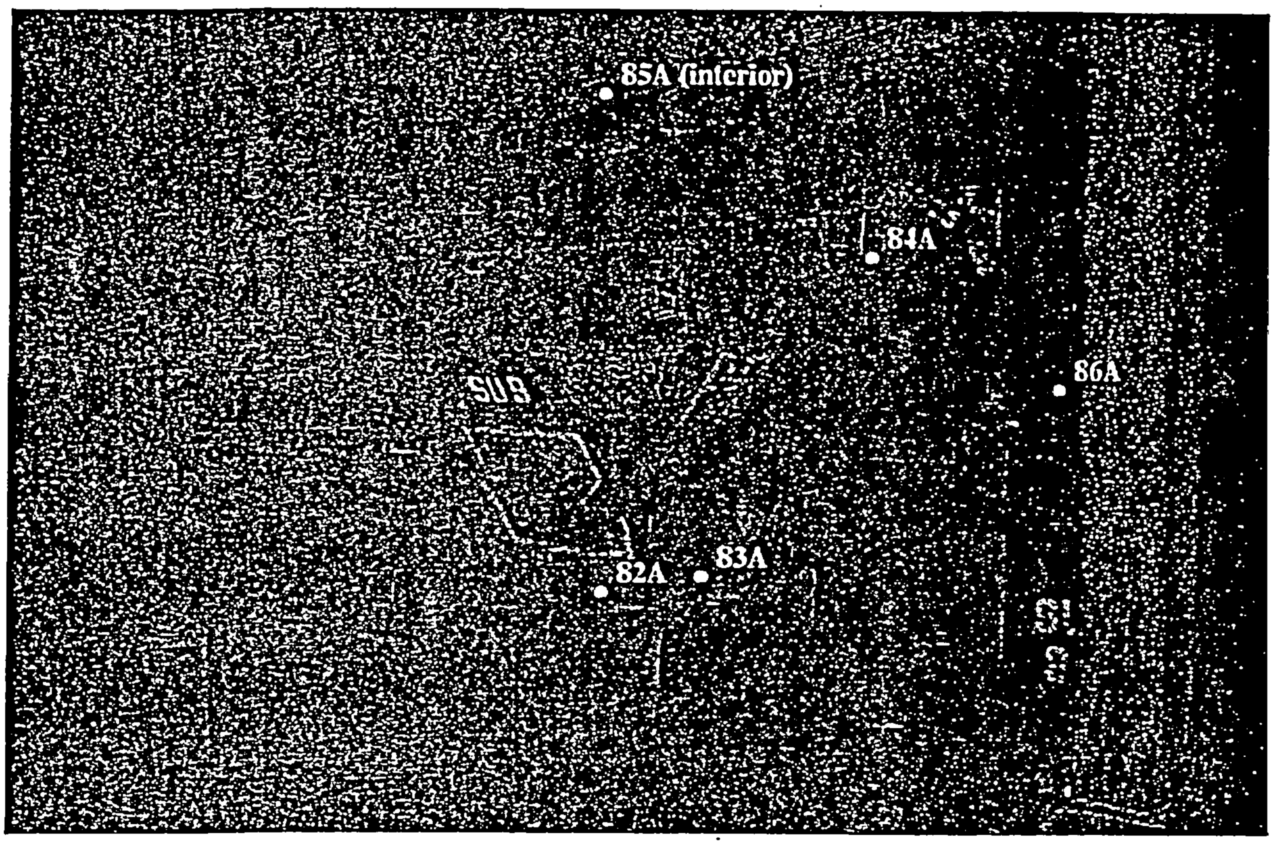
FIGURE 7: Wet Mill, Survey Unit 3 — Direct Measurement and Sampling Locations





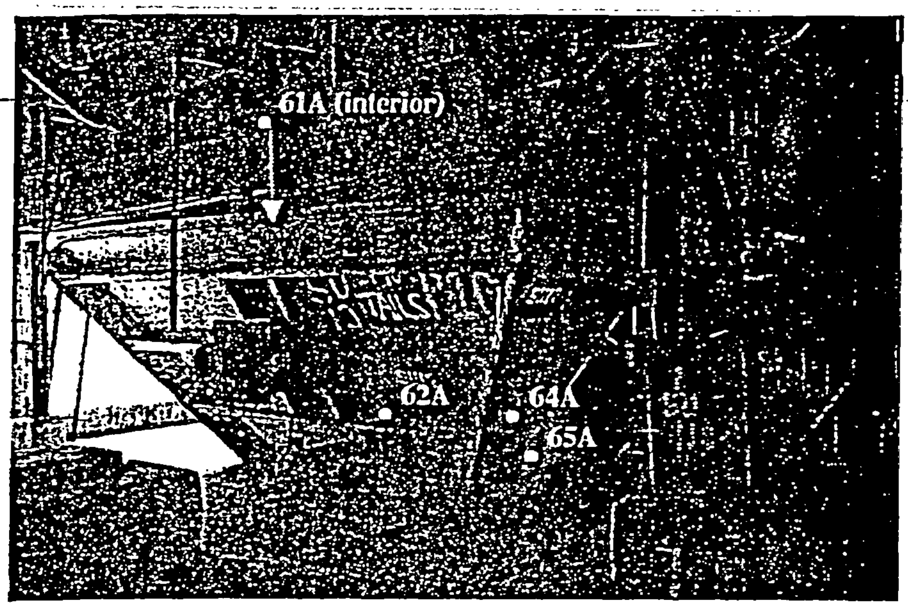
MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

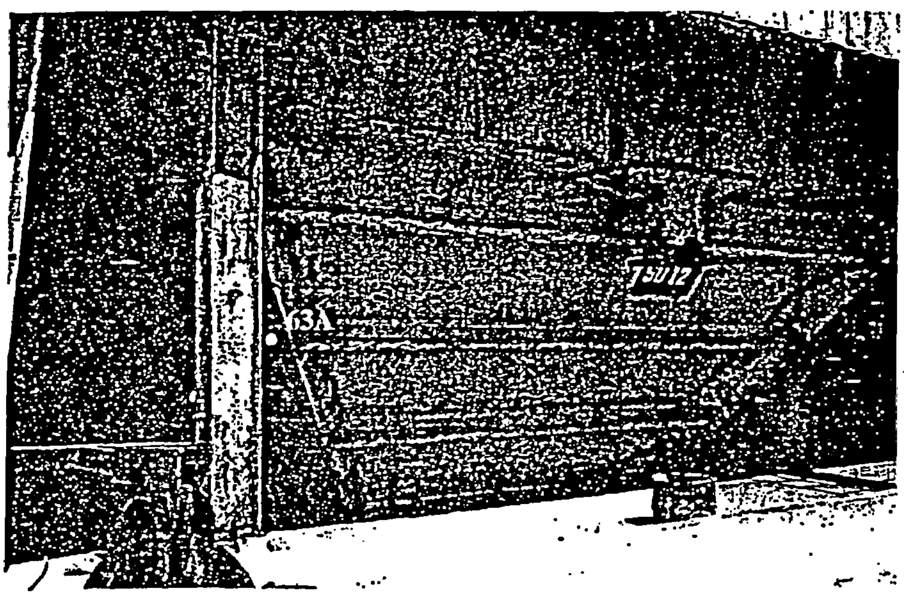
FIGURE 8: Wet Mill, Survey Unit 7 — Direct Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

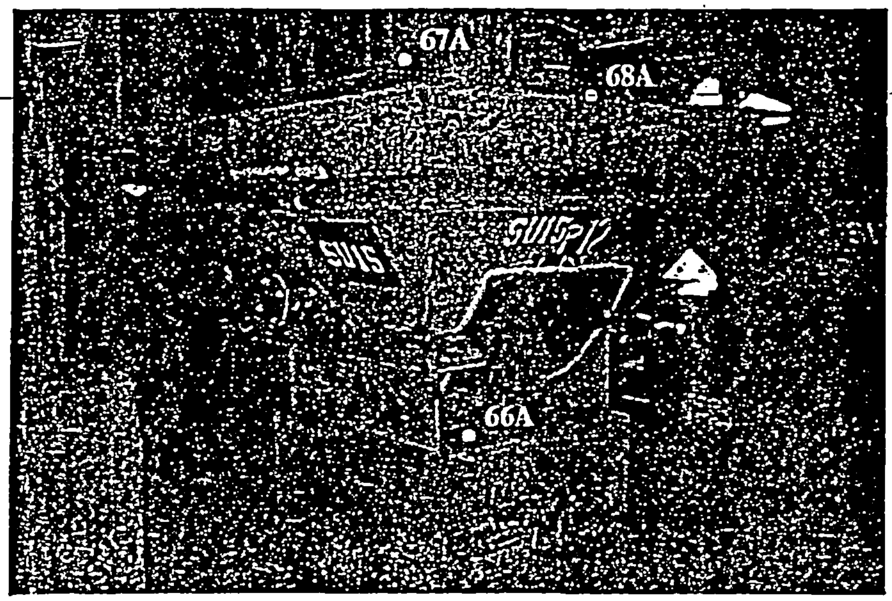
FIGURE 9: Wet Mill, Survey Unit 9 — Direct Measurement and Sampling Locations

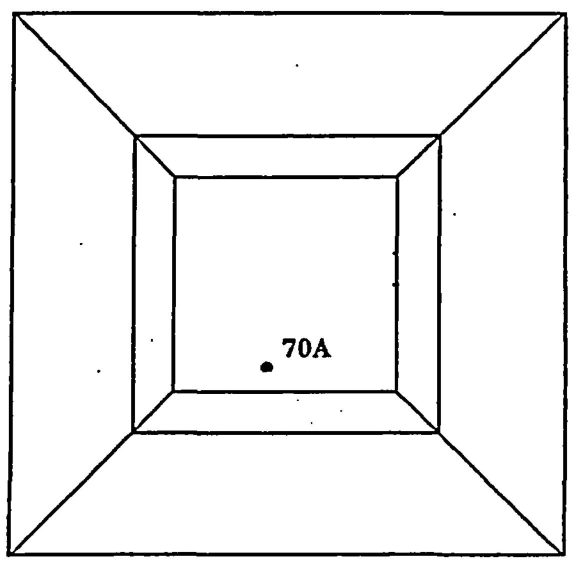




MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 10: Wet Mill, Survey Unit 12 — Direct Measurement and Sampling Locations

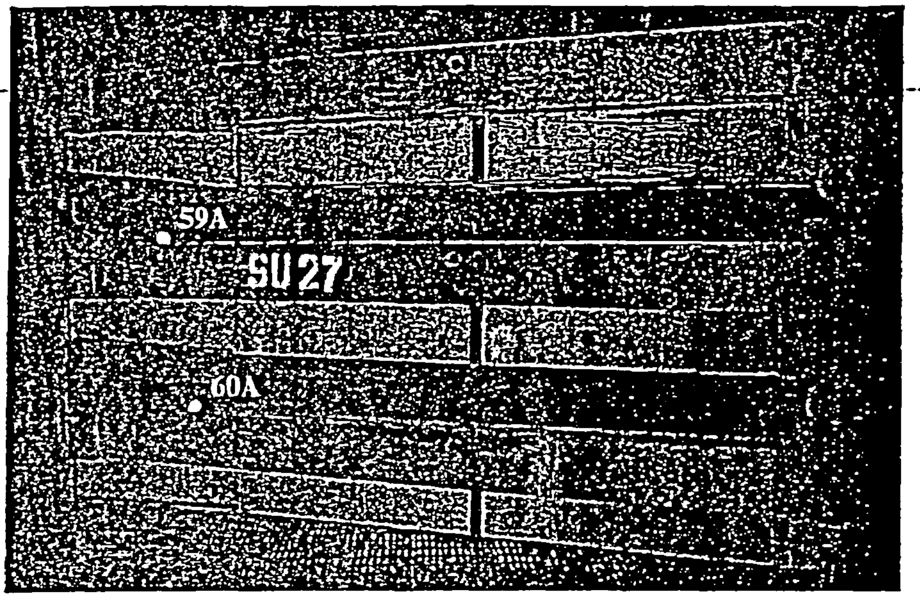




INTERIOR

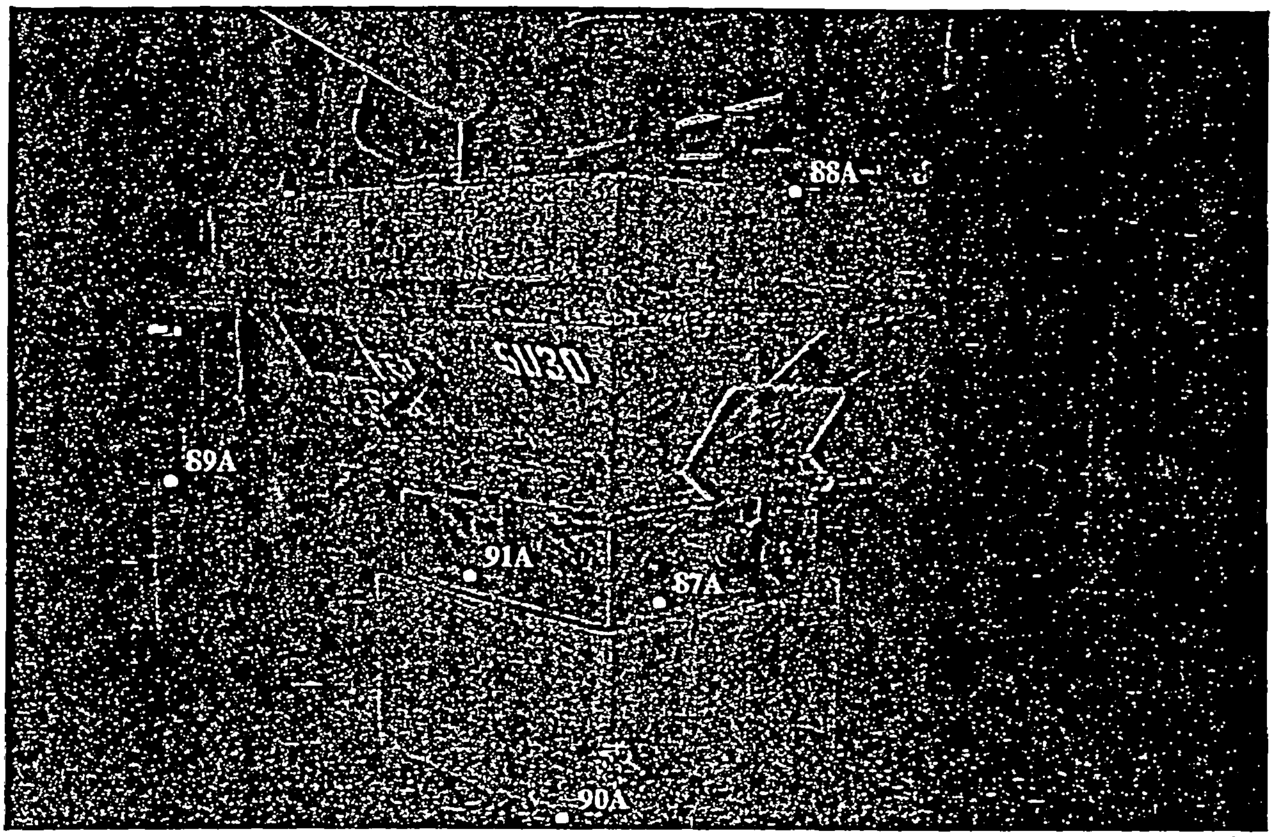
MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 11: Wet Mill, Survey Unit 15 — Direct Measurement and Sampling Locations



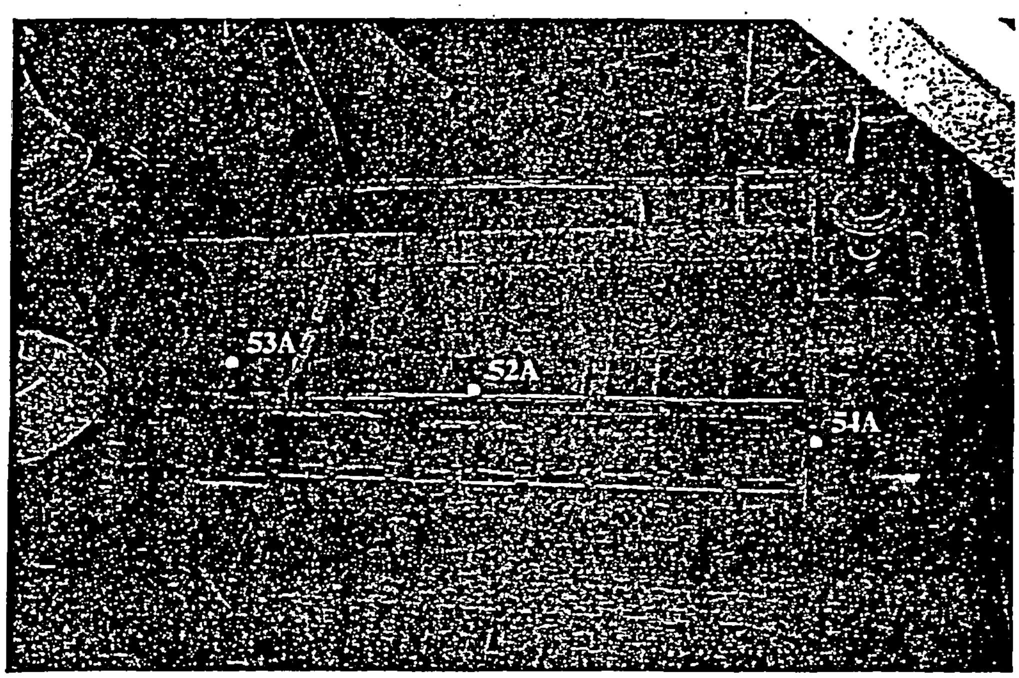
MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 12: Wet Mill, Survey Unit 27 — Direct Measurement and Sampling Locations



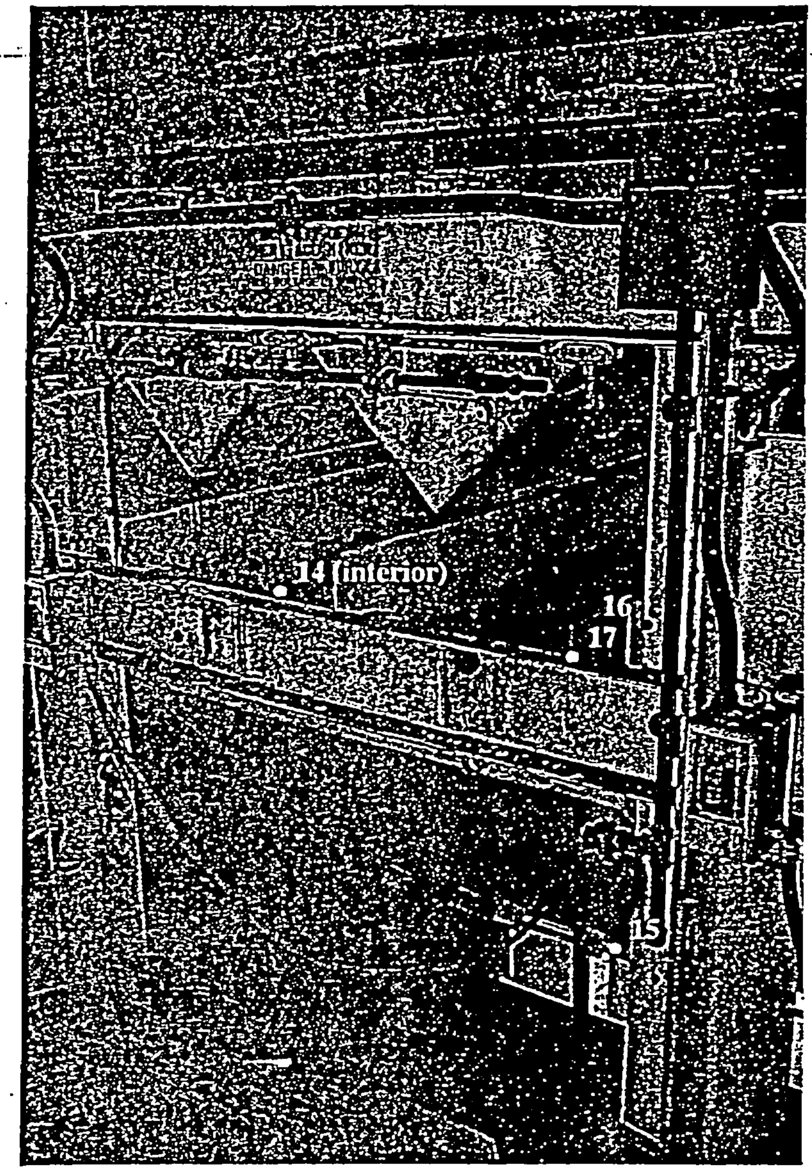
MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 13: Wet Mill, Survey Unit 30 — Direct Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 14: Wet Mill, Survey Unit 31 — Direct Measurement and Sampling Locations

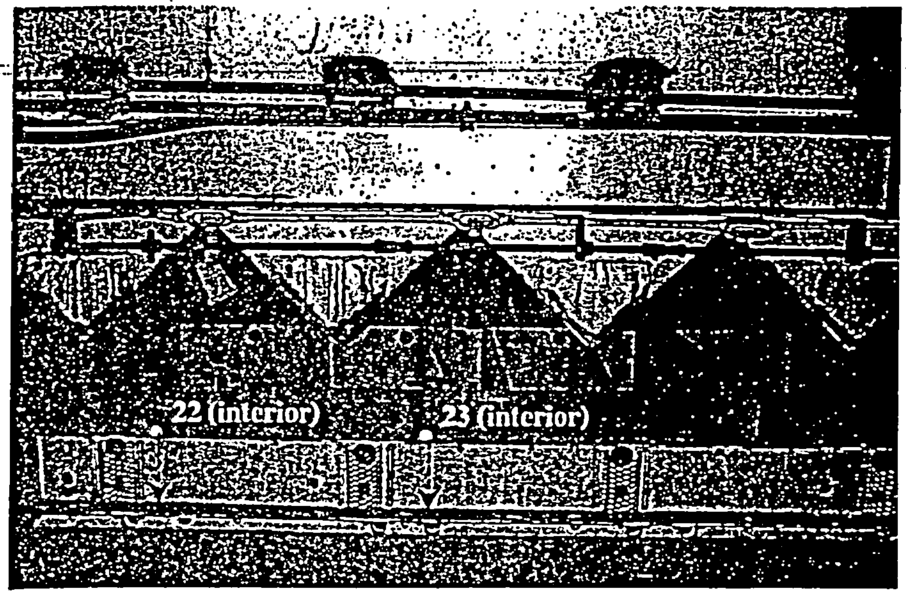


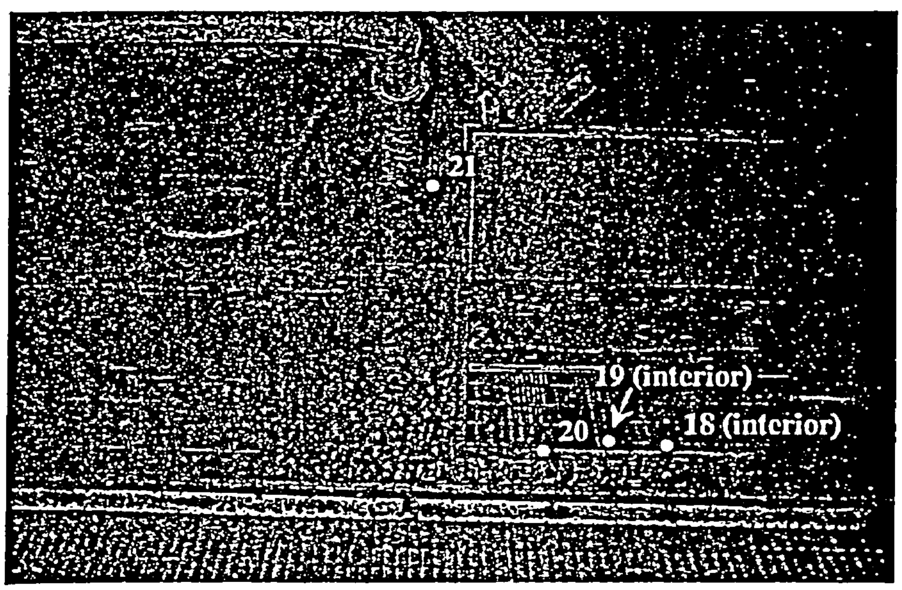
MEASUREMENT/SAMPLING LOCATIONS

• # SINGLE POINT

NOT TO SCALE

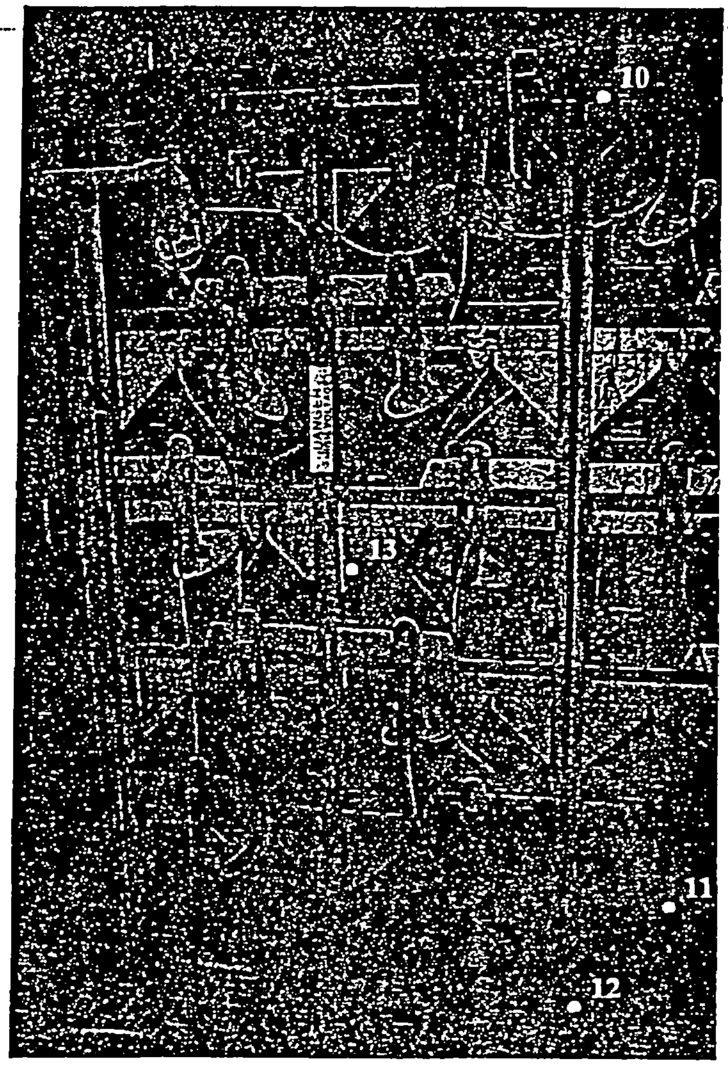
FIGURE 15: Dry Mill, Survey Unit 35 — Direct Measurement and Sampling Locations





MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 16: Dry Mill, Survey Unit 37 — Direct Measurement and Sampling Locations

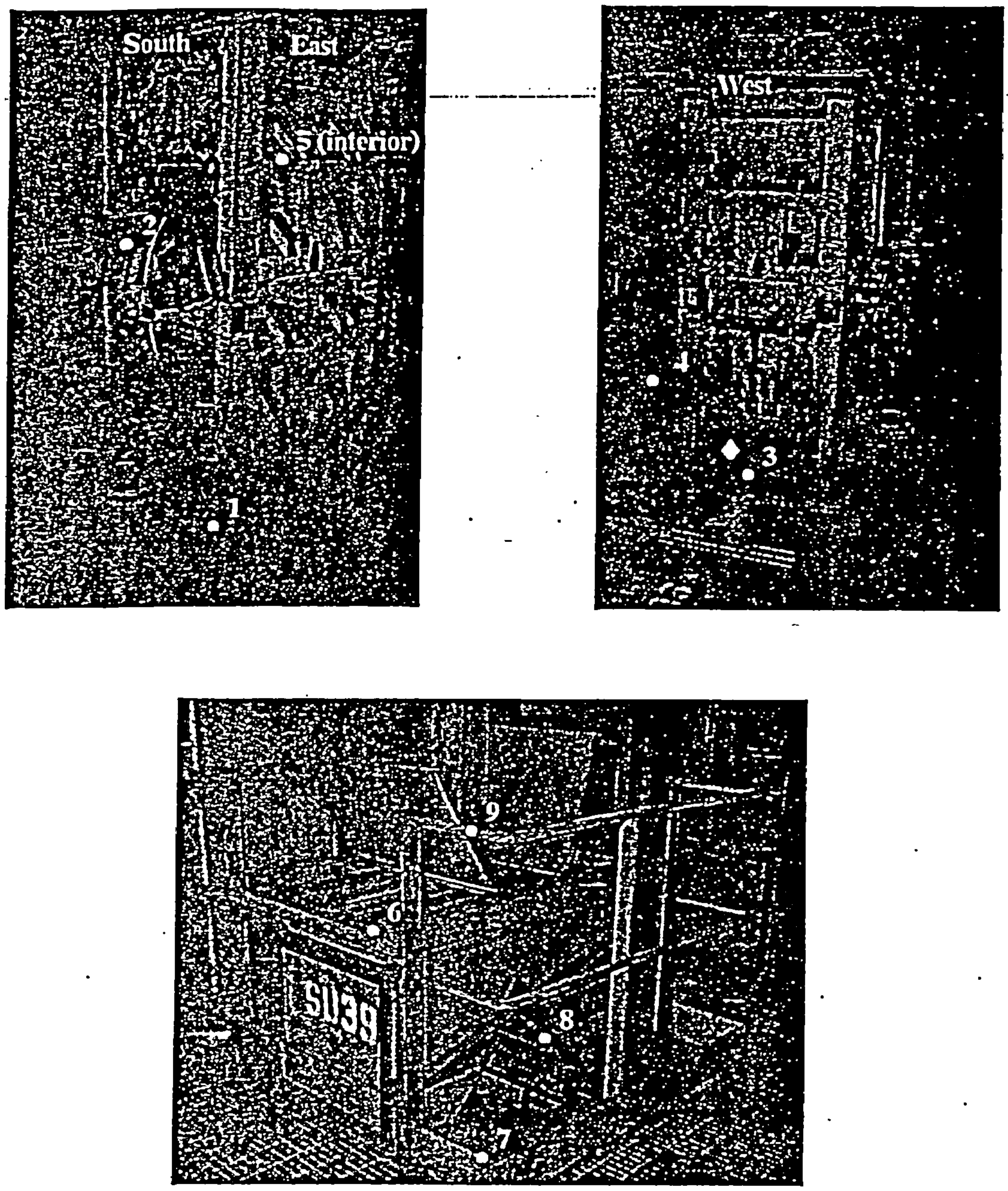


MEASUREMENT/SAMPLING LOCATIONS

• # SINGLE POINT

NOT TO SCALE

FIGURE 17: Dry Mill, Survey Unit 38 — Direct Measurement and Sampling Locations

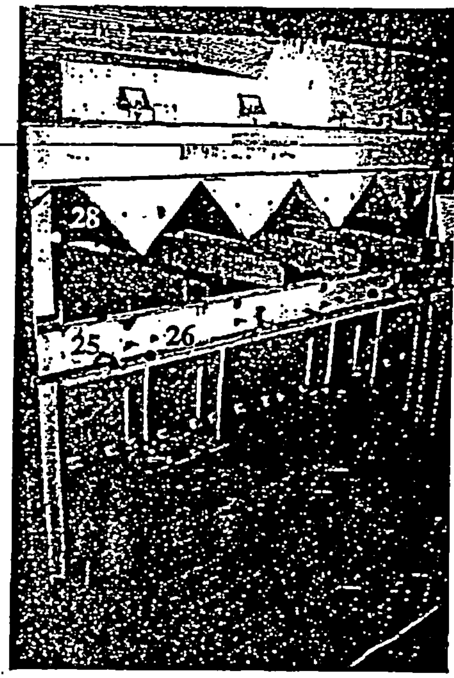


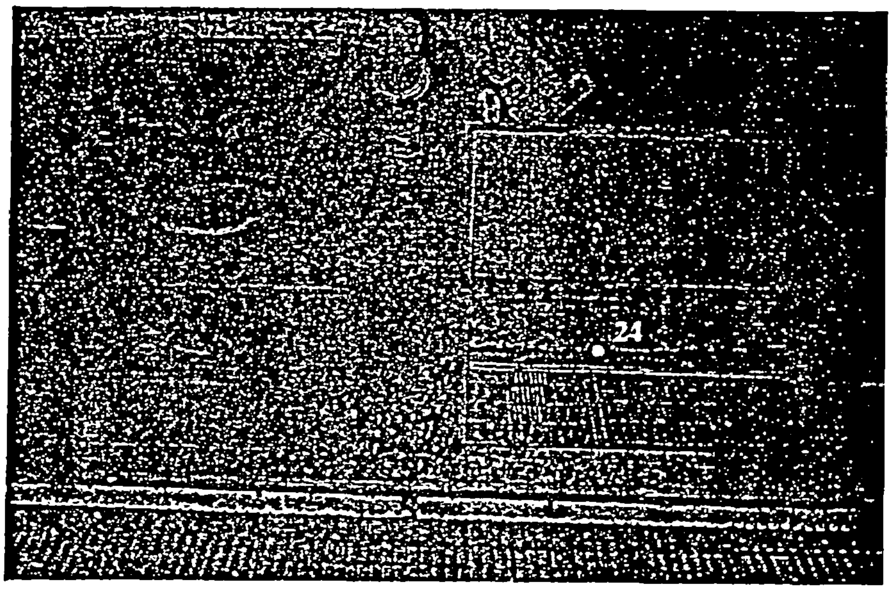
MEASUREMENT/SAMPLING LOCATIONS

- • SINGLE POINT
- ♦ RESIDUE SAMPLE

NOT TO SCALE

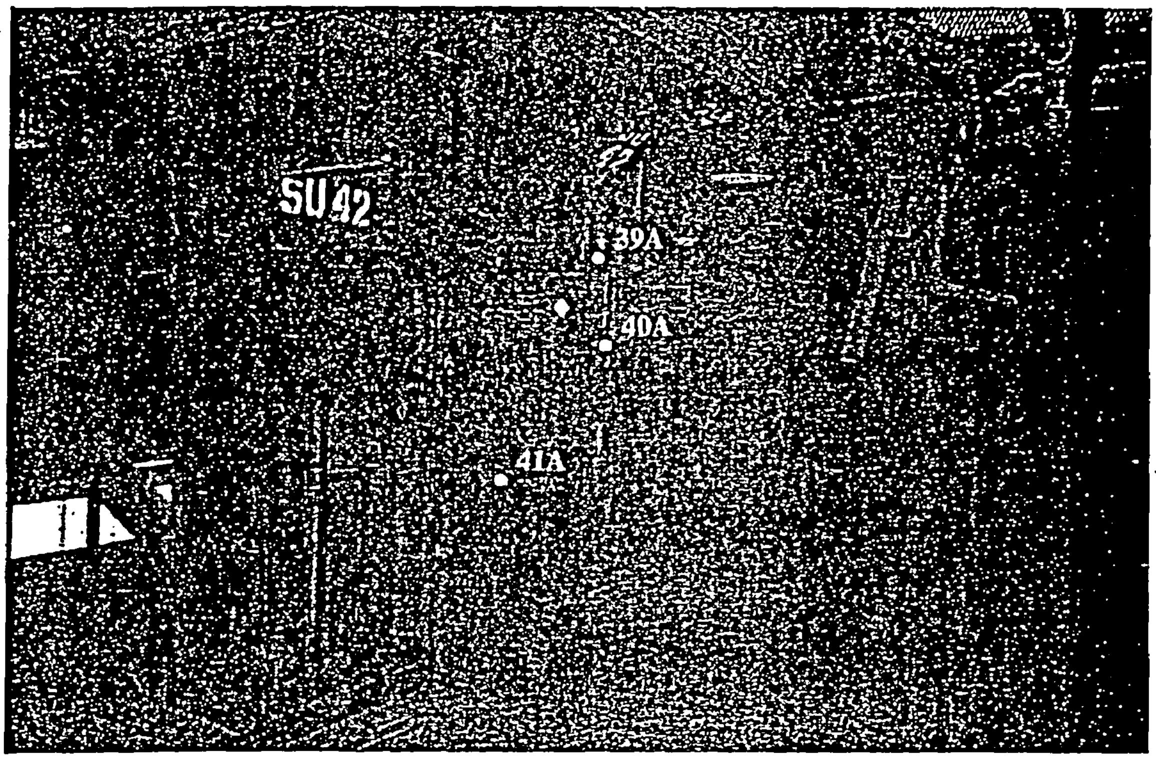
FIGURE 18: Dry Mill, Survey Unit 39 — Direct Measurement and Sampling Locations





MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 19: Dry Mill, Survey Unit 40 — Direct Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● # SINGLE POINT

