40-8681

ENVIRONMENTAL REPORT

WHITE MESA URANIUM PROJECT

SAN JUAN COUNTY, UTAH

FOR

ENERGY FUELS NUCLEAR, INC.

Prepared By

DAMES & MOORE

January 30, 1978

09973-015-14

January 30, 1978

Energy Fuels Nuclear, Inc.
Executive Offices, Suite 445
Three Park Central
1515 Arapahoe Street
Denver, Colorado 80202

Attention: Mr. Muril D. Vincelette
Vice President of Operations

Gentlemen:

With this letter we are transmitting the 160 copies that you requested of the "Environmental Report, White Mesa Uranium Project, San Juan County Utah For Energy Fuels Nuclear, Inc."

The scope of work performed and this report are in accordance with NRC Regulatory Guide 3.8 (April 1973) Preparation of Environmental Reports for Uranium Mills. On-going studies concluding in July 1978 will provide a year's baseline data as required by NRC Regulatory Guide 3.8 and will be presented in the Supplemental Report.

It has been a pleasure to work with you on this project. If we may be of further assistance, please do not hesitate to contact us.

Very truly yours,

DAMES & MOORE

Richard L. Brittain
Principal-In-Charge

Kenneth R. Porter, Ph.D.
Project Manager

RLB/KRP/tlg

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ENVIRONMENTAL REPORT
WHITE MESA URANIUM PROJECT
SAN JUAN AND WAYNE COUNTIES, UTAH
FOR
ENERGY FUELS NUCLEAR, INC.

1.0 PROPOSED ACTIVITIES

Energy Fuels Nuclear, Inc. proposes to construct and operate an acid leach uranium mill and associated facilities for producing yellowcake uranium concentrate and, when economically feasible, limited quantities of copper and/or vanadium concentrates. Ore for the mill feed will be provided by two existing uranium ore buying stations that Energy Fuels Nuclear, Inc. operates. These ore buying stations are located near Hanksville, Wayne County, Utah and Blanding, San Juan County, Utah and have been in operation since January 1977 and May 1977, respectively. Both buying stations receive ore from independent and company owned mines within a radius of about 100 miles (mi) of each station. Virtually all of the mines supplying ore to these buying stations have operated intermittently for 20-25 years.

Energy Fuels Nuclear, Inc. presently controls by ownership, leasing or contract an estimated 19 million pounds of U_3O_8 in potential reserves. These reserves include both Hanksville and Blanding areas and have an average grade of 0.13 percent U_3O_8. In addition, the presence of a sampling plant at the mill location and the mill design will allow Energy Fuels to process custom ores.

The mill and all associated facilities, including the tailing retention system, will be located on private land owned by Energy Fuels Nuclear, Inc. The mill site, excluding the tailing retention system, will include the existing Blanding ore buying station and will occupy about 50 acres, of which 16 acres are occupied by the buying station. All processing of ore will be indoors and liquids in the mill circuit will be confined in a closed system. Conventional milling methods will be used to process the ore, including grinding, two-stage leaching, solvent extraction, precipitation and thickening, drying and packaging. Recovery of U_3O_8 is expected to be approximately 94 percent of that contained in the ore. The mill is planned to have a 2,000 tons-per-day capacity and a projected life of 15 years. Coal will probably be used as fuel for both process heat and heating of buildings.

The tailing retention system will consist of three partially excavated 70-acre cells. Each tailing cell will be surrounded by an embankment and lined with an artificial membrane to prevent seepage. Each cell is designed to contain a 5-year production of tailing and each will be constructed and used sequentially. Tailing stabilization and reclamation will be accomplished as soon as possible after each cell is filled, beginning about the fifth year of project operation for the first cell, about five years later for the second cell, and at the end of the project for the third cell. The tailing retention system will be located adjacent to the mill site. A slurry pipeline will transport tailing by pumping from the mill to the tailing cells.

Fresh water for the mill and potable needs will be supplied by wells. The total fresh water requirement is estimated to be 500 gpm. Of this, an average of 380 gpm will be required for mill make-up water.

A septic tank will be used to treat sanitary wastes and the discharge will go to a leach field. Chemical wastes from the laboratory will go to the tailing retention system.

Electricity will be supplied by Utah Power & Light Public Utility by way of an existing electric power line on the site to the mill. The total electrical capacity requirement for the mill is estimated to be 2800 KVA.

The present schedule anticipates initiation of mill construction by January 1979 and completion of construction and commencement of operation of the mill by early 1980. A request will be made to construct non-operating buildings such as office, laboratory and warehouse in advance of this schedule. The yellowcake will be transported from the Blanding mill to UF_6 conversion plants located outside Utah. After conversion and processing into fuel, the uranium will be used for fueling power plants.

2.0 THE SITE

This section includes baseline descriptions of the physical, biological and socioeconomic aspects of the environment that may be affected by construction and operation of the White Mesa Uranium project.

2.1 SITE LOCATION AND LAYOUT

The White Mesa Uranium Project site is in San Juan County, in southeastern Utah and the Four Corners Region (Plate 2.1-1). The Four Corners Region, named for the intersection of the boundaries of Utah, Colorado, New Mexico, and Arizona, is characterized by an arid climate, a sparse population base and diverse topography. It is rich in scenic beauty and mineral resources. Tourism and energy resource development have been major factors in recent growth and urbanization of the Four Corners Region.

The project region, as the term is generally used throughout this report, is the Canyon Lands Section of the Colorado Plateau physiographic province. To the north, this section is distinctly bounded by the Book Cliffs and Grand Mesa of the Uinta Basin; western margins are defined by the tectonically controlled High Plateaus section, and the southern boundary is arbitrarily defined along the San Juan River. The eastern boundary is less distinct where the elevated surface of the Canyon Lands section merges with the Southern Rocky Mountain province.

The project vicinity is defined as White Mesa. This is a relatively flat mesa of approximately 29,000 acres bounded on the west by Westwater Creek and on the east by Corral Creek, both of which are tributary to the San Juan River (Plate 2.1-2). Surface drainage patterns on White Mesa are intermittent and poorly defined. The principal community in the project vicinity is Blanding, about 6 miles north of the project site. The project vicinity is crossed in a general north-south direction by Highway 163 and is primarily used for livestock grazing and wildlife range.

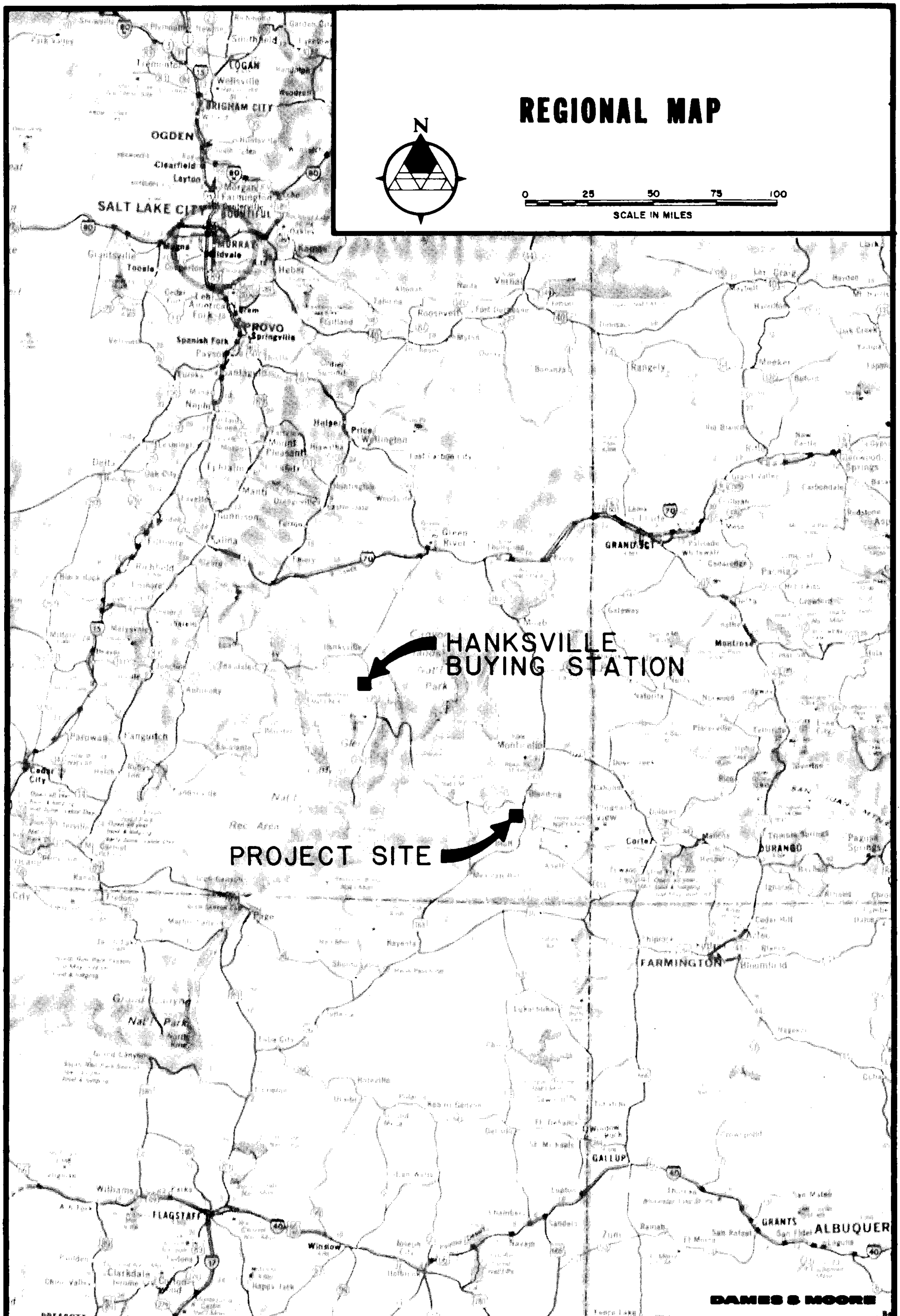

REGIONAL MAP
N
0 25 50 75 100
SCALE IN MILES
HANKSVILLE
BUYING STATION
PROJECT SITE
SALT LAKE CITY
OGDEN
LOGAN
BRIGHAM CITY
PROVO
GRAND JCT
DURANGO
FARMINGTON
GALLUP
FLAGSTAFF
ALBUQUER
PRESCOTT
DAMES & MOORE

PLATE 2.1-1

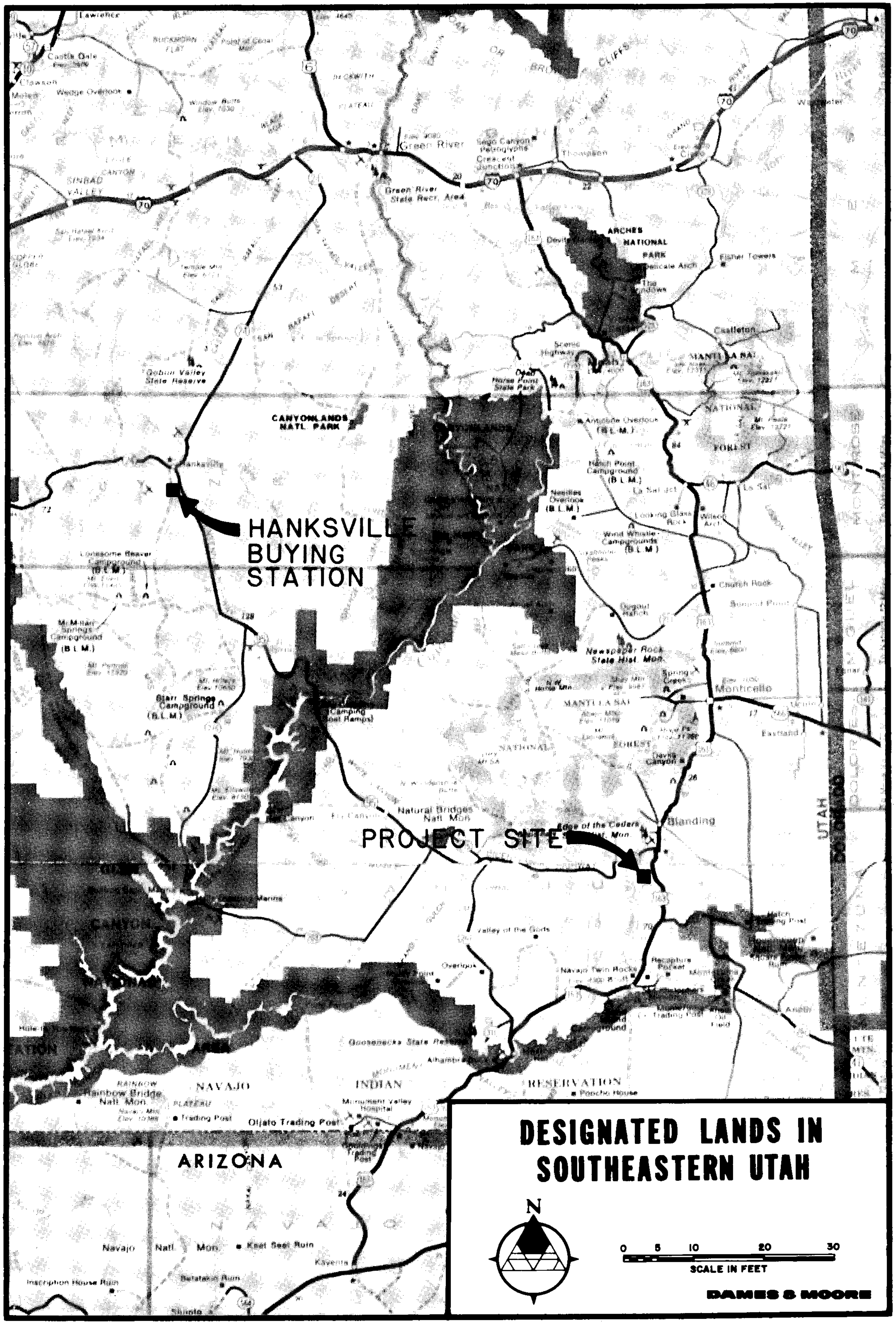

HANKSVILLE BUYING STATION
PROJECT SITE
DESIGNATED LANDS IN SOUTHEASTERN UTAH
N
0 5 10 20 30
SCALE IN FEET
DAMES & MOORE
ARIZONA
UTAH
COLORADO
ARCHES NATIONAL PARK
CANYONLANDS NATL. PARK
Green River
Hanksville
Monticello
Blanding
Natural Bridges Natl. Mon.
NAVAJO
INDIAN
RESERVATION
Rainbow Bridge Natl. Mon.
Oljato Trading Post
Kayenta

PLATE 2.2-2

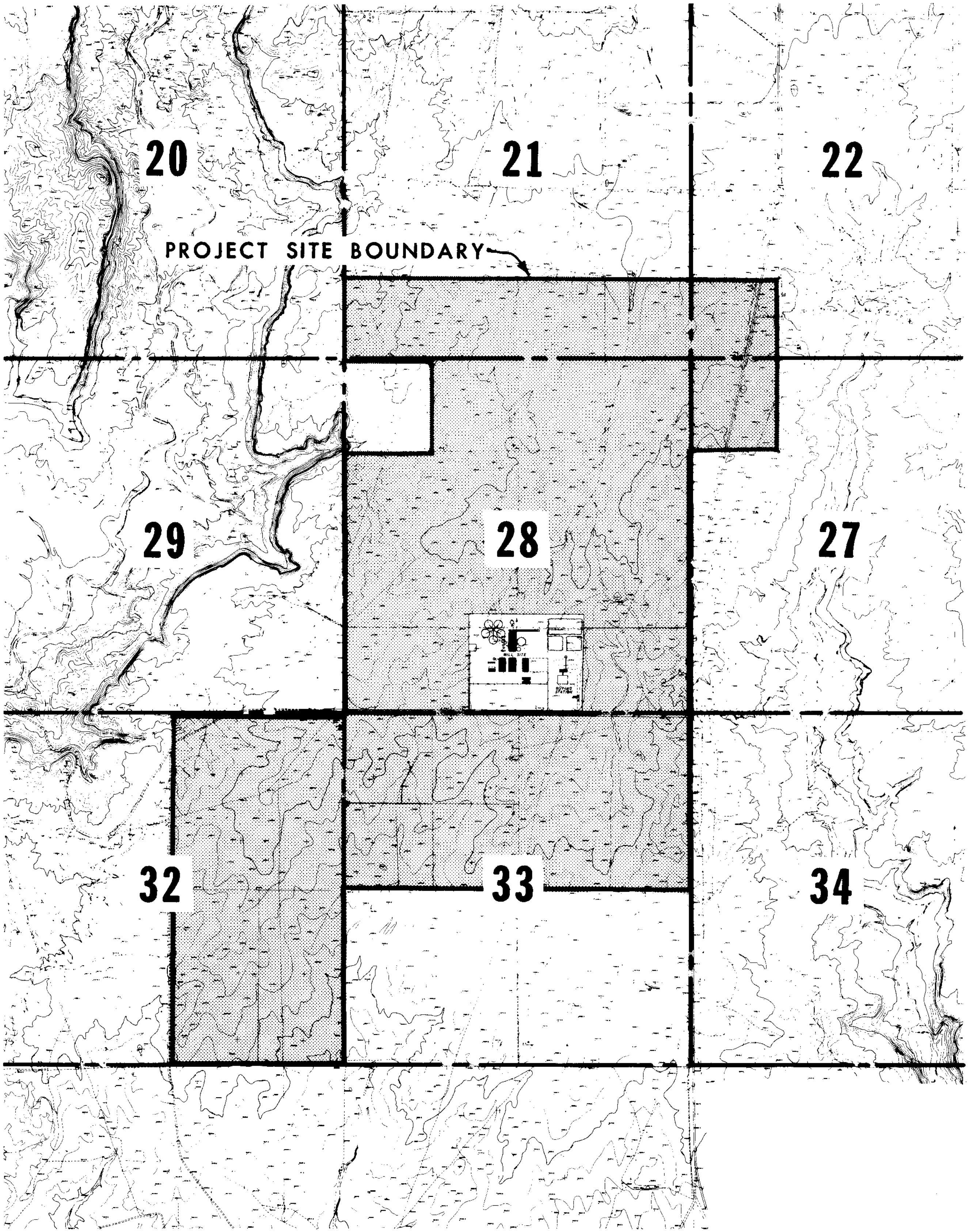
The White Mesa Uranium project site is defined as the total area owned by Energy Fuels Nuclear, Inc. near Blanding, including the existing Blanding uranium ore buying station and the proposed sites for the mill, tailing retention system, and associated facilities. This site is approximately 6 mi south of Blanding, Utah, which is the nearest town. The project site includes all of Section 28 and portions of Sections 21, 22, 27, 32 and 33 of T37S R22E (Plate 2.1-3). It comprises 1480 acres. The project site boundary shown on Plate 2.1-3 is also being used to define the restricted area. Thus, project site and restricted area are one and the same as defined here. Only a small portion of the project site will be disturbed by construction and operation of the proposed project. A total of about 77 acres (including 16 acres occupied by the existing buying station) in the southern one-fourth of Section 28 would be disturbed at the mill site. The tailing retention system will occupy a total of about 250 acres in the NE 1/4 of Section 32 and the NW 1/4 of Section 33. No disturbance is planned in Sections 21, 22 and 27. No economic deposits of oil, coal or minerals are known to be present on the project site.

As indicated previously, Energy Fuels Nuclear, Inc. owns the surface of the entire project site. The following adjoining properties are fee land:

T37S R22E Section 33, SE1/4
T37S R22E Section 21, NE1/4SW1/4
T37S R22E Section 21, N1/2SE1/4
T37S R22E Section 22, N1/2SW1/4

The surface of all other contiguous land is federally owned and administered by the U.S. Bureau of Land Management.

The existing Hanksville uranium ore buying station is located approximately 10 mi south-southeast of Hanksville, Utah in Section 36 of T29S R11E. This is about 122 mi from the Blanding uranium ore buying station and the site of the proposed mill (Plate 2.1-1).



PROJECT SITE MAP

(TOWNSHIP 37 SOUTH RANGE 22 EAST)

DAMES & MOORE

PLATE 2.1-3

2.2 REGIONAL DEMOGRAPHY AND LAND USES

2.2.1 Regional Setting

The proposed development would generate social and economic impacts of varying intensities in the project region. Social impacts associated with the uranium mill and buying station at Blanding would primarily affect Blanding and Monticello and, to a lesser extent, the small community of Bluff. The three towns are located within 30 miles of the mill site and are thus expected to share most of the population and economic growth induced by the proposed development. The primary impact area of the mill and Blanding buying station is therefore defined as San Juan County. The county is described in detail in Section 2.2.2 of this report, with special emphasis placed on Blanding, Monticello, and Bluff.

In comparison to population impacts, economic impacts of the project would affect a wider geographical area. There are no urban areas of substantial size within 60 miles of the proposed mill site. Thus, the regional service centers of Moab, Cortez, and Grand Junction would experience increased commercial activity due to population growth generated by the project, even though these cities are too far from the mill site to experience noticeable, direct population impacts.

The operation of the ore buying station at Hanksville, in Wayne County, and the transportation of ore to Blanding affect the socioeconomic impact area of the proposed development such that it includes the community of Hanksville, as well as the area traversed by Utah Route 95. The Hanksville to Blanding transportation corridor includes rural Wayne and San Juan Counties and a 30-mile segment of Garfield County. Designated areas in the Hanksville to Blanding corridor include the Glen Canyon National Recreation Area, Natural Bridges National Monument, and Manti-La Sal National Forest. A description of the existing environment of the Hanksville area and the transportation route to Blanding is presented in Section 2.2.3 of this report.

2.2.1.1 History of the Region

Southeastern Utah was sparsely inhabited by Navajo, Ute and Paiute Indians when European explorers first entered the area in 1540. The first recorded entry by whites consisted of a band of Spanish soldiers who were sent by Coronado to explore the Colorado River. Nothing more is known of the region until 1776, when the Dominguez-Escalante expedition entered Utah as part of an effort to establish a route from Santa Fe to California. During the next 70 years Utah was explored by Spanish, Mexican and Americans who came as fur trappers, tradesmen en route to California, and missionaries.

In 1846 the Mormon movement into Utah began, and by 1890 a Mormon mission was established in southeastern Utah on the San Juan River. Early inhabitants of southestern Utah included Indians, Mormons, and non-Mormon ranchers and homesteaders. Agriculture was the predominant economic pursuit, and some mining occurred in the La Sal and Blue Mountains. The area continued as an isolated, agricultural region until the 1950s, when the discovery of uranium generated a boom in population and economic activity.

2.2.1.2 Regional Demography

The population of Utah and Colorado is concentrated primarily in the major metropolitan areas of each state. The Denver-Boulder metropolitan area accounted for 56 percent of the total population of Colorado in 1976. Similarly, in 1975 the Salt Lake City-Ogden metropolitan area incorporated 65 percent of the total population of Utah. Outside of the major metropolitan areas and medium-sized cities of each state, the resident population base is thinly dispersed throughout a wide geographical area. A rugged terrain makes access to many areas difficult, and has effectively isolated much of the Four Corners region.

In the general region of the proposed Blanding Uranium Project the major population centers include Moab, Utah; Durango, Cortez and Grand Junction, Colorado; and Farmington, New Mexico. Table 2.2-1 summarizes the 1970 and 1975 populations of these cities and those of the

TABLE 2.2-1

POPULATION CENTERS OF THE PROJECT REGION

	1970 Population	1975 Population	Approximate Highway Mileage From the Project Sites: Hanksville Site (Miles)	Blanding Site (Miles)
Colorado	2,209,596	2,541,311		
Grand Junction	24,043	27,729	160	180
Cortez	6,032	6,793	215	85
Durango	10,333	11,771	260	130
Utah	1,059,273	1,202,672		
Blanding	2,250	2,768	130	5
Monticello	1,431	1,726	140	30
Bluff	119	150	140	20
Hanksville	na[a]	160[a]	10	140
Moab	4,793	4,500	120	80
New Mexico	1,017,055	1,143,827		
Farmington	21,979	27,802	290	160

[a] An official census estimate of the Hanksville area is not available because Hanksville is not incorporated. The 1975 estimate is by Westinghouse Environmental Systems Department (1977).

Source: U.S. Bureau of Census, 1976, 1977 primary impact communities of Hanksville, Blanding, Monticello and Bluff.

2.2.1.3 Regional Land Use and Ownership

This section focuses on land use and ownership patterns within 50 miles of Blanding and Hanksville, and along Utah Route 95, the Hanksville-Blanding corridor. The region includes Wayne, San Juan and Garfield Counties, Utah, and the Cortez and Dove Creek areas in Montezuma and Dolores Counties, Colorado.

The federal government owns and administers a significant proportion of land in the Four Corners Region. In San Juan County, which covers 4.9 million acres in southeastern Utah, the federal government owns 62 percent of the total land area. In south-central Utah, Wayne County encompasses 1.6 million acres, 90 percent of which are federally owned. Eighty-nine percent of Garfield County's 3.3 million acres are federal land (U.S. Soil Conservation Service, 1970). The Bureau of Land Management oversees the bulk of federal land in the region. This land is classified as multiple use and as such is leased for grazing, oil and gas exploration, and mining claims. Wildlife management and recreation uses also occur on BLM land (Verbal Communication, Ms. Opal Redshaw, BLM, Monticello Office, September 29, 1977). The U.S. Forest Service administers 450,000 acres of the Manti-La Sal National Forest in San Juan County, 162,000 acres in Wayne County, and 1 million acres of Dixie National Forest in Garfield County (U.S. Soil Conservation Service, 1970). National Forest land is also open to multiple uses, including recreation, agriculture, and timber and mineral production.

Several national parks and national monuments are located in the project region. Canyonlands National Park, Capitol Reef National Park, Glen Canyon National Recreation Area, Hovenweep National Monument and Natural Bridges National Monument are all located within 50 miles of Blanding, Hanksville, and/or Utah Route 95. Arches National Park, near Moab, and Mesa Verde National Park, east of Cortez, are located within a 100-mile radius of the project site.

Indian land reservations comprise another major category of land in the Four Corners Region. The Navajo Indian Reservation covers 24,700 square miles in Utah, New Mexico, and Arizona (McKinely Area Council of Governments, 1977). In southeastern Utah, this reservation includes 1.2 million acres. The Ute Mountain Indian Reservation encompasses 433,000 acres in southwestern Colorado, 107,500 acres in New Mexico and 13,500 acres adjacent to the Navajo Reservation in San Juan County, Utah (U.S. Bureau of Reclamation, 1977).

Non-federal land in the Utah portion of the project region is devoted almost exclusively to agriculture. However, this agricultural use is restricted by the arid climate and rugged landforms characteristic of the region. The predominant agricultural land use in south central and southeastern Utah is grazing.

Urban development in the region is limited to small, rural communities. Less than one percent of the total San Juan County acreage is classified as urban and transportation and this is accounted for by Monticello, Blanding and other communities along Route 163. In Wayne County, urban and transportation land uses represent 0.3 percent of the total acreage and are concentrated in the western portion of the county along Route 24. Urban and transportation uses cover 0.3 percent of the land area of Garfield County and are found in the western part of the county, over 50 air-miles from Route 95 (U.S. Soil Conservation Service, 1970).

Agriculture is the major use of land in southwestern Colorado. Non-irrigated and irrigated cropland and pinyon-juniper-rockland, used primarily for grazing, are the principal types of land in the Cortez and Dove Creek areas. The Ute Mountain Indian Reservation, located south and west of Cortez, is covered almost exclusively by pinyon-juniper-rockland. Urban development in Montezuma and Dolores Counties is limited to Cortez, Mancos, Dolores, and Dove Creek (U.S. Soil Conservation Service, 1976).

2.2.1.4 Transportation Facilities

The private automobile is the principal mode of transportation in the project region. Interstate 70, the major east-west highway in the region, passes through Utah in an area approximately 100 road-miles north of Blanding and 50 miles north of Hanksville. U.S. Route 163, the principal north-south highway in southeastern Utah, provides access from I-70 to Blanding and terminates at its junction with Route 160 in northern Arizona. Utah Route 95 extends 134 miles from Blanding to Hanksville, and Utah Route 24 provides access from Hanksville to Interstate 70. The above highways, with the exception of Interstate 70, are 2-lane, paved roads.

The Denver and Rio Grande Railroad provides freight service to Moab, Richfield, Green River and other portions of central Utah; no rail service extends into the Blanding or Hanksville areas. Commercial air service to the region is limited to Cortez, Durango, and Grand Junction, Colorado. Frontier Air Lines schedules flights daily to these cities. Although small municipal airports are located at Moab, Hanksville, Blanding, Monticello, Bluff and Canyonlands National Park, there is no commercial air service to the southeastern region of Utah.

2.2.1.5 Regional Economic Base

Agriculture, mining and tourism are key sectors of the economic base in the general project region. Dry bean and wheat farming and cattle production are the predominant agriculture in southeastern Utah and the Dove Creek area of Colorado. Mining activity, centering on uranium production, is on the upswing in the region and this is stimulating population growth and urban development throughout the Four Corners area. Tourism is keyed to the many diverse natural and scenic attractions. The large number of national parks, national monuments, and national forests in southern Utah and southwestern Colorado suggests that tourism will continue to be a strong factor contributing to regional economic growth in the future.

Several developments are proposed with the potential to generate social and economic changes in the region. These include the Dolores River Project, a water diversion project in Dolores and Montezuma Counties, Colorado and the Shell Oil Company's "CO-2 Project," which is a proposed pipeline from Cotez to Denver City, Texas for the transport of carbon dixoide used in oil recovery. Development of the Dolores River Project is expected to commence in 1978; final decision on the CO-2 Project is still pending (Verbal Communication, Mr. Ron Short, San Juan Basin Regional Planning Commission, September 6, 1977).

2.2.1.6 Housing and Social Service Systems

Social service systems are virtually non-existant in the Four Corners Region outside of established communities. Housing supplies and related public services are found primarily within and surrounding the towns.

Housing and social services in communities within the primary socioeconomic impact area are discussed in detail in Sections 2.2.2.6 and 2.2.3.6.

2.2.2 Blanding Area, Southeastern Utah

This section addresses the existing social and economic environment of southeastern Utah, the area potentially affected by the construction and operation of the proposed mill and by ongoing operations of the Blanding ore buying station. The primary socioeconomic impact area is contained within San Juan County. Thus, this section focuses on the county as a whole; however, Blanding, Monticello and Bluff are given special attention where appropriate.

2.2.2.1 History of San Juan County

Throughout its early history, southeastern Utah was inhabited by scattered bands of Navajo, Ute and Paiute Indians. The first recorded entry of Europeans into the region occurred in 1540, when a group of soldiers of the army of Francisco Vazquez de Cornado was sent to explore the Colorado River. The party was unsuccessful in its attempts to cross the river, due to steep impassable canyons, and turned back. Little is known of the next 200 years, although it is assumed that occasional Spanish expeditions took place as far as the Colorado River and canyons of the San Juan River. The best recorded early journey into the region was that of the Dominguez-Escalante expedition, organized in 1776 to establish a route from Santa Fe, New Mexico to Monterrey, California and to initiate contact with Indian tribes. The expedition entered Colorado at a point near Pagosa Springs, passed the present day sites of Durango and Dolores, and entered Utah near La Sal. The party then turned northward through the Grand Valley and crossed the Colorado River at Moab. By the time the group reached Sevier Lake in western Utah, winter weather had begun to set in; the voyage was therefore abandoned, and expedition members returned to Santa Fe. Although the Dominguez-Escalante expedition failed in its major purpose, the trip nevertheless provided the best documentation of the area at that time. This and other early Spanish forays into southeastern Utah helped to develop what was to become the Old Spanish Trail, the most important route through the region during the early 1800s.

During the century following the Dominguez-Escalante expedition, southeastern Utah was explored by Spanish, American and Mexican tradesmen en route to California, fur trappers and missionaries. Initially, Mexicans dominated commercial trade between New Mexico and California. American tradesmen came later, following the early trappers who were attracted to the La Sal and Blue (Abajo) Mountains in southeastern Utah during the 1820s and 1830s. By 1841, regular emigration to California began, producing a steady stream of travellers through Utah.

Although Mormon settlers began moving into Utah in 1846, San Juan County was not inhabited by whites until the late 1800s. Indians presented a constant threat to settlement of southeastern Utah. However, relations between the early Mormons and the federal government were strained; thus, the U.S. Army was not requested to assist in establishing peace with the Indians.

Ranchers from Colorado began to move into San Juan County in 1877, followed soon thereafter by Mormon missionaries and farmers. In 1878 the leaders of the Mormon Church directed a group of followers to construct a trail from Escalante, in south-central Utah, to the San Juan River. The expedition started out in April 1879 and arrived at Bluff the following year, after cutting a wagon trail through some of the most desolate, rugged territory on the continent. A mission was established in 1880 near the San Juan River in an attempt to initiate peaceful contact with the Indians and to protect the area from takeover by non-Mormons. As the Mormon mission grew into a cooperative agricultural village, the Indians learned to tolerate whites, traded with them and limited violence to the occasional theft of livestock. In return, the white settlers tolerated the Indians and minimized the establishment of outside (i.e., U.S. Army) control.

Two distinct societies grew up in southeastern Utah in the latter part of the 19th century. In Moab, La Sal and other northern portions of the region, the population was heavily non-Mormon and conformed to the traditional ideal of a western frontier society. Rugged individualism was the dominant characteristic of the northern population, which was composed primarily of cattle ranchers, miners and homesteaders. In contrast, southern San Juan County was inhabited primarily by Mormons attempting to establish an agricultural village society. The church, and not individual fortune, was the major influence over early Mormon pioneers. During the early years of inhabitation of San Juan County, three major groups of residents, including Indians, Mormons and ranchers, coexisted in a less than peaceful fashion. Confrontation between the groups was less than bloody, but constant. The county was formally established in 1880 (Perkins, et al., 1957; Peterson, 1975).

Monticello was established as a Mormon mission in 1888. Initial growth of the area was slow, due to uncertainty over water rights, which were in litigation at that time, and the possibility of the federal government designating the area an Indian Reservation. Frequent cowboy brawls further lessened the desirability of living in Monticello. In

1906 the town was described by one traveler from the east as "a wild place in the road," inhabited by 30 Mormon families (Perkins, et al., 1957). In 1910, the town of Monticello was incorporated and had 64 registered voters. Farming and cattle and sheep ranching were the principal economic pursuits of early Monticello residents.

In the early 1880s, the L.C. Ranch was established by a wealthy widow, Mrs. Lacey, on the south side of the Blue Mountains near what was to become Blanding. Mormons gradually began moving into the area and by 1905 the community, called Greyson, had a population of four families. In 1906 five more families moved in, and by 1916 the name of the town was changed and Blanding became an incorporated community. During this time Blanding received a substantial influx of Mormon families from Mexico who were driven away by the Mexican revolution (Perkins, et al., 1957).

San Juan County remained an isolated, agricultural area until the 1950s, when uranium and oil discoveries spurred significant population growth. Uranium activity and population growth rates slackened in the 1960s, and oil production, agriculture and tourism formed the economic mainstay of the area until 1975, when uranium production intensified once again. Today, San Juan County is a rural area experiencing rapid growth due to mineral exploration.

2.2.2.2 Demography of San Juan County

The largest county in Utah in terms of acreage, San Juan County is sparsely inhabited, with a 1977 population of 13,368. The 1977 average density of the county was 1.7 persons per square mile, compared to a statewide density of 14.6 persons per square mile in 1975. Table 2.2-2 summarizes the population distribution of the county and indicates that Blanding and Monticello, the county's largest communities, together account for 40 percent of the total resident population. Navajo Indians, most of whom reside on or near the Navajo Reservation, total 6,000 and represent 45 percent of the county total. Ute Mountain Indians residing at White Mesa number 295 (Written Communication, San Juan County Clerk and Recorder, March 1977).

TABLE 2.2-2

POPULATION ESTIMATES, SAN JUAN COUNTY, MARCH 1977

San Juan County total		13,368
Blanding	city	3,075
	surrounding	250
Monticello		2,208
Bluff		280
Navajos		,6000
White Mesa (Ute Mountain Indians)		295
Aneth		93
Mexican Hat		99
Monument Valley		92
Montezuma Creek		200
Cedar Point		59
Eastland & Horsehead		132
Ucolo		104
Bug Point		10
La Sal		378
Lisbon Valley		19
Boulder & "M" Ranch		15
Spanish Valley		59

Source: San Juan County Clerk and Recorder, 1977

Growth of San Juan County since the 1950s has been largely influenced by developments in the uranium industry. The population of the county increased by 70 percent from 1950 to 1960, concurrent with the region's first surge in uranium mining activity. From 1960 to 1970, the county population base experienced only a minimal (6 percent) increase. Since the early 1970s, however, San Juan County and its principal communities have experienced a steadily increasing population due to renewed interest in uranium mining and related activities. As Table 2.2-3 indicates, the 1975 county population was 11,964, representing a 24.5 percent increase since 1970. From 1975 to 1977, the growth rate increased and in March 1977 the county reached a population of 13,368. Since 1975 Bluff and Monticello have outpaced the rest of the county in terms of growth, while Blanding's growth has almost matched the countywide 11.7 percent increase.

Demographic Characteristics

Table 2.2-4 summarizes selected demographic characteristics for San Juan County and Utah and indicates significant social and economic differences between the county's population and that of the state as a whole. The county's population is heavily non-white, and native Americans account for most of this segment. The county had a significantly higher proportion of residents with less than 5 years of schooling and an overall lower median educational attainment than the statewide average. The median family income of San Juan County residents represented only 70 percent of the statewide median family income. Also, 33 percent of the families of San Juan County were below the poverty level in 1969, compared to 9 percent throughout the state.

Seasonal Population

Southeastern Utah experiences a significant influx of tourists each year. Table 2.2-5 summarizes visitor statistics for recreation areas in the region. The figures reveal variations in visitor use of each area, with an overall increasing trend at each location other than Manti-La Sal National Forest.

TABLE 2.2-3

HISTORICAL POPULATION ESTIMATES, BLANDING AREA

	1950	1960	1970	1973	1975	Percent Increase, 1970 to 1975	1977	Percent Increase, 1975 to 1977
San Juan County	5,315	9,040	9,606	11,303	11,964	24.5	13,368	11.7
Blanding	1,177	na[a]	2,250	2,651	2,768	23.0	3,075	11.1
Monticello	1,172	na[a]	1,431	1,657	1,726	20.6	2,208	27.9
Bluff	na[a]	na[a]	119	140	150	26.1	280	86.7

[a]na denotes data are not available, because communities of less than 2,500 residents were not contained in certain census reports.

Sources: 1950 to 1975 estimates from U.S. Bureau of Census, 1960, 1977
1977 estimates from San Juan County Clerk, 1977

TABLE 2.2-4

SELECTED DEMOGRAPHIC CHARACTERISTICS,
SAN JUAN COUNTY COMPARED TO UTAH, 1970

	San Juan County	Utah
Total Population	9,606	1,059,273
Race		
White	5,153	1,033,880
Other (%)	46.4	2.4
Foreign Born (%)	5.2	12.4
Leading Country of Origin	Mexico	United Kingdom
Education		
Median School Years Completed (Population 25 years and over)	10.7	12.5
Percent of Population with less than 5 years	27.0	2.0
Percent of Population with 4 years of college or more	8.8	14.0
Age		
Median Age	18.0	23.0
Percent under 5 years	13.9	10.6
Percent 5-17	36.0	29.6
Percent 18-64	45.6	52.5
Percent 65+	4.5	7.3
Income, 1969		
Median Family Income ($)	6,601	9,320
Percent of Families Below Low Income Level	33.2	9.2
Housing - occupied unit (number)	2,206	297,934
Average persons per unit	4.3	3.5
Lacking Some or all Plumbing Facilities (%)	32.2	1.8
With 1.01 or more persons per room (%)	39.8	10.0

Source: U.S. Bureau of Census, 1973

TABLE 2.2-5

VISITOR STATISTICS, RECREATION AREAS SOUTHEASTERN UTAH[a]

Area	Visitors (Thousands) 1972	1973	1974	1975	1976	1977 (Jan-Sept)
Glen Canyon N.R.A.						
Canyonlands N.P.	60.8	62.6	59.0	71.8	80.0	67.3
Manti-La Sal National Forest (visitor days)[b]	105.3	100.9	88.7	76.4		na[d]
Capitol Reel N.P.	272.0	311.2	234.0	292.1	469.6	364.2 (thru Aug)
Hovenweep N.M.[c]	12.1	12.0	11.0	13.2	19.4	16.2
Natural Bridges N.M.	58.5	42.7	40.3	48.4	71.9	67.1

[a]Data refer to actual visitations for each area except Manti-La Sal National Forest. Here, data indicate recreation visitor days. A visitor day is the equivalent of 1 person entering an area for 12 hours.

[b]Data refer to the Monticello Ranger District only.

[c]Data refer to the Square Tower Ruin Unit, near Blanding.

[d]Indicates data not available.

Projected Population

Table 2.2-6 presents population projections for Utah and San Juan County. The "high" projection, based on the assumptions of a gradual decline in mortality, constant fertility and positive net migration, forecasts a population of 33,300 in San Juan County by the year 2000, representing a 160 percent increase over the 1975 population level. In comparison, the high projection for the State shows a 78 percent increase from 1975 to 2000. A population base of 33,300 in San Juan County would represent a density of 4.3 persons per square mile, significantly lower than the 1975 statewide average of 14.6 persons per square mile.

Comparing these growth projections to estimates by the U.S. Bureau of Census and the San Juan County Clerk reveals that actual growth from 1970 to 1975 was below the "low projection," defined as a gradual decline in mortality, constant fertility and no net migration. However, from 1975 to 1977 the county apparently began to catch up with the projections outlined in Table 2.2-6. From 1975 to 1977, the county population increased approximately 5.9 percent annually. If this rate continues, the 1980 population of San Juan County would be 15,730, approximately midway between the high and low projections for that year.

Population Within A 5-Mile Radius of the Mill Site

The area within 5 miles of the proposed mill site is predominantly agricultural land owned by residents of Blanding (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, September 7, 1977). One farmhouse, located approximately one mile north of the mill site, is owned by a couple residing in Blanding and rented to a family of four (Verbal Communication, Mrs. Clisbee Lyman, November 2, 1977). A mobile home associated with a service station at the intersection of Routes 95 and 163 is occupied by 4 people (Verbal Communication, Mr. Willie Tortlita, Vowell and Sones Oil Co., 1977); this is within 3 miles of the mill site. Three persons live at the Blanding airport approximately 3.5 miles north of the project area. In addition, an average of 30 to 40 persons fly in and out of the airport each day (Verbal Communication, Mr. John Hunt, Manager, Blanding Airport, November 2, 1977).

TABLE 2.2-6

POPULATION PROJECTIONS[a]

	1975[b]	1980	1990	2000	Percent Increase, 1975-2000
Utah					
high	1,216,843	1,420,553	1,803,985	2,163,927	78
low	1,206,584	1,302,815	1,484,231	1,655,528	37
San Juan County					
high	12,816	17,373	26,002	33,300	160
low	12,716	13,954	16,917	19,753	55

[a]Figures shown indicate high and low projections; (see text for definitions); high medium and low medium are also presented in the reference.

[b]U.S. Census estimates for 1975 indicate a statewide population of 1,202,672, which is below the "low" projection presented in this table. In San Juan County, 1975 population was 11,964, which is also below the "low" projection.

Source: Utah Agricultural Experiment Station, December 1976. Population Projections by Age and Sex for Utah Counties, 1970-2000.

Southeast of the proposed mill site is White Mesa, a community of 295 Ute Mountain Indians. The homes associated with White Mesa are dispersed throughout a 4 to 5-mile area, and the northern edge of the community is approximately 3.5 miles south of the mill site. It is estimated that eight to ten of the families in White Mesa reside within 5 miles of the project area. This would represent between 60 and 75 persons, assuming an average of 7.4 persons per household in the community (Verbal Communications, Mr. Cleal Bradford, Utah Navajo Development Council and Ms. Anne Robinson, Ute Mountain Tribal Housing Authority, November 2, 1977).

Plate 2.2-1 summarizes permanent population estimates of the area within about 7 miles of the proposed mill site. Utah Route 163, the major north-south highway in southeastern Utah, provides access to the proposed mill site from Blanding. The mill would be located approximately one-half mile west of this highway. In 1975, the average daily traffic on Route 163 at a point eight miles south of Blanding was 740 vehicles. Between 27.5 percent and 32.49 percent of this traffic consisted of out of state vehicles; from 7.5 to 12.49 percent consisted of heavy truck traffic (Utah Department of Transportation, 1976).

2.2.2.3 Land Use and Ownership

The southeast corner of Utah, known as the Canyonlands area, is characterized by a dry climate and a rugged terrain featuring rocky buttes, mesas, escarpments, and narrow canyons. These landforms have resulted in limited access to the region and, together with the arid climate, have restricted agricultural and urban development. At the same time, unique rock formations and ancient Indian ruins, found in abundance in southeastern Utah, have made the area an increasingly popular destination for tourists.

Land ownership patterns of San Juan County are dominated by federal and Indian land, which encompass approximately 60 percent and 25 percent, respectively, of the total county land area. In San Juan County, Indian land includes over 1.2 million acres of the Navajo Reservation and 13,500

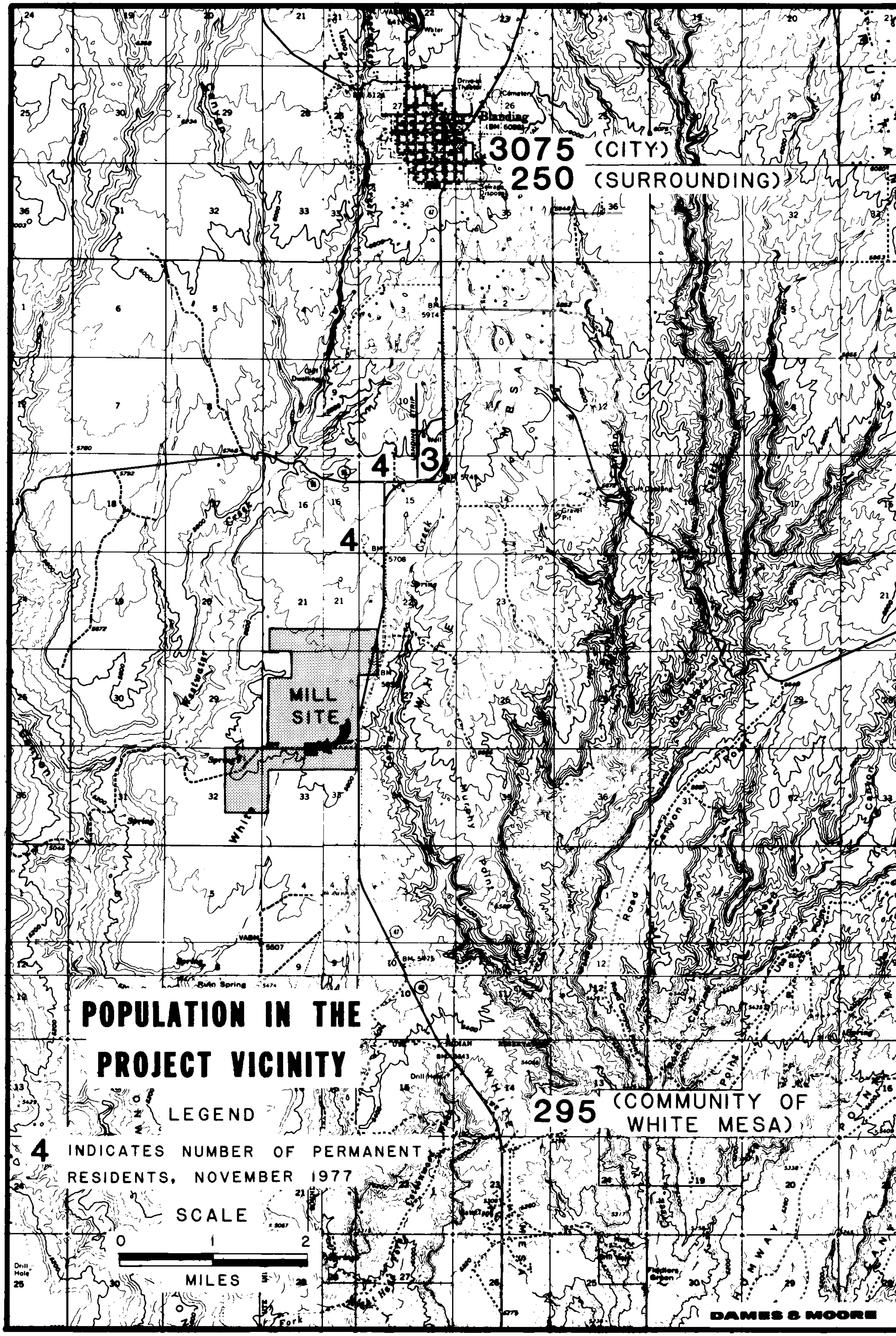

3075 (CITY)
250 (SURROUNDING)
Blanding
4
3
4
MILL SITE
POPULATION IN THE PROJECT VICINITY
LEGEND
4 INDICATES NUMBER OF PERMANENT RESIDENTS, NOVEMBER 1977
SCALE
0 1 2
MILES
295 (COMMUNITY OF WHITE MESA)
DAMES & MOORE

PLATE 2.2-1

acres of the Ute Mountain Indian Reservation, adjacent to the Navajo Reservation on the north (U.S. Bureau of Reclamation, 1977). In addition, the Glen Canyon National Recreation Area, Canyonlands National Park, Manti-La Sal National Forest, and numerous national and state monuments in the county are well known tourist and recreation sites. Federal land is typically classified as mulitple use and, as such, is leased for grazing, oil and gas exploration, mining claims, timber production, and wildlife management (Verbal Communication, Ms. Opal Redshaw, BLM, Monticello Office, September 29, 1977). The Bureau of Land Management administers the largest portion of federal land in San Juan County, consisting of approximately 2 million acres. The National Park Service has responsibility for 570,000 acres, the U.S. Forest Service manages 450,000 acres, and the Bureau of Reclamation oversees 1,200 acres in San Juan County (Utah State Forestry and Fire Control, 1975).

Private land accounts for only 8 percent of San Juan County's 4.9 million acres. Table 2.2-7 outlines land ownership patterns in the county and Plate 2.2-2 depicts the location of designated lands in the general region.

Approximately 40 percent of San Juan County is non-federal land, devoted almost exclusively to agriculture. Aridity has a pronounced effect on agricultural land uses; the growing seasons are extremely variable, and summer heat causes evaporation to substantially exceed precipitation (Battelle Memorial Institute, 1972). As a result, grazing is the predominant agricultural land use, and crop production is centered on dry farming, which produces primarily wheat and beans. Table 2.2-8 summarizes land use acreages for the county.

Residential, commercial and industrial land uses are limited to small, rural communities; there are no sizeable cities in San Juan County. Population centers occur primarily along U.S. Route 163, the region's principal north-south highway. The largest communities in the county are Blanding and Monticello. Urban and transportation land uses account for 0.3 percent of the total land area of San Juan County.

TABLE 2.2-7

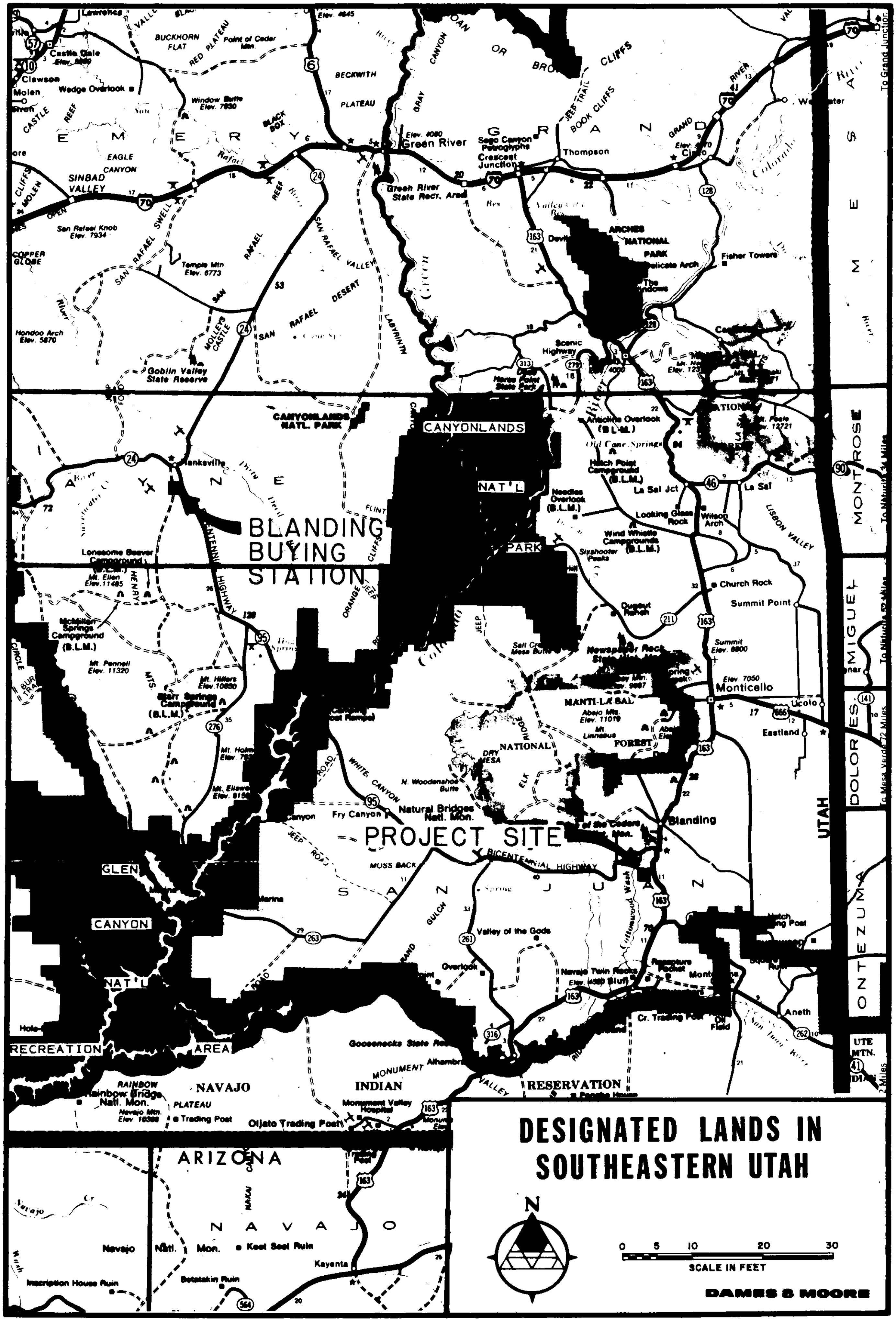
LAND OWNERSHIP IN SAN JUAN COUNTY, 1967

Ownership	Acres	Percent of County Total
Federal	2,985,630	59.8
Indian	1,247,563	25.0
Private	416,600	8.3
State	325,317	6.5
Urban and Transportation	15,253	0.3
Small Water[a]	997	---[b]
Total	4,991,360	

[a]Includes water areas of 2 to 40 acres and streams less than one-eight mile in width.

[b]Less than 0.1 percent.

Source: U.S. Department of Agriculture, 1970



DESIGNATED LANDS IN SOUTHEASTERN UTAH

PLATE 2.2-2

TABLE 2.2-8

LAND USE IN SAN JUAN COUNTY, EXCLUDING FEDERAL LAND,[a] 1967

	Acres	Percent of Total Non-Federal
Cropland	146,016	7.3
Irrigated	7,111	0.4
Non-irrigated	138,905	6.9
Pasture	60,531	3.0
Range	1,263,007	63.0
Forest	462,318	23.0
Other	57,608	2.9
Urban and Transportation	15,253	0.8
Small water[b]	997	---[c]
Total Non-Federal Land	2,005,730	100.0
Federal Land	2,985,630	---
Total County Acreage	4,991,360	---

[a]Water areas of more than 40 acres and rivers wider than one-eighth mile are also excluded.

[b]Includes water ares of 2 to 40 acres and streams less than one-eighth mile in width.

[c]Less than 0.1 percent.

Source: U.S. Soil Conservation Service, 1970.

Land Use Within a 5-Mile Radius of the Site

The proposed mill would be located near the existing Energy Fuels Blanding ore buying station, approximately 6 miles south of Blanding. Access to the site is provided via U.S. Route 163 from Blanding. The surrounding area is predominantly agricultural, consisting of grazing land, limited cropland, and some pinyon-juniper areas. A small airpark is located 2.5 miles north of the proposed mill site, and another uranium ore buying station operated by Plateau Resources, Ltd., is located near the intersection of Utah Route 95 and Route 163, approximately 2.5 miles north of the Energy Fuels property. A small, highway-related commercial establishment is also located at this intersection. An access road to a U.S. Army installation intersects Route 163 approximately 1.2 miles north of the Energy Fuels turnoff. This is a radar facility and is part of the Blanding Launch Site of the Utah Launch Complex, operated by the White Sands Missile Range. Several small buildings connected with this operation are located approximately 0.5 to 1 mile east of Route 163. In addition, the actual Launch Site is in Section 2 of Township 38S, Range 21 E, approximately four miles southwest of the proposed mill site. The Blanding Launch site has not been used for five or six years, due to military budgetary constraints. The possibility of future operation of the site is under study by the Army (Verbal Communications, Mr. Ed White, Public Affairs, White Sands Missile Range, and Mr. F. Sedillo, Facilities Planning, White Sands Missile Range, January 17, 1978).

The northern edge of the Ute Mountain Indian community of White Mesa lies within 3.6 miles of the proposed mill site. The homes of White Mesa residents are located on both sides of Route 163 and extend in a north-south direction for approximately 3-4 miles.

2.2.2.4 Transportation Facilities

The highway system in San Juan County consists of two-lane paved highways and smaller, unimproved roads. U.S. Route 163, the major north-south highway in the region, extends from Interstate 70 to Route 160 in northern Arizona. Interstate 70 is approximately 100 miles north of Blanding, and cuts through Grand County north of Moab.

Utah Route 95 provides access from Blanding to western San Juan County, Glen Canyon and Hanksville. This road has been designated the Bicentennial Highway because its paving was completed in 1976.

The average 1975 daily traffic volume of highways in the region is summarized in Table 2.2-9. The table indicates that the point of heaviest traffic flow in San Juan County occurred near Monticello, where 2685 vehicles per day were counted on Route 163. The figures also indicate a high proportion of out of state vehicles in the area.

Although complete traffic volume data are not available for 1977, estimates have been made for flows near Hanksville and Monticello. For the 1975 to 1977 interval, the data reveal an increase of 33 percent in traffic on Route 95 south of Hanksville, and a 43 percent increase on Route 163 near Monticello (Utah Department of Transportation, June 1977).

There is no rail or air service to San Juan County. The closest rail connection is in Moab, to which the Denver and Rio Grande Western Railway provides freight service. Although municipal airports are located in Blanding, Bluff, Monticello, and Canyonlands National Park, regularly scheduled commercial air service is not provided to southeastern Utah. Grand Junction and Cortez, Colorado are the locations of the closest airline connections (Utah Industrial Development Information System, 1973).

There is no bus service to San Juan County. Continental Trailways provides intercity bus service to Moab.

2.2.2.5 Economic Base

San Juan, Grand, Carbon and Emery Counties comprise the Southeastern Utah Planning District, one of the most rapidly growing areas of the state. Coal and uranium development is the major impetus behind recent growth trends. Mining, construction, transportation, finance, and services are the areas exhibiting the fastest gains in employment during

TABLE 2.2-9

TRAFFIC VOLUME, 1975

Highway	Segment	Average Daily Traffic Counts[a]	Approximate Percentage of Out of State Passenger Traffic
Utah Route 95	Blanding to Natural Bridges N.M.	310	20%
	Natural Bridges to Hite	95	10%
	Hite to Hanksville	95 - 290	10% - 20%
U.S. Route 163	Monticello to La Sal Junction	1490 - 2685	20% - 35%
	Monticello to Blanding	860 - 1895	10% - 25%
	Blanding to Utah Route 262 turnoff	740 - 925	20% - 30%
	Utah Route 262 to Bluff	530	40%
	Bluff to Mexican Hat	560	40%
Utah Route 276	Route 95 to Bullfrog Basin at Glen Canyon	220	25%
Utah Route 263	Route 95 to Halls Crossing at Glen Canyon	25 - 35	20%
Utah Route 261	Route 95 to Mexican Hat	130	50%

[a]Two figures in this column represent a range of values given for different points on the Traffic Volume Map. One figure indicates that a traffic count was taken at only one location.

Source: Traffic Volume Map, Utah Department of Transportation, 1976.

the year ending July 1977. During this time, total nonagricultural payroll employment in the region increased by 1,400, almost half of which was due to mining (Utah Department of Employment Security, 1977).

The economic base of San Juan County is heavily tied to the mineral extraction, agriculture and tourism industries. This county is the largest uranium producer in Utah and had several large mines and numerous intermediate-sized mines active in September 1977. One of the two uranium mills in the state is located near La Sal, in San Juan County; the second mill is located in Moab, approximately 70 miles north of Blanding (Written Communication, Larry Trimble, Utah Geological and Mineral Survey, September 29, 1977). In addition to uranium, natural gas and crude oil are the principal resources under development in southeastern Utah. The Aneth Oil Field, located in southern San Juan County, is the second largest field in Utah. Although oil production has been declining since 1974, it is still an important source of employment and income in the region. In 1976, oil production in San Juan County totaled 9.8 million barrels, representing a decline of 2.5 percent from the 1975 level of production. In contrast, natural gas production has been increasing steadily since 1975 (Utah Department of Employment Security, 1977).

Historically, agriculture has played a major role in the development of San Juan County. Due to an arid climate and rugged terrain, cattle and sheep grazing and dry land farming are the major agricultural activities. The principal crops produced in the county are wheat and beans (Verbal Communication, Mr. Lyman, Manager, Blanding Office of Employment Security, September 7, 1977). Agricultural production statistics for 1974 are summarized in Table 2.2-10. It should be noted that, although data are not available for bean production on a county basis, it is an important item in San Juan County. In 1976, the statewide production of dry beans was valued at $600,000 (State of Utah, Department of Agriculture, 1977).

TABLE 2.2-10

CROP PRODUCTION AND LIVESTOCK INVENTORY,
SAN JUAN COUNTY, 1974

Item	Unit of Measurement	Production
Wheat	Bushels	566,316
Oats	Bushels	10,510
Barley	Bushels	9,962
Corn for Grain or Seed	Bushels	637
Corn for Silage	Acres	300
Potatoes	100-weight	438
Hay and Grass Silage	Tons	9,517
Alfalfa Hay	Tons	6,233
Wild Hay	Tons	25
Cattle and Calves	Number	25,266
Sheep and Lambs	Number	11,894
Hogs	Number	526
Chickens over 2 mos.	Number	2,244

Source: U.S. Bureau of Census, 1974.

San Juan County offers a wide variety of scenic and historic features that draw tourists from a large geographical area. Tourism appears to be on the upswing in southeastern Utah; in 1976 tourist room sales in San Juan County, as well as total taxable sales, exhibited a 14 percent increase over 1975 levels, and tourist activity during 1977 has promised to reach even higher levels (Utah Department of Employment Security, 1977; Verbal Communication, Manager, Blanding Office of Employment Security, September 7, 1977). The importance of tourism is reflected in rates of employment in retail and service sectors.

Table 2.2-11 summarizes employment by industry in San Juan County and indicates that mining and government are the two largest sources of employment in the county. These two sectors accounted for 50.6 percent of total county employment in April 1977. Trade, services and agriculture are other important sources of employeemnt in the county.

Manufacturing in San Juan County is limited to four establishments in Blanding and four in Monticello. As summarized in Table 2.2-12, a variety of goods is produced by the local firms. Employment at each establishment ranges from less than 10 to 199.

According to a 1972 study, southestern Utah is deficient in key factors that are conducive to industrial growth. The lack of skilled labor, an absence of industrial buildings, the unavailability of financing, inadequate housing supplies and poor access to materials have been cited as the major barriers to industrial development in southeastern Utah (Battelle Memorial Laboratories, 1972).

Table 2.2-13 summarizes labor force and employment in San Juan County and indicates that employment growth has outpaced increases in the labor force since 1975. The unemployment rate for the county declined from a 1975 average of 10.6 to 8.6 in July 1977. For the same time periods, the statewide average unemployment rates were 7.2 and 6.1, respectively. Higher than average unemployment in southeastern Utah is

TABLE 2.2-11

EMPLOYMENT BY INDUSTRY,
SAN JUAN COUNTY[a]

	1976 Average		April 1977	
	Number	Percent of Total	Number	Percent of total
Nonagricultural Payroll Employment Total	2,523	90.3	2,306	89.5
Mining	784	28.1	683	26.5
Contract Construction	70	2.5	43	1.7
Manufacturing	169	6.1	140	5.4
Transportation, Communication, Utilities	147	5.3	139	5.4
Wholesale, Retail Trade	347	12.4	353	13.7
Finance, Insurance, Real Estate	22	0.8	22	0.9
Services	296	10.6	305	11.8
Government	688	24.6	621	24.1
Agricultural Employment	270	9.7	270	10.5
Total Payroll and Agricultural Employment	2,793	100.0	2,576	100.0

[a]Preliminary Estimates

Source: Utah Department of Employment Security, 1977

TABLE 2.2-12

LOCATION OF MANUFACTURING ESTABLISHMENTS, SAN JUAN COUNTY, 1977-1978

Location	Firm	Product	Employment Range
Blanding	Canyonlands 21st Century Corp.	Secondary Smelting and Refining	25-49
	Hurst Cabinet Shop	Wood Kitchen Cabinets	1-9
	Southern Utah Industries	Clothing	100-199
	Thin Bear Indian Arts and Crafts	Jewelry	1-9
Monticello	Blue Mountain Meats, Inc.	Meat Packing	25-49
	Four-Point Deer Processing	Meat Packing	1-9
	San Juan Record	Newspaper	1-9
	Youngs Machine Co.	Mining Machinery	10-24

Source: Utah Job Service, 1977

TABLE 2.2-13

CIVILIAN LABOR FORCE, EMPLOYMENT,
AND UNEMPLOYMENT RATES IN SAN JUAN COUNTY

	July 1977	1976	1975
Labor Force	4,270	4,409	4,211
Employed Persons[a]	3,903	3,980	3,763
Unemployment Rate	8.6	9.7	10.6

[a]This total does not correspond to the employment total in Table 2-11 because it is a broader category, including the self-employed, unpaid family and domestics. Table 2-11 includes agricultural and non-agricultural payroll employment only.

Source: 1977 estimate from the Blanding Office of Employment Security 1975, 1976 estimates from Utah Department of Employment Security, 1977.

due partly to the seasonal nature of agriculture and tourism, both of which are important sources of jobs in the area.

In addition to the unemployed, a number of local residents who have jobs but are actively seeking alternative employment have registered with the Blanding Office of Employment Security. In the first three months of 1977, that office reported over 800 active job applicants. The occupational characteristics of the applicants, summarized in Table 2.2-14, indicate that a substantial labor pool exists in categories related to the construction and machine trades. The data suggest that Energy Fuels may be able to hire a significant proportion of its work force from the local labor pool.

It should be noted that problems associated with unemployment and underemployment are not shared equally by all area residents. In April 1977 the Navajo Nation contained a potential labor force of 65,600; 16 percent of these people were unemployed and actively seeking work. Of the 40,000 tribal members who were employed at that time, 21 percent were earning less than $5,000 per year (Navajo Area Office of Vital Statistics, 1977). In the Blanding area, 76 percent of the active job applicants in early 1977 were Indians (Utah Department of Employment Security, 1977).

Per capita income in San Juan County was $3,300 in 1976, representing only 61 percent of the statewide average of $5,400. Table 2.2-15 indicates that, while income in San Juan County has remained well below the statewide average since 1973, its rate of growth has exceeded that of the state's in the recent past. Income in the county can be expected to continue to rise due to increased industrial and commercial activity. The forces which are expected to contribute to future economic growth in San Juan County are summarized below.

<u>Uranium</u> - Mining activity in San Juan County is centered on uranium production. Almost 100 new mining jobs opened up in the county during the year ending in July 1977, which have stimulated retail trade,

TABLE 2.2-14

OCCUPATIONAL CHARACTERISTICS OF JOB APPLICANTS, QUARTER ENDING, 3-31-77, BLANDING AREA

Total Applicants[a]	838
Professional, Technical, Managerial	57
Clerical, Sales	60
Service	122
Farm, Fisheries, Forestry	79
Processing	5
Machine Trades	47
Bench Work	75
Structural Work	285
Miscellaneous	108

[a] Includes persons actively seeking employment, some of whom were employed at the time.

Source: Utah Department of Employment Security, Job Service, 1977

TABLE 2.2-15

PER CAPITA INCOME, SAN JUAN COUNTY
COMPARED TO THE STATE, 1973-1976
(Dollars)

	1973	1974	1975	1976	Percent Increase 1973-1976
Utah	4,100	4,500	4,900	5,400	32
San Juan County	2,100	2,500	3,000	3,300	57

Source: 1973-1974, U.S. Department of Commerce, Bureau of Economic Analysis
1975-1976, Utah Department of Employment Security, Research and Analysis Section

residential construction, and other service industries (Utah Department of Employment Security, 1977). In addition to the Energy Fuels buying station, a uranium ore buying station is in operation in the area south of Blanding, and there is a possibility that the operator, Plateau Resources, Ltd., will construct a uranium mill (Verbal Communication, Manager, Blanding Employment Security Office, September 7, 1977). The exact number of active mines in the county is not known but is estimated to be 100-200, the majority of which are relatively small. Since 1975 regional uranium activity has intensified, and the Energy Fuels and Plateau Resources buying stations have been partially responsible for this upswing (Written Communication, Mr. Larry Trimble, Utah Geological and Mineral Survey, September 1977).

Navajo Reservation - The Utah Navajo Development Council (UNDC) oversees a long-term fund for the development of housing, cultural, educational and health facilities and agricultural capabilities on the Reservation. The fund is designed to benefit Navajo Indians in San Juan County. One major project of the UNDC is the construction of the Broken Arrow Center, a Native American cultural center adjacent to the new Edge of Cedars State Park near Blanding. Upon completion, the center is expected to contribute substantially to the tourism/recreation industry in the Blanding area (Verbal Communication, Manager, Blanding Office of Employment Security, September 7, 1977).

Construction of a marina on the San Juan branch of Lake Powell has been proposed by a private company. The marina, currently in the early planning stages, will be located on the Navajo Reservation and will further stimulate recreational activity in the general area (Verbal Communication, Manager, Blanding Office of Employment Security, September 7, 1977).

Support Services - Contiuned uranium, natural gas and oil production will ensure a strong demand for transportation and other industrial support services in the future. The Moab to Blanding corridor is expected to be used heavily to transport supplies to southeastern Utah from

Moab, the location of the closest rail connection (Verbal Communication, Mr. M.B. Lincoln, Manager, Moab Office of Employment Security, September 9, 1977). Also, increased tourism and regional population growth due to industrial development will further stimulate the construction and service industries in the county, in particular in Blanding and Monticello.

2.2.2.6 Housing and Public Services

San Juan County provides a range of public services, including general administration, police and fire protection, maintenance of roads and health and recreation facilities, and television reception. Table 2.2-16 summarizes 1975 and 1976 General Fund expenditures of the county and indicates that road maintenance is the largest expense, representing 43 percent of total General Fund expenditures in 1976.

Public Services in Blanding

The population of Blanding grew by approximately 4.6 percent per year from 1970 to 1975. Since 1975, growth has accelerated to a rate of almost 8 percent annually, primarily due to increased uranium mining activity. City officials expect Blanding to reach a population of 4,500 by 1981, which represents an annual growth rate of approximately 10 percent (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, October 12, 1977).

Planning for growth is an ongoing process in Blanding, tied to expectations of a population of 4,500 by 1981. City officials appear confident that continual improvement of facilities will enable the city to keep up with incrased demand in the future; services will be provided as a response to growth on an as-needed basis (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, October, 12, 1977).

Table 2.2-17 summarizes budgeted General Fund Expenditures for fiscal year 1977 and indicates that the largest single expenditure category is the electric, water and sewer fund. Outlays for this fund

TABLE 2.2-16

SUMMARY OF SAN JUAN COUNTY GENERAL FUND EXPENDITURES

Departments		1976 Budget	1977 Approved Budget
Commissioners		31,950.	31,950.
District Court		3,150.	3,150.
J.P. Courts		11,725.	15,000.
Other Judicial		6,500.	6,500.
Clerk-Auditor		35,900.	40,250.
Recorder		33,880.	36,980.
Attorney		24,200.	24,100.
Treasurer		14,200.	16,380.
Assessor		27,870.	28,825.
Surveyor		39,700.	39,970.
Planning Commission		1,000.	1,000.
Building & Grounds		16,850.	18,150.
Audit		3,500.	3,500.
Computer		5,000.	5,000.
Dues		6,500.	10,000.
Sheriff		77,800.	88,800.
County Jails		31,600.	36,100.
Liquor Control		16,000.	16,000.
Indian Task Force		11,270.	13,020.
Special Task Force		40,000.	38,000.
Fire Control		5,350.	5,835.
Emergency Services		11,830.	12,600.
Bi-Centennial		25,000.	15,000.
Other		10,000.	10,000.
County Road		635,500.	653,500.
Weed & Rodent		11,500.	11,500.
Poor & Indigent		6,000.	6,000.
Tourist		30,740.	32,070.
Extension Service		12,341.	13,875.
Airport:	Monticello	2,800.	82,800.
	Blanding	3,500.	3,500.
	Other	--	22,000.
Hospital		71,221.	204,815.
Recreation:	North	5,850.	6,340.
	N. Golf	16,833.	23,433.
	N. Swim	7,850.	8,150.
	South	12,000.	13,500.
	S. Swim	12,000.	10,900.
	S. Third	8,437.	8,970.
	Television Reception	6,800.	9,600.
County Fair		2,500.	5,000.
State Fair		300.	1,000.
Community Involvement		900.	---
Election		8,775.	---
Assessing & Collection		7,000.	7,000.
Employee Benefits		125,397.	140,000.
Total General Departments		1,479,419.	1,780,063.

Source: San Juan County, 1977

TABLE 2.2-17

CITY OF BLANDING, SUMMARY OF GENERAL FUND EXPENDITURES, FISCAL YEAR 1976-1977

	Fiscal Year 1976 Actual Expenditure	Fiscal Year 1977 Approved Budget
General Government	9,838	11,350
Public Safety		
Police Department	49,323	52,000
Fire Department	4,923	5,200
Inspection Department	180	540
Public Works		
Streets and Highways	22,071	23,300
Airport	4,858	5,200
Sanitation	14,429	16,500
Parks	105	125
Debt Service	27,037	36,428
Electric, Water and Sewer Fund	27,850	260,895
Payroll Taxes, Retirement Fund, Insurance, Etc.	9,397	11,675
Total Appropriated General Fund Expenditures	170,011	423,213

Source: City of Blanding, 1977

increased dramatically from 1976 to 1977, due primarily to planned improvements in Blanding's water treatment system.

Water

The City of Blanding obtains water from surface runoff and underground wells. In 1976 total consumption was approximately 200 million gallons, an average of 547,000 gallons per day. Peak daily use was 1.59 million gallons. The city operates a water treatment plant with a capacity of 1800 gallons per minute. City officials estimate that the existing water treatment system is adequate for serving a total population of 3,900, representing an increase of more than 80 families above the July 1977 population. Also, with minor improvements to the treatment plant, the system could support an additional increase of 600 residents, or a maximum population of 4,500 (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, September 7, 1977).

Blanding has not been forced to formally ration water use in years, despite drought conditions during 1977. Instead, the city has increased water rates, which has discouraged consumption. Water supply is not considered a major problem in Blanding due to the availability of a substantial reservoir of ground water. In September 1977 the city completed the drilling of a new 960-foot well, and additional wells will be drilled in the future to provide water as needed. Also, one water storage reservoir is under repair. The combined capacities of the existing storage reservoir and the one being repaired will be adequate to accommodate a 40 percent increase in population (Verbal Communication, Mr. Bud Nielson, October 12, 1977).

The water distribution system in Blanding is in need of improvement. The city is planning to install 2 miles of eight-inch pipes within the next six months. With planned improvements in the water transmission and storage systems and the ability to drill wells as needed, the city will be able to accommodate a maximum population of 4,500, representing a 40 percent increase in the June 1977 resident population.

Sewage Treatment

The city maintains a sewage treatment lagoon which is being expanded. The sewage treatment improvements are expected to be completed in 1981, and the system should then be adequate to accommodate a maximum population of 4,500. Because occasional overflow of sewage effluent is used for irrigation by the owner of property adjacent to the lagoon, the sewage is contained in a localized vicinity and does not pollute ground water. No problems or inadequacies in the town's sewage treatment are anticipated (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, September 7, 1977, October 12, 1977).

Utilities

Electricity is supplied within the Blanding City limits by the Utah Power and Light Company through a distribution system owned by the city of Blanding. In October 1977, consumption of electricity represented approximately one-half of the total capacity of the distribution system. There is no natural gas service in Blanding and propane is provided through 2 local companies (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, October 12, 1977).

There are no major constraints to supplying electricity to an increased population in Blanding; the local distribution system has excess capacity and the long-term supply outlook for Utah Power and Light is good (Verbal Communication, Mr. Jay Bell, Utah Power and Light, Moab Regional Office, October 27, 1977).

Solid Waste

The city of Blanding provides solid waste collection and disposal services. Collection occurs twice weekly. Waste is disposed at a dump located west of the community. Within the next 2 years, city officials hope to have a sanitary landfill, to be operated in cooperation with other communities or federal agencies (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, September 7, 1977).

Public Safety

The Blanding Police Department consists of 3 officers. A new member will be added to the force in fiscal year 1979. There are 2 patrol cars. The police force is supplemented by an auxiliary force of 8 members.

The city is served by a 15-member Volunteer Fire Department and maintains a 1750-gallon hose car and 11,500-gallon pumper truck. The fire insurance rating is 7 (Verbal Communication, Mr. Bud Nielson, Blanding City Manager, September 7, 1977).

Health Care

The San Juan County Hospital, located in Monticello, serves Blanding residents. The hospital is a 36-bed general care facility with an average occupancy rate of 40 percent. There is a 31-bed nursing home in Blanding. Two medical doctors, one dentist and one public health nurse provide services in Blanding (Verbal Communication, Mr. Arlo Freestone, San Juan County Hospital, October 20, 1977).

A public health nurse provides a range of services to the community, such as immunization clinics, home and school visits, visual screening, and handicapped children services. Public health nurses are assigned to Blanding, Monticello and the Navajo Reservation (Verbal Communication, Ms. Mabel Wright, Public Health Nurse, October 20, 1977).

Four Corners Mental Health, a regional agency supported by state, local and federal funds, provides psychological counseling services to residents of San Juan, Grand, Emergy and Carbon Counties. The agency has established a mental health clinic in Blanding, staffed by one therapist and one secretary. In addition, four outreach workers provide services to the Navajo Reservation and the communities of Bluff and Mexican Hat. San Juan County residents also have access to a psychologist at the mental health center in Moab. The average active caseload of the Blanding Mental Health Center is 80 (Verbal Communication, Ms. Colette Hunt, Blanding Mental Health Center, September 8, 1977).

Education

Two elementary schools and one high school are located in Blanding. Table 2.2-18 summarizes enrollment statistics and estimated peak capacities. Although the high school is currently overcrowded, new facilities are under construction which will alleviate this problem. A new high school will open in August 1978 at Montezuma Creek and another new high school is expected to open in 1979 or 1980 in the Oljato-Monument Valley area. School officials expect that enrollment in the San Juan High School will drop to 400 upon completion of the new facilities. (Written Communication, San Juan School District, November 3, 1977 and Verbal Communication, Ms. Clyda Christensen, San Juan School District, January 17, 1978).

Parks and Recreation

There are four public parks in Blanding which are maintained by the San Juan County Recreation Department. An additional park is in the planning stages. The San Juan County library is located north of Blanding on Route 163.

Housing

Demand for housing has been growing rapidly in Blanding during the past several years. Until 1975 residential construction activity in the town produced an average of 10 units per year. That rate has risen to 50 units per year in 1977 and construction is expected to further intensify in the future. The two largest builders in the area expect to double in capacity; each will be capable of producing 40 units per year by 1979 (Verbal Communication, Mr. Terry Palmer, Palmer Builders, October 27, 1977).

Construction of a 14-unit subdivision was underway in Blanding in the fall of 1977. Three single-family housing developments have recently been approved and, upon completion, will provide a total of 127 units. In addition, a 16-unit apartment complex is planned, and builders are anticipating the construction of one 16-unit complex each year for

TABLE 2.2-18

SCHOOL ENROLLMENT AND CAPACITY IN BLANDING, 1977-1978

School	Number of Students	Peak Enrollment Capacity	Teacher-Student Ratio
Blanding Elementary	341	400	1:18
Albert R. Lyman Elementary	289	350	1:26
San Juan High School	874	700	1:20

Source: Written Communication, San Juan School District, November 3, 1977; Verbal Communication, Ms. Clyda Christensen, San Juan School District, January 17, 1978.

four years (Verbal Communication, Mr. Terry Palmer, Palmer Builders, October 27, 1977).

New construction has managed to keep pace with demand, and in the fall of 1977 there was neither excess demand nor excess supply of single-family homes in Blanding. The supply of rental units is deficient, and planned construction should help to alleviate this problem (Verbal Communications, Mr. Ken Bailey, Hal Ken, Inc., October 27, 1977 and Mr. Terry Palmer, Palmer Builders, October 27, 1977).

Although the vacancy rate for housing is low, there is a substantial amount of reasonably priced land available within the Blanding city limits, and city officials have exhibited a pro-development posture. It is estimated that Blanding's development potential includes lots for 200 single-family homes, and the lead time necessary for construction of prefabricated, modular housing is from three to six months (Verbal Communications, Mr. Terry Palmer, Palmer Builders, and Mr. Ken Bailey, Hal Ken, Inc., October 27, 1977).

Water availability is a key consideration involved in development plans in Blanding. The city is taking steps now to alleviate the problem. At the present time, therefore, the major constraint to expanding the local housing stock is the difficulty of obtaining financing. There is no savings and loan institution in the area; funding for construction has come from the Federal Housing Administration and Farmers Home Loan programs (Verbal Communication, Mr. Terry Palmer, Palmer Builders, October 27, 1977).

In summary, the prevailing attitude among local developers is optimistic. It is generally believed that, although current housing supplies are barely keeping pace with demand, Blanding has the capacity to accommodate a rapidly growing population throughout the coming years. Given adequate sources of financing and several months of lead time, developers are willing to ensure an adequate housing stock for permanent residents. However, developers also admit that a shortage of rental housing exists which will probably not be alleviated by construction projects currently being planned.

Mobile home parks in Blanding have minimal capacity to absorb a growing population. According to the San Juan County Travel Council, there are two mobile home parks in Blanding. One has no vacancies and does not foresee any increase in capacity by 1979 (Verbal Communication, Palmer's Trailer Court, October 27, 1977). The second park has excess capacity of 25 to 27 spaces and is planning to add 12 to 14 new spaces in the coming year (Verbal Communication, Ms. Carol Thayne, Manager, Kamppark, November 3, 1977).

Public Services in Monticello

Table 2.2-19 summarizes General Fund expenditures of the city of Monticello. The general fund budget does not include utility fund expenditures of 369,600 (FY 1976) and thus is not entirely comparable to the Blanding General Fund expenditures outlined in Table 2.2-17.

Sewage Treatment

Monticello currently operates a digestor plant providing primary and secondary sewage treatment to the town's 2,208 residents. A population of 3,000 would represent maximum capacity of the existing plant. The city is planning to construct a new sewage treatment lagoon to replace the plant. The lagoon is in the preliminary planning stages and should be completed within the next two years. Upon completion, the new system will be adequate to serve from 4,000 to 5,000 residents (Verbal Communication, Mr. Dan Shoemaker, September 15, 1977).

Water

Ground water and surface runoff are the sources of water in the Monticello area. The city maintains a water treatment plant that is operating at approximately 55 percent of full capacity and processing an average flow of 160 to 200 gallons per minute (Verbal Communication, Mr. Dan Shoemaker, Monticello City Manager, September 15 and October 26, 1977).

TABLE 2.2-19

CITY OF MONTICELLO, SUMMARY OF GENERAL FUND EXPENDITURES
FISCAL YEAR 1976 AND 1977

Department	Fiscal Year 1975	Fiscal Year 1976
Administration	16,106	16,489
Municipal Court	6,547	2,939
Police Department	39,908	40,619
Fire Department	3,163	4,477
Streets, Curbs and Gutters	21,762	8,965
Parks and Recreation	4,015	2,210
Total Operating Disbursements	91,501	75,699

Source: San Juan Record, Thursday, September 15, 1977

Due to drought conditions, Monticello was forced to ration water in 1976 and 1977. The city is expanding its water supply by drilling eight new wells and, thus, local officials do not anticipate the need for rationing in 1978. Also, one of the town's two water storage reservoirs is being expanded; the completion of this project will result in a total storage capacity of 100 acre-feet. It is anticipated that the improved water supply system will accommodate a maximum population of 4,000; overall improvements should be completed within the next two years (Verbal Communication, Monticello City Manager, September 15, 1977).

Health

The San Juan County Hospital, located in Monticello, provides general care to residents of San Juan County and the Dove Creek area of western Colorado. The facility has 36 beds and an average occupancy rate of 40 percent. Four medical doctors, six registered nurses, and eight licensed practical nurses are employed by the hospital. Two of the doctors are from Monticello and two are from Blanding. There are no plans for expansion of the hospital (Verbal Communication, Mr. Arlow Freestone, San Juan County Hospital, October 20, 1977).

A public health nurse provides health care services including school visits, immunization clinics, home visits, visual screening, and handicapped children services. The Four Corners Mental Health agency has established a clinic in Monticello, staffed by one therapist, a part-time secretary, and one outreach worker. Monticello residents also have access to a Four Corners psychologist in Moab (Verbal Communication, Ms. Colette Hunt, Blanding Mental Health Center, September 8, 1977).

Recreation

Recreation services are provided by San Juan County, one city park with a playground and swimming pool and a public golf course are located in Monticello. The county also provides television reception.

Public Safety

The Monticello Police Department is staffed by one part-time and three full-time employees. The city owns one patrol car. The municipal police force is supplemented by 2 or 3 members of the County Sheriff Department who patrol the Monticello area.

Monticello has a 30-member volunteer fire department and three fire trucks.

Education

Educational services are provided by the Monticello Elementary School and Monticello High School. The elementary school has an enrollment of 365, representing only 66 percent of the estimated peak capacity of 550. The high school has an enrollment of 370 and peak capacity of 500. Teacher-student ratios are 1:22.8 at Monticello Elementary and 1:17.6 at Monticello High School (Written Communication, San Juan School District, November 3, 1977).

Utilities

Natural gas is supplied to Monticello residents by Utah Gas Service. At the present time there is no constraint to expanding the residential or commercial supply in Monticello (Verbal Communication, Mr. Jones, Utah Gas Service, October 27, 1977). Electricity is supplied by Utah Power and Light through the city of Monticello. Although the Monticello substation is in good condition, the local transmission system cannot accommodate any significant increase in demand. Utah Power and Light has submitted cost estimates and plans for an improved transmission system to the city of Monticello. There has been no response and hence there are no plans for improving electrical service to the Monticello area (Verbal Communication, Mr. Jay Bell, Utah Power and Light, Moab Regional Office, October 27, 1977).

Housing

In September 1977 there were between 650 and 700 houses in the Monticello City limits. New home construction produced 60 homes from

1976 to 1977, and it is anticipated that this rate will double in the coming year. Capacity for new home construction is somewhat lower in Monticello than in Blanding, due to less available land in the city limits, fewer local developers and, until recently, a less favorable attitude toward growth on the part of city officials. However, steps are being taken to promote development in the town. The city is undertaking an aggressive annexation program, and modification of the Monticello Master Plan and zoning ordinances is anticipated. An 80-acre tract of land is expected to be annexed soon and will provide between 150 and 200 single family lots. City officials are aware that large-scale growth will occur throughout San Juan County and do not want their city to be by-passed (Verbal Communications, Mr. Dan Shoemaker, Monticello City Manager, September 6, 1977; Mr. Terry Palmer, Palmer Builders, October 27, 1977; Mr. Bill Jones, United Farm Agency, November 2, 1977).

Monticello residents are faced with the difficulty of obtaining financing in the absence of a local savings and loan institution. One real estate agency has been successful in encouraging a corporation in Salt Lake City to begin to offer financing in the Monticello area. It is believed that the shortage of financial sources will be alleviated by mid-1978 (Verbal Communication, Mr. Bill Jones, United Farm Agency, November 2, 1977).

There are two mobile home parks in Monticello with excess capacity and additional land available for expansion.

Public Services in Bluff

Bluff is a small, newly incorporated community located approximately 19.5 miles south of the proposed mill site. Bluff is described as an ideal retirement area, and almost 20 percent of the town's population is composed of senior citizens. Commercial establishments in Bluff include 5 stores and 2 bars. The Church of the Latter Day Saints is the predominant religion. An Episcopal mission, St. Christopher's, is also located in Bluff. The 1977 population of the town is 280 (Written Communication, Ms. Clytie Barber, San Juan County Clerk, September

1977; Verbal Communication, Mrs. John Thompson, former Treasurer and Acting Secretary, Town of Bluff, September 8, 1977).

Since its incorporation in 1976, Bluff has been consolidating and upgrading public services. In 1975 the town installed a water supply system composed of three artesian wells and a 200,000 gallon storage tank. It is estimated that the system could accommodate a maximum population of 500, representing a 79 percent increase above the 1977 population.

Individual septic tanks now provide sewage treatment to Bluff residents. The town has proposed construction of a sewage treatment system, which will depend on federal funding. Timing of the project is uncertain, and it is believed that the system will not be constructed prior to the fall of 1978 (Verbal Communication, Mrs. John Thompson, September 8, 1977).

School-age children attend Bluff Elementary School. The school has an enrollment of 104 and peak capacity of 200. The teacher-student ratio is 1:17 (Written Communication, San Juan School District, November 3, 1977).

Public safety is provided in the general area by two sheriff deputies; the town has no municipal police force. An eight-member volunteer fire department provides fire protection.

Residential construction in the last five years has consisted of 25 or 30 new dwellings, and the vacancy rate for housing in Bluff is now zero. An increase in demand for housing would encourage some development and it is estimated that there are 70 vacant lots available with connections to the town's water system. Also, two mobile home courts in Bluff have excess capacity (Verbal Communication, Mrs. John Thompson, September 8, 1977).

Residential development capacity of Bluff is limited; there is a small number of lots available in the town. The prevailing attitude toward moderate growth in Bluff is favorable, but most residents would not welcome a population boom (Verbal Communication, Mrs. John Thompson, September 8, 1977).

2.2.3 Hanksville Area

This section describes the existing socioeconomic environment of the area surrounding the Hanksville ore buying station and the transportation corridor from Hanksville to Blanding. The ore buying station is located in central Wayne County, approximately 10 miles south of Hanksville, in south-central Utah. The transportation of uranium ore from the buying station to the mill at Blanding would occur via Utah Route 95, which crosses southern Wayne County, a thirty-mile segment of northeastern Garfield County, and rural San Juan County. The highway also traverses the Glen Canyon National Recreation Area. Because Blanding and San Juan County are addressed in Section 2.2.2 of this report, this section focuses on Hanksville, rural Wayne and Garfield Counties, and the Hite District of the Glen Canyon National Recreation Area. Hanksville is the only population center within this area and, hence, public services and housing data (Section 2.2.3.6) refer to the Hanksville vicinity.

2.2.3.1 History

Due to geographical isolation and lack of access, the Hanksville area was unexplored until relatively recently. The general area was occupied by Shoshone-speaking Paiute Indians until contact with whites occurred in the 19th century. In 1866, a group of 60 men, led by Captain James Andrews of the Utah militia, explored the Paria River, the Escalante and the then unnamed Fremont River. This party is believed to have been the first group of whites to observe the Hanksville area. Subsequently, Major John W. Powell made expeditions to the general area in 1869 and 1871, and named the Fremont River and the Henry Mountains.

White settlers from St. George, in southwestern Utah, were initially attracted to the Hanksville area by free grazing and free water. Also, the isolation of Hanksville made the area safe for families who wanted to practice polygamy, which was illegal. In the spring of 1883, a small settlement was established at the junction of the Fremont and Muddy Rivers by Ebenezer Hanks and several other families. The name of the settlement was changed from Graves Valley to Hanksville in 1885, and a post office was established (U.S. Bureau of Land Management). Since that time, Hanksville has remained a small, isolated, agriculturally-based community.

2.2.3.2 Demography

Wayne and Garfield Counties are sparsely populated, with average 1975 densities of 0.7 and 0.6 persons per square mile, respectively. Both counties experienced a decline in population from 1950 to 1970 which was reversed in the early 1970s. From 1970 to 1975 Wayne County increased by 14.7 percent and Garfield County grew by 4.5 percent. Table 2.2-20 summarizes population from 1950 to 1975 for the two counties.

Three small communities located in western Wayne County account for almost one-half of the total county population base. They are Loa (the county seat, with a 1975 population of 341), Bicknell (1975 population 282) and Torrey (1975 population 104). All are located along Utah Route 24, the principal east-west highway of the county. Torrey is the closest community to Hanksville and is located approximately 55 road miles to the west. Hanksville is the only population center in eastern Wayne county and in 1975 had an estimated population of 160 (Westinghouse Environmental Systems Department, 1977). In 1977 there were 100 registered voters in Hanksville and it was estimated that approximately 500 residents of the surrounding area came to town regularly to pick up their mail (Verbal Communication, Wayne County Clerk, September 15, 1977). No official population estimates for Hanksville are available.

Route 95 passes though an isolated, 30-mile segment of northeastern Garfield County. This area is effectively separated from the population

TABLE 2.2-20

POPULATION ESTIMATES OF THE HANKSVILLE AREA, 1950 to 1975

	Land Area (Sq Mi)	1950	1960	1970	1973	1975	Percent Change, 1970-1975
Wayne County	2,486	2,205	1,728	1,483	1,551	1,701	14.7
Hanksville	na[a]	na[a]	na[a]	na[a]	na[a]	160[b]	na[a]
Garfield County	5,158	4,151	3,577	3,157	3,171	3,300	4.5

[a]Official census estimates of the population of Hanksville are not available, because Hanksville is not an incorporated community and has a population of less than 2,500.

[b]This estimate refers to a 1975 estimate by the Westinghouse Environmental Systems Department (1977).

Source: U.S. Bureau of Census, 1977, 1973, 1960 (Hanksville estimate by Westinghouse Environmental Systems Department, 1977).

centers of central and western Garfield County by the Capital Reef National Park. There is no paved road directly linking the eastern and western portions of the county. Panguitch, the largest city and county seat of Garfield County, is located along U.S. Route 89 over 100 air-miles west of Route 95. The 1975 population of Panguitch was 1,314. Panguitch and 7 other communities ranging in size from 126 to 652 account for over 90 percent of the Garfield County population. The remaining residents, estimated to be 284 in 1975, are dispersed throughout 5,000-plus square miles (U.S. Bureau of Census, 1977).

Table 2.2-21 presents selected demographic characteristics for Wayne and Garfield Counties and for the state of Utah as a whole. The figures indicate that both counties had more a homogeneous population base than the state, with fewer nonwhite residents and fewer foreign born in 1970. Educational achievement at that time was similar in both counties and the state, although Wayne and Garfield Counties had fewer college graduates than the rest of Utah. In 1969, median family income was lower in Wayne and Garfield Counties than the statewide average. Also, housing conditions were somewhat poorer in both counties than the state.

Population forecasts summarized in Table 2.2-22 indicate that Garfield County's projected high and low growth scenarios parallel those of the State. In comparison, population growth in Wayne County through the year 2000 may be as high as 131 percent or as low as 29 percent. Even assuming high rates of growth, Wayne and Garfield Counties would be sparsely populated by 2000, with 2 persons per square mile in Wayne County and one person per square mile in Garfield County.

Comparing U.S. Bureau of Census population estimates with the 1975 projections outlined in Table 2.2-22 indicates that the projections have overstated actual growth from 1970 to 1975. The 1975 census estimates of 1,701 in Wayne County and 3,300 in Garfield County are below the "low" projections outlined in the table.

TABLE 2.2-21

SELECTED DEMOGRAPHIC CHARACTERISTICS,
WAYNE AND GARFIELD COUNTIES AND THE STATE OF UTAH, 1970

	Wayne County	Garfield County	Utah
Total Population	1,638	3,157	1,059,273
Race			
White	1,630	3,157	1,033,880
Other (%)	0.5	0	2.4
Foreign Born (%)			
Leading Country of Origin	Mexico	United Kingdom	United Kingdom
Education			
Median School Years Completed, Persons 25 years and over	12.1	12.2	12.5
Percent with less than 5 years	1.2	0.3	2.0
Percent with 4 years of college or more	8.9	8.7	14.0
Age			
Median Age	27.3	26.4	23.0
Percent under 5 years	7.4	8.2	10.6
Percent 5-17	35.4	32.6	29.6
Percent 18-64	49.3	49.4	52.5
Percent 65+	7.9	9.8	7.3
Income, 1969			
Median Family Income ($)	5,828	7,110	9,320
Percent of families below low income level	10.5	12.3	9.2
Housing - Occupied Units (Number)	472	923	297,934
Average Persons per unit	3.4	3.4	3.5
Lacking Some or All Plumbing Facilities (%)	4.9	3.3	1.8
With 1.01 or more persons per room (%)	14.2	13.0	10.0

Source: U.S. Bureau of Census, 1971

TABLE 2.2-22

POPULATION PROJECTIONS[a]
WAYNE COUNTY AND GARFIELD COUNTY COMPARED TO THE STATE

	1975	1980	1990	2000	Percent Change 1975-2000
Utah					
High	1,216,800	1,420,600	1,804,000	2,163,900	77.8
Low	1,206,600	1,302,800	1,484,200	1,655,500	37.2
Wayne County					
High	1,960	2,660	3,770	4,530	131.1
Low	1,950	2,060	2,310	2,510	28.7
Garfield County					
High	3,480	3,940	4,670	5,960	71.3
Low	3,470	3,760	4,460	5,120	47.6

[a]High projections assume a gradual decline in mortality, constant fertility and positive net migration. Low projections assume a gradual decline in mortality, constant fertility and no net migration.

Source: Utah Agricultural Experiment Station, 1976

2.2.3.3 Land Use and Ownership

Both Wayne and Garfield Counties contain a high proportion of federally owned land. This territory is multiple use land administered through the U.S. Bureau of Land Management, U.S. Forest Service and the National Park Service. Designated areas in Wayne County include portions of the Glen Canyon National Recreation Area, Canyonlands National Park, Capitol Reef National Park, Dixie National Forest and Fishlake National Forest. Glen Canyon, Capitol Reef National Park, and Dixie National Forest also extend into Garfield County.

Land ownership acreages of Wayne and Garfield Counties, summarized in Table 2.2-23, indicate that federal land encompasses 84.2 percent of Wayne County and 89 percent of Garfield County. The state of Utah owns the second largest proportion of both counties, while private land includes only 6.3 percent of Wayne County and 4 percent of Garfield County. There is no Indian land in either county. Urban development and transportation, occurring primarily in western Wayne County and central and western Garfield County, represent a relatively insignificant land use in terms of acreage.

Rangeland is the largest category of non-federal land in Wayne and Garfield Counties. Table 2.2-24 presents land use of non-federal land and indicates that rangeland encompasses 68 percent of non-federal land in Wayne County and 62 percent in Garfield County.

Land Use Specific to the Hanksville Buying Station and Route 95

Rangeland is the principal land use in the Hanksville area, although there is some irrigated cropland in the Fremont River Valley at Hanksville, approximately 12 miles west of the project site. Recreational activity is limited to seasonal hunting for game animals and waterfowl along the Fremont River (Westinghouse Environmental Systems Department, 1977). Northeastern Garfield County is similar to the Hanksville area and is predominantly rangeland.

TABLE 2.2-23

LAND OWNERHSIP,
WAYNE AND GARFIELD COUNTIES, 1967

	Wayne County		Garfield County	
	Acres	Percent of Total County	Acres	Percent of Total County
Federal	1,338,875	84.2	2,953,729	89.0
State	146,651	9.2	222,712	6.7
Indian	-0-	-0-	-0-	-0-
Private	99,965	6.3	132,337	4.0
Urban and Transportation	5,416	0.3	8,662	0.3
Small Water	133	--[a]	960	--[a]
Total County Acres	1,591,040	100.0	3,318,400	100.0

[a]Less than 0.1 percent

Source: U.S. Department of Agriculture, 1970

TABLE 2.2-24

LAND USE IN WAYNE AND GARFIELD COUNTIES, EXCLUDING FEDERAL LAND, 1967[a]

	Wayne County		Garfield County	
	Acres	Percent of Total Non-Federal	Acres	Percent of Total Non-Federal
Cropland	21,815	8.6	33,732	9.2
Irrigated	21,815	8.6	31,869	8.7
Non-irrigated	-0-	-0-	1,863	0.5
Pasture	-0-	-0-	3,660	1.0
Range	171,645	68.0	227,139	62.3
Forest	10,464	4.2	60,120	16.5
Other[b]	42,691	16.9	30,398	8.3
Urban and Railroads	5,416	2.1	8,662	2.4
Small Water[c]	133	---[d]	960	0.3
Total Non-Federal	252,165	100.0	364,671	100.0
Federal	1,338,875	---	2,953,729	---
Total County Acreage	1,591,040	---	3,318,400	---

[a]Water areas of more than 40 acres and rivers wider than one-eighth mile are excluded.

[b]"Other" includes strip mine areas, salt flats, mud flats, marshes, rock outcrops, feed lots, farm roads, ditch banks and miscellaneous agricultureal land.

[c]Includes water areas of 2 to 40 acres and streams less than one-eighth mile in width.

[d]Less than 0.1 percent.

Source: U.S. Department of Agriculture, 1970

Utah Route 95 is a winding, two-lane paved highway that was completed in 1976. Sharp curves and steep grades characterize much of the distance between Hanksville and Blanding. The highway traverses an isolated, rugged area. There are no cities between Hanksville and Blanding. Population centers or other signs of human activity are limited to the Hite Crossing of Glen Canyon, consisting of camping facilities, boat ramps and several mobile homes; Fry Canyon, which is a small truck stop; and the Natural Bridges National Monument, a tourist area adjacent to the highway.

2.2.3.4 Transportation Facilities

The highway system linking Hanksville to other parts of Utah consists of State Routes 95 and 24, which are two-lane, paved highways. Route 24 provides access from Hanksville to central Utah's major east-west highway, Interstate 70. The interstate is approximately 50 miles north of Hanksville. Route 24 also connects Hanksville to more populous areas in western Wayne County. In 1975, average daily traffic on Route 24 near Hanksville was 320 vehicles.

Utah Route 95, extending 135 miles from Hanksville to Blanding, cuts through isolated parts of Wayne, Garfield and San Juan Counties. Improvement of Route 95 to a paved, all-weather highway was completed in 1976. In 1975, traffic volume counts for Route 95 ranged from 95 vehicles per day at Natural Bridges National Monument to 310 vehicles per day near Blanding. At a point south of Hanksville, traffic flow was approximately 290 vehicles per day. Although complete traffic counts have not been estimated since 1975, a station near Hanksville reported an increase in traffic volume on Route 95 of 33 percent from June 1975 to June 1977. Increased use of the highway can be expected due to its recent completion.

Table 2.2-25 summarizes traffic volume counts for Hanksville area highways, Route 95 and connecting roads. The figures reveal that a substantial proportion of total volume that year was due to out of state visitors.

TABLE 2.2-25

TRAFFIC VOLUME, 1975

Highway	Segment	Average Daily Traffic Counts[a]	Approximate Percentage of Out of State Passenger Traffic
Utah Route 95	Blanding to Natural Bridges National Monument	310	20%
	Natural Bridges to Hite	95	10%
	Hite to Hanksville	95 - 290	10% - 20%
Utah Route 276	Route 95 to Bullfrog Basin at Glen Canyon	220	25%
Utah Route 263	Route 95 to Halls Crossing at Glen Canyon	25 - 35	20%
Utah Route 261	Route 95 to Mexican Hat	130	50%

[a]Two figures in this column represent a range of values given for different points on the Traffic Volume Map. One figure indicates that a traffic count was taken at only one location.

Source: Traffic Volume Map, by Utah Department of Transportation, 1976.

There is no air or rail service to Hanksville. Although Hanksville has an airpark, the closest airports with regular commercial service are located in Grand Junction and Cortez, Colorado. Richfield, Green River and Moab, Utah are the locations of the closest rail connections.

Bus service is not available to the Hanksville area. Continental Trailways provides service to Green River, Utah approximately 60 miles northeast of Hanksville.

2.2.3.5 Economic Base

Wayne and Garfield Counties are primarily rural in nature. Agricultural production, summarized in Table 2.2-26, is centered on livestock and dry land farming. Agriculture is a major source of employment, especially in Wayne County, where this sector accounts for over one-third of all jobs.

Table 2.2-27 presents estimates of employment by industry in Wayne and Garfield Counties. In Wayne County, government and agriculture are the largest sources of employment and together accounted for over 70 percent of total county employment in 1976. Employment patterns are more widely dispersed among industrial sectors in Garfield County. Here, government, manufacturing, services, agriculture, trade and mining all contribute substantially to the total employment picture.

As indicated in Table 2.2-28, unemployment in 1975 and 1976 was significantly higher in Wayne and Garfield Counties than in the rest of the state. The table also reveals that, although per capita income in Wayne County has matched the statewide average since 1975, income in Garfield County has remained below the rest of the state.

Wayne County is part of the Central Utah Planning District, where overall economic growth was sluggish throughout the year ending in July 1977. Nevertheless, key economic indicators have been optimistic for Wayne County, where 100 jobs were generated during the year ending in July 1977. The sectors of mining, construction, manufacturing, trade and

TABLE 2.2-26

CROP PRODUCTION AND LIVESTOCK INVENTORY,
WAYNE AND GARFIELD COUNTIES, 1974

Item	Unit of Measurement	Production
Wayne County		
Wheat	Bushels	2,232
Oats[a]	Bushels	9,576
Barley[a]	Bushels	98,335
Corn for silage	Acres	513
Potatoes	100-weight	15,457
Hay and grass silage	Tons	18,946
Alfalfa hay	Tons	16,766
Wild hay	Tons	100
Cattle and calves	Number	12,748
Sheep and lambs	Number	14,029
Hogs	Number	338
Chickens over 2 mos.	Number	376
Garfield County		
Wheat	Bushels	15,904
Oats[a]	Bushels	16,237
Barley[a]	Bushels	19,875
Corn for grain or seed	Bushels	110
Corn for silage	Acres	282
Potatoes	100-weight	2,299
Hay and grass silage	Tons	23,434
Alfalfa hay	Tons	17,337
Wild hay	Tons	520
Cattle and calves	Number	19,286
Sheep and lambs	Number	6,561
Hogs	Number	235
Chickens over 2 mos.	Number	2,501

[a]Includes only those farms with sales of $2,500 and over.

Source: U.S. Bureau of Census, 1974

TABLE 2.2-27

EMPLOYMENT BY INDUSTRY IN WAYNE COUNTY AND GARFIELD COUNTY, 1976-1977[a]

Industry	Wayne County				Garfield County			
	1976 Average		April 1977		1976 Average		April 1977	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Agriculture	190	33.8	190	35.1	170	12.1	170	13.2
Mining	22	3.9	20	3.7	79	5.6	202	15.7
Contract Construction	26	4.6	4	0.7	31	2.2	12	0.9
Manufacturing	26	4.6	14	2.6	251	17.9	216	16.8
Transporation, Communication, Utilities	3	0.5	1	0.2	57	4.1	46	3.6
Wholesale and Retail Trade	47	8.4	79	14.6	164	11.7	152	11.8
Finance, Insurance Real Estate	6	1.1	7	1.3	15	1.1	9	0.7
Services	37	6.7	18	3.3	281	20.0	185	14.4
Government	205	36.5	208	38.4	356	18.2	295	22.9
Total	562	100.0	541	100.0	1404	100.0	1287	100.0

[a]Figures represent preliminary estimates, and include nonagricultural payroll jobs and agricultural employment

Agricultural employment estimates from verbal communication, Mr. David Blaine, Utah Department of Employment Security, Research and Analysis, September 15, 1977

TABLE 2.2-28

LABOR FORCE, UNEMPLOYMENT AND PER CAPITA INCOME IN WAYNE AND GARFIELD COUNTIES COMPARED TO THE STATE

	1975	1976
Utah		
Labor Force	516,877	536,000
Unemployment Rate (%)	7.2	6.1
Per Capita Income ($)	4,900	5,400
Wayne County		
Labor Force	875	859
Unemployment Rate (%)	7.9	8.0
Per Capita Income ($)	4,900	5,400
Garfield County		
Labor Force	1,640	1,662
Unemployment Rate (%)	14.4	12.3
Per Capita Income ($)	4,100	4,500

Source: Utah Department of Employment Security services accounted for this gain. Also, the value of residential building permits during the first six months of 1977 was 230 percent above the value of permits issued during the first half of 1976 (Utah Department of Employment Security, 1977).

Garfield County is one of five counties in the Southwestern Planning District of Utah. Although economic growth in that region was stronger in early 1977 than in the previous year, Garfield County at that time was experiencing a slowdown in activity. Crude oil production, an important source of revenue in the county, has been declining at an accelerating rate since 1974. Crude oil production totalled 1.7 million barrels in 1974 and 1.2 million in 1976. In January 1977 production was 15 percent below that of January 1976. Both building construction activity and total employment in Garfield County in early 1977 were below levels of the previous year (Utah Department of Employment Security, 1977).

2.2.3.6 Public Services

Hanksville is not an incorporated community and, thus, Wayne County is responsible for the provision of many of the area's public services. The county supplies education, road maintenance, and law enforcement services to the Hanksville area. One part-time sheriff is assigned to Hanksville. Although the community does not have a fire station at the present, one is planned and construction should be complete in early 1978. Wayne County also operates a solid waste dump near Hanksville on U.S. Bureau of Land Management land (Verbal Communication, Ms. Angela Nelson, Wayne County Clerk, October 21, 1977). Table 2.2-29 summarizes General Fund expenditures of the county for 1975, 1976 and 1977.

There are no health care facilities in Hanksville. The closest hospital is in Moab, over 100 miles from Hanksville. Ambulance service and emergency medical personnel are available in Hanksville. The closest medical clinic is in Green River, Utah approximately 60 miles north of Hanksville (Verbal Communication, Ms. Angela Nelson, October 21, 1977).

TABLE 2.2-29

WAYNE COUNTY GENERAL FUND EXPENDITURES

	1975 Actual	1976 Estimated	1977 Approved Budget
County Commissioners	7,579	8,369	12,847
Judicial	6,436	5,800	7,720
Central Staff Agencies	12,683	1,579	4,029
Administration Agencies	23,543	22,838	36,587
Nondepartmental	8,055	1,203	23,687
General Government Buildings	19,576	12,488	22,825
Civic Center	26,661	29,145	--
Elections	76	3,350	180
Planning and Zoning	252	--	5,000
Elections	536	1,594	5,800
Law Enforcement	18,284	17,750	24,152
Fire Department	14,218	2,786	5,525
Civil Defense	168	120	620
Health Department	7,665	7,022	7,119
Ambulance	774	20,578	4,200
Streets and Highways	132,338	136,600	133,887
Airport	16,443	3,244	4,650
Parks	8,639	3,978	3,300
Libraries	2,639	2,639	3,200
Conservation and Economic Development	10,165	10,911	15,428
Miscellaneous (non-clarifiable)	37,305	10,911	15,428
Total General Fund Expenditures	451,460	402,845	343,176

Source: Wayne County, 1977

Hanksville Culinary Water Works, Inc. supplies water from a well to 150 residents through 37 connections. The system is currently operating at peak capacity and expansion of the supply is anticipated in the near future (Written Communication, Mr. Dean Ekker, President, Hanksville Culinary Water Works, Inc., November 1977). There is no centralized sewage treatment system in Hanksville; residences are equipped with individual septic tanks (Verbal Communication, Ms. Angela Nelson, October 21, 1977).

The capacity of Hanksville to absorb growth is limited. Excess housing is nonexistant and developable land with connections to the water system is not available (Written Communication, Mr. Dean Ekker, November 1977).

The Gar-Kane Power Company, an REA cooperative, supplies electricity to the Hanksville area.

The Hanksville School had a fall 1977 enrollment of 50 students in grades kindergarten through six. The school employs 3 teachers and has a maximum enrollment capacity of 60. Current plans for school construction call for a new classroom that will be built by September 1978. This will replace a temporary building now in use and will not increase the school's capacity.

Students in grades seven through twelve attend middle school and high school in Bicknell, 65 miles from Hanksville. The Bicknell Middle School has a fall 1977 enrollment of 105 and a staff of eight. The high school has 155 students and 13 teachers. Peak capacity of the middle school is 120 students and capacity of the high school is 200. The school district has no plans for expansion of Bicknell schools (Verbal Communication, Mr. John Brinkerhoff, Wayne county Board of Education, October 20, 1977).

Enrollment in schools throughout Wayne County is expected to remain stable or increase slightly in the foreseeable future. For several years prior to 1977, enrollment had been declining. School officials are not making school enrollment projections at this time (Verbal Communication, Mr. John Brinkerhoff, October 8, 1977).

Hanksville residents have access to the numerous recreational opportunities afforded by Capitol Reef National Park, Dixie and Fishlake National Forests, and Glen Canyon National Recreation Area. All of these areas are partially located in Wayne County. In addition, Arches National Park, Canyonlands National Park, and Manti-La Sal National Forests are located in southeastern Utah. No recreation services are provided locally.

2.3 REGIONAL HISTORIC AND CULTURAL, SCENIC AND NATURAL LANDMARKS

2.3.1 Historic and Cultural Sites

Landmarks of southeastern Utah included in the National Register of Historic Places are summarized in Table 2.3-1. Closest to the proposed mill site is the Edge of Cedars Indian Ruin, located in Blanding.

TABLE 2.3-1

HISTORIC SITES IN SOUTHEASTERN UTAH INCLUDED IN THE NATIONAL REGISTER OF HISTORIC PLACES
November 1977

LOCATION	SITE
San Juan County	
Blanding	Edge of Cedars Indian Ruin Hovenweep National Monument
Southeast of Mexican Hat	Poncho House
25 miles southeast of Monticello	Alkali Ridge
30 miles west of Monticello	Salt Creek Archaeological District
Glen Canyon National Recreation Area	Defiance House[a]
14 miles north of Monticello	Indian Creek State Park[a]
Wayne County	
Capital Reef National Park on Utah Rt. 24	Fruita School House

TABLE 2.3-1 (Concluded)

LOCATION	SITE
Wayne County - continued	
3 miles southeast of Bicknell	Nielson, Hans Peter, Gristmill
60 miles south of Green River, in Canyonlands National Park	Harvest Scene Pictograph
Green River vicinity	Horseshoe (Barrier) Canyon Pictograph Panel
Capital Reef National Park	Gifford Barn[a]
Capital Reef National Park	Lime Kiln[a]
Capital Reef National Park	Oyler Tunnel[a]
Garfield County	
46 Miles south of Hanksville	Starr Ranch

[a]Pending nominations to the National Register of Historic Places

Sources: U.S. Dept. of Interior, National Park Service, National Register of Historic Places, 1976 and the Federal Register Tues., Feb. 10, 1976, and subsequent issues through November 29, 1977

2.3.2 Scenic Areas

Southeastern Utah is known for its unusual scenic qualities, in particular the abundance of massive stone arches and other standing rock formations. The general area features a uniquely rugged terrain with wide vistas, badlands, and steep canyons.

Canyonlands National Park is an area of unusual geologic formations and the Glen Canyon National Recreation Area offers opportunities for water sports on Lake Powell, a manmade lake on the Colorado River. Capitol Reef National Park contains numerous colorful stone formations. At Natural Bridges National Monument, millions of tons of rock span deep canyons, forming the largest natural bridges in the world. These and other natural and scenic landmarks draw visitors to southeastern Utah every year. In addition, the area contains an abundance of Indian ruins and petroglyphs. Newspaper Rock State Park, Edge of Cedars State Park, and Hovenweep National Monument are noted areas of archaeological interest.

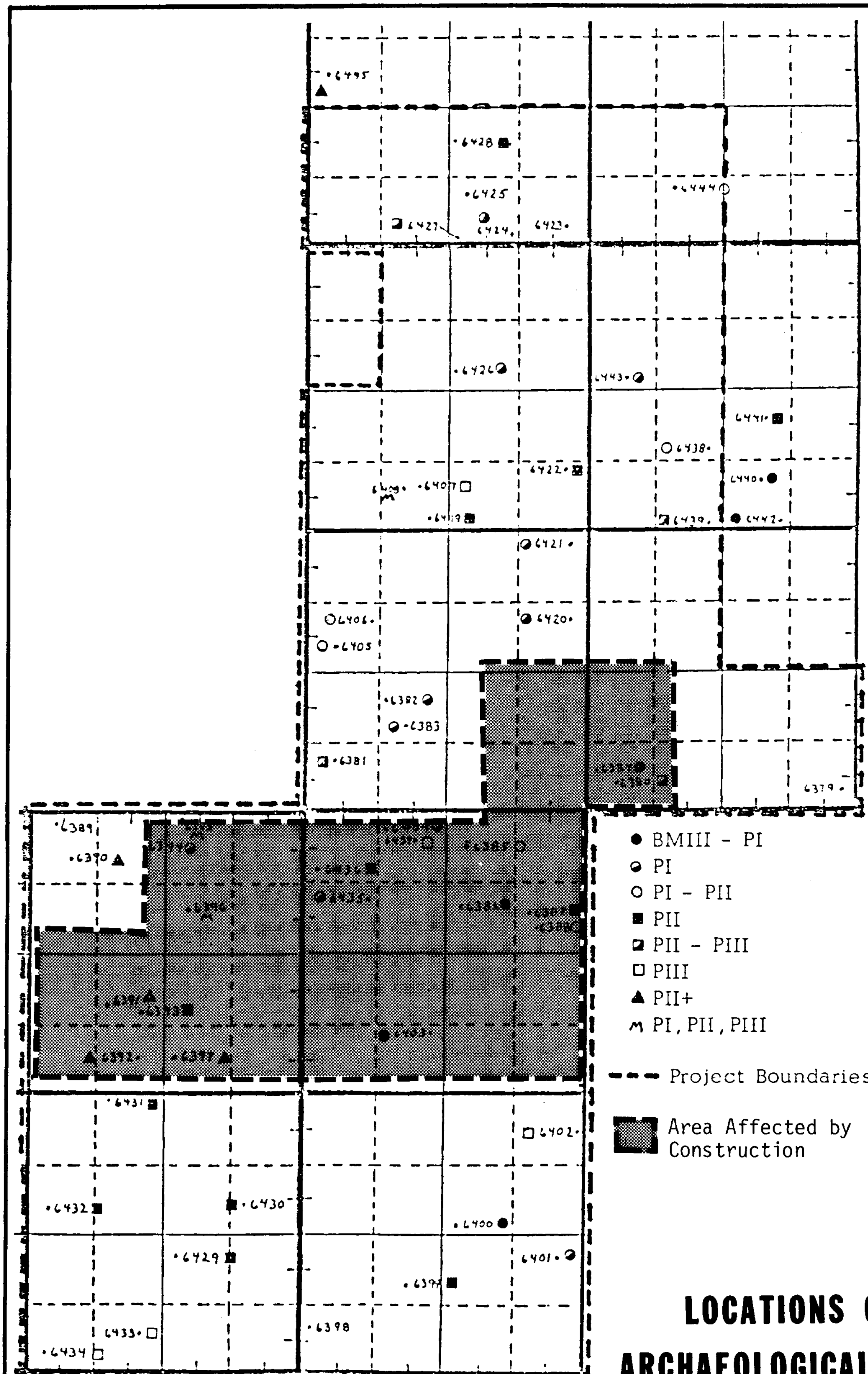
2.3.3 Archaeological Sites

An intensive archaeological survey of the project site was conducted in the fall of 1977 under the direction of Mr. Richard A. Thompson of Southern Utah State College (Appendix A). The survey was conducted on White Mesa, including Sections 21, 28, 32 and 33 of T37S, R22E. The total area encompasses 1260 acres, of which 180 are administered by the U.S. Bureau of Land Management. The remaining acreage is privately owned.

During the survey, 57 sites were recorded and all were determined to have an affiliation with the San Juan Anasazi. Plate 2.3-1 illustrates the location of the sites and indicates that all but four were found within the project boundaries.

Table 2.3-2 summarizes the recorded sites according to their probable temporal positions. The dates of occupation are the best estimates available, based on professional experience and expertise in the interpretation of archaeological evidence. However, it should be noted that the archaeological investigation was hindered by a lack of reliable evidence concerning the length of time the sites were occupied.

Available evidence suggests that settlement on White Mesa reached a peak in perhaps 800 A.D. Occupation remained at approximately that level until some time near the end of Pueblo II or in the Pueblo II/Pueblo III transition period. After this the population density declined sharply and it may be assumed that White Mesa was, for the most part, abandoned by about 1250 A.D.



White Mesa Project, San Juan Co., Utah
Secs. 21, 28, 32, and 33, T37S, R22E SLM

LOCATIONS OF ARCHAEOLOGICAL SITES

DAMES & MOORE

PLATE 2.3-1

TABLE 2.3-2

DISTRIBUTION OF RECORDED SITES ACCORDING TO TEMPORAL POSITION

Temporal Position	Approximate Dates[a] (A.D.)	Number of Sites	Identification Number of Each Site
Basket Maker III/ Pueblo I	575-850	6	6384, 6386, 6400, 6403, 6440, 6442
Pueblo I	750-850	11	6382, 6383, 6394, 6401, 6404, 6420, 6421, 6424, 6426, 6435, 6443
Pueblo I/Pueblo II	850-950	6	6385, 6388, 6405, 6406, 6438, 6444
Pueblo II	950-1100	12	6387, 6393, 6399, 6419, 6422, 6428, 6429, 6431, 6432, 6436, 6439, 6441
Pueblo II/Pueblo III	1100-1150	4	6380, 6381, 6427, 6439
Pueblo III	1150-1250	5	6402, 6407, 6433, 6434, 6437
Pueblo II +[b]		5	6390, 6391, 6392, 6397, 6445
Multicomponent[c]		3	6395, 6396, 6408
Unidentified[d]		5	6379, 6389, 6398, 6423, 6425

[a]Includes transitional periods.

[b]Although collections at these locations were lacking in diagnostic material, available evidence indicates that the site would have been used or occupied no earlier than 900 A.D., and possibly some time after.

[c]Ceramic collections from each of these sites indicate an occupation extending from Pueblo I through Pueblo II and into Pueblo III.

[d]Four of these sites produced sherds which could not be identified. The fifth site lacked ceramic evidence but contained an ovoid outline of vertical slabs. This evidence was not strong enough to justify any identification.

The survey crews recorded evidence of structures at 31 of the 57 sites. At 12 sites, depressions were reported with diameters ranging from 5 to 15 meters. Twenty-seven sites contain evidence of other, presumably surface, structural forms and at 8 sites depressions are combined with surface structures. The depressions are apparently pit houses or kivas and thus indicate permanent use or residence.

The dimensions of most of the apparent surface structures built of stone suggest that they were used primarily for storage. The only exception to this, in terms of direct observation, is at site 6441 where a Pueblo II room block measuring 12 by 3 meters is recorded. With the possible exception of two sites, the existence of structures cannot be precluded in the 26 locations where surface indications are lacking as the cultural data contained within a site are not often manifest on the surface. Also, there is a low degree of correlation between the extent of cultural debris on the surface of an archaeological site and the presence or absence of structures below the surface.

It would appear likely that many of the smaller sites, both with and without surface indications of structures, may well be what Haury (Willey, 1956) has called the "farm house." That author believes that the isolated one or two room structure is a concommitant aspect of nucleation. It is also suggested that these structures are not likely to be found dating from any point earlier than 1000 A.D., and that most come somewhat later in time, primarily in Pueblo III and, in some areas, in Pueblo IV.

It may well be, therefore, that White Mesa sites reflect Pueblo III nucleation trends. Determination of this issue would require additional field investigation.

2.3.4 Natural Landmarks

The Henry Mountains, located in Garfield County 43 miles south-southeast of Hanksville, are included in the National Registry of Natural

Landmarks. No other sites are included in the Registry from Wayne, San Juan or Garfield Counties.

2.4 GEOLOGY

The proposed project site is near the western margin of the Blanding Basin in southeastern Utah and within the Monticello uranium-mining district. Thousands of feet of multi-colored marine and non-marine sedimentary rocks have been uplifted and warped, and subsequent erosion has carved a spectacular landscape for which the region is famous. Another unique feature of the region is the wide-spread presence of unusually large accumulations of uranium-bearing minerals.

2.4.1 Regional Geology

2.4.1.1 Physiography

The project site is within the Canyon Lands section of the Colorado Plateau physiographic province. To the north, this section is distinctly bounded by the Book Cliffs and Grand Mesa of the Uinta Basin; western margins are defined by the tectonically controlled High Plateaus section, and the southern boundary is arbitrarilly defined along the San Juan River. The eastern boundary is less distinct where the elevated surface of the Canyon Lands section merges with the Southern Rocky Mountain province.

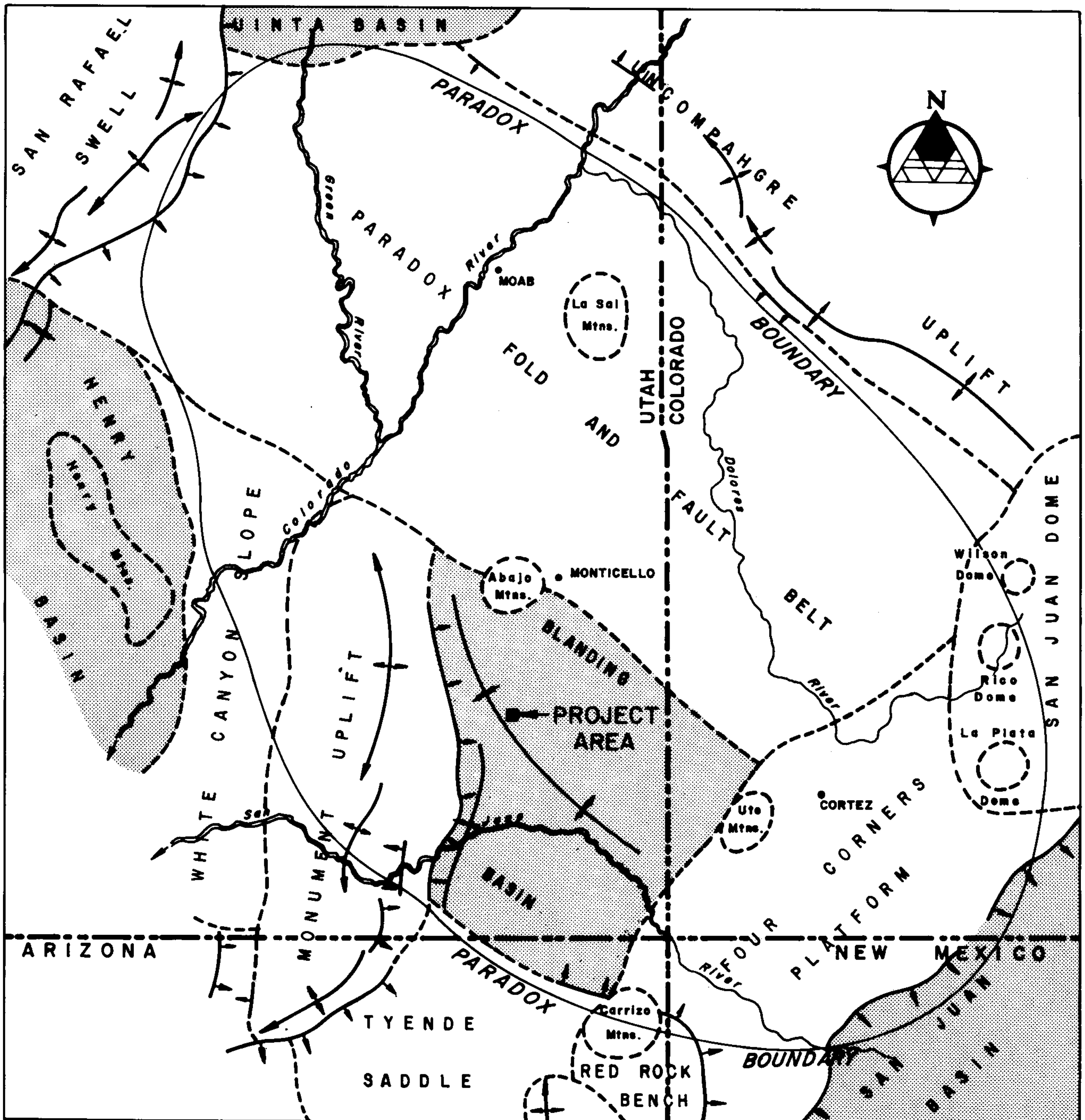
Canyon Lands has undergone epeirogenic uplift and subsequent major erosion has produced the region's characteristic angular topography reflected by high plateaus, mesas, buttes, structural benches, and deep canyons incised into relatively flat-lying sedimentary rocks of pre-Tertiary age. Elevations range from approximately 3000 feet (914 meters) in the bottoms of the deeper canyons along the southwestern margins of the section to more than 11,000 ft (3353 m) in the topographically anomalous laccolithic Henry, Abajo and La Sal Mountains to the northeast. With the exception of the deeper canyons and isolated mountain peaks, an average elevation in excess of 5000 ft (1524 m) persists over most of the Canyon Lands section.

On a more localized regional basis, the project site is located near the western edge of the Blanding Basin, sometimes referred to as the Great Sage Plain (Eardly, 1958), lying east of the north-south trending Monument Uplift, south of the Abajo Mountains and adjacent to the north-westerly-trending Paradox Fold and Fault Belt (Plate 2.4-1). Topographically, the Abajo Mountains are the most prominent feature in the region, rising more than 4000 ft (1219 m) above the broad, gently rolling surface of the Great Sage Plain.

The Great Sage Plain is a structural slope, capped by the resistant Burro Canyon Formation and the Dakota Sandstone, almost horizontal in an east-west direction but decends to the south with a regional slope of about 2000 ft (610 m) over a distance of nearly 50 mi (80 km). Though not as deeply or intricately dissected as other parts of the Canyon Lands, the plain is cut by numerous narrow and vertical-walled south-trending valleys 100 to more than 500 ft (30 to 152+ m) deep. Waters from the intermittent streams that drain the plain flow southward to the San Juan River, eventually joining the Colorado River and exiting the Canyon Lands section through the Grand Canyon.

2.4.1.2 Rock Units

The sedimentary rocks exposed in southeastern Utah have an aggregate thickness of about 6000 to 7000 ft (1829 to 2134 m) and range in age from Pennsylvanian to Late Cretaceous. Older unexposed rocks are known mainly from oil well drilling in the Blanding Basin and Monument Uplift. These wells have encountered correlative Cambrian to Permian rock units of markedly differing thicknesses but averaging over 5000 ft (1524 m) in total thickness (Witkind, 1964). Most of the wells drilled in the region have bottomed in the Pennsylvanian Paradox Member of the Hermosa Formation. A generalized stratigraphic section of rock units ranging in age from Cambrian through Jurassic and Triassic(?), as determined from oil-well logs, is shown in Table 2.4-1. Descriptions of the younger rocks, Jurassic through Cretaceous, are based on field mapping by various investigators and are shown in Table 2.4-2.



(After Shoemaker, 1956; Kelley, 1958)

EXPLANATION

BOUNDARY OF TECTONIC DIV.

MONOCLINE, SHOWING TRACE OF AXIS AND DIRECTION OF DIP

ANTICLINE, SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

SYNCLINE, SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

25 0 25 50 75

SCALE IN MILES

TECTONIC INDEX MAP

DAMES & MOORE

PLATE 2.4-1

TABLE 2.4-1

GENERALIZED STRATIGRAPHIC SECTION OF SUBSURFACE ROCKS BASED ON OIL-WELL LOGS

(After Stokes, 1954; Witkind, 1964; Huff and Lesure, 1965; Johnson and Thordarson, 1966)

Era	Age	Stratigraphic Unit	Thickness* (ft)	Description
MESOZOIC		Glen Canyon Group:		
	Jurassic and Triassic(?)	Navajo Sandstone	300-400	Buff to light gray, massive, cross-bedded, friable sandstone
	Triassic(?)	Kayenta Formation	100-150	Reddish-brown sandstone and mudstone and occasional conglomerate lenses
	Triassic	Wingate Sandstone	250-350	Reddish-brown, massive, cross-bedded, fine-grained sandstone
		Chinle Formation:		
		Undivided	600-700	Variegated claystone with some thin beds of siltstone and limestone
		Moss Back Member	0-100	Light colored, conglomeratic sandstone and conglomerite
		Shinarump Member	0-20	Yellowish-gray, fine to coarse-grained sandstone; conglomeratic sandstone and conglomerate
		Unconformity		
	Middle(?) and Lower Triassic	Moenkopi Formation	50-100	Reddish-brown mudstone and fine-grained sandstone
		Unconformity		
PALEOZOIC	Permian	Cutler Formation:		
		Organ Rock Member	0-600	Reddish-brown, sandy mudstone
		Cedar Mesa Sandstone Member	1100-1400	Reddish-brown, massive, fine to medium-grained sandstone
	Pennsylvanian and Permian(?)	Rico Formation	450	Red and gray calcareous, sandy shale; gray limestone and sandstone
	Pennsylvanian	Hermosa Formation:		
		Upper Member	1000-1200	Gray, massive limestone; some shale and sandstone
		Paradox Member	1200	Halite, anhydrite, gypsum, shale, and siltstone
		Lower Member	200	Limestone, siltstone, and shale
		Unconformity		
	Mississippian	Leadville Limestone	500	White to tan sucrose to crystalline limestone
	Devonian	Ouray Limestone	100	Light gray and tan, thin-bedded limestone and dolomite
		Elbert Formation	200	Gray and brown dolomite and limestone with thin beds green shale and sandstone
		Unconformity		
	Cambrian	Ophir Formation and Tintic Quartzite	600	Gray and brown limestone and dolomite, feldspathic sandstone and arkose

* To convert feet to meters, multiply by 0.3048. Average thickness given if range is not shown.

DAMES & MOORE

TABLE 2.4-2

GENERALIZED STRATIGRAPHIC SECTION OF EXPOSED ROCKS IN THE PROJECT VICINITY

(After Haynes et al., 1962; Witkind, 1964; Huff and Lesure, 1965)

ERA	SYSTEM	SERIES (Age)		STRATIGRAPHIC UNIT	THICKNESS* (ft)	LITHOLOGY
CENOZOIC	QUATERNARY	Holocene to Pleistocene		Alluvium	2-25+	Silt, sand and gravel in arroyos and stream valleys.
				Colluvium and Talus	0-15+	Slope wash, talus and rock rubble ranging from cobbles and boulders to massive blocks fallen from cliffs and outcrops of resistant rock.
				Loess	0-22+	Reddish-brown to light-brown, unconsolidated, well-sorted silt to medium-grained sand; partially cemented with caliche in some area; reworked partly by water.
				Unconformity		
MESOZOIC	CRETACEOUS	Upper Cretaceous		Mancos Shale	0-11(?)	Gray to dark-gray, fissile, thin-bedded marine shale with fossiliferous sandy limestone in lower strata.
				Dakota Sandstone	30 - 75	Light yellowish-brown to light gray-brown, thick bedded to cross-bedded sandstone, conglomeratic sandstone; interbedded thin lenticular gray carbonaceous claystone and impure coal; local course basal conglomerate.
				Unconformity		
		Lower Cretaceous		Burro Canyon Formation	50 -150	Light-gray and light-brown, massive and cross-bedded conglomeratic sandstone and interbedded green and gray-green mudstone; locally contains thin discontinuous beds of silicified sandstone and limestone near top.
				Unconformity(?)		
	JURASSIC	Upper Jurassic	Morrison Formation	Brushy Basin Member	200-450	Variegated gray, pale-green, reddish-brown, and purple bentonitic mudstone and siltstone containing thin discontinuous sandstone and conglomerate lenses.
				Westwater Canyon Member	0-250	Interbedded yellowish- and greenish-gray to pinkish-gray, fine- to course-grained arkosic sandstone and greenish-gray to reddish-brown sandy shale and mudstone.
				Recapture Member	0-200	Interbedded reddish-gray to light brown fine- to medium-grained sandstone and reddish-gray silty and sandy claystone.
				Salt Wash Member	0-350	Interbedded yellowish-brown to pale reddish-brown fine-grained to conglomeritic sandstones and greenish- and reddish-gray mudstone.
				Unconformity		
			San Rafael Group	Bluff Sandstone	0-150+	White to grayish-brown, massive, cross-bedded, fine- to medium-grained eolian sandstone.
				Summerville Formation	25-125	Thin-bedded, ripple-marked reddish-brown muddy sandstone and sandy shale.
				Entrada Sandstone	150-180	Reddish-brown to grayish-white, massive, cross-bedded, fine- to medium-grained sandstone.
		Middle Jurassic		Carmel Formation	20-100+	Irregulary bedded reddish-brown muddy sandstone and sandy mudstone with local thin beds of brown to gray limestone and reddish- to greenish-gray shale.
				Unconformity		

*To convert feet to meters, multiply feet by 0.3048.

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Paleozoic rocks of Cambrian, Devonian and Mississippian ages are not exposed in the southeastern Utah region. Most of the geologic knowledge regarding these rocks was learned from the deeper oil wells drilled in the region, and from exposures in the Grand Canyon to the southwest and in the Uinta and Wasatch Mountains to the north. A few patches of Devonian rocks are exposed in the San Juan Mountains in southwestern Colorado. These Paleozoic rocks are the result of periodic transgressions and regressions of epicontinental seas and their lithologics reflect a variety of depositional environments.

In general, the coarse-grained feldspathic rocks overlying the Precambrian basement rocks grade upward into shales, limestones and dolomites that dominate the upper part of the Cambrian. Devonian and Mississippian dolomites, limestones and interbedded shales unconformably overlie the Cambrian strata. The complete absence of Ordovician and Silurian rocks in the Grand Canyon, Uinta Mountains, southwest Utah region and adjacent portions of Colorado, New Mexico and Arizona indicates that the region was probably epeirogenically positive during these times.

The oldest stratigraphic unit that crops out in the region is the Hermosa Formation of Middle and Late Pennsylvanian age. Only the uppermost strata of this formation are exposed, the best exposure being in the canyon of the San Juan River at the "Goosenecks" where the river traverses the crest of the Monument Uplift. Other exposures are in the breached centers of the Lisbon Valley, Moab and Castle Valley anticlines. The Paradox Member of the Hermosa Formation is sandwiched between a relatively thin lower unnamed member consisting of dark-gray shale siltstone, dolomite, anhydrite, and limestone, and an upper unnamed member of similar lithology but having a much greater thickness. Composition of the Paradox Member is dominantly a thick sequence of interbedded salt (halite), anhydrite, gypsum, and black shale. Surface exposures of the Paradox in the Moab and Castle Valley anticlines are limited to contorted residues of gypsum and black shale.

Conformably overlying the Hermosa is the Pennsylvanian and Permian (?) Rico Formation, composed of interbedded reddish-brown arkosic sandstone and gray marine limestone. The Rico represents a transition zone between the predominantly marine Hermosa and the overlying continental Cutler Formation of Permian age.

Two members of the Cutler probably underlying the region south of Blanding are, in ascending order, the Cedar Mesa Sandstone and the Organ Rock Tongue. The Cedar Mesa is a white to pale reddish-brown, massive, cross-bedded, fine- to medium-grained eolian sandstone. An irregular fluvial sequence of reddish-brown fine-grained sandstones, shaly siltstones and sandy shales comprise the Organ Rock Tongue.

The Moenkopi Formation, of Middle(?) and Lower Triassic age, unconformably overlies the Cutler strata. It is composed of thin, evenly-bedded, reddish- to chocolate-brown, ripple-marked, cross-laminated siltstone and sandy shales with irregular beds of massive medium-grained sandstone.

A thick sequence of complex continental sediments known as the Chinle Formation unconformably overlies the Moenkopi. For the purpose of making lithology correlations in oil wells this formation is divided into three units: the basal Shinarump Member, the Moss Back Member and an upper undivided thick sequence of variegated reddish-brown, reddish- to greenish-gray, yellowish-brown to light-brown bentonitic claystones, mudstones, sandy siltstones, fine-grained sandstones, and limestones. The basal Shinarump is dominantly a yellowish-grey, fine- to coarse-grained sandstone, conglomeratic sandstone and conglomerate characteristically filling ancient stream channel scours eroded into the Moenkopi surface. Numerous uranium deposits have been located in this member in the White Canyon mining district to the west of Comb Ridge. The Moss Back is typically composed of yellowish- to greenish-gray, fine- to medium-grained sandstone, conglomeratic sandstone and conglomerate. It commonly comprises the basal unit of the Chinle where the Shinarump was not deposited, and in a like manner, fills ancient stream channels scoured into the underlying unit.

In the Blanding Basin the Glen Canyon Group consists of three formations which are, in ascending order, the Wingate Sandstone, the Kayenta and the Navajo Sandstone. All are conformable and their contacts are gradational. Commonly cropping out in sheer cliffs, the Late Triassic Wingate Sandstone is typically composed of buff to reddish-brown, massive, cross-bedded, well-sorted, fine-grained quartzose sandstone of eolian origin. Late Triassic(?) Kayenta is fluvial in origin and consists of reddish-brown, irregularly to cross-bedded sandstone, shaly sandstone and, locally, thin beds of limestone and conglomerate. Light yellowish-brown to light-gray and white, massive, cross-bedded, friable, fine- to medium-grained quartzose sandstone typifies the predominantly eolian Jurassic and Triassic(?) Navajo Sandstone.

Four formations of the Middle to Late Jurassic San Rafael Group unconformably overly the Navajo Sandstone. These strata are composed of alternating marine and non-marine sandstones, shales and mudstones. In ascending order, the formations are the Carmel Formation, Entrada Sandstone, Summerville Formation, and Bluff Sandstone. The Carmel usually crops out as a bench between the Navajo and Entrada Sandstones. Typically reddish-brown muddy sandstone and sandy mudstone, the Carmel locally contains thin beds of brown to gray limestone and reddish- to greenish-gray shale. Predominantly eolian in origin, the Entrada is a massive cross-bedded fine- to medium-grained sandstone ranging in color from reddish-brown to grayish-white that crops out in cliffs or hummocky slopes. The Summerville is composed of regular thin-bedded, ripple-marked, reddish-brown muddy sandstone and sandy shale of marine origin and forms steep to gentle slopes above the Entrada. Cliff-forming Bluff Sandstone is present only in the southern part of the Monticello district thinning northward and pinching out near Blanding. It is a white to grayish-brown, massive, cross-bedded eolian sandstone.

In the southeastern Utah region the Late Jurassic Morrison Formation has been divided in ascending order into the Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members. In general, these strata are dominantly fluvial in origin but do contain lacustrine sediments. Both the Salt Wash and Recapture consist of alternating mudstone and sandstone; the Westwater Canyon is chiefly sandstone with some sandy mudstone and claystone lenses, and the heterogeneous Brushy Basin consists of variegated bentonitic mudstone and siltstone containing scattered thin limestone, sandstone and conglomerate lenses. As strata of the Morrison Formation are the oldest rocks exposed in the project area vicinity and are one of the two principal uranium-bearing formations in southeast Utah, the Morrison, as well as younger rocks, is described in more detail in Section 2.4.2.2.

The Early Cretaceous Burro Canyon Formation rests unconformably(?) on the underlying Brushy Basin Member of the Morrison Formation. Most of the Burro Canyon consists of light-colored, massive, cross-bedded fluvial conglomerate, conglomeratic sandstone and sandstone. Most of the conglomerates are near the base. Thin, even-bedded, light-green mudstones are included in the formation and light-gray thin-bedded limestones are sometimes locally interbedded with the mudstones near the top of the formation.

Overlying the Burro Canyon is the Dakota Sandstone of Upper Cretaceous age. Typical Dakota is dominantly yellowish-brown to light-gray, thick-bedded, quartzitic sandstone and conglomeratic sandstone with subordinate thin lenticular beds of mudstone, gray carbonaceous shale and, locally, thin seams of impure coal. The contact with the underlying Burro Canyon is unconformable whereas the contact with the overlying Mancos Shale is gradational from the light-colored sandstones to dark-gray to black shaly siltstone and shale.

Upper Cretaceous Mancos Shale is exposed in the region surrounding the project vicinity but not within it. Where exposed and weathered, the shale is light-gray or yellowish-gray, but is dark- to olive-gray where fresh. Bedding is thin and well developed; much of it is laminated.

Quaternary alluvium within the project vicinity is of three types: alluvial silt, sand and gravels deposited in the stream channels; colluvium deposits of slope wash, talus, rock rubble and large displaced blocks on slopes below cliff faces and outcrops of resistant rock; and alluvial and windblown deposits of silt and sand, partially reworked by water, on benches and broad upland surfaces.

2.4.1.3 Structure and Tectonics

According to Shoemaker (1954 and 1956), structural features within the Canyon Lands of southeastern Utah may be classified into three main categories on the basis of origin or mechanism of the stress that created the structure. These three categories are: (1) structures related to large-scale regional uplifting or downwarping (epeirogenic deformation) directly related to movements in the basement complex (Monument Uplift and the Blanding Basin); (2) structures resulting from the plastic deformation of thick sequences of evaporite deposits, salt plugs and salt anticlines, where the structural expression at the surface is not reflected in the basement complex (Paradox Fold and Fault Belt); and (3) structures that are formed in direct response to stresses induced by magmatic intrusion including local laccolithic domes, dikes and stocks (Abajo Mountains).

Each of the basins and uplifts within the project area region is an asymetric fold usually separated by a steeply-dipping sinuous monocline. Dips of the sedimentary beds in the basins and uplifts rarely exceed a few degrees except along the monocline (Shoemaker, 1956) where, in some instances, the beds are nearly vertical. Along the Comb Ridge monocline, the boundary between the Monument Uplift and the Blanding Basin, approximately 8 mi (12.9 km) west of the project area, dips in the Upper Triassic Wingate sandstone and in the Chinle Formation are more than 40 degrees to the east.

Structures in the crystalline basement complex in the central Colorado Plateau are relatively unknown but where monoclines can be followed in Precambrian rocks they pass into steeply dipping faults. It is probable that the large monoclines in the Canyon Lands section are related to flexure of the layered sedimentary rocks under tangential compression over nearly vertical normal or high-angle reverse faults in the more rigid Precambrian basement rocks (Kelley, 1955; Shoemaker, 1956; Johnson and Thordarson, 1966).

The Monument Uplift is a north-trending, elongated, upwarped structure approximately 90 mi (145 km) long and nearly 35 mi (56 km) wide. Structural relief is about 3000 ft (914 m) (Kelley, 1955). Its broad crest is slightly convex to the east where the Comb Ridge monocline defines the eastern boundary. The uniform and gently descending western flank of the uplift crosses the White Canyon slope and merges into the Henry Basin (Plate 2.4-1).

East of the Monument Uplift, the relatively equidimensional Blanding Basin merges almost imperceptibly with the Paradox Fold and Fault Belt to the north, the Four Corners Platform to the southeast and the Defiance Uplift to the south. The basin is a shallow feature with approximately 700 ft (213 m) of structural relief as estimated on top of the Upper Triassic Chinle Formation by Kelley (1955), and is roughly 40 to 50 mi (64 to 80 km) across. Gentle folds within the basin trend westerly to northwesterly in contrast to the distinct northerly orientation of the Monument Uplift.

Situated to the north of the Monument Uplift and Blanding Basin is the most unique structural feature of the Canyon Lands section, the Paradox Fold and Fault Belt. This tectonic unit is dominated by northwest trending anticlinal folds and associated normal faults covering an area about 150 mi (241 km) long and 65 mi (104 km) wide. These anticlinal structures are associated with salt flowage from the Pennsylvanian Paradox Member of the Hermosa Formation and some show piercement of the overlying younger sedimentary beds by plug-like salt intrusions

(Johnson and Thordarson, 1966). Prominent valleys have been eroded along the crests of the anticlines where salt piercements have occurred or collapses of the central parts have resulted in intricate systems of step-faults and grabens along the anticlinal crests and flanks.

The Abajo Mountains are located approximately 20 mi (32 km) north of the project area on the more-or-less arbitrary border of the Blanding Basin and the Paradox Fold and Fault Belt (Plate 2.4-1). These mountains are laccolithic domes that have been intruded into and through the sedimentary rocks by several stocks (Witkind, 1964). At least 31 laccoliths have been identified. The youngest sedimentary rocks that have been intruded are those of Mancos Shale of Late Cretaceous age. Based on this and other vague and inconclusive evidence, Witkind (1964) has assigned the age of these intrusions to the Late Cretaceous or early Eocene.

Nearly all known faults in the region of the project area are high-angle normal faults with displacements on the order of 300 ft (91 m) or less (Johnson and Thordarson, 1966). The largest known faults within a 40-mi (64-km) radius around Blanding are associated with the Shay graben on the north side of the Abajo Mountains and the Verdure graben on the south side. Respectively, these faults trend northeasterly and easterly and can be traced for approximate distances ranging from 21 to 34 mi (34 to 55 km) according to Witkind (1964). Maximum displacements reported by Witkind on any of the faults is 320 ft (98 m). Because of the extensions of Shay and Verdure fault systems beyond the Abajo Mountains and other geologic evidence, the age of these faults is Late Cretaceous or post-Cretaceous and antedate the laccolithic intrusions (Witkind, 1964).

A prominent group of faults is associated with the salt anticlines in the Paradox Fold and Fault Belt. These faults trend northwesterly parallel to the anticlines and are related to the salt emplacement. Quite likely, these faults are relief features due to salt intrusion or salt removal by solution (Thompson, 1967). Two faults in this region, the Lisbon Valley fault associated with the Lisbon Valley salt anticline and the Moab fault at the southeast end of the Moab anticline have maximum vertical displacements of at least 5000 ft (1524 m) and 2000 ft (609 m), respectively, and are probably associated with breaks in the Precambrian basement crystalline complex. It is possible that zones of weakness in the basement rocks represented by faults of this magnitude may be responsible for the beginning of salt flowage in the salt anticlines, and subsequent solution and removal of the salt by ground water caused collapse within the salt anticlines resulting in the formation of grabens and local complex block faults (Johnson and Thordarson, 1966).

The longest faults in the Colorado Plateau are located some 155 to 210 mi (249 to 338 km) west of the project area along the western margin of the High Plateau section. These faults have a north to northeast echelon trend, are nearly vertical and downthrown on the west in most places. Major faults included in this group are the Hurrican, Toroweap-Sevier, Paunsaugunt, and Paradise faults. The longest fault, the Toroweap-Sevier, can be traced for about 240 mi (386 km) and may have as much as 3000 ft (914 m) of displacement (Kelley, 1955).

From the later part of the Precambrian until the middle Paleozoic the Colorado Plateau was a relatively stable tectonic unit undergoing gentle epeirogenic uplifting and downwarping during which seas transgressed and regressed, depositing and then partially removing layers of sedimentary materials. This period of stability was interrupted by northeast-southwest tangential compression that began sometime during late Mississippian or early Pennsylvanian and continued intermittently into the Triassic. Buckling along the northeast margins of the shelf produced northwest-trending uplifts, the most prominent of which are the Uncompahgre and San Juan Uplifts, sometimes referred to as the Ancestral Rocky Mountains. Clearly, these positive features are the earliest marked tectonic controls that may have guided many of the later Laramide structures (Kelley, 1955).

Subsidence of the area southwest of the Uncompahgre Uplift throughout most of the Pennsylvanian led to the filling of the newly formed basin with an extremely thick sequence of evaporites and associated interbeds which comprise the Paradox Member of the Hermosa Formation (Kelley, 1958). Following Paradox deposition, continental and marine sediments buried the evaporite sequence as epeirogenic movements shifted shallow seas across the region during the Jurassic, Triassic and much of the Cretaceous. The area underlain by the Paradox Member in eastern Utah and western Colorado is commonly referred to as the Paradox Basin (Plate 2.4-1). Renewed compression during the Permian initiated the salt anticlines and piercements, and salt flowage continued through the Triassic.

The Laramide orogeny, lasting from Late Cretaceous through Eocene time, consisted of deep-seated compressional and local vertical stresses. The orogeny is responsible for a north-south to northwest trend in the tectonic fabric of the region and created most of the principal basins and uplifts in the eastern-half of the Colorado Plateau (Grose, 1972; Kelley, 1955).

Post-Laramide epeirogenic deformation has occurred throughout the Tertiary; Eocene strata are flexed sharply in the Grand Hogback monocline, fine-grained Pliocene deposits are tilted on the flanks of the Defiance Uplift, and Pleistocene deposits in Fisher Valley contain three angular unconformaties (Shoemaker, 1956).

2.4.1.4 Uranium Deposits

Most of the productive uranium deposits in southeast Utah are in the Cutler, Chinle and Morrison Formations. Minor uranium mineralization is found in the Hermosa, Rico, Moenkopi, Wingate, and Kayenta Formations. Vanadium is a byproduct of most uranium deposits in the Morrison and of some in the Chinle. Deposits in the Morrison and Chinle are the most important in the Monticello mining district.

Two distinct types of uranium deposits exist in the region: (1) tabular, or peneconcordant, deposits nearly parallel to the bedding of fine- to coarse-grained to conglomeritic sandstone lenses, and (2) fracture-controlled deposits. None of the fracture-controlled deposits have yielded large production and their resource potential is small (Johnson and Thordarson, 1966).

Localization of tabular ore deposits is primarily controlled by sedimentary features that tend to restrict lateral movement of ore-bearing solutions. These features range from regional stratigraphic pinchouts to local channel fills and interfingering of sandstone and mudstone lenses. Ore deposits in the basal Shinarump and Moss Back Members of the Chinle Formation are located where ore-bearing solutions moving through permeable sandstone have been dammed by either the pinch-out of the sandstone or interfingering with less permeable rocks within a few miles of the northeastern regional pinchout of these members. The Salt Wash Member of the Morrison Formation is a highly lenticular and interfingering assemblage of claystone, mudstone, sandstone, and conglomeratic sandstone. The larger ore deposits are found where lenses of sandstone and mudstone predominate, the sandstones allowing passage of ore-bearing solutions and the less permeable mudstone confining the solutions in the sandstone.

Most of the ore-bearing sandstones are stream deposits that filled channels cut into less permeable underlying beds or laterally inter-fingered with fine-grained sediments that accumulated on flood plains. The ore bodies are usually in the lower parts of these filled channels where the sediments are irregularly-bedded, fine- to coarse-grained, sometimes conglomeratic, quartzose or arkosic sandstone. Carbonaceous materials (carbonized leaves, stems and wood fragments) are sparse to abundant. Localization of ore in the lower portions of these sediments is assumed to be due to either gravitational flow of the ore-bearing solutions to the channel bottoms or favorable compositional and textural characteristics of the sediments in this part of the fill.

Tabular deposits in the sinuous channel fills are usually elongate in the channel direction and nearly concordant with bedding in the host rock, but do not follow the bedding in detail. All layers range in thickness from a few inches to more than a few tens of feet. Some ore layers are split into two or more thin overlapping tongues, sometimes separated by several feet of barren sandstone. The ore bodies range in size from small masses only several feet wide, and containing only a few tons of ore, to those hundreds of feet across and containing several hundred thousand tons (Fischer, 1968).

According to Fischer (1956) ore deposits within the region are classified by the relative amounts of uranium, vanadium and copper that they contain: uranium deposits (containing little or no vanadium or copper), vanadium-uranium deposits (V_2O_5 content greater than U_3O_8), and copper-uranium deposits (more copper than U_3O_8). Typically, ore mined in the region ranges from about 0.05 to 0.2 percent U_3O_8, but small pods of high-grade within the ore bodies often contain more than 2.0 percent U_3O_8.

In general, ore minerals mainly coat the sand grains, either partially or completely filling the pore space in the sandstone. Often they form rich replacements of carbonized wood fragments and partially replace the sandstone enclosing the fragments. The minerals also impregnate or replace thin shaly seams and mudstones fragments in the ore-bearing sandstone.

Unoxidized primary ore minerals occur as low-valent oxides and silicates of uranium and vanadium. Principal uranium minerals are uraninite, an oxide, and coffinite, a silicate. The vanadium silicates are all micaceous and consist of vanadium-bearing chlorite, hydrous mica and roscoelite. Montroseite is the most abundant vanadium oxide. Accessory minerals are mainly sulfides and include pyrite, marcasite, chalcopyrite, bornite, chalcocite, galena, and sphalerite. Minerals containing selenium, nickel, cobalt, molybdenum, chromium, and silver are also present, but usually not abundant enough to be recognized (Finch, 1967; Fischer, 1968). Of course, not all of the accessory minerals occur in a single deposit.

Vanadium silicates are stable under oxidizing conditions, but the vanadium oxides, the uranium oxides and silicates, and the various sulfides oxidize and readily form simple to complex secondary ore minerals. During oxidation of vanadium-rich deposits, most of the available uranium combines with the vanadium to form the hydrous vanadate minerals carnotite and tyuyamunite. In vanadium-poor deposits, the uranium and associated sulfide minerals alter to secondary silicates, arsenates, carbonates, sulfates, and phosphates. If excess vanadium is present after forming the uranium vanadate minerals, other secondary vanadium oxide minerals may occur, such as dolorsite, navajoite, and corvusite. Other secondary vanadium minerals may include simplotite, hewettite and volborthite. Secondary accessory minerals may include malachite, azurite, cuprite, goethite, hematite, jarosite, calcite, gypsum, manganese oxides, and lepidocrocite (Finch, 1967).

Most investigators agree that the uranium-vanadium deposits are epigenetic (precipitated from solutions after placement of the host rocks) but differ as to the source of the metals.

2.4.1.5 Other Mineral Resources

Following the discovery and development of the Aneth oil field north of the San Juan River, numerous wildcat wells were drilled without success along the western border of the Blanding Basin. Seven wells have been drilled within an approximate 4-mi (6-km) radius surrounding the project site. All of these wells bottomed in the Paradox Member of the Hermosa Formation, except one that penetrated the Hermosa and bottomed in Cambrian limestones. All were dry and abandoned.

Thin discontinuous beds of carbonaceous shale, impure lignite and coal, and low-rank coal beds up to 2 ft (0.6 m) thick are known to occur throughout the areal extent of the Dakota Sandstone. Although several of these seams have been mined on a very limited scale in the

Blanding area, most of the coals are too impure for commercial use (Huff and Lesure, 1965) and of insufficient quantity to offer any mining potential.

Numerous small gold and silver mines operated in the Abajo Mountains from 1892 to 1905, but the amount of ore produced never equalled the amount of time and money invested (Witkind, 1964). Ore occurrences were located in sulfide-mineralized veins in the shatter zones surrounding the stocks and near the margins of the laccoliths. Sulfide minerals associated with the gold and silver included pyrite, chalcopyrite, sphalerite, and galena. Minor amounts of free gold were produced from placer deposits near the heads of Recapture and Johnson Creeks on the Abajo's southern flank.

Copper deposits are associated with the fracture-controlled uranium-vanadium deposits in the Abajo Mountains and with some tabular sedimentary deposits, especially in the Chinle Formation. Copper content of the mined uranium-vanadium ore has been as high as 3 percent (averages 1 to 2 percent in Chinle).

Pediment deposits up to 100 ft (30 m) in thickness on the north, east and south slopes of the Abajo Mountains are sources of base-coarse material and road metal used in pavement construction. These deposits consist of unconsolidated and poorly-sorted mixtures of angular to well-rounded sand, gravel, cobbles, and boulders up to 4 ft (1.2 m) on a side. Highway departments for the State and San Juan County have opened pits in these deposits and use the rock extensively after crushing, sizing and washing. Inclusions of chert and crytocrystalline quartz in these rocks preclude their use as suitable concrete aggregate (Witkind, 1964).

According to Huff and Lesure (1965) the Dakota and Burro Canyon Formations have been used as a source of sand used in highway construction. Rock from a quarry about 2 mi (3.2 km) east of Monticello was crushed and screened, mixed with gravel, and used in pavement.

Wells drilled on the Great Sage Plain uplands yield water supplies adequate for stock watering and, in some places, domestic use. These wells produce from saturated sandstone at the base of the Burro Canyon Formation. At some localities, water produced from the Dakota Sandstone and Burro Canyon is so highly mineralized that it is unfit for human consumption (Witkind, 1964). The underlying Morrison Formation does not contain any aquifers. Deep wells drilled into the Entrada and Navajo Sandstones have yielded potable water (Johnson and Thordarson, 1966; Witkind, 1964). Several springs in the project vicinity discharge ground water from the saturated sandstone at the base of the Burro Canyon Formation where this horizon crops out at the head of canyons.

2.4.2 Blanding Site Geology

2.4.2.1 Physiography and Topography

The project site is located near the center of White Mesa, one of the many finger-like north-south trending mesas that make up the Great Sage Plain. The nearly flat upland surface of White Mesa is underlain by resistant sandstone caprock which forms steep prominent cliffs separating the upland from deeply entrenched intermittent stream courses on the east, south and west.

Surface elevations across the project site range from about 5550 to 5650 ft (1692 to 1722 m) and the gently rolling surface slopes to the south at a rate of approximately 60 ft per mi (18 m per 1.6 km).

Maximum relief between the mesa's surface and Cottonwood Canyon on the west is about 750 ft (229 m) where Westwater Creek joins Cottonwood Wash. These two streams and their tributaries drain the west and south sides of White Mesa. Drainage on the east is provided by Recapture Creek and its tributaries. Both Cottonwood Wash and Recapture Creeks are normally intermittent streams and flow south to the San Juan River. However, Cottonwood Wash has been known to flow perennially in the project vicinity during wet years.

2.4.2.2 Rock Units

Only rocks of Jurassic and Cretaceous ages are exposed in the vicinity of the proposed project site. These include, in ascending order, the Upper Jurassic Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members of the Morrison Formation; the Lower Cretaceous Burro Canyon Formation; and the Upper Cretaceous Dakota Sandstone. The Upper Cretaceous Mancos Shale is exposed as isolated remnants along the rim of Recapture Creek valley several miles southeast of the project site and on the eastern flanks of the Abajo Mountains some 20 mi (32 km) north but is not exposed at the project site. However, patches of Mancos Shale may be present within the project site boundaries as isolated buried remnants that are obscurred by a mantle of alluvial windblown silt and sand.

The Morrison Formation is of particular economic importance in southeast Utah since several hundred uranium deposits have been discovered in the basal Salt Wash Member (Stokes, 1967).

In most of eastern Utah, the Salt Wash Member underlies the Brushy Basin. However, just south of Blanding in the project vicinity the Recapture Member replaces an upper portion of the Salt Wash and the Westwater Canyon Member replaces a lower part of the Brushy Basin. A southern limit of Salt Wash deposition and a northern limit of Westwater Canyon deposition has been recognized by Haynes et al. (1962) in Westwater Canyon approximately 3 to 6 mi (4.8 to 9.7 km), respectively, northwest of the project site. However, good exposures of Salt Wash are found throughout the Montezuma Canyon area 13 mi (21 km) to the east.

The Salt Wash Member is composed dominantly of fluvial fine-grained to conglomeratic sandstones, and interbedded mudstones. Sandstone intervals are usually yellowish-brown to pale reddish-brown while the mudstones are greenish- and reddish-gray. Carbonaceous materials ("trash") vary from sparse to abundant. Cliff-forming massive sandstone and conglomeratic sandstone in discontinuous beds make up to 50 percent or more of the member. According to Craig et al. (1955), the Salt

Wash was deposited by a system of braided streams flowing generally east and northeast. Most of the uranium-vanadium deposits are located in the basal sandstones and conglomeratic sandstones that fill stream-cut scour channels in the underlying Bluff Sandstone, or where the Bluff Sandstone has been removed by pre-Morrison erosion, in similar channels cut in the Summerville Formation. Mapped thicknesses of this member range from 0 to approximately 350 ft (0-107 m) in southeast Utah. Because the Salt Wash pinches out in a southerly direction in Recapture Creek 3 mi (4.8 km) northwest of the project site and does not reappear until exposed in Montezuma Canyon, it is not known for certain that the Salt Wash actually underlies the site.

The Recapture Member is typically composed of interbedded reddish-gray, white, and light-brown fine- to medium-grained sandstone and reddish-gray, silty and sandy claystone. Bedding is gently to sharply lenticular. Just north of the project site, the Recapture intertongues with and grades into the Salt Wash and the contact between the two cannot be easily recognized. A few spotty occurrences of uraniferous mineralization are found in sandstone lenses in the southern part of the Monticello district and larger deposits are known in a conglomeratic sandstone facies some 75 to 100 mi (121 to 161 km) southeast of the Monticello district. Since significant ore deposits have not been found in extensive outcrops in more favorable areas, the Recapture is believed not to contain potential resources in the project site (Johnson and Thordarson, 1966).

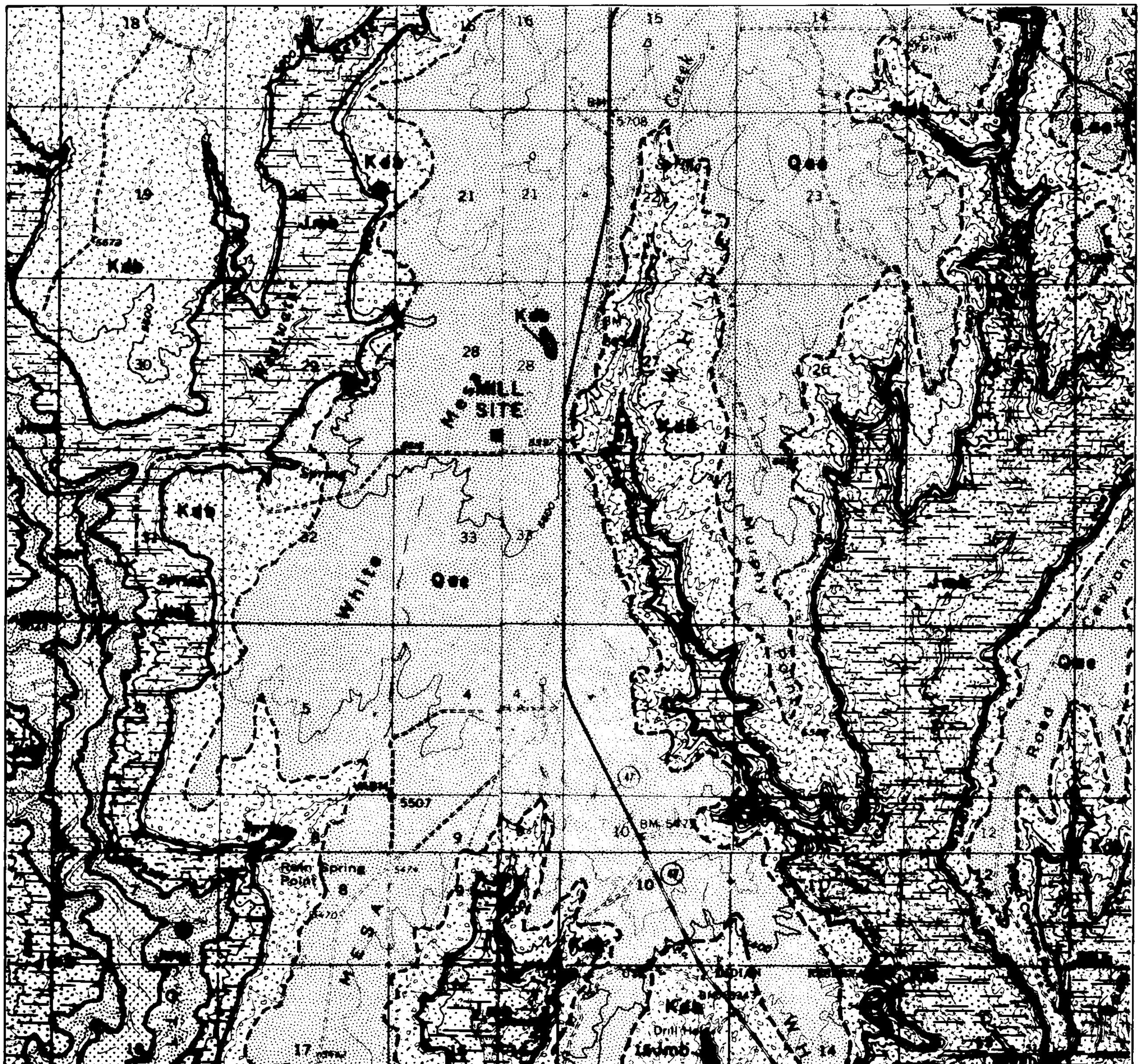
Just north of the project site, the Westwater Canyon Member intertongues with and grades into the lower part of the overlying Brushy Basin Member. Exposures of the Westwater Canyon in Cottonwood Wash are typically composed of interbedded yellowish- and greenish-gray to pinkish-gray, lenticular, fine- to coarse-grained arkosic sandstone and minor amounts of greenish-gray to reddish-brown sandy shale and mudstone. Like the Salt Wash, the Westwater Canyon Member is fluvial in origin, having been deposited by streams flowing north and northwest, coalescing with streams from the southwest depositing the upper part of the Salt Wash and the lower part of the Brushy Basin (Huff and Lesure, 1965). Several small and scattered uranium deposits in the Westwater Canyon are located in the extreme southern end of the Monticello district. Both the Recapture Member and the Westwater Canyon contain only traces of carbonaceous materials, are believed to be less favorable host rocks for uranium deposition (Johnson and Thordarson, 1966) and have very little potential for producing uranium reserves.

The lower part of the Brushy Basin is replaced by the Westwater Canyon Member in the Blanding area but the upper part of the Brushy Basin overlies this member. Composition of the Brushy Basin is dominantly variegated bentonitic mudstone and siltstone. Bedding is thin and regular and usually distinguished by color variations of gray, pale-green, reddish-brown, pale purple, and maroon. Scattered lenticular thin beds of distinctive green and red chert-pebble conglomeratic sandstone are found near the base of the member, some of which contain uranium-vanadium mineralization in the southernmost part of the Monticello district (Haynes et al., 1962). Thin discontinuous beds of limestone and beds of grayish-red to greenish-black siltstone of local extent suggest that much of the Brushy Basin is probably lacustrine in origin.

For the most part, the Great Sage Plain owes its existence to the erosion of resistant sandstones and conglomerates of the Lower Cretaceous Burro Canyon Formation. This formation unconformably(?) overlies the Brushy Basin and the contact is concealed over most of the project area by talus blocks and slope wash. Massive, light-gray to light yellowish-brown sandstone, conglomeratic sandstone and conglomerate comprise more than two-thirds of the formation's thickness. The conglomerate and sandstone are interbedded and usually grade from one to the other. However, most of the conglomerate is near the base. These rocks are massive cross-bedded units formed by a series of interbedded lenses, each lens representing a scour filled with stream-deposited sediments. In places the formation contains greenish-gray lenticular beds of mudstone and claystone. Most of the Burro Canyon is exposed in the vertical cliffs separating the relatively flat surface of White Mesa from the canyons to the west and east. In some places the resistant basal sandstone beds of the overlying Dakota Sandstone are exposed at the top of the cliffs, but entire cliffs of Burro Canyon are most common. Where the sandstones of the Dakota rest on sandstones and conglomerates of the Burro Canyon, the contact between the two is very difficult to identify and most investigators map the two formations as a single unit (Plate 2.4-2). At best, the contact can be defined as the top of a silicified zone in the upper part of the Burro Canyon that appears to be remnants of an ancient soil that formed during a long period of weathering prior to Dakota deposition (Huff and Lesure, 1965).

The Upper Cretaceous Dakota Sandstone disconformably overlies the Burro Canyon Formation. Locally, the disconformity is marked by shallow depressions in the top of the Burro Canyon filled with Dakota sediments containing angular to sub-rounded rock fragments probably derived from Burro Canyon strata (Witkind, 1964) but the contact is concealed at the project site. The Dakota is composed predominantly of pale yellowish-brown to light gray, massive, intricately cross-bedded, fine- to coarse-grained quartzose sandstone locally well-cemented with silica and calcite; elsewhere it is weakly cemented and friable. Scattered throughout the sandstone are lenses of conglomerate, dark-gray carbonaceous mudstones and shale and, in some instances, impure coal. In general, the lower part of the Dakota is more conglomeratic and contains more cross-bedded sandstone than the upper part which is normally more thinly bedded and marine-like in appearance. The basal sandstones and conglomerates are fluvial in origin, whereas the carbonaceous mudstones and shales were probably deposited in backwater areas behind beach ridges in front of the advancing Late Cretaceous sea (Huff and Lesure, 1965). The upper sandstones probably represent littoral marine deposits since they grade upward into the dark-gray siltstones and marine shales of the Mancos Shale.

The Mancos shale is not exposed in the project vicinity. The nearest exposures are small isolated remnants resting conformably on Dakota Sandstone along the western rim above Recapture Creek 4.3 to 5.5



REFERENCES: GEOLOGY, IN PART, AFTER HAYNES ET AL., 1962. BASE MAP PREPARED FROM PORTIONS OF THE BLANDING, BRUSHY BASIN WASH, BLUFF, AND MONTEZUMA CREEK U.S.G.S. 15-MINUTE TOPOGRAPHIC QUADRANGLES.

EXPLANATION

Qes	LOESS
Km	MANCOS SHALE
Kdb	DAKOTA AND BURRO CANYON FORMATIONS (UNDIFFERENTIATED)
Jmb	MORRISON FORMATION: BRUSHY BASIN MEMBER
Jmw	WESTWATER CANYON MEMBER
Jmr	RECAPTURE MEMBER
	CONTACT, DASHED WHERE APPROXIMATE
	STRIKE AND DIP OF BEDS
⊕	HORIZANTAL BEDS

SCALE

3000 0 3000 6000

FEET

GEOLOGIC MAP OF PROJECT AREA

DAMES & MOORE

PLATE 2.4-2

mi (6.9 to 8.9 km) southeast of the project site. Additional exposures are found on the eastern and southern flanks of the Abajo Mountains approximately 16 and 20 mi (26 and 32 km) to the north. It is possible that thin patches of Mancos may be buried at the project site but are obscurred by the mantle of alluvial windblown silt and sand covering the upland surface. The Upper Cretaceous Mancos shale is of marine origin and consists of dark- to olive-gray shale with minor amounts of gray, fine-grained, thin-bedded to blocky limestone and siltstone in the lower part of the formation. Bedding in the Mancos is thin and well developed, and much of the shale is laminated. Where fresh, the shale is brittle and fissile and weathers to chips that are light- to yellowish-gray. Topographic features formed by the Mancos are usually subdued and commonly displayed by low rounded hills and gentle slopes.

A layer of Quaternary to Recent reddish-brown eolian silt and fine sand is spread over the surface of the project site. Most of the loess consists of subangular to rounded frosted quartz grains that are coated with iron oxide. Basically, the loess is massive and homogeneous, ranges in thickness from a dust coating on the rocks that form the rim cliffs to more than 20 ft (6 m), and is partially cemented with calcium carbonate (caliche) in light-colored mottled and veined accumulations which probably represent ancient immature soil horizons.

2.4.2.3 Structure

The geologic structure at the project site is comparatively simple. Strata of the underlying Mesozoic sedimentary rocks are nearly horizontal; only slight undulations along the caprock rims of the upland are perceptible and faulting is absent. In much of the area surrounding the project site the dips are less than one degree. The prevailing regional dip is about one degree to the south. The low dips and simple structure are in sharp contrast to the pronounced structural features of the Comb Ridge Monocline to the west and the Abajo Mountains to the north.

Jointing is common in the exposed Dakota-Burro Canyon sandstones along the mesa's rim. More often than not, the primary joints are virtually parallel to the cliff faces and the secondary joints are almost perpendicular to the primary joints. Since erosion of the underlying weaker Brushy Basin mudstones removes both vertical and lateral support of the sandstone, large joint blocks commonly break away from the cliff leaving joint surfaces as the cliff face. Because of this, it is not possible to determine if the joints originated after the development of the canyons or if the joints influenced the development of canyons and cliffs. However, from a geomorphologic standpoint, it appears that the joints are related to the compaction of the underlying strata and, therefore, are sedimentary and physiographic features rather than tectonic in origin. Whatever the original cause, two sets of joint attitudes exist in the resistant sandstones adjacent to the west side of the project site. These sets range from N.10-18°E. and N.60-85°E. and nearly parallel the cliff faces.

2.4.2.4 Mineral Resources

Because of extensive and easily accessible outcrops in the dissected Great Sage Plain, the Salt Wash Member of the Morrison Formation has been one of the most prospected ore-bearing strata in southeastern Utah. One old and small possible prospect site was located in Cottonwood Canyon during field reconnaissance. No evidence of uranium mineralization was found at this location.

Other than the possibility of quarrying sandstone from the Dakota Sandstone and Burro Canyon Formation for construction materials, there are no other known mineral resources with potential for economic development beneath the project site.

2.4.2.5 Geotechnical Conditions at the Proposed Mill and Tailing Retention Sites

A geotechnical investigation of the proposed mill and tailing sites was conducted during September 1977. Field data and observations, results of laboratory testing, and conclusions based on the results of the investigation are presented in Appendix H.

The mill site is underlain by interbedded thin layers reddish-brown silty fine sand and fine sandy silt to depths ranging from 7.5 to 14.5 ft (2.3 to 4.4 m). These materials are loessal soils that have been partially reworked by surface water (probably by precipitation runoff). In general, they are loose at the surface, are medium dense within 1 to 2 ft (0.3 to 0.7 m), and become more dense with increasing depth. In places, these materials are slightly to moderately cemented with calcium carbonate. The tailing site is underlain by the same soil types possessing the same general characteristics, however, thicknesses range from 3 to 17 ft (1.0 to 5.2 m).

In 11 of the 28 borings drilled during the geotechnical investigation, a light gray-brown to grayish-green, stiff to very-stiff silty clay was encountered below the loessal soil materials. It is possible that these silty clays are weathered shales of the Mancos Formation. Thickness of the silty clays range from 1.5 to 11 ft (0.5 to 3.4 m). The thinner layers could be mudstones and claystones that are known to be included in the upper marine facies of the Dakota Sandstone, but the thicker layers tend to indicate that these materials could be Mancos. Regardless of origin, these materials have undergone substantial weathering and should be classified as soil rather than rock.

Underlying the loessal soils and silty clays is the Dakota Sandstone Formation. This formation is composed of a hard to very hard fine- to coarse-grained sandstone and conglomeritic sandstone. It is poorly to highly cemented with silica or calcium carbonate and, sometimes, with iron oxides. Losses of drilling fluid during the subsurface investigation indicate that open fractures or very permeable layers exist within the formation. The contact between the Dakota Sandstone and the underlying Burro Canyon Formation is extremely difficult to detect in a drill hole without continuous coring. Sometimes it may be identified by a thin greenish-gray mudstone layer beneath the Dakota's basal conglomerate. Where the sandstones of the Dakota rest on Burro Canyon sandstones, the contact can hardly be distinguished even in outcrops. From a geotechnical appraisal, the physical properties and characteristics of the two formations are nearly identical, even sharing the same joint patterns (see Section 2.4.2.3) and having similar zones of high permeability.

2.4.2.6 Geologic Hazards

Other than the possibility of very minor effects from seismic activity, no potentially hazardous geologic conditions are known to exist at the proposed project site.

2.5 SEISMOLOGY

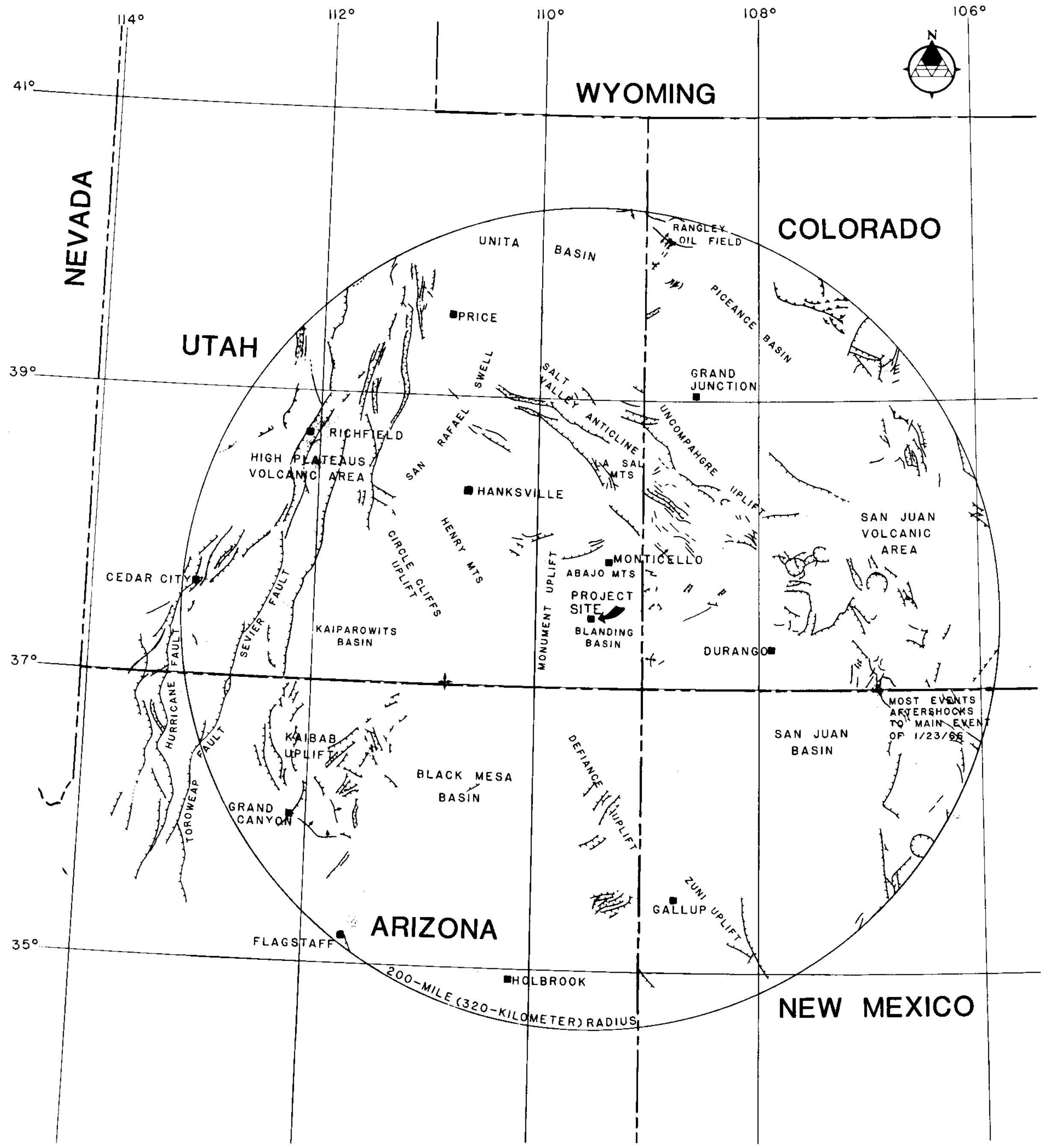
2.5.1 Seismic History of Region

Because of the region's late settlement, the record of earthquake occurrences in the Colorado Plateau and surrounding regions dates back only 125 years. Documentation of the earlier events was based solely on newspaper reports that frequently recorded effects only in the more populated areas which may have been some distance from the epicenters. Not until the late 1950s was a seismograph network developed to properly locate and evaluate seismic events in this region (Simon, 1972).

The project area is within a relatively tectonically stable portion of the Colorado Plateau noted for its scarcity of historical seismic events. Conversely, the border between the Colorado Plateau and the Basin and Range Province and Middle Rocky Mountain Province some 155 to more than 240 mi (249 to 386 km) west and northwest, respectively, from the site is one of the most active seismic belts in the western United States.

The epicenters of historical earthquakes from 1853 through 1976 within a 200-mi (320-km) radius of the site are shown on Plate 2.5-1. More than 450 events have occurred in the area, of which at least 45 were damaging; that is, having an intensity of VI or greater on the Modified Mercalli Scale. A description of the Modified Mercalli Scale is given in Table 2.5-1, and all intensities mentioned herein refer to this scale.

Only 15 epicenters have been recorded within a 100-mi (160-km) radius of the project area. Of these, 14 had an intensity IV or less (or



LEGEND

- UNCLASSIFIED FAULT
- THRUST FAULT: SAW TEETH ON UPTHROWN SIDE
- NORMAL FAULT: HACHURES ON DOWNTHROWN SIDE
- ANTICLINAL AXIS
- DOME

KEY TO EARTHQUAKE EPICENTERS

SYMBOL MODIFIED MERCALLI INTENSITY

VIII

VII

VI

V

IV OR LESS OR NO INTENSITY GIVEN

NUMBER REFERS TO MULTIPLE EVENTS IN SAME LOCATION. INTENSITY OF LARGEST EVENT IS PLOTTED.

References: Cook and Smith, 1967; Hadsell, 1968; Simon, 1972; Coffman and Von Hake, 1973a, 1973b, 1974, and 1975; Coffman and Stover, 1976; Giardina, 1977; NOAA, 1977. Tectonic base after Cohee ET AL, 1962.

SCALE

25 0 25 50 75 100

MILES

REGIONAL TECTONIC MAP SHOWING HISTORIC EARTHQUAKE EPICENTERS WITHIN 200-MILE RADIUS OF THE PROJECT SITE

DAMES & MOORE

TABLE 2.5-1

MODIFIED MERCALLI SCALE
(Abridged)

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated.

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.

V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

TABLE 2.5-1 (Concluded)

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown upward into the air.

unrecorded) and one was recorded as intensity V. The nearest event occurred in the Glen Canyon National Recreation Area approximately 43.5 mi (70 km) west-northwest of the project area. The next closest event occurred approximately 58.5 mi (94 km) to the northeast. Just east of Durango, Colorado, approximately 99 mi (159 km) due east of the project area, an event having a local intensity of V was recorded on August 29, 1941 (Hadsell, 1968). It is very doubtful that these events would have been felt in the vicinity of Blanding.

Three of the most damaging earthquakes associated with the seismic belt along the Colorado Plateau's western border have occurred in the Elsinore-Richfield area about 168 mi (270 km) northwest of the project site. All were of intensity VIII. On November 13, 1901, a strong shock caused extensive damage from Richfield to Parowan. Many brick structures were damaged; rockslides were reported near Beaver. Earth cracks with the ejection of sand and water were reported, and some creeks increased their flow. Aftershocks continued for several weeks (von Hake, 1977). Following several weeks of small foreshocks, a strong earthquake caused major damage in the Monroe-Elsinore-Richfield area on September 29, 1921. Scores of chimneys were thrown down, plaster fell from ceilings, and a section of a new 2-story brick wall collapsed at Elsinore's schoolhouse. Two days later, on October 1, another strong tremor caused additional damage to the area's structures. Large rockfalls occurred along both

Only 15 epicenters have been recorded within a 100-mi (160-km) radius of the project area. Of these, 14 had an intensity IV or less (or unrecorded) and one was recorded as intensity V. The nearest event occurred in the Glen Canyon National Recreation Area approximately 43.5 mi (70 km) west-northwest of the project area. The next closest event occurred approximately 58.5 mi (94 km) to the northeast. Just east of Durango, Colorado, approximately 99 mi (159 km) due east of the project area, an event having a local intensity of V was recorded on August 29, 1941 (Hadsell, 1968). It is very doubtful that these events would have been felt in the vicinity of Blanding.

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Seven events of intensity VII have been reported in the area shown on Plate 2.5-1. Of these, only two are considered to have any significance with respect to the project site. On August 18, 1912, an intensity VII shock damaged houses in northern Arizona and was felt in Gallup, New Mexico, and southern Utah. Rock slides occurred near the epicenter in the San Francisco Mountains and a 50-mi (80-km) earth crack was reported north of the San Francisco Range (U.S. Geological Survey, 1970). Nearly every building in Dulce, New Mexico, was damaged to some degree when shook by a strong earthquake on January 22, 1966. Rockfalls and landslides occurred 10 to 15 mi (16 to 24 km) west of Dulce along Highway 17 where cracks in the pavement were reported (von Hake, 1975). Both of these events may have been felt at the project site but, again, would certainly not have caused any damage.

2.5.2 Relationship of Earthquakes to Tectonic Structures

The majority of recorded earthquakes in Utah have occurred along an active belt of seismicity that extends from the Gulf of California, through western Arizona, central Utah, and northward into western British Columbia. The seismic belt is possibly a branch of the active rift system associated with the landward extension of the East Pacific Rise (Cook and Smith, 1967).

It is significant to note that the seismic belt forms the boundary zone between the Basin and Range and the Colorado Plateau-Middle Rocky Mountain Provinces. This block-faulted zone is about 47 to 62 mi (75 to 100 km) wide and forms a tectonic transition zone between the relatively simple structures of the Colorado Plateau and the complex fault-controlled structures of the Basin and Range Province (Cook and Smith, 1967).

Another zone of seismic activity is in the vicinity of Dulce, New Mexico near the Colorado border. This zone, which coincides with an extensive series of Tertiary intrusives, may also be related to the northern end of the Rio Grande Rift. This rift is a series of fault-controlled structural depressions extending southward from southern Colorado through central New Mexico and into Mexico.

Most of the events of intensity V and greater are located within 50 mi (80 km) of post-Oligocene extrusives. This relationship is not surprising because it has been observed in many other parts of the world (Hadsell, 1968).

2.5.3 Potential Earthquake Hazards to Project

The project site is located in a region known for its scarcity of recorded seismic events. Although the seismic history for this region is barely 125 years old, the epicentral pattern, or fabric, is basically set and appreciable changes are expected not to occur. Most of the larger seismic events in the Colorado Plateau have occurred along its margins rather than in the interior central region. Based on the region's seismic history, the probability of a major damaging earthquake occurring at or near the project site is very remote. Studies by Algermissen and Perkins (1976) indicate that southeastern Utah, including the site, is in an area where there is a 90 percent probability that a horizontal acceleration of four percent gravity (0.04g) would not be exceeded within 50 years.

Minor earthquakes, not associated with any seismic-tectonic trends, can presumably occur randomly at almost any location. Even if such an event with an intensity as high as VI should occur at or near the project site, horizontal ground accelerations would not exceed 0.10g but would probably range between 0.05 and 0.09g (Coulter et al., 1973; Trifunac and Brady, 1975). These magnitudes of ground motion would not pose significant hazards to the project's proposed facilities.

2.6 HYDROLOGY

2.6.1 Ground Water Hydrology

2.6.1.1 Regional Occurrence and Distribution of Ground Water

The occurrence and distribution of ground water in the region encompassing the Blanding area are influenced by the type and extent of rock formations and the structural features making up the Canyon Lands Section of the Colorado Plateau Physiographic Province (see Section 2.4).

In general, the rock formations of the region are flat-lying with dips of one to three degrees. The rock formations are incised by streams that have formed canyons between intervening areas of broad mesas and buttes. An intricate system of deep canyons along and across hog-backs and cuestas has resulted from faulting, upwarps and dislocation of rocks around the intrusive rock masses such as Abajo Mountains, approximately 25 miles to the north of the project site. Thus, the region is divided into numerous hydrological areas controlled by structural features such as the San Rafael Swell, the Monument Upwarp, and the Abajo, Henry and La Sal Mountains as well as the faulted anticlines in Salt, Spanish and Lisbon Valleys.

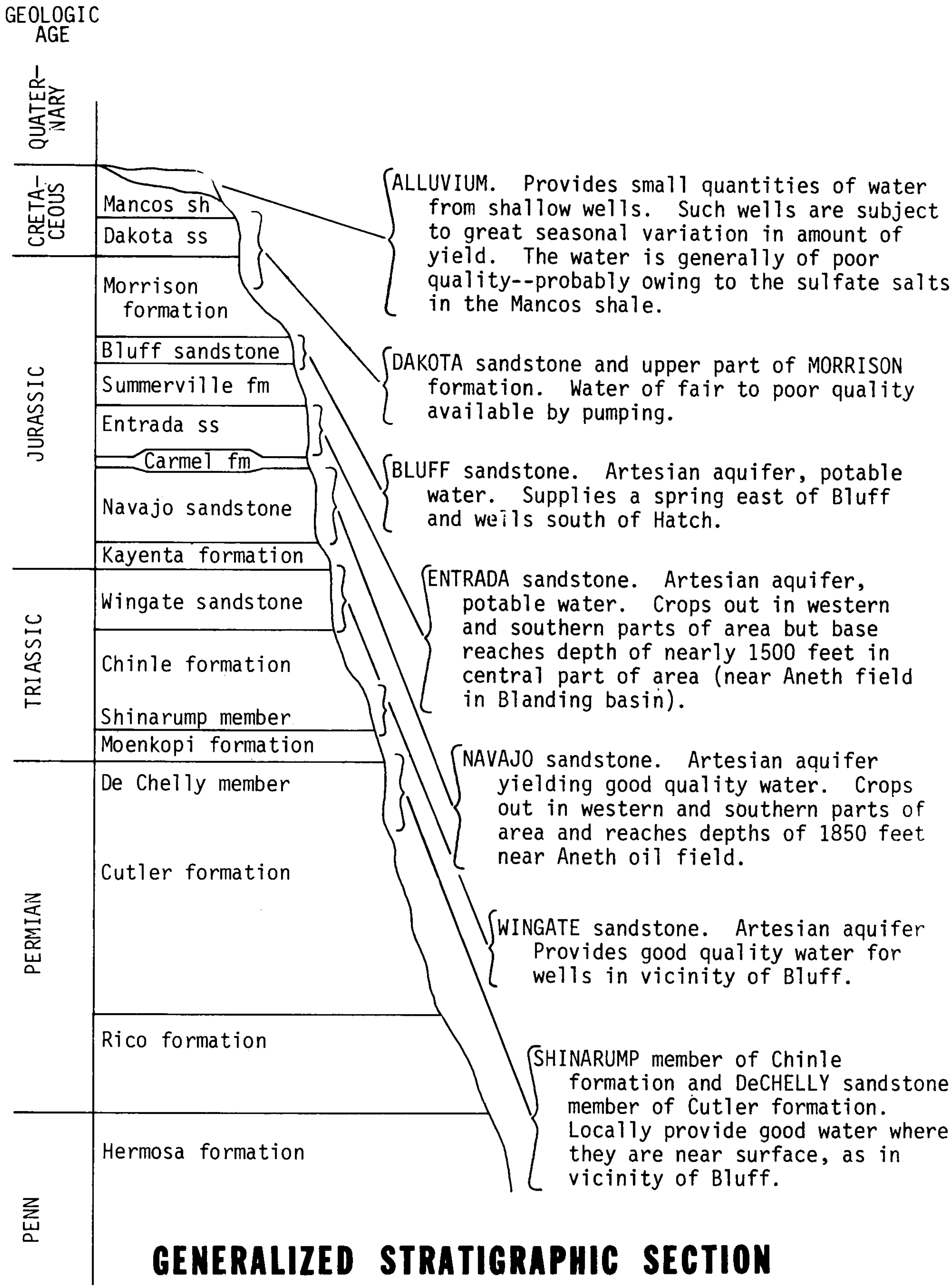
Water-bearing sedimentary rock formations of Cambrian and Devonian through Cretaceous age are exposed in the region or have been identified in oil wells in the Blanding basin. Data on bedrock aquifers for most of the region are sparce and that information available is largely restricted to wells located in only one or two areas that are not near the project site.

Bedrock Aquifers

On a regional basis, the formations that are recognized as bedrock aquifers are: the Cretaceous-age Dakota sandstone and the upper part of the Morrison formation of late Jurassic age; the Bluff sandstone, the Entrada sandstone and the Navajo sandstone of Jurassic age; the Wingate sandstone and the Shinarump member of the Chinle formation of Triassic age; and the DeChelle member of the Cutler formation of Permian age. These units are shown in Plate 2.6-1, a generalized section of stratigraphic units including water-bearing units in southeastern Utah.

Other formations within this sequence also contain water but its quality varies from slightly saline to very saline. Underneath the Permian Cutler formation are saline water-bearing units within the Rico formation and the Hermosa formation of Pennsylvanian age from which oil is produced in the Blanding basin.

There are no available reports with quantitative data regarding transmissivity, storage and other aquifer characteristics of major bedrock aquifers in this region of southeastern Utah. Some data on the reported yields of wells are contained in older geologic reports (Goode, 1958; Feltis, 1966; and Lofgren, 1954). For instance, according to Feltis (1966) the range in yield for six wells drilled into the Dakota sandstone and Burro Canyon formation east of Monticello varies from 22 to 125 gallons per minute (gpm). Two wells drilled into the Morrison formation in the same area yield 15 to 22 gpm whereas, in other areas of San Juan County, Utah, the yield from wells drilled into the Morrison is 1 or 2 gpm or less.



GENERALIZED STRATIGRAPHIC SECTION SHOWING FRESH WATERBEARING UNITS IN SOUTHEASTERN UTAH

DAMES & MOORE

Source: After Goode, 1958

Likewise, the Bluff sandstone, found only in southern San Juan County, has reportedly yielded 13 and 25 gpm in two wells drilled near Bluff (Feltis, 1966: 27). The Entrada sandstone is reported to yield an average of 143 gpm at five wells drilled in San Juan County, but yields as high as 1200 gpm have been reported in other areas of southeast Utah (Feltis, 1966: 27).

The Navajo sandstone is one of the most permeable bedrock aquifers in the region with reported yields as high as 1335 gpm (Feltis, 1966: 26), although many wells drilled into the Navajo in southeast Utah only have yields varying between 35 to 72 gpm. The Energy Fuels mill site well drilled into the Navajo sandstone is reported to have yielded 120 gpm after 1.5 hours of pumping shortly after it was drilled.

Throughout the region, small quantities of water are produced from shallow wells constructed in the alluvium that occurs in stream valleys and a veneer on the flat-top mesas. These wells are subject to great seasonal variation in yield and the water withdrawn is generally of poor quality, perhaps due to the leaching of sulfate salts in the Mancos shale which is present at or near the surface near stream valleys over much of the region.

