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Albuquerque District

RIO GRANDE FLOODWAY

Truth or Consequences Unit, NM



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CUCHILLO NEGRO DAM

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FOUNDATION REPORT, Volume III
Appendix E, Appendix F, and Appendix G

CONSTRUCTION FOUNDATION REPORTS
ER 1110-1-1801

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			RCC Dam, Earth Embankment, Auxiliary Spillway		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Cuchillo Negro Dam was completed in July 1991. The project, which is a dry, flood control only reservoir, consists of a main dam and an auxiliary spillway. The dam consists of a 750-foot-long earth embankment section and a 590-foot-long roller compacted concrete (RCC) section. The crest of the earth embankment section is 21 feet wide, and it is 25 feet wide for the RCC section. The dam has an overflow spillway and rises 134 feet above the channel bottom. The auxiliary spillway is an RCC lined spillway with a conventional concrete Ogee. It is 680 feet wide and extends from a point 260 feet from the right abutment of the RCC dam in a southeasterly direction. Numerous unanticipated geologic conditions were encountered during excavation of the foundation trench. This led to design changes and modifications to the contract.					
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APPENDIX E

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APPENDIX E

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Seismic Analysis Report

SEISMIC ANALYSIS REPORT
FOR
CUCHILLO NEGRO DAM SITE
SIERRA COUNTY, NEW MEXICO

SECTION 1 - INTRODUCTION

1.1 GENERAL

a. Authority. The authority for the preparation of this Seismic Analysis Report is contained in ER 1110-2-1806, dated 16 May 1983. Subject: Earthquake Design and Analysis for Corps of Engineers Dams.

b. Purpose and Scope. This report presents the results of seismic analysis studies for Cuchillo Negro Dam Site. These studies have been conducted by Tierra Engineering Consultants, Inc. under contract with the Albuquerque District, U.S. Army Corps of Engineers. A detailed geological and seismological review of all existing data was required to define the maximum earthquake. The design earthquake forms the basis for estimating ground motions felt at the site.

1.2 DESCRIPTION OF PROJECT

a. Location. The Cuchillo Negro dam site is located in the southeast quarter, section 35, T12S, R5W, Cuchillo 7.5 minute topographic quadrangle, Sierra County, New Mexico, approximately 6.3 miles northwest of Truth or Consequences, (T or C), (Figure 1). The dam site may be reached via I-25 north from T or C to state highway 52, west on state highway 52 to approximately 0.3 miles east of the center of the town of Cuchillo, then southeast via dirt roads in Cuchillo Negro Creek 2.5 miles to the dam site.

b. General Project Description. The Rio Grande Floodway was authorized by Section 203 of the Flood Control Act of 1948. Cuchillo Dam would be located on Cuchillo Negro Creek at the Cuchillo site and would retain the 100 year flood at this site. The dam would form a reservoir about 2.3 miles long with a capacity of 13,500 acre-feet at the spillway crest. The project consists of a roller compacted concrete section rising 119 feet above the streambed. The streambed alluvium at the damsite will be excavated to suitable rock (approximately 36 feet) and the ungated outlet works located approximately in the center of the dam. An earthfill embankment would extend from the RCC section to high ground on the left abutment. An RCC spillway would be located on a small unnamed tributary 800 feet south of the dam.

c. Dam. The earthfill embankment would be a zoned section having a 12-foot crest and 1V to 3H sideslopes. Seepage control would be provided by a semi-impervious core and inspection trench. Slope protection would be provided by 18-inches and 12-inches of dumped rock upstream and downstream, respectively.

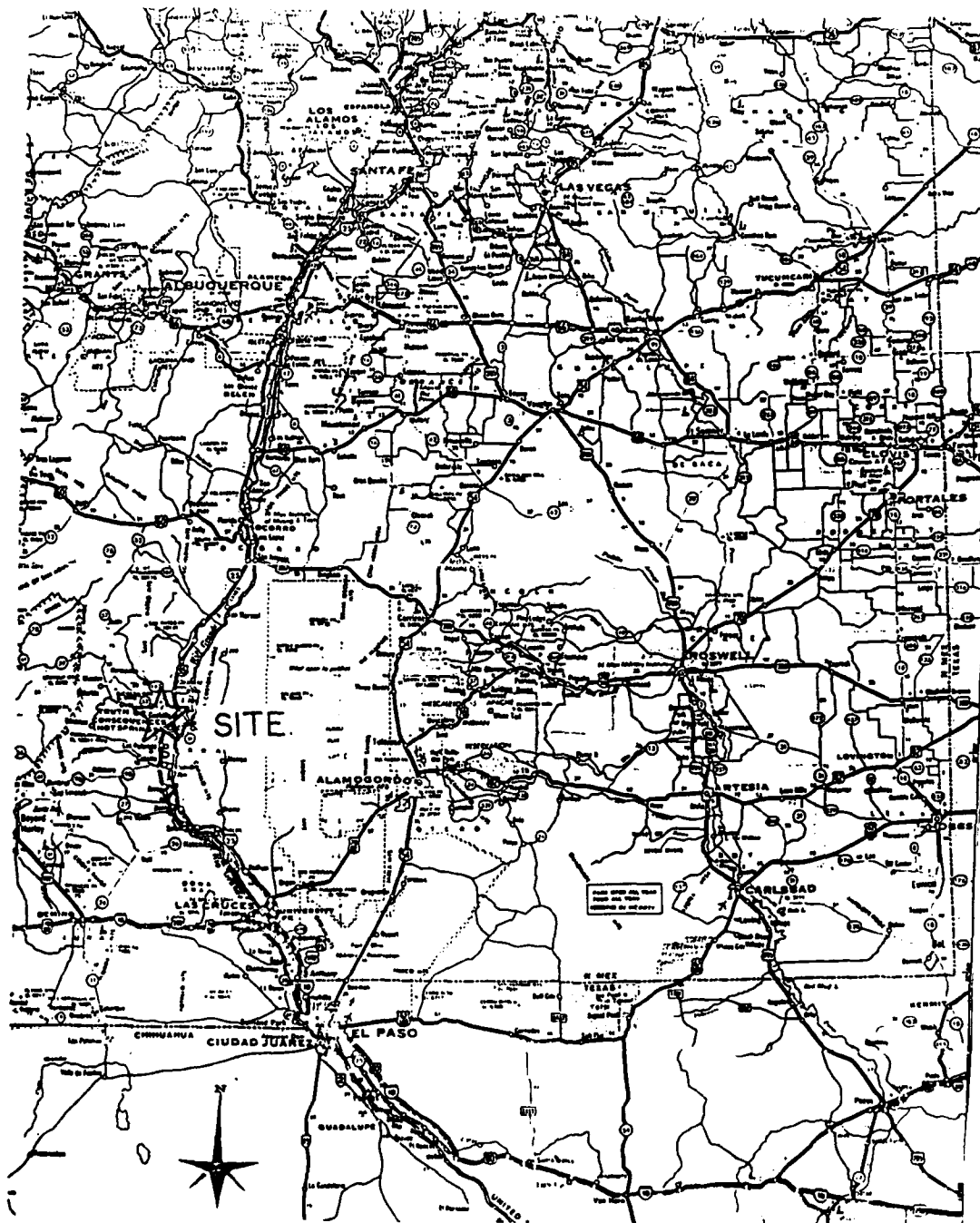


Figure 1
Map of New Mexico showing location of
Cuchillo Negro Dam Site

d. Outlet Works. The outlet works would consist of an intake structure with trashracks, an outlet conduit 111 feet long and a terminal energy dissipator. The reinforced concrete intake tower would be approximately 73 feet high.

e. Spillway. An RCC stepped spillway would be located on a small tributary 800 feet south of the dam on Cuchillo Creek. The structure would have a crest length of 1100 feet and a height above streambed of 71 feet. The upstream face would be vertical and the downstream slope would be comprised of steps 12 feet wide by 10 feet high. The ogee section, over the entire crest length, would be constructed of conventional concrete, two feet thick, as would the vertical faces of the stepped spillway. A small ungated outlet works with intake tower would be constructed for the spillway structure to pass low flows from the tributary drainage. The intake tower would be approximately 50 feet high with trashracks. An 800-foot wide overflow section would be excavated between the two drainage tributaries to provide access for the flood flows to reach the spillway structure.

f. Previous Studies. Studies of the Site Geology, construction materials and embankment design have been conducted by the Corp of Engineers. The results of these studies are included in the Formulation Plan for Cuchillo Negro dated 1986.

SECTION 2 - GEOLOGY

2.1 REGIONAL SETTING

The dam site is located along the west side of the Rio Grande rift in the Basin and Range physiographic province at the north end of the Mud Spring Mountains. The Mud Spring Mountains form the approximate boundary between the Engle basin to the north-northeast and the Palomas basin to the south-southwest (Figure 2). The Mud Spring Mountains, approximately 5.5 miles long and 1.5 miles wide, are a low, narrow range with a maximum relief of 1,400 feet above the floor of Cuchillo Negro Creek. Cuchillo Negro Creek is an ephemeral stream whose tributaries in the dam site area generally exhibit trellis drainage patterns. In the dam site area the valley of Cuchillo Negro Creek ranges in width from 2,000 feet to approximately 50 to 75 feet at the dam site.

The climate of the area is arid hot desert (Mueller, 1986). The vegetation consists of short desert grasses and creosote bush with minor mesquite trees and yucca. Mueller (1986) reports a mean annual temperature for T or C of 59.8 F with temperature extremes of 106 F July 14, 1979 and -5 F January 11, 1962. The average annual precipitation for the T or C area is 8.77 inches with extremes of 14.64 inches in 1972 and 3.36 inches in 1956. The record rainfall of 3.16 inches for a 24 hour period occurred on September 14, 1976.

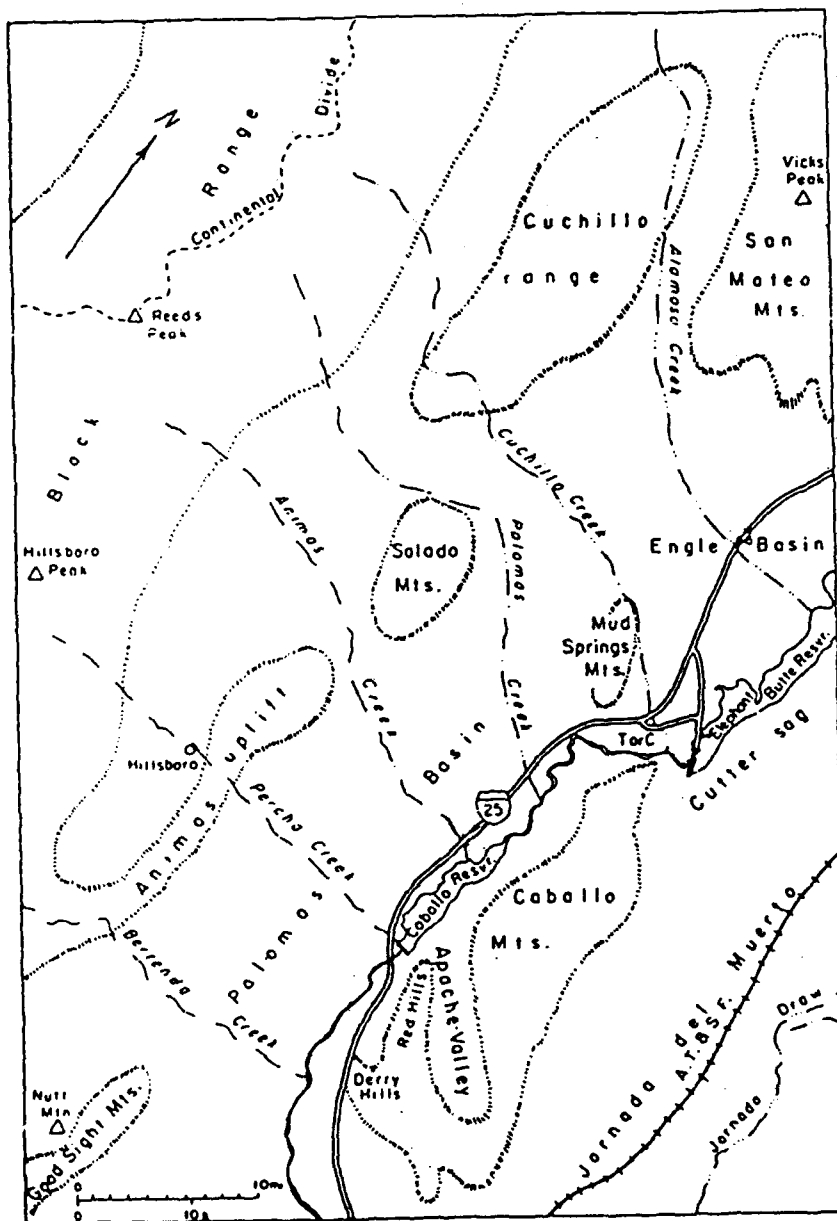
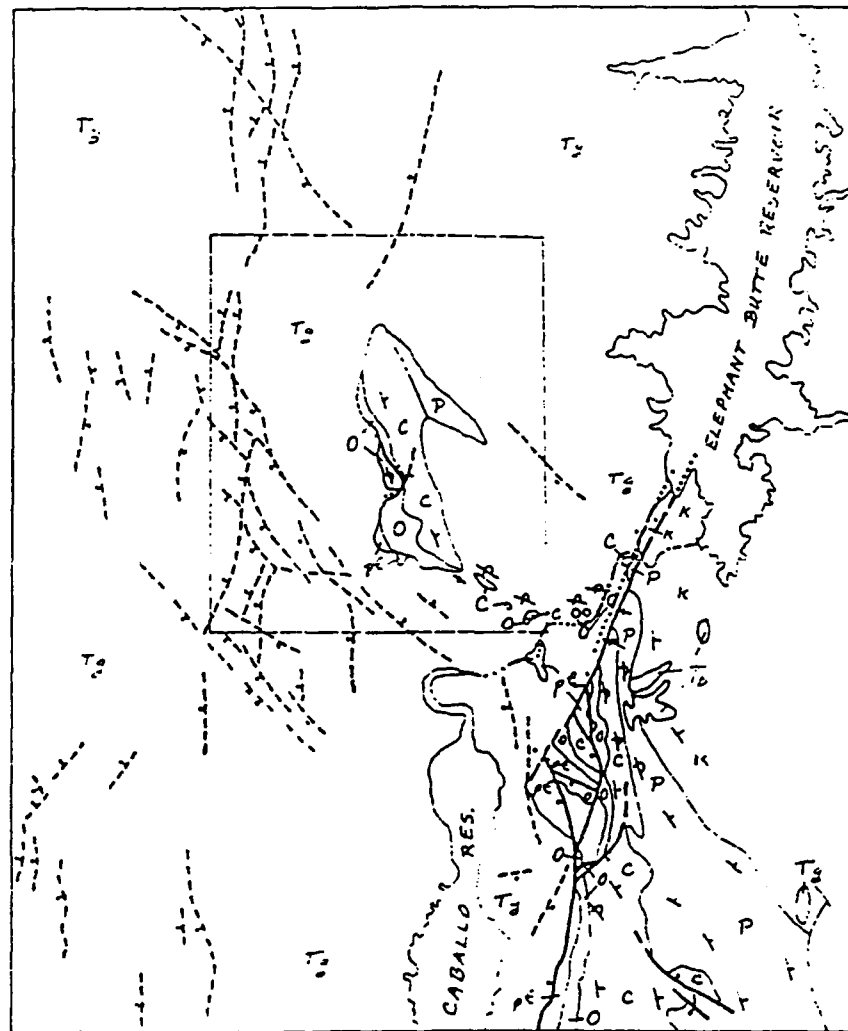


Figure 2
 Physiographic map showing location of the Mud
 Spring Mountains and T or C: Hawley and
 Seager, 1978



0 5 MILES
0 5 KILOMETERS

T ₃ Quaternary Basalt flows	— — Fault, bar and ball on downthrown side
T ₀ Tertiary gravels	--- --- Holocene fault
✓ Cretaceous rocks	—+— Generalized attitude of normal and overturned bedding
□ Permian rocks	
C Pennsylvanian rocks, with local Devonian Percha Shale	
O Ordovician rocks Cambrian sandstone at base	
Precambrian rocks	

Figure 3
Reconnaissance geologic map of the Cuchillo Quadrangle
and T or C area: Maxwell and Oakman, 1986

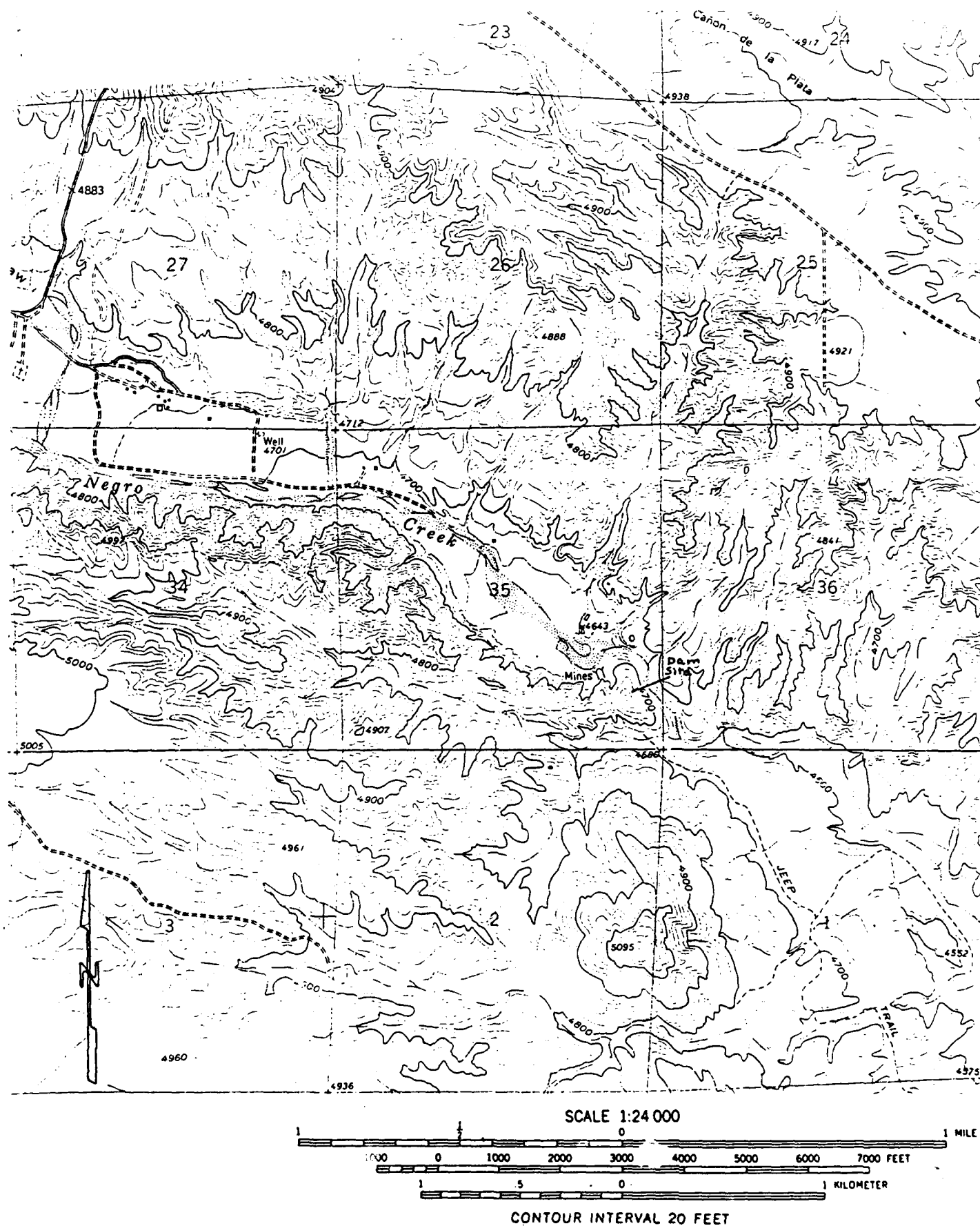


Figure 4
 Topographic map: Cuchillo 7.5 min. Quad., USGS
 E-7

2.2 Local Geology

The Mud Springs Mountains, a northeast dipping homoclinal structure is comprised of Precambrian through Pennsylvanian rocks. This northwest-southwest trending range abuts the Caballo uplift to the southeast along the northeast-southwest trending Hot Springs fault. This mountain range may be considered an intra-rift horst block. The block faulting appears to have commenced during the Laramide, + 70 mybp and appears to have been reactivated less than 10 mybp during Pliocene time as evidenced by deformation of Miocene sediments exposed in Cuchillo Negro Creek northwest of the north end of the Mud Spring Mountains. Figure 3 (Maxwell & Oakman, 1986) is a reconnaissance geologic map of the T or C area showing the regional geology. The far north end of the Mud Spring Mountains is just now being exposed by erosion. The thick sections of Miocene and Pliocene sediments that unconformably overly the Paleozoic section on the flanks of the Mud Springs Mountains were derived primarily from ancestral stream systems of what are now Cuchillo and Palomas creeks, with headwaters in the Black and Cuchillo ranges.

Figure 4 is a topographic map of the dam site area showing the location of the dam (Cuchillo Quad. 7.5 min. topo map USGS).

Figure 5 is a detailed geologic map of the dam site area (Maxwell and Oakman, 1986). Table 1, compiled from Maxwell and Oakman (1986) describes the lithologic units in the Cuchillo Negro dam site area shown on the geologic map. For a more detailed lithologic description the reader is referred to Maxwell and Oakman (1986).

TABLE 1

Description of Map Units

Qa1	<u>Alluvium (Holocene)</u> - unconsolidated sand, silt, and gravel. Includes some alluvial fan deposits and terrace gravels. <u>Terrace Gravels (Pleistocene)</u> - four levels of terraces have been developed on the slopes of the incised valleys.
Qt4	Youngest terrace, 20 - 30 ft above Cuchillo Negro Creek, silt, sand, gravel.
Qt3	Third terrace, 50 - 70 ft above Cuchillo Negro Creek, soil, sand, gravel, minor caliche.
Qt2	Second terrace, 90 - 120 ft above creek, soil, sand, gravel, poorly developed caliche.
Qt1	Oldest terrace, 150 - 200 ft above creek, 60 - 80 ft below Cuchillo pediment surface, caliche 2 - 4 ft thick, little soil or detritus.
Qtp	<u>Pediment deposits (Pliocene)</u> - silt, sand, gravel well-developed soil, developed on Palomas Gravels. Extensive Cuchillo surface very well developed on top of pediment surface.
Tpg	<u>Palomas Gravel (Pliocene)</u> - light-to-medium-gray lenticular gravel and sandy gravel interbedded with light-pink, tan and greenish-gray silt, sand, and conglomeratic sandstone, white sand, and moderate orange-red to brick-red and moderate green mudstone. Several altered ash beds near top of unit.
Tsf	<u>Santa Fe Group (Miocene)</u> - reddish-gray, pale-brown, and tan, slightly indurated conglomeratic and sandy mudstone, calcareous mudstone, and sandstone, in part tuffaceous.

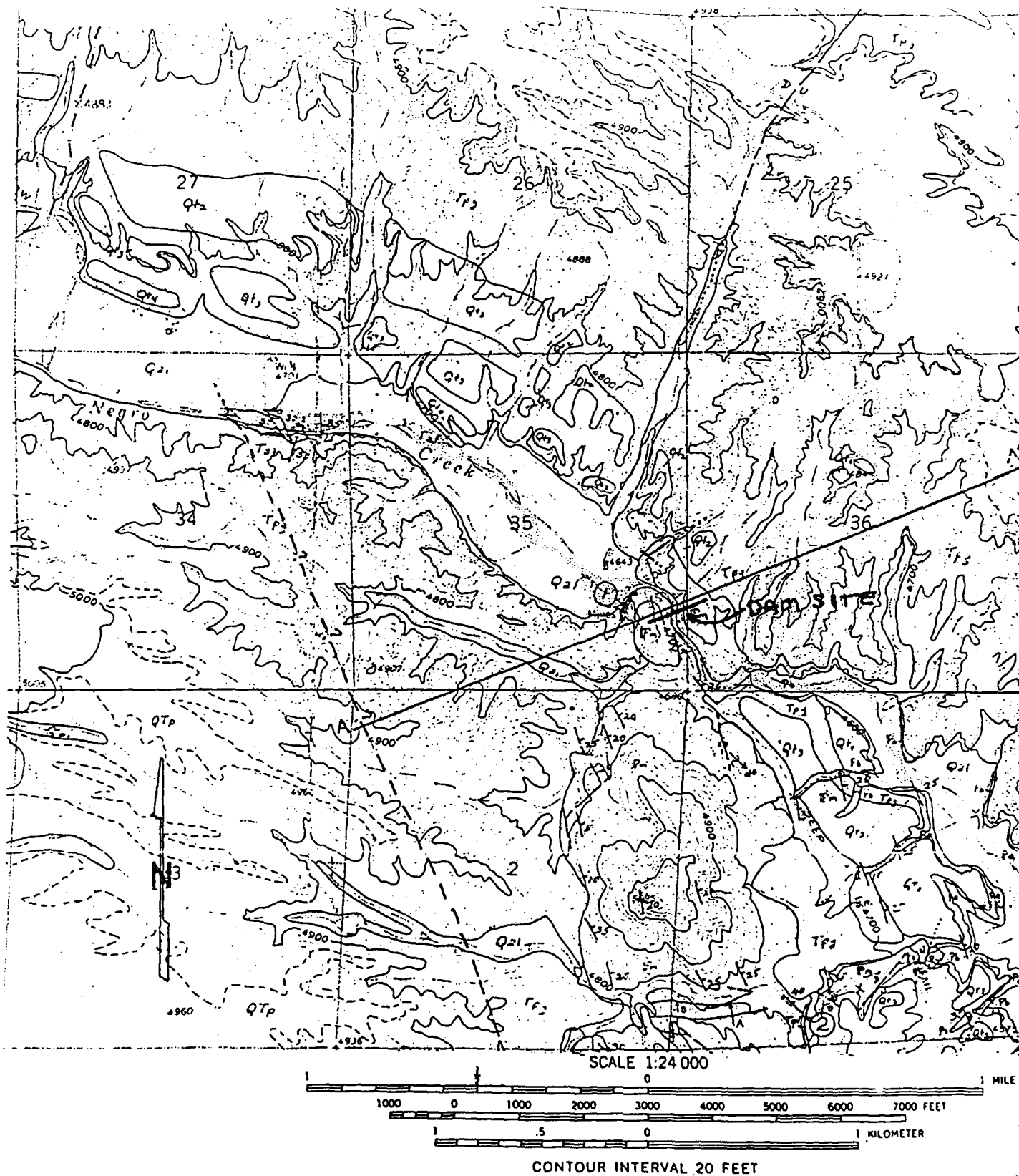


Figure 5
Detailed geologic map of the dam site area. Modified
from Maxwell and Oakman, 1986

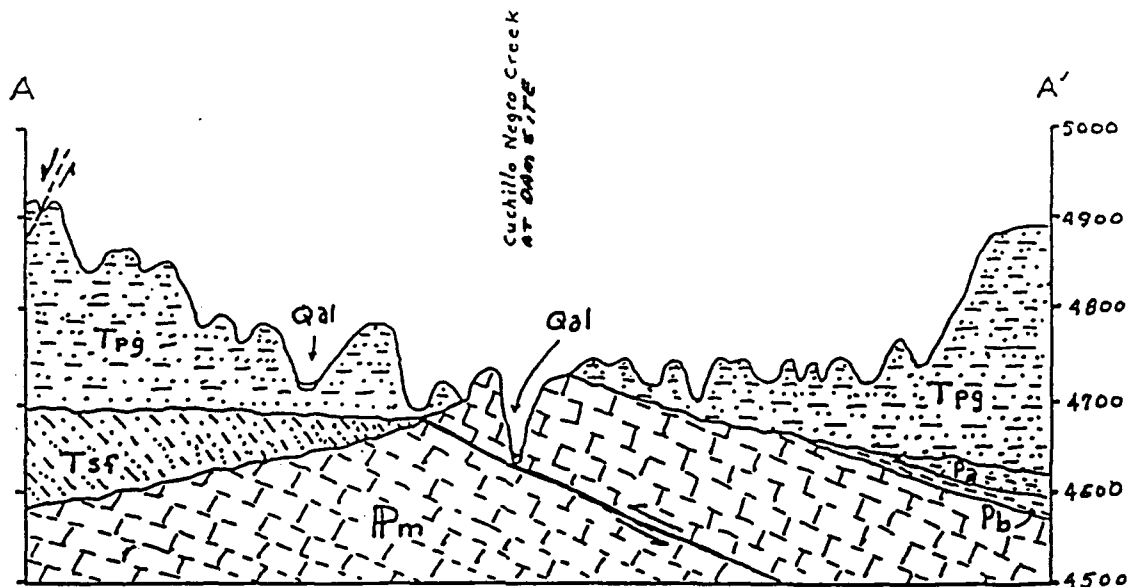


Figure 6
 Geologic Cross Section Looking Northwest, Cuchillo
 Negro Dam Site
 Horizontal scale: 1:24000
 Vertical scale: 1:2400
 Vertical exaggeration x10

Legend: Map and Cross Section

- CONTACT—Dashed where approximately located; dotted where concealed
- FAULT—Showing dip where measured. Dashed where approximately located or inferred; dotted where concealed. U, upthrown side; D, downthrown side. Arrows indicate relative lateral motion
- ANTICLINE
- SYNCLINE
- MONOCLINE—Showing trace and plunge of axis. A, anticlinal bend; S, synclinal bend
- DRAG FOLD—Showing plunge
- STRIKE AND DIP OF BEDS—Dot marks point of observation
- STRIKE OF VERTICAL BEDS
- STRIKE AND DIP OF OVERTURNED BEDS
- JASPEROID VEINS
- VEIN—Dashed where inferred
- MANGANESE MINERALIZATION
- F > FOSSIL LOCALITY
- * QUARRY
- MINE OR PROSPECT
- (3) SAMPLE LOCALITY

- Pa Abo Formation (Lower Permian) - dark-red shale and sandstone with minor lenses of orange-red arkosic sandstone and conglomerate and purplish-gray nodular calcareous mudstone.
- Pb Bursum Formation (Lower Permian) - moderate red, green, and purplish-gray shale and calcareous shale, minor red sandstone and gray limestone.
- Pm Madera Formation (Pennsylvanian) - upper part light-to-dark-gray thin-bedded shale, minor greenish-gray and reddish-gray siltstone and shale. Middle part thick to massive cherty limestone with thin gray shale interbeds. Lower part gray, thin-bedded, cherty limestone and calcarenite, light-gray and green, thin to thick shale beds.

The major faulting in the area commenced in the Laramide and was reactivated in the Pliocene. The throw on the range bounding faults of the Mud Springs Mountains can not be calculated as these faults are not exposed. However, the throw may be estimated in the thousands of feet. Faulting was again active during the Pliocene and remained active during the Pleistocene as evidenced by the faulted Pleistocene river terrace gravel deposits in sections 21 and 28, T12S, R5W, just west of the town of Cuchillo. The writer can not say with any degree of certainty that these faults are not active. There is, however some evidence for faulting in Recent (Holocene) geologic time, 10,000 years b.p. or younger west and north of the Mud Springs Mountains (Figure 3). The vertical displacement on these Pleistocene/Holocene faults appears to be no more than a few feet. The fault traces are indistinct and can only be inferred or approximately located. It is the writer's opinion that the only faults in the immediate area of the Mud Springs Mountains with the potential to be capable faults are the major range bounding faults which are not exposed and the Hot Springs fault which trends northeast-southwest just east of T or C. The Hot Springs fault does exhibit Pleistocene movement. There is some Pleistocene to Recent geologic faulting north and west of the mountains that tends to support the possibility that these range bounding faults are capable.

SECTION 3 - SEISMOLOGY

3.1 INTRODUCTION

The Cuchillo Negro dam site is in the Rio Grande rift in the New Mexico Basin and Range physiographic province. The Rio Grande rift is the most seismically active area in New Mexico. Most of the seismic activity occurs between Socorro and Albuquerque, (approximately 200 earthquakes have been recorded through 1980) and is attributed to the injection of magma at depth in the central part of the rift (Sanford, Olsen and Jaksha, 1980). The dam site is about 65 miles south southwest from Socorro and is outside the zone of high seismic activity.

3.2 EARTHQUAKE DATA

There have been several studies to estimate the size of an earthquake a given area can expect. Sanford, et. al., (1972) gave general projections of the magnitude of earthquakes within the Rio Grande Rift based on both historical records and on more recent instrument-detected earthquakes. Krinitzsky and Chang (1975) discuss the effects of distance on the intensity felt, for an earthquake of a give magnitude. They also discuss the ground motion produced by a given intensity shock. Bonilla and Buchanan (1970) give correlations between earthquake magnitude and the length of surface rupture. Bonilla (1970) gives corelations between earthquake magnitude and maximum displacement on a main fault. These references have all been used in developing the discussion which follows.

The nearest recorded earthquake to the dam site had its epicenter 28 miles south, southwest. That earthquake occurred January 31, 1939 and had a maximum intensity of IV (modified Mercalli) (Stover, Reagor and Algermissen, 1983).

Table 2 is a listing of the earthquakes reported felt in New Mexico prior to 1962 with maximum intensities (modified Mercalli) of V or greater (modified from Sanford, Olsen and Jaksha, 1981). The magnitudes for the earthquakes have been calculated using the proceedure set forth in Krinitzski and Chang (1975).

Figure 7, modified from Sanford, Olsen and Jaksha (1981) is a map of New Mexico depicting the data from Table 2. The large circle on the map centered at the dam site encompasses all the earthquakes within an 85 mile radius of the dam site, a total of 217 separate events through 1980 (Stover, Peagor and Algermissen, 1983). The maximum intensity of the epicenters inside the circle was an VIII (mM), 8 miles southwest of Socorro in 1906.

Figure 8, from Sanford, Olsen and Jaksha (1981), depicts the seismic events in New Mexico from 1962 through 1977. For a complete listing of all the recorded seismic events that occurred within New Mexico the reader is referred to Stover, Reagor and Algermissen (1983).

The May 3, 1887 earthquake with its epicenter located in the area of Batepito-Bavispe, Sonora, Mexico (Figure 9) represents a far field earthquake which may be felt at this site. The maximum intensity of this earthquake at the epicenter was XII (DuBois and Smith, 1980). The destruction of the towns was total. DuBois and Smith (1980) show a fault scarp 30 miles long resulting from this earthquake (Figure 9). The throw on the fault was up to 20 feet and the movement was right lateral. DuBois and Smith (1980) report there is additional geologic evidence (faults) indicating pre-1887 and post-1887 seismic activity in the region. Therefore the area is seismically active and the fault capable.

The effect of this earthquake in New Mexico was substantial. DuBois and Smith (1980) have calculated the maximum local intensity from recorded accounts of the shock in New Mexico.

Table 3 lists the maximum intensity (modified Mercalli) for various locals in New Mexico

TABLE 3

Location	Maximum Intensity (mM)
Albuquerque, Bernalillo Co, NM	VI
Cubero Mesa, Cibola Co., NM	VII
Deming, Luna Co., NM	VIII
Lake Valley, San Juan Co., NM	V
Las Cruces, Dona Ana Co., NM	VII
Las Vegas, San Miguel Co., NM	II
Mesilla, Dona Ana Co., NM	VI
Organ, Dona Ana Co., NM	V
Rio Grande Valley, NM	IV
Sabinal, Socorro Co., NM	IX
San Marcel, Socorro Co., NM	VII
Santa Fe, Santa Fe Co., NM	III
Silver City, Grant Co., NM	VIII

3.3 DESIGN EARTHQUAKE DEFINITIONS

Design earthquakes define the ground motion at the site of the structure.

a. Maximum Earthquake. The maximum earthquake is defined as the severest earthquake that is believed to be possible at the site on the basis of geological and seismological evidence.

b. Capable Fault. A capable fault is a fault that is considered to have the potential for generating an earthquake.

3.4 MAXIMUM EARTHQUAKE

The maximum earthquake for the site should be the earthquake that has the potential to produce the maximum ground motion. The three likely candidates for the Cuchillo Negro area are:

a. An earthquake along the western front of the Sierra Madres similar to the San Bernardino Valley, Sonora Mexico earthquake of 1887. This fault runs from near Douglas Arizona, south, a reported distance in excess of 50 kilometers. The fault is approximately 180 miles from Cuchillo Negro at its nearest location.

An earthquake originating along the Sierra Madres has the potential of producing an intensity of VII to VIII (mM) at Cuchillo Negro. Du Bois and Smith (1980) indicate geologic evidence of pre 1887 and post 1887 seismic activity in the region therefore the area is seismically active and the fault is capable.

b. An earthquake originating in the Socorro, area approximately 50 miles north.

An earthquake originating near Socorro, New Mexico has the potential of producing an intensity of VII to VIII (mM) at Cuchillo Negro.

c. A local earthquake originating in the near vicinity of the dam site. (See Figure 10).

The earthquake potential from a local source was evaluated based on the previous discussion of the range bounding faults in the vicinity of the Mud Springs Mountains. While the faults are not exposed and therefore cannot be evaluated there is some evidence for faulting in recent (Holocene) geologic time, 10,000 years b.p. or younger west and north of Mud Springs Mountains. This would indicate that the faults are capable.

A review of the fault trace presented as Figure 10 would indicate a potential fault length of about 20 to 25 miles.

A local fault is therefore capable and may have a fault length of 40 km. Assuming that 1/2 of the fault length could rupture and using the empirical relationships developed by Bonilla and Cuchanan (1970) and Bonilla (1970), which provide correlations between earthquake magnitude and the length of surface rupture a maximum earthquake of magnitude 6.0 is indicated. This relates to an intensity of VIII (mM).

3.5 GROUND MOTION

Krinitzsky and Chang (1975) present several graphs showing ground motions that can be expected, due to wave propagation, from earthquakes of different intensities and include the effects of distance from the source. Of particular note is the finding that peak velocities experienced at a site from near field and far field earthquakes are only slightly different. Peak accelerations however are substantially reduced from distant earthquakes.

Based on the above discussion, the earthquake likely to produce the maximum ground motion at the Cuchillo Negro site is the local event. A local earthquake having a magnitude of 6.0 was therefore selected as the design earthquake which is also the maximum earthquake.

An earthquake of magnitude 6.0, in the near field, has a 75% likelihood of a peak ground velocity of about 1.2 ft/sec or less; a peak acceleration of about 12.5 ft/sec (0.4 G's) or less, and a peak displacement of 0.52 feet or less. It should be noted that these figures refer to ground motions due to a shock and not to displacement along a surface rupture.

The intensity and duration of ground shaking are important characteristics of earthquake ground motion. The intensity of ground shaking relates to the magnitude of stress and strain induced in the soil; its duration affects the number of stress cycles to which the soil is subject. The duration is a function of the energy released, wave frequency, amplitude and distance from the epicenter. One measure of duration, called "bracketed duration", is the time during which the acceleration level equals or exceeds 0.05 G's. This threshold is used because of its approximate correspondence with the strong phase of ground shaking. Relations developed by Bolt (1973) indicate that for accelerations greater than 0.05 G's and a frequency greater than 1 hertz, the expected duration for the maximum earthquake would be about 11 seconds.

Table 2
Earthquakes reported felt in New Mexico prior to 1962
with maximum intensities (modified Mercalli) of V or
greater. Modified from Sanford, Olsen and Jaksha, 1981

Date mon/day/year	Origin time GMT hr/min/secs		Approximate location lat [°] N. long [°] W.		Magni- tude	Maximum intensity (Modified Mercalli)
Apr. 28, 1868			34.00	107.00	4.6	V
Apr. 1869			34.10	107.00	5.6	VII
1879			34.05	107.00	4.6	V
Jul. 6, 1886			34.00	107.05	4.6	V
May 3, 1887	22	50	30.81	109.21	8.1	XII
Jul. 12, 1893	13	30	35.00	106.40	4.6	V
Sep. 7, 1893			34.70	106.60	5.6	VII
Oct. 7, 1895			34.50	106.70	4.6	V
Oct. 31, 1895	12		34.05	107.05	5.1	VI
1897			33.95	107.00	5.1	VI
Jan. 20, 1904	2	10	33.95	107.05	5.1	VI
Jan. 20, 1904	9		34.10	107.10	4.6	V
Jan. 30, 1904	12	30	34.10	107.05	4.6	V
Mar. 9, 1904	7	30	34.10	107.00	4.6	V
Sep. 6, 1904	11	30	34.10	106.95	4.6	V
Jul. 2, 1906	10	15	34.15	107.10	5.1	VI
Jul. 12, 1906	12	15	33.95	106.95	6.1	VII to VIII
Jul. 16, 1906	19		34.00	106.95	6.1	VIII
Nov. 15, 1906	12	15	34.05	106.95	6.1	VIII
Jul. 18, 1913			34.00	107.00	-	?
Dec. 6, 1913	0	15	34.10	106.80	-	?
May 28, 1918	11	30	35.45	106.10	5.6	VII
Feb. 1, 1919	20	30	34.00	107.10	4.6	V
Aug. 13, 1924	4	23	36.00	104.50	4.6	V
Dec. 3, 1930	21	36	35.00	106.40	5.1	V to VI
Feb. 3, 1931	23	45	35.10	106.45	4.6	V
Feb. 5, 1931	4	48	35.00	106.45	5.1	VI
Jan. 8, 1934	1	32	34.05	107.10	4.6	V
May 7, 1934	5	22	32.70	108.20	4.6	V
Feb. 21, 1935	1	25	34.50	106.80	5.1	VI
Feb. 21, 1935	3	5	34.55	106.80	4.6	V
Dec. 18, 1935	5	33	34.80	106.80	5.1	V to VI
Dec. 19, 1935	1	57	34.80	106.85	5.1	V to VI
Sep. 17, 1938	17	20	33.20	108.60	5.1	VI
Sep. 20, 1938	5	40	33.25	108.60	4.6	V
Sep. 29, 1938	23	34	33.25	108.65	4.6	V
Nov. 1, 1938	1	26	33.00	108.70	5.1	V to VI
Nov. 27, 1938	0	13	33.20	108.65	4.6	V
Dec. 28, 1938	22	7	33.20	108.70	4.6	V
Jun. 4, 1939	1	15	33.25	108.75	4.6	V
Aug. 4, 1941	7	40	34.15	107.05	4.6	V
Nov. 6, 1947	16	50	35.00	106.40	5.1	VI
May 23, 1949	7	22	34.60	105.20	5.1	VI
Aug. 3, 1952	20	42	36.50	105.00	4.6	V
Aug. 17, 1952	10	45	35.50	106.20	4.6	V
Oct. 7, 1952	9	20	37.00	106.00	4.6	V

Table 2, cont.

Date mon/day/year	Origin time			Approximate location		Magni- tude	Maximum intensity (Modified Mercalli)
	GMT			lat	long		
	hr	min	secs	ON.	OW.		
Nov. 3, 1954	20	39		35.10	106.70	4.6	V
Aug. 3, 1955	6	39	42.0	37.00	107.30	5.1	VI
Aug. 12, 1955	16	20		35.70	106.10	4.6	V
Apr. 26, 1956	3	30		35.10	106.30	4.6	V
Jul. 22, 1960	15	49		34.30	106.85	4.6	V
Jul. 23, 1960	14	15		34.35	106.85	5.1	VI
Jul. 24, 1960	10	37		34.30	106.80	4.6	V
Jul. 3, 1961	7	6		34.10	106.95	5.1	VI

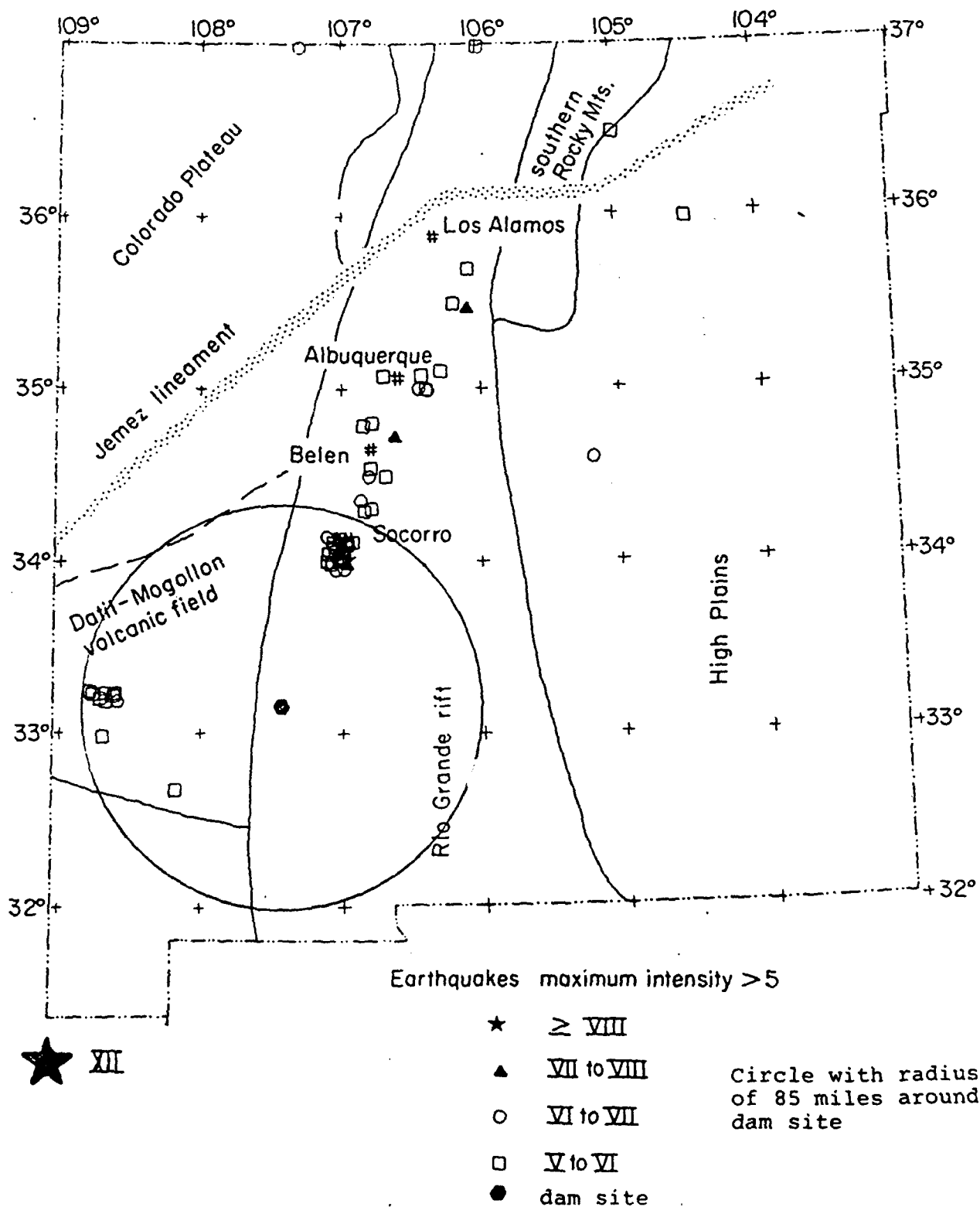


FIGURE 7-LOCATIONS OF EARTHQUAKES REPORTED PRIOR TO 1962 with maximum intensities of V or greater. Also shown on the map are the major physiographic provinces in New Mexico. From Sanford, Olsen and Jaksha, 1981

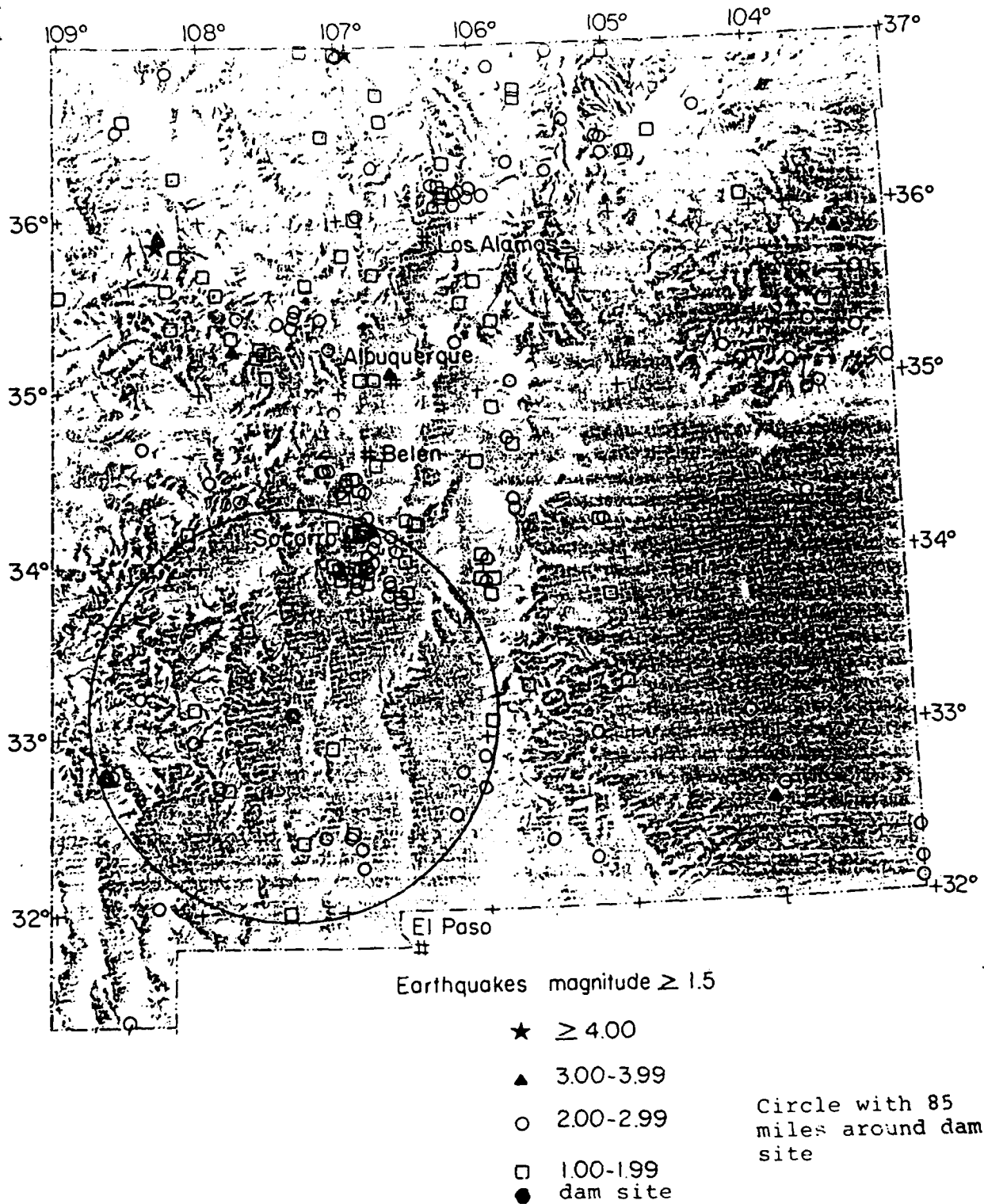


FIGURE 8—INSTRUMENTAL EPICENTERS FOR EARTHQUAKES ($M \geq 1.5$) recorded during the period 1962-1977. From Sanford, Olsen and Jaksha, 1981

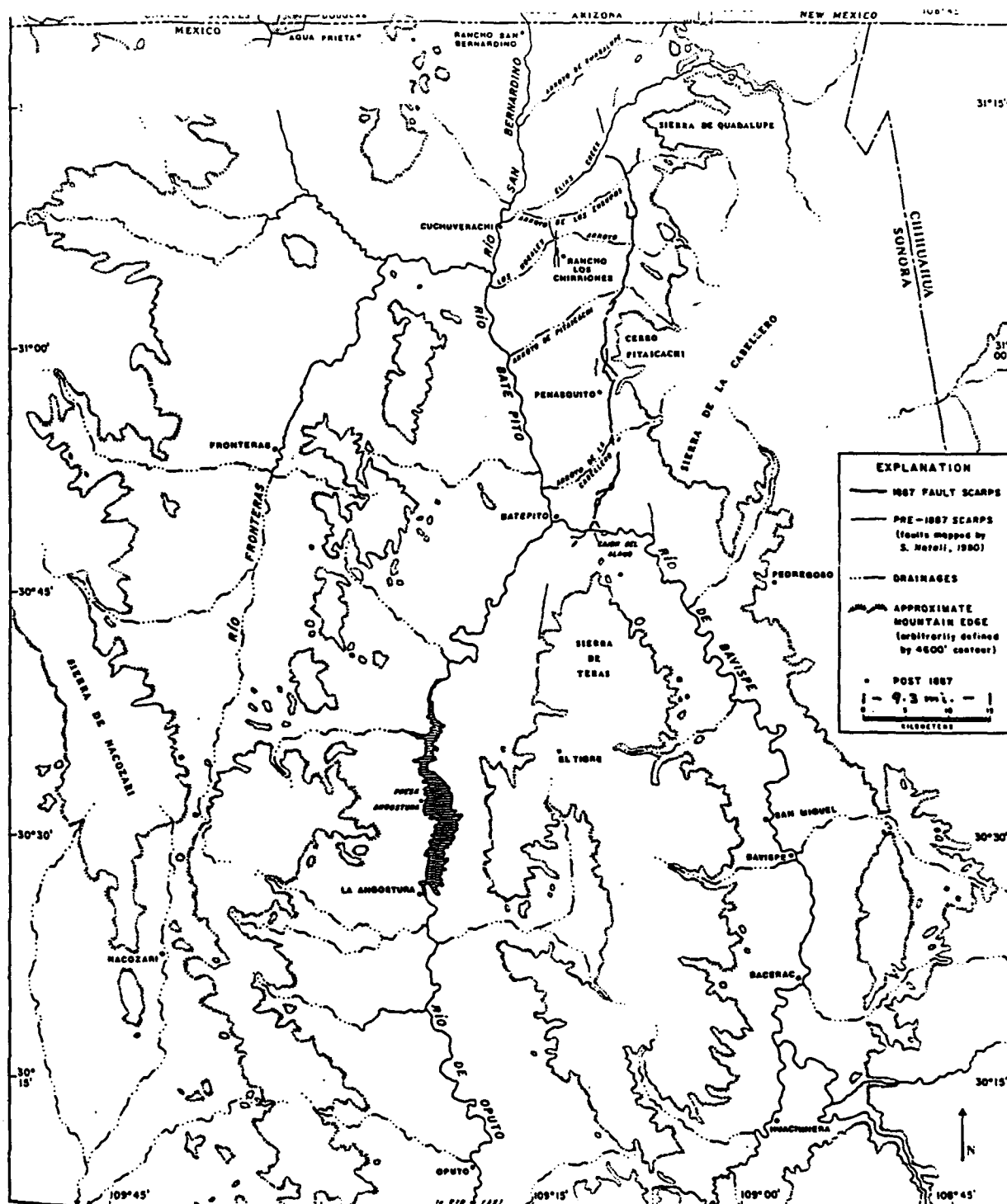
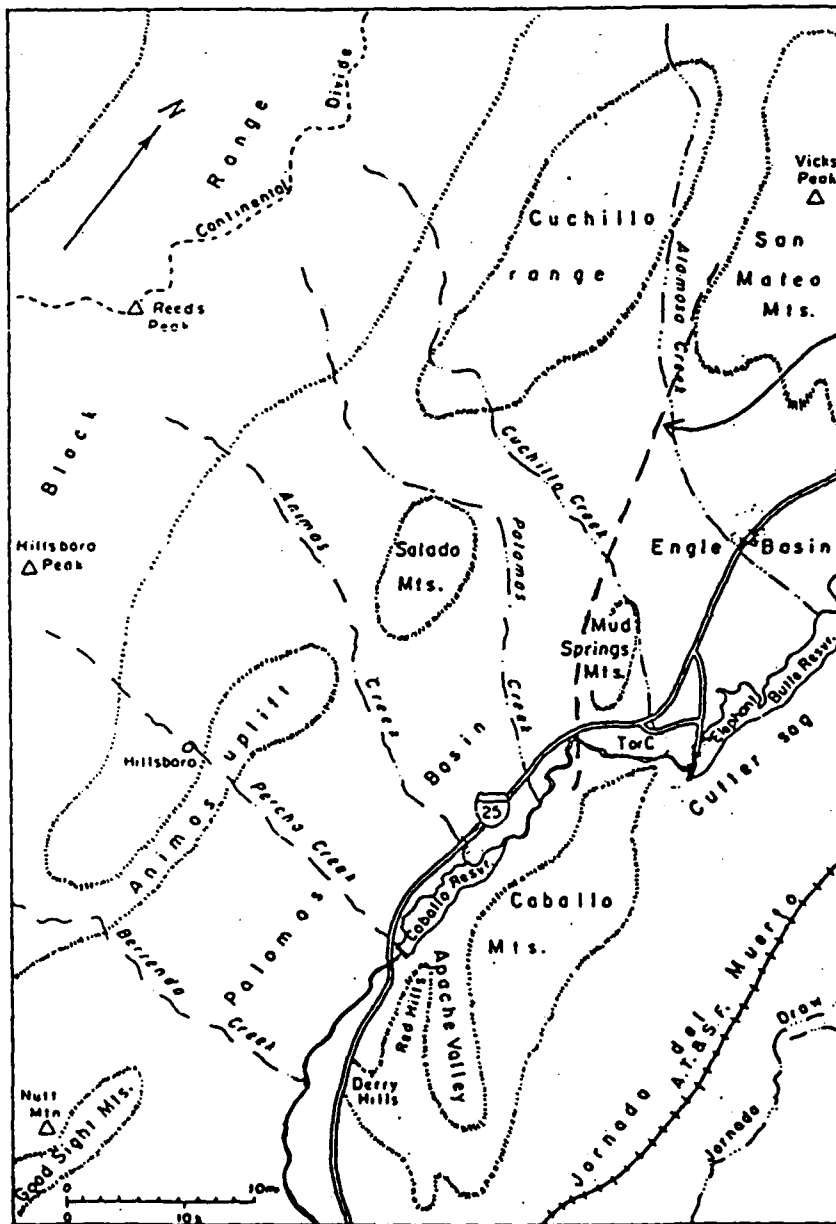


Figure 9
Area of San Bernardino Valley, Sonora, Mexico. The epicenter for the May 3, 1887 earthquake (mM XII) was somewhere between Batepito and Bavispe. From DuBois and Smith, 1980



Approximate location of fault trending N.W. on west side of Mud Springs Mountains Location is approximate as there is no surface expression. The fault probably joins up with range bounding fault on the west side of the San Mateo mountains. The range bounding fault is visible in the San Mateo Mountains. The southern boundary of the fault is probably the Hot Springs fault or it might be part of the Hot Springs fault system. (See Figure 3)

FIGURE 10

SECTION 4 - CONCLUSIONS

4.1 GENERAL

The objective of this study was to determine the maximum earthquake. This has been accomplished by: 1) A study of regional and local geology in order to identify capable faults and assess the magnitude of events that might be associated with rupture of these faults. 2) A seismic risk study which includes historical seismicity as well as geologic data.

4.2 MAXIMUM EARTHQUAKE

Based upon historic and geologic evidence (fault size), the maximum earthquake that could occur would be felt at the Cuchillo Negro Dam site as an Intensity VIII or magnitude 6 event, from within the Mud Springs Mountain Fault Zone. This event could produce peak accelerations of up to 0.4 G's, a peak ground velocity of up to 1.2 ft/sec and a peak displacement up to 0.5 feet, with a duration of 11 seconds.

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Probability of Combined Earthquake and Flood

PROBABILITY OF THE COMBINED OCCURRENCE OF A SEISMIC EVENT AND FLOOD RISK-STORAGE

5.1 The probability of an earthquake and flood-storage occurring simultaneously during the lifetime of a dam depends upon the return periods (frequency of occurrence) of the earthquake and the flood, the duration of the floodwater storage, and the expected design life of dam. Combined risk in this report is defined as the probability of the simultaneous occurrence of an earthquake and flood storage at least once during the lifetime of the dam. The following equation developed by Hynes (1978), was used to compute the combined risk for such an event:

$$\text{Combined Risk} = 1 - \left[1 - \left(1 - \left(1 - \frac{1}{52T_i} \right)^n \right) \right] \frac{1}{T_j} K$$

Where:

T_i - Annual return period of an earthquake exceeding magnitude i .

T_j - Annual return period of a flood exceeding storage level j .

n - Duration of floodwater storage in weeks.

K - Design lifetime of dam.

5.2 An anticipated life of 100 years was assumed for the project. Duration of floodwater storage was based on the PMF year flood routing. The duration of storage, n , used in the calculations was the PMF routing of 84 hours total duration. The SPF routing was only slightly shorter in duration at 77 hours. The duration of flows over the spillway crest are 33 and 19 hours respectively for the PMF and SPF. The PMF routing was the most conservative figure and was used for all of the calculations. Flood return periods of 10, 20, 50 and 100 years were used in the calculations. In order to present comparative levels of risk, three different earthquake return periods were used to compute combined risk. The results are summarized in the table below.

