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Basic Data Report for Drillhole AEC 7 (Waste Isolation Pilot Plant – WIPP)

Sandia National Laboratories
D'Appolonia Consulting Engineers

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
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(Division 9731)

and

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1.0 ABSTRACT

AEC 7 is a borehole drilled in western Lea County, New Mexico, in section 31, T.21S.,R.32E. AEC 7 was drilled to 3918 feet in 1974 by Oak Ridge National Laboratory; Sandia deepened the hole to 4732' in 1979. The borehole provided stratigraphic and lithologic information in the initial and final drilling. The borehole was used extensively for tests of borehole plugs and plugging operations.

AEC 7 penetrated, in descending order, Holocene sands and Mescalero caliche (8'), Santa Rosa Sandstone (109'), Dewey Lake Red Beds (542'), Rustler Formation (325'), Salado Formation (2014'), Castile Formation (1521'), and the upper Bell Canyon Formation (197'). Cores were obtained from much of the borehole. An extensive suite of geophysical logs provides information on stratigraphy, lithology, and structure. Beds were in normal stratigraphic sequence and without structural deformation except in the lower Castile. Anhydrite II and Halite II appear to be repeated in the borehole. This section was penetrated during deepening by Sandia; the structural complication is consistent with deformation found nearby in ERDA 6. The potential site on which AEC 7 is located was abandoned in 1976 after ERDA 6 was drilled.

The WIPP is a demonstration facility for the disposal of transuranic (TRU) waste from defense programs. The WIPP will also provide a research facility to investigate the interactions between bedded salt and high level wastes.

2.0 INTRODUCTION

The introduction describes background information on the WIPP and the drilling of AEC 7.

2.1 The Purpose of WIPP

The purpose of the WIPP is distinct from that of several other projects for the disposal of radioactive waste. The WIPP is planned to demonstrate disposal technology for the TRU waste resulting from this nation's defense programs over 30 years. After a period (5 years) of limited (pilot) operation, it is anticipated that the WIPP will allow for permanent disposal of defense TRU waste. The WIPP plans also include an underground research facility to examine, on a large scale, the interactions between bedded salt and high-level radioactive defense waste with its resultant thermal and radiation fluxes.

Additional information on the WIPP and characterization of the WIPP site may be found in Powers et al., (1978).

2.2 The Purpose of AEC 7

AEC 7 was originally drilled in 1974 under the direction of Oak Ridge National Laboratory (ORNL). The purpose of the borehole was to examine the stratigraphy and lithology of the evaporite sequence at a potential site for a waste repository. AEC 8 (Sandia National Laboratories and D'Appolonia, 1983) was also drilled by ORNL in 1974 to explore the same site. The geology of this site was shown to be unacceptable in 1975 when Sandia drilled ERDA 6; the Castile Formation and lower Salado Formation at ERDA 6 were much deformed structurally (e.g., see Powers et al., 1978, Chapter 2; Jones, 1981; Anderson and Powers, 1978; Barrows et al., in preparation; Borns, in preparation).

AEC 7 was deepened from the lower Castile Formation into the upper part of the Bell Canyon Formation by Sandia Laboratories in 1979 to connect with the upper fluid-bearing zone in the Bell Canyon. The objectives were to provide data on the potentiometric surface of the Bell Canyon and to provide a borehole in which plugging materials (grouts) could be tested. The information regarding the borehole plugging program is present elsewhere (see, e.g., Christensen and Peterson, 1981), and it will not be repeated here.

As part of the borehole plugging program, downhole television systems were used to examine the borehole condition. The application is described further in Christensen et al., (1980).

The borehole is plugged with grout over the interval 4477-4495' in Anhydrite I of the Castile Formation.

3.0 GEOLOGIC DATA FOR BOREHOLE AEC-7
LEA COUNTY, NEW MEXICO

By P. T. Banks and M. H. Freeland[1]

3.1 ABSTRACT

Borehole AEC-7 is an exploratory well drilled in Lea County, New Mexico to evaluate the stratigraphy, structure and lithology of the rock units in and around the site proposed for the Waste Isolation Pilot Plant (WIPP). The drilling was done at two separate times. The upper 3,918 feet of AEC-7 (of an eventual total depth of about 4,732 feet) was drilled in the period March 19, 1974 to April 18, 1974 and plugged. The hole was deepened to 4,731.9 in the period February 27, 1979 to April 19, 1980.

AEC-7 was drilled to a total depth of 4,731.9 feet (datum: kelly bushing) of which 3,685.9 feet were cored. The 1974 drilling period resulted in 2,878.0 feet of core and the 1979-1980 drilling period resulted in 807.9 feet of core. During the 1974 drilling period, core runs were numbered consecutively from 1 to 47. Additional cores taken in 1979 were also numbered consecutively 1 through 18 in field records. For the purposes of convenience and consistency in this report, the second set of core runs has been renumbered beginning with Number 48 and continuing through 65 (Table 1).

The stratigraphy penetrated by AEC-7 includes the following:

Quaternary:	Holocene deposits (eolian sand) Mescalero Caliche
Triassic:	Santa Rosa Sandstone

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(1) D'Appolonia Consulting Engineers, Denver, Colorado

Permian: Dewey Lake Red Beds

Rustler Formation
- Magenta Dolomite member
- Culebra Dolomite member

Salado Formation
- Upper member
- McNutt potash zone
- Lower member

Castile Formation
- Anhydrite III
- Halite II
- Anhydrite II
- Halite I
- Anhydrite I

Bell Canyon Formation
- Reef talus
- Lamar limestone
- Ramsey sandstone
- Ford shale
- Olds sandstone

Various geophysical logs were run in both the 1974 and 1979-1980 periods. In 1974 gamma ray and neutron logs were run to 3,914 feet. In 1979-1980 a more complete suite of geophysical logs was run to the total depth of 4,731.9 feet. These included:

- Gamma ray
- Compensated neutron density
- BHC acoustilog
- Dual laterolog-microlaterolog
- Gyro and multishot deviation surveys
- Magnetic inclinometer survey
- Caliper

Numerous hydrologic, hydraulic, chemical, and mineralogical analyses were also performed. The data from these hydrologic and lithologic tests are not presented in this chapter but are on file with the U.S. Geological Survey in Denver, Colorado.

The AEC-7 stratigraphic section is a sequence of mudstones, siltstones, limestones, and evaporites generally typical of the area. Preliminary interpretation does, however, indicate a marked thickening (or perhaps repetition) of stratigraphic units within the Permian Castile Formation. This thickening is restricted to the Castile: no evidence of deformation is observed in the overlying Salado Formation. The mechanism of deformation in the Castile Formation has not been determined.

3.2 INTRODUCTION

Borehole AEC-7 was drilled near the site of a proposed Waste Isolation Pilot Plant (WIPP) which is located in eastern Eddy County, New Mexico. Borehole AEC-7 is in western Lea County, New Mexico approximately 3.5 miles northeast of the northeast corner of the WIPP site (Figures 1 and 2).

The objectives of the drilling and geophysical programs were to (1) determine lithologic and stratigraphic details of the rocks underlying the site; (2) examine the structure of the rocks; (3) conduct downhole geophysical surveys to define rock and fluid properties; (4) obtain core samples for laboratory analysis, and (5) provide a data point for calibration of seismic records and construction of geologic cross sections through the WIPP site and surrounding areas.

The drilling of AEC-7 was done on behalf of the U.S. Department of Energy (formerly the U.S. Energy Research and Development Administration). Cuttings samples from 0-1040 feet, and core taken from 1040-3918 feet were described by P. J. Stubbs (independent geologist) and C. L. Jones (U.S. Geological Survey). Core taken from 3924-4732 feet was described by geologists from Fenix and Scisson, Inc., who supervised the drilling operations in this interval.

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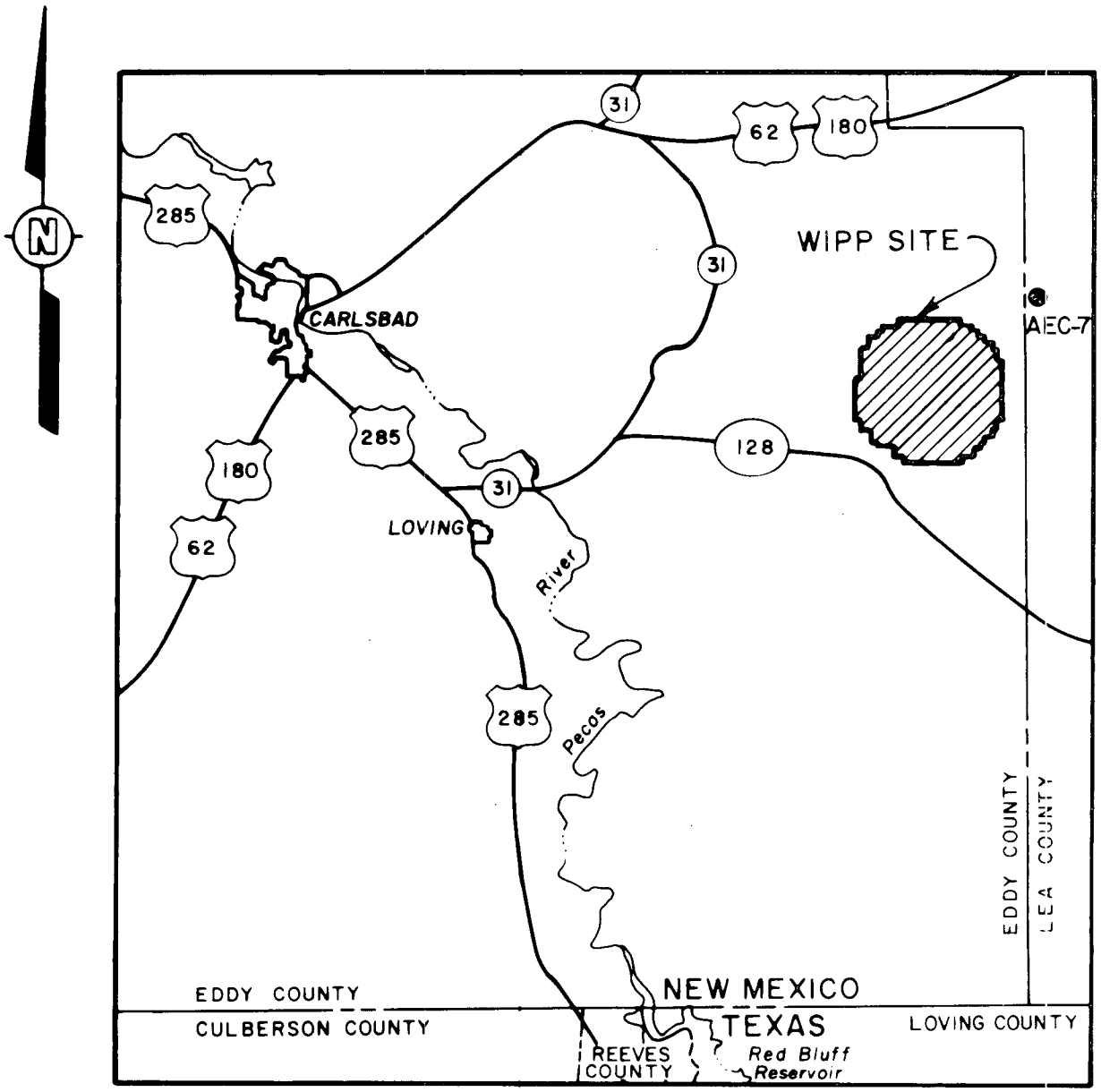

KEY MAP

FIGURE 1

LOCATION OF WIPP SITE AND BOREHOLE AEC-7

PREPARED FOR

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

REFERENCE:
U.S. GEOLOGICAL SURVEY
DENVER, COLORADO
DATED: 1981

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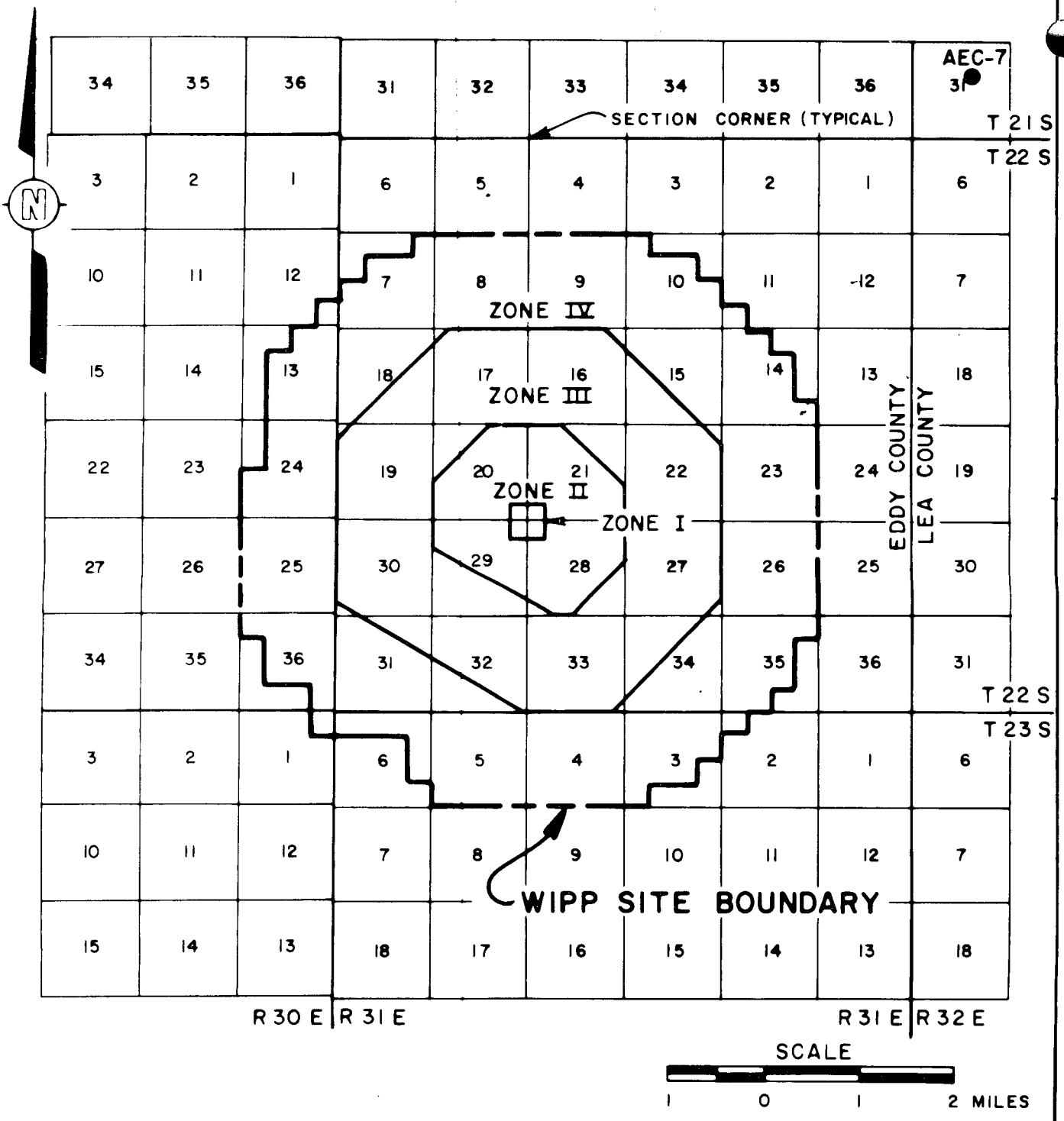

FIGURE 2

PLAN OF WIPP SITE
AND LOCATION OF BOREHOLE
AEC - 7

PREPARED FOR

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

REFERENCE:
U.S. GEOLOGICAL SURVEY
DENVER, COLORADO
DATED: 1981

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The raw data pertaining to AEC-7, and additional supporting information and guidance, were provided to the authors by Richard P. Snyder of the U.S. Geological Survey, Denver, Colorado. Details of the location and drilling of AEC-7 are summarized in Table 1, stratigraphic units and depths are listed in Table 2, and the lithology is described in detail in Table 3. The lithology and selected geophysical logs are correlated and presented graphically in Figure 3.

3.3 DESCRIPTION OF AEC-7

Borehole AEC-7 is located in Section 31, Township 21 South, Range 32 East in western Lea County, New Mexico. The borehole was started in 1974 (to a depth of about 3918 feet) and deepened in 1979 to a depth of 4731.9 feet as measured from the kelly bushing (KB) 12.2 feet above ground level at an elevation of 3667.7 feet MSL (mean sea level). Ground level (GL) elevation is 3655.5 feet MSL.

All depths reported herein, unless otherwise noted, are measured from the drilling kelly bushing set at 12.2 feet above ground surface. Depths below ground surface may be calculated by subtracting 12.2 feet from the reported depths.

Measurements in this document for AEC-7 are reported in the inch-pound (English) system. These units are consistent with the units used in the field to record the original observations. The inch-pound system also facilitates comparison of AEC-7 measurements with measurements made by surveyors in establishing the geographic coordinates of the boring, by drillers in determining well depth and drilling conditions, and by geophysical loggers in recording in-hole variations of rock properties with depth. If metric equivalents are desired, the following conversion factors are provided:

MULTIPLY ENGLISH UNIT	BY	TO OBTAIN METRIC UNIT
foot (ft)	0.3048	meter (m)
inch (in)	25.4	millimeter (mm)
inch (in)	2.54	centimeter (cm)
pounds (lb)	0.4536	kilogram (kg)
pounds per square inch (psi)	0.006895	megapascal (mpa)

Depth measurements presented graphically in Figure 3 are given in both English and metric units.

The stratigraphic section penetrated by AEC-7 encompasses unconsolidated deposits and sedimentary rocks from Quaternary to Permian age. The rocks are primarily marine evaporites of Permian age with some younger continental rocks present in the upper portions of the section. Marine clastic rocks of the Bell Canyon Formation appear in the lower portion of the boring.

3.3.1 Stratigraphy

AEC-7 penetrated a sequence of sedimentary clastic and evaporitic rocks from Quaternary to Permian age. The sequence is similar to that encountered in other boreholes on the WIPP site with the exception of thickened or repeated units within the Permian Castile Formation.

Where field depth measurements were not consistent with lithologic changes as interpreted from geophysical records, the depths of core runs and lithologic boundaries were adjusted to agree with geophysical logs presented in Figure 3. Table 1 lists these correction factors for each core run, and all depths reported in this document reflect those adjustments.

Quaternary System

Unconsolidated Quaternary deposits occur only in the upper 24.2 feet of AEC-7. An unnamed deposit of Holocene eolian sand, which overlies the bedrock on most of the WIPP site, is present from 16.2-20.2 feet. From 20.2-24.2 feet the Mescalero caliche, a white, chalky limestone, was penetrated.

Triassic System

Santa Rosa Sandstone

The interbedded sandstones, siltstones, and shales of the Santa Rosa Sandstone are present from 24.2-133.0 feet. The sandstones in this unit are primarily red and white, vary from fine grained to conglomeratic in places, and are typically poorly sorted.

Permian System

Permian rocks account for most of the stratigraphic section in AEC-7. Formations penetrated during drilling were: the Dewey Lake Red Beds, the Rustler Formation, the Salado Formation, the Castile Formation, and the Bell Canyon Formation, in descending order.

Dewey Lake Red Beds

The Dewey Lake Red Beds (from 133.0-675.0 feet) consist of interbedded sandstones, siltstones, and shales. The rocks are reddish in color with uncommon traces of green shale. The sandstones are fine to medium grained and in the lower part of the unit a trace of gypsum is present.

Rustler Formation

The Rustler Formation, found from 675.0-1000.6 feet, consists mostly of gypsum and white, dense anhydrite. Some beds of reddish, very fine grained sandstone, siltstone, and shale are also present. The unit also contains an occasional trace of red polyhalite.

Two dolomite members occur within the Rustler Formation. They are the Magenta Dolomite member (733.5-767.0 feet) and the Culebra Dolomite member (872.2-900.5 feet). The Magenta is a very finely crystalline, grayish-green dolomite and the Culebra is a finely crystalline, chalky dolomite.

Salado Formation

The Permian Salado Formation is a thick (2014.1 feet) evaporite sequence containing three stratigraphically distinct, informally named units: the upper member (1000.6-1505.1 feet), the McNutt potash zone (1505.1-1881.0 feet); and the lower member (1881.0-3014.7 feet). Numerous polyhalite and anhydrite marker beds occur throughout all three units (refer to Table 2 for the depth intervals of the marker beds). These beds consist of anhydrite and/or polyhalite and are persistent over large areas of the Permian Basin. Though often difficult to recognize in core or cuttings, the marker beds are readily distinguishable on geophysical logs (Figure 3) and are thus commonly used for wide-area correlation purposes. Depths of many of the marker beds identified are placed at the bottom of the bed. The possibility of erosional upper contacts renders the bottoms of the marker beds more stratigraphically significant.

Upper Member

The upper member of the Salado Formation (1000.6-1505.1 feet) consists primarily of finely to coarsely crystaline halite. The color of the halite varies among the following: orange, brown, pale-amber, light-gray, grayish-brown, moderate-reddish brown, light-red, greenish-gray (when argillaceous), and clear (especially when the halite occurs as large, secondary crystals).

The halite of the upper member is frequently argillaceous, polyhalitic, and anhydritic. Clay in the argillaceous halite occurs in streaks, inclusions, and partings and is usually brown or greenish-gray in color. Polyhalite occurs within the halite in beds (usually less than one foot thick), lenses, streaks, stringers, nodules, and blebs, or has been observed to be disseminated throughout the halite groundmass. The polyhalite is finely to very finely crystalline and appears moderate-red, moderate-reddish-orange, or light-brown, usually in contrast with the halite colors. White to gray anhydrite occurs in streaks, blebs, inclusions, beds, and stringers and is typically finely to very finely crystalline. Some light-gray magnesitic anhydrite is present in beds within the halite.

Rare blebs of the potassium-magnesium salt kainite are present within the halite at 1356.0-1356.8 feet.

The upper member of the Salado Formation also contains numerous, discrete beds of polyhalite. The polyhalite in these is dense and very finely crystalline with rare large crystals. Color varies as described above. Polyhalite beds often contain dense anhydrite, clay appearing as beds,

partings, or crystal coatings, and halite in partings, inclusions, and blebs.

Some anhydrite units are present in the upper member. The anhydrite is dense and massive and can be finely to very finely crystalline. Some of the anhydrite occurs in nodular form and some is embedded in a clay matrix. Color varies among gray, dark-gray and light-gray with some red mottling. The anhydrite units can contain halite, polyhalite, and magnesite. Polyhalite within the anhydrite units is orange and occurs in blebs or lenticular masses. Blebs, seams, and layers of halite pseudomorphs after gypsum are also present. Inclusions of amber halite, white magnesite blebs, and light-gray magnesite laminae are present in parts of the anhydrite. Rare carnallite ($KMgCl_3.6H_2O$) layers are present in the upper member.

The upper member of the Salado Formation in AEC-7 contains 13 recognized marker beds. These marker beds are composed mostly of polyhalite or anhydrite.

McNutt Potash Zone

The McNutt potash zone of the Salado Formation, found from 1505.1 to 1881.0 feet, consists mostly of halite, anhydrite, and polyhalite with some interstitial or minor bedded clastics. The member gets its name from the relatively high content of potassium and magnesium salts such as polyhalite, carnallite, kieserite, sylvite and langbeinite which contain ore-grade potassium concentrations. Also included in this stratigraphic interval are seven unnamed and two named marker beds: the Vaca Triste Sandstone and the Union Anhydrite.

Halite units in the McNutt are colored brown, red, buff, orange, reddish-orange, reddish-brown, pale-amber, white, light-red, gray, and greenish-gray. The halites can be argillaceous, polyhalitic, and less commonly anhydritic. Relatively high percentages of the following potassium-magnesium salt are also present: carnallite, sylvite, kieserite, langbeinite, kainite, and leonite.

Argillaceous halite in the McNutt member contains partings, blebs, inclusions, and bands of brown, gray, and greenish-gray, sometimes silty, clay. Occasionally the clay is disseminated throughout the halite units.

A trace of stringers and seams of gray anhydrite is present in the McNutt halites.

The potassium-magnesium salts appearing in the McNutt potash zone occur as follows:

Carnallite: Stringers, seams, blebs, inclusions, crystals, and crystalline masses of red, pink, maroon, and tan carnallite; some of the carnallite is bordered by anhydrite crystals.

Sylvite: Occurs in blebs and crystals.

Kieserite: Occurs as discrete crystals

Langbeinite: Occurs in crystals; occasionally the langbeinite crystals are rimmed with kainite and leonite. Some kainite/leonite pseudomorphs after langbeinite have been observed.

Polyhalite appears in the McNutt in two types of occurrences: as minor amounts in halite units or as discrete beds. The polyhalite found within McNutt halite units can be buff, red or orange colored. It occurs in bands, blebs, crystals, stringers, and seams or is disseminated in the halite body.

Polyhalite beds in the McNutt contain dense polyhalite colored light-red, pale-red moderate-orange-pink and light-gray. The polyhalite can be halitic (with inclusions, crystals, and blebs of halite), argillaceous (with stringers, seams, and inclusions of greenish-gray, green and brown clay), carnallitic, or anhydritic. Some of the clay in the argillaceous polyhalite is carnallitic or has been invaded by carnallite veins. Carnallite occurs as streaks, stringers, inclusions, or crystalline masses within the polyhalite units. Stringers, bladed crystals, and crystalline masses of anhydrite are also present. Some of the polyhalite has been partially replaced by carnallite and anhydrite crystals.

An occasional layer of dense, massive anhydrite occurs in the McNutt. The anhydrite is white, gray, and light-gray, often containing halite, polyhalite, potassium-magnesium salts, or clay. The clay is gray and occurs as partings; red polyhalite appears as growths and masses, and halite is present as inclusions and pseudomorphs after gypsum. The potassium-magnesium salts kieserite and pink carnallite are observed as stringers and inclusions. Rare magnesite laminae are also present.

Some discrete layers of clay and carnallite are present within the McNutt potash zone. The clay is brown, greenish-gray, and gray and can contain crystals, veins, and blebs of halite. Clay layers also may have blebs of polyhalite and veins of carnallite, and are often

silty. Carnallite layers contain pink to light-red carnallite with occasional halite crystals and inclusions of greenish-gray clay.

Seven numbered, but unnamed marker beds, consisting of polyhalite and anhydrite, are present in the McNutt. Two named marker beds, the Vaca Triste Sandstone unit, (1505.1-1514.1 feet) and the Union Anhydrite, (1696.2-1705.0 feet) are also present.

The Vaca Triste Sandstone in AEC-7 consists of silty and argillaceous halite. The halite is brown with numerous inclusions and partings of clay and silty clay.

The Union Anhydrite is a dense, massive, gray anhydrite with a few inclusions of carnallite and halite. Polyhalite growths and clay partings are also present within the Union Anhydrite.

Lower Member

The lower member of the Salado Formation consists mostly of halite with some beds of polyhalite, anhydrite, clay, and glauberite. Fourteen numbered marker beds and one named marker bed (the Cowden Anhydrite, 2520.0-2539.0 feet) are present within the lower member. Rocks of the lower member of the Salado Formation also contain hydrocarbons in AEC-7.

Halite in the lower member is colored brown, orange, reddish-orange, gray, moderate-orange-pink, moderate-red, transparent, pale-red, and white. Much of the halite is banded with alternating layers of light and dark shades of gray and some is mottled. Halite units can be argillaceous (with brown, gray, and dark-red partings and inclusions of clay), polyhalitic, anhydritic, or glauberitic. Recrystallized halite is also present.

Polyhalite within the halite units can be orange, red, moderate-orange-pink, pale-red, moderate-red, and white, and occurs in blebs, seams, streaks, and stringers. Anhydritic halite contains gray, dense anhydrite in seams and stringers.

Traces of glauberite [$Na_2Ca(SO_4)_2$] occur as crystals and crystalline clusters. The glauberite can be gray, moderate-pink, or very-dark-red.

Beds of dense, red and pale-red polyhalite are present in the lower member. The polyhalite can contain partings, inclusions, and stringers of brown and gray clay. Occasional halite inclusions and gray, dense anhydrite also occur within the polyhalite.

Some beds of white and gray, dense, massive anhydrite occur in the lower member. The anhydrite typically includes layered halite pseudomorphs after gypsum. Much of the anhydrite has been replaced by red and pink polyhalite. Beds and partings of gray clay and halite inclusions are also common within anhydrite units. Magnesite laminae are encountered at 2104.0 and 2934.0 feet. Gray to moderate-pink crystals and crystalline masses of glauberite also occur.

The Cowden Anhydrite consists of gray, dense, massive anhydrite with halite and anhydrite pseudomorphs after gypsum. Magnesite beds and magnesitic clay beds are present in the Cowden Anhydrite.

Castile Formation

The Permian Castile Formation (3014.7-4535.3 feet) consists of alternating sequences of halite and anhydrite. Typically, in the vicinity of AEC-7 the Castile Formation contains the following units: Anhydrite III, Halite II, Anhydrite II, Halite I, and Anhydrite I in descending order. Additional beds of halite and anhydrite, observed in other borings at

greater distances from the Capitan Reef are not reported in the area around this boring. AEC-7, however, appears to have encountered a thickened or perhaps repeated section in the Castile Formation. Numerous evidential observations such as anomalously steep dips in anhydrite laminae, severe contortion and folding in some zones, and the presence of apparent duplication of stratigraphic section suggest tectonic disruption of the Castile. Anhydrite III is anomalously thin in AEC-7 with a thickness of approximately 100 feet. This thickness is similar to the thickness of Anhydrite III (about 80 feet) encountered in WIPP-11 (Sandia, 1982). This and the presence of apparently repeated sections have not been explained.

Anhydrite III (3014.7-3113.0 feet) consists of dense, massive, gray to white anhydrite. It is occasionally bituminous and has halite-filled fractures and halite pseudomorphs after gypsum.

Halite II (first sequence) is found at 3113.0-3310.0 feet and is made up of alternating discrete layers of transparent (colorless) to white halite and anhydrite. Frequently the halite layers are banded with layers of anhydritic halite and halite pseudomorphs after gypsum. Halite-filled fractures and massive seams and bands of anhydrite are also common. White anhydrite bands are present and these bands are often buckled into S-shaped folds or cut by halite-filled fractures. The halite itself displays evidence of deformation in that it can be granular, schistose, or have broken and contorted bands of anhydrite.

The anhydrite layers within Halite II contain dense, massive, white to light-gray anhydrite. The anhydrite typically alternates with layers of halite pseudomorphs after gypsum. The anhydrite is also frequently bituminous and banded with alternating layers of light and dark colored anhydrite.

Anhydrite II (first sequence) from 3310.0-3506.9 feet contains dense, massive, white to light-gray anhydrite. The anhydrite is banded with irregular, alternating layers of light and darker shades of gray. Bituminous layers are also present.

