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

October 19, 1999

Docket No. 040-08980 License No. SMB-1541

Anthony J. Thompson, Esquire
ShawPittman
2300 N Street, NW
Washington, DC 20037-1128

SUBJECT: ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT - HERITAGE MINERALS, INC. (HMI)

Dear Mr. Thompson:

Enclosed are copies of the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) prepared to support renewal and amendment of License No. SMB-1541, issued for HMI's Lakehurst, New Jersey site. The EA and FONSI were publicly noticed in the September 1, 1999 Federal Register Notice (64 Federal Register 47872-47877), and contained a Notice of Opportunity for Hearing in accordance with Subpart L of 10 CFR Part 2.

We have not received a request for hearing within 30 days of publication in the Federal Register as prescribed by 10 CFR 2.1205(d)(1). Accordingly, remediation activities described in the Final Status Survey Plan should be implemented so that decommissioning of the site will be completed within the 24 month period allotted by 10 CFR 40.42(h)(1).

If you have any questions regarding this action, please contact me at (610) 337-5216. Thank you for your cooperation.

Sincerely,

[redacted], Senior Health Physicist
Decommissioning and Laboratory Branch
Division of Nuclear Materials Safety

Enclosures: As stated

cc:
John F. Lord, P.E.
Pat Gardner, NJDEP

Distribution:
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NUCLEAR REGULATORY COMMISSION

Docket No. 40-08980

ENVIRONMENTAL ASSESSMENT, FINDING OF NO SIGNIFICANT IMPACT, AND NOTICE OF OPPORTUNITY FOR A HEARING

AGENCY: NUCLEAR REGULATORY COMMISSION

ACTION: Environmental Assessment, Finding of No Significant Impact, and Notice of Opportunity for a Hearing for Remediation of the Lakehurst, New Jersey Site

SUMMARY AND CONCLUSIONS

The environmental assessment (EA) reviews the environmental impacts of the decommissioning actions proposed by Heritage Minerals, Incorporated (HMI) of their Lakehurst, New Jersey facility. Based upon the NRC staff evaluation of the HMI Final Status Survey Plan (FSSP), dated November 3, 1997, it was determined that the proposed decommissioning can be accomplished in compliance with the NRC public and occupational dose limits, effluent release limits, and residual radioactive material limits. In addition, the approval of the proposed action, i.e., decommissioning of HMI's Lakehurst, New Jersey facility in accordance with the commitments in NRC license SMB–1541 and the FSSP (decommissioning plan), will not result in significant adverse impact on the environment.

1.0 INTRODUCTION

1.1 Background

Heritage Minerals, Inc. is the current holder of NRC radioactive source materials license SMB–1541 (NRC Docket 40-08980) for the possession of radioactive material resulting from operations at their facility located in Lakehurst, New Jersey. The license authorizes HMI to possess at any one time a maximum of 300 kg of uranium in the form of natural uranium as monazite and 15,000 kg of thorium in the form of natural thorium as monazite. Processing of licensed material is not authorized except incident to facility decommissioning activities and packaging materials for shipment.

In December 1996, HMI informed the NRC staff that it intended to decommission the Lakehurst, New Jersey facility. The licensee submitted the Final Status Survey Plan (FSSP or decommissioning plan) to the NRC for review on November 3, 1997. The license was renewed on May 26, 1998 to authorize possession, packaging, storage, and decommissioning in accordance with the FSSP and transfer of products and waste to authorized recipients. Prior to the renewal, a safety evaluation report (SER), which evaluated conformance of the proposed action with NRC regulations and regulatory guidance was prepared and the opportunity for a hearing was publicly noticed in the March 12, 1998, Federal Register Notice (63 Federal Register 12114). In response to NRC requests, in 1998-99, HMI provided additional information to clarify certain planned remediation activities. The NRC is considering a license amendment which include additional HMI commitments during facility decommissioning.

1.2 Purpose and Need for Proposed Action

NRC is considering approval of the FSSP to allow Heritage Minerals, Inc. to remove radioactive material attributable to licensed operations at the site, to levels that permit release of the property for unrestricted use and termination of radioactive source materials license SMB–1541.

1.3 Description of Proposed Action

The objective of HMI is to decontaminate and decommission the Lakehurst, NJ facility to permit release for unrestricted use and termination of NRC license SMB–1541. Decommissioning will involve remediation of buildings and other above-grade structures, decontamination of process equipment and sumps, excavation of soil containing monazite sands, and restoration of excavated areas. Soil and other radioactively contaminated materials will be transported to either a licensed disposal facility or recipient authorized to receive such material.

NRC staff reviewed the information provided by HMI in the FSSP describing the proposed decommissioning actions and, by letter dated March 16, 1999, requested additional information regarding specific areas that needed clarification. NRC staff concluded that the decommissioning plan (FSSP) and supplemental information (letters dated November 30, 1998, June 24, 1999, July 13, 1999 and August 17, 1999) from A.J. Thompson, Attorney for HMI, Inc., responding to NRC comments provided an adequate information base for assessing potential environmental impacts from the proposed action.

2.0 FACILITY DESCRIPTION/OPERATING HISTORY

2.1 Site Locale and Physical Description

The Heritage Minerals, Inc. site is located on Route 70 in Lakehurst, Manchester Township (Ocean County), New Jersey, in the Atlantic Coastal Plain. It encompasses an area of approximately 7000 acres, of which 1000-1200 acres were used for mining operations involving monazite. Other areas remained undisturbed. The plant and production areas including mill tailings containing monazite (produced as a result of previous operations) occupied an estimated 500 acres. The monazite pile is located within a security fence and occupies approximately 700 cubic meters. Areas adjacent to the site are predominantly rural, with bands of existing or recently developed residential communities within Manchester Township.

In the Hydrogeologic Investigation Report prepared for HMI, Fellows, Read, & Associates, Inc. (1989) characterized the geology and hydrogeology of the facility. Geologic deposit formations consist of underlying sediments of stratified clay, silt, sand, and gravel on well-indurated bedrock. The topography is relatively flat, recontoured by surface mining of ilmenite surface deposits. Wetlands form the drainage of adjacent Wrangel Brook, which has an easterly streamflow. Two lakes were created along the Green Branch of Wrangel Brook as a result of mine dredging operations.

Groundwater flow occurs from areas located north and west of the site to east and northeast towards the tributaries of the Toms River. The Toms River and its tributaries represent the major groundwater discharge zones for the region. Local groundwater flow is from upland areas to lower areas where groundwater discharges to streams and wetlands. Site groundwater is recharged by precipitation and flows unconfined through underlying sands. The Green Branch, Michaels Branch, and Davenport Branch of Wrangel Brook serve as local discharge zones for shallow ground water, with subsequent discharge to the Toms River or Barnegat Bay.

2.2 Descriptions of Facility Operations

Between 1973 and 1982 the site was operated by ASARCO, Inc., for dredging and processing sand deposits to extract heavy minerals. The titanium mineral, ilmenite, was the primary mineral recovered by various physical separation methods. There was no chemical separation involved in the extraction and concentration processes. Heavy minerals, including monazite were pumped as slurry to a Wet Mill. At the Wet Mill, the heavy minerals were separated from the slurry, then stockpiled for dewatering, while the lighter fraction was returned to the dredge pond. The heavy mineral concentrate was heated in a Dry Mill, then screened to remove coarse material. The high conductivity of the titanium dioxide bearing minerals allowed electrical separation from other heavy minerals. Further magnetic refinement produced the final ilmenite product. The dry mill tailings containing essentially all the monazite from the heavy minerals concentrate were mixed with water and pumped to an area east of the dry mill building.

ASARCO ceased operations in 1982. Evaluation of residual materials by private companies for commercial use continued until the property was purchased by HMI in 1986. Plant facilities were leased to Mineral Recovery, Inc. (MRI), who performed operational testing for titanium recovery until 1987.

HMI assumed property control, conducting site operations under NRC license until 1990 when all production stopped. Operations were comparable to the ASARCO process, utilizing dry mill tailings as feed material. The tailings were mixed with water, pumped to the wet mill for mineral separation according to their conductive properties, proceeding through a dewatering and drying process. Minerals were recovered and sold as leucoxene and rutile (titanium dioxide products) and zircon. Licensable amounts of monazite were present throughout the electrical and magnetic separation processes. In early 1990, processing of feed materials continued followed by recycle of tailings from the MRI operations. Mill tailings containing monazite were deposited in a stockpile east of the dry mill,. Due to economic conditions, HMI terminated all operations In August 1990. Approximately 700 cubic meters of stockpiled tailings remain licensed to HMI.

3.0 RADIOLOGICAL STATUS OF THE FACILITY

3.1 Structures and Equipment

HMI performed decontamination of building surfaces and disposed of contaminated equipment in 1990-1991. Subsequent radiation (screening) surveys were conducted of the interiors of the wet mill and dry mill. Process trains within each building were characterized according to their monazite content and operating history as affected or unaffected areas using NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination" criteria. The methods used to dismantle and decontaminate process equipment in affected areas and for disposition of resultant materials are described in the FSSP. The same methods will be used for decontamination of building interiors prior to the final radiological survey and will serve as the basis for termination of NRC Source Material License SMB–1541.

The final release status surveys described in the FSSP will be performed in accordance with NUREG/CR–5849 criteria. Residual radioactive materials that exist in affected areas will meet current guidelines described in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use for Termination of Byproduct, Source, and Special Nuclear Material Licenses," (U.S. Nuclear Regulatory Commission, Policy and Guidance Directive FC 83-23, 1983). Details regarding the radiological status of affected areas within the Wet and Dry Mill buildings are described in the next sections. At present, contaminated material containing monazite is being stored in the outdoor tailings pile. A final survey of affected areas will be required by NRC after residual material is removed and decontamination is complete.

Following review of the Heritage Minerals, Inc. site radiological characterization of structures and equipment, the NRC staff finds characterization was performed in accordance with NUREG/CR–5849. The NRC staff review of the FSSP also finds it adequate for remediating structures and equipment to radiological levels below the NRC guidelines for unrestricted release (Nuclear Regulatory Commission, 1983). The staff concludes no adverse environmental impacts will result from planned remediation of the site structures and equipment.

3.1.1 Wet Mill Building

The Wet Mill Building process equipment used to extract product materials from raw feed was grouped into affected and unaffected survey units. The majority of survey units including floors, lower walls, and western mill areas are unaffected. Mechanical separation units and feed sumps involving transfer or processing of product material containing monazite were identified in the FSSP as affected areas. Final radiological surveys of interior surfaces will be within allowable release limits for natural thorium, the primary contaminant of concern. Prior to release of equipment in affected areas for unrestricted use, the NRC release limit of 1,000 dpm/100 cm^2 for average surface contamination and maximum release limit of 3,000 dpm/100 cm^2 will be met.

3.1.2 Dry Mill Building

Equipment in the Dry Mill Building was used to extract product materials from the Wet Mill process feed. Consistent with Wet Mill Building survey units, Dry Mill Building equipment was also grouped into affected and unaffected areas. Most areas of the Dry Mill involving monazite including floors, ceiling, and lower walls (up to two meters above floor level) are affected. These include dryers, high tension separators, and sumps. NRC surface contamination release limits are the same as those used for Wet Mill equipment.

3.2 Surface and Subsurface Soils

Radionuclide concentrations and direct radiation levels for surface and subsurface soils at the facility have been measured in the Wet Mill, Dry Mill, dust collectors, tailings (monazite) pile, and at various outdoor locations.

Direct radiation levels inside buildings and outdoor areas were routinely measured by HMI personnel since 1990. Direct gamma exposure rates at ground level and 1 meter above the surface were reported for the monazite pile and areas in and around the Wet and Dry Mills. Average monazite pile perimeter readings ranged between 300-1700 μR/hr up to 2000 μR/hr on the pile. Readings at outdoor locations around buildings were at or near background levels. The highest exposure rates were measured on storage drums located inside the security fence surrounding the pile, at levels up to 3000 μR/hr. Small amounts of residual material (unlicensed) exists from recycled ASARCO tailings deposits in adjoining owner controlled property locations. These areas showed direct gamma radiation readings ranging between 10-150 μR/hr and will not be included in the remediation. Normal background radiation levels for other facility production areas is 7-20 μR/hr.

In July 1996, Radiation Science, Inc. issued a Report of Site Background for HMI which included soil samples at a depth of six inches from undisturbed environment, representative of natural site conditions. Background levels were established by performing gamma spectral analysis for U-238 and Th-232 on 32 samples. Mean values reported for background samples was 0.31 pCi/gm for U-238 concentration and 0.25 pCi/gm for Th-232 concentration. Average dose rates measurements from areas where samples were taken was 3.0 μR/hr.

Sample analysis of soils taken from recycled tailings, an unused settling pond, plant tailings, and new feed materials did not exceed NRC limits for total uranium and thorium (i.e., 10 pCi/g above background) for unrestricted release. Only soil in the monazite pile was measured above licensable source material quantities, and showed total concentrations of Ra-226 and Ra-228 up to 1376 pCi/gm. The FSSP identifies these soils as the material to be considered for remediation activities.

Following review of the HMI site radiological characterization studies for soils, the NRC staff finds the characterization effort and FSSP adequate for determining areas of elevated radioactivity in soils that require remediation to limit concentrations to the NRC limits for unrestricted release (46 Federal Register 52061–52063).

3.3 Surface Water and Groundwater

Analyses for radioactivity of surface water samples collected from existing site monitoring wells and offsite streams were reported by Camp Dresser & McKee, Inc. in 1997 as part of the Mine Tailings Radiological Assessment Plan prepared for the New Jersey Department of Environmental Protection. Concentrations measured for groundwater samples were 2.0-7.0 pCi/l for gross alpha and under 2.0-5.0 pCi/l for gross beta. Results of surface water samples were 2.0-3.9 pCi/l gross alpha and 2.0-4.2 pCi/l gross beta. Due to the insoluble properties of monazite and generally low levels of radiological contamination identified in samples, no concern was found regarding dissolution of radioactivity into groundwater and surface water.

Following staff review of the characterization of surface waters and groundwater around the HMI site, the NRC staff concludes the characterization is adequate and radiological contamination of surface waters and groundwater is below levels that would be a concern for environmental impacts.

3.4 Air

HMI reported results from 1990 air sampling measurements in three locations of the Dry Mill taken by their contractor, Teledyne Isotopes. Air filters were analyzed for gross alpha activity using an alpha scintillation counter. Activity detected was assumed to be Th-232, with reported concentrations less than 1.6×10^{-12} µCi/ml. These concentrations were less than effluent concentrations limits allowed in 10 CFR Part 20, Appendix B, and are therefore found by NRC to be below levels that could lead to adverse environmental impacts. Dust and security control measures provide confidence that air quality will not be degraded during decommissioning activities to levels that exceed NRC limits in 10 CFR Part 20.

4.0 EVALUATION OF PROPOSED METHODS FOR DECONTAMINATION AND DISMANTLEMENT OF STRUCTURES, BUILDINGS, AND EQUIPMENT

4.1 Decontamination of Buildings, Equipment, and Outdoor Areas

HMI's proposal for decontamination of buildings, equipment, and outdoor areas is provided in the FSSP, supplemented by additional letters clarifying remediation activities in response to NRC's request for additional information. In 1991, process equipment, Wet and Dry Mill buildings, and survey units with operating equipment suspected to contain radioactive material were cleaned and decontaminated. Decontamination methods used for mill equipment included high pressure washing, steaming, general wipe down and scrubbing, blowing, and dusting and sweeping of surfaces. Radiation surveys of buildings and areas around the monazite pile have been performed routinely by HMI since that time.

The FSSP describes the proposed decommissioning activities and methods for protecting workers and the public during removal of monazite contaminated soil. Residual radioactivity remaining inside buildings is confined to fine sand grains present on equipment surfaces. Affected survey units may require further decontamination prior to performing the final status survey. Areas that contain only loosely adhered contamination will be HEPA vacuumed to remove contaminants. Fixtures, tanks, pumps, high tension separators, piping, and heavy equipment will be isolated, disassembled, and decontaminated as necessary, then resurveyed prior to release for unrestricted use. Equipment that cannot be economically decontaminated will be resurveyed, and all equipment with contamination above the NRC limits for unrestricted release or equipment suspected to contain radioactive material will be treated as radioactive waste.

When removal of process equipment from mill buildings is completed, building characterization surveys will be conducted. Walls up to two meters and floors are to be surveyed in accordance with the FSSP. Those buildings that contain residual contamination will be decontaminated below NRC guideline values using the most economical and reliable methods available. HMI's objective is to free release all buildings above grade to allow demolition (if deemed necessary) of clean buildings. Decontamination of ground-level floors will include the top surface of the concrete slabs, if needed. Material from demolition of ground-level floors and underlying soils will be surveyed for contamination and remediated.

Surface and subsurface soils with Th-232 concentrations greater than 10 pCi/g is restricted to the monazite pile. HMI proposes two excavations of materials with monazite concentrations greater than 10 pCi/g above background. Contaminated soil (monazite ore) will be excavated, placed into a hopper, and transferred to shipping containers. This will be followed by a second excavation of surface layer soil to be removed in a similar manner. A fenced security area near the existing pile will be established for staging of shipping containers and contaminated equipment prior to transportation off-site. After the second excavation, area radiation levels are expected to be reduced to no more than twice background. Excavation of soil to meet Th-232 cleanup criteria will also serve to remove residual uranium contamination because both contaminants are contained in the monazite-rich soil. Once remediated, the remaining soil will be resurveyed in a manner consistent with NRC-accepted methods to ensure residual thorium and uranium contamination meet the NRC unrestricted release criteria. Soil and other material will be transported from the site either to a licensed disposal facility or exported under NRC Export License XSOU8751, issued to HMI on May 2, 1997.

Under Condition 15 of Materials License SMB-1541, HMI cannot release for unrestricted use areas within plant buildings or the monazite pile without specific, written authorization from the NRC. Based on the NRC review of building and equipment decontamination methods described in the FSSP and supporting documents, NRC concludes that the methods are adequate for ensuring that equipment, buildings, and outdoor areas will meet the NRC guidelines for unrestricted use and no adverse environmental impacts will result from planned activities.

5.0 DECOMMISSIONING ALTERNATIVES AND IMPACTS

5.1 No Action

No decommissioning action by HMI would constitute a violation of 10 CFR 40.42(d) requirements, which requires that licensees begin site decommissioning of buildings and outdoor areas that contain residual radioactivity after permanently ceasing principal activities. Impacts of the no-action alternative are maintaining an NRC license, which would significantly reduce options for future property use, and require perpetual care and security of the site in its current radiological condition to prevent radiation exposure to monazite contamination and unauthorized public access.

5.2 Proposed Action

The proposed action is the approval to implement the Heritage Minerals, Inc. Final Status Survey Plan, for decommissioning activities at the Lakehurst, New Jersey facility that will permit unrestricted use of the site and termination of License No. SMB-1541. Decommissioning the facility for unrestricted release allows productive use of the land in the future. Site remediation is expected to mitigate potential future environmental impacts attributable to existing radiological contamination resulting from past operations.

5.3 Alternatives to Proposed Action

Two alternatives to the proposed action are considered. The first alternative is to not release the site for unrestricted use and keep the property under license. This alternative is unfavorable because maintaining an NRC license for the site would provide negligible, if any, environmental benefit, but would greatly reduce options for future use of the property. The second alternative involves storage of excavated soils on-site for an indefinite period should HMI be unable to export or transfer the material for disposal. While on-site storage defers the costs associated with disposal at a licensed facility, it removes the property from productive use, resulting in a negative impact to the economic potential of the local area.

The NRC determines the proposed action to be more favorable than either no-action or alternatives to the proposed action.

6.0 RADIATION PROTECTION PROGRAM

6.1 Radioactive Waste Management and Transportation Program

The radioactive waste management program at the HMI site includes identification, characterization, segregation, packaging, labeling, manifesting, and transporting waste in accordance with NRC, U.S. Department of Transportation (DOT), and other applicable federal, state, and local regulations. Included as contaminated radioactive waste materials from decommissioning activities will be equipment, tools, process material, building debris, decontamination materials (rags, wipes, filters), decontamination waste, soils, residual process equipment waste (sludges), and used personal protective equipment.

Since HMI intends to comply with all applicable requirements, NRC finds the planned radioactive waste management and transportation programs adequate for the materials at the site, and no adverse environmental impacts are expected from waste management activities or transfer of the material offsite.

6.2 Technical and Environmental Specifications

6.2.1 Unrestricted Use Guidelines

Guidelines for unrestricted use for natural thorium and uranium for the Heritage Minerals, Inc. site are Option 1 in the 1981 Branch Technical Position on "Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations" (46 FR 52061), and NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use for Termination of Byproduct, Source, and Special Nuclear Material Licensees," Policy and Guidance Directive, FC 83-23. The unrestricted release criteria are identified in the table below.

Soil release criteria[1]

Radionuclide	Maximum Soil Concentration (pCi/g)	Reference
Natural Thorium (Th-232 plus Th-228) if all daughters are in equilibrium	10	(46 Federal Register 52061–52063)

Natural Uranium Ores (U-238 plus U-234) if all daughters are present and in equilibrium	10	(46 Federal Register 52061–52063)

[1]If only one radionuclide is present, the maximum concentration is the value listed in this table. If more than one radionuclide is present, however, the ratio between the measured concentration and the corresponding limit listed in this table is determined. The sum of such ratios for all radionuclides present must not exceed one.

6.2.2 Radiological Health and Safety Program

HMI will select a decommissioning contractor who will follow radiation protection procedures sufficient to administer the radiation protection program authorized by License SMB-1541. The radiation protection program has been routinely inspected by NRC staff and found to be well implemented. The proposed action is limited in scope and not expected to include unique health and safety issues outside the scope of the radiation protection program. NRC will conduct site inspections while decommissioning activities are in progress. NRC determines the radiation protection program adequate for the proposed action.

6.2.3 Corporate Organization and Management

The HMI site manager will function as the licensee representative of the decommissioning project to provide oversight for all project activities. The site manager's function is to coordinate scheduling and status reports with the contractor Project Manager (PM) and HMI legal advisor. The PM will maintain overall responsibility for performance of project operations for the duration of the project until decommissioning activities are completed. The PM and decommissioning workers report directly to the HMI technical and legal staff for all project related activities, management direction, and resolution of operational issues. Primary responsibility of the PM includes on-site workforce management to ensure agreed to work schedules are met. The HMI Radiation Safety Officer (RSO) will report to the site manager and continue to perform oversight of all radiological work-related activities throughout the decommissioning project.

From review of job descriptions and responsibilities involved in radiological safety during decommissioning, NRC determines that the designated functions are acceptable to implement the radiological safety program during proposed decommissioning activities.

6.2.4 Radiological Exposure Control

Areas where radioactive materials are used and stored will be posted to control exposures to workers and visitors and avoid the spread of contamination. Measures to be taken to ensure control of contamination include donning of anti-contamination clothing, personnel monitoring, and frequent area radiation surveys. External radiation monitoring will be conducted through the use of environmental dosimeters placed at strategic locations around the monazite pile and work areas. The need for and type of dosimetry for workers and visitors in radiologically controlled areas will be determined by the contractor, and may include issuance of a radiation work permit. The primary dosimeter will be the thermoluminescent dosimeter (TLD) for whole body exposure, however, other types such as extremity TLD's will be employed, as conditions warrant.

For activities that have the potential to generate dusts, airborne particulate monitoring will be performed to demonstrate compliance with 10 CFR Part 20 intake limits, determine whether precautionary measures are needed (engineering controls, use of respiratory equipment), and show how exposures are being maintained ALARA. To reduce the amount of airborne particulates during excavations, the monazite pile will be sprayed with water twice per day. For equipment decontamination within affected survey units, HEPA air filtration in the immediate work area will be used, as needed.

Resuspension and airborne transport of contaminated soil during excavations serves as the primary pathway for off-site releases from decommissioning activities. HMI proposes to measure air particulates in the downwind direction through the use of a high-volume air sampler. Workers involved in excavations will be required to wear respiratory protection until radiological airborne activity levels are determined. HMI does not expect the proposed action will result in the generation of off-site, airborne concentrations that would result in dose to a member of the public in excess of the dose limits in 10 CFR Part 20. Previous results of groundwater and surface water sampling have shown negligible dose contribution due to the low levels of radionuclides during site operations. Decommissioning activities will have no further impact, therefore, additional water sampling is not needed.

HMI's total dose estimates for a worker based on direct gamma exposure rate from airborne soil releases from excavation activities of the monazite pile of 1mR/h is 320 mRem, with dust inhalation dose at 6% of the annual limit of intake (ALI) for the duration of the proposed action. The off-site (public) annual dose limit in 10 CFR Part 20 is 100 mrem. Given the low estimated exposure beyond the site boundary, the air sampling is adequate for off-site monitoring of potential releases to ensure compliance with the dose limits of 10 CFR Part 20.

Following review of radiological exposure controls, NRC determines the proposed program methodologies are adequate for detecting potential environmental impacts prior to license termination.

6.2.5 Security

Security of radioactive material at the HMI facility is maintained by a fence with a locked front entry gate around the perimeter of the monazite pile. Security for mill buildings is minimal, and other site areas are left unattended for long periods. Equipment theft in mill buildings has been a known concern within buildings, but missing equipment was believed to have been decontaminated after operations shut down in 1990. These concerns should be alleviated by the presence of on-site decommissioning personnel. HMI has committed to establishing a fenced exclusion area for shipping containers and equipment removed from buildings which cannot be released for unrestricted use.

NRC determines this is an adequate level of security to ensure radiological safety will be maintained during decommissioning activities at the site.

6.3 Radiological accident analysis

Potential accident scenarios considered include building fire and loading or shipping incidents of radioactive materials. Due to the low potential for fire or explosion in building structures and the limited quantities of material used during transfer operations, accidental releases of radioactive materials in quantities that could affect public health and safety are unlikely. A 24-hour number will be established to provide Radiation Safety Officer notifications in the event emergency response is necessary.

The NRC concludes that HMI has adequately addressed the potential for radiological accidents.

7.0 ENVIRONMENTAL IMPACTS

7.1 Radiological Impacts to the Public and Workers

Potential sources of worker exposure from decommissioning activities include characterization work, decontamination and remediation of buildings and associated structures (piping, foundations), and excavation of soils. Past NRC inspections showed activities resulted in no measurable internal or external dose to workers. These activities were similar to the proposed activities and included equipment and building decontamination, radiological characterizations, and monazite pile maintenance. NRC dose calculation based upon excavation and packaging of 700 m^3 of monazite soil at an average thorium soil concentration of 25 pCi/g (highest sample result obtained during NRC inspection) project an occupational worker exposure under 10 mRem, primarily due to external exposure. Based on the above, the staff believes that worker exposures will be well within the 10 CFR Part 20 annual worker dose limit of 5000 mRem, and that no adverse impacts to workers will result.

Potential sources of radiological impacts to the public from decommissioning activities at the HMI site are similar to those pertaining to worker exposures (decontamination and excavation dusts), but require transport over greater distances to reach off-site receptors. As a result, lower concentrations and doses are expected for members of the public than for workers. Previous NRC inspections showed that worker exposures during past activities were undetectable. Similarly, the public doses from these activities should be undetectable. The NRC staff has determined that HMI has provided adequate plans to ensure that potential radiological impacts to members of the public from the proposed action will not exceed NRC limits and are unlikely to result in adverse environmental impacts.

7.2 Nonradiological Impacts

There are no planned direct uses of chemicals in the proposed action, only the excavation of soil, and remediation of equipment and buildings. No other operations have a potential to affect the environment. During scoping and characterization surveys, an assessment of each building will be performed to identify the presence of hazardous or mixed wastes. The survey will identify items requiring management of hazardous substances, if found.

The NRC staff has determined that HMI has acceptably addressed the control of potential releases of nonradiological hazardous materials.

8.0 AGENCIES AND INDIVIDUALS CONSULTED

NRC transmitted the FSSP to the New Jersey Department of Environmental Protection (NJDEP), US Environmental Protection Agency, Region 2, and Township of Manchester by letters dated February 13, 1998, for review and comment. The response letter of March 18, 1998 from the NJDEP included comments regarding characterization of areas with thorium levels below licensable quantities and extent of soil removal, was forwarded to HMI for evaluation. HMI addressed the State's comments in their letter of November 30, 1998 to NRC providing acceptable responses to the NJDEP questions. No response was received from the EPA or Manchester Township. HMI has committed to coordinate with the NJDEP and comply with applicable State and local regulations during decommissioning activities.

9.0 FINDING OF NO SIGNIFICANT IMPACT

The Commission has prepared an EA related to the proposed unrestricted release, and removal from license SMB-1541, of 700 m^3 of monazite-rich soil from the Heritage Minerals, Inc., Lakehurst, New Jersey site. On the basis of the EA, the Commission has concluded that this licensing action would not significantly affect the environment and does not warrant the preparation of an environmental impact statement. Accordingly, it has been determined that a Finding of No Significant Impact is appropriate.