Recharge

The source of recharge to bedrock aquifers of the region is precipitation. Precipitation in southeastern Utah (see Sections 2.7.1 and 2.7.2) is characterized by wide variations in seasonal and annual rainfall and by long periods of deficient rainfall. Short-duration summer storms furnish rain in small areas of a few square miles and this is frequently the total rainfall for an entire month within a given area. The average annual precipitation in the region ranges from less than 20 cm (8 in) at Bluff to more than 41 cm (16 in) on the eastern flank of the Abajo Mountains, as recorded at Monticello. Precipitation at the project site is discussed in Section 2.7.1. The mountain peaks in the Henry, La Sal and Abajo Mountains may receive more than 76 cm (30 in) of precipitation but these areas are very small in comparison to the vast area of much lower precipitation in the region.

Recharge to bedrock aquifers in the region occurs by direct infiltration of precipitation into the aquifers along the flanks of the Abajo, Henry and La Sal Mountains and along the flanks of the folds, such as Comb Ridge Monocline and the San Rafael Swell, where the permeable formations are exposed at the surface. Recharge also occurs on the wide expanses of flat-lying beds that are exposed on the mesas between these major structural features. In these cases, some precipitation is able to percolate through the near-surface joints and fractures in the Mancos Shale and Dakota sandstone, where it circulates according to the local ground water regime.

2.6.1.2 Regional Utilization of Ground Water

Rainfall throughout most of the region is inadequate for growth of crops so that irrigation is necessary in most locations, except in a small area east and southeast of Monticello. Ground water is utilized for irrigation, livestock, domestic needs and more recently for municipal water supplies.

Present Use

The area of greatest present development of ground water use in the region is in the Blanding basin, an artesian basin east of Comb Ridge in San Juan county (see Plate 2.4-1 in Section 2.4.1.1). Within the Blanding basin in the areas of Montezuma Creek valley and south and east of Blanding, there are a number of deep wells which derive good quality water from the deep bedrock aquifers, i.e., the Entrada, Navajo and Wingate Sandstones. These waters are used for irrigation and domestic needs of residents in the area. The estimated total amount of ground water withdrawal of all these deep bedrock wells in the region is unknown but considered very small compared to the total amount of water available in the aquifers.

Within the last year (1977), a few deep wells for municipal water supplies have been drilled into the Entrada and Navajo sandstones near Blanding and Monticello, Utah. The present usage of these wells is not known. Blanding completed one deep well (960-foot depth) in October 1977 and anticipates drilling three more. Monticello is currently (fall, 1977) drilling a new 1000-foot deep well and anticipates drilling more as the need occurs.

Water from shallow wells, drilled principally into unconsolidated aluvium overlying the bedrock in many areas of the region, has been used from the earliest days of settlement to the present as a source of domestic and stock water supplies. Some of these shallow wells, mostly less than 150 feet deep, have been drilled into the saturated upper portion of the Dakota sandstone which directly underlies the Mancos shale throughout much of the region. The estimated total annual ground water withdrawal from these shallow aquifers in the region is unknown.

Another area of ground water development in the region outside of the Blanding basin is the broad, flat, plain east of Monticello. Here, the ground water is derived principally from the thin veneer of surface alluvium that overlies the Dakota sandstone and from the upper portion of the Dakota and underlying Morrison formation. Most of the wells in this area are shallow and, for the most part, water supply requirements are relatively small.

The remainder of the region is very sparsely populated with only a few scattered stock wells of low yields and shallow depth deriving water from alluvium and the upper part of the Dakota sandstone or Morrison formation.

Projected Use

The projected regional use of ground water for domestic purposes and stock watering will probably increase at the same rate as population growth occurs in the rural areas outside of the three population centers of Blanding, Monticello and Bluff, Utah. The ground water used for these purposes would likely be derived from near-surface sources such as alluvium, the Dakota sandstone, the Burro Canyon formation and the Morrison formation. Increases in use of ground water for irrigation will depend on the availability of land for raising of crops and an increase in tillable acreage. However, no significant change is anticipated.

Ground water use for municipal water supplies for Blanding, Monticello and Bluff will increase at a rate commensurate with the increase in population (see Section 2.2). The communities do anticipate drilling additional wells for water supplies to accommodate growth.

2.6.1.3 Ground Water Regime of Project Site

The project site, located on a flat-top mesa approximately two miles wide, is partly covered with a thin veneer of alluvium which in some places is underlain by the Mancos shale and in other locations by the Dakota Sandstone/Burro Canyon formations. The Mancos shale contains water soluble salts and generally water circulating through it becomes fairly highly mineralized. The Mancos is not a fresh water aquifer. Stratigraphically below the Mancos shale is the Dakota sandstone, the Burro Canyon formation and the Morrison formation which yield fresh to slightly saline water to numerous springs and shallow wells in the project vicinity. Both the Dakota sandstone and the Burro Canyon formation crop out in the canyon walls and valleys of Westwater Creek, Cottonwood Creek and Corral Creek near the site. The formations are continuous beneath the site, extending from the outcrops in Corral Creek Canyon east of the site to the Canyon of Cottonwood Creek and Westwater Creek west of the site.

The subsurface formations below the project site are represented by the typical stratigraphic rock section as discussed in Section 2.4 and illustrated in Plate 2.6-1. The known fresh water-bearing units below the Dakota sandstone, Burro Canyon and Morrison formations at the site are mainly the Entrada sandstone and the Navajo sandstone as shown on Plate 2.6-1 and discussed in Section 2.6.1.1. There are no quantitative aquifer data available on these formations in the site vicinity and little is known of the deeper aquifers such as the Wingate and Shinarump of the Chinle formation.

Recharge

In the project vicinity, the Dakota sandstone and the Burro Canyon formation locally receive recharge from infiltration of rainfall on the flat-lying mesa.

In the site area, the Dakota sandstone and Burro Canyon formation are well jointed by two joint sets trending N.10-18°E and N.60-85°E (see Section 2.4 for more detail). These open joints provide pathways for the percolation of rainfall and downward infiltration of ponded surface waters on the site. The joints also may act as conduits for the local movement of ground water underneath the site.

The recharge area for the underlying deeper aquifers such as the Navajo sandstone and the Entrada sandstone, as they occur within the Blanding basin and under the site, is the outcrop area of these sandstones along the length of the north-south trending Comb Ridge Monocline approximately 8 miles west of the project site.

Ground Water Movement

The movement of ground water occurring at shallow depths in the Dakota sandstone and Burro Canyon formation at the project site is believed to be confined to isolated zones within White Mesa. These formations are exposed and crop out in the canyon walls of the surface drainages both east and west of the site. Due to the location of the site on the northern margin of the northwest-southeast trending Blanding basin, the near surface formations dip one or two degrees to the south. Beneath the shallow aquifers, the Brushy Basin Member of the Morrison formation is generally impermeable and there are locally impermeable lenses in the base of the Burro Canyon formation. Thus, water percolating into the near surface formations of the project site, such as the Dakota sandstone and the Burro Canyon formation, will generally migrate southward downdip. It is probable that slight ground water mounding may occur in the east-central part of the mesa at the site. Ground water levels may be highest in the center of the mesa, coincident with the highest land elevations, and lower to the east and west where ground water can drain from the mesa through springs and seeps in the canyons of Westwater, Cottonwood and Corral Creeks. This is partially substantiated by water levels measured in drill holes and wells in the project vicinity. Several springs exist along the canyon walls adjacent to the project site.

Supplemental drilling at the mill site and tailing retention area is planned for the spring of 1978 and will provide more information on the local occurrence and movement of ground water at the site. Results from this study will be included in the Supplemental Report.

Ground water movement in the deeper aquifers is related to the deeper structures of the Blanding basin. The recharge area of the Entrada and Navajo sandstones is along Comb Ridge Monocline about 8 miles directly west of the site area. The ground water movement in these units is thought to proceed from the recharge area eastward and southeastward downdip toward the center of the Blanding basin, approximately 18 miles south-southeast of the project site. At present, there are no data to substantiate this hypothesis as there are neither maps of potentiometric surfaces in the Navajo or Entrada nor long-term records of water levels in the site vicinity for wells penetrating the Navajo or Entrada.

Ground Water Conditions at Mill Site and Tailing Retention Site

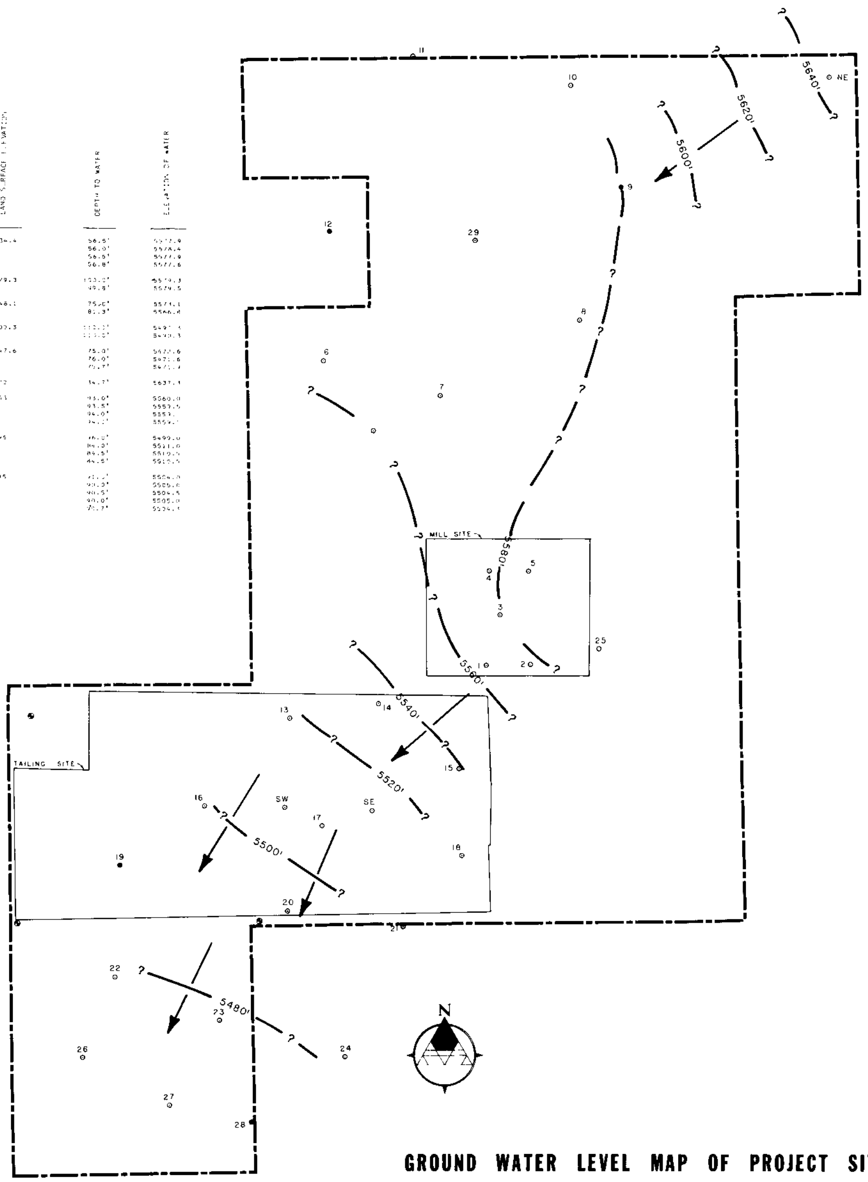
Ground water is present beneath the mill site at a depth of approximately 56 feet below the land surface (see log of borehole No. 3 in Appendix H). This ground water is probably the water table or unconfined ground water, although it may represent perched ground water.

As part of the geotechnical investigations of the mill site area and tailing retention site area, a number of boreholes were drilled in the project vicinity and water levels measured in those boreholes in which water was present. Based on these water level measurements and miscellaneous water level measurements made in some abandoned stock wells in the immediate vicinity, a ground water-level map was constructed showing the elevation of the water table (Plate 2.6-2) and indicating general gradients. The water levels mapped in Plate 2.6-2 are from a few boreholes and stock wells and are believed to represent a water table situation and not artesian conditions. However, it is not known if the water table recorded in each borehole is the same and is continuous or whether there are a number of "perched" water tables throughout the project vicinity. One of the objectives of the supplemental investigations at the mill site and tailing site areas in spring of 1978 will be to evaluate the ground water flow system in more detail.

Using the ground water-level map (Plate 2.6-2), it appears that the shallow ground water forming the water table throughout the project vicinity has a gradient toward the south-southwest. The general ground water gradient appears to be related to the general topographic gradient; i.e., the highest elevations are generally at the northeastern edge of the project site near Highway 47 and the lowest elevations are at the property's southwest corner. Based on the recorded water levels as shown on the map and assuming that the water table is continuous throughout the map area, it can be calculated that the water table gradient under the mill site is about 0.03, and that under the tailing retention area is 0.01.

A number of "permeability" tests were conducted in boreholes during the geotechnical investigation of the mill site and tailing retention site. The tests used packers in the boreholes and injection of water under pressure for various periods of time. The results of these "permeability" tests indicate that, in general, the hydraulic conductivity ("horizontal permeability") of the formations below the water table, on the average, ranges between 5 and 10 feet per year. However, it should be noted that some of the packer tests conducted above the water table indicated a much higher hydraulic conductivity while a few packer tests conducted both above and below the water table indicated a much lower hydraulic conductivity for selected intervals (see Appendix H).

DRILL HOLE NO.	DATE	LAND SURFACE ELEVATION	DEPTH TO WATER	ELEVATION OF WATER
1	09/19/77	5634.4	56.5'	55[illegible]7.9
	09/22/77		56.0'	5578.4
	09/27/77		56.5'	5577.9
	11/04/77		56.8'	5577.6
9	09/30/77	5679.3	1[illegible]0.0'	5579.3
	11/04/77		99.8'	5579.5
12	09/15/77	5646.1	75.0'	5571.1
	11/04/77		81.3'	5566.8
19	09/27/77	5603.3	[illegible]	549[illegible]
	11/04/77		[illegible]	5490.3
28	09/12/77	5547.6	75.0'	5472.6
	09/27/77		76.0'	5471.6
	11/04/77		[illegible]	547[illegible]
N.E.	11/04/77	5672	34.7'	5637.3
[illegible]	09/16/77	5653	93.0'	5560.0
	09/22/77		93.5'	5559.5
	09/27/77		94.0'	5559.[illegible]
	09/08/77		94.[illegible]	5559.[illegible]
S.E.	09/08/77	5545	[illegible]	5499.0
	09/16/77		84.0'	5511.0
	09/22/77		84.5'	5510.5
	09/27/77		84.5'	5510.5
S.W.	09/08/77	5595	[illegible]	5504.0
	09/16/77		90.0'	5505.0
	09/22/77		90.5'	5504.5
	09/27/77		90.0'	5505.0
	11/04/77		90.7'	5504.3



GROUND WATER LEVEL MAP OF PROJECT SITE

KEY

—5520'— ELEVATION OF WATER TABLE (FEET ABOVE MSL)

← DIRECTION OF SHALLOW GROUND WATER MOVEMENT

° 29 BOREHOLE LOCATION AND NUMBER ENCOUNTERING WATER

DAMES & MOORE

PLATE 2.6-2

Using the formula based on Darcy's Law

$$V = \frac{Ki}{\theta}$$

where:

V = the rate of movement of ground water through formation

K = "permeability"; hydraulic conductivity of formation (measured as 5 to 10 ft/yr)

θ = porosity of formation (assumed as 20 percent)

i = gradient (calculated as 0.03 at mill site and 0.01 at tailing retention site)

the average rate of ground water movement through the water-saturated portion of the formation below the water table can be estimated. Thus, based on the recorded values and implied assumptions, it is estimated that, on the average, the shallow ground water movement at the mill site is approximately 0.01 to 0.02 ft (0.3 to 0.6 cm) per year toward the south-southwest and the shallow ground water movement at the tailing retention site is approximately 0.0025 to 0.01 ft (0.08 to 0.3 cm) per year toward the south-southwest.

2.6.1.4 Utilization of Ground Water in Project Vicinity

Present Ground Water Use

There are 39 ground water appropriation applications on file with the Utah State Engineers Office for withdrawal of ground water within a 5-mile radius of the project site. Most of these applications are for small wells of less than 10 gpm. The total ground water withdrawal of the wells permitted by the appropriations within 5 mi of the project site is approximately 3.0 second-feet or about 2170 acre-feet per year. This includes 811 acre-feet per year requested by Energy Fuels and approved by the Utah State Engineers Office but not yet being pumped. Most of these wells produce water for irrigation, stock watering and domestic use. Within this 5-mi radius, only the existing 1800-ft depth well at the Energy Fuels mill site is withdrawing water from the underlying Navajo sandstone. All other wells in the project vicinity are shallow wells drilled in the alluvium, the Dakota sandstone, the Burro Canyon formation or upper parts of the Morrison formation. The locations of registered wells within a 5-mi radius of the project site are shown on Plate 2.6-3 and the description of these wells is included in Table 2.6-1. As indicated on Plate 2.6-3, the majority of the wells are north and therefore, upgradient of the project site.

Projected Ground Water Use

The only recorded projection of ground water use within 5 mi of the Blanding project site is the planned withdrawal of 811 acre-feet per year from four wells (three more to be constructed) at the Energy Fuels' mill site. Within a 5-mi radius of the proposed mill, there may be a few additional irrigation or domestic wells drilled into the Dakota or slightly deeper into the Morrison formation but no major change in the increase in use of ground water in the project vicinity is anticipated under the present land use.

2.6.1.5 Ground Water Regime of Hanksville Ore-Buying Station

The occurrence and distribution of ground water at the Hanksville ore-buying station are not well known. There are only a few wells and little data on ground water in the whole area. The geologic map of Utah indicates that, in general, the rock types are similar to the stratigraphic section present near Blanding. The rocks exposed at the land surface very near the Hanksville ore-buying station are the Summerville formation, the Curtis formation and the Entrada sandstone.

The driller's log of the water well drilled at Energy Fuel's ore-buying station shows that the well penetrated the Curtis formation at 20 ft below the land surface. At 140 ft below the land surface, the green glauconitic siltstones and shale of the Curtis formation are in contact with the underlying Entrada sandstone. The well was drilled to 460 ft in depth and completed in the Entrada sandstone with 40 ft of perforated casing.

The driller's log indicates that ground water was first noticed during the drilling at 40 feet below the surface within the Curtis formation. Its quality was considered unusable. This suggests a perched

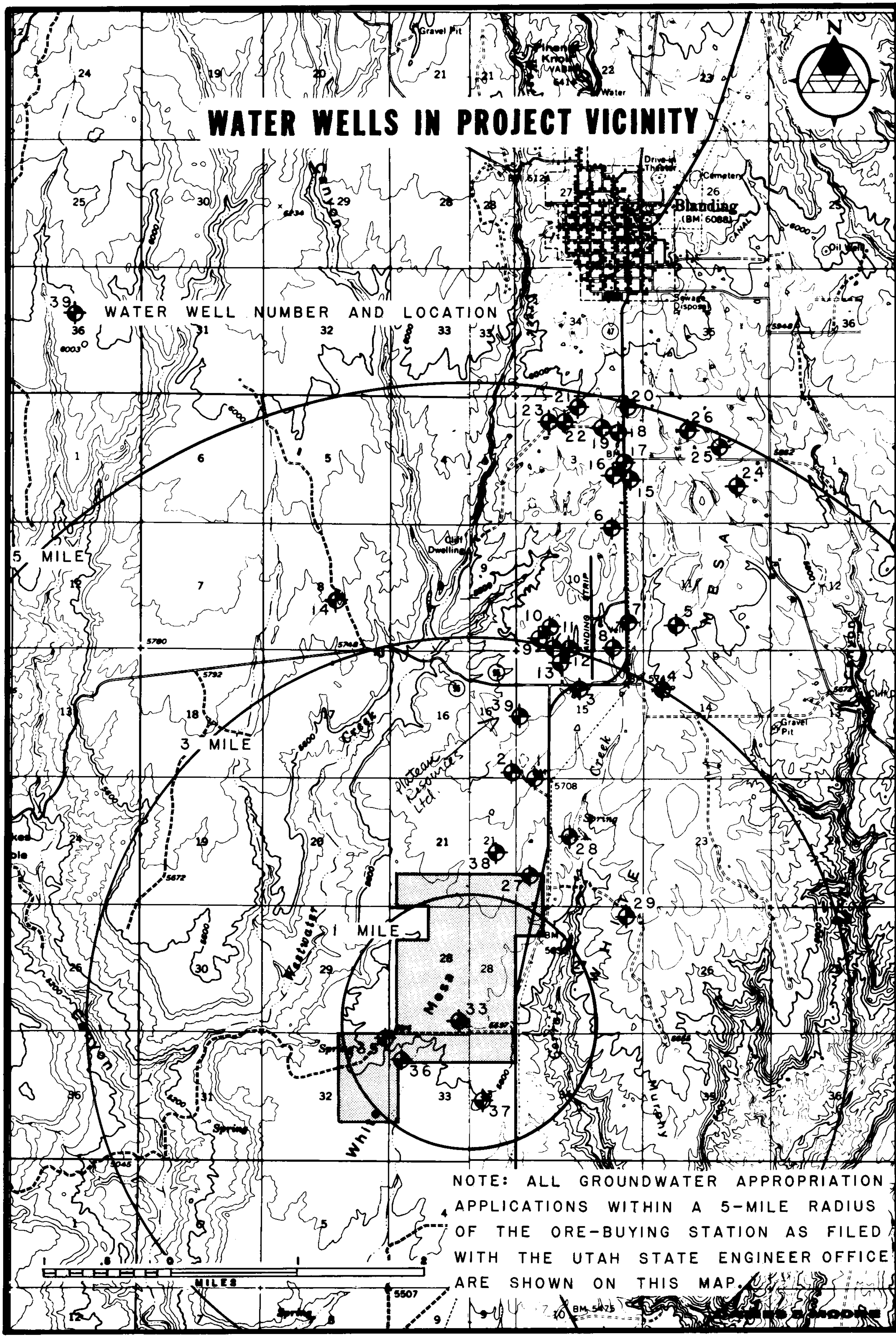

WATER WELLS IN PROJECT VICINITY
WATER WELL NUMBER AND LOCATION
Blanding
5 MILE
3 MILE
1 MILE
NOTE: ALL GROUNDWATER APPROPRIATION APPLICATIONS WITHIN A 5-MILE RADIUS OF THE ORE-BUYING STATION AS FILED WITH THE UTAH STATE ENGINEER OFFICE ARE SHOWN ON THIS MAP.
MILES
Plateau Resources Ltd.

PLATE 2.6-3

TABLE 2.6-1

WATER WELLS IN PROJECT VICINITY
BLANDING, UTAH

Well #	Utah App. #	Location T	Location R	Location Sec.	Owner/ Operator	Nature* of Use	Producing Formation	Depth of Well	Casing Depth	Size of Casing	Screen Interval	Yield of Well	Remarks
1	49630	37S	22E	15	Sheldon E. Holt	I,S	Dakota/Morrison	100'-700'	100'-700'	6"	--	.015 sec-ft	
2	19052	37S	22E	15	George F. Lyman	S	Dakota/Morrison	135'-150'	135'-150'	6"	--	.015 sec-ft	
3	29832	37S	22E	15	Clarence Tregellas	D	Dakota/Morrison	150'-200'	150'-200'	1"	--	.07 sec-ft	
4	48825	37S	22E	14	Bar Mark Ranches Inc.	I,D,S	Dakota/Morrison	100'-500'	100'-500'	6"	--	.015 sec-ft	
5	48827	37S	22E	11	Bar Mark Ranches Inc.	I,D,S	Dakota/Morrison	100'-500'	100'-500'	6"	--	.015 sec-ft	
6	16433	37S	22E	10	Douglas Galbraith	S	Dakota/Morrison	190'	190'	6 1/4"	--	0.10 sec-ft	
7	22160	37S	22E	10	Willard M. Gaymon	S	Dakota/Morrison	82'	82'	6"	--	0.015 sec-ft	
8	16124	37S	22E	10	BLM	S	Dakota/Morrison	165'	165'	6"	--	0.013 sec-ft	
9	49034-1	37S	22E	10	Clisbee N. Lyman	I,D,S	Dakota/Morrison	100'-400'	100'-400'	4" & 6"	--	0.50 sec-ft	
10	49034-2	37S	22E	10	Clisbee N. Lyman	I,D,S	Dakota/Morrison	100'-400'	100'-400'	4" & 6"	--	0.50 sec-ft	
11	49034-3	37S	22E	10	Clisbee N. Lyman	I,D,S	Dakota/Morrison	100'-400'	100'-400'	4" & 6"	--	0.50 sec-ft	4 separate wells joined
12	49034-4	37S	22E	10	Clisbee N. Lyman	I,D,S	Dakota/Morrison	100'-400'	100'-400'	4" & 6"	--	0.50 sec-ft	by 1200' of 8" pipe
13	21460	37S	22E	10	Fred S. Lyman	S,D,G	Dakota/Morrison	120'	21'	5" I.D.	--	10 gpm	
14	40274	37S	22E	8	BLM	S	Dakota/Morrison	170'	170'	6"	--	0.022 sec-ft	
15	41791	37S	22E	3	Robert E. Hosler	I,D,S	Dakota/Morrison	150'-200'	150'-200'	6"	--	0.015 sec-ft	
16	41867	37S	22E	3	William Simpson	S,D,I	Dakota/Morrison	180'	180'	4"	--	0.033 sec-ft	
17	31442	37S	22E	3	Ruffur Lee Lewis	D	Dakota/Morrison	100'-300'	100'-300'	4"	--	0.015 sec-ft	
18	29651	37S	22E	3	Waukesha of Utah	D	Dakota/Morrison	226'	226'	4 1/2" O.D.	--	0.015 sec-ft	
19	17495	37S	22E	3	Platte D. Lyman	S	Dakota/Morrison	200'	200'	6"	--	0.10 sec-ft	
20	48298	37S	22E	3	Dean W. Guymon	I,S	Dakota/Morrison	100'-200'	100'-200'	5"	--	0.015 sec-ft	
21	43570	37S	22E	3	Leonard R. Howe	O	Dakota/Morrison	100'-300'	100'-300'	8"	--	0.10 sec-ft	Water used for Drive-in theatre
22	44939	37S	22E	3	Leland Shumway	I,D,S	Dakota/Morrison	100'-200'	100'-200'	6"	--	0.015 sec-ft	
23	48824	37S	22E	3	Bar Mark Ranches	I,D,S	Dakota/Morrison	100'-500'	100'-500'	6"	--	0.015 sec-ft	
24	45749	37S	22E	2	Kloyd Perkins	S	Dakota/Morrison	100'-200'	100'-200'	6"	--	0.015 sec-ft	
25	41195	37S	22E	2	J. Farley Laws	I,D,S	Dakota/Morrison	150'-200'	150'-200'	6"	--	0.015 sec-ft	
26	16712	37S	22E	2	Willard M. Guyman	S	Dakota/Morrison	164'	20'	6"?	--	0.003 sec-ft	
27	46640	37S	22E	22	Grant L. Bayles	I,D,S	Dakota/Morrison	100'-200'	100'-200'	6"	--	0.015 sec-ft	
28	45195	37S	22E	22	Boyd Lows	I,D,S	Dakota/Morrison	100'-250'	100'-250'	6"	--	0.015 sec-ft	
29	39047	37S	22E	27	Utah Launch Complex	D	Dakota/Morrison	100'-300'	100'-300'	6"	--	0.015 sec-ft	
33	47331	37S	22E	28	Energy Fuels, Ltd.	I,D,O	Dakota/Morrison	100'-200'	100'-200'	6"	--	0.015 sec-ft	Well not yet drilled
34	47943	37S	22E	28	Energy Fuels, Ltd.	O	Navajo Ss	700'-1800'	700'	12"	--	1.11 sec-ft	One well drilled, three wells to be constructed
35	38681	37S	22E	32	Lorenzo Hankins	D,S	Dakota/Morrison	200'-250'	200'-250'	6"*	--	0.10 sec-ft	*Bottom 30' perforated
36	37099	37S	22E	33	Harris Shumway	I,D,S	Dakota/Morrison	800'	800'?	5"?	--	0.50 sec-ft	
37	27354	37S	22E	33	Alma U. Jones	S	Dakota/Morrison	200'	200'	4 1/2" O.D.	--	0.015 sec-ft	
38	44147	37S	22E	21	Kloyd E. Perkins	S	Dakota/Morrison	150'	150'	4"	--	0.015 sec-ft	
39	48648	37S	22E	15	Plateau Res. Ltd.	D	Dakota/Morrison	135'	60'	5 1/8" O.D.	--	0.015 sec-ft	

30 → 32?

Can't see #34 on map

See Plate 2.6-2 for well locations

*D = Domestic
S = Stockwatering
I = Irrigation
O = Industrial

water table in the Curtis formation. The driller's log indicates that the next appearance of water occurred at 400 feet below the surface in the Entrada sandstone. This water is probably under some artesian head and represents the main bedrock aquifer under the ore-buying station.

2.6.1.6 Utilization of Ground Water in Vicinity of Hanksville Ore-Buying Station

The vicinity of the Hanksville ore-buying station is very desolate and unpopulated with only a few scattered stock wells. In fact, within a five-mile radius of the Hanksville ore buying station there are only 5 ground water appropriation applications on file with the Utah State Engineer's Office and only three wells drilled. These well locations are shown on Plate 2.6-4 and their description is included in Table 2.6-2.

The total ground water usage as approved by the Utah State Engineer within 5 mi of the ore-buying station is approximately 15 second-feet or 10,860 acre-feet per year. Of this quantity, current usage is probably only 1/5 of the quantity authorized. The authorized amount of 10.0 per acre-feet for Energy Fuels, for instance, is based upon production yields of six (6) wells. Presently, only one well has been drilled and utilized for production.

2.6.2 Surface Water Hydrology

No perennial surface water occurs on the project site. The following sections describe the regional drainage and utilization of surface water, the project vicinity's watershed, and surface water hydrology of the project site.

2.6.2.1 Regional Occurrence and Drainage of Surface Water

The project site is situated on White Mesa which is drained almost equally by Corral Creek on the east and by Westwater Creek on the west (Plate 2.6-5). All drainages in the project vicinity are intermittent.

Corral Creek has a drainage area of about 5 sq mi (13 sq km) adjacent to the site and is tributary to Recapture Creek. Westwater Creek,

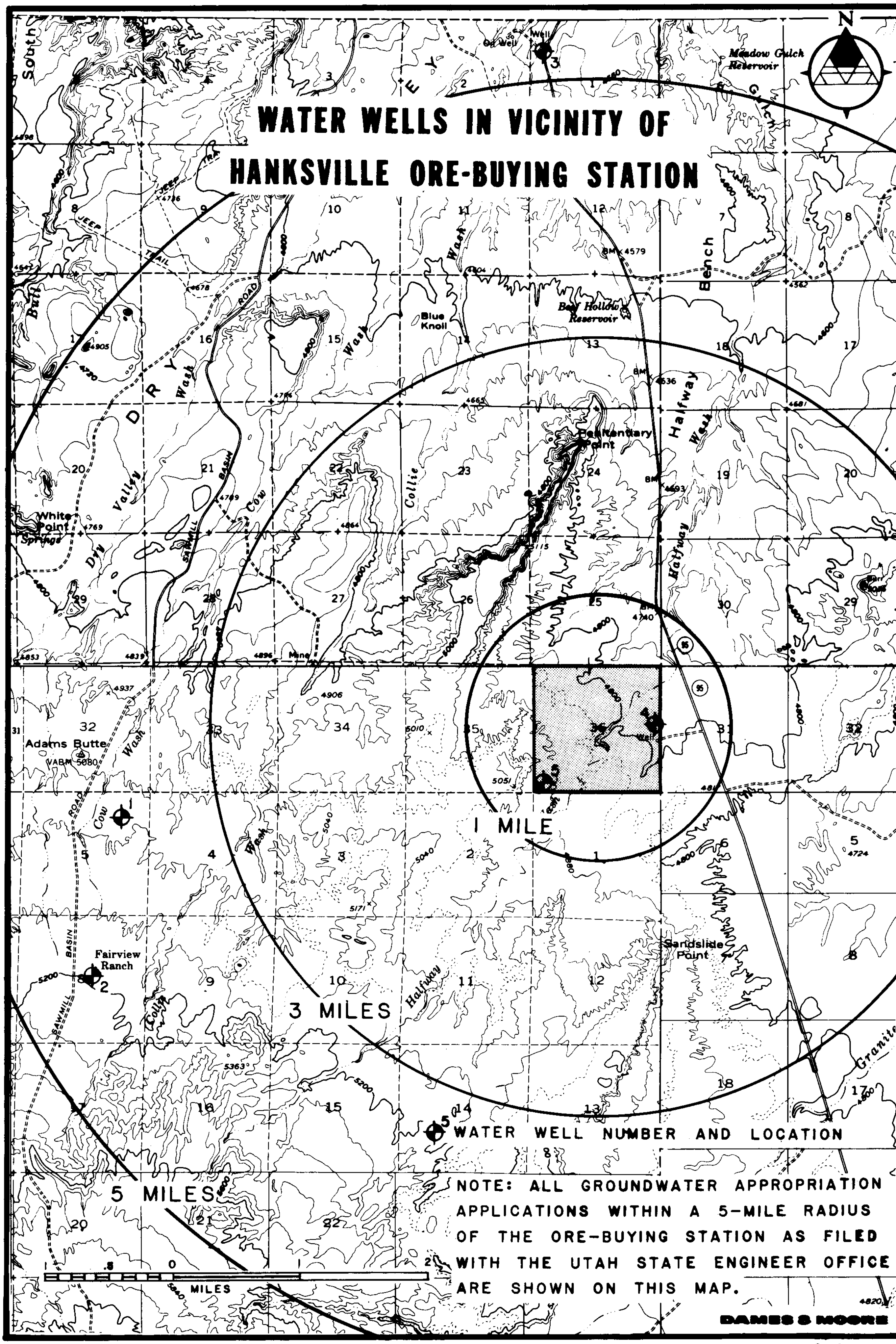

WATER WELLS IN VICINITY OF HANKSVILLE ORE-BUYING STATION
WATER WELL NUMBER AND LOCATION
NOTE: ALL GROUNDWATER APPROPRIATION APPLICATIONS WITHIN A 5-MILE RADIUS OF THE ORE-BUYING STATION AS FILED WITH THE UTAH STATE ENGINEER OFFICE ARE SHOWN ON THIS MAP.
1 MILE
3 MILES
5 MILES
MILES
N
Meadow Gulch Reservoir
Blue Knoll
Bull Hollow Reservoir
Penitentiary Point
Halfway Wash
Bench
White Point Springs
Dry Valley
Adams Butte
VABM 5080
Cow Wash
Collie Wash
Fairview Ranch
Sandslide Point
Granite
SAWMILL BASIN ROAD
JEEP TRAIL
Mine
DAMES & MOORE

PLATE 2.6-4

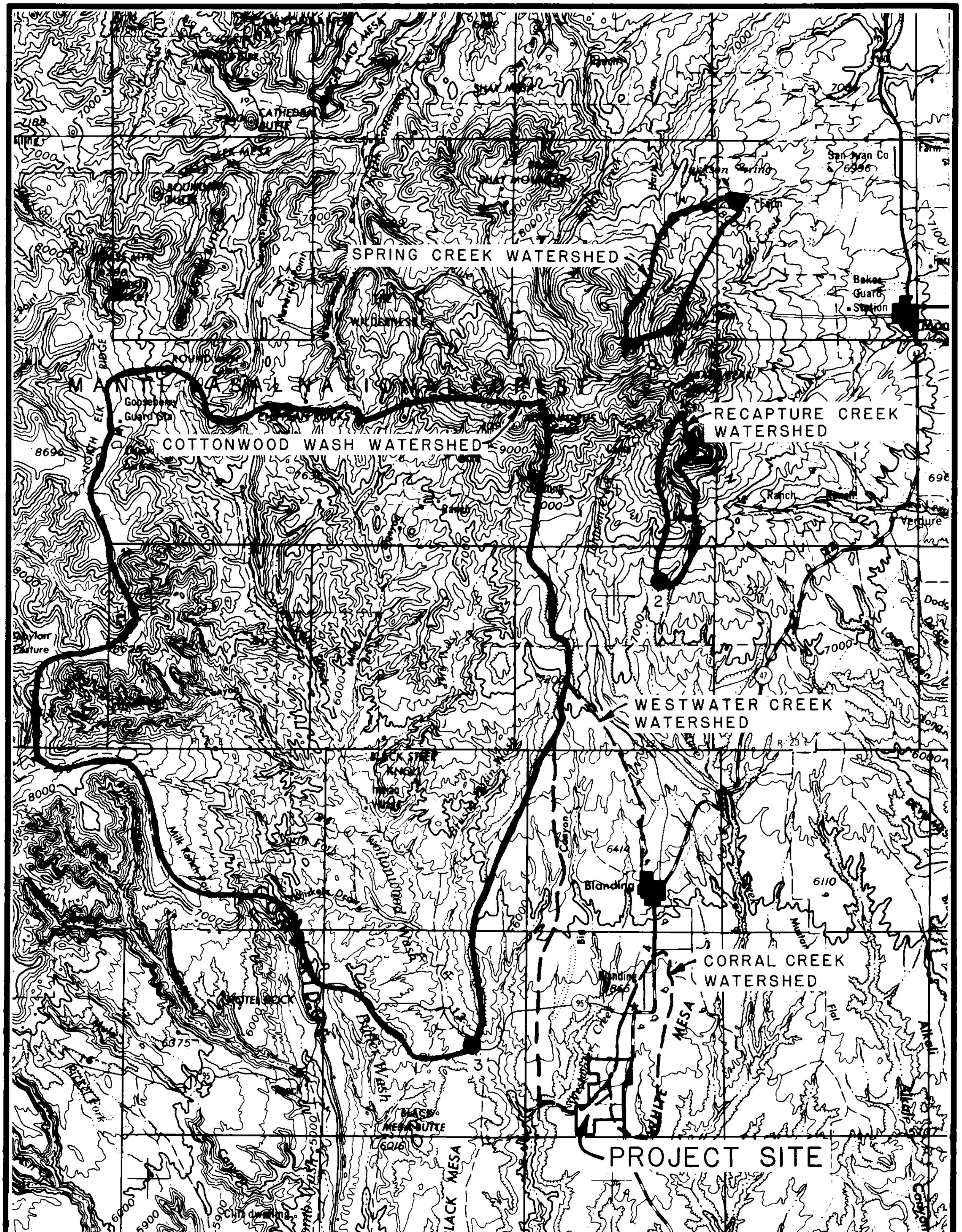
TABLE 2.6-2

WATER WELLS IN VICINITY OF HANKSVILLE ORE-BUYING STATION

Well #	Utah App. #	Location T	Location R	Location Sec.	Owner/ Operator	Nature* of Use	Producing Formation	Depth of Well	Casing Depth	Size of Casing	Screen Interval	Yield of Well	Remarks
1	44294	30S	11E	5	Ralph & Una Pace	D,S	Entrada SS	100'-300'	100'-300'	6"	--	0.03 sec-ft	
2	26288	30S	11E	8	Sophie Nicolas	I	Entrada SS	100'-500'	100'-500'	6"	--	4.0 sec-ft	
3	35302	29S	11E	1	BLM	S	Entrada SS	300'-350'	300'-350'	8"	--	0.063 sec-ft	
4	22954	29S	11E	36	LaVon Forsyth	S	Entrada SS	315'	315'	6"	--	0.015 sec-ft	
5	9198-1	29S	11E	36	Energy Fuels, Ltd.	I,D,S	Entrada SS	200'-1000'	200'-1000'	6"	--	0.015 sec-ft	
6	9198-2	29S	11E	36	Energy Fuels, Ltd.	I,D,S	Entrada SS	200'-1000'	200'-1000'	6"	--	}	
7	9198-3	29S	11E	36	Energy Fuels, Ltd.	I,D,S	Entrada SS	200'-1000'	200'-1000'	6"	--	}	
8	9198-4	29S	11E	36	Energy Fuels, Ltd.	I,D,S	Entrada SS	200'-1000'	200'-1000'	6"	--	}	
9	9198-5	29S	11E	36	Energy Fuels, Ltd.	I,D,S	Entrada SS	200'-1000'	200'-1000'	6"	--	} 10.0 sec-ft	6 wells (one well drilled, 5 to be constructed at future date)
10	9198-6	29S	11E	36	Energy Fuels, Ltd.	I,D,S	Entrada SS	200'-1000'	200'-1000'	6"	--	}	
										6"	--	}	

See Plate 2.6-3 for well locations

*D = Domestic
S = Stockwater
I = Irrigation
O = Industrial



●[1] USGS GAUGE NO. 09376900
●[2] USGS GAUGE NO. 09378630
●[3] USGS GAUGE NO. 09378700

N

DRAINAGE MAP OF PROJECT VICINITY

DAMES & MOORE

PLATE 2.6-5

on the western edge of the site, has a drainage area of nearly 27 sq mi (70 sq km) and is tributary to Cottonwood Wash. Both Cottonwood Wash and Recapture Creek drain in a southerly direction and are tributary to the major drainage artery of the region, the San Juan River. The confluences of Cottonwood Wash and Recapture Creek with the San Juan River are located approximately 18 mi (29 km) south of the project site. The drainage areas of Recapture Creek and Cottonwood Wash at their confluence with the San Juan River are approximately 200 sq mi (518 sq km) and 322 sq mi (860 sq km), respectively.

The San Juan River is a major tributary of the Upper Colorado River and drains approximately 23,000 sq mi (60,000 sq km) above Bluff, Utah which is located at the mouth of Cottonwood wash. The San Juan River flows in a westerly direction toward its confluence with the Colorado River at Lake Powell, which is about 114 river miles (183 km) west of Bluff.

The entire Cottonwood Wash watershed drains 332 sq mi (860 sq km) with the southern half being relatively narrow and the northern half being wider. The creek's headwaters are in the Manti-La Sal National Forest. Elevations within the basin range from nearly 11,000 ft (3333 m) mean sea level (msl) at Mt. Linnaeus Peak, to a low of about 4300 ft (1303 m) msl at the confluence of Cottonwood Wash and the San Juan River. The creek bottom is at elevation 5100 ft (1545 m) msl directly west of the project site. The overall basin slope averages about 154 ft (46.7 m) per mile, or nearly 3 percent.

The Recapture Creek drainage area encompasses 200 sq mi (518 sq km) and extends for nearly 38 mi (61 km) from its headwaters in the Abajo Mountains on the north to its confluence with the San Juan River to the south. The basin is very narrow, measuring less than 7 mi (11 km) wide at its broadest point. Elevations range from 11,360 ft (3442 m) msl at its headwaters on Abajo Peak, to 5200 ft (1576 m) msl directly east of the project site, to a low of 4400 ft (1333 m) msl at its confluence with the San Juan River. The overall basin slope is about 163 ft (49 m) per mile, or a little over 3 percent.

The Westwater Creek drainage basin covers nearly 27 sq mi (70 sq km) at its confluence with Cottonwood Wash, about 1.5 mi (2.5 km) west of the project site. The west and northwest portions of the project site lie within the Westwater Creek watershed.

The divide between Westwater Creek's drainage area and that of Recapture Creek passes through the City of Blanding. Runoff originating from within Blanding is collected by both of these watercourses.

Corral Creek is a small intermittent tributary of Recapture Creek and collects runoff from the eastern half of the project site. The drainage area of that portion of Corral Creek above and including the site is about 5 sq mi (13 sq km). The area of the entire Corral Creek basin measured at its confluence with Recapture Creek is 6 sq mi (15 sq km).

Table 2.6-3 summarizes the drainage areas in the general vicinity of the project site as well as the major watercourses of the region.

Runoff from storms in the region is characterized by a rapid rise in flow rates followed by a rapid recession of flow rates. This is probably due to the small storage capacity of shallow surface soils in the region. On August 1, 1968, a flow of 20,500 cfs was recorded on Cottonwood Wash near Blanding (205 sq mi drainage area). However, the average flow for that day was only 4,340 cfs. By August 4, the flow had returned to the pre-flood flow rate of 16 cfs. This is characteristic behavior for basins with very little storage capacity.

The U.S. Geological Survey (USGS) currently maintains two stream gauges on watercourses in the region. The locations and gauge numbers are: gauge number 09378630 is on Recapture Creek in the upper portion of the watershed, at elevation 7200 ft msl; gauge number 09378700 is on

TABLE 2.6-3

DRAINAGE AREAS OF PROJECT VICINITY AND REGION

Basin Description	Drainage Area Square Miles	Drainage Area Square Kilometers
Corral creek adjacent to project site	5.3	13.7
Corral Creek at confluence with Recapture Creek	5.8	15.0
Westwater Creek at confluence with Cottonwood Wash	26.6	68.8
Cottonwood Wash at USGS gauge west of project site	≤205	≤531
Cottonwood Wash at confluence with San Juan River	≤332	≤860
Recapture Creek at USGS gauge	3.8	9.8
Recapture Creek at Confluence with San Juan River	≤200	≤518
San Juan River at USGS gauge downstream of Bluff, Utah	≤23,000	≤60,000

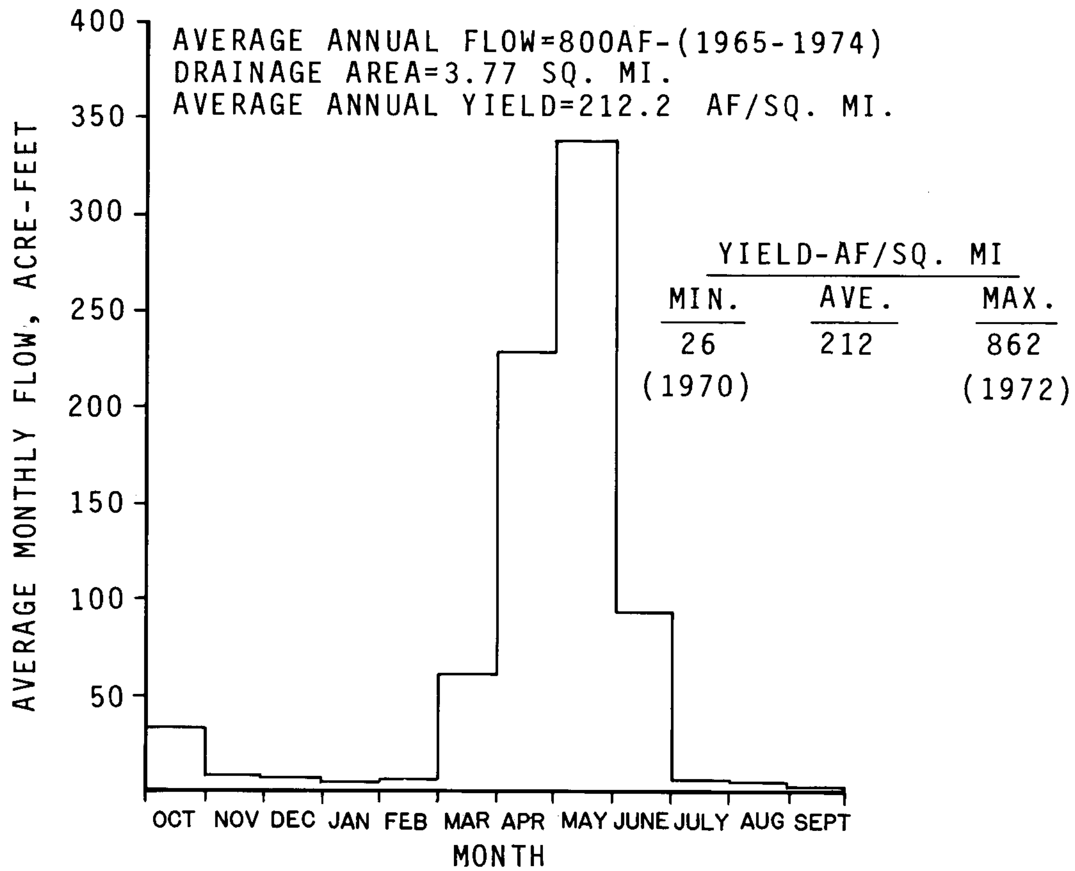
Cottonwood Wash about 7 mi (11 km) southwest of Blanding, at elevation 5138 ft msl. In addition, a gauge was formerly maintained on Spring Creek at elevation 7720 ft msl near Monticello. This gauge, numbered 09376900, was discontinued in 1971. The locations of these gauges are indicated on Plate 2.6-5.

During the October 1965 to present period of record for the Recapture Creek gauge, the average annual yield from the 3.8 sq mi (9.8 sq km) basin was 3.9 in (99 mm). The minimum and maximum annual yields on record were, respectively, 0.5 in (13 mm) for the period from October 1970 to September 1971 and 16.2 in (411 mm) for the period from October 1972 to September 1973. Average annual flows for the period 1965 to 1975 are shown on Plate 2.6-6.

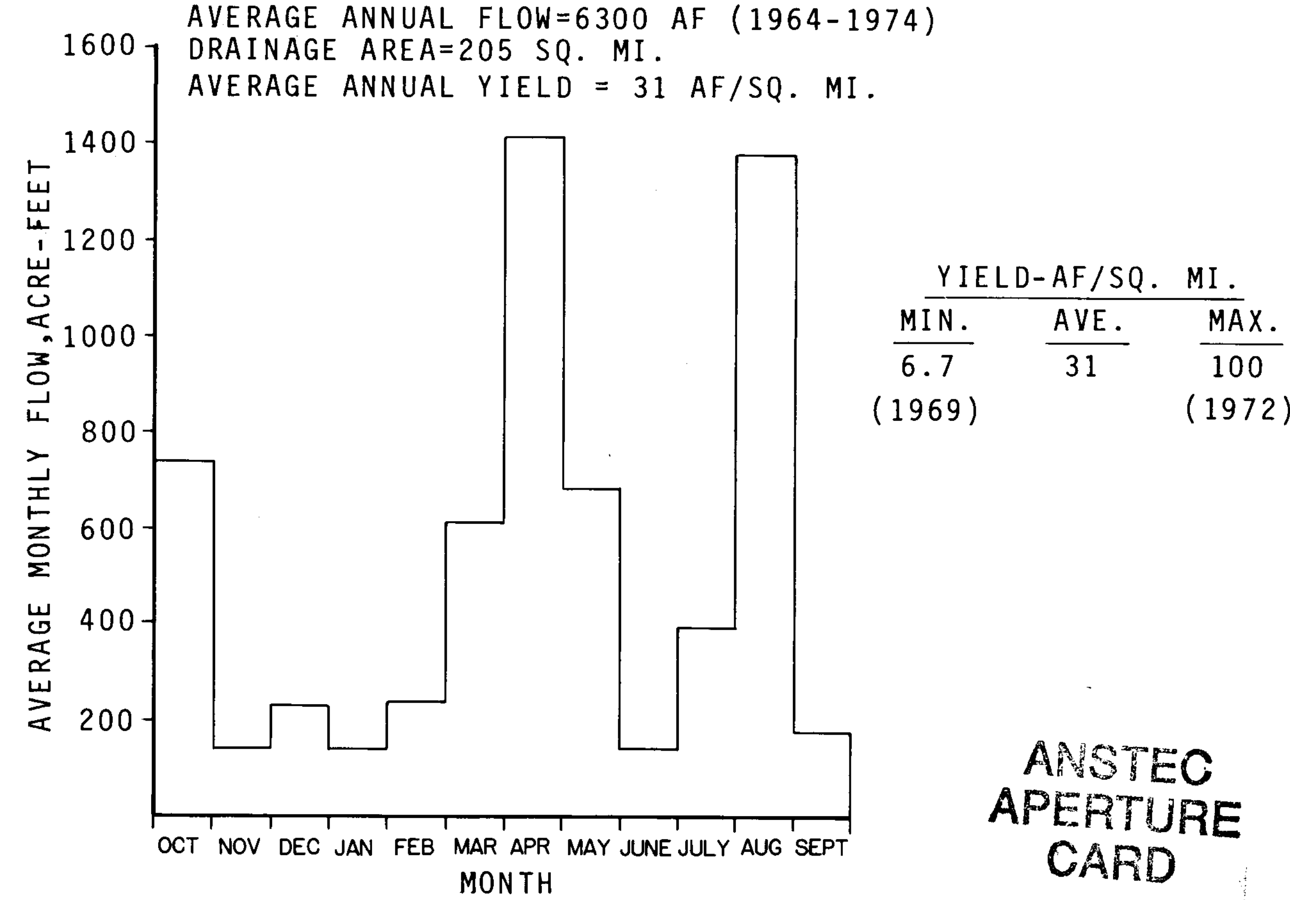
During the October 1964 to present period of record for the Cottonwood Wash gauge, the average annual yield from the 205 sq mi (531 sq km) basin was 0.57 in (14 mm). The minimum and maximum annual yields on record were, respectively, 0.13 in (3 mm) for the period from October 1970 to September 1971 and 1.87 in (48 mm) for the period from October 1972 to September 1973. Average annual flows for the period 1964 to 1975 are shown on Plate 2.6-6.

During the period that the gauge on Spring Creek was maintained, October 1965 to September 1972, the average annual yield from the 4.95 sq mi (13 sq km) basin was 2.8 in (71 mm). The minimum and maximum annual yields on record were, respectively, 0.88 in (22 mm) for the period from October 1969 to September 1970 and 5.27 in (134 mm) for the period from October 1965 to September 1966. Average annual flows for the period 1965 to 1972 are shown on Plate 2.6-6.

The average annual water yields outlined above, 3.9 in (99 mm) from Recapture Creek, 0.57 in (14 mm) from Cottonwood Wash, and 2.8 in (71 mm) from Spring Creek, reflect the higher yields per unit area expected from the higher altitudes of the basins. As shown on Plate 2.6-7, the upper reaches of the basins receive three times the annual



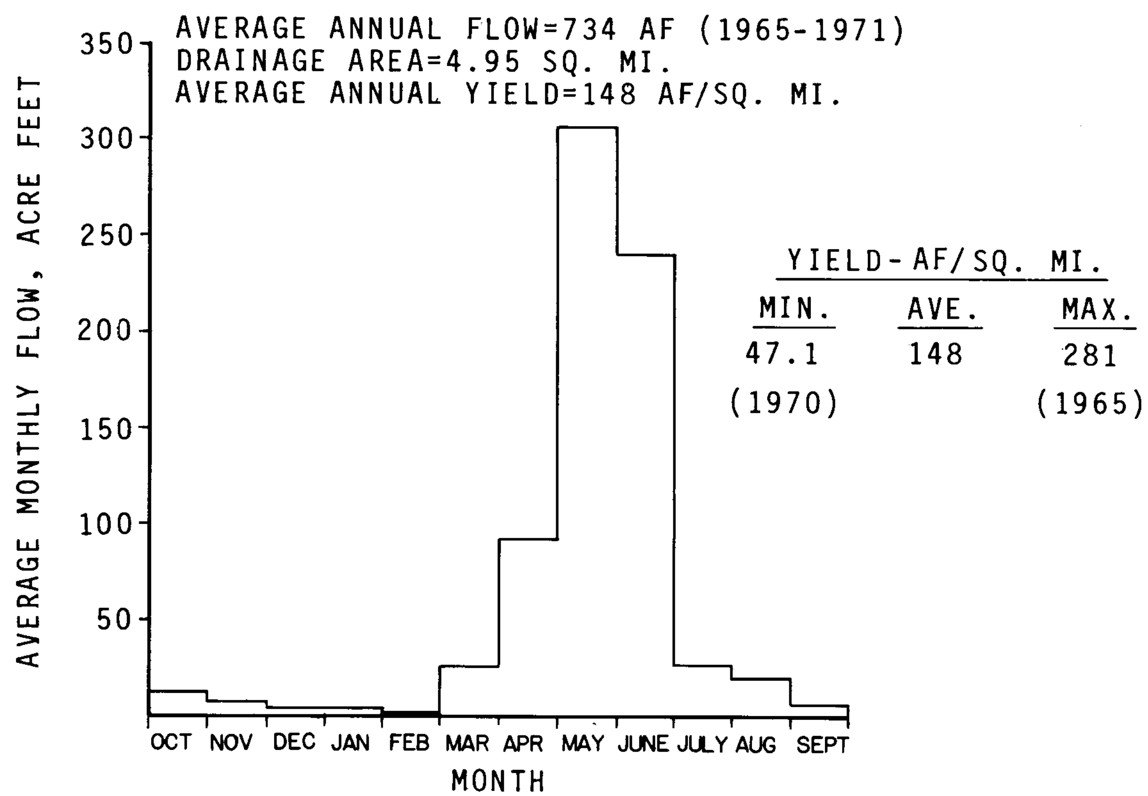
RECAPTURE CREEK NEAR BLANDING
USGS GAUGE 09378630



COTTONWOOD WASH NEAR BLANDING
USGS GAUGE 09378700

ANSTEC APERTURE CARD

Also Available on Aperture Card



SPRING CREEK ABOVE DIVERSIONS,
NEAR MONTICELLO
USGS GAUGE 09376900

NOTES

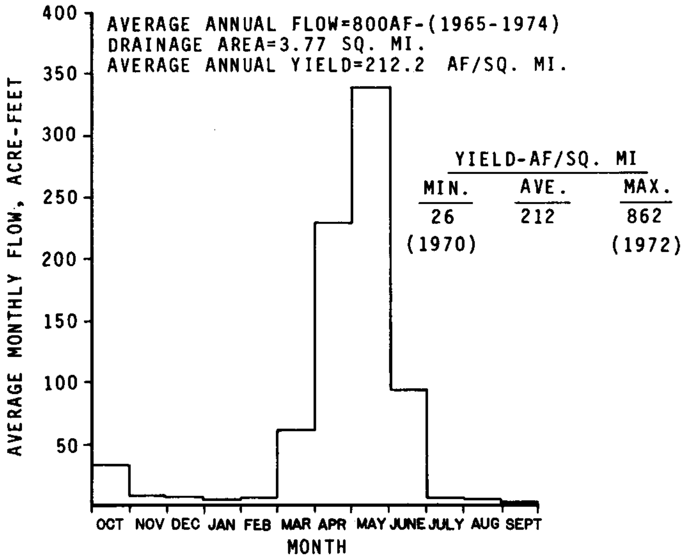
1. FOR THE LOCATION OF WATERCOURCES SUMMARIZED, SEE PLATE
2. SOURCE OF DATA. WATER RESOURCES DATA RECORDS. COMPILED AND PUBLISHED BY USGS

9503170269-01

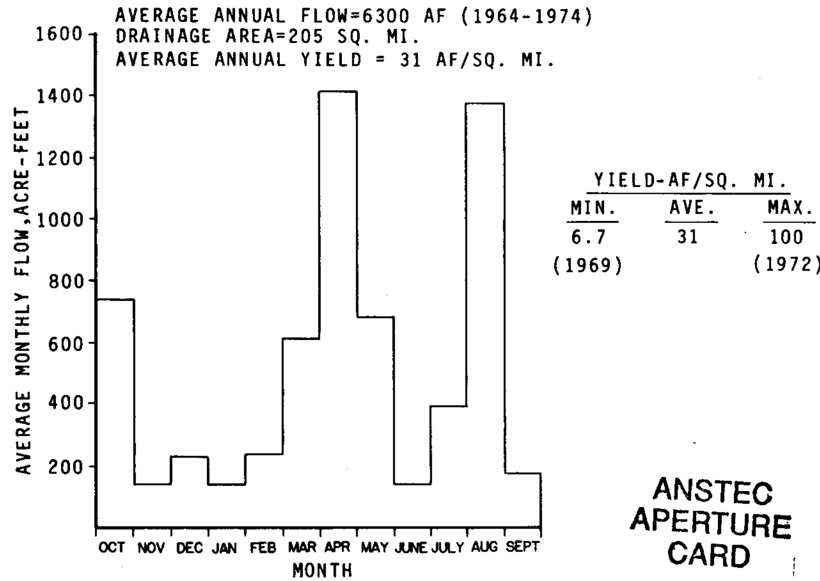
STREAMFLOW SUMMARY
BLANDING, UTAH VICINITY

DAMES & MOORE

PLATE 2.6-6



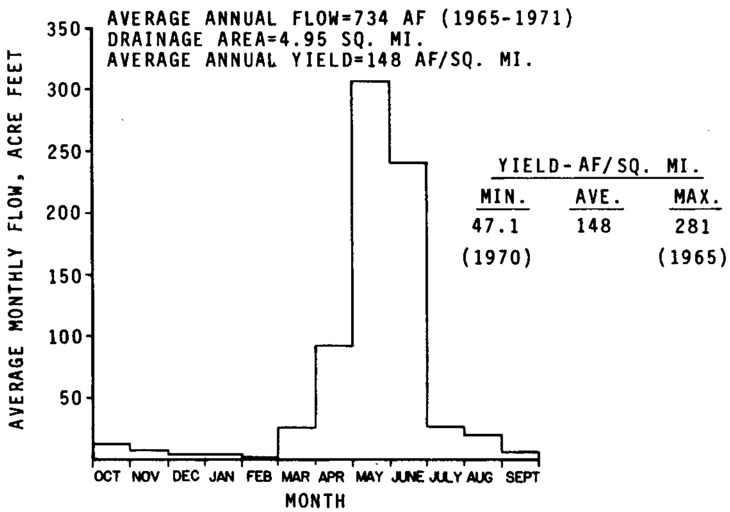
RECAPTURE CREEK NEAR BLANDING
USGS GAUGE 09378630



COTTONWOOD WASH NEAR BLANDING
USGS GAUGE 09378700

ANSTEC APERTURE CARD

Also Available on Aperture Card



SPRING CREEK ABOVE DIVERSIONS,
NEAR MONTICELLO
USGS GAUGE 09376900

NOTES

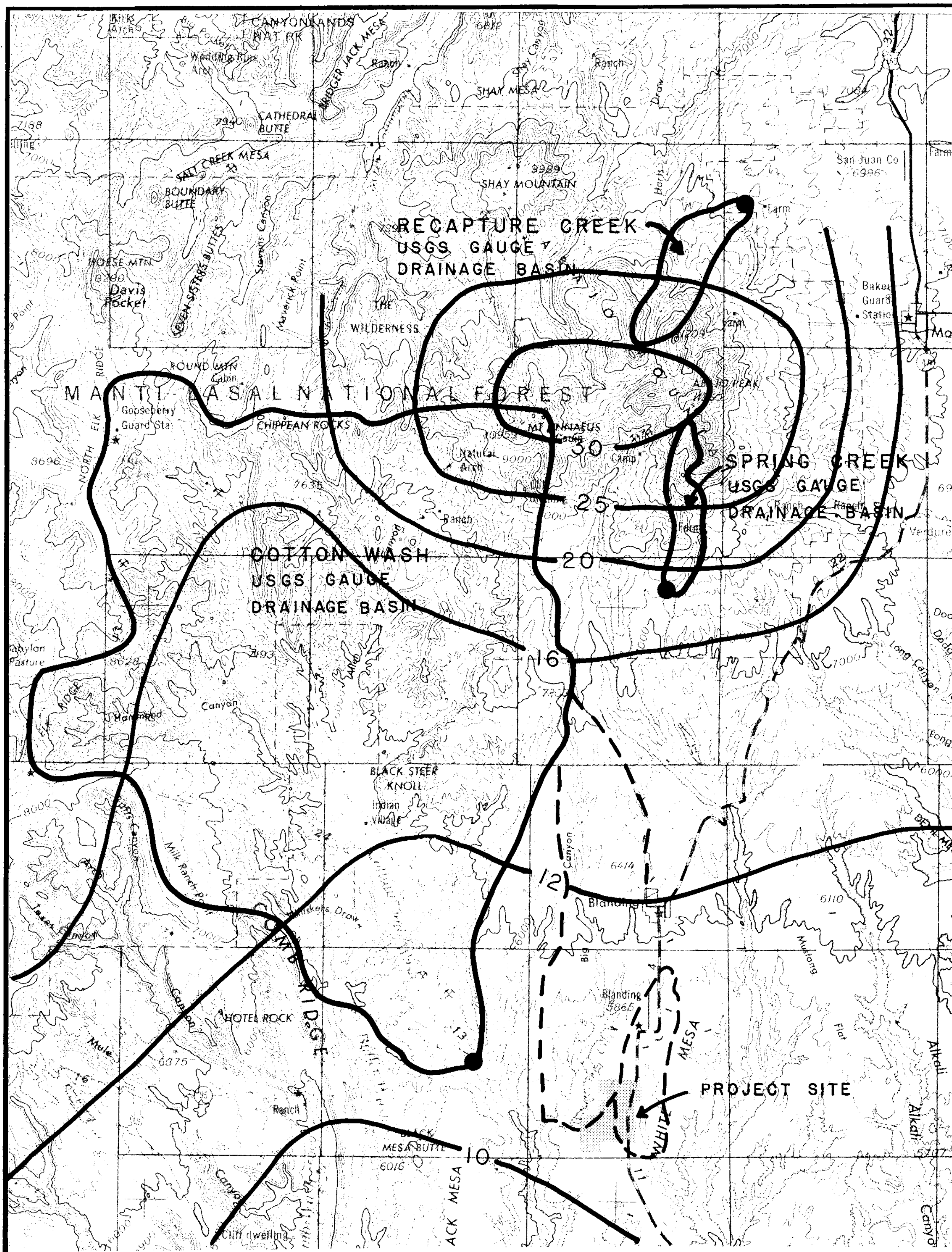
1. FOR THE LOCATION OF WATERCOURCES SUMMARIZED, SEE PLATE
2. SOURCE OF DATA. WATER RESOURCES DATA RECORDS. COMPILED AND PUBLISHED BY USGS

9503170269-01

STREAMFLOW SUMMARY
BLANDING, UTAH VICINITY

DAMES & MOORE

PLATE 2.6-[illegible]



NORMAL ANNUAL PRECIPITATION (INCHES)

DAMES & MOORE

PLATE 2.6-7

precipitation that the project site receives. The greater precipitation produces a greater amount of runoff.

2.6.2.2 Regional Utilization of Surface Water

Surface water use within the Cottonwood Wash, Recapture Creek, Corral Creek and Westwater Creek basins is primarily for agricultural irrigation and stock watering. Table 2.6-4 lists the existing water appropriations within the project vicinity. It is not known if all these rights are being exercised. The State of Utah's Department of Natural Resources, Division of Water Rights is in the process of compiling a statewide list to establish the current water users but the Blanding area has not yet been appraised. In addition, the Division of Water Rights has stated that "additional water rights could exist, in good condition, if the water was used for some beneficial use prior to 1903 as long as the right was still in use today."

On a more regional basis, water use from the San Juan River total 9900 acre-feet per year in Utah alone (Colo. Water Cons. Board and USDA, 1974). This 9900 acre-feet of water is used in many different ways as indicated in Table 2.6-5.

2.6.2.3 Project Vicinity Watershed

The project site is situated atop White Mesa from which surface runoff is conducted by several poorly defined, ephemeral drainages to either Westwater Creek or Corral Creek (see Section 2.6.2.1). The mesa is defined by these two adjacent main drainages which have cut deeply into the regional sandstone formations. White Mesa slopes gently to the south-southwest from the town of Blanding; its elevations range from over 6000 ft msl near Blanding to around 5400 ft msl at the southern extremity of the plateau. The project site is situated at elevations generally ranging between 5600 ft msl and 5650 ft msl. White Mesa is about 10 mi (16 km) in length, making its overall slope a little more than 1 percent.

TABLE 2.6-4

CURRENT SURFACE WATER USERS IN PROJECT VICINITY

NAME	ADDRESS	APPLICATION DATE	APPLICATION NUMBER	QUANTITY
CORRAL CREEK				
Fred Halliday	Blanding, UT	Aug 12, 1971	40839	0.5 cfs
COTTONWOOD CREEK OR WASH				
William Keller	Moab, UT	Nov 12, 1907	1647	1.0 cfs
Hyrum Perkins	Bluff, UT	June 22, 1910	3322	5.49 cfs
U.S. Indian Service	Ignacia, CO	Mar 12, 1924	9486	1.18 cfs
U.S. Indian Service	Ignacia, CO	Mar 24, 1924	9491	0.738 cfs
U.S. Indian Service	Ignacia, CO	Mar 24, 1924	9492	0.298 cfs
Kloyd Perkins	Blanding, UT	Apr 13, 1928	10320	1.455 cfs
W.R. Young	Blanding, UT	Oct 22, 1928	104935	0.0015 cfs
W.R. Young	Blanding, UT	Oct 23, 1928	10496	0.0022 cfs
W.R. Young	Blanding, UT	Oct 22, 1928	10497	0.002 cfs
San Juan County Water Conserv. District	Monticello, UT	Oct 10, 1962	34666	12,000 A-F
Earl Perkins	Blanding, UT	Apr 16, 1965	36924	5.0 cfs
WESTWATER CREEK				
Seth Shumway	Blanding, UT	Jan 7, 1929	10576	0.005 cfs
H.E. Shumway	Blanding, UT	Segregation Date Feb 28, 1970	37601a	0.7623 cfs
Preston Nielson	Blanding, UT	Segregation Date Oct 22, 1970	37601a	0.2377 cfs
Parley Redd	Blanding, UT	Claim Date Oct 16, 1970	Claim 2373	0.015 cfs
Kenneth McDonald	Blanding, UT	Change of Approp. June 12, 1974	42302	1.0 cfs

TABLE 2.6-5

PRESENT UTAH WATER USE (1965) OF SAN JUAN RIVER

Use	Acre-Feet
Irrigated Crops (5000 acres)	5500
Reservoir Evaporation	100
Incidental Use[a]	1300
Municipal & Industrial[b]	1800
Minerals[b]	1100
Augmented Fish and Wildlife[b]	100
Total	9900

[a]Incidental use of irrigation water by phreatophytes and other miscellaneous vegetation.

[b]Includes evaporation losses applicable to these sources of depletion.

Source: Colo. Water Cons. Board & USDA, 1974.

2.6.2.4 Project Site Drainage

The 1480-acre project site is drained by both Westwater Creek and Corral Creek. Of this area, surface runoff from approximately 384 acres is collected by Westwater Creek and about 383 acres are drained by Corral Creek. The remaining 713 acres in the southern and southwestern portions of the site are drained to Cottonwood Wash.

Surface water yield from the project site averages less than 0.5 inches annually, although just how much less is not known. Cottonwood Wash with a drainage basin composed of both mountainous land and arid lowlands, has an annual yield of 0.57 inches at the USGS gauge. Of that yield, a considerable portion is provided by the headwaters of the basin which is at a much higher elevation and provides a disproportionately higher yield. If one assumes that 15 percent of the basin is similar to Spring Creek and Recapture Creek and yielding 3 inches annually, then the remainder of the basin, which is similar to the project site, is providing only 0.14 inches of yield to make the weighted basin average 0.57 in. Thus, the project site is assumed to have an average annual yield in the range of 0.1 to 0.5 inches. The annual yield probably has wide variations because of occasional intense thunderstorms.

2.6.2.5 Project Site Flooding Potential

A flooding potential determination can be made either by examination of long-term stream flow records or by examination of precipitation records. Of the two techniques, an analysis of stream flow data is preferred since it requires fewer assumptions and is a more direct measure of the needed information. Unfortunately, few areas have the high quality, long-term flow records that are required for a statistical stream flow analysis. The Blanding area lacks such flow records and, therefore, precipitation analysis was used to determine the project site flooding potential.

Flooding Analysis

To analyze the threat of flooding to the project site from adjacent drainages and from direct precipitation, estimates of potential flooding resulting from a probable maximum flood (PMF) and a 100-year flood were used. A probable maximum flood is defnied by the World Meteorological Organization (1973) as:

> "The hypothetical flood characteristics (peak discharge, volume, and hydrograph shape) that are considered to be the most severe reasonably possible at a particular location, based on relatively comprehensive hydrometeorological analyses of critical runoff-producing precipitation (and snowmelt, if pertinent) and hydrological factors favorable for maximum flood runoff."

A PMF is prepared by estimating probable maximum precipitation (PMP) amounts over the drainage basins, and then arranging these amounts in an optimum time sequence to produce the maximum flood runoff likely. A PMF represents the most severe runoff conditions considered to be "reasonably possible."

While a PMF is an outstanding event, a flood resulting from the 100-year precipitaton (a 100-year flood) is smaller and more likely to occur. The term "100-year precipitation" is the rainfall of a particular duration, usually 24 hours or less, that is equaled or exceeded once every 100 years. A 100-year flood has about a one percent probability of occurring once in any one year.

<u>Precipitation Analysis</u> Probable maximum precipitation used in deriving the PMF, is defined by the World Meteorological Organization (1973) as:

> "The theoretically greatest depth of precipitation for a given duration that is meteorologically possible over the applicable drainage area that would produce flood flows of which there is virtually no risk of being exceeded. These estimates involve certain modifications and extrapolation of historical data to reflect more severe rainfall meteorological conditions than actually recorded, in the general region of the basin under study, insofar as these are deemed reasonably possible of occurrence on the basin of hydrometeorological reasoning."

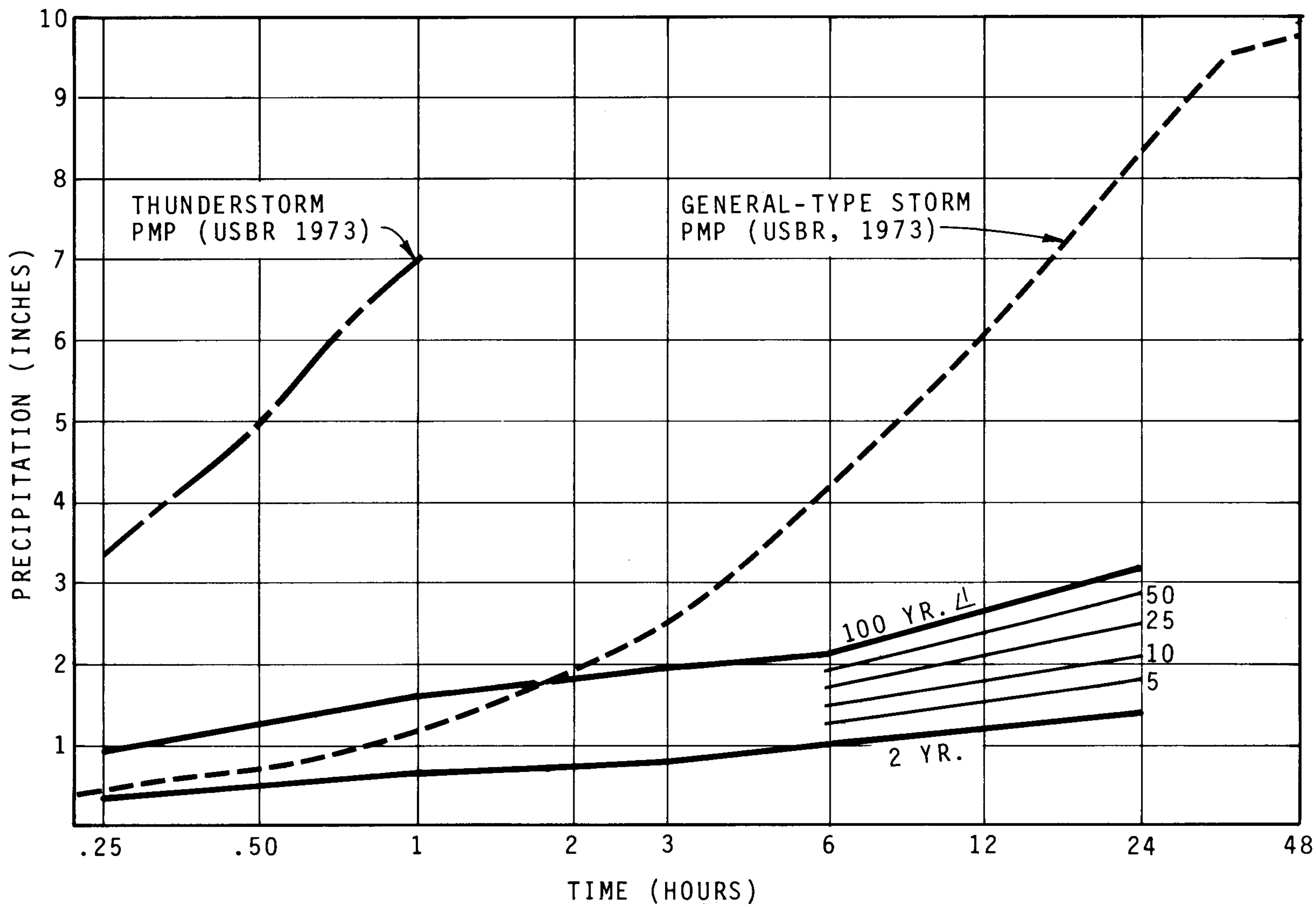
Two types of probable maximum precipitaton (PMP) were considered in developing the probable maximum flood. The first is thunderstorm rainfall, characterized by extremely intense precipitaton of short duration. The second is the rainfall from a general-type storm, characterized by less intense precipitation over a much longer period of time.

The PMP estimate for different durations from thunderstorm and general type storms are presented on Plate 2.6-8. These data were taken directly or derived from tables and charts of the U.S. Bureau of Reclamation's (1973) "Design of Small Dams." The values are for PMP at a point (applicable to an area up to 10 sq mi (26 sq km). For areas over 10 sq mi, the values shown must be reduced by appropriate areal reduction factors. As shown, the general type storm PMP produces 9.8 in (249 mm) of rainfall in 48 hours. The PMP generated by a thunderstorm is more intense, producing 7 in (178 mm) in only 1 hour. The thunderstorm is not expected to last more than 1 hour in this region (USBR, 1973:52).

In addition to the PMP rainfalls, the rainfall events having return periods of 2 to 100 years were determined for the area. The values shown on Plate 2.6-8 were computed from NOAA and NWS (1973). The resulting 2-, 5-, 10-, 25-, 50- and 100-year 24-hour precipitation depths are 1.4 in (35 mm), 1.8 in (45 mm), 2.1 in (53 mm) 2.5 in (63 mm), 2.8 in (72 mm) and 3.2 in (81 mm), respectively. Precipitation depths for these return periods are shown on Plate 2.6-8 for the 24-hour duration as well as intermediate durations down to 15 minutes.

Unit Hydrographs Unit hydrographs were developed to describe the rainfall-runoff response of the study basins which are the basins for the drainages adjacent to the project site shown on Plate 2.6-5. Ideally, the unit hydrographs should be determined and verified from historical floods and associated rainfall/runoff relationships. Since such data were not available for these watersheds, synthetic unit hydrographs were derived based on the physiographic characteristics of the drainage areas. These synthetic unit hydrographs were computed using the procedures set

1/ FROM, PRECIPITATION ATLAS OF THE WESTERN UNITED STATES, VOL. VI-U7A4-NOAA AND NWS, 1973.



PRECIPITATION DEPTH DURATION FREQUENCY

DAMES & MOORE

PLATE 2.6-8

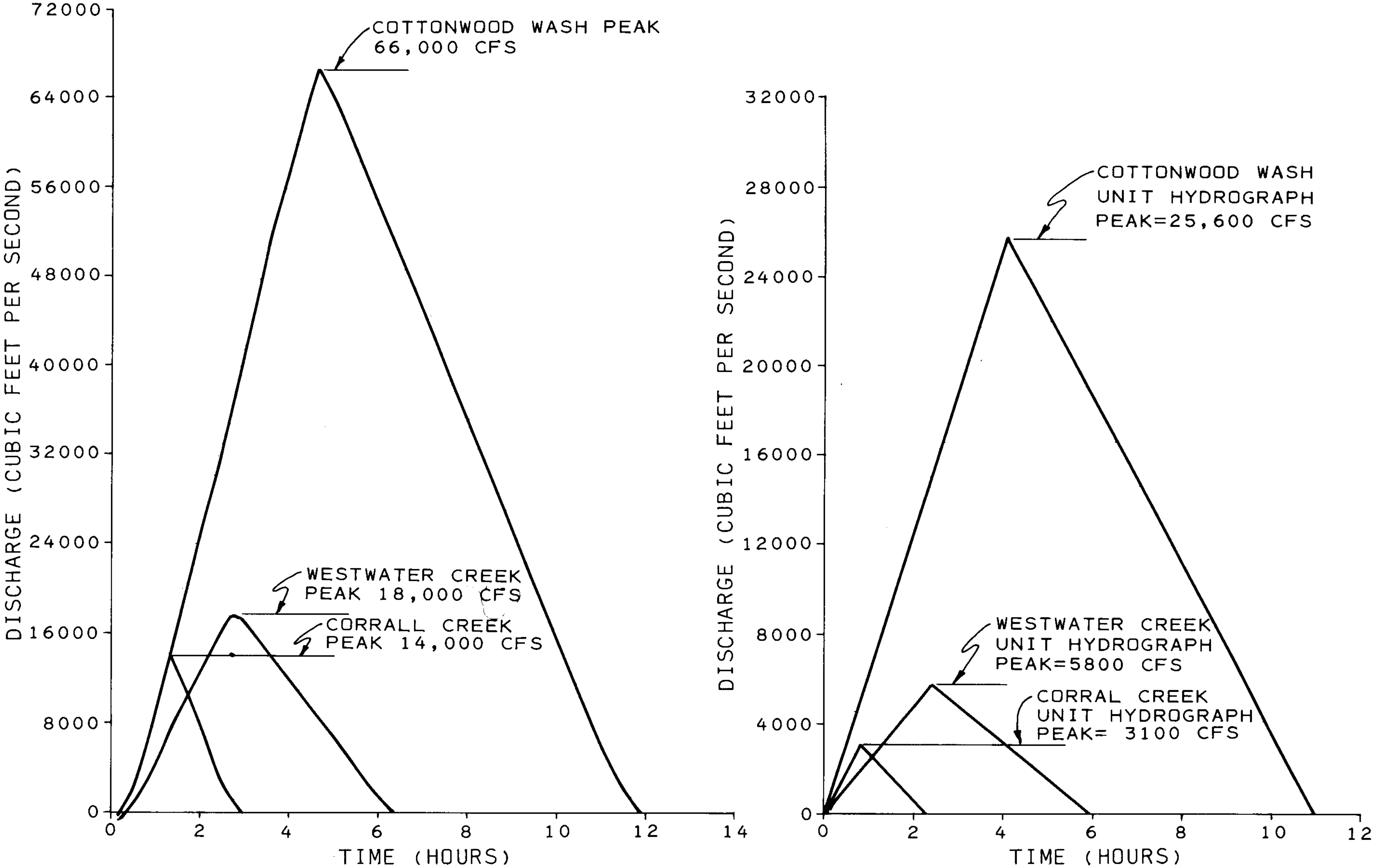
out by the U.S. Bureau of Reclamation (USBR) and the Soil Conservation Service (SCS).

Flood Hydrograph Analysis Using the previously described precipitation quantities and depth-duration relationships given on Plate 2.6-8, the runoff producing rainfall was computed. Retention losses, rainfall lost by soil infiltration or evaporated from the soil surface, were then determined by SCS criteria. For the PMP, near-saturated antecedent moisture conditions were adopted corresponding to curve number 85 (USBR, 1973). For the 100-year event, "average" basin conditions were assumed, resulting in the use of curve number 60. Incremental runoff quantities were then convoluted with the previously determined unit hydrographs to obtain the flood hydrographs for each event. Comparison of the PMF's front thunderstorms and general storms showed that the thunderstorm produced the longest peak flows. The hydrographs from a PMP thunderstorm are shown on Plate 2.6-9.

The PMF hydrographs shown for Cottonwood Wash, Westwater Creek and Corral Creek adjacent to the project site have peak discharges of 66,000 cfs (1869 cms), 18,000 cfs (510 cms) and 14,000 cfs (396 cms), respectively. The 100-year discharges for the same watersheds are 4500 cfs (127 cms), 450 cfs (12.7 cms) and 114 cfs (3.2 cms), respectively. By observation, the water courses for these three creeks have capacities which far exceed the computed PMF values. Therefore, the project site cannot be inundated due to floods on these drainages.

Flooding of the project site due to direct precipitation is discussed in detail in Appendix H. The precipitation depth-duration used in Appendix H is the same as that developed above, under "Precipitation Analysis."

The flood of record on Cottonwood Wash that occurred on August 1, 1968 was 20,500 cfs (581 cms). The rainfall that produced this record flow was almost 4.5 in (114 mm) in a 24-hour period. This flow is over 4 times the estimated 100-year discharge. As mentioned previously, no



FLOOD HYDROGRAPHS

UNIT HYDROGRAPHS

PROBABLE MAXIMUM THUNDERSTORM (PMT) HYDROGRAPHS

DAMES & MOORE

PLATE 2.6-9

statistical frequency analysis was performed on the meteorological data, but this 4.5 in (114 mm) rainfall was certainly an extremely unusual event, most probably generated by a general-type storm system, since high runoff occurred for several days both before and after the peak flow event.

The PMF hydrograph shown on Plate 2.6-9 is the result of the thunderstorm PMP, i.e. 7 in (178 mm) of rainfall in 1 hour. Although the PMP associated with a general-type storm produces more rainfall, 9.8 in (249 mm), the intensity is much less since the duration is much longer at 48 hours. The PMF hydrograph from such a rainfall would result in more volume of runoff than the PMF thunderstorm but the peak discharge would be less, therefore being less critical as far as flooding potential is concerned. Also, since the flood of record on Cottonwood Wash occurred in August, no snowmelt baseflow was added to the above PMF estimate. If the snowmelt component were included it would produce a negligible change in the peak flood flows shown.

2.6.3 Water Quality

Water quality determinations are being made of surface and ground waters in and around the proposed mill site to evaluate and describe the existing conditions and to be able to make predictions of possible future impacts on the water quality as a result of the planned action.

Sampling stations are located to provide baseline water quality conditions up gradient and down gradient from the site for both subsurface and surface waters. These locations were chosen to be as representative of specific conditions as possible and the frequency of sampling was selected to provide a statistically valid sampling.

The water quality parameters chosen for analysis represent the major chemical, physical and radiological properties that would be important for possible intended uses of the water and would be appropriate to monitor during the life of the project to detect possible changes in water quality.

An explanation of the significance of selected chemical and physical properties of water and a discussion of the water sampling procedures and techniques are included in Appendix B.

2.6.3.1 Ground Water Quality in Project Vicinity

In general, ground water quality is related to the type of geologic formation from which the water is derived. The ground water from wells drilled into the alluvium and at shallow depths in the Dakota sandstone, the Burro Canyon formation and the Morrison formation is slightly mineralized with a range of total dissolved solids from approximately 300 to 2000 milligrams per liter (mg/l) (Feltis, 1966:28).

The water quality in the deeper aquifers, such as the Navajo sandstone and the Entrada sandstone, varies considerably. The Entrada has yielded fresh water to water wells in some areas of southeastern Utah and saline water in others. No data are available regarding its quality in the vicintiy of the project site. The Navajo sandstone, however, yields fresh water to the mill site well. Its total dissolved solids content is about 245 mg/l. Generalized descriptions of ground water quality from many different formations present in the region and the Blanding vicinity are listed by specific wells and location in Table 3 of Feltis (1966).

Water samples have been collected and analyzed from springs and wells in the project vicinity as part of the baseline field investigations. The locations of these sampling sites and other preoperational water quality sampling stations are shown in Plate 2.6-10 (those north of the project site are upgradient). Results of analyses are listed in Table 2.6-6.

In general, the quality of the shallow ground water discharging from the springs in the project vicinity ranges from 780 to 1270 mg/l in total dissolved solids. The ground water is a sodium sulphate-bicarbonate to a sodium-calcium sulphate-bicarbonate type water with a neutral to slightly alkaline pH (see analyses of stations No. G4R and G3R).

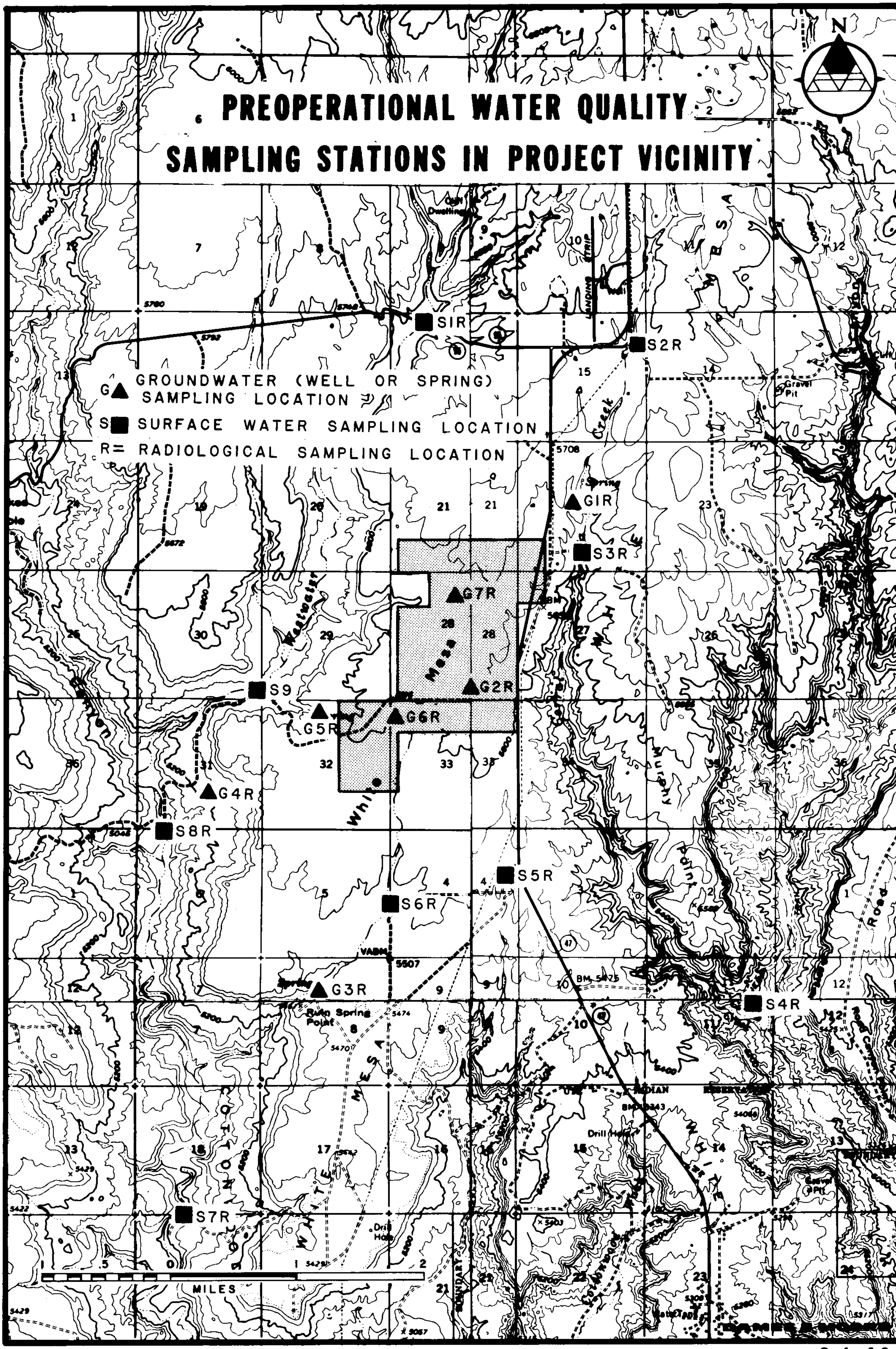

PREOPERATIONAL WATER QUALITY
SAMPLING STATIONS IN PROJECT VICINITY
N
G▲ GROUNDWATER (WELL OR SPRING) SAMPLING LOCATION
S■ SURFACE WATER SAMPLING LOCATION
R= RADIOLOGICAL SAMPLING LOCATION
S1R
S2R
G1R
S3R
G7R
G2R
S9
G5R
G6R
G4R
S8R
S5R
S6R
G3R
S4R
S7R
MILES
1
.5
0
1
2
PLATE 2.6-10

TABLE 2.6-6

WATER QUALITY OF GROUND WATERS AND SPRINGS IN PROJECT VICINITY

Location	Spring in Corral Ck		Blanding Mill Site Well in Navajo Sandstone				
Station No.	G1R		G2R				
Collection Date	7/25/77	11/10/77	1/27/77[1]	5/4/77[2]	7/25/77	12/05/77	12/05/77[3]
	LOW FLOW COULD NOT LOCATE SPRING	LOW FLOW COULD NOT LOCATE SPRING				ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY
Field Specific Conductivity (umhos/cm)			--	--	400		
Field pH			--	--	6.9		
Dissolved Oxygen			--	--	--		
Temperature (°C)			--	--	22.2		
Estimated Flow, gpm			--	--	20		
Determination (mg/l)							
pH			8.0	7.9	7.7		
TDS (@180°C)			244	245	1110		
Redox Potential			--	--	220		
Alkalinity (as $CaCO_3$)			189	180	224		
Hardness, total (as $CaCO_3$)			196	--	208		
Carbonate (as CO_3)			0.0	--	0		
Aluminum, dissolved			--	--	<0.01		
Ammonia (as N)			0.0	--	<0.1		
Arsenic, total			0.014	--	<0.01		
Barium, total			<0.0	--	0.13		
Boron, total			0.040	--	<0.1		
Cadmium, total			0.0	--	0.004		
Calcium, dissolved			51	49	51		
Chloride			0.0	50?	<1		
Sodium, dissolved			8.0	--	5.3		
Silver, dissolved			0.0	--	<0.002		
Sulfate, dissolved (as SO_4)			24	17	17		
Vanadium, dissolved			--	--	<0.002		
Manganese, dissolved			0.020	--	0.03		
Chromium, total			0.0	--	0.02		
Copper, total			0.0	--	0.005		
Fluoride, dissolved			0.17	0.1	0.22		
Iron, total			0.54	--	0.61		
Iron, dissolved			--	--	0.57		
Lead, total			0.0	--	0.02		
Magnesium, dissolved			17	19	18		
Mercury, total			0.0	00	0.002		
Molybdenum, dissolved			--	--	<0.01		
Nitrate (as N)			0.05	0.12	<0.05		
Phosphorus, total (as P)			(ortho) 0.03	--	<0.01		

[1]Utah State Division of Health Analysis, Lab No. 77061
[2]Partial analysis by Hazen Research, Inc., Sample No. HRI-11503
[3]Replicate sample analyzed for Quality Assurance on radioactivity

TABLE 2.6-6 (Continued)

Location	Spring in Corral Ck		Blanding Mill Site Well in Navajo Sandstone				
Station No.	G1R		G2R				
Collection Date	7/25/77	11/10/77	1/27/77[1]	5/4/77[2]	7/25/77	12/05/77	12/05/77[3]
Determination (mg/l)	LOW FLOW, COULD NOT LOCATE SPRING	LOW FLOW, COULD NOT LOCATE SPRING				ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY
Potassium, dissolved			3.0	--	3.2		
Selenium, dissolved			0.0	--	0.05		
Silica, dissolved (as SiO_2)			12	5.8	12		
Strontium, dissolved			--	--	0.67		
Uranium, total (as U)			--	--	<0.002		
Uranium, dissolved (as U)			--	--	<0.002		
Zinc, dissolved			0.0	--	0.39		
Total Organic Carbon			--	--	--		
Chemical Oxygen Demand			--	--	--		
Oil and Grease			--	--	--		
Total Suspended Solids			--	--	--		
Determination (pCi/l)							
Gross Alpha±Precision[4]			--	7±?	10.2±2.6		
Gross Beta±Precision[4]			--	<20±?	73±19		
Radium-226±Precision[4]			--	--	0.1±0.3		
Thorium-230±Precision[4]			--	--	0.7±2.7		
Lead-210±Precision[4]			--	--	1.0±2.0		
Polonium-210±Precision[4]			--	--	0.0±0.3		

[4]Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-6 (Continued)

Location	Spring in Cottonwood Creek		Spring in Cottonwood Creek		Spring in Westwater Creek		Abandoned Stock Well	
Station No.	G3R		G4R		G5R		G6R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Field Specific Conductivity (umhos/cm)	NOT ENOUGH WATER TO ADQUATELY SAMPLE	950	2400	760	NO WATER TO SAMPLE	NO WATER TO SAMPLE	UNABLE TO SAMPLE	UNABLE TO SAMPLE
Field pH		7.4	6.4	6.7				
Dissolved Oxygen		--	--	--				
Temperature (°C)		13.5	24	70				
Estimated flow, gpm		.5	10	2				
Determination (mg/l)								
pH		7.8	7.0	8.1				
TDS (@180°C)		975	1270	780				
Redox Potential		260	240	260				
Alkalinity (as $CaCO_3$)		187	643	252				
Hardness, total (as $CaCO_3$)		477	232	264				
Carbonate (as CO_3)		0	0	0				
Aluminum, dissolved		<0.1	0.06	0.4				
Ammonia (as N)		<0.1	0.13	<0.1				
Arsenic, total		--	<0.01	--				
Barium, total		<0.2	0.25	<0.2				
Boron, total		0.2	0.3	0.1				
Cadmium, total		0.004	0.004	0.002				
Calcium, dissolved		375	58	135				
Chloride		25	1	71				
Sodium, dissolved		200	400	115				
Silver, dissolved		--	0.004	--				
Sulfate, dissolved (as SO_4)		472	333	243				
Vanadium, dissolved		<0.01	0.006	<0.01				
Manganese, dissolved		<0.005	1.1	0.060				
Chromium, total		0.1	0.02	<0.01				
Copper, total		<0.005	0.005	<0.005				
Fluoride, dissolved		0.6	1.0	0.5				
Iron, total		0.05	0.34	0.16				
Iron, dissolved		0.02	0.32	0.11				
Lead, total		<0.05	0.03	<0.05				
Magnesium, dissolved		265	19	28				
Mercury, total		<0.005	0.002	0.001				
Molybdenum, dissolved		--	<0.01	--				
Nitrate (as N)		2.77	0.06	0.26				
Phosphorus, total (as P)		0.06	0.07	0.02				

TABLE 2.6-6 (Continued)

Location	Spring in Cottonwood Creek		Spring in Cottonwood Creek		Spring in Westwater Creek		Abandoned Stock Well	
Station No.	G3R		G4R		G5R		G6R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Determination (mg/l)	NOT ENOUGH WATER TO ADEQUATELY SAMPLE				NO WATER TO SAMPLE	NO WATER TO SAMPLE	UNABLE TO SAMPLE	UNABLE TO SAMPLE
Potassium, dissolved		2.8	6.6	4.3				
Selenium, dissolved		--	0.14	--				
Silica dissolved (as SiO_2)		9	29	16				
Strontium, dissolved		1.3	2.7	1.3				
Uranium, total (as U)		0.010	0.005	0.006				
Uranium, dissolved (as U)		0.010	0.004	0.006				
Zinc, dissolved		0.015	0.06	0.15				
Total Organic Carbon		1		8				
Chemical Oxygen Demand		28		39				
Oil and Grease		2		1				
Total Suspended Solids		11		21				
Determination (pCi/l)								
Gross Alpha±Precision[4]			10.2±3.1					
Gross Beta±Precision[4]			37±21					
Radium-226±Precision[4]			0.0±0.2					
Thorium-230±Precision[4]			0.2±0.8					
Lead-210±Precision[4]			0.0±2.0					
Polonium-210±Precision[4]			0.0±0.3					

[4]Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-6 (Continued)

Location	Abandoned Stock Well				
Station No.	G7R				
Collection Date	7/25/77	11/10/77	Future date	Future date	Future date
Field Specific Conductivity (umhos/cm)	UNABLE TO SAMPLE	UNABLE TO SAMPLE			
Field pH					
Dissolved Oxygen					
Temperature (°C)					
Estimated flow, gpm					
Determination (mg/l)					
pH					
TDS (@180°C)					
Redox Potential					
Alkalinity (as $CaCO_3$)					
Hardness, total (as $CaCO_3$)					
Carbonate (as CO_3)					
Aluminum, dissolved					
Ammonia (as N)					
Arsenic, total					
Barium, total					
Boron, total					
Cadmium, total					
Calcium, dissolved					
Chloride					
Sodium, dissolved					
Silver, dissolved					
Sulfate, dissolved (as SO_4)					
Vanadium, dissolved					
Manganese, dissolved					
Chromium, total					
Copper, total					
Fluoride, dissolved					
Iron, total					
Iron, dissolved					
Lead, total					
Magnesium, dissolved					
Mercury, total					
Molybdenum, dissolved					
Nitrate (as N)					
Phosphorus, total (as P)					

TABLE 2.6-6 (Concluded

Location					
Station No.	G7R				
Collection Date	7/25/77	11/10/77	Future date	Future date	Future date
Determination (mg/l)					
Potassium, dissolved	UNABLE TO SAMPLE	UNABLE TO SAMPLE			
Selenium, dissolved					
Silica dissolved (as SiO_2)					
Strontium, dissolved					
Uranium, total (as U)					
Uranium, dissolved (as U)					
Zinc, dissolved					
Total Organic Carbon					
Chemical Oxygen Demand					
Oil and Grease					
Total Suspended Solids					
Determination (pCi/l)					
Gross Alpha±Precision[4]					
Gross Beta±Precision[4]					
Radium-226±Precision[4]					
Thorium-230±Precision[4]					
Lead-210±Precision[4]					
Polonium-210±Precision[4]					

[4]Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

More information will be gathered regarding the quality of shallow ground water at the mill site and tailing retention site. These data will be submitted in the Supplemental Report.

The water quality analysis of ground water from the mill site well drilled into the Navajo sandstone is included in Table 2.6-6 for reference and comparison with other ground waters. However, it must be recognized that the ground water in the Navajo sandstone beneath the mill site is isolated from the shallow ground water regime of the Dakota-Morrison rock formations by several hundred feet of less permeable geologic formations. Therefore, because these geologic formations are of different character and physical composition, it is understandable that the ground water compositions are entirely different in each formation.

Specifically, based on analyses of water from the Blanding mill site well (Station No. G2R), the ground water in the Navajo sandstone is a calcium-bicarbonate type water with low total dissolved solids, and a very slightly alkaline pH. The dissolved iron content of 0.57 mg/l, however, would require treatment in order to meet U.S. Public Health Service (1962) recommended standards of 0.3 mg/l for drinking water.

2.6.3.2 Surface Water Quality in Project Vicinity

Surface water samples have been collected at several locations around the project site and analysed as part of the baseline field studies. The locations of these preoperational surface water quality sampling stations are shown on Plate 2.6-10 and the results of the analyses are presented in Table 2.6-7.

Two sets of surface water samples have been collected from the Blanding site area; one in July 1977, another in November 1977. Samples were collected from Westwater Creek, Cottonwood Creek and Corral Creek, intermittent streams which drain the mill site area; and, from a surface stock pond just southeast of the proposed mill site. Attempts have been made to sample Recapture Creek at Station No. S4R and a small wash south

TABLE 2.6-7

WATER QUALITY OF SURFACE WATERS IN PROJECT VICINITY, BLANDING, UTAH

Location	Westwater Creek		Corral Creek		Corral Creek		Corral/Recapture Creeks Junction	
Station No.	S1R		S2R		S3R		S4R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Field Specific Conductivity (umhos/cm)	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE	490	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE	2000	2400	NO WATER IN STREAM TO SAMPLE	NO WATER IN STREAM TO SAMPLE
Field pH		7.6			6.8			
Dissolved Oxygen		--			--	--		
Temperature (°C)		3			27.7	8		
Estimated Flow, sec-ft		0.02			0.09	0.02		
Determination (mg/l)								
pH		8.2			6.7	8.0		
TDS (@180°C)		496			1350	3160		
Redox Potential		220			260	240		
Alkalinity (as $CaCO_3$)		206			70	172		
Hardness, total (as $CaCO_3$)		262			853	1910		
Carbonate (as CO_3)		0			0	0		
Aluminum, dissolved		0.2			0.04	<0.1		
Ammonia (as N)		<0.1			0.15	<0.1		
Arsenic, total		--			<0.01	--		
Barium, total		<0.2			0.36	0.4		
Boron, total		0.1			0.1	0.2		
Cadmium, total		<0.002			0.004	0.006		
Calcium, dissolved		76			150	78		
Chloride		17			54	152		
Sodium, dissolved		31			115	160		
Silver, dissolved		--			0.004	--		
Sulfate, dissolved as SO_4)		103			803	2000		
Vanadium, dissolved		<0.01			0.004	<0.01		
Manganese, dissolved		0.030			0.20	0.030		
Chromium, total		<0.01			0.02	0.01		
Copper, Total		<0.005			0.01	0.010		
Fluoride, dissolved		0.3			0.32	0.6		
Iron, total		0.28			0.08	0.09		
Iron, dissolved		0.17			0.12	0.07		
Lead, total		<0.05			0.04	0.15		
Magnesium, dissolved		17			120	20		
Mercury, total		<0.0005			0.002	<0.0005		
Molybdenum, dissolved		--			<0.01	--		
Nitrate (as N)		<0.05			0.21	0.11		
Phosphorus, total (as P)		0.05			0.21	0.06		

TABLE 2.6-7 (Continued)

Location	Westwater Creek		Corral Creek		Corral Creek		Corral/Recapture Creeks Junction	
Station No.	S1R		S2R		S3R		S4R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Determination (mg/l)	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE		NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE	NOT ENOUGH WATER IN STREAM TO ADEQUATELY SAMPLE			NO WATER IN STREAM TO SAMPLE	NO WATER IN STREAM TO SAMPLE
Potassium, dissolved		2.8			13	4.8		
Selenium, dissolved		--			0.16	--		
Silica dissolved (as SiO_2)		7			10	2		
Strontium, dissolved		0.44			1.9	2.2		
Uranium, total (as U)		0.006			0.005	0.028		
Uranium, dissolved (as U)		0.002			0.002	0.028		
Zinc, dissolved		0.09			0.06	0.02		
Total Organic Carbon		6				11		
Chemical Oxygen Demand		23				79		
Oil and Grease		1				1		
Total Suspended Solids		12				9		
Determination (pCi/l)								
Gross Alpha±Precision[1]					15±2			
Gross Beta±Precision[1]					180±20			
Radium -226±Precision[1]					0.0±0.3			
Thorium -230±Precision[1]					3.1±6.5			
Lead -210±Precision[1]					1.4±2.1			
Polonium -210±Precision[1]					0.0±0.3			

[1]Variability of the radioactive disintegration process (counting error) at the 95% confidence level. 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-7 (Continued)

Location	Surface Pond		Unnamed Wash		Cottonwood Creek		Cottonwood Creek	
Station No.	S5R		S6R		S7		S8R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Field Specific Conductivity (umhos/cm)	NOT SAMPLED	100	NO WATER TO SAMPLE	NO WATER TO SAMPLE	UNABLE TO SAMPLE	UNABLE TO SAMPLE	550	445
Field pH		6.8					6.6	6.9
Dissolved oxygen		--					--	--
Temperature (°C)		7					35	6.0
Estimated flow, sec-ft		None					0.4	0.07
Determination (mg/l)								
pH		6.9					7.5	8.2
TDS (@180°C)		264					944	504
Redox Potential		280					220	260
Alkalinity (as $CaCO_3$)		218					134	195
Hardness, total (as $CaCO_3$)		67					195	193
Carbonate (as CO_3)		0					0	0
Aluminum, dissolved		2.0					3.0	0.7
Ammonia (as N)		<0.1					0.12	<0.1
Arsenic, total		--					0.02	--
Barium, total		<0.2					1.2	0.2
Boron, total		0.2					0.1	0.2
Cadmium, total		<0.002					0.004	<0.002
Calcium, dissolved		22					79	54
Chloride		8					13	24
Sodium, dissolved		0.6					36	66
Silver, dissolved		--					0.002	--
Sulfate, dissolved as SO_4)		64					564	132
Vanadium, dissolved		<0.01					0.003	<0.01
Manganese, dissolved		0.095					0.84	0.065
Chromium, total		0.04					0.14	<0.01
Copper, total		0.005					0.09	0.005
Fluoride, dissolved		<0.1					0.36	0.2
Iron, total		9.4					150	5.9
Iron, dissolved		1.2					1.4	0.62
Lead, total		<0.05					0.14	<0.05
Magnesium, dissolved		3.2					24	17
Mercury, total		<0.0005					0.002	<0.0005
Molybdenum, dissolved		--					<0.01	0.10
Nitrate (as N)		4.26					1.77	0.14
Phosphorus, total (as P)		0.04					0.05	3.2

TABLE 2.6-7 (Continued)

Location	Surface Pond		Unnamed Wash		Cottonwood Creek		Cottonwood Creek	
Station No.	S5R		S6R		S7		S8R	
Collection Date	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77	7/25/77	11/10/77
Determination (mg/l)								
Potassium, dissolved	NOT SAMPLED	14	NO WATER TO SAMPLE	NO WATER TO SAMPLE	UNABLE TO SAMPLE	UNABLE TO SAMPLE	6.9	3.2
Selenium, dissolved		--					0.08	--
Silica dissolved (as SiO_2)		2					10	8
Strontium, dissolved		0.10					0.64	0.60
Uranium, total (as U)		0.004					0.027	0.004
Uranium, dissolved (as U)		0.003					0.015	0.004
Zinc, dissolved		0.02					0.06	0.05
Total Organic Carbon		15						7
Chemical Oxygen Demand		71						61
Oil and Grease		2						2
Total Suspended Solids		268						146
Determination (pCi/l)								
Gross Alpha±Precision[1]							16±3	
Gross Beta±Precision[1]							72±17	
Radium-226±Precision[1]							0.6±1.3	
Thorium-230±Precision[1]							0.9±0.6	
Lead-210±Precision[1]							0.8±1.9	
Polonium-210±Precision[1]							0.0±0.3	

[1]Variability of the radioactive disintegration process (counting erros) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

TABLE 2.6-7 (Continued)

Location	Westwater Creek			
Station No.	S9			
Collection date	7/25/77	11/10/77	Future dates	Future dates
	NO WATER IN STREAM TO SAMPLE	NO WATER IN STREAM TO SAMPLE		
Field Specific Conductivity (umhos/cm)				
Field pH				
Dissolved Oxygen				
Temperature (°C)				
Estimated Flow, sec-ft				
Determination (mg/1)				
pH				
TDS (@180°C)				
Redox Potential				
Alkalinity (as $CaCO_3$)				
Hardness, total (as $CaCO_3$)				
Carbonate (as CO_3)				
Aluminum, dissolved				
Ammonia (as N)				
Arsenic, total				
Barium, total				
Boron, total				
Cadmium, total				
Calcium, dissolved				
Chloride				
Sodium, dissolved				
Silver, dissolved				
Sulfate, dissolved (as SO_4)				
Vanadium, dissolved				
Manganese, dissolved				
Chromium, total				
Copper, total				
Fluoride, dissolved				
Iron, total				
Iron, dissolved				
Lead, total				
Magnesium, dissolved				
Mercury, total				
Molybdenum, dissolved				
Nitrate (as N)				
Phosphorus, total (as P)				

TABLE 2.6-7 (Concluded)

Location	Westwater Creek			
Station No.	S9			
Collection date	7/25/77	11/10/77	Future dates	Future dates
Determination (mg/1)	NO WATER IN STREAM TO SAMPLE	NO WATER IN STREAM TO SAMPLE		
Potassium, dissolved				
Selenium, dissolved				
Silica, dissolved (as SiO_2)				
Strontium, dissolved				
Uranium, total				
Uranium, dissolved (as U)				
Zinc, dissolved				
Total Organic Carbon				
Chemical Oxygen Demand				
Oil and Grease				
Total Suspended Solids				
Determination (pCi/1)				
Gross Alpha±Precision[1]				
Gross Beta±Precision[1]				
Radium-226±Precision[1]				
Thorium-230±Precision[1]				
Lead-210±Precision[1]				
Polonium-210±Precision[1]				

[1]Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

of the plant site at Station No. S6R; but, at the times of sampling these stations have had no water to sample.

The sampling times in July and November occurred within a few days of major precipitation events within the drainage area of these streams. At other times during the period from July 1977 to present there has not been sufficient flow available in the streams for sampling. It is intended that these streams will be sampled at the same site locations in the spring at a time when the snowmelt runoff hopefully will provide adequate flow in the streams for representative sampling.

The analyses of water samples collected at Stations S1R and S8R on Westwater and Cottonwood Creeks indicate that the water is of a calcium-sodium sulphate type with a slightly alkaline pH. The water analyses from Station S3R on Corral Creek indicate that this water is a mixed calcium-sodium-magnesium sulphate type water of slightly acidic pH with high amounts of chlorides. The total dissolved solids of all the surface waters sampled in the project vicinity, except for the pond (Station No. S5R) range from 944 to 1350 mg/l, and the total suspended solids range from 9 to 146 mg/l.

2.6.3.3 Ground Water Quality in Vicinity of Hanksville Ore-Buying Station

The only available ground water information on the vicinity of the Hanksville Ore-Buying Station are the analyses of the ground water from the deep well at the ore-buying station (Table 2.6-8).

The analyses of the ore-buying station well water indicate that this water from the Entrada sandstone is slightly alkaline and moderately saline. The water is a sodium-sulphate type with a range of 6020 to 7230 mg/l in total dissolved solids and concentrations of manganese, silver, iron and sulphate that exceed permissible limits for drinking water as set by the U.S. Public Health Service (1962) and the U.S. EPA interim primary standards for public drinking water supplies (see Table B-2 of Appendix B).

TABLE 2.6-8

WATER QUALITY OF GROUND WATER AND SURFACE WATER IN VICINITY OF HANKSVILLE ORE-BUYING STATION, HANKSVILLE, UTAH

Location	Ore-Buying Station Well in Entrada Sandstone				
Station No.	HG1R				
Collection Date	12/21/76[1]	7/25/77	12/5/77	12/5/77[2]	Future date
Field Specific Conductivity (umhos/cm)		7400	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	
Field pH		6.6			
Dissolved Oxygen		--			
Temperature (°C)		19.5			
Estimated flow, gpm		20			
Determination (mg/1)					
pH	8.3	6.9			
TDS (@180°C)	7230	6020			
Redox Potential	-	240			
Alkalinity (as $CaCO_3$)	62	60			
Hardness, total (as $CaCO_3$)	1350	1080			
Carbonate (as CO_3)	0.0	0			
Aluminum, dissolved	-	<0.01			
Ammonia (as N)	1.2	0.53			
Arsenic, total	0.002	<0.01			
Barium, total	0.0	0.05			
Boron, total	1.06	1.2			
Cadmium, total	0.0	0.008			
Calcium, dissolved	352	345			
Chloride	132	94			
Sodium, dissolved	2020	1790			
Silver, dissolved	0.070	0.004			
Sulfate, dissolved (as SO_4)	4720	3920			
Vanadium, dissolved	-	<0.002			
Manganese, dissolved	0.160	0.06			
Chromium, total	0.0	0.03			
Copper, total	0.085	0.03			
Fluoride, dissolved	0.40	0.47			
Iron, total	1.28	2.2			
Iron, dissolved	-	1.3			
Lead, total	0.0	0.11			
Magnesium, dissolved	114	115			
Mercury, total	0.0	0.002			
Molybdenum, dissolved	-	0.01			
Nitrate (as N)	0.0	<0.05			
Phosphorus, total (as P) (ortho)	0.5	0.02			

[1]Utah Division of Health, Lab. No. 761461
[2]Replicate sample analysis for Quality Assurance on radioactivity.

TABLE 2.6-8 (Concluded)

Location	Ore-Buying Station Well in Entrada Sandstone				
Station No.	HG1R				
Collection Date	12/21/76[1]	7/25/77	12/5/77	12/5/77[2]	Future date
Determination (mg/l)			ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	ANALYSIS NOT YET COMPLETED BY COMMERCIAL TESTING LABORATORY	
Potassium, dissolved	15.0	9.9			
Selenium, dissolved	0.0002	0.38			
Silica dissolved (as SiO_2)	4.0	7			
Strontium, dissolved	-	11			
Uranium, total (as U)	-	0.015			
Uranium, dissolved (as U)	-	0.007			
Zinc, dissolved	0.999	1.0			
Total Organic Carbon	-	-			
Chemical Oxygen Demand	-	-			
Oil and Grease	-	-			
Total Suspended Solids	-	-			
Determination (pCi/l)					
Gross Alpha ±Precision[3]	-	700±40?			
Gross Beta±Precision[3]	-	2900±100?			
Radium-226±Precision[3]	-	0.2±0.3			
Thorium-230±Precision[3]	-	0.8±1.1			
Lead-210±Precision[3]	-	0.0±1.9			
Polonium-210±Precision[3]	-	0.0±0.3			

[3]Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Since the half-life of polonium-210 is 138 days, it will be in equilibrium with lead-210 in approximately 1380 days or 3.8 years. There will be equal activities of polonium-210 and lead-210 when in equilibrium.

2.6.3.4 Surface Water Quality in Vicinity of Hanksville Ore-Buying Station

The Hanksville ore-buying station is located in an area of very low precipitation (see Section 2.7.3). Consequently, there are no perennial streams near the site. Only small ill-defined channels drain the site area during short-duration storm events. Nevertheless, two surface water sampling stations on Halfway Wash (Plate 2.6-11) have been selected in the vicinity of the Hanksville ore-buying station to determine water quality during the few times a year when surface runoff may occur.

However, it has not been possible, from the period of July 1977 to December 1977, to collect water samples in the vicinity as there has been no collectable surface runoff.

2.7 METEOROLOGY AND AIR QUALITY

2.7.1 Regional Climatology

The climate of southeastern Utah is classified as dry to arid continental. Of main importantance in the determination of the climatology of this area are its location between major mountain ranges, its distance from major moisture sources and its proximity relative to major storm tracks. The region including the Blanding vicinity, is typified by warm summer and cold winter temperatures, precipitation averaging less than 35 centimeters (13.8 in) annually, low humidity, clear skies and large annual and diurnal temperature variations.

Total annual precipitation in the region is low as moisture from the Pacific and Gulf of Mexico is largely removed as it passes over the Sierra Nevada and Rocky Mountain chains. The Blanding vicinity, which averages nearly 30 centimeters (11.8 cm) annually, receives considerably more precipitation than areas to the west and northwest. Precipitation occurs throughout the year at Blanding but over one third of annual precipitation occurs in the three-month period of August through October. With the absence of local sources of moisture, thunderstorms (which usually comprise a major portion of the annual precipitation in most areas) are not abundant in this area; this accounts for the relatively

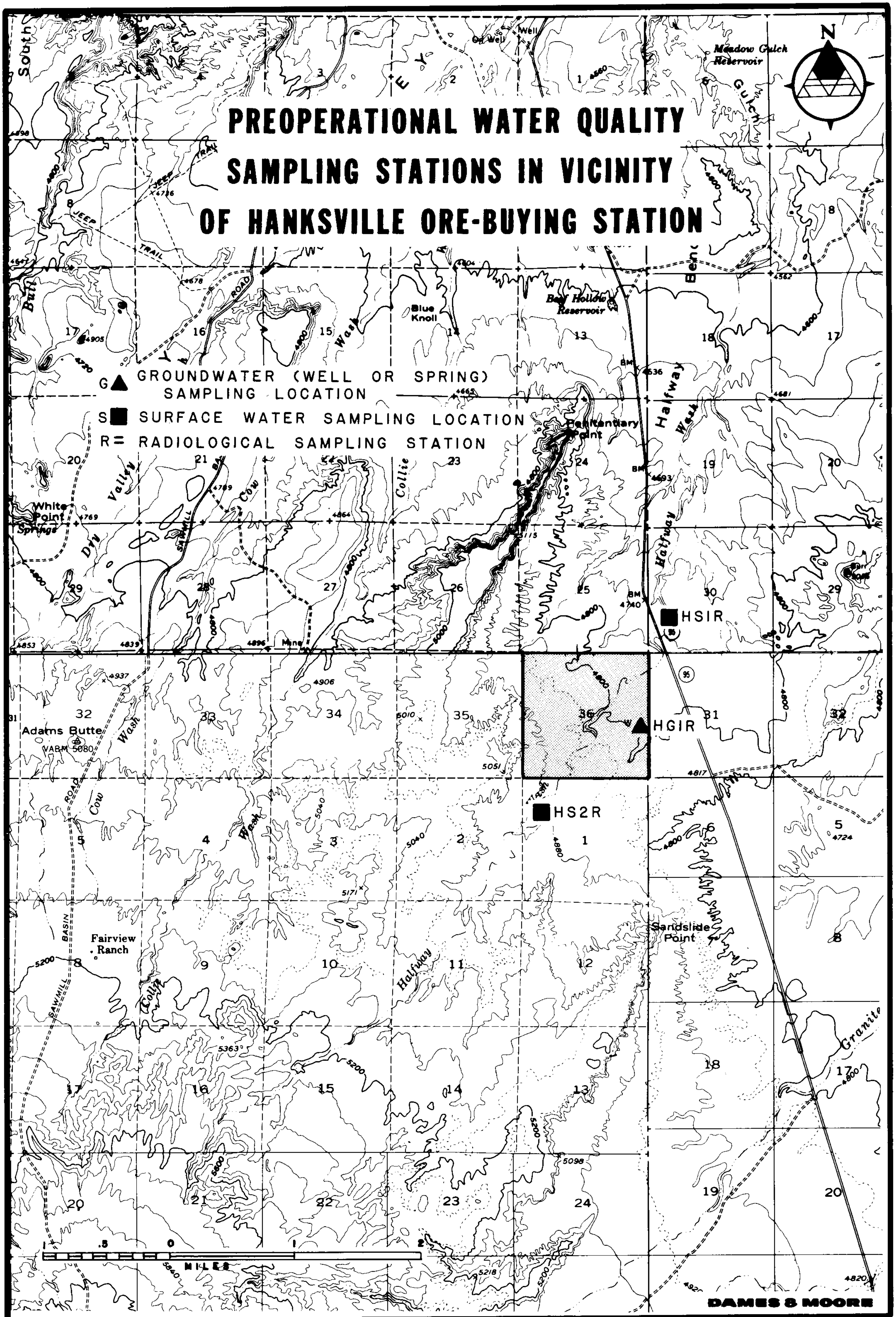

PREOPERATIONAL WATER QUALITY SAMPLING STATIONS IN VICINITY OF HANKSVILLE ORE-BUYING STATION
G ▲ GROUNDWATER (WELL OR SPRING) SAMPLING LOCATION
S ■ SURFACE WATER SAMPLING LOCATION
R= RADIOLOGICAL SAMPLING STATION
HSIR
HGIR
HS2R
N
Meadow Gulch Reservoir
Blue Knoll
Bull Hollow Reservoir
Penitentiary Point
White Point Springs
Dry Valley
Cow Wash
Collie
Halfway Wash
Adams Butte
VABM 5080
Fairview Ranch
Sandslide Point
Granite
SAWMILL BASIN ROAD
JEEP TRAIL
MILES
DAMES & MOORE

PLATE 2.6-11

light spring and summer rainfall. Likewise winter precipitation is scanty as this area is missed by many major winter storms that pass too far to the north or form too far to the east to significantly affect the area. Most of the winter precipitaton falls as snow but rapid warming during the day in the winter is characteristic so that snow does not remain on the ground long.

Winds are usually light in this area, averaging two to five meters per second; however, higher average speeds occur in the spring and summer. On an annual basis, northwest through north winds are the most frequent. With the high percentage of clear skies and low wind speeds, nighttime inversions are common.

2.7.2 Climatology of Blanding and Project Site

2.7.2.1 Data Sources

Long-term meteorological data are available from the National Weather Service station in Blanding, Utah, located approximately 10 kilometers north of the project area. With its close proximity and similar terrain, climatic conditions at Blanding should be fairly representative of those at the project site. Therefore, these data have been used to a large degree to describe the climatology of the project site. To a much lesser degree, additional meteorological data from Green River, Utah, located approximately 160 kilometers to the north-northwest have also been used in this report to estimate specific climatic conditions. Other sources employed in the compilation of this report are referenced within the text.

An on-site meteorological monitoring program was initiated in early March 1977 (see Section 6.1.3). The exact location of the monitoring station is indicated on Plate 2.7-1. Limited correlations between these data and concurrent Blanding meteorological data have been made in order to determine the representativeness of the Blanding station data to actual site conditions. A more detailed correlation is planned after the collection of one year of on-site data when it is felt that the data base will be of sufficient length to yield a more valid comparison. Results

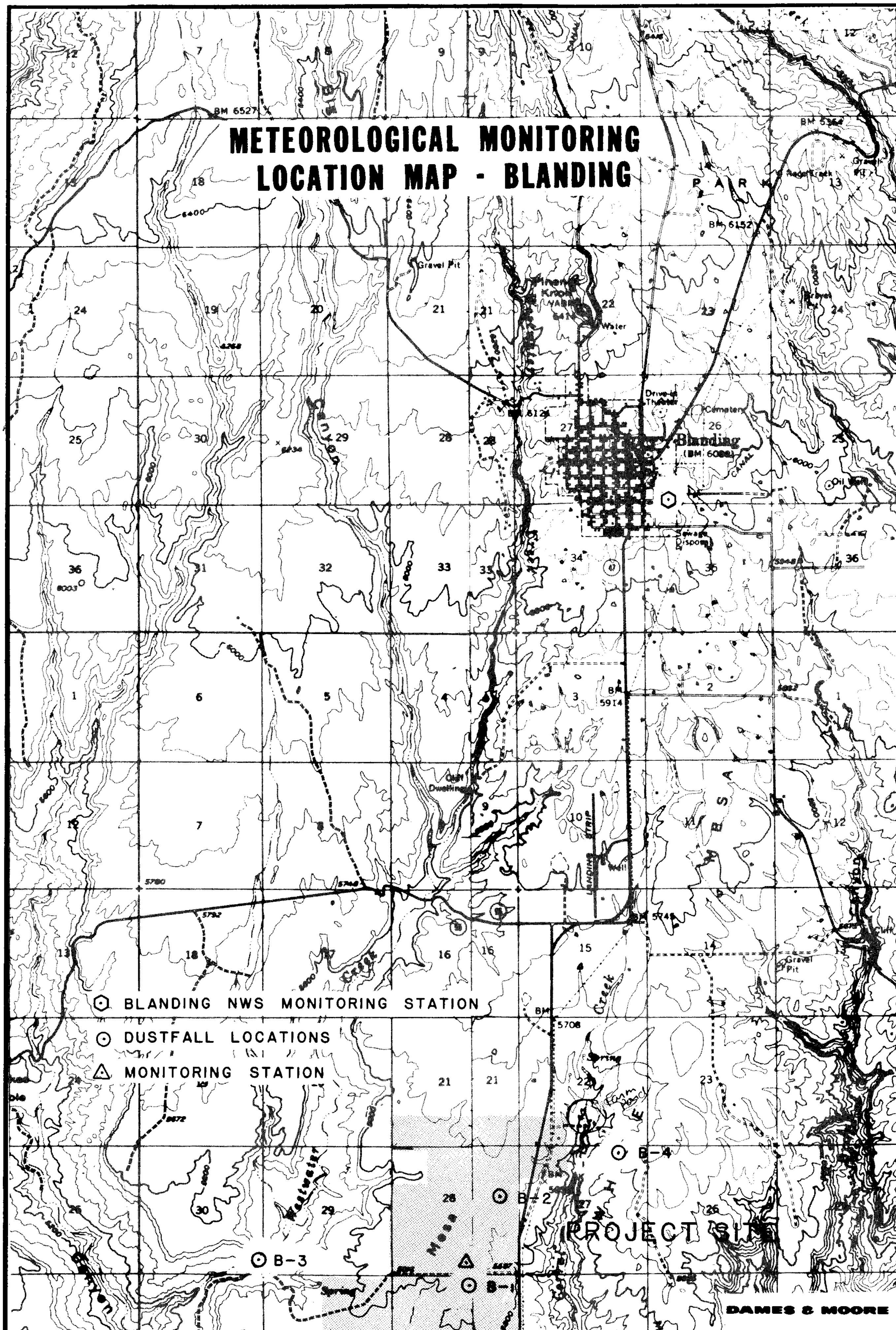

METEOROLOGICAL MONITORING
LOCATION MAP - BLANDING
BLANDING NWS MONITORING STATION
DUSTFALL LOCATIONS
MONITORING STATION
Blanding
PROJECT SITE
B-1
B-2
B-3
B-4
DAMES & MOORE

PLATE 2.7-1

of the first six months of data collection from this program are presented in Appendix C. Results from the full year of data collection will be presented in the Supplemental Report.

2.7.2.2 Temperature

Plate 2.7-2 summarizes means and extremes of temperatures recorded at Blanding, Utah from 1951 through 1974. These data show that the mean annual temperature is 9.9°C (49.8°F), and the mean monthly temperature varies between -2.5°C (27.5°F) in January and 23.1°C (73.6°F) in July. The average daily maximum temperatures range from 3.8°C (38.8°F) in January to 31.9°C (89.5°F) in July. The average daily minimum temperatures range from -8.8°C (16.2°F) to 14.2°C (57.6°F) in January and July, respectively. The normal diurnal variation of temperatures is 15.5°C (27.9°F), but normally the range is greater in the summer months and narrower in the winter.

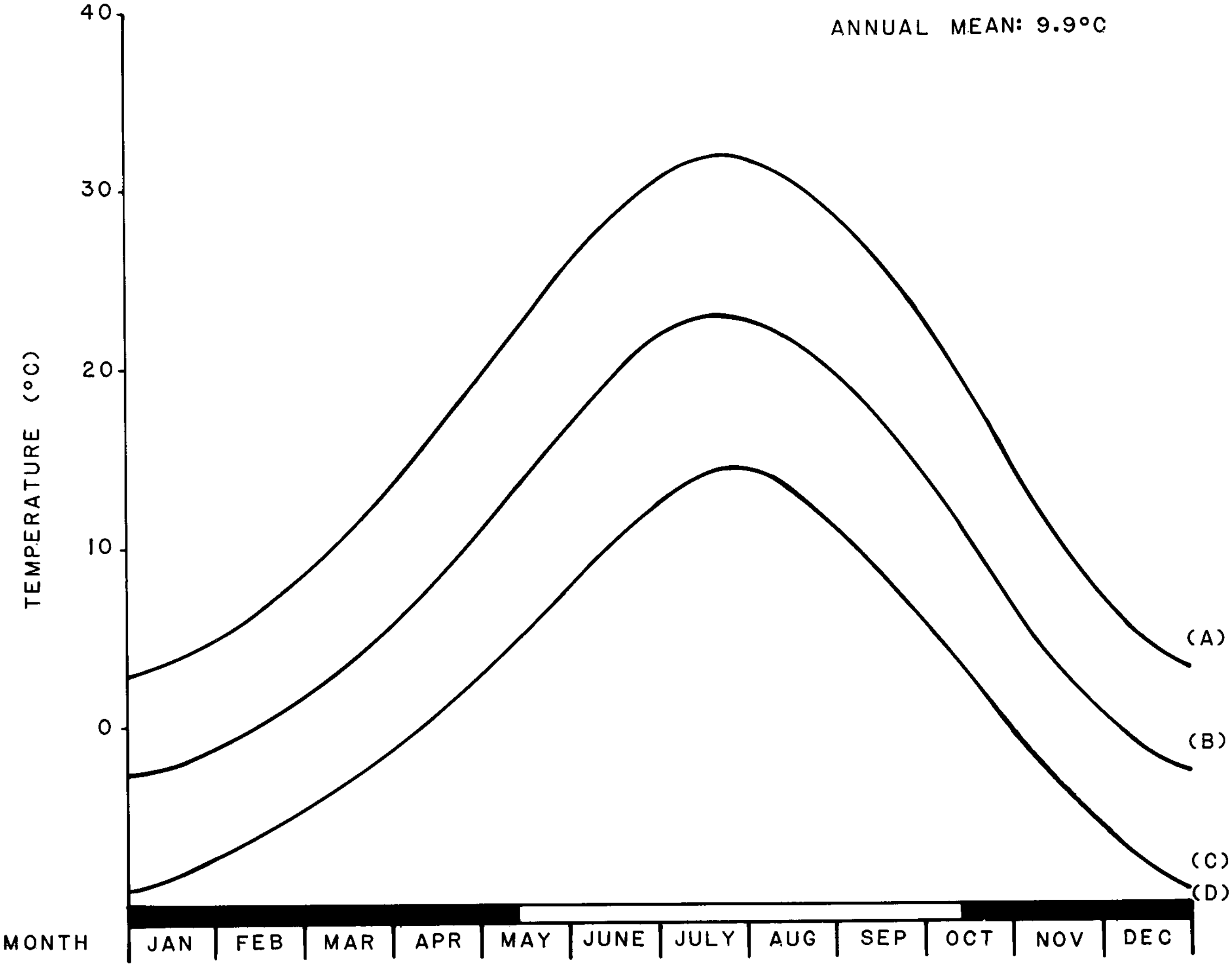
On the average, temperatures can be expected to rise to 32°C (90°F) or above 35 days per year and fall to -18°C (0°F) or below only 4 days per year. Only on an average of 15 days per year does the daily maximum temperature fail to rise above freezing but the daily minimum temperature dips to freezing or below on approximately 161 days per year.

As shown in Plate 2.7-2 the normal last and first freezes (temperature occurrences of 0°C or below) occur on May 12 and October 13, respectively. The average continuous period without freezes is 153 days. However, freezing conditions have been recorded in every month except July and August.

2.7.2.3 Precipitation

Plate 2.7-3 indicates the monthly means and extremes of precipitation recorded at Blanding, Utah from 1951 through 1974. Annual precipitation at Blanding averages 29.7 centimeters (11.69 in). August and October are typically the wettest months, averaging 4.2 and 4.1 centimeters (1.64 and 1.63 in), respectively; together these two months average almost 30 percent of the total annual precipitaton. June is

MONTHLY MEANS AND EXTREMES OF TEMPERATURES
BLANDING, UTAH

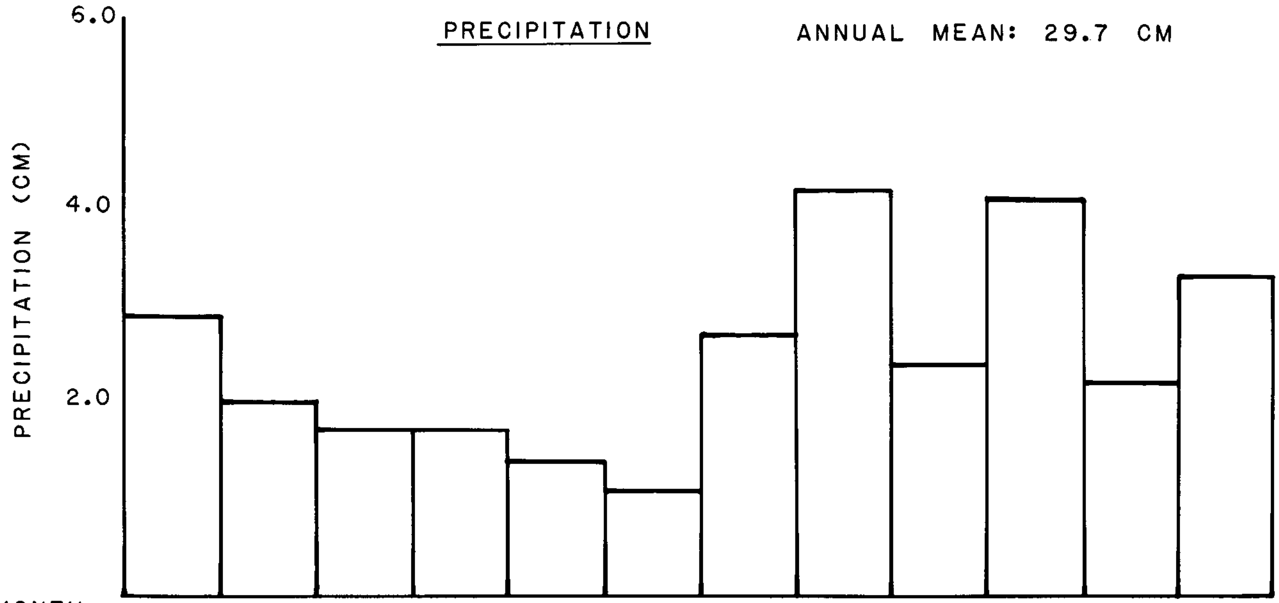


MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
EXTREME MAX.	16	18	24	27	33	38	38	37	34	29	21	15
MEAN MAX.	3.8	6.9	10.9	16.3	22.8	28.7	31.9	30.2	26.0	18.8	10.2	4.5
MEAN	-2.5	0.5	3.4	8.4	14.1	19.4	23.1	21.6	17.2	10.9	3.6	-1.7
MEAN MIN.	-8.8	-5.9	-3.2	0.4	5.4	10.1	14.2	13.1	8.4	2.9	-3.2	-7.8
EXTREME MIN.	-29	-22	-15	-11	-6	-1	8	3	-5	-12	-19	-22

(A) MEAN DAILY MAXIMUM
(B) MEAN MONTHLY
(C) MEAN DAILY MINIMUM
(D) FREEZE DATES

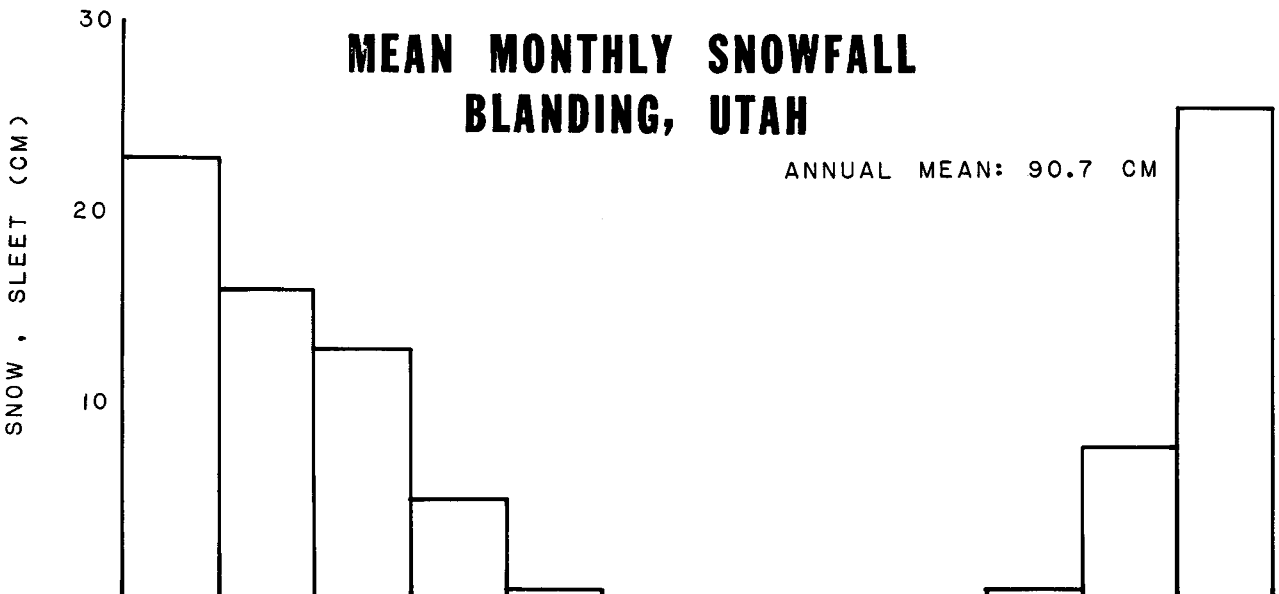
DAMES & MOORE

MEAN MONTHLY PRECIPITATION
BLANDING, UTAH



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
MONTHLY MEAN	2.9	2.0	1.7	1.7	1.4	1.1	2.7	4.2	2.4	4.1	2.2	3.3
MONTHLY MAXIMUM	10.3	4.4	5.0	5.4	5.1	5.5	7.8	12.6	9.6	16.8	5.2	9.3

MEAN MONTHLY SNOWFALL
BLANDING, UTAH



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
MONTHLY MEAN	22.9	16.0	13.0	5.1	0.3	0.0	0.0	0.0	0.0	0.3	7.9	25.4
MONTHLY MAXIMUM	93.5	55.9	45.5	38.6	4.1	-	-	-	-	3.3	27.9	73.7

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generally the driest month, receiving about 1.1 centimeters (0.42 in). Seasonally, spring is the driest and fall is normally the wettest. Daily precipitation amounts in excess of 0.25 centimeters (0.1 in) typically occur 31 days per year, and the greatest daily precipitation recorded in the 25-year record was 11.4 centimeters (4.48 in). The greatest monthly precipitaton recorded in the data period was 16.8 centimeters (6.62 in) and occurred in October 1972.

A good deal of the summer precipitation in the Blanding area is associated with thunderstorm activity. Approximatley 20 to 30 thunderstorm days occur each year in this area and brief but intense rainfall associated with these storms may occasionally result in local flooding.

While most of the precipitation in the Blanding vicinity falls as rain, snowfall accounts for approximatley 30 percent of the total annual precipitation. The annual average snowfall at Blanding is 90.7 centimeters (35.7 in), and some snowfall is normally recorded in every month from October through May. Monthly snowfall data are summarized in Plate 2.7-2 and show that the monthly maximum recorded snowfall was 39.5 centimeters (36.9 in). The greatest snowfall recorded from a single storm was 50.8 centimeters (20.0 in).

2.7.2.4 Relative Humidity

Relative humidity is dependent upon both moisture content and the temperature of the air. Generally relative humidity is the highest in the early morning hours and lowest in the afternoon.

While relative humidity data are not routinely collected at Blanding, the U.S. Department of Commerce (1965) presents general estimates for this area. Table 2.7-1 indicates the monthly and annual mean relative humidity in the Blanding vicinity. The mean annual relative humidity is 44 percent and on a monthly basis is highest in January and lowest in July, averaging 62 and 35 percent, respectively.

TABLE 2.7-1

MEAN MONTHLY RELATIVE HUMIDITY
BLANDING, UTAH

Month	Relative Humidityy (Percent)
Jan	62
Feb	58
Mar	47
Apr	38
May	38
Jun	36
Jul	35
Aug	40
Sep	41
Oct	42
Nov	46
Dec	58
Annual	44

Source: U.S. Department of Commerce, 1968

2.7.2.5 Fog

Based upon five years of Blanding meteorological data, 1970 through 1974, visibility reductions to 1.6 kilometers (1 mile) or less caused by fog or meteorological conditions concomitant with fog occur on the average of 8 days per year. Visibility reductions to less than 0.4 kilometers (0.25 mile) occur less than 5 days per year. The monthly distribution of fogging days is indicated in Table 2.7-2. Typically in this area heavy fog is more prevelent in the winter months with January having the most fogging occurrences. In the five-year data period, fog reducing visibility to 1.6 kilometers (1 mile) or less occurred exclusively in the five months of November through March.

2.7.2.6 Evaporation

The closest point to the Blanding project site where evaporation data have been collected is Green River, Utah approximately 160 kilometers to the north-northwest. Data from there indicate an average evaporation of 118.8 centimeters (46.8 in) from May through October. The greatest monthly evaporation occurs in July, averaging 25.8 centimeters (10.15 in).

Evaporation data are not collected from November through April due to freezing conditions; however, the U.S. Department of Commerce (1965) estimates that 76 percent of the total annual evaporation in this area occurs from May through October. Therefore on an annual basis evaporation is expected to average 156.3 centimeters (61.5 in).

2.7.2.7 Sunshine Duration and Cloud Cover

Sunshine duration is defined as the number of hours of sunshine reaching the surface that is intense enough to cause distinct shadows. Sunshine data are not collected at Blanding. However, the U.S. Department of Commerce (1968) has determined sunshine duration and cloud cover throughout the contiguous United States and the monthly and annual data from that source for the general Blanding vicinity are presented in Table 2.7-3.

TABLE 2.7-2

MEAN FOG OCCURRENCE DAYS AT BLANDING, UTAH
1970-1974

Month	Visibility <1.6 kilometers	Visibility <0.4 kilometers
Jan	3	2
Feb	1	<1
Mar	1	<1
Apr	0	0
May	0	0
Jun	0	0
Jul	0	0
Aug	0	0
Sep	0	0
Oct	0	0
Nov	1	1
Dec	2	1
Annual	8	4.6

TABLE 2.7-3

MONTHLY AND ANNUAL SUNSHINE DURATION AND SKY COVER AT BLANDING, UTAH

Month	Mean Percentage of Possible Sunshine	Mean Sky Cover (Percent)
Jan	61	59
Feb	70	52
Mar	69	51
Apr	70	51
May	71	51
Jun	81	34
Jul	72	48
Aug	73	46
Sep	81	29
Oct	72	40
Nov	64	40
Dec	60	49
Annual	70	46

Source: U.S. Department of Commerce, 1968

On the average the Blanding area receives 70 percent of the total possible sunshine annually. On a monthly basis, September receives the greatest amount and December the least. The mean annual daylight sky cover (clouds) for this area is 46 percent. January is usually the cloudiest month and September the clearest.

2.7.2.8 Winds

A wind rose of the annual percent frequency distribution of winds recorded at the Blanding NWS station from 1970 through 1974 is shown in Plate 2.7-4. Seasonal wind roses are presented in Plate 2.7-5. Tabulations of monthly and annual distributions of wind direction and mean wind speeds used in the compilation of Plates 2.7-4 and 2.7-5 are presented in Appendix C.

From the five-year Blanding wind record, northerly winds are the most frequent in all months and winds from the northwest, north-northwest and north collectively occur over 35 percent of the time annually. East and east-southeast winds are the least frequent and annually occur only 2.7 and 2.8 percent of the time, respectively. Calm conditions are not common, occurring 12.6 percent of the time in the winter, 4.0 percent in the spring and 7.6 percent annually.

From Appendix C (Tables C-1 through C-13) the mean annual wind speed is 3.0 meters per second (6.7 mph), but higher average wind speeds occur in the spring and early summer. On a monthly basis, April usually has the highest average wind speeds and January the lowest, averaging 3.9 and 2.2 meters per second (8.7 and 4.9 mph) for the respective months. Generally, the highest average wind speeds occur with south-southwest through west-southwest winds and the slowest with north and east winds.

Wind speeds in excess of 10 meters per second (22.4 mph) are not common and occur on an average of only 0.8 percent of the time annually (Table 2.7-4). High winds are most common in spring, especially in March and April when wind speeds in excess of 10 meters per second occur 2.0 percent and 1.9 percent of the time, respectively.

ANNUAL PERCENT FREQUENCY DISTRIBUTION
OF WIND BY DIRECTION
BLANDING, UTAH 1970-1974

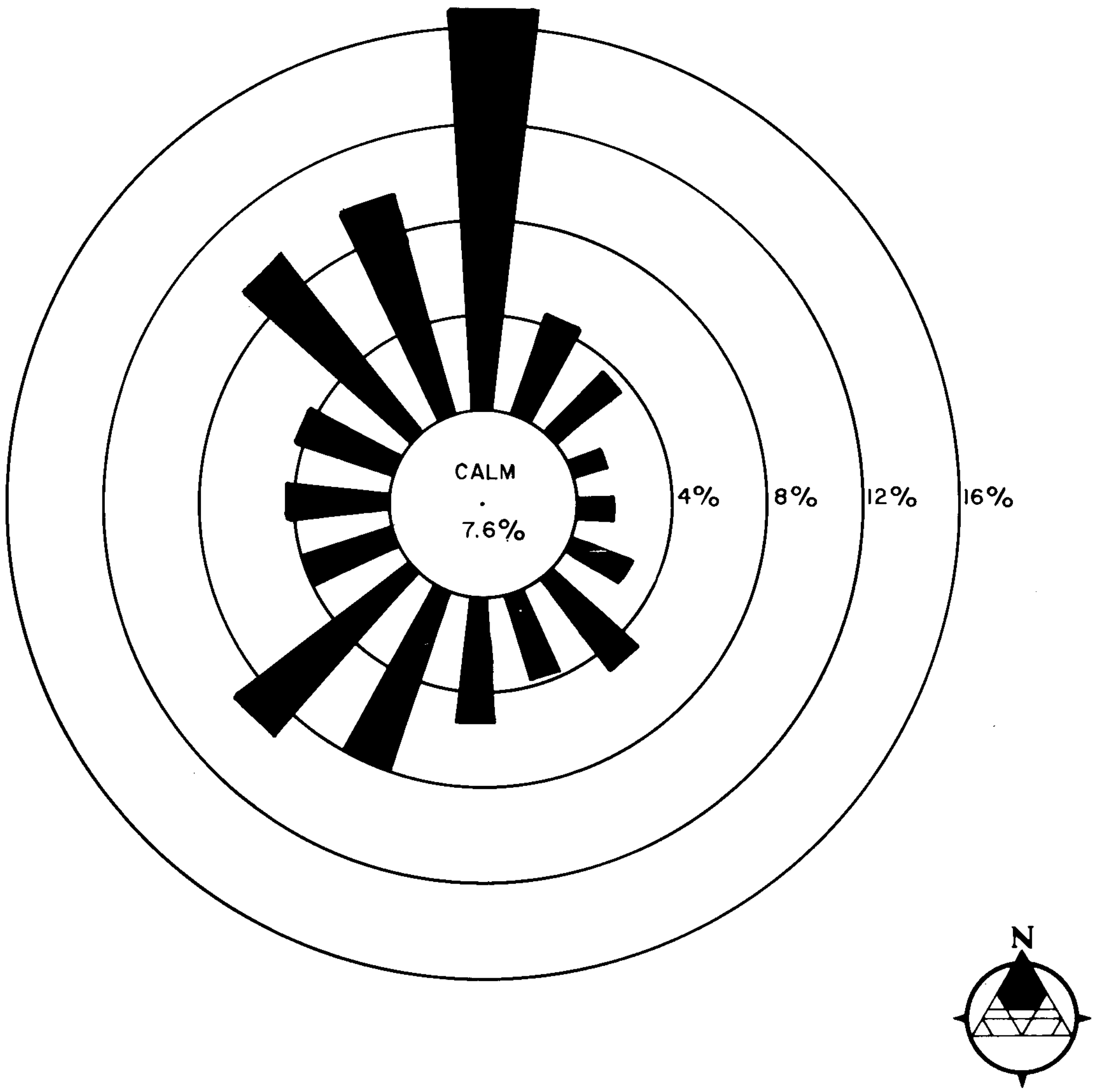

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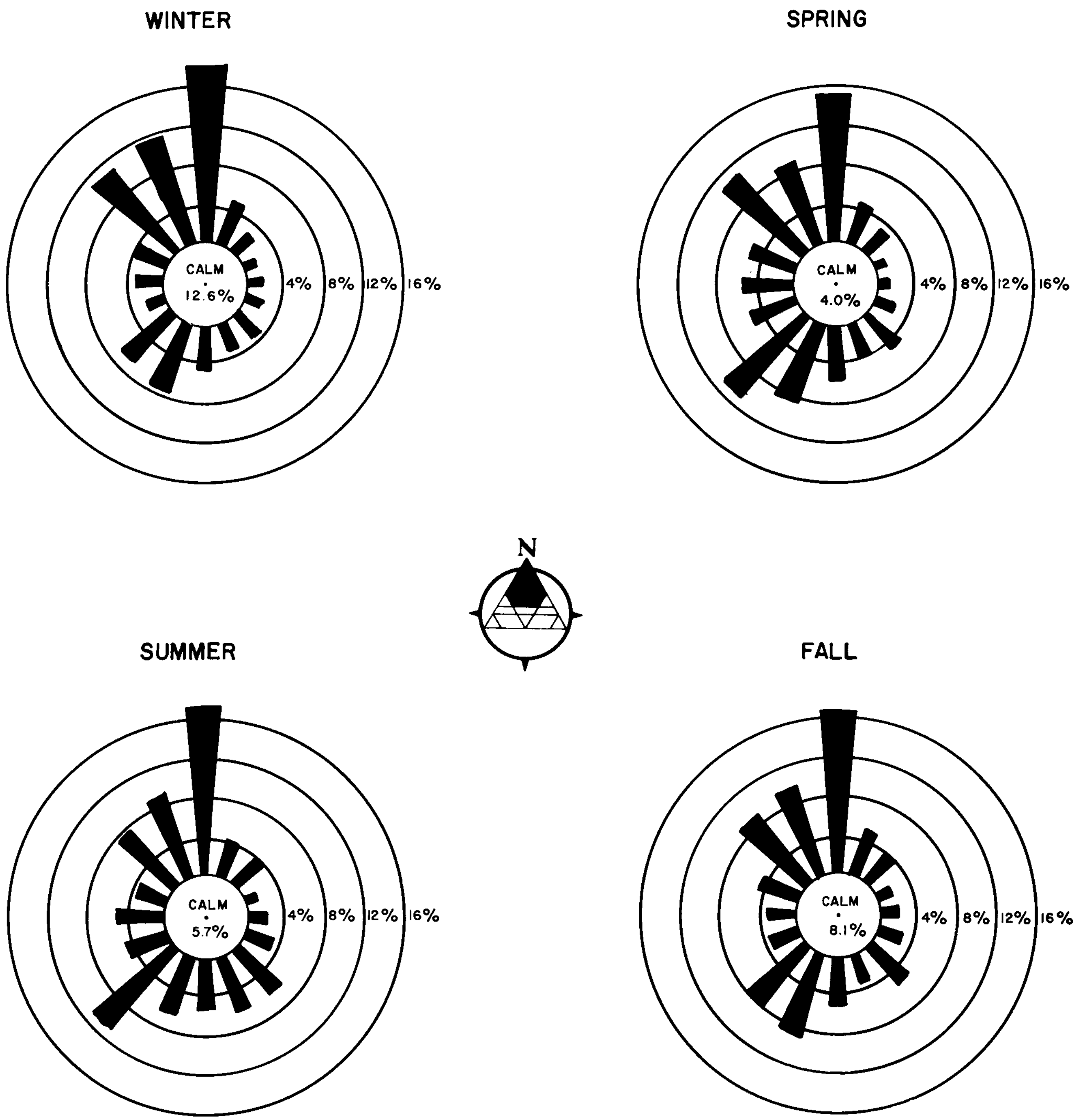
PLATE 2.7-4



SEASONAL PERCENT FREQUENCY DISTRIBUTION OF WIND BY DIRECTION BLANDING, UTAH 1970-1974

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TABLE 2.7-4

MONTHLY PERCENT FREQUENCY OCCURRENCE OF WIND SPEEDS
IN EXCESS OF 10 MPS BY DIRECTION

BLANDING, UTAH

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	All
N	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
NNE	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
NE	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
ENE	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
SSE	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SSW	0.1	0.0	0.1	0.5	0.7	0.3	0.0	0.0	0.1	0.3	0.2	0.0	0.2
SW	0.1	0.0	0.2	0.4	0.7	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.2
WSW	0.0	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WNW	0.1	0.2	0.1	0.2	0.0	0.1	0.0	0.0	0.3	0.0	0.1	0.0	0.1
NW	0.1	0.5	0.4	0.1	0.1	0.2	0.0	0.1	0.0	0.2	0.0	0.2	0.1
NNW	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.0	0.2	0.0	0.0	0.0	0.1
ALL	0.4	0.6	1.6	2.0	1.9	1.1	0.2	0.2	0.7	0.7	0.6	0.2	0.8

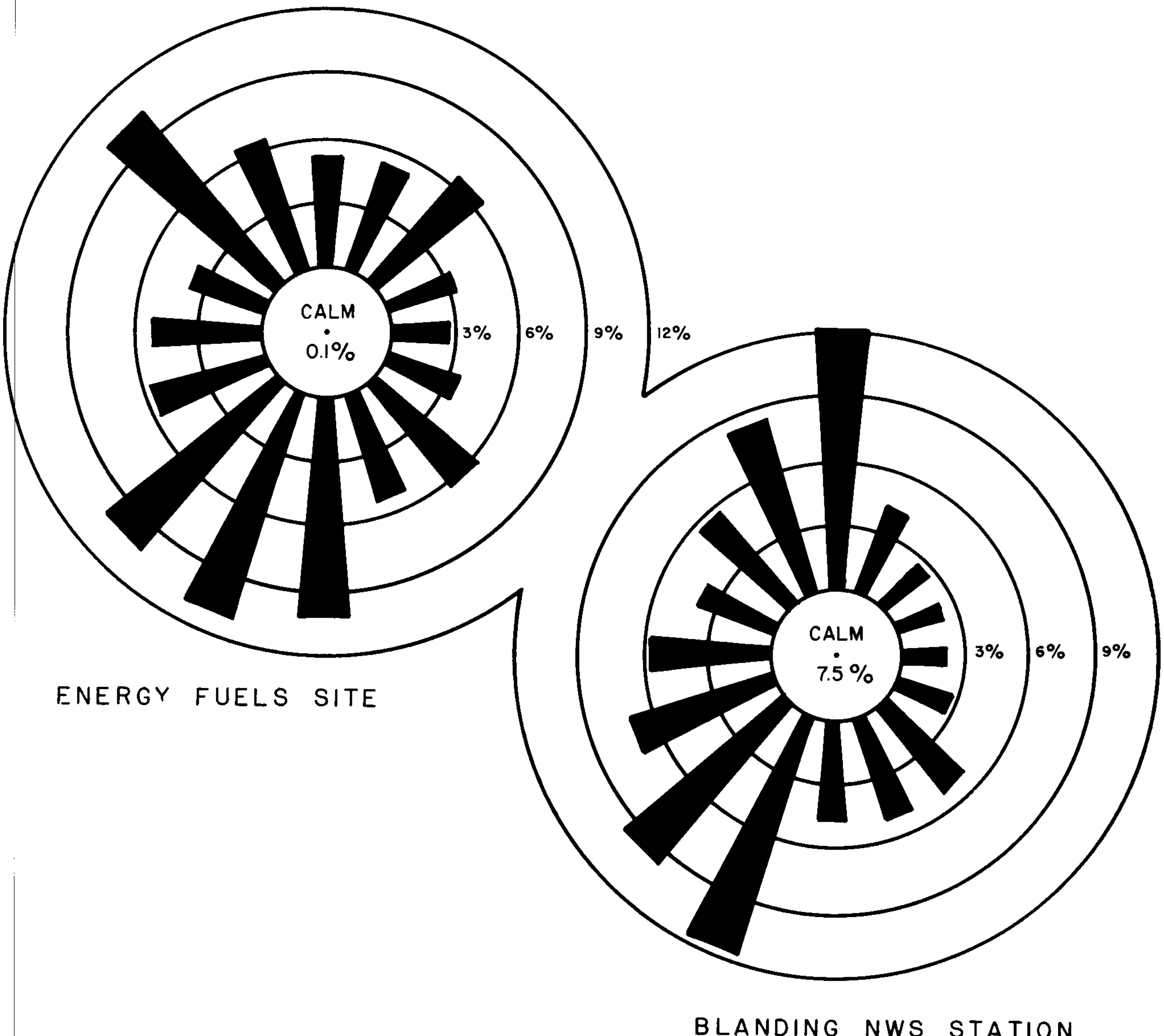
On-site wind data have been collected since March 1, 1977. Wind roses from the on-site program and the Blanding NWS station for the period March through August 1977 are presented for comparison in Plate 2.7-6. The tabulated percent frequencies of wind direction and mean wind speeds at each station are presented in Table 2.7-5.

The on-site data indicate that the first and second most frequent wind directions for the six-month period were south-southwest and northwest, occurring 10.8 and 10.3 percent of the time, respectively. For the same period the Blanding NWS data show that northerly winds prevailed and occurred 12.1 percent of the time; south-southwest winds were the second most frequent and accounted for 11.5 percent of the winds.

While north winds at the proposed site occurred only 5.0 percent of the time compared to 12.1 percent at the NWS station, the total occurrence of northwest, north-northwest and north winds at the site compared favorably to the NWS data, occurring 21.7 and 26.1 percent, respectively. Likewise 25.8 percent of the total recorded winds at the NWS station blew from the three sectors, south, south-southwest and southwest, compared to 31.0 percent at the site for the same three sectors. Wind frequencies from each of the other 10 sectors show agreement within 1.5 percent for each sector except the northeast where winds at the site occurred 6.6 percent of the time compared to only 2.6 percent at the NWS station.

The apparent differences in individual wind direction frequencies can be explained at least in part by the differences in data acquisition techniques at the two sites. The on-site winds were reduced as an average direction over the entire hour while the NWS station winds are reduced as no more than a 10-consecutive-minute average during the hour. Also as shown in Plate 2.7-1, the Blanding NWS station's elevation is slightly over 6000 feet MSL and the higher terrain to the northwest would tend to funnel winds from this direction into a more northerly direction.

PERCENT FREQUENCY OCCURRENCE OF WIND BY DIRECTION MARCH THROUGH AUGUST, 1977



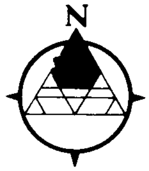


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TABLE 2.7-5

PERCENT FREQUENCY DISTRIBUTION OF WIND SPEED (CLASSES)[a]
BY WIND DIRECTION AT THE ON-SITE STATION AND THE BLANDING NWS STATION
March-August 1977

	On-Site						Blanding NWS					
	0-3	>3≤6	>6≤10	>10	Total[b]	MWS[c]	0-3	>3≤6	>6≤10	>10	Total	MWS[c]
N	1.7	2.5	0.7	0.1	5.0	4.2	6.9	4.7	0.3	0.1	12.1	2.9
NNE	1.3	3.5	0.6	0	5.4	4.1	2.4	1.7	0.2	0	4.3	3.1
NE	1.9	4.2	0.5	0	6.6	3.8	1.1	1.1	0.3	0.1	2.6	4.1
ENE	1.8	1.2	0.2	0	3.3	3.2	1.3	0.9	0.1	0.1	2.3	3.2
E	1.5	0.9	0.3	0	2.7	3.3	1.5	0.5	0.1	0	2.1	2.8
ESE	1.4	1.3	0.6	0.2	3.5	4.3	2.3	0.4	0.1	0	2.8	2.4
SE	1.8	3.4	0.9	0.1	6.1	4.2	3.0	1.8	0	0.3	5.1	3.1
SSE	1.4	3.1	0.5	0	5.1	4.0	2.0	2.6	0.3	0.1	5.0	3.4
S	1.8	6.1	2.0	0.3	10.2	4.7	2.0	2.0	0.6	0	4.6	3.5
SSW	1.2	5.0	3.4	1.1	10.8	6.1	2.8	5.4	3.0	0.3	11.5	4.7
SW	1.6	4.8	3.0	0.6	10.0	5.4	2.3	5.3	2.1	0.1	9.7	4.5
WSW	0.7	1.8	2.6	0.6	5.7	6.6	1.6	4.1	1.4	0	7.0	4.4
W	1.2	1.9	1.7	0.3	5.1	5.4	2.8	2.2	0.8	0	5.7	3.4
WNW	0.7	1.9	0.9	0.2	3.7	4.9	2.4	0.8	0.6	0	3.8	3.3
NW	1.9	5.1	2.4	0.9	10.3	5.8	2.7	2.6	0.4	0	5.6	3.4
NNW	1.7	3.4	1.0	0.2	6.4	4.5	4.9	2.5	0.9	0	8.4	3.1
Calm	0.1				0.1		7.5				7.5	
All	23.80	50.2	21.2	4.8	100.0	4.9	49.4	38.30	11.2	1.1	100.0	3.3

[a]Wind speed classes in meters per second

[b]Due to rounding summation of rows and columns may differ from total

[c]MWS = mean wind speed in meters per second

The fact that 0.1 percent calms were recorded at the site while 7.5 percent of all observations at the Blanding NWS station were recorded as calm is attributable to the different methods of data acquisition mentioned above and instrument sensitivity. The wind instrument at the site has a starting threshold speed of approximately 0.25 meters per second while the NWS station instrument has a starting threshold of approximately 1.3 meters per second. The 7.5 percent calm conditions recorded at the Blanding NWS station are not distributed by wind direction within the frequency distribution and thus could also affect the relative wind frequencies somewhat.

The March through August 1977 Blanding NWS wind rose (Plate 2.7-6) compares very favorably with climatological means. The mean wind speed of 3.3 meters per second is only slightly higher than the annual mean wind speed of 3.0 meters per second (see Appendix C, Table C-13). The 7.5 percent calm conditions observed in the six-month data set also compare very favorably with the climatic mean of 7.6 percent.

2.7.2.9 Severe Weather

Tornadoes

Tornado occurrences in the Blanding area are rare. From 1916 through 1958, only 8 tornadoes were reported in all of Utah and none was reported in the Blanding area. Thom (1963) states that the probability of a tornado occurring at any point in the project vicinity is virtually zero.

Strong Winds

Thom (1968) has computed the recurrence interval of extreme winds (as measured 30 feet above the surface). These are listed below (Table 2.7-6) for the project area.

TABLE 2.7-6

MAXIMUM WIND SPEED AND RECURRENCE INTERVAL IN THE BLANDING VICINITY

Recurrence Interval	Maximum Wind Speed
2 years	25 mps
10 years	29 mps
25 years	32 mps
50 years	35 mps
100 years	37 mps

On the average, 25-meter per second (56 mph) wind speeds should occur every two years at the site, while 35-meter per second (78 mph) winds should occur once every 50 years.

Maximum Precipitation

Hershfield (1961) and Miller (1964) have estimated maximum precipitation amounts for selected durations and recurrence intervals throughout the contiguous United States. These estimates are presented in Table 2.7-7 for the site area. These data suggest that a maximum one hour rainfall of 1.65 centimeters (0.65 in) should occur on the average of every two years at the site, and maximum daily and weekly precipitation of 9.8 and 12.90 centimeters (3.7 and 5.1 in) should occur once every 100 years.

The maximum single 24-hour precipitation amount recorded at Blanding in the 69-year data period (1906 through 1974) was 11.4 centimeters (4.5 in) and occurred on August 1, 1968. This precipitation amount exceeds the 100-year estimate presented in Table 2.7-7.

2.7.2.10 Diffusion Climatology

Mixing Heights

From a climatological standpoint, a general estimate of the atmospheric diffusion trend of an area can be made from examination of the mixing height and the mixing layer wind speeds of the area. The mixing height is defined as the height or layer above the surface through which

TABLE 2.7-7

ESTIMATED MAXIMUM POINT PRECIPITATION AMOUNTS (cm) IN THE BLANDING AREA FOR SELECTED DURATIONS AND RECURRENCE INTERVALS

Duration	Recurrence Intervals (Years)					
	2	5	10	25	50	100
30 minutes	--	--	--	--	--	--
1 hour	1.65	2.41	3.05	3.58	4.22	4.50
2 hours	1.98	2.69	3.51	4.14	4.75	5.38
3 hours	2.11	3.02	3.99	4.67	5.26	5.74
6 hours	2.74	3.81	4.37	5.18	5.66	6.53
12 hours	3.23	4.27	5.44	6.32	7.34	7.98
24 hours	3.81	5.03	6.25	7.29	7.72	9.80
2 days	4.78	5.92	6.50	7.75	8.03	10.39
4 days	5.18	6.32	8.03	9.17	10.57	12.09
7 days	6.05	7.04	8.46	10.52	12.01	12.90

relatively vigorous vertical mixing of effluents can take place. The average wind speed through this layer is called the mixing layer wind speed. Generally, the higher the mixing height and mixing layer wind speed the better the diffusion capabilities of the area, and conversely the lower the mixing height and mixing layer wind speed the poorer the atmospheric diffusion.

Seasonal and annual mean mixing heights and mixing layer wind speeds for the morning and afternoon hours for the general project site vicinity are presented in Table 2.7-8. As shown in this table, the morning mixing heights and wind speeds are generally lower than those in the afternoon. The annual mean morning mixing height in this area is 345 meters (1130 ft) compared with the mean afternoon height of 2650 meters (8690 ft). Mean wind speeds are 3.9 and 5.4 meters per second (8.7 and 12.1 mph), respectively, for morning and afternoon. Seasonally, spring demonstrates the best diffusion capabilities and winter demonstrates the worst.

The dispersion of pollutants may be limited during persisting conditions of mixing heights of 1500 meters (4920 ft) or less and mixing layer wind speeds of 4 meters per second (9 mph) or less (Stackpole, 1967; Gross, 1970). Holzworth (1972) tabulated the number of cases of such restrictive conditions for the five-year period, 1960 through 1964. Episodes persisting for at least two days for various combinations of mixing heights and wind speeds are summarized for the site area in Table 2.7-9.

From the table, 46 episodes of a 1500-meter or less mixing height and a 4.0-meter per second or less wind speed were observed in the five-year period and persisted for a total of 215 days. The greatest frequency of episodes occurred in the winter months, indicating that this is the worst season for dispersion of effluents.

Atmospheric Stability

A method for determining and classifying atmospheric stability based upon the parameters of sky cover, wind speed and solar angle

TABLE 2.7-8

SEASONAL AND ANNUAL MIXING HEIGHTS AND MEAN WIND SPEEDS
BLANDING VICINITY

	Morning		Afternoon	
	Mixing Height (meters)	Wind Speed (meters/sec)	Mixing Height (meters)	Wind Speed (meters/sec)
Winter	265	2.9	1160	3.9
Spring	580	5.1	3610	7.0
Summer	280	4.1	4060	6.5
Fall	260	3.4	2200	4.8
Annual	345	3.9	2650	5.6

Source: Holzworth, 1972

TABLE 2.7-9

NUMBER OF RESTRICTED MIXING EPISODES LASTING TWO OR
MORE DAYS IN FIVE YEARS AND TOTAL EPISODE DAYS
(IN PARENTHESES) IN THE BLANDING AREA

Wind Speed	Mixing Heights		
	≤500 m	≤1000 m	≤1500 m
≤2.0 m/sec	4(10)	11(30)	14(30)
≤4.0 m/sec	12(40)	33(150)	46(215)
≤6.0 m/sec	12(42)	41(195)	63(295)

Source: Holzworth, G.C., 1972

was developed by Pasquill and Turner (Pasquill, 1961). This method assumes that unstable conditions occur when the atmosphere near the surface undergoes warming during instances of low wind speeds, and stable conditions occur with atmospheric cooling associated with low wind speeds. Neutral conditions occur with either cloudy skies or high wind speeds. The stability classifications based upon this method are as follows:

Class	Degree of Stability
A	Extremely unstable
B	Unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Stable

Generally during unstable conditions volumes of air can move up or down freely, resulting in rapid vertical mixing through a relatively deep layer of air with little buildup near the surface. Conversely, during stable (inversion) conditions volumes of air do not move freely in a vertical direction but are restricted to a certain level and, as a result, pollutants may remain trapped near the ground. During neutral conditions, volumes of air will experience no upward or downward acceleration but will be free to move due to external impetuses such as winds.

The monthly and annual frequencies of each Pasquill stability class for Blanding, based upon 1970 through 1974 data, are indicated in Table 2.7-10. Annually, unstable conditions (Classes A, B, and C) occur approximately 26.0 percent of the time, stable conditions (Classes E and F) approximately 46.6 percent, and neutral (Class D) approximately 27.3 percent. January normally has the highest occurrence of stable (inversion) conditions, averaging 56.6 percent. However, the winter months (December, January, February) each average over 52 percent occurrence of stable conditions. The summer months, on the average, have the lowest frequency occurrence of stable conditions but the highest occurrence of unstable conditions. The three months of June, July, and August each average more than 36 percent occurrence of unstable conditions. Neutral

TABLE 2.7-10

MONTHLY PERCENT FREQUENCY OF OCCURRENCE FOR STABILITY CLASSES
BLANDING, UTAH

Month	A	B	C	D	E	F
Jan	0.0	4.0	11.1	28.3	13.3	43.3
Feb	0.5	6.6	10.7	29.4	15.6	37.3
Mar	0.2	9.5	12.9	35.8	16.0	25.6
Apr	0.3	7.7	14.6	36.5	15.2	25.8
May	3.0	14.4	16.7	23.8	15.7	26.4
June	5.7	17.2	15.9	18.8	13.9	28.5
July	6.5	16.5	16.3	21.1	13.3	26.3
Aug	4.6	14.8	17.3	21.7	12.0	29.6
Sep	0.2	14.9	13.5	20.0	14.0	37.4
Oct	0.1	12.4	10.6	32.9	11.6	32.5
Nov	0.0	4.4	13.7	29.2	14.2	38.5
Dec	0.0	5.4	9.3	31.0	13.6	40.7
Annual	1.8	10.7	13.6	27.3	14.0	32.6

conditions are infrequent throughout the year, averaging from 18.8 percent occurrence in June to 36.5 percent in April.

Plates 2.7-7 through 2.7-9 present the annual frequency distributions of Pasquill stability classes by wind direction. The monthly and annual frequency distributions of Pasquill stability classes by wind direction and associated mean wind speeds are also tabulated and presented in Appendix C (Tables C-1 through C-13). Throughout the year, unstable conditions occur most frequently with south through south-southwest winds and in every month stable conditions are predominately associated with north winds. Neutral conditions are more evenly distributed between northerly and southerly component winds throughout the year.

The spring months exhibit the best diffusion capacity and winter the worst. The high frequency of stable conditions in the winter months is probably the result of somewhat slower wind speeds during this season. The relatively high percentages of stable and unstable conditions and the relatively low frequency of neutral conditions throughout the year reflect the low winds and high percentage of clear skies that are characteristic of this area.

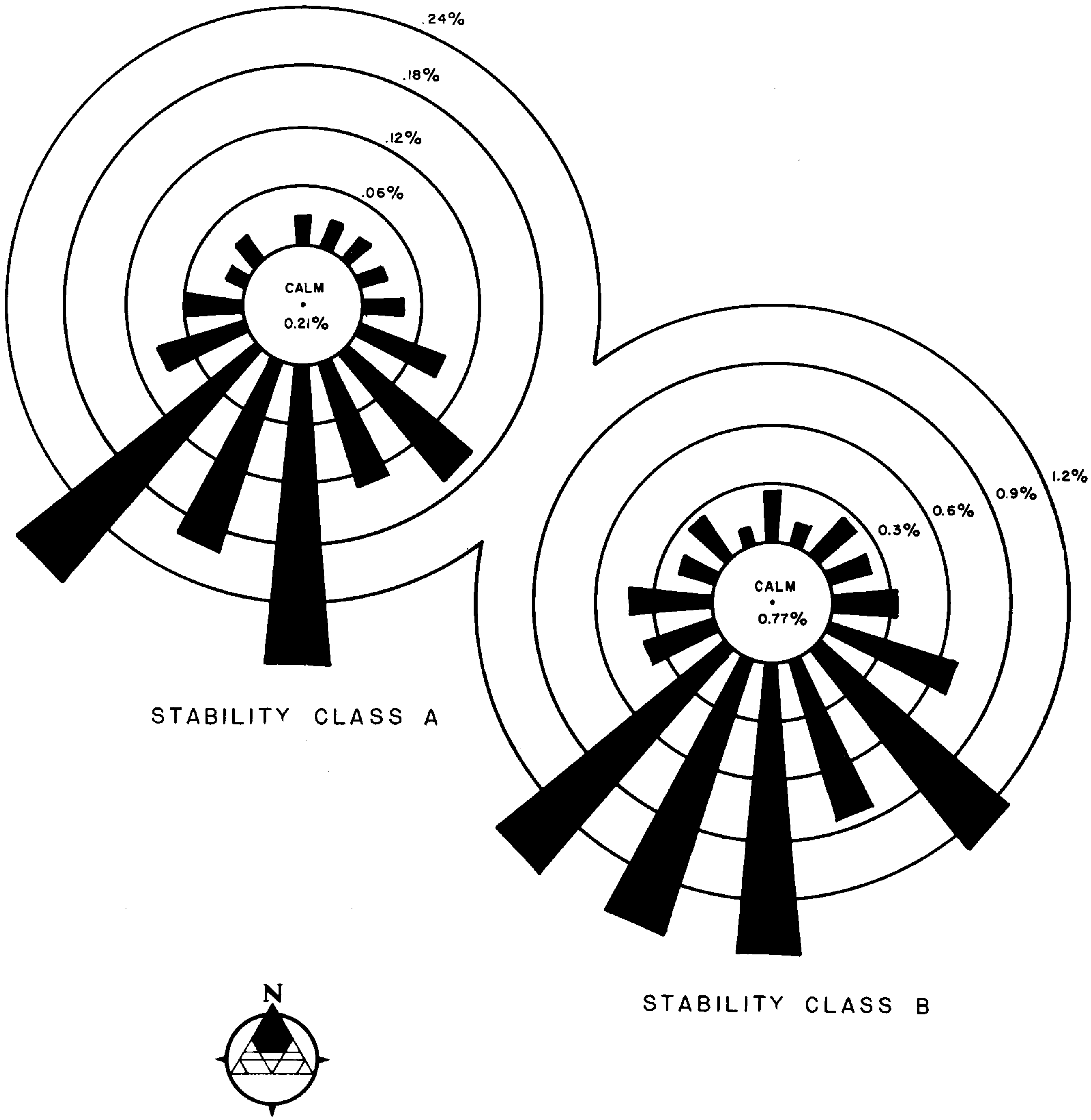
As shown in Appendix C (Table C-13) the annual mean wind speed associated with each stability class are as follows:

Class A	1.9 mps
Class B	2.4 mps
Class C	3.5 mps
Class D	4.2 mps
Class E	3.4 mps
Class F	1.9 mps

2.7.3 Climatology of Hanksville and Buying Station

The climate at Hanksville is similar to that at Blanding but the area is generally drier and the winds are somewhat slower.

ANNUAL PERCENT FREQUENCY DISTRIBUTION OF STABILITY CLASSES A AND B BY WIND DIRECTION BLANDING, UTAH 1970-1974



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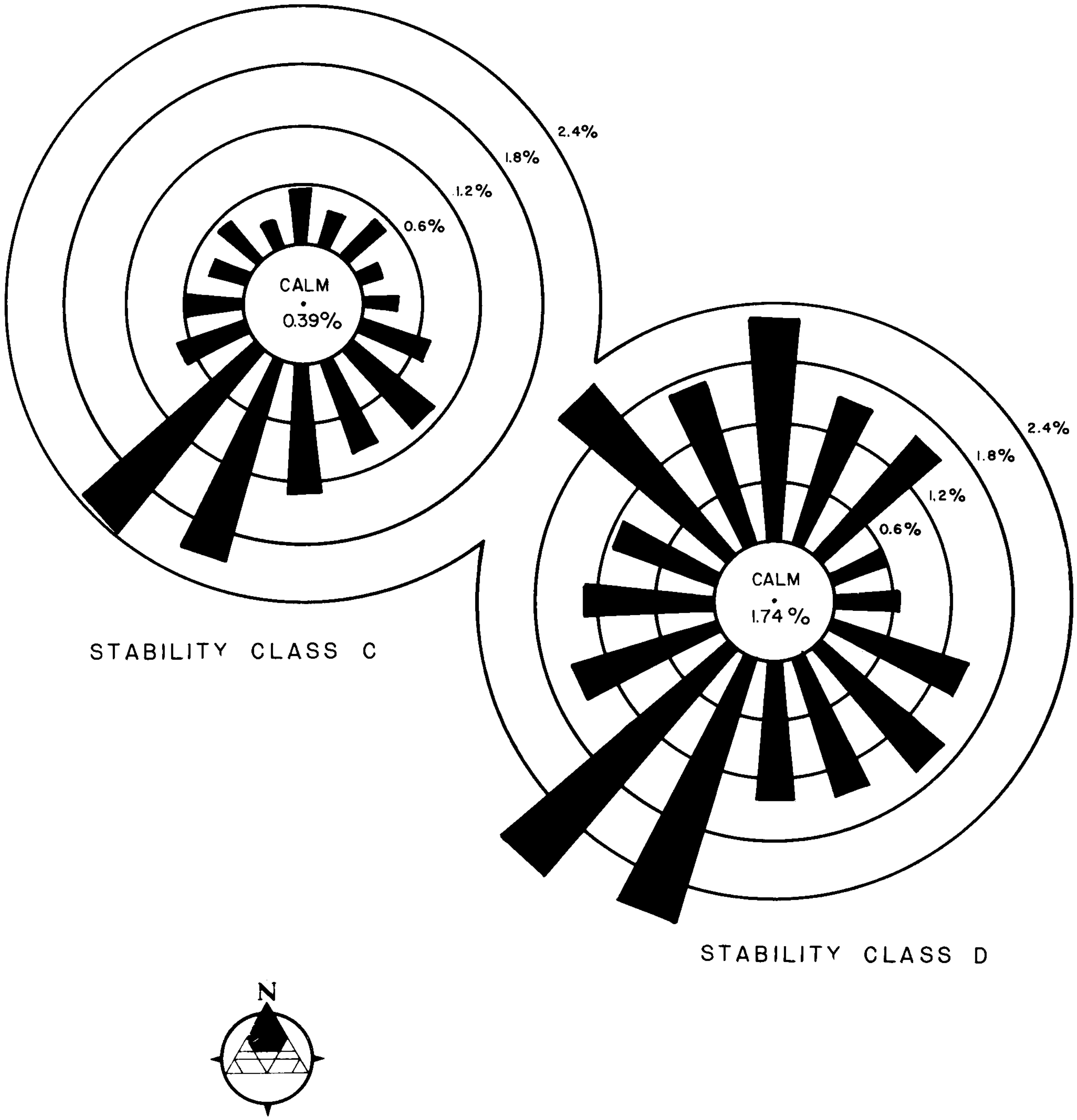
ANNUAL PERCENT FREQUENCY DISTRIBUTION OF STABILITY CLASSES C AND D BY WIND DIRECTION BLANDING, UTAH 1970-1974



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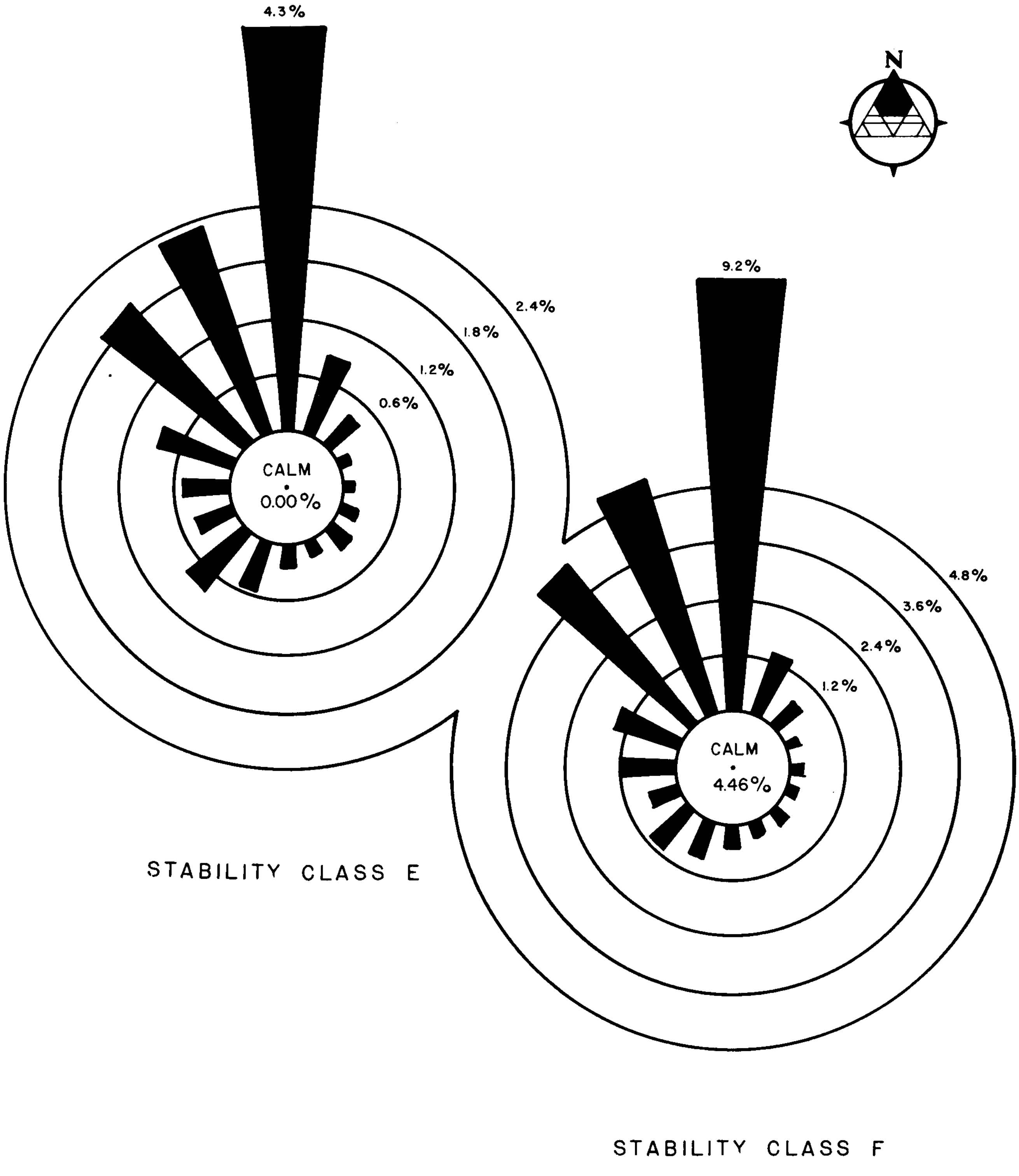

ANNUAL PERCENTAGE FREQUENCY DISTRIBUTION OF STABILITY CLASSES E AND F BY WIND DIRECTION BLANDING, UTAH 1970-1974

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PLATE 2.7-9

2.7.3.1 Data Sources

Long-term meteorological data are available from the National Weather Service station in Hanksville, Utah, located approximately 20 kilometers (12 mi) north of the site area (Plate 2.7-10). These data, to a large degree, have been used to describe the climatology of the site area and should generally be representative of site conditions. To a much lesser degree meteorological data from Green River, located approximately 98 kilometers (61 mi) northeast of the site, have also been used in this report to estimate specific climatic conditions.

An on-site meteorological monitoring program was initiated in early March 1977 (see Section 6.1.3). An insufficient data base has been collected from this program to adequately describe the site-specific climatology for the buying station at Hanksville. Therefore, these data have not been used in this report. However, results of the first six months of data collection from this program are presented in Appendix C. Results from the full year program will be presented in the Supplemental Report.

2.7.3.2 Temperature

Plate 2.7-11 summarizes of means and extremes of temperature recorded at Hanksville, Utah from 1951 through 1974. These data show that the mean monthly temperature varies from between -3.5°C (25.7°F) in January to 26.6°C (79.9°F) in July, and the annual average temperature is 11.7°C (53.1°F). The average daily maximum temperatures range from 4.3°C (39.8°F) in January to 36.3°C (97.3°F) in July, and the average daily minimum temperatures range from -11.3°C (11.6°F) to 16.9°C (62.5°F) in January and July, respectively. The normal diurnal range of temperatures (the difference between the daily maximum and minimum temperature) is 17.6°C (31.7°F) but on the average this range is highest in the summer months and lowest in the winter months. Singular record high and low temperature extremes are 43.3°C (110°F) and -33.3°C (-28°F).

On the average, temperatures can be expected to rise above 32°C (90°F) or above 86 days per year and fall to -18°C (0°F) or below only 9

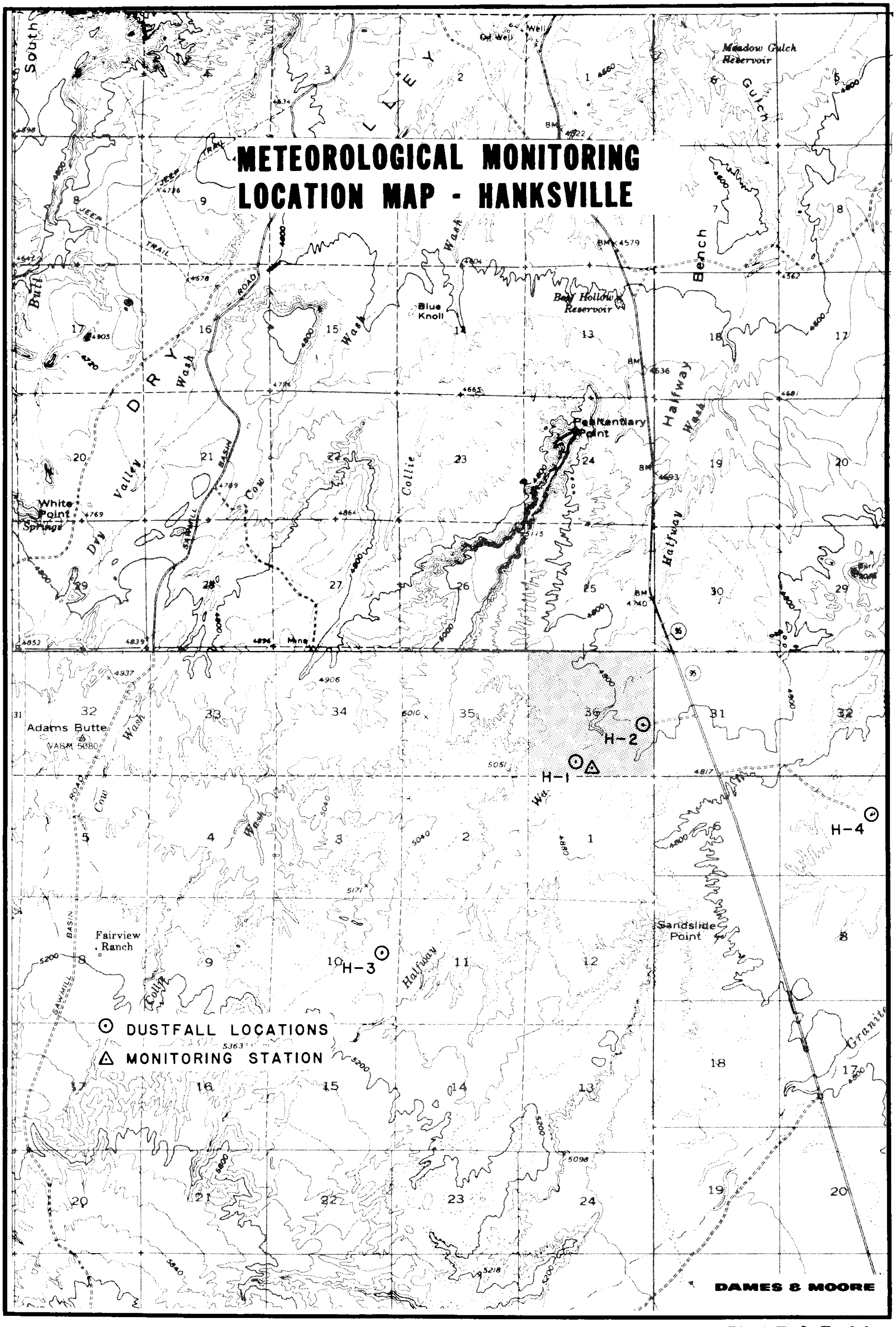
METEOROLOGICAL MONITORING LOCATION MAP - HANKSVILLE
DUSTFALL LOCATIONS
MONITORING STATION
H-1
H-2
H-3
H-4
Meadow Gulch Reservoir
Bench
Halfway Wash
Blue Knoll
Bull Hollow Reservoir
Penitentiary Point
Dry Valley
Dry Wash
Cow Wash
Collie
White Point Springs
SAWMILL BASIN ROAD
JEEP TRAIL
Adams Butte
Fairview Ranch
Sandslide Point
Halfway
Granite
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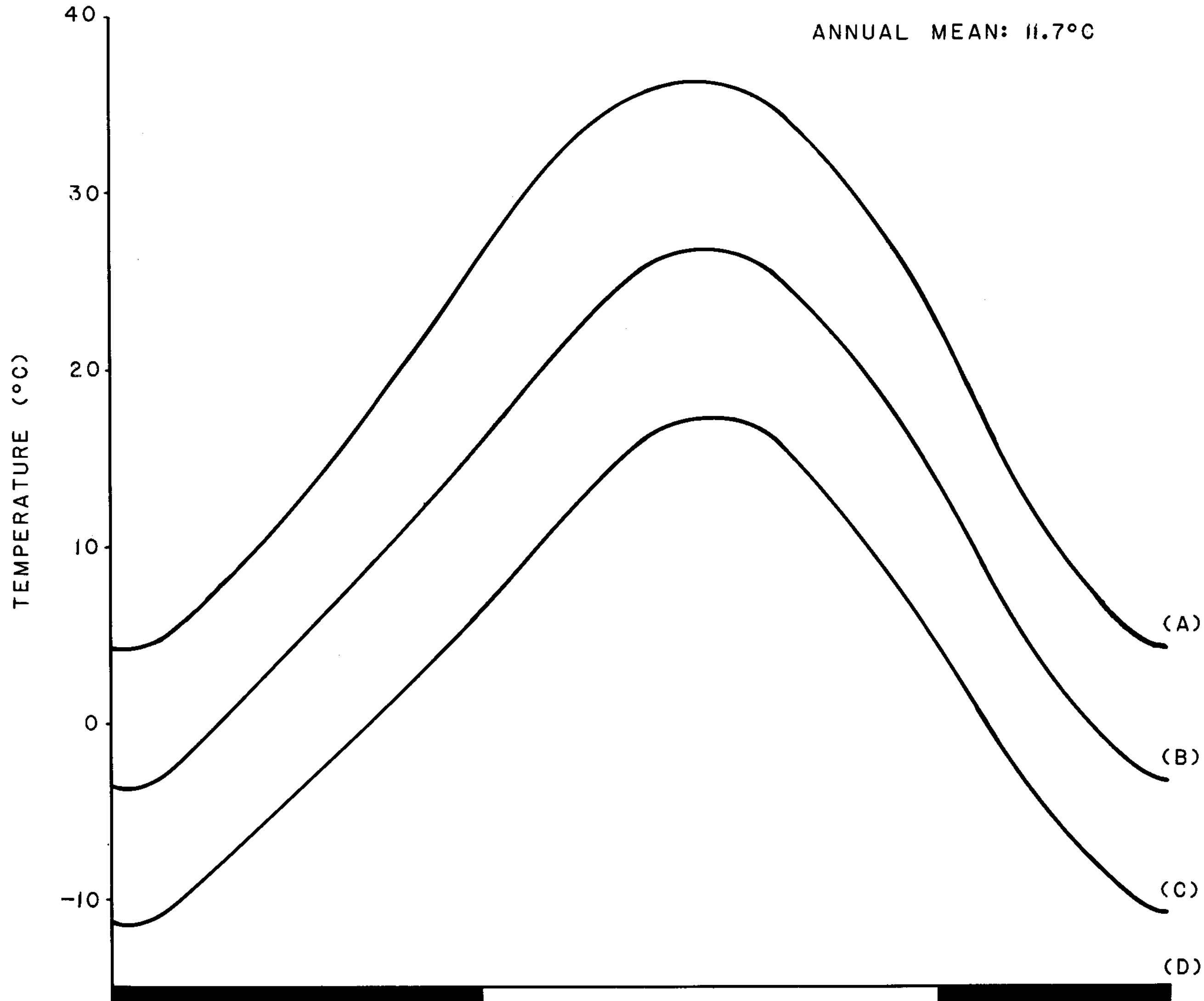
PLATE 2.7-10

MONTHLY MEANS AND EXTREMES OF TEMPERATURES HANKSVILLE, UTAH



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
EXTREME MAX.	18	23	29	32	38	42	43	41	39	33	26	20
MEAN MAX.	4.3	9.0	14.6	20.1	26.8	32.6	36.3	34.3	29.4	21.7	12.0	5.2
MEAN	-3.5	1.1	6.1	11.3	17.4	22.7	26.6	25.1	19.6	12.6	4.1	-2.1
MEAN MIN.	-11.3	-6.9	-2.4	2.4	7.9	12.7	16.9	15.9	9.8	3.3	-4.0	-9.4
EXTREME MIN.	-33	-29	-14	-9	-5	0	3	2	-2	-21	-22	-26

(A) MEAN DAILY MAXIMUM
(B) MEAN MONTHLY
(C) MEAN DAILY MINIMUM
(D) FREEZE DATES

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days per year. Substantial nocturnal cooling is common because of relatively clear skies and freezing temperatures (0°C) or less occur on an average of 154 days per year.

Normally, the last and first freezes (temperature occurrence of 0°C or below) occur on May 5 and October 13, respectively (Plate 2.7-10). The average freeze-free period is 160 days. However, freezing conditions have been recorded in every month except July and August.

2.7.3.3 Precipitation

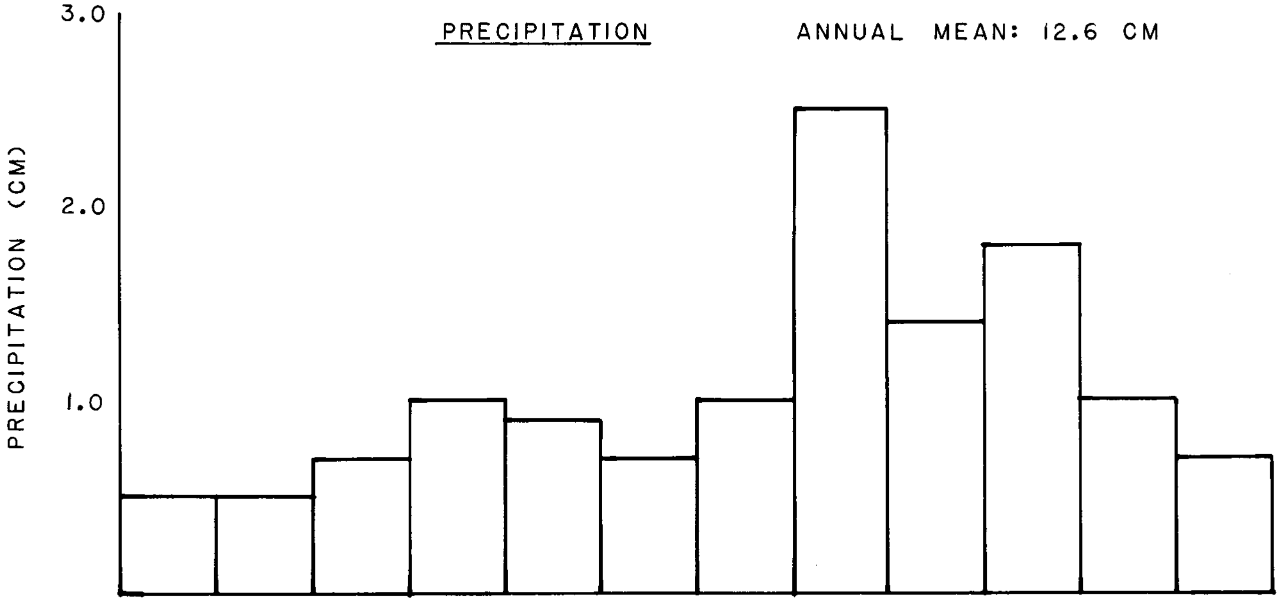
Mean monthly precipitation for Hanksville, based upon 24 years (1951-1974) of record, is indicated in Plate 2.7-12. The annual average precipitation at Hanksville is only 12.6 cm (4.96 in) with approximately 45 percent of the total occurring in the three months of August, September and October. August, which averages 2.5 cm (0.97 in) of precipitation, is normally the wettest month and it is the only month that averages more than 2.0 centimeters of precipitation. January and February are typically the driest months, receiving only 0.5 centimeters (0.2 in) of rainfall each. Daily precipitation amounts in excess of 0.25 centimeters (0.1 in) occur on the average of 14 days per year, and the greatest daily total precipitation amount recorded in the 24-year record was 4.6 centimeters (1.8 in). The greatest monthly precipitation amount recorded in the data period was 9.1 centimeters (3.58 in) and occurred in October 1972.

