040-08980
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Heritage Minerals, Inc.

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July 25, 1990

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SMB-1541

United States Nuclear Regulatory Commission
Region I, Nuclear Material Section B
475 Allendale Road
King of Prussia, PA 19406

Attention: Mr. John D. Kinneman, Chief

Re: Mail Control No. 110418
Docket No. 99990001

Dear Mr. Kinneman:

Thank you for your letter of July 5, 1990, in which you requested additional information regarding our application for a source material license for our facility. We appreciate the opportunity to respond and look forward to meeting with you in Washington to discuss this matter further.

As you note in your letter, the NRC's jurisdiction over materials at the site is limited. In particular, you noted that material which has resulted strictly from the mining or dredging of ore is not subject to NRC regulation. Since the mining activities at this site have been directed at producing mineral products other than source material, we have taken pains to delineate as clearly as possible the points at which source material presently occurs in Heritage's processing operations. Therefore, in order for NRC to properly evaluate appropriate licensing requirements for Heritage's operations, we have provided a history of operations, a description of current operations and maps that demonstrate the limited circumstances where source materials appear in our operations.

ASARCO processed sand naturally present at the site from 1972 until March, 1982. The ASARCO process, designed to recover ilmenite, generated wet mill tailings and dry mill tailings. Both of these materials were stockpiled on the site in the area shown on Map A (color coded as gray). These materials did not contain sufficient concentrations of thorium and uranium to be considered source material. Recent analysis shows that the ASARCO dry mill tailings contained approximately

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0.018% combined thorium and uranium. Thus, the areas from ASARCO's operations, which include the clean sand pile, revegetated areas, unused settling ponds, the initial dry mill tailings site and the oversize pile shown on Map A are not appropriate for or relevant to NRC regulation.

Hovson's Inc. acquired the site in 1986 and leased the plant site (approximately 287 acres) to Mineral Recovery, Inc. to process the stockpiled dry mill tailings for titanium and zircon recovery. Prior to beginning operations at the site, Mineral Recovery, Inc. sought and obtained from NRC a determination that a license for the possession and use of source material was unnecessary. Since no recovery of uranium or thorium was taking place, no by-product material was present either. Therefore, NRC declined jurisdiction over the site and any materials present at the site.

Mineral Recovery, Inc. (and subsequently Heritage Minerals, Inc.) proceeded to process the entire volume of ASARCO dry mill tailings through the plant. During Heritage's involvement in this production phase, (referred to hereafter as "Heritage Phase I"), a single waste stream, which combined the tailings from both the wet plant and the dry plant, was produced and deposited in the area color coded blue on Map A for future reprocessing. These tailings fall well below the concentration level for source material.

On January 12, 1989, NRC, Region I representatives inspected the site. Based on the results of that inspection, NRC determined that Heritage possessed materials containing sufficient concentrations of uranium and thorium to be considered source material. As a result of that inspection, Heritage submitted an application for possession and use of source material.

When the ASARCO dry mill tailings stockpile was exhausted, the plant was modified for reprocessing the tailings from Phase I (in the blue area). The reprocessing phase, (hereafter referred to as "Heritage Phase II"), which began in April, 1990, includes isolating a monazite-rich material for stockpiling and ultimate transferral to another party. This corresponds to the current and potential future operations at Heritage.

The Heritage Phase II process (as discussed in the response to item 6) first generates source material as table concentrate. The primary waste material (i.e., material that will remain on site and which is not to be sold as a commercial product or transferred for offsite disposal) generated by the entire Heritage process is the clean tailings. These materials consist of screen oversize and scavenger spiral tailings which are all created and collected prior to the generation of source material in the form of table concentrate. These clean tailings are deposited on the site in the areas color coded green on Map A. As discussed more fully below in the response to item 6, the table concentrate is processed through the dry mill with no waste streams being generated. Currently, three concentrates result from this operation titanium (leucoxene and rutile) zircon, and crude monazite. The crude monazite is stored in the segregated monazite storage area for possible further concentration and sale or transfer to another party.

Based on the brief description above, the red-colored area on Map A shows the locations in the plant where source material occurs in the process. These areas include only the wet mill after the point where table concentrate is produced, the dry mill and the monazite storage pile. At present, our plan is to proceed as follows. Upon decommissioning, plant areas where material containing source material has been present will be decontaminated by rinsing with water until required decontamination levels are reached. Any source material collected during this decontamination process will be added to the monazite pile for future transferral. The monazite pile will be considered a restricted area in accordance with the requirements of 10 CFR 20. Upon decommissioning, the monazite pile will be removed entirely and transferred to another party so that source material is no longer present at the site.

Heritage will continue to operate the plant as long as market conditions for zircon and titanium remain favorable. When it becomes uneconomical to do so, the operation will be discontinued. At that time, the plant facilities and the monazite storage area will be decommissioned and decontaminated as noted.

I hope this somewhat general description of our process plans and the site history is useful to you as you read the specific answers to your questions which are set out more fully below. Your attention to this matter is appreciated.

Sincerely,

John F. Lord

John F. Lord
Vice President/Manager
Heritage Minerals, Inc.

cc: Robert Fonner
U.S. Nuclear Regulatory Commission

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Additional Information Requested by the NRC

1. Please refer to Map A which shows the various categories in different colors. The uncolored portion denotes virgin land that has never been disturbed. The gray-colored areas indicate land and water that were affected by ASARCO through dredging, mining and processing for the recovery of ilmenite. The only areas that can be categorized as "disturbed only by mining or dredging" are the dredge ponds (shown as Lake No. 1 and Lake No. 2) and are included in the gray-colored areas. The areas labeled "previously mined and reclaimed" have been back filled with wet mill tailings, then covered with top soil and revegetated.

Also included in the gray-colored areas is the site that contained ASARCO's dry mill tailings, which have been removed by Heritage for processing during the Heritage Phase I operation. Nothing else was placed in that location.

The blue-colored area denotes the current storage for the tailings from the Heritage Phase I operation. The tailings are deposited on top of settling ponds previously used by ASARCO for water clarification. The ponds contain several feet of semi-dry consolidated clay slimes which resulted from ASARCO's activities. The Heritage Phase I tailings were deposited directly over the slimes.

The green-colored areas represent the clean sand and clean water discharges from current and future operations, known as Heritage Phase II operations.

The red-colored areas represent the processing plant facilities and the monazite stockpile. The red-colored areas are the only areas where source material (material with >0.05% Th+U) exists.

Heritage intends to decontaminate those areas of the mills that are affected by source material. The present plan is to remove the monazite pile from the site pursuant to applicable NRC license requirements.

2a. Description of Plant and Site: (See Exhibit I)

The plant facilities are situated in the east end of the 287-acre site. The wet mill building is a 3-story steel structure erected on a 229'x 99' concrete slab. The dry mill, also a 3-story steel structure is erected on a 120'x 95' concrete slab. Other buildings include the laboratory, the service building, the warehouse, the change house, the compressor house and the main office building.

The plant feed (Heritage Phase I tailings) occupy a 50-acre site north of the wet mill, whereas the monazite stockpile area is a 50'x 50' location southeast of the dry mill.

2b. Plant Location: (See Exhibit II)

The plant entrance is located at Mile Marker 41 on N.J. State Highway No.70, about 50 miles east of Camden, N.J. and 12 miles west of the Garden State Parkway. The nearest town is Lakehurst, N.J. which is located 2 miles east of the plant entrance on highway 70.

2c. Features: (See Exhibit III)

In referring to the exhibit, please note that all distances are from the plant site:

Summit Park, a small residential area, 11,000' northeast;
Manchester Municipal Complex, 12,000' northeast;
Borough of Lakehurst, 10,000' north;
Manchester High School, 9,000' northeast;
Crestwood Village, a small residential area, 8,000' southwest.

2d. Land and Water Usage:

Land surface in the vicinity of the plant area is not used for any specific purpose. All activities are conducted within the plant boundary limits.

Ground water usage is limited to the amounts removed from two deep wells (1,600') and one shallow well used for sanitary water supply. The ground water is not suitable for drinking because of its high iron content.

2e. Geohydrology: (See Exhibit IV)

Exhibit IV is a copy of the relevant pages from a hydrologic report prepared for Heritage by Fellows, Read and Associates, a consulting firm in Toms River, N.J.

3. History:

Geological studies and mineral exploration in the area were started by Asarco in 1956 and led to the construction of a plant for the extraction of ilmenite (titanium mineral). This was done by dredging the sand, pumping it to the wet processing plant to reject the majority of the silica by gravity separation. The silica (wet mill tailings) was used to back fill the mined out area except for the initial one million tons which was stockpiled.

The heavy concentrate was subsequently dried and further processed by electrostatic and magnetic separation in the dry mill. The dry mill product (ilmenite) was sold for titanium pigment manufacture.

The dry mill tailings were stockpiled for future recovery of the zircon values and additional titanium minerals which were lost during processing. Virtually all of the monazite was concentrated in the dry mill tailings, which contained approximately 0.018% Th+U.

For economic reasons, Asarco discontinued operations in March 1982, but maintained ownership of the property until February 1986.

In March 1986 the property was purchased by Heritage Minerals, Inc. for the purpose of developing the land into a residential community. Shortly after the purchase, however, the plant site and surrounding area (a total of 287.3 acres) was leased to Mineral Recovery, Inc., a new corporation which was formed for the purpose of processing the stockpiled tailing for zircon and titanium recovery using the old ASARCO plants after rehabilitation.

On August 28, 1986 the President of Mineral Recovery Inc., Dr. A.G. Naguib, accompanied by Dr. Max El Tawil, his technical consultant, visited the Region I offices of the NRC in King of Prussia, PA. They met with Dr. John E. Glenn, then Chief of Nuclear Material Safety at Region I. During the meeting, the operational plans and the source material analyses available from past test work were presented to Dr. Glenn. This was done in order to seek guidance from the NRC on whether it would be necessary to apply for a license for possession and use of source material. Based on the fact that material entering the processing plant (Asarco tailings) and material leaving the processing plant (zircon, leucoxene, rutile and tailings) were all below 0.05% U+Th and since processing was not to be done for the purpose of recovering uranium or thorium, Dr. Glenn determined that Mineral Recovery, Inc. was not required to apply for a license. This determination would be further reviewed at a future date if and when it was decided to concentrate a monazite product for sale for its rare earth content.

