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November 22, 2002

SMB-1541
04008980

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:

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

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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

Affidavit of John F. Lord

November 22, 2002

I, John F. Lord, do attest and declare as follows:

1. My name is John F. Lord. Currently, I am a consultant to Hovsons, Inc. which owns Heritage Minerals, Inc. ("HMI"). I have worked as Plant Manager, and later as a Consultant, for HMI since 1987. Prior to that, I was employed by ASARCO, Inc. from 1949-1977 as Exploration, Development and Design, Construction and Operation Manager of its *ilmenite* (a *titanium* mineral) mine in Manchester Township, NJ. I received my B.S. (Mining Engineering) from the University of California and am a Registered Professional Engineer in the State of New Jersey, New Jersey License No. 10744. I am a member of the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Society of Civil Engineers, and the National Society of Professional Engineers. I have attached a copy of my *curriculum vitae* to this affidavit.

2. I have worked in the area of exploration, mining, and environmental management for over 66 years since my initial employment with Yuba Consolidated Gold Fields in the State of California. I have worked on various projects across the United States and in South America and other foreign countries.

3. HMI has asked me to compile a history of the mineral recovery operations conducted at the HMI site in Manchester Township, NJ by each of the site's past and present owners and/or operators. Attached to this affidavit is a copy of my report ("Process History") regarding the mineral recovery operations of four (4) distinct entities that used some or all of the plant facilities at the HMI site for recovery of various *titanium* minerals and *zircon* for sale, or prospective sale, to customers. These four (4) entities include ASARCO, Inc. ("ASARCO"), Humphrey's Gold, Mineral Recovery, Inc. ("MRI"), and HMI, the current site owner. The Process History provides a physical description of the HMI site, a discussion of the types of mineral recovery operations that took place at the site, and, to the best of my ability, a discussion of their potential environmental impacts at the site.

4. In order to prepare this report, I engaged in several different types of research activities to insure that all information provided is as accurate as possible. I have consulted available files regarding mineral recovery operations conducted by ASARCO, Humphrey's Gold, MRI, and HMI, including schematic diagrams illustrating the mineral recovery processes used in the wet and dry mills at the HMI site, reports prepared by employees of ASARCO and HMI, and assessments prepared by SENES Consultants, Ltd. located in Ontario, Canada. I also have met with Tony Cuculic, former Plant Engineer for ASARCO and Plant Engineer and Radiation Safety Officer ("RSO") for HMI and reviewed the documents noted above to refresh my recollection and his regarding ASARCO and HMI operations. I contacted Eugene Whittle, site manager for Humphrey's Gold and similarly discussed his recollection of Humphrey's Gold activities.

I also reviewed letters and reports prepared by Max El Tawil, former Metallurgist for ASARCO and Consultant to MRI and HMI.

5. Over time, the mineral recovery operations conducted at the HMI site involved the dredging, processing, and re-processing of million of tons of fine sands. During normal operations, these sands were dredged from the subsurface and pumped to the wet mill. After being processed through the wet mill, the resulting heavy mineral *concentrate* was stored on the ground to the east of the dry mill for de-watering. This wet mill concentrate contained approximately 95 percent of the dredged sand's heavy mineral content, including *monazite*. From there, it was moved by front-end loader into the dry mill. HMI's Phase I reprocessing of ASARCO's dry mill tailings (from the Gray Area) and Phase II reprocessing of HMI tailings (from the Blue Area) also utilized front-end loaders to move materials into the dry mill feed hopper. Naturally, some of the concentrated material remained on the ground or was spilled during transport by front-end loader and was graded and re-graded over and into the surface.

6. Equipment malfunctions in the dry mill process contributed heavily to the presence of slightly elevated naturally occurring radioactive materials contained in the *monazite* component of the heavy mineral fraction on and below the current surface of the area to the south and east side of the dry mill. The dry mill utilized electrostatic separators designed to separate conductor from *non*-conductor materials and electromagnetic separators designed to separate magnetic from *non*-magnetic materials. When equipment malfunctions occurred in the dry mill (i.e., separation mechanisms required repair or replacement), both ASARCO and HMI used what I am terming "Mill Shutdown Avoidance Procedures" to insure that all mineral recovery operations were conducted in a cost-effective manner. When faced with such an equipment malfunction, both ASARCO and HMI were presented with two options: (1) shut down the entire dry mill at a cost of approximately $120,000 per hour until the malfunctioning unit(s) could be repaired or replaced or (2) shut down only the malfunctioning unit(s) and continue running the remaining units in the dry mill. Since the functioning dry mill units could continue to be run during repair or replacement of the malfunctioning unit(s), ASARCO and HMI opted to avoid complete dry mill shutdown which resulted in heavy mineral concentrates, which included *monazite*, being conveyed through portals in the south wall of the dry mill and stockpiled on the ground. Regardless of which unit(s) in the dry mill malfunctioned, the material stockpiled south of the dry mill would have contained elevated (i.e., above background) concentrations of *monazite*. In addition, depending on which unit(s) malfunctioned, the stockpiled material could contain even higher concentrations of *monazite* probably including some concentrations at *licensable source material* levels.

7. It is extremely important to note that the mineral recovery operations conducted by ASARCO at the HMI site were mining and milling operations involving the dredging, transportation, processing, and storage of millions of tons of fine sands. ASARCO, Humphrey's Gold, MRI, and HMI's mineral recovery operations spanned a period of approximately 15 years with ASARCO utilizing the site for a period of nine (9) years. Humphrey's Gold, MRI, and HMI did not conduct any dredging (mining) operations but

merely reprocessed portions of ASARCO's *dry mill tailings* and, as a result, processed considerably less material than ASARCO. Based on the duration of mineral recovery operations and the volume of materials processed, the vast majority of the material moved, processed, spilled, and graded onto the surface and into subsurface areas at the site was the result of ASARCO's mineral recovery operations. During this entire time period (excluding HMI mineral recovery operations post-NRC licensing), the aforementioned spills occurred on numerous occasions and the contents of such spills were graded and re-graded onto the surface and into the subsurface.

8. During its Phase II operations, when HMI was actively processing its Phase I tailings from the Blue Area and unit(s) of the dry mill required repair or replacement, HMI had difficulty re-inserting stockpiled materials from the Mill Shutdown Avoidance Procedures into the dry mill. HMI attempted to reprocess the stockpiled materials through the dry mill in several different ways. First, HMI attempted to re-insert the stockpile material directly into the dry mill which was unsuccessful. Second, HMI tried to blend the stockpiled material with material containing lower concentrations of magnetic materials and that was also unsuccessful. Finally, HMI tried to feed the blended material through the wet mill which was somewhat successful but did not result in the bulk of the stockpiled material being reprocessed. This resulted in some stockpiled materials being graded and re-graded onto the surface and into the subsurface south of the dry mill. However, due to the relatively smaller amounts of material processed by HMI during its mineral recovery operations compared to that processed by ASARCO, the amount of stockpiled materials graded and re-graded onto the surface and into the subsurface by HMI was also relatively smaller.

9. During active mineral recovery operations, both the wet and dry mills ran twenty-four (24) hours per day, seven (7) days per week. Thus, spills of sands from front-end loaders moving materials stockpiled on the ground as a result of the Mill Shutdown Avoidance Procedures were part of routine mineral recovery operations as was the grading and re-grading of sands containing naturally occurring heavy minerals in the stockpile areas. The net result of these Mill Shutdown Avoidance Procedures was that the stockpiled materials, moved with front-end loaders, graded, re-graded, and leveled over the south side of the dry mill, explains the presence of some elevated concentrations of naturally occurring radionuclides on the south side of the dry mill, including isolated "pockets" at *licensable source material* levels.

10. On January 17, 1988, HMI was cited by NRC for possession and use of monazite material which contained *licensable source material* levels. Until August 20, 1990, HMI continued mineral recovery operations to recover *zircon*, *leucoxene*, and *rutile* as saleable products and isolated the *monazite* content of all material processed through the dry mill. During this time period, HMI stockpiled approximately 1,400 tons of *monazite*-rich sand in the *Monazite* Pile. HMI did not engage in the above-mentioned Mill Shutdown Avoidance Procedures after NRC licensing.

11. It also is extremely important to note that the above-described mineral recovery operations used by each of the entities described in this Affidavit and Process History

used only physical separation processes. No chemicals were used at any time to recover any of the minerals produced by each respective site owner or operator, and, thus, the final product and resulting tailings remained in their original physical condition. Since no chemicals were used to change the form of the heavy minerals and these minerals are naturally stable and highly insoluble in water, there was no leaching of radionuclides into the subsurface or groundwater. As a result, the likelihood that any heavy minerals, including radionuclides, will leach into groundwater was, and continues to be, remote.

12. On July 9, 2001, HMI began shipping the contents of the *Monazite* Pile to International Uranium (USA) Corporation ("IUC") for processing as an alternate feed material and final disposal of the wastes generated as 11e.(2) byproduct material. Front-end loaders were used to remove the Monazite Pile and load its contents into intermodal containers for transport. Standard engineering practices suggested that, after removal of the Monazite Pile was complete, an estimated 1,600 tons of material (i.e., 200 tons more material than the 1,400 tons HMI placed in the *Monazite* Pile) would have been removed because front-end loaders cannot be expected to remove precise amounts of sands from a given area. However, when the intermodal transport containers containing material in excess of 1,600 tons were scanned for radionuclides, the results indicated that elevated concentrations of radionuclides were still present. As a result, when the excavation, loading, and transport of the material to be sent to IUC were completed, approximately 3,000 tons of sand was shipped off-site.