♦ RESIDUE SAMPLE

NOT TO SCALE

FIGURE 20: Dry Mill, Survey Unit 42 — Direct Measurement and Sampling Locations

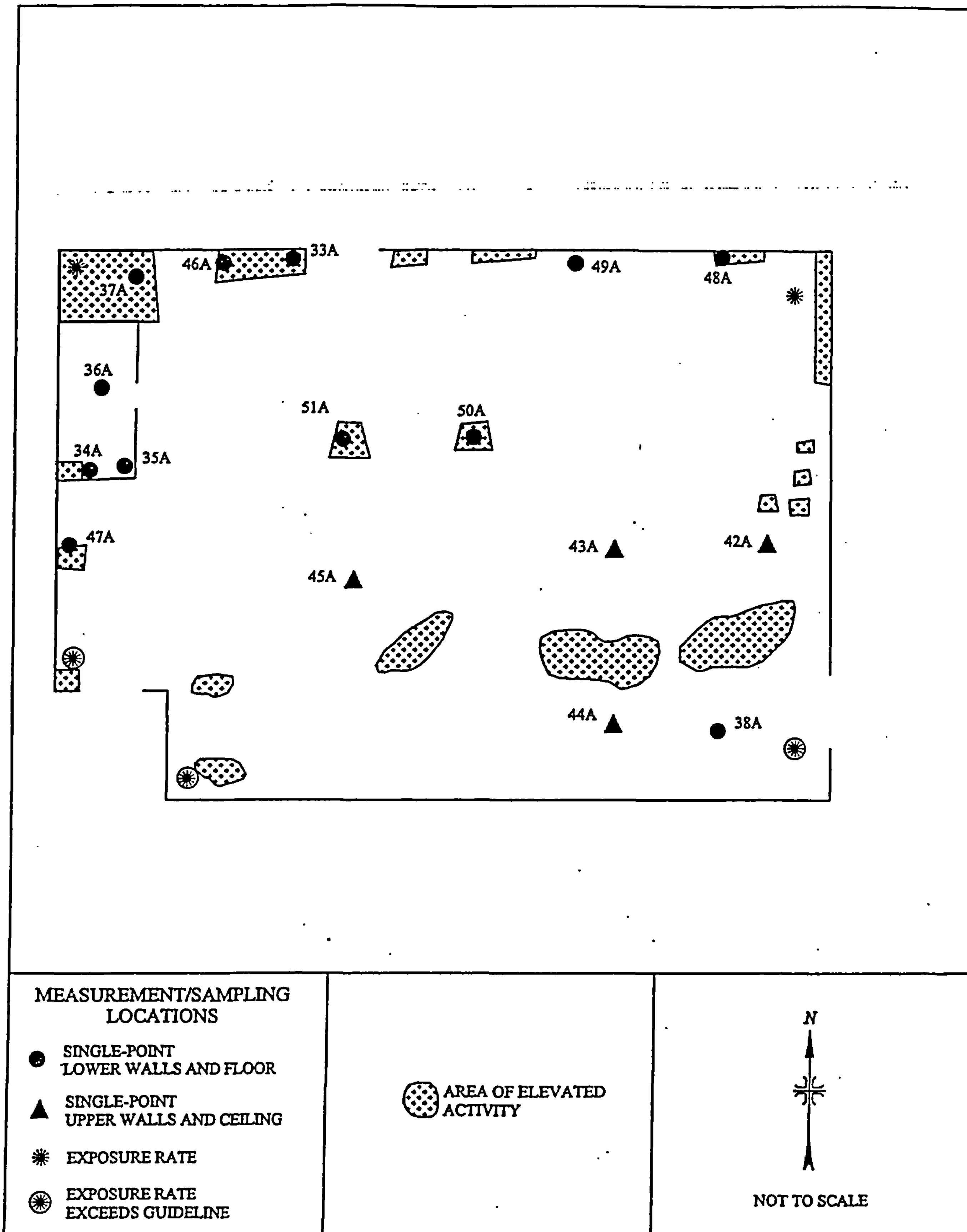


FIGURE 21: Dry Mill, Ground Floor - Measurement and Sampling Locations

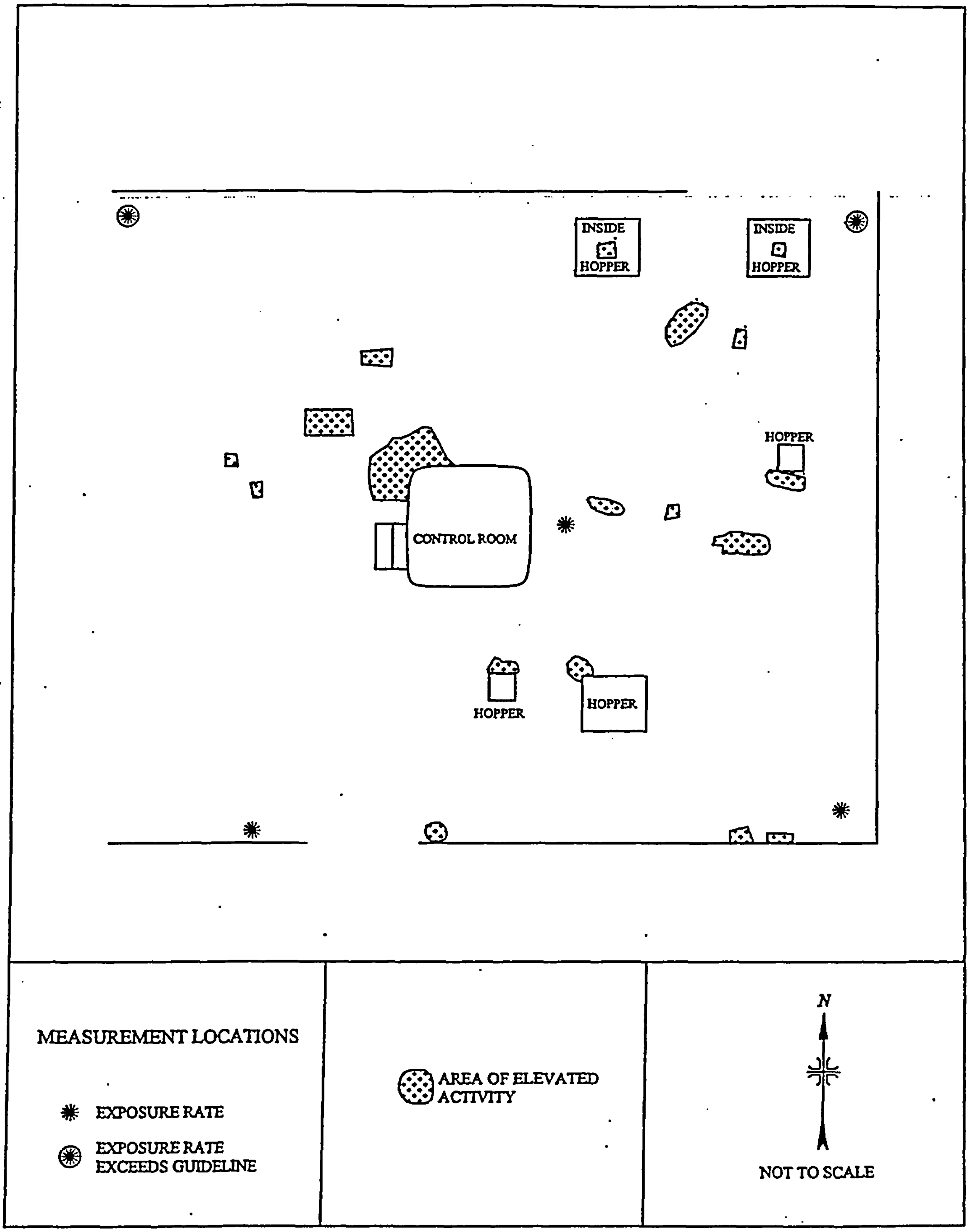


FIGURE 22: Wet Mill East End, Ground Floor - Measurements Locations

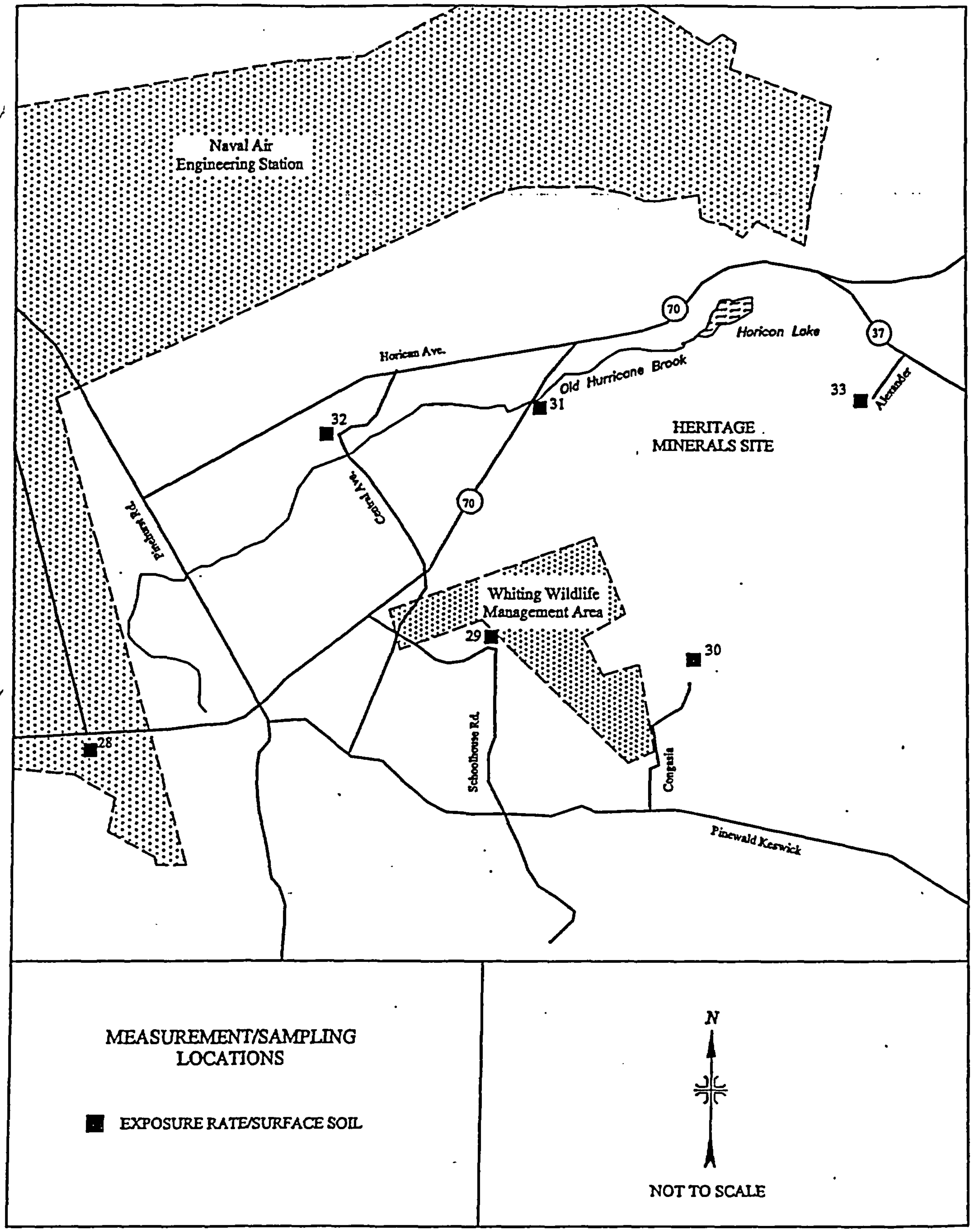


FIGURE 23: Heritage Minerals - Background Measurement and Sampling Locations

TABLES

Th 232 series α 6 β 4
U-238 series 8 6

TABLE 1

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Laboratory Building				
Room 1, Wall	9	-51	1	-3
Room 1, Table	NA	-44	0	-1
Room 1, Floor	NA	-200	0	1
Room 1, Door	NA	-73	3	3
Room 1, Wall	NA	-80	0	-4
Room 2, Cabinet	NA	130	0	2
Room 2, Sink	NA	100	3	-2
Room 2, Floor	NA	-170	0	3
Room 2, Wall	NA	-160	0	-2
Room 2, Sink	NA	25	0	-1
Room 2, Bench	120	270	1	-3
Room 2, Floor	NA	-200	1	1
Room 3, Floor-13A	720	3,500	1	-4
Room 3, Sill	NA	740	1	-1
Room 3, Floor	NA	210	5	6
Room 3, Floor	NA	1,100	5	16
Room 4, Floor	NA	-170	3	1
Room 4, Sill	160	1,100	1	-2
Room 4, Floor	NA	-110	3	1
Room 4, Door	NA	-170	1	-3

TABLE 1 (continued)

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Laboratory Building (continued)				
Room 5, Floor	NA	460	1	2
Room 5, Sill	120	300	5	-2
Room 5, Floor	NA	-130	0	-3
Room 5, Sill	NA	-100	3	2
Room 6, Wall	NA	-110	1	-2
Room 6, Floor	NA	-110	0	-3
Room 6, Floor	NA	-240	0	-2
Room 7, Floor	120	150	0	3
Room 7, Wall	310	1,100	1	1
Room 7, Floor	NA	-83	1	-3
Room 9, Sink	NA	200	1	-2
Room 9, Floor	NA	130	0	-1
Wet Mill				
SU1-92A	NA	4,400	0	-5
SU1-93A	NA	810	0	1
SU1-94A	NA	3,300	1	-2
SU1-95A	NA	5,400	1	-1
SU1-29	NA	2,100	0	-3
SU2-30	NA	1,900	1	-1
SU2-31	NA	1,600	5	-4

TABLE 1 (continued)

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Wet Mill (continued)				
SU2-32	NA	1,200	3	-1
SU2-33	NA	1,000	1	2
SU2-34	230	3,100	0	-3
SU3-71A	NA	6,300	1	-1
SU3-72A	NA	3,700	0	3
SU3-73A	NA	2,300	3	3
SU3-74A	NA	5,100	0	-2
SU3-75A	NA	2,900	0	-2
SU7-76A	NA	3,800	0	5
SU7-77A	NA	5,800	3	2
SU7-78A	NA	3,600	0	-3
SU7-79A	320	6,100	0	20
SU7-80A	NA	2,900	1	-3
SU7-81A	NA	5,400	0	9
SU9-82A	NA	5,000	3	2
SU9-83A	1,200	7,200	0	1
SU9-84A	NA	8,600	5	-2
SU9-85A	NA	5,500	9	14
SU9-86A	NA	5,200	0	-1
SU12-61A	NA	17,000	0	5

TABLE 1 (continued)

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Wet Mill (continued)				
SU12-62A	1,500	27,000	1	-1
SU12-63A	NA	8,900	3	5
SU12-64A	NA	5,600	1	4
SU12-65A	NA	4,000	3	-3
SU15-66A	NA	5,900	3	2
SU15-67A	700	9,500	0	1
SU15-68A	NA	7,600	0	-4
SU15-70A	NA	3,900	0	-1
SU27-57A	NA	19,000	1	10
SU27-58A	NA	11,000	0	-2
SU27-59A	240	19,000	0	-3
SU27-60A	NA	20,000	0	5
SU30-87A	NA	12,000	0	-2
SU30-88A	NA	3,300	0	-2
SU30-89A	NA	3,400	0	2
SU30-90A	NA	4,300	0	-3
SU30-91A	NA	2,200	3	5
SU31-52A	2,300	35,000	7	10
SU31-53A	NA	32,000	7	5

TABLE 1 (continued)

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Wet Mill (continued)				
SU31-54A	NA	8,800	3	4
SU31-55A	NA	8,900	1	-3
SU31-56A	390	11,000	0	-2
Dry Mill				
SU35-14	NA	7,200	NA	NA
SU35-15	NA	3,500	0	3
SU35-16	NA	3,300	9	1
SU35-17	2,400	14,000	0	-1
SU37-18	NA	8,600	3	-1
SU37-19	NA	17,000	16	4
SU37-20	NA	8,100	13	-1
SU37-21	NA	3,500	11	11
SU37-22	NA	2,500	9	2
SU37-23	660	6,500	3	-1
SU38-10	NA	1,100	1	2
SU38-11	NA	250	3	12
SU38-12	NA	4,000	1	5
SU38-13	NA	1,800	0	6
SU39-1	NA	28,000	3	-2
SU39-2	200	28,000	9	2

TABLE 1 (continued)

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Dry Mill (continued)				
SU39-3	2,600	89,000	5	21
SU39-4	NA	9,000	0	4
SU39-5	NA	9,500	NA	NA
SU39-6	NA	3,000	0	1
SU39-7	NA	8,300	33	25
SU39-8	NA	250	0	-2
SU39-9	NA	580	0	-2
SU40-24	1,100	2,700	5	4
SU40-25	NA	21,000	0	3
SU40-26	1,100	23,000	1	4
SU40-27	NA	2,100	1	-3
SU40-28	NA	12,000	0	-2
SU42-39A	960	15,000	160	730
SU42-40A	NA	5,700	0	1
SU42-41A	NA	4,500	5	8
Floor - 33A	NA	1,600	0	-3
Floor - 34A	1,000	4,800	5	4
Desk - 35A	NA	3,400	0	-2
Floor - 36A	NA	73	1	-2

TABLE 1 (continued)

SUMMARY OF SURFACE ACTIVITY LEVELS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
	Alpha	Alpha plus Beta[b]	Alpha	Beta
Dry Mill (continued)				
Floor - 37A	NA	6,200	1	-3
Column - 38A	370	6,600	13	20
I-Beam - 42A	2,400	16,000	3	-1
I-Beam - 43A	670	12,000	3	5
I-Beam - 44A	NA	5,800	5	6
I-Beam - 45A	NA	4,600	5	36
Wall - 46A	NA	4,500	0	-3
Wall - 47A	560	6,100	0	2
Wall - 48A	NA	4,800	1	2
Floor - 49A	NA	6,100	1	5
Floor - 50A	NA	2,300	1	4
Floor - 51A	NA	2,100	0	4

[a]Refer to Figures 4 through 21.
[b]ESSAP's data indicate that the alpha contribution to the alpha plus beta surface activity measurement count rate was consistently less than ten percent.

TABLE 2

INTERIOR EXPOSURE RATES
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Exposure Rate Range @ 1m (μR/h)
Laboratory	7 to 10
Wet Mill	8 to 17
Dry Mill	11 to 14
Background: Office Building	4 to 8

[a]Refer to Figures 21 through 22 for Wet and Dry Mill exposure rate locations. Exposure rate locations within the Laboratory and Main Office Building are not provided. Laboratory exposure rate measurements were performed at the center of each room.

TABLE 3

RADIONUCLIDE CONCENTRATIONS IN RESIDUE SAMPLES
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Location[a]	Radionuclide Concentration (pCi/g)					
	U-238	U-235	Total Uranium[b]	Th-228	Th-232	Total Thorium[c]
Dry Mill, SU39	59 ± 11[d]	5.0 ± 2.4	120	310 ± 17	325 ± 26	640
Dry Mill, SU42	670 ± 140	31 ± 37	1400	1520 ± 130	1580 ± 150	3100
Wet Mill, SU3	410 ± 370	49 ± 130	870	690 ± 100	610 ± 260	1300

[a]Refer to Figures 7, 18, and 20.
[b]Total uranium concentrations are calculated by multiplying the U-238 result by two and adding the U-235 concentrations.
[c]Total thorium was calculated by adding the Th-228 and Th-232 concentrations.
[d]Uncertainties represent the 95% confidence levels based on total propagated uncertainties.

TABLE 4

RADIONUCLIDE CONCENTRATIONS IN SOIL
FORMER MONZITE PILE AND ADJACENT AREAS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Sample Number[a]	Depth (cm)	Exposure Rate @ 1m (μR/h)	Radionuclide Concentration (pCi/g)					
			U-238	U-235	Total Uranium[b]	Th-228	Th-232	Total Thorium[c]
Monazite Pile								
1	0-15	17	4.0 ± 1.0[d]	0.1 ± 0.2	8.1	9.4 ± 0.5	9.1 ± 0.8	19
2	0-15	20	2.4 ± 1.0	0.1 ± 0.2	4.9	5.9 ± 0.3	5.8 ± 0.5	12
3	0-15	17	3.6 ± 1.0	0.1 ± 0.2	7.3	9.3 ± 0.5	9.1 ± 0.8	18
4	0-15	20	4.0 ± 1.1	0.1 ± 0.1	8.1	6.6 ± 0.4	6.4 ± 0.6	13
5	0-15	22	2.9 ± 0.9	-0.1 ± 0.1	5.7	6.0 ± 0.3	5.8 ± 0.5	12
Grid Block, 0N, 0E Surface (0-15 cm) Average					*6.8*			*15*
6	0-15	30	10.6 ± 3.5	0.1 ± 0.4	21	21.0 ± 1.2	20.2 ± 1.8	41
7	0-15	15	1.1 ± 0.8	0.1 ± 0.1	2.3	2.8 ± 0.2	2.8 ± 0.3	5.6
8	0-15	25	12.2 ± 3.6	0.7 ± 0.7	25	40.0 ± 2.2	38.7 ± 3.3	79
9	15-30	NA	36.7 ± 5.6	1.1 ± 1.3	75	205 ± 11	211 ± 17	420
10	0-15	20	2.1 ± 0.8	0.1 ± 0.1	4.3	3.9 ± 0.2	3.8 ± 0.4	7.7
11	0-15	NA	50 ± 11	2.0 ± 2.5	100	330 ± 18	330 ± 27	660
12	15-30	NA	45 ± 30	7.9 ± 7.7	97	720 ± 39	820 ± 67	1540
13	30-45	NA	61 ± 23	1.5 ± 4.1	120	430 ± 23	460 ± 37	890

TABLE (continued)

RADIONUCLIDE CONCENTRATIONS IN SOIL
FORMER MONZITE PILE AND ADJACENT AREAS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Sample Number[a]	Depth (cm)	Exposure Rate @ 1m (μR/h)	Radionuclide Concentration (pCi/g)					
			U-238	U-235	Total Uranium[b]	Th-228	Th-232	Total Thorium[c]
14	0-15	20	17.0 ± 4.6	0.0 ± 0.7[e]	34	64.0 ± 3.5	61.4 ± 5.0	130
15	15-30	NA	8.2 ± 3.2	-0.1 ± 0.5	16	23.9 ± 1.3	23.3 ± 2.0	47
16	15-30	30	51 ± 20	1.7 ± 4.7	100	380 ± 20	400 ± 33	770
Grid Block 10N, 0E Surface (0-15 cm) Average					*31*			*150*
17	0-15	15	7.5 ± 1.5	0.4 ± 0.3	15	13.6 ± 0.8	13.0 ± 1.1	27
18	0-15	18	19.0 ± 3.8	1.7 ± 1.1	40	29.9 ± 1.7	32.0 ± 2.9	62
19	15-30	NA	19.9 ± 4.7	2.2 ± 1.2	42	32.9 ± 1.9	35.3 ± 3.3	68
20	0-15	30	11.1 ± 3.2	0.6 ± 0.6	23	32.9 ± 1.8	32.7 ± 2.8	66
21	15-30	NA	15.3 ± 3.7	1.3 ± 0.7	32	46.9 ± 2.5	48.5 ± 4.0	95
22	30-45	NA	17.9 ± 4.4	1.2 ± 0.9	37	60.2 ± 3.2	61.1 ± 5.1	120
23	0-15	15	9.1 ± 1.8	0.4 ± 0.3	19	22.3 ± 1.2	21.8 ± 1.8	44
24	15-30	NA	7.4 ± 1.5	0.5 ± 0.2	15	16.3 ± 0.9	16.5 ± 1.4	33
25	0-15	20	22.8 ± 4.6	1.7 ± 1.5	47	89.1 ± 4.8	89.7 ± 7.4	180
26	15-30	NA	23.6 ± 5.1	1.7 ± 1.2	49	93.7 ± 5.1	94.8 ± 7.8	190
27	30-45	NA	8.1 ± 1.8	0.4 ± 0.3	17	15.2 ± 0.8	14.8 ± 1.3	30
Grid Block 30N, 10E Surface (0-15 cm) Average					*29*			*75*

TABLE (continued)

RADIONUCLIDE CONCENTRATIONS IN SOIL
FORMER MONZITE PILE AND ADJACENT AREAS
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Sample Number[a]	Depth (cm)	Exposure Rate @ 1m (μR/h)	Radionuclide Concentration (pCi/g)					
			U-238	U-235	Total Uranium[b]	Th-228	Th-232	Total Thorium[c]
Areas Outside the Monazite Pile Area								
34	0-15	NA	23.4 ± 5.5	2.0 ± 1.3	49	30.6 ± 1.8	30.3 ± 3.0	61
35	0-15	NA	19.4 ± 5.4	0.7 ± 0.9	40	44.9 ± 2.5	46.2 ± 4.0	91
36	0-15	NA	9.5 ± 1.7	0.6 ± 0.3	20	15.6 ± 0.9	15.9 ± 1.3	32
37	15-30	NA	9.3 ± 1.9	0.8 ± 0.4	19	18.4 ± 1.0	18.1 ± 1.6	37
38	15-30	NA	6.8 ± 1.1	0.4 ± 0.2	14	10.7 ± 0.6	10.6 ± 0.9	21
39	0-15	NA	24.2 ± 6.2	0.9 ± 1.3	49	95.3 ± 5.2	97.1 ± 8.0	190
40	0-15	24	22.3 ± 5.3	2.4 ± 1.5	47	64.1 ± 3.6	70.2 ± 6.0	130
Backgrounds								
28	0-15	3	0.2 ± 0.2	0.1 ± 0.0	0.5	0.3 ± 0.0	0.3 ± 0.1	0.6
29	0-15	3	0.3 ± 0.2	0.0 ± 0.0	0.6	0.1 ± 0.0	0.2 ± 0.1	0.3
30	0-15	5	0.5 ± 0.3	0.0 ± 0.0	1.0	0.3 ± 0.0	0.3 ± 0.1	0.6
31	0-15	4	0.3 ± 0.4	0.0 ± 0.1	0.6	0.3 ± 0.0	0.3 ± 0.1	0.6
32	0-15	7	0.4 ± 0.4	0.0 ± 0.1	0.8	0.3 ± 0.0	0.3 ± 0.1	0.6
33	0-15	4	1.1 ± 0.4	0.1 ± 0.1	2.3	0.5 ± 0.0	0.5 ± 0.1	1.0

[a]Refer to Figures 23 through 25.
[b]Total uranium concentrations are calculated by multiplying the U-238 result by two and adding the U-235 concentrations.
[c]Total thorium was calculated by adding the Th-228 and Th-232 concentrations.
[d]Uncertainties represent the 95% confidence levels based on total propogated uncertainties.
[e] Zero values are due to rounding.

TABLE 5

ANALYTICAL COMPARISON OF RSI SAMPLES
HERITAGE MINERALS INCORPORATED FACILITY
LAKEHURST, NEW JERSEY

Sample Number	Radionuclide Concentration (pCi/g)			
	RSI		ESSAP	
	Total Uranium[a]	Total Thorium[b]	Total Uranium[a]	Total Thorium[b]
50722068	15.1 ± 3.2	18.6 ± 1.8	17.5 ± 2.4	21.0 ± 1.1
50722002	39.3 ± 11.7	103.3 ± 9.8	45.2 ± 5.4	104.8 ± 5.2
50722052	18.0 ± 6.7	31.8 ± 3.0	20.0 ± 2.5	31.2 ± 1.6

[a]Total uranium calculated by doubling the Th-234 (63 keV) concentration and adding the U-235 (143 keV) concentration.
[b]Total thorium calulated by adding the Ac-228 (911 keV) concentration to the Pb-212 (239 keV) concentration.

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APPENDIX A
MAJOR INSTRUMENTATION

APPENDIX A
MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the authors or their employers.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

Alpha

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Ratemeter-Scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Eberline ZnS Scintillation Detector Model AC-3-7, Physical Area: 74 cm^2
(Eberline, Santa Fe, NM)

Alpha Plus Beta

Ludlum Floor Monitor Model 239-1
combined with
Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-37, Physical Area: 550 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Beta

Ludlum Ratemeter-Scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Eberline GM Detector Model HP-260, Physical Area: 20 cm^2
(Eberline, Santa Fe, NM)

Gamma

Eberline Pulse Ratemeter Model PRM-6
(Eberline, Santa Fe, NM)
coupled to
Victoreen NaI Scintillation Detector Model 489-55, Crystal: 3.2 cm x 3.8 cm
(Victoreen, Cleveland, OH)

DIRECT MEASUREMENT INSTRUMENT/DETECTOR COMBINATIONS

Alpha

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Ratemeter-Scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Eberline ZnS Scintillation Detector Model AC-3-7, Physical Area: 74 cm^2
(Eberline, Santa Fe, NM)

Alpha plus Beta

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Beta

Ludlum Ratemeter-Scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Eberline GM Detector Model HP-260, Physical Area: 20 cm^2
(Eberline, Santa Fe, NM)

Gamma (Exposure Rate)

Bicron Micro-Rem Meter
(Bicron Corporation, Newburg, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detector
Canberra/Tennelec Model No: ERVDS30-25195
(Canberra, Meriden, CT)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

High-Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(EG&G ORTEC, Oak Ridge, TN)
used in conjunction with:
Lead Shield Model SPG-16-K8
(Nuclear Data) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

Low Background Gas Proportional Counter
Model LB-5100-W
(Tennelec/Canberra, Meriden, CT)

APPENDIX B
SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available, standards of an industry-recognized organization were used.

Detectors used for assessing surface activity were calibrated in accordance with ISO-7503[1] recommendations. The total efficiency (ϵ_{total}) was determined for each instrument/detector combination and consisted of the product of the 2π instrument efficiency (ϵ_i) and surface efficiency (ϵ_s):

$$\epsilon_{total} = \epsilon_i \times \epsilon_s$$

The alpha calibration ϵ_i ranged from 0.38 - 0.41 for the gas proportional detectors and from 0.31 - 0.34 for the ZnS scintillation detectors calibrated to Th-230; the beta calibration ϵ_i ranged from 0.50 - 0.52 for the gas proportional detectors and 0.36 - 0.37 for the GM detectors calibrated to Tl-204. The beta calibration source was selected based on the beta energy distribution of the radionuclide. ISO-7503 recommends an ϵ_s of 0.25 when measuring alpha emitters and beta emitters with a maximum energy of less than 0.4 MeV and an ϵ_s of 0.5 for maximum beta energies greater than

ϵ^{β}_{total}		ϵ_s	ϵ_i alpha (Th230)	ϵ_i β Tl-204	ϵ^{α} alpha bkgd.	β bkgd
0.12	gas prop.	0.25	.38-.41	.50-.52	0.09-0.1	800-1400 cpm floor gas prop; 250-450 cpm hand gas prop
	ZnS	0.25	.31-.34	-	.08-.09	
	GM	0.25 / 0.5	-	.36-.37		35-60

bkgd

[1]International Standard. ISO 7503-1, Evaluation of Surface Contamination - Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters. August 1, 1988.

0.4 MeV. The total alpha efficiency factors ranged from 0.09 to 0.10 for the gas proportional detectors and 0.08 to 0.09 for the ZnS detectors. The total beta efficiency factors ranged from 0.25 to 0.26 for the gas proportional detectors and were 0.18 for the GM detectors.

Analytical and field survey activities were conducted in accordance with procedures from the following documents of the Environmental Survey and Site Assessment Program:

- Survey Procedures Manual, (September 2000)
- Laboratory Procedures Manual, (May 2001)
- Quality Assurance Manual, (June 2001)

The procedures contained in these manuals were developed to meet the requirements of DOE Order 414.1A and the U.S. Nuclear Regulatory Commission Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in MAPEP, NRIP, ITP and EML Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the detectors slowly over the surface; the distance between the detector and the surface was maintained at a minimum—nominally about 1 cm. A large surface area, gas proportional floor monitor was used to scan the floors of the surveyed areas. Other surfaces were scanned using small area (20 cm^2, 74 cm^2, or 126 cm^2) hand-held detectors. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Scan minimum detectable concentrations (MDCs) were estimated using the calculational approach described in NUREG-1507.[2] The scan MDC is a function of many variables, including the background level. Typical beta background levels range from 800 to 1400 counts per minute (cpm) for the floor monitor, range from 250 to 450 cpm for the hand-held gas proportional detector, and range from 35 to 60 cpm for the GM detectors. Additional parameters selected for the calculation of scan MDCs include a three-second observation interval, a specified level of performance at the first scanning stage of 95% true positive rate and 25% false positive rate, which yields a d' value of 2.32 (NUREG-1507, Table 6.1), and a surveyor efficiency of 0.5. The approximate instrument scanning efficiencies for the floor monitor/hand-held gas proportional/GM detector calibrated to Tl-204 were 0.39, 0.46, and 0.08, respectively. To illustrate an example for the hand-held gas proportional, the minimum detectable count rate (MDCR) and scan MDC can be calculated as follows:

b_i = (250 cpm)(3 second obs. interval based on scan speed} s)(1 min/60 s) = 12.5 counts,
MDCR = (2.32)(12.5 counts)$^{1/2}$ [(60 s/min)/(3 s)] = 164 cpm,
$MDCR_{surveyor} = 164/(0.5)^{1/2} = 231$cpm

The scan MDC is calculated assuming a surface efficiency of 0.5 (for Tl-204):

$$Scan\ MDC = \frac{MDCR_{surveyor}}{(\epsilon_s)\ (\epsilon_i)} = xxx\ dpm/100\ cm^2$$

[2]NUREG-1507. Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. US Nuclear Regulatory Commission. Washington, DC; June 1998.

For the given background range, the estimated scan MDC range for the floor monitor is 2,100 to 2,800 dpm/100 cm^2; 1,000 to 1,350 dpm/100 cm^2 for the hand-held gas proportional detector and 2,200 to 2,850 dpm/100 cm^2 for the GM detector.

The scan MDC for the NaI scintillation detector for uranium and thorium were obtained directly from NUREG-1507. The scan MDCs were 115 and 28.3 pCi/g, respectively, for total uranium and total thorium (includes sum of all radionuclides in the uranium and thorium decay series).

Surface Activity Measurements

Measurements of total surface activity levels were performed using gas proportional, GM, and ZnS detectors with portable ratemeter-scalers.

Count rates (cpm), which were integrated over one minute with the detector held in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the net rate by the total efficiency ($\epsilon_i \times \epsilon_s$) and correcting for the physical probe area of the detector.

Because different building materials (poured concrete, brick, wood, steel, etc.) may have different background levels, average background count rates were determined for each material encountered in the surveyed area at a location of similar construction and having no known radiological history. The alpha activity background count rates for the ZnS and gas proportional detectors averaged 1 cpm. The beta activity background count rates for the gas proportional detectors averaged 263 cpm for concrete block, 226 cpm for painted metal, 303 cpm for poured concrete, and 236 cpm for wood. The beta activity background count rate averaged 45 cpm for the GM detectors. The alpha MDCs were 67 dpm/100 cm^2 for the gas proportional detectors and 115 dpm/100 cm^2 for the ZnS, calibrated to Th-230 while the beta activity MDCs ranged from 231 to 297 dpm/100 cm^2 for the gas proportional detectors and averaged 950 dpm/100 cm^2 for the GM, calibrated to Tl-204. The physical probe area of the gas proportional, ZnS scintillation, and GM detectors were 126 cm^2, 74 cm^2, and 20 cm^2, respectively.

area		cpm α bkgd	cpm β bkgd	dpm/100cm² α MDC	β MDC
126	gas prop	1 cpm	226-303	67	231-297
74	ZnS	1 cpm	—	115	
20	GM	—	45	—	950

Removable Activity Measurements

Removable gross alpha and gross beta activity levels were determined using numbered filter paper disks, 47 mm in diameter. Moderate pressure was applied to the smear and approximately 100 cm^2 of the surface was wiped. Smears were placed in labeled envelopes with the location and other pertinent information recorded.

Exposure Rate Measurements

Measurements of dose equivalent rates (µrem/h) were performed at 1 m above the surface using a Bicron microrem meter. Although the instrument displays data in µrem/h, the µrem/h to µR/h conversion is essentially unity.

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

Residue Sampling

In order to determine if any removable activity was present in the dust/dirt layers on surfaces, residue samples were collected by scrapping the residue into a labeled plastic container with the location and other pertinent information recorded.

Analytical Procedures

Gross Alpha/Beta

Smears were counted for two minutes on a low background gas proportional system for gross alpha and gross beta activity. The MDCs of the procedure were 9 dpm/100 cm^2 for gross alpha and 15 dpm/100 cm^2 for gross beta.

Gamma Spectroscopy

Samples of soil and residues were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in a 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All photopeaks associated with the radionuclides of concern were reviewed for consistency of activity. Photopeaks used for determining the activities of radionuclides of concern and the typical associated MDCs for a one-hour count time were:

Radionuclide	Photopeak	MDC soil (pCi/g)
Th-228	0.583 MeV from Tl-208*	0.05
	(or 0.239 MeV from Pb-212*)	0.02
Th-232	0.911 MeV from Ac-228*	0.05
U-235	0.143 MeV (or 0.186 MeV)	0.06
U-238	0.063 MeV from Th-234*	0.21
	(or 1.001 MeV from Pa-234 m)*	1.74

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the total propagated uncertainties for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels.

Detection limits, referred to as minimum detectable concentration (MDC), were based on 3 plus 4.65 times the standard deviation of the background count [$3 + (4.65\sqrt{BKG})$]. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

APPENDIX C
GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

and

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces or premises, equipment, or scrap which are likely to be contaminated, but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement, shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to special circumstances such as razing of buildings, transfer from premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

    a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

    b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555,

and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

a. Identify the premises.

b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 1
ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm βγ/100 cm^2	15,000 dpm βγ/100 cm^2	1,000 dpm βγ/100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma- emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal Register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document establishes guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

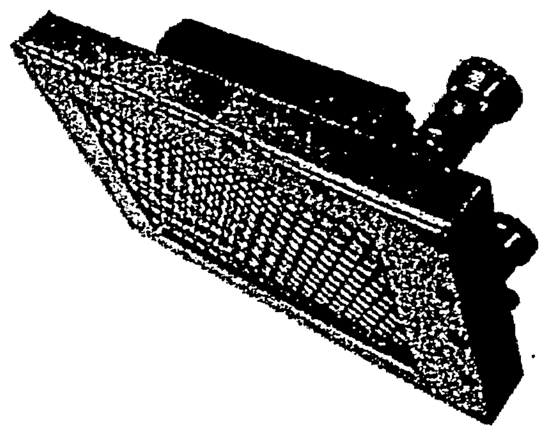
	Maximum Concentrations (pCi/g) above background for various options			
Material	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	---	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	---	1,000
Insoluble	35	300	---	3,000
Enriched Uranium:				
Soluble	30	100	---	1,000
Insoluble	30	250	---	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

MODEL 43-68 Gas Proportional Detector

PART NUMBER:47-2005

The Model 43-68 is a large area gas proportional detector for use in simultaneous alpha/beta surveys as well as alpha or beta surveys



INDICATED USE: Alpha-beta survey
RECOMMENDED COUNTING GAS: P-10 (*10% methane, 90% argon*)
GAS RECHARGE: Will operate on a static charge for over 15 hours with a 39" cable
WINDOW: Typically 0.8 mg/cm^2 aluminized mylar (*other thickness available*)
WINDOW AREA:
Active - 126 cm^2
Open - 100 cm^2
EFFICIENCY (4pi geometry): Typically 20% - Pu-239; 30% - Tc-99; 15% - C-14; less than 1% - gamma
BACKGROUND:
Alpha - Less than 5 cpm (*when operating on the alpha only plateau region*)
Beta - Typically 400 cpm or less (*10 microR/hr field*)
COMPATIBLE INSTRUMENTS: Model 12, 16, 18, 2000, 2200, 2221, 2224, 2225, 2241, 2350-1
OPERATING VOLTAGE:
Alpha - Typically 1000 - 1500 volts
Beta-gamma - Typically 1600 - 1800 volts
COUNTER THRESHOLD SETTING: Typically 2 - 5 mV
GAS CONNECTORS: Double end quick disconnect
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Anodized aluminum housing
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 3.9"(10cm)H X 4.6"(11.7cm)W X 7.8"(19.8cm)L
WEIGHT: 2 lbs (0.9kg)

Replacement Parts

Mylar Window
Protective Screen

Gas Fittings
Electrodes

Ordering Info.