Halite II [repeated sequence(?)] is 81.3 feet thick (3506.9-3588.2 feet) and is made up of alternating layers of gray, massive halite and anhydrite. The unit contains broken fragments of gray, laminated anhydrite also occurring in broken seams or elongated stringers. The halite is bituminous in places. Anhydrite layers in this unit consist of dense, massive, gray anhydrite frequently banded in varying shades of gray. The anhydrite also contains crystals of gray halite and is occasionally argillaceous.

Anhydrite II [repeated sequence(?)] is a 466.8-foot-thick (3588.2-4055.0 feet) section of dense, massive, finely to very finely crystalline, gray, olive-gray, and grayish-black anhydrite. The anhydrite contains brown, bituminous mottlings and irregular partings, and sinuous, grayish-brown, calcitic and bituminous laminations.

Halite I (4055.0-4182.3 feet) is a sequence of transparent, translucent to very-light-gray halite. The halite is finely to very coarsely crystalline. Anhydrite is present within the halite as blebs and stringers of white anhydrite and as highly folded, twisted, broken, slightly calcareous, gray to white, anhydrite stringers.

Anhydrite I (4182.3-4535.5 feet) is made up of very dense, predominantly massive bluish-gray and olive-gray anhydrite. The anhydrite is very finely crystalline and contains sinuous calcitic and bituminous laminations. Oil seeps are present as are silt bands. Some of the anhydrite is slightly dolomitic.

Throughout the units of the Castile Formation, beds and laminae were commonly observed to dip at steep angles varying from 35 to 60 degrees. It is postulated that the anomalous thickness of some units represents an apparent rather than true thickness resulting from the dip of the overall sequence.

Bell Canyon Formation (4535.5-4731.9 feet)

The Permian Bell Canyon Formation is an interbedded sequence of marine sandstone, siltstone, shale, and limestone.

Reef talus (4535.5-4584.7 feet). The reef talus unit represents a transition facies between the Capitan Reef and the Bell Canyon Formation and consists primarily of grayish-black, light-olive-gray, olive-gray, and olive-black siltstone derived from basin margin reef detritus. The siltstone is calcareous and, in places, faintly laminated with black to grayish-black shale. The siltstone is petroliferous and contains rare limestone clasts.

Lamar limestone (4584.7-4633.3 feet). The Lamar limestone consists of interbedded limestone, siltstone, and calcareous shale. The limestones are olive-gray to light-olive-gray, very finely crystalline, and silty. Some silty limestone clasts and finely crystalline, recrystallized limestone nodules are present. Grayish-black, brownish-black, and olive-gray shale laminae and some yellowish-gray fossil fragments occur within the limestone.

Siltstones in the Lamar limestone are olive-gray and grade to very fine grained sandstone in places. Olive-black shale laminae and finely crystalline limestone nodules are also present.

Greenish-black and olive-black, calcareous shale beds make up the remainder of the Lamar limestone.

Ramsey sand (4633.3-4678.5 feet). The Ramsey sand is dark-green, very fine grained, equigranular, silty, slightly calcareous sandstone. It is massive with some grayish-black shaley laminae and shale fragments. The Ramsey sand is possibly bioturbated.

Ford shale (4678.5-4714.9 feet). The Ford shale contains a light-olive-gray, well consolidated siltstone. The siltstone is slightly calcareous and slightly sandy.

Olds sandstone [4714.9-4731.9 feet (T.D.)]. The Olds sandstone was not fully penetrated by AEC-7. It consists of a light to medium-gray, very fine grained, rounded to subrounded, calcareous sandstone. The sandstone is poorly consolidated and contains a light-gray, calcareous siltstone and a trace of silty, very finely crystalline, olive-gray to olive-black limestone.

3.3.2 Additional Lithologic and Hydrologic Data

Numerous hydrologic and hydraulic tests were performed on Borehole AEC-7 to characterize aquifer and fluid properties as well as water quality. Lynes and Halliburton Services performed the hydraulic tests and the U.S. Geological Survey's water quality laboratories in Denver, Colorado analyzed groundwater to determine a full suite of physical and chemical parameters.

Further, core samples at various intervals (particularly within the McNutt Potash unit ore zones) were analyzed at the U.S. Geological Survey's rock laboratories in Denver, Colorado. X-ray diffraction and atomic absorption techniques were used to determine chemical and mineralogical properties of the rock. The results of these tests are not reported here, but all data pertaining to these activities are available from the U.S. Geological Survey in Denver, Colorado.

TABLE 1

ABRIDGED HISTORY OF BOREHOLE AEC-7

Location: Sec. 31 T21S R32E
2038.97 FNL
2037.26 FEL

Elevation: GL (ground level) 3655.54
KB (kelly bushing) 3667.74

Datum for depth measurements given in Tables 1, 2, and 3, and throughout this report is the kelly bushing (12.2 feet above ground level).

Field Lithologic Log Prepared By: Peter J. Stubbs (independent geologist), Wichita, Kansas and Charles L. Jones (U.S. Geological Survey) for 1974 drilling

S.L. Drellack, Jr., J. Gonzales, and A.F. McIntyre (Fenix and Scisson, Inc.) for 1979 drilling.

Geophysical Logs Recorded By: Welex - 1974
Dresser Atlas - 1979
Birdwell - 1979
McCullough - 1979
Sperry-Sun - 1979

Drilling Contractor: 1974 - Walters Drilling Company
Cactus Drilling Company
1979 Verna Drilling
Company Mack Chase, Inc.

Drilling Record: Commenced drilling March 19, 1974 and completed April 18, 1974 at a total depth of 3918 feet below kelly bushing. On April 19, 1974 a gas blowout occurred (damage was minor and no injuries resulted). The borehole was reopened and deepened to a total depth of 4,731.9 feet in the period February 27, 1979 to April 19, 1980.

TABLE 1

(Continued)

ABRIDGED HISTORY OF BOREHOLE AEC-7

CORE NO.	DRILLER'S DEPTH INTERVAL (FEET)	CORRECTION FACTOR TOP OF CORE (FEET)	CORRECT DEPTH BELOW KB (FEET)	RPM	WEIGHT ON BIT (LBS.)	CIRCULATING PRESSURE (PSI)	CORE INTERVAL FEET CORED	CORE INTERVAL FEET RECOVERED	PERCENT RECOVERE
1,2,3[1]	1040.0-1214.0	0	1040.0-1214.0	NO DRILLING DATA AVAILABLE			174.0	174.0	100
4	1214.0-1276.0	0	1214.0-1278.0	FOR CORE NUMBERS 1 THROUGH			64.0	64.0	100
5	1276.0-1338.5	+2.0	1278.0-1338.5	47			60.5	60.5	100
6	1338.5-1399.0	0	1338.5-1399.0				60.5	60.5	100
7	1399.0-1461.0	0	1399.0-1461.0				62.0	62.0	100
8	1461.0-1523.2	0	1461.0-1523.2				62.2	62.2	100
9	1523.2-1583.5	0	1523.2-1583.5				60.3	60.3	100
10	1583.5-1644.4	0	1583.5-1644.4				60.5	60.5	100
11	1644.4-1706.0	0	1644.4-1706.0				61.6	61.6	100
12	1706.0-1767.4	0	1706.0-1767.4				61.4	61.4	100
13	1767.4-1830.0	0	1767.4-1832.3				64.9	64.9	100
14	1830.0-1892.4	+2.3	1832.3-1894.6				62.3	62.3	100
15	1892.4-1954.0	+2.2	1894.6-1956.0				61.4	61.4	100
16	1954.0-2015.5	+2.0	1956.0-2017.3				61.3	61.3	100
17	2015.5-2076.0	+1.8	2017.3-2078.3				61.0	61.0	100
18	2076.0-2137.2	+2.3	2078.3-2139.9				61.6	61.6	100
19	2137.2-2197.0	+2.7	2139.9-2200.0				60.1	60.1	100
20	2197.0-2260.0	+3.0	2200.0-2262.8				62.8	62.8	100
21	2260.0-2321.0	+2.8	2262.8-2323.1				60.3	60.3	100
22	2321.0-2383.0	+2.1	2323.1-2384.0				60.9	60.9	100
23	2383.0-2443.0	+1.0	2384.0-2445.1				61.1	61.1	100
24	2443.0-2505.0	+2.1	2445.1-2507.2				62.1	62.1	100
25	2505.0-2566.0	+2.2	2507.2-2567.2				60.0	60.0	100
26	2566.0-2627.0	+1.2	2567.2-2628.1				60.9	60.9	100
27	2627.0-2690.0	+1.1	2628.1-2691.0				62.9	62.9	100
28	2690.0-2751.0	+1.0	2691.0-2752.3				61.3	61.3	100
29	2751.0-2812.0	+1.3	2752.3-2813.2				60.9	60.9	100
30	2812.0-2873.0	+1.2	2813.2-2874.8				61.6	61.6	100
31	2873.0-2935.0	+1.8	2874.8-2937.9				63.1	63.1	100
32	2935.0-2997.0	+2.9	2937.9-2999.8				61.9	61.9	100
33	2997.0-3058.6	+2.8	2999.8-3061.3				61.5	61.5	100
34	3058.6-3121.4	+2.7	3061.3-3122.1				60.8	60.8	100
35	3121.4-3181.2	+0.7	3122.1-3182.9				60.8	60.8	100
36	3181.2-3244.0	+1.7	3182.9-3246.9				64.0	64.0	100
37	3244.0-3303.5	+2.9	3246.9-3303.5				56.6	56.6	100
38	3303.5-3367.2	0	3303.5-3367.2				63.7	63.7	100
39	3367.2-3427.7	0	3367.2-3427.7				60.5	60.5	100
40	3427.7-3499.5	0	3427.7-3499.5				71.8	71.8	100
41	3499.5-3651.4	0	3499.5-3552.8				53.3	53.3	100
42	3651.4-3613.0	+1.4	3552.8-3615.2				62.4	62.4	100
43	3613.0-3673.0	+2.2	3615.2-3675.0				59.8	59.8	100
44	3673.0-3734.6	+2.0	3675.0-3736.1				61.1	61.1	100
45	3734.6-3796.2	+1.5	3736.1-3797.2				61.1	61.1	100
46	3796.2-3857.1	+1.0	3797.2-3857.6				60.4	60.4	100
47	3857.1-3918.0	+0.5	3857.6-3918.0				60.4	60.4	100
48[2]	3924.0-3925.4	0	3924.0-3925.4				1.4	1.4	100
49	3925.4-3933.0	0	3925.4-3933.0	60	18,000	650-800	7.6	7.6	100
50	3933.0-3981.3	0	3933.0-3981.3	65	18-20,000	800-1000	48.3	45.8	95
51	3981.3-4033.0	0	3981.3-4033.0	65	18,000	850-950	51.7	51.7	100
52	4033.0-4083.0	0	4033.0-4083.0	65	20,000	750-900	50.0	50.0	100
53	4083.0-4136.3	0	4083.0-4136.3	65	18,000	800	53.3	53.3	100
54	4136.3-4185.0	0	4136.3-4185.0	65	18,000	800	48.7	47.8	98
55	4185.0-4235.0	0	4185.0-4235.0	65	20,000	850	50.0	50.0	100
56	4235.0-4285.3	0	4235.0-4285.3	65	20,000	850	50.3	50.3	100
57	4285.3-4332.0	0	4285.3-4332.0	65	20,000	850	46.7	46.7	100
58	4332.0-4381.3	0	4332.0-4381.3	65	18,000	800-850	49.3	49.3	100
59	4381.3-4432.0	0	4381.3-4432.0	65	20,000	900	50.7	50.7	100
60	4432.0-4483.0	0	4432.0-4483.0	65	20,000	850	51.0	51.0	100
61	4483.0-4533.1	0	4483.0-4531.0	65	20,000	850	48.0	48.0	100
62	4533.1-4584.3	-2.1	4531.0-4582.2	65	22,000	850	51.2	51.2	100
63	4584.3-4615.4	-2.1	4582.2-4613.3	70	20,000	850	31.1	31.1	100
64	4615.4-4665.6	-2.1	4613.3-4663.5	65	20,000	850	50.2	50.2	100
65	4665.6-4717.0	-2.1	4663.5-4714.9	70	20,000	850	51.4	51.4	100

[1]Separate depth intervals for Cores 1, 2, and 3 were not reported.

[2]Core numbers 48 through 65 were drilled in 1979. Core numbers 1 through 47 were drilled in 1974.

TABLE 2

STRATIGRAPHIC SUMMARY OF BOREHOLE AEC-7

ROCK UNIT	DEPTH INTERVAL IN FEET[1,2] (BELOW KELLY BUSHING)
Quaternary	
Holocene - eolian sand	16.2-20.2
Mescalero caliche	20.2-24.2
Triassic	
Santa Rosa Sandstone	24.2-133.0
Permian	
Dewey Lake Red Beds	133.0-675.0
Rustler Formation	675.0-1000.6
Magenta Dolomite member	733.5-767.0
Culebra Dolomite member	872.2-900.5
Salado Formation	1000.6-3014.7
Upper member	1000.6-1505.1
MB 101[3]	1125.8
MB 102	1158.5
MB 103	1171.4-1186.5
MB 104	1197.0
MB 105	1211.5
MB 106	1230.5
MB 107	1269.0
MB 108	1278.0
MB 109	1303.8-1324.5
MB 111	1378.0
MB 112	1397.5
MB 114	1450.5
MB 116	1498.4
McNutt Potash zone	1505.1-1881.0
Vaca Triste Sandstone	1505.1-1514.1
MB 117	1578.9
MB 118	1595.6
MB 119	1619.8
MB 121	1661.5
MB 122	1668.5
Union Anhydrite	1696.2-1705.0
MB 123	1774.8-1781.2
MB 124	1785.5-1795.5
MB 126	1881.0

TABLE 2
(Continued)

ROCK UNIT	DEPTH INTERVAL IN FEET[1,2] (BELOW KELLY BUSHING)
Lower member	1881.0-3014.7
MB 128	1918.0
MB 129	1943.9
MB 131	2013.5
MB 132	2039.0
MB 133	2057.5
MB 134	2097.0-2109.0
MB 136	2161.0-2168.0
MB 139	2267.5
MB 140	2302.8-2314.2
MB 141	2364.5
MB 142	2400.2-2406.5
MB 143	2453.0-2455.6
Cowden Anhydrite	2520.0-2539.0
Castile Formation	3014.7-4535.3
Anhydrite III	3014.7-3113.0
Halite II	3113.0-3310.0
Anhydrite II	3310.0-3506.9
Halite II [repeated(?)]	3506.9-3588.2
Anhydrite II [repeated(?)]	3588.2-4055.0
Halite I	4055.0-4182.3
Anhydrite I	4182.3-4535.5
Bell Canyon Formation	4535.5-4731.9 (T.D.)
Reef talus	4535.5-4584.7
Lamar limestone	4584.7-4633.3
Ramsey sandstone	4633.3-4678.5
Ford shale	4678.5-4714.9
Olds sandstone	4714.9-4731.9

(1) Depth is base of unit when single number is given.

(2) Depths to units interpreted from geophysical logs.

(3) MB = Marker bed.

TABLE 3

LITHOLOGIC LOG OF BOREHOLE AEC-7

[Depths reported are measured from kelly bushing and corrected from geophysical logs. Color designations when included from original field records are from the Rock Color Chart (Goddard et al., 1948)]

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Kelly bushing (KB at 3667.74 feet MSL) to ground level (GL at 3655.54 feet MSL)	0-12.2
Artificial fill (drill pad)	12.2-16.2
Eolian sand (Holocene)	16.2-20.2
Caliche (Mescalero Caliche)	20.2-24.2
Sandstone	24.2-49.0
Shale, red, soft; streaks of fine grained, gray, shaley sandstone, red and white, soft, fine grained, well sorted	49.0-78.0
Sandstone, red to white, fine grained; much red shale	78.0-90.0
Sandstone, red to white, fine grained	90.0-100.0
Sandstone, red, fine grained; interbedded with red silty shale	100.0-110.0
Sandstone, fine grained; trace of red conglomeratic sandstone, coarse to fine grained, poorly sorted; trace of silty shale	110.0-120.0
Sandstone, red with trace green, very fine grained, grades to siltstone	120.0-133.0
Shale, red, well consolidated, interbedded with sandstone and siltstone	133.0-140.0
Shale, red, well consolidated; trace soft green shale	140.0-150.0
Shale, same as in unit at 140.0-150.0 feet; interbedded with red siltstone	150.0-180.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Shale interbedded with siltstone, same as in unit at 150.0-180.0 feet, hard	180.0-190.0
Shale interbedded with siltstone, same as in unit at 180.0-190.0 feet, trace of gypsum	190.0-200.0
Shale interbedded with siltstone, red, hard	200.0-340.0
Shale, red; siltstone; sandstone, fine grained, trace medium grained sandstone; trace of gypsum	340.0-350.0
No descriptive data	350.0-360.0
Shale, red; siltstone; sandstone, fine grained; trace gypsum	360.0-370.0
Shale, red; interbedded with siltstone and fine to medium grained sandstone	370.0-380.0
Shale, red; interbedded with siltstone and fine to medium grained sandstone, trace gypsum	380.0-400.0
Shale, red; siltstone; fine to medium grained sandstone; some gypsum	400.0-675.0
Anhydrite, white, dense	675.0-680.0
Anhydrite, white, dense; trace of gypsum	680.0-690.0
Anhydrite and gypsum	690.0-701.5
Siltstone, red, soft, unconsolidated; possibly a trace of gypsum and anhydrite	701.5-716.2
Anhydrite, white; some gypsum; some hard red shale	716.2-720.0
Anhydrite, hard; streaks of gypsum; some red clay streaks	720.0-733.5
Dolomite, gray-green, very finely crystalline, soft	733.5-767.0
Anhydrite, white, hard	767.0-774.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Gypsum and anhydrite, soft	774.0-797.0
Anhydrite, white, soft; some gypsum	797.0-836.0
Shale, red; siltstone; some anhydrite and gypsum	836.0-857.5
Gypsum and anhydrite, soft; some red polyhalite	857.5-872.2
Dolomite, finely crystalline, chalky	872.2-900.5
Gypsum, red; polyhalite; some anhydrite	900.5-913.0
Anhydrite, white	913.0-919.2
Shale, soft, probable breccia	919.2-954.5
Anhydrite	954.5-959.2
Sandstone, red, very fine grained; red siltstone, poorly cemented	959.2-1000.6
Halite	1000.6-1040.0

END DRILL CUTTING DESCRIPTIONS
BEGIN CORE DESCRIPTIONS (1974 INITIAL CORING: CORE NUMBERS 1-47)

Halite, light-orange, coarse grained; 10% fine grained polyhalite in blebs	1040.0-1049.0
Halite, light-brown, medium grained; contains numerous streaks of brown clay and some streaks of grayish-green clay	1049.0-1054.5
Halite, light-brown, medium to coarse grained; contains few streaks of brown clay; few streaks and blebs of orange polyhalite, a 1.0-inch-thick polyhalite bed at 1063.0 feet; 1.0-inch-thick streaks and inclusions of fine grained, white anhydrite in lower 3.0 feet	1054.5-1064.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, medium grained; contains numerous streaks, inclusions, and partings of brown clay, few streaks of grayish-green clay; clay percentage decreases downward; few streaks and blebs of polyhalite	1064.3-1071.5
Polyhalite, red, very fine grained; grayish-green halite at base	1071.5-1072.5
Halite, light-brown, coarse grained; contains a few streaks and inclusions of brown and grayish-green clay; few streaks and blebs of polyhalite	1072.5-1077.3
Halite, light-orange, medium to coarse grained; contains a few streaks and blebs of polyhalite; a 0.3-foot-thick polyhalite bed at 1078.2 feet	1077.3-1080.2
Halite, light-brown, fine to coarse grained; contains numerous streaks and inclusions of brown clay (10-30%), and a few streaks of grayish-green clay	1080.2-1087.4
Halite, light-brown, medium grained; contains some streaks and inclusions of brown clay; few blebs and streaks of polyhalite	1087.4-1089.7
Halite, light-orange, medium grained; contains a few streaks and inclusions of brown and grayish-green clay; some blebs and streaks of orange polyhalite	1089.7-1092.3
Halite, light-orange, medium grained; contains a few blebs of grayish-green clay; some streaks of polyhalite	1092.3-1094.5
Halite, light-brown, medium to coarse grained; contains a few streaks of brown clay; few streaks and blebs of orange polyhalite	1094.5-1097.5
Halite, brown, medium grained; contains numerous streaks and partings of brown clay (10-30%)	1097.5-1109.5
Clay, predominantly brown, but with a few streaks of grayish-green clay; contains inclusions of medium grained halite	1109.5-1117.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light-brown, medium to coarse grained; contains some inclusions of brown clay, increasing downward, and a few inclusions of grayish-green clay; few blebs and streaks of orange polyhalite	1117.0-1121.1
Polyhalite, red, very fine grained; parting of grayish-green clay at base	1121.1-1121.8
Halite, light-orange, medium grained; contains streaks and inclusions of grayish-green clay; streaks and blebs of orange polyhalite	1121.9-1124.8
Polyhalite, red, very fine grained	1124.8-1125.8
Carnallite	1125.8-1126.8
Halite, light-orange, medium grained; contains a few inclusions and streaks of grayish-green clay; numerous blebs and streaks of orange polyhalite; a 0.4-inch-thick bed of polyhalite appears at 1128.8 feet	1126.8-1129.8
Halite, brown, medium grained; contains numerous streaks and inclusions of brown clay (10-20%);large, transparent, secondary halite crystals	1129.8-1132.8
Halite, light-orange, medium grained; some streaks and blebs of polyhalite; a 0.1-inch-thick polyhalite bed appears at 1134.9; two 6.0-inch-thick beds of halite with brown clay inclusions in lower 2.0 feet	1132.8-1138.0
Halite, brown, medium grained; contains numerous inclusions, streaks, and partings of brown clay, decreasing downward; few inclusions and partings of grayish-green clay in upper 1.0 foot; few large, transparent, secondary halite crystals	1138.0-1147.0
Halite, light-orange, medium grained; some streaks, blebs, and thin lenses of polyhalite	1147.0-1157.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Polyhalite, red, very fine grained; grayish-green clay parting at base; a 2.0-inch-thick halite seam appears in middle; a few large polyhalite crystals	1157.0-1158.5
Halite, light-brown; contains some streaks and blebs of orange polyhalite; brown clay parting at 1161.7 feet; a few streaks and inclusions of brown clay at 1158.7-1159.1, 1159.4-1159.9, and 1161.8-1161.9 feet	1158.5-1163.0
Halite, light-brown, medium grained; contains numerous streaks and inclusions of brown clay (5-10%)	1163.0-1167.0
Halite, light-orange, medium grained; contains some streaks and blebs of polyhalite	1167.0-1170.4
Polyhalite, pink, very fine grained; contains numerous halite inclusions	1170.4-1171.4
Anhydrite, gray, very fine grained; contains numerous inclusions of halite pseudomorphs after gypsum; white magnesite blebs appear at 1973.8-1974.2 feet	1171.4-1175.5
Anhydrite and polyhalite, dark-gray, mottled with red, very fine grained; contains numerous halite pseudomorphs after gypsum; anhydrite and polyhalite, massive at 1177.5-1178.0 feet	1175.5-1180.0
Anhydrite and polyhalite, dark-gray, mottled with red	1180.0-1184.0
Anhydrite dark-gray, fine grained; laminated with light-gray magnesite; laminae wavy in lower 0.5 feet	1184.0-1186.5
Clay, brown	1186.5-1187.5
Halite, light-brown, medium grained; contains numerous inclusions of brown clay (5-7%)	1187.5-1192.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light-orange, medium grained; contains a few blebs of orange polyhalite; horizontal streaks of very fine grained, white anhydrite appear in upper 4.0 feet and a bed of light-gray magnesitic anhydrite is at 1196.8-1197.0 feet	1192.0-1204.0
Halite, light-brown, medium grained; contains some streaks and inclusions of brown clay and a few streaks and partings of grayish-green clay	1204.0-1210.5
Polyhalite and anhydrite, top 0.5 feet red, very fine grained polyhalite, grading to light-gray anhydrite in lower 0.2 feet; grayish-green clay parting at base	1210.5-1211.5
Halite, light-brown, medium grained; contains some streaks and inclusions of brown clay, decreasing downward	1211.5-1214.0
Halite, brownish-gray, argillaceous; clay content decreases downward to zero at base	1214.0-1215.2
Halite, pale-amber, polyhalitic (25%)	1215.2-1217.0
Halite, brownish-gray, argillaceous; clay content (2%) decreases downward to zero at the base	1217.0-1218.5
Halite, pale-amber to pale-orange at base, polyhalitic; polyhalite bands 0.05 feet thick at 0.5 foot intervals	1218.5-1223.8
Halite, brownish-gray, argillaceous; clay content (1%) decreasing downward to zero at base	1223.8-1225.0
Halite, pale-amber to pale-reddish-orange, polyhalitic; polyhalite bands 0.05 feet thick at 0.5-foot intervals; polyhalite increases in lower 0.3 feet (to 25%)	1225.0-1230.0
Polyhalite, red, dense; clay parting at base	1230.0-1230.5
Halite, brownish-gray, argillaceous; clay inclusions (5%)	1230.5-1233.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, gray, dense; halite blebs (25%) in upper 0.15 feet; halite pseudomorphs after gypsum in lower 0.15 feet	1233.5-1233.8
Halite, brownish-gray, argillaceous; a 0.01-foot-thick gray and reddish-brown clay seam at top; clay inclusions (10%) decrease downward to zero at base	1233.8-1237.6
Halite, amber, slightly argillaceous (1%) and polyhalitic (1%)	1237.6-1239.7
Halite, brownish-gray, argillaceous, inclusions of brown clay (4%); a thin parting of brown clay at top	1239.7-1240.3
Halite, pale-brownish-gray, argillaceous; inclusions of brown clay (0.5%); blebs of polyhalite	1240.3-1242.3
Halite, light-reddish-orange; polyhalite blebs (2%)	1242.3-1244.2
Halite, brownish-gray, argillaceous; 3-4% in inclusions of brown clay	1244.2-1250.0
Halite, pale-amber, slightly polyhalitic with 2% in polyhalite blebs; inclusions of brown and gray clay in upper 1.0 feet (<1%)	1250.0-1252.0
Anhydrite, light-gray, dense; partially replaced by orange polyhalite with 50% inclusions of amber halite	1252.0-1252.4
Halite, light-reddish-orange, polyhalitic; 2% in polyhalite blebs	1252.4-1253.4
Halite, very light-gray, slightly argillaceous; <1% inclusions of gray clay	1253.4-1254.1
Halite, very-light-amber, slightly polyhalitic	1254.1-1255.4
Halite, brownish-gray, argillaceous; 10-25% in partings and inclusions of brown clay	1255.4-1257.5
Halite, brownish-gray, argillaceous; 5% in inclusions of brown clay, occasional gray clay inclusions	1257.5-1264.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light-brownish-gray, argillaceous; 1% in inclusions of brown clay; 1% stringers of gray anhydrite	1264.4-1267.1
Halite, very-light-amber, anhydritic; 3% in anhydrite stringers	1267.1-1268.2
Anhydrite, gray, dense; 10% in halite pseudomorphs after gypsum; 50% polyhalite in lower 0.2 feet	1268.2-1269.0
Halite, very-light-brown, argillaceous; 1% in inclusions of brown clay; 1% in anhydrite stringers	1269.0-1271.8
Halite, very light-amber, slightly argillaceous, trace of gray clay; 1% in gray anhydrite stringers	1271.8-1273.2
Halite, light-orange, polyhalitic; 1% in polyhalite stringers to 1277.3, 10% polyhalite 1277.3-1278.0	1273.2-1278.0
Anhydrite, gray, dense; 10% in halite pseudomorphs after gypsum	1278.0-1278.2
Halite, light-gray, argillaceous; 4% in inclusions of gray clay	1278.2-1278.5
Halite, brown, argillaceous; 25% in inclusions of brown clay	1278.5-1279.0
Halite, brown, argillaceous; 5% in inclusions of brown clay; 1% in anhydrite stringers	1279.0-1281.5
Halite, brown, argillaceous; 10% in inclusions of brown clay at 1281.5-1287.0 feet; 1% in inclusions of brown clay in lower 1.0 foot	1281.5-1288.5
Halite, very light-brown, slightly argillaceous, (<0.5%)	1288.5-1290.0
Halite, brown, argillaceous; 5% in inclusions of brown clay; 2% blebs of grayish-white anhydrite	1290.0-1293.9
Halite, moderate-orange-pink, very slightly argillaceous; contains blebs of grayish-white anhydrite	1293.9-1296.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, argillaceous; 10% in inclusions of brown clay and occasional inclusions of gray clay	1296.0-1297.5
Halite, light brown, argillaceous, 2% in inclusions of brown clay; rare blebs of gray anhydrite	1297.5-1300.9
Halite, very light-amber to light-reddish-orange, polyhalitic; 5% in blebs and stringers of red polyhalite	1300.9-1302.5
Halite, brown, argillaceous; 2% in inclusions of brown clay and 2-5% blebs of polyhalite	1302.5-1303.0
Halite, reddish-orange, polyhalitic; 2% in blebs of polyhalite; a 0.1 foot irregular polyhalite seam at top	1303.0-1303.8
Anhydrite, gray, dense, massive; irregular blebs of halite; rare seams of halite pseudomorphs after gypsum	1303.8-1306.2
Anhydrite, gray, dense; banded with closely spaced layers of halite pseudomorphs after gypsum	1306.2-1309.9
Anhydrite, gray, dense; occasional halite pseudomorphs after gypsum	1309.9-1312.2
Anhydrite, gray, dense; 40% in blebs and lenticular masses of red polyhalite	1312.2-1314.2
Anhydrite gray, dense, nodular, embedded in a gray clay matrix	1314.2-1314.7
Polyhalite, red, dense; 20% in gray, dense anhydrite	1314.7-1315.6
Halite, reddish-orange, polyhalitic; irregular polyhalite seams and bands 0.1-0.2 feet thick at 0.4-0.6-foot intervals	1315.6-1319.9
Anhydrite, gray, dense; 10% in halite inclusions in upper and lower 0.1 feet	1319.9-1320.3
Halite, moderate-orange-pink, slightly anhydritic	1320.3-1320.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, gray, dense; closely spaced halite pseudomorphs after gypsum	1320.9-1321.4
Anhydrite, gray, dense, massive; magnesite laminae in lower half of unit	1321.4-1321.9
Anhydrite, gray, dense, nodular, embedded in a gray clay matrix	1321.9-1322.5
Anhydrite, gray, dense, massive; nodular polyhalite masses in lower 0.9 feet	1322.5-1324.5
Halite, reddish-orange, polyhalitic; 2% in polyhalite stringers	1324.5-1328.8
Polyhalite, red, dense; rare partings of gray clay	1328.8-1329.0
Halite, reddish-orange, slightly polyhalitic	1329.0-1329.5
Halite, light-brown, slightly argillaceous and polyhalitic	1329.5-1330.0
Halite, light-reddish-orange, polyhalitic	1330.0-1331.7
Polyhalite, red, dense; irregular blebs of halite	1331.7-1331.9
Halite, light-brown with orange mottling; argillaceous; 2% in inclusions of brown clay and 1% stringers of red polyhalite	1331.9-1334.2
Clay, reddish-brown with gray streaks and seams	1334.2-1334.6
Halite, brown, argillaceous; 5% in inclusions of brown clay	1334.6-1336.1
Halite, brown, argillaceous; 15% in inclusions of brown clay and 10% stringers of red polyhalite	1336.1-1337.1
Polyhalite, moderate-red, dense; brown clay seam at top	1337.1-1337.8