13. A simple mass-balance evaluation suggests that HMI shipped approximately twice the amount of material contained in the licensed *monazite* storage pile. It is apparent that significant quantities of unlicensed soils and sands containing elevated concentrations of radionuclides from the pre-licensing activities noted above and discussed in the Process History were shipped to IUC. It is, therefore, HMI's position that removal of the licensed *monazite* material for processing and disposal at IUC has been completed and the Monazite Pile should, therefore, be deleted from HMI's license.

14. In summary, after reviewing the materials and speaking to the people referenced in Paragraph #4 above, as well as compiling the Process History, I have concluded that the material excavated and transported to IUC in excess of the 1,400 tons of material HMI placed in the Monazite Pile which contained elevated radionuclide concentrations was the result of the following actions: (1) stockpiling of material on the ground south and east of the dry mill in and around the Monazite Pile area as a result of the above-mentioned Mill Shutdown Avoidance Procedures; (2) spills during loading of material from these Mill Shutdown Avoidance Procedures for re-insertion into the dry mill; (3) the routine grading and re-grading of the Mill Shutdown Avoidance Procedures stockpile area; and (4) the grading of the drainage ditch used to de-water the wet mill *concentrate*.

John F. Lord

Subscribed and Sworn to before me this 22 day of November, 2002.

My Commission
Expires: ______________

Notary Public

VIOLET GILLIES
A Notary Public of New Jersey
My Commission Expires 1/22/07

PROFESSIONAL PROFILE

JOHN F. LORD PLACER MINING CONSULTANT

PROFESSIIONAL CREDENTIALS:

B. S. University of California, 1936: Mining Engineering
Registered Professional Engineer; New Jersey License No. 10744

American Institute of Mining, Metallurgical and Petroleum Engineers;
American Society of Civil Engineers;
National Society of Professional Engineers

EMPLOYMENT RECORD

Pre-graduation -	Family owned hydraulic gold mine, California, U.S.A.
	Yuba Consolidated Gold Fields, California, U.S.A.
1936-1939	Yuba Consolidated Gold Fields, Inc., Califomia, U.S.A.
1939-1941	Pato Consolidated Gold Dredging Ltd., Colombia, South America
1941-1946	U. S. Navy Reserve
1946-1948	Pato Consolidated Gold Dredging Ltd., Colombia, South America
1948-1949	General Building Contractor – Califomia, U.S.A.
1949-1977	ASARCO Incorporated
1977-1979	Fellows, Read & Associates, Inc. Consulting Civil Engineering Firm, New Jersey, U.S.A.
1979 –1987	Placer – Exploration Engineer and Dredging Consultant
1987–Present	Hovsons, Inc. (Heritage Minerals Inc.) New Jersey, USA

PROFESSIONAL EXPERIENCE

Anaconda Minerals Co., Division of ARCO; ASARCO Incorporated; Exxon Minerals Co., USA; Homestake Mining Co.; International Executive Service Corps, United Nations; Kerr McGee Corp; Texasgulf Minerals Exploration Co.; Placer Development Ltd; Freeport MacMoran, Hovsons, Inc.

Advisor to ASARCO Incorporated facilities and subsidiaries throughout the world for placer exploration and development projects.

Resident Engineer and Manager for acquisition, development and installation of 25,000 ton per day heavy mineral mine and processing plant for ASARCO Incorporated.

Initiated and supervised the exploration and evaluation of alluvial deposits containing gold, platinum, diamonds and heavy minerals in Africa, Australia, Central America, Canada, China, Mexico, New Zealand, South America, USA, and West Indies. The scope of work ranged from regional studies through the acquisition, planning, development and construction phases for mines and plants which varied in size from small prospects to extensive offshore gold deposits in the Bearing Sea, Alaska.

Responsible for the exploration development of reserves and mine planning for a fleet of five large bucket line dredges and various hydraulic mines covering 400 square miles of claims in Colombia, South America for Pato Consolidated Gold Fields.

Engineering and Metallurgist for research projects specifically related to the testing, evaluation and installation of equipment for improving recovery and beneficiation of fine gold for Yuba Consolidated Gold Fields.

Heritage Minerals, Inc.

Process History

November 22, 2002

1.1 Site Description and History

The Heritage Minerals, Inc. ("HMI") site is situated in Lakehurst, NJ, (located in Manchester Township, Ocean County) approximately 75 miles south of New York City in the New Jersey Coastal Plain. The plant entrance is located at Mile Marker 41 on New Jersey State Highway No. 70 and 12 miles west of the Garden State Parkway. This area is characterized by fine to coarse sandy soils, gravels, and clays that geologically were formed by an estuary. It is located in the famous New Jersey Pine Barrens.[1]

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

The plant facilities used by HMI and its predecessors at the site are situated in the center of a 287 acre tract of land. The wet mill building is a three-story steel structure erected on a 229' x 99' concrete slab, and the dry mill building is also a three-story steel structure erected on a 120' x 95' concrete slab. Additional buildings at the site include the laboratory, the service building, the warehouse, the change house, the compressor house, and the main office building.[2]

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[1] An aerial photograph of the site is attached to this Process History as Attachment 1. The photograph is formatted as an index map to provide a complete reference to each building/facility at the HMI site.

[2] Attachment 2 is a computer-generated map entitled *Site Decommissioning Map* which shows the location of each building/facility at the HMI site.

The HMI site has been explored, owned and/or operated by several different entities since 1957. The following summaries describe the past mineral recovery operations at the HMI site and the time period during which such operations took place.

1.2 Site Ownership/Operating History

1.2.1 ASARCO

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

ASARCO's mineral recovery operations began in 1973 and continued until March of 1982, and it was primarily focused on the recovery of the *titanium* mineral *ilmenite*. ASARCO's mineral recovery operation consisted of hydraulic mining (dredging) of sand deposits located at the site, which had been identified as containing economic levels of recoverable *ilmenite*. These sand deposits also contained quantities of a variety of *titanium*-bearing and other heavy minerals which, in total, averaged approximately five percent of the total sand deposit, while approximately 95 percent of the sand deposit consisted of lighter silica sands, clays, and gravels. The full suite of *titanium*-minerals heavy minerals in these sand deposits included *ilmenite*, *leucoxene*, and *rutile*, as well as the heavy minerals *zircon, kyanite*, *sillimenite*, *staurolite*, *tourmaline*, and *monazite*. Initially, ASARCO determined that it would be economically profitable to recover only the *ilmenite*, *leucoxene*, and *rutile*.

Dredging was chosen as the most viable means of recovering the *titanium* minerals during the ASARCO operation because the HMI site's sand deposits were in the form of loosely consolidated alluvial sands, gravels, and clays. Topsoil overlying the mining areas was removed and stockpiled for future use during site reclamation. Dredging operations were conducted to a maximum depth of 65 feet and broke sand deposits into recoverable sizes, which were removed from the *ore* zone as a slurry. The dredge was advanced through the mining zone in a walking-type advance at a rate of 100 feet per week (five (5) to seven (7) acres per month) creating a path approximately 120 feet wide.

A pontoon-supported pipeline system transported the slurry from the *ore* zone to a screening and de-watering barge where oversized material (approximately ¼ inch) with no mineral value was returned to the dredge pond and a "middling fraction" was either returned to the pond or stockpiled as clean gravel. The remainder of the slurried material (the screen undersize) was then pumped to the wet mill at the rate of 1,000 to 1,200 tons per hour (12,000-13,000 gallons per minute).

After reaching the wet mill, the thickened slurry was initially fed onto a screen with any undersize material going to a concentrating circuit containing Humphrey spirals. The heavy mineral sands, including the *ilmenite*, were separated by gravity from the lighter sands, primarily *silica*, in this stage. The lighter fraction (wet mill tailings) was returned back to the dredge pond as backfill, and the heavy mineral *concentrate* was fed to a final finisher for further concentrating and then advanced to the dry mill for further processing.

This heavy mineral *concentrate,* which contained approximately 95 percent of the heavy minerals, including *ilmenite* and *monazite*, was then stored on the ground east of the wet mill building where most of the water was allowed to drain out. The resulting pile was continuously graded, moved, blended and ultimately fed at a rate of 50 tons per hour into the dry mill hopper using front-end loaders.

At this juncture, it is crucial to note that the dry mill process employed by ASARCO during its mineral recovery operation was composed of various units including conveyor belts, bucket elevators, and a series of electrostatic and electromagnetic separators in an integrated mineral recovery process. The proper operation of the dry mill *required* that, depending on their location in the dry mill circuit(s), the various electrostatic and electromagnetic separators be calibrated to the *ore* grade at that point in the recovery process to maximize mineral (*ilmenite*) recovery. As such, the various electrostatic and electromagnetic separators were constantly monitored to assure that they were functioning properly, and the final *ilmenite* product was constantly sampled to insure cost-effective mineral recovery as well as compliance with final product specifications.[3]

After processing in the wet mill was complete, the *concentrate* that was fed into the dry mill feed hopper went into an oil-fired rotary dryer and was completely dried by heating the *concentrate* to a temperature of 300 degrees F. The dried heavy mineral *concentrate* was fed to the first section of the dry mill (the high-tension circuit) where the *titanium*-bearing minerals were separated using three different stages of high-tension electrostatic separators that utilized high voltage D.C. current to separate mineral particles by virtue of the differences in their surface electrical conductivity. The first stage of electrostatic separators, called the "Rougher Circuit," was comprised of 34 individual high-tension separators, which were calibrated to process the *concentrate* produced by the wet mill to separate the conductor materials (*titanium* minerals) from the *non*-conductor materials (i.e., *aluminum silicates*, *monazite*, and *zircon*).