The NRC hereby provides notice that this is a proceeding on a license amendment falling within the scope of Subpart L, "Informal Hearing Procedures for Adjudications in Materials and Operator Licensing Proceedings," 10 CFR Part 2. Pursuant to Sec. 2.1205(a), any person whose interest may be affected by this proceeding may file a request for hearing in accordance with Sec. 2.1205 (d). A request for hearing must be filed within thirty (30) days of the date of publication of this Federal Register Notice.

The request for a hearing must be filed with the Office of the Secretary either:

1. By delivery to the Docketing and Service Branch of the Secretary at One White Flint North, 11555 Rockville Pike, Rockville , MD 20852-2738; or
2. By mail or telegram addressed to the Secretary, U.S. Nuclear Regulatory Commission, Washington , D.C., 20555. Attention: Docketing and Service Branch.

In addition to meeting other applicable requirements of 10 CFR Part 2 of the NRC's regulations, a request for a hearing filed by a person other than an applicant must describe in detail:

1. The interest of the requestor in the proceeding;
2. How that interest may be affected by the results of the proceeding, including the reasons why the requestor should be permitted a hearing, with particular reference to the factors set out in Sec. 2.1205(h),
3. The requestor's area of concern about the licensing activity that is the subject matter of the proceeding; and
4. The circumstances establishing that the request for a hearing is timely in accordance with Sec. 2.1205(d).

In accordance with Sec. 2.1205(f), each request for hearing must also be served, by delivering it personally or by mail, to:

1. Heritage Minerals, Inc., Attention: Anthony J. Thompson, Esquire, ShawPittman, 2300 N Street, NW, Washington, DC 20037-1128; and

2. The NRC staff, by delivery to the Executive Director for Operations, One White Flint North, 11555 Rockville Pike, Rockville, MD 20852-2738 or by mail, addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

The documents related to this proposed action are available for public inspection and copying at the NRC Public Document Room, 2120 L Street NW., Washington, DC 20555 or at the NRC's Region I offices located at 475 Allendale Road, King of Prussia, PA 19406.

10.0 REFERENCES

Berger, J.D., "Manual for Conducting Radiological Surveys in Support of License Termination," NUREG/CR–5849, Washington, DC: Nuclear Regulatory Commission. 1992.

Nuclear Regulatory Commission, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use for Termination of Byproduct, Source, and Special Nuclear Material Licenses," Policy and Guidance Directive FC 83-23, 1983.

Nuclear Regulatory Commission, "Final Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC Licensed Nuclear Facilities," NUREG–1496, Volume 2, 1997.

Orlando, D., et al., "NMSS Handbook for Decommissioning Fuel Cycle and Materials Licensees," NUREG/BR–0241, Washington, DC: Nuclear Regulatory Commission, 1997.

Dated at King of Prussia, Pennsylvania this 26th Day of August 1999

FOR THE NUCLEAR REGULATORY COMMISSION

George Pangburn, Director
Division of Nuclear Materials Safety

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

7D (0.00

August 16, 2000

Docket No. 04008980 License No. SMB-1541

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

SUBJECT: INSPECTION 04008980/2000001, HERITAGE MINERALS, INC.

Dear Mr. Lord:

This letter forwards a copy of NRC Form 591, "Safety Inspection," indicating that no items of non-compliance were found during the above described inspection of your licensed activities. Please retain the form in your files.

No acknowledgment of this letter is required. As we discussed during the inspection, please keep us apprised of the progress made to complete selection of the decommissioning contractor. Should you have any questions, we shall be pleased to discuss them with you.

In accordance with 10 CFR 2.790, a copy of this NRC Form 591 will be placed in the NRC Public Document Room and will be accessible from the NRC Web site at http://www.nrc.gov/NRC/ADAMS/index.html.

Your cooperation with us is appreciated.

Sincerely,

Original signed by Ronald R. Bellamy

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

Enclosure:
NRC Form 591

J. Lord
Heritage Minerals, Inc.

DOCUMENT NAME: G:\Docs\Current\Insp Letter\LSMB-1541.2000001.wpd

To receive a copy of this document, indicate in the box: "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	C	DNMS/RI	N				
NAME	CGordon		RBellamy					
DATE			8/18/00					

OFFICIAL RECORD COPY

NRC FORM 591 PART 1
(8-1997)
10 CFR 2.201

U.S. NUCLEAR REGULATORY COMMISSION

SAFETY AND COMPLIANCE INSPECTION

1. LICENSEE	2. REGIONAL OFFICE
HERITAGE MINERALS, INC. REPORT NUMBER(S)	REGION I US NUCLEAR REGULATORY COMMISSION 475 ALLENDALE ROAD KING OF PRUSSIA PA 19406-1415

3. DOCKET NUMBER(S)	4. LICENSE NUMBER(S)	5. DATE(S) OF INSPECTION
40-8980	SMB-1541	AUGUST 8, 2000

LICENSEE:
The inspection was an examination of the activities conducted under your license as they relate to radiation safety and to compliance with the Nuclear Regulatory Commission (NRC) rules and regulations and the conditions of your license. The inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector. The inspection findings are as follows:

- [x] 1. Based on the inspection findings, no violations were identified.
- [ ] 2. The violation(s), specifically described to you by the inspector as non-cited violations, are not being cited because they were self-identified, non-repetitive, and corrective action was or is being taken, and the remaining criteria in the NRC Enforcement Policy, NUREG-1600, to exercise discretion, were satisfied. _____ non-cited violation(s) were discussed involving the following requirement(s): _____
- [ ] 3. During this inspection certain of your activities, as described below and/or attached, were in violation of NRC requirements and are being cited. This form is a NOTICE OF VIOLATION, which is required to be posted in accordance with 10 CFR 19.11.

STATEMENT OF CORRECTIVE ACTIONS

I hereby state that, within 30 days, the actions described by me to the Inspector will be taken to correct the violations identified. This statement of corrective actions is made in accordance with the requirements of 10 CFR 2.201 (corrective steps already taken, corrective steps which will be taken, date when full compliance will be achieved). I understand that no further written response to NRC will be required, unless specifically requested.

TITLE	PRINTED NAME	SIGNATURE	DATE
LICENSEE	JOHN LORD	[signature]	8/8/00
NRC INSPECTOR	CRAIG GORDON	[signature]	8/8/00

DESIGNATED ORIGINAL/IE:07

APPENDIX A

MATERIALS DECOMMISSIONING INSPECTION RECORD

FOR FACILITIES NEEDING SIGNIFICANT DECOMMISSIONING EFFORT

Region I

Licensee (Name & Address):
Heritage Minerals, Inc.
One Hovchild Plaza
4000 Route 66
Tinton Falls, NJ 07753

Inspection Report No.: 00-01
License No.: SMB-1541
Docket No.: 40-08980
Telephone No.: 732/922-6100

Licensee Contact: John Lord, Site Manager
Priority: 2
Program Code: 11800
Date of Last Inspection: 1/13/99
Date of This Inspection: 8/8/00

Type of Inspection:

X	Announced		Unannounced
X	Routine		Special
	Initial Decommissioning		Reinspection of Decommissioning

Next Inspection: 11/00 [ ] Normal [X] Reduced [ ] Extended

Brief Description of Inspection Activities:

1) observe site areas where materials stored and secured 2) discuss status of contract proposals and schedule to initiate decommissioning activities

Brief Description of Findings and Action:

No active operation. Material stored and secured safely. Review of proposals for decommissioning contract nearly complete and expected to be approved. Cleanup activities authorized to begin upon contract approval.

Summary of Findings and Action:

- [X] No violations cited, clear NRC Form 591 or regional letter issued
- [ ] Violation(s), clear NRC Form 591 issued
- [ ] Violation(s), regional letter issued
- [ ] Followup on previous violations

Inspector: [signature] Date: 8/16/00
Craig Z. Gordon, Sr.Health Physicist

Approved: [signature] Date: 8/18/00
Ronald R. Bellamy, Chief, D&LB

[Field notes are to be used by the inspector to assist with the performance of the inspection. Note that all areas indicated in the field notes are not required to be addressed during each inspection. However, for those areas not covered during the inspection, a notation ("Not Reviewed") should be made in each section where applicable. Additionally, all areas covered during the inspection should be documented in sufficient detail to describe what activities and/or records the inspector observed. The fieldnotes to the "Decommissioning Inspection Procedure for Materials Licensees" should be supplemented with: (1) the applicable inspection procedures for operating facilities provided in the Inspection Procedure (IP) 87100 series; and (2) other written documentation of the inspection, as necessary.]

1. SUMMARY OF DECOMMISSIONING STATUS

The checklist below is intended to provide, in a written outline format, summary documentation of the status of the licensee's facility in the decommissioning process. This documentation will be filed as part of the inspection report. The inspector should use this information to develop each inspection plan(s) for the various stages of decommissioning, namely, before dismantlement, during dismantlement and site remediation, and after site remediation.

		Y	N
A.	Licensee ceased operational program	x	
B.	Required decommissioning financial assurance mechanisms in place.	x	
C.	Decommissioning Plan (DP) required.	x	
D.	Licensee final survey required.	x	
E.	NRC confirmatory survey required.	x	
F.	NRC closeout inspection required.	x	
G.	Licensee doing decommissioning planning and preparation before dismantlement	x	
H.	Licensee actively remediating site.		x
I.	Licensee completed site remediation.		x

Description of Facility Status:

No changes since last inspection. Site manager (SM) review of contract proposals for decommissioning work almost complete. A recommendation will be made to the site owner (Hovnanian Industries) for final approval. The SM indicated that work was expected to begin soon after contract approval.

2. INSPECTION OF KEY DECOMMISSIONING ACTIVITIES

The following is a generic checklist of major licensee activities occurring at various stages of decommissioning. From this generic checklist and from facility-specific activities you identify, develop the set of licensee activities to be inspected - for each individual inspection throughout the decommissioning process. Plan to inspect licensee activities that present potential high-risk conditions. Then apply the standard health and safety inspection areas in Section 3 of these fieldnotes (taken from the applicable 87100 series IP for the licensee's operational program) to the specific licensee decommissioning activities that are being inspected.

To complete the licensee activities checklist, the inspector will need to obtain information from the Licensing Project Manager, review the DP, make observations at the licensee's facility, review licensee records, take measurements and samples of contaminants, and undertake other investigative measures, to determine whether the licensee is meeting all regulatory and DP commitments for each decommissioning activity the licensee is performing.

A. LICENSEE ACTIVITIES INSPECTED BEFORE DISMANTLEMENT [ ] N/I [ ] N/A

1.	Licensed material used during operations has been removed from site.	[ ] Y	[x] N
2.	Facility license conditions are in place and met by licensee.	[x] Y	[ ] N
3.	Site security and control of contaminated material being maintained in compliance with 10 CFR 20.1801 and 20.1802.	[x] Y	[ ] N
4.	Support systems and services (e.g., lighting, water supply) are in place.	[x] Y	[ ] N
5.	Decommissioning schedules are consistent with timeliness requirements in 10 CFR 30.36, 40.42, and 70.38.	[x] Y	[ ] N
6.	Licensee's recordkeeping is consistent with 10 CFR 30.35, 40.36, and 70.25.	[x] Y	[ ] N
7.	Financial assurance requirements are being maintained in accordance with 10 CFR 30.35, 40.36, and 70.25.	[x] Y	[ ] N
8.	Licensee is conducting site characterization in accordance with applicable radiation protection procedures.	[x] Y	[ ] N
9.	Construction of new site features (e.g., roads, rail spurs, staging areas, sediment control ponds) conforms to DP and does not compromise health and safety of workers and public.	[ ] Y	[x] N
10.	Licensee activities conform to specific license conditions and licensee programs and procedures.	[ ] Y	[ ] N

11. Other licensee activities(describe below):

Basis for findings:

There was no operation involving licensed materials. Licensee efforts to begin decommissioning activities have been slow but showed progress. The SM indicated a decommissioning schedule will be developed once the contractor selection and approval are completed. Loading and packaging of material in shipping containers would occur during 4Q CY00, followed by offsite shipment in CY01. Site security and vandalism continue to be a problem but have not impacted the fenced monazite waste pile.

B. LICENSEE ACTIVITIES INSPECTED DURING DECONTAMINATION, DISMANTLEMENT, AND SITE REMEDIATION [ ] N/I [x] N/A

1. Site security and control of contaminated material being maintained in compliance with 10 CFR Part 20. ☐ Y ☐ N

2. Decontamination and dismantlement of structures are being performed consistent with DP and sound industry practice (structures include buildings, utilities, treatment lagoons, etc.). ☐ Y ☐ N

3. Decontamination and remediation of the following are being performed consistent with DP and sound industry practice: ☐ Y ☐ N

   a. Soil. ☐ Y ☐ N
   b. Sediment. ☐ Y ☐ N
   c. Surface waters. ☐ Y ☐ N
   d. Groundwater. ☐ Y ☐ N
   e. Other mediums (describe below): ☐ Y ☐ N

4 Licensee release and disposal of decommissioning wastes are consistent with DP and approved by NRC for: ☐ Y ☐ N

   a. Liquid wastes (e.g., groundwater, surface water, liquid from treatment ponds, process liquids). ☐ Y ☐ N

   b. Solid wastes (e.g., building materials, process and other facility equipment, concrete rubble, soil). ☐ Y ☐ N

   c. Other wastes (describe below): ☐ Y ☐ N

5. Temporary, on-site storage of low-level radioactive wastes from decommissioning meets license conditions and guidance in IP 84890. ☐ Y ☐ N

6. Packaging and shipment of radioactive waste materials meet requirements in 40 CFR Parts 173-178 and 10 CFR Part 71. ☐ Y ☐ N

7. Restoration of site-Licensee has restored site to meet license conditions and NRC-approved plans. ☐ Y ☐ N

8. Licensee survey of material and equipment for free release sufficient to demonstrate compliance with release criteria. ☐ Y ☐ N

9. Other licensee activities: ☐ Y ☐ N

Basis for Findings:

C. LICENSEE ACTIVITIES INSPECTED AFTER COMPLETION OF SITE REMEDIATION ☐ N/I ☒ N/A

1. Licensee has submitted NRC Form 314 for disposition of licensed material in accordance with 10 CFR 30.36, 40.42, and 70.38. ☐ Y ☐ N

2. Licensee's final survey program is acceptable (see Appendix B for inspection items for final surveys). ☐ Y ☐ N

3. NRC confirmatory survey performed. ☐ Y ☐ N

4. Site maintenance activities (if any, for restricted use) conform to license conditions and NRC-approved plans and are in place and functional. ☐ Y ☐ N

5. Other licensee activities: ☐ Y ☐ N

Basis for Findings:

3. INSPECTION OF STANDARD HEALTH AND SAFETY AREAS FROM THE OPERATIONAL INSPECTION PROGRAM

Identify the standard inspection areas (from the inspection program of the licensee's operational program) to be covered during each decommissioning inspection. [Inspection areas A through L below correspond to the typical inspection areas in the 87100 series IPs that are applicable to decommissioning.] Then identify the new activities within the standard inspection areas undertaken by the licensee during decommissioning. Some of the new activities given below, as well as any other activities the inspector identifies, should be considered inspection items under the general set of health and safety inspection areas used in the applicable 87100 series IP.

Minimum inspection areas for the initial decommissioning inspection: decommissioning organization (A.1); decommissioning activities in compliance with NRC-approved DP (A.2); licensee procedures for implementing the DP (A.3); Radiation Safety Committee (RSC) and Radiation Safety Officer (RSO) responsibilities (A.4); and the licensee's decommissioning training program (E.1).

A. GENERAL OVERVIEW

1. Describe the licensee's decommissioning organizational structure:

2. Licensee is performing decommissioning activities in compliance with its approved DP. ☐ Y ☐ N

Licensee has implemented procedures for the decommissioning activities identified in the DP. ☐ Y ☐ N

The RSC and RSO fulfill license requirements to deal with all decommissioning activities. ☐ Y ☐ N

Basis for Findings:

B. FACILITIES

1. Describe, from field observation, the licensee-identified facilities and outdoor areas to be decommissioned:

2. The licensee's remediation plan includes all the contaminated facilities and areas on-site and off-site ☐ Y ☐ N

3. All essential systems and services (e.g., electrical power, water supply, communications systems) are in place and functional for the planned decommissioning activities. ☐ Y ☐ N

4. Licensee's emergency plan is in place and operative for the duration of decommissioning. ☐ Y ☐ N

5. For complex sites needing site characterization, describe the key site characterization activities to be performed by the licensee to determine the nature and extent of contamination:

6. Licensee's characterization activities performed in conformance with good industry practice. ☐ Y ☐ N

Basis for Findings:

C. EQUIPMENT AND INSTRUMENTATION

1. Survey instruments are applicable to contaminants of interest. ☐ Y ☐ N

2. Use of survey instruments appropriate for site. ☐ Y ☐ N

Basis for Findings:

A. MATERIALS

1. Radioactive materials licensed during operations have been removed offsite; residual quantities conform to license conditions. ☐ Y ☐ N

2. Security and control of licensed materials, including contaminated areas, is being maintained. ☐ Y ☐ N

Basis for Findings:

E. TRAINING

1. Licensee has developed training program for new decommissioning activities (e.g., demolition of structures, excavation of soil); program is adequate. ☐ Y ☐ N

2. Training program being effectively implemented. ☐ Y ☐ N

Basis for Findings:

F. AREA RADIATION SURVEYS AND CONTAMINATION CONTROL

Area surveys are being performed in areas being decommissioned. ☐ Y ☐ N

Where active remediation (e.g., demolition of structures, excavation of soil) is being performed, radiation levels in unrestricted areas do not exceed 2 mrem in any one hour. ☐ Y ☐ N

Basis for findings:

G. RADIATION PROTECTION

The licensee's approved health physics program is being implemented in the field for new decommissioning activities. ☐ Y ☐ N

Site security and control of contaminated material are in compliance with 10 CFR 20.1801 and 20.1802. ☐ Y ☐ N

Basis for findings:

H. RADIOACTIVE WASTE MANAGEMENT/EFFLUENTS/ENVIRONMENTAL MONITORING

1. Offsite disposal of decommissioning wastes conforms to free release criteria and disposal site requirements. ☐ Y ☐ N

2. All new effluent releases conform to DP and applicable regulations. ☐ Y ☐ N

3. The licensee's environmental monitoring program is being implemented in conformance with the DP and all applicable limits are being met. ☐ Y ☐ N

4. Temporary storage/staging areas for radioactive wastes from building demolition, equipment dismantlement, soil excavation, etc., are adequately posted and protected. ☐ Y ☐ N

Basis for findings:

I. RECORDKEEPING FOR DECOMMISSIONING

1. Copies of the licensee's decommissioning cost estimates and funding methods are on file. ☐ Y ☐ N N

2. Licensee has adequate records for decommissioning activities performed (e.g., for decontamination and dismantlement of structures; decontamination and remediation of soil, sediment, surface waters, groundwater; surveys of remediated facilities). ☐ Y ☐ N N

3. Licensee's financial assurance conforms with the financial assurance requirements of NRC-approved possession limits and NRC regulations. ☐ Y ☐ N N

Basis for Findings:

J. TRANSPORTATION

1. Describe the licensee's program to package and ship decommissioning waste materials:

2. Licensee's program meets all applicable 10 CFR and 49 CFR requirements for marking labeling, placarding, and shipping paper requirements for radioactive waste shipments. ☐ Y ☐ N

Basis for Findings:

K. POSTING AND LABELING

1. All contaminated areas, waste processing areas, and waste handling areas are posted in conformance with regulations. ☐ Y ☐ N

2. Packaged radioactive waste materials are labeled in accordance with regulations. ☐ Y ☐ N

Basis for Findings:

L. OCCUPATIONAL HEALTH AND SAFETY

1. Describe the occupational health and safety observations made at the licensee's facilities:

2. Licensee and Occupational Safety and Health Administration were informed of occupational health and safety issues observed during the inspection. ☐ Y ☐ N

Basis for Findings:

4. VIOLATIONS, NON-CITED VIOLATIONS, FOLLOWUP ITEMS, AND OTHER ISSUES

Briefly state (1) the requirements and (2) how and when the licensee violated the requirement. For non-cited violations, indicate why the violation was not cited. Briefly describe followup items and other issues.

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

September 20, 2000

Docket No. 04008980 License No. SMB-1541

Edele Hovnanian
Sr. Vice President
Hovnanian Industries
1 Hovchild Plaza
4000 Route 66
Tinton Falls, NJ 07753

SUBJECT: HERITAGE MINERALS, INC.

Dear Ms. Hovnanian:

On October 19, 1999, the NRC issued an Environmental Assessment and Finding of No Significant Impact for the proposed activities in the "Final Status Survey Plan for License Termination of Heritage Minerals NRC License SMB-1541". Since that time we have been in contact with your staff to discuss plans to complete site decommissioning and dispose of licensed material.

During the August 8, 2000 inspection of HMI, the status of facility decommissioning was discussed with the Site Manager, Mr. J. Lord. We were informed that contract proposals for site remediation and transportation of contaminated materials were in the final stages of review, and that major work activities will begin when the decommissioning contractor is selected. Although some minimal remediation was performed by HMI staff, to date we have not seen any further progress in selection of a contractor to continue the outstanding decommissioning. In accordance with 10 CFR 40.42(h)(1), site decommissioning shall be completed no later than 24 months following initiation of decommissioning. For HMI, this date is October 19, 2001.

Please provide us your schedule for contract selection, decommissioning activities, final status surveys, and license termination. We would appreciate receiving the schedule within 30 days. Should you have any questions, we will be glad to meet with or discuss them with you. Please contact me at (610) 337-5200 or Craig Gordon, NRC Project Manager for HMI at (610) 337-5216.

Thank you for your cooperation.

Sincerely,

Original signed by Marie Miller

Decommissioning and Laboratory Branch
Division of Nuclear Materials Safety

cc:

Heritage Minerals, Inc.

ONE HOVCHILD PLAZA
4000 ROUTE 66
TINTON FALLS, NJ 07753
(732) 922-6100 · FAX (732) 922-9544

October 24, 2000

Ms. Marie Miller
USNRC
Decommissioning & Laboratory Branch
Division of Nuclear Materials Safety
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

RE: HERITAGE MINERALS, INC. – SITE DECOMISSIONING PLAN
LICENSE NO. SMB-1541

Dear Ms. Miller:

This letter is in response to your letter of September 20, 2000 requesting Heritage Minerals, Inc's (HMI) schedule for contract selection, decommissioning activities, final status surveys and license termination within 30 days. You also noted that, in accordance with 10 CFR40.42(h)(1), HMI's site decommissioning must be completed by October 19, 2001.

As John Lord indicated to Craig Gordon during the August 8, 2000 inspection at the HMI facility, the decommissioning contractor proposals are in the process of final evaluation. John and HMI's counsel, Anthony Thompson, are currently engaged in a detailed comparative cost analyses which likely will lead to additional questions for some contractors to clarify certain bid components. We hope to conclude this process and choose a contractor before the end of this year.

HMI is also awaiting receipt of an updated contract proposal to process the monazite feed material for uranium at International Uranium Corporation's (IUC) White Mesa Mill and subsequent disposal of post-processing wastes as 11e.(2) byproduct material. We will address this revised proposal as soon as we receive it. We note, however, that IUC's July 5, 2000 license amendment request to process HMI's monazite feed material is currently subject to a request for hearing in Docket No. 40-8681-MLA-8, ASLBP No. 00-782-08MLA (September 18, 2000), a potential source of delay over which HMI has no control.

Finally, I believe it would be premature to propose schedule for decommissioning activities, final status surveys and license termination until the contractor that will develop such schedules is finally selected and the status of the contract with IUC and its proposed license amendment is clarified. Counsel and John Lord will maintain contact with NRC to continually update our progress. Should you have any further questions, please call John Lord or Mr. Thompson.

With all best wishes.

Sincerely,

Edele Hovnanian

cc: A. J. Thompson, Esq.
Vincent Wildman, Asarco
John F. Lord

Heritage Minerals, Inc.

RECEIVED
REGION I

December 15, 2000
2000 DEC 21 PM 4: 20

ONE HOVCHILD PLAZA
4000 ROUTE 66
TINTON FALLS, NJ 07753
(732) 922-6100 · FAX (732) 922-9544

Ms. Marie Miller
USNRC
Decommissioning & Laboratory Branch
Division of Nuclear Materials Safety
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

RE: HERITAGE MINERALS, INC. – SITE DECOMMISSIONING PLAN

Dear Ms. Miller:

This letter is to update the status of Heritage Minerals, Inc.'s (HMI) decommissioning activities since my letter of October 24, 2000.

John Lord and HMI's Counsel, Anthony Thompson, have rigorously reviewed the five (5) contractor proposals for site cleanup and verification. Although we have a few questions that need clarification, a final decision on a contractor can be made as quickly as necessary. In part, we have not made a final decision because we are still examining the costs and benefits of different transportation proposals on a site cleanup contractor, since transportation of the material appears to be the largest, single cost component of our current decommissioning options. We are actively pursuing some additional information before we can make a final decision on this critical cost factor.

We have received a draft processing and disposal contract from IUC, as well as a draft disposal contract from Envirocare of Utah. We are actively considering these two options. With respect to the hearing status of IUC's amendment request, we understand that it may be resolved shortly and that any potential proceeding likely should not unnecessarily delay execution of a contract with IUC within the relevant timeframes for site decommissioning, should we choose to contract with them.

We will continue to move forward as rapidly as is prudent and will continue to keep you informed of our progress. We will be happy to meet with you and NJDEP at a mutually convenient time in the next two months to further discuss our progress.

Sincerely,

Edele Hovnanian
Vice President

EH:vg

cc: A. J. Thompson, Esq.
Craig Gordeon, USNRC
Vincent Wildman, ASARCO
John F. Lord, HMI

C:\My Documents\tf205\Other Projects\HMI\Miller - Site Decommissioning Plan.doc

ML010040065

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 29, 2000

RECEIVED REGION I

2001 JAN -8 PM 4: 16

Ms. Michelle Rehmann, Environmental Manager
International Uranium (IUSA) Corporation
Independence Plaza, Suite 950
1050 Seventeenth Street
Denver, Colorado 80265

SUBJECT: AMENDMENT 18 TO MATERIALS LICENSE SUA-1358 -- APPROVAL TO RECEIVE AND PROCESS ALTERNATE FEED MATERIAL FROM THE HERITAGE MINERALS SITE AT THE WHITE MESA URANIUM MILL

Dear Ms. Rehmann:

In your letter dated July 5, 2000, you asked that we amend your license for the White Mesa uranium mill to permit the receipt and processing of material from the Heritage Minerals Incorporated (HMI) site, located in Lakehurst, New Jersey. The material at the Heritage site is currently being regulated under NRC Source Materials License No. SMB 1541 and is in storage for decommissioning. You propose to receive this material at your White Mesa uranium mill in Blanding, Utah, use this material as alternate feed for the primary purpose of removing the uranium so that it can be reused, and dispose of the process tailings in the mill's tailings pile. You estimate the material amount to be up to 2000 cubic yards with a uranium content of approximately 0.05 percent by weight, or greater. You have determined, based on your review of the HMI information and use of your Listed Hazardous Waste Protocol, that this material does not contain listed hazardous waste.

We have determined that your request to receive and process this material as alternate feed is acceptable, and have amended your license accordingly. We have enclosed the amended license and our Technical Evaluation Report that provides our bases for granting the amendment. Our principal criteria for evaluating this request are contained in our guidance entitled, "Interim Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores" provided in the NRC Regulatory Issue Summary 2000-23 that was mailed to uranium recovery licensees on November 30, 2000. We also ensured that this request complies with our requirements for uranium mills in 10 CFR Part 40, Appendix A.

As you requested in your submittal, this material can not be received by the mill until it has been determined that adequate cell space is available. In approving the Heritage Minerals request, we have added the following license condition to your license:

10.16: The licensee is authorized to receive and process source material from the Heritage Minerals Incorporated siite, in accordance with statements, representations, and commitments contained in the amendment request dated July 5, 2000, and as supplemented by submittals November 16, 2000, and December 18, 2000.

Prior to the licensee receiving materials from the Heritage Minerals Incorporated site, the licensee must make a determination that adequate tailings space is available for the tailings produced from the processing of this material. This determination shall be made based on the SERP approved standard operating procedure for determination of tailings capacity. Design changes to the cells or the reclamation plan require the licensee to submit an amendment request for NRC review and approval.

Prior to the licensee receiving materials from the Heritage Minerals Incorporated site, the licensee must require that the generator of the material certify that the material does not contain listed hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) per a Radioactive Material Profile Record.

[Applicable Amendment: 18]

If you have any questions regarding this letter or the enclosures, please contact William von Till, the NRC Project Manager for the White Mesa mill, at (301) 415-6251 or by e-mail to rwv@nrc.gov.