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, argillaceous and polyhalitic; contains 1% brown clay	1337.8-1338.5
Halite, brown, argillaceous and polyhalitic; 25% in inclusions of polyhalite and 10% in inclusions of brown clay	1338.5-1339.1
Halite, moderate-orange-pink to amber, argillaceous and polyhalitic; contains 2% gray clay and 5% in stringers of buff polyhalite	1339.1-1341.1
Halite, moderate-orange-pink, polyhalitic; 1% in stringers of buff polyhalite	1341.1-1345.4
Halite, very light-brown, slightly argillaceous; 1% in inclusions of brown clay and occasional stringers of buff polyhalite	1345.4-1346.8
Halite, grayish-orange-pink, very slightly polyhalitic	1346.8-1348.6
Halite, very-light-brown, slightly argillaceous; contains 1% clay	1348.6-1350.8
Halite, grayish-orange-pink	1350.8-1352.5
Halite, grayish-orange-pink, very slightly argillaceous, rare 0.05 feet blebs of kainite at 1356.0-1356.8 feet	1352.5-1356.8
Halite, gray, argillaceous; 5% in inclusions and partings of gray clay	1356.8-1357.5
Halite, light-amber to orange, polyhalitic; 2% in polyhalite stringers	1357.5-1358.2
Polyhalite, red, dense	1358.2-1358.4
Halite, reddish-orange, polyhalitic; 30% in blebs and stringers of polyhalite	1358.4-1359.5
Halite, brown, very argillaceous; 15-25% in inclusions of brown clay	1359.5-1361.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, very argillaceous, 0.3-foot-thick-brown clay seams at top and bottom, 40% brown clay	1361.4-1362.9
Halite, mottled brown and orange; contains 2% brown clay in upper 2.0 feet and 5% red polyhalite in lower 1.5 feet	1362.9-1366.9
Halite, reddish-orange, polyhalitic; 5% in stringers of polyhalite	1366.9-1367.7
Polyhalite, brownish-orange, dense	1367.7-1367.8
Halite, reddish-orange, polyhalitic; 10% in stringers of polyhalite	1367.8-1368.9
Polyhalite, orange, dense	1368.9-1369.0
Halite, brown, argillaceous, brown clay partings at top; 2% in inclusions of brown clay	1369.0-1371.2
Halite, light-reddish-orange, slightly polyhalitic	1371.2-1372.0
Halite, white, very slightly polyhalitic; a 0.1-foot-thick band of buff polyhalite (40%) at 1377.0 feet	1372.0-1377.6
Polyhalite, moderate-orange-pink, dense	1377.6-1378.0
Halite, grayish-pink, slightly polyhalitic; 0.05 foot thick bands rich in polyhalite blebs spaced 0.2-0.3 feet apart	1378.0-1380.1
Halite, brown, argillaceous; 2% in inclusions of brown and gray clay and 1% stringers of red polyhalite	1380.1-1381.3
Halite, reddish-orange, polyhalitic	1381.3-1382.7
Halite, brown, very argillaceous; brown clay parting at top, contains 15% inclusions of brown clay	1382.7-1384.1
Clay, brown; consists of 30% crystals and blebs of halite	1384.1-1384.7
Halite, brown and gray, argillaceous; 7% in stringers of brown and gray clay and occasional stringers of polyhalite	1384.7-1386.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, very light-brown, argillaceous, occasional inclusions of brown clay	1386.5-1388.3
Halite, reddish-orange, very polyhalitic; 10% in stringers of polyhalite and occasional stringer of brown clay	1388.3-1389.0
Halite, brown and gray, argillaceous; 2% in inclusions and stringers of brown and gray clay; occasional stringers of red polyhalite	1389.0-1393.0
Halite, reddish-orange, polyhalitic; 10% in inclusions and stringers of red polyhalite	1393.0-1394.2
Polyhalite, red, dense, nodular structure	1394.2-1394.5
Halite, reddish-orange, polyhalitic; 10% in stringers and blebs and red polyhalite	1394.5-1396.1
Polyhalite, red, dense, nodular structure; 10% in blebs of halite	1396.1-1397.5
Halite, gray, very argillaceous; 0.1 foot thick gray clay seam at top; 15% in inclusions of clay	1397.5-1398.1
Halite, gray to reddish-orange; gray clay in upper 0.1 feet; 5% inclusions of red polyhalite at 1398.2-1399.0 feet	1398.1-1399.0
Halite, brown, argillaceous; 3% in inclusions of brown clay and rare blebs of polyhalite	1399.0-1402.0
Halite, moderate-orange-pink; rare blebs of polyhalite	1402.0-1403.9
Halite, light-brown, argillaceous; 2% in inclusions of brown clay	1403.9-1404.5
Halite, grayish-pink; contains rare blebs of polyhalite	1404.5-1405.4
Halite, brown, argillaceous; 2% in stringers and inclusions of brown clay	1405.4-1407.0
Halite, grayish-pink; occasional blebs of buff polyhalite	1407.0-1408.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; 15% is polyhalite	1408.9-1409.5
Halite, brown, argillaceous; 20% in inclusions of brown clay	1409.5-1411.0
Clay, brown; contains crystals and blebs of halite	1411.0-1411.9
Halite, brown, argillaceous; 5% in inclusions of brown clay and rare stringers of red polyhalite	1411.9-1413.9
Halite, light-gray; contains rare inclusions of gray and brown clay and stringers of red polyhalite	1413.9-1415.0
Halite, pale-red; 25% in stringers of red polyhalite	1415.0-1415.4
Halite, gray and brown, argillaceous; 3% in inclusions of gray and brown clay and rare stringers of polyhalite	1415.4-1418.5
Halite, light-gray to moderate-orange-pink; 15% in blebs of polyhalite in top 0.2 feet	1418.5-1419.8
Halite, light-brown to gray, slightly argillaceous; contains rare stringers of polyhalite	1419.8-1423.8
Halite, light-gray to moderate-orange-pink, very slightly polyhalitic	1423.8-1426.4
Halite, reddish-orange, very polyhalitic; 25% in stringers and blebs of red polyhalite	1426.4-1427.3
Halite, moderate-orange-pink, slightly polyhalitic	1427.3-1428.4
Halite, brownish-gray, argillaceous; 10% in inclusions of brown clay in upper 0.5 feet and occasional stringer of polyhalite	1428.4-1430.4
Halite, reddish-orange, polyhalitic; 50% in stringers of polyhalite	1430.4-1433.9
Halite, gray, argillaceous; contains 2% inclusions of gray clay	1433.9-1435.1

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; 10% in stringers of polyhalite	1435.1-1436.9
Halite, gray, argillaceous; contains 2% clay	1436.9-1437.7
Halite, moderate-orange-pink; 50% in stringers and growths of polyhalite	1437.7-1438.5
Halite, gray, slightly argillaceous; 1% in inclusions of gray clay	1438.5-1439.1
Halite, brown, very argillaceous; 15% in inclusions of brown clay and brown clay partings at 1439.9 and 1441.1	1439.1-1441.4
Halite, light-brown and gray, very slightly argillaceous	1441.4-1443.5
Halite, reddish-orange, very polyhalitic; contains 0.3 - foot-thick stringers and bands of polyhalite 0.5 feet apart	1443.5-1448.1
Polyhalite, moderate-reddish-orange, dense; occasional blebs of halite; gray clay parting at base	1448.1-1450.5
Halite, pale-orange, polyhalitic; 5% in stringers of polyhalite	1450.5-1451.4
Halite, brown, very argillaceous, 15% in brown clay; brown clay parting at center	1451.4-1452.3
Halite, light-brownish-gray; occasional stringers of brown clay	1452.3-1455.0
Halite, grayish-reddish-orange; polyhalite stringers increasing from a trace at top to 15% at base	1455.0-1457.6
Polyhalite, pale-red, dense; 10% in inclusions of halite	1457.6-1458.3
Halite, orange; slightly polyhalitic	1458.3-1459.7
Halite, brown and orange; 2% in inclusions of brown and gray clay and 1% in disseminated polyhalite	1459.7-1461.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; 2% in stringers of red polyhalite	1461.0-1464.2
Halite, reddish-orange, very polyhalitic, 5% in stringers of red polyhalite	1464.2-1464.4
Halite, reddish-orange; 20% in stringers of polyhalite concentrated in 0.2 foot thick zones 0.5 feet apart	1464.4-1467.1
Halite, gray, argillaceous; 2% in inclusions of gray clay	1467.1-1467.9
Halite, brown, argillaceous; 10% in inclusions of brown clay	1467.9-1471.1
Halite, light-brown to reddish-orange, slightly argillaceous in top 0.5 feet; occasional polyhalite stringer	1471.1-1473.6
Halite, brown, very argillaceous; 15% in brown clay	1473.6-1474.5
Halite, very light-brown, very slightly argillaceous; brown clay parting at base	1474.5-1476.1
Halite, moderate-orange-pink, slightly polyhalitic	1476.1-1477.9
Halite, gray, argillaceous; 10% in inclusions of gray clay	1477.9-1478.2
Halite, light-reddish-orange, polyhalitic; contains stringers of polyhalite concentrated in 0.2-foot-thick zones 1.0 feet apart	1478.2-1485.0
Halite, brownish-gray, argillaceous; 3% in inclusions of brown clay and rare blebs of polyhalite	1485.0-1486.2
Halite, pale-pink, polyhalitic; 5% in stringers of polyhalite in lower 0.9 feet	1486.2-1489.0
Halite, gray, argillaceous; 2% in inclusions of gray clay	1489.0-1489.3
Halite, reddish-orange, polyhalitic; 2% in stringers of polyhalite	1489.3-1496.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Polyhalite, moderate-pink, dense; contains occasional inclusions of halite	1496.4-1498.4
Halite, reddish-orange, polyhalitic; contains 15% in seams and stringers of polyhalite	1498.4-1499.4
Polyhalite, red, dense; clay parting at base	1499.4-1499.8
Halite, grayish-pink to pale-pink, slightly polyhalitic	1499.8-1505.1
Halite, brown, very argillaceous; contains 15% in inclusions of brown, silty clay; irregular clay partings at top, and at 0.2-0.3 foot intervals throughout unit	1505.1-1508.1
Halite, brown, very argillaceous; contains 50% in inclusions of brown, silty clay	1508.1-1510.5
Siltstone and brown clay; contains 25% in crystalline masses and blebs of halite	1510.5-1513.0
Halite, brown, argillaceous; contains 25% in prominent inclusions of brown, silty clay	1513.0-1514.1
Halite, reddish-orange, polyhalitic; banded at 0.5-foot intervals with brown, argillaceous halite containing 2% brown silty clay in 0.3-0.5 foot units	1514.1-1519.4
Halite, reddish-orange, polyhalitic	1519.4-1521.2
Polyhalite, red, dense; contains 10% in inclusions of halite	1521.2-1521.5
Halite, reddish-orange, polyhalitic; contains 3-5% red polyhalite in 0.3-foot-thick bands at 0.5 foot intervals	1521.5-1523.2
Halite, red and orange, polyhalitic; contains 10% in stringers of polyhalite	1523.2-1523.5
Halite, brown argillaceous; contains 3% in inclusions of brown clay	1523.5-1524.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; contains 2% red polyhalite	1524.2-1526.9
Halite, brown, argillaceous; contains 2% brown clay inclusions; clay parting at top	1526.9-1527.5
Halite, reddish-orange, polyhalitic, (2%)	1527.5-1528.0
Halite, brown, argillaceous, brown clay partings at top; 5% brown clay in upper 1.0 foot decreasing downward to a trace at the base	1528.0-1530.2
Halite, reddish-orange, slightly polyhalitic; 2% in inclusions of brown clay in the upper 1.0 foot, 2% in inclusions of brown clay in 0.3-foot-thick zone at 1532.0 feet	1530.2-1538.8
Halite, brown, argillaceous; 10% in irregular clay partings and prominent inclusions	1538.8-1539.5
Clay, brown; 20% in crystals and blebs of halite	1539.5-1539.8
Halite, brown, argillaceous; 30% in prominent inclusions of brown clay	1539.8-1540.5
Halite, reddish-brown; 25% in prominent blebs and stringers of polyhalite and 10% in brown clay	1540.5-1540.8
Halite, brown, argillaceous; 20% in prominent inclusions of brown and gray clay	1540.8-1542.5
Halite, reddish-brown, polyhalitic; 20% in stringers of red polyhalite and 5% brown clay	1542.5-1542.8
Halite, brown, argillaceous; 10% in stringers and inclusions of brown clay; occasional polyhalite stringers	1542.8-1543.9
Halite, reddish-orange, polyhalitic; 1% in stringers of red polyhalite	1543.9-1545.7
Polyhalite, red, dense	1545.7-1545.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; 5% in stringers of red polyhalite	1545.9-1546.7
Halite, gray, argillaceous; 3% in inclusions of gray and brown clay	1546.7-1547.0
Halite, red, polyhalitic; 5% in stringers of red polyhalite; 0.1-foot-thick polyhalite band at base	1547.0-1548.3
Clay, gray, silty; 25% in halite crystals	1548.3-1548.5
Clay, brown, silty; 30% in veins and blebs of halite crystals	1548.5-1550.0
Polyhalite, red, argillaceous; 20% in inclusions of brown clay and 30% in crystals and blebs of halite	1550.0-1550.8
Halite, reddish-orange, polyhalitic; 2% in stringers of polyhalite	1550.8-1554.0
Halite, brown, argillaceous; 2% in inclusions of brown clay; occasional bleb of polyhalite	1554.0-1554.6
Halite, reddish-orange, polyhalitic; 2% in stringers of polyhalite	1554.6-1557.0
Halite, brown, argillaceous; 2% in inclusions of brown clay	1557.0-1557.3
Halite, reddish-orange, polyhalitic; 2% in stringers and blebs of polyhalite, 2% in inclusions of brown clay at 1557.9-1558.1 and 1558.9-1559.0 feet	1557.3-1560.6
Halite, reddish-orange and gray, slightly polyhalitic and argillaceous	1560.6-1561.1
Halite, gray, argillaceous; 15% in inclusions of gray clay and 1% in carnallite blebs; clay parting at top;	1561.1-1561.4
Halite, brown and maroon, argillaceous and carnallitic; 7% in brown and gray clay and 5% in carnallite; gray clay parting at top	1561.4-1562.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, argillaceous very slightly carnallitic; brown clay parting at 1564.1 feet; 15% clay in upper 2.0 feet, 1-2% clay in lower part; 2% polyhalite in lower 0.5 feet	1562.9-1567.2
Halite, moderate-orange-pink to light-red, sylvitic and polyhalitic; 2% in sylvite blebs, 1% polyhalite	1567.2-1575.3
Halite, light-red; 5% sylvite; few blebs of polyhalite	1575.3-1576.1
Polyhalite, moderate-pink, dense; 15% in stringers of red carnallite; 0.8-1.3-inch-thick bladed anhydrite crystals (polyhalite being replaced by carnallite and anhydrite); 0.1-foot-thick seam of gray clay at base, clay seam invaded by carnallite veins	1576.1-1578.9
Halite, gray, argillaceous; 2% in inclusions of gray clay	1578.9-1579.1
Halite, light-red, slightly sylvitic; 3% in crystals and blebs of sylvite; few stringers of polyhalite; 0.1-foot-thick band of gray argillaceous halite at 1581.8 feet	1579.1-1582.9
Halite, gray and maroon, argillaceous and carnallitic; 10% gray clay, 2% maroon carnallite	1582.9-1583.5
Halite, greenish-gray, argillaceous and slightly polyhalitic and carnallitic; 5% greenish-gray clay, less than 1% carnallite	1583.5-1585.3
Halite, brown, argillaceous and slightly polyhalitic; trace carnallite; 5% brown clay	1585.3-1587.3
Halite, light-pink, carnallitic and slightly polyhalitic; argillaceous with inclusions of gray clay in upper 0.7 feet	1587.3-1589.5
Halite, pale-red and gray, carnallitic and argillaceous; 1% red carnallite, less than 1% green and brown clay; occasional stringers of polyhalite	1589.5-1591.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, buff, slightly polyhalitic; 5% carnallite; 5% anhydrite and kieserite at 1593.6-1594.5 feet	1591.5-1594.5
Polyhalite, moderate pink, dense; crystalline masses and stringers of anhydrite and carnallite; greenish-gray clay parting at base	1594.5-1595.6
Halite, gray, argillaceous, carnallitic; 2% clay, less than 1% carnallite	1595.6-1596.1
Halite, moderate-orange-pink; less than 1% carnallite and polyhalite; seams of 50% moderate-pink polyhalite at 1600.2 feet	1596.1-1601.9
Polyhalite, moderate-reddish-orange, dense; less than 1% in stringers of carnallite; few anhydrite crystals	1601.9-1602.5
Halite, pale-amber; 1% polyhalite; less than 1% carnallite	1602.5-1603.2
Halite, gray and flesh; 2% disseminated gray clay; scattered blebs of moderate-pink polyhalite; trace of carnallite	1603.2-1604.1
Halite, moderate-orange-pink with disseminated polyhalite; scattered inclusions of carnallite; trace of inclusions of gray clay at 1605.1-1605.5 feet	1604.1-1606.1
Halite, gray and brown, argillaceous; gray clay in upper 0.4 feet, brown clay in most of remainder; occasional blebs of polyhalite; clay partings 1606.5-1609.1 feet; 15% disseminated clay	1606.1-1609.8
Clay, brown and greenish-gray; contains veins of halite and carnallite	1609.8-1610.2
Halite, brown and orange; 2% disseminated brown clay; occasional polyhalite crystals	1610.2-1611.0
Halite, light-orange; 2% in blebs of polyhalite	1611.0-1613.0
Halite, gray and orange; 2% disseminated gray clay; occasional blebs of polyhalite	1613.0-1613.8

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; occasional scattered sylvite crystals; 0.05-foot-thick polyhalite seams at 1616.5, 1616.8, 1617.0, and 1617.8 feet; 10% polyhalite in lower 1.5 feet	1613.8-1617.8
Polyhalite, pale-red, dense; occasional streaks of carnallite; inclusions of gray clay; stringers of green clay at 1617.9 and 1618.3 feet and at base; polyhalite seam at 1618.1 feet	1617.8-1619.8
Halite, moderate-orange-pink and gray; 2% disseminated gray clay, occasional stringers of polyhalite, occasional small sylvite crystals; green clay parting at base	1619.8-1621.1
Halite, moderate-orange-pink, 0.55 sylvite crystals; trace of carnallite crystals	1621.1-1622.1
Halite, gray, argillaceous; 10% in inclusions of gray clay; trace of carnallite stringers	1622.1-1623.9
Halite, moderate-orange-pink to light-red, polyhalitic, 1% stringers of polyhalite; less than 1% inclusions of carnallite	1623.9-1626.9
Halite, gray and brown, argillaceous; 3% in inclusions of brown and gray clay; contains scattered blebs of red polyhalite; gray and brown clay parting at 1627.4 feet	1626.9-1628.1
Halite, white to light-pink, carnallitic; 2% in crystals of pink carnallite, some carnallite bordered by anhydrite crystals; trace of polyhalite blebs	1628.1-1631.9
Halite, gray, argillaceous and carnallitic; 5% greenish-gray clay, 5% red carnallite	1631.9-1632.8
Halite, light-pink, carnallitic; 5% in crystalline masses of pale-pink carnallite	1632.8-1634.5
Halite, gray, argillaceous and carnallitic; 5% in inclusions of greenish-gray clay, 20% in crystalline masses of pink carnallite	1634.5-1635.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite and sylvite, argillaceous, 25% sylvite, 5% greenish-gray clay; occasional inclusions of pink carnallite	1635.3-1637.7
Carnallite and halite, argillaceous; 30% carnallite, 3% clay	1637.7-1638.2
Halite, moderate-orange-pink and gray, slighty argillaceous and carnallitic; 1% in inclusions of greenish-gray clay, 1% in crystals of carnallite	1638.2-1638.9
Halite, moderate-orange-pink and light-pink, polyhalitic, slightly carnallitic; 0.2 foot thick zone of crystals and masses of anhydrite at 1642.3 feet; some kieserite with few crystals of sylvite	1638.9-1643.5
Anhydrite, white and light-gray, kieseritic; stringers of pink carnallite throughout	1643.5-1643.9
Halite, buff, slightly anhydritic	1643.9-1644.4
Halite, buff to moderate-orange-pink, slightly polyhalitic and sylvitic (sylvite less than 1%)	1644.4-1645.1
Halite, greenish-gray and maroon, argillaceous and carnallitic; 2% clay and 2% carnallite	1645.1-1646.0
Halite, pale-pink, carnallitic and slightly anhydritic; 10% in prominent blebs of pink carnallite with irregular seams of carnallite at 1648.1, 1649.4, and 1650.1 feet	1646.0-1650.3
Halite, greenish-gray, argillaceous and carnallitic; 5% in inclusions of greenish-gray clay, 10% in prominent blebs and seams of tan and pink carnallite	1650.3-1651.8
Halite, greenish-gray and brown, argillaceous and carnallitic; 5% in inclusions of greenish-gray and brown clay, 2% in blebs of carnallite; trace disseminated polyhalite	1651.8-1653.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, red and pink, polyhalitic and slightly carnallitic; contains a trace of inclusions of greenish-gray clay in upper 1.0 feet; 1% in stringers of carnallite and 2% in stringers of polyhalite	1653.4-1659.2
Polyhalite, light-red, dense; contains a few inclusions of carnallite; 0.2 feet of greenish-gray carnallitic clay at base	1659.2-1661.5
Halite, pale-reddish-orange to moderate-orange-pink, carnallitic and polyhalitic; trace of gray and brown clay in upper 0.5 feet; less than 1% carnallite; 2% polyhalite; a 0.2 foot thick bed of pink polyhalite with 25% halite inclusions at 1667.0 feet	1661.5-1668.0
Polyhalite, moderate to pink, dense, anhydritic and carnallitic	1668.0-1668.5
Halite, buff to pale-pink, polyhalitic; a 0.1 foot thick seam of polyhalite at 1668.8 feet; contains 5% in stringers of polyhalite throughout; trace of stringers of carnallite in lower 0.2 feet	1668.5-1669.4
Halite, greenish-gray and brown, argillaceous; greater than 2% greenish-gray and brown clay; trace of disseminated polyhalite; occasional stringers of carnallite	1669.4-1671.3
Halite, light-red to pale-pink, carnallitic, slightly anhydritic and polyhalitic; 2% carnallite	1671.3-1676.9
Halite, greenish-gray and brown, argillaceous; 7% greenish-gray and brown clay; 1% polyhalite; trace of carnallite	1676.9-1677.4
Halite, pale-red to moderate-orange-pink; occasional inclusions of gray and brown clay in upper 0.8 feet; scattered stringers of pink carnallite (2%) and buff polyhalite	1677.4-1681.9
Halite, greenish-gray, argillaceous; 7% greenish-gray clay, 1% in stringers of carnallite	1681.9-1682.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Carnallite, pink to light-red; 4% halite crystals and 7% in inclusions of greenish-gray clay	1682.2-1683.0
Halite, brown and gray, argillaceous; 7% in inclusions of brown and gray clay; scattered blebs and stringers of orange polyhalite	1683.0-1687.0
Halite, brown, reddish-orange, and gray, patchy masses of argillaceous halite alternating with masses of polyhalitic halite; contains 5% clay and 2% blebs and stringers of polyhalite	1687.0-1692.0
Halite, pale-reddish-pink, carnallitic and slightly polyhalitic; contains 3% stringers of carnallite and 2% polyhalite	1692.0-1696.2
Anhydrite, gray, dense, massive; a few inclusions of carnallite in upper 0.3 feet and widely spaced through upper 6.0 feet; contains occasional inclusions of halite throughout; prominent growths of polyhalite from 1698.2-1700.5 feet; gray clay parting at 1695.8 feet and at 1705.0 feet	1696.2-1705.0
Halite, gray, argillaceous; 10% gray clay; few blebs of polyhalite	1705.0-1705.4
Halite, reddish-orange, polyhalitic; 5% in stringers of polyhalite	1705.4-1706.0
Halite, pale-orange, polyhalitic; 2% in disseminated and streaky polyhalite; trace of sylvite crystals; 2% in masses of pink carnallite in lower 0.2 feet	1706.0-1708.2
Halite, greenish-gray, argillaceous, greenish-gray clay partings at top and bottom, 2% in inclusions of clay; 5% pinkish-red carnallite	1708.2-1708.9
Halite, moderate-orange-pink to reddish-orange; contains scattered streaks and blebs of pale-orange polyhalite; 2% pink carnallite in upper 0.6 feet; scattered sylvite crystals throughout rest of unit	1708.9-1714.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, greenish-gray, argillaceous and sylvitic; 7% in inclusions of greenish-gray clay, 3% sylvite; contains a few blebs of polyhalite; green and brown clay partings at 1715.6 feet	1714.3-1718.6
Halite, brown, very argillaceous; 10% in inclusions of brown and gray clay; clay partings at 1719.1, 1720.9, 1721.5, and 1723.4 feet; contains occasional masses and blebs of reddish-orange polyhalite	1718.6-1724.3
Clay, brown; contains about 50% halite crystals	1724.3-1724.8
Halite, gray and brown, argillaceous; 3% in inclusions of greenish-gray and brown clay; contains a few blebs of polyhalite; occasional carnallite masses; brown clay partings at 1715.2 and 1725.9 feet	1724.8-1727.1
Halite, pale-reddish-orange to moderate-orange-pink; some sylvite crystals; some small blebs of polyhalite; 5% sylvite between 1731.1 and 1731.7 feet	1727.1-1732.5
Halite, light-greenish-gray and orange, argillaceous; 2% in inclusions of greenish-gray clay; contains occasional sylvite crystals and small blebs of polyhalite; greenish-gray clay parting at base	1732.5-1734.4
Halite, grayish-orange-pink to light-pink, polyhalitic, slightly sylvitic (less than 1%)	1734.4-1736.6
Halite and sylvite, pink; trace of polyhalite; contains some kieserite crystals (most abundant at 1738.0-1739.0 feet); 25% sylvite	1736.6-1739.5
Halite, sylvite and kieserite, gray, argillaceous; 3% greenish-gray clay; 3% in red carnallite masses 1740.9-1741.8 feet; 10% sylvite; 25% kieserite	1739.5-1741.8
Halite, greenish-gray to light-red, argillaceous; 1% in inclusions of greenish-gray clay; few blebs of reddish-orange polyhalite; less than 1% scattered crystals of red sylvite	1741.8-1743.0
Halite, light-red, sylvitic and polyhalitic; 5% sylvite 1743.0-1744.6 feet; 2% polyhalite	1743.0-1746.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, greenish-gray, argillaceous and langbeinitic; langbeinite crystals rimmed with kainite/leonite; contains prominent masses of red polyhalite; some sylvite crystals; 10% sulfates; 2% in clay inclusions	1746.2-1747.4
Halite, orange and gray; contains prominent masses of kainite/leonite, occasional crystals of sylvite, blebs of reddish-orange polyhalite and inclusions of gray clay; 20% kainite/leonite	1747.4-1751.4
Halite, greenish-gray and pink, argillaceous; 1% in inclusions of greenish-gray clay; 1% red sylvite crystals; contains scattered small blebs of polyhalite	1751.4-1753.2
Halite, pale-orange, slightly polyhalitic; contains rare sylvite crystals; 20% in prominent masses of kainite/leonite in lower 0.4 feet	1753.2-1757.9
Halite, moderate-orange-pink to gray; 5% prominent masses of kainite/leonite; 1% disseminated gray clay; contains a few blebs of orange polyhalite	1757.9-1758.6
Halite, gray, argillaceous; 5% in inclusions of gray and brown clay; contains occasional polyhalite blebs	1758.6-1759.2
Halite, pale-red; 2% in scattered sylvite crystals; contains occasional polyhalite blebs	1759.2-1760.1
Halite, gray and brown, argillaceous; 2% in inclusions of gray and brown clay; contains rare sylvite blebs	1760.1-1761.6
Halite, brown, very argillaceous; 10% in prominent inclusions of brown clay	1761.6-1762.7
Halite, gray and pale-orange, polyhalitic and argillaceous; contains prominent stringers of reddish-orange polyhalite; streaks of brown and greenish-gray clay; 2% clay, 2% polyhalite	1762.7-1767.4
Halite, reddish-orange to buff, polyhalitic; 5% in stringers of red polyhalite at 1769.0-1770.3 feet; 5% pink sylvite crystals at 1770.5-1770.9 feet	1767.4-1773.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, buff, very polyhalitic; 30% in stringers and seams of buff polyhalite	1773.0-1773.8
Polyhalite, buff to light-gray, dense; few inclusions of halite	1773.8-1774.3
Halite, buff, polyhalitic	1774.3-1774.8
Anhydrite and polyhalite, gray, dense, massive; contains a few inclusions of halite	1774.8-1781.2
Halite, buff, dense; 25% in stringers and seams of gray anhydrite	1781.2-1782.3
Halite, buff to reddish-orange, polyhalitic; 0.1-foot-thick gray anhydrite band at top and at 1784.9 feet; anhydrite seams invaded by polyhalite masses	1782.3-1785.5
Anhydrite, gray, dense; capped by 0.2 feet of red polyhalite; 20% polyhalite masses in upper 1.0 foot; halite pseudomorphs after gypsum at 1786.5, 1786.8, 1787.6, and 1788.0 feet; anhydrite laminated with magnesite below 1789.5 feet	1785.5-1795.5
Shale, gray	1795.5-1796.1
Halite, reddish-orange to pale-pink, polyhalitic; contains stringers and blebs of polyhalite; 2% greenish-gray clay in upper 0.6 feet	1796.1-1800.2
Halite, gray and brown, very argillaceous; gray clay parting at top, brown clay parting at base; 10% gray clay in upper 0.9 feet; contains a 0.1-foot-thick band of brown clay at 1801.0 feet	1800.2-1801.3
Halite, gray and pink, slightly argillaceous, polyhalitic	1801.3-1803.0
Halite, pale-orange, slightly polyhalitic; contains 0.3 feet of recrystallized halite at 1805.0 feet	1803.0-1808.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, greenish-gray, argillaceous; 5% in inclusions of gray clay; few kainite/leonite pseudomorphs after langbeinite	1808.9-1809.5
Halite, brown, very argillaceous; clay partings at top and bottom, and 20% in clay inclusions	1809.5-1809.8
Halite, pink and gray; contains disseminated inclusions of gray clay and blebs of polyhalite	1809.8-1811.8
Halite, pale-orange, slightly polyhalitic	1811.8-1814.3
Halite, brown and gray, argillaceous; 10% in inclusions of brown clay in upper 0.3 feet and lower 0.3 feet; narrow band of kainite pseudomorphs after langbeinite at top of unit	1814.3-1815.4
Halite, reddish-orange, polyhalitic; 2% in blebs of polyhalite	1815.4-1817.2
Halite, brown and gray, argillaceous; 2% brown and gray clay; 5% kainite pseudomorphs after langbeinite in upper 0.4 feet	1817.2-1818.6
Halite and langbeinite, pink, white, and gray; 3% polyhalite in upper 0.3 feet; 40% kainite and langbeinite; 1-2% gray and brown clay	1818.6-1821.4
Halite, gray, argillaceous; 2% in inclusions of gray clay; contains a few blebs of kainite and polyhalite	1821.4-1822.4
Halite, orange, polyhalitic; contains streaks and blebs of reddish-orange polyhalite; 1% disseminated gray clay at 1823.4-1824.0 feet	1822.4-1827.4
Halite, reddish-orange; contains prominent seams and stringers of red polyhalite in top 0.4 feet	1827.4-1828.2
Halite, reddish-orange, langbeinitic, slightly polyhalitic; 2% in single crystals of langbeinite	1828.2-1829.0
Halite, gray, argillaceous, langbeinitic; 5% in gray clay, 5% in single crystals of langbeinite	1829.0-1829.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, reddish-orange, polyhalitic; contains trace of gray and brown clay in upper 0.8 feet; 5% polyhalite, 5% langbeinite in upper 0.8 feet	1829.3-1832.3
Halite, pale-orange, very slightly polyhalitic	1832.3-1832.4
Halite, gray, argillaceous; 2% in inclusions of gray clay.	1832.4-1832.7
Halite, reddish-orange and white; 2% in stringers of polyhalite in upper 0.5 feet	1832.7-1835.1
Halite, brown, argillaceous; contains 5% in disseminated brown and greenish-gray clay and scattered blebs of polyhalite	1835.1-1837.3
Halite, brown and pale-amber, argillaceous; less than 1% in inclusions of brown clay; 1% in stringers of polyhalite	1837.3-1838.4
Halite, reddish-orange, polyhalitic; 5% in polyhalite stringers at 1841.3-1843.6 feet; 1% in green clay inclusions at 1839.7-1842.3 feet; contains a green clay parting at base;	1838.4-1845.0
Halite, gray, slightly argillaceous	1845.0-1845.6
Halite, pale-orange, slightly polyhalitic	1845.6-1846.2
Halite, brown, argillaceous; 1% in inclusions of brown clay	1846.2-1846.4
Halite, grayish-orange-pink; contains occasional polyhalite stringers	1846.4-1847.5
Halite, brown, very argillaceous; 25% in inclusions and partings of brown clay	1847.5-1848.4
Halite, brown and gray, argillaceous; 2% in inclusions and partings of brown and gray clay, brown clay at 1849.0 and 1849.2 feet; contains occasional small blebs and stringers of buff to orange polyhalite	1848.4-1858.8
Halite, moderate-orange-pink to light-gray, polyhalitic; 1% in polyhalite stringers and blebs	1858.8-1863.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown and gray, argillaceous; 1% in inclusions of brown and gray clay	1863.2-1865.3
Halite, greenish-gray, argillaceous; 7% in inclusions and partings of greenish-gray clay; contains occasional patches of orange halite containing disseminated polyhalite	1865.3-1867.2
Halite, gray, brown and orange, argillaceous; 3% in inclusions of gray and brown clay; contains a few small blebs and stringers of orange polyhalite	1867.2-1871.4
Halite, brown, very argillaceous; 15% in inclusions and partings of brown clay	1871.4-1872.7
Halite, brown and gray, argillaceous; 2% in inclusions of brown clay; contains occasional blebs and stringers of reddish-orange polyhalite	1872.7-1876.2
Halite, flesh to pale-orange, polyhalitic; contains scattered stringers of red polyhalite	1876.2-1880.0
Polyhalite, red, dense; a 0.1-foot-thick brown clay parting at base	1880.0-1881.0
Halite, brown and orange, argillaceous and polyhalitic; 1% in inclusions of gray and brown clay, a few small blebs of orange polyhalite	1881.0-1881.6
Halite, brown, very argillaceous; 20% in inclusions and partings of brown clay	1881.6-1882.2
Halite, gray and brown, argillaceous; 1% in inclusions of brown clay	1882.2-1883.2
Halite, gray, polyhalitic; occasional stringers of orange polyhalite; contains traces of brown clay and a brown clay parting capped by prominent polyhalite blebs at 1887.0 feet	1883.2-1887.5
Halite, brown and gray, argillaceous; 1% in inclusions of brown clay	1887.5-1893.3
Halite, orange, polyhalitic; 1% in stringers of polyhalite	1893.3-1893.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, argillaceous; 2% in inclusions of brown clay	1893.9-1894.6
Halite, brown and orange, argillaceous; 2% in inclusions of brown clay; contains scattered blebs of orange polyhalite	1894.6-1895.1
Halite, brown and gray, argillaceous; 5% in inclusions of brown clay and thin partings of brown clay at 1895.8 and 1897.3 feet	1895.1-1897.9
Halite, brown to pale-orange; contains a trace a brown clay in upper half; few blebs of orange polyhalite	1897.9-1898.5
Halite, brown, argillaceous; 2% in inclusions of brown clay; contains occasional polyhalite blebs	1898.5-1899.5
Halite, gray and orange; polyhalite seams and inclusions at 1900.9, 1901.7 and 1903.0 feet; gray clay parting at 1901.0 feet	1899.5-1903.2
Halite, gray, argillaceous; contains scarce clay inclusions and stringers of red polyhalite	1903.2-1904.3
Halite, clear to light-orange, polyhalitic; contains stringers of red polyhalite throughout, and a 0.1 foot thick seam of red polyhalite at 1906.3 feet	1904.3-1906.7
Halite, gray, argillaceous; 1% in inclusions of grayish-brown clay; contains a few blebs of red polyhalite	1906.7-1907.9
Halite, reddish-orange, polyhalitic; 5% in blebs and streaks of red polyhalite; gray clay parting at 1910.1 feet	1907.9-1912.1
Halite, white; contains a few blebs of white polyhalite	1912.1-1913.5
Halite, buff to grayish-pink, polyhalitic; 5% in stringers and blebs of grayish-orange-pink polyhalite	1913.5-1917.2
Polyhalite, pale-red, dense; inclusions of gray clay in lower 0.1 feet and a gray clay parting at base	1917.2-1918.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, pale-orange, polyhalitic; contains scattered streaks and blebs of red polyhalite, and a 0.05 foot thick polyhalite band at base	1918.0-1920.3
Halite, brown, argillaceous; 2% brown clay	1920.3-1920.7
Halite, pale-orange, polyhalitic; 10% red polyhalite at 1921.0-1921.3 feet	1920.7-1921.4
Halite, gray, argillaceous; 2% gray clay	1921.4-1922.1
Halite, orange, polyhalitic; 1% in polyhalite blebs	1922.1-1922.9
Halite, gray, argillaceous; 1% gray clay and a gray clay parting at top	1922.9-1923.9
Halite, orange, polyhalitic; contains occasional stringers and blebs of polyhalite	1923.9-1924.8
Halite, gray and brown, very argillaceous; 20% in inclusions of gray and brown clay; contains occasional polyhalite blebs	1924.8-1925.5
Halite, gray, argillaceous; 5% in inclusions of brown and gray clay	1925.5-1930.3
Clay, brown, silty, halitic; 4% in halite crystals	1930.3-1930.8
Halite, brown argillaceous; 3% brown clay, and brown clay partings at 1931.5, 1932.8, and 1934.4 and at 1934.9 feet; contains few patches of orange polyhalitic halite	1930.8-1934.9
Halite, brown, very argillaceous; 25% in inclusions and partings of brown clay	1934.9-1936.5
Halite, orange, polyhalitic; contains few patches of brown argillaceous halite; clay seams at 1938.5 and 1939.0 feet	1936.5-1941.9
Polyhalite, pale-red, dense; contains rare inclusions of gray clay	1941.9-1943.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray, argillaceous; 25% gray clay in upper 0.5 feet, 2% in remainder of unit; contains a few prominent stringers of red polyhalite	1943.9-1945.4
Halite, brown, very argillaceous; 10% in inclusions of brown clay, and a brown clay parting at top	1945.4-1946.2
Halite, brown and orange; contains disseminated inclusions of brown clay, and scattered blebs of orange polyhalite	1946.2-1947.4
Halite, orange, polyhalitic; 0.1 foot thick reddish-orange polyhalite band at 1953.0 feet; gray clay parting at base of polyhalite band	1947.4-1953.7
Halite, gray, argillaceous; gray clay parting at top, 2% inclusions of gray clay	1953.7-1954.0
Halite, orange, polyhalitic; polyhalite appears as blebs	1954.0-1955.5
Halite, brown, argillaceous; 7% in inclusions of brown clay; brown clay parting at top	1955.5-1956.0
Halite, brown, argillaceous; 3% in inclusions of brown clay	1956.0-1956.4
Halite, white to pale-orange, polyhalitic; 5% in polyhalite stringers in lower 0.5 feet	1956.4-1959.4
Halite, gray, argillaceous; 10% in inclusions of gray clay; contains scattered blebs of orange polyhalite; gray clay parting at base	1959.4-1960.5
Halite, orange, polyhalitic; less than 1% polyhalite	1960.5-1963.0
Halite, grayish-brown, argillaceous; 5% in inclusions of gray clay in upper 1.0 feet decreasing to zero at base; contains occasional blebs of polyhalite and clay partings at 1964.3 and 1965.1 feet	1963.0-1966.8
Halite, orange, polyhalitic; 2% in stringers of orange polyhalite	1966.8-1970.1