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June 1974

U.S. ATOMIC ENERGY COMMISSION

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

REGULATORY GUIDE 1.86

TERMINATION OF OPERATING LICENSES FOR NUCLEAR REACTORS

A. INTRODUCTION

Section 50.51, "Duration of license, renewal," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that each license to operate a production and utilization facility be issued for a specified duration. Upon expiration of the specified period, the license may be either renewed or terminated by the Commission. Section 50.82, "Applications for termination of licenses," specifies the requirements that must be satisfied to terminate an operating license, including the requirement that the dismantlement of the facility and disposal of the component parts not be inimical to the common defense and security or to the health and safety of the public. This guide describes methods and procedures considered acceptable by the Regulatory staff for the termination of operating licenses for nuclear reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

When a licensee decides to terminate his nuclear reactor operating license, he may, as a first step in the process, request that his operating license be amended to restrict him to possess but not operate the facility. The advantage to the licensee of converting to such a possession-only license is reduced surveillance requirements in that periodic surveillance of equipment important to the safety of reactor operation is no longer required. Once this possession-only license is issued, reactor operation is not permitted. Other activities related to cessation of operations such as unloading fuel from the reactor and placing it in storage (either onsite of offsite) may be continued.

A licensee having a possession-only license must retain, with the Part 50 license, authorization for special nuclear material (10 CFR Part 70, "Special Nuclear Material"), byproduct material (10 CFR Part 30, "Rules of General Applicability to Licensing of Byproduct Material"), and source material (10 CFR Part 40, "Licensing of Source Material"), until the fuel, radioactive components, and sources are removed from the facility. Appropriate administrative controls and facility requirements are imposed by the Part 50 license and the technical specifications to assure that proper surveillance is performed and that the reactor facility is maintained in a safe condition and not operated.

A possession-only license permits various options and procedures for decommissioning, such as mothballing, entombment, or dismantling. The requirements imposed depend on the option selected.

Section 50.82 provides that the licensee may dismantle and dispose of the component parts of a nuclear reactor in accordance with existing regulations. For research reactors and critical facilities, this has usually meant the disassembly of a reactor and its shipment offsite, sometimes to another appropriately licensed organization for further use. The site from which a reactor has been removed must be decontaminated, as necessary, and inspected by the Commission to determine whether unrestricted access can be approved. In the case of nuclear power reactors, dismantling has usually been accomplished by shipping fuel offsite, making the reactor inoperable, and disposing of some of the radioactive components.

Radioactive components may be either shipped offsite for burial at an authorized burial ground or secured

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDE[a]	AVERAGE[b c]	MAXIMUM[b d]	REMOVABLE[b e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1000 dpm β-γ/100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

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Survey Data for Steel

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP1	05/19/03	Wet Mill	Lot #1	spirals/tanks	352	452	31	-53.19	10	10	0
HP1	05/19/03	Wet Mill	Lot #2	Spirals	280	164	36	-35.46	10	10	0
HP1	05/19/03	Wet Mill	Lot #3	Spirals	270	124	42	-14.18	10	10	0
HP2	05/19/03	Wet Mill	Lot #4	Beams	300	244	36	-35.46	10	10	0
HP2	05/19/03	Wet Mill	Lot #5	Beams	288	196	35	-39.01	10	10	0
HP2	05/19/03	Wet Mill	Lot #6	Tank/Hoppers	349	440	28	-63.83	10	10	0
HP3	05/20/03	Wet Mill	Lot #7	Hoppers	352	373	31	-53.19	6	6	0
HP3	05/20/03	Wet Mill	Lot #7	Hoppers	315	205	25	-74.47	6	6	0
HP3	05/20/03	Wet Mill	Lot #7	Hoppers	309	177	36	-35.46	6	6	0
HP4	05/21/03	Wet Mill	Lot #8	Tank/Hoppers	260	417	36	-35.46	8	8	0
HP4	05/21/03	Wet Mill	Lot #9	Tanks	228	278	38	-28.37	8	8	0
HP4	05/21/03	Wet Mill	Lot #10	Tank	268	452	41	-17.73	8	8	0
HP4	05/21/03	Wet Mill	Lot #11	Beams	305	613	43	-10.64	8	8	0
HP4	05/21/03	Wet Mill	Lot #12	Tank	247	361	36	-35.46	8	8	0
HP4	05/21/03	Wet Mill	Lot #13	Tank/Frame	271	465	35	-39.01	8	8	0
HP4	05/21/03	Wet Mill	Lot #14	Beam/Tray	263	430	36	-35.46	8	8	0
HP4	05/21/03	Wet Mill	Lot #15	Steel	193	126	49	10.64	8	8	0
HP4	05/21/03	Wet Mill	Lot #16	Tray	275	483	37	-31.91	8	8	0
HP4	05/21/03	Wet Mill	Lot #17	Tray	194	130	45	-3.55	8	8	0
HP5	05/22/03	Wet Mill	Lot #18	Tray	290	282	49	10.64	8	8	0
HP5	05/22/03	Wet Mill	Lot #19	Bin	278	227	32	-49.65	8	8	0
HP5	05/22/03	Wet Mill	Lot #20	Bin	244	73	42	-14.18	8	8	0
HP5	05/22/03	Wet Mill	Lot #21	Bin	288	273	31	-53.19	8	8	0
HP5	05/22/03	Wet Mill	Lot #22	Tank	269	186	16	-106.38	8	8	0
HP5	05/22/03	Wet Mill	Lot #23	Hoppers	300	327	41	-17.73	8	8	0
HP5	05/22/03	Wet Mill	Lot #24	Bin	249	95	32	-49.65	8	8	0
HP5	05/22/03	Wet Mill	Lot #25	Tray	288	273	26	-70.92	8	8	0
HP5	05/22/03	Wet Mill	Lot #26	Steel	259	141	29	-60.28	8	8	0
HP5	05/22/03	Wet Mill	Lot #27	Pipe	340	509	22	-85.11	8	8	0
HP5	05/22/03	Wet Mill	Lot #28	Tank	283	250	50	14.18	8	8	0
HP5	05/22/03	Wet Mill	Lot #29	Beams	270	191	51	17.73	8	8	0
HP6	05/27/03	Wet Mill	Lot #30	Bin	228	218	46	0.00	8	8	0
HP6	05/27/03	Wet Mill	Lot #31	Steel	220	189	44	-7.09	8	8	0
HP6	05/27/03	Wet Mill	Lot #32	Trough	226	211	30	-56.74	8	8	0
HP6	05/27/03	Wet Mill	Lot #33	Pipe	239	257	46	0.00	8	8	0
HP6	05/27/03	Wet Mill	Lot #34	Steel	203	129	40	-21.28	8	8	0
HP6	05/27/03	Wet Mill	Lot #35	Steel	205	136	48	7.09	8	8	0
HP6	05/27/03	Wet Mill	Lot #36	Bin	196	104	41	-17.73	8	8	0
HP6	05/27/03	Wet Mill	Lot #37	Bin	195	100	48	7.09	8	8	0
HP6	05/27/03	Wet Mill	Lot #38	Conveyor Belt	218	182	31	-53.19	8	8	0
HP6	05/27/03	Wet Mill	Lot #39	Hoppers	215	171	37	-31.91	8	8	0
HP6	05/27/03	Wet Mill	Lot #40	Conveyor Belt	209	150	47	3.55	8	8	0
HP6	05/27/03	Wet Mill	Lot #41	Steel	228	218	43	-10.64	8	8	0
HP6	05/27/03	Wet Mill	Lot #42	Beams/Spirals	202	125	40	-21.28	8	8	0
HP6	05/27/03	Wet Mill	Lot #43	Beams	208	146	32	-49.65	8	8	0
HP6	05/27/03	Wet Mill	Lot #44	Beams	200	118	40	-21.28	8	8	0
HP7	05/28/03	Wet Mill	Lot #45	Beams	224	200	63	57.14	10	10	0

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP7	05/28/03	Wet Mill	Lot #46	Pipe	199	111	34	46.43	10	10	0
HP7	05/28/03	Wet Mill	Lot #47	Beams	196	100	44	-10.71	10	10	0
HP7	05/28/03	Wet Mill	Lot #48	Beams	229	218	49	7.14	10	10	0
HP7	05/28/03	Wet Mill	Lot #49	Bin	237	246	50	10.71	10	10	0
HP7	05/28/03	Wet Mill	Lot #50	Bin	254	307	52	17.86	10	10	0
HP7	05/28/03	Wet Mill	Lot #51	Steel/Beams	240	257	19	-100.00	10	10	0
HP7	05/28/03	Wet Mill	Lot #52	Steel/Pipe	217	175	50	10.71	10	10	0
HP8	05/29/03	Wet Mill	Lot #53	Steel	211	129	39	-14.29	8	8	0
HP8	05/29/03	Wet Mill	Lot #54	Beams	217	150	47	14.29	8	8	0
HP8	05/29/03	Wet Mill	Lot #55	Beams	245	250	42	-3.57	8	8	0
HP8	05/29/03	Wet Mill	Lot #56	Beams	261	307	32	-39.29	8	8	0
HP8	05/29/03	Wet Mill	Lot #57	Hoppers	258	296	35	-28.57	8	8	0
HP8	05/29/03	Wet Mill	Lot #58	Hoppers	254	282	37	-21.43	8	8	0
HP8	05/29/03	Wet Mill	Lot #59	Beams	258	296	37	-21.43	8	8	0
HP8	05/29/03	Wet Mill	Lot #60	Beams	216	146	41	-7.14	8	8	0
HP8	05/29/03	Wet Mill	Lot #61	Hoppers	238	225	44	3.57	8	8	0
HP8	05/29/03	Wet Mill	Lot #62	Bin	230	196	42	-3.57	8	8	0
HP8	05/29/03	Wet Mill	Lot #63	Beams	236	218	38	-17.86	8	8	0
HP8	05/29/03	Wet Mill	Lot #64	Beams	197	79	59	57.14	8	8	0
HP8	05/29/03	Wet Mill	Lot #65	Beams	206	111	53	35.71	8	8	0
HP8	05/29/03	Wet Mill	Lot #66	Beams	201	93	49	21.43	8	8	0
HP8	05/29/03	Wet Mill	Lot #67	Beams	211	129	36	-25.00	8	8	0
HP8	05/29/03	Wet Mill	Lot #68	Frame	204	104	46	10.71	8	8	0
HP8	05/29/03	Wet Mill	Lot #69	Beam	216	146	38	-17.86	8	8	0
HP8	05/29/03	Wet Mill	Lot #70	Beam	213	136	46	10.71	8	8	0
HP8	05/29/03	Wet Mill	Lot #71	Beam	214	139	41	-7.14	8	8	0
HP8	05/29/03	Wet Mill	Lot #72	Beam	221	164	38	-17.86	8	8	0
HP8	05/29/03	Wet Mill	Lot #73	Beam	223	171	52	32.14	8	8	0
HP8	05/29/03	Wet Mill	Lot #74	Beams	257	293	48	17.86	8	8	0
HP8	05/29/03	Wet Mill	Lot #75	Beams	247	257	46	10.71	8	8	0
HP8	05/29/03	Wet Mill	Lot #76	Beams	243	243	38	-17.86	8	8	0
HP9	05/30/03	Wet Mill	Lot #77	Steel	238	169	40	-7.14	10	10	0
HP9	05/30/03	Wet Mill	Lot #78	Bin	221	110	39	-10.71	10	10	0
HP9	05/30/03	Wet Mill	Lot #79	Steel	250	210	46	14.29	10	10	0
HP9	05/30/03	Wet Mill	Lot #80	Frame	267	269	34	-28.57	10	10	0
HP9	05/30/03	Wet Mill	Lot #81	Frame	258	238	34	-28.57	10	10	0
HP9	05/30/03	Wet Mill	Lot #82	Spirals	226	128	42	0.00	10	10	0
HP9	05/30/03	Wet Mill	Lot #83	Beam	228	134	55	46.43	10	10	0
HP9	05/30/03	Wet Mill	Lot #84	Bin	235	159	44	7.14	10	10	0
HP9	05/30/03	Wet Mill	Lot #85	Frame/Bin	235	159	37	-17.86	10	10	0
HP9	05/30/03	Wet Mill	Lot #86	Beams/grating	220	107	62	71.43	10	10	0
HP9	05/30/03	Wet Mill	Lot #87	Bin	231	145	44	7.14	10	10	0
HP10	06/02/03	Wet Mill	Lot #88	Beams/Frame	249	246	35	-31.03	8	8	0
HP10	06/02/03	Wet Mill	Lot #89	Beams	259	282	38	-20.69	8	8	0
HP10	06/02/03	Wet Mill	Lot #90	Beams	221	146	42	-6.90	8	8	0
HP10	06/02/03	Wet Mill	Lot #91	Beams	226	164	44	0.00	8	8	0
HP10	06/02/03	Wet Mill	Lot #92	Beams	217	132	46	6.90	8	8	0

Heritage Minerals Final St(.s Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP10	06/02/03	Wet Mill	Lot #93	Beams	212	114	54	34.48	8	8	0
HP10	06/02/03	Wet Mill	Lot #94	Beams	218	136	46	6.90	8	8	0
HP10	06/02/03	Wet Mill	Lot #95	Beams	222	150	47	10.34	8	8	0
HP10	06/02/03	Wet Mill	Lot #96	Beams	203	82	52	27.59	8	8	0
HP10	06/02/03	Wet Mill	Lot #97	Bin	199	68	50	20.69	8	8	0
HP10	06/02/03	Wet Mill	Lot #98	Beam	200	71	49	17.24	8	8	0
HP10	06/02/03	Wet Mill	Lot #99	Beams	211	111	55	37.93	8	8	0
HP10	06/02/03	Wet Mill	Lot #100	Beams	208	100	36	-27.59	8	8	0
HP10	06/02/03	Wet Mill	Lot #101	Beams/Grating	242	221	50	20.69	8	8	0
HP10	06/02/03	Wet Mill	Lot #102	Beams	218	136	37	-24.14	8	8	0
HP10	06/02/03	Wet Mill	Lot #103	Beams	227	168	50	20.69	8	8	0
HP10	06/02/03	Wet Mill	Lot #104	Beams	223	154	42	-6.90	8	8	0
HP10	06/02/03	Wet Mill	Lot #105	Beams/Grating	221	146	52	27.59	8	8	0
HP10	06/02/03	Wet Mill	Lot #106	Tank	259	282	41	-10.34	8	8	0
HP10	06/02/03	Wet Mill	Lot #107	Bin	253	261	46	6.90	8	8	0
HP10	06/02/03	Wet Mill	Lot #108	Beams	225	161	50	20.69	8	8	0
HP10	06/02/03	Wet Mill	Lot #109	Beams	191	39	43	-3.45	8	8	0
HP10	06/02/03	Wet Mill	Lot #110	Auger	248	243	32	-41.38	8	8	0
HP11	06/03/03	Wet Mill	Lot #111	Beams	205	181	38	-18.52	11	11	0
HP11	06/03/03	Wet Mill	Lot #112	Beams	198	156	46	11.11	11	11	0
HP11	06/03/03	Wet Mill	Lot #113	Beams	211	204	41	-7.41	11	11	0
HP11	06/03/03	Wet Mill	Lot #114	Beam	189	122	45	7.41	11	11	0
HP11	06/03/03	Wet Mill	Lot #115	Beam	207	189	38	-18.52	11	11	0
HP11	06/03/03	Wet Mill	Lot #116	Frame	248	341	39	-14.81	11	11	0
HP11	06/03/03	Wet Mill	Lot #117	Beams	234	289	31	-44.44	11	11	0
HP11	06/03/03	Wet Mill	Lot #118	Beams	221	241	37	-22.22	11	11	0
HP11	06/03/03	Wet Mill	Lot #119	Beams/grating	227	263	35	-29.63	11	11	0
HP11	06/03/03	Wet Mill	Lot #120	Beams	244	326	32	-40.74	11	11	0
HP11	06/03/03	Wet Mill	Lot #121	frame	232	281	38	-18.52	11	11	0
HP11	06/03/03	Wet Mill	Lot #122	Beams	228	267	46	11.11	11	11	0
HP11	06/03/03	Wet Mill	Lot #123	Beams	210	200	42	-3.70	11	11	0
HP11	06/03/03	Wet Mill	Lot #124	Beam	200	163	36	-25.93	11	11	0
HP11	06/03/03	Wet Mill	Lot #125	Beam/grating	228	267	38	-18.52	11	11	0
HP11	06/03/03	Wet Mill	Lot #126	Beam/tray	229	270	36	-25.93	11	11	0
HP11	06/03/03	Wet Mill	Lot #127	Pipe	232	281	34	-33.33	11	11	0
HP11	06/03/03	Wet Mill	Lot #128	Beams	211	204	33	-37.04	11	11	0
HP11	06/03/03	Wet Mill	Lot #129	Beams/Spirals	217	226	38	-18.52	11	11	0
HP11	06/03/03	Wet Mill	Lot #130	Beams/Spirals/grating	238	304	42	-3.70	11	11	0
HP11	06/03/03	Wet Mill	Lot #131	Beams/rack	242	319	40	-11.11	11	11	0
HP11	06/03/03	Wet Mill	Lot #132	Beam/base/tray	245	330	36	-25.93	11	11	0
HP11	06/03/03	Wet Mill	Lot #133	trough	229	270	28	-55.56	11	11	0
HP11	06/03/03	Wet Mill	Lot #134	frame	234	289	44	3.70	11	11	0
HP11	06/03/03	Wet Mill	Lot #135	through/tray/beam/tin	248	341	49	22.22	11	11	0
HP14	06/09/03	Wet Mill	Lot #180	Beam	256	235	42	0.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #181	Beam	241	177	37	-17.86	10	10	0
HP14	06/09/03	Wet Mill	Lot #182	Beam	185	-38	39	-10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #183	Beam	236	158	44	7.14	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP14	06/09/03	Wet Mill	Lot #184	Beam	231	138	44	7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #185	Beam	249	208	44	7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #186	Beam	228	127	39	-10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #187	Beams	258	242	44	7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #188	Beam	224	112	45	10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #189	Beam	250	212	36	-21.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #190	Beam	258	242	43	3.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #191	Beam	229	131	27	-53.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #192	Beam	246	196	37	-17.86	10	10	0
HP14	06/09/03	Wet Mill	Lot #193	Beam	260	250	44	7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #194	Beam	223	108	42	0.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #195	Beam	231	138	42	0.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #196	Beam	244	188	45	10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #201	Beam	232	142	50	28.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #202	Beam	218	88	36	-21.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #203	Beam	224	112	43	3.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #204	Beam	236	158	44	7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #205	Beam	247	200	36	-21.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #206	Beams	254	227	42	0.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #207	Steel	237	162	55	46.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #208	Beam	234	150	54	42.86	10	10	0
HP14	06/09/03	Wet Mill	Lot #209	Beam	248	204	39	-10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #210	Tray	256	235	51	32.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #211	Beam	250	212	40	-7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #212	Beam	224	112	36	-21.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #213	Beam	231	138	56	50.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #214	Beam	243	185	34	-28.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #215	Beam	222	104	49	25.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #216	Beam	226	119	56	50.00	10	10	0
HP14	06/09/03	Wet Mill	Lot #217	Beam	239	169	57	53.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #218	Beam	212	65	55	46.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #219	Beam	214	73	41	-3.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #220	Beam	224	112	45	10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #221	Beam	238	165	40	-7.14	10	10	0
HP14	06/09/03	Wet Mill	Lot #222	Beam	242	181	55	46.43	10	10	0
HP14	06/09/03	Wet Mill	Lot #223	Beam	266	273	39	-10.71	10	10	0
HP14	06/09/03	Wet Mill	Lot #224	Beams	257	238	53	39.29	10	10	0
HP14	06/09/03	Wet Mill	Lot #225	Beam	249	208	57	53.57	10	10	0
HP14	06/09/03	Wet Mill	Lot #227	Beam	254	227	38	-14.29	10	10	0
HP14	06/09/03	Wet Mill	Lot #228	Beam	236	158	52	35.71	10	10	0
HP15	06/10/03	Wet Mill	Lot #229	Beam	210	165	46	10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #230	Beam	203	138	47	13.79	10	10	0
HP15	06/10/03	Wet Mill	Lot #231	Beam	216	188	35	-27.59	10	10	0
HP15	06/10/03	Wet Mill	Lot #232	Beam	195	108	44	3.45	10	10	0
HP15	06/10/03	Wet Mill	Lot #233	Beam	220	204	40	-10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #234	Beam	228	235	44	3.45	10	10	0
HP15	06/10/03	Wet Mill	Lot #235	Beam	211	169	51	27.59	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP15	06/10/03	Wet Mill	Lot #236	Beam	215	185	41	-6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #237	Beams	204	142	41	-6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #238	Beam	218	196	46	10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #239	Beam	213	177	39	-13.79	10	10	0
HP15	06/10/03	Wet Mill	Lot #252	Hopper	209	162	45	6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #253	Beam	213	177	28	-51.72	10	10	0
HP15	06/10/03	Wet Mill	Lot #254	Beam	202	135	50	24.14	10	10	0
HP15	06/10/03	Wet Mill	Lot #255	Beams	219	200	43	0.00	10	10	0
HP15	06/10/03	Wet Mill	Lot #256	Beam	218	196	54	37.93	10	10	0
HP15	06/10/03	Wet Mill	Lot #257	Beams	230	242	52	31.03	10	10	0
HP15	06/10/03	Wet Mill	Lot #258	Beam	205	146	43	0.00	10	10	0
HP15	06/10/03	Wet Mill	Lot #259	Beams	216	188	37	-20.69	10	10	0
HP15	06/10/03	Wet Mill	Lot #260	Beam	228	235	49	20.69	10	10	0
HP15	06/10/03	Wet Mill	Lot #261	Beams	232	250	36	-24.14	10	10	0
HP15	06/10/03	Wet Mill	Lot #262	Beam	200	127	53	34.48	10	10	0
HP15	06/10/03	Wet Mill	Lot #263	Beam	214	181	51	27.59	10	10	0
HP15	06/10/03	Wet Mill	Lot #264	Beam	205	146	53	34.48	10	10	0
HP15	06/10/03	Wet Mill	Lot #265	Beam	223	215	42	-3.45	10	10	0
HP15	06/10/03	Wet Mill	Lot #266	frame	215	185	51	27.59	10	10	0
HP15	06/10/03	Wet Mill	Lot #267	Beams	184	65	50	24.14	10	10	0
HP15	06/10/03	Wet Mill	Lot #268	Beam	208	158	48	17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #269	Beam	204	142	48	17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #270	Beam	206	150	33	-34.48	10	10	0
HP15	06/10/03	Wet Mill	Lot #271	Beam	193	100	50	24.14	10	10	0
HP15	06/10/03	Wet Mill	Lot #272	Beam	208	158	29	-48.28	10	10	0
HP15	06/10/03	Wet Mill	Lot #273	Beams	230	242	41	-6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #274	Steel	226	227	32	-37.93	10	10	0
HP15	06/10/03	Wet Mill	Lot #275	Beams	188	81	31	-41.38	10	10	0
HP15	06/10/03	Wet Mill	Lot #276	Beams	205	146	42	-3.45	10	10	0
HP15	06/10/03	Wet Mill	Lot #277	Beams	237	269	38	-17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #278	Beam	200	127	41	-6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #279	Beams	213	177	46	10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #280	Beam	214	181	46	10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #281	Beam	209	162	53	34.48	10	10	0
HP15	06/10/03	Wet Mill	Lot #282	Beam	207	154	40	-10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #283	Beam	228	235	43	0.00	10	10	0
HP15	06/10/03	Wet Mill	Lot #284	Hopper	243	292	49	20.69	10	10	0
HP15	06/10/03	Wet Mill	Lot #285	Beam/pipe	221	208	52	31.03	10	10	0
HP15	06/10/03	Wet Mill	Lot #286	Beam	196	112	40	-10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #287	Pipes	232	250	45	6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #288	Beams	219	200	46	10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #289	Beam	198	119	45	6.90	10	10	0
HP15	06/10/03	Wet Mill	Lot #290	Beam	211	169	34	-31.03	10	10	0
HP15	06/10/03	Wet Mill	Lot #291	Beams	206	150	38	-17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #292	Beam	214	181	38	-17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #293	Beam	195	108	49	20.69	10	10	0
HP15	06/10/03	Wet Mill	Lot #294	Beam	207	154	49	20.69	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP15	06/10/03	Wet Mill	Lot #295	Beam/pipe	240	281	31	41.38	10	10	0
HP15	06/10/03	Wet Mill	Lot #296	Beam	218	196	44	3.45	10	10	0
HP15	06/10/03	Wet Mill	Lot #297	Beams	216	188	48	17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #298	Beam	204	142	44	3.45	10	10	0
HP15	06/10/03	Wet Mill	Lot #299	Beams	199	123	52	31.03	10	10	0
HP15	06/10/03	Wet Mill	Lot #300	Beams	220	204	43	0.00	10	10	0
HP15	06/10/03	Wet Mill	Lot #301	Beam	185	69	46	10.34	10	10	0
HP15	06/10/03	Wet Mill	Lot #302	Beams	230	242	48	17.24	10	10	0
HP15	06/10/03	Wet Mill	Lot #303	Beam	193	100	46	10.34	10	10	0
HP37	07/09/03	Wet Mill		Steel Mix	257	150	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	260	162	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	239	81	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	253	135	46	14.81	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	252	131	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	246	108	50	29.63	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	250	123	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	242	92	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	244	100	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	245	104	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	249	119	47	18.52	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	227	35	49	25.93	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	236	69	45	11.11	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	240	85	45	11.11	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	231	50	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	245	104	44	7.41	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	249	119	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	249	119	50	29.63	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	248	115	48	22.22	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	241	88	46	14.81	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	235	65	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	251	127	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	253	135	47	18.52	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	233	58	46	14.81	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	238	77	47	18.52	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	241	88	45	11.11	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	236	69	50	29.63	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	236	69	51	33.33	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	237	73	51	33.33	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	240	85	47	18.52	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	239	81	46	14.81	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	249	119	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	251	127	44	7.41	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	252	131	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	254	138	42	0.00	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	253	135	45	11.11	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	233	58	47	18.52	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	237	73	43	3.70	11	11	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP37	07/09/03	Wet Mill		Steel Mix	236	69	43	3.70	11	11	0
HP37	07/09/03	Wet Mill		Steel Mix	232	54	42	0.00	11	11	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	48	26.92	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	44	11.54	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	45	15.38	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	44	11.54	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	42	3.85	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	57	61.54	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	44	11.54	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	42	3.85	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	44	11.54	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	43	7.69	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	56	57.69	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	46	19.23	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	44	11.54	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	42	3.85	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	52	42.31	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	51	38.46	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	45	15.38	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	54	50.00	13	13	0
HP40	07/14/03	Wet Mill	Launders	Launders	203	0	45	15.38	13	13	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	48	26.92	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	43	7.69	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	53	46.15	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	43	7.69	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	52	42.31	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	47	23.08	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	47	23.08	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	47	23.08	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	44	11.54	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	42	3.85	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	56	57.69	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	41	0.00	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	45	15.38	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	43	7.69	10	10	0
HP41	07/14/03	Wet Mill	Launders	Launders	203	0	50	34.62	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	42	0.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	42	0.00	10	10	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	45	12.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	54	48.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	59	68.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	56	56.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	48	24.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	47	20.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	46	16.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	42	0.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	45	12.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	44	8.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	51	36.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	49	28.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	45	12.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	42	0.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	46	16.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	44	8.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	48	24.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	42	0.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	49	28.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	47	20.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	45	12.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	44	8.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	47	20.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	46	16.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	45	12.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	42	0.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	48	24.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	50	32.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	53	44.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	54	48.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	44	8.00	10	10	0
HP42	07/10/03	Wet Mill	Launders	Launders	208	0	43	4.00	10	10	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	47	22.22	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	44	11.11	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	45	14.81	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	44	11.11	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	46	18.52	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	47	22.22	9	9	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	57	59.26	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	45	14.81	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	48	25.93	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	47	22.22	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	45	14.81	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	43	7.41	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	50	33.33	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	41	0.00	9	9	0
HP44	07/15/03	Wet Mill	Launders	Launders	196	0	44	11.11	9	9	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	0	-151.85	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	44	11.11	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	57	59.26	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	59	66.67	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	63	81.48	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	46	18.52	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	44	11.11	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	45	14.81	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	0	-151.85	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	0	-151.85	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	45	14.81	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	43	7.41	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	46	18.52	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	44	11.11	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	53	44.44	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	57	59.26	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	45	14.81	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	42	3.70	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	43	7.41	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	46	18.52	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	59	66.67	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	46	18.52	12	12	0
HP47	07/15/03	Wet Mill	Launders	Launders	196	0	54	48.15	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	55	24.00	12	12	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	57	32.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	50	4.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	50	4.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	50	4.00	12	12	0
HP48	07/16/03	Wet Mill	Launders	Launders	194	0	51	8.00	12	12	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	59	40.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	51	8.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	50	4.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	54	20.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	53	16.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP49	07/16/03	Wet Mill	Launders	Launders	194	0	49	0.00	16	16	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	48	11.54	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	55	38.46	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	49	15.38	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	55	38.46	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	46	3.85	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	49	15.38	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	49	15.38	11	11	0
HP52	07/17/03	Wet Mill	Launders	Launders	223	0	45	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	47	12.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	45	4.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	47	12.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	49	20.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	52	32.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	46	8.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	45	4.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	48	16.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	47	12.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	48	16.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	50	24.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	45	4.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	47	12.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	47	12.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	47	12.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	46	8.00	11	11	0
HP54	07/18/03	Wet Mill	Launders	Launders	220	0	44	0.00	11	11	0
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	52	32.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	8	10	-2

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	8	10	-2
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	52	32.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	46	8.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	48	16.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	55	44.00	8	10	-2
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	8	10	-2
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	48	16.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	46	8.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	7	10	-3
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	55	44.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	8	10	-2
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	8	10	-2
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	45	4.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	9	10	-1
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	49	20.00	8	10	-2
HP56	07/21/03	Wet Mill	Launders	Launders	220	0	44	0.00	8	10	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	54	38.46	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	50	23.08	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	8	9	-1
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	56	46.15	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	46	7.69	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	8	9	-1
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	45	3.85	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	8	9	-1
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	45	3.85	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	47	11.54	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	46	7.69	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	51	26.92	7	9	-2
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	48	15.38	8	9	-1
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	54	38.46	8	9	-1
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	48	15.38	9	9	0
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	57	50.00	8	9	-1
HP58	07/22/03	Wet Mill	Launders	Launders	213	0	44	0.00	8	9	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	53	34.62	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	10	10	0
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	50	23.08	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	49	19.23	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	46	7.69	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	45	3.85	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	53	34.62	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	51	26.92	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	62	69.23	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	46	7.69	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	46	7.69	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	47	11.54	10	10	0
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	10	10	0
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	10	10	0
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	47	11.54	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	56	46.15	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	49	19.23	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	50	23.08	9	10	-1
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	44	0.00	8	10	-2
HP61	07/22/03	Wet Mill	Launders	Launders	214	0	47	11.54	9	10	-1
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	51	25.93	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	45	3.70	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	45	3.70	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	57	48.15	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	48	14.81	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	49	18.52	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	51	25.93	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	54	37.04	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	45	3.70	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	49	18.52	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	45	3.70	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP64	07/23/03	Wet Mill	Launders	Launders	233	0	44	0.00	12	12	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	241	77	49	3.85	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	231	38	48	0.00	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	20	-107.69	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	238	65	48	0.00	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	233	46	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	231	38	48	0.00	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	226	19	48	0.00	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	242	81	52	15.38	7	9	-2
HP67	07/28/03	Wet Mill	Launders	Launders	235	54	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	232	42	53	19.23	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	248	104	49	3.85	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	9	9	0
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	52	15.38	8	9	-1
HP67	07/28/03	Wet Mill	Launders	Launders	221	0	48	0.00	8	9	-1
HP70	07/29/03	Wet Mill	Launders	Launders	241	80	47	11.54	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	231	40	44	0.00	7	8	-1
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	52	30.77	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	49	19.23	3	8	-5
HP70	07/29/03	Wet Mill	Launders	Launders	240	76	47	11.54	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	248	108	44	0.00	7	8	-1
HP70	07/29/03	Wet Mill	Launders	Launders	234	52	52	30.77	7	8	-1
HP70	07/29/03	Wet Mill	Launders	Launders	248	108	50	23.08	3	8	-5
HP70	07/29/03	Wet Mill	Launders	Launders	251	120	44	0.00	3	8	-5
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	47	11.54	2	8	-6
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	68	92.31	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	44	0.00	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	44	0.00	8	8	0
HP70	07/29/03	Wet Mill	Launders	Launders	243	88	57	50.00	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	241	80	44	0.00	7	8	-1
HP70	07/29/03	Wet Mill	Launders	Launders	237	64	49	19.23	7	8	-1
HP70	07/29/03	Wet Mill	Launders	Launders	239	72	48	15.38	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	250	116	44	0.00	5	8	-3
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	44	0.00	8	8	0
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	48	15.38	7	8	-1

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	45	3.85	9	8	1
HP70	07/29/03	Wet Mill	Launders	Launders	236	60	44	0.00	8	8	0
HP70	07/29/03	Wet Mill	Launders	Launders	230	36	44	0.00	8	8	0
HP70	07/29/03	Wet Mill	Launders	Launders	243	88	50	23.08	7	8	-1
HP70	07/29/03	Wet Mill	Launders	Launders	221	0	60	61.54	3	8	-5
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	50	7.69	10	12	-2
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	53	19.23	10	12	-2
HP71	07/29/03	Wet Mill	Launders	Launders	241	77	51	11.54	10	12	-2
HP71	07/29/03	Wet Mill	Launders	Launders	247	100	49	3.85	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	238	65	48	0.00	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	48	0.00	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	48	0.00	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	48	0.00	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	48	0.00	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	233	46	50	7.69	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	231	38	53	19.23	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	231	38	58	38.46	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	58	38.46	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	229	31	48	0.00	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	228	27	48	0.00	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	224	12	48	0.00	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	230	35	48	0.00	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	57	34.62	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	55	26.92	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	49	3.85	12	12	0
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	49	3.85	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	224	12	48	0.00	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	234	50	48	0.00	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	238	65	53	19.23	11	12	-1
HP71	07/29/03	Wet Mill	Launders	Launders	221	0	52	15.38	12	12	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	50	15.38	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	47	3.85	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	57	42.31	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	49	11.54	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	47	3.85	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	56	38.46	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	8	8	0
HP73	07/30/03	Wet Mill	Launders	Launders	213	0	51	19.23	8	8	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	47	3.85	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	53	26.92	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	48	7.69	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	50	15.38	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	52	23.08	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	48	7.69	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	46	0.00	9	9	0
HP75	07/30/03	Wet Mill	Launders	Launders	213	0	48	7.69	9	9	0
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	7	10	-3
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	9	10	-1
HP77	07/31/03	Wet Mill	Launders	Launders	229	77	46	14.81	9	10	-1
HP77	07/31/03	Wet Mill	Launders	Launders	232	88	47	18.52	8	10	-2
HP77	07/31/03	Wet Mill	Launders	Launders	226	65	44	7.41	8	10	-2
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	7	10	-3
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	8	10	-2
HP77	07/31/03	Wet Mill	Launders	Launders	219	38	45	11.11	8	10	-2
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	43	3.70	8	10	-2
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	46	14.81	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	51	33.33	7	10	-3
HP77	07/31/03	Wet Mill	Launders	Launders	235	100	44	7.41	7	10	-3
HP77	07/31/03	Wet Mill	Launders	Launders	224	58	44	7.41	9	10	-1

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP77	07/31/03	Wet Mill	Launders	Launders	228	73	45	11.11	9	10	-1
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	8	10	-2
HP77	07/31/03	Wet Mill	Launders	Launders	217	31	42	0.00	7	10	-3
HP77	07/31/03	Wet Mill	Launders	Launders	231	85	42	0.00	7	10	-3
HP77	07/31/03	Wet Mill	Launders	Launders	234	96	42	0.00	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	47	18.52	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	44	7.41	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	42	0.00	5	10	-5
HP77	07/31/03	Wet Mill	Launders	Launders	237	108	42	0.00	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	209	0	43	3.70	6	10	-4
HP77	07/31/03	Wet Mill	Launders	Launders	225	62	45	11.11	10	10	0
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	71	100.00	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	254	142	52	26.92	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	238	81	59	53.85	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	250	127	55	38.46	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	45	0.00	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	51	23.08	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	249	123	50	19.23	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	52	26.92	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	60	57.69	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	55	38.46	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	237	77	45	0.00	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	243	100	45	0.00	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	236	73	48	11.54	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	46	3.85	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	248	119	45	0.00	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	239	85	46	3.85	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	253	138	45	0.00	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	248	119	57	46.15	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	47	7.69	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	58	50.00	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	45	0.00	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	217	0	68	88.46	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	232	58	60	57.69	7	7	0
HP81	08/05/03	Wet Mill	Launders	Launders	247	115	49	15.38	6	7	-1
HP81	08/05/03	Wet Mill	Launders	Launders	253	138	51	23.08	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	56	42.31	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	65	76.92	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	47	7.69	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	281	127	54	34.62	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	268	77	53	30.77	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	274	100	55	38.46	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	263	58	63	69.23	7	7	0
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	60	57.69	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	279	119	45	0.00	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	277	112	62	65.38	7	7	0
HP84	08/05/03	Wet Mill	Launders	Launders	278	115	63	69.23	7	7	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	58	50.00	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	263	58	60	57.69	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	287	150	53	30.77	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	291	165	62	65.38	5	7	-2
HP84	08/05/03	Wet Mill	Launders	Launders	280	123	62	65.38	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	284	138	67	84.62	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	287	150	46	3.85	7	7	0
HP84	08/05/03	Wet Mill	Launders	Launders	288	154	45	0.00	7	7	0
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	54	34.62	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	53	30.77	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	285	142	59	53.85	7	7	0
HP84	08/05/03	Wet Mill	Launders	Launders	268	77	58	50.00	7	7	0
HP84	08/05/03	Wet Mill	Launders	Launders	279	119	55	38.46	6	7	-1
HP84	08/05/03	Wet Mill	Launders	Launders	248	0	56	42.31	5	7	-2
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	8	8	0
HP86	08/06/03	Wet Mill	Launders	Launders	271	60	49	0.00	8	8	0
HP86	08/06/03	Wet Mill	Launders	Launders	268	48	49	0.00	8	8	0
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	276	80	49	0.00	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	269	52	55	23.08	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	272	64	49	0.00	6	8	-2
HP86	08/06/03	Wet Mill	Launders	Launders	266	40	49	0.00	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	55	23.08	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	52	11.54	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	6	8	-2
HP86	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	6	8	-2
HP86	08/06/03	Wet Mill	Launders	Launders	273	68	49	0.00	5	8	-3
HP86	08/06/03	Wet Mill	Launders	Launders	282	104	49	0.00	6	8	-2
HP87	08/06/03	Wet Mill	Launders	Launders	282	104	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	291	140	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	285	116	52	11.54	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	293	148	59	38.46	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	307	204	68	73.08	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	289	132	59	38.46	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	271	60	55	23.08	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	267	44	54	19.23	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	283	108	57	30.77	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	279	92	56	26.92	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	287	124	57	30.77	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	57	30.77	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	274	72	50	3.85	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	280	96	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	264	32	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	8	9	-1

