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MONTICELLO MILLSITE ENVIRONMENTAL REPORT
FOR CALENDAR YEAR 1990 5/91

MONTICELLO MILLSITE ENVIRONMENTAL REPORT

FOR CALENDAR YEAR 1990

Prepared for

the U.S. Department of Energy

Grand Junction Projects Office

Idaho Operations Office

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ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
Bq/F	Becquerels per filter
Bq/Kg	Becquerels per kilogram
Bq/L	Becquerels per liter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
CFR	Code of Federal Regulations
DCG	Derived Concentration Guides
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
F/mm^2	Filter per square millimeter
FONSI	Finding of No Significant Impact
GJPO	Grand Junction Projects Office
MED	Manhattan Engineer District
m/s	meters per second
mg/F	milligrams per filter
mg/L	milligrams per liter
NEPA	National Environmental Policy Act of 1969
NPL	National Priorities List
pCi/F	picocuries per filter
pCi/L	picocuries per liter
pg/mL	picograms per milliliter
PM_{10}	Particulate matter less than 10 microns in diameter
QA	Quality Assurance
QAP	Quality Assurance Program
QAPP	Quality Assurance Program Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI/FS--EA	Remedial Investigation/Feasibility Study--Environmental Assessment
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
µg/F	micrograms per filter
$\mu g/m^3$	micrograms per cubic meter
µg/mL	micrograms per milliliter
µm	micrometers
µmhos/cm	micromhos/centimeter
UMTRCA	Uranium Mill Tailings Radiation Control Act
VCA	Vanadium Corporation of America

SUMMARY

This report contains information pertaining to environmental activities conducted during 1990 at and near the inactive uranium millsite in Monticello, Utah. It has been prepared in accordance with the requirements of U.S. Department of Energy (DOE) Orders 5400.1 and 5400.5 and with supplemental information received from DOE Headquarters. Monitoring and report preparation were performed by Chem-Nuclear Geotech, Inc., the DOE contractor for the Grand Junction Projects Office Facility in Grand Junction, Colorado.

Environmental activities conducted at the Monticello Millsite during 1990 included those associated with environmental compliance (in support of remedial action at the millsite) and radiological and nonradiological monitoring of air, surface water, and ground water.

Environmental compliance activities conducted were primarily those concerned with Comprehensive Response, Compensation, and Liability Act requirements. The *Draft Final Project Management Plan for the Monticello Remedial Action Project and the Monticello Vicinity Properties Project* (UNC Geotech 1990a) was submitted in January 1990. The Final Remedial Investigation/Feasibility Study--Environmental Assessment (UNC Geotech 1990b) was submitted to the State of Utah and the U. S. Environmental Protection Agency (EPA) in February 1990. The Record of Decision (US-DOE 1990) for the remediation of the Monticello Millsite was approved in August 1990.

Radiological and nonradiological air monitoring at the millsite included measurements of atmospheric radon, particulate matter, and meteorological parameters. Atmospheric radon concentration was measured at six off-site and two site-boundary locations. During 1990, one of the off-site and both of the site-boundary locations had radon concentrations exceeding the EPA standard for atmospheric radon. No off-site dose modeling was conducted for the millsite area in 1990.

Air particulate monitoring for radiological and nonradiological constituents was conducted at one on-site and two off-site locations with high-volume particulate samplers. The maximum airborne concentrations of radium-226, thorium-230, and uranium were all several orders of magnitude below the regulatory limits specified by DOE Order 5400.5. The maximum concentrations of lead were below the EPA limit of 1.5 micrograms per cubic meter ($\mu g/m^3$) at all measurement locations. The EPA standards of 50 $\mu g/m^3$ (annual arithmetic mean) and 150 $\mu g/m^3$ (24-hour average) for acceptable levels of particulate matter smaller than or equal to 10 micrometers (μm) were not exceeded at any location.

Meteorological monitoring was conducted at the millsite during 1990 to support environmental monitoring requirements. Meteorological parameters measured included wind speed, wind direction, relative humidity, barometric pressure, and temperature.

Surface water monitoring included water quality measurements within Montezuma Creek. This perennial creek, which flows through the millsite property, has frequently contained contaminants at levels exceeding State of Utah surface water standards as far as 3 to 5 kilometers (2 to 3 miles) downstream of the

property. Contamination of the creek results from discharge of the contaminated alluvial aquifer. During 1990, maximum concentrations of arsenic, nitrates, and gross alpha in samples obtained from the creek exceeded their respective standards of 0.05 milligrams per liter (mg/L), 10 mg/L, and 15 picocuries per liter (pCi/L). Montezuma Creek is used for both irrigation and livestock watering in the vicinity of the site.

Ground water monitoring was conducted for two aquifers underlying the Monticello Millsite--a shallow, alluvial aquifer and a deeper, confined Burro Canyon aquifer. The shallow aquifer is contaminated by leached products of uranium mill tailings. During 1990, Uranium Mill Tailings Radiation Control Act and State of Utah ground water standards for pH, nitrates, arsenic, selenium, and radium-226+228 were exceeded in one or more wells. Samples collected from the deeper Burro Canyon aquifer revealed no exceedances of federal or state standards.

INTRODUCTION

The Monticello Millsite is a 31.6-hectare (78-acre) tract located in San Juan County, Utah, within the city limits of Monticello (Figure 1). No residences are located within the millsite boundary, but residences do lie adjacent to the north and east edges of the site. As of 1980, an estimated 2,469 persons were living within a 2.5-kilometer (1.5-mile) radius of the millsite (Abramiuk and others 1984). The city of Monticello has a population of approximately 1,900.

Geographically, the millsite is located in the valley of Montezuma Creek, a perennial stream that flows from west to east through the center of the millsite. Alluvium and sedimentary rocks underlie the property. The surrounding land use is mainly farming/ranching and recreation (e.g., camping hiking, and hunting).

The mill was constructed by the Vanadium Corporation of America (VCA) in 1942 with funds from the Defense Plant Corporation. Initially, vanadium was produced, but from 1943 to 1944, a uranium-vanadium sludge was produced by VCA for the Manhattan Engineer District (MED). After milling operations ceased in 1944, VCA leased the mill from 1945 to 1946 to produce the uranium-vanadium sludge for MED. The Atomic Energy Commission purchased the site in 1948. Uranium milling commenced 15 September 1949 and continued to 1 January 1960, when the mill was permanently closed. Part of the land was transferred to the Bureau of Land Management, but otherwise the site has remained under the control of the Atomic Energy Commission and its successor agencies, the U. S. Energy Research and Development Administration and the U. S. Department of Energy (DOE).

The mill area covers approximately 4 hectares (10 acres), and the tailings impoundment area covers the remaining 27.5 hectares (68 acres). None of the original mill buildings remain, but contaminated foundations and scrap materials are buried on site. The tailings impoundment area contains an estimated 1,019,000 cubic meters (1,350,000 cubic yards) of tailings and contaminated soil in four discrete piles (Figure 2). An additional 204,000 cubic meters (270,000 cubic yards) of contaminated material is present on adjacent open lands (Marutzky and others 1985).

Prior to 1955, the environmental problems receiving attention at the Monticello Millsite arose from the salt roast procedure used to enhance vanadium recovery. An average of nearly 1182 kilograms (2600 pounds) of dust containing 0.363 percent U_{308} and 1.52 percent V_{205} escaped daily through the roaster stack (Allen and Klemenic 1954). Corrosion of wire fences, clotheslines, and galvanized roofs was verified by the mill operator in response to complaints from local residents.

U_3O_8 V_2O_5

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. Release of radium-226 was of special concern; soluble radium activity in Montezuma Creek was found to be 160 picocuries per liter (pCi/L). 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).

uranium oxide

vanadium pentoxide

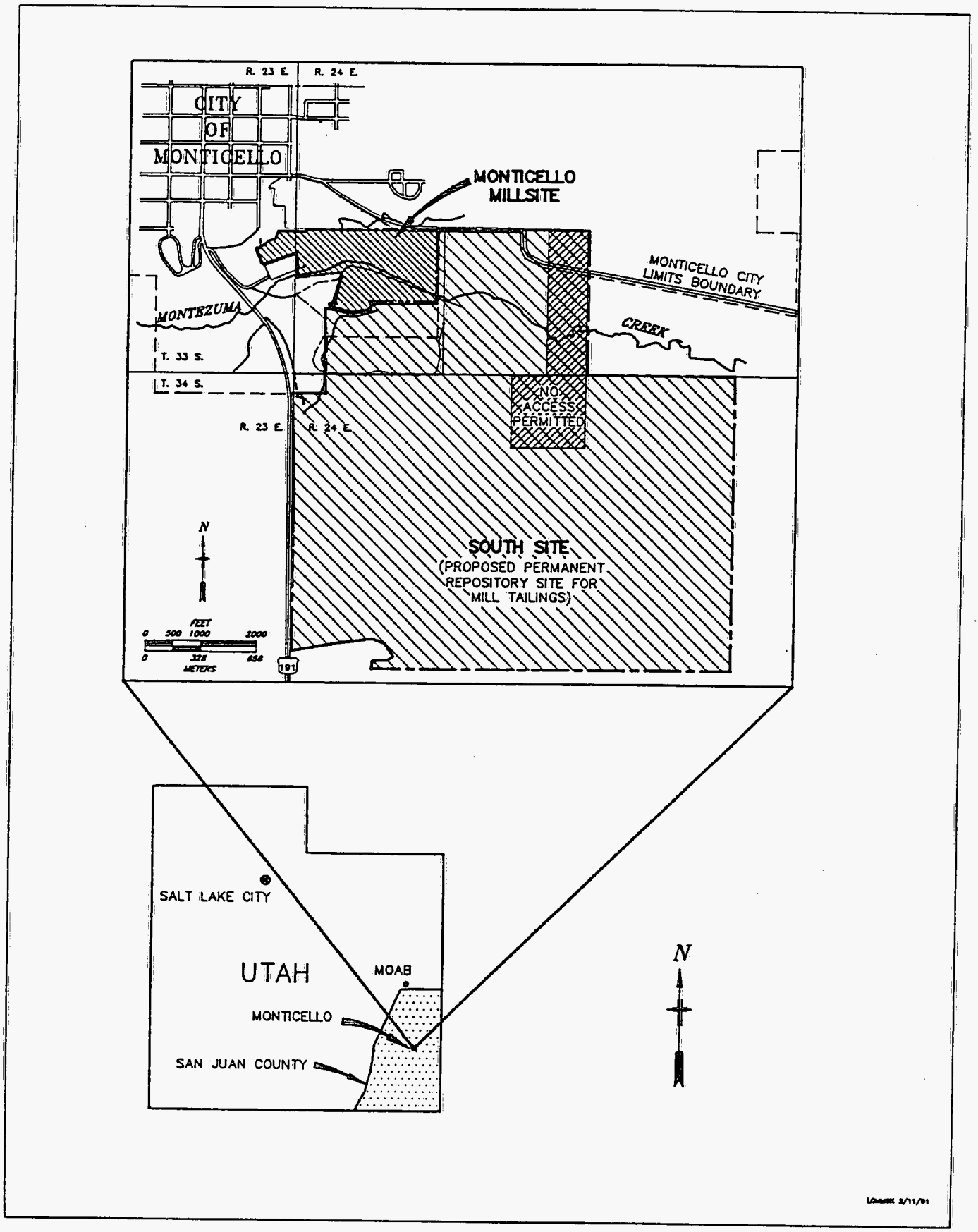

Figure 1. Site Location Map for the Monticello Millsite

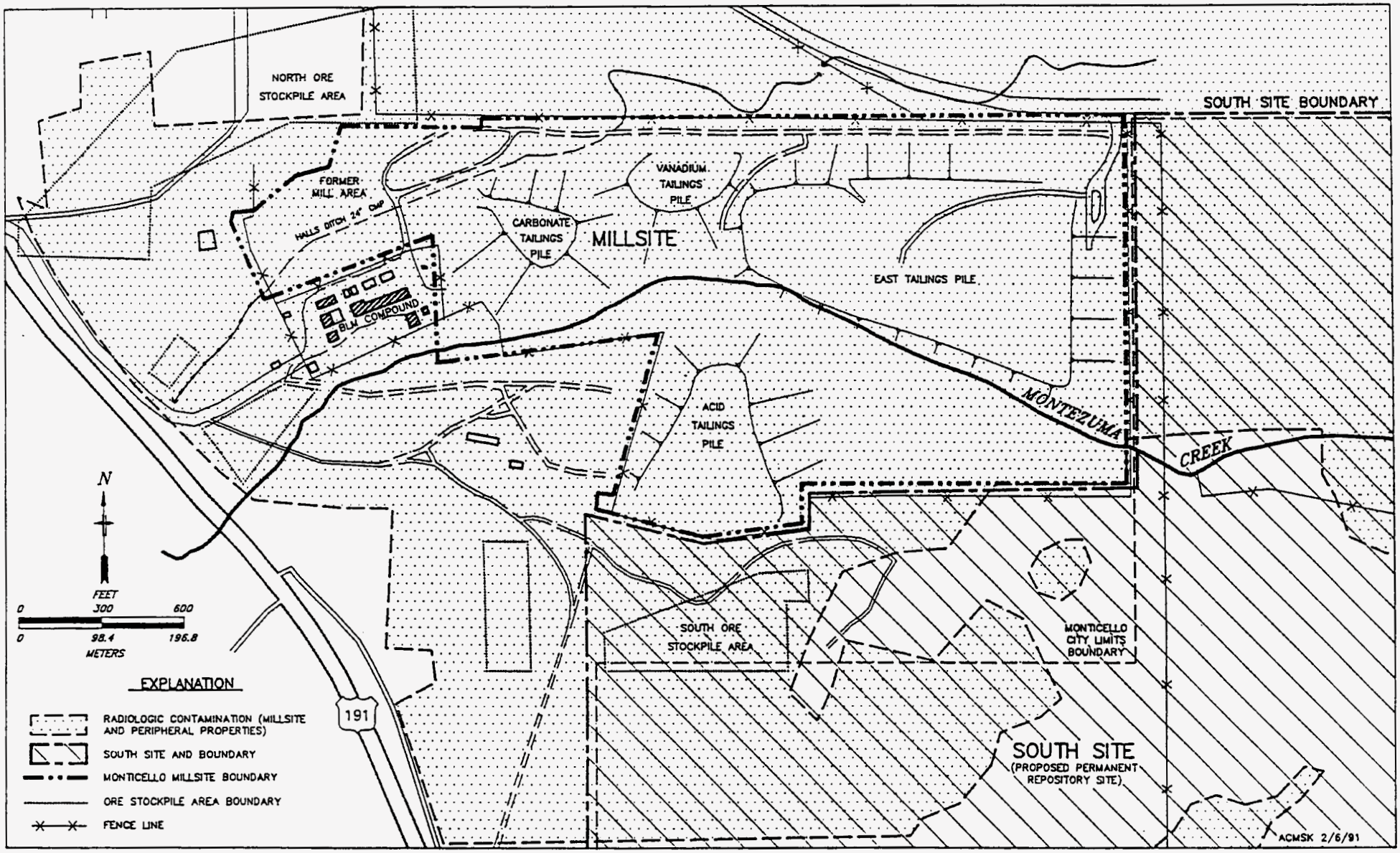

Figure 2. Radiological Contamination Map for the Monticello Millsite

During milling operations, the tailings were normally moist, and erosion by wind was minimal. Within a year after shutdown, however, the tailings dams and surfaces of the piles dried out, and tailings sand began to migrate as dunes. Erosion by water also became a problem. Several cleanup activities conducted since the time of mill closure have substantially stabilized the area but have not eliminated water contamination. Extensive studies conducted at Monticello demonstrate that all four tailings piles contribute to the contamination of ground water and surface water, both on and off site. Presently, the contaminated ground water is not used in the vicinity of the millsite, and Montezuma Creek water is used for livestock watering downstream of the millsite.

Responsibility for the administration, maintenance, and environmental monitoring of the inactive uranium millsite and tailings area, formerly operated by the Atomic Energy Commission, resides with the DOE's Grand Junction Projects Office (GJPO). Chem-Nuclear Geotech Inc. (Geotech), the contractor for the DOE-GJPO, performs the environmental monitoring at the millsite. The site was accepted into the Surplus Facilities Management Program in 1980. Under this program, the chief objective of the Monticello Remedial Action Project was to minimize potential health hazards to the public and environment that are associated with the tailings at the millsite. To provide a basis for making decisions regarding the remediation of the site, an environmental and engineering characterization was completed and documented in the *Monticello Remedial Action Project Site Analysis Report* (Abramiuk and others 1984). In addition, the *Final Remedial Investigation/Feasibility Study--Environmental Assessment for the Monticello, Utah, Uranium Mill Tailings Site* (UNC Geotech 1990b) report was finalized in March 1990.

Previous years of monitoring activity at the Monticello Millsite have clearly defined the contaminant type and distribution in ground water, surface water, and air. Because of the well-defined contaminant characteristics at the site, monitoring activities were reduced in 1990 (as in 1988 and 1989) to include only biannual ground water and surface water samplings. Analyses were performed for known contaminants such as gross alpha, radium-226, radium-228, uranium, vanadium, arsenic, selenium, molybdenum, and nitrate. Total alkalinity, pH, and specific conductance were measured to identify any change in the general water quality characteristics. Ambient air monitoring at the site was conducted as in previous years.

COMPLIANCE SUMMARY - 1990

COMPLIANCE STATUS

Compliance status for each of the major environmental statutes applicable to the Monticello Millsite is as follows:

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - The Monticello Millsite was listed on the National Priorities List (NPL) on November 21, 1989. Environmental restoration of the millsite is prescribed in a Federal Facility Agreement between the DOE-GJPO, the U. S. Environmental Protection Agency (EPA), and the State of Utah (agreement signed in December 1988). Since signing, Monticello has been in full compliance with all provisions of the agreement.

- Clean Air Act - Operations are continually monitored at the millsite to verify conformance with ambient air quality standards and to identify potential emission release points. As determined in the Remedial Investigation/Feasibility Study--Environmental Assessment (RI/FS--EA) (UNC Geotech 1990b), the Clean Air Act is a specified Applicable or Relevant and Appropriate Requirement (ARAR) for remedial action at the millsite. The Monticello Millsite is specifically identified under and subject to the provisions of 40 CFR Part 61, Subpart Q, which defines a radon flux standard for DOE facilities. Planned environmental restoration will eliminate any exceedances of standards that may be occurring as a result of the mill tailings.