Sincerely,

Philip Ting, Chief
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No. 40-8681
SUA-1358, Amendment No. 18

Enclosures: Technical Evaluation Report and Source Material License SUA-1358

cc: W. Sinclair, UT
C.Crist, Ute Mountain Ute Tribe EPA
Terry Brown, US EPA Region VIII

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

March 23, 2001

Docket No. 04008980 License No. SMB-1541

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

SUBJECT: MARCH 20, 2001 MEETING SUMMARY

Dear Ms. Hovnanian:

This letter summarizes discussions from the meeting held between the NRC staff and you and Heritage Minerals, Inc. (HMI) staff on March 20, 2001, at our King of Prussia, Pennsylvania office. The meeting was held to discuss your current plans to select a decommissioning contractor and complete site remediation by October 2001.

During the meeting you indicated that delays were encountered in selecting the contractor due to limitations on hauling options and related cost estimates associated with removal of the material from the site. Presently, however, your staff stated that a review of contract submittals was completed and that strong consideration was being given to a particular proposal. The contracts will cover all remediation activities described in the Final Status Survey Plan including material excavation, packaging, transportation, and transfer to an authorized recipient.

You estimated the contract schedule from initial decommissioning to final surveys at 4-5 months, with contract approval within several weeks. As we explained, it will necessary for HMI to adhere to this schedule in order meet the October 2001 deadline and maintain compliance with NRC regulations, particularly the Decommissioning Timliness Rule in 10 CFR 40.42.

A concern was raised by Mayor Fressola, Manchester Township, regarding potential radiological hazards associated with movement of material as it is transported offsite. You agreed to keep

ML010940409

Manchester Township officials informed of decommissioning activities which could potentially impact the local community.

We believe the meeting was beneficial in providing the current status of your plans to complete decommissioning of the HMI facility. Please notify me when a contract decision is reached or if there are any changes which could affect the proposed plans. I can be contacted at (610) 337-5200. For your information a list of meeting attendees is attached. Thank you for your cooperation.

Sincerely,

Original signed by Ronald R. Bellamy

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

cc:
John F. Lord, Site Manager
Hon. Michael Fressola, Mayor, Manchester Twp.
Nancy Stanley, NJDEP

Attachment 1

Heritage Minerals, Inc.

Edele Hovnanian, Vice President
Anthony Thompson, Esquire
John Lord, Site Manager

USNRC

George Pangburn, Director, DNMS
Ronald Bellamy, Chief, Decommissioning and Laboratory Branch
Craig Gordon, Sr. Health Physicist, DLB
Duane Schmidt, DWM, NRC Headquarters
Amir Kouhestani, DWM, NRC Headquarters (by telephone)

New Jersey Department of Environmental Protection

Nancy Stanley, Bureau of Environmental Radiation

Manchester Township, New Jersey

Michael Fressola, Mayor
Constance Lauffer, Business Administrator

HMI

February 16, 2001

U.S. NUCLEAR REGULATORY COMMISSION
REGION I
NOTICE OF LICENSEE MEETING

MN No. 01-009

Facility:	Heritage Minerals, Inc. (HMI)
Docket No.:	04008980
Time and date:	Tuesday, March 20, 2001 10:30 AM
Location:	U.S. Nuclear Regulatory Commission Region I Public Meeting Room 475 Allendale Road King of Prussia, PA 19406
Purpose:	Management meeting to discuss the status of remediation plans and progress for the HMI site.
NRC Attendees:	C. Gordon, Sr. Health Physicist, Decommissioning & Laboratory Branch (D&LB), Division of Nuclear Materials Safety (DNMS) R. Bellamy, Chief, D&LB, DNMS G. Pangburn, Director, DNMS
Other Attendees:	M. Fressola, Mayor, Lakehurst, New Jersey N. Stanley, New Jersey Department of Environmental Protection
Licensee Attendees:	E. Hovnanian, Vice President, Hovnanian Industries A. Thompson, Esquire J. Lord, Manager, HMI

Note: This meeting is open for public observation. Attendance by additional NRC personnel or handicapped persons requiring assistance to attend the meeting should be made known by Thursday, March 15, 2001 via telephone call to Craig Gordon, Region I, at (610) 337-5216.

Approved By: Craig Gordon
for Ronald R. Bellamy, Chief
Decommissioning and Laboratory Branch
Division of Nuclear Materials Safety

<u>Distribution</u>:
Commonwealth of Pennsylvania
DNMS Secretary
DRM Secretary (original)

Heritage Minerals, Inc.

RECEIVED
REGION 1

2001 JUN 14 PM 3: 08

ONE HOVCHILD PLAZA
4000 ROUTE 66
TINTON FALLS, NJ 07753
(732) 922-6100 · FAX (732) 922-9544

June 7, 2001

Mr. Craig Z. Gordon
Sr. Health Physicists, DLB
USNRC
Region 1
475 Allendale Road
King of Prussia, PA 19406-1415

RE: RELEASE OF THE HERITAGE MINERALS, INC. SOURCE MATERIAL LICENSE #SMB #1541

Dear Mr. Gordon:

Approval has been received to proceed with the scope of work required to release the Source Material License #SMB 1541.

The current status of the various proposals to initiate the scope of work is shown below:

1. Heritage Facilities: HMI
    - Office space, phone, fax
    - Provide electrical power, lighting, water and compressed area to buildings
    - Miscellaneous tools, vacuum and other items

2. HMI Site Preparation: Local Contractors
    - Clearing staging area for trucks, none will be staged overnight but brought in and shipped daily.
    - Grade, level and stabilize a loading area (± 25' x 100' sq.) for individual loading attached and adjacent to the existing monazite sand pile fence.
    - Install security fence with locking gates around, above, loading area.

3. Shipping: Environmental Rail Solutions, Inc.

Proposed Work Plan Schedule, at present, subject to minor change.

All work will be done in accordance with the NRC and DOT Regulations.

June 11 –	Health and safety meeting with RSI at plant site
June 29 -	Coordination meeting with IUC
July 2 -	Pre-mobilization meeting at plant
July 3 & 4 -	Holiday
July 5 -	Mobilize – travel to site, site preparation, baseline radiological Surveys/sampling
July 9 -	Start staging trucks and loading
July 26 -	Demobilize

4. Release of title and processing:International Uranium Material USA (IUC) Material will be transported to the IUC Uranium processing mill in White Mesa, Utah.

Very truly yours,

John F. Lord, P.E.
Manager

JFL:vg

C:\My Documents\tf205\Other Projects\HMI\Letter to Gordon re Release of SMB 1541.doc

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

1225 19th Street, NW., Suite 200
Washington, DC 20036
202-496-0780
Fax 202-496-0783
(e-mail): ajthompson@attglobal.net

September 24, 2001

Mr. Craig Gordon
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Re: HMI License #SMB-1541

Dear Craig:

I am writing to report on the status of Heritage Minerals Inc's (HMI's) decommissioning activities at its Lakehurst, New Jersey site as follows:

1. The excavation of the monazite pile has been completed and remaining monazite has been piled near the front truck pad for loading. Preliminary sampling indicates that release criteria have been satisfied in most of the pile storage area. There may be some small portions of that area requiring further excavation, but the estimated volume of material (i.e., excavated monazite and any further excavation that sampling indicates is necessary) is about 600 cubic yards. The final shipment of material began on September 25, 2001 and will be completed by the first week in October 2001.

2. Survey of the laboratory building and all other support buildings, with the exception of the office/warehouse, has been completed. No monazite has been discovered in the surveyed buildings.

3. Work at and in the Dry Mill is about 98% complete. The conveyor mechanics have been cleaned and surveyed. The floor has been cleaned with final survey pending. The large deposits of radioactive sand that were found inside the ductwork have been removed and placed in the pile area for shipment. The flue gas scrubber, previously thought to be an unaffected area, is contaminated above the release limits. Attempts to remove the rubber lining from the interior of the scrubber have not been successful. Cleaning the rubber only unveils more contamination. The scrubber has been taken down and cut into manageable pieces for disposal.

4. Work at and in the Wet Mill is about 90% complete. Cleaning of the launders was delayed by mechanical problems with a rented lift. All that remains is the final cleaning and survey of the floor.

In view of the above, HMI believes that a meeting with NRC at the site should be scheduled. One option is early to mid-October after shipping and final grading of the monazite storage area has been completed. Another option would be later in the year after NRC has done its confirmatory surveys and received the results. HMI projects delivery of a draft final status survey report (DFSSR) to NRC early in October.

As progress to date indicates, HMI believes that all fundamental site cleanup work will be completed before NRC's October 19, 2001 cut off date. However, site cleanup activities frequently result in unexpected (and we might add unwelcome) surprises -- witness the buried pipe and scrubber containing elevated contamination. In view of HMI's diligent efforts to complete final site cleanup for license termination, should there be any additional unforeseen delays beyond October 19th, HMI would request a waiver of enforcement action or an extension of the completion date.

With regard to any further unexpected delays, HMI has appreciated NRC Staff's patience and support throughout this decommissioning process. *However*, in the event of some unexpected delays, should Region I staff feel compelled to take some enforcement action based on rigid application of the relevant regulatory requirements and/or Commission guidance, HMI's counsel would not hesitate to approach headquarters staff or even the Commissioners themselves to seek any necessary waiver or extension of the completion date.

Again, many thanks for your ongoing support and guidance.

Sincerely,

Tony

Anthony J. Thompson

RSI

Radiation Science Inc.
10 South River Road
Cranbury, NJ 08512

November 28, 2001

Mr. John Lord
Hovnanian Industries
One Hovchild Plaza
4000 Rt. 66
Tinton Falls, NJ 07753

Dear Mr. Lord:

Enclosed please find the report detailing the results of the Final Status Survey performed at the Heritage Minerals site in Lakehurst, New Jersey during the summer and fall of 2001. The report is in 4 volumes, as follows:

Volume I	Report Text
Volume II	Appendix A, Part 1 (Survey Units 1 through 27)
Volume III	Appendix A, Part 2 (Survey Units 27 through 46)
	Conveyors Belts, Fencing and Tires
Volume IV	Appendix B (Soil Sample Results)
	Appendix C (Final Site Survey Plan)
	Appendix D (Calibration Certificates)

If you have any questions or require further assistance, please feel free to contact me.

Sincerely,

Joel Antkowiak, Field Services Manager
Radiation Science Inc.

ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

December 7, 2001

Mr. Craig Gordon
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406

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

Dear Mr. Gordon:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) has prepared the enclosed subject confirmatory survey plan for your review and comment. The survey is tentatively scheduled for December 10 through 13, 2001. For the schedule to be met, approval of the final survey plan would be needed by December 7, 2001. Attachment A provides the spending plan for the proposed activities.

If you have any questions, please direct them to me at (865) 576-0065 or Tim Vitkus at (865) 576-5073.

Sincerely,

Wade C. Adams
Project Leader/Health Physicist
Environmental Survey and
Site Assessment Program

WCA:ar

Enclosure

cc:
G. Purdy, NRC/NMSS/TWFN 7F27
E. Knox-Davin, NRC/NMSS/TWFN 8A23
W. Beck, ORISE/ESSAP
E. Abelquist, ORISE/ESSAP
T. Vitkus, ORISE/ESSAP
R. Morton, ORISE/ESSAP
D. Condra, ORISE/ESSAP
T. Brown, ORISE/ESSAP
D. Herrera, ORISE/ESSAP
File/0792

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

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. 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 where 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 would use 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.

Prepared by the Environmental Survey and Site Assessment Program, Oak Ridge Institute for Science and Education, under interagency agreement (NRC FIN No. A-9093) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

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 degrees 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 mill. 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 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 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 and a final status survey report, being prepared by RSI is expected in the immediate future. Some support buildings are still 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 1992). The major radiological contaminants of concern for the Wet and Dry Mills are thorium and uranium (and associated decay products).

The NRC's Division of Waste Management has 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. 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.

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. 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 deck grating steel/aluminum, 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 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.

There are also five other buildings on the site—these are the Laboratory, Maintenance, Warehouse, Main Office, and Change House buildings. These buildings are considered "unaffected" since monazite-rich products were never handled or present in any of these buildings. Source-material grade sand was not sampled or analyzed in the laboratory. Affected process equipment was repaired in the mill buildings rather than being repaired in the Maintenance Building (RSI 1997).

OBJECTIVES

The objectives of the radiological confirmatory survey are 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 will be gathered to evaluate the facility's current radiological status as reported by the licensee.

RESPONSIBILITY

Work described in this survey plan will be performed under the direction of W. L. (Jack) Beck, Program Director, Tim Vitkus, Survey Projects Manager, and Wade Adams, Project Leader, of the Environmental Survey and Site Assessment Program. The cognizant ESSAP site supervisor has the authority to make appropriate changes to the survey procedures as deemed necessary. After consultation with the NRC site representative, the scope of the survey plan may be altered. Deviations to the survey plan or procedures will be documented in the site logbook.

DOCUMENT REVIEW

ESSAP has reviewed the limited site documentation and draft final survey data and used the information gathered from that review to plan these confirmatory survey activities (RSI 1997 and 2001).

PROCEDURES

ESSAP personnel will visit the HMI facility and perform visual inspections and independent measurements and sampling of portions of the site that RSI has deemed ready for release. The NRC site representative may also request additional side-by-side measurements and samples with RSI personnel. If deemed appropriate by the NRC site representative, additional scoping surveys involving surface scans, direct measurements, and exposure rates may be performed in other buildings which were not included in the RSI surveys, such as, the Office, Warehouse, Service, and Change House buildings or other areas as noted in the NRC letter to A. J. Thompson, Legal Counsel for the licensee, date June 30, 1998 (NRC 1998). Survey activities will be conducted in accordance with the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2000 and 2001a). Specific survey procedures applicable to this survey are listed on pages 12 and 13 of this survey plan.

ESSAP will use 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) will be surveyed based on RSI's two classifications (Affected and Unaffected)—these classifications were based on the potential and extent of the area of origin's radiological hazards based on historical process knowledge and on RSI's characterization survey findings. ESSAP will perform confirmatory surveys in a minimum of 25% of the SUs for which RSI has provided data—these SUs will be selected based on RSI's final status data. The percentage of surveys for each classification or survey unit may increase or decrease based on findings as the survey activities progress and/or at the discretion of the NRC site representative.

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. Therefore, RSI used digital pictures to document surface activity measurement locations. The RSI reference system consisted of using digital pictures inserted into a data sheet with direct measurement and removable activity measurements data recorded on the bottom of the sheet and the measurement location indicated on the digital picture. For interior surfaces (Wet and Dry Mills), ESSAP will use the reference system established by RSI for measurement and sampling locations. RSI will provide ESSAP with the digital pictures for areas that will be surveyed by ESSAP personnel. For exterior (soil surfaces/Monazite Pile), ESSAP will use the 10 m × 10 m reference grid system used by RSI.

SURFACE SCANS

Based on the classification of the interior SUs by the licensee, surface scans for alpha, alpha plus beta, beta, and gamma radiation, within the selected SUs will be performed at up to 20% of the evaluated structural surfaces in affected survey units and at judgmental locations within the evaluated structural surfaces in unaffected survey units. Particular attention will be given to cracks and joints in the evaluated structural surfaces where material may have accumulated. Additional scans may be performed on suspect equipment and/or at the direction of the NRC site representative. Interior scans will be performed using gas proportional, ZnS, GM, and NaI scintillation detectors coupled to ratemeters or ratemeter-scalers with audible indicators. Any locations of elevated direct radiation detected by surface scans will be marked for further investigation—to include additional surface scans, as deemed necessary to delineate contamination boundaries.

Gamma scans will be conducted over 100% of accessible soil surfaces within and in the immediate vicinity of the Monazite Pile area. Gamma scans will be performed using NaI scintillation detectors coupled to ratemeters with audible indicators. Locations of elevated radiation will be marked and identified for further investigation.

SURFACE ACTIVITY MEASUREMENTS

Construction material specific backgrounds, performed in areas of similar construction but without a history of radioactive material use, will be used to correct gross surface activity measurements. Direct measurements of surface activity will be performed at a minimum of ten locations on each Survey Unit/Equipment that is selected for survey. Direct measurements will also be performed at locations of elevated direct radiation identified by surface scans—to include additional direct measurements as deemed necessary to delineate contamination boundaries and for the determination of 1 m^2 average activity values. Additional direct measurements will be performed on the equipment as deemed necessary by the NRC site representative. The majority of the direct measurements will be performed using gas proportional detectors—GM and ZnS scintillation detectors will be used in areas that are inaccessible to the gas proportional detectors. All detectors will be coupled to ratemeter-scalers. Smear samples, for determining removable gross alpha and gross beta activity levels, will be collected from each direct measurement location. Areas of residual activity, in excess of the site criteria, will be brought to the immediate attention of the NRC site representative. If additional remediation is performed during the ESSAP survey, follow-up measurements will be performed.

EXPOSURE RATE MEASUREMENTS

Interior background exposure rate measurements will be performed at five to ten locations of similar construction, but without a history of radioactive material use. Exposure rates will be performed at a minimum of five locations within each building and at any areas of elevated gamma detected by scans. Exposure rates will be performed at one meter from the surface using a microrem meter.

Exterior background exposure rate measurements will be performed at a minimum of six locations within a 0.5 to 10 km radius of the site. Site exposure rates will be measured at the center of each surveyed grid block and at locations of elevated direct gamma radiation identified by surface scans. Exposure rate measurements will be performed at one meter above the surface using a micro-rem meter.

MISCELLANEOUS MATERIAL SAMPLING

At the discretion of the NRC site representative, samples of miscellaneous material such as construction material, paint, sediment, drain, and dust residues may be collected from random locations, areas that are not accessible for direct survey, or from locations of elevated direct radiation detected by surface scans.

SOIL SAMPLING

Background soil samples will be collected from each external background exposure rate measurement location. Surface (0 to 15 cm) soil samples will be collected from a minimum of two randomly selected grid blocks within the Monazite Pile area. Four soil samples will be collected from each of the randomly selected grid blocks at the points midway between the center and grid block corners of the selected grid blocks. Additional soil samples will be collected at locations of elevated direct radiation identified by surface scans and/or judgmental locations based on licensee final status survey data. Subsurface soil samples may be collected if elevated radiation is suspected to be present below the initial 15 centimeters of exposed soils. Samples collected by RSI will be requested for confirmatory analysis.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data will be returned to ORISE's ESSAP laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses will be performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2001b). Soil and miscellaneous material samples will be analyzed by gamma spectrometry and results reported in picocuries per gram (pCi/g). The radionuclides of interest are uranium and thorium; however, spectra will be reviewed for other identifiable photopeaks. Smears will be analyzed for gross alpha and gross beta activity using a low-background gas proportional counter. Direct measurement data and smear data will be converted to units of disintegrations per minute per one hundred square centimeters (dpm/100 cm^2). Exposure rates will be reported in microroentgens per hour (μR/h).

The data generated will be compared with the applicable NRC guidelines established for release for unrestricted use (NRC 1981 and 1987). Results will be presented in a draft report and provided to the NRC for review and comment. Data and samples collected, as part of this survey, will be archived by ESSAP.

SITE GUIDELINE CRITERIA

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):

<u>Natural Uranium</u>

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

<u>Natural Thorium</u>

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 will use 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 1992). ESSAP's experience has shown that beta measurements typically provide a more accurate evaluation of thorium contamination on structure 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. RSI only performed alpha surface activity measurements—ESSAP will perform beta activity measurements at each measurement location and alpha activity measurements at 10 percent of the direct measurement locations. Therefore, a beta activity measurement that is greater than 670 dpm/100 cm^2 would be exceed the alpha activity guideline for thorium.

The NRC guideline for exposure rates at one meter above building surfaces is 5 µR/h above background (NRC 1991).

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

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

The exterior exposure rate guideline is 10 µR/h above background (NRC 1991).

TENTATIVE SCHEDULE

Measurement and Sampling	December 10 through 14, 2001
Sample Analysis	December 2001
Draft Survey Report	January 2002

The final letter report will be issued within 10 days of the receipt of the NRC comments on the draft letter report.

LIST OF CURRENT PROCEDURES

Applicable Sections of the ORISE/ESSAP Survey Procedures Manual (September 28, 2000) include:

Section 4.0 Quality Insurance and Quality Control
- 4.1 General Information
- 4.2 Training and Certification
- 4.3 Records and Reports
- 4.4 Equipment and Instrumentation
- 4.5 Sample Handling

Section 5.0 Instrument Calibration and Operational Check-Out
- 5.1 General Information
- 5.2 Electronic Calibration of Ratemeters
- 5.3 Gamma Scintillation Detector Check-Out and Cross-Calibration
- 5.4 Alpha Scintillation Detector Calibration and Check-Out
- 5.5 GM Detector Calibration and Check-Out
- 5.6 Proportional Detector Calibration and Check-Out
- 5.9 The Bicron Micro-Rem Meter Check-Out
- 5.11 Floor Monitor Check-Out
- 5.14 Field Measuring Tape Calibration
- 5.16 Job Hazard Analysis - Instrumentation Calibration and Setup

Section 6.0 Site Preparation
- 6.2 Reference Grid System
- 6.3 Job Hazard Analysis - Site Clearing and Gridding

Section 7.0 Scanning and Measurement Techniques
- 7.1 Surface Scanning
- 7.3 Alpha Radiation Measurements
- 7.4 Beta Radiation Measurements

7.5 Gamma Radiation (Exposure Rate) Measurement

7.6 Job Hazard Analysis - Surface Scanning and Surface Activity Measurements

Section 8.0 Sampling Procedures

8.1 Surface Soil Sampling

8.2 Subsurface Soil Sampling

8.7 Determination of Removable Activity

8.8 Miscellaneous Sampling

8.15 Sample Identification and Labeling

8.16 Sample Chain-of-Custody

8.17 Job Hazard Analysis - Sampling

Section 9.0 Integrated Survey Procedures

9.1 Background Measurements and Sampling

9.2 General Survey Approaches and Strategies

Section 10.0 Safety and Contamination Control

Applicable procedures from the ORISE/ESSAP Quality Assurance Manual (June 1, 2001) include:

Section 1	ESSAP Quality Assurance Responsibilities
Section 3	Training and Certification
Section 4	Instrument Quality Control
Section 7	Sample Chain-of-Custody
Section 8	Data Quality Control
Section 11	Critical Record Handling and Storage

REFERENCES

Oak Ridge Institute for Science and Education (ORISE). Survey Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, TN; September 28, 2000.

Oak Ridge Institute for Science and Education. Quality Assurance Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, TN; June 1, 2001a.

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U.S. Nuclear Regulatory Commission. Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproducts, Source, or Special Nuclear Material. Washington, DC; August 1987.

U. S. Nuclear Regulatory Commission. Policy and Guideline Directive FC91-2, Standard Review Plan: Evaluating Decommissioning Plans for Licensees Under 10 CFR Parts 30, 40, and 70. Washington, D.C.; August 1991.

U.S. Nuclear Regulatory Commission. Memorandum from J. Hickey (USNRC-HQ) to D. Collins (USNRC, Region II), RE: "Interpretation of Thorium Surface Contamination Limits"' February 20, 1992.

U.S. Nuclear Regulatory Commission. Draft—Manual for Conducting Radiological Surveys in Support of License Termination. NUREG/CR-5849; Washington, DC; June 1992.

U.S. Nuclear Regulatory Commission. Letter from M. Miller (USNRC, Region I) to A. Thompson (HMI Legal Counsel), RE: Final Status Survey Plan for License Termination of Heritage Minerals, NRC License No. SMB-1541. King of Prussia, PA; June 30, 1998.

ATTACHMENT A

FY 2002 SPENDING PLAN	PERFORMANCE PERIOD From	PERFORMANCE PERIOD To
Name of Laboratory: Oak Ridge Institute for Science and Education	Nov-01	Sep-01
Title of Project: Heritage Minerals	**ORISE Number** 500115	**Est. Project Cost** $52,630.00

COST ELEMENTS	Oct-01	Nov-01	Dec-01	Jan-02
Direct Costs	$0.00	$2,269.00	$17,014.00	$2,269.00
Indirect Costs- (G&A)	$0.00	$2,994.00	$22,459.00	$2,994.00
Total Estimate Costs	$0.00	$5,263.00	$39,473.00	$5,263.00
Project Completion	0.00%	10.00%	85.00%	95.00%
COST ELEMENTS	**Feb-02**	**Mar-02**	**Apr-02**	**May-02**
Direct Costs	$1,134.00	$0.00	$0.00	$0.00
Indirect Costs- (G&A)	$1,498.00	$0.00	$0.00	$0.00
Total Estimate Costs	$2,632.00	$0.00	$0.00	$0.00
Project Completion	100.00%	100.00%	100.00%	100.00%
COST ELEMENTS	**Jun-02**	**Jul-02**	**Aug-02**	**Sep-02**
Direct Costs	$0.00	$0.00	$0.00	$0.00
Indirect Costs- (G&A)	$0.00	$0.00	$0.00	$0.00
Total Estimate Costs	$0.00	$0.00	$0.00	$0.00
Project Completion	100.00%	100.00%	100.00%	100.00%

ACTIVITY INFORMATION	Hours	Estimated Cost [a]
Site Visit	0.00	$0.00
Document Review [b]	8.00	$930.00
Presurvey	30.00	$2,650.00
Travel- Labor	82.00	$5,580.00
Travel- Other Expenses	0.00	$6,360.00
Survey Activities	144.00	$12,580.00
Report Preparation	55.50	$4,980.00
Sample Analysis	61.83	$5,360.00
Sample Disposal	0.00	$0.00
ISM	2.00	$260.00
Other (Includes Common Cost	0.00	$13,930.00
Total	383.33	$52,630.00

Comments:

[a] Estimated hourly costs are bas
individual program personnel ra
are anticipated to provide proj
support.

[b] Document Review costs have al
been incurred. Cost included t
accurately estimate total site

[c] Common costs are estimates of
expected distributed general NR
contract support costs for proj
management, administrative supp
laboratory support, equipment
maintenance and related costs t
not associated with a specific RFTA.

Submitted by: Environmental Survey and Site Assessment Program
Radiological Safety, Assessments, and Training Unit
Oak Ridge Associated Universities, Inc.
Attention: Tim Vitkus, 865-576-5073; email vitkust@orau.gov; Fax 86

MN No. 02-002
January 10, 2002

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

NOTICE OF LICENSEE MEETING

Name of Licensee:	Heritage Minerals, Inc. Lakehurst, NJ
Docket No:	040-08980
License No:	SMB-1541
Time and Date of Meeting:	Tuesday, January 22, 2002 10:30 a.m. - 12:00 noon
Location of Meeting:	U.S. Nuclear Regulatory Commission Region I Public Meeting Room 475 Allendale Road King of Prussia, PA 19406
Purpose of Meeting:	Discuss plans to complete decommissioning of the Heritage Minerals, Inc. SDMP site
NRC Attendees:	George Pangburn, Director, Division of Nuclear Materials Safety Ronald R. Bellamy, Chief, Decommissioning & Laboratory Branch Craig Gordon, Sr. Health Physicist, Decommissioning & Laboratory Branch J. Bradley Fewell, Regional Counsel D. Orlando, Technical Assistant, Decommissioning Branch, NMSS (Via phone)
Attendees:	John Lord, Site Manager, HMI Anthony Thompson, Attorney Tom Bracke, Consultant, Radiation Sciences, Inc. Wade Adams, Health Physicist, ORISE Nancy Stanley, N.J. Department of Environmental Protection

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

February 14, 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: Confirmatory Survey for Heritage Minerals, Inc. Lakehurst, New Jersey site

Dear Mr. Lord

On October 19, 1999, the NRC staff approved the Final Status Survey (Decommissioning) Plan (FSSP) for remediation of the Heritage Minerals, Inc. (HMI) site. Licensed areas designated for remediation included the monazite pile and mill buildings to levels specified in the NRC Site Decommissioning Management Plan (SDMP) action plan criteria for unrestricted release. The Final Status Survey (FSS) for License Termination of HMI License SMB-1541 was performed by your contractor June through October 2001, and submitted to us on December 3, 2001. Your results indicated that residual contamination in soil and building surfaces were remediated to levels below the NRC's unrestricted release criteria.

Based upon the apparent readiness of the site for final NRC survey, in December 2001, the Oak Ridge Institute for Science and Education (ORISE), under NRC contract, performed independent confirmatory radiological survey activities of designated site locations. These locations included the monazite pile and surrounding area, and interior structures within the wet and dry mill buildings. The scope of confirmatory surveys included exposure rate measurements, alpha, beta, and gamma surface scans, alpha and beta surface activity measurements, and soil sampling.

In contrast to your surveys results, NRC surveys show that surface activity levels and radionuclide concentrations in the soil where the pile was removed and in adjacent areas to the pile were not remediated to meet unrestricted release guidelines. Preliminary results from the ORISE survey were discussed with you during the management meeting held on January 22, 2002, at the NRC Region I office. Enclosed is the preliminary survey results taken from the February 2002 draft ORISE report. The entire contents of the final report will be sent to you under separate cover.