COMBINED RISK OF SIMULTANEOUS OCCURRENCE
OF FLOOD STORAGE AND EARTHQUAKES
Design Life K = 100 Years

CONDUIT INVERT (NGVD)	FLOOD RETURN PERIOD T_j (YEARS)	DURATION OF STORAGE n (WEEKS)	EARTHQUAKE RETURN PERIOD T_i (YEARS)	ASSUMED COMBINED RISK PER 100 YEARS.
4681	25	0.5	10	3.84×10^{-3}
4681	50	0.5	10	1.92×10^{-3}
4681	100	0.5	10	9.62×10^{-4}
4681	25	0.5	20	1.92×10^{-3}
4681	50	0.5	20	9.61×10^{-4}
4681	100	0.5	20	4.81×10^{-4}
4681	25	0.5	50	7.69×10^{-4}
4681	50	0.5	50	3.85×10^{-4}
4681	100	0.5	50	1.92×10^{-4}
4681	25	0.5	100	3.85×10^{-4}
4681	50	0.5	100	1.92×10^{-4}
4681	100	0.5	100	9.62×10^{-5}

Reference: Hynes, M.E., "Notes on Joint Occurrence of Earthquakes and Floods", U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, March 1978.

Geophysical Investigation Report



DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P.O. BOX 631
VICKSBURG, MISSISSIPPI 39180-0631

REPLY TO
ATTENTION OF

CEWES-GH-I

8 JUL '87

MEMORANDUM FOR: Commander, U.S. Army Engineer District, Albuquerque, ATTN:
CESWA-ED-TA (Mr. Jim McAdoo), P.O. Box 1580, Albuquerque, NM 87103-1580

SUBJECT: Transmittal of Geophysical Test Results, Cuchillo Negro Dam Site,
New Mexico

1. As requested by Mr. Jim McAdoo of your office, I am sending you the results from the geophysical investigation conducted at Cuchillo Negro Dam Site, New Mexico (encl 1).
2. If you have any questions, please contact Mr. T. B. Kean II (FTS 542-2961) or Mr. J. R. Curro, Jr. (FTS 542-2235), respectively.

FOR THE COMMANDER AND DIRECTOR:

ROBERT W. WHALIN, PhD, PE
Technical Director

Encl

GEOPHYSICAL INVESTIGATION AT THE CUCHILLO NEGRO DAM SITE,
NEW MEXICO

Background

1. During the period 25 March through 1 April 1986, personnel from the Earthquake Engineering and Geophysics Division, Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station, conducted surface seismic refraction tests in support of the U.S. Army Engineer District, Albuquerque (CESWA), Cuchillo Negro Dam Site project. The purpose of these tests was to determine the compression-wave (P-wave) velocities of the in-situ material and the depth to competent rock in the proposed left abutment area. These data will be used in conjunction with other geotechnical studies to be performed by the CESWA, to determine the best location for the left abutment and to develop a construction excavation plan.

Site Description

2. The site was located in Serra County, New Mexico, along the Cuchillo Negro Creek near Truth or Consequences, New Mexico. The site was divided into two areas of investigation. Each of the two areas consisted of a "finger" or ridge trending away from Cuchillo Creek in a northeasterly direction, as shown in Figure 1. The materials at the site consisted of bedded limestone with layers of shale and sandstone of varying thickness and frequency. This system of limestone, shale, and sandstone is identified as the Santa Fe Formation and dips 20 to 25 degrees to the northeast. The near-surface material was made up of cobbles and sandy clay.

Test procedures and surveys conducted

3. Test procedures and data interpretation techniques were performed in accordance with Appendix B, EM 1110-1-1802, Geophysical Exploration, dated May 1979. In the seismic refraction tests, a seismic signal is generated at or near the ground surface by a small explosive charge or hammer blow to a steel plate. This seismic signal is detected by an array of geophones placed at selected intervals and extending in a straight line on the ground surface away from the source. The geophone responses were recorded using a 12-channel

seismograph. The surface seismic refraction tests were performed to determine the P-wave velocities of the geologic materials at the site and the depths to interfaces between materials with contrasting velocities. The interpretation of the data assumes that velocity increases with depth; thus, it is not possible with a seismic refraction survey to detect velocity inversions, i.e., a low velocity layer underlying a higher velocity layer.

4. Twelve surface seismic refraction lines, designated R1 through R12, were run at the site (See Figure 1). Six of the surveys were conducted on Ridge No. One, and six were conducted on Ridge No. Two. Seismic lines R1, R8, R9, R10, R11, and R12 were 130 ft long and had 10-ft geophone spacings. Seismic lines R4 and R7 were 325 ft long with 25-ft geophone spacings. Lines R2, R3, and R5, were 625 ft in length and line R6 was 575 ft long with 25-ft geophone spacings. The lengths of the lines above are from the source location at one end of the line to the source location at the other end.

Test Results

5. The basic data acquired from the forward and reverse traverses of each line are displayed as conventional P-wave arrival time versus distance (T/D) plots in Figures 2 through 13 for lines R1 through R12, respectively. The P-wave velocity of each layer and depths to layer interfaces beneath the source locations are indicated in the figures under "computed seismic profile." These velocity and depth data were used to construct P-wave velocity profiles for seismic lines R1 through R3 and R11 and R12, as shown in Figure 14, and for lines R5, R6, and R8 through R10 which is presented in Figure 15. Lines R4 and R7 were run perpendicular to the lines in the profiles as shown in Figure 1, therefore will be discussed separately.

6. Referring to Figure 14, a four-layer profile appeared to exist for Ridge No. One. The near-surface material exhibited velocities ranging from 940 to 1,300 fps and had a thickness of 1.5 to 3.5 ft. Layer Two had velocities ranging from 2,000 to 2,240 fps and extended to depths varying between 11 and 24 ft where the third layer began and extended to depths varying from 91 to 118 ft with a velocity range of 4,340 to 6,510 fps. The fourth layer exhibited a velocity range of 11,250 to 11,660 fps and extended to an undetermined depth. This layer is considered to be competent rock.

7. For line R4, the data presented in the T/D plot (Figure 5) showed two velocity layers. The first zone had a velocity of 1,870 fps where the second layer exhibited a 4,870 fps velocity. These velocities agree well with those for layers 2 and 3 of the profile in Figure 14. Since shotholes and 25-ft geophone spacings were used in the conduct of line R4, the near-surface layers (940-1,300 fps) in Figure 14 was probably not detected, therefore the depths presented above may be slightly shallow.

8. Referring to Figure 15, a five-layer velocity profile was interpreted for Ridge No. Two. The near-surface materials of Zone One had velocities ranging from 1,170 to 1,450 fps with thicknesses varying from 1.5 to 8.5 ft. The underlying layer, with velocities ranging from 2,120 to 2,510 fps, extended to depths between 14 and 17.5 ft. Zone Three, with velocities ranging from 3,160 to 4,960 fps, extended to depths varying from 32.5 to 69.5 ft. Layer Four exhibited velocities of 7,000 to 7,790 fps and extended to depths between 112 and 122 ft where the fifth zone was encountered with velocities ranging between 10,140 to 11,510 fps and extended to an undetermined depth. This latter zone is indicative of competent rock.

9. For line R7, the data in the T/D plot (Figure 8) indicated a three-layer velocity system. The first layer had a velocity of 2,090 fps and extended to depths of 6 to 18 ft. The second zone exhibited a 3,190 fps velocity to depths varying between 34.5 and 38.5 ft where a 7,630 fps zone was detected to an undetermined depth. These velocities agree well with those for Zones 2, 3, and 4 of the profile in Figure 15. Since shotholes and 25-ft geophone spacings were used in the conduct of line R7, it is possible that the near-surface zone (1,170-1,450 fps) shown in Figure 15 was not detected, therefore the depths presented above may be slightly shallow.

Conclusions

10. The following conclusions were drawn from the seismic investigation conducted at the site:

- a. Ridge one had a four-layer P-wave velocity profile. The near-surface zone ranged from 940 to 1,300 fps with thicknesses of 1.5 to 3.5 ft. The second zone had velocities ranging from 2,000 to 2,240 fps and extended to depths ranging between 11 and 24 ft. Zone Three exhibited velocities varying between 4,340 and 6,510 fps and extended to depths of 91 to 118 ft. The fourth zone of 11,250 to 11,660 fps is indicative of competent rock and extended to an undetermined depth.

- b. Area Two of this study exhibited a five-layer velocity profile. The first zone had velocities ranging between 1,170 and 1,450 fps. The thickness of this near-surface material ranged between 1.5 and 8.5 ft below the ground surface. Zone Two had velocities of 2,120 to 2,510 fps to depths of 14 to 17.5 ft where Zone Three was encountered with velocities ranging from 3,160 to 4,960 fps to depths varying between 32.5 and 69.5 ft. Zone Four exhibited velocities of 7,000 to 7,790 fps to depths between 112 and 122 ft where the final zone was encountered with velocities of 10,140 to 11,510 fps. This zone is indicative of competent rock.

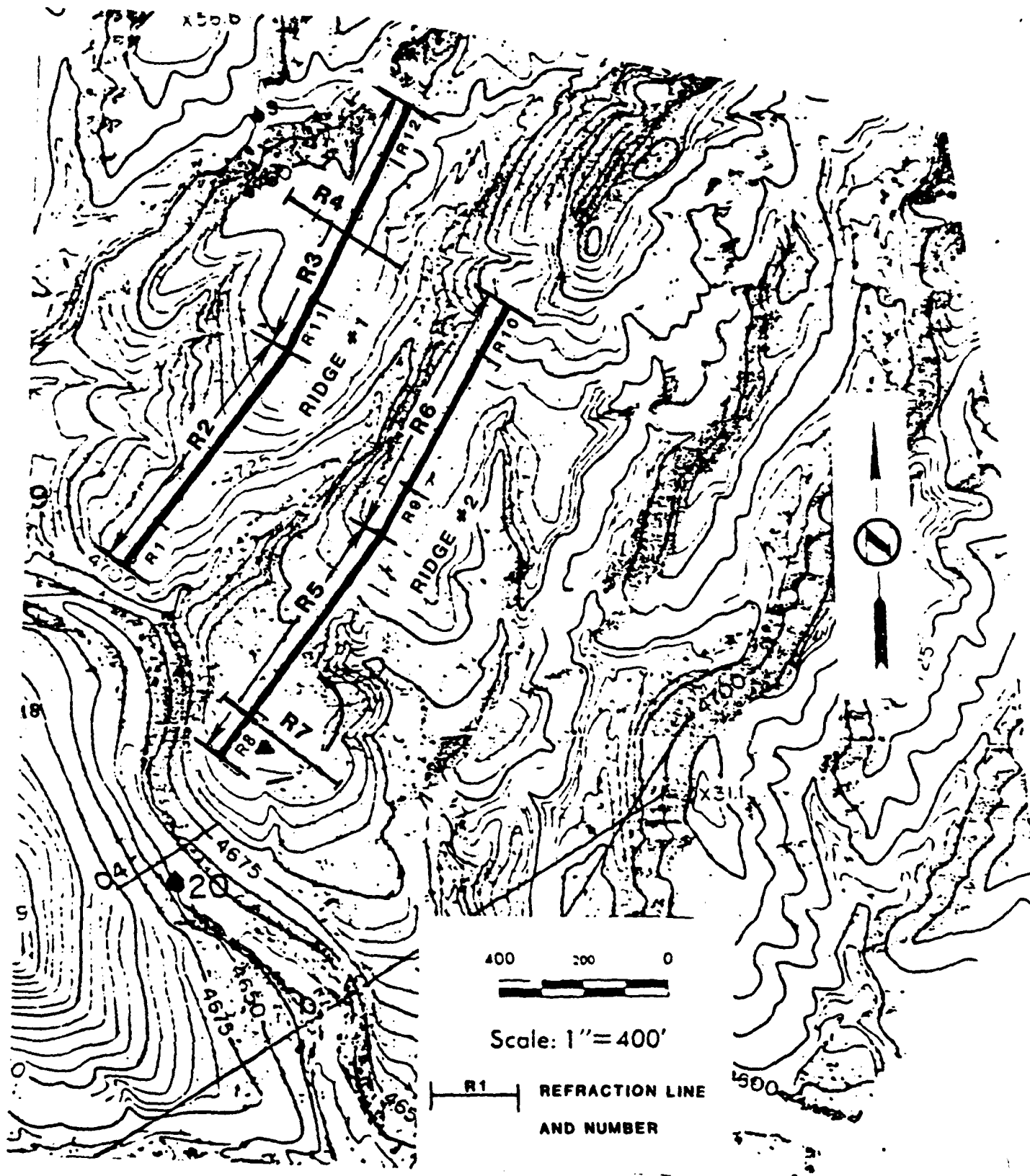


Figure 1. Seismic investigation site map

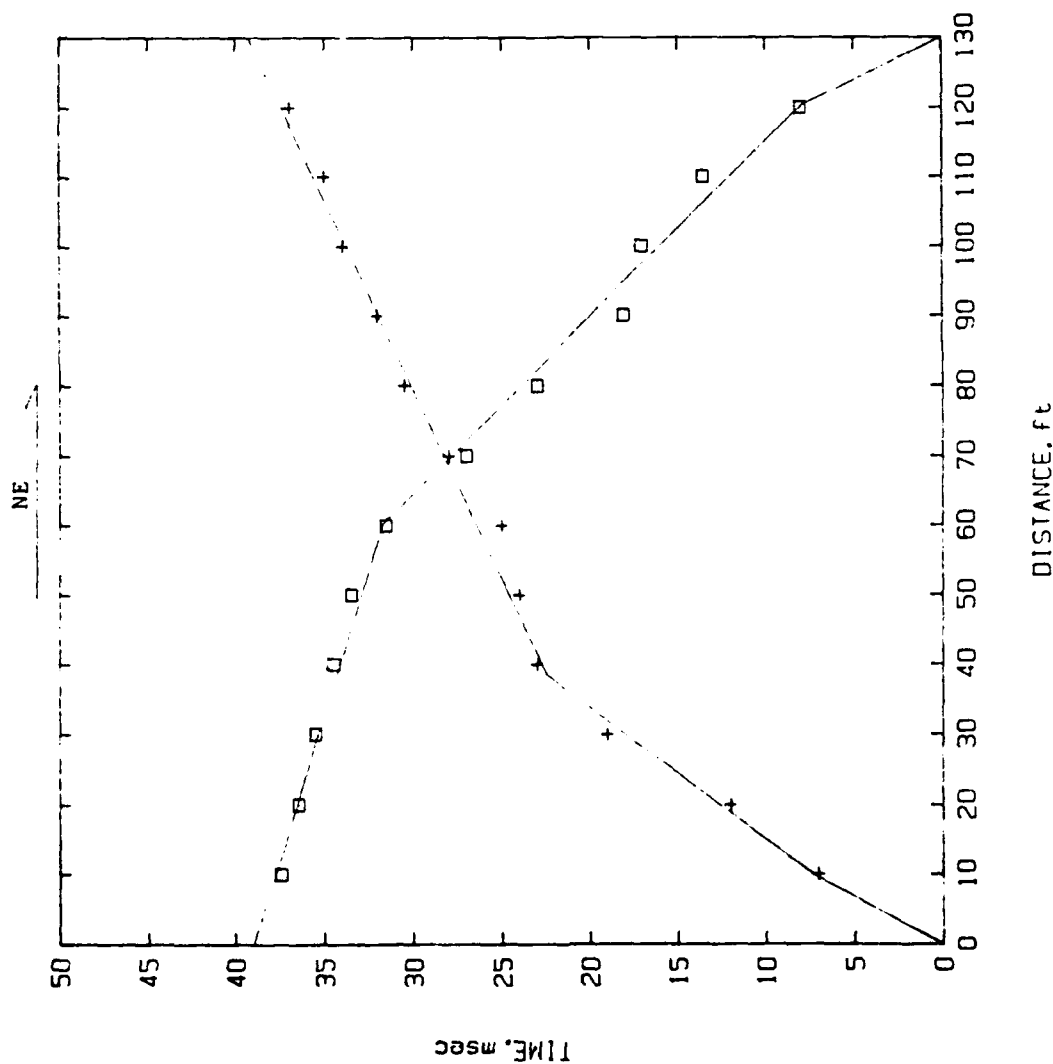
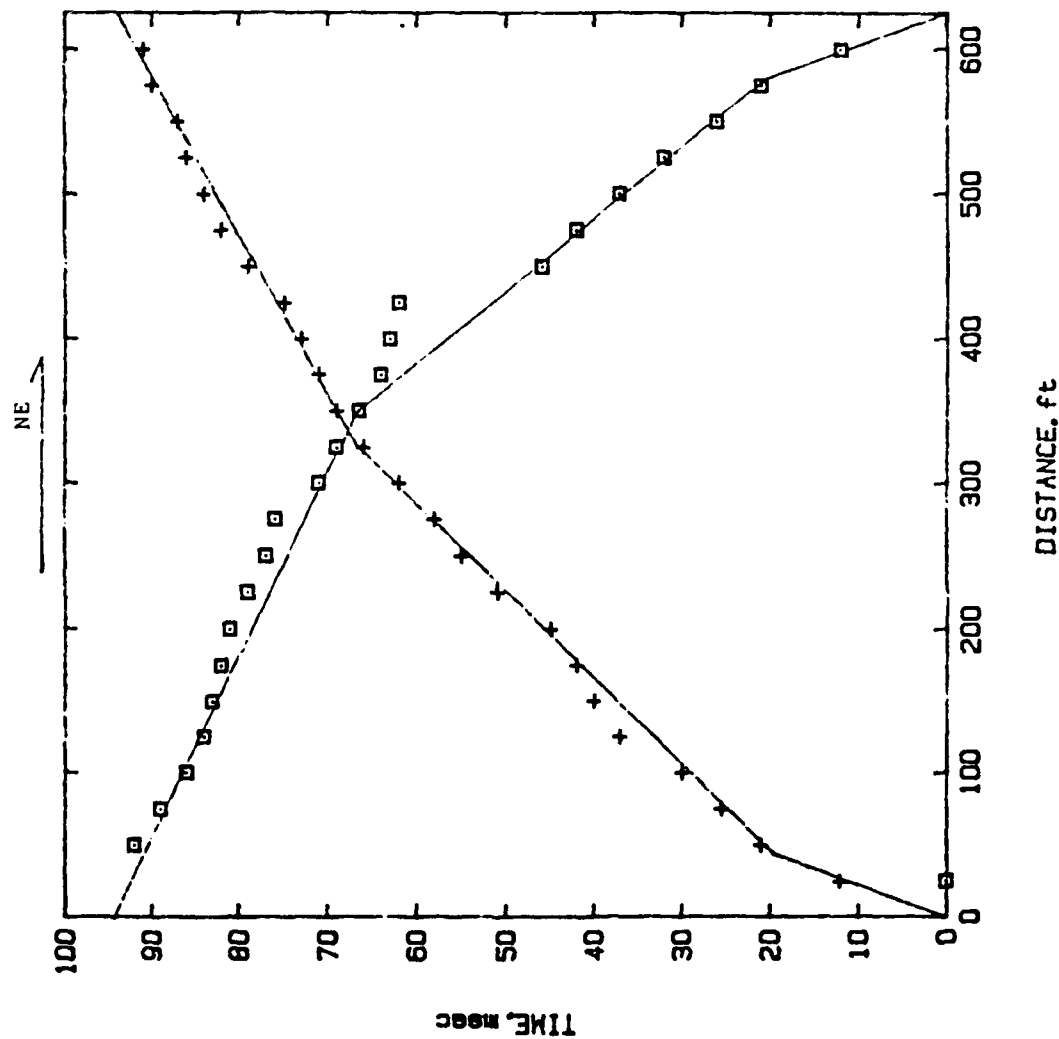


Figure 2. P-wave arrival time versus distance, Line R1



CH2NM

*** INPUT DATA ***

FORWARD REVERSE

LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	2240	0.0	2230	0.0
2	5081	12.2	4988	11.3
3	11008	37.2	12870	44.9

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	REV. FT.
1	2240		
2	5430	15.0	14.0
3	11000	89.5	115.0

Figure 3. P-wave arrival time versus distance, Line R2

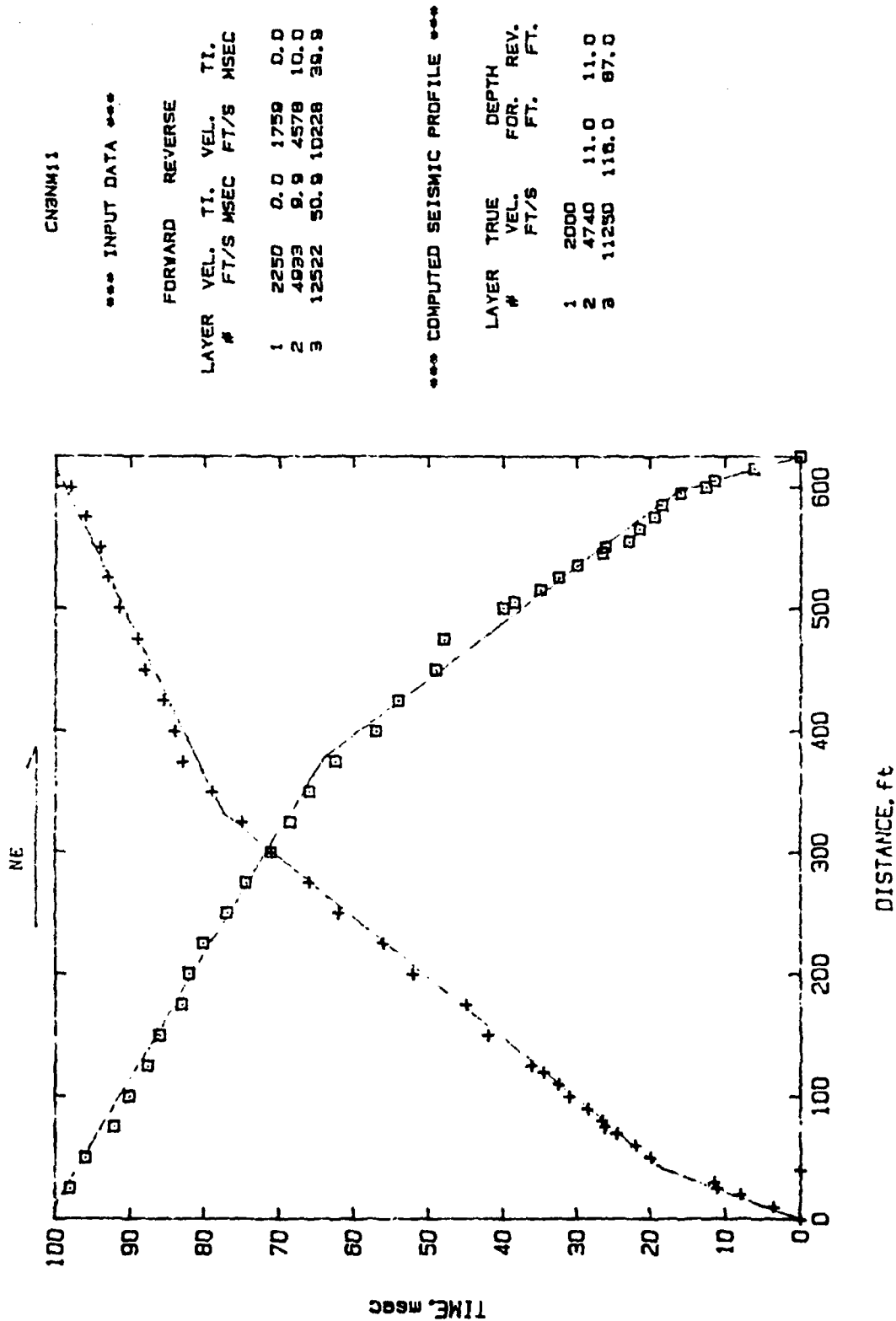


Figure 4. P-wave arrival time versus distance, Line R3

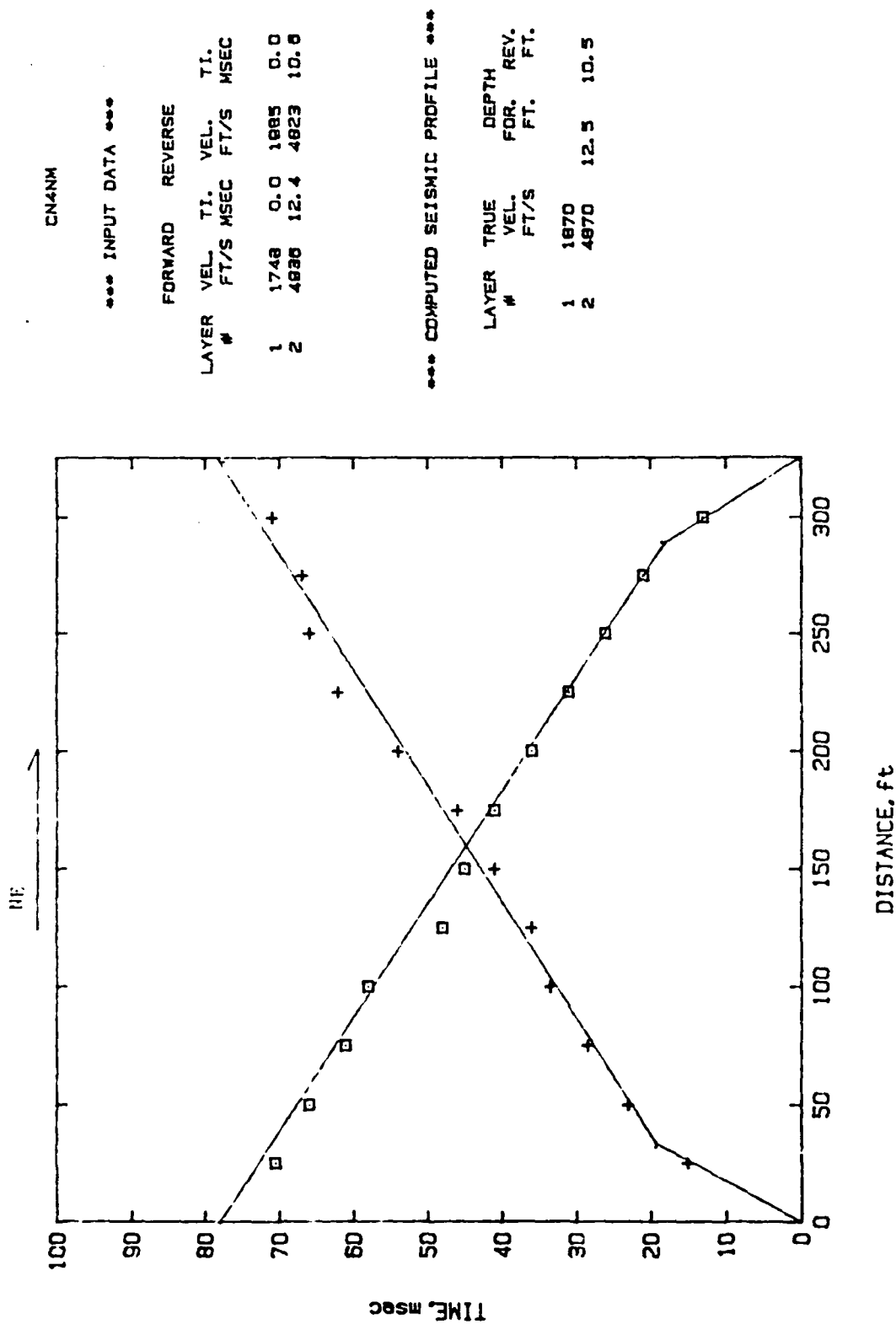


Figure 5. P-wave arrival time versus distance, Line R4

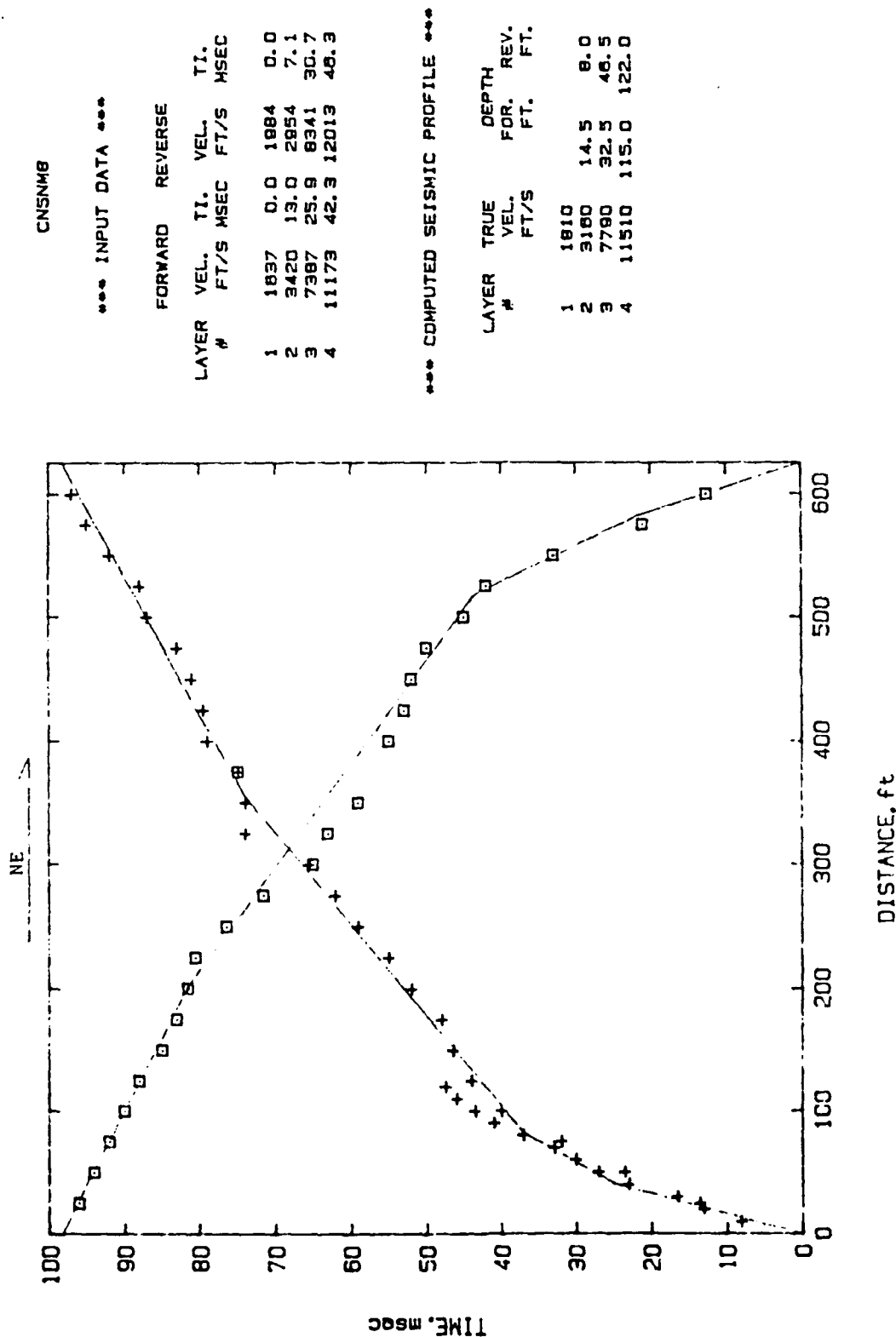
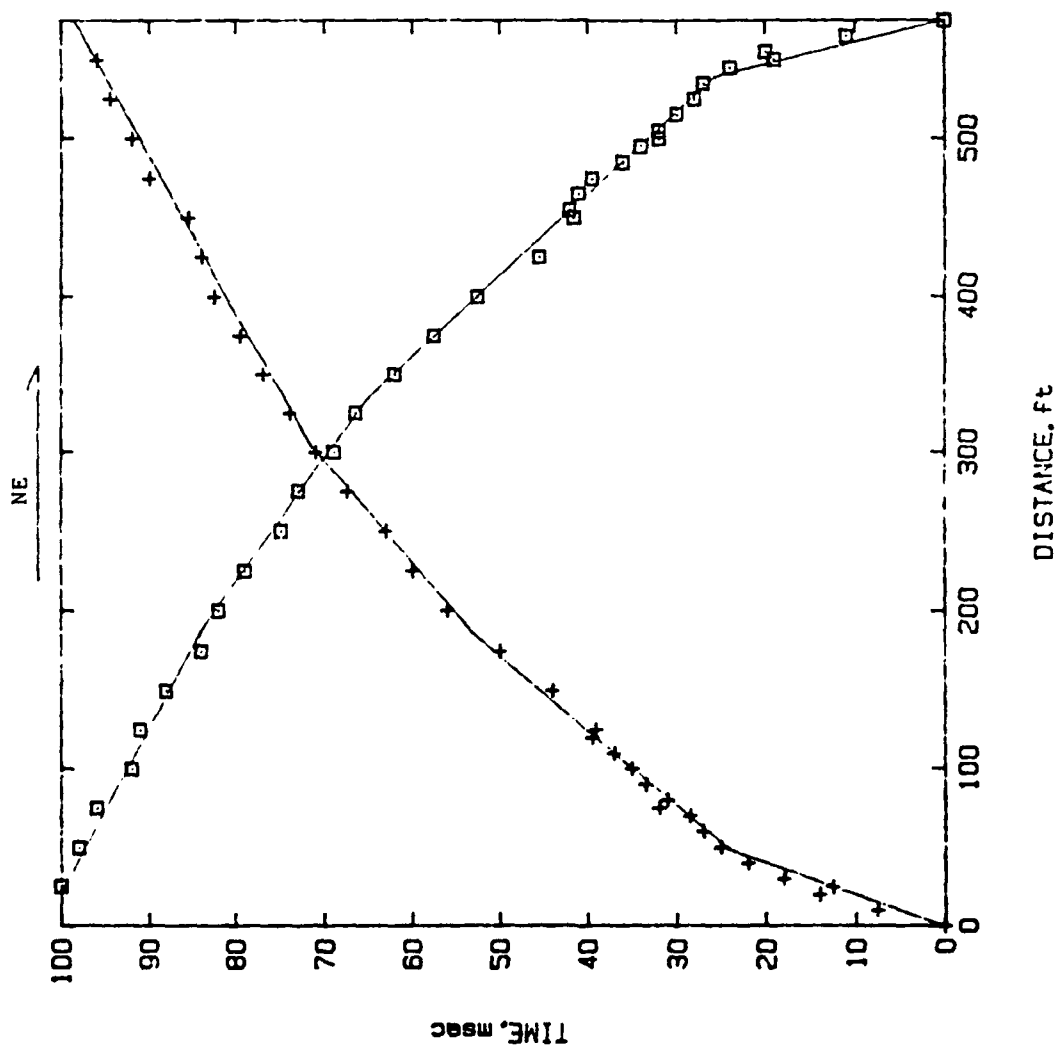


Figure 6. P-wave arrival time versus distance, Line R5



CN0NM9

*** INPUT DATA ***

LAYER #	FORWARD		REVERSE	
	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	2020	0.0	1400	0.0
2	4780	13.9	5181	18.7
3	8387	23.9	7780	34.2
4	10027	41.2	10402	48.8

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH	
		FOR. FT.	REV. FT.
1	1710	12.5	17.0
2	4860	48.0	88.5
3	7000	118.0	112.0
4	10140		

Figure 7. P-wave arrival time versus distance, Line R6

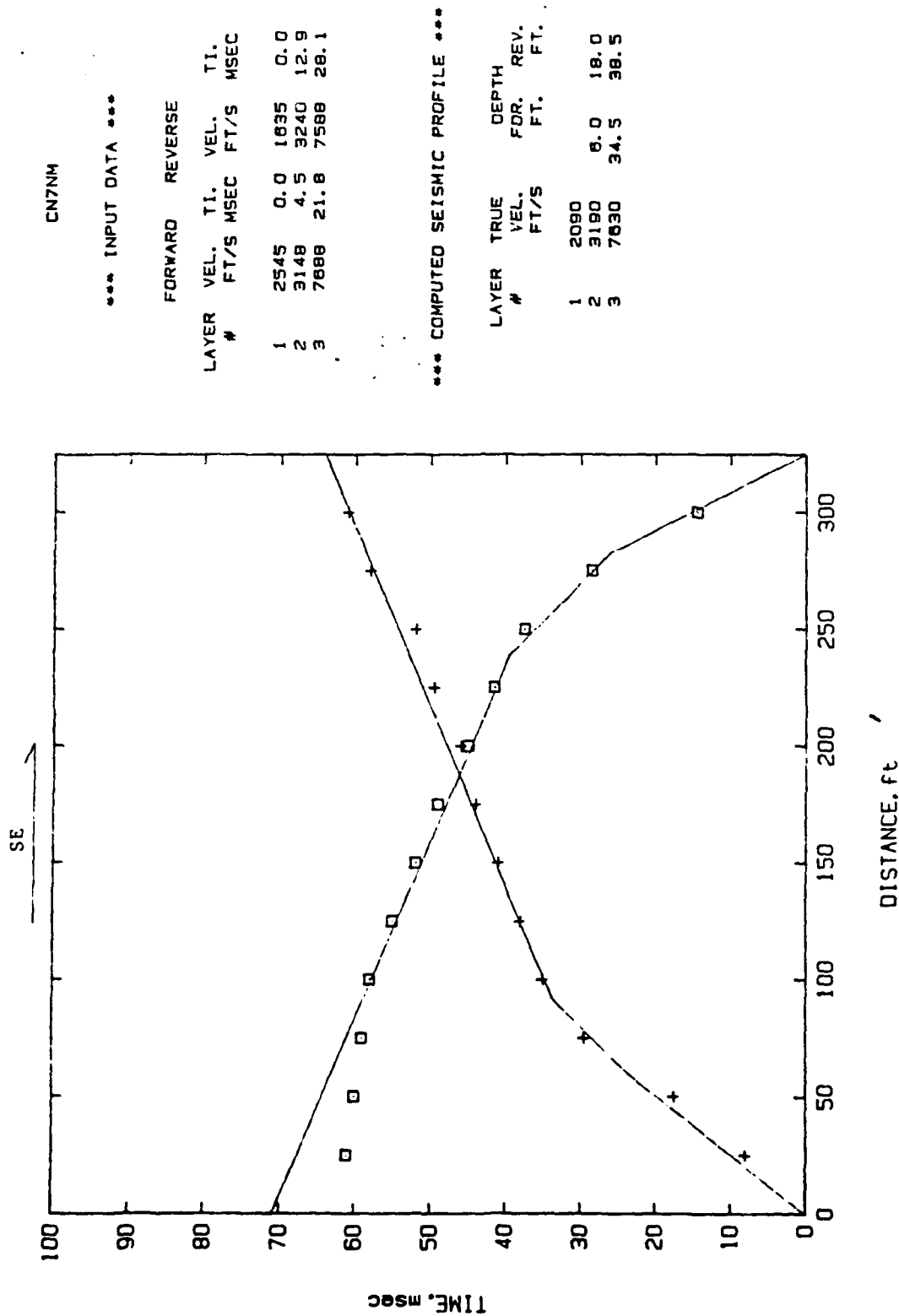


Figure 8. P-wave arrival time versus distance, Line R7

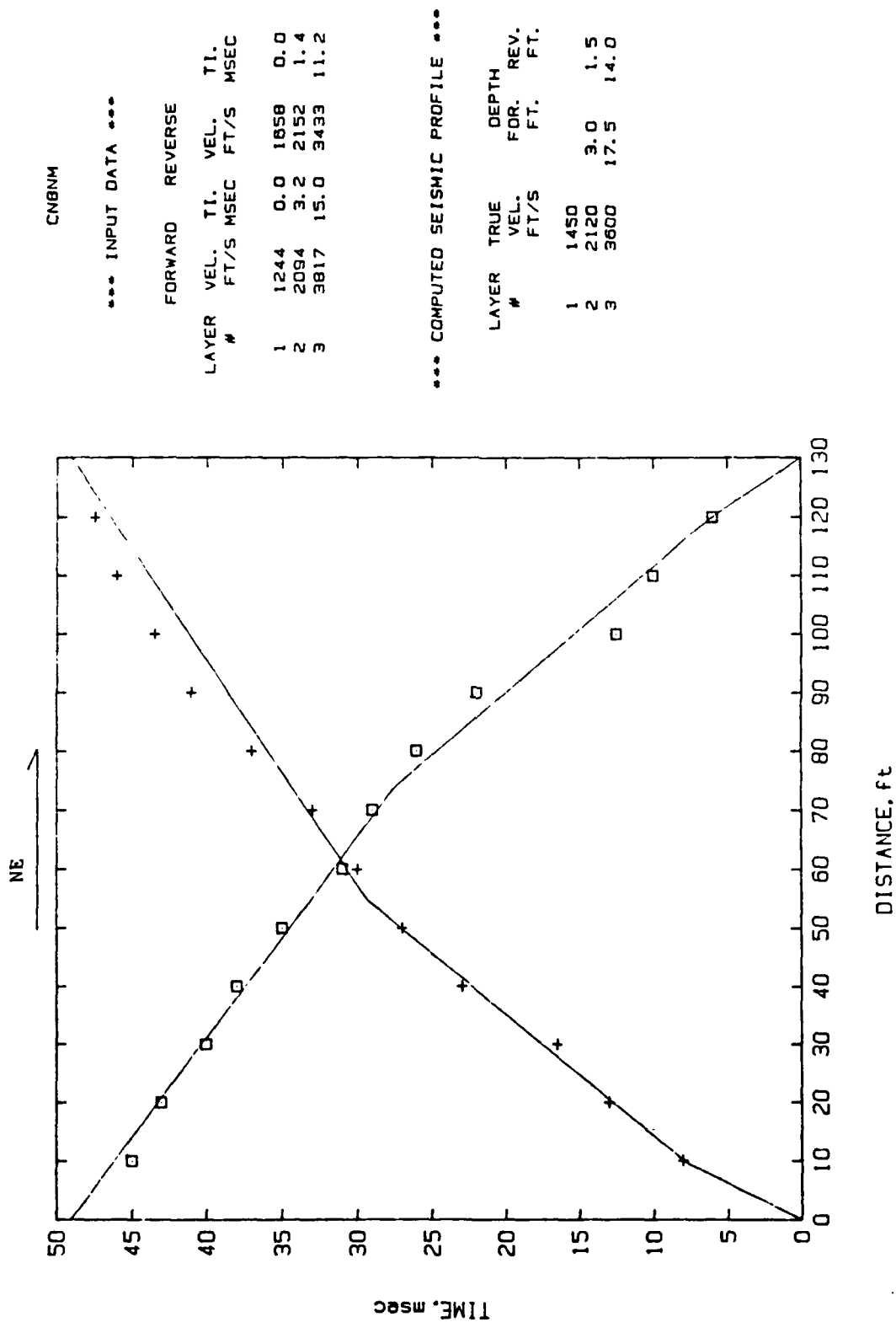
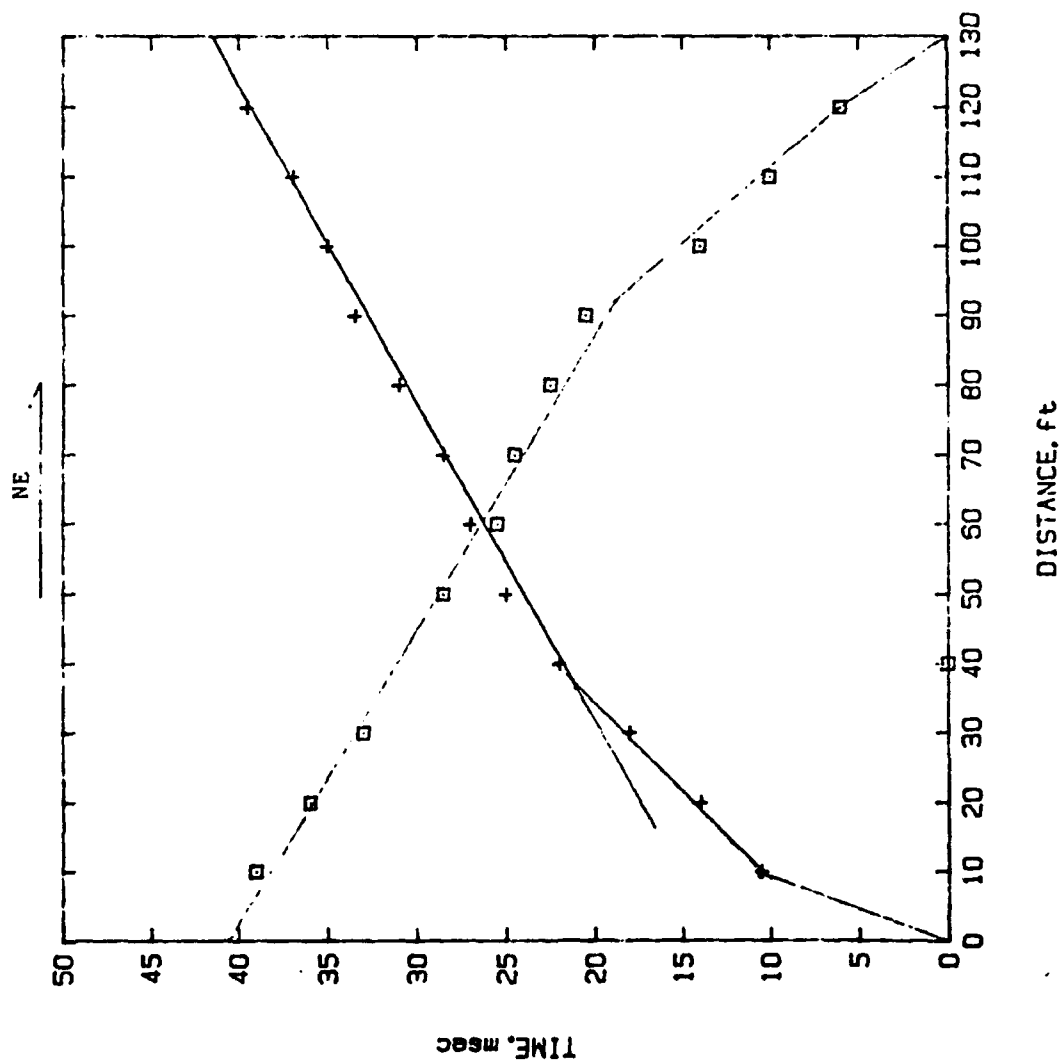


Figure 9. P-wave arrival time versus distance, Line R8



CN0NM

*** INPUT DATA ***

FORWARD REVERSE

LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	931	0.0	1082	0.0
2	2578	8.7	2179	1.4
3	4565	13.0	4236	9.9

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	REV. FT.
1	1310		
2	2350	5.0	1.0
3	4380	12.5	12.5

Figure 10. P-wave arrival time versus distance, Line R9

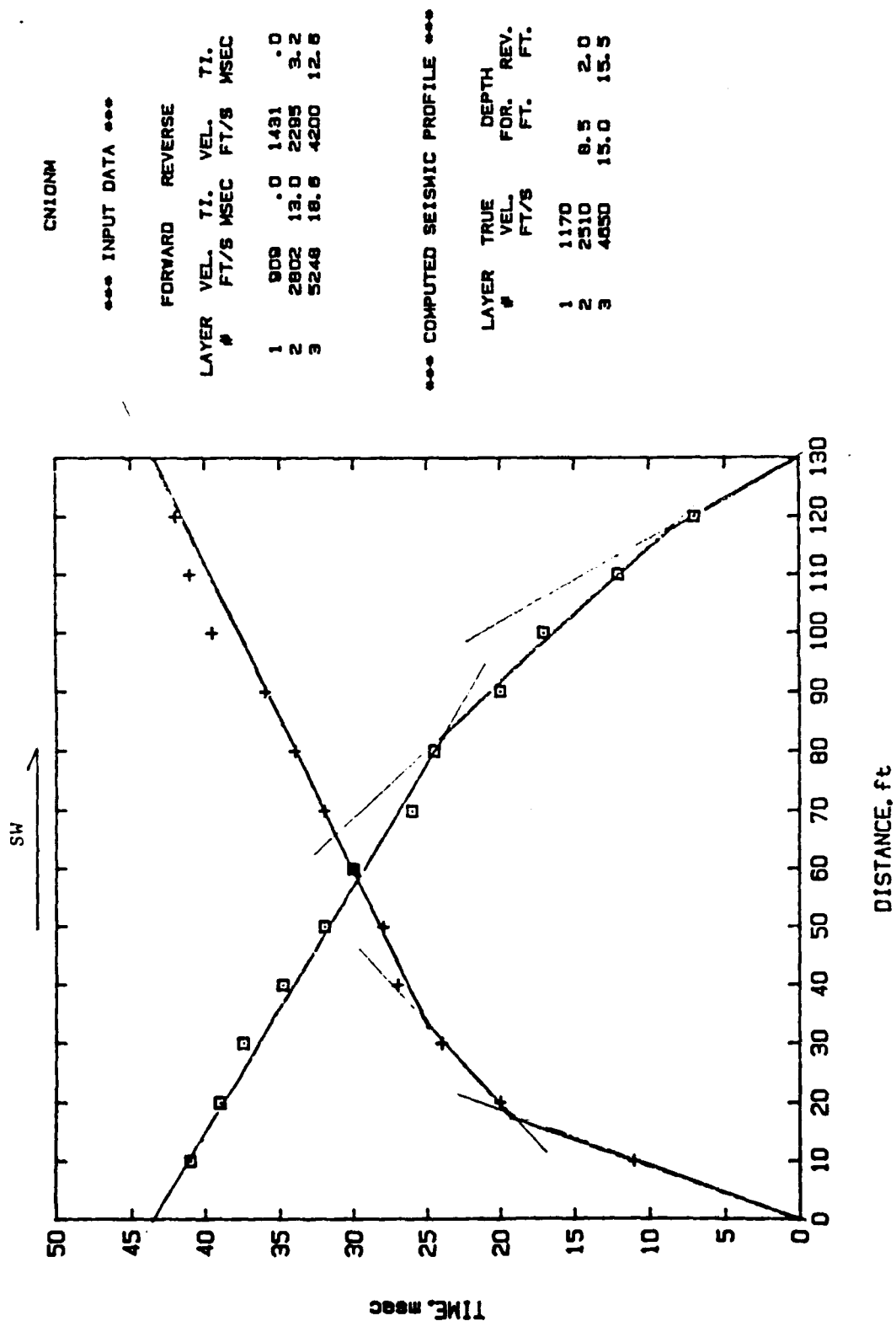


Figure 11. P-wave arrival time versus distance, Line R10

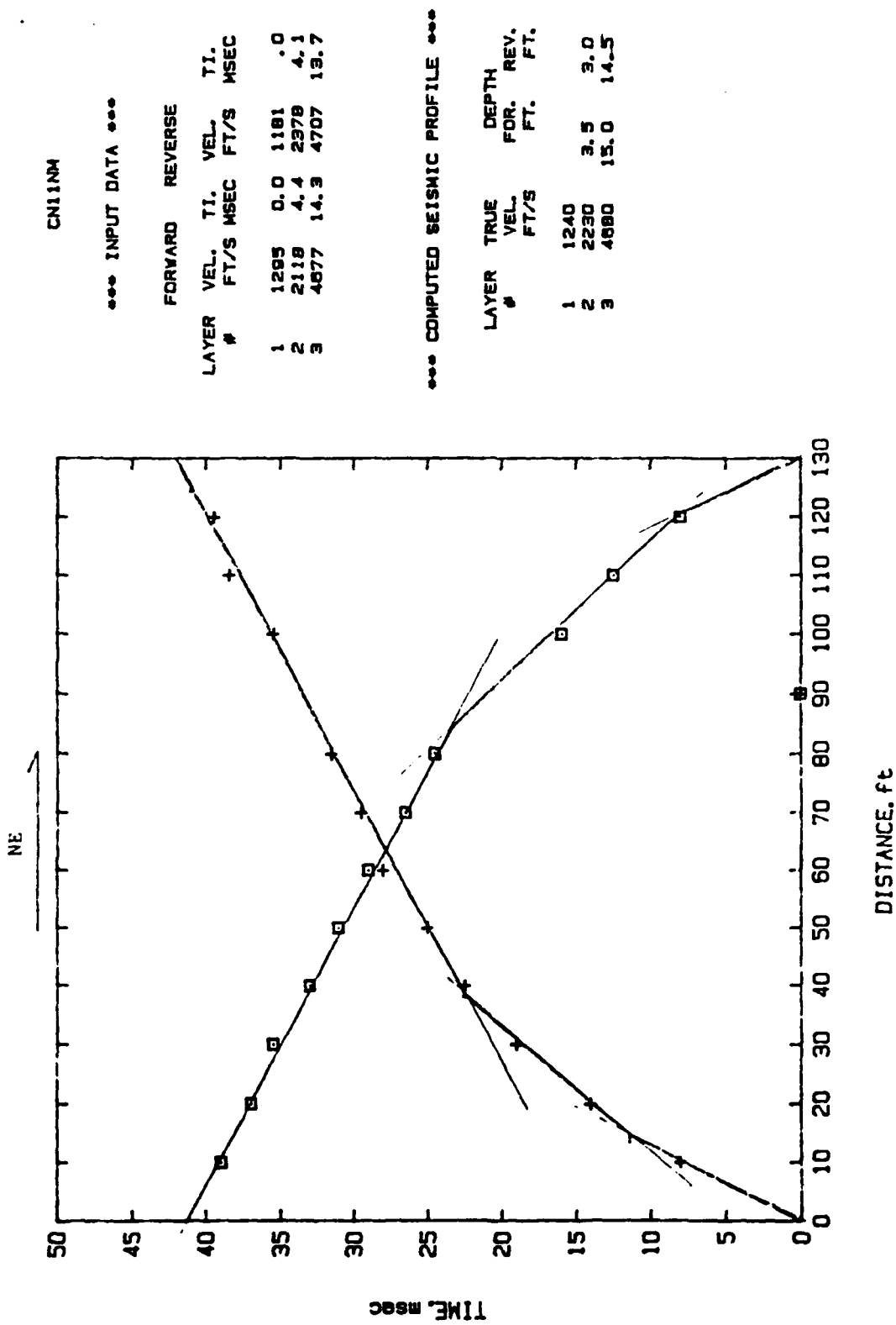
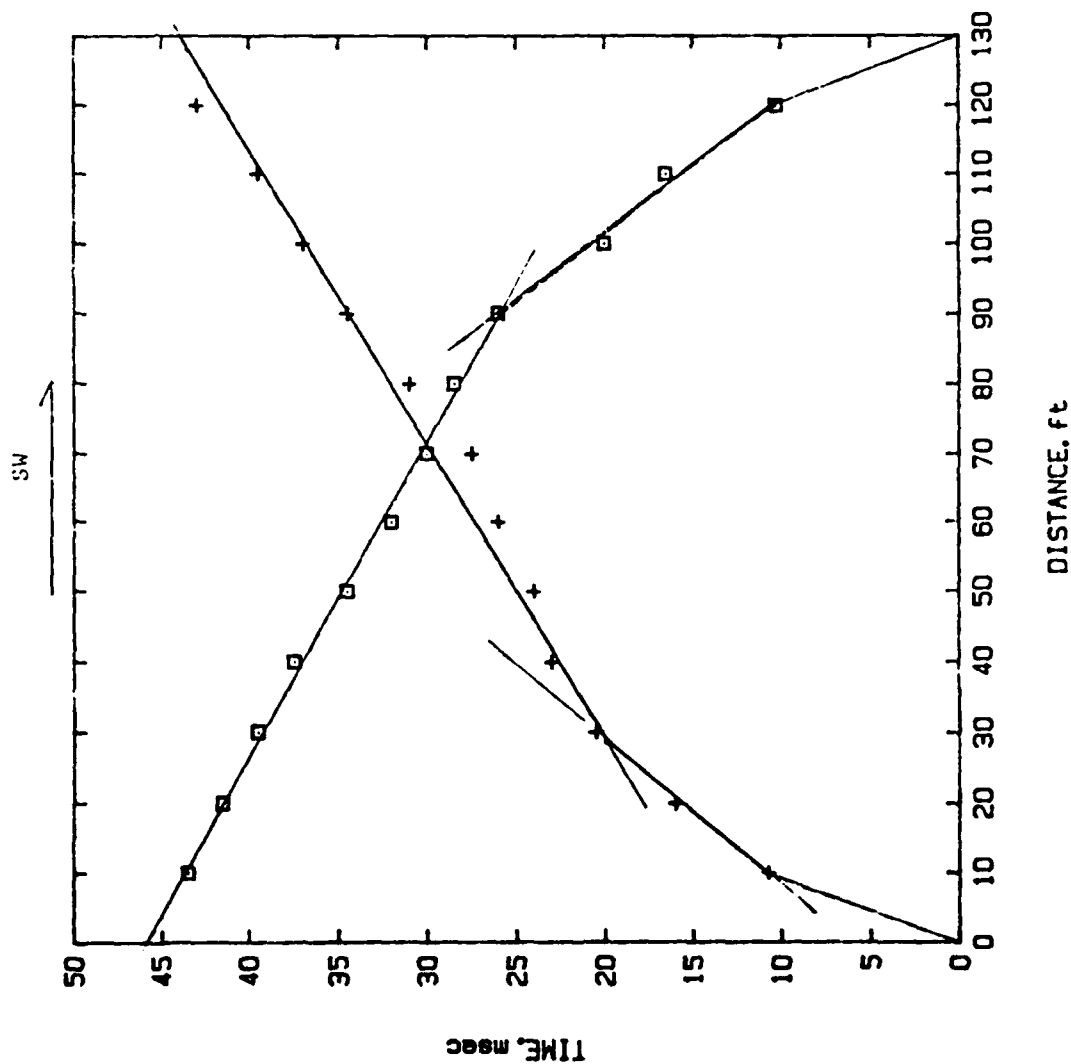


Figure 12. P-wave arrival time versus distance, Line R11



CN12NM

*** INPUT DATA ***

FORWARD REVERSE

LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	924	0.0	908	0.0
2	2088	6.0	1948	5.2
3	4208	13.1	4503	17.0

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	REV. FT.
1	940		
2	2010	2.0	3.0
3	4340	10.5	15.5

Figure 13. P-wave arrival time versus distance, Line R12



Figure 14. P-WAVE VELOCITY PROFILE OF SEISMIC REFRACTION LINES CONDUCTED ON RIDGE NUMBER 1

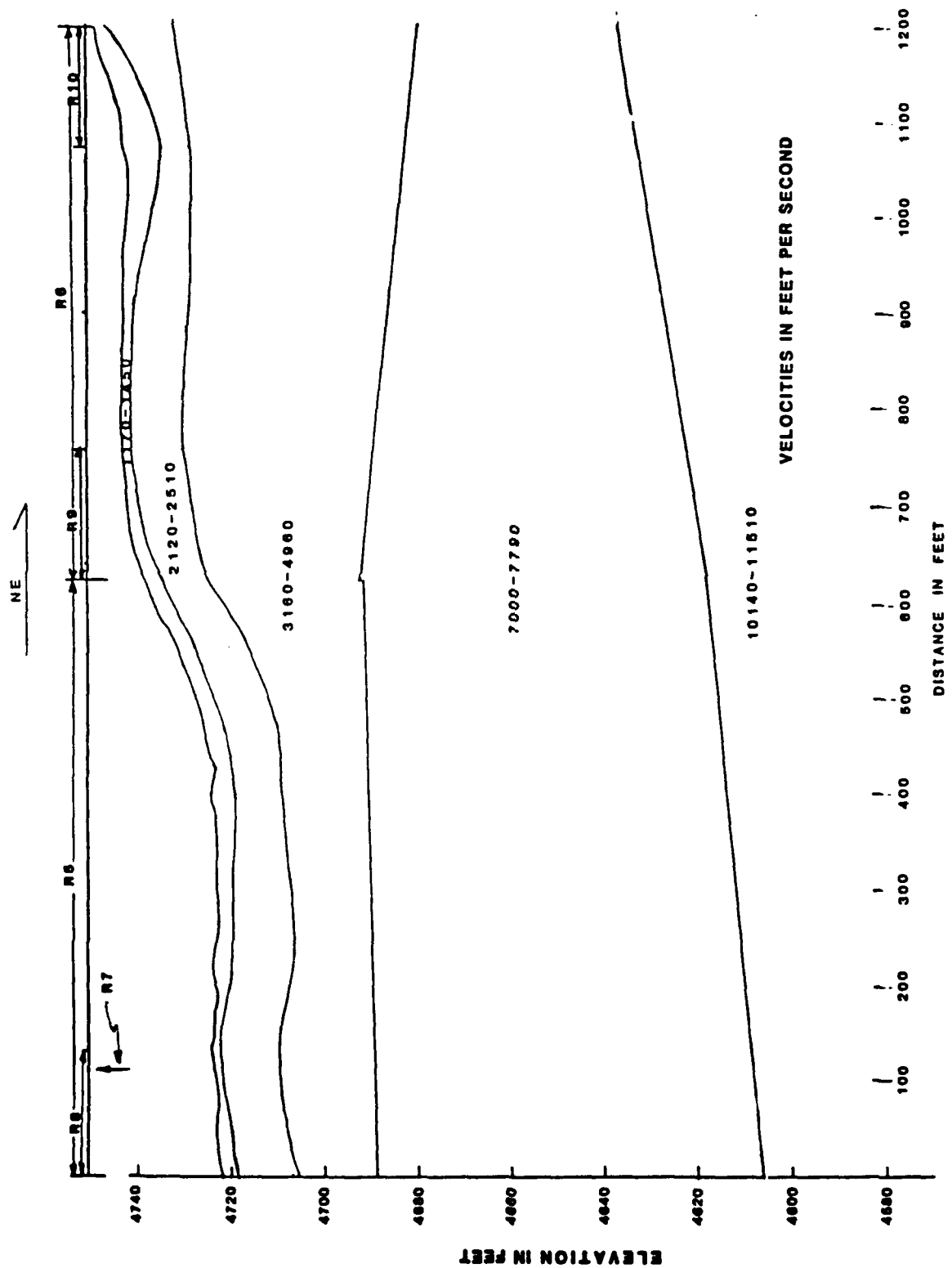


Figure 15. P-WAVE VELOCITY PROFILE OF SEISMIC REFRACTION LINES CONDUCTED ON RIDGE NUMBER 2

Test Results for Borrow Area Material



FOX & ASSOCIATES OF NEW MEXICO, INC.