Mineral Recovery, Inc. started production in October 1986 and continued until August 1987 when the land owner, Heritage Minerals. Inc. assumed the management and control of the operation. Heritage continued to operate the plant in the same mode until March 31, 1990 when the stockpiled tailings (the ASARCO dry mill tailings) were exhausted. The tailings produced during this phase of operation contained sufficient residual concentrations of titanium and zircon to justify reprocessing this material through the plant to extract additional values for sale. This was true because the markets for these products continued to be favorable.

On January 12, 1989 the plant was inspected by Dr. Laurence F. Friedman, Ph.D., C.H.P. of NRC's Region I. Based on the results of the inspection, Heritage was notified that the activities at the site were not conducted in full compliance with NRC requirements. A notice of violation was issued which stated that "Heritage Minerals, Inc. possessed and used table concentrate and monazite waste in which the concentrations of source material were greater than 0.05% by weight and was not authorized to do so in a specific or general license issued by NRC".

A license application was submitted on March 6, 1989 and is now pending.

In anticipation of potential decommissioning requirements, and at the recommendation of the NRC staff, a process modification was incorporated in the on-going recycling phase. This modification involves isolation of the monazite as a separate concentrate, which is being accumulated and stockpiled separately. The clean sand tailings produced in the wet mill remain separate from the monazite and are placed on the ground to the east of the plant. These materials are generated in the process prior to the time at which source material (table concentrates) is produced and fall well below the 0.05% Th+U level for source material.

4. The land (3,500 acres) is owned by Heritage Minerals, Inc., a wholly owned subsidiary of Hovson's, Inc. Future land use will probably be residential in nature. A residential community with recreational facilities is planned. The area associated with the current activities (287.3 acres) is included in this land ownership. Since only a small portion of this 287.3-acre area is associated with source material concentrations, its ultimate use has not yet been decided and would be considered in long-range development plans.

5. There has been a misunderstanding associated with this inquiry. None of the ponds on the site contain any source material and, therefore, they are not relevant to the licensing process or any release criteria such as those in option 2.

6. PROCESS DESCRIPTION: (Please refer to attached flow diagram)

The stockpiled tailings produced during the first phase of the Heritage operation are hauled back to the feed hopper using a front-end loader. A 200-ton capacity storage silo is fed from the hopper via a conveyor belt.

The material is metered out of the storage silo using a disc feeder at the bottom of the silo at the rate of 50-60 tons per hour of dry sand. The sand is transferred via another conveyor belt to a vibrating screen with 1/4 inch openings to remove oversize trash (pebbles, tree branches, etc.). The sand is mixed with water at the screen. The oversize debris is allowed to fall to the ground and is removed via a small loader "Bobcat" for disposal.

The screened material, now in the form of a slurry as it passes through the screen is received in a 6' X 6' inverted pyramid steel tank fitted with a centrifugal pump. The slurry is pumped into the top floor of the wet mill building and is fed to a pair of vibrating screens with a one millimeter equivalent opening in order to remove coarse sand which is troublesome in processing and contains no values. The oversize from both screens is combined and treated over another similar screen to separate any entrapped fine sand. The oversize is then gravity fed to the final tailings pump tank for disposal.

The screened sand is then pumped through to the Humphreys spirals. The function of the spirals is to employ gravity and centrifugal forces to separate the heavy minerals (zircon, leucoxene, and rutile) from the light minerals (silica and alumina). The small amount of naturally occurring monazite present in the feed ends up with the heavy minerals. The plant contains several stages of spirals in series to maximize the yield of titanium and zircon while producing a high grade concentrate. The tailings from the last stage (scavenger spirals) constitute the final plant tailings and are sluiced to the tailings pump tank for final disposal.

The spiral concentrate is pumped to the shaking tables to remove any remaining silica and alumina, thereby producing a very high quality heavy mineral concentrate. A hydraulic classifier is subsequently used to float off some of the residual fine silica which is difficult to remove with spirals and tables. The product of the hydroclassifier is then pumped to a vacuum filter for dewatering.

The table circuit tailings, in addition to silica and alumina, also contain a large percentage of the leucoxene which has become light weight as a result of weathering over thousands of years. To recover this leucoxene, which is feebly magnetic, the table circuit tailings are pumped to a cyclone to remove the bulk of the water then to a high intensity magnetic separator wherein the leucoxene is retained by the magnetic field and later released as a concentrated product which is stockpiled outside the mill for future processing in the dry mill. The nonmagnetic material is pumped to a separate set of scavenger spirals to recover any escaping zircon. The concentrate from these spirals is pumped to a separate shaking table for further processing whereas the tailings are rejected along with the rest of the scavenger spiral tailings.

The wet mill tailings, which consist of screen oversize and scavenger spiral tailings are estimated to be 45-50 tons per hour on a dry basis. They are pumped out as a slurry to a dewatering cyclone which separates most of the water for recycling while depositing the sand for final disposal.

The final concentrate from the wet mill (the table concentrate which had been desilicified in the hydroclassifier) is pumped to a cyclone for partial dewatering then to a horizontal vacuum filter to remove the rest of the water thus producing moist sand with about 5% moisture remaining in it.

The moist sand goes into a rotary dryer which is a cylindrical steel shell 54 inches in diameter and 35 feet long. The dryer shell is mounted with a down-hill slope which allows the sand to cascade down by gravity. At the lower end of the dryer shell is a brick furnace fitted with an oil burner. Fuel oil is burned in the furnace and the resulting hot gases are forced into the dryer shell. As the moist sand comes in contact with the hot gases the remaining moisture is driven off by evaporation and the sand is heated to about 350-400 degrees Fahrenheit at the point of discharge from the dryer.

The hot dry sand flows from the dryer, through a trash screen and onto a conveyor belt which carries the sand into the dry mill. The hot sand is transferred from the conveyor belt to a bucket elevator whereby it is carried to the top floor of the dry mill and discharged into the feed hoppers of the high-tension machines.

High-tension machines, also known as electrostatic separators are machines that utilize high voltage D.C. current to separate mineral particles by virtue of differences in their surface electrical conductivities. Minerals with high electrical conductivity (leucoxene and rutile) are separated from those with low conductivity (zircon, alumina and silica).

Monazite is a nonconductor and will go with the zircon. Three stages of high-tension separation are employed to effect complete separation of conductive minerals from nonconductors.

The clean conductors contain leucoxene and rutile which are separated from each other using high intensity magnetic separators. The magnetic product is the final leucoxene and is conveyed to a storage bin for shipping. The nonmagnetic product is impure rutile which is further cleaned using electrostatic separators then transferred to a separate storage bin for shipping.

The nonconductor product from the high tension separators contains the zircon and any residual alumina and silica that might have escaped the wet mill. The monazite is also present in this product. High intensity magnetic separators are used for final cleaning of the zircon. The magnetic impurities (monazite and ferroaluminum silicates) are collected on a belt conveyor which discharges into a slurrying tank wherein the monazite-containing material is mixed with water and pumped to the monazite storage area which is located outdoors, south east of the dry mill and is fenced off to control access. The monazite stockpile is maintained in a moist state to prevent drying and wind blowing.

It is worth mentioning that the nature of these minerals, including monazite is such that there is virtually no leaching of any metals as a result of contact with water. This was verified by analyzing process water and ground water (both upstream and downstream from the plant). No trace of uranium or thorium was detected in any of the water samples.

The water that accompanies the wet mill tailings and the monazite sand is allowed to drain and collect in the process water pond where it is clarified by settling and pumped back to the plant for reuse. Excess water overflows to the holding pond for further clarification and, during the rainy season, may be allowed to overflow to the Green Branch of the Wrangle Brook as clear water.

7 - Plant equipment which process source material include the shaking tables, the hydroclassifier, the dryer, the high tension separators and the zircon magnets. These facilities are marked in red on the process flow diagram. In addition, the monazite concentrate is stockpiled in a separate fenced-in area outside the dry mill. The monazite stockpile is the only area that may require posting in accordance with 10CFR 20-203(e)(2).

8 - The length of the remaining operation will depend entirely on the economics of the marketplace for the plant products. If market conditions remain favorable, the remaining reserves will require approximately two years to process. On the other hand, if the operation becomes uneconomical, it may be discontinued at any time. There are no other sand piles in the area that can be

processed. However, it is possible that similar material may be brought in from other locations for processing at the Heritage plant facilities. Alternatively, it is possible that the plant feed (recycled tailings) may be sold to others for processing elsewhere.

9 - The primary waste produced during the Heritage operation is the clean tailings which result from screen oversize material and scavenger spiral tailings which are created in the wet mill. As noted before, these materials are produced in the plant prior to the time that source material is created. These tailings take the form of a slurry which is subsequently dewatered by cycloning and deposited on the ground east of the plant. The water generated from cycloning the clean wet mill tailings is returned to the process water pond where it is held prior to recycling into the wet mill. Approximately 47 tons per hour of sand (dry basis) and 500 gallons per minute of water (in the form of combined wet mill tailings slurry) are discharged from the plant during operation.

Some spillage of material occurs in the wet mill, the dryer and the dry mill. These spillages are collected frequently and returned to the wet mill for reprocessing.

Finally, a relatively small amount of water is generated by the cyclone and filter ahead of the dryer which is used to dry the table concentrate. This water is recirculated to the wet mill. Since monazite is highly insoluble in water, virtually no radioactive contamination is present in the water. Note also that the monazite concentrate produced in the dry mill is mixed with water and pumped as a slurry to the storage area where the water is allowed to drain. Again, this drainage water contains little or no radioactivity.

10 - As discussed in item 9 above, the primary waste stream generated by the Heritage operation is the wet mill tailings which arise prior to the time that source material appears in the process. Spillages from the plant are not in fact waste since they are returned to the process. All water in the plant contains little or no radioactivity since the monazite is highly insoluble in water.