Heritage Minerals Final St(.s Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	8	9	-1
HP87	08/06/03	Wet Mill	Launders	Launders	281	100	52	11.54	8	9	-1
HP87	08/06/03	Wet Mill	Launders	Launders	276	80	56	26.92	9	9	0
HP87	08/06/03	Wet Mill	Launders	Launders	288	128	54	19.23	8	9	-1
HP87	08/06/03	Wet Mill	Launders	Launders	270	56	58	34.62	8	9	-1
HP87	08/06/03	Wet Mill	Launders	Launders	274	72	52	11.54	8	9	-1
HP87	08/06/03	Wet Mill	Launders	Launders	277	84	49	0.00	8	9	-1
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	50	3.85	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	276	80	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	57	30.77	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	52	11.54	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	267	44	52	11.54	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	271	60	19	-115.38	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	56	26.92	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	282	104	52	11.54	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	278	88	51	7.69	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	270	56	54	19.23	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	51	7.69	9	9	0
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	59	38.46	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	55	23.08	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	58	34.62	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	268	48	49	0.00	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	273	68	49	0.00	4	9	-5
HP87	08/06/03	Wet Mill	Launders	Launders	277	84	49	0.00	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	271	60	57	30.77	5	9	-4
HP87	08/06/03	Wet Mill	Launders	Launders	272	64	61	46.15	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	266	40	52	11.54	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	256	0	49	0.00	7	9	-2
HP87	08/06/03	Wet Mill	Launders	Launders	282	104	49	0.00	6	9	-3
HP87	08/06/03	Wet Mill	Launders	Launders	281	100	50	3.85	6	9	-3
HP93	08/08/03	Wet Mill	Launders	Launders	233	96	48	0.00	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	239	119	51	10.71	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	48	0.00	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	230	85	50	7.14	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	243	135	55	25.00	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	229	81	48	0.00	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	225	65	48	0.00	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	227	73	54	21.43	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	48	0.00	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	235	104	53	17.86	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	223	58	51	10.71	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	54	21.43	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	48	0.00	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	269	235	50	7.14	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	49	3.57	8	8	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP93	08/08/03	Wet Mill	Launders	Launders	262	208	56	28.57	8	8	0
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	52	14.29	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	48	0.00	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	48	0.00	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	218	38	49	3.57	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	289	312	56	28.57	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	238	115	59	39.29	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	49	3.57	6	8	-2
HP93	08/08/03	Wet Mill	Launders	Launders	208	0	52	14.29	7	8	-1
HP93	08/08/03	Wet Mill	Launders	Launders	234	100	54	21.43	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	6	8	-2
HP96	08/11/03	Wet Mill	Launders	Launders	227	74	56	53.85	6	8	-2
HP96	08/11/03	Wet Mill	Launders	Launders	233	96	42	0.00	6	8	-2
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	44	7.69	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	228	78	48	23.08	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	234	100	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	233	96	49	26.92	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	240	122	54	46.15	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	6	8	-2
HP96	08/11/03	Wet Mill	Launders	Launders	232	93	49	26.92	6	8	-2
HP96	08/11/03	Wet Mill	Launders	Launders	224	63	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	236	107	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	230	85	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	248	152	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	243	133	47	19.23	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	251	163	49	26.92	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	229	81	45	11.54	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	238	115	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	56	53.85	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	227	74	49	26.92	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	45	11.54	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	233	96	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	228	78	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	236	107	47	19.23	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	243	133	46	15.38	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	239	119	42	0.00	8	8	0
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	49	26.92	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	207	0	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	224	63	44	7.69	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	220	48	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	235	104	42	0.00	7	8	-1
HP96	08/11/03	Wet Mill	Launders	Launders	230	85	56	53.85	8	8	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP96	08/11/03	Wet Mill	Launders	Launders	232	93	47	19.23	8	8	0
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	8	10	-2
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	46	7.69	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	52	30.77	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	246	156	48	15.38	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	230	96	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	235	115	46	7.69	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	253	181	44	0.00	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	46	7.69	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	237	122	50	23.08	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	241	137	52	30.77	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	224	74	44	0.00	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	229	93	50	23.08	8	10	-2
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	8	10	-2
HP97	08/12/03	Wet Mill	Launders	Launders	226	81	44	0.00	8	10	-2
HP97	08/12/03	Wet Mill	Launders	Launders	265	226	52	30.77	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	258	200	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	270	244	44	0.00	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	239	130	44	0.00	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	46	7.69	10	10	0
HP97	08/12/03	Wet Mill	Launders	Launders	237	122	48	15.38	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	225	78	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	251	174	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	236	119	44	0.00	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	269	241	50	23.08	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	245	152	46	7.69	9	10	-1
HP97	08/12/03	Wet Mill	Launders	Launders	240	133	49	19.23	9	10	-1
HP98	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	228	89	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	233	107	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	232	104	53	34.62	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	240	133	44	0.00	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	253	181	48	15.38	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	235	115	49	19.23	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	231	100	53	34.62	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	267	233	52	30.77	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	251	174	44	0.00	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	273	256	45	3.85	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	234	111	48	15.38	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	258	200	44	0.00	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	261	211	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	233	107	49	19.23	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	265	226	44	0.00	8	9	-1

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP98	08/12/03	Wet Mill	Launders	Launders	226	81	50	23.08	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	204	0	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	219	56	51	26.92	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	232	104	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	240	133	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	245	152	44	0.00	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	204	0	58	53.85	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	256	193	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	204	0	49	19.23	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	241	137	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	278	274	58	53.85	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	280	281	44	0.00	8	9	-1
HP98	08/12/03	Wet Mill	Launders	Launders	258	200	44	0.00	9	9	0
HP98	08/12/03	Wet Mill	Launders	Launders	243	144	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	240	133	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	245	152	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	251	174	47	11.54	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	246	156	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	247	159	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	238	126	49	19.23	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	221	63	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	228	89	48	15.38	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	230	96	47	11.54	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	237	122	50	23.08	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	204	0	50	23.08	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	204	0	45	3.85	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	264	222	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	204	0	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	229	93	55	42.31	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	235	115	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	239	130	48	15.38	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	204	0	49	19.23	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	245	152	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	250	170	45	3.85	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	204	0	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	227	85	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	241	137	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	236	119	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	244	148	44	0.00	8	9	-1
HP99	08/13/03	Wet Mill	Launders	Launders	240	133	49	19.23	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	253	181	51	26.92	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	225	78	47	11.54	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	219	56	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	204	0	44	0.00	9	9	0
HP99	08/13/03	Wet Mill	Launders	Launders	246	156	44	0.00	9	9	0
HP101	08/14/03	Wet Mill	Launders	Launders	257	164	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	236	80	50	16.00	8	9	-1

Heritage Minerals Final S[illegible]us Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP101	08/14/03	Wet Mill	Launders	Launders	277	244	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	249	132	50	16.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	258	168	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	51	20.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	251	140	56	40.00	7	9	-2
HP101	08/14/03	Wet Mill	Launders	Launders	255	156	46	0.00	7	9	-2
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	50	16.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	252	144	65	76.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	259	172	52	24.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	263	188	47	4.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	9	9	0
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	9	9	0
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	53	28.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	237	84	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	239	92	46	0.00	9	9	0
HP101	08/14/03	Wet Mill	Launders	Launders	236	80	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	251	140	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	58	48.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	9	9	0
HP101	08/14/03	Wet Mill	Launders	Launders	259	172	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	248	128	52	24.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	242	104	57	44.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	247	124	51	20.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	53	28.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	49	12.00	7	9	-2
HP101	08/14/03	Wet Mill	Launders	Launders	239	92	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	243	108	46	0.00	8	9	-1
HP101	08/14/03	Wet Mill	Launders	Launders	216	0	50	16.00	8	9	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	54	32.00	4	8	-4
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	6	8	-2
HP102	08/14/03	Wet Mill	Launders	Launders	247	124	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	246	120	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	242	104	56	40.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	248	128	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	251	140	50	16.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	49	12.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	251	140	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	262	184	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	258	168	51	20.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	58	48.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	49	12.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	268	208	48	8.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	8	8	0

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP102	08/14/03	Wet Mill	Launders	Launders	246	120	51	20.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	249	132	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	237	84	49	12.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	245	116	55	36.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	245	116	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	51	20.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	63	68.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	246	120	67	84.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	239	92	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	245	116	61	60.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	49	12.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	7	8	-1
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	253	148	50	16.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	231	60	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	239	92	58	48.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	63	68.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	277	244	69	92.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	259	172	58	48.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	272	224	51	20.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	284	272	49	12.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	236	80	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	251	140	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	257	164	51	20.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	216	0	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	275	236	46	0.00	8	8	0
HP102	08/14/03	Wet Mill	Launders	Launders	252	144	50	16.00	8	8	0
AD 1	06/06/03	Wet Mill	AD 85	Beams	215	54	54	37.93	10	10	0
AD 1	06/06/03	Wet Mill	AD 86	Beams	206	21	48	17.24	10	10	0
AD 1	06/06/03	Wet Mill	AD 87	Beams	190	-36	53	34.48	10	10	0
AD 1	06/06/03	Wet Mill	AD 88	Beams	195	-18	48	17.24	10	10	0
AD 1	06/06/03	Wet Mill	AD 89	Beams	210	36	54	37.93	10	10	0
AD 1	06/06/03	Wet Mill	AD 90	Beams	188	-43	43	0.00	10	10	0
AD 1	06/06/03	Wet Mill	AD 91	Beams	183	-61	45	6.90	10	10	0
AD 1	06/06/03	Wet Mill	AD 92	Beams	180	-71	52	31.03	10	10	0
AD 2	06/17/03	Wet Mill	1701	Beams	370	71	44	0.00	10	10	0
AD 2	06/17/03	Wet Mill	1702	Beams	363	46	55	37.93	10	10	0
AD 2	06/17/03	Wet Mill	1703	Beams	400	179	35	-31.03	10	10	0
AD 2	06/17/03	Wet Mill	1704	Beams	412	221	45	3.45	10	10	0
AD 2	06/17/03	Wet Mill	1705	Beams	370	71	39	-17.24	10	10	0
AD 2	06/17/03	Wet Mill	1706	Beams	377	96	37	-24.14	10	10	0
AD 2	06/17/03	Wet Mill	1707	Beams	383	118	39	-17.24	10	10	0
AD 2	06/17/03	Wet Mill	1708	Beams	397	168	44	0.00	10	10	0
AD 2	06/17/03	Wet Mill	1709	Beams	402	186	40	-13.79	10	10	0
AD 2	06/17/03	Wet Mill	1710	Beams	368	64	56	41.38	10	10	0
AD 2	06/17/03	Wet Mill	1711	Beams	402	186	46	6.90	10	10	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
AD 2	06/17/03	Wet Mill	1712	Beams	394	157	51	24.14	10	10	0
AD 2	06/17/03	Wet Mill	1713	Beams	378	100	46	6.90	10	10	0
AD 2	06/17/03	Wet Mill	1714	Beams	390	143	36	-27.59	10	10	0
AD 2	06/17/03	Wet Mill	1715	Beams	378	100	44	0.00	10	10	0
AD 3	06/04/03	Wet Mill	AD 66	Beams	237	69	39	-10.34	10	10	0
AD 3	06/04/03	Wet Mill	AD 67	Beams	232	52	44	6.90	10	10	0
AD 3	06/04/03	Wet Mill	AD 68	Beams	222	17	34	-27.59	10	10	0
AD 3	06/04/03	Wet Mill	AD 69	Beams	212	-17	58	55.17	10	10	0
AD 3	06/04/03	Wet Mill	AD 70	Beams	227	34	44	6.90	10	10	0
AD 3	06/04/03	Wet Mill	AD 71	Beams	212	-17	40	-6.90	10	10	0
AD 3	06/04/03	Wet Mill	AD 72	Beams	234	59	44	6.90	10	10	0
AD 3	06/04/03	Wet Mill	AD 73	Beams	229	41	51	31.03	10	10	0
AD 3	06/04/03	Wet Mill	AD 74	Beams	207	-34	55	44.83	10	10	0
AD 3	06/04/03	Wet Mill	AD 75	Beams	205	-41	44	6.90	10	10	0
AD 3	06/04/03	Wet Mill	AD 76	Beams	202	-52	43	3.45	10	10	0
AD 3	06/04/03	Wet Mill	AD 77	Beams	208	-31	31	-37.93	10	10	0
AD 3	06/04/03	Wet Mill	AD 81	Beams	255	131	45	10.34	10	10	0
AD 3	06/04/03	Wet Mill	AD 82	Beams	197	-69	86	151.72	10	10	0
AD 4	06/11/03	Wet Mill	AD 94	Beams	245	155	50	17.86	10	10	0
AD 4	06/11/03	Wet Mill	AD 95	Beams	267	231	45	0.00	10	10	0
AD 4	06/11/03	Wet Mill	AD 96	Beams	289	307	45	0.00	10	10	0
AD 4	06/11/03	Wet Mill	AD 97	Beams	287	300	51	21.43	10	10	0
AD 4	06/11/03	Wet Mill	AD 98	Beams	279	272	45	0.00	10	10	0
AD 4	06/11/03	Wet Mill	AD 99	Beams	260	207	45	0.00	10	10	0
AD 4	06/11/03	Wet Mill	AD 100	Beams	211	38	47	7.14	10	10	0
AD 4	06/11/03	Wet Mill	AD 101	Beams	189	-38	45	0.00	10	10	0
AD 4	06/11/03	Wet Mill	AD 102	Beams	242	145	45	0.00	10	10	0
AD 4	06/11/03	Wet Mill	AD 103	Beams	212	41	46	3.57	10	10	0
AD 5	06/11/03	Wet Mill	AD 104	Tanks	204	14	49	14.29	10	10	0
AD 5	06/11/03	Wet Mill	AD 105	Tanks	216	55	52	25.00	10	10	0
AD 5	06/11/03	Wet Mill	AD 106	Tanks	213	45	44	-3.57	10	10	0
AD 5	06/11/03	Wet Mill	AD 107	Tanks	188	-41	44	-3.57	10	10	0
AD 5	06/11/03	Wet Mill	AD 108	Tanks	216	55	51	21.43	10	10	0
AD 5	06/11/03	Wet Mill	AD 109	Tanks	225	86	53	28.57	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	52	10.71	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	293	189	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	295	196	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	50	3.57	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	51	7.14	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	243	4	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	252	37	49	0.00	10	10	0
AD 6	06/24/03	Wet Mill	Steel Scrap	Steel Scrap	242	0	49	0.00	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	54	7.41	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	40	-44.44	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	44	-29.63	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	43	-33.33	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	56	14.81	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	48	-14.81	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	51	-3.70	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	51	-3.70	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	40	-44.44	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	29	-85.19	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	54	7.41	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	51	-3.70	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	50	-7.41	10	10	0
AD 7	07/01/03	Wet Mill	Launders	Launders	204	0	52	0.00	10	10	0
AD 8	07/02/03	Wet Mill	7201	Launders	217	0	64	75.00	10	10	0
AD 8	07/02/03	Wet Mill	7202	Launders	217	0	57	50.00	10	10	0
AD 8	07/02/03	Wet Mill	7203	Launders	217	0	44	3.57	10	10	0
AD 8	07/02/03	Wet Mill	7204	Launders	217	0	45	7.14	10	10	0
AD 8	07/02/03	Wet Mill	7205	Launders	217	0	51	28.57	10	10	0
AD 8	07/02/03	Wet Mill	7206	Launders	217	0	50	25.00	10	10	0
AD 8	07/02/03	Wet Mill	7207	Launders	217	0	49	21.43	10	10	0
AD 8	07/02/03	Wet Mill	7208	Launders	217	0	43	0.00	10	10	0
AD 8	07/02/03	Wet Mill	7209	Launders	217	0	50	25.00	10	10	0
AD 8	07/02/03	Wet Mill	7210	Launders	217	0	51	28.57	10	10	0
AD 8	07/02/03	Wet Mill	7211	Launders	217	0	53	35.71	10	10	0
AD 8	07/02/03	Wet Mill	7212	Launders	217	0	46	10.71	10	10	0
AD 8	07/02/03	Wet Mill	7213	Launders	217	0	43	0.00	10	10	0
CH 1	05/21/03	Wet Mill	CH 1	Steel Pieces	444	757	44	-7.14	8	8	0
CH 1	05/21/03	Wet Mill	CH 2	Steel Pieces	444	757	40	-21.43	8	8	0
CH 1	05/21/03	Wet Mill	CH 3	Steel Pieces	444	757	43	-10.71	8	8	0
CH 2	05/22/03	Wet Mill	CH 4	Steel Pieces	394	757	50	10.71	8	8	0
CH 2	05/22/03	Wet Mill	CH 5	Steel Pieces	394	757	43	-14.29	8	8	0
CH 2	05/22/03	Wet Mill	CH 6	Steel Pieces	394	757	53	21.43	8	8	0
CH 2	05/22/03	Wet Mill	CH 7	Steel Pieces	394	757	44	-10.71	8	8	0
CH 2	05/22/03	Wet Mill	CH 8	Steel Pieces	394	757	35	-42.86	8	8	0
CH 2	05/22/03	Wet Mill	CH 9	Steel Pieces	394	757	52	17.86	8	8	0
CH 2	05/22/03	Wet Mill	CH 10	Steel Pieces	394	757	47	0.00	8	8	0
CH 2	05/22/03	Wet Mill	CH 11	Steel Pieces	394	757	35	-42.86	8	8	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
CH 2	05/22/03	Wet Mill	CH 12	Steel Pieces	394	757	49	7.14	8	8	0
CH 2	05/22/03	Wet Mill	CH 13	Steel Pieces	394	757	50	10.71	8	8	0
CH 3	05/23/03	Wet Mill	CH 14	Steel Pieces	311	326	38	-17.86	10	10	0
CH 3	05/23/03	Wet Mill	CH 15	Steel Pieces	354	513	42	-3.57	10	10	0
CH 3	05/23/03	Wet Mill	CH 16	Steel Pieces	344	470	44	3.57	10	10	0
CH 3	05/23/03	Wet Mill	CH 17	Steel Pieces	347	483	42	-3.57	10	10	0
CH 3	05/23/03	Wet Mill	CH 18	Steel Pieces	324	383	42	-3.57	10	10	0
CH 3	05/23/03	Wet Mill	CH 19	Steel Pieces	336	435	55	42.86	10	10	0
CH 3	05/23/03	Wet Mill	CH 20	Steel Pieces	322	374	46	10.71	10	10	0
CH 3	05/23/03	Wet Mill	CH 21	Steel Pieces	300	278	37	-21.43	10	10	0
CH 3	05/23/03	Wet Mill	CH 22	Steel Pieces	327	396	43	0.00	10	10	0
CH 3	05/23/03	Wet Mill	CH 23	Steel Pieces	356	522	55	42.86	10	10	0
CH 3	05/23/03	Wet Mill	CH 24	Steel Pieces	315	343	52	32.14	10	10	0
CH 3	05/23/03	Wet Mill	CH 25	Steel Pieces	337	439	53	35.71	10	10	0
CH 3	05/23/03	Wet Mill	CH 26	Steel Pieces	325	387	44	3.57	10	10	0
CH 6	06/05/03	Wet Mill	CH 27	Steel Pieces	366	276	42	-24.14	8	10	-2
CH 6	06/05/03	Wet Mill	CH 28	Steel Pieces	361	259	53	13.79	8	10	-2
CH 6	06/05/03	Wet Mill	CH 29	Steel Pieces	386	345	44	-17.24	8	10	-2
CH 6	06/05/03	Wet Mill	CH 30	Steel Pieces	381	328	41	-27.59	8	10	-2
CH 6	06/05/03	Wet Mill	CH 31	Steel Pieces	346	207	53	13.79	8	10	-2
CH 6	06/05/03	Wet Mill	CH 32	Steel Pieces	389	355	53	13.79	8	10	-2
CH 5	06/10/03	Wet Mill	CH 48	Grating	327	28	45	6.90	11	11	0
CH 5	06/10/03	Wet Mill	CH 48	Grating	333	48	43	0.00	11	11	0
CH 5	06/10/03	Wet Mill	CH 48	Grating	359	138	43	0.00	11	11	0
CH 5	06/10/03	Wet Mill	CH 48	Grating	328	31	43	0.00	11	11	0
CH 5	06/10/03	Wet Mill	CH 48	Grating	330	38	46	10.34	11	11	0
CH 5	06/10/03	Wet Mill	CH 49	Baghouse pipe	369	172	48	17.24	11	11	0
CH 5	06/10/03	Wet Mill	CH 50	Baghouse pipe	364	155	64	72.41	11	11	0
CH 5	06/10/03	Wet Mill	CH 51	Baghouse pipe	360	141	43	0.00	11	11	0
CH 5	06/10/03	Wet Mill	CH 52	Baghouse pipe	357	131	44	3.45	11	11	0
CH 5	06/10/03	Wet Mill	CH 53	Baghouse pipe	381	214	43	0.00	11	11	0
CH 5	06/10/03	Wet Mill	CH 54	Baghouse pipe	336	59	46	10.34	11	11	0
CH 5	06/10/03	Wet Mill	CH 55	Baghouse pipe	348	100	50	24.14	11	11	0
CH 5	06/10/03	Wet Mill	CH 56	Baghouse pipe	352	114	43	0.00	11	11	0
CH 8	07/08/03	Wet Mill	Launders	Launders	242	158	54	37.04	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	251	192	44	0.00	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	276	288	50	22.22	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	287	331	44	0.00	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	292	350	53	33.33	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	277	292	52	29.63	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	270	265	50	-22.22	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	256	212	44	0.00	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	259	223	46	7.41	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	261	231	44	0.00	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	274	281	45	3.70	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	293	354	44	0.00	10	10	0
CH 8	07/08/03	Wet Mill	Launders	Launders	290	342	51	25.93	10	10	0

Heritage Minerals Final S(us Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP11	06/03/03	Dry Mill	Lot #136	tank	208	193	49	22.22	11	11	0
HP11	06/03/03	Dry Mill	Lot #137	trough/grating	204	178	47	14.81	11	11	0
HP11	06/03/03	Dry Mill	Lot #138	beam	202	170	42	-3.70	11	11	0
HP11	06/03/03	Dry Mill	Lot #139	beam	196	148	60	62.96	11	11	0
HP11	06/03/03	Dry Mill	Lot #140	beam	160	15	51	29.63	11	11	0
HP11	06/03/03	Dry Mill	Lot #141	electric panel	224	252	52	33.33	11	11	0
HP12	06/04/03	Dry Mill	Lot #142	beam	226	221	35	-24.14	11	11	0
HP12	06/04/03	Dry Mill	Lot #143	pipe	237	261	36	-20.69	11	11	0
HP12	06/04/03	Dry Mill	Lot #144	beam	212	171	38	-13.79	11	11	0
HP12	06/04/03	Dry Mill	Lot #145	elevator shaft	227	225	43	3.45	11	11	0
HP12	06/04/03	Dry Mill	Lot #146	beam	207	154	37	-17.24	11	11	0
HP12	06/04/03	Dry Mill	Lot #147	beams	218	193	44	6.90	11	11	0
HP12	06/04/03	Dry Mill	Lot #148	beams	234	250	42	0.00	11	11	0
HP12	06/04/03	Dry Mill	Lot #149	beams	229	232	63	72.41	11	11	0
HP12	06/04/03	Dry Mill	Lot #150	beams	215	182	47	17.24	11	11	0
HP12	06/04/03	Dry Mill	Lot #151	beams	232	243	55	44.83	11	11	0
HP12	06/04/03	Dry Mill	Lot #152	hopper bin/tank	262	350	49	24.14	11	11	0
HP12	06/04/03	Dry Mill	Lot #153	magnet	238	264	52	34.48	11	11	0
HP12	06/04/03	Dry Mill	Lot #154	beams	245	289	47	17.24	11	11	0
HP12	06/04/03	Dry Mill	Lot #155	beams	221	204	47	17.24	11	11	0
HP12	06/04/03	Dry Mill	Lot #156	beams	229	232	38	-13.79	11	11	0
HP12	06/04/03	Dry Mill	Lot #157	beams	236	257	38	-13.79	11	11	0
HP12	06/04/03	Dry Mill	Lot #158	beams	205	146	52	34.48	11	11	0
HP12	06/04/03	Dry Mill	Lot #159	beams	231	239	40	-6.90	11	11	0
HP12	06/04/03	Dry Mill	Lot #160	beams	237	261	53	37.93	11	11	0
HP13	06/05/03	Dry Mill	Lot #161	beams	216	233	36	-44.83	11	11	0
HP13	06/05/03	Dry Mill	Lot #162	beams	204	189	38	-37.93	11	11	0
HP13	06/05/03	Dry Mill	Lot #163	beams	221	252	44	-17.24	11	11	0
HP13	06/05/03	Dry Mill	Lot #164	beam	226	270	51	6.90	11	11	0
HP13	06/05/03	Dry Mill	Lot #165	beam	201	178	51	6.90	11	11	0
HP13	06/05/03	Dry Mill	Lot #166	staircase	190	137	37	-41.38	11	11	0
HP13	06/05/03	Dry Mill	Lot #167	staircase	194	152	57	27.59	11	11	0
HP13	06/05/03	Dry Mill	Lot #168	beam	202	181	45	-13.79	11	11	0
HP13	06/05/03	Dry Mill	Lot #169	beam	189	133	49	0.00	11	11	0
HP13	06/05/03	Dry Mill	Lot #170	beam	186	122	32	-58.62	11	11	0
HP13	06/05/03	Dry Mill	Lot #171	beam	199	170	45	-13.79	11	11	0
HP13	06/05/03	Dry Mill	Lot #172	beam	229	281	30	-65.52	11	11	0
HP13	06/05/03	Dry Mill	Lot #173	hopper bin	201	178	46	-10.34	11	11	0
HP13	06/05/03	Dry Mill	Lot #174	drum	209	207	46	-10.34	11	11	0
HP13	06/05/03	Dry Mill	Lot #175	beams	216	233	50	3.45	11	11	0
HP14	06/09/03	Dry Mill	Lot #176	Drum	237	162	42	0.00	10	10	0
HP14	06/09/03	Dry Mill	Lot #177	Drum	267	277	46	14.29	10	10	0
HP14	06/09/03	Dry Mill	Lot #178	Drum	210	58	42	0.00	10	10	0
HP14	06/09/03	Dry Mill	Lot #179	Drum	222	104	43	3.57	10	10	0
HP14	06/09/03	Dry Mill	Lot #197	Drum	266	273	55	46.43	10	10	0
HP14	06/09/03	Dry Mill	Lot #198	Drum	278	319	44	7.14	10	10	0
HP14	06/09/03	Dry Mill	Lot #199	Drum	263	262	51	32.14	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP14	06/09/03	Dry Mill	Lot #200	Drum	254	227	49	25.00	10	10	0
HP15	06/10/03	Dry Mill	Lot #240	Panel Box/Lids	215	185	38	-17.24	10	10	0
HP15	06/10/03	Dry Mill	Lot #241	Bin/Panel	228	235	40	-10.34	10	10	0
HP15	06/10/03	Dry Mill	Lot #242	Bin/Panel	225	223	45	6.90	10	10	0
HP15	06/10/03	Dry Mill	Lot #243	Bin Drum	239	277	39	-13.79	10	10	0
HP15	06/10/03	Dry Mill	Lot #244	Kiln	230	242	48	17.24	10	10	0
HP15	06/10/03	Dry Mill	Lot #245	Bin	236	265	40	-10.34	10	10	0
HP15	06/10/03	Dry Mill	Lot #246	Bin	225	223	34	-31.03	10	10	0
HP15	06/10/03	Dry Mill	Lot #247	Bin	215	185	32	-37.93	10	10	0
HP15	06/10/03	Dry Mill	Lot #248	Bin	229	238	45	6.90	10	10	0
HP15	06/10/03	Dry Mill	Lot #249	Bin	210	165	58	51.72	10	10	0
HP15	06/10/03	Dry Mill	Lot #250	Roof vent	218	196	38	-17.24	10	10	0
HP15	06/10/03	Dry Mill	Lot #251	Hopper	224	219	54	37.93	10	10	0
HP17	06/11/03	Dry Mill	Lot #304	Fan	226	168	39	-21.43	11	11	0
HP17	06/11/03	Dry Mill	Lot #305	Beams	200	75	50	17.86	11	11	0
HP17	06/11/03	Dry Mill	Lot #306	Beams	240	218	65	71.43	11	11	0
HP17	06/11/03	Dry Mill	Lot #307	Fan/Beam	228	175	54	32.14	11	11	0
HP17	06/11/03	Dry Mill	Lot #308	Beam	249	250	50	17.86	11	11	0
HP17	06/11/03	Dry Mill	Lot #309	Steel	260	289	49	14.29	11	11	0
HP17	06/11/03	Dry Mill	Lot #310	Frame	215	129	41	-14.29	11	11	0
HP17	06/11/03	Dry Mill	Lot #311	Steel	224	161	60	53.57	11	11	0
HP17	06/11/03	Dry Mill	Lot #312	Steel	221	150	56	39.29	11	11	0
HP17	06/11/03	Dry Mill	Lot #313	Bin	234	196	42	-10.71	11	11	0
HP17	06/11/03	Dry Mill	Lot #314	Beams	218	139	74	103.57	11	11	0
HP17	06/11/03	Dry Mill	Lot #315	Beams	223	157	46	3.57	11	11	0
HP17	06/11/03	Dry Mill	Lot #316	Steel	215	129	50	17.86	11	11	0
HP17	06/11/03	Dry Mill	Lot #317	Trays	220	146	34	-39.29	11	11	0
HP17	06/11/03	Dry Mill	Lot #318	Steel	215	129	57	42.86	11	11	0
HP17	06/11/03	Dry Mill	Lot #319	Steel	228	175	38	-25.00	11	11	0
HP17	06/11/03	Dry Mill	Lot #320	Beams	236	204	35	-35.71	11	11	0
HP17	06/11/03	Dry Mill	Lot #321	Beams/Grating	240	218	46	-3.57	11	11	0
HP17	06/11/03	Dry Mill	Lot #322	Beams	219	143	42	-10.71	11	11	0
HP17	06/11/03	Dry Mill	Lot #323	Beams	210	111	38	-25.00	11	11	0
HP18	06/12/03	Dry Mill	Lot #324	Steel	224	96	44	-17.24	11	11	0
HP18	06/12/03	Dry Mill	Lot #325	Beams	232	125	40	-31.03	11	11	0
HP18	06/12/03	Dry Mill	Lot #326	Trays	226	104	43	-20.69	11	11	0
HP18	06/12/03	Dry Mill	Lot #327	Beams/grating	233	129	34	-51.72	11	11	0
HP18	06/12/03	Dry Mill	Lot #328	Elevator shaft	245	171	64	51.72	11	11	0
HP18	06/12/03	Dry Mill	Lot #329	Steel	228	111	36	-44.83	11	11	0
HP18	06/12/03	Dry Mill	Lot #330	Bin	240	154	38	-37.93	11	11	0
HP18	06/12/03	Dry Mill	Lot #331	Bin/Grating	217	71	68	65.52	11	11	0
HP18	06/12/03	Dry Mill	Lot #332	Bin	233	129	39	-34.48	11	11	0
HP18	06/12/03	Dry Mill	Lot #333	Roof vents	219	79	40	-31.03	11	11	0
HP18	06/12/03	Dry Mill	Lot #334	Bin	225	100	41	-27.59	11	11	0
HP18	06/12/03	Dry Mill	Lot #335	Bin/Beam	229	114	35	-48.28	11	11	0
HP18	06/12/03	Dry Mill	Lot #336	Elevator/Bin	228	111	48	-3.45	11	11	0
HP18	06/12/03	Dry Mill	Lot #337	Hopper	233	129	33	-55.17	11	11	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP18	06/12/03	Dry Mill	Lot #338	Beams	226	104	53	13.79	11	11	0
HP18	06/12/03	Dry Mill	Lot #339	Hopper	238	146	71	75.86	11	11	0
HP19	06/16/03	Dry Mill	Lot #350	Steel	269	288	49	24.14	11	11	0
HP19	06/16/03	Dry Mill	Lot #351	Steel	278	324	47	17.24	11	11	0
HP19	06/16/03	Dry Mill	Lot #352	Steel	255	232	39	-10.34	11	11	0
HP19	06/16/03	Dry Mill	Lot #353	Beam/grating	241	176	43	3.45	11	11	0
HP19	06/16/03	Dry Mill	Lot #354	Steel	264	268	43	3.45	11	11	0
HP19	06/16/03	Dry Mill	Lot #355	Steel	240	172	58	55.17	11	11	0
HP19	06/16/03	Dry Mill	Lot #356	Beams	268	284	50	27.59	11	11	0
HP19	06/16/03	Dry Mill	Lot #357	Steel	236	156	49	24.14	11	11	0
HP19	06/16/03	Dry Mill	Lot #358	Beams	243	184	43	-3.45	11	11	0
HP19	06/16/03	Dry Mill	Lot #359	Steel	232	140	57	51.72	11	11	0
HP19	06/16/03	Dry Mill	Lot #360	Steel	236	156	30	-41.38	11	11	0
HP19	06/16/03	Dry Mill	Lot #361	Beam	246	196	47	17.24	11	11	0
HP19	06/16/03	Dry Mill	Lot #362	Steel	248	204	54	41.38	11	11	0
HP20	06/17/03	Dry Mill	Lot #363	Electrical panel/Beams	284	367	50	20.69	11	11	0
HP20	06/17/03	Dry Mill	Lot #364	Beams	250	241	47	10.34	11	11	0
HP20	06/17/03	Dry Mill	Lot #365	Beams/grating	228	159	45	-3.45	11	11	0
HP20	06/17/03	Dry Mill	Lot #366	Panel Boys	242	211	49	17.24	11	11	0
HP20	06/17/03	Dry Mill	Lot #367	Bins/Beam	225	148	35	-31.03	11	11	0
HP20	06/17/03	Dry Mill	Lot #368	Beams	246	226	55	37.93	11	11	0
HP20	06/17/03	Dry Mill	Lot #369	Bin	217	119	36	-27.59	11	11	0
HP20	06/17/03	Dry Mill	Lot #370	Grating/Beams	212	100	45	3.45	11	11	0
HP20	06/17/03	Dry Mill	Lot #371	Beam/Door	223	141	40	-13.79	11	11	0
HP20	06/17/03	Dry Mill	Lot #372	Bin	227	156	38	-20.69	11	11	0
HP20	06/17/03	Dry Mill	Lot #373	Vents/beams	214	107	47	10.34	11	11	0
HP20	06/17/03	Dry Mill	Lot #374	Bins/Beam	220	130	42	-6.90	11	11	0
HP20	06/17/03	Dry Mill	Lot #375	Fan ductwork	233	178	32	-41.38	11	11	0
HP20	06/17/03	Dry Mill	Lot #376	Housing frame	226	152	34	-34.48	11	11	0
HP20	06/17/03	Dry Mill	Lot #377	Box	231	170	38	-20.69	11	11	0
HP20	06/17/03	Dry Mill	Lot #378	Bin	221	133	47	10.34	11	11	0
HP20	06/17/03	Dry Mill	Lot #379	Bin	217	119	49	17.24	11	11	0
HP20	06/17/03	Dry Mill	Lot #380	Hopper	225	148	56	41.38	11	11	0
HP20	06/17/03	Dry Mill	Lot #381	Steps/hopper	241	207	64	68.97	11	11	0
HP20	06/17/03	Dry Mill	Lot #382	Hopper	260	278	49	17.24	11	11	0
HP20	06/17/03	Dry Mill	Lot #383	Beams	231	170	55	37.93	11	11	0
HP20	06/17/03	Dry Mill	Lot #384	Baghouse Base	236	189	66	75.86	11	11	0
HP20	06/17/03	Dry Mill	Lot #385	Beams/tin	248	233	55	37.93	11	11	0
HP20	06/17/03	Dry Mill	Lot #386	Beams/pipe	232	174	51	24.14	11	11	0
HP21	06/18/03	Dry Mill	Lot #387	Beams	268	166	51	27.59	10	10	0
HP21	06/18/03	Dry Mill	Lot #387	Trays	276	193	40	-10.34	10	10	0
HP21	06/18/03	Dry Mill	Lot #387	Pipe	288	234	56	44.83	10	10	0
HP21	06/18/03	Dry Mill	Lot #388	Beams	272	179	52	31.03	10	10	0
HP21	06/18/03	Dry Mill	Lot #388	Beams	267	162	53	34.48	10	10	0
HP21	06/18/03	Dry Mill	Lot #388	Beams	276	193	42	-3.45	10	10	0
HP21	06/18/03	Dry Mill	Lot #389	Beams	271	176	52	31.03	10	10	0
HP21	06/18/03	Dry Mill	Lot #389	Pipes	269	169	46	10.34	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP21	06/18/03	Dry Mill	Lot #389	Pipes	274	186	43	0.00	10	10	0
HP21	06/18/03	Dry Mill	Lot #390	Bin	268	166	48	17.24	10	10	0
HP21	06/18/03	Dry Mill	Lot #390	Bin	264	152	43	0.00	10	10	0
HP21	06/18/03	Dry Mill	Lot #390	Bin	282	214	38	-17.24	10	10	0
HP21	06/18/03	Dry Mill	Lot #391	Grating	276	193	48	17.24	10	10	0
HP21	06/18/03	Dry Mill	Lot #391	Beams	289	238	37	-20.69	10	10	0
HP21	06/18/03	Dry Mill	Lot #391	Beams	291	245	44	3.45	10	10	0
HP21	06/18/03	Dry Mill	Lot #392	Beams	263	148	55	41.38	10	10	0
HP21	06/18/03	Dry Mill	Lot #392	Grating	259	134	51	27.59	10	10	0
HP21	06/18/03	Dry Mill	Lot #392	Steps	288	234	45	6.90	10	10	0
HP21	06/18/03	Dry Mill	Lot #393	Pipe	275	190	67	82.76	10	10	0
HP21	06/18/03	Dry Mill	Lot #393	Pipe	294	255	53	34.48	10	10	0
HP21	06/18/03	Dry Mill	Lot #393	Pipe	279	203	39	-13.79	10	10	0
HP21	06/18/03	Dry Mill	Lot #394	Beams	289	238	49	20.69	10	10	0
HP21	06/18/03	Dry Mill	Lot #394	Grating	275	190	45	6.90	10	10	0
HP21	06/18/03	Dry Mill	Lot #394	Steps	268	166	46	10.34	10	10	0
HP21	06/18/03	Dry Mill	Lot #395	Beams	280	207	60	58.62	10	10	0
HP21	06/18/03	Dry Mill	Lot #395	Beams	268	166	51	27.59	10	10	0
HP21	06/18/03	Dry Mill	Lot #395	Beams	276	193	58	51.72	10	10	0
HP21	06/18/03	Dry Mill	Lot #396	Beams	288	234	46	10.34	10	10	0
HP21	06/18/03	Dry Mill	Lot #396	Staircase	272	179	35	-27.59	10	10	0
HP21	06/18/03	Dry Mill	Lot #396	Staircase	267	162	35	-27.59	10	10	0
HP21	06/18/03	Dry Mill	Lot #397	Beams	276	193	50	24.14	10	10	0
HP21	06/18/03	Dry Mill	Lot #397	Grating	271	176	48	17.24	10	10	0
HP21	06/18/03	Dry Mill	Lot #397	Grating	269	169	45	6.90	10	10	0
HP21	06/18/03	Dry Mill	Lot #398	Kiln	274	186	46	10.34	10	10	0
HP21	06/18/03	Dry Mill	Lot #398	Kiln	268	166	49	20.69	10	10	0
HP21	06/18/03	Dry Mill	Lot #398	Kiln	264	152	41	-6.90	10	10	0
HP21	06/18/03	Dry Mill	Lot #399	Steel Kiln Ring	282	214	50	24.14	10	10	0
HP21	06/18/03	Dry Mill	Lot #399	Steel Kiln Ring	276	193	51	27.59	10	10	0
HP21	06/18/03	Dry Mill	Lot #400	Steel	289	238	43	0.00	10	10	0
HP21	06/18/03	Dry Mill	Lot #400	Steel	291	245	37	-20.69	10	10	0
HP21	06/18/03	Dry Mill	Lot #401	Steel	263	148	52	-31.03	10	10	0
HP21	06/18/03	Dry Mill	Lot #401	Steel	259	134	38	-17.24	10	10	0
HP21	06/18/03	Dry Mill	Lot #402	Steel	288	234	41	-6.90	10	10	0
HP21	06/18/03	Dry Mill	Lot #402	Steel	275	190	37	-20.69	10	10	0
HP21	06/18/03	Dry Mill	Lot #403	Steel	294	255	47	13.79	10	10	0
HP21	06/18/03	Dry Mill	Lot #403	Steel	279	203	36	-24.14	10	10	0
HP22	06/19/03	Dry Mill	Lot #404	Steel	276	210	56	41.38	11	11	0
HP22	06/19/03	Dry Mill	Lot #404	Steel	263	166	49	17.24	11	11	0
HP22	06/19/03	Dry Mill	Lot #404	Steel	268	183	42	-6.90	11	11	0
HP22	06/19/03	Dry Mill	Lot #405	Tank	284	238	49	17.24	11	11	0
HP22	06/19/03	Dry Mill	Lot #405	Tank	261	159	33	-37.93	11	11	0
HP22	06/19/03	Dry Mill	Lot #405	Tank	267	179	42	-6.90	11	11	0
HP22	06/19/03	Dry Mill	Lot #406	Grating	278	217	49	17.24	11	11	0
HP22	06/19/03	Dry Mill	Lot #406	Beams	258	148	46	6.90	11	11	0
HP22	06/19/03	Dry Mill	Lot #406	Tin	261	159	37	-24.14	11	11	0