CONSULTING ENGINEERS AND GEOLOGISTS

ALBUQUERQUE OFFICE 3412 BRYN MAWR DRIVE, NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 884-0900

July 18, 1984

Corps of Engineers
Construction Branch
P. O. Box 1580
Albuquerque, NM 87103

Job No. 434690

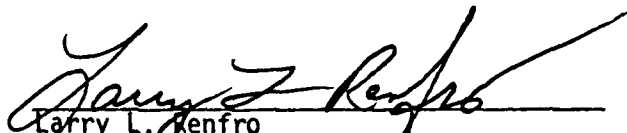
Attention: Mr. Don Luna

Subject: Sieve Analyses, Moistures and Atterberg Limits Tests for
Cuchillo Negro Creek, DACW47-83-D-0023, Delivery Order
#DM0007 (Item 0002)

Gentlemen:

Transmitted herein is the detailed test data for the subject
project.

FOX & ASSOCIATES OF NEW MEXICO, INC.


Larry L. Renfro
Materials & Testing Division Manager

Copies: Addressee (2)

Attached: Data Sheets (2)

jcg

Job No. 434690

Project: Chuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM00007

Page 1 of 2

Sample I.D.	Moisture Percent	Atterberg Limits		Sieve Analysis % Passing											Soil Description		
		LL	PI	3"	2"	1½"	1½"	1"	¾"	1/2"	3/8"	#4	#10	#40		#80	#200
CN-T-5 #1 ✓ @ 0' - 4'	4.5	-	-	-	100	-	-	93	77	63	59	46	33	9	3	1.2	sandy GRAVEL, light brown (GP)
CN-T-5 #2 ✓ @ 5.4' - 8'	4.5	-	-	-	-	100	-	-	96	90	77	52	30	10	5	3.5	very sandy GRAVEL, light brown (GP)
CN-T-6 #1 ✓ @ 1.3' - 7'	1.6	-	-	-	-	100	-	-	72	63	57	43	33	15	8	4.6	sandy GRAVEL, light brown (GP)
CN-T-6 #2 ✓ @ 7' - 9'	7.1	-	-	100	-	88	-	-	72	52	45	32	22	13	9	7.0	sandy GRAVEL, light brown (GP-GM)
CN-T-7 #1 ✓ @ 1.2' - 8.3'	2.1	-	-	-	-	100	-	-	81	71	63	50	37	20	11	5.8	very sandy GRAVEL, light brown (GP-GM)
CN-T-7 #2 ✓ @ 8.3' - 9.5'	12.8	-	-	-	-	-	-	-	100	97	95	91	86	33	9	4.4	slightly gravelly SAND, light brown (SP)
CN-T-8 #1 ✓ @ 0' - 2.4'	3.6	-	-	-	-	100	-	-	86	72	65	54	45	26	11	3.2	very gravelly SAND, light brown (SP)
CN-T-8 #2 ✓ @ 2.4' - 8'	1.6	-	-	-	-	100	-	-	99	86	76	48	25	5	3	2.6	very sandy GRAVEL, light brown (GP)
CN-T-8 #3 @ 8' - 8.3'	10.9	29	8	-	-	-	-	-	100	98	97	95	94	92	89	71.5	sandy CLAY, brown (CL)

Job No. 434690

Project: Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Page 2 of 2

Sample I.D.	Moisture Percent	Atterberg Limits		Sieve Analysis % Passing												Soil Description	
		LL	PI	3"	2"	1 1/2"	1 1/4"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#80		#200
CN-T-8 #4 @ 8.3' - 13.5'	2.7	-	-	-	-	100	-	-	85	75	65	38	19	8	6	3.7	sandy GRAVEL, light brown (GP)
CN-T-9 #1 @ 0' - 2.8'	3.9	-	-	100	-	81	-	-	46	35	28	18	11	3	2	0.3	sandy GRAVEL, light brown (GP)
CN-T-9 #2 @ 2.8' - 9.1'	2.0	-	-	100	-	78	-	-	48	42	38	30	23	10	7	4.9	sandy GRAVEL, light brown (GP)
CN-T-10 #1 @ 0.9' - 3.1'	3.1	NV	NP	100	-	89	-	-	76	70	68	62	57	39	29	13.2	very gravelly SAND, brown (SM)
CN-T-10 #2 @ 3.1' - 9.2'	1.0	-	-	100	-	77	-	-	55	47	41	32	26	12	7	3.5	sandy GRAVEL, light brown (GP)
CN-T-10 #3 @ 9.2' - 11'	2.6	-	-	-	-	100	-	-	87	85	81	64	33	10	7	3.4	very gravelly SAND, light brown (SP)
CN-T-11 #1 @ 0' - 5.2'	7.1	21	NP	-	-	100	-	-	97	93	88	83	79	73	63	34.5	very silty SAND, brown (SM)
CN-T-11 #2 @ 5.2' - 9.5'	2.9	-	-	-	-	100	-	-	91	73	68	58	50	21	5	1.3	very gravelly SAND, light brown (SP)
CN-T-12 #1 @ 0' - 6.1'	3.6	-	-	-	-	100	-	-	79	71	62	47	35	14	6	3.4	very sandy GRAVEL, light brown (GP)
CN-T-13 #1 @ 0' - 5.4'	0.7	-	-	100	-	90	-	-	66	57	51	39	27	9	4	1.7	very sandy GRAVEL, light brown (GP)
CN-T-13 #2 @ 5.4' - 9.1'	7.0	-	-	-	-	100	-	-	72	64	58	42	32	16	11	7.2	very sandy GRAVEL, light brown (GP-GM)



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8305 Washington Place, N.E.
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(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-14 Sampled By Corps Date N/A

Type of Aggregate Silty Gravelly Sand (SP-SM) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 @ 2' Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test	Result	Specification	Test STD
			Fineness Modulus			C125-
4"			Dry Rodded Unit Weight, pcf			C29-
3"			Lightweight Pieces, %			C123-
2"			Clay Lumps and Friable Particles			C142-
1½"			Organic Impurities			C40-
1¼"			Sand Equivalent Value			C2419-
1"	100		Resistance to Abrasion	% Wear, rev.		C131-
¾"	94			% Wear, 500 rev.		Grading
½"	75			% Wear, rev.		C535-
¼"	70			% Wear, 1000 rev.		Grading
¼"	62		Scratch Hardness, % by: Weight Count			C235-
No. 4	57		Fractured Faces, % by: Weight Count			
8	48		Liquid Limit Plasticity Index	* N.P.		D4318-
10	42		Cleanness Value			Calif. 227-
16	35					
30	30		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-
40	24			Optimum Moisture, %		
50	13			Method		
100	11		Specific Gravity	Absorption, %		☐ C127- ☐ C128-
200	8			Bulk (Dry)		
				Bulk (SSD)		
Finer than 200 ASTM C117-				Apparent		

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318



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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-14 Sampled By Corps Date N/A

Type of Aggregate Silty Gravelly Sand (SP-SM) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 4' - 6' Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test		Result	Specification	Test STD
			Fineness Modulus				C125-
4"			Dry Rodded Unit Weight, pcf				C29-
3"			Lightweight Pieces, %				C123-
2"			Clay Lumps and Friable Particles				C142-
1½"	100		Organic Impurities				C40-
1½"			Sand Equivalent Value				C2419-
1"	92		Resistance to Abrasion	% Wear, rev.			C131-
¾"	85			% Wear, 500 rev.			Grading
½"	70			% Wear, rev.			C535-
¼"	64			% Wear, 1000 rev.			Grading
¼"	56		Scratch Hardness, % by: Weight Count				C235-
No. 4	52		Fractured Faces, % by: Weight Count				
8	42		Liquid Limit Plasticity Index		* N.P.		D4318-
10	41		Cleanness Value				Calif. 227-
16	37						
30	34		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
40	31			Optimum Moisture, %			
50	26			Method			
100	15		Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
200	9			Bulk (Dry)			
				Bulk (SSD)			
				Apparent			
Finer than 200 ASTM C117-							

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*Liquid Limit was not determined in accordance
with ASTM D4318



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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-15

Sampled By Corps

Date N/A

Type of Aggregate Sandy Clay (CL)

Submitted By Corps

Date 4/87

Source of Aggregate Hole #1

Authorized By _____

Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test		Result	Specification	Test STD
			Fineness Modulus				C125-
4"			Dry Rodded Unit Weight, pcf				C29-
3"			Lightweight Pieces, %				C123-
2"			Clay Lumps and Friable Particles				C142-
1½"			Organic Impurities				C40-
1¼"			Sand Equivalent Value				C2419-
1"			Resistance to Abrasion	% Wear, rev.			C131-
¾"				% Wear, 500 rev.			Grading
½"				% Wear, rev.			C535-
⅜"				% Wear, 1000 rev.			Grading
¼"			Scratch Hardness, % by: Weight Count				C235-
No. 4	100		Fractured Faces, % by: Weight Count				
8	99		Liquid Limit Plasticity Index		44 28		D4318-
10	99		Cleanness Value				Calif. 227-
16	99						
30	98		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
40	98			Optimum Moisture, %			
50	97			Method			
100	90		Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
200	77			Bulk (Dry)			
				Bulk (SSD)			
Finer than 200 ASTM C117-				Apparent			

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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-16 Sampled By Corps Date N/A

Type of Aggregate Gravelly Clayey Sand (SP-SC) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 @ 1.5' Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test	Result	Specification	Test STD
			Fineness Modulus			C125-
4"			Dry Rodded Unit Weight, pcf			C29-
3"			Lightweight Pieces, %			C123-
2"			Clay Lumps and Friable Particles			C142-
1½"			Organic Impurities			C40-
1¼"			Sand Equivalent Value			C2419-
1"	100		Resistance to Abrasion	% Wear, rev.		C131-
¾"	91			% Wear, 500 rev.		Grading
½"	87			% Wear, rev.		C535-
⅜"	76			% Wear, 1000 rev.		Grading
¼"	64		Scratch Hardness, % by: Weight Count			C235-
No. 4	57		Fractured Faces, % by: Weight Count			
8	42		Liquid Limit Plasticity Index	25 16		D4318-
10	41		Cleanliness Value			Calif. 227-
16	34					
30	28		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-
40	26			Optimum Moisture, %		
50	24			Method		
100	16		Specific Gravity	Absorption, %		☐ C127- ☐ C128-
200	10			Bulk (Dry)		
				Bulk (SSD)		
				Apparent		
Finer than 200 ASTM C117-						

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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-16 Sampled By Corps Date N/A

Type of Aggregate Silty Clayey Sand (SC-SM) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 4' Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test		Result	Specification	Test STD
			Fineness Modulus				C125-
4"			Dry Rodded Unit Weight, pcf				C29-
3"			Lightweight Pieces, %				C123-
2"			Clay Lumps and Friable Particles				C142-
1½"			Organic Impurities				C40-
1¼"			Sand Equivalent Value				C2419-
1"			Resistance to Abrasion	% Wear, rev.			C131-
¾"				% Wear, 500 rev.			Grading
½"				% Wear, rev.			C535-
⅜"				% Wear, 1000 rev.			Grading
¼"			Scratch Hardness, % by: Weight Count				C235-
No. 4			Fractured Faces, % by: Weight Count				
8			Liquid Limit Plasticity Index		20 6		D4318-
10	100		Cleanness Value				Calif. 227-
16	99						
30	99		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
40	98			Optimum Moisture, %			
50	94			Method			
100	73		Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
200	46			Bulk (Dry)			
				Bulk (SSD)			
				Apparent			
Finer than 200 ASTM C117-							

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PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-17

Sampled By Corps

Date N/A

Type of Aggregate Silty Gravelly Sand (SM)

Submitted By Corps

Date 4/87

Source of Aggregate Hole #1

Authorized By _____

Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test	Result	Specification	Test STD
			Fineness Modulus			C125-
4"			Dry Rodded Unit Weight, pcf			C29-
3"			Lightweight Pieces, %			C123-
2"			Clay Lumps and Friable Particles			C142-
1½"			Organic Impurities			C40-
1½"			Sand Equivalent Value			C2419-
1"			Resistance to Abrasion	% Wear, rev.		C131-
¾"	100			% Wear, 500 rev.		Grading
½"	90			% Wear, rev.		C535-
¾"	88			% Wear, 1000 rev.		Grading
¼"	86		Scratch Hardness, % by: Weight Count			C235-
No. 4	83		Fractured Faces, % by: Weight Count			
8	79		Liquid Limit Plasticity Index	* N.P.		D4318-
10	79		Cleanness Value			Calif. 227-
16	76					
30	69		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-
40	61			Optimum Moisture, %		
50	52			Method		
100	33		Specific Gravity	Absorption, %		☐ C127- ☐ C128-
200	21			Bulk (Dry)		
				Bulk (SSD)		
Finer than 200 ASTM C117-				Apparent		

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318



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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-18 Sampled By Corps Date N/A

Type of Aggregate Clayey Sand (SC) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test		Result	Specification	Test STD
			Fineness Modulus				C125-
4"			Dry Rodded Unit Weight, pcf				C29-
3"			Lightweight Pieces, %				C123-
2"			Clay Lumps and Friable Particles				C142-
1½"			Organic Impurities				C40-
1¼"			Sand Equivalent Value				C2419-
1"			Resistance to Abrasion	% Wear, rev.			C131-
¾"				% Wear, 500 rev.			Grading
½"				% Wear, rev.			C535-
¼"				% Wear, 1000 rev.			Grading
¼"			Scratch Hardness, % by: Weight Count				C235-
No. 4			Fractured Faces, % by: Weight Count				
8	99		Liquid Limit Plasticity Index		46 15		D4318-
10	99		Cleanness Value				Calif. 227-
16	98						
30	91		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
40	76			Optimum Moisture, %			
50	58			Method			
100	31		Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
200	17			Bulk (Dry)			
				Bulk (SSD)			
				Apparent			
Finer than 200 ASTM C117-							

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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-19 Sampled By Corps Date N/A

Type of Aggregate Sandy Gravel (GP) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 @ Surface Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test		Result	Specification	Test STD
			Fineness Modulus				C125-
4"			Dry Rodded Unit Weight, pcf				C29-
3"			Lightweight Pieces, %				C123-
2"			Clay Lumps and Friable Particles				C142-
1 1/2"	100		Organic Impurities				C40-
1 1/8"			Sand Equivalent Value				C2419-
1"	86		Resistance to Abrasion	% Wear, rev.			C131-
3/4"	74			% Wear, 500 rev.			Grading
1/2"	64			% Wear, rev.			C535-
1/4"	57			% Wear, 1000 rev.			Grading
1/4"	49		Scratch Hardness, % by: Weight Count				C235-
No. 4	45		Fractured Faces, % by: Weight Count				
8	37		Liquid Limit Plasticity Index		* N.P.		D4318-
10	36		Cleanness Value				Calif. 227-
16	29						
30	16		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
40	9			Optimum Moisture, %			
50	5			Method			
100	2		Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
200	1			Bulk (Dry)			
				Bulk (SSD)			
				Apparent			
Finer than 200 ASTM C117.							

Copies to:

*Liquid Limit was not determined in accordance with
ASTM D 4318



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PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-19 Sampled By Corps Date N/A

Type of Aggregate Gravelly Sand (SP) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 2' Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test	Result	Specification	Test STD
			Fineness Modulus			C125-
4"			Dry Rodded Unit Weight, pcf			C29-
3"			Lightweight Pieces, %			C123-
2"			Clay Lumps and Friable Particles			C142-
1½"			Organic Impurities			C40-
1¼"			Sand Equivalent Value			C2419-
1"			Resistance to Abrasion	% Wear, rev.		C131-
¾"	100			% Wear, 500 rev.		Grading
½"	87			% Wear, rev.		C535-
⅜"	85			% Wear, 1000 rev.		Grading
¼"	82		Scratch Hardness, % by: Weight Count			C235-
No. 4	80		Fractured Faces, % by: Weight Count			
8	75		Liquid Limit Plasticity Index	* N.P.		D4318-
10	74		Cleaness Value			Calif. 227-
16	66					
30	44		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-
40	29			Optimum Moisture, %		
50	16			Method		
100	5		Specific Gravity	Absorption, %		☐ C127- ☐ C128-
200	3			Bulk (Dry)		
				Bulk (SSD)		
Finer than 200 ASTM C117-				Apparent		

Copies to:

*Liquid Limit was not determined in accordance
with ASTM D4318



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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-20 Sampled By Corps Date N/A

Type of Aggregate Gravelly Sand (SP) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 @ Surface Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test		Result	Specification	Test STD
			Fineness Modulus				C125-
4"			Dry Rodded Unit Weight, pcf				C29-
3"			Lightweight Pieces, %				C123-
2"			Clay Lumps and Friable Particles				C142-
1 1/2"			Organic Impurities				C40-
1 1/4"			Sand Equivalent Value				C2419-
1"	100		Resistance to Abrasion	% Wear, rev.			C131-
3/4"	91			% Wear, 500 rev.			Grading
1/2"	83			% Wear, rev.			C535-
1/4"	71			% Wear, 1000 rev.			Grading
1/4"			Scratch Hardness, % by: Weight Count				C235-
No. 4	53		Fractured Faces, % by: Weight Count				
8	41		Liquid Limit Plasticity Index		* N.P.		D4318-
10	39		Cleanness Value				Calif. 227-
16	33						
30	16		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
40	10			Optimum Moisture, %			
50	5			Method			
100	1		Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
200	0			Bulk (Dry)			
				Bulk (SSD)			
				Apparent			
Finer than 200 ASTM C117-							

Copies to:

*Liquid Limit was not determined in accordance
with ASTM D4318



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LABORATORY REPORT

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Client _____

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report _____

Reviewed By _____

Project Army Corps of Engineers

Location CN-T-20 Sampled By Corps Date N/A

Type of Aggregate Sandy Gravel (GP) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 2.5' Authorized By _____ Date _____

Sieve Analysis, ASTM C136-

Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification	Test	Result	Specification	Test STD
			Fineness Modulus			C125-
4"			Dry Rodded Unit Weight, pcf			C29-
3"			Lightweight Pieces, %			C123-
2"			Clay Lumps and Friable Particles			C142-
1 1/2"	100		Organic Impurities			C40-
1 1/4"			Sand Equivalent Value			C2419-
1"	79		Resistance to Abrasion	% Wear, rev.		C131-
3/4"	72			% Wear, 500 rev.		Grading
1/2"	67			% Wear, rev.		C535-
1/4"	59			% Wear, 1000 rev.		Grading
1/4"	53		Scratch Hardness, % by: Weight Count			C235-
No. 4	48		Fractured Faces, % by: Weight Count			
8	37		Liquid Limit Plasticity Index	* N.P.		D4318-
10	35		Cleanness Value			Calif. 227-
16	27					
30	15		Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-
40	9			Optimum Moisture, %		
50	5			Method		
100	1		Specific Gravity	Absorption, %		☐ C127- ☐ C120-
200	0			Bulk (Dry)		
				Bulk (SSD)		
				Apparent		
Finer than 200 ASTM C117-						

Copies to:

*Liquid Limit was not determined in accordance
with ASTM D4318

Test Results for Left Abutment Foundation Material

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 15292 (30 pages)

PROJECT: CUCHILLO NEGRO DAM : Contract No.
Feature: LEFT ABUTMENT :

TEST REQUEST NO.: E86910020 * : From: CHIEF
Dated: 15 JAN 1991 : ENG/PLNG DIVISION
Received: 17 JAN 1991 : ALBUQUERQUE DISTRICT

MATERIAL: DISTURBED AND UNDISTURBED SOIL SAMPLES
No. and type of samples: 7 RECORD SAMPLES, 1 BAG AND 3 CTNS.
Source or other identification: JOINT FILLING, SHEAR/BRECCIA ZONE
LEFT ABUTMENT

* CHANGE ORDER NUMBER 1
DATED: 03 MAR 1991.
RECEIVED: 15 APRIL 1991.

Date received: 12 AND 24 JAN 1991.

REMARKS: ALL TESTS HAVE BEEN PERFORMED IN ACCORDANCE WITH EM 1110-
2-1906. SAMPLES WITH GRAIN SIZE DISTRIBUTION AND ATTERBERG
LIMITS TESTS HAVE BEEN CLASSIFIED IN ACCORDANCE WITH MIL
STD. 619B. ALL OTHER SAMPLES HAVE BEEN VISUALLY CLASSIFIED ONLY.

RESULTS OF TESTS	TABLE 1
PLASTICITY CHART	PLATE 1
GRAIN SIZE DISTRIBUTION CURVES W/HYDROMETER	PLATES 2-12
RESIDUAL DIRECT SHEAR TESTS	PLATES 13-16
CONSOLIDATION TESTS	PLATES 17-28

Report sent to: : Copy furnished:
ALBUQUERQUE DISTRICT :

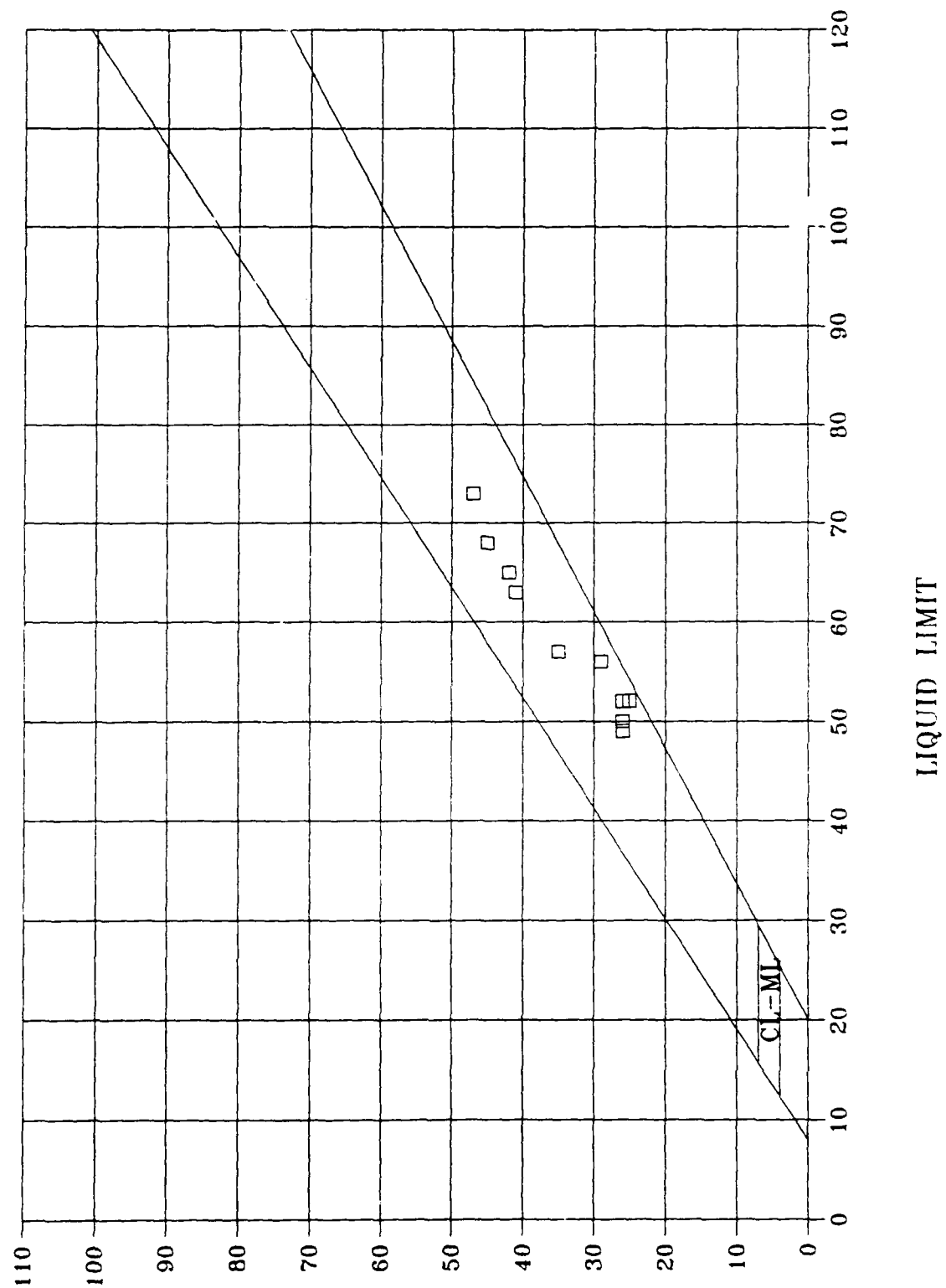
Date:	: Name and title:	: Signature
16 April 1991	: WILLIAM R. TANNER	: 
	: Director	
	: SWD Laboratory	

TABLE 1

RESULTS OF TESTS OF DISTURBED AND UNDISTURBED SOIL SAMPLES

SMED-6L REPORT NO. 15292 (UCHILLO NEGRO - LEFT ABUTMENT)

SORTING NO.	SUB NO.	FLO NO.	DEPTH, FT	SR	SA	FI	LL	PL	PI	LS	MC, %	POF	MAJOR TESTS	DESCRIPTION OF MATERIAL
	JOINT FILLING	91/	1 BAG-1	4650	0	1	99	73	25	47	37.7			- SHALE, BROWN TO LIGHT GRAY. MOIST, CALCAREOUS.
	SHE/ARRECTIA ZONE	91/	2 CTR-2	4640	2	1	97	56	27	29	18.6			- SHALE, PINK WITH YELLOW AND DARK REDDISH BROWN. HARD, CALCAREOUS. CALCAREOUS NODULES.
	1+350+1+600 L.ABT	91/	3 CTR-3	4625-4630	0	3	97	65	23	42	19.8			CH - FAT CLAY, YELLOW TO DARK BROWN, POSSIBLY HIGHLY WEATHERED SHALE, MOIST, SLIGHTLY CALCAREOUS.
														SCATTERED GRAVEL TO 2".
	2+700 LT.ABT	91/	4 CTR-4	4670	0	4	96	68	23	45	14.6			CH - FAT CLAY, REDDISH BROWN, POSSIBLY HIGHLY WEATHERED SHALE, MOIST, SLIGHTLY CALCAREOUS.
														SCATTERED GRAVEL TO 1 1/2".
	1+350, LT. ABT	91/	5 CVL	4640	0	1	99	49	23	26	11.1		CONSOL, RES. DS	- SHALE, LIGHT OLIVE BROWN WITH DARK REDDISH BROWN, MOIST, CALCAREOUS.
	1+350, LT. ABT	91/	6 CVL	4640	0	0	100	52	26	26	13.5			- SHALE, GRAYISH BROWN WITH YELLOWISH RED, MOIST, CALCAREOUS.
	1+350, LT. ABT	91/	7 CVL	4640	0	1	99	52	27	25	12.5		CONSOL	- SHALE, GRAYISH BROWN WITH DARK REDDISH BROWN, MOIST, CALCAREOUS.
	1+500 C/L, LT. ABT	91/	8 CVL	4635	0	2	98	50	24	26	8.8			CH - FAT CLAY, WHITE, POSSIBLE SHALE, DAMP, CALCAREOUS.
	1+550, LT. ABT	91/	9 CVL	4635	0	8	92	50	24	26	9.4		CONSOL, RES. DS	CH - FAT CLAY, WHITE, POSSIBLE SHALE, DAMP, CALCAREOUS.
	1+600, LT. ABT	91/	14 CVL	4635	2	6	92	63	22	41	19.2		RES. DS	- SHALE, GRAYISH BROWN WITH YELLOWISH RED, MOIST, CALCAREOUS.
	1+600, LT. ABT	91/	15 CVL	4630	0	2	98	57	22	35	13.2		CONSOL, RES. DS	- SHALE, GRAYISH BROWN WITH YELLOWISH RED, MOIST, CALCAREOUS.



CESWD-ED-GL RPT NO. 15292

E-61

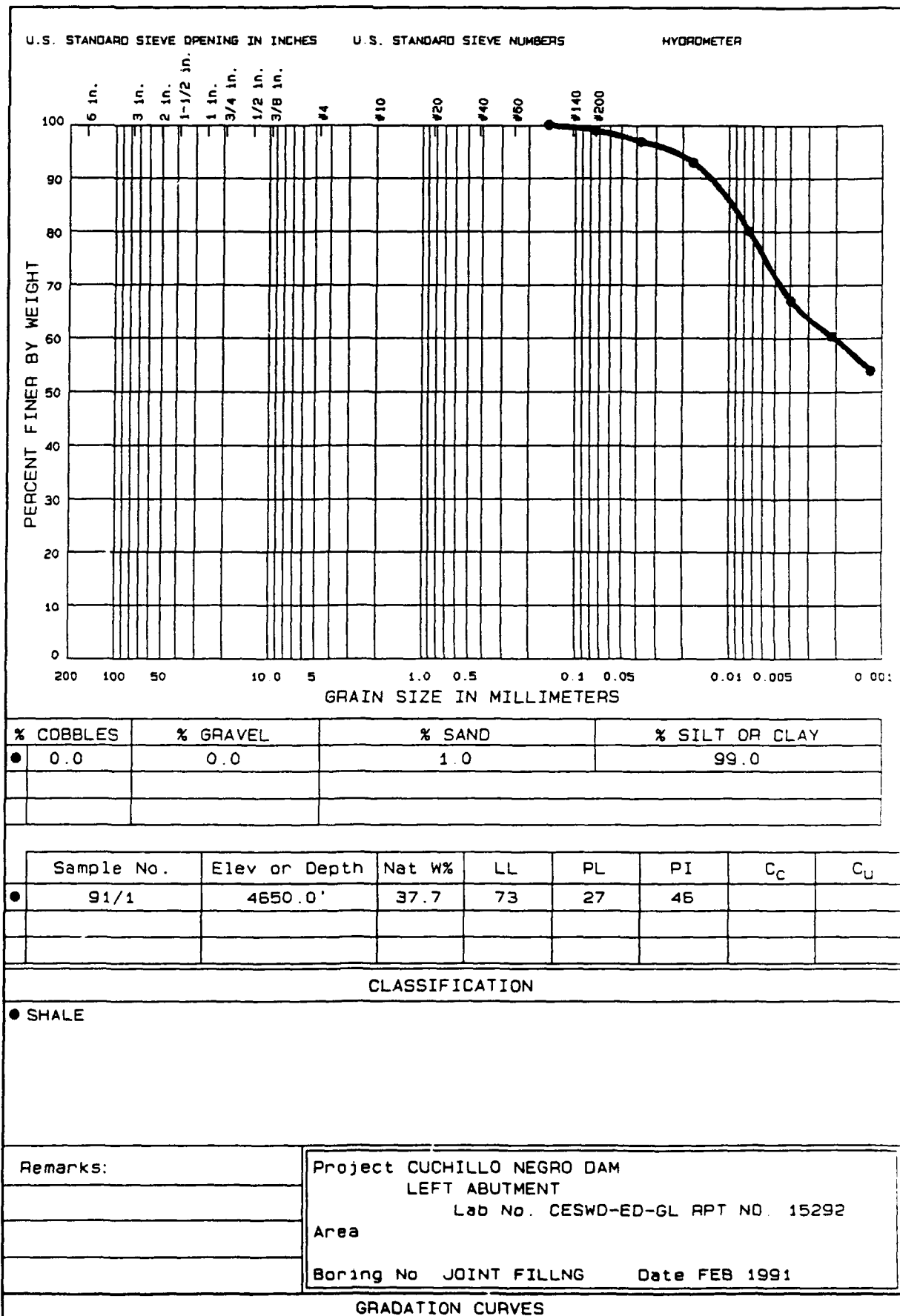
CUCHILLO NEGRO DAM
LEFT ABUTMENT
PLASTICITY CHART
PLATE #

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

Req. No.

Contract No.

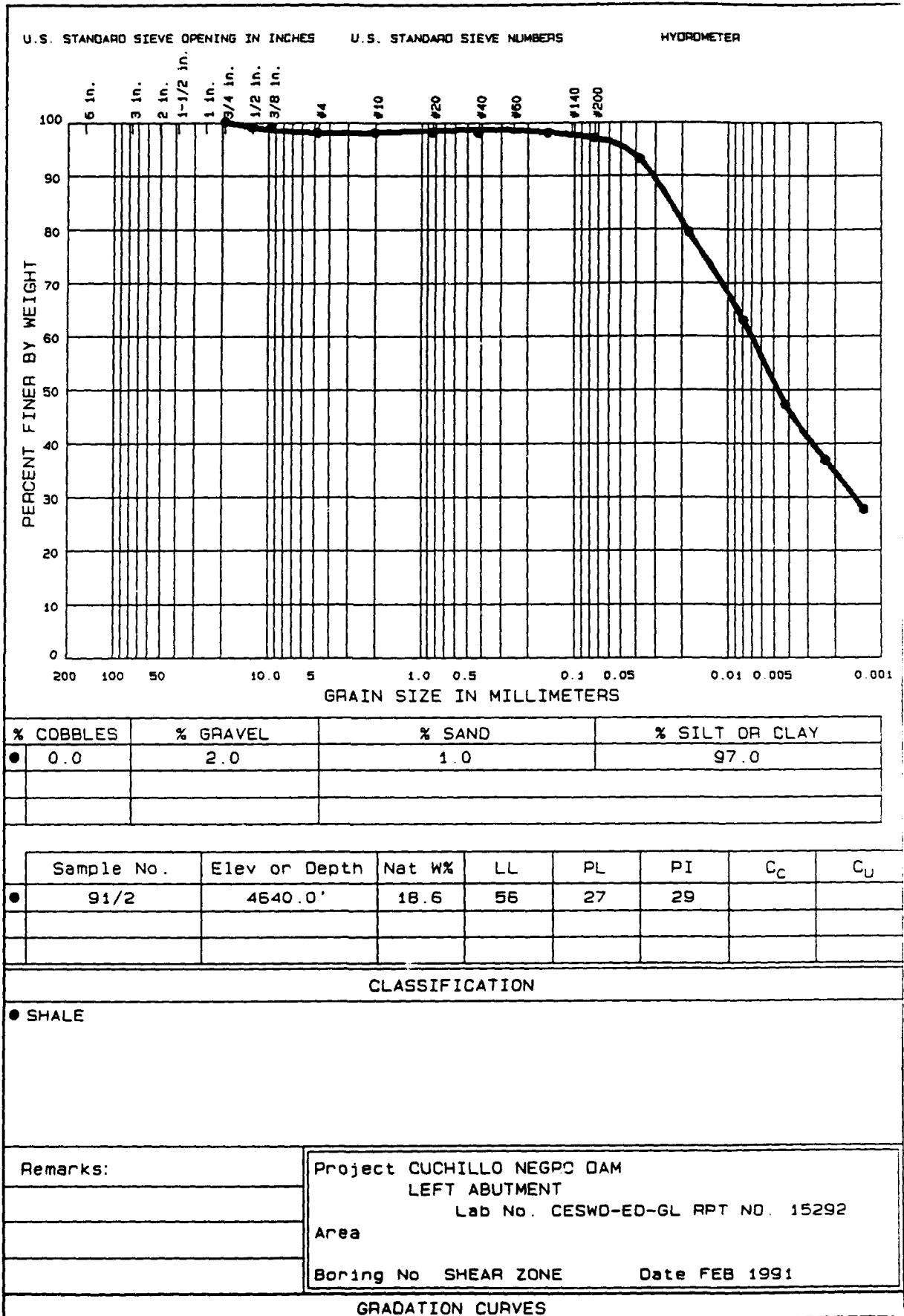


DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

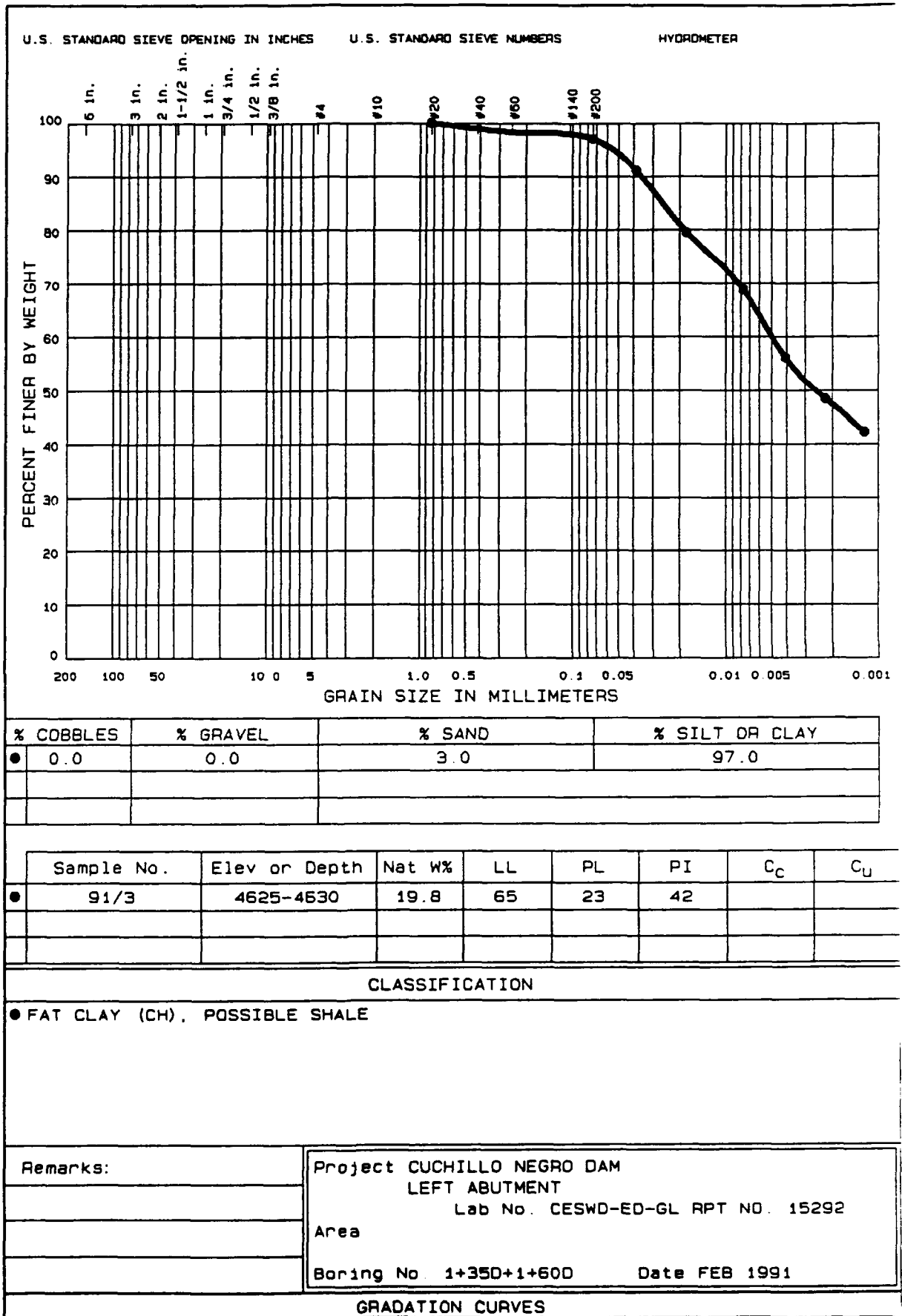
Req. No.

Contract No.



DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.

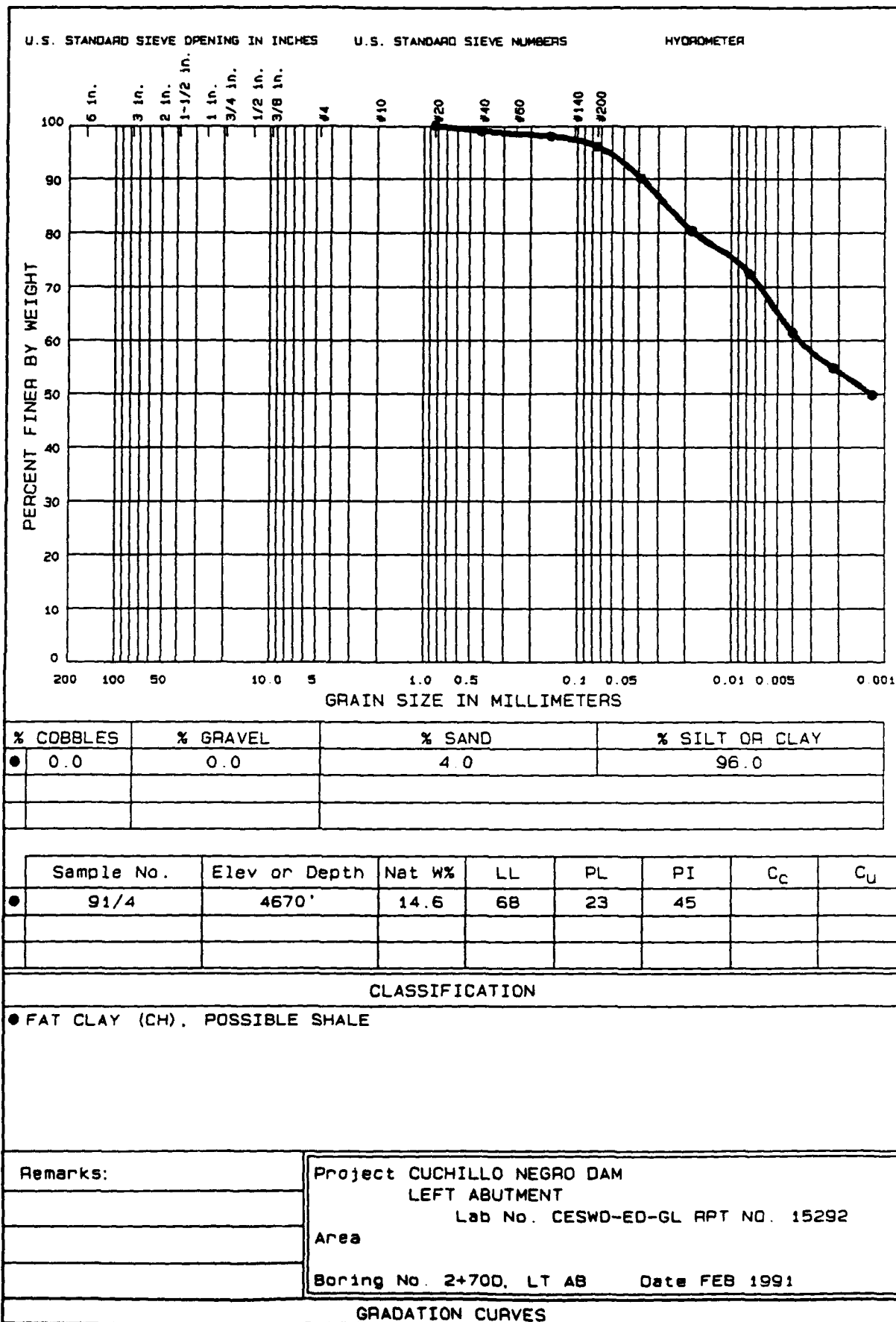


DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

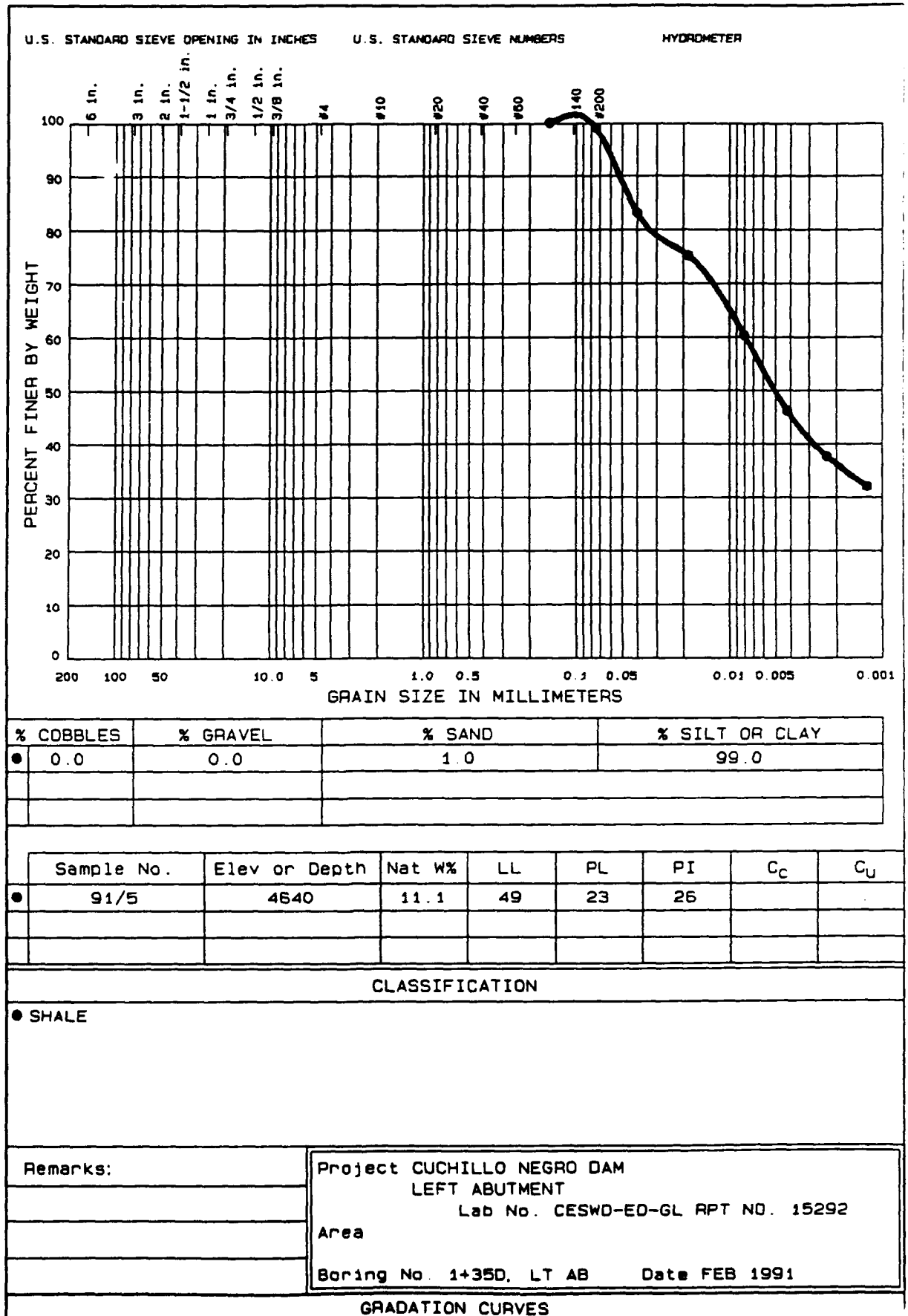
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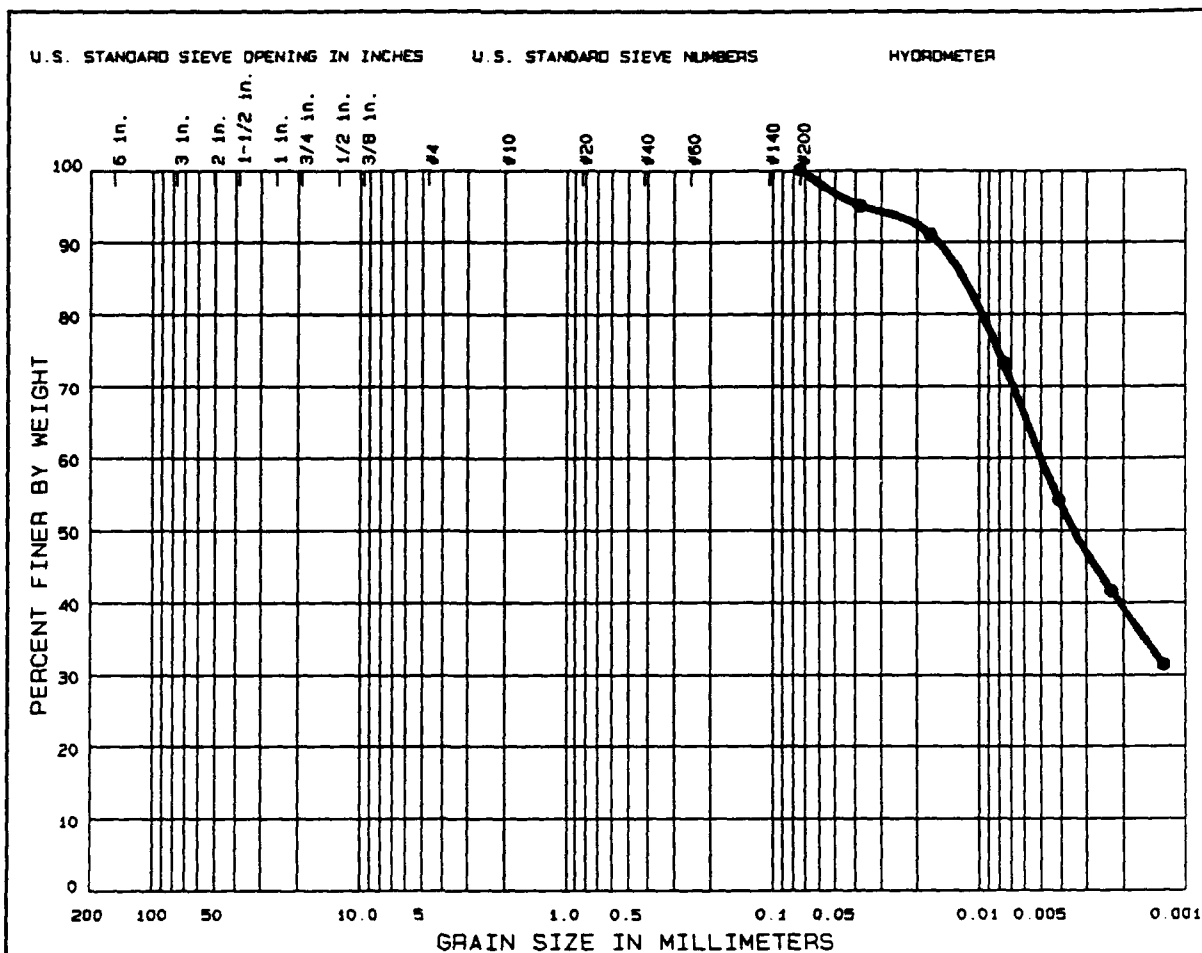


DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



W.O. No.
Req. No.
Contract



% COBBLES		% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	0.0	100.0

[illegible]

CLASSIFICATION

● SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT

Lab No. CESWD-EO-GL RPT NO. 15292

Area

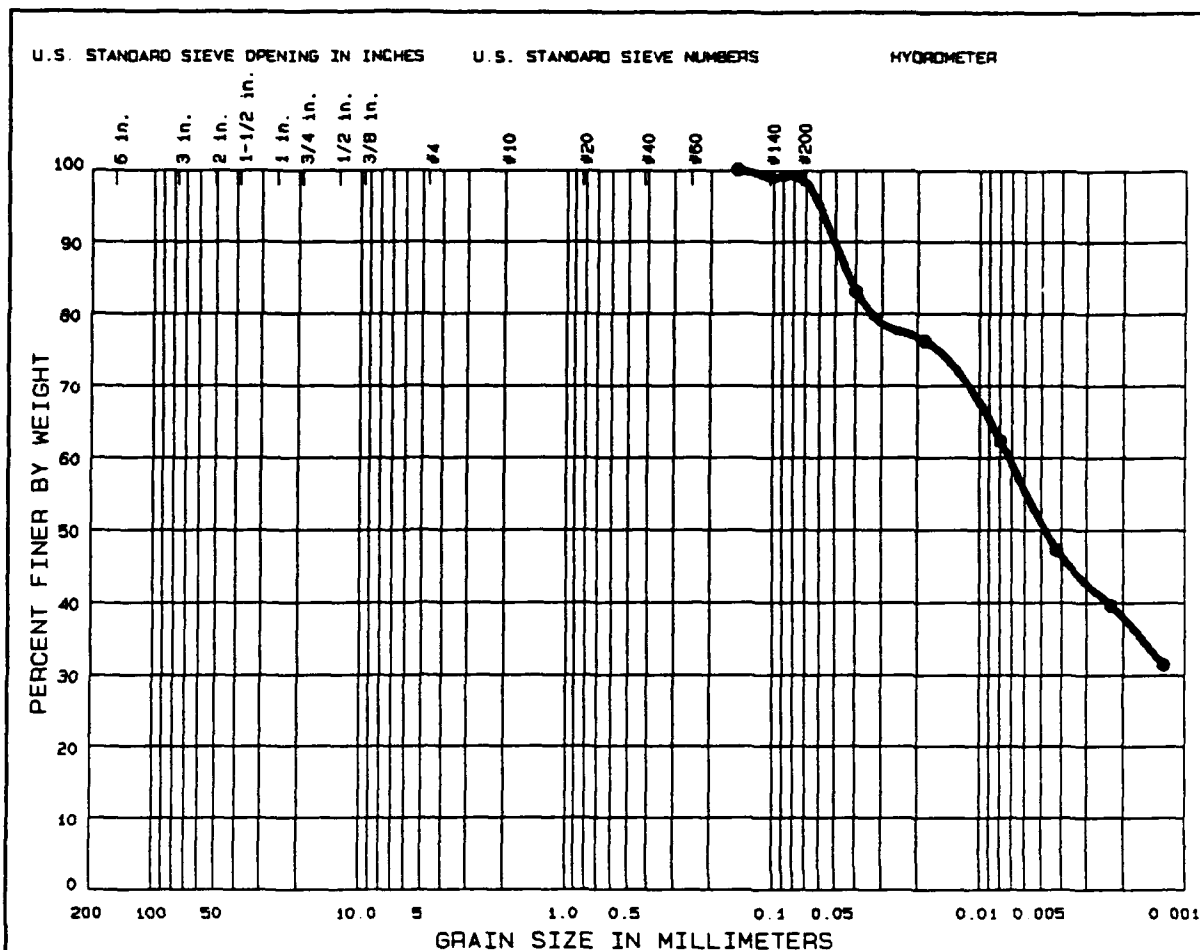
Boring No. 1+35D, LT AB

Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
0.0	0.0	1.0	99.0

Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C _c	C _u
91/7	4640	12.5	52	27	25		

CLASSIFICATION

● SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT

Lab No. CESWD-ED-GL RPT NO. 15292

Area

Boring No. 1+350, LT AB

Date FEB 1991

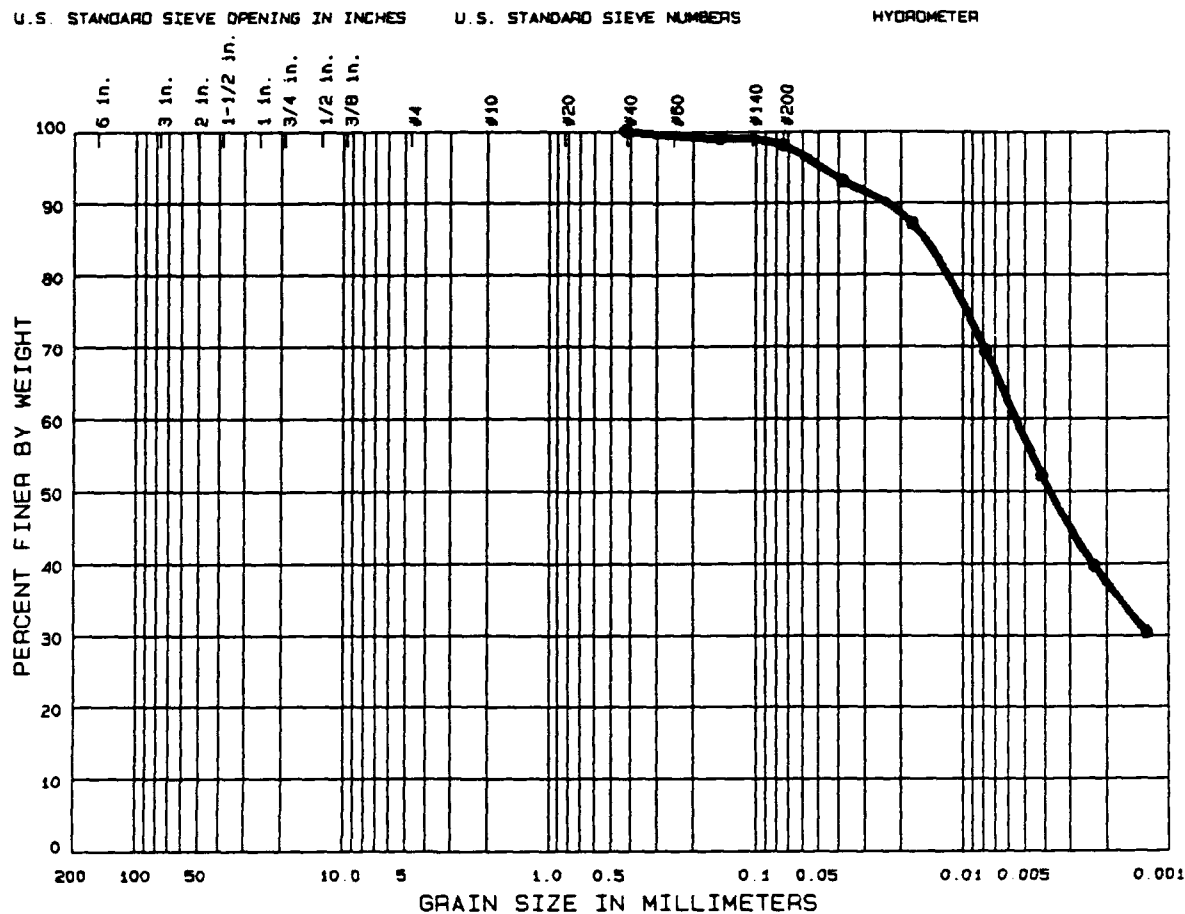
GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

Req. No.

Contract No.



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
0.0	0.0	2.0	98.0

Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C _c	C _u
91/8	4635	8.8	50	24	26		

CLASSIFICATION

● FAT CLAY (CH), POSSIBLE SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT

Lab No. CESWD-ED-GL RPT NO. 15292

Area

Boring No. 1+50D, CL, LT8

Date FEB 1991

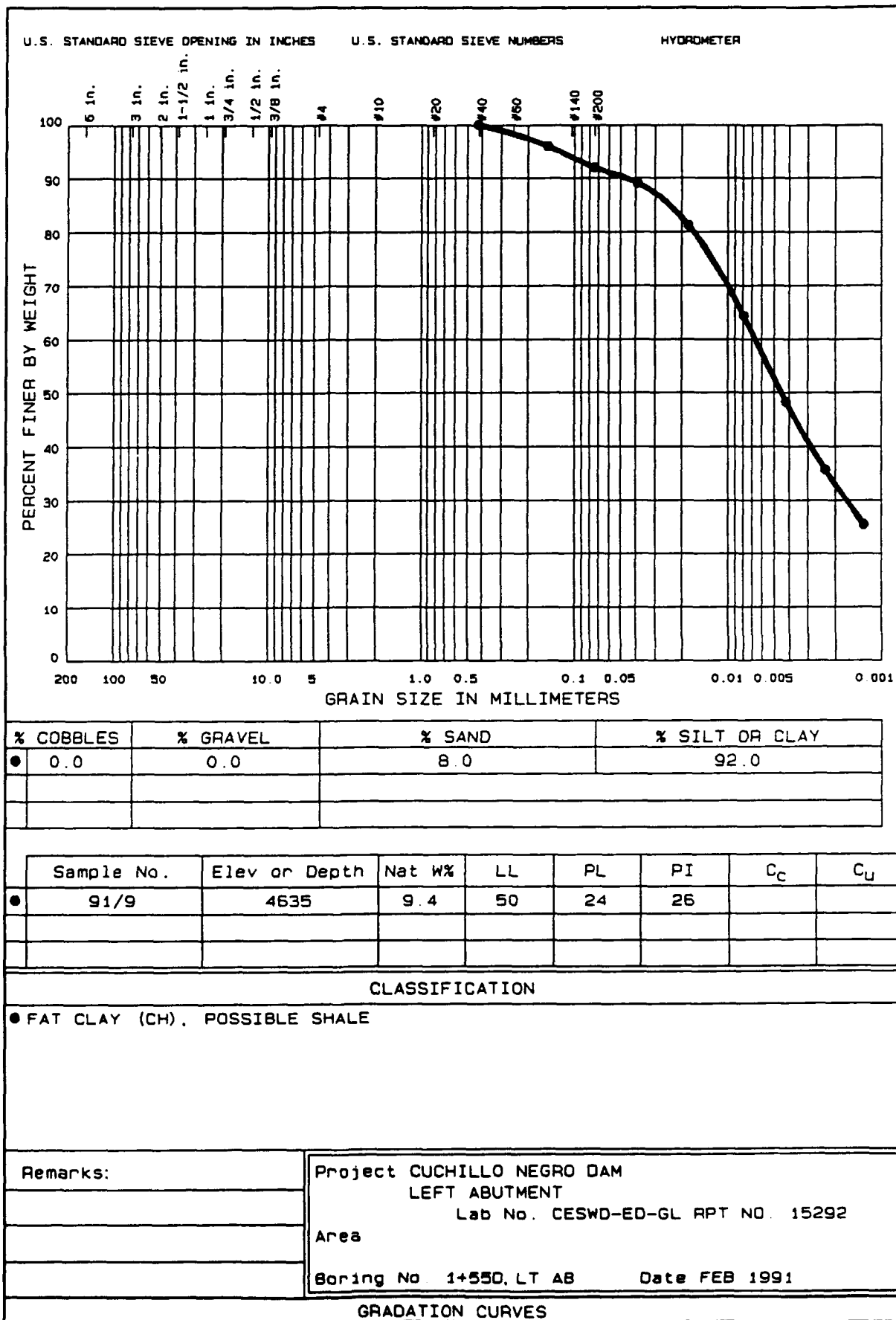
GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

Req. No.