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray, argillaceous; contains trace of inclusions of greenish-gray and brown clay and a few blebs of polyhalite	1970.1-1970.5
Halite, orange, polyhalitic	1970.5-1970.8
Halite, brown and gray, argillaceous; 5% in inclusions of gray and brown clay; contains a few stringers of reddish-orange polyhalite	1970.8-1975.8
Halite, moderate-orange-pink and gray; contains a few blebs of polyhalite, and a trace of inclusions of coarsely crystalline polyhalite	1975.8-1980.2
Halite, brown and gray, argillaceous; 3% in inclusions of brown and gray clay	1980.2-1981.9
Halite, moderate-orange-pink to light-brown, slightly argillaceous; contains a few polyhalite blebs	1981.9-1983.7
Halite, moderate-orange-pink, polyhalitic; contains stringers and blebs of polyhalite	1983.7-1986.1
Halite, brown and gray, argillaceous; clay inclusions decrease from 10% at top to trace at base; brown clay partings at 1986.4 feet	1986.1-1987.8
Halite, very-light-brown, very slightly argillaceous	1987.8-1988.9
Halite, gray and brown, argillaceous; 1% in inclusions of brown and gray clay, brown clay parting at 1989.5 feet	1988.9-1990.9
Halite, gray, very slightly argillaceous	1990.9-1993.4
Halite, orange, polyhalitic; 10% in polyhalite stringers increasing to 25% in lower 0.6 feet	1993.4-1995.9
Polyhalite, red, dense; 10% in halite inclusions	1995.9-1996.4
Halite, orange, polyhalitic; 2% polyhalite	1996.4-1996.7
Clay, brown; 25% inclusions and crystals of halite	1996.7-1997.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray and brown, argillaceous; 5% in inclusions of gray and brown clay; 5% in stringers of polyhalite at 2001.2 feet; gray and brown clay partings at 1998.4, 1999.0, 2001.3, 2002.1 and 2002.7 feet	1997.4-2002.8
Halite, orange and gray, polyhalitic; 5% in stringers of red polyhalite; trace of gray clay; a 0.3 foot thick zone of gray clay inclusions at 2002.9 feet	2002.8-2004.7
Halite, gray and brown, very argillaceous; 10% in inclusions of gray and brown clay, and gray clay partings at 2004.4 feet and at base	2004.7-2004.8
Halite, buff and orange, polyhalitic; 5% polyhalite in upper 1.0 foot, 2-5% in remainder of unit	2004.8-2012.5
Polyhalite, red, dense; a 0.05-foot-thick gray clay parting at base	2012.5-2013.5
Halite, gray and brown, argillaceous; 7% in inclusions of gray and brown clay, brown clay seam at 2014.5 feet and at base; contains a few stringers of red polyhalite	2013.5-2016.1
Halite, moderate-orange-pink, polyhalitic; contains stringers of red polyhalite	2016.1-2017.3
Halite, moderate-orange-pink to pale-orange; contains a few stringers and blebs of orange polyhalite; 0.05 feet of gray clay in 0.3-foot-thick zone at 2015.9 feet	2017.3-2019.2
Halite, gray, very argillaceous; 15% in inclusions of dark-gray clay, and gray clay partings at 2019.9,2020.7, and 2021.0 feet	2019.2-2021.1
Halite, moderate-orange-pink to light-orange, polyhalitic; contains stringers and blebs of orange polyhalite	2021.1-2025.0
Halite, gray and brown, very argillaceous; 25% gray clay in upper 0.6 feet, 10-15% brown clay in remainder of unit; clay partings at 2025.7, 2027.0, 2027.5, and 2028.9 feet; contains a few small blebs of orange polyhalite in lower 1.5 feet	2025.0-2029.7

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray and brown, argillaceous; 2% in inclusions of brown clay; contains scattered blebs of amber polyhalite; clay parting at 2032.7	2029.7-2033.0
Halite, moderate-orange-pink to orange, polyhalitic	2033.0-2038.1
Polyhalite, red, dense; contains a few stringers of clay in lower 0.2 feet, gray clay parting at base	2038.1-2039.0
Halite, gray, argillaceous; 2% gray clay, gray clay parting at 2041.2 feet	2039.0-2041.9
Halite, white to moderate-orange-pink, polyhalitic, contains scattered blebs and stringers of polyhalite, bands of buff polyhalite at 2050.6, 2051.4, 2051.8, 2052.1, and 2053.0 feet	2041.9-2053.6
Polyhalite, buff; contains a few inclusions of halite	2053.6-2054.4
Halite, moderate-orange-pink to moderate-pink, polyhalitic; contains stringers and seams of buff to moderate-pink polyhalite, (15%)	2054.4-2055.8
Anhydrite, gray; halite pseudomorphs after gypsum, completely replaced by pink polyhalite in upper 0.5 feet; 0.4-foot-thick bed of gray shale at base	2055.8-2057.5
Halite, gray, argillaceous; 5% in inclusions of clay; prominent red polyhalite stringers at top intruding overlying shale	2057.5-2057.6
Halite, moderate-orange-pink, polyhalitic; 2% in moderate-orange-pink to red polyhalite blebs	2057.6-2058.6
Halite, gray, argillaceous; 3% in inclusions of dark red clay, dark gray clay parting at top	2058.6-2061.3
Halite, white to pale-red, polyhalitic; 5% in stringers and masses of polyhalite in 0.2-foot-thick zone at 2061.8 feet, 40% in stringers and seams of red polyhalite in 0.4-foot-thick zone at 2062.8 feet	2061.3-2064.8

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray, argillaceous; 2% in inclusions of dark gray clay; contains a few small blebs of amber polyhalite	2064.8-2068.6
Halite, gray, argillaceous; some clay inclusions; 1% in moderate-orange-pink polyhalite blebs	2068.6-2073.4
Halite, moderate-orange-pink, polyhalitic; 3% in stringers of moderate-orange-pink polyhalite	2073.4-2078.3
Halite, same in unit 2073.4-2078.3	2078.3-2080.2
Polyhalite, red, dense, and anhydrite, gray, dense; 25% halite from 2080.5-2080.8 feet; polyhalite concentrated in upper 0.2 feet and in a 1.3-foot-thick zone below 2080.8 feet	2080.2-2082.6
Halite, gray, schistose and argillaceous; 5% in inclusions of gray clay	2082.6-2082.8
Clay, gray, halitic; 10% halite crystals	2082.8-2083.2
Halite, gray, argillaceous; 2% in inclusions of gray clay at top decreasing downward to zero at the base, few patches of moderate-orange-pink halite containing disseminated polyhalite in upper 1.2 feet; contains a gray clay parting at 2084.5 feet	2083.2-2086.0
Halite, moderate-orange-pink to polyhalitic; 1% in stringers of polyhalite with 5% of the polyhalite concentrated in basal 0.3 feet	2086.0-2088.2
Halite, gray, argillaceous; 10% in inclusions of gray clay at top decreasing downward to zero at base; gray clay parting at top	2088.2-2089.2
Halite, light-orange, polyhalitic; 1% in stringers and blebs of polyhalite	2089.2-2091.1
Halite, gray, argillaceous; 5% in inclusions of gray clay; gray clay parting at 2091.5 feet	2091.1-2091.6
Halite, orange, polyhalitic; 2% in stringers and blebs of polyhalite	2091.6-2092.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray, argillaceous; 5% in inclusions of gray clay	2092.2-2092.4
Halite, grayish-pink to light-orange, polyhalitic; 5% polyhalite in upper 0.1 feet and lower 0.2 feet	2092.4-2093.2
Halite, gray and moderate-orange-pink, argillaceous and polyhalitic; 1% in inclusions of gray clay; contains 2% in stringers of amber polyhalite; gray clay parting at top and at 2094.0 feet	2093.2-2095.0
Halite, transparent to light-amber, polyhalitic; contains stringers of polyhalite concentrated in 0.1-foot-thick zone at top and at 2095.3, 2095.8, and 2096.2 feet	2095.0-2097.0
Anhydrite, gray, dense, massive; 5% in halite inclusions in upper 0.3 feet; contains layered units of halite pseudomorphs after gypsum at 2097.8, 2099.0 feet and at 2103.5-2104.0 feet; anhydrite is mostly massive, but with magnesite laminae below 2104.0 feet	2097.0-2109.0
Clay, gray, halitic; contains crystals and veins of halite	2109.0-2109.2
Halite, gray, anhydritic; 0.05-foot-thick anhydrite seams throughout; 30% anhydrite	2109.2-2109.4
Halite, gray, very slightly argillaceous and anhydritic	2109.4-2113.3
Halite, moderate-orange-pink to light-gray; contains a trace of inclusions of gray clay in upper 0.6 feet; 5% gray anhydrite at 2115.2-2115.6 feet	2113.3-2116.3
Halite, gray, slightly argillaceous and anhydritic	2116.3-2118.4
Halite, light-gray to buff, anhydritic; contains thin stringers of gray anhydrite, 0.1-foot-thick gray, dense anhydrite zone at 2122.1 feet and 0.05 foot thick anhydrite zones at 2123.4, 2124.5, 2125.1, and 2125.2 feet	2118.4-2125.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, gray, dense; 10% in halite inclusions	2125.6-2125.8
Halite, gray to moderate-orange-pink; 20% in inclusions of gray clay in upper 0.6 feet, gray clay parting at top	2125.8-2126.5
Halite, gray and brown, argillaceous; 1% in inclusions of gray and brown clay; brown clay parting at top and at 2130.5 feet	2126.5-2132.0
Halite, brown, argillaceous; 5% in inclusions of brown clay; contains a few small blebs of red polyhalite; brown clay partings at top and at 2133.3 and 2134.2 feet	2132.0-2135.5
Halite, brown, argillaceous; 2% in inclusions of brown clay	2135.5-2136.6
Halite, gray to brown, contains a trace of inclusions of brown clay; blebs of red polyhalite	2136.6-2138.6
Halite, brown, argillaceous; 2% in inclusions of brown clay, 1% in blebs of orange polyhalite; brown clay parting at top	2138.6-2139.9
Halite, light-brown, argillaceous; 2% in inclusions of brown clay, decreasing to zero at base; 5% in stringers of polyhalite in top 1.0 foot, less than 1% in stringers of polyhalite in lower 1.0 foot	2139.9-2144.7
Halite, light-orange, polyhalitic; contains stringers of polyhalite	2144.7-2146.0
Halite, brown and gray, argillaceous; 25% massive brown and red polyhalite in upper 0.3 feet; 5% in inclusions of brown and gray clay in remainder of unit	2146.0-2147.5
Halite, light-orange, polyhalitic; 2% in stringers of polyhalite	2147.5-2149.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown and gray, argillaceous; 10% in brown clay in upper 0.6 feet decreasing to zero at base of unit; 2% in stringers of orange polyhalite in lower 1.0 feet; contains a few blebs of polyhalite in upper part of unit; brown clay parting at top and at 2150.5 feet	2149.5-2156.0
Halite, orange, polyhalitic; 2% in stringers of orange polyhalite; gray clay parting at 2158.0 feet	2156.0-2158.5
Halite and polyhalite, light-red; polyhalite appears in seams, stringers and irregular masses scattered throughout unit; a 0.2-foot-thick white saccaroidal mineral (unidentified) appears 1.5 feet below top of unit; 50% polyhalite, 10% unknown mineral	2158.5-2160.5
Halite, light-gray to moderate-orange-pink	2160.5-2161.0
Anhydrite and polyhalite; anhydrite gray, dense, shows varying stages of replacement by red, dense, polyhalite; lower 1.0 foot of unit is free of polyhalite	2161.0-2168.0
Shale, gray, and anhydrite; 15% anhydrite lenses, possibly magnesitic or silty	2168.0-2168.5
Halite, gray, argillaceous; 1% in inclusions of gray clay; 1% in stringers of moderate-orange-pink polyhalite	2168.5-2169.7
Halite, moderate-orange-pink, polyhalitic; contains stringers of red polyhalite	2169.7-2170.7
Halite, gray, argillaceous; 2% clay in upper 0.5 feet, 1% in inclusions of clay from 2170.7-2175.5 feet; trace of clay in remainder of unit; contains a few scattered blebs of red polyhalite	2170.7-2177.5
Halite, white to grayish-orange-pink, anhydritic; contains stringers of anhydrite in a 0.2-foot-thick zone at 2178.9 feet; seamlets of anhydrite appear at 2180.1 and 2181.0 feet; few blebs of polyhalite appear in a 0.5-foot-thick zone at 2179.7 feet and in lower 0.5 feet of unit	2177.5-2183.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray and moderate-orange-pink, argillaceous and polyhalitic; 3% in inclusions of gray clay in upper 0.8 feet, 2% in blebs of red polyhalite throughout unit	2183.0-2184.3
Halite, light-brown, argillaceous; 1% in inclusions of brown clay	2184.3-2194.5
Halite, brown, argillaceous; 5% in inclusions of brown clay, brown clay parting at top, at 2196.0-2197.9 and 2198.5 feet	2194.5-2199.5
Halite, gray and brown, argillaceous; 1% gray and brown clay	2199.5-2200.0
Halite, gray, anhydritic and slightly argillaceous	2200.0-2200.7
Halite, brown; 3% brown clay inclusions and small blebs of gray anhydrite	2200.7-2203.9
Halite, same as in unit 2200.7-2203.9 feet; brown clay disappears toward base of unit; anhydrite stringers appear in lower 3.0 feet	2203.9-2209.6
Halite, brown; 25% in inclusions of brown clay; contains clay partings at 2210.6 and 2211.6	2209.6-2211.6
Halite, same as in unit 2209.6-2211.6, but less argillaceous and anhydritic	2211.6-2214.8
Halite, brown, argillaceous; 40% brown clay in upper 0.2 feet decreasing to 0 at base; contains a few gray anhydrite stringers	2214.8-2216.6
Halite, gray; contains a 0.1-foot anhydrite stringer at 2218.0 feet	2216.6-2219.3
Anhydrite, gray, dense	2219.3-2219.6
Halite, brown, argillaceous; brown clay partings at top and at 2222.3 feet; 5% in brown clay inclusions	2219.6-2222.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light brown to gray; contains a trace of brown clay inclusions and gray anhydrite stringers	2222.3-2224.7
Halite, brown, argillaceous; 3% in brown clay inclusions and brown clay parting at top; 0.2 foot of recrystallized halite appears at 2225.3 feet	2224.7-2226.3
Halite, gray to light brown; contains sparse stringers of gray anhydrite; 1% brown clay inclusions in upper 0.6 feet	2226.3-2230.0
Halite, light-brown; 2% in brown clay inclusions and a 0.5-foot brown clay parting at top	2230.0-2234.8
Halite, buff, anhydritic and very sparsely polyhalitic; 10% in gray anhydrite stringers in seams in the lower 0.2 foot of the unit	2234.8-2237.9
Halite, brown; 2% brown clay inclusions and a gray clay parting at top	2237.9-2239.8
Halite, buff and light-red, anhydritic and polyhalitic; slight concentrations of polyhalite stringers 0.1 foot thick at 0.3-0.5-foot intervals; contains brown and gray clay inclusions in lower 0.5 feet	2239.8-2246.7
Halite, brown and light-red, argillaceous and sparingly polyhalitic; 1% in brown and gray clay inclusions and scattered polyhalite blebs; gray clay parting at top and brown clay parting at 2247.8 feet	2246.7-2247.9
Halite, amber, polyhalitic; 10% in amber polyhalite stringers	2247.9-2250.6
Halite, gray and brown, argillaceous; 2% in brown and gray clay inclusions; contains a dark-gray clay parting at top, and a few stringers of amber polyhalite	2250.6-2254.0
Halite, amber to light-brown, polyhalitic; 2% in stringers of amber polyhalite; 1% in brown clay inclusions	2254.0-2255.8

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray and brown, argillaceous; 2% in gray clay inclusions in upper 0.5 foot; gray clay partings at top and at 2256.3 feet, brown clay inclusions throughout remainder of unit; contains a few polyhalite blebs and in upper 0.5 foot, 2257.0-2257.5, and 2259.8-2260.8 feet; gray clay parting at base of unit	2255.8-2262.8
Halite, reddish-orange, polyhalitic; 2% in blebs and stringers of red polyhalite at top, increasing to 15% at base of unit	2262.8-2265.3
Anhydrite, gray, dense, halitic; halite pseudomorphs after gypsum appear throughout unit; contains a 0.2-foot band of red polyhalite at top, and a gray clay parting at base	2265.3-2267.5
Halite, orange, polyhalitic; 5% in polyhalite stringers, unit is banded with gray argillaceous halite in the top 0.4 foot, 0.2 foot at 2268.4, 0.5 foot at 2272.9, 0.3 foot at 2274.7, 1.0 foot at 2275.8-2276.4 feet; green clay parting at 2277.2 feet	2267.5-2277.5
Halite, gray, argillaceous; 3% in gray clay inclusions in upper 2.5 feet decreasing to zero at base; small patches of orange polyhalite appear in upper 1.5 feet; 5% in polyhalite stringers in lower 1.2 feet	2277.5-2282.2
Halite, orange, polyhalitic; prominent stringers and masses of red polyhalite comprise approximately 10% of unit	2282.2-2285.8
Halite, gray, argillaceous; 2% in light-greenish-gray clay inclusions	2285.8-2286.3
Halite, light-red, polyhalitic; 2% in polyhalite stringers and masses	2286.3-2287.3
Halite, gray, argillaceous; 2% in gray-brown clay inclusions; contains a few small patches of light-red polyhalite	2287.3-2293.7
Halite, gray and light-red, polyhalitic and argillaceous; 2% brown and gray clay in upper 1.1 feet; 2% polyhalite stringers throughout	2293.7-2296.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, gray and light-orange, argillaceous; 1% in inclusions of gray clay and blebs of red polyhalite	2296.6-2300.2
Halite, light-red, polyhalitic; 15% in polyhalite stringers in masses in lower 0.5 foot	2300.2-2301.7
Anhydrite, gray, dense; contains 0.1 foot of gray halite at 2301.8 feet	2301.7-2302.8
Polyhalite, red to buff; contains rare halite inclusions and many dense gray anhydrite remnants	2302.8-2314.2
Anhydrite, gray, dense; 20% in halite inclusions in a 0.3 foot zone at 2314.4 feet	2314.2-2314.9
Claystone, gray	2314.9-2315.3
Anhydrite, gray, dense and massive	2315.3-2316.4
Claystone, gray	2316.4-2316.6
Halite, gray, argillaceous; 3% in gray clay inclusions	2316.6-2317.4
Halite, light-orange, polyhalitic; 1% in orange polyhalite stringers and blebs, and 25% gray anhydrite in a 0.1-foot band at 2218.9 feet	2317.4-2319.8
Halite, brown and gray, argillaceous; 25% brown clay in upper 0.3 foot, 7% brown and gray clay in the remainder of unit; brown clay parting at top; contains a few blebs of reddish-orange polyhalite	2319.8-2323.1
Halite, red, polyhalitic; 5% polyhalite in upper 0.4 foot and lower 0.4 foot	2323.1-2324.1
Halite, brown and gray, argillaceous; 5% in brown and gray clay inclusions	2324.1-2324.6
Halite, brown, argillaceous; 2% in brown clay inclusions; contains 0.3-0.5-foot bands of orange polyhalitic halite at intervals of 0.5 feet	2324.6-2327.4
Halite, light-reddish-orange, polyhalitic; 2% in red polyhalite blebs in lower 0.4 foot	2327.4-2328.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, argillaceous; 5% in brown clay inclusions and clay a parting at 2328.6 feet	2328.5-2329.6
Halite, light-red; contains a trace of inclusions of brown clay	2329.6-2330.6
Halite, brown, argillaceous; 2% in brown clay inclusions	2330.6-2330.9
Halite, reddish-orange, polyhalitic; 10% in red polyhalite stringers containing 1% gray clay in lower 1.0 foot	2330.9-2335.0
Halite, light-red to light-gray, sparingly argillaceous; contains scarce blebs of red polyhalite	2335.0-2336.5
Halite, brown, argillaceous; 5% in brown clay inclusions	2336.5-2338.0
Halite, gray to light-brown, sparingly argillaceous; contains a few red polyhalite blebs	2338.0-2342.3
Halite, gray and brown, argillaceous; 2% in brown clay inclusions	2342.3-2344.6
Halite, light-gray and brown, argillaceous; 2% in brown clay inclusions from 2345.4-2345.9 and from 2346.6-2346.8 feet	2344.6-2347.1
Halite, light-gray and pale-orange; 1% in gray clay inclusions and stringers of orange polyhalite	2347.1-2351.8
Halite, brown, argillaceous; 5% in brown clay inclusions in upper 0.8 foot and brown clay parting at 2352.5 feet; 2% gray and brown clay in remainder of unit	2351.8-2354.2
Halite, brown, argillaceous; 2% in brown clay inclusions; dotted with patches of red-orange halite containing red polyhalite stringers and blebs	2354.2-2355.9
Halite, brown, argillaceous; 2% in brown clay inclusions	2355.9-2357.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, brown, argillaceous and polyhalitic; banded with 0.4-foot seams of orange polyhalitic halite at 0.5 foot intervals	2357.5-2360.2
Halite, pale-orange; sparingly polyhalitic	2360.2-2361.5
Glauberitic halite, red and gray; euhedral crystals in crystal masses and bands, (20%)	2361.5-2362.6
Anhydrite, gray, dense; with 0.2-foot seams of halite pseudomorphs after gypsum 0.2-0.3 foot apart; 25% glauberite crystals in lower 0.6 foot, some crystals cutting into halite pseudomorphs after gypsum	2362.6-2364.5
Claystone, gray; contains crystal clusters of glauberite	2364.5-2364.7
Halite, brown and gray, argillaceous; brown and gray clay parting at 2362.5 and 2363.7 feet; 7% in brown and gray clay inclusions, and a few blebs of gray anhydrite	2364.7-2384.0
Halite, same as in unit at 2364.7-2384.0 feet	2384.0-2394.6
Halite, gray, glauberitic; 5% in scattered crystals of gray to pink glauberite	2394.6-2400.2
Anhydrite, gray, dense, halitic; 25% in halite inclusions from 2400.2-2400.4 feet; 5% halite pseudomorphs after gypsum 2400.6-2401.4 feet; 20% layered halite pseudomorphs after gypsum 2402.1-2402.4; anhydrite replaced by crystals and crystalline masses of gray to pink glauberite below 2402.8 feet	2400.2-2406.5
Halite, gray to light-red; contains 0.8 to 1.2-foot intervals alternately rich in clay and in light-red to pink glauberite; clay units comprise 2% of unit, glauberite averages about 2%	2406.5-2434.4
Halite, gray, argillaceous; 5% in gray clay inclusions, 2% gray to pink glauberite crystals and crystal clusters	2434.4-2437.8