It is proposed that a daily sample of the clean tailings be taken and used to form a monthly composite which would then be tested for radium content. This material is expected to meet Option I of the Branch Technical Position. Past analysis show that this material contains 6.3 pci/g Ra-226 plus Ra-228 which is 5 pci/g above background. This figure will be considered as action level. A reporting level of 15 pci/g is proposed as it is not expected to occur under current operating conditions.

Because of the highly insoluble nature of the monazite, it is believed that virtually no radioactivity will be leached into the surface waters or the ground water. This was verified by performing gross-alpha and gross-beta measurements on surface waters, both upstream and downstream from the plant and the ground waters. These results are summarized below:

	Plant Upstream	Plant Downstream	Deep Well	Shallow Well
Alpha: (pci/l)	<1.0	1.1	<1.0	<1.0
Beta: (pci/l)	<2.0	2.0	2.5	2.2

Furthermore, a recent gamma spec. analysis of plant discharge waters from the process water pond and the holding pond gave readings of <1.0 pci/l Ra-226 and <0.8 pci/l Ra-228.

Based on the above evidence and due to the fact that the current process is not expected to change, it is believed that regular monitoring of surface and ground waters will be unnecessary.

11 - Exhibit V is the survey form proposed for use and a layout of the plant facilities showing the locations of the monthly direct gamma surveys. These surveys would be conducted to ascertain the continued safety and cleanliness of the workplace.

12 - A regular monthly survey program for the plant facilities and the monazite pile is proposed using a direct gamma micro-R survey meter. It is recognized that during plant operation direct gamma readings in the plant area will be higher than those specified by the Branch Technical Position. However, regular surveys, as shown in Exhibit V, will assist in monitoring the radiation levels in the workplace. After decommissioning and decontamination, the direct gamma readings in the plant area are expected to meet the Branch Technical Position.

Air monitoring for dust and radon need not be done on a regular basis since past inspections by MSHA and the State DEP have verified that the plant is dust free. This was also confirmed by recent radon analyses in both the wet mill and the dry mill, and dust analyses in the dry mill. These results are attached as Exhibits VI (radon) and VII (dust).

13 - Radon analysis kits were placed in locations where radon gas is likely to concentrate, as shown in Exhibit VII. The analytical report marked Exhibit VI shows these results. Dust monitoring was conducted by a commercial concern (Teledyne Isotope, Westwood, NJ).

These results confirm that the workplace is free of dust and radon contamination. These conditions are expected to continue since no process changes are contemplated.

14 - Under current operating conditions, the monazite-containing sand is being stockpiled. It represents the only source material stored at the site. The accumulated monazite will be analyzed to determine whether the monazite stockpile contains in excess of 100 millicuries of thorium or uranium. Once the license is issued it will be possible to begin shipping the monazite and reducing accumulations. At the present time, there exists approximately 1000 tons of monazite-containing material which contains about 9000 kilograms of thorium and 200 kilograms of uranium.

Upon termination of operations, the plant facilities and the monazite stockpile will be decontaminated to appropriate levels. Thus, the decommissioning plan consists of the following steps:

a. Decontamination of the mill equipment.
b. Removal of monazite pile and mill sweepings from site.
c. Survey the plant facilities and monazite area.

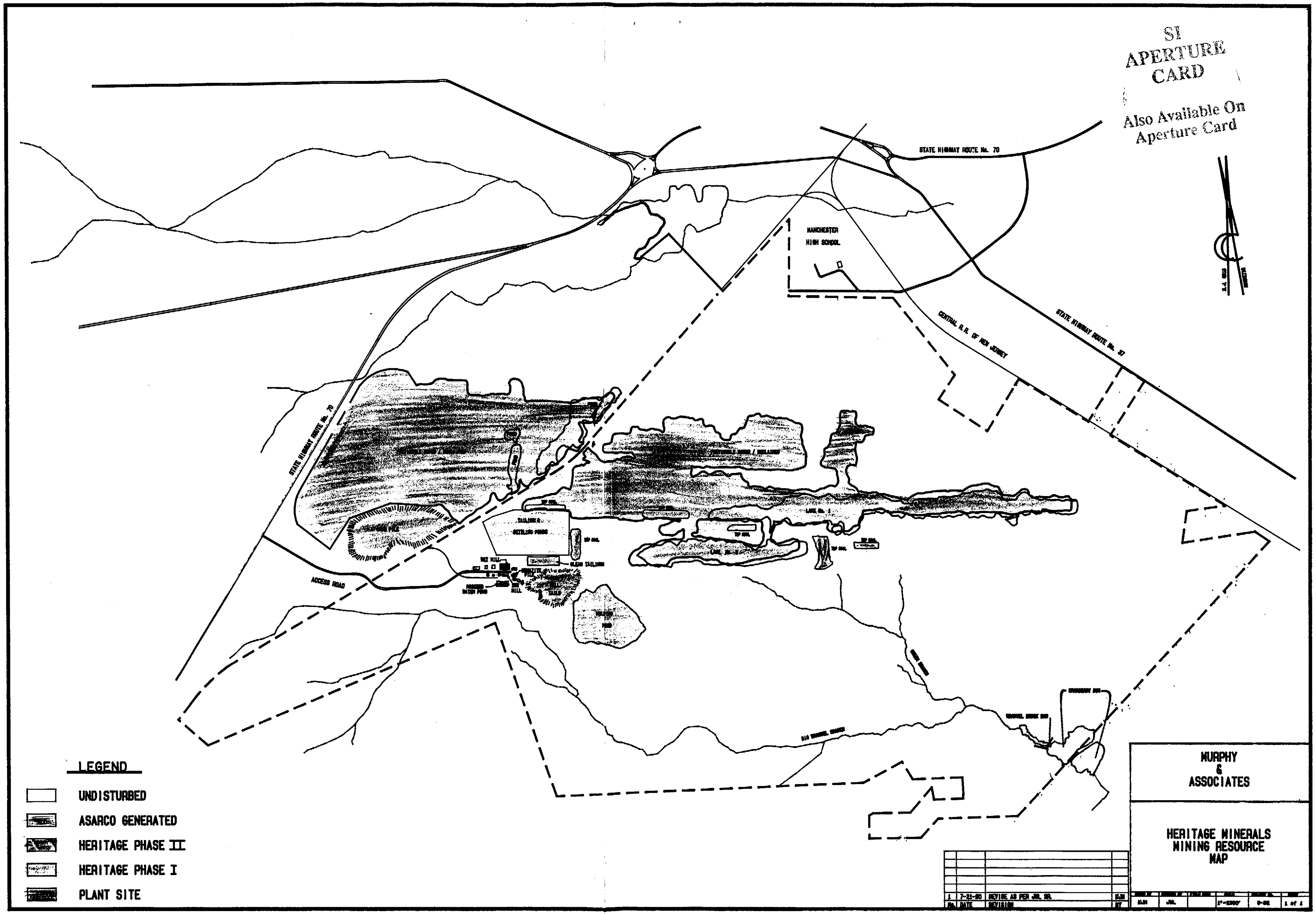
15 - Material which falls under the definition of source material, i.e. containing more than 0.05% U+Th will be transferred to another licensee in accordance with the regulations described in 10CFR 40.51

16 - A copy of Mr. Cuculic's training course curriculum is attached

17 - Duties of the Radiation Safety Officer:

a. to ensure that radiation safety surveys and monitoring programs are performed
b. to perform routine inspections of locations where radioactive materials are stored or handled
c. to ensure that the terms and conditions of the license are met and that required records are maintained

18 - The monazite area is fenced for controlled access and will be posted. The Radiation Safety Officer gives general instruction to those who have reason to be in the vicinity of the monazite to observe the necessary precautions. Form NRC-3 is posted by the time clock. When activities related to monazite shipping begin to take place, those individuals who will be involved in the handling, loading and shipping will be properly instructed and provided with personnel monitoring devices such as film badges or docimeters.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MANCHESTER HIGH SCHOOL
CENTRAL R.R. OF NEW JERSEY
STATE HIGHWAY ROUTE No. 37
ACCESS ROAD
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HERITAGE PHASE I
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MURPHY & ASSOCIATES
HERITAGE MINERALS MINING RESOURCE MAP