We acknowledge your efforts to initiate site decommissioning and remove the monazite pile. However, additional strategies are warranted to complete necessary remediations. For contaminated soil, surveys and sampling should be performed in accordance with NUREG/CR-5849 to meet commitments in the FSSP. In addition, provide your strategy for verifying that all licensed material previously part of the pile has been successfully removed from the site. For mill structures and surfaces, an accurate measure of activity should include alpha and beta activity to account for attenuation due to surface variations, not simply alpha surface activity as documented in your FSS.

You are requested to review the ORISE survey and respond to these issues. Please provide an updated schedule which includes plans for additional soil removal and remediation of mill buildings within 30 days of the date of this letter. Should you have any questions about the ORISE data or followup remediations, please contact me at (610) 337-5200 or Craig Gordon, Project Manager, at (610) 337-5216.

Thank you for your cooperation.

Sincerely,

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

Enclosures: Survey results tables, figures

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

ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

RECEIVED
REGION 1

2002 APR 24 PM 12: 57

April 22, 2002

Mr. Craig Gordon
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406

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

Dear Mr. Gordon:

Enclosed are three copies of the subject report for the confirmatory survey activities at the Heritage Minerals, Inc., facility in Lakehurst, New Jersey. Survey activities conducted during the period of December 10 through 13, 2001 consisted of alpha plus beta and gamma surface scans; gamma soil scans, alpha, alpha plus beta, and beta surface activity measurements; removable activity measurements; exposure rate measurements; residue sampling; and, soil sampling.

If you have any questions, please direct them to me at (865) 576-0065 or Tim Vitkus at (865) 576-5073.

Sincerely,

Wade C. Adams

Wade C. Adams
Project Leader/Health Physicist
Environmental Survey and
Site Assessment Program

WCA:ar

cc: Enclosure

cc: G. Purdy, NRC/NMSS/TWFN 7F27
E. Knox-Davin, NRC/NMSS/TWFN 8A23
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File/0792

CONFIRMATORY SURVEY OF PORTIONS OF THE HERITAGE MINERALS INCORPORATED FACILITY LAKEHURST, NEW JERSEY

J.R. Morton and W.C. Adams

Prepared for the
U.S. Nuclear Regulatory Commission
Region I Office

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program

NOTICES

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

J. R. Morton and W. C. Adams

Environmental Survey and Site Assessment Program
Oak Ridge Institute for Science and Education
Oak Ridge, Tennessee 37831-0117

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.

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

Prepared by: ______________________ Date: 3/20/02
J. R. Morton, Field Team Leader
Environmental Survey and Site Assessment Program

Prepared by: ______________________ Date: 3/21/2002
W. C. Adams, Project Leader
Environmental Survey and Site Assessment Program

Prepared by: ______________________ Date: 3/21/2002
T. J. Vitkus, Survey Projects Manager
Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 3/21/2002
R. D. Condra, Laboratory Manager
Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 3/26/02
A. T. Payne, Quality Manager
Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 3/25/02
E. W. Abelquist, Associate Program Director
Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 3/26/02
W. L. Beck, Program Director
Environmental Survey and Site Assessment Program

ACKNOWLEDGMENTS

The authors would like to acknowledge the significant contributions of the following staff members:

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ILLUSTRATORS

T. D. Herrera
T. L. Brown

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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

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

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

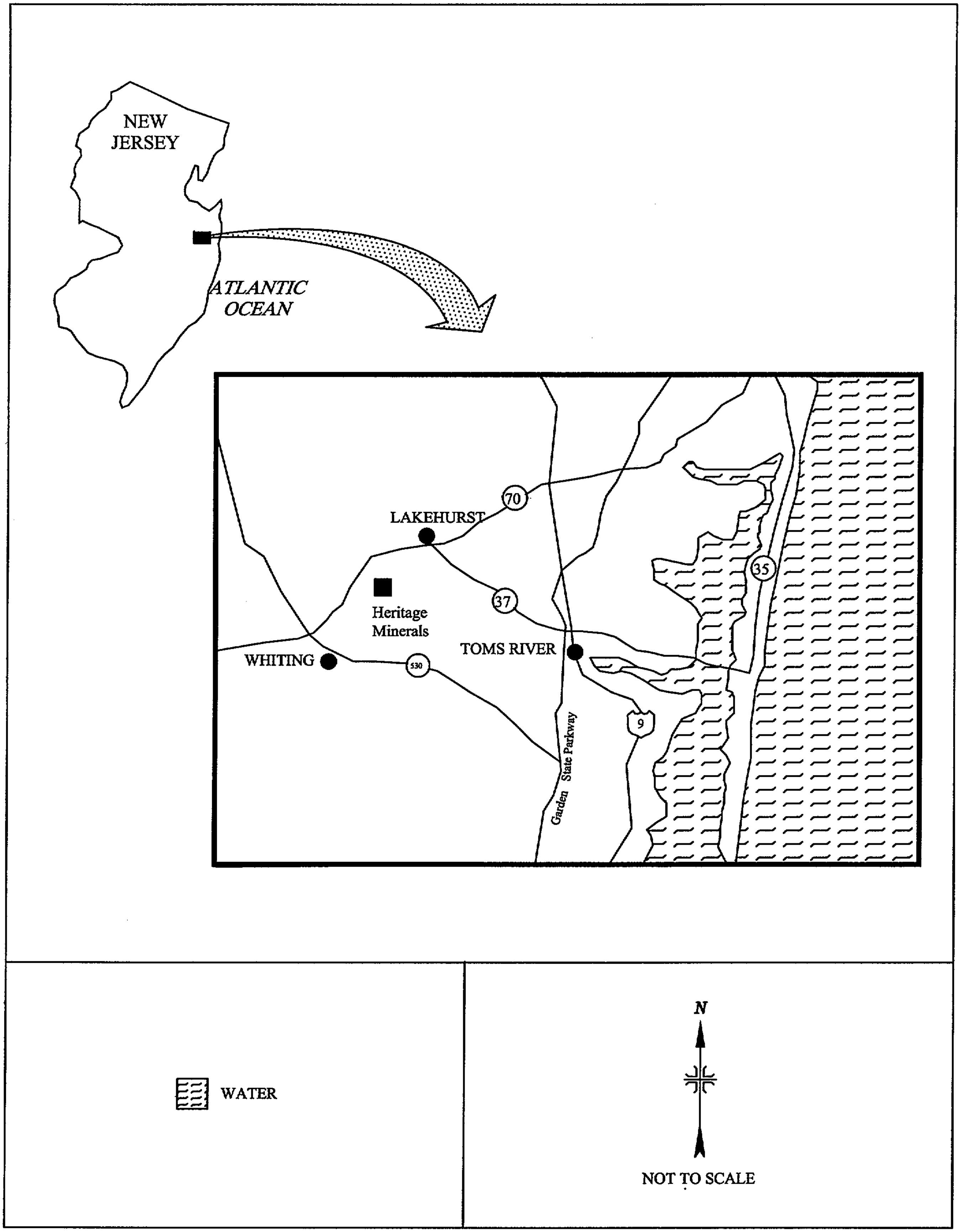


FIGURE 1: Location of the Heritage Minerals Site - Lakehurst, New Jersey

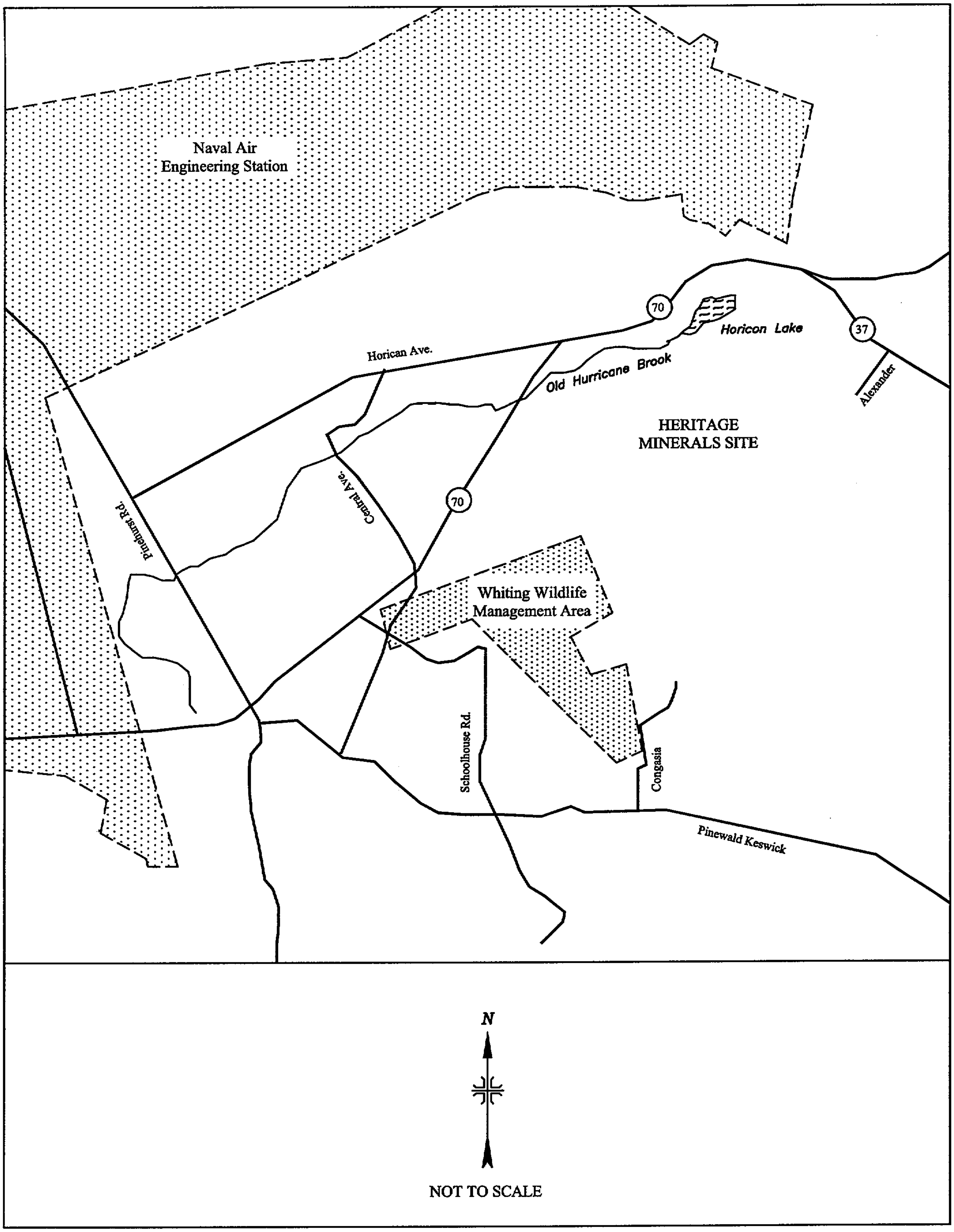


FIGURE 2: Heritage Minerals Site - Lakehurst, New Jersey

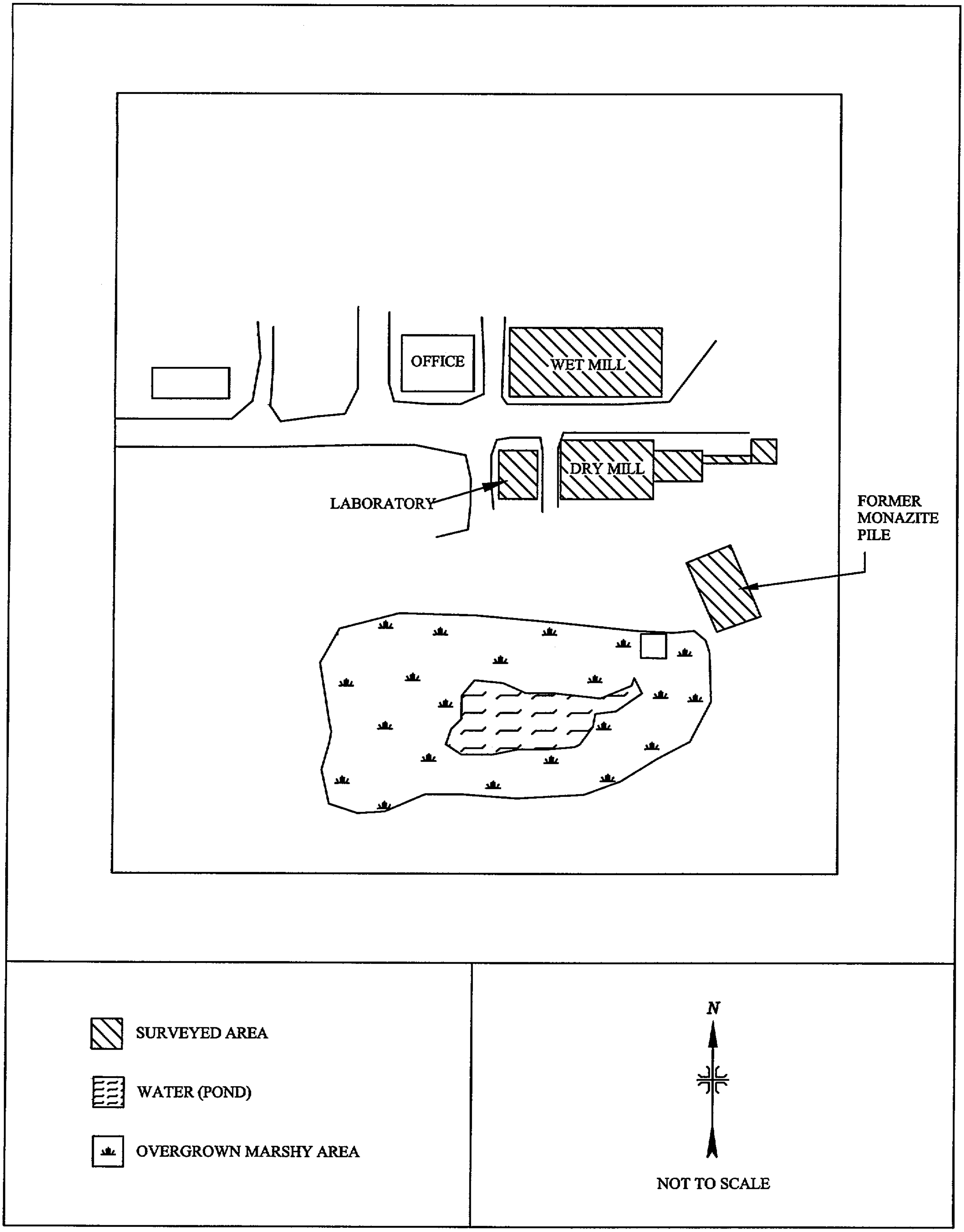
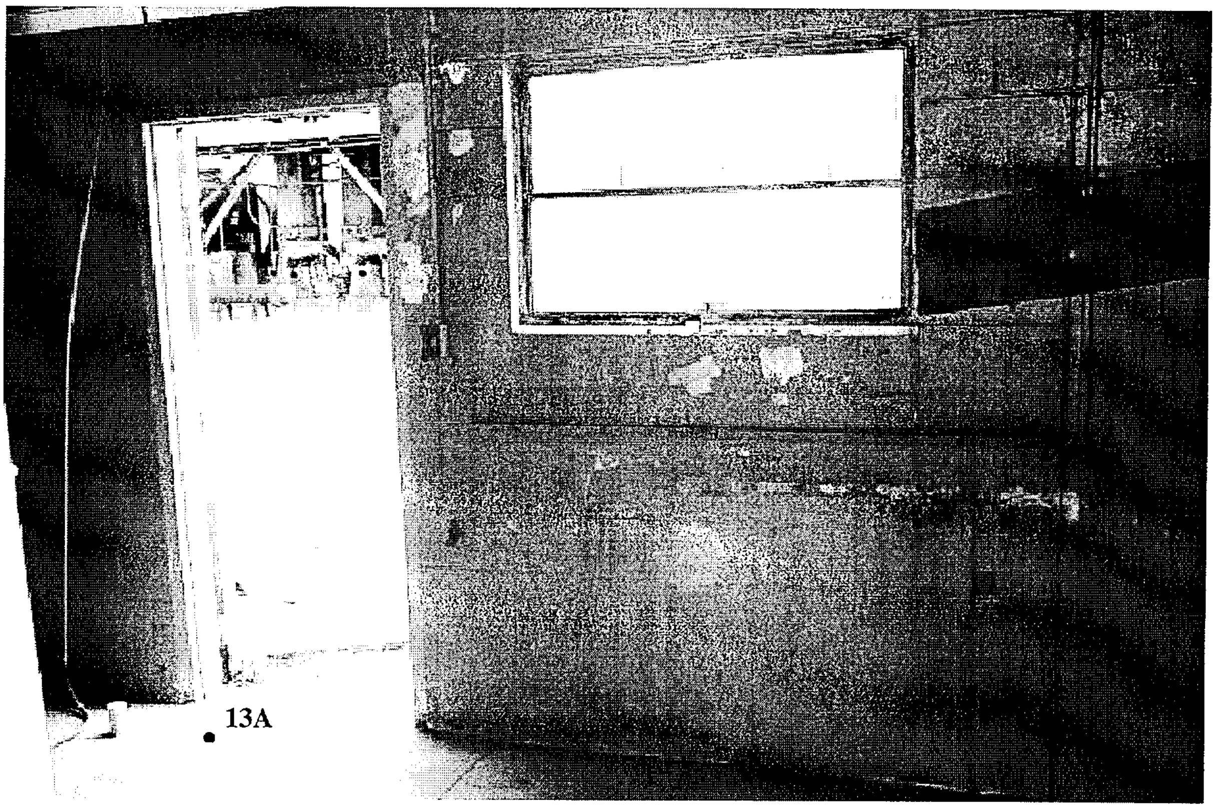
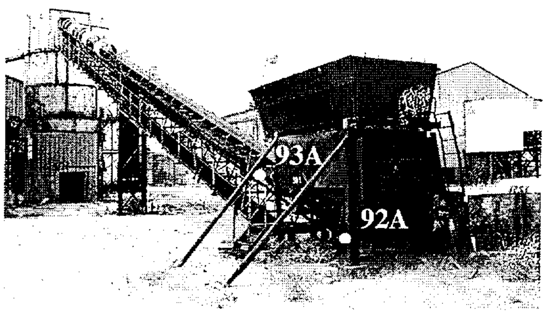


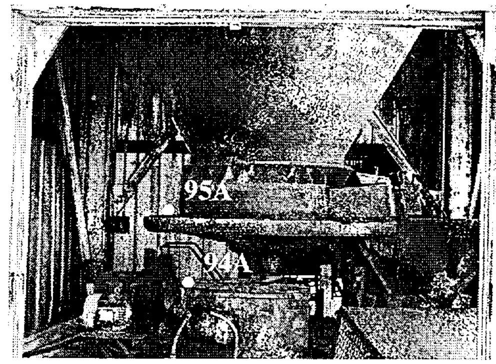
FIGURE 3: Heritage Minerals Site - Location of Surveyed Areas

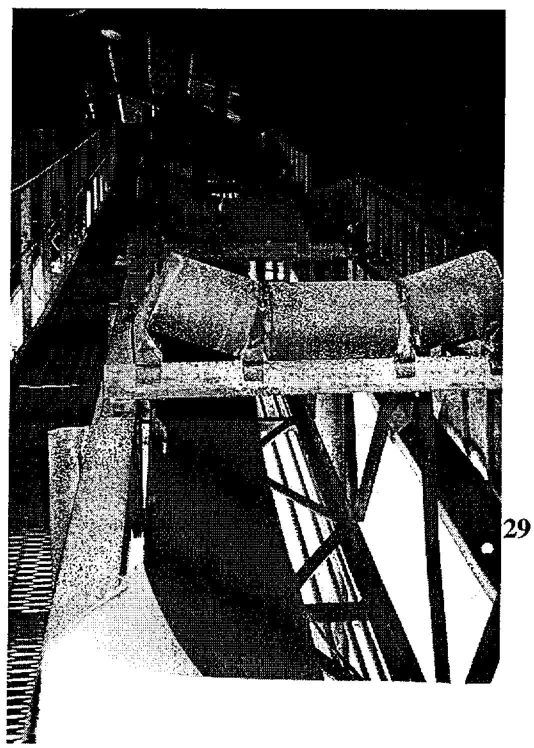


MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

FIGURE 4: Laboratory — Location of Measurement 13A





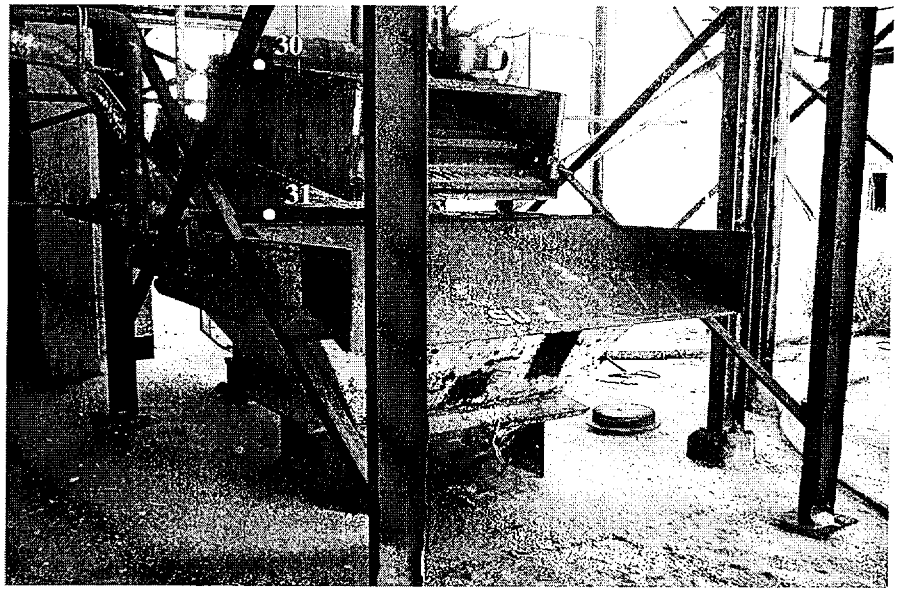


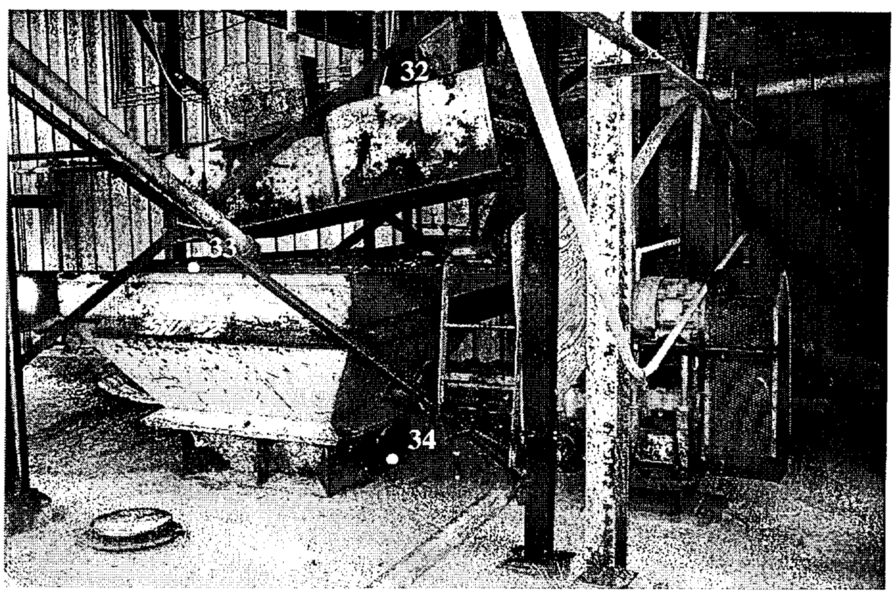
MEASUREMENT/SAMPLING LOCATIONS

● # SINGLE POINT

NOT TO SCALE

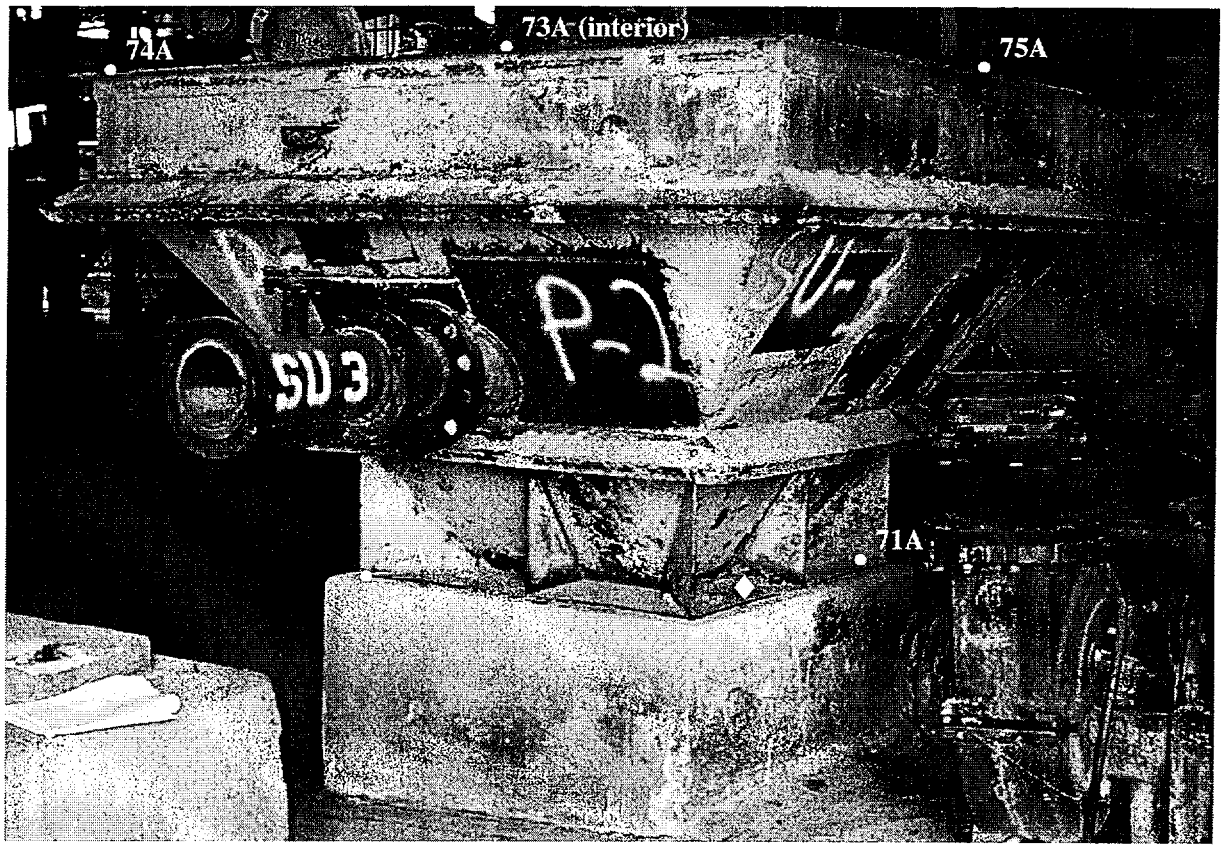
FIGURE 5: Survey Unit 1 — Direct Measurement and Sampling Locations