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP22	06/19/03	Dry Mill	Lot #407	Duraclone	257	145	52	27.59	11	11	0
HP22	06/19/03	Dry Mill	Lot #407	Beams	242	93	36	-27.59	11	11	0
HP22	06/19/03	Dry Mill	Lot #407	Beams	246	107	53	31.03	11	11	0
HP22	06/19/03	Dry Mill	Lot #408	Steel	253	131	61	58.62	11	11	0
HP22	06/19/03	Dry Mill	Lot #408	Beams	257	145	40	-13.79	11	11	0
HP22	06/19/03	Dry Mill	Lot #408	Beams	256	141	41	-10.34	11	11	0
HP22	06/19/03	Dry Mill	Lot #409	Table	257	145	48	13.79	11	11	0
HP22	06/19/03	Dry Mill	Lot #409	Table	271	193	53	31.03	11	11	0
HP22	06/19/03	Dry Mill	Lot #410	Grating	251	124	36	-27.59	11	11	0
HP22	06/19/03	Dry Mill	Lot #410	Beams	256	141	52	27.59	11	11	0
HP22	06/19/03	Dry Mill	Lot #410	Beams	253	131	49	17.24	11	11	0
HP22	06/19/03	Dry Mill	Lot #411	Pipe	267	179	61	58.62	11	11	0
HP22	06/19/03	Dry Mill	Lot #411	Pipe	271	193	45	3.45	11	11	0
HP22	06/19/03	Dry Mill	Lot #412	Grating	255	138	62	62.07	11	11	0
HP22	06/19/03	Dry Mill	Lot #412	Grating	251	124	46	6.90	11	11	0
HP22	06/19/03	Dry Mill	Lot #412	Grating	259	152	35	-31.03	11	11	0
HP22	06/19/03	Dry Mill	Lot #413	Steel	277	214	41	-10.34	11	11	0
HP22	06/19/03	Dry Mill	Lot #413	Air duct	273	200	52	27.59	11	11	0
HP22	06/19/03	Dry Mill	Lot #413	Air duct	276	210	39	-17.24	11	11	0
HP22	06/19/03	Dry Mill	Lot #414	Grating	281	228	37	-24.14	11	11	0
HP22	06/19/03	Dry Mill	Lot #414	Grating	256	141	54	34.48	11	11	0
HP22	06/19/03	Dry Mill	Lot #414	Grating	273	200	50	20.69	11	11	0
HP23	06/23/03	Dry Mill	Lot #415	Grating/Beams	223	157	48	20.69	10	10	0
HP23	06/23/03	Dry Mill	Lot #415	Grating/Beams	239	214	36	-20.69	10	10	0
HP23	06/23/03	Dry Mill	Lot #415	Grating/Beams	235	200	46	13.79	10	10	0
HP23	06/23/03	Dry Mill	Lot #416	Steel Kiln Ring	219	143	51	31.03	10	10	0
HP23	06/23/03	Dry Mill	Lot #416	Steel Kiln Ring	231	186	43	3.45	10	10	0
HP23	06/23/03	Dry Mill	Lot #417	Grating	211	114	37	-17.24	10	10	0
HP23	06/23/03	Dry Mill	Lot #417	Grating	218	139	38	-13.79	10	10	0
HP23	06/23/03	Dry Mill	Lot #417	Grating	223	157	48	20.69	10	10	0
HP23	06/23/03	Dry Mill	Lot #418	Beams/Hopper	233	193	33	-31.03	10	10	0
HP23	06/23/03	Dry Mill	Lot #418	Beams/Hopper	202	82	51	31.03	10	10	0
HP23	06/23/03	Dry Mill	Lot #418	Beams/Hopper	215	129	44	6.90	10	10	0
HP23	06/23/03	Dry Mill	Lot #419	Beams/frame/drum	229	179	38	-13.79	10	10	0
HP23	06/23/03	Dry Mill	Lot #419	Beams/frame/drum	228	175	46	13.79	10	10	0
HP23	06/23/03	Dry Mill	Lot #419	Beams/frame/drum	214	125	37	-17.24	10	10	0
HP23	06/23/03	Dry Mill	Lot #420	Beams/frame	233	193	52	34.48	10	10	0
HP23	06/23/03	Dry Mill	Lot #420	Beams/frame	249	250	44	6.90	10	10	0
HP23	06/23/03	Dry Mill	Lot #420	Beams/frame	221	150	41	-3.45	10	10	0
HP23	06/23/03	Dry Mill	Lot #421	Tin/trays/beams	248	243	45	10.34	10	10	0
HP23	06/23/03	Dry Mill	Lot #421	Tin/trays/beams	242	218	50	27.59	10	10	0
HP23	06/23/03	Dry Mill	Lot #421	Tin/trays/beams	221	139	35	-24.14	10	10	0
HP23	06/23/03	Dry Mill	Lot #422	Railing frame	244	218	49	24.14	10	10	0
HP23	06/23/03	Dry Mill	Lot #422	Beams/grating	223	139	60	62.07	10	10	0
HP23	06/23/03	Dry Mill	Lot #422	Beams/grating	253	243	56	48.28	10	10	0
HP23	06/23/03	Dry Mill	Lot #423	Steps/railing	262	271	52	34.48	10	10	0
HP23	06/23/03	Dry Mill	Lot #423	Beam	236	175	48	20.69	10	10	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP23	06/23/03	Dry Mill	Lot #423	Steps/grating	239	182	49	24.14	10	10	0
HP23	06/23/03	Dry Mill	Lot #424	Beams/pipe	231	150	44	6.90	10	10	0
HP23	06/23/03	Dry Mill	Lot #424	Grating	228	136	43	3.45	10	10	0
HP23	06/23/03	Dry Mill	Lot #424	Grating	237	164	37	-17.24	10	10	0
HP23	06/23/03	Dry Mill	Lot #425	Beams/frame	237	161	33	-31.03	10	10	0
HP23	06/23/03	Dry Mill	Lot #425	Ladder	256	225	44	6.90	10	10	0
HP23	06/23/03	Dry Mill	Lot #425	Ladder	248	193	51	31.03	10	10	0
HP23	06/23/03	Dry Mill	Lot #426	Beams/frame	242	168	43	3.45	10	10	0
HP23	06/23/03	Dry Mill	Lot #426	Beams/frame	246	179	50	27.59	10	10	0
HP23	06/23/03	Dry Mill	Lot #426	Beams/frame	239	150	45	10.34	10	10	0
HP23	06/23/03	Dry Mill	Lot #427	Beams	266	243	31	-37.93	10	10	0
HP23	06/23/03	Dry Mill	Lot #427	Beams	248	175	45	10.34	10	10	0
HP23	06/23/03	Dry Mill	Lot #427	Beams	257	204	50	27.59	10	10	0
HP23	06/23/03	Dry Mill	Lot #427	Beams	233	114	46	13.79	10	10	0
HP23	06/23/03	Dry Mill	Lot #427	Beams	243	146	39	-10.34	10	10	0
HP24	06/24/03	Dry Mill	Lot #428	Grating/Beams	256	217	54	17.86	11	11	0
HP24	06/24/03	Dry Mill	Lot #428	Grating/Beams	244	176	51	7.14	11	11	0
HP24	06/24/03	Dry Mill	Lot #428	Grating/Beams	262	238	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #429	Beams	256	217	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #429	Grating/Tin	235	145	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #429	Grating/Tin	224	107	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #429	Grating/Tin	229	124	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #430	Pipe stand	228	121	50	3.57	11	11	0
HP24	06/24/03	Dry Mill	Lot #430	Pipe stand	219	90	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #430	Pipe stand	256	217	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #431	Baghouse floor	270	266	57	28.57	11	11	0
HP24	06/24/03	Dry Mill	Lot #431	Baghouse floor	258	224	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #431	Baghouse floor	265	248	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #432	Beam	235	145	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #432	Beam	261	234	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #433	Kiln	258	224	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #433	Kiln	261	234	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #433	Kiln	232	134	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #434	Pipe	288	328	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #433	Pipe	259	228	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #434	Pipe	273	276	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #435	Steel Cage	248	190	56	25.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #435	Steel Cage	253	207	52	10.71	11	11	0
HP24	06/24/03	Dry Mill	Lot #435	Steel Cage	222	100	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #436	Beams	243	172	60	39.29	11	11	0
HP24	06/24/03	Dry Mill	Lot #436	Beams	235	145	52	10.71	11	11	0
HP24	06/24/03	Dry Mill	Lot #437	Kiln	236	148	50	3.57	11	11	0
HP24	06/24/03	Dry Mill	Lot #437	Kiln	233	138	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #437	Kiln	245	179	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #438	Baghouse wall	240	162	55	21.43	11	11	0
HP24	06/24/03	Dry Mill	Lot #438	Baghouse wall	244	176	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #438	Baghouse wall	236	148	49	0.00	11	11	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP24	06/24/03	Dry Mill	Lot #439	Baghouse wall	254	210	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #439	Baghouse wall	247	186	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #439	Baghouse wall	225	110	49	0.00	11	11	0
HP24	06/24/03	Dry Mill	Lot #440	Tank	238	155	51	7.14	11	11	0
HP24	06/24/03	Dry Mill	Lot #440	Tank	233	138	54	17.86	11	11	0
HP24	06/24/03	Dry Mill	Lot #440	Tank	246	183	49	0.00	11	11	0
HP27	06/25/03	Dry Mill	Lot # 441	Table	213	18	62	29.63	10	10	0
HP27	06/25/03	Dry Mill	Lot # 442	Bag house floor	276	243	60	22.22	10	10	0
HP27	06/25/03	Dry Mill	Lot # 443	Beams	264	200	85	114.81	10	10	0
HP27	06/25/03	Dry Mill	Lot # 444	Pipe	267	211	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 445	Fan Blade	290	293	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 446	Steel	291	296	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 447	Beams	263	196	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 448	Steel	270	221	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 449	Steel	290	293	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 450	Beam	268	214	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 451	Beam	277	246	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 452	Steel	268	214	54	0.00	10	10	0
HP27	06/25/03	Dry Mill	Lot # 453	Steel	294	307	58	14.81	10	10	0
HP27	06/25/03	Dry Mill	Lot # 454	Steel	289	289	70	59.26	10	10	0
HP27	06/25/03	Dry Mill	Lot # 455	Steel	251	154	59	18.52	10	10	0
HP27	06/25/03	Dry Mill	Lot # 456	Steel	276	243	58	14.81	10	10	0
HP27	06/25/03	Dry Mill	Lot # 457	Steel	271	225	59	18.52	10	10	0
HP27	06/25/03	Dry Mill	Lot # 458	Steel	280	257	62	29.63	10	10	0
HP27	06/25/03	Dry Mill	Lot # 459	Steel	294	307	71	62.96	10	10	0
HP28	06/26/03	Dry Mill	Lot # 460	Steel	277	279	57	11.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 461	Steel	282	297	59	18.52	11	11	0
HP28	06/26/03	Dry Mill	Lot # 462	Steel	247	176	54	0.00	11	11	0
HP28	06/26/03	Dry Mill	Lot # 463	Baghouse	268	248	57	11.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 464	Steel	268	248	59	18.52	11	11	0
HP28	06/26/03	Dry Mill	Lot # 465	Steel	261	224	57	11.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 466	Beams	246	172	54	0.00	11	11	0
HP28	06/26/03	Dry Mill	Lot # 467	Beams	257	210	54	0.00	11	11	0
HP28	06/26/03	Dry Mill	Lot # 468	Steel	266	241	59	18.52	11	11	0
HP28	06/26/03	Dry Mill	Lot # 469	Frames	257	210	57	11.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 470	Steel	257	210	84	111.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 471	Steel	249	183	78	88.89	11	11	0
HP28	06/26/03	Dry Mill	Lot # 472	Beams	241	155	84	111.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 473	Beams	250	186	77	85.19	11	11	0
HP28	06/26/03	Dry Mill	Lot # 474	Steel	251	190	84	111.11	11	11	0
HP28	06/26/03	Dry Mill	Lot # 475	Steel	259	217	85	114.81	11	11	0
HP29	06/30/03	Dry Mill	Lot # 476	Beams	289	172	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 477	Frames	290	176	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 478	Frames	282	148	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 479	Beams	294	190	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 480	Beams	300	210	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 481	Beams	292	183	54	0.00	10	10	0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP29	06/30/03	Dry Mill	Lot # 482	Beams	306	231	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 483	Beams	300	210	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 484	Beams	294	190	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 485	Baghouse	320	279	59	18.52	10	10	0
HP29	06/30/03	Dry Mill	Lot # 486	Baghouse	291	179	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 487	Tank	287	166	54	0.00	10	10	0
HP29	06/30/03	Dry Mill	Lot # 488	Panel Box	270	107	54	0.00	10	10	0
HP30	07/01/03	Dry Mill	Lot # 489	Baghouse	263	225	63	40.74	10	10	0
HP30	07/01/03	Dry Mill	Lot # 490	Tank	280	286	54	7.41	10	10	0
HP30	07/01/03	Dry Mill	Lot # 491	Frame/Grating	241	146	57	18.52	10	10	0
HP30	07/01/03	Dry Mill	Lot # 492	Tank top	252	186	52	0.00	10	10	0
HP30	07/01/03	Dry Mill	Lot # 493	Frame	281	289	60	29.63	10	10	0
HP30	07/01/03	Dry Mill	Lot # 494	Trough	243	154	61	33.33	10	10	0
HP30	07/01/03	Dry Mill	Lot # 495	Trough	268	243	52	0.00	10	10	0
HP30	07/01/03	Dry Mill	Lot # 496	Hood	242	150	52	0.00	10	10	0
HP30	07/01/03	Dry Mill	Lot # 497	Hood/beam/grate	263	225	52	0.00	10	10	0
HP30	07/01/03	Dry Mill	Lot # 498	Grating	272	257	58	22.22	10	10	0
HP30	07/01/03	Dry Mill	Lot # 499	Hood/beam/grate	271	254	56	14.81	10	10	0
HP30	07/01/03	Dry Mill	Lot # 500	Beam/tin	250	179	58	22.22	10	10	0
HP30	07/01/03	Dry Mill	Lot # 501	Baghouse/fan frame	246	164	55	11.11	10	10	0
HP30	07/01/03	Dry Mill	Lot # 502	Frame/assembly	276	271	90	140.74	10	10	0
HP30	07/01/03	Dry Mill	Lot # 503	Hood	268	243	53	3.70	10	10	0
HP30	07/01/03	Dry Mill	Lot # 504	Pipe/beam	260	214	52	0.00	10	10	0
HP30	07/01/03	Dry Mill	Lot # 505	Hood	269	246	61	33.33	10	10	0
HP30	07/01/03	Dry Mill	Lot # 506	Bin	282	293	65	48.15	10	10	0
HP30	07/01/03	Dry Mill	Lot # 507	Bin	249	175	52	0.00	10	10	0
HP31	07/02/03	Dry Mill	Lot # 508	Pipe	250	150	47	14.29	11	11	0
HP31	07/02/03	Dry Mill	Lot # 509	Bin	272	229	41	-7.14	11	11	0
HP31	07/02/03	Dry Mill	Lot # 510	Hood	263	196	53	35.71	11	11	0
HP31	07/02/03	Dry Mill	Lot # 511	Pipe	245	132	53	35.71	11	11	0
HP31	07/02/03	Dry Mill	Lot # 512	Pipe	250	150	48	17.86	11	11	0
HP31	07/02/03	Dry Mill	Lot # 513	Steel	254	164	49	21.43	11	11	0
HP31	07/02/03	Dry Mill	Lot # 514	Steel	264	200	44	3.57	11	11	0
HP31	07/02/03	Dry Mill	Lot # 515	Hood	270	221	50	25.00	11	11	0
HP31	07/02/03	Dry Mill	Lot # 516	Pipe/Beam	246	136	43	0.00	11	11	0
HP31	07/02/03	Dry Mill	Lot # 517	Panel Box/Beam/Trays	253	161	43	0.00	11	11	0
HP31	07/02/03	Dry Mill	Lot # 518	Beams/railing/grating	252	157	45	7.14	11	11	0
HP31	07/02/03	Dry Mill	Lot # 519	Panel/trough	244	129	46	10.71	11	11	0
HP31	07/02/03	Dry Mill	Lot # 520	Trough/tin	255	168	49	21.43	11	11	0
HP31	07/02/03	Dry Mill	Lot # 521	Trough	273	232	49	21.43	11	11	0
HP31	07/02/03	Dry Mill	Lot # 522	Conveyer	290	293	49	21.43	11	11	0
HP31	07/02/03	Dry Mill	Lot # 523	Pipe	257	175	46	10.71	11	11	0
HP31	07/02/03	Dry Mill	Lot # 524	Pipe/beams	249	146	52	32.14	11	11	0
HP32	07/07/03	Dry Mill	Lot # 525	Beams	252	192	55	40.74	10	10	0
HP32	07/07/03	Dry Mill	Lot # 526	Beams	243	158	48	14.81	10	10	0
HP32	07/07/03	Dry Mill	Lot # 527	Pipe/beams	235	127	54	37.04	10	10	0
HP32	07/07/03	Dry Mill	Lot # 528	Pipe/grating	248	177	52	29.63	10	10	0

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP32	07/07/03	Dry Mill	Lot # 529	Beams	245	165	44	0.00	10	10	0
HP32	07/07/03	Dry Mill	Lot # 530	Trough/rotor/grating	264	238	56	44.44	10	10	0
HP32	07/07/03	Dry Mill	Lot # 531	Pipe	280	300	59	55.56	10	10	0
HP32	07/07/03	Dry Mill	Lot # 532	Beams	249	181	58	51.85	10	10	0
HP32	07/07/03	Dry Mill	Lot # 533	Pipe	273	273	46	7.41	10	10	0
HP32	07/07/03	Dry Mill	Lot # 534	Beams/Tin/grating	261	227	44	0.00	10	10	0
HP32	07/07/03	Dry Mill	Lot # 535	Troughs	250	185	69	92.59	10	10	0
HP32	07/07/03	Dry Mill	Lot # 536	Box assembly	257	212	47	11.11	10	10	0
HP32	07/07/03	Dry Mill	Lot # 537	Frame	243	158	89	166.67	10	10	0
HP32	07/07/03	Dry Mill	Lot # 538	Frame	248	177	48	14.81	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Pump Case	218	304	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Impeller	226	333	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Pump Case	185	181	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Pump/Impeller	197	226	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Railing/grating	199	233	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Pump	183	174	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Bin	182	170	51	25.93	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Trough/beams/motor assembly	187	189	50	22.22	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Rollers	197	226	49	18.52	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Beam	170	126	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Elevator shaft	185	181	46	7.41	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Elevator shaft	204	252	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Elevator shaft	209	270	44	0.00	10	10	0
HP34	07/08/03	Dry Mill	Post Decon	Elevator shaft	194	215	52	29.63	10	10	0
HP35	07/08/03	Dry Mill	Lot # 539	Pipe	202	244	60	59.26	10	10	0
HP35	07/08/03	Dry Mill	Lot # 540	Bin	192	207	49	18.52	10	10	0
HP35	07/08/03	Dry Mill	Lot # 541	Beams	166	111	55	40.74	10	10	0
HP35	07/08/03	Dry Mill	Lot # 542	Frame	200	237	44	0.00	10	10	0
HP35	07/08/03	Dry Mill	Lot # 543	Pipe	196	222	52	29.63	10	10	0
HP35	07/08/03	Dry Mill	Lot # 544	Frame	178	156	53	33.33	10	10	0
HP35	07/08/03	Dry Mill	Lot # 545	Bin	187	189	45	3.70	10	10	0
HP35	07/08/03	Dry Mill	Lot # 546	Pipe	199	233	44	0.00	10	10	0
HP35	07/08/03	Dry Mill	Lot # 547	Metal Box	168	119	49	18.52	10	10	0
HP35	07/08/03	Dry Mill	Lot # 548	Bin	179	159	44	0.00	10	10	0
HP36	07/09/03	Dry Mill	Lot # 549	Pump Base	257	150	47	18.52	11	11	0
HP36	07/09/03	Dry Mill	Lot # 550	Pump Base	247	112	42	0.00	11	11	0
HP36	07/09/03	Dry Mill	Lot # 551	Pump Base	249	119	42	0.00	11	11	0
HP36	07/09/03	Dry Mill	Lot # 552	Beams	259	158	50	29.63	11	11	0
HP36	07/09/03	Dry Mill	Lot # 553	Roller Carriage	279	235	50	29.63	11	11	0
HP36	07/09/03	Dry Mill	Lot # 554	Roller Carriage	279	235	44	7.41	11	11	0
HP36	07/09/03	Dry Mill	Lot # 555	Shakers	267	188	54	44.44	11	11	0
HP36	07/09/03	Dry Mill	Lot # 556	Shakers	263	173	47	18.52	11	11	0
HP36	07/09/03	Dry Mill	Lot # 557	Tank	253	135	44	7.41	11	11	0
HP36	07/09/03	Dry Mill	Lot # 558	Roller Assembly	255	142	49	25.93	11	11	0
HP36	07/09/03	Dry Mill	Lot # 559	Steel case	276	223	42	0.00	11	11	0
HP36	07/09/03	Dry Mill	Lot # 560	Pipe	252	131	45	11.11	11	11	0
HP36	07/09/03	Dry Mill	Lot # 561	Elevator shaft	259	158	44	7.41	11	11	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP36	07/09/03	Dry Mill	Lot # 562	Tank	279	235	49	25.93	11	11	0
HP36	07/09/03	Dry Mill	Lot # 563	Elevator shaft	294	292	43	3.70	11	11	0
HP36	07/09/03	Dry Mill	Lot # 564	Elevator side	278	231	48	22.22	11	11	0
HP36	07/09/03	Dry Mill	Lot # 565	Elevator side	261	165	51	33.33	11	11	0
HP36	07/09/03	Dry Mill	Lot # 566	Elevator side	255	142	49	25.93	11	11	0
HP36	07/09/03	Dry Mill	Lot # 567	Elevator side	258	154	45	11.11	11	11	0
HP38	07/09/03	Dry Mill	Post Decon	Shaker Box	258	154	42	0.00	11	11	0
HP38	07/09/03	Dry Mill	Post Decon	Shaker Box	247	112	47	18.52	11	11	0
HP38	07/09/03	Dry Mill	Post Decon	Rollers	254	138	54	44.44	11	11	0
HP38	07/09/03	Dry Mill	Post Decon	Hopper	258	154	55	48.15	11	11	0
HP38	07/09/03	Dry Mill	Post Decon	Screw Assembly	255	142	62	74.07	11	11	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	250	123			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	259	158			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	234	62			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	258	154			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	253	135			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	240	85			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	261	165			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	255	142			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	252	131			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	248	115			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	235	65			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	236	69			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	241	88			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	258	154			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	240	85			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	227	35			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	239	81			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	241	88			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	243	96			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	249	119			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	236	69			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	233	58			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	244	100			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	235	65			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	239	81			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	236	69			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	244	100			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	232	54			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	249	119			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	246	108			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	240	85			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	236	69			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	233	58			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	245	104			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	252	131			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	253	135			12	12	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	242	92			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	233	58			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	226	31			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	228	38			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	239	81			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	226	31			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	234	62			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	238	77			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	231	50			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	254	138			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	258	154			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	250	123			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	228	38			12	12	0
HP39	07/09/03	Dry Mill	L.A. Smear	Tin siding	224	23			12	12	0
HP43	07/14/03	Dry Mill	Post Decon	Hopper	211	31	41	0.00	8	10	-2
HP43	07/14/03	Dry Mill	Post Decon	Hopper	206	12	62	80.77	8	10	-2
HP43	07/14/03	Dry Mill	Post Decon	Hopper/beam	225	85	41	0.00	8	10	-2
HP43	07/14/03	Dry Mill	Post Decon	Plate	221	69	41	0.00	6	10	-4
HP43	07/14/03	Dry Mill	Post Decon	Beams	234	119	43	7.69	6	10	-4
HP43	07/14/03	Dry Mill	Post Decon	Elevator shaft	229	100	52	42.31	6	10	-4
HP43	07/14/03	Dry Mill	Post Decon	Hopper	234	119	42	3.85	9	10	-1
HP43	07/14/03	Dry Mill	Post Decon	Steel	222	73	57	61.54	10	10	0
HP43	07/14/03	Dry Mill	Post Decon	Furnace motor	215	46	45	15.38	7	10	-3
HP43	07/14/03	Dry Mill	Post Decon	Beam/rollers	246	165	44	11.54	5	10	-5
HP43	07/14/03	Dry Mill	Post Decon	Hopper tray/motor	213	38	74	126.92	6	10	-4
HP43	07/14/03	Dry Mill	Post Decon	Elevator shaft	252	188	51	38.46	6	10	-4
HP43	07/14/03	Dry Mill	Post Decon	Tank	238	135	41	0.00	6	10	-4
HP43	07/14/03	Dry Mill	Post Decon	Pipe	206	12	45	15.38	5	10	-5
HP43	07/14/03	Dry Mill	Post Decon	Pipe	208	19	47	23.08	6	10	-4
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	207	39					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	197	4					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	197	4					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	198	7					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	209	46					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	205	32					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	205	32					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	210	50					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	235	139					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	197	4					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	197	4					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	199	11					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	199	11					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	197	4					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	198	7					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	227	111					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	216	71					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	235	139					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	234	136					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	222	93					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	204	29					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	224	100					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	196	0					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	207	39					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	219	82					0
HP45	07/15/03	Dry Mill	L.A. Smear	Tin siding	221	89					0
HP46	07/15/03	Dry Mill	Post Decon	Screw	346	536	43	7.41	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Tank	296	357	45	14.81	10	12	-2
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	324	457	45	14.81	11	12	-1
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	267	254	49	29.63	10	12	-2
HP46	07/15/03	Dry Mill	Post Decon	Trough	196	0	46	18.52	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Con. Bottom	196	0	46	18.52	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	255	211	48	25.93	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	264	243	66	92.59	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	273	275	46	18.52	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	252	200	42	3.70	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	259	225	0	-151.85	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Grating	216	71	50	33.33	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Electric separator	206	36	53	44.44	8	12	-4
HP46	07/15/03	Dry Mill	Post Decon	Hopper	218	79	58	62.96	8	12	-4
HP46	07/15/03	Dry Mill	Post Decon	Beam	196	0	43	7.41	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	217	75	0	-151.85	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Hopper	216	71	53	44.44	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Tank	223	96	58	62.96	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Elevator shaft	196	0	48	25.93	6	12	-6
HP46	07/15/03	Dry Mill	Post Decon	Tank	239	154	57	59.26	9	12	-3
HP46	07/15/03	Dry Mill	Post Decon	Steel sheet	226	107	48	25.93	5	12	-7
HP46	07/15/03	Dry Mill	Post Decon	Sheet metal	201	18	47	22.22	8	12	-4

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP46	07/15/03	Dry Mill	Post Decon	Hopper Frame	224	100	58	62.96	8	12	-4
HP50	07/16/03	Dry Mill	Post Decon	Trough	206	44	49	0.00	9	14	-5
HP50	07/16/03	Dry Mill	Post Decon	Trough	234	148	53	16.00	5	14	-9
HP50	07/16/03	Dry Mill	Post Decon	Tank	215	78	49	0.00	6	14	-8
HP50	07/16/03	Dry Mill	Post Decon	Tank	207	48	49	0.00	6	14	-8
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	211	63	65	64.00	5	14	-9
HP50	07/16/03	Dry Mill	Post Decon	Motor	238	163	63	56.00	5	14	-9
HP50	07/16/03	Dry Mill	Post Decon	Scrap Steel	227	122	49	0.00	7	14	-7
HP50	07/16/03	Dry Mill	Post Decon	Trough	221	100	49	0.00	6	14	-8
HP50	07/16/03	Dry Mill	Post Decon	Frame	216	81	49	0.00	5	14	-9
HP50	07/16/03	Dry Mill	Post Decon	Trough	194	0	49	0.00	10	14	-4
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	239	167	49	0.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Hopper	346	563	49	0.00	10	14	-4
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	270	281	59	40.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	277	307	61	48.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	213	70	54	20.00	10	14	-4
HP50	07/16/03	Dry Mill	Post Decon	Scrap Steel	236	156	49	0.00	9	14	-5
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	236	156	54	20.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Pipe	199	19	49	0.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	204	37	49	0.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Pipe	204	37	49	0.00	13	14	-1
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	211	63	49	0.00	11	14	-3
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	219	93	52	12.00	5	14	-9
HP50	07/16/03	Dry Mill	Post Decon	Elevator shaft	211	63	49	0.00	5	14	-9
HP50	07/16/03	Dry Mill	Post Decon	Motor	220	96	54	20.00	8	14	-6
HP50	07/16/03	Dry Mill	Post Decon	Beam	208	52	49	0.00	7	14	-7
HP51	07/10/03	Dry Mill	Post Decon	Roller Tray	271	233	83	164.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Pump Base	267	219	87	180.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Pipe	249	152	72	120.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Elbow	252	163	50	32.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Steel	248	148	42	0.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Shaker Box	257	181	70	112.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Screw	253	167	74	128.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Tank	254	170	53	44.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Trough	281	270	42	0.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Tank	246	141	54	48.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Tank	271	233	60	72.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Hopper	295	322	82	160.00	10	10	0
HP51	07/10/03	Dry Mill	Post Decon	Hopper	281	270	70	112.00	10	10	0
HP53	07/17/03	Dry Mill	Post Decon	Beams	243	80	53	30.77	12	12	0
HP53	07/17/03	Dry Mill	Post Decon	Elevator bin	306	332	45	0.00	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Elevator shaft	290	268	46	3.85	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Angle iron	314	364	47	7.69	7	12	-5
HP53	07/17/03	Dry Mill	Post Decon	Elevator bin	276	212	45	0.00	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Elevator bin	282	236	45	0.00	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Elevator bin	279	224	51	23.08	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Motor	223	0	45	0.00	5	12	-7

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP53	07/17/03	Dry Mill	Post Decon	Shaft	294	284	61	61.54	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Elevator bin	268	180	57	46.15	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Separator	299	304	69	92.31	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Motor	246	92	69	92.31	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Grating	267	176	47	7.69	5	12	-7
HP53	07/17/03	Dry Mill	Post Decon	Bin	318	380	45	0.00	6	12	-6
HP55	07/21/03	Dry Mill	Post Decon	Tank	277	219	56	48.00	5	11	-6
HP55	07/21/03	Dry Mill	Post Decon	Frame	246	100	44	0.00	7	11	-4
HP55	07/21/03	Dry Mill	Post Decon	Elevator shaft	262	162	44	0.00	5	11	-6
HP55	07/21/03	Dry Mill	Post Decon	Elevator shaft	245	96	47	12.00	6	11	-5
HP55	07/21/03	Dry Mill	Post Decon	Beam	290	269	44	0.00	6	11	-5
HP55	07/21/03	Dry Mill	Post Decon	Elevator shaft	286	254	50	24.00	6	11	-5
HP55	07/21/03	Dry Mill	Post Decon	Elevator shaft	259	150	53	36.00	6	11	-5
HP55	07/21/03	Dry Mill	Post Decon	Hopper	280	231	55	44.00	7	11	-4
HP55	07/21/03	Dry Mill	Post Decon	Hopper	288	262	56	48.00	6	11	-5
HP55	07/21/03	Dry Mill	Post Decon	Elevator shaft	274	208	67	92.00	7	11	-4
HP57	07/21/03	Dry Mill	Post Decon	Beam	203	0	44	0.00	12	12	0
HP57	07/21/03	Dry Mill	Post Decon	Beam	229	100	44	0.00	9	12	-3
HP57	07/21/03	Dry Mill	Post Decon	Beam	203	0	57	52.00	9	12	-3
HP57	07/21/03	Dry Mill	Post Decon	Beam	203	0	48	16.00	12	12	0
HP57	07/21/03	Dry Mill	Post Decon	Beam	235	123	45	4.00	12	12	0
HP57	07/21/03	Dry Mill	Post Decon	Beam	248	173	44	0.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	218	58	53	36.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	203	0	44	0.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	246	165	44	0.00	9	12	-3
HP57	07/21/03	Dry Mill	Post Decon	Beam	259	215	44	0.00	9	12	-3
HP57	07/21/03	Dry Mill	Post Decon	Beam	251	185	51	28.00	12	12	0
HP57	07/21/03	Dry Mill	Post Decon	Beam	265	238	44	0.00	11	12	-1
HP57	07/21/03	Dry Mill	Post Decon	Beam	244	158	44	0.00	11	12	-1
HP57	07/21/03	Dry Mill	Post Decon	Beam	235	123	47	12.00	12	12	0
HP57	07/21/03	Dry Mill	Post Decon	Beam	249	177	44	0.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	203	0	54	40.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	266	242	44	0.00	9	12	-3
HP57	07/21/03	Dry Mill	Post Decon	Beam	251	185	44	0.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	255	200	49	20.00	11	12	-1
HP57	07/21/03	Dry Mill	Post Decon	Beam	264	235	44	0.00	10	12	-2
HP57	07/21/03	Dry Mill	Post Decon	Beam	263	231	47	12.00	11	12	-1
HP57	07/21/03	Dry Mill	Post Decon	Beam	254	196	52	32.00	12	12	0
HP57	07/21/03	Dry Mill	Post Decon	Beam	262	227	53	36.00	9	12	-3
HP57	07/21/03	Dry Mill	Post Decon	Beam	203	0	44	0.00	11	12	-1
HP57	07/21/03	Dry Mill	Post Decon	Beam	224	81	44	0.00	11	12	-1
HP59	07/22/03	Dry Mill	Post Decon	Beams	282	233	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	289	259	51	26.92	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	271	193	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	267	178	45	3.85	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	287	252	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	219	0	44	0.00	10	10	0