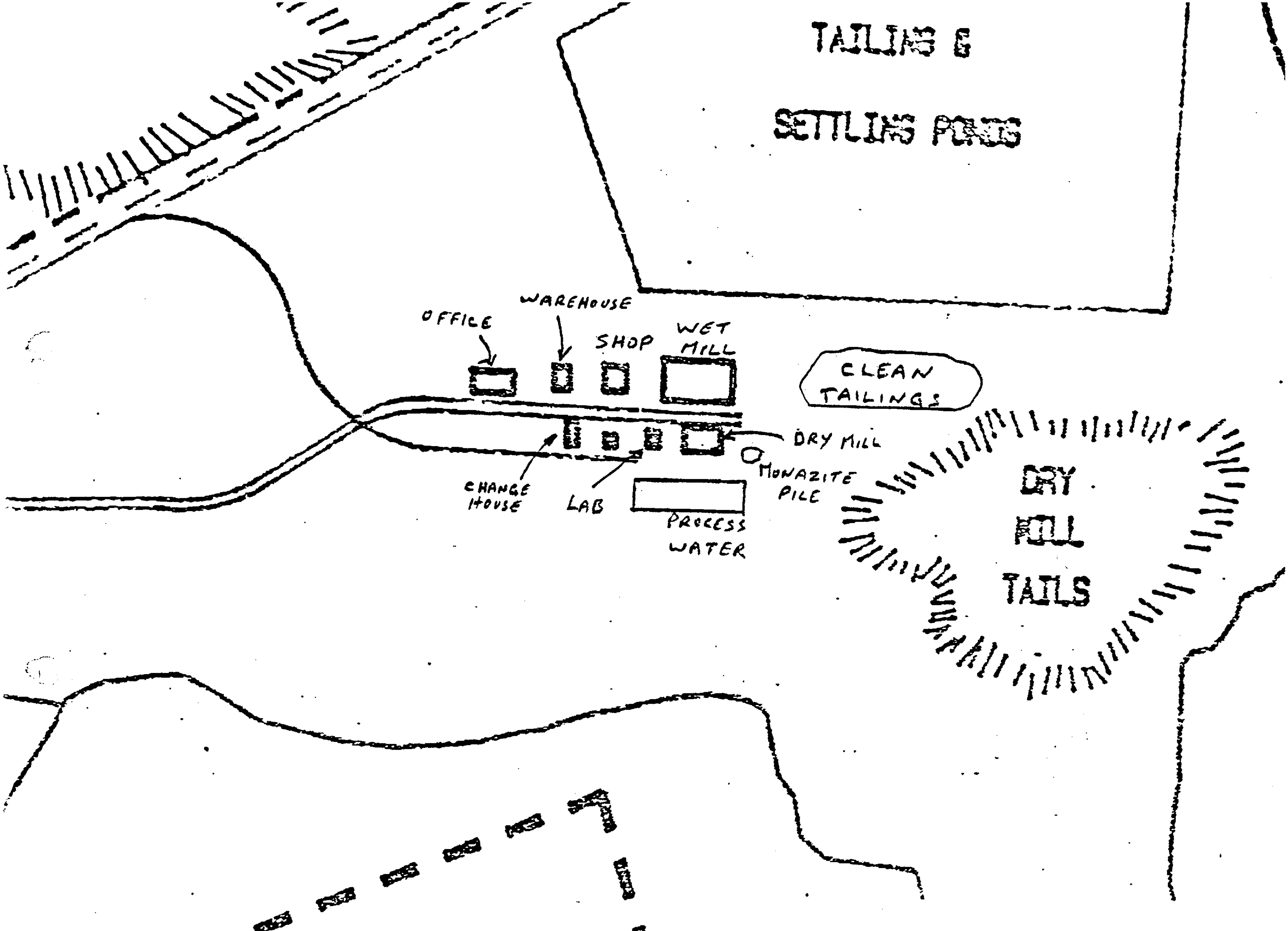

TAILINGS &
SETTLING PONDS
OFFICE
WAREHOUSE
SHOP
WET MILL
CLEAN TAILINGS
DRY MILL
MONAZITE PILE
CHANGE HOUSE
LAB
PROCESS WATER
DRY MILL TAILS

EXHIBIT I

EXHIBIT IV

PHASE I
HYDROGEOLOGIC INVESTIGATION REPORT
HERITAGE MINERALS, INC.
MANCHESTER TOWNSHIP, OCEAN COUNTY
NEW JERSEY

Prepared For:

Heritage Minerals, Inc.
Lakehurst, New Jersey

Prepared By:

Fellows, Read & Associates, Inc.
310 Main Street
Toms River, New Jersey 08753

October 31, 1989

personnel from two excavations in the vicinity of monitoring well MW-1 (Figure 5). Samples were collected using a bucket auger. One area had been used for the stockpiling of oil contaminated soils removed during the excavation of the buried distribution line (Samples 1A-1H). The second area was the former location of the waste oil storage tank Samples 2A-2F). In Spring, 1989, Heritage Minerals contracted to remove and dispose of the stockpiled soils, waste oil tank and soils in the vicinity of the waste oil tank. The fourteen shallow soil samples were collected to evaluate the adequacy of the soil removal.

Each of the samples were analyzed for total petroleum hydrocarbons and total percent solids. Selected soil samples were analyzed for volatile organic compounds and nontargetted compounds, base/neutral extractable organic compounds and nontargetted compounds and polychlorinated biphenyls. The laboratory results are presented in Appendix F.

3.0 INVESTIGATION RESULTS

The following section presents the results of the site investigation. This section includes a discussion of the hydrogeologic setting of the property and ground water quality at the site.

3.1. Hydrogeologic Setting

The topography of the Heritage property is relatively flat, with low topographic relief (50 ft). Due to the surface mining of the ilmenite deposits, the original topography of the central portion of the site has been recontoured. These wetlands form the drainage of Wrangel Brook. The drainage of Wrangel Brook has a dendritic pattern and streamflow is from the headwaters, located west of site to the east. Two large lakes, oriented east-west, were created along the Green Branch of Wrangel Brook as a result of dredging operations at the mine.

The deposits underlying the site consist of unconsolidated stratified clay, silt, sand and gravel. These deposits have been previously mapped by Anderson and Appeal (1969) as the Tertiary Age Cohansey Sand. The Cohansey Sand consists of a characteristically yellowish-brown, stratified, ilmentitic, fine to very coarse-grained quartz sand. White, dark gray and red kaolinitic clays are interbedded with the sands Reportedly, individual beds are difficult to trace as the clays and sands are lenticular and discontinuous. The clay beds are typically 8 to 10 feet thick but may be as much as 30 feet thick (Anderson and Appeal, 1969). This is corroborated by soil borings performed at the site to support historical mining activities.

As part of this investigation, 10 exploratory borings were completed in the vicinity of the plant site (Figure 3). The shallow, subsurface deposits were found to consist of brown, gray or yellow, fine to medium sand, with some coarse sand or gravel, and silt. The deposits are stratified and occasionally interbedded with layers of silt and/or clay. Beds of gray to white silty clay, 0.5 to 1.0 feet thick, were encountered at soil boring MW-8. Bedrock was not encountered in any of the borings. These observations are consistent with the conditions noted during installation of the facility's Raritan production wells which were installed to a depth of 1,600 feet without encountering bedrock.

Fill material was encountered in three of the borings (MW-6, MW-7 and MW-9). The fill material consisted of brown, fine to medium sand, with little silt, gravel and/or clay. The thickness of the fill material ranged from 1 to 2 feet.

3.2 Ground Water Hydrology

The Cohansey Sand represents the local water table aquifer. In general, regional ground water flow occurs from recharge areas located north and west of the study area to the east and northeast towards the tributaries of the Toms River. The Toms River and its tributaries represent the major ground water discharge zones for the region (Figure 2). Locally, ground water flow is from upland areas, which are recharged by precipitation, to lower areas where ground water discharges to streams and wetlands. Ground water flows unconfined through the Cohansey Sand in the vicinity of the site. The Green Branch, Michaels Branch and Davenport Branch of Wrangel Brook represent local discharge zones for shallow ground water. These streams flow east-northeast and discharge to the Toms River or Barnegat Bay.

Ground water elevations were recorded at the ten on-site monitoring wells on a bi-weekly basis from December 22, 1988 to the present. Depths to ground water for the period December 22, 1988 to September 20, 1989 are summarized on Table 3. Ground water elevations are presented on Table 4. These data indicate that ground water occurs at the site at depths ranging from 7.8 feet (MW-2 on January 13 1989) to 14.98 (MW-7 on January 26, 1989). In wells where free product was encountered (MW-2, MW-7, MW-8 and MW-9) the actual depth to the ground water table was determined using water level indicator tape with oil/water sensitive paste. The data presented on Table 3 and Table 4 for these monitoringwells represent the actual depths to water and have not been adjusted to compensate for depression of the water table by free product. The ground water elevation data for the monitoring wells were plotted and ground water contour maps were prepared in order to evaluate the direction of ground water flow at the site. Data for wells in which significant quantities of free product were detected were not utilized in the construction of contour maps, as the monitoring wells in which free product was not observed provided sufficient data. Review of the data indicates that ground water at the site generally flows unconfined, thought the Cohansey Sand, from the northeast to the south. On several occasions, however, ground water appears to flow in the opposite direction, from the south to the north. Based on the typically gentle hydraulic gradient observed at the site, it is anticipated that this apparent reversal is attributable to the fluctuating influence of the recycling pond and the settling pond, which serve as potential recharge or discharge sources at the site. Such is the case for the period January 13 through April 13, 1989. This effect is potentially related to the facility's discharge of water to the recycling pond, which commenced as a plant operation in January 1989, and the recharge of rainwater during March. As a result of the increase in the hydrostatic head of the pond, infiltration from the pond would have recharged ground water, resulting in localized ground water mounding and rising water levels in the monitoring wells located adjacent to the pond. Ground water levels in MW-2, located adjacent to the pond, increased from 79.94 feet, on December 29, 1988 to 83.80 feet, on April 13, 1989. Conversely, during this same time period, ground water levels in MW-9, located approximately 700 feet north of the recycling pond, increased by approximately one foot. As the level of the recycling pond varies substantially and rapidly in response to production needs, it is not possible to draw a correlation between the elevations recorded for the pond at the time of recording monitoring well elevations and the direction of ground water flow.

As the ground water contour maps developed for the site varied only slightly from the two referenced patterns during the period of observation, six groundwater contour maps are presented herein in order to reflect the above-referenced observations and represent seasonal changes in elevations. Ground water contour maps for the dates December 29, 1988; March 16, 1989; April 27, 1989; June 23, 1989; August 3, 1989; and September 20, 1989 are presented as Figures 6,7,8,9,10 and 11, respectively.