This Rougher Circuit produced a *concentrate* (conductor product) to be further processed in the later (i.e., electromagnetic) stages of the dry mill process, created a "middling fraction" of material that was continuously re-processed through the Rougher Circuit for additional *concentrate* production, and separated *non*-conductor materials which reported as tailings to the *dry mill tailings* area (which later became known as the Gray Area because of the way it was identified on color-coded maps). Just before these *non*-conductor materials were sent to the Gray Area, they were fed from the Rougher Circuit to the Scavenger Circuit, which was comprised of 14 individual high-tension electrostatic separators designed to capture any *titanium*-bearing minerals remaining in the *non*-conductor materials and to create a *concentrate* for further processing through the Rougher Circuit. The Scavenger Circuit also created a "middling fraction" which was continuously re-processed through the Scavenger Circuit to maximize conductor material recovery and separated *non*-conductor materials (tailings), which were slurried with water and pumped to the Gray Area. The tailings that finally reported in slurry form to the Gray Area from these circuits typically contained the vast majority of the *non*-conductor fraction, including *monazite* and *zircon*, although some residual *non*-conductor materials remained in the conductor *concentrate* produced from the high-tension separators.

The conductor *concentrate* from processing and re-processing in the Rougher Circuit ultimately proceeded to the Cleaner Circuit for further concentrating and refining.

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[3] The ASARCO dry mill process flow-sheet is attached to this Process History as Attachment 3.

The Cleaner Circuit was comprised of 25 high-tension electrostatic separators which were designed to produce a more refined conductor *concentrate* for further processing in the Electromagnetic Circuit, which will be described below, to create a "middling fraction" for re-processing through the Cleaner Circuit for additional conductor *concentrate* production for the Electromagnetic Circuit, and to separate any remaining *non*-conductor materials for further re-processing through the Rougher Circuit. None of the material fed directly from the Cleaner Circuit to the next stage in the dry mill process, the Electromagnetic Circuit was stockpiled in the *dry mill tailings* pile (Gray Area).

After running through the Electrostatic Circuits, the conductor *concentrate* from the Cleaner Circuit was fed to the Electromagnetic Circuit in order to produce a magnetic fraction, which comprised the final *ilmenite* product. The Electromagnetic Circuit consisted of 8-10 electromagnetic separators, in which the intensity of the magnetic field was adjusted to separate *ilmenite* (as a magnetic product) from all other minerals in the Electromagnetic Circuit feed (as a *non*-magnetic product). The minerals that were rejected in the *non*-magnetic product included *rutile, zircon, monazite,* and various *aluminum silicates*. Although *monazite* is a feebly magnetic mineral, the intensity of the magnetic field was adjusted so that *monazite* was not separated along with the *ilmenite*, but rather reported with the *non*-magnetic minerals. The *ilmenite* product was conveyed for storage in 200-ton bins to await shipment to the purchaser.

The *non*-magnetic fraction from the Electromagnetic Circuit was fed to a vibrating screen and the (coarse and fine) material from the screen was continuously fed through two MDL Plate Separators (a different kind of electrostatic separator) to separate rutile (a *non*-magnetic titanium mineral) from all the other *non*-magnetic minerals, including *zircon* and *monazite*. The MDL Plate Separators were adjusted to produce a *concentrate* for further processing, a "middling fraction" which was continuously re-processed through the MDL Plate Separators, and tailings, which contained *non*-conductor materials. The *concentrate* from the two MDL Plate Separators and, ultimately, the *concentrate* from the re-processed "middling fraction" were fed to a third MDL Plate Separator. This third MDL Plate Separator produced a final *rutile* product, which was combined with the final *ilmenite* product, another "middling fraction" for continuous re-processing through the third MDL Plate Separator, and tailings, which were returned to the above-mentioned residue screen for further processing. The tailings from the first two MDL Plate Separators were fed to a slow roll high-tension separator to recover any remaining conductor material (*titanium* minerals) which was fed back to the Electrostatic Circuit(s) for further processing. The *non*-conductor tailings reported to the Gray Area, including *zircon* and *monazite*.

As noted above, the dry mill process employed by ASARCO utilized a combination of various units, each of which was calibrated to correspond to various *concentrate* characteristics so that *ilmenite* recovery could be maximized. This process relied heavily on the continuous and simultaneous operation of these units. When any one component of any unit required repair or replacement, the dry mill could not produce final *ilmenite* product meeting product specifications. In response, the operator could shut down the *entire* dry mill at a cost of approximately $120,000 per hour (i.e., man hours, loss of material) or find a way to continue dry mill operations without compromising final product specifications. As a result, ASARCO determined that, to avoid *total* dry mill shutdown where possible, it would be cost-efficient to continue to run the dry mill while any malfunctioning unit(s) of the Electrostatic and/or Electromagnetic Circuits were repaired or replaced.[4] To be able to continue to run the dry mill without affecting the final product, ASARCO essentially short-circuited the malfunctioning unit(s) in the dry mill process and conveyed the in-process material (at whatever stage of the dry mill process a malfunction occurred) onto the ground in back of the dry mill (i.e., south of the dry mill building) through portals cut in the walls of the dry mill for future re-insertion into the dry mill process. The concentration of magnetic minerals in the stockpiled material, and the volume of such stockpiled material in this area varied depending on which unit(s) of the dry mill process were shut down and for what length of time. Thus, for example, if portions of the Rougher Circuit required repair or replacement, depending on where in the Rougher Circuit the malfunction occurred (e.g., pre-tailings reporting to the Gray Area), the in-process material conveyed through the portals in the south and east sides of the dry mill could have contained the full suite of magnetic minerals in elevated concentrations and/or the majority of the *non*-magnetic minerals that survived the wet mill process.

If these Mill Shutdown Avoidance Procedures were initiated as a result of the need to repair or replace malfunctioning components in the Electromagnetic Circuits, then the material conveyed outside the south side of the dry mill building would have lower concentrations of magnetic materials. If a component of the Scavenger Circuit required repair or replacement, then the material conveyed outside the dry mill building likely would have contained highly elevated concentrations of magnetic minerals.

[4] This "Mill Shutdown Avoidance Procedure" was only used in the dry mill because a minor malfunction in the wet mill process would not affect production of final product being produced in the dry mill.

After the stockpiled material from the Mill Shutdown Avoidance Procedure was returned to the dry mill feed hopper by front-end loader for re-insertion into the dry mill, the stockpile area was graded and re-graded to maintain level ground. Over time, this area was graded and re-graded each time the Mill Shutdown Avoidance Procedure was used. At any given time, there could have been multiple tons of material stockpiled on the ground south of the dry mill containing varying concentrations of radionuclides, portions of which, over time, were graded and re-graded onto the surface and into the subsurface. This explains the presence of elevated levels of radionuclides including "pockets" of *licensable source material* south of the dry mill.

When the *dry mill tailings* containing *zircon* and *monazite* were ready for stockpiling, they were mixed with water and pumped from the dry mill to the Gray Area. A narrow ditch was installed which ran from the Gray Area south to the process water pond to allow water draining from the *dry mill tailings* to be collected and recycled. Since ASARCO required physical access to the *dry mill tailings* in the Gray Area, an access road was constructed over the drainage ditch which, in turn, required installation of a 22 foot-long, 3/8 inch steel pipe culvert with a 16 inch diameter to allow the continued flow of drainage water to the process water pond. When this access road was no longer used, the pipe culvert was removed and the area was graded. The drainage water flowing through the drainage ditch contained various mineral sands from the dry mill tailings in the Gray Area, including *monazite*, and, when the pipe culvert was removed and the area was graded, these minerals remained in place or were spread around the area.

Finally, there was another ASARCO process-related activity that likely resulted in some elevated radionuclide concentrations in the area of the process water pond. A return water line ran from the northeast corner of the wet mill to the northeast corner of the process water pond. This water line carried the overflow or spills from the various sumps in the wet mill process. The material carried in the water line was a mixture of lighter sands and fine-grained concentrated heavy minerals, including *monazite*. This overflow material eventually mixed with surface drainage from and around the dry mill building in the area of the process water pond. The result is some elevated readings in soils in the northeast area of the process water pond.

ASARCO had planned to process the *dry mill tailings* at a later date for the extraction and sale of *zircon* and *monazite.* Extensive laboratory and pilot-plant tests were performed by ASARCO on the potential for recovery of *zircon* and *monazite*. However, deteriorating market conditions caused ASARCO to discontinue all operations at the HMI site in 1982.

1.2.2 Humphrey's Gold

In April 1982, ASARCO leased the HMI site to Humphrey's Gold, Inc. ("Humphrey's Gold") for the purpose of conducting a plant-scale pilot test using the *dry mill tailings* to determine if a commercial grade *zircon* could be produced economically. ASARCO's lease with Humphrey's Gold was for six (6) months, although Humphrey's Gold actually conducted pilot tests for only one (1) month. Since ASARCO was not directly involved with the Humphrey's Gold's pilot testing activities, HMI did not have access to any records generated by Humphrey's Gold regarding such pilot tests.

However, HMI has access to anecdotal data from personnel[5] who worked at the site for Humphrey's Gold.

Humphrey's Gold used a portable conveyor to feed the ASARCO *dry mill tailings* to the wet mill in an attempt to produce a higher grade heavy mineral *concentrate* which would, in turn, be fed to the dry mill for *zircon* recovery. Virtually all of the wet mill's units (including spirals, launders, pump/sump screens, and classifiers) were used in this pilot test. During Humphrey's Gold's operation, the heavy mineral *concentrate* from the wet mill process was stored on the surface east of the wet mill building and moved by front-end loader to the dry mill feed hopper.

