40-8681

Umetco Minerals Corporation

P.O. BOX 1029
GRAND JUNCTION, COLORADO 81502
☎ (303) 245-3700

RETURN ORIGINAL TO PDR, HQ.

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URFO RECEIVED

March 25, 1994

Mr. Ramon E. Hall, Director
U. S. Nuclear Regulatory Commission
Uranium Recovery Field Office
P. O. Box 25325
Denver, Colorado 80225

Re: Amendment to License No. SUA-1358 to allow acceptance of The Monticello Tailings

Dear Mr. Hall:

Umetco Minerals Corporation hereby requests that Source Materials License SUA-1358 be amended to allow the receipt and disposal at White Mesa of approximately 2.6 MM cubic yards of materials from the Department of Energy's Monticello Tailings Project. The materials would be disposed of in a dry state (as they exist at Monticello) in Cell 4A and in Cell 3, and, along with the proposed mill run, would utilize almost all of our existing tailings capacity. Final reclamation of the cells would be as outlined in our Tailings Reclamation submittal of June, 1988.

The following is a list of materials as characterized by the DOE Project Office in Grand Junction which would be considered for disposal at White Mesa:

<u>Uranium and Vanadium Mill Tailings</u>. Approximately 2 MM cubic yards of materials from previous operations on the sites. These materials are contained in four "piles" as follows: the Carbonate Pile, the Vanadium Pile, the East Pile, and the Acid Pile. While most are clearly 11(e)2 materials, there has been some question as to the classification of the "Vanadium Pile". While delineated as a separate pile, these materials are in fact intermingled with the "uranium" mill tailings, and probably can not be separated. Umetco's position is that they are similar in nature to materials already in the White Mesa tailings impoundments, and indeed, probably came from the same type of ores that provide the mill feed for the White Mesa Mill. Additionally, tests conducted by the DOE show the material to be non-RCRA. However, Umetco believes

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that the NRC will have to rule on whether the White Mesa facility can dispose of this material along with the other materials.

Mill Structures. Includes concrete foundations, structural steel, mill equipment, asbestos, sumps leach fields, septic tanks, dry wells, miscellaneous material that may be uncovered at the mill laboratory. Where feasible, byproduct material that is not radiologically contaminated will be sent to an alternative disposal site.

Vicinity Property Clean-up. Materials resulting from the clean-up of properties around the Monticello area that had used Monticello tailings for construction.

Ore Samples and Specimens. Small amounts of uranium-vanadium ores found during the vicinity property program. Umetco could either feed this material to the mill during the next mill run or direct dispose of it in tailings.

The DOE has told us that they would warrant that there would be no shipments of RCRA material to the White Mesa Mill. One unanswered question surrounds the use of the mill maintenance buildings by the USBLM as a shop. Umetco assumes that the NRC will clear up the characterization of this material with the DOE and the EPA prior to any material being disposed of. A more detailed description of the wastes proposed for disposal can be found in the March 24, 1994 transmittal from the DOE in the attachments.

Over the last year, the White Mesa Millsite has been evaluated for the final disposal of the Monticello Tailings by the USDOE, USEPA, the State of Utah, and others. Studies conducted during these evaluations have resulted in the White Mesa Mill being chosen as the preferred alternative by the DOE. Umetco has completed the conceptual design of the truck unloading and transfer conveyor systems, and is conducting a Health, Safety and Environmental Review of this system to ensure that the principles of ALARA are maintained.

To assist the NRC in the evaluation of this request, the following documents are attached for your review:

- Index, summary, and bibliography from the Final Remedial Investigation/Feasibility Study-Environmental Assessment for the Monticello, Utah, Uranium Mill Tailings Site, dated January, 1990. Should the NRC not have a complete copy of this document, Umetco would be pleased to supply one.

- DOE letter of August 23, 1993, detailing the volume of materials, geotechnical characteristics of the tailings and the proposed rate of tailings haulage.

- Rust Geotech letter of October 28, 1993, detailing analysis of drilling data and maps showing locations of the borings, and Dames and Moore information on metals and radiological samples.

- Roberts and Schaefer study of February 24, 1994, detailing proposed handling methods at the White Mesa site.

- List of Waste Materials on the Monticello Millsite Proposed for Disposal at the White Mesa Mill, dated March 24, 1994.

Should you require more information on the materials, Umetco suggests that the NRC contact the DOE Project Office in Grand Junction directly. However, to the extent that we have the data, we would be pleased to provide any additional information that we have received from the DOE.

Should you or your staff have any questions or require clarification on any issue with regard to this request, you may contact Butch Brice, Jerry Ray, or Scott Schierman at White Mesa, or , as always, I can be reached in the Grand junction office at 303-245-3700.

Regards,

Richard A. Van Horn

Director of Operations

cc: W. W. Brice, Umetco - White Mesa
D. W. Butcher, Umetco - Danbury (w/o attachments)
S. C. Cain, Umetco - Grand Junction (w/o attachments)
B. L. Doores, Concord - Denver (w/o attachments)
J. S. Hamrick, Umetco - Grand Junction (w/o attachments)
P. J. Morgan, Umetco - Danbury (w/o attachments)
G. G. Ray, Umetco - White Mesa (w/o attachments)
H. R. Roberts, Energy Fuels - Denver
W. J. Sinclair, Utah BRC, Salt Lake City (w/o attachments)
P. K. Willmott, Concord - Denver (w/o attachments)

Msg. Center No. ______

U.S. Department of Energy
Grand Junction Projects Office
Monticello Support Office
Communication Center
P.O. Box 909
Monticello, Utah 84535-0909

MONTICELLO FACSIMILE TRANSMISSION ROUTING SHEET

Date 3/23/94

This Cover Sheet Is For Transmittal of Unclassified Messages

Sent From RUST Geotech Inc., Monticello Support Office

Canon Fax L770
Commercial: 801-587-2672

Verification
Commercial: 801-587-2615

To: Rick VanHorn (Name) UMETCO (Location (Street or Bldg.)) 303-245-3700 (Phone)

Grand Junction (City & State)

From: Deb Richardson (Name) Monticello (Location) 587-2615 (Phone)

Send to Fax Machine Number 303 245-7543 Verification Number 245-3700

Special Instructions:

This Transmittal Consists of 1 Pages (Excluding Cover Sheet)

I certify this is an unclassified document and transmission is essential

C S Eldredge
Approved Signature

Date Sent ______ Verified ______

GJPO 1382C
12/93

LIST OF WASTES MATERIALS ON THE MONTICELLO MILLSITE PROPOSED FOR DISPOSAL AT THE WHITE MESA MILL

Uranium Mill Tailings

Vanadium Mill Tailings

These tailings are integrally mixed with uranium mill tailings in the vanadium and carbonate piles. Available data indicate that the material in the vanadium and carbonate piles is not a RCRA characteristic hazardous waste.

Mill Structures

Includes concrete foundations, structural steel, mill equipment, asbestos, sumps, leach fields, septic tanks, dry wells, miscellaneous material that may be uncovered at the mill laboratory. Where feasible, byproduct material that is not radiologically contaminated will be sent to an alternative disposal site.

Miscellaneous Spills and Leaks of Fuels, Solvents or Processing reagents.

Perchloroethylene has been identified in a sump associated with the mill laundry facilities, tricloroethylene has been identified in an area where maintenance of mill equipment occurred. Solvent odors were noticed in an excavation down hill from the laboratory. Fuels have been identified in the area of the mill fuel storage tanks and in the soil downhill from the fuel storage tanks. Sampling is proposed to characterize waste that may be considered a hazardous substance under CERCLA. These wastes are still proposed to be considered byproduct material. It will be the responsibility of DOE to ensure that any wastes or spills generated by the BLM during its use of the mill maintenance facility are not RCRA hazardous wastes prior to sending wastes from this area to Umetco.

Residual Ore

In the past, sproadic pieces of ore have been removed from vicinity and peripheral properties along with the tailings removed from these properties. Currently, where feasible, the ore is being segregated from the tailings.

Structures Containing Vanadium Tailings

Structures containing vanadium tailings (generally in morter used in construction) are being remediated.

Department of Energy
Grand Junction Projects Office
Post Office Box 2567
Grand Junction, Colorado 81502-2567

DELIVERED BY HAND

RECEIVED
AUG 23 1993
R.A. VAN HORN
— John Pepin —

AUG 23 1993

Mr. Richard A. Van Horn
Director of Operations
UMETCO Minerals Corporation
P.O. Box 1029
Grand Junction, Colorado 81502

SUBJECT: Request for Estimate of Fees for Disposal of Monticello Mill Tailings at the UMETCO Blanding, Utah Facility (SOLICITATION FOR INFORMATION OR PLANNING PURPOSES)

Dear Mr. Van Horn:

This solicitation is issued for the purpose of supporting an assessment of alternatives for disposal of vanadium and uranium mill tailings from the Monticello Mill Tailings Site. Cost information is required as a part of this assessment to establish the cost versus benefit for several disposal alternatives. To adequately evaluate the cost of the "Off Site: Existing Facilities" alternatives, which includes your facility in Blanding, Utah, an estimate of the disposal fees that would be charged to the Department of Energy (DOE) is required.