EXHIBIT V

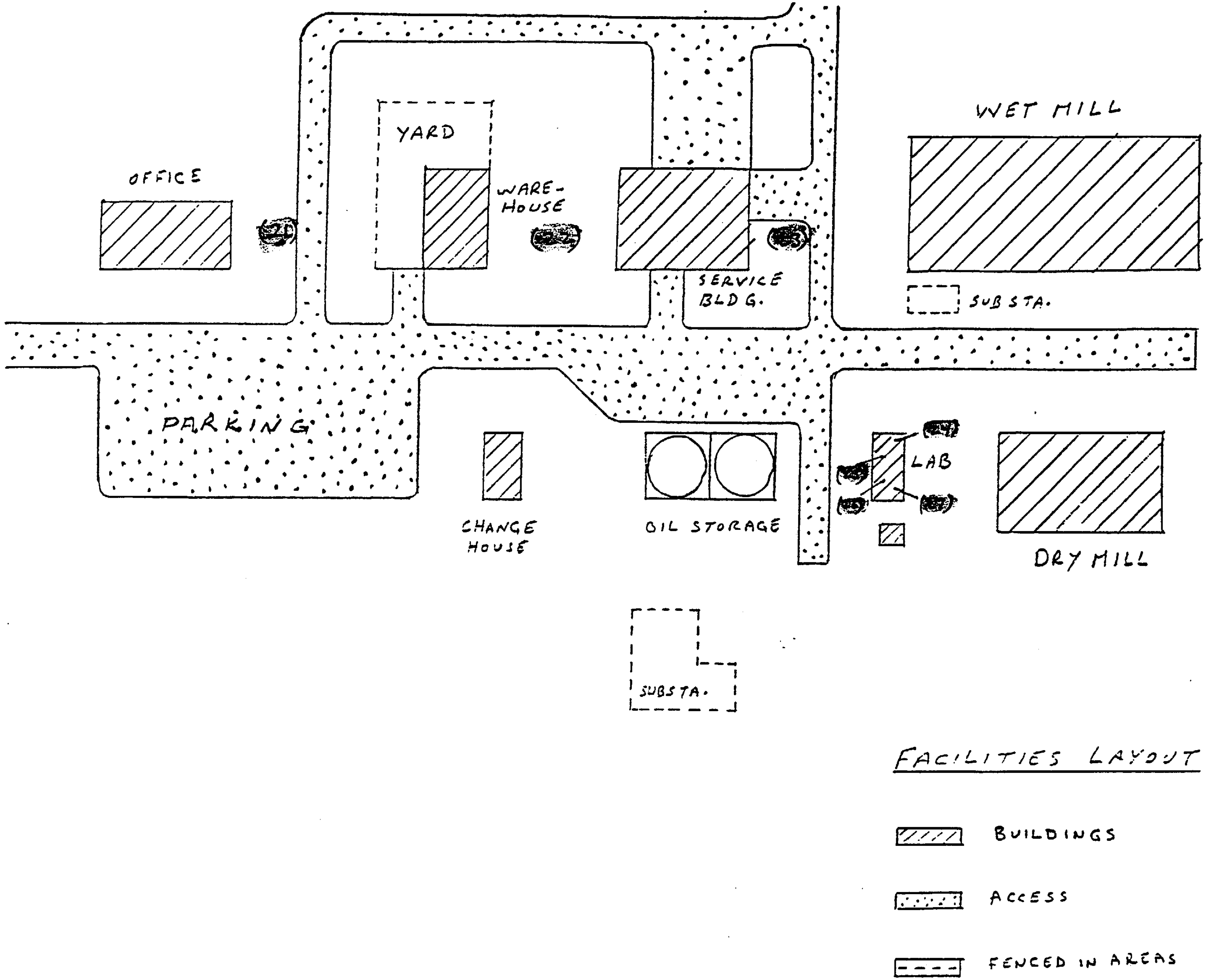
HERITAGE MINERALS INCORPORATED

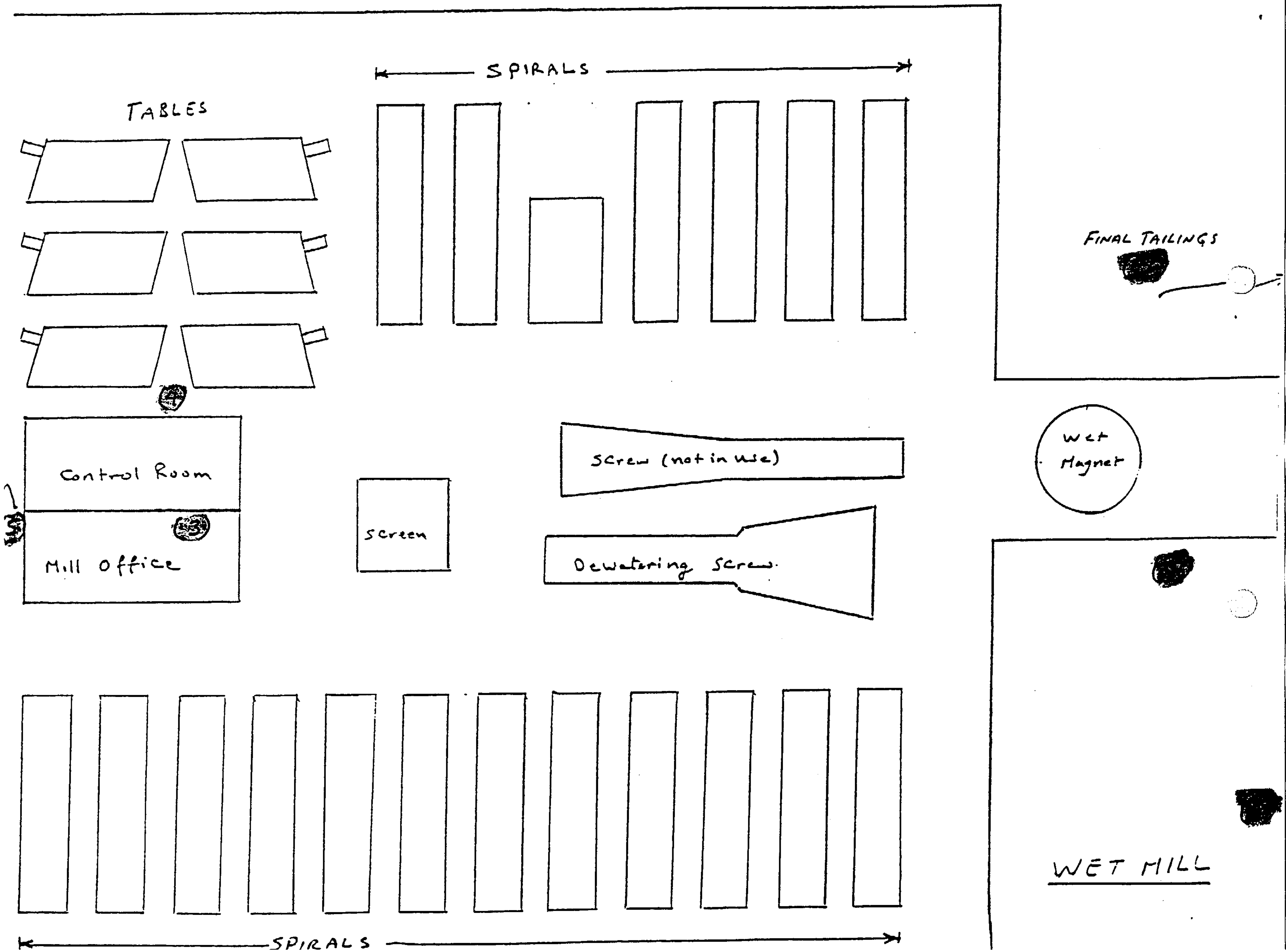
Direct Gamma Survey Form

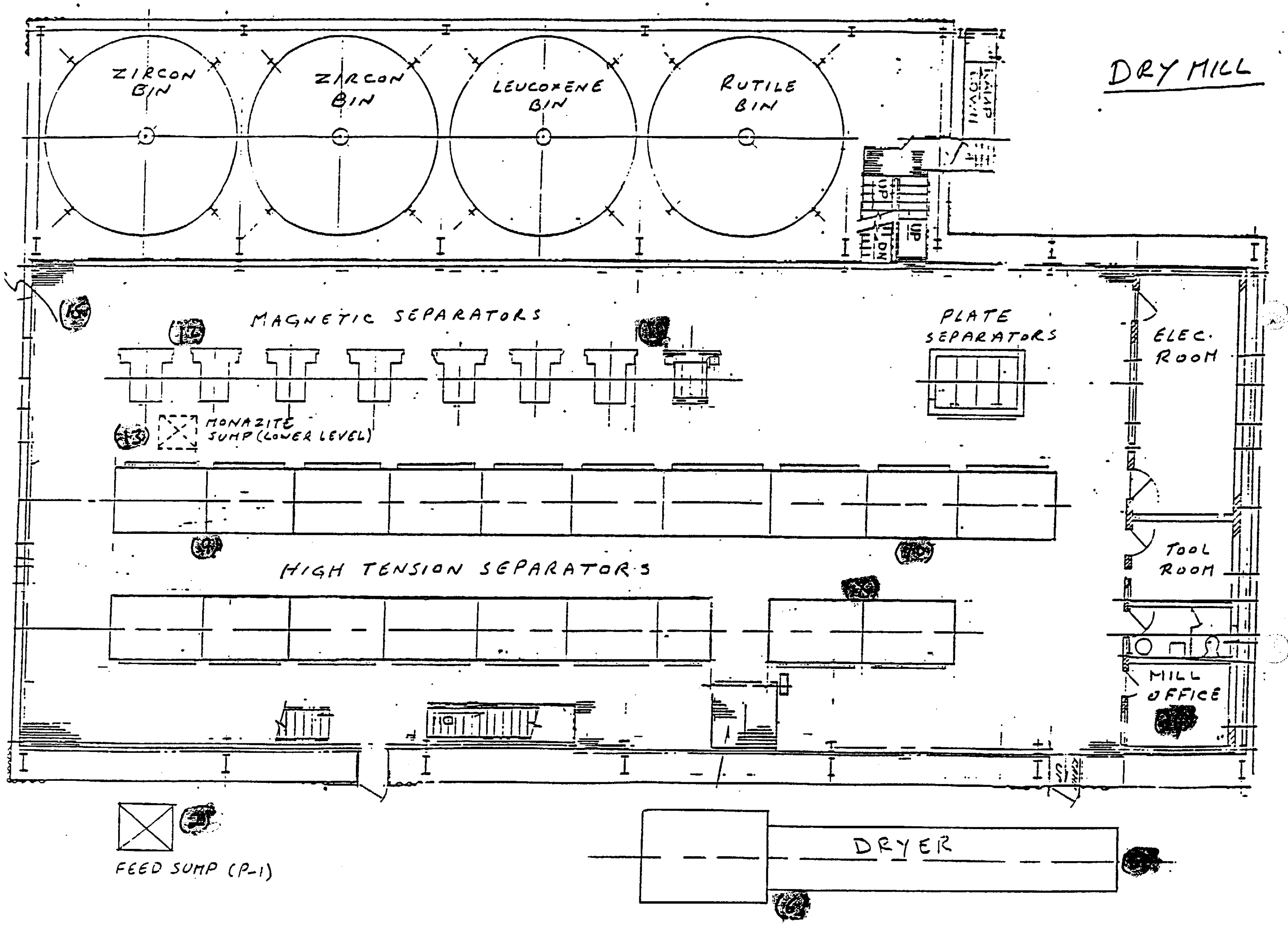
Location No. & Description	Reading, microR/hr
(1) Feed Pile (Range)	
(2) Feed Sump (P-1)	
(3) Wet Mill Office	
(4) Wet Tables (Conc. End)	
(5) Hydroclassifier	
(6) Dryer Discharge	
(7) Dryer Air Cyclone	
(8) Rougher H.T. Machines	
(9) Cleaner H.T. Machines	
(10) Recleaner H.T. Machines	
(11) Leucoxene Magnets	
(12) Monazite Magnets (Range)	
(13) Monazite Sump (P-20)	
(14) Dry Mill Office	
(15) Monazite Stockpile (3 Feet Above)	
(16) Final Tailings Stockpile	
(17) WHIMS Magnetics Stockpile	
(18) Clean-up Pile	
(19) Other (Describe Below)	
(20) Other (Describe Below)	
(21) East Of Office Building	
(22) Between Warehouse and Shop	
(23) Between Shop and Wet Mill	
(24) Lab (Sample Prep Hood)	
(25) Lab (Heavy Liquid Room)	
(26) Lab (Shatterbox Room)	
(27) Lab (Mag. Bench)	
(28) Other (Describe Below)	
(29) Other (Describe Below)	
(30) Other (Describe Below)	