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light-red to light-gray, glauberitic; 5% in crystals and masses of pink to gray glauberite at 2438.0-2438.2 and at 2441.5 feet; 25% maroon glauberite in a 0.2-foot zone coating the top of the underlying anhydrite unit	2437.8-2441.8
Anhydrite, gray, dense, halitic and argillaceous; 20% in irregular masses of halite and gray clay inclusions	2441.8-2442.3
Halite, gray and brown, argillaceous; 5% in gray and brown clay inclusions; gray and brown clay parting at 2443.8 feet	2442.3-2444.1
Halite, gray, anhydritic; 2% in gray anhydrite masses; contains a trace of gray clay inclusions in the upper 1.0 foot	2444.1-2445.1
Halite, same as in unit at 2444.1-2445.1 feet	2445.1-2446.1
Anhydrite, gray, dense, halitic; 10% in halite inclusions; contains a 0.05-foot thick halite-filled fracture roughly parallel to bedding and a gray clay parting at base	2446.1-2447.5
Halite, gray, anhydritic; 2% in irregular seams and stringers of gray anhydrite; contains a trace of gray clay inclusions in upper 0.5 foot	2447.5-2451.7
Halite, gray, anhydritic; 50% in gray anhydrite seams and stringers in upper 0.3 foot and 10% in lower 0.5 foot	2451.7-2453.0
Anhydrite, gray, dense, halitic; 10% in halite inclusions in upper 0.5 foot; laminated in lower 0.8 foot; gray clay parting at base	2453.0-2455.6
Halite, gray, argillaceous; 2% in gray clay inclusions and a few stringers of gray anhydrite	2455.6-2457.8
Halite, alternately light and darker gray, anhydritic and argillaceous; banded in 0.6-1.0-foot layers; anhydritic unit 1-2% anhydrite; argillaceous units 2-3% gray clay inclusions	2457.8-2464.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light-gray to white, anhydritic; 2% in anhydrite seams and stringers in 0.2 foot zones 0.5 foot apart; contains a 0.5-foot gray anhydrite seam at 2467.4 feet	2464.6-2467.8
Anhydrite, gray, dense; gray clay parting at base, 15% in halite pseudomorphs after gypsum in the upper 0.3 foot	2467.8-2468.3
Halite, gray, argillaceous; banded in 0.6-1.0-foot layers of lighter and darker shades of gray; clay content ranges from 1% in light layers to 3-4 % in darker layers; a few small blebs of gray anhydrite appear in places	2468.3-2475.7
Halite, white to light-gray, anhydritic; 2% in gray anhydrite stringers from 2478.0-2479.3 feet	2475.7-2480.2
Anhydrite, gray, dense, massive in lower half; abundant halite inclusions (50%) in upper half of gray clay parting at base	2480.2-2480.9
Halite, gray, argillaceous; banded in 0.2-0.6-foot zones containing 2% clay alternating with 0.5-foot intervals carrying a trace of clay	2480.9-2484.4
Halite, light and dark-gray, anhydritic; banded with lighter-gray layers containing stringers of gray anhydrite, alternating with darker gray layers 0.2-0.4 foot in thickness containing 2% gray clay	2484.4-2488.4
Halite, white and gray, anhydritic; 2% in seams and stringers of gray anhydrite throughout	2488.4-2492.8
Anhydrite, light-gray, dense, halitic; contains 25% cubic and rectangular halite crystals, and gray clay inclusions in seams at base; lower contact dips as much as 30°	2492.8-2493.2
Halite, banded alternately light and dark-gray; 0.2-0.4-foot darker layers contain 2% gray clay; lighter gray layers contain trace of gray clay and stringers of gray anhydrite	2493.2-2503.7

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, light-gray, anhydritic; contains a few stringers of gray anhydrite	2503.7-2507.2
Halite, light and dark gray; banded with 0.5-1.0-foot light-gray anhydrite layers alternating with dark-gray argillaceous layers 0.3-0.5 foot thick; contains sparse anhydrite stringers; 2% gray clay inclusions	2507.2-2517.1
Halite, gray, anhydritic and argillaceous; 5% to 25% in prominent stringers and masses of gray argillaceous anhydrite	2517.1-2520.0
Anhydrite, gray, dense, massive; 5% in halite pseudomorphs after gypsum at 2523.3-2529.6 feet	2520.0-2529.6
Anhydrite, gray, dense; much of anhydrite is halite pseudomorphs after gypsum; contains a trace of magnesite	2529.6-2535.5
Magnesite, gray, dense; 25% in laths of anhydrite	2535.5-2536.7
Clay, gray, magnesitic; 40% in gray anhydrite nodules at 2537.3-2538.0	2536.7-2539.0
Halite, banded with light-gray and darker gray to brown layers 0.2-0.5 foot thick; lighter-gray layers are anhydritic; darker-gray to brown layers are argillaceous with 2% in gray to brown clay inclusions, 25% in prominent blebs and stringers of gray anhydrite in the lower 0.1 foot	2539.0-2567.2
Halite, same as in unit at 2539.0-2567.2 feet; bands vary in thickness from 0.1-0.5 foot; gray clay parting at 2626.2 feet	2567.2-2628.1
Halite, banded in white and light-gray layers 0.5-0.8 foot thick; consists of alternating bands of argillaceous and anhydritic halite; argillaceous bands contain approximately 2% in clay inclusions	2628.1-2634.2
Halite, gray to light-brown, argillaceous; 2% in brown and gray clay inclusions, and a few stringers of gray anhydrite	2634.2-2638.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, very light-gray, anhydritic; 10% in prominent irregular masses of gray anhydrite partially altered to light-red glauberite; contains a few irregular patches of gray argillaceous halite	2638.6-2641.6
Halite, gray, argillaceous; 15% in gray clay seams and masses in the upper 0.3 foot, and 1% in gray inclusions in seams spaced about 0.1 foot apart through much of the lower interval; 0.1-foot thick dense gray anhydrite band at 2644.4 feet	2641.6-2644.4
Halite, gray, very anhydritic and sparingly argillaceous; 15% in prominent stringers and masses of gray anhydrite;contains sparse inclusions of gray and brown clay from 2638.6-2648.6 feet; halite is extensively recrystallized, appearing to be bent in a recumbent fold with nearly horizontal axis	2644.4-2648.6
Halite, white, anhydritic; 1% in anhydrite stringers in 0.05-foot seamlets at 2649.4, 2650.4, and 2651.0 feet	2648.6-2651.6
Anhydrite, gray, dense, massive; 0.2-foot zone of layered halite pseudomorphs after gypsum at 2651.9 feet and a 0.1 foot gray clay seam at base; halite pseudomorphs after gypsum oriented vertically	2651.6-2652.9
Halite, banded in white, very-light-gray and medium-gray in 0.2-0.5-foot-thick layers; darker layers are argillaceous, containing 2% clay; lighter layers sparingly anhydritic; bulk of halite grains are spindle-like and have long axis subhorizontal; rock is dominantly schistose with patches of equigranular texture only at long intervals; clay filmlets 0.04 inch or less thick are essentially horizontal to subhorizontal, the filmlets in the lower sections of the unit vary in dip between 30° and horizontal	2652.9-2691.0
Halite, same as in unit from 2652.9-2691.0 feet; some sections weakly schistose; other sections are generally equigranular	2691.0-2752.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite same as in unit 2652.9-2691.0 feet; 3% in gray clay inclusions; contains anhydrite stringers from 2766.9-2767.3, 2768.8-2769.1 and 2778.9-2779.0 feet	2752.3-2779.0
Halite, white; banded with gray argillaceous layers 0.1-0.2 foot thick containing less than 1% gray clay; much of the halite contains remnants of primary halite crystals	2779.0-2783.0
Halite, banded white and gray; contains gray argillaceous layers 0.1-0.4 foot thick alternating with white layers containing remnants of primary halite crystals and sparse stringers of white anhydrite; gray clay parting at 2783.0 feet	2783.0-2795.4
Halite, gray, argillaceous; 2% in gray clay inclusions and a gray clay parting at base	2795.4-2796.7
Halite, white, anhydritic; banded with gray argillaceous layers 0.2-0.4 foot thick; clay in anhydrite less than 2%; much halite contains remnants of primary halite crystals	2797.7-2804.4
Halite, light-gray, anhydritic and argillaceous; 15% in gray anhydrite masses in upper 0.4 feet; 4% gray anhydrite in gray clay below upper 0.4 feet, grading to less than 1% at base	2804.4-2807.6
Halite, white; banded with 0.1-foot layers of gray argillaceous halite at 0.1-0.3-foot intervals; much of the white halite contains remnants of primary halite crystals	2807.6-2813.2
Halite, same as in unit from 2807.6-2813.2 feet	2813.2-2823.9
Halite, white to transparent with rare seams and blebs of white anhydrite; much of halite in units between anhydrite layers contains remnants of primary halite crystals; very faintly fetid	2823.9-2828.5
Halite, gray, anhydritic; multiple seams and stringers of gray anhydrite make up 40% of unit; gray clay inclusions in massive anhydrite at base of unit	2828.5-2828.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, banded in light-gray and white layers 0.1-0.5 foot thick; 1-2% in inclusions of gray clay in gray layers; contains a seams and stringers of gray to white anhydrite; much halite in white layers contains remnants of primary halite crystals; fetid odor at 2861.0 feet	2828.9-2874.8
Halite, same as in unit 2828.9-2874.8 feet	2874.8-2882.8
Anhydrite, white, dense; contains stringers and masses with 20% in halite inclusions	2882.8-2883.0
Halite, light-gray, argillaceous; 2% in stringers of anhydrite and clay inclusions	2883.0-2884.3
Halite, same as in unit 2828.9-2874.8 feet	2884.3-2892.5
Halite, mottled and faintly banded very light and dark-gray; sparingly anhydritic; contains scattered recrystallized halite, and some remnants of primary crystals; 15% narrow seams and stringers of anhydrite from 2894.4-2895.0 feet	2892.5-2900.5
Anhydrite, white to very light-gray, massive, dense; 40% halite inclusions from 2903.0-2903.3 feet	2900.5-2903.6
Halite, white to very-light-gray, anhydritic; 50% in anhydrite/halite seams at 2904.2 feet	2903.6-2904.8
Anhydrite, white to very-light-gray, dense, massive; 20% in halite inclusions in upper 0.3 feet and in lower 0.3 feet	2904.8-2908.1
Halite, white to very-light-gray, sparingly anhydritic; seamlets of anhydrite at 2908.8-2909.2, 2911.6-2911.7 and 2914.4-2914.5 feet	2908.1-2914.7
Anhydrite, white to very-light-gray, dense, massive	2914.7-2917.1
Halite, white to very-light-gray, sparingly anhydritic; contains very minute filmlets of white anhydrite	2917.1-2918.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, white to very-light-gray, dense, massive; sparingly magnesitic; contains sparse halite pseudomorphs after gypsum from 2919.6-2920.6 feet	2918.6-2928.2
Halite, white to very-light-gray, anhydritic; 50% in dense gray anhydrite seams at 2929.4-2929.6 and 25% folded and buckled seams of anhydrite at 2930.2	2928.2-2931.6
Anhydrite, white to very-light-gray, massive, very sparingly magnesitic; contains 2% in halite inclusions in the lower 0.3 feet	2931.6-2932.5
Halite, white to very-light-gray, anhydritic; 50% gray to white anhydrite in 0.05-0.1-foot seams from 2933.1-2933.4 feet; white halite contains remnants of primary halite crystals	2932.5-2934.0
Anhydrite, gray to white to light-gray, dense, massive to faintly laminated; contains a trace of magnesite	2934.0-2937.9
Anhydrite, gray to white, dense, massive; contains subhorizontal seamlets of halite and occasional halite inclusions	2937.9-2942.0
Halite, light-gray to white, anhydritic; contains irregular masses of gray, dense anhydrite; remnants of primary halite crystals	2942.0-2944.4
Anhydrite, light-gray to white, massive, dense, halitic; 25% in halite inclusions in upper 0.3 foot; much of rock gives off bituminous odor	2944.4-2966.0
Halite, gray, anhydritic; contains thin anhydrite seams and veins throughout	2966.0-2968.6
Halite, transparent to white; contains recrystallized masses and many short intervals of white halite partially consisting of remnants of primary halite crystals; rare white anhydrite inclusions through much of the unit, and 25% anhydrite stringers in the lower 0.6 foot concentrated on the borders of cubic halite crystals	2968.6-2973.8

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, light-gray to white, dense, halitic; 10% in halite inclusions 0.1 foot thick at 2978.6 feet; faint dark laminae from 2976.8-2980.5 and 2985.4-2985.7 feet; contains a 0.1-foot halite seam at 2979.5 feet; slight bituminous odor	2973.8-2985.7
Halite, white and light-gray; contains bands rich in remnants of primary halite crystals and sparse stringers of white anhydrite	2985.7-2989.4
Halite, transparent, recrystallized with gray anhydrite stringers separating individual grains	2989.4-2989.7
Anhydrite, gray, dense	2989.7-2990.0
Halite, white, very sparingly anhydritic; some sections rich in remnants of primary halite crystals	2990.0-2991.6
Halite, light-gray, anhydritic; contains many filaments of white anhydrite comprising about 5% of the rock	2991.6-2996.2
Anhydrite, light-gray to white, dense, massive	2996.2-2999.8
Anhydrite, white, massive, dense	2999.8-3003.4
Halite, white to very-light-gray; some primary halite crystals in anhydrite seams 0.05 and 0.1 foot thick, both containing minor halite inclusions	3003.4-3005.7
Anhydrite, light-gray, dense, with irregular dark bituminous(?) layers	3005.7-3006.2
Halite, light-gray and white, containing many remnant primary crystals; contains minor irregular seams of gray anhydrite	3006.2-3014.7
Anhydrite, gray to white; contains dark bituminous filmlets at 0.05-0.2-foot intervals between 3014.7-3019.6 and 3022.7-3024.7 feet; 0.05-foot-thick halite-filled fracture appears from 3017.8-3019.4 feet; faint petroleum odor	3014.7-3061.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, very-light-gray to white, dense, massive; essentially featureless; contains a dark-gray stylolitic parting at 3071.1 feet; bituminous coating	3061.3-3088.2
Anhydrite, light-gray, dense, with faint laminations of light and very-light-gray, gradually becoming more distinct downward; distinct bituminous odor; some sections of laminated rock contain dark bituminous coating below 3103.7 feet	3088.2-3112.8
Anhydrite, very-light-gray to white; faintly laminated with a 0.05-foot layer of halite pseudomorphs after gypsum	3112.8-3113.0
Halite, transparent, banded with anhydritic layers composed of closely packed, nearly vertical halite pseudomorphs after gypsum 0.1-0.3 foot apart and 0.1 foot thick; massive anhydrite bands and pseudomorph layers make up 95 percent of rock at 3115.0-3114.7 and 3116.7-3118.0 feet	3113.0-3118.7
Anhydrite, very-light-gray to white, dense, massive, alternating with layers of halite pseudomorphs after gypsum	3118.7-3119.8
Halite, transparent, banded with alternating anhydritic layers and layers of halite pseudomorphs after gypsum	3119.8-3122.1
Halite, transparent; contains anhydritic halite bands spaced 0.1-0.3 foot apart, and a few dense massive anhydrite seams; halite-filled fractures at 3134.5, 3137.2, and 3137.7 feet; halite pseudomorphs after gypsum common	3122.1-3147.9
Anhydrite, very-light-gray to white, dense, massive; faintly banded with halite inclusions in 0.05-foot seams in 0.1-foot intervals	3147.9-3153.5
Halite, transparent, overlying a 0.2-foot very-light-gray to white anhydrite band with feathery upper and lower contacts; anhydrite band is buckled into S-shaped folds	3153.5-3155.7

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, transparent to white, banded with 0.1 to 0.2 foot feathery bands of white anhydrite and halite pseudomorphs after gypsum spaced at 0.1-0.5-foot intervals; some bands are folded or cut by halite-filled fractures	3155.7-3182.9
Anhydrite, very-light-gray, dense, with dark bituminous layers 0.2-0.4 inch apart	3182.9-3190.6
Halite, colorless to white; banded with feathery white anhydritic layers composed of halite pseudomorphs after gypsum; pseudomorphic crystals are upright to 3205.7 feet, then inverted from 3213.7 to base of unit; axis of recumbent fold appears to be between 3205.7 and 3213.7 feet	3190.6-3227.2
Anhydrite, very-light-gray, dense; laminated with dark bituminous layers 0.2-0.4 inches apart	3227.2-3236.2
Halite, colorless to white; banded with feathery white anhydritic layers composed of halite pseudomorphs after gypsum; rock is folded; much of the halite is granular to slightly schistose; much of the banding is broken and contorted	3236.2-3246.9
Halite, same as in unit 3236.2-3246.9 feet; halite pseudomorphs after gypsum appear to be inverted	3246.9-3263.1
Anhydrite, light-gray to white, dense; very faintly and indistinctly laminated in light and slightly darker shades of gray; feathery halite pseudomorphs after gypsum appear to be inverted at top and base of unit	3263.1-3273.0
Halite, colorless to white; banded by feathery anhydritic layers 0.1 foot thick composed of vertically oriented halite pseudomorphs after gypsum; much of the halite is schistose with spindle-shaped crystals; very friable, banding is broken and bent in "S" and recumbent folds; repetition of beds seems prevalent throughout. Anhydritic layers in 3282.7-3284.7-foot interval alternate with halite layers 0.04 inch and less in thickness; this zone is about 85% anhydrite	3273.0-3303.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, same as in unit 3273.0-3303.5 feet	3303.5-3310.0
Anhydrite, very-light-gray, dense; faintly banded with very light shades of gray-white; contains a few faint bituminous layers dipping 60° between 3326.8 and 3328.5 feet; a stylolitic bituminous layer at 3349.9 feet dips about 15°	3310.0-3367.2
Anhydrite, very-light-gray to white, dense, massive, and featureless	3367.2-3427.7
Anhydrite, same as in unit 3367.2-3427.7 feet	3427.7-3490.0
Anhydrite, same as in unit 3367.2-3427.7 feet	3490.0-3499.5
Anhydrite, similar to that in unit 3367.2-3427.7 feet, but faintly banded with light and slightly darker shades of gray-white; banding is irregular	3499.5-3506.9
Halite, medium-gray, massive; contains broken fragments of laminated anhydrite 0.2-0.7 foot thick, floating in the halite matrix	3506.9-3529.1
Anhydrite, gray, dense, faintly banded in medium to darker shades of gray; scattered crystals of gray halite are common; upper and lower contacts dip 30°+	3529.1-3532.1
Halite, gray, anhydritic; anhydrite seams appear at 3532.7 and 3533.2 feet	3532.1-3533.3
Anhydrite, gray, dense, with irregular banding in medium and darker shades of gray	3533.3-3533.7
Halite, medium to dark-gray; contains sparse broken fragments of gray anhydrite in lower 1.5 feet; bituminous	3533.7-3538.0
Anhydrite, gray, dense; faintly banded and sheared; contains a few elongated inclusions of gray halite as thick as 0.2 feet	3538.0-3541.1
Halite, light-gray; contains broken fragments of gray anhydrite at center	3541.1-3541.9

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, gray, dense; contains elongated halite inclusions in upper 0.1 foot	3541.9-3542.3
Halite, same as in unit 3541.1-3541.9 feet	3542.3-3545.4
Anhydrite, same as in unit 3541.9-3542.3 feet	3545.4-3546.3
Halite, gray, anhydritic with broken seams and elongated stringers of gray anhydrite; contains a few patches of white halite with clear margins	3546.3-3551.1
Anhydrite, gray, dense with faint banding in medium and darker grays; rock contains 25-50% elongated halite inclusions in the upper 0.5 and lower 0.2 feet; unit dips 30°	3551.1-3551.4
Halite, same as in unit 3546.3-3551.1 feet	3551.4-3552.8
Anhydrite, light-gray, massive, dense, but faintly laminated with bituminous stringers between 3559.4 and 3562.4 feet; laminae dip about 30°	3552.8-3564.9
Anhydrite, gray; rock is nodular, gray in a matrix of slightly darker-gray argillaceous anhydrite ground mass	3564.9-3566.8
Anhydrite, gray, dense; faintly banded in medium-gray and slightly darker shades of gray; a 0.1-foot-thick layer of argillaceous anhydrite at base of unit dips 30-40°	3566.8-3578.2
Halite, medium-gray; contains gray anhydrite bands at 3581.3, 3582.7, 3583.2, 3583.7 and 3585.1 feet	3578.2-3588.2
Anhydrite, gray, dense, with faint bands of medium and slightly darker shades of gray; bands dip 35-40°; color becomes darker downward within unit	3588.2-3615.2
Anhydrite, medium gray, massive, dense; virtually featureless; contains a few clusters of euhedral crystals of unknown minerals at 3618.1-3620.0, 3623.0-3624.6, 3628.0-3630.5, 3637.5-3638.8, and 3642.9-3644.5 feet; anhydrite emits bituminous odor when struck	3615.2-3675.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, medium-gray, dense, with faint brown bituminous mottling and irregular banding; emits bituminous odor when struck; dip at 3710.5 feet is about 50°	3675.0-3736.1
Anhydrite, medium-gray, dense with some brown bituminous mottling and irregular brown partings at 3736.2-3739.5, 3744.5-3748.0, and 3770.5-3724.5 feet	3736.1-3797.2
Anhydrite, medium gray, alternately massive and faintly to irregularly banded with brown bituminous partings at intervals of 0.05 and 0.1 foot; massive units are as thick as 4 feet, lighter gray and free of bituminous odor; banded units are as thick as 3.0 feet; bands dip 35-40°	3797.2-3857.6
Anhydrite, medium gray, dense; faintly banded in darker shades of gray, with lighter layers free of bituminous odor; bituminous partings appear in 3857.0-3859.0, 3860.5-3861.7, 3867.0-3871.0, and 3874.5-3918.0-foot intervals	3857.7-3918.0
No descriptive data	3918.0-3924.0
Anhydrite, medium-light-gray (N6), with grayish-blue (5PB 3/2) tint, very dense, very finely crystalline; sinuous grayish-brown (5YR 3/2) calcitic laminations from 3924.0-3925.0 feet, 0.04 inch thick	3924.0-3925.4
Anhydrite, light-gray (N7), with light-olive-gray (5Y 6/1) tint, very dense, very finely crystalline, massive, with very faint laminations in parts; sinuous "hairline" laminations dipping 18-20° from 3932.2-3933.0 feet, with grayish-brown (5YR 3/2), calcitic filling; one of these bands, 0.05 foot thick, splits forming a "Y" with a 105° angle between the two branches at 3930.3 feet, the lower "fork" intersects the core with an angle of 60°	3925.4-3933.0
Anhydrite, same as unit 3925.4-3933.0 feet; sinuous grayish-brown (5YR 3/2), calcitic laminations 0.04 inch thick dip 33° at 3938.5-3940.0 feet; very concentrated, 0.04-0.1 inch apart, with 56° dip from 3941.0-3941.5 feet; some branching at 3942.3 feet, 41° dip from 3943.0-3943.2 feet, 27° dip from 3942.5-	

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
3944.7 feet, horizontal from 3944.7-3946.5 feet, 11° dip from 3944.7-3946.5 feet, 11° dip from 3946.5-3946.7 feet, 26-40° dip from 3952.0-3961.0 feet, 24° dip from 3961.0-3962.0 feet, 0-5° dip from 3968.5-3971.8 feet; faint laminations, some appear to be branching from 3971.8-3978.8 feet, some with 0-26° dip; mottled appearance with very-light-gray spots (N8), 0.08 to 0.6 inch in diameter from 3953.5-3958.5, 3959.9-3961.0 and 3966.2-3966.7 feet; irregular blotches, olive-gray (5Y 4/1), from 3944.2-3944.4 and 3946.8-3947.7 feet, covering entire half of core in width	3933.0-3978.8
No core	3978.8-3981.3
Anhydrite, dark-gray (N3) to grayish-black (N2), with grayish-blue (5PB 5/2) tint, very dense, very finely crystalline; some recrystallization with numerous sinuous bituminous and calcitic laminations which are micro- and some kink folded, 0.04 inch thick, generally with 0-39° dip from 3995.0-3996.0 and 4006.4-4009.0 feet, 0-3° dip from 4031.0-4033.0 feet, 37° dip from 4011.8-4015.7 feet, 20-32° dip from 4015.7-4024.0 feet, 21° dip from 4024.0-4031.0 feet; laminations with predominant kink folding from 3983.5-3984.0 feet dips, 48-50° from 3988.9-3989.5 feet, 23-25° from 3998.0-3998.9 feet; recrystallized anhydrite, light-olive-gray (5Y 6/1) and translucent, appears as irregular blotches from 3985.7-3985.9, 3983.0-3984.0, 3999.8-4000.0, 4009.0-4009.3, 4010.3-4020.5 and 4010.8-4011.1 feet	3981.3-4033.0
Anhydrite, same as unit at 3981.3-4033.0 feet; numerous sinuous laminations with kink and microfolding at random intervals throughout; laminae are calcitic, 0.04 inch thick, generally with 0-45° dip; some thin, irregular halite veining between bedding at 4054.0-4055.5 feet	4033.0-4055.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Halite, translucent to very-light-gray (N8), some light-gray (N7), finely crystalline; contains medium-gray (N5) halite bands 0.3-0.5 foot thick at intervals of 0.4-0.7 feet; some very-light gray (N8) to white (N9), highly folded or broken, slightly calcareous, 0.08-0.16-inch-thick anhydrite stringers, some with euhedral halite crystals at intervals 4057.0-4058.0, 4060.0-4061.0, 4062.7-4063.0, 4067.5-4069.0, 4072.0-4073.0, and 4076.0-4077.0 feet; contact between halite and anhydrite unit above is wavy and dips 45-50°	4055.0-4083.0
Halite, transparent to translucent with light-gray (N7) tint, medium crystalline, equigranular; slight tendency toward a horizontal elongation of crystals in parts; very-light-gray (N8) to light-gray (N7) anhydrite stringers appear throughout; these are very irregular, broken, distorted and twisted; band of 0.08-0.16 thick, light-gray (N7) to light-olive-gray (5Y 6/1) anhydrite laminae from 4089.7-4089.9 feet, these are broken but horizontal; halitic, laminated, light-olive-gray (5Y 6/1) anhydrite band dipping 17° from 4092.8-4093.0 feet, containing some euhedral halite crystals up to 0.2 inch across; halite is very clean, and contains very little anhydrite in 4112.0-4136.4 foot zone	4083.0-4136.3
Halite, white (N9) to light-gray (N7), translucent, finely crystalline, with very faint traces of white (N9) anhydrite blebs; few irregular blebs and stringers 0.04-0.12 inch thick at 0.6-1.0 foot intervals of white (N9) anhydrite from 4139.5-4139.6 feet; dispersed zones of halite, 0.1-0.4 foot thick, medium-light-gray (N6) to medium gray (N7), with irregular blebs and stringers of white (N9) anhydrite	4136.3-4174.1
Halite, translucent to transparent with light-gray (N7) tint, some parts medium-light-gray (N6), very coarsely crystalline, recrystallized	4174.1-4182.0
Halite, same as unit 4136.3-4174.1 feet	4182.0-4182.3
Anhydrite, medium-bluish-gray (5B 5/1) to grayish-blue (5PB 5/2), very finely crystalline, with sinuous, microfolded, moderate-yellowish-brown (5YR 5/4) calcitic laminations, dipping horizontal to 16°	4182.3-4184.1