THE GOVERNMENT DOES NOT INTEND TO AWARD A CONTRACT ON THE BASIS OF THIS SOLICITATION OR TO OTHERWISE PAY FOR THE INFORMATION SOLICITED.

The following information is attached to assist you in the determination of the fees that you would charge:

- volume of millsite tailings and tailings contaminated soil, tailings contaminated soil from vicinity and peripheral properties and rubble,
- geotechnical characteristics of the tailings, and
- rate of tailings haulage.

The DOE would appreciate this estimate in dollars per bank cubic yard at the Monticello Millsite. This estimate would include all costs that would be incurred by your company associated with disposal of the Monticello tailings at your facility. No other costs, incidental or otherwise would be charged to the DOE.

If you have any questions, please call me at (303) 248-6008.

Sincerely,

Donald N. Leske
Project Manager

Attachments

cc w/attachments:
P. Mushovic, EPA
T. Howard, State of Utah
R. Kowalewski, DOE-HQ, EM-451
H. Perry, Chem-Nuclear Geotech, Inc.

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M-3-L

QUANTITIES

(Excavation of Bank Cubic Yards)

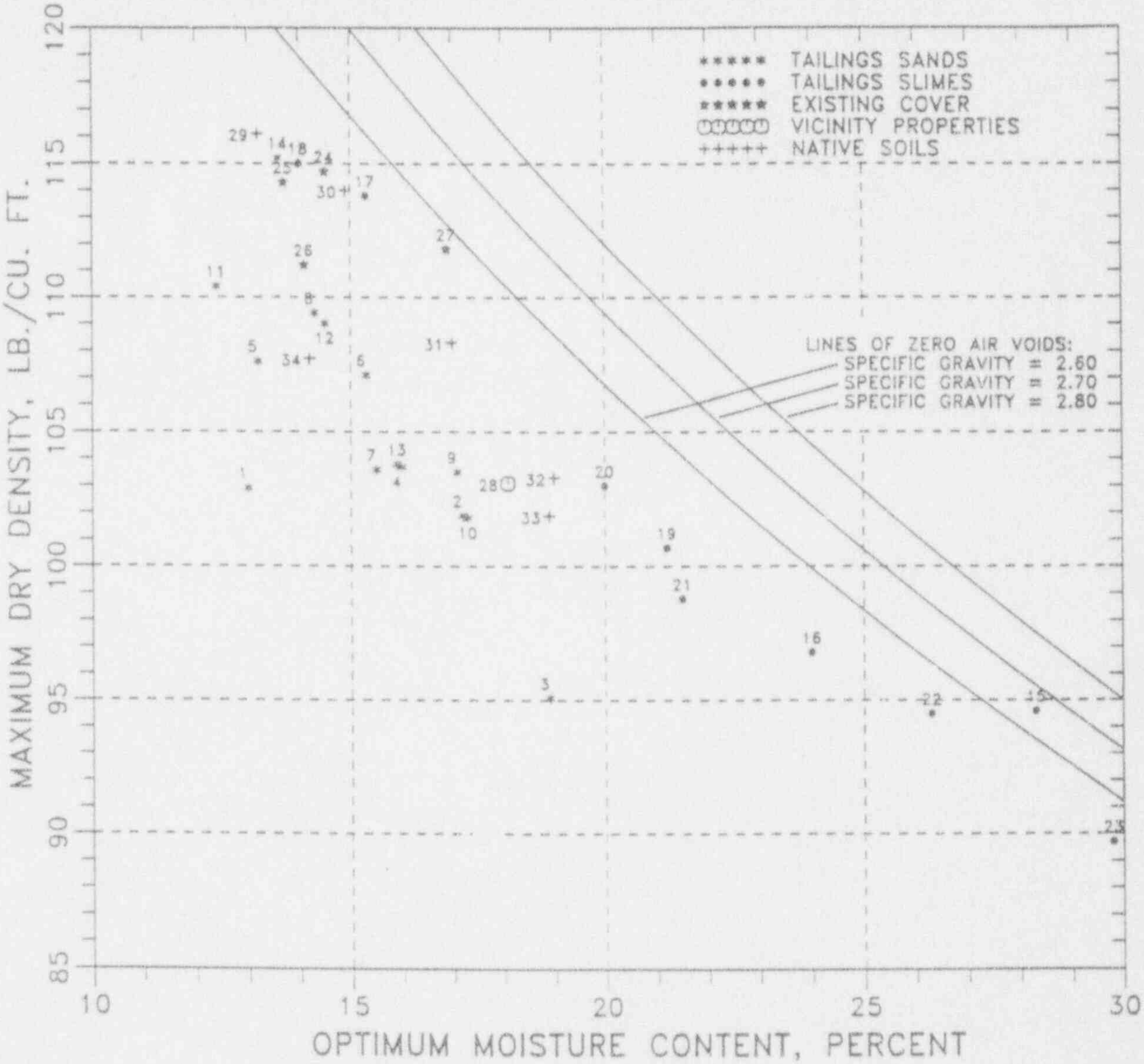
Tailings:	Sands =	1,39,306
	Slimes =	945,694
Contaminated Soil:	< 25 pcig =	300,000
	>25 - <100 pCig =	115,000
Rubble (concrete, rebar, soils)	>100 pCig =	100,000
	TOTAL =	2,600,000 (cost basis)
	+15%	2,990,000 (potential volume requirement)

PRODUCTION RATES

8,100 CY Bank/Day (average)
20 hrs/day
6 days/week

Ability to place 550 CY bank/hour as surge capacity

ASTM D 698 MAXIMUM DENSITY & OPTIMUM MOISTURE CONTENT TAILINGS & SOILS AT MONTICELLO MILLSITE, UTAH



KEY TO DATA POINT LABELS

1	–	MRAP-85-02 (PIT),	3.0 FT.
2	–	D&M TEST PIT 6,	4.5 FT.
3	–	D&M TEST PIT 6,	18.0 FT.
4	–	D&M TEST PIT 11,	6.0 FT.
5	–	MRAP-85-04 (PIT),	2.0 FT.
6	–	MRAP-85-06 (PIT),	3.0 FT.
7	–	MRAP-85-06 (PIT),	15.0 FT.
8	–	D&M TEST PIT 1,	15.0 FT.
9	–	D&M TEST PIT 2,	14.5 FT.
10	–	D&M TEST PIT 4,	14.0 FT.
11	–	MRAP-85-10 (PIT),	3.0 FT.
12	–	D&M TEST PIT 7,	2.0 FT.
13	–	D&M TEST PIT 8,	4.5 FT.
14	–	MRAP-85-21,	0.0-3.0 FT.
15	–	MRAP-85-02 (PIT),	6.0 FT.
16	–	D&M TEST PIT 11,	15.0 FT.
17	–	MRAP-85-04 (PIT),	7.0 FT.
18	–	D&M TEST PIT 12,	6.0 FT.
19	–	D&M TEST PIT 12,	12.0 FT.
20	–	D&M TEST PIT 2,	9.0 FT.
21	–	D&M TEST PIT 4,	9.5 FT.
22	–	MRAP-85-10 (PIT),	8.0 FT.
23	–	D&M TEST PIT 8,	13.0 FT.
24	–	MRAP-85-02 (PIT),	1.0 FT.
25	–	MRAP-85-04 (PIT),	1.0 FT.
26	–	MRAP-85-06 (PIT),	1.0 FT.
27	–	MRAP-85-10 (PIT),	1.0 FT.
28	–	D&M TEST PIT 1,	7.0 FT.
29	–	D&M TEST PIT 13,	5.0 FT.
30	–	D&M TEST PIT 9,	10.0 FT.
31	–	MRAP-85-17,	0.0-5.0 FT.
32	–	MRAP-85-18,	0.0-5.0 FT.
33	–	MRAP-85-20,	0.0-3.0 FT.
34	–	D&M TEST PIT 10,	5.0 FT.