Contract No.

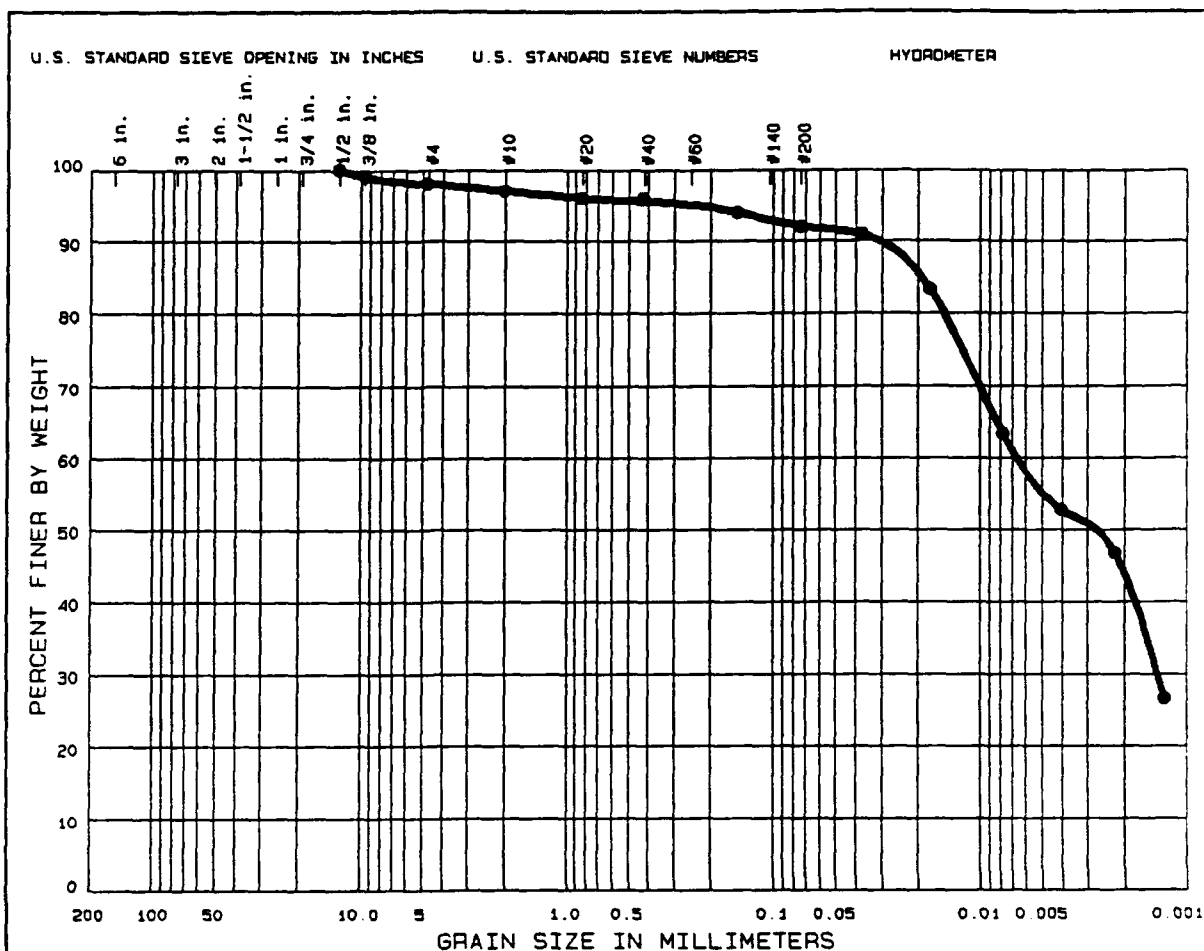


DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

Req. No.

Contract No.

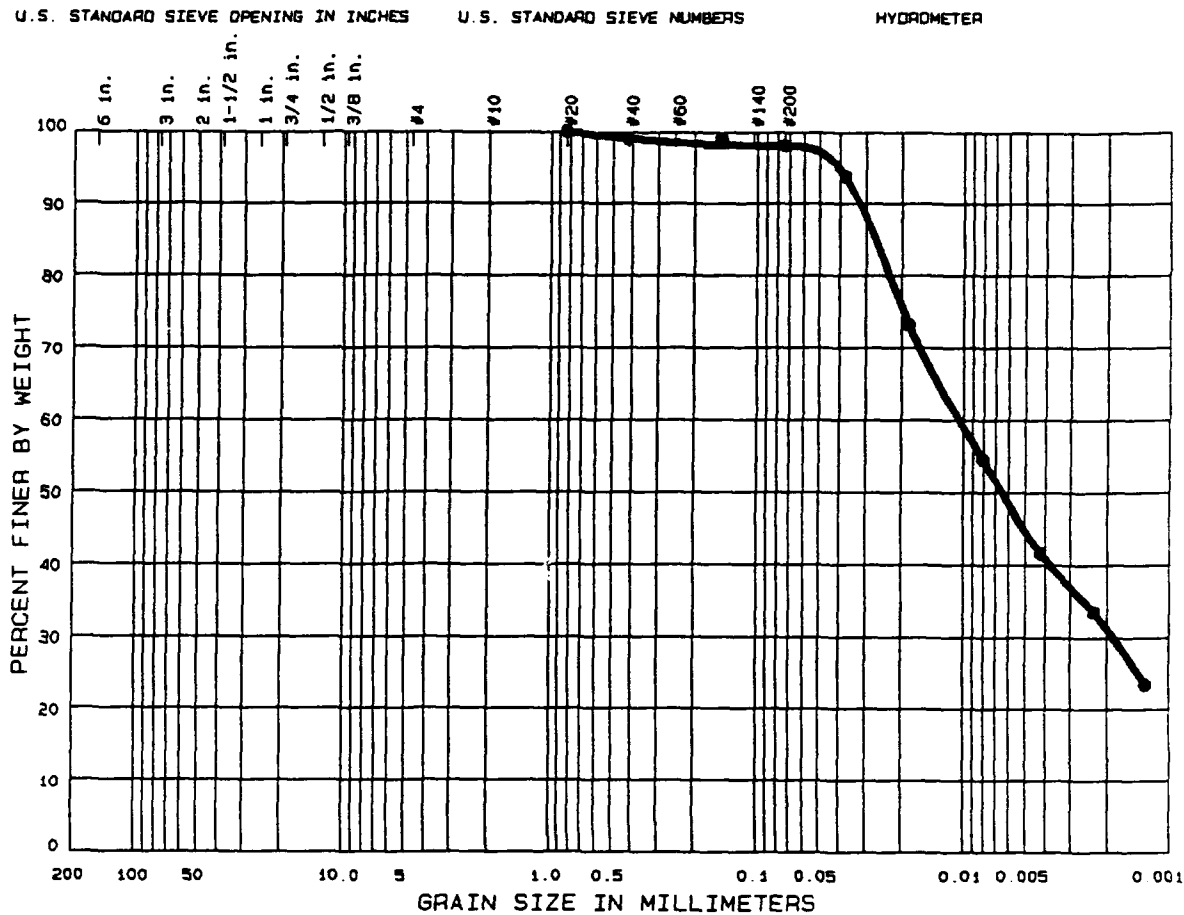


DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.

Req. No.

Contract No.



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
0.0	0.0	2.0	98.0

Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C _c	C _u
91/15	4630.0'	13.2	57	22	35		

CLASSIFICATION

● SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT

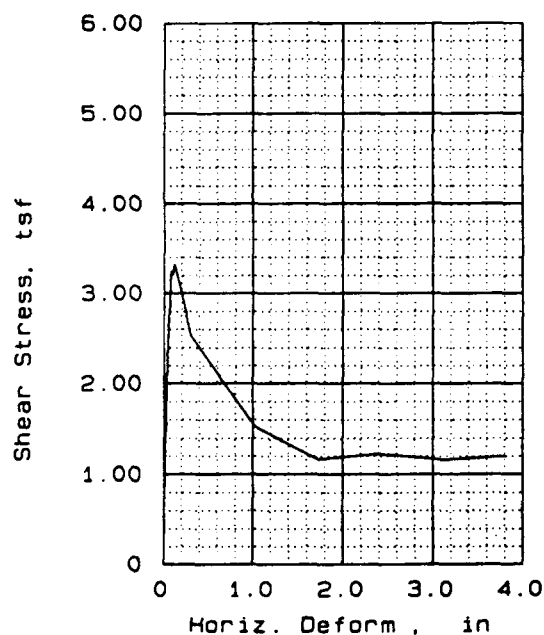
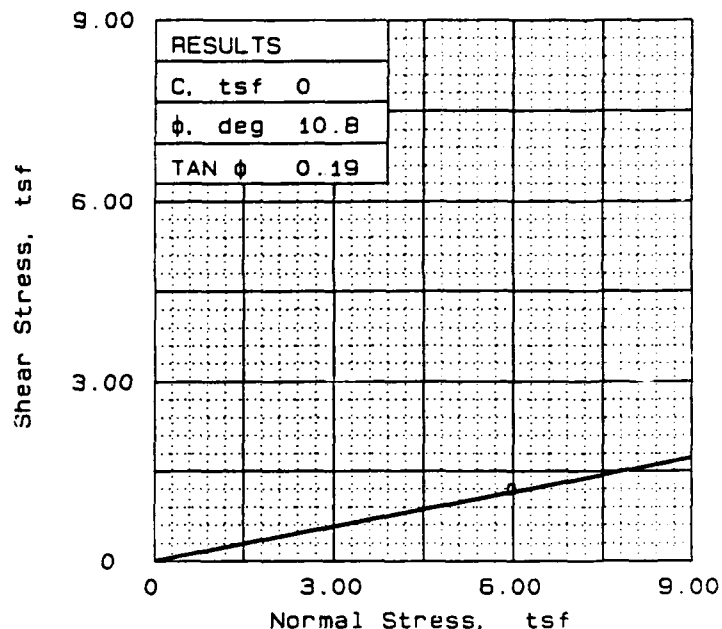
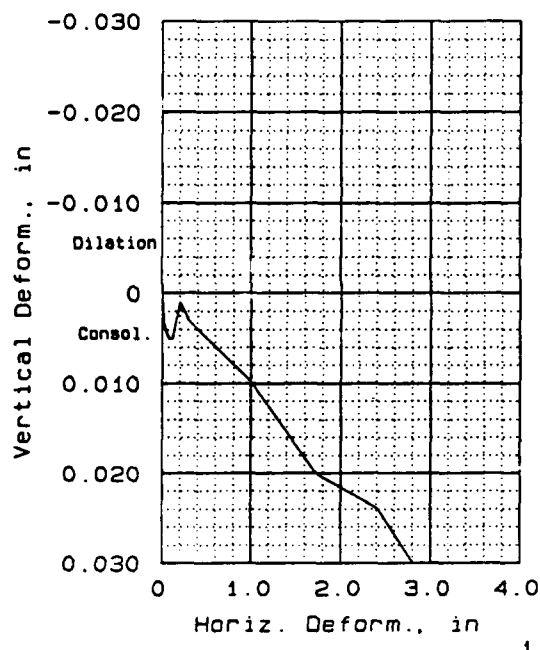
Lab No. CESWD-EO-GL RPT NO. 15293

Area

Boring No. STA 1+600

Date FEB 1991

GRADATION CURVES



SAMPLE NO. 1	
INITIAL	WATER CONTENT, % 11.0
	DRY DENSITY, pcf 119.0
	SATURATION, % 72.2
	VOID RATIO 0.412
	DIAMETER, in 2.51
	HEIGHT, in 1.00
AT TEST	WATER CONTENT, % 13.8
	DRY DENSITY, pcf 122.6
	SATURATION, % 100.7
	VOID RATIO 0.369
	DIAMETER, in 2.51
	HEIGHT, in 0.97
NORMAL STRESS, tsf 6.00	
MAX. SHEAR, tsf 3.32	
STRAIN RATE, %/min. 0.007	
ULT. SHEAR, tsf 1.20	

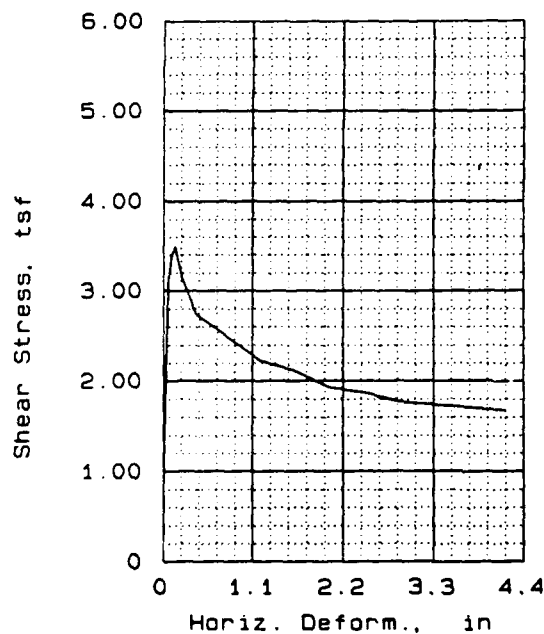
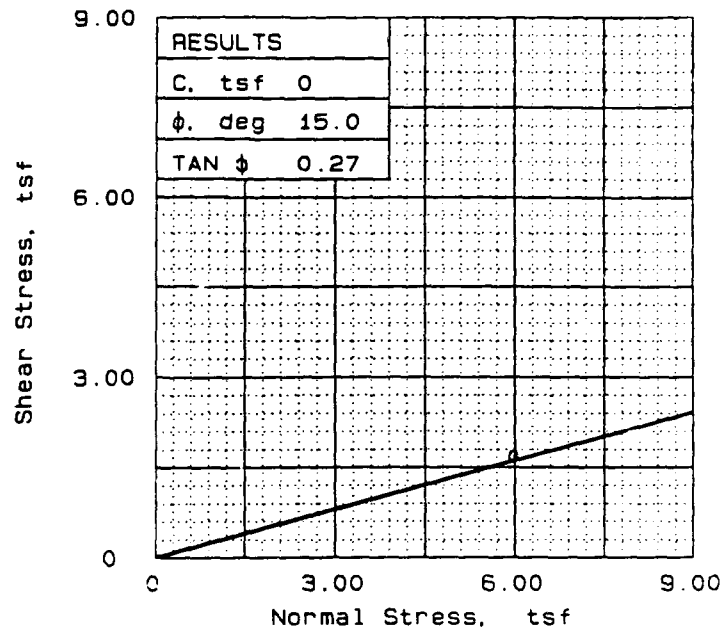
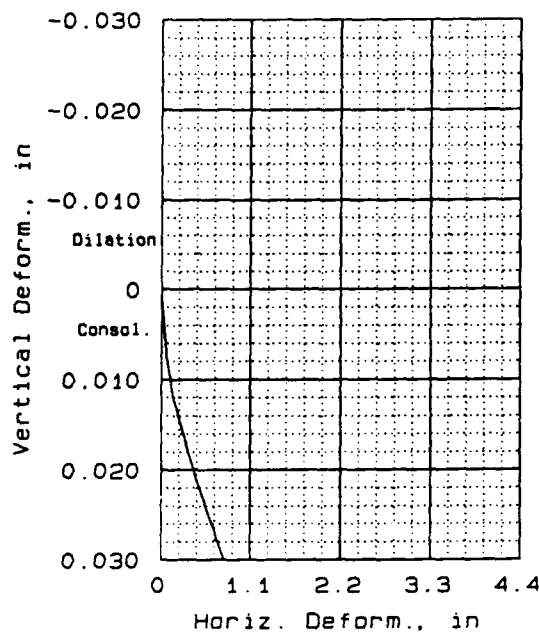
SAMPLE DATA
 SAMPLE TYPE: UNDISTURBED
 DESCRIPTION: SHALE, HIGHLY
 FRACTURED
 LL= 49 PL= 23 PI= 26.0
 SPECIFIC GRAVITY= 2.69
 REMARKS: SPECIFIC GRAVITY
 ESTIMATED

CLIENT: US ARMY CORPS OF ENGINEERS
 ALBUQUERQUE DISTRICT
 PROJECT: CUCHILLO DAM
 SAMPLE LOCATION: LEFT ABUTMENT, ELEV. 4640
 1+35 D, SWD LAB NO. 90/5
 PROJ. NO.: 15292 DATE: JAN 1991

DIRECT SHEAR TEST

CORPS OF ENGINEERS - SOUTHWESTERN

FIG. NO.



SAMPLE NO.		1
INITIAL	WATER CONTENT, %	9.4
	DRY DENSITY, pcf	105.2
	SATURATION, %	42.2
	VOID RATIO	0.597
	SIDE LENGTH, in	3.00
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	19.8
	DRY DENSITY, pcf	109.5
	SATURATION, %	100.1
	VOID RATIO	0.533
	SIDE LENGTH, in	3.00
	HEIGHT, in	0.96
NORMAL STRESS, tsf		6.00
MAX. SHEAR, tsf		3.50
STRAIN RATE, %/min.		0.007
ULT. SHEAR, tsf		1.68

SAMPLE DATA 1

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: FAT CLAY (CH)

POSSIBLE SHALE

LL= 50 PL= 24 PI= 26.0

SPECIFIC GRAVITY= 2.69

REMARKS: SPECIFIC GRAVITY ESTIMATED

CLIENT: US ARMY CORPS OF ENGINEERS

ALBUQUERQUE DISTRICT

PROJECT: CUCHILLO DAM

SAMPLE LOCATION: LEFT ABUTMENT, ELEV. 4635

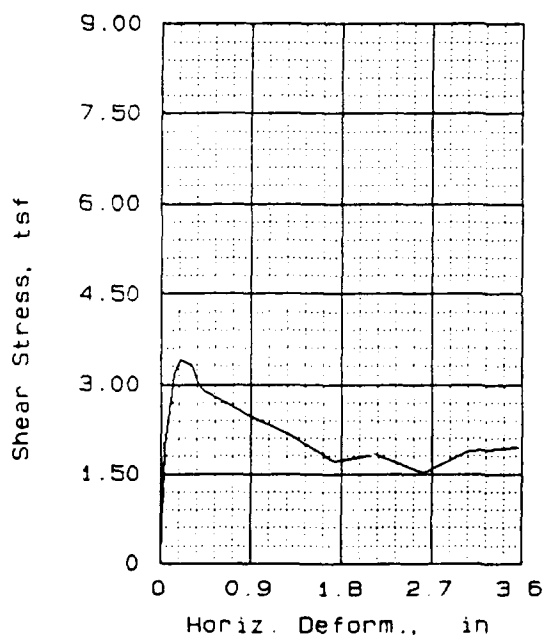
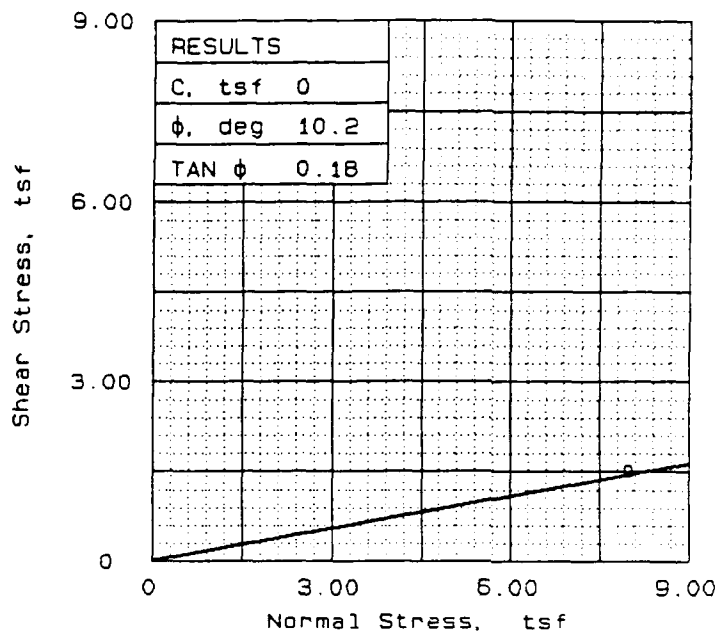
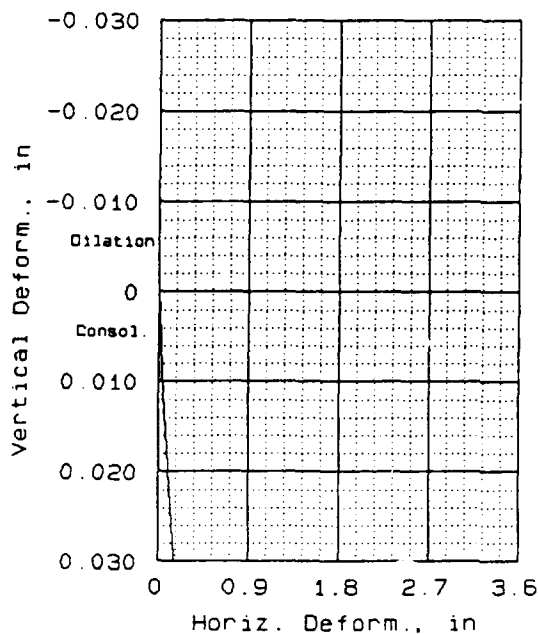
1+55 D. SWD LASB NO. 90/9

PROJ. NO.: 15292 DATE: JAN 1991

DIRECT SHEAR TEST

CORPS OF ENGINEERS - SOUTHWESTERN

FIG. NO.



SAMPLE NO.		1
INITIAL	WATER CONTENT, %	19.2
	DRY DENSITY, pcf	87.6
	SATURATION, %	56.2
	VOID RATIO	0.917
	SIDE LENGTH, in	3.00
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	30.6
	DRY DENSITY, pcf	87.6
	SATURATION, %	89.8
	VOID RATIO	0.917
	SIDE LENGTH, in	3.39
	HEIGHT, in	1.00
NORMAL STRESS, tsf		8.00
MAX. SHEAR, tsf		3.38
STRAIN RATE, %/min.		0.002
ULT. SHEAR, tsf		1.52

SAMPLE DATA
 SAMPLE TYPE: UNDISTURBED
 DESCRIPTION: SHALE
 LL= PL= PI=
 SPECIFIC GRAVITY= 2.69
 REMARKS: SPECIFIC GRAVITY ESTIMATED
 ULTIMATE SHEAR USED TO PLOT ϕ .

FIG NO

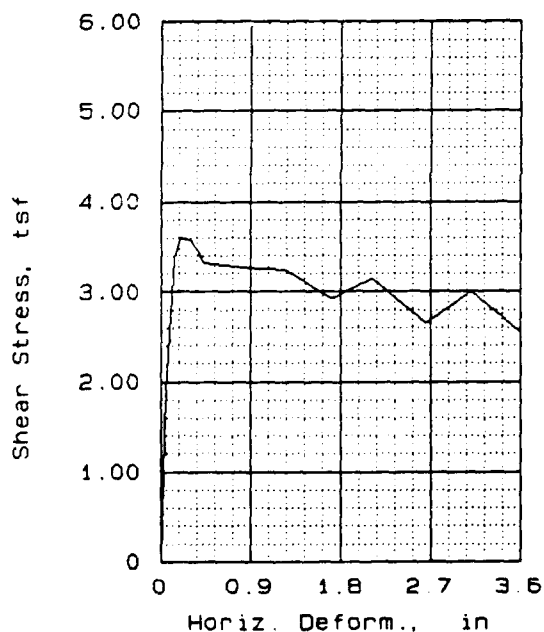
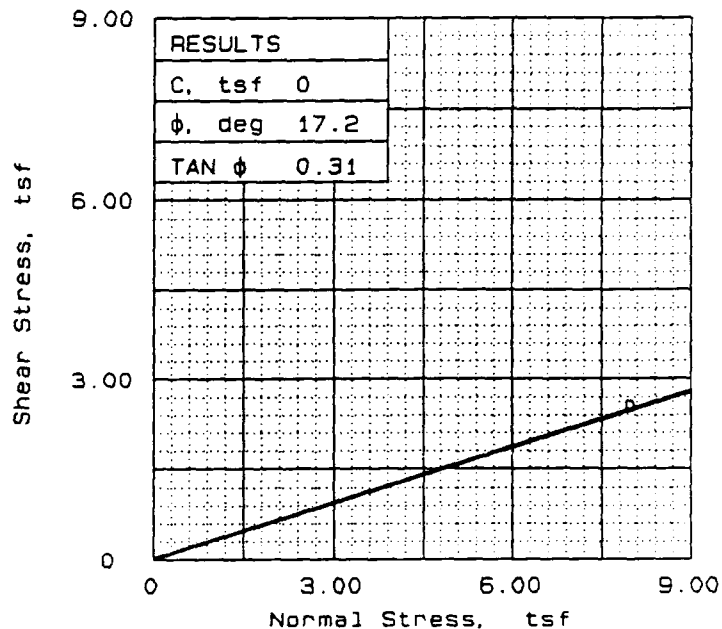
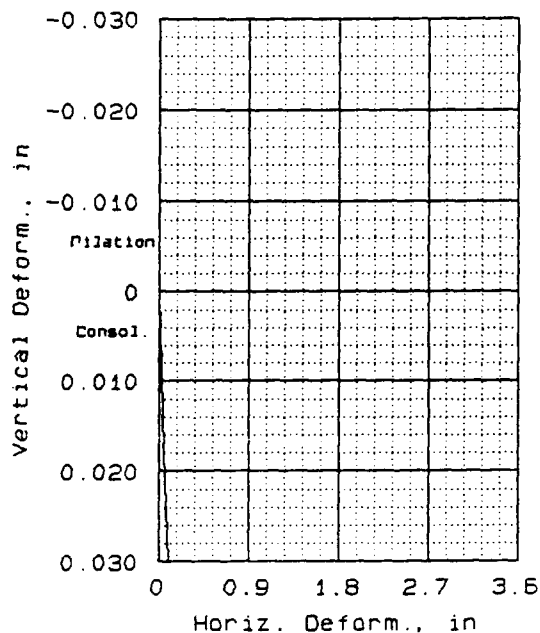
CLIENT: US ARMY CORPS OF ENGINEERS
 ALBUQUERQUE DISTRICT
 PROJECT: CUCHILLO DAM

SAMPLE LOCATION: STA. 1+600. ELEV. 4635
 SWD LAB NO. 91/14

PROJ NO.: 15292 DATE: FEB 1991

DIRECT SHEAR TEST

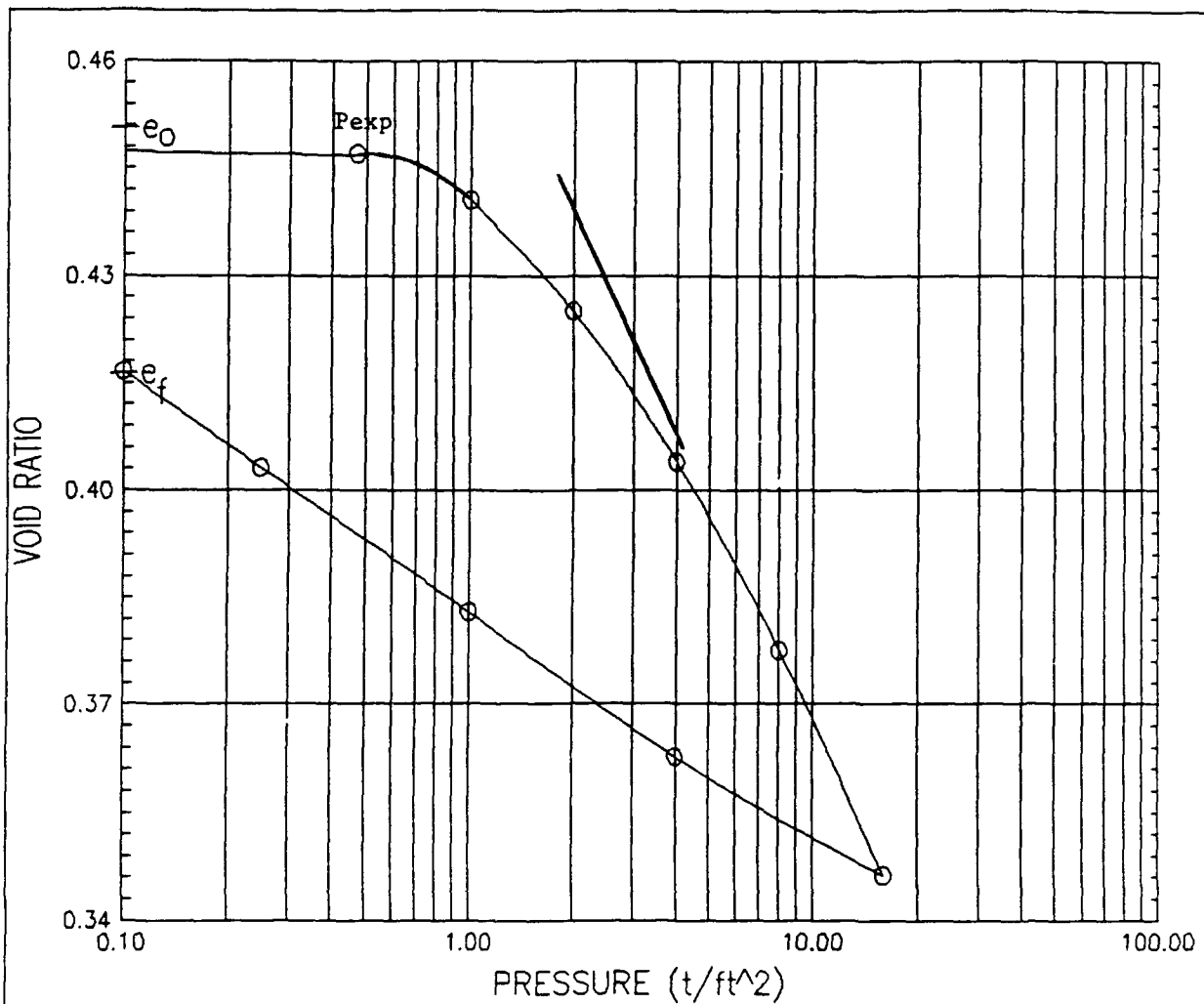
CORPS OF ENGINEERS - SOUTHWESTERN



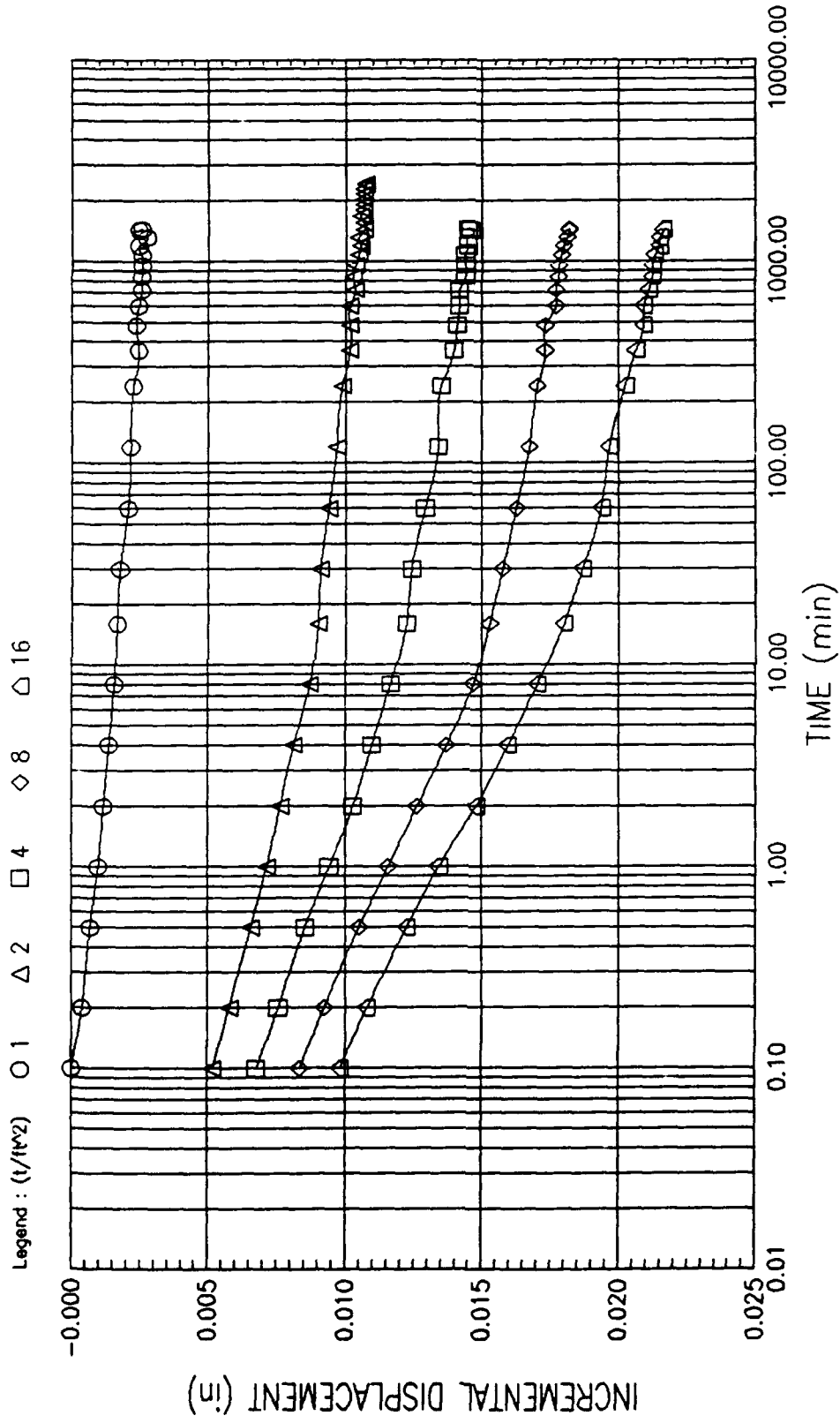
SAMPLE NO.		1
INITIAL	WATER CONTENT, %	10.7
	DRY DENSITY, pcf	77.0
	SATURATION, %	24.3
	VOID RATIO	1.181
	SIDE LENGTH, in	3.00
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	31.8
	DRY DENSITY, pcf	84.1
	SATURATION, %	85.6
	VOID RATIO	0.998
	SIDE LENGTH, in	3.39
	HEIGHT, in	0.92
NORMAL STRESS, tsf		8.00
MAX. SHEAR, tsf		3.75
STRAIN RATE, %/min.		0.002
ULT. SHEAR, tsf		2.55

SAMPLE DATA
 SAMPLE TYPE: UNDISTURBED
 DESCRIPTION: SHALE
 LL= PL= PI=
 SPECIFIC GRAVITY= 2.69
 REMARKS: SPECIFIC GRAVITY ESTIMATED
 ULTIMATE SHEAR USED TO PLOT ϕ .
 SAMPLE DID NOT SHEAR ALONG HORIZONTAL
 PLANE, THIS CAUSED LOAD TO CYCLE
 FROM HIGH TO LOW.
 FIG. NO.

CLIENT: US ARMY CORPS OF ENGINEERS
 ALBUQUERQUE DISTRICT
 PROJECT: CUCHILLO DAM
 SAMPLE LOCATION: STA. 1+600, ELEV. 4630
 SWD LAB NO. 91/15
 PROJ NO.: 15292 DATE: FEB 1991
 DIRECT SHEAR TEST
 CORPS OF ENGINEERS - SOUTHWESTERN



				BEFORE TEST	AFTER TEST	
OVERBURDEN PRESSURE (t/ft ²)		0.1	WATER CONTENT (%)		13.999	16.069
PRECONSOL. PRESSURE (t/ft ²)			DRY DENSITY (lb/ft ³)		115.746	118.539
COMPRESSION INDEX		0.10	SATURATION (%)		83.522	103.739
TYPE SPECIMEN			VOID RATIO		0.451	0.417
DIA. (in)	2.505	HT. (in)	1.000	BACK PRESSURE (t/ft ²)		
CLASSIFICATION SHALE						
LL	49.0	PL	23.0	PI	26.0	PROJECT CUCHILLO DAM
GS 2.690		D ₁₀		Data File: B:91-5.CNV		
REMARKS 1 + 35 D				BORING NO. LT. ABUTMT		SAMPLE NO. 91-5
☐ Start-Swell ☐ End-Swell				DEPTH 4640.0		DATE
SPECIFIC GRAVITY ESTIMATED				Army Corp of Engineers CONSOLIDATION TEST REPORT		



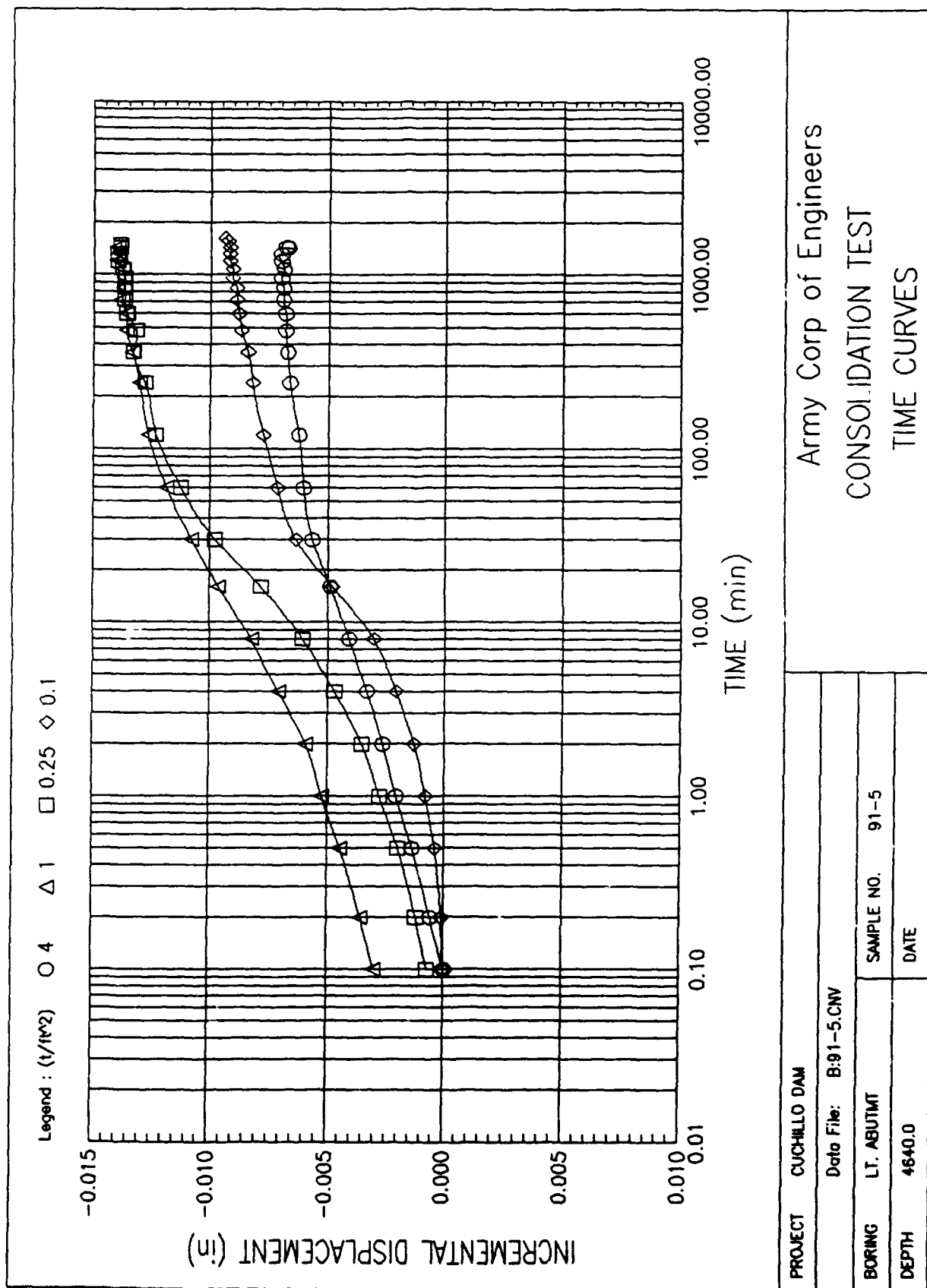
Army Corp of Engineers
CONSOLIDATION TEST
TIME CURVES

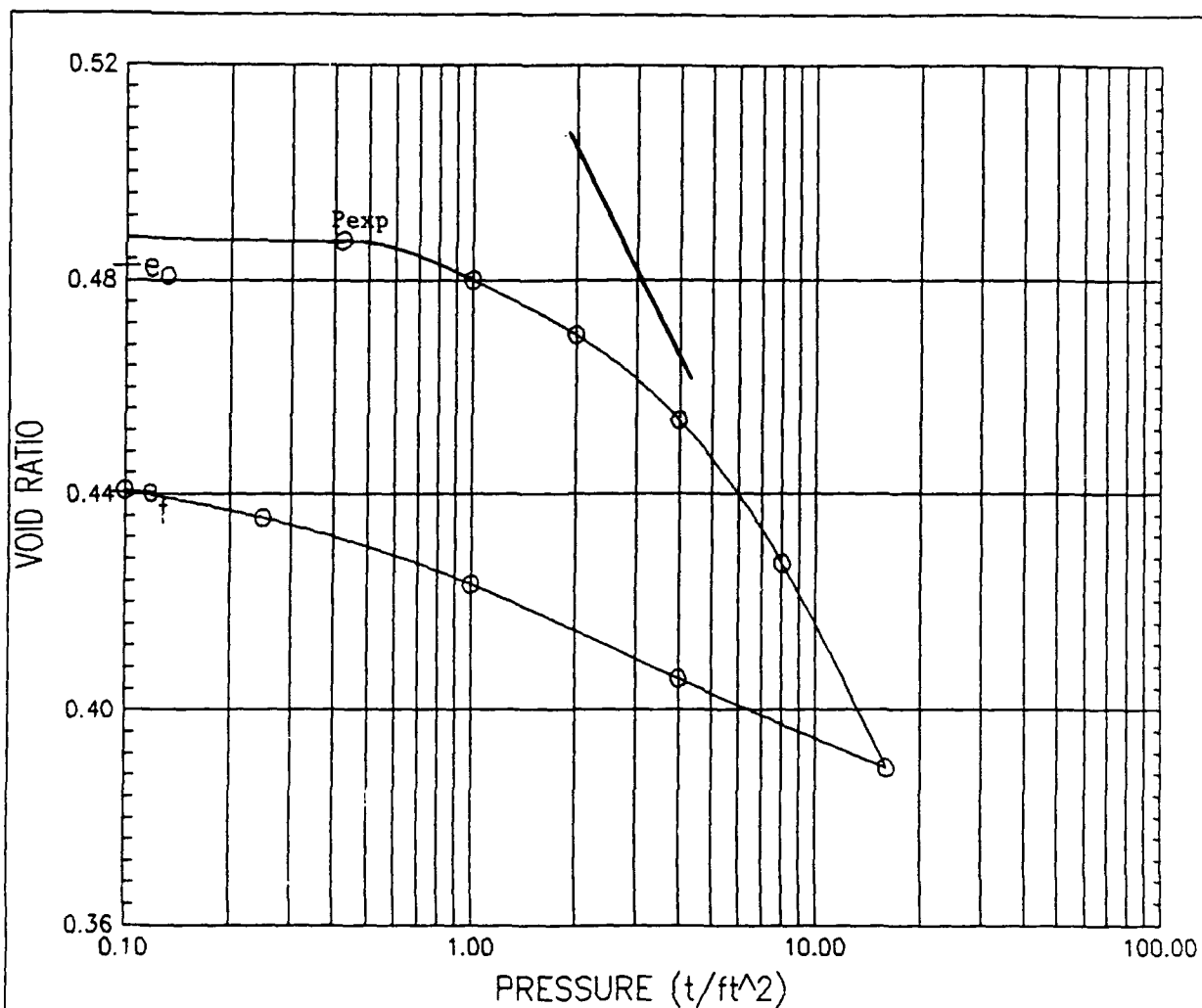
PROJECT CUCHILLO DAM

Data File: B:91-5.CNV

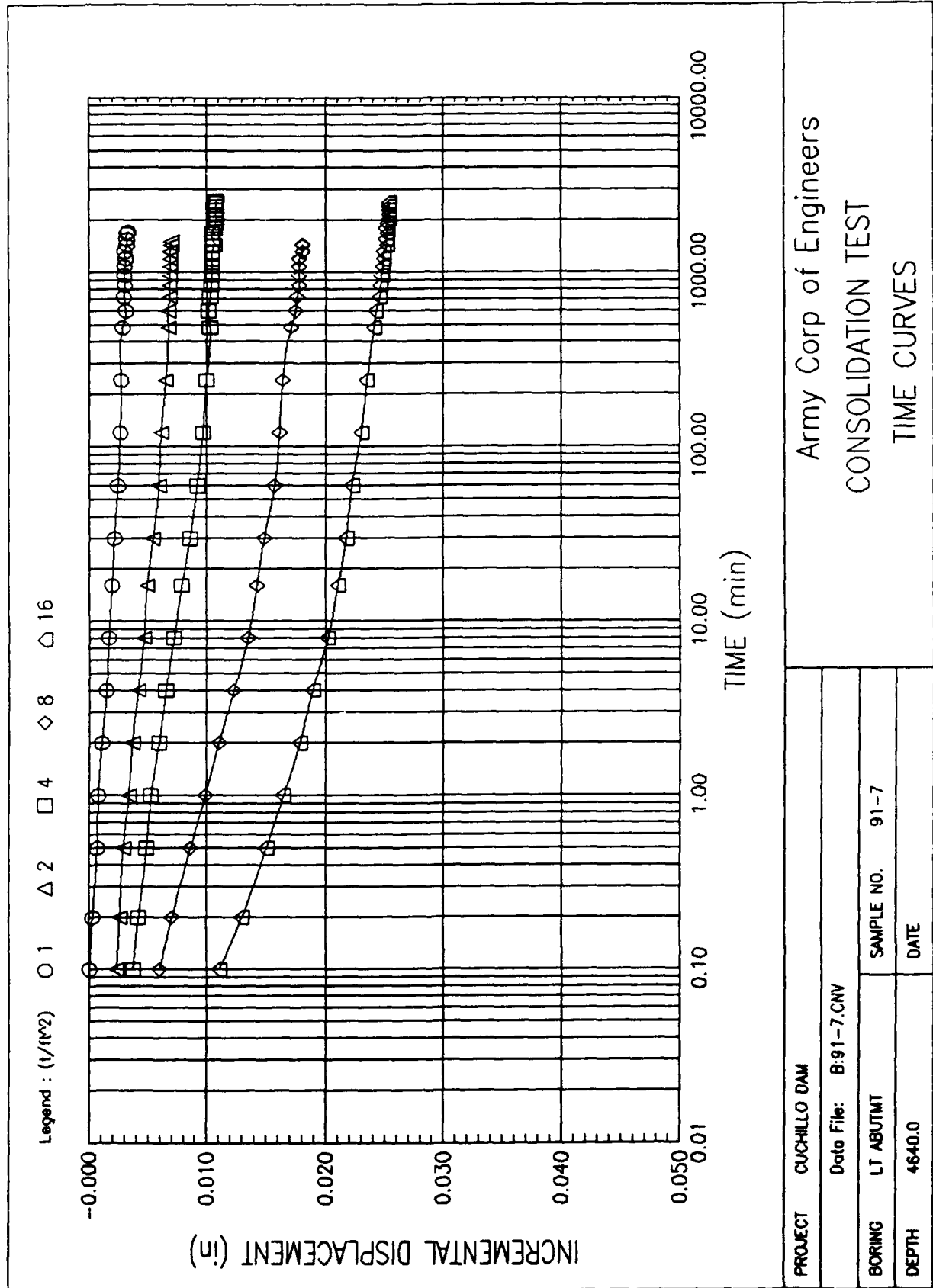
BORING LT. ABUTMT SAMPLE NO. 91-5

DEPTH 4640.0 DATE





				BEFORE TEST	AFTER TEST	
OVERBURDEN PRESSURE (t/ft ²)		0.1	WATER CONTENT (%)		14.266	16.382
PRECONSOL. PRESSURE (t/ft ²)			DRY DENSITY (lb/ft ³)		113.243	116.554
COMPRESSION INDEX		0.13	SATURATION (%)		79.465	99.973
TYPE SPECIMEN				VOID RATIO	0.483	0.441
DIA. (in)	2.505	HT. (in)	1.000	BACK PRESSURE (t/ft ²)		
CLASSIFICATION SHALE						
LL	52.0	PL	27.0	PI	25.0	PROJECT CUCHILLO DAM
GS 2.690		D ₁₀		Data File: B:91-7.CNV		
REMARKS 1 + 35 D				BORING NO. LT ABUTMT		SAMPLE NO. 91-7
☐ Start-Swell ☐ End-Swell				DEPTH 4640.0		DATE
SPECIFIC GRAVITY ESTIMATED				Army Corp of Engineers CONSOLIDATION TEST REPORT		
SAMPLE APPROX. 40 % REMOLDED.						



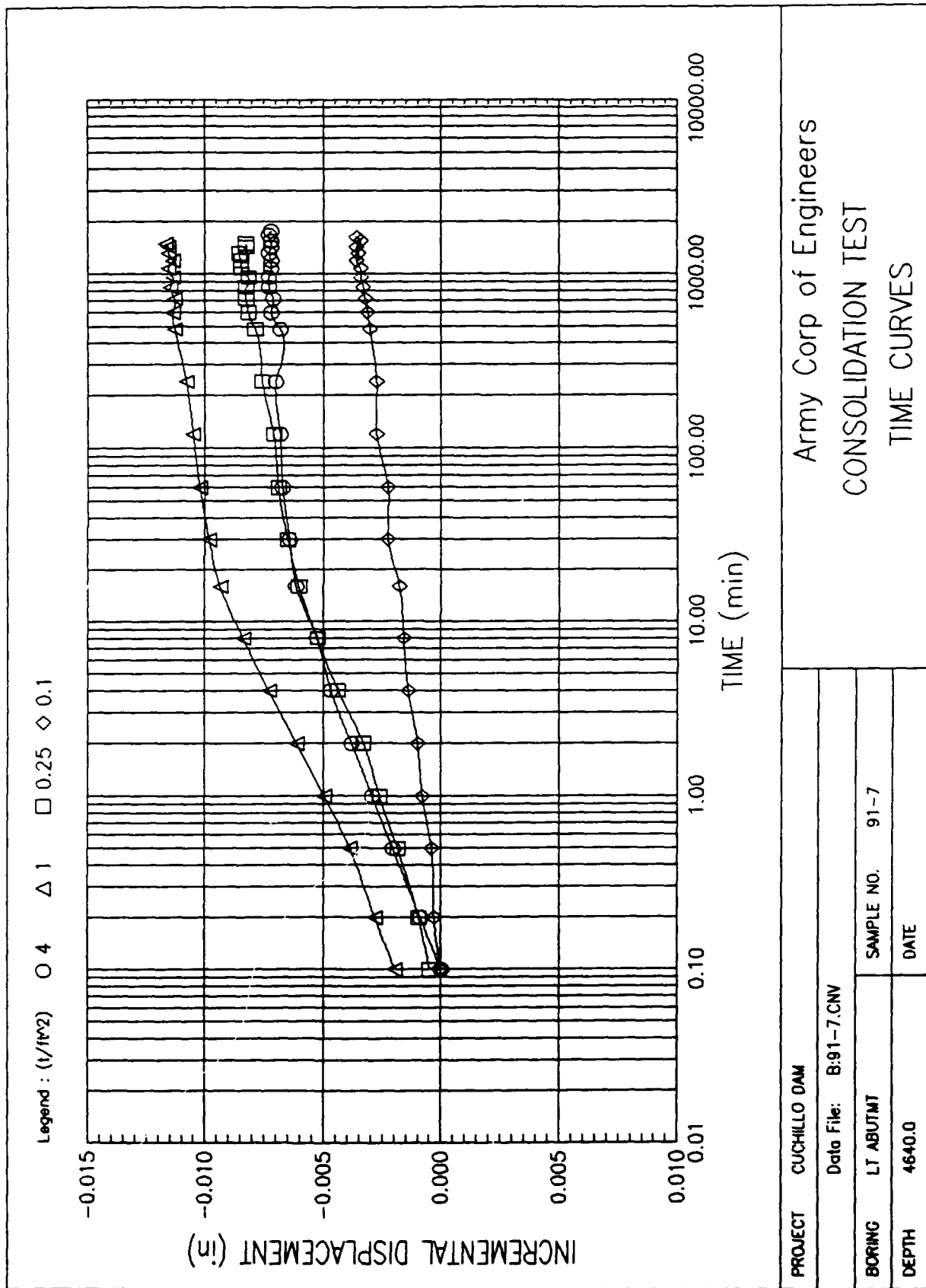
Army Corp of Engineers
CONSOLIDATION TEST
TIME CURVES

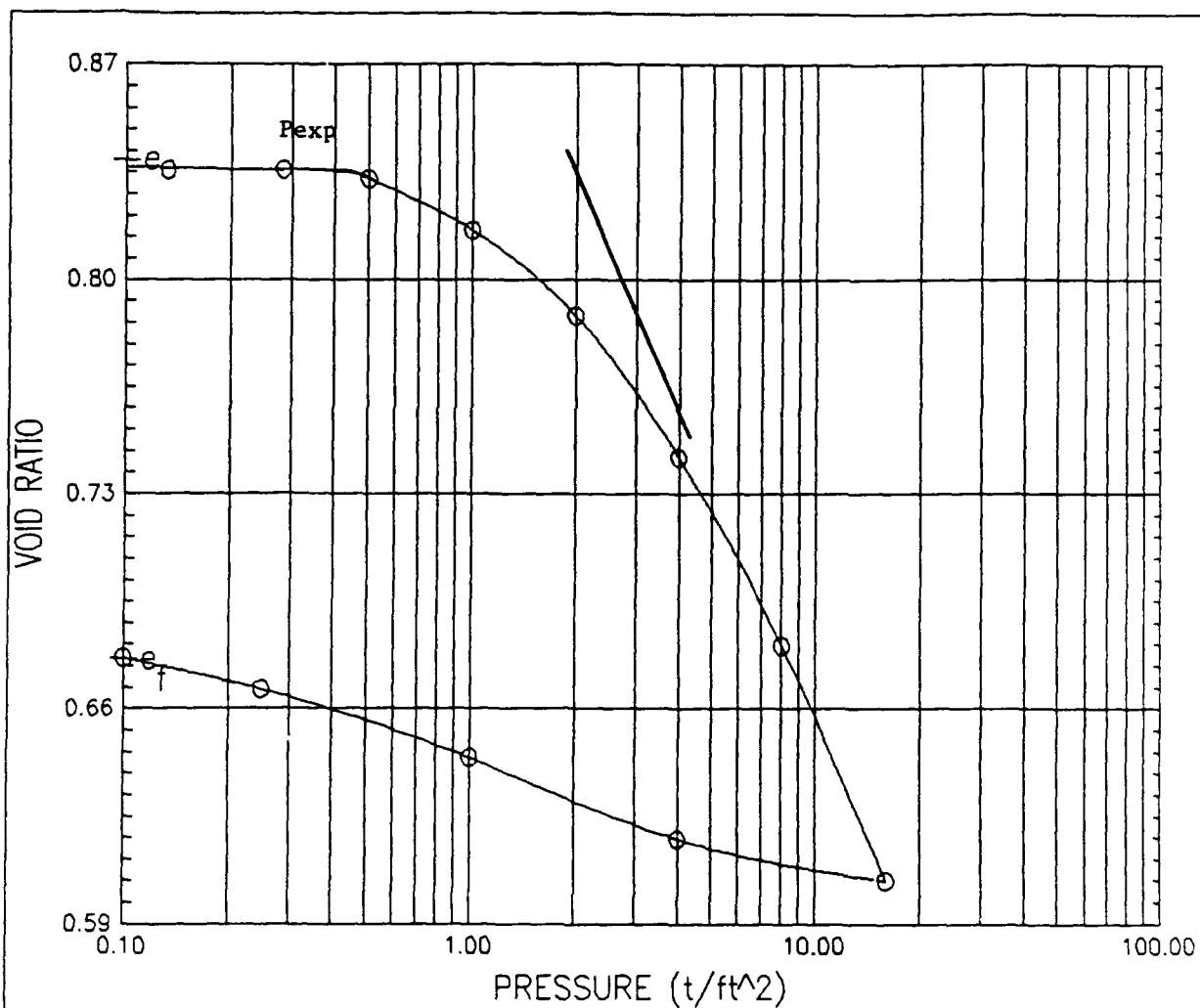
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Data File: B:91-7.CNV