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
No core	4184.1-4185.0
Anhydrite, olive-gray (5Y 4/1) and dark-gray (N3), with medium-bluish-gray (5B 5/1) tint, very finely crystalline; contains numerous sinuous brownish-gray (5YR 4/1), bituminous and calcitic laminations 0.04-0.06 inch thick, few dispersed bands, 0.12-0.06 inch thick, consistently dipping 0-4°, some as much as 13°; rounded anhydrite fragment at 4215.7 feet, rounded, 1.6 inch long by 2.7 inches wide, same as host rock without sinuous laminations; outer surface surrounded by 0.04 inch thick calcitic and bituminous material	4185.0-4235.0
Anhydrite, predominantly olive-gray (5Y 4/1), some approaching olive-black (5Y 2/1), some with medium-bluish-gray (5B 5/1) tint, very finely crystalline, very dense; predominantly massive; contains rare, faint, thin horizontal laminations	4235.0-4285.3
Anhydrite, olive-gray (5Y 4/1) to olive-black (5Y 2/1), very finely crystalline, very dense, with many thin, mostly horizontal, brownish-gray (5YR 4/1) laminae throughout, but more pronounced starting at 4315.0 feet	4285.3-4332.0
Anhydrite, same as unit 4285.3-4332.0 feet; contains many closely spaced thin, mostly horizontal (but few with approximately 5° dip), brownish-gray (5YR 4/1) laminae throughout; laminae are spaced into slightly wavy bands 0.2-0.6 inch thick from 4366.0-4370.0 feet	4332.0-4381.3
Anhydrite, olive-gray (5Y 4/1) and olive-black (5Y 2/1), laminated with brownish-gray (5YR 4/1) tint, very finely crystalline; contains a mottled, rounded "fragment" from 4400.4-4400.7 feet; 0.2 inch band of brownish-gray (5YR 4/1) anhydrite at 4398.6 feet	4381.3-4432.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Anhydrite, olive-gray (5Y 4/1) and olive-black (5Y 2/1), laminated with brownish-gray (5YR 4/1), finely to very finely crystalline; brownish-gray (5YR 4/1) laminae are generally calcareous; laminae in 4461.0-4483.0 foot zone are generally thicker, greater than 0.2 inch and less than 0.4 inch thick, above 4461.0 feet, laminae are 0.04-0.2 inch thick; minor oil seeping out of rock in lower 3 feet; probable open fractures at 4478.4, 4482.4, and 4482.9 feet, dipping 5-15°	4432.0-4483.0
Anhydrite, same as unit 4432.0-4483.0 feet; bluish-gray (5Y 4/1), slightly dolomitic; continuous 0.4-0.6 inch thick silt bands at 4484.3 and 4484.4 feet with 18° and 30° intersecting dips; contains recrystallized anhydrite, translucent with light-bluish-gray (5B 7/1) tint, 0.3-1.0 foot thick, with sections having a nodular appearance of 0.4-1.6 inch diameter rounded brownish-gray (5Y 4/1) "clasts" surrounded by bituminous laminations, or as homogeneous bands	4483.0-4531.0
Anhydrite, light-medium-gray (N6) and light-bluish-gray (5B 7/1), very finely crystalline and laminated in upper 0.5 foot; recrystallized, dense and nodular in lower 3.9 feet; pale-red (5R 6/2) outlines around nodules; contact at base with calcareous silt is angular and cuts across laminae of siltstone	4531.0-4535.5
Siltstone, grayish-black (N2), some laminae of light-olive-gray (5Y 5/2) seen on outside of core but not apparent inside; calcareous; oil seep on horizontal laminae at 4538.2 feet and on vertical healed fracture from 4537.8-4538.2 feet; core mostly very thinly laminated but 3538.4-3539.8 feet are thicker (0.4-1.6 inch) bands of black (N1) shale; black (N1) shale bands 0.1-0.4 inch thick also at 4563.7, 4565.1, 4565.6, 4566.0, 4566.5, 4567.6, 4567.9, and 4568.2 feet; laminae dips range from horizontal to 5°; core parts readily along laminar boundaries	4535.5-4582.2
Siltstone, olive-gray (5Y 4/1) to olive-black (5Y 2/1), calcareous, faintly laminated with grayish-black (N2) shale; light-olive-gray (5Y 5/2) rounded, irregular limestone clast at 4586.5 feet, 1.2 inch wide and 0.8 inch long	4582.2-4584.7

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Limestone, light-olive-gray (5Y 4/2), and silty limestone, olive-black (5Y 2/1), at irregular intervals of 0.2-1.5 feet, very finely crystalline; numerous wavy grayish-black (N2) shale laminae throughout, 0.04-0.16 inch thick and calcareous on parting surfaces; grayish-black (N2) rounded, silty limestone clasts at 4587.8, 4606.4 and 4609.7 feet, 0.4-1.2 inch diameter, in light-olive-gray (5Y 5/2) limestone; discontinuous fracture filled with calcareous silt at 4603.3 feet, with largest displacement 0.08 inch, dips 53°; numerous medium-light-gray (N6) limestone nodules from 4611.4-4611.9 feet, very irregular, less than 0.04-1.0 inch in diameter, recrystallized	4584.7-4613.3
Limestone, olive-gray (5Y 4/1) to light-olive-gray (5Y 4/2), similar to unit 4584.7-4613.3 feet, very finely crystalline, some silt; sinuous, brownish-black (5YR 2/1) discontinuous, shaly laminae, 0.04-0.12 inch thick	4613.3-4614.2
Shale, greenish-black (5GY 2/1), calcareous, dipping 10°	4614.2-4614.3
Siltstone, olive-gray (5Y 4/1), in parts grading to very fine-grained sandstone; contains faint horizontal shaly, olive-black (5Y 4/1) laminae; finely crystalline limestone "nodules" 0.4 inch in diameter, tend to be elongated horizontally from 4616.3-4617.0 feet	4614.3-4622.8
Limestone, light-olive-gray (5Y 5/2), very finely crystalline; contains darker olive-gray (5Y 3/2) shaly wavy and discontinuous, laminae, lying predominantly horizontally; silty in parts; traces of yellowish-gray (5Y 7/2) fossil fragments, 0.04-0.2 inch in diameter; some finely crystalline limestone nodules, 0.4-0.8 inch in diameter	4622.8-4633.3
Shale, olive-black (5Y 2/1), calcareous	4633.3-4633.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Sandstone, dark-green (5GY 4/1), very fine-grained, equigranular, slightly friable, slightly calcareous, predominantly massive, but some grayish-black (N2), shaly fragments and broken shaly laminae, possibly bioturbated; 4639.2-4642.2 feet is more massive, containing fewer shale fragments	4633.4-4663.5
Sandstone, silty; contains faint, horizontal, grayish-black (N2) laminae 0.04-0.12 inch thick; laminae more abundant from 4680.0-4680.6 feet	4663.5-4678.5
Siltstone, light-olive-gray (5Y 6/1), well consolidated, slightly calcareous, homogeneous, slightly sandy; contains irregular intervals 0.2-2.1 feet thick, of sandstone, same as unit 4633.4-4663.5 feet	4678.5-4714.9
Sandstone (65%), light-gray (N7) to medium-gray (N5), very fine-grained, subrounded to rounded, calcareous, poorly consolidated; contains calcareous, soft, light-gray (N7), siltstone (35%); trace of silty, very finely crystalline, olive-gray (5Y 4/1) to olive-black (5Y 2/1) limestone	4714.9-4727.9
Sandstone (90%), same as unit 4714.9-4727.9 feet; siltstone (10%), same as unit 4714.9-4727.9 feet; trace of limestone, same as unit 4714.9-4727.9 feet	4727.9-4731.9
	4731.9 T.D.

4.0 HYDROLOGY

Several drill-stem tests and hydraulic tests were performed in AEC 7 during the month of March 1974. The tests were performed and analyzed by G.A. Dinwiddie of the U.S. Geological Survey and the summary of results are reported in a memo from G.A. Dinwiddie to W.S. Twenhofel, July 10, 1974. The hole condition was open-hole to a total depth of 1006' below land surface.

Drill-stem tests were conducted across the Magenta and Culebra Dolomites and the Rustler-Salado Interface. The test across the Magenta estimates a water level of 486' below land surface (uncorrected) and a yield of 0.15 gpm. At the Culebra horizon a water level of 610' below land surface (uncorrected) and a yield of 0.15 gpm were determined. The Rustler-Salado test produced a depth to water of 838' below land surface (uncorrected) and a yield of 0.04 gpm.

A slug-test performed over the whole section, (41 to 1066') resulted in a transmissivity of 0.04 ft/day of the "saturated" section.

In 1979, drill-stem tests were conducted by the USGS in the Salado and Castile Formations and in the Bell Canyon sands. The tests conducted in the Bell Canyon sands produced the only pressure response which could be attributed to a fluid-bearing zone. Hydraulic conductivities of 4×10^{-2} ft/day were estimated (J.W. Mercer, 1983, in preparation).

5.0 REMARKS

The initial drilling by ORNL in 1974 did not reveal the structural problems later encountered by Sandia in ERDA 6. It appears that the initial drilling was stopped in an anhydrite bed which was believed to be the basal unit of the Castile. Deepening revealed a probable repeat.

Further testing of borehole plug properties in AEC 7 will be carried out by Sandia.

6.0 BIBLIOGRAPHY

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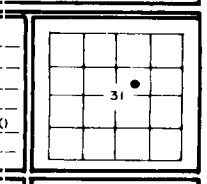
FIGURE 3
LITHOLOGIC AND GEOPHYSICAL LOGS OF AEC-7

U.S. GEOLOGICAL SURVEY
WELL RECORD

Company DEPARTMENT OF ENERGY
Well AEC-7
Sec. 31 Twp. 21S Rg. 32E
Location 2038.97' FNL & 2037.26' FEL
County LEA State NEW MEXICO
Area WIPP SITE



Log Measured From KELLY BUSHING +12.2 (Feet above or below datum)
Drilling Measured From KELLY BUSHING
Permanent Datum GROUND LEVEL

Elevation
KB 3667.74
DF 3666.74
GL 3655.54

Contractor CACTUS DRILLING CO. RIG 60
VERNA DRILLING CO. (RD, 1979)
Spud. MARCH 19, 1974 Comp. APRIL 18, 1974.
FEB. 27, 1979 APRIL 19, 1980 (TD)
TD 4731.9 FEET (BELOW K.B.)
Geologist(s) on well PETER J. STUBBS, C.L. JONES, S.L. DRELLACK JR., J. GONZALES, A.F. McINTYRE (1979).

Casing
Conductor 13 3/8" @ 490'
Surface 8 5/8" @ 1045.0'

Geologic Tops

Formation	Depth (ft)	Altitude (ft)
SANTA ROSA SANDSTONE	24.2	3631.3
DEWEY LAKE RED BEDS	133.0	3522.5
RUSTLER FM	675.0	2980.5
SALADO FM	1000.6	2654.9
CASTILE FM	3014.7	640.8
BELL CANYON FM	4535.3	-879.8

EXPLANATION

- MUDSTONE, CLAY SHALE
- SILTSTONE
- SANDSTONE
- ANHYDRITE
- GYPSUM
- HALITE
- POLYHALITE
- DOLOMITE
- CALICHE/LIMESTONE
- MAGNESITE
- POTASSIUM, MAGNESIUM SODIUM, AND CALCIUM SALTS
- CONGLOMERATE
- N.S. - NO SAMPLE (CORE OR CUTTINGS)

WOB WEIGHT ON BIT
RPM REVOLUTIONS PER MINUTE
PP PUMP PRESSURE (PSI)

MUD DATA
WT WEIGHT
VIS VISCOSITY
WL WATER LOSS/FILTRATE
CK (MUD) CAKE THICKNESS
CL CHLORIDE ION, PPM

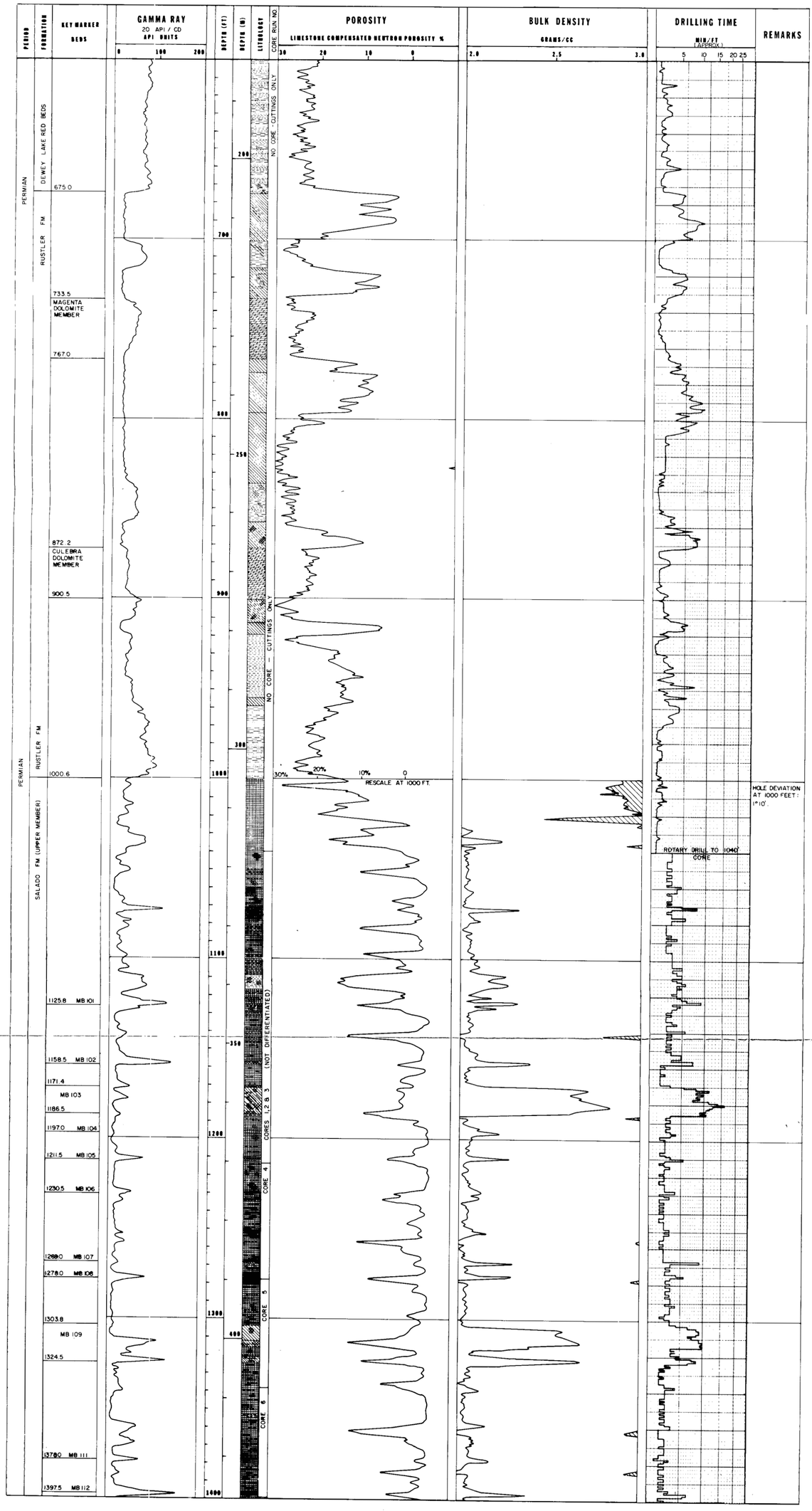
COMMENTS ON DRILLING FLUID IN REMARKS COLUMN TAKEN FROM DAILY DRILLING REPORT

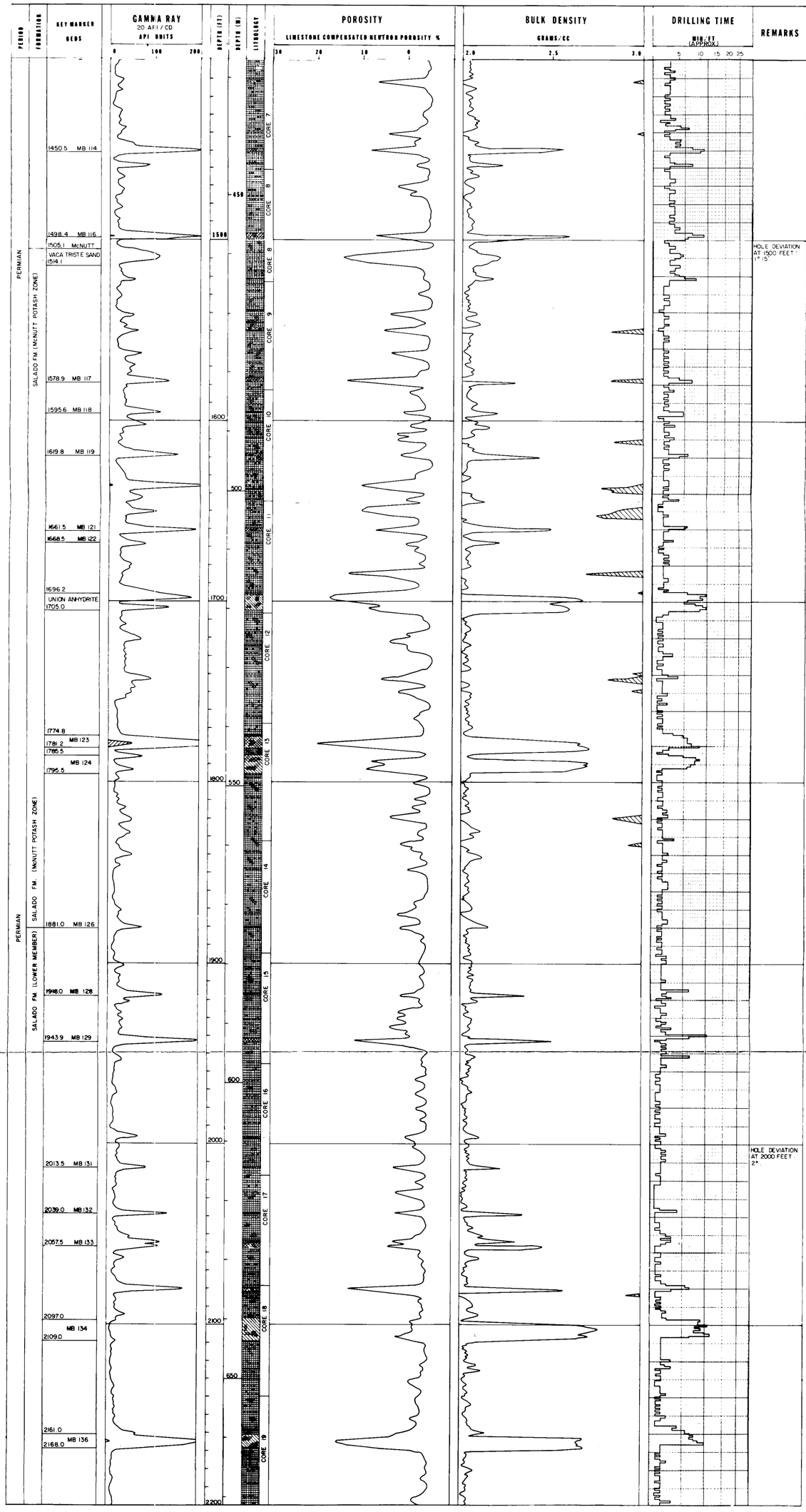
MUD TYPE (3926' - 4580')	MUD TYPE (4580' - 4731.9' TD)
SALT GEL	SALT GEL, MYLOGEL, IRONITE,
SODA ASH	CROMATE
CAUSTIC SODA, DRISPAC	

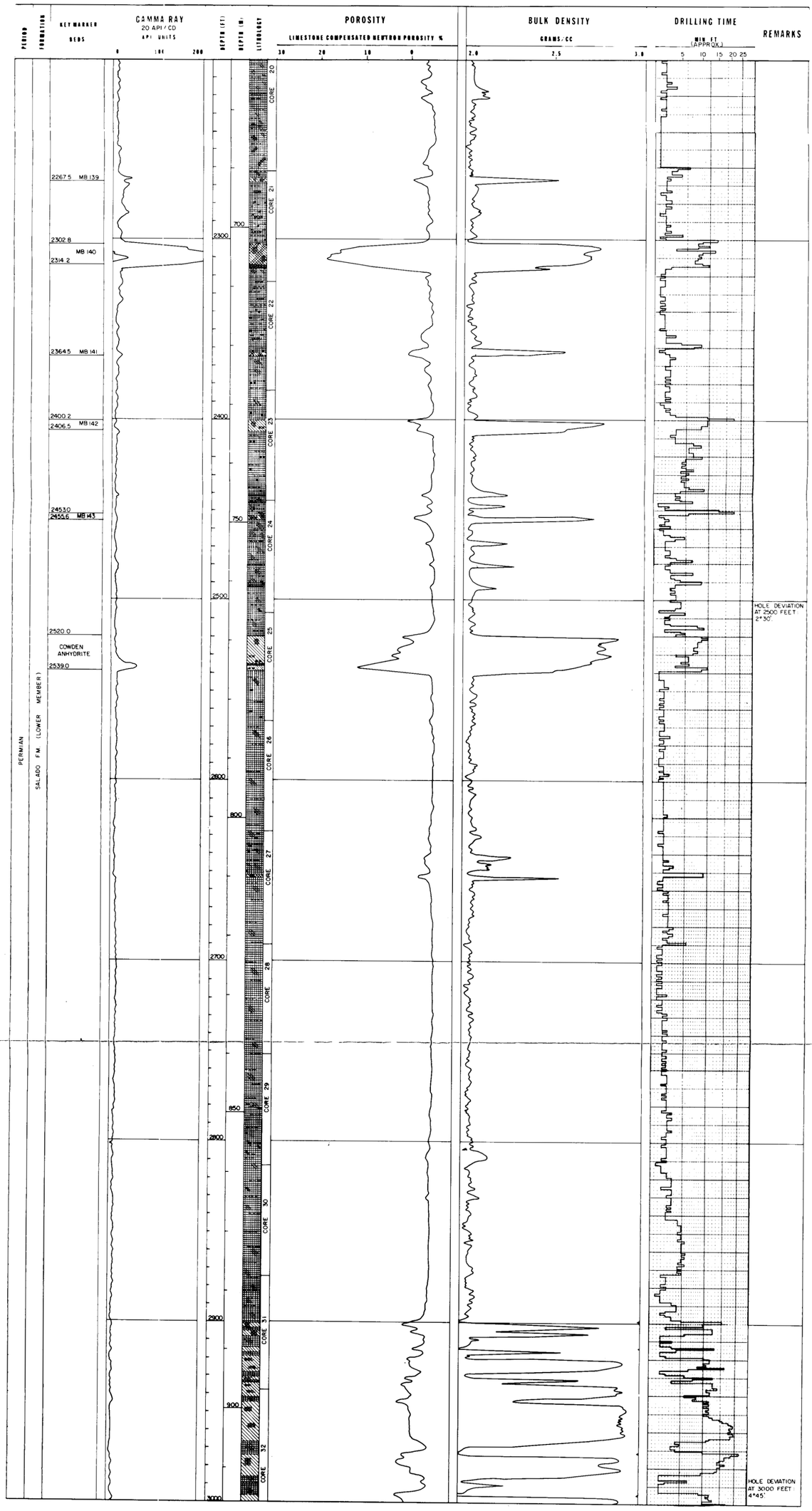
GEOPHYSICAL LOGS RUN BY: DRESSER ATLAS

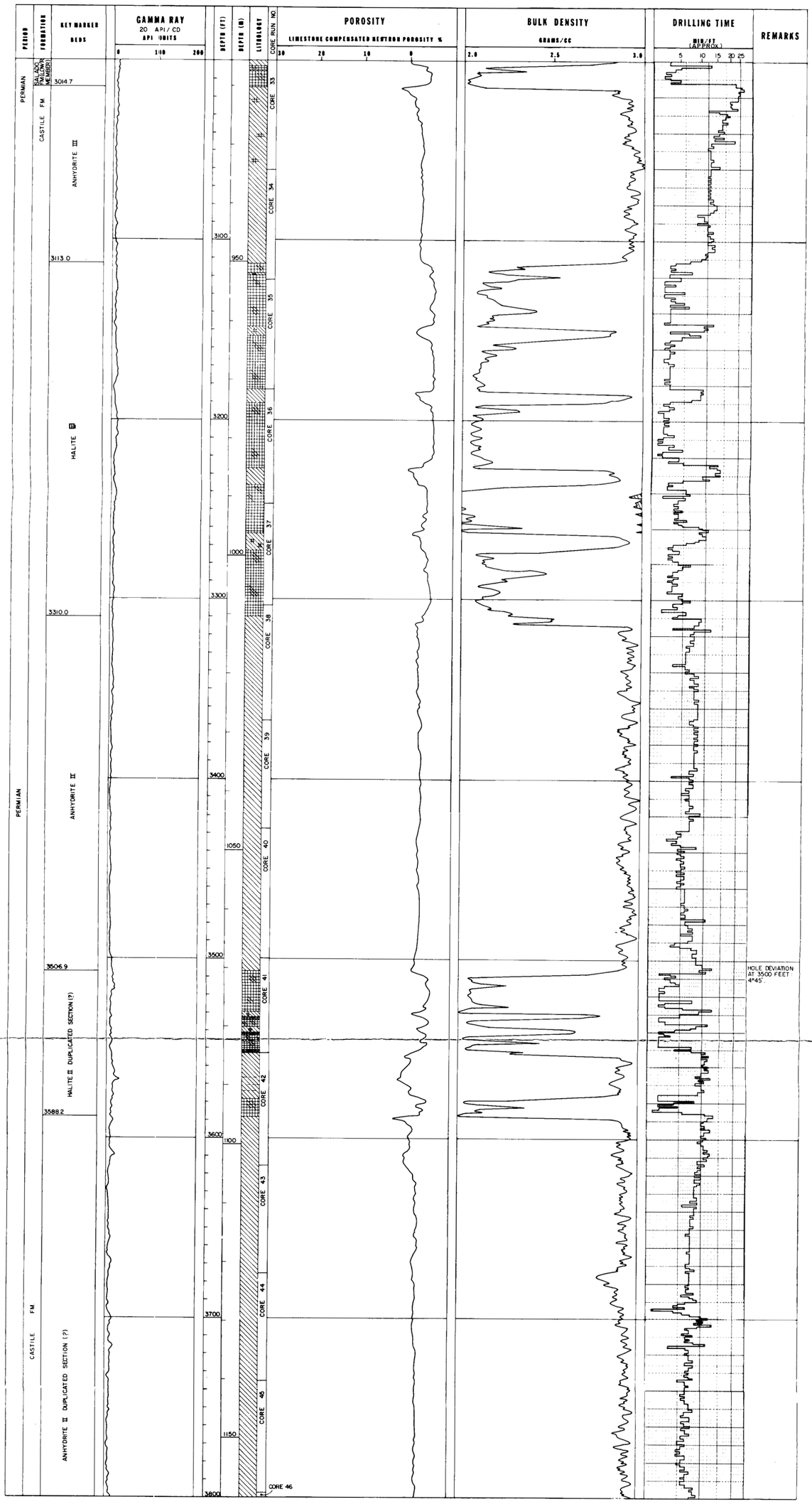
HOLE DEVIATION GIVEN IN DEGREES AND MINUTES.

PERIOD: QUATERNARY; TRIASSIC; PERMIAN
FORMATION: SANTA ROSA SANDSTONE; DEWEY LAKE RED BEDS
KEY MARKER BEDS: KELLY BUSHING 12.2; 16.2 ARTIFICAL FILL; 20.2 EOLIAN SAND; 24.2 MESCALERO CALICHE; 133.0
GAMMA RAY: 20 API / CD API UNITS (0, 100, 200)
DEPTH (FT): 100, 200, 300, 400, 500, 600
DEPTH (M): 50, 100, 150
LITHOLOGY: FILL; NO DESCRIPTIVE DATA; NO CORE - CUTTINGS ONLY; NO CORE - CUTTINGS ONLY
CORE RUN NO.
POROSITY: LIMESTONE COMPENSATED NEUTRON POROSITY % (45%, 30%, 15%, 0)
BULK DENSITY: GRAMS/CC (2.0, 2.5, 3.0); NO DATA 0-1000 FEET
DRILLING TIME: MIN/FT (APPROX.) (5, 10, 15, 20, 25)
REMARKS: HOLE DEVIATION AT 500 FEET: 1°.

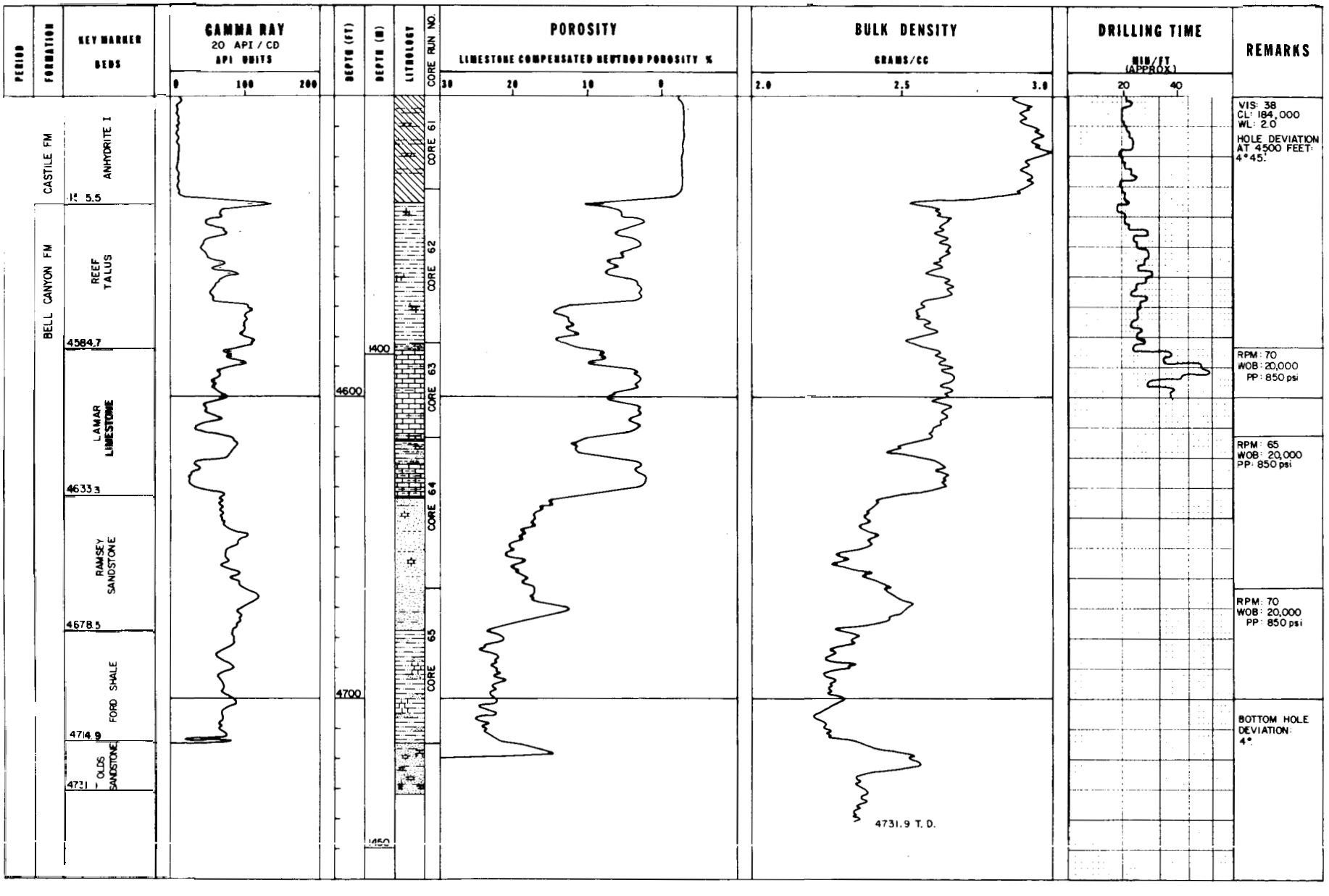

PERIOD
FORMATION
KEY MARKER BEDS
GAMMA RAY
20 API / CD
API UNITS
0 100 200
DEPTH (FT)
DEPTH (M)
LITHOLOGY
CORE RUN NO.
POROSITY
LIMESTONE COMPENSATED NEUTRON POROSITY %
30 20 10 0
BULK DENSITY
GRAMS/CC
2.0 2.5 3.0
DRILLING TIME
MIN/FT (APPROX.)
5 10 15 20 25
REMARKS
PERMIAN
RUSTLER FM
DEWEY LAKE RED BEDS
675.0
733.5
MAGENTA DOLOMITE MEMBER
767.0
872.2
CULEBRA DOLOMITE MEMBER
900.5
1000.6
SALADO FM (UPPER MEMBER)
1125.8 MB 101
1158.5 MB 102
1171.4
MB 103
1186.5
1197.0 MB 104
1211.5 MB 105
1230.5 MB 106
1268.0 MB 107
1278.0 MB 108
1303.8
MB 109
1324.5
1378.0 MB 111
1397.5 MB 112
NO CORE - CUTTINGS ONLY
NO CORE - CUTTINGS ONLY
CORES 1,2 & 3 (NOT DIFFERENTIATED)
CORE 4
CORE 5
CORE 6
30% 20% 10% 0
RESCALE AT 1000 FT.
ROTARY DRILL TO 1040'
CORE
HOLE DEVIATION AT 1000 FEET: 1°10'.