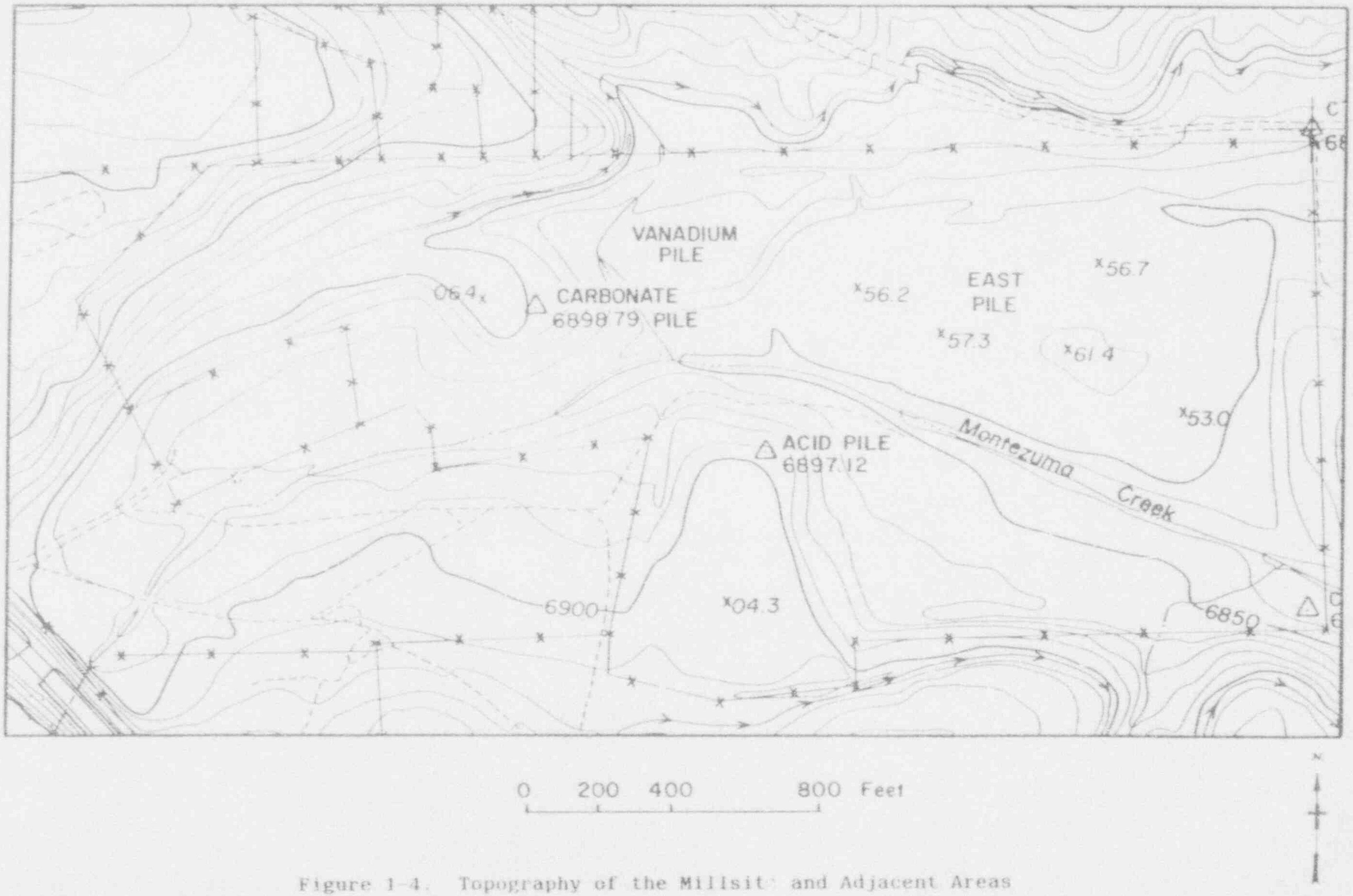


Figure 1-4. Topography of the Millsit: and Adjacent Areas

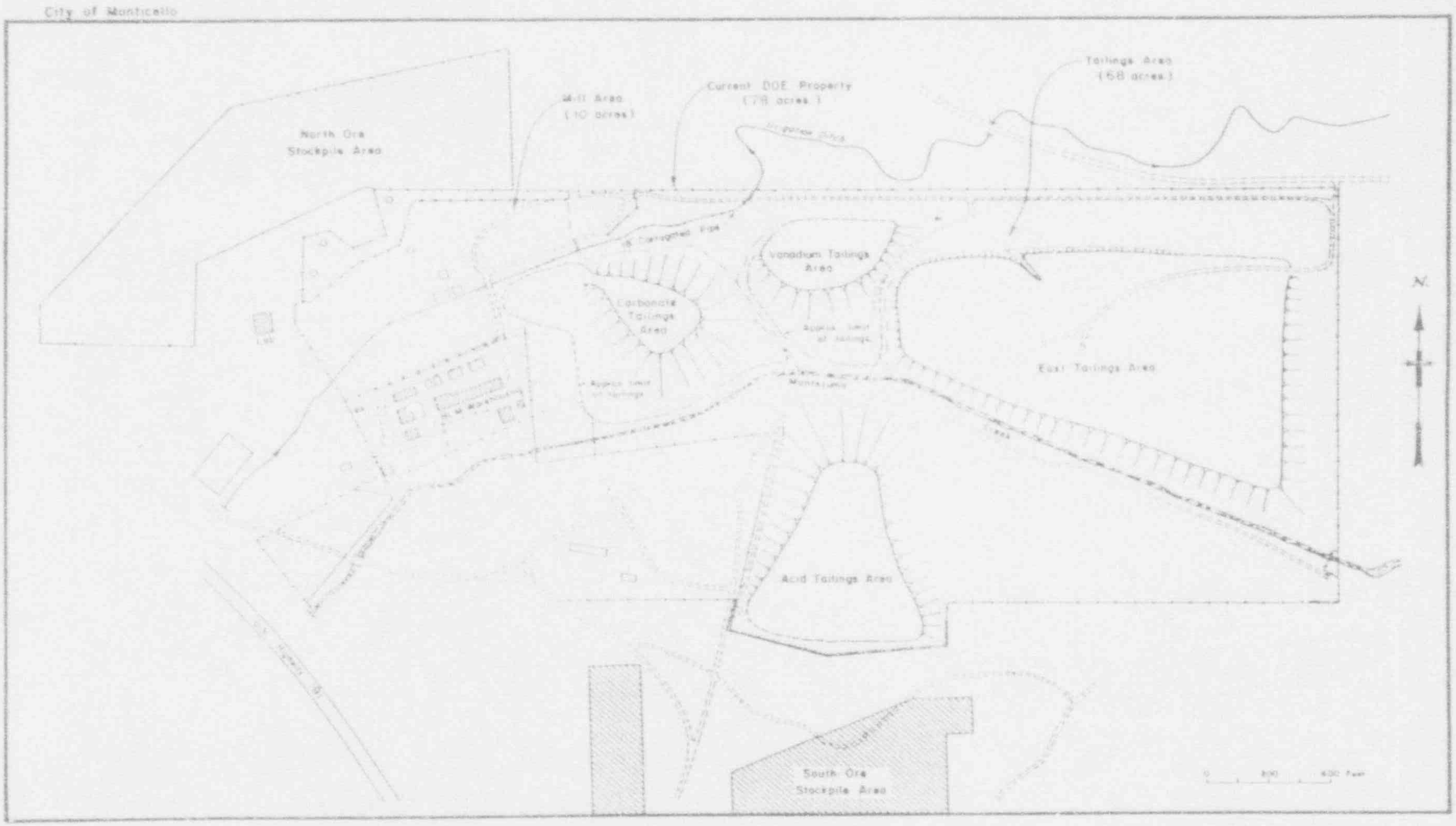


Figure 1-5. Monticello Millsite Plan

are contained in four piles: the Carbonate Pile, covering 6.3 acres; the Vanadium Pile, covering 4.5 acres; the East Pile, covering 24 acres; and the Acid Pile, covering 11 acres. The tailings impoundment area contains almost 2 million tons of tailings and contaminated soil. All of the piles presently have a vegetative cover consisting of alfalfa and mixed native grasses.

1.2.2 History of the Monticello Mill Operations

The uranium mill at Monticello was one of the earliest to operate on the Colorado Plateau and was at the forefront of developments in uranium-milling technology throughout its period of operation. The Monticello mill was one of the first two plants in the United States to use the acid leach resin-in-pulp (RIP) process and was the first to use the carbonate leach RIP process. Mill operations at Monticello were also a focal point of early environmental concerns. After the mill closed in 1960, it was the first inactive site to undergo extensive tailings stabilization.

This synopsis of the history of the Monticello mill is intended to provide general background information for understanding the environmental problems posed by the mill both during its operation and after its closure.

1.2.2.1 Mill Ownership

Vanadium Corporation of American (VCA) Operations, 1941 to 1946

In late 1940, the Vanadium Corporation of America (VCA) opened a vanadium ore-buying station at Monticello in order to stimulate vanadium mining in the region. Within a short time, ore production increased sufficiently to justify construction of a vanadium mill, and, in September 1941, the War Production Board approved the proposal submitted by VCA for mill construction. Funding for the construction was provided by the U.S. Government through the Defense Plant Corporation. The Metals Reserve Company assumed operation of the ore-buying station in April 1942, while the VCA operated the mill. The first vanadium was produced at the new mill on 24 August 1942. In 1943, VCA began producing a uranium-vanadium sludge for the Manhattan Engineer District (MED), which had recently initiated a program to obtain domestic uranium (Albrethsen and McGinley, 1982). The mill closed in February 1944.

The VCA reopened the mill from 1945 to 1946 under lease from the Defense Plant Corporation and purchased stockpiled ore from the Metals Reserve Company (Albrethsen and McGinley, 1982). During this period, the VCA produced a uranium-vanadium sludge which it sold to the Manhattan Engineer District.