- Clean Water Act - Operations are continually monitored at the millsite with respect to State of Utah water quality standards; both surface water and ground water adjacent to the millsite are contaminated by the leached products of uranium mill tailings. As determined in the RI/FS--EA, the Clean Water Act is a specified ARAR for remedial action at the millsite. The planned environmental restoration will eliminate any exceedances of standards that may be occurring as a result of the mill tailings.

- Resource Conservation and Recovery Act (RCRA) - No RCRA listed or characteristic hazardous waste is treated or disposed of at the site, and no treatment, storage, or disposal of such a waste is expected to occur during remedial action. As determined in the RI/FS--EA, RCRA is not an ARAR for the millsite.

- National Environmental Policy Act (NEPA) - An RI/FS--EA was completed for the millsite and submitted to the EPA and State of Utah for review and approval in February 1990. A Finding of No Significant Impact (FONSI) for the remediation of the millsite was issued in February 1990. The Monticello Mill Tailings Site Record of Decision (ROD) was submitted for signature to the EPA and State of Utah in August 1990. All ongoing activities at the millsite are being evaluated for compliance with NEPA.

CURRENT ISSUES AND ACTIONS

The *Draft Final Project Management Plan for the Monticello Remedial Action Project and the Monticello Vicinity Properties Project* (UNC Geotech 1990a) required by DOE Order 4700.1 was submitted to DOE-GJPO in January 1990. Updates of the Administrative Record for the Monticello Mill Tailings NPL Site and the Monticello Vicinity Properties NPL Site were prepared in April, September, and December 1990, as required by CERCLA.

The Soil Conservation Service (SCS) was contacted to determine, according to the Farmland Protection Policy Act, the classification of the dry farmland being considered for a repository site. The SCS stated in a letter dated 8 June 1990 that the land is not prime, unique, or important farmland.

The *Draft Final Screening Analysis for South Site Alternatives* (UNC Geotech 1990c) was submitted to EPA and the State of Utah in September 1990. This analysis evaluated the feasibility of construction of the repository at two locations.

The *Draft Remedial Design Work Plan* (Chem-Nuclear Geotech 1990a) for the design of the remedial action for the Monticello Millsite was submitted to DOE in November 1990.

The *Draft Final Community Relations Plan* (Chem-Nuclear Geotech 1990b) was submitted to the DOE-GJPO in November 1990.

Six working-level discussion documents were submitted to the DOE in December 1990. These documents addressed design and construction approaches that will be used to demonstrate compliance with several ARARs. These documents are

- Technical Approach for Designing the Monticello Repository Cover
- Ground Water Compliance Strategy for Engineering Design
- The Use of Engineering Controls in the Disposal of Low-Level Radioactive Uranium Mill Tailings
- Point of Compliance for Ground Water Monitoring at the Monticello Repository - Regulatory Interpretation
- Compliance with Applicable or Relevant and Appropriate Requirements for Peripheral Properties
- The Level of Effort Used to Decontaminate Radiologically Contaminated Building Materials and Mill Equipment in the Remedial Design for the Monticello Mill Tailings Site

SUMMARY OF FACILITY PERMITS

There are no permitted facilities at the Monticello Millsite.

COMPLIANCE SUMMARY - 1ST QUARTER 1991

COMPLIANCE STATUS

Compliance status for each of the major environmental statutes applicable to the Monticello Millsite is as follows:

- Comprehensive Environmental Response, Compensation, and Liability Act - Compliance status is unchanged from 1990.

- Clean Air Act - Compliance status is unchanged from 1990.

- Clean Water Act - Compliance status is unchanged from 1990.

- Resource Conservation and Recovery Act - Compliance status is unchanged from 1990.

- National Environmental Policy Act - Compliance status is unchanged from 1990.

CURRENT ISSUES AND ACTIONS

A revised draft Programmatic Health and Safety Plan was submitted to DOE-GJPO on 14 February 1991 for review, approval, and transmittal to the EPA and State of Utah.

The *Draft Remedial Design Work Plan* (Chem-Nuclear Geotech 1990a) for the design of the remedial action for the Monticello Millsite was submitted to the EPA and the Utah Department of Health in February 1991.

A public meeting on the Five-Year Plan was held at the San Juan County Courthouse 7 March 1991. Millsite and vicinity property work plans for FY 1993 through FY 1997 were discussed. A brief review on the prioritization system was presented.

The *Draft Final Community Relations Plan* (Chem-Nuclear Geotech 1990b) was approved by the DOE-GJPO in March 1991.

SUMMARY OF FACILITY PERMITS

No permits have been issued for the Monticello Millsite during the first quarter of 1991.

ENVIRONMENTAL PROGRAM INFORMATION

SOURCES OF CONTAMINATION

Radioactive mill tailings compose the principal waste type at the Monticello Millsite. Residual uranium ore in old ore stockpile areas at the millsite constitutes only a minor waste type. Historically, environmental concern has focused on the radiological hazards associated with the tailings and ore. However, a number of trace elements typically occur at elevated concentrations in uranium ore. These were not recovered during milling operations but were passed through the circuit to the tailings piles. Because hazardous organic chemicals were not used in the milling process, the hazardous substances selected for waste characterization were all inorganic.

According to Albrethsen and McGinley (1982), 819,291 metric tons (903,298 short tons) of uranium ore was processed at the Monticello mill between 1948 and 1960 to yield approximately 2,077 metric tons (2,290 short tons) of uranium oxide, U_3O_8, and 1,061 metric tons (1,170 short tons) of vanadium pentoxide, V_2O_5. Most of the original constituents of the ore, as well as the chemicals added during the milling process, reside in the tailings.

The tailings generated by the milling operations are contained in four piles referred to, in order of their construction, as the Carbonate Pile, Vanadium Pile, Acid Pile, and the East Pile (Figure 2). The Carbonate and Vanadium Piles were formed during the period from 1949 to 1955 when the mill was recovering vanadium as a by-product. The process used for the recovery was a salt roast/carbonate leach process. Use of the Acid Pile commenced about 1955. This pile received tailings from the acid leach resin-in-pulp process and a carbonate leach circuit. The East Pile operated from 1956 until mill shutdown in 1960 and received tailings from the acid leach circuit and the high temperature, carbonate leach resin-in-pulp circuit.

Photographs taken during the operation of the millsite indicated that earthen berms were initially used to impound the tailings. As the impoundment filled, sandy tailings were apparently used as berm material to maintain the ponds. After closure of the mill, the piles were regraded and stabilized by covering them with pit-run gravel and top soil and seeding a vegetative cover. Materials from all four tailings piles provide a contaminant source for ground water leachate and atmospheric releases.

ENVIRONMENTAL MONITORING SUMMARY

Air

Atmospheric Radon

The environmental radon monitoring program was initiated at the Monticello Millsite in 1984 with the installation of 19 sample locations. After a year of baseline data was collected, the sampling area was reduced to eight representative locations. In 1990, radon concentration was measured at these locations (Figure 3) with Terradex Track Etch® detectors. The detectors were exposed in duplicate 1 meter above the ground surface and were analyzed on a quarterly (3-month exposure) basis.

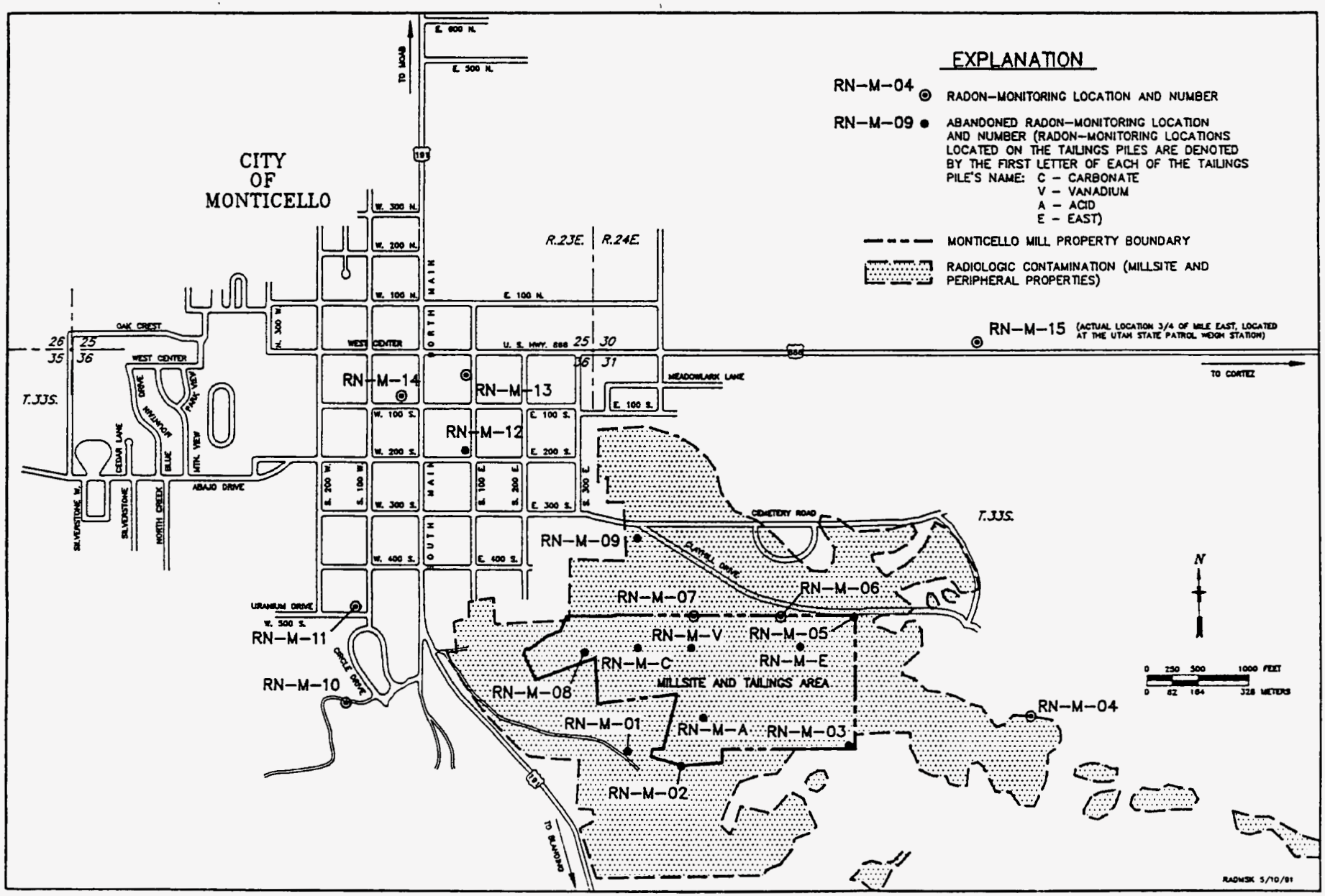

Figure 3. Atmospheric Radon Monitoring Locations At and Near the Monticello Millsite

The EPA standard (40 CFR Part 192) for atmospheric radon concentration (at the edge of an inactive uranium mill tailings pile) of 0.50 pCi/L above background has been adopted for the Monticello Millsite. From a natural background concentration of 0.41 pCi/L (UNC Geotech 1990b), the standard of 0.91 pCi/L has been calculated. As illustrated in Table 1, the atmospheric radon concentrations measured during 1990 exceeded the EPA standard at both locations along the site boundary and at one off-site location (RN-M-04). Concentrations at the remaining off-site locations were below the standard. These values are consistent with previous years' analytical results. Quarterly data collected at each location are listed in Tables A-1 through A-4 in Appendix A.

Air Particulates

Air particulate monitoring for the Monticello Millsite is conducted to comply with federal, state, and local regulatory requirements. DOE Order 5400.1, *General Environmental Protection Program,* specifies that environmental surveillance will be conducted to monitor the effects of DOE activities on-site and off-site natural resources. Demonstration of compliance with the public dose limits of DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* is based on calculations that make use of information obtained from environmental monitoring programs. DOE Order 5400.5 lists Derived Concentration Guides (DCGs) for air that provide reference values for conducting radiological environmental protection programs. DOE's guidance document *Radiological Effluent Monitoring and Environmental Surveillance* recommends identifying and monitoring diffuse sources such as tailings piles. National primary and secondary air quality standards (40 CFR Part 50) define maximum acceptable levels of particulate matter and lead necessary to protect public health.

Air particulate monitoring was initiated at the Monticello Millsite in August 1983. The original air sampling network consisted of three high-volume air samplers that sampled ambient air at 40 standard cubic feet per minute for 24 hours every sixth day. Particulates were collected on a glass-fiber filter. In March 1987, the monitoring program included the installation of 10-micrometer size-selective inlets in the intake of the samplers to separate particles 10 micrometers or smaller (PM_{10}) from larger particles. The 10-micrometer or smaller particles were considered to be the biological damaging component and were collected on a glass-fiber filter in the sampler. The heavier, windblown particulates and fugitive dust were eliminated by the 10-micrometer size-selective inlet.

Wind-rose data collected on site (Figures A-1 and A-2, Appendix A) have clearly identified two principal wind vectors in the area, one to the east and one to the north. Thus, sampling stations were located along these two directions as well as at a background site (Figure 4). The background site (AIR-M-6) is located approximately 0.5 kilometer (0.3 mile) west of the city of Monticello near the pumphouse building for the city water supply. The intake port for this sampler is 3 meters (10 feet) above ground level. The area west of this site is mostly natural desert and mountainous terrain and contains no local industrial activity. The east sampling station (AIR-M-4) is located on the eastern edge of the East Tailings Pile. The sampler intake is mounted approximately 3 meters (10 feet) above ground level on a steel tower.

Table 1. Comparison of Average Annual Radon Concentrations At and Near the Monticello Millsite to the EPA Standard for the Period 16 November 1989 to 15 November 1990

	Radon Concentration (pCi/L)	
Sampling Location	Annual Average	EPA Standard (including background)
On Site		
RN-M-06	1.32	0.91
RN-M-07	1.94	0.91
Off Site		
RN-M-04	1.39	0.91
RN-M-10	0.33	0.91
RN-M-11	0.25	0.91
RN-M-13	0.24	0.91
RN-M-14	0.23	0.91
RN-M-15	0.38	0.91

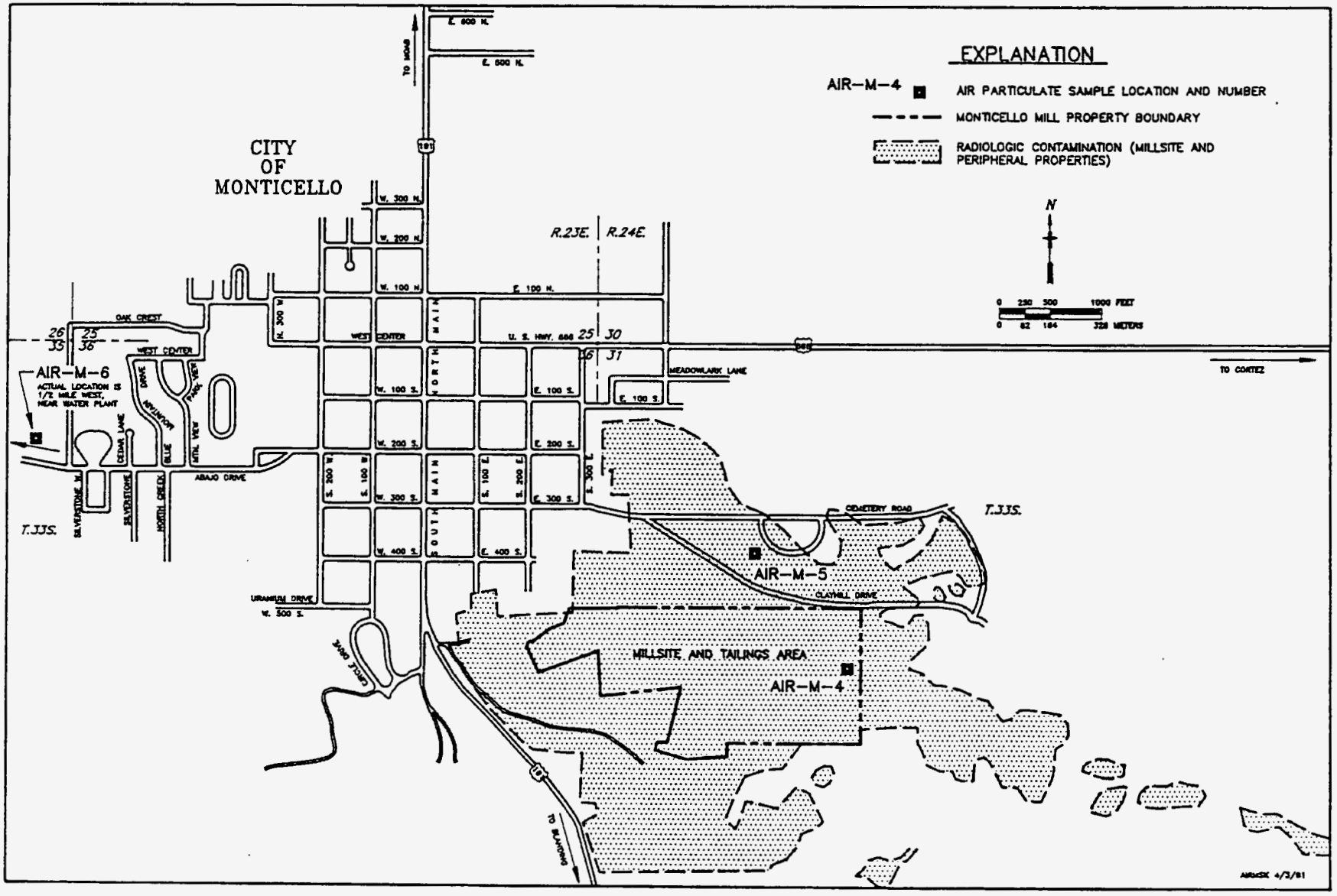

Figure 4. Air Particulate Sampling Locations At and Near the Monticello Millsite

The north station (AIR-M-5) is located on the west side of the City of Monticello cemetery grounds. This location is 30 meters (100 feet) north of the tailings area at an elevation of 100 meters (330 feet) above the piles. The sampler intake is 4 meters (13 feet) above ground level. During 1990, air particulate sampling was conducted 1 March through 27 October on every sixth day for 24 hours; sampling was suspended prior to 1 March and after 27 October because of inclement weather. Radiological analytes measured included uranium, radium-226, and thorium-230. Nonradiological analytes measured included PM_{10} particulate matter and lead. Results of the sampling are reported in Tables A-5 through A-10 in Appendix A.