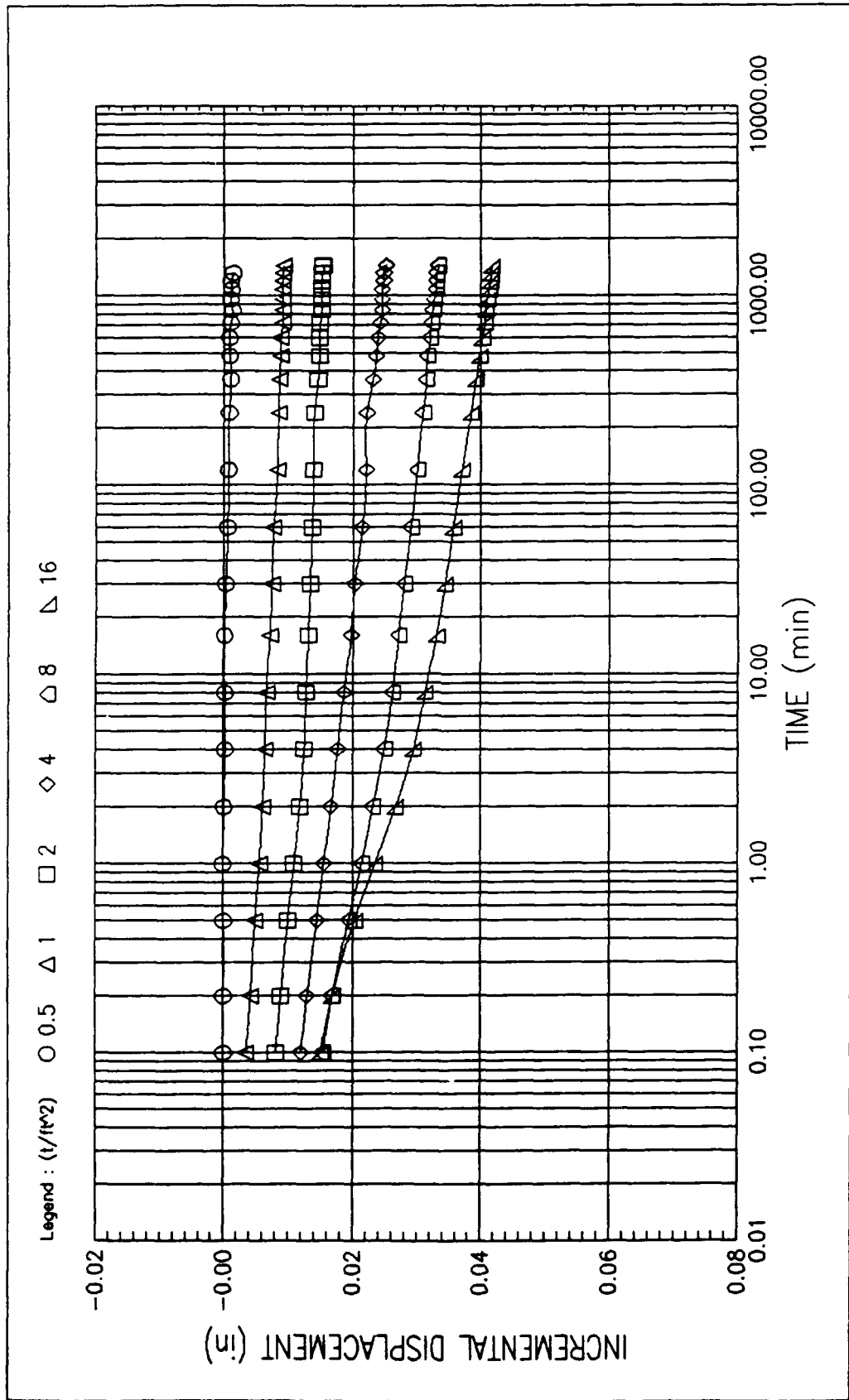
BORING LT ABUTMT SAMPLE NO. 91-7

DEPTH 4640.0 DATE



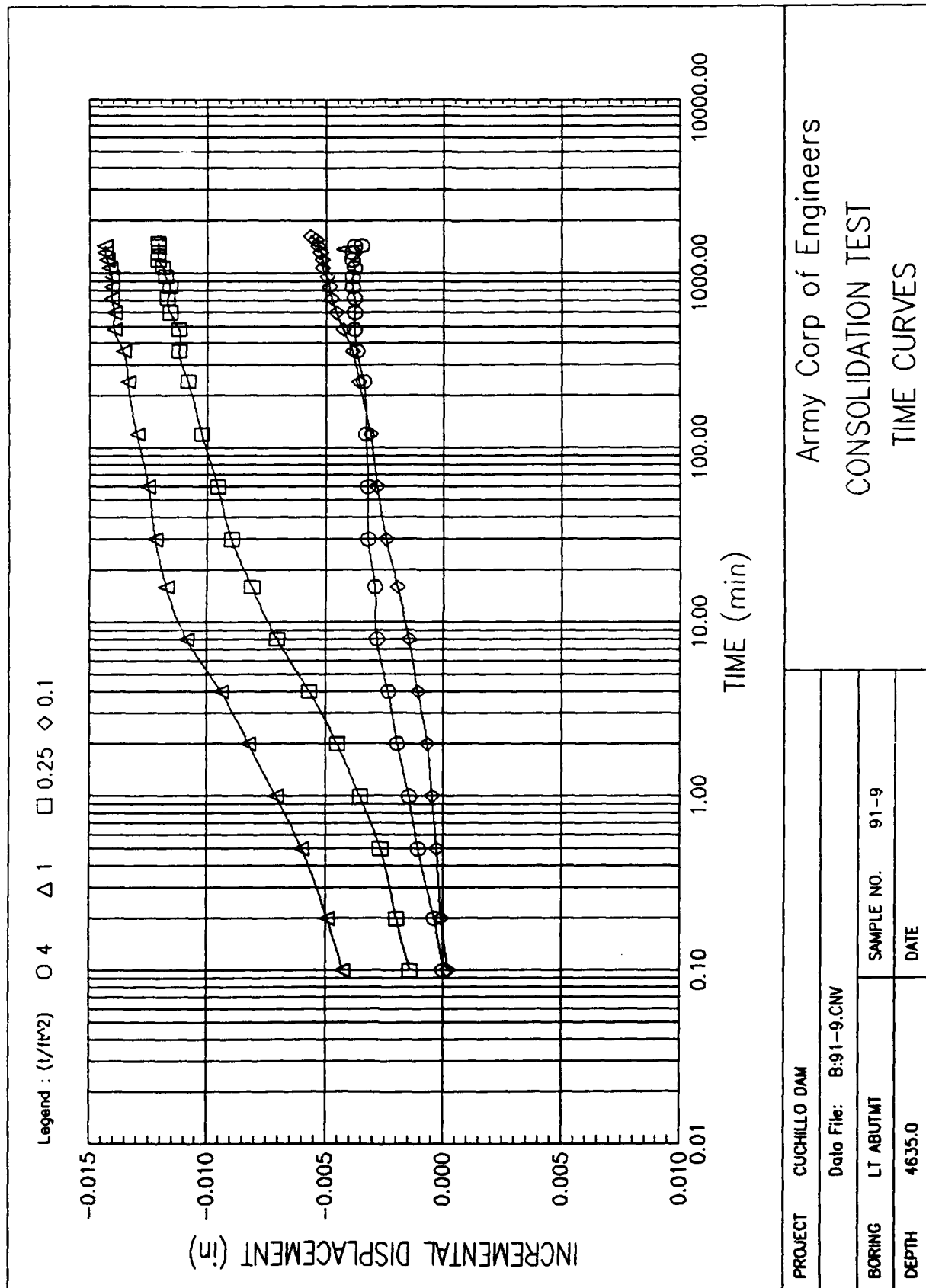


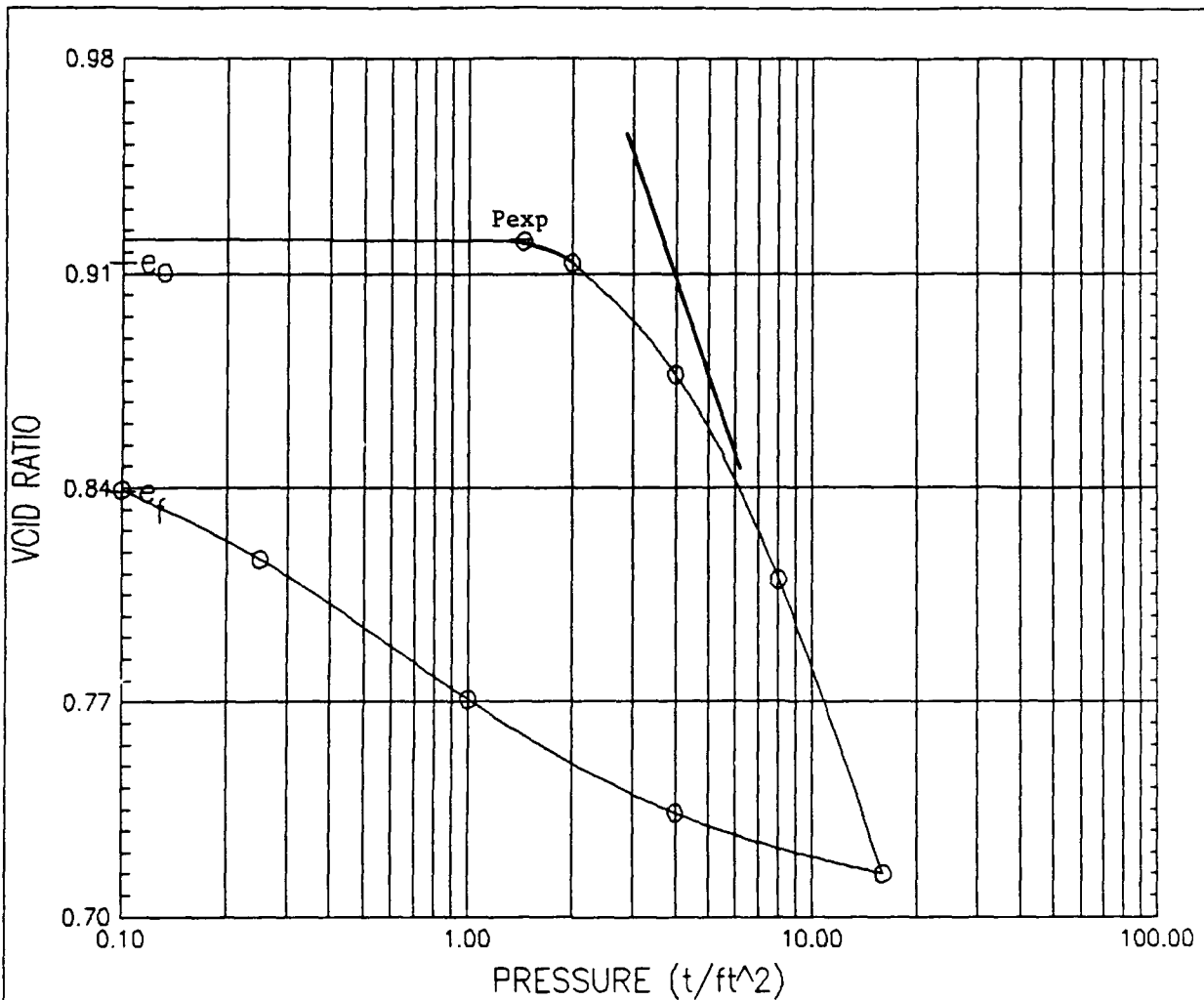
				BEFORE TEST	AFTER TEST	
OVERBURDEN PRESSURE (t/ft ²)		0.1		WATER CONTENT (%)	11.770	26.080
PRECONSOL. PRESSURE (t/ft ²)				DRY DENSITY (lb/ft ³)	91.290	100.161
COMPRESSION INDEX		0.27		SATURATION (%)	37.712	103.685
TYPE SPECIMEN				VOID RATIO	0.840	0.677
DIA. (in)	2.505	HT. (in)	1.000	BACK PRESSURE (t/ft ²)		
CLASSIFICATION FAT CLAY (CH), POSSIBLE SHALE						
LL	50.0	PL	24.0	PI	26.0	PROJECT CUCHILLO DAM
GS	2.690	D ₁₀		Data File: B:91-9.CNV		
REMARKS 1 + 55 D				BORING NO. LT ABUTMT		SAMPLE NO. 91-9
☐ Start-Swell ☐ End-Swell				DEPTH 4635.0		DATE
SPECIFIC GRAVITY ESTIMATED				Army Corp of Engineers CONSOLIDATION TEST REPORT		



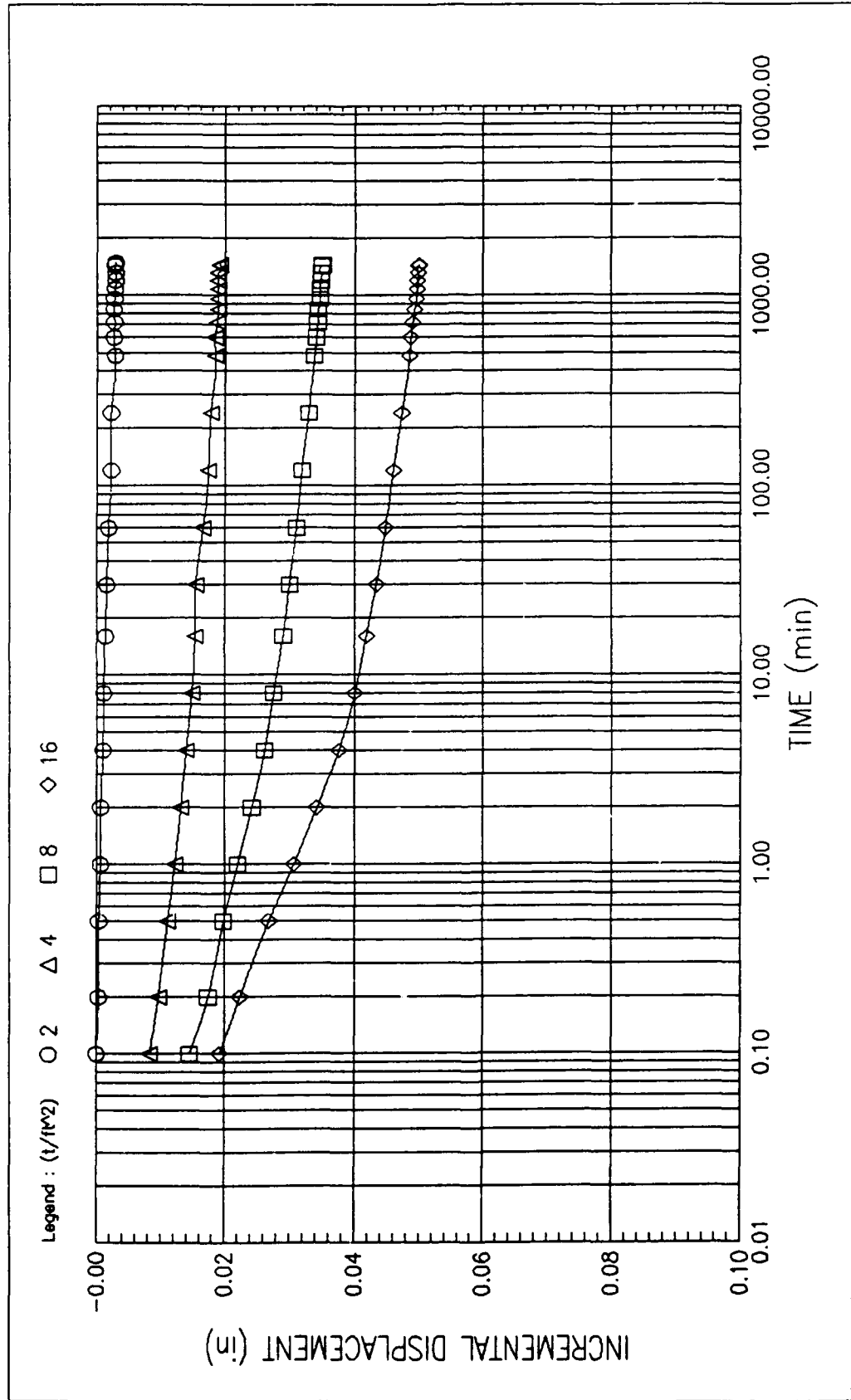
E-84

PROJECT CUCHILLO DAM		Army Corp of Engineers	
Data File: B:91-9.CNV		CONSOLIDATION TEST	
BORING LT ABUTMT	SAMPLE NO. 91-9	TIME CURVES	
DEPTH 4635.0	DATE		

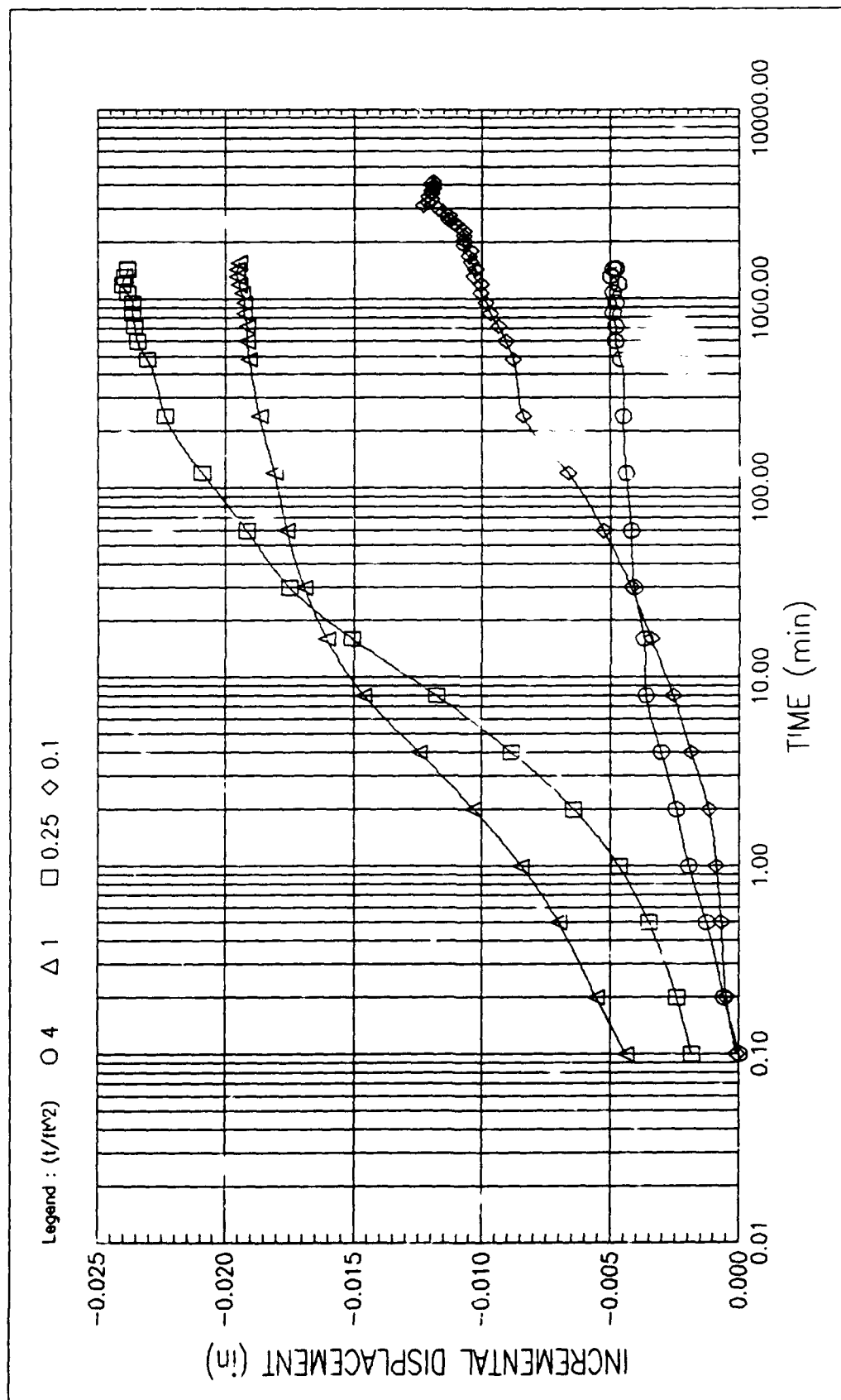




				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft ²)		0.1	WATER CONTENT (%)	13.223	31.727
PRECONSOL. PRESSURE (t/ft ²)			DRY DENSITY (lb/ft ³)	87.728	91.301
COMPRESSION INDEX		0.33	SATURATION (%)	38.908	101.684
TYPE SPECIMEN			VOID RATIO	0.914	0.839
DIA. (in)	2.505	HT. (in)	1.000	BACK PRESSURE (t/ft ²)	
CLASSIFICATION SHALE					
LL		PL	PI	PROJECT CUCHILLO DAM	
GS 2.690		D ₁₀		Data File: B:15.CNV	
REMARKS			BORING NO. STA. 1+600		SAMPLE NO. 91/15
☐ Start-Swell ☐ End-Swell			DEPTH 4630		DATE
SPECIFIC GRAVITY ESTIMATED			Army Corp of Engineers CONSOLIDATION TEST REPORT		
SAMPLE PARTIALLY REMOLDED					



PROJECT CUCHILLO DAM		Army Corp of Engineers	
Data File: B:15.CNV		CONSOLIDATION TEST	
BORING	STA. 1+600	SAMPLE NO.	91/15
DEPTH	4635	DATE	
		TIME CURVES	



PROJECT CUCHILLO DAM		Army Corp of Engineers	
Data File: B:15.CNV		CONSOLIDATION TEST	
BORING	STA. 1+600	TIME CURVES	
DEPTH	4635		
		SAMPLE NO.	91/15
		DATE	

Geophysical Logs and Report

Summary of Cuchilla Negro Geophysical Logs

Geophysical logs were made in 14 wells, by the U.S. Geological Survey logger, in the Cuchillo Negro dam-site location during May 1988. The cored-holes generally traverse the proposed location of a flood-water retention dam across Cuchillo Negro Wash and the spill-way location in an adjacent tributary.

Three of the holes originally planned for logging, had caved too shallow for usable logs. Two, of the 14 holes logged, were very shallow so only gamma logs were made in those. Natural Gamma, Gamma-Gamma Density, Neutron, and Caliper logs were made in the 12 deepest holes.

All of the holes showed a fracture zone except the northern-most (CH-17) and the southern-most (CH-22) which are situated on the highest elevations. The formation outcrops indicate an east-northeast dip of approximately 25 degrees making correlation of the lithology, from hole-to-hole, very difficult. The logs exhibit anomalies indicative of a very dirty subordinate limestone to clean limestone separated by layers of shale and clay. The clean limestone layers are relatively thin and pinch-out to zero in places but where it is present, few fractures appear in it. The fracture sections appear mostly in the shale sections, and the limestone/calcite sections, and generally at random without direct communications to areal holes. Any movement of ground-water would necessitate, vertical as well as horizontal flow, because of the apparent block-like nature of the formations, therefore areal permeability would be very low.

The attached over-lay, showing well locations, altitude of the land-surface, and altitude of the encountered fracture zones, indicate a fracture at

approximately 4,632 above MSL, that may be an exception. However, when the Gamma logs of the wells encountering the 4,632 fracture are compared, it is obvious that the section is not continuous and therefore not directly related.

Four of the holes contained a small amount of water and the Neutron logs show seeps in the fracture areas of these holes but not in others, leading to the belief that this is perched water or drilling fluid.

GAMMA LOG

NAME OF FIELD NO. 441 Survey of King
 PROJECT NAME Cashville Mts.
 GEOLOGICAL SURVEY NO. _____
 STATE N.M. COUNTY Sierra
 LOCATION _____
 _____' _____' _____' Sec. _____ T. _____ R. _____
 DEPTH BASE: _____ ft. (above, surface) land surface.
 which is _____ ft. (above, below) land surface.
 ALTITUDE: 40 ft. Land surface 9714 ft.
 Determined by _____
 OPERATOR(S) Hyman - Dewees
 EQUIPMENT (Vehicle No.) _____ Date _____

Logging Data

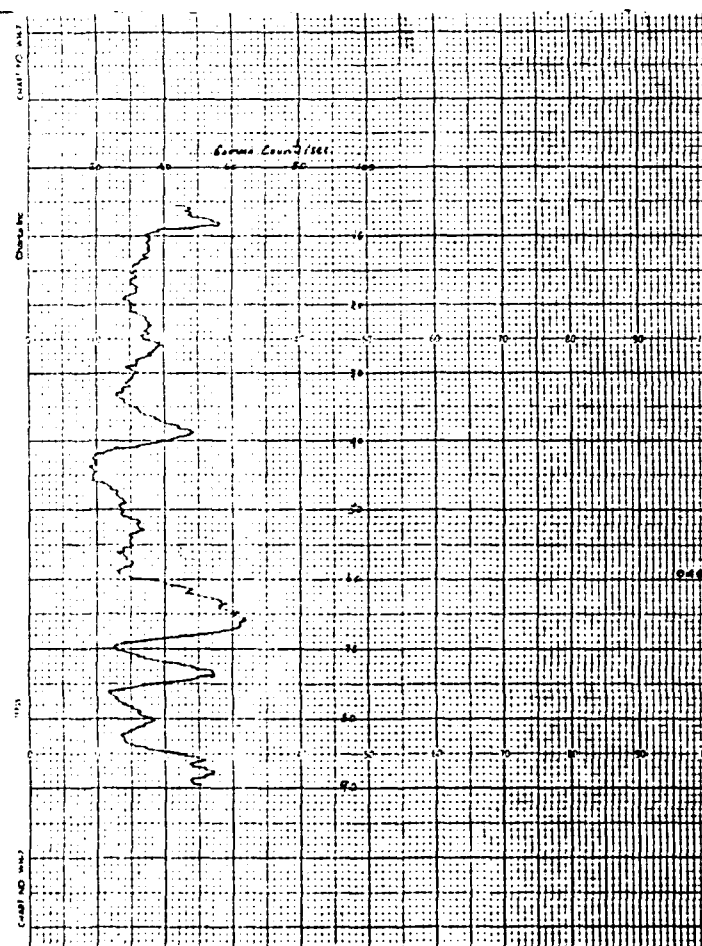
Run no. _____ or _____ runs. Probe Sensitivity (High
Descent): _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale ED
Potential circuit scale ED Time constant 2

Statistical Variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____

Calibration in hole: (G-R Scale) _____ Pot. circuit scale _____
Depth (ft.) _____ G-R. Time (min.) _____ meter Reading _____

_____	_____	_____
_____	_____	_____
_____	_____	_____

Radiation intensity increase $\rightarrow$ Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

LOGGING DATA

Casing: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Water Level: _____ ft. (above, below) _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., min.)
Date May 15, 1961

Depth drilled (feet): _____
Depth measured (feet): 29
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 1 run. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 Curran AM-BE Spacers 17 in.
Mora. Scale 1K T.C. 2 sec.
Sens. Scale 10 Base Scale 10

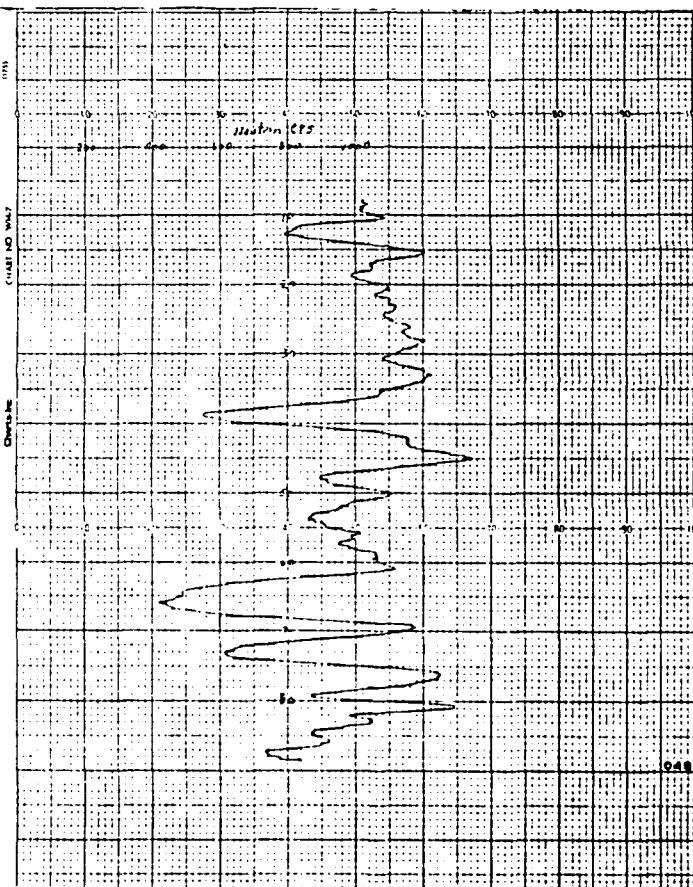
Owner or Field No. CH-1 Corp of Eng
Project Name Cuscuta Negro
U.S.G.S. No. _____ Town _____
State IL County or Parish Sioux
Location _____

Depth Datum: _____ which _____
is _____ ft. (above, below) land surface.
Altitude: MP _____ ft. Land surface _____ ft.

Determined by _____
Operator(s) Hudson-Powers
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, sec. _____
Resistivity, ohms: _____
Resistivity, D.B.T., ohms: _____ pH _____
Circ. Temp.: _____ D.B. Temp.: _____
Remarks: Probably formation water left



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Project Name Chickillo Negro
Geological Survey No. _____
State MS County Searcy
Location _____
Depth Datum _____ ft. (above, below) land surface.
which is _____ ft. Land surface 314 ft.
Altitude 20 ft. Land surface
Determined by _____
Operator(s) Hughes-DeVries
Equipment (vehicle No.) _____ Date _____

Casing Data
Casing: Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____

Bore Data
Bore: Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.

Filter Data
Filter: Type _____ Thickness _____ Characteristics _____
ft. to _____
ft. to _____

Perforations, Screen
Type, size _____
ft. to _____
ft. to _____

Water Level
ft. (above, below) _____ ft. (above, below) _____
Surface, shut-in head after _____ (hrs., mins.)
Date July 19, 1951

Total Depth
ft. Interval Logged _____ ft. to _____ ft.

Fluid in Hole
Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____

Water: Temperature
°F. at _____ Fluid Cond. _____
Bath. c/L _____ Beta-Gamma (uv c/L _____ U10-3 gr/l _____)

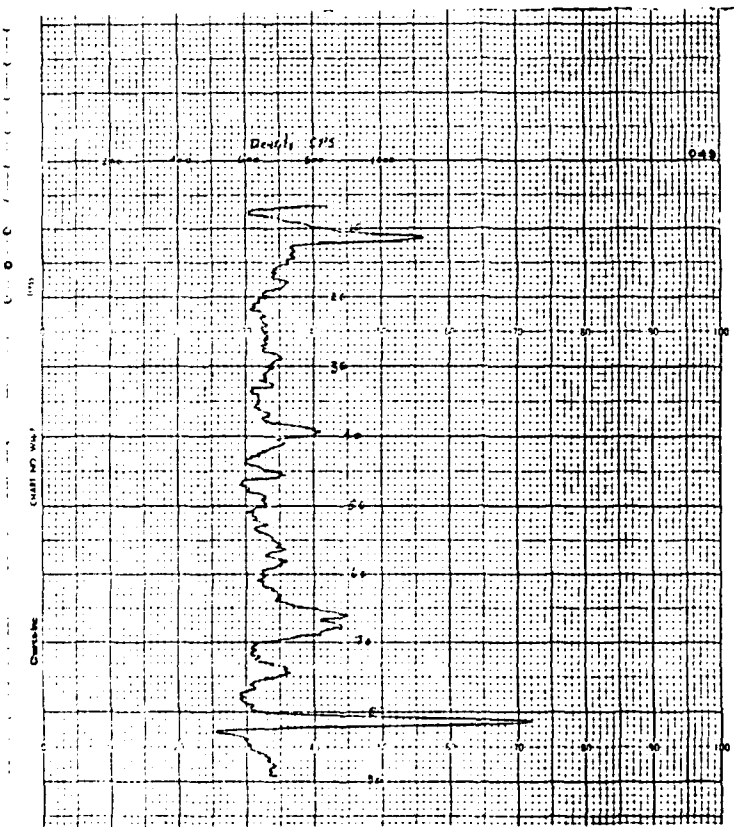
Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descent: _____ ft./min. Gamma-Ray circuit scale _____ Time constant _____
Potential circuit scale _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____ Time constant _____
Potential circuit scale _____

Statistical Variation
in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____

Calibration in Hole
(G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

Remarks
Depth directly used left

Radiation intensity increase _____ Depth Scale _____ 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-1 Capital City
Project name Cuckville Negro
U.S.G.S. No. _____ Town _____
State ALA County or Parish Seale
Location _____
Depth Datum: _____ ft. (above, below) land surface.
Is _____ ft. (above, below) land surface.

HOLE LOGGING DATA

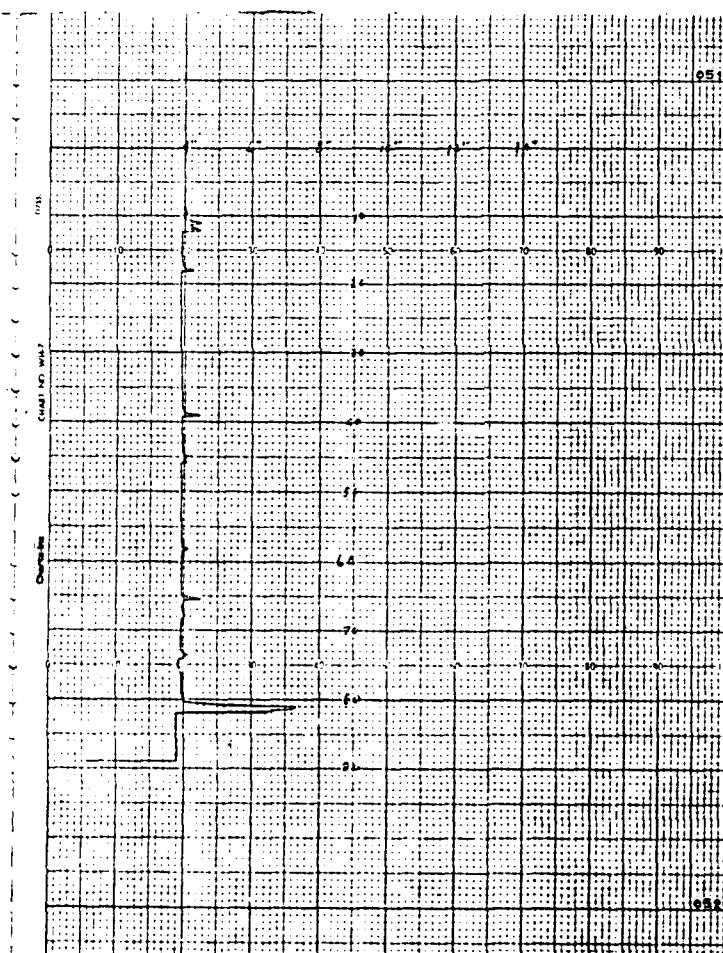
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson-Rodgers
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No. _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

FLUID DATA

Water Level _____ ft. (above, below) _____ Density, lbs./gal. _____
_____ which is _____ ft. (above, below) _____
Surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date May 12, 1917 Resistivity, ohms: _____
Depth drilled (feet) _____ Resistivity, B.H.T., ohms: _____
Depth measured (feet) 22 Circ. Temp.: _____ B.H. Temp.: _____
Interval logged: _____ ft. to _____ ft. Remarks: _____

OPERATION DATA

Run No. _____ of _____ runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: 100 in./in.



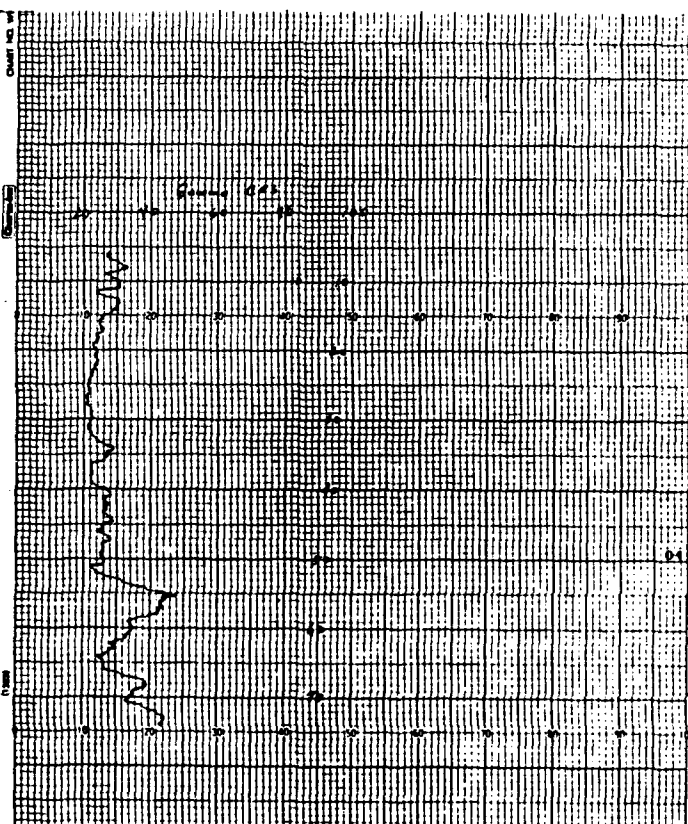
U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
SAMPA LOG

Geological Survey No. CH 3 C-1 E-9
State NY County Albany
Location _____
Depth Datum: _____
which is _____ ft. (above, below) land surface.
Altitude: 80 ft. Land surface 4705 ft.
Determined by _____
Operator(s) Hudson - Decker
Equipment (Vehicle No.) _____

Logging Data
Casing: Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics, _____
_____ ft. to _____ ft.
Perforations, Screen: Type, size _____
_____ ft. to _____ ft.
Water Level _____ ft. (above, below) _____
Surface, which is _____ ft. (above, below) _____
Date May 18, 1957
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Fluid Cond. _____
Salinity c/L _____ Date-Gamma ray c/L _____ U(10-3 gr/l) _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (High)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale _____ Time constant _____
Statistical Variation _____ in. at _____ ft. Water
Reading _____ S-S Scale _____ Time Constant _____
Calibration in hole: (S-S Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Water Reading _____

Radiation intensity increase _____ Depth Scale: _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

LOGGING DATA

Coring: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
surface. Shot-in head after _____ (hrs., min.)
Date May 18, 1977

Depth drilled (feet): _____
Depth measured (feet): 74
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curves AM-25 Spacers 17 in.
Note Scale 115 T.C. 2 sec.
Note Scale 1.0 Note Scale 10.0

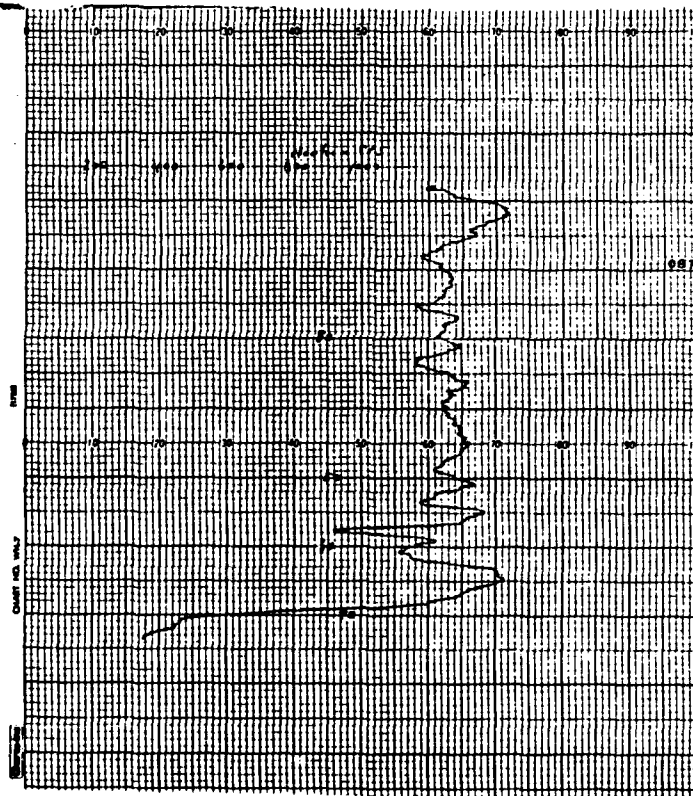
Survey or Field No. CM-3 C-10 of Log
Project Name Cuchilla Moya
U.S.G.S. No. _____ Town _____
State NM County or Parish Santa Fe
Location _____
_____ Sec. _____ T. _____ S. _____

Depth Datum: _____ which
is _____ ft. (above, below) land surface.
Altitude: 4705 ft. Land surface 4705 ft.

Determined by _____
Operator(s) Hudson - Dwyer
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cP: _____
Sensitivity, ohms: _____
Sensitivity, S.N.T., ohms: _____ gals.
Circ. Temp.: _____ S.N. Temp.: _____
Remarks: Permeability measured 16 ft



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

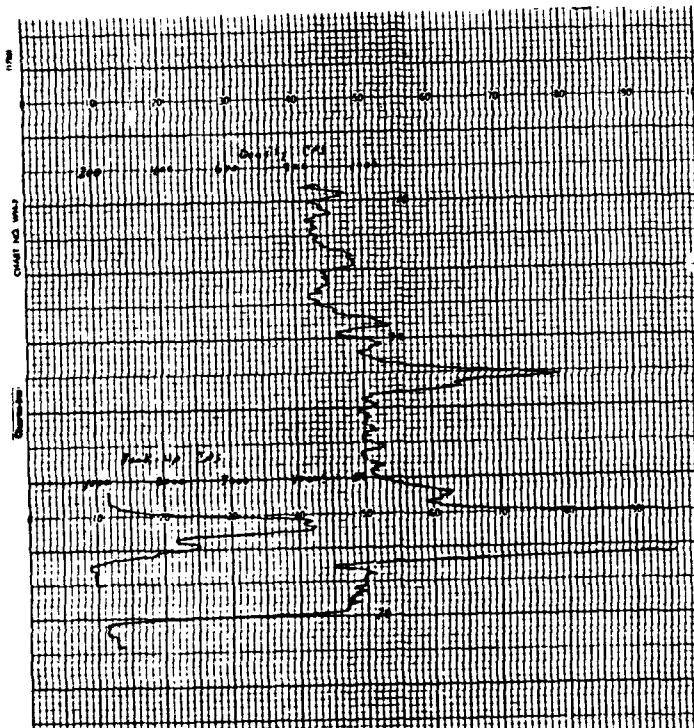
Survey or Field No. 04-3 A-1-E-1
Project Name Cochise Mts.
Geological Survey No. _____
State N.M. County Santa
Location _____
Depth Bottom _____ ft. (above, below) top of rock,
which is _____ ft. land surface 4205 ft.
Altitude _____ ft. Determined by _____
Operator(s) Hicken-Dewee
Equipment (model No.) _____ Date _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity Range _____
Descent: _____ ft./min. Gamma-ray circuit scale _____ Time constant _____
Potential circuit scale _____ Time constant _____
Logged run: _____ ft./min. Gamma-ray circuit scale 100/100
Potential circuit scale 1.0 Time constant 100

Logging Data
Statistical Variation _____ in. at _____ ft. Water
Reading _____ G.S. Scale _____ Time Constant _____
Calibration to hole: (G.S. Scale) _____ Pot. circ. scale _____
Depth (ft.) No. Time (min.) Water Reading _____

Logging Data
Filter: Type _____ Thickness _____ Characteristics _____
_____ ft. to _____
_____ ft. to _____
Perforations, Screen: type, size _____
_____ ft. to _____
_____ ft. to _____
Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
_____ ft. (above, below) _____
Date May 1, 1958
Total Depth _____ ft. Interval Logged _____ ft. to _____
_____ ft. to _____
Field to hole: _____ Characteristics _____
Field level _____ ft. Field Temperature _____ °F.
_____ °F. at _____ ft. _____
Water Temperature _____ °F. at _____ ft. _____
Bottom c/a _____ Date Gamma (or c/a) _____ (100-1 gr/l)
Remarks Bulk density scale left

Reduction tendency increase _____ Depth Scale: _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Sheet of field No. Alt 3 Cap of Eng
Project Name Cush. Ho. Nears
U.S.G.S. No. _____ Town _____
State Nad County or Parish Secur
Location _____
Depth Datum _____
Is _____ ft. (above, below) land surface.
Altitude: ND ft. Land surface 4785 ft.

WELL LOGGING DATA

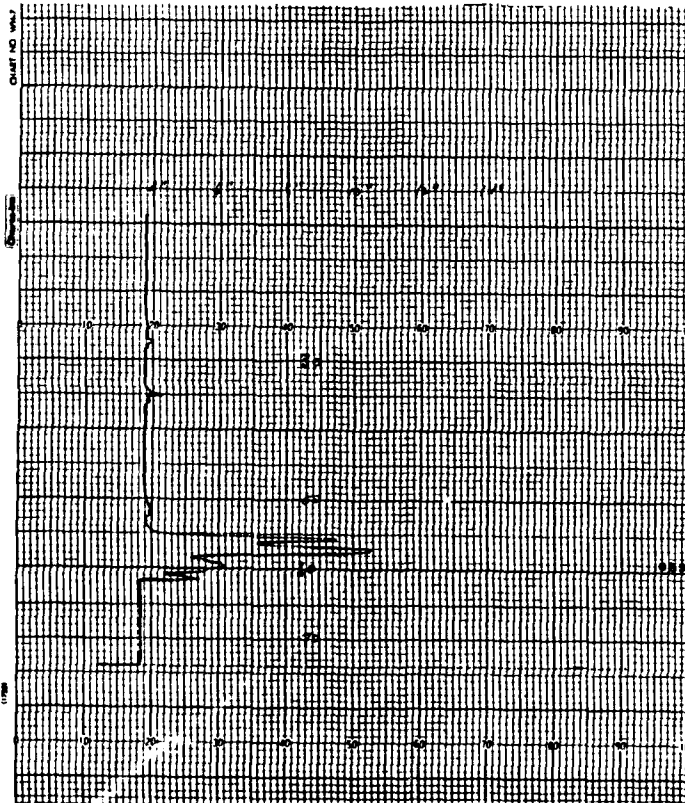
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson - Dancer
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No. _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

FLUID DATA

Water Level _____ ft. (above, below) _____ Density, lbs./gal. _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date May 12, 1966 Resistivity, ohm: _____
Depth drilled (feet) _____ Resistivity, S.M.T., ohm: _____
Depth measured (feet) 74 Circ. Temp.: _____ S.M. Temp.: _____
Interval logged: _____ ft. to _____ ft. Remarks: _____

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 20 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: 100 in./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
RARRA LOS

Geological Survey No. CH-9 Capital
State Georgia County _____
Location Cashville Hwy
Depth (ft.) _____ Sec. _____
which is _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface 478 ft.
Determined by _____
Operator(s) Hudson-Dowdy
Equipment (Vehicle No.) _____ Date _____

Casing Data
Casing: Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____

Filter: Type _____ Thickness _____ Characteristics _____
_____ ft. to _____ ft. to _____
Perforations, Screen: Type, size _____
_____ ft. to _____ ft. to _____

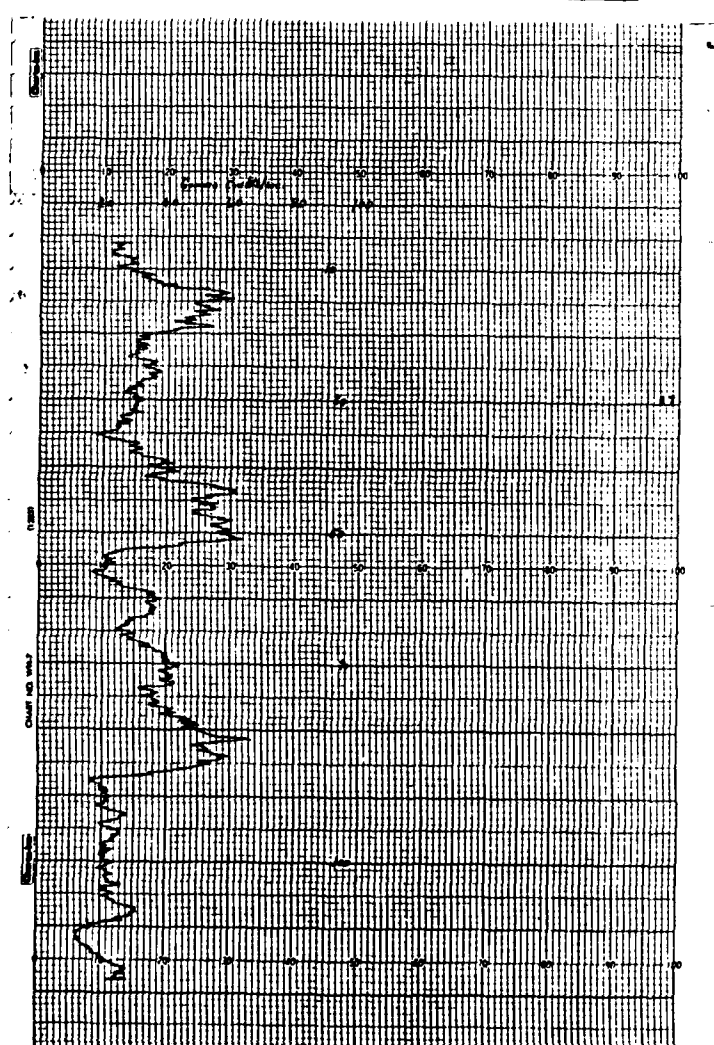
Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
Surface. Shut-in head after _____ (hrs., mins.)
Date 11/16/58
Total Depth 118 ft. Interval Logged 6 ft. to _____ ft.

Fluid in Hole: _____ Characteristics _____
Fluid Level 24 ft. Fluid Temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Saline c/L _____ Data-dome (in c/L) _____ (10-3 gr/l)

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (High)
Descent: _____ ft./min. Gamma-ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: 2.0 ft./min. Gamma-ray circuit scale 10.0
Potential circuit scale 1.0 Time constant 2

Statistical Variation _____ in. at _____ ft. Meter
Reading _____ S-S Scale _____ Time Constant _____
Calibration in hole: (S-S Scale) Pot. circ. scale _____
Depth (ft.) Sec. Time (min.) Meter Reading _____

Radiation intensity increase _____ Depth Scale: _____ 20 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
NEUTRON LOG

LOGGING DATA

Casing: Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Bore: Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
_____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., min.)
Date _____

Depth drilled (feet): _____
Depth measured (feet): 112
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 1 run. Logging Speed: 10 ft./min.
Vertical Scale 10 ft./in.
Source Y curtain AM-BE Spacers 17 in.
Bore Scale 18 T.C. 2 sec.
Beam Scale 1.0 Beam Scale 1.0

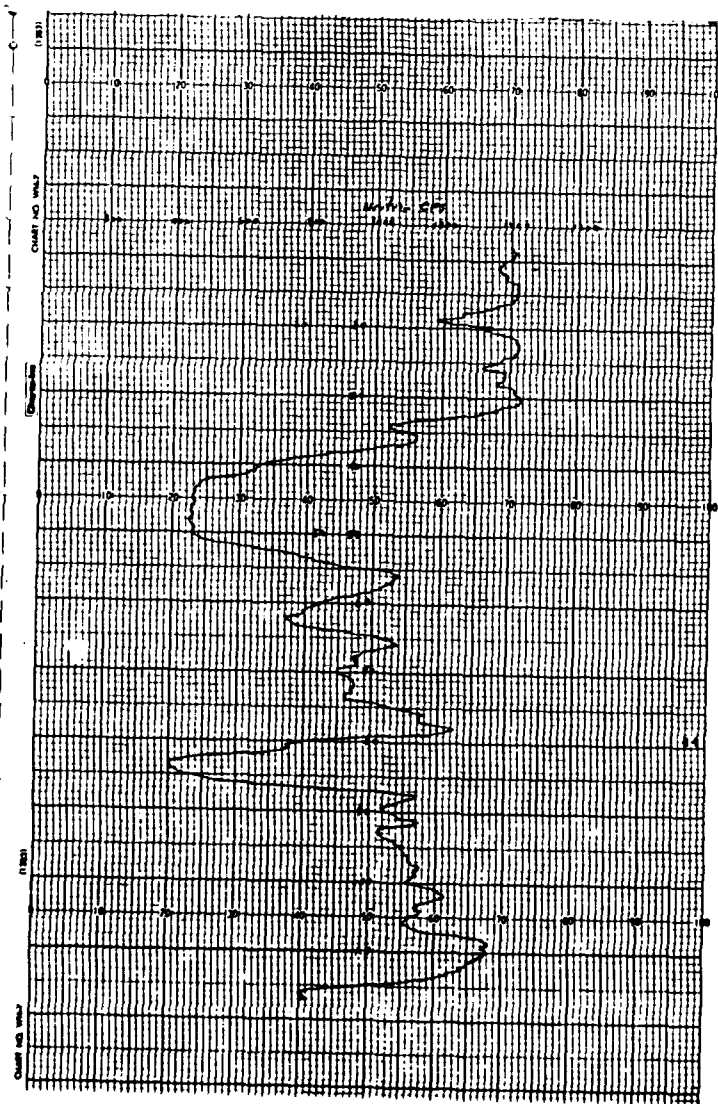
Office or Field No. CM-9 Camp 1 E-1
Project Name Cachilla Negro
U.S.G.S. No. _____ Town _____
State NM County or Parish Santa
Location _____

Depth Datum: _____ which
is _____ ft. (above, below) land surface.
Altitude MP _____ ft. Land surface 4732 ft.

Determined by _____
Operator(s) Hughes - Bawley
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cec _____
Radioactivity, ohms: _____ pH: _____
Radioactivity, S.N.T., ohms: _____
Circ. Temp.: _____ S.R. Temp.: _____
Remarks: Probably formation water at 10 ft



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

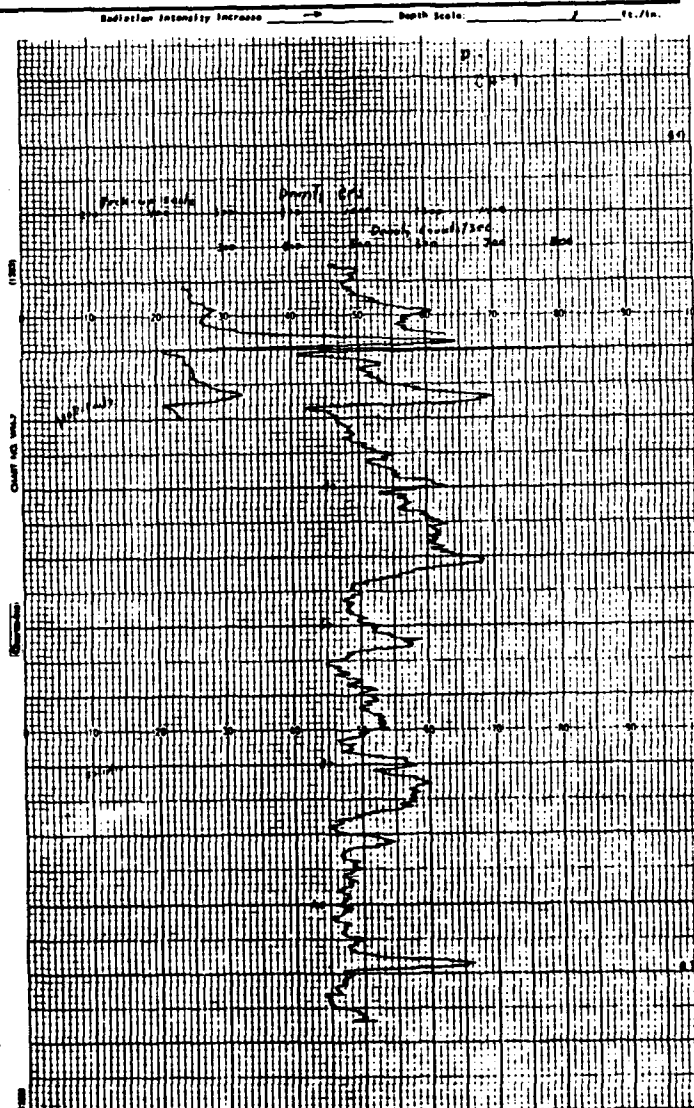
Project or Field No. 117
Project Name Richelle Mine
Geological Survey No. _____
State NY County Schoharie
Location _____
Depth Bottom: _____
which is _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface 425 ft.
Determined by _____
Operator(s) Harlan DeJong
Equipment (Vehicle No.) _____ Date _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descant: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: 20 ft./min. Gamma-Ray circuit scale 100/100
Potential circuit scale 1.0 Time constant 2

Logging Data
Statistical Variation _____ in. at _____ ft. Water
Reading _____ G-B Scale _____ Time Constant _____
Collaboration in hole: (G-B Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

Logging Data
Fluid in hole: _____ Characteristics _____
Fluid level: _____ ft. Fluid Temperature _____ °F.
Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
No (on c/L) Data-Gamma (or c/L) 9(10-5 gr/l) _____

Remarks _____



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-9 Gage & Log
Project Name Cuchillo Negro
U.S.G.S. No. _____ Town _____
State NM County or Parish Santa
Location _____
Depth Datum: _____ ft. (above, below) land surface, which is _____ ft. (above, below) land surface.

WELL LOGGING DATA

Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson-Perce
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No.: _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

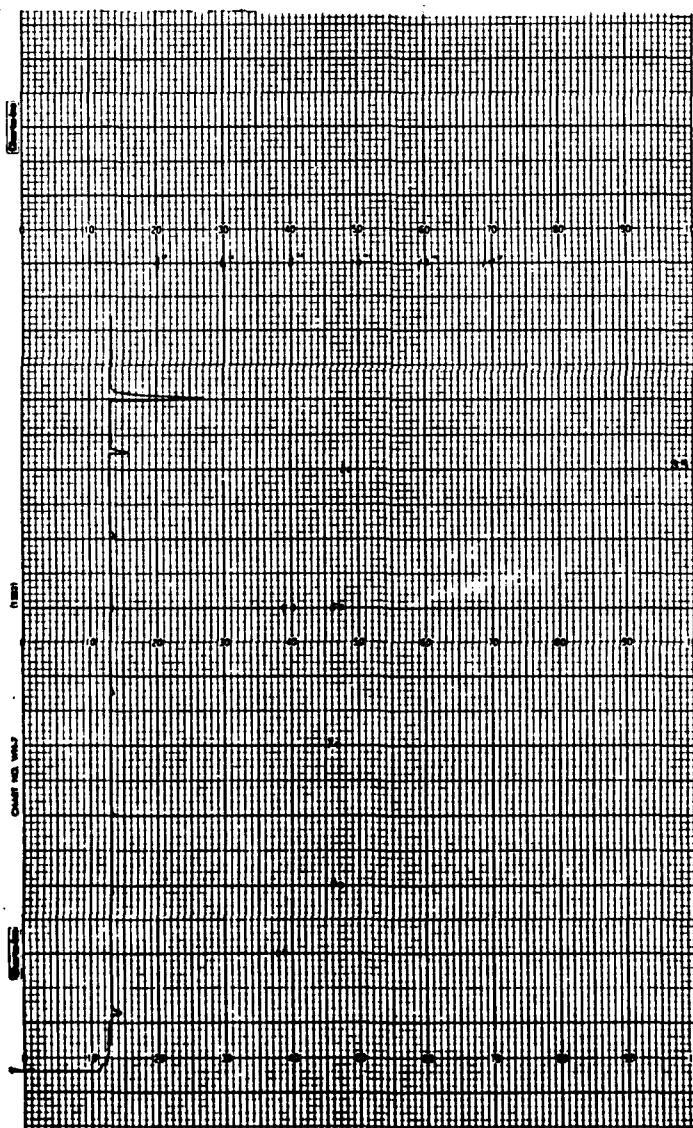
FLUID DATA

Water Level _____ ft. (above, below) _____
_____ which is _____ ft. (above, below) surface. Shut-in head after _____ (hrs., mins.)
Date May 16, 1961
Depth drilled (feet) _____
Depth measured (feet) 118
Interval logged: _____ ft. to _____ ft.

Type: _____
Density, lbs./gal. _____
Viscosity, ccs. _____
Resistivity, ohms: _____
Resistivity, D.M.V., ohms: _____ pH: _____
Circ. Temp.: _____ D.M. Temp.: _____
Remarks: _____

OPERATION DATA

Run No. _____ of _____ runs. Logging speed: _____ ft./min.
Vertical scale: _____ ft./in.
Horizontal scale: 1 in. = 100 ft.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Owner of field No. 41111 La-pal Las
Project Name Carbide Negro
Geological Survey No. _____
State NM County Santa
Location _____
Depth Datum: _____ ft. (above, below) land surface.
which is _____ ft. Land surface 4718 ft.
Altitude 4718 ft. Land surface 4718 ft.
Operator(s) Hudson - Dantes
Equipment (Vehicle No.) _____ Date _____

Casing Data
Casing: Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.

Bore
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Filter: Type _____ Thickness _____ Characteristics, _____
ft. to _____

Perforations, Screen: Type, size _____
ft. to _____
ft. to _____

Water Level _____ ft. (above, below) _____
surface. Shut-in head after _____ ft. (above, below) _____
Date May 19, 1961 (hrs., mins.)

Total Depth _____ ft. Interval logged _____ ft. to _____ ft.

Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____

Water: Temperature _____ °F. at _____ Field Cond. _____
Radio c/s _____ Beta-Gamma (uv c/s) _____ U(10-3 gr/l) _____

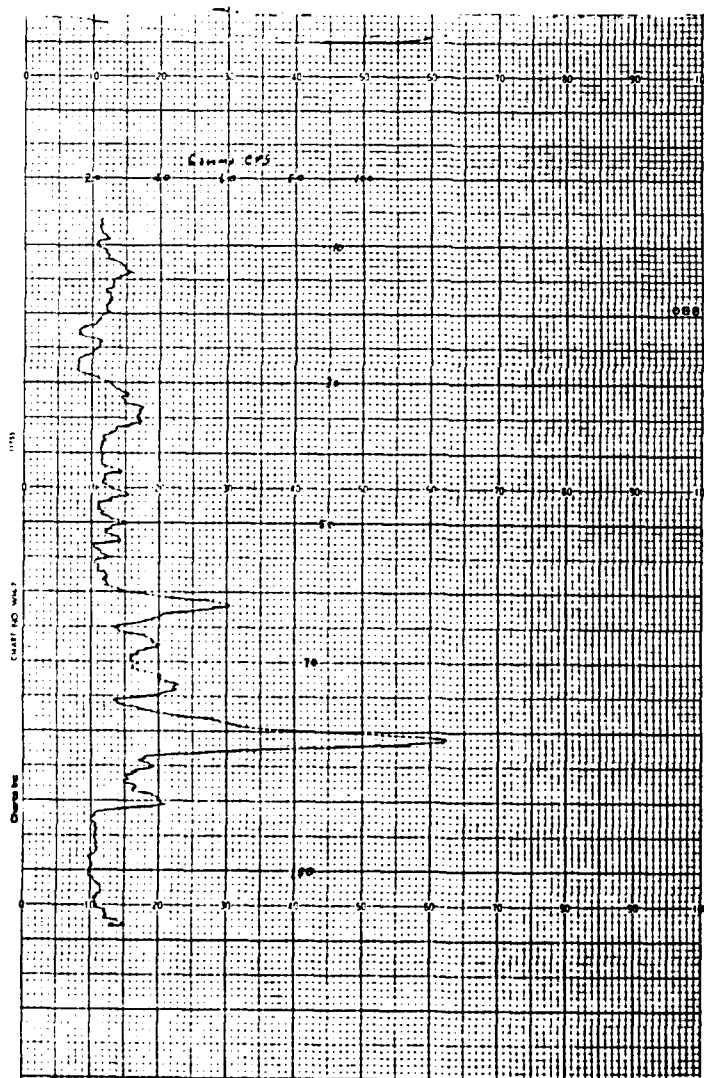
Logging Data
Run No. _____ or _____ Pump, Probe Sensitivity (High)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant 100
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant 1

Statistical Variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____

Calibration in hole: (G-R Scale) _____ Pot. circ. scale _____
Depth (ft.) Obs. Time (min.) Meter Reading _____

Remarks _____

Radiation Intensity Increase _____ Depth Scale: _____ 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

WELL LOGGING DATA

Casing: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., min.)