Atomic Energy Commission (AEC) Operations, 1948 to 1962

The Atomic Energy Commission (AEC) bought the Monticello millsite from the War Assets Administration in 1948. The American Smelting and Refining Company (AS&R) acted as the ore-buying agent for the AEC, and The Galigher Company was engaged to design and operate a uranium mill at the site (Butler, 1951; Albrethsen and McGinley, 1982). In February 1956, Lucius Pitkin, Inc., replaced AS&R as ore-buying agent, and, in April 1956, the National Lead

Company (NLC) assumed operation of the mill. Shortly thereafter, the NLC also took over ore weighing, sampling, and stockpiling activities, while Lucius Pitkin, Inc., continued to conduct administrative activities associated with ore purchase contracts, assaying, and settlements. The mill closed in January 1960, but the ore-buying station remained open until 31 March 1962 (Albrethsen and McGinley, 1982).

1.2.2.2 Milling Processes

VCA Salt Roast Process

During VCA operations at the Monticello mill, a salt roast process was used to convert vanadium minerals to soluble form. However, the high lime content of the carnotite ore processed at the mill presented metallurgic problems. The calcium carbonate caused excessive slagging, and the calcium liberated by roasting formed insoluble vanadium compounds (Merritt, 1971). To counteract these problems, pyrite was added to cause some of the calcium to form calcium sulfate. The hot ore was quenched in a solution of sodium carbonate, at which point most of the vanadium dissolved and calcium remaining as calcium chlorate precipitated as calcium carbonate. After successive washings, the sands were transferred to tailings. Precipitation of vanadium pentoxide (V_2O_5) from the pregnant liquor was induced by the addition of sulfuric acid. The precipitate was washed to remove sodium chloride and sodium sulfate, and the wash water was discharged to the nearby creek (Anonymous, 1944).

AEC Processes

Ores received at the AEC ore-buying station and processed at the mill came from a wide geographic area and had a broad spectrum of metallurgic properties that affected the milling. As many as 27 different ore types were recognized among Colorado Plateau ores (Philippone, 1955), which required a variety of milling processes. Tests on the ores for process amenability were performed by the Monticello Plant, by the U.S. Bureau of Mines in Salt Lake City, and by the AEC Pilot Plant in Grand Junction (Hollis and others, 1954; Moulton, 1954a and 1954b; Jones and others, 1956).

A number of milling processes were used at Monticello during the 11 years of AEC operation. These included raw ore carbonate leach, low-temperature roast/hot carbonate leach, and salt roast/hot carbonate leach up to 1955; acid leach resin-in-pulp (RIP) and raw ore carbonate leach from 1955 to 1958; and a carbonate pressure leach RIP process from August 1958 to mill closure in 1960. Descriptions of some of these processes are provided in Butler (1951), Allen and Klemenic (1954), Philippone (1955), Philippone and Johnson (1956), Joyce and Johnson (1956), and Whitman and Beverly (1958). Three of the AEC processes used at the Monticello mill are summarized below.

Salt Roast/Carbonate Leach Process -- Until 1955, vanadium was recovered with uranium. After being crushed, the ore was mixed with sodium chloride (common salt), 6 to 9 percent by weight, and roasted at temperatures near 850° C. The hot ore was quenched in a sodium carbonate solution, ground to natural grain size, and passed through a series of agitators and thickeners to dissolve the uranium and vanadium.

Sodium uranyl vanadate (yellowcake) was precipitated from solution by adding sulfuric acid to a pH of 6 and heating. Precipitation was considered complete when the filtrate contained less than 10 ppm U_3O_8. The filtrate was further acidified by the addition of sulfuric acid to pH 2.5 to precipitate vanadium oxide (red cake). The dried yellowcake was further refined by adding sodium chloride, sodium carbonate, and sawdust, and then fusing the substance in a furnace to produce uranium oxide (black cake). The vanadium and other impurities were removed by washing, and the wash solution was further treated to recover vanadium (Butler, 1951).

Acid Leach RIP Process -- In 1955, the salt roast process and vanadium recovery were discontinued in order to improve uranium extraction. In November 1955, an acid leach RIP plant began operation. The existing carbonate leach plant was retained so that the mill could run two circuits simultaneously. Testing of ores for amenability had been conducted previously (Hollis and others, 1954; Jones and others, 1956; Moulton, 1954a and 1954b). The acid plant flow sheet used at the mill is described in Whitman and Beverly (1958) and Joyce and Johnson (1956).

After being crushed and ground, the ore was mixed with sulfuric acid and manganese dioxide (oxidant) and passed through a series of eight agitators. Water for the leach circuit was recycled from the tailings pond overflow. The leached ore was passed through a series of classifiers to separate the sand and slime fractions. Sands were passed to the tailings pond, and slimes containing dissolved uranium were passed through a series of banks with screen baskets containing the ion exchange resin. The loaded resin was washed and eluted with a sodium nitrate solution acidified with sulfuric acid. Calcium hydroxide was added to the pregnant eluate to raise the pH to 3.4, whereupon white cake, consisting mostly of calcium sulfate (gypsum), was precipitated. The white cake was recycled through the leaching circuit and the filtrate advanced to the second stage of precipitation where yellowcake was produced by the addition of magnesium oxide to neutralize the filtrate.

The acid tailings were combined with the tailings from the carbonate plant to obtain partial neutralization. The combined tailings were then treated with calcium hydroxide to achieve complete neutralization and to flocculate the pulp, after which they were pumped to the tailings pond. About 130 gallons per minute of pond overflow was recycled through the leach circuit while 180 gallons per minute was discharged to Montezuma Creek (Whitman and Beverly, 1958). Combined capacity at this time for the acid leach RIP and alkaline leach plants was about 600 tons of ore per day (Merritt, 1971).

Carbonate Leach RIP Process -- Conversion of the acid leach RIP plant to a carbonate leach RIP plant began in June 1958. The new plant began processing ore on 8 August 1958 at a capacity of 150 tons per day. Jones and others (1955) and McArthur and others (1955) describe pilot plant studies that used ore from the Monticello stockpiles. In the study described by Jones and others (1955), the resin was eluted with a sodium chloride solution.

Precipitation of yellowcake was induced by the addition of sulfuric acid; neutralization with magnesium oxide followed.

Neither a flow sheet nor a reference describing the carbonate pressure leach RIP process has been located. However, the process used at Monticello is known to have been similar to the process later used at the uranium mill in Moab, Utah. There, the ore was ground to -65 mesh in a solution of sodium carbonate-bicarbonate. The pulp was then thickened to about 50 percent solids and subjected to pressure leaching with mechanical agitation in steam-heated autoclaves. After cooling, the leached pulp was passed through a sand-slime separation circuit. The uranium-bearing solution and slimes were then passed through the RIP circuit (F. E. McGinley, personal communication).

Relation of Tailings Piles and Milling Process

Prior to the installation of the acid leach RIP plant in 1955, tailings were discharged to two areas designated herein as the Carbonate Pile and the Vanadium Pile. The Carbonate Pile is believed to be the oldest of the tailings piles; it received tailings from the AEC salt roast/carbonate leach process. The Vanadium Pile apparently obtains its name from the fact that vanadium concentrations are higher in this pile than in the other tailings piles. However, the origin of these higher concentrations is unknown because of the uncertainty regarding the date of the pile's construction and its exact relation to the milling processes in use prior to start-up of the acid leach RIP plant.

There is evidence that the Carbonate and Vanadium Piles were operated simultaneously. The Operating Reports issued for 1951 and 1952 state:

> "A few hours with the dozer maintained an adequate sand tailings dam; the solution was syphoned to the settling pond, with no overflows from either sand or solution ponds going to the creek." (Galigher Company, 1951, p. 3)

> "... the liquor from the clarifier pond was pumped back to old tailings pond area." (Galigher Company, 1952, p.4).

These statements suggest that two separate ponds were used in the tailings disposal during this time period. It seems reasonable to equate the "sand pond" and "old tailings pond" with the Carbonate Pile and the "settling pond" and "clarifier pond" with the Vanadium Pile.