Humphrey's Gold operated the dry mill in the same manner as ASARCO except that ASARCO fed approximately 50 tons per hour of wet mill *concentrate* into the oil-fired rotary dryer for drying, heating, and processing while Humphrey's Gold only fed about 9 tons per hour into the dryer. When the *concentrate* was dried in the rotary dryer and placed on the conveyor belt for insertion into the Electrostatic Circuits, due to the greatly reduced volume, the *concentrate* cooled too quickly and became unsuitable for electrostatic processing. Humphrey's Gold found that this rendered the dry mill process inefficient and, as a result, only performed this mineral recovery operation for one (1) month. No barrel storage procedures or disposal locations were selected, and the tailings generated in the wet mill during this operation were pumped to the northeast section of the Gray Area and product produced from the dry mill operation also was delivered back to the Gray Area as well.

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[5] Personal Communications between John F. Lord, consultant for HMI, and Eugene Whittle, Humphrey's Gold Site Operations Manager, February 25 & 26, 2002.

1.2.3 Mineral Recovery, Inc. (Lease from HMI)

ASARCO placed the site on standby from March of 1982 until 1986 when the site was purchased by HMI. After purchasing the HMI site from ASARCO, HMI leased its plant facilities to Mineral Recovery, Inc. ("MRI"). On August 28, 1986, Dr. A. G. Naguib, President of MRI, and Dr. Max El Tawil, his technical consultant, consulted Dr. John E. Glenn, Chief of Nuclear Material Safety at NRC's Region I office in King of Prussia, PA to seek NRC's guidance as to whether or not MRI required an NRC license for the possession and use of *source material* at the HMI site. Based on the fact that the material entering the processing plant (ASARCO *dry mill tailings*) and material leaving the processing plant (*zircon, leucoxene, rutile* and tailings) were all below the 0.05% *licensable* level for source material and since processing was not to be done for the recovery of source material, Dr. Glenn determined that MRI would not require an NRC license. NRC noted that this decision would be reviewed at a future date if it were to be decided that a *monazite* (displaying radioactive thorium properties) product would be sold for its rare earth content.

When MRI began mineral recovery operations at the HMI site, it sought to recover *zircon*, *leucoxene*, and *rutile* from the ASARCO *dry mill tailings* rather than *ilmenite*. In order to engage in such activity, MRI altered the dry mill process to include additional electrostatic and electromagnetic separators to allow for the further separation of conductor from *non*-conductor materials and magnetic from *non*-magnetic materials so that *zircon*, *leucoxene*, and *rutile* recovery could be maximized. The extent of these alterations will be discussed in greater detail in Section 1.2.4 which addresses HMI's mineral recovery operations.

MRI started production in October of 1986 and continued until August of 1987 when the owner of the site property, HMI, assumed the management and control of the site.

1.2.4 HMI Operations

After MRI's lease was terminated in August of 1987, HMI assumed control of the site and commenced operations to process ASARCO's *dry mill tailings* stored in the Gray Area for the recovery of *zircon*, *leucoxene*, and *rutile*. HMI was the entity created by Hovsons to continue processing these *dry mill tailings* after terminating MRI's lease.

In **Phase I**[6] of HMI's operations, the ASARCO *dry mill tailings* located in the Gray Area were mixed with water and pumped to the wet mill as slurry at a rate of approximately 50-60 tons per hour. The slurry was then processed using the Humphrey spirals to remove as much of the remaining lighter fraction in the *dry mill tailings* as possible. Little or no *zircon* minerals or *monazite* were lost to tailings in the Humphrey spirals although there were some *titanium* mineral losses due to the presence of low-density and very fine weathered *ilmenite*. The resulting tailings (i.e., the lighter fraction) from the Humphrey spirals were collected in a large sump and pumped to an area north of the wet mill building which was occupied by the clay settling ponds from ASARCO's operations. This area was referred to as the Blue Area because it was identified as such in the color-coded maps. The wet mill *concentrate* was stockpiled and de-watered east of the dry mill similar to the process used by ASARCO.

The dry mill process employed by HMI was fundamentally similar to that used by ASARCO during its mineral recovery operations. However, since HMI was attempting to recover *zircon* as its main product and the *titanium* minerals, *rutile* and *leucoxene,* as

[6] HMI's **Phase I** dry mill process flowsheet is attached to this Process History as Attachment 4.

byproducts, the HMI dry mill process did contain some variations from the ASARCO process as implemented by MRI.

During HMI's active processing, the heavy mineral *concentrate* from the wet mill process was moved from the east side of the wet mill to the west side of the dry mill where it was fed into a feed hopper and heated to 300 degrees F in an oil-fired rotary dryer similar to, but considerably smaller than, the one used by ASARCO. The dried *concentrate* was then fed to a screen where oversized materials unfit for processing were removed. These oversized materials were screened out and sent to the Blue Area for stockpiling. The resulting dry, hot, and screened *concentrate* was then conveyed to the Rougher Circuit high-tension electrostatic separators in which minerals with high electrical conductivity (*leucoxene* and *rutile*) were separated from those with low conductivity (*zircon*, *monazite, alumina* and *silica*).[7] As with ASARCO, the Rougher Circuit also created a "middling fraction" containing residual *non*-conductor materials and this "middling fraction" was continuously re-processed through the Rougher Circuit to further separate conductor and *non*-conductor materials.

After leaving the Rougher Circuit, the conductor material was fed to a bucket elevator and then processed through a plate separator which again separated conductor from *non*-conductor materials as well as creating a "middling fraction," for continuous re-processing in the Rougher Circuit. The *non*-conductor material was fed back to the Rougher Circuit for re-processing while the conductor material was fed into a *Leucoxene* Feed Elevator and introduced to the *Leucoxene* Recovery Circuit. The conductor materials were fed through electromagnetic separators for further processing and cleaning of the *leucoxene* content. When the magnetic portion of these materials left these

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[7] The primary *titanium* mineral recovered was *leucoxene*, which is a transition mineral between *ilmenite* and *rutile*. *Monazite* is a *non*-conductor material and will follow the *zircon*.

leucoxene electromagnetic separators, it was fed to a Final *Leucoxene* Elevator for deposit into storage bins as final *leucoxene* product.

The *non*-magnetic portion of these materials was then fed to a Finisher Feed Elevator and conveyed to another set of high-tension electrostatic separators where conductor and *non*-conductor materials again were separated and a "middling fraction" was created, which was continuously processed through this set of high tension electrostatic separators. The *non*-conductor materials were conveyed back to the *Leucoxene* Screw Feed Elevator for further *leucoxene* recovery. The conductor materials were fed to a *Rutile* Bucket Elevator and then to the *Rutile* Plate Separator where another set of high-tension electrostatic separators further separated conductor from *non*-conductor materials as well as creating another "middling fraction." The "middling fraction" was fed back to the *Rutile* Bucket Elevator for continuous re-processing. The *non*-conductor materials were fed back to the *Rutile* Finisher Feed Elevator for further *rutile* recovery and the conductor materials were sent to the Final *Rutile* Elevator and then placed in plastic-lined steel drums as final *rutile* product.

During **Phase I** of HMI operations, the dry mill was divided into two separate and distinct circuits, namely, the *Leucoxene* (*titanium*) Circuit and the *Zircon* Circuit. The operations detailed above describe the *Leucoxene* Circuit. The *non*-conductor material from the high-tension circuit, including *zircon* and *monazite*, was re-slurried and pumped back to the wet mill where it was re-introduced onto a set of spirals to reject any remaining silica. The heavy mineral *concentrate* from these spirals was then fed to a set of wet shaking tables designed to reject the light/heavy *aluminum silicate* minerals and produce a high-grade heavy mineral *concentrate* containing primarily *zircon* and *monazite*. The table concentrate was pumped to a vacuum filter for de-watering and then to a second oil-fired rotary dryer for complete drying and heating. The dry, hot table *concentrate* was then conveyed to the *Zircon* Circuit in the dry mill, where it was fed to high-tension electrostatic separators which separated conductor from *non*-conductor materials and created a "middling fraction" which was continuously re-processed through this set of high-tension electrostatic separators to maximize mineral recovery. Any resulting conductor material was then fed to the magnetic separators in the *Leucoxene* Circuit, as mentioned above, where additional *leucoxene* and *rutile* were recovered. The *non*-conductor material was fed to a Re-Cleaner Circuit for further separation of conductor from *non*-conductor materials. The conductor material from the Re-Cleaner Circuit was fed back to the Cleaner Circuit for further processing and a "middling fraction" was created and continuously re-processed through the Re-Cleaner Circuit.

The *non*-conductor material from the Re-Cleaner high-tension electrostatic separators was then conveyed to the electromagnetic separators which separated magnetic (i.e., *monazite*) from *non*-magnetic materials (i.e., *zircon*). Note that these electromagnetic separators were set at a much higher magnetic field intensity as compared to the ASARCO *ilmenite* electromagnetic separators. As a result, *monazite,* which is a feebly-magnetic mineral, reported in the magnetic product in this operation, whereas in the ASARCO operation, *monazite* reported in the *non*-magnetic product. The *non*-magnetic material was conveyed to storage bins as the final *zircon* product. The magnetic material ("Magnetic Fraction") was mixed with the wet mill tailings and pumped to the Blue Area.

When the ASARCO *dry mill tailings* in the Gray Area were depleted, HMI conducted tests to determine whether sufficient amounts of *zircon* and *leucoxene* remained in the HMI Blue Area tailings to warrant reprocessing them for *zircon* and *leucoxene* recovery. After these tests were conducted, HMI determined that there were sufficient quantities of *zircon* and *leucoxene* available for reprocessing. At this point, HMI instituted **Phase II**[8] of its mineral recovery operations and began to reprocess the Blue Area tailings using the same wet and dry mill process described above.