Date May 19, 1977
Depth drilled (feet): _____
Depth measured (feet): 108
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 1 turn. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 Curries AM-BE Spacers 17 in.
Mora. Scale 1 K T.C. 2 sec.
Sema. Scale 10 Bone Scale 100

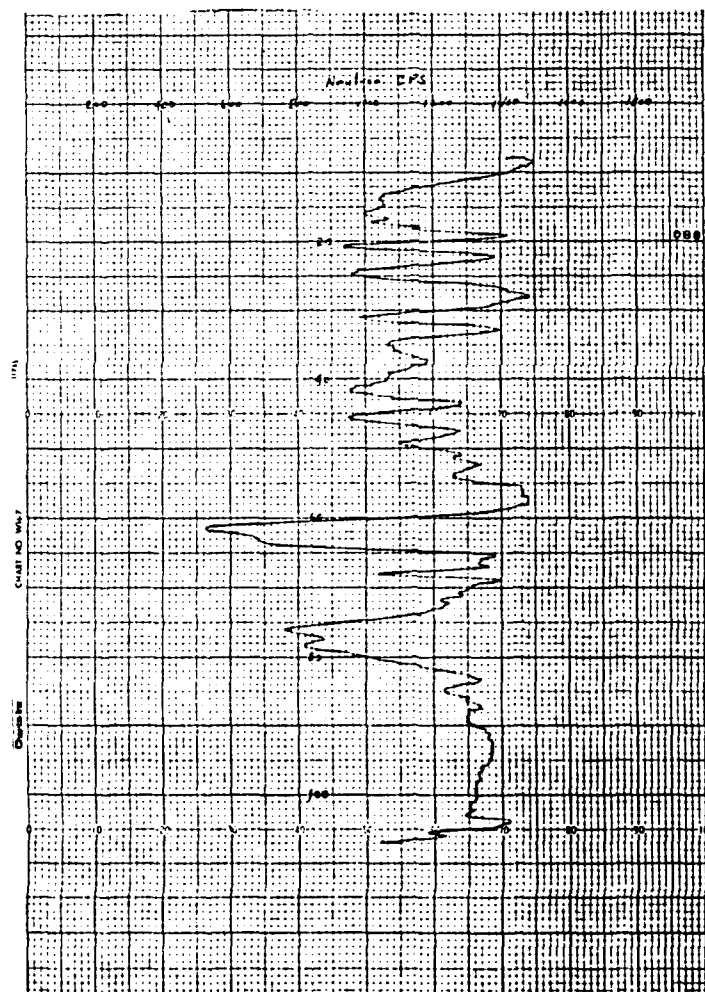
Owner or Field No. CH-11 P-10-1 E-3
Project Name Cushilla Negro
U.S.G.S. No. _____ Town _____
State NM County or Parish Sierra
Location _____ N Sec. _____ T R S M

Depth Datum: _____, which
is _____ ft. (above, below) land surface.
Altitude: NP ft. Land surface _____ ft.

Determined by _____
Operator(s) Hudson-Dewees
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cec. _____
Resistivity, ohm-in. _____
Resistivity, D.B.T., ohm-in. _____
Circ. Temp.: _____ D.B. Temp.: _____
Remarks: Primary formation water. 10 ft



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Owner or field no. C12-11 W. & L. C. Co.
Project name Wichita, Kansas
Geological Survey No. _____
State Kan. County Sevier
Location _____
Depth Bottom _____ ft. (above, below) land surface.
which is _____ ft. (above, below) land surface. 4718 ft.
Altitude _____ ft. Land surface 4718 ft.
Determined by _____
Operator(s) Hudges - Powers
Equipment (vehicle No.) _____ Date _____

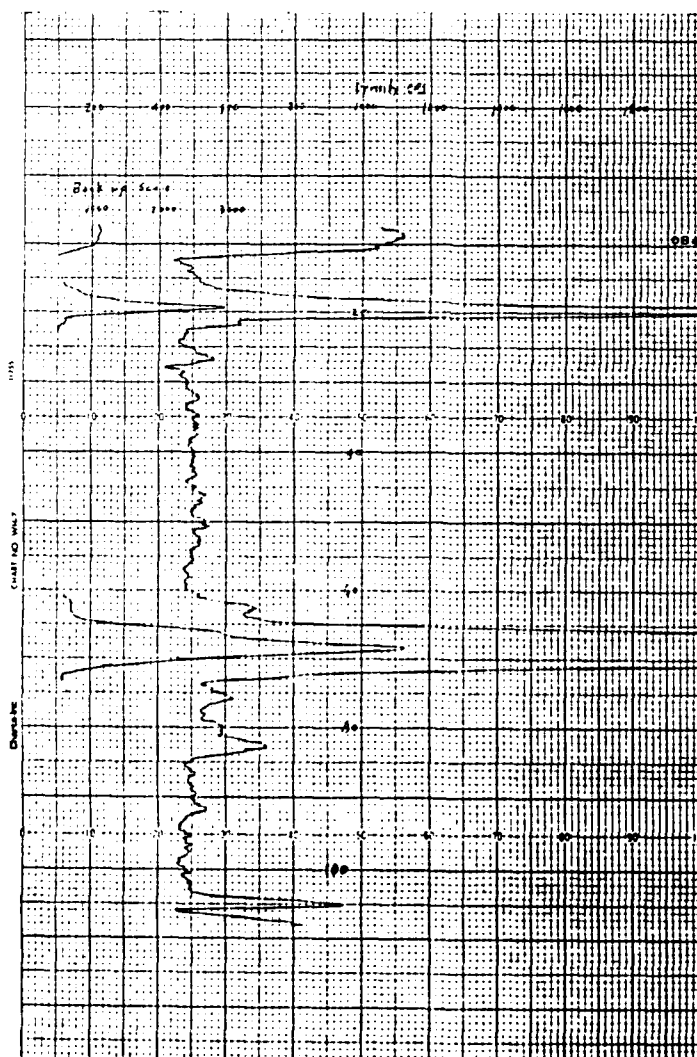
Casing Data
Casing: Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics _____
_____ ft. to _____ ft.
_____ ft. to _____ ft.
Perforations, Screen: Type, size _____
_____ ft. to _____ ft.
_____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
surface. Shut-in head after _____ ft. (above, below) _____
Date Aug 19 1958 (hrs., mins.) _____
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Collaboration in hole: (G-R scale) _____ Pot. circ. scale _____
Depth (ft.) Obs. Time (min.) Water Reading _____

Fluid in hole _____ Characteristics _____
Fluid level _____ ft. Fluid temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Below c/L _____ Beta-Gamma (uv c/L) _____ U(10-3 gr/l) _____

Remarks Full depth log 1-11

Radiation intensity increase → Depth Scale: _____ 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

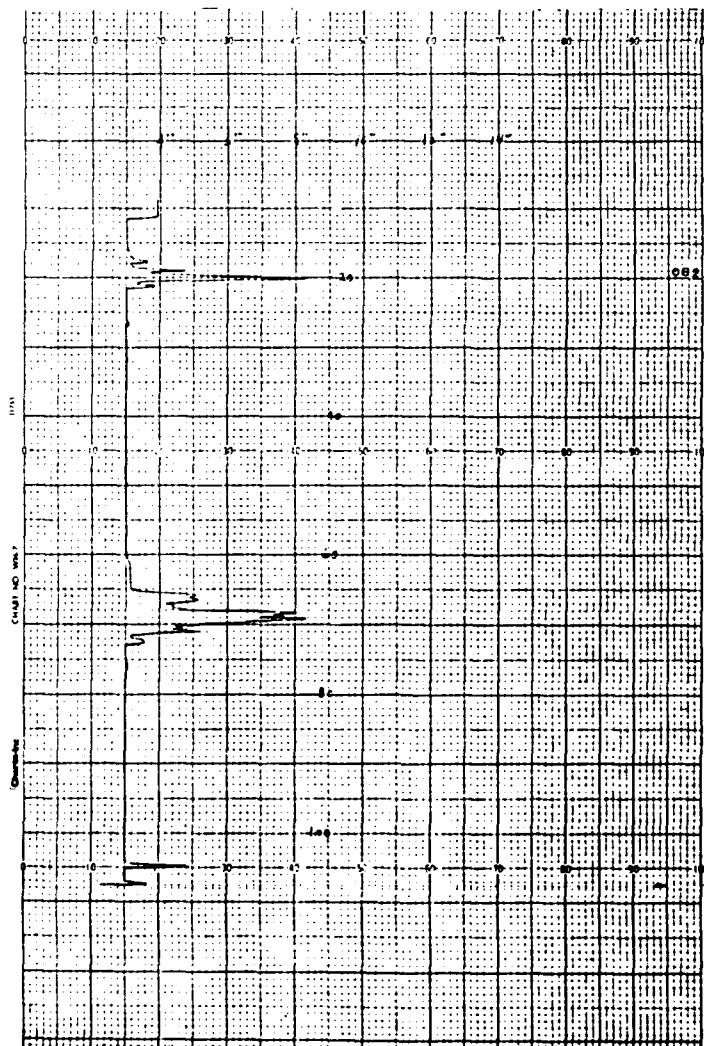
CALIPER LOG

Owner or Field No. CH-11 C. & P. Eng.
Project Name Cuchillo Negro
U.S.G.S. No. _____ Town _____
State NM County or Parish Santa
Location _____
Depth Below: _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface _____ ft.

WELL LOGGING DATA
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson - Dewers
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No.: _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

FLUID DATA
Type: _____
Water Level _____ ft. (above, below) _____ Density, lbs./gal. _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date May 19, 1977 Resistivity, ohm: _____
Depth drilled (feet) _____ Resistivity, B.H.T., ohm: _____
Depth measured (feet) 108 Circ. Temp.: _____ B.H. Temp.: _____
Interval logged: _____ ft. to _____ ft. Remarks: _____

OPERATION DATA
Run No. 1 of 1 runs. Logging speed 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: Two in./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Casing Data

Casing: Diam. in. ft. to ft. Thickness in. in.
 Diam. in. ft. to ft. Thickness in. in.
 Diam. in. ft. to ft. Thickness in. in.

Bore

Diam. in. ft. to ft. ft.
 Diam. in. ft. to ft. ft.
 Diam. in. ft. to ft. ft.

Filter Type Thickness Characteristics.
 ft. to ft. to
 ft. to ft. to
 ft. to ft. to

Perforations, Screen: Type, size
 ft. to ft. to
 ft. to ft. to

Water Level ft. (above, below) ft. (above, below)
 surface. Shot-in head after (hrs., mins.)
 Date May 19, 1971

Total Depth 27 ft. Interval logged ft. to ft.

Fluid in Hole: Characteristics
 Fluid level ft. Fluid temperature °F.
 Date

Water: Temperature °F. at Field Cond.
 Below c/l Beta-Gamma (uv c/l U10-3 gr/l)

Logging Data

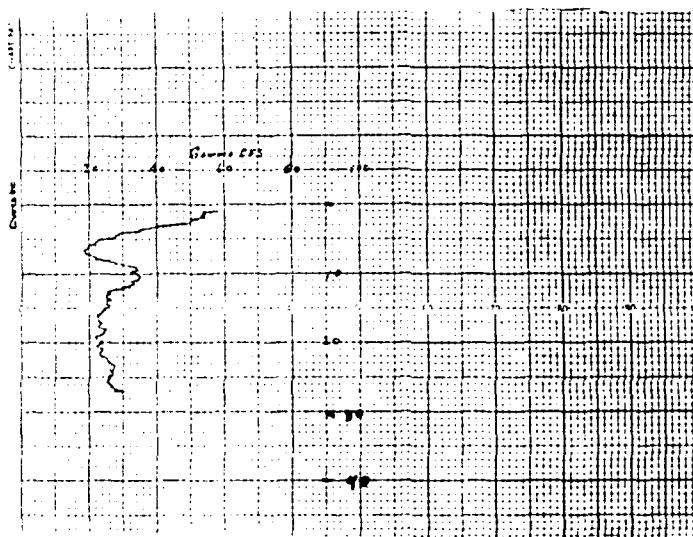
Run No. or runs. Probe Sensitivity (high)
 Descend: ft./min. Gamma-Ray circuit scale Time constant
 Potential circuit scale Time constant
 Logged out: ft./min. Gamma-Ray circuit scale (PD)
 Potential circuit scale PD Time constant

Statistical variation in. at ft. Meter
 Reading G-R Scale Time Constant

Calibration in hole: (G-R Scale) Pot. circ. scale
 Depth (ft.) Obs. Time (min.) Meter Reading

Remarks Only log made in this hole

Radiation intensity increase -p- Depth scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Coring Date _____
Casing: Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics _____
ft. to _____
ft. to _____
Perforations, Screen: Type _____ size _____
ft. to _____
ft. to _____
Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
Surface. Shut-in head after _____ (hrs., mins.)
Date _____
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Res (u c/l) _____ Base-Catena (u c/l) _____ U(10-3 gr/l) _____

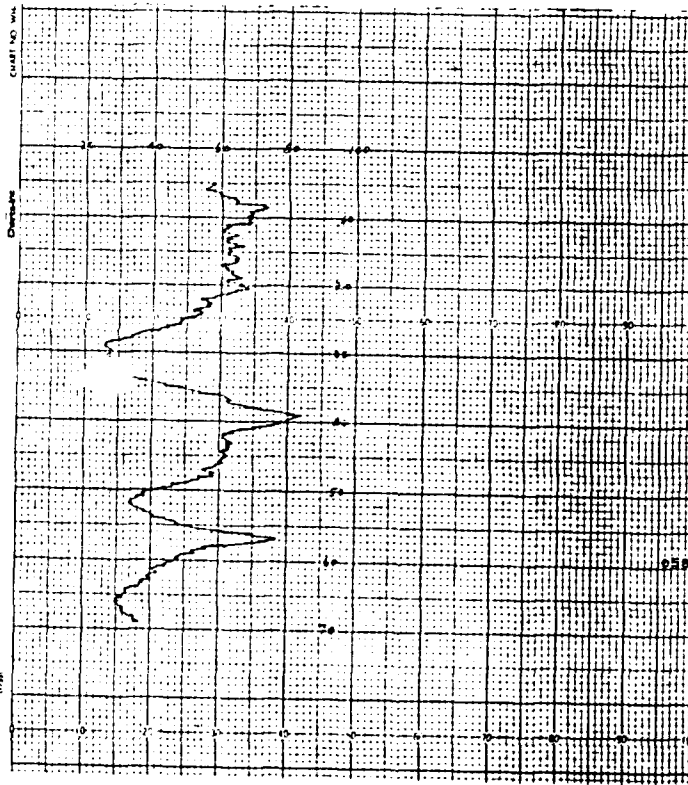
County of State No. _____
Project Name _____
Geological Survey No. _____
State _____ County _____
Location _____

Depth Datum _____
which is _____ ft. (above, below) land surface.
Altitude _____ ft. Land surface _____ ft.
Determined by _____
Operator(s) _____
Equipment (Vehicle No.) _____ Date _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (High)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____

Statistical Variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____
Collaboration in hole: (G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

Radiation Intensity Increase _____ Depth Scale: _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

MOLE LOGGING DATA

Coring: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.
Bore: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.

Water Level ft. (above, below) surface, which is ft. (above, below) surface. Shut-in head after (hrs., mins.)

Date _____
Depth drilled (feet): _____
Depth measured (feet): LP
Interval logged: ft. to ft.

OPERATION DATA

Run No. 1 of 1 run. Logging Speed: 15 ft./min.
Vertical Scale 16 ft./in.
Source 2 curve AM-BE Spacers 12 in.
Bore Scale 1/4 T.C. 2 sec.
Samp. Scale 1 g Base Scale 10 g

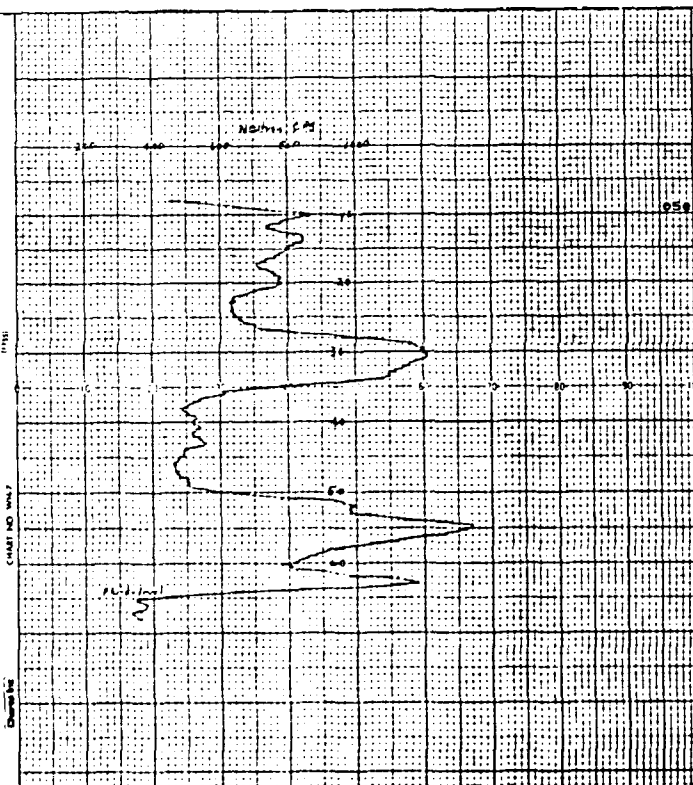
Owner or Field No. CH-12 Central Eng
Project Name Richville No. 2
U.S.G.S. No. _____ Town _____
State MD County or Parish Sicoma
Location _____

Depth Below: _____ which is _____ ft. (above, below) land surface.
Altitude: MD ft. Land surface _____ ft.

Determined by _____
Operator(s) Hudson-Proctor
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cent. _____
Reactivity, ohms: _____
Reactivity, S.B.T., ohms: _____
Circ. Temp.: _____ S.B. Temp.: _____
Remarks: Reactivity instrument over left



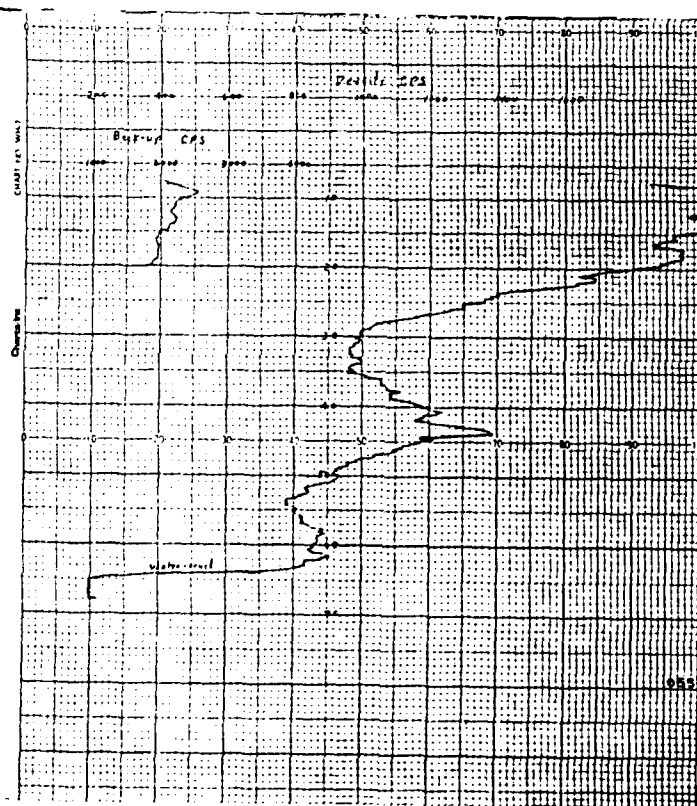
U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Project name Wichita Falls
Geological Survey No. _____
State NM County Santa Fe
Location _____
Depth below _____ ft. (above, below) land surface.
which is _____ ft. Land surface _____ ft.
Altitude _____ ft. Determined by _____
Operator(s) Hudson, Dewees
Equipment (vehicle No.) _____ Date _____

Casing Data
Casing. Diam. in. _____ ft. 10 _____ ft. Thickness in. _____
Diam. in. _____ ft. 10 _____ ft. Thickness in. _____
Diam. in. _____ ft. 10 _____ ft. Thickness in. _____
Bore. Diam. in. _____ ft. 10 _____ ft.
Diam. in. _____ ft. 10 _____ ft.
Diam. in. _____ ft. 10 _____ ft.
Filter. Type _____ Thickness _____ Characteristics _____
_____ ft. 10 _____
_____ ft. 10 _____
Perforations, Screen. Type, Size _____
_____ ft. 10 _____
_____ ft. 10 _____
Water Level _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.)
Date Aug. 17, 1957
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____
Water Temperature _____ °F. at _____ Field Cond. _____
Radio c/s Beta-Gamma (uv c/s) U(10-3) gr/l _____
Remarks Ex. about user left

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (High)
Percent _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out _____ ft./min. Gamma-Ray circuit scale/gp/sec _____
Potential circuit scale _____ Time constant _____
Statistical variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____
Calibration in hole: (G-R scale) _____ Pot. circ. scale _____
Depth (ft.) Obs. Time (min.) Meter Reading _____

Radiation intensity increase _____ Depth scale _____ 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-17 Cuyat Eng
Project Name Cuchilla Negra
U.S.G.S. No. _____ Town _____
Scale N/A County or Parish Sierra
Location _____
Depth Below: _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface _____ ft.

HOLE LOGGING DATA

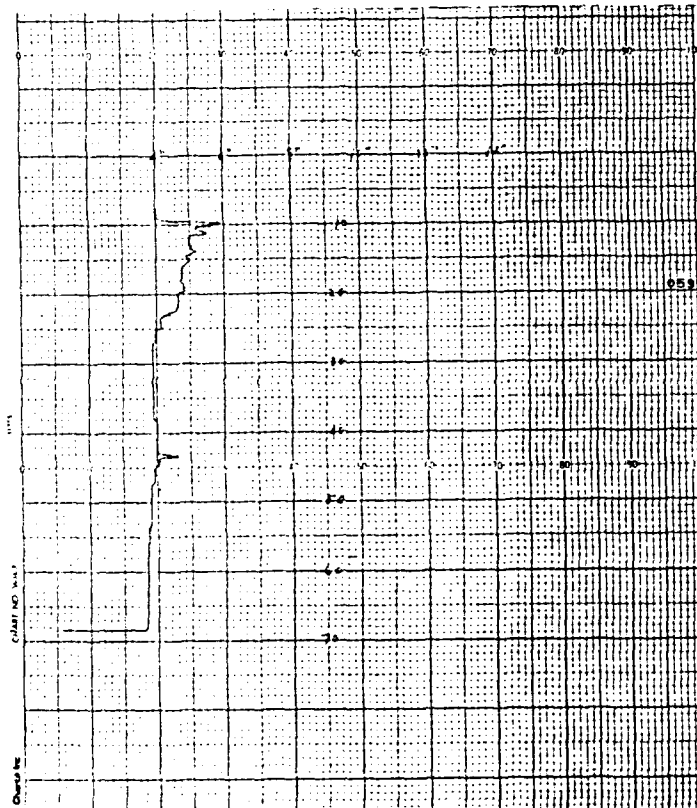
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Biam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson, Rodger
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No. _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

FLUID DATA

Type _____
Water Level _____ ft. (above, below) _____ Density, lbs./gal. _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date _____ Basalviscosity, cP: _____
Depth drilled (feet) _____ Basalviscosity, S.M.T., when: _____
Depth measured (feet) 69.5 Circ. Temp.: _____ S.M. Temp.: _____
Interval logged: _____ ft. to _____ ft. Remarks: _____

OPERATION DATA

Run No. _____ of _____ runs. Logging speed: 15 ft./min.
Vertical scale: 16 ft./in.
Horizontal scale: 700 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA LOG

Geological Survey No. 114-13 Page 6-5
State Ind County Starr
Location _____
Depth Datum _____ ft. (above, below) land surface.
which is _____ ft. Land surface 475 ft.
Altitude: _____ ft. Determined by _____
Operator(s) Hudson - Reeves
Equipment (Vehicle No.) _____ Date _____

Casing Data
Casing: Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.

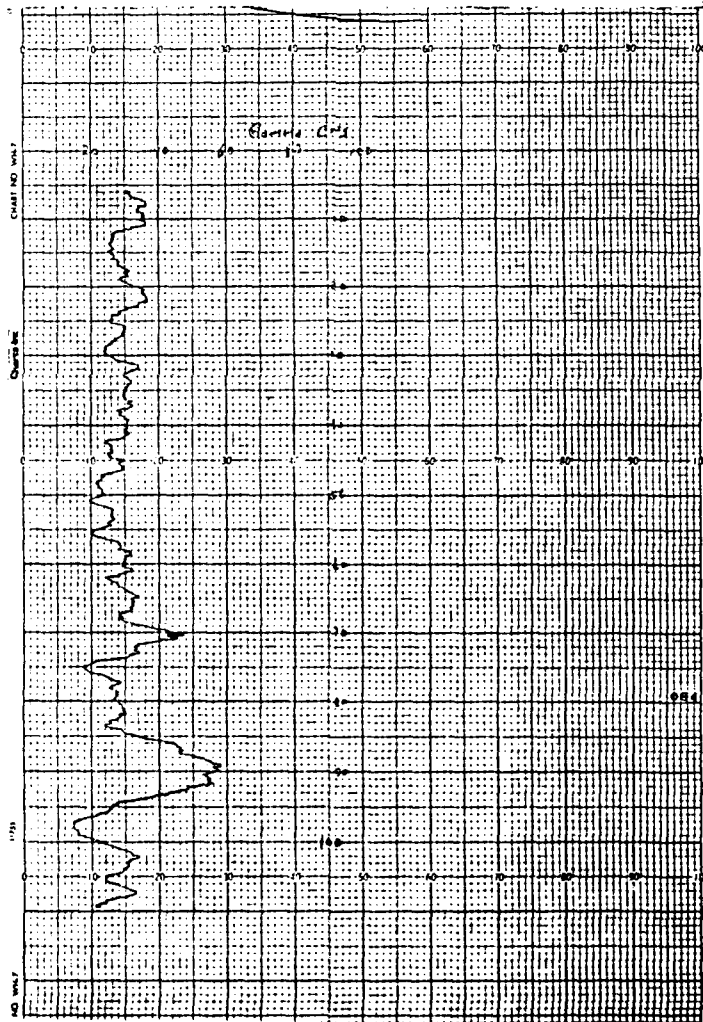
Filter: Type _____ Thickness _____ Characteristics _____
_____ ft. to _____ ft.
_____ ft. to _____ ft.
Perforations, Screen: Type, size _____
_____ ft. to _____ ft.
_____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
surface. Shot-in head after _____ (hrs., mins.)
Date May 18, 1957
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.

Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Res (u c/L) Beta-Gamma (u c/L) U(10-3 gr/l)

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 2
Statistical Variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____
Collaboration in hole: (G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

Radiation Intensity Increase → Depth Scale _____ 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

WELL LOGGING DATA

Casing: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., min.)
Date Aug 18, 1982

Depth drilled (feet): _____
Depth measured (feet): 118
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 2 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 Curries AM-BE Spacers 17 in.
Bore Scale 115/25 T.C. 2 sec.
Scan Scale 1.0 Base Scale 1.0

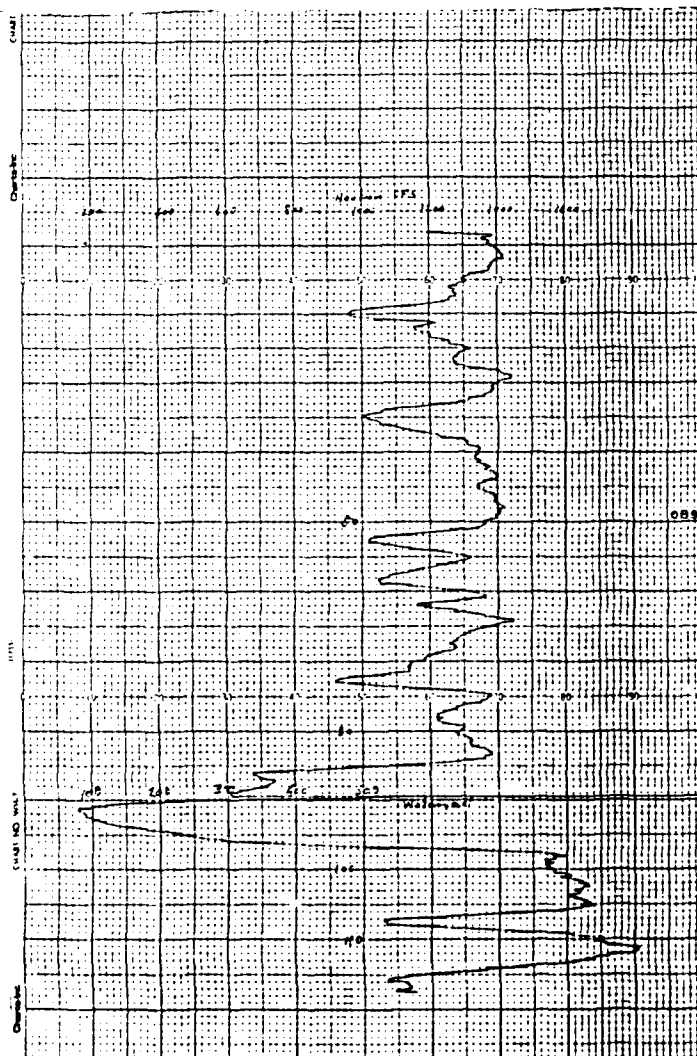
Owner of Field No. CH-12 Corp of Eng
Project Name Cash Hill Storage
U.S.G.S. No. _____ Town _____
State MD County or Parish Stearns
Location _____ Sec. _____ T. _____ R. _____

Depth Datum: _____ which
is _____ ft. (above, below) land surface.
Altitude: 470 ft. Land surface 470 ft.

Determined by _____
Operator(s) Hudson - Brown
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cP _____
Resistivity, ohm-in. _____
Resistivity, S.B.T., ohm-in. _____
Circ. Temp.: _____ S.B. Temp.: _____
Remarks: Penetration test run left
side scale change at 110 ft



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Case No. 11-1 11-1
Project name San Luis, 11-1
Geological Survey No. _____
State 11-1 County Sierra
Location _____
Depth Datum _____
which is _____ ft. (above, below) land surface.
Altitude HP _____ ft. Land surface 4725 ft.
Determined by _____
Operator(s) H. J. Decker
Equipment (vehicle No.) _____ Date _____

Casing Data
Casing: Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Diam. in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.

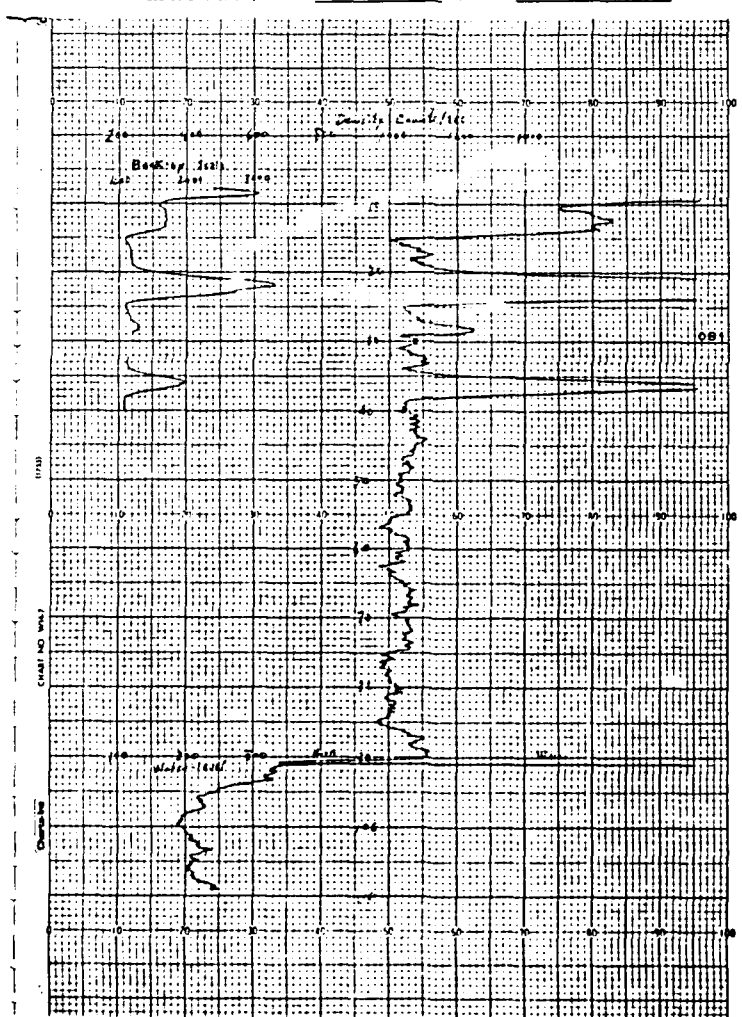
Filter: Type _____ Thickness _____ Characteristics _____
ft. to _____
Perforations, Screen: Type, size _____
ft. to _____
ft. to _____

Water Level: 91 ft. (above, below) Land surface
which is _____ ft. (above, below) surface. Shut-in head after _____ (hrs., mins.)
Date May 13, 1958
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Res (uv c/L) _____ Beta-Gamma (uv c/L) _____ U(10-3 gr/l) _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____

Statistical variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____
Calibration in hole: (G-R Scale) _____ Pot. circ. scale _____
Depth (ft.) Obs. Time (min.) Meter Reading _____

Remarks Entirely new well



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Date of field work: CH-18 Page 1 of 2
Project name: Cuchilla Negro
U.S.G.S. No. _____ Town _____
State: NM County or Parish: Socorro
Location: _____
Depth Datum: _____ ft. (above, below) land surface, which is _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface: 4720 ft.

HOLE LOGGING DATA

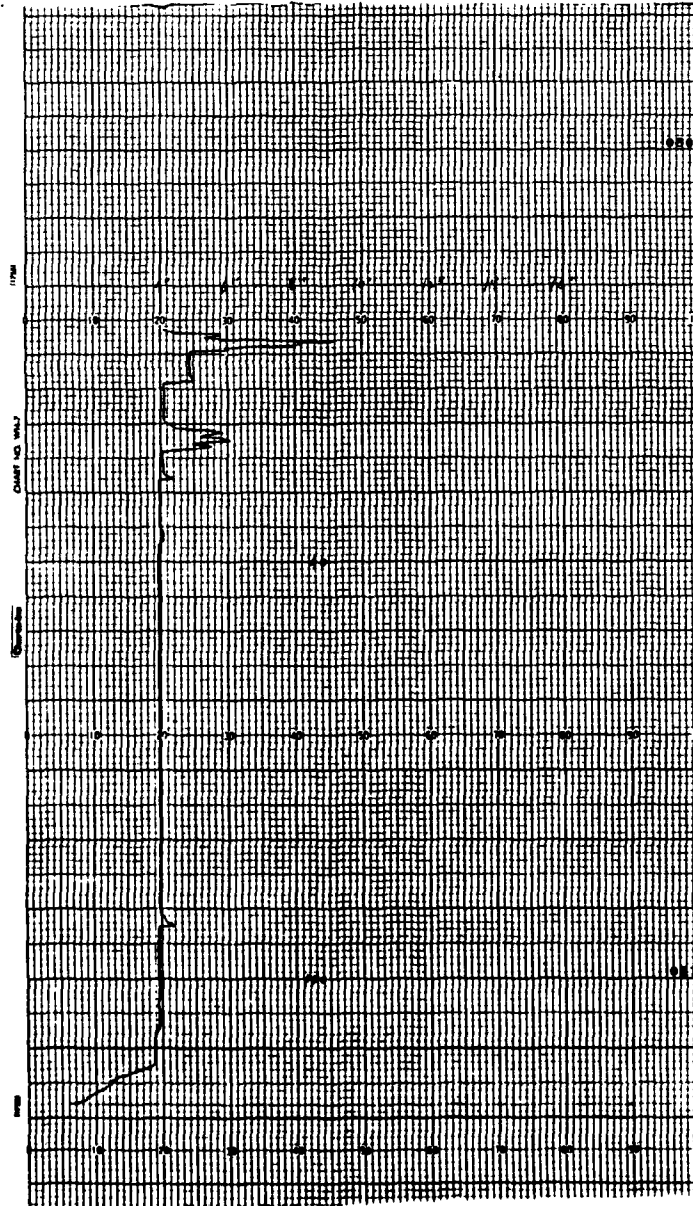
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s): Hudson-Dawson
Diam. _____ in. _____ ft. to _____ ft. Equipment: _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No.: _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft. _____
Diam. _____ in. _____ ft. to _____ ft. _____

FLUID DATA

Water level: _____ ft. (above, below) _____ ft. (above, below) land surface, which is _____ ft. (above, below) land surface. Shut-in head after _____ (hrs., mins.)
Date _____ Viscosity, sec. _____
Depth drilled (feet) _____ Resistivity, ohm-in. _____
Depth measured (feet) 118 Resistivity, S.M.F., ohm-in. _____
Interval logged: _____ ft. to _____ ft. Circ. Temp.: _____ S.M. Temp.: _____
Remarks: _____

OPERATION DATA

Run No. _____ of _____ runs. Logging speed: 15 ft./min.
Vertical scale: 70 ft./in.
Horizontal scale: 700 in./in.

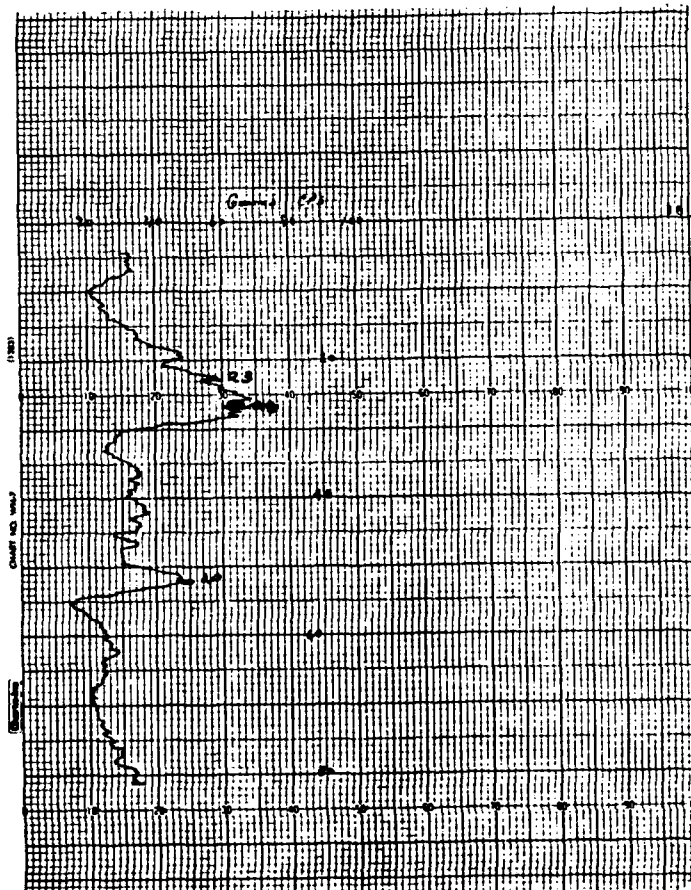


U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMA LOG

Coring Data
 Core: Diam. in. ft. to ft. Thickness in.
 Diam. in. ft. to ft. Thickness in.
 Diam. in. ft. to ft. Thickness in.
 Diam. in. ft. to ft. Thickness in.
 Diam. in. ft. to ft. Thickness in.
 Filter: Type Thickness Characteristics
 Perforations, Screen: Type, also
 Water Level ft. (above, below) surface, which is ft. (above, below) surface, 24-in. head after Date May 12, 1961
 Total Depth ft. Interval Logged ft. to ft.
 Field in hole: Reg Characteristics
 Fluid level ft. Fluid Temperature °F.
 Date May 12, 1961 Field Cond.
 Water: Temperature °F. at 10-3 gr/l
 Ba (ppm) c/L 2.3 Date-Gamma (ppm c/L) 10-3 gr/l
 Remarks

Logging Data
 Run No. or runs. Probe Sensitivity (high)
 Descant: ft./min. Gamma-Ray circuit scale 2.3
 Potential circuit scale 2.3 Time constant 2
 Logged out: ft./min. Gamma-Ray circuit scale
 Potential circuit scale Time constant
 Statistical variation in. at ft. Meter
 Reading G-R Scale Time Constant
 Calibration in hole: (G-R Scale) Pot. circ. scale
 Depth (ft.) Obs. Time (min.) Meter Reading

Radiation Intensity Increase 0.4 Depth Scale: 1.0 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

HOLE LOGGING DATA

Coring: Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Bore: Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Water Level _____ ft. (above, below) _____
surface, which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.)
Date May 17, 1958
Depth drilled (feet): _____
Depth measured (feet): 34
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

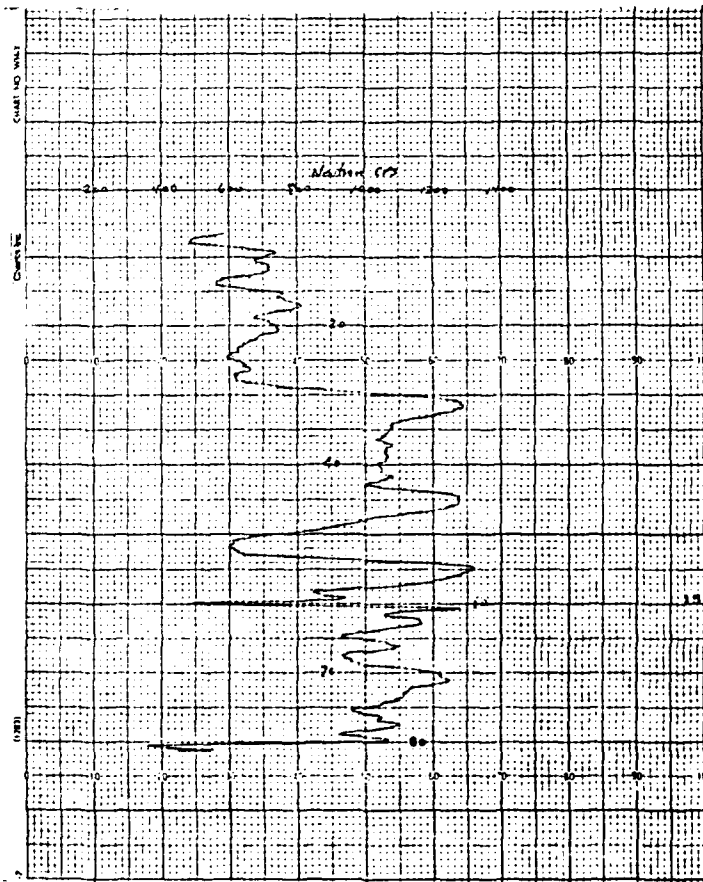
Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curves AM-BE Spacers 17 in.
Mora. Scale 1/5 T.C. 2 sec.
Sens. Scale 1.0 Beta Scale 1.0

Owner or Field No. CH-19 Camp of Ena
Project Name Cushilla Negro
U.S.G.S. No. _____ Town _____
State Nor County or Parish Sicilia
Location _____
_____ Sec. _____ T. _____ S. _____

Depth below: _____ which _____
is _____ ft. (above, below) land surface.
Altitude: 10 ft. Land surface 46.70 ft.
Determined by _____
Operator(s) Hudlow - Reeves
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cec. _____
Resistivity, ohm-in. _____
Resistivity, S.R.T., ohm-in. _____
Circ. Temp.: _____ S.R. Temp.: _____
Remarks: _____



Owner or Field No. CR-19 Camp of King
Project Name Cuchillo Negro
Ecological Survey No. _____
State NM County Sierra
Location _____

Logging Data

Coring: Blaw. in. ft. to ft. Thickness in. ft.
Diam. in. ft. to ft. Thickness in. ft.
Diam. in. ft. to ft. Thickness in. ft.

Bore. Blaw. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.

Filter: Type Thickness Characteristics,
ft. to
ft. to

Perforations, Screen: Type, size
ft. to
ft. to

Water Level ft. (above, below)
surface. Shut-in head, which is ft. (above, below)
ft. (above, below)
Data 11.0 2.2

Total Depth ft. Interval Logged ft. to ft.

Fluid in Hole: Characteristics
Fluid Level ft. Fluid Temperature °F.
Date Date

Water. Temperature °F. at Field Cond.
Rate c/L Rate-Corro (w c/L w/10-2 gr/L

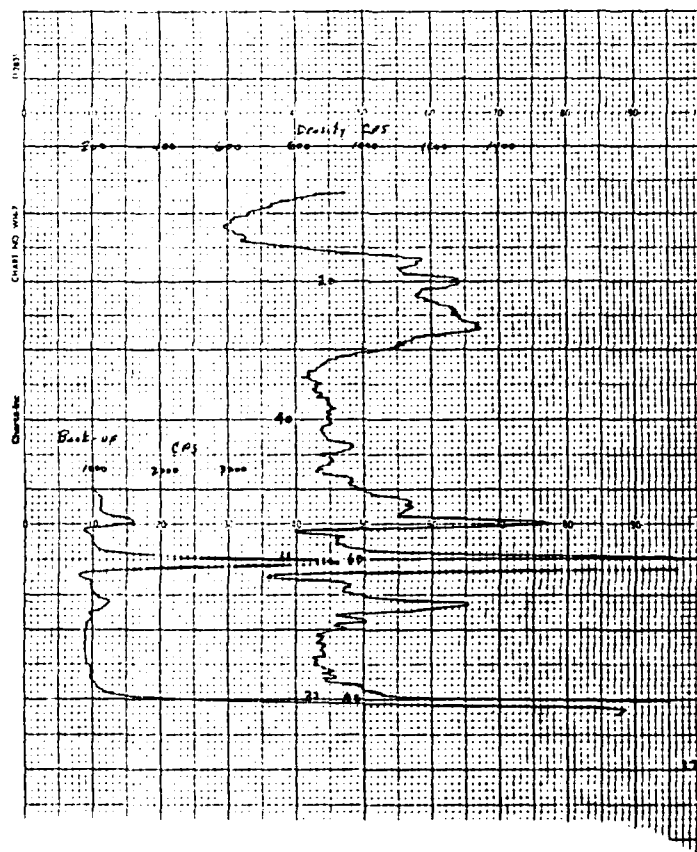
which is ft. (above, below) Land surface.
Altitude: 40 ft. Land surface 5620 ft.
Determined by
Operator(s) Hughes Dwyer
(Equipment (Vehicle No.) Date

Logging Data

Sun. No. or runs. Probe Sensitivity (high)
Recent: ft./min. Gamma-Ray circuit scale
Rate (at circuit scale) Time constant
Logged run: ft./min. Gamma-Ray circuit scale 90/1.5
Potential circuit scale 1.5 Time constant 5

Statistical Variation in. at ft. Meter
Reading G-R Scale Time Constant
Calibration in Hole: (G-R Scale) Pot. circ. scale
Depth (ft.) Obs. Time (min.) Meter Reading

Radiation Intensity Increase _____ Depth Scale: _____ ft _____ ft/in



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Project or Field No. CH-17 C-1 of E-1
Project Name Cuckin's Ridge
U.S.G.S. No. _____ Town _____
State IL County or Parish Sioux
Location _____
Depth Datum: _____ Sec. _____ T. _____ R. _____
is _____ ft. (above, below) land surface.

WELL LOGGING DATA

Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson-DeWitt
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No. _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft. _____
Diam. _____ in. _____ ft. to _____ ft. _____

FLUID DATA

Water Level _____ ft. (above, below) _____ Density, lbs./gal. _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date May 17, 1938 Resistivity, ohms _____
Depth drilled (feet) _____ Elasticity, S.W.T., ohms _____
Depth measured (feet) 22 Circ. Temp. _____ S.W. Temp. _____
Interval logged: _____ ft. to _____ ft. Remarks: _____

OPERATION DATA

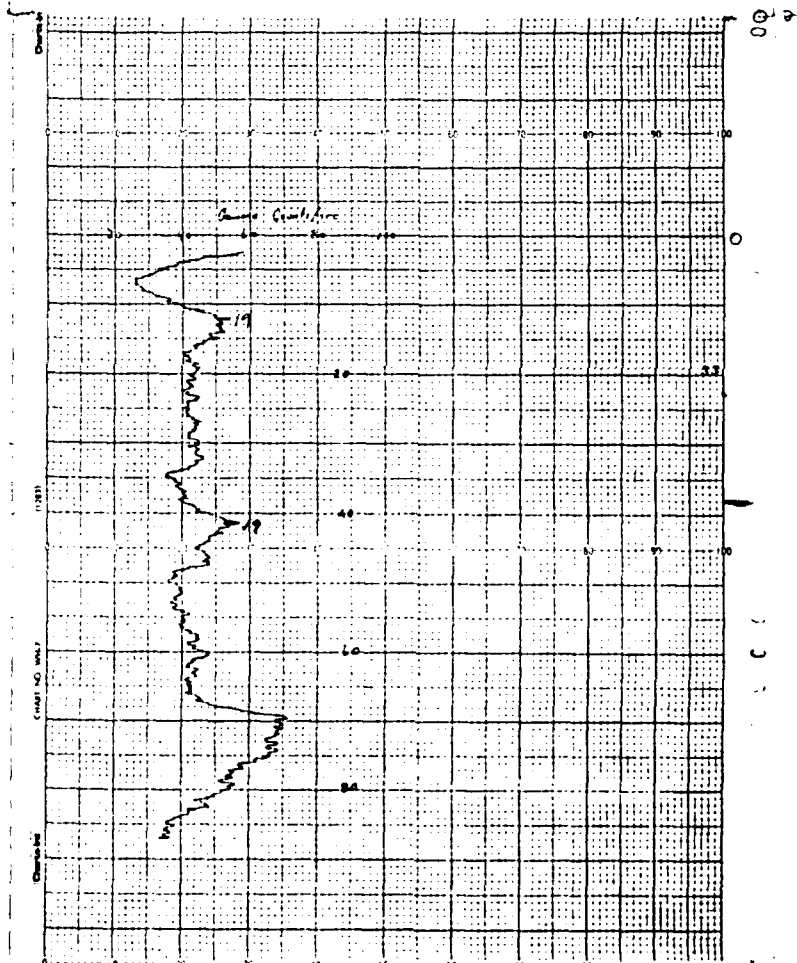
Run No. _____ of _____ runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: 100 in./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA LOG

Geological Survey No. CH-10 Cooking
State IL County Sevier
Location Cochise House
T 1 S 1 E Sec. 1 T 1 S E
Depth Datum: _____
which is _____ ft. (above, below) land surface.
Altitude: 463 ft. Land surface 463 ft.
Determined by _____
Operator(s) Hudson, Deane Date _____
Equipment (vehicle No.) _____
Logging Date _____
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 10 Time constant 2
Statistical Variation _____ in. at _____ ft. Water
Reading _____ G-R Scale _____ Time constant _____
Calibration in hole: (G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Dos. Time (min.) Water Reading _____
Remarks _____
Radiation intensity increase _____ Depth Scale: _____ ft./in.

Casing Data
Casing: Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Bore: Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics _____
_____ ft. to _____ ft.
_____ ft. to _____ ft.
Perforations, Screen: Type, size _____
_____ ft. to _____ ft.
_____ ft. to _____ ft.
Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
Surface, Shut-in head after _____ (hrs., mins.)
Date May 17, 1961
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Radio c/L _____ Data-Gamma (uv c/L) _____ U(10-3 gr/l) _____



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

LOGGING DATA

Casing: Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Bore: Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.
Dia. _____ in. _____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
surface, which is _____ ft. (above, below) _____
surface. Shot-in head after _____ (hrs., mins.)
Date 5/12/68

Depth drilled (feet): _____
Depth measured (feet): 17
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

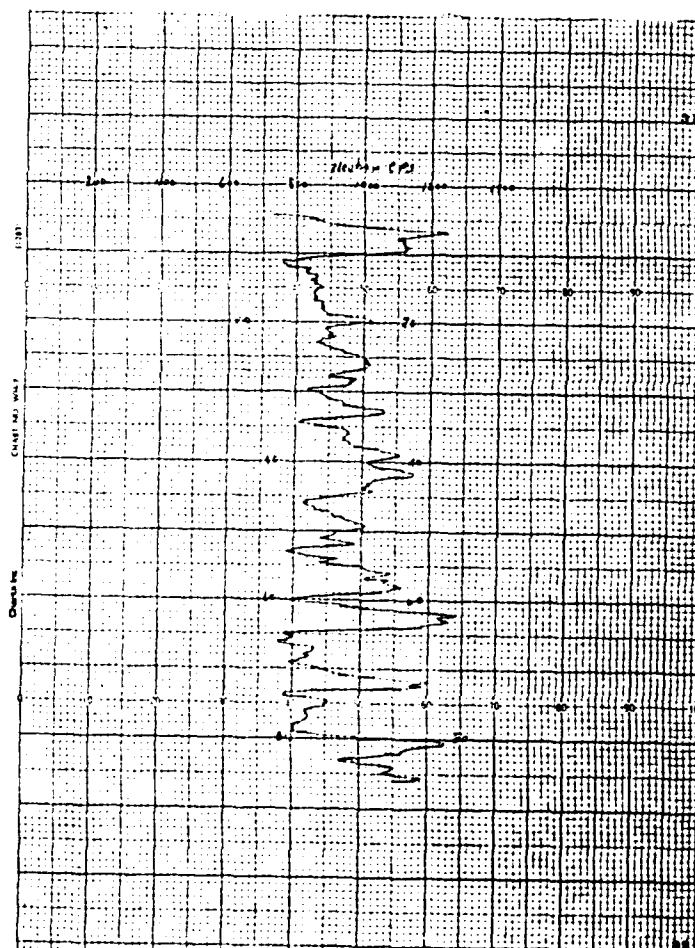
Run No. 1 of 1 run. Logging speed: 20 ft./min.
Vertical scale 10 ft./in.
Source 7 curries AM-BB Spacers 17 in.
Note. Scale 12 T.C. 7 sec.
Sens. Scale 10 Base Scale 10

Number of Field No. 2420 Comp. & Eng.
Project Name Chickillo Negro
U.S.G.S. No. _____ Town _____
State N.M. County of Parish Santa
Location _____
_____ Sec. _____ T. _____ S. _____

Depth Bottom: _____ which
is _____ ft. (above, below) land surface.
Altitude: 4662 ft. Land surface 4662 ft.
Determined by _____
Operator(s) Hudson - Dewees
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, sec. _____
Resistivity, ohms _____
Resistivity, D.B.T., ohms _____ pH _____
Circ. Temp. _____ D.B. Temp. _____
Remarks: Resistivity measured near well



Donor or Field No. 1000-1000-1000
Project Name Cochitilla Mts.
Geological Survey No. _____
State Utah County Snow
Location _____

Coring Data

Coring: Diam. in. ft. to ft. Thickness in.
Diam. in. ft. to ft. Thickness in.
Diam. in. ft. to ft. Thickness in.

Bore: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.

Filter Type _____ Thickness _____ Characteristics _____
ft. to _____
ft. to _____

Perforations, Screen: Type, size _____
ft. to _____
ft. to _____

Water Level _____ ft. (above, below) _____
_____ ft. (above, below) _____
Surface _____ Study Head after _____ (hrs., min.)
Date 5/7/68

Total Depth 37 ft. Interval Logged _____ ft. to _____ ft.

Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F
Date _____ Date _____ Field Cond. _____

Water: Temperature _____ °F at _____
Salinity c/L _____ Beta-Gamma (uv c/L) _____ U(10-3 gr/l)

which is _____ ft. (above, below) land surface.
Altitude _____ m _____ ft. Land Surface 4662 ft.
Determined by _____
Operator(s) Hall - Dewees
Equipment (Vehicle No.) _____ Date _____

Logging Data

Run No. _____ / _____ runs. Probe Sensitivity (high)
Resist.: _____ ft./in. Gamma-Ray circuit scale _____
Potential circuits s to _____ Time constant _____
Logged as: _____ ft./in. Gamma-Ray circuit scale m.p.
Potential circuit scale S Time constant E

Statistical Variation _____ in. at _____ ft. Water
Reading _____ G-S Scale _____ Time Constant _____

Calibration in hole: (G-S Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

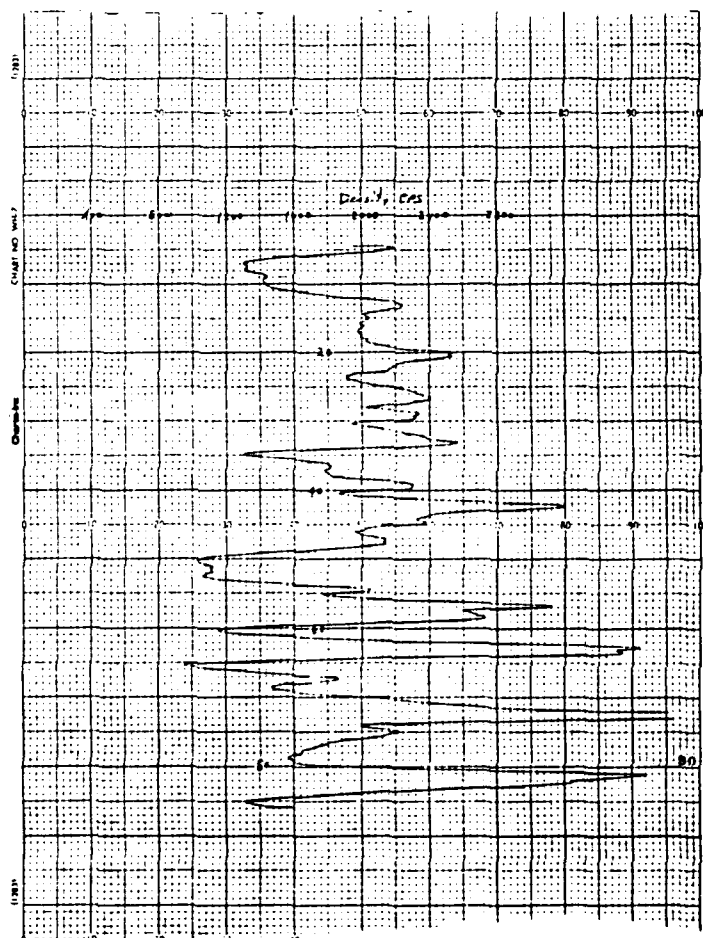
Logging Data

Run No. 1 of 1 runs. Probe Sensitivity (High)
Descent: 1 ft./min. Gamma-Ray circuit scale 1
Potential circuit scale 5 Time constant 1
Logged out: 1 ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 5 Time constant 2

Statistical variation 1 in. at 1 ft. Meter
Reading 1 G-R Scale 1 Time Constant 1

Calibration in hole: (Obs. Time Scale) Pot. Circ. Scale
Depth (ft.) Obs. Time (min.) Meter Reading

Some of the best off



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH 20 Camp 1 Eng
Project Name Rockville No. 2
U.S.G.S. No. _____ Town _____
State NH County or Parish Sherburne
Location _____
Depth Below _____ ft. (above, below) land surface.
Altitude: 466 ft. Land surface 466 ft.

HOLE LOGGING DATA

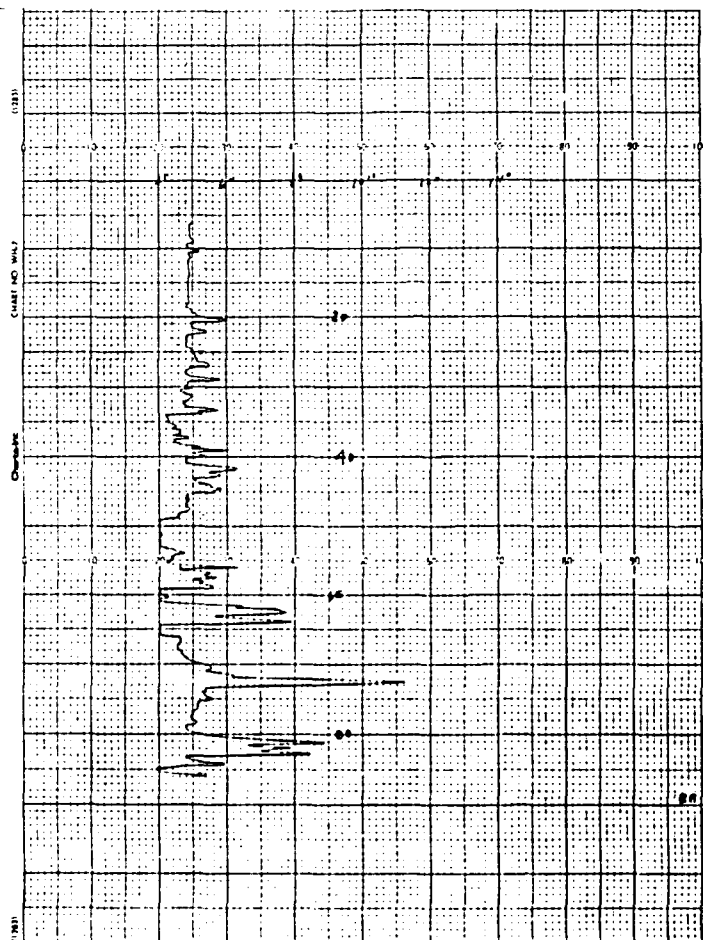
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson - Devereaux
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No.: _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft. _____
Diam. _____ in. _____ ft. to _____ ft. _____

FLUID DATA

Water Level _____ ft. (above, below) _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date 5/17/88 Resistivity, ohm-in. _____
Depth drilled (feet) _____ Circ. Temp.: _____
Depth measured (feet) 97 Remarks: _____
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 2.5 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: 1 in. = 100 ft.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA LOG

Geological Survey No. CH-21 Page 1 of 1
State NH County Sherburne

Location _____

Depth Datum: _____

which is _____ ft. (above, below) land surface.

Altitude: _____ ft. Land surface 472.5 ft.

Described by _____

Operator(s) Hudson-Dewey

Equipment (Vehicle No.) _____ Date _____

Casing Data
Casing: Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Filter: Type _____ Thickness _____ Characteristics _____

Perforations, Screen: Type, size _____

_____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____

Surface: Shot-in head after _____ ft. (above, below) _____

Date Aug 18 1977

Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.