Remarks:

Taken By:------------------------- Date:---------------


WET MILL
YARD
OFFICE
WARE-HOUSE
SERVICE BLDG.
SUBSTA.
PARKING
LAB
CHANGE HOUSE
OIL STORAGE
DRY MILL
SUBSTA.
FACILITIES LAYOUT
BUILDINGS
ACCESS
FENCED IN AREAS


SPIRALS
TABLES
FINAL TAILINGS
Control Room
Mill Office
Screen
Screw (not in use)
Dewatering Screw
Wet Magnet
WET MILL
SPIRALS


DRY MILL
ZIRCON BIN
ZIRCON BIN
LEUCOXENE BIN
RUTILE BIN
UP
UP
DN
MAGNETIC SEPARATORS
PLATE SEPARATORS
ELEC. ROOM
TOOL ROOM
MILL OFFICE
MONAZITE SUMP (LOWER LEVEL)
HIGH TENSION SEPARATORS
FEED SUMP (P-1)
DRYER

Teledyne Isotopes • 50 Van Buren Avenue • Westwood, New Jersey 07675 • Tel 201-664-7070

Teledyne Isotopes Radon Test

Laboratory Analysis Report

RECEIVED MAY 1 6 1990

Dr. Max Etanil
Heritage Minerals Inc.
P.O. Box 12
Lakhurst , NJ 08733

Test Site:
28-00719
Dr. Max Etanil
Heritage Minerals Inc.
P.O. Box 12
Lakhurst , NJ 08733

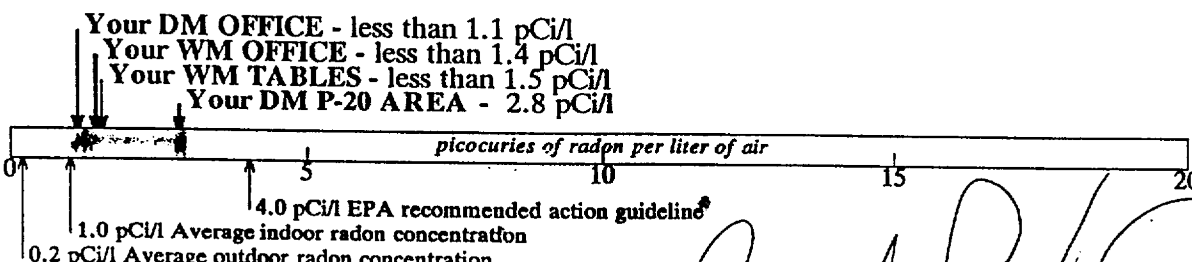
Report Date: 5/15/90

Our analyses of your Teledyne Isotopes Radon Test are listed below. The radon values are in picocuries of radon per liter of air (pCi/l).

Ref No.	Exposed	Received	Location	Radon	Comments
147598	5/ 1/90 to 5/ 5/90	5/14/90	WM TABLES	less than 1.5 pCi/l	
148480	5/ 1/90 to 5/ 5/90	5/14/90	WM OFFICE	less than 1.4 pCi/l	
147542	5/ 1/90 to 5/ 5/90	5/14/90	DM OFFICE	less than 1.1 pCi/l	
147546	5/ 1/90 to 5/ 5/90	5/14/90	DM P-20 AREA	2.8 pCi/l	

Use the chart below to compare your test results against the EPA guidelines. We have also enclosed additional radon information to help you interpret the results of your radon test.

For further information on the radon problem, call the New Jersey Radon Information Hotline at 800-648-0394.



Beverly Rowland
Teledyne Radon Measurement Laboratory

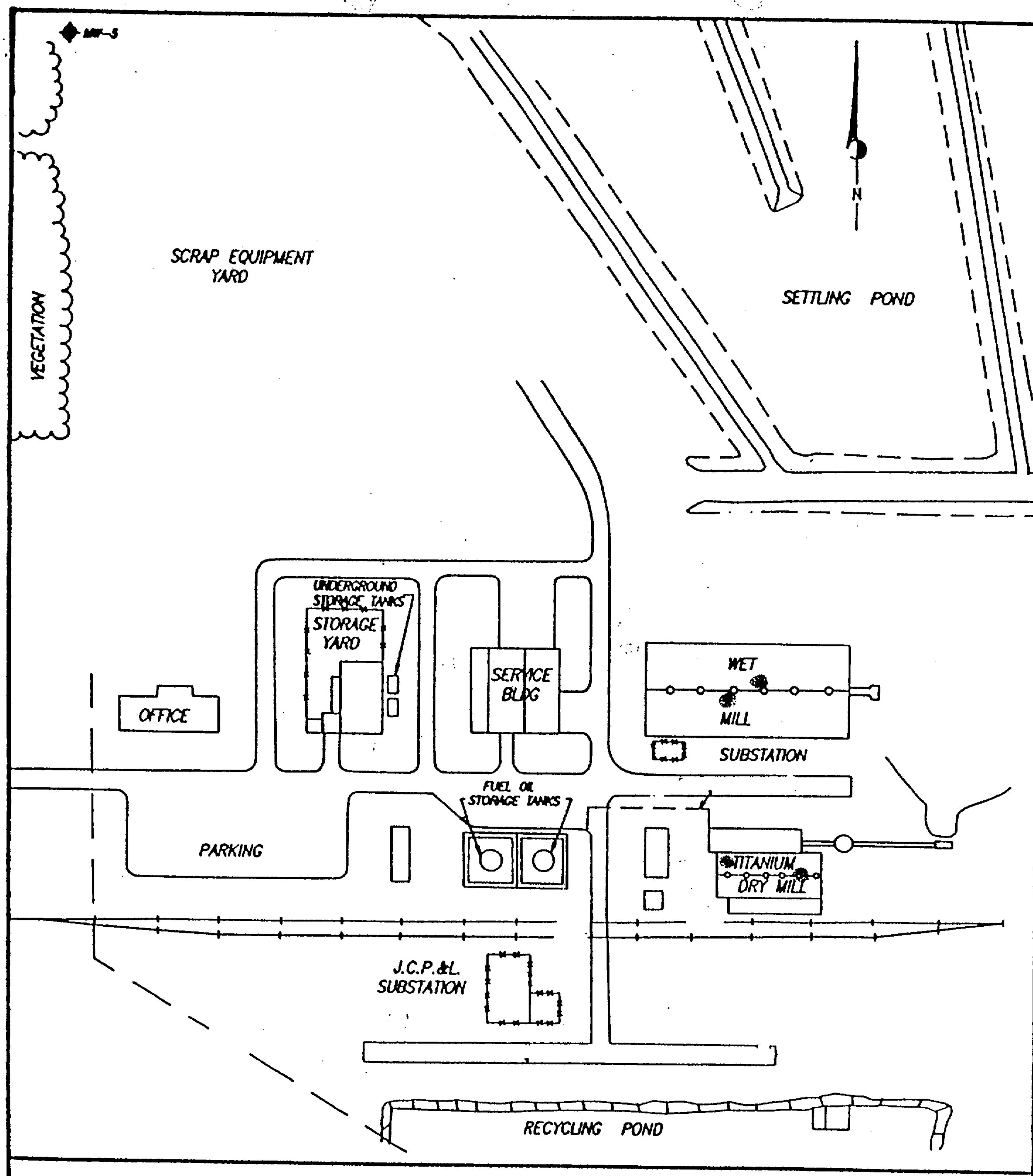
This laboratory analysis has been performed in accordance with the Interim Radon and Radon Decay Product Measurement Protocols prepared by the Office of Radiation Programs of the United States Environmental Protection Agency and is for your own personal use and evaluation. Teledyne Isotopes makes no recommendations, representations or warranties other than as specifically set forth in this report and shall not be responsible or liable for any action or the consequences of any action taken in connection with or reliance upon this report.

*The United States Environmental Protection Agency and the Centers for Disease Control have used a continuous exposure level of 4pCi/l or 0.02 WL as a guidance level at which further testing and/or remedial action are indicated. If levels in your home exceed 4 pCi/l or 0.02 WL, it is recommended that you notify the New Jersey Department of Environmental Protection at 1-800-648-0394."

EXHIBIT VI

OFFICIAL RECORD COPY ML 10

110418



RADON KIT PLACEMENTS

EXHIBIT VII

TELEDYNE ISOTOPES

50 VAN BUREN AVENUE

WESTWOOD, NEW JERSEY 07675

(201) 664-7070

July 13, 1990

RECEIVED JUL 17 1990

Dr. Max ElTawil
Heritage Minerals, Inc.
P.O. Box 12
Lakehurst, NJ 08733

Dear Dr. ElTawil:

On July 3, 1990, Scott Dennerlein of Teledyne Isotopes conducted air sampling at your facility in Lakehurst, New Jersey.