During both **Phase I** and **Phase II** mineral recovery operations, HMI used the same Mill Shutdown Avoidance Procedures which ASARCO used and placed heavy mineral concentrates on the ground south of the dry mill when a unit or units of the dry mill process required repair or replacement. Usually, these materials could not be re-inserted into the dry mill because they had become too concentrated for the dry mill process. For example, attempts to run such material through the mill were unsuccessful because, as stated in HMI's March 1990 Monthly Report, "[t]he heavy mineral content averaged in the 40% to 50% range, which was two to three times the normal rate previously fed. The plant flow-sheet could not be adjusted to accept this wide range."[9] Once again, the Mill Shutdown Avoidance Procedure resulted in magnetic materials containing elevated levels of radionuclides being dug up by front-end loaders and mixed with soils during storage or attempted re-insertion into the wet or dry mill processes and subsequent grading and re-grading of the stockpile area.[10] This also resulted in some stockpiled material being graded and re-graded onto the surface and into the subsurface to keep the ground south of the dry mill level and to keep the material away from the dry mill's siding. However, due to the relatively limited time period in which HMI conducted its mineral recovery operation and the limited material HMI processed, by comparison the amount of material stockpiled by HMI south of the dry mill due to the Mill Shutdown Procedures was less than that stockpiled by ASARCO.

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[8] HMI's **Phase II** dry mill process flow-sheet is attached to this Process History as Attachment 5.
[9] HMI Monthly Report, March, 1990 (April 17, 1990).
[10] Attachment 6 to this Process History is a computer-generated Index Map showing the areas south of the dry mill where spills of heavy mineral fraction materials occurred as a result of the Mill Shutdown Avoidance Procedures and where such material was eventually graded and re-graded onto the surface and into the subsurface.

Like the ASARCO dry mill process, the amount and types of material conveyed through holes in the dry mill as a result of Mill Shutdown Avoidance Procedures depended on where a breakdown in the dry mill process(es) occurred and the amount of time necessary to repair or replace the malfunctioning unit(s). For example, if a unit in the Rougher or the Cleaner Circuit required repair or replacement, then the concentrations of magnetic minerals in the stockpiled material would be slightly elevated above background levels. The initiation of Mill Shutdown Avoidance Procedures at this point in the dry mill process could have resulted in substantial amounts of material containing varying levels of *monazite* being stockpiled on the ground south of the dry mill.

If either the *Leucoxene* or the *Zircon Recovery* Circuit had a component that required repair or replacement, the magnetic fraction *concentrate* could be even higher since these circuits were at the back-end of the dry mill process. The removal of any magnetic materials stockpiled in this area combined with standard grading and re-grading of the stockpile area inevitably led to the presence of "pockets" of elevated radionuclide concentrations, including some at *licensable source material* levels.

Phase II of HMI's mineral recovery operations also incorporated some minor variations in the dry mill process described above to allow for better process-flow and more efficient mineral recovery. For example, additional stages of Humphrey spirals were added to the wet mill process to improve the rejection of *silica* sands and *aluminum* minerals. Another variation, which was incorporated later to reduce fuel consumption, was eliminating the second oil-fired rotary dryer and processing the Humphrey's spiral product directly on the shaking tables prior to processing in the dry mill.

Additionally, on January 12, 1989, the HMI site and plant facilities were inspected by Dr. Laurence F. Friedman of NRC's Region I office. Based on the results of this inspection, NRC directed HMI to apply for an NRC license in which HMI would isolate the monazite product from the materials processed through the wet and dry mills and store such product in a separate stockpile area (the "*Monazite* Pile"). The clean sand tailings from the wet mill process would not include the *monazite* product and would be stored east of the plant facilities in the Blue Area.

HMI submitted an application for an NRC license on March 10, 1989. After about 200,000 tons of tailings from the Blue Area were reprocessed, on August 20, 1990, HMI terminated all mineral recovery operations as a result of reduced demand and depressed prices for *zircon* and *leucoxene* products. The reprocessing of the 200,000 tons of Blue Area tailings yielded 1,400 tons of *monazite*-rich tailings which were stored separately in the *Monazite* Pile. Then, on January 2, 1991, NRC issued HMI's license, and the *Monazite* Pile and the wet and dry mill buildings became subject to NRC License No. SMB-1541.

Respectfully Submitted,

John F. Lord
Consulting Engineer, HMI

ATTACHMENT 1

(1) Wet mill, heavy mineral concentrate storage, also magnetic concentrate photo #_5_

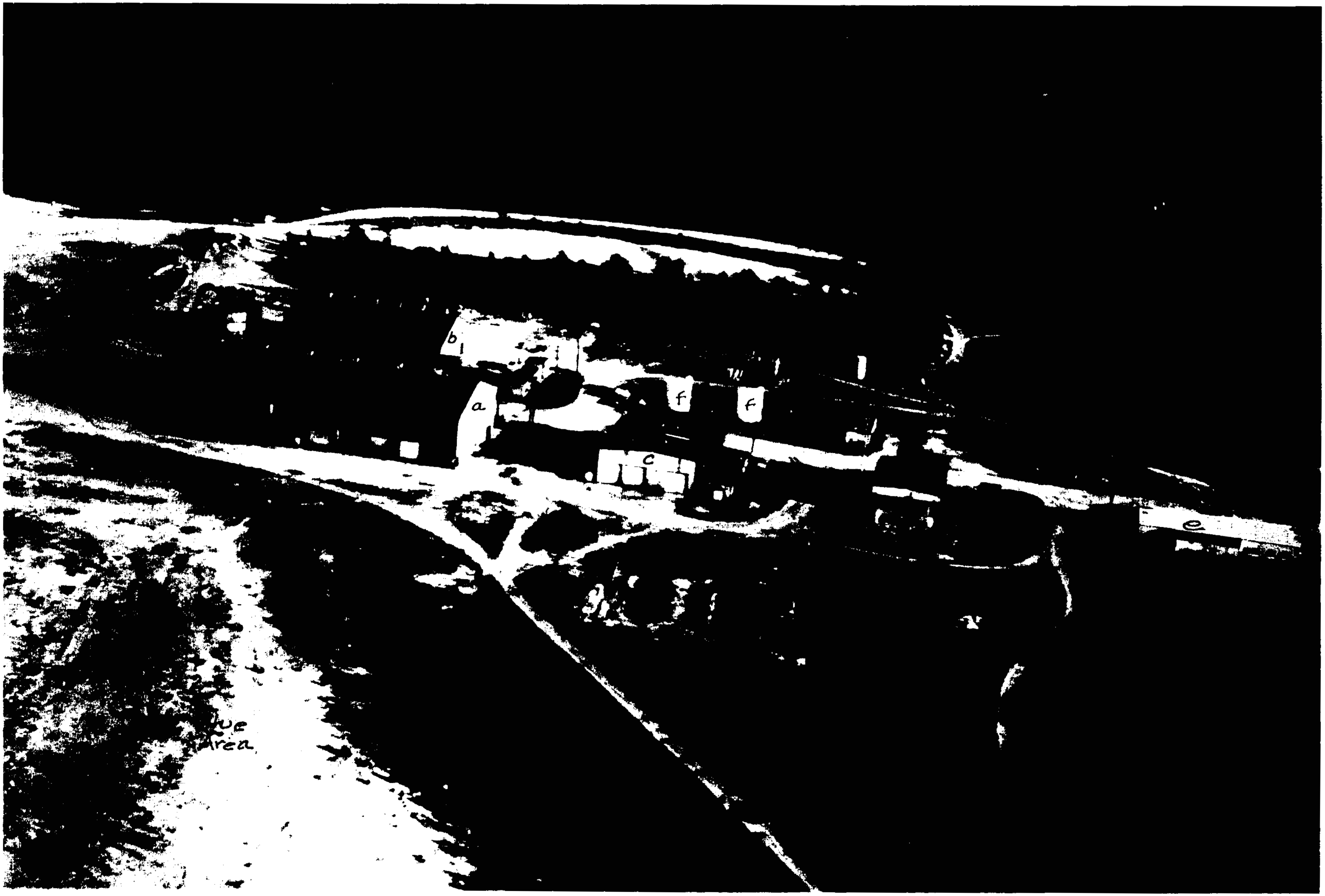
(2) Western 1/3 of settling pond – Blue area. Wet mill tails mixed with monazite deposited here and capped with Gray area scrapings.