Radiological air particulate levels are regulated at DOE facilities by DOE Order 5400.5, which lists DCGs applicable to the Monticello Millsite. Used as reference values for conducting radiological environmental protection programs, DCGs represent concentrations that would cause a member of the public to receive a dose of 100 mrem per year from inhalation of a specific radionuclide. Table 2 compares uranium, radium-226, and thorium-230 DCGs (inclusive of background levels) with maximum and average concentrations measured at and near the Monticello Millsite during 1990. All measured concentrations are well below the respective DCGs.

Acceptable levels of lead and PM_{10} particulate matter are defined by the EPA under the National Ambient Air Quality Standards. The lead standard specifies that a 3-month average concentration is not to exceed 1.5 micorgrams per cubic meter (Çg/m^3); the PM_{10} standard specifies a maximum annual arithmetic mean of 50 Çg/m^3 and a 24-hour concentration not to exceed 150 Çg/m^3. The maximum lead concentration of 0.085 Çg/m^3, the maximum PM_{10} annual average of 19.98 Çg/m^3, and the 24-hour maximum concentration of 49.66 Çg/m^3 measured in 1990 (Table 2) are all within their respective compliance levels.

Meteorology

Meteorological monitoring at the Monticello Millsite is conducted in accordance with DOE Orders 5400.1 and 5400.5. DOE Order 5400.1 requires the collection of meteorological data at DOE facilities to support environmental monitoring programs. DOE Order 5400.5, *Radiation Protection of the Public and Environment*, requires input of meteorological data into an approved dose model.

Meteorological conditions at the Monticello Millsite are monitored by a data-gathering station located on the millsite (Figure 5). Installed in 1982, the station is mounted on a 3-meter tower and records temperature, relative humidity, wind direction, wind velocity, and barometric pressure. Average monthly and annual meteorological data for 1990 are presented in Table 3; wind statistics and wind-rose diagrams are contained in Tables A-11 and A-12 and Figures A-1 and A-2 in Appendix A.

The newly released DOE guidance document *Radiological Effluent Monitoring and Environmental Surveillance* specifies performance standards for meteorological monitoring equipment that the present equipment does not meet. Deficiencies in the present equipment include less-than-recommended sensitivities in the wind speed and wind direction sensors, less-than-recommended instrument tower

Table 2. Results of the Monticello Millsite Air Particulate Study Conducted During 1990

Station		Radiological Elements					Nonradiological Element	Suspended Particulates
		Uranium (pg/mL)	Uranium[a] (µCi/mL)	Radium-226 (µCi/mL)	Thorium-230 (µCi/mL)	Thorium-230[b] (pg/mL)	Lead ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
	Standard	No Standard	2.0E-12	1.0E-12	4.0E-14	No Standard	1.5	150 maximum 50 annual avg.
AIR-M-4	Maximum[c]	0.0025	1.7E-15	6.3E-16	7.6E-16	3.9E-8	0.085	49.661
	Average[d]	0.0013	9.0E-16	4.5E-16	4.6E-16	2.3E-8	0.033	19.982
	Count[e]	30(30)	30(30)	30(16)	30(30)	30(30)	30(30)	30(27)
AIR-M-5	Maximum	0.0018	1.2E-15	6.7E-16	6.7E-16	3.5E-8	0.080	35.212
	Average	0.0013	8.5E-16	4.3E-16	4.1E-16	2.1E-8	0.034	17.118
	Count	29(29)	29(29)	29(13)	29(28)	29(28)	29(29)	29(27)
AIR-M-6	Maximum	0.0025	1.6E-15	6.8E-16	6.8E-16	3.5E-8	0.085	34.352
	Average	0.0013	8.5E-16	4.8E-16	4.1E-16	2.1E-8	0.029	11.683
	Count	37(36)	37(36)	37(20)	37(37)	37(37)	37(37)	37(32)

[a]This activity is derived from the measured concentration assuming equilibrium. The activity is approximately 0.666 pCi/µg based on both U-238 and U-234.
[b]This concentration is derived from the measured activity. The conversion factor used is 51.55 µg/µCi.
[c]Maximum concentration.
[d]Annual average concentration; average is calculated using only those values above the minimum detection limit.
[e]Number of samples; number in parentheses indicates number of samples above detection limit.

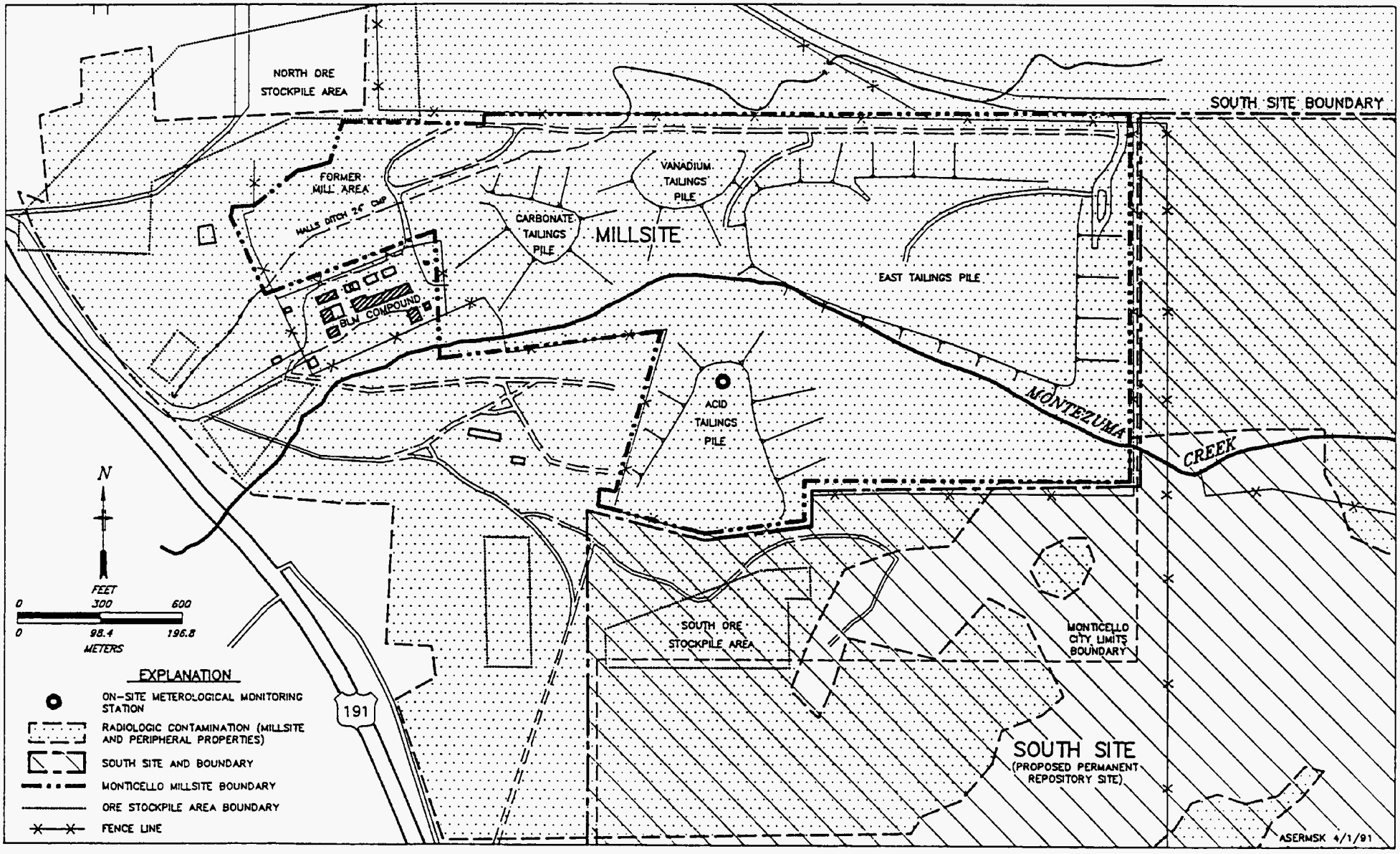

Figure 5. Meteorological Monitoring Station for the Monticello Millsite

Table 3. Monticello Millsite Meteorological Data, 1990[a]

Month/ Statistic	Temperature (C°)	Relative Humidity (percent)	Barometric Pressure (kilopascals)	Wind Velocity (m/s)
January				
Mean	-2.5	66.2	77.9	3.9
Minimum	-12.7	24.0	77.0	.4
Maximum	13.0	98.9	79.2	11.2
February				
Mean	-1.6	62.3	77.5	5.8
Minimum	-13.3	20.2	76.3	.9
Maximum	8.1	98.9	78.9	13.2
March				
Mean	4.3	46.1	78.0	4.2
Minimum	-8.5	15.4	77.1	.5
Maximum	17.6	97.6	79.2	12.1
April				
Mean	7.5	48.4	78.0	4.2
Minimum	-4.5	14.1	77.2	.4
Maximum	22.0	97.1	79.2	12.5
May				
Mean	11.2	29.5	78.0	4.6
Minimum	-4.9	12.8	77.4	.4
Maximum	24.8	97.1	79.1	12.8
June				
Mean	20.0	19.6	78.5	4.4
Minimum	-1.4	8.9	77.7	.4
Maximum	35.4	95.5	79.2	12.1
July				
Mean	19.7	38.8	78.8	3.9
Minimum	1.3	9.7	78.3	.4
Maximum	33.7	95.9	79.6	8.0
August				
Mean	18.1	34.6	78.8	3.6
Minimum	-.2	10.1	78.4	.4
Maximum	32.4	96.0	79.5	9.8
September				
Mean	15.2	52.7	78.8	3.4
Minimum	-2.3	10.5	78.2	.4
Maximum	31.2	96.1	79.4	7.8
October				
Mean	7.4	39.9	78.5	4.0
Minimum	-5.7	14.9	77.4	.4
Maximum	20.2	95.6	79.3	9.1
Annual				
Mean	11.4	41.7	78.3	4.1
Minimum	-13.3	8.9	76.3	.4
Maximum	35.4	98.9	79.6	13.2

[a]No meteorological data were recovered during the months of November and December.

height, and lack of a solar radiation sensor. To meet these performance standards, wind sensors with the recommended sensitivities, a 10-meter tower, and a solar radiation sensor will be added to the station during 1991.

Surface Water

Montezuma Creek, the main surface water body in the project area, flows through the middle of the property. Although flow is perennial, the creek can be quite low or dry during the late summer. There also can be substantial flooding, as occurred in the spring of 1983. Sampling sites W-3 and W-5 (Figure 6) have been used to collect upgradient water quality samples from the creek. Although site W-5 is not located on the creek itself but on an irrigation ditch, it diverts water from Montezuma Creek upstream of the millsite and is representative of upgradient conditions.

Downstream water quality has been sampled at several locations, including the W-4 site, located approximately 100 meters (325 feet) downstream of the east boundary of the property; the Sorenson site, located approximately 2 kilometers (1.25 miles) downstream of the millsite; and the Montezuma Canyon site, located approximately 10 kilometers (6 miles) downstream of the millsite (Figure 6). Levels of molybdenum, uranium, and gross alpha activity typically are higher in samples obtained downgradient and off site within the creek, which suggests that contributions from the contaminated alluvial aquifer are greatest downstream of the millsite. Seeps from the shallow aquifer are visible along the creek downstream of the eastern millsite boundary, and creek discharge increases throughout this section for approximately 2 kilometers (1.25 miles). Data comparisons have shown little decrease in contamination in samples between the W-4 and Sorenson sites. Downstream water quality within Montezuma Creek is described in detail in the Final RI/FS--EA (UNC Geotech 1990b).

Four state use classifications (in accordance with Title 26, Chapter 11, Utah Code Annotated) have been applied to the segment of Montezuma Creek that flows through and below the millsite. These classifications, which include (1) Domestic Source 1C, (2) Recreation and Aesthetics 2B, (3) Agriculture, and (4) Aquatic Wildlife 3B, are associated with specific numeric standards, which are listed in Table 4.

Montezuma Creek water is used as a source of municipal water supply about 1.6 kilometers (1 mile) upstream of the tailings area. Downstream of the tailings area, surface water is used primarily for stock watering.

Several seeps and ponds on the millsite contain water that has been contaminated by contact with uranium mill tailings. Like the ground water (see Ground Water Protection Program section in this report), these surface waters often contain higher-than-background levels of uranium, radium-226, gross alpha, arsenic, molybdenum, selenium, and vanadium. Permanent surface water bodies consist of the drainage between the Carbonate and Vanadium Piles (drainage designated W-2 in Figure 6) and the seep-fed pond adjacent to the Carbonate Pile (designated Carbonate Seep in Figure 6). This pond, which covers approximately 12.5 square meters (15 square yards), typically is the only one of the seeps surrounding the tailings piles that contains water during the dry season.

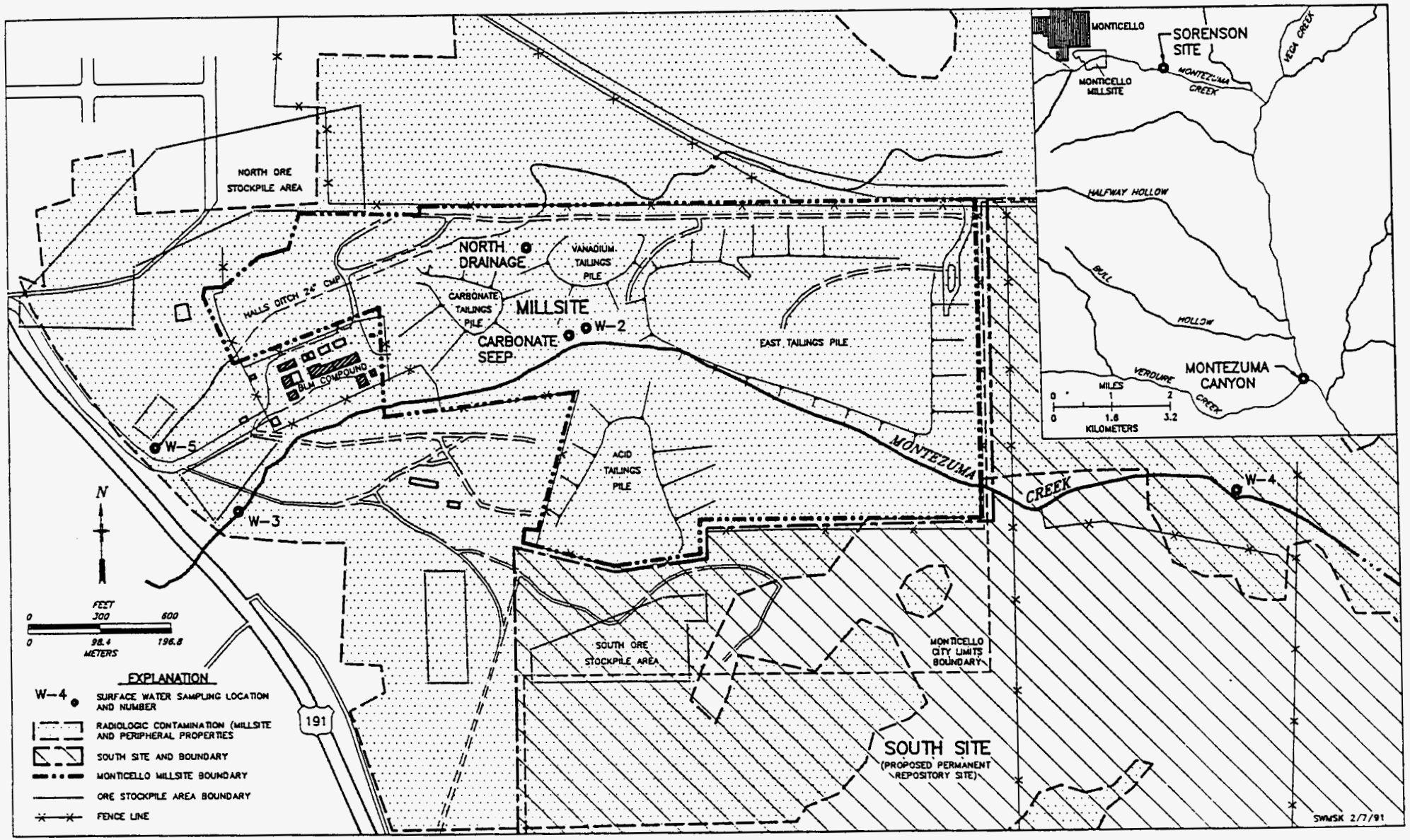

Figure 6. Surface Water Sampling Locations At and Near the Monticello Millsite

Table 4. Comparison of State of Utah Water Quality Standards[a] to 1990 and Historical Maximum Concentrations Within Montezuma Creek

Constituent	State Standard	1990 Maximum[b,c] Up-Gradient	1990 Maximum[b,c] Down-Gradient	Historical Maximum[d,c] Up-Gradient	Historical Maximum[d,c] Down-Gradient
Bacteriological					
Total Coliforms	5000/100 mL	ND	ND	ND	ND
Fecal Coliforms	200/100 mL	ND	ND	ND	ND
Physical					
Dissolved Oxygen	5.5 mg/L	ND	ND	ND	ND
pH	6.5-9.0 Units	8.0-9.2	7.1-8.1	6.6-8.7	7.2-8.6
Turbidity Increase	10 NTU	ND	ND	ND	ND
Metals (acid soluble)					
Arsenic	0.05 mg/L	<0.01	0.011	<0.01	0.027
Barium	1.0 mg/L	ND	ND	<0.01	0.12
Cadmium	0.01 mg/L	ND	ND	<0.005	<0.001
Chromium	0.05 mg/L	ND		<0.005	<0.005
Copper	0.2 mg/L	ND	ND	ND	ND
Iron	1.0 mg/L	ND	ND	0.10	0.15
Lead	0.05 mg/L	ND	ND	0.003	0.001
Mercury	0.002 mg/L	ND	ND	<0.002	<0.002
Selenium	0.01 mg/L	<0.005	0.007	0.007	0.042
Silver	0.05 mg/L	ND	ND	<0.0005	0.002
Inorganics					
Boron	0.75 mg/L	ND	ND	ND	ND
Fluoride	1.4-2.4 mg/L	ND	ND	<1.0	<1.0
Nitrates (as N)	10 mg/L	0.17	2.3	0.7	5.2
Total Dissolved Solids	1200 mg/L	ND	ND	ND	ND
Radiological					
Gross Alpha	15 pCi/L	<25	517	17	332
Radium-226+228	5 pCi/L	0.8[e]	1.2[e]	<1.0	<3.0
Strontium-90	8 pCi/L	ND	ND	ND	ND
Tritium	20,000 pCi/L	ND	ND	ND	ND
Organics					
2,4-D	100 µg/L	ND	ND	ND	ND
2,4,5-TP	10 µg/L	ND	ND	ND	ND
Endrin	0.2 µg/L	ND	ND	ND	ND
Lindane	4 µg/L	ND	ND	ND	ND
Methoxychlor	100 µg/L	ND	ND	ND	ND
Toxaphene	5 µg/L	ND	ND	ND	ND
Pollution Indicators					
Gross Beta	50 pCi/L	ND	ND	ND	ND
Biological Oxygen Demand	5 mg/L	ND	ND	ND	ND
Phosphate (as P)	0.05 mg/L	ND	ND	ND	ND

[a]State of Utah Water Quality Standards for the Montezuma Creek segment, Title 26, Chapter 11, Utah Code Annotated.
[b]An "ND" indicates not determined; a "<" symbol indicates that the maximum concentration was below detection limits (number shown is detection limit).
[c]The listed values are in the units shown under the State Standard column.
[d]Based on maximum concentrations observed from 1984 through 1989.
[e]Value represents radium-226 only.