Fluid in hole: _____ Characteristics _____

Fluid level _____ ft. Fluid Temperature _____ °F.

Date _____

Water: Temperature _____ °F. at _____ Field Cond. _____

Radio c/L _____ Beta-Gamma (mc/c/L) _____ U(10-3 gr/l) _____

Logging Date _____

Run No. _____ or _____ runs. Probe Sensitivity (High)

Descent: _____ ft./min. Gamma-Ray circuit scale _____

Potential circuit scale _____ Time constant _____

Logged out: _____ ft./min. Gamma-Ray circuit scale 0.5

Potential circuit scale 0.5 Time constant 1

Statistical Variation _____ in. at _____ ft. Meter

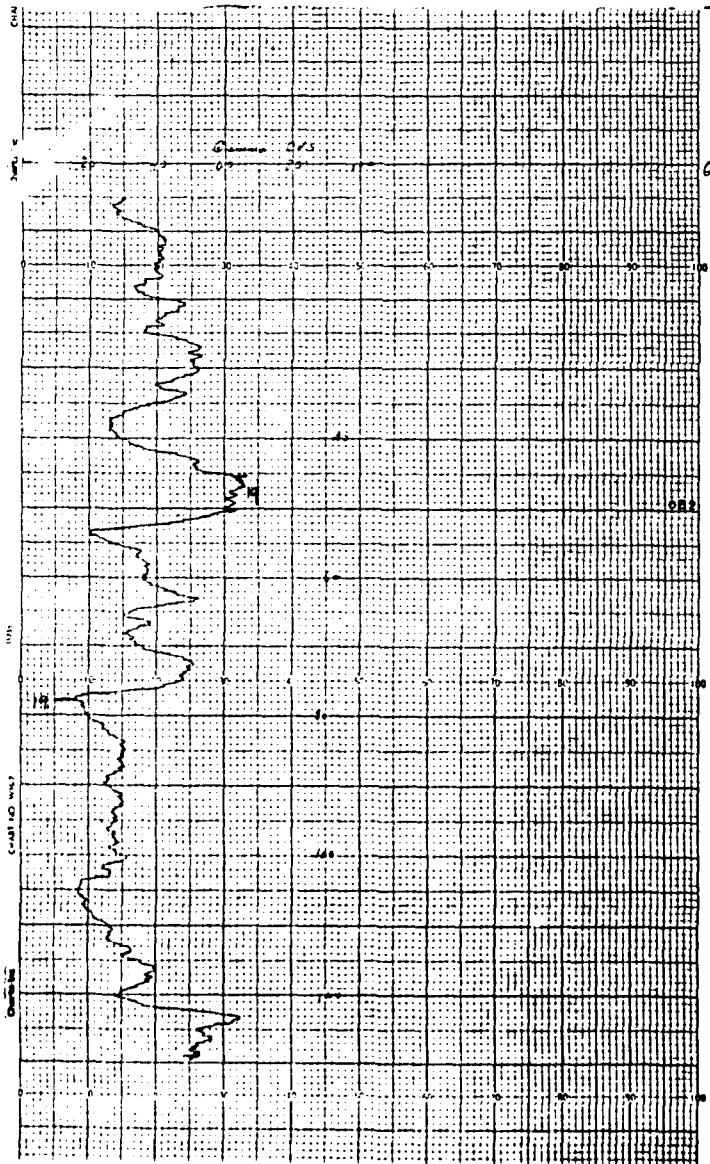
Reading _____ G-R scale _____ Time Constant _____

Calibration in hole: (G-R scale) _____ Pot. circ. scale _____

Depth (ft.) Obs. Time (min.) Meter Reading _____

Remarks _____

Radiation intensity increase _____ Depth Scale: _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

WELL LOGGING DATA

Casing: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.
Note: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.

Water Level ft. (above, below) surface, which is ft. (above, below) surface. Shut-in head after (hrs., min.) Date May 13, 1968

Depth drilled (feet):
Depth measured (feet): 122
Interval logged: ft. to ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 Curries AM-BE Spacers 17 in.
Mud. Scale 1.5 T.C. 2 sec.
Sens. Scale 1 in. Base Scale 10 ft.

Owner or Field No. CH-31 City of Eng
Project Name Cushman Naps
U.S.G.S. No. Town
State NM County or Parish Sierra
Location
Sec. T S R

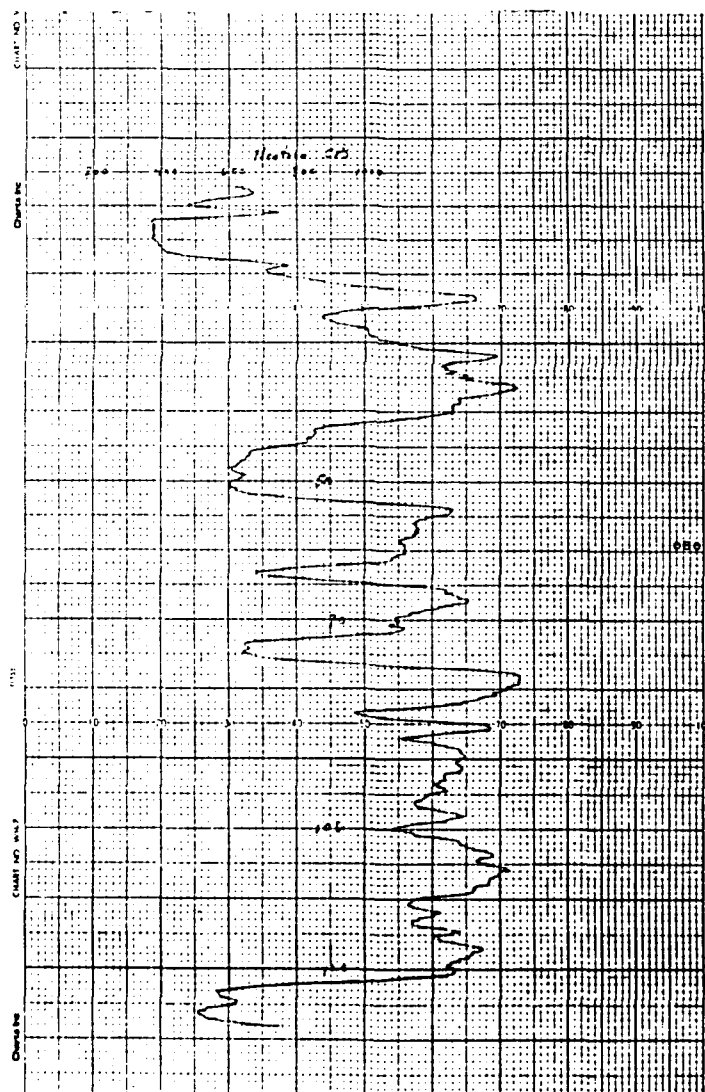
Depth Datum: which is ft. (above, below) land surface.
Altitude: 10 ft. Land surface 4780 ft.

Determined by
Operator(s) Hudson-Denker
Equipment Date
Equipment No. Vehicle No.

FLUID DATA

Type:
Density, lb./gal.
Viscosity, cP:
Sensitivity, ohms:
Sensitivity, S.N.T., ohms:
Circ. Temp.: S.N. Temp.:
Remarks:

Pressure positive max. left



H. G. HYDROLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Owner or Field No. CH 11 (1954)
Project Name Columbia River
Geological Survey No. _____
State Ill. County Surge
Location _____
Depth Bottom _____ ft. (above, below) land surface.
which is _____ ft. Land surface 4710 ft.
Altitude: AD _____ ft. Land surface
Determined by _____
Operator(s) William DeWitt
Equipment (vehicle No.) _____ Date _____

Casing Data
Casing: Diam. in. ft. to ft. Thickness in. _____
Diam. in. ft. to ft. Thickness in. _____
Diam. in. ft. to ft. Thickness in. _____
Bore: Diam. in. ft. to ft. _____
Diam. in. ft. to ft. _____
Diam. in. ft. to ft. _____

Filter: Type _____ Thickness _____ Characteristics, _____
ft. to _____
Perforations, Screen: Type, size _____
ft. to _____

Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
Surface. Shut-in head after _____ (hrs., mins.)
Date May 18, 1957

Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F
Date _____ Date _____

Water: Temperature _____ °F. at _____ Field Cond. _____
Radio c/L _____ Beta-Gamma (uv c/L) _____ U(10-3 gr/l) _____

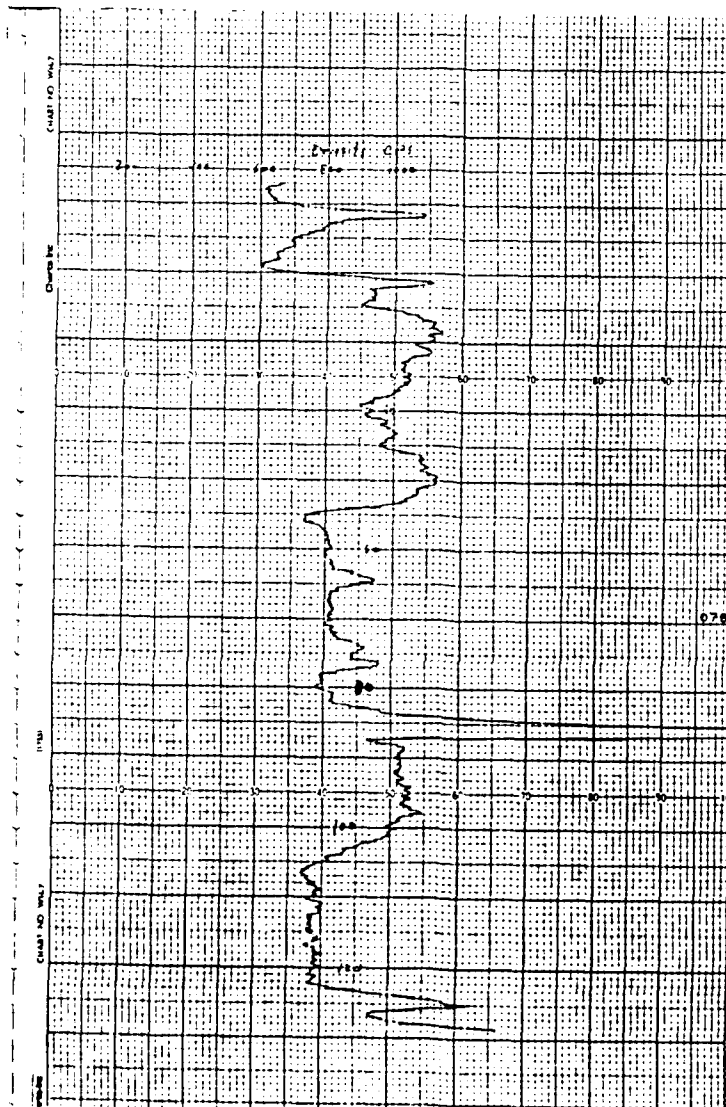
Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (High)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____

Statistical Variation _____ in. at _____ ft. Water
Reading _____ G-R Scale _____ Time Constant _____

Calibration in hole: (G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Water Reading _____

Remarks But density measurement

Radiation Intensity Increase _____ Depth Scale: _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Order of Field No. 04-21 C-4-4 Aug
P.O. box name Quail Hill, Miss.
U.S.G.S. No. _____ Town _____
State MISS County or Parish Singer
Location _____
Depth Datum: _____ ft. (above, below) land surface.
Is _____ ft. (above, below) land surface.
Altitude, AP _____ ft. Land surface 4770 ft.

WELL LOGGING DATA

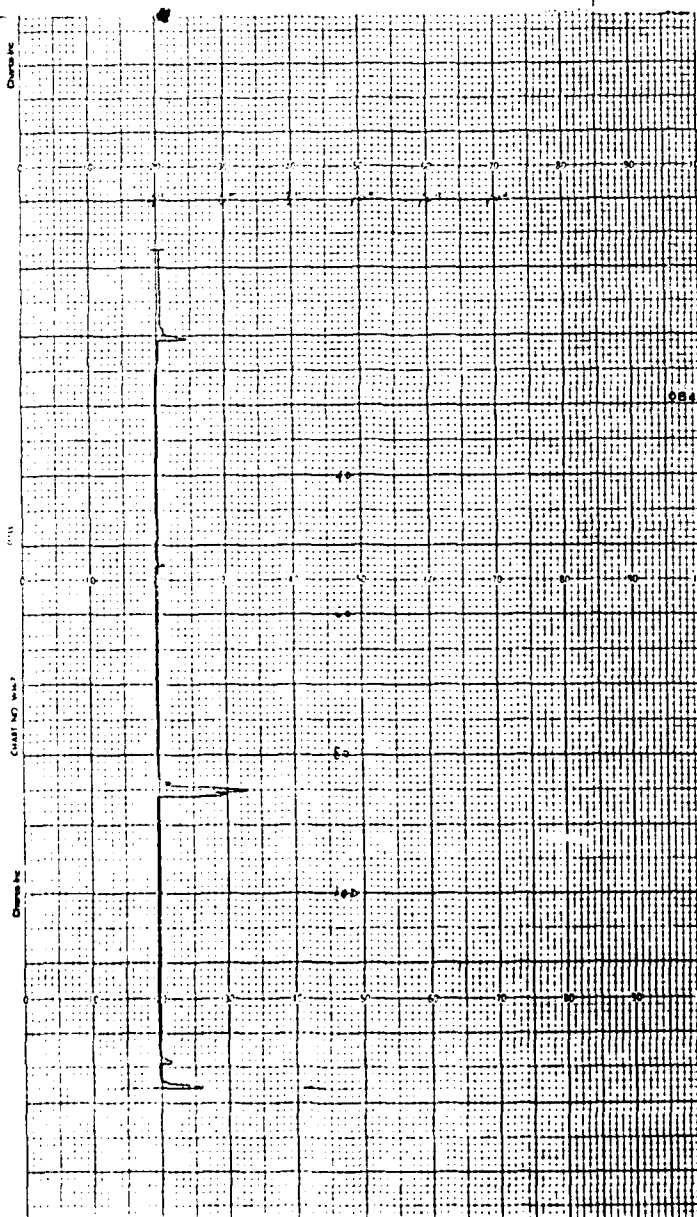
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Friedman - DeWitt
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No. _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft. _____
Diam. _____ in. _____ ft. to _____ ft. _____

FLUID DATA

Water Level _____ ft. (above, below) _____ Type: _____
_____ which is _____ ft. (above, below) _____ Density, lbs./gal. _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date May 12, 1956 Resistivity, ohms _____
Depth drilled (feet) _____ Resistivity, B.H.T., ohms _____
Depth measured (feet) 128 Circ. Temp. _____ B.H. Temp. _____
Interval logged: _____ ft. to _____ ft. Remarks: _____

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: 7-5 in./in.



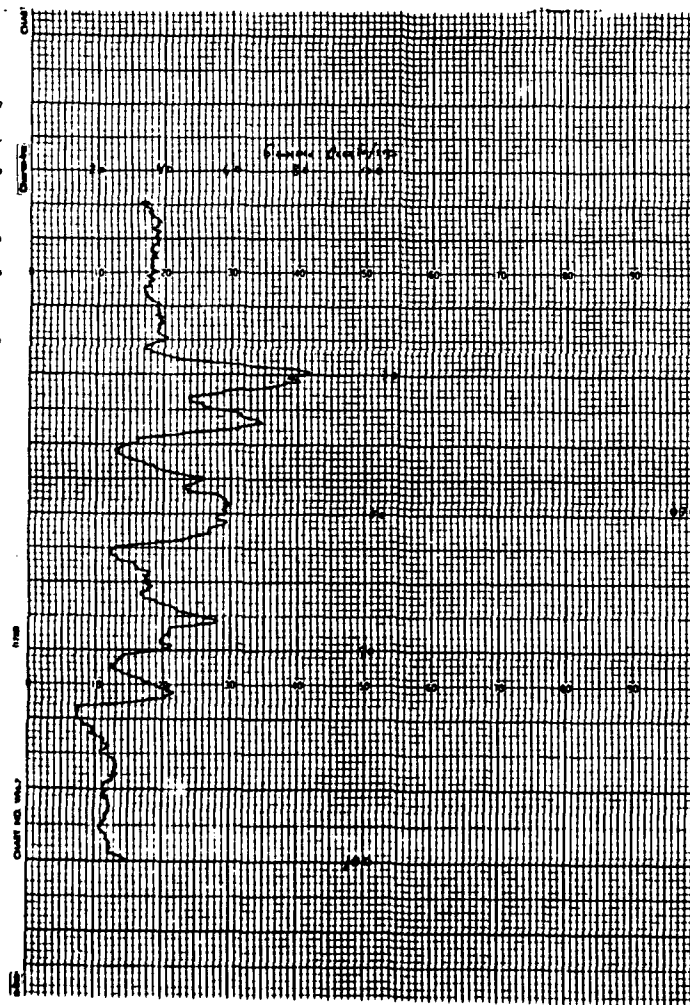
U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA LOG

Geological Survey No. CH-22 Camp et Eng
State N.M. County Santa
Location Cochillo Negro
Depth Datum _____ ft. (above, below) land surface.
which is _____ ft. Land surface 4742 ft.
Altitude: _____ ft. Determined by _____
Operator(s) Harlan Deane
Equipment (Vehicle No.) _____ Date _____

Casing Data
Casing: Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Diam. in. _____ ft. to _____ ft. Thickness in. _____
Bore: Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Diam. in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics, _____
ft. to _____
ft. to _____
Perforations, Screen: Type, size _____
ft. to _____
ft. to _____
Water Level: _____ ft. (above, below) _____ ft. (above, below)
surface. Shut-in head after _____ (hrs., mins.)
Date May 18, 1961
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Field in hole: Characteristics _____
Field level: _____ ft. Field Temperature _____ °F.
Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Res (m c/L) _____ Data-Gamma (m c/L) U(10-3 gr/l)

Logging Data
Run No. _____ or runs. Probe Sensitivity (High)
Detent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale 4.5
Potential circuit scale _____ Time constant _____
Statistical Variation in. at _____ ft. Meter
Reading _____ g-r Scale _____ Time Constant _____
Calibration in hole: (g-r Scale) _____ Pot. circ. scale _____
Depth (ft.) Obs. Time (min.) Meter Reading _____

Radiation Intensity Increase _____ Depth Scale: 40 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

SOLE LOGGING DATA

Coring: Diam. in. ft. in. ft.
Diam. in. ft. in. ft.
Diam. in. ft. in. ft.
Diam. in. ft. in. ft.
Diam. in. ft. in. ft.
Diam. in. ft. in. ft.

Water level ft. (above, below) which is ft. (above, below) surface. Shut-in head after (hrs., min.)
Date May 17, 1917

Depth drilled (feet):
Depth measured (feet): 100
Interval logged: ft. to ft.

OPERATION DATA

Run No. 101 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 cutting AM-BB Spacers 17 in.
Bar. Scale 1K T.C. 2 sec.
Bar. Scale 1.0 Bar. Scale 10.0

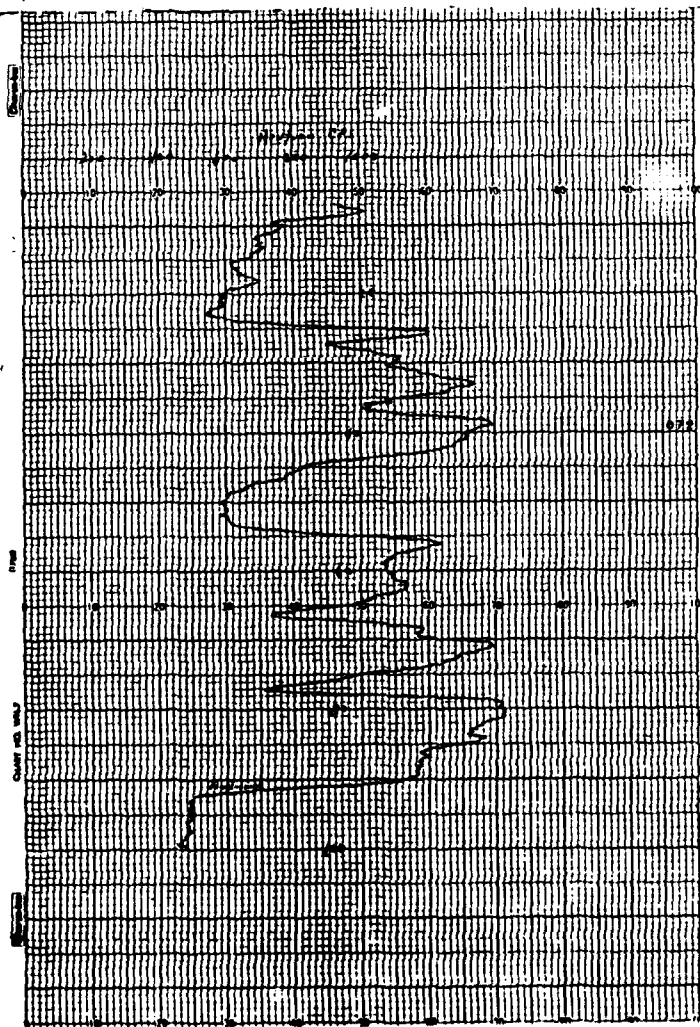
Order or Field No. CH 22 Report Eng
Project Name Cushilla Mays
U.S.G.S. No. _____
State ALM County or Parish Sierra
Location _____

Depth Datum: _____ which is _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface 474 ft.

Determined by _____
Operator(s) Heiden - Bueger
Equipment: _____ Date _____
Equipment No.: _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, cec. _____
Reactivity, ohm: _____
Reactivity, S.R.T., ohm: _____
Circ. Temp.: _____ S.R. Temp.: _____
Remarks: Permeability 1000 to 1000



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Owner or Title No. CH 22 Capital Exp
Project Name Cashville Neg-2
Geological Survey No. _____
State MS County Stennis
Location _____
Depth Bottom _____ ft. (above, below land surface)
which is _____ ft. Land surface 474 ft.
Altitude _____ ft.
Determined by _____
Operator(s) Hubert - Dwyer
Equipment (make & no.) _____ Date _____

Sealing Data
Casing: Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.

Grout: Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.
Diam. _____ in. _____ ft. _____ in. Thickness _____ in.

Filter: Type _____ Thickness _____ Characteristic _____
_____ ft. _____ in. _____

Perforations, Screen: Type, size _____
_____ ft. _____ in. _____

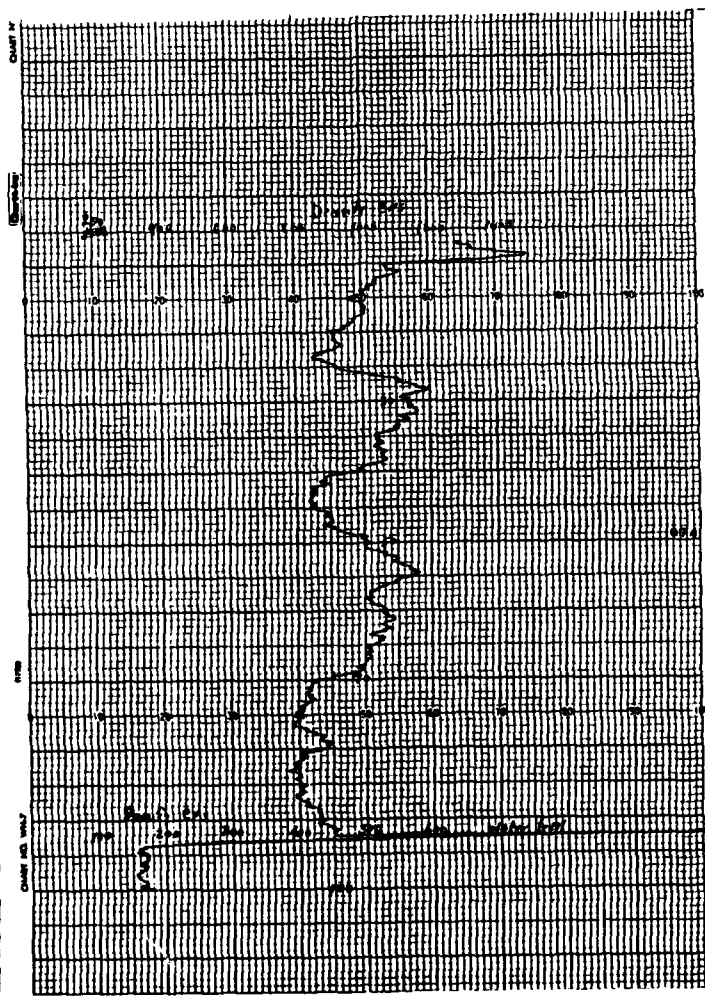
Water Level _____ ft. (above, below)
Surface _____ ft. (above, below)
which is _____ ft. (above, below)
Date May 18 1961 after _____ (hrs., min.)

Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.

Field in hole: _____ ft. Field Temperature _____ °F.
Field Type _____ Date _____
Water: Temperature _____ °F. at _____ ft. Field Cond. _____
Below c/L _____ Date-Sample (on c/L) _____ g/l

Remarks Rock Density 1.65 g/cc

Radiation intensity increase _____ Depth Scale: _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

WELL LOGGING DATA

Coring: Dia. _____ in. _____ ft. 00 _____ ft. _____
 Dia. _____ in. _____ ft. 00 _____ ft. _____
 Dia. _____ in. _____ ft. 00 _____ ft. _____
 Core: Dia. _____ in. _____ ft. 00 _____ ft. _____
 Dia. _____ in. _____ ft. 00 _____ ft. _____
 Dia. _____ in. _____ ft. 00 _____ ft. _____

Owner or Field No. CH-22 Gap at Eng
 Project Name Puchillo Mine
 U.S.G.S. No. _____ Town _____
 State NM County or Parish Santa
 Location _____
 Depth Below _____ ft. (above, below) land surface, which is _____ ft. (above, below) land surface.
 Altitude: _____ ft. Land surface 4942 ft.

Described by _____
 Operator(s) Hudson-Decker
 Equipment _____
 Equipment No. _____ Vehicle No. _____

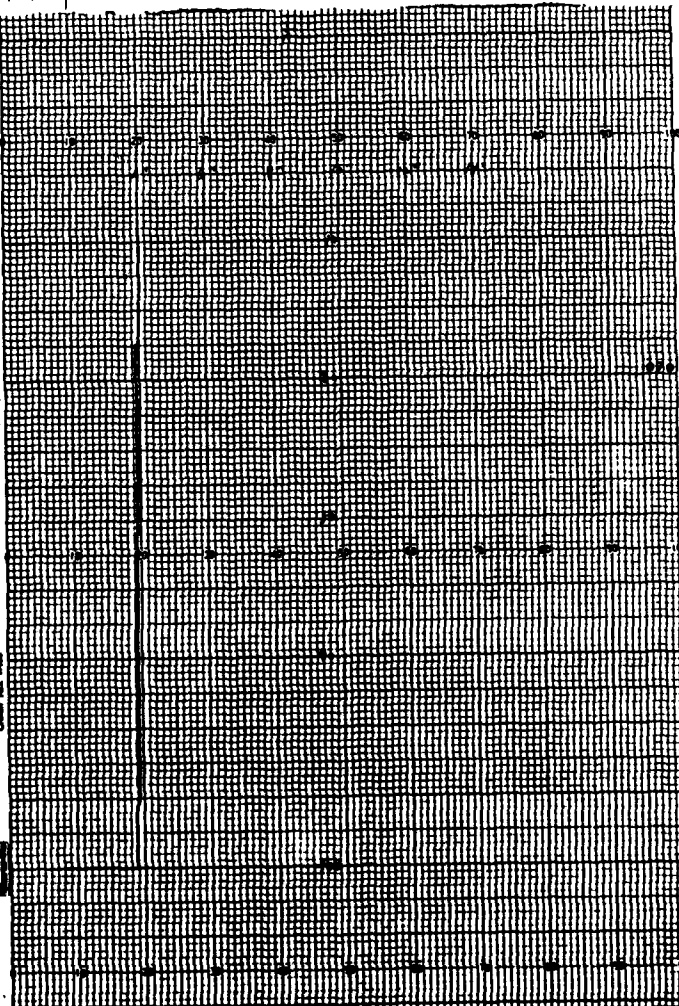
FLUID DATA

Water Level _____ ft. (above, below) _____
 _____ which is _____ ft. (above, below) surface. Shut-in head after _____ (hrs., mins.)
 Date Aug 18, 1988
 Depth drilled (feet) _____
 Depth measured (feet) 100
 Interval logged: _____ ft. 00 _____ ft. _____

Type: _____
 Density, lb./gal. _____
 Viscosity, cP. _____
 Resistivity, ohm-ft. _____
 Resistivity, S.C.T., ohm-ft. _____
 Circ. Temp. _____
 Remarks: _____

OPERATION DATA

Run No. _____ of _____ runs. Logging speed: 16 ft./min.
 Vertical scale: 10 ft./in.
 Horizontal scale: 100 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA LOG

Geological Survey No. W-13 C-15
State MD County Stearns
Location Cushilla Maper
Beach Datum: _____
which is _____ ft. (above, below) land surface.
Altitude: 46 ft. Land surface 466 ft.
Determined by _____
Operator(s) Hudson-Dewees
Equipment (Vehicle No.) _____ Date _____

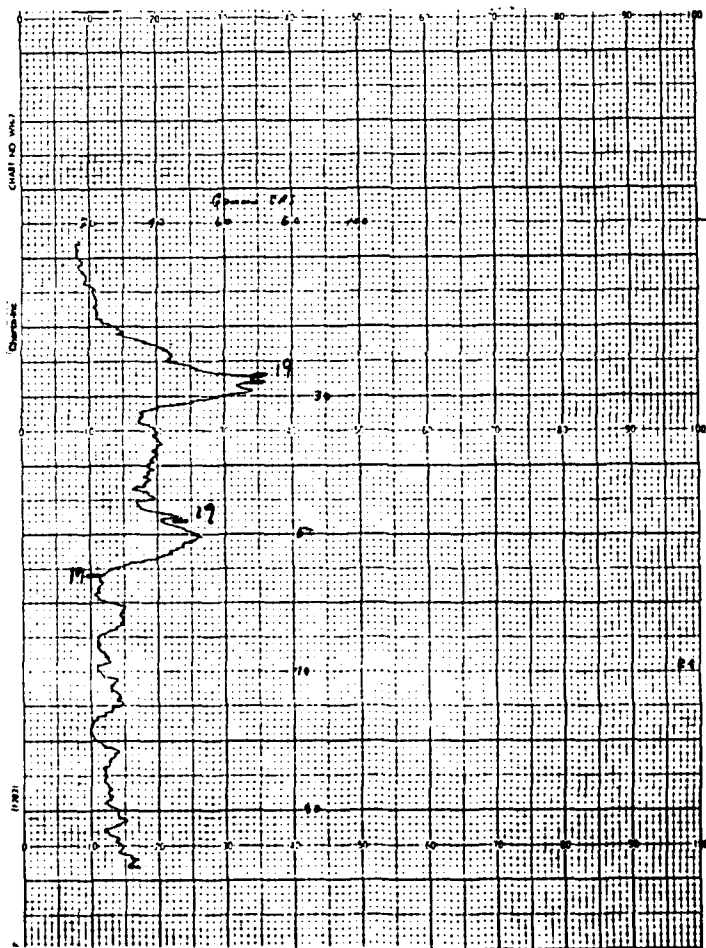
Casing Data
Casing: Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics _____
_____ ft. to _____ ft. to _____ ft.
Perforations, Screen: Type, size _____
_____ ft. to _____ ft. to _____ ft.
Water Level: _____ ft. (above, below) _____ ft. (above, below)
Surface: Shut-in head after _____ (hrs., mins.)
Date May 17, 1979
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristic _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____
Water: Temperature _____ °F. at _____ Field Cond. _____
Res/c/L _____ Date-Gamma (uv c/L) _____ U(10-3 gr/l) _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (High)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Statistical Variation _____ in. at _____ ft. Meter
Reading _____ G-R Scale _____ Time Constant _____

Calibration in hole: (G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

Remarks _____

Radiation Intensity Increase _____ Depth Scale: _____ / 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

WELL LOGGING DATA

Casing: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

Water Level _____ ft. (above, below) _____
which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., min.)
Date 5/17/68

Depth drilled (feet): _____
Depth measured (feet): 92
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 2.0 ft./min.
Vertical Scale _____ ft./in.
Source 3 Curvicon AM-BE Spectra 17 in.
Mura. Scale 115 T.C. 2 sec.
Sema. Scale 1.0 Beta Scale 1.0

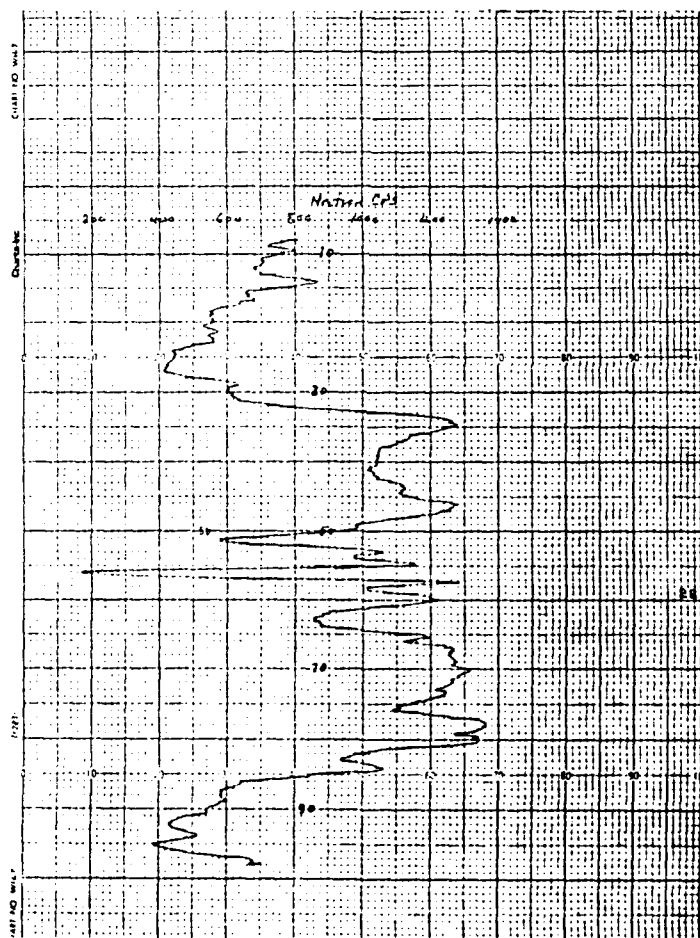
Owner or Field No. CH-23 G. & E. Eng.
Project Name Cuchilla Negro
U.S.G.S. No. _____ Town _____
State NM County or Parish Santa Fe
Location _____

Depth Datum: _____, which is _____ ft. (above, below) land surface.
Altitude: 60 ft. Land surface 4660 ft.

Determined by _____
Operator(s) Hudson - Dewar
Equipment _____ Date _____
Equipment No. _____ Vehicle No. _____

FLUID DATA

Type: _____
Density, lbs./gal. _____
Viscosity, sec. _____
Resistivity, ohm-in. _____
Resistivity, B.H.T., ohm-in. _____
Circ. Temp. _____ B.H. Temp. _____
Remarks: Pressure measurement same as left
Water coming into hole at 56 ft



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

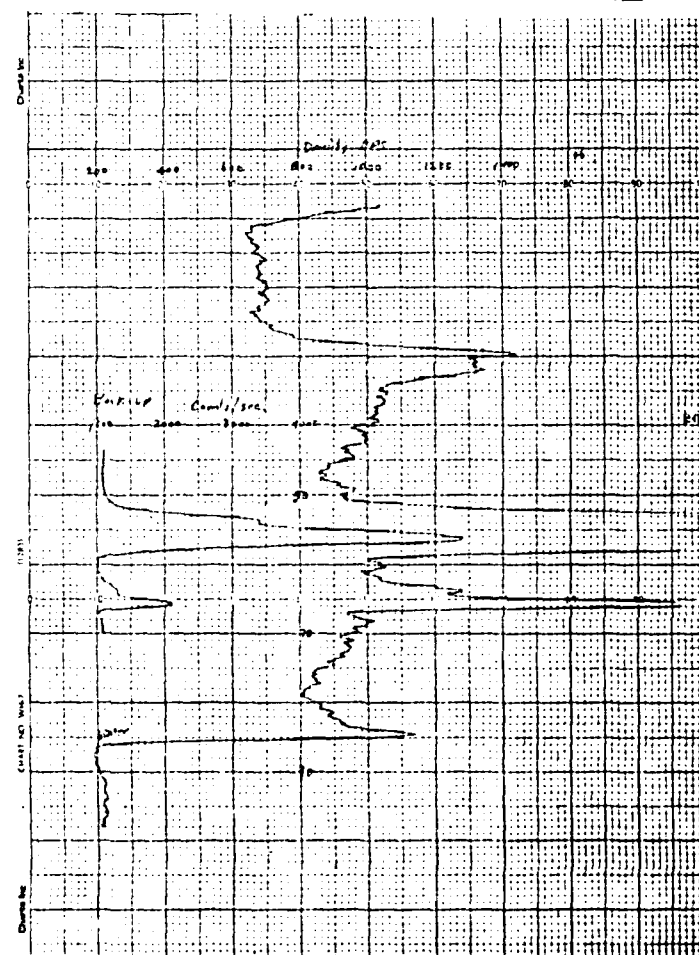
Owner of field No. 10-23
Project name Rocky Mt.
Geological Survey No. _____
State NE County Sierra
Location _____

Casing Data
Casing: Diam. in. ft. to ft. Thickness in.
Diam. in. ft. to ft. Thickness in.
Diam. in. ft. to ft. Thickness in.
Bore: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.
Filter: Type _____ Thickness _____ Characteristics, _____
ft. to _____
ft. to _____
Perforations, Screen: Type, size _____
ft. to _____
ft. to _____
Water level _____ ft. (above, below) _____
Surface, shut-in head after _____ ft. (above, below) _____
Date 5/1/54 _____
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____
Water: Temperature _____ °F. at _____ Fluid Cond. _____
As (u c/l) _____ Data-Gamma (u c/l) _____ U(10-3 gr/l) _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Statistical Variation _____ in. at _____ ft. Meter
Reading _____ G-A Scale _____ Time Constant _____
Calibration in hole: (G-A Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Meter Reading _____

Remarks See notes on p. 111

Radiation Intensity Increase _____ Depth Scale _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-33 Camp of Eng.
Project Name Cash/No. Alegre
U.S.G.S. No. _____ Town _____
State NM County or Parish Santa
Location _____
Depth Datum: _____ ft. (above, below) land surface.
Altitude: _____ ft. Land surface 4660 ft.

HOLE LOGGING DATA

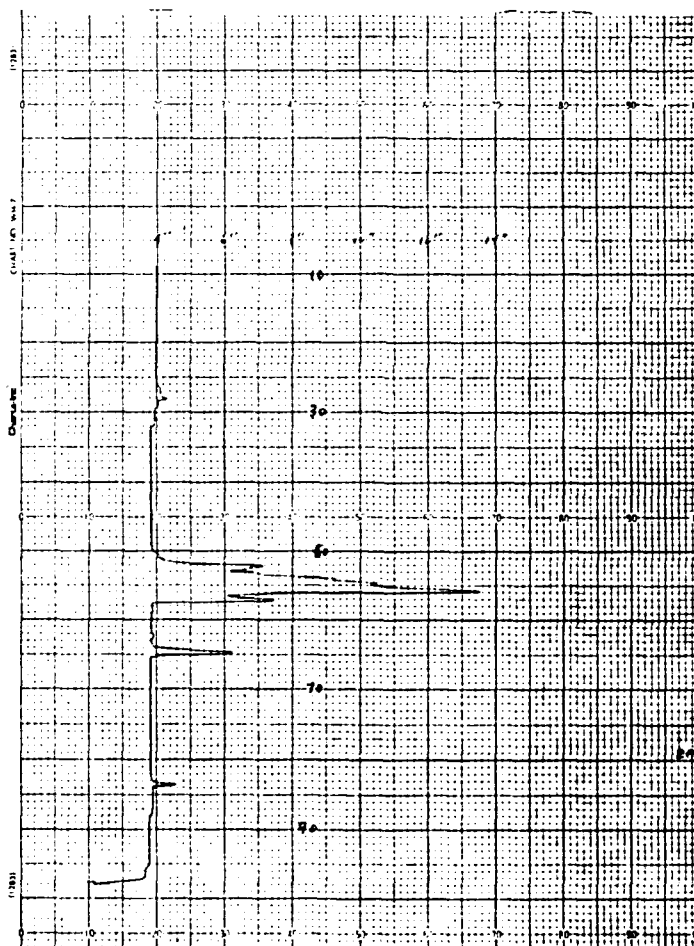
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson - Decker
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No.: _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

FLUID DATA

Water Level _____ ft. (above, below) _____
_____ ft. (above, below) surface. Shut-in head after _____ (hrs., mins.)
Date May 12, 1988
Depth drilled (feet) _____
Depth measured (feet) 98
Interval logged: _____ ft. to _____ ft.

OPERATION DATA

Run No. _____ of _____ runs. Logging speed: 20 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: Two in./in.



GAMMA LOG

Depth Below _____
which is _____ ft. (above, below) land surface.

Operator(s) John J. Jones
Equipment (Vehicle No.) _____ Date _____

Operator(s) James J. O'Leary
Equipment (Vehicle No.) _____ Date _____

Run No. _____ of _____ runs. Probe Sensitivity (high
to low) _____

Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale / °

Potential circuit scale 10 time constant 1

Reading _____ G-R Scale _____ Time Constant _____

Depth (ft.) Obs. Time (min.) Meter Reading

Remarks only log made in this boat

Bore: Diam. _____ in. _____ ft. to _____ ft.
 Diam. _____ in. _____ ft. to _____ ft.
 _____ in. _____ ft. to _____ ft.

Filter: Type _____ Thickness _____ (Characteristics, _____ ft. to _____)

Perforations, Screen: Type, size _____
ft. to _____
ft. to _____

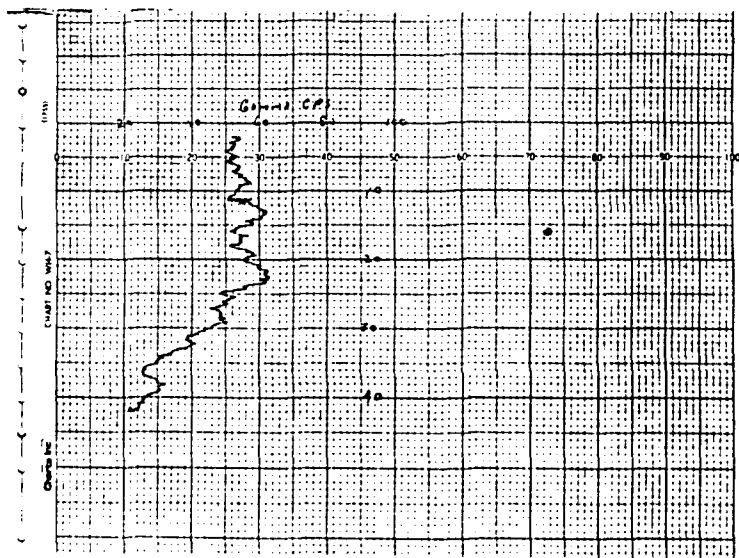
Water level _____ ft. (above, below) _____

surface. Shut-in head after _____ ft. (above, below)
(hrs., mins.)
Date July 14, 1988

Fluid in Hole _____ Characteristics _____
 Fluid Level _____ Ft. Fluid Temperature _____ °F.

Date _____ Date _____
Water: Temperature _____ °F. at _____, Field Cond. _____
Substrate _____

Revised 1/1/77 Date-Change 1/1/77 010-3 8771

Radiation intensity increase 

U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

WELL LOGGING DATA

Casing: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.
Bore: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.

Water Level ft. (above, below)
surface, which is ft. (above, below)
surface. Shut-in head after (hrs., min.)

Date May 17, 1958
Depth drilled (feet):
Depth measured (feet): 79
Interval logged: ft. to ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 carries AM-BE Spacers 17 in.
Note Scale 1K T.C. 2 sec.
Sens. Scale 1.0 Base Scale 1.0

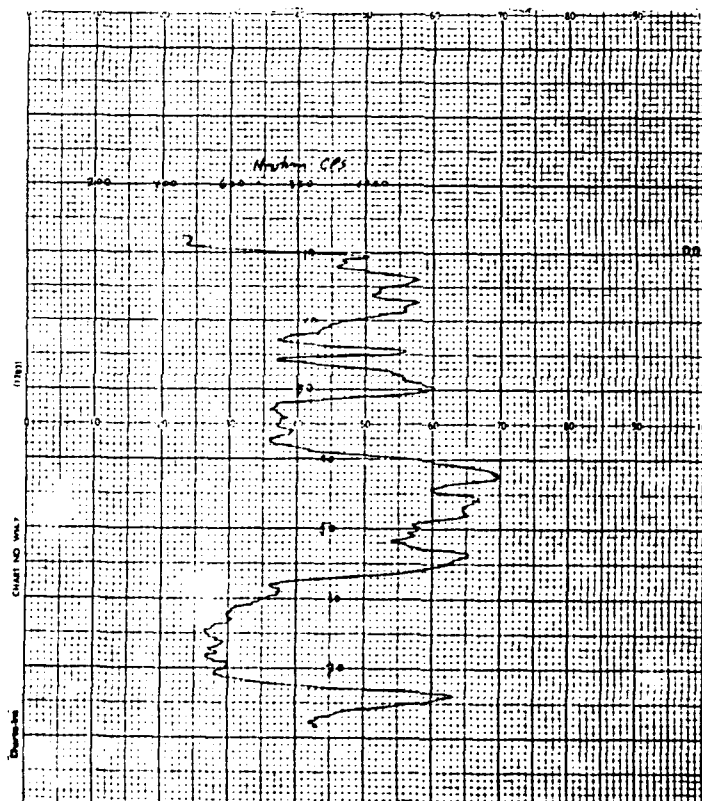
Survey or Field No. 914-25 Cope & King
Project Name Cuchilla Moya
U.S.G.S. No. Town
State 111 County or Parish Sierra
Location

Depth Datum: which
is ft. (above, below) land surface.
Altitude: 10 ft. Land surface 4610 ft.

Determined by
Operator(s) Hudson-Dewees
Equipment Date
Equipment No. Vehicle No.

FLUID DATA

Type:
Density, lbs./gal.
Viscosity, sec.
Reactivity, ohms:
Reactivity, S.B.T., ohms: 100
Circ. Temp.: S.B. Temp.:
Remarks: Pressure/temperature now left



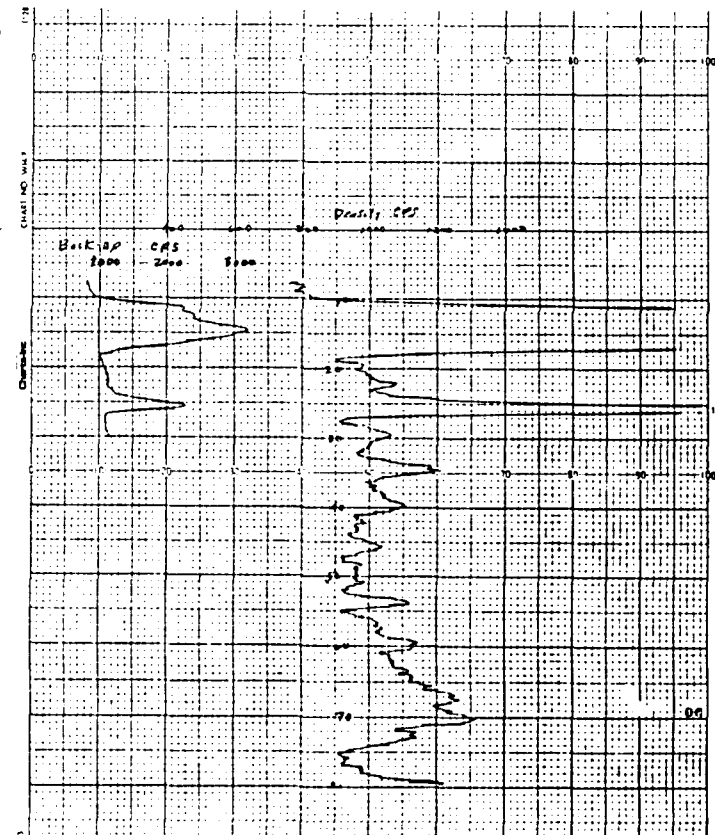
U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GAMMA-GAMMA LOG

Owner or Field No. CH-15 C-2-16-5
Project Name Cuchilla Blanca
Geological Survey No. _____
State Chile County S. Cruz
Location _____
Depth Bottom _____
which is _____ ft. (above, below) land surface.
Altitude 4610 ft. Land surface 4610 ft.
Determined by _____
Operator(s) Julian R. Jones
Equipment (vehicle No.) _____ Date _____

Casing Data
Casing: Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Diam. _____ in. _____ ft. to _____ ft. Thickness _____ in.
Bore: Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.
Filter: Type _____ Thickness _____ Characteristics, _____
_____ ft. to _____ ft.
Perforations, Screen: Type, size _____
_____ ft. to _____ ft.
Water Level _____ ft. (above, below) _____
Surface. Shut-in head after _____ ft. (above, below) _____
Date May 17, 1951 (hrs., mins.)
Total Depth _____ ft. Interval Logged _____ ft. to _____ ft.
Fluid in hole: _____ Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F
Date _____
Water Temperature _____ °F at _____ Field Cond. _____
Below c/L _____ Beta-Gamma (uv c/L) U(10-3 gr/l) _____

Logging Data
Run No. _____ or _____ runs. Probe Sensitivity (high)
Descent: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Logged out: _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant _____
Statistical Variation _____ in. at _____ ft. Water
Reading _____ G-R Scale _____ Time Constant _____
Calibration in hole: (G-R Scale _____ Pot. circ. scale _____)
Depth (ft.) Obs. Time (min.) Water Reading _____

Radiation Intensity Increase _____ Depth Scale _____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-25 Comp 16
Project Name Cochise Mts
U.S.G.S. No. _____ Town _____
State Ariz County or Parish Cocon
Location _____
Depth Datum _____ ft. (above, below) land surface, which is _____ ft. Land surface 46th ft.

HOLE LOGGING DATA

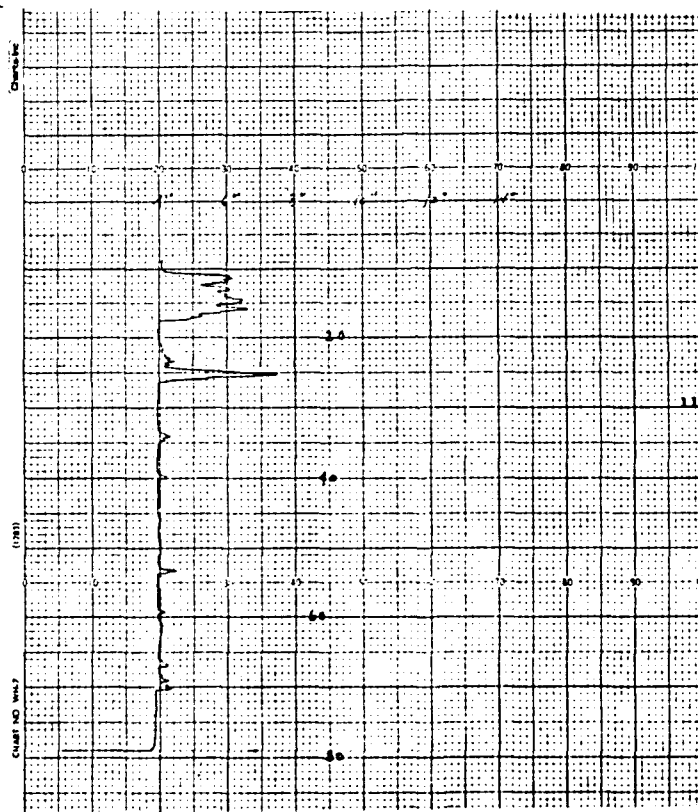
Casing: Diam. _____ in. _____ ft. to _____ ft. Determined by _____
Diam. _____ in. _____ ft. to _____ ft. Operator(s) Hudson - De Vries
Diam. _____ in. _____ ft. to _____ ft. Equipment _____ Date _____
Bore: Diam. _____ in. _____ ft. to _____ ft. Equipment No. _____ Vehicle No. _____
Diam. _____ in. _____ ft. to _____ ft.
Diam. _____ in. _____ ft. to _____ ft.

FLUID DATA

Water Level _____ ft. (above, below) _____ Density, lbs./gal. _____
_____ which is _____ ft. (above, below) _____
surface. Shut-in head after _____ (hrs., mins.) Viscosity, sec. _____
Date May 17, 1988 Resistivity, ohms _____
Depth drilled (feet) _____ Resistivity, S.M.T., ohms _____
Depth measured (feet) 79 Circ. Temp. _____ S.M. Temp. _____
Interval logged: _____ ft. to _____ ft. Remarks _____

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: 100 in./in.



Aggregate Investigation Report

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SWDED-GL REPORT 14735

(10 pages)

PROJECT: CUCHILLO NEGRO DAM

Contract No.

Feature: AGGREGATE INVESTIGATION

TEST REQUEST NO.: E86880058

From: Chief

Dated: 28 June 88

Engineering Division

Received: 05 July 88

Albuquerque District

MATERIAL:

No. and type of samples: 1 Natural gravel and sand, 1 chunk stone

Source or other identification: Cuchillo Negro Dam

Date received: 17 June 88

REMARKS:

SEE ATTACHED PAGES.

Report sent to:

Copy furnished:

Albuquerque District

Date:

Name and title:

Signature

24 Aug 88

WILLIAM R. TANNER

Director

SWD Laboratory



ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

1. REFERENCE: Reference is made to Albuquerque District test request E86880058, dated 28 June 88, requesting testing of concrete aggregate and riprap.

2. SAMPLES: The following samples were received 17 June 88:

SWD NO.	MATERIAL	SOURCE	AMOUNT
C-1846	NATURAL SAND AND GRAVEL	CUCHILLO NEGRO	66 BAGS
C-1847	CHUNK STONE	CUCHILLO NEGRO	1200 LB

3. PETROGRAPHIC REPORT:

A. C-1846. The natural sand and gravel consisted of well rounded particles of the following:

ROCK TYPE	PERCENT
ACID VOLCANIC	43.4
BASIC VOLCANIC	22.2
INTERMEDIATE VOLCANIC	17.0
QUARTZ	5.0
FELDSPAR	4.7
SANDSTONE	3.6
CHERT	3.3
LIMESTONE	0.8

The ACID VOLCANIC rocks were well rounded, fine-grained, slightly fractured, slightly weathered and ranged from reddish orange to purple in color. The fractures were hairline, tight and were well healed with quartz. The acid volcanic rocks appeared to be rhyolites in composition and about 30% were porphyritic. No volcanic glass was noted.

The BASIC VOLCANIC rocks were well rounded, fine-grained, slightly fractured, slightly weathered and ranged in color from medium to dark gray. The fractures were hairline, tight and were well healed with quartz. The basic volcanics appeared to be basalts in composition and about 20% were porphyritic.

The INTERMEDIATE VOLCANIC rocks were well rounded, fine-grained, slightly fractured, slightly weathered and ranged in color from yellowish green to light gray. The fractures were hairline, tight and well-healed with quartz. The intermediate volcanics appeared to be

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

andesites in composition. No volcanic glass was noted.

The QUARTZ was clear to white, hard, dense, durable and slightly weathered. The particles were subangular to subrounded. Slight iron-staining was noted on a few of the quartz grains.

The FELDSPAR was pink to white, moderately hard, dense, durable, and subrounded.

The SANDSTONE was greenish gray, fine-grained, slightly weathered and cemented with silica. The particles were rounded to subrounded in shape.

The CHERT was varicolored, hard, dense, durable, and was slightly fractured. The particles were subrounded to subangular in shape. No CHALCEDONY was noted.

The LIMESTONE was medium to dark gray, very fine-grained, dense, durable and moderately hard. Particle shape was rounded.

B. C-1847. The chunk stone sample consisted of medium to dark gray, fine-grained, slightly fractured, slightly weathered, moderately hard, dense, durable LIMESTONE. About 80% of the sample (C-1847-A) contained gray and light brown mottling. Twenty percent (C-1847-B) of the sample was thin-bedded. The fractures were hairline, tight and filled with calcite. Weathering was noted as a slight discoloration along the outer surfaces of the chunks and along fractures. Chunk size ranged from 6" x 8" x 10" to 12" x 14" x 22.

4. RESULTS OF FREEZE-THAW TESTING

A. C-1847-A and C-1846-B. After 20 cycles of freeze-thaw testing the slabs remained intact with only very minor slaking of sand-size particles (SEE PLATES 1 & 2).

5. RESULTS OF ALKALI-AGGREGATE REACTION, CHEMICAL TEST:

Results of the Chemical test for reactivity of aggregate with sodium hydroxide are listed in the following table:

ALBUQUERQUE DISTRICT
 CUCHILLO NEGRO DAM
 AGGREGATE ANALYSIS
 SWDED-GL REPORT NO. 14735

Sample	Point	Sc	Rc
C-1846 Fines	A	90	249
	B	78	262
	C	89	255
C-1846 Corase	A	95	218
	B	62	214
	C	82	245

The tests show that both samples are innocuous, containing no reactive minerals. (SEE PLATE 3).

ALBUQUERQUE DISTRICT
 CUCHILLO NEGRO DAM
 AGGREGATE ANALYSIS
 SWDED-GL REPORT NO. 14735

TABLE 1
 OVERALL GRADATION

SWD SAMPLE NO.	C-1846
GRADATION. % PASSING	
3"	100.0
2 1/2"	99.3
2"	97.8
1-1/2"	95.5
1"	89.6
3/4"	84.2
1/2"	75.1
3/8"	67.6
#4	51.1
#8	38.5
#16	27.9
#30	18.6
#50	9.1
#100	4.7
#200	2.9

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

TABLE 2
RESULTS OF TESTS OF PLUS #4 MATERIAL

SWD SAMPLE NO.	C-1846
GRADATION, % PASSING	
3"	100.0
2 1/2"	98.6
2"	95.8
1-1/2"	90.9
1"	78.8
3/4"	67.8
1/2"	49.1
3/8"	33.7
#4	0.0
SPECIFIC GRAVITY (BULK SSD)	2.52
ABSORPTION, %	3.5
FLAT OR ELONGATED PARTICLES, %	3.2
LA ABRASION, "B" GRADING, 500 CYCLES, % LOSS	18.9
SOUNDNESS, MAGNESIUM SULFATE, 5 CYCLES, % LOSS	
PLUS 1"	(3.0)
1" - 3/4"	3.0
3/4" - 3/8"	10.6
3/8" - #4	25.3
WEIGHTED AVERAGE	13.1

ALBUQUERQUE DISTRICT
 CUCHILLO NEGRO DAM
 AGGREGATE ANALYSIS
 SWDED-GL REPORT NO. 14735

TABLE 3
 RESULTS OF TESTS OF MINUS #4 MATERIAL

SAMPLE NUMBER	C-1846
GRADATION, % PASSING	
#4	100.0
#8	75.3
#16	54.7
#30	36.4
#50	17.8
#100	9.2
#200	5.7
SPECIFIC GRAVITY (BULK SSD)	2.49
ABSORPTION, %	4.3
ORGANIC IMPURITIES	SATISFACTORY
SOUNDNESS, MAGNESIUM SULFATE, 5 CYCLES, % LOSS	
#4 - #8	39.3
#8 - #16	22.0
#16 - #30	14.7
#30 - #50	11.0
MINUS #50	(0.0)
WEIGHTED AVERAGE	19.0

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

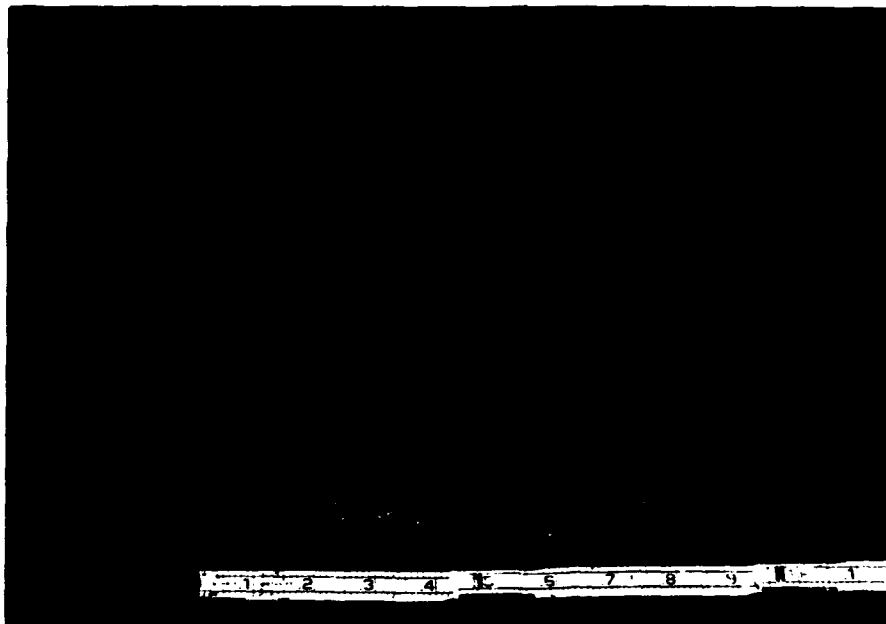
TABLE 4
RESULTS OF TESTS OF RIPRAP

SWD SAMPLE NO.	C-1846	C-1846-A	C-1846-B
SPECIFIC GRAVITY (BULK SSD)	2.70		
ABSORPTION, %	0.4		
LA ABRASION, "1" GRADING, 1000 REVOLUTIONS. % LOSS	35.5		
SOUNDNESS, MAGNESIUM SULFATE, % LOSS 2-1/2" - 1-1/2"	1.4		
SOUNDNESS, FREEZING AND THAWING			
NUMBER OF CYCLES		20	20
NUMBER OF FRAGMENTS*		1	1
% REMAINING*		97.4	95.4

*INCLUDES FRAGMENTS REMAINING AT END OF TEST WEIGHING
MORE THAN 25% OF THE INITIAL DRY WEIGHT.