While most of the precipitation in the vicinity falls as rain, the annual average snowfall at Hanksville is 19.8 centimeters (7.8 in). The maximum monthly recorded snowfall was 43.2 centimeters (17.0 in), and the greatest snowfall from a single storm was 38.1 centimeters (15 in). Snowfall data are summarized in Plate 2.7-12.

2.7.3.4 Relative Humidity

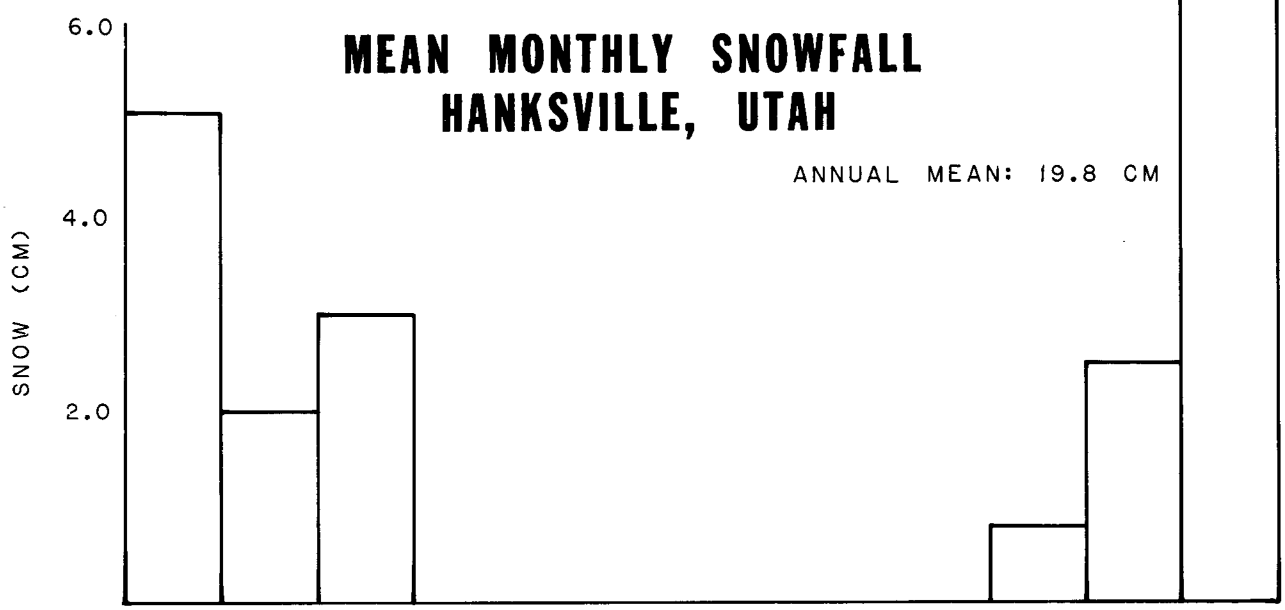
While humidity data are not collected in the Hanksville area, the relative humidity in this area is generally low. Estimates from the U.S. Department of Commerce (1968) indicate that the mean annual relative

MEAN MONTHLY PRECIPITATION
HANKSVILLE, UTAH



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
MONTHLY MEAN	0.5	0.5	0.7	1.0	0.9	0.7	1.0	2.5	1.4	1.8	1.0	0.7
MONTHLY MAXIMUM	1.7	1.3	2.6	6.0	2.5	3.2	3.1	7.5	4.6	9.1	4.2	3.9

MEAN MONTHLY SNOWFALL
HANKSVILLE, UTAH



MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
MONTHLY MEAN	5.1	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.5	6.4
MONTHLY MAXIMUM	44.7	12.7	20.8	0.5	–	–	–	–	–	17.8	17.3	43.2

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humidity in this area is approximately 40 percent and varies from a winter average of approximately 65 percent to a summer average of approximately 30 percent.

2.7.3.5 Evaporation

The closest available evaporation data to the Hanksville area are collected at Green River, Utah approximately 90 kilometers north-northeast. These data show that an average evaporation of 118.8 centimeters (46.8 in) occurs from May through October. The greatest monthly evaporation occurs in July, averaging 25.8 centimeters (10.2 in).

Evaporation data are not collected from November through April due to freezing conditions; however, the U.S. Department of Commerce (1965) estimates that 76 percent of the total annual evaporation in this area occurs from May through October. Therefore on an annual basis evaporation is expected to average 156.3 centimeters (61.5 in).

2.7.3.6 Sunshine Duration and Cloud Cover

Sunshine duration is defined as the number of hours of sunshine reaching the surface that is intense enough to cause distinct shadows. The U.S. Department of Commerce (1968) has determined sunshine duration and cloud cover throughout the contiguous United States. Monthly and annual data for the general Hanksville area are presented in Table 2.7-11.

On the average, Hanksville receives 71 percent of the possible annual sunshine. Sunshine duration is highest in September and the lowest in December. The mean annual daylight (sunrise to sunset) sky cover (clouds) for this area is slightly less than 50 percent. The greatest amount of daylight sky cover occurs in January and December, averaging approximately 60 percent, and the least amount occurs in September, averaging 30 percent.

TABLE 2.7-11

MONTHLY AND ANNUAL SUNSHINE DURATION AND SKY COVER AT HANKSVILLE, UTAH

Month	Mean % of Possible Sunshine	Mean % Sky Cover
Jan	59	61
Feb	71	58
Mar	69	57
Apr	71	58
May	72	51
Jun	81	39
Jul	78	46
Aug	76	48
Sep	82	30
Oct	71	39
Nov	62	47
Dec	54	60
Annual	71	49

Source: U.S. Department of Commerce, 1968.

2.7.3.7 Winds

Plate 2.7-13 presents the annual wind rose at Hanksville based upon 1949 through 1954 surface meteorological data. Table 2.7-12 presents the seasonal and annual frequency distribution of wind direction and wind speed at Hanksville for the same 5-year data period. Calm conditions, which were recorded approximately 19.8 percent of the time, are included in the distributions as a weighted average.

Northwest winds are the most frequently occurring in all seasons except summer and, on an annual basis, winds from the northwest through north occur nearly 27 percent of the time. During the summer winds from the south-southwest are the most dominant, occurring 10.5 percent of the time. Winds from the west-southwest and west are the least frequently occurring during all seasons and, on an annual basis, winds from these directions occur only 2.9 and 3.4 percent, respectively.

During all seasons the lowest average wind speeds occur with easterly winds while the highest average wind speeds are associated with south-southwest winds. With the relatively high occurrence of calm conditions, the mean annual recorded wind speed is only 2.5 meters per second (5.6 mph). The highest average wind speeds occur in the spring and the lowest in the winter averaging 3.2 and 1.9 meters per second (7.2 and 4.3 mph), respectively.

2.7.3.8 Severe Weather

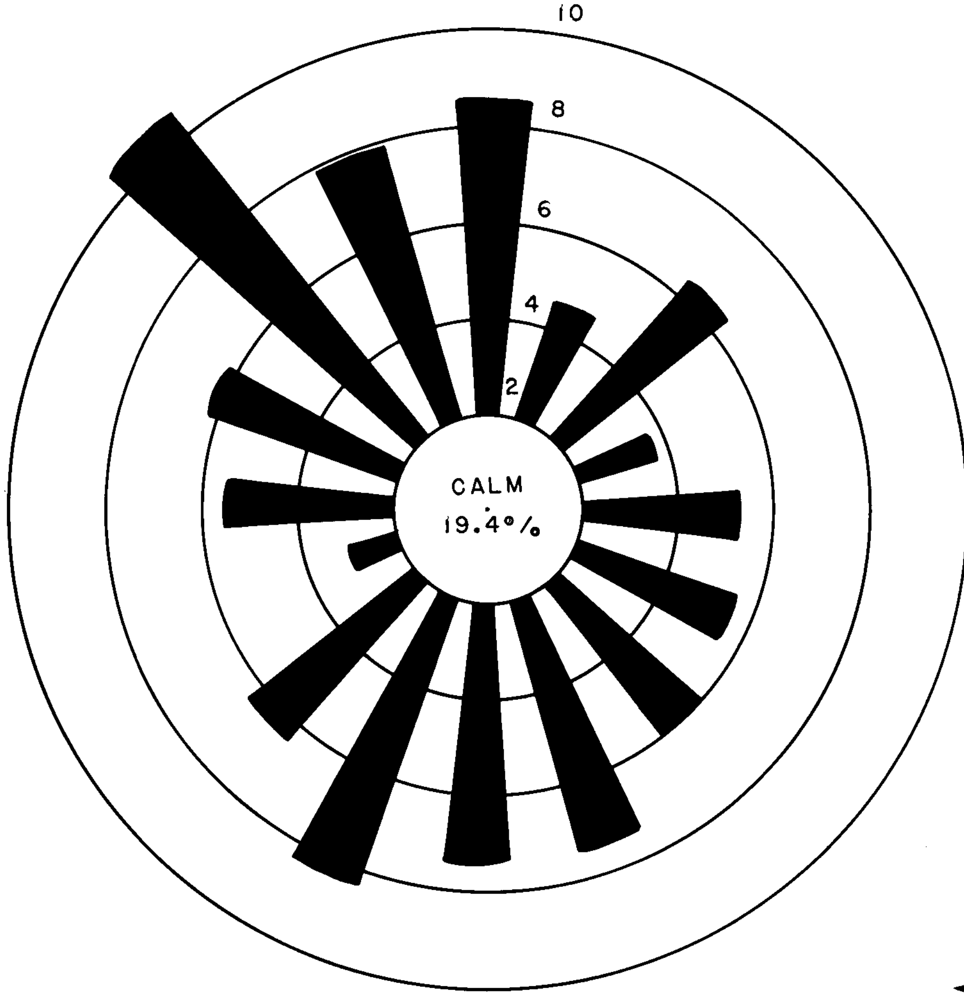
<u>Tornadoes</u>

Tornadoes are extremely rare in the Hanksville area. Thom (1963) states that the probability of a tornado occurring in this area is virtually zero.

<u>Strong Winds</u>

Thom (1968) has computed the recurrence interval of extreme winds (measured 30 feet above the surface); these are listed in Table 2.7-13 for the Hanksville vicinity. On the average, 25-meter per second (56

ANNUAL PERCENT FREQUENCY DISTRIBUTION OF WIND DIRECTION HANKSVILLE, UTAH 1949-1954



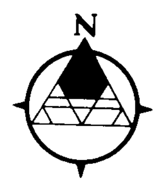


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TABLE 2.7-12

SEASONAL AND ANNUAL PERCENT FREQUENCY OF WIND DIRECTION AND WIND SPEED AT HANKSVILLE, UTAH 1949-1954

Direction	Winter		Spring		Summer		Fall		Annual	
	Occurrence (%)	MWS[a] (mps)	Occurrence (%)	MWS[a] (mps)	Occurrence (%)	MWS[a] (mps)	Occurrence (%)	MWS[a] (mps)	Occurrence (%)	MWS[a] (mps)
N	12.2	2.4	6.4	2.7	6.5	2.3	9.4	2.1	8.5	2.3
NNE	6.5	2.8	3.9	3.1	3.9	2.7	4.4	2.3	4.6	2.7
NE	7.9	2.0	5.3	2.8	5.1	2.4	7.6	2.2	6.4	2.3
ENE	3.5	1.5	3.5	2.4	3.8	2.3	3.8	2.0	3.7	2.1
E	5.5	1.3	4.8	1.9	5.3	1.9	5.8	1.5	5.3	1.6
ESE	4.5	1.7	5.7	2.4	6.3	2.3	5.4	2.1	5.5	2.2
SE	5.6	1.6	5.6	2.5	6.5	2.4	6.5	2.0	6.0	2.2
SSE	6.2	2.5	7.5	3.3	8.8	3.3	6.7	2.7	7.3	3.0
S	5.9	2.2	6.7	3.4	8.7	3.4	7.8	2.7	7.3	3.0
SSW	5.0	5.0	9.9	6.3	10.4	5.3	7.3	5.1	8.2	5.6
SW	4.2	3.4	7.3	5.5	8.0	4.5	6.0	3.6	6.4	4.4
WSW	2.1	2.7	3.3	4.2	3.7	3.8	2.6	2.8	2.9	3.6
W	3.7	2.4	3.6	3.4	3.2	2.9	3.0	2.2	3.4	2.8
WNW	6.4	3.0	7.4	4.7	5.5	3.2	4.9	2.8	6.1	3.6
NW	12.2	2.7	11.2	4.2	7.6	3.0	10.8	2.6	10.5	3.2
NNW	8.7	2.2	7.6	3.6	6.6	2.9	8.2	2.3	7.8	2.8
Average	-	1.9	-	3.2	-	2.8	-	2.0	-	2.5

MWS - Mean Wind Speed in meters per second

Source: National Climatic Center, 1971

mph) wind speeds should occur every two years in the area while 37-meter per second (83 mph) winds should occur only once every 100 years.

TABLE 2.7-13

MAXIMUM WIND SPEEDS AND RECURRENCE INTERVALS AT HANKSVILLE

Recurrence Interval	Maximum Wind Speed (meters per second)
2 years	25
10 years	29
25 years	33
50 years	35
100 years	37

Maximum Precipitation

Table 2.7-14 presents estimated maximum precipitation and recurrence intervals within the general Hanksville vicinity. It is estimated that a one-hour rainfall maximum of 1.66 centimeters should occur every two years, and a 24-hour maximum of 6.35 centimeters should fall every 100 years. From 1951 through 1974, the greatest daily precipitation amount recorded at Hanksville was 4.57 centimeters and occurred on August 1, 1968.

2.7.3.9 Diffusion Climatology

Mixing Heights and Wind Speeds

Holzworth (1972) determined the seasonal and annual mean mixing heights and wind speeds for the morning and afternoon hours throughout the contiguous United States for the five-year period 1960 through 1964. These are presented in Table 2.7-15 for the general Hanksville area.

From Table 2.7-15, the morning mixing heights and wind speeds are lower than the afternoon. The annual mean morning mixing height is 285 meters (935 ft) compared with the afternoon height of 2520 meters (8266 ft); mean wind speeds are 4.3 and 5.4 meters per second (9.6 and

TABLE 2.7-14

ESTIMATED MAXIMUM POINT PRECIPITATION AMOUNTS (cm)
AT HANKSVILLE SITE FOR SELECTED
DURATIONS AND RECURRENCE INTERVALS

HANKSVILLE, UTAH

	Recurrence Intervals (Years)					
Duration	2	5	10	25	50	100
1 Hour	1.55	2.18	2.72	3.25	3.73	4.24
2 Hours	1.68	2.36	2.97	3.53	4.01	4.67
3 Hours	1.83	2.59	3.15	3.86	4.34	4.93
6 Hours	2.08	2.77	3.61	4.24	4.88	5.36
12 Hours	2.31	3.15	4.04	4.88	5.23	6.12
24 Hours	2.49	3.71	4.47	5.00	5.94	6.35
2 Days	2.82	3.86	4.93	5.62	6.25	7.16
4 Days	3.38	4.32	5.13	6.30	6.91	7.82
7 Days	3.81	4.42	5.66	6.93	7.29	8.15

Sources: Hershfield, 1961; Miller, 1964

TABLE 2.7-15

SEASONAL AND ANNUAL MIXING HEIGHTS AND MEAN WIND SPEEDS
HANKSVILLE VICINITY

	Morning		Afternoon	
	Mixing Height (meters)	Wind Sped (Meters/sec)	Mixing Height (meters)	Wind Speed (meters/sec)
Winter	250	3.5	1070	4.1
Spring	395	5.3	2940	6.6
Summer	245	4.2	3970	6.1
Fall	230	4.3	2090	4.9
Annual	285	4.3	2520	5.4

Source: Holzworth, 1972

12.1 mph), respectively. Seasonally, winter and fall demonstrate the worst diffusion capabilities and spring the best.

According to the National Air Pollution Potential Forecasting Program (Stackpole, 1967; Gross, 1970) the dispersion of pollutants could be limited with persisting mixing heights of 1500 meters or less and mixing layer wind speeds of 4 meters per second or less. Holzworth (1972) tabulated the number of cases of such restrictive conditions for the five-year period, 1960 through 1964. Episodes persisting for a least two days for various combinations of mixing heights and wind speeds are summarized for the general Hanksville vicinity in Table 2.7-16 (page 2-213).

Fifty-two episodes of a 1,500-meter or less mixing height and a four-meter per second or less wind speed were observed in the five-year period and persisted for a total of 220 days. The greatest frequency of episodes occurred in the winter months.

From Table 2.7-17, it appears that spring exhibits the best diffusion capacity and winter the worst. The high frequency of unstable conditions in the summer months is probably the result of the somewhat slower wind speeds and greater solar insolation during this season. The relatively high percentages of stable and unstable conditions and the relatively low frequency of neutral conditions throughout the year reflect the low winds and high percentage of clear skies that are characteristic of this area.

Table 2.7-18 presents the annual frequency distribution of Pasquill stability classes by wind direction and associated wind speeds. Generally, unstable conditions occur most frequently with south-southeast winds and stable conditions are associated with northwest through north winds.

TABLE 2.7-17

SEASONAL AND ANNUAL FREQUENCY OF STABILITY OCCURRENCE (%)
HANKSVILLE, UTAH

Season	Stability Class					
	A	B	C	D	E	F
Winter	0.32	11.47	11.70	21.69	5.41	49.40
Spring	2.91	14.99	10.67	30.47	7.52	33.43
Summer	6.61	19.82	13.02	18.45	6.85	32.26
Fall	1.80	19.06	9.41	16.05	5.24	48.44
Annual	2.93	16.36	11.20	21.68	6.26	41.57

TABLE 2.7-18

ANNUAL PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY CLASSES BY DIRECTION
HANKSVILLE, UTAH

Direction	A % Frequency	B % Frequency	C % Frequency	D % Frequency	E % Frequency	F % Frequency
N	0.1	0.7	0.6	1.3	0.7	5.3
NNE	0.1	0.5	0.4	0.8	0.4	2.4
NE	0.2	0.8	0.6	0.9	0.4	3.7
ENE	0.2	0.7	0.4	0.4	0.2	2.0
E	0.2	1.2	0.5	0.3	0.1	3.2
ESE	0.3	1.4	0.8	0.5	0.2	2.2
SE	0.3	1.6	0.8	0.7	0.3	2.4
SSE	0.4	1.9	1.1	1.6	0.3	1.9
S	0.3	1.7	1.1	1.5	0.4	2.2
SSW	0.2	1.1	1.1	4.0	0.4	1.2
SW	0.1	1.0	0.8	2.3	0.5	1.6
WSW	0.1	0.5	0.4	0.9	0.2	0.8
W	0.1	0.5	0.4	0.7	0.3	1.4
WNW	0.1	0.9	0.7	1.8	0.5	2.1
NW	0.1	1.1	0.9	2.5	0.8	5.2
NWN	0.2	0.9	0.7	1.5	0.5	4.1
All[a]	2.9	16.4	11.2	21.7	6.3	41.6

[a]May not equal total of column because of rounding off

TABLE 2.7-16

NUMBER OF RESTRICTED MIXING EPISODES LASTING TWO OR MORE DAYS IN FIVE YEARS AND TOTAL EPISODE DAYS (IN PARENTHESIS) IN THE HANKSVILLE VICINITY

Wind Speed	Mixing Heights		
	≤500 m	≤1000 m	≤1500 m
≤2.0 m/sec	1(3)	5(12)	6(13)
≤4.0 m/sec	16(55)	37(141)	52(220)
≤6.0 m/sec	12(42)	44(215)	62(294)

Source: Holzworth, G.C., 1972

2.7.4 Air Quality

2.7.4.1 Regulatory Standards

Ambient air quality standards for various gaseous and particulate pollutants have been promulgated by the U.S. Environmental Protection Agency (EPA), and the Utah Division of Health has adopted these standards as applicable throughout the state. The current national and Utah primary and secondary air quality standards are presented in Table 2.7-19. Primary air quality standards define the relative air quality levels judged necessary, with an adequate safety margin, to protect the public health. Secondary air quality standards are those specifically

Atmospheric Stability

Seasonal and annual percentage frequency distributions of each Pasquill stability class (see Section 2.7.2.10 for explanation) for Hanksville are presented in Table 2.7-17. Annually, unstable conditions (Classes A, B, and C) occur approximately 30.5 percent of the time, stable or inversion conditions (Classes E and F) approximately 47.8 percent, and neutral (Class D) approximately 21.7 percent. Unstable conditions occur most frequently in the summer months, averaging 39.5 percent and are least frequent in winter, averaging 23.5 percent. Stable conditions throughout an average year vary between 41.0 percent (spring) and 54.8 percent (winter).

TABLE 2.7-19

NATIONAL AND STATE OF UTAH AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal Primary Standard	Federal Secondary Standard
Nitrogen Dioxide[b]	Annual Average	0.05 ppm[c] (100 μg/m^3)[d]	0.05 ppm (100 μg/m^3)
Sulfur Dioxide	Annual Average	0.03 ppm (80 μg/m^3)	-- --
	24 Hour	0.14 ppm (365 μg/m^3)	
	3 Hour	--	0.05 ppm (1300 μg/m^3)
Suspended Particulate	Annual Geometric Mean	75 μg/m^3	60 μg/m^3
	24 Hour	260 μg/m^3	150 μg/m^3
Hydrocarbons (corrected for methane)	3 Hour 6-9 A.M.	0.24 ppm[e] (160 μg/m^3)	0.24 ppm (160 μg/m^3)
Photochemical Oxidants	1 Hour	0.08 ppm (160 μg/m^3)	0.08 ppm (160 μg/m^3)
Carbon Monoxide	8 Hour	9 ppm (10 mg/m^3)[f]	9 ppm (10 mg/m^3)
	1 Hour	35 ppm (40 mg/m^3)	35 ppm (40 mg/m^3)

All standards except annual average are not to be exceeded more than once a year.

[a] From the Bureau of National Affairs, 1975
[b] Nitrogen dioxide is the only one of the nitrogen oxides considered in the ambient standards
[c] ppm = parts per million
[d] μg/m^3 = micrograms per cubic meter
[e] Maximum 3 hour concentration between 6-9 A.M.
[f] mg/m^3 = milligrams per cubic meter

concerned with protecting the public welfare from any known or adverse effects of a pollutant.

National and Utah New Source Performance Standards (NSPS) governing the release of emissions are not applicable for projects of this small size.

2.7.4.2 Priority Classifications

The project site, located in San Juan County, is part of the Four Corners Interstate Air Quality Control Region which encompasses parts of Colorado, New Mexico and Arizona as well as Utah. A classification system for all Air Quality Control Regions (AQCR) was established (as outlined in the Federal Register of April 14, 1971) for the purpose of air pollution control planning and evaluation. Each AQCR is classified into one of three groups for each major pollutant.

A Priority I classification indicates that significant violation of the federal standards exists for a portion of the region and special emission controls are needed. Priority II and III classifications indicate better air quality within the region, with a priority III classification indicating better air quality than priority II. Each AQCR is classified separately with respect to each of the following pollutants: sulfur oxides, particulate matter, carbon monoxide, nitrogen dioxide, and photochemical oxidants. Where an AQCR is classified Priority I on the basis of measured or estimated air quality levels resulting from emissions predominately from a single point source, it is further classified Priority IA. Ambient pollutant concentrations that define the classification system are outlined in Table 2.7-20.

The priority classifications for the Four Corners Interstate Air Quality Control Region are presented in below.

	Particulate Matter	Sulfur Oxides	Nitrogen Dioxide	Carbon Monoxide	Photochemical Oxidants (HC)
Priority Classification	IA	IA	III	III	III

TABLE 2.7-20

FEDERAL REGIONAL PRIORITY CLASSIFICATIONS BASED ON AMBIENT AIR QUALITY

Pollutant	Avg. Time	Priority Group I	Priority Group II	Priority Group III
		Greater than	From - To	Less than
Sulfur Oxides	Ann. Avg.	100 μg/m^3	60-100 μg/m^3	60 μg/m^3
	24-hour	455 μg/m^3	260-455 μg/m^3	260 μg/m^3
	3-hour		1300 μg/m^3	1300 μg/m^3
Particulate Matter	Ann. Avg.	95 μg/m^3	60-95 μg/m^3	60 μg/m^3
	24-hour	325 μg/m^3	150-325 μg/m^3	150 μg/m^3
Carbon Monoxide	8-hour	14 mg/m^3	---	14 mg/m^3
	1-hour	55 mg/m^3	---	55 mg/m^3
Nitrogen Dioxide	Ann. Avg.	110 μg/m^3	---	110 μg/m^3
Photochemical Oxidants	1-hour	195 μg/m^3	---	195 μg/m^3

Note: In absence of measured data to the contrary, any region containing an area whose 1970 "urban place" population exceeds 200,000 will be classified Priority I. All others will be classified Priority III.

No Priority II classification for CO, NO_2, and Photochemical Oxidants

Hydrocarbon classifications will be same as for Photochemical Oxidants

Source: Code of Federal Regulations; 40 CFR 51.3

The priority IA classification of particulates and sulfur dioxide for the AQCR are based upon emissions from specific fossil-fueled power plants within the region, none of which lies within 50 kilometers of the Blanding site. Therefore, the air quality in the vicinity of the Blanding site is expected to be better than the IA classification would indicate.

2.7.4.3 Significant Deterioration

Rules have been promulgated by the Environmental Protection Agency as of December 1974 and as further modified in the Clean Air Act Amendments of 1977 with regard to prevention of significant deterioration (PSD). Under this law, each area of the nation with air quality better than that defined by the National Ambient Air Quality Standards for sulfur dioxide (SO_2) and total suspended particualtes (TSP) must be identified and designated as Class I, II or III for purposes of allowable air quality degradation. A class I area would allow a very small increase in air pollution, in Class II a larger increase and Class III would allow air pollution levels up to, but not exceeding, the national ambient standards. Currently San Juan County, in which the project site is located, is classified as a Class II area.

The significant deterioration regulations apply specifically to certain stationary source types and sizes (of which uranium milling processes are not included), and more generally to any source that has the potential to emit more than 250 tons per year of any air pollutant. With the expected low emission rates, this law should not be applicable to the proposed milling project.

Preliminary estimates based upon current planning indicate total particulate emissions from the White Mesa Uranium Project will not be greater than 200 tons per year. However, detailed planning is in progress and a more refined estimate of total emissions will be presented in the Supplemental Report.

2.7.4.4 Existing Air Quality

The Utah Division of Health maintains a network of air monitoring stations throughout the state. The closest monitoring station to the project area is at Bull Frog Marina located approximately 105 kilometers (66 mi) west of the proposed site. Only particulate and sulfur dioxide concentrations are measured at Bull Frog (Table 2.7-21).

Only the short-term (24-hour) particulate standard has been exceeded at the Bull Frog station; the annual average is well below the standard of 60 $\mu g/m^3$ for all three data years. The 24-hour violations must have been associated with conditions of high winds and blowing dust.

While only 1976 data are available, sulfur dioxide concentrations measured at Bull Frog Marina are low and well below the applicable ambient standards. The maximum one hour average recorded in 1976 was only 0.03 ppm.

As part of the on-site monitoring program, four sulfation plate monitoring stations were installed at various locations around the project site; sampling locations are shown on Plate 2.7-1. Data collection strated in March 1977 and the sulfation plates were routinely exposed for one month periods. Results of the first seven months (March through September 1977) of data collected are presented in Table 2.7-22.

While conversion of sulfation plate data to actual SO_2 concentrations is not accurate, sulfation plates do provide an indication of background sulfur dioxide. From Table 2.7-22, all monthly sulfation values were below the minmum detectable limit of the analysis procedure. This would tend to indicate that sulfur dioxide concentrations in the site vicinity are very low. This conclusion agrees with the state data collected at the Bull Frog Marina.

In October 1977, a total suspended particulate sampling program was initiated at the project site. Plate 2.7-1 dipicts the exact sampling location. While data collection has been limited, initial

TABLE 2.7-21

AIR QUALITY DATA COLLECTED AT
BULL FROG MARINA, 1975 THROUGH 1977

	Total Suspended Particulates ($\mu g/m^3$)		Sulfur Dioxide (ppm)	
Year	Annual Average[1]	Maximum 24-hour	Annual Average	Maximum 1-hour
1977[2]	24	258	ND[3]	ND[3]
1976	15	120	<.01	.03
1975	14	183	ND[3]	ND[3]

[1]Annual average as a geometric mean

[2]Determined from January through September data only. Annual geometric mean extrapolated for full year.

[3]No data-specific parameter not operational

TABLE 2.7-22

MONTHLY SULFATION VALUES ($\mu g\ SO_3/cm^2/day$)
BLANDING, UTAH, 1977

	March	April	May	June	July	August	September
B-1	<1.3	<1.2	<1.5	<1.3	<1.1	<1.6	<1.3
B-2	<1.3	<1.2	<1.5	<1.3	<1.1	<1.6	<1.3
B-3	--	--	<1.5	<1.3	<1.1	<1.6	<1.3
B-4	--	--	<1.5	<1.3	<1.1	<1.6	<1.3

indications are that total suspended concentrations agree fairly well with the longer term Bull Frog Marina data.

2.8 ECOLOGY

2.8.1 General Ecology of Region

The natural vegetation occurring on the project site and within a 25-mile radius is characterized by Pinyon-Juniper woodland intergrading with the Big Sagebrush association of the Northern Desert shrub formation (Hunt, 1953). A plant formation used in this context refers to a grouping of plant communities, whose distribution is largely influenced by climate, specifically in the semi-arid region of the Project site by altitude. An association is defined as groupings of plant communities, whose distribution is locally affected by soils and available moisture. Both associations are extensively distributed throughout Utah. In 1947, 20 percent of Utah was covered by Pinyon-Juniper woodland; the remaining area was dominated by Northern Desert Shrub vegetation, with minor occurrences of Aspen-fir and Alpine Tundra (Woodbury, 1947; Tidestrom, 1925). Cottam (1961) estimates that the areal extent of the Pinyon-Juniper woodland in Utah has increased sixfold since white settlement in the mid-1800s. This is attributed to overgrazing and lack of fires.

The Pinyon-Juniper woodland, also called pigmy conifer woodland, is dominated by Utah Juniper (Juniperus osteosperma) in Utah, with occurrences of Pinyon Pine (Pinus edulis) as a co-dominant or sub-dominant tree species. The woodland forms a belt between the Northern Desert Shrub Formation and Western Yellow Pine forest formation. The woodland is altitudinally distributed from 5000 ft (1650 m) to about 7500 ft (2273 m) in San Juan County, reaching 6000 (1818 m) to 6500 ft (1969 m) msl in the Abajo Mountains to the east of the project site. The lower limits of distribution reach about 5200 ft (1576 m), although the woodland also extends down drainages meeting the Big Sagebrush type. The project site lies at an elevation of 5600 to 5700 ft (1697 to 1727 m), just above the lower altitudinal limit of this association. The appearance of the woodland is short scrubby conifers with a dense canopy, although upon inspection the understory is usually more open with wide spaces between trees. The understory is composed of grasses, forbs and shrubs also found in the Big Sagebrush association. At the lower limits of distribution, the stands are more open with individuals of shorter heights than in the more dense stands at the upper distribution of the association.

Usually the Pinyon-Juniper woodland occurs on shallow rocky impermeable soils of exposed canyon ridges and slopes while communities of the Big Sagebrush association occur on deeper well drained soils on flatter terrain of valley floors, mesas or flattened slopes (Woodbury, 1947).

The Pinyon-Juniper woodland contains a variety of wildlife habitats including isolated trees on rocky cliffs dense stands of trees and stands interrupted by Big Sagebrush communities. Understory vegetation comprised mostly of forbs and shrubs also provides further habitat diversity. Most of the wildlife species found in the Pinyon-Juniper woodland are not permanent residents but use other vegetative associations found above and below the woodland. The most characteristic small mammals inhabiting the pigmy conifer woodland include woodrats (Neotoma sp.) and the Pinyon Mouse (Peromyscus truei) although the ubiquitous Deer Mouse (Peromyscus maniculatus) usually is the most abundant rodent. The Pinyon Jay (Gymnorhinus cyanocephalus), the Plain Titmouse (Parus inornatus) and the Common Bushtit (Psaltriparus minimus) are permanent bird residents (Frischknecht, 1975). Throughout the year, about 75 species inhabit this kind of woodland at various times, making up the most numerous vertebrate fauna (Frischknecht, 1975). These species include several raptors: Golden Eagle (Aquila chrysaetos), Ferruginous Hawk (Buteo regalis), Bald Eagle (Haliaeetus leucocephalus), Great Horned Owl (Bubo virginianus), Swainson's Hawk (Buteo swainsoni), Kestrel (Falco sparverius) and Red-tailed Hawk (Buteo jamaicensis).

Mule Deer (Odocoileus hemionus) are also a dominant species in the woodland, and the principal big game species. Other mammals found in the Pinyon-juniper include Coyotes (Canis latrons), Bobcats (Lynx rufus), Badger (Taxidea taxus) and Desert Cottontail Rabbits (Sylvilagus audubonii) (Frischknecht, 1975).

Communities occurring in the Big Sagebrush association are characterized by the dominant, Big Sagebrush (Artemesia tridentata), which grows from 2 to 16 ft (0.6 to 4.9 m) in height on favorable areas and is widely distributed altitudinally from 3800 to to 7500 ft (1151 to 2273 m) msl (Woodbury, 1947). Usually the shrubs in the association are widely spaced but occur closer together in more favorable areas. Grasses are the principal component of the understory. Historically, areas of well-developed Big Sagebrush stands have yielded good dryland farmland in Utah, probably reflecting Big Sagebrush's preference for deep alluvial soils (Tidestrom, 1925).

Since the Big Sagebrush Association is widely distributed altitudinally, many species occurring in the Pinyon-Juniper woodland and in desert shrub associations also occur in this association. Important small mammals of this association include Pocket Mice (Perognathus sp.), Kangaroo Mice (Microdipodops sp.) and Voles (Microtus sp.). In western Utah, Deer Mice and Kangaroo Rats are numerous but locally restricted. Blacktail Jackrabbits (Lepus townsendii) are also important constituents of the fauna. Generally, bird species utilizing this association came from other associations, such as the Swainson's Hawk, Prairie Falcon (Falco mexicanus), Burrowing Owl (Bubo virginianus) and Horned Lark. Bird populations are low during the breeding season according to Kendeigh (1961), averaging 25 pairs per 40 hectares (100 acres). Other important bird species occurring in this association include the Sage Grouse (Centrocercus urophasianus), Poor-will (Phalaenoptilus nuttallii), Sage Thrasher (Oreoscoptes montanus), Sage Sparrow (Amphispiza belli) and Brewer's Sparrow (Spizella breweri). Reptiles occurring in this association are also common to other associations but occur in lesser numbers (Shelford, 1963). Lizards are abundant and visible. Important reptiles include the Collared Lizard (Crotaphytus collaris), Sagebrush Lizard (Sceloporus gaciosus), Striped Whipsnake (Masticophis taeniatus), and Prairie Rattlesnake (Crotalus viridis) (Kendeigh, 1961).

Throughout the region and on the project area itself, communities of the Pinyon-Juniper woodland and Big Sagebrush association intergrade.

This integradation is influenced by soil type, texture, available soil moisture and past grazing practices. Where the soil type is preferred by one community type, there is a sharp demarcation line between the associations but where soils are more intermediate communities of the Pinyon-Juniper woodland and Big Sagebrush associations intergrade. Where they intergrade, as on some parts of the project site, junipers are widely scattered among species common to the Big Sagebrush association, being 100 ft (30.3 m), or more apart.

Since whiteman's settlement, the project site and portions of the surrounding region and San Juan County in general have been utilized for cattle grazing and to a much lesser extent for dryland farming and some irrigated farming (USDA, 1962).

Cattle and sheep grazing reached its peak in San Juan County between 1925 and 1930. During that period, cattle numbers ranged from 26,184 in 1925 to 15,168 to 119,802 in 1930 (USDA, 1962). According to the United States Department of Agriculture (1962: 13) "Heavy grazing by large numbers of livestock has brought changes to the vegetation in the area and has caused the range to deteriorate." Various practices to increase the productivity of the rangeland including controlled fires and chaining, were and still are being used. As a result of these treatment practices, many seral plant communities to the climax Pinyon-Juniper woodland and Big Sagebrush associations occur throughout the region.

2.8.2 Ecology of Project Site

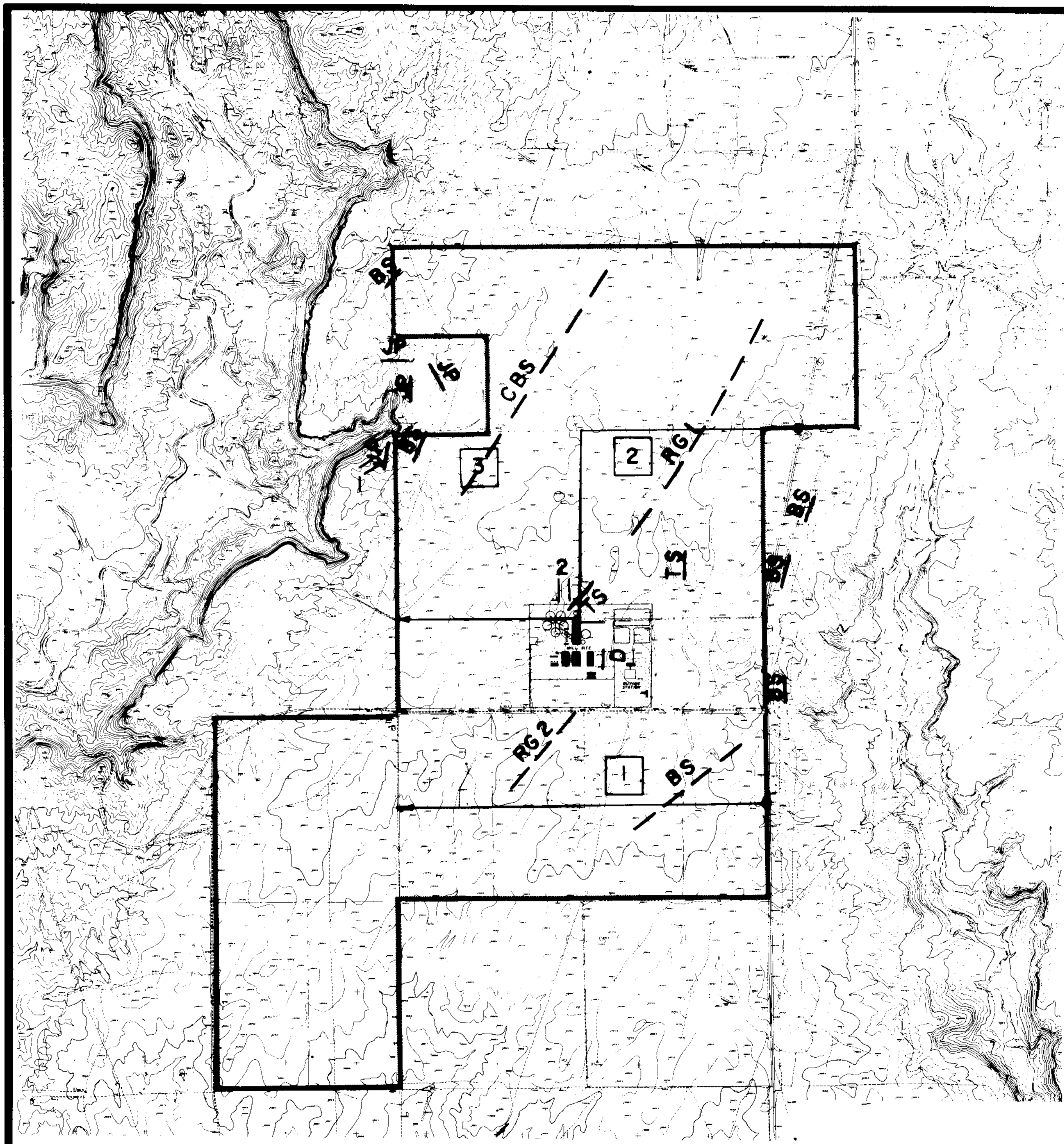
As discussed elsewhere (Sections 2.4 and 2.6), the project site lies on a plateau, with gently rolling topography that is incised with deep canyons. Elevations range from 5577 ft (1690 m) msl in the south to 5685 ft (1723 m) msl in the north. Canyons with steep rocky slopes and shallow rocky fine sandy loam soils border the east side of the project site beyond State Highway 47 and the west side. Two soil types occur on the site, the Mellenthin soil type and the Blanding soil (see Section 2.10). The natural climax vegetation that occurs on Mellenthin soils is the Pinyon-Juniper woodland and on the Blanding soil, a deep very fine sandy loam, communities of the Big Sagebrush association (USDA, 1962). All the plant communities studied on the project site except the Pinyon-Juniper woodland occur on the Blanding soil type. Annual precipitation in the region averages 12.77 inches per year and the average length of the growing season is 129 days from May 25 to October 1. Precipitation is distributed throughout the year but May and June are drier than the rest of the growing season. Precipitation is distributed so about 55 percent occurs during the growing season and 45 percent during the winter (see Section 2.7).

2.8.2.1 Vegetation

Vegetation sampling locations are indicated on Plate 2.8-1. Seven communities found on the project site are outlined on Plate 2.8-2. The communities are named either according to the dominant species in the climax vegetation (for example, Big Sagebrush community) or so as to identify the type of disturbance that contributes to the present vegetative composition (for example, reseeded grassland).

Community Distributions and Structure

With the exception of small portions of the Pinyon-Juniper woodland and the Big Sagebrush community type, the majority of the plant communities found on the project site are seral or disturbed communities that reflect past grazing use and treatments designed to improve the site for rangeland. These treatments include chaining, plowing and reseeding with Crested Wheatgrass. About 94 acres of Pinyon-Juniper woodland occur on portions of the eastern and western edges of the site, 232 acres of Big Sagebrush, 5 acres of vegetation associated with stockponds and overflow, 27 acres of disturbed vegetation on and immediately surrounding the present buying station and seral communities recovering from past disturbances of chaining and plowing, 567 acres of controlled Big Sagebrush, and 369 acres of reseeded grassland. These communities are separated by fences once used to separate individual pastures. Species composition of the communities sampled on the site are listed in Table 2.8-1. Parameters describing the structure of communities described below are presented on Table 2.8-2. Sampling methods and locations are discussed in Section 6.1.4.3.



PROJECT SITE ECOLOGY SAMPLING LOCATIONS

VEGETATION

Transect Locations

J-P - Juniper - Pinyon Community
BS - Big Sagebrush Community
CBS - Controlled Big Sagebrush Community
RG I - Reseeded Grassland I Community
RG 2 - Reseeded Grassland II Community
D - Disturbed Community
T-S - Tamarisk-Salix Community

N

2000 1500 1000 500 0 1000 2000 3000

SCALE IN FEET

WILDLIFE

Small Mammal Live-Trapping Transect
1 Juniper-Pinyon Transect
2 Tamarisk-Grass Transect (Tamarisk-Salix)
1 Big Sagebrush Grid
2 Grassland Grid (Reseeded Grassland I)
3 Big Sagebrush/Grass Grid (Controlled Big Sagebrush)

Modified Emlen Bird Transect
Emlen I - Grassland
Emlen 2 - Big Sagebrush
origin - O direction of travel

PLATE 2.8-1

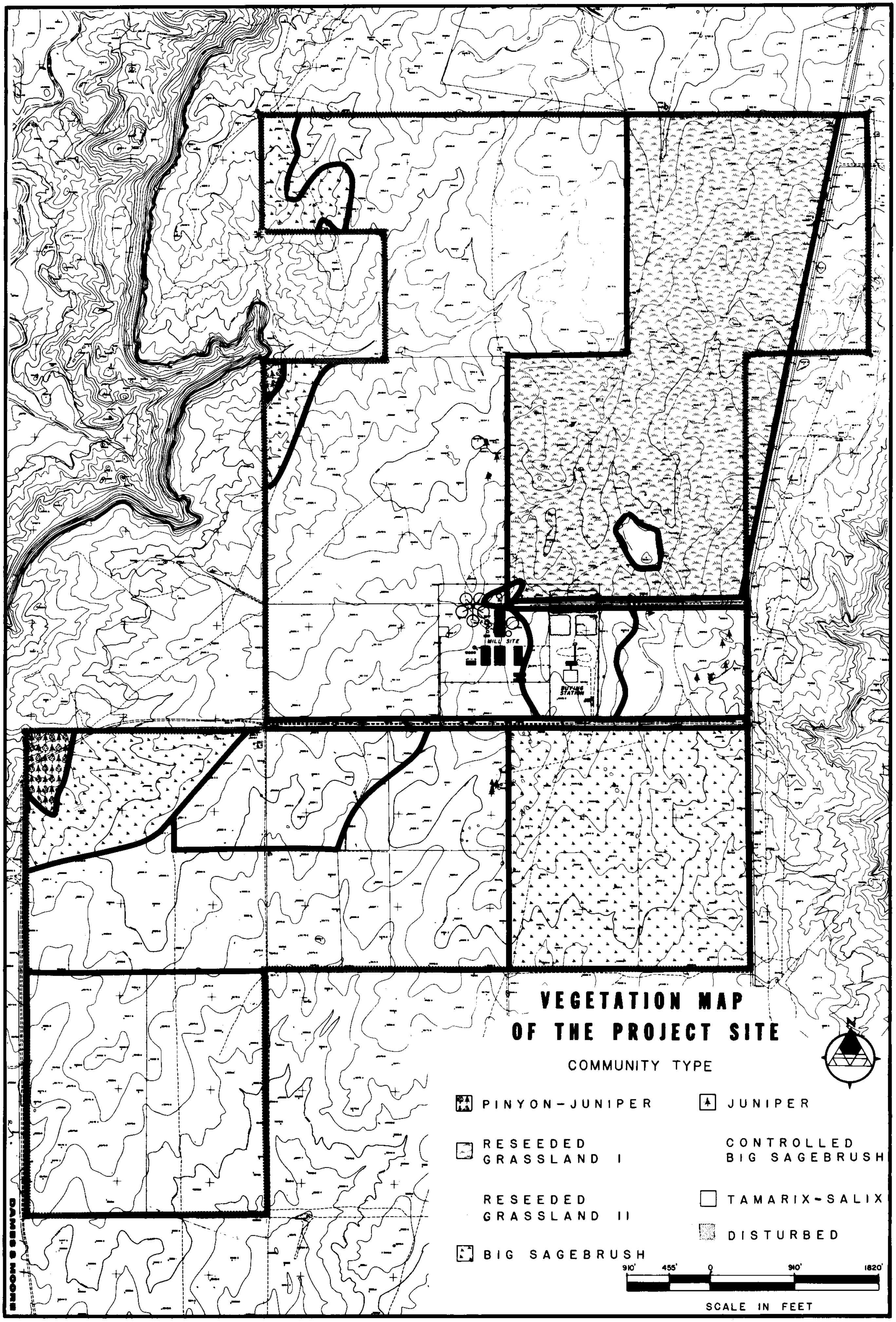

VEGETATION MAP
OF THE PROJECT SITE
COMMUNITY TYPE
PINYON-JUNIPER
JUNIPER
RESEEDED GRASSLAND I
CONTROLLED BIG SAGEBRUSH
RESEEDED GRASSLAND II
TAMARIX-SALIX
DISTURBED
BIG SAGEBRUSH
910'
455'
0
910'
1820'
SCALE IN FEET
MILL SITE
BUYING STATION
DAMES & MOORE

PLATE 2.8-2

TABLE 2.8-1

SPECIES COMPOSITION OF COMMUNITIES SAMPLED
AT THE BLANDING PROJECT SITE

Scientific Name	Common Name	Community of Occurrence
Grasses and Grasslike Plants		
Agropyron desertorum	Crested Wheatgrass	RG1,RGII,TS,CBS
Aristida longiseta	Red Threeawn	RG1,JP
Bromus tectorum	Cheatgrass	JP
Festuca octophora	Sixweeks Fescue	TS,JP
Hilaria jamesii	Galleta Grass	BS,JP,CBS,RGII
Oryzopsis hymenoides	Indian Ricegrass	JP,CBS
Sitanion hystrix	Bottlebrush Squirreltail	BS,JP,CBS,RGII
Sporobolus cryptandrus	Sand Dropseed	RGII
Forbs		
Asclepias subverticillata	Butterfly Milkweed	RGII
Artemesia biennis	Biennial Wormwood	TS
Aspergo procumbens	Catchweed	TS
Aster arvenosus	Aster	RGII
Astragalus convallarius	Timber Poison Milkvetch	CBS
Chichorium intybus	Chicory	RGII
Convolvulus arvensis	European Gloryvine	RGII
Conyza canadensis	Horseweed Fleabane	RGII
Eriogonum gordonii	Eriogonum	TS
Eriogonum ovulotolium	Eriogonum	JP
Euphorbia fendleri	Euphorbia	RGII
Grindelia squarrosa	Curlycup Gumweed	TS,D,RGII
Gilia leptomeria	Gilia	JP
Helianthus annuus	Common Sunflower	RGII
Lappula redowski	Stickweed	JP
Medicago sativa	Alfalfa	D
Salsola kali	Common Russian-Thistle	CVS,RR1,BS,RGII
Senecio longilobus	Threadleaf Groundsel	RGII
Senecio multicapitatus	Groundsel	RGII
Sphaeraicea coccinea	Scarlet Globemallow	RG1,CBS,RGII
Tragopogon pratensis	Meadow Salsify	RG1
Shrubs		
Artemesia ludoviciana	Louisiana Sagebrush	RGII
Artemesia tridentata	Big Sagebrush	RG1,BS,JP
Chrysothamnous viscidiflorus var. *slenophyllus*	Douglas Rabbitbrush	RGII

TABLE 2.8-1 (Concluded)

Scientific Name	Common Name	Community of Occurrence
Shrubs		
Cowania mexicana var *puberulus*	Cliffrose	JP
Echinocereus triglochidiatus	Claretcup Echinocereus	CBS
Ephedra viridis	Green Ephedra	RGl,BS,JP,CBS
Gutierrezia sarothrae	Broom Snakeweed	CBS,RGII
Lycium pallidum	Pale Wolfberry	RGl,RGII
Opuntia polyacantha	Plains Pricklypear	JP,CBS,RGII
Yucca angustissima	Fineleaf Yucca	BS,JP
Trees		
Juniperus osteosperma	One-seeded Juniper	RGl,JP,CBS
Pinus edulis	Pinyon Pine	JP
Salix exigua	Coyote Willow	TS
Tamarix pentandra	Tamarisk	TS

Communities - Juniper-pinyon (JP); Big Sagebrush (BS); Controlled Big Sagebrush (CBS); Reseeded Grassland 1 (RGl); Reseeded Grassland II (RGII); Disturbed (D); Tamarix-Salix (TS)

TABLE 2.8-2

COMMUNITY STRUCTURE PARAMETERS OF THE BLANDING SITE PLANT COMMUNITIES

Parameter	Relative[1] Density	Percent[1] Cover	Relative[1] Cover	Relative[1] Frequency	Importance Value
COMMUNITY					
RESEEDED GRASSLAND I					
GROUP SPECIES					
Grasses and Grasslike Plants					
Agropyron desertorum	92.0	12.0	78.2	66.4	236.2
Festuca octofora	1.0	0.1	0.5	5.6	7.5
Hilaria jamesii	2.0	0.3	2.4	2.4	6.4
Sitanion hystrix	1.0	0.1	0.5	2.4	3.5
Total		12.5			
Forbs					
Cichorium intybus	0.3	0.2	1.2	2.4	3.5
Sphaeralcea coccinea	0.3	0.1	0.5	2.4	2.8
Total		0.3			
Shrubs					
Gutierrezia sarothrae	4.0	1.9	13.3	16.0	33.3
Lycium pallidum	0.3	0.5	3.6	2.4	5.9
Total		2.4			
Total Vegetative Cover		15.2			
Bare Ground		61.0			
Litter		24.2			
RESEEDED GRASSLAND II					
Grasses and Grasslike Plants					
Agropyron desertorum	96.0	8.9	82.7	75.0	253.7
Total		8.9			

[1] Percentages may not add to one hundred due to rounding.

TABLE 2.8-2 (Continued)

Parameter		Relative Density		Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY							
RESEEDED GRASSLAND II (cont'd)							
Forbs							
	Salsola kali	0.6		0.1	1.2	5.0	6.8
	Sphaeralcea coccinea	3.0		1.4	13.0	15.0	31.0
			Total	1.5			
Shrubs							
	Gutierrezia sarothrae	0.6		0.3	3.1	5.0	8.7
			Total	0.3			
Total Vegetative Cover				10.7			
Bare Ground				79.7			
Litter				9.5			
TAMARIX-SALIX							
Forbs							
	Asperugo procumbens	3.8		0.5	4.1	7.7	15.6
	Grindelia squarrosa	66.0		9.0	75.0	53.9	194.9
	Salsola kali	1.9		0.2	1.7	7.7	11.3
			Total	9.7			
Shrubs							
	Artemesia tridentata	9.4		0.8	6.7	15.4	31.5
			Total	0.8			
Trees							
	Salix exigua	1.9		1.0	8.3	7.7	17.9
	Tamarix pentandra	16.9		0.5	4.2	7.7	28.8
			Total	1.5			
Total Vegetative Cover				12.0			
Bare Ground				67.9			
Litter				20.1			

TABLE 2.8-2 (Continued)

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
DISTURBED					
Grasses and Grasslike Plants					
Agropyron desertorum	92.0	9.0	68.0	66.0	226.6
Festuca octoflora	2.0	0.2	2.0	16.7	20.7
Total		9.2			
Forbs					
Salsola kali	6.0	4.0	30.0	16.7	52.7
Total		4.0			
Total Vegetative Cover		13.2			
Bare Ground		80.0			
Litter		7.0			
CONTROLLED BIG SAGEBRUSH					
Grasses and Grasslike Plants					
Agropyron desertorum	19.0	3.4	19.3	15.0	53.3
Hilaria jamesii	16.0	2.8	15.9	18.0	49.9
Oryzopsis hymenoides	3.0	0.5	3.0	2.0	8.0
Sitanion hystrix	10.0	1.7	9.8	24.0	43.8
Total		8.4			
Forbs					
Astragalus convallarius	3.0	0.5	3.0	5.0	11.0
Salsola kali	11.0	1.9	11.2	15.0	37.2
Sphaeralcea coccinea	0.2	0.1	0.2	2.0	2.4
Total		2.4			
Shrubs					
Artemesia tridentata	27.0	4.7	27.0	7.0	61.0
Gutierrezia sarothrae	10.0	1.8	10.4	12.0	32.4
Total		6.5			
Total Vegetative Cover		17.3			
Bare Ground		67.4			
Litter		15.3			

TABLE 2.8-2 (Continued)

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
BIG SAGEBRUSH					
Grasses and Grasslike Plants					
Hilaria jamesii	72.8	12.7	38.1	35.9	146.8
Sitanion hystrix	19.0	1.1	3.3	23.4	45.7
Total		13.8			
Shrubs					
Artemesia tridentata	4.6	18.9	56.8	20.3	81.7
Gutierrezia sarothrae	3.6	0.5	1.5	10.9	16
Total		19.4			
Lichen		0.1	0.3	9.4	11.2
Total Vegetative Cover		33.3			
Bare Ground		49.9			
Litter		16.9			
PINYON-JUNIPER					
Grasses and Grasslike Plants					
Aristida longiseta	13.1	2.1	8.1	9.7	29.3
Bromus tectorum	1.2	0.1	0.4	4.8	12.4
Hilaria jamesii	26.2	0.8	3.1	9.7	39.0
Oryzopsis hymenoides	1.2	0.6	2.3	1.6	5.0
Sitanion hystrix	4.8	0.1	0.4	3.2	8.3
Total		3.8			
Forbs					
Gilia leptomeria	8.3	0.04	0.1	1.6	10.1
Lappula redowski	1.2	2.4	9.3	1.6	11.7
Total		2.44			

TABLE 2.8-2 (Concluded)

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
PINYON-JUNIPER (cont'd)					
Shrubs					
Artemesia tridentata	5.9	4.0	15.4	9.7	30.3
Chrysothamnous viscidiflorus var. Slenophylhs	1.2	0.3	1.1	3.2	5.6
Cowania mexicana	3.6	4.0	15.4	4.8	23.0
Erigonium ovulofolium	3.6	0.1	0.4	1.6	5.6
Gutierrezia sarothroe	14.3	1.3	5.0	11.3	30.4
Opuntia polycantha	2.4	0.2	0.8	3.2	6.3
Total		9.9			
Trees					
Juniperus osteosperma	4.8	7.2	27.8	6.5	37.6
Pinus edulis	1.2	0.8	3.1	1.6	5.7
Total		8.0			
Lichen		1.0	3.9	19.4	29.5
Moss		0.8	3.1	3.2	6.3
Total Vegetative Cover		25.9			
Bare Ground		55.6			
Litter		15.6			
Rock		4.4			

The Pinyon-Juniper woodland on the site is restricted to shallow soils along the canyon rims on the east and west of the site. A sharp boundary occurs between this community and the other communities on the site. About 30 individual Utah Juniper trees are scattered across the project site on the Blanding soil (see Plate 2.8-2). The Pinyon-Juniper woodland contains the most species of communities sampled on the site (see Table 2.8-1). While the woodland is stratified into four layers, the dominant tree layer gives the woodland an overall appearance of dense vegetation. However, its species are widely separated; vegetative cover made up only 25.9 percent of the ground cover and bare ground made up 55.6 percent in areas sampled. Litter is an important component of ground cover, comprising 15.6 percent with rock 4.4 percent and lichens and mosses 1.8 percent (Table 2.8-2). The dominant species as reflected by importance value in the woodland is Utah Juniper (Juniperus osteosperma) with infrequent occurrences of Pinyon Pine (Pinus edulis). In the shrub layer, shrubs were widely spaced with grasses and forbs occurring in open areas, the shrub layer was the most important component of the understory, contributing about 10 percent of the vegetative cover. Big Sagebrush, Cliffrose (Cowania mexicana) and Broom Snakeweed (Gutierrezia sarothrae) were the dominant shrubs, based upon importance value.

The Big Sagebrush community is composed of two layers shrubs and grasses. This community is dominated by open stands of Big Sagebrush, 3 to 5 feet tall. The stand is interspersed with occasional shrubs of Broom Snakeweed (Gutierrezia sarothroae). About 20 percent of the ground cover is Big Sagebrush with open spaces of bare ground interspersed with grasses (Table 2.8-2). About 52 percent of cover was bare ground. The understory layer of grasses was not diverse, two species were sampled with Galleta Grass (Hilaria jamesii) being the most important grass species.

The other five communities occurring on the site are in various stages of recovery from past disturbances due to range treatment and overgrazing. Evidence of chaining and plowing was apparent in the reseeded rangeland communities and controlled Big Sagebrush communities. Old trunks of Big Sagebrush made up much of the litter sampled in those communities. Chaining not only increases the litter but also removes the dominant shrub layer in the community, releasing grasses and forbs from competition by shrubs. Several weedy species common to abandoned pastures and overgrazed rangeland are common in these communities (See Table 2.8-1). Species classed as weeds because they are introduced and provide little or no forage value to wildlife or livestock, include Aristida longiseta, Sitanion hystrix, Salsola kali, Cichorium intybus, Asperugo procumbens, Grindelia squarrosa (Holmgren and Anderson, 1970). Table 2.8-2 presents relative frequency, relative cover, relative density and importance values of species sampled in each community type.

The reseeded Grassland I, occupying the northeastern portion of the site is dominated by the grass layer, with occasional occurrences of shrubs such as Broom Snakeweed (Gutierrezia sarothroe) and Wolfberry (Lycium pallidum). In addition to being chained in the past, this area was also reseeded in Crested Wheatgrass (Agropyron desertorum), which made up 8.9 percent of the ground cover and was the dominant species in the community, based upon importance value. The vegetative cover is sparse in this community; 61 percent of ground cover was bare ground and 24.2 percent litter. The relative frequency of Crested Wheatgrass sampled was 75 percent while Broom Snakeweed was 3.1 percent and forbs 14.2 percent (Table 2.8-2). Usually with chained areas, native species reinvade 12-15 years after treatment. With the additional reseeding of Crested Wheat, this period would be much longer.

The reseeded Grassland II community in the southern portion of the project site is physically separated from the other communities by fences and roads (see Plate 2.8-2). This community is in an earlier stage of recovery from disturbance than the reseeded Grassland I community in the northern portion of the site. Vegetative cover is sparse, 10.7 percent of ground cover, and is dominated by the only grass species sampled Crested Wheatgrass (Agropyron desertorum). Bare ground makes up 79.7 percent of cover and litter 9.5. Only four species were sampled in this community, Crested Wheatgrass which was used in reseeding, and three weedy species. In later stages of recovery from mechanical treatment and reseeding, rangeland should support a more diverse composition of native grasses as well as introduced species than the rangeland communities studied.

The controlled Big Sagebrush community appears to be the oldest community to recover from chaining. A shrub layer is present and the dominant species in the community is Big Sagebrush, based upon importance values. Crested Wheatgrass was the dominant species in the grass layer. Vegetative cover was a low 17.3 percent, while bare ground contributed 67.4 percent to ground cover and litter, mainly uprooted Big Sagebrush, 15.3 percent.

The disturbed plant community on and surrounding the present Blanding buying station contained a single layer dominated by Crested Wheatgrass. Vegetative cover was sparse, being 13.2 percent of ground cover, while bare ground made up 8.0 percent.

The Tamarix-Salix community type is associated with two stock ponds on the project site (see Plate 2.8-2). The water levels in the ponds fluctuate and at the time of sampling the ponds were dry. The variability in moisture around the ponds is reflected in the forb layer which was composed of only weedy species. Vegetative cover was sparse (12.0 percent), bare ground was 67.9 percent of ground cover and litter 20.1 percent (see Table 2.8-1). No grasses were sampled, and forbs were the dominant group in the vegetative cover. The most prominent layer in the community is the tree layer made up of Tamarix and willows along the dam. Although not sampled, two mature cottonwood trees occur at the westernmost pond and several saplings occurred at the easternmost pond (see Plate 2.8-2).

<u>Vegetative Production</u>

Annual production on the project site was measured as total air dry yields from seasonal clippings (see Section 6.1.4.3 for sampling methods and locations). Only two range sites occur on the site, the semidesert upland stony hills (Pinyon-Juniper) range site and semidesert loam range site. Descriptions for these two range sites were used to estimate condition classes of the communities sampled (USDA, 1971 and 1975). The Pinyon-Juniper community sampled is on the semidesert upland stony hills (Pinyon-Juniper) range site while the other communities sampled are on the semidesert loam. Because all community types other than the Pinyon-Juniper community had been subjected to various range improvement treatments (such as chaining, plowing and reseeding with Crested Wheatgrass), production samples were taken from each community type and condition classes were then based upon the semidesert loam range site description.

Annual production samples from the project site varied between communities within the semidesert loam range site and between the semidesert upland stony hills (Pinyon-Juniper) range site and the semidesert loam rangesite. Production measurements discussed below may be misleading since precipitation for 1977 at the project site and for San Juan County was classed as drought conditions (see Section 2.7). Until July, no production was evident during sampling on the site.

Based upon percent composition by dry weight, the Pinyon-Juniper community is in fair condition (see Table 2.8-3 for actual percentages in comparison to climax composition). Total yield for the Pinyon-Juniper community was 206 lbs/acre air dry, while the total annual yield in an unfavorable year for a semidesert stony hills (Pinyon-Juniper) range site in fair condition is 1200-500 lbs/acre air dry (USDA, 1971). Generally, understory cover varies from 35 to 40 percent. However, in the Pinyon-Juniper community sampled total understory vegetative cover was 30 percent which may account for the lower yield. This community type also was overgrazed in the past, as evidenced by the high percentage of increaser shrubs present. An increaser species is one that increases in occurrence when the range is grazed too heavily. Big Sagebrush, rabbitbrush and snakeweed composition in the Pinyon-Juniper community totalled

TABLE 2.8-3

PRODUCTION AND PERCENT COMPOSITION OF THE PINYON-JUNIPER COMMUNITY ON THE SEMIDESERT STONYHILLS (Pinyon-Juniper) Range Site[a]

Plant Group and Species	Maximum Percent in Climax	Percent in Juniper-Pinyon Community
Grasses and Grasslike Plants		
Agropyron spicatum	25	
Muhlenbergia emersleyi	2	
Bouteloua gracilis	5	
Carex geophila	10	
Hilaria jamesii	1	5
Oryzopsis hymenoides	25	23
Koeleria cristata	1	
Sitanion sp.	1	0.1
Agropyron smithii	1	
Poa secunda	1	
Forbs		
Erigeron sp.	1	
Chrysopsis villosa	1	
Astragalus sp.	Tr	
Others	2	
Phlox sp.	1	
Shrubs and Trees		
Artemesia tridentata	5	12
Artemesia nova	1	
Juniperus sp.	35	
Phlox sp.	1	
Pinus edulis	15	
Chrysothamnous sp.	5	4
Aster sp.	1	
Gutierrezia sarothrae	3	14
Total percent composition		36.1
Total production		206 lbs/acre
Condition class		Fair

[a]Taken from the SCS range site description

30 percent while increaser percent composition in the potential native community normally ranges from 5 to 12 percent (USDA, 1971).

Based upon percent dry weight composition, all the communities sampled on the semidesert loam range site were in poor condition except the Big Sagebrush and controlled Big Sagebrush community types (Table 2.8-4). Production on these sites was mostly weeds causing the low condition class classification. Annual dry weight production in the reseeded Grassland I community was 119 lbs/acre, on the reseeded grassland II community 148 lbs/acre, on the disturbed community 32 lbs/acre and on the Tamarix-Salix community 1585 lbs/acre. On a semidesert loam rangesite in an unfavorable year, production generally varies from 300 to 225 lbs/acre (USDA, 1971).

The Big Sagebrush and Controlled Big Sagebrush community types were in fair condition (see Table 2.8-4). Production of the Big Sagebrush community was 159 lbs/acre and the Controlled Big Sagebrush community 380 lbs/acre. In an unfavorable year on a semidesert loam range site in fair condition production can range from 1100 lbs/acre to 250 lbs/acre (USDA, 1971).

Endangered and Threatened Plant Species

No plant species designated as endangered and offered special protection by the U.S. government occurs in Utah (Federal Register Vol. 42 (155): 40682-40685, August 11, 1977). Fifty-nine species nominanted as possibly warranting endangered or threatened status and protection occur in Utah (Federal Register Vol. 41 (117): 24524-24572, June 16, 1976). Of these species all are endemic to certain areas in Utah and six occur in San Juan County. Brief descriptions of the type localities for the latter, taken from Welsh, et al. (1975), are listed below.

Erigeron kachinensis Welsh & Moore

Habitat - an endemic species known only from its type locality, hanging gardens and seeps near Kachina Natural Bridges in Natural Bridges National Monument, about 45 miles west of the project site.

TABLE 2.8-4

PRODUCTION AND PERCENT COMPOSITION OF COMMUNITIES SAMPLED ON THE SEMIDESERT LOAM RANGE SITE[1]

Plant Group and Species	Maximum Percent in Climax	Community: Big Sagebrush	Controlled Big Sagebrush	Reseeded Grassland I	Reseeded Grassland II	Disturbed	Tamarix-Salix
Grasses and Grasslike Plants							
Agropyron spicatum	10						
Bouteloua gracilis	15						
Sitanion hystrix	5	Tr	10		Tr		
Hilaria jamesii	10	9	11		6		
Oryzopsis hymenoides	20		5				
Stipa comata	20						
Aristida sp.	2						
Forbs							
Annuals	5						
Aster sp.	1						
Erigeron sp.	1						
Eriogonum sp.	2						
Astragalus sp.	2						
Lomatium sp.	1						
Brassica sp.	2						
Lathyrus sp.	2						
Penstemon sp.	1						
Phlox sp.	2						
Sphaeralcea coccinea	5			5			
Lappula sp.	2						

TABLE 2.8-4 (Concluded)

Plant Group and Species	Maximum Percent in Climax	Big Sagebrush	Controlled Big Sagebrush	Community Reseeded Grassland I	Reseeded Grassland II	Disturbed	Tamarix-Salix
Shrubs and Trees							
Artemesia tridentata	20	85	19				6
Artemesia nova	5						
Artemesia spinescens	10						
Eriogonum sp.	1						
Atriplex canescens	5						
Artemesia campestris	15						
Phlox hoodii	1						
Ephedra sp.	1						
Gilia sp.	1						
Opuntia polyacantha	1						
Atriplex confertifolia	8						
Gutierrezia sarothrae	5	9	20	6	30		
Eurotia lanata	40						
Chrysothamnous sp.	5						
Total percent composition		34%	44%	11%	1%	0%	6%
Total production		159 lbs/acre	380 lbs/acre	119 lbs/acre	148 lbs/acre	20 lbs/acre	1585 lbs/acre
Condition class		Fair	Fair	Poor	Poor	Poor	Poor

[1]Taken from the SCS range site description

Astragalus cronquistii Barneby

Habitat - an endemic species very restricted, its type locality is in the desert along west side of Comb Wash, 9 miles west of Bluff and about 30 miles south-southwest of the project site.

Astragalus iselyi Welsh

Habitat - an endemic, edaphically restricted, type locality is at Brumley Bridge, about 1.5 miles north of Pack Creek Ranch and about 70 miles north of the project site.

Phacelia indecora Howell

Habitat - an endemic species, type locality Bluff, about 20 miles south of the project site.

Eriogonum humivagans Reveal

Habitat - an endemic species known only from the type locality about 13.5 miles east of Monticello at 6,800 feet, about 30 miles northeast of the project site.

Zigadenus vaginatus Rydb

Habitat - an endemic species, type locality Armstrong Canyon near Natural Bridges, about 40 miles west of the project site.

According to the BLM Monticello (Personal Communications, Mr. Nick Sandberg and Mr. Rick McQuire Range and Wildlife Specialists, November 10, 1977) no endangered species occurs in the vicinity of or on the project site. Although an extensive list and description of endangered, threatened, extinct and endemic species of Utah was published in 1975 (Welsh et al. 1975), only the species listed above were designated by the Federal government as warranting further study for designation as endangered or threatened. Due to the disturbed nature of the project site it is unlikely any species listed above occurs on the site.

2.8.2.2 Wildlife

This section contains baseline information collected through four seasons at the Blanding site for the purpose of predicting impacts associated with construction and operation of the proposed mill and formulating mitigation measures to reduce those impacts. The ensuing discussion concentrates on species actually observed, trapped, or positively known to occur in the area from unmistakable sign such as scat, tracks and middens (see Plates 2.8-1 and 2.8-3 for sampling locations). A list of species potentially occurring in the vicinity, based on general distributions, is in Appendix D.

Amphibians and Reptiles

Amphibians function as secondary consumers in ecosystems, feeding primarily upon insects and other invertebrates and, in turn, are consumed by vertebrate predators. The arid nature of the project site, the lack of perennial water, and the limited number of vegetated stock ponds indicate that local amphibian populations are small or non-existent. Seven species potentially occur in the area (see Appendix D) based on distribution range maps (Stebbins, 1966). However, the only amphibian seen during field work for this report was one Tiger Salamander (*Ambystoma tigrinum*) in Pinyon-Juniper habitat to the west of the project site.

Reptiles function as secondary or tertiary consumers in ecosystems, depending upon the species. Eleven species of lizards and five species of snakes potentially occur in the area (see Appendix D) based on distribution range maps (Stebbins, 1966). Any of the eleven lizard species could occur in the project vicinity, but not all would occur together in one habitat. Ten sympatric lizard species is the highest number known in western North America and a maximum of five species may occur sympatrically in southeastern Utah according to Pianka (1965). Three species of lizards were observed during fieldwork: the Sagebrush Lizard (*Sceloporus graciosus*) and the Western Whiptail (*Cnemidophorus tigris*) both occurred in sagebrush and the Short-horned Lizard (*Phrynosoma douglassi*) was observed in grassland. By mid-October

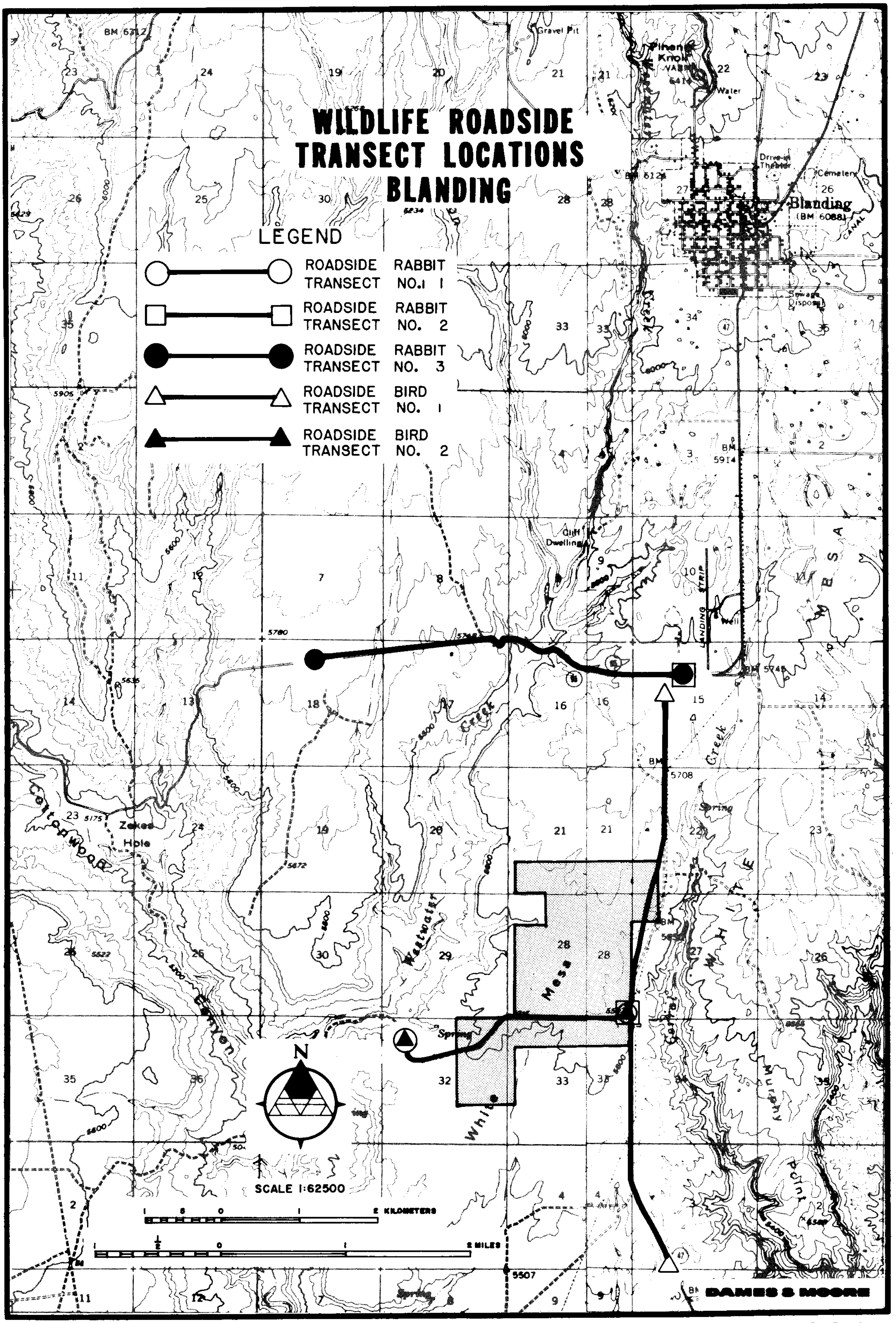

WILDLIFE ROADSIDE
TRANSECT LOCATIONS
BLANDING
LEGEND
ROADSIDE RABBIT TRANSECT NO. 1
ROADSIDE RABBIT TRANSECT NO. 2
ROADSIDE RABBIT TRANSECT NO. 3
ROADSIDE BIRD TRANSECT NO. 1
ROADSIDE BIRD TRANSECT NO. 2
SCALE 1:62500
2 KILOMETERS
2 MILES
Blanding
(BM 6088)
White Mesa
Cottonwood
Zekes Hole
Canyon
Westwater Creek
Cliff Dwelling
LANDING STRIP
Cemetery
Drive-in Theater
Gravel Pit
Piñon Knoll
Murphy Point
Spring
Well
DAMES & MOORE

PLATE 2.8-3

adults were in hibernation but young of the year Sagebrush Lizards were still active in sagebrush. No snakes were observed during field work.

Birds

Birds are directly linked to functioning of ecosystems through the pattern and magnitude of energy flow. One dimension of the importance or role of non-game birds in rangeland ecosystems is the pattern of food consumption. Total prey consumption values for rangeland similar to that of the site have been determined from simulation models to fall in a restricted range (0.215 to 0.405 g dry wt per m^2 per season) over the 150-day breeding season from April through August (Wiens and Dyer, 1975). Animal prey rather consistently comprises 80 percent or more of the total prey biomass consumed. In general, chewing insects dominate the diet which also includes small percentages of omnivorous invertebrates, scavengers, and grass seeds (Wiens and Dyer, 1975). No one has been able to quantify the effects of avian predation on controlling prey populations or their effects on such factors as herbage consumption by chewing insects or plant growth suppression by sucking forms (Wiens and Dyer, 1975).

A second way to view the importance of a bird community is to evaluate energy flow through the avifauna in comparison with total energy transfers among trophic levels of the ecosystem. Wiens and Dyer (1975) reported avian biomass was several orders of magnitude less than that of primary producers (photosynthetic plants), and the biomass of secondary consumer (primarily insect-eaters) was 2-5 times higher than that of primary consumer.

A third way of assessing the importance of birds is by the role that they play in nutrient cycling. Relative to invertebrates population turnover in birds is slow. This means that nutrients ingested by birds are not available for some time to other components of the ecosystem. These nutrients can be exported out of the local ecosystem via migration coupled with higher mortality rates on wintering grounds (Fretwell, 1972 and Wiens, 1974). However, the magnitude of nutrient export by birds is generally negligible compared with that of streamflow (Wiens and Dyer, 1975).

Another dimension of the importance of birds is the recreation that they provide for bird-watchers. Payne and DeGraaf (1975) estimated the total national direct expenditures for the enjoyment of non-game birds to be $500 million. They predicted continued moderate growth in this form of recreation.

In four seasons of field work, 56 species of birds were observed in the project vicinity (Table 2.8-5). A list of species potentially present is in Appendix D. The estimated abundance of birds in the project vicinity derived from modified Emlen transects and roadside bird counts varied with habitat and season. Only four species were observed during winter sampling in February. The most abundant species was the Horned Lark (*Eremophila alpestris*) which was concentrated in grassland (Table 2.8-6). The Horned Lark and Common Raven (*Corvus corax*) were seen in two of the four habitats sampled. Most winter roadside bird observations (55 percent) occurred in grassland habitat (Table 2.8-7). Spring sampling in May showed a great influx of breeding species. The most abundant species was again the Horned Lark in grassland (Table 2.8-6). Horned Larks, Western Meadowlarks (*Sturnella neglecta*), Brewer's Blackbirds (*Eugphagus cyanocephalus*), Common Ravens, White-throated Swifts (*Aeronautes saxatalis*), Violet-green Swallows (*Tachycineta thalassina*), and Lark Sparrows (*Chondestes grammacus*) were observed in two of the four habitats sampled. Most spring roadside bird observations (62 percent) occurred in grassland habitat (Table 2.8-8). While grassland continued to be important to year-round residents, sagebrush became important in spring; particularly to sparrows and meadowlarks (Table 2.8-6). Summer sampling in August saw the continuation of the Horned Lark as the most abundant species in grassland (Table 2.8-6). The Black-billed Magpie (*Pica pica*) was seen in all four habitats, while the Common Crow and Mourning Dove (*Zenaida macroura*) were seen in three habitat types. Most summer roadside bird observations (53 percent) occurred in grassland (Table 2.8-9). The overall distribution of birds became more uniform in

TABLE 2.8-5

BLANDING BIRD INVENTORY

Species	Statewide Relative Abundance Status[a]	Species	Statewide Relative Abundance Status
Mallard	CP	Bushtit	CP
Pintail	CP	Bewick's Wren	CP
Turkey Vulture	US	Mockingbird	US
Red-tailed Hawk	CP	Mountain Bluebird	CS
Golden Eagle	CP	Black-tailed Gnatcatcher	H
Marsh Hawk	CP	Ruby-crowned Kinglet	CP
Merlin	UW	Loggerhead Shrike	CS
American Kestrel	CP	Starling	CP
Sage Grouse	UP	Yellow-rumped Warbler	CS
Scaled Quail[b]		Western Meadowlark	CP
American Coot	CS	Red-winged Blackbird	CP
Killdeer	CP	Brewer's Blackbird	CP
Spotted Sandpiper	CS	Brown-headed Cowbird	CS
Mourning Dove	CS	Blue Grosbeak	CS
Common Nighthawk	CS	House Finch	CP
White-throated Swift	CS	American Goldfinch	CP
Yellow-bellied Sapsucker	CP	Green-tailed Towhee	CS
Western Kingbird	CS	Rufous-sided Towhee	CP
Ash-throated Flycatcher	CS	Lark Sparrow	CS
Say's Phoebe	CS	Black-throated Sparrow	CS
Horned lark	CP	Sage Sparrow	US
Violet-green Swallow	CS	Dark-eyed Junco	CW
Barn Swallow	CS	Chipping Sparrow	CS
Cliff Swallow	CS	Brewer's Sparrow	CS
Scrub Jay	CP	White-crowned Sparrow	CS
Black-billed Magpie	CP	Song Sparrow	CP
Common Raven	CP	Vesper Sparrow	CS
Common Crow	CW		
Pinyon Jay	CP		

[a]After Behle and Perry (1975)

[b]Not listed in Behle (1960 or Behle and Perry (1975)

Relative Abundance	Status
C = common	P = permanent
U = uncommon	S = summer resident
H = hypothetical	W = winter visitant

TABLE 2.8-6

BLANDING BIRD POPULATION ESTIMATES FROM EMLEN TRANSECTS[a]

Habitat/Species	Individuals/100 Acres			
	Winter	Spring	Summer	Fall
Grassland				
Horned Lark	33.9	96.9	36.4	98.8
Meadowlark	--	7.3	7.3	18.8
Lark Sparrow	--	19.4	0.6	--
Brewer's Sparrow	--	--	--	47.1
Mourning Dove	--	--	2.4	--
Common Crow	--	--	--	1.1
Green-tailed Towhee	--	--	--	1.2
Black-billed Magpie	--	--	--	4.7
House Finch	--	--	--	9.4
American Goldfinch	--	--	--	36.2
Mountain Bluebird	--	--	--	2.4
Sagebrush				
Horned Lark	4.7	26.5	3.5	13.7
Meadowlark	--	23.5	9.4	--
Lark Sparrow	--	17.7	4.1	--
Brewer's Sparrow	--	25.9	--	12.5
Vesper Sparrow	--	4.7	--	--
Sage Sparrow	--	3.5	13.0	--
Black-throated Sparrow	--	2.4	7.1	--
Mourning Dove	--	3.5	4.1	--
Brewer's Blackbird	--	8.6	--	--
Loggerhead Shrike	--	2.4	3.8	--
American Kestrel	--	--	--	1.0

[a]Average from surveys on two consecutive days.

TABLE 2.8-7

BLANDING WINTER 1977 ROADSIDE BIRD SURVEY

	Relative Abundance by Habitat			
Species	Grassland	Sage/Grass	Sagebrush	Pinyon/ Juniper
Common Raven	5	1	--	--
Starling	1	--	--	--
Dark-eyed Junco	--	--	--	4
Totals	6	1	0	4
No. of Species	2	1	0	1
Species Diversity	0.65	0.00	0.00	0.00

TABLE 2.8-8

SPRING 1977 ROADSIDE BIRD SURVEY

Species	Relative Abundance by Habitat: Grassland	Sage/Grass	Sagebrush	Pinyon/ Juniper
Mourning Dove	10	--	--	--
Western Meadowlark	6	--	15	--
Brewer's Blackbird	9	--	--	2
Starling	8	--	--	--
Common Raven	3	1	--	--
Horned Lark	6	--	--	--
Western Kingbird	2	--	--	1
Cliff Swallow	12	--	--	--
White-throated Swift	2	2	--	--
Violet-green Swallow	16	--	1	--
Barn Swallow	--	--	--	--
Mockingbird	3	--	--	--
Scaled Quail	--	--	1	--
Loggerhead Shrike	--	--	--	1
Ash-throated Flycatcher	--	--	--	1
Brewer's Sparrow	--	--	4	--
Lark Sparrow	--	--	16	--
Black-throated Sparrow	--	--	1	--
Turkey Vulture	4	--	--	--
Totals	81	3	38	5
No. of Species	12	2	6	4
Species Diversity	3.31	0.92	1.81	1.92

TABLE 2.8-9

SUMMER 1977 ROADSIDE BIRD SURVEY

Species	Grassland	Sage/Grass	Sagebrush	Pinyon/ Juniper
	Relative Abundance by Habitat			
Mourning Dove	4	3	--	16
Western Meadowlark	2	--	3	--
Brewer's Blackbird	1	--	--	--
Common Crow	15	2	--	7
Horned Lark	--	3	1	--
Cliff Swallow	50	4	--	--
Violet-green Swallow	4	--	--	--
Black-billed Magpie	5	1	1	2
Mockingbird	--	--	--	1
Loggerhead Shrike	1	3	--	--
Ash-throated Flycatcher	--	--	--	1
Brown-headed Cowbird	1	3	--	--
Common Nighthawk	--	--	--	9
Lark Sparrow	--	--	5	--
Black-throated Sparrow	--	--	5	--
Chipping Sparrow	--	--	--	2
American Kestrel	--	1	--	--
Totals	83	20	15	38
No. of Species	9	8	5	7
Species Diversity	1.91	2.87	2.04	2.19

summer, with species appearing in the sage/grass and pinyon/juniper for the first time. In fall (October) the Horned Lark continued to be the most abundant species in grassland (Table 2.8-6). The Western Meadowlark was the most widely distributed species occurring in three of the four habitats sampled. Most fall roadside bird observations (94 percent) occurred in grassland (Table 2.8-10). With the approach of winter the distribution of birds was again centering on grassland as summer residents left the area.

Species diversity is a measure of the probability of encountering an individual of a given species among all the species present in an area. In general, the greater the species diversity the greater the ecosystem stability. Avian species diversities measured by the Shannon-Wiener formula (Smith, 1974) are shown for roadside bird counts by habitat in Tables 2.8-7 through 2.8-10. Species diversity was generally low in winter and greatest in grassland. In spring, diversity increased in all habitats and remained greatest in grassland. In summer, diversity declined in grassland and peaked in all other habitats. In fall, diversity decreased and remained greatest in grassland.

The relatively small group of species characterizing the breeding avifauna of the site was typical of rangeland habitat (Wiens and Dyer, 1975). Also typical was the small total number of species which inhabited the area. The Horned Larks and meadowlarks were the associated breeding majority species of the project site grassland (Table 2.8-6). Average avian densities measured by Wiens and Dyer (1975) on other rangeland during the breeding season ranged from 185 to 329 individuals/km^2. The avian density on grassland of the project site during spring was 305 individuals/km^2 based on extrapolation of Emlen transect data. Eighty-four percent of these individuals belonged to the two most abundant species, which is also typical of rangeland habitats (Wiens and Dyer, 1975). Shrub-steppe avifaunas generally contain more migratory species than grassland avifaunas. The high interseasonal species turnover at the project site supports the preceeding statement. Wiens and Dyer (1975) found that the total rangeland breeding bird community

TABLE 2.8-10

FALL 1977 BLANDING ROADSIDE BIRD SURVEY

Species	Grassland	Sage/Grass	Sagebrush	Pinyon/ Juniper
	Relative Abundance By Habitat			
Brewer's Blackbird	29	--	--	--
Common Crow	2	--	4	--
Western Meadowlark	4	1	2	--
Horned Lark	3	--	1	--
Black-billed Magpie	9	--	--	--
Red-tailed Hawk	--	2	--	--
Totals	47	3	7	0
No. of Species	5	2	3	0
Species Diversity	1.64	0.92	1.38	0

appeared to be more stable annually than individual populations of the dominant species; shrub-steppe densities exhibited the greatest instability.

Raptors are important as a recreational resource, often being the favorites of bird watchers. They are also indicators of quality habitat. Since raptors occupy the ecological niche of tertiary consumer, their density and diversity in a particular area are positively correlated with the local ecosystem's structural and functional stability and production. The following discussion presents raptor life history information, largely derived from Eyre and Paul (1973), plus evidence of breeding, habitat utilization, and migration on and adjacent to the proposed mill site.

Harrier - The Harrier or Marsh Hawk (*Circus cyaneus*) is listed by Eyre and Paul (1973) as a common year around resident in Utah, being often associated with open lowlands and marshes. However, some individuals do migrate. Migrating birds arrive in March or April and leave during November. Mating takes place in early April, nesting in early May, egg hatching in June, and fledging in July. The diet consists of small mammals, birds, amphibians, reptiles and some insects. Rodents generally account for more than two-thirds of their diet. Some Harriers live longer than 16 years.

Harriers were sighted twice during the fall site reconnaissance, once on an evening hunting flight in grassland 1/4 mile west of the crusher and once near the pond 1/4 mile northeast of the site. No evidence of nesting was found on the project site. The probability of their nesting on the site is low considering the ephemeral nature of local streams and this species' predilection for wetland nesting areas.

Prairie Falcon - Prairie Falcons (*Falco mexicanus*) are year-round residents in Utah with numbers augmented in fall by migrants (Eyre and Paul, 1973). Mating occurs in March, egg hatching in May, and fledging about a month later. The diet consists of birds, mammals, reptiles and some insects. In the Blanding area the summer diet may consist almost entirely of Horned Larks, doves, and ground squirrels. The winter diet is largely Horned Larks and Rosy Finches.

No sightings were made of this species but what may have been a cliff eyrie was located about 3/4 mile east of the site. This species has a strong tendency to return to the same nest for several years if undisturbed.

American Kestrel - The American Kestrel or Sparrow Hawk (*Falco sparverius*) is perhaps the most common raptor in Utah and is a permanent resident (Eyre and Paul, 1973). Mating takes place in April, egg hatching in June and fledging in late June and July. The diet consists primarily of insects and rodents. Sparrow-size birds are also eaten.

Kestrels were observed on or near the site in spring, summer and fall. No evidence of nesting was found on the site. However, nests of this species are inconspicuous and probably occur in juniper tree cavities and in the cliffs west and east of the site. Kestrels are also reported to use woodpecker holes and old crow and magpie nests (Eyre and Paul, 1973). These latter species are present on the site.

Merlin - The Merlin or Pigeon Hawk (*Falco columbarius*) is an uncommon fall and winter visitor in Utah (Eyre and Paul, 1973). There are only a few records of this species breeding in Utah (Eyre and Paul, 1973). The diet consists almost entirely of passerine birds, such as the House Finch.

One winter observation (Feburary 1977) was made of a Merlin in sagebrush/juniper on the northwestern edge of the site.

Red-tailed Hawk - The Red-tailed Hawk (*Buteo jamaicensis*) is the most common buteo (broad-winged hawk) in Utah and is a year around resident (Eyre and Paul, 1973). Some individuals migrate to Mexico. Mating and nesting take place in March, egg hatching in May, and fledging in June and July. The diet varies seasonally with prey availability, small mammals constituting 85 to 90 percent of the prey base. Rabbits are preferred in sagebrush areas. Mice and ground squirrels are substituted in areas lacking rabbits. Birds and snakes are taken infrequently.

The Red-tailed Hawk was observed on or near the site in summer and fall. No evidence of nesting was found on the site or in the cliffs to the west of the site. One suspected Red-tailed Hawk eyrie was located in the cliffs about 3/4 mile east of the site. This species has a strong tendency to reoccupy the same nest for several years.

Golden Eagle - The Golden Eagle (*Aguila chrysaetos*) is a common year around resident in Utah (Eyre and Paul, 1973). Mating and nest construction begins in January and February, egg hatching in late March and April, and fledging in June. The diet consists generally of mammals but Golden Eagles are the only raptors which are consistently successful in preying on other raptors. Rabbits are important food items and Whitetail Antelope Ground Squirrels, which occur on the site, are utilized.

A Golden Eagle was sighted on a power pole in sagebrush/grassland 1/2 mile southeast of the Blanding ore buying station on October 10, 1977. Suitable nesting habitat is probably not available on or near the site. This species prefers tall trees or tall cliffs generally remote from man for nesting.

Turkey Vulture - The Turkey Vulture (*Cathartes aura*) is a common spring and summer resident in Utah arriving in March and migrating south in September and October (Eyre and Paul, 1973). Nesting takes place from April through June, egg hatching 5-7 weeks later, and fledging about 2-2 1/2 months later. Turkey Vultures are scavengers and provide the important ecological function of accelerating the decomposition process and the recycling of carbon and nutrients back into the ecosystem. The Turkey Vulture was sighted once in sagebrush south of the buying station, once in grassland of the site and three individuals were seen north of the site in grassland in spring. One individual was sighted in pinyon-juniper about 2 miles northeast of the site in summer. No evidence of local cliff nesting was found.

Great Horned Owl - The largest resident owl in Utah, the Great Horned Owl (*Bubo virginianus*) establishes territories in November, mates in December and January, with egg hatching from February through April, and fledging occurring 2-2 1/2 months later. The diet consists almost entirely of mammals. Jackrabbits, cottontails, and kangaroo rats are principal prey items. Birds, amphibians, reptiles, fish, and insects are also eaten. This species fills an important niche as a nocturnal and crepuscular counterpart to diurnal raptors.

No sightings were made of this species, but a pellet was found one mile west of the site in summer. Nests could occur in the area. Nests are inconspicuous, usually in potholes of cliffs, and without the usual white wash evident at other raptor cliff-nest sites. Great horned owls also nest in remote abandoned buildings.

Mammals

Mammals are discussed below under the headings: big game, livestock, predators, rabbits, rodents and bats. A list of species potentially occurring in the project vicinity, based upon general distributions, is in Appendix D.

Big Game - The Mule Deer (*Odocoileus hemionus*) is an important and significant species in the structure and function of the project vicinity's ecosystem. Deer undoubtedly constitute a significant proporation of the faunal biomass on a seasonal basis. Deer are an economic resource of the area and offer recreation for hunters and nature lovers.

Mule Deer inhabit the project vicinity and adjacent canyons during winter. They spend the diurnal hours resting in pinyon/juniper habitat located adjacent to the site's east and west boundary. They move out into sagebrush and sagebrush/grass areas of the site to feed at dawn and dusk, probably being more active in the evenings. Numerous pellet groups and shed antlers were observed in sagebrush and pinyon/juniper habitats, attesting to high winter use. Mule Deer bucks shed their antlers in January and February of each year. Winter deer use of the project vicinity, as measured by browse utilization, is among the heaviest in southeastern Utah and is estimated at 61 deer days use per hectare (25 deer days use/acre) in the pinyon-juniper-sagebrush type in the project vicinity (Personal Communication, Mr. Larry J. Wilson, Supervisor Southeastern Region Utah Division of Wildlife Resources, July 27, 1977). This heavy browse utilization may be from light use by a large number of deer or heavy use by a small number of deer. Since the Utah Division of Wildlife resources does not fly witner aerial censuses, the present size of the local herd is not known.

In addition to winter use, the project vicinity is heavily used as a migration route. Daily movement of deer has been observed between Westwater Creek and Murphy point (Personal Communication, Mr. Larry Wilson). The deer move across the project site to Murphy point to winter (see Plate 2.8-3).

Livestock - The project site lies in the White Mesa Grazing Allotment of the Moab District of the U.S. Bureau of Land Management. The Allotment supports an estimated 4,531 AUM's, being grazed by about 755 cattle from December 1 to May 31. The entire area is only in fair condition due to a past history of overgrazing.

Predators - There are seven species of mammalian predators that may contribute to the structure and function of the project vicinity's ecosystem: the Coyote (*Canis latrans*), Red Fox (*Vulpes vulpes*), Gray Fox (*Urocyon cinereoargenteus*), Striped Skunk (*Mephitis mephitis*), Badger (*Taxidea taxus*), Longtail Weasel (*Mustela frenata*), and Bobcat (*Lynx rufus*). Structurally, these predators occupy the ecological niche of secondary and tertiary consumers and sit at the apex of the pyramid of biomass and at the top of the food web. Functionally, predators reduce numbers of herbivores and complete the nutrient cycle. Of the species named, the Coyote probably is the dominant influent. Coyote scats were observed on the site and have been trapped on the site and in adjacent areas and sold to furriers (Personal Communication, Mr. Bryan Holt, October 13, 1977).

The Coyote is active year around and is primarily nocturnal but occasionally seen during the day. They are generally solitary but may hunt in pairs. Rodents and rabbits are principal prey items but Coyotes are omnivorous and will eat berries, insects, carrion, game animals and domestic sheep (Lechleitner, 1969). The hunting route is normally about 10 miles but may be up to 100 miles (Burt and Grossenheider, 1964). Coyotes mate from January through February and pups are born in April and May. Litter size averages 5-6 but may be inversely related to population density (McMahan, 1975). The Coyote has lived 18 years in captivity (Burt and Grossenheider, 1964).

The Longtail Weasel is probably the most common and widely distributed mammalian predator in Utah. Burt and Grossenheider (1964) state it is found in all land habitats near water. However, free water availability does not necessarily limit the distribution of this species. Utah individuals have been observed in burrows 3 miles from the nearest perennial water. Assuming a home range of 30-40 acres (Burt and Grossenheider, 1964), the Utah observations indicate that Longtail Weasels are not dependent on free water. Physiologically, it should be possible for weasels to maintain water balance from prey body fluids. Weasels, which may be active anytime, feed mostly on small mammals and birds. Mating takes place from July through August and the young are born the following spring. The longtail weasel is of minor economic importance. They occasionally raid poultry houses but also kill many small rodents.

Bobcats may also occur in the area. This species is nocturnal and seldom seen. None was observed during this study but the boulder strewn cliffs to the west and east of the site appear to be suitable habitat. Tracks were seen at a stock pond within 3 miles of the site. The Bobcat is solitary (Sparks, 1974) and feeds on small mammals, birds and untainted carrion (Burt and Grossenheider, 1964). Reptiles and amphibians are also taken (Lechleitner, 1969). Mating takes place in late winter and spring. The kittens (2-4) are born any month and leave their mother in autumn or the following year. Bobcats usually wander within a 2-mile radius but may wander 25-50 miles (Burt and Grossenheider, 1964). The Bobcat has economic value. Its fur is sought by trappers (Sparks, 1974) and an ESSA survey indicated 1977 wholesale pelt prices ranged from $90-$100/pelt (USDI, 1977). Individuals may raid poultry houses of farms and ranches (Lechleitner, 1969) but Bobcats also destroy many rodents. Due to declining numbers, the Bobcat is now under total state protection in Utah (Utah Div. Wildlife Resources, 1977).

The two fox species, Striped Skunks, and Badgers are probably only minor predator influents in the site vicinity based on the lack of evidence for their presence. However, lack of evidence of the presence of these species does not mean that they do not occur in the area. The Red Fox had declining populations in 1952, while the Gray Fox occurred "sparingly" (Durant, 1952). These species prefer mountainous terrain, which implies site habitat is only marginally suitable. Possible fox scats were observed on the site. Frischknecht (1975) did not mention foxes in his discussion of predators within the pinyon-juniper ecosystem. Armstrong (1972) and Lechleitner (1969) both reported the Gray Fox as an inhabitant of Pinyon-Juniper in Colorado. The lack of Striped Skunk roadkills in the region suggests that the area may be too arid for this species, which commonly frequents irrigated farms. The Badger den has a characteristic entrance configuration and badgers dig rodents out of their burrows. No den entrances or digging were seen on or around the project site.

Rabbits are important to the functioning of an ecosystem in ways similar to those of rodents discussed in the next section. Rabbits are particularly important prey of Coyotes and buteos. Cottontail rabbits are classified as small game by the State of Utah and provide recreation and food for hunters.

Rabbits were uncommon in 1977, as indicated by the results of the roadside rabbit survey (Table 2.8-11). Cottontail burrows were evident with highest concentrations noted in sagebrush habitat. Blacktail Jackrabbits were occasionally seen during all seasons.

TABLE 2.8-11

BLANDING RABBIT TRANSECT COUNTS

Species	Seasonal Number of Individuals Observed/Mile[a]			
	Winter	Spring	Summer	Fall
Desert Cottontail	0.06	0.00	0.13	0.06
Blacktail Jackrabbit	0.00	0.00	0.13	0.00

[a]40 Total Miles Driven

Rodents - Rodents are important to the functioning of an ecosystem in a number of ways. They aid in the propagation of plants by seed dispersal in scats and caches. They increase plant productivity through fertilizing nutrients, such as soluble salts, in their scats and by burrowing. Burrows facilitate the penetration of water and oxygen to greater depths and their mixing of soil horizons increases soil water-holding capacity. These burrows also provide hibernation places for lizards and snakes. Rodents constitute an important prey base for mammalian carnivores, raptors and snakes. Finally, rodents can, in times of population increase, influence the success of reclamation efforts.

Nine species of rodents were trapped or observed during this study. The distribution and relative abundance by habitat of each of these species is shown in Table 2.8-12. Actual trap data are shown in Table 2.8-13. The Deer Mouse was the most abundant rodent and accounted for 52 percent of the individual rodents trapped. The Deer Mouse also had the greatest distribution on the site. In contrast, only one Gunnison Prairie Dog and one Northern Grasshopper Mouse were recorded on the site. Note that abundance for all rodents was low compared to studies in similar Upper Sonoran areas and that designations of abundance in Table 2.8-12 are relative between and within habitats on the site. Although

TABLE 2.8-12

RODENT DISTRIBUTION AND RELATIVE ABUNDANCE BY HABITAT

	Grassland	Sagebrush/Grassland	Sagebrush	Pinyon/Juniper	Tamarisk/Grass
Gunnison Prairie Dog	R		C	A	
Whitetail Antelope Squirrel	U		C	A	
Least Chipmunk				C	
Colorado Chipmunk				C	
Silky Pocket Mouse	C	A	U		
Ord Kangaroo Rat			U	C	C
Deer Mouse	C	C	A		C
Pinyon Mouse				A	
Northern Grasshopper Mouse		R			
Whitethroat Woodrat	U			U?	

A = Abundant
C = Common
U = Uncommon
R = Rare
? = None trapped, but middens indicate presence

TABLE 2.8-13

RODENT GRID AND TRANSECT TRAPPING DATA

Habitat/Species	No. Trapped Per 100 Trap Nights (Days)	Habitat Trapping Success %	Individuals Trapped	Recaptures	Minimum Density (No/HA)	Sex Ratio M:F	Average Weight (g)	Minimum Estimated Biomass (g/HA)
Sagebrush		7						
Deer Mouse	4		16	21	4.9	9:7	18.1	89.4
Silky Pocket Mouse	<1		4	0	1.2	3:1	7.8	9.3
Whitetail Antelope Squirrel	1		6	5	1.8	2:4	99.3	183.9
Ord Kangaroo Rat	<1		3	2	0.9	2:1	50.0	45.0
Sagebrush/Grass		2						
Deer Mouse	2		7	6	2.2	4:3	18.5	40.0
Silky Pocket Mouse	<1		2	1	0.6	1:1	10.0	6.2
Northern Grasshopper Mouse	<1		1	0	0.3	1:0	19.8	5.9
Grass		2						
Deer Mouse	1		6	3	1.8	5:1	19.2	34.6
Silky Pocket Mouse	1		9	1	2.8	5:4	9.0	25.0
Tamarisk/Grass		5						
Deer Mouse	5		2	0	2.3	2:0	18.2	41.4
Pinyon/Juniper		13						
Pinyon Mouse	4		2	0	2.3	2:0	20.8	47.8
Whitetail Antelope Squirrel	4		2	0	2.3	0:2	104.1	239.4
Ord Kangaroo Rat	2		1	0	1.1	1:0	50.4	55.4
Colorado Chipmunk	2		1	0	1.1	0:1	47.0	51.7
Least Chipmunk	2		1	0	1.1	0:1	49.0	53.9

rodent populations cycle through periods of abundance and scarcity, it is unlikely that different species would exhibiting synchrony in their population cycles. Thus, it appears that the site was not particularly productive of rodents in 1977. The fact that this was an exceptionally dry year may have been a contributing factor in limiting rodent production.

Species diversity is a measure of the probability of encountering an individual of a given species among all the species present in an area. Rodent species diversity from the trap data, as measured by the Shannon-Wiener formula (Smith, 1974), increased in the order: tamarisk/grass (0.00), Grassland (1.00), sagebrush/grassland (1.30), sagebrush (1.64), Pinyon-Juniper (2.24). Greater species diversity usually is an indication of greater ecosystem stability. Given the relative degrees of disturbance in each of the project site habitats, the relative diversity values are as would be expected. With the exception of the tamarisk/grass habitat, the species diversity increases with increasing spatial diversity. Rodent species diversity by habitat was also positively correlated with minimum estimated rodent biomass (Table 2.8-13) by habitat ($r = 0.83$, $p < 0.01$). In other words, the habitats with more kinds of rodents also produced more grams of rodents.

Bats - No bats were observed in the Blanding area during field work. A list of species potentially present in this vicinity is in Appendix D.

Endangered and Threatened Species

Two currently recognized endangered species (USDI, 1977) plus one formerly considered to be endangered could conceivably occur in the project vicinity. However, the probability of habitation is low considering the food requirements of each of these species. The Black-footed Ferret (Mustela nigripes) preys primarily on Black-tailed Prairie Dogs which do not occur in Utah. Only one specimen of the ferret has been recorded from Utah in San Juan County and that prior to 1952. This specimen was from the D. Bayliss Ranch, 2 miles south of Blanding (Durrant, 1952). Utah State Division of Wildlife Resources records indicate only one unverified ferret sighting since 1952 near Vernal, Utah. The Division feels it is highly unlikely that this animal occurs in Utah (Linder and Hillman, 1973).

The American Peregrine Falcon (Falco peregrinus anatum) preys on passerine birds, waterfowl, and shorebirds (Snow, 1972). The lack of significant aquatic habitat in the project vicinity indicates a low probability for occurrence of this species. However, an eyrie has been discovered about 30 miles west of Blanding in a desert rim-rock habitat (Personal Communication, Al Heggens, Chief of Research in Non-Game Animals Utah Division of Wildlife Resources, December 14, 1977). This species may hunt the Blanding area during migrations.

The Spotted Bat (Euderma maculatum) is a rare inhabitant of the region which has been removed from the Endangered Species List. Habitat requirements appear to include sedimentary cliffs in proximity to water (Snow, 1974). The lack of such habitat in the project area probably indicates the absence of this species.

The Utah Division of Wildlife Resources reports the Abert's Squirrel (Sciurus aberti) as a species limited by habitat availability. This species occurs in Ponderosa Pine habitat around Monticello, Utah. None is expected in the project area since there is no Ponderosa Pine habitat.

2.8.3 Ecology of Hanksville Buying Station Vicinity

2.8.3.1 Ecology of Hanksville Region

Vegetative associations occurring on the Hanksville site and within a 25-mile radius of the site are characteristic of the Northern Desert Shrub formation, the most widely distributed vegetation in Utah and Nevada (Shantz, 1925). A formation used in the following discussions refers to a grouping of plant communities whose distribution is largely influenced by climatic factors. In the arid region of Hanksville, climatic factors are most affected by altitude. An association is defined as groupings of plant communities, whose distribution is locally affected by soils and available moisture (Hunt, 1953). In the Hanksville region, plant associations cover large areas usually dominated by one species for which the association is named. On large portions of the desert surrounding the Henry Mountains below 5,000 ft. (about 14 miles directly SSW of the Hanksville site) and on the site, the shadscale (Atriplex sp.) and Blackbrush (Colegyne ramoissima) associations occur. In areas with high salinity along streams below 5,000 ft, greasewood (Sarcobatus sp.) occurs (Hackman, 1973). The Big Sagebrush association and Pinyon-Juniper Woodland associations occur at higher elevations (5000 to 7000 ft), as on the Blanding site.

The shadscale association is characterized by Shadscale Saltbrush (Atriplex confertifolia) and Galleta Grass (Hilaria jamesii), the two dominant species, although Mormon Tea (Ephedra torreyana) and Single-leaf Ash (Fraxinus anomala) also may occur as co-dominants on sandstone dip slopes and mesa tops. The shadscale association occurs from the lower edge of the Big Sagebrush Association to alkali bottomlands and the desert floor. It is found on alluvial soils of stream terraces, flood plains, sandstone dip slopes and mesas and flats of sandy desert. The shrub layer reaches about 18 inches in height and shrubs are spaced a few feet apart. Shadscale is a shallow rooted shrub that prefers areas of low salt concentration in the upper soil layers and tolerates higher alkalinity in the deeper layers. During prolonged periods of drought, shadscale may be temporarily replaced as the dominant species by Broom Snakeweed (Gutierrezia sarothrae) (Shantz, 1925). Common shrubs in this association include Atriplex canescens, Atriplex powellii, Atriplex cuneata, Atriplex graciliflora, Eurotia lanata, Gutierrizia sarothrae and Chrysothamnus sp. (Hunt, 1953).

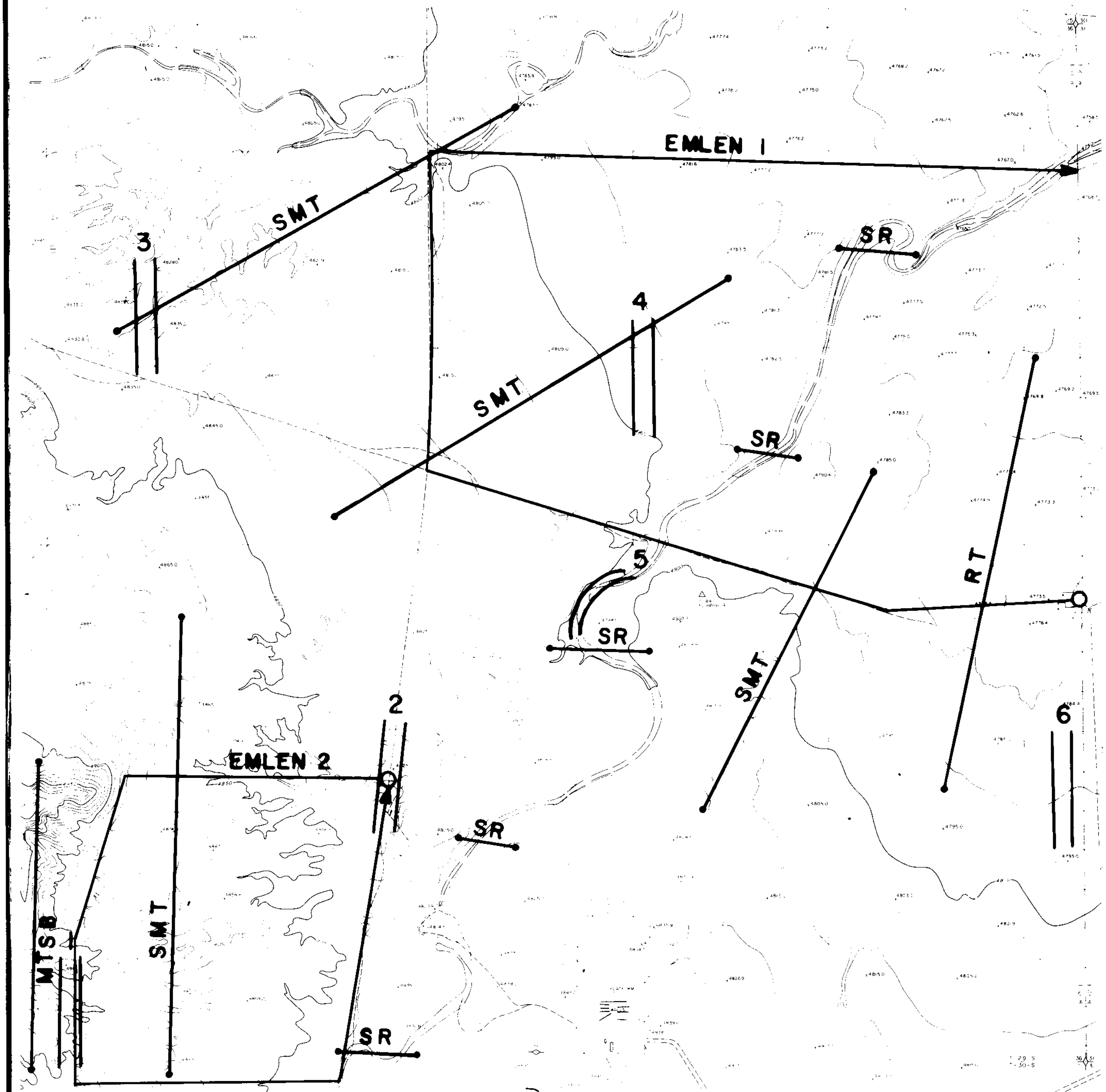
The Blackbrush association also covers large areas of desert in the region. The Blackbrush association usually occurs on sandier soils and lower areas of the desert than the shadscale association. Sometimes this is reversed as occurs on the Hanksville site. Common shrubs in this association include Ephedra nevadensis, Ephedra viridis, Yucca harrimaniae, Gutierrizia sarothrae and Chrysothamnous sp. (Hunt, 1953).

Within the Northern Desert Shrub formation, rodents are the most common mammals. Large mammals are generally absent, although Mule Deer occur in small localized numbers. Common rodents include pocket mice, kangaroo rats, deer mice, kangaroo mice, woodrats and Antelope Ground Squirrels. Blacktail Jackrabbits and Desert Cottontails also are common. Predators include Badgers, foxes, Coyotes and Bobcats. Generally, birds are scarce in this formation but the greatest species numbers occur along wastes or water where vegetation diversity offers more habitats. Dominant bird species include Red-tailed Hawk, Mourning Dove, Great Horned Owl Loggerhead Shrike and Black-throated Sparrow, Prairie Falcon and Swainson's Hawk (Kendeigh, 1961; Shelford, 1963).

2.8.3.2 Vegetation of Hanksville Buying Station Vicinity

Community Structure

The plant communities occurring in the vicinity of the Hanksville buying station are physiognomically similar, being dominated by the shrub layer and large spaces of bare ground between shrubs. These communities were distinguished in this study by species composition, occurrence on soil type and the degree of disturbance of the area. Vegetation sampling locations are indicated on Plate 2.8-4. Plant distribution on the site is influenced by geology, soils and available water. The topography of the Hanksville buying station vicinity is gently rolling alluvial fans on the east that becoming hilly toward the west and extend to a series of eroded shallow soil covered breaks or cliffs on the west. Relief is fairly flat, elevations range from 4760 feet msl on the alluvial fans to the east of the station to 4913 feet on the breaks in the west of the site. Annual mean precipitation in the area is 6 in with an approximate 180-day growing season (see Section 2.7.3). May and June receive the least amount of rainfall during the growing season; the most rainfall for one month occurs in August and September (NOAA, 1977). Due to the uneven distribution of precipitation in summer and winter, two phenological groups of plants occur in the region, warm season plants that utilize summer precipitation and begin growth in May and mature in September and cool season plants that utilize water stored in the soil during winter for initial growth and mature by May or June or become dormant if sufficient water is not present.



HANKSVILLE ECOLOGY SAMPLING LOCATIONS

VEGETATION

Transect Location

SMT - Snakeweed - Mormon Tea - Shadscale Community
SR - Snakeweed - Rabbitbrush Community
RT - Russian Thistle Community
MTSB - Mormon Tea - Shadscale - Blackbrush Community

WILDLIFE

Small Mammal Live - Trapping Transect Location

1 Mormon Tea/Shadscale/Steep Breaks
2 Mormon Tea/Shadscale/Gentle Breaks
3 Shadscale/Sagebrush
4 Mormon Tea/Grass
5 Rabbitbrush Wash Bottom
6 Grassland

Modified Emlen Bird Transects

Emlen I - Mormon Tea - Grass Bird Transect
Emlen 2 - Mormon Tea - Shadscale Bird Transect

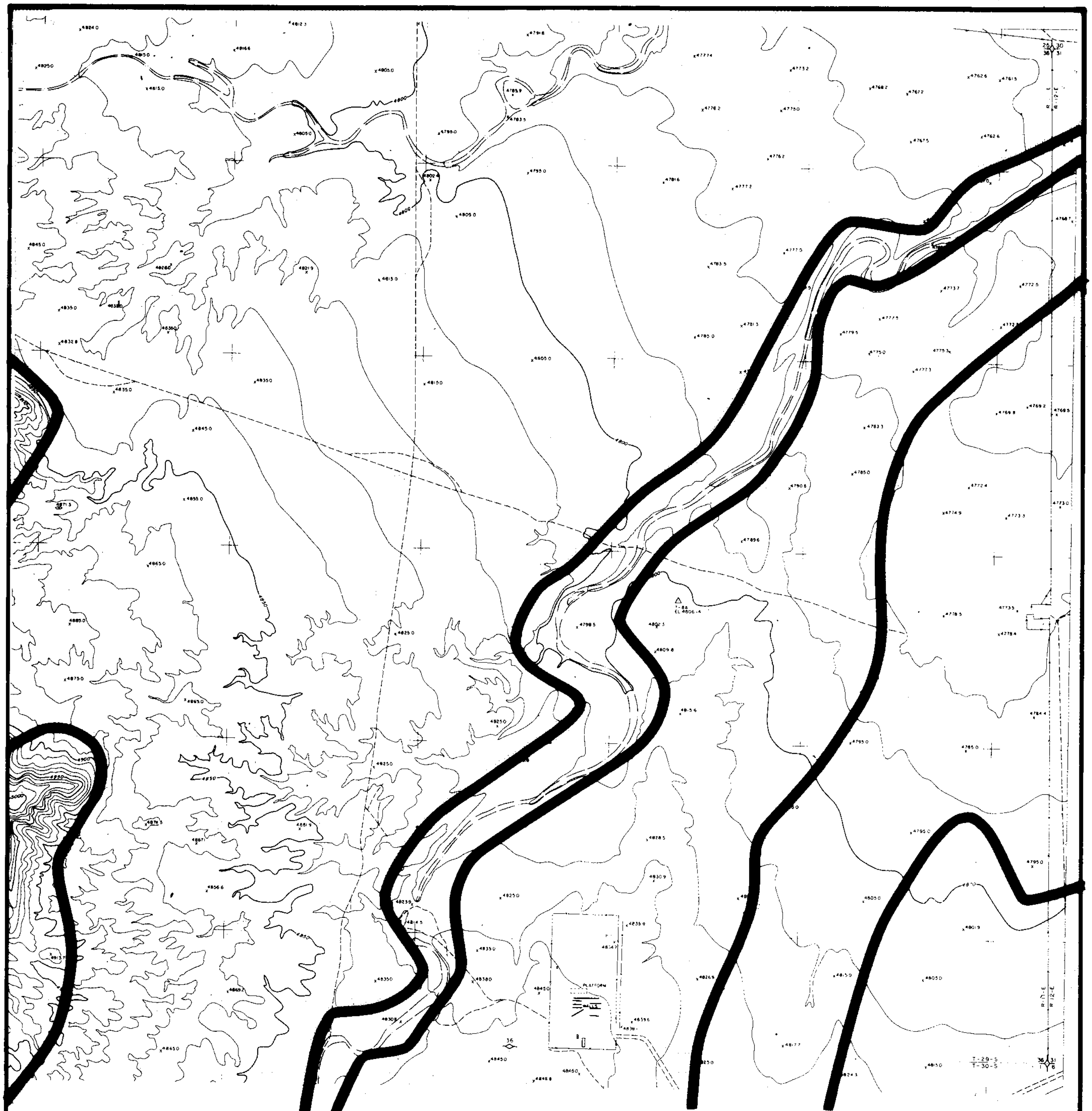
O⟶ origin - O direction of travel ⟶

N

SCALE 1: 418750

Four plant communities occur on the site, three are associated with the Shadscale association and one with the Blackbrush association, both of which were discussed above. These communities are named according to the dominant shrub species present and that which gives the community its general appearance. The communities are the Snakeweed-Mormon Tea-Shadscale type, the Russian Thistle type (Salsola kali), and Snakeweed-Rabbitbrush type, all of which are components of the shadscale association and the Mormon Tea-Shadscale-Blackbrush type, part of the Blackbrush association. The communities are grouped into the two associations based upon species composition, distribution of the associations in the region (Hackman, 1973) and distribution on soil types. The Snakeweed-Mormom Tea-Shadscale type covers 79 percent of the vicinity studied, 504 acres; the Snakeweed-Rabbitbrush type, occurring along a wash dissecting the site, covers 6 percent or 42 acres of the area, the Russian Thistle type covers 13 percent or 80 acres on an old dry lake bed and the Mormon Tea-Shadscale-Blackbrush type occurs on the breaks, covering 2 percent or 14 acres. All the communities except the Shadscale-Mormon Tea-Blackbrush type occur on alluvial fans on the Neskahi (like), Rairdent (like) and unnamed, soil types (see section 2.10.2 for a detailed description of soils). The Shadscale-Mormon Tea-Blackbrush type occurs on the eroded badland breaks. Plate 2.8-5 outlines the distribution of these communities in the study area and Table 2.8-14 contains a list of species found on the site. Section 6.1.4.3 includes a description of the sampling methods and locations used in analyzing the vegetation.

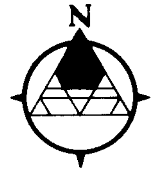
The Snakeweed-Mormon Tea-Shadscale community is dominated by several shrubs, the dominant Broom Snakeweed, and sub-dominants Mormon Tea and Shadscale Saltbush (Table 2.8-15). Generally, Shadscale Saltbush and Mormon Tea would be expected to be dominant shrubs in communities of the Shadscale association. However, within the community sampled these dominants were distributed into subtypes reflecting varying salt levels in the soils, varying salt tolerences of the species and moisture content of the soils. Within this community three soil types occur: the Neskahi (like), Rairdent (like), Cambic Gypsiorthid fine loamy-mixed and unnamed (see Section 2.10 for specific soil descriptions). Analysis of these



VEGETATION MAP OF THE HANKSVILLE SITE

COMMUNITY TYPE

- SNAKEWEED-MORMON TEA-SHADSCALE
- MORMON TEA-SHADSCALE-BLACKBRUSH
- SNAKEWEED-RABBITBRUSH
- RUSSIAN THISTLE



DAMES & MOORE

PLATE 2.8-5

TABLE 2.8-14

SPECIES COMPOSITION OF COMMUNITIES
SAMPLED AT THE HANKSVILLE SITE

Scientific Name[a]	Common Name	Community of Occurrence[b]
Grasses and Grasslike Plants		
Aristida longiseta	Red Threeawn	SR
Hilaria jamesii	Galleta Grass	SMS;SR;RT;MTSB
Oryzopsis hymenoides	Indian Ricegrass	SMS;SR;MTSB
Sporobolus airoides	Alkali Sacaton	SR
Forbs		
Dalea polygonoides	Sixweeks Dalea	SMS;SR;MTSB
Eriogonum inflatum	Desert Trumpet Eriogonum	RT: MTSB
Eriogonum jamesii	James Eriogonum	SMS;SR
Eriogonum microthecum	Slenderbush Eriogonum	SMS
Eriogonum ovalifolium	Cushion Eriogonum	MTSB
Euphorbia fendleri	Fendler Spurge	SR;MTSB
Heterotheca villosa	Telegraph-plant	RT
Lepidium fremontii	Fremont Pepperweed	SMS;SR;MTSB
Phlox caepitosa	Tufted Phlox	SMS;MTSB
Salsola kali	Russian Thistle	SMS;SR;RT
Wyethia scabra	Badlands Wyethia	MTSB

TABLE 2.8-14 (Concluded)

Scientific Name	Common Name	Community of Occurrence
Shrubs		
Artemesia filifolia	Sand Sagebrush	SMS;SR
Atriplex canescens	Fourwing Saltbush	SR
Atriplex confertifolia	Shadscale Saltbush	SMS;SR;MTSB
Chrysothamnous nauseous	Rubber Rabbitbrush	SR
Coleogyne ramossissima	Blackbrush	MTSB
Ephedra torreyana	Torrey Ephedra	SMS;SR;MTSB
Gutierrezia sarothrae	Broom Snakeweed	SMS;SR
Opuntia polyacantha	Plains Pricklypear	SMS;SR
Sarcobatus vermiculatus	Black Greasewood	SMS
Forbs		
Tamarix pentandra	Tamarisk	SR

[a] Nomenclature follows Nickerson, Mona F., Glen E. Brink and Charles Feddema, 1976; "Principal Range Plants of the Central and Southern Rocky Mountains, January 1976, the USDA Forest Service General Technical Report Rm-20 and identifications were verified at the Rocky Mountain Herbarium, University of Wyoming.

[b]
SMS Snakeweed-Mormon Tea-Shadscale Community Type
SR Snakeweed-Rabbitbrush Community Type
RT Russian Thistle Community Type
MTSB Mormon Tea-Shadscale-Blackbrush Community Type

TABLE 2.8-15

COMMUNITY STRUCTURE OF THE HANKSVILLE SITE PLANT COMMUNITIES

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
SNAKEWEED-MORMON TEA-SHADSCALE					
Group Species					
Grasses and Grasslike Plants					
Hilaria jamesii	66.7	3.9	23.7	26.9	117.3
Oryzopsis hymenoides	3.7	1.0	6.0	6.6	16.3
Total		4.9			
Forbs					
Dalea polygonoides	0.3	0.5	3.1	3.3	6.7
Eriogonum jamesii	0.3	0.5	2.7	1.1	4.1
Eriogonum microthecum	0.5	0.5	3.2	2.2	5.9
Lepidium fremonti	3.7	0.7	4.3	9.9	17.9
Phlox caepitosae	4.7	0.5	3.4	8.2	16.3
Salsola kali	3.4	0.2	1.1	4.9	9.4
Total		2.9			
Shrubs					
Atriplex confertifolia	2.6	1.4	8.4	9.9	20.9
Artemesia filifolia	0.2	0.1	0.6	0.5	1.3
Ephedra torreyana	2.2	2.8	17.2	7.7	27.1
Gutierrezia sarothrae	11.3	3.4	20.9	17.6	49.8
Opuntia polyacantha	0.5	0.3	1.5	1.1	3.1
Total		8.00			
Lichen		0.6	3.7		3.7
Total Vegetative Cover		16.4			
Bare Ground		74.1			
Rock		4.0			
Litter		5.2			

TABLE 2.8-15 (Continued)

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
SNAKEWEED-RABBITBRUSH					
Grasses and Grasslike Plants					
Aristida longiseta	23.1	0.6	3.1	4.5	31
Hilaria jamesii	40.3	2.6	13.2	20.5	74
Oryzopsis hymenoides	1.5	0.4	2.1	2.3	6
Sporobolus airoides	9.0	2.3	11.7	11.4	32
	Total	5.9			
Forbs					
Dalea polygonoides	0.7	0.7	3.5	4.5	9
Eriogonum jamesii	1.5	0.8	4.1	6.8	12
Lepidium fremontii	0.7	0.1	0.6	2.3	4
Salsola kali	1.5	0.2	1.0	2.3	5
	Total	1.8			
Shrubs					
Artemesia filifolia	3.0	1.5	7.6	9.1	20
Artiplex canescens	0.7	0.1	0.4	2.3	3
Chrysothamnous naseosus	3.0	5.7	29.4	9.1	42
Ephedra torreyana	0.7	0.6	3.1	2.3	6
Gutierrezia sarothrae	12.7	2.3	11.9	18.2	43
Opuntia polyacantha	0.7	0.4	2.1	2.3	5
	Total	10.6			

TABLE 2.8-15 (Continued)

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
SNAKEWEED-RABBITBRUSH (Continued)					
Trees					
Tamarix pentandra	0.7	1.2	6.2	2.3	9
Total Vegetative Cover		17.9			
Bare Ground		60.0			
Rock		10.6			
Litter		10.4			
RUSSIAN THISTLE					
Grasses and Grasslike Plants					
Hilaria jamesii	42.0	1.4	59.0	32.4	133.4
Total		1.4			
Forbs					
Eriogonum inflata	2.0	0.1	4.9	8.1	15.0
Salsola kali	56.0	0.9	36.1	59.5	151.6
Total		1.0			
Total Vegetative Cover		2.4			
Bare Ground		95.5			
Rock		0.3			
Litter		1.7			
MORMON TEA-SHADSCALE-BLACKBRUSH					
Grasses and Grasslike Plants					
Hilaria jamesii	42.2	2.2	12.4	18.2	72.8
Oryzopsis hymenoides	1.6	0.2	1.1	3.0	5.7
Total		2.4			

TABLE 2.8-15 (Concluded)

Parameter	Relative Density	Percent Cover	Relative Cover	Relative Frequency	Importance Value
COMMUNITY					
Forbs					
Dalea polyacantha	1.6	0.4	2.3	3.0	6.9
Eriogonum inflata	23.4	0.2	1.1	3.0	27.5
Lepidium fremontii	1.6	0.2	1.1	3.0	5.7
Phlox caespitosa	6.3	1.4	7.9	9.1	23.3
Wyethia scabra	1.6	0.4	2.3	3.0	6.9
	Total	2.6			
Shrubs					
Atriplex confertifolia	10.9	3.0	16.9	21.2	49.0
Coleogyne ramoissima	3.1	2.2	12.4	9.1	24.6
Ephedra torryana	7.8	6.8	38.4	15.0	61.2
	Total	12.0			
Lichen		0.7	3.9	12.1	16.0
Total Vegetative Cover		17.7			
Bare Ground		72.1			
Rock		4.8			
Litter		5.3			

soils showed varying alkalinities in the upper 30 in (76 cm). On the Neskahi (like) and unnamed soils, salt levels were low (i.e., ECe values of 3 or less in the upper 30 in; see Table 2.10-2) and Broom Snakeweed was the dominant shrub sampled. Shadscale saltbush and Mormon Tea, however, were the co-dominants in the samples occurring on the Rairdent (like) Combic Gypsiorthid fine-loamy mixed soil. Analysis indicated that this soil type contained moderately high salt levels (i.e., ECe of over 5 in the first 30 in; see Table 2.10-2 for complete analysis of the soils). Based upon similarity indices of Jaccard (Mueller-Dombois and Ellenbergy, 1974), these subtypes are similar (Is_J = 79 percent) and belong to the same community. Although forbs were abundant in the grass-forb layer, grasses were the dominant life form group based upon importance values (Table 2.8-15). Galleta Grass, a salt tolerant grass, was the dominant grass species, vegetative cover was low (16.4 percent of cover) while bare ground made up 74 percent and rock and litter 9.2 percent.

Only three species occurred in the Russian thistle type that occurred on the old lake bottom to the east of the site. These are the very salt tolerant, Hilaria jamesii, Eriogonum inflata and Salsola kali. The occurrence of these three species was very sparse. Vegetative cover made up only 2.4 percent of cover while bare ground made up 95.5 percent and, rock and litter 2.0 percent. Russian Thistle, a species preferring disturbed areas and classed as a weed (Holmgren and Anderson, 1970) was the dominant species. This community occurs on the Rairdent (like) Cambic Cypsiorthid fine-loamy, mixed, calcareous soil type. Chemical analysis of this soil showed the highest salt content of any soil types on the site.

The Snakeweed-Rabbitbrush community occurs along the wash that dissects the site. This community is also dominanted by the shrub layer, Broom Snakeweed and Rubber Rabbitbrush are the dominant species based upon importance values (Table 2.8-15). Most vegetative cover was made up by shrubs, 10.6 percent. Sixty percent of cover measured was bare ground while rock and litter made up 21 percent, reflecting the large amount of debris carried through the wash during flood stage. The only tree species on the area was in this community, Tamarisk (Tamarix pendra).

The Mormon Tea - Shadscale-Blackbrush community occurs on the badly eroded breaks on the west side of the area. This community is dominated by Mormon Tea (Ephedra torreyana) and Shadscale Saltbrush (Atriplex confertifolia). Blackbrush, which is the dominant species in communities of the Blackbrush association occurs as a less important species. Vegetation in this community is sparsely distributed, Galleta Grass was the most important species sampled in the grass and forb layer (Table 2.8-15). Seventy-two percent of ground cover was bare ground and 10 percent rock and litter.

Vegetative Production

Production studies were conducted during the 1977 growing season on each of the plant communities sampled. Section 6.1.4.3 describes the sampling methods used. Only a trace of production (less than $3g/10m^2$) was apparent on two communities (the Snakeweed-Mormon Tea-Shadscale community and Snakeweed-Rabbitbrush Community) and none on the remaining communities sampled. The only species showing even a trace of production were Dalea polygonoides, Pheox caepositsoa and Atriplex confertifolia.

Although no other site specific data are available on the production of communities in the Hanksville vicinity, expected production values for range sites occurring in the area are discussed below, in order to provide some information on potential production at the Hanksville buying station site.

Two range sites occur in the area studied, the Desert Loam and Desert Sand range sites (SCS, 1971 and 1975). Ninety-two percent of the area is covered by the Desert Loam range site and 6 percent is covered by the Desert Sand range site. The badlands were not considered as range sites since they make up only two percent of the area and the terrain is unsuitable for livestock grazing. Production values discussed below are based upon SCS range site descriptions. In a favorable year with a Desert Loam range site in excellent condition, annual production is expected to be about 750 lbs/acre air-dry plant material, in an average year 650 lbs/acre and in an unfavorable year 500 lbs/acre.

A Desert Sand range site in excellent condition during a favorable year may produce 900 lb/acre, during an average year 625 lbs/acre and an unfavorable year 500 lbs/acre air-dry material. If the range is in poor condition during an unfavorable year production can range from 300 to 35 lbs/acre. The Hanksville site lies in the BLM Hanksville allotment. The area received heavy grazing pressure by sheep and cattle in the 1800s and early 1900s. In 1973, the general condition of the area of the Hanksville site was poor (BLM, no date). Therefore, the low production measured during the unfavorable 1977 year is not unexpected for the site.

Endangered and Threatened Plant Species

No endangered plants in the Federal Register August 11, 1977 and designated endangered and offered special protection by the U.S. Government occur in Utah. Of the species nominated as warranting designation and protection in the Federal Register's June 16, 1976 proposed list, 7 species occur in Utah and in Wayne County. These include *Gaillardia spathulata*, *Sclerocactus wrightiae*, *Astragalus harrisoni*, *Astragalus loanus*, *Astragalus serpens*, *Phacelia indecora*, and *Gilia caespitosa*. Brief descriptions of type localities of these species are listed below. These descriptions were taken from Welsh et al. (1975).

Gaillardia spathulata A. Gray

Habitat - an endemic, common throughout its range, neither threatened nor endangered, found in Carbon, Emery, Garfield, Grand and Wayne counties Utah. Type locality Rabbit Valley, Wayne County at 7,000 feet.

Sclerocactus wrightiae L. Benson

Habitat - an endemic, restricted and rare species found in Emery and Wayne counties. Type locality near San Rafael Ridge, Emery Co., Utah at 5,000 feet.

Astragalus harrisonii Barneby

Habitat - an endemic, rare, known only from the type area, wash below the Natural Bridge near Fruita, Wayne County, about 45 miles west of Hanksville.

Astragalus loanus Barneby

Habitat - an endemic, rare, found in Garfield Piute, Sevier and Wayne counties. Type locality Canyon east of Glenwood, Sevier county. Found on open hillsides among sagebrush in gravelly volcanic soil 6,000-8,900 feet. Apparently known only from the divide between the Sevier and Fremont rivers in Sevier and western Wayne counties (Barneby, 1964).

Astragalus serpens M.E. Jones

Habitat - an endemic, local, and periodically abundance in disjunct populations considered by Welsh et al. neither threatened nor endangered. Found in Garfield, Piute and Wayne counties. Type locality Loa Pass Wayne County about 8400 feet.

Phacelia indecora J.T. Howell

Habitat - an endemic and rare species found in Wayne and San Juan counties. Type locality Bluff, San Juan County. According to Howell (1943) Phacelia indecora is probably restricted to cliff gardens on the bluffs of the San Juan River.

Gilia caespitosa A. Gray

Habitat - an endemic, rare, species found in Wayne County. Type locality Rabbit Valley on barren cliffs of sandstone, Wayne County at 7,000 feet. Specimen in the Garrett Herbarium University of Utah was collected in Wayne County, N side of Boulder Mt. 1 mile SW of Teasdale T29S, R.4E Section 20 at 8,500 feet, on white sandstone in rock crevices on a north facing slope in Juniper-pinyon woodland (Personal communication, Ms. Lois Arnow, Curator, Garrett Herbarium, December 9, 1977).

Although an extensive list and discussion of endangered, threatened, extinct and endemic species of Utah was published in 1975 by Welsh et al., only the species listed above are designated by the Federal government as warranting further study for inclusion on the endangered list of plants and animals.

The other species listed either occur at different altitudes and in different habitats, based upon the type locality, are known only from the type locality or are common throughout their range (Welsh et al., 1975).

2.8.3.3 Wildlife

This section contains baseline information collected through four seasons for the purpose of predicting impacts associated with the continued operation of the Hanksville uranium ore buying station and for formulation of mitigation measures to reduce the magnitude of those impacts. The ensuing discussion concentrates on species actually observed, trapped, or positively known to occur in the vicinity of the buying station from unmistakable sign (for example, scat, tracks and middens). Sampling locations are indicted on Plates 2.8-4 and 2.8-6. A list of species whose general distribution includes the project vicinity and, therefore, that possibly occur on the site is given in Appendix D.

Amphibians and Reptiles

The functions of amphibians and reptiles in ecosystems are discussed in Section 2.8.2.1. No amphibians were observed during field work and the scarcity of free water limits the potential use of the Hanksville site by amphibians. Great Basin spadefoot toads (*Scaphiopus intermontanus*) and Woodhouse's toads (*Bufo woodhousei*) occur in the area, possibly being the most xeric-adapted of Utah amphibians.

Based on general distributions (Stebbins, 1966), any of seven species of lizards and five species of snakes (see Appendix D) could

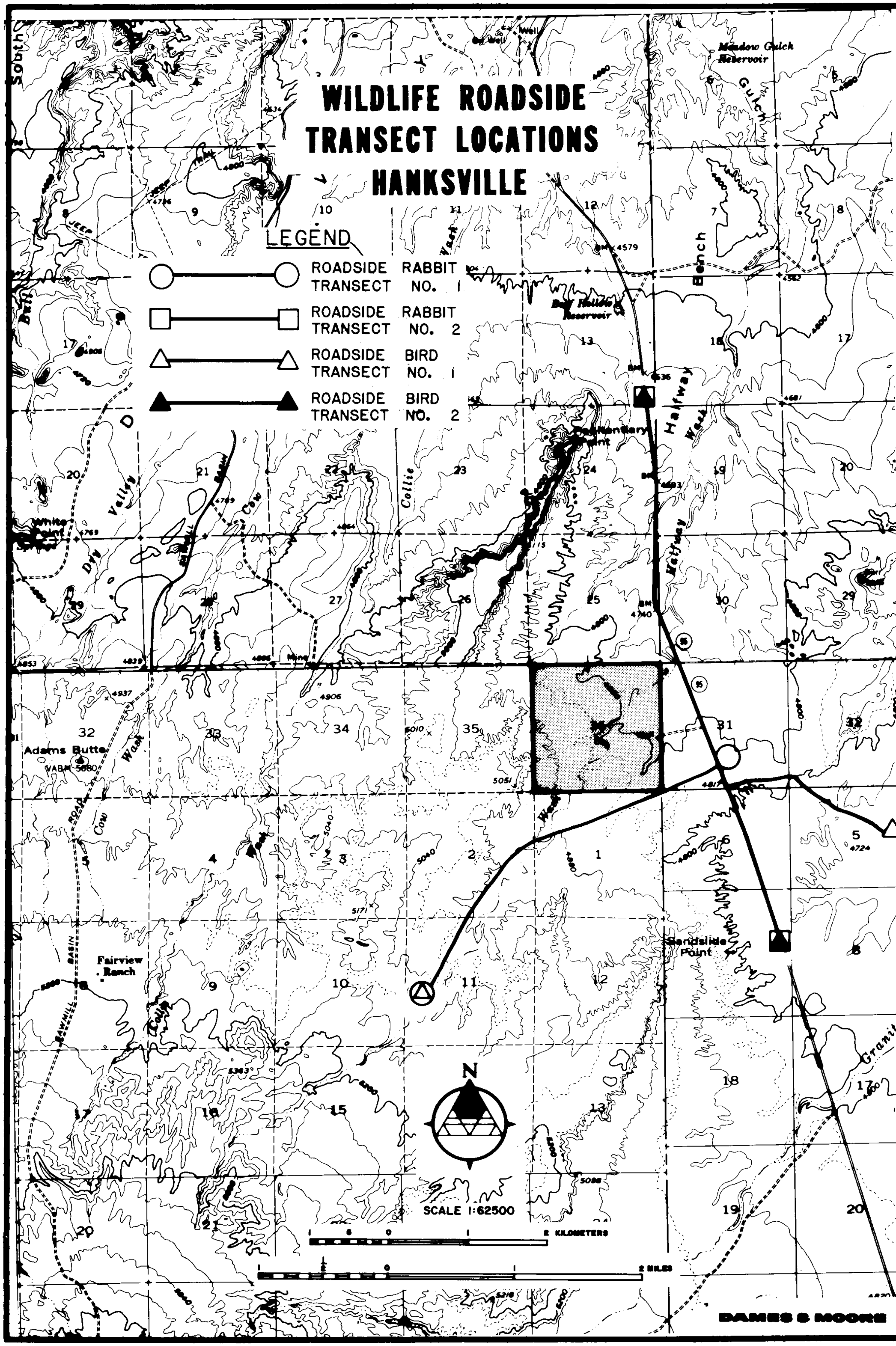

WILDLIFE ROADSIDE
TRANSECT LOCATIONS
HANKSVILLE
LEGEND
ROADSIDE RABBIT TRANSECT NO. 1
ROADSIDE RABBIT TRANSECT NO. 2
ROADSIDE BIRD TRANSECT NO. 1
ROADSIDE BIRD TRANSECT NO. 2
N
SCALE 1:62500
2 KILOMETERS
2 MILES
Adams Butte
Fairview Ranch
Halfway Wash
Halfway Bench
Sandslide Point
Meadow Gulch Reservoir
DAMES & MOORE

PLATE 2.8-6

occur in the project vicinity. The only lizard species observed on the Hanksville site during this survey were the Sagebrush Lizard (Sceloporus graciosus) and the Side-blotched Lizard (Uta stansburiana). Young of the year Sagebrush Lizards were active in October after adults had entered hibernation. Gopher Snakes (Pituophis melanoleucas) and Desert Striped Whipsnakes (Masticophis t. taeniatus) probably occur in the area. Presence of the Midget Faded Rattlesnake (Crotalus viridis concolor) is questionable considering the aridity of the area. No snakes were observed during field work for this report.

Birds

The function and importance of birds in the ecosystem are discussed in Section 2.8.2.2. Only 18 species of birds were observed in four seasons of field work at the Hanksville site (Table 2.8-16). Of these, five species (Table 2.8-17) were seen during transect walks following Emlen (1971) methods. Four additional species (Table 2.8-18) were observed during roadside bird transect counts following methods of Rotenberry and Wiens (1976), and Robbins and Van Velzen (1967 and 1974). Thus, only nine species of birds occurred with any measurable frequency. The Horned Lark was the dominant bird influent during all seasons of 1977.

Only two raptor species were seen in the Hanksville region. A pair of Burrowing Owls (Speotyto cunicularia) was observed in a wash during the summer sampling effort and an American Kestrel (Falco sparverius) was sighted during summer field work. Possible evidence of a Prairie Falcon (Falco mexicanus) eyrie was found in the cliffs about 2.6 miles WNW of the Hanksville ore buying station. At the base of this "eyrie" a few rabbit ribs and some Coyote leg bones were found. It is more likely, however, that this was the roost site of a Red-tailed Hawk (Buteo jamaicensis), Great Horned Owl (Bubo virginianus) or Golden Eagle (Aquila chrysaetos).

Mammals

Mammals are discussed below under the headings: big game, livestock, predators, rabbits, and rodents. The function and importance of

TABLE 2.8-16

HANKSVILLE BIRD INVENTORY

Species	Statewide Relative Abundance[a]	Statewide Status[a]
American Kestrel	C	P
Mourning Dove	C	S
Burrowing Owl	U	P
Common Nighthawk	C	S
White-throated Swift	C	S
Say's Phoebe	C	S
Common Raven	C	P
Common Crow	C	W
Rock Wren	C	S
Loggerhead Shrike	C	S
Western Meadowlark	C	P
Brewer's Blackbird	C	P
Blue Grosbeak	C	S
American Goldfinch	C	P
Black-throated Sparrow	C	S
Sage Sparrow	U	S
Dark-eyed Junco	C	W
Song Sparrow	C	P

Relative Abundance	Status
C = common	P = permanent resident
U = uncommon	S = summer resident
	W = winter visitant

[a]After Behle and Perry (1975)

TABLE 2.8-17

HANKSVILLE BIRD POPULATION ESTIMATES FROM EMLEN TRANSECTS[a]

Habitat/Species	Individuals/100 Acres			
	Winter	Spring	Summer	Fall
Ephedra-Grass				
Horned Lark	24.9	43.3	10.5	129.8
Sage Sparrow	5.2	--[b]	5.3	--
Black-throated Sparrow	--	2.6	5.3	--
Rock Wren	--	--	--	2.6
Ephedra-Shadscale				
Horned Lark	--	1.8	2.7	28.1
Black-throated Sparrow	--	9.0	7.2	--
Mourning Dove	--	3.6	--	--

[a]Average from results of surveys on two consecutive days

[b]-- indicates none observed

TABLE 2.8-18

HANKSVILLE ROADSIDE BIRD TRANSECTS[a]

Season/Species	Relative Abundance By Habitat: Grassland	Ephedra/Shadscale/ Sage	Roadside Rabbitbrush
Winter			
Horned Lark	47	--	5
Sage Sparrow	--	2	--
Spring			
Horned Lark	5	--	--
Black-throated Sparrow	--	3	--
Common Raven	--	1	--
Summer			
Horned Lark	--	5	2
Black-throated Sparrow	--	2	--
Burrowing Owl	--	3	--
Fall			
Horned Lark	6	50	--
Western Meadowlark	--	--	1
Loggerhead Shrike	--	1	--

[a]Total observed during surveys on two consecutive days

each of these groups is discussed under the respective heading in Section 2.8.2.2.

Big Game

A few Pronghorn (Antilocapra americana) winter in the vicinity but they are a minor influent. There is no evidence that deer use the area.

Livestock

The Hanksville project site lies in the Henry Mountain Resource Area Planning Unit of the Richfield District of the U.S. Bureau of Land Management. The total allotment containing the Hanksville project site covers 95,989 acres of which only 29,906 acres are suitable for grazing. The latest available data for use were from 1974. Six cattle operators ran 600 cattle from September 1 to May 31. One sheep operator ran 2,090 sheep from October 1 to May 5. The total AUM's in the allotment was 5,992. Considering the total acreage of this allotment, the area's available forage was low. Low annual precipitation is one factor responsible for low production. However, a past history of severe overgrazing by cattle and sheep has resulted in a poor range condition (Hanksville BLM files).

Predators

There are four species of mammalian predators that may contribute to the structure and function of the terrestrial ecosystem of the Hanksville buying station vicinity: the Coyote (Canis latrans), Badger (Taxidea taxus), Longtail Weasel (Mustela frenata), and Bobcat (Lynx rufus). Of these, the Coyote is probably the dominant influent since it is known to occur in the area based on Scats. The habitat may be marginal for the other three species. Life history parameters and ecological relationships of these species are reported in Section 2.8.2.2. The numbers of predators supported by the vicinity of the buying station would have been low in 1976-1977 because of the limited numbers of rodents and rabbits present.

Rabbits

Rabbits and hares were uncommon in 1977, as indicated by the results of the roadside rabbit survey (Table 2.8-19). Cottontail burrows were present on the site, particularly in washes where they were the most dense, but no individuals were seen during field work. Blacktail Jackrabbits (*Lepus californicus*) were occasionally seen during all seasons. Eight carcasses were found in a pile in mid-October at the junction of the buying station road and Highway 95. Presumably, these animals had been shot in the area.

TABLE 2.8-19

HANKSVILLE ROADSIDE RABBIT SURVEY

Species	Number of Individuals/Mile[a]			
	Winter	Spring	Summer	Fall
Blacktail Jackrabbit	0	0.2	0.2	0
Desert Cottontail	0	0	0	0

[a] 48 Total Miles Driven

Rodents

Only five species of rodents were trapped or observed on the Hanksville site: the Great Basin Pocket Mouse (*Perognathus parvus*), Canyon Mouse (*Peromyscus crinitus*), Desert Woodrat(*Neotoma lepida*), Ord Kangaroo Rat (*Dipodomys ordi*), and Whitetail Antelope Squirrel (*Ammospermophilus leucurus*). The results of trapping (Table 2.8-20) as well as the few observations of Whitetail Antelope Squirrels suggest that the site was not productive of rodents during the study period. Little vegetation production occurred in 1977 due to low precipitation. This may have been a factor limiting rodent numbers.

Rare and Endangered Wildlife Species

No federally protected endangered or threatened wildlife species is known to occur or migrate through this section of Utah.

TABLE 2.8-20

HANKSVILLE RODENT TRANSECT TRAPPING DATA

Habitat/Species	No. Trapper per 100 Trap Nights (days)	Habitat Trapping Success (%)	Individuals Trapped	Minimum Density (No/Ha)	Sex Ratio M:F	Average Weight (g)	Minimum Estimated Biomass (g/Ha)
Ephedra/Shadscale/ Steep Breaks		4					
Great Basin Pocket Mouse	3		2	2.3	1:1	12.4	28.5
Canyon Mouse	1		1	1.1	0:1	17.0	19.4
Ephedra/Shadscale/ Gentle Breaks		9					
Great Basin Pocket Mouse	9		6	6.8	2:4	13.6	92.5
Shadscale/Sagebrush		1					
Desert Woodrat	1		1	1.1	1:0	120.0	136.4
Ephedra/Grass		8					
Great Basin Pocket Mouse	8		4	4.5	2:2	17.2	78.2
Rabbitbrush Wash Bottom		6					
Great Basin Pocket Mouse	4		2	2.3	1:1	14.5	33.0
Desert Woodrat	1		1	1.1	0:1	76.0	86.4
Ord Kangaroo Rat	1		1	1.1	0:1	45.0	51.1
Grassland		1					
Ord Kangaroo Rat	1		1	1.1	0:1	56.0	63.6

2.9 BACKGROUND RADIOLOGICAL CHARACTERISTICS

On-going environmental radiation measurement programs are being conducted at both the project site and in the vicinity of the Hanksville buying station. The programs are designed to provide data from one full year to establish the radiation levels and concentrations of selected members of the uranium series decay chain in terrestrial biota, soils, air, and surface and ground water. The environmental radiation survey programs are summarized in Section 6.1.5.

The radiometric data accumulated to date are provided in this section. The Supplemental Report will contain the results of the full year program upon its completion.

2.9.1 Blanding

2.9.1.1 Airborne Particulates

High volume air sampling of the environs of the project site at Blanding was begun in April 1977 and will continue for one year. Samples are being collected for twenty-four hours once a month. The sampling location is indicated in Plate 2.9-1. The results of the radiometric analyses performed to date are presented in Table 2.9-1.

Low volume air sampling of the environs at the project site was initiated in September 1977. The three locations selected are being sampled continuously for a seven-day period (168 hours) on a quarterly basis. The locations of these sampling stations are shown in Plate 2.9-1. Data collected as a result of this program will be presented in the Supplemental Report.

2.9.1.2 Radon Concentrations in Air

Measurement of radon-222 concentration in air was initiated March 29, 1977 and was repeated again in September of 1977. The results of these measurements are presented in Table 2.9-2. The initial measurement of ambient Rn-222 concentration was performed by LFE Environmental Analysis Laboratories using the "single filter method." The second

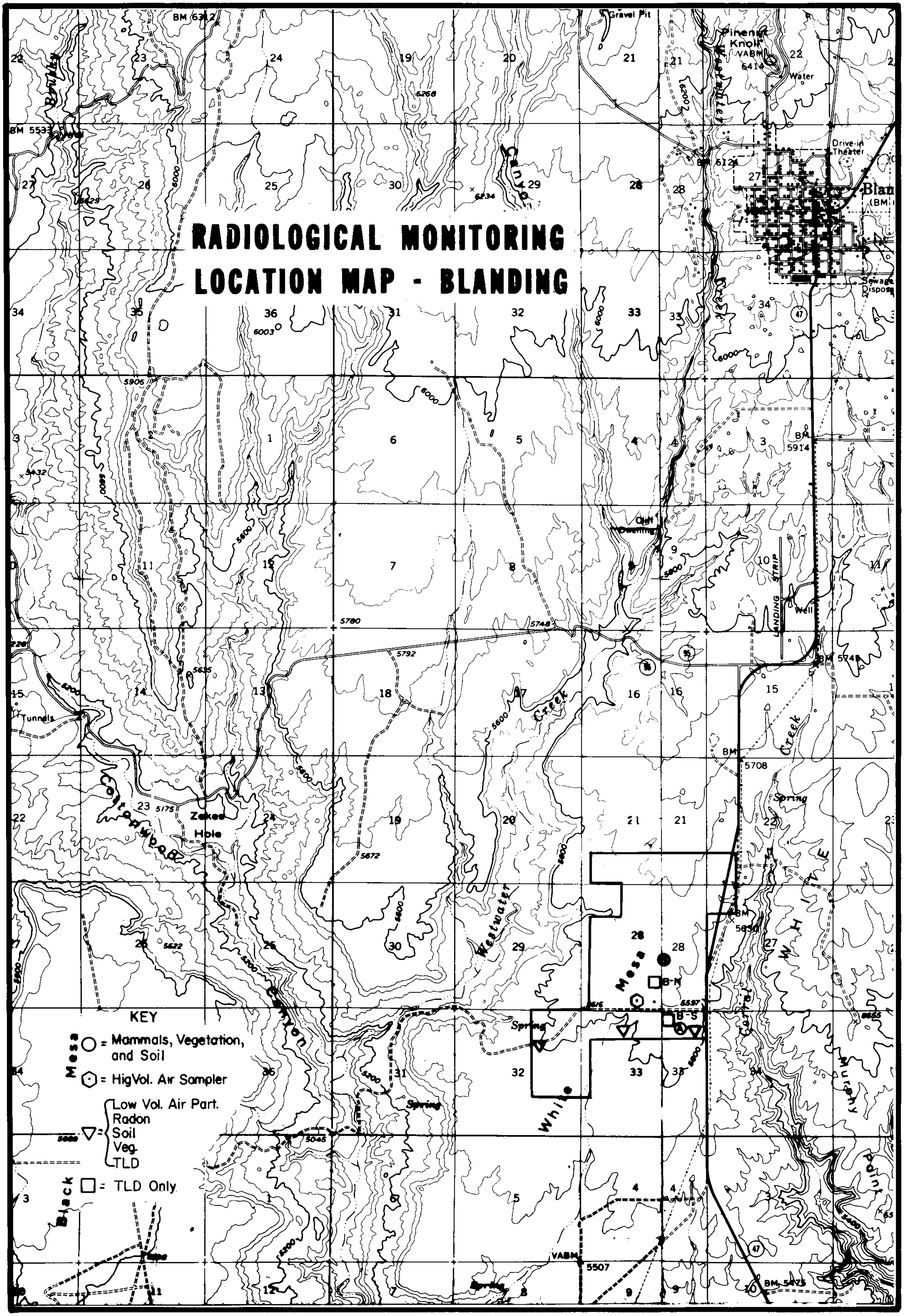

RADIOLOGICAL MONITORING
LOCATION MAP - BLANDING
KEY
Mesa ○ = Mammals, Vegetation, and Soil
⬡ = HigVol. Air Sampler
▽ = Low Vol. Air Part. Radon Soil Veg. TLD
Black Mesa □ = TLD Only
White Mesa
Westwater Creek
Cottonwood Canyon
Zekes Hole
Landing Strip
Cliff Dwelling
Gravel Pit
Piñenut Knoll
Drive-in Theater
Sewage Disposal
Spring
Tunnels
B-N
B-S
Murphy Point

PLATE 2.9-1

TABLE 2.9-1

RADIOMETRIC ANALYSES OF AIR PARTICULATES COLLECTED[a] IN THE ENVIRONS OF THE BLANDING SITE

Collection Date	Analyses	Activity Concentration[b] (pCi/m^3)
April 1-2, 1977	Gross Alpha	0.0 ± 0.001
	Gross Beta	0.311 ± 0.018
	Uranium	<0.001
	Thorium-230	<0.001
	Radium-226	<0.001
	Lead-210	0.013 ± 0.001
May 23-24, 1977	Gross Alpha	0.023 ± 0.006
	Grass Beta	1.154 ± 0.058
	Uranium	0.001 ± 0.001
	Thorium-230	0.002 ± 0.001
	Radium-226	<0.001
	Lead-210	0.021 ± 0.001

[a] Collected by high-volume sampler

[b] Uranium concentration in μg/m^3

TABLE 2.9-2

AMBIENT RADON-222 CONCENTRATIONS IN AIR AT BLANDING SITE

Sampling Station	Date	Wind Speed & Direction	Rn-222 Concentration (pCi/l)
BR-1	April 29, 1977	5-10 mph SE	0.009 ± 0.001
DM-1	Sep 18, 1977	0-5 mph S	0.145 ± 0.055
DM-2	Sep 18, 1977	0-5 mph S	0.125 ± 0.026
DM-3	Sep 18, 1977	0-5 mph S	0.303 ± 0.123

sampling was performed by Dames & Moore personnel using the "scintillation flask method" (see Section 6.1.5.6).

2.9.1.3 Ground Water

Quarterly sampling of ground water and radiometric analysis of composite samples was begun in July 1977 as part of the water quality monitoring program described in Section 2.6.3.1. The results of analyses to date are presented in Table 2.6-6.

2.9.1.4 Surface Water

Collection of composite surface water samples from the environs of the project site was begun in July 1977 and is on-going (see Section 2.6.3.2). The results of radiometric analyses of samples collected to date are presented in Table 2.6-7.

2.9.1.5 Soils

Collection of soil samples from the environs of the project site was initiated in June 1977 and will be repeated, on a quarterly basis, for a period of one year. The results of radiometric analyses will be presented in the Supplemental Report.

2.9.1.6 Vegetation

Composite terrestrial vegetation samples were collected May 17, 1977 at two locations on the project site. The results of the radiometric analyses of these samples are presented in Table 2.9-3.

The higher concentration of lead-210 relative to the other nuclides is attributed to the foliar deposition of lead-210 as a result of the decay of atmospheric radon-222. This concentration is normal for radionuclide measurements in vegetation.

2.9.1.7 Wildlife

Collection of terrestrial mammals, primarily Dipodomys ordi, in the vicinity of the project site was begun during May 1977. Samples were composited by station prior to analysis. The results of the

TABLE 2.9-3

RADIOMETRIC ANALYSES OF VEGETATION
COLLECTED ON THE PROJECT SITE

Radiometric Analysis[a]	Sampling Station D&M-A	Sampling Station D&M-B
Uranium (μg/g)	0.3 ± 0.1	0.2 ± 0.1
Thorium-230 (pCi/g)	0.10 ± 0.01	0.12 ± 0.02
Radium-226 (pCi/g)	0.054 ± 0.003	0.011 ± 0.001
Lead-210 (pCi/g)	2.0 ± 0.1	2.6 ± 0.1

[a]Dry Weight

radiometric analyses conducted to date on these samples are presented in Table 2.9-4.

2.9.1.8 Environmental Radiation Dose

An initial program designed to measure, on a monthly basis, the environmental dose at the site was initiated on April 1, 1977. This program was supplemented by a second program begun on September 19, 1977. Both programs were temporarily suspended on October 15, 1977, pending response checks on several thermoluminescent dosimeters (TLDs) used in the program.

The results of the TLD measurements collected to date are presented in Table 2.9-5. The average annual dose equivalent for the Blanding site is calculated to be 141.9 mrem. Of this total, 67.8 mrem are attributed to cosmic radiation (Oakley and Golden, 1972) and 74.1 mrem is attributed to terrestrial sources.

2.9.2 Hanksville

2.9.2.1 Airborne Particulates

High-volume sampling of airborne particulates at the Hanksville ore buying station, on a one day per month basis, was initiated in April 1977 and will continue for a period of one year. The location of this station is shown in Plate 2.7-10. The results of the radiometric analyses performed to date are presented in Table 2.9-6.

A supplemental program of low-volume air sampling of the environs at the station was begun in September 1977 and will continue for one year. Samples are being collected for a seven-day (168-hour) period on a quarterly basis. Data collected upon completion of these programs will be presented in the Supplemental Report.

2.9.2.2 Radon Concentrations in Air

Measurement of radon-222 concentrations in air was initiated March 29, 1977 and was repeated again in September 1977. The results of these measurements are presented in Table 2.9-7. The initial measurement

TABLE 2.9-4

RADIOMETRIC ANALYSES OF TERRESTRIAL MAMMALS
COLLECTED IN THE VICINITY OF THE PROJECT SITE

Radiometric Analysis[a]	Sampling Station D&M-A	D&M-B
Uranium (μg/g)	0.4 ± 0.1	0 ± 0.1
Thorium-230 (pCi/g)	0.08 ± 0.01	0.022 ± 0.007
Radium-226 (pCi/g)	0.109 ± 0.005	0.026 ± 0.002
Lead-210 (pCi/g)	0.29 ± 0.01	0.13 ± 0.01

[a]Dry Weight

TABLE 2.9-5

ENVIRONMENTAL RADIATION DOSE AT THE PROJECT SITE

Exposure Period	B-N Dose (mrem/day)	B-S Dose (mrem/day)
April 1 to May 1, 1977	0.162 ± 0.301	0.164 ± 0.588
May 1 to June 1, 1977	0.136 ± 0.467	0.092 ± 0.363
June 2 to June 30, 1977	0.496 ± 0.076	---[a]
June 30 to July 30, 1977	0.686 ± 0.694	0.677 ± 0.621
Aug 1 to Sep 19, 1977	---[a]	0.694 ± 0.293

[a]These data are preliminary and are being reviewed.

TABLE 2.9-6

RADIOMETRIC ANALYSIS OF AIR PARTICULATES COLLECTED BY HIGH-VOLUME SAMPLER IN THE ENVIRONS OF THE HANKSVILLE STATION

Collection Date	Analyses	Activity Concentration[a] (pCi/m^3)
April 12-13, 1977	Gross Alpha	0.23 ± 0.012
	Gross Beta	1.211 ± 0.058
	Uranium	0.027 ± 0.003
	Thorium-230	0.013 ± 0.001
	Radium-226	0.011 ± 0.001
	Lead-210	0.035 ± 0.002
May 19-20, 1977	Gross Alpha	0.076 ± 0.012
	Grass Beta	0.883 ± 0.041
	Uranium	0.004 ± 0.001
	Thorium-230	0.002 ± 0.001
	Radium-226	<0.001
	Lead-210	0.021 ± 0.001
June 14-15, 1977	Gross Alpha	0.020 ± 0.004
	Gross Beta	1.275 ± 0.065
	Uranium	0.002 ± 0.001
	Thorium-230	0.006 ± 0.001
	Radium-226	<0.001
	Lead-210	0.018 ± 0.001
July 7-8, 1977	Gross Alpha	0.041 ± 0.006
	Gross Beta	1.305 ± 0.074
	Uranium	0.014 ± 0.001
	Thorium-230	0.003 ± 0.001
	Radium-226	0.006 ± 0.001
	Lead-210	0.036 ± 0.002

[a]Uranium concentration in $\mu g/m^3$

TABLE 2.9-7

HANKSVILLE AMBIENT RADON-222 CONCENTRATIONS

Sampling Station	Date	Wind Speed & Direction	Rn-222 Concentration (pCi/l)
HR-1	April 29, 1977	5-10 mph S-SE	0.0116 ± 0.006
DM-4	Sep 19, 1977	15-20 mph S-SE	0.210 ± 0.043

was performed by LFE Environmental Analysis Laboratory using the "single-filter method." The second measurement, a grab sample, was performed by Dames & Moore personnel using "the scintillation flask method."

Quarterly measurement of radon-222 concentration will continue and discussion of results from a full year will be presented in the Supplemental Report.

2.9.2.3 Ground Water

Radiometric analysis of composite ground water samples on a quarterly basis was initiated in July 1977 as part of the water quality monitoring program (see Section 2.6.3.3). The results of analyses performed to date are presented in Table 2.6-8.

2.9.2.4 Surface Water

Permanent surface water bodies do not exist in the immediate environs of the Hanksville station. Attempts will be made during the program to collect samples of surface water from seasonal accumulations that occur after rainy periods (see Section 2.6.3.4).

2.9.2.5 Soils

Collection of soil samples on a semi-annual basis was initiated in June 1977 and is continuing. The results of the radiometric analyses performed on these samples will be presented in the Supplemental Report.

2.9.2.6 Vegetation

Composite terrestrial vegetation samples were collected at two locations adjacent to the Hanksville buying station on May 17, 1977. The results of the radiometric analyses of these samples are presented in Table 2.9-8.

The higher concentration of lead-210, relative to the other nuclides, is attributed to the foliar deposition of lead-210 as a result of decay of the atmospheric radon-222. The relative concentration of lead-210 compared to other radionuclides is normal.

TABLE 2.9-8

RADIOMETRIC ANALYSES OF VEGETATION COLLECTED
IN THE VICINITY OF THE HANKSVILLE ORE BUYING STATION

Radiometric Analysis[a]	Sampling Station D&M-C	Sampling Station D&M-D
Uranium (μg/g)	0.8 ± 0.1	0.6 ± 0.1
Thorium-230 (pCi/g)	0.29 ± 0.01	0.21 ± 0.01
Radium-226 (pCi/g)	0.125 ± 0.006	0.027 ± 0.001
Lead-210 (pCi/g)	2.1 ± 0.01	2.1 ± 0.1

[a]Dry Weight

2.9.2.7 Wildlife

Collection of terrestrial mammals, primarily genera Perognathus and Dipodomys, in the vicinity of the Hanksville ore buying station was initiated in early May 1977. Samples were composited by sampling station prior to analysis. The results of the radiometric analyses of mammal samples collected to date are presented in Table 2.9-9.

2.9.2.8 Environmental Radiation Dose

A program designed to measure, on a monthly basis, the environmental dose at the Hanksville buying station was initiated on April 1, 1977. This program was supplemented by a second program begun on September 19, 1977. Both programs were temporarily suspended on October 15, 1977, pending response checks on several TLDs used in the program.

The results of the TLD measurements collected to date are presented in Table 2.9-10. The average dose equivalent at the site is calculated to be 121.9 mrem per year. The average cosmic ray dose equivalent for Utah is estimated to be 67.8 mrem per year (Oakley and Golden, 1972). The remaining 54.1 mrem are attributed to terrestrial sources.

2.9.3 Highway Corridor from Hanksville to Blanding

2.9.3.1 Environmental Radiation Dose

Thermoluminescent Dosimeters (TLDs) were placed in triplicate along the highway corridor (Utah State Road 95) between Blanding and Hanksville during September 1977. These TLDs will be collected and read on a quarterly basis for a period of one year. The locations of these stations are indicated in Table 2.9-11. Results from this one year program will be presented in the Supplemental Report.

2.10 OTHER ENVIRONMENTAL FEATURES

2.10.1 Soils

2.10.1.1 Project Site

The Blanding vicinity is characterized by steep canyons incised into rolling plains. White Mesa, on which the project site lies, is a broad ridge between Westwater and Corral Creeks. Its slopes are flat

TABLE 2.9-9

RADIOMETRIC ANALYSES OF MAMMALS COLLECTED
IN THE VICINITY OF THE HANKSVILLE ORE BUYING STATION

Radiometric Analysis[a]	Sampling Station D&M-C	Sampling Station D&M-D
Uranium (μg/g)	1.1 ± 0.1	0 ± 0.1
Thorium-230 (pCi/g)	0.18 ± 0.01	0.04 ± 0.01
Radium-226 (pCi/g)	0.39 ± 0.02	0.090 ± 0.004
Lead-210 (pCi/g)	0.94 ± 0.05	0.53 ± 0.03

[a]Dry Weight

TABLE 2.9-10

ENVIRONMENTAL RADIATION DOSE IN THE VICINITY OF THE HANKSVILLE BUYING STATION[a]

Exposure Period	HR-1 Dose (mrem/day)	HR-2 Dose (mrem/day)
April 1-30, 1977	---[b]	0.658 ± 0.279
May 1-June 2, 1977	0.033 ± 0.351	0.092 ± 0.363
June 2-30, 1977	---	0.336 ± 0.422
June 30-July 30, 1977	0.483 ± 0.630	0.467 ± 0.655
Aug 1-Sep 19, 1977	0.307 ± 0.115	Q.D.

[a]These data are preliminary and are being reviewed.

[b]--- = Missing Data

TABLE 2.9-11

LOCATION OF THERMOLUMINESCENT DOSIMETERS
ALONG STATE ROAD 95 (BLANDING TO HANKSVILLE) UTAH

Station	Location
DM-R-1	23 miles from Blanding
DM-R-2	43 miles from Blanding, west of intersection with State Road 275
DM-R-3	68 miles from Blanding, 4 miles north of Fry Canyon
DM-R-4	95 miles from Blanding
DM-R-5	10 miles south of Hanksville

near the center and range up to 15-20 percent on the edges of the site (Table 2.10-1). Soils are formed in the windblown silts and sands that blanket the area. These materials range in depth from less than a foot on the edges to many feet on the ridgeline. The climate is semi-arid with 8-12 inches of precipitation per year. The Blanding soil is leached to a depth of 10-20 inches and is calcareous throughout the remainder of the parent material.

Rangeland is the most successful and common land use in this vicinity. Dry-farming has generally not been successful. A considerable amount of range improvement has been done on land in the site vicinity. Improvement methods have consisted primarily of removal of sagebrush, disking or plowing of the land, and reseeding with grasses. The land is easily tilled except where bedrock outcrops are encountered.

Published information about the soils of the Blanding site is available. A published soil survey report (Olsen, et al., 1962) contains a soil map that includes the project site and descriptions of the Blanding and associated soils. Results from laboratory tests of the major series are reported from various locations in the county.

Other literature is published (see for example Gates et al., 1956; or West and Ibrahim, 1968) which details soil-plant relationships in southwest and southeast Utah. These studies associate the upland desert types of vegetation occurring in these regions with moderately alkaline non-saline situations.

The Blanding soil series is the only soil occurring on the project site in significant proportions (Plate 2.10-1). A small area of Mellenthin very rocky fine sandy loam has been mapped on the eastern edge of the site. This soil is like the Blanding soil, except that bedrock occurs within 15-20 inches of the surface. Complete soil profile descriptions and results from laboratory analyses are contained in Appendix F.

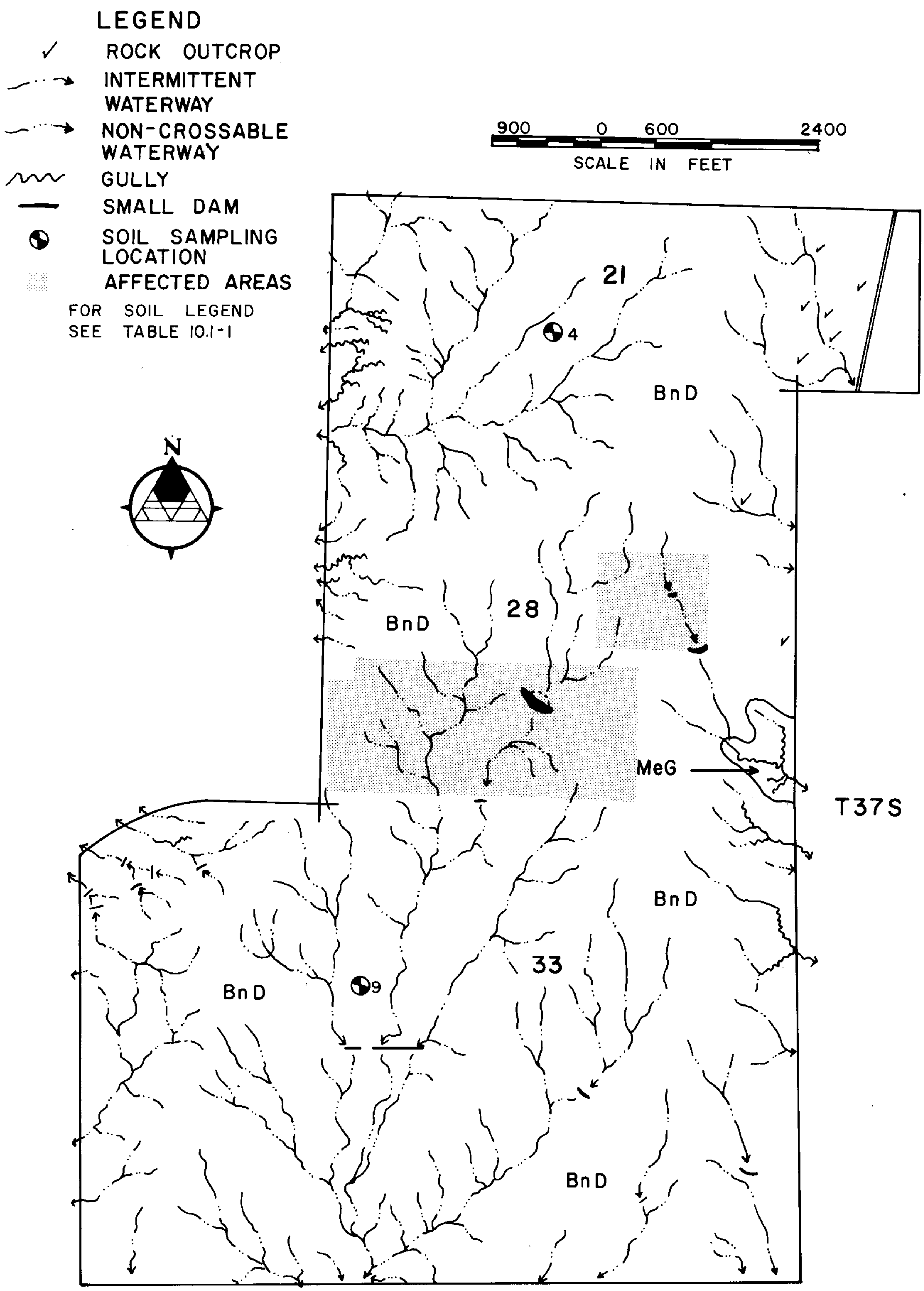
TABLE 2.10-1

SOIL SERIES INFORMATION FOR PROJECT SITE AND VICINITY OF HANKSVILLE ORE BUYING STATION

Symbol	Profile Nos.	Soil Series	Slope	Site Coverage % of Site	Site Coverage Approx. Acreage	Position	Parent Material	Range Site	Classification
Project Site at Blanding[a]									
BnD	4,9	Blanding silt loam	2-6%	99.3	1520	Loess Uplands	Windblown sandy & silty mtls.	Semi-desert loam	Ustollic Haplargid fine-silty mixed mesic
MeG	-	Mellenthin very rocky fine sandy loam	4-25%	0.7	11	Hilly Uplands	Windblown sands & sandstone	Semi-desert stony hills	Lithic Ustollic Calciorthid loamy-skeletal, mixed mesic
Vicinity of Hanksville Buying Station[b]									
BL:Ro	-	Badlands & Rock Outcrops	25%+	5.5	35	Uplands	Mixed sandstones and shales	Not classified	Unclassified
NsB	3,5,7	Neskahi(like) fine sandy loam	1-4%	52.1	334	Alluvial fan	Mixed alluvium	Desert sandy loam	Typic Torrifluvent coarse-loamy, mixed, calcareous, mesic
R1A	8	Rairdent(like) sandy clay loam	0-2%	10.2	65	Smooth valley bottom	Mixed alluvium	Desert loam	Cambic Gypsiorthid fine-loamy, mixed, calcareous, mesic
RsB	6	Rairdent(like) fine sandy loam	2-4%	21.7	139	Alluvial fan	Mixed alluvium	Desert sandy loam	Cambic Gypsiorthid fine-loamy, mixed, mesic
S1BD	4	Unnamed fine sandy loam	2-10%	9.4	60	Alluvial fans	Mixed alluvium	Desert sandy loam	Cambic Gypsiorthid coarse-loamy, mixed, mesic

[a] Acreage values total 1531 acres within boundaries of this survey.

[b] Acreage values total 640 acres which includes an unlisted 7 acres of disturbed land at the buying station site.



SOIL SURVEY MAP- PROJECT SITE

SOURCE USDA SOIL CONSERVATION SERVICE

DAMES & MOORE

PLATE 2.10-1

Blanding soils are deep soils formed in windblown fine sands and silts. Soil textures in the profile are predominantly silt loam; however, silty clay loam textures are found at some point in most profiles (Table 2.10-2). Typically, this soil has a 4 to 5-inch reddish brown silt loam 'A' horizon overlying a reddish brown silt loam to silty clay loam 'B' horizon that extends downward to 12 or 16 inches. The 'C' horizon and the underlying parent material is a light reddish brown calcareous silt loam or silty clay loam. The 'A' and 'B' horizons are non-calcareous with a pH of about 8.0. Ph values on the 'C' horizon are higher, with 8.5, as an average value. The 'C' horizon is calcareous. Subsoil sodium levels (expressed as Exchangeable Sodium Percentage) range up to 12 percent in some areas. This level is close to the upper limit of acceptability for use in reclamation work. Other elements such as boron and selenium, are well below potentially hazardous levels.

Potassium and phosphorus values are high in this soil and are adequate for plant growth. Nitrogen is low, and could be added if irrigation were to be used and green lush growth desired. However, it is not generally recommended for open range seedings. Available moisture percentage values are typical for silt loams and range from 6-9 percent of the soil mass.

This soil is well suited to support crop growth. Low moisture levels are the most common limiting factor. These soils are highly erodible when exposed, and appropriate measures are needed to conserve topsoil and moisture.

The Blanding soil series profiles on the project site, in contrast with those generally found county-wide, are higher in silt content, having silty clay loam textures in the profile. They also have higher carbonate concentrations than those representative for the whole survey. These differences represent variations sometimes found in the Blanding series.

TABLE 2.10-2

RESULTS OF SOIL SAMPLE TEST ANALYSES FOR PROJECT SITE AND VICINITY OF HANKSVILLE BUYING STATION

Symbol	Soil Series	Profile No.[1]	Depth	Texture[2]	Available Moisture %	Water at Saturation %	pH 1:1	pH 1:5	Lime %	Gypsum %	ECe mm/cc	ESP %	Organic Carbon %	Phosphate ppm	Potassium ppm	CEC meq/100 g.
BLANDING SITE																
BnD	Blanding	4	0-4	SiL	7.6	36.0	7.4	7.9	0.3	0.15	1.2	1.1	0.63	15	198	12.8
	Ustollic Haplargid		4-12	SiCL	8.7	49.0	7.6	8.0	0.3	0.14	0.8	0.2	0.53	3	170	16.6
	fine-silty, mixed		18-40	SiCL	8.0	43.7	8.0	8.5	2.0	0.30	0.7	0.6	0.42	2	162	15.2
			40-50	SiCL	6.4	37.8	8.1	8.6	2.1	0.18	1.2	2.0	0.32	3	165	14.9
		9	0-5	SiL	8.9	38.7	7.6	8.1	0.3	0.17	0.9	1.8	0.53	10	182	13.1
			5-12	SiL	9.3	45.6	8.0	8.4	0.3	0.18	0.9	1.4	0.47	2	138	10.9
			18-40	SiL	8.0	38.7	8.5	9.0	3.8	0.18	1.2	11.5	0.37	2	123	11.9
			40-50	SiCL	9.0	38.9	8.8	9.2	1.6	0.18	1.0	12.5	0.26	1	161	15.9
HANKSVILLE SITE																
NsB	Neskahi (like)	3	0-5	SL	5.7	25.6	8.3	8.8	6.1	0.20	1.4	3.6	0.42	9	174	8.5
	Typic Torrifluvent		5-28	SL	4.9	26.6	8.1	8.7	7.2	0.29	1.3	4.0	0.32	2	182	8.5
	coarse-loamy,		28-38	SL	6.0	32.3	7.2	8.2	8.2	9.50	4.2	0.1	0.32	4	167	8.7
	mixed, calcareous		38-60	SL	6.9	35.5	7.4	8.3	8.5	9.50	5.4	0.1	0.26	2	122	7.9
		5	0-3	SL	5.1	23.8	7.8	8.4	4.2	0.25	1.3	4.3	0.37	4	223	8.3
			3-12	SL	5.0	25.2	7.9	8.6	4.5	0.23	1.2	3.1	0.32	1	175	7.8
			12-30	SL	5.9	28.6	8.0	8.7	8.2	0.20	1.4	3.3	0.32	3	157	8.6
			30-42	SL	5.3	27.5	7.2	8.2	7.3	6.90	3.6	0.9	0.26	3	189	7.6
			42-60	SL	5.9	27.4	7.2	8.1	7.3	5.20	4.6	1.5	0.26	1	200	7.8
		7	0-12	SL	5.7	36.6	7.7	8.5	8.1	0.24	5.0	0.1	0.37	2	151	8.0
			12-46	SL	4.3	23.2	7.4	8.1	5.5	1.50	1.4	2.7	0.21	1	248	8.5
R1A	Rairdent (like)	8	0-4	SCL	7.2	37.6	7.6	8.5	8.5	0.17	5.7	0.1	0.42	10	196	12.7
	Cambic Gypsiorthid		4-48	CL	8.1	43.8	7.3	8.2	8.0	13.00	4.8	0.1	0.37	3	206	17.5
	fine-loamy, mixed,		48-54	SL	6.9	41.5	7.2	8.2	5.5	14.00	8.7	7.6	0.26	1	114	8.4
	calcareous		54-60	SL	10.2	51.6	7.3	8.2	6.4	11.00	6.2	0.1	0.32	1	111	7.8
RsB	Rairdent (like)	6	0-2	SL	5.4	30.2	7.0	8.0	7.2	2.60	4.2	0.8	0.42	27	206	7.7
	Cambic Gypsiorthid		2-36	SCL	9.0	48.6	7.2	8.1	6.2	14.00	6.2	6.6	0.37	1	345	12.7
	fine-loamy, mixed		36-50	SCL	7.1	40.5	7.5	8.4	7.6	7.70	5.4	0.2	0.32	3	271	13.4
S1BD	Unnamed	4	0-30	SL	10.6	46.7	7.3	8.2	5.3	18.00	3.1	0.1	0.32	1	136	8.1
	Cambic Gypsiorthid		30-48	SL	8.0	42.9	7.3	8.2	6.7	12.00	6.5	0.1	0.21	1	236	8.0
	coarse-loamy, mixed															

[1] Numbering system of soil profiles are independent for each site.
[2] CL = clay loam; SCL = sandy clay loam; SiCL = silty clay loam; SiL = silt loam; SL = sandy loam.

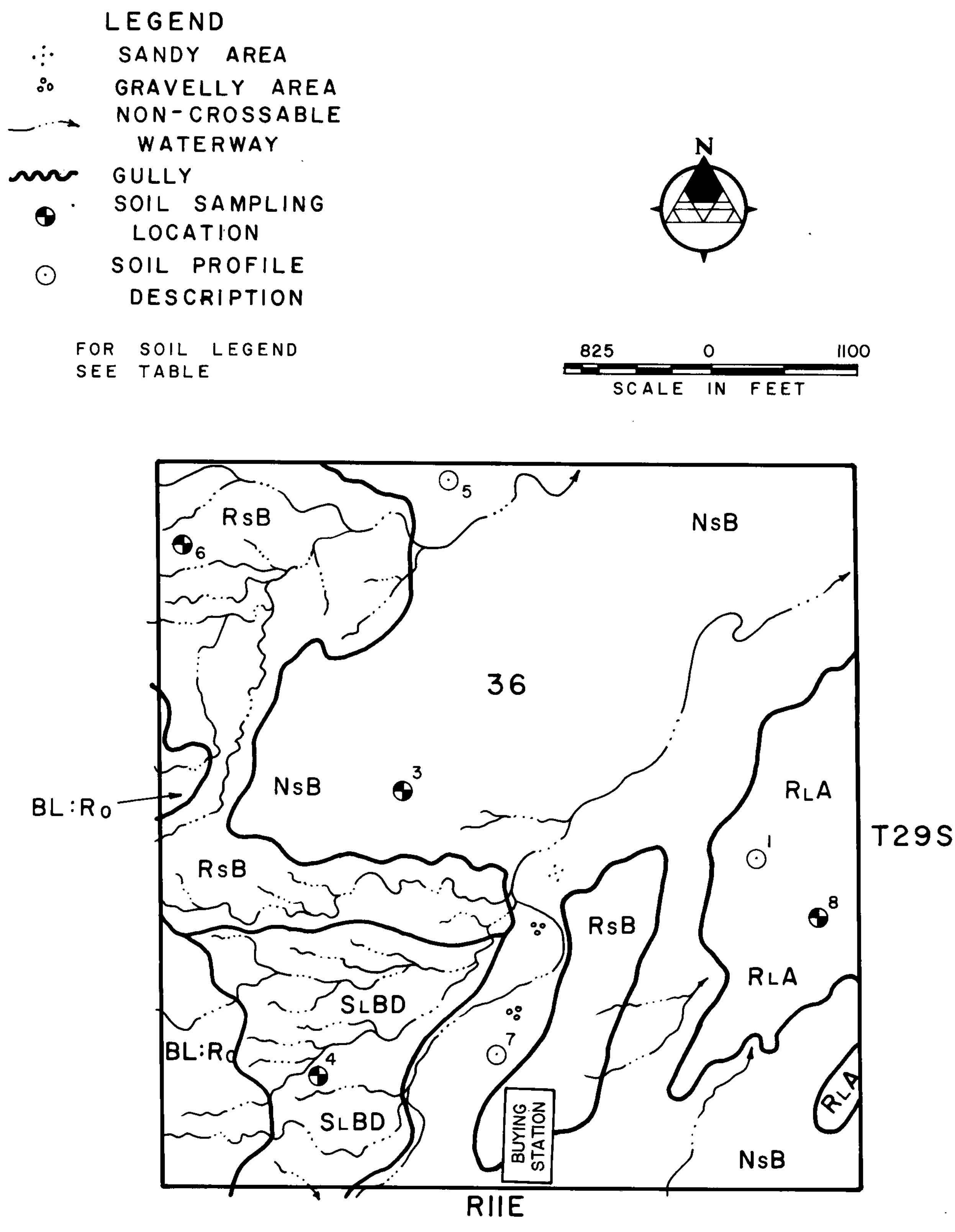
2.10.1.2 Hanksville Vicinity

The vicinity of the Hanksville buying station is characterized by gently sloping broad alluvial fans set on the edge of severely eroded badlands. The badlands, consisting of shale-sandstone breaks, occur immediately to the west of the buying station. Broad fans occupy most of the vicinity and in some areas are severely eroded and gullied. A dry lake bed occurs to the east of the buying station. Slopes in the vicinity generally range from 2-4 percent. Materials from which the fans are derived are weathered sandstone and shales transported downslope from the breaks. The soils are predominantly sandy loams with 5-15 percent gravels mixed in. A few areas have sandy clay loam textures in the profile. All soils are calcareous, and about half of the area mapped has high levels of gypsum in the profile.

This area has been used as rangeland over the years. The vegetation is sparce and not conducive to intensive grazing. The primary limiting factor is low precipitation, which annually is about 6 inches. No dryland farming has been attempted in the area.

Several research papers have been published on soil-vegetation relationships of the desert plants in southern Utah (Fireman and Hayward, 1952; Gates et al., 1956; Mason et al., 1967; West and Ibrahim, 1968). Shadscale tends to occupy soils with non-saline surface horizons and saline-alkaline subsoils. This shrub occurs in nearly all of the mapping units in the vicinity of the Hanksville buying station.

Literature relating to specific soils of the buying station vicinity is unavailable and this area had not been surveyed for range or soil conditions prior to the present study. Soils on the site were found to comprise five mapping units (Plate 2.10-2 and Table 2.10-1). The soils described are not known to have been previously mapped or classified in the United States. Several of the profiles are similar or related to soils already mapped and these have been classed as "like" the comparable series. Mapping units R1A and RsB have very similar physical



SOIL SURVEY MAP
HANKSVILLE STATION VICINITY
SOURCE USDA SOIL CONSERVATION SERVICE

DAMES & MOORE

PLATE 2.10-2

and chemical properties but occur on different landscape positions. They have been differentiated for the purposes of this report.

All soils in the area mapped have minimal soil development. Soil material from the surface downward is calcareous and classified as "C" horizon, or undeveloped, material. Soil textures on the majority of the site are sandy loam (Table 2.10-2). Mapping units RlA and RsB have sandy clay loam textures in the profile. The soils have moderately alkaline pH values and lime contents ranging from 4-9 percent. Gypsum is high in all mapping units with the exception of NsB. Sodium values are low, not exceeding 7.6 percent exchangeable sodium. The combination of salts present is reflected in electrical conductivity values (ECe) which range from 3 to 9. At these levels, production by plants, especially those sensitive to salts, will be reduced. Organic carbon values are low, reflecting the low return of organic material in the desert environment. Phosphorus values range from low to high relative to recommendations for native range. Potassium values are high. The available moisture ranged in samples from 5 to 10 percent and the moisture content at saturation from 25 to 50 percent. These values, while somewhat low for soils in general, are typical of sandy loam soils.

All soils on the study area are highly erosive. Those having sandy loam surface textures will be most prone to wind and water erosion. The sand clay loam and clay loam textures would be difficult to work and cultivate in reclamation operations. If soils high in gypsum are used in reclamation and construction operations, the potential of differential settlement after being leached is possible. High gypsum in these soils would not cause toxicity problems. Over 1/2 of the soils on the site, are well suited for use in reclamation to depths up to 40 inches.

The following paragraphs describe specifically the four soil mapping units defined. The fifth mapping unit is badlands and rock outcrop (see Appendix F).

NsB: Neskahi (like) Fine Sandy Loam

This soil covers over half of the area mapped and occurs on the central and east sides. It has fine sandy loam textures in the profile. This soil does not contain excessive amounts of salt. Electrical conductivity (ECe) values reach 5.0 in most profiles below depths of 40 inches. This level of salt concentration, if exposed, would restrict the yield of some salt sensitive plants. All soil material above 40 inches would be adequate for use in reclamation.

RlA: Rairdent (like) Sandy Clay Loam

This soil occurs on the dry lake bed toward the east side of the site. It covers 10 percent of the total area mapped. It is heavier textured than most soils on the area, with sandy clay loam and clay loam textures to depths over 40 inches. This soil has high gypsum contents throughout its profile and electrical conductivity values from 5-9. It is fine textured and highly susceptible to wind erosion. It is not suitable for use in reclamation.

RsB: Rairdent (like) Fine Sandy Loam

This soil occurs on the north and west sides of the area mapped. It covers about 140 acres, occurring on an alluvial fan position, and is gullied by recent erosion. This soil has a high gypsum content and moderate electrical conductivity values of about 4-6. The dominant condition of soil textures and salt content make this soil unsuitable for uses in reclamation unless leached by irrigation.

SlBD: Unnamed Fine Sandy Loam

This unit occurs in the southwest corner of the site. It is highly eroded with severe gullying and washing. It has a high gypsum content and moderate conductivity values (3-6.5). This soil is generally unsuited for use in reclamation operations. However, specific small areas are reclaimable if construction is planned in the areas of this mapping unit.

2.10.2 Noise

To adequately describe sound quality in the area of the project, an ambient sound survey was conducted at eight locations near Blanding and Hanksville (Plates 2.10-3 and 2.10-4). These locations, tabulated below, were selected to reflect the present on-site sound climates and those at nearby noise sensitive land use areas.

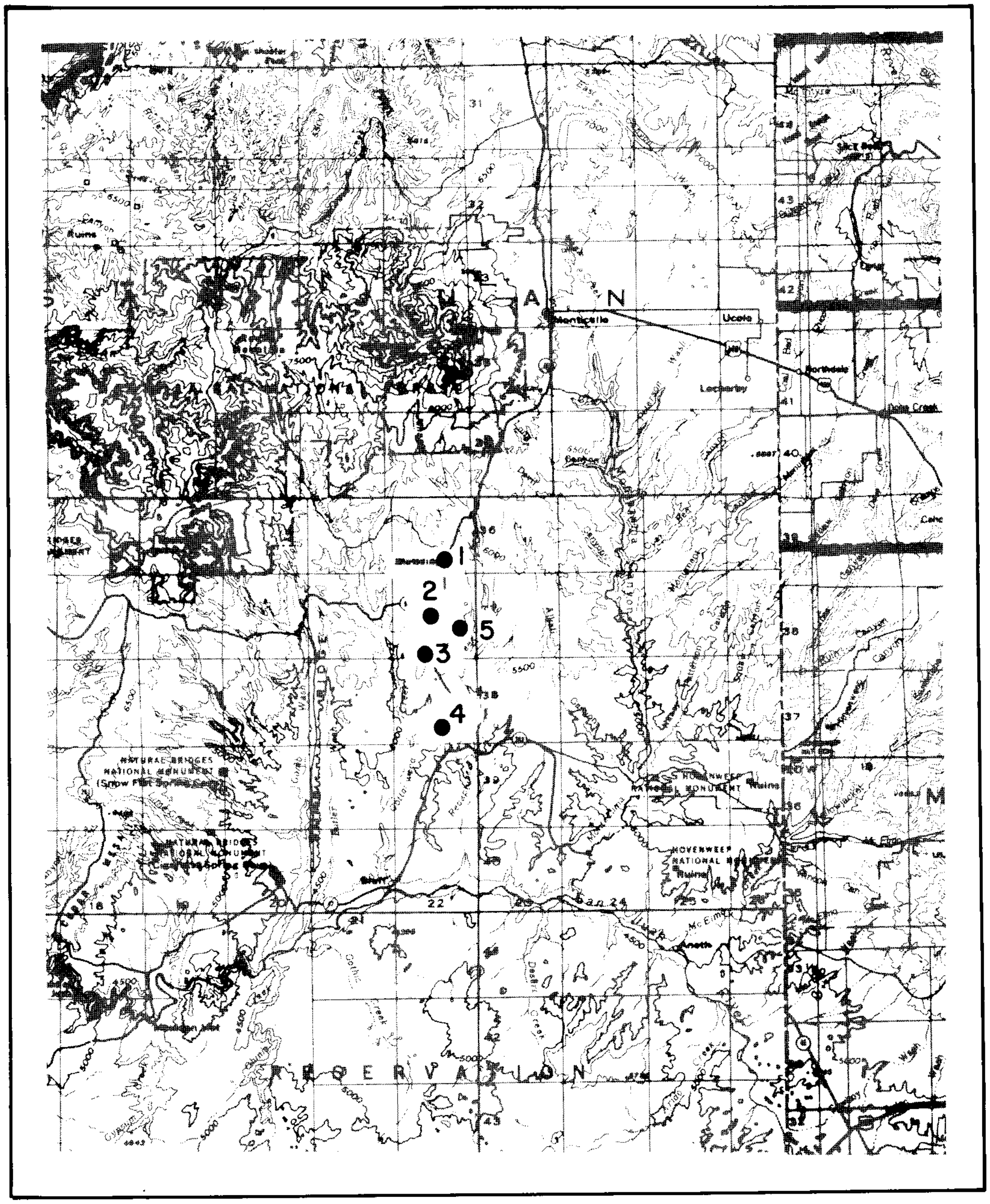
Blanding Vicinity (see Plate 2.10-3)

Location #1	Playground near corner of Route 300 South and 100 West Street between Blanding Elementary School and Blanding Chapel.
Location #2	North of project site along Route 163 near junction of Route 95, adjacent to "Plateau Resources" uranium ore buying station.
Location #3	On project site, south of the uranium ore buying station.
Location #4	South of project site, near residence and day care center in community of White Mesa.
Location #5	East of project site, adjacent to White Sands Missile Range.

Hanksville Vicinity (see Plate 2.10-4)

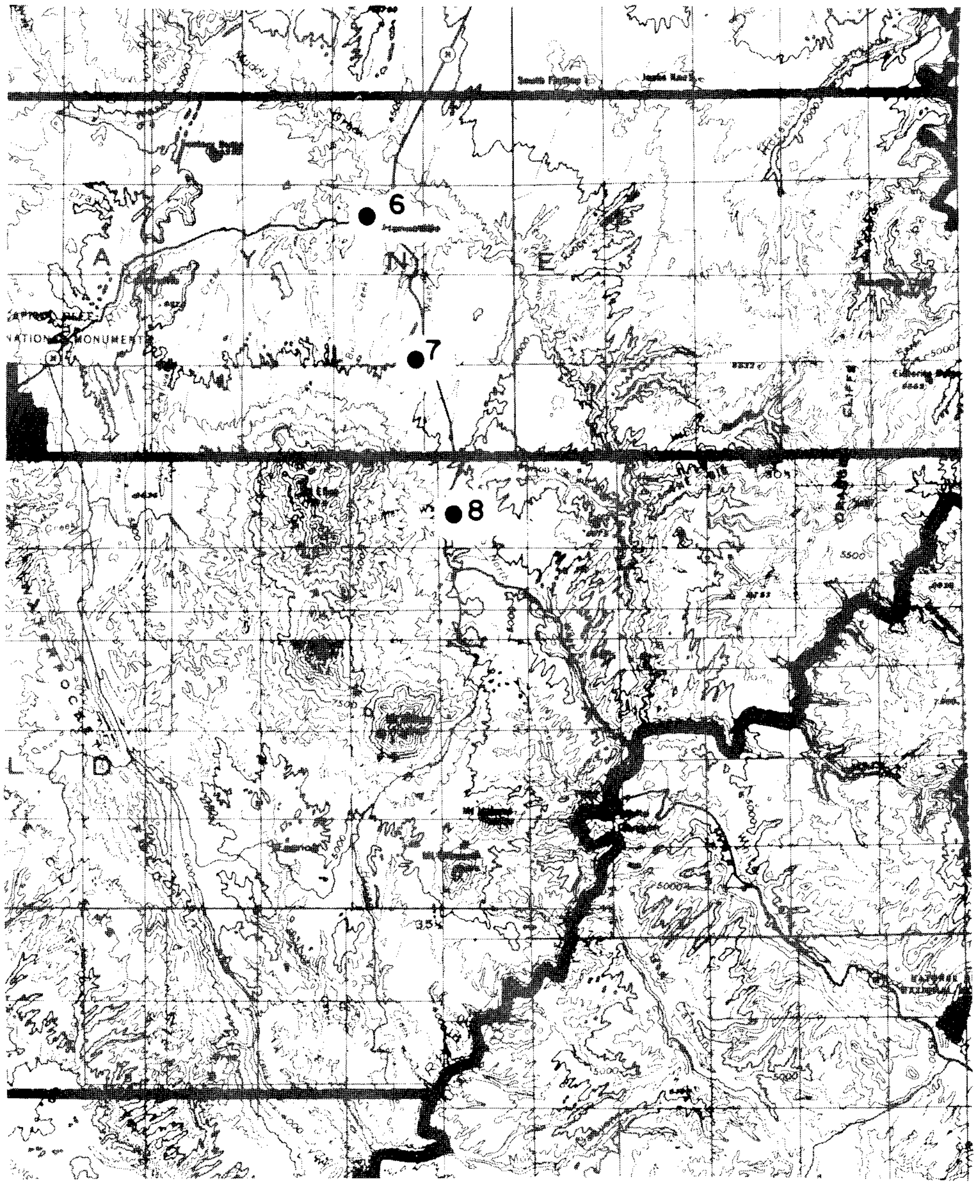
Location #6	Hanksville Elementary School yard approximately 10 miles north of the buying station.
Location #7	On site, north of the uranium buying station.
Location #8	Along Route 95, approximately 11 miles south of the buying station and 70 feet from road.