Several intermittent surface water bodies exist on the millsite, mostly in the form of seeps surrounding the tailings piles. The only intermittent source sampled is located in a "low spot" between the Carbonate and Vanadium tailings piles (designated as North Drainage in Figure 6). It receives both surface runoff and seeping ground waters.

Surface water monitoring during the past 9 years at and near the Monticello Millsite has provided a consistent and extensive baseline of data. Because of this, monitoring activities from 1987 to present have been significantly reduced from those of previous years, the primary goal having been to detect only major changes in water chemistry. Locations sampled in 1990 included those designated in Figure 6 as W-5, which represents background conditions on Montezuma Creek; W-2 and the Carbonate Seep, which represent on-site surface water conditions; and W-4, Montezuma Canyon, and Sorenson sites, which represent downgradient conditions on the creek. Sites designated as W-3 and the North Drainage are usually sampled, but these sites were dry during the sampling periods. Sampling was performed in April and October for the following analytes: gross alpha, gross beta, radium-226, radium-228, uranium-234, uranium-238, arsenic, molybdenum, nitrate, selenium, uranium, and vanadium. Alkalinity, pH, and specific conductance were measured in the field.

Upgradient surface water quality at site W-5 in 1990 was characterized by low levels of mill-tailings-related contaminants and an average pH of 8.58, an average specific conductance of 1,147 micromhos per centimeter (umhos/cm), and an average alkalinity of 346 mg/L (as $CaCO_3$). These levels are slightly higher than those in 1989 and previous years because of decreased runoff. Analyses of downgradient samples from the W-4, Montezuma Creek, and Sorenson sites revealed that higher-than-background levels of mill-tailings-related contaminants existed in Montezuma Creek during 1990. Maximum levels for arsenic, gross alpha, and uranium-234+238 were 0.11 mg/L, 517 pCi/L, and 305 pCi/L, respectively. All surface water quality values measured in 1990 are tabulated in Tables A-13 and A-14 in Appendix A.

A comparison of data from Montezuma Creek samples collected from 1984 through 1989 to State of Utah Surface Water Standards is presented in Table 4. From this table, it can be seen that, historically, upgradient surface water samples have exceeded State of Utah standards only with respect to gross alpha, and downgradient samples have exceeded standards with respect to gross alpha and selenium. In 1990, the upgradient pH measurement and the downgradient measurements for arsenic and gross alpha exceeded state standards, probably because of lower-than-usual flows within the creek.

Contaminant levels within the on-site ponds and seeps remained high in 1990. Although the state surface water standards for Montezuma Creek are not applicable to these water bodies, the standards provide a useful reference for contaminant evaluations. Concentrations of gross alpha, radium-226, arsenic, and selenium exceeded state standards for these constituents (Tables A-13 and A-14, Appendix A). Levels of molybdenum and uranium also exceeded levels considered acceptable for ground water (see Ground Water Protection Program section in this report).

Consistent with findings of previous years' monitoring, contamination was greatest in the areas of the Carbonate Seep, location W-2, and the downgradient Sorenson site (Figure 6).

ENVIRONMENTAL DOCUMENTS/PERMITS

Key environmental documents completed in 1990 included the *Final Remedial Investigation/Feasibility Study-Environmental Assessment for the Monticello, Utah, Uranium Mill Tailings Site* (UNC Geotech 1990b), the *Monticello Mill Tailings Site Declaration for the Record of Decision and Record of Decision Summary* (US-DOE 1990), and the *Grand Junctions Projects Office Groundwater Protection Plan* (UNC Geotech 1990d). There were no environmental permits issued for the Monticello Millsite in 1990.

ENVIRONMENTAL ACTIVITIES SUMMARY

A monitoring well abandonment and upgrade project was completed at the Monticello Millsite in August of 1990. Fifteen monitoring wells were abandoned in accordance with the State of Utah well abandonment regulations. Monitoring wells abandoned included damaged wells, older monitoring wells that were poorly constructed, and wells that were no longer useful for monitoring purposes. In addition, 27 monitoring wells were upgraded by adding protective steel casing, padlocks, concrete pads, and steel guardposts.

Geotechnical and engineering evaluations of the proposed permanent repository (South Site) were conducted in 1990. A drilling program was undertaken in February 1990 to determine the suitability of subsurface conditions for permanent storage of uranium mill tailings and related contaminated materials. Eighty-two monitoring wells were completed.

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

RADIOACTIVE EFFLUENT DATA

No radioactive effluent was released from the Monticello Millsite during 1990.

ENVIRONMENTAL SAMPLING FOR RADIOACTIVITY

Surface water and air were sampled on the millsite for radioactive constituents. Surface water analytes included radium-226, radium-228, uranium-234, uranium-238, and gross alpha; air was sampled for radon and for particulates containing radium-226, thorium-230, and uranium. Sampling locations, frequency, methodology, and results are discussed under the Environmental Program Information section in this report. Also included in that section are comparisons of measured constituent levels with their federal and state regulatory levels.

OFF-SITE DOSE MODELING

No off-site dose modeling was conducted during 1990. In the Monticello Millsite RI/FS--EA (UNC Geotech 1990b), source terms were calculated for exposure rates, air-particulate concentrations, and radon emissions. Calculated source terms subsequently were used as input to dose commitment models. The models used to estimate dose equivalents expected to be received by Monticello residents included the Atmospheric Transport Model (Raridon and others 1982) and a dosimetric model described by the U.S. Nuclear Regulatory Commission (1980). Site-specific data used in the modeling were collected from 1981 through 1987. Interpretation of monitoring data collected in 1990, although more limited in scope, indicated that atmospheric radon and air particulate concentrations were consistent with previous years' values. In view of this, the dose commitments listed in Table 5, which are summarized from the RI/FS--EA, should be representative of the site during 1990.

Table 5. Population[a] Dose Commitments to Monticello Residents from Natural Background and Present Enhanced Conditions

Source	Dose Commitment (person-rem per year) Whole Body	Lung
NATURAL BACKGROUND		
Direct External Exposure	316	NA[b]
Radon Daughters	NA	1265
ENHANCED CONDITIONS		
Direct External Exposure	165	NA
Radon Daughters	NA	188

[a]Population assumed to be 2,469.
[b]Not applicable.

ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

NONRADIOLOGICAL EFFLUENT DATA

No nonradiological effluent was released from the Monticello Millsite during 1990.

ENVIRONMENTAL SAMPLING FOR NONRADIOLOGICAL POLLUTION

Surface water and air particulates emanating from the uranium mill tailings piles were sampled for a variety of nonradiological constituents on the Monticello Millsite. These sampling programs are described in the Environmental Program Information section of this document. A comparison of measured constituent levels with federal and state regulatory levels also is contained in that section.

SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) TITLE III REPORTING

No SARA Title III reporting was required at the inactive Monticello Millsite.

GROUND WATER PROTECTION PROGRAM

HYDROGEOLOGY

There are two primary aquifers underlying the Monticello Millsite and surrounding area. Unconsolidated materials deposited by Montezuma Creek constitute an alluvial aquifer along the valley bottom. An underlying sandstone aquifer, the Burro Canyon Formation, is separated from the alluvial aquifer by the Mancos Shale and by fine-grained units of the Dakota Sandstone, which act as a major aquitard in the project area (Figure 7).

The alluvial aquifer is approximately 3 meters (15 feet) thick near Montezuma Creek and thins gradually toward the valley sides. Montezuma Creek is in hydraulic communication with the aquifer on the upstream side of the East Tailings Pile. However, because of a realignment of the stream channel, the aquifer and Montezuma Creek are separated in the vicinity of the East Tailings Pile. The creek and the aquifer are reunited downstream of the East Tailings Pile.

Recharge of the alluvial aquifer is from infiltration of precipitation and surface water. Like the local surface waters, water levels within the aquifer fluctuate seasonally. Discharge from the aquifer occurs through seepage into fractures of the underlying Mancos Shale and into Montezuma Creek. Across the East Tailings Pile, discharge from the aquifer is estimated to be approximately 113,550 to 132,475 liters (30,000 to 35,000 gallons) per day. Hydraulic conductivities are highly variable between wells, with values ranging from 3.5×10^{-6} to 7.1×10^{-3} centimeters per second (0.01 to 20 feet per day). As water traverses the site, water quality is degraded by movement through the tailings. The leachate contributes uranium, vanadium, radium, sulfate, selenium, and molybdenum to ground water in the alluvial aquifer. Generally, groundwater flow direction is to the east and southeast. Water from the alluvial aquifer presently is not used in the vicinity of the millsite.

The Burro Canyon Formation is a confined aquifer that is separated from the alluvial aquifer by an aquitard consisting of the Mancos Shale and fine-grained units of the Dakota Sandstone. It is recharged through the tilted, exposed area of the formation located along the margin of the Abajo Dome west of the millsite. Discharge from the aquifer occurs across the Great Sage Plain, along erosional margins, and in areas where canyons dissect the formation. Numerous stock ponds and marshy areas are created as a result of spring-fed discharge from the Burro Canyon aquifer.

To date, analysis of ground water samples indicates that the Burro Canyon aquifer is not being degraded by the tailings piles. Water in the Burro Canyon aquifer is used for domestic water supply in the Monticello area.

GROUND WATER MONITORING PROGRAM

The objectives of the ground water monitoring program at the Monticello Millsite have been to (1) determine the baseline water quality and quantity conditions of the shallow alluvial aquifer underlying the site,
(2) characterize the type and extent of contamination within the aquifer,
(3) verify compliance with federal and state ground water quality standards,

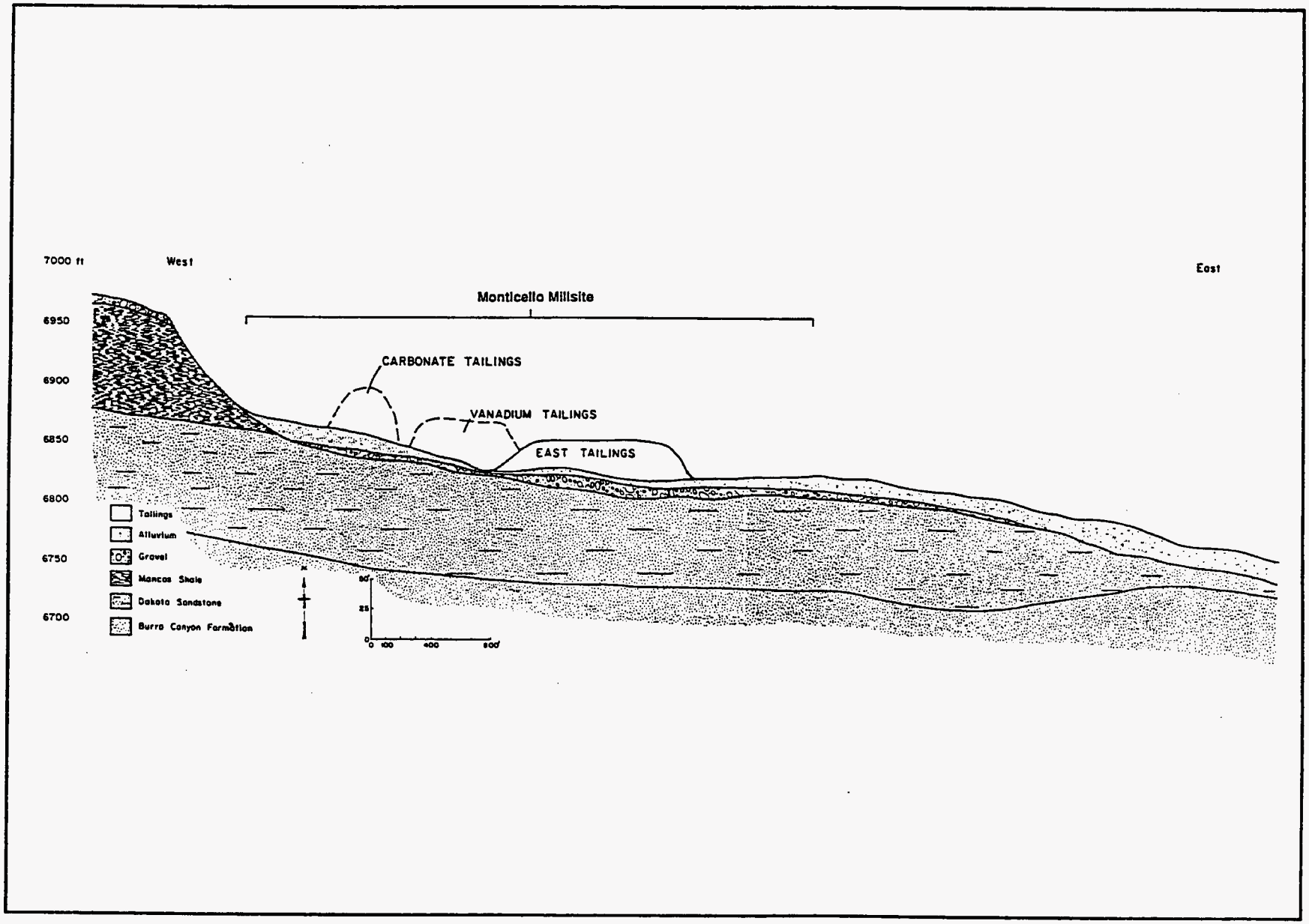

Figure 7. Generalized West-East Cross Section Through the Monticello Millsite

and (4) detect changes in water quality resulting from remedial action at the site. Monitoring programs conducted since 1980 on 55 upgradient, on-site, and downgradient wells have defined baseline conditions and characterized contaminant types within the ground water; current monitoring focuses on the measurement of a smaller number of representative wells for meeting the latter two objectives. To verify compliance with federal and state standards, measured water quality values are compared to federal standards promulgated by the Uranium Mill Tailings Radiation Control Act (UMTRCA) and state standards promulgated by Title 26, Chapter 11 of the Utah Code Annotated. The numeric standards applicable to the millsite are listed in Table 6 (Table 6 combines federal and state standards into one list for comparison purposes; federal standards are listed separately in 40 CFR 192.12).

Ground water samples were collected from the alluvial and Burro Canyon aquifers at the Monticello site in April and October of 1990 with a peristaltic pump, an electric submersible pump, or a polyethylene disposable bailer, depending on individual well conditions. Alluvial well samples were collected from two upgradient wells (82-20 and 82-43), eight on-site wells (82-30B, 82-31B-E, 82-36A, 82-40A, 82-45B, 82-51, 82-52), and one downgradient well (82-08) (see Figures 8 and 9 for well locations). Samples were collected from one well completed in the Burro Canyon aquifer (84-74). Samples requiring filtration were run through a 0.45-μm filter in line with the collection vessel. Samples were then preserved and analyzed according to procedures prescribed in the *Analytical Chemistry Laboratory Handbook of Analytical and Sample-Preparation Methods* (Chem-Nuclear Geotech 1990c). In Table 6, 1990 and historical maximum concentrations are listed and compared to federal and state ground water standards. Analytical results on all 1990 well samples are presented in Tables A-13 and A-14 in Appendix A.

Historically, upgradient alluvial aquifer water quality data have been acquired from wells 82-19, 82-20, 82-43, and 82-44 (Figure 8). Over the past 7 years, elements detected in low concentrations as compared to on-site well concentrations included arsenic, barium, chloride, iron, molybdenum, lead, vanadium, zinc, and radium-226. At times, concentrations of nitrate, selenium, and uranium have exceeded applicable standards (Table 6). In 1990, only upgradient wells 82-20 and 82-43 were sampled. No measured constituent in these upgradient wells was above standard.

Ground water sampled on site from the shallow aquifer is contaminated by elements leached from the tailings piles. In general, the highest concentrations of contaminants are found in the vicinity of the Vanadium and East Tailings Piles. Historically, levels of gross alpha, arsenic, molybdenum, nitrate, pH, selenium, uranium, and radium-226 have, at times, exceeded standards (Table 6). In 1990, concentrations of arsenic, selenium, uranium, gross alpha, and radium-226 exceeded standards in one or more on-site ground water samples.

Downgradient alluvial aquifer monitoring wells on private property east of the Monticello Millsite (Figure 9) have provided evidence of contaminant migration. At times in the past, levels of gross alpha, molybdenum, pH, selenium, and uranium have exceeded standards (Table 6). In 1990, gross alpha and uranium exceeded federal and state standards in well 82-08.