(3) Upper northwest corner of gray area where ASARCO drymill tails were stored and which were reprocessed by Mineral Recovery and Heritage Minerals

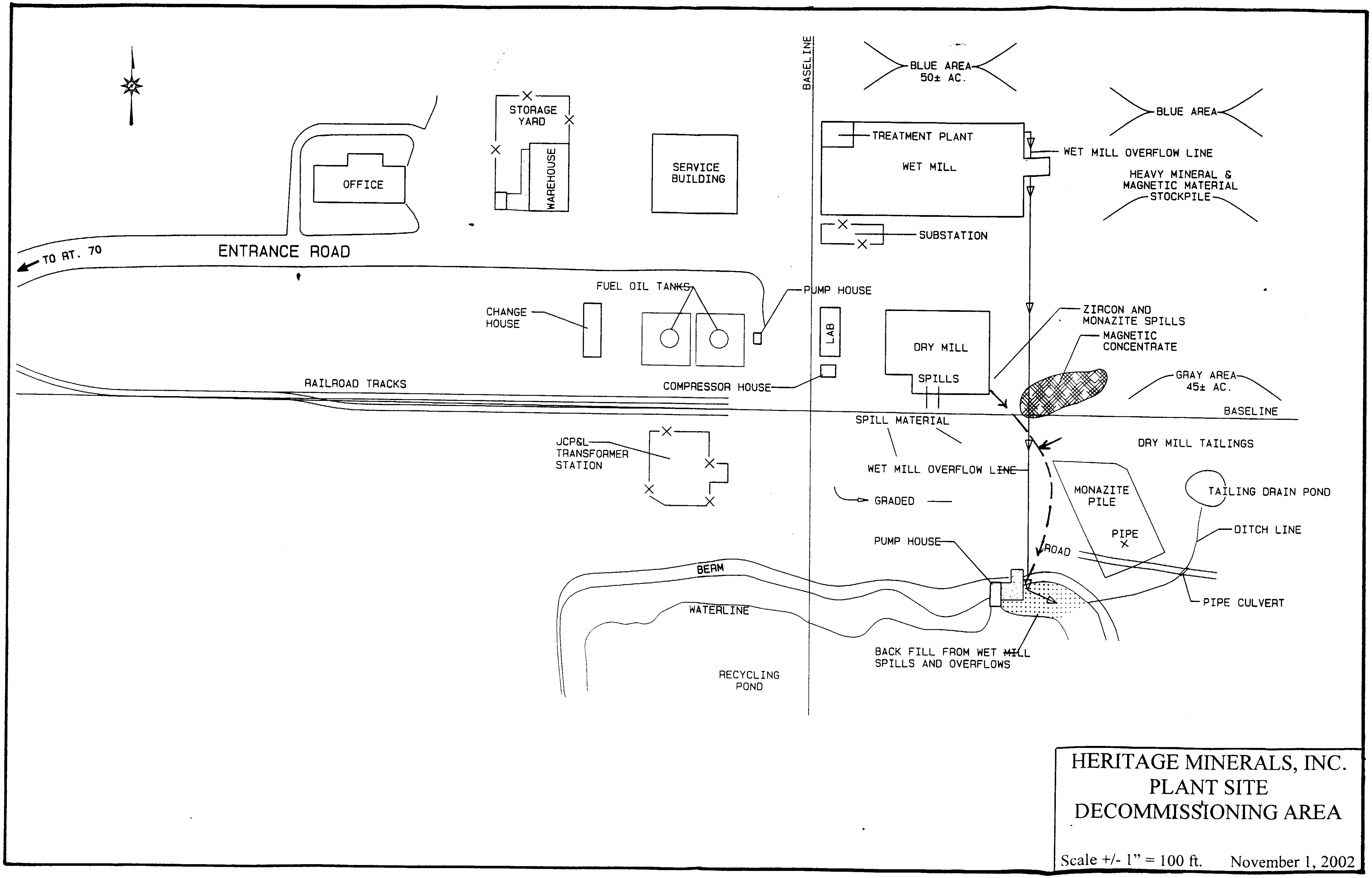
(4) Monazite pile

(5) SE corner of dry mill where HMI concentrate was stored while being fed to a second dryer when it was used (ultimately removed). Scrapings of area south of dry mill were also placed here.

(a) wet mill
(b) dry mill
(c) service building, incl. Treatment plant
(d) warehouse
(e) old office building
(f) fuel oil tanks
(g) laboratory building
(h) GPU substation