The background ambient sound survey was conducted at the above locations on Tuesday through Thursday, September 6-8, 1977. Sound level recordings were made during daytime (0700-1800), evening (1800-2200), and nighttime (2200-0700) periods. Ten decibels were added to nighttime (2200-0700) sound in computing the day/night average sound level, L_{dn}, as defined by the U.S. EPA (1974). A description of nomenclature, instrumentation and data acquisition and analysis of the ambient sound survey is presented in Appendix G.



AMBIENT SOUND SURVEY MEASUREMENT LOCATIONS
PROJECT VICINITY

DAMES & MOORE



AMBIENT SOUND SURVEY MEASUREMENT LOCATIONS
HANKSVILLE VICINITY

6 3 0 6 12
SCALE IN MILES

DAMES & MOORE

2.10.2.1 Ambient Sound Levels

A summary of the ambient sound survey data collected at the eight monitoring locations is presented in Table 2.10-3. This table contains the statistical A-weighted sound level L_{90}, L_{50}, and L_{10}, L_{eq}, L_d, L_n and L_{dn} at each measurement location. These data represent the typical ambient sound levels of the existing environment that would be affected by the proposed project.

Detailed results of the ambient sound survey are presented in Appendix G, including A-weighted sound level histograms (indicating the percentage of time a particular sound level occurred during the measurement period) and the cumulative distribution of the A-weighted sound level (indicating the percentage of time a sound level is exceeded). Also included on each plate is the cumulative distribution of the sound pressure level at the octave band center frequencies. The meteorological conditions during which these data were taken are indicated in Table G-1, Appendix G.

Measurement locations 1 and 4 are representative of noise-sensitive residential areas north and south of the Blanding site, respectively. The major daytime sound sources at location 1 were local traffic, intermittent low flying aircraft and residential activities. At location 4, the major daytime sound sources were residential activities, traffic entering and leaving the day-care center and distant traffic.

At location 2, the microphone was located approximately 400 feet from the ore crushing, stockpiling and logistic operations of the Plateau Resources' ore buying station, and about 70 feet from junction of Route 94 and Route 163. During the evening, the ore buying station activities and local car traffic noise were reduced; however, the average sound level (L_{eq}) increased due to trucks passing by and distant shotgun noise.

Location 3 represents the existing sound levels at the Blanding ore buying station. Existing major daytime sound sources included

TABLE 2.10-3

SUMMARY OF AMBIENT SOUND LEVELS - dBA

Statistical Sound Levels	Daytime (0700-1800)	Evening (1800-2200)	Nighttime (2200-0700)	Day/Night Sound Levels
Location 1	9-6-77 @ 0915	9-6-77 @ 2025	9-7-77 @ 0035	
L_{90}	45	40	37	
L_{50}	50	44	45	
L_{10}	61	52	50	
L_{eq}	57.5	50.6	46.4	
L_d				56.5
L_n				46.4
L_{dn}				56.5
Location 2	9-6-77 @ 1000	9-6-77 @ 1950	9-6-77 @ 2355	
L_{90}	46	34	25	
L_{50}	49	37	31	
L_{10}	54	56	49	
L_{eq}	55.7	58.6	47.1	
L_d				56.7
L_n				47.1
L_{dn}				56.9
Location 3	9-6-77 @ 1040	9-6-77 @ 1800	9-6-77 @ 2240	
L_{90}	45	35	30	
L_{50}	47	38	32	
L_{10}	49	42	44	
L_{eq}	46.9	39.7	39.2	
L_d				45.8
L_n				39.2
L_{dn}				47.4
Location 4	9-6-77 @ 1120	9-6-77 @ 1835	9-6-77 @ 2200	
L_{90}	35	35	28	
L_{50}	39	38	33	
L_{10}	50	48	42	
L_{eq}	46.4	47.7	39.9	
L_d				46.8
L_n				39.9
L_{dn}				48.2

TABLE 2.10-3 (Concluded)

Statistical Sound Levels	Daytime (0700-1800)	Evening (1800-2200)	Nighttime (2200-0700)	Day/Night Sound Levels
Location 5	9-6-77 @ 1445	9-6-77 @ 1915	9-6-77 @ 2320	
L_{90}	34	26	30	
L_{50}	35	27	32	
L_{10}	36	34	38	
L_{eq}	36.2	30.9	35.1	
L_d				35.3
L_n				35.1
L_{dn}				41.5
Location 6	9-7-77 @ 1345	9-8-77 @ 1800	9-8-77 @ 2200	
L_{90}	39	42	39	
L_{50}	41	46	41	
L_{10}	47	51	46	
L_{eq}	45.4	51.2	43.1	
L_d				47.8
L_n				43.1
L_{dn}				50.6
Location 7	9-7-77 @ 1440	9-8-77 @ 1850	9-8-77 @ 2245	
L_{90}	34	37	24	
L_{50}	36	44	25	
L_{10}	45	49	30	
L_{eq}	41.3	45.4	27.7	
L_d				42.8
L_n				27.7
L_{dn}				41.5
Location 8	9-8-77 @ 1000	9-8-77 @ 1940	9-8-77 @ 2330	
L_{90}	33	34	24	
L_{50}	37	37	25	
L_{10}	49	46	33	
L_{eq}	47.8	49.3	41	
L_d				48.3
L_n				41
L_{dn}				49.5

construction and ore crushing activities at the station, and traffic on Road 163 in the background.

At location 5, near the presently inactive abandoned White Sands Missile Range, sound levels were relatively uniform throughout a 24-hour day with wind, insects, and distant aircraft and traffic contributing to the ambient sound.

Measurement location 6 is representative of noise-sensitive areas in Hanksville. The major sources of daytime sound included local traffic, children playing in school playground, aircraft, birds, and insects. Evening sound levels increased somewhat due to motorcycle traffic and an increase in windspeed.

Location 7 represents areas exposed to noise from existing ore stockpiling and ore crushing operations at the Hanksville buying station, traffic on Route 95 and intermittent aircraft. Evening levels increased somewhat due to the combined effect of strong winds, and traffic on Route 95 even though buying station activities had subsided.

Location 8 represents areas adjacent to Route 95 approximately 11 miles south of the site. The average sound level (L_{eq}) remained relatively constant throughout a 24-hour day with intermittent truck traffic contributing to the sound levels.

Throughout the study area, during lulls in local traffic or facility activities, environmental sound was produced by wind, insects and birds. During the nighttime, when local activities are minimal, the sounds of wind and insects were particularly prevalent.

The ambient sound data discussed above were used with computations of construction activity noise and facility operation noise to estimate future ambient sound levels. The projected future sound levels, the background ambient sound levels, and federal EPA and State guidelines were used to assess the impact of the proposed facility on the environmental sound quality.

3.0 THE MILL AND BUYING STATIONS

Conventional milling methods for uranium ore processing will be used. The ore will be crushed and ground to a size suitable for sulfuric acid leaching to extract the uranium. The uranium-bearing solution will then be separated from the ore residue, purified and concentrated by solvent extraction, and the uranium precipitated as ammonium diuranate, also known as "yellow cake." The yellow cake precipitate will be dewatered, calcined, crushed, and placed in drums for shipment.

When economically feasible, as determined by market conditions and ore characteristics, by-products of copper and/or vanadium will be recovered. The recovery methods for by-products are discussed in Sections 3.2.1 and 3.2.2. The milling rate of 2000 tpd is predicated on recovery of all by-products. Should the copper circuit not be initially operated, the milling rate will be 1700 tpd.

3.1 EXTERNAL APPEARANCE OF THE MILL

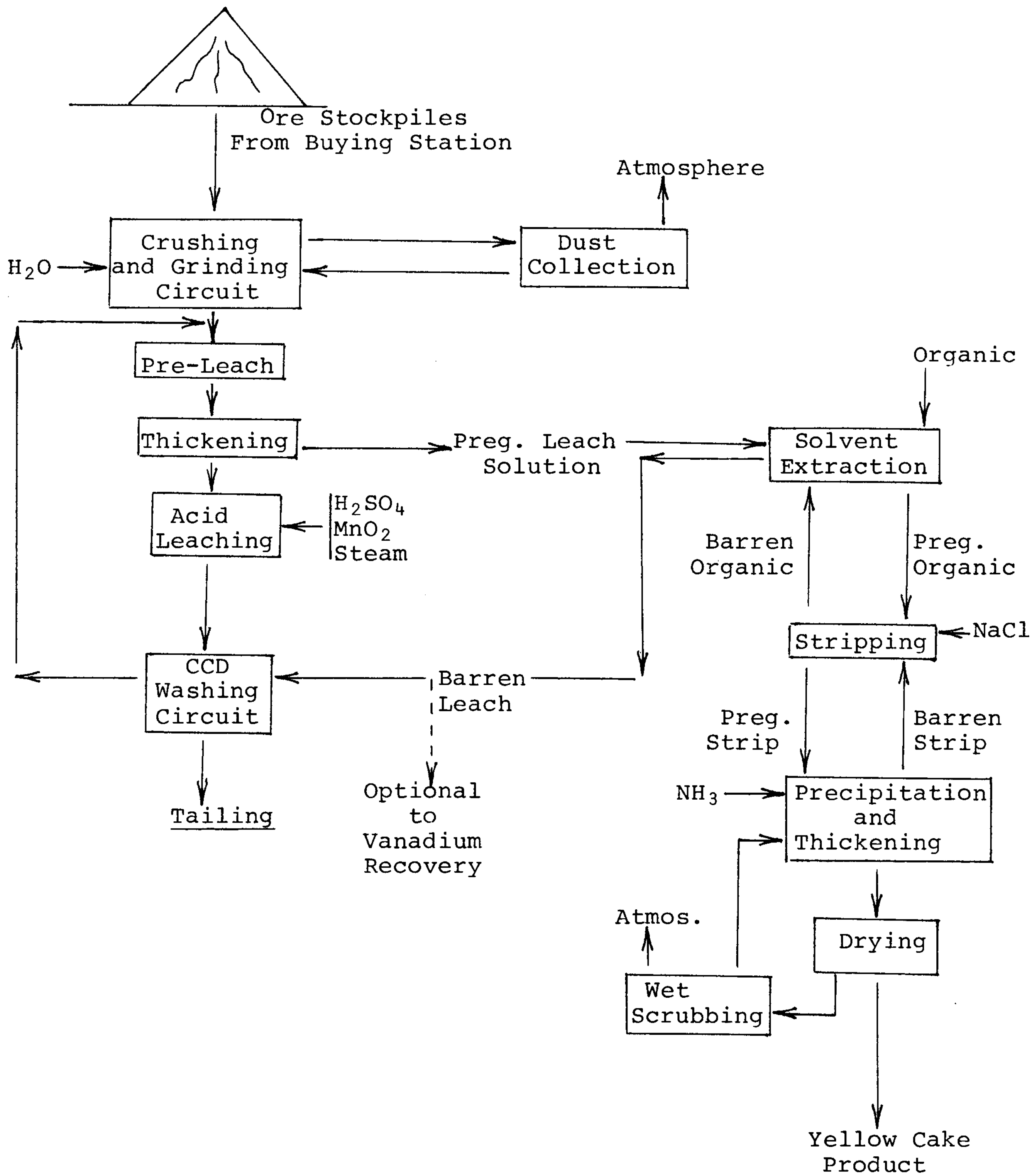
The plant buildings will be mainly of prefabricated construction and the exterior panels will be of a color(s) aesthetically pleasing with the surrounding terrain. The actual physical facility will resemble the artist's rendition (Plate 3.1-1), but the final layout may vary somewhat depending on equipment selection.

3.2 THE MILL CIRCUIT

Plate 3.2-1 shows a generalized flowsheet for the proposed uranium milling process. The mill will process about 2,000 tons of ore per day. The average U_3O_8 content is estimated to be about 2 1/2 pounds per ton. 0.125% U_3O_8

3.2.1 Uranium Circuit

Since the ores will originate from many different mines, it is planned to blend them according to their chemical and metallurgical characteristics. The crushed ore will be wet-ground in a rod mill to pass a 28-mesh (0.0232 inch) screen. The ore slurry produced by the wet



GENERALIZED FLOWSHEET FOR THE URANIUM MILLING PROCESS

DAMES & MOORE

grinding step will be leached in two stages with sulfuric acid, manganese dioxide, and steam in amounts that will produce a solution having a pH of 0.2 and a temperature of 70°C. The function of the first stage leach will be to utilize the residual acidity of the pregnant leach liquor by reacting it with the alkaline constituents of the freshly ground ore, thereby achieving chemical economies. It is anticipated that approximately 95 percent of the uranium contained in the crude ore will be dissolved over a period of twelve to twenty-four hours of leaching. The uranium bearing solution will be separated from the barren waste by counter-current decantation using thickeners. Polymeric flocculants will be used to enhance the settling characteristics of the undissolved solids. The decanted pregnant leach solution is expected to have a pH of approximately 1.5 and contain less than one gram per liter of U_3O_8. The barren waste will be pumped to the tailing retention area.

Solvent extraction will be used to concentrate and purify the uranium contained in the decanted leach solution. The solvent extraction process will be carried out in a series of mixer and settling vessels, using an amine-type compound carried in kerosene (organic) which will selectively absorb the dissolved uranyl ions from the aqueous leach solution. The organic and aqueous solutions will be agitated by mechanical means and then allowed to separate into organic and aqueous phases in the settling tank. This procedure will be performed in four stages using a counter-flow principle wherein the organic flow is introduced to the preceding stage and the aqueous flow (drawn from the bottom) feeds the following stage. It is estimated that, after four stages, the organic phase will contain about two grams of U_3O_8 per liter and the depleted aqueous phase (raffinate) about 5 mg per liter. The raffinate will be recycled to the counter-current decantation step previously described or further processed for the recovery of vanadium discussed in Section 3.2.2. The organic phase will be washed with acidified water and then stripped of uranium by contact with an acidified sodium chloride solution. The barren organic solution will be returned to the solvent extraction circuit and the enriched strip solution containing about 20 grams of U_3O_8 per liter will be neutralized with ammonia to precipitate ammonium diuranate ("yellow cake"). The yellow cake will be settled in two thickeners in series and the overflow solution from the first filtered, conditioned and returned to the stripping stage.

The thickened yellow cake slurry will be dewatered further in a centrifuge to reduce its water content to about 40 percent. This slurry will then pumped to an oil or gas fired multiple-hearth dryer (calciner) at 650°C (1200°F). The dried uranium concentrate (about 90 percent U_3O_8) will be passed through a hammer mill to produce a product of less than 1/4 inch size. The crushed concentrate, which will be the final product of the plant, will then be packaged in 55-gallon drums for shipment.

The uranium concentrate drying, crushing and packaging operation will be conducted in an isolated, enclosed building with a negative ventilation pressure to contain and collect (by wet scrubbing) all airborne U_3O_8 particles. This system will not only enhance the recovery of uranium but will decrease the exposure of employees to potential radiation. In addition, the design of the mill will be such that any leaks or spills in the plant will be collected and recycled to the appropriate part of the process, thus minimizing contamination of the surrounding areas.

During processing of the ore, approximately the following chemical quantities will be consumed per day of operation for the recovery of uranium:

	lbs/day
Sulfuric acid (196 lb/ton)	392,000
Manganese dioxide (15 lb/ton)	30,000
Flocculants (0.3 lb/ton)	600
Sodium chloride (3.0 lb/lb U_3O_8)	15,000
Soda ash (2.0 lb/lb U_3O_8)	10,000
Ammonia (0.4 lb/lb U_3O_8)	2,000
Organic (95 percent kerosene)	1,680

3.2.2 By-Product Copper Recovery

Ores from the White Canyon Mining District of Utah, one of the districts supplying the mill, usually contain copper associated with the uranium. The copper occurs in sulfide form, such as chalcopyrite, and can approach a one percent copper content. Copper in sulfide form is readily recovered by the froth flotation process commonly used in mineral beneficiation plants. Energy Fuels intends to segregate ores of this type and provide within the mill building a separate grinding, flotation, concentrate leaching, and filtration circuit for processing copper-uranium ore. Approximately 15 percent (300 tons per day) of the total mill tonnage is expected to be of this type.

Processing will consist of wet grinding the copper ore in a rod mill-cyclone circuit to minus 28-mesh followed by rougher flotation and two-stage cleaning. Flotation will be carried out in water using about 0.1 lb xanthate and 0.08 lb Dowfroth 250 (or equivalent) per ton of solids. The tailing from flotation will be essentially barren of copper but it will contain the major part of the uranium present in the crude ore. Therefore, the flotation tailing will be partially dewatered in a thickener, commingled with the ground ore in the main uranium circuit described in Section 3.2.1 and carried on through the mill process.

The copper flotation concentrate (froth) is expected to assay 12 to 20 percent copper but it will also contain ten to twenty percent of the total uranium present in the crude ore. In order to recover this uranium, it will be necessary to acid leach the copper concentrate under approximately the same temperature and acidity conditions as used in the main uranium mill circuit (see Section 3.2.1). The principal difference will be that the copper concentrate leach circuit will involve relatively small equipment because less than one ton per hour of solids will need to be handled. The copper, in the form of chalcopyrite, will be essentially insoluble in the leach step. Filtration of the leach slurry will, therefore, produce a filter cake of the copper sulfide minerals and a filtrate containing the uranium. A water wash will be applied to the filter to displace the leach solution from the filter cake.

The filtrate (solution) will be pumped to the first counter-current decantation thickener in the main circuit. The filter cake (copper sulfide) will be stockpiled and periodically sold to a copper smelter. Plate 3.2-2 shows the flowsheet planned for the recovery of copper. The copper concentrate after leaching will contain less than 0.05 percent U_3O_8.

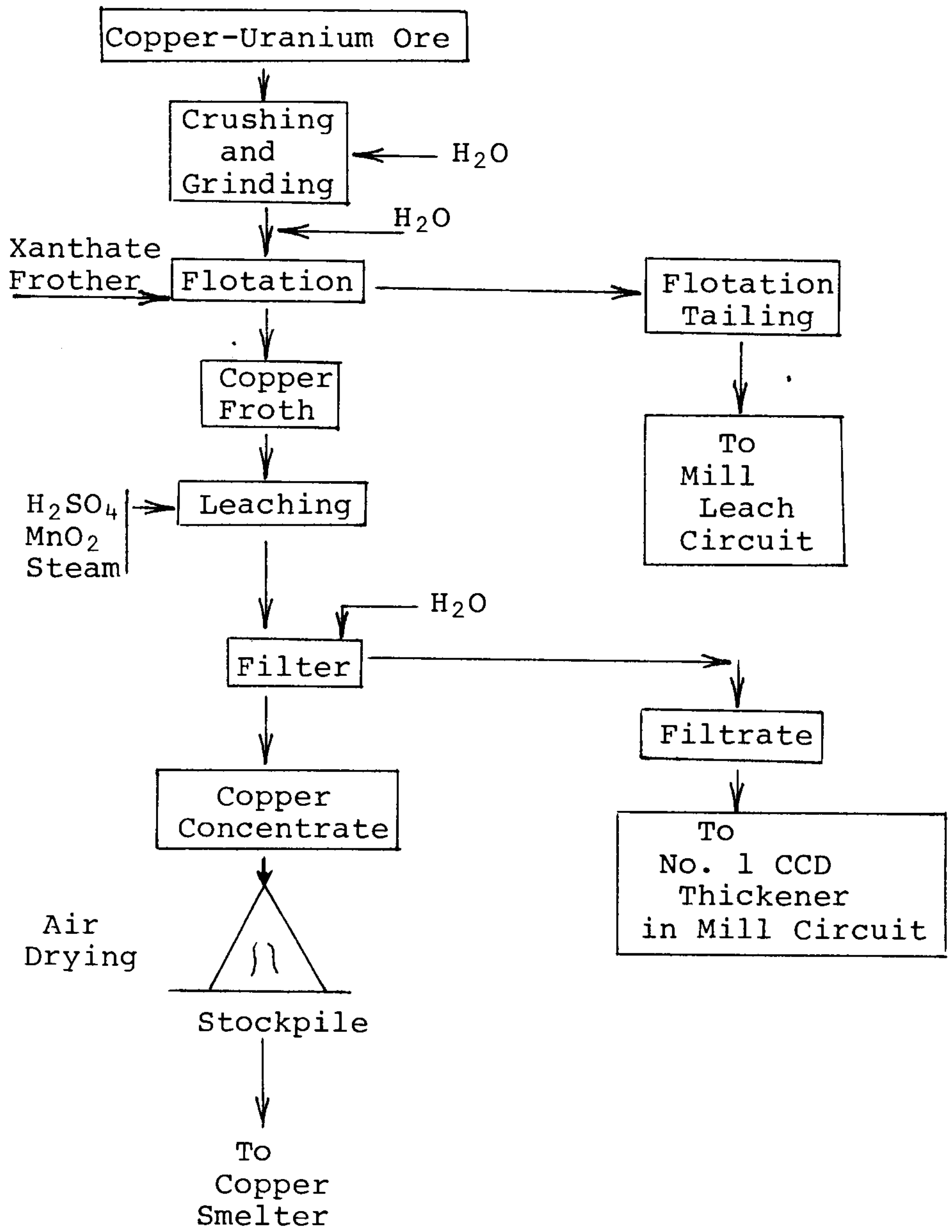
Copper is of minor economic importance to the overall plant and at times it may not justify recovery. It is planned to operate this by-product circuit only when the quantity and grade of copper ores are significant and an attractive price for copper exists. At the time of this writing, the copper industry in the United States is faced with an oversupply of copper and a depressed market. Metallurgically, it makes little difference if the uranium ores containing copper are processed in the by-product circuit or in the main mill process. The uranium extraction is essentially the same in either case.

3.2.3 By-Product Vanadium Recovery

Vanadium is present in some of the ores and will be soluble to a major degree along with the uranium during leaching. The solubilized vanadium will report to the uranium raffinate. Depending on the vanadium content of the uranium raffinate, it will either be recycled to the counter-current decantation step (see Section 3.2.1) or further processed for recovery of the vanadium before recycling.

The vanadium recovery process will consist of a separate solvent extraction section to treat the uranium raffinate and precipitate the vanadium from the strip solution. The flowsheet shown in Plate 3.2-3 illustrates the process.

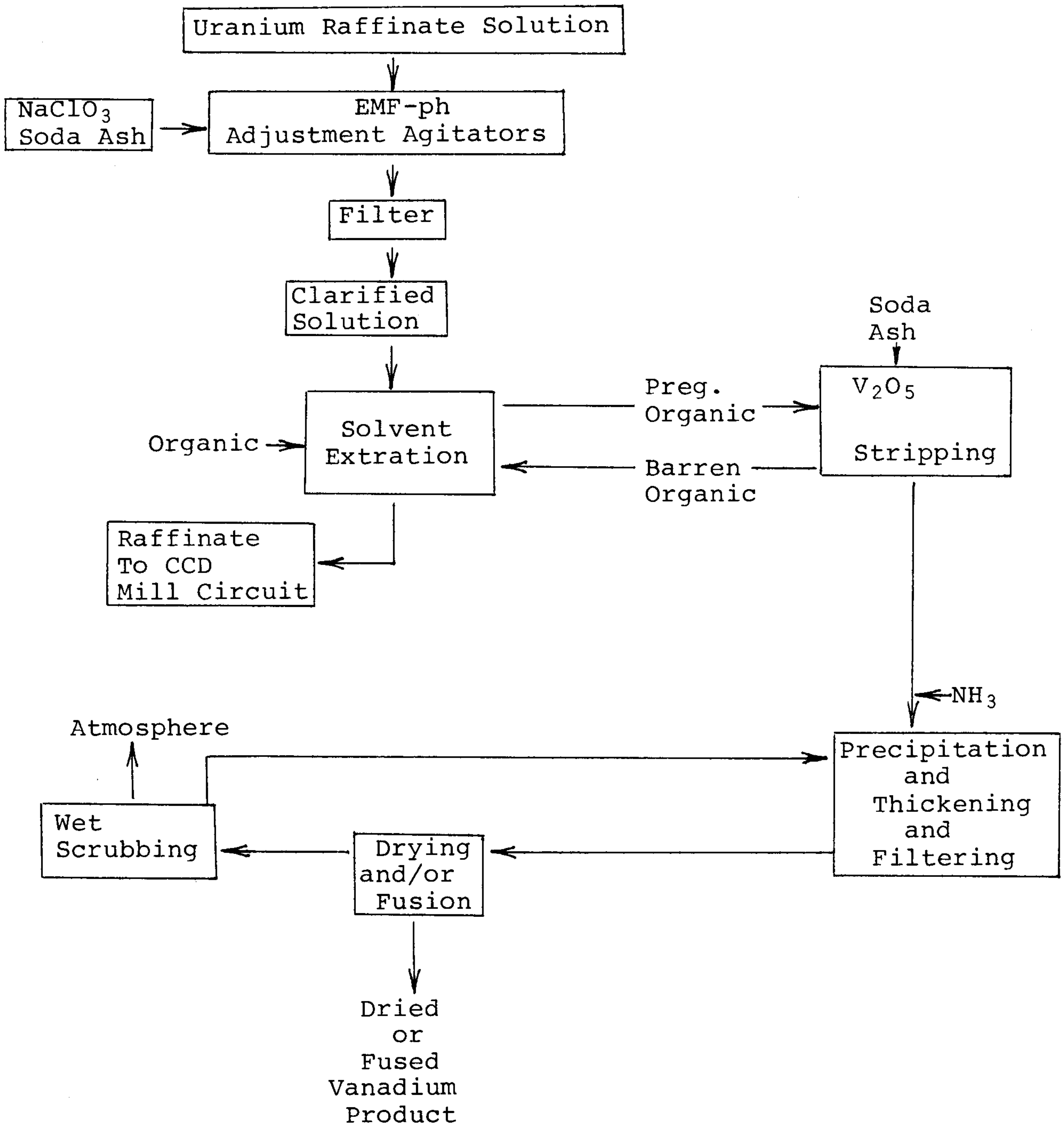
The uranium raffinate will be pumped to a series of agitators where the EMF (oxidation potential) will be adjusted to -700 mv with sodium chlorate and the pH raised to 1.8-2.0. The solution may possess some turbidity after this step and will be filtered prior to passing to a 5-stage solvent extraction circuit. Except for the one additional stage



GENERALIZED FLOWSHEET SHOWING RECOVERY OF COPPER

DAMES & MOORE

PLATE 3.2-2



GENERALIZED FLOWSHEET SHOWING RECOVERY OF VANADIUM

DAMES & MOORE

PLATE 3.2-3

of extraction, the solvent extraction section will be essentially the same as utilized for the uranium. An amine type compound carried in kerosene (same as for uranium) will selectively absorb the vanadium ions from the uranium raffinate solution. The organic will then be stripped of vanadium by contact with a soda ash solution. The barren organic solution will be returned to the solvent extraction circuit and vanadium will be precipitated from the enriched strip solution on a batch basis as ammonium metavanadate.

The vanadium precipitate will be thickened and filtered prior to drying in a an oil or gas fired dryer. The dried precipitate will be subjected to a fusion step at approximately 800°C to produce V_2O_5 black flake and packaging will be in 55-gallon drums. The vanadium product will not be radioactive.

The drying and fusion step along with packaging will be conducted in an enclosed area with a negative ventilation pressure to contact and collect (by wet scrubbing) all airborne dust and vapors.

3.3 SOURCES OF MILL WASTES AND EFFLUENTS

3.3.1 Non-Radioactive Mill Wastes and Effluents

3.3.1.1 Gaseous Effluents

Milling of the ore will release several non-radioactive vapors to the atmosphere. The leaching processes (crude ore and copper concentrates) will produce vapors of carbon dioxide, sulfur dioxide and some sulfuric acid. The rate of release for the carbon dioxide is estimated to be 4800 lb/hr whereas those of the other vapors are estimated to be a maximum of 0.05 lb/hr for each. The solvent extraction process (uranium and vanadium) will release organic vapor (95 percent kerosene) at an estimated rate of 0.10 lb/hr. There are no State of Utah or national standards applicable to the specific release of kerosene. However there are ambient standards that apply to non-methane hydrocarbons. The state and national ambient hydrocarbon standard is 160 $\mu g/m^3$ as a maximum 3-hour standard (effective between 6am and 9am) and the resultant ground-level kerosene concentrations will be well below the allowable standard.

During the concentrate drying process, gaseous effluents will be emitted from the dryer stack. These emissions will primarily be comprised of water vapor and carbon dioxide with maximum release rates of 205 and 105 pounds per hour, respectively. Significant amounts of sulfur dioxide and oxides of nitrogen may be emitted depending on whether the furnace-drying process is gas or oil fired. If gas is used SO_2 and NO_x emissions will be insignificant; if fuel oil is used, fuel consumption is estimated at 3.0 gallons per hour resulting in maximum SO_2 and NO_x emission rates of 2 and 0.5 pounds per hour, respectively.

Assuming the use of fuel oil (No. 2) as the dryer fuel, the furnace dryer will normally operate at a heat input of approximately 450,000 BTU's per hour. No Utah or national emission standards apply to facilities of this small size. However, state and national ambient standards will apply to the resultant SO_2, NO_2 and particulate ambient concentrations.

Using the design parameters presented in Section 6.1.3.4, the maximum 1 hour SO_2 concentration beyond the site boundary was calculated to be less than 25 $\mu g/m^3$. The maximum NO_2 and particulate concentrations were calculated to be less than 6 and 5 $\mu g/m^3$, respectively. These low values would indicate that the short and long-term ambient standards for each pollutant would not be approached. Ground-level concentrations of each pollutant in fact would be well below their respective standards.

3.3.1.2 Liquid Effluents

The major liquid effluent discharged from the mill will be water contained in the plant tailing slurry. The discharge rate of water present in the tailing slurry is expected to average 335 gallons per minute and, based on laboratory test work, should have an analysis approximately as follows:

Ion	Grams/Liter
V	0.24
U	0.0025
Na	4.90
NH_3	0.065
Cl	3.05
SO_4	82.2
Cu	1.62
Ca	0.48
Mg	4.06
Al	4.26
Mn	4.58
Zn	0.09
Mo	0.007
Organics	See discussion below
pH	1.8-2.0

Radiochemical analyses of the above tailing water and solids were as follows:

	Assay, pCi/Liter				
	Radioactivity				
	Gross Alpha	Gross Beta	Th^{230}	Ra^{226}	Pb^{210}
Liquid	$2.5x10^5$	$2.3x10^5$	$1.3x10^5$	$2.3x10^2$	$2.8x10^2$

	Assay, pCi/g	
Solids	Th^{230}	Ra^{226}
	$1.5x10^2$	$3.7x10^2$

The above liquid effluent will contain a portion of the organic phase from the uranium (and vanadium) solvent extraction steps. The organic residue will be entrained with the tailing solids. The amount of organic (mostly kerosene) released will be about 0.2 gallon per 1000 gallons of raffinate or 70 lb/hr. All liquid effluents exiting from the mill will be confined in the tailing impoundment area. No liquid effluents will cross the property boundary of the mill site.

3.3.1.3 Solid Effluents

By far the largest emission from the ore stockpiles and feeding facilities will be the release of fugitive dust to the atmosphere. Dust emissions from these sources are difficult to define because they are highly dependent, among other variables, upon the temporal variations of wind and moisture content of the ore. Some concentrate particles would be released from the drying stack during the process. With the flue gas scrubbers, total particulate loss should be less than 0.03 grains per cubic foot.

A recent study by the EPA (1973) has estimated general dust emission rates for various aggregate stockpiles. General dust loading data related to the type of aggregate storage that will occur at the proposed mill site indicate that approximately 1.5 pounds per year of dust could be emitted for each ton of stockpiled ore.

A rough estimate of the fugitive dust emissions resulting from the anticipated 250,000 tons of ore stockpiles is 37,500 pounds per year or 102 pounds per day. However, the same EPA study (1973) states that dust emissions can be reduced from 50 to 90 percent by keeping the surfaces of the stockpiles moist. The ore will generally be coarse particles and will be kept wet as required to control dust as discussed below.

Current emission standards are not applicable to fugitive dust emissions. However, ambient air quality standards would apply to the resultant surface concentrations. The state and national ambient standards are 150 $\mu g/m^3$ as a 24-hour maximum not to be exceeded more than once per year and 60 $\mu g/m^3$ as an annual average based upon a geometric mean.

Fugitive dust emissions in a large sense are dependent upon the use of mitigating measure to control their release. During milling operations, ore stockpiles will be watered and dust suppression systems and scrubbers will be used throughout ore handling processes. These should substantially reduce dust emissions.

3.3.2 Radioactive Mill Wastes and Effluents

This section considers the airborne radioactive effluents from the mill. Radioactivity associated with non-airborne solid effluents will be contained within the site and all radioactivity associated with the liquid effluents will be impounded in the tailing area which is designed to totally contain the liquid effluents (analyses indicated in Section 3.3.1.2). More discussion on liquid effluents can be found in 5.2.2.

The radioactivity released during milling of natural uranium is primarily associated with uranium-238 and its radioactive daughters present in the ore. Secular equilibrium has been conservatively assumed to exist between the members of the U-238 decay chain series. Also present in the ore is uranium-235 and its daughters. The concentration of U-235 in natural uranium is 0.714 atom percent. Compared with the U-238 decay series, the U-235 decay series contributes negligibly to the quantity of the radioactivity dispersed (Scarano et al., 1977). Basic mill operating data used in the analyses of the radioactive effluents are summarized below.

Uranium Ore Feed Rate	= 2000 tons/day
Operation Schedule	= 340 days/year
	= 24 hours/day
U_3O_8 Content of the Ore	= 2.5 lbs/ton
U-238 Concentration in the Ore	= 353 pCi/g
U-235 Concentration in the Ore	= 16 pCi/g
U_3O_8 Recovery Rate	= 94%
Fraction of Th-230 to Tailing	= 0.95
Fraction of Ra-226 to Tailing	= 0.998

In the following sections, the release of radioactivity in the milling steps is discussed and, on the basis of the available data from operating mills, the radioactivity that would be released by the proposed mill is estimated. The potential release estimates assume a 15-year milling period and conservative assumptions were made.

3.3.2.1 Ore Storage Pads

The feed for the proposed mill will be crushed ore from the two buying stations that has been stored on pads to provide a continuous supply for blending. These pads will continue to release Rn-222, a daughter of Ra-226, and windblown particulates to the atmosphere.

Rn-222 release can be estimated utilizing the following data and assumptions:

1. Area of the Ore Storage Pads	= 8 acres
2. Ra-226 Concentration	= 353 pCi/g
3. Density of Ore	= 1.6 g/ml
4. Decay Constant of Rn-226	= 2.1×10^{-6} sec^{-1}
5. (D_e/V)* for Ore Storage Pads (Schiager, 1974)	= 2.5×10^{-2} cm^2/sec
6. Emanation Coefficient of Ore (Clements et al., 1978)	= 0.07

The Rn-222 flux (J) at the surface of an area containing infinite depth of material can be estimated from (Schiager, 1974)

$$J = C_t . E . \sqrt{\lambda . (D_e/v)}$$

where (C_t) is the concentration of Ra-226 in bulk medium in (pCi/ml). This equation yields the flux from the pads of 90.6 pCi/(m^2-sec) which results in a total annual Rn-222 release of 92.4 Ci.

During dry seasons, the exposed surfaces of the ore piles maybe a source of dust generated by wind action and ore feeding and blending operations. It has been conservatively estimated by Sears et al. (1975) that about 4 lbs/(hr-acre) of fugitive dust may occur from this type of operation. This figure was used here for radiological calculations. However, most of the radioactivity will be associated with dust of a

*Diffusion coefficient/void fraction

large diameter and, under normal atmospheric conditions, blowing dust will not contribute to the transport of radioactivity outside the mill site boundary (Sears et al., 1975). Nevertheless, 5 percent of this release was assumed to be fines that could be carried away by wind. This yields an ore storage pad release rate of 2.1 mCi/year for U-238 and each of its daughters.

3.3.2.2 Ore Grinding Operation

Wet grinding of the ore will minimize the release of dust. However, about 51.5 μCi of Rn-222 per ton of ore is estimated as the release rate during grinding (Schiager, 1974). This yields an expected release rate of about 35 Ci/year of Rn-222 from the grinding of ore.

3.3.2.3 Leaching Operation

The two stage leaching operation is a wet process and will not contribute to emission of particulates. This part of the milling process need not be considered for the release of Rn-222, since the transit time of the ore through the mill circuit will be rather short.

3.3.2.4 Uranium Concentrate Drying and Packaging

The uranium concentrate (precipitated ammonium diuranate) will be dried at 650°C. The product (yellow cake) will be about 90 percent U_3O_8 and will represent about 94 percent of the uranium in the ore. In addition yellow cake will contain 5 percent of the Th-230 and 0.2 percent of Ra-226 and daughters originally in the ore. Emission of particulates to air during uranium concentrate drying and packaging will be controlled by a wet scrubber, as described in Section 3.4.

The estimated release of uranium concentrate will be 0.04 lbs/hr. This corresponds to an annual release of radioactivity of 43.4 mCi of U-238, 2.3 mCi of Th-230 and 0.1 mCi of Ra-226 and daughters.

3.3.2.5 Tailing

The tailing produced by the mill operation will be stage impounded in a series of cells each having a total area of approximately 70 acres.

Details of the design and integrity of the tailing retention area are discussed in Appendix H and Section 3.4. The design will provide for total containment of solids and liquids. During operation, it is estimated that about 90 percent of the tailing surface will be covered by the tailing solution. The remaining area will be kept moist when necessary to control wind blown dusting.

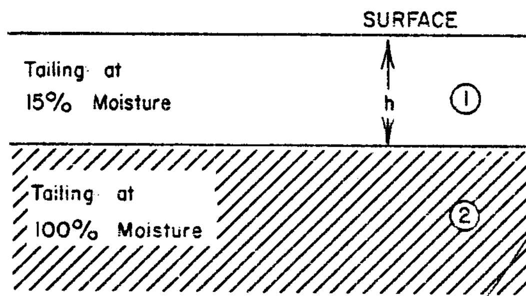
Prior to stabilization, the tailing will be allowed to dry to about an estimated 15 percent moisture. During this interim period Rn-222 will be emitted. The following data and assumptions were used to estimate the radon release from the tailing as they are drying.

1.	Maximum area of tailing exposed at any one time	= 70 acres
2.	Ra-226 content	= 353 pCi/g
3.	Density of tailing	= 1.6 g/ml
4.	Decay constant of Rn-222	= 2.1×10^{-6} sec^{-1}
5.	Emanation Coefficient for tailing (E) (Schiager, 1974)	= 0.2
6.	(D_e/v) for tailing at 15% moisture (Schiager, 1974)	= 1×10^{-2} cm^2/sec
7.	(D_e/v) for tailing at 100% moisture (Schiager, 1974)	= 5.7×10^{-6} cm^2/sec
8.	Thickness of the dry tailing layer	= 0.5 feet

The Rn-222 flux (J) at the surface of an area containing infinite depth of material was estimated from (Schiager, 1974).

$$J = C_t \cdot E \cdot \sqrt{\lambda (D_e/v)}$$

where (C_t) is the concentration of Ra-226 in bulk medium (in pCi/ml). The tailing were assumed to be composed of two layers as shown on the following page.



The flux at the surface for this configuration is given by (Sears et al., 1975; Tanner, 1964)

$$J = J_1 \tanh \left\{ \sqrt{\lambda h^2/(D_e/v)_1} \right\} + J_2 \exp \left\{ -\sqrt{\lambda h^2/(D_e/v)_1} \right\}$$

where the subscripts (1) and (2) refer to the layers shown in the figure, and where (J_1) and (J_2) are the fluxes at the surface of an area containing infinite depth of materials (1) and (2), respectively. The (tanh) term is a correction for the finite thickness of the layer, and the (exp) term is the attenuation of (J_2) through the upper layer.

(from 353 pCi/g tailings!)

Using the above data and equation yields a flux of 38.9 pCi/(m^2-sec). This dry condition of the tailing can be assumed to prevail no more than three months before reclamation is initiated. Thus, the total release anticipated during this period is calculated to be about 90 Ci of Rn-222.

3.3.2.6 Summary of Airborne Release Rates

A summary of release rates computed for the various mill operations and several radionuclides are given in the table below.

Source	Rn-222 Ci/yr	U-238 mCi/yr	U-234 mCi/yr	Th-230 mCi/yr	Ra-226 & Daughters mCi/yr
Ore Pads	93	2.1	2.1	2.1	2.1
Ore Grinding	35	---[a]	---	---	---
Yellow Cake	--	43.4	43.4	2.3	0.1
Tailing	90	---	---	---	---

[a] --- = insignificant

3.4 CONTROLS OF MILL WASTES AND EFFLUENTS

The control of dust in the Hanksville and Blanding Buying Stations is discussed in 3.6.3.5 and 3.6.4.4, respectively.

At the proposed mill, the processing buildings and equipment will be provided with ventilation fans, hoods and ducting to control the concentration of gaseous effluents to levels below the applicable standards. A forced-air ventilation system designed for the entire solvent extraction and stripping buildings will remove kerosene vapors.

Dust generated in the final crushing step, conveyor transfers and fine ore storage will be collected in cyclonic precipitators and bag houses. The collected dust will be processed in the mill circuit. Fugitive dust from ore piles will be controlled by sprinkling with water. A dust suppression spray system will be installed in the mill crushing building and used when exceedingly dry ores are being handled. The water added in this manner will remain with the ore and go to process.

Yellow cake particles carried in the flue gases from the uranium dryer and packaging area will pass through a wet fan scrubber operating at an equivalent venturi scrubber pressure of 20" W.G. The solution and particulates collected from the scrubber will be recycled to the No. 1 yellow cake thickener in the mill.

A wet dust collector will also be installed to collect and recycle dust form the vanadium drying operation. A separate building for precipitation, drying, and packaging of the vanadium is planned.

The design of the mill is be such that any leaks or spills will be collected and recycled to the appropriate part of the process, thus eliminating any product loss or contamination of the surrounding area.

Most process liquids will be recycled in the mill; however, about one ton of liquid (water) for every one ton of barren tailing solids will be discharged to the retention area. The water (expected analysis given in Section 3.3.1.2) will be required to transport the solid tailing to the retention area. In addition, the elimination of some process water in this manner will avoid a build-up in chemical ions that could be harmful to the process. No liquid or solid effluent will cross the property boundary, other than wind blown dust.

The tailing retention system will consist of a series of 70-acre cells, each of sufficient capacity to hold the quantity of mill tailing produced from a 5-year operating period. The cells will be lined with an impervious membrane to provide total containment of solids and liquids. The cell area is calculated to be sufficient to achieve evaporation of the total liquid effluent.

Appendix H describes the preliminary design for the tailing retention system.

3.5 SANITARY AND OTHER MILL WASTE SYSTEMS

3.5.1 Sanitary and Solid Wastes

All applicable State of Utah, Division of Health standards will be met in the design and operation of the sanitary facility associated with the mill complex. Sanitary wastes will be disposed of by a septic tank and leach field designed and operated in accordance with U.S. Public Health Service standards and all applicable regulations.

Trash, rags, wood chips, and other solid debris will be collected and buried in designated areas.

Coveralls used in yellow cake product areas will be laundered at the mill. Furthermore, mill personnel will be provided with a change room and laundering facility to allow them to leave their work clothes at the mill. All liquid effluents from the laundry will be routed to the tailing retention system.

3.5.2 Building and Process Heating

In keeping with the nation's energy shortage, coal will be used to fire the boilers needed to produced steam for heating the leach pulp and other process requirements.

3.5.2.1 Gaseous Wastes

Steam necessary for buildings and process heating will be generated from coal-fired boilers. Approximately 60 tons of coal per day will be required for this at a heat input of approximately 50 million BTU's per hour. As a result of the boiler combustion, various stack gases will be released to the atmosphere including carbon dioxide, water vapor, sulfur dioxide and nitrogen oxides.

State and national emission standards are not applicable to a steam generating boiler of this small size. Likewise significant deterioration regulations are not applicable; however, state and national ambient air quality standards will apply to the resultant ambient concentrations. The combustion of 60 tons per day of 0.3 percent sulfur coal would generate approximately 720 pounds of sulfur dioxide per day and approximately one-half this amount (360) pounds of NO_x. Section 6.1.3.4 presents the estimated design and emission parameters for the boiler.

3.5.2.2 Solid Wastes

The combustion of coal will produce two ash products, fly ash and bottom ash. With a coal usage rate of 60 tons per day, the total ash production would be less than 6 tons per day which will be sent to the tailing retention system. These ash products would remain in the tailing cell, settling with the tailing solids, and present no additional waste problems.

Stack emissions from the coal-fired boilers will be subject to a precipitator to remove fly ash, and less than 190 pounds per day of particulate matter will be released to the atmosphere. Fly ash deposits from the precipitators will also be sent to the tailing cells.

3.5.3 Analytical Laboratory

The mill facility will be complemented with an analytical laboratory which will routinely assay products of ore, process streams and final products to assure adequate quality control and plant operating efficiency. The laboratory fume hoods will collect air and mixed chemical fumes for dilution and venting to the atmosphere. These gases will contain non-radioactive chemicals, including HCl and NO_2. The volume of gaseous fumes emitted from the laboratory operations will be small and considering the dilution in the collection stack and air eductors should be inconsequential.

Liquid laboratory wastes will be discharged to the tailing retention system.

3.6 HANKSVILLE AND BLANDING BUYING STATIONS

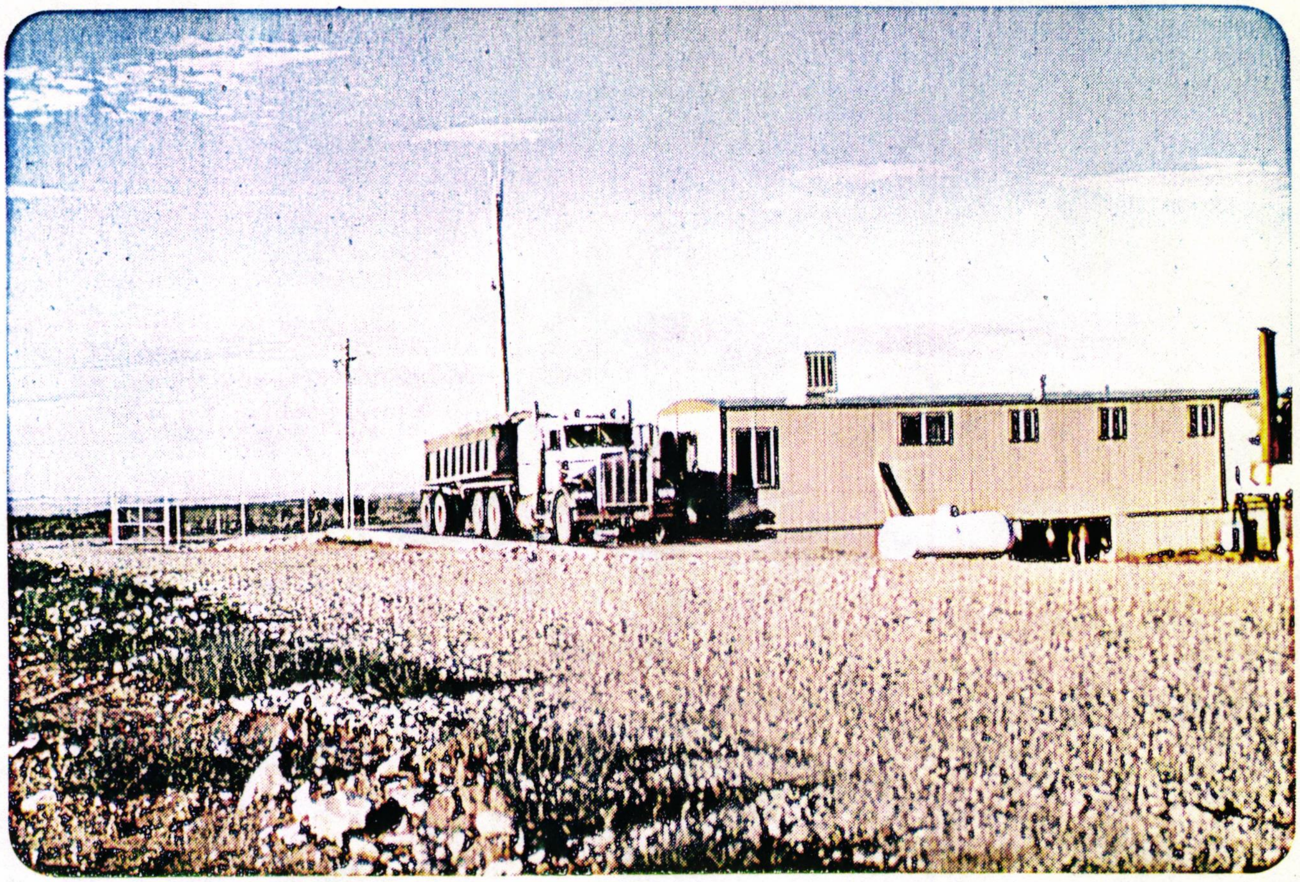
Energy Fuels currently is operating two uranium ore buying stations located near Hanksville, Utah and Blanding, Utah. The stations are approximately 135 miles apart and each provides a market for ore produced by independent mine operators. The applicant also has several mining properties under exploration which are expected to supply ore to the buying stations in the future. The Hanksville and Blanding buying stations commenced operations in January 1977 and May 1977, respectively.

3.6.1 External Appearance of Buying Stations

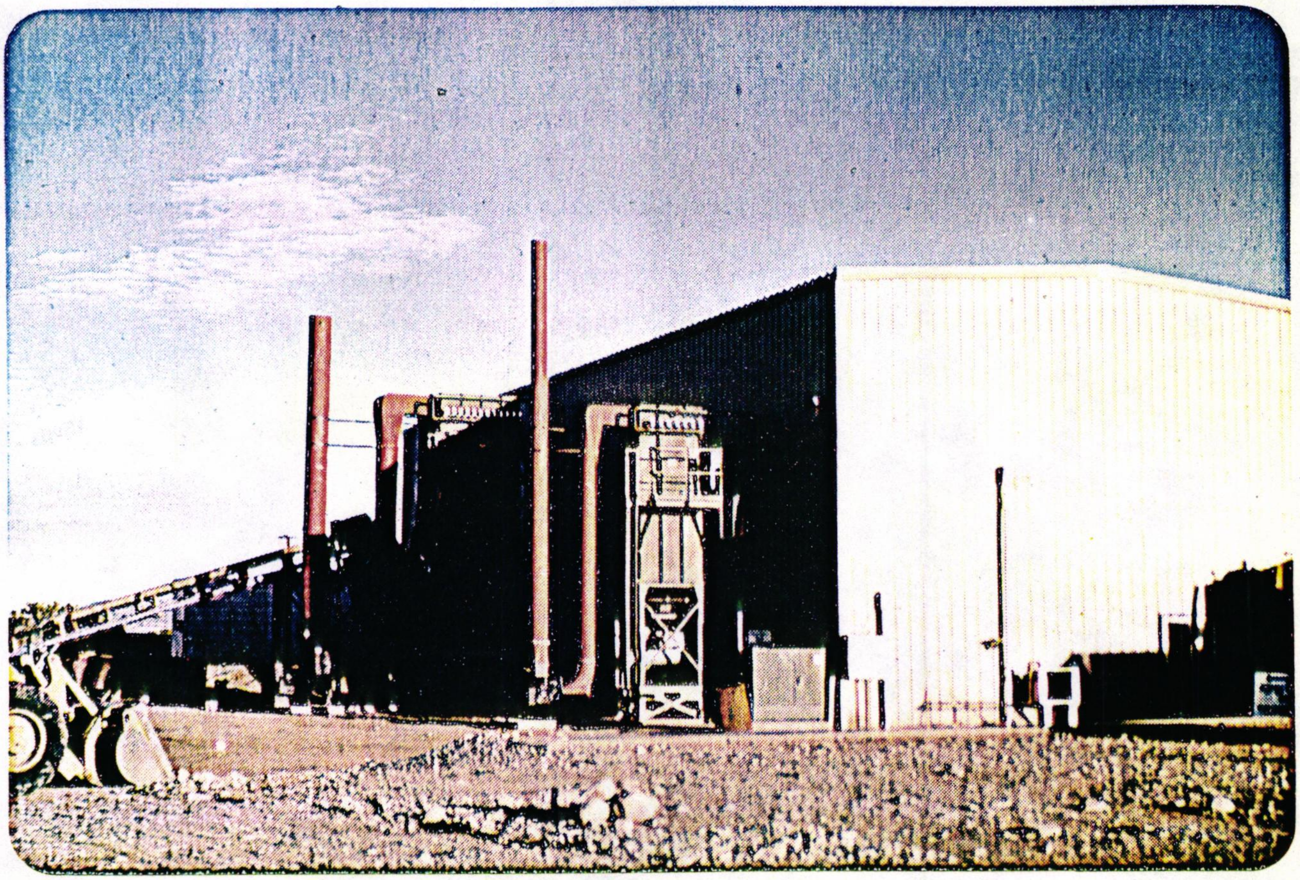
The principal buildings of the two buying stations (Plates 3.6-1 and 3.6-2) are of prefabricated construction and the exterior walls are a desert sand color, which present an unobstrutive appearance.

3.6.2 Sources of Ore

Many small to medium sized uranium mines operate in southeastern Utah and southwestern Colorado. The ores occur in sedimentary formations and, for the most part, are mined underground methods. The availability of a local ore buying station provides a market for ores in the area and encourages the mining and exploration of the deposits. Virtually all the mining properties have operated intermittently for 20-25 years.

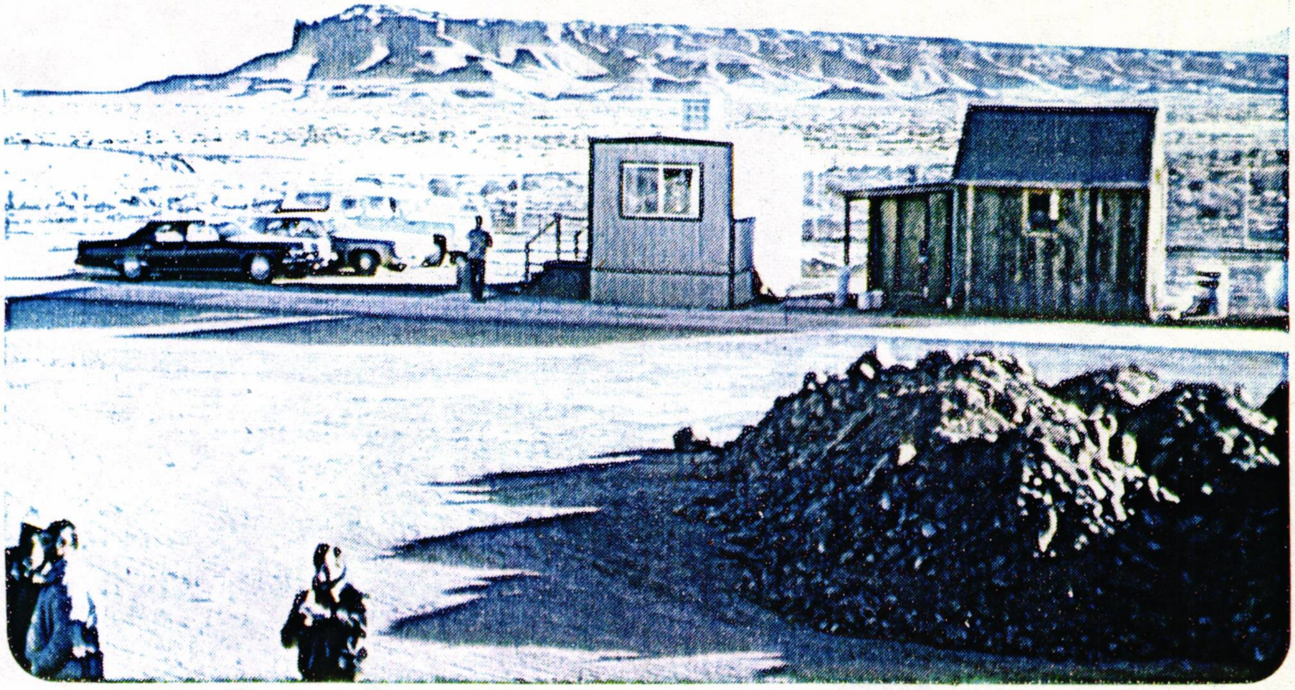


The Truck Scale and Scale House at Blanding Buying Station.

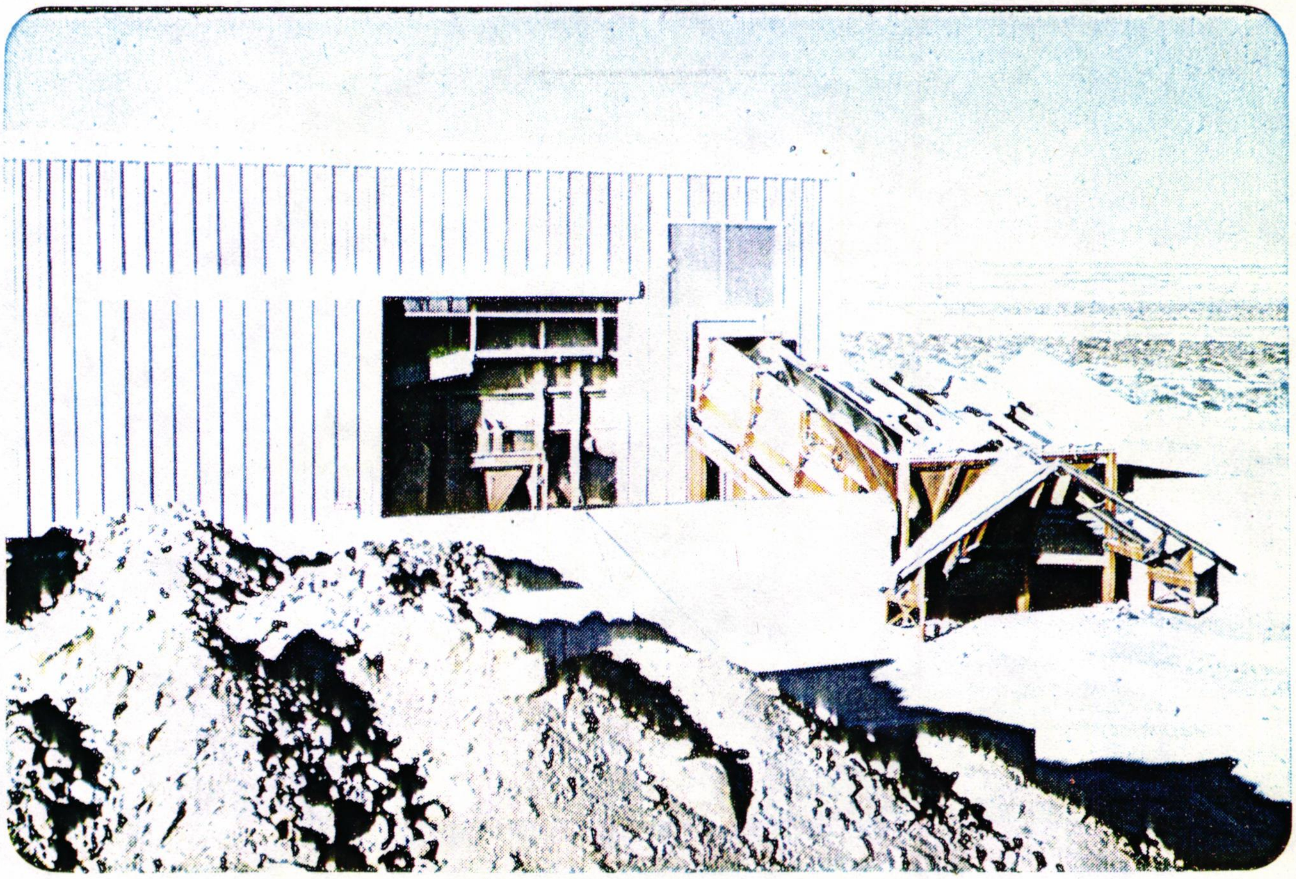


The Blanding Crushing and Sampling Plant.

PLATE 3.6-1



The Truck Scale and Scale House at Hanksville Buying Station.



The Hanksville Crushing and Sampling Plant.

3.6.2.1 Hanksville Station

Independent mine operators within a radius of about 100 miles of Hanksville mine and sell their ore to the applicant. The proximity of the buying station to the individual mines reduces shipping costs and, therefore, permits the mining of lower grade ores. Plate 3.6-3 shows the general location of the mines with respect to the buying station and the major routes utilized for ore haulage. Trucks provide the sole means of haulage as there are no railroads in the immediate vicinity.

3.6.2.2 Blanding Station

This station provides a market for a large area and receives ore from numerous mines within about a 125-mile radius. Refer to Plate 3.6-3 for the location of the mines with respect to the buying station and the major truck routes. In most cases, the major part of the haulage distance is on asphalt surfaced roads. The trucks are virtually all diesel powered and of 30-ton capacity.

3.6.3 Hanksville Station Operations

3.6.3.1 Receiving and Stockpiling of Delivered Ore

Ore from the various mines in the area is delivered by truck to the Hanksville buying station; whereupon arrival, it is weighed on a 60-ton truck scale and then dumped in a specified space on the ore pad. The empty truck is reweighed to determine the net wet tons of ore delivered. A "grab" moisture sample is immediately taken from the ore as it is dumped on the concrete ore pad and the percent moisture determined. The net dry tons of ore in the load is then calculated. Each truck load is handled in this manner and each mine (shipper) has its designated dumping space. After numerous truck loads of ore from a specific mine have been accumulated on the pad, the "lot" is closed and passed through the sampling plant of the buying station.

The sample obtained from the sampling plant is prepared for chemical assay and payment for the ore is made to the shipper based on the uranium content.

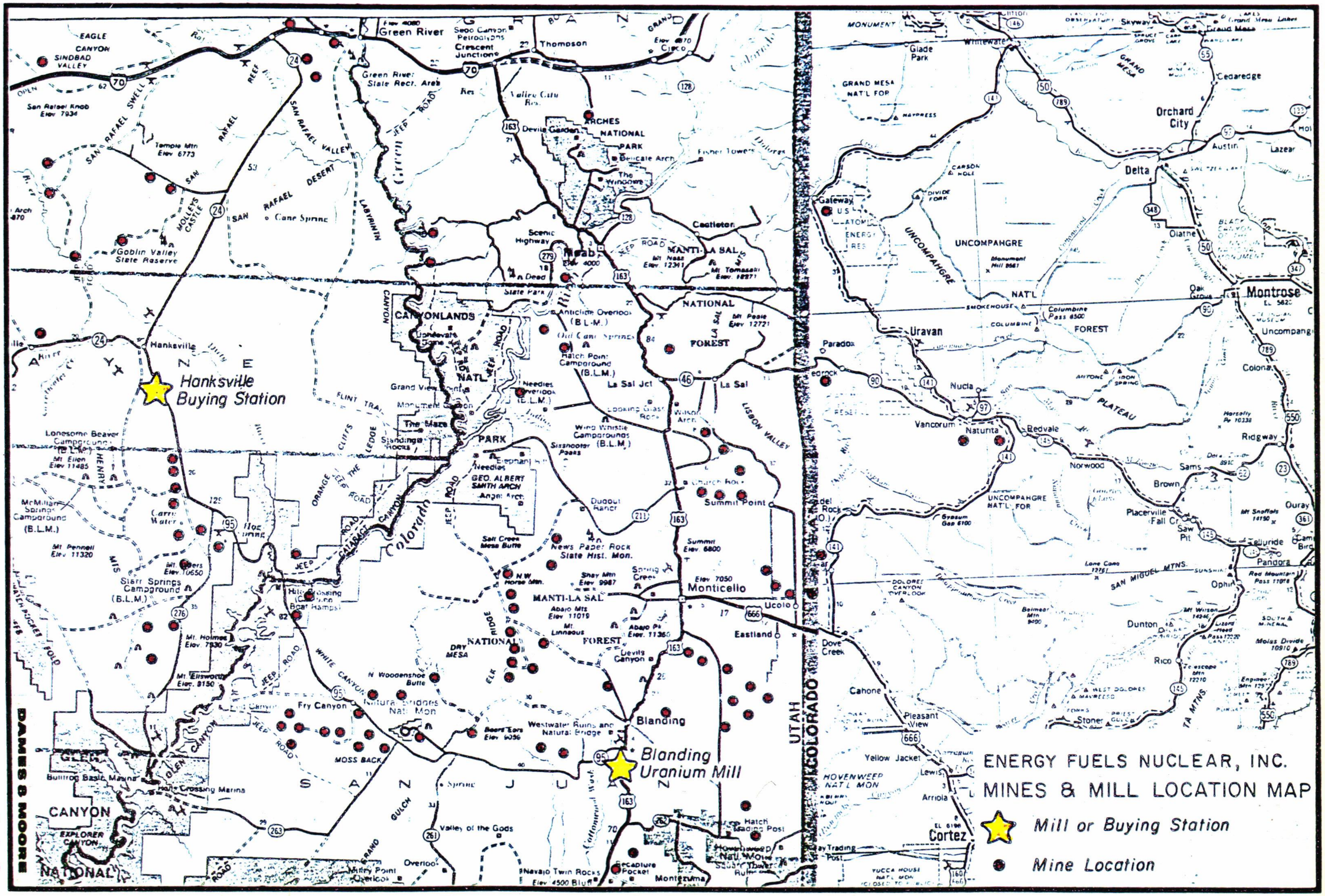


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PLATE 3.6-3

3.6.3.2 Crushing of Delivered Ore

The sampling plant at the Hanksville buying station is housed in a 30 by 100-foot building and handles approximately 75 tons of ore per hour on a one shift per day basis. Operation of the plant is intermittent because all equipment must be thoroughly cleaned between consecutive runs so as to prevent any residual ore from one shipper being mixed with ore from another shipper. This is standard practice for any sampling facility.

Stockpiled ore on the concrete pad is generally accumulated for a one month period and then passed through the sampling plant. Longer stockpiling periods would unduly delay the payment to be made to the shipper.

A front-end loader moves the ore from the concrete pad to a receiving hopper that feeds the sampling plant. In the sampling plant, the ore passes through four stages of crushing with intermediate mechanical samples between each stage (Plate 3.6-4). This operation produces a small sample representative of the lot of ore and a reject constituting most of the original weight of ore at a nominal 1 1/2 inch size.

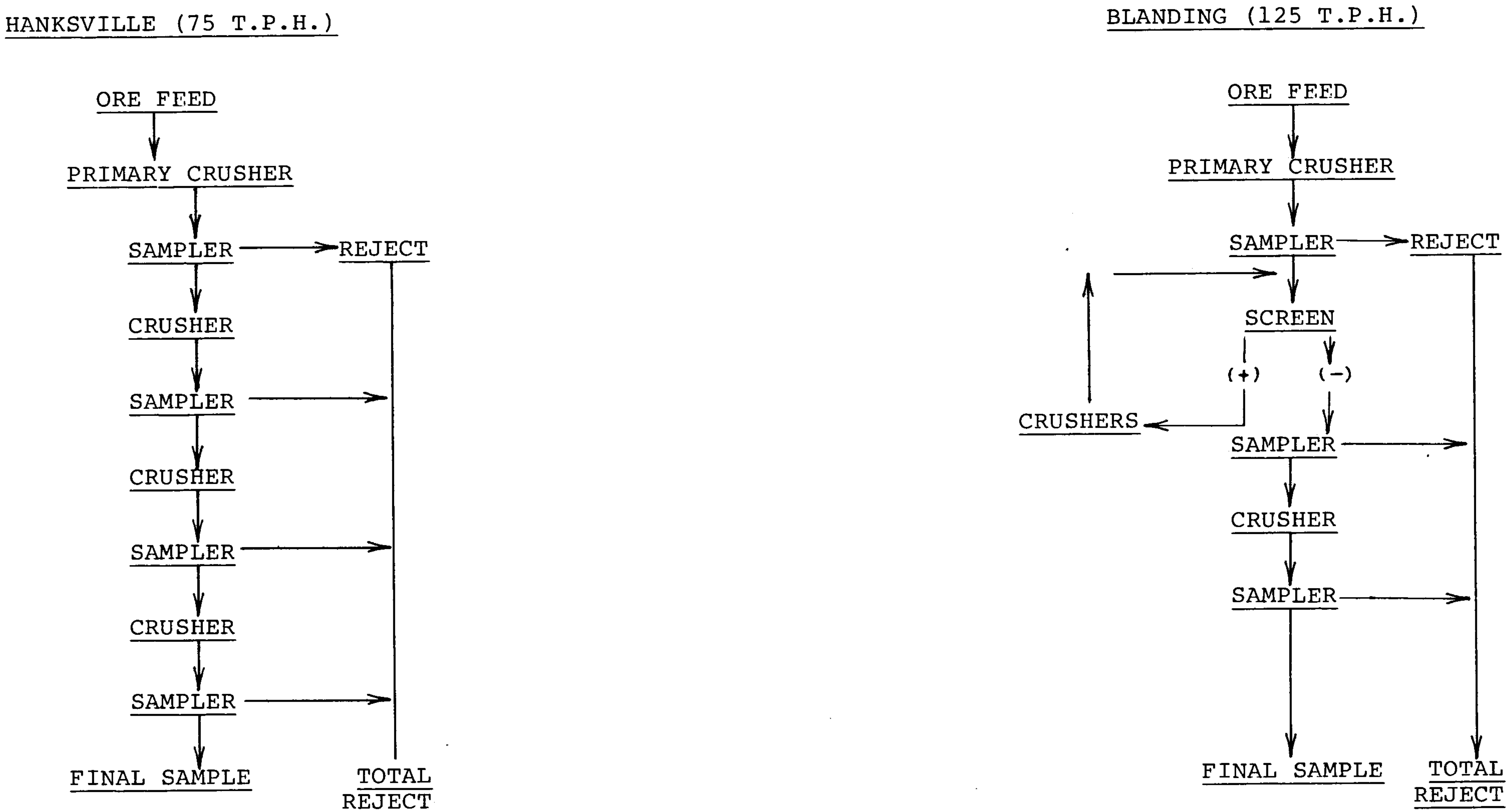
3.6.3.3 Stockpiling of Crushed Ore

The ore reject from the sampling plant is collected on a central belt conveyor that discharges to a system of four 50-ft long portable conveyors terminating with a 100-ft long portable belt stacker. This system of conveyors provides considerable flexibility for stockpiling the crushed ore according to grade and ore type.

The reject is stored on pads in a fenced area. Eventually, it is planned that all ore stockpiled at the Hanksville buying station will be hauled by truck to the proposed mill near Blanding.

3.6.3.4 Sample Preparation

The sample (minus 3/16") obtained from the final mechanical sampler in the sampling plant is prepared for assaying using standard procedures.



GENERALIZED FLOWSHEETS OF THE HANKSVILLE AND BLANDING BUYING STATIONS.

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The sample is crushed to 10-mesh and then mixed, split, dried overnight at 110°C, pulverized to minus 100-mesh, mixed, and final samples split out for assay by both the buyer (Energy Fuels) and the shipper. A third sample is reserved for "umpire" assay, in case of a disagreement between the assay results of the buyer and shipper. Sample preparation is performed in a closed room within the sampling plant building.

3.6.3.5 Control of Dust in Plant

Dust generated during crushing and handling of the ore in the sampling plant is collected in five mechanical shaker bag houses. The collected dust is recombined with the ore at appropriate points so as to not influence the grade of ore.

All feeders, chutes, crushers and transfer points are enclosed in hoods connected to a system of ducts under negative pressure. The ducts discharge to their respective bag houses. The design parameters for the bag house collectors are summarized in the following table:

System	Model	CFM	Sq Ft	Ratio Air:Cloth
1	TU-288	5000	1991	2.51 to 1
2	72-LS	1025	250	4.1 to 1
3	72-LS	1025	250	4.1 to 1
4	36-LS	600	125	4.8 to 1
5	18VDS	180	18	10.1 to 1

The ducts are sized for air velocities of 3,500 feet per minute and equipped with dampers to adjust air flow.

When an ore is noted to be unusually dry or has other physical characteristics that could produce above average amounts of dust, the ore is sprayed with water on the pad before it is fed to the sampling plant. This procedure is usually required when the ore contains less than four percent moisture. The use of water spraying to control dust is the responsibility of the sampling plant foreman.

Some dust is emitted during preparation of the sample for assay and in cleaning of the equipment between samples. Control of this dust is accomplished by a wall-mounted hood over the sample grinders. The hood is connected to a duct leading to the System 5 dust collector indicated in the foregoing table. As an added precaution, the person working in the preparation room is required to wear a respirator. Work in the sample preparation room is on an intermittent basis.

No chemical emissions are produced in the sampling plant. A 275 KW diesel-generator set supplies all the electric power required at the Hanksville buying station. Power from a public utility is not available due to the remote location of the facility.

3.6.3.6 Haulage to Blanding Mill

Haulage of the crushed ore from the Hanksville buying station to the proposed mill near Blanding will be done under contract with canvas-covered dump trucks of 30-ton capacity. The ore will not be heaped in the truck beds but, rather, will be evenly distributed to prevent ore spillage during transportation. The use of a tightly tied canvas cover over the truck bed will eliminate the possibility of dust loss during haulage.

3.6.4 Blanding Station Operations

3.6.4.1 Receiving and Stockpiling of Delivered Ore

The applicant employs the same procedure for receiving and stockpiling ore delivered to the Blanding buying station as it does at Hanksville. The procedure is described in Section 3.6.3.1.

3.6.4.2 Crushing of Delivered Ore

The sampling plant at the Blanding buying station is similar to the applicant's plant at Hanksville discussed in Section 3.6.3.2. The major difference is that the Blanding plant handles approximately 125-tons of ore per hour and a closed circuit crushing-screening system is used in the secondary circuit. In the future, it will be necessary to about double the crushing capacity of this plant by substituting a larger primary crusher and installing a secondary crusher. Generalized flowsheets of the two plants are shown on Plate 3.6-4 for a convenient comparison between the systems. The Blanding sampling plant building is 40 feet by 100 feet.

As at Hanksville, the Blanding plant produces a small sample representative of the lot of ore and a reject constituting most of the original weight of ore. The reject is a nominal 1 1/2-inch size.

3.6.4.3 Stockpiling of Crushed Ore

The stockpiling of crushed ore at the Blanding station is different then practiced at Hanksville. At the Blanding station, the crushed ore (reject) is collected on a central belt conveyor that discharges to one 50-foot long conveyor and then onto a 110-foot long portable belt stacker. The stacker discharges into a 50-ton capacity ore bin. The ore is discharged from the bin through a bottom gate into a truck which hauls it to the appropriate stockpile. This system offers considerable flexibility in segregating the ore according to grade and ore type. The stockpile area is only a few hundred feet away and the ground surface is well packed. The release of particulates to air resulting from transportation to the stockpile is minimal.

The crushed ore is stockpiled in a fenced area and, after construction of the applicant's proposed mill, the ore will be moved by front-end loader to the mill feed bin to be located a few hundred feet away.

3.6.4.4 Sample Preparation

Sample preparation procedures at the Blanding station are the same as those described for the Hanksville station (refer to Section 3.6.3.4).

An additional feature at the Blanding station that is not at Hanksville, is a small analytical laboratory used to perform the required chemical analysis. This laboratory carries out the assays required by both sampling plants. A larger analytical laboratory will eventually be needed to serve the requirements of the applicant's proposed mill.

3.6.4.5 Control of Dust in Plant

For the most part, the dust collection system at the Blanding station is similar to the one at the Hanksville station described in Section 3.6.3.5. However, because of the difference in flowsheets (Plate 3.6-4), only three bag house collectors were installed. The collectors use an automatic reverse jet for bag cleaning in contrast to the mechanical shaker design used at Hanksville.

All feeders, crushers, screens, chutes, and transfer points are enclosed in hoods that are connected to ducts connected to their respective bag houses. The collected dust is recombined with the ore at appropriate points so as to not influence the grade of ore.

The specifications for the Blanding bag house collectors are summarized in the following table:

System	Western Precipitation Model	CFM Air Volume	Sq Ft Bag Area	Air:Cloth Ratio
1	$PF^2$4510-144	9750	1742	5.6 to 1
2	$PF^2$4510-49	3000	593	5.1 to 1
3	$PF^2$4510-49	3250	593	5.5 to 1

The ducts are sized for air velocities of 3,500 to 5,000 feet per minute and equipped with appropriate blast gates.

At times when exceedingly dry or dusty ores are encountered, (usually less than four percent moisture) the ore is sprayed with water on the pad before it is fed to the sampling plant. This practice, which is the responsibility of the sampling plant foreman, reduces the dust potential and insures acceptable control of dust within the plant.

Control of dust in the sample preparation room is accomplished by two wall-mounted hoods over the sample grinders. The two hoods are connected by duct work and discharge to the System 3 bag collector listed in the above table. A respirator is required to be worn by the person working in the sample preparation room. Work in the sample preparation room is on an intermittent basis.

Public power is available and utilized at the Blanding buying station.

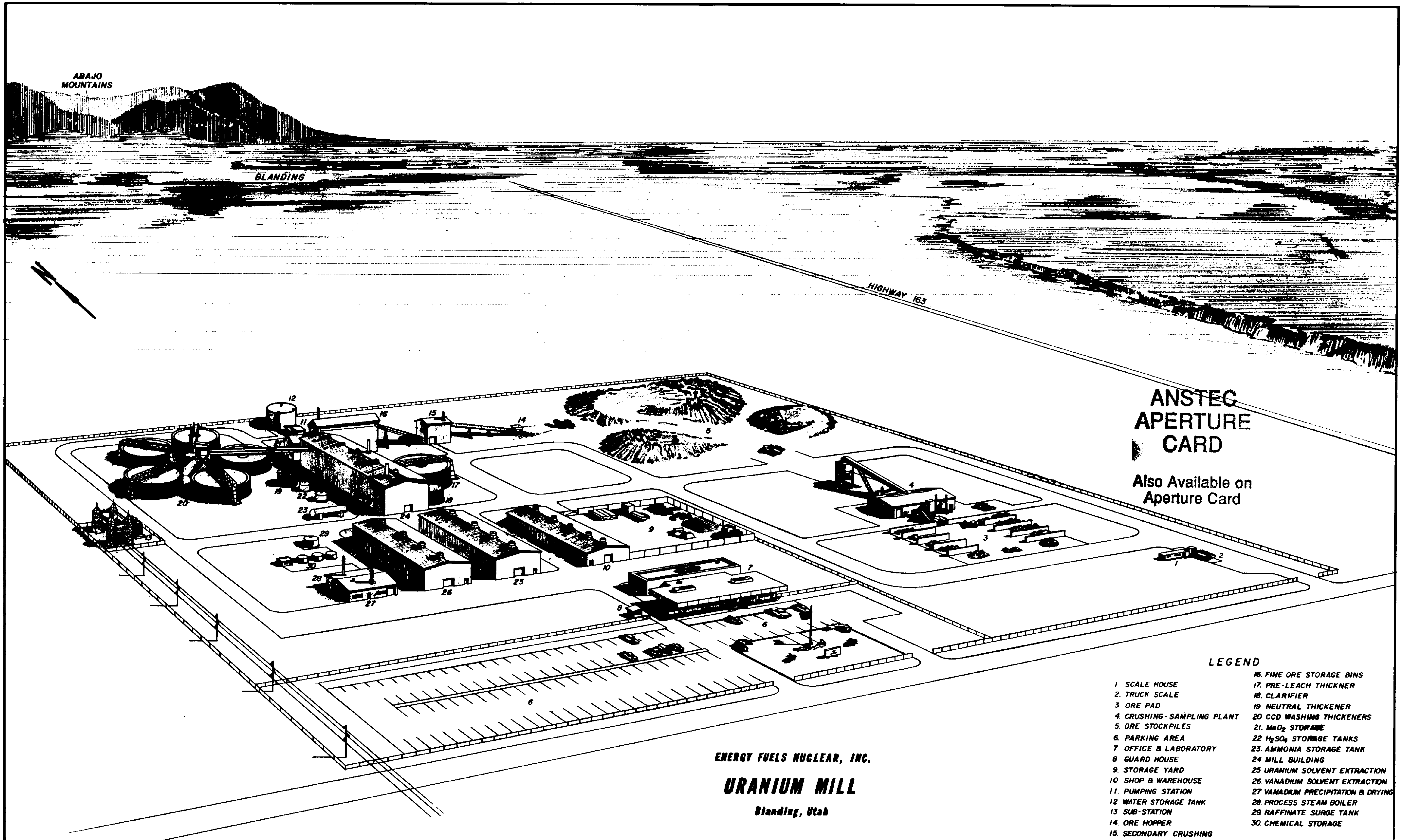

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PLATE 3.1-1

4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND MILL CONSTRUCTION

4.1 EFFECTS ON THE PHYSICAL ENVIRONMENT

4.1.1 Air Quality

Effects on the surrounding air quality attendant to the construction and preoperational phases of the proposed milling project will primarily result from fugitive dust and to a lesser degree gaseous emissions from construction machinery and vehicles. Fugitive dust is expected to be generated from handling of loose dirt and fine aggregates, wind erosion of loose dirt, equipment traffic on unpaved roads and heavy construction activity. Combustion emissions of gaseous contaminants and particulates are expected from heavy-duty diesel and light duty gasoline engines in construction machinery. However, air quality impacts during these phases will be of a short-term nature and will terminate at the conclusion of construction.

The total quantity of dust generated will be dependent upon a number of variables, such as: soil particle size, moisture content, vegetative cover, tire tread pattern, tire speed, and wind speed and turbulence. Although particulate emissions cannot be accurately quantified, the quantity of particles lifted by tires is roughly linearly dependent on tire speed (EPA, 1976) and the quantity of particles lifted by wind is a function of the third power of wind speed (U.S. Department of Agriculture 1968).

Construction activity of the mill and tailing retention facility will be a phased operation but will result in the total removal of approximately 310 acres of surface vegetation. As a result of construction traffic and activity, soil (fugitive dust) will be lifted into the air and a portion will remain as suspended particulates. According to the EPA (1973), particulate loading at a typical construction site will average 1 to 2 tons/ acre/month during all phases of activity. Wind speeds are normally low in the project area which should help lessen dust emissions; in late fall and winter, dust loading should be at a minimum due to snow covered or frozen surfaces, reduced activity and the normally lower wind speeds. During the spring and early summer when wind speeds are normally fastest, precipitation is usually lowest and construction activity is high, fugitive dust emissions will be at a maximum and suitable mitigating measures will have to be instigated.

Frequent watering and/or chemical treatment of exposed areas and heavily travelled areas will help to reduce fugitive dust resulting from construction activity. Covering of haul trucks and reducing vehicle speeds will also help reduce dust loading. Depending upon the degree of activity, even with control measures in effect, construction could cause occasional short-term impacts on the concentration of particulates within or near the construction area.

To a much lesser degree, gaseous emissions from vehicle and other internal combustion construction equipment will impact the air quality. However, due to the spatial and temporal variations of these emission sources, the contribution to the overall impact of preoperational activity is expected to be negligible to the extent that specific mitigation measures will not be warranted.

4.1.2 Surface Water Hydrology

During construction of the mill, slurry pipeline and tailing cells the ground surface will be disturbed for excavation, haul roads, spoil areas and other construction related activities. In a more humid climate, such ground disturbances would cause a substantial increase in the water and sediment yield from the affected areas due to vegetation removal and steepening of slopes. In this arid climate, however, soils are presently exposed to erosion due to the lack of vegetative cover. The soil remains in place primarily because storms capable of causing water erosion occur very infrequently. Nevertheless construction activities are expected to increase the possibility of larger water and sediment yields from the project site. However, the larger yield will be dependent on the occurrence of a significant, erosion producing, rainfall. If such a rainfall did occur, the increase in sediment production would be small, although the total sediment production could be large.

Once the first tailing cell's embankment is about half completed, nearly all construction activities will be contained within the drainage basin upstream of that embankment. This will have the net effect of reducing the water and sediment yields from these basins to zero.

The extreme eastern edge of the project site lies within the Corral Creek Basin. This area, which totals less than 10 acres, is not within the basin of the tailing retention system. Any sediments that are eroded from this area would eventually find their way to Corral Creek, thence to Recapture Creek, the San Juan River and the Colorado River.

4.1.3 Ground Water Hydrology

The effect of the preparation of the mill site and mill construction on ground water will be negligible. The depth of the water table at the mill site is below the planned depth of excavation; thus, site dewatering will not be required and construction will not occur within the saturated zone below the water table.

Preparation of the tailing retention site and construction of the retention system will have only minimal effect on the ground water system. The water table is about 100 feet below the land surface at the tailing retention site. Therefore, construction activities will not be in contact with the ground water. Subsequently, after the retention cells are lined with an impermeable membrane, no seepage is anticipated from the tailing retention system downward to the water table.

None of the planned surface construction activities is projected to have any effects on the deeper aquifers underlying the project vicinity. However, the pumping of ground water from the Navajo Sandstone by the well(s) at the mill site may in time cause a decline in the potentiometric surface within the Navajo Sandstone in the immediate vicinity of the pumping wells. At the present time, with the lack of any quantitative aquifer data on the Navajo Sandstone in the project vicinity, it is not possible to predict either the amount of drawdown or the radius of influence of the pumping with time.

4.1.4 Water Quality

As discussed in Section 4.1.2, site preparation and construction are expected to increase the total sediment yield to Corral Creek and downstream drainages if erosion producing precipitation occurs. Under such conditions, the relative increase in sedimentation will be small. No other impacts on water quality are anticipated.

4.1.5 Land

Construction and site preparation operations will disturb the existing soils on approximately 310 affected acres. Areas impacted by these operations are detailed in Section 9.7. The disturbance will consist of removal and stockpiling of the top 6-inch layer of the soil by scraper or dozer. After removal of facilities, the topsoil material will be respread back over the subsoil.

The disturbance and handling of these soils will not have a serious impact on their future productivity. The sandy loam and silt loam textures found in these soils are well suited to disturbance and machine traffic. Productivity can be restored by reseeding and proper maintenance of vegetation. These soils are erosive. Erosion can be controlled, however, by good ground cover, and by mulching where needed.

4.1.6 Sound

4.1.6.1 Construction Noise Sources

At this conceptual planning stage, no construction methodology or schedule has been provided. Therefore, the construction of the mill and tailing retention system has been assumed to be similar to the construction of an average industrial facility as described by the EPA (1973). It is estimated that the noisiest period of construction will be during the excavation phase. The construction equipment required for this phase of construction and associated sound levels are listed in Table 4.1-1. The average sound level (A-weighted here and elsewhere unless otherwise noted), L_{eq} (see Appendix F for discussion of nomenclature), that will prevail during the excavation phase of mill and tailing retention facilities construction is estimated to be 65.8 dB at 300 meters (1000 ft) from the center of activity.

The slurry pipeline between the mill and tailing retention cells will be above ground. No heavy equipment will be required for its construction. Thus, it is anticipated that the sound level radiating offsite will be negligible from construction of the slurry pipeline.

TABLE 4.1-1

CONSTRUCTION EQUIPMENT NOISE LEVELS - EXCAVATION OF PROCESSING PLANT AND TAILING RETENTION CELLS

Equipment	A-Weighted Sound Level @ 15 m (50 ft) - dB[a]	Number of Units	Usage Factor[b]
Compactor	80	1	0.40
Crawler Tractor	87	1	0.50
Grader	78	3	0.40
Pick up Truck	78	2	0.50
Scraper	88	3	0.55
Water Truck	78	1	0.50

A-weighted L_{eq} (total) - 91.8 dB at 15 m (50 ft);
65.8 dB at 300 m (1000 ft)

[a] U.S. EPA, "Characteristics of Construction Site Activity," Phase I Interim Report. February 1977.

[b] Definition of Usage Factor - Fraction of time equipment operates at its noisiest mode. Reference: Dames & Moore, Draft "Construction Site Noise Control, Cost-Benefit Estimating," prepared for U.S. Army Corps of Engineers, May 1977.

4.1.6.2 Ambient Sound Levels During Construction

The ambient sound levels at each measurement location were estimated from the summation of the construction sound level contributions and the background ambient sound levels. Table 4.1-2 presents the estimated ambient sound levels during construction at the eight measurement locations used to obtain the background ambient sound. A 15-hour/day construction schedule was assumed.

TABLE 4.1-2

AMBIENT SOUND LEVELS DURING CONSTRUCTION OF THE PROCESSING PLANT, TAILING CELLS, AND SLURRY PIPELINE - dB

Location	Background Ambient Sound Levels			Construction Ambient Sound Levels			Change in Ambient Sound Levels		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
1	56.5	46.4	56.9	56.5	46.4	56.5	0	0	0
2	56.7	47.1	56.9	56.9	47.1	57.0	0	0	0
3	45.8	39.2	47.4	60.0	39.2	56.2	14	0	11
4	46.8	39.9	48.2	47.3	39.9	42.4	1	0	0
5	35.3	35.1	41.5	46.7	35.1	46.2	11	0	5
6	47.8	43.1	30.6	47.8	43.1	50.6	0	0	0
7	42.8	27.7	41.5	42.8	27.7	41.5	0	0	0
8	48.3	41.0	49.5	48.3	41.0	49.5	0	0	0

4.1.6.3 Impact Assessment

Using the baseline data obtained from the ambient sound survey and the estimated sound level contributions due to construction of the mill and tailing cells, the impact on the local noise environment has been evaluated. No local noise ordinances have been adopted by the county of San Juan or the nearby city of Blanding. The Federal Environmental Protection Agency has promulgated information that indicates ambient sound levels below L_{dn} - 55 dB do not degrade public health and welfare. At no place along the boundary line of the proposed project site will the ambient level increase above L_{dn} = 55 dB during the construction phase. Furthermore, no increase in ambient sound level is estimated for the noise sensitive areas of Blanding and White Mesa (Locations 1 and 4).

4.2 IMPACTS ON THE ECOLOGICAL ENVIRONMENT

4.2.1 Aquatic Biota

Since the only streams in the project vicinity are in the canyons to the west and east of the project site and since those streams are ephemeral no measurable impacts to aquatic biota are expected. The one stock pond to be destroyed provides water and associated vegetation for song bird and some mammal use. There are no streams or stock ponds at the Hanksville site.

4.2.2 Terrestrial Biota

4.2.2.1 Vegetation

Preparation of the mill site will necessitate removal of 5 acres of reseeded grassland, 23 acres of disturbed vegetation, 2 acres of Tamarix-Salix vegetation associated with the stockpond and 31 acres of controlled sagebrush. None of these communities is part of the climax vegetation. They have been disturbed to varying degrees by either chaining, plowing, reseeding or fluctuating water levels.

In the preparation of the tailing retention area, 33 acres of climax Big Sagebrush, 119 acres of disturbed reseeded grassland and 97 acres of controlled sagebrush will be removed.

During construction, approximately 40 lbs/acre/month of suspended particulates will be emitted into the air by construction activities including traffic (see Section 2.7). These particulates, will eventually settle out and be deposited in part on the surrounding vegetation. Generally, dust settling out onto vegetation will adversely affect photosynethesis and reduce the vigor of the vegetation. The direction and disposition rate of suspended particulates will vary temporally and spatially and cannot be estimated. However, since the prevailing wind direction is N-NW and the highest wind speeds occur during March, April and May, the disposition will probably occur south-southeast of the site over a wide area mostly dominated by Pinyon-Juniper woodland. Since the highest wind speeds occur during the beginning of the growing season reduced vigor due to dust settling onto vegetation would be less than if lower wind speed and greater disposition occurred during this period. The degree to which photosynthetic activity and vigor of vegetation would be reduced cannot be assessed.

4.2.2.2 Wildlife

Wildlife in the project vicinity would be affected by site preparation and mill construction. Loss of 310 acres of habitat, increased human activity, traffic, noise and effluent contamination would be the major causes of impacts. There may be increased roadkills of small mammals (mainly lagomorphs) and deer on Highway 163 during the construction period. Roadkills are both beneficial and detrimental to scavengers (see Section 5.5.1.2).

Amphibians

Some amphibian habitat may be lost by construction of the mill. Burrows of the fossorial Great Basin Spadefoot may be destroyed. Any rodent burrows used by Tiger Salamanders and Woodhouse's Toads for over-wintering will be destroyed. Quantification of this potential impact is not possible because the only amphibian seen in baseline studies was one Tiger Salamander. Qualitatively, the lack of permanent water and amphibian sightings indicates the impact would be negligible.

Reptiles

Local populations of Sagebrush Lizards, Side-blotched Lizards, Short-horned Lizards, and Western Whiptails will decline in number with the destruction of about 310 acres of habitat. Some lizards will be destroyed during construction others may escape into surrounding areas but the net result will be a reduction in lizard biomass, since it is assumed the surrounding area is at or near its lizard carrying capacity.

No snakes were seen during field work but Gopher Snakes and Striped Whipsnakes are probably present in the area. Loss of about 310 acres of habitat for hunting would be the primary impact affecting snakes.

Birds

Habitat loss (including several cottonwood trees) would affect small populations of seed-eating birds directly, and insectivorous and raptorial birds indirectly. The large raptors now using the area for hunting and roosting would probably avoid the area during mill construction due to increased human activity, traffic and noise. Based on lost acreages, Table 4.2-1 indicates the maximum number of individuals of dominant bird species that would be affected, as calculated from Emlen transect data.

Mammals

Construction would eliminate a total of about 310 acres of rodent and lagomorph habitat. Deer Mice, Whitetail Antelope Squirrels, Ord Kangaroo Rats, and Silky Pocket Mice would be most affected. A few cottontails and Blacktail Jackrabbits would be destroyed or displaced. Table 4.2-2 attempts to quantify the impact for some species of rodents. Numbers in Table 4.2-2 were calculated from live-trapping data.

Two major impacts on mammals during mill construction would be: the loss of habitat and increased deer roadkills in the winter along Highway 47. Deer migrate on and near the project site when moving from Cottonwood Creek to Murphy Point. Roadkills could be reduced if employees and ore truck drivers were made aware of the problem and its solution. Deer are blinded at night by vehicle headlights. When a deer is seen on or near the road, a simultaneous reduction in speed and momentary turning off of the headlights will almost always prevent a roadkill.

The loss of 161 acres of controlled sagebrush and Big Sagebrush habitat could conceivably adversely affect the local wintering deer herd. The Utah Division of Wildlife Resources stated 595.2 acres of sage-grass,

TABLE 4.2-1

MAXIMUM SEASONAL NUMBER OF BIRDS OCCURRING
IN HABITAT TO BE REMOVED FROM PRODUCTION

Mill Site (61 acres)	
Horned Lark	60
Western Meadowlark	12
Lark Sparrow	12
Brewer's Sparrow	29
Mourning Dove	1
Common Crow	1
Green-tailed Towhee	1
Black-billed Magpie	3
House Finch	6
American Goldfinch	22
Mountain Bluebird	1
Tailing Retention Area (249 acres)	
Horned Lark	65
Western Meadowlark	59
Lark Sparrow	44
Brewer's Sparrow	65
Vesper Sparrow	12
Sage Sparrow	31
Black-throated Sparrow	19
Mourning Dove	9
Brewer's Blackbird	22
Loggerhead Shrike	9
American Kestrel	3

if only in average condition, would support 49 head of deer during a winter period (Personal Communication, Mr. Larry J. Wilson, Supervisor Southeastern Region, July 27, 1977). Therefore, 128 acres of controlled sagebrush and 33 acres of Big Sagebrush habitat would support about 11 deer, assuming that these acreages are equivalent to 130 of sage-grass habitat. The assumption leading to the 130-acre figure is that controlled sagebrush supplies half as much forage as sage-grass habitat and Big Sagebrush supplies twice as much forage as sage-grass habitat. It is not known whether the habitat loss will result in deer casualities or thinner deer. This distinction is important because in the long term any doe casualties must be considered a cumulative impact, since most healthy does would have had twins the next spring.

TABLE 4.2-2

MINIMUM NUMBER OF RODENTS SUPPORTED
BY HABITAT TO BE REMOVED FROM PRODUCTION

Mill Site (61 acres)	
Deer Mouse	44
Silky Pocket Mouse	69
Tailing Retention Area (249 acres)	
Deer Mouse	221
Silky Pocket Mouse	59
Northern Grasshopper Mouse	31

4.3 IMPACTS ON THE SOCIOECONOMIC ENVIRONMENT

4.3.1 Population

Construction of the proposed uranium mill would begin in February 1979 and would require one year. The construction work crew would consist of 25 people initially, and would escalate to a peak of 250 by August 1979. The average work force employed throughout the 12-month construction period would be 175.

Population impacts associated with the proposed development would stem from the need to import workers for jobs not filled by the local labor supply. Based on the results of a 1975 survey of major construction projects in seven western states, it can be assumed that approximately 60 percent of the Energy Fuels construction work force would be imported into the region (Mountain West Research, 1975). Sixty percent importation would result in an initial influx of 15 workers in February 1979, which would increase steadily until August, when peak employment would bring 150 construction workers to the Blanding area. The average work force of 175 would generate an average influx of 105 workers throughout the 12-month construction phase.

Table 4.3-1 summarizes projected employment for each month of the construction phase and the number of in-migrating workers associated with importation of 60 percent of the work force.

Some of the newcomer construction workers may elect to bring their families for the duration of construction activities. Others may be weekday residents only, commuting to their permanent residences on weekends. The total population increment, including imported workers, spouses and children, would represent a temporary population impact experienced by the Blanding area for no more than one year. Table 4.3-2 summarizes the population growth potentially induced by mill construction and indicates that, during the 3-month period of peak activity, up to 341 persons may be added to the local resident population base; an influx of 239 would represent the 12-month average.

Blanding, located approximately 6 miles north of the mill site, is closer than any other community and thus would receive the greatest share of project-induced population impacts. Monticello is almost 29 miles north of the mill site and Bluff is approximately 19.5 miles to the south. Monticello and Bluff can also be expected to absorb some of the short-term growth induced by construction activities.

The distribution of newcomers between Blanding, Monticello and Bluff would depend on a number of factors, including proximity to the mill site, the relative availability of rental housing or mobile home spaces

TABLE 4.3-1

CONSTRUCTION WORK FORCE REQUIREMENTS

Time frame	Employment[a]	Imported Workers (60%)[b]
February 1979	25	15
March	75	45
April	150	90
May	225	135
June	225	135
July	225	135
August	250	150
September	250	150
October	250	150
November	225	135
December	150	90
January 1980	50	30
Average	175	105

[a] Source: Energy Fuels Nuclear, Inc.

[b] 60% based on Construction Worker Profile, by Mountain West Research (see text).

TABLE 4.3-2

POPULATION INCREMENT ASSOCIATED WITH PROJECT CONSTRUCTION[a]

	Multipliers[b]	Initial Work Force (Feb. 1979)	Average Work Force	Peak Work Force (Aug.-Oct. 1979)
Total Employment	--	25	175	250
Imported Workers	60%	15	105	150
Population Associated with Imported Workers:				
Single workers	24.6%	4	26	37
Married-family absent	26.5%	4	28	40
Married-family present	48.9%	7	51	73
Spouses	48.9%	7	51	73
Children	78.9%	12	83	118
Total Population Influx		34	239	341

[a]Basic Employment figures supplied by Energy Fuels Nuclear, Inc.

[b]Multipliers are based on the Construction Worker Profile, by Mountain West Research (1975).

and the quality of public facilities and commercial services in each town, and the personal preferences of the work force members. Conventional housing for rent is almost completely lacking in Blanding, Monticello and Bluff, and the situation is not expected to improve significantly by 1979. The quantity of mobile home accommodations is comparable in each community. In terms of public and commercial services, Bluff would offer the least to prospective residents, due to its small size. One particular factor which may attract newcomers to Monticello is its relatively liberal liquor control policy. Monticello has three restaurants or clubs which serve liquor. In contrast, Blanding is a "dry" town and Bluff has beer only (Verbal Communication, Manager, Utah Liquor Control Commission, Monticello outlet, November 3, 1977).

Table 4.3-3 summarizes the anticipated population increment induced by mill construction compared to the present and projected population of San Juan County and the combined population of Blanding, Monticello and Bluff. Due to the considerations presented above, it would be speculative and misleading to predict the proportion of newcomers who would move into each of three impact communities. However, it can be assumed that a majority would live in Blanding, and that Monticello and Bluff would also experience growth during the mill construction phase.

The population increment associated with construction activities would represent less than three percent of the total county population in 1979. The impact on each community would be more noticeable; induced population growth would represent from 5 to 5.4 percent of the combined population of Blanding, Monticello and Bluff. The impact on Blanding may be significant. If all newcomers were to locate in Blanding, the town would experience as much as a 10 percent increase in population. As noted above, however, it is unlikely that Blanding would receive 100 percent of the project-induced population influx.

4.3.2 Housing

Although some construction workers may decide to remain in the Blanding area upon termination of the project, it can be assumed that

TABLE 4.3-3

PROJECT CONSTRUCTION-INDUCED POPULATION GROWTH COMPARED TO 1979 POPULATION[1]

	San Juan County	Blanding	Monticello	Bluff	Combined Total of Three Primary Impact Communities
July 1975 Population	11,964	2,768	1,726	150	4,644
July 1977 Population	13,368	3,075	2,208	280	5,563
1979 Population, Assuming:					
a. Continuation of 1975-1977 Growth Rates	14,940	3,420	2,830	520	6,760
b. "High" growth rate projected for San Juan County by the Utah Agricultural Experiment Station. (Cities are assumed to grow in direct proportion to the county.)	15,270	3,510	2,520	320	6,350
Population Associated with Mill Construction:[2]					
a. Initial (February 1979)	34				
b. Average	239				
c. Peak (August-October 1979)	341				
Peak Project-Induced Population (341) as a Percentage of 1979 Population Base, Assuming:					
a. Continuation of 1975-1977 Growth Rates	2.3%				5.0%
b. High Growth Projection	2.2%				5.4%

[1] Blank spaces indicate no applicable data
[2] Assumes Importation of 60 percent of the work force.

Source: 1975 Population, U.S. Bureau of Census, 1977
1977 Population, San Juan County Clerk, 1977
1979(b): Utah Agricultural Experiment Station, 1976

most newcomers will leave upon completion of the mill, in January 1980. The temporary nature of construction employment suggests that most or all newcomers would desire short-term, rental housing. However, conventional housing for rent is almost nonexistent in Blanding, Monticello and Bluff. Current construction plans call for the addition of 16 apartment units per year in Blanding; no other rental unit construction is anticipated. It is assumed, therefore, that mobile homes would accommodate the majority of incoming project personnel during the construction phase.

Managers of mobile home parks in Blanding, Monticello and Bluff were queried in November 1977 in regard to current and projected vacancies and plans for expansion. The results, summarized in Table 4.3-4, indicate that between 62 and 67 mobile home spaces should be available in January 1979. In addition, as many as 30 spaces may be available in a Monticello mobile home park, and three parks have land available for expansion.

Peak employment would occur from August to October and would induce an influx of approximately 150 workers, 73 of whom may be accompanied by dependents. Many single workers and married workers without their families present can be expected to share living accommodations, due to the scarcity of temporary housing. It can be assumed, therefore, that a minimum of 99 housing units would be needed during the peak period of construction activity (i.e., 73 units for families and between 26 and 39 units for the remaining 77 workers).

From May to July and in November, employment of 225 workers would result in an influx of 135, which is slightly less than the peak. The estimated housing need for this work force would be a minimum of 89 units (i.e., 66 for families and from 23 to 35 for single and married workers without families).

Table 4.3-5 summarizes the estimated 1979 housing supply and the project-induced demand. The data indicate that, from May to November 1979, houses and apartments for rent and mobile home spaces in the three impact communities would be fully occupied. Motels would be used to

TABLE 4.3-4

CURRENT AND PROJECTED EXCESS CAPACITY OF MOBILE HOME PARKS
NOVEMBER 1977

	Vacancies[a]	Projected Available Spaces Jan. 1979	Plans for Expansion by 1979
Blanding:			
Kamppark	25	35-37	Adding 10-12 spaces (reflected in 1979 projection)
Palmers	0	0	No plans
Monticello:			
Rowley's	4-5	4-5	No definite plans; however, there is land available for expansion
Westerner	30	Impossible to predict, may be as high as 30	No definite plans; available land would allow for an additional 15 spaces
Bluff:			
Trail's End	11	11	No definite plans; 5.5 acres are available for expansion
Coral Sands	9	12-14	Plan to add 12-14 new spaces (reflected in 1979 projection)

[a]Indicates spaces not filled by permanent residents.

Source: San Juan County Travel Council, and verbal communications with the following: Rowley's Trailer Court, October 27, 1977; Mrs. Palmer, Palmer's Trailer Court, October 27, 1977; Ruth Chase, Westerner Trailer Court, November 3, 1977; Dale Barkman, Trail's End Trailer Park, November 3, 1977; Carol Thayne, Kamppark, November 3, 1977; Mrs. McCleery, Coral Sands Trailer Court, November 3, 1977

TABLE 4.3-5

ESTIMATED HOUSING SUPPLY, 1979
AND PROJECT-INDUCED DEMAND

Housing Demanded by Project Workers

	Total Newcomers	Families (1 unit per family)	Units Needed for Single and Married Workers Without Families Present (2-3 workers per unit)	Total Housing Units Demanded
Peak Activity (August-October 1979)	150	73	26-39	99-112
High Rates of Activity (May-July and November 1979)	135	66	23-35	89-101

Housing Supply, 1979

	Apartment Units	Mobile Home Spaces	Total Possible Units
Blanding	16 new units to be constructed in 1978 and 1979	35-37	51-53
Monticello	---	4-5 probable 30 possible Plus room for expansion in 2 trailer courts	34-35
Bluff	---	23-25 probable Plus land available for expansion in one trailer court	23-25
Total Possible Units Available	16	92-97	108-113

accommodate potential overflows, particularly from August until October, with the result that summertime tourists may encounter difficulty in obtaining lodging. Overcrowded conditions would endure until November 1979, when construction employment would begin to decline. By February 1980 construction activity is expected to terminate, and most temporary residents will have left the area.

4.3.3 Public Service Delivery Systems

Construction of the proposed mill would result in increased road maintenance costs that would be borne primarily by the State of Utah. In addition, population growth resulting from construction activity would result in greater useage of public services provided by San Juan County. Health care, mental health, public safety and recreational services would experience some increased demand. However, the temporary nature of construction-induced population growth suggests that increased expenditures by the county to accommodate demand would be minimal.

Blanding, Monticello and Bluff, the focal points of construction-induced population growth, will be faced with noticeable increases in demand for public services with or without the construction of the Energy Fuels uranium mill, as the proposed project is only one of a number of sources of future growth. In 1979, the temporary population growth generated by the project would represent an increment of 5 percent of the combined population of the three towns.

Water

Local officials and developers have indicated that water supply is the major constraint to growth in San Juan County. The cities of Blanding and Monticello are expanding their water supply systems and officials of both towns have asserted that wells will be drilled on an "as-needed" basis and will be able to keep up with increasing demand. The water supply of Bluff comes from three wells. The maximum population that can be served by the existing system is 500, and additional wells can be drilled if necessary. If Bluff continues to grow at the rate sustained since 1975, new wells will be necessary to accommodate the population by 1979, with or without mill construction. Population growth resulting from mill construction will add to the demand exerted on local water supplies but should not, in itself, necessitate increased well drilling.

Sewage Treatment

The sewage treatment lagoon serving Blanding will be upgraded by 1981, and will then have capacity for a population of 4,500. In the interim, overflow from the lagoon is used to irrigate adjacent property, and sewage reportedly does not pollute local drainage systems (Verbal Communication, Mr. Bud Nielson, October 12, 1977). In this manner, any increase in use will be accommodated by the existing system.

The sewage treatment plant of Monticello is being replaced by a new system which, by 1979, will have capacity for serving 4,000 to 5,000 residents. According to growth projections outlined in Table 2.2-6, Monticello will have less than 3,000 residents by 1979. Therefore, the project-induced population would not place excessive burdens on the Monticello system.

Bluff does not have a sewage treatment system. New septic tanks are planned for one trailer court expansion.

Schools

Due to the short time frame of construction activities, it is expected that most imported workers would not bring their families. According to multipliers reported in the Construction Worker Profile, up to 48.9 percent of the imported members of the work force may be accompanied by school-age children. During peak periods of activity this would represent 118 children, which would constitute an increment of five percent of the combined 1977 enrollments of Blanding, Monticello and Bluff schools.

During peak periods of construction activity, an influx of 118 children would represent an addition of five percent to the 1977 enrollment of schools in Blanding, Monticello and Bluff. In 1977, all of these schools except the high school had excess capacity. By August 1978, a new high school will be completed which will relieve overcrowding in San Juan High School. It should be noted that the impact caused by mill construction would be temporary; by February 1980 temporary construction worker families would leave the area.

Utilities

The natural gas supply to Monticello would not be burdened by the project-induced population; the supply situation in November 1977 was good. Blanding and Bluff do not have natural gas service. Electrical supplies in Blanding and Bluff are capable of withstanding increased use, although the Monticello electrical distribution system may be overloaded by any significant increase in demand (see Section 2.2.2.6 for details).

4.3.4 Economic Base

Construction of the proposed uranium mill would stimulate the economic base of San Juan County through wage disbursements and the procurement of supplies and equipment. It is projected that construction costs would amount to $38 million. Of this total, approximately $7 million would represent wage payments to the construction work force. A significant proportion of this income would be injected directly into the local economy in the form of food, housing and other personal consumption expenditures. In addition, regional centers of commercial activity, including Moab, Cortez and Grand Junction, would experience increased spending for goods and services. This increment would represent a smaller proportion of total spending and hence a less noticeable impact in the larger cities than in Blanding, Monticello and Bluff.

Based on nationwide expenditure patterns recorded in 1977 by the Bureau of Labor Statistics, the construction work force can be expected to devote approximately 36 percent of its income to personal consumption expenditures. This would result in the injection of approximately $2.5 million into local and regional economies during the 12-month construction phase.

The procurement of supplies and equipment during the construction phase would stimulate regional, state and national economies. Table 4.3-6 summarizes anticipated expenditures and their region of impact.

4.3.5 Taxes

The construction of the proposed mill would add to federal, state and local tax revenue through wage and salary payments to the construction work force. Personal income tax obligations representing approximately 19 percent of total income would amount to $1.3 million during the 12-month construction phase and would benefit the state and federal governments (U.S. Bureau of Labor Statistics, 1977). In addition, a sales tax of 5 percent would be applied to personal consumption expenditures in Utah (Verbal Communication, Mr. Robert Cooper, Utah State Tax Commission, December 9, 1977). Assuming that the bulk of expenditures of the construction work force would occur in San Juan County, it can be deduced that sales tax revenue would amount to $125,000 (0.05 times $2.5 million in local expenditures). Of this total, $112,500 would benefit the State and $12,500 would be contributed to San Juan County (Verbal Communication, Mr. Robert Cooper, December 9, 1977).

4.3.6 Quality of Life

Communities of southeastern Utah have traditionally been small and close-knit, with social life revolving around the predominant religion, the Church of Jesus Christ of Latter Day Saints (LDS). Family life, educational attainment and marriage within the church are emphasized. Also, rural LDS communities generally have low rates of crime (Westinghouse Environmental Systems Department, 1977). Newcomers among the construction work force may be perceived by long-term residents as a negative, disruptive influence. However, Blanding, Monticello and Bluff have experienced high rates of growth since 1975 and will continue to do so in the future. By February 1979 local residents should be accustomed to growth and change, and this would help to soften perceived disruption of community cohesion and lifestyle during the mill construction phase.

TABLE 4.3-6

SUMMARY OF MILL CONSTRUCTION COSTS
(1977 Dollars)

Wage Payments - Total		$ 7,000,000
Personal consumption expenditures (36%)	$2,520,000	
Equipment and Supplies - Total		$18,000,000
Southeastern Utah (10%)	$1,800,000	
Other parts of Utah (50%)	$9,000,000	
Out of State (40%)	$7,200,000	
Indirect Costs - Total		$13,000,000
Total Cost During Construction[a]		$38,000,000

[a]Includes copper and vanadium circuits

Source: Energy Fuels Nuclear, Inc.

The influx of up to 150 construction workers would create crowded housing conditions and a rapid increase in demand for local goods and services. Local businesses would benefit from increased spending flows but some inflation can be expected, which would have a negative impact on the long-time residents who are directly or indirectly involved in the proposed project. The poor and those living on fixed incomes would be particularly hard-hit. Balanced against this adverse impact would be an increase in employment opportunities for local residents, who are expected to account for at least 40 percent of the construction work force.

4.3.7 Land Use Impacts

Construction of the proposed mill and tailing retention facility would commit approximately 310 acres of rangeland for the duration of the operating life of the mill, expected to be 15 years. Construction activity would also add to traffic levels on Route 163, thereby creating increased noise and dust. Because the area south of Blanding is devoid of residential development, transportation impacts in the immediate project vicinity would not be noticeable. Blanding residents, however, may be affected by increased traffic due to trucks and increased population.

Secondary, short-term impacts on land use would stem from the temporary influx of construction workers. The increased use of mobile homes would be the most noticeable impact on local land use patterns.

4.3.8 Historical and Archaeological Sites

The historical landmark closest to the proposed mill site is the Edge of Cedars Indian Ruin, located in Blanding. This site and others listed in the National Register of Historic Places should not be adversely impacted by project construction.

Where the proposed project will affect significant archaeological resources, Energy Fuels will permit such resources to be examined and/or excavated.

4.4 RESOURCES COMMITTED

No commercial deposits of oil, coal or mineral are known to occur on the project site that would be irretrievably lost as a result of the proposed project.

It is anticipated that all of the approximate 310-acre area committed to the proposed project will be reclaimed as wildlife habitat and livestock range. Thus, the mill site would not represent an irretrievable loss of resources.

Site preparation would temporarily destroy wildlife habitat for the duration of the project, and animals in these habitats would be displaced or destroyed. However, reduction in the animal populations on the project site probably would not be an irretrievable commitment of the animal resources in the region.

Other resources that would be required during construction of the project include electricity, construction materials and fossil fuels. However, the amounts of these materials are insignificant.

5.0 ENVIRONMENTAL EFFECTS OF MILL OPERATIONS

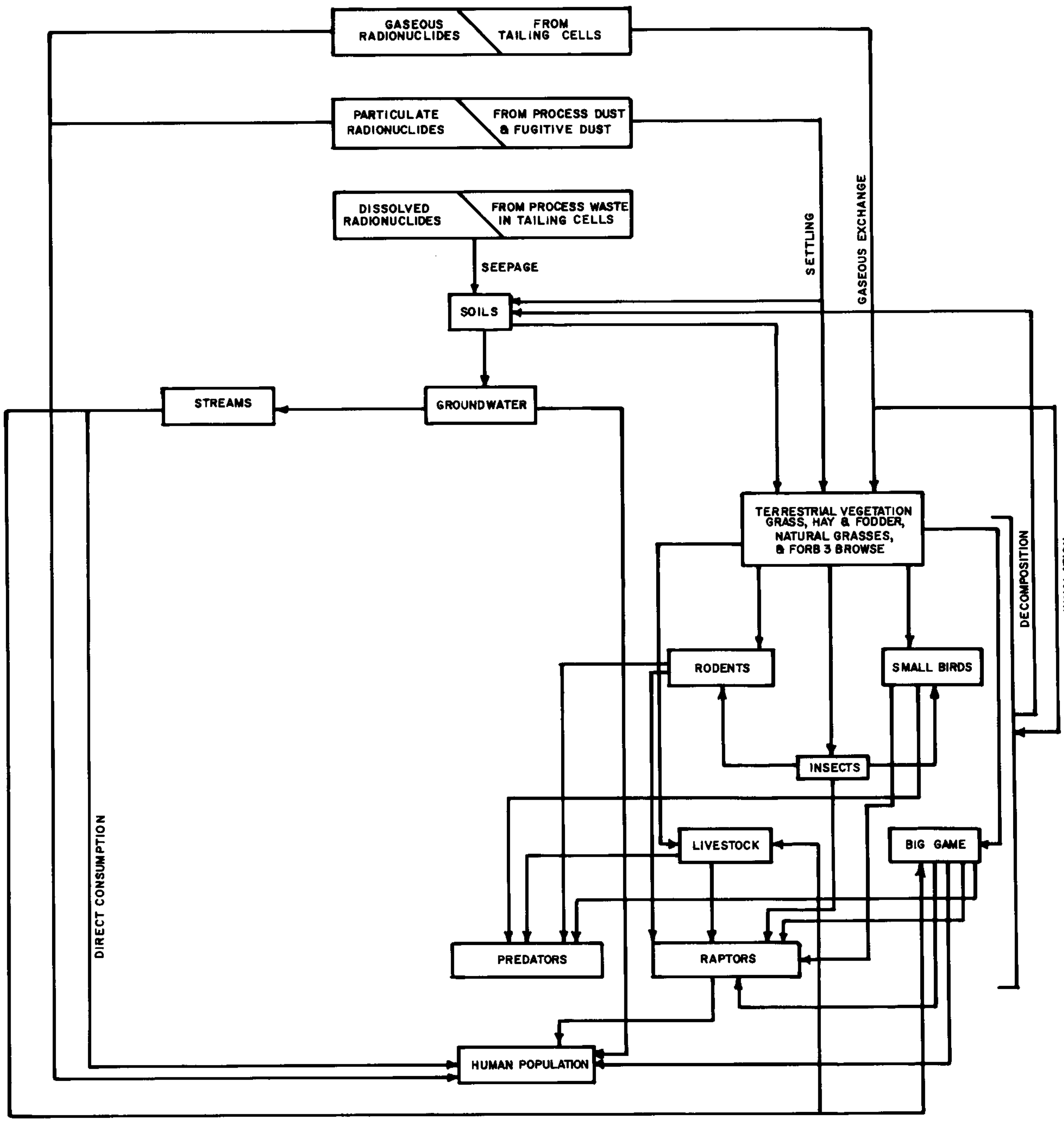
5.1 RADIOLOGICAL IMPACT ON BIOTA OTHER THAN MAN

In evaluating the impact of radioactivity discharged in trace amounts in the effluents from a uranium mill, it is necessary to consider if such discharges: (1) can be directly harmful to life forms in the area upon immediate exposure, (2) can be harmful to organisms if accumulated over a life span, and (3) can be accumulated and concentrated by species which form part of the food chain for other species (including man).

Analysis of the radiological effects of the proposed project on biota in the vicinity, as detailed in the following sections, agrees with the experience at other uranium mills. Under normal operation the net effect of the gaseous and particulate releases from the mill and tailing retention system will not significantly increase the amount of radiation to which biota in the vicinity are subjected. The concentrations of radionuclides in the environment from mill effluents would be a small percent of the concentrations indicated in Appendix B of 10CFR 20. Thus, no direct radiological effect on the biota, either of an immediate or long-term nature, would be attributable to the releases from the mill and tailing retention system. In addition, because of the low radiation levels and the absence of any significant concentrating mechanism of these releases in the food chain, the radiological effects along this path would be minimal.

5.1.1 Exposure Pathways

Radiation exposure of flora and fauna (both local and migratory) and man could potentially occur via a number of pathways from mill-related activities. Plate 5.1-1 illustrates some of the possible pathways by which exposure to limited amounts of radioactivity could theoretically occur; this diagram should not be interpreted as suggesting the actual existence of all of them, or that any one path would be continuously available.



PRINCIPAL THEORETICAL EXPOSURE PATHWAYS FROM THE PROPOSED MILL

DAMES & MOORE

Radionuclides can enter the environment in three forms: as radioactive gas, as particulate or solid matter, and as a dissolved material carried by water. The sources within the mill for each form are discussed in Section 3.3. External to the mill, radon-222 would be released as a gas from the ore storage, crushing and tailing retention area.

Airborne particulates containing uranium would be released in small quantities from the process equipment vents and as dust from the ore pads. The particulates may be deposited on vegetation or soil, and enter the food chain through the consumption of vegetation by grazing animals. The area surrounding the facility is uncultivated. Exposures of higher life forms from uptake through the food chain are expected to be negligible in view of the uncultivated nature of the area and the small quantities of effluents released. Exposure can also occur from inhalation of the dust. However, the small quantities that would be involved here are not expected to cause any measurable effects.

Liquid effluents will not be discharged to surface water bodies except to the tailing cells. Inasmuch as the radionuclide concentrations in the liquid effluent discharged to the tailing area should be very small and the tailing cells are designed for the total containment of liquid effluents (see Section 5.2.2), the potential pathway to biota and man through liquid effluents would require that animals enter or drink the tailing water. The tailing retention area will be fenced and, thus, potential exposure of large wildlife species and livestock will be minimized.

5.1.2 Radioactivity in the Environment

Details of the mill circuit including a description of means for minimizing releases of radioactivity and estimates of release rates, are presented in Sections 3.3 and 3.4.

In Sections 5.2.3, 5.2.4, and 5.2.5, a conservative "worst case" estimate of annual deposition of uranium isotopes and their daughter products over the anticipated operational life of the facility, and the impact on man are presented. These are based upon the Environmental Protection Agency's AIREM computer code (see Section 5.2.3.2).

Table 5.1-1, which is taken from computer printouts given in Tables 1 through 53 of Appendix E presents the maximum dry deposited activity. This maximum is expected to occur at the southern sector at 805 meters and 1,609 meters after one year of continuous release for all long-lived isotopes considered part of the source term from the mill site. Also included is the maximum dry deposited activity at the project area boundaries which is estimated to occur at the southern sector at a distance of 1,082 meters.

In order to convert these deposited activities to figures that can be compared with environmental radioactivity measurements, the "effective surface density" of soil quoted by U.S. NRC Regulatory Guide 1.109 of 240 kg/m^2 was used. With this figure, the calculated maximum deposition rates (see Table 5.1-1) of 2288 pCi/m^2 and 1343 pCi/m^2 for U-238 correspond to 9.55 pCi/kg and 5.60 pCi/kg, respectively, and the rates 111 pCi/m^2 and 65 pCi/m^2 for Ra-226 correspond to 0.46 pCi/kg and 0.27 pCi/kg, respectively. The measured background levels for U-238 and Ra-226 in the soil are 0.43 pCi/g and 0.51 pCi/g, respectively (see Section 2.9). Thus, these depositions would increase the background levels for U-238 by 2.3 percent and 1.3 percent at 805 meters and at the project area boundary, respectively; Ra-226 would increase by 0.1 percent and 0.05 percent at 805 meters and at the project area boundary, respectively.

Deposition of uranium-238 on vegetation at the indicated maximum deposition area was estimated as follows. The deposition rate from Table 5.1-1 at 805 meters would be 2288 pCi/m^2. This is the deposition that would be due to one year's release. During this period there would be continuous deposition, immediate retention by vegetation, and decay due to the retention half-life of the vegetation. The equilibrium concentration (C_e) under these conditions is given by the formula:

TABLE 5.1-1

MAXIMUM ACTIVITY DENSITY DRY DEPOSITION-MILL EFFLUENT
SOUTHERN SECTOR

(PICOCURIES/METER^2)

Isotope	805m	Project Site Boundary (1082m)	1609m
U-238	2288	1343	705
U-234	2288	1343	705
Th-230	221	130	68
Ra-226	111	65	34
Pb-210	108	63	33
Po-210	39	23	12

$$C_e = 2288 \cdot (R_c/T) \cdot {}_o^T \; \exp(- t)dt = 2288 \cdot R_c/(T)$$

where T is the period involved, which is one year; R_c is the immediate retention coefficient which was assumed to be 0.3, and is the decay constant of retention which was calculated from the assumed retention half-life of 15 days. This calculation yields 40.78 pCi/m^2 as the equilibrium concentration of U-238 at the maximum deposition point. The corresponding figure for radium-226 is 1.97 pCi/m^2.

The foregoing evaluation indicates that deposition of anticipated dust emissions will not cause measurable increases in offsite radioactivity levels above background.

Since it is not planned to discharge liquid waste from the mill to receiving water bodies, no buildup of mill effluent radionuclides in surface water bodies is anticipated.

5.1.3 Effect on Biota

Concentrations of radionuclides are reduced with every transfer, as when transferred from soil to plants, when plants are consumed by animals and when animal wastes return to the soil. Concentrations are also reduced by atmospheric diffusion, soil dispersion and diffusion, and by the movement of animals. As a result, radioactive material added to the environment will not accumulate but will become diluted and dispersed into a much wider area, becoming undetectable within short distances from the mill. Consequently, because of this dilution and because of the low levels of radioactivity that would be deposited by particulates associated with the mill's raw materials, processes, and product, no single source of input is considered sufficient to produce a detectable detrimental effect upon any of the organisms normally found in the vicinity.

5.2 RADIOLOGICAL IMPACT ON MAN

Man is exposed in varying degrees, depending upon his activities and location, to sources of radiation found in nature. For example, cosmic radiation entering the earth's atmosphere and crust is a natural radiation source. Other natural radiation sources affecting man are the radioactive elements found in the earth's crust, such as uranium and thorium and their decay products including radium and radon.

While all the naturally occurring radionuclides contribute to internal radiation, only a few are found to be of measurable significance. Among these are radium and its daughter radon which are released to varying extents during uranium milling operations. Radon concentrations vary due to atmospheric and soil conditions as well as on a diurnal and seasonal basis.

It is known that population doses attributable to the uranium milling industry are relatively low because these mills are located in very remote and sparsely populated areas and because waste treatment and retention systems are employed during operations. While uranium milling activities contribute to the content of radioactive material in the environment, population doses from this source cannot be distinquished from background radiation which, in the State of Utah, is an annual whole body dose of approximately 180 mrem per person (EPA-520/1-76-010).

5.2.1 Exposure Pathways

Man can be exposed to radionuclides via the pathways described in Section 5.1.1 as the final consumer in the food web or by direct exposure to gaseous or particulate airborne effluents. However, since the quantities of radionuclides released would be so small and the dispersion distance significant to any residences or concentrations of people, none of these pathways will result in measurable exposures. Exposure via gaseous and liquid effluents is discussed further in the following sections.

5.2.2 Liquid Effluents

There will be no liquid effluents discharged to surface waters. All liquid effluents will be impounded in the tailing retention system which is designed to totally contain these effluents. This will be accomplished through an impervious liner at the bottom of the cells. The cell area is designed to be sufficient to achieve evaporation of the total liquid effluents.

In the event, however unlikely, that the liner integrity is violated there could be seepage into the strata below the tailing area. This seepage could carry some radionuclides dissolved in water depending on the chemical conditions and solubility of the radionuclides. The depth to the ground water from the bottom of the cells will be approximately 75 feet. The stratum is mainly sandstone with some interbedded clay whose primary permeability is negligible, and whose secondary permeability is estimated to be about 5 feet/yr. It is likely that the tiny fissures and cracks that constitute this secondary permeability contain material deposited over the ages that is likely to enhance the radionuclide retardation capability of the stratum. For example if the retardation coefficient were 10, (retardation coefficients for western U.S. desert soil, mostly sand, have been quoted [BNWL-1900] as 14,300 for U-238 and 500 for Ra-226 which are quite normal for these radionuclides) than the radionuclides would move 10 times slower than water. In addition, it is likely that the clay material in the tailing would seal these tiny fissures and cracks preventing further migration of water, and as a consequence, radionuclides.

5.2.3 Airborne Effluents

The calculated release rates of airborne effluents that would result from the ore storage area, ore grinding operation, yellowcake drying and packaging operation, and tailing retention area were calculated in Section 3.3.2 and are summarized in Table 5.2-1. The data base utilized in addition to these source terms, and the calculational procedures, are outlined in the next two sections.

5.2.3.1 Data Base

Meteorological wind frequency distributions including Pasquil-lized hourly surface data were obtained from the readings taken during

TABLE 5.2-1

SUMMARY OF RELEASE RATES

Source	Rn-222 Ci/yr	U-238 mCi/yr	U-234 mCi/yr	Th-230 mCi/yr	Ra-226t Daughters mCi/yr
Mill	128	45.5	45.5	4.4	2.2
Tailing	90[a]	--[b]	--	--	--

[a]Not continuous. Release is due to intentional drying of tailing prior to stabilization for each of three areas.

[b]-- = insignificant release levels

1970-1974 at the Blandings National Weather Service Station (see Section 2.7.2) Summaries of the data are provided in Appendix C. Occurrences of calm conditions have been distributed in the 0-3 miles per hour wind speed class categories based upon the number of observations in the 0-3 and 4-6 miles per hour categories. These data, tabulated in accordance with the standard U.S. Department of Commerce format, were changed to conform to the U.S. NRC Regulatory Guide 1.23 format for the computer analysis.

A population wheel with a radius of 7 miles (11 km) was determined from the project site in order to include the town of Blanding, the nearest significant population. Specific population figures were used wherever possible, otherwise conservative estimates obtained from an average rural density were used.

5.2.3.2 Radiological Diffusion Analysis

Estimates of individual whole body lung, bone and kidney organ dose commitments at annular ring centerline distance from 0.5 mi (804 m) out to 6.5 mi (10,458 m) from the mill are presented in Appendix E. These calculations, based upon meteorological data from the weather station, were made using a semi-infinite cloud model with effluent concentrations per unit emission (X/Q) data. The computer printouts with the results in exponential notation are to be found Tables 13 to 29 of Appendix E.

All calculations represent 50-year dose commitments, in conformity with the output of the EPA program, AIREM, which was used to determine dose commitments. The 50-year dose commitment is a concentration time integral that prevailed during a particular time interval. This views radioactive atmospheric contamination as a one year episode or period of exposure and the resultant 50-year dose resulting from the radionuclides as they are eliminated from the body through radioactive decay as well as biological elimination. The 50-year dose commitment is most correctly reported as a mrem dose rather than a dose rate such as mrem per year. (A mrem is an abbreviation for milli roentgen equivalent man. A mrem is 1/1,000 of a rem, the quantity of radiation producing a biological effect, on man, which is equivalent to that resulting from absorption of one roentgen of gamma or x-radiation.)

AIREM3 is a computer code useful for the calculation of doses to the general population due to atmospheric emissions of radionuclides. A standard sector-averaged Gaussian-diffusion equation is solved repeatedly for each radionuclide, wind sector, stability class, and downwind distance. Radionuclide contributions to doses to as many as four critical organs are summed and printed by sector and downwind distance. Population doses (man-rem) are also calculated.

The code accounts for the following physical processes: cloud diffusion, ground and inversion-lid reflections, radionuclide decay by time of flight, first daughter-product buildup, ground deposition of particulates (independently), cloud depletion, in-plant holdup and decontamination factors, and sector-to-sector contributions to external gamma dose.

The code is dose model independent such that dose conversion factors, provided as input data, are used for calculations of dose that are proportional to radionuclide concentrations in the cloud. Dose conversion tables obtained from U.S. NRC Regulatory Guide 1.109 were utilized.

The idealization of the sources to point sources introduces singularities, which result in calculations that are not reliable too near the source. This idealization cannot be avoided, and the results should be interpreted accordingly (see Section 5.2.4, tailing area calculations). Also, the dose commitment estimates presented herein are in addition to the existing baseline radioactivity levels within the project site. These baseline radioactivity levels due to natural sources are about 180 mrem/year for each person in the State of Utah.

5.2.4 Dose Estimates From Atmospheric Pathways

Detailed estimates of whole body and significant organ 50-year individual dose commitments due to effluents at each sector affected and at 0.5 (0.8), 1.5 (2.4), 2.5 (4.0), 3.5 (5.6), and 4.5 mi (7.2 km) distances are presented in Tables 5.2-2 and 5.2-3. These tables were taken from the more extensive computer printouts presented in Tables 13 through 29 Appendix E. Summaries of 50-year individual dose commitments at the project boundaries due to mill effuents are given in Table 5.2-4.

Tailing area effluent estimates were treated in a different way than those for the mill effluents. It was deemed inappropriate to approximate the tailing area as a point source (which is the less conservative case) due to the areal extent of the tailing, the relatively close site boundaries, and the three stage construction. The AIREM3 program was run for the unit tailing effluent for a large number of distances, i.e., a parametric analysis was performed, and these results were numerically integrated over the tailing areas to obtain the individual doses.

Table 5.2-5 gives the areally integrated lung doses from each of the tailing areas at distances measured from the approximate center of the respective areas in eight compass directions at two points: the edge of the respective tailing area and the project site boundary in that direction.

Table 5.2-6 further summarizes exposure to individuals at significant specific locations in the vicinity of the sources.

5.2.5 Population Doses From Atmospheric Pathways

The 50-year dose commitments to the population for whole body and significant organs attributable to the mill effluents are presented in Tables 13 through 29 of Appendix E. The total population 50-year dose commitment resulting from one year's release is estimated to be 0.01 man-rem (population dose) to the whole body, 1.39 man-rem to the lung,

TABLE 5.2-2

INDIVIDUAL WHOLE BODY AND LUNG DOSE COMMITMENTS
FROM MILL SITE EFFLUENT

Whole Body Individual Dose Commitments (mrem)[a]

SECTOR

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
805m	.17	.23	.29	.14	.20	.23	.60	.67	1.3	.25	.15	.06	.07	.09	.16	.12
2414m	.02	.03	.04	.02	.03	.03	.09	.10	.18	.04	.02	.01	.01	.01	.02	.02
4023m	.01	.01	.02	.01	.01	.01	.04	.04	.08	.02	.01	<.01	<.01	.01	.01	.01
5632m	.01	.01	.01	<.01	.01	.01	.02	.02	.04	.01	<.01	<.01	<.01	<.01	<.01	<.01
7241m	<.01	<.01	.01	<.01	<.01	.01	.01	.02	.03	.01	<.01	<.01	<.01	<.01	<.01	<.01

Lung Individual Dose Commitments (mrem)[a]

SECTOR

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
805m	14.	19.	24.	12.	17.	19.	51.	59.	108.	21.	13.	5.0	6.2	7.3	13.	9.8
2414m	2.0	2.8	3.7	1.8	2.7	3.2	8.4	9.5	18.	3.4	2.0	.76	.95	1.1	1.9	1.5
4023m	.86	1.2	1.6	.79	1.2	1.4	3.7	4.2	7.9	1.5	.88	.33	.41	.45	.80	.62
5632m	.50	.70	.92	.46	.71	.83	2.2	2.5	4.7	.89	.52	.19	.24	.26	.46	.36
7241m	.33	.47	.62	.31	.48	.56	1.5	1.7	3.2	.61	.35	.13	.16	.17	.30	.24

[a] 50-year dose commitments resulting from 1 year release

TABLE 5.2-3

INDIVIDUAL BONE AND KIDNEY DOSE COMMITMENTS FROM MILL SITE EFFLUENT

Bone Individual Dose Commitments (mrem)[a]

SECTOR

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
805m	3.6	4.9	6.2	3.0	4.3	4.9	13.	14.	27.	5.3	3.3	1.3	1.6	1.9	3.4	2.6
2414m	.52	.72	.92	.46	.66	.77	2.0	2.3	4.2	.83	.50	.19	.24	.28	.48	.38
4023m	.20	.29	.37	.19	.27	.31	.81	.93	1.7	.34	.20	.08	.09	.11	.19	.15
5632m	.11	.16	.20	.10	.15	.17	.45	.52	.95	.19	.11	.04	.05	.06	.10	.08
7241m	.07	.10	.13	.07	.09	.11	.29	.33	.61	.12	.07	.03	.03	.04	.07	.05

Kidney Individual Dose Commitments (mrem)[a]

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
805m	1.0	1.3	1.7	.82	1.2	1.3	3.5	3.9	7.3	1.5	.89	.35	.44	.53	.93	.71
2414m	.14	.20	.25	.13	.18	.21	.55	.63	1.2	.23	.14	.05	.06	.08	.13	.10
4023m	.06	.08	.10	.05	.07	.09	.22	.25	.47	.09	.05	.02	.03	.03	.05	.04
5632m	.03	.04	.06	.03	.04	.05	.12	.14	.26	.05	.03	.01	.01	.02	.03	.02
7241m	.02	.03	.04	.02	.03	.03	.08	.09	.17	.03	.02	.01	.01	.01	.02	.01

[a] 50-year dose commitments resulting from 1 year release

TABLE 5.2-4

DOSE COMMITMENTS AT PROJECT BOUNDARIES
FOR EACH SECTOR EFFECTED FROM
MILL SITE EFFLUENT [a]

Sector	Distance (meters)	Whole Body (mrem)	Lung (mrem)	Bone (mrem)	Kidney (mrem)
N	1750	0.04	3.49	0.85	0.23
NNE	1890	0.05	4.20	1.03	0.28
NE	1170	0.15	12.32	3.11	0.85
ENE	876	0.12	9.87	2.54	0.70
E	800	0.20	17.15	4.30	1.18
ESE	876	0.20	16.69	4.15	1.14
SE	1170	0.31	27.03	6.46	1.77
SSE	1170	0.35	30.45	7.32	2.00
S	1082	0.73	64.86	15.54	4.24
SSW	1170	0.13	11.14	2.70	0.74
SW	2180	0.02	2.35	0.55	0.15
WSW	1690	0.02	1.37	0.34	0.09
W	800	0.08	6.23	1.59	0.44
WNW	876	0.08	6.18	1.64	0.45
NW	1170	0.08	6.51	1.68	0.46
NNW	990	0.08	6.74	1.77	0.48

[a] 50-year dose commitments resulting from 1 year release

TABLE 5.2-5

INDIVIDUAL LUNG DOSE COMMITMENTS
FROM TAILING EFFLUENTS (mrem)[a]

Direction	Tailing Area 1		Tailing Area 2		Tailing Area 3	
	Area Edge	Project Boundary	Area Edge	Project Boundary	Area Edge	Project Boundary
N	64.7	2.87	54.7	2.18	54.7	1.80
NE	64.9	1.71	55.0	2.13	55.0	2.23
E	62.6	4.08	52.2	3.78	58.5	3.78
SE	155.0	33.0	142.	58.9	150.	130.
S	154.0	41.6	141.	57.6	150.	121.
SW	151.0	4.05	140.	7.55	149.	8.73
W	21.2	4.40	18.3	13.9	18.3	11.9
NW	63.3	54.8	53.9	13.6	53.9	6.05

[a] 50-year dose commitment resulting from 1 year release

TABLE 5.2-6

EXPOSURE TO INDIVIDUALS AT SPECIFIC LOCATIONS IN THE VICINITY OF THE MILL[a]

Location	Sector	Distance (meters)	Whole Body (mrem)	Lung (mrem)	Bone (mrem)	Kidney (mrem)
Point of maximum ground level concentrations offsite	S	1082	0.73	64.86	15.54	4.24
Boundary in the direction of the prevailing wind	S	1082	0.73	64.86	15.54	4.24
Boundary nearest to the sources of emission	E	800	0.20	17.15	4.30	1.18
Direction at which the maximum lung dose would be received at the boundary	S	1082	0.73	64.86	15.54	4.24
Direction of nearest population center (Blanding, Utah)	NNE	10458	<0.01	0.27	0.05	0.01

[a] 50-year dose commitments resulting from 1 year release

0.27 man-rem to the bone and 0.07 man-rem to the kidney based upon the best available population wheel described in Section 5.2.3.1.

5.3 EFFECTS OF CHEMICAL DISCHARGES

5.3.1 Airborne Discharges

5.3.1.1 Vehicle Emissions

Emissions from vehicles used in the milling processes and ore transport from the Blanding and Hanksville buying station as well as vehicles used for mill maintenance and service would impact the atmosphere to some extent. The EPA (1976) has estimated average emissions rates for various gasoline and diesel powered vehicles and these are presented in Table 5.3-1. The suspected temporal and spatial characteristics of these emissions and the relatively low vehicle emission rates will be such that their impact on the local atmosphere should be insignificant.

Possible impacts resulting from fugitive dust due to vehicular traffic should also be minimal. The largest potential source of these emissions will be the 30-ton trucks hauling ore from the buying stations to the mill site. Under normal mill operation, 15 truckloads per day of ore will be hauled from the Hanksville buying station to the mill. These trucks will travel paved roads and the ore will be evenly distributed in the truck beds and covered with tightly tied canvas, thus essentially eliminating dust emissions.

5.3.1.2 Mill Stack Emissions of Chemicals

Attendant with the operation of the proposed mill, quantities of SO_2, NO_x and particulates will be emitted from the various stacks, most importantly the process boiler and secondarily the yellowcake dryer (see Section 3.5.2.1). These emissions will be relatively small and with reference to the ambient air quality standards should result in only slight impacts on the local air quality.

Calculations of ground-level concentrations resulting from these emissions were performed assuming various meteorological conditions. The

TABLE 5.3-1

EMISSION RATES FOR HEAVY-DUTY DIESEL-POWERED AND GASOLINE-POWERED CONSTRUCTION EQUIPMENT
(grams per second)
(From U.S. EPA, 1976)

	Carbon Monoxide	Exhaust Hydrocarbons	Nitrogen Oxides (NO_2)	Sulfur Oxides (SO_2)	Particulates
Diesel-Powered					
Tracklaying tractor	<0.1	<0.1	0.2	<0.1	<0.1
Wheeled tractor	0.3	<0.1	0.1	<0.1	<0.1
Wheeled dozer	0.1	<0.1	0.6	<0.1	<0.1
Scraper	0.2	0.1	0.8	0.1	0.1
Motor grader	<0.1	<0.1	0.1	<0.1	<0.1
Wheeled loader	0.1	<0.1	0.3	<0.1	<0.1
Tracklaying loader	<0.1	<0.1	0.1	<0.1	<0.1
Off-highway truck	0.2	0.1	1.0	0.1	<0.1
Roller	<0.1	<0.1	0.1	<0.1	<0.1
Miscellaneous	0.1	<0.1	0.3	<0.1	<0.1
Gasoline-Powered					
Wheeled tractor	1.2	<0.1	0.1	<0.1	<0.1
Motor grader	1.5	0.1	<0.1	<0.1	<0.1
Wheeled loader	2.0	0.1	0.1	<0.1	<0.1
Roller	1.7	0.1	<0.1	<0.1	<0.1
Miscellaneous	2.1	0.1	0.1	<0.1	<0.1

Source: U.S. EPA, 1976

maximum 1 hour concentrations of SO_2, NO_x and particulates were calculated to be 113, 54 and 28 $\mu g/m^3$, respectively, and were calculated to occur at a point 2.0 kilometers from the boiler stack. The above calculations assume stable atmospheric conditions with a light persistent wind parallel to the dryer and boiler stacks. The modeling techniques, assumptions and design and emission parameters used in these calculations are presented in detail in Section 6.1.3.4.

Using the Turner time averaging method (Turner, 1970), estimated maximum 3-hour SO_2 concentrations should be 95 $\mu g/m^3$ and the 24-hour maximum SO_2 and particulate concentrations should be 67 and 17 $\mu g/m^3$, respectively. These values are well below the respective state and national standards and indicate that SO_2, NO_2 and particulate concentrations should be also below the applicable annual average standards.

It should be noted that these values are based upon estimated "worst" case conditions. Upon the completion of one year of on-site data collection an additional diffusion modeling using actual site data will be performed and presented in the Supplemental Report.

5.3.2 Liquid Discharges

All liquids from the mill operation will be contained in a closed system. No effects from these are anticipated since no discharge will occur.

5.4 EFFECTS OF SANITARY AND OTHER WASTE DISCHARGES

Effluent from laundry will discharge into the tailing retention system. Sanitary wastes will be treated in a septic tank and drained into a leach field. There would be no other waste discharges. It is anticipated, therefore, that no impacts on surface waters, ground water or biota would result from waste disposal.

5.5 OTHER EFFECTS

5.5.1 Terrestrial Biota

5.5.1.1 Vegetation

The projected impacts on air quality from operation of the mill (see Section 5.3.1) are not so significant that they would affect vegetation. No other effect on vegetation is anticipated from operation of the proposed mill.

5.5.1.2 Wildlife

Roadkills of deer and rabbits are expected to increase with increased traffic associated with ore hauling on Highway 95 between its junction with Highway 163 and the Hanksville ore buying Station and on Highway 163 between the town of Blanding and the proposed mill site. This impact and its mitigation has been discussed in Section 4.1.2.2. Roadkills provide food for scavengers. However, scavengers themselves are subject to being killed by collisions with vehicles when flushed from such feeding situations. Utah Division of Wildlife Resources personnel indicate that increased truck traffic on Highway 89 between Kanab and Page has resulted in several recorded incidents of Golden Eagle and other raptors colliding with coal trucks (Personal Communication, Mr. Joe L. Kennedy, Assistant Superintendent National Park Service Glen Canyon National Recreation Area, November 8, 1977).

Relatively minor impacts are anticipated at the mill site during the 15-year operational life of the project. Noise may affect shy species, such as large raptors. Poaching of deer is expected to increase in the general vicinity of the project site; this impact could be partially mitigated by a company employment policy forbidding carrying of firearms in vehicles on company property. Song birds and waterfowl may be adversely affected by attempting to use the tailing retention cells for resting, drinking and feeding areas. This impact is not expected to be significant for waterfowl since the mill site is not on a major migratory flyway and 1977 observations indicated minor waterfowl use of existing stock ponds in the project area; however, it could be significant on song birds, depending on water quality of the tailing retention cells. If the impact is significant, mitigation could include noise makers or netting of cells to discourage use by birds but the estimated magnitude of the impact probably does not warrant mitigation.

5.5.2 Socioeconomic Impacts of Project Operation

Operation of the proposed mill is expected to begin in February 1980 and to employ 75 to 80 workers. The anticipated operating life of the project is 15 years. Impacts on the social and economic environment of the Blanding area would stem primarily from the importation of workers and the increased spending due to wage and salary disbursements and annual property tax payments to local government.

The Hanksville and Blanding ore buying stations are in operation and are, therefore, part of the existing socioeconomic environment. No additional impacts would result from a continuation of the buying station operations.

5.5.2.1 Population

Operation of the proposed mill would generate an increase in population through the importation of some proportion of the project work force. According to the Blanding office of the Utah Department of Employment Security, the requirement for all but highly skilled, technical personnel for the mill could be fulfilled from the local labor pool (Verbal Communication, Mr. Lyman, Manager, Blanding Office of Employment Security, September 7, 1977). Energy Fuels Nuclear, Inc. anticipates that 25 percent of the work force would be of a skill level which could not be found locally. Therefore, because every effort would be made to hire as many local residents as possible, it is expected that mill operation would necessitate the importation of only 20 workers.

According to population multipliers recorded in the <u>Construction Worker Profile</u> (Mountain West Research, 1975), families moving into the project region during the impact period would have an average size of 3.5. (This also corresponds to the average number of person per household in Utah in 1970.) Applying this to the number of anticipated workers, it can be seen that the total number of newcomers directly associated with mill operation would be 70, which represents 1.3 percent of the combined 1977 population of Blanding, Monticello and Bluff.

The above discussion is a realistic, though somewhat optimistic, assessment of impacts of the proposed mill. It should be noted that, in the event of implementation of the project, a number of factors may be at work which would alter this forecast. Most significantly, importation of more than 25 percent of the project work force would necessitate an upward adjustment of all population-related impacts. If 100 percent of the work force were imported, for example, direct population growth would be as high as 280, representing five percent of the combined 1977 populations of Blanding, Monticello and Bluff.

In addition to the newcomers directly associated with the project, mill operation would foster indirect population growth due to stimulation of the local economy through a multiplier effect. This process is explained in Section 5.5.2.3. The creation of 88 indirect, service-sector jobs would result in a secondary wave of population growth. Assuming: 1) 24 percent of the new families would have working spouses, and 2) an overall average of 3.5 persons per household, indirect growth would consist of 235 new residents (Mountain West Research, 1975). This growth would occur over the long run, as a response to economic conditions and other variables which cannot be accurately predicted at this point (see Section 5.5.2.3). Therefore, it should be noted that this projection of indirect growth should be interpreted as a general guide and is subject to change.

Because the pace and extent of indirect growth cannot be accurately predicted, subsequent sections of this report address impacts of direct growth only. It should be noted that secondary growth would add to the demand on housing and public services. However, this would not occur simultaneously with increases in demand exerted by the project operation crew; the indirect growth process may occur over several years.

The combined direct and indirect population increment would total approximately 300, representing 5.5 percent of the combined 1977 populations of Blanding, Bluff and Monticello. Although this growth would be concentrated in Blanding, it is anticipated that Monticello and Bluff would share in the direct and/or indirect growth generated by operation of the project.

5.5.2.2 Housing

In the fall of 1977, Blanding, Monticello and Bluff had little or no excess housing capacity. Although developers are planning construction projects in Blanding and Monticello, it is probable that, in the absence of advanced notice, there would be a minimal number of houses available when mill operation commences in February 1980. Therefore, mobile homes are likely to be the short-term answer to housing needs of the project work force. Local developers have indicated an interest in providing housing for permanent residents associated with the mill and it is anticipated that the two largest developers in Blanding will have the capacity to produce 40 units per year by 1980 (Verbal Communication, Mr. Terry Palmer, Palmer Builders, October 27, 1977). Therefore, it is assumed that an influx of 20 families associated with project operation could be accommodated by the temporary and permanent housing stock in the Blanding area.

Table 5.5-1 summarizes the type of housing demand that can be expected from the project work force and indicates that the majority of newcomers would purchase single-family homes if available (Mountain West Research, 1975).

TABLE 5.5-1

ANTICIPATED HOUSING DEMAND OF IMPORTED PROJECT WORKERS

Type of Unit	Percent of Newcomers	Number of Units Demanded
Single-family	55	11
Multiple family	17	3
Mobile Home	25	5
Other	2	1
Total	99	20

Source: Multipliers based on Construction Worker Profile, by Mountain West Research, 1975.

5.5.2.3 Municipal Services and the Tax Base

The influx of 20 families directly associated with mill operation would have a minimal long-term impact on public facilities and services in the Blanding area in 1980. Increased capital expenditures and operating costs would eventually be offset by increased property tax revenue resulting from the mill and from new residential construction for newcomers. However, municipalities may experience increased costs one or two years before the increased tax revenue occurs.

Water and Sewage Treatment

The cities of Blanding and Monticello are currently expanding their water supply systems and will continue to drill wells to keep pace with future demand. Also, sewage treatment systems in both cities are being upgraded. Improvements to the Blanding sewage lagoon should be completed by 1981. In the interim, sewage overflow is used to irrigate adjacent property, and increases in demand are expected to be accommodated in this manner. The time frame for the planned lagoon system in Monticello is uncertain, although its completion is expected within the new two years. At that time, the Monticello system is expected to have the capacity to accommodate 4000 to 5000 residents. The community of Bluff is attempting to obtain federal funding for a sewage treatment system. In the absence of funding, a continuation of the use of individual septic tanks can be expected. Table 5.5-2 summarizes alternative population projections of the potentially impacted communities compared to the expected capacity of water and sewage treatment systems and indicates that planned expansions should enable services to keep up with growth occurring with or without the development of the mill.

Schools

Approximately 30 school-age children would be included in the population increment directly induced by mill operation. This would constitute an addition of one percent to the 1977 combined enrollment of schools in Blanding, Monticello and Bluff and, therefore, would not create a significant or adverse impact on the San Juan School District. In 1977, elementary schools in the three communities had excess capacity.

TABLE 5.5-2

LONG-TERM PROJECT-INDUCED POPULATION GROWTH COMPARED TO 1980 POPULATION AND CAPACITY OF PUBLIC SERVICES

	San Juan County	Blanding	Monticello	Bluff
July 1975 Population	11,964	2,768	1,726	150
July 1977 Population	13,368	3,075	2,208	280
1980 Population Assuming:				
a) Continuation of the 1975-1977 Growth Rate	15,730	3,580	3,140	640
b) "High" Growth Rate Projected by the Utah Agricultural Experiment Station (Cities are assumed to grow in proportion in county)	16,215	3,730	2,680	340
Population Directly Associated with Mill Operation	70	na[a]	na[a]	na[a]
Projected Capacity (in terms of population) of Public Services, 1980-1981:				
Water Supply	na[a]	Drill as needed	Drill as needed	500
Sewage Treatment	na[a]	4,500	4,000-5,000	Not Available
Water Treatment	na[a]	4,500[b]	4,000	Not Available

[a]Not applicable

[b]Minor improvements would be needed to reach this capacity. Otherwise the peak capacity is 3,900.

Source: 1975 Population, U.S. Bureau of Census, 1977
1977 Population, San Juan County Clerk, 1977
1979(b) Yun Kim, for Utah Agricultural Experiment Station, 1976

Two new high schools will alleviate overcrowded conditions in the San Juan High School in Blanding. One school will be completed in August 1978 and one is scheduled for completion by 1979 or 1980 (Verbal Communication, Ms. Clyda Christensen, San Juan School District, January 17, 1978).

Energy Supplies

The natural gas supply to Monticello is reportedly adequate for meeting future needs. The city-owned electrical distribution system, however, is in need of expansion if additional residents are to be served in Monticello.

The Blanding electrical distribution system is adequate. The basic source of electricity, Utah Power and Light, expects to have no problems in meeting the needs of a growing population.

Increased Costs to Local Governments

It has been estimated that capital expenditures for improvement of water, sewage treatment and school systems in rural, energy-impacted communities in western Colorado amount to $1,000 per new resident (Verbal Communication, Mr. Steve Schmidt, Director, Colorado West Council of Governments, November 2, 1977). If it is assumed that the Blanding area will experience similar cost increases, the population directly induced by mill operation would require capital expenditures of $70,000. In addition, annual operating expenditures for municipal services would rise. In the 1976-77 fiscal year, General Fund expenditures in Blanding and Monticello for services which are particularly sensitive to the level of demand were between $20 and $30 per capita. Applying this rate to the projected number of newcomers associated with the mill operating work force, it is assumed that local communities would experience an annual increase in operating expenditures of between $1,400 and $2,100. This assumes no excess capacity in existing services and no economies of scale in the provision of services.

Services provided by San Juan County that would be subject to cost increases in proportion to population growth include health care, recreation and public safety. The approved budget for 1977 indicates a per-capita expenditure of between $20 and $30 for these services. Therefore, the county would also experience operating cost increases of $1,400 to $2,100 throughout the life of the project.

The San Juan School District had an operating budget of $1,001 per student in 1977. Assuming an influx of 30 school-age children, the impact in school expenditures would be $30,090 per year.

Taxes

The operation of the proposed mill would benefit state and local taxing jurisdictions directly through increased corporate income and property tax payments and indirectly through increased sales tax revenue and personal income taxes of the work force. Using total construction costs as a guide to the fair cash value of the facility, the assessed valuation, computed as 20 percent of true value, would be $7.6 million. The current applicable mill levy is 60; therefore, the annual property tax obligation resulting from the proposed development would be approximately $456,000. The San Juan County School District would receive 66 percent of this total, San Juan County would receive 17 percent, and the remaining 17 percent would be distributed to special county funds (Verbal Communication, Mr. Robert Cooper, Utah State Tax Commission, December 9, 1977). Table 5.5-3 summarizes the distribution of anticipated property taxes generated by the project. It should be noted that depreciation of buildings and equipment has not been incorporated into this estimate but would have a dampening effect on property taxes after the first year of operation.

Sales tax revenue resulting from annual personal consumption expenditures of $522,800 would amount to 26,100. Of this total, $23,500 would benefit the State of Utah and $2,600 would benefit San Juan County.

TABLE 5.5-3

ESTIMATED PROPERTY TAX PAYMENTS
1977 Dollars

Property Tax		
Total ($38 million x 20% x 60 mills)		456,000
San Juan School District (40 mills)	304,000	
San Juan County General Fund (10.3 mills)	78,280	
San Juan County Capital Improvement - Roads (3 mills)	22,800	
San Juan County Capital Improvement - Buildings, Equipment and Grounds (1 mill)	7,600	
Library (0.9 mill)	6,840	
Tort Liability (0.1 mill)	760	
Health (0.7 mill)	5,320	
Water Conservancy District (2 mills)	15,200	
Blanding Cemetery (2 mills)	15,200	

Source: Construction cost estimate supplied by Energy Fuels. Methodology for computing tax obligations is based on a verbal communication with Mr. Robert Cooper, Utah State Tax Commission, December 9, 1977. Mill levies are based on a verbal communication with the San Juan County Treasurer, December 9, 1977.

Personal income tax obligations of the operating work crew would represent approximately 13.8 percent of wage and salary payments, or an annual total of $188,400 (U.S. Bureau of Labor Statistics, 1977). This would benefit the state and federal governments.

Corporate income tax payments would be substantial, but cannot be accurately predicted at this point.

5.5.2.4 Economic Base

The proposed project would be an important source of long-term employment and income in the Blanding area. The local labor market is currently subject to wide, seasonal fluctuations in employment. Mill operation would benefit the area by providing 75-80 stable year-round jobs. This would have a stimulating, feed-through effect on the local and regional economies. Uranium mines throughout southeastern Utah can be expected to increase production and employment in response to increased demand generated by the mill. Industrial support services, in particular the transportation industry, would also experience higher levels of activity. In addition, local service industries such as finance, retail trade, personal and professional services, etc. would benefit from an increase in demand generated by population and employment growth.

Mill operation would be considered one of the basic industries of the region, defined as those which are engaged in the production of goods or services that are sold beyond the region's borders and/or which account for income drawn into the region. In contrast, employment in finance, insurance, real estate and most personal and professional services are considered non-basic. Non-basic service industries are primarily local in scope and depend on the distribution of income initially earned in the basic employment sector. Basic employment is, therefore, viewed as primary insofar as it supports and largely determines the level of non-basic and ultimately total employment.

The ratio of basic and non-basic employment in a region can be used to measure the expansion (or contraction) in employment when an addition (or reduction) in basic employment occurs or is anticipated. The basic/non-basic ratio is referred to as a multiplier relationship because an increase in basic employment will have an expansionary effect throughout the local economy. Table 5.5-4 presents basic and non-basic employment for San Juan County and indicates that the basic/non-basic employment multiplier is 1.1. This suggests that, by creating 75 to 80 basic jobs, the proposed mill would indirectly generate up to 88 jobs in the local service sector. In addition, increased employment in uranium mining operations in the area would cause a similar expansion.

Growth in non-basic employment would produce an increase in local population because a number of new jobs would be filled by new residents accompanied by families. This growth would occur over the long run and would depend on a number of factors. An increase in regional unemployment caused by a decline in jobs or an increase in the labor force participation rate would dampen the population growth resulting from increased employment opportunities. Also, a high proportion of two-worker households among newcomers would have a similar dampening effect.

Annual operating costs of the mill are expected to amount to $10.5 million. Of this total, approximately $1,365,000 would represent wage and salary payments to the project work force, assuming that the labor cost component of 2.1 million includes 35 percent for fringe benefits. Current data on income multipliers and spending flows in Utah are not available. Therefore, nationwide expenditure patterns recorded in 1976 by the Bureau of Labor Statistics were used to calculate the effect of project wages on local and state economies (U.S. Department of Labor, Bureau of Labor Statistics, 1977). Assuming that local personal consumption expenditures would represent 38.3 percent of family income, annual retail expenditures of the project work force would amount to $522,800. Blanding, Bluff and Monticello would experience the bulk of this spending. The major regional centers of Moab, Cortez or Grand Junction may also experience an increment in consumption expenditures as

TABLE 5.5-4

BASIC AND NON-BASIC EMPLOYMENT, SAN JUAN COUNTY, 1976 ANNUAL AVERAGE

Sector	Total Employment	Basic	Non-Basic
Agriculture	270	270	
Mining	784	784	
Contract Construction	70		70
Manufacturing	169	169	
Transportation, Communication, Public Utilities	147		147
Wholesale, Retail Trade	347	65	282
Finance, Insurance, Real Estate	22		22
Services	296		296
Government	688		
Federal		39	649
State and Local			
Total		1327	1466

Basic/Non-Basic Multiplier: 1.1

Source: Dames & Moore, 1977, based on Utah Department of Employment Security, 1977.

a result of the project. However, this would represent a minor or insignificant addition to existing spending flows; impacts on Blanding, Monticello and Bluff would be considerably greater.

5.5.2.5 Quality of Life

The operation of the proposed mill would have positive impacts on the quality of life due to the provision of 75 to 80 long-term, stable jobs. Because Energy Fuels plans to hire as many local residents as possible, the population increment associated with mill operation would represent a noticeable but not disruptive force in local communities. An influx of 20 families would not cause significant or long-term adverse impacts on the quality of life.

Negative impacts on the quality of life would stem primarily from the transportation of uranium ore from mines throughout the region to the Hanksville and Blanding buying stations and from Hanksville to the mill at Blanding. A noticeable increase in heavy truck traffic would affect travellers on Utah Route 95, U.S. Route 163, and other highways in southeastern Utah. Increased noise and air pollution would result. Also, the trucks would represent a safety hazard due to the increased probability of automobile accidents (see Section 5.5.2.5).

5.5.2.6 Land Use Impacts

Operation of the mill and tailing retention system would directly impact land use patterns by the commitment of 310 acres of rangeland throughout the life of the project. Indirect impacts would stem from increased residential and commercial development in the Blanding area resulting from induced population growth. Land is available for development in the Blanding city limits and in Bluff; the City of Monticello is pursuing an active annexation program. Therefore, increased development would not represent an inconsistent or conflicting land use in the potentially impacted communities.

Regional transportation systems would experience increased activity during the operation phase of the project. Uranium mines throughout southeastern Utah would transport ore to the Blanding and Hanksville buying stations via 30-ton diesel trucks and trailers. Trips from mines to the buying stations are anticipated to total 70 each day, with 53 to the Blanding buying station and 17 to Hanksville. In addition, transportation of ore from the Hanksville buying station to Blanding would be accomplished via 30-ton trucks approximately 15 times daily. Plate 3.6-3 (page 3-26) indicates the location of mines that would be sending ore to the buying stations and mill.

Utah Route 95 and U.S. Route 163 would experience the heaviest truck traffic associated with the buying stations and mill. In addition, U.S. Route 666 and Utah Routes 262, 276, 263 and 24 would be affected by ore movement from mines to the buying stations. All of the above roads are two-lane, paved highways maintained by the State of Utah. In addition, secondary, county-maintained and private roads would accommodate up to 15 percent of the project-induced truck traffic.

In 1975 average daily traffic flows ranged from 95 to 310 on Utah Route 95 and from 530 to 2100 on Route 163. As summarized in Table 5.5-5, other potentially affected roads accommodated average daily traffic counts of 25 to 1235 vehicles. Project-induced truck traffic would constitute a noticeable increase in existing traffic flows.

Designated lands potentially affected by the transportation of ore include Glen Canyon National Recreation Area, Canyonlands National Park, Manti-La Sal National Forest, Natural Bridges and Hovenweep National Monuments, Capitol Reef National Park, and the Henry Mountains. These areas attract a large number of visitors during summer months. A substantial increase in truck traffic, particularly during peak vacation periods, may create a safety hazard. The Hite Crossing at Glen Canyon National Recreation Area generates heavy tourist traffic and would be particularly affected by truck traffic on Route 95.

The project work force would add to traffic circulation in the Blanding area. Local residents would experience noticeable increases

TABLE 5.5-5

AVERAGE DAILY TRAFFIC ON POTENTIALLY IMPACTED HIGHWAYS

Highway (Segment)[a]	Range of 1975 Average Daily Traffic Estimates[b]
Utah Route 95 (Hanksville-Blanding)	95-310
U.S. Route 163 (Moab-Bluff)	530-2100
U.S. Route 666 (East of Monticello)	950-1235
Utah Route 263	25-35
Utah Route 276	220
Utah Route 262 (Colorado border to Route 163)	410-440
Utah Route 24 (West of Hanksville to Capitol Reef National Park)	310-320
Utah Route 24 (North of Hanksville)	65-475

[a]Where no segment is specified, numbers refer to the entire length.

[b]Traffic on most of the highways is counted and reported for several stations. For example, traffic on Utah Route 163 is higher near Blanding than in the Bluff area. The ranges in this table refer to multiple estimates for each highway segment.

Source: Utah Department of Transportation, 1976.

in traffic and noise during peak periods of construction activity. Assuming 2 trips per worker per day in the Blanding area, the peak work force would represent an additional traffic load of 500 trips per day, representing an increment of 68 percent above the 1975 average daily traffic flow on Route 163 in the vicinity of the mill.

5.5.3 Sound

5.5.3.1 Ambient Sound Levels During Operation

The noise emitted from this facility's operation will be principally from the mill. In a previous study for the Bear Creek Uranium Project, the sound level from a similar mill half the size of the one under consideration was estimated to be 75 dB at 100 ft (10 m). Doubling the facility size and operation doubles the assumed sound energy emitted. Thus, the estimated sound level contribution for the proposed mill is 78 dB at 100 ft (30 m). This contribution is extrapolated assuming hemispherical radiation to the measurement locations previously used for the background ambient sound level survey.

To estimate the sound levels during plant operation, the contribution from the plant operation and the background ambient sound levels were combined. Table 5.5-6 indicates the projected daytime, nighttime and day/night average sound levels. Twenty-four hour plant operation was assumed.

Truck traffic along highways between local mine sites and the buying stations will be increased. The sound level contribution due to trucks delivering ore to the plant site was estimated to be insignificant for noise sensitive land uses at large distances from the highways. For those areas adjacent to the highway, the expected increase in noise due to truck traffic was estimated to be about three decibels.

5.5.3.2 Impact Assessment

No significant impact on the ambient sound level is anticipated from operation of the proposed mill, sound levels along all site boundaries will be less than 55 dB (see Section 4.1.6.3 for significance).

TABLE 5.5-6

AMBIENT SOUND LEVELS DURING MILL OPERATION - dB

Location	Background Ambient Sound Levels			Operation Ambient Sound Levels			Change in Ambient Sound Levels		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
1	56.5	46.4	56.9	56.5	46.5	56.5	0	0	0
2	56.7	47.1	56.9	56.7	47.4	57.0	0	0	0
3	45.8	39.2	47.4	55.9	55.6	62.0	10	16	15
4	46.8	39.9	48.2	40.9	40.2	48.4	0	0	0
5	35.3	35.1	41.5	40.3	40.2	46.6	5	5	5
6	47.8	43.1	50.6	47.8	43.1	50.6	0	0	0
7	42.8	27.7	41.5	42.8	27.7	41.5	0	0	0
8	48.3	41.0	49.5	48.3	41.0	49.5	0	0	0

Truck traffic will increase by 50-100 percent for some roads near the buying stations. Noise due to truck passby on major routes to Blanding is projected to increase ambient sound levels by about three decibels in areas adjacent to the highways. This traffic will occur only during daytime hours and only a small number of people will be affected.

5.5.4 Surface Water

Although the operation of the mill and tailing retention system will have little effect on the hydrologic characteristics of the area, the presence of the tailing retention system, which will impound surface runoff, will reduce water and sediment yields from the basin. The drainage area upstream of the tailing cells that would be affected is about 260 acres. The cells themselves, at ultimate development, will occupy an area of about 240 acres; combined with the upstream 260 acres this results in a total of about 500 acres that would be taken out of the Cottonwood Wash basin. If one assumes an average annual surface runoff of 0.2 inches (see Section 2.6.2), the total annual reduction in runoff, expressed as volume, would be 8.3 acre-feet. This is about 0.13 percent of the average annual flow of Cottonwood Wash at State Highway 95, into which this water would normally flow.

The change in sediment yield due to the project has not been estimated due to insufficient data.

Peak flood flows in Westwater Creek and Cottonwood Wash would also be reduced due to the impoundment caused by the tailing retention system. This decrease in peak-flow would be small in comparison with the total since the affected drainage area will be less than one square mile while the Cottonwood Wash drainage area at Highway 95 is over 200 sq mi.

5.6 RESOURCES COMMITTED

During the life of the proposed mill, about 15 years, approximately 730,000 tons of ore would go to the mill annually to be processed and 1,898,000 pounds of U_3O_8 concentrate would be produced annually. This mineral resource would be irreversibly committed to energy production.

The area occupied by the proposed mill and tailing retention system (about 310 acres) would be committed until the life of the mill ends, about 15 years. This area would be removed as wildlife habitat and livestock range until the end of the mill operation and reclamation is completed. The acreage occupied by the tailing retention would be committed until radiation levels are below acceptable standards. The length of time necessary after reclamation is completed is indeterminate.

Portions of the project site are utilized by Mule Deer in migration and overwintering. Project facilities and human activities would alter the use of these areas by deer. Fenced areas would not be available for their use for about 15 years and until reclamation is completed. The displacement and accompanying effects upon the deer herd utilizing the area represents a resource committed, the magnitude of which cannot be ascertained. In general, the biota occurring on the project site are not unique in the region. Short-term removal of land and wildlife habitat as a result of the project operations is not expected to represent an irreversible or irretrievable commitment of resources in the region.

Water used in the mill circuit would be temporarily tied up in the mill circuit. Additional water would be cycled to the tailing retention system but much of that in the tailing cells would return to the hydrologic cycle through evaporation. Water used at the mill for dust control, sanitary and general uses would also be returned to the hydrologic cycle through evaporation or infiltration.

6.0 EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAM

The following section describes the methodologies used in collecting baseline environmental data and the proposed programs for monitoring impacts that the proposed uranium mill may have on the environment. In some instances, the methodologies described are currently being used in on-going studies which are necessary to complete a year of data collection.

6.1 PREOPERATIONAL ENVIRONMENTAL PROGRAMS

6.1.1 Surface Water

An on-going baseline surface water quality monitoring program is being conducted in the project vicinity near Blanding and in the vicinity of the Hanksville ore-buying station for an initial period of one year (July 1977 to July 1978). Physical, chemical and radiological parameters of the waters are being documented.

The sampling locations in the project vicinity near Blanding are located on Westwater Creek, Cottonwood Creek and Corral Creek and in a drainage wash and at a pond down gradient of the proposed mill site (see Plate 2.6-10). The locations of the surface water sampling stations are:

Station No.	Location
S1R	Westwater Creek at downstream (south) side of Highway 95 Bridge
S2R	Corral Creek at downstream (south) side of small bridge
S3R	Corral Creek at spillway of small earthfill dam
S4R	Corral Creek at junction with Recapture Creek (1/4 mi from end of jeep road)
S5R	Surface pond south of mill site, 1/8 mi west of Highway 47
S6R	Small wash south of mill site, 1 mi west of Highway 47
S7R	East side of Cottonwood Creek, at jeep trail intersection south-southwest of mill site
S8R	East side of Cottonwood Creek, jeep trail intersection west-southwest of mill site
S9	East side of Westwater Creek, at jeep trail intersection

Sampling stations S1R, S2R and S3R are upgradient from the project site, the remaining downgradient.

The sampling locations in the vicinity of the Hanksville ore buying station are located on Halfway Wash at two stations, one upstream and one downstream of the ore buying station (see Plate 2.6-11). The locations of these two sampling stations are:

Station No.	Location
HS1R	Halfway Wash, downstream of buying station, 1/8 mi east of Highway 95 at confluence with unnamed wash draining ore buying station site area
HS2R	Halfway Wash, upstream of buying station, 1/8 mi south of property boundary of ore buying station

The stations are sampled on a quarterly basis when accessible and when water is flowing. Because the streams are ephemeral to intermittent, there is not always a flow to sample at the time that sampling is scheduled. As a result, there has been no water available to sample at some stations and, consequently, there are no analyses of existing water quality.

Effort will be made to increase the frequency of sampling for a period of time in spring 1978 in order to obtain a series of water samples at these stations when water may be flowing continuously for a few weeks as a result of snowmelt runoff.

Water samples for complete chemical analysis and radiological analysis were collected in the project vicinity in July 1977 and November 1977. The results of those analyses are discussed in Section 2.6.3.2 and listed in Table 2.6-7. Details of the techniques and procedures of sampling and types of analyses are discussed in Appendix B. Parameters being measured are listed in Table 6.1-1 of Section 6.1.2.2.

6.1.2 Ground Water

Existing baseline ground water conditions in the project vicinity near Blanding and in the vicinity of the Hanksville ore buying station are being measured for a period of one year (July 1977 to July 1978) as discussed in Section 2.6.1 and 2.6.3.

6.1.2.1 Sampling Locations

The ground water baseline sampling locations in the project vicinity near Blanding are located both upgradient (to the north) and down gradient (to the south) of the proposed mill and tailing retention sites (see Plate 2.6-10). The locations of the ground water sampling stations are:

Station No.	Location
G1R	Spring in Corral Creek, 500 feet upstream of earth dam and surface water station S3R, upgradient of project site
G2R	Deep well at mill site, taps Navajo Sandstone
G3R	Spring near Ruin Spring Point, drains to Cottonwood Creek, down gradient of project site
G4R	Spring near base of Dakota sandstone cliffs about 500 ft east of jeep trail, drains into Cottonwood Creek, down gradient of projected site
G5R	Spring about 1500 ft east of Westwater Creek in canyon, to west and possibly down gradient of project site
G6R	Abandoned stock well, 1000 ft down gradient from mill site
G7R	Abandoned stock well, 1000 ft upgradient of mill site

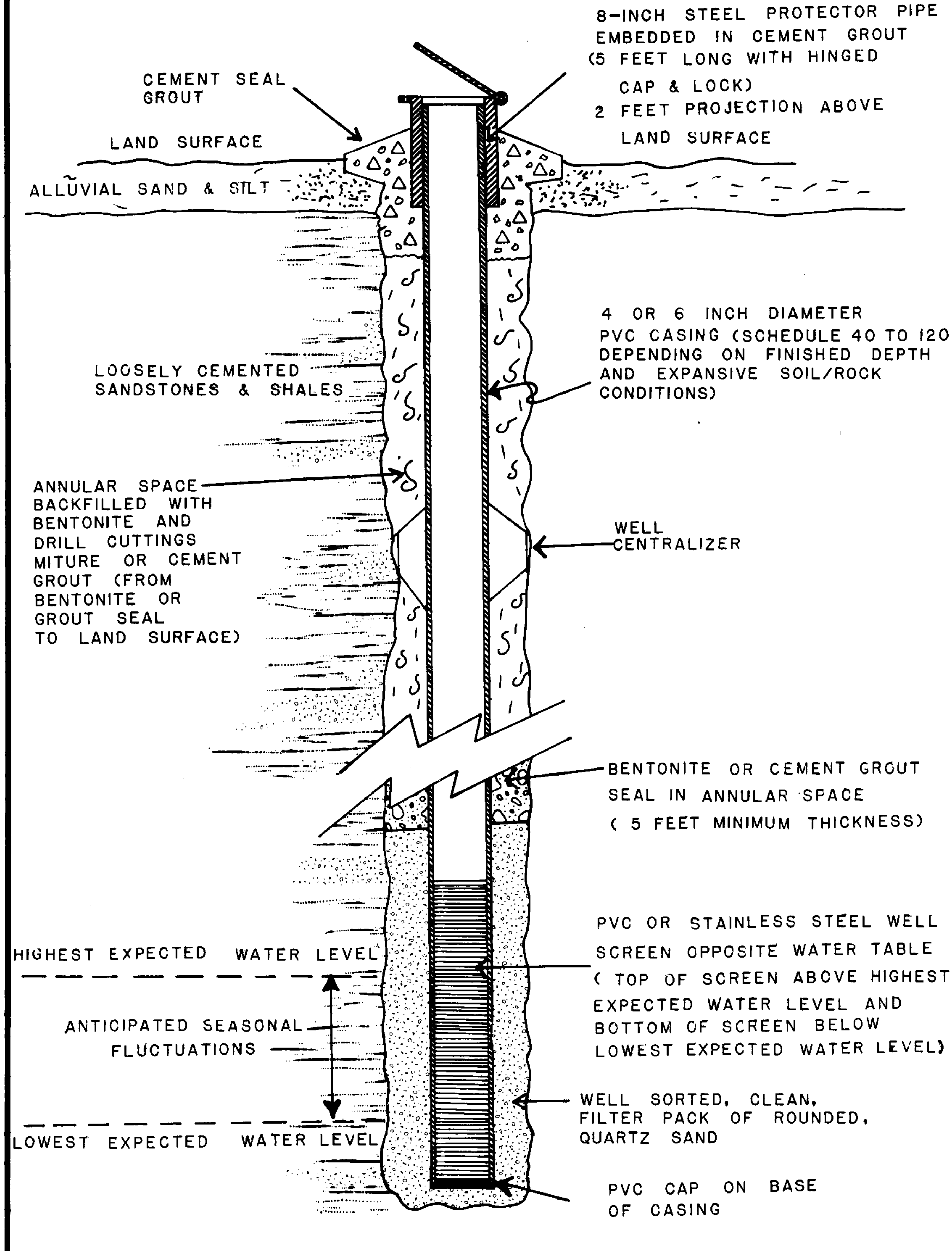
The baseline ground water station (HG1R) at the Hanksville ore buying station is the main supply well located at the station. This well withdraws ground water from the underlying Entrada Sandstone from a depth of 400-440 ft below the land surface directly below the station.

Additional ground water investigations in the vicinity of the mill site and tailing retention site are planned for early 1978. This work will consist of site-specific drilling and installation of ground water observation/monitoring wells. The purpose of these investigations will be to obtain a more accurate representation of ground water levels, ground water flow directions, types of movement and ground water quality in the critical areas near the mill site and tailing retention area. The pre-operational ground water monitoring program will be completed with the installation of several monitoring wells. Conclusions from the additional investigations and the final design of an operational ground water monitoring program will be described in the Supplemental Report.

The tentative design of a site-specific pre-operational ground water monitoring program will include three or more observation/monitoring wells to be installed at locations predominantly down gradient from the mill site and tailing retention site (see Appendix H, Plate 2).

In general, the monitoring wells (Plate 6.1-1) will be constructed of 4- or 6-inch diameter PVC plastic casing to a depth below the lowest expected water level. The lower portion of the well will be screened with either PVC plastic, well screen or stainless steel screen. The top of the screened portion of the well will be above the highest expected water level. The annular space in the borehole between the formation and the casing will be filled wilth clean, inert, natural stone filter material for the entire screened interval. The remainder of the annular space, above a 5-foot bentonite seal on top of the filter, will be grouted or backfilled with a mixture of the drill cuttings and grout or bentonite. A cement seal will be emplaced around the exposed PVC casing at the land surface to prevent surface water from entering the borehole around the casing. For further protection, a steel casing with a hinge cap and lock will be encased around the PVC plastic casing and will be seated in the cement seal.

Once in operation, the well will be sampled for a ground water quality analysis quarterly. The well diameter will be large enough so that a 3.75" OD submergible pump can be installed and the well pumped for a sufficient period of time to obtain a representative sample of the



SKETCH OF TYPICAL GROUND WATER MONITORING WELL

(FOR WATER TABLE OR PERCHED GROUND WATER)

DAMES & MOORE

PLATE 6.1-1

in-situ ground water quality. The radius of influence of the pumping will be enough so that ground water within several feet of the well in all directions will be drawn in toward the well. In this manner, the sampling area being monitored can be considered as much larger than a single point per well.

In the event that there may be reason to suspect ground water contamination, the frequency of the sampling will be increased and the number of parameters increased. If necessary, more wells will be drilled and constructed.

Water levels in the monitoring wells will be measured and recorded quarterly to provide a long-term record of the configuration of the water table and water-level fluctuations. These data will be useful to more accurately predict the potential direction of ground water movement.

6.1.2.2 Physical and Chemical Parameters

The parameters measured on a quarterly basis for ground water (and surface water quality) are listed in Table 6.1-1.

CDM-Accu-Labs, Inc. (Denver) is analyzing radiological and chemical water parameters. Sample bottles are supplied by Accu-Labs. All analyses are done according to "Standard Methods for the Examination of Water and Wastewater" (APHA, 1971).

Temperature (°C), dissolved oxygen, specific conductivity and pH are measured in the field at the time of sampling. Temperature and dissolved oxygen are measured by use of a YSI DO Meter (Model 57), specific conductivity by a Lab-line Lectro Mho-Meter, and pH by a Sargents pH meter, Model PBL.

Sample procedures and techniques are discussed in Appendix B.

TABLE 6.1-1

PHYSICAL AND CHEMICAL WATER QUALITY PARAMETERS

Specific conductance (field; micromhos/cm)	Manganese
Total suspended solids	Aluminum
Temperature (field)	Arsenic
pH (lab, field)	Barium
Redox potential	Boron
Total dissolved solids	Cadmium
Dissolved oxygen (field)	Chromium
Oil and grease	Copper
Total hardness as $CaCO_3$	Lead
Total alkalinity as $CaCO_3$	Mercury
Carbonate as CO_3	Molybdenum
Chloride	Nickel
Cyanide	Selenium
Fluoride	Strontium
Nitrate as N	Vanadium
Sulfate as SO_4	Zinc
Calcium	Silver
Iron, Total and dissolved	Polonium 210
Magnesium	Lead 210
Ammonia as N	Thorium 230
Phosphorus, Total as P	Uranium (Natural)
Potassium	Radium 226
Silica	Gross α
Sodium	Gross β
Chemical Oxygen Demand (COD)	

6.1.3 Air

6.1.3.1 Meteorological Monitoring Programs

On-going site-specific preoperational meteorological monitoring programs were initiated at both the project site and at the Hanksville buying station in early March 1977. These programs monitor the parameters of wind speed, wind direction, temperature, relative humidity and total precipitation. Each program employs identical instrumentation; however, the Hanksville wind instruments are battery operated while commercial power is used at Blanding. The stations are located so as to not be affected by local terrain or structures. Plates 2.7-1 and 2.7-10, respectively, show the exact locations of the monitoring stations at the Blanding and Hanksville sites relative to the planned operations and surrounding terrain.

Table 6.1-2 presents the respective manufacturer's specifications and the sampling height of each sensor. Data are collected via strip chart recorders and wind speed and wind direction data are reduced as hourly averages, temperature and relative humidity as instantaneous values (on the half hour) and precipitation as daily totals. As part of the quality assurance procedures, calibrations of each sensor are performed quarterly and are documented on standard forms. Standard quality assurance practices are adhered to throughout the data collection and analysis processes.

6.1.3.2 Air Quality

Preoperational air quality monitoring programs have been initiated at each site to document background particulate and sulfation rate concentrations. Settleable particulates are measured at four locations at both the Blanding and Hanksville areas through the use of dustfall samplers. In addition total suspended particulates are monitored at one location at the Blanding site by a high volume sampler. Sulfation rate, which provides an indication of sulfur dioxide concentrations, is also measured via lead dioxide plates at four locations at each area. Sampling locations are shown on Plates 2.7-1 and 2.7-10.

TABLE 6.1-2

METEOROLOGICAL MONITORING PROGRAM SENSOR INFORMATION

PARAMETER	MANUFACTURER	MODEL NO.	SENSING TECHNIQUE	MFRS. LISTED PRECISION	MFRS. LISTED THRESHOLD	MONITORING HEIGHT
Wind Speed	Met One, Inc.	010	Cups/Light Chopper	±0.15 mph	0.5 mph	10m
Wind Direction	Met One, Inc.	020	Vane/Potentiometer	±3°	0.6 mph	10m
Temperature	Bendix Corp.	256	Bourdon Tube	±1°F	--	1.5m
Relative Humidity	Bendix Corp.	256	Human Hair Bundle	±3%	--	1.5m
Precipitation	Weather Measure Corp.	P511P	Tipping Bucket /Heated	±0.01 in	--	1.5m

Settleable particulate sampling and anlaysis are performed in accordance with procedures described in ASTM D-1739 and sulfation plate analysis is performed by the turbidimetric technique. The sulfation plates and dustfall samplers are mounted at a sampling height of approximately 2.5 meters above ground. Sampling started in March 1977, and each sample is routinely exposed for a one month period. Analysis is performed by an independent laboratory (Corning Laboratories, Inc.) and results are presented as monthly averages.

The Blanding total suspended particulate monitor (high volume air sampler) is located just south of the proposed mill site (see Plate 2.7-1). Sampling and analysis procedures conform to the EPA reference technique as presented in the Federal Register Vol. 36 No. 84. This type of sampler collects airborne particulate matter on a glass fiber filter by drawing a high volume of air, approximately 40 cubic feet per minute, through the filter for a 24-hour period. Total weight of the particulate matter is then calculated by subtracting the pre-exposure weight of the filter from the weight of the used filter. The resultant weight is directly related to total suspended particulates in micrograms per cubic meter of air.

Sampling started in October, 1977 and samples are taken continuously from midnight to midnight every sixth day, in conformity with the U.S. EPA standard sampling schedule. The sampler is mounted on a monitoring platform such that the intake is approximately 3 meters (10 feet) above ground to prevent biasing of the data by heavier, non-suspended particles resulting from surface interferences. Sampling flow rate is continuously recorded through the use of a recording pressure transducer. The unit is also equipped with a timer that records the actual length of operation to the nearest 0.1 minute. All filters are weighed at the Dames & Moore Denver laboratory in a low relative humidity room.

6.1.3.3 Computer Models

STAR MIL - Takes hourly surface meteorological observations and computes a Pasquill stability class for each observation based upon:

1) incoming solar radiation intensity, 2) sky cover, 3) cloud height, 4) wind speed.

DT ROSE - Takes the output from STAR MIL, and computes the frequency distribution of stability by wind direction and wind speed intervals.

6.1.3.4 Other Models

Diffusion Analysis for Determination of Chemical Concentrations from Stacks

The downwind, ground level concentration of effluents emitted from the various stacks was computed using the Pasquill-Gifford diffusion equation (Turner, 1970). This equation assumes that the distribution of effluents downwind from a stack will be Gaussian (normal) in both the horizontal and vertical planes of the plume. The equation is:

$$\chi(x,y,O,H) = \frac{Q}{\pi\sigma_y \sigma_z \overline{U}} \exp\left(-1/2\ (H/\sigma_z)^2\right)\exp\left(-1/2\ (y/\sigma_y)^2\right)$$

where:

$\chi(x,y,O,H)$ = Concentration in micrograms per cubic meter ($\mu g/m^3$) at the point x,y,O from an elevated source with effective height, H.

Q = emission rate in micrograms per second

σ_y = the standard deviation in the crosswind direction of the plume concentration distribution

σ_z = the standard deviation in the vertical of the plume concentration distribution

$\overline{U}$ = mean wind speed in meters per second

H = effective height of emission (physical stack height + plume rise)

x = distance downwind in the direction of the mean wind

y = crosswind distance

Ground level concentrations computed using the present equation are for averaging times of approximately ten minutes. These ten-minute concentrations can be converted to longer averaging times using the following relationship (Turner, 1970):

$$\chi_s = \chi_k \, (t_k/t_s)^{0.2}$$

where:

χ_s = concentration estimate for longer sampling time

χ_k = calculated ten-minute concentration

t_k = ten minutes

t_s = longer sampling time

Possibly the most difficult term to accurately assess in the above equation is the effective height of release (H) or, more specifically, plume rise (Δh)· Holland's equation (Turner, 1970) was developed for stacks of the size and buoyancy of those to be employed at the mill. While it is generally accepted that the Holland equation tends to under-predict plume rise it was considered as the "best fit" equation but should be somewhat conservative in the predictions. Holland's equation is:

$$\Delta h = \frac{V_s d}{u} \left(1.5 + 2.68 \times 10^{-3} \, p \, \frac{T_s - Ta}{T_s} \, d\right) K$$

where:

Δh = rise of the plume above the stack in meters

V_s = stack exit velocity in meters per second

d = inside stack (top) diameter in meters

u = wind speed at stack height in meters

P = atmospheric pressure in millibars

T_s = stack gas exit temperature in degrees Kelvin

T_a = air temperature in degrees Kelvin

K = constant, assume 0.85 for stable conditions and 1.15 for unstable conditions

The following design and emission data were used in the appropriate stack diffusion models:

DRYER	Stack Height	13.7 m
	Stack Exit Diameter	0.22 m
	Stack Exit Velocity	23.2 mps
	Stack Exit Temperature	366°K
	SO_2 Emission Rate	0.25 gm/sec
	NO_x Emission Rate	0.06 gm/sec
	Particulate Emission Rate	0.05 gm/sec
BOILER	Stack Height	27.4 m
	Stack Exit Diameter	1.22 m
	Stack Exit Velocity	4.6 mps
	Stack Exit Temperature	360°K
	SO_2 Emission Rate	4.0 gm/sec
	NO_x Emission Rate	2.0 gm/sec
	Particulate Emission Rate	1.0 gm/sec

It was found that maximum ground level concentrations from the dryer and boiler stack were obtained with stable conditions and low wind speeds. Therefore, assumptions used in diffusion calculations include use of a stable atmosphere (F stability) and wind speed of 2 meters per second. Maximum off-site ground-level concentrations from the dryer stack emissions occur at a point approximately 800 meters from the stack and maximum concentrations resulting from the boiler occur at a point approximately 2000 meters for the boiler. Therefore, terrain was not considered in these calculations because, within 2000 meters of the proposed mill, terrain fluctuations are slight.

6.1.4 Land

6.1.4.1 Soils

Field and laboratory studies were undertaken to supplement literature in identifying the soil types present and to characterize soil properties important in reclamation.

Soil Survey & Classification

At both the Blanding and Hanksville areas, soils were identified and classified according to range site, and soil taxonomy. In addition, soil slopes were measured and landscape position and parent material identified. At the Hanksville area, a soil survey map was made because prior work had not been done. At Blanding, the existing soil survey was verified. The survey and field descriptions were completed by Mr. Lowell Woodward of Provo, Utah, (retired USDA Soil Conservation Service soil scientist) and a Dames & Moore soil scientist. Field studies were completed during September 1977.

During the survey, soil profiles were located, sampled and described. At least one profile was described for each mapping unit. Samples of each layer were bagged for laboratory testing.

Laboratory Testing

Tests were conducted at Agricultural Consultants, Inc. of Brighton, Colorado, a soil testing laboratory. Soils were analyzed for their potential use in reclamation operations and for boron and selenium levels. Each test is briefly described below with a description of the significance of test results.

Soil Texture - This classification represents the combination of sand, silt, and clay size materials found in the portion of the field sample less than 2.0 mm. The size ranges for each is given below:

sand	2.0 mm - 0.05 mm
silt	0.05 mm - 0.002 mm
clay	<0.002 mm

Materials coarser than sand have the following size groupings:

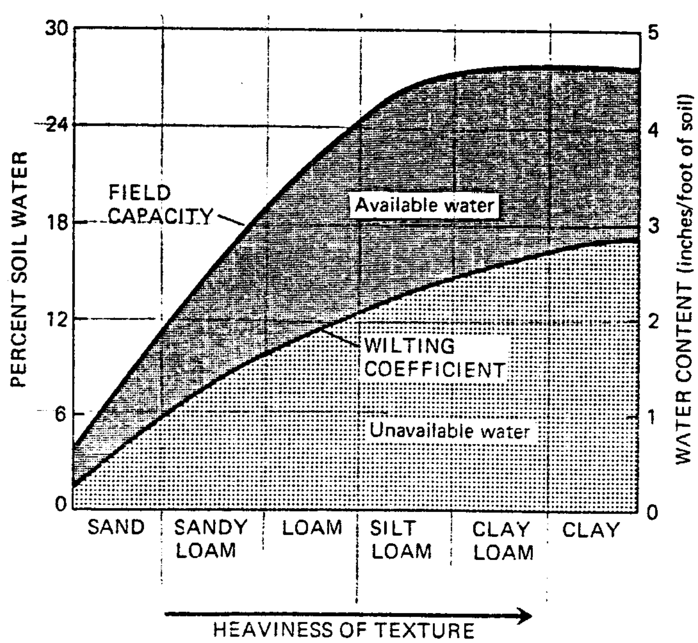
stones	>10"
cobbles	3-10"
gravel	2.0 mm - 3"

Soils with less than 15 percent larger material do not require a modifier on the textural class. Those with 15-35 percent by volume larger materials are named 'gravelly silt loam,' or 'stony clay.' Those with over 35 percent larger materials have 'very' added in front of the textural modifier.

Soils with sandy loam, loam, silt loam, and light clay loam textures are best suited for reclamation uses. Soils with clay loam, sandy clay loam, silty clay loam and clay textures would present tillage difficulties when moved and respread. Packing would occur, and the soil would become hard and cloddy upon drying.

Soils that are the most erosive are the sandy loams and silt loams. They are both highly susceptible to wind and water erosion.

Soil textures ranging through loams, clay loams, and silt loams have good water-holding characteristics. Sandy loam soils have reduced water holding and supplying capabilities. The following graph (after Brady 1974) shows characteristic values for several types of water, and the relationships between soils:



Water-Holding Capacity - 1/3 and 15 Bar: These values together reflect the amount of water that is available to a plant. The difference in the amount of 1/3 Bar (field capacity water) and 15 Bar (wilting point water) gives the amount of water available for plant use. The graph above shows these relationships for various textural classes of soils. Note that sandy loam and sandy soils have considerably reduced water supplying potential.

Saturation Percentage: This value expresses the water content of a soil paste that is saturated. In general, values over 80 may indicate high clay contents or sodium levels. Values less than 25 may indicate coarse textured materials that have low water supplying capabilities.

pH (1:1 and 1:5): This is a measure of the hydrogen ion activity in the soil and expresses the degree of acidity or alkalinity. Soils with pH values below 7.0 are acid, those with pH values at 7.0 are neutral and those with pH values above 7.0 are alkaline. This influences considerably the availability of plant nutrients.

Most commonly, tests for soil pH involve using both 1:1 and 1:5 dilution factors. In the west, the 1:5 factor is the probably the most nearly correct. Generally, the 1:1 dilution factor is from 0.3 to 1.0 pH unit less than the 1:5 factor. Soils high in sodium show a greater gap between 1:1 and 1:5 pH values than those without sodium. The following general rules about 1:5 values reflect soils experience in the west:

pH	>9.0	sodium problems in soils
	8.8-9.0	usable
	<8.8	soil is generally good plant growth material

It is always wise to use both sodium levels and EC_e values to substantiate the dominant soil-salt situation.

Lime (%): Values reflecting the lime content of the soil represent the amount of calcium carbonate ($CaCO_3$) in the soil. Some lime helps to stabilize the soil and aids in forming good soil structure. Where lime exceeds about 10 percent, it becomes detrimental and weakens soil structure. A common field test for lime is to use 0.1N HCL. This detects low levels of free lime. The following relationships show approximate field levels of lime:

Violently effervescent	>2% Lime
Mild effervescent	1-2% Lime
Barely observable	<1% lime

These figures will generally hold true, but specific salt combinations may cause different responses.

Gypsum: Results for gypsum reflect the amount of calcium sulfate ($CaSO_4 \cdot 2H_2O$) in the soil. Gypsum is highly soluble in water and is quickly leached from the profile by moving water. It is commonly applied with irrigation water to alkaline soils to remove excessive sodium from the profile. As a material itself, it is not harmful to plant growth. When soils are used as engineering materials, leaching of gypsum from soil causes severe foundation settling problems.

Electrical Conductivity (ECe): This is a commonly used measure of soil salts. It reflects the fact that the capability of the soil to transmit electrical current depends on the kinds of salts present. The following characterizations show the effects of various salt concentrations as reflected by ECe values (Richards, L.A., 1954).

ECe	Effect
0-2 mmhos/cm	Saline effects mostly negligible
2-4	Yield of very sensitive crops may be restricted
4-8	Yield of many crops restricted
8-16	Only tolerant crops yield satisfactorily
>16	Only a few very tolerant crops yield satisfactorily

A general rule is that soils with ECe values over 3 or 4 have potential salt problems.

Exchangeable Sodium Percentage (ESP): The amount of sodium held on exchange sites is reflected in this value. It is calculated using the following formula:

$$ESP = \frac{Na+}{CEC} \times 100$$

This value cannot be used solely to evaluate soils, as sodium interacts with other ions to cause saline conditions. The following general relationships may be used as guidelines:

ESP	Comments
>12%	Generally sodic condition; will need to be corrected for use in reclamation
5-12	Highly variable - borderline values. Sodium can interact with magnesium in this range to disperse soil. ESP values can sometimes go up to 10-12 without causing high SAR or ECe values.
<5	Soils usually good for use in reclamation.

Sodium Adsorption Ratio (SAR): This test should be used together with ESP to determine salt balances in the soil. It is calculated from the following relationships:

$$SAR = \frac{Na+}{\sqrt{\frac{Ca{+}{+} + Mg{+}{+}}{2}}}$$

The following limits can be used to characterize soils:

SAR	Comments
>13	Soil is classified as natric. Soils will commonly be dispersed or have high ECe values.
10-13	Usually indicates alkaline soils.
<10	Soils are generally well suited for crop growth

Organic Carbon (%): Measures the amount of organic carbon and indirectly the amount of organic matter in the soil. Organic matter can be estimated using the following relationship.

OM% = O.C.% x 1.9

Soils on the arid west commonly contain from 0-1 percent organic carbon. Very dark colored soils in the midwest contain 2-4 percent organic carbon. Soils with organic carbon values from 12-18 percent or greater are considered organic.

Phosphate (P_2O_5): Measures the residual phosphorus in the soil available to plants. For Utah soils (R.E. Lamborne, 1977), the following ratings are given for test results:

Irrigated Cropland:

Level	Response
0-8 ppm	Probable Response
9-10	Variable Response
11 and greater	Very low probability of any response

Dry Rangeland:

On the surface - the above applies in general

For the subsoil - a 2-3 ppm rating would be adequate

Potassium (K^+): Measures the mount of potassium available in the soil for plant growth. Utah soils are generally high in potassium. For irrigated cropland, soils with over 100 ppm potassium are considered adequate.

Nitrate-Nitrogen: This test measures the amount of nitrogen occurring as nitrate that is present in the soil. This is the most readily available form of nitrogen in the soil. Other forms are available only over a longer period of time and after biological decomposition. Nitrate nitrogen is highly soluble, and is quickly leached from the soil. Nitrogen applied in the fall can be gone by spring from leaching.