In contrast, ground water samples collected from the Burro Canyon well during 1990 exceeded no federal or state standards.

Table 6. Comparison of Federal[a] and State of Utah[b] Ground Water Quality Standards to 1990 and Historical Maximum Concentrations in the Alluvial Aquifer

Constituent	Federal/State Standard		1990 Maximum[c,d]			Historical Maximum[d,e]		
			Up-Gradient	On-Site	Down-Gradient	Up-Gradient	On-Site	Down-Gradient
Physical								
Color	15.0	Units	ND	ND	ND	ND	ND	ND
Corrosivity	noncorrosive		ND	ND	ND	ND	ND	ND
Odor (threshold no.)	3.0		ND	ND	ND	ND	ND	ND
pH	6.5-8.5	Units	6.9-7.2	6.6-7.3	6.4-8.0	6.5-8.6	4.5-12.5	6.0-7.8
Inorganics								
Fluoride	2.4	mg/L	ND	ND	ND	0.20	1.2	0.73
Foaming agents	0.5	mg/L	ND	ND	ND	ND	ND	ND
Molybdenum	0.1	mg/L	<0.01	0.8	<0.01	0.06	116	0.53
Nitrate (as N)	10.0	mg/L	1.30	7.4	1.14	19.6	36	1.78
Metals								
Arsenic	0.05	mg/L	<0.01	0.14	<0.01	0.01	0.19	0.02
Barium	1.0	mg/L	ND	ND	ND	<0.10	0.85	<0.10
Cadmium	0.01	mg/L	ND	ND	ND	<0.005	0.005	<0.001
Chromium	0.05	mg/L	ND	ND	ND	0.01	0.02	<0.01
Copper	1.0	mg/L	ND	ND	ND	ND	ND	ND
Lead	0.05	mg/L	ND	ND	ND	<0.025	0.025	<0.01
Mercury	0.002	mg/L	ND	ND	ND	0.002	<0.0002	<0.0002
Selenium	0.01	mg/L	<0.005	0.04	0.0096	0.013	0.16	0.038
Silver	0.05	mg/L	ND	ND	ND	<0.025	<0.025	<0.010
Zinc	5.0	mg/L	ND	ND	ND	2.82	1.40	0.47
Organics								
Endrin	0.2	µg/L	ND	ND	ND	<0.012	<0.012	<0.012
Lindane	4.0	µg/L	ND	ND	ND	<0.008	<0.008	<0.008
Methoxychlor	100.0	µg/L	ND	ND	ND	<0.005	<0.005	<0.005
Toxaphene	5.0	µg/L	ND	ND	ND	<0.48	<0.48	<0.48
2,4-D	100.0	µg/L	ND	ND	ND	<0.2	<0.2	<0.2
2,4,5-TP Silvex	10.0	µg/L	ND	ND	ND	ND	ND	ND
Trichloroethylene	0.005	mg/L	ND	ND	ND	ND	ND	ND

[a]Standards from the Uranium Mill Tailings Radiation Control Act of 1978.
[b]State of Utah Ground Water Quality Standards, Title 26, Chapter 11, Utah Code Annotated.
[c]An "ND" indicates not determined; a "<" symbol indicates that the maximum concentration was below detection limits (number shown is detection limit).
[d]The listed values are in the units shown under the Standard column.
[e]Based on maximum concentrations observed from 1984 through 1989.

Table 6 (continued). Comparison of Federal[a] and State of Utah[b] Ground Water Quality Standards to 1990 and Historical Maximum Concentrations in the Alluvial Aquifer

Constituent	Federal/State Standard	1990 Maximum[c,d]			Historical Maximum[d,e]		
		Up-Gradient	On-Site	Down-Gradient	Up-Gradient	On-Site	Down-Gradient
Organics (continued)							
Carbon tetrachloride	0.005 mg/L	ND	ND	ND	ND	ND	ND
Vinyl chloride	0.002 mg/L	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	0.005 mg/L	ND	ND	ND	ND	ND	ND
Benzene	0.005 mg/L	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	0.007 mg/L	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.200 mg/L	ND	ND	ND	ND	ND	ND
para-Dichlorobenzene	0.075 mg/L	ND	ND	ND	ND	ND	ND
Trihalomethanes	0.1 mg/L	ND	ND	ND	ND	ND	ND
Radiological							
Radium-226+228	5.0 pCi/L	0.3	5.8	0.5	0.20	38.0	<2.0
Gross Alpha (excluding radon and uranium)	15.0 pCi/L	<76[f]	3400[f]	95[f]	15[f]	7280[f]	134[f]
Uranium-234+238	30.0 pCi/L	10.8	~2930[g]	83.9	~1465[g]	~8525[g]	~2000[g]

[a]Standards from the Uranium Mill Tailings Radiation Control Act of 1978.
[b]State of Utah Ground Water Quality Standards, Title 26, Chapter 11, Utah Code Annotated.
[c]An "ND" indicates not determined; a "<" symbol indicates that the maximum concentration was below detection limits (number shown is detection limit).
[d]The listed values are in the units shown under the Standard column.
[e]Based on maximum concentrations observed from 1984 through 1989.
[f]Values represent total gross alpha, including uranium.
[g]Uranium concentrations were actually measured in mg/L, but were converted to pCi/L for comparison purposes. The conversion assumes equilibrium and an activity of 0.666 pCi/ug

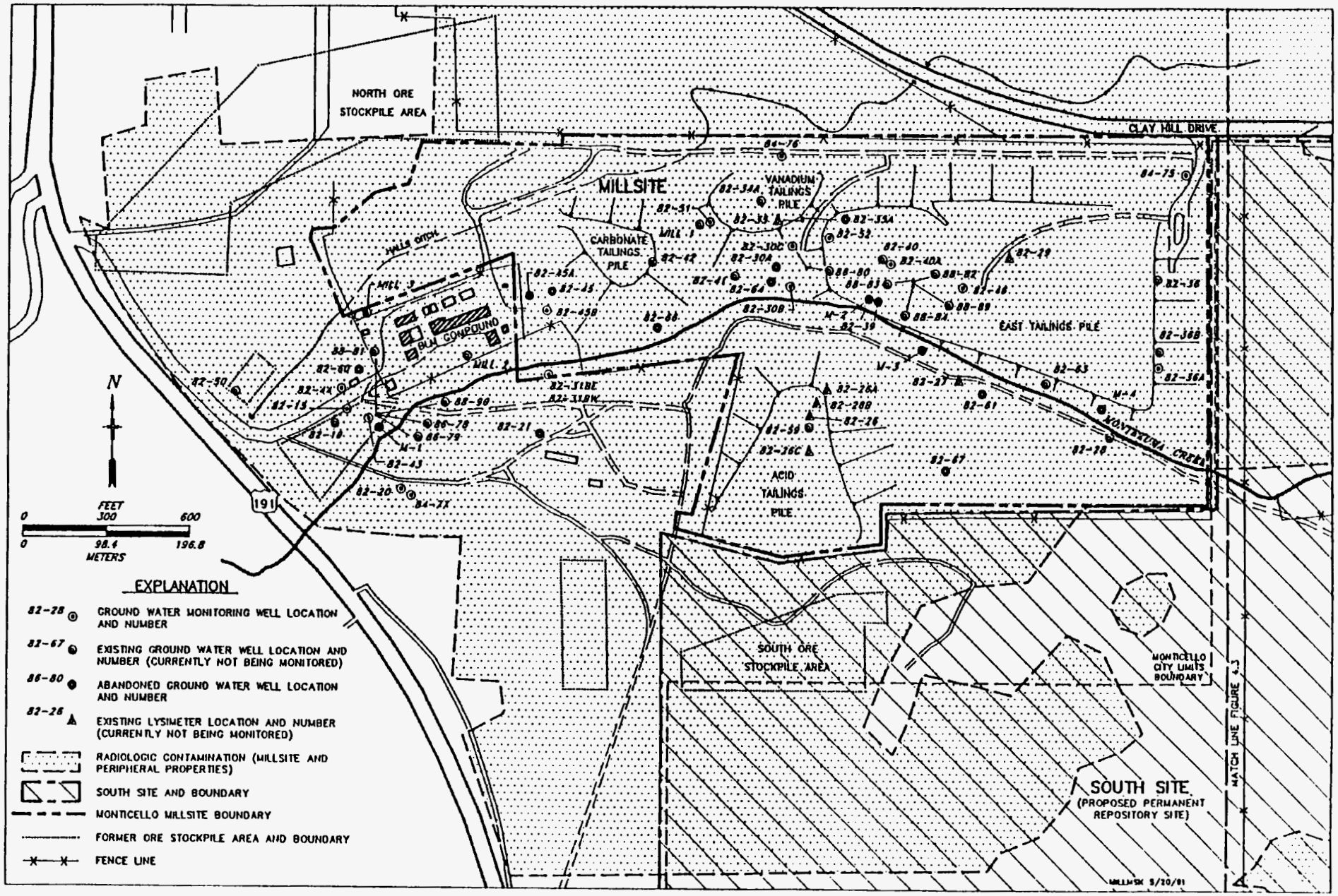

Figure 8. Ground Water Sampling Locations On-Site and Upgradient of the Monticello Millsite

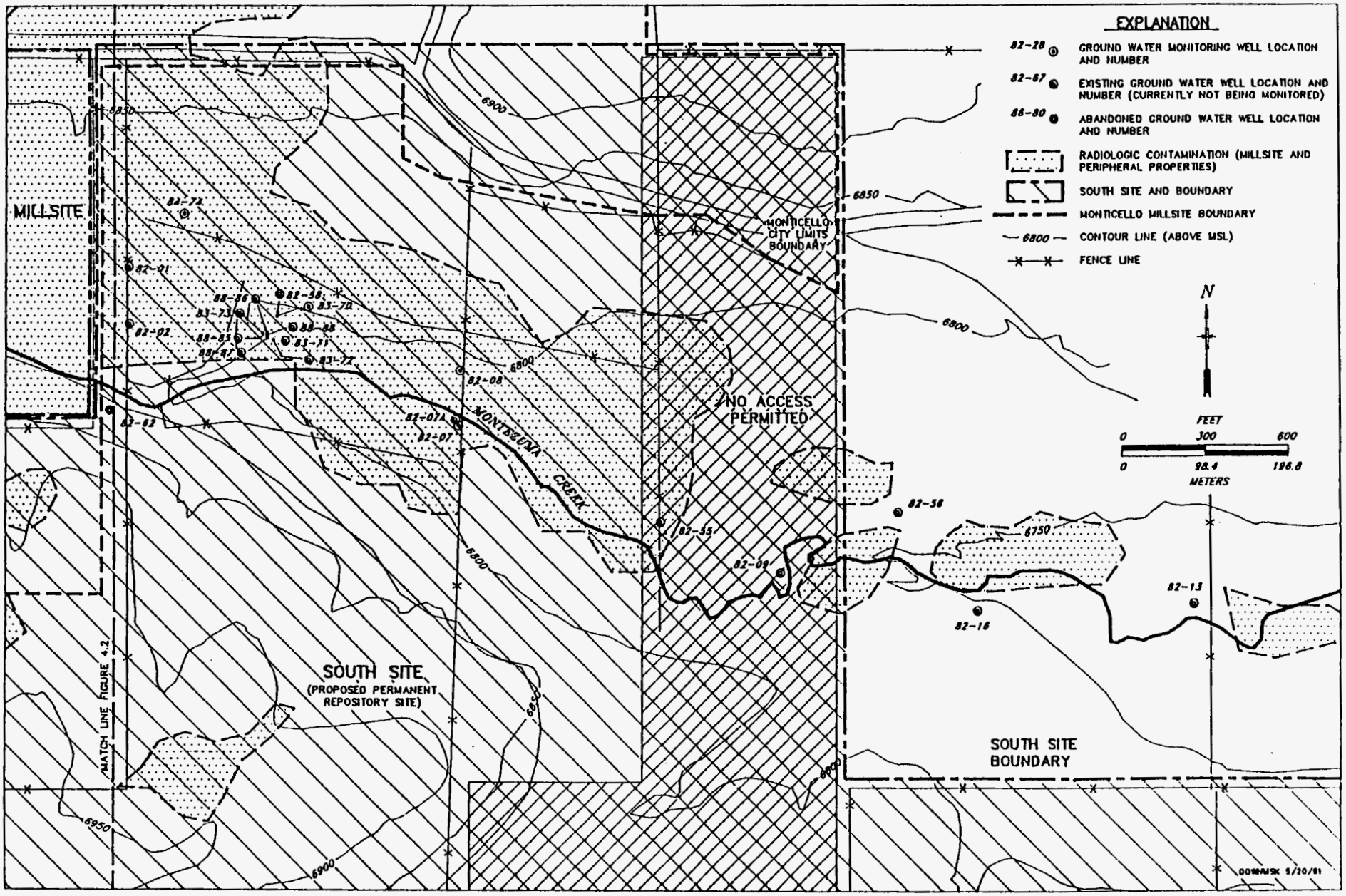

Figure 9. Ground Water Sampling Locations Downgradient of the Monticello Millsite

QUALITY ASSURANCE

Geotech has a Quality Assurance Program (QAP) that is consistent with and responsive to DOE Order 5700.6B, *Quality Assurance*, and addresses the requirements of ANSI/ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities* (ANSI/ASME NQA 1983). This program provides a structured approach for the application of quality assurance (QA) principles to work performed by Geotech and is implemented through the *Quality Assurance Manual* (Chem-Nuclear Geotech 1990d).

A Quality Assurance Program Plan (QAPP) was developed for specific environmental monitoring and surveillance needs at the Monticello Millsite and will be appended to the *Environmental Monitoring Plan* (in preparation). The primary foci of the QAPP are to ensure that all data and documentation are valid and traceable and meet requirements and to ensure that all environmental monitoring results are valid. In addition, the QAPP addresses organizational responsibility, design, procedures, records, and audits. Field and laboratory quality control (QC), human factors, chain-of-custody, performance reporting, and independent data verification are addressed by the organizations responsible for the work.

SAMPLING

Sampling methodologies used for environmental monitoring at the Monticello Millsite are described in the *Environmental Procedures Catalog* (Chem-Nuclear Geotech 1990e) and follow EPA guidance given in *Test Methods for Evaluating Solid Waste* (USEPA 1986). QA and QC measures are integrated into all sampling activities to ensure sample representativeness, sample accuracy, sample precision, data comparability, and data completeness.

LABORATORY ANALYSIS

The Analytical Chemistry Laboratory performs analyses in support of the environmental monitoring programs and implements QA requirements through the *Analytical Chemistry Laboratory Administrative Plan and Quality Control Methods* (Chem-Nuclear Geotech 1990f). The Analytical Chemistry Laboratory objective is to provide high-quality analytical data that adequately meet the environmental monitoring program requirements. This objective is met by implementing laboratory protocol that ensures that a sample will retain its proper identity, that analytical results will be obtained and reported correctly, and that a well-documented sample history will be maintained. QA and QC measures addressed include organizational responsibility, training/qualification of personnel, laboratory records, records control, laboratory QC, data acceptance, sample analysis, data recording and calculation, data deficiencies, chain-of-custody, procurement of services, and quality assessment. Sampling and analytical methodologies are detailed in the *Analytical Chemistry Laboratory Handbook of Analytical and Sample-Preparation Methods* (Chem-Nuclear Geotech 1990c).

The Analytical Chemistry Laboratory maintains an internal QC organization to provide independent data review and evaluation of QA data. The QA section

staff includes in its audit program the evaluation of the effectiveness of the Analytical Chemistry Laboratory QC program.

Subcontracted analytical laboratories are under the supervision of the Analytical Chemistry Laboratory. It is the responsibility of the Analytical Chemistry Laboratory to monitor a subcontracted laboratory's methodologies and sample results and ensure that proper QC is practiced.

Interlaboratory Quality Assurance Programs

The Analytical Chemistry Laboratory participates in the DOE interlaboratory QA program coordinated by the DOE Environmental Measurements Laboratory for radioactive materials, as mandated by DOE Order 5400.1. This interlaboratory program is designed to test the quality of the environmental measurements being reported to the DOE by its contractors. Real or synthetic environmental samples that have been prepared and thoroughly analyzed at the program laboratory are distributed to the contractors for analysis, and the results are compiled for comparison. The Analytical Chemistry Laboratory also participates in two non-DOE interlaboratory QA programs: (1) EPA's Environmental Measurement Systems Laboratory for radioactive materials, and (2) the National Institute for Occupational Safety and Health Proficiency Analytical Testing Program for airborne metal, silica, and asbestos. A summary of the 1990 Analytical Chemistry Laboratory's results for the three interlaboratory QA programs is shown in Table 7. The precision of the laboratory's results can be determined by comparing the reported laboratory values with the reference values listed in Table 7.

DATA MANAGEMENT

Data management objectives for environmental monitoring activities are to maximize the usefulness and protection of important program information and to minimize the recordkeeping burden and cost. These objectives are achieved through establishment and implementation of continuous, systematic, and effective controls for each phase of a record's life cycle. Records must be identifiable, legible, and retrievable and must be protected against deterioration, damage, or loss.

Data management for environmental monitoring activities includes receipt of laboratory results via network transfer, data entry of information, and formatting of data for report preparation and statistical analysis. All environmental monitoring data are stored in an ORACLE database on a MicroVAX computer system that is maintained by Geotech.

Records generated in support of environmental monitoring activities are subject to the requirements for maximum-level records as specified in the QAPP for the *Environmental Monitoring Plan* (in preparation) and in Section 13 of Geotech's *Management Policies Manual* (Chem-Nuclear Geotech 1990g).