PERIOD
FORMATION
KEY MARKER BEDS
GAMMA RAY
20 API / CD
API UNITS
0 100 200
DEPTH (FT)
DEPTH (M)
LITHOLOGY
POROSITY
LIMESTONE COMPENSATED NEUTRON POROSITY %
30 20 10 0
BULK DENSITY
GRAMS/CC
2.0 2.5 3.0
DRILLING TIME
MIN / FT (APPROX.)
5 10 15 20 25
REMARKS
PERMIAN
SALADO FM. (LOWER MEMBER)
SALADO FM. (McNUTT POTASH ZONE)
1450.5 MB 114
1498.4 MB 116
1505.1 McNUTT
VACA TRISTE SAND
1514.1
1578.9 MB 117
1595.6 MB 118
1619.8 MB 119
1661.5 MB 121
1668.5 MB 122
1696.2
UNION ANHYDRITE
1705.0
1774.8
1781.2 MB 123
1786.5
MB 124
1795.5
1881.0 MB 126
1918.0 MB 128
1943.9 MB 129
2013.5 MB 131
2039.0 MB 132
2057.5 MB 133
2097.0
MB 134
2109.0
2161.0
2168.0 MB 136
1500
1600
1700
1800
1900
2000
2100
2200
650
500
550
600
650
CORE 7
CORE 8
CORE 8
CORE 9
CORE 10
CORE 11
CORE 12
CORE 13
CORE 14
CORE 15
CORE 16
CORE 17
CORE 18
CORE 19
HOLE DEVIATION AT 1500 FEET 1° 15'
HOLE DEVIATION AT 2000 FEET 2°


PERIOD
FORMATION
KEY MARKER BEDS
GAMMA RAY
20 API / CD
API UNITS
0
100
200
DEPTH (FT)
DEPTH (M)
LITHOLOGY
POROSITY
LIMESTONE COMPENSATED NEUTRON POROSITY %
30
20
10
0
BULK DENSITY
GRAMS/CC
2.0
2.5
3.0
DRILLING TIME
MIN. PT.
(APPROX.)
5
10
15
20
25
REMARKS
PERMIAN
SALADO FM. (LOWER MEMBER)
2267.5 MB 139
2302.8
MB 140
2314.2
2364.5 MB 141
2400.2
2406.5 MB 142
2453.0
2455.6 MB 143
2520.0
COWDEN ANHYDRITE
2539.0
2300
2400
2500
2600
2700
2800
2900
3000
700
750
800
850
900
CORE 20
CORE 21
CORE 22
CORE 23
CORE 24
CORE 25
CORE 26
CORE 27
CORE 28
CORE 29
CORE 30
CORE 31
CORE 32
HOLE DEVIATION AT 2500 FEET 2°30'
HOLE DEVIATION AT 3000 FEET 4°45'


PERIOD
FORMATION
KEY MARKER BEDS
GAMMA RAY
20 API/CD
API UNITS
0
100
200
DEPTH (FT)
DEPTH (M)
LITHOLOGY
CORE RUN NO.
POROSITY
LIMESTONE COMPENSATED NEUTRON POROSITY %
30
20
10
0
BULK DENSITY
GRAMS/CC
2.0
2.5
3.0
DRILLING TIME
MIN/FT
(APPROX.)
5
10
15
20
25
REMARKS
PERMIAN
CASTILE FM
SALADO (SALT) (UNDIFFERENTIATED)
ANHYDRITE III
HALITE II
ANHYDRITE II
HALITE II DUPLICATED SECTION (?)
ANHYDRITE II DUPLICATED SECTION (?)
3014.7
3113.0
3310.0
3506.9
3588.2
3100
950
3200
1000
3300
3400
1050
3500
3600
1100
3700
1150
3800
CORE 33
CORE 34
CORE 35
CORE 36
CORE 37
CORE 38
CORE 39
CORE 40
CORE 41
CORE 42
CORE 43
CORE 44
CORE 45
CORE 46
HOLE DEVIATION AT 3500 FEET 4°45'.

PERIOD
FORMATION
KEY MARKER BEDS
GAMMA RAY
20 API / CD
API UNITS
0
100
200
DEPTH (FT)
DEPTH (M)
LITHOLOGY
POROSITY
LIMESTONE COMPENSATED NEUTRON POROSITY %
30
20
10
0
BULK DENSITY
GRAMS/CC
2.0
2.5
3.0
DRILLING TIME
MIN/FT
5
10
20
30
40
REMARKS
PERMIAN
ANHYDRITE II DUPLICATED SECTION (?)
4055.0
HALITE I
4182.3
CASTILE FM.
ANHYDRITE I
3900
4000
4100
4200
4300
4400
4500
1200
1250
1300
1350
NO DESCRIPTIVE DATA
CORE 46
CORE 47
CORE 48
CORE 49
CORE 50
CORE 51
CORE 52
CORE 53
CORE 54
CORE 55
CORE 56
CORE 57
CORE 58
CORE 59
CORE 60
CORE 61
DRILLING TIME LOG / RESCALE MIN/FT
3926
(APPROX.)
RPM: 60
WOB: 18,000 LBS.
PP: 650-800 psi
RPM: 65
WOB: 18-20,000 LBS.
PP: 800-1000 psi
3980-3982
WT : 10.3
VIS : 37
CK : 1/32
CL : 175,000
WL : 4.8
RPM : 65
WOB : 18,000 LBS.
PP : 850-950 psi
HOLE DEVIATION AT 4000 FEET 6°
RPM: 65
WOB: 20,000 LBS.
PP: 750-900 PSI
RPM : 65
WOB : 18,000 LBS.
PP : 800 psi
4083-4136
WT : 10.2
VIS : 38
CL : 172,000
WL : 3.6
RPM: 65
WOB: 18,000 LBS.
PP: 800 psi
RPM : 65
WOB : 20,000 LBS
PP : 850 psi
4185-4235
WT : 10.3
VIS : 35
CL : 188,000
WL : 2.0
RPM: 65
WOB: 20,000 LBS.
PP: 850 PSI
RPM : 65
WOB : 20,000 LBS.
PP : 850 psi
4331-4381
WT : 10.4
VIS : 41
CL : 186,000
WL : 5.0
RPM : 65
WOB : 20,000 LBS
PP : 900 psi
RPM: 65
WOB: 20,000 LBS.
PP: 850 PSI
RPM : 65
WOB : 20,000 LBS.
PP : 850 psi
4482-4532
WT : 10.4


PERIOD
FORMATION
KEY MARKER BEDS
GAMMA RAY
20 API / CD
API UNITS
0
100
200
DEPTH (FT)
DEPTH (M)
LITHOLOGY
CORE RUN NO.
POROSITY
LIMESTONE COMPENSATED NEUTRON POROSITY %
30
20
10
0
BULK DENSITY
GRAMS/CC
2.0
2.5
3.0
DRILLING TIME
MIN/FT (APPROX.)
20
40
REMARKS
CASTILE FM
BELL CANYON FM
ANHYDRITE I
REEF TALUS
LAMAR LIMESTONE
RAMSEY SANDSTONE
FORD SHALE
OLDS SANDSTONE
4584.7
4633
4678.5
4714.9
4731
4600
4700
1400
1450
CORE 61
CORE 62
CORE 63
CORE 64
CORE 65
4731.9 T. D.
VIS: 38
CL: 184,000
WL: 2.0
HOLE DEVIATION AT 4500 FEET: 4°45'
RPM: 70
WOB: 20,000
PP: 850 psi
RPM: 65
WOB: 20,000
PP: 850 psi
RPM: 70
WOB: 20,000
PP: 850 psi
BOTTOM HOLE DEVIATION: 4°

APPENDIX A

JUSTIFICATION

INTRODUCTION TO APPENDIX A, JUSTIFICATION

Memoranda or documents specifically covering the original justification by ORNL for drilling AEC 7 are not available. Deepening the borehole took place under the borehole plugging program. The test program objectives are contained in the following document:

Christensen, C.L., 1979, Test Plan, Bell Canyon Test, WIPP Experimental Program, Borehole Plugging: SAND79-0739, Sandia National Laboratories, Albuquerque, NM 87185.

As this document is already published, the material will not be reproduced here.

APPENDIX B

DRILLING AND TESTING PLAN

INTRODUCTION TO APPENDIX B

DRILLING AND TEST PLAN

There is no drilling and test plan available covering the initial drilling of AEC 7 by ORNL. AEC 7 was deepened under the borehole plugging program. The drilling and test plan are not repeated here as they are contained within the following document.

Christensen, C.L., 1979, Test Plan, Bell Canyon Test, WIPP Experimental Program, Borehole Plugging: SAND79-0739, Sandia National Laboratories, Albuquerque, NM 87185.

APPENDIX C

HOLE HISTORY

INTRODUCTION TO APPENDIX C, HOLE HISTORY

The hole history is a document provided soon after completion of the borehole, and it summarizes the relevant information on the daily log kept by the contractor. The hole history is not edited to ensure conformance in every detail with later information developed for previous chapters. Further information may be obtained as necessary through examination of the original daily time logs.

FENIX & SCISSON, INC.

HOLE HISTORY DATA

ADDITIONAL WORK

DATE: July 22, 1980 Data Sheet Revision

HOLE No.: AEC #7	W. O. No.:	I. D. No.:
USER: Sandia Lab	TYPE HOLE: Exploratory	
LOCATION: New Mexico	COUNTY: Lea	AREA: Bell Canyon
SURFACE COORDINATES: 2034.94' FNL, 2035.26' FEL*		GROUND ELEVATION: *
RIG ON LOCATION:	SPUDDED: 2-15-79**	Recompleted: 5-6-79
CIRCULATING MEDIA: Salt base mud		
No. of COMPRESSORS & SIZE:		

BORE HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I. D.	WT./FT.	WALL	GRADE	CPL'G	FROM	TO	CU. FT. CMT.
0'	40'	17-1/2"	12.715"	48#		H-40		0'	40'	
40'	1016'	12-1/4"	8.017"	28#		H-40		0'	1016'	
016'	4734'	7-7/8"								

TOTAL DEPTH: 4734' | MANDREL DEPTH | PLUGS:

LINK:

LOGGING DATA: Page 19 | SURVEYS PAGE: | CORING PAGE: 19

BOTTOM HOLE COORDINATES: @ | REFERENCE:

NON-OPERATIONAL TIME		OPERATIONAL DELAY TIME		WORKING TIME	
ve Rig up & down	____ days	Equipment Repair	____ days	Drilling Time	____ days
cured	____ days	Caving	____ days	Trip Time	____ days
& Run Mandrel	____ days	Lost Circ.	____ days	Single Shot Survey Time	____ days
gging	____ days	Fishing	____ days		____ days
vey	____ days	W.O. Equipment	____ days	Total	____ days
sing	____ days		____ days	Total Suspended Time	____ days
ment	____ days		____ days	Non-Operational Time	____ days
ring	____ days		____ days	Operational Delay Time	____ days
	____ days		____ days	Working Time	____ days
OTAL	____ days	TOTAL	____ days	TOTAL ELAPSED TIME	____ days

REMARKS: * Location of brass monument: 2038.97' FNL, 2037.26' FEL, Sec. 31, T21S, R32E. Elevation: 3655.54'.

** Originally drilled by Union Carbide in 1974.

Depths shown are from kelly bushing elevations 12.2' above ground level elevation.

Rig No.	Name	Type	
14	Verna Drilling Co.		49.00 days
	(Time to clean out and recomplete on 9-6-79.)		____ days
			____ days
			____ days
			____ days

WDS:sjw

FENIX & SCISSON, INC.
P. O. BOX 15408
LAS VEGAS, NEVADA 89114
702/734-3481

ADDRESS REPLY TO: ADM-4192

May 14, 1980

Mr. R. D. Statler
Department 1133
Sandia Laboratories
P. O. Box 5880
Albuquerque, NM 87115

CARLSBAD HOLE HISTORIES

Enclosed is the original hole history on the recompletion of AEC #7 for your distribution.

for J. A. CROSS, MANAGER
LAS VEGAS BRANCH

WDS:sjw

Enclosure

Copies: F&S/Carlsbad, w/encl. (2)
W. D. Sutherland, F&S/LVO, w/encl.
Central Files/Mercury, w/encl.

FENIX & SCISSON, INC.

HOLE HISTORY DATA

ADDITIONAL WORK

ATE: May 14, 1980

OLE No.: AEC #7	W. O. No.:	I. D. No.:
ER: Sandia Lab	TYPE HOLE: Exploratory	
OCATION: New Mexico	COUNTY: Lea	AREA: Bell Canyon
URFACE COORDINATES: 2034.94' FNL, 2035.26' FEL*		GROUND ELEVATION: *
G ON LOCATION:	SPUDDED: 2-15-79**	Recompleted: 5-6-79
RCULATING MEDIA: Salt base mud		
o. of COMPRESSORS & SIZE:		

BORE HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I. D.	WT./FT.	WALL	GRADE	CPL'G	FROM	TO	CU. FT. CMT.
0'	40'	17-1/2"	12.715"	48#		H-40		0'	40'	
40'	1016'	12-1/4"	8.017"	28#		H-40		0'	1016'	
1016'	4734'	7-7/8"								

TAL DEPTH: 4734'	MANDREL DEPTH	PLUGS:
NK:		
GGING DATA: Page 19	SURVEYS PAGE:	CORING PAGE: 19
TTOM HOLE COORDINATES:		REFERENCE:

NON-OPERATIONAL TIME		OPERATIONAL DELAY TIME		WORKING TIME	
ve Rig up & down	____ days	Equipment Repair	____ days	Drilling Time	____ days
cured	____ days	Caving	____ days	Trip Time	____ days
l & Run Mandrel	____ days	Lost Circ.	____ days	Single Shot Survey Time	____ days
gging	____ days	Fishing	____ days		____ days
rvey	____ days	W. O. Equipment	____ days	Total	____ days
sing	____ days		____ days	Total Suspended Time	____ days
ment	____ days		____ days	Non-Operational Time	____ days
ring	____ days		____ days	Operational Delay Time	____ days
	____ days		____ days	Working Time	____ days
TAL	____ days	TOTAL	____ days	TOTAL ELAPSED TIME	____ days

EMARKS: * Location of brass monument: 2038.97' FNL, 2037.26' FEL, Sec. 31, T21S, R32E.
Elevation: 3655.54'.

** Originally drilled by Union Carbide in 1974.

Depths shown are from kelly bushing elevations 12.2' above permanent datum of 3667.74'.

Rig No.	Name	Type	
14	Verna Drilling Co.		49.00 days
	(Time to clean out and recomplete on 9-6-79.)		____ days
			____ days
			____ days
			____ days
			____ days

AEC #7
HOLE HISTORY

Depths reported are from Kelly bushing elevation (KB) 12.2' above ground level elevation (GL) unless otherwise noted.

2-15-79 Ran USGS fluid probe, water level at 626' (GL). Filled hole with brine water (42 barrels).

2-16-79 Fluid level at 160' (GL), lost fluid at an average rate of 8' per hour. Cut off existing casinghead and welded a Gulfco 10" series 900, 3000# casinghead on the 8-5/8" O.D. casing. Top of casinghead 1" below GL.

3-19-79 Moved in Verna Drilling Company's rig #14 and rigged up.

3-20-79 Made up drilling string consisting of 7-7/8" rock bit, 20 6-1/4" drill collars and 4-1/2" drill pipe. Ran in hole and tagged fish at 991'. Circulated and conditioned hole with brine. Made trip with a 7.5" O.D. impression block and tagged fish with 4000# weight, fish appeared to be centered inside the 8-5/8" O.D. casing. Made up 7-1/2" O.D. overshot with 6" Bowen jars and 5-3/4" bumper sub. Ran in hole and worked over fish. Made several attempts to unseat packer, no movement indicated. Pulled out of hole, no recovery. Made up 7-3/4" O.D. x 6-1/2" I.D. milling tool, overall length of tool was 13.15'. Milled over fish and pulled out of hole. Made trip with the overshot and jarred on fish.

3-21-79 Recovered 1.37' of 2-3/8" O.D. tubing. Made 2 trips with the milling tool and overshot. Jarred on fish each time and started out of hole.

3-22-79 Recovered TIW packer, slips and part of rubber element had been milled away. Ran 7-1/2" O.D. magnet in the hole to 1003' and circulated hole, recovered 3 pieces of a perforating gun and piece of packer slip. Ran Baker 498 retrievable packer in the hole on 4-1/2" drill pipe and set at 816'. Filled annulus with water. Filled drill pipe with water and broke down perforations from 924' to 934' and 884' to 894' with water at a rate of 3 barrels per minute with 350 psi. Displaced drill pipe with 12 barrels of fresh water. Pressured up on annulus to 500 psi. Squeezed perforations using Dowell with 50 (59ft3) sacks of class H cement with 2% friction reducing additive and 2% fluid loss additive followed by 100 sacks (105 ft3) of class H cement and 2% calcium chloride. No pressure build up while pumping cement. Displaced cement in stages gradually building up pressure and letting pressure stabilize after pumping ceased. Pumped in 100 sacks (105 ft3) of class H with 2% calcium chloride. Displaced cement in stages to a final pressure of 350 psi. Released pressure.

3-23-79 Reversed out drill pipe with brine. Released packer and pulled out of hole. Waited on cement from 0215 to 2230 hours. Ran 7-7/8" bit in the hole and tagged cement at 849'.

3-24-79 Drilled out cement from 849' to 973' and cleaned out to 1002'. Pulled drill pipe leaving 1 stand in the hole. Closed blow out preventer rams around drill pipe and pressured up to 1700 psi for 15 minutes. Picked up 7-5/8" wash over pipe with 7-3/4" O.D. x 3-1/2" I.D. milling shoe on bottom. Ran in hole and tagged Hallibruton SV EZ drill packer at 1002.20' and milled to 1002.84'. Pulled out of hole and ran 7-3/8" O.D. overshot. Tagged fish at 1002' and worked to 1002.60'. Jarred on fish and lowered to 1005' without taking weight. Pulled out of hole, no recovery. Made trip with overshot to fish at 1111.03', no recovery.

3-25-79 Ran wash over pipe and shoe in the hole and pushed fish to 1579.5' and milled to 1580'. Laid down wash pipe, recovered 3 packer element rubbers and 8.5" of fishing neck. Made trip with overshot, no recovery. Ran 6-3/4" bit in the hole to a ledge at 1580' and fish at 1589', pushed fish to 2949'.

3-26-79 Pushed fish to 3812'. Started drilling on fish. Mixed salt base mud at 3871'. Drilled on fish to 3919'. Pulled out of hole and ran Birdwell gamma and caliper tool in the hole to 2155', tool hung up at 2040' and 2056' both going in and coming out of the hole. Ran 6-3/4" bit in the hole, cleaned out bridge at 2039' and worked to 3919'. Mixed mud and conditioned mud.

3-27-79 Continued conditioning hole and working bit from 3919' to 3800', pipe hanging up at 3860'. Pulled out of hole. Ran Birdwell caliper and inclinometer logs. Ran 7-7/8" bit in the hole to tight place at 3830' and reamed to 3919'. Pulled up to 3480' and reamed to 3919' several times. Circulated and conditioned mud.

3-28-79 Reduced mud viscosity and conditioned mud. Pulled bit into casing and bit dragged from 1730' to 1850'. Worked thru tight place until hole was clear. Waited on hole for 2 hours and ran bit to 3919'. Pulled out of hole and bit dragged slightly from 1700' to 1850'. Ran junk basket in the hole and milled on junk.

3-29-79 Changed out preventer rams and ran 2-3/8" O.D., 4.70#, EUE, N-80 tubing in the hole to 3018.86' to blow fluid out of the hole. Pumped 50,000 ft3 of nitrogen down the annulus at 1050 psi, broke back to 950 psi at 1250 cubic feet per minute (cfm). Pumped 277,000 ft3 down the tubing at 1250 cfm at start and increased to 2000 cfm. Shut in for 2 hours waiting on nitrogen and pumped 160,000 ft3 down the tubing

3-29-79 (Con't.)

at 1250 cfm and increased to 2000 cfm at 1500 psi. Released pressure on tubing and casing.

3-30-79 — Ran USGS fluid probe, fluid level at 2016'. Ran 1" O.D. coil tubing inside the 2-3/8" O.D. tubing to 2500'. Established a pumping rate and pressure and blew fluid out of the hole to 2500', 2775' and 3000'. Pulled 1" O.D. tubing and released pressure on hole. Rigged up Dresser Atlas.

3-31-79 — Ran fluid probe, fluid level at 2862'. Pulled 2-3/8" O.D. tubing. Pressure tested 20 joints of the tubing. Ran tubing back in the hole to 3021'. Ran Dresser Atlas fluid probe. fluid level at 2826'. Pulled out of hole. Made up Lynes inflatable packer with 139.58' of 2-3/8" O.D. tubing on bottom, one pup joint perforated. Ran in the hole with two 1/4" plastic air lines taped to the outside of the 2-3/8" O.D. tubing and connected to the packer. Set packer at 976.59'.

4-1-79 — Permeability test could not performed. Released pressure on packer and tested hole. Lowered packer to 2521.91' along with air lines and set packer. Monitored down hole pressure and tested formation.

4-2-79 — Reset packer at 2097' and tested formation. Reset packer at 1982' and tested formation. Released pressure and laid packer. Ran tubing back in the hole. Ran Dresser Atlas fluid probe, fluid level at 2695'. Laid down tubing.

4-3-79 — Changed out preventer rams for 4-1/2" drill pipe. Ran in hole with a Reed junk basket on top of a Globe basket. Washed 3' to bottom and worked over junk, Globe basket was full of small pieces of iron, 2-1/4" x 1' angle iron and a 1-1/4" x 12" bolt and nut. Ran baskets back in hole with a stabilizer on top of the drill collars.

4-4-79 — Made 2 trips with baskets and recovered small pieces of iron and part of core cut by the Globe basket. Made trip with a 7-7/8" bit and a Reed junk basket and worked bit. Ran in hole with a Reed junk basket on top of a reverse basket.

4-5-79 — Washed over junk and pulled out of hole. Made trip with a magnet and Reed junk basket, no recovery with magnet and small pieces of iron in the Reed basket. Made up 7-13/16" Dowco diamond core bit and barrel, measured in hole. Cut core #1 from 3926' to 3932', recovered 7.6'.

4-6-79	Cut core #2 from 3932' to 3960'.
4-7-79	Completed core #2 from 3960' to 3982', recovered 45.95'. Washed and reamed from 3926' to 3983'. Cut core #3 from 3983' to 3992'.
4-8-79	Completed core #3 from 3992' to 4033', recovered 51.70'. Started cutting core #4.
4-9-79	Completed core #4 from 4033' to 4083', recovered 50.20'. Cut core #5 from 4083' to 4135'.
4-10-79	Recovered 53.40' on core #5. Cut core #6 from 4135' to 4185', recovered 49.15'. Reamed tight place 30' off bottom and started cutting core #7.
4-11-79	Completed core #7 from 4185' to 4235', recovered 50.02'. Worked pipe thru tight area.
4-12-79	Cut core #8 from 4235' to 4285'.
4-13-79	Recovered 50.35' on core #8. Started cutting core #9.
4-14-79	Completed cutting core #9 from 4285' to 4331', recovered 46.60'. Ran in hole and bit stopped at 3890', reamed to 3960' and pulled bit.
4-15-79	Made trip with 7-7/8" bit and reamers and reamed tight hole, circulated hole clean.
4-16-79	Made up 7-13/16" coring assembly and started cutting core #10.
4-17-79	Completed cutting core #10 from 4331' to 4381', recovered 49.30'. Changed out bottom stabilizer on the core barrel, installed Grant stabilizers on top of #2 drill collar and #6 drill collar. Measured in hole and corrected depth to 4382.88'. Started cutting core #11. Hydrogen sulfide started showing up in the hole from 4389' to 4396' to a maximum of 40 ppm.
4-18-79	Completed cutting core #11 from 4383' to 4432'. Hydrogen sulfide varied from 0 ppm at 4426' to 42 ppm at 4432'. Mixed Ironite sponge and conditioned mud. Started out of hole.
4-19-79	Recovered 49.70' on core #11. Cut core #12 from 4432' to 4482'. Hydrogen sulfide varied from 0 to 5 ppm maximum. Started out of hole.
4-20-79	Recovered 50.10' on core #12. Cut core #13 from 4482' to 4522'. Hole making a small amount of hydrogen sulfide.

4-21-79	Completed core #13 from 4522' to 4532', recovered 50.10'. Started cutting core #14. Hole making a small amount of hydrogen sulfide. Mixed Ironite sponge each tour.
4-22-79	Completed core #14 from 4532' to 4583.65', recovered 51.01'. Measured out of hole and corrected depth to 4583.65'. Made trip with 7-7/8" bit and reamer, reamed hole from 4483' to 4583'.
4-23-79	Made up Lynes test tool and ran in hole. Set center of packer at 4531.58'. Opened tool at 0730 hours for drill stem test #1.
4-24-79	Completed test at 0645 hours. Made up 7-13/16" core bit and washed to bottom. Cut core #15 from 4583' to 4592'.
4-25-79	Completed core #15 from 4592' to 4614', recovered 31.1'. Reamed hole from 4580' to 4614' and cut core #16 from 4614' to 4618'.
4-26-79	Completed core #16 from 4618' to 4664', recovered 50.25'. Cut core #17 from 4664' to 4714'.
4-27-79	Recovered 51.40' on core #17. Made trip with 7-7/8" bit and reamed to bottom. Ran Birdwell logs. Made up Lynes test tool and set packer at 4609' to test interval from 4609' to 4714'. Opened tool at 2215 hours for drill stem test #2.
4-28-79	Completed test #2 at 1015 hours. Attempted to run Birdwell caliper log. Ran test tool in the hole to test interval from 4495' to 4714'. Opened tool at 2300 hours for drill stem test #3.
4-29-79	Completed test at 1200 hours. Laid down test tool and ran 7-7/8" bit in the hole. Drilled 7-7/8" hole from 4714' to 4734'. Conditioned mud.
4-30-79	Pulled bit and ran Dresser Atlas logs. Ran Sperry-Sun gyroscopic survey.
5-1-79	Completed logging and surveying. Conditioned mud and laid down drill pipe. Changed out preventer rams to 2-3/8".
5-2-79	Repaired casing and rig. Made trip with 2-3/8" O.D. tubing and measured out of hole. Made up S3 bottom packer.
5-3-79	Ran packer in the hole on 2-3/8" O.D. tubing and set at 4520'. Pulled tubing and ran top packer in the hole. Ran 1" coil tubing inside the 2-3/8" to 4400' and started evacuating the hole using Nowsco with nitrogen. Recovered 183.79 barrels of fluid using 132,000 ft3 of nitrogen.

5-4-79	Continued blowing hole with nitrogen. Ran Dresser Atlas log, fluid at 2342' and at 2367' in 15 minutes. Continued blowing hole. Pulled 1" tubing. Log top of fluid at 4434'. Recovered a total of 272.46 barrels of fluid with a total of 450,000 ft^3 of nitrogen.
5-5-79	Released pressure on casing. Released packer. Log top of fluid at 3452'. Ran 1" tubing back in the hole and blew hole with nitrogen. Pulled 1" and 2-3/8" O.D. tubing and top packer. Ran Dresser Atlas log. Ran Lynes packer back in the hole and set at 3377'. Blew fluid out of the hole with nitrogen. Total nitrogen used 652,000 ft^3.
5-6-79	Continued blowing hole. Laid down tubing and packer. Log top of fluid at 3546'. Rigged down government equipment and released rig at 2400 hours. Total fluid recovered 279.46 barrels. Total nitrogen used 750,000 ft3. Phase 1 completed 5-6-79.
5-8-79	Installed a blind flange on the 13-3/8" casinghead with a 2" discharge line to pit on north side and a pressure gage on the south side.
5-10-79	Pecos Valley Construction Company erected fence around mud and reserve pits.
5-17-79	Moved in Mack Chase rig #19 and rigged up. Picked up 2-3/8" O.D., 4.70# Hydril CS tubing. Ran Dresser Atlas logs, fluid level at 2793', could not get below 4472'. Worked days only.
5-18-79	Measured 2-3/8" O.D. tubing. Ran Dresser Atlas logs, found bottom at 4472'. Fluid level was 2712' at 1400 hours and 2709' at 1500 hours.
5-19-79	Ran Lynes packer in the hole on 2-3/8" O.D. tubing and set top of packer element at 4347.85'. Started swabbing tubing for water test #1.
5-21-79	Rig secured from 1830 hours on 5-19-79 to 0800 hours on 5-21-79. Completed test #1. Reset top of packer element at 3352.95'.
5-22-79	Pulled out of hole packer rubber ruptured. Made up 5-5/8" Lynes production injection packer (PIP) and ran in hole on 2-3/8" O.D. tubing, set packer at 3460.97'. Released tubing from packer and pulled up 1.5'. Started swabbing tubing for water test #2. Secured rig at 1730 hours.
5-23-79	Rig secured to 0830 hours. Continued testing to 1448 hours. Pulled out of hole and found tubing had backed off at seating nipple of packer. Ran Artesia Chemical Company's downhole video survey to 2981' (GL).