According to the June 1955 Financial and Operating report, the salt roast performed for vanadium recovery was discontinued on 10 June 1955. Vanadium precipitation in the circuit was continued, but the precipitated vanadium was passed to the "high vanadium tailing pond storage" (Galigher Company, 1955, pp. 4-5). This practice suggests that the Vanadium Pile may have been used to stockpile high-vanadium tailings for a short period of time following the cessation of vanadium recovery, although H. A. Johnson, resident manager of the mill at the time, has no recollection of a separate stockpiling (F.E. McGinley, personal communication, 1983). It is certain, however, that the Vanadium Pile was not constructed for this purpose. A photograph of the millsite (Figure 1-6) shows the Vanadium Pile near its final size in August 1955, just two months after cessation of vanadium recovery at the mill. The

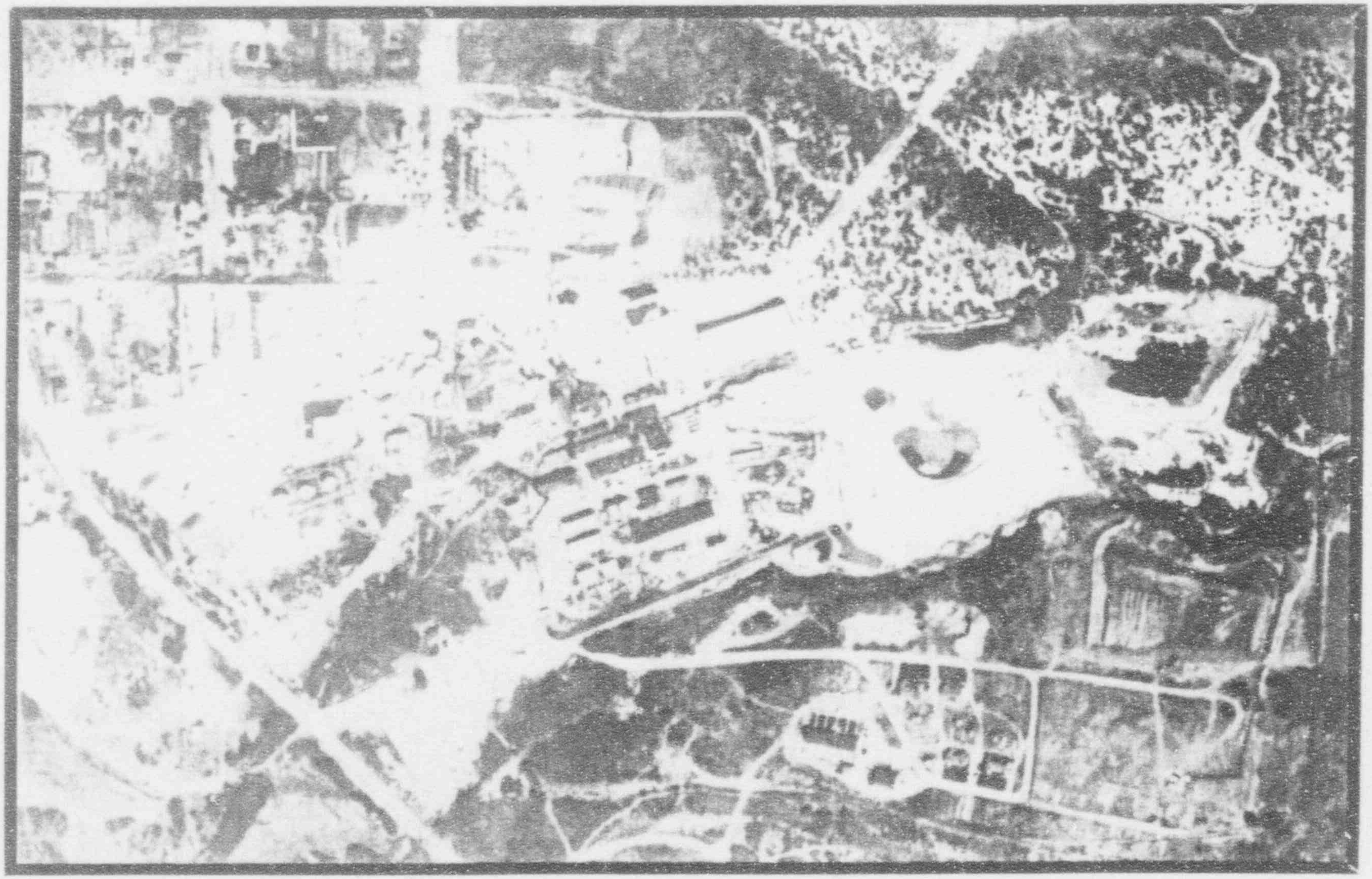


Figure 1-6. Aerial View of the Millsite and Tailings Piles at Monticello, Utah. At the time this photo was taken (31 August 1955), the Carbonate and Vanadium Tailings Ponds were in use, and the South or Acid Pond was under construction.

volume of tailings is too great to have been produced by a plant that processed no more than about 100 to 120 tons of ore per day.

Because the acid leach RIP process required more water, a third pond was constructed south of Montezuma Creek to accommodate the added volume of discharge. How the Acid Pond (or South Pond) looked shortly after the opening of the acid leach RIP plant can be seen in Figure 1-7. This pond, referred to herein as the Acid Pile, contains the combined tailings, produced in 1955 and 1956, from the acid leach RIP and carbonate leach circuits.

After construction of the Acid Pond, it soon became apparent that a larger tailings pond would be required. Additional land, some of which had already been damaged by mill releases, was purchased east of the AEC property, and a new pond was constructed to retain a projected 578 acre-feet of tailings (Tonry, 1956). This pond, referred to herein as the East Pile, received tailings from 1956 to 1960 when the mill closed.

1.2.2.3 Environmental Problems Associated with Mill Operations

Air Pollution

Prior to 1955, the environmental problems receiving attention at the Monticello mill arose from the salt roast procedure used to enhance vanadium recovery. Large quantities of dust, chlorine, and hydrogen chloride gas produced in this step of the mill flow sheet were exhausted through the roaster stack. One study indicated that an average of nearly 2600 lb of dust containing 0.363 percent U_3O_8 and 1.52 percent V_2O_5 escaped daily through the stack. This amounted to annual losses of 14,000 lb V_2O_5 and more than 3000 lb U_3O_8. Local residents complained about corrosion of wire fences, clotheslines, galvanized roofs, etc.; these complaints were verified by The Galigher Company (Allen and Klemenic, 1954).

Water Pollution

Liquid effluent from the salt roast/carbonate leach plant, which contained substantial concentrations of chloride, sulfate, carbonate, bicarbonate, sodium, and other dissolved species, was released into Montezuma Creek. The resulting water pollution attracted the attention of the Utah Water Pollution Control Board who contacted the Atomic Energy Commission and requested that the situation be corrected (Allen and Klemenic, 1954). The solution to this problem was not immediately forthcoming. Although problems relating to stack releases largely disappeared when vanadium recovery was discontinued in 1955, seepage from the Carbonate Pile continued to release chloride to surface water and, it was suspected, to ground water as well (Lennemann, 1956).

Elimination of effluent releases to Montezuma Creek became a goal in the subsequent design of tailings ponds and in research on milling processes. The Acid Pond was lined with 6 inches of compacted bentonite in an attempt to prevent seepage. Water from this pond was partly recycled to the acid plant, and research was conducted to obtain 100 percent recycling. About 3500 gallons of barren eluate were bled from the elution cycle daily to prevent resin poisoning. However, this solution contained high concentrations of

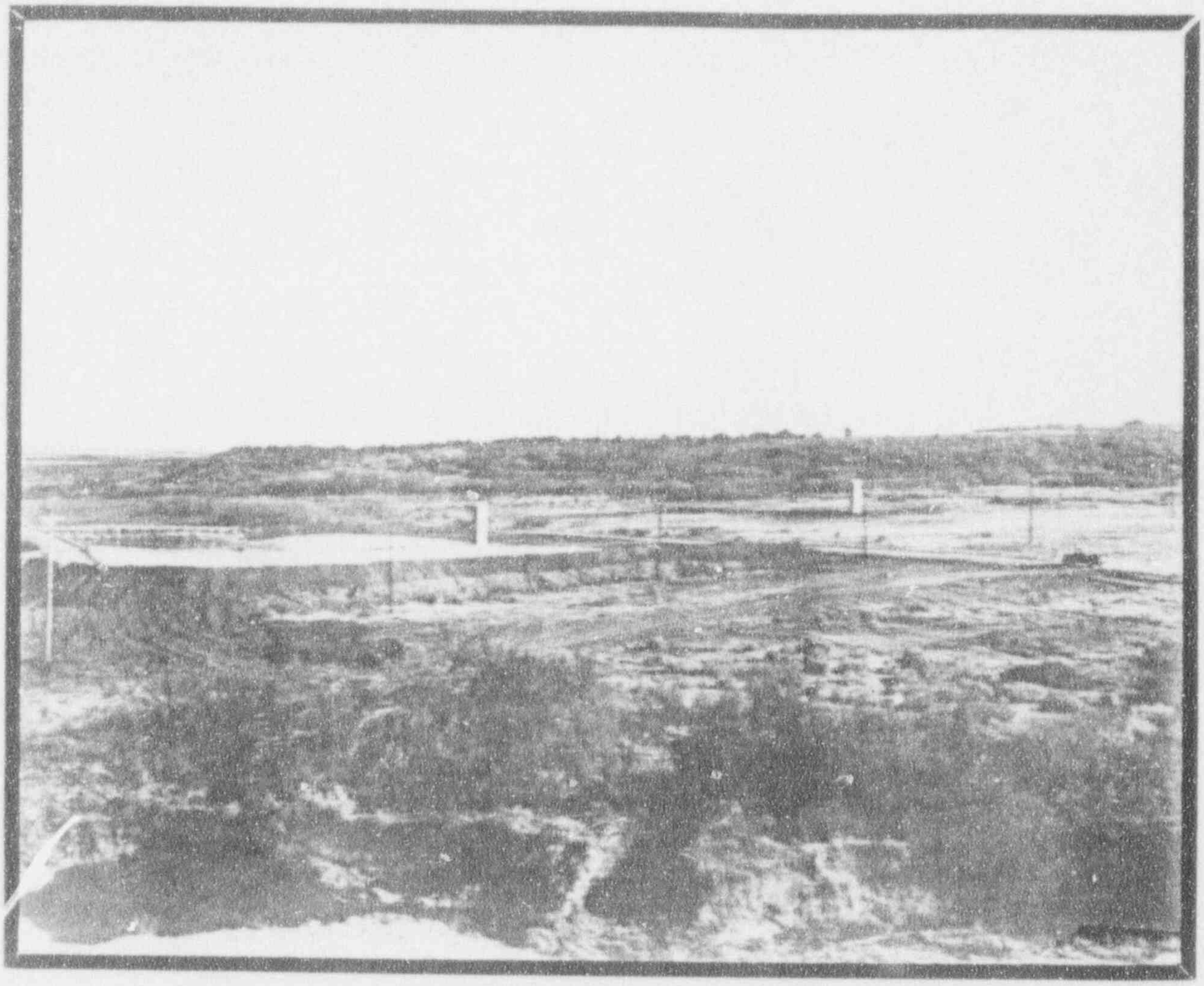


Figure 1-7. View of the Acid Pond Shortly after Start-up of the Acid Leach RIP Plant. Photo dated 2 November 1955.