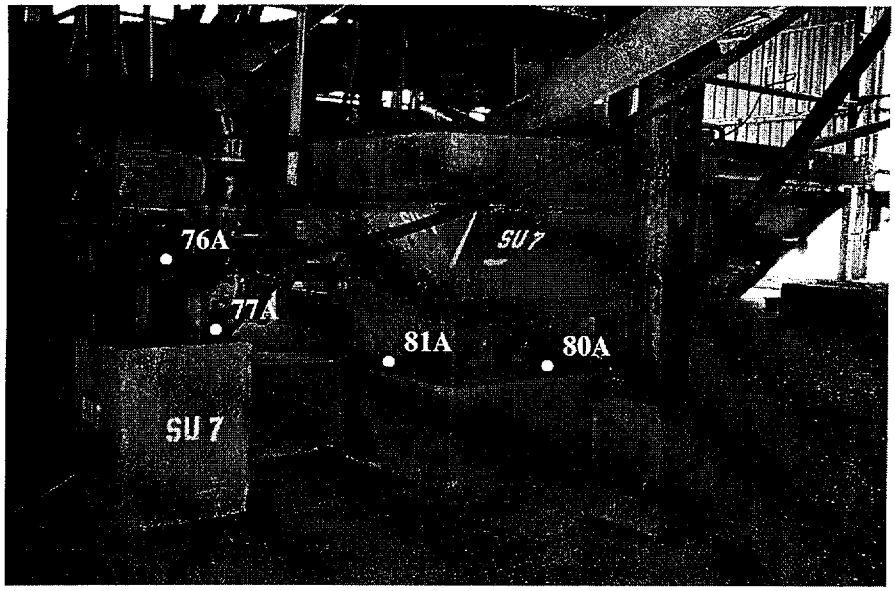
MEASUREMENT/SAMPLING LOCATIONS	NOT TO SCALE
• # SINGLE POINT	

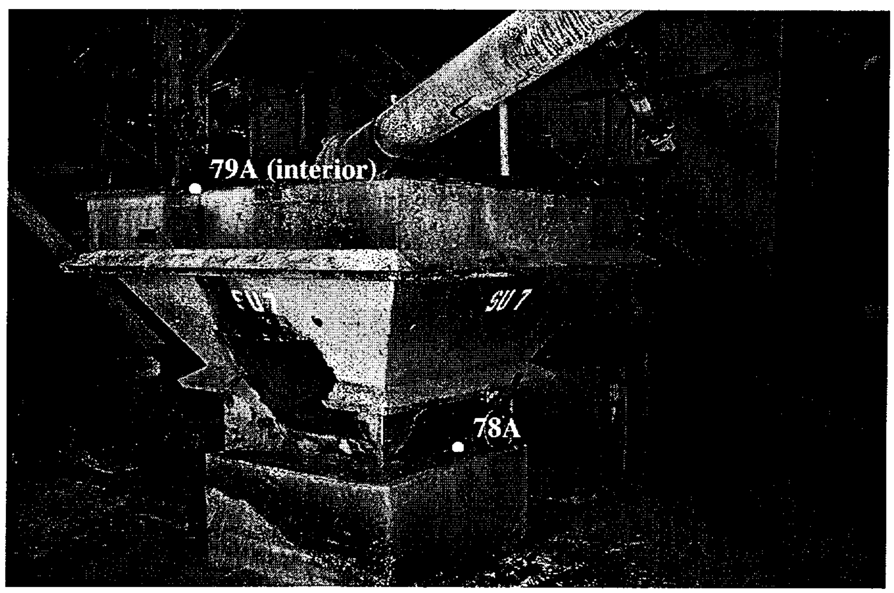
FIGURE 6: Wet Mill, Survey Unit 2— Direct Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS	NOT TO SCALE
● # SINGLE POINT ♦ RESIDUE SAMPLE	

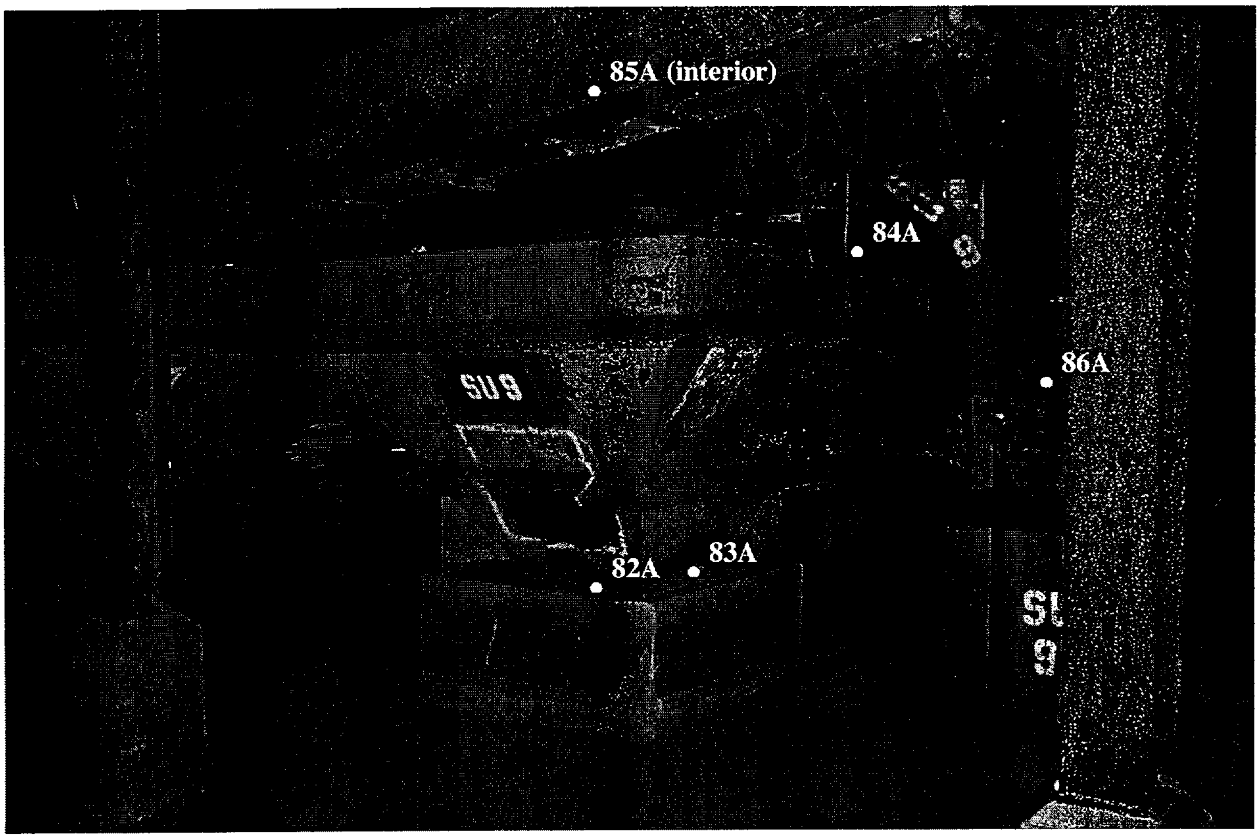
FIGURE 7: Wet Mill, Survey Unit 3 — Direct Measurement and Sampling Locations





MEASUREMENT/SAMPLING LOCATIONS ● # SINGLE POINT	NOT TO SCALE

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

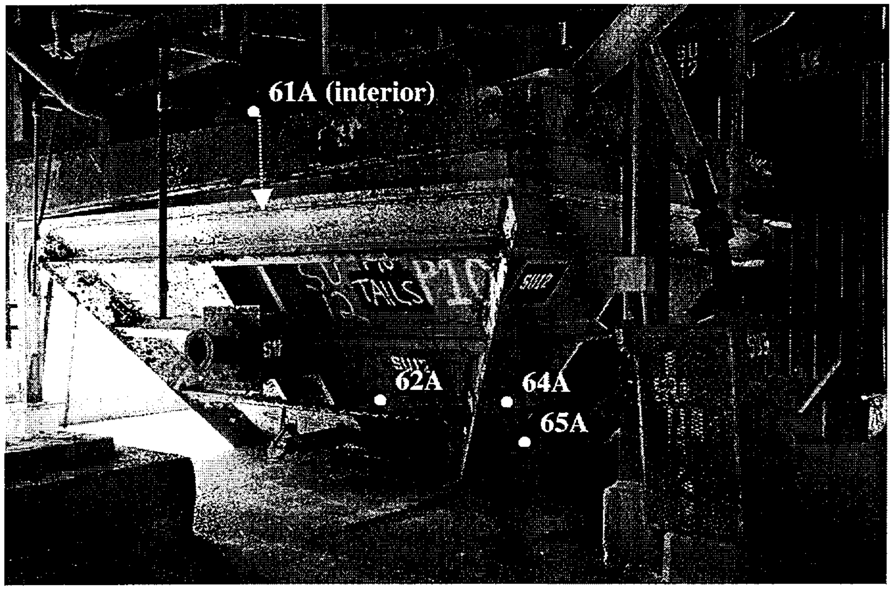


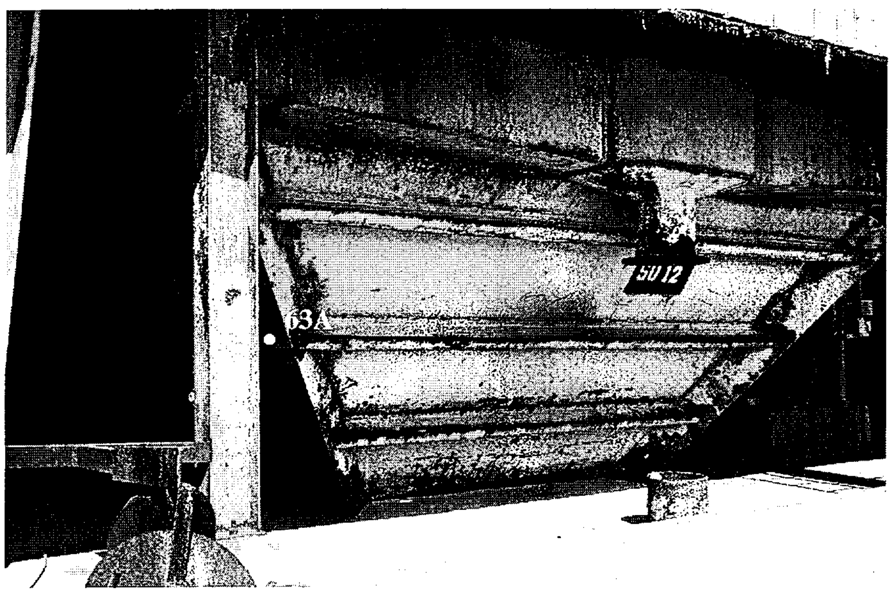
MEASUREMENT/SAMPLING LOCATIONS

● # SINGLE POINT

NOT TO SCALE

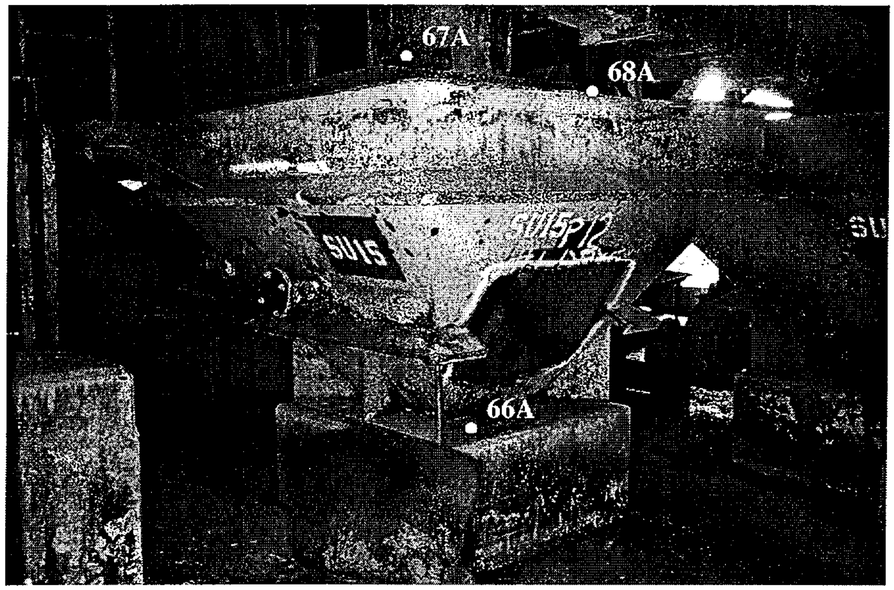
FIGURE 9: Wet Mill, Survey Unit 9 — Direct Measurement and Sampling Locations

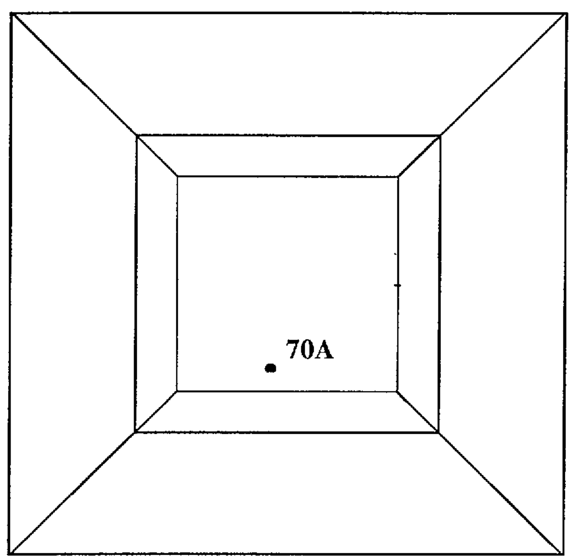




MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

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

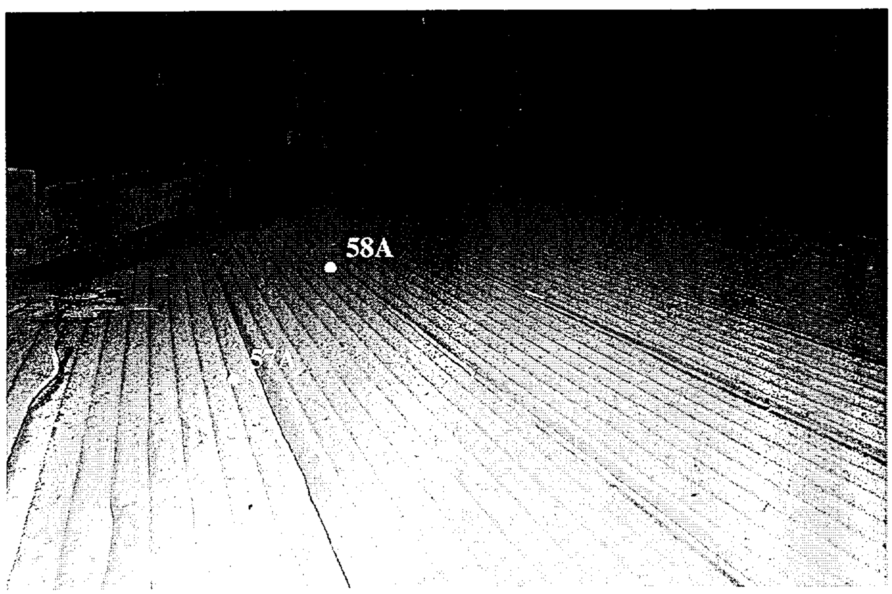




INTERIOR

MEASUREMENT/SAMPLING LOCATIONS ● # SINGLE POINT	NOT TO SCALE

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

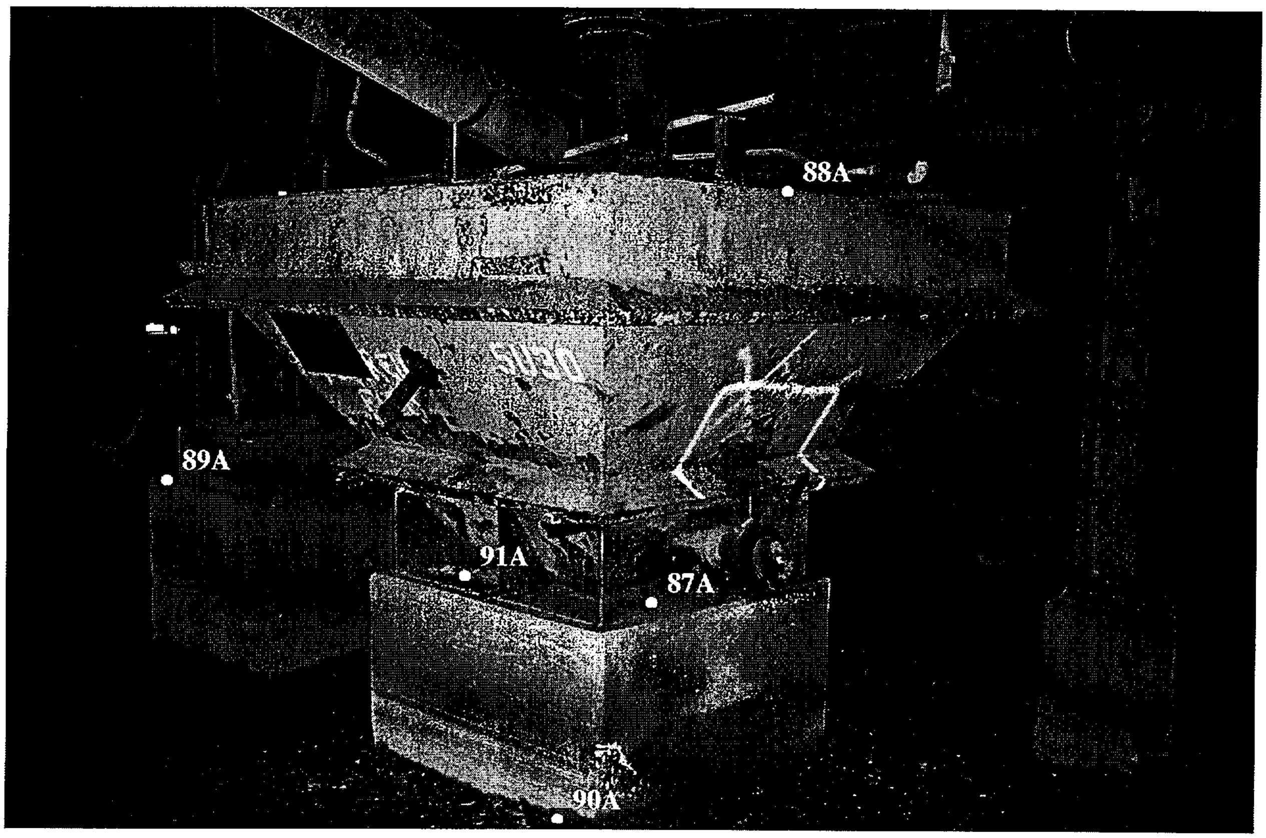


MEASUREMENT/SAMPLING LOCATIONS

• # SINGLE POINT

NOT TO SCALE

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

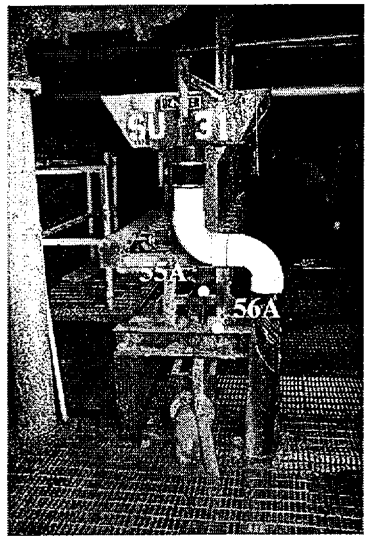


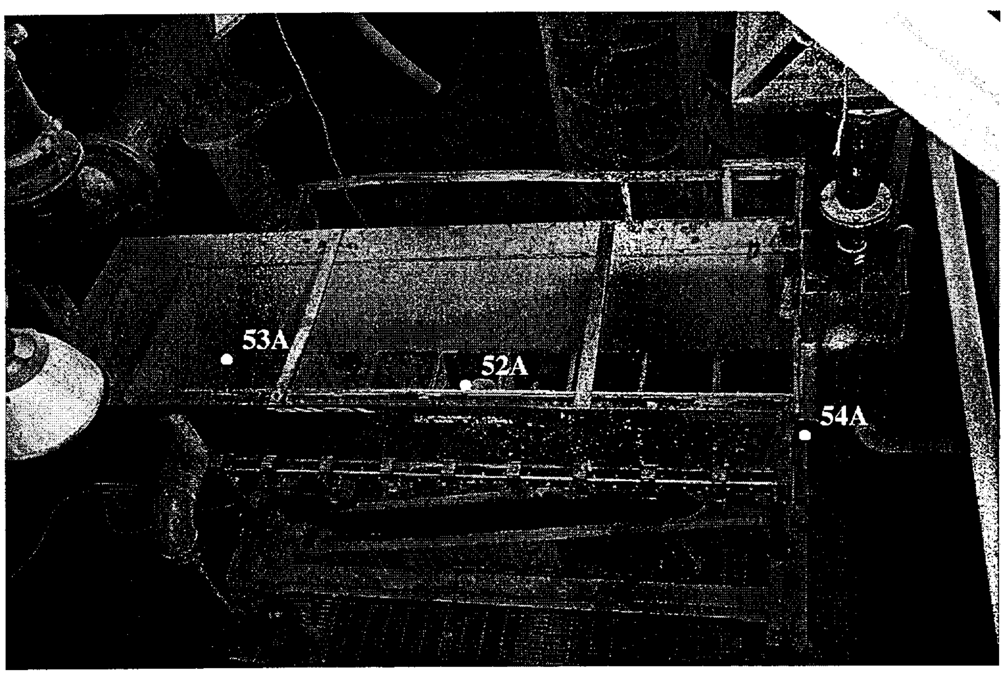
MEASUREMENT/SAMPLING LOCATIONS

● # SINGLE POINT

NOT TO SCALE

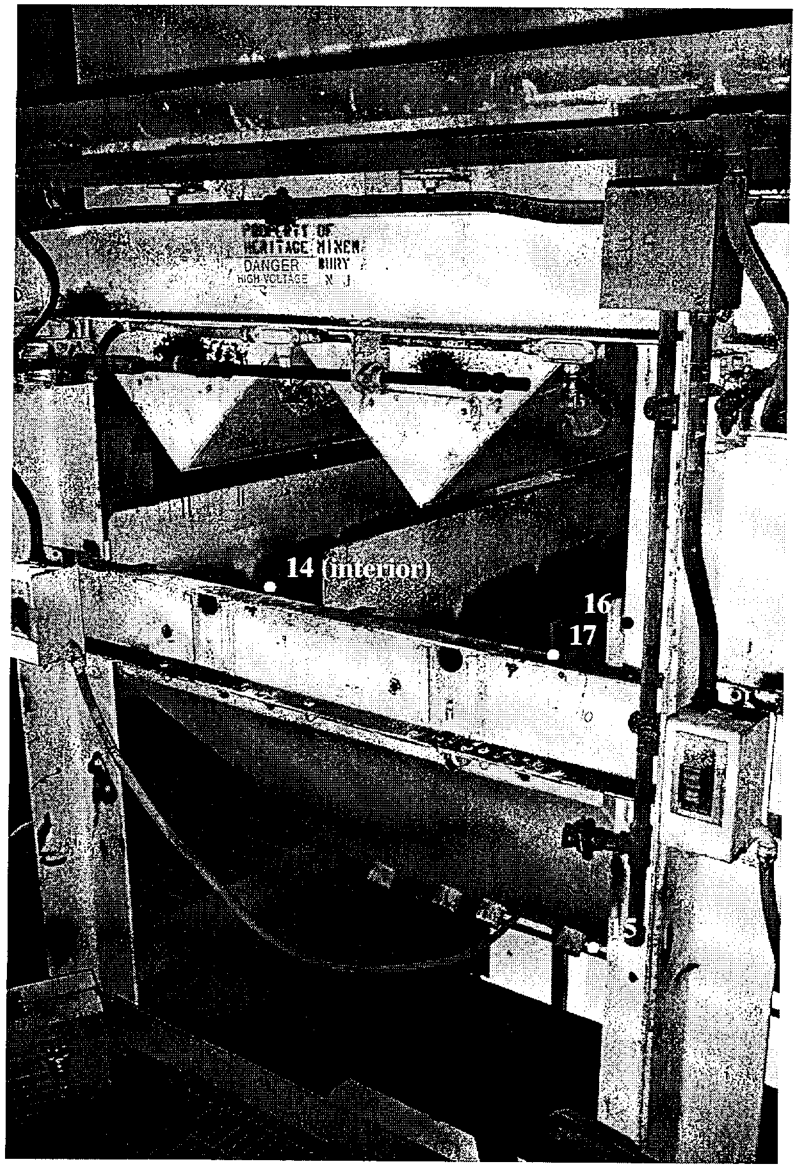
FIGURE 13: Wet Mill, Survey Unit 30 — Direct Measurement and Sampling Locations





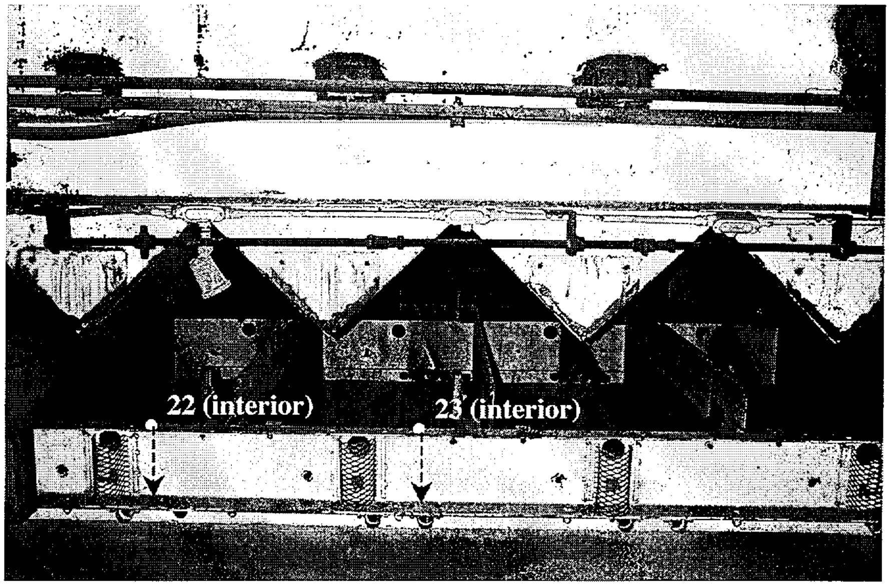
MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

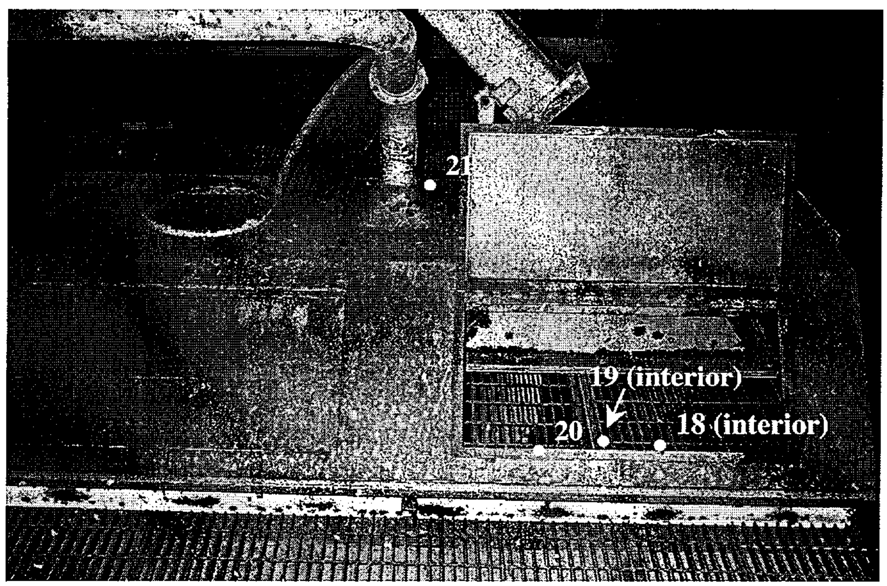
FIGURE 14: Wet Mill, Survey Unit 31 — Direct Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS	NOT TO SCALE
• # SINGLE POINT	

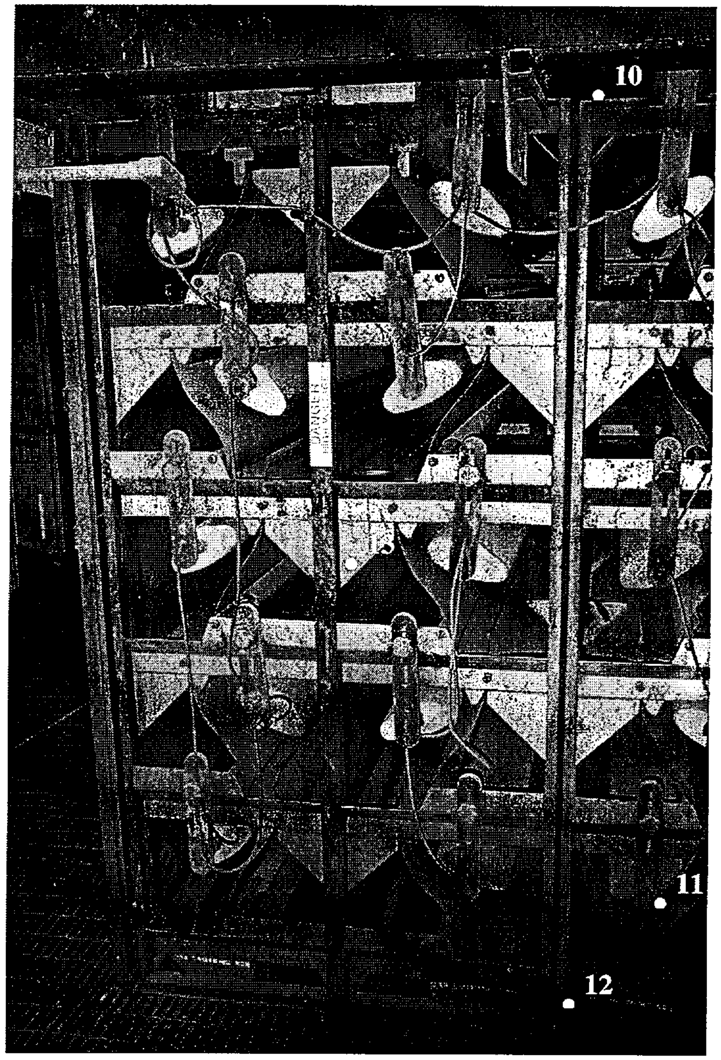
FIGURE 15: Dry Mill, Survey Unit 35 — Direct Measurement and Sampling Locations