5-24-79	Attempted to run Dresser Atlas temperature log, tool failed. Made up 4-9/16" O.D. x 3-1/2 " I.D. overshot with 2-3/8" left hand release grapple. Ran in hole on 2-3/8" O.D. tubing to seating nipple at 3454.72'. Worked over fish and deflated packer, pulled out of hole and recovered fish. Dressed packer and ran in hole. Set top of packer element at 3025.50'. Released tubing from packer and pulled out of hole.
5-25-79	Made second run with the video camera to observe hole conditions and monitor fluid rise.
5-29-79	Rig secured from 5-25-79 to 5-29-79. Ran tubing in the hole and latched onto packer. Deflated packer and pulled out of hole. Made up Lynes inflatable packer with a 5-3/8" O.D. x 136" long element. Ran in hole and set top of element at 3830'. Released tubing from packer and pulled up 2', started swabbing at 1445 hours for test #3.
5-30-79	Completed test at 1600 hours. Latched onto packer and deflated. Pulled out of hole.
5-31-79	Made up Lynes PIP packer with a 6-5/8" O.D. x 58" element. Ran in hole on 2-3/8" O.D. tubing and set top of element at 2790'. Released tubing from packer and monitored fluid level with USGS neutron log.
6-1-79	Ran USGS neutron log. Made up Lynes double straddle packer assembly spaced 89.86' apart.
6-2-79	Ran packer assembly in the hole on 2-3/8" O.D. tubing with 19-1/4" plastic tubing lines strapped to the outside of the 2-3/8". Set top of top packer at 2189.96' (GL) and inflated packers with nitrogen.
6-3-79	Deflated all 4 packers and pulled out of hole to check leaks in the plastic tubing. Ran back in hole and set top of top packer at 2189.96' (GL). Inflated packers and monitored test.
6-4-79	Deflated packers and reset top of top packer at 1717.80' (GL). Inflated packers and monitored test.
6-5-79	Reset top of top packer at 504.24' (GL) inside the 8-5/8" O.D. casing and ran comparison test.
6-6-79	Deflated packers and pulled out of hole. Made up Lynes disconnect coupling on 2-3/8" O.D. tubing and ran in hole. Did not find packer set at 2790', found packer at 2807.29' and would move down the hole with 1000# to 2000# weight on packer. USGS monitored fluid levels. Attempted to latch onto packer and worked to 2910.01'. Pulled out of hole.

6-7-79 Made up Lynes disconnect coupling with a 6-5/8" O.D. belled skirt on 2-3/8" O.D. tubing. Ran in hole, pushed packer to 2969' and latched onto packer. Packer hung up at 2910' where it was deflated. Laid down packer, element damaged. Ran Dresser Atlas logs, could not get below 4461'.

6-8-79 Made up 7" O.D. Lynes inflatable straddle test tool with 99.40' spacing between packers. Ran in hole on 2-3/8" O.D. tubing and set packers to straddle zone from 4297.83' to 4397.23'. Attempted to swab water out of the tubing used to set the packers but could not get below 1600'.

6-9-79 Rigged up Nowsco and ran 1" coil tubing inside the 2-3/8" tubing, blew fluid out of the 2-3/8" tubing with nitrogen. Opened tool at 1300 hours and tested lower zone to 1800 hours. Dropped sinker bar and opened ports to test intermediate zone. Completed test at 1830 hours. Laid down test tool.

6-11-79 Rig secured from 6-9-79 to 6-11-79. Ran Lynes straddle test tool in the hole and set packers to straddle zone from 3900.45' to 4009.85'. Opened tool at 1730 hours to monitor and test lower zone.

6-12-79 Opened tool at 1115 hours to test intermediate zone, completed test at 1345 hours. Reset packers to test zone from 3490.61' to 3600.07'. Opened tool at 1620 hours and monitored test.

6-13-79 Completed test at 1400 hours. Pulled test tool out of the hole. Ran 2-3/8" O.D. tubing in the hole to 2960.28' with a seating nipple above a 4' slotted pup joint.

6-14-79 Swabbed tubing for water test. Pulled out of hole and made up Lynes straddle packer test tool. Ran in hole and set packers from 2893.07' to 3042.47'. Opened tool at 1800 hours and monitored test.

6-15-79 Completed test at 1500 hours. Pulled out of hole and secured rig.

6-18-79 Rig secured from 6-15-79 to 6-18-79. Made up 7" O.D. x 136" Lynes inflatable bridge plug and set at 4300.03'. Released tubing from packer and started test at 1215 hours.

6-19-79 Continued test and monitored with USGS logging truck.

6-20-79 Continued test to 1500 hours and pulled out of hole.

6-21-79 Made up Lynes straddle packer test tool and set packers from 3460.55' to 3610.01'. Opened tool at 1245 hours and tested zone to 1800 hours. Opened tool to test zone below bottom packer.

6-22-79 Completed test at 1015 hours. Pulled out of hole. Dressed Lynes tool and ran in hole to test zone from 2890' to 3039'. Started test at 1600 hours.

6-23-79 Completed test at 1300 hours. Laid down packers.

6-24-79 Rig secured.

6-25-79 Made up straddle test tool and ran in hole, set packers from 4150' to 4190'. Started test and 1215 hours and stopped at 1415 hours. Test was a misrun.

6-26-79 Made up test tool and attempted to set packers from 4160' to 4200', top packer element ruptured. Pulled out of hole and ran Lynes retrievable bridge plug, set at 1174'. Laid down tubing and rigged up USGS to monitor hole.

6-27-79 Monitored hole to 0800 hours. Ran retrieving tool in the hole and recovered bridge plug. Made up test tool and set packers from 4050' to 4200'. Started test at 1315 hours to test below and between packers.

6-28-79 Continued test.

6-29-79 Continued test to 0830 hours. Dressed tool and set packers from 2290' to 2330'. Started test at 1600 hours.

6-30-79 Completed test at 0815 hours. Respaced packers and reset from 2890' to 3040'. Started drill stem test #8 test at 1340 hours of zones below and between packers.

7-1-79 Rig secured.

7-2-79 Completed test at 0830 hours. Laid down packers Ran retrieving tool in the hole to recover bridge plug at 4300'. Tagged 6' of fill on top of the retrieving neck at 4295.53'.

7-3-79 Circulated fill from bridge plug. Pulled out of hole, no recovery. Welded a 7" skirt on the overshot and ran in hole. Pushed bridge plug to 4424', washed and pushed plug to 4695'.

7-4-79 Rig secured.

7-5-79 Circulated hole with water and recovered bridge plug at 4695'. Started rigging down.

7-6-79 Rigged down blow out preventer and laid down tubing. Released rig at 1530 hours.

8-6-79 Hole suspended from 7-6-79 to 8-6-79. Moved in Mack Chase rig #19 and rigged up. Shut in pressure was 134 psi. Hole flowed a 2" stream of brine water for 5 minutes after opening. Ran 6-1/8" bit in the hole on 2-3/8" O.D. tubing. Cleaned out bridge at 4156' and ran to 4674' (GL).

8-7-79 Pulled out of hole. Made up Lynes instrument package onto 6-1/2" O.D. production injection packer and started in hole on 2-3/8" O.D. tubing. Packer came loose from disconnect coupling and fell in hole. Changed out coupling and ran in hole to fish at 4634'. Unable to latch onto packer. Pulled out of hole and worked thru tight hole at 1500'. Made up a 7" O.D. skirt on the disconnect coupling and ran in hole. Worked thru tight spot at 1500' and latched onto fish. Pulled out of hole, no recovery.

8-8-79 Made trip with a 6-5/8" O.D. skirt on the disconnect coupling, no recovery. Made trip with a Bowen overshot with a 2-3/8" O.D. grapple, no recovery.

8-9-79 Ran overshot back in the hole and latched onto fish at 4615' (GL), bottom of fish at 4660' (GL), total depth of hole at 4674' (GL). Jarred on fish and recovered packer and instrument package.

8-10-79 Laid down tubing. Installed a blind flange on the casinghead and released rig. Fluid level at 120' (GL).

8-25-79 Moved in Mack Chase rig #6.

8-26-79 Rig secured.

8-27-79 Rigged up. Ran 7-7/8" bit in the hole on 2-7/8" O.D. tubing to bridge at 1460'. Washed and reamed from 1460' to 1700', hole clean from 1700' to 3700', washed and reamed from 3700' to 4101'. Circulated with brine water.

8-28-79 Washed and reamed from 4101' to 4400' and from 4600' to 4734'. Circulated hole clean and displaced hole with 260 barrels of 10# brine. Laid down tubing. Attempted to run Dresser Atlas caliper log, could not get below 4183'.

8-29-79 Made up S3 instrument package and Lynes 6-1/2" O.D. production-injection packer and ran in hole on 2-3/8" O.D. Hydril tubing, could not get below 4184' (GL). Pulled out of hole.

8-30-79 Added 40.35' of 5-1/2" O.D. casing to bottom of S^3 instrument package with a centralizer 5' from bottom end of casing, another 25' from the bottom and a third on the S3 package. Ran instrument and Lynes packer in the hole on 2-3/8" O.D. tubing, set packer at 4492'. Released tubing and pulled out of hole. Rigged up Sandia geophone and ran in hole on the tubing, could not get below 4184' (GL). Started water test.

8-31-79 Continued testing.

9-4-79	Rig secured from 8-31-79 to 9-4-79. Continued testing to 1200 hours. Recovered geophone. Picked up 42.60' of 5-1/2" O.D., 15.50# casing with 3 centralizers spaced on the outside. Ran in hole on 2-3/8" O.D. tubing with the casing used to centralize the retrieving tool. Worked thru bridge at 4272' and did not tag packer at 4492'.
9-5-79	Lowered tool to 4652' and latched onto packer, recovered packer and instrument. Ran 2-3/8" O.D. tubing in the hole with plastic hose taped to the outside for a gas monitor.
9-6-79	Lowered tubing to 1023'.
9-7-79	Lowered tubing to 4413' and swabbed. Pulled out of hole.
9-8-79	Made up packer and S^3 instrument package. Ran in hole to 4491' and set packer.
9-9-79	Rig secured.
9-10-79	Swabbed tubing. Checked packer top at 4485' and pulled tubing.
9-11-79	Made up packer and ran in hole, set top at 4446'. Tested zone from 4450' to 4491'.
9-12-79	Continued testing to 1000 hours. Pulled out of hole and laid down packer. Made up retrieving tool with a perforated joint of 2-3/8" tubing above the tool. Ran in hole and latched onto packer at 4491'. Swabbed tubing.
9-13-79	Pulled out of hole and laid down packer and instruments.
9-14-79	Rigged up McCullough dump bailer and loaded with 188# of sand. Lowered in hole and found bottom at 4720'. Pulled out of hole.
9-18-79	Rig secured from 9-14-79 to 9-18-79. Ran packer and S^3 instrument package in the hole and set at 4502'.
9-19-79	Pulled out of hole, packer failed.
9-20-79	Ran Lynes inflatable packer and instruments in the hole to 4300'. Released from packer and ran second packer in the hole to test zone from 4254' to 4300'. Started test.
9-21-79	Completed test. Recovered top packer.
9-22-79	Recovered packer set at 4300'.
9-23-79	Rig secured.
9-24-79	Made up Lynes packer and S^3 instrument package. Set packer at 4502'.

9-25-79	Ran McCullough dump bailer and dumped sand on top of the packer.
9-26-79	Dowell mixed grout and placed grout on top of the sand plug with a dump bailer. Released rig at 1400 hours.
9-28-79	Ran USGS fluid probe, fluid level at 455' (GL).
10-6-79	Moved in Mack Chase rig #19 and rigged up.
10-7-79	Rig secured.
10-8-79	Ran 6-5/8" O.D. Lynes injection packerand Sandia instrument package in the hole on 2-3/8" O.D. tubing. Tagged cement plug at 4489', picked up to 4488' and set packer. Swabbed tubing dry and knocked out plug in the packer.
10-9-79	Ran Lynes continuous wire line recorder probe inside the tubing, tagged fluid at 3126' and monitored test.
10-10-79	Continued testing.
10-11-79	Completed testing and pulled probe. Attempted to release packer, ran McCullough perforating gun and perforated packer element. Laid down same.
10-12-79	Ran 2-3/8" O.D. tubing in the hole to 4486' and swabbed tubing. Laid down same.
10-13-79	Ran Lynes straddle packers in the hole and tested zone between 4476' and 4489'.
10-14-79	Rig secured. Tool in closed position.
10-15-79	Continued testing.
10-16-79	Contined testing.
10-17-79	Completed test. Pulled tubing.
10-18-79	Ran tubing in the hole and swabbed 63.5 barrels of fluid for sample gas.
10-19-79	Ran Lynes PIP packer in the hole, set center of packer element at 4478'. Set tubing slips and packed off. Knocked out shear plug in the packer and swabbed tubing. Moved out rig. Filled annulus with fresh brine. Ran McCullough fluid probe, tag fluid at 4394'.

10-23-79	Ran McCullough log, fluid at 4380'.
10-25-79	Moved in Mack Chase rig #19 and rigged up.
10-26-79	Released packer and laid down. Installed a stripper head for 2-3/8" tubing.
10-27-79	Ran 2-3/8" O.D. tubing in the hole with a 5-1/2" guide on bottom. Swabbed tubing for tracer gas sample, displaced well bore with 400 barrels of fresh brine. Ran 6-5/8" O.D. Lynes PIP packer in the hole on 2-3/8" tubing. Could not get below ledge at 4184', started turning to the left to work below ledge and backed off tubing at 1420'.
10-28-79	Ran an overshot in the hole and recovered tubing and packer. Ran back in hole with a 5-1/2" O.D. fabricated guide on bottom. Set packer at 4478' and started test.
10-29-79	Released packer and pulled out of hole. Ran tubing in the hole to 4488' and swabbed for gas sample. Ran packer back in the hole with a Sandia instrument package. Set packer at 4478' and swabbed tubing dry.
10-30-79	Ran gas test.
10-31-79	Released packer and pulled out of hole. Ran tubing in the hole to 4489' and swabbed tubing. Pulled tubing and ran PIP packer back in the hole. Set packer, swabbed tubing dry and left tool open.
11-1-79	Completed test and laid down packer. Ran 2-3/8" O.D. tubing back in the hole to 4488'. Swabbed tubing dry and started gas test.
11-2-79	Pulled tubing, ran packer and instrument package in the hole. Set packer at 4478'.
11-5-79	Rig secured from 1500 hours on 11-2-79 to 0800 hours on 11-5-79. Completed test. Laid down tubing, packer and rigged down.
11-6-79	Ran 5-1/2" O.D. slotted casing guide shoe in the hole on 2-3/8" O.D. tubing and tagged cement plug at 4490'. Pulled up 3" and swabbed tubing for gas test. Laid down tubing.
12-7-79	Ran Lynes 6-5/8" PIP packer in the hole on 2-3/8" O.D. tubing with a geophone on top of the packer. Set center of packer at 4476.85' and ran Sandia test.

12-10-79	Rig secured from 12-7-79 to 12-10-79 monitoring test. Swabbed tubing and ran fluid test.
12-11-79	Completed test at 0900 hours. Released packer and laid down same. Ran 2-3/8" O.D. tubing and 5-1/2" guide shoe in the hole to 4489'. Swabbed tubing and ran test.
12-12-79	Completed test at 0945 hours. Laid down guide shoe and ran Lynes 6-5/8" O.D. inflatable packer in the hole. Set center of packer element at 4477'. Swabbed tubing and ran test.
12-13-79	Completed test at 0900 hours. Unable to release packer, perforated packer using GO with 3 holes and laid down packer. Ran 2-3/8" O.D. tubing and 5-1/2" guide shoe to 4490'. Swabbed tubing and started test.
12-14-79	Completed test at 0800 hours. Pulled tubing and ran Lynes 6-5/8" O.D. inflatable packer and instruments in the hole on 2-3/8" O.D. tubing. Set center of packer element at 4476'. Swabbed tubing and started shut in test.
12-18-79	Test completed at 0800 hours. Released packer and pulled out of hole. Readings indicated test failed. Ran assembly back in the hole, tagged cement plug at 4489' and set center of packer rubber at 4476'. Started shut in test over.
12-21-79	Completed test. Pulled packer and instruments out of the hole. Ran Lynes 6-5/8" O.D. packer in the hole on 2-3/8" O.D. tubing and set center of packer at 4476.50'. Hung tubing in well head tubing hanger. Released rig and started test. Fluid level at 4364.5' by McCullough.
1-11-80	Fluid level at 4253.5' by McCullough.
1-16-80	Moved in Mack Chase Company's rig #19 and rigged up. Released packer and pulled tubing.
1-17-80	Ran Lynes 7" O.D. packer and instruments in the hole and set center of packer rubber at 4475.5'. Opened ports to test zone below packer to bottom at 4489'. Started test.
1-18-80	Continued test.
1-23-80	Completed test, released packer and pulled out of hole.

1-28-80	Tested zone from 4455' to 4488'. Laid down packer and tubing.
1-29-80	Ran Lynes 7" O.D. packer and instruments in the hole.
1-30-80	Set center of packer rubber at 4472' and tested zone from 4475' to 4488'.
1-31-80	Continued test.
2-1-80	Completed test at 0800 hours. Released packer and pulled out of hole. Ran Lynes 6-5/8" O.D. retrievable bridge plug in the hole and set bottom of packer at 4478'. Monitored zone from 4478' to 4488'.
2-2-80	Released tubing from pacer and pulled tubing, top of packer, body at 4461'. Ran Lynes 7" production packer and instruments in the hole on 2-3/8" O.D. tubing, set packer at 4448'. Started test.
2-3-80	Continued monitoring test, rig secured.
2-4-80	Continued monitoring test.
2-5-80	Completed test. Released packer and laid down. Recovered bridge plug and laid down.
2-8-80	Standby ready 0800 to 1600 from 2-6-80 through 2-8-80.
2-11-80	Rig secured from 2-8-80 to 0800 hours on 2-11-80. Standby ready. Installed blow out preventer with blind and 2-3/8" tubing rams.
2-12-80	Standby ready.
2-13-80	Pressure tested blowout equipment. Ran 2-3/8" O.D. tubing in the hole with a 6' joint on bottom that had been cut on a slant with a plate welded on bottom. Two 1/2" x 1-1/2" slots were cut in the sides of the tubing and one more slot cut in the plate. Tagged fill at 4488' and washed to 4490'. Displaced fluid in the hole with 350 barrels of 10# brine.
2-14-80	Filled hole with brine. Hung tubing at 4487.5' and set cement plug using Dowell with 20 barrels of CW100 chemical wash, 20 barrels of D104 spacer 1000, 200 sacks of 70% Class H cement, 30% Litepoz self-stress cement. The tubing was rotated while pumping spacer. Cement in place at 1130 hours. Pulled tubing to 4467' and displaced tubing with 420 barrels of brine. Pulled 122' of tubing and swabbed 54 barrels of fluid.

2-15-80	Waited on cement until 1200 hours. Tagged top of plug at 4473.98'. Laid down tubing and released rig.
2-18-80	Repaired casinghead.
2-25-80	Moved in Chase Drilling Company's Unit #12 and rigged up.
2-26-80	Ran 2-3/8" O.D. tubing in the hole and tagged cement plug at 4475'. Installed Sandia geophones on the tubing at 120' and 900' below surface.
2-27-80	Completed gas release test and pulled tubing.
2-28-80	Ran 7" O.D. Lynes production injection packer in the hole, found tight places at 1620' and 4176'. Set packer to test zone from 4465' to cement plug at 4475'.
3-4-80	Continued test from 2-28-80 to 0800 hours on 3-4-80 with rig secured. Released packer and laid down. Ran 2-3/8" O.D. tubing in the hole with slots on bottom, tagged cement plug at 4475', hole full of fluid. Closed blow out preventer rams around the tubing and pumped 8 barrels of water down the annulus at 1/2 barrel per minute at 80 psi, no returns. Increased rate to 2 barrels per minute at 150 psi and 4 barrels per minute at 300 psi. Pumped a total of 40 barrels of water, no returns. Pumped a total of 100 barrels of water down the annulus checking discharge for gas sample, no gas. Ceased pumping and flowed back the estimated volume pumped.
3-5-80	Pulled tubing and ran 7" Lynes test and treat-type packer in the hole, tagged cement plug at 4477' and set packer at 4465' and started test.
3-6-80	Continued monitoring test. Rig on standby ready.
3-7-80	Continued test to 0800 hours. Released packer and lowered to plug at 4477'. Reversed out fluid for gas samples. Reset packer at 4465' and continued test.
3-10-80	Rig secured from 3-7-80 to 0800 hours on 3-10-80. Continued monitoring test, rig on standby ready.
3-11-80	Continued test, rig on standby ready.
3-12-80	Continued test, rig on standby ready.

3-13-80	Continued test to 0800 hours. Released packer and laid down tubing.
3-14-80	Made up 7" production injection packer and ran in the hole. Tagged cement plug at 4477' and set packer at 4465'. Monitored test.
3-15-80	Continued test.
3-18-80	Rig secured from 3-15-80 to 0800 hours on 3-18-80. Continued testing. Rig on standby ready.
3-19-80	Continued testing with rig on standby ready.
3-20-80	Continued testing with rig secured.
3-21-80	Continued testing.
3-24-80	Rig secured from 3-21-80 to 0800 hours on 3-24-80. Monitored test. Released packer and pulled out of hole. Worked packer thru tight place at approximately 1650' and left outer rubber and 1/4" steel tube from the packer element in the hole.
3-25-80	Ran 5" spear, bumper sub and hydraulic jars in the hole on 2-3/8" O.D. tubing to 4477'. Worked tubing and recovered all of fish. Ran 7-7/8" bit and reamer in the hole and reamed from 1596' to 1720' to remove tight place, circulated no fluid. Laid down tools, lost 2" x 4" x 1/2" thick steel tong die in the hole.
3-26-80	Ran Lynes packer in the hole and tagged cement plug at 4477'. Displaced hole with fresh brine water and circulated. Attempted to set packer at 4465' with no results. Laid down packer.
3-27-80	Ran 6-5/8" Lynes production injection type packer in the hole and set at 4465'. Released rig.
4-3-80	Moved in Mack Chase Drilling Company's Unit #19 and rigged up. Swabbed tubing, no fluid in hole.
4-4-80	Rigged up Sandia wireline unit. Ran fluid probe. Prepared to run geophones.
4-5-80	Ran wireline geophones inside the 2-3/8" O.D. tubing.
4-6-80	Rig secured.

4-7-80	Pulled geophones out of the hole.
4-8-80	Made up a 5-1/2" O.D. pup joint with a 1" x 5" opening on bottom. Ran in hole on 2-3/8" O.D. tubing, tagged bottom at 4463' and washed to 4466', unable to lower deeper. Pulled out of hole and ran Lynes test and treat packer, could not set packer.
4-9-80	Ran a sinker bar inside the tubing and attempted to knock out obstruction. Attempted to circulate down the tubing, pressured up to 2000 psi. Pumped 22 barrels of water down the annulus at 150 psi, no returns. Laid down packer and found salt crystals had plugged tubing at 4404'. Ran production injection packer in the hole, tagged bottom at 4466' and set packer at 4453'.
4-10-80	Monitored test, rig on standby ready.
4-14-80	Rig secured from 4-10-80 to 0800 hours on 4-14-80. Continued monitoring test. Modified 6-5/8" O.D. x 66" Lynes hydrologic testing assembly.
4-15-80	Released packer and laid down. Ran 5-1/2" pup joint in the hole on the 2-3/8" O.D. tubing. Tagged bottom and washed from 4465' to 4477'. Laid down tubing.
4-16-80	Ran Lynes shut in test tool in the hole, tagged bottom at 4472' with 2000# weight and set packer at 4460'.
4-17-80	Continued test. Reset packer at 4456' and continued testing.
4-18-80	Laid down packer and ran 5-1/2" O.D. pup joint in the hole on 2-3/8" O.D. tubing, tagged bottom at 4472'. Swabbed tubing for gas test. Laid down tubing and released rig.
4-19-80	Moved out rig.

CORE RECORD

Core No.	Interval Feet	Feet Cored	Feet Recovered	% Recovery
1	3926 - 3932	6	7.60	127
2	3932 - 3982	50	45.95	92
3	3983 - 4033	50	51.70	104
4	4033 - 4083	50	50.20	100
5	4083 - 4135	52	53.40	103
6	4135 - 4185	50	49.15	98
7	4185 - 4235	50	50.02	100
8	4235 - 4285	50	50.35	101
9	4285 - 4331	46	46.60	101
10	4331 - 4381	50	49.30	99
11	4383 - 4432	49	49.70	101
12	4432 - 4482	50	50.10	100
13	4482 - 4532	50	50.10	100
14	4532 - 4583	51	51.01	100
15	4583 - 4614	31	31.10	100
16	4614 - 4664	50	50.25	101
17	4664 - 4714	50	51.40	103

NOTE: Core information taken from drilling records.

LOG INDEX

Type Log	Date	Run No.	Depth Driller	Depth Logger	Logged From	Logged To
BIRDWELL						
Magnetic Inclinometer Survey	3-27-79	1	3918'	3550'	1016'	3550'
Gamma Ray-Caliper	3-27-79	1	3918'	3917'	50'	3912'
DRESSER ATLAS						
Gamma Ray Neutron	3-31-79	1	3908'	3050'	0'	3050'
Compensated Densilog-Neutron	4-30-79	1	4734'	4733'	0'	4731'
BHC Acoustilog	4-30-79	1	4734'	4733'	1017'	4726'
Dual Laterolog - Micro Laterolog	4-30-79	1	4734'	4733'	1017'	4730'
Gamma Ray Neutron	6-7-79	2	4734'	4461'	0'	4459'
McCULLOUGH						
Gamma Ray	9/24-25-26/79	1	4734'	4489'	4300'	4489'
SPERRY-SUN						
Gyro	4-30-79	1	4734'	1000'	0'	1000'
Multishot	4-30-79	1	4734'	4734'	1000'	4734'

NOTE: Log information furnished by F&S/Carlsbad.

SURVEY MONUMENT "AS BUILT"

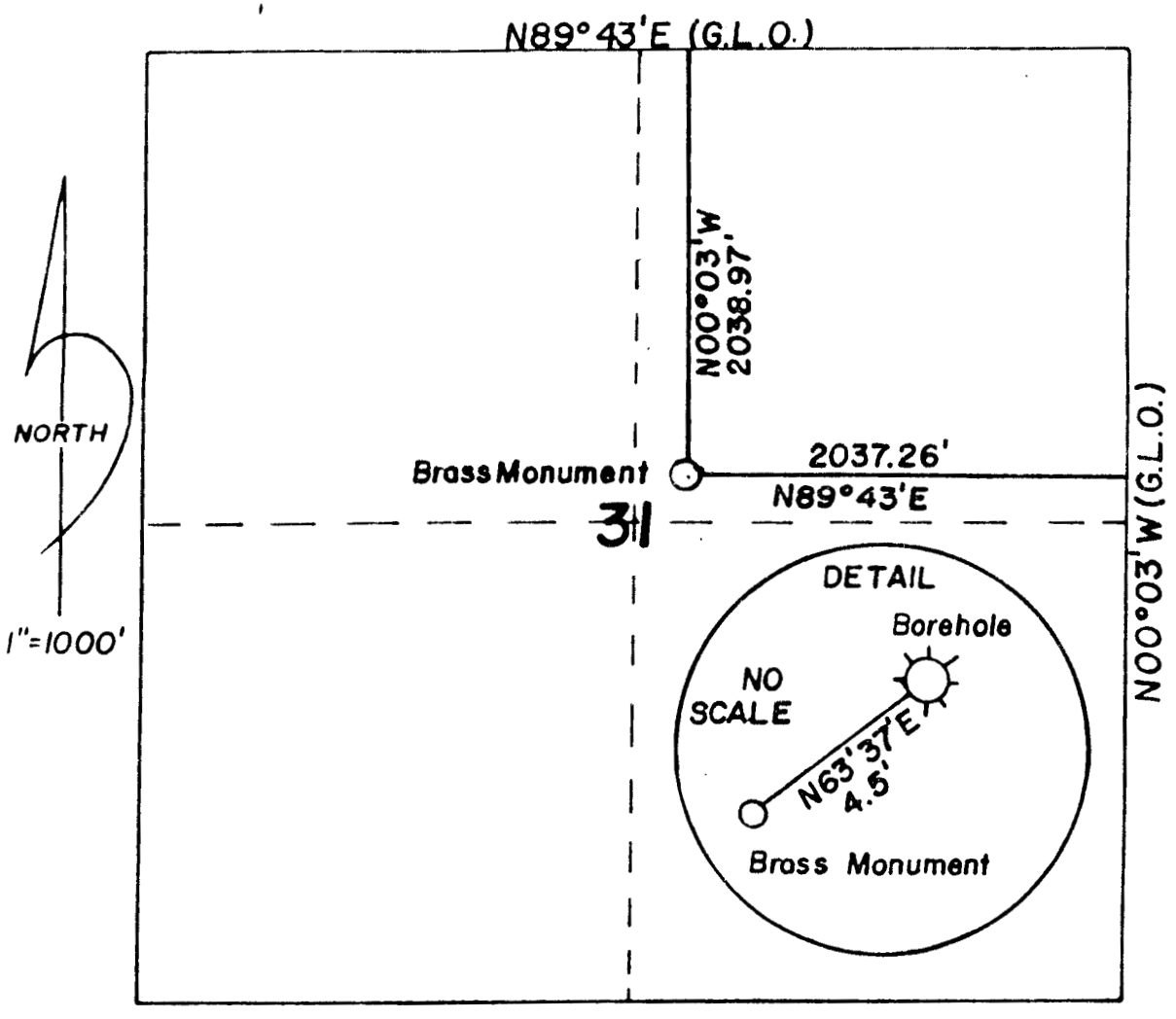
A.E.C. 7

SECTION 31, TOWNSHIP 21S, RANGE 32E N.M.P.M.

LEA COUNTY, NEW MEXICO

ELEVATION OF BRASS MONUMENT 3655.54'

2038.97 FNL & 2037.26 FEL



This is to certify that the foregoing plat was made from field notes of a bonafide survey made by me and is true and correct to the best of my knowledge and belief.

Dan R. Reddy

Dan R. Reddy

N.M.P.E. & L.S # 5412

DAN R. REDDY NEW MEXICO 5412 LAND SURVEYOR REGISTERED PROFESSIONAL ENGINEER

APPENDIX D

LOGS

compiled by

S-E. Shaffer
Division 9731
Sandia National Laboratories

AEC 7 Logs[1]

Log	Company	ELSI#2	Top of Logged Interval[3] (feet)	Bottom Logged Interval (feet)	Date
Caliper	Welex		1000	1646	6-20-75
Compensated Density	Welex		Surface	3913	4-19-74
Micro-Seismogram	Welex		750	976	6-27-75
Radioactivity	Welex		Surface	3913	4-19-74
Temperature	Welex		260	1647	6-20-75
Caliper	Welex		966	4460	6-07-79
Compensated Densilog Compensated Neutron	Dresser		Surface	4731	4-30-79
BHC Acoustilog	Dresser	W8621Z	1017	4726	4-30-79
Dual Laterolog Micro Laterolog	Dresser	W8621Y	1017	4730	4-30-79
Fluid Density	Dresser		2500	3050	3-31-79
Gamma Ray Neutron	Dresser		Surface	4459	6-07-79
Gamma Ray Caliper	Birdwell		50	3917	3-27-79
Magnetic Inclinometer Survey	Birdwell		1020	3500	3-27-79
Gamma Ray	McCullough		4300	4489	9-26-79
Gyro	Sperry-Sun		0	1000	4-30-79
Multishot	Sperry-Sun		1000	4734	4-30-79

[1]Original data is retained in Sandia WIPP Central File, Division 9732, Sandia National Laboratories, Albuquerque, NM 87185
[2]Order number for logs available through West Texas Electric Log Service, Inc. (ELSI), 105 West Wall Ave., Midland, TX.
[3]Depths measured from ground surface; elevation officially 3564' above MSL.