Nitrogen fertilization is seasonal and should be applied for each crop. For rangeland with a 6-inch rainfall, no response could be expected from fertilization. In an area with 13 inches of rainfall or more, some response could be expected from fertilizer applications of 50 lb per acre.

Carbon Exchange Capacity (CEC): This value represents the sum-total of the exchangeable cations that a soil can absorb. It is closely related to the clay content of a soil. It represents the nutrient supplying capability of a soil. It is, however, rarely used as a measure of soil quality, but more often is used as an indicator of the required frequency of fertilizer applications.

Boron and Selenium - These elements are most commonly toxic in western soils. Following are levels for these elements that can be regarded as general guidelines:

	Low or Deficient	Moderate	Excessive or Toxic
Selenium	0.1 ppm	0.1-1.0	>1.0
Boron	0.5 ppm	0.5-2.0	>3.0

6.1.4.2 Land Use and Demographic Surveys

Published data were used wherever possible. U.S. Bureau of Census estimates were obtained for counties and communities in 1970 and 1975. The 1977 estimates for San Juan County and towns were prepared by the County Clerk, Ms. Clytie Barber.

Mr. Cleal Bradford of the Utah Navajo Development Council and Mr. Bud Nielson of the City of Blanding were consulted regarding population within five- and eight-mile radii of the mill site. Mr. Bradford indicated that three residences were occupied within the area. These included Vowell & Sons Trading Company, a residence at the Blanding airpark, and a house owned by Mr. and Mrs. Clisbee Lyman. Each home was then consulted regarding the number of permanent residents.

County land use statistics were published in Utah Agricultural Statistics, 1977 by the Utah Department of Agriculture. Land use of the project site was determined by direct observation.

6.1.4.3 Ecological Parameters

Vegetation

The plant ecology field program was designed to obtain quantitative and qualitative data on the structure and production of plant communities at the Blanding and Hanksville areas.

Plant communities - At each of the study areas communities were delineated based upon aerial photo-interpretation, site reconnaissance and interpretation of range sites distributions. At the Blanding site determination of range site distributions was done in coordination with Mr. Stan Powell, SCS District Conservationist, and at the Hanksville site in coordination with Mr. Horace Andrews, SCS Area Range Conservationist.

Transects were established in each community in order to obtain percent cover, density and frequency data. Transects were set out in each vegetation community so that they ran through representative portions of the communities and did not straddle more than one type. Five one meter square quadrats were placed every 10m along a 100 m transect. The number of transects per community type varied depending upon the size of the community and homogeneity of the community. Plates 2.8-1 and 2.8-4 shows the locations of sampling sites. Similarity coefficients between communities were computed using Jaccords similarity coefficient (Mueller-Dombosis and Ellenberg, 1976) to confirm sampling homogeneity.

Species densities were determined by counting the number of individual plants per quadrat. Canopy cover of each species was determined by ocularly estimating the surface area covered by the species to the nearest percent. Rock, litter and bareground were also estimated for each quadrat. Mathematical computations for relative frequency, relative density and relative cover were computed using the following equations.

$$\text{Frequency} = \frac{\text{Number of quadrat occurrences of a species}}{\text{Total number of quadrats per community}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species per community}} \times 100$$

$$\text{Density} = \frac{\text{Sum of the individuals of a species in all quadrats per community}}{\text{Total number of quadrats per community}}$$

$$\text{Relative Density} - \frac{\text{Mean number of individuals of a species per meter square per community}}{\text{Total mean number of all species per meter square per community}} \times 100$$

$$\text{\% Cover} = \frac{\text{Sum percent cover of a species in all quadrats per community}}{\text{Total number of quadrats per community}}$$

Plant species were collected on both sites during spring and summer field studies. Species collected were tentatively identified in the field with the aid of floral keys (Harrington, 1964). Specimens were pressed, labeled and returned to the laboratory for drying. Identifications were verified at the Rocky Mountain Herbarium of the University of Wyoming. A species list was compiled following scientific nomenclature of the Rocky Mountain Herbarium. Common names and species' symbols follow that of Nickerson et al. (1976).

Successional status was determined by species composition and percent of climax vegetation present.

Production - At Blanding, the vegetative community sample size of the Pinyon-Juniper community was 25 one meter square samples, in the Big Sagebrush community 40 one meter square samples, in the Tamarisk-Salix community 10 one meter square samples, in the disturbed community 5 one meter square samples, in the reseeded grassland I community 25 one meter square samples in the reseed grassland II community 15 one meter square samples and in the controlled Sagebrush community 25 one meter square samples. At Hanksville in the Snakeweed-Mormon Tea-Shadscale community 10 one meter samples were taken.

Production studies where carried out on the Blanding and Hanksville sites during the 1977 growing season, April through September. Both sites experienced drought conditions during this period. The average precipitation from March 30 to September 30 was 3.51 in at Blanding and 2.17 in at Hanksvile (See Section 2.7 for discussion of climatology of the sites).

Where production was evident, transects were placed in each vegetative community in coordination with community structure studies. Since no grazing occurred on the sites, grazing exclosures were not set up. One meter square plots were placed every 10 m along the transect. The plots were clipped and the wet weight of new growth for each species in the plot determined by weighing with a hand held spring scale. The species sampled were pooled for the entire sample and oven-dried for 24 hours at 112°C. The percent wet weight of a sample was then adjusted to dry weight biomass by computing the percent weight loss change from the combined wet weights of the species and multiplying the resulting percent dry weight by the wet weights taken in the field. This method assumes equal water loss in all samples. Production was then extrapolated to pounds per acre.

With Big Sagebrush production samples, a percent of the current production was taken, weighed and the resulting weight multiplied to yield the production for the entire plant. The procedures described above were then employed.

Wildlife

Amphibians and reptiles were observed and recorded opportunistically during other scheduled activities of this study. A list of species possibly occurring in the vicinity of the project areas (Appendix D) was made based upon range distribution maps in Stebbins (1966).

In 1977 birds were censused seasonally (February, May, late June, and October) by: 1) a roadside count, where all birds sighted within a 1/4 mi radius circle at observation stops 0.5 mi (0.8 km) apart along the transect route were tallied by species; and 2) a walked transect count, where all bird sightings were tallied by species and the lateral distance form the transect line to the sighted individual noted. Surveys were conducted on two transects of each method on two consecutive days in each season at each site. The roadside count (see Howell, 1951) is an efficient means of sampling for an overview of bird composition and abundance. The walked transect counts followed a method developed by Emlen (1971) with the exception of not recording audibles. This method is useful for estimating densities in selected habitats where vegetation or other features may bias observations. Locations of transects are indicated on Plates 2.8-1 and 2.8-4. A list of species possibly occurring in the vicinity of the project areas (Appendix D) was made, based upon the sources cited at the end of Appendix D. An inventory of all birds sighted at each site indicating their status (whether summer resident, winter visitant, transient or year-round resident) was made based on Behle and Perry (1975).

Determination of big game use of the project areas was based on sign and information supplied by Messrs. Larry Wilson and Larry Dalton of the Utah Division of Wildlife Resources. Livestock information was obtained from the U.S. Bureau of Land Management. Mammalian predator presence was determined by sign (scat, tracks, burrows, etc.) and opportunistic observations.

Rabbits and hares were counted by driving on two consecutive evenings each season along two roadside rabbit transects at each site. All seasonal counts were summed and reported on a per mile driven basis. The locations of the transects are indicated on Plates 2.8-3 and 2.8-6.

Small mammal community dynamics, including abundance, diversity and distribution by habitat were evaluated from three trap grids and two assessment trap lines at the Blanding site and six assessment trap lines at the Hanksville site. The trapping grid design described by Jorgenson, Smith and Scott (1975, in press) was used. The grid consists of 12 trapping stations per line at 49 ft (15 m) intervals with 12 parallel trapping lines spaced 15 meters apart, covering an effective trapping area of 8.1 ac (3.2 ha). One live trap (large, folding Sherman was placed at each trapping point and checked each morning and night for a minimum of three consecutive nights in the summer (August) and fall (October). Each individual captured was ear-tagged for identification and released where captured. Data recorded for each animal included species identification, sex and age class. A minimum estimate of density and biomass was determined for each important species. Relative abundance was determined but the numbers of individuals trapped of all species were too small to make meaningful population estimates using the Lincoln Index (Smith, 1974).

Assessment trapping was performed in important minor habitats at the Blanding site and at the Hanksville buying station vicinity to note the relative abundance, diversity, distribution and habitat of species in these areas. Trap lines, set in two parallel rows 30 m apart and consisting of 20 to 26 small mammal traps spaced at 15-meter intervals, were operated for one day and night. Tagging data, recording and analysis procedures were the same as for trapping grids.

6.1.5 Radiological Survey

Environmental radiation survey programs are currently being conducted at both the Blanding and Hanksville sites to determine the radiation levels and their variations along the potential pathways to biota and man. These programs were begun in April 1977 and will continue until June 1978. Baseline data collected for the full program will be presented in the Supplemental Report.

The programs, the parameters of which are summarized in Tables 6.1-3 and 6.1-4, include measurements of radionuclide concentrations in air, ground water, surface water, soil, vegetation and terrestrial mammals. Tables 6.1-3 and 6.1-4 include a description of the sampling site, sampling schedules (duration, frequency, etc.), and analyses performed on each sample. The specific sampling locations are indicated in Plates 2.7-10 and 2.9-1. The laboratory analyses are being performed

TABLE 6.1-3

PRE-OPERATIONAL MONITORING PROGRAM - HANKSVILLE SITE

Air		
1. Downwind of near the site the site boundary nearest to ore piles	Particulates Low-Volume Sample continuously for a seven-day period on a quarterly basis	gross alpha, gross beta, Unat, Th-230, Ra-226, Pb-210
	Radon Field measurements on a quarterly basis	Radon-222
2. Upwind in the prevalent wind direction	High-Volume Sample continuously for a 24-hour period on a monthly basis	gross alpha, gross beta, Unat, Th-230, R-226, Pb-210
Water		
	Quarterly composite samples (as possible)	Unat, Th-230, Ra-226, Pb-210
Soil		
1. At two locations in the general site environs	Semi-Annual composite samples	Unat, Th-230, Ra-226, Pb-210
Vegetation		
1. At two locations in the general site environs	Semi-Annual composite samples	Unat, Th-230, Ra-226, Pb-210
Terrestrial Mammals		
1. At two locations in the general environs of the site.	Semi-Annual composite samples (as possible)	Unat, Th-230, Ra-226, Pb-210
Direct Radiation		
1. At two locations upwind of the prevalent wind direction	TLD measurement read on a monthly basis	Terrestrial and Cosmic Radiation
2. At two locations in the general site environs	TLD measurement read on a quarterly basis	

TABLE 6.1-4

PRE-OPERATIONAL MONITORING PROGRAM - BLANDING SITE

Air		
	Particulates	
1. Downwind of potential mill building and ore storage area at area of maximum potential deposition airborne particulates	Low-Volume Sample continuously for a seven-day period on a quarterly basis	gross alpha, gross beta, Unat, Th-230, Ra-226, Pb-210
2. Downwind, near the site boundary nearest to mill, ore piles and tailing retention area.	Radon Field measurements on a quarterly basis	Radon-222
3. Downwind, near the site boundary in the direction of the nearest residence.	High-Volume Sample continuously for a 24-hour period on a monthly basis	gross alpha, gross beta, Unat, Th-230, Ra-226, Pb-210
Water		
	Quarterly composite samples (as possible)	Unat, Th-230, Ra-226, Pb-210
Soil		
1. Samples collected at locations adjacent to low-volume air sampling units.	Quarterly composite samples	Unat, Th-230, Ra-226, Pb-210
2. At least one location in the general site environs.	Semi-Annual composite samples	
Vegetation		
1. At each of the low-volume air sampling stations 2. At two locations in the general site environs.	Semi-Annual composite samples	Unat, Th-230, Ra-226, Pb-210
Terrestrial Mammals		
1. At two locations in the general environs of the site.	Quarterly composite samples (as possible)	Unat, Th-230, Ra-226, Pb-210
Direct Radiation		
1. At each low-volume air sampling station (3 TLDs per station).	TLD measurement read on a monthly basis	Terrestrial and Cosmic Radiation
2. At two locations in the general site environs (3 TLDs per station).	TLD measurement read on a quarterly basis	

by LFE, Environmental Analyses Laboratories Division, Richmond, California, and CDM/Accu-Labs, Wheat Ridge, Colorado.

6.1.5.1 Direct Environmental Radiation

Thermoluminescent Dosimeters (TLDs) were placed in triplicate at each low-volume are sampling station, in the areas adjacent to the high-volume air samplers and along Route 95 between Hanksville and Blanding, (Table 6.1-5), to obtain environmental gamma radiation measurements. The TLDs at the air sampling stations stations are read on a monthly basis while the TLDs along the road are read on a quarterly basis.

TABLE 6.1-5

PRE-OPERATIONAL MONITORING PROGRAM - HIGHWAY CORRIDOR

Direct Radiation

1. At five locations between between Blanding and Hanksville	TLD measurement, read on a quarterly basis	Terrestrial and Cosmic Radiation

The dosimeters used are Harshaw, Model 2040 TLDs, consisting of a dysprosium activated calcium fluoride (CaF_2Dy) bulb type dosimeter (Model 2038) enclosed in an energy compensating shield (Model 2039) designed to minimize a characteristics over-response to low energy gamma rays. The marked fading or loss of response with time is corrected for by an empirically derived relationship. The correction factor used is the measured fading over a two-week period, based on unpublished results (Verbal Communication, Jon Olafson, Dames & Moore Radiologist, July 27, 1976) and is valid for integration periods up to 90 days. Basic dosimeters calibration is performed by exposure to a certified radium-226 source, with secondary calibration on a day-to-day basis by way of an internal light source in the reader. The reader used is a Harshaw 200P reader-integrator system, consisting of a Model 2000P reader and a Model 2000B integrating picoameter.

6.1.5.2 Radionuclides in Soils

Soil samples are being collected at locations adjacent to the low-volume air sampling at both the Hanksville and Blanding locations where the potential deposition of particulates would be a maximum and in the general site environs. The weight of each sample is approximately 1.0 kg (2.2 lbs) and is composited from the top 7.6 cm (3 inches) of soil in an area of approximately 1.0 square meter (9 square feet). Samples are dried and analyzed by gamma spectroscopy and appropriate radiochemical techniques with sensitvities of 0.5 pCi/g.

6.1.5.3 Radionuclides in Water

See Sections 6.1.1 and 6.1.2 for water sampling locations and radionuclide analyses being performed.

6.1.5.4 Biological Radioactivity

Terrestrial Vegetation

Samples of native vegetation, grasses, shrubs and herbaceous species are being collected at the same locations as the soil samples. Samples of 1 Kg (2.2 lbs) wet weight are collected, ashed and analyzed by gamma spectroscopy and appropriate radiochemical techniques with sensitivities of 0.2 pCi/g.

Terrestrial Mammals

Small mammals are being collected in the environs adjacent to the project site and Hanksville buying station wherever possible. Samples are analyzed for specific radionuclides by gamma spectroscopy and radiochemical techniques with sensitivities of 0.2 pCi/g.

6.1.5.5 Airborne Particulates

The locations for sampling airborne particulates were determined primarily from the calculations of the areas of highest potential deposition and activity resulting from effluent release from the facility (mill, tailing area, and ore piles) during operation and site reconnaissance. The locations encompass those indicated in NRC Regulatory Guide 4.14.

Low-volume regulated flow air samplers (Eberline RAS-1) are being run continuously for a seven-day period on a quarterly basis at each designated location to collect airborne particulates. Sampling is performed at one meter above ground to sample the breathing air zone. The sampling rate is 50 liters per minute, providing a 504-cubic-meter sample in 168 hours. The samplers are fitted with a Gelman type AE glass fiber filters having an efficiency greater than 99 percent for 0.3 micron diameter particles. Filters are changed at the end of the sample period for each location and are sent to CDM/Accu-Lab Laboratories for analysis. Discrete high sensitivity radiochemical analyses of uranium, radium, thorium and lead are being performed that provide sensitivities of 2.5 pCi/filter or better.

Any variability in particulate activity as a function of temporal or seasonal climatic changes will be determined by repeating the measurements at predetermined intervals during the program.

High volume regulated flow air samples are being run at each site for a twenty-four hour period per month. The samplers, General Metal Works Model 2000-H, consist of a vacuum pump and a filter head assembly. The samplers are enclosed in a protective metal housing and are mounted on cinder blocks to give an effective sampling period. The actual flow rate (in cubic feet per minute) is calculated from the recorded flow rate by adjusting for pressure differences due to altitude. A General Metal Works standard calibration curve is used for reference.

6.1.5.6 Radon Concentrations in Air

The initial radon-222 concentration measurements were obtained by using the "single-filter" method. In this method, airborne particulates were impinged on a filter by using a high-volume air sampler which was run for 10 minutes. Rn-222 concentrations were determined from the field measurement of radon-222 daughters Po-218, Pb-214 and Bi-214. The calculation of radon-222 concentration from the daughter concentrations was based on the assumption that radon-222 is in secular equilibrium with its daughters. In this case the radon-222 concentration is assumed to be twice the highest measured daughter concentration.

Subsequent ambient radon concentations are being determined by on-site low-volume air sampling utilizating a low-volume air pump (Eberline RAP-1) to collect an air sample. The sample is pulled through a Gelman type AE filter to remove particulates and a dessicant for moisture removal. The filtered air is collected in a scintillation chamber (Eberline SC-6; 1.4 liters) and counted by a scintillation photomultiplier system (Eberline SAC-R5 and scaler). A sensitivity of 0.1 pCi/liter or better is attainable.

Any variability in radon concentrations as a function of temporal or seasonal climatic changes will be determined by repeating the measurements at predetermined intervals during the program.

6.2 PROPOSED OPERATIONAL MONITORING PROGRAMS

6.2.1 Radiological Monitoring

6.2.1.1 Effluent Monitoring Program

The program to periodically monitor the airborne effluents from various release points within the proposed mill and at the site boundary, and leakage of liquid effluents (if any) from the tailing area is defined in Table 6.2-1. This program conforms to the requirements of the proposed NRC Regulatory Guide 4.14, "Measuring, Evaluating, and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Airborne Effluents From Uranium Mills." A direct comparison with the background levels of the analyzed radionuclides will be possible because the preoperational sampling program encompasses the same locations and utilizes the same instrumentation and collection procedures.

6.2.1.2 Environmental Radiological Surveillance Program

An environmental surveillance program, will also be performed on a regular basis in the unrestricted area around the site of the proposed mill and tailing area. This program is described in Table 6.2-2.

TABLE 6.2-1

EFFLUENT MONITORING PROGRAM

Monitoring/Sampling Location	Sampling Frequency	Type of Sample	Radionuclide to be Analyzed
A. Airborne Effluents			
1. Each stack in the mill except for yellow cake drier and packaging stack	Semi-annually	Sufficient duration to determine release rates and concentration	Unat
2. Yellow cake drier and packaging stack.	Semi-annually	Sufficient duration to determine release rates and concentration	Unat, Th-230, Ra-226
3. At three locations on the site boundary typically a) nearest to effluent release sources (combined) b) in direction of nearest residence c) at point of estimated maximum concentrations	Continuously collected with weekly change of filters		Unat, Th-230, Ra,226, Pb-210
Radon			
4. At same locations as in 3.	Continuously collected for one week per month-several samples/week analyzed (sampling time $\leq$ 48 hours)		Radon-222
B. Liquid Effluents			
2. Wells (3 or more) located hydrologically downslope from tailing cells	Quarterly	Grab	Unat, Th-230, Ra-226, (soluble and insoluble)

TABLE 6.2-2

ENVIRONMENTAL SURVEILLANCE PROGRAM

Sample Type & Location	Sampling Schedule	Radionuclide Analysis
Air		
At essentially the same locations as sampled during the preoperational monitoring program (not duplicating locations designated in Table 6.2-1).	Quarterly	Unat, gross alpha and beta, Radon-222
Soil		
At same locations as during preoperational monitoring program.	Quarterly during first year annually in succeeding years	Unat, Th-230, Ra-226, Pb-210
Vegetation		
At same locations as during preoperational monitoring program.	Annually	Unat, Th-230, Ra-226, Pb-210
Terrestrial Animals		
In same locations as vegetation samples	Annually	Unat, Th-230, Ra-226, Pb-210

In addition, periodic measurements will be made in the vicinity of the Hanksville buying station.

6.2.2 Chemical Effluent

6.2.2.1 Ground Water

The operational ground water monitoring program will be fully described in the Supplemental Report. Additional information on ground water levels and flow directions, which may influence the final design of an operational monitoring program, will be obtained in early 1978 during the site-specific ground water investigations at which time the preoperational monitoring program will be completed. The operational program will monitor both quality and levels of ground water, as described in Section 6.1.2.

6.2.2.2 Surface Water

Monitoring of surface water quality will continue throughout the life of the project. Location and frequency of sampling will be as described in Section 6.1.1.

6.2.3 Meteorological Monitoring

The preoperational scope of meteorological monitoring as described in section 6.1.3.1 will continue during the operation phase of the project. Monitoring needs and requirements will periodically be reviwed and monitoring scope alterations will be made as necessary.

6.2.4 Ecological Monitoring

Aerial photography, using appropriate false-color infrared or color processes, will be used to monitor, record, and map vegetation and wildlife habitats, vegetation removal and recovery, and vegetation health. Photography will be scheduled and coordinated with project activities and with natural biotic events (e.g., maximum spring bloom) to enhance the usefulness of the monitoring efforts. This will provide a record of construction and milling activities and will document the effects, if any, of the proposed project on the project site and environs. Aerial photography will also be useful for documentation of natural environmental stresses such as drought which may encroach on the project site.

Additional terrestrial monitoring will consist of managing the reclamation and restoration of affected areas as discussed in Section 9.0.

7.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS

7.1 MILL ACCIDENTS

A spectrum of potential mill accidents ranging from trivial to serious has been established by classes of occurrence and each class of accident evaluated (Table 7.1-1). Emergency plans for coping with the accidents are also described.

TABLE 7.1-1

SPECTRUM OF POTENTIAL MILL ACCIDENTS

Type of Accident	Severity	Probability
Failure of tailing retention system	4	3
Tank or pipe leakage	1	1
Tank or pipe breakage major	3	3
Electrical power failure	1	1
Process equipment malfunction	1	1
Operator error	1	1
Tornado	3	3
Fire, minor	1	2
Fire, major	3	3
Transportation accident	3	3
Earthquake, intensity 5 or greater	4	3

The severity of accidents is based on their potential impact on the environment and is not a measure of dollar loss or employee injury. The categories in Table 7.1-1 are:

1 = Trivial - No impact. Necessary repairs made.

2 = Insignificant - No impact. Corrective action taken.

3 = Significant - Slight impact. Corrective action taken.

4 = Serious - Corrective action necessary. Minor local impact.

5 = Very serious - Corrective action necessary. Major local and/or regional impact.

The probability categories in Table 7-1 are defined as follows:

1 = Probable - expected to occur during operating life of the plant.

2 = Improbable - possibly one or two of these events can be expected to occur during the life of the plant.

3 = Highly Improbable - not expected to occur during the life of the project.

7.1.1 Failure of Tailing Retention and Transport Systems

Four events that could cause release of tailing water and solids outside of the proposed tailing impoundment area are discussed below. The volume of loss from the system and the area covered could vary considerably depending upon cause or causes of failure, the size of the system's failure, the volume of water available for erosion and transport of the tailing, and the density of the tailing and its general resistance to erosion and flow. If tailing escapes to the environment, by whatever means, water will tend to transport the tailing downslope toward Cottonwood Wash, then to the San Juan River and the closest downslope population, at Bluff, Utah some 20 miles away. The movement of tailing would probably require many years, since tailing is essentially sand size particles and is not easily transported except by rapidly flowing water which is rarely present near tailing embankments. No physical damage would occur because of an embankment failure, even if it were instantaneous, because the maximum depth of water in the cells would be about 2 feet (stored water plus the probable maximum precipitation). This water would not discharge rapidly because of its shallow depth. Each of the possible failure events is discussed below:

7.1.1.1 Flood Water Breaching of Retention System

In general, flood water breaching of tailing embankments presents one of the greatest dangers for the sudden release of tailing and impounded water. For this project, however, because of the design of the tailing retention system and drainage basin involved, this danger is eliminated. Within the tailing cells themselves, both during operation and after reclamation, sufficient volume will be available to store any flood which would occur, including the probable maximum flood. The drainage basin upstream of the tailing retention facility does not contribute water to the impounded area. Flood waters which flow towards the tailing dikes will be stored upstream of the upstream dike where flood waters will be evaporated over a period of time (see Section 9.5.1 and Appendix H).

The possibility of floods in Westwater Creek, Corral Creek or Cottonwood Wash causing damage to the tailing dam is extremely remote. This is due to the aproximately 200-foot elevational difference between the streambeds of the creeks and the toe of the tailing dikes.

7.1.1.2 Overflow of Tailing Slurry

The retention system could overflow causing the discharge of tailing materials to the surrounding hydrologic environment only if the tailing system were operated unattended for several months. The tailing in the first cell will rise a total of 32 feet in 5 years of maximum production. This converts to a rate of 6.4 feet per year. A minimum of 5 feet of freeboard will be maintained at the top of the tailing. In order to produce an overflow of tailing slurry, the tailing level would have to rise to the maximum level; this would have to be followed by more than 9 months of unattended operation at maximum production rate. During regular operation, the retention system operator will make frequent and regular inspections of the cell and tailing level to insure safe operation.

7.1.1.3 Structural Failure of Tailing Dikes

Failure of the tailing dikes which would produce a potential release of waste from the tailing area is possible by three basic modes: (1) spontaneous slope failure due to internal pore water pressures, (2) failure due to earthquake, (3) failure due to flood water breaching. Such failures are considered extremely unlikely for the following reasons:

(1) The stabilities of both upstream and downstream slopes at various cross-sections have been checked. The minimum factor of safety encountered was 2.21. Because the tailing cells will be lined, no seepage is expected through the embankments. Because the project is in an arid region, the only water available for producing pore water pressures will be direct precipitation. This water is expected to penetrate 12 inches or less into the surface of the tailing dikes, thereby presenting very little possibility for pore pressures.

(2) The site is in a low seismic risk area. Potential earthquakes are defined as minor and would not be sufficiently severe to cause failure of the system. A stability analysis has been done on the embankments using a static analysis with the 0.1 g horizontal loading. The minimum factor of safety encountered in this analysis was 1.65. This very conservative analysis has produced a very high factor of safety compared to typical water retention dams.

(3) Failure of the embankments due to overtopping by flood waters is extremely remote, as discussed in Section 7.1.1.1 above.

7.1.1.4 Seismic Damage to Transport System

The rupture of the tailing retention slurry pipeline would result in a minor impact on the environment. The tailing retention system pipe, as planned, will be in the same drainage basin as the retention system. Any tailing slurry released by a pipe rupture, no matter what the cause, would flow downhill where it would be impounded against the tailing dike. This would prevent any spillage or escape of the tailing slurry (see Appendix H).

7.1.2 Minor Pipe or Tank Leakage

Minor leaks resulting from loose connections in piping or tanks overflowing, etc., will be collected in sumps designed for this type of spill. Sump pumps will be used to return the material to the circuit and the reason for the spill determined and corrected. No environmental impact would result from this type of occurrence.

7.1.3 Major Pipe or Tank Breakage

All of the mill drainage including chemical storage tanks will flow into a large catchment basin upstream from the tailing impoundment site.

If a tank collapses and results in the escape of a large quantity of liquids, chemicals or slurry, they would be collected in the catchment basin upstream from the tailing retention system. Liquids from such a spill would be pumped back to the mill or to the tailing cell. Chemicals would be recovered for the mill if suitable, or transferred to the tailing cell or even neutralized in the catchment basin. Residue from a slurry loss would be cleaned up and contaminated soil would be removed and disposed of in the tailing retention system.

7.1.4 Electrical Power Failure

Temporary loss of electrical power to various sections within the mill or throughout the entire mill would cause no more than a tank or vessel to overflow temporarily. No impact would result from such an occurrence. Emergency lights will be situated in various parts of the mill that will activate during power failure enabling personnel to take appropriate action.

Electrical or mechanical failure to the yellow cake scrubber fan could temporarily cause more than normal amounts of yellow cake to be discharged to atmsophere. Such an occurrence would be noticed very quickly, as the temperature on the yellow cake dryer would elevate quickly. An audible signal would activate as a result of the increase in temperature and the dryer would be shut down.

7.1.5 Process Equipment Malfunction and/or Operator Error

Process equipment malfunction and operator error could result in several different types of accidents. However, none of these would result in any environmental impact, with the exception of the tailing line breakage, yellow cake scrubber failure and yellow cake dryer explosions which are described elsewhere.

7.1.6 Tornado

The most significant environmental impact from a tornado would be transport of tailing from cells or liquids from mill process tanks into the environment. This dispersed material would contain some uranium, radium and thorium. An increase in background radiation could result and, if sufficient quantities could be detected and isolated, they would be cleaned up.

7.1.7 Minor Fire

Small fires that might result from welding in the maintenance shop or involving small amounts of combustible material could occur but would be unlikely because of industrial safety precautions. Such a fire would be extinguished rapidly and no impact expected.

7.1.8 Major Fire

The most likely place a major fire would occur would be in the solvent extraction building or in the yellow cake or vanadium roasters.

If the solvent in the solvent extraction circuit should catch on fire or an explosion of the yellow cake dryer should occur, the radiological environmental effects would be confined within an estimated few hundred feet of the building. Recovery of the uranium scattered by the explosion or burning solvent would be cleaned up by removing the topsoil and processing it in the mill.

The possibility of a fire as a result of an explosion in the yellow cake dryer is remote as Industrial Safety Codes will be strictly enforced during construction and operation. The possibility of a major fire in the solvent extraction buildings is remote, as very strict safety precautions will be adhered to. Furthermore, this part of the process will be kept isolated and in separate buildings due to the large quantities of kerosene present. These facilities will be equipped with an independent fire detection and protection system.

In spite of the safety precautions, if a major fire were to occur, the radiological environmental effects would be confined within a few hundred feet of the buildings. Recovery of uranium that would be scattered by the burning solvent would be performed and a survey of the site would be required. Uranium bearing soil would be processed in the mill circuit.

In the past several years, two solvent extraction fires have occurred at other uranium mills. Neither fire resulted in appreciable release of uranium to the unrestricted environmental and essentially complete recovery of the uranium was obtained. Consequently, the impact from such an event at the proposed mill would be limited to (1) cleanup of contaminated solid, (2) replacement of destroyed mill components, and (3) a short duration release of nonradioactive combustion products to the atmosphere.

7.2 TRANSPORTATION ACCIDENTS

Concentrates will be shipped in sealed 55-gallon drums built to withstand normal handling and minor accidents. Each drum will contain approximately 900 pounds of yellow cake. A maximum of 60 drums will be shipped in each closed van. The drums will be sealed and marked "Radioactive LSA" (low specific activity), and the trucks will be properly marked. Because most of the radioactive daughter products of uranium are removed in the extraction process and radioactive buildup of daughter products is slow, yellow cake has a very low level of radioactivity and is, therefore, classified by the Department of Transportation as a low specific material.

The environmental impact of a transportation accident involving release of the product would be minimal. Even in a severe accident, drums would likely be breached and, since yellow cake has a high density, it would not easily disperse. More than likely, the drums and any released material would remain within the damaged vehicle or in an area of close proximity of the accident site.

Even if the yellow cake were to spill out of the vehicle, it could be detected easily by sight and by the use of survey equipment. Thus, the yellow cake could be reclaimed to prevent any significant environmental impact. At most, the cleanup operation would involve removing small amounts of pavement, topsoil and vegetation in the immediate area of the accident.

Proper and safe shipment guidelines for radioactive materials will be the responsbility of the Radiation Safety Officer, with actual shipment being the Shipping Department's responsibility.

Driver or carrier instructions will be given to each driver of each transport leaving the plant site with a load of yellow cake. These instructions will consist of an explanation of the product, preliminary precautions at the accident site, whom to notify and what to do in case of fire. A copy of these instructions is included in the Application for Source Material License.

7.2.1 Special Training for Yellow Cake Transport Accidents

Energy Fuels will select and train capable personnel to prepare for any eventuality of this nature. A team will be supervised by the radiation safety officer or plant superintendent, or his appointee. This team will have good background knowledge in radiation safety as is required. Further training in containment, recovery, decontamination, and the equipment needed to control such a spill will be given on a semi-annual basis.

In the event of a spill of any magnitude, the team will have been adequately trained and provided with the equipment to contain and decontaminate any accident site. The training and the equipment required to accomplish this task are, for the most part, listed below. Responsibility assignment will be directed by the supervisor of the team.

7.2.2 Spill Countermeasures

Proper authorities will be notified. The Region IV Director, Office of Investigation and Enforcement, U.S. Nuclear Regulatory Commission, Arlington, Texas; State Public Health Department; and the Department of Environmental Quality, or equivalent, in the state wherein the accident occurred will be immediately notified by the Applicant. Training of personnel as set forth by the National Fire Protection Association, Publication SPP-4A, "Handling Radiation Emergencies," 1977, will be utilized as applicable.

Immediate containment of the product will be achieved by covering the spill area with plastic sheeting or equivalent material to prevent wind and water erosion. If sheeting is not available, soil from the surrounding area will be used. Embankment ditching would be used to contain any runoff caused by precipitation.

All human and vehicular traffic through the spill area will be restricted. The area would be cordoned off if possible. All non-participants will be restricted to 50 feet from the accident site. Law enforcement officers may be asked to assist in this activity.

Covered containers and removal equipment--i.e., large plastic sheeting, radioactive signs, ropes, hoses, shovels, axes, stakes, heavy equipment (front-end loaders, graders, etc.), will be procured to clean up the yellow cake, as required.

If possible, during removal activities, a wetting agent will be applied in a fine spray to assist in dust abatement. Plain water will be used if a wetting agent is not available, but has a tendency to cause dusting if not applied in a very fine mist.

Gloves, protective clothing, and any personal clothing contaminated during cleanup operations will be encased in plastic bags and returned to the plant for decontamination.

Any fire at the site will be controlled by local experienced fire fighting personnel wearing appropriate respiratory protective equipment.

Team members will have a thorough knowledge in basic first aid and of the physical hazards in inhalation, ingestion, or absorption of radionuclides. Team members will adequately protect themselves.

7.2.3 Emergency Actions

Emergency procedures will be established by the Radiation Safety Officer for accidents that could occur.

Personnel safety, environmental conditions and prompt corrective actions will be taken as well as notification of regulatory official, as is required.

7.3 QUALITY ASSURANCE

Energy Fuels intends to maintain quality in design, construction and operation of the mill. A qualified engineering and construction company will be contracted to design and construct the plant. Energy Fuels will review design and construction plans and performance continually by qualified personnel, in order to insure that quality assurance is obtained at all times. The mill manager or his assigned representative will inspect all equipment prior to acceptance.

Operational quality assurance will be the responsibility of the mill manager. Operational control methods will be established and approved by the mill manager and radiation safety officer. Continual monitoring of the operations will be conducted by qualified staff and supervisors. Operational reports from each unit operation, including tailing retention, will be submitted to the mill manager on a daily basis. These reports will be submitted by the various operators and the responsibility of the shift foreman. These reports will be reviewed daily by the mill foreman, mill metallurgist and mill manager.

Regular Inspections will be made continually by the shift foreman who will notify either the mill foreman or mill manager immediately upon discovery of any unusual condition.

An inventory of in-process uranium, as well as finished product and uranium in ore at the site, will be performed on a monthly basis. A metallurgical balance of processed uranium will also be performed on a monthly basis.

8.0 ECONOMIC AND SOCIAL EFFECTS OF MILL CONSTRUCTION AND OPERATION

This section is a summary of impacts described in detail in Sections 4.1.3 and 5.5.2.

8.1 BENEFITS

The major benefit of the proposed project would be the production of 1.6 million pounds of uranium oxide annually for 15 years, representing a total of 25 million pounds. Output of the Energy Fuels mill would substantially increase the national supply of uranium oxide for energy development.

Construction and operation of the proposed mill would provide up to 250 short-term and 80 long-term jobs in the Blanding area. The economic base of southeastern Utah is heavily dependent on tourism and agriculture, which are seasonal in nature and subject to wide fluctuations in activity. Mill operation would contribute to economic stability by providing yeur-round employment for 15 years. Every effort would be made to hire local residents, which would mitigate adverse impacts associated with a large population influx. Wage and salary payments would have a stimulating effect on the local and regional economies. Similarly, the procurement of supplies and equipment for construction and operation of the mill would have positive impacts on the regional, state and national economies.

Tax revenue would benefit federal, state, county and municipal governments as a direct and indirect result of the proposed project. Corporate income tax payments would be substantial and, together with personal income taxes of the project work force, would benefit the federal and state governments. Property taxes assessed against the mill would benefit San Juan County, the San Juan School District, and various political subdivisions. In addition, sales tax revenue would accrue to the state and county as a result of personal consumption expenditures of the project work force and the local procurement of supplies and equipment for mill construction and operation.

Table 8.1-1 summarizes the quantifiable benefits discussed above.

8.2 COSTS

Internal costs would total $38 million during the construction phase and $10.5 million each year of operation.

External costs would be borne by the state, county and municipal governments. The State of Utah and San Juan, Wayne, and Garfield Counties would experience increased road maintenance costs due to heavy truck traffic during construction and operation. Other governmental costs would stem from the need to accommodate an increase in population. San Juan County would be faced with higher expenditures for public services, particularly recreation, health and public safety. The San Juan County School District would pay higher operating costs. The primary impact communities of Blanding, Bluff and Monticello would be faced with increased capital improvement expenditures and higher annual operating costs for services which are particularly sensitive to the number of residents. The external costs of accommodating the project-induced population increment are discussed with regard to the long-term operation phase only. The construction phase would last one year, and most of the imported workers would be in the Blanding area for several months or less. Thus, local government costs would be minimal and temporary. Probable, quantifiable governmental expenditures necessitated by construction and operation of the mill are summarized in Table 8.2-1.

Non-quantifiable costs would include adverse impacts on the quality of life and the disruption of community cohesion and stability potentially resulting from a rapid influx of up to 150 construction workers. This would represent a temporary impact; construction workers would be replaced by a smaller operating work crew in February 1980. The operating employees would be permanent residents of the area. Because every effort would be made to hire as many local residents as possible,

TABLE 8.1-1

QUANTIFIABLE BENEFITS[a]
(1977 Dollars)

	Construction Phase (Total)	Operation Phase (Annual)
Internal Benefit		
Gross revenue from U_3O_8 production		67,184,000
External Benefits		
Wage and salary payments	7,000,000	1,365,000
Personal income taxes	1,344,000	188,400
Personal consumption expenditures	2,492,000	522,800
State sales tax revenue (4.5%)	112,100	23,500
County sales tax revenue (0.5%)	12,500	2,600
Procurement of supplies and equipment	18,000,000	
Southeastern Utah	1,800,000	
Other areas in Utah	9,000,000	
Other states	7,200,000	
Sales tax revenue in Utah (5%)	540,000	
Property taxes against the mill		456,000

[a]Blank spaces indicate no applicable data

TABLE 8.2-1

QUANTIFIABLE COSTS ASSOCIATED WITH THE PROPOSED PROJECT[a]
(1977 Dollars)

	Construction Phase (Total)	Operation Phase (Annual)
Internal Costs		
Mill Construction	38,000,000	
Mill Operation		10,500,000
Local Property Tax Payments		456,000
Reclamation Costs		
External Costs		
San Juan County		
Increased Health, Recreation and Public Safety Expendituresexpenditures		1,400-2,100
San Juan School District		
Increased Operating Expenditures		30,090
Primary Impact Communities: Blanding, Monticello and Bluff		
Capital Improvement Expenditures	70,000	
Increased Operating Expenditures		1,400-2,100

[a]Blank spaces indicate no applicable data

population growth directly resulting from mill operation is not expected to constitute a major adverse impact on local communities.

Adverse impacts on regional highway systems would stem from the transportation of uranium ore from mines throughout southeastern Utah to Energy Fuels buying stations at Hanksville and Blanding and from the Hanksville buying station to the mill. Ore movement would require a substantial increase in truck traffic, with potential ramifications on recreational enjoyment and highway safety in Glen Canyon National Recreation Area, Manti-La Sal National Forest, Canyonlands National Park, and other areas in southeastern Utah.

9.0 RECLAMATION AND RESTORATION

9.1 EXISTING AND PROPOSED LAND USE AND ECOSYSTEM EVALUATION

9.1.1 Project Site

The on-site ecosystem was originally a semi-desert Big Sagebrush shrubland and Pinyon-Juniper woodland. The dominant Big Sagebrush vegetation has been cleared in many places and reseeded with grasses, primarily Crested Wheatgrass, in an attempt to improve the rangeland for livestock grazing. Some small areas were plowed prior to being reseeded. The majority of the area has been grazed by livestock, some very heavily.

Soils on the project site are relatively uniform and are adequate for reclamation. In these soils, about 1 foot of the surface material is leached and contains some organic matter and roots. Soil materials down to a depth of 5-6 feet are all generally adequate for use in reclamation.

Revegetation of affected areas will be for the purpose of returning it to livestock range and wildlife habitat through establishment of a mixture of grasses, forbs and shrubs.

9.1.2 Hanksville Buying Station

The surrounding ecosystem consists of a desert shrubland on low-lying alluvial fans that are heavily gullied on some areas but have a basic 2 to 4 percent slope. The predominant vegetation consists of Shadscale Saltbrush, Snakeweed and Mormon Tea. The vicinity has been grazed by cattle and is used as rangeland.

Soils in the vicinity of the Hanksville buying station are variable in terms of their quality. In general they are very thin alkaline sandy loams. Soils on about half the area surveyed (see Section 2.10.1.2 and Plate 2.10-2) have gypsum or salt contents too high for use in reclamation. In contrast, about half the area has 30 inches of soil material that would be good for use in reclamation and are adequate to reclaim the buying station site.

Reclamation of the 9-acre disturbed area will be for the purpose of restoring the site as rangeland and will emphasize establishment of a mixture of grasses and shrubs.

9.2 PLANS FOR RECLAIMING AND RESTORING AFFECTED AREAS

9.2.1 Tailing Retention System

The following plan will be implemented sequentially for the three tailing cells as each is inactivated, approximately after the fifth year of operation, the tenth year of operation, and at termination of the project. The reclamation plan has been designed to provide both long term stabilization of tailing and controlled release of radioactivity.

9.2.1.1 Summary of Tailing Retention Plan

The proposed mill will have an acid leach process and a 2,000-ton per day capacity. The project site is located approximately 6 miles south of Blanding, Utah and will include an existing ore buying station as well as the proposed mill and a tailing retention system. A more detailed description of the project is provided in Section 3.0.

The proposed tailing retention plan calls for the disposal of mill tailing in three partially excavated rectangular cells southwest of the mill site, each approximately 4,000 feet long, 650 feet wide and 35 feet deep. Each of the three cells is designed to contain five years of tailing; thus, reclamation will occur at approximately five-year intervals.

A basic feature of this retention plan is the lining of each cell (excavated trench and surrounding dike) with chlorinated polyethylene or an equivalent liner. Before the first cell is filled, the second would be constructed and a portion of the material excavated from the second would be used as cover for the first cell. Similarly, excavation of the third cell would provide cover material for the second and would be completed before the second would be reclaimed. It is currently estimated that approximately 300,000 cubic yards of material will have to be excavated to cover the third cell. This cover material will either come from excavation of this cell or will be excavated from an area immediately south of the western edge of the third cell. For radiological calculations, the total storage volume of the three tailing cells was estimated at 9.0×10^6 cubic yards and it was assumed that they will cover a total maximum surface area of approximately 210 acres. The total disturbed area for tailing retention is estimated to be 249 acres.

More detailed discussions of the tailing retention plan, alternatives considered and the reasons for rejecting the other alternatives may be found in Sections 3.0 and 10.0 and in Appendix H.

9.2.1.2 Cover Material

This section presents the results of an analytical study evaluating various cover materials that could be utilized for post-operational tailing reclamation.

The criteria used in evaluating alternative cover materials for post-operational tailing reclamation were:

- A reduction in the gamma radiation to essentially background levels;
- A reduction in the radon emanation flux from the affected surface to not greater than twice background levels;
- Minimization (elimanation) of monitoring and long-term maintenance requirements;
- The cost effectiveness of each alternative;
- Suitability for revegetation.

A general description of the various materials and the estimated costs of each are summarized in Table 9.2-1.

9.2.1.3 Background Radioactivity

Radon Emanation

At the present time, there are neither measurements of the radon-222 flux at the proposed tailing retention site nor in the general environs of the site. A program is currently being conducted to determine these values. Background radon-222 fluxes can be estimated from the average

TABLE 9.2-1

ALTERNATIVE COVER MATERIAL[a] EVALUATED FOR TAILING MANAGEMENT

Alternative	Description	Cost (x \$1000)[b]
1	Regrade partially dried tailing. Cover with 9.0 feet of silt/sand material. Add 1/2 foot of mixed topsoil and sand, fertilize and revegetate.	1,749
2	Regrade partially dried tailing. Cover with 17.0 feet of silt/sand-sand mixture. Add 1/2 foot of mixed topsoil and sand, fertilize and revegetate.	2,938
3	Regrade partially dried tailing. Cover with more than 20.0 feet of sand, fertilize and revegetate.	4,032
4	Regrade partially dried tailing. Cover with 2.0 inch thick asphalt cap followed by 3.0 feet of silt/sand material. Add 1/2 foot of mixed topsoil and sand, fertilize and revegetate.	653

[a] A search is being conducted for an adequate supply of Mancos Shale or clay. If such material is available, it will be evaluated as an alternative cover and discussed in the Supplemental Report.

[b] Cost is estimate for total 210-acre surface assumed for combined 3-cell configuration.

see p.9-9 for (De/v) →

$$J = C_t E \sqrt{\lambda (D_e/v)}$$
$$= (1.6\ g/ml)(0.47\ pCi/g)(0.2) \times \sqrt{(2.1 \times 10^{-6}\ sec^{-1})(1 \times 10^{-2}\ cm^2/sec)}$$
$$= (1.6)(0.47)(0.2)\sqrt{2.1 \times 10^{-8}}\ pCi/cm^2\text{-}sec$$
$$= (1.6)(0.47)(0.2)\sqrt{2.1}\ pCi/m^2\text{-}sec$$
$$\cong 0.22\ pCi/m^2\text{-}sec$$

radium-226 concentration of soil samples collected within the project site boundaries by using a conversion factor of 1.6 pCi/m^2-sec of radon-222 per pCi/g of radium-226 in soil (Schiager, 1974). An average radium-226 concentration of 0.470 pCi/g of soil was obtained for the collected soil samples. This concentration yields a background radon-222 flux of 0.752 pCi/m^2-sec. why not treat same as below or vice versa? (~0.22 pCi/m²-sec)

Background Gamma Radiation

An on-going program is being conducted to document the environmental dosage at the project site (Section 2.9.2.8). The results of this program will be presented in the Supplemental Report. The average annual dose attributable to terrestrial and man-made sources is presently estimated to be 74 mrem.

9.2.1.4 Tailing Radioactivity

The tailing slurry discharged from the mill will be a well-mixed combination of sands and slimes. It has been assumed that the radium content of the tailing will be homogeneous and that there will be a concentration of 353 pCi of radium-226 per gram of tailing. Since there are no physical separation processes planned for post-entrainment, it is assumed that this concentration will exist at all times prior to reclamation.

Tailing Radon Flux

No data are currently available on the radon fluxes from the projected tailing.

The radon-222 flux from the tailing, prior to reclamation, is estimated to be 38.9 pCi of Rn-222 per m^2-sec (see Section 3.3.2.5).
from 353 pCi/g tails! Using 1 pCi/m²-sec flux per pCi Ra/g tails flux is 353 pCi/m²-sec.

Tailing Gamma Radiation Exposure Rates

Estimation of the gamma exposure above the tailing can be obtained by multiplying the calculated radium-226 concentration in the tailing by a conversion factor of 2.5 μR/hr (Schiager, 1974). Multiplication of the average tailing Ra-226 concentration of 353 pCi/g by the above conversion factor gives an exposure rate of 882.5 μR/hr/or 7,736 mrem per year.

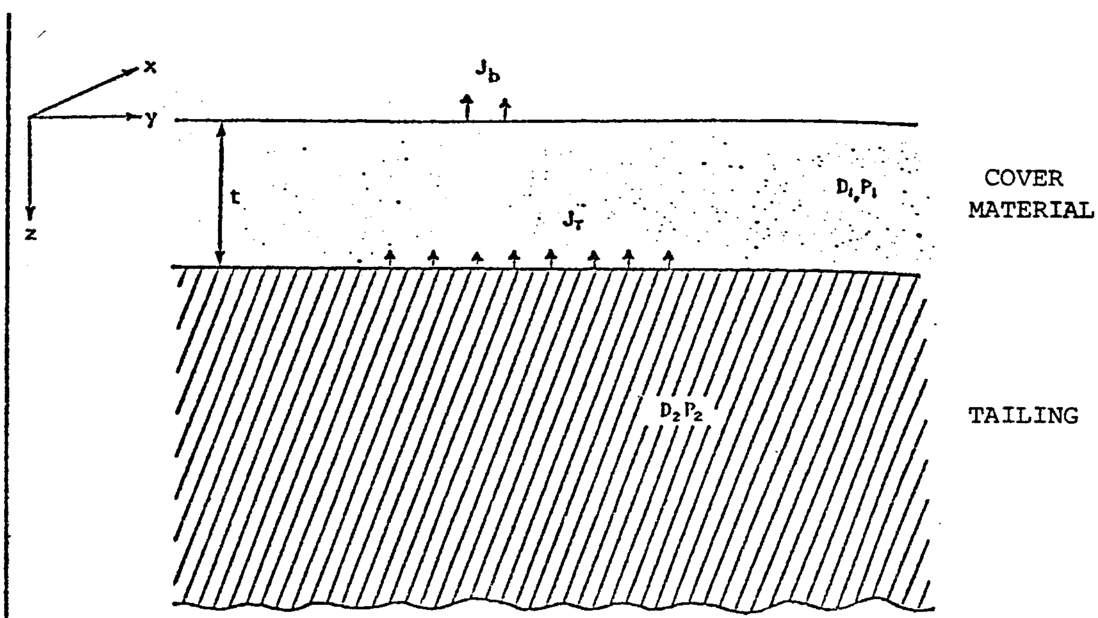
9.2.1.5 Radioactivity Attenuation

Cover Materials

There are essentially two types of naturally occurring materials available on site which could be used to cover the tailing area, a silt-sand and a sand. A more detailed description of these materials is provided in Appendix H. A search is being made for economic clay deposits in the vicinity of the project site.

Radon Attenuation

The model chosen for calculating the thickness of material necessary to reduce radon emanation to not greater than twice background is the one quoted by Clements, et al (1978). The model consists of a uniform layer of material of finite thickness, covering a material of "infinite" thickness, as illustrated below. Both materials are assumed to contain radium and are capable of producing and diffusing radon.



Idealized Sketch of the Model Used for Gaseous Diffusion

Clements, W.E., Barr, S., and Marple, S.L., 1978, Uranium mill Tailings Piles as sources of atmospheric Rn-222, Submitted to the Natural Radiation Environments III

The steady state equation governing the diffusion of radon into the atmosphere from these layers is:

$$D \frac{\partial^2}{\partial^2_z} C - \lambda C + P = 0 \tag{1}$$

where:

C = is the radon concentration in the interstitial space (pCi/cm^3)

D = is the effective diffusion coefficient, i.e., the diffusion coefficient divided by the porosity (cm^2/sec)

P = is the specific radon production rate in the interstitial space ($pCi/sec\ cm^3$)

The boundary conditions appropriate to the problem are:

$$C_1 (z=1) = (z=1)\ C_2 \tag{2}$$

$$-D_1 \frac{\partial C_1}{\partial z}\Big|_{z=t} = -D_2 \frac{\partial C_2}{\partial z}\Big|_{z=t} \tag{3}$$

$$C_1 (z=0) = 0 \tag{4}$$

$$\lim_{z \to \infty} C_2(z) = P_2/\lambda \tag{5}$$

Substituting the solutions of (1) into (2)-(5) and noting

$$J_1(z=0) = -D_1 \frac{\partial C_1}{\partial z}\Big|_{z=0}$$

gives

$$\frac{J(z=0)}{J_b} \left\{ \frac{(1-P_2/P_1) - (1+a)e^{r,t}}{\sinh(r_1 t) + a \cosh(rt)} + 1 \right\} \tag{6}$$

where:

$J\ (z=0)$ = Surface Flux (pCi/m^2-sec)

J_b = Background Flux (pCi/m^2-sec)

a = D_1/D_2 (Dimensionless)

r_1 = $\sqrt{\lambda/D_1}\ (cm)^{-1}$

t = Thickness of Cover Material (cm)

Defining J_T as the flux from the uncovered tailing the above may be rearranged in the form

$$\frac{J(z=0)}{Jb} = - \left\{ \frac{(1 - \exp(r_1 t)) - a \exp(r_1 t)\left[J_T \exp(-r_1 t)/Jb + 1.\right]}{\sinh(r_1 t) + a \cosh(r_1 t)} + 1. \right\} \quad (7)$$

It should be noted that the term in the square brackets is the model used by Tanner (1964), Alekseev et al. (1957) and others.

The term $J(z=0)/J_b$ represents the ratio of the surface flux to the background and must be less than 2.0 to fill the criteria on radon flux emanation.

Because of tediousness of substituting different values of thickness in the above equation a computer program was written to solve the right hand side for 1/2 foot increments of cover material thickness for various diffusion coefficients and flux ratios, i.e., tailing to background flux. The code is designed to terminate when the thickness of cover reached is sufficient to reduce the ratio $J(z=0)/J_b$ to less than 2.0.

The unknown parameters in the model are the effective diffusion coefficients of the tailing and the cover materials.

- The diffusion coefficient of the ultimately dry tailing is estimated to be 1.0×10^{-2} cm^2/sec. The estimate was made based on published values of similar types of material (Sears et al., 1975; Tanner, 1964; Alekseev et al., 1957) and the expected homogeneous nature of the tailing. It is expected that the finer grade (-200 mesh) material will take up much of the bulk void space, thus decreasing the allowable pathways for radon diffusion so this value may be considered a conservative overestimate.

- The diffusion coefficient of the silt-sands found in the area is estimated at 1.0×10^{-2} cm^2/sec. What is long-term moisture?

- A diffusion coefficient of 6.8×10^{-2} cm^2/sec for the sands.

- The diffusion coefficient of a mixture of these two materials is estimated at 3.4×10^{-2} cm^2/sec. Such a material would have to be well mixed to reduce interstitial voids in the sand.

Substitution of these values and the value of the ratio of the tailing to background flux in the right hand side of Equation 7 allows the determination of radon reduction versus cover material. Table 9.2-2 presents the results of these calculations for various thicknesses of different cover materials.

As is obvious, a thickness of 9.0 feet of silt-sand reduces the surface radon flux to less than twice background. A mixture of silt-sand and sand or a cover of sand would require 16 feet or >20 feet, respectively, to achieve the same goal.

It should be noted that most of the attenuation occurs in the first few feet of material. The first six feet of the silt/sand, for example, reduces the ratio of the uncovered tailing radon flux to background by an order of magnitude. The remainder of the material is basically needed to compensate for the radium in the cover and the residual component of the tailing flux.

TABLE 9.2-2

THICKNESS OF COVERS VS. RATIO OF RADON SURFACE FLUX
TO RADON BACKGROUND FLUX FOR VARIOUS COVER MATERIALS

Thickness of Covers (Feet)	Silt/Sand	Silt/Sand-Sand	Sand
1.0	33.6	44.8	48.1
2.0	21.9	33.0	43.7
3.0	14.4	26.2	39.1
4.0	9.6	25.3	34.6
5.0	6.5	20.4	30.2
6.0	4.6	16.4	26.2
7.0	3.3	13.2	22.6
8.0	2.5	10.6	19.5
9.0	<2	8.6	16.7
10.0		7.0	14.4
11.0		5.7	12.3
12.0		4.7	10.6
13.0		3.9	9.1
14.0		3.3	7.8
15.0		2.8	6.8
16.0		2.4	5.9
17.0		2.1	5.1
18.0		<2	4.5
19.0			3.9
20.0			3.5

Gamma Radiation Attenuation

Theoretically, each foot of packed earth cover will reduce the gamma exposure rate by approximately an order of magnitude. (Gamma Ray attenuation is heavily dependent on atomic electron interactions e.g., Compton collisions, photoelectric absorption, so that the absolute type of material, clay, etc., is irrelevant to this discussion.) Thus, considering the worse case, 9.0 feet of cover material, the reduction is of the order of 10^9. This would reduce the gamma dose of 7,736 mrem/year to significantly less than 0.001 mrem/ year.

9.2.1.6 Tailing Reclamation Alternatives

Several tailing disposal concepts were considered prior to selection of the proposed plan (e.g., conventional surface disposal at a number of locations); these are discussed in Section 10.0 and Appendix H.

Four tailing reclamation alternatives were considered for the proposed plan using the results of the previous section for radon attenuation. The total cost of each alternative was derived from the component costs for each phase of the reclamation.

Two costs are fixed for each alternative, the cost of twenty years of monitoring on a regular basis and the cost of revegetation. The first of these was conservatively estimated at $5,000/year and includes the costs of radon measuring equipment and quarterly surveys. An average cost of revegetation, $600/acre, was used but it should be recognized that this cost varies appreciably throughout the southwest and is heavily dependent on a number of parameters (Kennedy et al., 1977). Individual alternative cover costs were estimated from the following simple formula.

$$\text{Cover Cost} = k \times A \times t \times c \times f\,(1,d) \qquad (8)$$

where:

$k = 43560\ (ft^2/acre) \times \frac{1}{27}\ (yd^3/ft^3) = 1613.3\ yd^3/acre.$

A = Area covered (acres)

t = Thickness of cover (ft)

c = Average cost per cubic yard of cover

f(1,d) = empirical correction factor dependent on the distance the material is hauled (1) and the degree of difficulty of compacting, grading, etc., for the case unity.

It should be noted that, in all the calculations, the background flux quote is based on non-secular equilibrium for the thorium, radium ratio.

If secular equilibrium were assumed, i.e. a natural soil value of 0.71 pCi/g of radium, the radon flux would be 1.15 pCi/m^2-sec. The effect on the thickness of cover material would be to reduce it by approximately 1.5 to 2.0 feet. This would reduce the estimated cost of the alternatives by $508,000 to $678,000, respectively. This cost adjustment may be made as more data become available.

Similarly, as more data are gathered, further reduction may become evident. Graphically, it can be shown that 4 feet of material are sufficient to reduce radon flux to levels comparable with other parts of Utah, e.g. Moab. This further reduction would essentially divide the costs for reclamation of the tailing retention system by one-third to one-half.

A search is being conducted for suitable clay material as an alternative cover. If this search is successful, that alternative will be evaluated in the Supplemental Report.

The following costs were developed using the assumption that a portion of the cover material would be that material initially excavated (see Appendix H) and that excavation costs would be absorbed as operational expenditures not reclamation expenditures.

Alternative I - Silt-Sand Cover With One Half Foot of Mixed Sand and Topsoil

Approximately 9.0 feet of silt-sand material would be placed over the dried tailing. The area would be contoured and compacted. Approximately one-half foot of mixed topsoil and sand would be placed on the cover to help promote revegetation. Artifical fertilization and revegetation would follow. The cost of this alternative would be approximately as follows:

Cover Cost:	
(43,560 ft^3/acre x 210 acres x 9.0 feet x 1/27 yd^3/ft^3) less	
(749,000 yd^3 previously excavated) x 0.65	=$1,496,000
Mixed Topsoil and Sand:	
1613.3 yd^3/ft acre x 210 acres x 0.5 ft x $0.16	= 27,200
Revegetation: $600/acre x 210 acres	= 126,000
Monitoring: (20 years)	
$5,000/year x 20 years	= 100,000
Total Cost	$1,749,200

Thus, the estimated cost of this alternative, including costs of moving and compacting the volume of cover material, revegetation and monitoring for 20 years is $1,749,200.

Alternative II - A Mixture of Silt-Sand and Sand with One Half Foot of Mixed Sand and Topsoil

Alternative II involves reducing the radon flux and gamma dose with a mixture of silt-sand and sand. The required thickness of this cover is estimated to be 17.0 feet of silt-sand and sand. Again approximately one-half foot of mixed topsoil and sand would be added to help promote revegetation. Fertilization and revegetation would follow. A cost analysis utilizing a similar procedure as for the previous alternative yields a total estimated cost of $2,937,700.

Alternative III - Sand Cover With One-Half Foot of Mixed Sand and Topsoil

Alternative III utilizes a sand cover for radon flux and gamma exposure rate reduction. The amount of material necessary for this alternative is estimated to be in excess of 20.0 feet. One-half foot of mixed topsoil and sand would cover the cap. Fertilization and revegetation would follow. The estimated cost of this alternative is about $4,032,170.

Alternative IV - Asphalt Cap

This alternative would involve the placement of a two-inch asphalt cap on the tailing followed by three feet of silt-sand material. The asphalt cap would serve as an impermeable barrier to gas diffusion while the silt-sand would limit gamma ray exposure. Mixed sand and topsoil would be followed by revegetation as in the other alternatives. The estimated cost of this alternative is about $653,000.

Other Alternatives

Other alternatives have been considered and rejected on a technical feasibility and/or cost basis. A search is underway for clay deposits within a fifty-mile radius of the project site. If this search is successful, use of clay material as a cover material will be evaluated and discussed in the Supplemental Report.

Consideration of other alternatives presented in Table 10.6 of NUREG-0128 have been rejected for this site.

9.2.1.7 Conclusions and Recommendations

The only current alternative not completely viable from a long-term radiological health basis is Alternative IV. Artificial covers such as asphalt will crack due to recurring thermal expansion and contraction and root pressure. Thus, long term stability of the asphalt cover cannot be guaranteed.

Unless a suitable and adequate supply of clay can be located, the current plan is to use a silt-sand cover (Alternative I) for reclamation of the tailing retention area.

Final verification of the required thickness and distribution of cover material(s) for the selected alternative will be achieved through actual field measurements at the site. The results of the program will be incorporated into the Supplemental Report and will indicate tailing cover requirements as determined from the combined analytical and experimental efforts.

Background radon flux measurements will be taken in the vicinity of the tailing retention site at locations of generally similar soil conditions as those underlying the tailing area. The area monitored will be of sufficient distance from the mill and tailing to minimize distortion of the natural background from effluents released from these sources.

Flux determinations will be made from radon and progeny alpha activity measurements of 1.4 liter radon samples extracted at short time intervals from a 200-liter container sealed into the ground. Background radon fluxes will be measured at various upwind localities in the vicinity of the tailing.

Flux measurement on tailing will be made in dry areas where possible. If no dry areas are available, it may be necessary to take composite grab samples of the tailing slurry, allow them to dry and measure the fluxes in a controlled environment.

Equilibrium distribution coefficients for U-238, Ra-226, and Th-230 for typical site soils will be measured as cells are excavated. Permeabilities and other hydraulic parameters may also be measured.

A close check on soil temperature, air temperature and barometric pressure will be made during all flux measurements. The radium content of the tailing, cover material and background station soils will be determined in order to thoroughly calculate radon fluxes for comparative purposes.

9.2.2 Decommissioning of Facilities

Upon termination of the project, all facilities will be decommissioned and affected land reclaimed. Energy Fuels will perform these activities in accordance with regulatory requirements then in existence, using accepted industrial practices and procedures.

It is not possible at this stage to delineate the specific details of the decommissioning and reclamation program because of the lack of prior precedent and regulatory guidance. It is our understanding that regulatory guidance is currently being prepared by the NRC which will be available within the next few months. In addition, Battelle Northwest Laboratories is presently performing a study of decommissioning of uranium fuel cycle facilities, which should provide useful data. Furthermore, the work on Updating the Environmental Survey of the Uranium Fuel Cycle, will include an evaluation of the environmental effects from decommissioning the fuel cycle facilities, including uranium mills. Using these sources and other relevant industrial experience Energy Fuels will develop, at the appropriate time, a detailed decommissioning and reclamation program.

In general, the decommissioning procedure will involve the performance of surveys of the facility, equipment, and site to map radiation levels; reduction, by cleaning where feasible, of surface contamination levels to below those specified which permits the release of material or equipment for unrestricted use (Alpha: 2,500 dpm/100 cm^2 total, 100 dpm/100 cm^2 removable; Beta/Gamma: 0.2 mR/hr total, 1,000 dpm/100 cm^2 removable); and disposal as low-level radioactive waste of that material and equipment whose surface contamination levels cannot be reduced to below these levels. Upon completion of the decommissioning program, facilities and equipment will be suitable for release as non-radioactive, or disassembly without radiation protection.

Reclamation will involve either disassembly of the facilities and restoration of the entire site for other use; or use of the facilities for other purposes, with accompanying restoration of the remainder of the site.

9.3 SEGREGATION AND STABILIZATION OF TOPSOILS

Topsoil materials will be beneficial to reclamation for several reasons, and where possible will be stored and saved during the life of the proposed project. At the project site, prior to construction or other disturbance, topsoil will be stripped to a depth of 6 inches and stored (see Appendix H). The material will be stored in a large pile and seeded with quick germinating species to stabilize the pile. After the project is completed, topsoil material will be respread over disturbed areas in about the same thickness as was removed. Debris and organic matter will be incorporated with the surface materials when stripping is done and will provide a mulching effect on the retopsoiled areas.

At Hanksville, since no additional construction is planned, no topsoil will be saved.

9.4 TYPE AND MANNER OF PROPOSED REVEGETATION

The following plan for revegetation has been developed with recommendations from Mr. Lamar Mason, Agronomist with the USDA Soil Conservation Service, and Mr. A. Perry Plummer, Range Scientist with the USDA Forest Service. The revegetation practices are intended to replace the desert shrubland formerly at the Hanksville buying station site and rangeland currently present at the project site.

9.4.1 General Practices

Revegetation practices at both the project site and Hanksville will consist of seeding smoothed surfaces with grasses, forbs and shrubs. Seeding equipment, used commonly in farming, will be used for reclamation except on areas or spots that are inaccessible. These areas will be hand broadcast. Due to the arid climate, irrigation will be required at Hanksville to insure establishment of seedlings. Successful establishment of vegetation has a high probability at the project site during normal precipitation years; in extremely dry years, irrigation may be used to facilitate germination and initial growth. Mulching will not be required at the project site where topsoil is respread over reclaimed areas but will be used at the Hanksville site.

9.4.2 Species and Seeding Rates

Because of the climatic differences between Blanding and Hanksville, separate seeding mixtures will be used for each site.

9.4.2.1 Project Site

The climate at Blanding, with its annual rainfall of about 12 inches, permits use of a variety of species in revegetation of the project site. Two initial seed mixtures are invisioned, one for the slopes of tailing retention dikes and one for roadsides and relatively level disturbed areas. Results from plantings will be evaluated periodically and reseeding modified as deemed appropriate. Every attempt will be made to establish a diversity of native species that will provide quality forage for wildlife and livestock. The species listed below are only tentative.

Relatively Level Areas of Disturbances

Relatively level areas will be reseeded for use as rangeland. Depending upon availability of seed, a mixture such as the following would be used.

	Seeding Rate (Lb/Acre)
Grasses	
'Luna' Pubescent Wheatgrass	5.5
Fairway (Crested) Wheatgrass	1.5
Forbs	
Yellow Sweetclover	1.0
Palmer Penstemon	0.1
Alfalfa	1.0
Shrubs	
Fourwing Saltbrush	0.5
Common Winterfat	0.5
Big Sagebrush	0.1
	10.2 Lb/Acre

Dike Slope Stabilization

Species for the tailing retention dike slopes will be chosen especially for their aggressive spreading habits and soil-holding properties. Examples include:

	Seeding Rate (Lb/Acre)
Grasses	
'Luna' Pubescent Wheatgrass	2
Fairway (Crested) Wheatgrass	0.5
Forbs	
Yellow Sweetclover	0.5
Palmer Penstemon	0.25
Alfalfa	1
Shrubs	
Spreading Rabbitbrush	0.25
Common Winterfat	0.5
Fourwing Saltbush	0.5
	5.5 Lb/Acre

The introduced Fairway (Crested) Wheatgrass and 'Luna' Pubescent Wheatgrass would be considered because of adaptation to this climate. Forbs would be used to increase diversity and provide early growth as ground cover. As an example, Palmer Penstemon provides a colorful flower as well as unusually good cover on raw and eroding sites; it is especially useful on roadside cuts. A shrub such as Spreading Rabbitbrush that is well adapted to alkaline sites and spreads rapidly by underground root stocks would be used.

9.4.2.2 Hanksville Buying Station Site

Species seeded here will include a mixture of grasses, forbs and shrubs. Examples are listed below along with the rate of seeding:

	Seeding Rate (Lb/Acre)
Grasses	
Pubescent Wheatgrass	5.0
Alkali Sacaton	0.25
Indian Ricegrass	4.0
Sand Dropseed	0.2
Shrubs	
Fourwing Saltbush	1
Common Winterfat	2
	12.45 lb/acre

Pubescent Wheatgrass, an introduced sod-forming grass, appears to be highly useful for disturbed areas (Plummer, 1977). Alkali Sacaton is a sod-forming native grass well-suited to moderately alkaline areas. Indian Ricegrass and Sand Dropseed are native bunchgrasses well-adapted to the area. Winterfat is a low-stature shrub that grows well on calcareous soils and has an outstanding ability to spread (Plummer, et al. 1968). Fourwing Saltbush is also well-adapted to the area and is a hardy shrub.

9.4.3 Cultural Practices

Preparation for planting will begin with smoothing the replaced topsoil with a disk. No mulching will be needed at the project site as topsoil containing debris will be respread over the area. At Hanksville, the affected areas will be mulched with about 2 tons of native hay per acre prior to seeding. It will be crimped into the soil with a standard crimper to prevent blowing.

Seeding will be done with a suitable rangeland drill. At Hanksville, rice hulls will be mixed with Sand Dropseed to prevent seed wastage through the drill. The following are depths of seeding that will be used in seeding species listed:

Grasses	Depth
'Luna' Pubescent Wheatgrass	0-1/4"
Fairway (Crested) Wheatgrass	0-1/4"
Indian Ricegrass	3"
Sand Dropseed	1/4-1/2"
Forbs	
Yellow Clover	1/2-1"
Palmer Penstemon	0-1/4"
Alfalfa	1/2-1"
Shrubs	
Spreading Rabbitbrush	1/4-1/2"
Common Winterfat	1/4-1/2"
Four-wing Saltbush	1/4-1/2"
Big Sagebrush	1/4-1/2"

Seeding will be done in November to allow early spring germination and use of spring moisture. Seeds may presently be purchased from several sources. Care will be taken at the time of purchase to insure that seeds taken are of an ecotype suitable to the area. This will be especially important for the shrubs and Palmer Penstemon which may die out after several years if planted in an unsuitable area. The following sources presently have or can provide seed:

Arkansas Valley Seeds, Inc.
P.O. Box 270
Rocky Ford, Colorado 81067

Native Plants, Inc.
400 Wakara Way
Salt Lake City, Utah 84108

Marton Plummer
c/o A.P. Plummer
Provo, Utah

At Hanksville, the area will be drip irrigated in early spring and 1-2 more times during the spring and summer. Irrigation will not be needed after the first summer of plant growth.

Fertilizer levels in soils are presently adequate for range growth. Mechanical or chemical weed control techniques will be used only in the case of extreme weed take-over of planted areas. It is anticipated that natural succession will gradually take place and replace early weed growth with desirable plants.

9.5 LONG-TERM MAINTENANCE AND CONTROL

9.5.1 Diversion of Surface Water and Erosion Control

During project operation, two storm water retention dikes will protect the mill area from peak storm runoff by storing flood waters and gradually releasing them (see Appendix H). After abandonment, impoundment areas will gradually fill with sediments and the dikes may be overtopped or eroded as the area returns to nearly a natural state. This will be a very gradual process, probably requiring hundreds of years.

After project termination, the upstream tailing retention dike will continue to impound surface runoff in the natural drainage basin surrounding the proposed mill site. This runoff will continue to evaporate from the surface as it does during operation (see Section 3.0 and Appendix H). Sufficient volume will be available in the natural drainage basin to store the probable maximum flood, thereby eliminating the possibility of erosion of the tailing dikes by water flowing around the perimeter of the tailing retention system.

The reclaimed surface of the tailing cells will have a perimeter road constructed of erosion-resistant sandstone on the surface and relatively impermeable compacted silty materials beneath. This road will be approximately 2 feet higher than the top of the level tailing cover. This 2 feet of freeboard will accommodate the probable maximum precipitation of 10 inches. Direct precipitation on the tailing surface cover will not run off and will, therefore, not concentrate and cause erosion of the tailing dikes. Precipitation will either be stored at the surface and evaporated or it will seep into the surface soil cover and be gradually released by vegetation as evapotranspiration.

Direct precipitation and wind will be the only causes of erosion of exterior tailing dike surfaces. The rate of erosion of these surfaces cannot be quantitatively evaluated with any confidence at this time. During operation of the project, dike erosion rates will be monitored as part of the regular inspection program. If erosion rates are excessive, additional work will be done to reduce erosion to within acceptable limits. During initial construction the exterior slopes of the embankments will be built at slopes of three horizontal to one vertical to reduce erosion. Further, the exterior slopes will be constructed of granular sandstone materials which are inherently more resistant to erosion than fine grained materials. As part of the reclamation of the area, the slopes will be revegetated which will further reduce erosion.

9.5.2 Maintenance of Established Vegetation

Appropriate measures will be taken to assure the establishment of a self-sustaining plant community. Areas where germination does not occur or where plants die out will be reseeded until a suitable stand is obtained. If weeds become dominant within the stand to the exclusion of grasses or shrubs, chemical or mechanical control measures will be used.

The ultimate goal of all revegetation efforts will be an established community that requires no artificial inputs like fertilizer or supplemental irrigation. Vegetation will be monitored until stand establishment and perpetuation is assured.

9.6 FINANCIAL ARRANGEMENTS

Energy Fuels Nuclear, Inc. will bond in accordance with applicable rules and regulations.

10.0 ALTERNATIVES TO THE PROPOSED ACTION

The proposed plan of action for the White Mesa Uranium Project is the culmination of a decision-making process during which various alternatives were evaluated. Choices among alternatives have been influenced by both environmental and practical considerations. The following sections together with Appendix H describe and evaluate feasible alternatives to project plans, including that of "no action," and provide the rationale for rejection.

10.1 NO ACTION

The "No Action" alternative to the proposed White Mesa Uranium Project would involve milling of ore presently at the two Energy Fuels' buying stations and ore to be mined from independent mines in the future at another mill either existing or new. The nearest existing mill is the Atlas Mill at Moab, Utah approximately 80 highway miles from Blanding and 110 highway miles from Hanksville. The additional transportation costs are estimated to be at the rate of $0.10 per ton per mile. In view of the low grade ore involved, averaging about 2.6 pounds of U_3O_8 per ton, the increased transportation cost alone would be about $0.04 per pound of U_3O_8 per mile; this translates into added transportation costs of about $3.08 per pound of U_3O_8 hauled from Blanding and $4.24 per pound of U_3O_8 hauled from Hanksville.

In addition to the increased hauling costs, the probability of transportation accidents transporting ore to Moab will increase. Furthermore, there will still be adverse environmental impacts resulting from the processing of the ores. These impacts would occur much closer to a population center than would be the case if the ore is processed in the applicant's proposed mill. At the present time, it is not known whether the Atlas mill will have the capability, capacity or willingness to process the ore that is to be processed in the applicant's mill.

If the applicant's mill is not constructed, it is likely that other mills will be proposed in the area to handle the ore now programmed for applicant's proposed mill. If no mills are constructed, a substantial economic base of the Hanksville-Blanding area will be removed because many of the small independent mines will be forced to close.

10.2 ALTERNATIVE LOCATIONS OF PROCESSING FACILITIES

Selection of the mill and tailing retention sites involved several considerations, including the following:

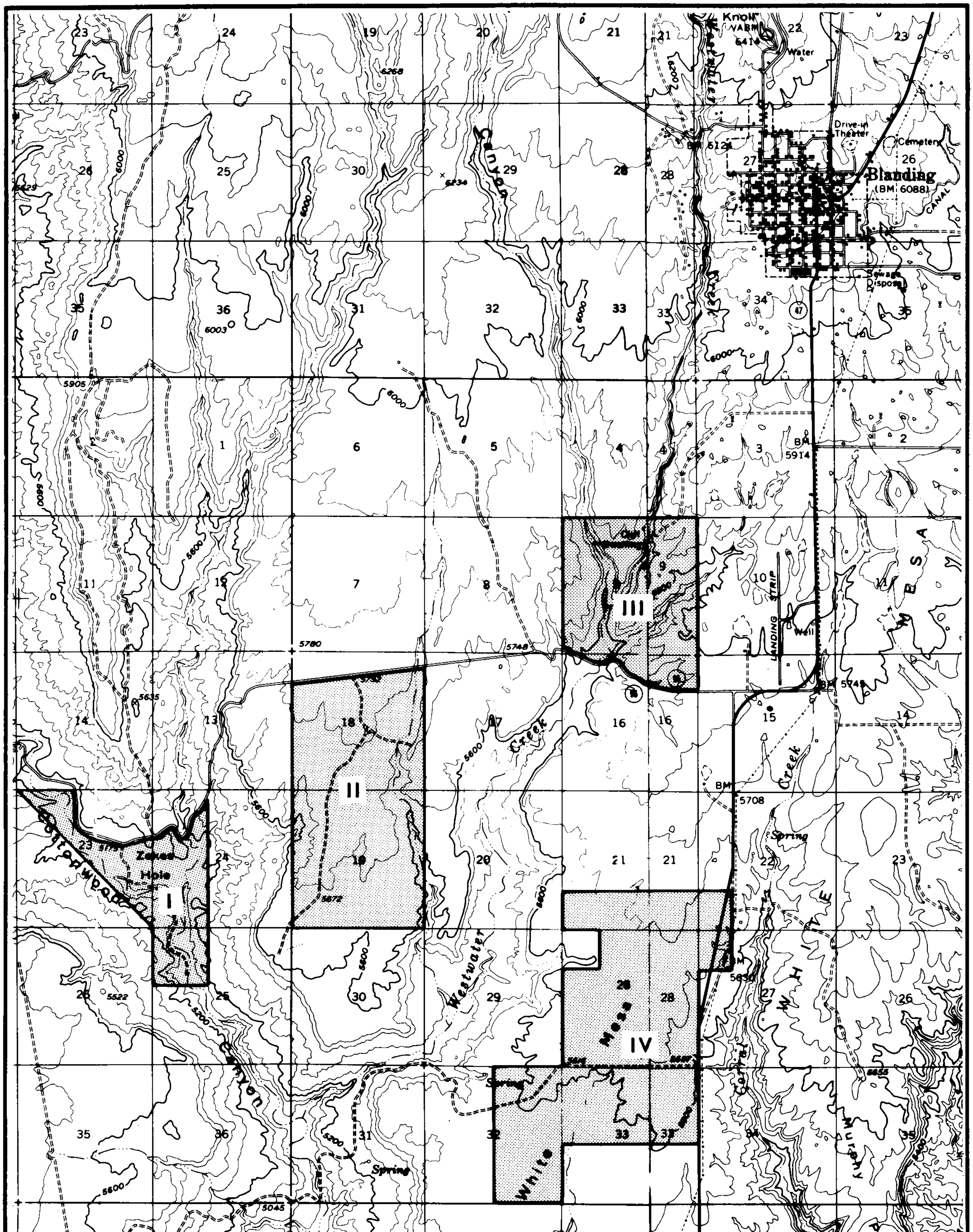
- Proximity to producing mines and known ore reserves;
- Surface ownership and availability for purchase;
- Proximity to human residences and activities;
- Ecological factors;
- Geotechnical and hydrological factors;
- Topography;
- Accessibility;
- Availability of power and communications.

10.2.1 Hanksville Vicinity

Both the Hanksville vicinity and the Blanding vicinity were evaluted initially for possible mill and tailing retention sites. The Hanksville vicinity was rejected because of the geographical distribution of known sources of uranium ore, socioeconomic limitations, and seismic risk. Approximately 75 percent of the known uranium ore available for the proposed mill is in the vicinity of Blanding. The Hanksville vicinity is in a seismologically more active area than is the Blanding vicinity (see Section 2.5). Moreover, the Hanksville vicinity lacks available commercial power for the proposed mill, lacks commercial communications (radio and telephone service), lacks access to a community where employees are available or where new employees could live, and lacks sufficient available fee land for a mill site (see Section 2.2.3 for further discussion of Hanksville's socioeconomic environment).

10.2.2 Blanding Vicinity

Four general areas in the Blanding vicinity were considered, including the selected project site (see Plate 10.2-1).



LEGEND

I = ZEKES HOLE AREA

II = MESA AREA

III = CALVIN BLACK PROPERTY

IV = WHITE MESA

ALTERNATIVE AREAS NEAR BLANDING FOR MILL SITE

DAMES & MOORE

PLATE 10.2-1

10.2.2.1 Zekes Hole

This location is approximately 5 miles southwest of Blanding, adjacent to and on the south side of State Highway 95. Cottonwood Creek drains directly through the middle of the approximately 700-acre area. An old abandoned oil well that was reported to have a good flow of water at depth is located on the property.

The Zekes Hole area was rejected as a proposed mill-tailings disposal site for five principal reasons: the site is on public domain; the Cottonwood Creek drainage through the middle of the site posed potential hydrological and water quality impacts from construction and/or accidental discharges; the area is in a prevailing up-wind direction from Blanding, there is insufficient acreage for proper siting of the mill and associated facilities; the area provides poor access to commercial power.

10.2.2.2 Mesa

This location is approximately 4 air miles southwest of Blanding. Approximately 2 sections of public land adjacent to and on the south side of State Highway 95 were inspected. This is a flat wooded mesa sandwiched between the Cottonwood Creek and Westwater drainages.

The mesa area was rejected as a potential project site becasue: it is located on public domain; its vegetative cover of Pinyon-Juniper and Big Sagebrush is important habitat for Mule Deer and there would be more severe ecological impacts from construction and operation of the proposed project than where other vegetation types exist; the area is in a prevailing up-wind direction from Blanding; potential sources of water are questionable; the area provides poor access to commercial power.

10.2.2.3 Calvin Black Property

This property is located approximately 2 miles south of Blanding along the north side of State Highway 95. It encompasses 720 acres more or less of fee ground.

The Calvin Black property was rejected as a project site for the following reasons: three separate drainages cross the site, posing potential hydrological and water quality impacts from construction and/or accidental discharges; private residences exist within 1/4 mile in two directions and the site is only about 2 miles from the town of Blanding; the topography is too rough for siting of project facilities and the property provides insufficient area for site requirements; the area provides doubtful access to a water source.

10.2.2.4 White Mesa

The White Mesa area was selected as the proposed project area. This area encompasses 1480 acres of fee ground and is crossed by the Black Mesa road and an existing power line. The area is approximately 6 miles south of Blanding on the west side of Highway 163.

White Mesa was selected as the general project area for the following reasons: it provides good topographic conditions relative to drainage and siting of facilities; the 1480-acre area is totally fee ground bounded to the east, west and south by public domain; no occupied residences occur on the site and the nearest such residence is approximately 1 mile north of the northern property line; much of the vegetative cover on the property has been disturbed previously in attempts to improve range conditions by removal of Pinyon-Juniper woodland and sagebrush; the area provides good access by an existing road and good access to commercial power from an existing line; the area has a good water source through deep wells.

10.2.3 Alternative White Mesa Sites

Reference is made to Appendix H which describes a site selection process used to determine the most desirable location on the White Mesa area for the mill and tailing retention system. This study considered both engineering and environmental features in evaluating alternatives.

10.3 ALTERNATIVE MILLING AND EXTRACTION PROCEDURES

Energy Fuels considered alkaline and acid leaching processes initially. The latter was found by metallurgical test work to produce superior recoveries on the various ore types constituting the mill feed. For this reason, the sulfuric acid leach process was selected. Certain individual ores could be successfully treated by the alkaline leach process but, overall, the ores were more amenable to the acid leach process.

Resin based processes, such a resin-in-pulp and resin ion exchange in clarified solution, were also considered. These processes were eliminated on the basis of higher operating costs as evidenced by the fact the latest uranium mills have all chosen the counter-current decantation and solvent extraction system.

The presence of vanadium in some of the ores and the Energy Fuels' intention to recover vanadium as a by-product necessitates the use of a strong sulfuric acid leach, counter-current decantation and two stages of solvent extraction. This processing procedure represents the latest technology.

Need to consider belt filtration process c/ solid-liquid separation.

11.0 BENEFIT-COST ANALYSIS AND SUMMARY

Sections 4.1.3 and 5.5.2 explain project costs and benefits in detail and provide background information regarding the derivation of estimated costs and benefits. Section 8.0 extracts from detailed analysis sections and summarizes non-quantifiable benefits and costs.

This section summarizes quantifiable direct and indirect project benefits (Table 11.0-1) and summarizes quantifiable direct and indirect costs (Table 11.0-2).

Long-term economic benefits and costs associated with operation of the project are presented in terms of annual projections and as a 15-year stream, discounted to the present values. Short-term impacts associated with the construction of the project are presented in the tables as a total, one-time cost or benefit, and are not discounted. All costs and benefits reflect 1977 dollars.

TABLE 11.0-1

QUANTIFIABLE BENEFITS[a]
(1977 Dollars)

	Construction Phase Total, 1-Year	Long-Term Operation Phase: Annual	Long-Term Operation Phase: Present Value[b]
Internal Benefit			
Gross revenue from U_3O_8 production		\$67,184,000	610,770,000
External Benefits			
Wage and salary payments	7,000,000	1,365,000	12,409,000
Personal income taxes	1,344,000	188,400	1,713,000
Personal consumption expenditures	2,492,000	522,800	4,753,000
State sales tax revenue (4.5%)	112,100	23,500	214,000
County sales tax revenue (0.5%)	12,500	2,600	23,600
Procurement of supplies and equipment	18,000,000		
Southeastern Utah	1,800,000		
Other areas in Utah	9,000,000		
Other states	7,200,000		
Sales tax revenue in Utah (5%)	540,000		
Property taxes against the mill		456,000	4,145,000

[a] Blank spaces indicate no applicable data

[b] Represents a 15-year stream of income, discounted to the present value by the formula:

$$V = A \frac{(1 + i)^{n-1}}{(1 + i)^n}$$

where V = Value in 1977 dollars of a future stream of income
A = Annuity
n = number of years, in this case 15
i = rate of discount, in this case 10%

TABLE 11.0-2

QUANTIFIABLE COSTS[a]
(1977 Dollars)

	Construction Phase Total	Operation Phase Annual	Operation Phase Present Value[b]
Internal Costs			
Mill Construction	38,000,000		
Mill Operation		10,500,000	95,460,000
Local Property Tax Payments		456,000	4,145,000
External Costs			
San Juan County			
Increased Health, Recreation and Public Safety Expendituresexpenditures		1,400-2,100	12,700-19,100
San Juan School District			
Increased Operating Expenditures		$30,090	273,500
Primary Impact Communities (Blanding, Monticello and Bluff)			
Capital Improvement Expenditures[c]	70,000		
Increased Operating Expenditures		$1,400-2,100	12,700-19,100

[a]Blank spaces indicate no applicable data

[b]Represents a 15-year cost stream, discounted to the present value by the formula:

$$V = A \frac{(1 + i)^{n-1}}{(1 + i)^{n}}$$

where V = Value in 1977 dollars of a future stream of income
A = Annuity
n = number of years, in this case 15
i = rate of discount, in this case 10%

[c]This represents an initial cost for expansion or improvement of public facilities which would occur as a response to project-induced growth in 1980.

12.0 ENVIRONMENTAL PERMITS AND APPROVALS

The following permits and approvals are necessary before Energy Fuels Nuclear, Inc., can initiate the White Mesa Uranium Project:

1. National Pollution Discharge Elimination System Permit (NPDES) from the Utah Bureau of Water Quality and the United States Environmental Protection Agency.
2. Water well permits from the Utah State Engineer's Office.
3. Water quality construction permit from the Utah Bureau of Water Quality and the Utah Water Pollution Control Committee.
4. Approval as a public drinking water system from the Utah Bureau of Water Quality and Utah Water Pollution Control Committee.
5. Construction permit from the Utah Bureau of Air Quality and Utah Air Conservation Committee.
6. Source Material License from the Nuclear Regulatory Commission regarding the construction of operation of the White Mesa Uranium Project. ?
7. Possible approvals from the Bureau of Solid Waste Management concerning the disposal of mill tailing. ?
8. Approval from the Bureau of Sanitation with respect to temporary sanitation facilities.

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* * *

The following are attached and complete this report.

Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H

Very truly yours,

DAMES & MOORE

Richard L. Brittain
Principal-In-Charge

Kenneth R. Porter, Ph.D.
Project Manager

RLB/KRP/tlg

APPENDIX A

CULTURAL RESOURCE INVENTORY REPORT LETTER
FROM STATE HISTORIC PRESERVATION OFFICER

AN INTENSIVE CULTURAL RESOURCE INVENTORY CONDUCTED ON WHITE MESA, SAN JUAN COUNTY, UTAH

submitted to the
Bureau of Land Management

and to the
Antiquities Section of the
Utah Division of State History

in behalf of

Energy Fuels Nuclear, Inc.
Denver, Colorado

by
Richard A. Thompson
Southern Utah State College

with ceramic analysis by
Alan Spencer
Brigham Young University

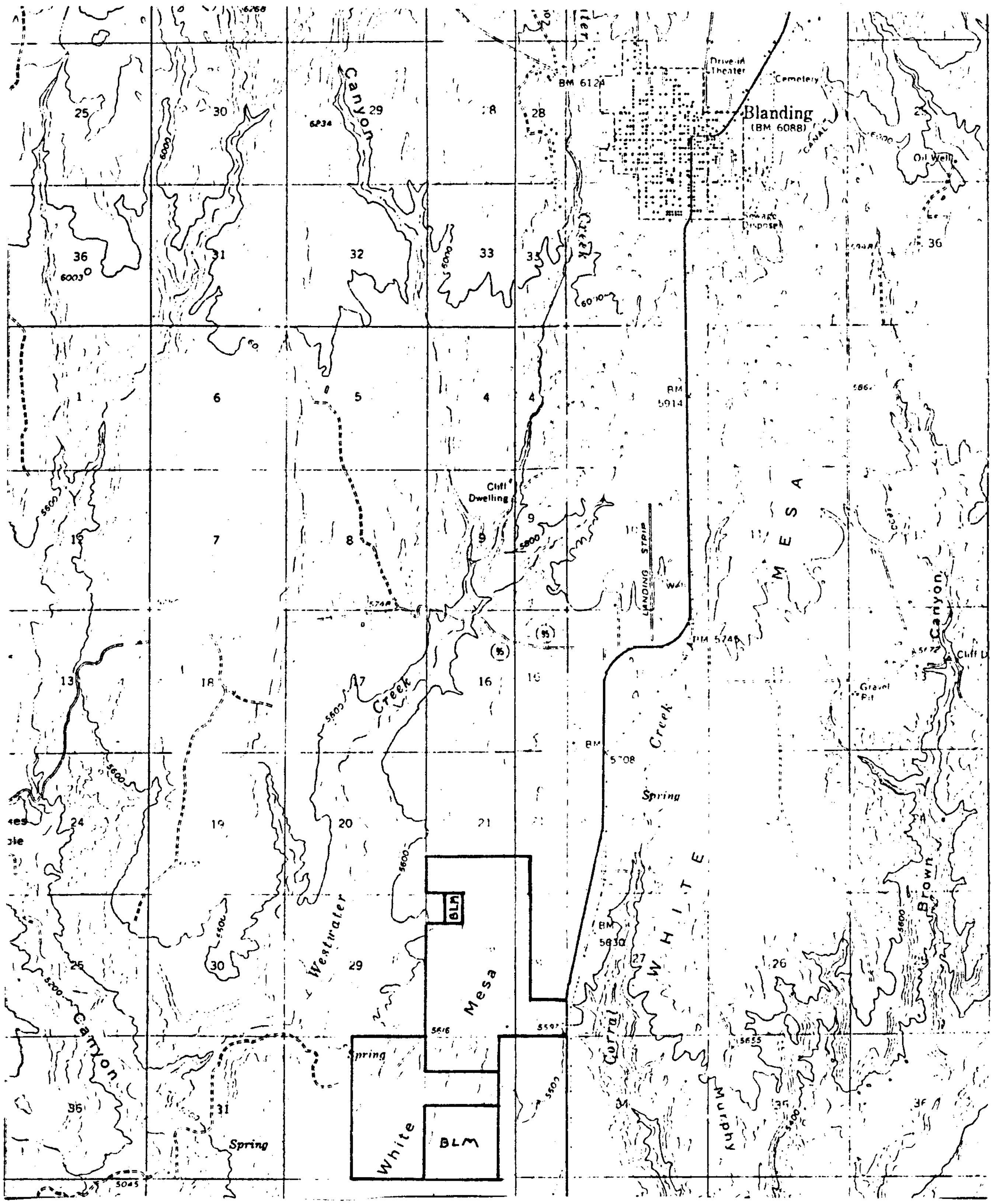
December 7, 1977
International Learning and Research, Inc.
Cedar City, Utah

AN INTENSIVE CULTURAL RESOURCE INVENTORY CONDUCTED ON WHITE MESA, SAN JUAN COUNTY, UTAH

This report summarizes the fundings of an intensive archeological survey conducted on 1260 acres of land extending over parts of Sections 21, 28, 32, and 33 of T37S, R22E (SLM) on White Mesa. The tract is eight miles south of Blanding in San Juan Co., Utah. Although the greater part of the project area is privately owned, 180 acres are lands administered by the Bureau of Land Management. The project area is marked on the map to be found on page 2.

The survey was undertaken at the request of Energy Fuels Nuclear, Inc. of Denver, Colorado and it was authorized by Department of the Interior Antiquities Permit No. 77-Ut-066, and by Utah State Antiquities Permit No. 257. The writer directed the work in the field as the research representative of International Learning and Research, Inc., of Cedar City, Utah. Others participating in the project included Barbara Burden, Jan Crofts, Patricia Davis, Timothy Olson, Charles Sivley, Alan Spencer, Patricia Spencer, and Georgia Thompson.

Survey teams varied from four to six workers with the size depending on the number of workers available on any given day. In addition to the writer, Alan Spencer of Brigham Young University served as a crew leader.


Blanding
(BM 6088)
Drive-in Theater
Cemetery
BM 6124
Canyon
Oil Well
Creek
BM 5914
Cliff Dwelling
LANDING STRIP
M E S A
Canyon
BM 5746
Creek
Gravel Pit
BM 5708
Creek
Spring
W H I T E
Brown
BM 5630
Westwater
White Mesa
BLM
Corral
Murphy
Canyon
Spring
White
BLM
Spring

Recognized standards for intensive survey work were maintained at all times and the method employed was the same for all teams. The procedure was facilitated greatly by the ready identification of key section corner markers and by the felicitous placement of a number of fences in the project area.

Beginning at the section corner, each crew leader established the line of march by sighting with a tripod-mounted Brunton compass with appropriate correction from magnetic to true north. Landmarks were noted in order to aid in maintaining the proper alignment. Once this had been done, the leader took a position 7.5 meters from the corner on a line at right angles to the line of march and toward the center of the unit to be surveyed. The other crew members then positioned themselves along this line at 15 meter intervals. The crew would thus be prepared to cover the ground in transects which were 15 meters wide for each worker. A four member team would thus cover a transect 60 meters wide with each worker being responsible for the ground extending 7.5 meters to the right and to the left of his line of march.

As crews walked a transect, leaders recorded the distance covered by counting their paces and using a mechanical counter to note the distance covered at 10 or 20 meter intervals as seemed most appropriate. At periodic intervals which varied with the terrain, the leader then called for flagging the course. The worker at the opposite end of the line would them affix flagging to a convenient bush.

While landmarks were useful in maintaining alignments, the leader and the flagger made repeated checks either with an oil-damped compass or with a hand-held Brunton. On all subsequent traverses across the area, the procedure remained essentially the same until the entire unit had been covered by a series of contiguous transects.

Every site located was subjected to an intensive surface examination by the entire team. The purpose was to determine the limits of the site, to assess the nature of the cultural debris, to detect the presence of structures where they could be identified and, where diagnostic materials could be found, to collect a sample suitable for establishing the cultural and the temporal position of the site. Crew leaders were responsible for the completion of the site forms while another crew member took both black and white and color transparency photographs as the crew leader requested.

In so far as the project area is concerned, White Mesa is covered with a layer of sandy but stabilized aeolian soil which has a relief of no more than some 25 meters (80 ft.) which is manifest in gently rolling ridges and knolls. The soil is underlain by the Dakota Sandstone and, in places, the still lower Burro Canyon Formation, undifferentiated, reaches the base of the soil layer. The Burro Canyon Formation produces a green shale that was noted at many sites where it appears to have been employed in the manufacture of some kinds of flaked stone artifacts. The mean elevation of the project area is about 1710 meters (5600 ft.).

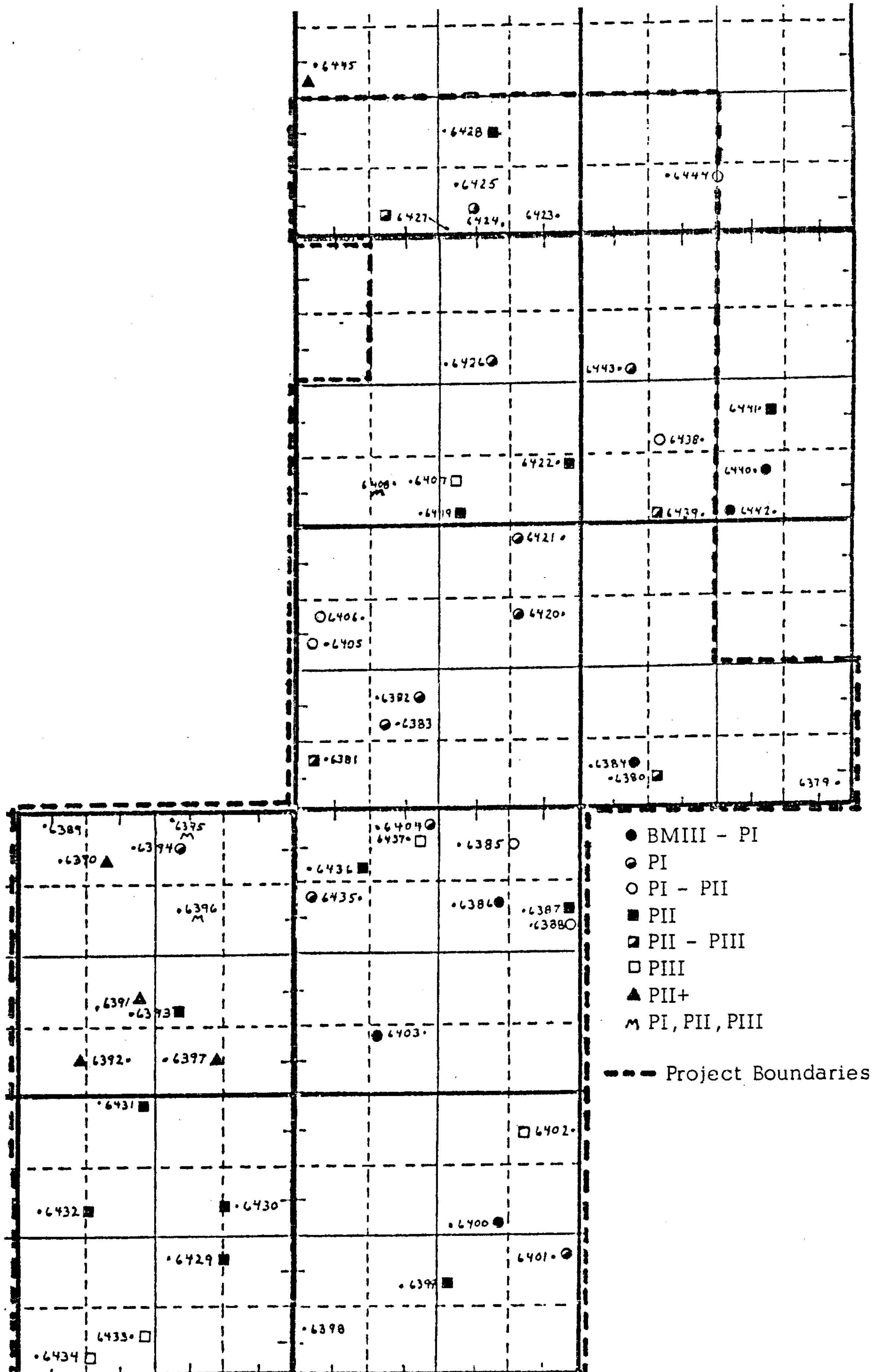
Cottonwood Canyon, which marks the western boundary of White Mesa, may have contained water during much of the year in prehistoric times. While it could thus have been a valuable source of water, USGS maps mark a spring just west of the NE corner of the NE 1/4 of Sec. 32. This spring proves to be the closest source of water for all sites in the project area. Other springs as well as the available water in Cottonwood Canyon were doubtless used, but this spring appears at present to have been the most convenient source of water for this entire area.

Limited stands of juniper and pinon exist, or have existed, in the northwest corner of the northeast quarter of Sec. 32, in the northwest corner of Sec. 28, and in the western part of much of Sec. 21. The balance of the project area, and of surrounding land as well, has been covered with a rather dense stand of sage. All of the privately owned land has, however, been railed and all of the private land in the project portions of Secs. 32 and 33 as well as in the southern three quarters of Sec. 28 has been seeded with a large drill as well. The northern quarter of Sec. 28 and the southern quarter of Sec. 21 have not been seeded. Basically, however, the natural vegetation cover appears to have been sage brush in association with some grass, snake weed, rabbit brush, salt bush, and an occasional prickley pear.

When the ceramic collections had been washed, catalogued, and labeled, Alan Spencer undertook the ceramic analysis with the aid of a binocular microscope. Once the sherds were identified, their temporal values were assigned on the basis of the dates projects in Breternitz, Rohn and Morris (1974). The combination of the dates assigned to various ceramic types found at a given site were then used to fix its probable position in time. All sites were identified as having an affiliation with the San Juan Anasazi. The counts for all diagnostic sherds are included in the narrative site descriptions that are included in an appendix to this paper.

A total of 57 sites were recorded during the survey. Of this number, four were found in areas outside the project area under circumstances which led one team to extend its coverage beyond unfenced boundaries. These sites will, however, be included in this discussion. All sites, together with symbols indicating their temporal positions, are plotted on the locational chart on the following page.

In the absence of Lino Gray sherds it proved impossible to separate Basket Maker III sites from Pueblo I sites since Chapin Gray covers the entire period from 575 to 900 A.D. In a number of cases, however, Pueblo I could be isolated on the basis of the presence of Moccasin Gray in association with Chapin Gray and Chapin B/W. This paper follows Fike and Lindsay (1976) in making no attempt to consider sites classed as PI/PII or as PII/PIII as multicomponent sites. Distinctions cannot be made at these points without excavation and there is also reason to view these ceramic associations as representative of a transitional period rather than of two distinct phases.



White Mesa Project, San Juan Co., Utah
Secs. 21, 28, 32, and 33, T37S, R22E SLM

The following list thus provides a breakdown of the sites recorded by the survey in their temporal positions. The numbers are those given the sites in the standard Smithsonian trinomial system. The first two elements of that system have been deleted for clarity.

BMIII/PI	6384, 6386, 6400, 6403, 6440, 6442	6
PI	6382, 6383, 6394, 6401, 6404, 6420	11
	6421, 6424, 6426, 6435, 6443	
PI/PII	6385, 6388, 6405, 6406, 6438, 6444	6
PII	6387, 6393, 6399, 6419, 6422, 6428	12
	6429, 6431, 6432, 6436, 6439, 6441	
PII/PIII	6380, 6381, 6427, 6439	4
PIII	6402, 6407, 6433, 6434, 6437	5
PII+	6390, 6391, 6392, 6397, 6445	5
Multicomp.	6395, 6396, 6408	3
Unident.	6379, 6389, 6398, 6423, 6425	5

Following statements made above, it will be noted that only three sites have been classed as multicomponent. The designation is based on the fact that the ceramic collections from each of these argues an occupation extending from Pueblo I through Pueblo II and into Pueblo III. Additionally, five sites have been termed PII+. This means that collections made or observed at these locations were lacking diagnostic material but that at least a few corrugated body sherds were noted. This would indicate that the site would have been used or occupied no earlier than 900 A.D. but that it might be at some time after that date.

Finally, there are five sites which, although thought to have a San Juan Anasazi cultural affiliation, are listed as having an undetermined temporal position. Four of these produced a very small number of plain ware sherds. The sherds themselves could not be identified. The fifth site lacked any ceramic evidence but contained an ovoid outline of vertical slabs measuring 1.0 by 1.5 meters. The absence of ceramics and the configuration of the structure might justify a Basket Maker II designation. This was not done, however, in view of the fact that the site produced no cultural debris of any kind. There is the further fact that 42Sa6427 produced ceramics indicative of the PII - PIII transition and a pothole which revealed a slab-lined granary.

Any attempt to elicit patterns from limited survey data must steer a cautious course between the excessive reticence which comes from a recognition of the incomplete nature of the information available and the enthusiasm for suggestive clues which may, too easily, lead to dogmatic statements based on tenuous evidence. The darkest shadow cast over this attempt is the lack of reliable data concerning the length of time that sites were occupied. At the same time, however, a study of the site counts for each of the temporal periods is suggestive.

Fike and Lindsay use a modification of the puebloan chronology derived from Jennings. In terms of the Christian calendar, their dates for each period are as follows:

BMIII	450 - 750
PI	750 - 950
PII	850 -1100
PIII	1100 -1300

A modification of this may be suggested to fit the observed data on White Mesa which would include the transitional periods:

BMIII/PI	575 - 850
PI	750 - 850
PI/PII	850 - 950
PII	950 - 1100
PII/PIII	1100 - 1150
PIII	1150 - 1250

Using this chronology in a most tentative manner, the BMIII/PI period of 275 years witnesses the occupation of the area by six sites. The PI period of 100 years, however, sees 11 sites in the project area while the PI/PII transitional period of 100 years finds only 6 sites on the mesa. In the 150 years of PII, some 12 sites are located in the same area while the PII/PIII transition finds four sites in an apparent 50 year period. In the 100 years of PIII, only 5 sites are known for the area.

Despite the fact that there is a strong possibility of some distortion in the calculations of the time involved between late BMIII and PII, and allowing for the fact that the multicomponent sites have not been taken into account, a trend would seem to emerge. Settlement on White Mesa reached a peak at perhaps 800 A.D. and the occupation remained at substantially that level, despite the apparent decline seen in these figures for the PI/PII transition, until some time near the end of PII or in the PII/PIII transition after which, the population density declined sharply and it may be assumed that the mesa was substantially abandoned by about 1250 A.D.

Fike and Lindsay expressed the view that PII patterns of settlement persist on White Mesa well into the accepted PIII era and that there is no nucleation of settlement such as reported for PIII in other parts of southeastern Utah. Certainly this survey found none of the "pure" PIII sites to be large. They are, in fact, quite small. The greater size of the multicomponent sites is, quite possibly, more a function of the total length of occupation, whether continuous or spasmodic, than it is of an increased number of persons in the terminal PIII period. Even if there were more people resident in the multicomponent sites in the final period, none of these three sites are large enough to represent the kind of aggregation generally considered characteristic of the larger PIII sites. They remain, in other words, characteristically PII.

Were it not for an accidental discovery on the final day of the field work, this paper would have persisted in seeing the absence of nucleation while remaining happily forgetful of the perils of cultural generalizations based up projects confined to modern legal boundaries. In this instance, a survey team working the western edge of Sec. 28 arrived at the northeastern corner of the NW 1/4 of the SW 1/4 of the NW 1/4 of the section. A project marker was found to verify the location. Directly to the north, in the abrupt and deep entrenchment of a tributary to Cottonwood Canyon, was a massive masonry wall between 6 and 10 meters high and sheltered in a larger overhang. Additional masonry structures were observed in other shelters to the northeast. It is unfortunate that the press of time precluded a visit to these sites and it cannot be verified that they are PIII structures. There would appear, however, to be a good possibility that they are. Although these sites are locally known, a records search shows that they remain unrecorded. The important fact is, however, that they leave open the question of the role of settlement on the mesa top. Certainly this and other sites known or yet to be recorded in Cottonwood Canyon may well represent PIII nucleated settlements of people who were still farming the top of White Mesa.

These observations bring into sharper focus the question of the function of all of the sites recorded on White Mesa. The field work in this project was handicapped by the fact that so much of the area had been railed of its sage brush cover and subsequently subjected to the disturbance of seed drills. While this type of activity would not seem to have caused disturbance in great depth, its effect on the surface features of small sites has been devastating.

Despite these limitations, however, the survey crews recorded evidence of structures at 31 of the 57 sites. At 12 sites depressions are reported with diameter ranges of from 5 to 15 meters while an additional 23 sites report evidence of other, presumably surface, structural forms. At 8 sites depressions are combined with surface structures. In all cases, the depressions should be regarded as indicating permanent use or residence for it is apparent that these will be either pit houses or kivas. Following Brew's findings at Alkalai Ridge (1946) some 15 miles east of the project area, no kiva should be anticipated with a diameter greater than 5 meters while pit houses may attain diameters as great as 18 meters.

The dimensions of most of the apparent surface structures built of stone suggest that they were used primarily for storage. The only exception to this, in terms of direct observation, is at 42Sa6441 where a PII room block measuring 12 by 3 meters is recorded. With the possible exception of two sites, the existence of structures cannot be precluded in the 26 locations where surface indications are lacking. It is well known that the archeologist finds that he must excavate precisely because all of the cultural data contained within a site is not manifest on the surface.

Further, there is nothing more than a very rough and low degree of correlation between the extent of cultural debris on the surface and the presence or absence of structures below the surface.

It would appear likely, then, that many of the smaller sites, both with and without surface indications of structures may well be what Haury (Willey, 1956, 7) has called the "farm house." He believes that the isolated one or two room structure is a concommitant aspect of nucleation and goes so far as to suggest that none of these are likely to be found dating from any point earlier than 1000 A.D. and that most come somewhat later in time, primarily in PIII and, in some areas in PIV.

It may well be, therefore, that White Mesa sites may reflect PIII nucleation trends rather more than Fike and Lindsay or, it must be admitted, this writer, have thought. Resolution of that issue requires much additional field investigation.

Recommendations

Federal statutes and administrative directives require that mitigating measures be taken to protect historic and prehistoric cultural resources either through programmed avoidance of sites or, where this is impractical, through excavation by professionally qualified archeologists. These requirements are imposed in all cases where federal lands are involved. Less well-known is the fact that the same regulations are applicable both in the case of firms using funds backed by federal guarantees or where some aspect of corporate activity requires federal licensing. In all cases, however, it is the preference of both the federal government and of archeologists as a professional group, that sites be avoided and protected whenever this is possible. When the nature of proposed land-altering projects is such that avoidance is impossible, plans must be made to recover the largest body of data at the lowest reasonable cost.

It is the view of the writer that only six sites will not require mitigation. These are 42Sa6440, 6441, 6442, and 6445, which are outside the project area. Sites 42Sa6389 and 6390 seem certainly to represent secondary depositions of material. A careful examination of erosional channels in these sites failed to produce evidence of midden and it appears that these may safely be ignored.

While cost estimates for survey work can be calculated in advance with a good deal of precision, estimates of excavation costs must necessarily remain open-ended against the inevitable subsurface contingencies. The approach to be used and the schedule to be maintained must also bear a relationship to the program of the development. Will all of the land be disturbed early in the project or will expanded land use be a matter of increments at intervals over a number of years?

This report will make no estimate of cost outlays except to say that, if sites cannot be avoided and if the entire project area is to be placed in industrial use, the costs will be substantial. Under such circumstances, the methodologies used can have a very direct bearing on costs.

In most sites, for example, much time and money can be saved with a minimal loss of cultural resources if testing is initiated through trenching with a back hoe, provided, of course, that the work is supervised by a competent archeologist. In this way the extent of the excavations that will be needed can be determined quickly and excavators will be guided to the most significant parts of each site without protracted exploratory hand excavation. There must, however, be no time lag between these tests and the start of excavations since the information revealed to archeologists will also be revealed to the vandals who have been exceptionally active in San Juan County for a good many years.

It is recommended that the developers facing mitigation requirements contact scholars and institutions with the longest record of survey and excavation in the San Juan Anasazi culture area. Each should be asked for estimates and for a recommended methodological approach to the project. It may be found that the use of more than one group would prove to be most advantageous. It does seem certain, however, that the greatest economy will be obtained by reaching agreement with an institution with experience in the area rather than accepting an apparently lower cost estimate from a group unfamiliar with the area and the culture.

At the present time the institutions with the greatest long-term experience in the area would include the Antiquities Section of the State Division of History, the University of Utah, Brigham Young University, the University of Colorado, San Jose State University, and Washington State University. This is not meant as an endorsement of any particular institution nor is it meant to exclude another group working in the area with which the writer is unfamiliar.

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APPENDIX

NARRATIVE SITE DESCRIPTIONS

NARRATIVE SITE DESCRIPTIONS

42Sa6379 - At an elevation of 1710 meters, the central and only feature of the site is an oval outline of vertical stone slabs measuring 1.0 by 1.5 meters. No evidence of activity is apparent on the surrounding surface. The site is on the upper part of the N bank of a wash which drains down to the NNW. The aeolian soil slopes down to the N with a floral cover dominated by sage brush in association with rabbit brush, Russian thistle and a single small juniper. The vertical slab form of the element points to a pueblo affiliation but a more precise assignment cannot be made. It should be noted that Bruce Louthan of the Moab District of the BLM reports that Matheny of BYU has found that features of this type frequently prove to be ventilator openings to pit houses for which there is no surface evidence. The possibility should be taken into account.

42Sa6380 - The distribution of cultural debris on this heavily disturbed aeolian soil extends over an area of at least 120 meters in diameter. The disturbance of the area may be related to the construction of the uranium ore receiving facility which is just to the E. Evidence of disturbance is supported by the fact that Russian thistle is the sole covering vegetation. With an elevation of 1710 meters, the area slopes down to the W at a gentle 3°. Analysis revealed the following diagnostic sherds: 4 Mesa Verde Corrugated rims (23 corrugated body sherds), 1 Mancos B/W, 9 McElmo B/W (9 white ware body sherds). Following dates suggested by Breternitz, the site should be classed as San Juan Anasazi, PII-PIII with the most likely dates of occupation coming at about 1100 to 1150 A.D.

42Sa6381 - The cultural debris of this site, primarily sherds, spreads over an area 50 meters in diameter. The area may have been enlarged somewhat during the process of chaining and seed-drilling. The aeolian soil slopes down to the NE at a gentle 2° while the present vegetation is composed of sage brush, salt bush, Russian thistle, rabbit brush, grass, and snake weed. The elevation is 1710 meters. A rather confined scatter of stone rubble suggests the possibility of a crescent or an "L" shaped structure open to the S or SE. Ceramic analysis reveals the following association of diagnostic sherds: 4 Mesa Merde Corrugated rims (71 corrugated body sherds), 4 Mancos B/W, 15 McElmo B/W, 105 Mesa Verde B/W (53 slipped white ware sherds), and 1 Deadmans B/R. Following dates offered by Breternitz, the site should be considered a San Juan Anasazi occupation during the PII-PIII period with the most likely dates calculated at 1100-1250 A.D.

42Sa6382 - This site is 40 meters in diameter and was found at an elevation of 1710 meters on aeolian soil that slopes down to the SE at 4°. The area has been railed of its original sage brush cover and the surface was even more disturbed by the use of a seed drill. The present vegetation includes

Russian thistle, grass, and rabbit brush. Analysis of the collected sherds produced the following diagnostic materials: 5 Chapin gray, 2 Mancos Corrugated rims (19 corrugated body sherds), 3 Chapin B/W, 8 Mancos B/W, 1 Abajo R/O, and 1 Deadmans B/R. Breternitz dates would argue a San Juan Anasazi occupation in late PI or early PII at some time around 900 A.D.

42Sa6383 - With an elevation of 1710 meters, the site area extends over a 60 meter diameter on the top of a low knoll which drops in all directions at about 6°. As the result of the railing of sage brush and the use of a seed drill, the aeolian soil now produces some grass and a good deal of Russian thistle. A graded road to three small powder magazines cuts across the middle of the site. In addition to ground stone fragments noted, the sherd collection produced the following diagnostic samples: 141 Chapin gray, 31 Moccasin gray, 13 Chapin B/W, and 4 Deadmans B/R. Using the Breternitz dates, the combination suggests a San Juan Anasazi' PI occupation between 800 and 900 A.D.

42Sa6384 - The site is situated on a slope that drops down to the W at 6° at an elevation of 1710 meters. A concentration of unmodified stone which may mark the original site area lies near the top of the slope. Below this stone is a limited scatter of sherds and flakes which may have been moved by runoff flow or by the activity of railing the sage and seeding with a drill. The cover is grass with a curious absence of Russian thistle. Within the 35 meter diameter of the site, a collection of sherds was made which reveals the following: 98 Chapin gray and 2 Chapin B/W. This argues for a San Juan Anasazi BMIII-PI occupation at some time between 575 and 900 A.D. if the Breternitz dates are accepted.

42Sa6385 - Situated on the 3° SE slope of a knoll, this site is 50 meters in diameter and is found at an elevation of 1710 meters. The area has been railed of its original sage brush cover and now the aeolian soil produces some grass. Russian thistle, and rabbit brush. While there was no evidence of structures, the sherd collection produced, after analysis, this breakdown of diagnostic items: 3 Chapin gray; 1 Moccasin gray; 2 Mesa Verde Corrugated rims, 4 Mancos Corrugated rims (96 corrugated body sherds), 1 Chapin B/W, 36 Mancos B/W, 5 Deadmans B/R, and 1 Bluff B/R. For such a collection, a reading of Breternitz argues a San Juan Anasazi PI-PII site use sometime between 875 and 1125 A.D.

42Sa6386 - A small site of 30 meters diameter was found near the crest of a low ridge with a 5° slope down to the N. The elevation is 1710 meters. The area has been railed and seeded with a drill. Grass is accompanied by Russian thistle and snake weed. The site area is marked by a scatter of unmodified stone which may indicate the remnants of a disturbed structure. A number of mano fragments were also noted. The ceramic collection produced 55 Chapin gray and 3 Chapin B/W sherds which, according to Breternitz, would mean a BMIII-PI San Juan Anasazi occupation at some time between 575 and 900 A.D.

42Sa6387 - At an elevation of 1710 meters, this site was found to extend over an area 40 meters in diameter on ground that slopes down to the W at 6°. Since the original sage brush has been railed, the cover consists of grass, Russian thistle, and 2 small juniper trees. The sherd and lithic scatter also revealed a number of mano fragments. Ceramic analysis following Breternitz suggests a San Juan Anasazi occupation in Late PI-PII falling between 990 and 1000 A.D. Diagnostic ceramics supporting this include: 6 Chapin gray, 5 Mancos Corrugated rims (66 corrugated body sherds), 1 Chapin B/W, 5 Cortez B/W, 30 Mancos B/W and 8 Deadmans B/R.

42Sa6388 - This site was located on the slope of the same knoll as 42Sa6387 although clearly separate from it. Here the ground slopes to the SW at 5° and the site is 30 meters in diameter. The elevation is 1710 meters. Railing and seeding has removed any surface evidence of structures that may have existed. At present a sparse stand of grass covers the entire site. The analysis of diagnostic sherds recovered includes: 68 Chapin gray, 2 Mancos Corrugated rims (10 corrugated body sherds), 4 Chapin B/W, 4 Bluff B/R, and 2 Deadmans B/R. The Breternitz analysis points to a late PI and early PII San Juan Anasazi occupation between 875 and 925 A.D.

42Sa6389 - One of the few sites to be found in a juniper-pinon stand, this site measured 20 meters N-S and 40 meters E-W and was situated on a slope that falls to the NW at 5°. The vegetation consists of juniper and pinon with an understory of sage brush and rabbit brush. The elevation is 1710 meters. The cultural material is confined to 4 non-diagnostic plain ware sherds and to a thinly distributed assemblage of secondary flakes. Although there is a possibility that this material may be a secondary deposit, the site may tentatively be considered to indicate a San Juan Anasazi use at some time after about 600 A.D.

42Sa6390 - This site, located SE of 42Sa6389, is also S of a road that angles through the NW corner of the project area in the NW 1/4 of the NW 1/4 of the NE 1/4 of Section 32. This site, measuring 35 meters E-W and 50 meters N-S, is at an elevation of 1710 meters and is also on the same slope as the previously mentioned site. Here too, the cultural debris was found on a slope dropping to the NW at 8° in a stand of juniper and pinon with an undisturbed understory of sage brush accompanied by some rabbit brush. It is possible that the material from these two sites has drifted down from a low ridge to the SE where both railing and chaining are evident. The ridge top failed, however, to show any indication of a site. In the site area a slab metate and 3 mano fragments were found. A small sherd collection produced 5 corrugated body sherds, 1 Chapin gray which may have come from a corrugated vessel, and 2 white ware sherds. It is thus possible only to postulate a San Juan Anasazi use of the area at some time after 900 A.D.

42Sa6391 - Grass, Russian thistle, and snake weed cover the 3° slope to the W on the aeolian soil of the site. With an elevation of 1710 meters, the site has an area 40 meters in diameter. Cultural materials occured as a very thin scatter of sherds, flakes, and ground stone fragments near the top of a very low ridge. Although no ceramic collection was made, painted, corrugated and B/R sherds were noted. These argue an Anasazi occupation of 900 A.D. or later.

42Sa6392 - At an elevation of 1710 meters, this site is 40 meters in diameter and is found in a very shallow, natural crescentic depression with an opening drainage falling at 3° to the W. The area has been railed and seeded and the aeolian soil now supports grass, snake weed, and some sage brush. The thin scatter of cultural materials included flakes, ground stone fragments, and a few sherds either painted or corrugated which suggests a San Juan Anasazi occupation some time after 900 A.D.

42Sa6393 - Measuring 50 meters in diameter, this site is at an elevation of 1710 meters and has a slope down to the W at 3°. The original sage brush cover has been railed and the aeolian ground seeded with the result that the present cover is composed of grass, some sage brush, prickley pear, and some thistle. Cultural materials include a notched ground axe head, mano fragments, cores and flakes. Sherds collected produced the following diagnostic items: 4 Mancos Corrugated rims (41 corrugated body sherds), 18 Mancos B/W, and 5 Deadmans B/R. Following Breternitz, this suggests a San Juan Anasazi occupation in PII times, probablu between 900 and 1000 A.D.

42Sa6394 - This site yielded the usual sherd and lithic assemblage but it differs from those recorded just before it in that, while the area has been railed, the seed drill was apparently not used and the darker soil of the site is thus more visible. The aeolian soil slopes down to the W at 6° while the vegetation includes Russian thistle, sage and some grass. The elevation is 1710 meters. Analysis of the sherds collected identifies 7 Chapin gray, 2 corrugated body sherds, and 7 Chapin B/W. A reading of Breternitz projects San Juan Anasazi use of the area between 850 and 900 A.D. - perhaps slightly later.

42Sa6395 - Located on the point of a very low ridge, the ground around this site slopes down to the SE, S and SW at 5°. As the site extends under the fence marking the N boundary of Section 32, it has apparently been railed but not seeded. With an area 100 meters in diameter, the ground cover includes Russian thistle, sage, grass, and rabbit brush. The surface revealed a very heavy sherd scatter with ground stone fragments, secondary flakes, and cores. Mounded areas of heavy stone rubble suggest a square or circular structure at least 15 meters in diameter. It seems quite possible that the large depression at the center of this feature may be a kiva. The analysis of the sherd collection revealed 8 Chapin gray, 3 Mancos Corrugated rims, 5 Mesa Verde Corrugated rims, 6 Chapin B/G, 4 Cortez B/W, 11 Mancos B/W, 46 Mesa Verde B/W (56 white ware body sherds), 1 Deadmans B/R, 4 Abajo R/O, and 9 Tusayan polychrome. Breternitz supplies dates which would argue for a lengthy or for a multiple San Juan Anasazi occupation from PI to PIII times with dates ranging from no later than 900 to 1200 A.D.

42Sa6396 - This site was found near the top of a low ridge which had a slight slope down to the SE at 5°. The area has been railed and seeded with the result that the cover is now composed of sage, rabbit brush, thistle and grass. With an area measuring 50 meters in diameter and an elevation of 1710 meters, the central feature of the site is a circular depression 15 meters in diameter. A mounded area on the S, E, and W sides of the depressson suggests a square or a U shaped surface structure. A small concentration of cultural debris was noted on a low knoll 20 meters to the SW of the edge of the site. The ceramic collection revealed, when analyzed, the diagnostic sherds to include 62 Chapin Gray, 1 Mancos Corrugated rim (47 corrugated body sherds). 8 Chapin B/W, 1 Cortez B/W, 39 Mancos B/W, 4 Deadmans B/R and 3 Tusayan Polychrome. Breternitz would thus seem to indicate a long or a multiple San Juan Anasazi occupation from late PI to early PIII taking place within the minimum time span of 900 to 1150 A.D.

42Sa6397 - This site area measures 100 meters in diameter and is located at an elevation of 1710 meters. The aeolian soil slopes down to the NE and E at 3° and, as the result of railing and seeding, the present cover includes grass, some sage brush, rabbit brush, and some Russian thistle. No collection was made fom the thin flake and sherd scatter which probably has been "smeared" by the seed drill, but the plain corrugated, and painted sherds noted in the field suggests an early PII San Juan Anasazi use probably around 900 A.D.

42Sa6398 - This site with its 40 meter diameter was located in an undisturbed sage brush area where some grass grows in the interspaces. With an elevation of 1710 meters, the slope is to the NE at 4°. The site was characterized by a rather light scatter of sherds and flakes, a mano fragment and other ground stone fragments. No structural element could be identified. Although no collection was made, the sherds suggest, in the absence of the corrugated form, an occupation or use of the area some time between 800 and 900 A.D.

42Sa6399 - This rather nebulous site was found near the S end of a small ridge in an area of undisturbed sage, grass, and snake weed. With an elevation of 1710 meters and an area 40 meters in diameter, the surface of the aeolian soil slopes down at 6^{o} in all directions except to the N. There is a good supply of potential building stone in the area although no structural features could be identified. The contours of the powdery soil suggest that some structures may exist. The ceramic collection was quite light but members of the survey team remarked that, in previous passes to the S, random sherds had been noted with some frequency. The analysis of sherds collected at the site reveal 3 Chapin Gray, 1 Mancos Corrugated rim (41 corrugated body sherds), 13 Mancos B/W, 6 McElmo B/W (12 white ware body sherds), and 2 Deadmans B/R. A reading of Breternitz suggests a PII San Juan Anasazi occupation that probably occured between 1000 and 1100 A.D.

42Sa6400 - This small site of only 15 meters diameter, slopes down to the E at 4^{o}. The undisturbed aeolian soil supported an overstory of sage brush with snake weed and some grass as the understory. The elevation is 1710 meters. The limited scatter of sherds, flakes, and ground stone fragments, perhaps represents only the residue of materials that have largely been carried away by runoff. No structures were evident. The small sherd collection analyzed reveals 25 Chapin Gray, 5 Moccasin Gray, and 8 Chapin B/W. This would argue a San Juan Anasazi use in the PI period between 775 and 900 A.D.

42Sa6401 - A site was found on a low knoll with a 4^{o} slope down in all directions save to the N. The aeolian soil was covered with sage, snakeweed, and some grass throughout its 20 meter diameter and beyond as well. With an elevation of 1710 meters, the site produced only limited cultural material. The fact that the 4 Chapin gray sherds were accompanied by a large corner-notched dart point would appear to suggest an occupation at around 575 A.D. While no evidence of structures was found, the presence of ground stone fragments argues something more than a casual use area.

42Sa6402 - At this location a light sherd and flake scatter covered an area 20 meters in diameter where the aeolian soil was covered with a rather open sage brush stand with a grass understory. The ground slopes down to the W at 5^{o} while the elevation is 1710 meters. No structural evidence could be identified but the analysis of sherds recovered produced 6 Mesa Verde Corrugated rims (28 corrugated body sherds), 3 Mancos B/W, 4 McElmo B/W, and 5 Mesa Verde B/W. The combination suggests a PIII use between 1150 and 1250 A.D.

42Sa6403 - Located in an area that has been railed and seeded, this site is at an elevation of 1710 meters and has a vegetation cover of grass, snake weed, and Russian thistle. The aeolian soil slopes down to the

SE at 4^{o}. A fair scatter of sherds, flakes and ground stone fragments extends over an area 30 meters in diameter. No structures could be identified but some mounded areas fully covered with soil and the presence of scatters of stone rubble suggest that structures do exist. The 15 Chapin Gray sherds that comprise the total site collection would indicate a San Juan Anasazi use of the site in either BMIII or PI times at some point in time between 575 and 900 A.D.

42Sa6404 - Measuring 40 meters in diameter, this site produced a limited assortment of flakes, a few ground stone fragments, and a modest ceramic collection. No structures were identified. With an elevation of 1710 meters, the ground slopes down to the E at 6^{o}. The area has been railed and seeded and the cover includes grass, some sage, rabbit brush, and snake weed. The ceramic collection produced diagnostic sherds including 65 Chapin Gray, 4 Chapin B/W and 1 Mancos B/W. The Breternitz dates suggest a San Juan Anasazi use in late PI or early PII at some time close to 900 A.D.

42Sa6405 - The most visible feature at this site is a circular depresssion 5.5 meters in diameter. Other elements may exist but they could not be identified with assurance. Most of the cultural debris was found down to the SW of the site despite the fact that the slope in the site area is down to the NW at 5^{o}. This suggests a trash area to the SW. The aeolian soil has been railed and seeded and the present cover includes sage, grass, Russian thistle, and snake weed. The elevation is 1710 meters. Cultural debris included sherds, secondary flakes, metate and mano fragments, and a few cores. A ceramic analysis produced 4 Chapin Gray, 1 Moccasin Gray, 1 Mancos Corrugated rim (13 corrugated body sherds), 6 Mancos B/W (3 white ware body sherds), 1 Abajo R/O, 1 Deadman s B/R and 48 unslipped red sherds. The Breternitz analysis suggests that the San Juan Anasazi used the site in PI-PII times between about 850 and 950 A.D.

42Sa6406 - This site, measuring 30 meters in diameter, was located at a point where the aeolian soil sloped down to the NW at 6^{o}. The elevation is 1710 meters. The area has been railed and seeded and the present vegetative cover consists of sage brush, grass, and rabbit brush. Cultural materials involved a light scatter of flakes, ground stone fragments and sherds. No structural features could be identified. Ceramic analysis produced 123 Chapin Gray sherds and 2 corrugated body sherds. If the corrugated body sherds are significant, a late PI or an early PII San Juan Anasazi occupation is suggested although it could be earlier if the presence of the 2 corrugated sherds is fortuitous.

42Sa6407 - This small site was found just above a slope that drops to the NW at 5^{o}. Measuring some 20 meters in diameter, the site and the surrounding area has been railed and seeded. Present cover includes sage brush, grass, and 1 dead juniper. Near the dead tree a linear cluster of stone rubble running N-S, measures 3 meters long and 0.75 meters wide and may represent a surface storage element. A thin scatter of cultural debris included sherds, flakes, and ground stone fragments. Analysis of the sherds revealed 2 Chapin Gray, 2 Mesa Verde Corrugated rims (11 corrugated body sherds), 2 McElmo B/W, 7 Mesa Verde B/W (2 white ware body sherds). Discounting the 2 Chapin Gray sherds as possibly from a corrugated vessel, the Breternitz dates suggest a San Juan Anasazi occupation in PIII at some time between 1200 and 1300 A.D.

42Sa6408 - The central feature of this site is two circular depressions. The largest of these is 10 meters in diameter while, just to the NE, the other is 8 meters across. Mounded areas adjacent to the circles suggest L shaped surface structures with kivas, represented by the depressions, at the inner angles of the Ls. 20 meters downslope to the E was a large pot hole revealing some evidence of masonry not apparent near the depressions. The site is at an elevation of 1710 meters and has an overall diameter of 60 meters. It is not clear whether or not the area has been railed and seeded but the present cover includes sage brush, grass, snake weed, prickley pear, and a small juniper. Two ceramic collections were made. One was from the surface while the other is composed of sherds taken from the spoil dirt around the pot hole left by vandals. The surface collection produced, upon analysis, 6 Chapin Gray, 1 Moccasin Gray, 1 Mesa Verde Corrugated rim (40 corrugated body sherds), 1 Chapin B/W, 10 Mancos B/W, 7 McElmo B/W, 1 Bluff B/R and 1 Tusayan polychrome. The material left by vandals included 12 Chapin Gray, 1 Mancos Corrugated rim, 1 Mesa Verde Corrugated rim (78 corrugated body sherds), 15 Mancos B/W, 32 McElmo B/W, 1 Abajo R/O, and 10 Deadmans B/R. Following Breternitz, a San Juan Anasazi occupation or multiple occupation for a period ranging from PI through PIII is suggested for the years from about 850 to 1150 although this period might be contracted somewhat.

42Sa6419 - This site, 75 meters in diameter, sits on a low ridge that has been railed and chained and where the aeolian soil is now covered with a sage and grass association. At an elevation of 1710 meters, the surface slopes down to the N at 7°. Cultural debris appeared in the form of a fairly dense scatter of sherds, flakes, and ground stone fragments. Two stone clusters suggest wall elements but no rooms could be defined. A number of low, elongated mounds also suggest linear structural elements but their existance is not established. Ceramic analysis produced 37 Chapin Gray, 4 Mancos Corrugated rims (50 corrugated body sherds), 1 Chapin B/W, 59 Mancos B/W, 9 Deadmans B/R, and 1 Tusayan Polychrome. According to the Breternitz cslculations, this argues a San Juan Anasazi PII occupation at some time between 900 and 1100 A.D.

42Sa6420 - The sherds, flakes, and ground stone fragments of this small scatter appears to have been "smeared" by chaining and railing to a diameter of some 40 meters. With a 1710 meter elevation, the surface slopes down both to the E and the W at 7° while the present cover for the aeolian soil is sage, grass, and rabbit brush. No structures were visible. Ceramic analysis, following Breternitz, produced 46 Chapin Gray, 1 Moccasin Gray, 7 corrugated body sherds, 2 Chapin B/W, and 1 Mancos B/W. This suggests an occupation of the San Juan Anasazi in late PI or early PII at about 900 A.D.

42Sa6421 - At a point where the aeolian surface soil slopes down to the E at 5° this site covers an area measuring 50 meters in diameter. The site does not appear to have been railed or seeded but the present vegetative cover is limited to sage brush and to grass. The elevation is 1710 meters. Cultural materials occur in the form of a medium dense sherd scatter along with flakes and ground stone fragments. Also noted was a dense scatter of stone rubble and the fact that the soil here was more powdery than sandy - suggesting an ash content. While there is no direct evidence of structures, the stone rubble makes them seem to be likely. Analysis of the ceramic collection produced 84 Chapin Gray, 3 corrugated body sherds, and 3 Chapin B/W. This argues a late PI San Juan Anasazi occupation around 900 A.D. although a discounting of the 3 corrugated sherds could push this back to an earlier time.

42Sa6422 - This small sherd and flake scatter was found on the SW slope of a low hill where the surface drops at 5°. The site is 20 meters in diameter and the cover is confined to sage and Russian thistle. The area has been heavily disturbed by railing although it does not appear to have been seeded. The elevation is 1710 meters. No structures were found but a small ceramic collection has produced 2 Mancos Corrugated rims (18 corrugated body sherds), 15 Mancos B/W (12 white ware body sherds), and 5 Deadmans B/R. The Breternitz dates suggest a PII San Juan Anasazi occupation at some time between 900 and 1000 A.D.

42Sa6423 - Again on ground that has been railed but not seeded, this site had a diameter of 30 meters on ground that slopes to the S at 4°. The aeolian soil is now covered by Russian thistle, grass, some sage, and 4 small juniper. The elevation is 1710 meters. A very thin scatter of sherds, flakes and ground stone fragments produced only plain ware sherds. Since no collection was made the site can only by ascribed to the San Juan Anasazi, probably in BMIII or PI times between 575 and 900 A.D. No structures were observed.

42Sa6424 - With an elevation of 1710 meters, this site covers an area 30 meters in diameter. The aeolian soil slopes down at 3° to the E, SE and S while the cover, after heavy distrubance by railing and seeding, is now composed of rabbit brush, Russian thistle, and some sage brush. An amorphous cluster of stone rubble may represent the remains of a small structure. A small sherd collection has been found to include 25 Chapin

Gray, 5 Mancos Gray, and 8 Chapin B/W. According to Breternitz, this should place the San Juan Anasazi occupation rather neatly in late PI between 875 and 900 A.D.

42Sa6425 - In an area disturbed by railing and seeding, the small sherd scatter covers an area with a diameter of 30 meters - which may represent a "smearing" by the seeding operation. The aeolian soil slopes down to the E at 3° while the present vegetation consists of sage brush, Russian thistle, grass, and some rabbit brush. Flakes and some ground stone fragments were noted, an occupation may, with caution, be postulated for the San Juan Anasazi between 575 and 900 A.D. either in BMIII or PI times.

42Sa6426 - This site covers an area with a diameter of 35 meters and is located on a ridge that drops down to the E, SE, and S at 7°. The cover is sage brush, rabbit brush, and several small juniper together with some grass. Although the area has not been railed, a vehicle track has beaten down the brush across the N end of the site. The elevation is 1710 meters. While no structures were identified with certainty, a cluster of stone rubble measuring 2 meters N-S and 1 meter wide was noted. There is a possibility that others may exist in the rather dense stand of brush. A light scatter of flakes and sherds accounted for the cultural debris. Analysis of the ceramics revealed 27 Chapin Gray, 1 Moccasin Gray, and 1 Chapin B/W. Dates suggested by Breternitz would thus fix a San Juan Anasazi PI occupation between 775 and 900 A.D.

42Sa6427 - This site was found near the E edge of a fairly level ridge top with the slope of the aeolian soil dropping to the E at 6°. The area may not have been railed and the present vegetation includes sage, grass, 1 juniper, and snake weed. With an elevation of 1710 meters, the site has a diameter of 75 meters and may be larger. Structural elements were only suggested on the surface but vandals had dug out a slab lined granary in the NW quarter of the site. This feature measures 3 meters long and nearly 2 meters wide. The digging produced a number of slab metates and manos. Additional pot hunting down the slope was visible but nothing could be determined as to the depth of the midden. Other mounded areas suggest but do not outline linear or L shaped surface structures. The ceramic collection produced 1 Mesa Verde Corrugated rim (54 corrugated body sherds), 2 Chapin B/W, 14 Mancos B/W, 15 McElmo B/W (11 white ware sherds), 1 Deadmans B/R and 1 Tusayan Polychrome. Breternitz dates thus suggest a PII-PIII San Juan Anasazi occupation for the period between 990 and 1150.

42Sa6428 - This small site produced a light sherd scatter among the heavier concentration of apparent stone rubble. A single piece of bruned clay is the only evidence of a structure - possibly although not necessarily jacal.

The elevation is 1710 meters and the site diameter is 20 meters. The slope is down to the NW at 7°. Although the site area has not been chained or railed, it has been a cattle "yarding" area because of the presence of a number of juniper. Other vegetation includes sage, grass, and snakeweed. Analysis of the small sherd collection produced 2 Chapin Gray, 11 corrugated body sherds, 2 Mancos B/W, and 1 Abajo R/O. Following Breternitz, an accounting for all of these sherds would postulate a late PI or an early PII San Juan Anasazi occupation between about 900 and 950 A.D.

42Sa6429 - With a diameter of 15 meters and an elevation of 1710 meters, the aeolian soil of this site area slopes down to the SE at a barely perceptable 1°. The ground has been railed and seeded and the present vegetation is restricted to grass and Russian thistle. The site is marked by a small block of from 1 to 3 rooms, apparently of coursed stone although burned clay fragments may also suggest the use of jacal. The analysis of the sherd collection following dates given by Breternitz produces 4 Mancos Corrugated rims (19 corrugated body sherds), 7 Mancos B/W (9 white ware sherds), 3 Deadmans B/R, and 1 McElmo B/W. This argues a PII occupation by the San Juan Anasazi between 900 and 1000 A.D.

42Sa6430 - Situated in an area that has been fully railed and seeded, this site is on a 3° slope to the SW with grass and Russian thistle forming the only cover for the aeolian soil. The elevation is 1710 meters and the site measures 35 meters by 30 meters. The principle cultural feature is a circular depression 5 meters in diameter. Although this is an apparent PII site, evidence of jacal suggests that this was a pit house. Cultural materials included primary and secondary flakes, a metate fragment and 3 hammerstones. A ceramic analysis of magerial collected produced 2 Chapin Gray, 2 Mancos Corrugated rims (40 corrugated body sherds), 30 Mancos B/W (21 white ware sherds), and 1 Deadmans B/R. This argues a San Juan Anasazi PII occupation between 900 and 1000 A.D.

42Sa6431 - With a 30 meter diameter, this site is located on aeolian soil that slopes to the SW at 3°. The area has been railed and seeded and the present vegetation is confined to Russian thistle and some grass. The elevation is 1710 meters. Cultural debris consists of primary and secondary flakes, a hammerstone, 1 mano and numerous ground stone fragments as well as sherds. Sherds collected have been analyzed to reveal 2 Chapin Gray, 1 Mancos Corrugated rim (16 corrugated body sherds), 16 Mancos B/W, and 3 Deadmans B/R. This would, according to Breternitz, argue a PII San Juan Anasazi occupation between 900 and 1000 A.D.

42Sa6432 - The central feature of this site is a depression 10 meters in diameter with a trash midden lying just to the SW of it. The site is on a small ridge of aeolian soil which slopes down to the SE at 2°. With an elevation of 1710 meters, the area has been railed and seeded and present vegetation is confined to 1 small juniper, Russian thistle, and some grass. Cultural debris included flakes, a hammerstone, a metate fragment, and other ground stone fragments and sherds. Analysis of the sherds produced 46 Chapin Gray with an additional 14 sherds of the same type but of unusal thickness, 4 corrugated body sherds, and 6 Mancos B/W. While it does not quite accord with Breternitz, a PII San Juan Anasazi occupation is postulated for the period between 900 and 950 A.D.

42Sa6433 - A circular depression 5 meters in diameter is surrounded by midden that apparently represents trash deposits. The aeolian soil appears to be perfectly level, perhaps the result of railing and seeding. Present vegetation is limited to a sparse cover of grass. The site measures 10 meters in diameter and the elevation is 1710 meters. Cultural debris includes flakes, two manos, ground stone fragments, and sherds. Ceramic analysis revealed 13 corrugated body sherds, 26 Mesa Verde B/W and 29 white ware sherds. This rather simple assortment follows Breternitz to postulate a San Juan Anasazi PIII occupation between 1200 and 1300 A.D.

42Sa6434 - Again resting upon aeolian soil that appears to be quite level, this site is at an elevation of 1710 meters and has a diameter of 15 meters. The vegetation in the area is composed entirely of Russian thistle with some grass. Two contiguous depressions mark the focus of the site while cultural material includes both metate and mano fragments as well as other ground stone fragments, primary and secondary flakes, and a modest collection of sherds found to include 1 Mesa Verde Corrugated rim (6 corrugated body sherds), 1 Mancos B/W, 1 McElmo B/W, 4 Mesa Verde B/W and 5 white ware sherds. A study of Breternitz suggests a PIII San Juan Anasazi occupation between 1125 and 1225 A.D.

42Sa6435 - With a 20 meter diameter, this site is marked by a scatter of flakes and sherds with no evidence of structures. The site is on a low ridge with a slope to the E at 3°. The area has been railed and seeded and the present cover is given exclusively to Russian thistle. The elevation is 1710 meters. An analysis of the Sherds collected produced 5 Chapin Gray, 14 corrugated body sherds, 3 Chapin B/W, 10 Mancos B/W (11 white ware sherds), and 3 Deadmans B/R. This assortment argues a PI-PII occupation for the San Juan Anasazi between 875 and 1000 A.D.

42Sa6436 - Central to this site is a small structure of shaped stone comprising one or two rooms. The site is on aeolian soil sloping at 1° to the E. The area has been railed and seeded and the present cover is composed of Russian thistle with some salt bush. The site diameter is 15 meters and the elevation is 1710 meters. Primary and secondary flakes were accompanied by a few sherds. Although these were not collected, field identification of Mancos Corrugated and Mancos B/W assigns a PII San Juan Anasazi occupation of from about 990 to 1150 A.D.

42Sa6437 - This site, 30 meters in diameter at an elevation of 1710 meters, rests on aeolian soil that slopes down to the E at 2^{o}. The site is just above a modern "root cellar". Stone rubble suggests a small structure apparently no more than 1 meter square. The area has been railed and seeded and present vegetation includes some sage brush and Russian thistle. Cultural materials were confined to primary and secondary flakes and sherds. The sherds include 6 corrugated body sherds, 2 Mancos B/W, 22 Mesa Verde B/W (7 white ware sherds) and 2 Deadmans B/R. The Breternitz study suggests a PIII occupation by the San Juan Anasazi between 1150 and 1300 or perhaps a bit later.

42Sa6438 - This site rests on a small knoll where the central feature is a depression 2 meters in diameter and 50 cm. deep. The ground slopes to the NE at a very gradual 1^{o}. The area has been railed and seeded and the aeolian soil is presently covered with grass, sage, Russian thistle and one juniper. The site measures 40 meters by 30 meters and the elevation is 1710 meters. Cultural material observed includes primary and secondary flakes, mano and metate fragments, hammerstones, and sherds. The ceramic analysis reveals 31 Chapin Gray, 2 Moccasin Gray, 4 Chapin B/W, 49 Mancos B/W (9 slipped white ware), 6 Deadmans B/R, and 2 Tusayan Polychrome. Following the lead of Breternitz, this suggests a PI-PII San Juan Anasazi occupation for a period between 850 and 1050 or perhaps a bit later.

42Sa6439 - This site is located on aeolian soil with a slope of only 1^{o} to the NW. The area has been railed and seeded and the present cover is confined to Russian thistle with some grass. At an elevation of 1710 meters and a site diameter of 30 meters, the central feature is a depression 8 meters in diameter and 75 cm. deep with a small block of from 1 to 3 rooms to the SE of the depression. The block is formed of coursed stone and measures 4 by 3 meters. Cultural material included a slab metate and a basin metate, mano fragments, primary and secondary flakes, hammerstones and sherds. Ceramic analysis identified 3 Chapin Gray, 3 Mesa Verde Corrugated rime (80 corrugated body sherds), 14 Mancos B/W, 33 Mesa Verde B/W (24 white ware sherds). If the Chapin Gray be considered undecorated parts of corrugated vessles, a PII-PIII San Juan Anasazi occupation can be postulated for a time about 1000 to 1300 A.D.

42Sa6440 - Located on aeolian soil with a slight 1^{o} slope to the S, this site area has been railed and seeded and the present vegetation is limited to Russian thistle and some sage brush. The elevation is 1710 meters and the site is some 15 meters in diameter. The site reveals both some apparent building stone and burned adobe rubble. The rubble is evident both on the surface and in a pot hole dug by vandals. Cultural debris was confined to flakes, ground stone fragments and sherds. Sherds include 17 Chapin Gray, 3 Chapin B/W, and 2 white ware sherds. This argues, according to Breternitz, a BMIII-PI San Juan Anasazi occupation some time between 575 and 900 A.D.

42Sa6441 - The central feature at this site is a room block measuring 12 by 3 meters and apparently made of coursed stone though the structure is now seriously damaged as the result of railing and seeding. Some 5 meters W of the room block is a well-defined flaking area. The entire site is 35 meters in diameter. The vegetation is confined to Russian thistle and wolf berry. The aeolian soil of the site slopes at 2° to the SE and the elevation is 1710 meters. Cultural debris included primary and secondary flakes, a mano, ground stone fragments, and sherds. Sherds include 15 Chapin Gray, 18 corrugated body sherds, 3 Chapin B/W, 48 Mancos B/W (16 white ware sherds), 4 Deadman B/R, and 1 Tusayan Polychrome. According to Breternitz, this combination of sherds might be found between 900 and 1000 A.D. and thus a San Juan Anasazi PII occupation can be suggested.

42Sa6442 - With a slope of 2°, the aeolian soil of this site is covered with Russian thistle and some sage and grass as a result of railing and seeding. The site measures 15 meters in diameter with an elevation of 1710 meters. The primary feature of the site is the surface evidence of burned adobe which suggests a jacal structure. Cultural debris was confined to flakes and sherds. The sherds were, in turn, limited to 54 Chapin Gray and 1 Chapin B/W. The Breternitz study thus argues a BMIII-PI San Juan Anasazi occupation some time between 575 and 900 A.D.

42Sa6443 - A depression measuring 10 by 15 meters and surface evidence of burned adobe suggesting jacal form the central elements at this site which has a 25 meter diameter at an elevation of 1710 meters. The aeolian soil slopes to the SE at 3° and, as a result of railing and chaining, the vegetation here is confined to Russian thistle. Cultural debris is limited to flakes and to sherds which include 63 Chapin Gray, 1 Chapin B/W, and 1 Abajo R/O, an association which Breternitz would limit to the period between 700 and 900 A.D. so that a PI San Juan Anasazi occupation is postulated.

42Sa6444 - In an area railed and seeded, the site is on aeolian soil that slopes at a bare 1° to the SE. The elevation is 1710 meters and the vegetation is limited to Russian thistle and some grass. The site measures 50 meters in diameter and appears to represent two distinct components. In one portion of the site, structures appear to have been built of jacal and of coursed stone while in the second area, a pit structure seems to be indicated. In the area of the possible pit structure, Component A, the sherds include 50 Chapin Gray and 10 Chapin neck-banded, 1 Chapin B/W and 3 Deadmans B/R. This argues of PI occupation by San Juan Anasazi between 800 and 900 A.D. In component B where surface structures appear to have been built, the sherds include 24 Chapin Gray, 3 Mancos Corrugated rims (15 corrugated body sherds), 2 Chapin B/W, 16 Mancos B/W, and 15 Deadman B/R. Use of Breternitz here argues the San Juan Anasazi were present in PII times between 900 and 1100 A.D.

42Sa6445 - The principle feature of this site is a one room structure of coursed stone measuring 3 by 4 meters with walls 0.5 meters thick. Vandals have dug a pot hole in the S portion of the site which is 10 meters in diameter. The site is covered with juniper, pinon and sage. The aeolian soil slopes down to the SE at 2^{o} while the elevation is 1710 meters. Very little cultural debris was present but Mancos Corrugated sherds were noted in the field and thus an occupation by the San Juan Anasazi is probably a PII manifestation although it can only be said that it was later than 900 A.D.

STATE OF UTAH
Scott M. Matheson, Governor
DEPARTMENT OF
DEVELOPMENT SERVICES
Michael D. Gallivan
Executive Director
104 State Capitol
Salt Lake City, Utah 84114
Telephone: (801) 533-5961

December 29, 1977

Mr. Milo A. Barney, Chairman
Environmental Coordinating Committee
State Planning Office
118 State Capitol
Salt Lake City, UT 84114

Dear Mr. Barney:

RE: Energy Fuels Nuclear, Inc., Uranium Mill approximately seven miles south of Blanding

On the basis of staff review and recommendation, the State Historic Preservation Officer has determined that as long as the recommendations for mitigation made by Richard A. Thompson in AN INTENSIVE CULTURAL RESOURCE INVENTORY CONDUCTED ON WHITE MESA, SAN JUAN COUNTY, UTAH are followed, then this project will have no known effect on any recognized or potential National Register historical, archeological, or cultural sites. Please be advised, however, that should artifacts or cultural objects be discovered during the construction stage, it is the responsibility of the Federal agency or community receiving block grant funds to notify this office immediately as provided for in the Utah State Antiquities Act of 1973 and Public Law 93-291.

Should you need assistance or clarification, please contact Wilson G. Martin, Preservation Planner, Utah State Historical Society, 603 East South Temple, Salt Lake City, Utah 84102, (801) 533-5755.

Sincerely,

Michael D. Gallivan
Executive Director
and
State Historic Preservation Officer

WGM:jjw:B255SJ

cc: Ms. Nancy E. Kennedy, Assistant Economist, Dames & Moore, 605 Parfet Street, Denver, CO 80215

conditional clearance

STATE OF UTAH
Scott M. Matheson, Governor
DEPARTMENT OF
DEVELOPMENT SERVICES

Michael D. Gallivan
Executive Director
104 State Capitol
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January 27, 1978

RECEIVED
FEB 7 1978

Mr. Gerald W. Grandey
Corporate Counsel
Energy Fuels Corporation
Executive Offices
Three Park Central, Suite 445
1515 Arapahoe
Denver, CO 80202

Dear Mr. Grandey:

RE: Energy Fuels Corporation, Uranium Mill approximately seven miles south of Blanding, Utah

In reference to our letter dated December 29, 1977, to Mr. Milo A. Barney, Chairman, Environmental Coordinating Committee. In that letter we stated that as long as the recommendations for mitigation made by Richard Thompson are followed, then your project will have no known effect on any recognized or potential National Register historic, archeological, or cultural sites. This letter is intended to outline the measures your company should follow for mitigation.

The sites within the environmental area of the energy fuels plant and tailings pond will need to be tested to determine eligibility of the site for inclusion on the National Register of Historic Places (see 36 CFR Part 800). Excavation will not be conducted unless determined necessary. Enclosed is a list of qualified archeologists who may be available to conduct the testing. If sites are determined to be eligible for inclusion in the National Register of Historic Places, then mitigation measures as outlined in 36 CFR Part 800 will need to be followed.

The State Historic Preservation Officer is also concerned that secondary impacts be avoided where at all possible and that should artifacts or cultural objects be discovered during the construction stage it is the responsibility of the Federal agency to notify this office immediately as provided for in the Utah State Antiquities Act of 1973 and Public Law 93-291.

A copy of the testing report will be supplied to the Historic Preservation Office in order for our office to comment about the eligibility of the sites in question.

If you have any comments or questions, please contact Wilson G. Martin, Preservation Planner, Utah State Historical Society, 603 East South Temple, Salt Lake City, Utah 84102, (801) 533-5755.

Sincerely,

M D Gallivan

Michael D. Gallivan
Executive Director
and
State Historic Preservation Officer

WGM:jjw:B255SJ

Enclosure

clearance

P.S. We will send you the Legislation under separate cover!

QUALIFIED ARCHEOLOGISTS

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APPENDIX B

WATER QUALITY INFORMATION

APPENDIX B

WATER QUALITY

General Physiocochemical Properties of Water

The constituents analyzed in water are the substances in solution in water. Dissolved solids commonly determined by analytical methods and expressed as concentrations of ions are the cations (positively charged ions), calcium, magnesium, sodium, and potassium; anions (negatively charged ions), sulfate, chloride, fluoride, nitrate; and those contributing to alkalinity (usually expressed in terms of an equivalent amount of carbonate and bicarbonate). Other substances determined, but not as routinely, are boron, phosphate, selenium, and various trace elements.

Certain chemical and physical properties of water also are reported in water analyses. Some of these properties include the amount of total dissolved solids, water hardness expressed as equivalent quantities of calcium carbonate, and specific conductance. The source and significance of chemical and physical properties of natural waters are given in Table B-1.

Physical and Chemical Constituents of Water Related to Use

The quality of water is often judged according to the intended use of the water. Generally, the lower the amount of dissolved solids, the better the water quality is considered. However, the concentration of particular constituents in water may be more important than the total concentration of dissolved solids. General water quality evaluation criteria for common uses are discussed below.

Domestic and Municipal Use

Chemical quality standards for water used for public carriers and by others subject to federal quarantine regulations have been established by the U.S. Public Health Service (USPHS, 1962). These regulations concern bacteria, radioactivity, and chemical constituents that may be objectionable in a public water supply. Recommended maximum concentrations of constituents established by the USPHS and proposed and

TABLE B-1

SIGNIFICANCE OF COMMON CHEMICAL AND PHYSICAL PROPERTIES OF WATERS

Constituent or Physical Property	Source or Cause	Significance
Arsenic (As)	In wastes from some industry and mining activity, and in residues from certain insecticides and herbicides. In natural water, trace quantities may be fairly common.	Arsenic is toxic to humans and animals. It can accumulate in tissue and result in serious physiological effects. (See text for maximum limit recommended for drinking water.)
Bicarbonate (HCO_3) and Carbonate (CO_3)	Action of carbon dioxide in water on carbonate rocks such as limestone and dolomite.	Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot-water facilities to form scale and release corrosive carbon dioxide gas--in combination with calcium and magnesium cause carbonate hardness.
Boron (B)	Dissolved from soil and rock, particularly those of igneous origin. Waters from hot springs and especially waters from areas of recent volcanic activity may be rather high in boron. May be added to water through disposal of waste materials, especially from cleaning operations where borates are used as detergents.	Small amounts in irrigation water and soil are damaging to certain crops. It is essential in trace quantities in plant nutrition, but becomes toxic to some plants in concentrations as small as 1.0 mg/l in irrigating water.
Calcium (Ca)	Dissolved from most soils and rocks but especially from limestone, dolomite, and gypsum. Some brines contain large concentrations of calcium.	Calcium and magnesium cause most of the hardness and scale-forming properties of water; soap consuming. (See Hardness) Calcium products may deposit on pipe walls and in well-screen openings and reduce the water-transmitting efficiency.
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and found in large concentrations in ancient brines, sea water, and industrial brines.	High concentrations increase the corrosiveness of water and, in combination with sodium, give a salty taste.
Dissolved Solids	Mineral constituents dissolved from rocks and soils, or added as a result of man-made conditions. May include dissolved organic constituents and some water of crystallization.	Dissolved solids values are a measure of the collective concentration of constituents in the water; the higher the value the higher the concentration. Tons per acre-foot and tons per day are calculated values that are measures of the total dissolved salt load in an acre-foot of the water and in the total volume of the water passing the sampling site in a 24-hour period.
Fluoride (F)	Dissolved in small to minute quantities from most rocks and soils.	Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. However, it may cause mottling of the teeth depending on the concentration of fluoride, the age of the child, the amount of drinking water consumed, and the susceptibility of the individual.
Hardness ($CaCO_3$)	In most waters nearly all the hardness is due to calcium and magnesium. Metallic cations other than the alkali metals also cause hardness.	Consumes soap before a lather will form, and deposits soap curds on bathtubs. Hard water forms scale in boilers, water heaters, and pipes. Hardness equivalent to the bicarbonate and carbonate is called carbonate hardness. Any hardness in excess of this is called noncarbonate hardness.
Iron (Fe)	Dissolved from most rocks and soils. May also be derived from iron pipes, pumps, and other equipment. More than 1 or 2 mg/l of soluble iron in surface waters generally indicates mine drainage or other sources.	On exposure to air, iron in ground water oxidizes to reddish-brown sediment. More than about 0.3 mg/l stains laundry and utensils reddish-brown. Objectional for food processing, beverages, dyeing, bleaching, ice manufacture, and other purposes. Large concentrations cause unpleasant taste and favor growth of iron bacteria.
Magnesium (Mg)	Dissolved from most soils and rocks but especially from dolomitic limestone. Some brines contain large concentrations of magnesium.	Magnesium and calcium cause most of the hardness and scale-forming properties of water; soap consuming.

TABLE B-1 (Concluded)

Nitrogen Ammonia (NH_3) Nitrite (NO_2) Nitrate (NO_3)	May occur in water in these forms depending on the level of oxidation. Dissolved from igneous rocks; soils enriched by legumes and commercial fertilizers; barnyard and stock corrals; and sewage effluent.	Concentrations much above average for any form of nitrogen probably indicate pollution. Nitrate encourages growth of algae and other organisms that produce undesirable tastes and odors. Concentrations of nitrate greater than 45 mg/l may cause methemoglobinemia in infants, the so-called "blue-baby" disease.
pH (Hydrogen-ion activity)	Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, phosphates, silicates, and borates raise the pH.	A pH of 7.0 indicates neutrality of a solution. Higher values denote increasing alkalinity; lower values, increasing acidity. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline waters may also attack metals. pH is a measure of the activity of the hydrogen ions.
Phosphate (PO_4)	Weathering of igneous rocks, leaching of soils containing organic wastes from plants and animals, phosphates added by fertilizers, and domestic and industrial sewage. Phosphate in detergents is important source in sewage effluent.	High concentrations can indicate leaching from excessive application of fertilizers, cesspools or recharge from cooling waters.
Potassium (K)	Dissolved from most rocks and soils. Found also in ancient brines, sea water, some industrial brines, and sewage.	Large concentrations, in combination with chloride, give a salty taste. Potassium is essential in plant nutrition and will be taken into the plant. The potassium will return to the soil when the plant dies, unless the plant is removed. The soil must be replenished with potassium to remain productive.
Selenium (Se)	Principal source of selenium-bearing rocks are volcanic emanations and sulfide deposits which have been redistributed by erosion and weathering. Found in rocks of Cretaceous age, especially shales, and soils derived from them.	Selenium is toxic in small quantities, and in some areas its presence in vegetation and water constitutes a problem in livestock management. Selenium is hazardous because it can accumulate in animal tissue and result in serious physiological effects.
Silica (SiO_2)	Dissolved from most rocks and soils, generally in small amounts from 1 to 30 mg/l. Higher concentrations, as much as 100 mg/l, may occur in highly alkaline waters.	Forms hard scale in pipes and boilers. Carried in steam of high-pressure boilers to form deposits on blades of steam turbines. Inhibits deterioration of zeolite-water softeners.
Sodium (Na)	Dissolved from most rocks and soils. Found also in ancient brines, sea water, industrial brines, and sewage.	Large concentrations, in combination with chloride, give a salty taste. High sodium content commonly limits use of water for irrigation.
Specific Conductance (micromhos at 25°C)	Specific conductance is dependent upon dissolved mineral content of the water. Numerically equal in moderately mineralized water to approximately 1.1 to 1.8 times the dissolved solids.	Specific conductance is a measure of the capacity of water to conduct an electric current. This property varies with concentration and degree of ionization of the constituents, and with temperature (therefore reported at 25°C). Can be used to estimate the total mineralization of the water.
Strontium (Sr)	Dissolved from rocks and soils, especially carbonate sediments and rocks of igneous origin.	Concentrations generally are too low to be of concern to most water users.
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Commonly present in mine waters and in some industrial wastes.	High concentrations may have a laxative effect and, in combination with other ions, give a bitter taste. Sulfate in water containing calcium forms a hard scale in boilers.
Temperature		Affects usefulness of water for many purposes. In general, temperature of shallow ground water shows some seasonal fluctuation, whereas temperature of ground water from moderate depths remains near the mean annual air temperature of the area. In very deep wells, water temperature generally increases about 1°F for each 60-foot increment of depth.

entered by the U.S. Environmental Protection Agency (1974-1977) are shown in Table B-2.

The inclusion of this table does not mean to imply that there are plans to use water of the project area for a public water supply. The EPA recommended standards, when referred to, are used merely as a basis for comparison of water qualities.

Hardness is important in evaluating the suitability of water for domestic, municipal, and industrial uses. A rating has been established by the U.S. Geological Survey as follows:

Hardness as $CaCO_3$ (mg/l)	Rating
0 - 60	soft
61 - 120	moderately hard
121 - 180	hard
greater than 180	very hard

A water quality classification based on concentration of total dissolved solids or specific conductance has been in use by the U.S. Geological Survey as follows:

Water Quality Class	Dissolved Solids (ppm)	Specific conductance (micromhos/cm at 25°C)
Fresh	0 to 1,000	0 to 1,400
Slightly saline	1,000 to 3,000	1,400 to 4,000
Moderately saline	3,000 to 10,000	4,000 to 14,000
Very saline	10,000 to 35,000	14,000 to 50,000
Briny	More than 35,000	More than 50,000

Industrial Use

Water quality criteria for industrial purposes vary considerably, depending on the use. Some industries have strict quality requirements. Requirements for cooling and waste disposal are more lenient, although certain waters may require treatment to prevent corrosion and scale.

TABLE B-2

DRINKING WATER CRITERIA FOR INORGANIC CHEMICALS

	U.S. Public Health Service 1962		EPA Interim Primary Regulation (1975-1976) and National Secondary Drinking Water Regulations (1977)
Chemical Constituents	Recommended Limit mg/l[a]	Tolerance Limit mg/l[b]	Maximum Contaminant Level mg/l
Arsenic (As)	0.1	0.05	0.05
Barium (Ba)	--	1.0	1.0
Boron (B)	1.0	--	--
Cadmium (Cd)	--	0.01	0.010
Carbon Chloroform Extract (CCE)	0.2	--	0.7
Chloride (Cl)	250	--	250
Chromium, Hexavalent (Cr^{+6})	--	0.05	0.05
Copper (Cu)	1.0	--	1.0
Cyanide (CN)	0.01	0.2	0.2
Fluoride (F)	0.8-1.7[c]	1.4-2.4[c]	1.4-2.4[c]
Hydrogen Sulphide	--	--	0.05
Iron, Total (Fe)	0.3	--	0.3
Lead (Pb)	--	0.05	0.05
Manganese (Mn)	0.05	--	0.05
Mercury (Mg)	--	0.005	0.002
Nitrogen (N)	10.0	--	--
Nitrate (N)	--	--	10.0
Phenols	0.001	--	--
Selenium (Se)	--	0.01	0.01
Silver (Ag)	--	0.05	0.05
Sulfate (SO4)	250	--	250
Total Dissolved Solids (TDS)	500	--	500
Turbidity (Turbidity Unit)	--	--	1.0
Zinc (Zn)	5	--	5.0
Radium 226-228	--	--	5 pCi/l
Gross Alpha Activity	--	--	15 pCi/l
Gross Beta Activity	--	--	4 millirem/year

[a] Recommended Limit: Concentrations which should not be exceed where more suitable water supplies are available. Concentrations measured in milligrams per liter unless otherwise indicated.

[b] Tolerance Limit: Concentrations greater than these shall constitute grounds for rejection of the supply. Concentrations measured in milligrams per liter unless otherwise indicated.

[c] Fluoride: Dependent on annual average maximum daily air temperature over not less than a 5-year period. Where fluoridation is practiced, minimum recommended limits are also specified.

Irrigation

The chemical quality of water is an important factor in evaluating its usefulness for irrigation. Total concentration of dissolved solids and relative proportions of calcium, magnesium, and sodium must be known in order to estimate the effects of irrigation water on soil. The calcium and magnesium content of the soil and subsoil, topography, position of the water table, amounts of water used and the method of application, kinds of crops grown, and climate of the area also need to be considered prior to the application of irrigation water.

If salinity (total dissolved solids) of irrigation water is high, excess soluble matter left in the soil from irrigation often is removed by leaching of the topsoil. The resulting solution percolates downward by gravity to the water table. If the water table rises excessively, this process of drainage disposal of salts may not be effective and "water logging" of the soil with saline water results.

In addition to potential dangers from high salinity, a sodium hazard sometimes exists in irrigation water. The two principal effects of "too much" sodium in the irrigation water are the reduction in soil permeability and a "hardening" of the soil. Both effects are caused by the replacement of calcium and magnesium ions in the soil by sodium ions from the irrigation water. The potential for these effects can be estimated by the sodium adsorption ratio (SAR) expressed as:

$$SAR = \sqrt{\frac{Na}{\frac{Ca + Mg}{2}}}$$

where: Na, Ca, and Mg represent concentrations in milliequivalents per liter of the applied water. Plate B-1 is a diagram for estimating sodium and salinity hazards of irrigation water.

Another concern regarding the quality of irrigation water is the presence of constituents in the water that are toxic or harmful to plant growth. Some of the specific ions that are known to be toxic to plants

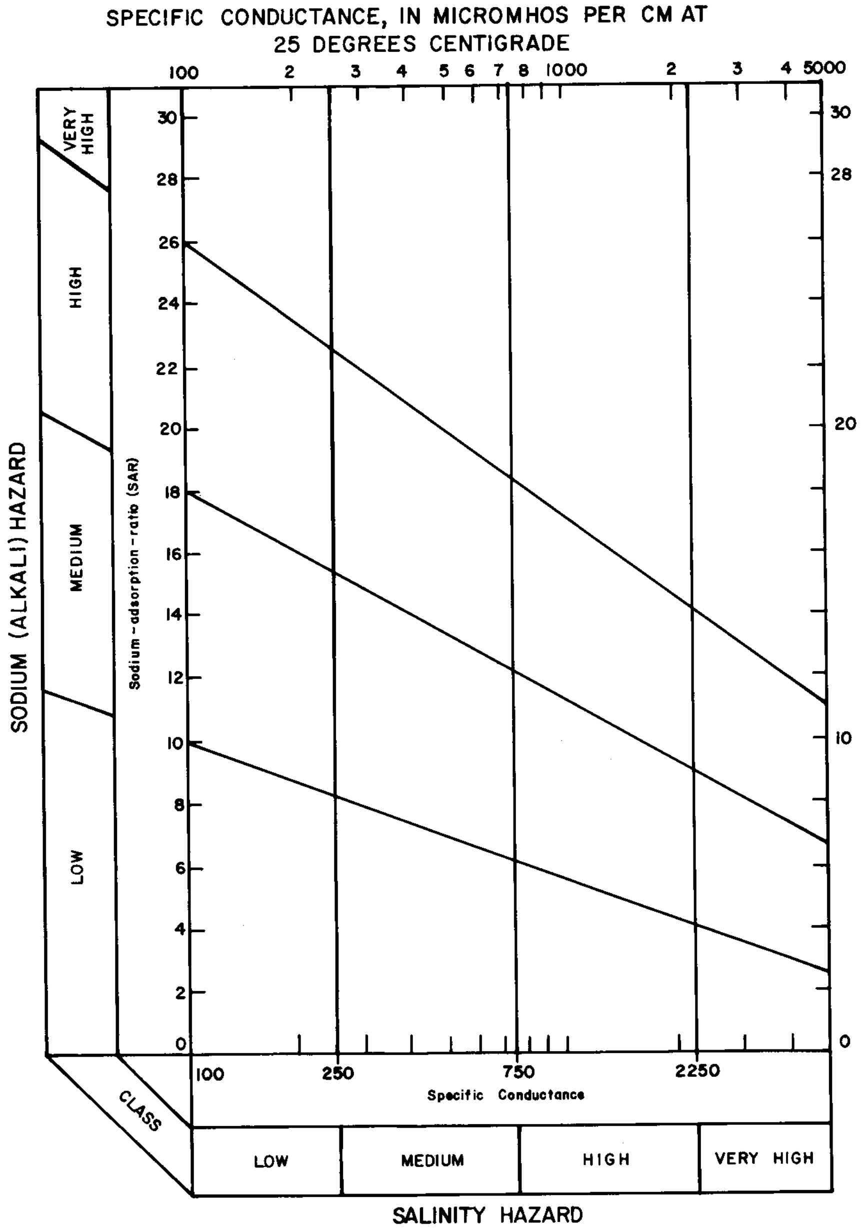

DIAGRAM FOR ESTIMATING SODIUM AND SALINITY HAZARDS OF IRRIGATION WATER

(REFERENCE: U.S. SALINITY LABORATORY, 1954)

DAMES & MOORE

PLATE B-1

in excessive quantities are aluminum, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, fluoride, iron, manganese, nickel, selenium, and zinc. The effects of these elements on plant growth, the types of plants they affect, and the concentrations at which they may become toxic vary widely and are not discussed.

Water Sampling Procedures and Techniques

The following describes the sampling procedures and techniques employed in the collection, preservation, shipment and analysis of surface and ground water samples for measurement of the existing (baseline) physical, chemical and radiological water quality conditions as described in Section 2.6.3 of the Environmental Report.

In-situ Measurements

At each sampling station at the time of sample collection the following measurements were made: temperature, pH, dissolved oxygen (surface water only), and specific conductance. All measurements are immediately recorded on a standard water sample data sheet for each set of samples collected at a station. Important factors, such as an estimate of flow, weather, and other site conditions are recorded on the water sample data sheet.

Sample Collection and Preservation

At each sampling station a set of samples is collected for analyses; i.e., (1) 3.8 l of water in plastic container with nitric acid (HNO_3) preservative for radioactivity for metals (2) 25.0 ml of water in plastic container with sulphuric acid (H_2SO_4) preservative for ammonia and nitrogen analyses (3) one liter of water in glass container with sulphuric acid (H_2SO_4) preservative for oil and grease and total organic carbon analyses and (4) one liter of raw water in plastic container for boron, chloride, fluoride, etc. The containers are labeled and verified and placed in a refrigerated container for shipment to a commercial testing laboratory within 24 hours of the time of collection.

The preservatives are carefully measured and added to the sample container by the commercial testing laboratory before they are taken to the field for sample collection. The preservative techniques retard the chemical (and biological) changes that continue after a sample is collected. This is accomplished by controlling the pH, refrigeration and chemical addition. All sampling and preservation are in accordance with EPA's Manual of Methods for Chemical Analysis of Water and Wastes (1974) and the U.S. Geological Survey's Methods of Collection and Analysis of Water Samples for Dissolved Minerals and Gases Book 5 Laboratory Analysis (1970).

Containers

Before use, all containers are thoroughly cleansed, filled with water and allowed to soak several days to remove water-soluble material from the container surface. In addition, glass bottles are washed in hot detergent solution, rinsed in warm tap water, rinsed in diluted hydrochloric acid and fully rinsed in distilled water and placed overnight in 300°C oven.

Plastic type containers are used for collecting and storing water samples for analysis of silica, boron, sodium and hardness, other metals and radioactivity; whereas glass bottles are used for total organic carbon and oil and grease.

Quality Control

For quality control on water quality analyses certain procedures have been implemented in the baseline study. As routine procedure, samples are split and the replicate sample is sent to a second commercial testing laboratory for analyses to compare with the results of the primary commercial testing laboratory. In other cases a sample is split and the split portion assigned a different field number and it is sent to the same laboratory for analysis and comparison with the other portion of the surface sample. The analysis of these quality control samples can be statistically evaluated with the other analyses to provide a degree of confidence of the analyses results.