Sample #1 was obtained on the ground floor of the titanium dry mill (east end). Sample #2 was obtained in the vicinity of the stack from the bag house east of the dry mill. Sample #3 was obtained in the break room on the second floor of the titanium dry mill. All locations are identified on Figure I. All samples were taken using an oil-less, diaphragm pump drawing air at twenty liters per minute through a 0.8 μm filter placed at least three feet above ground level. After several days (to allow radon progeny to decay), the filters were counted for alpha activity using an alpha scintillation counter. The raw data is included, as well as the calculated concentrations. The counting system does not discriminate between alpha particles from different isotopes. Therefore, for the purpose of calculations it was assumed that all alpha activity was due to thorium. I have also calculated the percent of the Maximum Permissible Concentration (MPC) for occupational exposure for all samples.

Within the scope of this sampling program, no worker at your facility is being exposed to airborne activity above the applicable limits.

If you have any questions or require additional information, please do not hesitate to contact us.

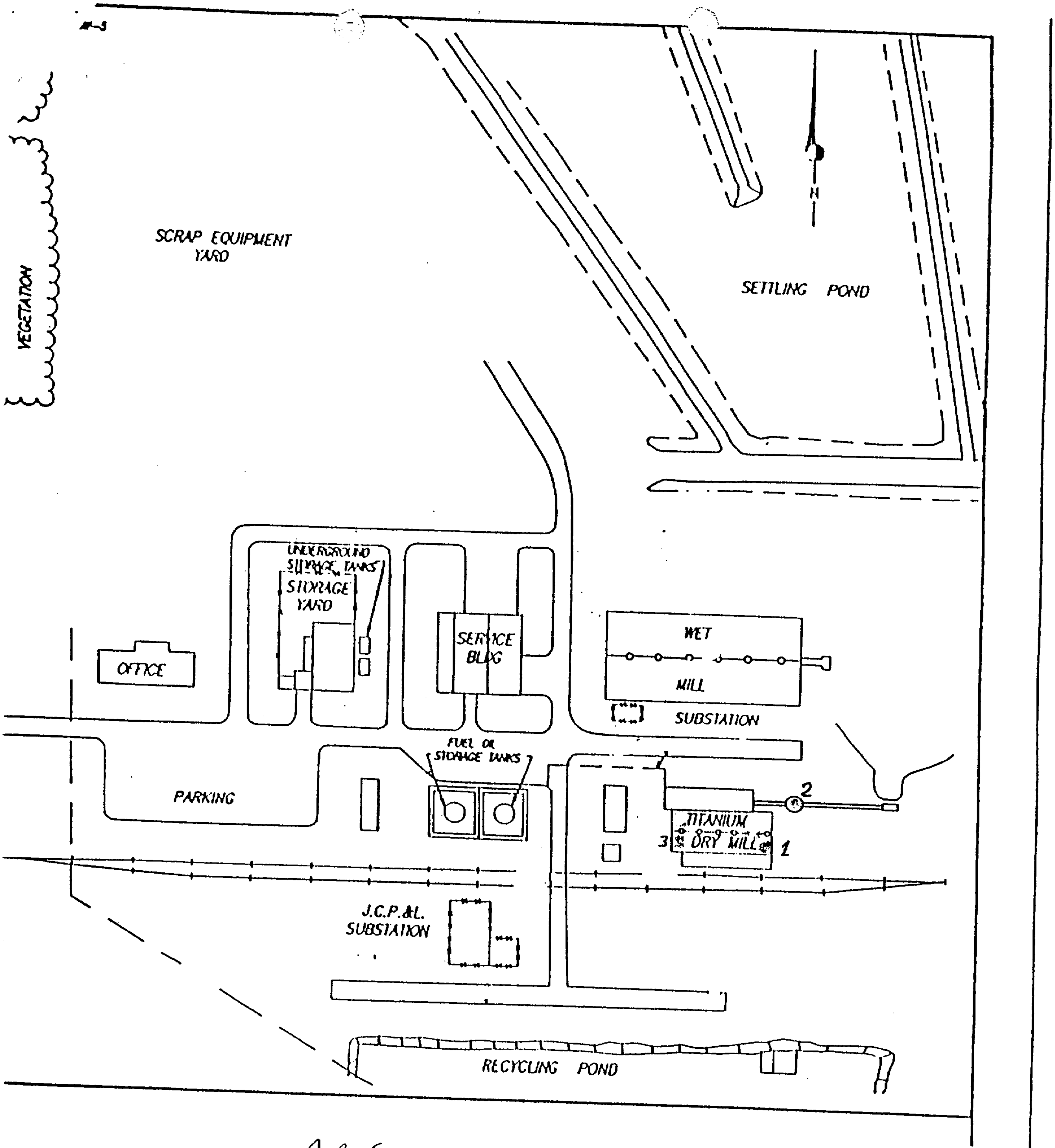
Sincerely,

TELEDYNE ISOTOPES

Scott W. Dennerlein

SWD:jk

Scott W. Dennerlein, Health Physicist
Radiological Services Department



AIR SAMPLING LOCATIONS

TELEDYNE ISOTOPES

AIR SAMPLE RECORD

Counted By Scott Dennerlein

Date Counted 7/10/90

Detector Type Eberline SAC-4, Serial #271, Calibrated 4/24/90

Background Count time (min) 50

Background Counts 20

Detector efficiency 0.27

Sample Count Time	Start Date/Time	Stop Date/Time	Sample ID	Sample Counts	OCC/EFF	LPM	Limiting Isotope	Rotometer
50 minutes	7-3/1544	7-3/1614	#1	35	OCC	20	Th-232	20
50 minutes	7-3/1615	7-3/1645	#2	18	OCC	20	Th-232	20
50 minutes	7-3/1646	7-3/1716	#3	36	OCC	20	Th-232	20

IWL-HP-14

AIR SAMPLE REPORT

SAMPLE ID No.	COUNTED BY	COUNT DATE	INSTRUMENT USED	BACKGROUND CTS.	BACKGROUND TIME	EFF.	START DATE	START TIME	STOP DATE	STOP TIME	FLOW RATE	VOLUME	SAMPLE COUNTS	LIMITING ISOTOPE	OCC/ EFF.	MPC VALUE	RESULT uCi/ml.	PERCENT MPC
1	S. Dennerlein	7/10/90	SAC-4	20	50	0.27	7/ 3/90	1544	7/ 3/90	1614	20.0	6.00E+05	35	Th-232	OCC	3E-11	<1.16E-12	< 3.86

Number of samples reported: 1

APPROVED BY: [signature] DATE: 7/13/90

AIR SAMPLE REPORT

Date:7/12/90

SAMPLE ID No.	COUNTED BY	COUNT DATE	INSTRUMENT USED	BACKGROUND CTS.	BACKGROUND TIME	EFF.	START DATE	START TIME	STOP DATE	STOP TIME	FLOW RATE	VOLUME	SAMPLE COUNTS	LIMITING ISOTOPE	OCC/ EFF.	MPC VALUE	RESULT uCi/ml.	PERCENT MPC
2	S. Dennerlein	7/10/90	SAC-4	20	50	0.27	7/ 3/90	1615	7/ 3/90	1645	20.0	6.00E+05	18	Th-232	OCC	3E-11	<1.16E-12	< 3.86

Number of samples reported: 1

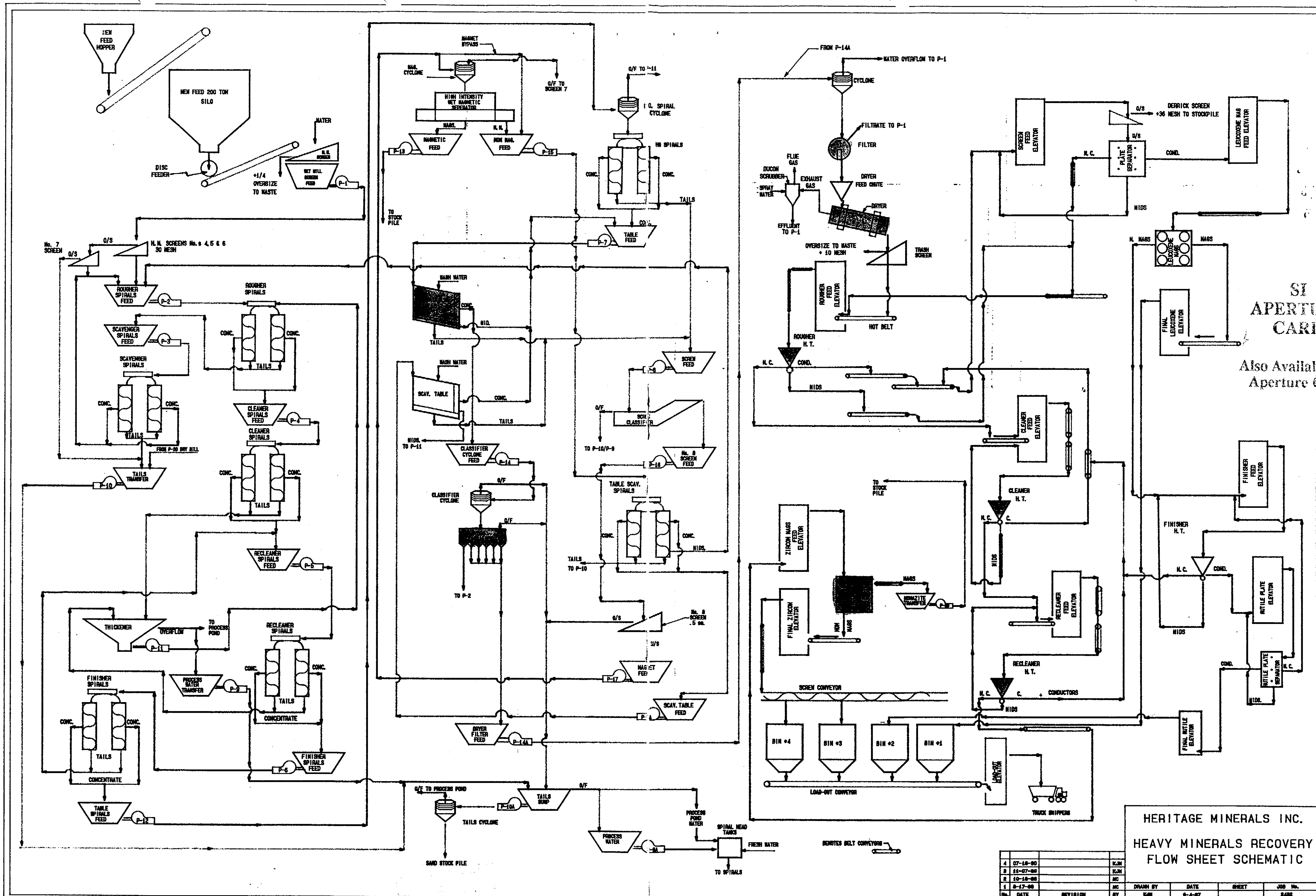
APPROVED BY: [signature] DATE: 7/13/90

AIR SAMPLE REPORT

SAMPLE ID No.	COUNTED BY	COUNT DATE	INSTRUMENT USED	BACKGROUND CTS.	BACKGROUND TIME	EFF.	START DATE	START TIME	STOP DATE	STOP TIME	FLOW RATE	VOLUME	SAMPLE COUNTS	LIMITING ISOTOPE	OCC/ EFF.	MPC VALUE	RESULT uCi/ml.	PERCENT MPC
3	S. Dennerlein	7/10/90	SAC-4	20	50	0.27	7/ 3/90	1646	7/ 3/90	1716	20.0	6.00E+05	36	Th-232	OCC	3E-11	<1.16E-12	< 3.86