Table 7. Summary of Analytical Results for the Interlaboratory Quality Assurance Programs

ANALYSIS DATE	MATRIX TYPE	ISOTOPE ANALYZED	REPORTED LABORATORY VALUE		REFERENCE VALUE	
DOE ENVIRONMENTAL MEASUREMENT LABORATORY						
03/90	Air	Be-7	54.3	Bq/F	51.4	Bq/F
03/90	Air	Mn-54	9.9	Bq/F	9.6	Bq/F
03/90	Air	Co-57	7.4	Bq/F	6.5	Bq/F
03/90	Air	Co-60	9.1	Bq/F	9.4	Bq/F
03/90	Air	Sr-90	0.26	Bq/F	0.24	Bq/F
03/90	Air	Cs-134	15.9	Bq/F	18.2	Bq/F
03/90	Air	Cs-137	21.0	Bq/F	20.4	Bq/F
03/90	Air	Ce-144	32.2	Bq/F	31.2	Bq/F
03/90	Air	Pu-239	0.036	Bq/F	0.039	Bq/F
03/90	Air	Am-241	0.056	Bq/F	0.054	Bq/F
03/90	Air	U	2.20	Bq/F	2.01	Bq/F
03/90	Soil	K-40	480.0	Bq/kg	608.0	Bq/kg
03/90	Soil	Sr-90	690.0	Bq/kg	665.0	Bq/kg
03/90	Soil	Cs-137	19600.0	Bq/kg	17500.0	Bq/kg
03/90	Soil	Pu-239	200.0	Bq/kg	212.0	Bq/kg
03/90	Soil	Am-241	114.0	Bq/kg	106.0	Bq/kg
03/90	Soil	U	12.0	Bq/kg	10.3	Bq/kg
03/90	Vegetn	Sr-90	66.0	Bq/kg	70.2	Bq/kg
03/90	Vegetn	Pu-239	0.390	Bq/kg	0.333	Bq/kg
03/90	Vegetn	Am-241	0.310	Bq/kg	0.307	Bq/kg
03/90	Water	H-3	1740.0	Bq/L	960.0	Bq/L
03/90	Water	Mn-54	109.0	Bq/L	103.0	Bq/L
03/90	Water	Co-57	194.0	Bq/L	198.0	Bq/L
03/90	Water	Co-60	193.0	Bq/L	206.0	Bq/L
03/90	Water	Sr-90	96.4	Bq/L	111.0	Bq/L
03/90	Water	Cs-134	430.0	Bq/L	462.0	Bq/L
03/90	Water	Cs-137	204.0	Bq/L	198.0	Bq/L
03/90	Water	Ce-144	423.0	Bq/L	403.0	Bq/L
03/90	Water	Pu-239	1.25	Bq/L	1.04	Bq/L
03/90	Water	Am-241	0.89	Bq/L	0.86	Bq/L
03/90	Water	U	0.069	Bq/L	0.0788	Bq/L

ANALYSIS DATE	MATRIX TYPE	ISOTOPE ANALYZED	REPORTED LABORATORY VALUE		REFERENCE VALUE	
EPA ENVIRONMENTAL MONITORING SYSTEM LABORATORY						
01/19/90	Water	PU-239	5.30	pCi/L	5.6	pCi/L
03/09/90	Water	Ra-226	4.57	pCi/L	4.9	pCi/L
03/09/90	Water	Ra-228	14.10	pCi/L	12.7	pCi/L
03/11/90	Water	Gross Alpha	21.00	pCi/L	22.0	pCi/L
03/11/90	Water	Gross Beta	14.67	pCi/L	15.0	pCi/L
03/30/90	Air	Gross Alpha	5.00	pCi/F	5.0	pCi/F
03/30/90	Air	Gross Beta	22.33	pCi/F	31.0	pCi/F
03/30/90	Air	Sr-90	10.00	pCi/F	10.0	pCi/F
03/30/90	Air	Cs-137	17.67	pCi/F	10.0	pCi/F
06/22/90	Water	H-3	2976.00	pCi/L	2933.0	pCi/L
07/20/90	Water	U	20.50	pCi/L	20.8	pCi/L
08/24/90	Water	Pu-239	8.87	pCi/L	9.1	pCi/L
08/31/90	Air	Alpha	11.33	pCi/F	10.0	pCi/F
08/31/90	Air	Beta	55.00	pCi/F	62.0	pCi/F
08/31/90	Air	Sr-90	19.33	pCi/F	20.0	pCi/F
08/31/90	Air	Cs-137	26.33	pCi/F	20.0	pCi/F
09/21/90	Water	Gross Alpha	9.67	pCi/L	10.0	pCi/L
09/21/90	Water	Gross Beta	9.67	pCi/L	10.0	pCi/L
10/05/90	Water	Co-60	19.33	pCi/L	20.0	pCi/L
10/05/90	Water	Zn-65	121.67	pCi/L	115.0	pCi/L
10/05/90	Water	Ru-106	145.67	pCi/L	151.0	pCi/L
10/05/90	Water	Cs-134	11.67	pCi/L	12.0	pCi/L
10/05/90	Water	Cs-137	10.67	pCi/L	12.0	pCi/L
10/05/90	Water	Ba-137	95.00	pCi/L	110.0	pCi/L
10/19/90	Water	H-3	6813.00	pCi/L	7203.0	pCi/L
10/19/90	Water	Ra-228	7.23	pCi/L	7.4	pCi/L
11/09/90	Water	Ra-226	8.07	pCi/L	7.7	pCi/L

Table 7 (Continued). Summary of Analytical Results for the Interlaboratory Quality Assurance Programs

ANALYSIS DATE	MATRIX TYPE	ELEMENT ANALYZED	REPORTED LABORATORY VALUE		REFERENCE VALUE	
NIOSH PROFICIENCY ANALYTICAL TESTING PROGRAM (PAT)						
02/21/90	Air	Pb	0.0452	mg/F	0.0443	mg/F
02/21/90	Air	Pb	0.0599	mg/F	0.0591	mg/F
02/21/90	Air	Pb	0.0200	mg/F	0.0201	mg/F
02/21/90	Air	Pb	0.0332	mg/F	0.0328	mg/F
02/21/90	Air	Cd	0.0091	mg/F	0.0089	mg/F
02/21/90	Air	Cd	0.0119	mg/F	0.0118	mg/F
02/21/90	Air	Cd	0.0160	mg/F	0.0157	mg/F
02/21/90	Air	Cd	0.0102	mg/F	0.0099	mg/F
02/21/90	Air	Zn	0.1020	mg/F	0.1043	mg/F
02/21/90	Air	Zn	0.0850	mg/F	0.0847	mg/F
02/21/90	Air	Zn	0.1710	mg/F	0.1704	mg/F
02/21/90	Air	Si	0.0893	mg/F	0.0738	mg/F
02/21/90	Air	Si	0.0984	mg/F	0.0881	mg/F
02/21/90	Air	Si	0.0940	mg/F	0.1102	mg/F
02/21/90	Air	Si	0.1186	mg/F	0.0986	mg/F
02/21/90	Air	Asbestos	862.9	F/mm^2	763.4	F/mm^2
02/21/90	Air	Asbestos	167.2	F/mm^2	158.5	F/mm^2
02/21/90	Air	Asbestos	367.8	F/mm^2	383.3	F/mm^2
05/23/90	Air	Pb	0.0237	mg/F	0.0241	mg/F
05/23/90	Air	Pb	0.0413	mg/F	0.0419	mg/F
05/23/90	Air	Pb	0.0569	mg/F	0.0575	mg/F
05/23/90	Air	Pb	0.0362	mg/F	0.0361	mg/F
05/23/90	Air	Cd	0.0147	mg/F	0.0150	mg/F
05/23/90	Air	Cd	0.0078	mg/F	0.0080	mg/F
05/23/90	Air	Cd	0.0119	mg/F	0.0119	mg/F
05/23/90	Air	Cd	0.0097	mg/F	0.0100	mg/F
05/23/90	Air	Zn	0.2058	mg/F	0.2153	mg/F
05/23/90	Air	Zn	0.1757	mg/F	0.1842	mg/F
05/23/90	Air	Zn	0.1218	mg/F	0.1275	mg/F
05/23/90	Air	Zn	0.0945	mg/F	0.1009	mg/F
05/23/90	Air	Si	0.0995	mg/F	0.0910	mg/F
05/23/90	Air	Si	0.0882	mg/F	0.0755	mg/F
05/23/90	Air	Si	0.0968	mg/F	0.0707	mg/F
05/23/90	Air	Si	0.0271	mg/F	0.0391	mg/F
05/23/90	Air	Asbestos	251.4	F/mm^2	17.8	F/mm^2
05/23/90	Air	Asbestos	117.8	F/mm^2	147.1	F/mm^2
05/23/90	Air	Asbestos	251.4	F/mm^2	246.8	F/mm^2
05/23/90	Air	Asbestos	530.9	F/mm^2	459.6	F/mm^2
08/23/90	Air	Pb	0.0638	mg/F	0.0642	mg/F
08/23/90	Air	Pb	0.0272	mg/F	0.0268	mg/F
08/23/90	Air	Pb	0.0840	mg/F	0.0843	mg/F
08/23/90	Air	Pb	0.0482	mg/F	0.0483	mg/F
08/23/90	Air	Cd	0.0090	mg/F	0.0090	mg/F
08/23/90	Air	Cd	0.0187	mg/F	0.0192	mg/F
08/23/90	Air	Cd	0.0119	mg/F	0.0119	mg/F
08/23/90	Air	Zn	0.1087	mg/F	0.1071	mg/F
08/23/90	Air	Zn	0.1333	mg/F	0.1297	mg/F
08/23/90	Air	Zn	0.2220	mg/F	0.2185	mg/F
08/23/90	Air	Zn	0.1786	mg/F	0.1751	mg/F
08/23/90	Air	Si	0.0915	mg/F	0.0702	mg/F
08/23/90	Air	Si	0.0893	mg/F	0.0778	mg/F
08/23/90	Air	Si	0.1021	mg/F	0.0842	mg/F
08/23/90	Air	Asbestos	456.1	F/mm^2	369.3	F/mm^2
08/23/90	Air	Asbestos	477.7	F/mm^2	573.2	F/mm^2
08/23/90	Air	Asbestos	732.5	F/mm^2	783.1	F/mm^2
08/23/90	Air	Asbestos	235.7	F/mm^2	224.8	F/mm^2
11/20/90	Air	Pb	0.0728	mg/F	0.0717	mg/F
11/20/90	Air	Pb	0.0261	mg/F	0.0265	mg/F
11/20/90	Air	Pb	0.0387	mg/F	0.0392	mg/F
11/20/90	Air	Pb	0.0628	mg/F	0.0598	mg/F
11/20/90	Air	Cd	0.0073	mg/F	0.0072	mg/F
11/20/90	Air	Cd	0.0103	mg/F	0.0107	mg/F
11/20/90	Air	Cd	0.0106	mg/F	0.0111	mg/F
11/20/90	Air	Cd	0.0178	mg/F	0.0185	mg/F
11/20/90	Air	Si	0.0972	mg/F	0.0978	mg/F
11/20/90	Air	Si	0.0340	mg/F	0.0381	mg/F
11/20/90	Air	Si	0.1156	mg/F	0.0937	mg/F
11/20/90	Air	Si	0.1328	mg/F	0.1206	mg/F
11/20/90	Air	Asbestos	182.2	F/mm^2	173.3	F/mm^2
11/20/90	Air	Asbestos	359.0	F/mm^2	361.6	F/mm^2
11/20/90	Air	Asbestos	549.4	F/mm^2	521.3	F/mm^2
11/20/90	Air	Asbestos	533.4	F/mm^2	554.4	F/mm^2

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APPENDIX A

MONITORING DATA

Table A-1. Monticello Millsite Radon, First Quarter 1990

Sample Location	Detector Number	Start Date	End Date	Reported Radon[a] (pCi/L)	Corrected Radon[b] (pCi/L)	Radon Concen. (μCi/mL)
RN-M-4	972554	11-15-1989	02-21-1990	1.749	0.992	9.920986E-10
RN-M-4	972555	11-15-1989	02-21-1990	1.709	0.968	9.688923E-10
RN-M-6	972550	11-15-1989	02-21-1990	1.729	0.980	9.804925E-10
RN-M-6	972551	11-15-1989	02-21-1990	1.252	0.702	7.020115E-10
RN-M-7	972552	11-15-1989	02-21-1990	2.286	1.305	1.305392E-09
RN-M-7	972553	11-15-1989	02-21-1990	2.028	1.154	1.154548E-09
RN-M-10	972564	11-15-1989	02-21-1990	0.457	0.237	2.378709E-10
RN-M-10	972565	11-15-1989	02-21-1990	0.338	0.168	1.682504E-10
RN-M-11	972562	11-15-1989	02-21-1990	0.357	0.179	1.798541E-10
RN-M-11	972563	11-15-1989	02-21-1990	0.278	0.133	1.334398E-10
RN-M-13	972558	11-15-1989	02-21-1990	0.218	0.098	9.862925E-11
RN-M-13	972559	11-15-1989	02-21-1990	0.357	0.179	1.798541E-10
RN-M-14	972560	11-15-1989	02-21-1990	0.238	0.110	1.102330E-10
RN-M-14	972561	11-15-1989	02-21-1990	0.477	0.249	2.494747E-10
RN-M-15	972556	11-15-1989	02-21-1990	0.576	0.307	3.074921E-10
RN-M-15	972557	11-15-1989	02-21-1990	0.497	0.261	2.610784E-10

[a]The reported Radon values are the results received from the subcontracted laboratory.

[b]The corrected Radon values are derived by applying a correction factor to the reported values. The correction factor is the ratio of a known exposure value to the value that is measured and reported.

Table A-2. Monticello Millsite Radon, Second Quarter 1990

Sample Location	Detector Number	Start Date	End Date	Reported Radon[a] (pCi/L)	Corrected Radon[b] (pCi/L)	Radon Concen. (μCi/mL)
RN-M-4	972544	02-21-1990	05-16-1990	0.905	0.897	8.970745E-10
RN-M-4	972545	02-21-1990	05-16-1990	0.997	0.989	9.890824E-10
RN-M-6	972540	02-21-1990	05-16-1990	1.717	1.702	1.702147E-09
RN-M-6	972541	02-21-1990	05-16-1990	2.483	2.461	2.461204E-09
RN-M-7	972542	02-21-1990	05-16-1990	0.997	0.989	9.890824E-10
RN-M-7	972543	02-21-1990	05-16-1990	0.928	0.920	9.200762E-10
RN-M-10	972534	02-21-1990	05-16-1990	0.208	0.207	2.070176E-10
RN-M-10	972535	02-21-1990	05-16-1990	0.069	0.069	6.900568E-11
RN-M-11	972536	02-21-1990	05-16-1990	0.185	0.184	1.840148E-10
RN-M-11	972537	02-21-1990	05-16-1990	0.185	0.184	1.840148E-10
RN-M-13	972548	02-21-1990	05-16-1990	0.046	0.046	4.600387E-11
RN-M-13	972549	02-21-1990	05-16-1990	0.208	0.207	2.070176E-10
RN-M-14	972538	02-21-1990	05-16-1990	0.069	0.069	6.900568E-11
RN-M-14	972539	02-21-1990	05-16-1990	0.185	0.184	1.840148E-10
RN-M-15	972546	02-21-1990	05-16-1990	0.348	0.345	3.450290E-10
RN-M-15	972547	02-21-1990	05-16-1990	0.208	0.207	2.070176E-10

[a]The reported Radon values are the results received from the subcontracted laboratory.

[b]The corrected Radon values are derived by applying a correction factor to the reported values. The correction factor is the ratio of a known exposure value to the value that is measured and reported.

Table A-3. Monticello Millsite Radon, Third Quarter 1990

Sample Location	Detector Number	Start Date	End Date	Reported Radon[a] (pCi/L)	Corrected Radon[b] (pCi/L)	Radon Concen. (μCi/mL)
RN-M-4	972575	05-16-1990	08-13-1990	3.090	2.996	2.996329E-09
RN-M-4	972576	05-16-1990	08-13-1990	1.271	1.187	1.187636E-09
RN-M-6	972570	05-16-1990	08-13-1990	1.249	1.165	1.165839E-09
RN-M-6	972571	05-16-1990	08-13-1990	1.161	1.078	1.078679E-09
RN-M-7	972573	05-16-1990	08-13-1990	3.090	2.996	2.996329E-09
RN-M-7	972574	05-16-1990	08-13-1990	3.550	3.453	3.453955E-09
RN-M-10	972589	05-16-1990	08-13-1990	0.306	0.228	2.288105E-10
RN-M-10	972590	05-16-1990	08-13-1990	0.876	0.795	7.953889E-10
RN-M-11	972586	05-16-1990	08-13-1990	0.898	0.817	8.171809E-10
RN-M-11	972587	05-16-1990	08-13-1990	0.175	0.098	9.806177E-11
RN-M-13	972581	05-16-1990	08-13-1990	0.547	0.468	4.685175E-10
RN-M-13	972582	05-16-1990	08-13-1990	0.438	0.359	3.595599E-10
RN-M-14	972583	05-16-1990	08-13-1990	0.306	0.228	2.288105E-10
RN-M-14	972584	05-16-1990	08-13-1990	0.350	0.272	2.723933E-10
RN-M-15	972577	05-16-1990	08-13-1990	0.525	0.446	4.467255E-10
RN-M-15	972580	05-16-1990	08-13-1990	0.986	0.904	9.043465E-10

[a]The reported Radon values are the results received from the subcontracted laboratory.

[b]The corrected Radon values are derived by applying a correction factor to the reported values. The correction factor is the ratio of a known exposure value to the value that is measured and reported.

Table A-4. Monticello Millsite Radon, Fourth Quarter 1990

Sample Location	Detector Number	Start Date	End Date	Reported Radon[a] (pCi/L)	Corrected Radon[b] (pCi/L)	Radon Concen. (μCi/mL)
RN-M-4	972591	08-13-1990	11-15-1990	1.846	1.556	1.556263E-09
RN-M-6	972606	08-13-1990	11-15-1990	1.493	1.241	1.241304E-09
RN-M-6	972607	08-13-1990	11-15-1990	1.535	1.278	1.278359E-09
RN-M-7	972609	08-13-1990	11-15-1990	2.946	2.538	2.538185E-09
RN-M-7	972610	08-13-1990	11-15-1990	2.593	2.223	2.223226E-09
RN-M-10	972603	08-13-1990	11-15-1990	0.726	0.555	5.558061E-10
RN-M-10	972605	08-13-1990	11-15-1990	0.560	0.407	4.075917E-10
RN-M-11	972601	08-13-1990	11-15-1990	0.311	0.185	1.852690E-10
RN-M-11	972602	08-13-1990	11-15-1990	0.394	0.259	2.593762E-10
RN-M-13	972596	08-13-1990	11-15-1990	0.373	0.240	2.408499E-10
RN-M-13	972597	08-13-1990	11-15-1990	0.456	0.314	3.149571E-10
RN-M-14	972599	08-13-1990	11-15-1990	0.414	0.277	2.779035E-10
RN-M-14	972600	08-13-1990	11-15-1990	0.622	0.463	4.631726E-10
RN-M-15	972593	08-13-1990	11-15-1990	0.456	0.314	3.149571E-10
RN-M-15	972594	08-13-1990	11-15-1990	0.435	0.296	2.964299E-10

[a]The reported Radon values are the results received from the subcontracted laboratory.