APPENDIX C

METEOROLOGICAL DATA

TABLE C-1

MONTH: JANUARY

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.2	1.3	0.2	3.1	2.7	2.5	3.3	3.0	12.1	2.1	18.5	2.3
NNE	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.5	1.0	3.0	1.6	2.0	3.6	2.4
NE	0.0	0.0	0.0	0.0	0.1	1.5	1.1	2.8	0.2	2.4	0.9	1.7	2.4	2.3
ENE	0.0	0.0	0.2	1.5	0.1	4.6	0.4	2.7	0.2	3.1	0.4	2.3	1.2	2.6
E	0.0	0.0	0.2	1.5	0.2	1.9	0.7	1.9	0.1	2.1	0.2	2.1	1.5	1.9
ESE	0.0	0.0	0.2	1.5	0.7	2.0	0.4	2.5	0.2	2.3	0.2	2.1	1.6	2.1
SE	0.0	0.0	0.4	1.5	1.3	2.3	1.4	2.6	0.2	2.1	0.3	2.3	3.6	2.3
SSE	0.0	0.0	0.2	1.5	1.5	2.4	1.5	2.4	0.2	3.1	0.8	2.0	4.2	2.3
S	0.0	0.0	0.4	1.5	1.7	2.4	2.0	2.4	0.2	3.1	1.0	1.5	5.2	2.2
SSW	0.0	0.0	0.9	1.5	2.4	2.8	2.6	3.6	0.3	2.8	1.4	1.7	7.6	2.7
SW	0.0	0.0	0.8	1.4	1.5	3.0	1.9	3.6	0.6	3.5	2.0	1.9	6.8	2.7
WSW	0.0	0.0	0.1	1.5	0.4	2.4	0.4	4.9	0.3	3.7	1.0	2.3	2.2	3.0
W	0.0	0.0	0.1	1.5	0.2	3.1	0.7	3.2	1.0	3.4	1.2	2.0	3.3	2.8
WNW	0.0	0.0	0.1	1.5	0.2	2.9	0.9	4.6	1.0	3.4	1.3	2.2	3.5	3.2
NW	0.0	0.0	0.0	0.0	0.0	0.0	2.6	5.6	1.9	3.5	4.6	1.9	9.1	3.3
NNW	0.0	0.0	0.0	0.0	0.1	4.6	2.1	3.7	2.8	3.1	6.0	2.2	11.0	2.8
CALM	0.0	--	0.4	--	0.4	--	5.7	--	0.0	--	8.3	--	14.7	--
ALL	0.0	0.0	4.0	1.3	11.1	2.5	28.3	2.7	13.3	3.1	43.3	1.6	100.0	2.2

TABLE C-2

MONTH: FEBRUARY

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.2	1.5	0.5	2.6	3.1	3.5	4.8	3.3	9.5	2.2	18.0	2.7
NNE	0.0	0.0	0.1	1.5	0.2	3.3	2.0	3.7	0.7	3.2	1.5	2.2	4.5	3.0
NE	0.0	0.0	0.3	1.5	0.1	1.0	1.4	4.0	0.3	4.3	0.5	1.8	2.5	3.2
ENE	0.0	0.0	0.1	1.5	0.2	3.0	0.4	3.0	0.1	2.1	0.4	2.1	1.1	2.5
E	0.0	0.0	0.2	1.5	0.2	3.9	0.9	3.1	0.2	2.1	0.0	0.0	1.4	2.9
ESE	0.0	0.0	0.2	3.6	0.1	3.1	0.3	2.2	0.1	3.6	0.5	1.9	1.1	2.5
SE	0.0	0.0	0.6	2.6	0.6	2.7	1.7	3.1	0.0	0.0	0.5	1.7	3.4	2.7
SSE	0.0	0.0	0.5	2.7	1.0	3.4	1.6	3.6	0.1	2.6	0.5	1.9	3.8	3.1
S	0.0	0.0	0.9	2.0	2.2	2.7	0.7	3.1	0.5	2.6	0.6	1.9	4.9	2.5
SSW	0.0	0.0	1.4	2.4	2.4	3.1	2.4	2.9	0.8	3.2	1.3	1.9	8.4	2.7
SW	0.0	0.0	1.1	2.4	1.7	3.0	2.2	4.1	0.7	3.3	1.6	2.3	7.3	3.1
WSW	0.0	0.0	0.1	3.1	0.0	0.0	1.0	4.1	0.4	3.1	0.6	2.3	2.1	3.3
W	0.0	0.0	0.1	3.1	0.5	3.7	1.0	5.2	0.7	3.7	1.1	1.8	3.3	3.5
WNW	0.0	0.0	0.0	0.0	0.2	2.8	1.5	5.6	0.8	3.5	1.2	2.1	3.7	3.9
NW	0.0	0.0	0.1	2.6	0.2	1.5	3.3	6.8	2.7	3.5	6.7	2.1	13.0	3.6
NNW	0.0	0.0	0.1	1.5	0.1	5.1	3.2	5.2	2.8	3.4	5.9	2.2	12.1	3.3
CALM	0.5	--	0.6	--	0.6	--	2.8	--	0.0	--	5.0	--	9.5	--
ALL	0.5	0.0	6.6	2.1	10.7	2.8	29.4	3.9	15.6	3.3	37.3	1.8	100.0	2.8

TABLE C-3

MONTH: MARCH

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.5	1.7	0.6	2.4	2.9	3.9	3.9	3.3	7.1	2.3	15.0	2.9
NNE	0.0	0.0	0.3	1.5	0.7	2.6	2.1	5.3	0.9	3.1	1.3	2.2	5.4	3.6
NE	0.0	0.0	0.7	2.2	0.7	2.3	2.1	4.8	0.3	2.7	0.5	2.2	4.4	3.5
ENE	0.0	0.0	0.3	2.2	0.2	2.3	0.9	3.6	0.2	2.6	0.2	2.0	1.7	2.9
E	0.0	0.0	0.2	2.4	0.1	4.1	0.4	3.1	0.1	3.1	0.3	1.8	1.1	2.6
ESE	0.0	0.0	0.3	2.3	0.6	2.9	0.8	3.0	0.3	3.2	0.2	1.9	2.3	2.8
SE	0.0	0.0	1.2	2.6	0.6	3.1	2.4	3.4	0.1	2.1	0.3	2.0	4.6	3.0
SSE	0.0	0.0	0.4	2.8	0.8	3.4	1.2	3.7	0.2	3.1	0.2	2.4	3.0	3.4
S	0.1	0.5	1.1	2.5	1.1	3.8	1.6	3.1	0.1	3.1	0.1	2.6	4.1	3.1
SSW	0.0	0.0	1.2	2.2	1.4	3.9	3.3	4.9	0.3	4.1	0.3	1.9	6.6	4.0
SW	0.0	0.0	1.0	2.5	1.2	3.9	4.5	5.5	1.0	3.5	0.9	2.2	8.6	4.4
WSW	0.0	0.0	0.2	2.3	0.7	3.9	3.0	5.2	0.3	3.3	0.5	2.2	4.6	4.5
W	0.0	0.0	0.7	2.5	1.2	3.7	1.4	6.1	0.7	3.2	1.1	2.2	5.2	3.8
WNW	0.0	0.0	0.5	2.2	0.6	4.5	1.8	5.6	1.6	3.7	1.4	2.2	5.9	3.9
NW	0.0	0.0	0.2	2.3	1.1	4.1	3.9	5.5	3.0	4.0	3.8	2.2	11.9	3.9
NNW	0.0	0.0	0.0	0.0	0.8	3.4	2.7	6.5	2.9	3.6	4.8	2.4	11.2	3.8
CALM	0.2	--	0.5	--	0.4	--	0.9	--	0.0	--	2.4	--	4.3	--
ALL	0.2	0.2	9.5	2.2	12.9	3.4	35.8	4.8	16.0	3.5	25.6	2.1	100.00	3.4

TABLE C-4

MONTH: APRIL

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

Direction	A		B		C		D		E		F		ALL	
	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.1	3.6	0.4	4.2	2.1	4.7	4.7	3.5	6.9	2.2	14.2	3.1
NNE	0.0	0.0	0.1	1.5	0.2	3.0	1.4	5.1	0.6	3.8	1.3	2.4	3.6	3.8
NE	0.0	0.0	0.4	2.5	0.6	3.5	2.2	5.9	0.2	3.8	0.5	2.0	3.6	4.6
ENE	0.0	0.0	0.1	2.6	0.3	3.9	0.3	4.6	0.3	2.8	0.3	2.4	1.3	3.3
E	0.0	0.0	0.1	3.6	0.3	2.2	0.4	3.6	0.0	0.0	0.3	1.9	1.1	2.8
ESE	0.0	0.0	0.6	2.1	0.8	3.7	0.6	3.3	0.1	3.6	0.3	1.9	2.3	3.0
SE	0.1	2.1	0.6	2.3	1.4	3.1	1.8	3.9	0.3	4.4	0.3	1.7	4.4	3.3
SSE	0.0	0.0	1.0	2.8	1.2	3.6	2.3	3.8	0.1	2.6	0.2	2.6	4.8	3.5
S	0.1	2.6	0.9	2.5	1.4	4.5	2.1	4.6	0.3	2.3	0.1	1.5	4.9	4.0
SSW	0.0	0.0	1.2	2.7	2.0	4.3	5.2	7.2	0.6	4.2	0.5	2.5	9.5	5.6
SW	0.2	2.3	0.8	2.8	2.2	4.3	6.4	6.5	1.3	4.0	0.7	2.2	11.5	5.2
WSW	0.0	0.0	0.3	3.1	0.9	4.4	2.5	5.9	0.4	3.2	0.6	2.3	4.6	4.8
W	0.0	0.0	0.4	2.9	1.1	3.4	2.2	5.8	0.6	4.0	1.2	2.1	5.5	4.1
WNW	0.0	0.0	0.0	0.0	0.8	4.9	1.8	6.0	1.1	4.1	1.9	2.3	5.5	4.2
NW	0.0	0.0	0.4	2.8	0.9	4.7	2.6	6.0	2.4	3.9	4.2	2.2	10.4	3.8
NNW	0.0	0.0	0.1	2.1	0.1	4.6	2.1	6.1	2.4	3.6	3.6	2.4	8.3	3.7
CALM	0.0	--	0.6	--	0.1	--	0.4	--	0.0	--	3.2	--	4.3	--
ALL	0.3	2.3	7.7	2.4	14.6	4.0	36.5	5.7	15.2	3.7	25.8	2.0	100.0	3.9

TABLE C-5

MONTH: MAY

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.1	4.6	0.7	4.4	1.6	5.0	5.5	3.6	8.4	2.4	16.2	3.1
NNE	0.2	2.0	0.0	0.0	0.7	5.3	1.3	6.4	1.1	3.7	1.0	2.1	4.3	4.4
NE	0.1	2.6	0.0	0.0	0.3	5.3	1.1	4.8	0.2	3.9	0.4	1.9	2.2	4.2
ENE	0.1	2.1	0.2	2.0	0.3	4.5	0.4	4.1	0.1	2.1	0.1	1.5	1.2	3.4
E	0.1	2.1	0.6	2.9	0.4	4.2	0.5	4.4	0.2	2.3	0.2	1.7	2.0	3.3
ESE	0.1	2.6	1.2	2.9	0.7	3.2	0.9	4.0	0.0	0.0	0.1	1.5	3.0	3.2
SE	0.3	2.3	2.0	2.8	0.9	3.8	1.1	4.0	0.0	0.0	0.5	1.8	4.8	3.1
SSE	0.2	2.1	1.6	3.2	1.1	4.3	0.7	4.1	0.2	2.3	0.1	2.6	3.7	3.6
S	0.5	2.4	2.6	3.0	2.2	4.3	1.2	5.1	0.5	3.7	0.3	1.9	7.4	3.7
SSW	0.4	2.1	1.7	3.1	2.7	5.8	3.4	6.6	0.5	4.3	0.5	2.3	9.2	5.1
SW	0.6	2.5	1.5	3.8	3.1	5.0	4.1	6.3	1.4	4.1	1.1	2.4	11.7	4.8
WSW	0.1	2.6	0.6	3.6	1.5	5.3	2.3	5.3	0.4	3.3	0.9	2.3	5.7	4.5
W	0.2	2.6	0.8	3.5	0.6	4.9	1.3	4.9	0.6	2.7	1.1	2.3	4.7	3.6
WNW	0.0	0.0	0.5	2.8	0.4	4.2	0.3	6.2	0.6	3.1	1.7	2.3	3.5	3.1
NW	0.1	1.5	0.6	3.0	0.7	5.0	2.1	5.6	1.9	3.5	4.0	2.4	9.4	3.6
NNW	0.0	0.0	0.2	2.3	0.4	4.6	0.8	6.1	2.6	3.3	3.4	2.2	7.5	3.2
CALM	0.2	--	0.2	--	0.0	--	0.5	--	0.0	--	2.5	--	3.4	--
ALL	3.0	2.2	14.4	3.0	16.7	4.8	23.8	5.4	15.7	3.5	26.4	2.1	100.0	3.7

TABLE C-6

MONTH: JUNE

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.5	2.8	0.8	4.0	1.7	5.1	5.4	3.6	9.7	2.4	18.1	3.1
NNE	0.2	2.0	0.3	2.4	0.2	5.1	1.3	5.7	0.4	3.2	1.0	2.0	3.3	3.8
NE	0.0	0.0	0.1	2.1	0.6	4.3	1.2	4.0	0.5	2.8	0.6	1.9	3.0	3.4
ENE	0.1	1.5	0.3	3.4	0.1	3.1	0.2	2.0	0.0	0.0	0.2	1.8	0.8	2.5
E	0.0	0.0	0.6	2.9	0.3	3.3	0.5	4.5	0.1	3.6	0.3	1.7	1.7	3.3
ESE	0.3	2.3	1.2	2.9	0.4	3.5	0.4	4.5	0.1	4.1	0.2	1.3	2.5	3.2
SE	0.6	2.1	1.9	3.0	1.1	3.6	0.7	4.6	0.2	2.1	0.5	2.1	5.0	3.1
SSE	0.4	2.5	1.4	2.7	0.7	3.7	0.5	4.3	0.1	2.1	0.0	0.0	3.1	3.2
S	1.3	2.4	3.2	2.7	1.0	4.5	1.0	4.6	0.3	3.6	0.3	2.1	7.0	3.2
SSW	0.8	2.4	2.0	3.1	2.1	4.9	2.3	6.3	0.3	3.0	0.1	2.6	7.6	4.5
SW	0.8	2.0	2.8	3.4	3.5	4.9	2.8	5.1	0.5	3.8	1.0	1.9	11.4	4.1
WSW	0.2	2.6	0.8	3.6	2.1	5.3	1.7	5.6	0.6	3.5	0.4	2.1	5.8	4.6
W	0.2	2.3	0.9	3.6	0.5	4.4	1.0	4.4	0.3	3.5	2.4	2.2	5.3	3.1
WNW	0.2	2.1	0.3	4.0	2.0	4.4	0.8	5.5	0.4	2.9	1.9	2.4	4.7	3.5
NW	0.1	2.1	0.1	4.1	1.0	4.3	0.8	7.6	2.1	4.0	3.8	2.3	8.0	3.6
NNW	0.0	0.0	0.3	3.7	0.4	4.5	1.0	3.8	2.5	3.4	4.1	2.3	8.4	3.0
CALM	0.8	--	0.3	--	0.1	--	0.8	--	0.0	--	2.2	--	4.2	--
ALL	5.7	2.0	17.2	3.0	15.9	4.5	18.8	4.9	13.9	3.5	28.5	2.1	100.0	3.4

TABLE C-7

MONTH: JULY

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.2	1.5	0.6	2.8	1.0	3.9	2.5	3.9	4.9	3.3	8.1	2.3	17.3	2.9
NNE	0.1	2.1	0.0	0.0	0.6	4.6	2.0	4.2	1.3	3.4	0.8	2.2	4.8	3.7
NE	0.2	1.8	0.2	3.8	0.4	4.3	1.7	5.6	0.8	3.3	0.5	1.6	3.9	4.2
ENE	0.2	2.3	0.2	3.2	0.2	3.4	0.8	4.7	0.1	4.1	0.2	2.8	1.8	3.8
E	0.2	1.5	0.5	2.7	0.4	2.7	0.3	3.7	0.2	3.1	0.4	1.7	2.1	2.6
ESE	0.4	2.0	1.1	2.7	1.2	3.6	0.9	3.0	0.1	3.1	0.1	3.1	3.8	3.0
SE	0.3	2.2	3.0	2.9	1.8	3.5	1.1	4.8	0.5	3.7	0.3	2.2	7.1	3.3
SSE	0.6	2.2	0.8	2.7	0.5	3.1	0.7	3.5	0.0	0.0	0.1	3.1	2.6	2.9
S	1.1	2.1	2.0	2.4	0.7	3.2	0.7	2.6	0.0	0.0	0.3	1.9	4.7	2.4
SSW	0.7	2.2	2.1	3.2	1.6	4.3	1.2	5.5	0.1	2.1	0.2	1.8	5.8	3.8
SW	1.5	2.3	3.0	3.6	4.4	4.1	1.8	4.5	0.3	2.7	0.8	1.8	11.9	3.6
WSW	0.2	2.1	0.6	3.1	0.6	3.7	1.2	4.1	0.2	3.4	0.7	2.1	3.5	3.3
W	0.2	2.6	0.6	2.6	0.6	4.1	1.6	4.8	0.3	3.1	1.3	1.8	4.6	3.3
WNW	0.1	2.6	0.0	0.0	0.2	3.1	0.7	4.0	0.6	2.7	1.1	2.1	2.7	2.8
NW	0.1	2.6	0.8	3.3	0.8	3.6	2.2	4.6	1.7	3.1	3.4	2.2	9.0	3.2
NNW	0.0	0.0	0.2	2.6	0.9	4.1	1.2	4.1	2.1	3.3	4.4	2.4	8.6	3.0
CALM	0.6	--	0.8	--	0.2	--	0.6	--	0.0	--	3.6	--	5.8	--
ALL	6.5	2.0	16.5	2.9	16.3	3.8	21.1	4.2	13.3	3.3	26.3	1.9	100.0	3.0

TABLE C-8

MONTH: AUGUST

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

Direction	A % Freq.	A Mean W.S.(mps)	B % Freq.	B Mean W.S.(mps)	C % Freq.	C Mean W.S.(mps)	D % Freq.	D Mean W.S.(mps)	E % Freq.	E Mean W.S.(mps)	F % Freq.	F Mean W.S.(mps)	ALL % Freq.	ALL Mean W.S.(mps)
N	0.2	2.0	0.1	1.5	0.7	3.5	1.7	4.7	4.4	3.3	8.6	2.2	15.8	2.9
NNE	0.0	0.0	0.1	2.1	0.3	5.0	1.3	5.2	0.9	3.1	1.6	2.1	4.2	3.5
NE	0.1	1.5	0.5	2.9	1.2	3.1	1.7	3.9	0.7	3.7	1.0	2.1	5.2	3.2
ENE	0.1	2.1	0.2	1.5	0.6	3.4	0.5	5.4	0.2	2.8	0.2	2.8	1.7	3.6
E	0.2	1.8	0.3	1.9	0.8	3.0	1.0	3.7	0.1	5.1	0.3	2.4	2.7	3.0
ESE	0.3	2.3	1.2	2.3	1.6	3.1	0.7	3.2	0.2	4.6	0.2	2.0	4.3	2.9
SE	0.6	1.9	2.3	2.6	1.6	3.0	1.4	4.5	0.2	3.3	0.2	1.5	6.2	3.0
SSE	0.4	2.2	0.8	2.1	1.4	3.1	1.2	3.0	0.2	3.1	0.3	1.5	4.3	2.7
S	0.6	2.1	1.6	2.3	1.5	3.0	0.7	2.5	0.2	2.8	0.1	1.5	4.5	2.5
SSW	0.6	2.1	1.9	2.8	1.7	3.7	1.2	4.8	0.1	3.6	0.3	1.6	5.8	3.4
SW	0.7	2.3	2.2	3.0	3.2	3.4	2.3	4.3	0.2	2.9	0.7	1.9	9.3	3.4
WSW	0.7	2.3	0.9	2.8	0.7	4.3	0.7	4.7	0.5	3.2	0.7	1.8	4.2	3.2
W	0.1	2.1	0.8	2.8	1.0	3.4	2.0	4.4	0.2	4.1	0.9	2.2	4.9	3.5
WNW	0.0	0.0	0.2	1.7	0.2	3.3	1.2	5.0	0.5	3.1	1.7	2.2	3.9	3.2
NW	0.1	2.1	0.3	3.2	0.2	4.4	1.6	4.3	1.3	3.2	3.2	2.3	6.8	3.1
NNW	0.0	0.0	0.2	2.8	0.2	1.9	1.5	4.7	2.1	3.1	5.2	2.4	9.2	2.9
CALM	0.2	--	1.1	--	0.2	--	0.9	--	0.0	--	4.5	--	6.9	--
ALL	4.6	2.1	14.8	2.4	17.3	3.3	21.7	4.1	12.0	3.3	29.6	1.9	100.0	2.9

TABLE C-9

MONTH: SEPTEMBER

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.2	1.8	0.3	4.3	1.2	4.5	3.3	3.5	8.6	2.3	13.6	2.8
NNE	0.0	0.0	0.1	1.5	0.6	2.9	1.6	5.5	1.0	3.8	1.4	2.2	4.7	3.7
NE	0.0	0.0	0.3	1.5	0.8	3.2	1.4	5.1	0.4	2.9	0.8	2.0	3.7	3.5
ENE	0.0	0.0	0.6	2.0	0.6	2.4	0.3	2.7	0.2	4.1	0.5	2.4	2.2	2.4
E	0.0	0.0	0.4	1.8	0.7	2.8	0.3	4.1	0.1	2.1	0.3	2.5	1.8	2.7
ESE	0.0	0.0	1.1	2.7	1.2	2.8	0.6	3.6	0.1	4.1	0.2	2.1	3.1	2.9
SE	0.0	0.0	1.8	2.5	1.3	3.4	0.8	2.5	0.6	3.1	0.7	1.8	5.1	2.7
SSE	0.0	0.0	1.5	2.4	0.5	2.8	0.8	4.3	0.1	5.1	0.6	1.9	3.6	2.9
S	0.0	0.0	2.1	2.4	0.8	3.2	1.1	4.1	0.5	3.5	0.8	2.0	5.4	2.9
SSW	0.0	0.0	1.9	2.8	2.0	4.2	1.9	6.6	1.3	4.0	1.1	2.1	8.2	4.1
SW	0.0	0.0	2.3	2.4	2.3	4.1	2.0	5.8	1.0	4.1	1.2	2.1	8.8	3.8
WSW	0.0	0.0	0.8	2.7	0.5	4.5	2.0	6.2	0.7	3.5	0.5	2.2	4.5	4.6
W	0.0	0.0	0.3	2.2	0.8	3.7	1.0	4.2	0.5	3.5	1.3	2.1	3.9	3.2
WNW	0.0	0.0	0.2	2.0	0.3	4.1	1.5	6.2	0.9	3.5	2.3	2.2	5.2	3.7
NW	0.0	0.0	0.3	1.7	0.3	3.3	1.4	5.6	1.9	3.8	6.5	2.2	10.5	3.0
NNW	0.0	0.0	0.2	2.3	0.2	3.3	1.4	6.3	1.4	3.7	7.4	2.4	10.5	3.1
CALM	0.2	--	0.9	--	0.4	--	0.4	--	0.0	--	3.2	--	5.2	--
ALL	0.2	0.0	14.9	2.3	13.5	3.4	20.0	5.2	14.0	3.7	37.4	2.1	100.0	3.1

TABLE C-10

MONTH: OCTOBER

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.6	1.4	0.7	2.3	1.9	2.8	3.1	3.3	11.0	2.1	17.2	2.4
NNE	0.0	0.0	0.2	1.5	0.9	2.4	2.0	4.5	0.7	4.3	2.3	2.1	6.1	3.1
NE	0.0	0.0	0.2	1.9	1.0	3.0	2.1	3.7	0.2	3.1	0.3	2.0	3.8	3.3
ENE	0.0	0.0	0.4	1.6	0.2	3.6	1.2	3.3	0.0	0.0	0.4	2.5	2.2	2.9
E	0.0	0.0	0.6	1.7	0.5	3.3	0.8	2.9	0.1	2.1	0.2	1.3	2.2	2.5
ESE	0.0	0.0	0.5	2.6	0.5	3.0	1.6	3.1	0.3	2.5	0.3	2.0	3.2	2.8
SE	0.0	0.0	1.2	2.5	0.3	3.2	2.9	4.0	0.2	2.6	0.3	1.5	5.0	3.3
SSE	0.0	0.0	1.0	2.7	0.9	3.7	2.0	3.7	0.2	3.3	0.5	2.1	4.6	3.3
S	0.0	0.0	1.6	2.1	0.7	3.5	2.5	3.5	0.2	2.8	0.7	2.0	5.6	2.9
SSW	0.0	0.0	1.8	2.6	1.6	4.1	4.7	4.9	0.9	3.6	1.1	2.2	10.1	4.0
SW	0.0	0.0	1.4	2.6	1.5	4.2	2.7	4.0	1.1	3.4	1.0	2.1	7.6	3.5
WSW	0.0	0.0	0.2	2.7	0.4	2.9	1.7	4.0	0.3	3.1	0.6	2.5	3.3	3.4
W	0.0	0.0	0.2	2.4	0.3	3.0	0.7	4.1	0.7	3.2	0.7	2.2	2.6	3.0
WNW	0.0	0.0	0.3	2.2	0.2	2.6	0.7	3.7	0.6	4.0	0.7	2.5	2.6	3.1
NW	0.0	0.0	0.3	1.6	0.3	2.5	2.0	4.8	1.0	3.8	3.4	2.1	7.0	3.1
NNW	0.0	0.0	0.0	0.0	0.1	2.6	1.2	4.0	2.2	3.6	5.6	2.3	9.1	2.8
CALM	0.1	--	1.7	--	0.5	--	2.2	--	0.0	--	3.4	--	7.9	--
ALL	0.1	0.0	12.4	2.0	10.6	3.2	32.9	3.7	11.6	3.5	32.5	1.9	100.0	2.8

TABLE C-11

MONTH: NOVEMBER

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.2	1.5	0.7	1.4	2.4	3.1	5.1	2.9	10.9	2.2	19.2	2.5
NNE	0.0	0.0	0.2	2.5	0.3	1.5	1.4	3.2	1.3	3.4	1.1	2.3	4.2	2.8
NE	0.0	0.0	0.1	1.5	0.5	4.4	1.9	3.8	0.8	3.4	1.0	1.9	4.3	3.3
ENE	0.0	0.0	0.0	0.0	0.1	2.6	0.3	4.3	0.3	2.8	0.3	2.2	0.8	3.0
E	0.0	0.0	0.3	2.2	0.2	1.5	1.1	2.3	0.0	0.0	0.4	1.6	1.9	2.1
ESE	0.0	0.0	0.2	2.3	0.6	3.4	1.4	2.5	0.3	2.9	0.3	2.1	2.7	2.7
SE	0.0	0.0	0.9	1.7	1.0	2.8	2.4	2.9	0.3	2.2	0.8	1.6	5.4	2.4
SSE	0.0	0.0	0.3	1.8	1.1	2.6	1.4	2.9	0.3	2.4	0.3	1.5	3.4	2.5
S	0.0	0.0	0.6	1.7	1.0	2.5	1.9	2.5	0.2	2.1	0.8	1.7	4.5	2.2
SSW	0.0	0.0	0.3	2.3	2.7	3.1	2.8	5.0	0.5	2.2	1.4	1.8	7.7	3.5
SW	0.0	0.0	0.4	1.5	2.2	2.8	2.6	4.0	0.7	3.0	1.2	1.9	7.1	3.0
WSW	0.0	0.0	0.1	1.5	0.4	3.0	1.0	3.4	0.2	2.1	1.0	2.1	2.7	2.7
W	0.0	0.0	0.2	2.5	0.4	2.8	1.1	2.9	0.4	3.0	0.9	2.3	3.0	2.7
WNW	0.0	0.0	0.0	0.0	0.3	2.2	1.5	4.2	1.1	3.9	1.5	2.1	4.5	3.3
NW	0.0	0.0	0.1	1.5	0.3	2.3	2.4	4.9	1.4	3.7	4.4	2.2	8.6	3.2
NNW	0.0	0.0	0.0	0.0	0.1	1.5	0.9	5.1	1.5	2.9	6.0	2.1	8.5	2.6
CALM	0.0	--	0.6	--	1.7	--	2.8	--	0.0		6.2	--	11.3	--
ALL	0.0	0.0	4.4	1.6	13.7	2.4	29.2	3.3	14.2	3.1	38.5	1.8	100.0	2.5

TABLE C-12

MONTH: DECEMBER

MONTHLY PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.0	0.0	0.0	0.0	0.2	2.0	3.0	2.7	3.4	3.2	9.9	2.1	16.6	2.4
NNE	0.0	0.0	0.1	1.5	0.0	0.0	1.7	2.6	0.7	3.0	2.6	1.9	5.2	2.3
NE	0.0	0.0	0.2	1.5	0.2	2.8	1.2	3.2	0.2	2.8	0.7	1.8	2.5	2.6
ENE	0.0	0.0	0.0	0.0	0.1	3.6	0.8	2.7	0.0	3.4	0.2	2.2	1.1	2.7
E	0.0	0.0	0.1	1.5	0.2	3.0	0.5	2.2	0.2	3.1	0.2	1.5	1.1	2.4
ESE	0.0	0.0	0.5	1.5	0.7	2.6	1.3	2.2	0.2	3.1	0.2	2.2	3.0	2.2
SE	0.0	0.0	0.6	1.5	1.1	2.4	2.3	2.7	0.2	2.1	0.2	2.6	4.3	2.5
SSE	0.0	0.0	0.4	1.5	1.1	2.7	1.5	2.6	0.2	3.1	0.3	2.3	3.4	2.4
S	0.0	0.0	0.7	1.5	1.2	2.4	2.0	2.3	0.2	2.4	0.4	1.5	4.5	2.2
SSW	0.0	0.0	1.0	1.5	2.4	2.3	2.4	3.1	0.6	2.7	1.5	1.9	7.8	2.4
SW	0.0	0.0	0.6	1.5	1.0	3.0	2.8	3.2	0.8	2.9	1.7	1.8	6.9	2.6
WSW	0.0	0.0	0.0	0.0	0.3	2.6	1.1	3.4	0.4	2.9	0.7	2.0	2.5	2.8
W	0.0	0.0	0.0	0.0	0.1	2.1	1.7	3.4	0.8	3.6	0.7	1.8	3.3	2.9
WNW	0.0	0.0	0.1	1.5	0.1	2.1	1.0	3.5	1.1	3.4	1.5	2.3	3.7	3.0
NW	0.0	0.0	0.0	0.0	0.3	3.7	2.5	5.8	1.9	2.8	4.8	1.9	9.6	3.3
NNW	0.0	0.0	0.1	1.5	0.2	3.6	2.3	4.9	2.6	3.2	6.0	2.1	11.2	2.9
CALM	0.0	--	1.2	--	0.1	--	2.9	--	0.0	--	9.1	--	13.3	--
ALL	0.0	0.0	5.4	1.2	9.3	2.6	31.0	3.0	13.6	3.1	40.7	1.6	100.0	2.3

TABLE C-13

ANNUAL PERCENT FREQUENCY DISTRIBUTION OF PASQUILL STABILITY
BY DIRECTION AND MEAN WIND SPEED (mps) AT BLANDING, UTAH
1970 - 1974

	A		B		C		D		E		F		ALL	
Direction	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)	% Freq.	Mean W.S.(mps)
N	0.03	1.8	0.26	2.1	0.57	3.3	2.22	3.7	4.31	3.3	9.23	2.2	16.65	2.5
NNE	0.03	2.1	0.12	1.8	0.39	3.5	1.59	4.5	0.88	3.4	1.46	2.1	4.49	3.3
NE	0.03	1.9	0.26	2.3	0.54	3.4	1.61	4.4	0.40	3.3	0.65	1.9	3.50	3.5
ENE	0.03	2.1	0.22	2.2	0.24	3.3	0.54	3.6	0.12	3.0	0.28	2.3	1.44	3.0
E	0.04	1.7	0.33	2.3	0.35	3.0	0.62	3.1	0.11	2.9	0.27	1.9	1.73	2.7
ESE	0.09	2.2	0.69	2.5	0.76	3.1	0.83	3.0	0.16	3.3	0.22	2.0	2.75	2.8
SE	0.16	2.1	1.39	2.6	1.09	3.1	1.65	3.5	0.23	3.0	0.40	1.9	4.93	2.9
SSE	0.13	2.3	0.83	2.6	0.97	3.2	1.28	3.4	0.15	2.9	0.33	2.0	3.70	3.0
S	0.30	2.2	1.47	2.4	1.29	3.3	1.45	3.3	0.24	3.1	0.46	1.8	5.22	2.9
SSW	0.20	2.2	1.45	2.7	2.08	3.9	2.77	5.3	0.52	3.4	0.80	2.0	7.84	3.9
SW	0.31	2.3	1.49	2.9	2.31	4.0	3.00	5.0	0.80	3.6	1.15	2.0	9.08	3.8
WSW	0.09	2.4	0.38	3.0	0.71	4.4	1.55	5.0	0.40	3.3	0.67	2.2	3.81	3.9
W	0.06	2.5	0.44	2.9	0.60	3.7	1.31	4.6	0.56	3.3	1.16	2.1	4.14	3.4
WNW	0.02	2.3	0.19	2.5	0.38	3.9	1.15	5.1	0.85	3.6	1.51	2.2	4.11	3.5
NW	0.03	2.1	0.26	2.8	0.52	4.0	2.29	5.6	1.93	3.7	4.36	2.2	9.42	3.4
NNW	0.00	0.0	0.10	2.7	0.31	3.8	1.70	5.1	2.32	3.3	5.18	2.3	9.62	3.1
CALM	0.21	--	0.77	--	0.39	--	1.74	--	0.00	--	4.46	--	7.56	--
ALL	1.77	1.9	10.65	2.4	13.53	3.5	27.32	4.2	13.99	3.4	32.58	1.9	100.0	3.0

TABLE C-14

PROJECT SITE TEMPERATURE DATA MARCH-AUGUST, 1977

MAR 1977 TEMPERATURE(CENTIGRADE)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	-1.1	-1.1	-1.7	-2.2	-1.1	-2.2	-2.8	-.6	1.7	4.4	6.7	7.8	8.9	9.4	8.9	7.8	6.7	4.4	2.2	1.7	1.1	.6	-2.8	-2.8
2	-2.8	-3.3	-4.4	-5.0	-5.0	-4.4	-4.4	-3.3	-1.1	-.6	.6	1.1	1.7	1.1	2.2	2.8	1.7	0.	-2.8	-3.3	-3.9	-4.4	-5.6	-6.1
3	-6.7	-6.7	-6.7	-7.8	-8.3	-6.7	-6.1	-3.3	-1.1	0.	1.7	3.3	4.4	5.0	5.6	3.9	3.3	1.1	-1.1	-1.7	-2.8	-3.9	-4.4	-3.9
4	-3.9	-4.4	-4.4	-3.3	-2.2	-2.2	-2.8	-1.1	-.6	.6	2.8	.6	1.1	1.1	.6	1.7	2.8	0.	-2.2	-2.8	-2.8	-3.3	-3.3	-3.9
5	-4.4	-5.6	-5.6	-5.6	-6.7	-8.3	-7.2	-2.8	0.	1.1	2.8	3.9	4.4	5.6	3.3	3.9	3.3	1.7	-.6	-2.2	-3.3	-3.9	-4.4	-5.6
6	-5.0	-3.9	-6.1	-6.7	-6.1	-6.7	-5.6	-1.7	1.1	2.8	4.4	4.4	7.2	8.3	9.4	10.0	9.4	7.8	5.0	3.3	.6	-1.1	-.6	-1.1
7	0.	-1.1	-2.2	-1.1	-1.1	-1.7	-1.7	.6	3.3	5.6	7.2	8.3	10.0	11.1	11.7	12.2	12.2	10.0	8.3	5.6	4.4	3.3	3.3	3.3
8	3.3	3.9	1.7	1.7	2.2	1.7	1.7	2.2	3.9	6.1	8.5	10.6	12.8	13.3	14.4	14.4	13.9	11.7	8.3	7.2	3.3	3.3	2.2	3.3
9	1.7	2.2	0.	.6	.6	0.	2.2	3.9	5.0	7.2	10.6	11.7	12.8	14.4	15.6	16.1	16.1	13.9	12.8	12.2	11.1	10.6	9.4	8.3
10	5.6	7.8	.6	0.	-1.1	-2.2	-2.8	-2.8	-1.1	-1.1	0.	0.	.6	1.1	0.	-.6	.6	0.	-.6	-.6	0.	0.	0.	-.6
11	-1.1	-1.7	-2.2	-2.2	-2.8	-2.2	-1.7	.6	1.1	2.2	3.3	3.9	5.0	5.0	5.0	4.4	3.9	2.2	0.	-1.7	-1.7	-2.2	-3.3	-3.3
12	-3.9	-3.3	-4.4	-2.8	-3.9	-4.4	-3.3	0.	2.2	3.9	5.6	6.7	8.3	8.9	10.0	10.0	8.9	7.8	4.4	4.4	1.7	1.7	-1.7	-.6
13	0.	.6	.6	-1.1	-2.2	-1.7	-.6	2.2	4.4	6.7	8.5	11.1	12.8	14.4	14.4	14.4	15.0	12.2	10.6	10.0	8.9	7.8	4.4	2.8
14	1.1	1.1	0.	0.	-1.7	-1.7	-1.7	1.1	4.4	5.0	3.3	3.9	1.1	3.3	5.0	4.4	3.9	3.3	0.	-2.2	-2.8	-4.4	-4.4	-4.4
15	-5.0	-5.6	-5.6	-6.7	-7.2	-6.7	-4.4	-1.1	1.7	2.8	4.4	5.6	7.2	8.3	9.4	10.0	8.9	7.2	4.4	2.8	.6	.6	1.1	1.7
16	2.8	1.7	.6	-2.2	-2.2	-1.1	1.1	2.8	3.9	5.6	9.4	11.1	12.8	13.9	15.0	15.0	15.0	12.8	11.1	10.0	8.3	7.2	6.1	5.0
17	5.0	3.9	-1.1	-1.1	-1.1	-2.2	-1.1	.6	2.2	3.9	3.5	5.0	5.0	5.0	7.2	7.2	6.1	4.4	1.7	1.1	1.1	.6	0.	.6
18	0.	-.6	-1.1	-1.7	-1.7	-1.7	-1.1	0.	0.	.6	2.8	4.4	6.1	6.1	6.1	5.6	5.0	3.3	-.6	-1.1	-1.1	-.6	-1.1	-2.8
19	-3.9	-4.4	-5.6	-5.6	-5.6	-5.6	-4.4	0.	1.1	2.8	3.5	5.0	6.7	7.8	8.3	7.8	7.8	6.7	3.9	2.8	1.7	0.	1.1	.6
20	-1.1	-1.1	-1.7	-3.3	-3.3	-3.3	-2.2	1.1	2.8	4.4	6.1	8.3	9.4	8.3	8.3	7.8	7.8	6.1	3.9	2.8	2.8	1.1	1.1	.6
21	-1.1	0.	-1.1	-1.7	-3.3	-3.3	-2.2	99.9	3.3	3.9	5.6	7.2	8.9	10.0	10.6	12.2	11.7	10.6	7.2	5.6	3.3	0.	.6	.6
22	0.	.6	.6	2.2	-1.1	-.6	.6	2.8	5.6	7.8	10.0	11.1	12.8	13.9	15.6	15.0	15.0	15.0	10.0	10.0	7.8	5.0	5.0	3.9
23	3.3	3.3	3.3	1.1	2.2	1.7	2.8	5.0	8.3	11.1	11.1	12.8	15.0	16.1	17.8	17.8	17.2	16.1	12.2	10.6	10.0	8.9	7.2	6.1
24	5.6	4.4	4.4	3.3	3.3	2.8	2.8	5.0	7.8	9.4	10.6	12.2	13.3	14.4	14.4	14.4	13.9	13.3	12.8	11.7	10.0	9.4	8.9	6.1
25	6.7	6.1	6.7	6.1	5.0	4.4	1.7	1.7	3.9	5.6	6.7	7.8	8.9	9.4	9.4	8.9	9.4	8.3	6.7	5.6	5.0	4.4	3.9	3.9
26	3.9	2.8	1.7	1.1	.6	0.	1.1	2.8	5.0	6.1	7.2	9.4	10.0	11.1	12.8	12.8	11.7	11.7	8.3	6.1	5.0	4.4	3.9	2.2
27	2.2	2.8	2.8	3.3	2.8	2.2	3.3	5.6	8.3	10.0	11.1	12.2	13.9	14.4	16.1	16.1	15.6	13.9	12.2	8.9	7.2	8.3	9.4	8.9
28	8.9	1.7	1.1	0.	-2.8	-4.4	-5.0	-3.9	-.6	.6	1.1	1.7	2.2	2.8	3.3	3.3	2.8	2.2	-.6	-1.7	-3.3	-3.9	-5.0	-5.6
29	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6	-5.0	-3.3	-1.7	-1.1	-.6	1.1	.6	2.2	1.7	2.2	1.7	.6	-.6	-2.2	-3.3	-4.4	-5.0	-5.6
30	-5.6	-5.6	-8.3	-8.9	-8.9	-8.3	-5.6	-1.7	.6	1.7	3.3	4.4	5.0	6.7	7.2	7.8	7.8	7.8	6.1	5.6	5.0	4.4	3.3	2.2
31	1.7	1.1	-.6	-.6	-1.1	-1.1	-.6	2.8	5.0	6.7	8.3	9.4	10.6	10.6	10.6	11.1	12.2	10.6	8.3	7.8	7.2	6.7	3.3	2.2

TABLE C-14 (Continued)

APR 1977 TEMPERATURE(CENTIGRADE)
ENERGY FUELS,BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1.7	.6	99.9	99.5	99.9	99.9	0.	-1.1	0.	2.8	4.4	4.4	6.1	6.1	6.1	6.1	5.6	5.6	3.9	2.2	1.7	.6	.6	-.6
2	-1.1	-1.7	-1.7	-1.1	-1.1	-1.7	-1.7	-1.1	1.7	3.9	4.4	4.4	6.1	6.7	6.1	5.6	5.0	3.3	1.1	0.	0.	0.	0.	0.
3	0.	0.	0.	-.6	-1.1	-1.1	-1.1	1.1	2.2	3.3	4.4	5.0	5.6	6.1	6.1	6.1	5.6	5.6	3.9	1.7	.6	.6	0.	0.
4	-.6	-1.7	-2.2	-2.8	-3.3	-4.4	-4.4	-1.7	1.1	4.4	6.7	10.0	11.1	12.2	12.8	13.3	14.4	13.3	12.2	9.4	6.7	3.9	3.9	3.3
5	3.3	1.7	1.7	1.1	0.	0.	-.6	3.9	7.8	9.4	12.2	13.3	15.0	15.6	15.6	16.7	17.2	16.7	15.0	12.2	9.4	7.8	6.7	6.7
6	3.9	3.3	4.4	3.9	4.4	3.3	3.3	6.7	9.4	10.6	12.8	14.4	16.1	-16.1	18.3	18.9	18.3	17.8	15.6	12.8	12.2	8.9	8.9	5.6
7	5.6	7.2	5.6	5.0	4.4	2.8	3.3	8.9	11.1	12.8	14.4	16.7	18.9	20.0	20.6	21.1	21.1	20.6	18.9	16.1	14.4	12.2	10.0	7.8
8	7.8	7.8	7.2	6.7	7.2	6.7	7.8	8.9	13.3	14.4	16.1	17.8	19.4	21.1	22.2	22.2	22.2	22.2	20.6	16.7	15.0	12.8	10.6	8.9
9	10.0	8.9	10.0	8.9	7.8	5.6	5.6	10.0	11.7	13.9	16.7	19.4	21.7	22.8	23.9	24.4	23.9	23.3	21.7	19.4	17.8	16.1	14.4	12.8
10	12.8	11.1	10.6	8.9	9.4	9.4	8.9	9.4	13.9	15.6	16.7	17.8	20.0	21.1	21.7	21.7	21.1	20.0	17.8	16.7	13.9	13.9	13.3	12.8
11	11.1	11.1	10.0	8.9	8.9	10.6	10.6	10.6	12.2	13.9	13.3	15.6	16.7	16.7	17.2	17.2	16.7	15.0	12.2	10.6	9.4	7.8	8.3	8.3
12	7.8	7.2	6.7	5.0	3.9	3.3	7.8	10.0	11.7	13.3	14.4	15.6	15.6	16.1	17.2	14.4	15.0	14.4	10.0	8.9	7.2	7.2	7.2	7.2
13	5.0	5.0	2.8	3.3	3.3	3.3	5.6	8.9	11.1	12.8	15.0	16.1	17.2	17.8	18.3	17.8	17.2	15.6	13.3	11.1	8.9	6.7	8.3	8.3
14	7.8	7.2	5.6	5.0	5.0	6.7	10.0	12.2	13.3	15.0	17.2	18.9	18.9	19.4	19.4	18.9	17.8	16.7	13.3	13.3	12.2	10.6	8.3	7.2
15	6.1	5.0	3.9	2.8	1.7	1.7	2.8	3.9	6.1	6.7	7.8	8.9	9.4	10.0	10.6	10.6	10.6	9.4	5.6	5.6	4.4	3.9	2.8	2.2
16	2.2	2.8	3.3	2.8	0.	2.8	6.1	7.8	13.3	12.2	14.4	15.6	17.2	17.8	18.3	17.8	17.2	16.7	12.8	11.7	11.1	7.8	6.7	6.7
17	7.2	6.7	6.7	6.7	5.6	6.7	11.1	13.9	16.7	17.8	19.4	21.1	22.2	22.8	23.3	22.8	22.2	21.1	16.7	15.6	16.7	13.9	11.7	12.2
18	12.2	11.1	9.4	8.3	7.2	6.7	5.6	9.4	12.2	15.6	17.8	20.0	20.6	22.2	22.8	23.3	22.8	21.7	19.4	17.8	16.1	10.0	12.8	11.1
19	10.0	9.4	8.3	7.8	7.2	7.2	7.8	8.9	10.6	11.1	12.2	12.8	10.0	8.9	10.0	9.4	8.9	7.8	6.7	4.4	3.9	3.3	2.8	2.2
20	3.9	3.9	4.4	4.4	4.4	3.9	6.7	7.2	8.9	10.6	12.8	12.2	13.3	14.4	15.0	15.0	13.9	14.4	11.1	9.4	8.3	7.8	5.0	3.9
21	3.9	3.3	3.3	1.1	1.7	1.1	5.6	8.3	11.7	13.3	15.0	16.7	17.2	18.3	18.9	18.9	18.9	18.3	15.0	11.7	6.1	6.7	7.8	6.1
22	3.9	5.0	5.0	3.9	5.0	5.6	9.4	11.1	12.2	14.4	17.8	18.9	20.6	21.7	21.7	21.7	21.7	20.0	16.7	15.6	14.4	11.1	10.0	9.4
23	8.9	8.9	7.8	5.6	5.6	6.1	10.0	15.0	16.7	17.2	19.4	21.1	22.2	23.3	23.9	23.9	22.8	21.7	18.9	17.8	16.1	15.0	12.8	11.7
24	11.7	10.6	8.9	8.9	11.1	10.0	12.8	15.0	16.7	18.3	19.4	21.1	22.8	23.9	22.8	21.7	21.1	20.0	16.7	15.6	13.9	12.8	11.7	10.6
25	10.6	9.4	8.9	8.9	8.9	8.9	10.0	99.9	12.8	13.9	16.7	17.8	18.9	18.9	21.1	20.0	22.2	21.1	19.4	18.9	17.2	15.0	13.3	12.8
26	10.6	10.0	9.4	9.4	9.4	7.8	8.9	11.1	13.3	14.4	16.1	18.3	21.1	22.8	23.9	23.3	23.9	22.8	22.2	18.9	17.8	17.2	13.9	15.0
27	14.4	12.8	12.8	12.8	12.2	11.1	11.7	12.2	13.9	16.7	18.3	20.6	22.2	22.8	23.3	23.3	22.8	22.2	22.2	20.6	18.9	18.3	16.1	17.8
28	16.7	16.1	15.6	14.4	12.8	11.1	10.6	11.1	12.8	14.4	15.6	17.8	18.9	20.6	15.6	17.8	20.0	19.4	19.4	18.3	13.9	12.8	11.7	10.6
29	10.0	9.4	8.9	9.4	7.8	7.2	8.9	12.8	15.0	16.7	17.8	19.4	21.1	23.3	22.2	23.3	23.3	22.8	23.3	22.2	18.9	17.2	15.6	13.3
30	12.2	13.3	13.3	11.7	10.0	11.1	10.6	11.7	15.6	17.2	18.3	20.0	21.7	23.3	23.3	23.3	23.3	23.3	22.8	22.2	18.3	16.7	16.1	15.1

TABLE C-14 (Continued)

MAY 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS.BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	15.6	12.2	11.1	11.7	10.0	11.7	13.3	12.8	13.3	15.0	16.7	18.3	17.8	17.8	19.4	20.6	21.1	21.1	21.1	19.4	17.8	15.0	15.6	13.9
2	11.7	11.1	11.1	11.1	9.4	6.1	5.0	7.2	13.3	15.6	17.8	18.9	20.0	21.1	21.7	22.8	22.8	21.7	21.1	18.9	16.7	12.2	11.1	11.1
3	10.6	10.6	11.1	10.0	11.1	11.1	10.6	12.2	13.3	13.9	15.6	17.2	17.8	17.2	17.2	17.8	20.0	19.4	18.9	17.8	16.1	15.6	15.0	14.4
4	13.3	12.8	11.1	11.1	8.9	8.3	7.2	10.6	12.2	14.4	15.6	17.8	18.3	19.4	20.0	20.6	20.6	20.6	20.0	17.8	15.6	14.4	14.4	12.8
5	11.1	10.6	8.9	8.3	6.1	6.7	5.6	9.4	12.2	14.4	16.7	18.3	19.4	20.6	21.1	21.7	21.7	20.6	20.0	18.3	17.2	16.1	14.4	13.3
6	12.2	11.7	10.6	9.4	8.3	8.9	9.4	11.1	12.2	12.8	14.4	16.1	17.8	19.4	20.6	20.6	21.7	21.7	20.6	18.3	17.2	16.1	14.4	13.9
7	13.9	11.7	11.7	10.0	10.0	9.4	8.9	11.7	13.9	16.1	17.2	18.3	19.4	20.6	23.3	23.3	21.7	21.1	20.6	19.4	18.3	17.2	16.7	15.6
8	13.9	13.3	12.8	11.7	11.1	10.6	11.1	11.7	14.4	16.1	17.8	19.4	20.6	22.2	22.8	22.8	22.8	22.8	22.8	21.7	20.6	18.3	17.8	15.6
9	15.6	14.4	13.9	11.7	10.0	8.9	8.9	11.1	15.6	19.4	21.1	22.2	23.3	23.9	25.0	25.0	25.0	23.9	21.1	18.9	15.6	11.7	10.0	9.4
10	8.9	8.3	8.3	8.3	7.8	6.7	7.2	7.8	9.4	10.0	11.7	12.8	13.9	14.4	15.0	15.6	15.6	15.6	15.0	11.7	11.1	9.4	6.1	4.4
11	5.0	4.4	3.9	3.9	3.3	3.3	7.2	10.0	11.7	13.3	15.6	17.8	18.3	20.0	20.6	20.6	20.0	20.0	18.3	16.1	15.0	11.7	12.8	13.9
12	11.7	10.0	9.4	7.2	8.9	5.6	10.0	13.3	16.1	17.2	18.9	20.6	21.1	22.8	17.8	18.9	17.8	16.1	16.1	14.4	14.4	12.2	11.7	11.1
13	10.0	10.0	9.4	10.0	10.0	10.0	8.9	11.1	12.2	14.4	16.1	16.7	16.7	13.3	11.7	8.3	10.0	6.7	6.7	6.7	6.7	6.1	5.6	5.0
14	5.0	4.4	3.9	3.9	3.3	3.3	2.8	3.3	4.4	4.4	6.1	7.2	6.7	8.9	9.4	10.6	11.1	10.0	8.3	7.8	7.8	7.8	7.2	7.2
15	7.2	6.7	6.7	6.7	5.0	5.6	6.1	7.8	9.4	10.0	12.2	12.8	14.4	15.6	17.2	17.2	17.8	16.1	18.3	14.4	11.7	10.6	10.0	9.4
16	8.3	8.3	8.3	7.2	6.7	6.1	6.7	12.8	13.9	15.0	16.7	18.9	19.4	20.0	21.1	20.0	19.4	18.9	17.2	16.1	15.0	13.9	12.8	11.7
17	10.6	8.3	7.2	6.7	6.1	6.7	8.9	10.6	12.2	12.8	13.9	16.1	17.8	18.3	18.3	20.0	18.3	17.2	15.6	12.8	11.1	9.4	7.8	6.7
18	5.6	3.9	3.3	2.8	2.8	3.3	5.0	6.7	7.8	8.9	10.0	11.7	12.2	12.8	13.9	13.9	13.3	12.8	10.6	9.4	7.8	7.2	5.0	4.4
19	3.9	1.1	0.	0.	.6	3.3	7.2	9.4	10.6	12.2	12.8	12.8	15.0	16.1	16.7	14.4	13.9	13.9	12.8	10.6	8.9	7.8	7.8	6.7
20	7.8	6.7	7.2	7.2	7.2	7.8	9.4	12.2	13.9	15.6	16.1	16.7	17.2	16.7	17.8	17.2	16.7	16.1	15.0	13.3	11.7	11.1	11.1	9.4
21	8.9	6.7	6.7	6.1	6.1	7.2	10.6	12.2	13.9	15.0	16.7	17.8	18.9	18.9	20.6	20.6	20.0	19.4	18.3	15.6	14.4	13.3	11.7	9.4
22	9.4	9.4	6.7	7.8	8.3	7.8	11.1	13.9	16.1	17.2	18.9	20.0	21.7	22.8	23.3	23.3	23.9	23.3	22.2	19.4	18.9	24.4	15.6	15.6
23	14.4	13.3	13.3	12.8	9.4	10.6	10.0	16.7	19.4	21.1	22.8	23.9	25.6	26.1	25.0	25.6	25.0	23.9	21.7	20.0	18.3	17.8	16.7	15.0
24	15.0	14.4	15.0	14.4	15.0	16.1	17.2	15.6	16.7	17.8	17.8	17.2	15.6	12.8	11.1	11.1	10.0	7.8	6.7	7.2	7.2	7.8	7.8	6.7
25	6.7	7.2	6.7	6.7	6.7	6.7	7.2	9.4	10.0	10.6	11.7	12.8	14.4	15.0	16.1	17.2	17.2	16.7	16.7	14.4	13.3	12.2	11.1	11.1
26	11.7	11.1	10.6	8.9	8.3	8.9	9.4	11.1	12.8	13.9	15.0	15.0	16.1	16.7	17.2	18.3	17.8	17.8	17.2	15.6	13.9	12.2	10.6	10.0
27	10.0	10.0	9.4	8.9	8.9	9.4	11.1	12.8	13.9	15.6	17.2	18.3	19.4	20.0	20.6	21.1	21.1	20.6	19.4	18.9	16.1	15.0	13.3	12.8
28	11.1	11.7	12.2	11.7	10.6	8.9	9.4	12.8	14.4	16.7	18.3	20.0	21.1	22.2	22.8	23.3	23.3	22.8	22.2	21.1	18.9	17.8	16.1	15.0
29	12.8	12.2	11.7	9.4	9.4	10.0	10.0	14.4	16.7	18.3	20.0	21.7	22.2	23.3	23.9	25.6	24.4	26.1	25.6	24.4	21.1	19.4	17.2	18.3
30	16.7	16.1	16.1	15.6	15.6	13.3	12.2	13.3	17.8	20.6	23.3	24.4	26.1	27.8	28.3	28.9	28.3	28.9	28.3	26.7	22.8	18.9	18.3	17.8
31	15.6	16.7	16.1	17.2	15.0	13.9	15.6	17.8	22.2	25.0	26.7	28.3	30.0	30.6	31.1	31.1	31.7	31.7	31.1	29.4	26.7	22.8	21.1	18.3

TABLE C-14 (Continued)

JUN 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	18.9	17.2	18.9	15.0	16.1	17.2	17.2	20.0	23.3	24.4	25.6	27.2	29.4	31.1	32.2	31.1	32.8	31.7	31.1	29.4	25.0	23.9	24.4	22.2
2	20.6	18.9	21.1	16.7	17.8	17.8	16.1	21.1	22.2	21.7	23.9	27.8	29.4	29.4	30.0	28.9	30.6	30.0	28.3	26.1	25.6	23.9	23.3	22.8
3	21.7	20.6	21.1	18.9	18.3	16.7	16.1	20.6	22.8	23.9	25.6	21.1	28.3	29.4	30.6	30.0	29.4	30.6	29.4	26.7	24.4	23.3	22.2	22.2
4	20.0	18.3	17.2	16.7	15.0	15.0	15.0	18.9	22.2	22.8	23.9	25.0	27.2	29.4	28.9	28.3	28.3	27.8	27.8	26.7	23.3	22.2	20.6	19.4
5	19.4	18.3	16.7	16.1	16.1	16.7	17.8	21.1	23.3	25.0	26.1	27.8	28.9	30.0	30.6	31.1	30.6	31.1	28.9	26.7	25.0	23.3	23.9	22.2
6	20.0	19.4	18.3	17.2	17.2	17.8	17.8	19.4	22.8	25.6	28.3	29.4	30.0	30.6	31.1	31.1	30.6	30.0	27.8	25.6	23.3	21.7	22.8	22.8
7	21.7	21.1	20.6	19.4	18.9	18.9	20.6	22.8	24.4	26.1	26.7	28.3	29.4	30.0	30.0	30.6	25.6	25.0	24.4	23.3	22.8	21.1	19.4	19.4
8	18.9	17.8	17.2	17.2	17.2	17.2	18.9	21.1	23.3	25.0	26.1	27.8	28.3	28.9	27.2	26.7	25.0	24.4	22.8	21.1	18.9	18.3	18.3	18.3
9	18.3	17.8	17.2	15.6	15.0	16.7	18.9	20.0	21.7	23.3	25.6	24.4	26.7	27.8	27.8	26.7	26.7	26.7	24.4	22.2	21.1	21.1	24.4	23.3
10	22.8	20.6	15.0	13.3	11.7	14.4	18.3	19.4	21.1	23.3	24.4	25.6	26.1	26.7	27.2	27.2	26.7	26.1	24.4	21.7	19.4	18.9	17.8	15.6
11	16.7	15.0	15.6	13.9	12.2	13.9	18.3	20.0	22.8	23.9	24.4	25.0	26.1	26.7	27.8	26.7	27.8	27.2	25.6	21.7	20.6	18.9	18.3	18.9
12	13.9	13.9	14.4	13.3	13.3	14.4	18.3	20.6	22.2	23.3	25.0	26.1	27.2	28.3	28.9	27.8	27.8	27.8	27.2	23.9	21.7	20.6	17.8	17.8
13	15.0	14.4	14.4	12.8	12.2	13.3	19.4	21.7	22.8	24.4	26.1	27.8	29.4	30.0	30.6	30.6	30.6	30.0	28.9	25.0	23.9	21.1	18.9	17.8
14	16.7	17.2	15.0	13.9	13.3	16.7	20.0	22.2	24.4	25.6	27.2	28.9	30.0	31.7	31.7	32.2	32.2	31.7	30.0	25.6	24.4	19.4	19.4	18.9
15	18.9	17.8	16.7	15.6	11.7	15.6	19.4	21.7	23.9	25.6	27.8	28.9	30.0	31.1	31.7	31.7	31.7	31.1	30.6	25.6	23.9	21.1	18.9	17.8
16	16.1	19.4	19.4	15.6	16.1	17.2	20.0	22.2	23.9	26.1	27.8	29.4	30.6	31.1	32.2	32.2	31.7	31.1	29.4	26.7	24.4	19.4	18.9	22.8
17	21.1	20.6	18.9	17.8	14.4	16.1	19.4	22.2	23.3	26.1	27.8	30.0	31.1	31.1	32.2	32.2	32.2	31.7	30.0	26.7	24.4	23.3	22.8	21.7
18	20.0	20.0	15.6	17.2	15.1	16.7	18.3	22.2	23.3	25.0	26.7	27.8	28.9	29.4	30.6	30.6	31.1	30.6	28.3	25.6	23.9	18.9	17.2	18.9
19	18.3	13.3	13.9	12.2	11.1	12.2	15.0	19.4	22.8	24.4	26.1	26.7	28.9	30.0	30.0	30.6	30.6	30.0	28.3	26.1	23.3	22.2	21.7	20.0
20	17.8	17.2	15.6	14.4	13.9	12.2	16.7	21.1	23.3	25.0	25.6	26.7	27.2	27.8	28.9	29.4	29.4	28.3	26.7	23.3	22.2	18.9	17.8	15.6
21	15.0	15.0	13.9	12.2	12.2	14.4	19.4	20.6	22.2	23.9	25.0	26.7	27.2	28.3	28.9	27.8	28.9	28.9	21.7	22.8	22.8	21.1	19.4	16.7
22	16.7	16.7	16.7	12.8	12.8	14.4	19.4	15.6	22.8	24.4	26.7	27.8	29.4	29.4	29.4	30.0	30.6	29.4	27.8	25.0	22.8	21.7	20.6	19.4
23	16.7	15.6	15.0	13.9	15.6	16.7	20.6	22.2	23.9	25.6	27.2	27.2	28.3	30.0	29.4	23.9	25.0	24.4	25.0	23.9	26.7	20.0	18.9	17.8
24	17.8	16.7	16.7	16.1	15.6	15.0	18.9	21.1	22.8	23.9	26.7	27.8	30.6	31.1	27.8	27.8	27.8	25.6	23.3	22.2	21.1	20.0	20.0	18.9
25	18.3	16.7	16.1	16.1	17.2	16.7	20.0	21.7	23.3	25.6	26.7	28.9	31.1	28.9	28.3	28.3	28.9	27.2	25.0	23.9	23.3	23.3	22.2	20.6
26	18.3	17.2	16.1	16.1	16.1	16.1	20.6	22.8	23.3	26.1	28.3	30.0	31.1	31.7	32.2	26.7	26.1	25.6	25.0	23.9	22.8	19.4	20.0	20.0
27	18.9	16.1	15.6	15.0	15.6	17.8	22.2	24.4	26.1	28.3	29.4	31.1	30.0	32.8	33.3	33.9	33.9	31.1	30.6	28.3	26.1	25.0	23.3	22.8
28	23.3	22.8	23.9	18.9	19.4	18.9	23.9	27.8	30.0	31.7	32.8	32.2	33.9	34.4	35.0	34.4	34.4	33.3	33.3	31.1	27.2	26.7	23.9	24.4
29	23.3	22.8	21.7	20.0	21.1	21.7	21.1	23.9	25.6	26.7	28.9	30.0	31.1	31.7	31.7	32.2	31.7	31.1	30.0	28.9	26.7	25.0	22.2	23.3
30	21.7	21.7	19.4	19.4	18.3	18.9	21.1	25.6	27.8	30.0	31.1	31.7	33.3	33.9	33.9	33.9	34.4	33.3	31.1	30.0	28.3	26.7	26.1	25.1

TABLE C-14 (Continued)

JUL 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	23.9	22.2	20.0	20.0	21.1	20.0	21.1	25.6	27.2	28.9	29.4	30.0	32.2	32.8	33.3	32.2	31.1	31.1	30.6	27.8	25.7	24.4	23.3	22.8
2	21.7	21.1	20.0	18.3	18.3	17.2	18.9	23.3	24.4	26.1	27.8	30.0	31.1	32.2	32.8	32.8	31.1	32.2	30.6	29.4	27.2	25.6	24.4	23.9
3	23.9	25.0	23.3	21.1	21.7	22.2	22.2	23.9	26.7	28.9	30.0	31.1	30.0	31.7	30.6	30.0	31.7	30.6	27.8	27.2	26.1	25.6	25.0	23.9
4	20.0	18.3	17.2	16.7	16.1	16.1	15.6	16.1	16.7	16.1	16.1	16.7	20.0	21.1	22.2	21.7	21.1	22.2	21.1	18.3	17.8	17.2	16.7	16.7
5	16.7	16.1	16.1	15.6	15.6	15.6	15.6	20.0	21.7	23.3	24.4	26.1	26.7	28.3	27.2	26.7	22.8	23.3	22.2	19.4	18.3	18.3	16.1	15.6
6	15.0	15.0	15.0	13.3	14.4	17.2	20.0	21.7	23.3	26.1	26.7	28.3	28.9	29.4	29.4	30.0	23.9	28.9	25.6	22.8	22.8	22.2	19.4	17.8
7	17.2	17.8	16.1	15.0	16.7	18.3	22.2	25.0	26.7	28.9	30.0	31.1	31.7	32.2	32.2	32.2	31.7	30.6	26.7	25.0	22.8	20.0	19.4	19.4
8	17.2	16.1	16.7	16.1	16.7	18.9	24.4	24.4	26.7	28.3	30.0	31.7	32.8	32.8	32.8	32.8	32.8	31.7	28.9	26.7	25.0	21.1	23.9	22.2
9	21.7	20.6	20.0	19.4	18.9	21.1	22.2	23.3	24.4	26.7	28.9	30.6	31.7	32.2	32.8	32.2	31.7	31.1	28.3	26.7	25.6	23.3	22.8	21.7
10	20.6	20.6	20.0	18.9	17.2	18.9	23.9	26.7	28.3	29.4	30.0	30.6	31.7	31.7	31.7	31.7	31.7	30.6	28.3	26.1	25.0	23.3	21.7	19.4
11	20.6	20.6	18.9	19.4	19.4	21.7	22.8	22.2	22.2	22.2	25.6	26.7	28.3	29.4	30.6	30.6	30.6	30.0	28.9	25.6	23.9	22.2	21.7	21.1
12	24.4	23.9	21.7	15.6	15.0	16.1	20.6	22.8	24.4	26.7	28.3	30.0	31.1	31.7	31.7	31.7	31.1	30.6	29.4	27.8	26.7	23.9	22.2	21.7
13	21.7	21.1	20.6	20.6	20.6	20.0	21.7	22.8	22.8	25.6	26.7	28.3	29.4	30.6	31.1	31.1	31.1	31.1	28.9	26.7	26.1	24.4	22.8	22.8
14	23.3	22.8	21.1	20.0	19.4	20.0	21.1	22.8	24.4	26.7	27.8	29.4	31.1	32.2	31.1	33.3	31.1	32.2	30.0	25.6	23.9	21.7	20.6	20.0
15	18.9	18.3	17.8	17.8	17.8	18.3	20.0	22.2	23.3	25.0	26.7	28.3	29.4	30.6	31.1	31.1	31.1	30.0	27.8	24.4	26.1	24.4	22.8	22.2
16	21.7	20.6	19.4	18.9	17.8	17.8	20.6	22.2	23.9	25.0	26.7	28.9	30.0	31.7	32.8	33.3	32.8	31.1	29.9	28.3	26.1	24.4	25.0	22.8
17	22.2	21.7	21.1	20.6	20.6	20.6	21.7	25.6	25.6	26.1	28.3	30.0	31.7	33.3	33.9	33.3	33.3	32.8	30.0	27.2	25.0	20.0	20.0	20.0
18	20.0	18.9	18.3	18.9	19.4	18.3	19.4	23.3	25.0	27.8	28.3	28.9	31.1	31.7	31.7	31.7	30.6	28.9	24.4	23.9	23.9	22.2	20.6	20.0
19	19.4	19.4	19.4	18.9	18.9	20.6	21.7	23.3	24.4	26.1	28.3	27.2	28.3	28.3	27.2	28.3	28.3	25.0	22.8	21.7	21.1	20.6	19.4	19.4
20	18.9	18.3	17.2	16.7	17.2	20.0	21.7	23.9	24.4	26.7	27.8	27.8	29.4	30.6	31.1	31.7	23.9	20.6	19.4	17.2	16.1	16.1	16.1	16.1
21	16.1	16.7	16.7	16.7	16.7	17.2	18.3	18.9	20.0	21.1	23.3	24.4	25.6	25.0	24.4	23.9	23.9	23.3	22.2	21.7	13.9	15.0	16.1	16.1
22	15.6	16.1	15.6	15.6	16.1	17.8	20.0	20.6	21.1	22.2	23.9	24.4	26.1	27.8	26.7	26.7	26.1	25.0	20.6	20.0	16.1	16.1	16.1	16.1
23	16.1	16.1	16.1	16.1	16.7	17.8	18.9	20.0	21.7	21.7	22.8	25.6	26.1	26.7	27.2	25.0	25.0	23.9	20.0	18.3	17.8	17.2	17.2	17.2
24	16.1	16.1	16.1	16.1	16.7	17.2	16.7	16.7	16.7	16.7	20.0	21.7	22.8	23.3	23.9	23.9	23.9	22.8	25.0	17.8	17.8	16.7	16.7	16.7
25	16.1	15.6	15.0	14.4	15.6	17.2	19.4	20.6	22.2	22.8	25.6	26.1	27.2	26.7	28.9	28.9	29.4	29.4	28.3	25.6	23.3	21.7	20.6	20.6
26	19.4	18.3	18.3	18.3	17.2	17.2	20.6	22.8	23.9	25.0	26.7	28.3	30.0	31.1	30.6	30.6	30.6	27.2	25.0	23.9	22.2	20.6	20.0	19.4
27	18.3	17.8	17.2	17.8	16.1	17.2	20.0	21.7	23.3	24.4	26.1	27.2	29.4	30.6	31.1	30.6	31.1	28.9	26.1	23.9	23.3	21.7	21.7	19.4
28	18.9	19.4	17.8	16.7	15.6	17.2	20.0	23.3	25.0	26.1	27.2	28.9	29.4	28.3	31.1	31.7	31.7	30.6	28.3	24.4	22.8	22.2	20.6	20.0
29	18.3	18.3	19.4	18.3	17.2	16.7	21.1	22.8	25.0	26.7	28.3	30.6	31.7	32.8	33.3	33.3	31.7	32.2	28.3	25.6	23.9	23.9	23.3	23.3
30	20.6	20.6	18.9	18.3	17.2	18.3	22.8	24.4	26.7	28.3	30.6	32.2	33.9	33.9	34.4	34.4	33.9	32.8	30.6	27.2	26.1	25.0	22.8	22.8
31	21.7	23.3	21.7	22.8	20.0	16.7	20.6	23.9	26.1	28.3	31.1	32.2	32.8	32.8	32.2	32.2	31.7	30.6	29.4	25.0	24.4	23.3	23.3	19.4

TABLE C-14 (Concluded)

AUG 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	18.9	18.9	19.4	20.0	19.4	20.0	20.6	22.8	25.1	27.8	30.6	31.7	33.3	33.3	33.9	33.9	33.9	33.3	31.1	27.8	22.8	22.8	21.7	21.1
2	21.7	21.1	18.9	18.3	18.3	20.0	23.3	26.1	28.3	29.4	31.7	32.8	33.9	34.4	35.0	35.0	35.0	33.9	31.7	28.3	26.1	24.4	21.7	22.8
3	21.7	20.0	19.4	18.9	18.3	16.1	18.3	22.8	25.6	26.7	28.9	30.6	32.2	33.9	35.0	35.0	35.0	33.3	29.4	28.9	27.2	26.7	25.0	24.4
4	24.4	24.4	23.9	22.8	21.7	20.0	21.7	23.9	25.6	27.2	28.3	28.9	30.0	31.7	31.7	31.1	29.4	29.4	28.9	26.7	25.0	22.8	22.2	21.7
5	22.8	21.7	21.7	20.6	19.4	18.9	19.4	22.2	24.4	26.1	27.8	28.9	30.6	31.7	31.7	31.7	31.7	31.1	30.6	27.2	26.1	23.3	22.8	21.1
6	21.7	20.6	20.6	20.0	19.4	19.4	20.6	17.8	25.6	27.8	30.0	31.1	32.2	32.8	33.3	33.3	33.9	32.8	31.7	28.9	27.2	27.2	20.6	21.7
7	23.3	20.6	21.1	21.1	18.9	17.8	17.8	22.8	25.6	28.9	29.4	30.0	31.7	31.7	31.7	31.1	30.6	30.6	29.4	27.8	26.7	26.1	23.9	22.2
8	21.7	20.6	20.6	19.4	18.3	18.3	17.2	20.6	25.0	26.7	28.9	30.6	31.1	31.7	31.7	32.2	31.7	30.0	28.9	26.1	25.0	24.4	23.9	22.8
9	21.1	19.4	18.9	18.3	16.7	17.2	21.1	24.4	25.0	27.2	29.4	31.7	32.2	32.8	33.3	32.8	32.2	30.0	28.3	26.7	25.0	22.2	21.7	21.7
10	20.6	18.3	17.2	16.7	16.1	17.2	20.0	22.2	23.9	24.4	25.6	27.8	28.3	28.3	27.2	27.2	27.8	27.2	25.6	23.9	21.7	20.6	20.0	18.9
11	18.3	16.7	17.2	17.2	17.2	17.8	20.0	21.1	22.8	24.4	26.1	27.2	28.3	28.9	29.4	27.8	26.1	23.3	20.0	19.4	18.3	16.7	16.7	16.1
12	16.1	15.6	15.0	14.4	13.9	15.0	18.3	20.6	22.2	23.9	26.1	27.2	28.3	29.4	30.0	28.9	28.3	28.3	26.7	25.0	23.9	22.8	20.6	20.0
13	19.4	17.8	16.7	16.7	17.8	16.7	20.6	22.8	23.9	25.6	26.7	30.0	31.1	27.8	27.8	30.6	29.4	27.8	26.7	25.0	21.1	23.3	21.7	21.1
14	19.4	19.4	17.8	17.2	17.2	17.2	21.1	22.8	24.4	25.6	27.2	28.3	29.4	30.0	30.6	29.4	28.9	28.3	26.1	23.9	21.7	21.1	20.0	17.8
15	16.1	16.1	15.6	16.1	16.1	16.7	18.3	17.8	18.9	19.4	20.6	21.7	22.8	25.0	26.1	26.1	26.7	26.1	25.6	23.9	23.3	18.9	17.8	16.1
16	16.1	16.7	16.1	16.1	16.1	16.1	16.1	17.8	19.4	20.0	21.1	22.8	24.4	26.1	27.2	27.2	27.8	26.7	25.0	23.3	22.2	21.1	20.0	18.9
17	17.2	16.7	16.7	16.7	16.1	16.1	17.2	17.2	18.9	20.0	21.1	22.2	22.8	23.9	24.4	19.4	21.1	21.1	20.6	19.4	19.4	18.9	18.3	18.3
18	17.8	16.7	16.1	16.1	16.1	16.1	17.2	18.9	21.6	21.1	23.3	25.0	26.1	27.2	28.3	28.3	28.3	27.8	26.7	23.3	22.2	22.2	21.1	19.4
19	18.3	18.3	17.2	17.8	17.2	17.2	17.8	21.1	23.3	25.0	27.2	28.9	29.4	31.1	31.7	31.7	31.1	30.6	28.9	26.7	25.0	24.4	21.1	20.6
20	19.4	17.8	17.2	15.7	16.7	16.7	18.3	21.1	23.3	24.4	26.1	27.8	28.9	30.0	31.1	30.6	28.9	28.3	27.2	25.0	23.9	22.8	23.3	22.8
21	21.1	19.4	18.3	18.3	18.9	18.3	18.9	21.7	23.3	24.4	26.1	27.8	29.4	30.6	31.7	28.9	30.6	30.6	29.4	26.7	25.0	23.9	21.7	22.2
22	20.6	20.6	19.4	18.9	16.7	16.7	17.2	22.8	23.9	25.6	28.3	30.6	30.0	23.3	26.7	27.2	25.6	25.0	23.3	22.8	21.7	20.6	19.4	19.4
23	18.9	18.3	18.3	18.3	17.8	17.8	19.4	21.7	23.3	24.4	26.1	27.2	27.2	28.9	25.0	25.0	22.8	22.2	18.9	18.3	17.8	17.8	17.2	16.1
24	16.1	16.1	15.0	14.4	13.9	13.9	15.6	18.9	20.0	21.7	23.9	22.8	21.7	25.0	26.1	26.1	26.1	24.4	22.8	20.6	19.4	19.4	18.9	18.3
25	16.7	16.1	16.7	15.6	15.6	15.6	16.1	19.4	21.1	22.8	25.0	26.1	26.1	26.7	28.3	28.3	28.3	27.8	26.1	23.9	22.8	22.2	18.9	18.3
26	18.3	17.8	17.2	16.1	16.1	15.0	17.2	19.4	21.7	23.3	25.0	26.1	27.2	28.9	30.0	30.0	30.6	28.9	27.2	25.6	25.0	23.9	23.3	17.2
27	16.1	15.6	13.9	12.2	12.8	11.1	12.8	15.0	15.7	18.9	20.0	20.6	22.2	23.3	23.9	23.9	23.3	22.8	21.1	19.4	16.7	15.6	16.1	16.1
28	13.9	12.8	12.8	12.2	10.6	13.9	12.2	15.6	20.0	22.2	23.9	24.4	25.0	26.1	26.1	26.7	26.7	26.7	24.4	21.1	18.9	16.7	16.1	15.6
29	15.0	13.3	13.9	13.3	12.8	13.9	13.3	20.6	20.6	22.2	24.4	26.1	27.8	28.9	29.4	29.4	28.9	28.9	26.1	24.4	23.9	19.4	18.3	18.3
30	18.3	18.3	15.6	15.6	14.4	16.7	17.2	20.0	22.8	24.4	26.1	27.8	29.4	30.0	29.4	30.6	30.0	29.4	27.2	24.4	22.8	22.8	21.7	16.7
31	18.3	18.3	17.8	17.8	15.6	15.0	16.7	21.1	22.8	24.4	26.7	28.3	28.9	30.0	30.0	28.9	28.3	27.8	26.1	24.4	22.8	22.2	20.0	19.4

TABLE C-15

MONTHLY SUMMARY OF TOTAL PRECIPITATION
APRIL-AUGUST 1977
PROJECT SITE

Month	Precipitation (cm)
April	0.03
May	1.22
June	0.15
July	4.62
August	2.21

TABLE C-16

PROJECT SITE RELATIVE HUMIDITY DATA MARCH-AUGUST, 1977

MAR 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS.BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	48	48	48	50	49	51	54	52	45	38	34	31	28	27	26	28	32	48	60	58	56	58	82	93
2	92	86	70	88	82	66	63	63	51	44	38	37	33	34	35	36	40	40	46	50	51	52	55	56
3	60	61	68	70	72	68	68	62	58	53	48	44	38	36	35	35	34	54	62	68	66	65	62	61
4	60	63	62	60	66	69	71	64	62	59	60	70	59	61	58	52	54	54	56	58	60	60	58	58
5	59	59	59	60	60	62	62	54	42	39	34	31	28	27	30	30	29	30	34	38	42	43	46	48
6	50	49	52	53	54	55	57	49	40	37	33	32	29	27	25	23	23	23	26	28	33	36	38	39
7	38	40	42	40	40	42	43	43	38	36	34	31	28	24	24	32	22	23	24	27	28	30	31	32
8	31	30	32	34	33	33	34	34	34	29	26	23	21	20	20	18	19	20	22	23	29	29	30	30
9	31	30	33	34	34	34	33	30	29	28	26	24	22	21	19	18	17	17	18	18	18	22	25	34
10	54	72	70	69	68	70	64	63	54	51	49	50	52	54	59	68	56	55	60	60	53	52	51	50
11	53	55	59	58	59	56	53	48	47	44	39	38	35	34	33	34	36	38	41	44	44	45	48	49
12	49	47	48	42	45	45	46	41	35	33	30	27	25	25	24	24	24	24	26	26	28	30	35	36
13	36	35	35	37	39	40	41	36	34	31	29	24	20	17	14	13	11	11	11	11	11	12	15	19
14	21	24	29	32	34	36	37	35	25	30	31	46	55	84	44	26	25	25	30	34	42	45	47	48
15	50	50	53	56	59	57	52	41	32	30	27	24	22	20	17	16	16	17	19	21	23	24	25	24
16	24	25	26	30	32	32	32	31	30	29	26	23	21	18	15	15	14	12	12	13	14	16	10	12
17	28	42	99	95	94	95	83	64	54	46	46	42	40	37	32	32	36	39	44	47	48	48	50	51
18	51	52	53	54	55	55	57	54	54	51	44	41	32	23	20	18	17	16	19	21	23	25	28	33
19	36	38	42	43	45	46	46	39	35	32	30	28	26	24	22	22	22	23	25	26	28	30	31	32
20	34	35	36	39	41	42	42	36	33	31	29	30	29	30	29	30	31	34	36	36	35	35	35	36
21	39	41	42	43	46	47	48	33	36	34	32	30	29	27	26	26	26	27	29	30	33	37	39	39
22	40	40	40	38	43	44	42	39	36	32	30	28	25	23	21	20	19	18	20	20	23	25	27	28
23	30	30	33	36	33	34	32	30	26	24	23	21	20	18	16	16	16	17	19	21	22	23	24	26
24	28	31	34	39	45	49	51	49	45	38	35	32	27	25	25	26	25	24	25	26	28	28	30	33
25	35	39	45	48	53	60	89	94	83	65	53	55	42	40	39	38	38	41	45	50	56	61	64	60
26	60	82	97	97	97	97	96	74	51	43	33	26	20	17	15	17	22	25	34	48	49	52	51	52
27	48	47	46	46	43	42	39	33	27	25	22	19	16	13	8	8	8	10	13	16	18	19	20	21
28	21	62	34	31	24	26	25	24	21	20	15	18	18	16	15	14	14	15	17	18	20	24	30	32
29	34	36	38	38	39	39	38	37	35	33	30	25	32	30	30	30	30	32	34	35	37	39	42	44
30	36	36	40	41	42	42	40	34	29	26	23	20	18	16	15	14	14	15	15	16	16	17	19	21
31	23	25	28	32	34	36	36	36	35	34	31	28	26	23	21	19	18	19	20	22	24	25	26	26

TABLE C-16 (Continued)

APR 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS. BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	31	32	999	999	999	999	48	90	70	42	30	23	20	18	20	22	24	25	30	42	52	54	62	73
2	70	79	79	92	97	98	95	91	62	43	34	28	23	20	18	20	25	28	60	71	70	65	66	68
3	62	60	60	60	58	57	53	42	36	31	28	25	23	21	18	18	17	17	20	23	25	28	29	32
4	35	38	41	42	.44	47	49	44	38	30	29	27	25	24	23	22	20	20	21	24	26	30	32	33
5	34	36	38	39	42	45	46	42	36	33	30	27	25	23	23	21	20	22	23	24	28	30	33	34
6	39	42	43	44	43	45	46	40	35	32	29	26	23	21	19	18	17	16	18	21	21	24	24	27
7	30	29	32	33	35	38	39	33	28	25	24	22	20	16	14	13	13	14	15	17	18	20	20	23
8	25	27	28	28	28	29	28	28	23	22	20	19	17	14	13	12	12	12	12	14	15	17	19	21
9	21	22	22	23	24	27	30	27	24	22	20	18	15	14	11	11	10	10	11	12	12	12	13	15
10	16	16	17	18	19	19	21	23	20	20	19	16	15	13	10	10	9	9	10	10	12	13	24	28
11	30	32	35	33	32	32	33	33	32	29	28	20	18	16	14	14	14	15	24	42	49	52	52	53
12	52	56	60	64	67	70	58	51	46	40	37	35	34	32	31	35	34	37	44	49	52	52	68	73
13	76	79	74	73	76	78	66	59	46	36	28	24	20	15	14	16	16	16	16	16	18	20	21	21
14	22	22	26	28	30	30	28	28	28	24	21	17	16	14	14	14	14	15	18	24	28	29	31	32
15	33	34	34	33	32	33	34	33	30	29	26	24	23	21	18	18	18	18	21	22	23	24	26	28
16	34	34	36	34	44	44	44	44	38	35	33	33	32	31	30	32	32	32	36	39	40	42	46	48
17	48	49	50	49	52	52	44	39	35	32	29	26	24	22	21	17	16	17	18	20	21	22	24	25
18	24	28	29	32	35	37	36	31	29	27	25	24	21	19	17	16	16	16	17	18	19	20	34	40
19	42	43	45	46	46	45	46	46	42	38	39	40	64	61	57	56	58	62	68	75	77	77	78	77
20	73	73	72	67	65	68	58	57	50	40	32	31	28	26	25	24	24	24	25	26	27	28	30	30
21	31	31	32	34	35	36	33	31	28	26	23	20	19	17	15	14	13	12	12	12	12	14	15	16
22	19	19	20	20	20	19	20	19	18	18	16	14	12	11	10	10	10	10	10	11	11	13	15	16
23	16	17	18	20	21	22	22	18	16	16	15	14	13	11	10	10	10	10	12	12	12	14	15	16
24	16	17	19	21	26	32	37	38	38	34	31	27	24	22	23	23	24	28	38	39	46	49	52	54
25	60	65	67	68	73	75	71	999	62	59	51	44	39	39	29	27	27	28	28	28	31	38	44	49
26	54	55	58	59	60	63	63	57	53	50	46	40	34	30	25	22	22	22	22	24	25	26	30	31
27	35	37	38	41	46	48	49	48	43	40	38	35	33	30	26	26	26	26	26	27	29	30	31	35
28	39	45	50	64	75	75	92	89	70	62	53	42	36	30	47	40	32	30	30	38	55	58	61	61
29	60	61	63	63	66	70	67	56	48	34	37	34	28	24	23	22	22	21	20	21	21	23	27	32
30	34	33	35	39	41	41	43	43	34	30	29	25	23	19	18	18	18	17	16	15	15	16	16	17

TABLE C-16 (Continued)

MAY 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	19	21	24	25	29	29	36	46	48	43	37	33	32	31	29	26	25	23	22	21	22	24	24	25
2	26	28	29	29	31	35	39	34	31	29	25	23	20	17	16	15	14	14	14	14	15	17	19	21
3	22	22	22	22	23	24	25	26	25	25	27	30	30	31	32	29	27	26	25	26	27	26	24	23
4	24	25	27	27	27	27	27	26	25	23	22	22	21	20	19	19	18	17	18	19	21	22	23	24
5	26	27	28	29	31	33	35	35	36	34	31	29	27	25	25	25	24	24	25	26	28	32	39	44
6	48	51	58	64	69	70	69	58	52	48	45	40	34	31	25	23	21	21	21	23	22	22	24	27
7	28	33	36	39	39	41	43	42	43	41	36	32	30	27	20	18	17	19	20	21	22	25	26	26
8	27	27	27	29	31	32	33	34	33	33	30	26	23	21	21	21	20	20	20	21	22	24	26	28
9	30	31	33	34	37	40	41	40	36	35	24	22	20	17	17	17	16	16	18	21	30	38	42	44
10	44	44	42	45	41	43	43	41	38	36	31	27	25	24	21	19	17	16	17	19	21	22	25	29
11	28	29	29	29	29	29	24	20	17	16	16	15	13	11	9	8	7	6	7	7	8	9	9	9
12	11	12	13	15	15	18	15	13	13	15	16	13	13	18	27	25	29	32	35	38	39	43	45	47
13	52	55	57	56	56	57	57	53	52	47	42	38	36	60	58	62	70	80	72	80	76	66	67	68
14	73	80	77	72	75	78	80	81	71	76	70	68	63	55	42	34	34	35	40	46	48	54	56	59
15	61	67	62	64	74	68	64	55	49	44	34	30	24	20	17	17	15	11	12	24	33	41	38	39
16	41	37	34	37	37	38	36	29	25	22	16	14	10	9	9	9	9	10	12	12	14	17	19	21
17	23	26	29	30	32	36	30	27	27	27	25	22	15	14	13	10	10	9	13	17	20	22	25	27
18	30	34	36	36	35	35	31	27	24	22	19	17	15	13	12	11	10	9	10	14	19	23	26	27
19	28	32	36	38	38	37	30	25	23	21	19	17	14	14	12	19	19	18	20	22	23	24	24	24
20	24	26	29	30	31	29	27	23	21	16	15	15	12	11	11	11	11	13	14	16	18	21	23	25
21	27	29	29	29	31	30	27	24	21	20	17	15	13	12	11	10	10	10	11	13	14	17	18	19
22	19	20	23	23	23	23	21	17	16	15	14	13	12	10	10	10	9	8	8	9	10	11	12	13
23	14	15	15	17	21	20	20	18	17	16	15	12	10	8	8	8	8	8	9	10	11	11	13	14
24	15	15	16	16	17	21	19	18	19	19	19	21	25	38	57	57	64	72	84	68	63	59	59	72
25	65	63	65	66	65	66	59	49	45	41	34	29	25	22	16	16	15	15	16	20	24	31	39	37
26	33	36	39	46	48	49	45	41	29	24	26	23	21	21	19	17	17	17	17	20	21	24	27	29
27	29	30	34	35	35	35	33	29	25	23	19	17	13	11	11	11	9	9	9	11	13	14	16	18
28	21	21	21	22	23	28	28	24	22	19	17	14	12	12	11	9	9	10	10	11	13	14	15	16
29	21	25	27	31	33	33	33	29	25	22	19	15	13	11	11	11	11	11	10	10	12	13	15	15
30	17	19	21	22	22	25	28	28	25	20	17	13	13	11	10	9	8	8	7	7	12	15	16	16
31	18	17	18	17	19	20	20	[illegible]	[illegible]	13	11	10	9	9	9	7	6	6	6	7	9	10	12	13

TABLE C-16 (Continued)

JUN 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	13	15	14	15	15	15	15	16	15	15	15	14	12	10	8	8	6	6	6	7	8	10	11	12
2	13	15	15	18	[illegible]	19	21	19	18	18	15	14	13	12	12	11	10	10	11	13	14	16	17	19
3	21	22	21	23	25	28	30	25	24	22	20	18	15	13	12	13	13	12	12	15	17	19	20	27
4	34	40	43	45	48	48	48	41	35	32	29	26	23	19	17	17	18	18	18	20	23	25	28	30
5	30	32	35	37	39	37	35	30	25	23	23	21	19	18	16	16	16	16	17	18	20	22	25	29
6	32	34	37	37	37	36	35	30	29	26	22	20	18	17	14	13	13	13	15	21	24	26	24	26
7	27	30	34	37	39	40	37	33	29	26	25	23	21	19	19	18	26	27	28	28	34	37	39	41
8	45	54	61	52	50	52	47	40	33	29	26	23	21	18	20	23	24	25	30	34	36	44	44	46
9	46	48	49	52	54	49	44	40	35	32	23	24	20	16	14	16	16	14	15	17	17	16	17	18
10	19	22	23	25	27	29	24	23	22	21	19	17	15	13	12	12	12	12	13	14	13	14	15	16
11	17	18	18	20	22	21	17	15	15	15	15	15	13	12	12	11	10	9	8	9	10	11	11	11
12	15	15	15	16	16	16	14	13	12	12	11	10	9	8	7	7	7	8	8	9	10	11	12	13
13	16	17	18	19	20	20	18	16	15	14	13	11	8	6	5	5	5	5	5	6	7	8	9	10
14	12	12	13	15	16	16	14	13	11	10	9	8	7	6	5	5	4	4	4	5	5	6	7	8
15	8	9	11	12	14	15	12	10	9	9	9	7	5	5	5	5	4	4	4	4	4	5	6	7
16	8	8	8	10	10	11	10	9	9	8	8	7	6	6	5	4	4	4	4	4	5	6	8	6
17	7	7	8	9	10	10	9	8	7	6	6	5	4	4	3	3	2	2	3	3	4	6	7	9
18	9	10	11	12	13	13	12	10	9	8	7	6	5	5	4	4	3	2	2	3	3	5	6	6
19	6	8	8	9	10	11	11	9	8	7	7	6	5	5	4	4	5	5	5	5	6	7	8	9
20	10	10	11	12	13	13	13	14	13	13	12	11	11	10	10	9	8	9	9	10	11	12	12	13
21	14	15	16	17	18	18	17	18	16	14	13	12	11	10	9	9	9	9	9	10	10	11	12	13
22	18	18	17	21	25	26	20	17	16	15	13	10	11	10	10	10	10	10	11	15	20	23	25	26
23	29	31	33	35	34	34	29	27	25	23	21	20	19	18	17	17	37	35	31	27	35	38	42	47
24	49	52	52	52	55	58	46	40	35	32	29	25	24	19	23	19	23	26	31	32	35	38	38	39
25	40	44	47	47	46	47	42	39	36	32	25	26	22	20	21	21	21	23	25	27	27	28	32	34
26	36	38	41	42	44	44	39	35	33	30	26	23	22	20	18	30	27	28	34	33	34	48	45	43
27	50	62	58	60	54	51	50	36	33	29	26	24	23	20	19	19	18	19	19	21	24	28	30	30
28	29	30	29	37	36	37	29	23	20	17	16	16	15	14	14	14	14	14	14	15	18	19	22	22
29	24	23	26	30	29	29	32	28	28	27	25	23	21	20	19	17	17	17	17	18	19	21	22	21
30	21	20	20	20	22	21	20	17	15	15	14	13	12	11	10	10	10	10	11	14	16	17	18	19

TABLE C-16 (Continued)

JUL 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	20	21	24	23	22	23	24	20	19	19	17	17	16	16	16	17	18	18	18	21	22	27	29	32
2	36	38	42	63	57	62	57	39	36	31	[illegible]	24	20	15	15	14	15	15	16	17	19	19	20	21
3	22	22	23	25	25	26	25	24	23	21	19	18	18	18	18	18	18	20	23	23	25	26	28	33
4	54	70	79	79	78	81	79	71	69	72	78	48	37	42	46	36	40	71	65	65	66	64	60	66
5	64	66	74	73	74	76	55	44	38	33	25	23	18	13	14	18	22	21	24	27	31	32	35	42
6	44	47	47	50	48	40	35	31	25	21	19	15	13	11	9	8	8	8	9	11	13	13	16	17
7	18	17	20	19	17	17	16	14	11	10	5	4	4	3	2	2	2	2	4	5	6	7	8	9
8	10	10	10	10	10	11	8	8	7	6	6	4	3	3	3	3	3	4	5	7	7	10	19	24
9	26	29	31	32	34	32	30	27	25	21	15	11	8	5	4	4	4	4	5	6	7	8	9	11
10	13	14	16	17	20	19	16	15	12	12	11	9	9	9	9	9	9	8	9	11	12	12	12	13
11	13	12	13	17	38	36	32	34	35	37	28	26	24	21	16	13	11	10	12	15	17	24	32	37
12	39	41	44	47	49	49	45	39	34	29	24	18	14	13	11	11	11	12	12	14	19	31	35	37
13	37	38	38	39	39	40	38	36	34	31	25	25	21	18	16	16	13	14	15	17	19	19	21	22
14	31	32	35	35	42	42	40	37	34	29	26	22	18	14	13	12	14	12	16	25	26	32	35	37
15	39	41	42	43	45	48	45	41	36	33	30	27	25	23	21	19	20	20	23	30	25	29	30	33
16	39	43	47	50	53	53	47	41	39	37	33	29	26	23	20	18	18	18	20	21	25	32	30	42
17	44	44	46	50	49	49	47	39	37	35	32	28	23	20	18	17	17	17	21	27	34	65	61	60
18	60	73	70	66	62	75	64	45	38	30	29	26	22	20	21	20	21	24	35	36	36	47	49	52
19	56	56	54	61	61	57	49	42	39	33	30	30	28	32	30	29	27	35	41	43	46	45	47	54
20	60	62	64	65	62	53	48	41	39	32	28	27	23	20	20	19	43	48	58	82	83	73	72	75
21	70	62	57	63	59	54	53	50	45	37	29	27	26	25	26	26	27	30	38	40	79	71	62	68
22	72	69	71	66	63	50	43	43	40	35	31	29	23	21	22	20	22	32	39	52	76	76	75	69
23	67	67	70	65	59	53	51	40	39	41	46	24	22	20	19	26	27	40	54	56	71	68	72	76
24	72	74	75	71	64	62	72	72	74	70	52	45	40	38	35	33	35	41	60	61	63	72	72	72
25	73	77	74	75	67	56	52	45	40	33	29	27	26	24	22	22	21	21	17	21	27	31	42	40
26	42	49	49	45	53	55	37	30	29	26	24	21	15	15	14	12	16	19	20	22	30	40	43	48
27	53	53	52	56	60	54	41	36	32	27	23	21	17	15	16	15	12	17	21	23	23	27	26	50
28	50	47	53	55	59	51	39	26	22	21	18	16	12	14	10	10	10	10	11	17	18	17	18	19
29	24	24	21	23	30	30	24	21	18	17	15	13	11	8	7	8	8	9	13	21	24	23	21	25
30	26	27	31	32	37	37	28	25	22	17	14	10	8	5	4	3	3	4	5	8	8	8	9	10
31	9	8	9	7	9	15	13	9	7	6	3	1	1	0	0	0	0	0	0	1	2	2	4	6

TABLE C-16 (Concluded)

AUG 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	8	8	9	9	9	10	11	15	13	11	8	7	6	6	5	5	5	5	4	4	7	7	8	8
2	9	10	11	12	12	11	14	10	9	8	7	6	5	5	4	4	4	4	4	5	5	7	8	8
3	9	10	13	14	15	19	15	16	13	12	12	11	11	10	9	7	8	9	14	14	17	19	20	21
4	22	23	25	27	29	32	32	29	27	25	23	22	20	18	17	18	19	20	20	23	24	26	27	27
5	29	29	30	32	34	36	37	33	31	28	25	24	22	18	17	17	17	17	17	19	20	22	24	26
6	27	28	28	28	29	29	29	25	23	20	17	16	13	12	11	10	10	10	11	13	14	14	21	20
7	19	21	21	20	23	25	27	22	20	19	18	18	18	18	19	19	20	20	22	23	25	26	33	38
8	43	55	52	55	58	57	59	39	35	31	27	23	22	19	18	17	19	19	21	23	23	33	36	38
9	42	45	47	51	57	54	44	38	34	27	21	16	12	11	10	9	10	10	12	13	13	15	17	19
10	22	24	24	24	25	27	29	36	35	33	30	27	25	25	26	25	24	24	26	29	35	47	51	56
11	56	59	60	60	63	62	54	49	42	38	33	30	27	25	23	24	25	27	48	50	59	62	66	67
12	68	68	67	67	67	64	51	42	36	32	27	24	23	22	21	26	23	23	24	25	23	25	29	31
13	33	41	45	48	44	53	46	43	40	36	31	25	20	22	20	18	18	19	21	23	26	26	29	31
14	35	38	41	44	45	44	38	36	33	32	31	27	24	23	23	24	25	25	27	34	43	45	45	82
15	79	79	77	72	67	69	65	65	55	49	47	45	40	32	28	28	25	26	29	35	45	54	73	74
16	76	73	68	69	72	73	69	56	49	46	39	34	27	23	21	20	20	21	27	32	41	49	53	58
17	74	79	75	73	75	72	71	63	51	47	47	41	41	36	36	69	51	58	62	64	65	65	67	64
18	76	70	71	76	67	65	62	50	47	42	37	32	26	23	19	20	18	18	20	29	31	30	36	42
19	54	51	55	50	49	50	49	40	35	28	23	20	17	13	12	12	11	12	14	16	21	27	34	36
20	41	49	49	54	56	58	49	40	34	31	26	24	20	20	17	17	15	19	24	23	26	26	27	29
21	32	36	40	40	40	44	44	36	34	31	27	24	21	18	16	21	12	12	14	22	24	26	30	32
22	34	36	38	39	46	47	47	42	39	34	28	24	22	46	34	26	30	34	42	35	39	45	51	50
23	52	54	52	53	55	55	55	46	41	37	32	30	25	24	39	36	39	37	57	59	63	63	65	71
24	70	67	69	72	74	76	71	53	46	39	32	35	50	31	28	27	27	33	39	43	49	50	52	57
25	67	70	71	73	72	73	70	54	46	39	31	26	25	21	17	16	14	14	16	20	22	22	32	34
26	34	33	32	34	35	43	42	36	31	24	19	17	14	11	9	8	8	9	10	12	14	16	16	32
27	36	40	46	49	43	47	50	37	32	27	24	24	19	17	12	11	10	10	10	12	21	28	26	24
28	25	25	25	27	29	27	29	27	20	17	13	12	12	11	11	10	10	10	10	13	17	22	25	25
29	24	29	30	30	30	30	30	28	24	21	19	15	13	12	11	10	10	10	11	13	14	18	21	22
30	22	22	23	25	28	27	27	23	20	20	19	17	15	14	13	11	11	11	13	14	15	16	17	20
31	21	21	21	22	24	27	24	24	22	21	19	17	16	15	14	14	15	15	16	18	19	21	23	26

TABLE C-17

PROJECT SITE WIND DIRECTION DATA, MARCH-AUGUST, 1977

MAR 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	45	45	45	315	999	113	68	23	90	113	135	158	180	180	158	180	203	225	248	248	248	225	203	135
2	113	113	158	203	293	270	270	248	248	248	248	248	270	270	248	270	248	248	293	293	293	293	315	293
3	315	338	338	23	360	360	360	999	135	158	158	180	180	203	225	203	158	113	315	338	293	315	338	315
4	338	315	315	338	315	315	315	315	338	293	999	999	138	68	68	68	338	315	315	315	315	315	315	315
5	315	315	315	315	315	315	315	315	270	248	999	999	999	270	23	23	23	360	360	315	338	338	338	360
6	360	360	360	293	293	293	293	23	23	225	203	158	158	225	225	203	203	180	180	135	68	45	45	45
7	23	23	45	360	45	113	90	45	113	158	158	158	158	158	180	180	180	180	158	45	23	360	338	360
8	45	225	68	68	68	68	338	270	113	135	158	135	135	180	180	180	180	180	203	45	45	45	45	23
9	23	23	23	68	68	45	68	90	113	113	135	180	180	158	180	203	225	225	203	203	203	203	225	248
10	248	248	270	338	270	293	293	293	293	315	315	315	315	315	315	315	315	315	315	315	293	315	315	338
11	338	293	293	293	293	293	315	315	338	338	315	338	315	315	315	315	315	315	315	338	68	180	999	999
12	293	315	338	293	23	999	203	248	225	158	225	203	248	225	203	203	180	130	180	158	135	68	23	23
13	45	68	90	113	113	90	68	23	158	158	180	180	180	180	180	203	225	225	225	225	225	203	203	248
14	248	203	203	203	203	203	180	999	203	203	203	248	225	270	248	270	248	248	248	248	23	23	23	360
15	23	360	360	23	23	23	360	360	293	135	135	158	158	180	180	158	158	113	135	23	360	360	23	23
16	68	45	999	68	68	45	999	999	113	113	135	135	158	180	180	203	203	225	225	203	203	203	203	203
17	203	225	225	248	248	225	225	248	248	248	248	248	270	270	270	248	248	248	248	225	225	248	225	248
18	248	225	203	135	113	135	113	68	999	315	315	293	315	999	315	315	315	315	315	315	315	338	338	338
19	999	338	338	338	45	360	360	360	999	158	158	180	180	203	203	203	180	203	180	180	90	113	68	360
20	23	45	45	45	68	45	45	45	90	135	158	180	999	999	248	315	338	315	315	315	315	338	315	315
21	293	293	293	360	999	999	293	338	315	158	270	270	293	999	999	225	203	203	180	203	999	45	338	338
22	315	315	315	23	45	999	203	113	113	90	158	158	158	180	158	203	180	180	203	203	158	360	360	338
23	338	338	360	45	45	23	315	338	135	180	158	135	135	158	999	225	203	203	203	203	225	225	180	180
24	203	158	158	158	158	158	158	135	135	158	180	203	203	130	203	180	180	180	180	203	203	203	203	203
25	180	180	203	203	203	203	203	248	270	248	225	203	248	225	225	225	225	225	225	203	225	270	293	315
26	203	203	180	113	45	45	45	23	23	23	45	68	135	999	225	293	315	315	45	315	315	315	315	315
27	293	293	293	315	315	315	293	315	315	293	293	293	293	315	338	315	315	248	248	248	225	225	248	248
28	248	293	315	315	315	315	315	315	315	315	293	315	293	293	293	293	293	293	315	338	338	338	360	360
29	360	999	999	158	999	293	270	270	248	248	225	248	270	293	270	248	270	248	248	293	338	338	360	338
30	999	999	360	360	336	315	338	360	45	113	999	999	999	999	999	147	135	133	121	117	126	175	148	135
31	108	108	82	60	23	27	10	32	85	116	175	209	207	207	234	243	232	235	255	257	[illegible]	207	175	175

TABLE C-17 (Continued)

APR 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	194	180	999	999	999	999	208	248	212	214	230	240	243	238	234	248	243	243	239	239	223	194	203	194
2	194	175	170	191	185	180	210	192	220	239	243	216	211	225	225	270	280	247	355	36	25	75	214	260
3	320	325	335	325	325	325	318	315	315	310	305	305	315	325	325	325	333	338	347	342	320	310	190	115
4	123	175	95	175	24	24	30	104	153	180	220	300	270	209	204	202	350	331	342	355	350	350	360	360
5	333	310	310	300	352	35	50	10	255	127	157	207	230	225	225	297	238	234	315	8	329	342	337	352
6	349	9	353	324	336	329	70	100	121	999	999	999	999	180	238	225	198	197	198	216	292	351	342	288
7	347	343	350	333	135	34	27	63	113	122	124	166	175	192	216	220	225	198	207	195	298	17	355	45
8	31	18	12	350	360	360	315	315	119	143	166	180	180	203	193	190	192	190	180	130	107	9	27	40
9	70	72	75	62	53	40	36	72	100	107	130	180	180	198	198	197	198	194	197	216	210	205	210	225
10	190	202	200	351	315	360	360	50	101	122	171	190	208	211	213	215	214	158	135	205	75	115	126	360
11	325	347	82	100	215	248	255	10	195	203	200	200	200	209	180	192	220	225	214	259	315	297	280	290
12	324	18	113	123	40	60	31	52	162	180	216	210	220	360	16	275	10	27	23	15	23	5	325	325
13	325	337	342	18	355	297	285	225	175	170	170	185	197	186	234	232	256	225	283	320	14	36	30	18
14	15	5	333	45	40	45	60	100	170	164	180	198	240	220	262	264	261	279	276	280	310	310	325	330
15	325	330	325	325	315	305	293	291	284	257	102	123	145	147	135	125	139	180	208	243	279	263	315	18
16	6	27	18	360	298	40	32	180	140	180	234	225	237	230	225	225	241	234	170	200	270	306	342	8
17	9	324	324	313	320	335	332	270	225	205	215	216	234	225	225	256	245	260	262	262	283	333	333	305
18	277	225	315	67	34	35	37	82	999	153	171	203	189	189	189	209	215	225	225	220	207	198	275	317
19	332	310	315	315	304	287	298	300	315	310	310	351	277	305	298	315	315	317	324	331	8	320	304	324
20	318	328	310	302	315	205	171	186	159	224	258	258	305	320	315	330	324	324	328	322	342	345	343	315
21	320	320	324	343	200	159	315	351	185	189	178	190	210	225	237	210	197	195	222	232	258	307	322	342
22	5	32	30	18	315	310	175	170	135	135	135	167	190	207	207	205	202	189	205	233	321	349	343	8
23	327	305	888	18	44	30	18	322	142	150	165	180	170	155	187	147	162	207	232	265	330	358	5	352
24	327	75	63	5	36	50	54	113	126	129	133	165	197	232	310	327	20	119	190	201	229	120	95	72
25	99	999	299	256	999	63	73	130	154	153	144	196	230	280	306	327	36	27	27	288	200	115	115	82
26	54	40	28	21	351	324	327	90	120	127	120	180	198	216	243	210	195	170	143	126	95	10	315	16
27	35	45	50	27	352	335	18	95	118	165	175	200	207	230	235	230	260	248	211	160	126	333	275	261
28	253	303	54	90	54	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
29	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
30	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

TABLE C-17 (Continued)

MAY 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
3	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
4	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
5	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
6	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
7	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
8	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
9	999	999	999	999	999	999	999	999	999	999	999	162	157	189	194	203	203	214	225	230	261	277	264	270
10	265	260	207	171	139	200	198	203	204	203	212	223	194	180	214	214	220	195	207	232	306	340	346	12
11	10	12	20	24	27	45	92	126	135	164	120	184	200	207	207	210	208	208	213	253	297	53	85	174
12	99	85	61	40	18	29	63	99	135	135	140	165	140	173	104	102	104	100	70	63	72	18	114	108
13	155	112	156	110	143	108	74	123	127	127	137	144	144	999	999	999	999	999	999	999	999	999	999	999
14	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
15	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
16	999	999	999	999	999	999	999	999	175	175	175	185	187	196	190	198	194	200	200	205	210	205	194	194
17	200	194	187	220	227	259	51	153	178	184	180	184	194	195	198	194	200	206	210	248	259	259	265	280
18	259	232	238	228	173	130	166	184	190	202	205	191	216	210	205	193	238	258	270	270	297	313	321	346
19	330	324	12	24	18	15	33	65	115	115	173	172	230	242	216	270	302	300	309	324	339	330	314	306
20	313	330	335	324	311	310	313	313	324	270	281	265	292	328	320	313	324	324	335	330	330	340	346	335
21	324	318	320	324	320	320	320	310	312	281	261	274	292	281	270	313	318	324	339	340	335	341	356	335
22	319	260	310	324	320	320	310	230	205	192	184	195	205	222	214	216	230	227	216	205	178	121	80	140
23	147	168	184	162	39	54	40	110	132	162	162	190	200	194	200	210	205	208	222	222	210	208	184	173
24	140	140	156	170	210	173	178	156	184	205	194	194	210	205	254	270	205	205	173	151	147	168	165	151
25	162	170	173	190	184	173	162	184	201	184	184	175	194	205	210	216	227	227	227	258	296	313	352	292
26	255	262	303	339	313	309	290	240	232	227	206	227	216	227	216	216	200	220	137	216	290	339	330	320
27	320	307	277	182	227	265	258	194	173	194	216	231	238	238	238	259	259	259	254	270	259	242	324	303
28	310	320	315	259	220	335	104	142	176	189	190	209	216	210	205	259	259	259	259	270	283	292	286	313
29	334	18	346	7	18	276	313	254	151	162	180	184	184	195	195	184	184	216	225	234	251	335	330	309
30	320	330	308	313	29	29	27	72	270	224	265	275	292	263	216	205	188	216	232	313	18	335	319	346
31	332	335	335	335	335	346	216	216	205	63	173	173	203	216	205	216	216	227	246	313	331	356	350	346

TABLE C-17 (Continued)

JUN 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	357	357	255	346	61	42	340	267	130	130	115	135	202	216	216	238	238	227	210	230	227	265	313	290
2	356	76	65	16	7	29	43	126	173	119	115	173	151	162	194	222	205	184	276	281	173	188	194	194
3	173	151	195	205	35	21	29	104	162	178	162	205	216	216	313	169	205	194	157	184	178	100	130	135
4	91	356	350	7	4	354	20	87	111	130	130	173	135	157	888	56	71	45	37	30	65	82	76	28
5	356	24	29	26	26	40	72	63	132	159	184	173	179	179	164	147	136	130	70	43	37	86	119	65
6	32	7	33	18	14	356	18	888	92	108	130	145	157	146	151	151	151	151	148	108	41	38	47	100
7	119	114	116	115	119	116	108	119	141	179	184	173	216	216	227	324	324	61	48	43	205	190	179	146
8	83	135	10	346	346	888	194	195	162	134	128	162	184	205	194	184	220	227	227	238	264	248	194	173
9	173	173	168	179	168	135	140	179	184	182	200	205	205	189	205	205	200	205	227	220	216	227	210	213
10	188	136	140	114	65	54	87	168	30	194	210	190	195	205	195	190	205	200	205	194	205	216	221	276
11	7	292	888	66	50	23	50	135	140	168	208	184	216	227	227	222	273	202	223	238	287	324	324	342
12	356	888	276	313	12	340	308	216	179	190	190	190	194	216	205	200	194	219	244	265	353	342	335	340
13	340	888	32	43	48	39	43	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
14	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
15	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
16	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
17	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
18	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
19	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
20	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
21	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
22	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
23	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
24	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
25	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
26	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
27	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
28	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
29	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
30	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

TABLE C-17 (Continued)

JUL 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
3	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
4	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
5	999	999	999	999	999	999	999	180	175	189	198	216	225	234	234	225	207	207	225	216	207	234	170	63
6	63	45	36	27	330	9	347	140	171	189	180	189	207	225	216	225	234	252	242	234	255	306	333	342
7	333	333	335	360	18	360	315	261	180	180	190	190	190	225	207	216	225	225	243	247	279	333	333	324
8	333	351	12	350	288	306	360	63	135	144	144	153	171	198	225	189	225	234	234	243	288	333	888	126
9	126	120	120	135	130	153	144	144	144	144	158	180	193	230	230	225	236	234	252	270	303	304	279	270
10	254	324	350	180	72	36	36	36	216	216	252	252	252	252	252	252	252	258	265	275	280	306	323	324
11	135	72	45	99	180	216	225	198	198	207	216	216	198	152	180	207	225	225	207	207	189	171	180	162
12	135	90	36	27	36	36	18	207	162	180	180	190	225	180	190	190	200	190	190	180	190	198	192	198
13	162	162	207	252	270	306	225	216	216	216	216	216	216	216	216	216	216	256	252	263	252	207	108	12
14	54	108	108	117	144	117	126	135	135	126	126	126	144	190	225	225	270	288	198	162	117	108	180	80
15	180	100	72	45	63	63	80	80	144	144	144	999	135	160	162	135	180	153	144	45	63	180	216	180
16	144	153	144	153	205	298	306	162	126	135	135	180	198	180	216	180	170	170	108	90	63	36	126	180
17	144	189	351	45	85	117	335	234	170	162	180	225	198	207	234	217	180	200	198	352	306	270	315	310
18	324	280	303	342	324	279	10	135	171	195	210	243	261	180	195	198	225	214	216	298	288	333	342	63
19	126	80	42	324	80	117	117	126	135	153	180	180	253	270	261	270	261	261	180	60	80	72	36	36
20	72	90	80	45	35	36	45	135	144	156	180	225	257	290	315	270	261	180	90	288	207	99	180	48
21	54	23	360	30	27	45	360	45	110	350	999	999	117	95	117	108	117	90	108	108	108	306	342	333
22	63	54	39	45	36	27	27	56	144	135	153	135	144	162	135	270	255	220	171	45	94	144	190	310
23	324	328	313	888	16	21	360	360	80	144	126	135	207	180	171	153	102	72	72	270	45	323	351	348
24	323	45	87	63	23	360	45	90	90	135	126	36	270	250	243	243	180	190	140	36	22	27	27	27
25	18	322	333	355	20	360	324	261	333	90	126	234	90	99	888	54	234	298	297	333	333	350	10	100
26	80	360	350	333	333	324	225	180	135	135	162	162	234	270	288	315	108	108	112	108	126	108	99	72
27	45	36	21	342	9	27	90	162	153	153	180	180	190	270	298	306	298	306	350	30	50	40	31	360
28	80	21	351	333	360	18	27	90	135	153	153	153	270	352	352	306	225	162	58	27	18	350	333	333
29	27	360	333	27	18	36	76	99	108	135	150	153	189	225	234	216	236	234	135	45	36	27	333	5
30	36	45	54	45	36	45	72	126	123	135	172	207	252	297	297	315	306	324	333	360	350	350	344	342
31	342	333	207	348	325	63	270	275	225	360	315	324	324	324	324	324	315	324	333	351	342	351	342	306

TABLE C-17 (Concluded)

AUG 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	315	324	324	324	324	315	126	186	171	162	153	171	162	234	225	234	216	216	324	333	342	324	315	319
2	319	315	360	225	279	324	345	99	135	198	225	207	234	234	225	225	216	216	242	324	342	324	330	342
3	324	324	36	54	54	36	36	117	171	144	162	180	180	189	198	230	242	260	270	270	270	275	165	261
4	234	225	234	225	230	180	162	207	198	198	207	198	216	225	225	234	198	198	207	275	320	324	315	324
5	306	320	300	287	270	360	36	81	117	180	189	198	216	243	243	234	243	227	216	234	246	315	18	18
6	45	18	54	45	27	18	63	99	126	171	189	234	242	225	234	338	234	252	243	270	288	315	23	9
7	315	108	252	170	117	108	90	135	171	190	207	198	225	234	225	198	190	195	175	171	164	175	180	190
8	205	225	888	36	81	81	90	135	135	144	180	198	225	243	243	252	243	243	234	234	225	212	216	219
9	225	225	144	99	225	22	22	351	180	180	225	225	242	261	243	243	236	252	270	261	306	324	279	306
10	315	270	63	40	45	57	63	69	198	189	189	184	207	207	207	225	207	216	225	270	315	234	135	126
11	54	36	36	45	67	27	360	100	144	153	144	144	135	135	153	153	117	63	351	9	171	171	135	130
12	99	72	27	360	324	324	333	315	207	225	216	225	243	270	261	261	252	252	252	265	315	9	36	50
13	54	45	54	36	27	9	351	888	162	144	180	190	270	295	310	320	315	315	342	342	27	63	97	72
14	36	72	63	54	33	360	333	888	126	144	153	144	135	171	171	185	180	171	162	90	50	40	45	144
15	104	63	50	36	18	5	333	36	36	63	126	130	189	194	225	234	225	10	162	158	180	207	252	360
16	342	27	54	45	360	333	360	36	144	150	135	148	144	171	190	144	153	178	207	180	50	41	80	204
17	180	162	108	27	20	27	30	45	40	171	170	189	207	225	225	297	324	324	333	342	333	342	342	333
18	279	209	261	9	320	288	252	260	180	189	216	216	207	225	242	253	261	260	253	245	261	297	317	324
19	324	36	23	27	36	36	36	72	124	159	155	225	230	252	242	253	252	255	270	302	351	333	18	216
20	261	36	36	42	59	45	32	135	126	144	171	198	213	261	288	126	288	315	324	317	333	296	82	45
21	36	72	54	32	340	360	27	90	126	117	135	153	180	225	261	54	225	261	225	153	99	90	36	54
22	351	261	175	108	36	36	48	126	162	178	171	192	225	16	45	350	333	14	36	104	117	72	40	42
23	36	45	50	58	45	45	54	63	108	144	180	180	175	260	342	340	320	315	333	15	45	315	54	340
24	2	43	54	45	45	45	45	72	126	152	153	166	297	261	252	252	216	198	189	171	126	180	198	36
25	36	30	888	56	36	36	35	108	189	190	207	196	200	198	198	202	207	225	203	207	216	192	126	93
26	142	144	144	140	184	164	171	180	182	189	194	202	203	216	225	230	234	234	222	222	225	225	238	324
27	324	324	333	342	41	158	216	292	292	292	254	225	244	234	241	252	270	270	292	333	40	40	38	23
28	18	19	355	360	342	346	333	315	279	225	243	234	225	211	171	225	243	169	144	57	22	9	36	324
29	4	9	346	306	306	148	27	18	135	139	135	162	198	180	207	212	198	198	192	162	324	20	5	333
30	5	9	333	297	32	32	58	72	108	180	170	189	207	202	225	243	252	252	252	257	252	267	288	27
31	62	297	333	27	36	63	36	36	175	192	[illegible]	[illegible]	189	192	216	198	216	198	180	189	192	220	315	33

TABLE C-18

PROJECT SITE WIND SPEED DATA, MARCH-AUGUST, 1977

MAR 1977 WIND SPEED (M.P.S.)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	2.7	3.1	2.2	1.3	1.8	1.3	1.8	2.2	3.6	6.3	11.6	5.8	5.8	5.8	7.2	8.0	9.8	6.7	8.9	7.2	6.7	4.9	2.7	3.6
2	2.7	2.7	2.2	4.0	4.0	5.4	4.5	4.9	5.8	6.3	6.7	7.2	6.3	6.3	5.4	6.7	6.7	6.3	4.9	4.0	4.0	3.6	3.6	2.2
3	2.7	3.6	2.7	3.6	2.2	1.8	.9	.4	1.8	2.7	3.1	3.1	4.9	4.0	3.1	3.1	3.6	4.0	4.0	2.7	2.7	3.1	3.1	3.1
4	3.1	2.7	2.7	1.3	3.1	4.0	5.4	3.6	2.2	3.6	1.8	3.6	4.0	4.5	4.0	5.4	7.2	5.8	5.8	4.5	5.4	4.9	5.4	6.3
5	6.3	5.4	3.6	4.0	4.0	3.6	2.7	2.2	1.8	2.7	2.7	2.7	3.1	3.6	5.4	7.2	6.7	5.8	4.5	4.5	4.5	3.6	2.2	2.7
6	3.1	3.6	2.2	1.8	3.1	2.7	1.8	2.7	.9	1.8	3.1	2.2	3.1	2.2	2.7	2.7	3.1	4.0	3.1	1.8	2.2	3.6	4.5	4.0
7	4.5	4.5	3.1	1.8	2.7	1.3	1.3	1.3	1.8	2.7	3.6	3.1	2.7	2.7	3.6	4.0	3.1	2.7	2.2	1.8	4.0	3.6	3.6	3.1
8	3.1	.4	1.8	3.6	3.1	.9	1.3	1.3	1.3	3.6	2.2	3.1	2.7	2.7	4.0	4.9	4.0	3.6	1.8	2.7	3.1	4.5	5.8	5.4
9	4.5	2.7	2.2	3.6	3.1	3.1	2.7	2.2	2.7	3.6	2.7	2.7	3.1	4.5	5.8	5.8	5.8	9.4	8.0	8.9	9.8	8.9	9.4	8.0
10	9.8	10.7	7.6	12.1	11.2	11.6	10.7	11.2	11.2	13.0	14.3	13.9	12.5	13.4	12.5	12.1	11.6	11.6	12.1	11.6	10.7	12.1	12.1	12.5
11	8.5	6.7	8.9	8.9	7.2	6.3	6.3	6.7	9.4	8.0	9.8	8.9	7.6	7.6	8.0	8.5	9.8	9.4	7.2	2.2	1.8	2.2	1.8	2.2
12	2.2	4.5	4.9	2.7	4.0	2.7	2.7	2.7	1.8	2.2	4.0	2.7	3.6	2.7	3.6	3.1	3.1	3.1	3.6	2.2	1.8	1.8	4.0	4.5
13	4.0	2.7	2.7	2.2	2.2	1.3	1.3	2.7	2.2	2.7	4.5	5.4	7.2	8.0	9.4	10.3	8.5	8.9	8.9	8.0	7.6	8.0	7.6	4.0
14	4.5	3.1	4.9	5.4	4.5	1.8	1.8	.9	3.1	6.3	7.6	10.7	9.4	9.4	9.4	10.3	8.9	8.9	7.2	3.1	2.7	4.0	3.6	5.8
15	6.3	4.5	2.7	4.0	4.0	4.9	5.4	2.7	1.3	3.6	5.4	3.1	4.0	4.5	3.1	2.7	2.2	2.2	2.2	1.8	4.5	4.0	5.4	4.5
16	2.2	.9	1.3	2.2	3.6	4.0	2.2	1.3	1.8	1.3	3.1	5.4	5.8	6.3	7.2	7.2	6.7	7.2	12.5	13.0	11.2	9.8	10.7	8.5
17	6.7	9.8	9.4	8.9	6.3	4.9	6.3	4.9	7.2	8.9	8.5	9.8	11.2	10.3	8.5	8.5	7.2	8.0	6.7	4.9	2.7	3.1	2.7	5.4
18	2.2	2.7	2.2	1.8	2.2	1.8	1.3	1.3	1.3	5.4	5.8	4.0	2.7	3.1	5.4	5.8	6.7	6.7	6.7	4.0	4.0	3.1	4.5	3.1
19	2.7	5.4	4.0	4.0	1.8	1.8	2.2	1.8	1.3	2.2	3.6	4.0	4.9	4.9	5.4	6.7	6.3	5.8	4.0	2.7	2.7	2.2	2.7	1.3
20	2.7	3.1	2.2	3.1	3.1	2.7	2.7	3.1	1.8	2.2	2.7	2.7	1.8	4.0	3.1	5.8	6.3	8.0	6.7	4.0	5.8	6.7	5.4	5.4
21	4.0	3.1	5.8	4.5	1.8	2.2	3.1	2.7	1.3	2.7	4.9	7.6	4.9	3.1	2.7	3.6	4.5	4.5	3.1	2.7	1.8	4.0	4.0	3.6
22	3.1	3.1	2.7	2.7	2.2	.9	1.3	1.3	2.2	1.8	2.2	3.1	2.7	3.1	3.6	3.1	3.6	3.1	3.1	3.1	1.3	4.9	6.7	4.5
23	2.7	1.3	2.7	4.5	4.5	4.9	3.6	1.8	1.3	2.2	2.7	4.0	3.1	3.6	2.2	3.6	4.5	5.8	4.9	2.7	2.2	3.1	4.0	4.0
24	4.0	4.5	4.5	4.9	5.4	4.9	4.9	3.6	2.7	5.4	8.0	9.4	8.5	9.4	9.4	9.4	9.4	9.4	8.0	8.9	9.4	7.6	8.9	7.6
25	5.8	7.6	8.0	10.3	9.8	8.9	8.0	4.9	4.5	3.6	5.8	8.0	6.7	8.5	7.2	5.8	4.0	3.1	4.0	2.7	4.5	5.8	4.0	3.1
26	2.2	4.9	3.6	1.3	4.0	3.6	4.0	4.5	5.8	3.6	3.6	4.5	3.6	2.2	3.1	3.6	5.4	5.4	6.7	4.5	5.8	5.8	5.4	4.9
27	4.0	4.9	4.9	6.3	6.7	6.3	6.7	6.3	5.8	4.5	5.4	5.4	4.5	4.9	5.8	6.3	5.8	7.2	9.4	4.9	3.6	4.9	8.5	10.3
28	10.7	13.0	10.7	10.7	12.1	11.2	8.0	7.6	8.9	7.6	6.7	6.7	7.2	6.3	6.7	6.3	6.3	5.8	5.4	4.9	4.5	4.9	5.8	3.1
29	3.1	2.2	.9	1.8	.9	1.8	2.2	1.3	1.8	1.8	2.7	4.0	4.0	7.2	8.0	7.2	8.5	7.2	4.5	3.6	3.6	4.9	6.3	5.4
30	1.3	1.3	3.1	3.1	3.6	3.6	2.7	3.1	2.7	99.9	99.9	99.9	99.9	99.9	8.9	10.7	14.8	12.1	11.6	10.7	9.8	7.2	6.3	5.8
31	6.3	5.8	6.3	6.7	8.9	7.2	6.3	5.4	7.2	9.8	13.0	11.6	14.8	14.3	12.5	14.8	15.2	11.6	9.8	9.4	9.8	9.8	9.4	8.5

TABLE C-18 (Continued)

APR 1977 WIND SPEED (M.P.S.)
ENERGY FUELS. BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	8.9	7.6	99.9	99.9	99.9	99.9	17.0	6.7	5.4	14.3	17.9	18.8	18.3	17.0	17.9	17.4	13.0	14.3	15.2	10.7	8.0	8.5	9.4	9.8
2	7.2	6.7	8.9	6.3	6.3	7.2	5.4	7.2	6.0	9.8	9.8	13.4	12.5	10.3	8.9	5.4	10.7	7.6	6.7	5.4	3.6	2.7	3.1	5.4
3	6.3	6.7	8.0	17.0	13.4	15.6	17.9	18.4	17.4	20.6	21.5	25.0	22.8	21.5	24.1	22.3	16.1	14.3	7.2	5.4	4.9	5.8	4.5	3.6
4	2.7	4.0	4.5	6.7	8.5	7.6	5.4	6.3	4.5	4.5	6.7	11.2	9.4	10.3	8.9	10.7	11.6	8.9	7.6	8.0	7.6	9.4	10.7	8.0
5	4.9	5.4	4.5	4.9	4.9	5.4	2.2	3.6	4.9	6.3	6.7	8.0	5.4	7.2	6.3	7.2	9.4	7.2	7.6	6.3	8.0	8.9	10.7	8.5
6	11.2	9.8	8.5	6.7	3.6	4.0	5.4	6.7	99.9	99.9	99.9	8.0	7.6	7.2	6.7	8.9	9.4	5.4	4.0	3.6	9.8	11.2	4.5	6.3
7	8.0	8.0	7.2	3.6	9.4	9.4	6.3	6.3	7.2	6.7	7.2	8.0	9.8	8.5	9.8	8.9	8.5	4.9	2.7	3.1	3.6	4.5	4.5	3.6
8	5.8	5.8	4.9	2.7	2.2	2.2	2.2	1.3	2.7	4.0	3.6	3.1	2.7	4.5	5.4	5.4	4.9	4.5	3.6	4.0	3.6	2.7	4.9	4.0
9	2.7	2.2	1.8	1.3	2.7	4.5	3.1	2.7	4.0	4.0	4.5	5.4	5.8	7.6	9.4	9.8	10.3	7.2	6.3	6.3	5.8	6.3	5.4	3.6
10	3.6	4.9	4.0	3.1	1.8	1.3	2.7	2.2	3.6	4.0	4.5	6.3	5.8	6.3	7.6	6.7	5.4	3.1	1.8	1.8	2.2	2.7	3.6	4.5
11	3.1	1.8	1.8	2.7	7.2	5.4	3.1	2.7	6.0	7.2	7.6	8.0	6.3	7.2	6.7	6.7	5.4	4.0	4.5	7.2	7.6	5.8	4.5	4.5
12	4.5	3.1	1.8	1.3	1.3	2.2	4.5	2.7	2.2	3.1	2.7	2.7	2.7	2.7	2.2	2.2	5.8	4.5	4.5	4.9	5.8	5.4	4.9	6.7
13	5.8	3.6	3.6	4.5	4.0	3.1	3.1	1.8	2.7	3.6	4.5	4.9	4.9	6.3	6.7	6.7	6.3	3.6	3.1	1.8	4.5	5.4	6.7	5.4
14	4.9	3.1	3.1	4.5	4.5	4.0	2.2	2.2	3.6	3.6	3.1	2.7	4.5	5.4	5.8	6.3	8.0	8.0	6.3	4.5	8.0	9.4	8.9	10.3
15	6.7	11.2	10.7	8.5	8.5	7.2	6.7	8.9	7.6	3.1	4.0	4.9	6.3	7.2	7.2	6.7	4.0	3.6	3.6	4.0	3.1	2.7	2.7	3.1
16	3.1	4.0	2.2	.9	2.7	1.8	2.2	3.1	3.1	3.1	3.6	4.5	4.0	4.0	3.1	3.6	4.0	3.6	3.6	3.1	3.1	3.6	3.6	4.9
17	4.9	3.6	3.6	3.6	3.6	3.1	2.7	1.3	2.2	2.7	3.1	4.5	5.4	6.7	7.6	7.6	8.9	8.5	6.7	5.8	4.5	2.7	2.7	3.6
18	2.2	3.1	2.7	2.7	4.0	4.0	4.0	3.1	4.0	4.5	4.9	5.8	7.6	8.9	9.4	9.4	8.9	9.4	8.5	6.7	5.8	5.4	6.7	8.5
19	6.3	7.6	7.6	5.8	4.5	4.0	5.8	5.8	5.4	3.6	4.9	3.1	8.0	8.9	8.0	8.0	6.7	5.8	6.7	4.9	3.6	3.6	4.5	4.5
20	4.5	4.5	5.8	5.4	4.0	1.8	1.8	2.7	3.1	3.1	4.9	5.4	9.4	8.9	9.4	8.0	8.9	9.0	7.2	5.4	4.9	6.3	5.4	4.5
21	4.5	4.0	4.0	4.0	1.8	1.3	3.1	2.2	2.7	3.1	4.5	4.0	4.0	4.9	5.4	4.9	5.4	5.8	4.9	3.1	2.7	2.2	3.1	4.0
22	3.6	4.9	4.5	4.5	1.8	1.3	1.3	2.2	3.6	3.6	3.6	4.0	3.6	4.5	4.0	4.0	4.5	3.6	3.1	1.8	3.6	4.5	2.7	3.6
23	3.6	3.6	1.8	3.6	4.0	5.4	5.4	1.8	3.1	3.6	3.6	3.1	3.6	4.5	4.0	4.0	3.1	3.6	3.1	2.2	3.1	6.3	5.4	4.5
24	4.0	3.6	3.6	4.0	1.3	1.8	2.7	5.4	6.7	5.8	4.0	4.0	4.5	4.5	8.9	5.4	7.6	6.7	7.2	5.4	3.1	1.3	2.2	3.1
25	2.2	2.2	1.8	1.3	1.3	1.3	1.8	3.1	3.6	3.6	3.1	3.1	3.1	6.7	8.5	5.4	8.0	6.7	3.1	4.9	3.6	3.6	3.1	3.1
26	3.6	4.5	4.0	3.1	2.2	1.8	1.3	3.1	3.6	4.5	3.1	3.1	3.1	3.6	4.5	2.7	3.6	2.7	2.7	2.7	2.7	3.6	3.1	3.6
27	4.5	3.1	2.2	1.8	2.2	2.2	1.8	3.1	3.6	3.6	3.1	4.5	5.4	5.8	6.3	6.7	6.7	4.5	1.8	1.8	1.8	3.1	5.8	4.0
28	4.9	3.6	3.6	5.4	4.5	99.9	99.9	4.5	3.6	3.1	4.0	3.6	4.5	6.7	5.4	2.7	3.6	2.2	3.1	7.6	7.2	6.3	5.8	5.8
29	5.4	5.8	4.9	5.4	5.4	5.4	3.1	2.7	3.1	2.2	2.7	3.6	3.6	5.8	4.5	2.7	2.2	3.1	2.7	4.0	4.5	4.9	3.6	3.1
30	2.7	4.0	3.6	4.5	3.1	2.2	3.1	2.2	3.1	3.6	3.6	3.1	4.0	5.8	6.3	5.4	4.9	6.3	6.7	5.4	4.5	2.7	1.8	1.3

TABLE C-18 (Continued)

MAY 1977 WIND SPEED (M.P.S.)
ENERGY FUELS, BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	2.2	2.2	2.7	3.1	3.6	8.0	7.6	4.9	5.4	5.8	6.7	5.8	6.3	5.8	7.6	6.7	4.9	4.5	5.8	4.9	4.0	4.5	3.6	3.1
2	3.1	2.7	1.3	2.2	4.0	4.5	3.6	2.2	3.6	4.5	3.6	5.4	6.3	6.3	5.4	6.3	5.4	4.5	3.1	1.3	2.2	4.5	5.8	5.4
3	4.5	3.1	2.7	2.2	.9	1.3	2.2	2.7	4.0	2.7	5.8	6.7	6.3	6.7	5.4	3.1	3.6	4.5	6.7	7.6	6.3	6.7	7.6	8.0
4	8.0	6.7	6.3	5.4	2.2	4.0	3.6	3.1	4.9	6.7	6.7	8.0	8.0	8.9	10.7	8.9	8.0	7.6	7.2	4.5	1.8	.9	1.3	2.2
5	3.6	3.6	2.7	2.2	1.3	.9	3.1	3.1	6.7	5.8	8.9	11.2	9.8	10.3	10.3	10.3	11.2	11.2	12.5	10.7	10.3	8.9	8.0	8.0
6	7.2	8.0	7.2	5.8	5.4	5.8	8.0	11.2	10.3	9.4	8.5	7.6	8.5	8.9	9.8	9.4	9.4	9.4	8.9	8.0	7.2	6.7	6.3	7.6
7	5.4	2.7	1.3	1.8	1.8	.9	1.3	3.6	7.2	10.3	8.9	7.2	7.6	7.6	8.5	10.3	10.3	7.6	6.3	4.9	4.5	4.0	3.6	2.7
8	4.0	4.5	4.0	3.6	3.1	2.7	1.8	1.8	2.7	4.0	5.8	6.7	7.6	8.0	6.3	6.3	8.9	9.8	8.9	7.6	6.3	4.5	3.1	3.6
9	2.2	3.1	2.7	2.2	2.7	3.1	3.1	99.9	99.9	99.9	6.7	7.2	7.2	8.5	9.4	10.3	11.2	11.6	11.2	10.3	9.4	8.9	7.6	8.0
10	6.7	5.8	6.3	6.3	7.6	7.2	5.8	6.7	7.2	7.6	6.7	5.8	5.4	4.9	4.5	4.5	4.9	4.0	3.6	2.2	1.8	3.6	3.6	4.9
11	6.3	6.3	5.8	5.8	5.4	4.5	1.8	3.1	5.4	4.9	4.5	4.9	6.3	4.9	6.7	7.2	6.7	6.7	3.6	2.7	2.7	2.2	1.3	2.7
12	1.3	2.2	2.2	3.6	3.1	4.5	3.1	3.1	5.4	7.6	6.7	4.9	5.4	7.6	14.8	13.4	11.6	9.8	8.0	5.4	4.5	2.7	2.7	3.6
13	2.7	2.7	3.6	2.7	1.8	3.6	3.1	5.8	7.6	8.0	8.0	8.0	6.3	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
14	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
15	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
16	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	11.2	10.7	10.3	11.6	13.0	14.8	15.2	15.2	16.5	15.6	14.8	13.0	10.3	9.4	9.4	9.4
17	7.6	5.8	4.0	2.2	1.8	1.3	2.2	4.0	7.2	7.6	7.6	8.0	10.3	12.5	10.3	13.4	13.9	13.9	13.0	8.0	6.3	8.9	10.3	6.7
18	5.4	4.9	3.6	2.7	3.1	2.7	2.7	4.0	4.9	6.7	6.3	5.8	6.3	6.7	6.7	7.2	6.7	8.9	8.9	7.6	5.4	4.5	4.0	4.0
19	3.1	1.8	2.2	5.8	6.7	6.3	4.9	4.0	3.6	3.1	3.6	3.6	3.1	3.6	3.1	7.6	9.4	7.2	5.8	3.1	4.0	4.0	4.5	4.0
20	5.4	4.5	4.0	5.8	7.2	8.0	7.2	5.4	4.0	2.7	3.6	4.0	5.8	7.6	8.5	8.9	8.9	8.5	8.9	7.6	8.0	3.6	6.7	6.3
21	5.8	5.8	5.4	5.8	5.8	5.8	5.4	4.9	4.9	4.9	5.4	4.9	4.5	4.9	3.6	4.5	5.4	6.7	6.3	5.8	5.4	4.5	4.0	4.5
22	4.0	3.1	2.2	2.7	3.1	3.6	1.8	1.3	1.8	2.7	3.6	4.9	5.8	5.8	6.3	5.4	4.0	5.8	6.7	3.6	2.7	2.2	2.2	3.1
23	4.5	4.0	2.7	2.7	4.0	1.8	2.7	3.6	4.9	6.3	7.6	10.3	12.1	14.3	13.0	12.1	13.0	13.0	13.0	10.7	6.7	5.4	4.0	3.6
24	4.0	4.9	5.4	4.0	4.5	10.7	8.5	6.3	6.7	5.8	8.0	10.7	11.2	10.3	5.8	7.2	9.0	8.0	6.3	5.4	8.5	9.4	8.0	6.3
25	4.9	7.2	5.4	3.6	2.7	2.7	1.8	5.4	5.4	5.8	5.8	6.3	7.2	7.2	7.2	7.2	6.3	4.9	4.0	5.4	3.1	2.7	3.1	3.6
26	4.0	3.6	3.6	4.5	4.5	4.5	2.7	2.7	4.5	4.9	5.8	4.9	5.4	4.9	3.1	4.0	4.5	4.5	3.6	3.1	2.2	2.7	3.6	3.6
27	3.1	3.1	2.7	1.3	2.7	4.0	3.6	4.5	5.4	5.4	6.7	6.3	7.6	7.2	7.2	8.5	8.9	8.9	8.5	4.9	2.2	1.3	2.2	3.6
28	3.6	2.2	3.1	4.0	3.6	2.7	2.7	2.7	4.5	4.9	4.5	5.4	6.3	6.3	6.3	11.6	11.6	11.6	10.7	7.6	6.7	6.7	3.6	3.1
29	3.6	2.2	1.3	2.2	1.3	1.3	1.3	2.2	4.0	4.0	4.9	5.4	5.8	5.8	5.8	7.2	7.6	8.0	7.2	4.0	3.6	3.6	4.0	4.0
30	2.7	3.1	4.0	3.6	3.1	4.5	2.2	1.3	.9	3.1	3.6	3.6	3.6	4.0	4.5	3.1	3.6	5.4	7.6	5.8	4.5	4.9	4.9	4.5
31	4.9	4.9	4.9	4.0	3.6	2.2	1.8	1.8	2.7	2.2	2.7	3.1	5.8	5.4	5.8	4.9	3.6	3.6	5.8	5.8	4.5	6.3	5.8	4.9

TABLE C-18 (Continued)

JUN 1977 WIND SPEED (M.P.S.)
ENERGY FUELS• BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	4.9	6.3	3.1	2.2	4.0	2.2	3.1	2.2	3.1	4.0	3.1	3.1	4.9	5.8	5.4	5.8	4.0	4.9	4.9	4.0	3.1	5.4	5.4	3.6
2	3.1	3.1	2.7	4.0	4.5	4.0	3.6	3.1	3.1	3.6	3.1	4.0	6.7	5.8	5.4	4.5	3.6	3.6	5.4	9.9	5.8	4.5	4.0	6.3
3	5.4	5.8	4.5	2.2	2.7	2.2	2.7	2.7	2.7	2.7	3.6	4.0	4.5	4.5	3.6	3.1	3.6	3.1	3.1	6.3	4.0	2.2	4.0	9.4
4	6.3	2.2	3.1	4.5	4.9	3.6	2.2	3.1	1.8	2.7	3.6	2.7	3.1	3.6	3.1	4.5	3.6	3.1	3.1	3.6	4.0	3.6	2.7	3.1
5	6.3	4.0	5.4	4.5	4.9	3.6	1.8	2.7	3.6	3.6	3.6	3.6	3.1	3.1	3.6	3.6	4.9	3.6	6.3	6.7	7.6	6.3	8.5	4.0
6	5.8	5.8	4.9	4.5	4.5	4.5	3.6	2.2	4.0	6.7	5.4	6.7	7.2	7.2	5.8	5.4	5.4	4.5	3.6	3.6	6.3	7.2	6.7	8.5
7	10.3	6.3	7.6	8.5	6.7	5.4	4.5	4.5	4.9	4.5	4.5	4.0	4.5	4.9	4.0	3.6	3.6	8.0	6.3	3.6	4.0	7.2	3.1	2.2
8	1.8	2.7	3.1	5.8	5.4	2.7	3.1	2.7	1.8	3.1	3.6	3.6	3.6	5.4	5.8	6.7	5.8	4.9	5.4	5.4	3.1	1.8	1.8	1.8
9	1.8	1.3	1.3	1.8	1.3	1.3	1.3	1.8	2.2	2.7	3.6	3.6	3.6	4.9	5.8	5.8	5.4	4.0	5.4	4.0	2.7	3.6	3.6	1.8
10	1.8	1.8	2.2	1.3	1.3	1.8	1.3	1.8	3.1	3.6	4.0	4.9	4.9	4.5	4.5	4.5	4.9	3.6	3.6	2.7	2.2	1.8	1.8	1.8
11	1.3	1.3	1.3	1.3	1.8	3.1	1.8	1.3	1.8	1.8	2.7	3.6	4.0	4.5	4.0	3.6	3.1	3.6	3.6	2.7	2.2	2.2	2.2	2.7
12	2.2	2.2	1.3	.9	.9	1.3	.9	.9	1.3	1.8	2.2	2.2	2.2	2.2	2.7	2.7	1.8	1.3	1.8	1.3	.9	1.3	1.3	2.2
13	2.2	1.8	3.1	2.7	2.2	3.1	2.2	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
14	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
15	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
16	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
17	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
18	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
19	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
20	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
21	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
22	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
23	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
24	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
25	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
26	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
27	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
28	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
29	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
30	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9

TABLE C-18 (Continued)

JUL 1977 WIND SPEED (M.P.S.)
ENERGY FUELS.BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
2	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
3	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
4	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
5	99.9	99.9	99.9	99.9	99.9	99.9	99.9	2.7	3.6	3.6	4.5	5.4	5.4	6.3	5.4	5.4	8.0	9.8	7.2	3.6	3.6	3.6	1.8	2.7
6	2.7	3.6	3.6	3.6	2.7	2.7	1.8	1.8	2.7	2.7	3.6	5.4	5.4	5.4	5.4	6.3	6.3	6.3	5.4	5.4	3.6	2.7	3.6	3.6
7	3.6	3.6	2.7	2.7	2.7	2.7	1.8	2.7	2.7	3.6	3.6	5.4	6.3	6.3	6.3	5.4	5.4	6.3	6.3	5.4	3.6	3.6	4.5	3.6
8	3.6	3.6	5.4	5.4	3.6	3.6	2.7	3.6	6.3	5.4	4.5	4.5	4.5	6.3	6.3	7.2	6.3	5.4	7.2	6.3	3.6	2.7	3.6	8.9
9	8.0	6.3	5.4	5.4	6.3	3.6	6.3	8.0	7.2	5.4	5.4	6.3	6.3	7.2	8.9	8.0	9.8	8.9	7.2	5.4	2.7	1.8	1.8	2.7
10	4.5	2.7	1.8	1.8	1.8	3.6	2.7	1.8	4.5	8.0	11.6	11.6	11.6	10.7	9.8	8.9	9.8	10.7	8.0	5.4	3.6	1.8	2.7	3.6
11	1.8	2.7	2.7	2.7	3.6	5.4	6.3	6.3	9.8	9.8	4.5	6.3	6.3	5.4	6.3	5.4	5.4	7.2	4.5	4.5	4.5	3.6	3.6	2.7
12	2.7	.9	2.7	4.5	4.5	3.6	2.7	1.8	2.7	2.7	3.6	4.5	5.4	3.6	3.6	3.6	3.6	3.6	4.5	4.5	4.5	9.8	11.6	10.7
13	6.3	3.6	2.7	1.8	1.8	1.8	1.8	3.6	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	8.0	8.0	6.3	3.6	2.7	2.7	3.6
14	4.5	6.3	7.2	5.4	4.5	3.6	1.8	1.8	6.3	5.4	4.5	4.5	3.6	3.6	3.6	3.6	3.6	3.6	3.6	8.0	12.5	8.0	2.7	1.8
15	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	4.5	5.4	5.4	5.4	5.4	4.5	3.6	3.6	4.5	4.5	7.2	8.9	5.4	3.6	3.6	5.4
16	5.4	5.4	5.4	4.5	2.7	1.8	1.8	1.8	3.6	3.6	3.6	3.6	3.6	2.7	3.6	3.6	4.5	5.4	6.3	3.6	2.7	3.6	4.5	10.7
17	4.5	1.8	3.6	2.7	3.6	2.7	.9	.9	2.7	3.6	3.6	3.6	4.5	3.6	4.5	4.5	3.6	3.6	5.4	8.9	7.2	7.2	6.3	7.2
18	5.4	5.4	5.4	2.7	3.6	1.8	.9	.9	2.7	2.7	3.6	4.5	4.5	4.5	4.5	4.5	5.4	5.4	6.3	8.0	8.0	5.4	3.6	2.7
19	3.6	2.7	3.6	2.7	1.8	2.7	3.6	5.4	4.5	3.6	3.6	4.5	6.3	7.2	6.3	8.9	7.2	7.2	6.3	6.3	3.6	2.7	2.7	4.5
20	2.7	4.5	4.5	3.6	4.5	3.6	3.6	1.8	2.7	2.7	2.7	2.7	5.4	6.3	4.5	2.7	2.7	7.2	6.3	4.5	5.4	8.0	5.4	2.7
21	3.6	3.6	5.4	6.3	5.4	3.6	1.8	1.8	1.8	1.8	99.9	99.9	3.6	3.6	3.6	4.5	4.5	3.6	1.8	1.8	2.7	6.3	5.4	6.3
22	5.4	3.6	4.5	4.5	3.6	3.6	2.7	1.8	4.5	5.4	4.5	4.5	5.4	3.6	3.6	2.7	2.7	2.7	2.7	7.2	8.0	8.0	7.2	4.5
23	5.4	4.5	4.5	1.8	1.8	2.7	2.7	2.7	1.8	2.7	4.5	4.5	3.6	3.6	3.6	3.6	5.4	7.2	5.4	5.4	5.4	5.4	2.7	3.6
24	2.7	3.6	5.4	2.7	2.7	1.8	1.8	1.8	1.8	1.8	2.7	2.7	2.7	1.8	2.7	3.6	3.6	5.4	3.6	5.4	4.5	5.4	4.5	4.5
25	3.6	2.7	1.8	2.7	3.6	3.6	2.7	1.8	1.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	3.6	2.7	3.6	4.5	3.6	2.7	2.7	5.4
26	3.6	2.7	3.6	2.7	2.7	2.7	1.8	2.7	2.7	2.7	3.6	3.6	2.7	4.5	6.3	6.3	5.4	9.0	8.0	5.4	6.3	6.3	5.4	5.4
27	4.5	3.6	3.6	2.7	3.6	3.6	2.7	2.7	3.6	3.6	3.6	3.6	3.6	2.7	4.5	5.4	3.6	5.4	8.0	6.3	7.2	6.3	6.3	5.4
28	4.5	3.6	3.6	2.7	3.6	4.5	3.6	2.7	2.7	3.6	3.6	3.6	3.6	4.5	3.6	3.6	2.7	2.7	2.7	5.4	4.5	4.5	4.5	4.5
29	2.7	2.7	1.8	3.6	3.6	4.5	3.6	3.6	2.7	3.6	4.5	4.5	4.5	6.3	5.4	5.4	5.4	6.3	4.5	5.4	7.2	6.3	2.7	3.6
30	5.4	5.4	3.6	4.5	5.4	4.5	3.6	3.6	2.7	3.6	3.6	3.6	4.5	4.5	5.4	5.4	6.3	6.3	5.4	6.3	7.2	6.3	6.3	4.5
31	3.6	5.4	3.6	3.6	4.5	2.7	2.7	1.8	2.7	2.7	3.6	5.4	7.2	7.2	8.9	8.9	8.0	9.0	6.3	5.4	5.4	5.4	5.4	4.5

<u>TABLE C-18 (Concluded)</u>

AUG 1977 WIND SPEED (M.P.S.)
ENERGY FUELS. BLANDING, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	5.4	5.4	5.4	6.3	6.3	5.4	2.7	2.7	1.8	2.7	3.6	3.6	3.6	3.6	5.4	4.5	3.6	2.7	5.4	5.4	4.5	4.5	4.5	4.5
2	3.6	4.5	3.6	2.7	1.8	3.6	1.8	1.8	2.7	3.6	3.6	4.5	5.4	6.3	6.3	5.4	4.5	6.3	6.3	5.4	4.5	3.6	4.5	3.6
3	3.6	2.7	3.6	2.7	2.7	4.5	4.5	3.6	3.6	3.6	3.6	3.6	4.5	5.4	6.3	7.2	8.0	8.9	10.7	8.0	9.8	8.0	6.3	6.3
4	7.2	8.0	6.3	7.2	8.0	5.4	2.7	3.6	4.5	4.5	5.4	5.4	4.5	6.3	7.2	8.0	8.0	7.2	5.4	5.4	5.4	3.6	3.6	3.6
5	4.5	7.2	6.3	5.4	4.5	1.8	2.7	1.8	2.7	3.6	4.5	6.3	6.3	6.3	8.0	7.2	6.3	6.3	3.6	3.6	2.7	2.7	5.4	4.5
6	4.5	2.7	2.7	2.7	3.6	4.5	2.7	3.6	3.6	4.5	5.4	7.2	6.3	7.2	7.2	7.2	6.3	7.2	4.5	2.7	2.7	2.7	5.4	4.5
7	2.7	1.8	1.8	2.7	1.8	3.6	3.6	1.8	3.6	3.6	5.4	5.4	6.3	6.3	6.3	5.4	6.3	4.5	5.4	5.4	5.4	7.2	6.3	4.5
8	2.7	1.8	2.7	2.7	1.8	2.7	1.8	2.7	3.6	4.5	3.6	3.6	5.4	7.2	8.9	8.9	8.9	8.0	7.2	4.5	3.6	6.3	9.8	8.0
9	6.3	4.5	2.7	2.7	1.8	4.5	3.6	1.8	2.7	4.5	4.5	4.5	7.2	6.3	7.2	7.2	7.2	6.3	6.3	5.4	3.6	3.6	4.5	3.6
10	3.6	2.7	3.6	6.3	5.4	4.5	3.6	2.7	3.6	5.4	5.4	5.4	7.2	7.2	7.2	5.4	4.5	3.6	3.6	4.5	3.6	3.6	6.3	3.6
11	1.8	3.6	4.5	2.7	1.8	1.8	1.8	2.7	4.5	5.4	5.4	4.5	3.6	3.6	3.6	4.5	10.7	11.6	9.8	8.0	5.4	7.2	6.3	3.6
12	2.7	2.7	3.6	3.6	2.7	2.7	2.7	2.7	3.6	2.7	2.7	3.6	2.7	3.6	3.6	4.5	5.4	6.3	6.3	5.4	3.6	7.2	5.4	3.6
13	3.6	3.6	4.5	4.5	3.6	2.7	2.7	2.7	2.7	2.7	3.6	3.6	2.7	4.5	8.9	6.3	5.4	5.4	3.6	2.7	3.6	3.6	2.7	2.7
14	3.6	2.7	2.7	3.6	3.6	2.7	2.7	2.7	3.6	4.5	4.5	4.5	5.4	3.6	4.5	7.2	6.3	5.4	4.5	4.5	9.8	7.2	3.6	4.5
15	4.5	4.5	6.3	4.5	4.5	3.6	2.7	2.7	3.6	2.2	3.6	3.1	2.2	2.7	2.7	2.2	1.8	2.2	2.7	4.0	6.7	8.9	4.9	4.0
16	3.1	2.7	3.6	3.6	3.6	2.2	2.2	1.8	1.3	2.2	2.7	3.1	2.7	2.7	3.1	3.1	3.6	3.6	3.1	3.1	4.9	4.9	5.4	6.3
17	3.6	3.1	1.8	1.8	2.7	3.1	2.2	2.2	1.8	2.2	3.1	3.1	3.1	2.7	2.7	4.0	1.8	3.1	2.7	2.7	2.2	2.2	3.1	2.2
18	1.8	4.0	2.2	2.2	2.2	2.2	1.8	2.2	2.7	3.1	2.7	2.7	4.5	4.9	6.7	6.7	6.7	7.2	5.8	4.0	3.1	2.2	2.7	3.1
19	2.7	1.8	2.2	2.2	2.7	2.7	3.6	2.2	2.2	3.1	3.1	4.0	5.4	6.3	6.7	6.3	6.7	7.2	5.4	3.1	2.2	2.7	4.9	3.1
20	2.7	3.6	3.6	4.5	3.6	3.1	3.1	2.7	3.6	3.6	3.1	3.6	4.0	3.1	3.6	4.0	4.9	4.5	4.5	4.9	4.9	2.7	1.8	2.2
21	2.2	2.7	3.1	2.7	2.7	2.2	1.8	2.7	3.6	3.6	3.6	4.5	5.4	4.9	5.8	4.0	4.5	6.3	5.4	3.1	3.6	2.7	3.1	2.7
22	3.6	3.1	2.7	2.7	4.5	4.5	3.6	3.6	4.0	4.0	3.1	3.1	3.6	6.7	4.0	4.5	5.4	5.8	5.4	2.2	1.8	2.2	3.6	4.0
23	4.0	3.6	3.1	2.7	3.6	4.0	3.1	2.7	3.1	4.0	4.5	4.5	4.0	4.0	6.7	4.9	7.6	8.5	6.3	8.0	6.3	6.3	5.4	4.5
24	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.7	4.5	4.0	3.6	4.5	6.3	4.0	7.2	6.7	6.3	5.8	4.9	4.0	3.1	1.8	2.2	1.3
25	3.6	3.1	2.2	3.1	3.6	4.0	3.6	2.2	3.6	5.4	5.8	7.6	8.0	8.9	8.5	8.0	7.6	7.6	5.8	4.0	3.1	2.2	2.2	2.2
26	2.2	1.8	2.2	2.7	3.6	4.5	5.8	6.3	6.7	8.0	8.5	8.0	8.9	9.4	11.6	12.5	12.1	12.5	11.6	11.6	11.6	11.6	11.2	9.8
27	11.6	11.2	8.0	6.7	3.1	2.7	2.2	4.0	4.0	2.7	2.7	3.6	4.5	6.3	8.5	8.9	8.9	8.0	5.8	4.0	4.9	5.8	5.4	5.4
28	5.4	6.3	4.9	4.5	4.5	3.6	2.2	1.3	2.7	3.1	3.6	4.5	5.4	5.8	5.4	5.8	3.1	3.6	4.5	4.9	4.5	4.0	4.0	3.1
29	3.6	5.4	4.9	3.6	3.6	1.8	2.7	1.8	3.6	3.6	3.6	3.6	4.0	4.5	4.5	4.9	3.6	3.6	4.0	2.7	1.3	4.5	4.9	4.0
30	4.0	4.5	4.0	2.2	5.4	3.6	3.1	2.2	3.6	4.5	4.5	4.9	5.4	6.3	7.2	10.3	9.8	8.9	7.2	5.4	4.5	3.6	2.7	2.2
31	1.3	.9	1.3	1.8	3.6	3.1	4.5	2.7	4.0	5.4	5.8	5.4	6.3	6.3	6.3	6.3	4.5	5.4	4.9	4.5	4.5	3.6	2.2	3.6

TABLE C-19

HANKSVILLE BUYING STATION TEMPERATURE DATA, MARCH-AUGUST, 1977

MAR 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1															7.2	6.7	5.0	2.8	2.2	1.1	.6	0.	-1.1	-2.2
2	-2.2	-2.8	-3.3	-3.9	-3.9	-3.9	-3.3	-1.1	1.1	2.2	3.9	2.2	3.3	3.3	3.3	2.8	1.7	.6	-.6	-1.1	-1.7	-2.2	-3.3	-3.9
3	-3.9	-4.4	-3.3	-3.3	-4.4	-6.7	-3.9	-1.1	.6	2.2	3.9	3.9	5.6	6.7	6.1	5.6	4.4	3.9	1.7	1.1	.6	0.	0.	0.
4	-.6	-1.1	-1.1	-1.7	-2.8	-2.8	-3.3	-2.2	0.	2.2	3.3	4.4	3.9	3.3	3.3	2.2	1.7	1.1	-1.1	-1.1	-2.8	-2.8	-3.9	-4.4
5	-5.6	-7.2	-7.8	-8.9	-8.9	-8.9	-5.6	-2.2	-1.1	1.1	2.8	3.9	4.4	5.0	6.1	5.6	5.6	3.9	-1.1	-2.8	-3.9	-5.0	-6.1	-6.7
6	-6.1	-7.2	-7.2	-7.8	-8.9	-8.9	-7.8	-3.3	0.	2.2	4.4	5.6	7.2	8.9	9.4	10.0	10.0	8.9	3.3	1.7	-.6	-1.1	0.	-2.8
7	-1.1	-3.9	-5.0	-4.4	-5.6	-6.7	-6.7	-3.3	.6	3.3	6.7	8.3	10.6	12.2	13.9	15.0	13.9	12.8	10.6	8.9	5.0	5.6	2.2	2.8
8	5.6	1.7	1.1	1.1	.6	2.2	1.1	1.1	3.3	6.7	11.1	13.9	16.1	16.7	17.2	17.2	16.1	15.0	9.4	6.7	5.6	3.3	4.4	1.1
9	0.	3.3	1.1	.6	.6	-1.1	.6	1.1	3.9	6.1	10.0	12.2	12.8	13.3	16.7	17.2	17.2	16.1	14.4	12.8	11.1	10.6	6.7	4.4
10	3.3	1.7	.6	0.	-1.1	-2.2	-2.2	-2.2	-1.1	0.	1.1	2.2	2.8	2.8	3.9	3.9	3.3	2.2	.6	0.	0.	0.	-.6	-1.1
11	-1.1	-1.1	-2.2	-2.8	-2.8	-3.3	-3.9	-2.2	0.	2.2	3.5	4.4	5.6	5.6	6.1	6.7	6.1	6.1	4.4	2.2	0.	-.6	-1.7	-2.8
12	-3.9	-5.0	-6.1	-7.2	-7.2	-8.9	-9.4	-6.1	-2.2	1.1	2.8	3.9	5.0	5.6	8.3	8.9	8.9	8.9	8.3	5.6	4.4	4.4	0.	-.6
13	-1.7	-1.7	5.0	5.6	4.4	4.4	6.7	6.7	6.7	6.7	8.9	10.6	10.6	12.2	13.3	13.9	14.4	12.8	10.6	8.9	8.3	6.7	4.4	2.2
14	0.	-3.3	-3.9	-5.0	-4.4	-3.9	-5.0	-1.7	2.8	3.9	3.3	3.3	2.8	4.4	5.6	6.7	4.4	4.4	2.2	0.	-2.2	-4.4	-5.6	-6.1
15	-6.1	-6.7	-7.2	-6.7	-8.3	-9.4	-8.9	-3.9	-1.1	2.2	3.3	5.0	6.1	8.3	8.9	9.4	9.4	8.3	6.7	3.9	1.1	0.	0.	-2.2
16	-4.4	-5.0	-5.0	-6.1	-5.6	-6.7	-7.2	-3.3	-1.7	3.9	5.6	8.9	12.2	14.4	14.4	13.9	13.9	12.8	8.9	10.6	10.6	8.9	8.3	7.2
17	6.1	4.4	4.4	3.9	2.8	2.2	2.2	2.8	5.0	6.1	6.7	8.3	8.9	9.4	10.6	10.6	8.9	7.2	4.4	2.8	1.1	-.6	-1.1	.6
18	.6	.6	0.	-.6	-2.2	-1.7	-1.1	-.6	1.7	2.2	3.9	4.4	5.6	5.6	5.6	5.6	5.6	5.0	2.2	1.1	-1.7	-3.9	-4.4	-5.6
19	-6.1	-6.7	-7.2	-7.2	-7.2	-8.3	-9.4	-4.4	0.	2.2	5.6	6.7	8.3	10.0	11.7	11.7	12.2	10.6	8.9	7.2	2.8	5.6	5.6	3.9
20	3.9	2.2	4.4	5.6	3.3	1.7	0.	2.2	4.4	5.6	6.7	8.9	8.9	8.9	9.4	8.9	8.3	7.8	6.1	4.4	3.9	2.2	2.2	2.2
21	2.2	2.8	1.7	1.7	0.	-2.2	-3.9	-4.4	-1.7	2.8	6.1	6.7	7.8	9.4	10.6	11.7	11.7	10.6	6.1	3.9	2.2	1.1	0.	0.
22	-1.1	-2.2	-2.2	-3.9	-5.0	-4.4	-1.1	3.9	5.6	7.8	10.6	12.2	13.9	14.4	15.6	15.0	15.0	13.9	11.1	5.6	3.3	2.2	2.8	1.7
23	1.1	-1.1	-2.8	-2.8	-3.9	-4.4	-2.2	3.9	6.7	10.0	11.1	13.3	15.6	18.9	19.4	17.2	16.1	13.3	12.2	11.7	12.8	12.2	12.2	11.7
24	11.7	11.1	10.6	10.0	9.4	10.0	11.7	11.7	12.2	12.8	12.8	15.6	15.6	15.6	16.1	15.6	14.4	13.9	13.3	12.2	11.1	10.6	9.4	9.4
25	2.8	5.0	3.3	2.8	3.9	4.4	6.7	8.3	9.4	10.0	10.6	11.1	11.7	10.6	9.4	8.9	8.3	7.8	7.2	6.1	1.7	1.1	1.7	1.1
26	.6	0.	.6	.6	.6	1.1	2.8	3.9	3.9	4.4	7.2	8.9	8.9	10.0	11.1	11.1	10.6	7.8	5.6	4.4	5.6	5.6	5.0	3.9
27	3.9	1.7	0.	1.7	2.2	0.	3.3	7.2	9.4	11.1	12.8	13.3	14.4	15.6	15.6	15.6	16.1	15.6	13.9	14.4	13.3	6.7	2.8	2.2
28	-1.7	-2.2	-2.8	-3.3	-3.9	-4.4	-2.8	-1.7	0.	1.1	1.7	2.8	3.9	2.8	3.3	2.8	1.7	.6	-1.1	-2.2	-2.8	-2.2	-3.3	-5.0
29	-7.8	-6.1	-5.0	-5.0	-5.0	-5.6	-2.8	-1.1	.6	1.1	2.8	2.2	1.7	3.3	2.8	2.2	2.2	1.1	-1.7	-4.4	-6.1	-7.2	-8.3	-8.9
30	-8.9	-9.4	-9.4	-10.0	-10.6	-9.4	-5.0	-2.2	1.1	2.2	5.0	5.6	6.7	7.2	7.8	7.8	7.8	6.1	3.3	3.9	1.7	1.7	-.6	-2.8
31	-5.0	-5.6	-6.7	-6.7	-5.6	-5.6	-1.1	1.7	3.9	5.6	9.4	11.1	12.2	12.8	12.2	12.2	11.7	9.4	6.7	5.6	3.9	2.8	-.6	0.

TABLE C-19 (Continued)

APR 1977 TEMPERATURE(CENTIGRADE)
ENERGY FUELS.HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0.	1.1	99.9	99.9	99.9	99.9	0.	2.8	6.7	7.8	7.8	7.8	8.3	6.1	6.1	3.9	3.3	3.3	.6	.6	-.6	-1.1	-1.7	-1.7
2	-.6	0.	-1.1	-2.2	-3.9	-4.4	0.	1.7	3.3	5.0	5.6	5.6	6.1	6.7	6.7	6.7	6.1	3.9	2.2	1.7	.6	0.	-.6	-.6
3	-.6	-1.7	-1.7	-2.8	-2.8	-2.8	.6	2.2	3.3	5.0	6.1	5.7	7.2	7.2	7.8	7.8	7.8	6.7	5.0	3.9	3.3	1.7	1.1	1.1
4	1.7	1.1	0.	-.6	-2.8	-5.0	-1.7	2.8	6.1	8.3	10.6	12.2	13.3	13.9	15.0	15.0	15.0	14.4	11.1	10.0	9.4	8.3	6.7	6.1
5	6.1	6.7	4.4	4.4	3.9	3.9	4.4	6.1	11.1	12.2	12.8	13.9	15.6	16.1	16.7	16.1	16.1	15.0	12.8	9.4	7.2	6.1	5.6	5.0
6	3.3	2.8	2.8	1.7	.6	.6	3.3	7.2	10.6	12.8	15.6	16.7	17.8	18.9	19.4	19.4	19.4	18.3	16.1	12.2	8.9	7.8	7.2	6.7
7	5.0	5.6	3.3	2.8	2.2	1.1	5.0	8.3	11.7	14.4	16.7	17.8	20.6	22.2	22.2	21.7	21.7	20.0	18.3	15.0	13.9	10.0	12.2	11.7
8	8.9	-15.6	-16.1	-16.7	-17.8	3.9	6.7	11.1	14.4	15.6	19.4	21.7	24.4	23.9	23.3	23.3	22.8	22.2	21.1	18.9	17.2	16.7	15.0	13.9
9	15.6	17.8	13.9	13.3	13.3	12.2	12.2	14.4	16.7	18.3	20.6	21.1	22.2	22.8	23.3	23.3	23.3	22.8	22.2	17.8	12.8	12.2	14.4	15.6
10	13.9	12.8	11.7	9.4	6.7	8.3	5.0	7.2	13.9	15.6	18.9	20.0	20.6	21.1	21.7	22.2	22.2	22.2	21.7	20.6	16.7	15.6	12.8	11.7
11	13.9	12.2	11.7	11.1	11.1	8.9	7.8	6.1	11.1	13.9	16.1	15.0	12.2	13.3	12.8	12.2	12.8	15.6	19.4	18.3	16.7	11.1	10.0	9.4
12	6.1	7.8	7.2	7.8	7.2	7.2	6.7	10.0	11.1	13.3	15.0	15.0	16.1	16.7	17.8	17.8	17.2	16.1	14.4	13.3	10.6	12.8	12.8	12.2
13	6.1	3.9	2.8	2.2	3.3	1.1	1.1	3.9	7.2	8.9	10.6	12.8	14.4	15.6	16.7	16.7	17.2	17.8	17.2	15.6	12.8	11.1	10.0	8.9
14	8.9	8.9	7.8	5.6	6.1	5.6	4.4	5.6	8.9	11.7	13.9	15.6	17.8	17.8	19.4	20.0	20.0	18.9	14.4	13.3	11.7	10.6	8.9	7.2
15	5.6	4.4	3.3	2.8	2.2	2.2	2.2	3.3	5.6	6.7	6.7	5.1	6.7	7.8	10.0	11.1	12.2	12.2	12.2	11.1	10.0	7.8	5.0	5.0
16	6.1	6.7	6.7	7.8	6.7	5.0	3.3	6.7	9.4	11.1	13.3	13.9	15.6	16.7	17.2	17.8	18.9	18.9	18.3	17.8	15.0	11.1	9.4	8.9
17	8.9	7.8	6.7	5.6	5.0	4.4	3.3	5.0	10.0	13.3	15.6	17.2	19.4	21.1	22.8	23.3	23.3	23.3	22.8	22.8	21.7	20.0	17.8	16.7
18	13.9	12.2	11.7	9.4	7.8	7.2	10.6	13.3	17.2	20.0	22.2	21.7	22.2	22.8	24.4	23.9	17.2	14.4	11.7	10.6	9.4	9.4	9.4	8.9
19	8.3	8.3	6.7	6.7	6.1	5.6	7.2	7.2	7.8	7.8	8.3	9.4	12.2	9.4	10.0	10.6	10.6	9.4	8.3	7.2	6.7	5.6	4.4	5.0
20	4.4	5.0	4.4	4.4	3.9	3.9	6.7	8.3	10.0	12.2	13.9	14.4	15.6	15.7	16.7	16.7	16.1	15.6	13.9	12.2	9.4	10.0	10.0	7.2
21	7.2	6.7	6.1	4.4	1.1	.6	5.0	8.3	11.7	13.9	15.6	17.2	18.9	20.0	20.0	20.0	19.4	18.3	15.6	15.0	11.1	11.1	8.3	7.8
22	8.3	7.8	3.9	3.3	3.9	2.8	7.8	11.1	14.4	16.1	18.3	20.0	22.2	23.3	23.3	23.3	22.8	21.1	19.4	13.9	11.1	10.0	8.3	8.3
23	10.0	7.8	5.0	3.9	3.3	4.4	6.7	9.4	12.8	16.7	20.0	21.7	23.9	24.4	25.0	25.0	23.9	23.3	22.2	17.8	13.9	13.3	12.2	11.1
24	10.0	8.9	7.8	7.2	6.7	5.0	7.8	13.3	16.1	19.4	20.6	22.2	23.9	24.4	25.6	25.6	25.0	24.4	23.9	17.8	14.4	18.3	17.8	15.6
25	15.0	13.3	13.9	13.9	13.3	12.8	12.2	15.6	17.8	99.9	18.3	18.9	21.1	22.2	23.3	24.4	23.9	23.9	23.9	21.7	18.3	15.6	16.1	15.0
26	16.7	15.0	14.4	13.9	10.6	11.7	8.3	9.4	15.1	18.3	20.0	21.7	21.7	22.8	24.4	23.9	25.0	25.0	25.0	22.8	20.6	18.9	17.2	15.6
27	17.8	18.3	16.7	16.7	15.0	13.9	13.3	12.8	15.0	18.9	20.6	21.7	22.8	24.4	25.6	25.0	25.6	24.4	23.9	22.8	21.1	20.0	20.0	19.4
28	18.9	19.4	18.3	17.2	15.6	13.3	14.4	12.8	16.7	17.2	16.1	17.8	18.3	19.4	20.6	21.1	21.7	22.8	21.7	20.0	16.7	13.9	12.8	10.0
29	9.4	10.6	7.2	7.2	7.2	8.9	8.9	11.1	12.2	13.9	16.1	18.3	20.0	21.7	23.3	23.9	24.4	23.9	23.9	22.8	20.6	19.4	18.3	15.6
30	15.0	13.9	11.1	11.1	10.0	9.4	8.3	8.9	14.4	18.3	20.0	22.2	24.4	25.0	25.0	25.0	25.0	23.3	22.8	22.8	20.6	18.9	17.8	15.6

TABLE C-19 (Continued)

MAY 1977 TEMPERATURE(CENTIGRADE)
ENERGY FUELS.HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	14.4	15.6	12.2	13.3	14.4	15.0	16.1	15.0	14.4	14.4	15.6	17.8	18.3	18.9	18.3	19.4	19.4	21.1	21.1	21.1	19.4	18.3	15.0	16.1
2	16.1	16.1	16.1	15.0	12.8	9.4	7.2	6.7	7.8	13.9	15.0	17.8	19.4	20.6	22.8	22.8	21.7	21.1	21.1	20.6	18.9	13.9	15.0	12.8
3	12.2	10.6	10.6	10.0	11.1	10.0	11.1	10.0	15.1	15.3	20.0	17.8	14.4	16.7	17.2	18.3	20.0	17.8	17.8	16.7	15.6	14.4	15.6	15.0
4	13.9	13.9	12.2	11.7	11.1	10.6	12.2	15.0	15.0	15.6	17.8	18.9	19.4	20.0	21.1	22.8	21.7	21.1	20.0	18.3	17.2	16.1	13.9	12.2
5	10.6	12.8	12.8	13.9	12.8	11.1	11.7	15.0	15.6	16.7	18.3	17.8	18.9	19.4	19.4	21.7	21.7	21.7	20.0	18.3	17.2	16.1	16.1	16.1
6	15.0	13.9	13.3	12.8	12.2	12.2	12.8	13.3	15.0	16.1	15.6	16.7	17.8	18.9	19.4	20.0	20.0	19.4	18.9	18.3	17.2	16.7	16.1	15.6
7	14.4	13.9	12.2	11.1	11.1	11.1	12.8	14.4	15.6	16.7	17.8	19.4	19.4	20.6	20.6	20.0	20.6	20.6	20.0	18.9	18.3	18.3	18.3	17.8
8	16.1	15.0	13.9	14.4	12.2	12.2	14.4	16.1	17.2	17.8	18.3	19.4	20.6	21.7	22.8	23.3	23.3	23.3	22.8	21.1	19.4	19.4	17.2	15.6
9	15.0	13.9	15.0	15.0	15.0	15.0	15.0	16.1	17.8	18.3	19.4	20.6	21.7	22.2	21.7	21.7	22.2	21.7	20.6	17.2	13.9	12.2	10.6	8.9
10	7.8	7.8	7.2	6.1	5.6	5.0	6.1	7.8	11.1	11.7	12.8	13.3	14.4	15.0	16.1	17.8	16.1	16.1	15.6	14.4	12.8	11.7	11.1	10.6
11	8.3	8.3	4.4	4.4	3.9	2.8	3.9	8.9	11.1	13.9	16.1	13.9	19.4	19.4	20.6	20.6	20.6	20.0	19.4	18.3	16.1	13.9	11.7	9.4
12	7.8	9.4	8.9	9.4	8.3	11.1	10.0	15.0	17.2	18.9	20.6	21.7	22.8	23.3	23.9	24.4	24.4	25.0	22.8	21.7	20.0	17.2	17.8	17.2
13	16.1	16.1	15.0	15.0	14.4	13.9	13.9	15.0	16.1	17.8	18.3	18.9	20.0	20.6	19.4	10.0	12.2	9.4	8.9	8.9	7.8	6.7	6.1	5.0
14	4.4	3.3	3.3	3.3	3.9	3.9	3.9	6.7	8.3	10.0	11.1	12.8	13.3	13.9	13.9	13.9	14.4	15.0	15.0	13.3	13.3	12.8	12.2	11.7
15	11.1	10.6	9.4	10.0	9.4	9.4	9.4	10.6	12.8	13.9	14.4	15.0	15.0	13.9	13.3	14.4	15.0	13.9	13.9	13.9	13.9	13.9	13.9	13.3
16	12.8	10.6	11.7	11.7	11.7	11.1	11.1	11.7	13.3	13.9	15.0	16.1	17.2	18.3	18.3	18.3	17.8	17.8	17.2	16.1	15.0	10.6	9.4	8.9
17	8.9	8.3	7.8	7.2	6.7	6.1	5.6	6.7	8.3	10.6	12.8	12.8	13.9	15.0	15.6	15.6	15.6	15.0	13.3	11.7	10.6	8.9	8.3	7.2
18	6.1	5.6	3.3	1.7	2.2	1.7	3.9	6.1	8.3	9.4	10.6	11.7	12.2	11.1	11.1	10.6	10.6	8.9	10.0	9.4	6.7	7.2	6.1	5.0
19	5.0	4.4	2.8	1.1	-.6	-1.1	2.2	7.2	8.3	10.6	11.7	13.3	15.0	15.0	16.1	16.1	16.1	16.7	16.7	13.9	11.7	11.1	9.4	9.4
20	9.4	8.9	7.8	7.8	7.2	7.2	8.3	10.0	11.1	12.8	14.4	15.0	16.1	17.2	17.2	17.2	17.2	17.2	16.1	15.0	13.3	12.2	9.4	9.4
21	9.4	8.3	7.8	8.3	7.8	7.8	7.2	10.6	13.3	15.0	15.6	17.2	18.3	19.4	20.6	21.1	21.7	21.7	21.7	20.6	17.8	16.1	13.9	13.3
22	11.7	10.6	9.4	9.4	6.7	6.7	6.7	10.6	15.0	16.7	18.9	21.7	22.8	23.9	23.9	25.0	24.4	24.4	23.9	23.9	22.8	21.7	20.6	18.3
23	18.3	17.2	18.3	17.8	17.8	15.6	15.6	16.1	17.2	18.9	20.6	22.2	22.2	23.3	23.9	23.9	23.9	23.3	22.8	21.7	20.0	19.4	18.3	17.2
24	17.2	17.2	14.4	13.9	15.0	15.6	16.1	16.1	15.6	13.9	15.0	14.4	12.8	11.7	11.7	12.2	12.2	11.7	11.7	11.7	11.1	11.1	11.1	10.6
25	9.4	8.3	8.3	7.8	7.2	7.2	7.2	8.3	11.7	12.8	12.8	13.9	15.6	16.1	16.1	16.7	15.0	15.0	14.4	13.3	11.7	10.6	10.0	8.3
26	8.9	7.8	8.9	8.3	6.7	5.0	7.2	9.4	12.2	13.9	14.4	15.6	16.7	16.1	15.6	16.1	16.1	15.7	18.3	16.7	14.4	12.2	12.8	12.8
27	11.7	9.4	8.9	7.8	6.1	5.6	9.4	13.3	15.0	17.2	18.3	19.4	19.4	20.6	21.7	21.7	21.7	21.1	21.1	20.0	17.2	16.7	16.1	15.0
28	12.2	10.0	7.8	7.8	7.2	7.8	9.4	12.2	15.6	18.9	20.0	22.8	21.1	20.6	22.2	22.8	21.7	22.2	20.0	19.4	17.2	15.6	12.8	11.7
29	10.0	8.9	8.3	7.8	7.2	6.1	7.2	12.2	14.4	17.2	19.4	22.2	24.4	25.0	25.0	25.6	26.7	26.1	26.1	25.0	24.4	23.3	21.7	18.9
30	17.8	16.1	11.7	11.7	11.1	10.6	10.6	10.6	13.9	18.3	20.0	21.1	23.3	24.4	25.0	26.1	26.1	26.1	26.1	25.6	23.9	19.4	19.4	15.6
31	15.0	14.4	16.1	13.3	11.1	10.6	10.6	14.4	17.8	20.6	23.9	25.6	27.2	28.9	29.4	30.0	30.6	30.6	30.0	28.9	26.7	21.1	20.0	17.8

TABLE C-19 (Continued)

JUN 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS.HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	16.7	15.6	15.0	14.4	13.3	12.2	11.1	16.7	22.2	23.3	25.6	28.3	31.1	32.8	32.8	34.4	33.9	34.4	31.7	30.6	28.9	28.3	27.8	24.4
2	20.6	21.1	20.5	20.0	18.3	19.4	16.7	17.8	22.2	26.1	27.2	30.0	31.1	31.7	30.0	28.3	27.2	27.8	27.8	27.2	26.1	25.6	23.3	22.2
3	19.4	18.3	17.8	16.7	14.4	14.4	15.0	15.6	20.6	24.4	27.8	30.0	31.1	31.7	32.8	31.7	32.2	32.8	31.7	31.1	29.4	27.8	25.6	26.1
4	24.4	25.0	25.0	23.9	22.2	21.7	20.6	21.7	23.3	24.4	26.1	25.7	29.4	30.6	31.1	30.6	31.7	31.7	31.7	30.6	29.4	29.4	27.2	26.7
5	26.7	25.0	22.2	20.6	18.9	18.9	19.4	20.0	22.8	26.1	27.2	29.4	30.6	31.7	32.2	32.8	32.8	32.8	32.8	32.8	31.7	27.8	27.8	27.2
6	25.0	24.4	23.3	22.8	21.7	21.1	20.0	18.9	19.4	25.0	26.1	28.3	30.0	31.7	30.0	31.7	32.2	31.7	31.7	31.1	28.9	27.2	23.9	21.7
7	25.0	23.3	23.3	22.8	20.0	20.0	18.9	23.9	25.0	26.1	27.8	29.4	30.6	31.1	31.1	30.6	31.1	31.1	30.6	30.6	28.3	26.1	26.1	26.1
8	23.9	22.8	21.7	21.1	21.1	21.1	21.1	22.2	21.7	22.8	24.4	25.0	26.1	27.2	27.8	27.8	26.7	24.4	21.7	20.0	20.6	20.0	18.3	18.3
9	16.7	17.2	17.2	16.1	15.0	17.8	20.0	21.7	23.3	25.0	26.1	26.7	27.2	28.3	28.3	27.8	27.2	26.1	22.8	21.7	19.4	18.9	17.2	16.7
10	14.4	14.4	15.6	15.6	16.1	17.2	18.9	21.7	22.2	24.4	25.6	26.1	26.7	27.2	27.2	26.7	26.7	26.7	26.1	22.8	19.4	19.4	19.4	17.8
11	17.2	16.7	14.4	12.8	11.7	12.2	17.8	21.1	23.9	25.0	25.6	26.1	26.7	27.2	27.2	27.8	27.2	27.2	26.1	23.9	20.6	18.9	16.1	16.7
12	19.4	19.4	17.2	15.0	13.3	13.3	20.0	22.8	23.3	25.6	26.7	28.3	28.9	29.4	29.4	30.0	28.9	28.9	28.3	26.1	23.9	21.1	20.0	18.3
13	15.0	14.4	13.9	13.9	13.9	13.3	16.1	21.7	23.9	26.1	27.8	29.4	30.0	30.6	30.6	30.6	30.0	28.9	27.2	25.0	23.9	22.8	21.1	20.0
14	17.8	17.2	18.3	16.1	17.8	18.3	23.3	23.9	27.8	28.9	29.4	30.6	30.6	31.7	31.7	31.7	31.1	30.6	28.3	22.2	22.8	24.4	23.3	23.3
15	20.6	18.9	18.3	17.2	13.9	18.9	21.7	25.0	26.7	28.3	30.0	31.1	31.1	30.6	31.1	30.6	30.0	28.9	26.1	22.8	22.2	22.8	20.0	21.1
16	20.0	16.7	15.6	13.3	17.8	20.6	24.4	27.2	27.8	28.9	30.6	31.1	31.7	32.2	32.8	33.3	32.2	31.1	28.9	28.3	25.6	22.8	22.8	20.0
17	16.1	15.0	12.8	15.6	20.0	23.9	26.7	29.4	31.7	31.7	32.2	32.2	32.2	32.2	31.7	30.6	30.0	25.6	26.1	26.1	25.6	23.3	22.2	21.7
18	20.0	19.4	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
19	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
20	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	25.6	26.1	27.2	27.8	28.3	28.3	28.3	27.8	27.8	26.1	24.4	22.2	20.6	17.8
21	19.4	18.9	18.9	18.3	18.3	18.3	20.6	22.2	23.9	25.6	26.1	27.2	28.3	29.4	29.4	30.0	30.0	30.0	29.4	26.7	23.9	22.2	21.1	19.4
22	17.2	15.6	15.6	17.2	16.7	16.1	18.9	21.1	22.8	23.9	25.6	27.2	27.8	29.4	30.0	31.1	31.1	31.1	30.6	29.4	26.7	23.3	23.9	22.8
23	22.8	21.7	21.1	21.1	18.3	18.3	19.4	22.2	25.0	26.7	28.3	29.4	31.1	32.8	33.3	32.8	32.8	32.8	32.8	31.7	28.9	25.6	26.7	27.8
24	25.6	24.4	23.3	22.8	21.1	18.3	18.9	22.8	25.6	27.2	28.9	30.6	31.7	32.2	32.8	33.3	33.3	31.1	31.1	31.1	28.9	26.1	26.7	25.0
25	23.9	23.9	23.3	22.8	22.2	18.9	20.6	23.9	25.0	27.8	29.4	31.1	31.7	32.2	33.3	30.0	29.4	30.0	29.4	28.3	27.2	25.6	23.3	23.9
26	23.9	23.3	21.7	21.1	20.0	18.3	17.8	22.8	25.0	26.7	26.7	28.3	31.1	31.7	32.8	33.9	33.9	32.8	32.8	32.8	30.6	29.4	27.8	27.2
27	23.9	22.2	22.2	18.9	18.9	18.3	18.3	22.8	26.1	27.8	30.0	32.2	33.3	34.4	35.0	35.6	33.9	33.3	33.3	31.7	30.6	30.6	28.9	28.3
28	27.2	26.1	25.0	24.4	22.8	21.7	22.2	25.0	27.2	29.4	30.6	31.7	32.8	34.4	35.0	35.6	35.6	35.0	33.9	31.7	30.0	28.9	27.2	27.8
29	27.2	27.2	25.6	25.0	22.8	22.8	22.8	26.7	25.3	30.0	30.6	31.7	32.2	32.8	33.9	33.9	33.3	33.3	32.8	31.1	29.4	27.8	23.9	22.8
30	22.2	21.1	20.0	20.6	18.9	16.7	17.2	20.6	25.6	27.8	30.6	31.7	32.8	33.9	34.4	35.0	35.6	34.4	33.3	31.7	30.6	28.3	25.6	25.6

TABLE C-19 (Continued)

JUL 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	25.0	22.8	20.0	19.4	21.1	23.9	24.4	24.4	25.6	29.4	31.1	32.2	33.3	26.7	25.0	26.1	25.6	26.1	24.4	23.9	22.8	21.1	17.2	16.1
2	16.1	17.2	16.7	16.1	15.0	13.9	13.9	18.9	21.7	23.9	25.0	26.7	30.0	33.3	33.9	33.9	33.9	33.3	32.8	31.7	31.1	28.9	28.3	27.8
3	27.2	27.2	26.1	25.0	23.3	21.7	21.7	22.8	25.6	27.2	29.4	30.6	30.6	30.0	28.9	26.7	26.7	26.1	27.2	27.2	26.1	25.0	24.4	25.0
4	23.9	22.8	21.7	18.3	18.3	18.3	18.3	17.8	19.4	20.6	21.7	23.9	25.6	24.4	20.0	22.2	24.4	26.1	23.3	22.8	21.7	20.6	20.0	19.4
5	18.9	18.3	16.7	15.6	15.0	13.9	15.6	20.0	21.7	23.3	25.0	26.1	27.8	30.0	28.9	28.9	29.4	28.9	27.2	26.7	25.0	23.3	22.2	20.6
6	20.0	17.8	16.1	15.0	13.9	13.9	15.0	20.6	22.8	23.9	26.1	27.8	28.9	30.0	30.6	30.6	31.7	31.1	30.6	30.0	27.8	26.7	24.4	23.3
7	22.2	18.9	17.2	16.7	15.0	15.0	16.7	22.9	25.0	26.7	28.3	29.4	31.1	31.7	32.8	33.3	34.4	33.9	33.9	32.8	28.9	27.8	25.6	25.0
8	23.9	21.7	20.6	21.7	20.6	20.0	15.6	22.2	22.8	26.7	28.3	30.6	32.2	31.7	32.8	33.9	33.9	33.9	32.8	32.2	30.0	26.7	25.6	23.9
9	27.2	30.0	27.8	26.1	26.7	26.1	26.1	23.9	25.6	27.2	28.9	30.0	31.1	31.7	33.3	33.9	33.9	33.9	33.3	32.2	31.1	29.4	26.1	23.3
10	25.6	25.0	23.9	25.0	25.0	25.0	23.9	25.6	27.2	28.3	29.4	30.6	31.1	32.2	32.8	33.3	33.9	33.9	33.9	33.3	32.8	30.6	28.3	27.8
11	27.2	24.4	21.1	20.6	18.3	17.2	19.4	20.6	23.9	28.3	30.0	29.4	30.6	31.7	32.2	32.8	32.8	31.7	31.1	30.0	28.3	26.7	25.6	25.0
12	29.4	28.9	27.8	27.2	26.7	23.3	27.2	28.3	31.1	27.8	29.4	31.7	32.8	32.8	33.3	33.3	33.3	32.8	32.8	30.6	29.4	28.3	27.2	26.7
13	25.0	24.4	23.9	24.4	23.9	23.9	23.9	25.0	26.7	26.1	26.1	29.4	29.4	31.7	31.7	31.1	30.6	30.6	31.1	31.1	28.9	28.3	26.1	25.6
14	23.3	22.2	21.7	19.4	17.2	17.2	19.4	25.0	27.2	28.3	30.6	32.2	32.8	33.9	33.9	33.9	33.9	33.9	32.8	31.7	30.0	28.3	28.3	26.1
15	25.0	25.0	24.4	22.8	21.1	22.8	21.1	25.0	26.7	28.9	29.4	30.6	31.7	32.2	30.6	30.0	31.7	32.2	31.7	31.1	27.8	27.2	27.8	27.2
16	26.1	25.0	25.0	25.0	24.4	23.3	23.3	25.0	26.1	27.8	29.4	30.6	32.2	33.3	32.2	32.2	33.9	33.9	32.8	31.7	29.4	28.3	26.1	23.9
17	22.8	23.9	25.0	23.9	23.3	23.9	21.1	22.8	25.6	28.3	28.3	28.9	29.4	31.7	32.2	33.3	32.2	32.2	31.7	30.6	29.4	28.3	26.7	25.6
18	25.6	25.6	24.4	22.2	21.1	20.6	20.0	20.0	23.9	26.1	27.8	29.4	30.6	31.7	30.6	29.4	30.0	27.2	25.0	24.4	23.3	24.4	23.3	23.3
19	21.7	21.1	20.0	21.7	21.7	21.7	21.7	23.3	23.9	25.0	26.1	28.3	26.9	21.1	22.8	23.3	23.9	25.0	24.4	23.3	20.6	20.0	20.0	18.9
20	18.3	17.8	17.8	16.1	15.6	16.1	18.9	21.7	22.8	23.3	26.1	27.8	28.3	29.4	30.6	27.8	25.6	26.7	26.1	25.0	23.9	23.3	22.8	22.8
21	20.6	21.1	21.7	19.4	18.3	17.8	20.0	22.2	23.9	25.0	26.1	27.2	28.9	29.4	29.4	28.9	28.9	25.0	22.2	19.4	19.4	20.0	20.0	18.3
22	17.2	17.2	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
23	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
24	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
25	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
26	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
27	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	28.3	30.0	29.4	29.4	27.2	26.1	26.7	27.2	25.6	24.4	22.8	22.8	18.9	19.4
28	18.3	17.8	17.8	17.8	17.8	17.2	17.2	20.6	22.2	23.3	25.6	27.2	28.9	30.6	31.7	32.8	33.3	33.3	32.2	32.2	27.8	24.4	23.9	22.2
29	20.6	20.6	20.6	20.0	19.4	18.9	18.9	21.1	25.6	28.3	30.0	31.7	33.3	33.9	35.0	32.8	32.8	32.8	31.1	30.6	30.0	28.3	26.1	25.0
30	25.6	22.8	22.2	23.3	26.1	26.7	25.6	25.6	28.3	30.0	31.1	32.2	33.3	34.4	35.6	35.0	35.0	35.0	33.9	32.2	30.6	28.3	27.8	24.4
31	23.9	23.9	22.8	20.0	21.7	19.4	19.4	21.1	22.8	26.7	27.8	28.9	30.6	31.7	32.8	32.8	32.8	32.8	32.8	32.2	30.6	24.4	25.0	25.0

TABLE C-19 (Concluded)

AUG 1977 TEMPERATURE (CENTIGRADE)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	23.9	22.8	22.2	21.1	21.7	20.6	21.1	21.1	24.4	23.9	27.2	28.3	29.4	30.6	31.7	32.8	33.3	33.9	34.4	34.4	33.9	33.3	30.6	23.9
2	22.8	25.0	25.6	24.4	23.9	23.3	22.8	20.6	17.2	13.3	22.8	26.7	31.7	32.8	35.0	35.0	35.6	35.0	35.0	34.4	31.1	26.7	25.0	24.4
3	23.9	22.2	20.0	20.6	18.9	18.9	18.9	20.6	26.1	28.9	32.2	33.3	33.9	33.3	35.0	33.3	33.9	33.9	32.2	31.1	30.0	29.4	27.2	27.2
4	27.2	26.7	25.0	22.8	22.2	23.9	23.3	23.9	26.7	29.4	31.1	31.7	32.2	33.3	31.1	30.0	27.8	28.9	27.8	26.7	25.6	25.0	23.9	23.9
5	22.2	21.7	25.0	25.0	23.9	23.3	23.9	26.1	23.9	25.0	26.7	29.4	30.6	31.7	31.1	30.6	31.7	32.2	31.7	30.0	26.7	25.0	27.2	25.6
6	26.1	25.0	25.6	24.4	22.8	21.7	19.4	23.3	27.2	30.6	31.7	33.3	34.4	34.4	35.0	35.6	35.6	35.0	33.3	32.8	31.1	30.6	29.4	29.4
7	28.9	27.8	27.2	25.6	25.0	23.3	21.1	22.8	26.1	30.6	31.7	31.1	32.8	33.9	34.4	34.4	34.4	34.4	33.9	32.2	30.6	29.4	28.9	27.8
8	25.0	25.6	26.1	26.1	23.9	23.9	24.4	23.3	23.9	25.6	28.3	30.0	32.2	32.2	32.8	34.4	33.9	32.8	32.8	32.8	30.6	28.3	27.8	26.7
9	26.7	24.4	23.3	20.0	19.4	17.8	17.2	19.4	22.8	26.7	29.4	30.6	31.1	31.7	32.8	32.8	33.3	33.3	32.8	32.2	30.0	28.9	26.1	25.0
10	23.9	22.2	20.6	20.0	18.9	17.8	17.2	18.3	22.2	26.1	29.4	30.6	31.7	30.6	30.6	27.2	25.6	28.9	29.4	27.2	23.9	23.9	23.3	22.2
11	19.4	18.9	17.2	16.1	16.1	16.1	17.8	22.8	24.4	26.1	28.3	29.4	30.0	29.4	28.9	29.4	30.6	29.4	29.4	26.7	23.9	24.4	23.3	23.9
12	21.7	21.1	20.6	19.4	18.3	18.3	18.9	20.6	22.2	23.9	25.6	25.7	28.3	30.0	30.6	30.0	29.4	30.6	28.9	27.8	26.1	23.3	22.2	21.1
13	19.4	18.3	19.4	18.3	17.8	16.1	16.1	17.2	22.8	26.1	27.8	29.4	30.0	31.7	32.2	32.2	31.1	31.7	31.1	30.6	28.9	26.1	25.6	27.8
14	26.1	26.7	23.9	23.3	23.3	22.2	20.6	21.7	25.0	26.7	27.8	28.9	29.4	30.0	31.7	31.1	31.7	29.4	25.0	25.6	26.1	25.6	25.6	24.4
15	22.8	23.9	23.9	22.8	21.7	21.1	20.6	20.6	20.0	20.0	21.1	22.2	23.9	27.2	27.2	27.2	27.2	25.0	25.0	23.9	22.8	22.8	21.7	21.1
16	20.6	20.6	20.0	19.4	19.4	20.0	18.3	20.6	21.7	22.8	24.4	25.6	25.6	27.2	28.9	26.1	25.0	25.0	23.9	23.3	22.8	22.8	21.7	21.7
17	21.1	21.1	20.6	20.6	20.6	20.6	20.6	20.6	21.7	22.8	23.9	23.9	25.0	21.1	23.9	23.3	20.6	18.3	19.4	19.4	18.3	18.3	17.8	17.8
18	17.8	17.2	16.7	16.1	16.1	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
19	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
20	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
21	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	26.7	26.1	23.9	22.2	22.8	20.6	19.4	21.7	20.0	18.9
22	19.4	18.3	16.7	17.8	21.1	23.9	26.7	27.8	25.6	31.1	30.0	28.3	28.9	28.3	27.8	28.3	27.8	26.7	26.7	26.1	23.3	22.8	21.1	20.6
23	18.3	18.3	17.8	17.8	16.7	17.8	22.2	25.0	27.2	29.4	30.0	30.6	27.8	26.1	22.2	23.3	23.3	21.7	21.7	21.7	23.3	21.1	20.6	20.6
24	18.9	18.9	18.9	18.9	18.9	18.9	18.9	21.1	23.9	22.8	25.0	26.1	26.7	27.2	28.3	29.4	27.8	27.8	27.2	26.1	25.0	23.9	23.9	22.8
25	21.7	20.6	18.3	17.8	18.9	17.2	15.6	18.3	22.8	26.1	27.2	28.3	29.4	29.4	30.0	30.6	30.6	30.0	29.4	28.3	27.2	26.1	26.1	23.9
26	24.4	22.8	24.4	24.4	23.3	23.9	23.3	22.8	25.0	26.1	27.2	27.2	27.8	28.3	30.0	30.6	30.6	29.4	27.2	26.7	21.7	19.4	18.3	17.8
27	13.3	12.8	12.2	12.2	10.6	10.0	10.6	11.7	13.9	16.1	16.7	18.3	19.4	20.6	21.1	21.7	22.2	22.2	22.2	21.1	19.4	17.8	16.1	15.6
28	13.3	12.8	11.7	11.1	11.7	11.1	10.6	12.8	17.2	19.4	21.1	22.2	23.9	24.4	25.0	26.1	27.2	26.1	26.1	25.0	21.7	19.4	19.4	18.9
29	18.9	17.2	16.1	15.0	12.8	12.2	11.7	11.1	15.6	18.9	21.7	23.9	25.0	26.1	26.7	28.3	29.4	29.4	29.4	29.4	27.8	26.1	24.4	25.6
30	23.3	21.1	20.6	18.3	17.2	15.6	15.0	14.4	19.4	22.2	26.1	27.8	30.0	31.7	31.7	29.4	31.7	30.6	30.6	29.4	28.3	26.1	23.9	25.6
31	25.6	25.0	22.2	21.7	20.6	16.7	15.6	15.6	19.4	22.2	25.0	26.7	28.3	30.0	30.6	30.6	30.6	30.6	30.0	28.9	26.7	25.0	25.0	25.0

TABLE C-20

MONTHLY SUMMARY OF TOTAL PRECIPITATION
APRIL-AUGUST 1977
ENERGY FUELS' HANKSVILLE STATION

Month	Precipitation (cm)
April	0.13
May	0.18
June	0.05
July	2.34
August	1.70

TABLE C-21

HANKSVILLE BUYING STATION, RELATIVE HUMIDITY DATA, MARCH-AUGUST, 1977

MAR 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS.HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1															22	26	32	87	39	43	42	41	42	46
2	47	49	49	45	49	48	50	47	42	38	34	39	36	34	34	35	36	38	42	44	46	46	48	50
3	50	53	51	51	53	54	56	51	46	41	39	36	33	31	30	30	30	32	34	34	37	40	39	40
4	42	45	46	46	48	49	59	50	46	40	36	33	33	35	35	40	43	38	42	43	44	46	48	49
5	50	52	54	56	53	58	60	50	45	40	35	34	32	30	27	26	26	26	28	32	36	38	40	42
6	45	46	48	49	51	53	54	47	40	36	32	29	27	24	23	22	21	21	22	25	30	32	34	35
7	36	37	40	42	42	45	46	43	38	34	30	28	24	20	17	14	14	15	16	17	18	20	22	23
8	23	24	25	27	28	28	28	29	28	24	20	17	14	11	10	10	8	9	10	12	14	16	17	18
9	20	20	21	22	23	24	24	23	23	20	18	14	13	12	12	10	10	11	12	13	14	16	32	42
10	40	42	39	39	38	41	40	41	42	39	35	36	33	34	33	32	33	34	38	39	40	41	42	44
11	44	44	46	46	46	46	46	48	46	40	37	34	33	31	31	30	29	29	30	32	34	36	38	40
12	42	44	46	48	50	52	54	54	48	42	38	35	32	31	30	27	25	25	25	27	28	30	32	35
13	36	37	36	30	30	30	28	27	26	26	26	19	16	14	13	12	10	10	12	14	14	16	19	20
14	33	42	49	55	57	58	59	55	44	39	35	32	43	39	34	27	28	26	30	33	36	39	40	41
15	42	44	45	45	46	48	50	46	39	34	32	28	26	20	17	14	13	13	14	16	18	18	19	21
16	23	25	26	28	29	30	32	32	29	24	21	18	13	9	8	10	10	10	12	12	12	14	15	19
17	29	36	34	33	35	35	35	36	34	30	31	30	27	27	22	22	24	27	38	41	44	47	49	48
18	47	44	43	42	44	44	44	43	40	38	32	30	28	25	24	22	22	23	27	30	33	35	38	40
19	43	44	46	48	49	50	52	50	40	36	31	27	24	22	21	20	19	20	21	22	25	29	28	28
20	31	32	31	30	30	32	35	34	32	31	34	34	30	30	28	28	29	29	30	32	33	36	38	40
21	41	42	42	42	45	47	52	54	54	47	40	34	30	28	26	26	26	27	28	32	34	36	39	40
22	41	43	44	46	49	50	46	39	35	32	29	25	23	22	20	18	17	18	19	22	25	27	28	28
23	30	32	34	36	37	38	38	32	27	24	22	19	17	15	12	14	14	16	17	17	18	19	22	23
24	26	28	31	32	33	34	32	31	30	26	26	22	22	22	21	20	20	22	22	24	32	35	39	35
25	92	54	74	64	56	46	41	40	26	28	27	23	22	22	28	32	35	39	38	44	95	95	94	95
26	95	95	95	95	94	93	90	73	72	67	56	42	40	35	34	32	31	38	51	50	42	38	34	38
27	35	39	49	42	40	52	48	31	23	20	15	15	12	11	12	12	13	10	11	10	12	23	29	26
28	34	27	30	29	31	33	32	29	24	21	16	13	12	14	13	13	13	14	16	22	28	29	30	32
29	35	36	34	34	34	35	33	28	24	21	18	16	18	15	15	18	18	19	25	30	34	38	38	39
30	40	41	42	42	43	46	38	35	28	24	19	14	12	10	10	8	7	8	9	12	14	15	17	20
31	23	25	27	29	30	29	25	20	19	14	13	11	9	7	6	6	7	8	13	18	22	23	26	29

TABLE C-21 (Continued)

APR 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	28	28	999	999	999	999	30	27	21	18	17	18	18	26	32	49	50	50	92	78	95	95	94	74
2	70	52	84	84	90	82	62	38	34	25	20	13	15	14	16	16	14	22	45	47	52	49	48	48
3	48	48	49	49	49	50	41	38	28	22	15	14	14	14	14	13	17	20	25	27	29	32	33	34
4	35	36	37	39	42	48	46	38	32	28	24	23	20	18	18	17	17	17	19	21	27	30	33	37
5	39	39	43	45	47	48	47	42	34	30	28	25	22	20	18	17	17	19	20	24	27	30	33	34
6	38	39	40	42	45	48	44	35	30	25	23	20	17	16	15	13	12	12	13	15	18	20	22	25
7	25	25	26	28	30	32	30	24	22	19	16	14	12	10	8	8	9	9	10	12	14	17	17	17
8	20	22	23	24	26	28	26	22	18	15	13	10	6	4	3	2	2	3	4	5	5	6	7	8
9	8	7	8	9	10	11	12	13	10	9	7	4	4	4	3	2	2	2	3	4	5	6	6	5
10	5	6	7	7	8	6	10	10	10	8	7	5	4	3	3	2	1	0	0	0	0	1	2	3
11	8	10	12	15	17	20	22	25	24	21	19	21	19	17	18	18	16	20	26	31	38	40	44	45
12	43	35	32	30	28	28	29	28	25	23	22	22	22	22	20	19	20	21	26	30	50	89	86	84
13	84	95	95	95	94	95	95	90	68	56	44	38	22	20	10	16	12	11	10	11	18	22	24	26
14	28	28	29	32	35	37	40	39	32	28	22	19	16	14	11	10	10	12	22	21	22	23	25	28
15	26	26	26	26	27	28	31	32	30	26	32	39	42	38	34	34	34	34	35	38	40	43	49	54
16	56	56	57	57	58	62	67	60	52	48	42	38	34	32	29	27	25	24	24	26	28	32	34	34
17	37	39	41	42	46	48	50	48	38	33	30	26	22	19	16	14	12	11	11	11	12	14	17	18
18	2	0	0	0	0	1	2	2	23	18	15	14	12	11	10	14	24	28	33	34	34	32	30	28
19	26	24	25	25	25	26	26	33	31	31	32	30	28	38	41	36	39	41	46	50	56	58	60	60
20	59	54	46	37	34	31	26	23	19	16	15	12	10	7	6	6	6	7	9	10	12	13	14	15
21	16	16	17	18	20	21	20	18	15	14	13	10	9	8	6	6	5	4	4	4	5	6	8	9
22	9	9	10	12	12	12	12	10	9	8	7	5	4	4	3	2	2	2	2	3	5	6	7	8
23	8	9	10	11	12	12	12	11	10	8	7	5	4	4	3	3	3	3	3	3	4	5	6	7
24	8	9	10	10	11	11	11	10	8	9	5	8	8	7	6	5	5	5	6	6	8	14	20	24
25	27	29	31	32	35	37	35	36	32	999	28	26	24	21	19	17	17	15	14	14	15	18	18	20
26	23	25	26	27	27	29	33	34	29	27	24	22	21	19	13	12	12	12	12	14	19	22	25	26
27	27	27	28	30	31	32	33	34	33	30	27	24	22	17	13	12	13	14	15	15	17	19	21	21
28	24	25	27	30	32	36	36	36	36	41	45	44	41	38	32	30	28	23	30	31	37	50	55	59
29	61	60	64	72	75	75	73	66	60	55	50	44	36	32	24	19	18	18	17	16	16	17	17	18
30	19	19	21	23	23	24	26	26	22	18	17	15	13	11	10	10	10	9	9	8	9	10	12	14

TABLE C-21 (Continued)

MAY 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	15	15	16	17	17	18	21	28	36	40	38	34	30	27	28	26	25	21	21	20	20	21	24	21
2	21	22	21	21	24	31	33	34	32	25	24	21	19	15	12	10	8	7	6	6	6	7	8	9
3	10	11	12	12	13	14	14	14	12	15	13	11	22	22	20	19	17	18	16	18	18	19	15	16
4	15	14	15	16	18	19	20	19	17	19	17	15	14	13	12	11	10	10	10	11	11	12	14	15
5	17	17	18	19	20	22	23	22	21	22	21	20	18	17	17	16	16	15	14	15	17	19	20	22
6	26	31	35	37	38	41	43	41	35	33	31	29	27	23	21	21	20	19	18	17	17	19	21	23
7	25	27	30	33	37	40	41	40	37	33	31	26	24	24	20	21	21	19	19	19	22	20	19	18
8	21	23	25	25	29	30	30	28	28	28	26	25	24	22	21	19	17	16	16	16	17	18	20	22
9	22	23	23	24	26	29	30	30	30	30	25	21	19	18	16	15	15	11	9	9	13	17	21	24
10	26	26	28	30	32	32	36	31	32	32	25	26	23	23	21	20	20	19	19	21	23	25	26	27
11	28	30	33	34	35	36	35	32	29	25	18	12	11	9	6	6	5	5	5	6	7	8	9	11
12	12	13	13	14	15	15	15	13	11	11	10	9	8	7	6	5	5	5	13	16	19	20	25	29
13	33	34	35	36	37	41	43	42	41	37	35	34	32	28	25	75	60	86	78	73	77	90	78	83
14	90	92	87	87	86	87	88	60	57	44	36	33	28	25	25	25	25	25	26	27	29	30	35	41
15	47	60	63	57	59	55	57	53	47	39	37	34	32	44	43	39	39	41	42	42	31	30	30	32
16	34	36	31	31	29	29	29	30	27	22	19	16	13	10	9	9	10	12	12	12	15	23	25	29
17	30	30	31	32	34	35	35	32	27	23	20	19	16	15	12	12	12	12	14	16	19	20	23	24
18	25	25	32	37	37	36	33	29	24	21	18	15	12	15	19	20	20	28	23	21	24	28	35	38
19	41	46	48	50	49	49	46	40	38	33	28	23	17	16	14	13	13	12	13	19	25	26	27	28
20	29	29	32	33	33	33	32	30	28	25	21	17	16	15	14	13	13	13	14	16	19	21	25	26
21	26	27	29	30	31	32	32	28	24	22	20	18	15	14	13	12	11	10	10	11	12	13	17	18
22	19	20	21	21	23	24	25	23	19	17	15	12	11	10	9	8	8	8	6	8	8	9	8	9
23	9	10	10	10	10	11	11	12	12	12	10	6	7	7	5	4	4	4	4	4	4	5	5	6
24	7	9	12	20	28	25	22	19	17	18	24	24	24	31	43	49	47	49	47	47	49	51	54	48
25	49	56	64	69	73	75	74	73	67	30	28	26	23	21	19	17	20	17	18	21	31	33	37	44
26	46	47	48	59	74	77	69	58	44	27	25	23	19	15	14	14	13	13	13	13	14	15	17	19
27	21	24	26	27	29	31	28	25	21	18	16	13	12	10	10	8	8	9	10	10	12	13	14	15
28	17	20	24	26	27	28	27	24	21	16	13	10	9	11	10	10	10	10	15	16	17	21	25	29
29	33	35	37	38	40	42	42	37	32	28	22	14	11	10	9	9	9	8	9	9	10	10	13	13
30	17	23	31	33	35	37	39	34	29	25	17	15	11	7	5	4	4	4	4	4	5	7	8	10
31	12	12	12	14	16	17	18	15	13	10	7	5	4	2	1	1	0	0	-0	0	0	2	3	4

TABLE C-21 (Continued)

JUN 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	5	6	7	7	8	10	11	10	16	12	11	9	7	6	5	5	5	4	6	6	7	9	10	12
2	15	14	15	16	17	17	19	19	17	14	13	11	10	7	9	10	13	12	12	12	13	15	15	16
3	18	20	21	23	25	27	28	28	22	19	15	13	11	10	8	6	8	8	6	9	9	11	11	11
4	11	12	15	21	27	28	29	28	27	25	24	23	20	18	17	16	16	15	15	16	17	17	18	19
5	19	20	23	25	28	29	29	29	26	23	23	19	18	17	15	14	13	13	13	13	19	20	18	18
6	19	21	33	31	33	33	33	34	30	26	23	19	17	16	17	15	14	13	13	13	15	17	19	21
7	21	23	25	27	30	28	29	26	24	23	21	19	18	16	15	15	15	14	14	14	16	18	19	20
8	25	27	31	38	36	36	35	33	35	34	34	31	28	25	23	23	24	29	37	47	41	41	45	45
9	48	50	55	60	62	52	46	37	31	27	17	15	14	12	9	10	15	15	22	25	28	31	36	36
10	38	40	39	38	36	35	33	29	26	18	15	12	10	10	10	10	10	10	10	11	14	14	14	15
11	16	16	18	20	21	22	18	16	14	9	8	8	7	6	5	4	4	4	4	5	7	9	11	12
12	12	15	16	16	17	18	15	15	14	13	11	9	8	7	6	6	6	6	6	6	7	9	10	11
13	13	15	16	17	19	20	19	15	14	12	11	7	6	5	5	5	4	3	4	5	5	6	6	7
14	8	9	9	10	11	11	9	8	6	5	4	3	2	1	0	0	0	0	1	2	3	4	4	5
15	6	7	9	10	12	11	9	8	7	5	4	2	2	1	1	1	2	2	2	2	3	4	5	6
16	7	8	9	10	12	11	9	8	6	6	5	4	4	3	2	2	1	1	1	2	3	3	4	4
17	5	6	7	8	8	8	6	5	4	2	0	0	0	0	0	0	0	0	0	1	3	5	5	6
18	6	6	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
19	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
20	999	999	999	999	999	999	999	999	999	999	11	10	9	9	8	8	8	8	8	8	9	9	10	11
21	12	13	15	17	18	19	20	19	18	17	15	14	12	10	8	7	7	7	9	14	17	21	23	25
22	29	31	34	33	34	35	33	31	29	27	24	21	19	17	15	14	13	13	13	14	15	16	17	20
23	22	23	24	25	28	28	26	23	22	21	19	17	15	13	9	8	7	8	9	9	10	11	13	14
24	16	21	24	27	29	30	30	27	25	22	21	18	17	16	14	13	13	14	14	14	16	18	21	24
25	27	28	29	29	31	34	34	31	27	24	22	20	18	18	16	19	19	18	20	22	22	24	24	26
26	26	27	28	29	32	34	34	30	27	26	25	23	21	19	17	16	15	17	17	18	19	20	23	24
27	26	30	29	32	34	36	36	31	25	25	23	20	20	15	14	14	15	16	16	17	17	18	20	21
28	22	21	23	24	25	26	26	24	21	19	19	16	15	14	13	13	13	13	13	16	17	18	18	17
29	17	17	19	19	20	21	21	19	17	14	13	13	13	12	12	12	12	12	12	12	13	13	15	15
30	15	15	16	16	17	18	19	17	15	14	12	11	10	9	9	9	9	9	9	9	10	12	14	15

TABLE C-21 (Continued)

JUL 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	15	16	17	18	20	19	21	22	19	17	15	13	13	30	47	37	33	31	35	36	37	47	71	79
2	69	62	66	70	74	79	81	57	52	37	32	29	21	11	10	10	8	9	9	10	10	12	14	14
3	13	13	15	16	18	20	21	20	18	17	15	14	14	15	16	22	23	22	21	22	26	25	25	25
4	26	34	37	43	71	69	69	74	80	68	57	50	40	35	48	68	63	33	31	43	45	49	49	49
5	50	55	57	61	67	73	75	66	46	41	30	24	17	18	18	19	21	23	25	27	27	28	27	26
6	25	26	31	35	38	40	41	35	27	26	21	17	15	13	11	9	7	7	7	6	7	8	9	10
7	9	10	11	12	14	15	13	10	8	8	7	5	5	4	4	3	3	2	2	2	3	4	5	5
8	5	7	7	8	9	9	12	10	10	8	7	5	5	5	5	5	5	6	6	6	7	8	9	10
9	9	10	12	14	15	15	16	16	18	17	15	10	7	6	3	0	0	0	0	1	4	5	6	7
10	8	8	8	9	9	8	7	5	5	4	3	3	4	4	4	4	4	4	4	4	4	5	3	2
11	3	3	4	5	6	7	7	7	7	8	8	9	9	7	5	2	4	6	8	9	10	11	11	11
12	15	19	27	31	34	40	39	33	29	24	19	15	10	11	11	11	11	11	11	13	15	17	18	18
13	19	21	23	25	27	27	28	27	26	27	27	20	17	15	15	14	15	15	15	14	16	16	15	14
14	15	16	16	17	18	19	17	14	14	12	10	10	9	8	7	7	6	6	8	9	10	12	12	22
15	25	26	27	29	31	32	31	28	25	24	23	22	20	19	14	17	16	15	16	17	20	21	22	22
16	23	25	27	29	30	34	37	37	35	29	28	25	23	21	19	18	17	16	16	18	20	21	23	24
17	25	25	31	32	33	35	34	34	33	29	28	28	27	25	23	20	20	23	22	23	24	25	32	35
18	34	34	39	51	55	57	60	59	45	39	39	32	28	27	26	26	25	24	32	35	37	40	42	47
19	46	49	48	50	53	53	50	54	47	49	46	42	36	34	69	60	61	52	45	45	49	68	73	72
20	77	82	77	80	83	85	77	49	43	40	35	29	24	21	19	24	17	14	15	17	19	19	19	22
21	39	38	46	53	58	55	50	44	41	37	34	31	27	25	25	25	24	38	54	63	70	59	64	83
22	79	85	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
23	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
24	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
25	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
26	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
27	999	999	999	999	999	999	999	999	999	999	25	23	22	23	37	35	32	29	33	49	45	41	61	55
28	57	57	59	53	51	53	54	43	37	32	28	25	22	19	13	7	6	6	6	8	18	27	26	32
29	35	34	35	36	35	35	35	33	24	19	17	15	13	12	10	11	12	13	15	16	16	18	19	19
30	17	23	22	20	18	17	17	17	16	12	10	9	8	7	6	5	4	4	5	5	5	6	7	9
31	9	10	10	12	12	13	13	12	13	9	8	7	6	5	4	4	4	4	3	3	4	8	8	8

TABLE C-21 (Concluded)

AUG 1977 RELATIVE HUMIDITY (PERCENT)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	8	9	10	11	11	12	12	12	10	10	9	7	6	5	3	3	2	2	2	2	3	7	8	7
2	7	7	8	9	10	11	14	14	12	9	7	6	6	5	4	4	4	4	4	4	5	8	9	10
3	10	11	12	12	14	15	16	15	10	9	9	7	7	7	7	8	8	8	9	11	13	12	16	15
4	17	17	18	21	23	25	27	29	26	21	17	15	15	13	15	16	21	21	21	22	26	26	30	28
5	30	32	35	36	43	45	45	42	33	31	25	25	21	18	18	19	17	16	16	17	19	20	18	18
6	17	18	18	19	21	23	25	23	19	15	13	11	10	9	9	9	8	8	9	10	10	10	11	11
7	11	12	12	13	14	15	18	18	17	13	11	9	11	11	9	9	9	10	11	11	12	15	19	21
8	24	25	27	29	34	34	34	34	34	27	22	16	15	15	14	12	13	13	13	12	11	11	11	12
9	12	14	15	20	27	36	36	32	30	25	15	13	11	10	9	9	8	8	8	9	10	13	17	18
10	23	27	27	27	26	24	25	29	27	27	21	20	21	18	19	23	25	19	19	23	27	29	31	33
11	35	37	40	44	45	46	45	36	33	31	29	27	25	26	23	22	17	18	17	21	25	29	32	33
12	36	40	43	59	62	62	59	53	46	40	35	31	27	25	23	23	22	17	17	19	25	26	28	30
13	33	33	32	35	36	38	38	36	28	24	21	19	17	16	15	16	16	16	16	17	18	20	21	24
14	23	23	33	31	32	34	36	32	28	26	24	25	24	20	19	18	30	36	30	35	32	30	38	35
15	33	33	39	45	51	55	57	57	59	56	47	43	38	38	37	37	36	40	40	41	48	49	53	56
16	56	56	59	61	61	62	65	63	57	54	49	46	48	40	37	40	42	45	49	51	51	48	50	52
17	53	58	56	56	70	73	72	69	66	60	55	55	53	63	61	65	80	81	77	85	88	87	89	87
18	87	86	88	88	90	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
19	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
20	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
21	999	999	999	999	999	999	999	999	999	999	999	999	999	999	31	33	38	41	40	49	56	40	46	49
22	40	51	58	59	52	31	25	23	23	22	22	20	18	17	20	21	20	19	22	21	20	21	26	34
23	36	37	45	42	51	54	50	43	35	29	23	22	20	18	27	31	46	39	43	44	39	38	35	40
24	42	47	56	54	52	52	53	54	47	39	40	35	30	29	28	26	28	28	30	32	33	36	37	40
25	43	49	57	58	54	58	66	57	44	30	23	17	19	19	18	18	17	15	17	17	18	19	20	22
26	21	23	20	19	18	15	15	16	15	15	15	15	14	15	14	13	13	14	17	18	28	33	34	36
27	65	78	82	72	83	89	65	77	61	38	34	30	28	25	23	22	20	19	19	19	22	26	29	30
28	35	39	41	44	42	41	44	39	30	25	21	18	14	13	12	12	10	10	11	12	15	18	19	20
29	21	22	26	29	35	38	40	41	34	28	22	18	16	14	12	10	9	8	8	9	11	12	11	14
30	15	16	20	22	22	27	28	28	23	18	14	13	10	8	8	10	8	8	8	8	10	11	13	12
31	12	12	14	15	18	24	29	32	27	24	19	17	15	13	11	10	10	10	11	12	15	17	18	19