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP59	07/22/03	Dry Mill	Post Decon	Beams	282	233	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	291	267	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	287	252	45	3.85	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	276	211	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	280	226	61	65.38	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	288	256	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	289	259	56	46.15	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	260	152	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	245	96	47	11.54	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	281	230	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	280	226	60	61.54	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	257	141	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	260	152	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	266	174	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	248	107	44	0.00	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	287	252	45	3.85	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	261	156	54	38.46	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	265	170	56	46.15	10	10	0
HP59	07/22/03	Dry Mill	Post Decon	Beams	282	233	47	11.54	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	321	396	64	76.92	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	287	270	50	23.08	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	307	344	55	42.31	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	261	174	51	26.92	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	220	22	51	26.92	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	229	56	63	73.08	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	235	78	44	0.00	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	248	126	53	34.62	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	214	0	58	53.85	10	10	0
HP62	07/22/03	Dry Mill	Post Decon	Magnetic Coils	255	152	59	57.69	10	10	0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	253	74					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	253	74					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	249	59					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	235	7					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	242	33					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	235	7					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	275	156					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	257	89					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	238	19					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	288	204					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	272	144					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	260	100					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	238	19					0

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	233	0					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	274	152					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	252	70					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	249	59					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	255	81					0
HP63	07/23/03	Dry Mill	L.A. Smear	Tin siding	236	11					0
HP65	07/23/03	Dry Mill	Post Decon	Beam/Roller	282	181	44	0.00	9	11	-2
HP65	07/23/03	Dry Mill	Post Decon	Pipe	274	152	44	0.00	9	11	-2
HP65	07/23/03	Dry Mill	Post Decon	Pipe	267	126	44	0.00	5	11	-6
HP65	07/23/03	Dry Mill	Post Decon	Beams	326	344	47	11.11	7	11	-4
HP65	07/23/03	Dry Mill	Post Decon	Beams	253	74	44	0.00	7	11	-4
HP65	07/23/03	Dry Mill	Post Decon	Trough/Tray	301	252	54	37.04	10	11	-1
HP65	07/23/03	Dry Mill	Post Decon	Motor	243	37	59	55.56	7	11	-4
HP65	07/23/03	Dry Mill	Post Decon	Beam	283	185	44	0.00	6	11	-5
HP65	07/23/03	Dry Mill	Post Decon	Beam	280	174	44	0.00	6	11	-5
HP65	07/23/03	Dry Mill	Post Decon	Beam	266	122	48	14.81	7	11	-4
HP65	07/23/03	Dry Mill	Post Decon	Conveyor	298	241	48	14.81	4	11	-7
HP65	07/23/03	Dry Mill	Post Decon	Conveyor	283	185	44	0.00	4	11	-7
HP65	07/23/03	Dry Mill	Post Decon	Beams	253	74	44	0.00	4	11	-7
HP65	07/23/03	Dry Mill	Post Decon	Beams	233	0	44	0.00	4	11	-7
HP65	07/23/03	Dry Mill	Post Decon	Magnet holder	269	133	54	37.04	5	11	-6
HP65	07/23/03	Dry Mill	Post Decon	Magnet holder	298	241	71	100.00	10	11	-1
HP65	07/23/03	Dry Mill	Post Decon	Magnet holder	275	156	48	14.81	9	11	-2
HP65	07/23/03	Dry Mill	Post Decon	Copper Roll	284	189	44	0.00	10	11	-1
HP65	07/23/03	Dry Mill	Post Decon	Tank	272	144	56	44.44	8	11	-3
HP65	07/23/03	Dry Mill	Post Decon	Beam	252	70	44	0.00	9	11	-2
HP65	07/23/03	Dry Mill	Post Decon	Roller	291	215	52	29.63	9	11	-2
HP65	07/23/03	Dry Mill	Post Decon	Hopper	305	267	71	100.00	10	11	-1
HP65	07/23/03	Dry Mill	Post Decon	Tank	288	204	59	55.56	10	11	-1
HP65	07/23/03	Dry Mill	Post Decon	Magnet holder	260	100	55	40.74	10	11	-1
HP65	07/23/03	Dry Mill	Post Decon	Beams	293	222	56	44.44	11	11	0
HP66	07/24/03	Dry Mill	Post Decon	Beams	233	59	49	18.52	7	13	-6
HP66	07/24/03	Dry Mill	Post Decon	Beams	227	37	45	3.70	7	13	-6
HP66	07/24/03	Dry Mill	Post Decon	Beams	217	0	46	7.41	7	13	-6
HP66	07/24/03	Dry Mill	Post Decon	Beams	245	104	44	0.00	8	13	-5
HP66	07/24/03	Dry Mill	Post Decon	Beams	222	19	44	0.00	8	13	-5
HP66	07/24/03	Dry Mill	Post Decon	Seperator	263	170	50	22.22	7	13	-6
HP66	07/24/03	Dry Mill	Post Decon	Pipe	217	0	47	11.11	9	13	-4
HP66	07/24/03	Dry Mill	Post Decon	Frame	234	63	44	0.00	10	13	-3
HP66	07/24/03	Dry Mill	Post Decon	Beams	241	89	46	7.41	9	13	-4
HP66	07/24/03	Dry Mill	Post Decon	Beams	255	141	48	14.81	10	13	-3
HP66	07/24/03	Dry Mill	Post Decon	Beams	217	0	46	7.41	13	13	0
HP66	07/24/03	Dry Mill	Post Decon	Beams	267	185	54	37.04	12	13	-1
HP66	07/24/03	Dry Mill	Post Decon	Beams	222	19	44	0.00	10	13	-3
HP66	07/24/03	Dry Mill	Post Decon	Beams	248	115	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Beams	256	144	48	14.81	5	13	-8

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP66	07/24/03	Dry Mill	Post Decon	Beams	259	156	44	0.00	10	13	-3
HP66	07/24/03	Dry Mill	Post Decon	Beams	231	52	44	0.00	4	13	-9
HP66	07/24/03	Dry Mill	Post Decon	Beams	233	59	46	7.41	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Beams	252	130	64	74.07	6	13	-7
HP66	07/24/03	Dry Mill	Post Decon	Beams	234	63	56	44.44	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Magnet holder	239	81	46	7.41	8	13	-5
HP66	07/24/03	Dry Mill	Post Decon	Magnet holder	250	122	52	29.63	8	13	-5
HP66	07/24/03	Dry Mill	Post Decon	Beams	230	48	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Beams	246	107	45	3.70	8	13	-5
HP66	07/24/03	Dry Mill	Post Decon	Beams	262	167	46	7.41	9	13	-4
HP66	07/24/03	Dry Mill	Post Decon	Beams	217	0	44	0.00	6	13	-7
HP66	07/24/03	Dry Mill	Post Decon	Beams	269	193	53	33.33	9	13	-4
HP66	07/24/03	Dry Mill	Post Decon	Beams	220	11	45	3.70	8	13	-5
HP66	07/24/03	Dry Mill	Post Decon	Beams	231	52	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Beams	237	74	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Beams	298	300	64	74.07	6	13	-7
HP66	07/24/03	Dry Mill	Post Decon	Beams	278	226	49	18.52	6	13	-7
HP66	07/24/03	Dry Mill	Post Decon	Beams	222	19	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Beams	217	0	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Trough	276	219	44	0.00	5	13	-8
HP66	07/24/03	Dry Mill	Post Decon	Hopper	289	267	44	0.00	7	13	-6
HP66	07/24/03	Dry Mill	Post Decon	Hopper	217	0	44	0.00	9	13	-4
HP68	07/28/03	Dry Mill	Post Decon	Hopper	267	177	48	0.00	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Beam	250	112	48	0.00	7	7	0
HP68	07/28/03	Dry Mill	Post Decon	Gear Box	257	138	48	0.00	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Base	266	173	48	0.00	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	289	262	20	-107.69	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	357	523	54	23.08	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	299	300	48	0.00	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Magnet holder	247	100	49	3.85	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Pulley	281	231	58	38.46	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Pulley	224	12	48	0.00	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Pulley	290	265	48	0.00	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Beams	322	388	51	11.54	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Roller	366	558	48	0.00	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	270	188	49	3.85	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	347	485	48	0.00	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Beam	295	285	80	123.08	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Beam	223	8	48	0.00	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	307	331	51	11.54	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Elevator shaft	248	104	48	0.00	6	7	-1
HP68	07/28/03	Dry Mill	Post Decon	Pipe	278	219	48	0.00	5	7	-2
HP68	07/28/03	Dry Mill	Post Decon	Pulley	269	185	48	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Frame	221	0	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Bin	256	140	48	15.38	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Bin	253	128	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Frame	235	56	44	0.00	5	7	-2

Heritage Minerals Final St[illegible]s Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP69	07/29/03	Dry Mill	Post Decon	Hopper	264	172	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beam	241	80	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Hopper	262	164	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Column	221	0	49	19.23	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Hopper	282	244	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Frame	221	0	50	23.08	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Roller assembly	247	104	45	3.85	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Roller	278	228	45	3.85	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Trough	250	116	48	15.38	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Gear Box	284	252	47	11.54	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Gear Box	256	140	47	11.54	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beam	221	0	46	7.69	4	7	-3
HP69	07/29/03	Dry Mill	Post Decon	Tank	261	160	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Shoot	246	100	44	0.00	7	7	0
HP69	07/29/03	Dry Mill	Post Decon	Pipe	283	248	47	11.54	7	7	0
HP69	07/29/03	Dry Mill	Post Decon	Tank	260	156	51	26.92	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Trough	246	100	47	11.54	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Blower motor	256	140	52	30.77	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Column	261	160	48	15.38	7	7	0
HP69	07/29/03	Dry Mill	Post Decon	Tank	221	0	44	0.00	7	7	0
HP69	07/29/03	Dry Mill	Post Decon	Steel	221	0	47	11.54	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Pipe	258	148	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beam	275	216	53	34.62	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beam	243	88	54	38.46	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beam	221	0	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Hopper	262	164	44	0.00	4	7	-3
HP69	07/29/03	Dry Mill	Post Decon	Beam	250	116	52	30.77	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Frame	257	144	53	34.62	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Hopper	268	188	52	30.77	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Frame	246	100	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Bean	250	116	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Gear Box	251	120	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beam	221	0	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beam	221	0	58	53.85	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Gear Box	223	8	46	7.69	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Frame	241	80	47	11.54	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Hopper	256	140	47	11.54	4	7	-3
HP69	07/29/03	Dry Mill	Post Decon	Ring Gear	249	112	57	50.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Steel plate	221	0	50	23.08	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Steel Ring	286	260	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Steel Blade	221	0	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Hopper	272	204	50	23.08	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Columns	244	92	60	61.54	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	221	0	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	262	164	77	126.92	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	232	44	65	80.77	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	240	76	50	23.08	6	7	-1

Heritage Minerals Final S[illegible]us Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP69	07/29/03	Dry Mill	Post Decon	Beams	245	96	47	11.54	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	238	68	54	38.46	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	253	128	50	23.08	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	231	40	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	244	92	45	3.85	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	291	280	52	30.77	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	243	88	48	15.38	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	251	120	46	7.69	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	256	140	47	11.54	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	261	160	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	246	100	44	0.00	5	7	-2
HP69	07/29/03	Dry Mill	Post Decon	Beams	221	0	44	0.00	6	7	-1
HP69	07/29/03	Dry Mill	Post Decon	Beams	284	252	49	19.23	6	8	-2
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	213	0	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	213	0	46	0.00	5	7	-2
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	388	625	67	80.77	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	238	89	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	246	118	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	243	107	46	0.00	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Frame	213	0	46	0.00	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Magnet holder	240	96	48	7.69	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Column	225	43	53	26.92	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Beam	230	61	48	7.69	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Tank	213	0	46	0.00	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Pipe	213	0	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Trough	429	771	58	46.15	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Trough/Roller	259	164	46	0.00	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Beam	257	157	46	0.00	5	7	-2
HP72	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	5	7	-2
HP72	07/30/03	Dry Mill	Post Decon	Pipe	213	0	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Roller Assembly	239	93	47	3.85	5	7	-2
HP72	07/30/03	Dry Mill	Post Decon	Trough	233	71	52	23.08	5	7	-2
HP72	07/30/03	Dry Mill	Post Decon	Frame	213	0	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Pipe	236	82	48	7.69	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Elevator shaft	254	146	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Trough	252	139	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Hopper	265	186	47	3.85	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Hopper	257	157	48	7.69	7	7	0
HP72	07/30/03	Dry Mill	Post Decon	Mixing Blade	231	64	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Ring Gear	254	146	46	0.00	6	7	-1
HP72	07/30/03	Dry Mill	Post Decon	Heating element	233	71	46	0.00	7	7	0
HP74	07/30/03	Dry Mill	Post Decon	Trough	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pipe	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Fan motor	213	0	56	38.46	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Elevator shaft	213	0	46	0.00	12	12	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP74	07/30/03	Dry Mill	Post Decon	Trough	255	150	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	51	19.23	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Trough	246	118	59	50.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pipe	231	64	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Roller	236	82	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Roller	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pully	274	218	48	7.69	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Grating	250	132	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pump housing	213	0	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pipe	213	0	47	3.85	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pipe	238	89	49	11.54	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Beam	225	43	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pump housing	253	143	57	42.31	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Grating	223	36	46	0.00	12	12	0
HP74	07/30/03	Dry Mill	Post Decon	Pipe	246	118	53	26.92	12	12	0
HP76	07/31/03	Dry Mill	Post Decon	Pipe	238	112	41	0.00	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Trough	251	162	41	0.00	8	8	0
HP76	07/31/03	Dry Mill	Post Decon	Elevator shaft	269	231	46	20.83	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Grating	228	73	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Magnet	219	38	41	0.00	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Trough	258	188	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Roller Assembly	267	223	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Magnet	220	42	41	0.00	8	8	0
HP76	07/31/03	Dry Mill	Post Decon	Beam	209	0	43	8.33	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Steel Plate	209	0	49	33.33	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Frame	209	0	41	0.00	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Pipe	221	46	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Steel	230	81	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Pulley	246	142	42	4.17	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Frame	224	58	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Roller Assembly	248	150	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Motor	274	250	52	45.83	8	8	0
HP76	07/31/03	Dry Mill	Post Decon	Magnet holder	209	0	45	16.67	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Magnet holder	209	0	43	8.33	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Roller Assembly	248	150	50	37.50	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Magnet	209	0	41	0.00	6	8	-2
HP76	07/31/03	Dry Mill	Post Decon	Magnet	231	85	44	12.50	5	8	-3
HP76	07/31/03	Dry Mill	Post Decon	Fan vent	262	204	41	0.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Beam	256	181	59	75.00	7	8	-1
HP76	07/31/03	Dry Mill	Post Decon	Beam	209	0	41	0.00	7	8	-1
HP78	08/01/03	Dry Mill	Post Decon	Beam	236	119	52	37.04	8	8	0
HP78	08/01/03	Dry Mill	Post Decon	Beam	254	188	42	0.00	6	8	-2
HP78	08/01/03	Dry Mill	Post Decon	Roller	268	242	57	55.56	5	8	-3

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP78	08/01/03	Dry Mill	Post Decon	Roller	232	104	47	18.52	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Spiral	205	0	42	0.00	6	8	-2
HP78	08/01/03	Dry Mill	Post Decon	Rubber Blades	249	169	50	29.63	8	8	0
HP78	08/01/03	Dry Mill	Post Decon	Steel	257	200	42	0.00	7	8	-1
HP78	08/01/03	Dry Mill	Post Decon	Roller	238	127	45	11.11	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Sheet metal	205	0	46	14.81	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Sheet metal	205	0	42	0.00	6	8	-2
HP78	08/01/03	Dry Mill	Post Decon	Motor	248	165	57	55.56	6	8	-2
HP78	08/01/03	Dry Mill	Post Decon	Motor	225	77	55	48.15	6	8	-2
HP78	08/01/03	Dry Mill	Post Decon	Motor	240	135	59	62.96	6	8	-2
HP78	08/01/03	Dry Mill	Post Decon	Motor	232	104	54	44.44	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Pipe	224	73	42	0.00	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Vent	228	88	42	0.00	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Spiral	205	0	42	0.00	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Pulley	247	162	61	70.37	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Steel	256	196	62	74.07	5	8	-3
HP78	08/01/03	Dry Mill	Post Decon	Motor	205	0	44	7.41	5	8	-3
HP79	08/01/03	Dry Mill	Post Decon	Tin	243	146	47	18.52	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Grating	232	104	46	14.81	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Angle iron	245	154	42	0.00	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Roller	205	0	42	0.00	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Pipe	240	135	45	11.11	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Beam	231	100	42	0.00	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Elevator shaft	238	127	42	0.00	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Tubing	205	0	44	7.41	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Elevator shaft	205	0	42	0.00	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Frame	240	135	49	25.93	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Roller	254	188	52	37.04	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Switch Box	205	0	45	11.11	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Elevator shaft	255	192	50	29.63	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Trough	241	138	46	14.81	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Steel plate	227	85	47	18.52	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Rollup door	232	104	48	22.22	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Pipe	236	119	45	11.11	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Tin	223	69	47	18.52	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Beam	205	0	53	40.74	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Hopper	244	150	59	62.96	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Tank	251	177	54	44.44	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Wiring	205	0	42	0.00	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Column	205	0	43	3.70	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Pipe	242	142	42	0.00	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Motor	205	0	42	0.00	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Pipe	243	146	42	0.00	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Roller	247	162	42	0.00	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Steel plate	268	242	44	7.41	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Column	244	150	45	11.11	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Bin	246	158	42	0.00	6	10	-4

Heritage Minerals Final S[illegible]s Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP79	08/01/03	Dry Mill	Post Decon	Tin	250	173	54	44.44	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Beam	236	119	49	25.93	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Column	234	112	42	0.00	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Grating	242	142	47	18.52	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Mesh wire	225	77	43	3.70	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Beam	237	123	43	3.70	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Tubing	220	58	45	11.11	9	10	-1
HP79	08/01/03	Dry Mill	Post Decon	Steel plate	239	131	42	0.00	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Fuse Panel	205	0	45	11.11	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Steel plate	238	127	45	11.11	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Wiring	224	73	42	0.00	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Frame	237	123	48	22.22	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Column	229	92	42	0.00	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Column	228	88	51	33.33	6	10	-4
HP79	08/01/03	Dry Mill	Post Decon	Tank	244	150	43	3.70	8	10	-2
HP79	08/01/03	Dry Mill	Post Decon	Elevator shaft	259	208	54	44.44	10	10	0
HP79	08/01/03	Dry Mill	Post Decon	Water pipe	205	0	42	0.00	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Beam	227	85	47	18.52	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Beam	231	100	45	11.11	7	10	-3
HP79	08/01/03	Dry Mill	Post Decon	Grating	241	138	49	25.93	7	10	-3
HP80	08/04/03	Dry Mill	Post Decon	Grating	207	0	48	11.11	8	8	0
HP80	08/04/03	Dry Mill	Post Decon	Trough	243	133	50	18.52	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Beam	227	74	45	0.00	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Mesh wire	219	44	45	0.00	8	8	0
HP80	08/04/03	Dry Mill	Post Decon	Roller	238	115	48	11.11	9	8	1
HP80	08/04/03	Dry Mill	Post Decon	Tubing	207	0	52	25.93	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Wire	207	0	45	0.00	9	8	1
HP80	08/04/03	Dry Mill	Post Decon	Hopper	253	170	55	37.04	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Roller	239	119	53	29.63	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Beam	228	78	45	0.00	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Beam	226	70	45	0.00	8	8	0
HP80	08/04/03	Dry Mill	Post Decon	Steel	240	122	51	22.22	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Motor	207	0	45	0.00	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Motor	207	0	46	3.70	9	8	1
HP80	08/04/03	Dry Mill	Post Decon	Column	207	0	46	3.70	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Column	207	0	45	0.00	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Column	257	185	48	11.11	6	8	-2
HP80	08/04/03	Dry Mill	Post Decon	Roller Assembly	262	204	44	-3.70	7	8	-1
HP80	08/04/03	Dry Mill	Post Decon	Steel plate	233	96	49	14.81	6	8	-2
HP80	08/04/03	Dry Mill	Post Decon	Tin	244	137	45	0.00	6	8	-2
HP80	08/04/03	Dry Mill	Post Decon	Pipe	207	0	45	0.00	6	8	-2
HP80	08/04/03	Dry Mill	Post Decon	Grating	207	0	46	3.70	6	8	-2
HP80	08/04/03	Dry Mill	Post Decon	Tubing	207	0	45	0.00	6	8	-2
HP80	08/04/03	Dry Mill	Post Decon	Trough	252	167	53	29.63	8	8	0
HP80	08/04/03	Dry Mill	Post Decon	Motor	207	0	47	7.41	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Pipe	227	74	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Grating	233	96	45	0.00	6	8	-2

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP83	08/04/03	Dry Mill	Post Decon	Motor	232	93	48	11.11	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Motor	226	70	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Motor	224	63	46	3.70	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Pipe	225	67	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Bin	229	81	50	18.52	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Column	229	81	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Hopper	233	96	48	11.11	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Hopper	231	89	52	25.93	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Beam	231	89	45	0.00	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Beam	232	93	50	18.52	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Beam	207	0	53	29.63	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Beam	207	0	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Magnet holder	207	0	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Magnet holder	207	0	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Roller Assembly	207	0	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Roller Assembly	236	107	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Beam	234	100	49	14.81	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Grating	232	93	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Roller	238	115	48	11.11	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Steel	243	133	50	18.52	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Steel plate	239	119	47	7.41	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Motor	228	78	48	11.11	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Stainless box	233	96	50	18.52	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Stainless box	239	119	50	18.52	8	8	0
HP83	08/04/03	Dry Mill	Post Decon	Bin	247	148	52	25.93	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Hopper	253	170	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Beam	207	0	46	3.70	8	8	0
HP83	08/04/03	Dry Mill	Post Decon	Beam	207	0	45	0.00	8	8	0
HP83	08/04/03	Dry Mill	Post Decon	Beam	207	0	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Roller Assembly	240	122	49	14.81	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Trough	248	152	46	3.70	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Column	207	0	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Stainless box	237	111	48	11.11	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Pipe	207	0	52	25.93	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Tank	246	144	47	7.41	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Roller Assembly	233	96	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Steel plate	228	78	45	0.00	5	8	-3
HP83	08/04/03	Dry Mill	Post Decon	Tin	234	100	45	0.00	6	8	-2
HP83	08/04/03	Dry Mill	Post Decon	Steel	242	130	50	18.52	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Spirals	207	0	45	0.00	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Trough	234	100	51	22.22	7	8	-1
HP83	08/04/03	Dry Mill	Post Decon	Beam	207	0	45	0.00	6	8	-2
HP85	08/05/03	Dry Mill	Post Decon	Gear	297	188	57	46.15	6	8	-2
HP85	08/05/03	Dry Mill	Post Decon	Trough	287	150	64	73.08	8	8	0
HP85	08/05/03	Dry Mill	Post Decon	Pipe	290	162	67	84.62	8	8	0
HP85	08/05/03	Dry Mill	Post Decon	Motor	283	135	57	46.15	8	8	0
HP85	08/05/03	Dry Mill	Post Decon	Trough	248	0	62	65.38	6	8	-2

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Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP85	08/05/03	Dry Mill	Post Decon	Gear wheel	309	235	71	100.00	7	8	-1
HP85	08/05/03	Dry Mill	Post Decon	Metal box	295	181	60	57.69	6	8	-2
HP85	08/05/03	Dry Mill	Post Decon	Blade shaft	298	192	58	50.00	7	8	-1
HP85	08/05/03	Dry Mill	Post Decon	Roller Assembly	276	108	50	19.23	7	8	-1
HP85	08/05/03	Dry Mill	Post Decon	Steel Frame	270	85	57	46.15	6	8	-2
HP85	08/05/03	Dry Mill	Post Decon	Motor	279	119	59	53.85	7	8	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	271	60	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	275	76	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	271	60	52	11.54	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	270	56	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	268	48	51	7.69	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	50	3.85	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	286	120	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	282	104	52	11.54	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	277	84	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	273	68	58	34.62	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	276	80	52	11.54	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	269	52	54	19.23	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	278	88	49	0.00	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	50	3.85	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	52	11.54	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	284	112	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	63	53.85	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	280	96	52	11.54	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	271	60	51	7.69	7	7	0
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	265	36	53	15.38	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	273	68	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	289	132	50	3.85	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	277	84	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	5	7	-2
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	52	11.54	5	7	-2
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	284	112	49	0.00	5	7	-2
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	282	104	49	0.00	5	7	-2

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	288	128	49	0.00	5	7	-2
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	5	7	-2
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	54	19.23	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	51	7.69	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	274	72	53	15.38	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	285	116	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	283	108	52	11.54	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	49	0.00	6	7	-1
HP88	08/06/03	Dry Mill	Post Decon	Conveyor Belt	256	0	51	7.69	6	7	-1
HP89	08/06/03	Dry Mill	Post Decon	Trough	287	124	49	0.00	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Pipe	283	108	53	15.38	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Fan motor	305	196	49	0.00	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Frame	283	108	49	0.00	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Panel box	256	0	52	11.54	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Motor	289	132	49	0.00	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Beam	256	0	49	0.00	9	9	0
HP89	08/06/03	Dry Mill	Post Decon	Gear	321	260	86	142.31	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Pipe	284	112	71	84.62	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Bin	298	168	85	138.46	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Bin	319	252	49	0.00	9	9	0
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	283	108	87	146.15	9	9	0
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	315	236	79	115.38	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	307	204	60	42.31	9	9	0
HP89	08/06/03	Dry Mill	Post Decon	Separator	295	156	72	88.46	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	334	312	98	188.46	9	9	0
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	332	304	79	115.38	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Bin	285	116	73	92.31	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Column	256	0	59	38.46	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Hopper frame	297	164	49	0.00	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Grating	256	0	70	80.77	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Motor	256	0	84	134.62	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	317	244	61	46.15	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Pipe	286	120	51	7.69	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Pipe	281	100	62	50.00	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Bin	298	168	72	88.46	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Pipe	292	144	80	119.23	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Roller	307	204	61	46.15	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Beam	282	104	81	123.08	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Tank	286	120	59	38.46	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Steel plate	273	68	49	0.00	8	9	-1
HP89	08/06/03	Dry Mill	Post Decon	Pipe	256	0	49	0.00	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Beam	292	144	54	19.23	6	9	-3
HP89	08/06/03	Dry Mill	Post Decon	Frame	288	128	56	26.92	6	9	-3
HP89	08/06/03	Dry Mill	Post Decon	Motor	283	108	58	34.62	7	9	-2
HP89	08/06/03	Dry Mill	Post Decon	Roller Assembly	305	196	86	142.31	7	9	-2
HP90	08/06/03	Dry Mill	Post Decon	Beam	297	164	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Bin	289	132	49	0.00	9	9	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP90	08/06/03	Dry Mill	Post Decon	Hopper	324	272	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Beam	307	204	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Pipe	312	224	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Pipe	309	212	50	3.85	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Grating	286	120	50	3.85	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Tin	256	0	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Hopper	295	156	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Tank	302	184	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Beam	256	0	51	7.69	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Beam	256	0	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Beam	256	0	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Magnet holder	256	0	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Roller Assembly	293	148	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Motor	281	100	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Motor	279	92	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Roller	287	124	49	0.00	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Beam	267	44	50	3.85	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Pipe	270	56	52	11.54	8	9	-1
HP90	08/06/03	Dry Mill	Post Decon	Pipe	256	0	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Grating	256	0	51	7.69	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Pipe	272	64	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Grating	288	128	49	0.00	9	9	0
HP90	08/06/03	Dry Mill	Post Decon	Beam	291	140	49	0.00	9	9	0
HP91	08/07/03	Dry Mill	Post Decon	Hopper	245	115	48	0.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Bin	251	137	55	28.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Pipe	239	93	49	4.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Beam	257	159	48	0.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Beam	214	0	48	0.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Roller/motor	254	148	58	40.00	7	7	0
HP91	08/07/03	Dry Mill	Post Decon	motor/fan	262	178	63	60.00	7	7	0
HP91	08/07/03	Dry Mill	Post Decon	Beam	227	48	48	0.00	7	7	0
HP91	08/07/03	Dry Mill	Post Decon	Grating	214	0	49	4.00	7	7	0
HP91	08/07/03	Dry Mill	Post Decon	Motor	214	0	48	0.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Fan case	236	81	55	28.00	6	7	-1
HP91	08/07/03	Dry Mill	Post Decon	Separator	249	130	56	32.00	6	7	-1
HP92	08/07/03	Dry Mill	Post Decon	Beam	237	85	48	0.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Roller Assembly	231	63	51	12.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Motor	214	0	48	0.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Grating	214	0	58	40.00	6	8	-2
HP92	08/07/03	Dry Mill	Post Decon	Steel	235	78	55	28.00	6	8	-2
HP92	08/07/03	Dry Mill	Post Decon	Bin	250	133	60	48.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Pipe	228	52	61	52.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Roller	214	0	50	8.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Trough	261	174	48	0.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Beam	214	0	48	0.00	7	8	-1
HP92	08/07/03	Dry Mill	Post Decon	Beam	256	156	48	0.00	7	8	-1
HP92	08/07/03	Dry Mill	Post Decon	Beam	247	122	48	0.00	8	8	0

Heritage Minerals Final S[illegible]us Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP92	08/07/03	Dry Mill	Post Decon	Pipe	238	89	48	0.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Tubing	240	96	48	0.00	7	8	-1
HP92	08/07/03	Dry Mill	Post Decon	Steel	271	211	51	12.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Motor	214	0	49	4.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Grating	214	0	49	4.00	6	8	-2
HP92	08/07/03	Dry Mill	Post Decon	Roller	244	111	53	20.00	6	8	-2
HP92	08/07/03	Dry Mill	Post Decon	Roller Assembly	269	204	55	28.00	6	8	-2
HP92	08/07/03	Dry Mill	Post Decon	Motor	214	0	51	12.00	6	8	-2
HP92	08/07/03	Dry Mill	Post Decon	Beam	214	0	50	8.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Trough	281	248	50	8.00	8	8	0
HP92	08/07/03	Dry Mill	Post Decon	Steel	263	181	48	0.00	7	8	-1
HP92	08/07/03	Dry Mill	Post Decon	Pipe	214	0	53	20.00	7	8	-1
HP92	08/07/03	Dry Mill	Post Decon	Bin	269	204	59	44.00	7	8	-1
HP94	08/08/03	Dry Mill	Post Decon	Motor	208	0	59	39.29	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Motor	208	0	48	0.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Roller	208	0	51	10.71	7	9	-2
HP94	08/08/03	Dry Mill	Post Decon	Fan	234	104	53	17.86	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Gear	259	204	55	25.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Steel	238	120	48	0.00	7	9	-2
HP94	08/08/03	Dry Mill	Post Decon	Spiral	208	0	60	42.86	7	9	-2
HP94	08/08/03	Dry Mill	Post Decon	Roller Assembly	245	148	53	17.86	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller Assembly	251	172	51	10.71	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller	227	76	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Bin	252	176	63	53.57	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Steel	261	212	59	39.29	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Beam	208	0	53	17.86	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Beam	208	0	51	10.71	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Roller	234	104	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Separator	250	168	87	139.29	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Motor	230	88	58	35.71	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Motor/Roller	208	0	53	17.86	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Motor	208	0	48	0.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Pipe	208	0	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller	225	68	59	39.29	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Motor	224	64	54	21.43	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Hopper	261	212	90	150.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Bin	249	164	97	175.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Beam	208	0	52	14.29	7	9	-2
HP94	08/08/03	Dry Mill	Post Decon	Motor	208	0	51	10.71	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller	230	88	53	17.86	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller	237	116	50	7.14	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller Assembly	246	152	56	28.57	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Bin	254	184	54	21.43	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Hopper	252	176	60	42.86	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Beam	236	112	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Gear	247	156	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Pipe	228	80	66	64.29	9	9	0

Heritage Minerals Final Status Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP94	08/08/03	Dry Mill	Post Decon	Roller	244	144	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Spiral	231	92	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Pipe Ring	252	176	48	0.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Grating	245	148	53	17.86	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Column	208	0	48	0.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Steel	208	0	48	0.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Bin	257	196	48	0.00	8	9	-1
HP94	08/08/03	Dry Mill	Post Decon	Trough	239	124	53	17.86	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Roller	224	64	54	21.43	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Separator	251	172	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Elevator	258	200	48	0.00	9	9	0
HP94	08/08/03	Dry Mill	Post Decon	Spirals	208	0	64	57.14	9	9	0
CH 4	06/09/03	Dry Mill	CH 33	Steel Pieces	356	138	49	25.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 34	Steel Pieces	353	128	47	17.86	11	10	1
CH 4	06/09/03	Dry Mill	CH 35	Steel Pieces	341	86	42	0.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 36	Steel Pieces	337	72	47	17.86	11	10	1
CH 4	06/09/03	Dry Mill	CH 37	Steel Pieces	338	76	43	3.57	11	10	1
CH 4	06/09/03	Dry Mill	CH 38	Steel Pieces	339	79	58	57.14	11	10	1
CH 4	06/09/03	Dry Mill	CH 39	Steel Pieces	335	66	42	0.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 40	Steel Pieces	326	34	51	32.14	11	10	1
CH 4	06/09/03	Dry Mill	CH 41	Steel Pieces	327	38	42	0.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 42	Steel Pieces	329	45	49	25.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 43	Steel Pieces	327	38	49	25.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 44	Steel Pieces	349	114	42	0.00	11	10	1
CH 4	06/09/03	Dry Mill	CH 45	Steel Pieces	360	152	42	0.00	11	10	1
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	308	250	62	37.04	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	318	286	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	348	393	59	25.93	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	331	332	57	18.52	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	325	311	67	55.56	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	346	386	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	337	354	73	77.78	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	338	357	63	40.74	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	321	296	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	288	179	55	11.11	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	283	161	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	341	368	60	29.63	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	303	232	58	22.22	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	285	168	61	33.33	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	327	318	55	11.11	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	358	429	53	3.70	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	349	396	62	37.04	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	378	500	54	7.41	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	330	329	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	328	321	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	319	289	52	0.00	10	10	0
CH 7	06/30/03	Dry Mill	Beams/scrap	Beams/scrap	327	318	58	22.22	10	10	0

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
CD 1	06/10/03	Dry Mill	CD 1	Bin	390	736	66	79.31	8	8	0
CD 1	06/10/03	Dry Mill	CD 2	Bin	336	491	53	34.48	8	8	0
CD 1	06/10/03	Dry Mill	CD 3	Bin	372	655	48	17.24	8	8	0
CD 1	06/10/03	Dry Mill	CD 4	Bin	301	332	50	24.14	8	8	0
CD 1	06/10/03	Dry Mill	CD 5	Bin	361	605	36	-24.14	8	8	0
CD 1	06/10/03	Dry Mill	CD 6	Bin	330	464	49	20.69	8	8	0
CD 1	06/10/03	Dry Mill	CD 7	Bin	327	450	48	17.24	8	8	0
CD 2	07/03/03	Dry Mill	CD 8	Beams	329	658	67	74.07	9	9	0
CD 2	07/03/03	Dry Mill	CD 9	Magnet casing	231	281	59	44.44	9	9	0
CD 2	07/03/03	Dry Mill	CD 10	Bin	288	500	52	18.52	9	9	0
CD 2	07/03/03	Dry Mill	CD 11	Beams	212	208	64	62.96	9	9	0
CD 2	07/03/03	Dry Mill	CD 12	Beams/magnet	247	342	48	3.70	9	9	0
CD 2	07/03/03	Dry Mill	CD 13	Beams	303	558	65	66.67	9	9	0
CD 2	07/03/03	Dry Mill	CD 14	Beams	301	550	57	37.04	9	9	0
CD 2	07/03/03	Dry Mill	CD 15	Beams	220	238	47	0.00	9	9	0
CD 2	07/03/03	Dry Mill	CD 16	Beams	237	304	51	14.81	9	9	0

Survey Data
Wet and Dry Mill Pads

Heritage Minerals Final St[illegible]s Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	304	208	51	18.52	9	9	0
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	362	431	49	11.11	8	9	-1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	335	327	48	7.41	8	9	-1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	281	119	53	25.93	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	306	215	51	18.52	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	330	308	54	29.63	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	331	312	56	37.04	6	9	-3
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	268	69	51	18.52	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	308	223	54	29.63	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	357	412	56	37.04	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	261	42	56	37.04	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	250	0	56	37.04	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	250	0	54	29.63	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	306	215	51	18.52	14	9	5
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	280	115	54	29.63	8	9	-1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	258	31	52	22.22	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	266	62	52	22.22	8	9	-1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	250	0	51	18.52	12	9	3
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	282	123	46	0.00	8	9	-1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	296	177	69	85.19	17	9	8
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	280	115	46	0.00	12	9	3
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	250	0	51	18.52	10	9	1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	287	142	54	29.63	9	9	0
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	296	177	46	0.00	10	9	1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	268	69	46	0.00	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	291	158	48	7.41	10	9	1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	296	177	49	11.11	7	9	-2
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	250	0	46	0.00	10	9	1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	289	150	46	0.00	10	9	1
HP106	09/05/03	Wet Mill Pad	30 point	Unaffected	308	223	46	0.00	8	9	-1

Heritage Minerals Final St(.s Survey Master Database

Survey #	Date	Wet/Dry Mill	Survey Unit	Unit Description	Direct CPM	Direct DPM	Smear CPM	Smear DPM	microR Reading	microR Bkg.	Net microR
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	322	292	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	361	442	43	0.00	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	301	212	46	11.54	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	358	431	55	46.15	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	297	196	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	274	108	43	0.00	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	281	135	43	0.00	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	297	196	44	3.85	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	311	250	47	15.38	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	286	154	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	325	304	47	15.38	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	315	265	55	46.15	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	300	208	43	0.00	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	263	65	49	23.08	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	302	215	43	0.00	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	285	150	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	308	238	50	26.92	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	295	188	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	327	312	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	310	246	48	19.23	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	280	131	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	309	242	44	3.85	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	288	162	45	7.69	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	264	69	43	0.00	9	9	0
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	285	150	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	289	165	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	307	235	48	19.23	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	281	135	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	261	58	43	0.00	8	9	-1
HP105	08/20/03	Dry Mill Pad	30 point	Unaffected	286	154	43	0.00	8	9	-1