b
a
f
f
c
e

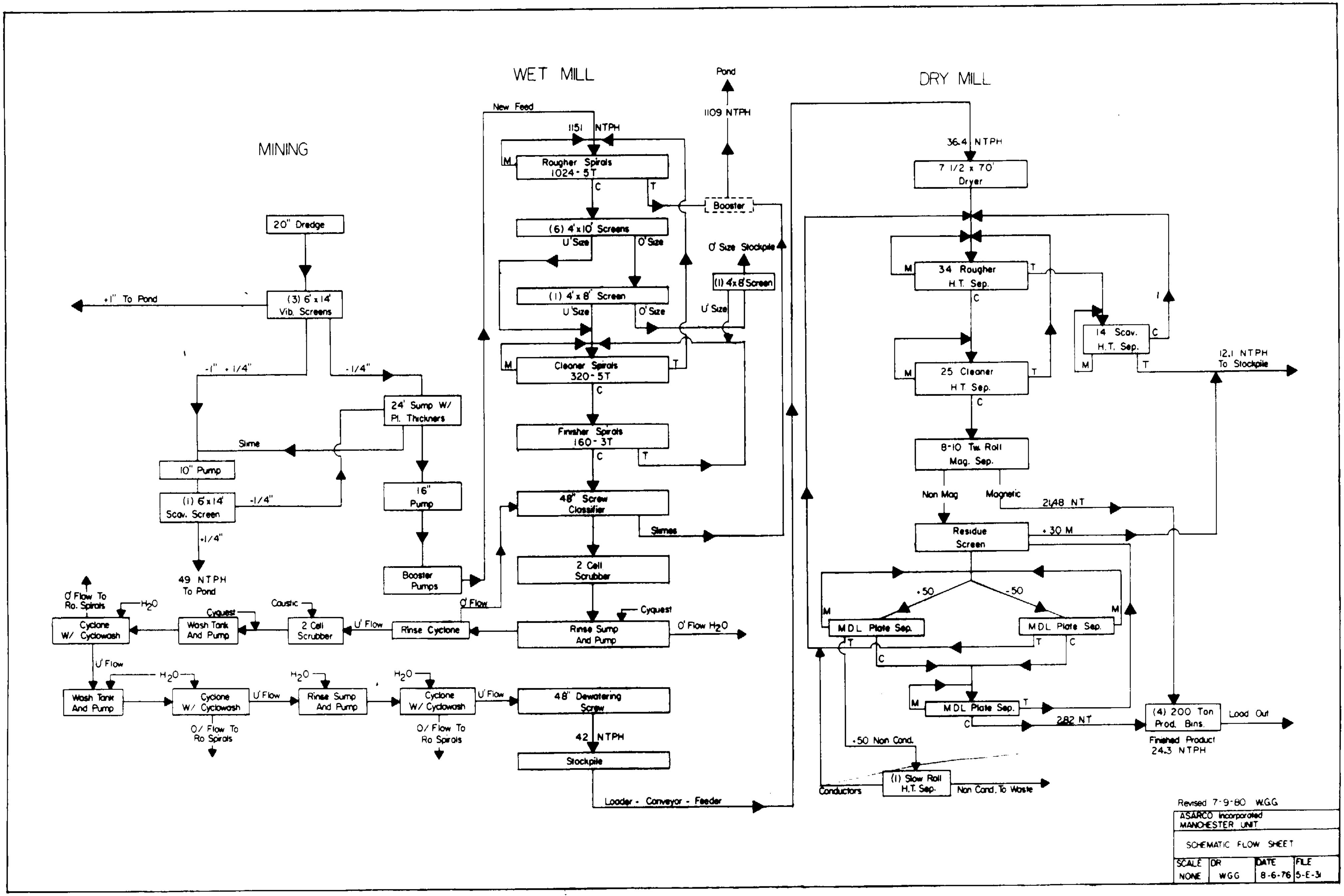
ATTACHMENT 2



HERITAGE MINERALS, INC.
PLANT SITE
DECOMMISSIONING AREA

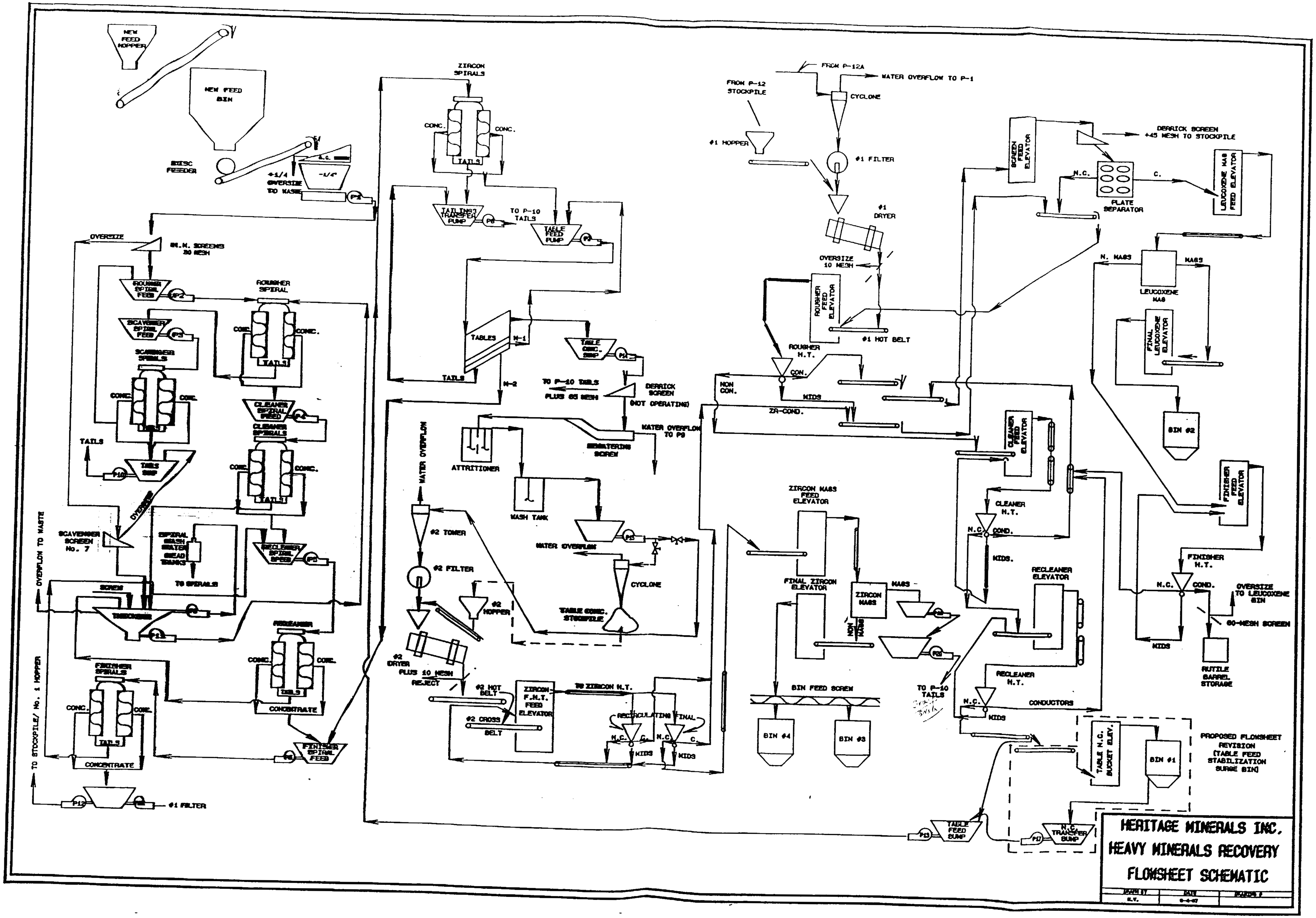
Scale +/- 1" = 100 ft. November 1, 2002

ATTACHMENT 3

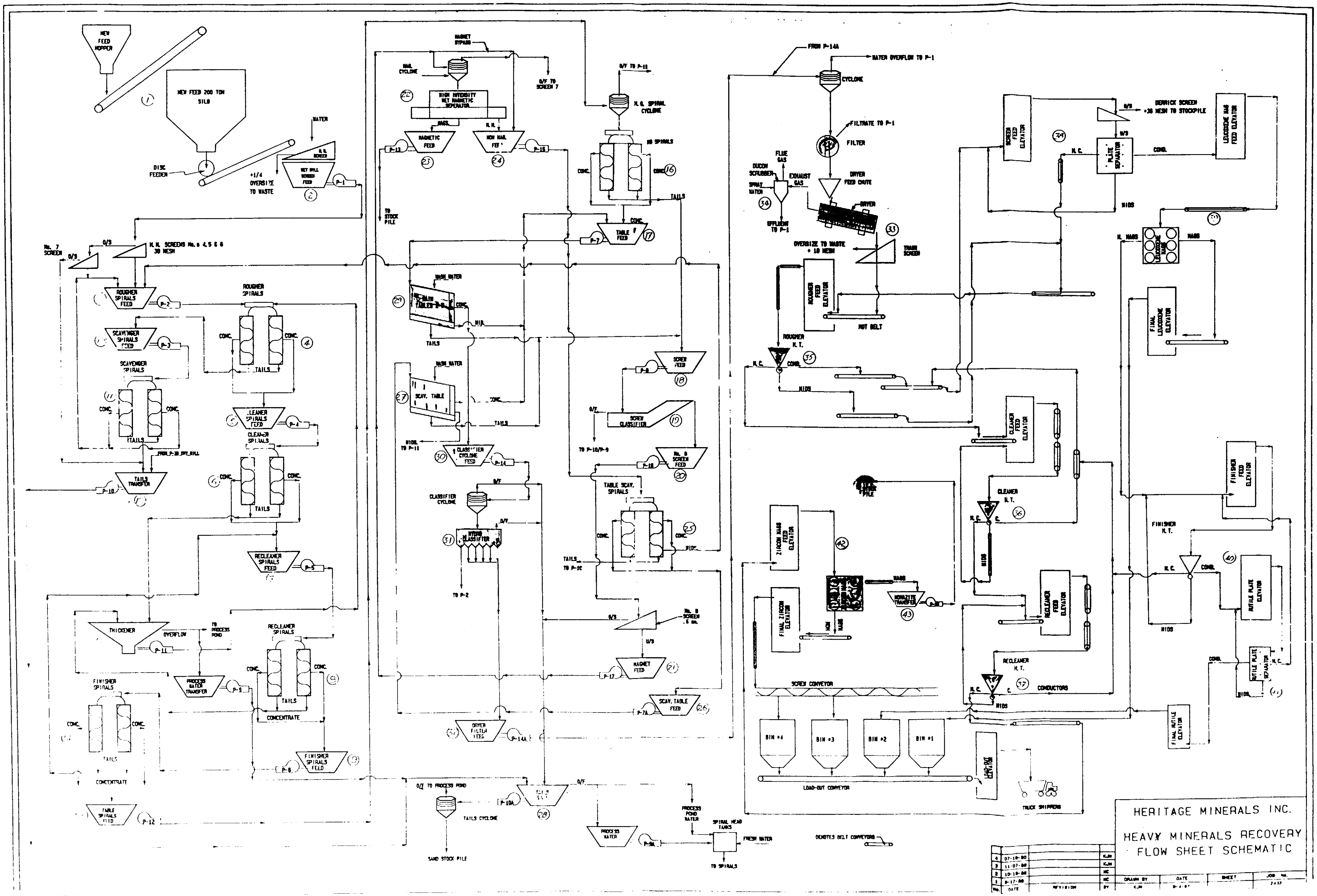


MINING
WET MILL
DRY MILL
20" Dredge
(3) 6' x 14' Vib. Screens
+1" To Pond
-1" +1/4"
-1/4"
24' Sump W/ Pl. Thickners
Slime
10" Pump
(1) 6' x 14' Scav. Screen
-1/4"
+1/4"
49 NTPH To Pond
16" Pump
Booster Pumps
New Feed
1151 NTPH
Rougher Spirals 1024 - 5T
(6) 4' x 10' Screens
U' Size
O' Size
(1) 4' x 8' Screen
Cleaner Spirals 320 - 5T
Finisher Spirals 160 - 3T
48" Screw Classifier
Slimes
2 Cell Scrubber
Rinse Sump And Pump
Cyquest
O' Flow H_2O
Rinse Cyclone
O' Flow
U' Flow
2 Cell Scrubber
Caustic
Wash Tank And Pump
Cyclone W/ Cyclowash
O' Flow To Ro. Spirals
H_2O
Wash Tank And Pump
Cyclone W/ Cyclowash
O/ Flow To Ro Spirals
Rinse Sump And Pump
48" Dewatering Screw
42 NTPH
Stockpile
Loader - Conveyor - Feeder
Pond
1109 NTPH
Booster
O' Size Stockpile
(1) 4x8 Screen
U' Size
36.4 NTPH
7 1/2 x 70' Dryer
34 Rougher H.T. Sep.
14 Scav. H.T. Sep.
25 Cleaner H.T. Sep.
12.1 NTPH To Stockpile
8-10 Tw. Roll Mag. Sep.
Non Mag
Magnetic
21.48 NT
Residue Screen
+30 M
+.50
-.50
MDL Plate Sep.
MDL Plate Sep.
MDL Plate Sep.
2.82 NT
(4) 200 Ton Prod. Bins
Load Out
Finished Product 24.3 NTPH
+.50 Non Cond.
(1) Slow Roll H.T. Sep.
Conductors
Non Cond. To Waste
Revised 7-9-80 W.G.G.
ASARCO Incorporated MANCHESTER UNIT
SCHEMATIC FLOW SHEET
SCALE NONE
DR WGG
DATE 8-6-76
FILE 5-E-31