[b]The corrected Radon values are derived by applying a correction factor to the reported values. The correction factor is the ratio of a known exposure value to the value that is measured and reported.

Table A-5. Monticello Millsite Air Samples, 1990, Station AIR-M-4

Sample Date	Ticket Number	Lead		Radium-226		Thorium-230			Uranium		
		(µg/F)	(µg/m³)	(pCi/F)	(µCi/mL)	(pCi/F)	(µCi/mL)	(pg/mL)	(µg/F)	(pg/mL)	(µCi/mL)
03-01-1990	MDV 942	63	0.03986	0.7	4.4E-16	0.6	3.8E-16	2.0E-08	2	0.0012	8.4E-16
03-13-1990	MDV 945	59	0.03732	<0.6	<4.E-16	0.5	3.2E-16	1.6E-08	2	0.0012	8.4E-16
03-19-1990	MDV 948	58	0.03669	<1.7	<1.E-15	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
03-25-1990	MDV 976	67	0.04239	<1.5	<9.E-16	0.5	3.2E-16	1.6E-08	2	0.0012	8.4E-16
03-31-1990	MDV 978	63	0.03986	<1.5	<9.E-16	0.5	3.2E-16	1.6E-08	2	0.0012	8.4E-16
04-06-1990	MDV 981	63	0.03986	<1.5	<9.E-16	0.6	3.8E-16	2.0E-08	2	0.0012	8.4E-16
04-24-1990	MDV 957	64	0.04049	<1.5	<9.E-16	0.5	3.2E-16	1.6E-08	2	0.0012	8.4E-16
04-30-1990	MDV 960	65	0.04112	<1.1	<7.E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
05-06-1990	MDV 962	57	0.03606	<1	<6.E-16	0.9	5.7E-16	2.9E-08	2	0.0012	8.4E-16
05-12-1990	MDV 967	34	0.08477	<1.1	<7.E-16	0.8	5.1E-16	2.6E-08	4	0.0025	1.6E-15
05-18-1990	MDV 969	71	0.04492	<0.8	<5.E-16	0.8	5.1E-16	2.6E-08	2	0.0012	8.4E-16
05-30-1990	MDV 973	63	0.03986	<1.7	<1.E-15	1.2	7.6E-16	3.9E-08	3	0.0019	1.2E-15
06-05-1990	MNL 938	68	0.04302	<0.9	<6.E-16	0.8	5.1E-16	2.6E-08	2	0.0012	8.4E-16
06-11-1990	MNL 939	76	0.04808	<0.6	<4.E-16	0.8	5.1E-16	2.6E-08	2	0.0012	8.4E-16
06-17-1990	MNL 943	53	0.03353	0.5	3.2E-16	0.4	2.5E-16	1.3E-08	2	0.0012	8.4E-16
06-23-1990	MNL 948	56	0.03543	0.9	5.7E-16	0.8	5.1E-16	2.6E-08	3	0.0019	1.2E-15
07-05-1990	MDV 983	59	0.03732	0.6	3.8E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
07-11-1990	MDV 987	54	0.03416	0.6	3.8E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
07-17-1990	MDV 990	52	0.03290	<0.4	<3.E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
07-23-1990	MDV 993	55	0.03479	1	6.3E-16	0.8	5.1E-16	2.6E-08	3	0.0019	1.2E-15
07-29-1990	MDV 996	53	0.03353	0.5	3.2E-16	0.6	3.8E-16	2.0E-08	2	0.0012	8.4E-16
08-04-1990	MDV 999	51	0.03226	0.5	3.2E-16	0.6	3.8E-16	2.0E-08	2	0.0012	8.4E-16
08-10-1990	MNZ 653	51	0.03226	0.6	3.8E-16	0.9	5.7E-16	2.9E-08	2	0.0012	8.4E-16
08-16-1990	MNZ 656	17	0.01075	0.7	4.4E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
08-22-1990	MNZ 659	10	0.00633	0.9	5.7E-16	1	6.3E-16	3.2E-08	1	0.0006	4.2E-16
08-29-1990	MNZ 661	21	0.01329	0.8	5.1E-16	0.9	5.7E-16	2.9E-08	2	0.0012	8.4E-16
09-03-1990	MNZ 663	19	0.01202	0.8	5.1E-16	1.1	7.0E-16	3.6E-08	2	0.0012	8.4E-16
09-27-1990	MNZ 668	21	0.01329	0.8	5.1E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
10-21-1990	MNZ 674	22	0.01392	0.5	3.2E-16	0.7	4.4E-16	2.3E-08	2	0.0012	8.4E-16
10-27-1990	MDV 839	20	0.01265	0.9	5.7E-16	0.8	5.1E-16	2.6E-08	2	0.0012	8.4E-16

Table A-6. Monticello Millsite Air Samples, 1990, Station AIR-M-5

Sample Date	Ticket Number	Lead		Radium-226		Thorium-230			Uranium		
		(µg/F)	(µg/m^3)	(pCi/F)	(µCi/mL)	(pCi/F)	(µCi/mL)	(pg/mL)	(µg/F)	(pg/mL)	(µCi/mL)
03-01-1990	MDV 941	62	0.03763	0.7	4.2E-16	0.7	4.2E-16	2.2E-08	3	0.0018	1.2E-15
03-13-1990	MDV 944	60	0.03641	<0.7	<4.E-16	0.5	3.0E-16	1.5E-08	2	0.0012	8.0E-16
03-19-1990	MDV 947	58	0.03520	<1.4	<8.E-16	0.6	3.6E-16	1.9E-08	2	0.0012	8.0E-16
03-25-1990	MDV 950	69	0.04188	<1.6	<1.E-15	0.5	3.0E-16	1.5E-08	2	0.0012	8.0E-16
03-31-1990	MDV 979	64	0.03884	<2.1	<1.E-15	0.5	3.0E-16	1.5E-08	2	0.0012	8.0E-16
04-06-1990	MDV 980	65	0.03945	<1.4	<8.E-16	0.5	3.0E-16	1.5E-08	2	0.0012	8.0E-16
04-12-1990	MDV 951	66	0.04006	<1.7	<1.E-15	0.5	3.0E-16	1.5E-08	2	0.0012	8.0E-16
04-18-1990	MDV-953	65	0.03945	<1.6	<1.E-15	0.7	4.2E-16	2.2E-08	2	0.0012	8.0E-16
04-24-1990	MDV 958	63	0.03824	<1.4	<8.E-16	0.5	3.0E-16	1.5E-08	2	0.0012	8.0E-16
04-30-1990	MDV 961	71	0.04309	<0.9	<5.E-16	0.6	3.6E-16	1.9E-08	3	0.0018	1.2E-15
05-06-1990	MDV 963	56	0.03399	<1	<6.E-16	0.7	4.2E-16	2.2E-08	2	0.0012	8.0E-16
05-12-1990	MDV 966	59	0.03581	<0.8	<5.E-16	1	6.1E-16	3.1E-08	2	0.0012	8.0E-16
05-18-1990	MDV-970	62	0.03763	<1	<6.E-16	0.9	5.5E-16	2.8E-08	2	0.0012	8.0E-16
05-30-1990	MDV 972	74	0.04491	<0.8	<5.E-16	0.7	4.2E-16	2.2E-08	3	0.0018	1.2E-15
06-05-1990	MDV 974	72	0.04370	<0.9	<5.E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.0E-16
06-11-1990	MNL 940	59	0.03581	<0.7	<4.E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.0E-16
06-17-1990	MNL 944	54	0.03277	0.5	3.0E-16	0.6	3.6E-16	1.9E-08	2	0.0012	8.0E-16
06-23-1990	MNL 947	55	0.03338	0.6	3.6E-16	0.6	3.6E-16	1.9E-08	2	0.0012	8.0E-16
07-05-1990	MDV 985	59	0.03581	0.9	5.5E-16	<0.5	<3.E-16	1.5E-08	2	0.0012	8.0E-16
07-11-1990	MDV 988	55	0.03338	0.7	4.2E-16	0.6	3.6E-16	1.9E-08	2	0.0012	8.0E-16
07-17-1990	MDV 991	53	0.03217	0.5	3.0E-16	0.7	4.2E-16	2.2E-08	2	0.0012	8.0E-16
07-23-1990	MDV 994	54	0.03277	0.7	4.2E-16	0.4	2.4E-16	1.2E-08	2	0.0012	8.0E-16
07-29-1990	MDV 997	51	0.03095	0.5	3.0E-16	0.6	3.6E-16	1.9E-08	2	0.0012	8.0E-16
08-04-1990	MNZ 651	53	0.03217	0.7	4.2E-16	0.6	3.6E-16	1.9E-08	2	0.0012	8.0E-16
08-10-1990	MNZ 654	51	0.03095	0.7	4.2E-16	0.9	5.5E-16	2.8E-08	2	0.0012	8.0E-16
08-16-1990	MNZ 657	12	0.00728	1.1	6.7E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.0E-16
10-15-1990	MNZ 672	21	0.01275	<0.7	<4.E-16	0.7	4.2E-16	2.2E-08	2	0.0012	8.0E-16
10-21-1990	MNZ 675	24	0.01457	0.9	5.5E-16	1.1	6.7E-16	3.5E-08	2	0.0012	8.0E-16
10-27-1990	MDV 840	13	0.00789	0.8	4.9E-16	0.7	4.2E-16	2.2E-08	2	0.0012	8.0E-16

Table A-7. Monticello Millsite Air Samples, 1990, Station AIR-M-6

Sample Date	Ticket Number	Lead		Radium-226		Thorium-230			Uranium		
		(µg/F)	(µg/m³)	(pCi/F)	(µCi/mL)	(pCi/F)	(µCi/mL)	(pg/mL)	(µg/F)	(pg/mL)	(µCi/mL)
03-01-1990	MDV 940	69	0.04236	<0.7	<4.E-16	0.7	4.3E-16	2.2E-08	4	0.0024	1.6E-15
03-13-1990	MDV 943	55	0.03376	0.6	3.7E-16	0.6	3.7E-16	1.9E-08	2	0.0012	8.1E-16
03-19-1990	MDV 946	54	0.03315	<0.7	<4.E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
03-25-1990	MDV 949	70	0.04297	<1.5	<9.E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
03-31-1990	MDV 977	64	0.03929	<1.8	<1.E-15	0.6	3.7E-16	1.9E-08	2	0.0012	8.1E-16
04-12-1990	MDV 952	66	0.04051	<2.1	<1.E-15	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
04-18-1990	MDV-954	65	0.03990	<1.6	<1.E-15	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
04-24-1990	MDV 956	63	0.03867	<1.8	<1.E-15	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
04-30-1990	MDV 959	57	0.03499	<1.1	<7.E-16	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
05-06-1990	MDV 964	82	0.05034	<1	<6.E-16	0.6	3.7E-16	1.9E-08	3	0.0018	1.2E-15
05-12-1990	MDV 965	58	0.03560	<0.9	<6.E-16	1.1	6.8E-16	3.5E-08	2	0.0012	8.1E-16
05-18-1990	MDV-968	57	0.03499	<1.3	<8.E-16	0.6	3.7E-16	1.9E-08	2	0.0012	8.1E-16
05-30-1990	MDV 971	58	0.03560	<1	<6.E-16	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
06-05-1990	MDV 975	76	0.04665	<1.1	<7.E-16	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
06-11-1990	MNL 941	61	0.03745	<0.5	<3.E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
06-16-1990	MNL 942	53	0.03253	<0.7	<4.E-16	0.4	2.5E-16	1.3E-08	2	0.0012	8.1E-16
06-23-1990	MNL 946	54	0.03315	0.6	3.7E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
07-05-1990	MDV 986	59	0.03622	0.9	5.5E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
07-11-1990	MDV 989	53	0.03253	0.9	5.5E-16	0.6	3.7E-16	1.9E-08	2	0.0012	8.1E-16
07-17-1990	MDV 992	52	0.03192	0.5	3.1E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
07-23-1990	MDV 995	53	0.03253	0.6	3.7E-16	0.6	3.7E-16	1.9E-08	2	0.0012	8.1E-16
07-29-1990	MDV 998	50	0.03069	0.6	3.7E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
08-04-1990	MNZ 652	52	0.03192	0.5	3.1E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
08-10-1990	MNZ 655	46	0.02824	<0.3	<2.E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
08-16-1990	MNZ 658	18	0.01105	0.7	4.3E-16	0.9	5.5E-16	2.8E-08	2	0.0012	8.1E-16
08-22-1990	MNZ 660	32	0.01964	1	6.1E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
08-29-1990	MNZ 662	20	0.01228	1.1	6.8E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
09-03-1990	MNZ 664	21	0.01289	0.6	3.7E-16	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
09-09-1990	MNZ 665	16	0.00982	0.6	3.7E-16	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
09-15-1990	MNZ 666	21	0.01289	0.8	4.9E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
09-21-1990	MNZ 667	19	0.01166	0.8	4.9E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
09-27-1990	MNZ 669	16	0.00982	1	6.1E-16	0.6	3.7E-16	1.9E-08	2	0.0012	8.1E-16
10-03-1990	MNZ 670	20	0.01228	0.9	5.5E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
10-09-1990	MNZ 671	22	0.01350	<0.5	<3.E-16	0.7	4.3E-16	2.2E-08	2	0.0012	8.1E-16
10-15-1990	MNZ 673	18	0.01105	0.9	5.5E-16	0.5	3.1E-16	1.6E-08	2	0.0012	8.1E-16
10-21-1990	MDV 838	22	0.01350	1	6.1E-16	0.8	4.9E-16	2.5E-08	2	0.0012	8.1E-16
10-27-1990	MDV 841	9	0.00552	1	6.1E-16	0.7	4.3E-16	2.2E-08	<1	<0.000	<4.0E-16

Table A-8. Monticello Millsite Total Suspended Particulates (PM_{10}), 1990, Station AIR-M-4

Sample Location	Sample Date	Filter Paper No.	Ticket Number	Weight (µg/F)	Concentration (µg/m^3)
AIR-M-4	03-01-1990	5537753	MDV-941	.057	34.947
AIR-M-4	03-13-1990	5537750	MDV-945	.053	32.494
AIR-M-4	03-19-1990	5545463	MDV-948	.034	20.845
AIR-M-4	03-25-1990	5545480	MDV-976	.044	26.976
AIR-M-4	03-31-1990	5545469	MDV-978	.029	17.78
AIR-M-4	04-06-1990	5545471	MDV-981	.037	22.685
AIR-M-4	04-24-1990	5545431	MDV-957	.001	.613
AIR-M-4	04-30-1990	5545429	MDV-960	.013	8.232
AIR-M-4	05-06-1990	5545424	MDV-962	.027	17.088
AIR-M-4	05-12-1990	5545422	MDV-967	.02	12.642
AIR-M-4	05-18-1990	5545417	MDV-969	.046	29.062
AIR-M-4	05-30-1990	5545414	MDV-973	.081	49.661
AIR-M-4	06-05-1990	5545289	MNL-938	.017	5.211
AIR-M-4	06-11-1990	5545286	MNL-941	.008	4.905
AIR-M-4	06-17-1990	5545285	MNL-943	.024	15.168
AIR-M-4	06-23-1990	5545281	MNL-948	.048	30.363
AIR-M-4	06-29-1990	5545279	MDV-983	.052	31.881
AIR-M-4	07-11-1990	5545264	MDV-987	.032	20.243
AIR-M-4	07-17-1990	5545261	MDV-990	.018	11.394
AIR-M-4	07-23-1990	5545258	MDV-993	.05	31.553
AIR-M-4	07-29-1990	5545255	MDV-996	.02	12.658
AIR-M-4	08-04-1990	5545252	MDV-999	.031	19.567
AIR-M-4	08-10-1990	5545249	MNZ-653	.048	30.349
AIR-M-4	08-16-1990	5545246	MNZ-656	.013	8.232
AIR-M-4	08-22-1990	5545243	MNZ-659	.033	20.894
AIR-M-4	08-28-1990	5545210	MNZ-661	.02	12.665
AIR-M-4	09-03-1990	5545208	MNZ-663	.015	9.499
AIR-M-4	09-27-1990	5545206	MNZ-668	.021	13.296
AIR-M-4	10-21-1990	5545201	MNZ-674	.014	8.864
AIR-M-4	10-27-1990	5767694	MDV-839	.018	11.398

Table A-9. Monticello Millsite Total Suspended Particulates (PM_{10}), 1990, Station AIR-M-5