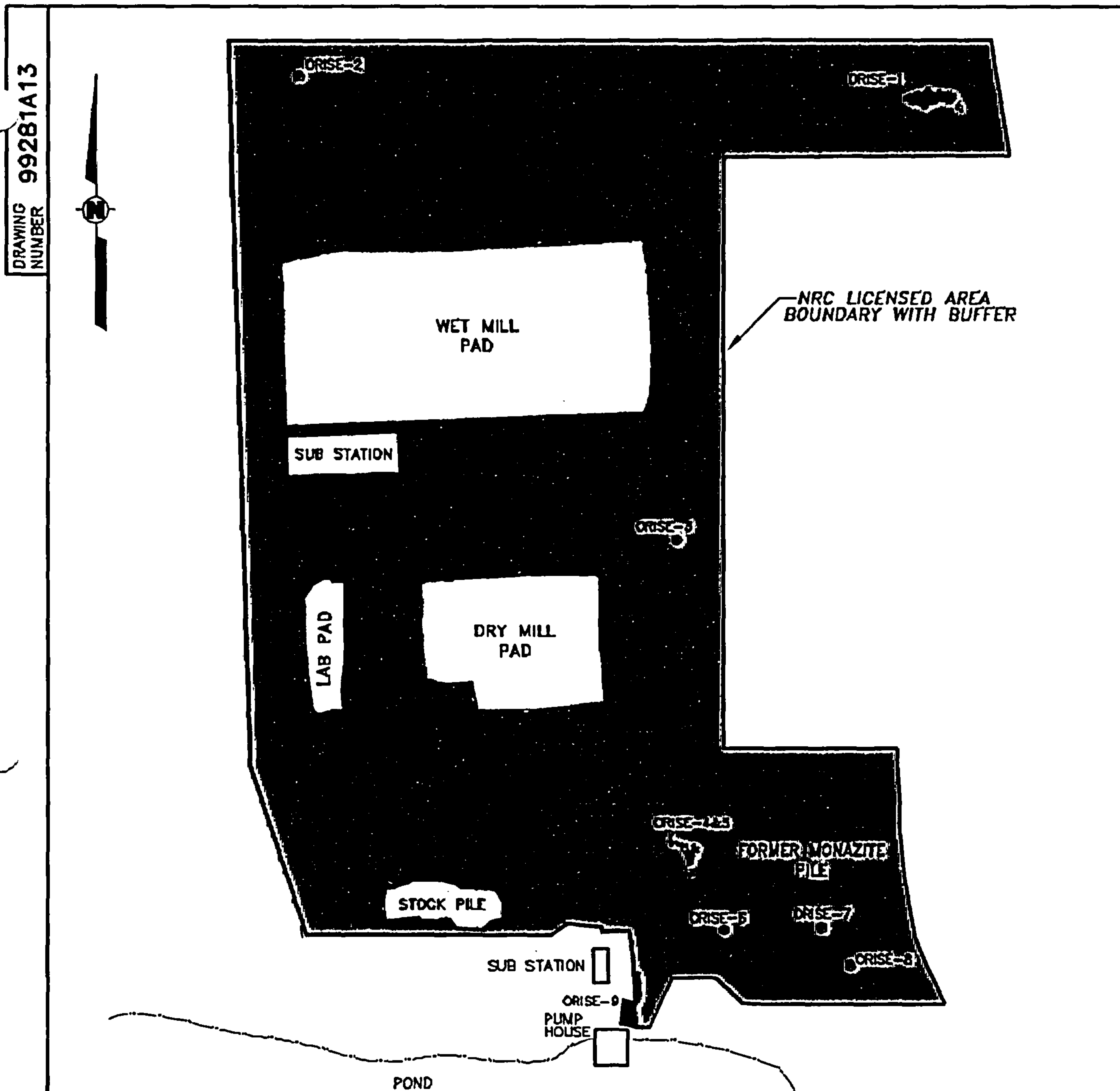
Table
Laboratory Data Confirming Removal of Locations Identified by ORISE and ENERCON

Table
Total Thorium and Total Uranium Analysis to Confirm Removal of Fugitive Licensable Source Materials

Sample Number	Total thorium (1)(2)	Total uranium (2)(3)	Bottom of Excavation Sampling to Verify Removal of Fugitive Source Material	NRC Approved release criteria (4)
04-01A	1.18	4.06	Bottom of excavation, northeast of wet mill pad at ORISE 1	10 pCi/g thorium, 10 pCi/g uranium
04-01B	1.09	6.26	Bottom of excavation, northeast of wet mill pad at ORISE 1	10 pCi/g thorium, 10 pCi/g uranium
04-02	0.06	ND (5)	Bottom of excavation, north of wet mill pad at ORISE 2	10 pCi/g thorium, 10 pCi/g uranium
04-03	0.89	0.34	Bottom of excavation, northeast of dry mill pad at ORISE 3	10 pCi/g thorium, 10 pCi/g uranium
05-04	ND (5)	6.24	Bottom of excavation, west of monazite pile footprint at ORISE 4	10 pCi/g thorium, 10 pCi/g uranium
05-05	0.37	3.84	Bottom of excavation, west of monazite pile footprint at ORISE 5	10 pCi/g thorium, 10 pCi/g uranium
05-6A	0.07	ND (5)	Bottom of excavation, west of monazite pile footprint at ORISE 6A	10 pCi/g thorium, 10 pCi/g uranium
04-6B	1.79	7.62	Bottom of excavation, west of monazite pile footprint at ORISE 6B	10 pCi/g thorium, 10 pCi/g uranium
04-07	2.00	ND (5)	Bottom of excavation, monazite pile footprint at ORISE 7	10 pCi/g thorium, 10 pCi/g uranium
04-08	6.59	5.37	Bottom of excavation, monazite pile footprint at ORISE 8	10 pCi/g thorium, 10 pCi/g uranium
05-9A	ND (5)	3.79	Bottom of excavation, adjacent pumphouse at ORISE 9A	10 pCi/g thorium, 10 pCi/g uranium
05-9B	0.40	6.74	Bottom of excavation, adjacent pumphouse at ORISE 9B	10 pCi/g thorium, 10 pCi/g uranium
05-9C	0.12	1.60	Bottom of excavation, adjacent pumphouse at ORISE 9C	10 pCi/g thorium, 10 pCi/g uranium
05-10A	0.59	5.08	Confirmatory stockpile removal beneath plastic liner ORISE 10A	10 pCi/g thorium, 10 pCi/g uranium
05-10B	1.86	8.66	Confirmatory stockpile removal beneath plastic liner ORISE 10B	10 pCi/g thorium, 10 pCi/g uranium
05-10C	0.70	5.16	Confirmatory stockpile removal beneath plastic liner ORISE 10C	10 pCi/g thorium, 10 pCi/g uranium
05-10D	1.45	7.64	Confirmatory stockpile removal beneath plastic liner ORISE 10D	10 pCi/g thorium, 10 pCi/g uranium

Notes
1. Total thorium quantified by assuming secular equilibrium of Thorium-228 with Ra-228 daughter, Thorium-232 with Pb-212 daughter then calculating total thorium.
2. Reported values above the established site background of 0.48 pCi/g total thorium and 0.62 pCi/g total uranium.
3. Total uranium quantified by assuming secular equilibrium of Uranium-238 with U-238 daughter then calculating total uranium.
4. NRC approved release criteria as stated in Final Status Survey Plan for License Termination
5. ND values represent no detected radionuclides above the established site background values listed in Note 2.

Figure 1
Location of Fugitive Licensable Material
Identified by ORISE and Enercon (Red Area Map)



GAMMA SCAN SCALE

Color	Range Beg.	Range End
■	0.00	180000.00
■	180000.00	600000.00

FIGURE 1

NRC LICENSED AREA BOUNDARY WITH BUFFER

HERITAGE MINERALS
LAKEHURST, NEW JERSEY

PREPARED FOR
ENERCON SERVICES, INC.
MURRYSVILLE, PENNSYLVANIA

CUMMINGS RITER CONSULTANTS, INC.

DRAWING NUMBER
99281A13

			DRAWN BY: *T.E. McKee*	DATE: *6-8-04*	
			CHECKED BY:	DATE:	
REVISION	DATE	DESCRIPTION	APPROVED BY:	DATE:	

Removal of Fugitive Licensable Soil Report
June 12, 2003

Removal of Fugitive Licensable Soil
Heritage Minerals, Inc.

ENERCON Services, Inc. (ENERCON) is please to provide this report on field activities conducted at the Heritage Mineral Inc. (HMI) facility located in Lakehurst, NJ. ENERCON was retained to manage and oversee final decommissioning and decontamination (D&D) activities at the HMI facility in accordance with the March 10, 2003 plan and schedule for final D&D activities and modifications resulting from follow-up phone conversation with NRC on April 9, 2003. The D&D plan of March 10, 2003 details two specific items: removal of fugitive licensable soils in and around the footprint of the former monazite pile and final D&D of the wet and dry process mill buildings. This report details activities concerning the first stage of D&D activities, removal of fugitive licensable material inside and around the footprint of the former monazite pile.

The former monazite pile refers to an area southeast of the dry mill where HMI initially placed 1,400 tons of monazite rich minerals, the tailings of the dry mill. This tailing product was licensed by the NRC for its high Uranium and Thorium content and removed during site activities conducted by Radiation Science Inc. (RSI) in 2001. To ensure that all source material had been removed, NRC contracted ORISE to perform confirmatory surveys of the former monazite pile, which concluded that residual pockets of fugitive licensable material, or hotspots, remained in the footprint of the pile. Additionally, ORISE determined that small pockets of licensable material were present in locations west of the former monazite pile footprint. Following this survey, RSI performed a gamma walkover survey of the former monazite pile and areas west and adjacent the pile. The RSI survey also showed areas of residual activity in the same locations identified by ORISE.

An investigation into the history of the plant determined the source of these fugitive licensable materials in areas west of the former monazite pile was the resultant of plant operations dating back to the year ASARCO operated the plant. It was determined that during interruptions of the dry mill process when the plant malfunctioned, material was diverted out the south and southeast side of the dry mill. These materials were then spread over the area between the dry mill and the pump house located approximately 200 feet south of the dry mill. Following identification of these soils, NRC required HMI to remove and dispose these soils in and around the monazite pile which are still above licensable limits as a requirement for license termination.

Objective

Following review of the D&D plan and discussions with both HMI representatives and NRC Region 1 personnel, ENERCON organized and performed field activities at the HMI site to remove the licensable soils identified by ORISE and RSI. The agreed upon definition of licensable material between HMI and NRC is any location where soil concentration exceeds 116 pCi/g total Thorium, the primary element of concern. As shown in the sample results from RSI and ORISE, there were 17 locations in and around the monazite pile that exceeded 116 pCi/g total Thorium. Figures 25 and 26 in the ORISE report dated April 10, 2002, and Figure 1 in the RSI report dated November 2002 show these locations. The elevated areas were located in a 200x200 foot square area stretching from the pump house to the dry mill and eastward to include the former monazite pile. ENERCON's objective was to delineate and remove previously identified licensable soils in this area. Each excavation was to be continued until soil sampling at the bottom of the specific area excavated resulted in total Uranium and Thorium levels each under 10 pCi/g.

Summary of Activities

ENERCON personnel, Mr. Gerry Williams and Mr. Corey DeWitt, performed sitework at the HMI site from Monday, April 14, through Friday April 18, 2003. The first activity conducted onsite was the location of the previously identified areas that exceeded the threshold for licensable classification. This was done using a Ludlum Model 44-10 sodium iodide instrument with lead columnator. Using the area maps produced by RSI and ORISE, each of the locations were located and scanned. Some locations were previously marked with blue pin flags and stakes while others were unmarked due to erosion. Following location of the hotspots, each area was delineated with stakes and/or marker tape. In some cases, a number of previously identified locations represented a small contiguous area and were delineated accordingly. The delineation was completed applying a surface cutoff level of 300,000 counts beta from the 44-10 scan as a value to ensure that fugitive licensable source materials were removed.

After each elevated area was found and marked, an excavator and dump truck were brought onsite to excavate the soils and transport them to a polypropylene lined area south and adjacent the dry mill. The soils were temporarily stored onsite until sampling confirmed all material had been removed to NRC specifications. The effectiveness of each soil excavation was monitored by scanning the excavated areas laterally at the surface outward to ensure that only material above 300,000 counts beta was removed. Additionally, the bottom of each excavation was scanned to determine when the excavation was complete. For this purpose, a count of 40,000 counts beta was established as an effective threshold to meet the 10 pCi/g total Uranium and Thorium concentration requirement. When a scan of the bottom of the excavation was below 40,000 counts, the excavation was halted and a sample taken from the bottom of the hole. Confirmatory surface samples were also taken at locations exhibiting the highest surface count 1 meter away from each excavation to ensure that no licensable material remained around the excavation. After all confirmatory sampling was completed each excavation was back filled with clean sand due to safely concerns associated with open excavations. Figures 1 through 17 show photographs of the various work areas and the typical excavation and backfill operations completed during the removal of licensable source materials.

The final activity conducted onsite was a GPS survey of the excavations. The four points of the 200-foot square coordinate system were measured in addition to the center point of each excavated area. A map of the work area is provided as an attachment to this report. By surveying the coordinates of each excavated area and overlapping these data with the hotspots found by ORISE and RSI, it can be shown that excavations were completed in the appropriate locations.

After all site work was completed, all soil samples were sent to American Radiation Services for Thorium and Uranium analysis. All preliminary sample data from the excavation process meets the required criteria in the Final Status Survey Plan for License Termination. All samples taken from the bottoms of the excavations are under the BTP-81 limits of 10 pCi/g Uranium and 10 pCi/g Thorium. Table 1 presents these data. All samples taken from surface areas around each excavation had analytical results under 116 pCi/g total Thorium, or under source material levels. Table 2 presents these data.

After the sample results confirmed the appropriate soils were removed, the soils were trucked offsite to International Uranium Corporation located in White Mesa, Utah. These soils were accepted for processing to remove licensable material under an NRC approved license amendment for the IUC facility. The quantity removed from the site and shipped to the facility totaled 313.35 tons.

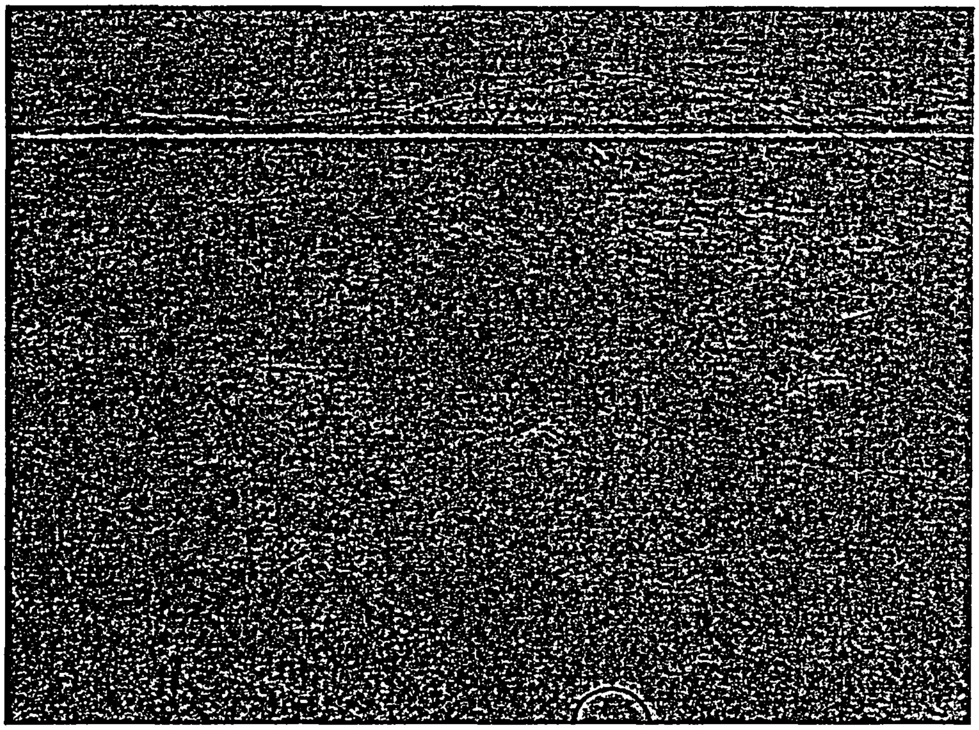


Figure 1
Location of Samples 16-01, 16-02, and 17-02 to 17-04 (North Excavation Area)
At the Excavation to Remove Fugitive Source Materials Outside the Monazite Pile Footprint

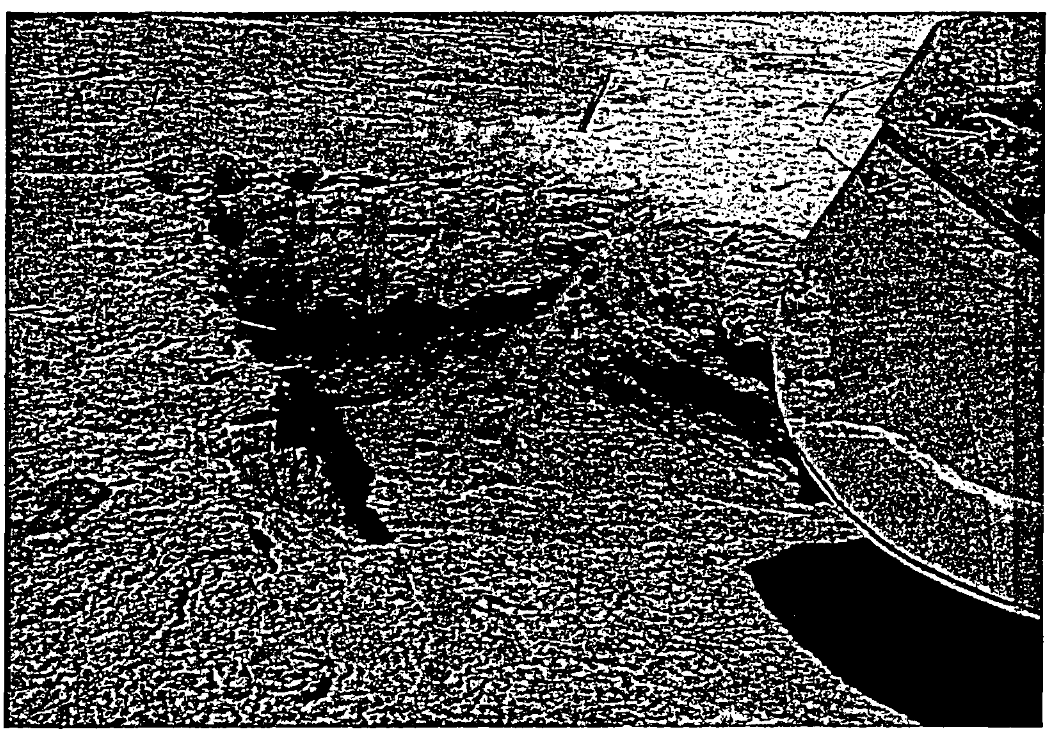


Figure 2
Location of Samples 16-01, 16-02, and 17-02 to 17-04 (North Excavation Area) at the Start of Excavation to Remove Fugitive Source Materials Outside the Monazite Pile Footprint

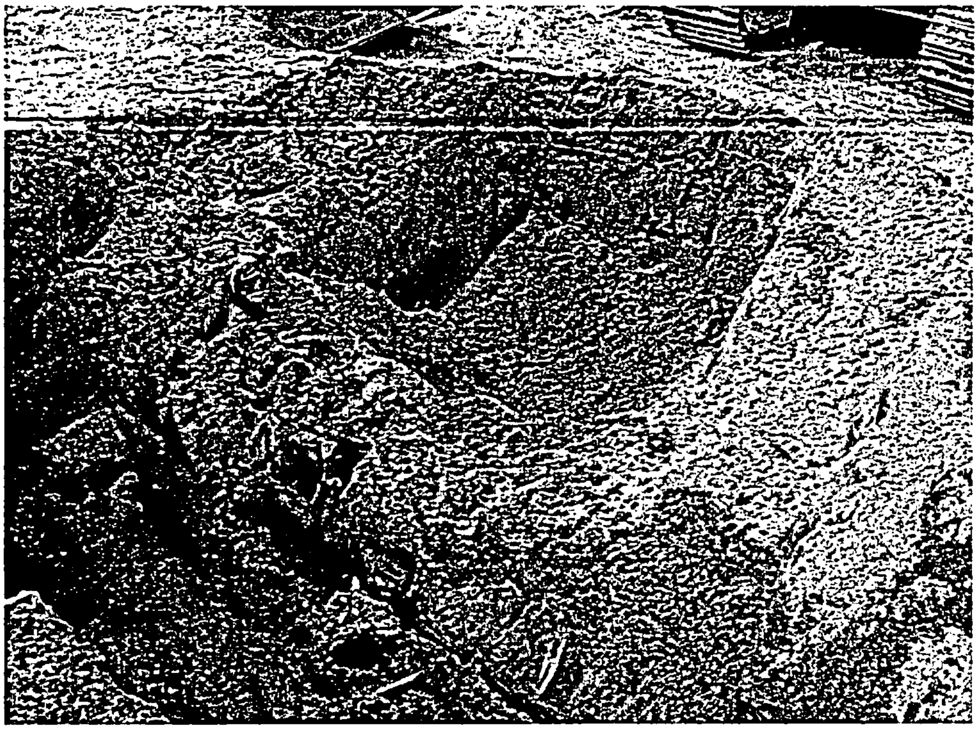


Figure 3
Location of Samples 16-01, 16-02, and 17-02 to 17-04 (North Excavation Area)
at the Excavation to Remove Fugitive Source Materials Outside the Monazite Pile Footprint
(Note: Abandoned PVC Drainline Encountered and Removed)

Figure 4
View of North Excavation Area and Trench After Excavation, Sampling and Backfilling
(View from North)

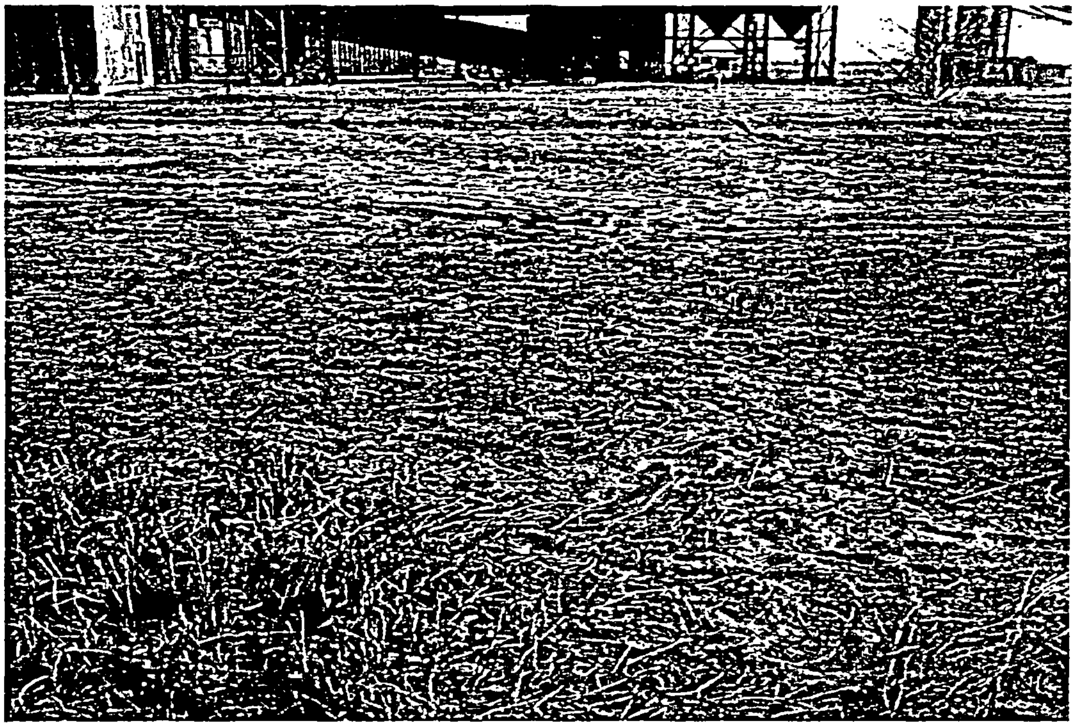


Figure 5
Location of Sample 17-01 – Approximately 30 feet North Of Pumphouse Concrete Pad Prior to Removal of Fugitive Source Material Outside The Monazite Pile Footprint

Figure 6
Location of Samples 17-05 to 17-08 Prior to Excavation of the Trench Outside of the Monazite Pile Footprint (View from South)

Figure 7
View of the Trench and North Excavation Area During Work

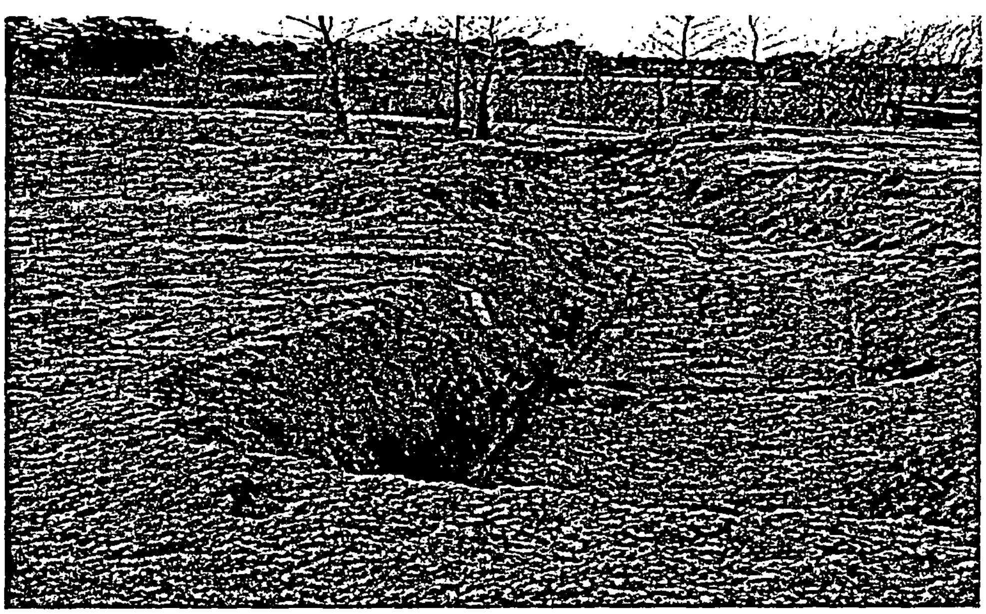


Figure 8
Location of Samples 17-05 to 17-08 After Complete Excavation of the Trench East of The Monazite Pile Footprint (View from North End of Trench)

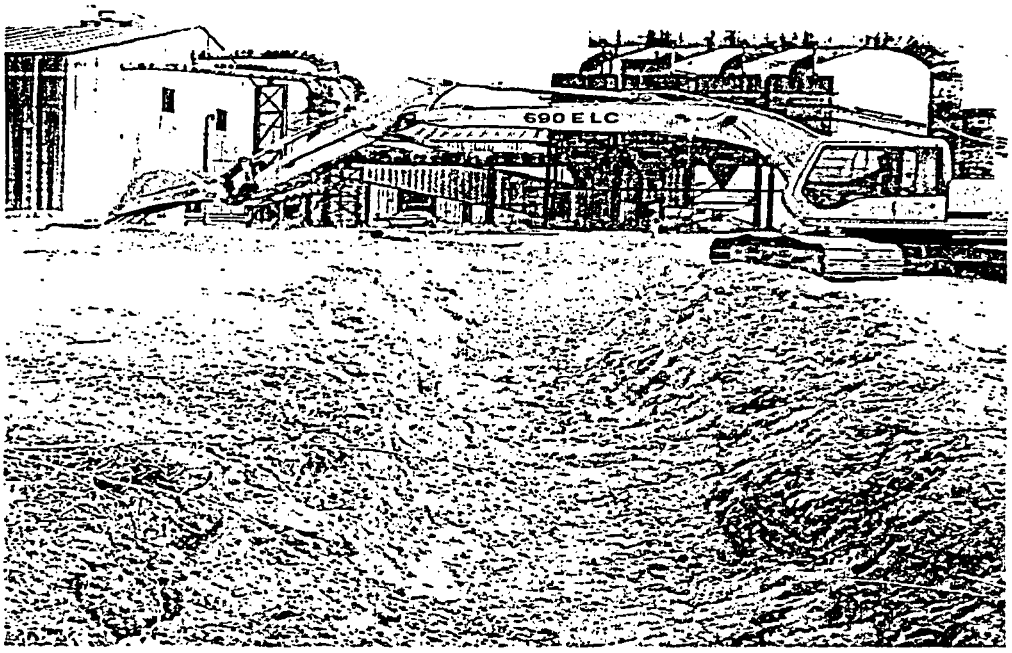


Figure 9
Location of Samples 17-05 to 17-08 During Backfilling of Trench After Collection of Samples 17-05 to 17-08 (View From South)

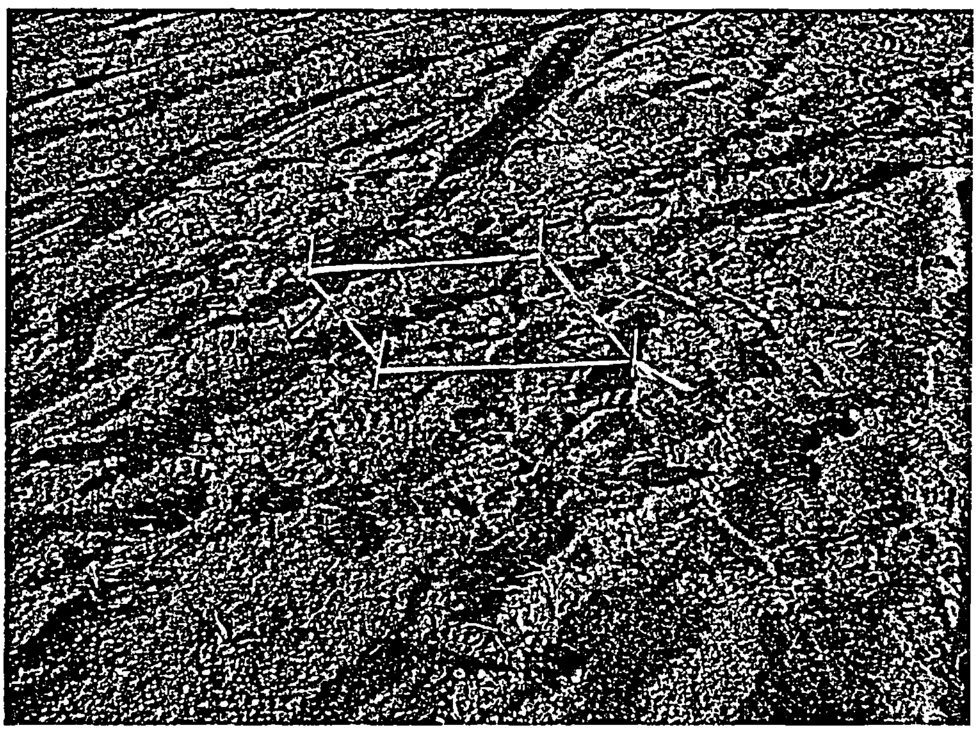


Figure 10
Location of Sample 17-09 Prior to Excavation of Fugitive Source Material Outside of the Monazite Pile Footprint

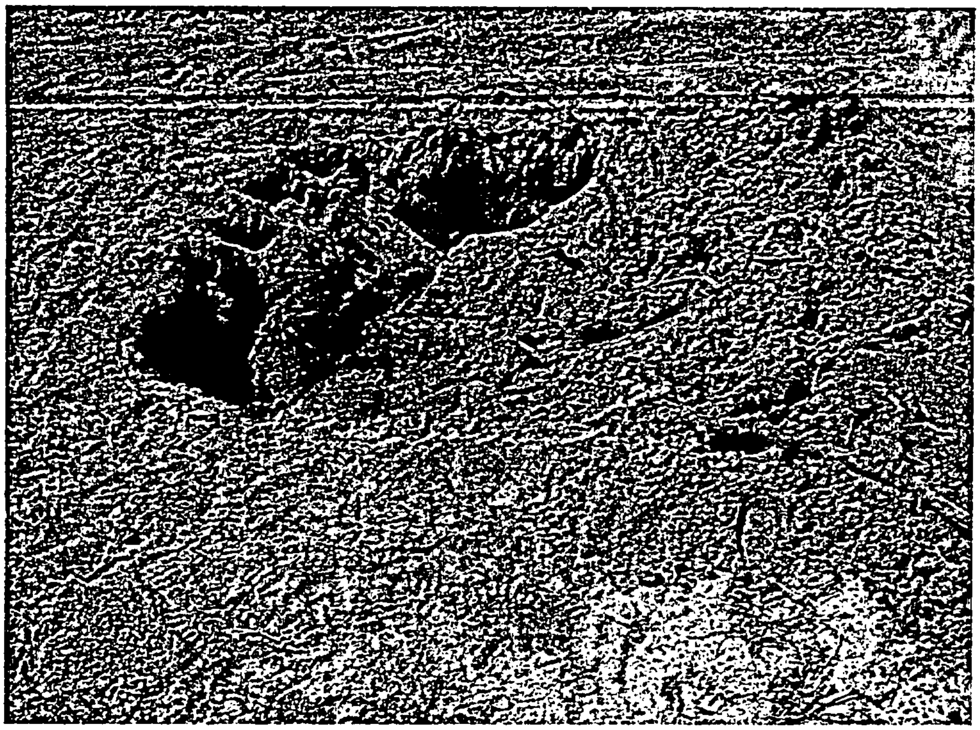


Figure 11
Location of Sample 17-09 After Excavation of Fugitive Source Material Outside of the Monazite Pile Footprint

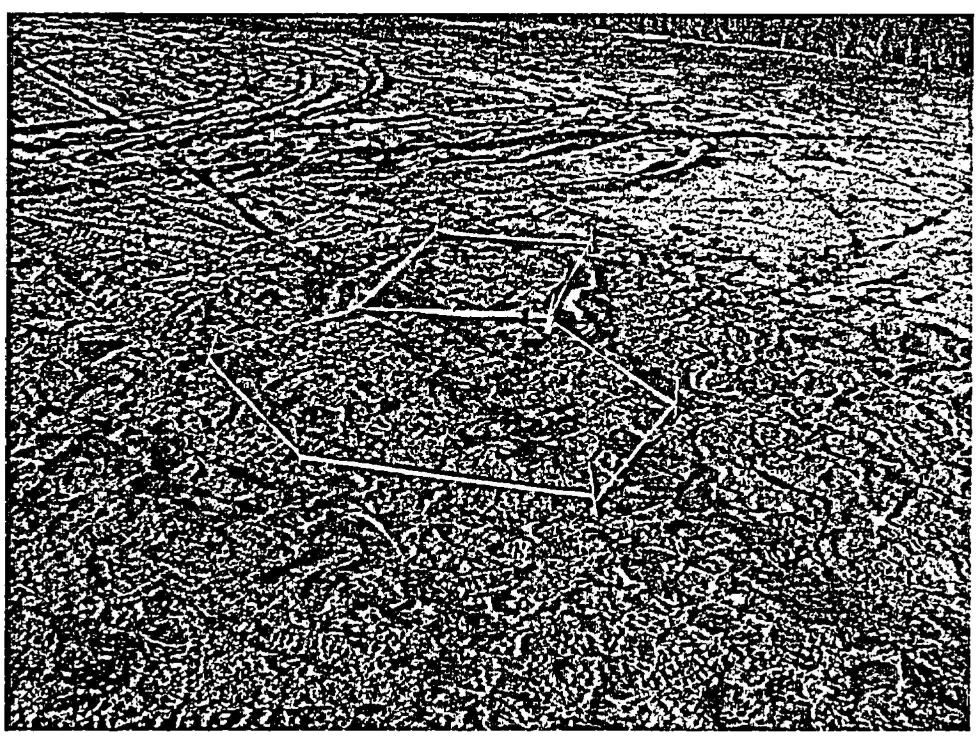


Figure 12
Location of Sample 17-10 Prior to Excavation Area Inside of the Monazite Pile Footprint

Figure 13
Location of Sample 17-10 After Excavation of Fugitive Source Material Inside of the Monazite Pile Footprint

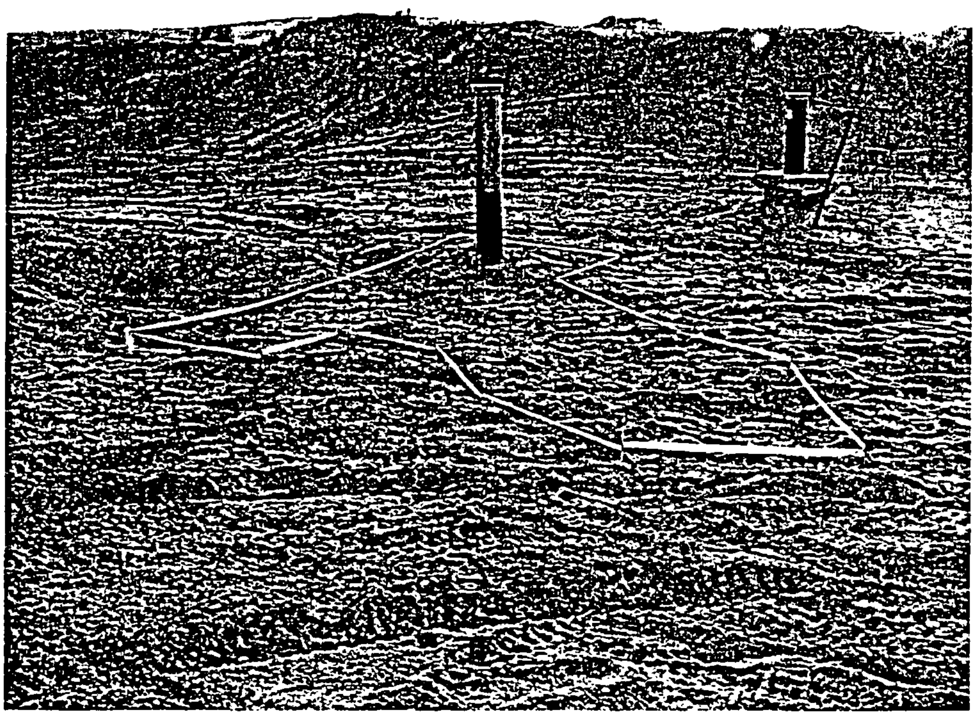


Figure 14
Location of Sample 17-11 Prior to Excavation

Figure 15
Location of Sample 17-11 After Excavation of Fugitive Source Material
Inside Monazite Pile Footprint