nitrate and could neither be released into Montezuma Creek nor be recycled. Instead, it was disposed of in separate ponds and allowed to evaporate. It was hoped that pond overflow could be eliminated entirely with changes in milling process, but use of solar evaporation in the East Pond was considered should such changes prove impractical (Tonry, 1956).

A water-sampling program was begun in March 1956 and continued through March 1959. The data acquired in the survey indicated that even with the East Pond, discharge of salts exceeded Utah water quality standards (George, 1958). In particular, when the carbonate leach RIP plant began operation, the pH values and concentrations of total dissolved solids, carbonate, bicarbonate, sodium, and chloride increased to levels above those observed during operation of the acid plant (George, 1959).

Emphasis shifted toward radiologic aspects of uranium milling in 1957 when the AEC released the "Standards for Protection Against Radiation" as Title 10, Part 20, of the Code of Federal Regulations (Federal Register, v. 22, no. 14, 22 January 1957). Included were standards for exposure of individuals to radiation and maximum permissible concentrations of radionuclides in water and air. Part 20 applied specifically to AEC licensees, so the Monticello mill was not legally subject to these standards. However, a directive was issued to achieve compliance at Monticello in order to provide a model for private mills (Johnson, 1958). The program developed to reach compliance also included approval of sampling and analysis methods and development of controls for disposing of hazardous substances. A summary of this program is given in Beverly (1958).

Release of radium-226 was of special concern. As early as 1950, it was recognized that radium levels in water and stream sediments were increasing as a result of uranium mill operations. In 1955, the flow in Montezuma Creek below the Monticello mill was noted to consist mostly of overflow and seepage from the tailings ponds. Soluble radium in the mill effluent was measured at 81 pCi/L (Tsivoglou and others, 1956; Tsivoglou, 1964). The radium-226 balance in the Monticello acid leach RIP plant was examined to determine what fraction was dissolved in the milling process and the ultimate disposition of radium through the various chemical separations. It was found that only about 3 percent of the radium in the ore was dissolved in the leach circuit. Of this amount, 10 percent precipitated with yellowcake. Most of the remainder of the dissolved radium was removed upon neutralization of the tailings in the tailings treatment step. Ultimately only 0.03 percent of the radium fed to process entered Montezuma Creek as solute. Soluble radium activity in Montezuma Creek was found to be 160 pCi/L; the maximum permissible concentration was 4 pCi/L above natural background. It was also recognized that the suspended solids contained considerable radium activity and that dry tailings were being washed into the creek (Whitman and Beverly, 1958).

A number of studies were subsequently conducted to determine methods for removing the small amount of dissolved radium (Beverly, 1958; DeSesa, 1958; DeSesa, 1959). Barium sulfate was found to be the most effective compound for removing radium from tailings solutions. A test circuit was set up at Monticello to determine the feasibility of the treatment on a plant scale. Significant reductions of radium-226 were achieved (DeSesa, 1958), although the average concentration was still above 4 pCi/L. A second test circuit included iron sulfate heptahydrate ($FeSO_4 \cdot 7\ H_2O$) as treatment to flocculate suspended solids; this brought dissolved radium concentrations to within acceptable levels (DeSesa, 1959).

Early Cleanup Activities

During milling operations, the tailings were normally moist so that erosion by wind was minimal. Within a year after shutdown, however, the tailings dams and surfaces of the piles dried out, and tailings sand started migrating as dunes. Erosion by water also became a problem. The condition of the tailings piles at that time is illustrated in Figures 1-8 through 1-15.

In Summer 1961, the Atomic Energy Commission began to regrade, stabilize, and vegetate the piles. This work was initiated on the East Pile because, being the largest pile, it presented the greatest potential for wind erosion and migration of tailings off site. At the onset, a small pond still existed in the lowest part of the East Pile and it was drained to the extent possible.

Slimes retained considerable moisture, even in "dry" parts of the pile, and many areas would not support heavy equipment. To overcome this obstacle tailings sand was hauled from the other three piles and spread over the surface. These tailings mixed with the fluid slimes to provide a stable surface over which cover material could be spread. The depth of sand fill reached as much as 6 ft in places but averaged 3 or 4 ft. After the grading was completed, 8 to 12 in. of fill dirt and rock, excavated nearby, were spread over the tops and sides of the piles. Topsoil was added to the tops of the piles, fertilized, and a variety of native grasses were planted (U.S. Atomic Energy Commission, 1963).

The mill facilities were dismantled concurrently. Equipment was sold to private firms, and unsold scrap material was buried or burned. Trenches were excavated near the Carbonate Pile and scrap was buried under several feet of tailings (Figures 1-16 and 1-17). These tailings were covered with rock and soil and seeded in the same way as the piles (Paas, 1966).

Within a few years, it was evident that erosion problems were under control (Atomic Energy Commission, 1966). Data suggested that dissolved and particulate radium concentrations in Montezuma Creek were diminishing (Federal Water Pollution Control Administration, 1966). A radiologic survey of the site conducted in May 1965 concluded that exposure rates on the piles were slightly above background but did not result in a dose that exceeded the Federal Radiation Council Guide limit of 0.5 rem/yr for the general public. This was not true of the ore-storage areas. These areas had been cleared of visible ore fragments when the mill closed, but ore apparently remained buried in the soil. During the Summer of 1965, 6 to 12 inches of topsoil was removed from the ore-storage areas. Photographs archived at the Grand Junction Projects Office suggest that the contaminated soil was used as fill material to partially bury the mill foundations (Figures 1-18 and 1-19). A subsequent radiologic survey of the ore-storage areas was conducted by the AEC Grand Junction Office, results of which indicated that a radiation hazard no longer existed according to standards in effect at that time (Paas, 1966).

In 1972, the AEC requested additional radiation surveys of the south stockpile area and the ore-buying station. These surveys indicated that considerable contamination remained (Ward, 1972; Freytag, 1972), and recommendations were made to remove nearly 15,000 cubic yards of contaminated soil from these

Figure 1-8. View of the Monticello Mill, Summer 1960

Figure 1-9. Surface of the East Pile. Note small pond in background. Photo dated 12 May 1960.

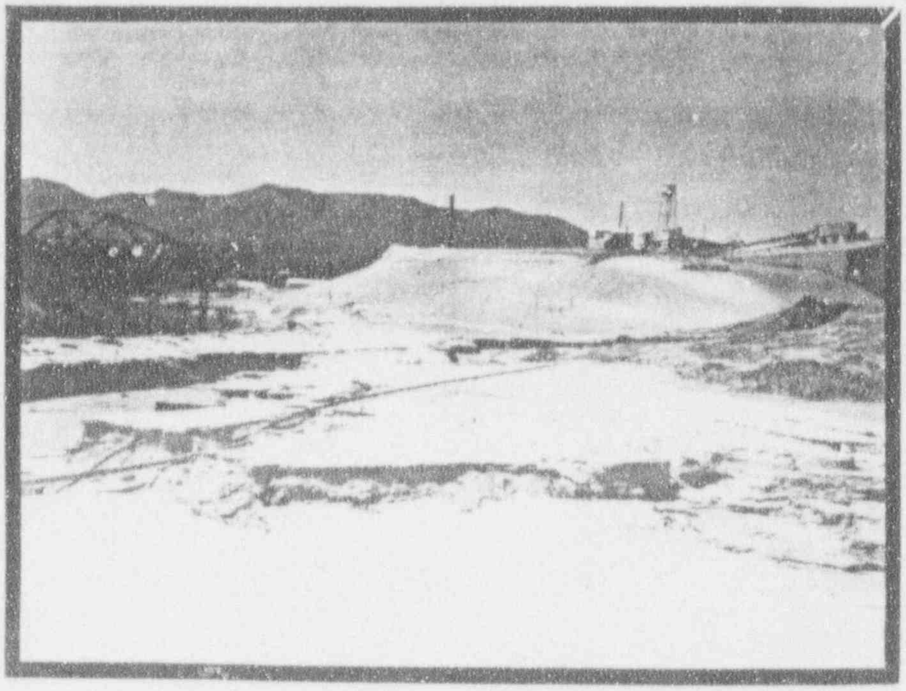


Figure 1-10. View of the Carbonate Pile (center background) and the Toe of the Vanadium Pile (right midground). Drainage channels in foreground and midground were cut by storm runoff. Montezuma Creek runs beneath the steel structure at the left. Photo dated 12 September 1961.