MEASUREMENT/SAMPLING LOCATIONS • # SINGLE POINT	NOT TO SCALE

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

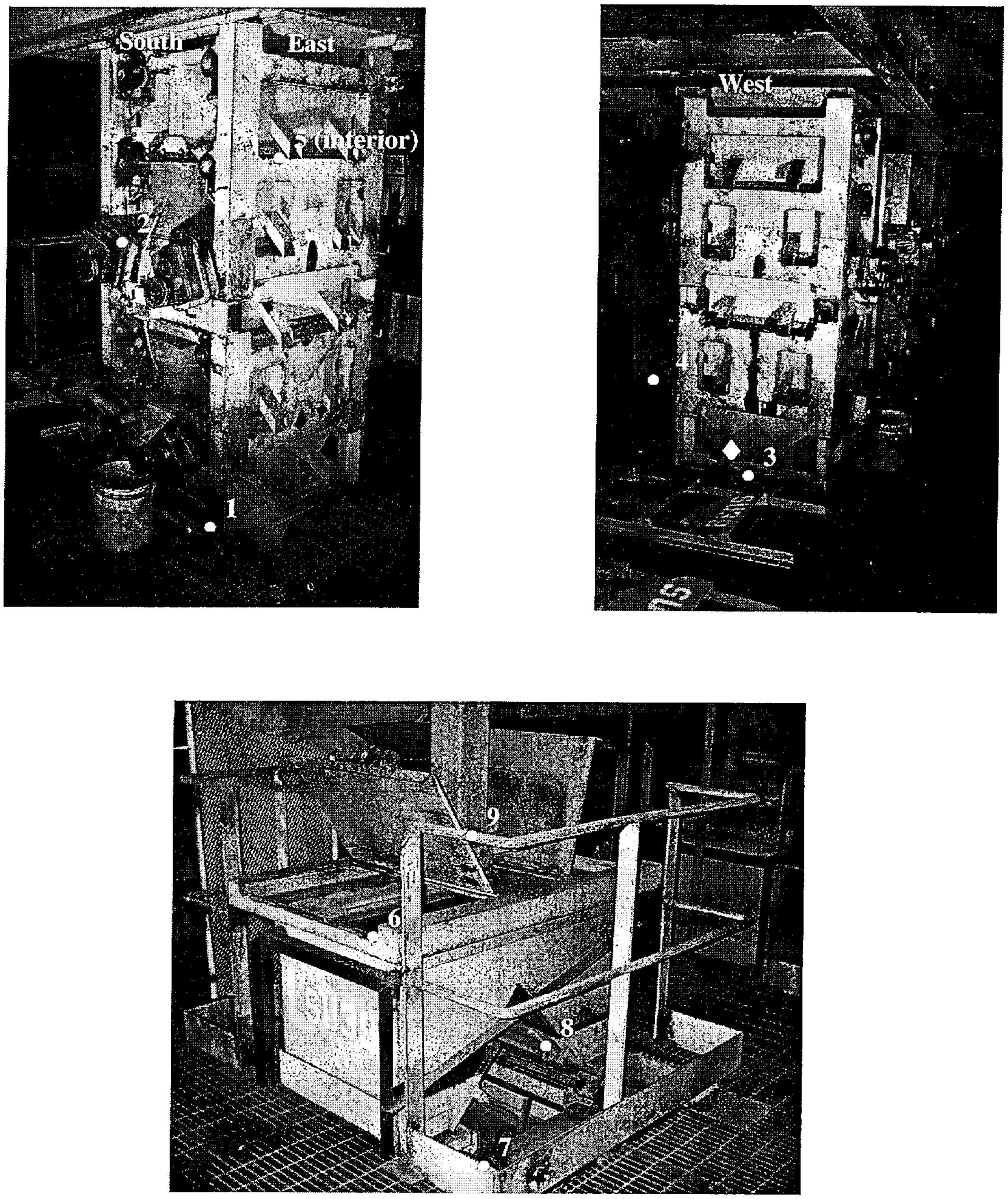


MEASUREMENT/SAMPLING LOCATIONS

● # SINGLE POINT

NOT TO SCALE

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



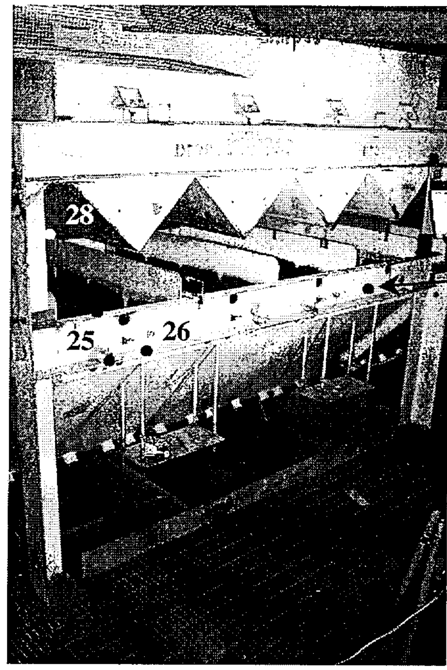
MEASUREMENT/SAMPLING LOCATIONS

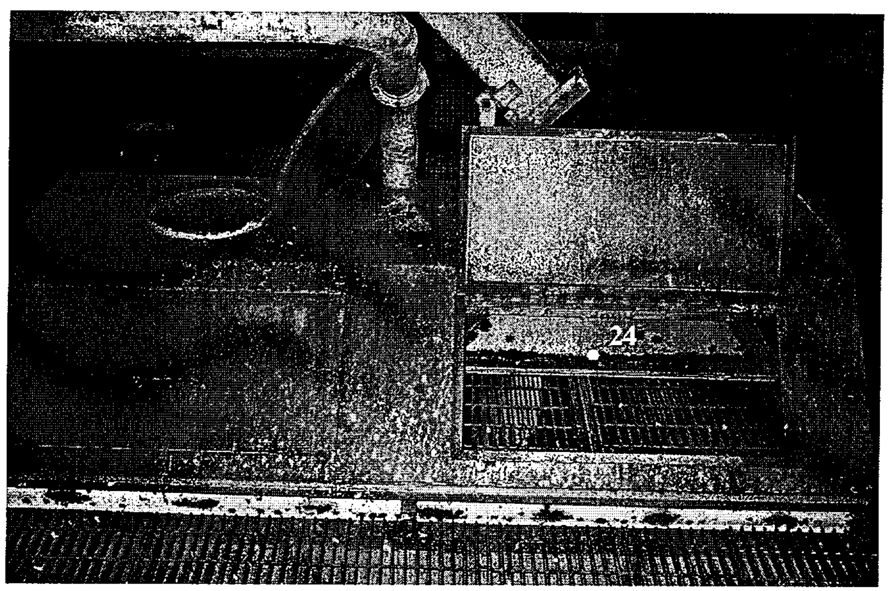
● # SINGLE POINT

♦ RESIDUE SAMPLE

NOT TO SCALE

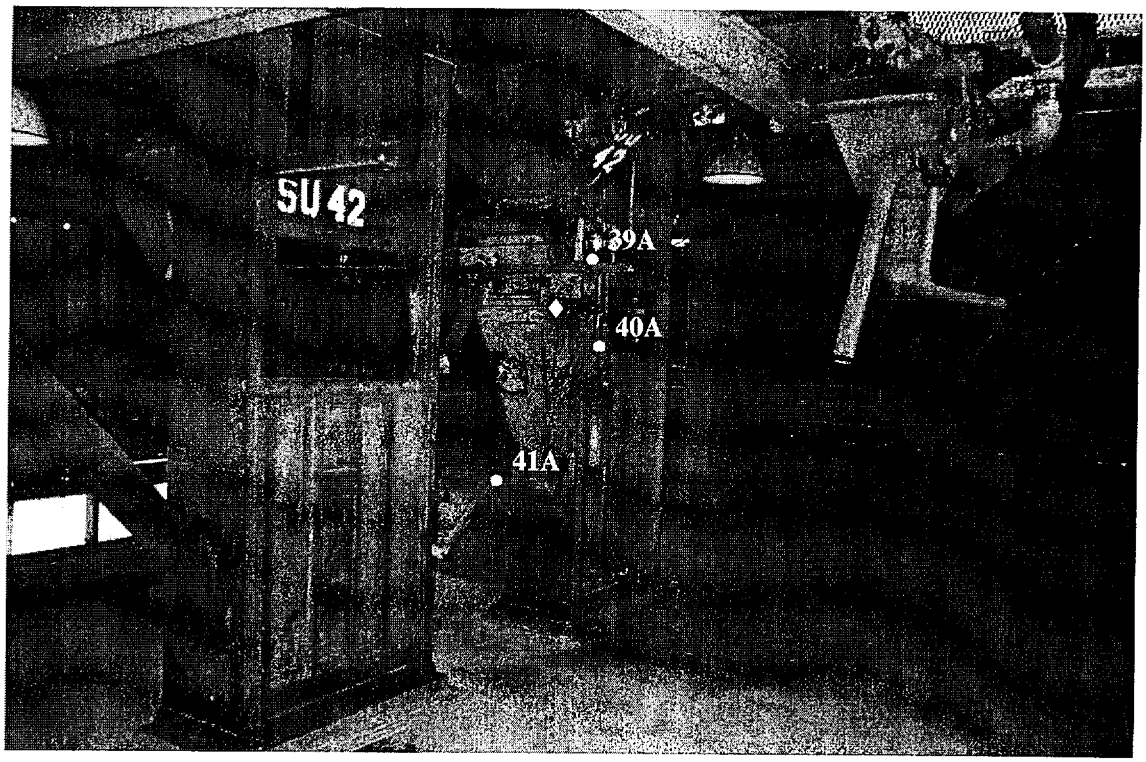
FIGURE 18: Dry Mill, Survey Unit 39 — Direct Measurement and Sampling Locations





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

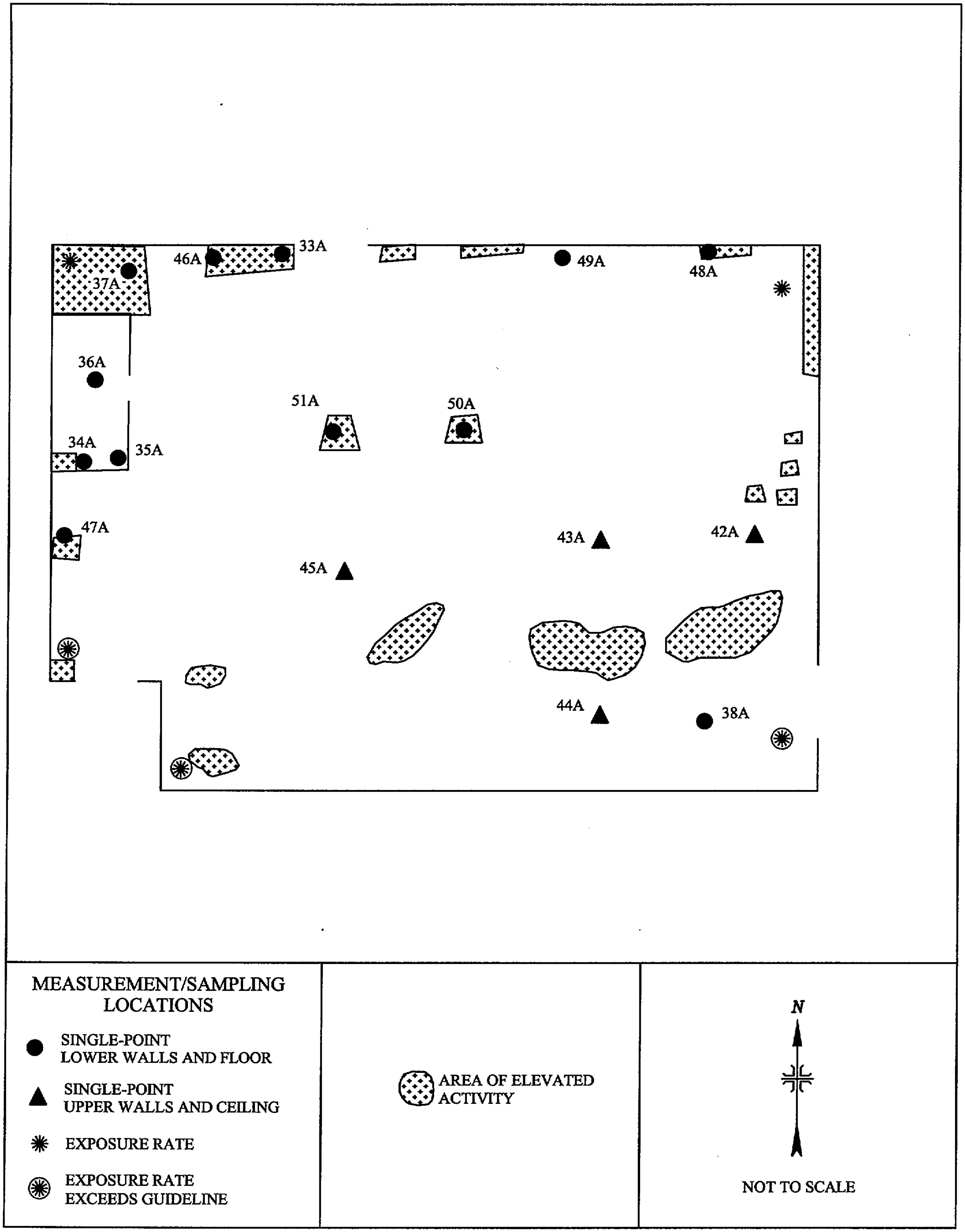


FIGURE 21: Dry Mill, Ground Floor - Measurement and Sampling Locations

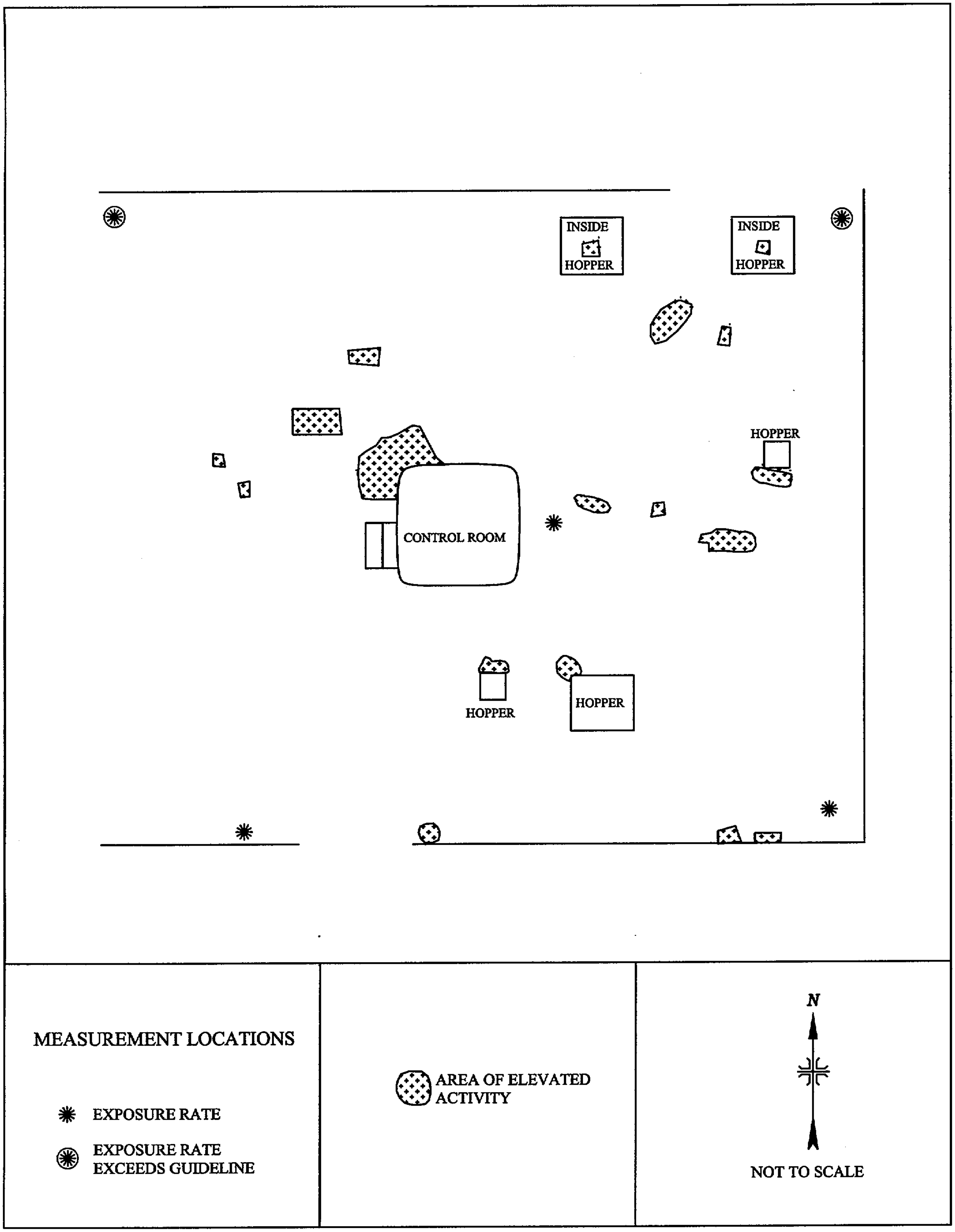


FIGURE 22: Wet Mill East End, Ground Floor - Measurements Locations

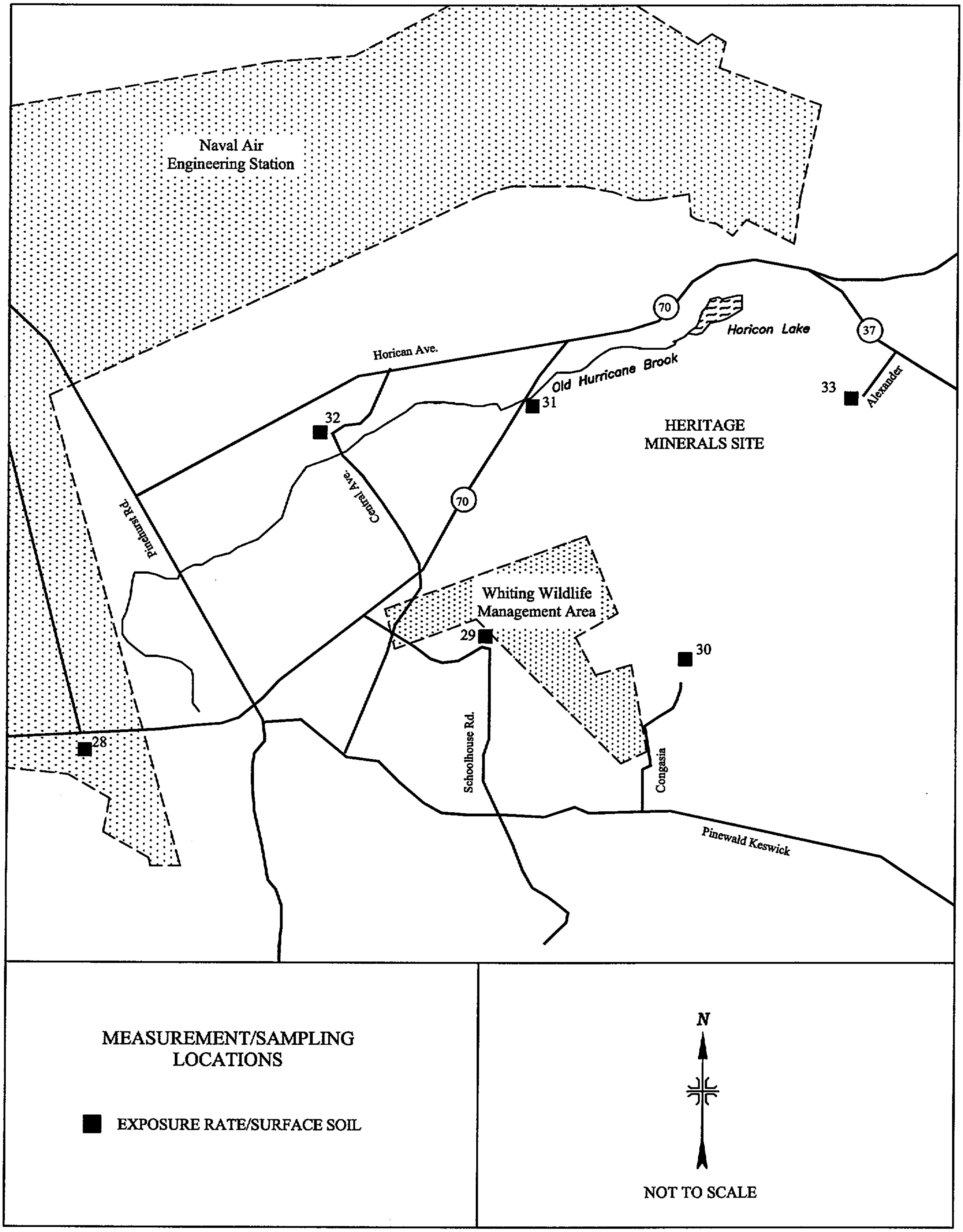


FIGURE 23: Heritage Minerals - Background Measurement and Sampling Locations

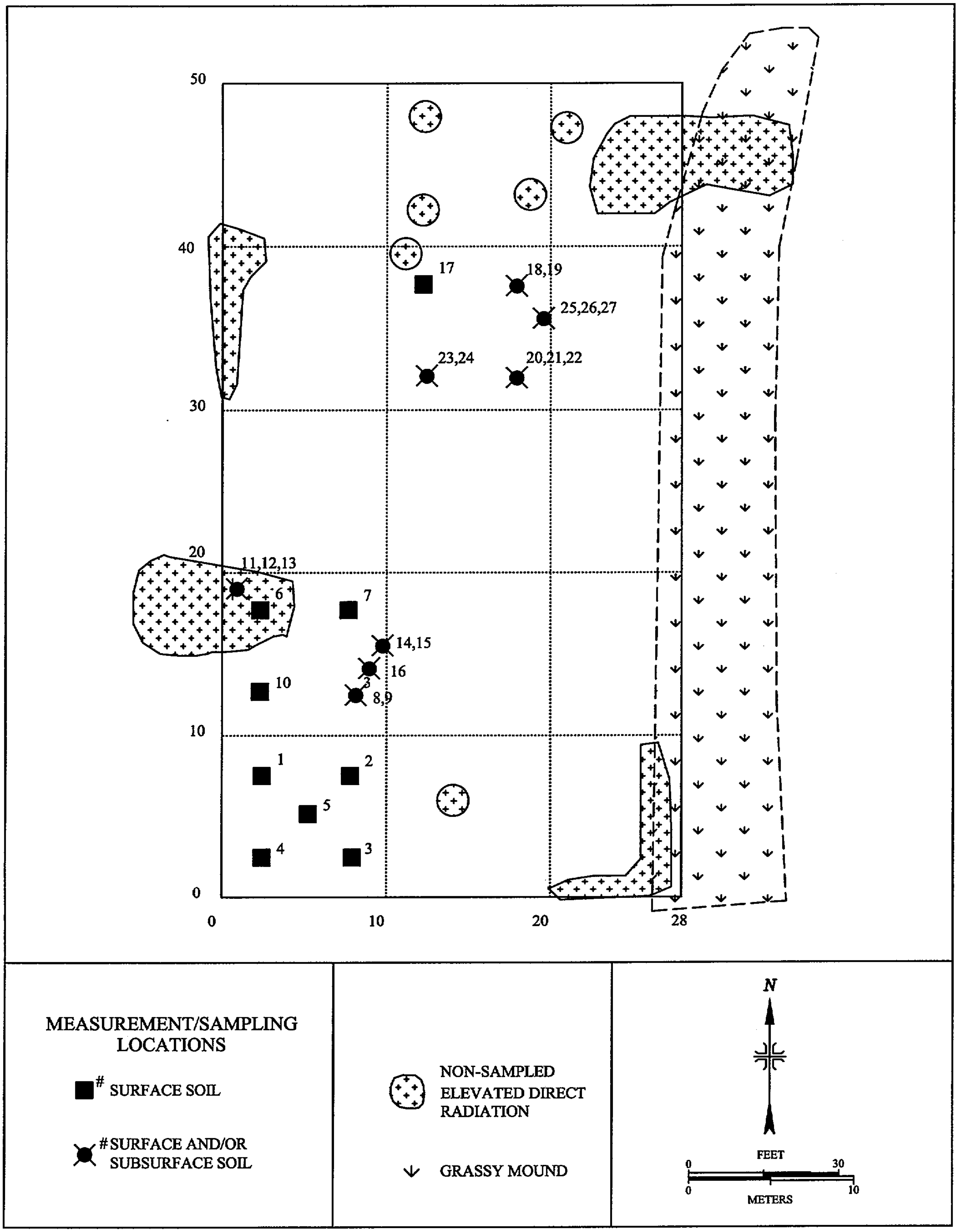


FIGURE 24: Former Monazite Pile - Measurement and Sampling Locations

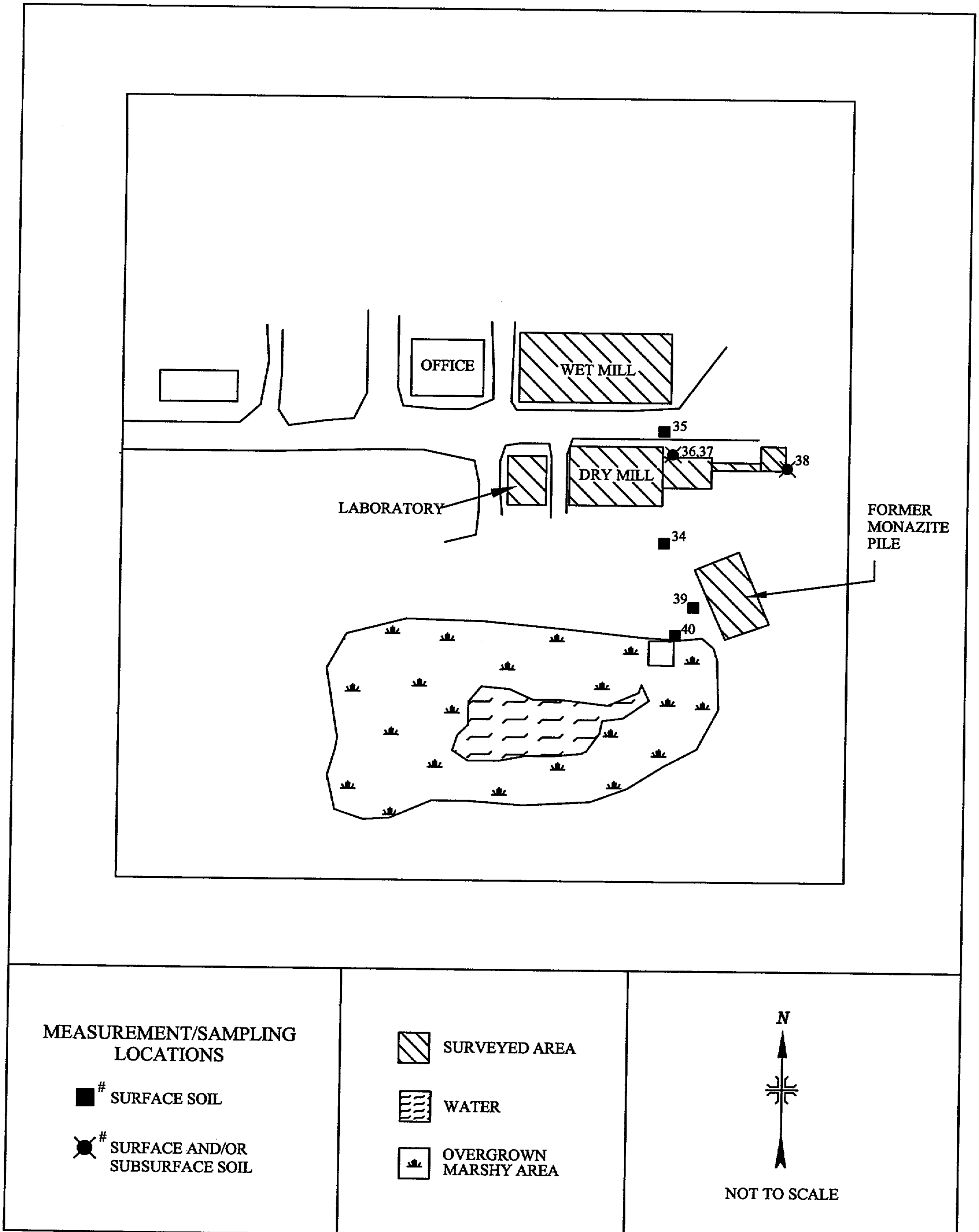


FIGURE 25: Heritage Minerals Site - Exterior Measurement and Sampling Locations

TABLES

TABLE 1

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
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 cm^2)		Removable Activity (dpm/100 cm^2)	
	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 cm^2)		Removable Activity (dpm/100 cm^2)	
	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 cm^2)		Removable Activity (dpm/100 cm^2)	
	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 4 (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 4 (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

[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)$^{1/2}$ = 231cpm

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.