Sample Location	Sample Date	Filter Paper No.	Ticket Number	Weight (µg/F)	Concentration (µg/m^3)
AIR-M-5	03-01-1990	5537752	MDV-942	.058	17.78
AIR-M-5	03-13-1990	5537751	MDV-944	.051	31.268
AIR-M-5	03-19-1990	5545464	MDV-947	.044	26.976
AIR-M-5	03-25-1990	5545466	MDV-950	.036	22.072
AIR-M-5	03-31-1990	5545468	MDV-979	.031	19.006
AIR-M-5	04-06-1990	5545479	MDV-980	.035	21.459
AIR-M-5	04-12-1990	5545475	MDV-951	.056	34.334
AIR-M-5	04-18-1990	5545433	MDV-953	.013	7.97
AIR-M-5	04-30-1990	5545427	MDV-961	.009	5.463
AIR-M-5	05-06-1990	5545423	MDV-963	.018	10.923
AIR-M-5	05-12-1990	5545421	MDV-966	.019	11.485
AIR-M-5	05-18-1990	5545418	MDV-970	.058	35.212
AIR-M-5	05-30-1990	5545415	MDV-972	.07	21.252
AIR-M-5	06-05-1990	5545412	MDV-974	.026	15.791
AIR-M-5	06-11-1990	5545287	MNL-940	.002	1.214
AIR-M-5	06-17-1990	5545283	MNL-944	.028	16.947
AIR-M-5	06-23-1990	5545280	MNL-947	.033	20.039
AIR-M-5	06-29-1990	5545278	MDV-985	.055	16.687
AIR-M-5	07-11-1990	5545263	MDV-988	.024	14.589
AIR-M-5	07-17-1990	5545260	MDV-991	.018	10.932
AIR-M-5	07-23-1990	5545257	MDV-994	.019	11.524
AIR-M-5	07-29-1990	5545254	MDV-997	.01	6.073
AIR-M-5	08-04-1990	5545251	MNZ-651	.03	18.228
AIR-M-5	08-10-1990	5545248	MNZ-654	.034	20.658
AIR-M-5	08-16-1990	5545245	MNZ-657	.017	10.329
AIR-M-5	10-15-1990	5767697	MNZ-672	.018	10.927
AIR-M-5	10-21-1990	5767696	MNZ-675	.025	15.165
AIR-M-5	10-27-1990	5767693	MDV-840	.023	13.955

Table A-10. Monticello Millsite Total Suspended Particulates (PM_{10}), 1990, Station AIR-M-6

Sample Location	Sample Date	Filter Paper No.	Ticket Number	Weight (µg/F)	Concentration (µg/m^3)
AIR-M-6	03-01-1990	5537754	MDV-940	.047	14.408
AIR-M-6	03-13-1990	5545462	MDV-943	.022	13.488
AIR-M-6	03-19-1990	5545465	MDV-946	.029	17.78
AIR-M-6	03-25-1990	5545467	MDV-949	.029	17.78
AIR-M-6	03-31-1990	5545470	MDV-977	.021	12.875
AIR-M-6	04-12-1990	5545434	MDV-952	.018	11.036
AIR-M-6	04-18-1990	5545432	MDV-954	.009	5.518
AIR-M-6	04-24-1990	5545428	MDV-956	.009	5.518
AIR-M-6	04-30-1990	5545426	MDV-959	.006	3.704
AIR-M-6	05-12-1990	5545420	MDV-965	.025	15.394
AIR-M-6	05-18-1990	5545419	MDV-968	.015	9.197
AIR-M-6	05-31-1990	5545416	MDV-971	.031	19.006
AIR-M-6	06-05-1990	5545413	MDV-975	.023	14.101
AIR-M-6	06-11-1990	5545288	MNL-939	.01	6.131
AIR-M-6	06-16-1990	5545284	MNL-942	.022	13.488
AIR-M-6	06-23-1990	5545282	MNL-946	.024	14.714
AIR-M-6	06-29-1990	5545265	MDV-986	.046	28.203
AIR-M-6	07-11-1990	5545262	MDV-989	.023	14.101
AIR-M-6	07-17-1990	5545259	MDV-992	.011	6.744
AIR-M-6	07-23-1990	5545256	MDV-995	.016	9.81
AIR-M-6	07-29-1990	5545253	MDV-998	.017	10.423
AIR-M-6	08-04-1990	5545250	MNZ-652	.021	12.878
AIR-M-6	08-10-1990	5545247	MNZ-655	.026	15.956
AIR-M-6	08-16-1990	5545244	MNZ-658	.013	7.976
AIR-M-6	08-22-1990	5545242	MNZ-660	.018	11.044
AIR-M-6	08-28-1990	5545209	MNZ-662	.013	7.97
AIR-M-6	09-03-1990	5545207	MNZ-664	.015	9.192
AIR-M-6	09-09-1990	5545205	MNZ-665	.016	9.815
AIR-M-6	09-15-1990	5545204	MNZ-666	.056	34.352
AIR-M-6	09-21-1990	5545203	MNZ-667	.013	7.976
AIR-M-6	09-27-1990	5545202	MNZ-669	.013	7.976
AIR-M-6	10-03-1990	5767700	MNZ-670	.002	1.227
AIR-M-6	10-15-1990	5767698	MNZ-673	.008	4.909
AIR-M-6	10-21-1990	5767695	MDV-838	.009	5.521
AIR-M-6	10-27-1990	5767692	MDV-841	.016	9.808

Table A-11. Monticello Millsite Wind Statistics, 1990

Degree Interval Begin	Degree Interval End	Number of Observations	Percent Frequency	Average Velocity (m/s)
.000	5.000	58.000	.961	4.165
5.000	10.000	46.000	.762	3.892
10.000	15.000	36.000	.597	3.468
15.000	20.000	39.000	.646	3.213
20.000	25.000	36.000	.597	3.126
25.000	30.000	41.000	.679	3.157
30.000	35.000	38.000	.630	3.123
35.000	40.000	21.000	.348	2.620
40.000	45.000	23.000	.381	3.110
45.000	50.000	13.000	.215	2.766
50.000	55.000	18.000	.298	2.977
55.000	60.000	12.000	.199	2.755
60.000	65.000	19.000	.315	3.278
65.000	70.000	23.000	.381	2.170
70.000	75.000	21.000	.348	2.585
75.000	80.000	24.000	.398	2.565
80.000	85.000	31.000	.514	2.618
85.000	90.000	32.000	.530	2.643
90.000	95.000	28.000	.464	2.320
95.000	100.000	31.000	.514	2.974
100.000	105.000	35.000	.580	3.210
105.000	110.000	28.000	.464	2.889
110.000	115.000	28.000	.464	2.869
115.000	120.000	27.000	.447	2.849
120.000	125.000	25.000	.414	3.503
125.000	130.000	36.000	.597	3.328
130.000	135.000	46.000	.762	3.381
135.000	140.000	77.000	1.276	3.294
140.000	145.000	62.000	1.027	3.860
145.000	150.000	79.000	1.309	3.889
150.000	155.000	101.000	1.674	4.205
155.000	160.000	94.000	1.558	4.292
160.000	165.000	130.000	2.154	4.709
165.000	170.000	139.000	2.303	4.838
170.000	175.000	143.000	2.370	4.981
175.000	180.000	145.000	2.403	4.923
180.000	185.000	167.000	2.767	5.111
185.000	190.000	173.000	2.867	5.313
190.000	195.000	172.000	2.850	5.674
195.000	200.000	150.000	2.486	5.570
200.000	205.000	158.000	2.618	5.510
205.000	210.000	144.000	2.386	5.218
210.000	215.000	104.000	1.723	4.802
215.000	220.000	142.000	2.353	4.887
220.000	225.000	113.000	1.872	4.826
225.000	230.000	95.000	1.574	4.140

Table A-11 (continued). Monticello Millsite Wind Statistics 1990

Degree Interval Begin	Degree Interval End	Number of Observations	Percent Frequency	Average Velocity (m/s)
230.000	235.000	74.000	1.226	3.956
235.000	240.000	74.000	1.226	3.898
240.000	245.000	78.000	1.292	3.587
245.000	250.000	133.000	2.204	3.174
250.000	255.000	185.000	3.065	2.836
255.000	260.000	277.000	4.590	2.897
260.000	265.000	307.000	5.087	2.980
265.000	270.000	236.000	3.911	3.120
270.000	275.000	131.000	2.171	3.448
275.000	280.000	95.000	1.574	3.635
280.000	285.000	68.000	1.127	3.207
285.000	290.000	83.000	1.375	3.845
290.000	295.000	71.000	1.176	4.102
295.000	300.000	70.000	1.160	4.147
300.000	305.000	68.000	1.127	4.208
305.000	310.000	95.000	1.574	4.753
310.000	315.000	90.000	1.491	5.139
315.000	320.000	116.000	1.922	5.162
320.000	325.000	106.000	1.756	5.303
325.000	330.000	84.000	1.392	5.454
330.000	335.000	71.000	1.176	5.196
335.000	340.000	61.000	1.011	4.675
340.000	345.000	54.000	.895	4.336
345.000	350.000	72.000	1.193	3.989
350.000	355.000	62.000	1.027	4.374
355.000	360.000	71.000	1.176	4.325

Table A-12. Fractional Frequency Table, Wind Velocity Intervals (m/s)[a]

Wind Dir.	LE 1	GT 1 LE 2	GT 2 LE 4	GT 4 LE 6	GT 6 LE 9	GT 9	Avg. Vel.
N	.0008	.0030	.0169	.0104	.0015	.0002	3.702
NNE	.0010	.0030	.0156	.0030	.0007	.0000	3.035
NE	.0008	.0028	.0066	.0017	.0005	.0000	2.818
ENE	.0027	.0063	.0081	.0010	.0015	.0000	2.585
E	.0013	.0043	.0131	.0023	.0013	.0000	2.854
ESE	.0007	.0045	.0138	.0035	.0023	.0000	3.257
SE	.0015	.0056	.0285	.0182	.0063	.0010	3.908
SSE	.0007	.0048	.0265	.0442	.0209	.0025	4.820
S	.0010	.0035	.0244	.0500	.0368	.0075	5.459
SSW	.0013	.0051	.0313	.0295	.0239	.0050	4.981
SW	.0023	.0083	.0295	.0147	.0066	.0018	3.812
WSW	.0070	.0240	.1279	.0169	.0023	.0003	2.970
W	.0017	.0043	.0418	.0164	.0028	.0002	3.555
WNW	.0013	.0027	.0220	.0224	.0106	.0017	4.580
NW	.0008	.0028	.0192	.0200	.0230	.0028	5.202
NNW	.0007	.0022	.0177	.0194	.0063	.0005	4.305
AVG. VEL.	.686	1.565	3.093	4.883	7.060	10.160	4.138

[a]LE = Less than or equal to; GT = greater than.

Table A-13. Water Chemistry Data for Monticello Millsite, 11 April 1990

Well ID REQUISITION - 4206	Ticket Number	Sample Date	Alky (mg/L) as $CaCO_3$	Alpha (pCi/L)	As (mg/L)	Beta (pCi/L)	Cdt (µmho/cm)	Dtw (feet)	Mo (mg/L)	No_3 (mg/L)	pH	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Se (mg/L)	Temp (°C)	U (mg/L)	V (mg/L)
Ground Water																	
82-08	MLY 001	04-11-1990	246	<48	<0.01	<42	2620	10	<0.01	5.07	6.4	0.3	<1	0.0072	10.7	0.076	<0.05
82-20	MLY 002	04-11-1990	298	<54	<0.01	<42	2780	16.58	<0.01	5.78	6.9	<0.1	<1	<0.005	9.4	0.009	<0.05
82-30B	MLY 003	04-11-1990	418	658	0.1	155	2590	17.43	0.33	0.21	6.98	0.4	<1	0.04	10.7	0.73	0.37
82-31B-E	MLY 004	04-11-1990	384	<65	<0.01	<56	3210	5.47	<0.01	9.42	6.97	0.2	<1	<0.005	8.9	0.021	<0.05
82-36A	MLY 005	04-11-1990	570	3400	<0.01	701	4570	50.76	0.8	32.6	7.03	5.8	<2	<0.005	11.1	4.4	0.18
82-40A	MLY 006	04-11-1990	386	688	0.044	200	2490	21.79	0.2	0.2	6.86	3.3	<1	<0.005	11.4	0.97	0.46
82-43	MLY 007	04-11-1990	246	<43	<0.01	<34	2260	8.89	<0.01	0.75	7	<0.1	<1	<0.005	8.1	0.01	<0.05
82-43 (DUPLICATE)	MLY 020	04-11-1990	No Data	<43	<0.01	<34	No Data	No Data	<0.01	0.56	No Data	<0.2	<2	<0.005	No Data	0.013	<0.05
82-45B	MLY 008	04-11-1990	304	<29	<0.01	<24	1515	4.55	<0.01	0.96	6.93	0.2	<1	<0.005	8.9	0.024	<0.05
82-51	MLY 009	04-11-1990	318	<34	<0.01	<28	1696	9.96	<0.01	0.12	6.76	0.4	<1	<0.005	10.6	0.063	<0.05
82-51 (DUPLICATE)	MLY 021	04-11-1990	No Data	<34	<0.01	<28	No Data	No Data	<0.01	0.12	No Data	0.3	<1	<0.005	No Data	0.062	<0.05
82-52	MLY 010	04-11-1990	386	36	<0.01	<28	1835	21.15	<0.01	0.13	6.86	0.1	<1	<0.005	11.2	0.09	<0.05
84-74	MLY 011	04-11-1990	213	<11	<0.01	<10	610	62.45	<0.01	0.1	7.45	1.3	2	<0.005	13.1	<0.005	<0.05
Surface Water																	
CARBONATE SEEP	MLY 019	04-11-1990	360	3127	0.54	726	2620	No Data	0.43	0.11	8.4	5.4	<2	0.035	16.4	4.5	10
MONTEZUMA CREEK	MLY 018	04-11-1990	249	48	<0.01	<33	2010	No Data	0.015	0.14	8	0.1	<1	<0.005	15.5	0.12	<0.05
SORENSON SITE	MLY 017	04-11-1990	285	272	<0.01	63	2420	No Data	0.045	0.21	8.15	1.2	<1	<0.005	16.3	0.41	<0.05
W-2	MLY 012	04-11-1990	759	836	1.7	232	7290	No Data	5.3	54.4	9.26	6	<2	0.89	15.3	1.4	89
W-4	MLY 014	04-11-1990	374	517	<0.01	134	2300	No Data	0.086	10.3	7.13	0.3	<1	<0.005	10.8	0.84	0.3
W-5	MLY 015	04-11-1990	319	<25	<0.01	<21	1318	No Data	<0.01	0.75	8.01	0.8	<1	<0.005	13.6	0.04	<0.05
QA/QC																	
EQUIPMENT BLANK	MLY 022	04-11-1990	No Data	<5	<0.01	<8	No Data	No Data	<0.01	0.13	No Data	<0.1	<1	<0.005	No Data	<0.005	<0.05
TRIP BLANK	MLY 023	04-11-1990	No Data	<5	<0.01	<8	No Data	No Data	<0.01	0.13	No Data	<0.1	<1	<0.005	No Data	<0.005	<0.05

Table A-14. Water Chemistry Data for Monticello Millsite, 16 October 1990.

Well ID Requisition 5248	Ticket Number	Sample Date	Alkly (mg/L) as $CaCO_3$	Alpha (pCi/L)	As (mg/L)	Cdt (µmho/cm)	Dtw (feet)	Pb (mg/L)	NO_3 (mg/L)	pH	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Se (mg/L)	Temp (°C)	U-234 (pCi/L)	U-238 (pCi/L)	(mg/L)
Ground Water																	
82-08	MLY 151	10-16-1990	264	95	<0.01	2470	11.16	<0.01	4.76	8.03	0.5	<2	0.0096	12.2	43.7	40.2	<0.05
82-20	MLY 152	10-16-1990	318	<76	<0.01	2410	17.8	<0.01	4.51	7.01	<1.7	<2	<0.005	9.3	5.5	2.5	<0.05
82-30B	MLY 153	10-16-1990	433	575	0.14	2240	19.05	0.293	0.16	7.34	0.4	<3	0.035	11.5	236	250	3.54
82-31B-E	MLY 154	10-16-1990	395	<102	<0.01	3120	4.46	<0.01	3.38	6.83	<1.7	<2	<0.005	13	25.1	8.3	<0.05
82-36A	MLY 155	10-16-1990	522	2547	<0.01	6930	46.69	0.578	33	6.65	5.6	<6	<0.005	10.5	1223	1254	0.283
82-40A	MLY 156	10-16-1990	408	712	0.051	2110	23.02	0.167	0.27	7.13	2.3	<3	<0.005	10.6	312	326	0.408
82-43	MLY 157	10-16-1990	281	<63	<0.01	2080	9.94	<0.01	1.6	7.19	0.3	<2	<0.005	10.8	6.2	4.6	<0.05
82-45B	MLY 158	10-16-1990	292	<46	<0.01	1574	4.75	<0.01	1.27	7.13	0.4	<3	<0.005	12.8	9.3	8.2	<0.05
82-51	MLY 159	10-16-1990	313	<41	<0.01	1388	10.51	<0.01	0.27	6.97	<1.5	<2	<0.005	10.5	17.7	16	<0.05
82-51 (DUPLICATE)	MLY 172	10-16-1990	No Data	45	<0.01	No Data	No Data	0.01	0.18	No Data	<1.4	<2	<0.005	No Data	17.8	16.6	<0.05
82-52	MLY 160	10-16-1990	340	<44	0.016	1462	22.79	<0.01	0.51	6.92	<1.4	<2	<0.005	11.5	27.9	25.8	<0.05
84-74	MLY 161	10-16-1990	220	<17	<0.01	605	64.88	<0.01	0.58	7.75	1	<3	<0.005	10.4	0.6	<0.2	<0.05
Surface Water																	
CARBONATE SEEP	MLY 170	10-16-1990	292	2612	0.4	2500	No Data	0.358	0.35	7.3	11.9	<5	0.0061	12.3	1055	1111	6.7
MONTEZUMA CREEK	MLY 169	10-16-1990	222	<43	<0.01	1605	No Data	<0.01	0.21	7.72	<1.7	<2	<0.005	11.4	6.6	5.6	<0.05
NORTH DRAINAGE	MLY 167	10-16-1990	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
SORENSEN SITE	MLY 168	10-16-1990	303	322	<0.01	2170	No Data	0.034	0.16	8.11	<1.5	<3	<0.005	12.6	151	154	<0.05
W-2	MLY 163	10-16-1990	1044	1269	2.8	6220	No Data	5.22	99.8	9.1	6.1	<3	0.89	10.1	594	604	104
W-3	MLY 164	10-16-1990	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
W-4	MLY 165	10-16-1990	338	145	0.011	2290	No Data	0.026	0.77	7.93	<1.4	<2	0.007	4.7	56.2	55.8	0.325
W-5	MLY 166	10-16-1990	374	<31	<0.01	977	No Data	<0.01	0.32	9.16	0.5	<3	<0.005	7.2	3	1.9	<0.05
QA/QC																	
EQUIPMENT BLANK	MLY 171	10-16-1990	No Data	<8	<0.01	No Data	No Data	<0.01	0.1	No Data	0.1	<2	<0.005	No Data	<0.1	<0.1	<0.05