Figure 1-11. View of the Carbonate Pile (right midground), Acid Pile (background), and Vanadium and East Piles (left midground and background). Note effects of wind and water erosion. Photo dated 13 September 1961.

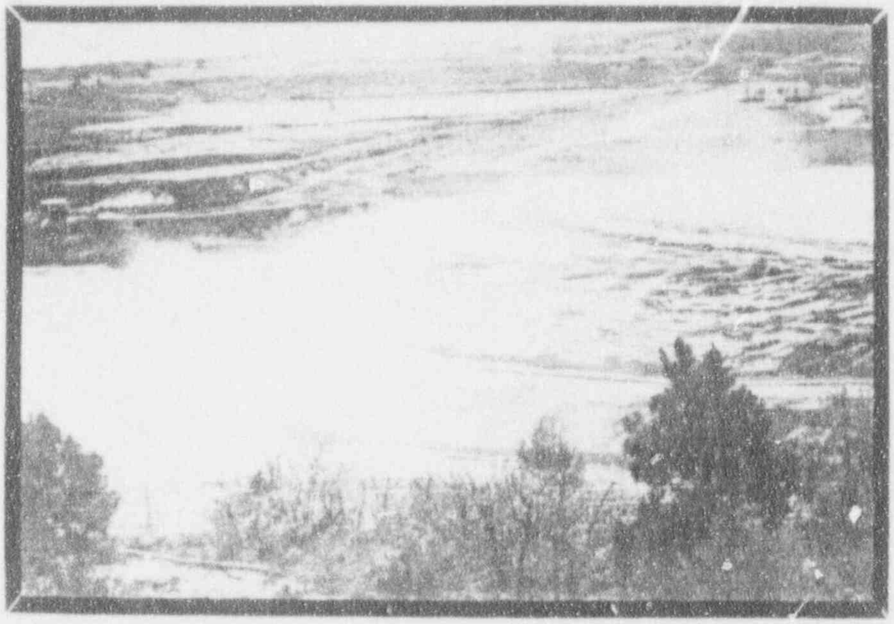


Figure 1-12. Cloud of Windblown Tailings from Carbonate Pile. Photo dated 19 October 1961.

Figure 1-13. Eroded Slopes of the Vanadium Pile. Note cutbank of Montezuma Creek in foreground. Photo dated 11 September 1961.

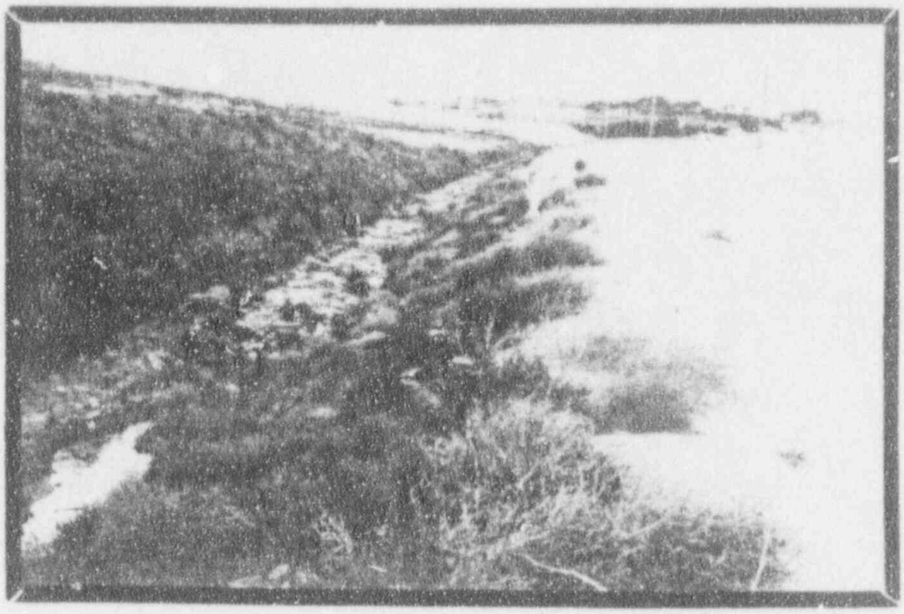


Figure 1-14. View West Up Montezuma Creek. Windblown tailings from the East Pile mantle the surface at right. Photo dated 26 July 1961.

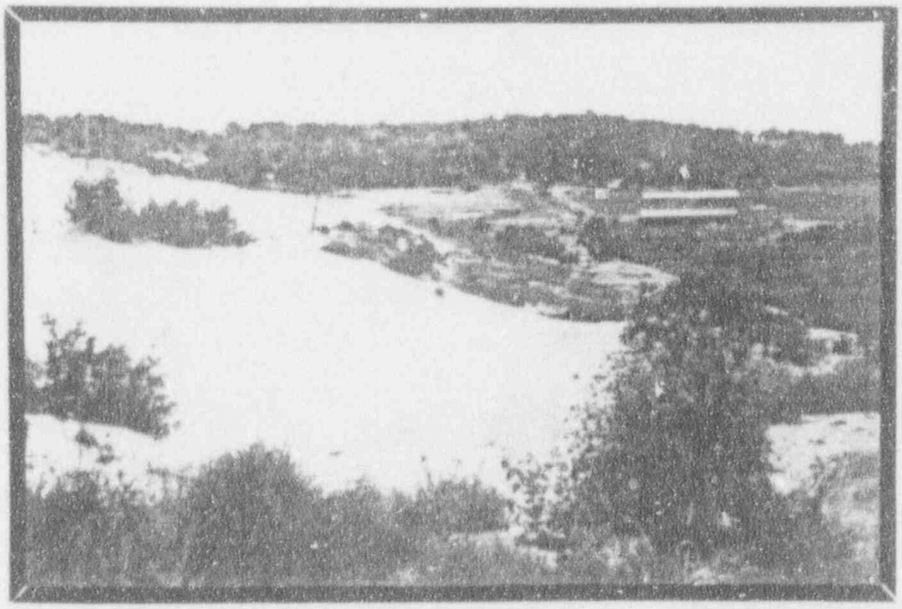


Figure 1-15. Tailings Sand Dune at East End of the East Pile. Photo dated 9 August 1961.

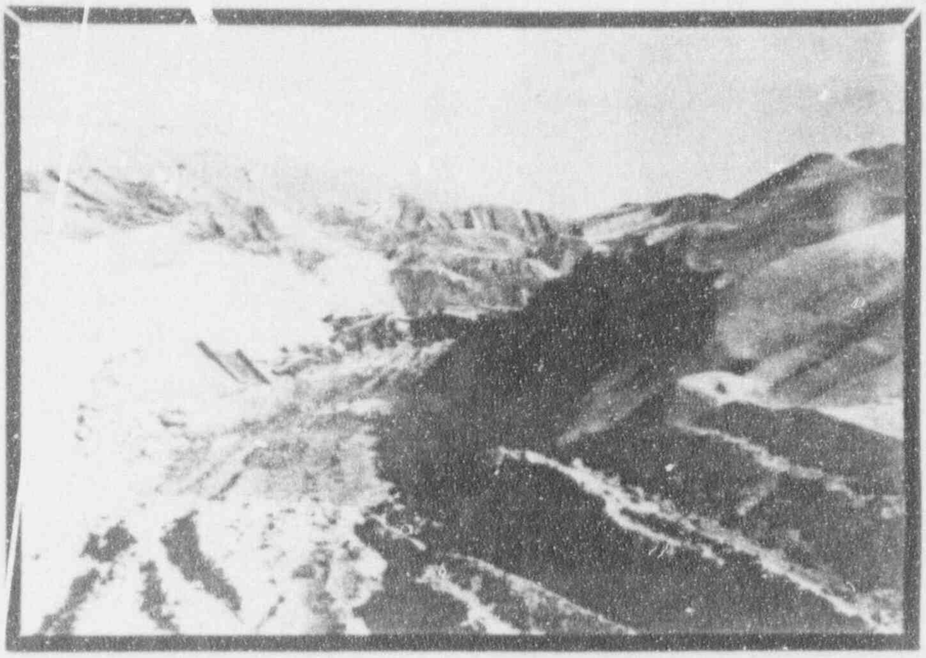


Figure 1-16. Contaminated-Scrap Burial Trench on West Flank of the Carbonate Pile. Photo dated 9 November 1960.

Figure 1-17. View of the Contaminated-Scrap Burial Trench (midground). Note rill erosion on slope in foreground; this slope consists largely of spilled tailings. Photo dated 9 November 1960.