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 cm²	15,000 dpm α/100 cm²	1,000 dpm α/100 cm²
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm²	300 dpm/100 cm²	20 dpm/100 cm²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm²	3,000 dpm/100 cm²	200 dpm/100 cm²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. cm²	5,000 dpm βγ/100 cm²	15,000 dpm βγ/100 cm²	1,000 dpm βγ/100

[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 cm².

[e]The amount of removable radioactive material per 100 cm² 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.

Heritage Minerals, Inc.

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March 26, 2002

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

Dear Mr. Bellamy:

I am writing in response to your letter of February 14, 2002 regarding site decommissioning efforts at Heritage Minerals, Inc.'s (HMI) Lakehurst, New Jersey site.

Site decommissioning issues at the HMI Lakehurst site can be divided into two general categories: (1) remaining soil contamination within the monazite pile storage area and potential soil contamination at other areas of the site and (2) remaining contamination in the mill buildings (wet and dry).

1. Soil Contamination

Your letter indicates that HMI will need to do additional surveys and sampling in accordance with NUREG-5849 to meet commitments in the site FSSP, and to provide a strategy for "verifying that all *licensed material previously part of the pile* has been successfully removed from the site."

2. Monazite Pile Storage Area

HMI recognizes that there may be some additional soil sampling to demonstrate that surface soil concentrations in certain of the grids in the monazite pile area satisfy the 10pCi/g limit for unrestricted release. However, information that has come to light from the ORISE sampling indicates that there are areas in some other grids within the monazite pile storage area where concentrations of material are higher below grade even after significant amounts of surface soil and the stored monazite have been removed and shipped to International Uranium Corporation (IUC) for processing. HMI believes that, without some additional sampling, confirmatory sampling in accordance with NUREG-5849 in these areas is no longer relevant activity. Indeed, attached hereto is a sampling protocol proposed by Radiation Science, Inc. (RSI) to characterize fully the scope and nature of elevated concentrations of radionuclides *within* the monazite pile area identified by ORISE. Presently, it is HMI's position that these elevated concentrations *likely* are not from the monazite placed and stored in the monazite area by HMI. HMI believes that it can provide information that will reasonably demonstrate how much monazite material it placed in the monazite pile area. Even if the documentation is not precise, it will be adequate since HMI has scraped up and removed more than twice the amount of monazite material it estimated was placed within the licensed monazite storage area. The "unbarrelled" monazite was covered and fenced at all times so significant windblown monazite contamination would not be a reasonable assumption. As regular radiation surveys by HMI's RSO (A.E. Albrethsen) demonstrate, readings outside the pile area essentially remained the same since the material was placed there. Simple mathematics suggests that HMI has already removed a significant amount of material that was not placed there by HMI and, consequently, was not technically subject to NRC jurisdiction. Additionally, since the cover allowed infiltration of precipitation, the "unbarrelled" material was generally moist including when it was removed. To the extent there was some potential for leaching due to infiltration to cause the contamination at the depth of some of ORISE's samples, HMI will address the issue.

As to elevated concentrations in areas around the mill other than *within* the monazite storage area, any such materials were not placed there by HMI, and, to the extent there are not source material concentrations, HMI takes the position that NRC has no jurisdiction over any such materials, and, thus, they are not relevant to the license termination process. HMI will vigorously resist attaching NRC jurisdiction to materials that are (or were) not from the monazite placed in the monazite storage area.

HMI is developing processing history information regarding how much monazite it placed in the storage area and where processed material from other operations was placed to provide reasonable assurance that any remaining materials, either within or without the monazite pile area that contain elevated concentrations, were not put there by HMI. It is HMI's position that, unless there are licensable source material concentrations, they are not within NRC's jurisdiction. HMI will also endeavor to do some geo-technical analysis of the characterization data which we believe will indicate that the elevated concentrations at depth *within* the monazite storage area could not have come from the monazite placed out there that was the subject of NRC licensing actions.

HMI will take the data from the above noted characterization activities and, at that time, in conjunction with NRC, make decisions about what, if anything, must be done. For example, if it is determined that the licensable source material within the monazite pile area is a limited amount of material, it may make sense to remove it and send it to IUC. On the other hand, if there is a large quantity of material, HMI has no particular interest in funding the disposal of materials which it did not place there, especially in light of the fact that it is now clear that HMI has already incurred substantial costs to remove material that it did not place on the site.

3. **Mill Buildings**

HMI recognizes that the ORISE data utilizing beta/gamma sampling suggests that there may be some significant pockets of contamination remaining in the mills. First, there are some areas where it appears that there has been some settling out of material since RSI surveyed the area (*e.g.*, elevator shaft area), and secondly, there are some pockets which are inaccessible or are contained inside equipment that must be completely disassembled prior to cleaning, and, thirdly, the beta/gamma scans suggest some very high readings that the alpha scans did not reveal. HMI wants to review ORISE's sampling protocol and laboratory analysis protocols. ORISE's scanning methodology may be too conservative and may greatly overestimate any remaining surface contamination. HMI will discuss those matters with NRC when it has had an opportunity to do the necessary analysis of ORISE's data and methodology.

It has also come to light that some of ORISE's measurements were in areas of the wet and dry mills that were never utilized by HMI at any time during its processing activities. This raises another question about the proper scope of NRC's jurisdiction for license termination purposes. HMI is investigating the feasibility and cost of dismantling the wet and dry mills and cleaning any materials or equipment that are to be salvaged so that they can be released for unrestricted use. The question of HMI's responsibility for cleaning up contamination that was not caused by HMI and which is not at source material levels is a thorny one that remains to be addressed with NRC.

HMI will not proceed with the characterization of or other confirmatory surface sampling *within* the monazite storage area without a written signoff by NRC *and* ORISE. As soon as we have received a sign-off from NRC and ORISE, RSI will perform the characterization sampling and develop the results. In the meantime, HMI is continuing to develop process history information and to investigate dismantling and cleaning the mills. When all of these tasks have been completed, HMI would propose a meeting with NRC to discuss the status of license termination efforts.

HMI believes it will be able to show that the licensed monazite in the monazite pile area has been appropriately remediated. Hopefully, remediation of the licensed areas in the wet and dry mills can be done expeditiously as well to get the "SDMP" licensed materials off of NRC's books.

I will mention one final note that I believe needs to be addressed. HMI has proceeded in good faith to satisfy relevant NRC schedules for decommissioning the facility. It was always recognized that, although there is a clear definitional dichotomy between the NRC-licensed Atomic Energy Act (AEA) materials and non-AEA materials, physically, chemically and radiologically, they are similar. This suggested from the beginning that there could be difficulties differentiating and cleaning up only the NRC-licensed materials for license termination. For example, the effect of "shine" on sampling accuracy was a potentially significant issue. It turns out that these issues likely are significantly more complicated than anyone anticipated. As a result, HMI requests an exemption from, or an extension on, any relevant NRC regulatory time frames. Any enforcement action would be unfair and, more importantly, unnecessary in view of the cooperative efforts made by HMI and NRC staff (with the advice of NJDEP) to terminate the HMI license.

Sincerely,

John J. Lord

John Lord

(RBellamyltr.doc)

cc: A. J. Thompson, PC
Tom Bracke, RSI

ATTACHMENT

Sampling Protocol

The monazite pile created by Heritage Minerals was placed in a specific, more limited area that which had previously been used to deposit tailings from various processes. In spite of this, because of the levels of naturally occurring radionuclides associated with heavy metals deposits on the site and site processing history, it may be difficult to distinguish between material that preexisted the HMI monazite pile. Since the pile was bounded by a fence and covered with a weighted tarp to prevent windblown contamination, it is unlikely that large amounts of material placed in the monazite pile by HMI could have been disbursed locally in the surrounding areas. As a result, it is necessary to perform further site characterization work to attempt to identify (with site processing history) any contamination that may be the responsibility of HMI. The purpose of this protocol is to establish a clear picture of the location of remaining materials, characterize them in our attempt to substantiate their origin, and to determine what material may have to be removed or otherwise addressed to complete the remediation.

1. Tie the grid coordinate system to the State Plan Coordinate system to establish a more accurate and reproducible mapping of the area where the monazite pile was located. The grid system will be established over the pile location and extend beyond the boundaries of the "fence-line" a reasonable distance. A square grid will be defined on 20-foot centers. Elevations will be obtained at each grid intersection. Approximately 80 intersections, representing 63 grids will be marked.

2. A shielded sodium iodide detector will be used to obtain an integral count-rate of the gamma flux at the surface and at 1-meter height above each intersection and at each 2-foot subdivision of the grid. The data will be used to construct a 3-D map of the area showing locations of higher concentrations. The ratio of surface to elevated measurement will be useful to predict depth of contamination.

3. A Geo-probe will be used to extract a 1 to 2-inch core sample at each grid intersection and at the center of each location where the gamma flux is indicative of higher concentrations of material. Each core will be divided into 6-inch lofts that will be analyzed by gamma spectroscopy using a sodium iodide detector system.

4. Analysis of each core sample will be conducted on site or at a local facility where proper analytical and Quality Controls can be implemented. Samples will be analyzed using a "Prospector" portable multi-channel analyzer with a 2 or 3-inch sodium iodide scintillation detector mounted in a lead cave. Samples will be counted in marinelli geometry. Total uranium activity will be calculated as twice the activity of the ^{214}Pb daughter in equilibrium accounting for both isotopes of Uranium (^{238}U and ^{234}U) in the decay chain. Total thorium will be calculated as twice the activity of the ^{228}Ac daughter in equilibrium plus the total uranium concentration accounting for the two isotopes of Thorium (^{232}Th and ^{228}Th) in the Thorium decay chain and the two isotopes of Thorium (^{234}Th and ^{230}Th) in the Uranium decay chain. Total Thorium and total Uranium will be independently compared to the 10 pico-curie per gram release criteria.

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.

Heritage Minerals, Inc.

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REGION 1

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April 15, 2002

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

RE: USNRC LICENSE #SMB 1541, FINAL STATUS SURVEY

Dear Mr. Bellamy:

Please find attached a copy of the RSI November 28, letter transmitting the Final Status Survey, with Appendices which was not included with the copy (disc) sent to the NRC. Please excuse the oversight.

As per your request for a second disc, this will be sent to you ASAP.

Sincerely yours,

John F. Lord, PE

JFL:vg

cc: Craig Gordon, NRC
A. J. Thompson, Esq.
Tom Bracke, RSI

RSI

Radiation Science Inc.
10 South River Road
Cranbury, NJ 08512

November 28, 2001

Mr. John Lord
Hovnanian Industries
One Hovchild Plaza
4000 Rt. 66
Tinton Falls, NJ 07753

Dear Mr. Lord:

Enclosed please find the report detailing the results of the Final Status Survey performed at the Heritage Minerals site in Lakehurst, New Jersey during the summer and fall of 2001. The report is in 4 volumes, as follows:

Volume I	Report Text
Volume II	Appendix A, Part 1 (Survey Units 1 through 27)
Volume III	Appendix A, Part 2 (Survey Units 27 through 46)
	Conveyors Belts, Fencing and Tires
Volume IV	Appendix B (Soil Sample Results)
	Appendix C (Final Site Survey Plan)
	Appendix D (Calibration Certificates)

If you have any questions or require further assistance, please feel free to contact me.

Sincerely,

Joel Antkowiak, Field Services Manager
Radiation Science Inc.

Phone: 609 395-1996 email: staff@radsci.com fax: 609 395-1178

RSI

Radiation Science Inc.
10 South River Road
Cranbury, NJ 08512

April 22, 2002

Mr. John Lord
Hovnanian Industries
One Hovchild Plaza
4000 Rt. 66
Tinton Falls, NJ 07753

Re: Response to the ORISE Report

Dear Mr. Lord:

This letter provides our response to the ORISE report with regard to the mill buildings at the HMI facility. We conclude that ORISE has overstated the activity of any remaining materials, but demonstrated the need for additional cleaning and decommissioning activities prior to the release these facilities. The following paragraphs present our technical arguments and propose an alternative method for proceeding with the release of these facilities.

The mill buildings at Heritage Minerals, Inc. were surveyed for final release by detection of the alpha emission rate to quantify direct and removable characteristics of radioactive contamination. Measurement of the alpha emission rate was chosen to make a practical determination of the activity for comparison against the release criteria in Regulatory Guide 1.86. This simplification is possible for two reasons: 1) alpha particles are easy to distinguish from other radiation using standard survey methods (utilizing energy discrimination), and 2) once corrected for detector efficiency, the conversion between the alpha emission rate and isotopic activity is one-to-one.

ORISE argues however that because the alpha radiation can theoretically be shielded more readily than other types of radiation by rust, paint, or minor debris on the surface of potentially contaminated equipment, and therefore adversely affect detector efficiency, the measurement of alpha radiation alone is insufficient to account for all radioactive material present. ORISE attempts to correct for this problem by using instrumentation setup to detect beta radiation, which is not subject to the same shielding characteristics. Since only the alpha and beta radiation correspond uniquely with decay events, counting hits radiation alone would represent an accurate determination of the activity for comparison against the release criteria. The concept deserves merit but the ORISE procedure is inherently flawed because their methods lack ability to distinguish between concurrent beta and gamma radiation.

Because gamma radiation varies with yield (there can be as many as 200 gamma rays emitted per decay event) and energy (most of the gamma rays are emitted in the low energy spectrum), it is only possible to associate gamma rays with individual decay events using proportional counting methods. Although ORISE used gas proportional detectors to perform their survey, ORISE employed single channel analyzers, with no energy threshold or window to process the proportional signal. Thus, ORISE cannot distinguish between beta particles that deposit their energy in the gas volume of the detector and electrons that are "knocked" into the gas volume as a result of gamma rays "striking" the detector wall. Therefore, it is our opinion that the activity measured by the ORISE technique "counts" multiple gamma ray emissions and interprets these counts as individual decay events, hence grossly overstating the true activity.

A crude approximation of the overstatement can be obtained by a simple experiment (described in more detail below). Placing a 3/8" Plexiglas shield between the detector and source while maintaining the source to detector geometry will eliminate the beta component and allow an estimation of the overstatement. The results of estimating the gamma contribution by this method imply that the measured

RSI

Radiation Science Inc.
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Cranbury, NJ 08512

count rate is overstated by as much as 33%. If we take 33% off the ORISE numbers, the picture looks much different inside the mills. Instead of the broad conclusion that nothing is releasable, the picture is one of a few isolated hotspots or accumulations of material in hard to reach places.

Still, both ORISE's and RSI's data raise the question of what efficiency to apply to the count rate to properly convert the measured count rate to dpm. Alpha counting raises the issue of geometric efficiency (a practical concern), while attempting to count beta radiation raises questions regarding the more theoretical concerns of energy efficiency and detector response. It seems that neither is sufficient alone to determine an acceptable release.

Perhaps the most practical solution is presented in the ORISE report itself. The report quotes the 1991 NRC guideline for exposure rates at one meter above building surfaces as being 5 μR/h above ambient background. Since this methodology measures only the gamma emissions that are not affected by shielding concerns and the acceptable exposure rate has been determined based on the NRC's radiological considerations, then perhaps this should be used as the criteria for release of equipment from the mills.

Applying this criterion to the standing buildings and equipment will be a daunting task. From a practical sense, the mill buildings probably present more of an OSHA hazard to workers than a radiation hazard to the general public. Structurally speaking, the aging portions of the mill buildings probably have not been accessed in years. Many of the obvious construction methods are questionable. Walking on the elevated platforms with missing floor grates alone pose a worker safety issue let alone crawling and climbing over equipment and unsecured work areas. It could be unsafe to perform the cleaning and survey work necessary to free release the mill buildings according to these standards. However, it is practical and possible to disassemble the mill buildings through a process of controlled demolition. Once disassembled with pieces staged in a safe and workable fashion, each piece can be surveyed and cleaned as necessary to warrant free release. Using the 5 μR/h standard, a radiological survey can be performed at ground level in a practical, accurate, and safe manor using a micro-rem meter. If contamination were found, the ground level staging of the piece would make it amenable to rapid disassembly and further cleaning. This would provide the efficiency necessary to continue the demolition process using conventional demolition equipment.

Once the buildings and equipment have been removed, the remaining open slabs could be surveyed according to the same criteria as has been found acceptable for the monazite pile, chiefly to demonstrate that the dose contribution due to any radioactive materials remaining on the slabs is below 10 μR/h above background at one meter.

SUMMARY

It is the opinion of RSI that the mill buildings should be torn down using conventional demolition techniques; the pieces surveyed and further disassembled and cleaned as necessary using power washing equipment. The cleaned pieces should be released and removed from the site as scrap. Any radioactive material collected during the demolition and cleaning process should be removed along with any materials, if any, removed from the monazite pile footprint.

The monazite pile footprint and surrounding area should be further characterized according to the plan set forth by RSI. Any additional materials identified by that process and that contain licensable source material and which HMI cannot reasonably demonstrate were not due to the stored monazite must be addressed by HMI with NRC concurrence.

Once these materials, including any source material collected from the demolition of the mill buildings, have been removed, a dose assessment and final survey should be performed by RSI to

RSI

Radiation Science Inc.
10 South River Road
Cranbury, NJ 08512

demonstrate that the remaining licensed property no longer meets the NRC's SDMP criteria and should be removed from that listing and the source material license terminated.

Notes: The overstatement was determined by using the identical equipment used by ORISE under identical operating conditions. That is by using a Ludlum 44-68 gas proportional detector operating at 1700 volts HV and a Ludlum model 12 Survey meter. Note that use of a "gas proportional detector" does not in itself constitute proportional analysis, which is in this case a function of the meter electronics. Rather a simple acrylic shield (approx. 3/8" thickness) is used to shield the alpha and beta radiations, allowing only the gamma component to be counted. Alpha/beta activity is determined by subtracting the gamma component from the total count rate as determined without the shield in place. This is a conservative estimate of the true count rate because the acrylic shield and geometry attenuate <u>some</u> of the low energy gamma and x-rays, understating their contribution to the total count rate.

Sincerely,

Thomas P. Bracke P.E.
cc: Craig Gordon, Anthony Thompson

Phone: 609 395-1996 email: staff@radsci.com fax: 609 395-1178

Agenda

HERITAGE MINERALS, INC.

April 23, 2002

Address Comments in ORISE Report

Discuss Responses from March 26, 2002 Letter

1) Subsurface soil in pile at source material concentration

2) Process history- amount of HMI material in pile

   Sampling protocol (attachment to letter)
   Geotechnical analysis/ additional characterization

3) Migration and possible leaching of material from pile

4) Wet and Dry Mill buildings

   ORISE survey methodology

   Investigation of efforts to clean and dismantle equipment and structures

5) Dose assessment

   Identify limiting scenario

   Dose to average member of critical group

6) Other issues- State, NMSS, schedule

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June 26, 2002

Mr. Craig Gordon
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Dear Craig:

Attached is an analysis of ORISE's beta "overcounting" prepared by SENES, (see attached CV) which agrees with RSI's analysis that was submitted to you at our last meeting in King of Prussia. The likelihood of significant beta overcounting could have profound implications for decontamination and decommissioning of the mill buildings and the equipment therein.

John Lord is preparing a "mass balance" analysis along with a report of operational history which we believe will demonstrate with reasonable assurance that the NRC licensed SDMP monazite has gone to IUC. All remaining material with elevated radionuclide concentrations is the result of pre-NRC license activities of HMI or its predecessors. Of course, HMI will have to address any *licensable* source material concentrations but, that would be a separate (non-SDMP) licensing matter. HMI expects to have this analysis in final form by the end of July or sooner.

Edele Hovnanian is reviewing a draft sample protocol from RSI, which will be submitted to NRC for review within the next ten days. As soon as NRC approval is received RSI will begin the sampling.

HMI has sent out RFP's to salvage companies regarding demolition and/or removal of the equipment in the mill structures and/or the mill structures themselves. Meetings to discuss such activities are being set up at the site. HMI expects to complete this process by the end of August or sooner.

Thus, as you can see things are moving, so we can still hope to satisfy SDMP timelines.

Sincerely,

Tony

Anthony J. Thompson

(letter to c.gordon(june))

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.

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.

ACRP-22, Protection of Non-Human Biota from Ionizing Radiation Former Advisory Committee on Radiological Protection for the CNSC, INFO 0703 CNSC April 2002. (Chairman of Working Group).

Research on Selected Aspects of a Rapid Surveillance System Prepared for Cancer Care Ontario November 2001 (with R. Stager).

The Current Status of Biological Dosimeters Chapter 40 of Second Edition of Medical Management of Radiation Accidents eds. I.A.. Gusev, A.K. Gushkera and F.A. Mettler Jr. CRC Press 2001 (with H.A. Phillips).

Environmental Issues in the 21st Century. Invited keynote address at International Symposium on the Uranium Production Cycle and the environment, International Atomic Energy Agency, Vienna, Austria, 2-6 October 2000.

Remediation During Changing Regulatory Requirements for Characterization Surveys. Uranium 2000, September. (R.H. Stager).

Uravan – A Case History of Decommissioning a Large U.S. Title II Uranium Site Illustrating the Practical Application of Risk Assessment Principles. September 2000. (G.M. Wiatzka, C. Sealy and J. Hamrick).

Metal Leaching of Sulphide Mine Wastes Under Neutral pH Conditions. ICARD, Denver 2000. (J.M. Scharer, C.M. Pettit, J.L. Kirkaldy, L. Bolduc and B.E. Halbert).

Perspectives on Molecular Epidemiology. Presented to the 2000 Canadian Radiation Protection Association Annual Conference, Montreal, Quebec, May 2000. (N.E. Gentner).

Environmental Risk Assessment – A Practitioner's Perspective. Canadian Nuclear Society, 21st Annual Conference, 11-14 June 2000, Toronto, ON. (M.W. Davis).

Risk – What It is, and How to Manage it. Invited presentation Mining Millenium 2000, CIMM Annual Meeting March 2000. (G.M. Wiatzka).

Screening Level Dose Assessment of Aquatic Biota Downstream of the Marcoule Nuclear Complex in Southern France. Health Physics 77(3): 313-321, September 1999 (with S. St-Pierre, L.M. Lowe and J.G. Bontoux).

Radiation (Protection) in the 21st Century. Invited Presentation Canadian Radiation Protection Association, June 1999, Saskatoon, SK.

LNG and Risk Based Standards, LNG 12, International Conference, Perth Australia, 1995. (With J. P. Lewis, R.B. Felder, S.J. Wiersma and R.G. (Charlwood).

Uncertainty is Part of Making Decisions. Invited paper, Human and Ecological Risk Assessment (HERA), 5 (2): 255-261, 1998 (with F.O. Hoffman and R.H. Stager).

Practical Issues in the Risk Management of Low Dose Radiation. Presented at The Nineteenth Annual Conference of the Canadian Nuclear Society, Toronto, ON, 18-21 October 1998 (with M.W. Davis, N.C. Garisto and L.M. Lowe).

Long Term Population Dose Due to Radon from Uranium Mill Tailings. Presented at The Uranium Institute Twenty-Third Annual Symposium, London, U.K., 10-11 September 1998. (Available at www.uilondon.org) (with L.M. Lowe and R.H. Stager).

Steps Towards Harmonization of Risk From Chemical and Radioactive Contaminants Spectrum '98 – International Conference on Nuclear and Hazardous Waste Management, 13-17 September 1998 (with N.C. Garisto, S.L. Fernandes, H.A. Phillips and G.W. Wiatzka).

Transport, Chemistry, and Thermodynamics of Uranium Hexafluoride in the Atmosphere-Evaluation of Models Using Field Data. Atmospheric Environment 32 (10): 1729-1741, 1998 (with S.K. Nair, Z.R. Radonjic and S. Park.

Long Term Contaminant Migration and Impacts From Uranium Mill Tailings. 1998. Journal of Environmental Radioactivity 42:289-304, 1999 (with H. Camus, R. Little, D. Acton, A. Agüero, L. Chanmey, J.L. Daroussin, J. Droppo, C. Ferry, E. Gnanapragasam, C. Hallam, J. Horyna, D. Lush, D. Stammose, T. Takahashi, L. Toro and C. Yu).

Trade-off Analysis of Risk, Cost and Quality of Life in the Risk Management of Contaminated Sites Mixed Wastes. Society for Risk Analysis annual meeting, Dec. 1997 (with N.C. Garisto, G.M. Wiatzka, A.J. Thompson, W. Goldammer).

Risk Based Decision Model for Community Water Systems. Society for Risk Analysis Annual Meeting, Dec. 1997. (with N.C. Garisto, R. Copes, V. Carmichael, B. Willoughby).

Review of Models Used for Determining Consequences of UF_6 Release – Development of Model Evaluation Criteria. NUREG/CR-6481, Vol. 1,November 1997 (with S.K. Nair, S.H. Park and F.O.Hoffman).

The Effect of Uncertainty in WLM (Dose) on Risks of Lung Cancer in the Beaverlodge Miner Cohort. Invited Presentation to NIH Workshop on Uncertainties in Radiation Dosimetry and Their Impact on Dose-Response Analyses, NIH Workshop, Washington DC, September 1997 (with R.H. Stager and S.E. Frost).

Low Dose Linearity – A Practitioner's Review of Its Science and Applications. Invited presentation by D.B. Chambers at the joint Nuclear Regulatory Commission (NRC) – National Mining Association (NMA) Workshop, Denver, CO, 3 June 1997 (with M.W. Davis and L.M. Lowe).

Probabilistic Assessment of Accidental Exposures to Inorganic Arsenic in Drinking Water. Presented to the American Industrial Hygiene Conference and Exposition, Dallas, TX, May 1997 (with M.W. Davis and H.A. Phillips).

Ecological Risk Assessment for a Contaminated Truck Maintenance Site. Presented at 18th Annual SETAC Meeting, November 1997 (with S.L. Wilkinson, H.A. Phillips and R.B. German).

Assessment of Radiation Effects on Biota in Proximity to Uranium Mining and Milling Sites in Canada: Field Observations and Model Predictions. In: Symposium on Radiological Impacts from Nuclear Facilities on Non-Human Species, Ottawa, 2-3 December 1996 (with N.C. Garisto, M.W. Davis, J.M. Takala, D. Krochak, R.G. Barsi and S.M. Bartell).

Operational Use of Mathematical Modelling; Prediction of Acid Mine Drainage. Presented at MEND Vancouver Workshop, November 1996 (with C.M. Pettit).

Review of J.B. Hicks and L. Beard (1990). *Exposure Assessment of Local Community to Airborne Emissions of Dioxins and Furans: Technical Communications Issue. Colloquium on Technical Risk Assessment in Business and Regulatory Decision Making.* Institute for Risk Research Calgary, Alberta, 19-20 September 1996 (with N.C. Garisto and S.L. Wilkinson).

Risk/Cost Analysis: A Case Scenario in the Decommissioning of a Radiological Site. Presented at Probabilistic Safety Assessment '96, Park City, Utah, 29 September - 3 October 1996 (with A.J. Thompson and G.M. Wiatzka).

Comment on ICRP Recommendations on Radon, and Revised Background Doses from Radon. Sixth International Symposium on the Natural Radiation Environment (NRE-VI), 5-9 June, 1995, Montréal, Quebec. In: Environment International Vol. 22 (Suppl. 1): S1037-S1044, 1996 (with L.M. Lowe).

Implications of Naturally Occurring Radioactive Materials (NORM) on the Decommissioning of an Elemental Phosphorus Refinery. Presented at the Sixteenth Annual Conference of the Canadian Radiation Protection Association, Trois-Rivières, June 1996 (with S. St-Pierre and L.M. Lowe).

Investigations Into the Effect of Uncertainty in the Exposure Variable on the Feasibility of Epidemiological Investigations. Prepared for Centers for Disease Control (Atlanta), April 1996 (with M. Tai, R.H. Stager and P. Reilly).

Development of Cleanup Criteria for Historic Low-Level Radioactive Waste Sites in Canada. In: Proceedings of The Fifth International Conference on Radioactive Waste Management and Environmental Remediation (ICEM '95) Vol. 2 Management of Low-Level Waste and Remediation of Contaminated Sites and Facilities, pp. 1433-1437 (ASME), Berlin, Germany 3-8 September 1995 (with R.W. Pollock and L.M. Lowe).