TABLE C-22

HANKSVILLE BUYING STATION WIND DIRECTION DATA, MARCH-AUGUST, 1977

MAR 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS-HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1																								
2											293	293	225	293	315	315	315	315	293	293	270	270	270	270
3	270	270	270	270	270	270	270	270	270	270	315	360	999	999	999	999	113	135	158	203	315	193	193	193
4	293	270	270	270	270	270	270	293	293	315	338	360	999	23	315	360	338	293	315	315	293	293	270	270
5	270	270	248	999	248	248	270	270	293	23	315	360	360	999	999	360	999	999	180	248	248	248	248	248
6	248	225	248	248	248	248	248	248	45	360	45	999	999	90	135	135	135	135	158	56	248	248	248	225
7	225	203	248	248	225	225	248	248	999	360	23	23	999	999	999	113	158	158	158	158	135	99	248	248
8	999	999	248	999	248	999	248	248	293	360	360	45	135	135	135	135	158	158	158	225	225	225	225	999
9	248	225	225	999	999	999	248	999	360	315	360	158	135	135	158	203	225	225	248	248	248	270	315	293
10	293	293	293	315	315	315	293	315	315	315	315	338	338	338	315	315	315	315	315	315	293	315	315	33
11	293	293	293	270	293	293	270	293	293	315	315	360	360	360	360	23	23	45	45	338	338	338	338	293
12	248	248	225	248	248	248	248	248	45	338	999	45	90	90	90	135	158	158	158	180	158	999	248	225
13	225	158	158	158	135	113	135	135	135	135	158	158	203	203	203	203	203	203	225	270	270	270	270	999
14	338	248	248	248	270	293	270	315	315	360	23	23	293	248	315	293	999	338	338	315	248	248	248	225
15	248	248	248	248	225	248	248	999	45	338	360	999	999	135	135	135	158	135	203	158	999	180	315	248
16	225	225	248	225	225	225	225	225	999	360	360	999	999	158	203	203	203	225	225	225	248	248	248	248
17	225	225	999	338	293	270	270	999	90	999	270	248	270	293	293	293	270	293	315	315	338	315	270	315
18	315	338	338	338	315	315	315	315	315	293	315	315	315	338	338	338	338	338	360	338	248	248	248	248
19	248	248	248	248	248	248	248	248	360	360	999	135	135	135	999	999	203	203	203	203	225	248	203	225
20	248	248	270	270	360	225	248	293	270	338	338	315	338	315	338	338	338	338	338	338	338	315	315	315
21	315	315	293	315	999	248	255	999	999	338	360	360	999	23	999	999	135	158	225	248	248	248	225	225
22	225	248	248	248	248	248	248	315	338	338	338	360	360	999	23	360	23	68	999	248	248	248	248	248
23	248	248	248	248	248	248	225	135	23	23	23	999	23	999	203	203	180	203	180	158	203	999	270	270
24	225	225	203	158	158	158	180	180	158	158	158	158	158	180	180	158	180	203	203	225	203	180	203	203
25	203	225	203	225	225	203	203	225	999	999	158	158	158	158	158	158	158	135	158	270	270	158	158	999
26	293	293	293	270	293	270	293	293	15	360	360	338	315	360	999	338	315	315	293	248	248	293	293	270
27	293	293	293	999	270	293	999	360	360	315	360	999	999	135	158	135	158	158	270	248	248	248	293	315
28	293	315	315	315	315	315	315	315	315	315	315	315	315	315	338	338	315	338	338	338	293	293	293	293
29	315	293	293	293	293	293	270	293	293	293	315	315	293	293	338	293	293	293	315	338	293	248	248	248
30	248	248	248	248	248	248	225	225	23	360	68	135	135	158	158	158	158	158	90	45	68	315	293	270
31	248	248	248	248	248	248	999	999	[illegible]	999	999	999	999	999	999	207	225	243	243	333	304	288	304	207

TABLE C-22 (Continued)

APR 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS.HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	234	243	999	999	999	999	135	225	242	342	275	288	279	279	230	234	999	999	999	999	999	999	999	999
2	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
3	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
4	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
5	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
6	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
7	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
8	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
9	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
10	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
11	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
12	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
13	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
14	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
15	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
16	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
17	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
18	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
19	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
20	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
21	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
22	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
23	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
24	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
25	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
26	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
27	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
28	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
29	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
30	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

TABLE C-22 (Continued)

MAY 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
3	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
4	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
5	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
6	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
7	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
8	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
9	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
10	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
11	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
12	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
13	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
14	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
15	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
16	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
17	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
18	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
19	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
20	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
21	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
22	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
23	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
24	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
25	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
26	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
27	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
28	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
29	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
30	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
31	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

TABLE C-22 (Continued)

JUN 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS. HANKSVILLE,UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	999	999	999	995	999	999	994	999	999	999	995	999	999	999	999	999	999	999	994	995	999	994	999	999
2	999	999	999	995	999	999	999	999	999	999	995	999	999	999	999	999	999	999	999	999	999	999	999	999
3	999	999	999	995	999	999	999	999	999	999	995	999	999	999	999	999	999	999	999	999	999	999	999	999
4	999	999	999	995	999	999	999	999	999	999	995	999	999	999	999	999	999	999	999	999	999	999	999	999
5	999	999	999	995	999	999	999	999	999	999	995	999	999	999	999	999	999	999	999	995	999	999	999	999
6	999	999	999	995	999	999	999	999	999	999	995	999	999	999	999	999	999	999	999	999	999	999	999	999
7	999	999	999	995	999	999	999	999	999	999	995	999	999	151	151	210	184	184	287	297	48	137	143	184
8	146	140	140	97	140	216	296	104	190	313	7	356	356	18	50	72	72	335	292	305	346	34	248	319
9	335	270	270	7	216	303	187	162	148	140	157	168	173	179	173	184	230	216	253	292	308	313	297	308
10	286	179	190	190	216	238	324	335	346	270	184	184	184	173	173	179	173	173	173	184	221	222	216	221
11	173	260	270	255	249	227	184	60	15	265	173	173	176	173	173	177	184	184	184	171	216	205	7	307
12	281	275	265	192	227	227	245	297	7	24	888	888	146	135	135	168	151	168	162	159	162	184	302	346
13	227	231	214	227	227	227	281	54	145	125	130	141	150	162	158	162	162	173	173	170	173	200	184	227
14	157	149	162	162	190	179	184	357	313	146	146	151	151	151	151	162	178	184	176	173	180	216	231	238
15	232	265	216	259	184	212	302	90	102	119	140	216	173	184	173	176	210	184	184	190	190	200	233	238
16	259	252	259	182	205	200	254	357	120	86	888	888	888	324	249	210	270	195	173	195	270	284	227	270
17	195	184	195	216	198	184	119	216	303	100	208	216	168	162	999	157	162	151	151	140	151	190	210	210
18	227	270	270	290	227	216	232	18	86	97	341	18	119	130	173	162	162	135	135	135	130	130	205	150
19	151	184	195	173	184	173	162	108	97	110	130	119	130	135	130	140	145	150	155	145	151	162	173	195
20	190	190	184	173	184	184	130	125	119	128	135	125	119	130	119	119	123	125	130	135	130	130	180	184
21	187	184	184	184	184	184	184	195	205	216	310	332	97	119	115	102	119	134	150	227	216	216	210	209
22	205	176	157	173	184	169	179	186	205	234	248	259	29	97	248	248	195	238	242	292	330	145	170	188
23	184	193	196	173	151	97	125	76	31	97	184	122	292	195	216	216	238	238	259	286	297	162	270	302
24	140	148	157	162	173	324	167	308	157	130	125	7	40	40	40	29	346	320	324	313	313	275	184	162
25	162	153	153	147	151	227	179	184	261	330	18	346	61	888	346	286	292	259	190	179	162	190	210	184
26	7	281	216	195	152	220	248	24	281	335	18	18	50	108	356	7	324	340	302	297	292	265	184	158
27	195	270	250	194	184	220	227	7	356	355	61	335	18	281	292	357	346	270	287	276	270	275	281	313
28	302	292	281	286	277	275	303	324	313	317	23	29	346	324	313	324	356	292	292	270	265	281	292	275
29	281	275	281	275	270	270	276	287	313	335	356	1	1	1	303	292	335	330	302	294	313	313	281	270
30	270	292	259	267	184	140	220	130	29	14	18	356	18	346	335	324	300	302	340	335	322	296	273	270

TABLE C-22 (Continued)

JUL 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	259	248	240	205	238	297	296	324	125	125	141	140	140	270	40	29	335	324	324	356	335	346	216	227
2	233	335	281	281	248	190	216	242	356	18	40	130	145	248	240	216	238	250	281	281	257	243	248	270
3	270	259	265	286	292	216	282	40	90	80	36	72	85	270	265	250	232	216	179	292	356	259	270	173
4	151	184	190	151	154	156	147	153	140	150	160	324	270	156	108	86	97	130	140	142	162	156	156	148
5	259	259	270	238	227	227	238	270	292	888	130	130	168	324	216	227	216	190	194	199	167	158	184	190
6	194	281	324	225	222	227	216	162	194	156	119	72	50	346	285	146	162	162	151	162	162	156	156	147
7	888	222	227	227	238	238	238	233	244	253	281	40	61	72	61	29	35	50	125	243	302	7	303	270
8	194	156	156	159	298	281	340	324	264	308	2	238	270	46	888	24	18	888	72	97	216	188	184	184
9	205	205	205	194	210	238	227	249	281	290	287	130	220	184	184	180	210	173	162	151	151	168	173	184
10	216	227	227	216	205	205	205	205	216	222	227	227	244	234	297	184	195	194	211	216	210	216	220	216
11	216	205	216	216	194	194	194	194	194	200	194	205	216	227	222	227	244	270	285	259	324	180	194	205
12	119	292	302	324	233	140	114	108	259	227	18	108	119	119	119	126	140	123	135	130	108	108	61	135
13	173	190	135	135	156	140	114	114	76	140	162	145	170	151	140	130	135	135	135	135	140	145	162	270
14	216	18	151	114	114	125	114	119	114	114	119	114	114	114	119	100	233	205	184	119	119	145	135	119
15	115	179	184	102	117	216	205	162	151	173	216	179	108	119	119	190	281	135	265	270	12	216	292	324
16	346	348	83	114	119	119	108	105	108	114	125	145	110	130	140	155	190	97	97	86	86	97	127	125
17	140	145	130	119	119	125	119	119	114	108	114	114	108	108	108	108	106	105	108	105	105	86	90	86
18	65	78	140	119	108	108	130	162	108	173	194	184	102	102	108	112	140	92	86	80	99	86	65	76
19	216	194	216	156	162	165	165	125	91	144	71	75	234	198	216	218	315	9	328	306	336	18	297	225
20	171	216	252	234	243	255	297	261	360	27	96	63	45	63	45	96	351	270	270	283	291	297	270	265
21	270	171	192	167	108	195	257	225	306	15	90	144	153	135	126	162	162	168	30	325	288	85	188	153
22	153	155	153	153	135	189	126	225	135	208	360	342	351	340	315	321	333	33	360	270	324	252	252	270
23	270	170	153	162	135	63	294	315	360	180	117	90	90	135	135	117	117	140	126	135	117	81	225	328
24	252	153	153	144	117	152	135	120	189	207	207	333	330	315	54	198	252	336	348	297	252	261	275	270
25	288	288	288	279	279	45	335	252	300	330	9	18	36	45	40	45	36	63	77	81	135	225	243	198
26	225	252	288	288	265	225	207	234	333	342	270	45	99	135	171	167	153	153	108	90	162	270	234	235
27	177	189	165	157	162	162	144	147	144	144	144	126	144	144	148	270	198	126	162	198	247	280	306	270
28	279	297	270	279	288	288	270	288	306	360	27	96	72	360	333	36	27	9	63	143	153	234	216	288
29	225	243	270	189	234	261	270	270	297	18	36	144	144	225	276	297	234	162	144	153	167	180	225	234
30	256	223	90	306	279	270	277	297	324	315	333	342	360	360	333	351	351	347	342	342	335	333	333	306
31	288	288	279	315	283	270	280	288	27	342	342	352	350	351	360	360	27	45	63	40	108	243	270	265

TABLE C-22 (Concluded)

AUG 1977 WIND DIRECTION (DEGREES)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	270	270	265	270	275	277	275	279	360	351	351	18	63	45	360	10	360	10	40	80	170	234	234	270
2	290	270	263	261	300	342	189	315	333	306	330	350	27	360	36	10	180	315	10	72	162	234	234	234
3	255	225	207	260	234	225	225	225	235	144	144	144	128	117	108	207	180	252	315	270	262	270	262	243
4	108	315	284	279	279	268	243	207	171	153	162	171	153	18	342	351	360	225	189	243	306	315	295	306
5	288	270	268	279	292	297	306	324	360	315	252	45	225	234	351	34	45	90	72	90	360	324	360	36
6	81	108	54	10	261	243	261	261	270	265	255	243	225	162	324	243	225	135	180	260	230	252	252	234
7	216	225	207	190	198	194	198	198	207	228	243	239	234	225	229	216	225	99	354	222	333	315	216	225
8	198	207	180	180	170	170	171	163	171	175	160	126	107	280	297	63	153	126	162	135	117	225	270	261
9	261	258	225	225	189	193	216	261	270	297	306	888	189	189	207	203	207	180	170	170	198	153	168	175
10	180	297	225	234	243	63	95	144	95	180	81	243	90	108	117	126	180	153	144	180	162	135	126	130
11	153	153	144	90	99	107	99	99	108	117	126	153	180	153	117	90	162	126	126	126	169	162	117	135
12	162	144	162	162	162	198	198	234	270	135	101	90	180	148	.126	126	130	90	85	135	95	99	103	108
13	105	103	108	105	103	95	97	99	99	90	90	88	81	88	90	102	110	144	180	171	180	234	175	140
14	144	146	171	261	270	234	306	351	283	333	351	306	162	171	162	180	180	180	198	162	150	144	153	153
15	153	162	170	162	144	144	144	162	162	198	180	315	312	306	360	20	14	315	306	297	324	315	279	276
16	315	297	342	297	297	308	306	324	333	275	171	207	243	270	288	279	265	283	310	247	225	180	207	148
17	108	149	162	153	153	153	160	162	999	999	153	153	157	153	63	360	24	333	27	207	112	198	252	297
18	279	270	275	275	250	279	288	260	189	234	265	342	18	18	5	36	36	108	180	189	18	126	117	207
19	234	135	36	297	297	277	261	261	252	252	288	288	270	265	9	360	320	351	27	45	9	45	225	888
20	63	90	90	108	170	190	192	292	22	45	225	225	280	256	270	279	265	295	306	351	360	20	54	135
21	225	153	115	45	9	347	300	279	306	9	297	261	234	252	325	344	229	243	237	261	252	351	9	19
22	36	36	99	9	63	27	171	9	27	198	135	198	234	225	252	261	260	250	180	225	225	180	180	243
23	252	9	306	351	45	138	144	315	180	175	162	135	135	162	279	284	270	238	216	252	225	225	261	243
24	216	234	225	243	45	90	126	117	117	153	171	204	180	265	270	243	126	180	175	185	180	180	170	175
25	170	185	162	162	170	170	165	144	144	148	140	153	150	189	162	162	170	170	165	170	175	170	160	158
26	170	180	216	9	353	279	306	261	225	261	252	290	90	360	42	144	175	170	185	186	180	180	189	189
27	198	198	180	171	189	180	126	234	225	225	220	216	202	281	36	315	198	171	177	171	180	196	220	225
28	225	230	256	262	310	327	324	295	319	310	333	180	162	225	306	261	281	333	330	324	330	344	351	45
29	342	36	45	27	40	45	36	22	351	333	320	288	243	238	234	234	230	243	248	288	252	333	333	333
30	342	333	350	18	9	306	306	175	153	117	117	144	225	261	288	279	297	.279	304	261	243	230	237	243
31	230	360	334	342	12	45	888	888	360	126	72	135	130	130	158	180	175	144	252	250	254	225	227	198

TABLE C-23

HANKSVILLE BUYING STATION WIND SPEED DATA, MARCH-AUGUST, 1977

MAR 1977 WIND SPEED (M.P.S.)
ENERGY FUELS. HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12
1												
2											5.8	6.3
3	3.6	4.0	4.0	4.0	3.6	3.1	3.1	3.1	4.5	4.5	4.0	2.2
4	3.6	4.0	4.5	4.9	4.0	4.5	4.5	3.6	4.0	4.5	4.5	3.1
5	3.6	2.7	1.3	.9	2.2	1.3	1.3	3.1	2.7	1.8	2.7	2.2
6	2.7	1.8	2.2	2.7	2.7	2.2	2.7	2.7	.9	1.3	1.3	1.8
7	2.2	1.3	2.2	2.7	2.2	2.2	2.2	1.3	.4	.9	.9	1.3
8	1.8	1.8	2.2	1.8	1.3	1.8	2.7	1.8	1.8	1.8	.9	1.3
9	3.1	3.1	2.2	1.3	2.2	1.8	1.8	1.8	1.8	1.8	2.7	6.9
10	10.3	10.3	11.6	10.7	13.0	13.4	9.8	9.4	5.8	11.6	11.2	10.3
11	5.4	4.5	4.0	4.5	5.4	4.9	5.4	5.4	5.8	7.2	6.3	6.3
12	2.7	1.3	2.7	2.7	2.7	2.7	2.7	1.8	.9	1.8	1.8	1.8
13	2.2	6.3	7.6	7.2	6.7	6.7	6.3	7.6	8.5	8.0	4.5	7.6
14	2.2	1.8	1.8	2.7	2.2	2.7	1.8	.9	.9	2.2	1.8	1.8
15	3.1	2.7	2.7	2.2	1.8	2.2	2.2	.9	1.3	1.3	1.8	1.3
16	3.1	2.7	2.2	2.2	1.8	2.2	1.3	1.3	.9	.4	1.3	1.8
17	11.2	4.9	4.0	5.8	4.0	6.7	6.3	1.8	1.3	2.2	5.8	6.3
18	2.2	3.1	3.1	3.6	2.2	3.1	3.1	4.5	4.9	4.0	4.9	4.5
19	2.2	2.7	2.2	2.7	2.2	2.2	1.8	1.3	.9	.9	1.8	2.7
20	2.2	2.7	3.1	4.0	1.8	1.3	2.2	2.2	3.1	3.6	3.1	5.8
21	6.7	4.9	3.1	2.7	2.2	2.2	1.8	1.3	.9	1.8	2.2	1.3
22	2.2	2.7	2.7	2.2	2.2	2.7	1.8	1.8	3.1	2.2	2.2	1.8
23	2.7	1.8	1.8	2.7	2.2	1.8	2.2	.9	.9	1.3	1.3	1.8
24	4.5	3.6	3.6	6.3	6.7	6.7	5.8	7.2	7.2	8.5	8.5	8.5
25	9.8	10.7	8.0	8.0	5.8	7.6	5.4	6.3	4.0	4.0	5.8	7.6
26	2.7	4.5	3.6	4.5	4.0	3.6	2.7	2.2	2.2	2.7	2.7	3.6
27	2.2	3.6	1.8	1.3	1.8	2.2	.9	1.3	1.3	3.1	1.3	1.3
28	8.9	10.3	10.3	8.9	7.2	7.6	5.4	8.0	7.6	8.0	8.0	8.0
29	2.2	1.8	2.7	3.1	3.1	3.1	2.7	2.7	4.0	3.6	4.9	4.9
30	2.7	3.1	2.7	2.7	2.2	1.8	1.8	1.3	.9	.9	2.2	4.0
31	2.7	2.2	2.2	2.7	2.7	2.7	99.9	99.9	99.9	99.9	99.9	99.9

DAY	13	14	15	16	17	18	19	20	21	22	23	24
1												
2	5.8	7.6	8.9	8.0	6.7	7.2	7.2	5.8	5.4	4.9	4.5	4.0
3	1.8	1.8	1.8	1.8	.9	1.3	1.3	2.2	3.6	5.4	4.5	4.5
4	3.1	3.6	6.3	5.4	5.8	3.6	2.7	2.2	3.6	3.6	3.6	2.7
5	2.2	1.8	2.2	1.8	1.8	1.3	1.8	2.2	2.7	2.2	2.7	2.7
6	1.8	2.2	3.1	3.6	3.6	3.1	1.8	1.8	2.2	2.7	2.2	1.3
7	1.3	2.2	2.7	3.1	4.9	5.4	4.5	3.6	1.8	2.2	1.8	2.7
8	3.1	4.0	4.0	3.6	3.1	2.7	2.7	2.2	1.8	2.7	2.2	1.3
9	11.6	10.3	8.9	6.7	8.5	7.6	8.5	7.2	5.8	5.4	6.7	9.8
10	9.8	8.0	9.4	9.4	12.1	11.2	8.0	8.5	7.2	7.2	7.6	5.8
11	5.8	4.5	4.9	3.6	4.5	3.6	2.7	1.3	1.8	1.8	1.3	1.3
12	1.8	2.2	3.1	3.1	3.1	4.0	3.1	1.8	1.3	.9	1.8	1.8
13	8.0	7.6	8.5	7.6	8.9	9.0	5.8	6.3	7.6	8.0	4.9	1.8
14	7.6	5.4	5.4	4.5	2.7	3.6	4.0	2.7	2.2	2.2	2.7	1.8
15	1.8	2.7	6.7	7.2	6.3	4.0	2.7	1.8	1.8	2.2	1.3	1.8
16	3.6	6.7	5.8	7.6	6.3	4.9	2.2	3.6	6.3	8.0	7.2	7.2
17	5.8	6.3	4.0	4.9	4.9	6.7	7.2	4.9	3.1	1.8	1.3	1.8
18	5.4	6.3	7.2	6.7	6.3	5.4	4.5	2.7	2.2	2.2	2.7	2.2
19	3.1	4.0	1.8	3.6	5.4	6.3	3.1	2.2	1.8	3.1	2.7	2.7
20	6.7	8.0	7.6	7.6	7.6	8.5	7.2	7.2	3.6	4.5	5.8	6.7
21	2.2	2.2	2.2	2.2	1.8	1.3	1.3	2.7	2.2	1.8	2.2	2.2
22	2.2	1.8	1.8	2.2	1.3	1.3	.9	2.2	2.7	3.1	2.7	3.1
23	1.8	3.1	5.8	6.7	6.7	5.4	4.0	3.6	3.1	1.3	3.1	3.6
24	7.6	7.6	8.0	7.2	7.6	6.3	7.6	8.0	8.9	9.4	8.9	7.6
25	7.2	4.5	5.8	6.7	4.9	4.5	4.5	3.6	2.2	4.5	2.2	.9
26	3.1	1.8	1.3	2.7	3.1	2.7	1.8	1.8	2.2	4.9	5.4	4.5
27	1.8	1.8	2.7	5.4	6.7	6.7	5.4	4.5	6.7	8.9	10.7	11.2
28	5.8	5.8	4.9	5.8	6.3	5.4	4.9	3.6	3.1	4.0	4.5	2.7
29	4.9	4.5	3.1	5.8	5.8	4.5	4.0	1.8	1.8	2.2	2.7	1.3
30	4.9	5.4	4.9	4.9	4.0	3.1	1.8	1.3	3.1	1.3	3.6	2.2
31	99.9	99.9	99.9	6.7	6.3	6.7	4.0	4.5	3.1	2.7	1.8	.9

TABLE C-23 (Continued)

APR 1977 WIND SPEED (M.P.S.)
ENERGY FUELS.HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1.8	2.2	99.9	99.9	99.9	99.9	1.8	.9	1.8	1.8	2.7	5.8	5.8	6.7	6.3	4.9	2.7	6.3	5.4	4.5	3.1	99.9	99.9	1.3
2	2.2	2.2	4.9	2.7	1.3	.9	1.8	1.8	3.1	2.2	1.8	1.8	1.3	2.2	4.0	2.7	3.1	1.8	3.1	5.8	3.6	4.5	4.9	4.9
3	4.9	5.4	5.4	4.5	4.5	3.6	4.0	3.6	4.5	5.4	5.8	8.0	7.2	5.4	5.4	4.5	4.0	8.5	8.9	4.5	6.7	5.4	4.9	4.5
4	4.5	4.9	4.0	3.6	.9	2.2	.9	.9	3.1	3.1	1.3	1.8	1.8	2.2	2.2	2.7	2.2	3.1	3.1	2.7	4.5	4.5	4.0	4.0
5	4.0	4.9	4.9	4.9	4.9	4.5	3.1	1.3	1.8	1.8	3.1	3.1	2.2	2.2	3.1	3.1	3.1	3.1	2.2	1.3	3.1	4.0	3.6	1.8
6	1.3	2.7	2.2	1.3	1.8	1.3	1.3	.9	1.8	2.7	1.8	1.8	2.2	2.2	3.1	2.7	4.0	4.5	4.0	3.1	1.8	2.7	3.1	2.7
7	1.8	2.2	2.2	1.8	1.8	2.7	2.2	.9	.9	1.3	1.3	1.8	2.7	2.2	3.6	5.4	6.3	5.8	4.9	4.0	3.6	2.2	2.7	1.8
8	2.2	1.3	2.7	2.7	3.1	1.3	1.3	.4	1.3	1.3	1.3	2.7	3.1	4.9	8.0	8.5	8.0	8.0	6.7	4.5	4.5	5.4	4.5	2.7
9	4.9	5.8	3.6	4.0	6.7	4.5	4.9	6.7	8.5	9.4	10.7	9.4	9.4	9.4	8.9	8.9	9.4	6.7	2.7	3.1	3.1	4.5	4.9	3.6
10	3.6	3.1	1.3	1.8	2.2	2.2	2.7	1.8	1.3	4.5	8.5	9.4	8.9	8.9	7.6	7.6	6.3	4.9	3.1	3.6	2.7	1.8	4.5	2.7
11	2.2	3.6	3.1	2.2	2.7	1.3	1.3	2.2	2.7	4.0	5.4	2.2	4.9	7.6	7.2	6.7	8.5	6.3	3.6	1.3	1.8	6.3	4.5	2.2
12	3.1	4.0	4.9	4.0	5.4	5.4	4.5	2.7	2.7	2.7	2.2	3.1	2.7	2.7	2.7	2.2	2.2	4.0	3.1	5.4	5.8	3.1	2.2	1.8
13	1.8	1.8	1.8	2.7	2.7	2.2	1.8	.9	2.2	1.3	1.8	2.2	3.6	3.6	4.0	4.0	4.9	4.9	3.6	2.2	2.2	3.6	3.6	4.0
14	4.5	3.6	2.2	4.0	3.6	2.2	.9	1.3	3.1	2.7	1.3	1.8	2.2	3.6	4.5	6.7	8.0	9.8	10.3	8.0	9.4	8.0	7.2	8.0
15	8.5	7.2	9.8	9.8	8.0	8.0	6.7	7.2	7.6	7.6	6.7	4.0	3.6	6.3	4.5	4.0	3.1	3.1	3.1	1.3	.9	1.8	3.1	1.3
16	.9	1.3	1.3	.9	1.3	1.8	.9	.9	1.8	1.8	2.2	2.7	2.7	3.1	2.7	2.7	2.2	1.8	1.3	1.8	2.7	3.6	2.2	2.2
17	1.3	2.7	1.3	1.8	2.2	2.2	.9	.4	1.3	1.3	1.8	3.1	3.6	4.0	4.5	4.9	6.3	4.5	4.5	4.9	6.7	5.8	4.0	2.2
18	2.7	4.5	4.5	5.4	2.7	.9	.9	1.3	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
19	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
20	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
21	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
22	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
23	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	1.8	3.6	5.8
24	6.3	7.6	8.0	8.0	8.0	8.0	9.4	8.9	8.5	8.0	7.6	6.7	6.3	6.7	5.4	4.5	5.4	6.7	4.9	4.0	4.5	7.6	4.9	3.6
25	2.2	3.1	1.8	6.7	7.2	8.0	4.5	4.0	3.1	2.2	2.7	2.2	2.2	3.1	4.9	5.4	5.4	5.4	4.9	4.9	5.4	5.8	6.3	5.4
26	4.0	3.1	3.6	3.6	4.5	3.6	3.6	3.1	2.7	3.6	4.9	4.0	5.4	4.9	4.5	4.9	4.9	4.9	1.3	.9	1.3	1.3	.9	.9
27	.9	1.3	2.2	2.2	2.2	2.2	3.6	4.5	5.4	5.8	4.5	4.0	3.6	2.7	2.2	2.2	1.8	1.3	1.3	2.2	1.8	1.3	.9	.9
28	1.8	1.8	1.3	1.3	1.8	1.8	1.8	2.7	3.1	3.1	3.1	3.6	2.7	2.2	1.8	2.2	2.7	3.1	4.9	5.8	6.3	2.7	1.3	1.3
29	1.8	1.3	1.3	2.7	2.2	2.7	2.2	.9	1.8	3.1	2.2	1.8	2.2	2.2	2.2	2.7	2.2	2.7	4.0	4.5	4.0	4.5	4.5	3.1
30	1.8	1.3	2.2	2.2	1.8	2.2	2.2	1.3	.4	1.3	1.3	3.1	6.7	8.9	7.6	7.6	8.0	7.6	5.4	5.8	4.9	4.9	4.0	2.2

TABLE C-23 (Continued)

MAY 1977 WIND SPEED (M.P.S.)
ENERGY FUELS-HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	3.1	4.5	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
2	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
3	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
4	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	3.6	6.3	6.3	6.3	6.3	3.6	4.0	3.6
5	3.6	3.6	5.4	6.3	7.2	4.9	4.5	1.8	4.9	10.7	12.5	13.0	12.1	9.4	10.3	10.3	9.4	9.4	8.5	8.5	6.7	5.4	4.5	6.7
6	5.8	8.0	7.6	8.5	7.6	7.6	7.6	6.7	8.0	8.0	8.0	6.7	6.7	7.6	8.0	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
7	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
8	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	8.5	10.3	10.3	11.6	8.0	6.7	7.6	9.4	5.8	5.4
10	6.7	8.5	9.4	8.0	6.3	3.1	3.1	4.5	3.1	3.6	4.5	99.9	6.7	5.8	5.8	6.7	7.2	7.6	6.7	6.7	5.4	3.6	3.1	2.7
11	1.8	1.3	2.7	2.2	2.7	1.8	.9	1.3	1.8	1.3	7.6	9.4	9.8	9.8	8.9	8.0	7.6	6.7	6.3	2.7	2.7	3.1	2.7	1.8
12	2.7	3.6	2.7	1.3	3.1	2.2	1.8	99.9	7.6	8.9	7.2	8.0	8.0	8.5	8.0	4.9	3.6	8.5	6.3	9.4	99.9	99.9	99.9	99.9
13	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
14	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
15	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
16	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
17	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
18	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
19	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
20	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
21	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
22	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
23	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
24	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
25	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
26	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
27	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
28	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
29	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
30	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
31	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9

TABLE C-23 (Continued)

JUN 1977 WIND SPEED (M.P.S.)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
2	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
3	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
4	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
5	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
6	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9
7	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	4.5	5.8	6.7	4.5	3.1	3.1	3.1	3.6	6.3	8.5	4.9
8	5.4	6.3	4.9	3.1	3.6	2.7	2.7	3.1	3.1	1.8	4.5	3.6	3.6	3.1	2.2	3.6	4.0	6.3	11.2	6.7	2.2	1.3	.4	.9
9	.9	2.2	2.2	2.2	1.8	2.2	4.5	5.8	6.0	8.5	9.4	10.3	9.8	4.9	11.6	8.0	5.8	5.4	7.2	6.7	5.4	5.8	6.3	4.9
10	2.2	2.7	2.7	1.8	2.2	1.3	1.8	2.2	2.7	4.9	6.7	8.0	8.0	8.0	7.2	7.2	6.3	6.3	5.4	3.1	3.6	4.0	4.0	3.6
11	1.8	1.3	1.3	1.3	1.8	2.7	1.8	1.3	1.8	4.5	7.6	6.7	6.3	8.5	8.5	7.6	6.7	7.2	6.7	4.5	1.8	.9	1.3	3.6
12	5.8	5.8	4.0	2.7	1.3	2.2	2.2	3.1	2.2	2.2	2.2	3.1	5.4	5.8	6.7	6.3	8.0	7.6	7.6	5.8	2.7	2.2	1.3	.9
13	1.8	3.6	2.7	3.1	2.7	2.2	.9	1.8	1.3	2.2	5.8	10.3	9.8	8.0	8.0	8.0	8.0	7.6	6.3	5.4	4.9	3.6	2.7	2.2
14	2.7	1.3	1.3	1.8	.9	.9	1.8	2.2	4.5	8.0	8.5	9.8	9.4	8.0	8.5	7.2	7.6	6.3	3.6	2.7	4.0	4.5	4.9	4.9
15	2.7	1.3	1.3	2.2	.9	2.2	1.3	.9	1.3	2.2	2.7	4.9	7.2	6.3	6.7	5.4	5.8	5.4	5.8	4.9	4.5	4.5	4.9	1.8
16	3.6	3.6	3.1	.9	1.3	1.3	.9	.9	.9	1.8	2.2	2.2	2.7	3.1	2.7	2.2	3.1	5.4	5.8	5.8	6.3	4.9	2.2	2.7
17	2.2	2.2	.9	1.3	1.8	1.3	.9	.9	1.3	2.7	3.1	6.3	7.6	6.7	99.9	6.7	6.7	6.3	6.7	6.7	4.9	4.5	5.8	8.0
18	6.3	2.2	1.3	2.2	2.2	2.2	.9	1.3	1.3	1.8	1.8	2.7	2.7	3.6	5.8	3.1	5.8	8.5	8.0	7.2	6.7	5.4	3.1	1.8
19	3.6	2.2	1.8	1.8	2.2	1.8	1.3	4.5	4.5	6.3	8.5	8.9	8.9	9.4	8.5	7.6	9.0	6.7	7.2	6.3	3.6	3.6	4.5	3.6
20	6.3	7.6	6.3	3.6	2.7	1.8	1.8	1.8	4.0	4.5	4.0	5.8	6.7	7.2	8.0	7.6	7.2	7.6	6.3	5.8	4.0	1.8	1.8	1.8
21	3.1	4.0	4.0	3.1	3.1	4.0	4.0	4.0	3.6	2.2	1.8	1.8	2.7	3.1	3.1	3.6	3.1	3.1	3.1	6.3	4.5	3.6	3.1	2.7
22	1.3	1.3	3.1	3.1	3.6	3.1	2.7	2.7	2.7	2.2	1.3	1.3	1.8	1.8	1.8	1.3	1.8	1.8	1.8	1.3	1.3	1.8	3.1	3.6
23	4.0	3.1	3.1	3.1	1.8	.9	1.3	.9	1.8	1.8	1.8	1.8	2.2	2.2	2.7	2.7	2.7	2.7	2.7	2.7	1.3	1.3	3.6	4.5
24	2.7	5.8	6.3	5.8	2.2	.9	.9	1.8	5.8	4.5	3.1	2.2	2.2	2.2	2.7	2.7	4.5	8.9	4.5	2.7	1.3	2.7	6.3	5.8
25	6.3	6.3	6.3	5.8	3.6	1.3	1.3	2.2	2.2	1.8	1.3	1.8	2.2	2.7	4.5	12.1	8.0	3.6	6.3	6.3	4.0	3.1	2.7	2.7
26	3.6	3.6	1.8	1.3	1.3	2.2	1.3	.9	1.3	1.8	2.7	1.8	2.7	2.7	2.2	2.7	4.0	4.5	5.8	4.9	4.9	5.8	6.3	4.9
27	2.2	2.2	1.8	1.3	1.3	1.8	2.2	1.3	.4	1.3	1.3	1.3	1.8	2.7	3.1	4.5	4.0	4.9	7.6	4.9	4.0	4.5	3.6	3.6
28	3.1	4.0	4.9	4.9	4.5	3.1	1.8	1.8	2.7	2.2	2.7	1.8	2.7	2.7	2.7	3.1	3.6	3.6	5.8	6.3	6.3	4.5	4.9	4.9
29	4.5	5.4	5.4	5.4	4.5	4.5	4.5	3.6	3.6	3.6	4.0	3.6	3.1	1.8	1.8	3.6	1.8	6.3	7.2	6.7	5.8	5.4	3.6	4.5
30	3.6	3.6	2.7	3.6	.9	1.3	1.3	.4	1.3	1.3	1.8	2.2	2.2	4.0	5.8	6.3	5.8	5.8	5.8	5.4	4.0	5.4	4.9	3.6

TABLE C-23 (Continued)

JUL 1977 WIND SPEED (M.P.S.)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	2.7	3.1	3.1	1.3	5.8	5.8	2.7	1.3	2.2	3.1	3.6	4.5	8.5	8.9	3.1	4.5	3.1	6.3	5.4	4.9	3.6	1.8	2.7	1.8
2	1.3	4.5	3.6	2.7	2.7	.9	1.8	.9	1.3	1.3	2.7	3.6	3.6	5.8	6.7	6.7	6.3	5.8	5.8	4.5	6.3	8.9	7.2	6.7
3	8.0	7.6	6.7	3.6	1.8	1.3	.4	1.3	1.3	1.8	3.1	2.7	3.1	11.6	13.4	9.4	9.8	6.3	4.9	2.7	2.7	2.7	2.2	2.7
4	5.4	3.6	5.8	8.0	8.0	8.0	8.0	5.8	5.4	3.6	1.3	2.7	4.0	5.8	3.1	3.6	2.7	5.8	8.9	9.4	9.8	7.6	8.0	3.1
5	.9	1.3	1.3	2.2	2.2	2.2	1.3	.9	1.3	1.8	4.9	5.8	3.6	6.3	5.8	4.9	4.5	5.8	4.5	4.5	5.4	4.5	2.7	1.8
6	1.8	.9	1.3	1.8	2.2	2.2	1.3	3.1	2.2	2.7	2.7	2.2	3.1	3.1	3.6	4.5	6.3	99.9	99.9	4.5	4.9	6.7	6.3	3.6
7	1.8	2.2	2.7	2.2	2.7	4.0	4.5	3.6	3.6	4.5	2.7	1.3	1.8	2.2	2.7	3.1	3.6	3.6	4.0	4.0	2.7	2.7	3.6	3.1
8	3.1	4.5	4.5	3.6	1.8	2.2	3.6	3.6	4.9	3.6	1.3	1.3	2.2	1.8	1.8	1.3	1.3	1.3	2.2	2.7	5.8	8.9	9.4	8.9
9	7.6	6.7	5.8	4.0	3.6	3.6	3.1	6.3	5.8	3.1	1.3	2.2	2.7	1.3	1.8	3.6	7.6	8.0	6.7	7.2	7.6	8.0	8.5	6.7
10	5.8	6.7	7.2	7.6	7.2	7.6	6.7	5.8	4.5	3.6	4.5	5.8	4.5	1.8	5.4	6.7	7.6	6.3	6.7	6.3	4.9	5.8	4.5	4.5
11	4.5	3.6	5.4	5.8	6.3	6.7	6.3	7.2	5.8	6.3	5.4	4.9	6.3	7.6	7.6	6.7	4.5	3.6	3.6	1.8	2.7	1.3	.9	2.7
12	1.8	2.2	1.8	6.7	8.0	5.8	3.6	2.2	2.7	4.0	5.8	6.7	7.2	7.2	6.3	5.4	5.4	4.5	3.1	3.6	2.2	1.8	1.8	1.8
13	3.1	3.6	1.8	2.2	4.0	3.6	3.1	4.9	4.5	5.4	4.5	6.7	7.2	7.2	6.7	7.6	7:6	7.2	6.7	4.5	4.5	2.7	1.8	1.8
14	1.3	5.4	5.8	6.3	6.3	6.7	5.8	6.7	5.4	5.8	5.8	4.9	6.3	5.8	6.3	4.5	6.7	4.0	5.4	4.0	3.6	4.5	3.6	2.2
15	3.1	1.8	2.2	1.3	1.8	.9	1.8	1.8	.9	.4	1.3	1.8	1.8	1.3	2.2	2.2	2.2	3.1	3.6	3.1	3.1	4.5	5.8	5.8
16	4.9	4.9	4.9	6.7	6.7	5.8	5.8	6.3	3.6	2.2	2.7	2.2	1.3	1.3	1.8	1.3	2.7	3.1	3.1	3.6	4.0	6.7	4.9	2.7
17	3.6	3.6	2.7	4.0	4.0	4.5	5.8	5.4	4.9	6.3	8.5	7.6	6.7	5.8	4.9	4.5	4.5	3.6	3.1	2.7	1.8	1.3	2.2	2.7
18	2.2	2.7	1.3	.4	.4	1.3	1.8	4.5	2.2	1.8	1.3	.9	1.3	2.7	2.7	3.6	4.0	2.7	2.7	2.2	1.3	3.1	4.9	3.1
19	3.6	4.0	4.0	5.4	5.4	2.7	1.3	1.3	.9	2.2	1.8	2.2	2.2	3.1	4.5	3.1	2.7	4.5	5.4	3.1	2.7	2.7	2.7	2.7
20	3.6	2.2	2.2	1.3	2.2	1.8	1.3	.9	.9	1.8	1.3	1.8	1.8	2.2	2.7	2.7	4.5	11.6	9.4	6.3	4.0	3.1	4.0	4.5
21	4.5	2.2	3.1	4.9	1.8	1.3	2.2	1.8	2.2	1.3	1.8	4.0	3.1	4.0	4.5	4.5	4.0	2.2	8.5	4.9	4.9	2.2	3.6	5.4
22	8.0	8.5	5.4	2.7	2.7	3.1	1.3	.4	.9	.9	1.3	1.8	3.1	3.6	3.6	2.7	2.2	2.7	1.8	1.3	1.3	2.2	3.1	3.1
23	8.5	10.7	8.5	5.8	3.1	2.2	2.7	.4	.9	.9	1.3	1.3	1.8	2.2	2.7	3.1	4.0	4.0	3.6	3.6	4.5	3.1	2.2	2.2
24	2.7	7.2	5.8	2.7	3.1	2.7	3.1	2.7	2.2	.9	1.3	1.8	4.0	5.8	4.9	1.3	3.6	1.3	1.3	.9	.9	3.1	4.5	5.8
25	5.4	4.0	4.9	4.5	2.7	.4	.9	1.3	3.1	2.7	2.2	2.2	3.1	3.1	3.1	3.1	3.1	3.1	2.7	1.8	1.8	2.2	3.1	2.2
26	2.2	1.8	1.8	2.7	1.8	.9	1.3	1.3	.9	1.3	1.3	1.8	2.7	2.7	3.1	3.6	2.7	1.3	1.3	2.2	4.5	1.3	3.6	4.5
27	5.8	6.7	8.0	7.6	6.3	6.3	4.0	4.0	4.5	5.4	4.9	4.9	4.9	3.6	2.7	3.6	3.6	3.6	4.0	3.1	2.2	4.5	3.1	3.1
28	3.6	4.5	4.5	5.8	5.8	4.5	4.5	3.6	3.1	2.7	1.8	1.8	1.3	1.8	1.8	2.2	2.2	2.2	1.8	1.3	1.8	3.1	1.8	1.8
29	2.7	2.2	1.3	2.2	2.7	1.8	1.8	1.8	1.3	1.3	1.8	2.2	2.7	1.8	1.8	4.5	7.2	5.8	5.4	5.4	5.4	2.7	4.0	4.0
30	4.0	2.2	1.3	4.5	7.6	7.6	6.3	4.0	2.7	3.1	3.6	3.1	2.7	3.1	3.1	4.5	6.3	8.0	8.5	8.0	6.7	6.3	5.4	4.9
31	5.4	6.3	4.0	4.5	4.9	4.9	3.1	1.3	1.3	3.6	3.1	3.6	4.0	4.0	4.0	4.0	3.1	3.6	1.8	2.2	1.8	4.0	5.4	5.4

TABLE C-23 (Concluded)

AUG 1977 WIND SPEED (M.P.S.)
ENERGY FUELS, HANKSVILLE, UTAH

HOUR OF THE DAY

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	4.9	4.5	4.5	4.0	4.0	4.5	4.5	3.1	2.2	3.1	2.7	2.2	1.8	3.1	2.7	2.7	3.1	3.1	2.2	.4	1.8	4.0	4.5	4.0
2	3.1	4.5	4.9	4.5	1.3	.9	.4	.9	3.1	4.0	2.7	2.7	2.2	1.8	2.2	2.2	2.2	2.2	1.8	1.3	2.2	3.1	2.7	3.6
3	1.3	.9	1.3	1.8	2.7	2.2	1.3	1.3	4.0	4.5	3.6	4.0	4.0	3.6	1.8	3.6	6.3	4.0	1.8	3.6	4.9	6.7	6.7	2.2
4	2.2	5.8	6.3	4.9	3.6	2.7	1.8	3.6	3.6	3.1	3.6	3.1	2.2	2.2	2.7	2.2	2.2	4.5	5.8	9.4	7.6	5.8	5.8	7.2
5	4.0	8.5	8.0	6.3	4.5	3.1	2.2	2.2	3.1	1.8	1.3	.9	1.3	1.3	1.8	2.2	2.2	2.2	2.2	3.1	4.0	2.7	2.2	2.7
6	1.8	1.3	3.1	4.0	4.9	5.4	5.8	5.8	6.3	4.0	1.8	1.8	1.3	.4	1.3	1.8	4.0	5.4	3.6	4.5	4.5	4.5	4.9	5.8
7	7.2	7.2	7.2	7.2	5.8	5.8	4.9	5.8	7.6	5.8	4.9	4.9	2.7	3.1	1.8	1.3	1.8	2.2	3.6	3.1	5.4	5.4	6.3	7.2
8	7.2	6.7	6.3	5.8	5.4	5.4	4.0	4.5	4.0	2.2	1.3	3.6	3.1	4.5	3.1	3.1	3.1	.9	.9	1.3	1.8	2.2	2.7	2.2
9	2.7	2.7	2.2	3.1	3.1	3.1	2.7	1.3	3.1	3.6	4.0	4.5	4.9	2.7	.9	1.3	1.8	1.8	2.7	1.8	.9	.9	1.3	1.8
10	1.8	3.1	2.7	2.2	2.7	2.2	2.7	2.2	1.8	2.7	4.0	3.6	1.8	1.3	1.3	2.2	1.8	.9	.4	.9	.9	.9	.9	1.3
11	4.0	3.6	4.0	4.5	5.4	5.8	4.0	6.3	6.9	8.0	4.5	3.1	1.8	3.1	3.6	2.7	1.8	1.3	.4	.9	1.8	1.8	1.3	2.2
12	1.3	1.3	2.2	1.8	1.3	1.8	2.2	1.8	1.8	2.7	4.0	5.8	4.0	3.1	1.8	2.7	3.6	4.5	6.7	7.6	7.6	5.4	5.4	4.9
13	5.4	4.5	4.5	4.5	3.1	2.2	2.7	3.6	3.6	3.6	3.1	3.1	2.7	2.2	5.8	4.9	3.1	1.8	.9	1.8	2.2	2.2	2.7	1.8
14	1.3	2.7	4.0	4.0	4.5	2.7	2.2	1.3	1.8	6.3	4.5	2.2	1.3	2.2	3.6	8.5	11.6	8.9	7.6	4.0	4.5	5.8	5.4	7.2
15	8.0	8.9	8.0	7.2	5.8	5.4	4.5	3.6	3.6	4.5	3.1	4.5	7.2	5.8	3.1	2.7	3.1	2.7	2.7	3.1	1.3	1.3	2.7	2.2
16	2.7	1.8	1.8	1.3	.9	1.8	1.8	1.8	1.8	1.8	1.8	3.1	4.9	5.8	5.8	4.9	4.9	4.9	4.0	2.7	1.3	.9	1.3	1.3
17	.9	2.2	4.5	4.0	4.5	4.9	5.8	5.8	5.4	99.9	4.5	5.4	4.5	3.1	1.8	2.7	3.1	2.2	1.8	1.8	1.8	1.8	1.3	2.2
18	2.7	2.7	2.7	3.1	1.8	1.3	1.3	.9	.9	1.3	.9	1.3	.9	1.8	1.3	1.8	1.8	1.8	1.8	5.4	3.1	2.7	2.7	1.8
19	4.5	4.9	2.2	2.7	4.0	3.6	3.1	1.8	1.3	.9	1.3	1.8	3.1	3.6	2.7	1.8	3.1	3.1	2.7	2.2	1.8	1.8	2.2	2.2
20	1.8	2.2	1.8	2.2	1.8	3.6	4.0	5.8	5.4	5.4	1.8	1.8	1.3	1.8	2.2	2.7	2.2	2.7	2.7	1.8	1.8	1.8	1.3	2.2
21	1.8	2.7	2.2	1.8	2.7	2.7	2.2	5.4	4.9	4.5	4.5	3.6	3.6	2.2	2.7	2.2	1.3	3.6	3.1	2.2	1.3	.9	1.3	2.2
22	2.2	1.8	2.2	2.2	2.2	2.2	4.9	4.0	3.6	1.8	2.7	3.1	2.7	2.2	1.3	1.3	2.7	3.1	.9	.9	.9	1.3	1.3	1.8
23	1.3	1.3	2.2	1.8	1.8	2.2	2.2	10.7	6.5	8.0	6.3	4.9	4.9	3.6	6.7	5.4	4.5	4.0	3.1	2.2	1.3	1.3	1.8	3.6
24	2.2	1.8	2.7	1.3	.4	1.3	1.8	2.2	3.1	2.7	3.1	5.8	7.6	8.0	7.6	5.8	4.9	3.1	3.1	5.9	4.9	6.3	8.0	6.7
25	5.4	5.8	7.6	7.2	6.3	5.8	5.8	6.7	7.6	6.3	7.2	7.6	8.9	7.6	8.9	8.5	8.5	6.7	5.4	6.7	8.0	8.0	4.5	3.6
26	3.6	4.0	2.7	1.3	1.3	1.3	2.2	2.2	1.8	.9	.9	.9	1.8	2.2	3.1	3.1	9.4	9.4	9.4	9.4	9.4	9.4	10.3	8.9
27	8.9	7.2	4.9	2.7	2.2	3.1	5.8	3.1	6.9	8.9	8.0	9.8	8.5	3.1	2.7	2.7	7.6	10.3	9.4	8.5	8.5	8.0	8.0	6.7
28	7.2	8.0	9.8	9.8	8.5	7.6	7.6	7.2	8.0	8.0	2.7	2.2	1.8	1.3	1.8	3.6	3.1	2.2	2.7	3.1	2.7	1.8	2.2	2.2
29	2.7	2.7	3.1	2.2	2.2	2.2	1.8	1.8	1.8	1.8	1.8	1.8	3.1	2.7	2.2	1.8	2.2	1.8	1.3	.9	1.3	1.3	1.3	1.8
30	1.8	1.8	2.7	2.7	2.7	3.1	1.8	2.2	2.2	2.2	1.3	2.2	1.8	2.7	3.1	4.0	2.7	2.2	.4	1.3	2.7	1.8	1.8	2.2
31	.9	1.8	1.3	1.3	1.8	2.2	2.2	2.2	2.7	3.1	[illegible]	5.4	5.8	5.8	4.9	4.5	3.6	3.6	2.7	2.7	2.2	2.2	2.7	1.3

APPENDIX D

VERTEBRATE SPECIES LIST

APPENDIX D

VERTEBRATE SPECIES LIST[1]

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
AMPHIBIANS & REPTILES		
Order-Caudata-Salamanders Family-Ambystomidae		
Ambystoma tigrinum	Tiger Salamander	B
Order-Anura-Frogs & Toads Family-Pelobatidae		
Scaphiopus intermontanus	Great Basin Spadefoot	B,H
Family-Bufonidae		
Bufo woodhousei	Woodhouse's Toad	B,H
Bufo punctatus	Red Spotted Toad	B
Family-Hylidae		
Hyla arenicolor	Canyon Treefrog	B
Family - Ranidae		
Rana pipiens	Leopard Frog	B
Order-Squamata-Lizards & Snakes		
Family - Iguanidae		
Crotaphytus collaris	Collared Lizard	B
C. wislizenii	Leopard Lizard	B,H
Holbrookia maculata	Lesser Earless Lizard	B
Phrynosoma douglassi	Short-Horned Lizard	B,H
Sceloporus graciosus	Sagebrush Lizard	B,H
S. magister	Desert Spiny Lizard	B
S. undulatus	Eastern Fence Lizard	B,H
Urosaurus ornatus	Tree Lizard	B,H
Family-Teiidae		
Uta stansburiana	Side-Blotched Lizard	B,H
Cnemidophorus velox	Plateau Whiptail	B
C. tigris	Western Whiptail	B,H

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Family-Colubridae		
Hypsiglena torguata	Night Snake	B,H
Masticophis taeniatus	Striped Whipsnake	B,H
Pituophis melanoleucas	Gopher Snake	B,H
Thamnophis elegans	Western Terrestrial Garter Snake	B,H
Family-Crotalidae		
Crotalus viridis	Western Rattlesnake	B,H
BIRDS		
Order-Anseriformes-Waterfowl Family-Anatidae-Swans, Geese, Ducks		
Anas platyrhynchos	Mallard	B
Anas strepera	Gadwall	B
Anas acuta	Pintail	B
Anas crecca	Green-winged Teal	B
Anas discors	Blue-winged Teal	B
Anas americana	American Widgeon	B
Anas clypeata	Northern Shoveler	B
Aythya americana	Redhead	B
Aythya valisineria	Canvasback	B
Aythya affinis	Lesser Scaup	B
Mergus serrator	Red-breasted Merganser	B
Order-Falconiformes-Vultures, Hawks, Kites, Falcons, and Eagles Family-Cathartidae-American Vultures		
Cathartes aura	Turkey Vulture	B,H
Family Accipitridae-Kites, Hawks, Eagles and Harriers		
Buteo jamaicensis	Red-tailed Hawk	B,H
Buteo lagopus	Rough-legged Hawk	B,H
Buteo swainsoni	Swainson's Hawk	B,H
Buteo regalis	Ferruginous Hawk	B,H
Aquila chrysaetos	Golden Eagle	
Haliaeetus leucocephalus	Bald Eagle	B,H
Circus cyaneus	Marsh Hawk (Harrier)	B,H

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Family-Falconidae-Caracaras and Falcons		
Falco mexicanus	Prairie Falcon	B,H
Falco columbarius	(Merlin) Pigeon Hawk	B,H
Falco peregrinus	Peregrine Falcon	B
Falco sparverius	American Kestrel	B,H
Order Galliformes-Grouse, Pheasants, Ptarmigans, Prairie Chickens, Quail, and Turkeys		
Family Tetraonidae-Grouse and Ptarmigans		
Centrocercus urophasianus	Sage Grouse	B
Phaisanus colchicus	Ring-necked Pheasant	B
Lophortyx gambelii	Gambel's Quail	B
Callipepla squamata	Scaled Quail	B
Order Gruiformes-Cranes Rails, and Allies		
Family Rallidae-Rails, Gallinules and Coots		
Fulica americana	American Coot	B
Order Charadriiformes-Shorebirds, Gulls and Allies		
Family Charadriidae-Plovers, Turnstones and Surfbirds		
Charadrius vociferus	Killdeer	B
Family Scolopacidae-Woodcock, snipe and Sandpipers		
Actitus macularia	Spotted Sandpiper	B
Order Columbiformes-Pigeons and Doves		
Family Columbidae-Pigeons and Doves		
Coluba livia	Rock Dove	B
Columba fasciata	Band-tailed Pigeon	B
Zenaida macroura	Mourning Dove	B,H
Order Strigiformes -Owls		
Family Tytonidae-Barn Owls		
Tyto alba	Barn Owl	B,H

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Family Strigidae-Typical Owls		
Otus asio	Screech Owl	B,H
Bubo virginianus	Great Horned Owl	B
Speotyto cunicularia	Burrowing Owl	H
Asio otus	Long-eared Owl	B
Aegolius acadicus	Saw-whet Owl	B
Order Caprimulgiformes-Goatsuckers		
Family Caprimulgidae-Goatsuckers		
Phalaenoptilus nuttallii	Poor-will	B,H
Chordelies minor	Common Nighthawk	B
Order Apodiformes - Swifts and Hummingbirds		
Family Apodidae-Swifts		
Aeronautes saxatalis	White-throated Swift	B
Family Trochilidae-Hummingbirds		
Archilochus alexandri	Balck-chinned Hummingbird	B
Selasphorus rufus	Rufous Hummingbird	B,H
Order Piciformes-Woodpeckers, Flickers, and Sapsuckers		
Family Picidae-Woodpeckers, Flickers, and Sapsuckers		
Colaptes auratus	Common Flicker	B
Sphyrapicus varius	Yellow-bellied Sapsucker	B
Dendrocopos villosus	Hairy Woodpecker	B
Dendrocopos pubescens	Downy Woodpecker	B
Order Passeriformes-Perching Birds		
Family Tyrannidae-Tryant Flycatchers		
Tyrannus verticalis	Western Kingbird	B
Tyrannus vociferans	Cassin's Kingbird	B
Myiarchus cinerascens	Ash-throated Flycatcher	B,H
Sayornis saya	Say's Phoebe	B,H
Empidonax wrightii	Gray Flycatcher	B
Contopus sordidulus	Western Wood Pewee	B
Family Alaudidae-Larks		

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Eremophila alpestris	Horned Lark	B,H
Family Hirundinidae-Swallows		
Tachycineta thalassina	Violet-green Swallow	B
Riparia riparia	Bank Swallow	B,H
Stelgidopteryx ruficollis	Rough-winged Swallow	B,H
Hirundo rustica	Barn Swallow	B
Petrochelidon pyrrhonota	Cliff Swallow	B
Family Corvidae-Jays, Magpies, and Crows		
Aphelocoma coerulescens	Scrub Jay	B
Pica pica	Black-billed Magpie	B
Corvus corax	Common Raven	B,H
C. brachyrhynchos	Common Crow	B,H
Gymnorhinus cyanocephalus	Pinyon Jay	B
Family Paridae-Chickadees, Titmice, Verdins,		
Parus gambeli	Mountain Chickadee	B
Parus inornatus	Plain Titmouse	B
Psaltriparus minimus	Bushtit	B
Family Troglodytidae-Wrens		
Thryomanes bewickii	Bewick's Wren	B
Catherpes mexicanus	Canyon Wren	B,H
Salpinctes obsoletus	Rock Wren	B,H
Family Mimidae-Mockingbirds and Thrashers		
Mimus polyglottos	Mockingbird	H
Toxostoma bendirei	Bendire's Thrasher	B
Oreoscoptes montanus	Sage Thrasher	B,H
Family Turdidae-Thrushes, Solitaires, and Bluebirds		
Turdus migratorius	American Robin	B
Sialia mexicana	Western Bluebird	B
Sialia currucoides	Mountain Bluebird	B
Family Sylviidae-Arctic Warblers, Kinglets, Gnat-catchers		
Regulus calendula	Ruby-crowned Kinglet	B
Polioptila caerulea	Blue-gray Gnatcatcher	B

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
P. melanura	Black-tailed Gnat-catcher	B
Family Motacillidae-Pipits		
Anthus spinoletta	Water Pipit	H
Family Laniidae-Shrikes		
Lanius excubitor	Northern Shrike	B,H
Lanius ludovicianus	Loggerhead Shrike	B,H
Family Sturnidae-Starlings		
Sturnus vulgaris	Starling	B
Family Parulidae-Wood Warblers		
Dendroica nigrescens	Black-Throated Gray Warbler	B
Dendroica coronata auduboni	Audubon's Warbler	B
Family Ploceidae-Weaver Finchs		
Passer domesticus	House Sparrow	B,H
Family Icteridae-Meadowlarks, Blackbirds, and Orioles		
Sturnella neglecta	Western Meadowlark	B,H
Agelaius phoeniceus	Red-winged Blackbird	B,H
Icterus galbula	Northern Oriole	B,H
Eugphagus cyanocephalus	Brewer's Blackbird	B,H
Molothrus ater	Brown-headed Cowbird	B,H
Family Fringillidae-Grosbeaks, Sparrows, Finches and Buntings		
Guiraca caerulea	Blue Grosbeak	B,H
Carpodacus mexicanus	House Finch	B,H
Leucosticte tephrocotis	Gray-crowned Rosy Finch	B,H
Spinus tristis	American Goldfinch	B,H
Chlorura chlorura	Green-tailed Towhee	B
Pipilo erythrophthalmus	Rufous-sided Towhee	B
Spinus pinus	Pine Siskin	B
Passerculus sandwichensis	Savannah Sparrow	B
Pooecetes gramineus	Vesper Sparrow	B
Chondestes grammacus	Lark Sparrow	B
Amphispiza bilineata	Black-throated Sparrow	B,H
Amphispiza belli	Sage Sparrow	B,H
Junco caniceps	Gray-headed Junco	B
Junco hyemalis oreganus	Oregon Junco	B,H
Spizella arborea	Tree Sparrow	B

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Spizella passerina	Chipping Sparrow	B
Spizella breweri	Brewer's Sparrow	B,H
Zonotrichia leucophrys	White-crowned Sparrow	B,H
Melospiza lincolnii	Lincoln's Sparrow	B,H
Melospiza melodia	Song Sparrow	B,H
Order Insectivora-Insectivores		
Family Soricidae-Shrews		
Sorex merriami	Merriam Shrew	B
Notiosorex crawfordi	Desert Shrew	H
Order Chiroptera-Bats		
Family Vespertilionidae-Plain-nose Bats		
Myotis lucifugus	Little Brown Bat	B,H
Myotis yumanensis	Yuma Bat	H
Myotis thysanodes	Fringed Myotis	B,H
Lasionycteris noctivagans	Silver-haired Bat	B
Pipistrellus hesperus	Western Pipistrelle Bat	B,H
Eptesicus fuscus	Big Brown Bat	B
Lasiurus borealis	Red Bat	B
L. cinereus	Hoary Bat	B,H
Plecotis rafinesquei	Western Long-eared Bat	B,H
Plecotis phyllotis	Mexican Big-eared Bat	B
Euderma maculatum	Spotted Bat	B,H
Antrozous pallidus	Pallid Bat	B,H
Family Molossidae-Freetail Bats		
Tadarida brasiliensis	Mexican Freetail Bat	B,H
Order Lagomorpha-Pikas, Hares, Rabbits		
Family Leporidae-Hares and Rabbits		
Lepus californicus	Blacktail Jackrabbit	B,H
Sylvilagus audubonii	Desert Cottontail	B,H
Order Rodentia-Rodents		
Family Sciuridae-Squirrels, Prairie Dogs		
Cynomys gunnisoni zuniensis	Zuni Prairie Dog	B
Spermophilus spilosoma	Spotted Ground Squirrel	B
Spermophilus variegatus	Rock Squirrel	B
Ammospermophilus leucurus	Whitetail Antelope Squirrel	B,H
Eutamias minimus	Least Chipmunk	B,H
Eutamias dorsalis	Cliff Chipmunk	B
Eutaminas quadrivittatus	Colorado Chipmunk	B

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Family Heteromyidae-Pocket Mice, Kangaroo Mice and Kangaroo Rats		
Perognathus flavus	Silky Pocket Mouse	B
Perognathus parvus	Great Basin Pocket Mouse	H
Dipodomys ordi	Ord Kangaroo Rat	B,H
Dipodomys merriami	Merriam Kangaroo Rat	B,H
Family Cricetidae-Native Rats and Mice		
Reithrodontomys megalotis	Western Harvest Mouse	B,H
Peromyscus crinitus	Canyon Mouse	B,H
Peromyscus maniculatus	Deer Mouse	B,H
Peromyscus boylii	Brush Mouse	B
Permoyscus truei	Pinyon Mouse	B
Onychomys leucogaster	Northern Grasshopper Mouse	B,H
Neotoma mexicana	Mexican Wood Rat	B
Neotoma lepida	Desert Wood Rat	H
Lagurus curtatus	Sagebrush Vole	B,H
Order Carnivora-Carnivores Family Canidae-Foxes, Coyotes		
Canis latrans	Coyote	B,H
Vulpes vulpes	Red Fox	B,H
Urocyon cinereoargenteus	Gray Fox	B,H
Family Procyonidae-Racoons and Ringtailed Cats		
Bassariscus astutus	Ringtailed Cat	B,H
Family Mustelidae-Weasels, Skunks, etc.		
Mustela frenata	Longtail Weasel	B,H
Taxidea taxus	Badger	B,H
Mephitis mephitis	Striped Skunk	B,H
Spilogale putorius	Spotted Skunk	B
Family Felidae-Cats		
Lynx rufus	Bobcat	B,H
Felis concolor	Mountain Lion	B
Order Artiodactyla-Even-toed Ungulates Family Cervidae-Deer and Allies		
Odocoileus hemionus	Mule Deer	B

Scientific Name	Common Name	Potentially Present B = Blanding, H = Hanksville
Family Antilocapridae-Pronghorn Antelope		
Antilocapra americana	Pronghorn Antelope	H

[1] Derived from the following sources:

A.O.U. (1957)
Behle, et al. (1958)
Behle (1960)
Behle and Perry (1975)
Burt and Grossenheider (1964)
Durrant (1952)
Frischnecht (1975)
Kelson (1951)
Legler (1963)
Peterson (1961)
Robbins, et al. (1966)
Sparks (1974)
Stebbins (1966)
Tanner (1975)
Woodbury (1931)
Woodbury and Russel, Jr. (1945)

APPENDIX E

RADIOLOGICAL DATA

TABLE E-1

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF U 238
DRY DEPOSITION

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	8230.	10723.	13561.	6354.	9355.	10479.	27502.	30784.	.1767E+05
450.	952.	1267.	1599.	762.	1101.	1241.	3235.	3642.	.5301E+05
681.	428.	577.	729.	350.	504.	571.	1487.	1678.	.4332E+05
805.	312.	422.	533.	257.	370.	420.	1092.	1234.	.2719E+05
929.	239.	325.	411.	199.	286.	326.	848.	959.	.5910E+05
1609.	90.	124.	158.	77.	112.	128.	336.	381.	.7570E+06
2414.	42.	58.	74.	37.	53.	61.	158.	180.	.3906E+06
2919.	30.	42.	53.	26.	38.	44.	114.	130.	.6867E+06
4023.	17.	24.	31.	15.	22.	26.	67.	77.	.2540E+07
5631.	9.	13.	17.	9.	12.	14.	37.	43.	.3558E+07
7241.	6.	8.	11.	6.	8.	9.	24.	27.	.4575E+07
8849.	4.	6.	8.	4.	6.	6.	17.	19.	.5592E+07
10458.	3.	4.	6.	3.	4.	5.	13.	14.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	57789.	11453.	7049.	2762.	3531.	4247.	7487.	5704.	.3835E-02
450.	6783.	1355.	833.	330.	413.	502.	880.	675.	.5190E-02
681.	3115.	623.	382.	151.	187.	228.	399.	307.	.5698E-02
805.	2288.	458.	280.	111.	137.	166.	291.	224.	.5932E-02
929.	1777.	355.	217.	86.	106.	128.	224.	172.	.6325E-02
1609.	705.	140.	84.	33.	40.	48.	84.	65.	.8297E-02
2414.	331.	66.	40.	16.	19.	23.	39.	31.	.8776E-02
2919.	239.	48.	28.	11.	13.	16.	28.	22.	.9382E-02
4023.	141.	28.	17.	7.	8.	9.	16.	13.	.1069E-01
5631.	78.	15.	9.	4.	4.	5.	9.	7.	.1171E-01
7241.	50.	10.	6.	2.	3.	3.	6.	4.	.1255E-01
8849.	35.	7.	4.	2.	2.	2.	4.	3.	.1327E-01
10458.	26.	5.	3.	1.	1.	2.	3.	2.	.1391E-01

TABLE E-2

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF U 238
WET DEPOSITION- WASHCO= .100E-02 RAINF= .600E-01

DISTANCE (METERS)	SECTOR N	NNE	NE	ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	917.	1059.	1240.	503.	646.	639.	1531.	1651.	.1767E+05
450.	272.	320.	375.	153.	193.	191.	455.	491.	.5301E+05
681.	165.	197.	230.	94.	118.	116.	276.	297.	.4332E+05
805.	133.	160.	187.	76.	95.	94.	223.	240.	.2719E+05
929.	110.	133.	156.	64.	79.	78.	184.	198.	.5910E+05
1609.	49.	62.	73.	30.	36.	35.	83.	89.	.7570E+06
2414.	24.	33.	38.	16.	18.	18.	41.	44.	.3906E+06
2919.	17.	23.	27.	11.	13.	12.	29.	30.	.6867E+06
4023.	8.	12.	14.	6.	6.	6.	14.	15.	.2540E+07
5631.	3.	6.	6.	3.	3.	3.	6.	6.	.3558E+07
7241.	1.	3.	3.	1.	1.	1.	3.	3.	.4575E+07
8849.	1.	2.	2.	1.	1.	1.	2.	1.	.5592E+07
10458.	0.	1.	1.	0.	0.	0.	1.	1.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	3121.	726.	535.	240.	322.	472.	824.	609.	.2657E-03
450.	921.	216.	160.	72.	95.	141.	246.	182.	.5034E-03
681.	555.	131.	97.	44.	57.	85.	150.	111.	.6213E-03
805.	446.	106.	79.	35.	46.	69.	121.	90.	.6811E-03
929.	368.	88.	65.	29.	38.	57.	100.	74.	.7888E-03
1609.	162.	40.	30.	13.	17.	26.	45.	34.	.1412E-02
2414.	79.	20.	15.	7.	8.	13.	23.	17.	.1573E-02
2919.	53.	14.	11.	5.	6.	9.	16.	12.	.1770E-02
4023.	25.	7.	5.	2.	3.	4.	8.	6.	.2133E-02
5631.	10.	3.	2.	1.	1.	2.	3.	2.	.2348E-02
7241.	4.	1.	1.	0.	0.	1.	1.	1.	.2479E-02
8849.	2.	1.	1.	0.	0.	0.	1.	1.	.2560E-02
10458.	1.	0.	0.	0.	0.	0.	0.	0.	.2611E-02

TABLE E-3

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF U 234
DRY DEPOSITION

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	8230.	10723.	13561.	6354.	9354.	10479.	27502.	30783.	.1767E+05
450.	952.	1267.	1599.	762.	1101.	1241.	3235.	3642.	.5301E+05
681.	428.	577.	729.	350.	504.	571.	1487.	1678.	.4332E+05
805.	312.	422.	533.	257.	370.	420.	1092.	1234.	.2719E+05
929.	239.	325.	411.	199.	286.	326.	848.	959.	.5910E+05
1609.	90.	124.	158.	77.	112.	128.	336.	381.	.7570E+06
2414.	42.	58.	74.	37.	53.	61.	158.	180.	.3906E+06
2919.	30.	42.	53.	26.	38.	44.	114.	130.	.6867E+06
4023.	17.	24.	31.	15.	22.	26.	67.	77.	.2540E+07
5631.	9.	13.	17.	9.	12.	14.	37.	43.	.3558E+07
7241.	6.	8.	11.	6.	8.	9.	24.	27.	.4575E+07
8849.	4.	6.	8.	4.	6.	6.	17.	19.	.5592E+07
10458.	3.	4.	6.	3.	4.	5.	13.	14.	.6608E+07

DISTANCE (METERS)	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	57788.	11453.	7049.	2762.	3530.	4246.	7487.	5704.	.3835E-02
450.	6782.	1355.	833.	330.	413.	502.	880.	675.	.5190E-02
681.	3115.	623.	382.	151.	187.	228.	399.	307.	.5698E-02
805.	2288.	458.	280.	111.	137.	166.	291.	224.	.5932E-02
929.	1777.	355.	217.	86.	106.	128.	224.	172.	.6325E-02
1609.	705.	140.	84.	33.	40.	48.	84.	65.	.8297E-02
2414.	331.	66.	40.	16.	19.	23.	39.	31.	.8776E-02
2919.	239.	48.	28.	11.	13.	16.	28.	22.	.9382E-02
4023.	141.	28.	17.	7.	8.	9.	16.	13.	.1069E-01
5631.	78.	15.	9.	4.	4.	5.	9.	7.	.1171E-01
7241.	50.	10.	6.	2.	3.	3.	6.	4.	.1255E-01
8849.	35.	7.	4.	2.	2.	2.	4.	3.	.1327E-01
10458.	26.	5.	3.	1.	1.	2.	3.	2.	.1391E-01

TABLE E-4

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF U 234
WET DEPOSITION- WASHCO= .100E-02 RAINF= .600E-01

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	917.	1059.	1240.	503.	646.	639.	1531.	1651.	.1767E+05
450.	272.	320.	375.	153.	193.	191.	455.	491.	.5301E+05
681.	165.	197.	230.	94.	118.	116.	276.	297.	.4332E+05
805.	133.	160.	187.	76.	95.	94.	223.	240.	.2719E+05
929.	110.	133.	156.	64.	79.	78.	184.	198.	.5910E+05
1609.	49.	62.	73.	30.	36.	35.	83.	89.	.7570E+06
2414.	24.	33.	38.	16.	18.	18.	41.	44.	.3906E+06
2919.	17.	23.	27.	11.	13.	12.	29.	30.	.6867E+06
4023.	8.	12.	14.	6.	6.	6.	14.	15.	.2540E+07
5631.	3.	6.	6.	3.	3.	3.	6.	6.	.3558E+07
7241.	1.	3.	3.	1.	1.	1.	3.	3.	.4575E+07
8849.	1.	2.	2.	1.	1.	1.	2.	1.	.5592E+07
10458.	0.	1.	1.	0.	0.	0.	1.	1.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	3121.	726.	535.	240.	322.	472.	824.	609.	.2657E-03
450.	921.	216.	160.	72.	95.	141.	246.	182.	.5034E-03
681.	555.	131.	97.	44.	57.	85.	150.	111.	.6213E-03
805.	446.	106.	79.	35.	46.	69.	121.	90.	.6811E-03
929.	368.	88.	65.	29.	38.	57.	100.	74.	.7888E-03
1609.	162.	40.	30.	13.	17.	26.	45.	34.	.1412E-02
2414.	79.	20.	15.	7.	8.	13.	23.	17.	.1573E-02
2919.	53.	14.	11.	5.	6.	9.	16.	12.	.1770E-02
4023.	25.	7.	5.	2.	3.	4.	8.	6.	.2133E-02
5631.	10.	3.	2.	1.	1.	2.	3.	2.	.2348E-02
7241.	4.	1.	1.	0.	0.	1.	1.	1.	.2479E-02
8849.	2.	1.	1.	0.	0.	0.	1.	1.	.2560E-02
10458.	1.	0.	0.	0.	0.	0.	0.	0.	.2611E-02

TABLE E-5

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF TH 230
DRY DEPOSITION

DISTANCE (METERS)	N	NNE	NE	ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	796.	1037.	1311.	614.	905.	1013.	2660.	2977.	.1767E+05
450.	92.	123.	155.	74.	106.	120.	313.	352.	.5301E+05
681.	41.	56.	70.	34.	49.	55.	144.	162.	.4332E+05
805.	30.	41.	52.	25.	36.	41.	106.	119.	.2719E+05
929.	23.	31.	40.	19.	28.	31.	82.	93.	.5910E+05
1609.	9.	12.	15.	7.	11.	12.	32.	37.	.7570E+06
2414.	4.	6.	7.	4.	5.	6.	15.	17.	.3906E+06
2919.	3.	4.	5.	3.	4.	4.	11.	13.	.6867E+06
4023.	2.	2.	3.	1.	2.	2.	6.	7.	.2540E+07
5631.	1.	1.	2.	1.	1.	1.	4.	4.	.3558E+07
7241.	1.	1.	1.	1.	1.	1.	2.	3.	.4575E+07
8849.	0.	1.	1.	0.	1.	1.	2.	2.	.5592E+07
10458.	0.	0.	1.	0.	0.	0.	1.	1.	.6608E+07

DISTANCE (METERS)	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	5588.	1108.	682.	267.	341.	411.	724.	552.	.3708E-03
450.	656.	131.	81.	32.	40.	49.	85.	65.	.5019E-03
681.	301.	60.	37.	15.	18.	22.	39.	30.	.5510E-03
805.	221.	44.	27.	11.	13.	16.	28.	22.	.5736E-03
929.	172.	34.	21.	8.	10.	12.	22.	17.	.6117E-03
1609.	68.	14.	8.	3.	4.	5.	8.	6.	.8024E-03
2414.	32.	6.	4.	2.	2.	2.	4.	3.	.8486E-03
2919.	23.	5.	3.	1.	1.	2.	3.	2.	.9073E-03
4023.	14.	3.	2.	1.	1.	1.	2.	1.	.1034E-02
5631.	8.	1.	1.	0.	0.	0.	1.	1.	.1132E-02
7241.	5.	1.	1.	0.	0.	0.	1.	0.	.1213E-02
8849.	3.	1.	0.	0.	0.	0.	0.	0.	.1283E-02
10458.	3.	1.	0.	0.	0.	0.	0.	0.	.1345E-02

TABLE E-6

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF TH 230
WET DEPOSITION- WASHCO= .100E-02 RAINF= .600E-01

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	89.	102.	120.	49.	63.	62.	148.	160.	.1767E+05
450.	26.	31.	36.	15.	19.	18.	44.	47.	.5301E+05
681.	16.	19.	22.	9.	11.	11.	27.	29.	.4332E+05
805.	13.	15.	18.	7.	9.	9.	22.	23.	.2719E+05
929.	11.	13.	15.	6.	8.	8.	18.	19.	.5910E+05
1609.	5.	6.	7.	3.	3.	3.	8.	9.	.7570E+06
2414.	2.	3.	4.	2.	2.	2.	4.	4.	.3906E+06
2919.	2.	2.	3.	1.	1.	1.	3.	3.	.6867E+06
4023.	1.	1.	1.	1.	1.	1.	1.	1.	.2540E+07
5631.	0.	1.	1.	0.	0.	0.	1.	1.	.3558E+07
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	302.	70.	52.	23.	31.	46.	80.	59.	.2569E-04
450.	89.	21.	15.	7.	9.	14.	24.	18.	.4868E-04
681.	54.	13.	9.	4.	6.	8.	14.	11.	.6008E-04
805.	43.	10.	8.	3.	4.	7.	12.	9.	.6587E-04
929.	36.	8.	6.	3.	4.	6.	10.	7.	.7628E-04
1609.	16.	4.	3.	1.	2.	2.	4.	3.	.1365E-03
2414.	8.	2.	1.	1.	1.	1.	2.	2.	.1521E-03
2919.	5.	1.	1.	0.	1.	1.	2.	1.	.1711E-03
4023.	2.	1.	1.	0.	0.	0.	1.	1.	.2062E-03
5631.	1.	0.	0.	0.	0.	0.	0.	0.	.2271E-03
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.2397E-03
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.2475E-03
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.2525E-03

TABLE E-7

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF RA 226
DRY DEPOSITION

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	398.	518.	655.	307.	452.	507.	1329.	1488.	.1767E+05
450.	46.	61.	77.	37.	53.	60.	156.	176.	.5301E+05
681.	21.	28.	35.	17.	24.	28.	72.	81.	.4332E+05
805.	15.	20.	26.	12.	18.	20.	53.	60.	.2719E+05
929.	12.	16.	20.	10.	14.	16.	41.	46.	.5910E+05
1609.	4.	6.	8.	4.	5.	6.	16.	18.	.7570E+06
2414.	2.	3.	4.	2.	3.	3.	8.	9.	.3906E+06
2919.	1.	2.	3.	1.	2.	2.	6.	6.	.6867E+06
4023.	1.	1.	1.	1.	1.	1.	3.	4.	.2540E+07
5631.	0.	1.	1.	0.	1.	1.	2.	2.	.3558E+07
7241.	0.	0.	1.	0.	0.	0.	1.	1.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	1.	1.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	1.	1.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	2793.	554.	341.	134.	171.	205.	362.	276.	.1854E-03
450.	328.	65.	40.	16.	20.	24.	43.	33.	.2510E-03
681.	151.	30.	18.	7.	9.	11.	19.	15.	.2755E-03
805.	111.	22.	14.	5.	7.	8.	14.	11.	.2868E-03
929.	86.	17.	10.	4.	5.	6.	11.	8.	.3058E-03
1609.	34.	7.	4.	2.	2.	2.	4.	3.	.4012E-03
2414.	16.	3.	2.	1.	1.	1.	2.	1.	.4243E-03
2919.	12.	2.	1.	1.	1.	1.	1.	1.	.4536E-03
4023.	7.	1.	1.	0.	0.	0.	1.	1.	.5170E-03
5631.	4.	1.	0.	0.	0.	0.	0.	0.	.5661E-03
7241.	2.	0.	0.	0.	0.	0.	0.	0.	.6066E-03
8849.	2.	0.	0.	0.	0.	0.	0.	0.	.6416E-03
10458.	1.	0.	0.	0.	0.	0.	0.	0.	.6723E-03

TABLE E-8

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF RA 226
WET DEPOSITION- WASHCO= .100E-02 RAINF= .600F-01

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	44.	51.	60.	24.	31.	31.	74.	80.	.1767E+05
450.	13.	15.	18.	7.	9.	9.	22.	24.	.5301E+05
681.	8.	10.	11.	5.	6.	6.	13.	14.	.4332E+05
805.	6.	8.	9.	4.	5.	5.	11.	12.	.2719E+05
929.	5.	6.	8.	3.	4.	4.	9.	10.	.5910E+05
1609.	2.	3.	4.	1.	2.	2.	4.	4.	.7570E+06
2414.	1.	2.	2.	1.	1.	1.	2.	2.	.3906E+06
2919.	1.	1.	1.	1.	1.	1.	1.	1.	.6867E+06
4023.	0.	1.	1.	0.	0.	0.	1.	1.	.2540E+07
5631.	0.	0.	0.	0.	0.	0.	0.	0.	.3558E+07
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	151.	35.	26.	12.	16.	23.	40.	29.	.1285E-04
450.	45.	10.	8.	3.	5.	7.	12.	9.	.2434E-04
681.	27.	6.	5.	2.	3.	4.	7.	5.	.3004E-04
805.	22.	5.	4.	2.	2.	3.	6.	4.	.3293E-04
929.	18.	4.	3.	1.	2.	3.	5.	4.	.3814E-04
1609.	8.	2.	1.	1.	1.	1.	2.	2.	.6826E-04
2414.	4.	1.	1.	0.	0.	1.	1.	1.	.7605E-04
2919.	3.	1.	1.	0.	0.	0.	1.	1.	.8556E-04
4023.	1.	0.	0.	0.	0.	0.	0.	0.	.1031E-03
5631.	0.	0.	0.	0.	0.	0.	0.	0.	.1135E-03
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.1198E-03
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.1238E-03
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.1262E-03

TABLE E-9

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF PB 210
DRY DEPOSITION

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	389.	506.	641.	300.	442.	495.	1299.	1454.	.1767E+05
450.	45.	60.	76.	36.	52.	59.	153.	172.	.5301E+05
681.	20.	27.	34.	17.	24.	27.	70.	79.	.4332E+05
805.	15.	20.	25.	12.	17.	20.	52.	58.	.2719E+05
929.	11.	15.	19.	9.	14.	15.	40.	45.	.5910E+05
1609.	4.	6.	7.	4.	5.	6.	16.	18.	.7570E+06
2414.	2.	3.	3.	2.	2.	3.	7.	9.	.3906E+06
2919.	1.	2.	3.	1.	2.	2.	5.	6.	.6867E+06
4023.	1.	1.	1.	1.	1.	1.	3.	4.	.2540E+07
5631.	0.	1.	1.	0.	1.	1.	2.	2.	.3558E+07
7241.	0.	0.	1.	0.	0.	0.	1.	1.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	1.	1.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	1.	1.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	2730.	541.	333.	130.	167.	201.	354.	269.	.1854E-03
450.	320.	64.	39.	16.	19.	24.	42.	32.	.2510E-03
681.	147.	29.	18.	7.	9.	11.	19.	14.	.2755E-03
805.	108.	22.	13.	5.	6.	8.	14.	11.	.2868E-03
929.	84.	17.	10.	4.	5.	6.	11.	8.	.3058E-03
1609.	33.	7.	4.	2.	2.	2.	4.	3.	.4012E-03
2414.	16.	3.	2.	1.	1.	1.	2.	1.	.4243E-03
2919.	11.	2.	1.	1.	1.	1.	1.	1.	.4536E-03
4023.	7.	1.	1.	0.	0.	0.	1.	1.	.5170E-03
5631.	4.	1.	0.	0.	0.	0.	0.	0.	.5661E-03
7241.	2.	0.	0.	0.	0.	0.	0.	0.	.6066E-03
8849.	2.	0.	0.	0.	0.	0.	0.	0.	.6415E-03
10458.	1.	0.	0.	0.	0.	0.	0.	0.	.6723E-03

TABLE E-10

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF PB 210
WET DEPOSITION- WASHCO= .100E-02 RAINF= .600E-01

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	43.	50.	59.	24.	31.	30.	72.	78.	.1767E+05
450.	13.	15.	18.	7.	9.	9.	22.	23.	.5301E+05
681.	8.	9.	11.	4.	6.	5.	13.	14.	.4332E+05
805.	6.	8.	9.	4.	4.	4.	11.	11.	.2719E+05
929.	5.	6.	7.	3.	4.	4.	9.	9.	.5910E+05
1609.	2.	3.	3.	1.	2.	2.	4.	4.	.7570E+06
2414.	1.	2.	2.	1.	1.	1.	2.	2.	.3906E+06
2919.	1.	1.	1.	1.	1.	1.	1.	1.	.6867E+06
4023.	0.	1.	1.	0.	0.	0.	1.	1.	.2540E+07
5631.	0.	0.	0.	0.	0.	0.	0.	0.	.3558E+07
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	147.	34.	25.	11.	15.	22.	39.	29.	.1285E-04
450.	44.	10.	8.	3.	4.	7.	12.	9.	.2434E-04
681.	26.	6.	5.	2.	3.	4.	7.	5.	.3004E-04
805.	21.	5.	4.	2.	2.	3.	6.	4.	.3293E-04
929.	17.	4.	3.	1.	2.	3.	5.	4.	.3814E-04
1609.	8.	2.	1.	1.	1.	1.	2.	2.	.6826E-04
2414.	4.	1.	1.	0.	0.	1.	1.	1.	.7605E-04
2919.	3.	1.	1.	0.	0.	0.	1.	1.	.8556E-04
4023.	1.	0.	0.	0.	0.	0.	0.	0.	.1031E-03
5631.	0.	0.	0.	0.	0.	0.	0.	0.	.1135E-03
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.1198E-03
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.1238E-03
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.1262E-03

TABLE E-11

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF PO 210
DRY DEPOSITION

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	142.	185.	233.	109.	161.	180.	473.	530.	.1767E+05
450.	16.	22.	28.	13.	19.	21.	56.	63.	.5301E+05
681.	7.	10.	13.	6.	9.	10.	26.	29.	.4332E+05
805.	5.	7.	9.	4.	6.	7.	19.	21.	.2719E+05
929.	4.	6.	7.	3.	5.	6.	15.	17.	.5910E+05
1609.	2.	2.	3.	1.	2.	2.	6.	7.	.7570E+06
2414.	1.	1.	1.	1.	1.	1.	3.	3.	.3906E+06
2919.	1.	1.	1.	0.	1.	1.	2.	2.	.6867E+06
4023.	0.	0.	1.	0.	0.	0.	1.	1.	.2540E+07
5631.	0.	0.	0.	0.	0.	0.	1.	1.	.3558E+07
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.6608E+07

DISTANCE (METERS)	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	995.	197.	121.	48.	61.	73.	129.	98.	.1854E-03
450.	117.	23.	14.	6.	7.	9.	15.	12.	.2510E-03
681.	54.	11.	7.	3.	3.	4.	7.	5.	.2755E-03
805.	39.	8.	5.	2.	2.	3.	5.	4.	.2868E-03
929.	31.	6.	4.	1.	2.	2.	4.	3.	.3058E-03
1609.	12.	2.	1.	1.	1.	1.	1.	1.	.4012E-03
2414.	6.	1.	1.	0.	0.	0.	1.	1.	.4243E-03
2919.	4.	1.	0.	0.	0.	0.	0.	0.	.4536E-03
4023.	2.	0.	0.	0.	0.	0.	0.	0.	.5170E-03
5631.	1.	0.	0.	0.	0.	0.	0.	0.	.5661E-03
7241.	1.	0.	0.	0.	0.	0.	0.	0.	.6066E-03
8849.	1.	0.	0.	0.	0.	0.	0.	0.	.6415E-03
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.6723E-03

TABLE E-12

ACTIVITY DENSITY AT END OF RELEASE PERIOD FOR A UNIFORM RELEASE RATE
PICOCURIES/M**2 OF PO 210
WET DEPOSITION- WASHCO= .100E-02 RAINF= .600E-01

DISTANCE (METERS)	N	NNE	NE	SECTOR ENE	E	ESE	SE	SSE	AREAS(M**2) SECTOR-SEGMENT
150.	16.	18.	21.	9.	11.	11.	26.	28.	.1767E+05
450.	5.	6.	6.	3.	3.	3.	8.	8.	.5301E+05
681.	3.	3.	4.	2.	2.	2.	5.	5.	.4332E+05
805.	2.	3.	3.	1.	2.	2.	4.	4.	.2719E+05
929.	2.	2.	3.	1.	1.	1.	3.	3.	.5910E+05
1609.	1.	1.	1.	1.	1.	1.	1.	2.	.7570E+06
2414.	0.	1.	1.	0.	0.	0.	1.	1.	.3906E+06
2919.	0.	0.	0.	0.	0.	0.	0.	1.	.6867E+06
4023.	0.	0.	0.	0.	0.	0.	0.	0.	.2540E+07
5631.	0.	0.	0.	0.	0.	0.	0.	0.	.3558E+07
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.4575E+07
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.5592E+07
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.6608E+07

	S	SSW	SW	WSW	W	WNW	NW	NNW	CURIES DEPOSITED WITHIN RADII
150.	54.	12.	9.	4.	6.	8.	14.	10.	.1285E-04
450.	16.	4.	3.	1.	2.	2.	4.	3.	.2434E-04
681.	10.	2.	2.	1.	1.	1.	3.	2.	.3004E-04
805.	8.	2.	1.	1.	1.	1.	2.	2.	.3293E-04
929.	6.	2.	1.	1.	1.	1.	2.	1.	.3814E-04
1609.	3.	1.	1.	0.	0.	0.	1.	1.	.6826E-04
2414.	1.	0.	0.	0.	0.	0.	0.	0.	.7605E-04
2919.	1.	0.	0.	0.	0.	0.	0.	0.	.8556E-04
4023.	0.	0.	0.	0.	0.	0.	0.	0.	.1031E-03
5631.	0.	0.	0.	0.	0.	0.	0.	0.	.1135E-03
7241.	0.	0.	0.	0.	0.	0.	0.	0.	.1198E-03
8849.	0.	0.	0.	0.	0.	0.	0.	0.	.1238E-03
10458.	0.	0.	0.	0.	0.	0.	0.	0.	.1262E-03

TABLE E-13

DOSE TO AN INDIVIDUAL IN THE INDICATED SECTOR AND ANNULAR RING(MREM)

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE
150.	.4499E+01	.5862E+01	.7413E+01	.3473E+01	.5113E+01	.5728E+01	.1503E+02	.1683E+02
450.	.5205E+00	.6925E+00	.8739E+00	.4163E+00	.6016E+00	.6783E+00	.1768E+01	.1991E+01
681.	.2342E+00	.3154E+00	.3983E+00	.1915E+00	.2755E+00	.3121E+00	.8126E+00	.9172E+00
805.	.1704E+00	.2306E+00	.2913E+00	.1406E+00	.2021E+00	.2294E+00	.5970E+00	.6745E+00
929.	.1307E+00	.1777E+00	.2248E+00	.1089E+00	.1566E+00	.1781E+00	.4637E+00	.5243E+00
1609.	.4902E-01	.6761E-01	.8617E-01	.4235E-01	.6123E-01	.7023E-01	.1836E+00	.2081E+00
2414.	.2276E-01	.3175E-01	.4049E-01	.2010E-01	.2876E-01	.3317E-01	.8645E-01	.9838E-01
2919.	.1620E-01	.2272E-01	.2903E-01	.1448E-01	.2071E-01	.2394E-01	.6243E-01	.7114E-01
4023.	.9258E-02	.1310E-01	.1680E-01	.8447E-02	.1209E-01	.1405E-01	.3669E-01	.4190E-01
5631.	.5044E-02	.7204E-02	.9256E-02	.4694E-02	.6676E-02	.7801E-02	.2034E-01	.2330E-01
7241.	.3209E-02	.4617E-02	.5937E-02	.3030E-02	.4285E-02	.5027E-02	.1309E-01	.1503E-01
8849.	.2268E-02	.3265E-02	.4193E-02	.2143E-02	.3014E-02	.3541E-02	.9200E-02	.1058E-01
10458.	.1705E-02	.2451E-02	.3142E-02	.1606E-02	.2246E-02	.2643E-02	.6851E-02	.7891E-02

DISTANCE	S	SSW	SW	WSW	W	WNW	NW	NNW
150.	.3159E+02	.6261E+01	.3853E+01	.1510E+01	.1930E+01	.2321E+01	.4092E+01	.3118E+01
450.	.3708E+01	.7407E+00	.4552E+00	.1805E+00	.2255E+00	.2746E+00	.4812E+00	.3690E+00
681.	.1703E+01	.3405E+00	.2086E+00	.8280E-01	.1024E+00	.1247E+00	.2181E+00	.1677E+00
805.	.1251E+01	.2501E+00	.1529E+00	.6072E-01	.7483E-01	.9099E-01	.1591E+00	.1225E+00
929.	.9716E+00	.1941E+00	.1184E+00	.4695E-01	.5770E-01	.6996E-01	.1223E+00	.9425E-01
1609.	.3852E+00	.7638E-01	.4602E-01	.1812E-01	.2207E-01	.2630E-01	.4602E-01	.3559E-01
2414.	.1812E+00	.3602E-01	.2161E-01	.8576E-02	.1029E-01	.1232E-01	.2151E-01	.1669E-01
2919.	.1308E+00	.2598E-01	.1553E-01	.6165E-02	.7361E-02	.8782E-02	.1534E-01	.1192E-01
4023.	.7692E-01	.1522E-01	.9030E-02	.3583E-02	.4244E-02	.5025E-02	.8779E-02	.6837E-02
5631.	.4261E-01	.8435E-02	.4979E-02	.1985E-02	.2322E-02	.2753E-02	.4805E-02	.3751E-02
7241.	.2740E-01	.5428E-02	.3193E-02	.1279E-02	.1481E-02	.1759E-02	.3068E-02	.2398E-02
8849.	.1924E-01	.3820E-02	.2244E-02	.9059E-03	.1042E-02	.1245E-02	.2172E-02	.1696E-02
10458.	.1432E-01	.2848E-02	.1674E-02	.6803E-03	.7784E-03	.9363E-03	.1635E-02	.1274E-02

TABLE E-14

DOSE TO AN INDIVIDUAL IN THE INDICATED SECTOR AND ANNULAR RING(MREM)

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE
150.	.3158E+03	.4115E+03	.5204E+03	.2438E+03	.3590E+03	.4021E+03	.1055E+04	.1181E+04
450.	.3992E+02	.5296E+02	.6737E+02	.3210E+02	.4736E+02	.5349E+02	.1406E+03	.1579E+03
681.	.1863E+02	.2498E+02	.3190E+02	.1534E+02	.2272E+02	.2578E+02	.6791E+02	.7635E+02
805.	.1375E+02	.1852E+02	.2369E+02	.1143E+02	.1697E+02	.1930E+02	.5088E+02	.5724E+02
929.	.1064E+02	.1437E+02	.1842E+02	.8921E+01	.1326E+02	.1511E+02	.3989E+02	.4489E+02
1609.	.4059E+01	.5557E+01	.7179E+01	.3520E+01	.5276E+01	.6058E+01	.1606E+02	.1811E+02
2414.	.2012E+01	.2779E+01	.3611E+01	.1786E+01	.2689E+01	.3104E+01	.8251E+01	.9320E+01
2919.	.1460E+01	.2025E+01	.2640E+01	.1311E+01	.1979E+01	.2290E+01	.6097E+01	.6892E+01
4023.	.8574E+00	.1198E+01	.1569E+01	.7847E+00	.1191E+01	.1384E+01	.3695E+01	.4182E+01
5631.	.4940E+00	.6952E+00	.9159E+00	.4610E+00	.7031E+00	.8211E+00	.2198E+01	.2491E+01
7241.	.3295E+00	.4662E+00	.6167E+00	.3119E+00	.4776E+00	.5595E+00	.1501E+01	.1702E+01
8849.	.2419E+00	.3424E+00	.4536E+00	.2297E+00	.3528E+00	.4141E+00	.1112E+01	.1262E+01
10458.	.1879E+00	.2659E+00	.3525E+00	.1787E+00	.2750E+00	.3232E+00	.8692E+00	.9866E+00

DISTANCE	S	SSW	SW	WSW	W	WNW	NW	NNW
150.	.2218E+04	.4395E+03	.2705E+03	.1060E+03	.1355E+03	.1630E+03	.2873E+03	.2189E+03
450.	.2958E+03	.5843E+02	.3565E+02	.1385E+02	.1753E+02	.2078E+02	.3660E+02	.2803E+02
681.	.1429E+03	.2813E+02	.1706E+02	.6584E+01	.8300E+01	.9733E+01	.1714E+02	.1316E+02
805.	.1071E+03	.2105E+02	.1272E+02	.4899E+01	.6163E+01	.7192E+01	.1267E+02	.9737E+01
929.	.8400E+02	.1648E+02	.9933E+01	.3815E+01	.4792E+01	.5565E+01	.9808E+01	.7544E+01
1609.	.3386E+02	.6590E+01	.3926E+01	.1494E+01	.1865E+01	.2122E+01	.3747E+01	.2891E+01
2414.	.1741E+02	.3371E+01	.1990E+01	.7539E+00	.9362E+00	.1050E+01	.1857E+01	.1436E+01
2919.	.1287E+02	.2485E+01	.1460E+01	.5517E+00	.6836E+00	.7607E+00	.1347E+01	.1043E+01
4023.	.7809E+01	.1499E+01	.8739E+00	.3287E+00	.4057E+00	.4452E+00	.7902E+00	.6126E+00
5631.	.4648E+01	.8874E+00	.5131E+00	.1922E+00	.2362E+00	.2556E+00	.4547E+00	.3530E+00
7241.	.3176E+01	.6038E+00	.3469E+00	.1296E+00	.1587E+00	.1699E+00	.3029E+00	.2354E+00
8849.	.2354E+01	.4462E+00	.2553E+00	.9536E-01	.1166E+00	.1242E+00	.2219E+00	.1723E+00
10458.	.1840E+01	.3478E+00	.1984E+00	.7414E-01	.9053E-01	.9611E-01	.1721E+00	.1334E+00

TABLE E-15

DOSE TO AN INDIVIDUAL IN THE INDICATED SECTOR AND ANNULAR RING(MREM)

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE
150.	.9479E+02	.1235E+03	.1562E+03	.7318E+02	.1077E+03	.1207E+03	.3167E+03	.3545E+03
450.	.1097E+02	.1459E+02	.1841E+02	.8771E+01	.1267E+02	.1429E+02	.3726E+02	.4195E+02
681.	.4935E+01	.6645E+01	.8392E+01	.4035E+01	.5805E+01	.6575E+01	.1712E+02	.1932E+02
805.	.3589E+01	.4858E+01	.6138E+01	.2963E+01	.4258E+01	.4832E+01	.1258E+02	.1421E+02
929.	.2755E+01	.3744E+01	.4736E+01	.2295E+01	.3299E+01	.3751E+01	.9769E+01	.1105E+02
1609.	.1033E+01	.1425E+01	.1815E+01	.8923E+00	.1290E+01	.1480E+01	.3868E+01	.4385E+01
2414.	.4794E+00	.6690E+00	.8530E+00	.4234E+00	.6060E+00	.6988E+00	.1821E+01	.2073E+01
2919.	.3414E+00	.4787E+00	.6116E+00	.3050E+00	.4362E+00	.5045E+00	.1315E+01	.1499E+01
4023.	.1951E+00	.2759E+00	.3539E+00	.1780E+00	.2547E+00	.2961E+00	.7731E+00	.8829E+00
5631.	.1063E+00	.1518E+00	.1950E+00	.9891E-01	.1407E+00	.1644E+00	.4285E+00	.4909E+00
7241.	.6762E-01	.9727E-01	.1251E+00	.6385E-01	.9028E-01	.1059E+00	.2757E+00	.3166E+00
8849.	.4780E-01	.6879E-01	.8833E-01	.4516E-01	.6350E-01	.7461E-01	.1938E+00	.2230E+00
10458.	.3594E-01	.5165E-01	.6619E-01	.3386E-01	.4734E-01	.5568E-01	.1443E+00	.1663E+00

DISTANCE	S	SSW	SW	WSW	W	WNW	NW	NNW
150.	.6656E+03	.1319E+03	.8119E+02	.3181E+02	.4066E+02	.4891E+02	.8622E+02	.6569E+02
450.	.7812E+02	.1561E+02	.9590E+01	.3803E+01	.4752E+01	.5785E+01	.1014E+02	.7774E+01
681.	.3588E+02	.7174E+01	.4394E+01	.1744E+01	.2158E+01	.2627E+01	.4596E+01	.3534E+01
805.	.2635E+02	.5270E+01	.3222E+01	.1279E+01	.1577E+01	.1917E+01	.3352E+01	.2580E+01
929.	.2047E+02	.4089E+01	.2494E+01	.9891E+00	.1216E+01	.1474E+01	.2577E+01	.1986E+01
1609.	.8116E+01	.1609E+01	.9696E+00	.3817E+00	.4651E+00	.5541E+00	.9696E+00	.7499E+00
2414.	.3817E+01	.7588E+00	.4554E+00	.1807E+00	.2168E+00	.2595E+00	.4531E+00	.3516E+00
2919.	.2756E+01	.5473E+00	.3272E+00	.1299E+00	.1551E+00	.1850E+00	.3231E+00	.2511E+00
4023.	.1621E+01	.3207E+00	.1903E+00	.7549E-01	.8941E-01	.1059E+00	.1850E+00	.1440E+00
5631.	.8978E+00	.1777E+00	.1049E+00	.4185E-01	.4894E-01	.5801E-01	.1012E+00	.7903E-01
7241.	.5772E+00	.1144E+00	.6727E-01	.2696E-01	.3122E-01	.3707E-01	.6464E-01	.5055E-01
8849.	.4054E+00	.8048E-01	.4730E-01	.1909E-01	.2196E-01	.2624E-01	.4578E-01	.3574E-01
10458.	.3016E+00	.6001E-01	.3528E-01	.1434E-01	.1641E-01	.1974E-01	.3446E-01	.2685E-01

TABLE E-16

DOSE TO AN INDIVIDUAL IN THE INDICATED SECTOR AND ANNULAR RING(MREM)

DISTANCE	N	NNE	NE	ENE	E	ESE	SE	SSE
150.	.2594E+02	.3380E+02	.4275E+02	.2003E+02	.2949E+02	.3303E+02	.8670E+02	.9704E+02
450.	.3001E+01	.3994E+01	.5040E+01	.2401E+01	.3469E+01	.3912E+01	.1020E+02	.1148E+02
681.	.1351E+01	.1819E+01	.2297E+01	.1104E+01	.1589E+01	.1800E+01	.4686E+01	.5289E+01
805.	.9825E+00	.1330E+01	.1680E+01	.8111E+00	.1165E+01	.1323E+01	.3443E+01	.3890E+01
929.	.7540E+00	.1025E+01	.1296E+01	.6281E+00	.9029E+00	.1027E+01	.2674E+01	.3024E+01
1609.	.2827E+00	.3899E+00	.4969E+00	.2442E+00	.3531E+00	.4050E+00	.1059E+01	.1200E+01
2414.	.1312E+00	.1831E+00	.2335E+00	.1159E+00	.1659E+00	.1913E+00	.4985E+00	.5673E+00
2919.	.9343E-01	.1310E+00	.1674E+00	.8349E-01	.1194E+00	.1381E+00	.3600E+00	.4103E+00
4023.	.5339E-01	.7552E-01	.9687E-01	.4871E-01	.6972E-01	.8104E-01	.2116E+00	.2417E+00
5631.	.2909E-01	.4155E-01	.5338E-01	.2707E-01	.3850E-01	.4499E-01	.1173E+00	.1344E+00
7241.	.1851E-01	.2662E-01	.3424E-01	.1747E-01	.2471E-01	.2899E-01	.7547E-01	.8666E-01
8849.	.1308E-01	.1883E-01	.2418E-01	.1236E-01	.1738E-01	.2042E-01	.5306E-01	.6103E-01
10458.	.9836E-02	.1414E-01	.1812E-01	.9267E-02	.1296E-01	.1524E-01	.3951E-01	.4551E-01

DISTANCE	S	SSW	SW	WSW	W	WNW	NW	NNW
150.	.1822E+03	.3611E+02	.2222E+02	.8708E+01	.1113E+02	.1339E+02	.2360E+02	.1798E+02
450.	.2138E+02	.4271E+01	.2625E+01	.1041E+01	.1301E+01	.1584E+01	.2775E+01	.2128E+01
681.	.9820E+01	.1963E+01	.1203E+01	.4775E+00	.5908E+00	.7190E+00	.1258E+01	.9673E+00
805.	.7213E+01	.1442E+01	.8820E+00	.3502E+00	.4315E+00	.5247E+00	.9175E+00	.7063E+00
929.	.5603E+01	.1119E+01	.6827E+00	.2707E+00	.3328E+00	.4034E+00	.7054E+00	.5435E+00
1609.	.2221E+01	.4405E+00	.2654E+00	.1045E+00	.1273E+00	.1517E+00	.2654E+00	.2053E+00
2414.	.1045E+01	.2077E+00	.1246E+00	.4946E-01	.5935E-01	.7102E-01	.1240E+00	.9625E-01
2919.	.7545E+00	.1498E+00	.8957E-01	.3555E-01	.4245E-01	.5065E-01	.8844E-01	.6873E-01
4023.	.4436E+00	.8777E-01	.5208E-01	.2066E-01	.2447E-01	.2898E-01	.5063E-01	.3943E-01
5631.	.2457E+00	.4864E-01	.2871E-01	.1145E-01	.1340E-01	.1588E-01	.2771E-01	.2163E-01
7241.	.1580E+00	.3130E-01	.1841E-01	.7380E-02	.8546E-02	.1015E-01	.1769E-01	.1384E-01
8849.	.1110E+00	.2203E-01	.1295E-01	.5226E-02	.6012E-02	.7182E-02	.1253E-01	.9783E-02
10458.	.8256E-01	.1642E-01	.9655E-02	.3925E-02	.4491E-02	.5402E-02	.9432E-02	.7349E-02

TABLE E-17

POPULATION DOSE IN THE INDICATED SECTOR AND ANNULAR RING(MAN-REM)

DIS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	RUNNING TOTAL
300.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
600.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
762.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
848.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1010.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2208.	0.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
2620.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
3219.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
4827.	0.00	0.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
6436.	0.00	0.00	.00	0.00	0.00	0.00	.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
8045.	0.00	0.00	0.00	0.00	0.00	0.00	.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
9654.	.00	.00	.00	0.00	0.00	0.00	.00	.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
11263.	0.00	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01

THE CONTRIBUTING RADIONUCLIDES ARE

ISOTOPE	CRT ORGAN	DCF	CURIES RELEASED	DECAY CONSTANT (1/SEC)	DECON FACTOR
U 238	WB	.1310E+06	.4550E-01	.487E-17	.100E+01
U 234	WB	.1500E+06	.4550E-01	.890E-12	.100E+01
TH 230	WB	.1470E+08	.4400E-02	.396E-12	.100E+01
RA 226	WB	.2110E+08	.2200E-02	.198E-10	.100E+01
PB 210	WB	.1930E+06	.2200E-02	.151E-08	.100E+01
PO 210	WB	.2220E+05	.2200E-02	.836E-07	.100E+01

TOTAL CI.= .1020E+00

TABLE E-18

POPULATION DOSE IN THE INDICATED SECTOR AND ANNULAR RING(MAN-REM)

DIS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	RUNNING TOTAL
300.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
600.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
762.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
848.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1010.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2208.	0.00	.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02
2620.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02
3219.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02
4827.	0.00	0.00	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.03
6436.	0.00	0.00	.00	0.00	0.00	0.00	.05	.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
8045.	0.00	0.00	0.00	0.00	0.00	0.00	.04	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.23
9654.	.02	.03	.05	0.00	0.00	0.00	.06	.06	.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.57
11263.	0.00	.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39

THE CONTRIBUTING RADIONUCLIDES ARE

ISOTOPE	CRT ORGAN	DCF	CURIES RELEASED	DECAY CONSTANT (1/SEC)	DECON FACTOR
RN 222	LUNG	.5450E+05	.1280E+03	.210E-05	.100E+01
U 238	LUNG	.1060E+08	.4550E-01	.487E-17	.100E+01
U 234	LUNG	.1210E+08	.4550E-01	.890E-12	.100E+01
TH 230	LUNG	.1440E+09	.4400E-02	.396E-12	.100E+01
RA 226	LUNG	.2710E+08	.2200E-02	.198E-10	.100E+01
PB 210	LUNG	.6090E+07	.2200E-02	.151E-08	.100E+01
PO 210	LUNG	.7270E+07	.2200E-02	.836E-07	.100E+01

TOTAL CI.= .1281E+03

TABLE E-19

POPULATION DOSE IN THE INDICATED SECTOR AND ANNULAR RING(MAN-REM)

DIS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	RUNNING TOTAL
300.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
600.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
762.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
848.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1010.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2208.	0.00	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
2620.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
3219.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
4827.	0.00	0.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
6436.	0.00	0.00	.00	0.00	0.00	0.00	.01	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.03
8045.	0.00	0.00	0.00	0.00	0.00	0.00	.01	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.05
9654.	.00	.01	.01	0.00	0.00	0.00	.01	.01	.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.11
11263.	0.00	.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.27

THE CONTRIBUTING RADIONUCLIDES ARE

ISOTOPE	CRT ORGAN	DCF	CURIES RELEASED	DECAY CONSTANT (1/SEC)	DECON FACTOR
U 238	BONE	.2220E+07	.4550E-01	.487E-17	.100E+01
U 234	BONE	.2410E+07	.4550E-01	.890E-12	.100E+01
TH 230	BONE	.5300E+09	.4400E-02	.396E-12	.100E+01
RA 226	BONE	.2900E+08	.2200E-02	.198E-10	.100E+01
PB 210	BONE	.6120E+07	.2200E-02	.151E-08	.100E+01
PO 210	BONE	.9190E+05	.2200E-02	.836E-07	.100E+01

TOTAL CI.= .1020E+00

TABLE E-20

POPULATION DOSE IN THE INDICATED SECTOR AND ANNULAR RING(MAN-REM)

DIS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	RUNNING TOTAL
300.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
600.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
762.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
848.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1010.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2208.	0.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
2620.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
3219.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
4827.	0.00	0.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
6436.	0.00	0.00	.00	0.00	0.00	0.00	.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
8045.	0.00	0.00	0.00	0.00	0.00	0.00	.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01
9654.	.00	.00	.00	0.00	0.00	0.00	.00	.00	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.03
11263.	0.00	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.07

THE CONTRIBUTING RADIONUCLIDES ARE

ISOTOPE	CRT ORGAN	DCF	CURIES RELEASED	DECAY CONSTANT (1/SEC)	DECON FACTOR
U 238	KDNY	.5050E+06	.4550E-01	.487E-17	.100E+01
U 234	KDNY	.5770E+06	.4550E-01	.890E-12	.100E+01
TH 230	KDNY	.1490E+09	.4400E-02	.396E-12	.100E+01
RA 226	KDNY	.1570E+05	.2200E-02	.198E-10	.100E+01
PB 210	KDNY	.4910E+07	.2200E-02	.151E-08	.100E+01
PO 210	KDNY	.6830E+06	.2200E-02	.836E-07	.100E+01

TOTAL CI.= .1020E+00

TABLE E-21

PROBLEM SUMMARY

FACILITY	PERIOD FROM	PERIOD TO	ENERGY (MWD(TH))
ENERGY FUELS MILL	P01/01/70	12/31/74	-0.

MONTHS OF OPERATION	TOTAL FREQUENCY	TOTAL POPULATION	HOLDUP (DAYS)	HEFF (METERS)
12.00	99.9	3636.	0.0	0.

RADIONUCLIDE CONTRIBUTIONS TO POPULATION DOSES ARE

U 238	WB	.00	MAN-REM
U 234	WB	.00	MAN-REM
TH 230	WB	.01	MAN-REM
RA 226	WB	.00	MAN-REM
PB 210	WB	.00	MAN-REM
PO 210	WB	.00	MAN-REM
RN 222	LUNG	1.21	MAN-REM
U 238	LUNG	.05	MAN-REM
U 234	LUNG	.06	MAN-REM
TH 230	LUNG	.06	MAN-REM
RA 226	LUNG	.01	MAN-REM
PB 210	LUNG	.00	MAN-REM
PO 210	LUNG	.00	MAN-REM
U 238	BONE	.01	MAN-REM
U 234	BONE	.01	MAN-REM
TH 230	BONE	.24	MAN-REM
RA 226	BONE	.01	MAN-REM
PB 210	BONE	.00	MAN-REM
PO 210	BONE	.00	MAN-REM
U 238	KDNY	.00	MAN-REM
U 234	KDNY	.00	MAN-REM
TH 230	KDNY	.07	MAN-REM
RA 226	KDNY	.00	MAN-REM
PB 210	KDNY	.00	MAN-REM
PO 210	KDNY	.00	MAN-REM

TABLE E-22

PERCENT FREQUENCY FOR EACH SECTOR AND EACH WIND STABILITY CLASS

WIND FREQ IN PERC BY STA. CLASS FOR EACH SECTOR AND TOTAL FREQUENCY

DIR	A	B	C	D	E	F	TOTAL
N	.34	1.61	1.34	1.61	.24	.54	5.68
NNE	.23	1.56	2.13	2.91	.52	.94	8.29
NE	.35	1.58	2.37	3.12	.80	1.35	9.57
ENE	.10	.40	.72	1.62	.40	.78	4.02
E	.07	.47	.62	1.37	.56	1.36	4.45
ESE	.02	.20	.39	1.21	.86	1.74	4.42
SE	.03	.28	.53	2.39	1.94	5.06	10.23
SSE	0.00	.11	.31	1.78	2.33	5.97	10.50
S	.03	.28	.59	2.44	4.32	10.69	18.35
SSW	.04	.13	.41	1.72	.89	1.69	4.88
SW	.03	.28	.56	1.74	.40	.76	3.77
WSW	.04	.24	.25	.59	.12	.32	1.56
W	.05	.37	.37	.68	.11	.32	1.90
WNW	.10	.74	.79	.92	.16	.25	2.96
NW	.18	1.51	1.14	1.82	.23	.47	5.35
NNW	.15	.90	1.01	1.40	.15	.39	4.00

TABLE E-23

MEAN WIND SPEED FOR EACH SECTRO AND EACH STABILITY CLASS

WIND SPEEDS IN M/SEC BY STA.CLASS FOR EACH DIRECTION

DIR	A	B	C	D	E	F
N	2.20	2.40	3.30	3.30	3.10	1.80
NNE	2.20	2.70	3.90	5.30	3.40	2.00
NE	2.30	2.90	4.00	5.00	3.60	2.00
ENE	2.40	3.00	4.40	5.00	3.30	2.20
E	2.50	2.90	3.70	4.60	3.30	2.10
ESE	2.30	2.50	3.90	5.10	3.60	2.20
SE	2.10	2.80	4.00	5.60	3.70	2.20
SSE	0.00	2.70	3.80	5.10	3.30	2.30
S	1.80	2.10	3.30	3.70	3.30	2.20
SSW	2.10	1.80	3.50	4.50	3.40	2.10
SW	1.90	2.30	3.40	4.40	3.30	1.90
WSW	2.10	2.20	3.30	3.60	3.00	2.30
W	1.70	2.30	3.00	3.10	2.90	1.90
WNW	2.20	2.50	3.10	3.00	3.30	2.00
NW	2.10	2.60	3.10	3.50	3.00	1.90
NNW	2.30	2.60	3.20	3.40	2.90	2.00

TABLE E-24

CONCENTRATION OF AIRBORNE EFFLUENTS PER UNIT EMISSION
(Undepleted and Undecayed X/Q (sec/m^3))

DISTANCE (METERS)

DIR	404	1209	2414	4023	5632	7241	8849	10458
N	.570E-05	.793E-06	.243E-06	.105E-06	.609E-07	.410E-07	.303E-07	.237E-07
NNE	.753E-05	.108E-05	.335E-06	.146E-06	.855E-07	.578E-07	.428E-07	.334E-07
NE	.959E-05	.139E-05	.437E-06	.192E-06	.113E-06	.769E-07	.570E-07	.446E-07
ENE	.456E-05	.677E-06	.216E-06	.957E-07	.568E-07	.388E-07	.288E-07	.225E-07
E	.675E-05	.102E-05	.328E-06	.147E-06	.877E-07	.602E-07	.448E-07	.352E-07
ESE	.762E-05	.116E-05	.379E-06	.171E-06	.102E-06	.705E-07	.526E-07	.414E-07
SE	.201E-04	.309E-05	.101E-05	.457E-06	.275E-06	.190E-06	.142E-06	.112E-06
SSE	.225E-04	.347E-05	.114E-05	.517E-06	.311E-06	.215E-06	.161E-06	.127E-06
S	.422E-04	.651E-05	.214E-05	.968E-06	.583E-06	.403E-06	.301E-06	.237E-06
SSW	.832E-05	.127E-05	.411E-06	.185E-06	.111E-06	.761E-07	.567E-07	.445E-07
SW	.508E-05	.758E-06	.242E-06	.107E-06	.638E-07	.436E-07	.323E-07	.253E-07
WSW	.197E-05	.288E-06	.909E-07	.400E-07	.236E-07	.161E-07	.119E-07	.933E-08
W	.250E-05	.362E-06	.114E-06	.498E-07	.293E-07	.199E-07	.147E-07	.115E-07
WNW	.295E-05	.413E-06	.126E-06	.539E-07	.312E-07	.209E-07	.154E-07	.120E-07
NW	.521E-05	.729E-06	.223E-06	.959E-07	.557E-07	.375E-07	.276E-07	.216E-07
NNW	.398E-05	.562E-06	.173E-06	.743E-07	.432E-07	.291E-07	.214E-07	.167E-07

APPENDIX F

SOILS INFORMATION

<u>SOIL MAPPING UNIT AND SITE DESCRIPTIONS</u>

MAPPING UNIT DESCRIPTION

BL-Ro: Badlands and Rock Outcrops

This land occurs on the west side of the Hanksville site. It consists of barren badlands with sandstone and shale outcrops. It occurs as sloping to very steep slopes with cliffs in some parts. It has very little vegetation and is of little to no use for livestock. This unit is not considered a soil as no soil has developed on these slopes. The area is highly erosive, and runoff is extremely rapid. This unit is called a land type, and thus, is not classified in rangeland or soil groupings.

☐ CORRECT THE FOLLOWING CARD TO READ AS FOLLOWS

☐ ADD THIS CARD

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

NRC FORM-332
(2-77)

ADP CORRECTION CARD

U.S. NUCLEAR REGULATORY COMMISSION

NECC/HP-25560

BLANDING SITE BnD-4

Name: Blanding silt loam **Date Sampled:** 9-12-77

Location: Approximately 2700' west and 600' north of SW corner, Sec. 21, T37S, R22E

Physiographic Position: On the upper part of a sideslope, just below the ridgeline

Slope: 5% NW facing **Approximate Elevation:** 5670' msl

Taxonomic Class: Ustollic Haplargid, fine-silty, mixed, mesic

Range Site: Semi-desert loam

Vegetation: Mixed seeded grasses with about 10-20% sagebrush

Drainage: Well **Effective Rooting Depth:** >60 inches

Notes: Profiles #4 and #9 were both sampled and described. Profile #9 differed little from the above. The "A1" horizon was an inch thicker and the "B2t" an inch thinner. The "B2t" horizon is well developed having 27% increase in clay content over the "A" horizon.

Profile: BnD-4

Profile Description (Colors are for dry soil unless otherwise indicated):

A1 horizon, 0 to 4 inches--Reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) when moist; moderate medium platy structure; soft, very friable, slightly sticky, slightly plastic; common fine roots; noncalcareous; moderately alkaline (pH 7.9); clear smooth boundary.

B2t horizon, 4 to 12 inches--Reddish brown (5YR 5/4) silty clay loam; reddish brown (5YR 4/4 when moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots, thin patchy clay films mainly around pores and bridging sand grains; noncalcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

C1 horizon, 12 to 40 inches--Light reddish brown (5YR 6/4) silty clay loam; reddish brown (5YR 4/4) when moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; very few fine roots; no clay films; noncalcareous above 18 inches, moderately calcareous below 18 inches; moderately alkaline (pH 8.5).

C2 horizon, 40 to 50 inches--Reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) when moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; moderately calcareous; strongly alkaline (pH 8.6).

HANKSVILLE SITE NsB-3

Name: Neskahi (Like) fine sandy loam

Date Sampled: 9-13-77

Location: Approximately 1810' east and 2420' south of NW corner, Sec.36, T29S, R11E

Physiographic Position: On a nearly level broad alluvial fan

Slope: 2% NE facing

Approximate Elevation: 4830' msl

Taxonomic Class: Typic torrifluvent, coarse-loamy, mixed calcareous, mesic

Range Site: Desert loam

Vegetation: Mixed shadscale, greasewood, Mormon tea, Russian thistle, Indian ricegrass, snakeweed, galleta, and other minor species

Drainage: Well to excessive

Effective Rooting Depth: >60 inches

Notes: This profile description fits very closely profiles #5 and #7 in addition. Parts of this unit have been recently eroded with deep gullies. An erosion pavement is evident on parts of the unit.

Profile: NsB-3

Profile Description (Colors are for dry soil unless otherwise indicated):

C1 horizon, 0 to 5 inches--Light brown (7.5YR 6/4) fine sandy loam; brown (7.5YR 5/4) when moist; moderate medium platy structure; slightly hard, very friable, non-sticky, non-plastic; few fine roots, moderately calcareous; strongly alkaline (pH 8.9); gradual smooth boundary.

C2 Horizon, 5 to 28 inches--Reddish yellow (7.5YR 6/5) fine sandy loam; strong brown (7.5YR 5/5) when moist, slightly hard, very friable, non-sticky, non-plastic; massive breaking to single grain; very few fine roots; moderately calcareous; strongly alkaline (pH 8.7).

C3 horizon, 28 to 38 inches--Pink (7.5YR 7/4) fine sandy loam; brown (7.5YR 5/4) when moist; slightly hard, very friable, non-sticky, non-plastic; massive; moderately calcareous (weak zone of lime accumulation); moderately alkaline (pH 8.2).

C4 horizon, 38 to 60 inches--Light brown (7.5YR 6/4) fine sandy loam; brown (7.5YR 5/4) when moist; slightly hard, very friable, non-sticky, non-plastic; moderately calcareous; moderately alkaline (pH 8.3).

HANKSVILLE SITE R1A-8

Name:	Rairdent (Like) sandy clay loam	**Date Sampled:**	9-13-77

Location: Approximately 770' east and 2475' north of SE corner, Sec. 36, T29S, R11E

Physiographic Position: Smooth valley floor--presently ponds water after rains

Slope: Flat   **Approximate Elevation:** 4778' msl

Taxonomic Class: Cambic Gypsiorthid, fine-loamy, mixed, calcareous, mesic

Range Site: Desert loam

Vegetation: Mixed Russian thistle, galleta, buckwheat, and other minor species

Drainage: Well to excessive   **Effective Rooting Depth:** >60 inches

Notes: Profile #1 was described in addition, and was very similar.

Profile: R1A-8

Profile Description (Colors are for dry soil unless otherwise indicated):

C1 horizon, 0 to 4 inches--Light reddish brown (5YR 6/4) sandy clay loam; reddish brown (5YR 5/4) when moist; moderate medium platy structure; slightly hard, firm, sticky, plastic, common fine roots; vesicular pores, moderately calcareous; strongly alkaline (pH 8.5).

C2 horizon, 4 to 48 inches--Light reddish brown (5YR 6/4) clay loam; reddish brown (5YR 5/4) when moist; massive, slightly hard, friable, slightly sticky, slightly plastic; no clay films; strongly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C3cs horizon, 48 to 54 inches--Pink (7.5YR 7/4) fine sandy loam; light brown (7.5YR 6/4) when moist; accumulation of gypsum; moderately alkaline (pH 8.2).

C4 horizon, 54 to 60 inches--Light brown (7.5YR 6/4) very fine sandy loam; brown (7.5YR 5/4) when moist; moderately alkaline (pH 8.2).

HANKSVILLE SITE RsB-6

Name: Rairdent (Like) fine sandy loam

Date Sampled: 9-13-77

Location: Approximately 1000' east and 600' south of NW corner, Sec.36, T29S, R11E

Physiographic Position: Old alluvial fan since eroded by gullies.

Slope: 2% NE facing

Approximate Elevation: 4830' msl

Taxonomic Class: Cambic Gypsiorthid, fine-loamy, mixed, mesic

Range Site: Desert loam

Vegetation: Mixed shadscale, galleta, Mormon tea, snakeweed, Russian thistle, Indian ricegrass, sage, and other minor grasses.

Drainage: Well to excessive

Effective Rooting Depth: >60 inches

Notes:

Profile: RsB-6

Profile Description (Colors are for dry soil unless otherwise indicated):

C1 horizon, 0 to 2 inches--Light brown (7.5YR 6/4) fine sandy loam; brown (7.5YR 5/4) when moist; moderate medium platy structure; soft, very friable, slightly sticky, non-plastic; few fine roots; moderately calcareous; moderately alkaline (pH 8.0).

C2ca horizon, 2 to 36 inches--Pinkish gray (7.5YR 7/2) sandy clay loam; brown (7.5YR 5/4) when moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; no clay films; strongly calcareous; moderately alkaline (pH 8.1).

C3 horizon, 36 to 50 inches--Light brown (7.5YR 6/4) sandy clay loam; brown (7.5YR 5/4) when moist; massive; slightly hard, very friable, slightly sticky, non-plastic; moderately calcareous; moderately alkaline (pH 8.4).

HANKSVILLE SITE S1BD-4

Name: Unnamed fine sandy loam **Date Sampled:** 9-13-77

Location: Approximately 1160' east and 880' north of SW corner, Sec.36, T29S, R11E

Physiographic Position: An old alluvial fan, since severely gullied.

Slope: 4% NE facing **Approximate Elevation:** 4850' msl

Taxonomic Class: Cambic Gypsiorthid, coarse loamy, mixed, mesic

Range Site: Desert loam

Vegetation: Mixed shadscale, galleta, Mormon tea, snakeweed, Russian thistle, Indian ricegrass, sagebrush, and other minor species

Drainage: Well to excessive **Effective Rooting Depth:** >60 inches

Notes: On this soil, erosion appears to have removed the original surface and left the underlying gypsic horizon exposed. This land is severely gullied and the surface is covered with an erosion pavement.

Profile: SlBD-4

Profile Description (Colors are for dry soil unless otherwise indicated):

Clsc horizon, 0 to 30 inches--Pinkish white (5YR 8/2) fine sandy loam; pink (5YR 7/3) when moist; massive; hard, very friable, slightly sticky, non-plastic; very few fine roots; no clay films; moderately calcareous; strongly gypsiferous with many gypsum crystals; moderately alkaline (pH 8.2).

C2 horizon, 30 to 48 inches--Pink (5YR 7/3) sandy loam bordering to loam; light reddish brown (5YR 6/4) when moist; slightly hard, very friable, slightly sticky, non-plastic; no clay films; moderately calcareous; no observable gypsum, moderately alkaline (pH 8.2).

RESULTS OF LABORATORY ANALYSES

AGRICULTURAL CONSULTANTS INC
240 S FIRST AVE / PO 507 / 303-659-2313
BRIGHTON COLORADO 80601

FOR: DAMES & MOORE / WALTER EPLEY

PROJECT: TOPSOIL / SOUTHERN UTAH SITES

DATE: 09/23/77

E.C.- (1) ELECTRIC CONDUCTANCE OF SOIL EXTRACT MM/CC

S.A.R.-(1) SODIUM ADSORPTION RATIO
ESP- (1) EXCH SODIUM PERCENTAGE
EXCH NA- (1) EXCHANGEABLE SODIUM MEQ/100G
CEC- (3) CATION EXCHANGE CAPACITY MEQ/100G

NO3-N- (3) NITRATE NITROGEN PPM

PHOS- (3) AVAILABLE PHOSPHORUS PPM

K- (3) AVAILABLE POTASSIUM PPM

GYPSUM- (1) GYPSUM %

BORON- (3) WATER SOLUBLE BORON PPM

SE- (3) WATER SOLUBLE SELENIUM PPM

OC- (3) ORGANIC CARBON (WALKLEY-BLACK)
LM- (3) LIME (CACO3) %

SAT- (1) % WATER AT SOIL STAURATION
WHC1/3- (1) WATER HOLDING CAPACITY AT 1/3 BAR
WHC15- (1) WATER HOLDING CAPACITY AT 15 BAR

TEXT- (2) TEXTURE CLASS
SN- (2) SAND OR SANDY

SI- (2) SILT OR SILTY
CL- (2) CLAY
REFERENCE:

(1) USDA HANDBOOK #60
(2) AMER SOCIETY OF AGRONOMY #9 PART 1
(3) AMER SOCIETY OF AGRONOMY #9 PART 2

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SAMPLE BLANDING #4 0-4

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	69	3.0
CALCIUM	74	3.7
MAGNESIUM	32	2.7

PH (PASTE)	7.4
PH(1:5)	7.9
EC	1.2
SAR	1.7
EXCH NA	0.1
CEC	12.8
ESP	1.1
NO3-N	7
PHOS	15
K	198
GYPSUM%	0.15
BORON	0.3
SE	0.01
OC%	0.63
LM%	0.3
%WHC1/3	17.7
%WHC15	10.1
SAT%	36.0
TEXT	SI LO
%SN	20
%SI	73
%CL	7

SAMPLE BLANDING #4 4-12

SATURATED SOIL

EXTRACT:	PPM	MEQ/L
SODIUM	43	1.9
CALCIUM	76	3.8
MAGNESIUM	33	2.7

PH (PASTE)	7.6
PH(1:5)	8.0
EC	0.8
SAR	1.0
EXCH NA	0.1
CEC	16.6
ESP	0.2
NO3-N	4
PHOS	3
K	170
GYPSUM%	0.14
BORON	0.5
SE	0.01
OC%	0.53
LM%	0.3
%WHC1/3	23.8
%WHC15	15.1
SAT%	49.0
TEXT	SI CL LO
%SN	17
%SI	49
%CL	34

SAMPLE ELANDING #4 18-40

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	53	2.3
CALCIUM	73	3.6
MAGNESIUM	31	2.6

PH (PASTE)	8.0
PH(1:5)	8.5
EC	0.7
SAR	1.3
EXCH NA	0.1
CEC	15.2
ESP	0.6
NO3-N	4
PHOS	2
K	162
GYPSUM%	0.30
BORON	0.4
SE	0.02
OC%	0.42
LM%	2.0
%WHC1/3	20.8
%WHC15	12.8
SAT%	43.7
TEXT	SI CL LO
%SN	8
%SI	56
%CL	36

SAMPLE BLANDING #4 40-50

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	101	4.4
CALCIUM	73	3.7
MAGNESIUM	31	2.6

PH (PASTE)	8.1
PH(1:5)	8.6
EC	1.2
SAR	2.5
EXCH NA	0.3
CEC	14.9
ESP	2.0
NO3-N	4
PHOS	3
K	165
GYPSUM%	0.18
BORON	0.6
SE	0.02
CC%	0.32
LM%	2.1
%WHC1/3	18.3
%WHC15	11.9
SAT%	37.8
TEXT	SI CL LO
%SN	5
%SI	64
%CL	31

SAMPLE BLANDING #9 Ø-5

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	9Ø	3.9
CALCIUM	64	3.2
MAGNESIUM	32	2.7

PH (PASTE)	7.6
PH(1:5)	8.1
EC	Ø.9
SAR	2.3
EXCH NA	Ø.2
CEC	13.1
ESP	1.8
NO3-N	6
PHOS	1Ø
K	182
GYPSUM%	Ø.17
BORON	Ø.4
SE	Ø.Ø2
OC%	Ø.53
LM%	Ø.3
%WHC1/3	19.6
%WHC15	1Ø.7
SAT%	38.7
TEXT	SI LO
%SN	36
%SI	59
%CL	6

SAMPLE BLANDING #9 5-12

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	79	3.4
CALCIUM	78	3.9
MAGNESIUM	33	2.7

PH (PASTE)	8.0
PH(1:5)	8.4
EC	0.9
SAR	1.9
EXCH NA	0.2
CEC	10.9
ESP	1.4
NO3-N	3
PHOS	2
K	138
GYPSUM%	0.18
BORON	0.4
SE	0.01
OC%	0.47
LM%	0.3
%WHC1/3	24.5
%WHC15	15.2
SAT%	45.6
TEXT	SI LO
%SN	30
%SI	64
%CL	6

SAMPLE ELANDING #9 18-40

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	291	12.6
CALCIUM	25	1.3
MAGNESIUM	14	1.1

PH (PASTE)	8.5
PH(1:5)	9.0
EC	1.2
SAR	11.5
EXCH NA	1.4
CEC	11.9
ESP	11.5
NO3-N	4
PHOS	2
K	123
GYPSUM%	0.18
BORON	0.7
SE	0.01
OC%	0.37
LM%	3.8
%WHC1/3	18.5
%WHC15	10.5
SAT%	38.7
TEXT	SI LO
%SN	27
%SI	64
%CL	9

SAMPLE BLANDING #9 40-50

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	224	9.8
CALCIUM	18	0.9
MAGNESIUM	11	0.9

PH (PASTE)	8.8
PH(1:5)	9.2
EC	1.0
SAR	10.3
EXCH NA	2.0
CEC	15.9
ESP	12.5
NO3-N	5
PHOS	1
K	161
GYPSUM%	0.18
BORON	0.8
SE	0.01
OC%	0.26
LM%	1.6
%WHC1/3	19.5
%WHC15	10.5
SAT%	38.9
TEXT	SI CL LO
%SN	4
%SI	67
%CL	29

SAMPLE BLANDING #3 0-5

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	145	6.3
CALCIUM	65	3.2
MAGNESIUM	34	2.8

PH (PASTE)	8.3
PH(1:5)	8.8
EC	1.4
SAR	3.6
EXCH NA	0.3
CEC	8.5
ESP	3.6
NO3-N	4
PHOS	9
K	174
GYPSUM%	0.20
BORON	0.3
SE	0.01
OC%	0.42
LM%	6.1
%WHC1/3	13.8
%WHC15	8.1
SAT%	25.6
TEXT	SN LO
%SN	61
%SI	21
%CL	18

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SAMPLE ELANDING #3 5-28

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	150	6.5
CALCIUM	75	3.8
MAGNESIUM	34	2.8

PH (PASTE)	8.1
PH(1:5)	8.7
EC	1.3
SAR	3.6
EXCH NA	0.3
CEC	8.5
ESP	4.0
NO3-N	4
PHOS	2
K	182
GYPSUM%	0.29
BORON	0.5
SE	0.01
OC%	0.22
LM%	7.2
%WHC1/3	13.6
%WHC15	8.7
SAT%	26.6
TEXT	SN LO
%SN	56
%SI	33
%CL	11

SAMPLE ELANDING #3 28-38

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	90	3.9
CALCIUM	499	24.9
MAGNESIUM	152	12.6

PH (PASTE)	7.2
PH(1:5)	8.2
EC	4.2
SAR	0.9
EXCH NA	0.1
CEC	8.7
ESP	0.1
NO3-N	1
PHOS	4
K	167
GYPSUM%	9.50
BORON	0.2
SE	-0.01
OC%	0.32
LM%	8.2
%WHC1/3	15.8
%WHC15	9.8
SAT%	32.3
TEXT	SN LO
%SN	61
%SI	23
%CL	16

SAMPLE BLANDING #3 38-60

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	87	3.8
CALCIUM	573	28.7
MAGNESIUM	282	23.5

PH (PASTE)	7.4
PH(1:5)	8.3
EC	5.4
SAR	0.7
EXCH NA	0.1
CEC	7.9
ESP	0.1
NO3-N	1
PHOS	2
K	122
GYPSUM%	9.50
BORON	0.4
SE	0.02
OC%	0.26
LM%	8.5
%WHC1/3	17.6
%WHC15	10.7
SAT%	35.5
TEXT	SN LO
%SN	55
%SI	34
%CL	11

SAMPLE BLANDING #4 Ø-3Ø

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	47	2.Ø
CALCIUM	528	26.4
MAGNESIUM	58	4.8

PH (PASTE)	7.3
PH(1:5)	8.2
EC	3.1
SAR	Ø.5
EXCH NA	Ø.1
CEC	8.1
ESP	Ø.1
NO3-N	1
PHOS	1
K	136
GYPSUM%	18.ØØ
BORON	Ø.1
SE	Ø.Ø1
OC%	Ø.32
LM%	5.3
%WHC1/3	23.8
%WHC15	13.2
SAT%	46.7
TEXT	SN LO
%SN	53
%SI	29
%CL	18

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SAMPLE BLANDING #4 30-48

SATURATED SOIL EXTRACT:

	PPM	MEQ/L
SODIUM	107	4.7
CALCIUM	597	29.9
MAGNESIUM	282	23.3

PH (PASTE)	7.3
PH(1:5)	8.2
EC	6.5
SAR	0.9
EXCH NA	0.1
CEC	8.0
ESP	0.1
NO3-N	1
PHOS	1
K	236
GYPSUM%	12.00
BORON	0.5
SE	0.01
OC%	0.21
LM%	6.7
%WHC1/3	22.3
%WHC15	14.3
SAT%	42.9
TEXT	SN LO
%SN	52
%SI	39
%CL	9

SAMPLE BLANDING #5 Ø-3

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	147	6.4
CALCIUM	73	3.7
MAGNESIUM	32	2.6

PH (PASTE)	7.8
PH(1:5)	8.4
EC	1.3
SAR	3.6
EXCH NA	Ø.4
CEC	8.3
ESP	4.3
NO3-N	3
PHOS	4
K	223
GYPSUM%	Ø.25
BORON	Ø.1
SE	Ø.Ø1
OC%	Ø.37
LM%	4.2
%WHC1/3	12.5
%WHC15	7.4
SAT%	23.8
TEXT	SN LO
%SN	53
%SI	43
%CL	4

SAMPLE BLANDING #5 3-12

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	119	5.2
CALCIUM	65	3.3
MAGNESIUM	32	2.7

PH (PASTE)	7.9
PH(1:5)	8.6
EC	1.2
SAR	3.0
EXCH NA	0.2
CEC	7.8
ESP	3.1
NO3-N	2
PHOS	1
K	175
GYPSUM%	0.23
BORON	0.3
SE	0.01
OC%	0.32
LM%	4.5
%WHC1/3	13.0
%WHC15	8.0
SAT%	25.2
TEXT	SN LO
%SN	76
%SI	11
%CL	13

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SAMPLE ELANDING #5 12-30

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	122	5.3
CALCIUM	78	3.9
MAGNESIUM	32	2.7

PH (PASTE)	8.0
PH(1:5)	8.7
EC	1.4
SAR	2.9
EXCH NA	0.3
CEC	8.6
ESP	3.3
NO3-N	2
PHOS	3
K	157
GYPSUM%	0.20
BORON	0.4
SE	0.01
OC%	0.32
LM%	8.2
%WHC1/3	15.1
%WHC15	9.2
SAT%	28.6
TEXT	SN LO
%SN	52
%SI	31
%CL	17

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SAMPLE BLANDING #5 30-42

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	135	5.8
CALCIUM	567	28.3
MAGNESIUM	80	6.7

PH (PASTE)	7.2
PH(1:5)	8.2
EC	3.6
SAR	1.4
EXCH NA	0.1
CEC	7.6
ESP	0.9
NO3-N	1
PHOS	3
K	189
GYPSUM%	6.90
BORON	0.4
SE	0.01
OC%	0.26
LM%	7.3
%WHC1/3	14.3
%WHC15	9.0
SAT%	27.5
TEXT	SN LO
%SN	71
%SI	22
%CL	7

SAMPLE BLANDING #5 42-60

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	190	8.3
CALCIUM	550	27.5
MAGNESIUM	175	14.6

PH (PASTE)	7.2
PH(1:5)	8.1
EC	4.6
SAR	1.8
EXCH NA	0.1
CEC	7.8
ESP	1.5
NO3-N	1
PHOS	1
K	200
GYPSUM%	5.20
BORON	0.4
SE	0.01
OC%	0.26
LM%	7.3
%WHC1/3	12.8
%WHC15	6.9
SAT%	27.4
TEXT	SN LO
%SN	59
%SI	37
%CL	4

PAGE: 20

SAMPLE BLANDING #6 0-2

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	136	5.9
CALCIUM	572	28.6
MAGNESIUM	73	6.1

PH (PASTE)	7.0
PH(1:5)	8.0
EC	4.2
SAR	1.4
EXCH NA	0.1
CEC	7.7
ESP	0.8
NO3-N	2
PHOS	27
K	206
GYPSUM%	2.60
BORON	0.5
SE	0.01
CC%	0.42
LM%	7.2
%WHC1/3	15.4
%WHC15	10.0
SAT%	30.2
TEXT	SN LO
%SN	65
%SI	20
%CL	15

SAMPLE BLANDING #6 2-36

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	570	24.8
CALCIUM	344	17.2
MAGNESIUM	208	17.3

PH (PASTE)	7.2
PH(1:5)	8.1
EC	6.2
SAR	6.0
EXCH NA	0.8
CEC	12.7
ESP	6.6
NO3-N	1
PHOS	1
K	345
GYPSUM%	14.00
BORON	0.4
SE	0.02
OC%	0.37
LM%	6.2
%WHC1/3	25.3
%WHC15	16.3
SAT%	48.6
TEXT	SN CL LO
%SN	55
%SI	15
%CL	30

SAMPLE ELANDING #6 36-50

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	109	4.7
CALCIUM	562	28.1
MAGNESIUM	178	14.8

PH (PASTE)	7.5
PH(1:5)	8.4
EC	5.4
SAR	1.0
EXCH NA	0.1
CEC	13.4
ESP	0.2
NO3-N	1
PHOS	3
K	271
GYPSUM%	7.70
BORON	2.1
SE	-0.01
OC%	0.32
LM%	7.6
%WHC1/3	19.6
%WHC15	12.5
SAT%	40.5
TEXT	SN CL LO
%SN	62
%SI	18
%CL	20

SAMPLE BLANDING #7 0-12

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	71	3.1
CALCIUM	521	26.0
MAGNESIUM	199	16.6

PH (PASTE)	7.7
PH(1:5)	8.5
EC	5.0
SAR	0.7
EXCH NA	0.1
CEC	8.0
ESP	0.1
NO3-N	3
PHOS	2
K	151
GYPSUM%	0.24
BORON	0.7
SE	0.01
OC%	0.37
LM%	8.1
%WHC1/3	16.5
%WHC15	10.8
SAT%	36.6
TEXT	SN LO
%SN	65
%SI	30
%CL	5

SAMPLE BLANDING #7 12-46

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	108	4.7
CALCIUM	77	3.9
MAGNESIUM	35	2.9

PH (PASTE)	7.4
PH(1:5)	8.1
EC	1.4
SAR	2.5
EXCH NA	0.2
CEC	8.5
ESP	2.7
NO3-N	1
PHOS	1
K	248
GYPSUM%	1.50
BORON	0.6
SE	0.01
OC%	0.21
LM%	5.5
%WHC1/3	11.9
%WHC15	7.6
SAT%	23.2
TEXT	SN LO
%SN	59
%SI	27
%CL	14

SAMPLE BLANDING #8 Ø-4

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	93	4.Ø
CALCIUM	567	28.4
MAGNESIUM	346	28.8

PH (PASTE)	7.6
PH(1:5)	8.5
EC	5.7
SAR	Ø.8
EXCH NA	Ø.1
CEC	12.7
ESP	Ø.1
NO3-N	4
PHOS	1Ø
K	196
GYPSUM%	Ø.17
BORON	Ø.7
SE	-Ø.Ø1
OC%	Ø.42
LM%	8.5
%WHC1/3	17.2
%WHC15	1Ø.Ø
SAT%	37.6
TEXT	SN CL LO
%SN	6Ø
%SI	12
%CL	28

PAGE: 26

SAMPLE BLANDING #8 4-48

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	48	2.1
CALCIUM	584	29.2
MAGNESIUM	320	26.6

PH (PASTE)	7.3
PH(1:5)	8.2
EC	4.8
SAR	0.4
EXCH NA	0.1
CEC	17.5
ESP	0.1
NO3-N	2
PHOS	3
K	206
GYPSUM%	13.00
BORON	0.9
SE	-0.01
OC%	0.37
LM%	8.0
%WHC1/3	20.6
%WHC15	12.5
SAT%	43.8
TEXT	CL LO
%SN	42
%SI	26
%CL	32

SAMPLE BLANDING #8 48-54

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	771	33.5
CALCIUM	493	24.6
MAGNESIUM	317	26.4

PH (PASTE)	7.2
PH(1:5)	8.2
EC	8.7
SAR	6.6
EXCH NA	0.6
CEC	8.4
ESP	7.6
NO3-N	19
PHOS	1
K	114
GYPSUM%	14.00
BORON	0.9
SE	0.06
OC%	0.26
LM%	5.5
%WHC1/3	18.9
%WHC15	12.0
SAT%	41.5
TEXT	SN LO
%SN	70
%SI	18
%CL	12

PAGE: 28

SAMPLE BLANDING #8 54-60

SATURATED SOIL EXTRACT:	PPM	MEQ/L
SODIUM	91	4.0
CALCIUM	496	24.8
MAGNESIUM	339	28.2

PH (PASTE)	7.3
PH(1:5)	8.2
EC	6.2
SAR	0.8
EXCH NA	0.1
CEC	7.8
ESP	0.1
NO3-N	41
PHOS	1
K	111
GYPSUM%	11.00
BORON	1.0
SE	0.16
OC%	0.32
LM%	6.4
%WHC1/3	26.4
%WHC15	16.2
SAT%	51.6
TEXT	SN LO
%SN	60
%SI	28
%CL	12

PRIMARY DATA SUMMARY:

COLUMN DESIGNATION:

1- DEPTH
2- PASTE PH
3- EC
4- SAR
5- LIME%
6-BORON
7-SELENIUM
8- SAT%
9- TEXTURE NUMERICAL EQUIVALENT:
.. 1=CL 2=SICL 3=SNCL 4=SICLLO 5=CLLO 6=SNCLLO
.. 7=SILO 8=LO 9=SNLO 10=LOSN 11=SN 12=SI 13=FRK
10- NO3-N
11- PHOS
12- POTASSIUM
13- GYPSUM

SAMPLE: ELANDING #4

1	2	3	4	5	6	7	8	9	10	11	12	13
0-4	7.4	1.2	1.7	0.3	0.3	0.01	36.0	7	7	15	198	0.2
4-12	7.6	0.8	1.0	0.3	0.5	0.01	49.0	4	4	3	170	0.1
18-40	3.0	0.7	1.3	2.3	0.4	0.02	43.7	4	4	2	162	0.3
40-50	8.1	1.2	2.5	2.1	0.6	0.02	37.8	4	4	3	165	0.2

SAMPLE: ELANDING #9

1	2	3	4	5	6	7	8	9	10	11	12	13
0-5	7.6	0.9	2.3	0.3	0.4	0.02	38.7	7	6	10	189	0.2
5-12	8.0	0.9	1.9	0.3	0.4	0.01	45.6	7	3	2	138	0.2
18-40	8.5	1.2	11.5	3.8	0.7	0.01	38.7	7	4	2	123	0.2
40-50	8.8	1.0	10.3	1.6	0.8	0.01	38.9	4	5	1	161	0.2

SAMPLE: ELANDING #3

1	2	3	4	5	6	7	8	9	10	11	12	13
0-5	8.3	1.4	3.6	6.1	0.3	0.01	25.6	9	4	9	174	0.2
5-28	8.1	1.3	3.6	7.2	0.5	0.01	26.6	9	4	2	182	0.3
28-38	7.2	4.2	0.9	8.2	0.2	-.01	32.3	9	1	4	167	9.5
38-60	7.4	5.4	0.7	8.5	0.4	0.02	35.5	9	1	2	122	9.5

SAMPLE: ELANDING #4

1	2	3	4	5	6	7	8	9	10	11	12	13
0-30	7.3	3.1	0.5	5.3	0.1	0.01	46.7	9	1	1	136	18.0
30-48	7.3	6.5	0.9	6.7	0.5	0.01	42.9	9	1	1	236	12.0

SAMPLE: ELANDING #5

1	2	3	4	5	6	7	8	9	10	11	12	13
0-3	7.8	1.3	3.6	4.2	0.1	0.01	23.8	9	3	4	223	0.2
3-12	7.9	1.2	3.0	4.5	0.3	0.01	25.2	9	2	1	175	0.2
12-30	8.0	1.4	2.9	8.2	0.4	0.01	28.6	9	2	3	157	0.2
30-42	7.2	3.6	1.4	7.3	0.4	0.01	27.5	9	1	3	189	6.9
42-60	7.2	4.6	1.8	7.3	0.4	0.01	27.4	9	1	1	200	5.2

SAMPLE: ELANDING #6

1	2	3	4	5	6	7	8	9	10	11	12	13
0-2	7.0	4.2	1.4	7.2	0.5	0.01	30.2	9	2	27	226	2.6
2-36	7.2	6.2	6.0	6.2	0.4	0.02	48.6	6	1	1	345	14.0
36-50	7.5	5.4	1.0	7.6	2.1	-.01	42.5	6	1	3	271	7.7

SAMPLE: ELANDING #7

1	2	3	4	5	6	7	8	9	1Ø	11	12	13
Ø-12	7.7	5.Ø	Ø.7	8.1	Ø.7	Ø.Ø1	36.6	9	3	2	151	Ø.2
12-46	7.4	1.4	2.5	5.5	Ø.6	Ø.Ø1	23.2	9	1	1	248	1.5

SAMPLE: ELANDING #8

1	2	3	4	5	6	7	8	9	1Ø	11	12	13
Ø-4	7.6	5.7	Ø.8	8.5	Ø.7	-.Ø1	37.6	6	4	1Ø	196	Ø.2
4-48	7.3	4.8	Ø.4	8.Ø	Ø.9	-.Ø1	43.8	5	2	3	2Ø6	13.Ø
48-54	7.2	8.7	6.6	5.5	Ø.9	Ø.Ø6	41.5	9	19	1	114	14.Ø
54-6Ø	7.3	6.2	Ø.8	6.4	1.Ø	Ø.16	51.6	9	41	1	111	11.Ø

APPENDIX G

SOUND

APPENDIX G

SOUND

This appendix contains a description of nomenclature and instrumentation used in data acquisition and data analysis, and detailed results of the background ambient sound level survey.

G.1 NOMENCLATURE

The range of sound pressures that can be heard by humans is very large. This range varies from two ten-thousand-millionths (2×10^{-10}) of an atmosphere for sounds barely audible to humans to two thousandths (2×10^{-3}) of an atmosphere for sounds which are so loud as to be painful. The decibel notation system is used to present sound levels over this wide physical range. Essentially, the decibel system compresses this range to a workable range using logarithms. It is defined as:

$$\text{Sound pressure level in decibels (dB)} = 20 \, \text{Log}_{10} \left(\frac{P}{P_o}\right)$$

Where P_o is a reference sound pressure required for a minimum sensation of hearing. Zero decibels is assigned to this minimum level and 140 decibels to sound which is painful. Thus a range of more than one million is expressed on a scale of zero to 140. P is the measured sound pressure.

The human ear does not perceive sounds at low frequencies in the same manner as those at higher frequencies. Sounds of equal intensity at low frequency do not seem as loud as those at higher frequencies. The A-weighting network is provided in sound analysis systems to simulate the human ear. A-weighted sound levels are expressed in units known as decibels (dB). These levels in dB are used by the engineer to evaluate hearing damage risk (OSHA) or community annoyance impact. These values are also used in federal, state and local noise ordinances.

Sound is not constant in time. Statistical analysis is used to describe the temporal distribution of sound and to compute single number descriptors for the time-varying sound. This report contains the statistical A-weighted sound levels:

L_x - This is the sound level exceeded x% of the time during the measurement period. For example:

L_{90} - This is the sound level exceeded 90 percent of time during the measurement period and is often used to represent the "residual" sound level.

L_{50} - This is the sound level exceeded 50 percent of the time during the measurement period and is used to represent the "median" sound level.

L_{10} - This is the sound level exceeded 10 percent of the time during the measurement period and is often used to represent the "intrusive" sound level.

L_{eq} - This is the equivalent steady sound level which provides an equal amount of acoustic energy as the time varying sound.

L_d - Average sound level, Leq, for the daytime period (0700-2200) only.

L_n - Average sound level, L_{eq}, for the nighttime period (2200-0700) only.

L_{dn} - Day/night average sound level, defined as:

$$L_{dn} = 10\ Log_{10}[(15x10^{L_d/10} + 9x10^{(L_n+10)/10})/24]$$

Note: A 10 dB correction factor is added to the nighttime sound level.

G.2 DATA ACQUISITION AND ANALYSIS

This section describes the instrumentation, data acquisition and analysis of the ambient sound survey conducted at the proposed mine site.

The data acquisition system consists of a GenRad omnidirectional one-inch electret condenser microphone with windscreen, a GenRad Type 1933 Sound Level Meter and Octave Band Analyzer, and a Nagra 4.2L single track magnetic tape recorder. The GenRad Type 1933 Sound Level Meter and Octave Band Analyzer was used as a linear amplifier and step attenuator. Ambient sound was recorded on Scotch 177 magnetic tape. The data acquisition system is shown schematically in Figure A-1.

The above system was calibrated before each recording by means of a reference signal at 1000 Hertz of 114 dB generated by a GenRad Type 1652A Sound Level Calibrator.

The microphone was mounted on a tripod four feet above the ground surface and at least ten feet from any sizable sound reflecting surfaces in order to avoid major interference with sound propagation.

Most recordings of the background ambient sound were 15 minutes in length. However, if a large number of intrusions, such as aircraft over-flights or wind induced system overloads, occurred, the measurement period was extended.

Meteorological parameters such as wet bulb and dry bulb temperature, barometric pressure, and wind speed and direction were noted during each recording period. If high relative humidity (over 90 percent) or excessive wind speed (over six meters per second) occurred during the measurement period, the recording session was terminated. The tape recorded data were returned to the acoustic laboratory at Dames & Moore for analysis, using GenRad Real-Time Analyzer and a Digital Equipment Corporation mini-computer shown schematically in Figure A-2.

During the recording sessions, any unusual intrusions, such as wind pop over the microphone or clipping due to overloads, were noted by the engineer monitoring the signal input to the tape. Such intrusions are not characteristic of the acoustic environment, and are deleted during the analysis phase. Each sample tape is used to obtain a cumulative distribution of A-weighted sound levels.

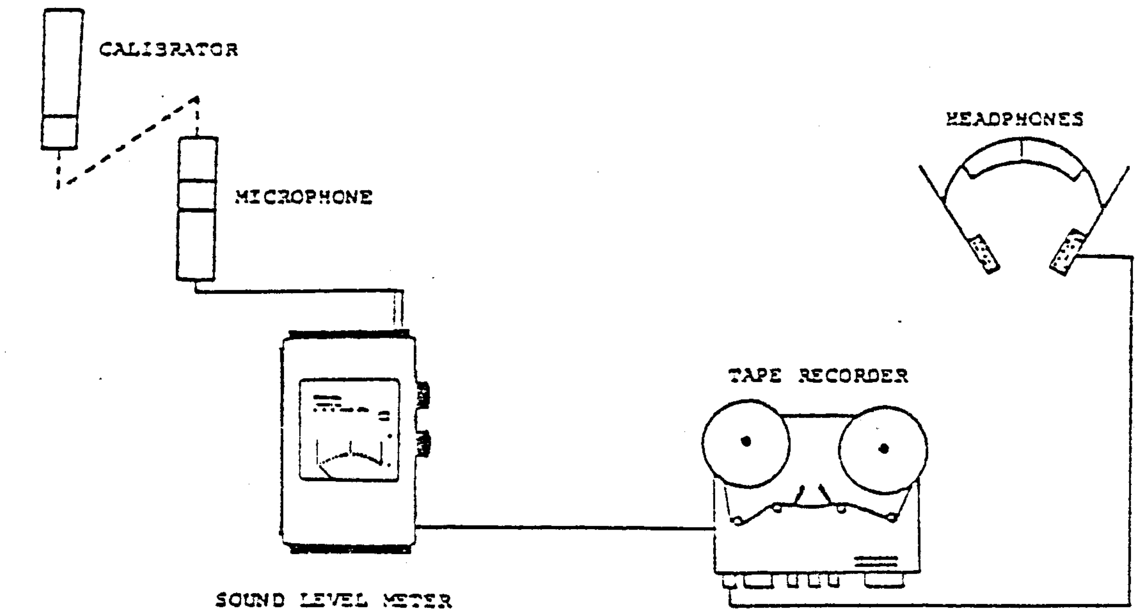

FIGURE A-1 DATA ACQUISITION SYSTEM

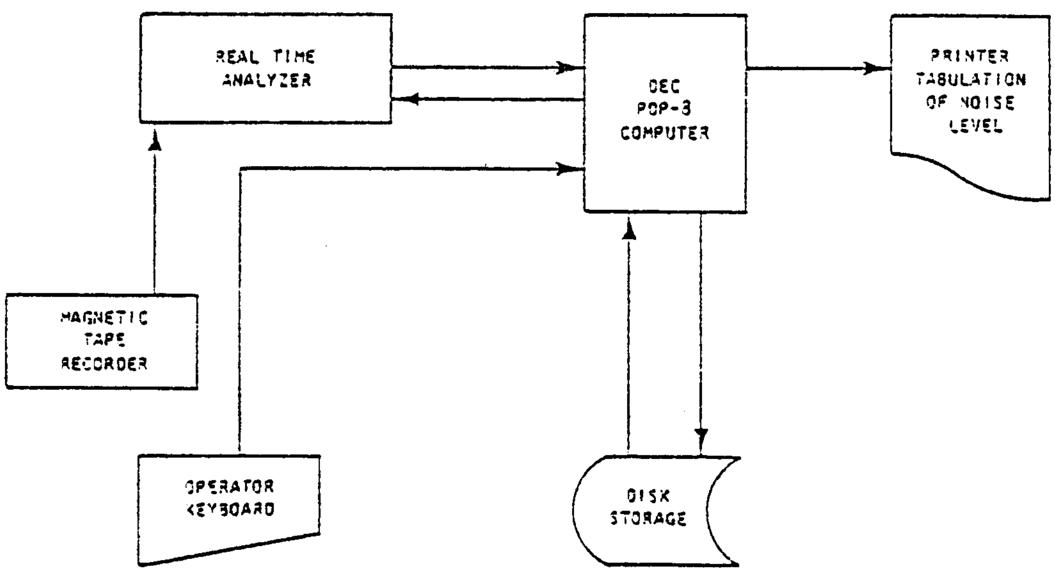

FIGURE A-2 COMPUTER CONTROLLED DATA ANALYSIS SYSTEM

TABLE A-1

METEOROLOGICAL DATA

LOC.	DATE	TIME	TEMP (°C)	HUM. (%)	WIND SPEED (M/S)	WIND DIRECTION
			DAYTIME			
1	9-6-77	0915	23	34	0-1	Variable
2	9-6-77	1000	25	27	0-1	Variable
3	9-6-77	1040	28	27	4	South
4	9-6-77	1120	28	24	4	Variable
5	9-6-77	1445	35	9	0-2 (4.0 Gusts)	Variable
6	9-7-77	1345	34	11	0-2 (3.6 Gusts)	Variable
7	9-7-77	1440	38	9	0-2 (4.5 Gusts)	Variable
8	9-8-77	1000	24	12	0.2 (3.6 Gusts)	Variable
			EVENING			
1	9-6-77	2025	24	24	0-1	Variable
2	9-6-77	1950	26	18	0-1	Variable
3	9-6-77	1800	32	12	0-2 (4.5 Gusts)	Variable
4	9-6-77	1835	32	12	3	Variable
5	9-6-77	1915	28	17	0-1	Variable
6	9-8-77	1800	33	13	3.5 (7.0 Gusts)	North
7	9-8-77	1850	31	6	5 (7.0 Gusts)	North
8	9-8-77	1940	29	10	4 (5.0 Gusts)	North
			NIGHTTIME			
1	9-7-77	0035	20	31	0-1	Variable
2	9-6-77	2355	22	24	0-1	Variable
3	9-6-77	2240	21	22	2	Variable
4	9-6-77	2200	23	22	0-1	Variable
5	9-6-77	2320	18	30	0-1	Variable
6	9-8-77	2200	24	13	0-1	Variable
7	9-8-77	2245	20	16	0-1	Variable
8	9-8-77	2330	20	20	0-1	Variable

G.3 RESULTS OF BACKGROUND AMBIENT SOUND LEVEL SURVEY

This section includes detailed results of the ambient sound level survey conducted on and near the proposed Project sites during September 6-8, 1977. Data were collected at eight locations shown on Figures 1 and 2 during daytime (0700-1800), evening (1800-2200) and nighttime (2200-0700) periods.

Figures A-3 through A-26 contain an A-weighted sound level histogram, indicating the number of times a particular sound level occurred during the measurement period, and the cumulative distribution of the A-weighted sound levels, indicating the percentage of time a sound level is exceeded. Also included are the L_{90}, L_{50}, L_{10}, and L_{eq} of the sound pressure levels at octave band center frequencies. Table A-1 presents a summary of the meteorological conditions during the measurement periods.

FILE UTAH01.DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	64.8	68	67	63	60	60
63	66.6	72	69	64	52	51
125	65	71	69	59	54	53
250	58.3	64	61	49	43	42
500	53.8	58	54	44	39	38
1000	53.3	58	53	44	39	38
2000	49.2	53	48	38	34	34
4000	47.2	46	41	34	34	34
8000	46.5	37	35	34	34	34
A-WT.	57.5	64	61	50	45	45

Figure A-3
Background Ambient Sound Level Data

Location: 1
Date: 09/06/77
Time: 0915

FILE UTAH01.DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20 µPa

```
44  ************  2.9 %
45  *****************************  7.3 %
46  *******************  4.7 %
47  *********************************  8.3 %
48  *****************************************  10.3 %
49  *********************************  8.4 %
50  ********************************************  11 %
51  **************************  6.5 %
52  **********************  5.6 %
53  *******************  4.8 %
54  *****************  4.2 %
55  ***********  2.8 %
56  ****************  4 %
57  ************  3 %
58  ***********  2.7 %
59  ********  2 %
60  *****  1.2 %
61  ********  1.9 %
62  *******  1.7 %
63  ****  1.1 %
64  ******  1.4 %
65  ****  1 %
66  **  0.5 %
67  ****  1 %
68  **  0.5 %
69  *  0.2 %
70  *  0.3 %
71  *  0.3 %
72  *  0.1 %
73  *  0.1 %
74  *  0.2 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	45
90	45
85	47
80	47
75	48
70	48
65	49
60	49
55	50
50	50
45	51
40	52
35	52
30	54
25	55
20	56
15	58
10	61
5	64

EQUIVALENT SOUND LEVEL = 57.5 DB

FILE UTAH02. DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	60. 5	63	62	57	55	54
63	65. 5	69	68	64	59	57
125	65. 6	67	63	57	55	55
250	58. 2	59	56	51	49	49
500	51. 1	53	48	42	39	38
1000	48. 6	52	47	40	36	35
2000	44. 1	47	45	38	34	34
4000	38. 8	41	36	34	34	34
8000	34. 8	35	34	34	34	34
A-WT.	55. 7	58	54	49	46	46

Figure A-4

Background Ambient Sound Level Data

Location: 2
Date: 09/06/77
Time: 1000

FILE UTAH02. DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20 uPa

```
44  *  0. 2 %
45  ************  4. 3 %
46  ***********************  8. 5 %
47  **************************  9. 8 %
48  ****************************************************  19. 2 %
49  ******************************************************  19. 9 %
50  *********************************  12. 1 %
51  ****************  6 %
52  **************  5. 1 %
53  ********  3. 1 %
54  *********  3. 3 %
55  ***  1. 2 %
56  ****  1. 4 %
57  *  0. 4 %
58  **  0. 7 %
59  *  0. 3 %
60  **  0. 7 %
61  *  0. 2 %
62  *  0. 3 %
63  **  0. 7 %
64  *  0. 2 %
65  *  0. 4 %
66  *  0. 3 %
67  *  0. 1 %
68  *  0. 4 %
69  *  0. 3 %
70  *  0. 3 %
71  *  0. 1 %
72  *  0. 2 %
73  *  0. 1 %
74
75  *  0. 1 %
76  *  0. 1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	46
90	46
85	47
80	47
75	48
70	48
65	48
60	48
55	49
50	49
45	49
40	49
35	50
30	50
25	51
20	51
15	52
10	54
5	58

EQUIVALENT SOUND LEVEL = 55. 7 DB

FILE UTAH03.DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	61	67	65	56	52	51
63	50.2	54	52	49	47	47
125	60.2	62	62	60	58	57
250	49.4	52	52	49	45	44
500	35.4	38	37	34	34	34
1000	34	34	34	34	34	34
2000	34	34	34	34	34	34
4000	34	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	46.9	49	49	47	45	44

Figure A-5

Background Ambient Sound Level Data

Location: 3
Date: 09/06/77
Time: 1040

FILE UTAH03.DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20µPa

```
42  *  0.4 %
43  ****  2 %
44  **************  6.2 %
45  *********************************  14.6 %
46  **************************************************  22.7 %
47  ****************************************************  23.6 %
48  *********************************************  20.2 %
49  *****************  7.4 %
50  *****  2.5 %
51  *  0.3 %
```

EQUIVALENT SOUND LEVEL = 46.9 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	44
90	45
85	45
80	45
75	46
70	46
65	46
60	46
55	46
50	47
45	47
40	47
35	47
30	48
25	48
20	48
15	48
10	49
5	49

FILE UTAH04. DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	60. 8	67	64	56	49	47
63	57	62	59	54	53	53
125	55. 6	61	58	48	43	42
250	48. 3	55	52	38	35	35
500	43. 3	50	46	34	34	34
1000	39	45	42	34	34	34
2000	35. 4	39	36	34	34	34
4000	34. 2	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	46. 4	54	50	39	35	34

Figure A-6

Background Ambient Sound Level Data

Location: 4
Date: 09/06/77
Time: 1120

FILE UTAH04. DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20 uPa

33	1 %
34	6. 6 %
35	12. 3 %
36	12. 8 %
37	9. 7 %
38	7. 4 %
39	5. 4 %
40	4. 5 %
41	4 %
42	3. 9 %
43	4. 1 %
44	3. 2 %
45	3. 4 %
46	3. 3 %
47	2. 3 %
48	2. 1 %
49	2. 2 %
50	2 %
51	1. 4 %
52	1. 9 %
53	1. 3 %
54	1. 4 %
55	1. 4 %
56	0. 8 %
57	0. 6 %
58	0. 7 %
59	0. 1 %
60	
61	0. 1 %
62	0. 1 %

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-
95	34
90	35
85	35
80	36
75	36
70	36
65	37
60	37
55	38
50	39
45	39
40	41
35	42
30	43
25	45
20	46
15	48
10	50
5	54

EQUIVALENT SOUND LEVEL = 46. 4 DB

FILE UTAH05. DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	58. 8	64	59	43	36	36
63	45. 7	48	46	44	44	44
125	44	47	45	41	40	40
250	38	37	36	35	35	35
500	34. 5	34	34	34	34	34
1000	34. 2	34	34	34	34	34
2000	34	34	34	34	34	34
4000	34	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	36. 2	37	36	35	34	34

Figure A-7

Background Ambient Sound Level Data

Location: 5
Date: 09/07/77
Time: 1445

FILE UTAH05. DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20µPa

```
33  ***  2. 5 %
34  ***********************************************  46. 7 %
35  ***********************************  34. 1 %
36  *********  9 %
37  ****  3. 4 %
38  **  1. 7 %
39  *  0. 7 %
40  *  0. 4 %
41  *  0. 6 %
42  *  0. 3 %
43
44  *  0. 2 %
45
46
47
48  *  0. 1 %
49
50
51  *  0. 1 %
52
53
54
55
56
57
58
59  *  0. 1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	34
90	34
85	34
80	34
75	34
70	34
65	34
60	34
55	34
50	35
45	35
40	35
35	35
30	35
25	35
20	35
15	36
10	36
5	37

EQUIVALENT SOUND LEVEL = 36. 2 DB

FILE UTAH16. DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	56. 4	63	60	50	45	43
63	56. 2	59	57	55	54	54
125	52. 2	57	54	48	45	45
250	46. 2	51	47	41	39	39
500	42. 3	47	44	37	35	35
1000	38. 4	44	40	34	34	34
2000	35. 8	39	37	34	34	34
4000	34. 1	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	45. 4	50	47	41	39	38

Figure A-8

Background Ambient Sound Level Data

Location: 6
Date: 09/07/77
Time: 1345

A-Weighted Sound Level - dB re 20 µPa

38	****************	7. 8 %
39	***	21. 9 %
40	***	19. 7 %
41	************************	11. 5 %
42	******************	8. 7 %
43	**************	6. 8 %
44	************	5. 6 %
45	********	3. 6 %
46	*******	3. 3 %
47	*****	2. 4 %
48	****	1. 6 %
49	***	1. 4 %
50	**	1 %
51	**	1 %
52	**	0. 6 %
53	**	0. 8 %
54	*	0. 3 %
55	*	0. 5 %
56	*	0. 3 %
57	*	0. 4 %
58	*	0. 3 %
59	*	0. 3 %
60	*	0. 3 %
61	*	0. 1 %

EQUIVALENT SOUND LEVEL = 45. 4 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	38
90	39
85	39
80	39
75	39
70	40
65	40
60	40
55	40
50	41
45	41
40	41
35	42
30	43
25	43
20	44
15	45
10	47
5	50

FILE UTAH17. DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	68. 4	75	73	61	46	41
63	58. 9	65	62	54	53	53
125	47. 9	54	51	45	42	42
250	39. 2	45	42	37	35	35
500	35	38	35	34	34	34
1000	38. 8	44	41	34	34	34
2000	34	34	34	34	34	34
4000	34	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	41. 3	48	45	36	34	34

Figure A-9

Background Ambient Sound Level Data

Location: 7
Date: 09/07/77
Time: 1440

FILE UTAH17. DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re · 20µPa

```
33 *  0.3 %
34 ***********************************  13.8 %
35 *******************************************************  21.6 %
36 *******************************************  16.9 %
37 **********************************  13.2 %
38 ****************  6.3 %
39 *************  5.1 %
40 *******  3 %
41 *******  2.9 %
42 ******  2.1 %
43 ******  2.1 %
44 ******  2.5 %
45 *******  2.6 %
46 ****  1.4 %
47 **  0.8 %
48 **  1 %
49 **  0.6 %
50 ****  1.3 %
51 *  0.4 %
52 ****  1.5 %
53 *  0.5 %
54 *  0.1 %
```

EQUIVALENT SOUND LEVEL = 41.3 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	34
90	34
85	35
80	35
75	35
70	35
65	35
60	36
55	36
50	36
45	37
40	37
35	37
30	38
25	39
20	40
15	42
10	45
5	48

FILE UTAH18.DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	62.2	70	67	52	40	37
63	56.3	61	59	53	52	52
125	55.5	61	57	46	40	40
250	48.5	55	50	38	35	34
500	44.4	50	45	34	34	34
1000	42.2	49	42	34	34	34
2000	37.5	43	37	34	34	34
4000	34.2	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	47.8	55	49	37	33	33

Figure A-10

Background Ambient Sound Level Data

Location: 8
Date: 09/08/77
Time: 1000

A-Weighted Sound Level - dB re 20 µPa

```
32  *  0.3 %
33  *******************************************************  18.8 %
34  *************************************************  16.7 %
35  ****************  5.3 %
36  ********************  6.3 %
37  *********************  6.8 %
38  ******************  5.9 %
39  ****************  5.3 %
40  **************  4.6 %
41  ************  3.8 %
42  **********  3 %
43  *********  2.6 %
44  ******  2.1 %
45  *******  2.3 %
46  ******  2.1 %
47  ******  2.1 %
48  *****  1.3 %
49  ****  1.3 %
50  ****  1.1 %
51  **  0.7 %
52  **  0.8 %
53  ***  1.2 %
54  *  0.4 %
55  ***  1.3 %
56  **  0.5 %
57  **  0.7 %
58  **  0.7 %
59  *  0.3 %
60  **  0.8 %
61  *  0.3 %
62  **  0.6 %
63  *  0.3 %
64  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	33
90	33
85	33
80	34
75	34
70	34
65	34
60	35
55	36
50	37
45	38
40	39
35	39
30	41
25	42
20	44
15	46
10	49
5	55

EQUIVALENT SOUND LEVEL = 47.8 DB

FILE UTAH10.DA

OCTAVE BAND HZ.	LEQ DB	L_5	L_{10}	L_{50}	L_{90}	L_{95}
31.5	53.1	57	55	52	49	49
63	53.3	59	57	50	45	44
125	59.1	64	61	53	49	48
250	50.4	55	52	42	37	35
500	44.1	50	46	39	36	35
1000	44.4	50	46	36	33	32
2000	40	45	39	30	28	27
4000	33.8	37	32	24	24	24
8000	26.6	27	25	24	24	24
A-WT.	50.6	56	52	44	40	40

FILE UTAH10.DA
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20 µPa

```
37  **  0.5 %
38  ****  1 %
39  ************  3.1 %
40  *********************************  8.3 %
41  *********************************************  11.5 %
42  **************************************************  12.9 %
43  ********************************************  11.3 %
44  ******************************************  10.7 %
45  *******************************  8 %
46  *********************  5.4 %
47  *******************  4.9 %
48  ****************  4.1 %
49  ************  3.1 %
50  *********  2.4 %
51  *********  2.2 %
52  ********  1.9 %
53  ****  1.1 %
54  *****  1.4 %
55  ****  1.1 %
56  *****  1.3 %
57  **  0.4 %
58  *  0.3 %
59  **  0.6 %
60  ***  0.7 %
61  *  0.3 %
62  **  0.4 %
63  *  0.3 %
64  **  0.4 %
65  *  0.1 %
66  *  0.1 %
67
68
69  *  0.1 %
70
71  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	40
90	40
85	41
80	41
75	42
70	42
65	42
60	43
55	43
50	44
45	44
40	45
35	45
30	46
25	47
20	48
15	50
10	52
5	56

EQUIVALENT SOUND LEVEL = 50.6 DB

FILE UTAH09.DAK

OCTAVE BAND HZ.	LEQ DB	L_{5}	L_{10}	L_{50}	L_{90}	L_{95}
31.5	54	57	54	42	38	37
63	50	54	50	45	45	45
125	65.9	68	60	44	38	37
250	60	61	53	35	35	35
500	52.8	56	49	34	34	34
1000	52.6	57	52	34	34	34
2000	47.1	51	46	34	34	34
4000	41.2	43	38	34	34	34
8000	34.7	35	34	34	34	34
A-WT.	58.6	63	56	37	34	34 ?

Figure A-12

Background Ambient Sound Level Data

Location: 2
Date: 09/06/77
Time: 1950

FILE UTAH09.DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20µPa

```
33  * 0.1 %
34  ************************ 12 %
35  ************************************************ 23.8 %
36  ************************** 13 %
37  ************* 6.2 %
38  ********* 4.2 %
39  ****** 2.8 %
40  ***** 2.2 %
41  ***** 2.1 %
42  **** 1.7 %
43  **** 1.8 %
44  **** 1.6 %
45  **** 1.7 %
46  **** 1.9 %
47  **** 1.8 %
48  ***** 2.2 %
49  ***** 2.1 %
50  **** 1.7 %
51  *** 1.3 %
52  **** 1.7 %
53  *** 1.2 %
54  ** 0.7 %
55  *** 1.1 %
56  *** 1.2 %
57  ** 0.9 %
58  ** 1 %
59  ** 0.8 %
60  ** 0.8 %
61  * 0.1 %
62  * 0.3 %
63  ** 1 %
64  ** 0.9 %
65  ** 0.8 %
66  * 0.5 %
67  * 0.3 %
68  * 0.5 %
69  * 0.1 %
70  * 0.3 %
71  * 0.2 %
72  * 0.2 %
73  * 0.3 %
74  * 0.3 %
75  * 0.1 %
76
77
78  * 0.1 %
79  * 0.1 %
80
81  * 0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	34
90	34
85	35
80	35
75	35
70	35
65	35
60	36
55	36
50	37
45	37
40	39
35	41
30	43
25	46
20	49
15	52
10	56
5	63

EQUIVALENT SOUND LEVEL = 58.6 DB

FILE UTAH06. DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	62. 1	69	66	49	42	41
63	48. 7	53	51	46	45	45
125	49. 9	55	53	48	42	41
250	40. 7	45	43	38	35	35
500	35. 2	38	36	34	34	34
1000	34. 5	35	34	34	34	34
2000	34. 1	34	34	34	34	34
4000	34	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	39. 7	43	42	38	35	35

Figure A-13

Background Ambient Sound Level Data

Location: 3
Date: 09/06/77
Time: 1800

FILE UTAH06. DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20μPa

```
34   **********  3. 3 %
35   ****************************  9. 4 %
36   ****************************************  13. 5 %
37   ******************************************  14. 2 %
38   ************************************  12. 1 %
39   ***********************************************  15. 9 %
40   *********************************  11. 1 %
41   *********************  7 %
42   ***************  5. 1 %
43   ***********  3. 8 %
44   ***  1. 1 %
45   ***  1. 2 %
46   **  0. 7 %
47   **  0. 5 %
48   *  0. 4 %
49   *  0. 4 %
50   *  0. 1 %
51   *  0. 1 %
52   *  0. 1 %
```

EQUIVALENT SOUND LEVEL = 39. 7 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	35
90	35
85	36
80	36
75	36
70	37
65	37
60	37
55	38
50	38
45	39
40	39
35	39
30	40
25	40
20	41
15	41
10	42
5	43

FILE UTAH07.DA<

OCTAVE BAND HZ.	LEQ DB	L_5	L_{10}	L_{50}	L_{90}	L_{95}
31.5	57.3	63	62	53	46	44
63	51.1	57	54	47	44	44
125	57.1	62	57	45	40	40
250	51.3	56	49	37	35	35
500	44.6	49	44	34	34	34
1000	39.2	44	41	34	34	34
2000	35.2	37	35	34	34	34
4000	34.1	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	47.7	54	48	38	35	35

Figure A-14

Background Ambient Sound Level Data

Location: 4
Date: 09/06/77
Time: 1835

FILE UTAH07.DA<
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20 μPa

```
34  ********  2.2 %
35  ********************************************  12.3 %
36  **************************************************  14 %
37  ***********************************************  13 %
38  ***********************************************  13.1 %
39  ************************  6.7 %
40  ***********************  6.5 %
41  ***************  4.3 %
42  ***************  4.3 %
43  *************  3.8 %
44  *********  2.5 %
45  ******  1.8 %
46  ********  2.3 %
47  ********  2.2 %
48  *****  1.5 %
49  ****  1.2 %
50  ***  0.7 %
51  *****  1.4 %
52  **  0.6 %
53  *  0.3 %
54  ***  0.9 %
55  ***  0.9 %
56  *  0.3 %
57  **  0.5 %
58  ***  0.7 %
59  **  0.5 %
60  **  0.4 %
61  *  0.2 %
62  *  0.2 %
63  *  0.2 %
64  *  0.1 %
65  *  0.1 %
66
67
68
69  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	35
90	35
85	36
80	36
75	36
70	37
65	37
60	37
55	38
50	38
45	39
40	39
35	40
30	41
25	42
20	43
15	46
10	48
5	54

EQUIVALENT SOUND LEVEL = 47.7 DB

FILE UTAH08.DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	47.5	54	51	41	33	31
63	36.9	41	39	35	34	34
125	39.7	47	43	31	29	29
250	29.7	36	34	26	25	25
500	27.5	32	30	24	24	24
1000	26.3	30	28	24	24	24
2000	24.1	24	24	24	24	24
4000	24.1	24	24	24	24	24
8000	24.1	24	24	24	24	24
A-WT.	30.9	36	34	27	26	25

Figure A-15

Background Ambient Sound Level Data

Location: 5
Date: 09/06/77
Time: 1915

FILE UTAH08.DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20uPa

```
25  ******************  7.3 %
26  ************************************************************  24.2 %
27  ********************************************************  22.6 %
28  ***********************  9.5 %
29  ***********  4.4 %
30  *****************  6.8 %
31  ************  4.9 %
32  ***********  4.4 %
33  ********  3.3 %
34  *********  3.9 %
35  ****  1.8 %
36  *******  3 %
37  ****  1.6 %
38  **  0.8 %
39  **  0.7 %
40  *  0.2 %
41  *  0.3 %
42  *  0.1 %
43
44
45
46
47
48
49
50  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	25
90	26
85	26
80	26
75	26
70	26
65	27
60	27
55	27
50	27
45	28
40	28
35	29
30	30
25	31
20	32
15	33
10	34
5	36

EQUIVALENT SOUND LEVEL = 30.9 DB

FILE UTAH23.DA

OCTAVE BAND HZ.	LEQ DB	L_{5}	L_{10}	L_{50}	L_{90}	L_{95}
31.5	71.1	78	75	65	52	50
63	61.4	67	65	58	54	54
125	57.9	63	61	55	51	50
250	50.3	54	52	46	42	41
500	49.8	49	47	41	37	37
1000	43.4	45	43	38	34	34
2000	38.9	39	37	34	34	34
4000	35.9	34	34	34	34	34
8000	34.3	34	34	34	34	34
A-WT.	51.2	53	51	46	42	41

Figure A-16

Background Ambient Sound Level Data

Location: 6
Date: 09/08/77
Time: 1800

A-Weighted Sound Level - dB re: 20 μPa

```
40  ************  2.3 %
41  **************************  5.1 %
42  *******************************  6.1 %
43  *******************************************  8.6 %
44  ***************************************************  10.2 %
45  *********************************************************  11.5 %
46  ***************************************************  10.3 %
47  *********************************************  9 %
48  **********************************  6.8 %
49  *******************************************  8.6 %
50  ******************************************  8.4 %
51  ***********************  4.6 %
52  *****************  3.3 %
53  *******  1.5 %
54  ***  0.7 %
55  ***  0.6 %
56  **  0.5 %
57  *  0.2 %
58  **  0.5 %
59  *  0.3 %
60
61
62  *  0.2 %
63
64
65  *  0.2 %
66  *  0.3 %
67
68  *  0.1 %
69  *  0.2 %
70  *  0.1 %
71  *  0.1 %
72  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	41
90	42
85	43
80	43
75	44
70	44
65	45
60	45
55	46
50	46
45	47
40	47
35	48
30	49
25	49
20	50
15	50
10	51
5	53

EQUIVALENT SOUND LEVEL = 51.2 DB

FILE UTAH24.DA

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	74	78	77	73	67	64
63	65.5	70	69	64	57	56
125	56.6	61	60	55	48	46
250	46.2	51	50	44	37	36
500	36.7	41	39	35	34	34
1000	34	34	34	34	34	34
2000	34	34	34	34	34	34
4000	34	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	45.4	50	49	44	37	36

Figure A-17

Background Ambient Sound Level Data

Location: 7
Date: 09/08/77
Time: 1850

A-Weighted Sound Level - dB re: 20 µPa

```
33  *  0.3 %
34  ****  0.9 %
35  ******  1.5 %
36  ***************  3.4 %
37  *********************  4.6 %
38  ********************  4.4 %
39  ********************  4.5 %
40  ***************************  6.2 %
41  ********************************  7.3 %
42  **************************  6 %
43  ****************************************  8.9 %
44  **************************************  8.6 %
45  *************************************  8.5 %
46  **************************************  8.7 %
47  ***********************************  7.9 %
48  *********************************  7.5 %
49  *********************  4.7 %
50  **********  2.3 %
51  *********  2 %
52  *****  1.1 %
53  ***  0.6 %
54  **  0.3 %
```

EQUIVALENT SOUND LEVEL = 45.4 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	36
90	37
85	38
80	40
75	40
70	41
65	42
60	43
55	43
50	44
45	44
40	45
35	45
30	46
25	47
20	47
15	48
10	49
5	50

FILE UTAH25.DA

OCTAVE BAND HZ.	LEQ DB	L_5	L_{10}	L_{50}	L_{90}	L_{95}
31.5	66.8	72	70	64	57	55
63	58.1	63	61	56	54	53
125	55.4	60	55	46	41	40
250	49.7	50	45	36	35	35
500	47.9	46	40	34	34	34
1000	42.9	48	40	34	34	34
2000	36.3	39	35	34	34	34
4000	34.1	34	34	34	34	34
8000	34	34	34	34	34	34
A-WT.	49.3	53	46	37	34	33

Figure A-18
Background Ambient Sound Level Data

Location: 8
Date: 09/08/77
Time: 1940

A-Weighted Sound Level - dB re: 20 uPa

```
32  *  0.1 %
33  **************************  8.4 %
34  *************************************************  15.8 %
35  **********************************  11.1 %
36  ************************************  11.5 %
37  *******************************  10.2 %
38  ***********************  7.6 %
39  ********************  6.6 %
40  *****************  5.4 %
41  ***********  3.4 %
42  *********  2.8 %
43  *********  2.8 %
44  ******  1.9 %
45  ****  1.3 %
46  *****  1.7 %
47  ***  0.8 %
48  ***  0.8 %
49  **  0.6 %
50  ***  0.8 %
51  ***  0.8 %
52  ***  0.8 %
53  ***  0.8 %
54  **  0.7 %
55  **  0.4 %
56  ***  0.9 %
57  **  0.7 %
58  *  0.2 %
59  *  0.3 %
60
61  *  0.2 %
62  *  0.1 %
63
64  *  0.3 %
65  *  0.1 %
66
67  *  0.2 %
68
69  *  0.1 %
70  *  0.1 %
71  *  0.1 %
72  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	33
90	34
85	34
80	34
75	35
70	35
65	35
60	36
55	36
50	37
45	37
40	38
35	39
30	39
25	40
20	41
15	43
10	46
5	53

EQUIVALENT SOUND LEVEL = 49.3 DB

FILE UTAH15.DA<

OCTAVE BAND HZ.	LEQ DB	L_{5}	L_{10}	L_{50}	L_{90}	L_{95}
31.5	49	54	52	48	44	44
63	39.5	43	42	38	36	36
125	45	50	48	44	39	39
250	35.5	41	38	33	30	30
500	42.9	47	46	42	34	34
1000	43.5	48	47	42	32	30
2000	30.4	33	33	30	27	27
4000	24.1	24	24	24	24	24
8000	25.7	27	25	24	24	24
A-WT.	46.4	51	50	45	37	37

Figure A-19

Background Ambient Sound Level Data

Location: 1
Date: 09/07/77
Time: 0035

FILE UTAH15.DA<
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20μPa

```
35  *  0.1 %
36  *****************  4.8 %
37  ****************************  8 %
38  ************************  6.7 %
39  ******************  5 %
40  *******  1.9 %
41  ******  1.8 %
42  *********  2.7 %
43  ******************  5.1 %
44  **********************  6.2 %
45  *****************************  8.4 %
46  ********************************************  12.9 %
47  **************************  7.5 %
48  ******************************  8.5 %
49  ***************************  7.6 %
50  ********************  5.6 %
51  ***************  4.4 %
52  *******  1.9 %
53  ***  0.7 %
54  *  0.1 %
```

EQUIVALENT SOUND LEVEL = 46.4 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-
95	37
90	37
85	38
80	39
75	40
70	42
65	43
60	44
55	45
50	45
45	46
40	46
35	47
30	47
25	48
20	49
15	49
10	50
5	51

FILE UTAH14.DA<

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	50.9	56	55	48	40	38
63	49.4	56	52	45	43	43
125	52.4	58	50	38	32	30
250	44.9	51	45	28	25	25
500	44.6	49	45	27	24	24
1000	41.1	48	43	24	24	24
2000	36.7	43	36	24	24	24
4000	29.8	31	24	24	24	24
8000	25	24	24	24	24	24
A-WT.	47.1	54	49	31	25	25

Figure A-20

Background Ambient Sound Level Data

Location: 2
Date: 09/06/77
Time: 2355

FILE UTAH14.DA<
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20uPa

```
25 ****************************  10.6 %
26 ********************************************  17 %
27 ***********  4.3 %
28 *****************  6.6 %
29 ****************  6.1 %
30 ********  3.1 %
31 *******  2.7 %
32 *************  5.2 %
33 *************  5.2 %
34 ************  4.6 %
35 *******  2.8 %
36 **********  3.9 %
37 ******  2.1 %
38 *******  2.7 %
39 *******  2.6 %
40 *****  1.8 %
41 ****  1.4 %
42 ******  2.2 %
43 ***  1.1 %
44 ***  1 %
45 ***  1.2 %
46 *  0.3 %
47 **  0.8 %
48 **  0.6 %
49 ***  1 %
50 **  0.7 %
51 ****  1.6 %
52 **  0.7 %
53 *  0.4 %
54 ***  1.2 %
55 ***  0.9 %
56 **  0.7 %
57 **  0.8 %
58 **  0.5 %
59 *  0.1 %
60 *  0.2 %
61 **  0.7 %
62 *  0.2 %
63 *  0.2 %
64
65 *  0.1 %
66 *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	25
90	25
85	26
80	26
75	26
70	27
65	28
60	29
55	30
50	31
45	32
40	33
35	34
30	36
25	38
20	40
15	43
10	49
5	54

EQUIVALENT SOUND LEVEL = 47.1 DB

FILE UTAH12. DAK

OCTAVE BAND HZ.	LEQ DB	L_{5}	L_{10}	L_{50}	L_{90}	L_{95}
31. 5	48. 2	54	53	44	33	31
63	39	45	42	36	35	35
125	40. 8	48	44	35	30	29
250	32. 1	39	37	26	25	25
500	35	43	40	24	24	24
1000	34. 5	42	39	24	24	24
2000	26. 1	31	28	24	24	24
4000	28. 7	30	29	29	27	27
8000	24. 5	25	24	24	24	24
A-WT.	39. 2	46	44	32	30	29

Figure A-21

Background Ambient Sound Level Data

Location: 3
Date: 09/06/77
Time: 2240

FILE UTAH12. DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20 μPa

```
27  *  0. 1 %
28  *  0. 2 %
29  **************  6. 7 %
30  ********************  9. 9 %
31  ****************************  13. 6 %
32  *****************************************  20. 4 %
33  ********************  10 %
34  *************  6. 3 %
35  *********  4. 2 %
36  ******  3 %
37  *****  2. 3 %
38  ****  1. 7 %
39  *****  2. 3 %
40  ***  1. 4 %
41  ****  1. 6 %
42  ******  2. 6 %
43  ****  1. 7 %
44  *****  2. 2 %
45  *********  4. 2 %
46  ****  1. 7 %
47  **  0. 9 %
48  **  1 %
49  **  0. 9 %
50  *  0. 4 %
51  *  0. 5 %
52
53
54  *  0. 1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	29
90	30
85	30
80	31
75	31
70	31
65	32
60	32
55	32
50	32
45	33
40	33
35	34
30	35
25	37
20	39
15	42
10	44
5	46

EQUIVALENT SOUND LEVEL = 39. 2 DB

FILE UTAH11.DAK

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31.5	45	51	49	41	35	34
63	46.6	51	48	44	43	43
125	48.6	52	48	35	31	31
250	39.8	42	38	27	25	25
500	36	41	38	25	24	24
1000	33.6	41	37	24	24	24
2000	28	34	30	24	24	24
4000	27.9	30	30	28	24	24
8000	24.7	26	25	25	24	24
A-WT.	39.9	47	42	33	28	28

Figure A-22

Background Ambient Sound Level Data

Location: 4
Date: 09/06/77
Time: 2200

FILE UTAH11.DAK
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re: 20µPa

```
26  **  0.6 %
27  ***********  3.2 %
28  *********************  6.3 %
29  *****************  4.9 %
30  ********************************  9.3 %
31  **********************************************  13.5 %
32  ***************************************  11.5 %
33  **********************************  10 %
34  **********************  6.6 %
35  ********************  5.8 %
36  ***************  4.4 %
37  **********  2.9 %
38  ********  2.5 %
39  *************  3.7 %
40  ********  2.3 %
41  ******  1.8 %
42  ******  1.7 %
43  ***  0.9 %
44  ****  1.2 %
45  ****  1 %
46  ***  0.8 %
47  ******  1.6 %
48  **  0.6 %
49  ***  0.9 %
50  **  0.6 %
51  *  0.3 %
52  *  0.2 %
53  *  0.2 %
54  *  0.3 %
55  *  0.2 %
56  *  0.1 %
57
58
59  *  0.1 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-D
95	28
90	28
85	29
80	30
75	31
70	31
65	31
60	32
55	32
50	33
45	33
40	34
35	34
30	35
25	36
20	38
15	39
10	42
5	47

EQUIVALENT SOUND LEVEL = 39.9 DB

FILE UTAH13. DA<

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	44. 8	51	50	37	26	25
63	41. 9	47	45	36	35	35
125	44. 4	52	49	35	30	29
250	34. 5	42	37	26	24	24
500	28. 9	34	31	24	24	24
1000	25. 3	28	27	24	24	24
2000	24. 2	25	25	24	24	24
4000	27. 5	28	28	27	27	27
8000	24. 3	25	24	24	24	24
A-WT.	35. 1	41	38	32	30	30

Figure A-23

Background Ambient Sound Level Data

Location: 5
Date: 09/06/77
Time: 2320

FILE UTAH13. DA<
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20 µPa

```
29  * 0.2 %
30  ************************************************* 19.8 %
31  ******************************************************* 22.2 %
32  ************************ 9.7 %
33  ****************************** 12.4 %
34  ********************** 8.9 %
35  ***************** 6.6 %
36  ************* 5.1 %
37  ******* 3 %
38  ****** 2.1 %
39  ******* 2.7 %
40  *** 1.5 %
41  **** 1.6 %
42  **** 1.7 %
43  *** 1.4 %
44  * 0.2 %
45  ** 0.8 %
46  * 0.1 %
```

EQUIVALENT SOUND LEVEL = 35.1 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	30
90	30
85	30
80	30
75	31
70	31
65	31
60	31
55	32
50	32
45	33
40	33
35	34
30	34
25	35
20	36
15	37
10	38
5	41

FILE UTAH26.DA

OCTAVE BAND HZ.	LEQ DB	L_{5}	L_{10}	L_{50}	L_{90}	L_{95}
31.5	51.5	56	54	49	46	45
63	54.4	60	58	49	46	46
125	52.8	57	54	51	49	49
250	44.8	51	48	41	39	39
500	38	44	41	34	33	33
1000	33	38	35	30	28	28
2000	30.4	33	31	29	28	28
4000	31.3	35	34	31	25	25
8000	24.4	25	25	24	24	24
A-WT.	43.1	48	46	41	39	39

Figure A-24

Background Ambient Sound Level Data

Location: 6
Date: 09/08/77
Time: 2200

A-Weighted Sound Level - dB re: 20µPa	%
38	* 0.3 %
39	13.4 %
40	24.3 %
41	21.4 %
42	14.6 %
43	7.8 %
44	4.8 %
45	3.3 %
46	2.5 %
47	2.4 %
48	1.9 %
49	1 %
50	0.9 %
51	0.3 %
52	0.7 %
53	0.1 %
54	0.2 %
55	
56	0.1 %
57	0.1 %

EQUIVALENT SOUND LEVEL = 43.1 DB

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	39
90	39
85	40
80	40
75	40
70	40
65	40
60	41
55	41
50	41
45	41
40	42
35	42
30	42
25	43
20	43
15	44
10	46
5	48

FILE UTAH27. DA<

OCTAVE BAND HZ.	LEQ DB	L_5	L_{10}	L_{50}	L_{90}	L_{95}
31. 5	36. 5	42	41	25	24	24
63	43. 2	44	44	43	43	43
125	34. 2	40	34	30	29	29
250	27. 3	33	27	25	25	25
500	25. 3	30	27	24	24	24
1000	25	27	25	24	24	24
2000	24	24	24	24	24	24
4000	24	24	24	24	24	24
8000	24. 1	24	24	24	24	24
A-WT.	27. 7	33	30	25	24	24

Figure A-25

Background Ambient Sound Level Data

Location: 7
Date: 09/08/77
Time: 2245

FILE UTAH27. DA<
A-WT. SOUND LEVELS

A-Weighted Sound Level - dB re 20uPa

23	*	0. 1 %
24	***	43. 7 %
25	**************************************	33. 3 %
26	*****	3. 9 %
27	*****	4. 4 %
28	**	1. 6 %
29	**	1. 8 %
30	***	1. 9 %
31	***	2. 1 %
32	**	1. 4 %
33	**	1. 7 %
34	**	1. 1 %
35	*	0. 6 %
36	*	0. 8 %
37	*	0. 6 %
38	*	0. 4 %
39	*	0. 3 %
40	*	0. 2 %
41	*	0. 1 %
42		
43		
44		
45	*	0. 1 %

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	24
90	24
85	24
80	24
75	24
70	24
65	24
60	24
55	25
50	25
45	25
40	25
35	25
30	25
25	25
20	26
15	27
10	30
5	33

EQUIVALENT SOUND LEVEL = 27. 7 DB

FILE UTAH29. DA

OCTAVE BAND HZ.	LEQ DB	L 5	L 10	L 50	L 90	L 95
31. 5	42. 7	46	43	27	24	24
63	44. 5	47	44	43	43	43
125	47. 3	48	39	31	30	30
250	33	35	28	25	25	24
500	36. 7	35	28	24	24	24
1000	37. 2	38	29	24	24	24
2000	30. 7	30	25	24	24	24
4000	24. 9	24	24	24	24	24
8000	24	24	24	24	24	24
A-WT.	41	42	33	25	24	24 ?

A-Weighted Sound Level - dB re: 20uPa