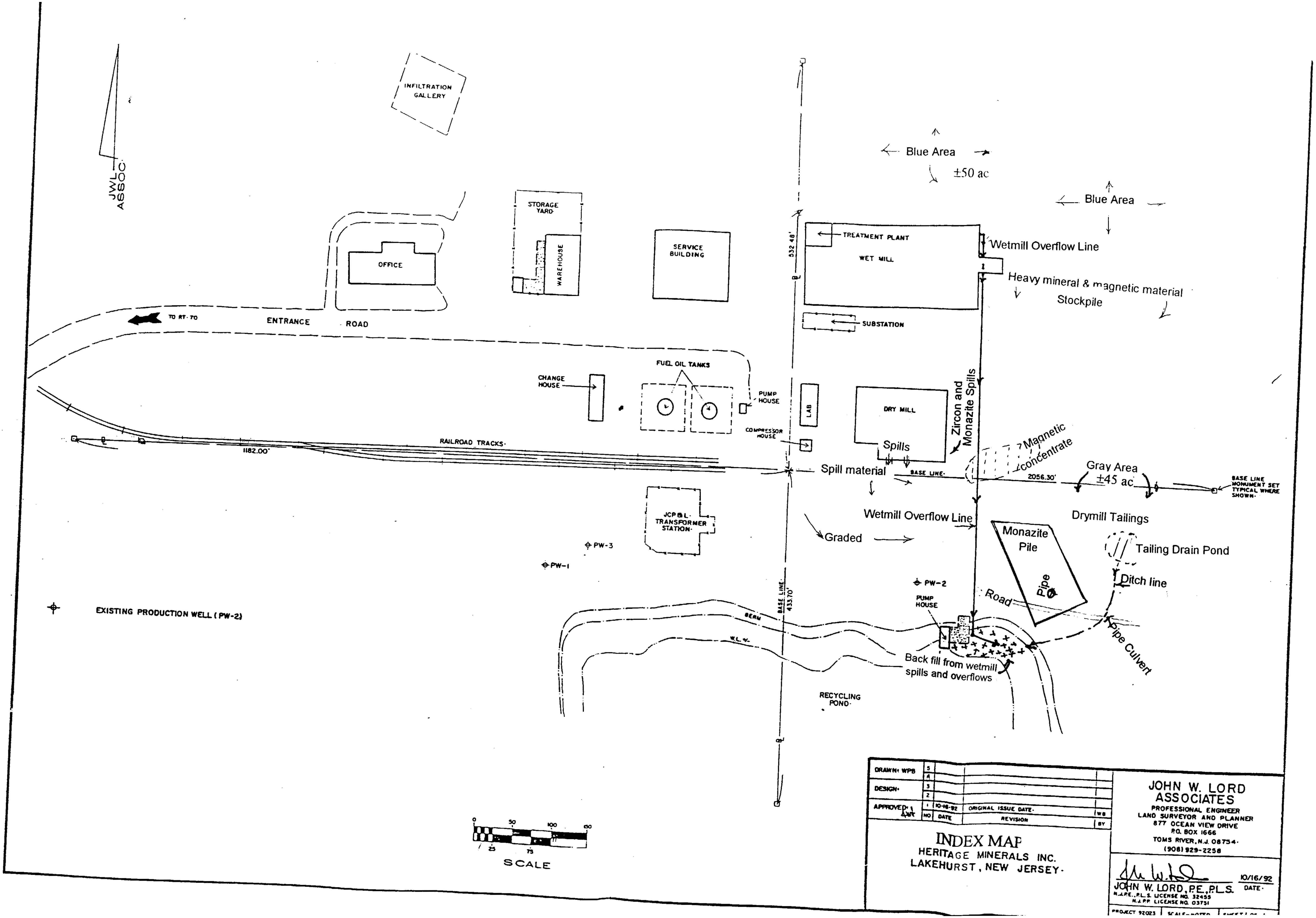
ATTACHMENT 4


HERITAGE MINERALS INC.
HEAVY MINERALS RECOVERY
FLOWSHEET SCHEMATIC
NEW FEED HOPPER
NEW FEED BIN
DISC FEEDER
+1/4 OVERSIZE TO WASTE
-1/4"
OVERSIZE
ROUGHER SPIRAL FEED
ROUGHER SPIRAL
SCAVENGER SPIRAL FEED
SCAVENGER SPIRALS
CONC.
TAILS
CLEANER SPIRAL FEED
CLEANER SPIRALS
TAILS SUMP
OVERSIZE
SCAVENGER SCREEN No. 7
TO SPIRALS
RECLEANER SPIRAL FEED
SCREEN
THICKENER
RECLEANER
FINISHER SPIRALS
CONCENTRATE
FINISHER SPIRAL FEED
#1 FILTER
OVERFLOW TO WASTE
TO STOCKPILE/ No. 1 HOPPER
ZIRCON SPIRALS
TAILINGS TRANSFER PUMP
TO P-10 TAILS
TABLE FEED PUMP
TABLES
N-1
N-2
TABLE CONC. SUMP
TO P-10 TAILS
PLUS 65 MESH
DERRICK SCREEN (NOT OPERATING)
ATTRITIONER
DEWATERING SCREEN
WATER OVERFLOW TO P9
WASH TANK
WATER OVERFLOW
CYCLONE
TABLE CONC. STOCKPILE
WATER OVERFLOW
#2 TOWER
#2 FILTER
#2 HOPPER
#2 DRYER
PLUS 10 MESH REJECT
#2 HOT BELT
#2 CROSS BELT
ZIRCON F.H.T. FEED ELEVATOR
TO ZIRCON H.T.
RECIRCULATING
FINAL
N.C.
C.
MIDS
FROM P-12A
WATER OVERFLOW TO P-1
FROM P-12 STOCKPILE
CYCLONE
#1 HOPPER
#1 FILTER
#1 DRYER
OVERSIZE 10 MESH
ROUGHER FEED ELEVATOR
#1 HOT BELT
ROUGHER H.T.
CON.
NON CON.
MIDS
ZR-COND.
ZIRCON MAGS FEED ELEVATOR
FINAL ZIRCON ELEVATOR
ZIRCON MAGS
MAGS
NON MAGS
BIN FEED SCREW
BIN #4
BIN #3
TO P-10 TAILS
SCREEN FEED ELEVATOR
DERRICK SCREEN +45 MESH TO STOCKPILE
N.C.
C.
PLATE SEPARATOR
LEUCOXENE MAG FEED ELEVATOR
N. MAGS
MAGS
LEUCOXENE MAG
FINAL LEUCOXENE ELEVATOR
BIN #2
CLEANER FEED ELEVATOR
CLEANER H.T.
COND.
MIDS.
RECLEANER ELEVATOR
RECLEANER H.T.
CONDUCTORS
MIDS
FINISHER FEED ELEVATOR
FINISHER H.T.
COND.
OVERSIZE TO LEUCOXENE BIN
60-MESH SCREEN
RUTILE BARREL STORAGE
TABLE N.C. BUCKET ELEV.
BIN #1
PROPOSED FLOWSHEET REVISION (TABLE FEED STABILIZATION SURGE BIN)
TABLE FEED SUMP
N.C. TRANSFER SUMP
DRAWN BY
DATE

ATTACHMENT 5


HERITAGE MINERALS INC.
HEAVY MINERALS RECOVERY
FLOW SHEET SCHEMATIC
NEW FEED HOPPER
NEW FEED 200 TON SILO
DISC FEEDER
WATER
WET MILL SCREEN FEED
+1/4 OVERSIZE TO WASTE
N.H. SCREENS No.s 4,5 & 6 30 MESH
No. 7 SCREEN
ROUGHER SPIRALS FEED
ROUGHER SPIRALS
SCAVENGER SPIRALS FEED
SCAVENGER SPIRALS
CLEANER SPIRALS FEED
CLEANER SPIRALS
TAILS TRANSFER
RECLEANER SPIRALS FEED
RECLEANER SPIRALS
THICKENER
OVERFLOW
TO PROCESS POND
PROCESS WATER TRANSFER
FINISHER SPIRALS
FINISHER SPIRALS FEED
CONCENTRATE
TABLE SPIRALS FEED
MAGNET BYPASS
MAG. CYCLONE
HIGH INTENSITY WET MAGNETIC SEPARATOR
MAGNETIC FEED
NON MAG. FEED
O/F TO SCREEN 7
TO STOCK PILE
H.G. SPIRAL CYCLONE
HG SPIRALS
TABLE FEED
WASH WATER
SCAV. TABLE
CLASSIFIER CYCLONE FEED
CLASSIFIER CYCLONE
HYDRO CLASSIFIER
TO P-2
SCREW FEED
SCREW CLASSIFIER
TO P-10/P-9
No. 8 SCREEN FEED
TABLE SCAV. SPIRALS
No. 8 SCREEN
MAGNET FEED
SCAV. TABLE FEED
DRYER FILTER FEED
O/F TO PROCESS POND
TAILS CYCLONE
SAND STOCK PILE
PROCESS WATER
PROCESS POND WATER
SPIRAL HEAD TANKS
FRESH WATER
TO SPIRALS
FROM P-14A
WATER OVERFLOW TO P-1
CYCLONE
FILTRATE TO P-1
FILTER
FLUE GAS
DUCON SCRUBBER
EXHAUST GAS
SPRAY WATER
EFFLUENT TO P-1
DRYER FEED CHUTE
DRYER
OVERSIZE TO WASTE +10 MESH
TRASH SCREEN
ROUGHER FEED ELEVATOR
HOT BELT
ROUGHER H.T.
SCREEN FEED ELEVATOR
DERRICK SCREEN +30 MESH TO STOCKPILE
PLATE SEPARATOR
LEUCOXENE MAG FEED ELEVATOR
FINAL LEUCOXENE ELEVATOR
CLEANER FEED ELEVATOR
CLEANER H.T.
RECLEANER FEED ELEVATOR
RECLEANER H.T.
FINISHER FEED ELEVATOR
FINISHER H.T.
RUTILE PLATE ELEVATOR
RUTILE PLATE SEPARATOR
FINAL RUTILE ELEVATOR
CONDUCTORS
ZIRCON MAG FEED ELEVATOR
FINAL ZIRCON ELEVATOR
MONAZITE TRANSFER
SCREW CONVEYOR
BIN #4
BIN #3
BIN #2
BIN #1
LOAD-OUT CONVEYOR
TRUCK SHIPPERS
DENOTES BELT CONVEYORS
REVISION
DRAWN BY
DATE
SHEET
JOB No.

ATTACHMENT 6



JWL ASSOC
INFILTRATION GALLERY
STORAGE YARD
WAREHOUSE
OFFICE
SERVICE BUILDING
TREATMENT PLANT
WET MILL
Blue Area
±50 ac
Blue Area
Wetmill Overflow Line
Heavy mineral & magnetic material
Stockpile
SUBSTATION
TO RT. 70
ENTRANCE
ROAD
CHANGE HOUSE
FUEL OIL TANKS
PUMP HOUSE
LAB
DRY MILL
COMPRESSOR HOUSE
Zircon and Monazite Spills
Spills
? Magnetic concentrate
RAILROAD TRACKS
1182.00'
Spill material
BASE LINE
2056.30'
Gray Area
±45 ac
BASE LINE MONUMENT SET TYPICAL WHERE SHOWN
JCP&L TRANSFORMER STATION
Wetmill Overflow Line
Drymill Tailings
Graded
Monazite Pile
Tailing Drain Pond
PW-3
PW-1
PW-2
Ditch line
Pipe
Road
BASE LINE 433.70'
532.48'
EXISTING PRODUCTION WELL (PW-2)
PUMP HOUSE
BERM
W.L.
Pipe Culvert
Back fill from wetmill spills and overflows
RECYCLING POND
0 25 50 75 100 150
SCALE
DRAWN: WPB
DESIGN:
APPROVED:
1 10-16-92 ORIGINAL ISSUE DATE. WB
NO DATE REVISION BY
INDEX MAP
HERITAGE MINERALS INC.
LAKEHURST, NEW JERSEY.
JOHN W. LORD ASSOCIATES
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LAND SURVEYOR AND PLANNER
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10/16/92
DATE
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PROJECT 92023