Number of samples reported: 1

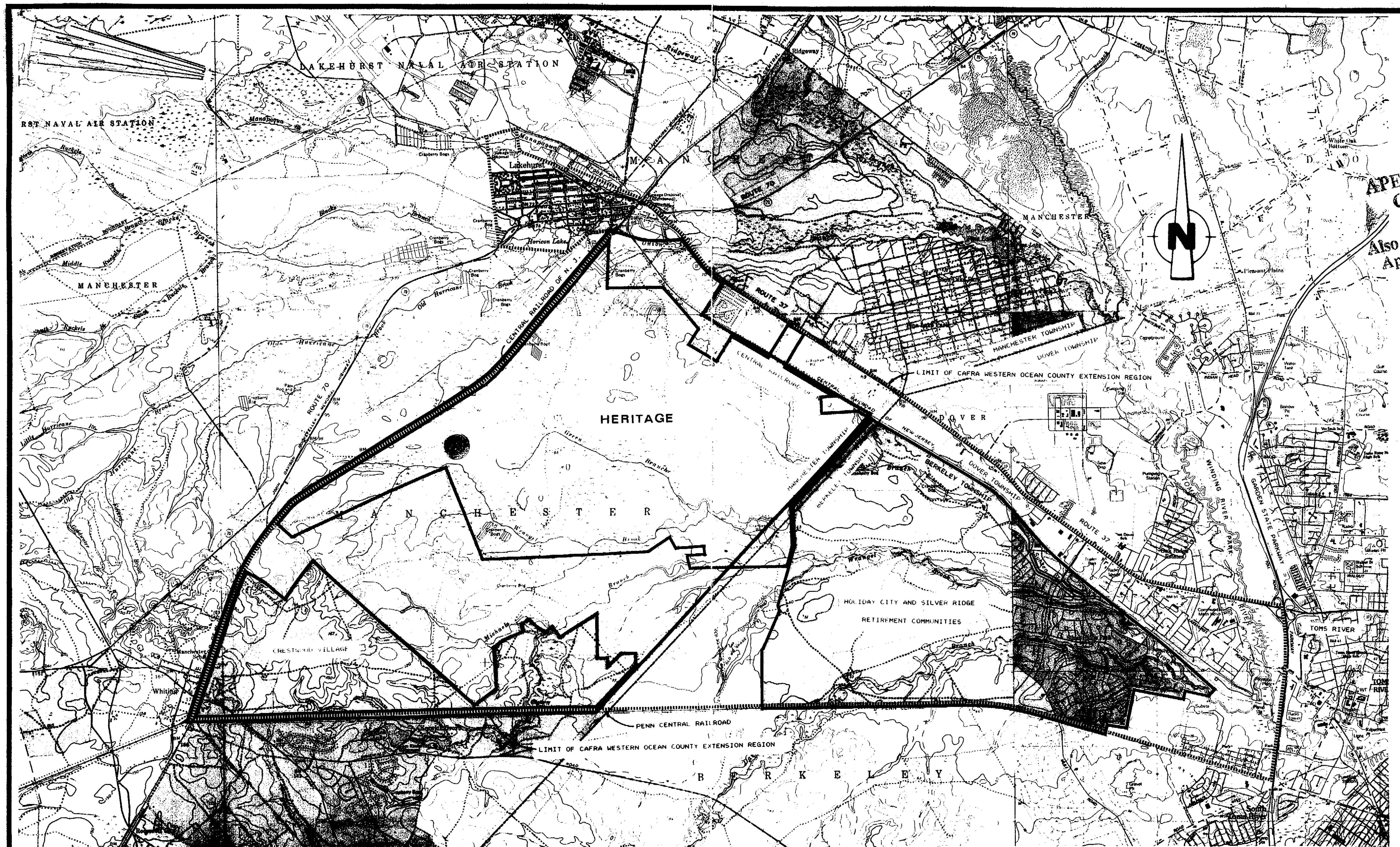
APPROVED BY: [signature] DATE: 7/13/90



SI APERTURE CARD

Also Available On Aperture Card

9103140103-01



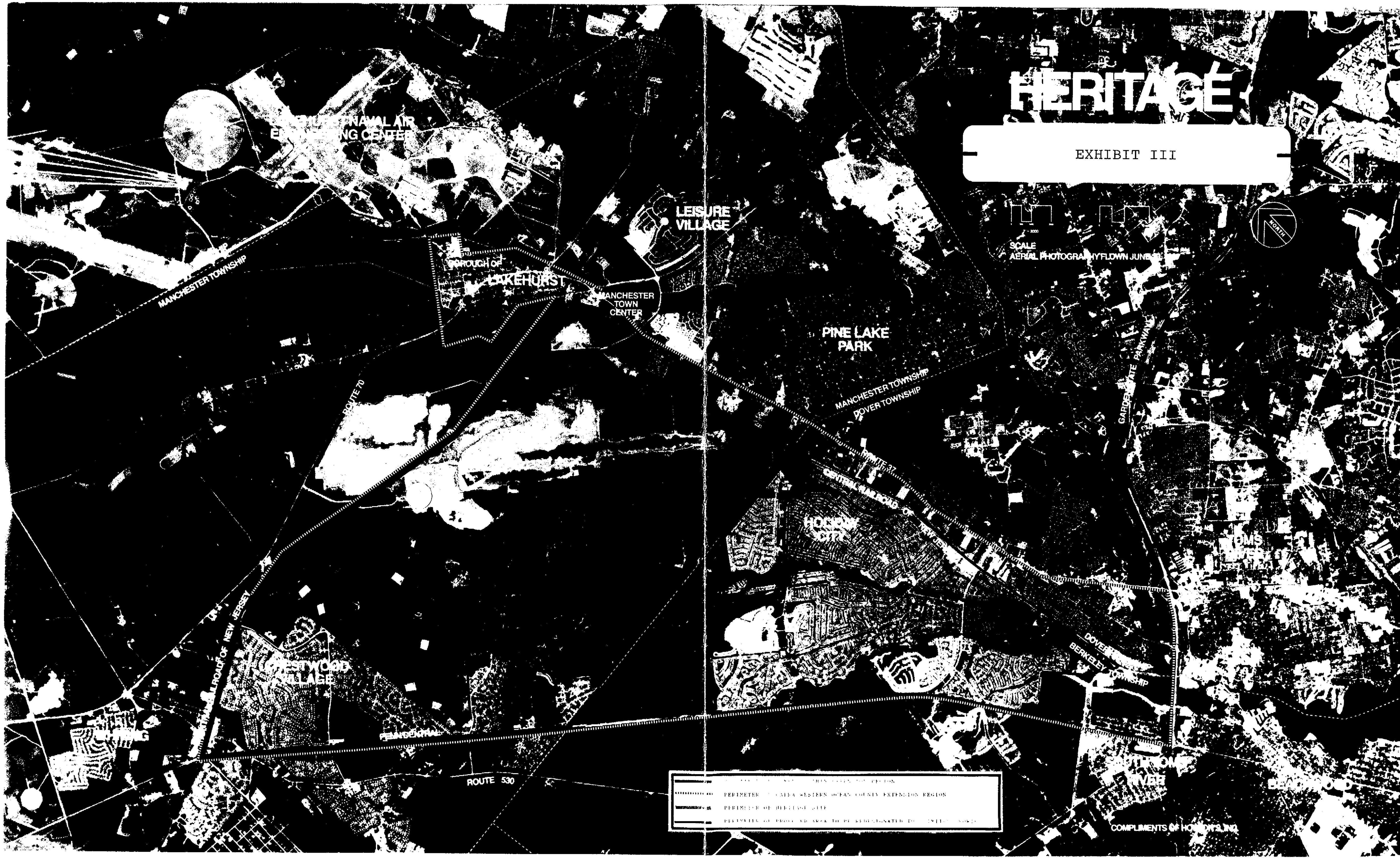
SURROUNDING RESIDENTIAL DEVELOPMENTS
PRIVATE DEVELOPMENT WITHIN EXTENSION REGION
PERIMETER OF CAFRA WESTERN OCEAN COUNTY EXTENSION REGION
PERIMETER OF HERITAGE SITE
PERIMETER OF PROPOSED AREA TO BE REDESIGNATED TO "LIMITED GROWTH"

EXHIBIT II

UNITED STATES GEOLOGICAL SURVEY MAP SCALE : 1" = 2000'

COMPOSITE OF: KESWICK GROVE QUADRANGLE
TOMS RIVER QUADRANGLE
WHITING QUADRANGLE
LAKEWOOD QUADRANGLE
LAKEHURST QUADRANGLE
CASSVILLE QUADRANGLE

9103140103-03



9103140103-04