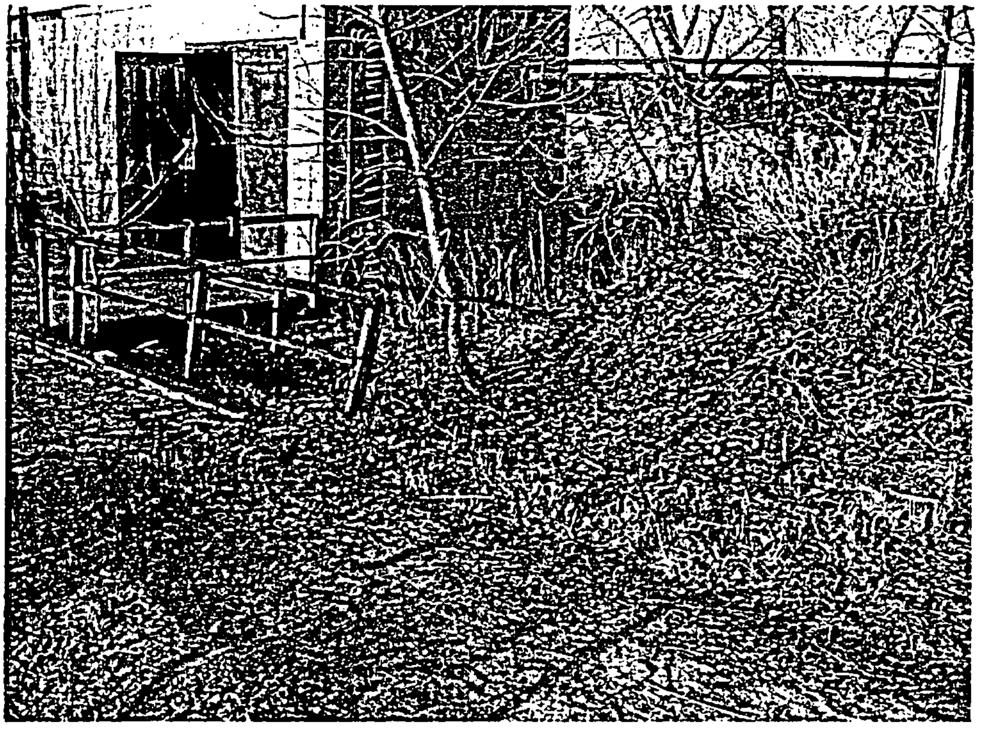


Figure 16
Location of Sample 17-12 At Pumphouse Prior to Excavation

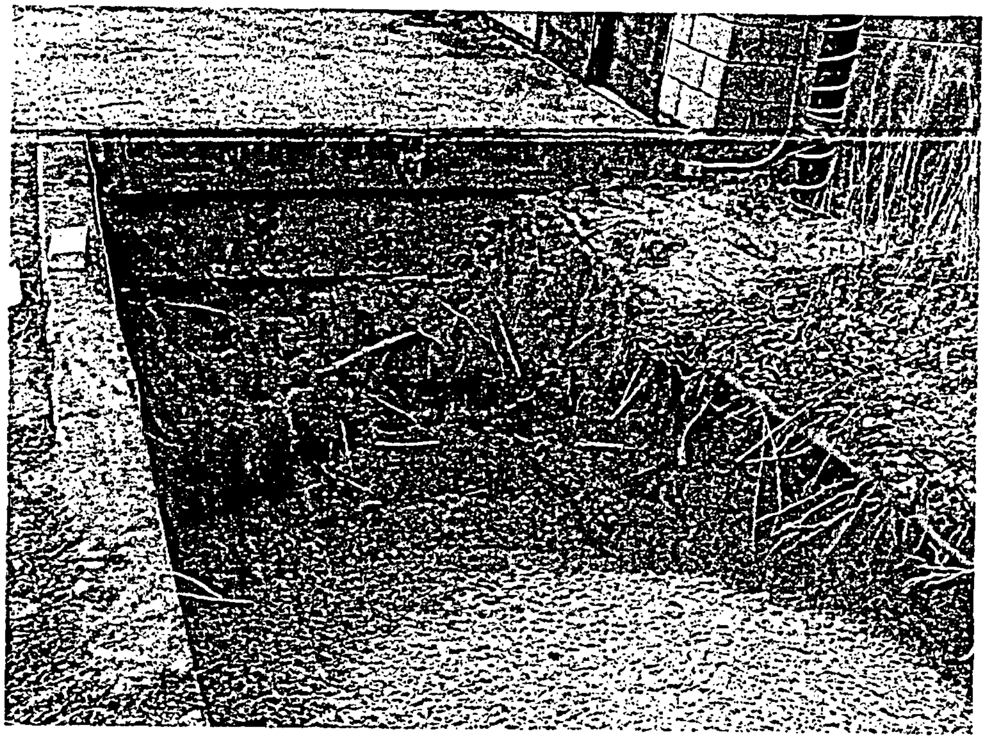


Figure 17
Backfilling of Excavation After Collection of Sample 17-12

Table 1
Total Thorium and Total Uranium Analysis to Confirm Removal of Fugitive Licensable Source Materials

Sample Number	Total thorium (1)(2)	Total uranium (2)(3)	Bottom of Excavation Sampling to Verify Removal of Fugitive Source Material within 200 foot Grid Area South/Southeast of Dry Mill	NRC Approved release criteria (4)
16-01	9.49	8.30	Bottom of excavation, northwest of monazite pile at RSI samples 1, 2, & 4	10 pCi/g thorium, 10 pCi/g uranium
16-02	2.66	7.10	Bottom of excavation, northwest of monazite pile at RSA samples 1,2,&4	10 pCi/g thorium, 10 pCi/g uranium
17-01	1.05	3.95	Bottom of excavation, ~30 feet north of pump house near ORISE sample 39	10 pCi/g thorium, 10 pCi/g uranium
17-02	ND (5)	2.69	Bottom of excavation, northwest of monazite pile at RSI samples 1, 2, & 4	10 pCi/g thorium, 10 pCi/g uranium
17-03	0.19	1.78	Bottom of excavation, northwest of monazite pile at RSI samples 1, 2, & 4	10 pCi/g thorium, 10 pCi/g uranium
17-04	ND (5)	4.55	Bottom of excavation, northwest of monazite pile at RSI samples 1, 2, & 4	10 pCi/g thorium, 10 pCi/g uranium
17-05	0.26	3.11	Bottom of trench excavation, approximately 5 feet from south end	10 pCi/g thorium, 10 pCi/g uranium
17-06	ND (5)	2.41	Bottom of trench excavation, approximately 19.5 feet from south end	10 pCi/g thorium, 10 pCi/g uranium
17-07	0.12	3.67	Bottom of trench excavation, approximately 33.5 feet from south end	10 pCi/g thorium, 10 pCi/g uranium
17-08	0.27	1.78	Bottom of trench excavation, approximately 42 feet from south end	10 pCi/g thorium, 10 pCi/g uranium
17-09	0.27	2.69	Bottom of excavation, center/southwest monazite pile boundary near ORISE samples 11, 12 & 13	10 pCi/g thorium, 10 pCi/g uranium
17-10	5.57	7.50	Bottom of excavation, center/southwest monazite pile boundary at ORISE samples 9,14,16	10 pCi/g thorium, 10 pCi/g uranium
17-11	1.73	3.25	Bottom of excavation, northwest corner of monazite pile footprint near monitoring well 22-D	10 pCi/g thorium, 10 pCi/g uranium
17-12	0.21	4.56	Bottom of excavation, adjacent to pump house pad at RSI sample 11, ORISE sample 40	10 pCi/g thorium, 10 pCi/g uranium

Notes
1. Total thorium quantified by assuming secular equilibrium of Thorium-228 with Ra-228 daughter, Thorium-232 with Pb-212 daughter then calculating total thorium.
2. Reported values above the established site background of 0.48 pCi/g total thorium and 0.62 pCi/g total uranium.
3. Total uranium quantified by assuming secular equilibrium of Uranium-238 with U-238 daughter then calculating total uranium.
4. NRC approved release criteria as stated in Final Status Survey Plan for License Termination
5. ND values represent no detected radionuclides above the established site background values listed in Note 2.

ARS
AMERICAN RADIATION SERVICES, INC.
1726 Wooddale Court • Baton Rouge, Louisiana 70806
1 (800) 401-4277 • Fax (225) 927-6822

ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 16-1	**ARS Sample I.D.:**	ARS030728-2951
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	4.462	1.796	0.779	pCi/gm	EPA 901.1M	4/30/03 1852	DR
Total Uranium	8.924	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1852	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

Notes: American Radiation Services, Inc assumes no liability for the use or interpretation of any analytical results provided other than the cost of the performed analysis itself. Reproduction of this report in less than full requires the written consent of the client.

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Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	4.535	0.500	0.184	pCi/gm	EPA 901.1M	4/30/03 1852	DR
Th-228	5.439	0.337	0.090	pCi/gm	EPA 901.1M	4/30/03 1852	DR
Total Thorium	9.974	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1852	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 16-2	**ARS Sample I.D.:**	ARS030728-2944
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	3.862	1.304	0.514	pCi/gm	EPA 901.1M	5/1/03 0827	DR
Total Uranium	7.724	NA	NA	pCi/gm	EPA 901.1M	5/1/03 0827	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 16-2	**ARS Sample I.D.:**	ARS030728-2944
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.495	0.343	0.158	pCi/gm	EPA 901.1M	5/1/03 0827	DR
Th-228	1.645	0.210	0.057	pCi/gm	EPA 901.1M	5/1/03 0827	DR
Total Thorium	3.140	NA	NA	pCi/gm	EPA 901.1M	5/1/03 0827	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-1	**ARS Sample I.D.:**	ARS030728-2964
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.285	1.247	0.487	pCi/gm	EPA 901.1M	4/30/03 1639	KP
Total Uranium	4.570	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1639	KP

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-1	**ARS Sample I.D.:**	ARS030728-2964
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.721	0.267	0.137	pCi/gm	EPA 901.1M	4/30/03 1639	KP
Th-228	0.806	0.167	0.075	pCi/gm	EPA 901.1M	4/30/03 1639	KP
Total Thorium	1.527	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1639	KP

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-2	**ARS Sample I.D.:**	ARS030728-2939
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.656	0.473	0.340	pCi/gm	EPA 901.1M	4/30/03 1526	DR
Total Uranium	3.312	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1526	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

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Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.216	0.221	0.118	pCi/gm	EPA 901.1M	4/30/03 1526	DR
Th-228	0.235	0.100	0.052	pCi/gm	EPA 901.1M	4/30/03 1526	DR
Total Thorium	0.451	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1526	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-3	**ARS Sample I.D.:**	ARS030728-2950
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.201	0.792	0.409	pCi/gm	EPA 901.1M	5/1/03 1008	DR
Total Uranium	2.402	NA	NA	pCi/gm	EPA 901.1M	5/1/03 1008	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-3	**ARS Sample I.D.:**	ARS030728-2950
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.314	0.256	0.132	pCi/gm	EPA 901.1M	5/1/03 1008	DR
Th-228	0.358	0.121	0.050	pCi/gm	EPA 901.1M	5/1/03 1008	DR
Total Thorium	0.672	NA	NA	pCi/gm	EPA 901.1M	5/1/03 1008	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-4	**ARS Sample I.D.:**	ARS030728-2955
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.583	0.789	0.270	pCi/gm	EPA 901.1M	4/30/03 1703	KP
Total Uranium	5.166	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1703	KP

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-4	**ARS Sample I.D.:**	ARS030728-2955
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.122	0.119	0.143	pCi/gm	EPA 901.1M	4/30/03 1703	KP
Th-228	0.229	0.105	0.040	pCi/gm	EPA 901.1M	4/30/03 1703	KP
Total Thorium	0.351	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1703	KP

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-5	**ARS Sample I.D.:**	ARS030728-2956
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.865	0.799	0.294	pCi/gm	EPA 901.1M	5/1/03 0819	DR
Total Uranium	3.730	NA	NA	pCi/gm	EPA 901.1M	5/1/03 0819	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-5	**ARS Sample I.D.:**	ARS030728-2956
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.347	0.226	0.150	pCi/gm	EPA 901.1M	5/1/03 0819	DR
Th-228	0.389	0.130	0.050	pCi/gm	EPA 901.1M	5/1/03 0819	DR
Total Thorium	0.736	NA	NA	pCi/gm	EPA 901.1M	5/1/03 0819	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-6	**ARS Sample I.D.:**	ARS030728-2953
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.514	0.548	0.351	pCi/gm	EPA 901.1M	4/29/03 0958	DR
Total Uranium	3.028	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0958	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-6	**ARS Sample I.D.:**	ARS030728-2953
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.163	0.218	0.120	pCi/gm	EPA 901.1M	4/29/03 0958	DR
Th-228	0.036	0.100	0.062	pCi/gm	EPA 901.1M	4/29/03 0958	DR
Total Thorium	0.199	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0958	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-7	**ARS Sample I.D.:**	ARS030728-2936
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.145	0.986	0.355	pCi/gm	EPA 901.1M	4/30/03 2026	DR
Total Uranium	4.290	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2026	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-7	**ARS Sample I.D.:**	ARS030728-2936
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.198	0.246	0.134	pCi/gm	EPA 901.1M	4/30/03 2026	DR
Th-228	0.399	0.167	0.069	pCi/gm	EPA 901.1M	4/30/03 2026	DR
Total Thorium	0.597	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2026	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-8	**ARS Sample I.D.:**	ARS030728-2946
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.198	0.676	0.295	pCi/gm	EPA 901.1M	4/29/03 0927	DR
Total Uranium	2.396	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0927	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-8	**ARS Sample I.D.:**	ARS030728-2946
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.355	0.210	0.134	pCi/gm	EPA 901.1M	4/29/03 0927	DR
Th-228	0.390	0.131	0.066	pCi/gm	EPA 901.1M	4/29/03 0927	DR
Total Thorium	0.745	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0927	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9	**ARS Sample I.D.:**	ARS030728-2949
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.657	0.729	0.503	pCi/gm	EPA 901.1M	4/30/03 1922	DR
Total Uranium	3.314	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1922	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9	**ARS Sample I.D.:**	ARS030728-2949
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.345	0.240	0.122	pCi/gm	EPA 901.1M	4/30/03 1922	DR
Th-228	0.400	0.146	0.059	pCi/gm	EPA 901.1M	4/30/03 1922	DR
Total Thorium	0.745	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1922	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10	**ARS Sample I.D.:**	ARS030728-2933
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	4.059	1.485	0.634	pCi/gm	EPA 901.1M	4/29/03 0923	DR
Total Uranium	8.118	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0923	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10	**ARS Sample I.D.:**	ARS030728-2933
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	2.546	0.450	0.189	pCi/gm	EPA 901.1M	4/29/03 0923	SM
Th-228	3.500	0.269	0.059	pCi/gm	EPA 901.1M	4/29/03 0923	SM
Total Thorium	6.046	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0923	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11	**ARS Sample I.D.:**	ARS030728-2942
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error $\pm 2\sigma$	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.935	1.212	0.502	pCi/gm	EPA 901.1M	4/29/03 1423	SM
Total Uranium	3.870	NA	NA	pCi/gm	EPA 901.1M	4/29/03 1423	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11	**ARS Sample I.D.:**	ARS030728-2942
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.059	0.279	0.133	pCi/gm	EPA 901.1M	4/29/03 1423	SM
Th-228	1.155	0.186	0.063	pCi/gm	EPA 901.1M	4/29/03 1423	SM
Total Thorium	2.214	NA	NA	pCi/gm	EPA 901.1M	4/29/03 1423	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-12	**ARS Sample I.D.:**	ARS030728-2937
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.591	1.069	0.416	pCi/gm	EPA 901.1M	4/28/03 1736	SM
Total Uranium	5.182	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1736	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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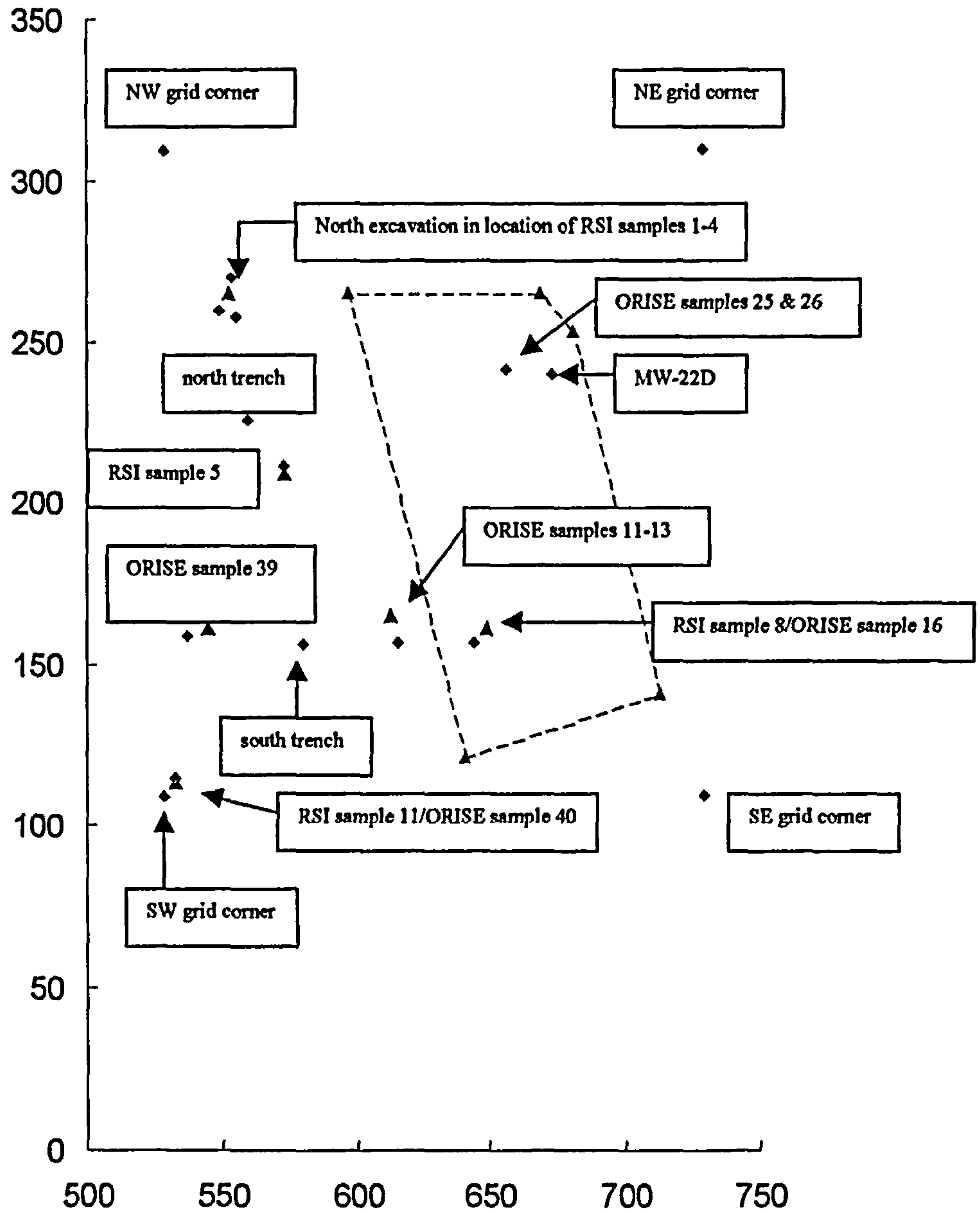
ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-12	**ARS Sample I.D.:**	ARS030728-2937
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.180	0.163	0.163	pCi/gm	EPA 901.1M	4/28/03 1736	SM
Th-228	0.508	0.128	0.042	pCi/gm	EPA 901.1M	4/28/03 1736	SM
Total Thorium	0.688	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1736	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review



Data from ORISE and RSI sample collection and testing activities that identified the approximate location of fugitive source materials are shown with green triangles. ENERCON GPS data shown in blue diamond markers document the locations of soil excavation, sampling, and backfillling to address these areas. The approximate footprint of the original monazite pile is shown in red.

GPS data collected by Enercon is in New Jersey State plane coordinate system northing and easting. X-Y values are coordinate northing and easting All points were verified by referencing the data to monitoring well 22D. This well has known coordinates that are referenced to the site benchmark.

Table 2
Total Thorium and Total Uranium Analysis to Confirm Removal of Fugitive Licensable Source Materials

Sample Number	Total thorium (1)(2)	Total uranium (2)(3)	Sampling adjacent to Excavations to Verify Removal of Fugitive Source Material within 200 foot Grid Area South/Southeast of Dry Mill	Source Material Level
North excavation northeast side	6.10	11.42	Surface sample northeast of the monazite pile footprint northeast of excavations located at RSI samples 1,2, & 4	Below source material levels of 116 pCi/g total thorium
North excavation east side	12.36	17.90	Surface sample northeast of the monazite pile footprint east of excavations located at RSI samples 1,2, & 4	Below source material levels of 116 pCi/g total thorium
North excavation south side	19.65	21.04	Surface sample northeast of the monazite pile footprint south of excavations located at RSI samples 1,2, & 4	Below source material levels of 116 pCi/g total thorium
North excavation southwest side	5.32	10.62	Surface sample northeast of the monazite pile footprint southwest of excavations located at RSI samples 1,2, & 4	Below source material levels of 116 pCi/g total thorium
North excavation northwest side	6.77	9.96	Surface sample northeast of the monazite pile footprint northwest of excavations located at RSI samples 1,2, & 4	Below source material levels of 116 pCi/g total thorium
Trench north	2.87	8.13	Surface sample north of the northern end of the trench	Below source material levels of 116 pCi/g total thorium
Trench south	21.41	15.35	Surface sample south of the southern end of the trench	Below source material levels of 116 pCi/g total thorium
Trench east	3.86	9.14	Surface sample east of trench approximately 2 feet from south end of trench	Below source material levels of 116 pCi/g total thorium
Trench east	5.09	4.63	Surface sample east of trench approximately 25 feet from south end of trench	Below source material levels of 116 pCi/g total thorium
17-09N	0.47	3.05	Surface samples around excavation at center/southwest monazite pile boundary near ORISE samples 11, 12 & 13	Below source material levels of 116 pCi/g total thorium
17-09E	3.81	9.65	Surface samples around excavation at center/southwest monazite pile boundary near ORISE samples 11, 12 & 13	Below source material levels of 116 pCi/g total thorium

17-09S	6.78	6.99	Surface samples around excavation at center/southwest monazite pile boundary near ORISE samples 11, 12 & 13	Below source material levels of 116 pCi/g total thorium
17-09W	9.60	10.03	Surface samples around excavation at center/southwest monazite pile boundary near ORISE samples 11, 12 & 13	Below source material levels of 116 pCi/g total thorium
17-10N	1.64	4.38	Surface samples around excavation at center/south monazite pile footprint near ORISE samples 9, 14 & 16	Below source material levels of 116 pCi/g total thorium
17-10E	10.55	5.36	Surface samples around excavation at center/south monazite pile footprint near ORISE samples 9, 14 & 16	Below source material levels of 116 pCi/g total thorium
17-10S	0.39	3.10	Surface samples around excavation at center/south monazite pile footprint near ORISE samples 9, 14 & 16	Below source material levels of 116 pCi/g total thorium
17-10W	3.24	9.54	Surface samples around excavation at center/south monazite pile footprint at ORISE samples 9,14,16	Below source material levels of 116 pCi/g total thorium
17-11N	4.09	7.28	Surface samples around excavation at northwest corner of monazite pile footprint near monitoring well 22-D	Below source material levels of 116 pCi/g total thorium
17-11E	3.60	5.57	Surface samples around excavation at northwest corner of monazite pile footprint near monitoring well 22-D	Below source material levels of 116 pCi/g total thorium
17-11S	5.37	9.61	Surface samples around excavation at northwest corner of monazite pile footprint near monitoring well 22-D	Below source material levels of 116 pCi/g total thorium
17-11W	4.07	6.76	Surface samples around excavation at northwest corner of monazite pile footprint near monitoring well 22-D	Below source material levels of 116 pCi/g total thorium
17-13N	2.020	4.98	Surface sample~34 feet north of pump house near ORISE sample 39	Below source material levels of 116 pCi/g total thorium

Notes

1. Total thorium quantified by assuming secular equilibrium of Thorium-228 with Ra-228 daughter, Thorium-232 with Pb-212 daughter then calculating total thorium.
2. Reported values above the established site background of 0.48 pCi/g total thorium and 0.62 pCi/g total uranium.
3. Total uranium quantified by assuming secular equilibrium of Uranium-238 with U-238 daughter then calculating total uranium.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI North Excavation	**ARS Sample I.D.:**	ARS030728-2943
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	6.018	1.797	0.690	pCi/gm	EPA 901.1M	4/29/03 0955	DR
Total Uranium	12.036	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0955	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI North Excavation	**ARS Sample I.D.:**	ARS030728-2943
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	3.041	0.441	0.204	pCi/gm	EPA 901.1M	4/29/03 0955	DR
Th-228	3.534	0.293	0.073	pCi/gm	EPA 901.1M	4/29/03 0955	DR
Total Thorium	6.575	NA	NA	pCi/gm	EPA 901.1M	4/29/03 0955	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI North Excavation	**ARS Sample I.D.:**	ARS030728-2967
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	9.258	2.452	0.976	pCi/gm	EPA 901.1M	4/28/03 1922	SM
Total Uranium	18.516	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1922	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI North Excavation	**ARS Sample I.D.:**	ARS030728-2967
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	5.520	0.626	0.229	pCi/gm	EPA 901.1M	4/28/03 1922	SM
Th-228	7.316	0.452	0.097	pCi/gm	EPA 901.1M	4/28/03 1922	SM
Total Thorium	12.836	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1922	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample North Excavation	**ARS Sample I.D.:**	ARS030728-2941
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	10.830	3.026	1.228	pCi/gm	EPA 901.1M	4/28/03 1956	SM
Total Uranium	21.660	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1956	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample North Excavation	**ARS Sample I.D.:**	ARS030728-2941
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	9.421	0.696	0.214	pCi/gm	EPA 901.1M	4/28/03 1956	SM
Th-228	10.704	0.453	0.090	pCi/gm	EPA 901.1M	4/28/03 1956	SM
Total Thorium	20.125	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1956	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample North Excavation	**ARS Sample I.D.:**	ARS030728-2958
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	5.621	1.786	0.699	pCi/gm	EPA 901.1M	4/30/03 1517	DR
Total Uranium	11.242	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1517	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample North Excavation	**ARS Sample I.D.:**	ARS030728-2958
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	2.763	0.365	0.109	pCi/gm	EPA 901.1M	4/30/03 1517	DR
Th-228	3.041	0.270	0.063	pCi/gm	EPA 901.1M	4/30/03 1517	DR
Total Thorium	5.804	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1517	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample North Excavation	**ARS Sample I.D.:**	ARS030728-2965
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	5.291	1.781	0.763	pCi/gm	EPA 901.1M	4/29/03 1419	SM
Total Uranium	10.582	NA	NA	pCi/gm	EPA 901.1M	4/29/03 1419	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample North Excavation	**ARS Sample I.D.:**	ARS030728-2965
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	3.361	0.654	0.199	pCi/gm	EPA 901.1M	4/29/03 1419	SM
Th-228	3.886	0.287	0.056	pCi/gm	EPA 901.1M	4/29/03 1419	SM
Total Thorium	7.247	NA	NA	pCi/gm	EPA 901.1M	4/29/03 1419	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample Trench North	**ARS Sample I.D.:**	ARS030728-2948
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	4.377	1.642	0.663	pCi/gm	EPA 901.1M	5/1/03 1002	DR
Total Uranium	8.754	NA	NA	pCi/gm	EPA 901.1M	5/1/03 1002	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample Trench North	**ARS Sample I.D.:**	ARS030728-2948
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.432	0.356	0.189	pCi/gm	EPA 901.1M	5/1/03 1002	DR
Th-228	1.917	0.239	0.067	pCi/gm	EPA 901.1M	5/1/03 1002	DR
Total Thorium	3.349	NA	NA	pCi/gm	EPA 901.1M	5/1/03 1002	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Trench South	**ARS Sample I.D.:**	ARS030728-2968
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	7.984	2.245	1.005	pCi/gm	EPA 901.1M	4/30/03 1204	DR
Total Uranium	15.968	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1204	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Trench South	**ARS Sample I.D.:**	ARS030728-2968
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	10.588	0.758	0.107	pCi/gm	EPA 901.1M	4/30/03 1204	DR
Th-228	11.306	0.476	0.085	pCi/gm	EPA 901.1M	4/30/03 1204	DR
Total Thorium	21.894	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1204	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample Trench East	**ARS Sample I.D.:**	ARS030728-2963
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	4.881	1.969	0.739	pCi/gm	EPA 901.1M	4/28/03 1735	SM
Total Uranium	9.762	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1735	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample Trench East	**ARS Sample I.D.:**	ARS030728-2963
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.982	0.374	0.153	pCi/gm	EPA 901.1M	4/28/03 1735	SM
Th-228	2.362	0.301	0.094	pCi/gm	EPA 901.1M	4/28/03 1735	SM
Total Thorium	4.344	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1735	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample Trench East	**ARS Sample I.D.:**	ARS030728-2935
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.623	1.529	0.647	pCi/gm	EPA 901.1M	4/30/03 1605	KP
Total Uranium	5.246	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1605	KP

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample Trench East	**ARS Sample I.D.:**	ARS030728-2935
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	2.551	0.346	0.124	pCi/gm	EPA 901.1M	4/30/03 1605	KP
Th-228	3.017	0.256	0.070	pCi/gm	EPA 901.1M	4/30/03 1605	KP
Total Thorium	5.568	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1605	KP

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9N	**ARS Sample I.D.:**	ARS030728-2966
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error $\pm 2\sigma$	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.835	0.944	0.537	pCi/gm	EPA 901.1M	4/30/03 1210	DR
Total Uranium	3.670	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1210	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9N	**ARS Sample I.D.:**	ARS030728-2966
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.429	0.356	0.184	pCi/gm	EPA 901.1M	4/30/03 1210	DR
Th-228	0.516	0.162	0.080	pCi/gm	EPA 901.1M	4/30/03 1210	DR
Total Thorium	0.945	NA	NA	pCi/gm	EPA 901.1M	4/30/03 1210	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9E	**ARS Sample I.D.:**	ARS030728-2959
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	5.135	1.301	0.495	pCi/gm	EPA 901.1M	4/30/03 2150	DR
Total Uranium	10.270	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2150	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9E	**ARS Sample I.D.:**	ARS030728-2959
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.895	0.357	0.151	pCi/gm	EPA 901.1M	4/30/03 2150	DR
Th-228	2.393	0.214	0.049	pCi/gm	EPA 901.1M	4/30/03 2150	DR
Total Thorium	4.288	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2150	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9S	**ARS Sample I.D.:**	ARS030728-2952
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	3.807	1.632	0.707	pCi/gm	EPA 901.1M	4/30/03 2119	DR
Total Uranium	7.614	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2119	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9S	**ARS Sample I.D.:**	ARS030728-2952
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	3.114	0.410	0.185	pCi/gm	EPA 901.1M	4/30/03 2119	DR
Th-228	4.141	0.298	0.071	pCi/gm	EPA 901.1M	4/30/03 2119	DR
Total Thorium	7.255	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2119	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9W	**ARS Sample I.D.:**	ARS030728-2961
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	5.326	1.934	0.776	pCi/gm	EPA 901.1M	4/28/03 1705	SM
Th-228	4.750	0.314	0.067	pCi/gm	EPA 901.1M	4/28/03 1705	SM
Total Thorium	10.076	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1705	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-9W	**ARS Sample I.D.:**	ARS030728-2961
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	5.326	1.934	0.776	pCi/gm	EPA 901.1M	4/28/03 1705	SM
Total Uranium	10.652	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1705	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10N	**ARS Sample I.D.:**	ARS030728-2957
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.499	1.197	0.497	pCi/gm	EPA 901.1M	4/28/03 1807	SM
Total Uranium	4.998	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1807	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10N	**ARS Sample I.D.:**	ARS030728-2957
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.929	0.317	0.192	pCi/gm	EPA 901.1M	4/28/03 1807	SM
Th-228	1.191	0.208	0.064	pCi/gm	EPA 901.1M	4/28/03 1807	SM
Total Thorium	2.120	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1807	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10E	**ARS Sample I.D.:**	ARS030728-2934
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.998	1.887	0.787	pCi/gm	EPA 901.1M	4/28/03 2013	SM
Total Uranium	5.976	NA	NA	pCi/gm	EPA 901.1M	4/28/03 2013	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10E	**ARS Sample I.D.:**	ARS030728-2934
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	5.264	0.523	0.139	pCi/gm	EPA 901.1M	4/28/03 2013	SM
Th-228	5.769	0.334	0.077	pCi/gm	EPA 901.1M	4/28/03 2013	SM
Total Thorium	11.033	NA	NA	pCi/gm	EPA 901.1M	4/28/03 2013	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10S	**ARS Sample I.D.:**	ARS030728-2938
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	1.862	0.915	0.622	pCi/gm	EPA 901.1M	4/28/03 1912	SM
Total Uranium	3.724	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1912	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10S	**ARS Sample I.D.:**	ARS030728-2938
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.403	0.244	0.153	pCi/gm	EPA 901.1M	4/28/03 1912	SM
Th-228	0.463	0.156	0.065	pCi/gm	EPA 901.1M	4/28/03 1912	SM
Total Thorium	0.866	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1912	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10W	**ARS Sample I.D.:**	ARS030728-2954
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	5.081	1.617	0.599	pCi/gm	EPA 901.1M	4/29/03 1029	DR
Total Uranium	10.162	NA	NA	pCi/gm	EPA 901.1M	4/29/03 1029	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-10W	**ARS Sample I.D.:**	ARS030728-2954
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.483	0.388	0.184	pCi/gm	EPA 901.1M	4/29/03 1029	DR
Th-228	2.240	0.256	0.068	pCi/gm	EPA 901.1M	4/29/03 1029	DR
Total Thorium	3.723	NA	NA	pCi/gm	EPA 901.1M	4/29/03 1029	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11N	**ARS Sample I.D.:**	ARS030728-2962
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	3.948	1.671	0.668	pCi/gm	EPA 901.1M	4/28/03 1942	SM
Total Uranium	7.896	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1942	SM

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11N	**ARS Sample I.D.:**	ARS030728-2962
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.905	0.368	0.148	pCi/gm	EPA 901.1M	4/28/03 1942	SM
Th-228	2.660	0.257	0.072	pCi/gm	EPA 901.1M	4/28/03 1942	SM
Total Thorium	4.565	NA	NA	pCi/gm	EPA 901.1M	4/28/03 1942	SM

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11E	**ARS Sample I.D.:**	ARS030728-2945
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	3.094	1.226	0.523	pCi/gm	EPA 901.1M	4/30/03 2120	DR
Total Uranium	6.188	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2120	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11E	**ARS Sample I.D.:**	ARS030728-2945
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.514	0.349	0.150	pCi/gm	EPA 901.1M	4/30/03 2120	DR
Th-228	2.566	0.256	0.074	pCi/gm	EPA 901.1M	4/30/03 2120	DR
Total Thorium	4.080	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2120	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11S	**ARS Sample I.D.:**	ARS030728-2947
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	5.111	1.556	0.617	pCi/gm	EPA 901.1M	4/30/03 2047	DR
Total Uranium	10.222	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2047	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11S	**ARS Sample I.D.:**	ARS030728-2947
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	3.020	0.370	0.076	pCi/gm	EPA 901.1M	4/30/03 2047	DR
Th-228	2.833	0.232	0.045	pCi/gm	EPA 901.1M	4/30/03 2047	DR
Total Thorium	5.853	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2047	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

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ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11W	**ARS Sample I.D.:**	ARS030728-2940
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	3.692	1.520	0.614	pCi/gm	EPA 901.1M	5/1/03 1055	DR
Total Uranium	7.384	NA	NA	pCi/gm	EPA 901.1M	5/1/03 1055	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

AMERICAN RADIATION SERVICES, INC.

1726 Wooddale Court • Baton Rouge, Louisiana 70806
1 (800) 401-4277 • Fax (225) 927-6822

ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-11W	**ARS Sample I.D.:**	ARS030728-2940
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	1.723	0.432	0.176	pCi/gm	EPA 901.1M	5/1/03 1055	DR
Th-228	2.822	0.245	0.068	pCi/gm	EPA 901.1M	5/1/03 1055	DR
Total Thorium	4.545	NA	NA	pCi/gm	EPA 901.1M	5/1/03 1055	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

Quality Assurance Review

ARS AMERICAN RADIATION SERVICES, INC.
1726 Wooddale Court • Baton Rouge, Louisiana 70806
1 (800) 401-4277 • Fax (225) 927-6822

ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-13N	**ARS Sample I.D.:**	ARS030728-2960
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
U-238	2.798	1.016	0.727	pCi/gm	EPA 901.1M	4/30/03 2151	DR
Total Uranium	5.596	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2151	DR

Notes:U-238 quantified assuming secular equilibrium with the Th-234 daughter, and U-238 can be assumed to be the same as U-234.

Quality Assurance Review

ARS
AMERICAN RADIATION SERVICES, INC.

1726 Wooddale Court • Baton Rouge, Louisiana 70806
1 (800) 401-4277 • Fax (225) 927-6822

ARS Tracking Number:	ARS030728	**P.O. Number:**	RL-101 TASK 1
Client I.D.:	HMI Sample 17-13N	**ARS Sample I.D.:**	ARS030728-2960
Date Sampled:	4/17/03	**Date Received:**	4/22/03
Time Sample:	NA	**Time Received:**	1141
Type of Sample:	Solid	**Date of Report:**	5/12/03
NELAP Certification #:	E87558	**L. A. Agency Interest #:**	30658

Analysis Description	Analysis Result	Analysis Error ±2 σ	Detection Limit	Analysis Unit	Analysis Test Method	Analysis Date & Time	Analysis Technician
Th-232	0.990	0.219	0.115	pCi/gm	EPA 901.1M	4/30/03 2151	DR
Th-228	1.506	0.203	0.062	pCi/gm	EPA 901.1M	4/30/03 2151	DR
Total Thorium	2.496	NA	NA	pCi/gm	EPA 901.1M	4/30/03 2151	DR

Notes:Th-232 quantified assuming secular equilibrium with the Ra-228 daughter, and Th-228 quantified assuming secular equilibrium with the Pb-212 or Bi-212 daughter.

David D[illegible]

Quality Assurance Review