Factors Affecting ARD Production: Kinetics of Sulphide Oxidation. To be presented at Sudbury '95, Mining and the Environment, 28 May - 1 June 1995, Sudbury, Ontario (with J.M. Scharer, E.C.M. Kwong, R.V. Nicholson and C.M. Pettit).

Approach to Mine Decommissioning in Europe: Decommissioning the Former East German Uranium Industry. To be presented at Sudbury '95, Mining and the Environment, 28 May - 1 June 1995, Sudbury, Ontario (with G.M. Wiatzka and C.M. Pettit).

Ecological Risk Analysis of Uranium Mining in Northern Saskatchewan. Presented at Sudbury '95, Mining and the Environment, 28 May - 1 June 1995, Sudbury, Ontario (with D.K. Krochak, S.M. Bartell and M.B. Wittrup).

Ecological Risk Analysis of Uranium Mining in Northern Saskatchewan, Canada. Presented at the Society for Risk Analysis Annual Meeting, 5-8 December 1993 in Ottawa, Ontario (with S.M.

Bartell, D.K. Krochak, M. Wittrup, H.A. Spankie and T. Collins).

Impact of Radon Emanation on the ALIs for ^{226}Ra and Uranium Ore Dust. Health Physics 65(1): 104, July 1993 (with L.M. Lowe and M.W. Davis).

Mathematical Simulation of a Waste Rock Heap. Presented at the International Land Reclamation and Mine Drainage Conference and the Third International Conference on Abatement of Acidic Drainage, Pittsburgh, PA, 24-29 April 1993 (with J.M. Scharer, C.M. Pettit and E.C. Kwong).

International Perspective on the Role of Acid Generation in Selecting Decommissioning Techniques for Uranium Mining Sites in Eastern Germany. Presented at the Third International Conference on Abatement of Acidic Drainage, Pittsburgh, PA, 25-29 April 1993 (with D.G. Feasby, J.M. Scharer, C.M. Pettit, R.G. Dakers and M.H. Goldsworthy).

Implications for Underground Uranium Mining of the ICRP 1990 and C-122 Recommended Dose Limits. Presented at the International Conference on Radiation Safety in Uranium Mining, Saskatoon, SK, 25-28 May 1992 (with L.M. Lowe and R.H. Stager).

Radiological Implications of Naturally Occurring Radioactivity in an Elemental Phosphorus Refinery. In: Proceedings of the Eighth International Congress of the International Radiation Protection Association (IRPA8), Montréal, Quebec, Vol. II: 1375-1378, 17-22 May 1992 (with L.M. Lowe).

Reconstruction of the Radon Daughter Exposure of Beaverlodge Uranium Workers. In: Proceedings of the Eighth International Congress of the International Radiation Protection Association (IRPA8), Montréal, Quebec, Vol. II: 1586-1589, 17-22 May 1992 (with R.H. Stager, F.D. Bernard and L.M. Lowe).

Risk - Experience from the Nuclear Industry. Presented at the CIRAC/AWMA-OS Joint International Conference on Atmospheric Chemistry, Toronto, Ontario, 26-28 January 1992.

Radiological Significance of ^{227}Ac and ^{231}Pa in Inhaled Natural Uranium. Health Physics 61(6): 918, December 1991 (with L.M. Lowe and M.W. Davis).

Preparing Environmental Impact Statements. Presented at the 1991 Conference on Environmental Management in Mining, Saskatoon, Saskatchewan, November 1991 (with C.M. Pettit and B.E. Halbert).

Effects of Exposure Uncertainty on Estimation of Radon Risks. In: "Twenty-Ninth Hanford Symposium on Health and the Environment, Indoor Radon and Lung Cancer: Reality or Myth? – Part 2" (ed. F.T. Cross) Battelle Press, pp. 987-1012, 15-19 October 1990 (with P. Reilly, R.H. Stager, L.M. Lowe and P. Duport).

Communicating Risks to the Community: A Tale of Two Incinerators. Presented to the 1990 Annual Meeting of the Society for Risk Analyses (with J.F. Peters and J.M. Southwood).

Environmental Assessment Modelling. Published as Section 8.1 of the IAEA Monograph "Environmental Behaviour of Radium." Technical Report Series No. 310, 1990 (with B.E. Halbert, V.J. Cassaday and F.O. Hoffman).

Examples of Dose Assessment: Mining and Milling in Canada. In: "The Environmental Behaviour of Radium – Vol.2". IAEA Technical Report Series No. 310, pp. 419-439, 1990 (with L.M. Lowe and R. John).

Assessing Risks From Incineration of Municipal Solid Wastes. Published in proceedings of EPA/ORNL Workshop on Risk Assessment for Municipal Waste Combustion, Deposition, Food Chain Impact, Uncertainty and Research Needs. 1989 (with B. Ibbotson and B. Powers).

Risk Assessment as an Environmental Tool. Presented at the American Mining Congress Convention, San Francisco, CA September 1989.

Radon in the Uranium Mine Environment: Exposure Estimation and Risk Prediction. Presented at Workshop/ Symposium on: Radiation Protection: Past and Future ("Marko" Conference), Chalk River, ON, 20-22 March 1989. Published as AECL-9959, June 1989 (with L.M. Lowe).

Exposures from Mining and Mine Tailings. Invited paper in special issue on "Radionuclides In The Environment", Radiation Physics and Chemistry 34(2): 295-307, 1989 (with L.M. Lowe and V.J. Cassaday).

The Assessment of Incineration Risks (A.I.R.) Model. Presented at the 1988 Annual Conference, Society for Risk Analysis, Washington, DC. (with J.D. Phyper, B. Powers, M. Rawlings and R. Willes)

A Primer on Radon and Potential Health Risks from Exposure to Radon Daughters. Prepared for International Symposium on Uranium and Electricity -

Teachers' Program. Saskatoon, SK, September 1988 (with L. M. Lowe).

Canadian Perspectives on the Management of Low-Level Radioactive Wastes. Keynote Address, International Symposium on Uranium and Electricity, Toronto, September 1988 (with R.A. Knapp and G.G. Case).

The Potential Radiological Impacts of Phosphogypsum Stacks. Presented at the Ninth Annual Conference of the Canadian Radiation Protection Association, Montebello, Quebec, 11-13 May 1988 (Abstract in Health Physics 56(4): 581, April, 1989.) (with L.M. Lowe and M.W. Davis).

Development of Clean-up Criteria For The Port Hope Remedial Program. In: Proceedings of the Annual Meeting of the Society for Risk Analysis, 1-4 November, 1987 Houston, Texas. Published as "Risk Assessment in Setting National Priorities" (eds. J.J. Bonin and D. E. Stevenson), Plenum Press, New York, pp. 25-41, 1989 (with L.M. Lowe, G.G. Case and R.W. Pollock).

Estimation of Long-Term Risk from Canadian Uranium Mill Tailings. Risk Analysis, Vol. 7, No. 3, 1987, pp. 287-298 (with R.A. Knapp and S. Kaplan).

Risks and Consequences of Occupational Exposure to Radon Daughters. Presented at the Eighth Annual Conference of the Canadian Radiation Protection Association, Saskatoon, SK, 27-29 May 1987 (abstract in conference proceedings) (with L.M. Lowe).

An Assessment of the Potential Health Risks From Exposure to Radon Daughters. Prepared for the Health Protection Branch, Department of National Health and Welfare, May 1987 (with L.M. Lowe).

Assessment of Risk from Uranium Mining in Virginia. In: "Environmental Health Risks: Assessment and Management." (ed. R.S. McColl) Waterloo, University of Waterloo Press, 1987, pp. 237-258 (Proceedings of symposium held on 29 May 1985) (with L.M. Lowe and V.J. Cassaday).

An Approach to Risk Assessment for Canadian Uranium Mill Tailings. Presented at the Second International Conference on Radioactive Waste Management, Winnipeg, Manitoba, September 1986 (with M.L. Murray, R.A. Knapp, and R.W. Holmes).

Probabilistic Assessment of the Long-Term Effects of Uranium Mill Tailings. Presented at the Second International Conference on Radioactive Waste Management, Winnipeg, Manitoba, September 1986 (with B.E. Halbert, M.L. Murray and D.I. Beals).

Probabilistic Analysis of the Environmental Behaviour of Uranium Mill Tailings. Presented to the Society for Computer Simulation, San Diego, January 1986 (with B.E. Halbert, M.L. Murray and D.I. Beals).

Health Effects of Radon. Presented at Workshop on Information Needs for Risk Assessment in Canada, Toronto, ON, September 1985. In: "Information Needs For Risk Management" (eds. C.D. Fowle, A.P. Grima and R.E. Munn), Environmental Monograph No. 8, Institute for Environmental Studies, University of Toronto, pp. 177-192, November 1988 (with L.M. Lowe).

Probabilistic Analysis of Radon Released from Uranium Mill Tailings. Presented at the Sixth Annual Meeting of the Canadian Radiation Protection Association, Saint John, NB, 11-13 June 1985 (with L.M. Lowe and M.L. Murray).

Safety Assessment of Uranium Mill Tailings: The National Uranium Tailings Program. Presented at the annual meeting of the Canadian Nuclear Society, Ottawa, ON, June 1985 (with W.C. Harrison and B.E. Halbert).

Conceptual Design Study of a Low-Level Radioactive Disposal Facility. Presented at the Health Physics Society annual meeting, Chicago, IL, May 1985 (with G.G. Case and R.A. Knapp).

Pilot ALARA Analysis Applied to Dose Reduction in an Underground Uranium Mine. In: Occupational Radiation Safety in Mining, Proceedings of the International Conference, Toronto, ON, 14-18 October 1984, Vol. 1, pp. 45-51. (Published by the Canadian Nuclear Association 1985) (with L.M. Lowe, J.L. Chakravatti, D. Lahoux, K. Black and K. Culver).

Beta Radiation Considerations in the Mining and Milling of High Grade Uranium Ore. To be presented at the International Conference on Occupational Radiation Safety in Mining. Toronto, ON, October 1984 (with J.R. Mernagh).

Potential Co Carcinogens in the Uranium Mine Environment. Presented at the International Conference on Occupational Radiation Safety in Mining, Toronto, ON, October 1984 (with R. Marchant).

Conceptual Design for Disposal of Uranium Refinery Wastes in Mined Limestone Caverns. Presented at Health Physics Society Annual Meeting, New Orleans, LA, June 1984 (with G. Case, J. Davis, D. Moffet).

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A Model for the Regional Transport and Environmental Cycling of Carbon-14. Presented at the Twenty-Eighth Annual Meeting of the Health Physics Society, Baltimore, MA, 19-23 June 1983 (Abstract in Health Physics 45(1): 209, July 1983) (with J.M. Scharer and L.M. Lowe).

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Design for Radiation Protection in the Mining of High Grade Uranium Ore. Chapter 70 of "Radiation Hazards in Mining - Control, Measurements and Medical Aspects", the Proceedings of the First International Conference, Colorado School of Mines, Golden, CO, October 1982 (with J. Mernagh and R.T. Torrie).

Overview of Uranium Tailings Management Practice. Presented at the International Conference on Radioactive Waste Management, Winnipeg, Man., September 1982 (with L.M. Lowe, R.A. Knapp and B.G. Ibbotson).

Assessment of Hypothetical Disposal Facilities for Canada's Low-Level Radioactive Waste. Presented at the Third International Conference on Radioactive Waste Management, Winnipeg, MB, September 1982 (with L.M. Lowe, A. Buchnea, L. Cabeza and E.J. Chart).

Environmental Considerations Related to Uranium Exploration. Presented at the Third Annual Conference of the Canadian Nuclear Society, Toronto, ON, June 1982 (with B.G. Ibbotson and V.J. Cassaday).

Public Health Effects of Radon from Uranium Mining and Milling. Presented at the Twenty-Sixth Annual Meeting of the Health Physics Society, Louisville, KY, 21-26 June 1981. (Abstract (slightly different title) in Health Physics 41(6): 874, December 1981) (with L.M. Lowe and R.B. Sutherland).

Fuel Cycle Risks - The Front End. Presented to the Canadian Nuclear Association Seminar on Nuclear Power Risks in Perspective, Toronto, ON, May 1981 (with S.E. Frost and V.J. Cassaday).

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The Canadian Experience - A Review of Environmental Considerations Associated with Uranium Mining Operations in Elliot Lake. Presented at the operation Action UP Conference on Uranium Mining and Radiation Safety at Michigan Tech University, Houghton, MI, September 1980 (with D.M. Gorber and B.G. Ibbotson).

Development and Use of Radon Source Terms in Environmental Impact Assessments. Presented at the Twenty-Fifth Annual Meeting of the Health Physics Society, Seattle, WA, 20-25 July 1980 (Abstract in Health Physics 39(6): 1030, December 1980) (with L.M. Lowe, V.J. Cassaday, J. Nantel and J. Archibald).

Radium in Water, Sources, Levels and Effects. Presented at the Annual Conference of the Ontario Section, American Waterworks Association, Toronto, ON, April 1980 (with D.M. Gorber and B.G. Ibbotson).

Radiological Evaluation of a Uranium Mines Expansion: A Case Study. Presented at the Twenty-Fifth Winter Meeting of the American Nuclear Society, San Francisco, CA, 11-15 November 1979 (with L.M. Lowe).

Environmental Assessments - A Consultant's Viewpoint. Presented at the Canadian Nuclear Association International Conference, Toronto, ON, June 1979.

Radiological Monitoring of Uranium Fuel Processing Facilities. Seminar at Environment Canada, March 1979.

Environmental Factors Related to the Development of a New Uranium Refinery. Presented at the Eighth Annual Hydrometallurgical Meeting, Montreal, PQ, August 1978 (with J.P. Jarrell).

Radium Removal - Perspectives for the Future. Presented to the Canadian Uranium Producers' Metallurgical Committee Workshop on Radium-226 Control, Ottawa, ON, October 1977 (with R.A. Knapp).

Industrial Hygiene Survey of Uranium Mining and Milling Industry in Canada. Seminar at Canada Centre for Mineral and Energy Technology, Ottawa, ON, July 1977.

Taught Course in Air Pollution Control Engineering at University of Toronto (Spring 1976, Spring 1977). Offered by Department of Civil Engineering to fourth year and graduate students.

The Role of Noise in Environmental Impact Statements. Presented to a joint meeting of the PCAO and Ontario APCA, Toronto, ON, November 1976.

Comparison of Environmental Factors Relating to Alternative Sites for a Nuclear Generating Station in New Brunswick. Presented at Environment II, Association of Consulting Engineers of Canada, Montreal, PQ, September 1976 (with R.D. Gillespie and E. Koczkur).

Noise Pollution. Seminar #4 - Man and the Environment, Conservation Council of Ontario, February 1976.

Sources and Emissions of Atmospheric Mercury. Presented at the International Conference on Heavy Metals in the Environment, Toronto, ON, October 1975 (with D.M. Gorber and E. Koczkur).

Air Environment Review of Asbestos, Mercury and Lead. Presented at the Industrial Waste Conference, Toronto, ON, June 1975 (with D.M. Gorber and E. Koczkur).

Role of Consulting Engineer in Air Pollution Control. Seminar at Centre for Air Measurements Studies at Pennsylvania State University, 1974.

Review of Noise in Canada - Attitudes and Levels. Presented at the Ontario - Quebec APCA Joint Fall Meeting, Ottawa, ON, 1974 (with E. Koczkur).

Stack Testing, Odour Measurement and In-plant Measurements. Joint seminar of the MOE and PCAO, Toronto, ON, 1974 (with E. Koczkur).

Review of Industrial and Environmental Noise Concerns. Presented at the AIME Fall Meeting, Hamilton, ON, 1973 (with E. Koczkur).

SENES Consultants Limited

MEMORANDUM

TO:	A.J. Thompson	33291
FROM:	Doug Chambers	21June 2002
SUBJ:	Overestimate of Beta Surface Activity in the ORISE report on Heritage Minerals	

ORISE carried out a confirmatory survey at Heritage Minerals Inc. and reported "survey activities including gamma, alpha plus beta, and beta surface scans, direct measurements, soil sampling, miscellaneous sampling, and exposure rate measurements." (p.6 (ORISE 2002). This memo focuses on alpha, and alpha/beta surface scans carried out on construction material using gas proportional counters, specifically the Ludlum Gas Proportional Detector Model 43-68 (p. 7 and Appendix A ORISE 2002)

We expect that the alpha/beta surface scan measurements of building materials reported by ORISE overestimate the true beta activity for the following reasons:

1. The gamma background has not been properly subtracted out of the alpha/beta measurements (alpha/beta measurements were made at gamma exposure rates that were at least four times higher than the gamma exposure rate in which the alpha/beta background was measured);
2. The alpha activity has not been subtracted out of the alpha/beta count; and
3. The contribution of low energy gamma and x-rays to the alpha/beta count has not been subtracted in the calculation of the beta activity.

1. Overestimate of Beta Activity Attributable to Underestimate of Gamma Background

Using the gas flow proportional counter, ORISE measured alpha/beta surface contamination in the laboratory, wet and dry mills and reported the results in Table 1 (p.43-49, ORISE 2002). Also, ORISE reported gamma exposure rates up to 10 μR/h in the centre of rooms in the laboratory, and up to 17 and 14 μR/h at 1 m above surfaces in the wet and dry mills, respectively (Table 2 p. 50, p. 8, ORISE 2002). The gamma exposure rates at the gas proportional counter in contact with surfaces in the laboratory, wet and dry mills are expected to have been higher than the reported values of 10, 17 and 14 μR/h.

ORISE reported that the background for the gas proportional detector operating on the alpha/beta plateau ranged from 236 cpm on wood to 303 cpm on poured concrete. Also, ORISE reported that the "background rates were determined for each material encountered in the surveyed area at a location of similar construction and **having no known radiological history**" (p. B-4 ORISE 2002) bolding added here for emphasis. It is reasonable to expect that the gamma exposure rate in the area having no known radiological history were similar to "Background exposure rates ranged from 3 to 7 μR/h and averaged 4μR/h" (p. 12, ORISE 2002).

Ludlum Measurements Inc. reports that the background on the alpha/beta plateau of the Model 43-68 gas proportional detector is "typically 400 cpm or less (10 microR/hr field)" (Ludlum 2002). ORISE's background measurements ranging from 236 to 303 cpm are consistent with the specification by Ludlum. However, ORISE's values underestimate the true background for subtraction where gross alpha/beta measurements were made in gamma exposure rates of 17 μR/h and higher. Therefore, ORISE overestimated the beta surface contamination levels by subtracting the underestimated background from the gross alpha/beta proportional counts made in contact with the high gamma exposure rates.

2. The alpha activity has not been subtracted out of the alpha/beta count; and

The results of the alpha/beta surface scans are reported in the third column from the left in Table 2 (p. 43-49, ORISE 2002). It appears that ORISE has overestimated the beta activity by concluding that it is equal to the alpha/beta total activity. ORISE reports that "the alpha contribution to the alpha plus beta surface activity measurement count rate was consistently less than ten percent". The alpha activity is not less than 10% in the following examples: I-Beam-42A (p. 49); SU40-24 and Floor-34A (p. 48); etc. Therefore, ORISE has overestimated the beta activity on surfaces, if they have not subtracted the alpha activity from the alpha/beta activity in Table 2 (p. 43-49, ORISE 2002).

3. Contribution of low energy Gamma and X-rays to the Alpha/beta Count

RSI estimated that the beta contamination levels on surfaces are overestimated by reference to the alpha/beta measurements by gas proportional counter reported by ORISE. RSI reached their conclusion by observing that approximately 33% of the alpha/beta count rate remained after placing a ¼" plexiglass shield to intercept the beta particles between the contaminated surface and the detector. The remaining counts in the gas proportional detector are attributable to:

- gamma radiation from the contaminated surface that penetrates the plexiglass;
- gamma radiation from the surroundings that penetrates the sides and back of the detector; and
- intrinsic background in the detector.

We expect that the 67% of the count rate that was intercepted by the plexiglass is not composed only of beta particles. It comprises alpha particles as discussed in 2 above, and a fraction of the low energy gamma and x-rays that contributed to the alpha/beta count are also intercepted by the plexiglass. For example, more than 10% of the low energy gamma rays at 50 keV are attenuated by the plexiglass, and this value approaches 30% as the energy decreases to 30 keV. Based on the measurements using plexiglass reported by RSI, we expect that the beta contamination levels estimated by ORISE from the alpha/beta proportional counting are overestimates of the true beta contamination levels by more than 33%.

To develop an estimate of the contribution of low energy gamma and x-rays to the alpha/beta count rate and the corresponding reduction by absorbers such as a piece of plexiglass requires an experimental program at the site or under rigorously similar circumstances that duplicate all of the essential characteristics of the measurements. The problem is too complex to investigate using a theoretical approach alone. We would be pleased to work with RSI, or others, to develop an experimental program that would address these issues.

References:

Oak Ridge Institute for Science and Education (ORISE) 2002 Confirmatory survey of portions of the Heritage Minerals Incorporated facility Lakehurst, New Jersey. Docket No. 040-8980; RFTA No. 01-012

Ludlum Measurements Inc. 2002 web site www.ludlums.com/product/m43-68.htm

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August 5, 2002

Mr. Craig Gordon
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Dear Craig:

Attached is HMI's proposed Sampling Protocol to further characterize potential licensable source material concentrations within the boundaries of the monazite pile and in other areas adjacent thereto on the eastern side of the dry mill.

Radiation Science Inc. (RSI) will be developing a grid in accordance with the attached Sampling Protocol and will be attempting to get into the field as soon as possible.

If you have any additional questions, please feel free to contact me.

Sincerely,

Tony

Anthony J. Thompson

AJT/cls
Enclosure

(C.Gordonsamplingltr.doc)

Sampling Protocol

The monazite pile created by Heritage Minerals was placed in an area that previously was used at various times to deposit materials from and/or for processing activities. Thus it appears that the NRC licensed monazite was not placed on pristine soils. Since these materials likely derived from the "magnetic fraction" created by dry mill processing they likely contained elevated levels of naturally occurring radionuclides. We know the licensed monazite pile was bounded by a fence and covered with a weighted tarp, so it is unlikely that any significant amount of material outside the fence-line of the monazite pile came from the HMI operations which produced the monazite. But because elevated radioactive levels have been identified within the monazite pile footprint and possibly without as well, it is necessary to perform a further characterization to identify any licensable source material deposits. The purpose of this protocol is to establish a clear picture of the location of any such remaining licensable source material and to determine how much material, if any, may have to be addressed with NRC in order to complete final remediation of the site as opposed to final remediation of the licensed monazite stored in the pile. Pre-NRC licensing process materials in this area, which do not contain licensable source material concentrations, apparently were not the result of NRC licensed HMI activities although they must still be addressed with the state of New Jersey.

1. A square grid, measuring approximately 200' by 200' and tied into the State Plan Coordinate system will be laid out on 20-foot centers to establish an accurate and reproducible map of the area behind the dry mill. The area of concern will extend south from the dry mill to the pump house at the process water pond and eastward, capturing the footprint of the former monazite pile. Approximately 120 such grids will be marked.
2. A shielded sodium iodide detector will be used to obtain an integral count of the gamma flux at the surface at each intersection and at each 4-foot subdivision of the grid. Additionally, each subdivision will be scanned to determine the existence of any hot spots. An integral count will be obtained at any hot spot not representative of the subdivision. The data will be used to construct a gamma flux map of the area.

3. A Geo-probe will be used to extract a core sample to a depth of four (4) feet at the center of each hot spot identified in the process above. Each core will be divided into samples represented by 12-inch lofts. The samples will be screened on-site to insure that the depth of sampling is sufficient. If the screening indicates that background levels of radioactive materials have not been reached, the Geo-probe will be used to extract an additional core sample at greater depth. The process will be repeated until the depth of any deposit has been fully characterized.
4. The samples will be further analyzed at an off-site laboratory using a sodium iodide gamma spectroscopy detector system to determine the concentrations of radioactive materials.

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

November 22, 2002

Docket No. 04008980
Control No. 131796

License No. SMB-1541

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

SUBJECT: DECOMMISSIONING OF THE HERITAGE MINERALS, INC. (HMI), LAKEHURST, NEW JERSEY SITE

Dear Ms. Hovnanian:

This responds to the June 20, 2002 letter from Mr. Anthony J. Thompson, Attorney, to Mr. Craig Gordon of my staff, regarding radiation detection methodology used by our contractor, the Oak Ridge Institute for Science and Education (ORISE), for performance of confirmatory surveys at the HMI site. You provided contractor (RSI) and third party (SENES Consultants Limited) evaluations of the ORISE measurement techniques used for surveys of mill structures and equipment, indicating that beta surface activity was overestimated.

The evaluations were forwarded by Technical Assistance Request (TAR) to the NRC Office of Nuclear Materials Safety and Safeguards (NMSS) for review. NMSS has completed their review and provided responses to each comment (enclosed). Overall, the review supports ORISE's conclusions for considering the beta contribution to determine residual contamination on surfaces. This information should be used to develop revised final survey plans for mill buildings and contents prior to requesting NRC release for unrestricted use.

In the ORISE report, concerns were identified about characterization of soils outside the dry mill and around the monazite pile. Mr. Thompson's letter indicated that a report of operational history was being prepared which addresses the issues related to outdoor contamination. The extent of soil contamination and additional remediation needed should be noted in your report and provided for NRC review at the earliest possible date.

Should you have any questions about our review, please contact me at (610) 337-5200.

Thank you for your cooperation.

Sincerely,

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

Enclosures:
1. TAR response
2. Letter from A. J. Thompson to NRC dated June 20, 2002

cc: Anthony J. Thompson, Esquire

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202-496-0780
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November 22, 2002

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: Ron

Please find attached a copy of the Affidavit of John F. Lord, Consulting Engineer to and former Plant Manager for Heritage Minerals, Inc. ("HMI") and a document entitled *Heritage Minerals, Inc. Process History* ("Process History") which describes mineral recovery operations at the HMI site in Manchester Township, New Jersey. An analysis of sampling performed recently at the HMI site by Radiation Science, Inc.'s ("RSI") consultant Thomas Bracke, which appears to be entirely consistent with the findings in the Affidavit and Process History, is in process and should be available in the near future.

With this letter, HMI requests that the Nuclear Regulatory Commission ("NRC") delete the Monazite Pile from License No. SMB-1541. As shown in the attached Process History, HMI placed approximately 1,400 tons of monazite sand in the Monazite Pile area after NRC issued its license for the HMI site on January 2, 1991. In 2001, HMI removed approximately 3,000 tons of soils from the Monazite Pile area and shipped this material to International Uranium (USA) Corporation for processing as an alternate feed and for final disposal of all resulting process wastes. A simple mass-balance analysis indicates that HMI has removed in excess of two (2) times the amount of the licensed material placed in the Monazite Pile area. The attached Affidavit and Process History indicate that soils located in the areas east and south of the dry mill which contain slightly elevated levels of radionuclides are the result of mineral recovery operations conducted by other unlicensed parties and by HMI prior to the issuance of its NRC license.

The existence of "pockets" of *licensable* source material in those same areas is also consistent with the Affidavit and Process History. As demonstrated in the Process

History, these slightly elevated concentrations of radionuclides (including some at *licensable* source material levels) are the result of pre-NRC licensing mineral recovery operations by four separate entities: ASARCO, Inc., Humphrey's Gold, Mineral Recovery, Inc., and HMI. Therefore, as the current site owner, HMI proposes to remove these "pockets" of *licensable* source material from the site with approval from NRC through an administrative letter or a separate licensing action under HMI's existing license. Any residual *monazite* concentrations remaining on-site that are below NRC *licensable* levels will be addressed with the State of New Jersey's Department of Environmental Protection ("NJDEP") along with all other areas of the HMI site which contain slightly elevated levels of radionuclides resulting from mineral recovery operations. In this regard, within the next thirty (30) days, HMI is anticipating receipt of an expert analysis which it commissioned that will address options for complying with NJDEP's site remediation regulations where operations have resulted in elevated levels of naturally occurring radionuclides at the site after such operations cease. HMI intends to evaluate its options and, thereafter, to continue its dialogue with the State of New Jersey regarding disposition of *non*-NRC regulated portions of the site which require addressing.

Finally, with respect to the decommissioning and decontamination (D&D) of the final components of HMI's licensed facilities, the wet and dry mill buildings, HMI is currently awaiting receipt of NRC's determination regarding the issue of "overcounting" of beta measurements by ORISE during its evaluation of HMI's D&D of the buildings and equipment therein. Depending on NRC's decision in this matter, HMI will submit a response to that decision and/or provide a plan to complete D&D of the mills and equipment.

If you have any questions regarding these submissions, please do not hesitate to contact me at (202) 496-0780.

Respectfully Submitted,

Anthony J. Thompson, Esq.

AJT/cls
Enclosures