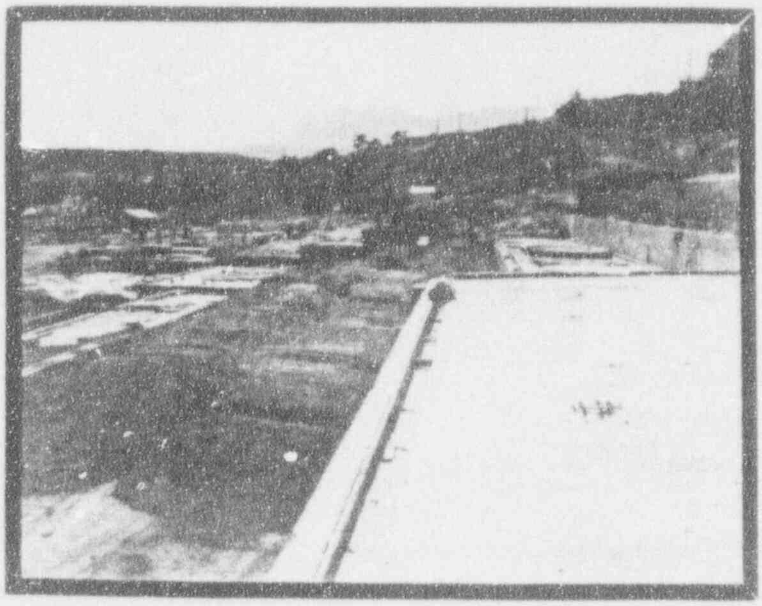


Figure 1-18. "Ore Residue" Dumped on Foundation of Carbonate Plant at Monticello. This ore residue is apparently the contaminated soil scraped from the ore-stockpile areas following the radiologic survey conducted by Paas in May 1965. Photo dated 21 July 1965.

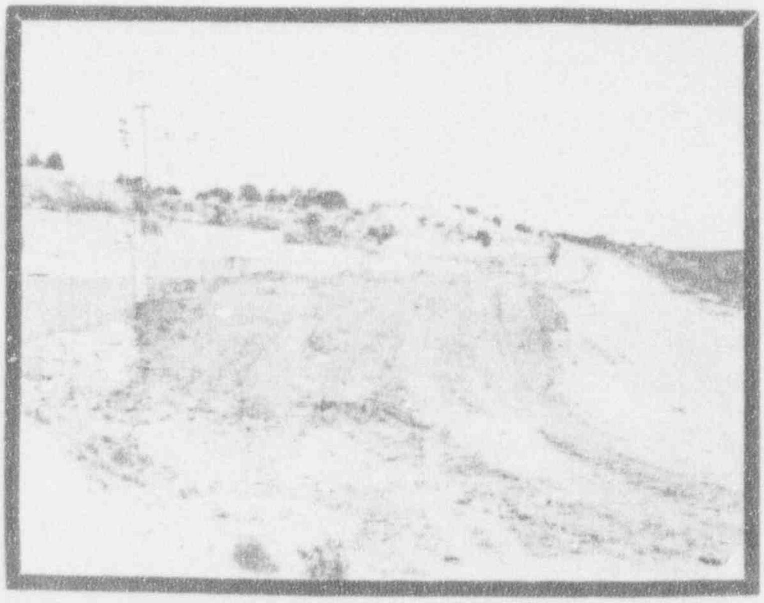


Figure 1-19. "Ore Residue" Covering Foundation of the Resin-in-Pulp Building at Monticello. This ore residue is apparently the contaminated soil scraped from the ore-stockpile areas following the radiologic survey conducted by Paas in May 1965. Photo dated 21 July 1965.

areas. Removal of contaminated soil and the mill foundations was undertaken between May 1974 and August 1975. Ore-contaminated soil scraped from the ore-storage areas was dumped on the previously stabilized surface of the East Pile; though graded, contoured, and reseeded, it was not covered with uncontaminated soil to prevent dispersal. Mill foundations were demolished and bulldozed into adjacent pits. The slope was then regraded to a maximum of 16 degrees and diversion ditches were constructed to minimize erosion by water. Radiologic surveys of the area conducted after completion of these cleanup activities indicated that the exposure rates were reduced to no more than 0.04 mR/hr above the background rate of 0.02 mR/hr (Ward and Gisler, 1976).

1.3 NATURE AND EXTENT OF PROBLEMS

1.3.1 Quantities of Tailings and Contaminated Materials

1.3.1.1 Tailings and Contaminated Material: On Site

Albrethsen and McGinley (1982) noted that AEC records contain two estimates of ore fed to process at the Monticello Mill: the AEC production data book shows a total of 907,917 tons of ore, while an AEC audit report shows 903,298 tons of ore. Albrethsen and McGinley regarded the latter as more accurate. Mill production totaled 2292 tons of U_3O_8 and 1171 tons of V_2O_5. The amount of chemicals added to the ore during milling is unknown. The quantity of tailings produced by the Monticello Mill is considered in this report to be 903,000 tons. This figure assumes that the materials added approximately equal the materials extracted.

Mountain States Research and Development (1980) estimated the total quantity of tailings to be 1.6 million tons. Because this estimate was made from a topographic map, it includes earthen berms originally constructed to impound the tailings and the earthen cover used to stabilize the piles. The Mountain States figure, therefore, should be regarded as representing both tailings and contaminated soil. Additionally, Mountain States assumed the substrate was contaminated to a depth of 5 ft below the original surface; consequently, they obtained a total of 400,000 tons of contaminated material. Thus, the total for contaminated soil and tailings was estimated at 2 million tons.

UNC Geotech (1987, p. 1-1) estimated the tailings and contaminated soil to total 1,400,000 cubic yards, or approximately 1.9 million tons. An estimated 100,000 cubic yards is believed to be present in the mill area, bringing the total to 1,500,000 cubic yards of contaminated soil and tailings on site. This figure is considered to be the most accurate and is used in the accompanying Feasibility Study.

1.3.1.2 Contaminated Materials: Off Site

Using the radiologic survey of Marutsky and others (1985) and unpublished data collected subsequently, UNC Geotech (1987, p. G-7) estimated the contaminated material on peripheral properties (properties adjacent to DOE property, but owned by other individuals or entities) to be 300,000 cubic yards, or approximately 0.4 million tons. Contaminated material from vicinity properties (generally residential properties in the town of Monticello) was estimated at 100,000 tons.

1.3.2 Hazards Associated with the Site

Hazards associated with wastes and contaminated materials at the Monticello millsite include leaching and migration of trace elements into surface water and ground water and exposure to gamma radiation and radon. Tailings-related surface-water contamination has been documented previously in environmental monitoring reports issued by the Grand Junction Projects Office since 1980. Ground-water contamination has been documented previously in the Site Analysis Report (Abramiuk and others, 1984), in the draft Environmental Assessment (Bendix Field Engineering Corporation, 1985), and in environmental monitoring reports since 1980. Ground-water contamination appears to be confined to the shallow alluvial aquifer and does not seem to have reached the deeper Burro Canyon aquifer that serves as a public drinking water supply. Monitoring indicates that concentrations of trace elements such as uranium, vanadium, molybdenum, selenium, and arsenic in some wells on the site exceed concentrations observed for these constituents in upgradient wells. The primary concern with ground-water contamination in the alluvial aquifer is its potential for affecting the water quality of Montezuma Creek, which is used for livestock watering and crop irrigation. Sampling of the surface water in Montezuma Creek indicates that some constituents exceed water-quality standards.

The generation of radon-222 from the radioactive decay of radium-226 in the tailings constitutes another potential health hazard. Radon is a noble gas and does not enter into chemical reactions that would fix or immobilize it. Thus, it is free to migrate through the tailings into the atmosphere. Inhalation of radon and its alpha-emitting decay products by humans increases cancer risk. Exposure to gamma radiation from the tailings poses a similar health hazard. However, restricted access to the site currently limits this hazard primarily to workers involved in site characterization and remediation activities.

1.4 REPORT ORGANIZATION

This Remedial Investigation is organized according to the format recommended in the *Guidance on Remedial Investigations Under CERCLA* (U.S. Environmental Protection Agency, 1985a). The Federal Facilities Agreement, however, requires the use of a subsequent guidance document (U.S. Environmental Protection Agency, 1988) issued after completion of the initial draft of the Remedial Investigation. The potential conflict was resolved by EPA direction to DOE (Duprey to Murphy, 2/2/89) which requires that the RI be consistent with the content of the 1988 guidance.

Section 1.0 primarily describes historical details relating to the environmental work performed under the Surplus Facilities Management Program and operation of the mill. Section 2.0 discusses cultural information, such as demography and land use, and local climatology. Sections 3.0, 4.0, and 5.0 discuss the results of the mill tailings characterization and hydrogeologic investigations of soils, local geology, and ground and surface water. Section 6.0 describes radon monitoring and air-particulate sampling. Section 7.0

lists biota of the area. Section 8.0 addresses results of the health risk assessment for existing conditions on site.

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