```
24  *********************************************************  34. 3 %
25  *********************************************************  34 %
26  ************  6. 9 %
27  *******  4. 1 %
28  ***  2. 3 %
29  ****  2. 4 %
30  ***  2. 3 %
31  **  1. 4 %
32  **  1. 1 %
33  **  1. 3 %
34  **  1 %
35  *  0. 5 %
36  *  0. 5 %
37  *  0. 3 %
38  *  0. 7 %
39  **  0. 9 %
40  *  0. 4 %
41  *  0. 4 %
42  *  0. 4 %
43  *  0. 2 %
44  *  0. 3 %
45  *  0. 8 %
46  *  0. 4 %
47  *  0. 3 %
48  *  0. 1 %
49  *  0. 3 %
50  *  0. 1 %
51  *  0. 2 %
52  *  0. 5 %
53  *  0. 3 %
54  *  0. 3 %
55  *  0. 2 %
56  *  0. 3 %
57  *  0. 3 %
58  *  0. 1 %
59  *  0. 1 %
60  *  0. 3 %
61  *  0. 2 %
```

CUMULATIVE DISTRIBUTION

(%) EXCEEDED	SOUND PRESSURE LEVEL-DB
95	24
90	24
85	24
80	24
75	24
70	24
65	25
60	25
55	25
50	25
45	25
40	25
35	25
30	26
25	26
20	28
15	30
10	33
5	42

Figure A-26

Background Ambient Sound Level Data

Location: 8
Date: 09/08/77
Time: 2330

EQUIVALENT SOUND LEVEL = 41 DB

APPENDIX H

REPORT
SITE SELECTION AND DESIGN STUDY
TAILING RETENTION AND MILL FACILITIES

REPORT
SITE SELECTION AND DESIGN STUDY
TAILING RETENTION AND MILL FACILITIES
WHITE MESA URANIUM PROJECT
BLANDING, UTAH
FOR ENERGY FUELS NUCLEAR, INC.

09973-015-14

January 17, 1978

Energy Fuels Nuclear, Inc.
Suite 445
Three Park Central
1515 Arapahoe Street
Denver, Colorado 80202

Attention: Mr. Muril D. Vincelette

Gentlemen:

With this letter we are transmitting our report titled "Site Selection and Design Study, Tailing Retention and Mill Facilities, White Mesa Uranium Project, Blanding, Utah, for Energy Fuels Nuclear, Inc." The purpose and scope of this study were planned in discussions between Mr. Muril Vincelette of Energy Fuels and Messrs. Richard Brittain and K.R. Porter of Dames & Moore. The purpose and scope are summarized in our submittal titled "Proposed Mill and Tailings Disposal Site Selection Studies, Environmental Studies, and Cost/Task Schedules for Energy Fuels" dated July 1977.

This investigation was performed in two parts. The initial studies for a mill at White Mesa involved the selection of the most suitable tailing retention site. The subsequent studies were concerned with design recommendations for the tailing retention facility, and for the earthwork and foundations associated with the mill. Detailed descriptions of the site conditions encountered, site selection studies, and design recommendations are contained in the report. A detailed description of the field explorations and laboratory testing performed in conjunction with this study are presented in Appendix A and Appendix B, respectively.

We appreciate the opportunity of performing this study for you. If you have any questions concerning this report or if we can be of further service, please contact us.

Very truly yours,

DAMES & MOORE

Kenneth R. Porter, Ph.D.
Project Manager

Ronald E. Versaw
Senior Engineer

KRP:REV:tlg

Enclosure

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WHITE MESA URANIUM PROJECT
BLANDING, UTAH
FOR ENERGY FUELS NUCLEAR, INC.

INTRODUCTION

This report presents the results of Dames & Moore's site investigation and design study for the proposed tailing retention system and mill facilities near Blanding, Utah. The general location of the site is shown on Plate 1, Vicinity Map.

PURPOSE AND SCOPE

The purpose of the study was two-fold:

1. To select the most desirable tailing retention and mill sites with regard to engineering and general environmental considerations.
2. To provide geotechnical and hydrological parameters for preliminary design of the tailing retention system and mill. These design studies provide the information required as part A of the support data for an operating license.

To accomplish these purposes, the scope of work was completed in two phases. The first phase, or site selection phase, included the following items:

1. Review of existing engineering, topographic and geologic data for tentative selection of possible retention sites, followed by preliminary engineering calculations of area/depth requirements for each site.
2. A field reconnaissance of each potential retention site and the mill site for a preliminary assessment of geotechnical and environmental conditions.
3. Design of a drilling and sampling program for the retention areas and the mill site selected as being the most suitable sites based on the preceding office and field investigations.

The second phase, or detailed field exploration and preliminary design phase, included the following items.

1. A subsurface investigation program of the areas defined in the site selection phase which included; drilling, logging and sampling of 28 borings; field permeability measurements by means of packer tests in five of those borings; and installation of five standpipe piezometers.

2. A surface investigation program which included detailed geologic mapping of the site area and investigation of potential clay and sand borrow areas.

3. A laboratory testing program which included moisture and density determinations, Atterberg limit determinations, grain size analyses, consolidation tests, compaction tests, permeability tests on undisturbed and recompacted samples, triaxial compression and direct shear tests on undisturbed and recompacted samples, and chemical analyses.

4. A program of engineering analysis and preliminary design which included:

   a. Seismology study to derive seismic design criteria for use in slope stability, foundation stability and liquefaction potential analyses.

   b. Foundation design and site grading criteria for the mill area.

   c. Layout of the tailing retention system and dike design, including recommendations for slope angle, crest width, dike height and volumes, freeboard, construction materials, compaction criteria, and the calculation of pond capacity-surface area relationships.

   d. Estimates of seepage from the tailing areas under various lined and unlined conditions to evaluate alternatives for seepage control.

   e. Design of the layout and installation details for monitor wells.

   f. Evaluation of the control of surface runoff.

   g. Design of a final reclamation program for the tailing retention facility.

5. Preparation of this report, which summarizes Dames & Moore's conclusions and recommendations, presents appropriate construction plans and sections and documents the supporting field, laboratory and engineering data.

DESIGN CONSIDERATIONS

The uranium processing mill and tailing retention facility planned for construction by Energy Fuels Nuclear, Inc., near Blanding, Utah will mill ore from approximately 100 relatively small mining operations in the Four Corners Region. Feed for the mill is presently being stockpiled at two buying stations, one located on the project site and the other located 122 miles away by road near Hanksville, Utah.

The mill is planned to process 2000 tons per day (tpd) of uranium ore using an acid leach process. The solid wastes (tailing) produced by the mill will be slurried to approximately 50 percent water by weight. This slurry will be transported in a pipeline to the tailing retention facility. Any excess water which is not permanently entrained in the tailing will be evaporated from the surface of the pond. During the projected 15-year life of the mill approximately 11 million tons of solid tailing will be produced at a rate of 2000 tpd. Tailing will be permanently contained in the tailing retention facility. The objective of the design of the tailing retention system is to provide permanent safe containment for the required quantity of tailing with a minimum of impact on the surrounding environment.

Since the natural soils and bedrock at the site are permeable, some type of lining system will be required to control seepage from the disposal area. Laboratory testing on the soils indicates that these materials respond to compaction with a decrease in permeability of approximately one order of magnitude. Regardless of the type of seepage control system used, observation wells will be established at appropriate locations around the pond perimeter for monitoring of ground water quality.

Precipitation and annual evaporation rate must be accounted for in water balance calculations. Storm runoff outside the retention facility area will, at most locations, flow naturally away from the tailing retention area. Runoff from the main drainage depressions north of the mill site and tailing retention area must be prevented from flowing uncontrolled.

The emanation of radioactive gases from the surface of the tailing retention facility must be controlled in accordance with applicable rules and regulations.

RETENTION SYSTEM SELECTION

Prior to the selection of the tailing retention system detailed in this report, several concepts were considered. These included: using tailing to backfill the mines from which ore was extracted; burial in a single large pit; storage behind "conventional" dams or dikes; and storage in cells constructed partially below grade.

(See additional study, Appendix I, on Alternative Tailings Disposal Systems dated April, 1978 by Western Knapp Engineering with Energy Fuels' staff comments.)

ALTERNATIVE CONCEPTS

Backfilling Mines

Replacing the tailing in the mines from which the ore was extracted was considered but this alternative is not suited to a central milling operation which services approximately 100 small, widely distributed mines with diverse ownerships. The management of such a procedure would be very difficult because tailing could only be backfilled in mines which were depleted and inoperative. Placement of the tailing in an active mine could interfere with mining operations and could create a radon exposure hazard to miners. Adequate control of the transportation, handling and storage of the tailing, and monitoring the effects of the tailing on the environment would be virtually impossible. Transportation costs for this alternative would be prohibitive.

Large Pit

Total burial of the tailing would require the excavation and disposal of a volume of soil and underlying sandstone bedrock equal to the volume of the tailing. This requirement would lead to additional disturbance of land and would be prohibitively expensive. It would also be very difficult and expensive to effectively control seepage from the sidewalls and bottom of the pit. Moreover, the pit would place the tailing closer to the ground water than other alternatives and a high potential for ground water contamination would result.

REVISED
ltr dtd 5/2/78

DESIGN CONSIDERATIONS

The uranium processing mill and tailing retention facility planned for construction by Energy Fuels Nuclear, Inc., near Blanding, Utah will mill ore from approximately 100 relatively small mining operations in the Four Corners Region. Feed for the mill is presently being stockpiled at two buying stations, one located on the project site and the other located 122 miles away by road near Hanksville, Utah.

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Since the natural soils and bedrock at the site are permeable, some type of lining system will be required to control seepage from the disposal area. Laboratory testing on the soils indicates that these materials respond to compaction with a decrease in permeability of approximately one order of magnitude. Regardless of the type of seepage control system used, observation wells will be established at appropriate locations around the pond perimeter for monitoring of ground water quality.

Precipitation and annual evaporation rate must be accounted for in water balance calculations. Storm runoff outside the retention facility area will, at most locations, flow naturally away from the tailing retention area. Runoff from the main drainage depressions north of the mill site and tailing retention area must be prevented from flowing uncontrolled.

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Total burial of the tailing would require the excavation and disposal of a volume of soil and underlying sandstone bedrock equal to the volume of the tailing. This requirement would lead to additional disturbance of land and would be prohibitively expensive. It would also be very difficult and expensive to effectively control seepage from the sidewalls and bottom of the pit. Moreover, the pit would place the tailing closer to the ground water than other alternatives and a high potential for ground water contamination would result.

DESIGN CONSIDERATIONS

The uranium processing mill and tailing retention facility planned for construction by Energy Fuels Nuclear, Inc., near Blanding, Utah will mill ore from approximately 100 relatively small mining operations in the Four Corners Region. Feed for the mill is presently being stockpiled at two buying stations, one located on the project site and the other located 122 miles away by road near Hanksville, Utah.

The mill is planned to process 2000 tons per day (tpd) of uranium ore using an acid leach process. The solid wastes (tailing) produced by the mill will be slurried to approximately 50 percent water by weight. This slurry will be transported in a pipeline to the tailing retention facility. Any excess water which is not permanently entrained in the tailing will be evaporated from the surface of the pond. During the projected 15-year life of the mill approximately 11 million tons of solid tailing will be produced at a rate of 2000 tpd. Tailing will be permanently contained in the tailing retention facility. The objective of the design of the tailing retention system is to provide permanent safe containment for the required quantity of tailing with a minimum of impact on the surrounding environment.

Since the soils and bedrock at the site are permeable, a relatively impermeable liner will be required to control seepage from the disposal area. Observation wells will be established at appropriate locations around the pond perimeter to permit the monitoring of ground water quality.

Precipitation and annual evaporation rate must be accounted for in water balance calculations. Storm runoff outside the retention facility area will, at most locations, flow naturally away from the tailing retention area. Runoff from the main drainage depressions north of the mill site and tailing retention area must be prevented from flowing uncontrolled.

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The emanation of radioactive gases from the surface of the tailing retention facility must be controlled in accordance with applicable rules and regulations.

RETENTION SYSTEM SELECTION

Prior to the selection of the tailing retention system detailed in this report, several concepts were considered. These included: using tailing to backfill the mines from which ore was extracted; burial in a single large pit; storage behind "conventional" dams or dikes; and storage in cells constructed partially below grade.

ALTERNATIVE CONCEPTS

Backfilling Mines

Replacing the tailing in the mines from which the ore was extracted was considered but this alternative is not suited to a central milling operation which services approximately 100 small, widely distributed mines with diverse ownerships. The management of such a procedure would be very difficult because tailing could only be backfilled in mines which were depleted and inoperative. Placement of the tailing in an active mine could interfere with mining operations and could create a radon exposure hazard to miners. Adequate control of the transportation, handling and storage of the tailing, and monitoring the effects of the tailing on the environment would be virtually impossible. Transportation costs for this alternative would be prohibitive.

Large Pit

Total burial of the tailing would require the excavation and disposal of a volume of soil and underlying sandstone bedrock equal to the volume of the tailing. This requirement would lead to additional disturbance of land and would be prohibitively expensive. It would also be very difficult and expensive to effectively control seepage from the sidewalls and bottom of the pit. Moreover, the pit would place the tailing closer to the ground water than other alternatives and a high potential for ground water contamination would result.

Not adequately evaluated

Grd. water 70-100 ft (perched table?)

Conventional Surface Retention

Four conventional retention sites were studied. The locations of these are shown on Plate 2, Plot Plan.

Two of the conventional alternatives could be classified as dams, where the tailing would be contained in a valley by means of a dam of considerable height, while the other two alternatives are essentially ponds, where the tailing would be contained over a large area of the gently sloping surface of the mesa by dikes of relatively low height.

East Site - This would involve constructing a 120-foot high dam across Corral Creek Canyon which is east of the buying station, across Highway 163. The reservoir surface area would be relatively small, which is beneficial for reclamation purposes. However, the drainage area for the reservoir is large, and flood control would a problem. Also, sealing the steep canyon walls, which are mostly sandstone, would be difficult. The reservoir surface area, drainage area and maximum dam height for this and the other alternatives discussed in this section are summarized in Table 1.

TABLE 1

COMPARISON OF ALTERNATE DISPOSAL SITES

Dam Site	Surface Area (acres)	Drainage Area (acres)	Maximum Dam Height (feet)
East	120	3400	120
West	68	850	230
North	215	420	80
South	250	590	65
Proposed Pond System	70 (each cell)	70 (each cell)	45

West Site - A dam could be constructed across a minor tributary of the Westwater Creek Canyon. While this site would have the least pond surface area and a moderate drainage area, the dam itself would have to be quite high in order to provide the required storage capacity. Also, the toe of the dam would be in the flood plain of Westwater Creek. Control of seepage into the nearly vertical sandstone canyon walls would be extremely difficult. Also this site would encroach upon a well-preserved Moqui Indian cliff dwelling.

North and South Sites - Both of these would entail the construction of a single long dike to contain the tailing on the gently sloping mesa between the Westwater and Corral Creeks. Relatively low dikes and large pond surface areas would result. For these conditions, seepage would be expected to travel downwards to the water table in the mesa, some 50 to 100 feet below the ground surface. Because of the close proximity of the north site to the Westwater Creek Canyon, seepage into this drainage would have a relatively short flow path.

Retention Cells

The scheme finally selected for the tailing retention system will comprise three rectangular trenches lined with impermeable membranes each cell with a storage capacity of 5 years. This system will be constructed in 3 stages and could be reclaimed in three stages. Other advantages include; small surface areas, partial burial of the tailing below the existing ground surface, effectively zero cell seepage and reduced dike heights. The scheme is described in detail in subsequent sections of this report and illustrated on Plate 2.

PROJECT VICINITY CONDITIONS

TOPOGRAPHY, VEGETATION AND CLIMATE

The site is located on the gently rolling, slightly sloping White Mesa in San Juan County, Utah, approximately 6 miles south of Blanding. The mesa is comprised of about 29,000 acres and is bounded on the west by the deeply incised Westwater Creek and Cottonwood Wash and on the east by Corral Creek. The southerly sloping topography creates a drop in elevation across the project site (see Plate 2) of about 150 feet, from a maximum elevation of approximately 5700 feet at the northern end about to a minimum elevation of approximately 5550 feet at the southern end. Ground surface elevation over the proposed tailing retention and mill sites varies by approximately 50 feet. All creeks and drainages in the vicinity of the site are intermittent, although a few springs are located in the canyon walls.

Vegetation consists principally of Pinyon-Juniper woodland along the rocky slopes of the deeply incised canyons, with Big Sagebrush community being dominant on the deeper soil and flatter terrain of the mesa.

Typically, temperatures in the area range from highs near 100°F in summer to lows below zero in winter. Annual precipitation at the site averages about 12 inches and is distributed relatively uniformly. The average total annual evaporation rate is about 64 inches per year.

ENGINEERING GEOLOGY

Structure

The geologic structure at the project site is simple. Strata of the underlying Mesozoic sedimentary rocks are nearly horizontal with only slight undulations along the caprock rims of the mesa. Faulting is absent. In much of the area surrounding the project site the dips are less than one degree. The prevailing regional dip is about one degree to the south. The low dips and simple structure are in sharp contrast to the pronounced structural features of the Comb Ridge Monocline to the west and the Abajo Mountains to the north.

Jointing is common in the exposed Dakota-Burro Canyon sandstones along the mesa's rim. Most of the joints are essentially parallel to the cliff faces. Since erosion of the underlying weaker Brushy Basin mudstones removes both vertical and lateral support of the sandstone, large joint blocks commonly break away from the cliff leaving joint surfaces as the cliff face. Because of this, it is not possible to determine if the joints influenced the development of canyons and cliffs. However, from a geomorphologic standpoint, it appears that the joints are related to the compaction of the underlying strata and, therefore, are sedimentary features rather than tectonic in origin. Whatever the original cause, two sets of joint attitudes exist in the resistant sandstones at the project site. These sets range from N10-18°E and N60-85°E and nearly parallel the cliff faces.

Geotechnical Conditions at the Proposed Site

The geotechnical conditions of the site were investigated in detail during September 1977. A total of 28 borings were drilled and this information was supplemented by site reconnaissance. The field exploration program is described in detail in Appendix A.

The mill site is covered by relatively thin reddish-brown silty fine sand and fine sandy silt soil layer which ranges from 7.5 to 14.5 ft in thickness. These soils are of a loessal origin, but have been partially reworked by surface water (probably precipitation runoff). In general, they are loose at the surface, are medium dense within 1 to 2 feet, and become more dense with an increase in depth. In places, these materials are slightly to moderately cemented with calcium carbonate. The tailing retention site is underlain by the same soil types. However, the thickness of soil in this area ranges from 3 to 17 ft.

clay

In 11 of the 28 borings drilled during the field investigation, a light gray-brown to grayish-green, stiff to very-stiff, silty clay was encountered below the loessal soil materials. It is possible that these silty clays are highly weathered shales of the Upper Cretaceous Mancos Formation. Thickness of the silty clays range from 1.5 to 11 ft. The thinner layers could be mudstones and claystones that are known to be included in the upper marine facies of the underlying Dakota Sandstone, but the thicker layers tend to indicate that these materials could be Mancos shale. Regardless of origin, these materials have undergone substantial weathering and should be classified as soil rather than rock.

Underlying the loessal soils and silty clays is the Dakota Sandstone Formation. This formation is composed of a hard to very hard, fine-to coarse-grained sandstone and conglomeratic sandstone. It is poorly to highly cemented with silica or calcium carbonate, sometimes with iron oxides. Losses of drilling fluid during the subsurface investigation indicate that permeable zones exist within the formation. The contact between the Dakota Sandstone and the underlying lower Cretaceous Burro Canyon Formation is extremely difficult to detect in a drill hole without continuous coring. Sometimes it may be identified by a thin greenish-gray mudstone layer beneath the Dakota's basal conglomerate. Where the sandstones of the Dakota rest on Burro Canyon sandstones, the contact can hardly be distinguished even in outcrops. From a geotechnical appraisal, the physical properties and characeristics of the two formations are nearly identical, even sharing the same joint patterns and having similar zones of high permeability.

SEISMOLOGY

Seismic History of Region

Because of the region's late settlement, the record of earthquake occurrences in the Colorado Plateau and surrounding regions dates back only 125 years. Documentation of the early events was based solely on newspaper reports that frequently recorded effects only in the more populated areas which may have been some distance from the epicenters. Not until the late 1950s was a seismograph network developed to properly locate and evaluate seismic events in this region (Simon, 1972).

From a tectonic standpoint, the project area is within a relatively stable portion of the Colorado Plateau. The area is noted for its scarcity of historical seismic events. In contrast, the border between the Colorado Plateau and the Basin and Range Province and Middle Rocky Mountain Province (which ranges from 155 miles west to 239 miles north-west of the site) is one of the most active seismic belts in the western United States.

The epicenters of historical earthquakes from 1853 through 1976 within a 200 mile radius of the site are shown on Plate 3, Regional Epicenter Map. More than 450 events have occurred in the area, of which at least 45 were damaging; that is, having an intensity of VI or greater on the Modified Mercalli Scale.

Relationship of Earthquakes to Tectonic Structures

The majority of recorded earthquakes in Utah have occurred along an active belt of seismicity that extends from the Gulf of California, through western Arizona, central Utah, and northward into western British Columbia. The seismic belt is possibly a branch of the active rift system associated with the landward extension of the East Pacific Rise (Cook and Smith, 1967).

It is significant to note that the seismic belt forms the boundary zone between the Basin and Range and the Colorado Plateau-Middle Rocky Mountain Provinces. This block-faulted zone is about 47 to 62 miles wide and forms a tectonic transition zone between the relatively simple structures of the Colorado Plateau and the complex fault-controlled structures of the Basin and Range Province.

Another zone of seismic activity is in the vicinity of Dulce, New Mexico near the Colorado border. This zone, which coincides with an extensive series of Tertiary intrusives, may also be related to the northern end of the Rio Grande Rift. This rift is a series of fault-controlled structural depressions extending southward from southern Colorado through central New Mexico and into Mexico.

SURFACE WATER HYDROLOGY

Site Drainage

All project facilities are located on a relatively flat, slightly sloping mesa on which the surface water drainage patterns are poorly defined. Westwater Creek to the west and Corral Creek to the east are the major drainage channels which define the mesa; however, the southern end of the project drains directly to Cottonwood Wash below its confluence with Westwater Creek. The majority of project features will be constructed within that portion of the mesa which drains to Cottonwood Wash. Corral Creek, on the eastern edge of the mesa, receives runoff flow from only a small part of the buying station. Plate 4, Site Drainage, shows a plan of the project site drainage.

Normal Annual Conditions

The average annual surface water yield of this region expressed as depth has been estimated as 0.5 inches or less. If all this runoff occurred in one day, a pond would form against the north side of the northern retention cell just slightly larger than the 100 year pond shown on Plate 4. Such a pond would be approximately two to four feet deep. This water could easily be evaporated in the following twelve months, since the annual evaporation in the project area is about 64 inches.

However, the annual runoff, does not occur in a single day; rather, it occurs in several smaller parts throughout the year. Therefore we expect that a pond would only rarely form and then for only a few days. The alternate filling and evaporating would limit the pond size to less than one acre in most years and in dry years, no pond would form at all.

Flood Flows

The drainage of interest is that area which contributes to flow across the mill site and to the impoundment caused by the northern tailing cell. North of the mill the topography causes a concentration of surface water runoff at two points as it enters the fenced area around the mill and tailing retention sites. These drainages turn west within the restricted area and then join to form one drainage which exits the fenced area along the western perimeter. At the northern fence line the areas for these drainages are 41 acres and 20 acres for the western and eastern basins respectively.

Using the results of a precipitation analysis and the rational formula for flood flows with a SCS (Soil Conservation Service) curve number of 60, the peak flood flows with a recurrence interval of 100 years have been computed to be approximately 41 cfs and 20 cfs for the western and eastern basins respectively. The probable maximum precipitation, which would occur as a thunderstorm, would produce a peak flow (curve number 85) of about 540 cfs in the western basin and 265 cfs in the eastern basin.

GROUND WATER HYDROLOGY

Ground Water Regime

The project site, located on a flat-top mesa approximately 2 to 3 miles wide, is partly covered with a thin veneer of loessal soils which in some places is underlain by the Mancos shale and in other locations by the Dakota sandstone formation. The Mancos is not an aquifer at the site. Stratigraphically below the Mancos shale is the Dakota sandstone, the Burro Canyon formation and the Morrison formation which yield fresh to slightly saline water to springs and shallow wells in the project vicinity. Both the Dakota sandstone and the Burro Canyon formation crop out in the canyon walls and valleys on Cottonwood Creek and Corral Creek near the site. The formations are continuous beneath the site, extending from the outcrops in Corral Creek Canyon east of the site to the Canyon of Cottonwood Creek and Westwater Creek west of the site.

Recharge

In the project vicinity, the Dakota sandstone and the Burro Canyon formation locally receive recharge from infiltration of rainfall on the flat-lying mesa.

In the site area, the Dakota sandstone and Burro Canyon formation are well jointed by a series of sub-parallel joint sets trending between roughly N10-18E and N60-85E. These joints provide pathways for the percolation of rainfall and downward infiltration of ponded surface waters on the site. The joints also act as conduits for the local movement of ground water underneath the site.

Ground Water Depth

As shown on the logs of borings in Appendix A attached to this report the ground water depth is in the range of 50 to 60 feet in the mill area and 70 to 100 feet in the tailing retention area. This water is thought to be a perched table confined to the Dakota sandstone and Burro Canyon formations.

Ground Water Movement

The movement of ground water occurring at shallow depths in the Dakota sandstone and Burro Canyon formation at the project site is believed to be confined to a very local area. These formations are exposed and crop out in the canyon walls of the surface drainages both east and west of the site. The near surface formations dip one or two degrees to the south. Thus, water percolating into the near surface formations of the project site, such as the Burro Canyon and Dakota sandstone, will generally migrate southward downdip. It is probable that slight ground water mounding may occur in the central part of the mesa at the site. Ground water levels may be higher in elevation in the center of the mesa and lower in elevation to the east and west where some of the shallow depth ground water drains from the mesa through springs and seeps in the canyons of Westwater, Cottonwood and Corral Creeks.

It appears that the shallow ground water forming the water table throughout the project vicinity has a gradient toward the south-southwest. The general ground water gradient appears to be related to the general topographic gradient; i.e., the highest elevations are generally at the northeastern edge of the project site near Highway 163 and the lowest elevations are at the property's southwest corner. Based on the recorded water levels as shown on the boring logs and assuming that the water table is continuous throughout the site, it can be calculated that the water table gradient under the mill site is about 0.03, and that under the tailing retention area is 0.01.

A number of "permeability" tests were conducted in boreholes during the geotechnical investigation of the mill site and tailing retention site. The tests used packers and injection of water under pressure for various periods of time. The results of these "permeability" tests indicate that, in general, the hydraulic conductivity ("horizontal permeability") of the formations below the water table, on the average, ranges between 5 and 10 feet per year. However, it should be noted that some of the packer tests conducted above the water table indicated a much higher hydraulic conductivity while a few packer tests conducted both above and below the water table indicated a much lower hydraulic conductivity for selected intervals.

Using the formula based on Darcy's Law

$$V = \frac{Ki}{\theta}$$

where:

V = the rate of movement of ground water through formation

K = "permeability"; hydraulic conductivity of formation (measured as 5 to 10 ft/yr)

θ = porosity of formation (assumed as 20 percent)

i = gradient (calculated as 0.03 at mill site use 0.01 at tailing retention site)

the average rate of ground water movement through the water-saturated portion of the formation below the water table can be estimated. Thus, based on the recorded values and implied assumptions, it is estimated that, on the average, the shallow ground water movement at the mill site is approximately 0.01 to 0.02 ft per year toward the south-southwest and the shallow ground water movement at the tailing retention site is approximately 0.0025 to 0.01 ft per year toward the south-southwest.

DESIGN OF TAILING RETENTION FACILITY

GENERAL

The tailing retention system will consist of three individual, rectangular lined cells with horizontal bottoms. The cell dikes will be constructed from materials excavated from within the cell interiors. As a result the bottom of the cells will generally be below the existing ground level. The excavated material will also be used for covering the cells during final reclamation. Topsoil will be removed and stockpiled before commencement of other construction activities. The location and layout of the cell system and topsoil storage-borrow area are shown on Plate 2.

Each cell will have a surface area of approximately 70 acres to meet water balance requirements. Cell depths of approximately 37 feet will provide storage capacity for approximately 5 years of mill operation at a feed rate of 2000 tpd, and including 5 feet of freeboard for containing precipitation and wave action. Construction of the cells will be staged so that each cell will be completed shortly before the preceding cell is filled. This will result in a minimum of site disturbance and exposed cell surface area at any one time. It is intended to commence operation with the north cell and then to construct and operate the middle and south cells in turn. The elevation versus surface area and capacity curves for the north cell is given on Plate 5. The corresponding curves for the middle and south cells would be similar to the north cell except for different elevations.

The north cell has been designed to achieve an approximate balance between excavated material and dike fill requirements. The middle and south cells are designed to provide a sufficient excess of excavated material to enable adequate covering of the adjacent cell during reclamation. The south cell will be covered by material borrowed immediately to the south unless sufficient material is generated in the cell's construction.

The interior of each cell will be constructed with a horizontal bottom and uniformly sloping sides. This regularity will facilitate the installation of the impermeable membrane liner which will be installed in each cell to control seepage. To protect the liner from damage, a layer of fine sand and silt bedding will be placed over the excavated rock surface prior to installation. Following installation of the liner, a covering layer of fine sand and silt will be installed over the entire liner surface to protect the liner from wind loads, abrasion, punctures and similar accidents. Typical sections illustrating lining details are shown on Plate 6.

Dikes will be constructed with constant interior and exterior slopes of 3 (horizontal): 1 (vertical). Considering the fact that the cell lining should prevent significant seepage through the dikes, these slope angles are conservative from the point of view of dike stability. The angles are also appropriate for reclamation of the exterior dike slopes and for facilitating liner installation on the interior dike slopes.

The cells will have no spillway facilities since each will be a closed system with ample freeboard for storage of the design storm as defined by Regulatory Guide 3.11.

Following paragraphs of this section summarize the analyses which were completed in designing the tailing retention facility and detailed design recommendations.

DESIGN ANALYSES

Seepage

Field permeability testing (packer tests) indicated that the permeability of the Dakota sandstone is generally in the range of 5 to 10 feet per year and that zones of high permeability are also present. This indicates that seepage from the tailings cells could possibly enter shallow ground water. Therefore, it is necessary to line the cells. However, there are no suitable on-site soils which could be used for lining material. Shale formations (predominantly from the Jurassic Morrison formation) outcrop in valley bottoms and canyons walls around the site, but these are not clay-like and probably would require considerable processing at high cost to produce a clay-like material which could be used for a lining. Even if these shales were processed, the seepage from a single cell lined with 2 feet of processed shale has been estimated at between 50 and 100 gpm. Therefore, to minimize seepage, the cell system has been designed with a synthetic membrane lining. This design should result in negligible seepage.

Material Properties

The physical properties of the materials which will be involved in the construction of the tailing cells were evaluated by means of

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Each cell will have a surface area of approximately 70 acres to meet water balance requirements. Cell depths of approximately 37 feet will provide storage capacity for approximately 5 years of mill operation at a feed rate of 2000 tpd, and including 5 feet of freeboard for containing precipitation and wave action. Construction of the cells will be staged so that each cell will be completed shortly before the preceding cell is filled. This will result in a minimum of site disturbance and exposed cell surface area at any one time. It is intended to commence operation with the north cell and then to construct and operate the middle and south cells in turn. The elevation versus surface area and capacity curves for the north cell is given on Plate 5. The corresponding curves for the middle and south cells would be similar to the north cell except for different elevations.

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The interior of each cell will be constructed with a horizontal bottom and uniformly sloping sides. This regularity will facilitate the installation of the impermeable membrane liner which will be installed in each cell to control seepage. To protect the liner from damage, a layer of fine sand and silt bedding will be placed over the excavated rock surface prior to installation. Following installation of the liner, a covering layer of fine sand and silt will be installed over the entire liner surface to protect the liner from wind loads, abrasion, punctures and similar accidents. Typical sections illustrating lining details are shown on Plate 6.

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The cells will have no spillway facilities since each will be a closed system with ample freeboard for storage of the design storm as defined by Regulatory Guide 3.11.

Following paragraphs of this section summarize the analyses which were completed in designing the tailing retention facility and detailed design recommendations.

DESIGN ANALYSES

Seepage

Field permeability testing (packer tests) indicated that the permeability of the Dakota sandstone is generally in the range of 5 to 10 feet per year and that zones of high permeability are also present. Laboratory tests on the natural soils indicated permeabilities ranging from 3.9 to 144 feet per year. These results indicate that seepage from the tailing cells could possibly enter shallow ground water. Therefore it will be necessary to use a lining in the cells. Results of the laboratory permeability testing on compacted samples of the soil from one location on the site indicate that some of the soil could be suitable for use as a compacted lining. The quantity of on-site material which could be used as a lining has not been determined and the effect of acidic tailing effluent on the caliche (calcitic) soils has not been investigated. Shale formations (predominantly from the Jurassic Morrison formation) outcrop in valley bottoms and canyon walls around the site, and these clay shales could be used for a lining. However these shales are only slightly weathered and would require considerable effort for placement and compaction. With proper compaction, the shales should provide a relatively impervious lining.

Material Properties

The physical properties of the materials which will be involved in the construction of the tailing cells were evaluated by means of field explorations and laboratory testing. These are summarized in Appendices A and B, respectively. The material properties which were used in the stability analyses of the dikes are shown on Plates 7 and 8, Stability Sections, and are listed below in Table 2.

TABLE 2

MATERIAL PROPERTIES USED FOR DIKE STABILITY ANALYSES

Material Type	Bulk Density (lbs/cu ft)	Friction Angle (degrees)	Cohesion (lbs/sq ft)
In Situ Fine Sand and Silt (SM/ML)	110	28	0
Compacted Find Sand and Silt (SM/ML)	125	33	0
Saturated Tailing	62.4	0	0
In Situ Sandstone	130	45	10,000
Compacted Sandstone	120	37	0
In Situ Clay/Clay-stone	130	20	3,000

Seismic Design Criteria

The project site is located in a region known for its scarcity of recorded seismic events. Although the seismic history for this region is barely 125 years old, the epicentral pattern, or fabric, is basically set and appreciable changes are not expected to occur. Most of the larger seismic events in the Colorado Plateau have occurred along its margins rather than in the interior central region. Based on the region's seismic history, the probability of a major damaging earthquake occurring at or near the project site is very remote. Studies by Algermissen and Perkins (1976) indicate that southeastern Utah, including the site, is in an area where there is a 90 percent probability that a horizontal acceleration of four percent gravity (0.04 g) would not be exceeded within 50 years.

Minor earthquakes, not associated with any seismic-tectonic trends, can presumably occur randomly at almost any location. Even if such an event with an intensity as high as VI should occur at or near the project site, horizontal ground accelerations probably would not exceed 0.05 g and almost certainly would be less than 0.10 g (Trifunac and Brady, 1975). Both of these values are used in stability analyses which follow.

Liquefaction Evaluation

Liquefaction of a soil mass is typically brought about when a series of dynamic pulses results in rapid densification of a saturated soil mass. This increases pore pressure and reduces shear strength, and as a result, the mass acts like a fluid. The potential for liquefaction within a particular soil mass under a given dynamic loading depends on the existence and location of the water table and the gradation and relative density of the soil mass.

Although the fine sand and silt sections of the dikes (Plate 6) have a grain size distribution suited to liquefaction, adequate compaction and the absence of saturation in this material will minimize the possibility of liquefaction. The compacted sandstone portion of the dikes (Plate 6) will be completely drained and the material is too coarse to experience liquefaction.

The tailing material constitute the only component of the tailing retention system which can be considered susceptible to liquefaction. However, as the stability analyses which are described in the next section illustrate, even if the tailing did liquefy the stability of the tailing retention system would not be adversely affected.

Stability Analyses

Method of Analyses - The stability of the dike which will be constructed to contain the tailing was analyzed using dike sections A-A' and B-B', as shown on Plates 7 and 8. Section A-A' can be considered a critical stability section because it is located where the dike height is greatest. Section B-B' has been analyzed to evaluate the effect of the claystone layer, which in places underlies the dikes, on the stability of the dikes.

The Simplified Bishop method, which is based on the assumptions of limiting equilibrium mechanics, was used to perform the stability analyses. This is a method of slices which has been shown to produce accurate results over a wide range of conditions. The forces acting on each slice are determined so that the total driving forces and resisting forces along the assumed failure circle can be calculated. The factor of safety is then defined in terms of moments about the center of the failure arc as the moment of the shear stresses along the failure surface divided by the moment of the weight of the soil in the failure mass.

To facilitate calculations, a Dames & Moore computer program was used for the slope stability analyses. In order to account for the effect of possible earthquake loadings on the dikes, a pseudo-static analysis was used in which the dynamic loads of the earthquake are replaced by a static, horizontal force equal to the product of the seismic coefficient and the weight of the soil mass. Seismic coefficients of 0.05 g and 0.10 g were used to simulate earthquake loading conditions.

As indicated on the stability sections, a phreatic surface has been assumed to occur through the compacted fine sand and silt at the same level as the maximum tailing elevation within the cell. The phreatic surface is then assumed to drop rapidly through the compacted sandstone to reflect the higher permeability anticipated for this material. This phreatic surface is considered to be a reasonable representation of the water distribution which could occur with an unlined pond. However, the membrane liner should ensure that no significant seepage occurs; therefore, the phreatic surface assumed for the purpose of the analysis is conservative.

The tailing has been assigned zero shear strength for analysis which models the situation in which the tailing have liquefied. This is considered to be very conservative, particularly for low level seismic activity characteristic of the site areas.

Results of Stability Analyses - The results of Dames & Moore's stability analyses, as presented on Plates 7 and 8 and summarized in Table 3, indicate that the dikes are conservatively designed with regard to stability.

Case A-A' represents the usual situation, where the dike foundation consists of fine sand and silt overlying sandstone, while case B-B' represents the less common situation where a highly weathered claystone lies between the fine sand and silt and the sandstone.

The end of construction condition specified for analysis in Regulatory Guide 3.11 (Design, Construction, and Inspection of Embankment Retention Systems For Uranium Mills) has not been considered because there are no highly impermeable materials to be used in the construction in which excess pore water pressures could be sustained for any significant length of time.

No upstream stability analysis has been undertaken on section B-B' since section A-A' is the higher and, therefore, a more critical case.

TABLE 3

SUMMARY OF STABILITY ANALYSES

Case	Earthquake Loading (g)	Minimum Calculated Factor of Safety	Minimum Factor of Safety Required by Regulatory Guide 3.11
A-A' Downstream Slope	0.00	2.21	1.5
	0.05	1.89	
	0.10	1.65	1.0
A-A' Upstream Slope	0.00	2.05	1.5
	0.05	1.54	
	0.10	1.22	1.0
B-B' Downstream Slope	0.00	2.35	1.5
	0.05	2.01	
	0.10	1.74	1.0

All factors of safety calculated considerably exceed the minimum values designated by Regulatory Guide 3.11. The stability analyses indicate that the stability of the dikes would be adequate even without the membrane liner.

Settlement

Settlements of the dikes are expected to be less than one half inch. These settlements should be elastic and instantaneous during construction. Therefore, long term settlements are not expected to occur.

Freeboard and Flood Protection

Each cell has been designed with a final freeboard of 5 feet at its maximum tailing storage level (USBR, 1974). Additional freeboard will exist at all times other than when the cell is filled to design capacity. Since only the precipitation which falls directy on the cell's surface can enter it, this freeboard is adequate to accommodate the design storm of approximately 17 inches of rain and still leave over three feet of freeboard for wave action. Therefore, there is no need for a spillway which would be incompatible with the objective of containment of tailing and effluent liquids.

Water Balance of Cells

The surface areas of the cells have been determined based on water balance requirements and maximum utilization of the project site. The 70-acre surface area in each cell would on average evaporate approximately 300-acre feet of water annually. Based on the mill processing 2000 tpd, about 540-acre feet per year of water will be discharged into the cell. Approximately 170-acre feet per year of water will be permanently entrained within the voids of the tailing solids. Therefore, about 370-acre feet per year of excess water will enter the cell.

The excess of water entering the pond over that which will be evaporated on average results is a net surplus of approximately 70-acre feet of water annually. This will ensure that there is always sufficient excess water to adequately cover the tailing and reduce radon gas emissions and dust problems, even in years of unusually high evaporation. Depending on the actual rate of buildup of surplus water it may be necessary to complete the construction of the middle and south cells before their tailing storage capacity is required in order to utilize their evaporative capacity.

DESIGN RECOMMENDATIONS

Design Section

Based on Dames & Moore's engineering evaluation of the foundation and embankment materials and the requirements of construction and reclamation, the dike section shown on Plate 6, Typical Sections, is recommended as being a suitable configuration of all dike construction. The section consists of 3 (horizontal): 1 (vertical) side slopes for both interior and exterior slopes. The recommended crest width of 15 feet will provide access along the crest for vehicular traffic and meet state crest width requirements. Use of compacted fine sand and silt for the interior segment of the embankment and compacted sandstone for the outer portion is in accordance with good engineering practice, since this will result in a more permeable downstream shell, even though the membrane liner should result in no significant seepage through the dike. The exact proportions of fine sand and silt and of sandstone used in construction is not critical. The maximum constructed dike height would be approximately 45 feet, although the average dike height would be about one half that amount as measured from the present ground surface.

The cell bottoms will be covered by a nominal 6-inch layer of rolled, low carbonate fine sand and silt to provide a smooth surface for the installation of the liner. Following installation of the liner, a 1 foot layer of fine sand and silt will be installed as a cover on the cell bottom and interior slopes to protect against damage from wind, sunlight wave action and equipment operations.

Site Preparation

The upper 6 inches of soil at the site should be stripped and stockpiled for later use for revegetation. The underlying soil does not have a high organic content, and would be suitable for dike construction. Any vegetation, roots, debris, perishable or otherwise objectionable material should be removed from any surface on which the raised embankment is placed and none of this material should be incorporated in the fill material. This stripping should be performed to the satisfaction of a qualifed soils engineer.

Prior to placing any fill on a stripped soil surface the soil should be scarified and conditioned to a depth of at least 8 inches and compacted according to the same criteria specified for fill materials in a later section.

Construction Materials

Both the fine sand and silt and the sandstone material excavated from within the cell should provide suitable materials for embankment construction. However, any clay or claystone or clayey sandstone encountered in the excavation should not be incorporated into the dikes because of possibly unfavorable shear strength and permeability characteristics. The clayey materials may be stockpiled for later use in the cover over the top of the tailing.

The fine sand and silt can generally be excavated by dozers and scrapers without blasting, although some ripping may be required in the highly calcareous zones. Low carbonate fine sand and silt, which generally occurs within the upper few feet of the surface should be separately stockpiled for use as bedding material for the cell liner. The more calcareous material can be used for dike construction as it is excavated. No additional breaking down of this material beyond what is achieved during excavation and compaction should be required.

If soft or unstable materials are encountered during this process they should be removed and replaced with proper fill. In areas where fill will be placed on excavated rock surfaces, the surfaces should be smoothed so that no local projections or cavities greater than 3 inches are present. This smoothing process probably could be accomplished with a heavy dozer or heavy sheepsfoot compactor.

The sandstone which underlies the fine sand and silt may in part be excavated by scrapers after ripping, but some blasting may also be required. Some crushing of the sandstone may be required to obtain a satisfactory size distribution. All sandstone used for dike construction should be minus 6 inch.

The construction of the north cell will involve the excavation of approximately 440,000 cubic yards of fine sand and silt, and approximately 575,000 cubic yards of sandstone/claystone. All of the fine sand and silt and approximately 480,000 cubic yards of the sandstone/claystone will be used in dike construction and bedding and cover placement for the liner. This should result in a slight excess of excavated material which may be later used for cover material over the tailings or in the construction of the next dike, depending on whether it is clayey or not.

The earthwork volumes involved in construction of the middle and southern cells will depend on the amount of cover material which is required to reduce the radon gas emission from the previous cell to an acceptable level. For example, if 6 feet of cover is required, this will involve the excavation and placement of approximately 700,000 cubic yards of material in addition to the material required for dike construction and bedding and cover for the liner. Therefore the final design of these cells cannot be formulated until reclamation plans are finalized.

Fill Placement

The materials placed in the embankments should be carefully controlled with inspection and testing by a qualified soils engineer. Fine sand and silt used in the construction of the embankments should be placed in lifts not exceeding eight inches in loose thickness, and should be compacted to at least 95 percent of maximum dry density as defined by the AASHTO* T-99, method of compaction. Adjustments in moisture content of the on site material may be necessary to achieve adequate compaction.

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*American Association of State Highway and Transportation Officials

For the most part it is expected that water will have to be added to achieve satisfactory compaction results. Sheepsfoot rollers or self-propelled compactors should be suitable for this compaction.

Fine sand and silt placed as bedding material for the membrane line should be placed in a single lift and rolled smooth with a drum type roller. The interior surfaces of the dikes should be finished in a similar manner.

Sandstone used in the construction of the embankments should be screened to remove oversize material and placed in lifts not exceeding one foot in loose thickness. The sandstone should be compacted by approximately four to six passes of a sheepsfoot roller.

The distribution of material in the fill should be such that there are no lenses, pockets or streaks of material differing substantially from the surrounding fill. Fill should not be placed on frozen surfaces, nor should snow, ice, or frozen material be incorporated into the fill.

Cell Lining

In order to control seepage to the maximum extent practical, membrane liners will be installed on all interior cell surfaces. Such control of seepage may be achieved by the use of 20 mil (0.020 inch) polyvinyl chloride (PVC) on the cell bottom and 20 mil chlorinated polyethylene (CPE) on the interior side slopes. The more expensive CPE is recommended on side slopes because it is stable even when exposed to long periods of direct sunlight. Although all liner materials will have a 1 foot thick soil cover, the use of CPE on side slopes should protect against the possibility of liner deterioration should wind or operational procedures temporarily remove the soil cover. If the soil cover is ever removed, it should be replaced as soon as feasible.

Since membrane liners can be damaged and their effectiveness diminished by improper handling and installation, careful installation procedures will be necessary. Therefore, the liner should be installed under the supervision of a suitably qualified engineer. The surface on which the liner is layed should be smooth and free from any projections which could puncture the lining. The strength of all splices, seams and joints, and the physical characteristics of the materials used should meet the specifications of the fabricator. Furthermore, it is recommended that the PVC/CPE bond be fabricated in the factory rather than on site. This would make it possible to bond only like materials in the field.

Radiation Control and Reclamation

Nuclear Regulatory Commission guidelines call for keeping radon gas emission from the reclaimed tailing retention area to twice background. Normally, a soil cover comprised of on-site soil is used for this purpose. The thickness of the soil cover depends on the ability of the soils to inhibit radon gas emanation. Clayey soils are generally the most effective and require the least thickness, while gravelly soils would be least effective.

For this project a mixture of on-site fine-grained sand and silt and sandstone is planned to be used for the soil cover. The required thickness of this cover is calculated to be approximately 9 feet. The material to cover the first cell will be obtained from the excavation for the second pond and a similar sequence will be used to cover the second pond. Material to cover the third cell will come from either stockpiling material during the construction of the third cell or from a borrow area immediately south of the third cell or both of these.

Following placement of the 9-foot layer of cover material, the entire surface will be topdressed with about 6 inches of previously stockpiled topsoil and revegetated. The borrow area will be graded to blend in with adjacent topography, covered with about 6 inches of topsoil, and revegetated.

Ground Water Monitoring

The tentative design of a pre-operational ground water monitoring program consists of 3 or more observation/monitoring wells to be installed at location predominantly down gradient from the mill site and tailing retention site (Plate 2).

In general, the monitor wells should be constructed of 4- or 6-inch diameter PVC plastic casing (as shown on Plate 9) to a depth below the lowest expected water level. The lower portion of the well should be screened with either PVC plastic well screen or stainless steel screen. The top of the screened portion of the well should be higher than the highest expected water level. The annular space between the borehole wall and the casing should be filled with clean, inert, natural stone filter material for the entire screened interval. The remainder of the annular space, above a 5-foot bentonite seal on top of the filter, should be grouted or backfilled with a mixture of the drill cuttings and grout or bentonite. A concrete seal should be placed around the exposed PVC casing at the ground surface to prevent surface water from entering the borehole around the casing. For further protection a steel casing with a large cap and lock should be placed around the PVC plastic casing and should be seated in the cement seal.

FOUNDATION DESIGN RECOMMENDATIONS - MILL FACILITY

In this section of the report, preliminary earthwork and foundation design recommendations are provided for the mill facility. These recommendations are based on the findings of the field investigation in the proposed mill site area.

EARTHWORK

Site Preparation

Prior to the construction of any foundations at the mill site, all grasses and other vegetation should be removed from the foundation area. Although there is no highly organic topsoil, the upper 6 inches of soil should be removed and stockpiled for later use in revegetation.

Site Grading

Site grading may require minor cut slopes within the fine sand and silt, although no cut slopes are expected to exceed 10 feet in height. Excavating all cut slopes at an angle of 3 horizontal to 1 vertical or flatter should ensure stable slopes while making revegetation feasible.

Slopes in fill areas should also be 3 horizontal to 1 vertical or flatter. Fine sand and silt excavated from the ground surface in the vicinity of the mill site should provide an adequate fill material when properly compacted. The soil or rock surface upon which fill is placed should be prepared in the same manner as prescribed for the tailing cell construction.

The mill site should be graded so that water flows away from the mill structures and to enable the collection of any spills from the mill circuit for pumping to the tailing retention system or back into the mill circuit.

Excavation

Excavations for foundations on other facilities around the mill area may be constructed with unsupported vertical side slopes up to a maximum depth of 4 feet.

Excavations deeper than 4 feet should be shored if the side slopes are vertical. Unsupported excavations deeper than 4 feet should be constructed with side slopes of 1 horizontal to 1 vertical or flatter.

Compaction Criteria

All structural fill should be placed in lifts not exceeding 8 inches in loose thickness. Each lift in structural foundation areas should be compacted to a density of at least 95 percent of the maximum dry density as determined by the AASHTO T-99 method of compaction prior to placing successive lifts. A compacted dry density of 90 percent AASHTO T-99 maximum dry density should be adequate for fill areas which will not support structural foundations.

Fill should not be placed on a frozen surface, nor should snow, ice, or frozen material be incorporated into the fill. The fill should be placed at or near its optimum moisture content, and should be inspected and approved by a qualified soils engineer during placement.

Surface Water Diversion

The probable maximum precipitation as a thunderstorm would produce a peak flow (curve number 85) of about 540 cfs in the western basin and 265 cfs in the eastern basin. These are nearly instantaneous flows and they could cause a substantial amount of damage if they occurred and were not controlled. Therefore, flood control dikes which will be high enough to collect and store the probable maximum flood volume should be constructed just north of the mill site. These dikes would be 10 to 15 feet high. An 8-inch diameter corrugated metal culvert pipe should be constructed under these dikes to allow a slow release of the stored flood waters. Each of these pipes would have a discharge of about 6 cfs under maximum conditions. This water would then be collected in a small ditch which would conduct the flows safely to the western perimeter of the mill site. It would then flow in the natural drainages and impound upstream of the tailing retention system (Plate 4).

Overland flood flows from the mill site together with flows from the other parts of the drainage area shown on Plate 4 will collect along the perimeter of the tailing cells. The tailing cells will have two areas of impoundment; the first, along the northern edge where the contributing drainage area is 221 acres and the second, along the eastern edge where the contributing drainage area is 35 acres. The volume of storage created north of the tailing cells is large enough to contain even the probable maximum flood (PMF) without the release of water and without submerging project facilities. The maximum pond depth along the northern tailing cell resulting from the PMF would be about 13 feet.

Thus any radioactive solids accidentally released during a flood, or any other time, would be washed into the impoundment. This would prevent their getting into Westwater Creek.

FOUNDATIONS

Bearing Capacity

Based on our field and laboratory investigations, it appears that foundations for the mill facilities can be satisfactorily established on natural soil or on fill consisting of properly compacted fine sand and silt. Conventional spread and continuous-wall foundations should adequately support most of the mill facilities, although mat foundations may be required for some heavy mill equipment.

For spread and continuous-wall foundations established on natural soil or compacted fill, an allowable net bearing pressure of 3600 pounds per square foot may be used for design purposes. A minimum foundation width of 1 foot is recommended. Exterior foundations should be established at least 3 feet below adjacent final grade for confinement and/or frost protection purposes. Interior foundations not subjected to the full effects of frost may be found at a depth of 18 inches.

Mat foundations established on on-site material can be designed using an allowable net bearing pressure of 3600 pounds per square foot provided that the loading is static. Mat foundations should be established at least 18 inches or 3 feet below adjacent final grade depending upon whether they are interior or exterior, respectively.

Separate design criteria are required for mat foundations supporting vibrating equipment such as crushers and ball mills. Of particular concern is the upper few feet of the soil, since this is the zone in which vibratory compaction forces will be greatest, and below this depth calcareous cementation generally increases. Mat foundations for vibrating equipment should be excavated down to the cemented caliche zone and backfilled with compacted, well-graded sand and gravel. It is estimated that approximately 4 feet of excavation below grade would be required for this type of foundation. The allowable net bearing pressure for this type of foundation should be taken as 3600 pounds per square foot.

Settlement

Settlements of structures founded on in situ soil or compacted fill and designed for the recommended maximum bearing pressure are expected to be minor. Settlements of spread and continuous wall foundations are not expected to exceed 1/4 inch, while settlements of mat foundations should not exceed 1/2 inch.

Lateral Pressure

Lateral movements of foundations can be resisted by passive soil pressure and frictional resistance between the base of the foundation and the underlying soil. The passive lateral earth pressure may be calculated by assuming that the soil against the foundation is a fluid with a unit weight of 300 pounds per cubic foot. Where foundations are not poured neat against in situ soil, backfill against the foundation should consist of on-site soil and should be compacted to at least 95 percent of AASHTO T-99 maximum dry density. The upper 1 foot of soil should be neglected when making the passive pressure calculation. A friction coefficient of 0.35 between the base of the foundation and the underlying soil may be used for calculating lateral load resistance. Passive soil resistance and frictional resistance should be combined only after one or the other has been reduced by 50 percent.

The active force exerted on a wall may be calculated by assuming that the soil against the foundation is a fluid with a unit weight of 40 pounds per cubic foot.

Frost Protection

All water lines should be placed at least 3 feet below the lowest adjacent ground surface to prevent freezing. Exterior foundations should also be placed 3 feet below lowest adjacent grade.

what about slurry lines?

Cement Type

Sulfate analyses on four soil samples taken from boreholes within the proposed mill area indicate consistently low contents of soluble sulfates. The maximum concentration of soluble sulfates in any sample is

0.078 percent, which is rated as giving a negligible degree of sulfate attack. Therefore, in accordance with U.S. Bureau of Reclamation Guidelines (1966), the use of special sulfate resistant cement should not be necessary.

* * *

The following are attached and complete this report:

References

Plate 1	Vicinity Map
Plate 2	Plot Plan (in Map Pocket)
Plate 3	Regional Epicenter Map
Plate 4	Site Drainage
Plate 5	Area - Capacity Curves for North Pond
Plate 6	Typical Sections
Plate 7	Stability Section A-A'
Plate 8	Stability Section B-B'
Plate 9	Sketch of Typical Ground Water Monitoring Well
Appendix A,	Field Exploration
Appendix B	Laboratory Test Data

Respectively submitted

DAMES & MOORE

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Partner

Ronald E. Versaw
Senior Engineer

LKD:REV:GM:tlg

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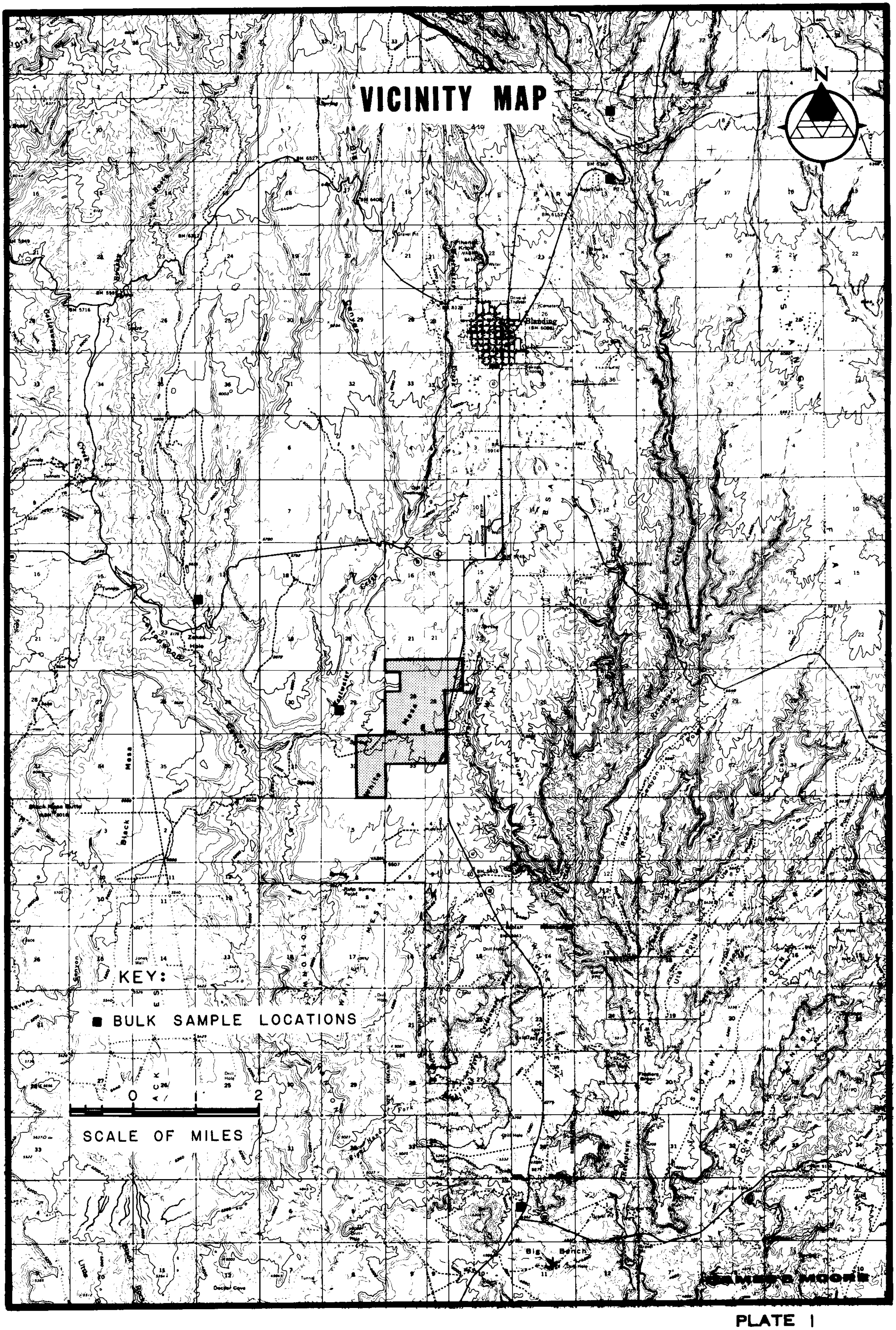

VICINITY MAP
N
Blanding
KEY:
BULK SAMPLE LOCATIONS
0 1 2
SCALE OF MILES

PLATE I

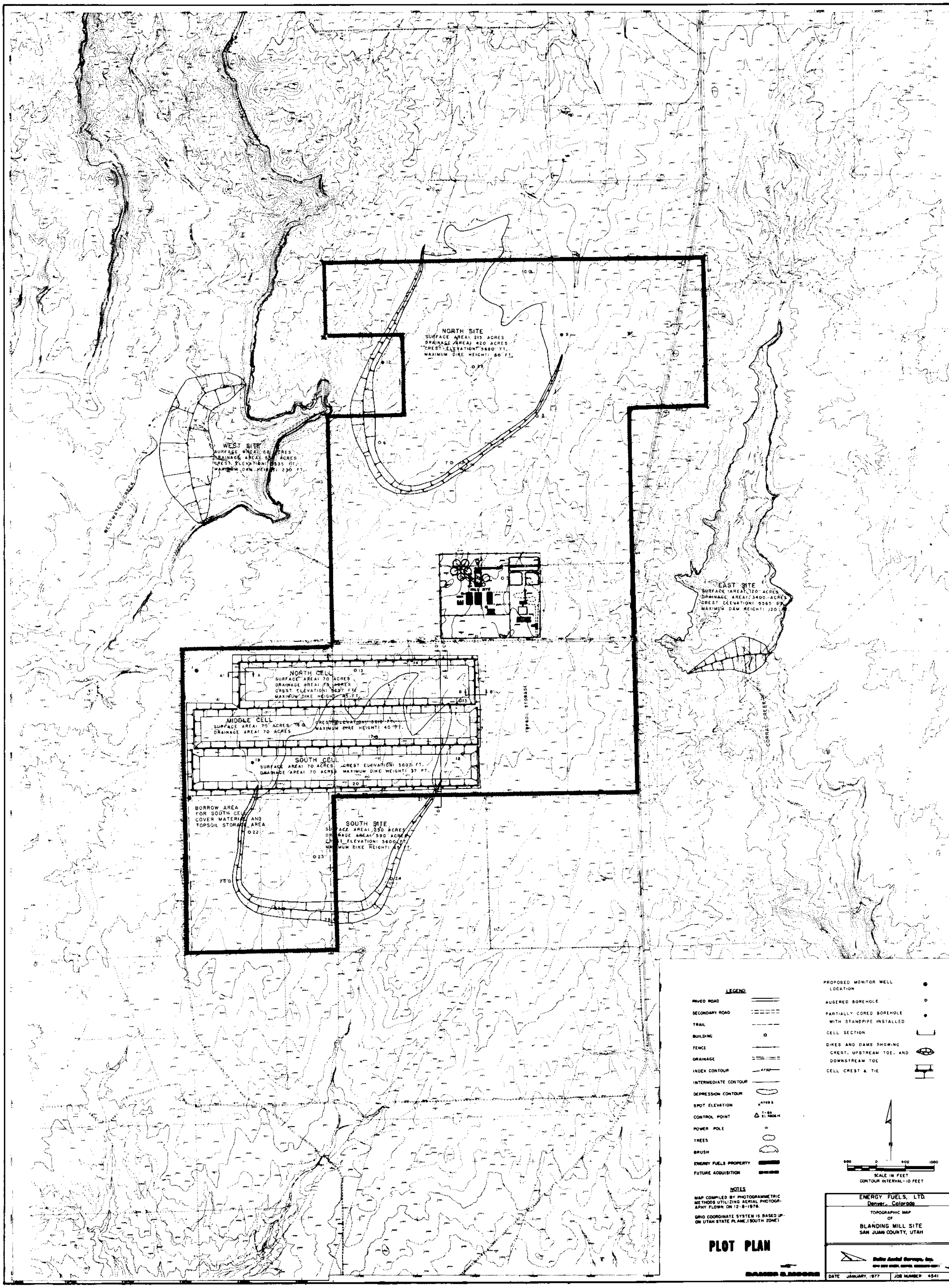
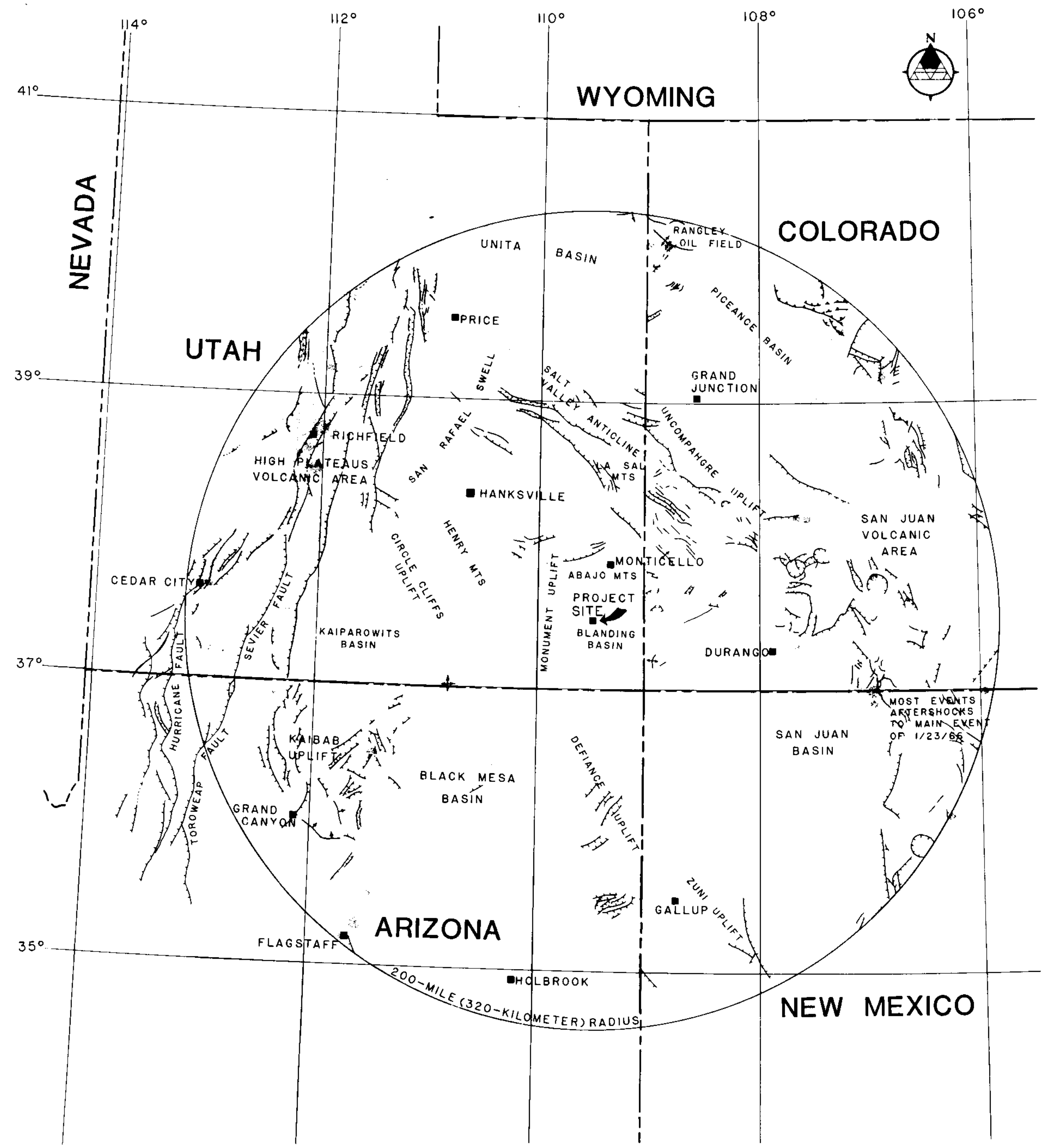

NORTH SITE
SURFACE AREA: 215 ACRES
DRAINAGE AREA: 420 ACRES
CREST ELEVATION: 5680 FT.
MAXIMUM DIKE HEIGHT: 80 FT.
WEST SITE
EAST SITE
SURFACE AREA: 120 ACRES
DRAINAGE AREA: 3400 ACRES
NORTH CELL
SURFACE AREA: 70 ACRES
MIDDLE CELL
SURFACE AREA: 70 ACRES
DRAINAGE AREA: 70 ACRES
MAXIMUM DIKE HEIGHT: 40 FT.
SOUTH CELL
SURFACE AREA: 70 ACRES
CREST ELEVATION: 5607 FT.
DRAINAGE AREA: 70 ACRES
MAXIMUM DIKE HEIGHT: 37 FT.
BORROW AREA
FOR SOUTH CELL
COVER MATERIAL AND
TOPSOIL STORAGE AREA
SOUTH SITE
SURFACE AREA: 250 ACRES
DRAINAGE AREA: 590 ACRES
CREST ELEVATION: 5600 FT.
LEGEND
PAVED ROAD
SECONDARY ROAD
TRAIL
BUILDING
FENCE
DRAINAGE
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
SPOT ELEVATION
CONTROL POINT
POWER POLE
TREES
BRUSH
ENERGY FUELS PROPERTY
FUTURE ACQUISITION
PROPOSED MONITOR WELL LOCATION
AUGERED BOREHOLE
PARTIALLY CORED BOREHOLE WITH STANDPIPE INSTALLED
CELL SECTION
DIKES AND DAMS SHOWING CREST, UPSTREAM TOE, AND DOWNSTREAM TOE
CELL CREST & TIE
NOTES
MAP COMPILED BY PHOTOGRAMMETRIC METHODS UTILIZING AERIAL PHOTOGRAPHY FLOWN ON 12-8-1976.
GRID COORDINATE SYSTEM IS BASED UPON UTAH STATE PLANE, (SOUTH ZONE)
SCALE IN FEET
CONTOUR INTERVAL=10 FEET
PLOT PLAN
ENERGY FUELS, LTD.
Denver, Colorado
TOPOGRAPHIC MAP OF
BLANDING MILL SITE
SAN JUAN COUNTY, UTAH
DATE JANUARY, 1977
JOB NUMBER 4541

PLATE 2



LEGEND

- UNCLASSIFIED FAULT
- THRUST FAULT: SAW TEETH ON UPTHROWN SIDE
- NORMAL FAULT: HACHURES ON DOWNTHROWN SIDE
- ANTICLINAL AXIS
- DOME

KEY TO EARTHQUAKE EPICENTERS

SYMBOL MODIFIED MERCALLI INTENSITY

VIII

VII

VI

V

IV OR LESS OR NO INTENSITY GIVEN

NUMBER REFERS TO MULTIPLE EVENTS IN SAME LOCATION. INTENSITY OF LARGEST EVENT IS PLOTTED.

REGIONAL TECTONIC MAP SHOWING HISTORIC EARTHQUAKE EPICENTERS WITHIN 200-MILE RADIUS OF THE PROJECT SITE

References: Cook and Smith, 1967; Hadsell, 1968; Simon, 1972; Coffman and Von Hake, 1973a, 1973b, 1974, and 1975; Coffman and Stover, 1976; Giardina, 1977; NOAA, 1977. Tectonic base after Cohee ET AL, 1962.

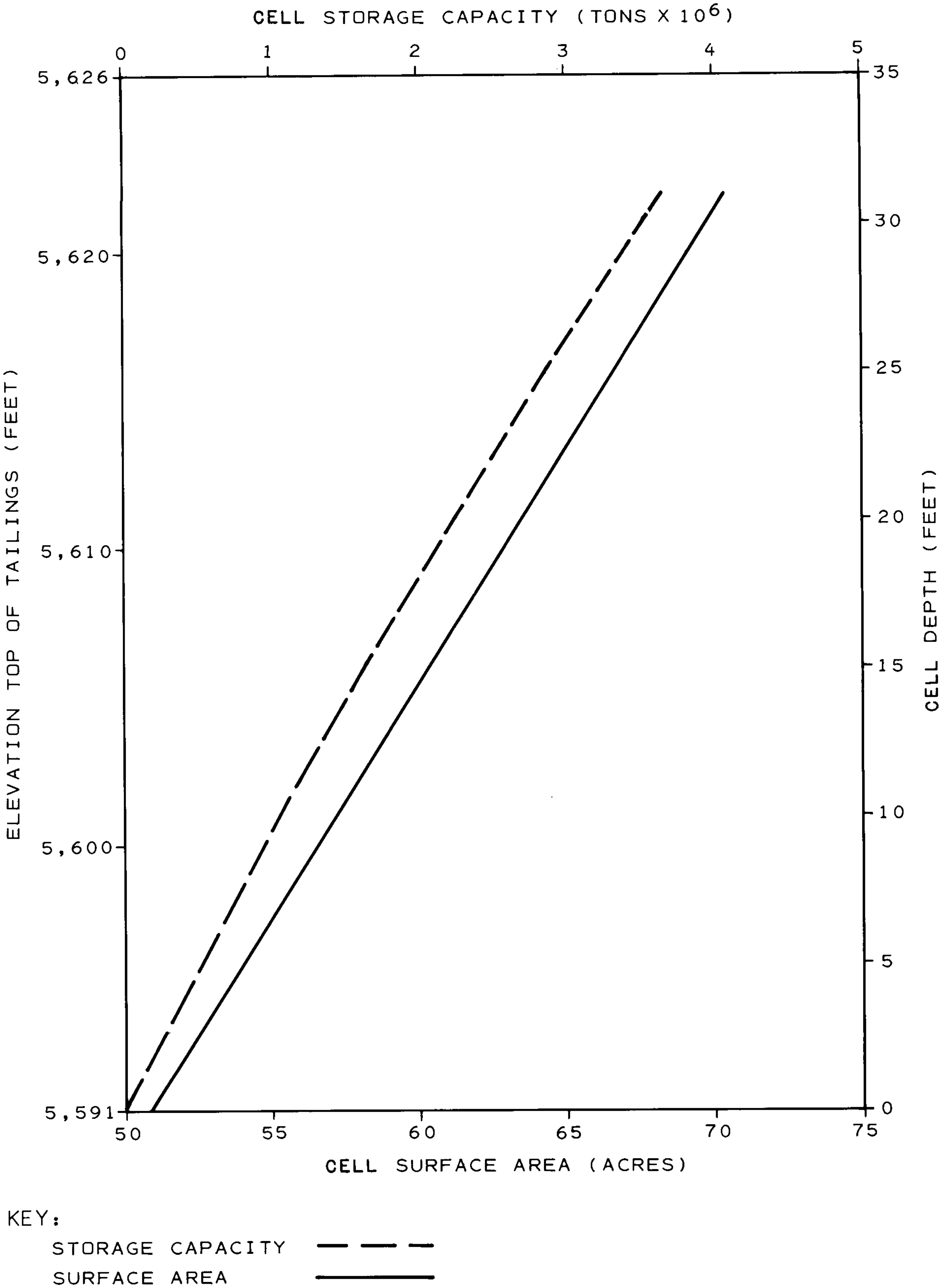
SCALE

25 0 25 50 75 100

MILES

DAMES & MOORE

PLATE 3



AREA-CAPACITY CURVES FOR NORTH CELL

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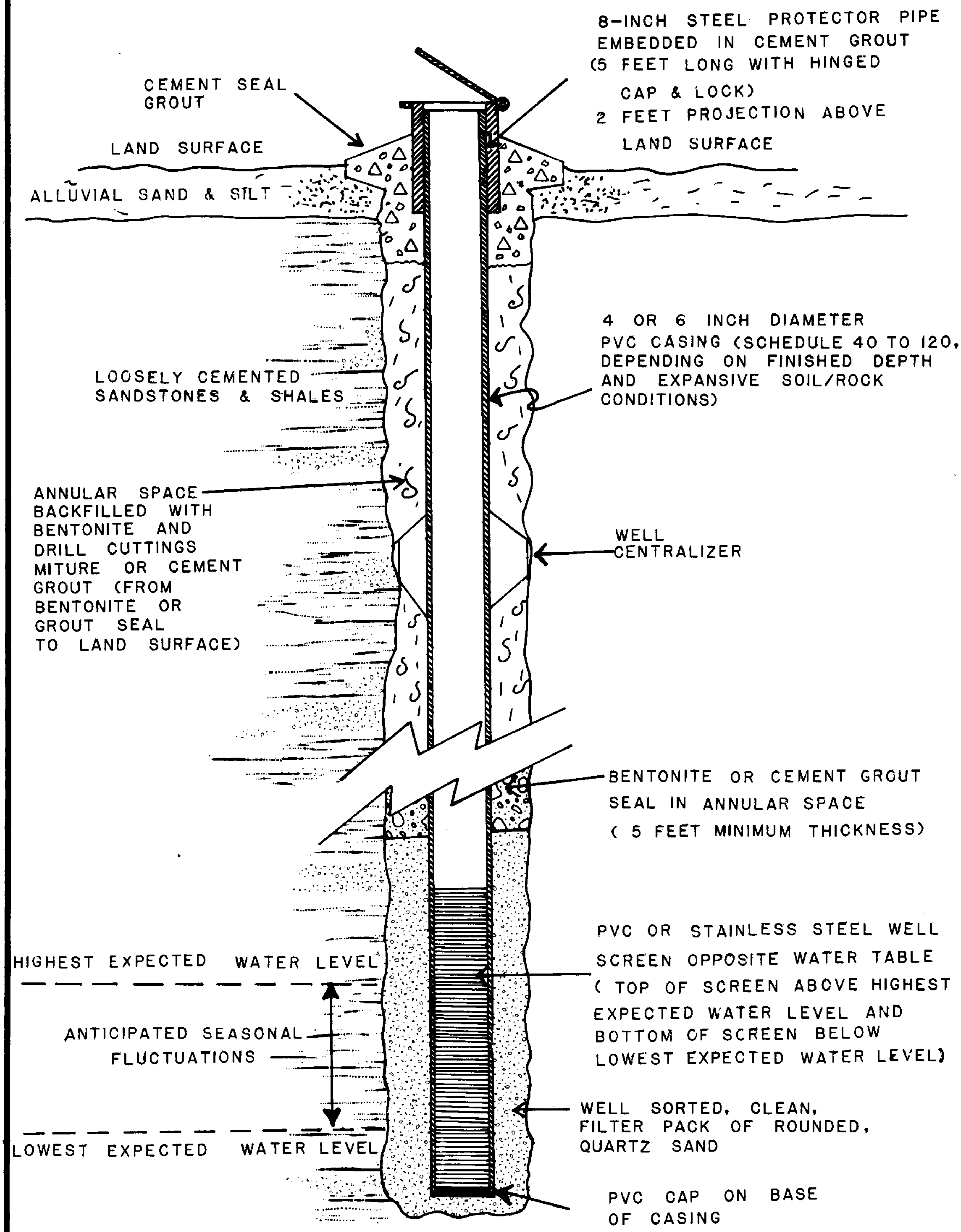
PLATE 5



SKETCH OF TYPICAL GROUND WATER MONITORING WELL

(FOR WATER TABLE OR PERCHED GROUND WATER)

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APPENDIX A
FIELD EXPLORATION

study of subsites

GEOLOGIC RECONNAISSANCE

During the site selection phase of the investigation, a brief geologic reconnaissance visit was conducted at each of the feasible, alternate tailings disposal areas. These areas are shown on Plate 2 in the text of this report. During this geologic reconnaissance, general geologic, topographic, and environmental considerations for each of the four sites were studied. This information was used to help select the most suitable tailing retention site.

A more detailed geologic reconnaissance was carried out at the site after the proposed location of the tailing retention facility had been selected. The purpose of this reconnaissance, which was conducted by an experienced engineering geologist, was to identify the general geologic conditions at the site, including the relationships of the geologic units, the locations of springs, and the general occurrences of potential borrow sources for the pond construction.

SUBSURFACE INVESTIGATION

Subsurface conditions at the site area were investigated by drilling, sampling, and logging a total of 28 borings which ranged in depth from 6.5 feet to 132.4 feet. Of these borings, 23 were augered to bedrock to enable soil sampling and the estimation of the thickness of the soil cover. The remaining 5 borings were drilled through bedrock to below the water table, with continuous in situ permeability testing where possible and selective coring in bedrock. Standpipes were installed in each of the cored holes to enable monitoring of the water table level. Four shallow borings and one deep hole were drilled within the porposed mill site. Ten shallow borings and one deep hole were drilled in the immediate vicinity of the proposed tailing retention facility. The remaining holes were located around the perimeters of and within the North and South alternative sites. The locations of all borings are shown on Plate 2, Plot Plan, in the text of this report.

The field exploration program was conducted and supervised by an experienced Dames and Moore soils engineer. The borings were advanced using a truck mounted CME 55 rotary drilling rig using 4 inch diameter, continuous-flight augers in soil and a tricone bit in the bedrock.

Relatively undisturbed soil samples were obtained using a Dames & Moore soil sampler Type U, as shown on Plate A-1. Disturbed soil samples were recovered from the Standard Penetration Test sampler. Selective diamond coring in the bedrock was achieved using a 5 foot long NX double tube core barrel with a split inner tube.

The soils encountered in the borings were classified by visual and textural examination in the field, and a complete log for each boring was maintained. Field classifications were supplemented and verified by inspection and testing in the Dames & Moore laboratory. A graphical representation of the soils encountered in the borings is presented on Plates A-3 through A-11, Log of Borings. Along with written descriptions of the soils, data on in situ moisture content and density, type of sample obtained, blow counts, and ground water levels are presented on the logs. The terminology used to describe the soils encountered in the borings is shown on Plate A-2, Unified Soil Classification System and Graphic Log Symbols.

A geotechnical log was maintained for all rock core recovered during drilling. The following items were logged:

1) Rock type and description of rock material
2) Core run and percent recovery
3) Descripton of rock defects, such as bedding plane breaks and joints
4) Rock quality designation (RQD: the RQD is a modified core recovery percentage in which only the pieces of sound core over 4 inches long are counted as recovery)
5) Degree of alteration or weathering
6) Relative strength of the rock

The core log for each cored hole is presented as the continuation of the soil log for the same hole. Information on bedrock between the cored section was developed from drill response and interpolation from available core.

Single packer field permeability tests were performed on the bedrock to provide in situ permeability data. Permeability was measured over the full length of the bedrock where field conditions permitted. Results of the permeability tests are presented on the boring logs.

* * *

The following plates are attached and complete this Appendix:

Plate A-1 Soil Sampler Type U

Plate A-2 Unified Soil Classification System and Graphic Log Symbols

Plate A-3 through A-11 Log of Borings

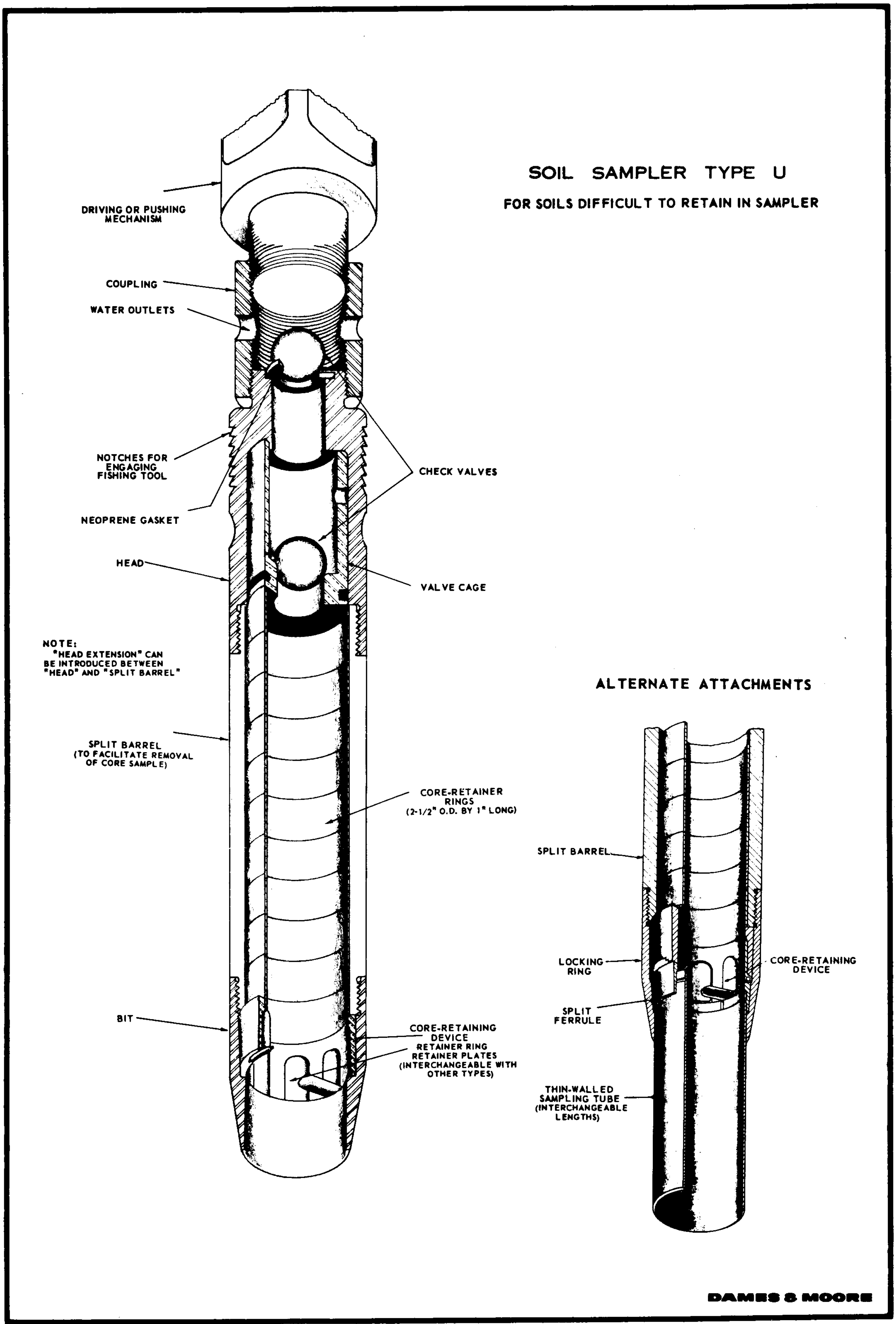

SOIL SAMPLER TYPE U
FOR SOILS DIFFICULT TO RETAIN IN SAMPLER
DRIVING OR PUSHING MECHANISM
COUPLING
WATER OUTLETS
NOTCHES FOR ENGAGING FISHING TOOL
NEOPRENE GASKET
CHECK VALVES
HEAD
VALVE CAGE
NOTE: "HEAD EXTENSION" CAN BE INTRODUCED BETWEEN "HEAD" AND "SPLIT BARREL"
SPLIT BARREL (TO FACILITATE REMOVAL OF CORE SAMPLE)
CORE-RETAINER RINGS (2-1/2" O.D. BY 1" LONG)
BIT
CORE-RETAINING DEVICE
RETAINER RING
RETAINER PLATES (INTERCHANGEABLE WITH OTHER TYPES)
ALTERNATE ATTACHMENTS
SPLIT BARREL
LOCKING RING
CORE-RETAINING DEVICE
SPLIT FERRULE
THIN-WALLED SAMPLING TUBE (INTERCHANGEABLE LENGTHS)
DAMES & MOORE

PLATE A-1

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50 % OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50 % OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICTY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

SOIL CLASSIFICATION CHART

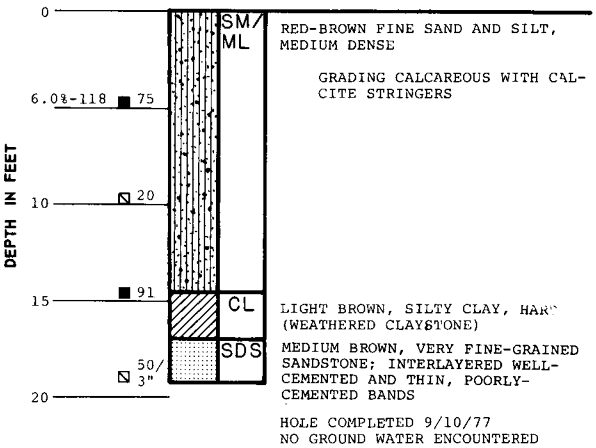
	SDS	SANDSTONE		SLN	SILTSTONE
	CLS	CLAYSTONE		CGL	CONGLOMERATE

GRAPHIC LOG SYMBOLS FOR ROCK

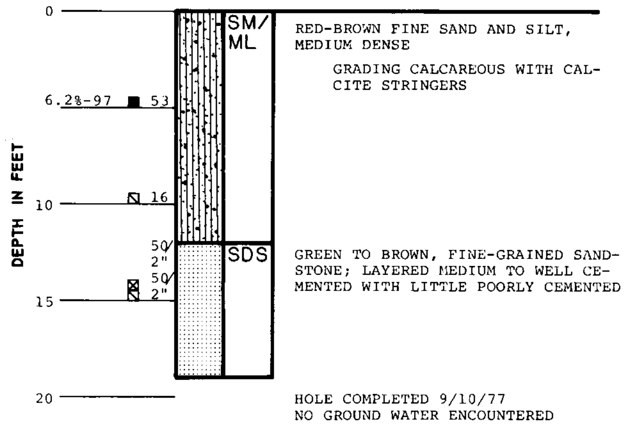
UNIFIED SOIL CLASSIFICATION SYSTEM AND GRAPHIC LOG SYMBOLS

DAMES & MOORE

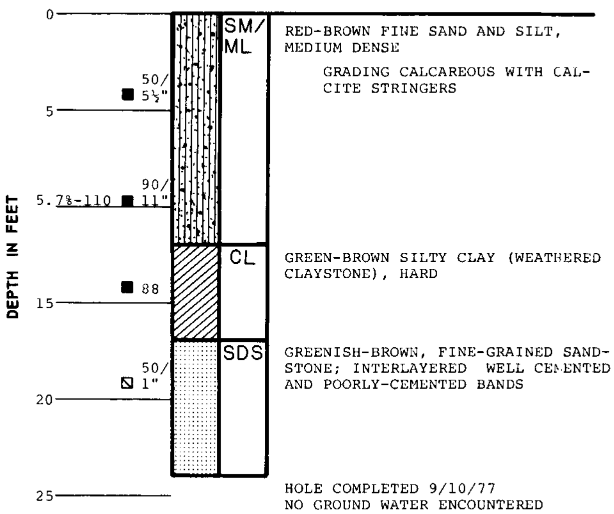
BORING NO. 1
EL. 5629.0 FT.



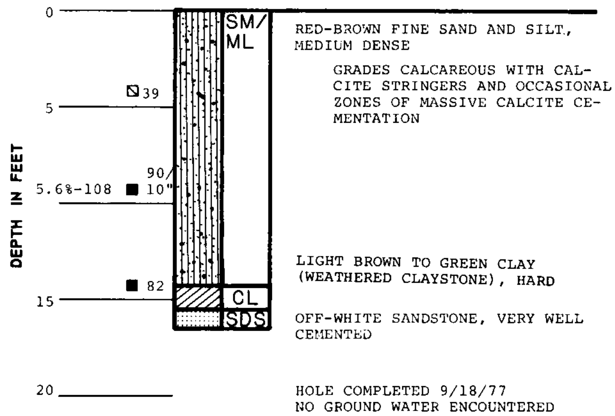
BORING NO. 5
EL. 5632.9 FT.



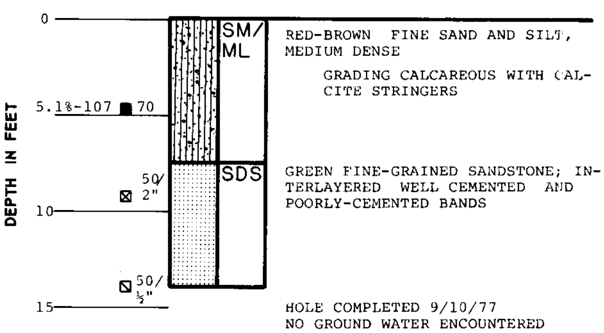
BORING NO. 2
EL. 5634.3 FT.



BORING NO. 6
EL. 5633.5 FT.



BORING NO. 4
EL. 5623.2 FT.



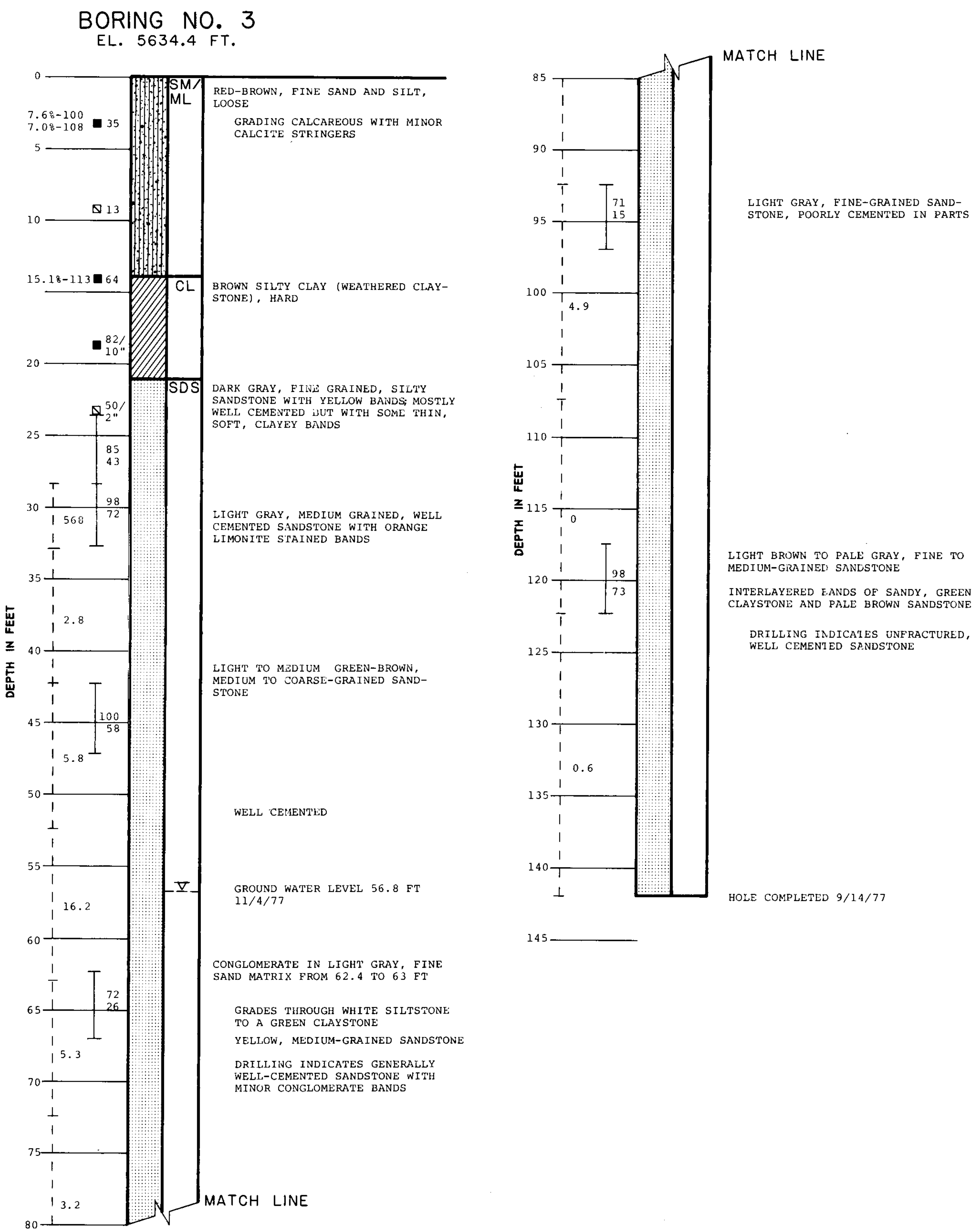
KEY

A-B ■ C	INDICATES DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED USING DAMES & MOORE SAMPLER
⊠ C	INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED USING DAMES & MOORE SAMPLER
□ C	INDICATES SAMPLE ATTEMPT WITH NO RECOVERY
⧅ C	INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED USING STANDARD PENETRATION TEST SAMPLER
A	FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL
B	DRY DENSITY EXPRESSED IN LBS/CU FT
C	BLOWS/FT OF PENETRATION USING A 140-LB HAMMER DROPPING 30 INCHES
I D E	INDICATES NC CORE RUN
D E	PERCENT OF CORE RECOVERY RQD*
I F	INDICATES PACKER TEST SECTION
F	PERMEABILITY MEASURED BY SINGLE PACKER TEST IN FT/YR
NA	NOT APPLICABLE (USED FOR RQD IN CLAYS OR MECHANICALLY FRACTURED ZONES)
NOTE:	ELEVATIONS PROVIDED BY ENERGY FUELS NUCLEAR, INC.

* ROCK QUALITY DESIGNATION -- PERCENTAGE OF CORE RECOVERED IN LENGTHS GREATER THAN 4 INCHES

LOG OF BORINGS

DAMES & MOORE



LOG OF BORINGS

DAMES & MOORE

LOG OF BORINGS

BORING NO. 7
EL. 5656.9 FT.

DEPTH IN FEET: 0 – 20

Samples: 3.9%-103 ■ 90/11"; ◪ 97/10"; ◪ 53/6"

SM/ML — RED-BROWN FINE SAND AND SILT, MEDIUM DENSE

GRADING CALCAREOUS WITH CALCITE STRINGERS AND OCCASIONAL ZONES OF MASSIVE CALCITE CEMENTATION

SDS — PALE BROWN, FINE GRAINED, WEATHERED SANDSTONE, GRADING HARDER

DARK BROWN TO DARK GRAY, FINE TO MEDIUM GRAINED, WEATHERED SANDSTONE, GRADES HARDER AND TAN COLORED

INTERBEDDED HARD AND VERY HARD, LIGHT GRAY SANDSTONE

HOLE COMPLETED 9/18/77
NO GROUND WATER ENCOUNTERED

BORING NO. 8
EL. 5668.4 FT.

DEPTH IN FEET: 0 – 30

Samples: ⊠ 54/6"; ◪ 50/6"; ◪ 37; □ 50/2½"

SM/ML — RED-BROWN FINE SAND AND SILT, DENSE

GRADING CALCAREOUS WITH CALCITE STRINGERS

GRADING TO MASSIVE CALCITE CEMENTATION

SDS — GREEN, MEDIUM TO COARSE GRAINED, WEATHERED SANDSTONE

CLS — DARK GRAY, SILTY CLAYSTONE, WEATHERED WITH YELLOW-ORANGE IRON STAINING, GENERALLY VERY DRY

GRADES TO VERY HARD

SDS — DARK GRAY, MEDIUM-GRAINED SANDSTONE, RELATIVELY UNCEMENTED

OFF-WHITE, MEDIUM-GRAINED SANDSTONE, WELL CEMENTED

HOLE COMPLETED 9/19/77
NO GROUND WATER ENCOUNTERED

BORING NO. 10
EL. 5690.9 FT.

DEPTH IN FEET: 0 – 20

Samples: 6.7%-106 ■ 85/10"; ◪ 84/8"; ◪ 70

SM/ML — RED-BROWN FINE SAND AND SILT, DENSE

GRADING CALCAREOUS WITH CALCITE STRINGERS

GRADING VERY CALCAREOUS AND VERY DENSE

SDS — YELLOW TO GREEN, FINE TO MEDIUM GRAINED, WEATHERED SANDSTONE

GRADING HARD, GREEN, MEDIUM TO COARSE-GRAINED SANDSTONE

HOLE COMPLETED 9/19/77
NO GROUND WATER ENCOUNTERED

BORING NO. 11
EL. 5677.8 FT.

DEPTH IN FEET: 0 – 15

Samples: ⊠ 50/4½"; ◪ 50/4½"

SM/ML — RED-BROWN FINE SAND AND SILT

GRADING CALCAREOUS WITH CALCITE STRINGERS AND SOME ZONES OF MASSIVE CALCITE CEMENTATION

SDS — LIGHT BROWN, FINE GRAINED, WEATHERED SANDSTONE

GRADING WELL CEMENTED

HOLE COMPLETED 9/18/77
NO GROUND WATER ENCOUNTERED

BORING NO. 13
EL. 5602.4 FT.

DEPTH IN FEET: 0 – 10

Samples: □ 50/½"

SM/ML — RED-BROWN FINE SAND AND SILT, MEDIUM DENSE

SDS — PALE GREEN, MEDIUM-GRAINED SANDSTONE BECOMES VERY WELL-CEMENTED

HOLE COMPLETED 9/18/77
NO GROUND WATER ENCOUNTERED

BORING NO. 14
EL. 5597.5 FT.

DEPTH IN FEET: 0 – 15

Samples: 3.2%-105 ■ 42

SM/ML — RED-BROWN FINE SAND AND SILT, MEDIUM DENSE

GRADING CALCAREOUS WITH CALCITE STRINGERS

SDS — LIGHT GRAY TO OFF-WHITE, MEDIUM TO COARSE-GRAINED SANDSTONE, VERY WELL CEMENTED

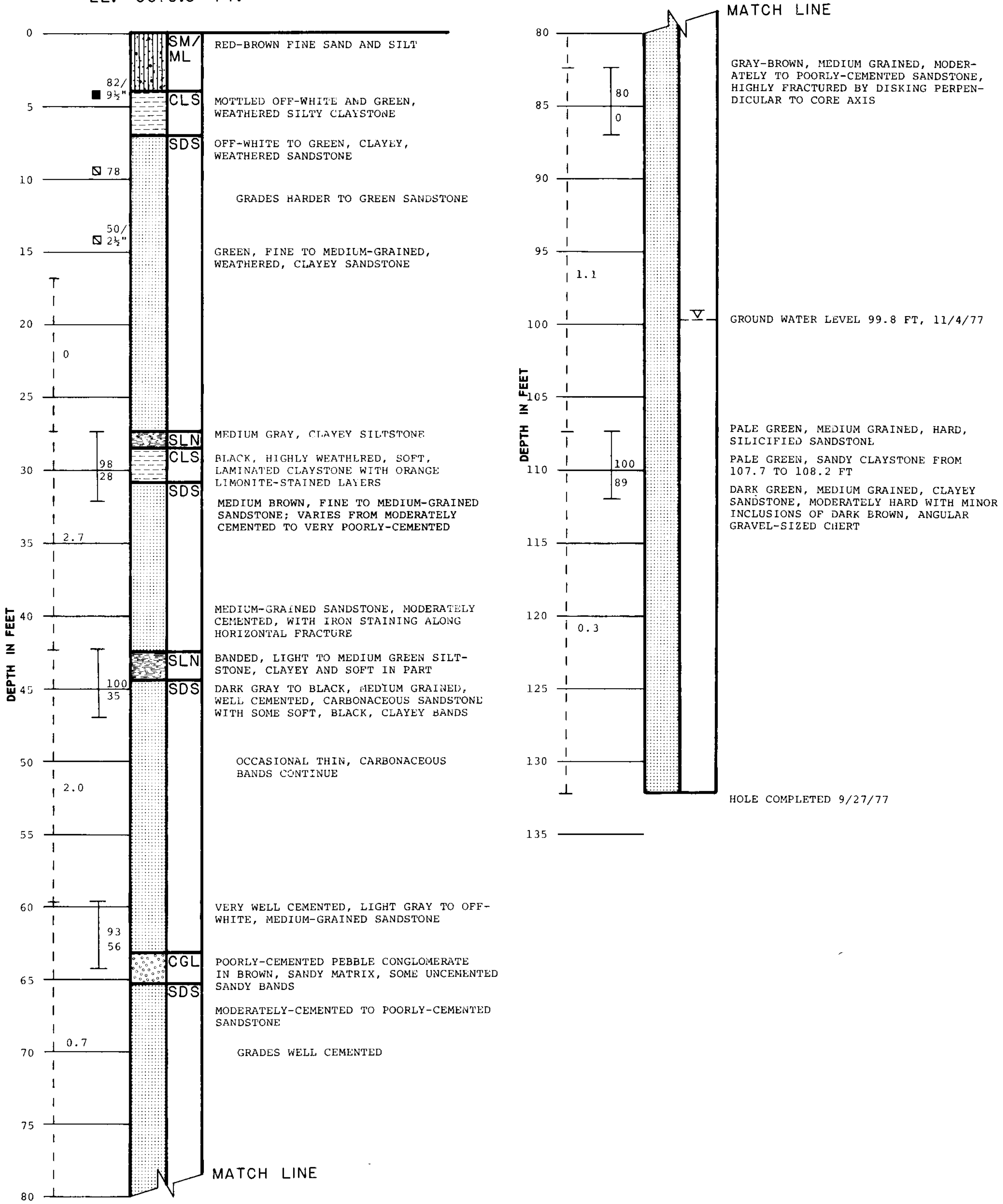
COLOR GRADES TO YELLOW-TAN

HOLE COMPLETED 9/18/77
NO GROUND WATER ENCOUNTERED

DAMES & MOORE

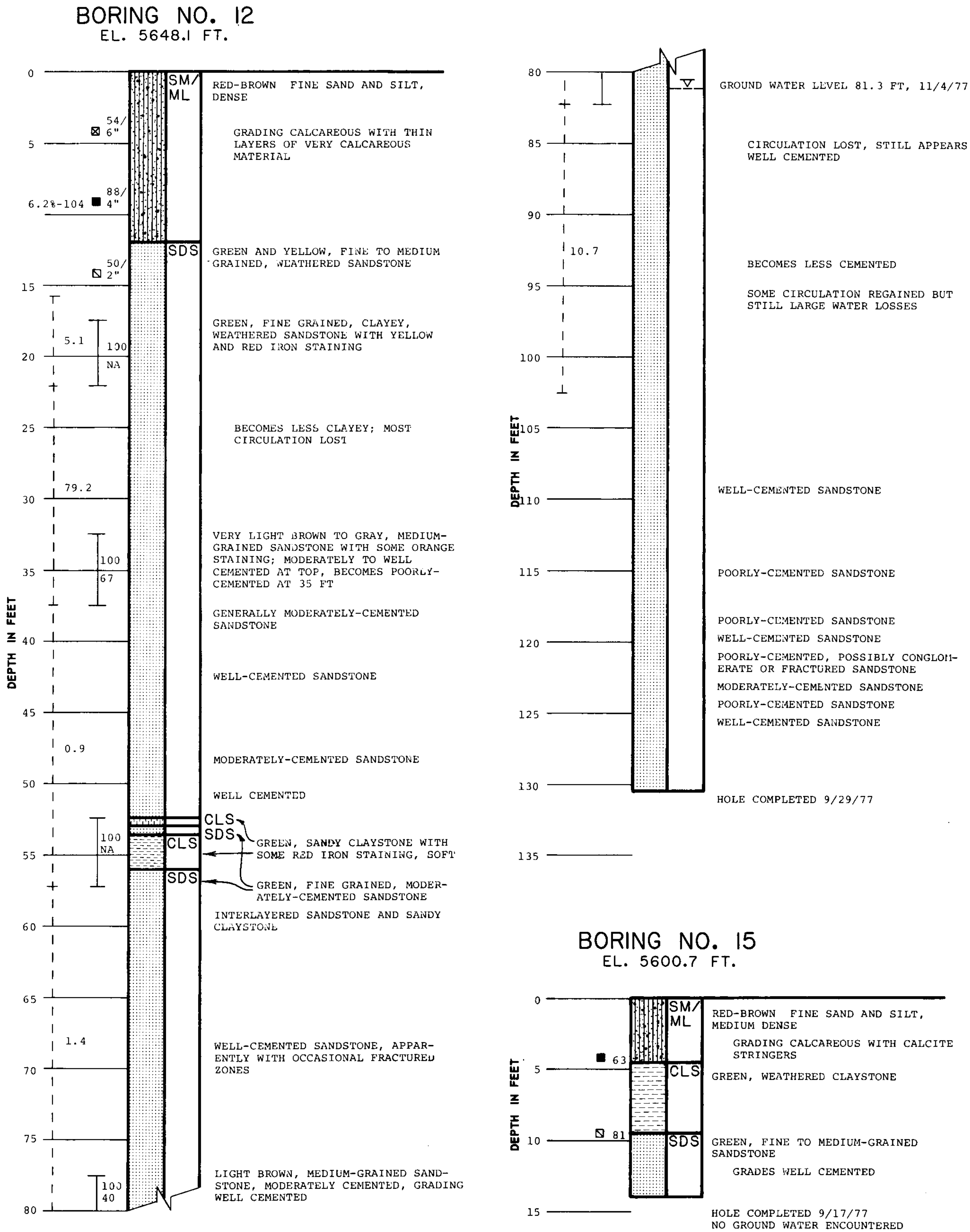
BORING NO. 9

EL. 5679.3 FT.



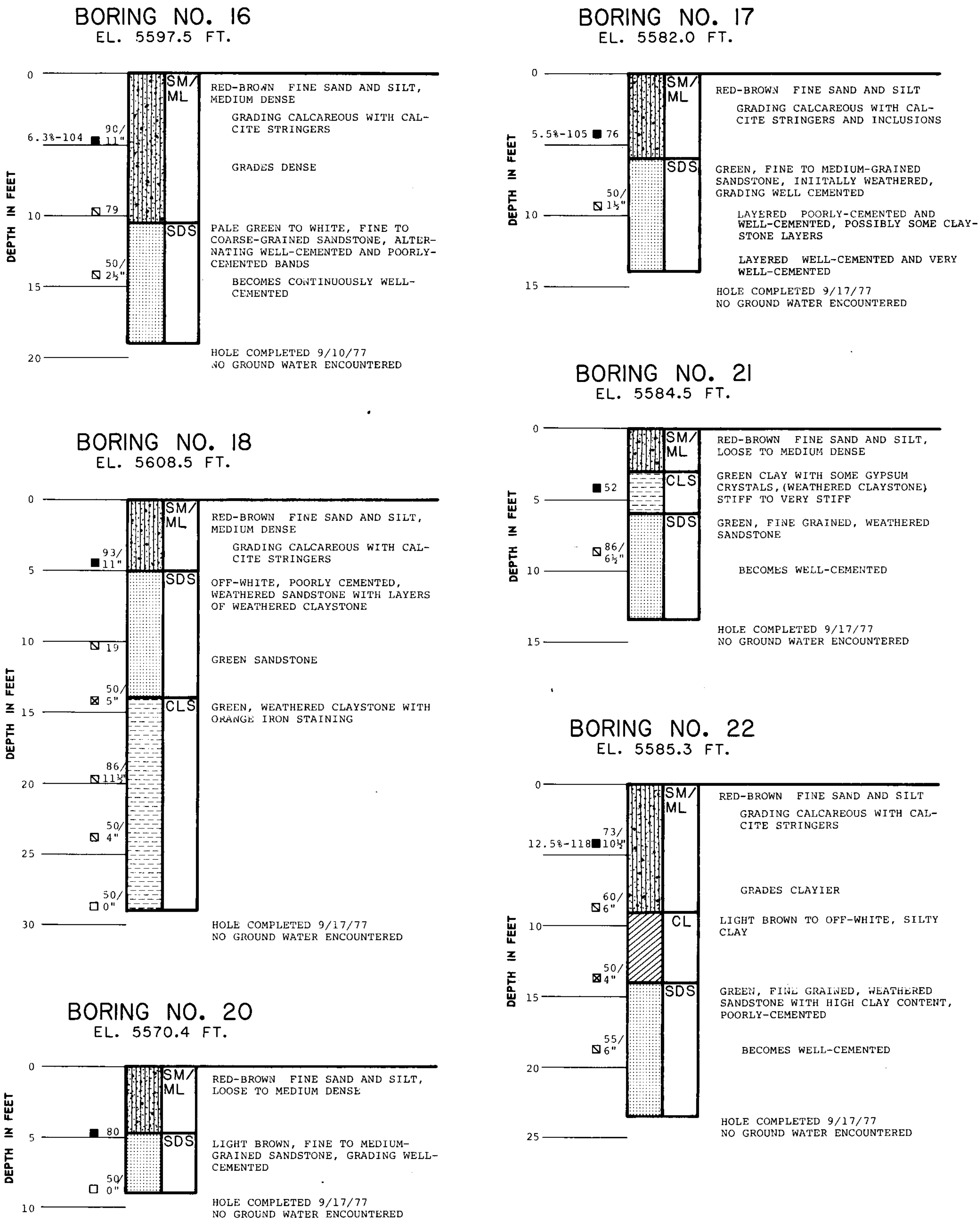
LOG OF BORINGS

DAMES & MOORE



LOG OF BORINGS

DAMES & MOORE



LOG OF BORINGS

DAMES & MOORE

BORING NO. 19

EL. 5600.3 FT.

DEPTH IN FEET

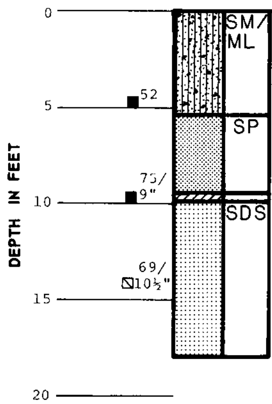
Depth (ft)	Sample / core data	Symbol	Description
0		SM/ML	RED-BROWN FINE SAND AND SILT, MEDIUM DENSE
	93/ 11" ; 12.4%-92		GRADING CALCAREOUS WTIH CALCITE STRINGERS
5			GRADES VERY CALCAREOUS AND VERY DENSE
			BECOMES VERY LOOSE, POSSIBLY WITH VOIDS
10	10		BECOMES DENSE
15	95/ 9"		
		SDS	GREEN, FINE TO MEDIUM-GRAINED SANDSTONE, WEATHERED, WITH SOME ORANGE AND YELLOW IRON STAINING
20	85/ 9½"		
	50/ 4½"		GRAY-GREEN, FINE TO MEDIUM GRAINED, WEATHERED, CLAYEY SANDSTONE WITH ORANGE AND YELLOW IRON STAINING
25	98 / 71		BECOMES LESS WEATHERED WITH LESS CLAY, PREDOMINANTLY GRAY WITH ORANGE IRON STAINING, MODERATELY CEMENTED, MEDIUM GRAINED
30	7.0		
35			BROWN-YELLOW, COARSE-GRAINED SANDSTONE
		CGL	FINE GRAVEL CONGLOMERATE WITH CONSIDERABLE COARSE-GRAINED SAND AND CALCAREOUS MATRIX
40	85 / 8	SDS	BROWN TO YELLOW, COARSE-GRAINED SANDSTONE WITH CONSIDERABLE NEAR HORIZONTAL FRACTURING AND SOME ORANGE IRON STAINING, MODERATELY CEMENTED
45	943		
50			WATER RETURN COMPLETELY LOST
55	78 / 0		LIGHT GRAY, MEDIUM TO COARSE-GRAINED SANDSTONE; HIGHLY FRACTURED ALONG HORIZONTAL BEDDING, CONSIDERABLE LIMONITE STAINING ALONG BEDDING FRACTURES; MODERATELY CEMENTED TO UNCEMENTED, CORE LOSSES ASSUMED DUE TO WASHING AWAY OF UNCEMENTED ZONES
60			LIMITED WATER RETURN
65			BECOMES VERY UNCEMENTED, WATER RETURN LOST
70			HOLE LOST AT 72 FT; HOLE 19A DRILLED 15 FT SOUTH OF HOLE 19; NO WATER RETURN OBTAINED; NO SAMPLING POSSIBLE; HOLE LOGGED FROM DRILLING PROGRESS
75			VERY WELL-CEMENTED SANDSTONE (72 FT) MODERATELY-CEMENTED SANDSTONE (73 FT)
80			MODERATELY WELL-CEMENTED CONGLOMERATE OR FRACTURED SANDSTONE, GRADING BETTER CEMENTED
85			GRADING LESS CEMENTED VERY POORLY-CEMENTED SANDSTONE
			MODERATELY-CEMENTED CLAYSTONE
90			POORLY-CEMENTED SANDSTONE WITH MINOR HARD LENSES MODERATELY-CEMENTED SANDSTONE GRADES LESS CEMENTED
95			APPEARS CLAYEY MODERATELY-CEMENTED SANDSTONE
100			
105			
110			GROUND WATER LEVEL 110 FT, 11/4/77 POORLY-CEMENTED SANDSTONE WITH OCCASIONAL BANDS OF GRAVEL OR CONGLOMERATE
115			VERY WELL-CEMENTED SANDSTONE VERY POORLY-CEMENTED SANDSTONE VERY WELL-CEMENTED SANDSTONE
120			
125			BECOMES LESS CEMENTED AND CLAYEY HOLE COMPLETED 9/25/77
130			

LOG OF BORINGS

DAMES & MOORE

PLATE A-9

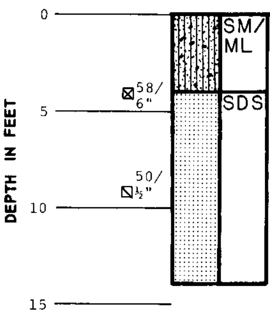
BORING NO. 23
EL. 5555.9 FT.



RED-BROWN FINE SAND AND SILT, LOOSE TO MEDIUM DENSE
GRADING CALCAREOUS WITH CALCITE STRINGERS
GRADES MEDIUM-GRAINED
MOTTLED COLORS FROM RED TO WHITE AND YELLOW
YELLOW TO LIGHT BROWN, MEDIUM TO COARSE-GRAINED SAND (WEATHERED SANDSTONE)
GREEN TO WHITE MOTTLED CLAY (WEATHERED CLAYSTONE)
OFF-WHITE TO YELLOW BROWN, MEDIUM TO COARSE-GRAINED, POORLY CEMENTED SANDSTONE, GRADES WELL CEMENTED

HOLE COMPLETED 9/10/77
NO GROUND WATER ENCOUNTERED

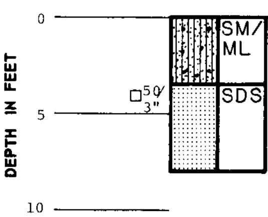
BORING NO. 24
EL. 5573.4 FT



RED-BROWN FINE SAND AND SILT, LOOSE TO MEDIUM DENSE
GRADING CALCAREOUS WITH CALCITE STRINGERS
OFF-WHITE, FINE GRAINED, WEATHERED SANDSTONE, GRADES WELL-CEMENTED
OFF-WHITE, FINE TO MEDIUM GRAINED, MODERATELY WELL-CEMENTED SANDSTONE
LIGHT BROWN, FINE TO MEDIUM GRAINED, WELL-CEMENTED SANDSTONE

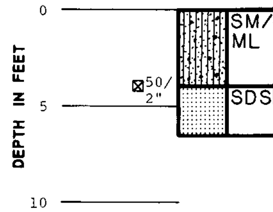
HOLE COMPLETED 9/17/77
NO GROUND WATER ENCOUNTERED

BORING NO. 26
EL. 5578.3 FT.



RED-BROWN FINE SAND AND SILT, LOOSE TO MEDIUM DENSE
GRADING CALCAREOUS WITH CALCITE STRINGERS
OFF-WHITE, FINE TO MEDIUM-GRAINED SANDSTONE, WEATHERED, GRADING WELL-CEMENTED
VERY WELL CEMENTED
HOLE COMPLETED 9/17/77
NO GROUND WATER ENCOUNTERED

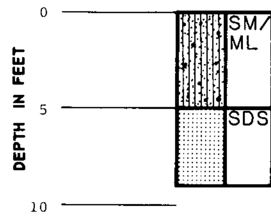
BORING NO. 27
EL. 5555.0 FT.



RED-BROWN FINE SAND AND SILT, LOOSE TO MEDIUM DENSE
GRADING CALCAREOUS WITH CALCITE STRINGERS
GREENISH, FINE TO MEDIUM-GRAINED SANDSTONE, VERY WELL-CEMENTED

HOLE COMPLETED 9/17/77
NO GROUND WATER ENCOUNTERED

BORING NO. 29
EL. 5655.0 FT. (APPROX.)



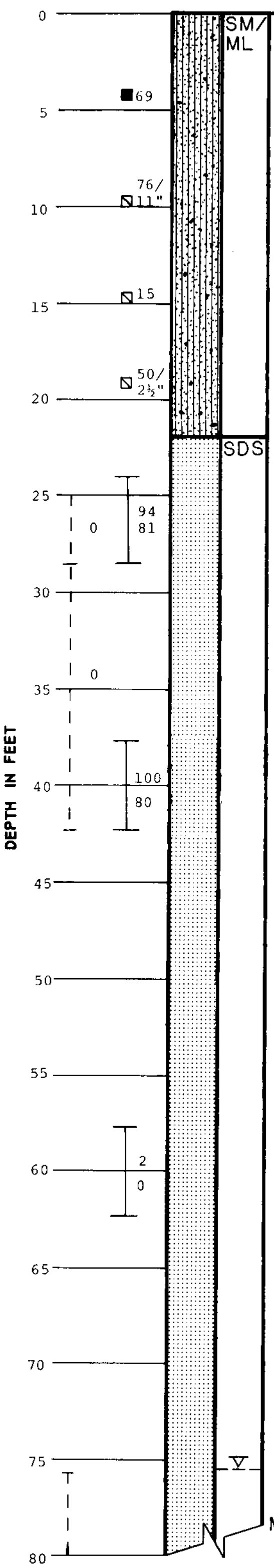
RED-BROWN FINE SAND AND SILT, LOOSE
GRADES MEDIUM DENSE
GRADING CALCAREOUS
WHITE TO SLIGHTLY TAN SANDSTONE
BECOMES WELL-CEMENTED

HOLE COMPLETED 9/30/77
NO GROUND WATER ENCOUNTERED

LOG OF BORINGS

DAMES & MOORE

BORING NO. 28
EL. 5547.6 FT.



RED-BROWN FINE SAND AND SILT, MEDIUM DENSE

GRADING CALCAREOUS WITH CALCITE STRINGERS

GRADES LIGHT BROWN AND VERY DENSE

BECOMES LOOSE

BECOMES VERY DENSE

ORANGE TO YELLOW, MEDIUM TO FINE GRAINED, SILTY SAND (WEATHERED SANDSTONE)

LIGHT GREENISH-GRAY, FINE TO MEDIUM-GRAINED SANDSTONE WITH SOME GRAVEL TO PEBBLE-SIZED INCLUSIONS; SOME MINOR LIMONITE STAINING; FRACTURES HORIZONTAL

LIGHT GREEN, FINE-GRAINED SANDSTONE WITH LAYERS OF GREEN CLAYSTONE UP TO 4 INCHES THICK

MEDIUM TO LIGHT BROWN, MEDIUM TO COARSE GRAINED, WELL-CEMENTED SANDSTONE, IRON STAINING EVIDENT AT CONTACT WITH OVERLYING FINER-GRAINED SANDSTONE

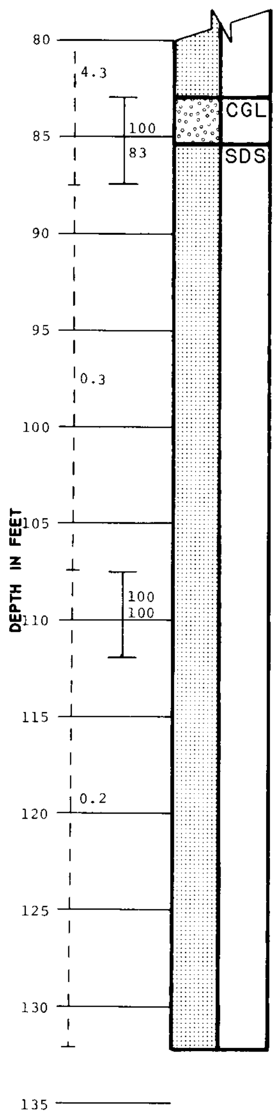
CIRCULATION LOST

LIGHT GRAY, MEDIUM TO COARSE-GRAINED SANDSTONE WITH SECTIONS OF VERY POORLY-CEMENTED SANDSTONE

INTERLAYERED, POORLY-CEMENTED AND WELL-CEMENTED SANDSTONE AND CONGLOMERATE

CASING INSTALLED TO 74 FT

GROUND WATER LEVEL 75.7 FT, 11/4/77



GRAVEL AND PEBBLE CONGLOMERATE WITH SANDY MATRIX IN PLACES UNCEMENTED

LIGHT GRAY TO OFF-WHITE, FINE TO MEDIUM-GRAINED SANDSTONE, WELL CEMENTED

GENERALLY LIGHT GRAY SANDSTONE WITH OCCASIONAL BANDS OF BROWN, CLAYIER SANDSTONE

GRADES DARKER GRAY

LIGHT GRAY, WELL-CEMENTED SANDSTONE

LIGHT GRAY, MEDIUM GRAINED, WELL-CEMENTED SANDSTONE; FRACTURES GENERALLY NEAR HORIZONTAL

HOLE COMPLETED 9/21/77

LOG OF BORINGS

DAMES & MOORE

APPENDIX B

LABORATORY TEST DATA

GENERAL

Representative soil samples obtained from the borings were subjected to various laboratory tests to aid in their identification and to study their engineering properties. The laboratory tests included moisture and density determinations, Atterberg limits determinations, grain-size analyses, compaction tests, permeability tests, consolidation tests, direct and triaxial shear strength tests, and chemical analyses.

MOISTURE AND DENSITY TESTS

Moisture and density tests were performed on selected, relatively-undisturbed soil samples to define the in situ moisture content and density of the soils; to aid in classifying the soils; and to help correlate other test data. The results of the moisture and density tests are presented on the left side of the boring logs on Plates A-3 through A-11.

ATTERBERG LIMITS

Atterberg limits were measured on several soil samples from bulk samples of potential borrow sources. These tests provide information regarding the plasticity of the clayey and silty soils. The results of the Atterberg limits tests are presented in Table B-1, Atterberg Limits Test Data.

GRAIN-SIZE DETERMINATIONS

Grain-size determination tests were performed on representative soil samples from the vicinity of the proposed tailing retention area and from potential borrow sources for clay and sand. The purpose of these tests was to enable accurate classification of the samples. Hydrometer tests were used to determine the grain-size distribution of material in the silt and clay size range for some of the samples. The results of the grain-size determinations are presented on Plates B-1 through B-4, Gradation Curves.

TABLE B-1

ATTERBERG LIMITS TEST DATA

Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Classification
L-C Ranch	0	143.0	18.0	125.0	CH
L-C Ranch	0	228.5	34.6	193.9	CH*
Cottonwood Canyon	0	72.4	22.4	50.0	CH
US 47 and Utah 262	0	45.1	18.7	26.4	CL

* Obtained using Blenderized Method

COMPACTION TESTS

Compaction tests were performed on a bulk sample of material obtained adjacent to borehole 19. This material is representative of the fine sand and silt which may be used in the construction of parts of the dikes and as bedding and cover material for the cell liners. The purpose of the compaction tests was to provide the compaction criteria for this material. Once the compaction tests were completed, several recompacted samples were prepared in the laboratory to simulate the as-constructed condition of the dike. These samples were subjected to permeability and strength testing so that this information could be used in our analysis of the stability and seepage characteristics of the dikes.

The compaction tests were performed in accordance with the AASTHO T-99 method of compaction. The results of the compaction tests are presented on Plate B-5, Compaction Test Data.

PERMEABILITY TESTS

Permeability tests were performed on relatively undisturbed samples and on recompacted soil samples. Samples used for recompaction were from a bulk sample taken adjacent to borehole 19, and were compacted to approximately 95 percent of AASHTO T-99 maximum dry density. The tests were performed in accordance with the method described on Plate B-6, Method of Performing Percolation Tests. The results of the permeability tests are presented in Table B-2, Permeability Test Data.

CONSOLIDATION TESTS

Consolidation tests were performed on two relatively undisturbed samples of silty fine sand and one sample of weathered claystone, all from borings in the mill area. The purpose of these tests was to evaluate the compressibility of the on-site soils. The tests were performed in accordance with the method described on Plate B-7, Method of Performing Consolidation Tests. The consolidation test results are presented on Plate B-8, Consolidation Test Data.

SHEAR STRENGTH TEST DATA

DIRECT SHEAR TESTS

Direct shear tests were performed on four relatively undisturbed samples of fine sand and silt obtained from borings in the mill area to determine strength characteristics of the in situ aeolian sand and silt. The tests were run with varying confining pressures, with the samples being saturated prior to testing. The tests were performed in accordance with the procedure described in Plate B-9, Method of Performing Direct Shear Friction Tests. The results of the direct shear tests are presented in Table B-3.

TABLE B-3

DIRECT SHEAR TEST DATA

Boring Number	Depth (ft)	Dry Density (pcf)	Confining Pressure (psf)	Peak Shear Strength (psf)
1	5	117.8	1000	925
3	4	107.3	2000	1600
2	9-1/2	109.4	4000	2325
5	5	97.3	6000	3680

TABLE B-2

PERMEABILITY TEST DATA

Boring Number	Depth (ft)	Soil Classification	Surcharge Pressure (psf)	Permeability (k) (ft/yr)	(cm/sec)
6	9	SM/ML	1000	11.6	1.2×10^{-5}
7	4-1/2	SM/ML	1000	10.3	1.0×10^{-5}
10	4	SM/ML	1000	12.4	1.2×10^{-5}
12	9	SM/ML	1000	144	1.4×10^{-4}
16	4-1/2	SM/ML	1000	21.6	2.1×10^{-5}
17	4-1/2	SM/ML	1000	92.8	9.0×10^{-5}
19	4	SM/ML	1000	70.1	6.8×10^{-5}
22	4	ML	1000	3.9	3.8×10^{-6}
Recompacted	1	ML	1000	0.35	3.4×10^{-7}
Recompacted	1	ML	1000	0.56	5.4×10^{-7}
Recompacted	1	ML	1000	0.19	1.8×10^{-7}

TRIAXIAL COMPRESSION TESTS

Consolidated-undrained triaxial compression tests with pore pressure measurements (TX-CU/PP) were performed on relatively undisturbed and recompacted samples of silty fine sand. The recompacted samples were compacted to approximately 95 percent of AASHTO T-99 maximum dry density. The tests were performed to determine the strength parameters of these materials, and the results were used in our stability analyses. The tests were run with varying confining pressures to simulate the pressures which would be exerted on the soils by the dikes. The samples were consolidated at the assigned confining pressure and saturated prior to testing.

The tests were performed in accordance with the procedure described on Plate B-10, Methods of Performing Unconfined Compression and Triaxial Compression Tests. The results of the triaxial compression tests are presented on Plates B-11 and B-12.

CHEMICAL ANALYSES

Chemical analyses were performed on soil samples from the proposed mill site to determine the percentage of soluble sulfates contained in the soil. Soluble sulfate content is required for determining the appropriate cement type required for foundations and all other concrete structures at or below grade. The results of these tests are presented in Table B-4, Chemical Test Data.

TABLE B-4

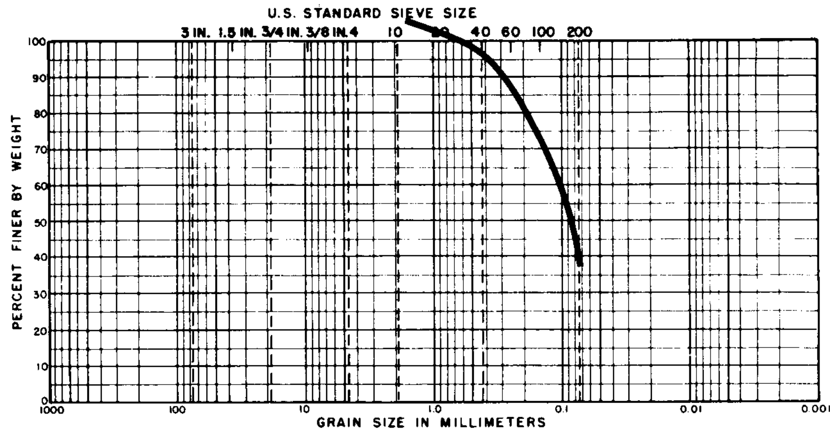
CHEMICAL TEST DATA

Boring Number	Depth (ft)	Percent Magnesium as $MgSO_4$	Percent Sodium as $NaSO_4$	Percent Calcium as $CaSO_4$	Percent Total Soluble Solids	pH
1	4.5	0.013	0.042	0.032	0.382	7.65
2	4	0.010	0.032	0.068	0.112	7.90
4	4	0.012	0.018	0.055	0.090	7.69
5	4.5	0.009	0.020	0.029	0.088	7.63

*　　*　　*

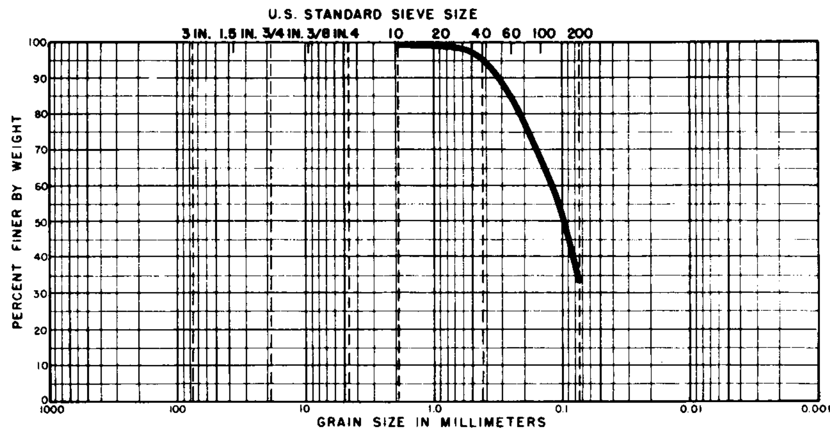
The following plates are attached and complete this appendix:

Plate B-1	Gradation Curves
Plate B-2	Gradation Curves
Plate B-3	Gradation Curves
Plate B-4	Gradation Curves
Plate B-5	Compaction Test Data
Plate B-6	Method of Performing Percolation Tests
Plate B-7	Method of Performing Consolidation Tests
Plate B-8	Consolidation Test Data
Plate B-9	Method of Performing Direct Shear Friction Tests
Plate B-10	Methods of Performing Unconfined Compression and Triaxial Compression Tests
Plate B-11	Triaxial Compression Tests
Plate B-12	Multi Phase Triaxial Compression Tests



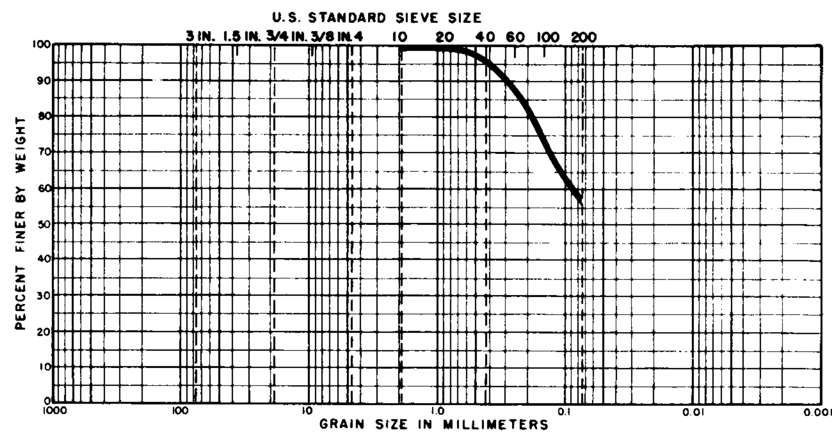
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
BORING 3	3.5 FT.	SM	SILTY FINE SAND					



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
BORING 4	4.5 FT.	SM	SILTY FINE SAND					

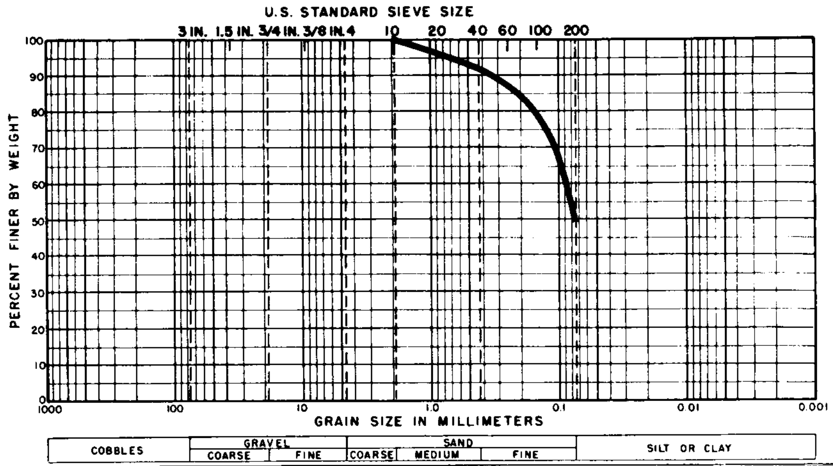


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

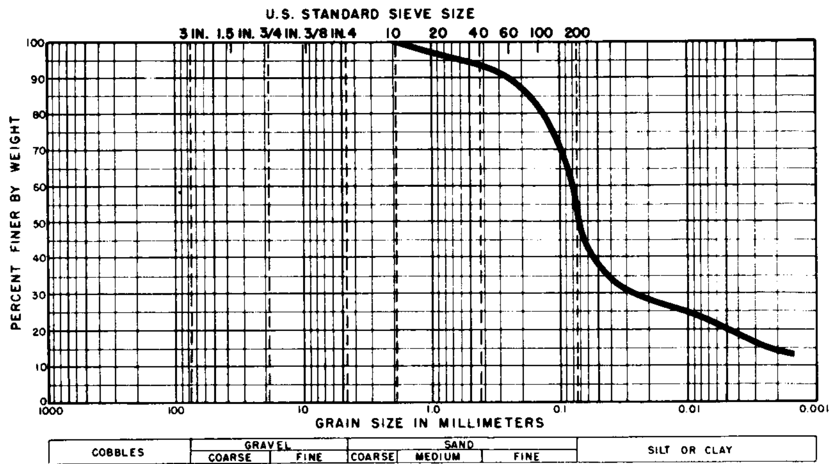
LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
BORING 10	3.5 FT.	ML/SM	SILT & FINE SAND					

GRADATION CURVES

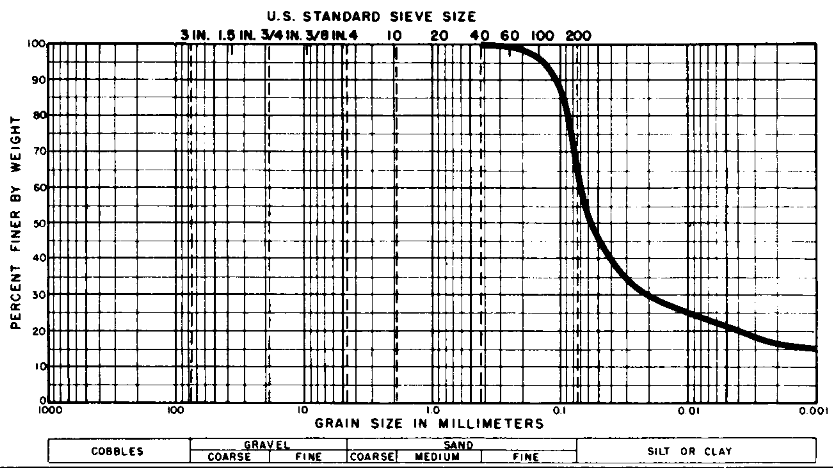
DAMES & MOORE



LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
BORING 12	9 FT.	SM/ML	FINE SAND & SILT					



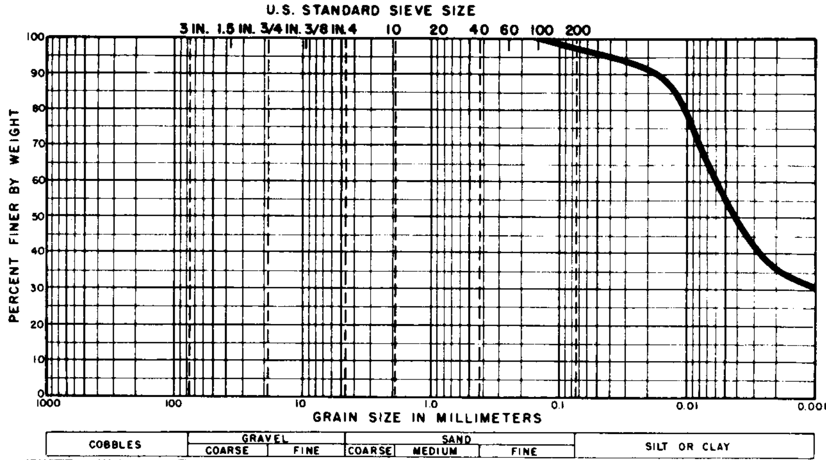
LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
BORING 17	4.5 FT.	SM/ML	SILT & FINE SAND WITH SOME CLAY & MEDIUM SAND					



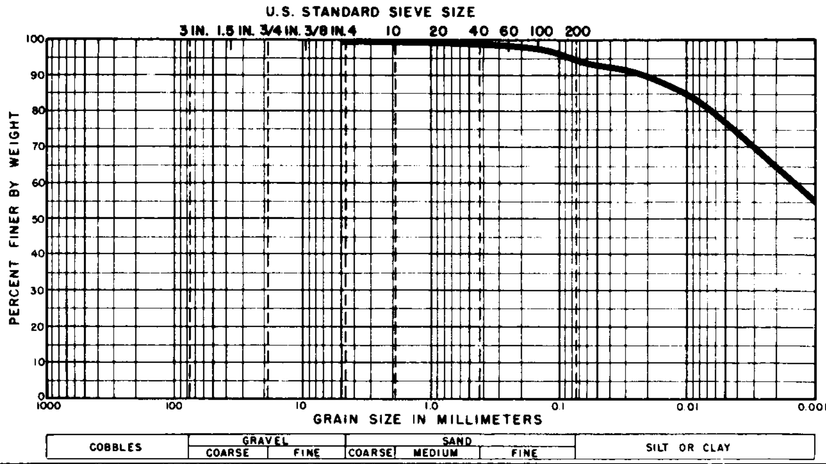
LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
BULK 19A	1–2 FT.	ML	SILT WITH FINE SAND AND SOME CLAY					

GRADATION CURVES

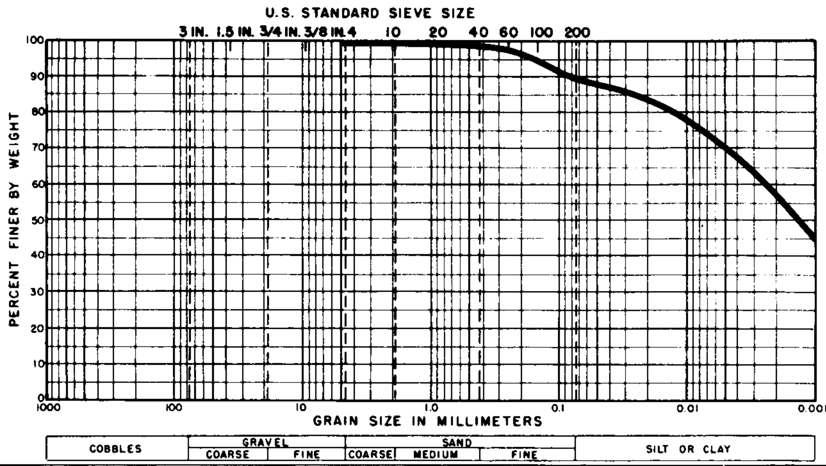
DAMES & MOORE



LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
US 47 & UTAH 262	SAMPLE 3	CL	SILTY CLAY WITH A TRACE OF FINE TO MEDIUM SAND		45.1	18.7	26.4	



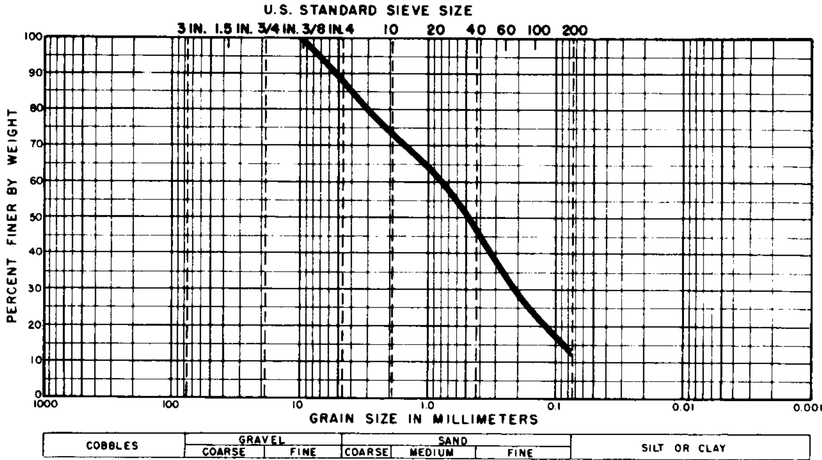
LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
L-C RANCH	FROM STOCKPILE	CH	SILTY CLAY WITH A TRACE OF FINE TO MEDIUM SAND		143.0	18.0	125.0	



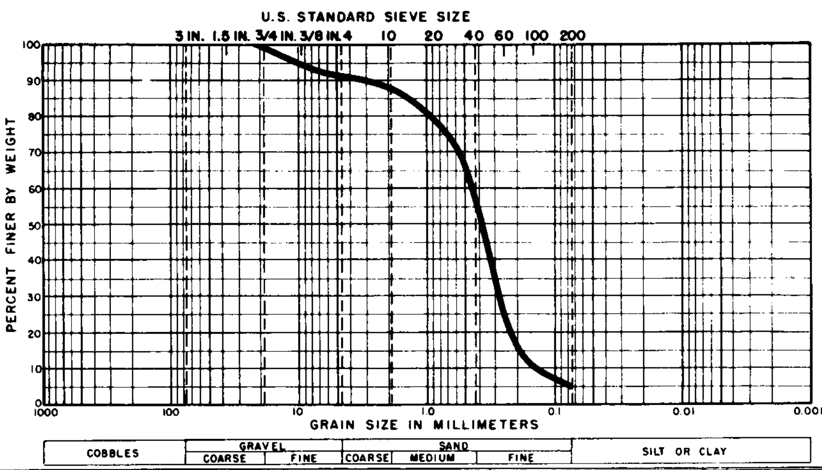
LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
COTTONWOOD CANYON	SAMPLE 2	CH	SILTY CLAY WITH A TRACE OF FINE TO MEDIUM SAND		72.4	22.4	50.0	

GRADATION CURVES

DAMES & MOORE



LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
GRAVEL REJECT	FROM STOCKPILE	SM	SILTY FINE TO COARSE SAND WITH SOME FINE GRAVEL					



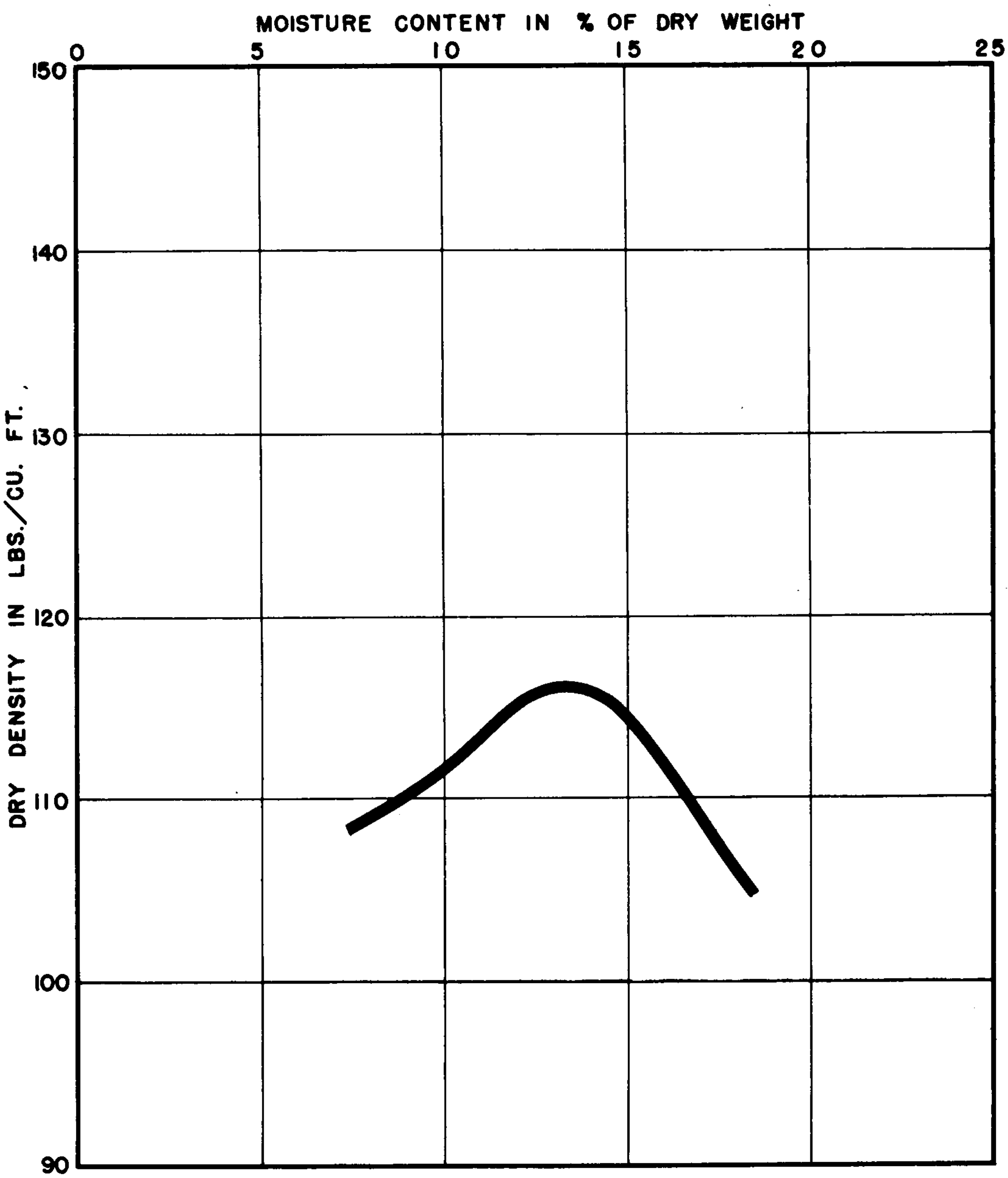
LOCATION	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
WEST WATER CR.	SURFACE	(SP/SM)	FINE TO COARSE SAND WITH SOME FINE GRAVEL AND SILT					

GRADATION CURVES

DAMES & MOORE

PLATE B-4

SAMPLE NO. 19A DEPTH 1'-2' ELEVATION 5600'
SOIL FINE SANDY SILT (ML/SM)
LOCATION BLANDING, UTAH
OPTIMUM MOISTURE CONTENT 14 PERCENT
MAXIMUM DRY DENSITY 116 PCF
METHOD OF COMPACTION AASHTO T-99



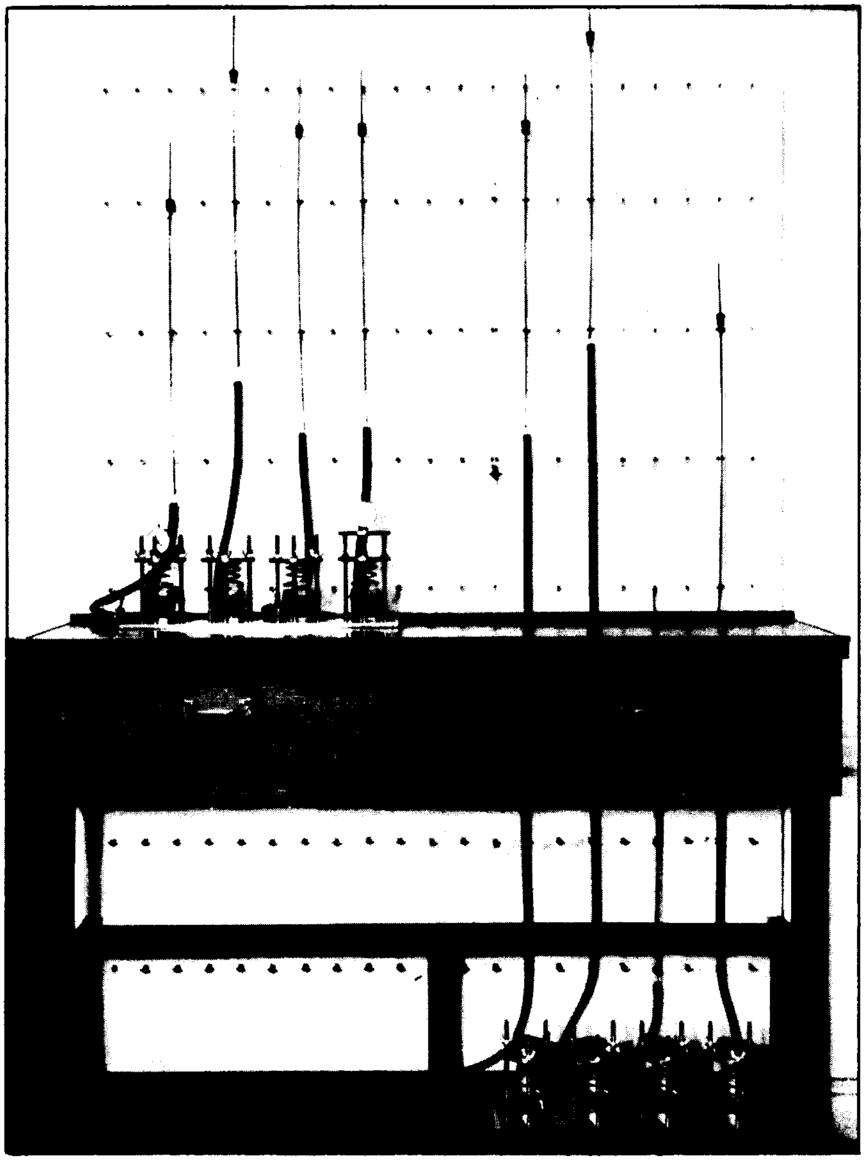
COMPACTION TEST DATA

DAMES & MOORE

METHOD OF PERFORMING PERCOLATION TESTS

The quantity and the velocity of flow of water which will escape through an earth structure or percolate through soil are dependent upon the permeability of the earth structure or soil. The permeability of soil has often been calculated by empirical formulas but is best determined by laboratory tests, especially in the case of compacted soils.

A one-inch length of the core sample is sealed in the percolation apparatus, placed under a confining load, or surcharge pressure, and subjected to the pressure of a known head of water. The percolation rate is computed from the measurements of the volume of water which flows through the sample in a series of time intervals. These rates are usually expressed as the velocity of flow in feet per year under a hydraulic gradient of one and at a temperature of 20 degrees Centigrade. The rate so expressed may be adjusted for any set of conditions involving the same soil by employing established physical laws. Generally, the percolation rate varies over a wide range at the beginning of the test and gradually approaches equilibrium as the test progresses.



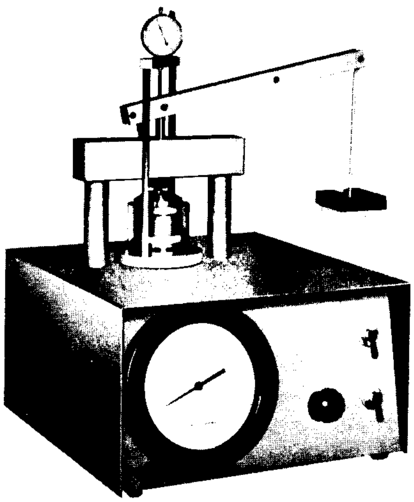
APPARATUS FOR PERFORMING PERCOLATIONS TESTS
Shows tests in progress on eight samples simultaneously.

During the performance of the test, continuous readings of the deflection of the sample are taken by means of micrometer dial gauges. 'he amount of compression or expansion, expressed as a percentage of the original length of the sample, is a valuable indication of the compression of the soil which will occur under the action of load or the expansion of the soil as saturation takes place.

Method Of Performing Consolidation Tests

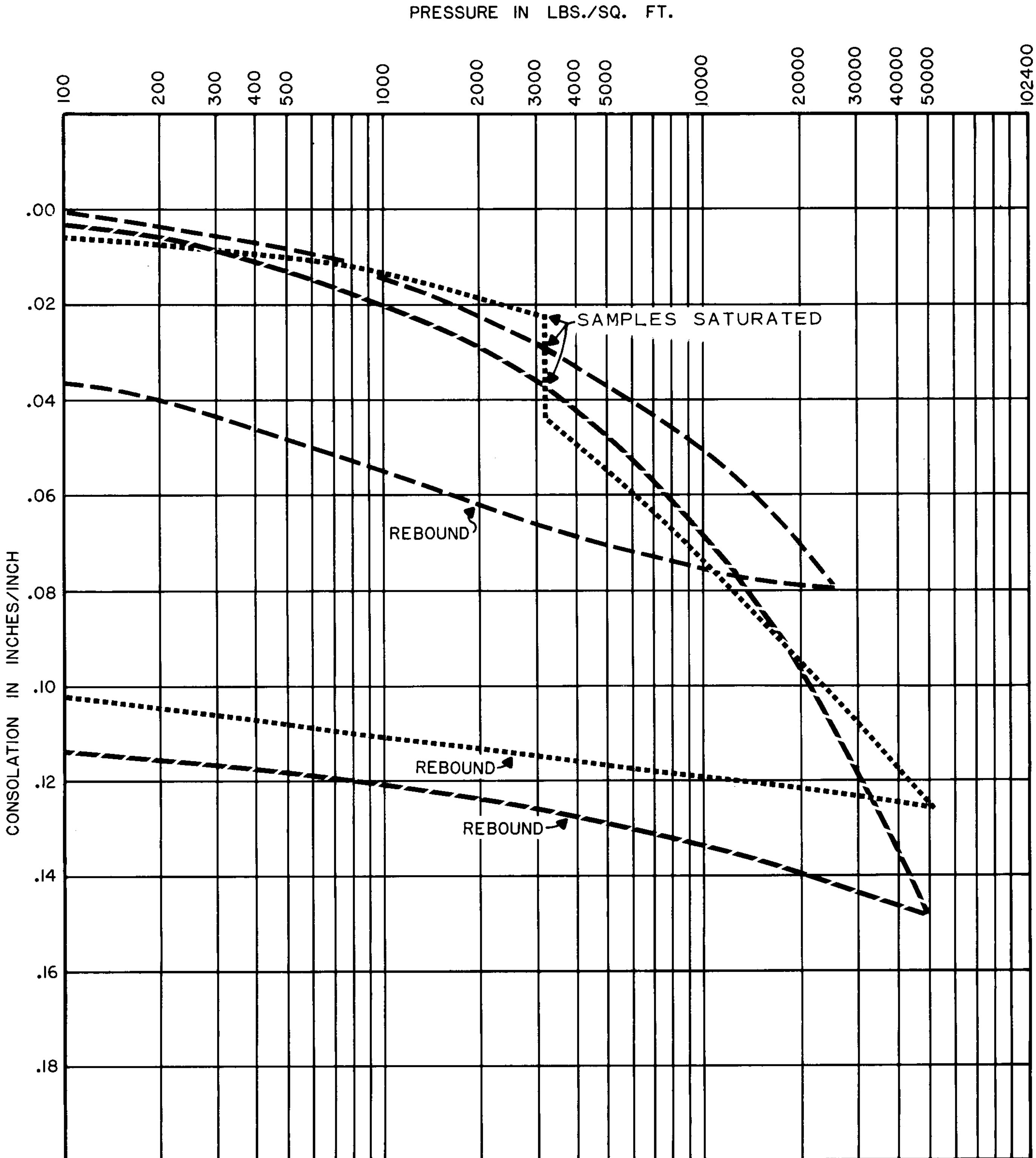
Consolidation tests are performed to evaluate the volume changes of soils subjected to increased loads. Time-consolidation and pressure-consolidation curves may be plotted from the data obtained in the tests. Engineering analyses based on these curves permit estimates to be made of the probable magnitude and rate of settlement of the tested soils under applied loads.

Each sample is tested within brass rings two and one-half inches in diameter and one inch in length. Undisturbed samples of in-place soils are tested in rings taken from the sampling device in which the samples were obtained. Loose samples of soils to be used in constructing earth fills are compacted in rings to predetermined conditions and tested.



DEAD LOAD-PNEUMATIC CONSOLIDOMETER

In testing, the sample is rigidly confined laterally by the brass ring. Axial loads are transmitted to the ends of the sample by porous disks. The disks allow drainage of the loaded sample. The axial compression or expansion of the sample is measured by a micrometer dial indicator at appropriate time intervals after each load increment is applied. Each load is ordinarily twice the preceding load. The increments are selected to obtain consolidation data representing the field loading conditions for which the test is being performed. Each load increment is allowed to act over an interval of time dependent on the type and extent of the soil in the field.

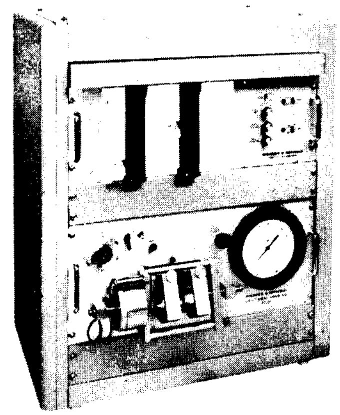


BORING		SOIL TYPE	MOISTURE CONTENT IN PERCENT		DRY DENSITY IN LBS./CU. FT.		SYMBOL
NO.	DEPTH		BEFORE	AFTER	BEFORE	AFTER	
3	4'	(SM) SILTY FINE SAND	7.6	18.0	100	112	▬ ▬ ▬ (short dash)
3	14'	(CL) WEATHERED CLAYSTONE	15.1	17.1	113	117	▬ ▬ ▬ (long dash)
4	4'	(SM) SILTY FINE SAND	5.1	13.9	107	119	....

CONSOLIDATION TEST DATA

DAMES & MOORE

METHOD OF PERFORMING DIRECT SHEAR AND FRICTION TESTS



DIRECT SHEAR APPARATUS WITH ELECTRONIC RECORDER

DIRECT SHEAR TESTS ARE PERFORMED TO DETERMINE THE SHEARING STRENGTHS OF SOILS. FRICTION TESTS ARE PERFORMED TO DETERMINE THE FRICTIONAL RESISTANCES BETWEEN SOILS AND VARIOUS OTHER MATERIALS SUCH AS WOOD, STEEL, OR CONCRETE. THE TESTS ARE PERFORMED IN THE LABORATORY TO SIMULATE ANTICIPATED FIELD CONDITIONS.

EACH SAMPLE IS TESTED WITHIN THREE BRASS RINGS, TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.

DIRECT SHEAR TESTS

A THREE-INCH LENGTH OF THE SAMPLE IS TESTED IN DIRECT DOUBLE SHEAR. A CONSTANT PRESSURE, APPROPRIATE TO THE CONDITIONS OF THE PROBLEM FOR WHICH THE TEST IS BEING PERFORMED, IS APPLIED NORMAL TO THE ENDS OF THE SAMPLE THROUGH POROUS STONES. A SHEARING FAILURE OF THE SAMPLE IS CAUSED BY MOVING THE CENTER RING IN A DIRECTION PERPENDICULAR TO THE AXIS OF THE SAMPLE. TRANSVERSE MOVEMENT OF THE OUTER RINGS IS PREVENTED.

THE SHEARING FAILURE MAY BE ACCOMPLISHED BY APPLYING TO THE CENTER RING EITHER A CONSTANT RATE OF LOAD, A CONSTANT RATE OF DEFLECTION, OR INCREMENTS OF LOAD OR DEFLECTION. IN EACH CASE, THE SHEARING LOAD AND THE DEFLECTIONS IN BOTH THE AXIAL AND TRANSVERSE DIRECTIONS ARE RECORDED AND PLOTTED. THE SHEARING STRENGTH OF THE SOIL IS DETERMINED FROM THE RESULTING LOAD-DEFLECTION CURVES.

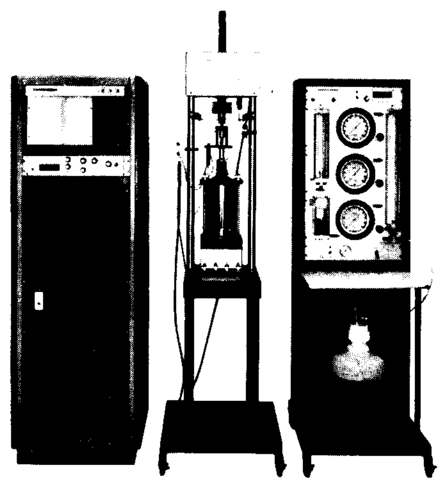
FRICTION TESTS

IN ORDER TO DETERMINE THE FRICTIONAL RESISTANCE BETWEEN SOIL AND THE SURFACES OF VARIOUS MATERIALS, THE CENTER RING OF SOIL IN THE DIRECT SHEAR TEST IS REPLACED BY A DISK OF THE MATERIAL TO BE TESTED. THE TEST IS THEN PERFORMED IN THE SAME MANNER AS THE DIRECT SHEAR TEST BY FORCING THE DISK OF MATERIAL FROM THE SOIL SURFACES.

METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

THE SHEARING STRENGTHS OF SOILS ARE DETERMINED FROM THE RESULTS OF UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS. IN TRIAXIAL COMPRESSION TESTS THE TEST METHOD AND THE MAGNITUDE OF THE CONFINING PRESSURE ARE CHOSEN TO SIMULATE ANTICIPATED FIELD CONDITIONS.

UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS ARE PERFORMED ON UNDISTURBED OR REMOLDED SAMPLES OF SOIL APPROXIMATELY SIX INCHES IN LENGTH AND TWO AND ONE-HALF INCHES IN DIAMETER. THE TESTS ARE RUN EITHER STRAIN-CONTROLLED OR STRESS-CONTROLLED. IN A STRAIN-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO A CONSTANT RATE OF DEFLECTION AND THE RESULTING STRESSES ARE RECORDED. IN A STRESS-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO EQUAL INCREMENTS OF LOAD WITH EACH INCREMENT BEING MAINTAINED UNTIL AN EQUILIBRIUM CONDITION WITH RESPECT TO STRAIN IS ACHIEVED.



TRIAXIAL COMPRESSION TEST UNIT

YIELD, PEAK, OR ULTIMATE STRESSES ARE DETERMINED FROM THE STRESS-STRAIN PLOT FOR EACH SAMPLE AND THE PRINCIPAL STRESSES ARE EVALUATED. THE PRINCIPAL STRESSES ARE PLOTTED ON A MOHR'S CIRCLE DIAGRAM TO DETERMINE THE SHEARING STRENGTH OF THE SOIL TYPE BEING TESTED.

UNCONFINED COMPRESSION TESTS CAN BE PERFORMED ONLY ON SAMPLES WITH SUFFICIENT COHESION SO THAT THE SOIL WILL STAND AS AN UNSUPPORTED CYLINDER. THESE TESTS MAY BE RUN AT NATURAL MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SOILS.

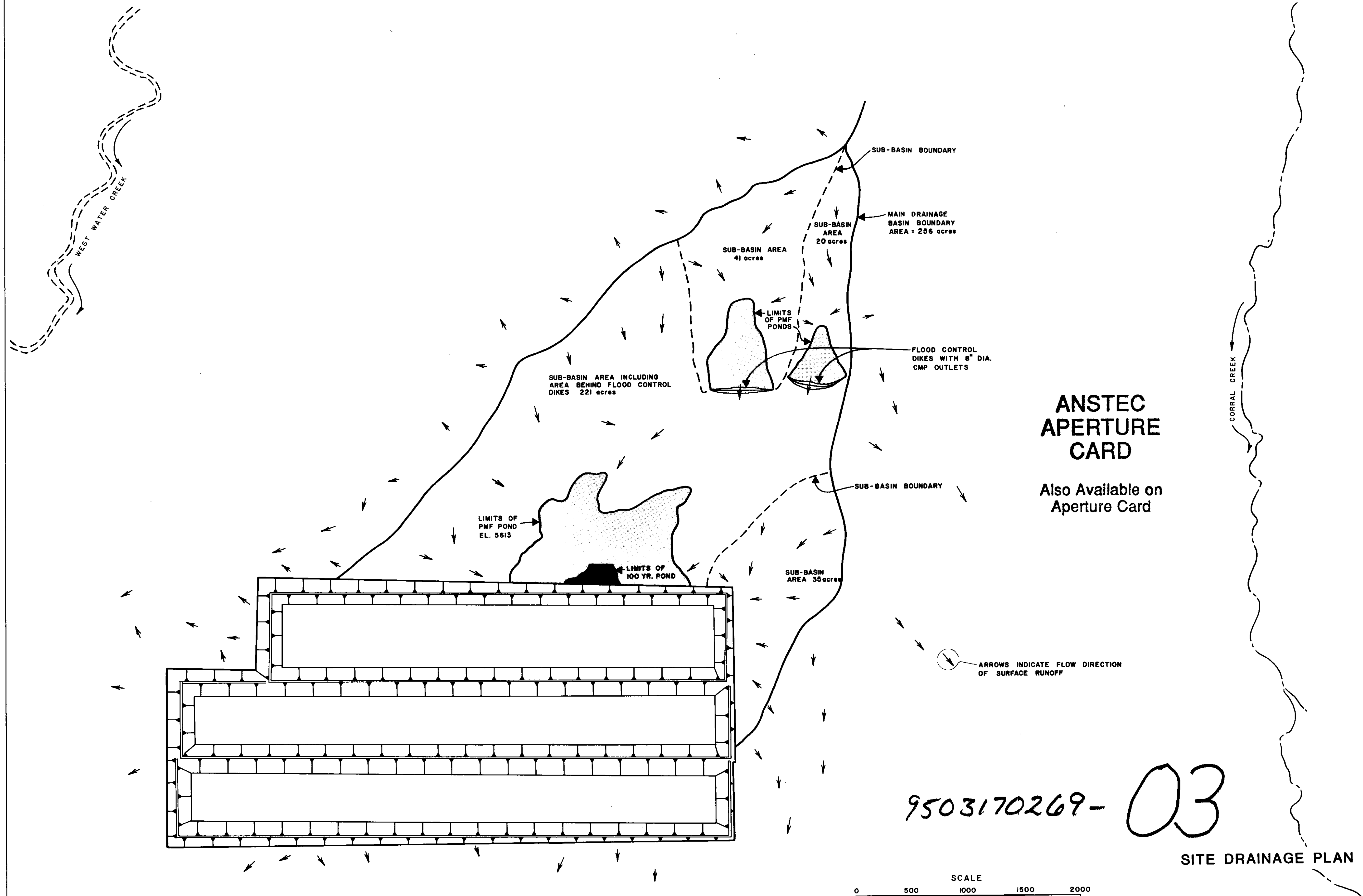
IN A TRIAXIAL COMPRESSION TEST THE SAMPLE IS ENCASED IN A RUBBER MEMBRANE, PLACED IN A TEST CHAMBER, AND SUBJECTED TO A CONFINING PRESSURE THROUGHOUT THE DURATION OF THE TEST. NORMALLY, THIS CONFINING PRESSURE IS MAINTAINED AT A CONSTANT LEVEL, ALTHOUGH FOR SPECIAL TESTS IT MAY BE VARIED IN RELATION TO THE MEASURED STRESSES. TRIAXIAL COMPRESSION TESTS MAY BE RUN ON SOILS AT FIELD MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SAMPLES. THE TESTS ARE PERFORMED IN ONE OF THE FOLLOWING WAYS:

UNCONSOLIDATED-UNDRAINED: THE CONFINING PRESSURE IS IMPOSED ON THE SAMPLE AT THE START OF THE TEST. NO DRAINAGE IS PERMITTED AND THE STRESSES WHICH ARE MEASURED REPRESENT THE SUM OF THE INTERGRANULAR STRESSES AND PORE WATER PRESSURES.

CONSOLIDATED-UNDRAINED: THE SAMPLE IS ALLOWED TO CONSOLIDATE FULLY UNDER THE APPLIED CONFINING PRESSURE PRIOR TO THE START OF THE TEST. THE VOLUME CHANGE IS DETERMINED BY MEASURING THE WATER AND/OR AIR EXPELLED DURING CONSOLIDATION. NO DRAINAGE IS PERMITTED DURING THE TEST AND THE STRESSES WHICH ARE MEASURED ARE THE SAME AS FOR THE UNCONSOLIDATED-UNDRAINED TEST.

DRAINED: THE INTERGRANULAR STRESSES IN A SAMPLE MAY BE MEASURED BY PERFORMING A DRAINED, OR SLOW, TEST. IN THIS TEST THE SAMPLE IS FULLY SATURATED AND CONSOLIDATED PRIOR TO THE START OF THE TEST. DURING THE TEST, DRAINAGE IS PERMITTED AND THE TEST IS PERFORMED AT A SLOW ENOUGH RATE TO PREVENT THE BUILDUP OF PORE WATER PRESSURES. THE RESULTING STRESSES WHICH ARE MEASURED REPRESENT ONLY THE INTERGRANULAR STRESSES. THESE TESTS ARE USUALLY PERFORMED ON SAMPLES OF GENERALLY NON-COHESIVE SOILS, ALTHOUGH THE TEST PROCEDURE IS APPLICABLE TO COHESIVE SOILS IF A SUFFICIENTLY SLOW TEST RATE IS USED.

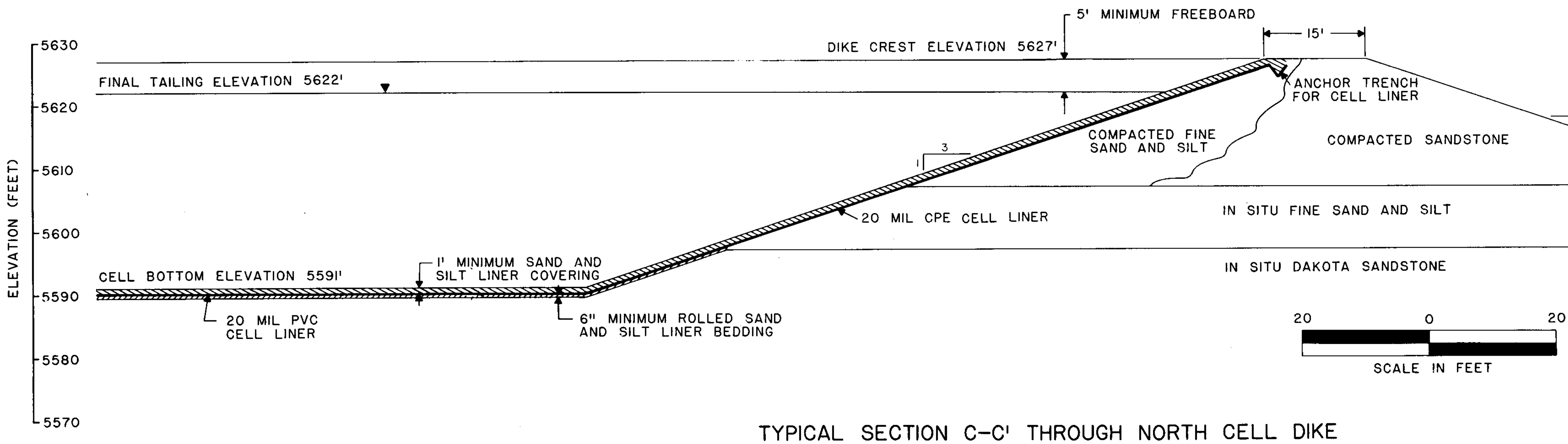
AN ALTERNATE MEANS OF OBTAINING THE DATA RESULTING FROM THE DRAINED TEST IS TO PERFORM AN UNDRAINED TEST IN WHICH SPECIAL EQUIPMENT IS USED TO MEASURE THE PORE WATER PRESSURES. THE DIFFERENCES BETWEEN THE TOTAL STRESSES AND THE PORE WATER PRESSURES MEASURED ARE THE INTERGRANULAR STRESSES.



9503170269-03

SITE DRAINAGE PLAN

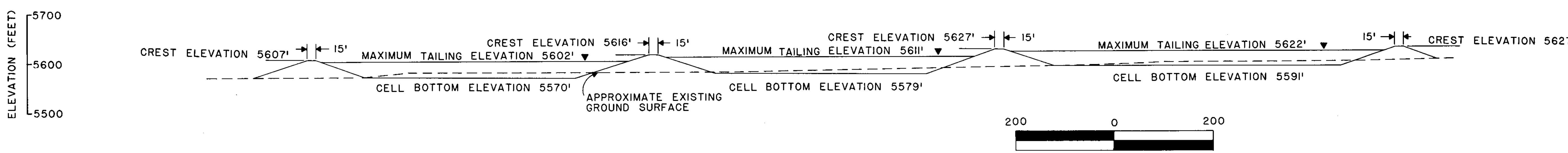
PLATE 4



TYPICAL SECTION C–C' THROUGH NORTH CELL DIKE

ANSTEC APERTURE CARD

Also Available on Aperture Card



NOTES:

ALL DIKE SLOPES 3(HORIZONTAL) : 1(VERTICLE)

SEE PLATE 2 FOR LOCATION OF SECTIONS

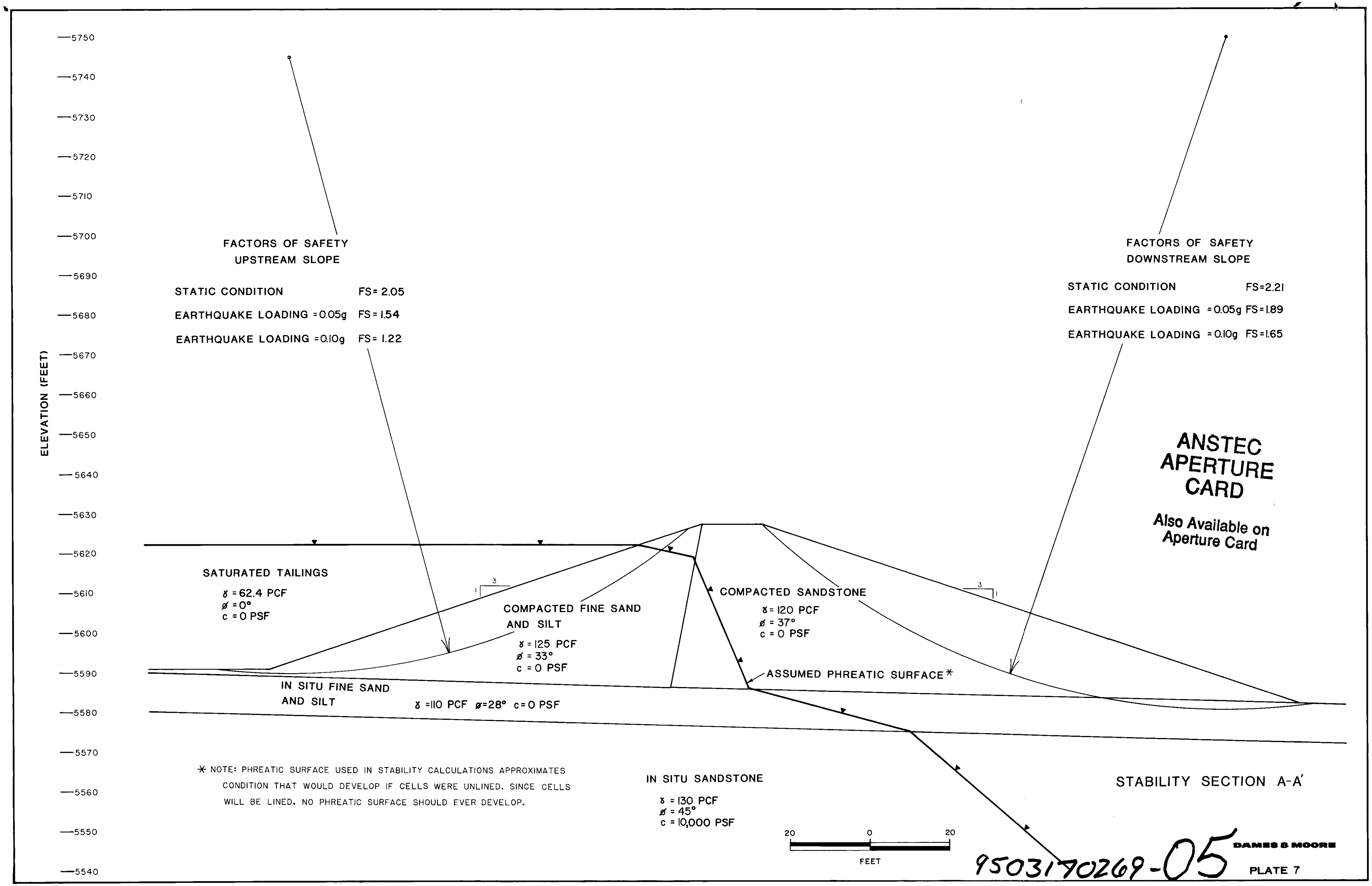
TYPICAL SECTION D–D' THROUGH CELL SYSTEM

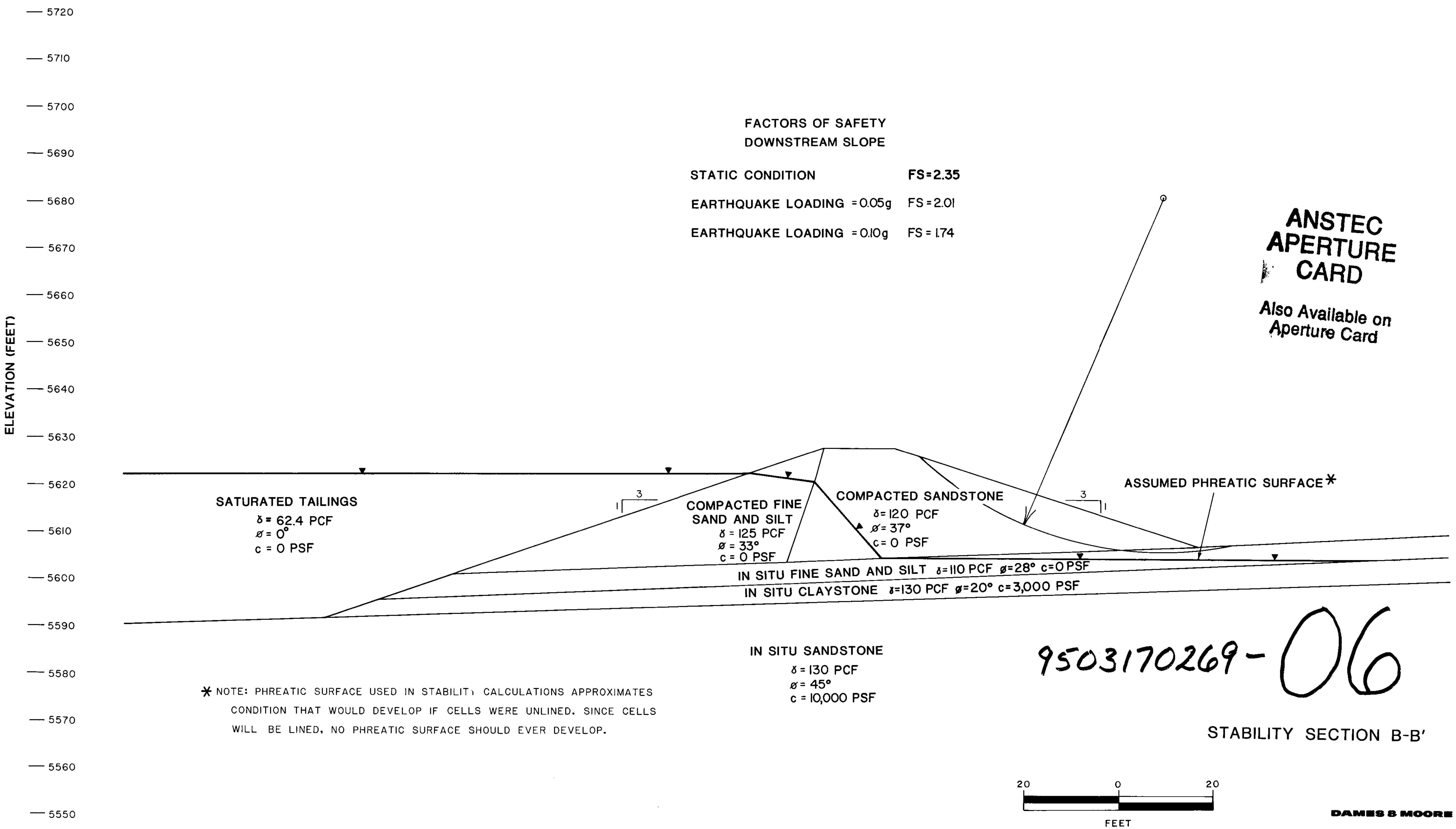
TYPICAL SECTIONS

9503170269-04

DAMES & MOORE

PLATE 6


5750
5740
5730
5720
5710
5700
5690
5680
5670
5660
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
ELEVATION (FEET)
FACTORS OF SAFETY
UPSTREAM SLOPE
STATIC CONDITION FS= 2.05
EARTHQUAKE LOADING =0.05g FS= 1.54
EARTHQUAKE LOADING =0.10g FS= 1.22
FACTORS OF SAFETY
DOWNSTREAM SLOPE
STATIC CONDITION FS=2.21
EARTHQUAKE LOADING =0.05g FS=1.89
EARTHQUAKE LOADING =0.10g FS=1.65
ANSTEC APERTURE CARD
Also Available on Aperture Card
SATURATED TAILINGS
γ =62.4 PCF
ø =0°
c =0 PSF
3
1
COMPACTED FINE SAND AND SILT
γ =125 PCF
ø = 33°
c = 0 PSF
COMPACTED SANDSTONE
γ = 120 PCF
ø = 37°
c = 0 PSF
ASSUMED PHREATIC SURFACE*
IN SITU FINE SAND AND SILT
γ =110 PCF ø=28° c=0 PSF
* NOTE: PHREATIC SURFACE USED IN STABILITY CALCULATIONS APPROXIMATES CONDITION THAT WOULD DEVELOP IF CELLS WERE UNLINED. SINCE CELLS WILL BE LINED, NO PHREATIC SURFACE SHOULD EVER DEVELOP.
IN SITU SANDSTONE
γ = 130 PCF
ø = 45°
c = 10,000 PSF
20 0 20
FEET
STABILITY SECTION A-A'
9503170269-05
DAMES & MOORE
PLATE 7



* NOTE: PHREATIC SURFACE USED IN STABILITY CALCULATIONS APPROXIMATES CONDITION THAT WOULD DEVELOP IF CELLS WERE UNLINED. SINCE CELLS WILL BE LINED, NO PHREATIC SURFACE SHOULD EVER DEVELOP.

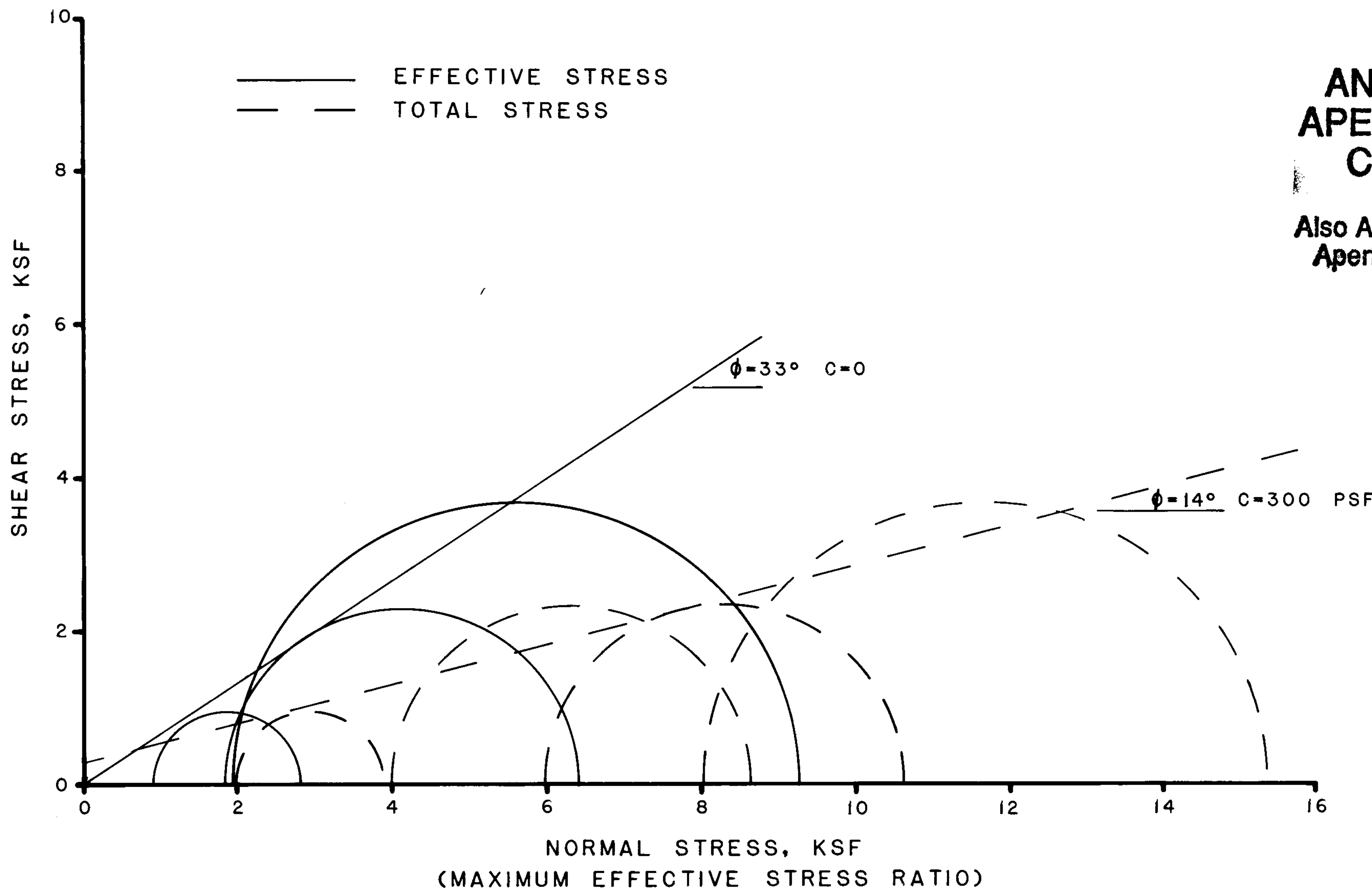
9503170269-06

STABILITY SECTION B-B'

DAMES & MOORE

PLATE 8

TRIAXIAL COMPRESSION TESTS ON SILTY FINE SAND COMPACTED TO 95% OF AASHTO T-99 MAXIMUM DRY DENSITY



ANSTEC APERTURE CARD

Also Available on Aperture Card

KEY		(1)		(2)		(3)		(4)	
BORING		19A		19A		19A		19A	
SAMPLE		1		2		3		4	
DEPTH (FEET)		Buck		Buck		Buck		Buck	
INITIAL	w, %	13.3		13.2		13.3		13.1	
	γ_d, PCF	111.1		111.2		111.1		111.3	
	e_0	0.529		0.527		0.528		0.526	
	S %	68 %		68 %		68 %		67 %	
FINAL	w, %	18.2		17.4		16.7		16.1	
	γ_d, PCF	114.7		117.1		117.0		120.5	
	e_f	0.481		0.450		0.451		0.409	
	S %	100 %		100 %		100 %		100 %	
BACK PRESSURE (PSI)		86.1		72.2		165		145	
STRAIN RATE (INCHES / MINUTE)		.000833		.000833		.000833		.000800	
STRESS CONDITION		PEAK $\sigma_1-\sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1-\sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1-\sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1-\sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$
TOTAL STRESS	ε, %	13.49	5.56	20.00	10.98	17.69	8.51	20.00	5.90
	TIME TO FAIL (MIN.)	960	396	1421	780	1261	606	1424	438
	σ_3, KSF	2.00	2.00	4.00	4.00	6.00	6.00	8.00	8.00
	$\sigma_1 - \sigma_3$	2.48	1.88	5.68	4.59	5.12	4.57	11.68	7.37
	σ_1, KSF	4.48	3.88	9.68	8.59	11.12	10.57	19.68	15.37
	$\frac{1}{2}(\sigma_1 - \sigma_3)$	1.24	0.94	2.84	2.29	2.53	2.29	5.84	3.68
	$\frac{1}{2}(\sigma_1 + \sigma_3)$	3.24	2.94	6.84	6.30	8.59	8.28	13.84	11.69
	u, KSF	0.72	1.07	1.61	2.19	3.84	4.15	4.33	6.09
	A, $u/(\sigma_1-\sigma_3)$	0.29	0.57	0.28	0.48	0.75	0.91	0.37	0.83
EFFECTIVE STRESS	ε, %	13.49	5.56	20.00	10.98	17.69	8.51	20.00	5.90
	TIME TO FAIL (MIN.)	960	396	1421	780	1261	606	1424	438
	$\bar{\sigma}_3$, KSF	1.28	0.93	2.39	1.81	2.16	1.85	3.67	1.91
	$\bar{\sigma}_1 - \bar{\sigma}_3$	2.48	1.88	5.68	4.59	5.12	4.57	11.68	7.37
	$\bar{\sigma}_1$, KSF	3.76	2.81	8.07	6.40	7.28	6.42	15.35	9.28
	$\frac{1}{2}(\bar{\sigma}_1 - \bar{\sigma}_3)$	1.24	0.94	2.84	2.29	2.53	2.29	5.84	3.68
	$\frac{1}{2}(\bar{\sigma}_1 + \bar{\sigma}_3)$	2.52	1.87	5.23	4.11	4.75	4.13	9.51	5.60
	u, KSF	0.72	1.07	1.61	2.19	3.84	4.15	4.33	6.09
	A, $u/(\bar{\sigma}_1-\bar{\sigma}_3)$	0.29	0.57	0.28	0.48	0.75	0.91	0.37	0.83
	$\bar{\sigma}_1/\bar{\sigma}_3$	2.94	3.01	3.38	3.53	3.38	3.47	4.19	4.86

9503170269-07

TRIAXIAL COMPRESSION TEST REPORT

TYPE OF TEST CONSOLIDATED - UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENT

TYPE MATERIAL COMPACTED CORE

SAMPLE DESCRIPTION

CLASSIFICATION REDDISH - BROWN CLAYEY SILT

LIQUID LIMIT – PLASTIC LIMIT – SPECIFIC GRAVITY, G_s 2.70 (ASS.)

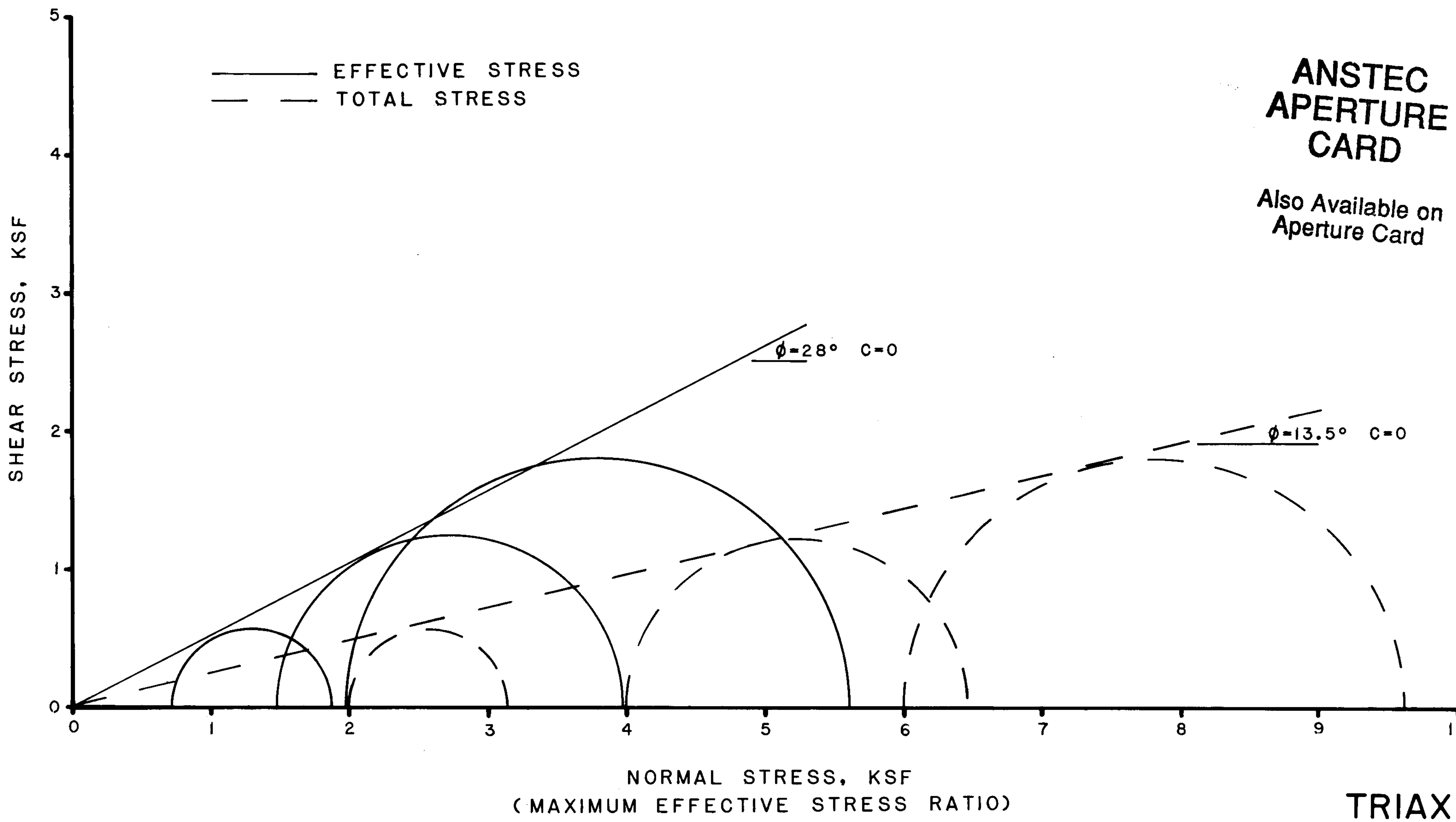
PROJECT ENERGY FUELS

LOCATION DENVER

JOB NO. 9973-015-14 PREPARED BY RH , 10/27/77

CHECKED BY RH , 10/27/77

MULTI PHASE TRIAXIAL COMPRESSION TESTS ON SILTY FINE SAND AT NATURAL DENSITY



ANSTEC APERTURE CARD

Also Available on Aperture Card

KEY		1		2		3	
BORING		14		14		14	
SAMPLE		1		1		1	
DEPTH (FEET)		4'		4'		4'	
INITIAL	ω, %	3.2		19.7		17.7	
INITIAL	γ_d, PCF	104.7		108.6		112.6	
INITIAL	e_o	.5803		.5227		.4693	
INITIAL	B	.15		1.0		1.0	
FINAL	ω, %	19.7		17.7		17.6	
FINAL	γ_d, PCF	108.6		112.6		113.7	
FINAL	e_f	.5227		.4693		.4542	
FINAL	B	1.0		1.0		1.0	
BACK PRESSURE (PSI)							
STRAIN RATE (INCHES / MINUTE)							
STRESS CONDITION		PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$	PEAK $\sigma_1 - \sigma_3$	MAX. $\bar{\sigma}_1/\bar{\sigma}_3$
TOTAL STRESS	ε, %	1.5	2.5	1.0	1.5	1.0	2.0
TOTAL STRESS	TIME TO FAIL (MIN.)	15	25	10	15	10	19
TOTAL STRESS	σ_3, PSF	2000	2000	4000	4000	6000	6000
TOTAL STRESS	$\sigma_1 - \sigma_3$	1171	1160	2484	2467	3764	3628
TOTAL STRESS	σ_1, PSF	3171	3160	6484	6467	9764	9624
TOTAL STRESS	$\frac{1}{2}(\sigma_1 - \sigma_3)$	585	580	1242	1234	1882	1814
TOTAL STRESS	$\frac{1}{2}(\sigma_1 + \sigma_3)$	2585	2580	5242	5234	7882	7812
TOTAL STRESS	u, PSF	1166	1282	2318	2506	3442	4018
TOTAL STRESS	A, $u/(\sigma_1 - \sigma_3)$	.996	1.11	.933	1.02	.914	1.11
EFFECTIVE STRESS	ε, %	1.5	2.5	1.0	1.5	1.0	2.0
EFFECTIVE STRESS	TIME TO FAIL (MIN.)	15	25	10	1500	10	19
EFFECTIVE STRESS	$\bar{\sigma}_3$, PSF	834	718	1682	1494	2558	1982
EFFECTIVE STRESS	$\bar{\sigma}_1 - \bar{\sigma}_3$	1171	1160	2484	2467	3764	3628
EFFECTIVE STRESS	$\bar{\sigma}_1$, PSF	2005	1878	4166	3961	6322	5610
EFFECTIVE STRESS	$\frac{1}{2}(\bar{\sigma}_1 - \bar{\sigma}_3)$	585	580	1242	1234	1882	1814
EFFECTIVE STRESS	$\frac{1}{2}(\bar{\sigma}_1 + \bar{\sigma}_3)$	1420	1298	2924	2728	4440	3796
EFFECTIVE STRESS	u, PSF	1166	1282	2318	2506	3442	4018
EFFECTIVE STRESS	A, $u/(\bar{\sigma}_1 - \bar{\sigma}_3)$	.956	1.11	.933	1.02	.914	1.11
EFFECTIVE STRESS	$\bar{\sigma}_1/\bar{\sigma}_3$	2.40	2.62	2.48	2.65	2.47	2.83

9503170269-08

TRIAXIAL COMPRESSION TEST REPORT

TYPE OF TEST Tx-CU-PP

TYPE MATERIAL Brn Silt & F. Sand

SAMPLE DESCRIPTION

CLASSIFICATION SM/ML

LIQUID LIMIT N/A PLASTIC LIMIT N/A SPECIFIC GRAVITY, G_s 2.65 assumed

PROJECT ENERGY Fuels

LOCATION BLANDING UT.

JOB NO. 09973-015-14 PREPARED BY LWC, 11/21/77

CHECKED BY ______, / /

PLATE B-12