**SEE SAMPLE C-1530-1 RESULTS

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735



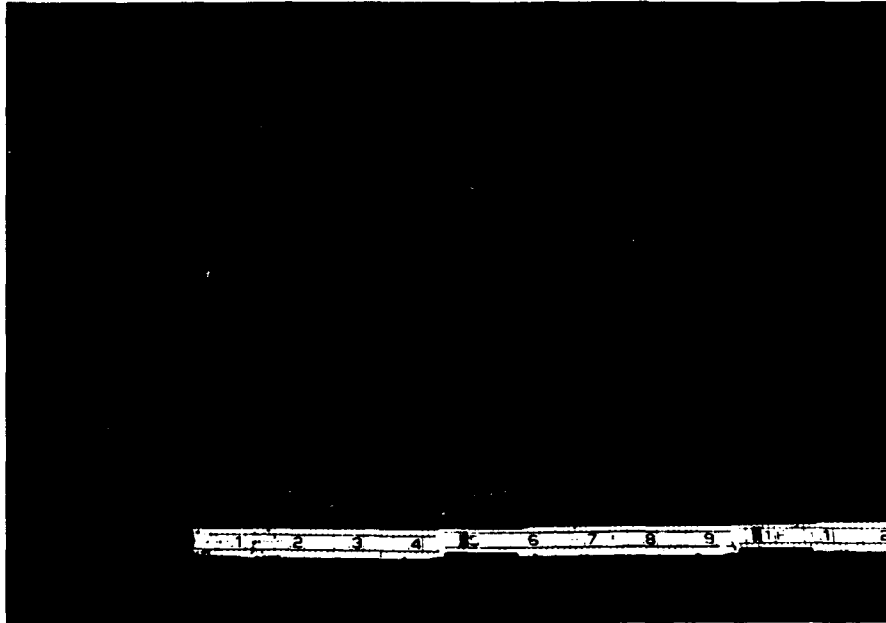
Sample C-1847-A before freezing and thawing.



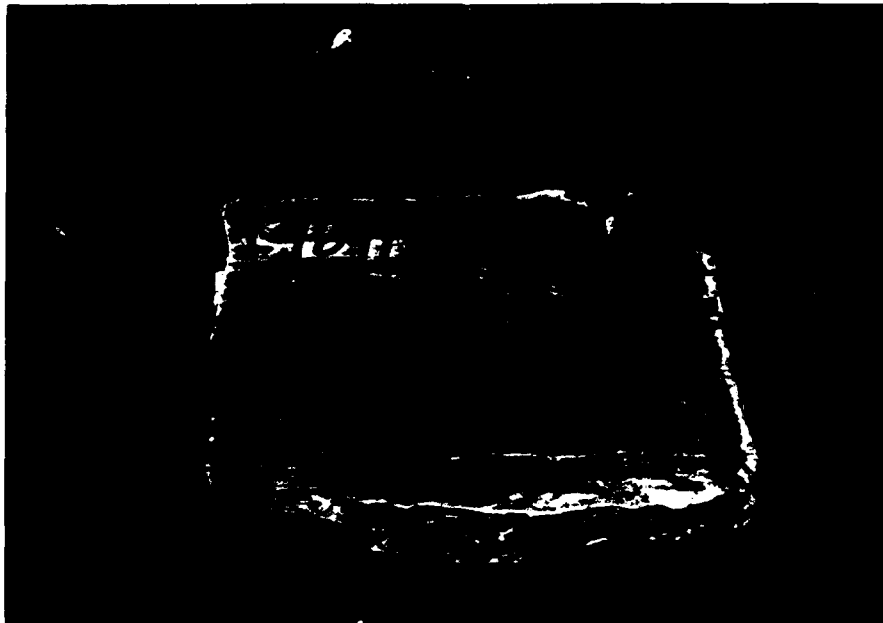
Sample C-1847-A after 20 cycles of freezing and thawing.

PLATE 1

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735



Sample C-1847-B before freezing and thawing.



Sample C-1847-B after 20 cycles of freezing and thawing.

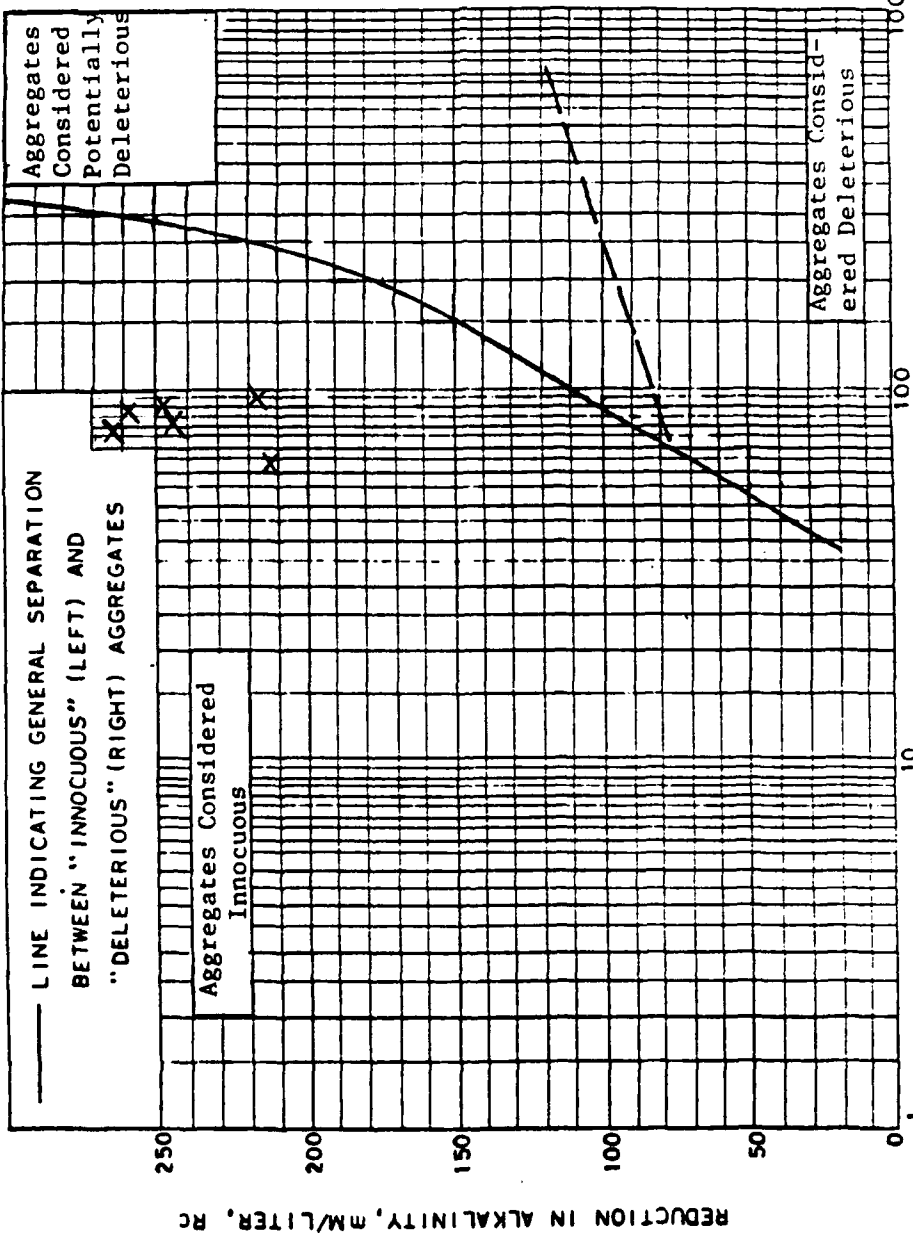
PLATE 2

CORPS OF ENGINEERS, U. S. ARMY, SOUTHWESTERN DIVISION.

PROJECT Cuchillo Negro Dam

METHOD CRD-C 128

LEGEND



DISSOLVED SILICA, mm/LITER, SC

RESULTS OF CHEMICAL TEST FOR REACTIVITY OF AGGREGATE WITH SODIUM HYDROXIDE

DATE: August, 1988

Diamond Core Laboratory Test Results



FOX & ASSOCIATES OF NEW MEXICO, INC.

CONSULTING ENGINEERS AND GEOLOGISTS

ALBUQUERQUE OFFICE 3412 BRYN MAWR DRIVE, NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 884-0900

August 13, 1984

Corps of Engineers
Construction Branch
P. O. Box 1580
Albuquerque, NM 87103

Job No. 434690

Attention: Mr. Don Luna

Subject: Laboratory Test Results for Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Gentlemen:

The results of the laboratory testing on the rock core
for Cuchillo Negro Creek are presented on the attached table.

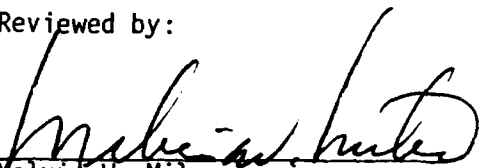
The remaining untested rock core is being held at our office
pending further instructions.

If you have any questions, please contact our office.

FOX & ASSOCIATES OF NEW MEXICO, INC.


Steven L. Brewer
Staff Geologist

Reviewed by:


Melvin W. Miles
Area Manager

Copies: Addressee (2)

jcg

E-151

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Job No.	434690						
Project:	Cuchillo Negro Creek (Item 0002) DACW47-83-D-0023, Delivery Order #DM0007						
Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description	
RCCH-1	20' to 22'	2.391	5.944	25,857	-	limestone, gray, fine-grained	
RCCH-1	58' to 59'	2.392	5.900	21,096	2.60	limestone, gray, fine-grained	
RCCH-1	69½' to 70'	2.392	6.192	6,698	-	shale, gray, limestone nodules	
RCCH-1	71½' to 72'	2.392	5.955	7,188	2.67	shale, gray, limestone nodules	
RCCH-1	74' to 75'	2.393	5.952	12,674	-	shale, gray, calcareous, chert and limestone	
RCCH-1	78½' to 79'	2.393	5.842	9,294	-	limestone with shale partings, gray	
RCCH-1	93'	2.387	6.481	4,626	2.53	shale, brown, calcareous	
RCCH-2	40' to 41'	2.408	6.128	15,173	2.67	limestone, gray, crystalline	
RCCH-2	56' to 57'	2.400	5.715	9,549	2.52	shale, dark gray, calcareous	
RCCH-2	59' to 60'	2.366	5.709	4,253	2.50	limestone, gray, silty	
RCCH-3	31'	2.392	5.970	28,617	2.71	limestone, red-brown, crystalline	
RCCH-3	64' to 65'	2.391	5.960	4,900	-	shale and limestone, gray	

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Job No. 434690

Project: Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM00007

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
RCCH-3	71'	2.398	6.012	13,241	-	limestone, gray, shale partings
RCCH-3	77' to 78'	2.387	6.041	6,749	2.65	shale, brown, calcareous

* Specimens coated with paraffin

**ASTM D 3148-72

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Project: Cuchill Negro Creek, Cuchillo Dam Site

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
CN-CH-1	20' to 22'	2.391	5.944	25,857	-	limestone, gray, fine-grained
CN-CH-1	58' to 59'	2.392	5.900	21,096	2.60	limestone, gray, fine-grained
CN-CH-1	69 1/2' to 70'	2.392	6.192	6,698	-	shale, gray, limestone nodules
CN-CH-1	71 1/2' to 72'	2.392	5.955	7,188	2.67	shale, gray, limestone nodules
CN-CH-1	74' to 75'	2.393	5.952	12,674	-	shale, gray, calcareous chert and limestone
CN-CH-1	78 1/2' to 79'	2.393	5.842	9,294	-	limestone with shale parting gray
CN-CH-1	93'	2.387	6.481	4,626	2.53	shale, brown, calcareous
CN-CH-2	40' to 41'	2.408	6.128	15,173	2.67	limestone, gray, crystalline
CN-CH-2	56' to 57'	2.400	5.715	9,549	2.52	shale, dark gray, calcareous
CN-CH-2	59' to 60'	2.366	5.709	4,253	2.50	limestone, gray silty
CN-CH-3	31'	2.392	5.970	28,617	2.71	Limestone, red-brown, crystalline
CN-CH-3	64' to 65'	2.391	5.960	4,900	-	shale and limestone, gray
CN-CH-3	71'	2.398	6.012	13,241	-	limestone, gray, shale partings
CN-CH-3	77' to 78'	2.387	6.041	6,749	2.65	shale, brown, calcareous

*Specimens coated with paraffin

**ASTM D 3148-72

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Project: Cuchillo Negro Creek, Cuchillo Dam Site

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
CN-CH-9	10.5 - 11	2.401	6.101	19,065	2.62	limestone, fine-grained
CN-CH-9	41.0 - 41.5	2.397	5.873	10,461	2.57	limestone, argillaceous
CN-CH-10	20.5 - 21.0	2.400	5.730	17,468	2.60	limestone, fine-grained
CN-CH-10	36.5 - 37.0	2.393	6.113	9,864	2.55	shale, calcareous
CN-CH-11	14.0 - 14.5	2.407	5.790	18,727	2.61	limestone, fine-grained
CN-CH-11	33.0 - 34.0	2.397	6.130	17,647	2.61	limestone, fine-grained
CN-CH-12	15 - 16	2.403	5.831	14,069	-	limestone, argillaceous
CN-CH-12	33.0 - 33.5	2.399	6.140	9,711	-	shale, calcareous

* Specimens coated with paraffin

**ASTM D 3148-72

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Record#	HOLE	DEPTH	DIA	LEN	PSI	DEN	RK	MOD
1	CN-CH-1	20.0 - 22.0	2.391	5.944	25,857	---	LIMESTONE, FINE GRAINED	--
2	CN-CH-1	58.0 - 59.0	2.392	5.900	21,096	162.7	LIMESTONE, FINE GRAINED	--
3	CN-CH-1	69.5 - 70.0	2.392	6.192	6,698	---	SHALE, WITH LIMESTONE	--
4	CN-CH-1	71.5 - 72.0	2.393	5.955	7,188	167.1	SHALE, WITH LIMESTONE	--
5	CN-CH-1	74.0 - 75.0	2.393	5.952	12,674	---	SHALE, CALCAREOUS	--
6	CN-CH-1	78.5 - 79.0	2.393	5.842	9,294	---	LIMESTONE, SHALE PART.	--
7	CN-CH-1	93.0 - 94.0	2.387	6.481	4,626	158.3	SHALE, CALCAREOUS	--
8	CN-CH-2	40.0 - 41.0	2.408	6.128	15,173	167.1	LIMESTONE	--
9	CN-CH-2	56.0 - 57.0	2.400	5.715	9,549	157.7	SHALE, CALCAREOUS	--
10	CN-CH-2	59.0 - 60.0	2.366	5.709	4,253	156.4	LIMESTONE, ARGILLACEOUS	--
11	CN-CH-3	31.0 - 32.0	2.392	5.970	28,617	169.6	LIMESTONE	--
12	CN-CH-3	64.0 - 65.0	2.391	5.960	4,900	---	SHALE, LIMESTONE	--
13	CN-CH-3	71.0 - 72.0	2.398	6.012	13,241	---	LIMESTONE, SHALEY	--
14	CN-CH-3	77.0 - 78.0	2.387	6.041	6,749	165.8	SHALE, CALCAREOUS	--
15	CN-CH-9	10.5 - 11.0	2.401	6.101	19,065	163.9	LIMESTONE, FINE GRAINED	--
16	CN-CH-9	41.0 - 41.5	2.397	5.873	10,461	160.8	LIMESTONE, ARGILLACEOUS	--
17	CN-CH-10	20.5 - 21.0	2.40	5.730	17,468	162.7	LIMESTONE	--
18	CN-CH-10	36.5 - 37.0	2.393	6.113	9,864	159.5	SHALE, CALCAREOUS	--
19	CN-CH-11	14.0 - 14.5	2.407	5.790	18,727	163.3	LIMESTONE, FINE GRAINED	--
20	CN-CH-11	33.0 - 34.0	2.397	6.130	17,647	163.3	LIMESTONE, FINE GRAINED	--
21	CN-CH-12	15.0 - 16.0	2.403	5.831	14,069	---	LIMESTONE, ARGILLACEOUS	--
22	CN-CH-12	33.0 - 33.5	2.399	6.140	9,711	---	SHALE, CALCAREOUS	--
23	CN-CH-15	33.7-35.0	2.43	5.35	6,998	167.8	LIMESTONE,GRAY,HARD	4.71E+06
24	CN-CH-16	29.7-30.6	2.41	4.96	14,848	173.9	LIMESTONE,DK. GRAY,HARD	2.14E+07
25	CN-CH-16	42.1-43.4	2.43	4.99	16,459	173.4	LIMESTONE,GRAY,HARD	1.51E+07
26	CN-CH-17	30.0-31.0	2.64	4.71	6,587	166.9	LIMESTONE,LT. GRAY,HARD	6.12E+06
27	CN-CH-17	35.1-36.8	2.64	4.63	1,638	158.9	SHALE,BROWN,MOD. SOFT	1.32E+06
28	CN-CH-18	11.4-13.0	2.62	5.01	17,963	174.1	LIMESTONE,LT. GRAY,HARD	9.94E+06
29	CN-CH-18	25.0-26.3	2.62	4.93	19,220	172.6	LIMESTONE,GRAY,HARD	1.09E+07
30	CN-CH-19	32.4-33.9	2.44	4.88	5,553	171.9	LIMESTONE,GRAY,HARD	3.03E+06
31	CN-CH-19	45.6-47.3	2.44	4.80	5,299	172.4	LIMESTONE,GRAY,SL. WEA.	2.84E+06
32	CN-CH-20	7.0-8.4	2.66	4.84	14,025	172.3	LIMESTONE,MED.GRAY,HARD	4.19E+06

CUCHILLO NEGRO DAMSITE
SUMMARY OF UNCONFINED COMPRESSIVE STRE
OF ROCK CORE SAMPLES

HOLE NUMBER	DEPTH (FEET)	CORE DIAMETER (INCHES)	CORE LENGTH (INCHES)	UNCONFINED COMPRESSIVE STRENGTH (PSI)	DENSITY (PCF)	MODUL OF ELAST
CN-CH-1	20.0 - 22.0	2.391	5.944	25,857	---	--
CN-CH-1	58.0 - 59.0	2.392	5.900	21,096	162.7	--
CN-CH-1	69.5 - 70.0	2.392	6.192	6,698	---	--
CN-CH-1	71.5 - 72.0	2.393	5.955	7,188	167.1	--
CN-CH-1	74.0 - 75.0	2.393	5.952	12,674	---	--
CN-CH-1	78.5 - 79.0	2.393	5.842	9,294	---	--
CN-CH-1	93.0 - 94.0	2.387	6.481	4,626	158.3	--
CN-CH-2	40.0 - 41.0	2.408	6.128	15,173	167.1	--
CN-CH-2	56.0 - 57.0	2.400	5.715	9,549	157.7	--
CN-CH-2	59.0 - 60.0	2.366	5.709	4,253	156.4	--
CN-CH-3	31.0 - 32.0	2.392	5.970	28,617	169.6	--
CN-CH-3	64.0 - 65.0	2.391	5.960	4,900	---	--
CN-CH-3	71.0 - 72.0	2.398	6.012	13,241	---	--
CN-CH-3	77.0 - 78.0	2.387	6.041	6,749	165.8	--
CN-CH-9	10.5 - 11.0	2.401	6.101	19,065	163.9	--
CN-CH-9	41.0 - 41.5	2.397	5.873	10,461	160.8	--
CN-CH-10	20.5 - 21.0	2.40	5.730	17,468	162.7	--
CN-CH-10	36.5 - 37.0	2.393	6.113	9,864	159.5	--
CN-CH-11	14.0 - 14.5	2.407	5.790	18,727	163.3	--
CN-CH-11	33.0 - 34.0	2.397	6.130	17,647	163.3	--
CN-CH-12	15.0 - 16.0	2.403	5.831	14,069	---	--
CN-CH-12	33.0 - 33.5	2.399	6.140	9,711	---	--
CN-CH-15	33.7-35.0	2.43	5.35	6,998	167.8	4.71E
CN-CH-16	29.7-30.6	2.41	4.96	14,848	173.9	2.14E

CN-CH-16	42.1-43.4	2.43	4.99	16,459	173.4	1.51E
CN-CH-17	30.0-31.0	2.64	4.71	6,587	166.9	6.12E
CN-CH-17	35.1-36.8	2.64	4.63	1,638	158.9	1.32E
CN-CH-18	11.4-13.0	2.62	5.01	17,963	174.1	9.94E
CN-CH-18	25.0-26.3	2.62	4.93	19,220	172.6	1.09E
CN-CH-19	32.4-33.9	2.44	4.88	5,553	171.9	3.03E
CN-CH-19	45.6-47.3	2.44	4.80	5,299	172.4	2.84E
CN-CH-20	7.0-8.4	2.66	4.84	14,025	172.3	4.19E
CN-CH-21	7.8-8.5	2.60	4.28	12,068	165.2	4.32E
CN-CH-21	46.5-47.5	2.43	3.57	2,879	162.4	1.84E
CN-CH-21	74.5-75.4	2.40	4.63	3,267	167.6	3.11E
CN-CH-22	52.1-53.2	2.36	4.67	1,147	162.8	1.60E

Borehole Camera Surveys

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14683 (32 pages)

PROJECT: CUCHILLO NEGRO DAM SITE : Contract No.
Feature: VIDEO INVESTIGATIONS OF SELECTED :
BOREHOLES :

TEST REQUEST NO.: E8680027 : From: Chief
Dated: 18 March 1988 : Geotechnical Branch
Received: 25 March 1988 : Albuquerque District

Identification:

BOREHOLES 1, 3, 15, 16, 17, 18 AND 20.

Dates: 23 through 25 March 1988

REMARKS:

SEE ATTACHED PAGES.

Report sent to: : Copy furnished:
Albuquerque District :
:

Date: : Name and title: : Signature
09 May 88 : WILLIAM R. TANNER :
: Director :
: SWD Laboratory : 

LETTER REPORT FOR THE
ALBUQUERQUE DISTRICT
VIDEO CAMERA INVESTIGATION
VIDEO-EL REPORT NO. 14683

1. REFERENCE: Reference is made to Albuquerque District test request EB6880027, dated 18 March 1988, requesting video camera investigations of selected borinos. The photography was performed during the week of 21 March 1988.

2. REPORT: Attached are the results of the findings of this field investigation.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera. 0-5' - no casing - boring broken and enlarged from casing removal.
9.3	11.1		0.2500	Open	No Dip Direction Noted.
15.8	16.7		0.2500	Open	No Dip Direction Noted.
17.7	17.8	180.0	0.2500	Open	
35.2	36.0	180.0	0.0625	Healed	Light mineral filling.
37.4	37.9		0.0625	Healed	No Dip Direction Noted. Light mineral filling.
37.9	37.9				Top of cavity - rock missing - boring enlarged.
39.4	39.4				Bottom of cavity.
43.4	44.2		0.0313	Healed	No Dip Direction Noted. Light mineral filling.
44.2	45.3		0.2500	Open	No Dip Direction Noted.
45.5	46.9	240.0	0.0625	Healed	Light mineral filling.
48.0	48.9		0.0625	Healed	No Dip Direction Noted. Light mineral filling.
54.2	55.3	240.0	0.0625	Healed	
55.2	55.7	10.0	0.1250	Open	
57.5	57.5				Top of vertical fracture. tight, rock broken out by drilling action.
59.9	59.9				Bottom of vertical fracture.
64.9	64.9				Horizontal fracture, open, boring enlarged, cavity noted.
65.4	65.4				Bottom of cavity.
72.8	73.5	10.0	0.0313	Healed	Light mineral filling.
77.6	78.1	10.0	0.0625	Healed	Light mineral filling.
80.4	80.4				Top of cavity.
82.6	82.6				Bottom of cavity.
86.6	87.5		0.3500	Healed	No Dip Direction Noted. Light mineral filling.
89.4	89.9	315.0	0.0313	Healed	Light mineral filling.
89.6	90.5	330.0	0.0313	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : (unclassified) Hegre Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (inches)	Joint Type	Remarks
-----	-----	-----	-----	-----	-----
91.6	91.6				End of videotaping, casing in boring.

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera. 0-5' - no casing - boring broken and enlarged from casing removal. No Dip Direction Noted. No Dip Direction Noted.
10.2		82.1	0.0342	Open	
16.7		74.6	0.0665	Open	
17.8	180.0	21.9	0.2319	Open	
35.6	180.0	72.8	0.0185	Healed	Light mineral filling.
37.7		63.6	0.0278	Healed	No Dip Direction Noted. Light mineral filling.
37.9					Top of cavity rock missing - boring enlarged - Bottom of cavity.
39.4		72.8	0.0093	Healed	No Dip Direction Noted.
43.6					Light mineral filling.
44.8		77.3	0.0551	Open	No Dip Direction Noted.
46.2	240.0	79.9	0.0109	Healed	Light mineral filling.
48.5		74.6	0.0166	Healed	No Dip Direction Noted. Light mineral filling.
54.8	240.0	77.3	0.0138	Healed	
55.5	10.0	63.6	0.0556	Open	
57.5					Top of vertical fracture. tight, rock broken out by drilling action.
58.9					Bottom of vertical fracture.
64.9					Horizontal fracture, open, boring enlarged, cavity noted, Bottom of cavity.
65.4					Light mineral filling.
73.2	10.0	70.5	0.0105	Healed	Light mineral filling.
77.8	10.0	63.6	0.0278	Healed	Top of cavity.
80.4					Bottom of cavity.
82.6					No Dip Direction Noted.
87.1		74.6	0.0931	Healed	Light mineral filling.
89.7	315.0	63.6	0.0139	Healed	Light mineral filling.
90.1	330.0	74.6	0.0083	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
91.6					End of videotaping, casing in boring.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera.
4.0	4.0				Bottom of casing.
6.1	6.1				Water influx along horizontal healed fracture.
9.4	9.4		0.2500	Open	No Dip Direction Noted. Horizontal and partially open. Rock broken along fracture plane.
17.1	17.3	120.0	0.2500	Open	Partially open, rock broken along fracture plane.
18.0	18.2	280.0	0.2500	Open	Partially open, rock broken along fracture plane.
19.7	19.8	330.0	0.7500	Open	Rock broken out along fracture plane.
27.0	27.1		0.1250	Healed	No Dip Direction Noted.
27.2	27.2		0.0000	Tight	No Dip Direction Noted. Horizontal and hairline.
28.3	28.4		0.0300	Open	No Dip Direction Noted.
28.3	29.5	90.0	0.1300	Open	Broken out by drilling action.
32.0	32.1		0.0000	Tight	No Dip Direction Noted. Hairline.
35.6	35.9		0.0000	Tight	No Dip Direction Noted. Hairline.
35.9	36.2	240.0	0.1700	Open	
36.3	36.3				Top of cavity, rock broken away from boring wall, boring enlarged.
37.3	37.3				Bottom of cavity.
49.9	49.9				Healed, horizontal fracture.
52.3	52.3				Top of slightly broken zone, boring slightly enlarged.
54.0	54.0				Bottom of slightly broken zone.
56.6	56.6				Top of broken zone, rock broken away from boring wall, boring enlarged.
64.0	64.0				Bottom of broken zone.
65.4	65.4				Water level.
66.7	67.3		0.1300	Open	No Dip Direction Noted.
68.5	68.7	10.0	0.0010	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Luchillo North Line
Drill Hole Name : 3
Drill Hole Size : 1 1/2"
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
71.4	71.4				Top of fracture zone, rock slightly broken, casing wall intact, no enlargement.
75.4	75.8		0.1900	healed	No Dip Direction noted. Filled with rock debris, recemented with white material.
76.6	76.9		0.4000	healed	No Dip Direction Noted. Filled with mottled material.
77.1	77.1				Bottom of fracture zone, end of videotape.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
4.0					Most of boring logged from side wall viewing camera.
6.1					Bottom of casing.
9.4		0.0	0.2500	Open	Water influx along horizontal healed fracture.
17.5	120.0	70.5	0.0836	Open	No Dip Direction Noted. Horizontal and partially open. Rock broken along fracture plane.
18.1	280.0	38.8	0.1947	Open	Partially open, rock broken along fracture plane.
19.8	330.0	21.9	0.6957	Open	Partially open, rock broken along fracture plane.
27.0		16.8	0.1197	Healed	Rock broken out along fracture plane.
27.2		0.0	0.0000	Tight	No Dip Direction Noted.
28.3		16.8	0.0287	Open	No Dip Direction Noted.
28.9	90.0	78.3	0.0263	Open	Horizontal and hairline.
32.0		16.8	0.0000	Tight	No Dip Direction Noted.
35.8		16.8	0.0000	Tight	Broken out by drilling action.
36.0	240.0	50.4	0.1084	Open	No Dip Direction Noted.
36.3					Hairline.
37.3					No Dip Direction Noted.
49.9					Healed, horizontal fracture.
52.3					Top of slightly broken zone, boring slightly enlarged.
54.0					Bottom of slightly broken zone.
56.6					Top of broken zone, rock broken away from boring wall, boring enlarged.
64.0					Bottom of broken zone.
65.4					Water level.
67.0		67.5	0.0497	Open	No Dip Direction Noted.
68.6	10.0	38.8	0.0008	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
71.4					Top of fracture zone, rock slightly broken, boring wall intact, no enlargement.
75.6		58.2	0.1002	Healed	No Dip Direction Noted. Filled with rock debris, recemented with white material.
76.8		50.4	0.2551	Healed	No Dip Direction Noted. Filled with mottled material.
77.1					Bottom of fracture zone, end of videotape.

BOREHOLE ANALYSIS Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
31.8	31.8				Start videotape.
31.9	32.0	270.0	0.1250	Healed	Light mineral filling.
33.7	33.9	60.0	0.1250	Open	Partly filled with dark min.
34.0	34.5	260.0	0.0010	Healed	Hairline with light mineral filling.
38.3	38.5	60.0	0.2500	Healed	Light mineral filling.
39.1	40.0	225.0	0.1250	Healed	Light mineral filling.
41.7	42.5	260.0	0.0010	Healed	Hairline with light mineral filling.
47.6	48.3	270.0	0.0010	Healed	Hairline with light mineral filling.
47.8	47.8	0.0	0.0010	Healed	Hairline with light mineral filling.
49.4	50.3	260.0	0.0010	Healed	Hairline with light mineral filling.
55.3	56.0	220.0	0.0625	Open	Partly filled with lt min.
57.2	58.2	270.0	0.0010	Healed	Hairline with light mineral filling.
58.0	58.6	270.0	0.0010	Healed	Hairline with light mineral filling.
62.9	63.8	260.0	0.0625	Healed	Light mineral filling.
64.3	64.6	270.0	0.0625	Healed	Light mineral filling.
64.9	65.7	250.0	0.1250	Open	Partly filled with lt min.
65.4	65.4				Water level
65.8	66.0	45.0	0.1250	Open	Partly filled with lt min.
66.3	66.5	45.0	0.1250	Healed	Light mineral filling.
69.5	69.7	60.0	0.0020	Healed	Hairline with light mineral filling.
70.1	71.0	260.0	0.3750	Open	Partly filled with lt min.
70.7	71.8	260.0	0.1250	Healed	Light mineral filling.
76.0	76.0				Fracture zone, numerous fractures 1/16 inch wide.
77.0	77.0				Bottom of fracture zone.
77.6	79.0	225.0	0.0010	Healed	Hairline with light mineral filling.
77.8	78.0	60.0	0.0010	Open	Hairline.
78.2	78.3	60.0	0.0010	Healed	Hairline with light mineral filling.
78.3	78.5	60.0	0.0010	Healed	Complex and hairline with light mineral filling.
78.6	78.8	60.0	0.0010	Healed	Hairline with light mineral filling.
78.9	79.1	60.0	0.0010	Healed	Hairline with light mineral filling.
79.2	79.6	60.0	0.0010	Healed	Hairline with light mineral filling.
79.4	79.4	0.0	0.0010	Healed	Horizontal and hairline with light mineral filling.
79.5	79.8	60.0	0.0010	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchilla Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
80.0	80.0				End of videotapeing.

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
31.8					Start videotape.
32.0	270.0	17.6	0.1191	Healed	Light mineral filling.
33.8	60.0	32.4	0.1055	Open	Partly filled with dark min.
34.3	260.0	57.8	0.0005	Healed	Hairline with light mineral filling.
36.4	60.0	32.4	0.2111	Healed	Light mineral filling.
39.5	225.0	70.7	0.0413	Healed	Light mineral filling.
42.1	260.0	68.5	0.0004	Healed	Hairline with light mineral filling.
48.0	270.0	65.8	0.0004	Healed	Hairline with light mineral filling.
47.8	0.0	0.0	0.0010	Healed	Hairline with light mineral filling.
49.8	260.0	70.7	0.0003	Healed	Hairline with light mineral filling.
55.7	220.0	65.8	0.0257	Open	Partly filled with lt min.
57.7	270.0	72.5	0.0003	Healed	Hairline with light mineral filling.
58.3	270.0	62.3	0.0005	Healed	Hairline with light mineral filling.
63.3	260.0	70.7	0.0207	Healed	Light mineral filling.
64.4	270.0	43.6	0.0453	Healed	Light mineral filling.
65.3	250.0	58.5	0.0458	Open	Partly filled with lt min.
65.4					water level
65.9	45.0	32.4	0.1055	Open	Partly filled with lt min.
66.4	45.0	32.4	0.1055	Healed	Light mineral filling.
66.6	60.0	32.4	0.0017	Healed	Hairline with light mineral filling.
70.6	260.0	70.7	0.1239	Open	Partly filled with lt min.
71.3	260.0	74.0	0.0344	Healed	Light mineral filling.
76.0					Fracture zone, numerous fractures 1/16 inch wide.
77.0					Bottom of fracture zone.
78.3	225.0	77.3	0.0002	Healed	Hairline with light mineral filling.
77.9	60.0	32.4	0.0008	Open	Hairline.
78.3	60.0	17.6	0.0010	Healed	Hairline with light mineral filling.
78.4	60.0	32.4	0.0008	Healed	Complex and hairline with light mineral filling.
78.7	60.0	32.4	0.0008	Healed	Hairline with light mineral filling.
79.0	60.0	32.4	0.0008	Healed	Hairline with light mineral filling.
79.4	60.0	51.8	0.0006	Healed	Hairline with light mineral filling.
79.4	0.0	0.0	0.0010	Healed	Horizontal and hairline with light mineral filling.
79.7	60.0	43.6	0.0007	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
80.0					End of videotaping.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 16
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
30.8	30.8				Start videotape.
31.0	31.0				Bottom of casing.
34.2	34.2				Cavity, rock broken back. Boring enlarged.
34.4	34.4				Bottom of cavity.
36.2	37.1	225.0	0.0010	Healed	Hairline with light mineral filling.
44.0	44.2	210.0	0.0010	Healed	Hairline with light mineral filling.
45.7	46.5	240.0	0.2500	Open	Partly filled with lt min.
50.5	51.3	225.0	0.0010	Healed	Hairline with light mineral filling.
57.9	58.1	45.0	0.0010	Healed	Hairline with dark mineral filling.
59.7	60.0	45.0	0.0020	Healed	Hairline with dark mineral filling.
60.7	61.3	270.0	0.0010	Healed	Hairline with dark mineral filling.
62.8	63.7	260.0	0.0010	Healed	Hairline with dark mineral filling.
75.3	77.2	225.0	0.0020	Healed	Hairline with light mineral filling.
78.8	79.5	225.0	0.1250	Healed	Dark Mineral filling.
84.1	94.9	225.0	0.1250	Open	Partly filled with lt min.
105.0	105.3	60.0	0.0020	Healed	Hairline with light mineral filling.
106.5	106.5				Water level.
106.6	106.7	15.0	0.0010	Healed	Hairline with light mineral filling.
106.7	106.8	15.0	0.0010	Healed	Hairline with light mineral filling.
106.9	108.1	225.0	0.7500	Healed	Light mineral filling.
109.4	109.5	60.0	0.0010	Healed	Hairline with light mineral filling.
109.6	111.5	180.0	0.0010	Healed	Hairline with light mineral filling.
112.0	112.0				Top of fracture zone, fractures range from hairline to 1/8 inch wide, dip direction 150 degrees, angle of 60.
117.3	117.3				Bottom of fracture zone.
117.9	117.9				End of videotaping.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Hydro Dam
 Drill Hole Name : 16
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
30.8					Start videotape.
31.0					Bottom of casing.
34.2					Cavity, rock broken back, boring enlarged.
34.4					Bottom of cavity.
36.7	125.0	70.7	0.0003	Healed	Hairline with light mineral filling.
44.1	210.0	32.4	0.0008	Healed	Hairline with light mineral filling.
46.1	140.0	68.5	0.0916	Open	Partly filled with lt. min.
50.9	225.0	68.5	0.0004	Healed	Hairline with light mineral filling.
58.0	45.0	32.4	0.0008	Healed	Hairline with dark mineral filling.
59.8	45.0	43.0	0.0014	Healed	Hairline with dark mineral filling.
61.0	270.0	62.3	0.0005	Healed	Hairline with dark mineral filling.
63.3	260.0	70.7	0.0005	Healed	Hairline with dark mineral filling.
76.8	125.0	70.7	0.0007	Healed	Hairline with light mineral filling.
78.2	225.0	65.6	0.0513	Healed	Dark Mineral filling.
84.5	125.0	69.5	0.0459	Open	Partly filled with lt. min.
103.2	60.0	40.6	0.0014	Healed	Hairline with light mineral filling.
105.5					Water level.
106.7	15.0	17.0	0.0010	Healed	Hairline with light mineral filling.
108.8	15.0	17.0	0.0010	Healed	Hairline with light mineral filling.
109.5	225.0	75.3	0.1905	Healed	Light mineral filling.
109.4	60.0	17.6	0.0010	Healed	Hairline with light mineral filling.
110.3	180.0	82.8	0.0001	Healed	Hairline with light mineral filling.
112.0					Top of fracture zone, fractures range from hairline to 1/8 inch wide, dip direction 150 degrees, angle of 60.
117.3					Bottom of fracture zone.
117.9					End of videotaping.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 17
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
19.1	19.1				Begin videotape.
22.2	22.2				Bottom of casing.
35.9	37.3	60.0	0.2000	Open	Surrounding rock slightly broken.
37.2	37.4	90.0	0.2500	Open	North side of boring wall broken out
38.4	38.6	90.0	0.0010	Healed	Tight
39.5	39.5				Top of broken area, north side of boring broken out, probably due to drilling action.
40.8	40.8				Bottom of broken area.
42.2	43.2				Top of rough and slightly broken area.
44.0	44.0				Bottom of rough and slightly broken area.
48.9	49.1	0.0	0.0010	Healed	Tight.
49.3	50.3	270.0	0.0010	Healed	Tight.
54.3	54.8	270.0	0.0625	Open	Partially filled, rock broken along fracture plane.
55.1	55.2	90.0	0.0010	Tight	Hairline.
55.2	56.9	90.0	0.0010	Tight	Hairline.
55.5	56.4	210.0	0.1250	Open	Partially healed to open, 1/4 inch healed to 1/4 inch open.
57.9	58.9	10.0	0.0010	Healed	Light mineral filling.
61.4	62.4	80.0	0.0625	Healed	Light mineral filling.
64.8	64.8				Water level.
64.1	65.4	290.0	0.0625	Healed	Light mineral filling.
64.3	66.0	300.0	0.0625	Healed	Light mineral filling.
65.6	65.9	45.0	0.0625	Healed	Light mineral filling.
67.6	67.7	45.0	0.0625	Healed	Light mineral filling.
67.9	68.1	0.0	0.0625	Healed	Light mineral filling.

**BOREHOLE ANALYSIS
Output Data**

Project Name : Cushman Meadows Dam
 Drill Hole Name : 10
 Drill Hole Size : 480
 Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
19.1					Begin videotape.
22.2					Bottom of casing.
36.6	60.0	77.3	0.0439	Open	Surrounding rock slightly broken.
37.3	90.0	31.4	0.2111	Open	North side of boring wall broken out
38.5	90.0	31.4	0.0008	Healed	Tight
39.5					Top of broken area, north side of boring broken out, probably due to drilling action.
40.8					Bottom of broken area.
43.2					Top of rough and slightly broken area.
44.0					Bottom of rough and slightly broken area.
49.0	0.0	32.4	0.0008	Healed	Tight.
49.8	270.0	72.5	0.0003	Healed	Tight.
54.5	270.0	57.8	0.0333	Open	Partially filled, rock broken along fracture plane.
55.2	90.0	17.6	0.0010	Tight	Hairline.
56.0	90.0	79.5	0.0002	Tight	Hairline.
57.0	210.0	83.8	0.0135	Open	Partially healed to open. 1/4 inch healed to 1/4 inch open.
58.4	10.0	72.5	0.0003	Healed	Light mineral filling.
61.9	80.0	72.5	0.0188	Healed	Light mineral filling.
64.6					Water level.
64.8	290.0	76.4	0.0147	Healed	Light mineral filling.
65.2	300.0	79.5	0.0114	Healed	Light mineral filling.
65.8	45.0	17.6	0.0596	Healed	Light mineral filling.
67.7	45.0	17.6	0.0596	Healed	Light mineral filling.
68.0	0.0	32.4	0.0528	Healed	Light mineral filling.

**BOREHOLE ANALYSIS
Input Data**

Project Name : Cuchilla Negro Dam
Drill Hole Name : 18
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
14.0	14.4	315.0	1.5000	Open	Broken back from hole wall.
16.2	16.3	60.0	1.1250	Open	Broken back from hole wall.
19.9	19.9				Top of broken zone.
24.3	24.3				Bottom of broken zone.
27.1	27.3	90.0	0.0010	Healed	Light mineral filling.
27.7	27.9	0.0	2.0000	Open	Broken back from hole wall.
27.9	27.0	270.0	0.1500	Open	Partly filled with lt min.
35.0	35.0				Top of broken zone.
38.1	38.1				Bottom of broken zone, appears con.
40.6	41.4	135.0	0.0010	Healed	Light mineral filling.
41.9	41.9	195.0	0.0010	Healed	Light mineral filling.
40.8	42.8	330.0	0.0010	Healed	Light mineral filling.
43.3	44.3	270.0	0.0010	Healed	Light mineral filling.
44.1	44.8	170.0	0.0010	Healed	Light mineral filling, discontinuous.
46.4	46.5	45.0	0.7500	Healed	Light mineral filling, irregular.
46.4	47.0	200.0	0.0625	Healed	Light mineral filling, discontinuous.
53.3	53.4	45.0	1.0000	Healed	Broken, brecciated zone.
53.6	53.9	40.0	0.0010	Healed	Light mineral filling.
54.1	54.1				Vertical fracture, irregular, discontinuous, 1/4 inch to 1 inch wide, healed with light mineral filling.
55.8	55.8	0.0	0.0010	Healed	Zone of about 5 horizontal fractures with light mineral filling, irregular.
59.9	60.1	75.0	1.5000	Healed	Light mineral filling.
62.3	62.6	50.0	0.0010	Healed	Light mineral filling.
62.5	62.5				Water level.
62.8	63.2	240.0	0.0010	Healed	Light mineral filling.
63.2	63.5	270.0	0.0010	Healed	Complex fracture with light mineral filling.
64.7	64.9	45.0	0.0010	Healed	Light mineral filling.
65.7	66.1	270.0	0.0010	Healed	Light mineral filling.
69.0	69.0				Hairline, tight, vertical fracture noted, discontinuous, exact orientation unavailable.
69.2	70.3	180.0	1.0000	Healed	Light mineral filling.
70.1	70.9	270.0	0.0010	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : LUGN-17-140000-000
Drill Hole Name : 18
Drill Hole Size : 40
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
73.3	73.3	0.0	0.0010	Healed	Horizontal with light mineral filling.
74.6	75.1	270.0	0.0010	Healed	Light mineral filling.
75.2	75.3	30.0	0.0300	Open	
75.5	75.8	30.0	0.0010	Healed	Light mineral filling.
75.8	76.0	30.0	0.0010	Healed	Light mineral filling.
77.9	78.1	30.0	0.0300	Healed	Light mineral filling.
78.3	78.3	270.0	0.2500	Healed	Light mineral filling.
79.8	80.3	30.0	0.0010	Healed	Light mineral filling.
87.4	87.8	150.0	0.0010	Healed	Light mineral filling.
92.9	92.9				Broken zone, rock broken away from boring wall, appears rough.
94.0	94.0				Bottom of broken zone.
94.1	94.1	0.0	0.5000	Open	Horizontal, 1/4 to 1/2 inch wide.
100.7	102.0	160.0	0.0300	Open	Partly filled with light and dark mineral filling.
101.2	102.0	0.0	0.0010	Open	Horizontal, partly filled with dark min.
103.5	103.5				End videotape.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 18
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
14.2	315.0	51.8	0.9283	Open	Broken back from hole wall.
16.3	60.0	17.6	1.0723	Open	Broken back from hole wall.
19.9					Top of broken zone.
24.3					Bottom of broken zone.
27.2	90.0	32.4	0.0008	Healed	Light mineral filling.
27.8	0.0	32.4	1.6987	Open	Broken back from hole wall.
28.5	270.0	74.0	0.0413	Open	Partly filled with it min.
35.0					Top of broken zone.
38.1					Bottom of broken zone. appears open.
41.1	135.0	62.3	0.0005	Healed	Light mineral filling.
41.4	195.0	72.5	0.0003	Healed	Light mineral filling.
41.8	330.0	81.0	0.0002	Healed	Light mineral filling.
43.8	270.0	72.5	0.0003	Healed	Light mineral filling.
44.5	170.0	65.8	0.0004	Healed	Light mineral filling. discontinuous.
46.5	45.0	17.6	0.7149	Healed	Light mineral filling. irregular.
46.7	200.0	62.3	0.0291	Healed	Light mineral filling. discontinuous.
53.3	45.0	17.6	0.9532	Healed	Broken, preexisting zone.
53.8	40.0	43.6	0.0007	Healed	Light mineral filling.
54.1					Vertical fracture. irregular, discontinuous, 1/4 inch to 1 inch wide, healed with light mineral filling.
55.8	0.0	0.0	0.0010	Healed	Zone of about 5 horizontal fractures with light mineral filling, irregular.
60.0	75.0	32.4	1.2665	Healed	Light mineral filling.
62.5	50.0	43.6	0.0007	Healed	Light mineral filling.
62.5					water level.
63.0	240.0	51.8	0.0006	Healed	Light mineral filling.
63.3	270.0	43.6	0.0007	Healed	Complex fracture with light mineral filling.
64.8	45.0	32.4	0.0008	Healed	Light mineral filling.
65.9	270.0	51.8	0.0006	Healed	Light mineral filling.
69.0					Hairline, tight, vertical fracture noted, discontinuous, exact orientation unavailable.
69.8	180.0	74.0	0.2754	Healed	Light mineral filling.
70.5	270.0	68.5	0.0004	Healed	Light mineral filling.

**BOREHOLE ANALYSIS
Output Data**

Project Name : Cuchillo Negro Dam
 Drill Hole Name : 18
 Drill Hole Size : 110
 Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (inches)	Joint Type	Remarks
73.3	0.0	0.0	0.0010	Healed	Horizontal with light mineral filling.
74.8	270.0	57.8	0.0005	Healed	Light mineral filling.
75.3	30.0	17.6	0.0286	Open	
75.6	30.0	57.8	0.0005	Healed	Light mineral filling.
75.9	30.0	32.4	0.0008	Healed	Light mineral filling.
78.0	30.0	32.4	0.0253	Healed	Light mineral filling.
78.8	270.0	72.5	0.0751	Healed	Light mineral filling.
80.1	60.0	57.8	0.0005	Healed	Light mineral filling.
85.6	150.0	85.9	0.0001	Healed	Light mineral filling.
92.9					Broken zone, rock broken back from boring wall, appears rough.
94.0					Bottom of broken zone.
94.1	0.0	0.0	0.5000	Open	Horizontal, 1/4 to 1/2 inch wide.
101.3	180.0	76.4	0.0071	Open	Partly filled with light and dark mineral filling.
102.3	0.0	0.0	0.0010	Open	Horizontal, partly filled with dark min.
109.5					End videotape.

BOREHOLE ANALYSIS Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					Boring logged with front view camera, no orientations available.
0.0	0.0				Begin videotape, top of casing.
29.6	29.8				Bottom of casing, top of highly broken zone, boring enlarged.
31.5	31.8		0.0010	Healed	Filled with light mineral, two fractures intersect at right angles. 45 degrees to borehole.
52.2	52.2				Bottom of highly broken zone.
52.3	52.3				Top of broken zone.
52.7	52.7				Bottom of broken zone.
53.4	53.4		0.5000	Open	Horizontal, rock broken along fracture plane.
53.6	53.7		0.1250	Healed	Light mineral filling.
53.7	53.7		0.5000	Open	Horizontal, rock broken along fracture plane.
53.8	53.9		0.1250	Healed	Light mineral filling.
53.9	54.3		0.5000	Open	Rock broken along fracture plane.
54.3	54.5		0.2500	Open	Partly filled with lt min.
54.5	54.5				Top of highly broken zone, boring enlarged.
56.6	56.6				Bottom of broken zone.
57.0	57.0				Top of highly broken zone, boring enlarged.
60.7	60.7				Bottom of broken zone.
61.0	61.0				Top of slightly broken zone, boring enlarged.
61.4	61.4				Bottom of slightly broken zone.
61.7	61.7				Top of moderately broken zone, boring enlarged.
62.1	62.3		0.0010	Healed	Dark Mineral filling.
62.6	62.6				Top of highly broken zone, boring greatly enlarged.
66.6	66.6				Bottom of highly broken zone.
66.5	66.6		0.1250	Healed	Light mineral filling.
66.7	66.8		0.1250	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Luchillo Negro Dam
Drill Hole Name : 20
Drill Hole Size : 40
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent width (Inches)	Joint Type	Remarks
67.9	67.9				Top of highly broken zone, boring enlarged.
68.9	69.2		0.0010	Healed	Dark Mineral filling.
69.3	69.5		0.0010	Healed	Dark Mineral filling.
70.1	70.1				Bottom of highly broken zone.
71.6	71.6				Top of highly broken zone, boring enlarged.
71.8	72.7		0.0010	Closed	Tight.
72.7	72.8		0.0010	Closed	Tight.
77.8	77.8				Bottom of highly broken zone.
80.4	80.4				Top of highly broken zone, boring enlarged.
81.0	81.0				Bottom of highly broken zone.
82.2	82.2				Top of broken zone - boring enlarged.
85.0	85.0				Water cloudy, unable to see.
87.1	87.1				End videotape.

**BOREHOLE ANALYSIS
Output Data**

Project Name : Cuchillo Negro Dam
 Drill Hole Name : 20
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
0.0					Boring logged with front view camera, no orientations available.
29.8					Begin videotape, top of casing.
					Bottom of casing, top of highly broken zone, boring enlarged.
31.6		43.6	0.0007	Healed	Filled with light mineral, two fractures intersect at right angles. 45 degrees to borehole.
52.2					Bottom of highly broken zone.
52.3					Top of broken zone.
52.7					Bottom of broken zone.
53.4		0.0	0.5000	Open	Horizontal, rock broken along fracture plane.
53.7		17.6	0.1191	Healed	Light mineral filling.
53.7		0.0	0.5000	Open	Horizontal, rock broken along fracture plane.
53.8		17.6	0.1191	Healed	Light mineral filling.
54.1		51.8	0.3094	Open	Rock broken along fracture plane.
54.4		32.4	0.2111	Open	Partly filled with lt min.
54.5					Top of highly broken zone, boring enlarged.
56.6					Bottom of broken zone.
57.0					Top of highly broken zone, boring enlarged.
60.7					Bottom of broken zone.
61.0					Top of slightly broken zone, boring enlarged.
61.4					Bottom of slightly broken zone.
61.7					Top of moderately broken zone, boring enlarged.
62.2		32.4	0.0008	Healed	Dark Mineral filling.
62.6					Top of highly broken zone, boring greatly enlarged.
66.6					Bottom of highly broken zone.
66.6		17.6	0.1191	Healed	Light mineral filling.
66.8		17.6	0.1191	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

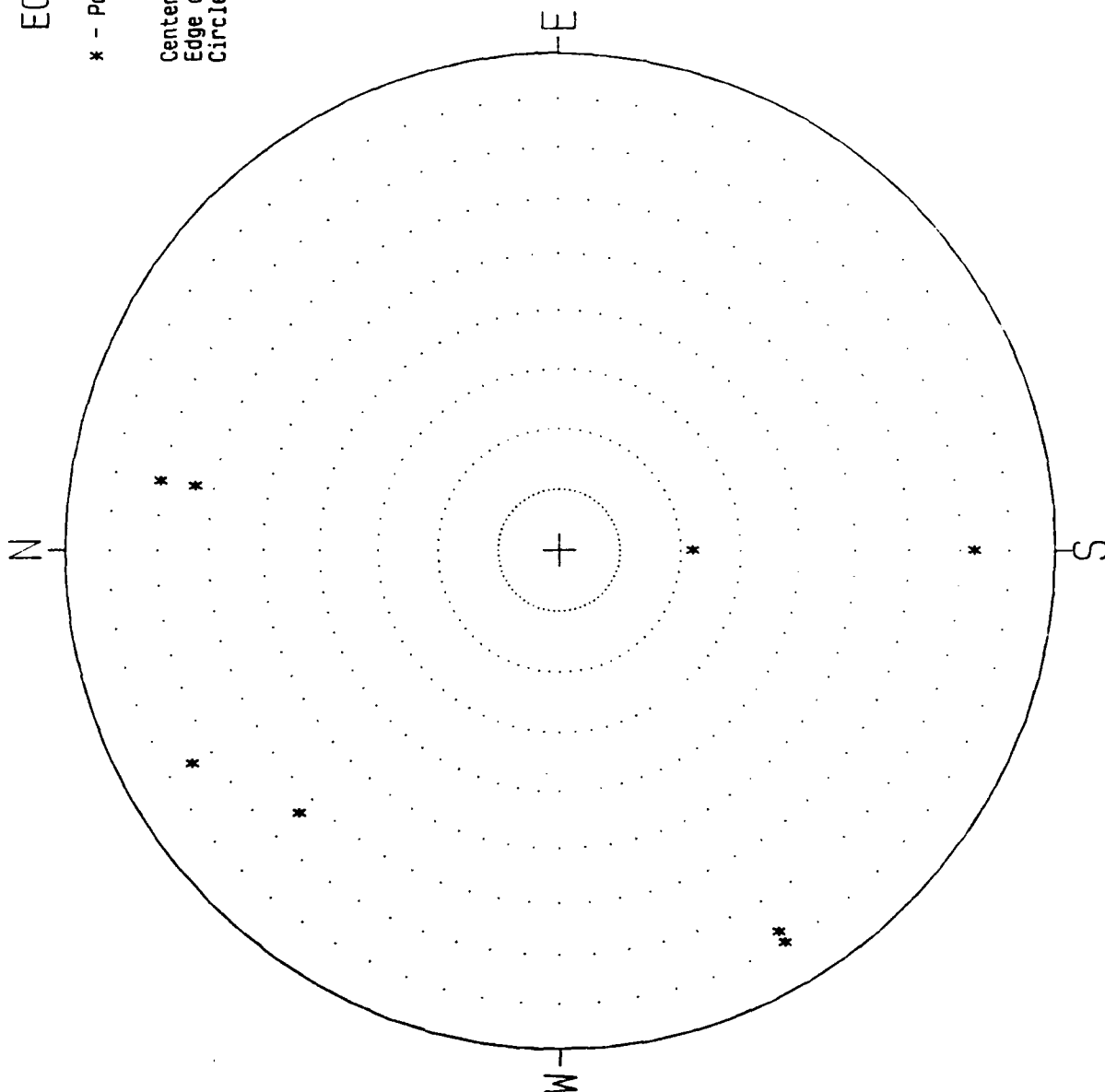
Project Name : Cuchilla Negra Van
Drill Hole Name : 20
Drill Hole Size : HE
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (inches)	Joint Type	Remarks
67.9					Top of highly broken zone, boring enlarged.
68.1		43.6	0.0007	Healed	Dark Mineral filling.
69.4		32.4	0.0008	Healed	Dark Mineral filling.
70.1					Bottom of highly broken zone.
71.6					Top of highly broken zone, boring enlarged.
72.1		57.8	0.0005	Closed	Tight.
72.4		47.6	0.0007	Closed	Tight.
77.8					Bottom of highly broken zone.
80.4					Top of highly broken zone, boring enlarged.
81.0					Bottom of highly broken zone.
81.6					Top of broken zone - boring enlarged.
85.0					Water cloudy, unable to see.
87.1					End videotape.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : 1 Hole Size : NX

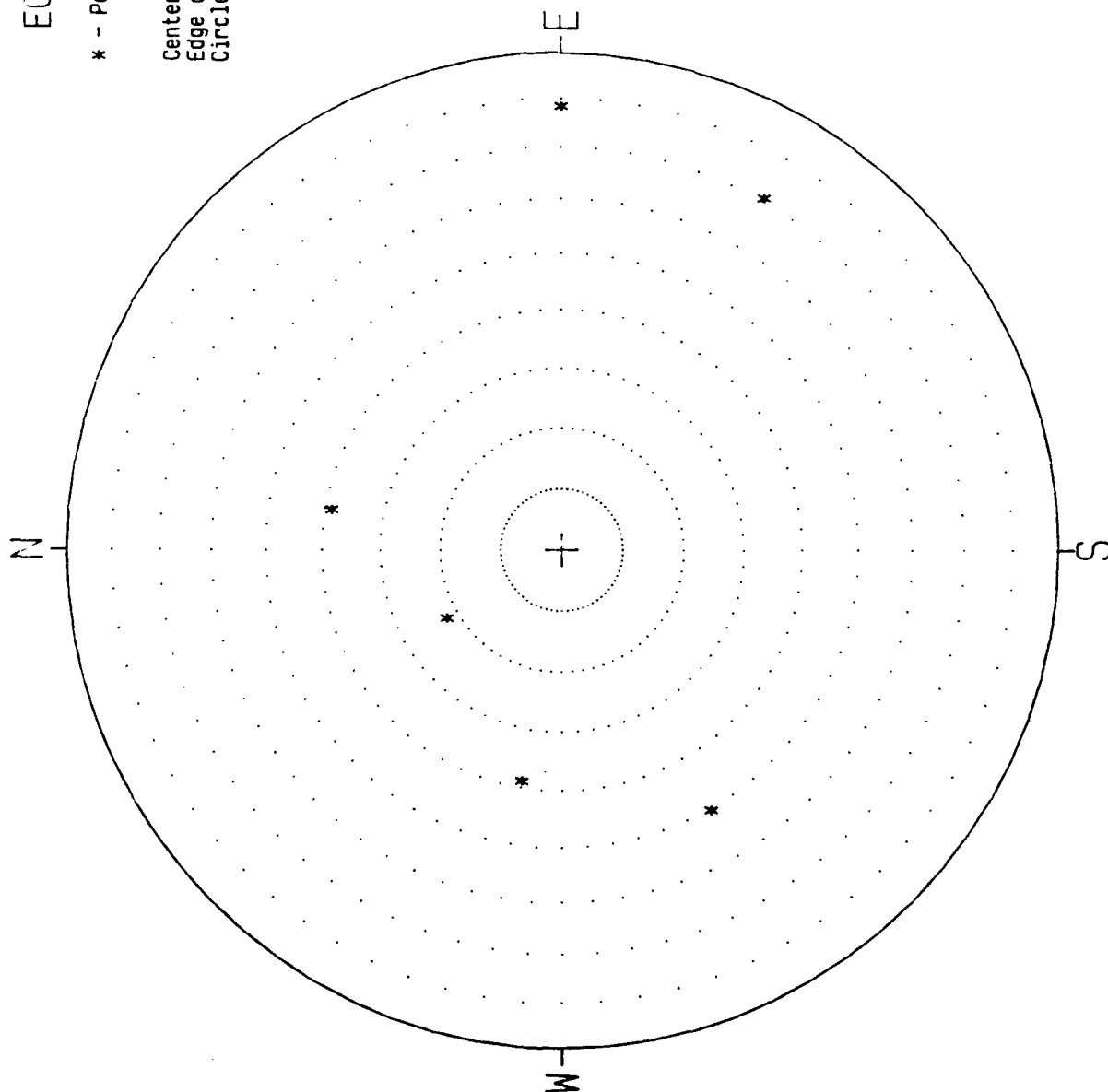
Orientation : Vertical

Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

- * - Pole representing dip direction and dip of planar features.
- Center of plot equals 0 degrees dip
- Edge of plot equals 90 degrees dip
- Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : 3 Hole Size : NX

Orientation : Vertical

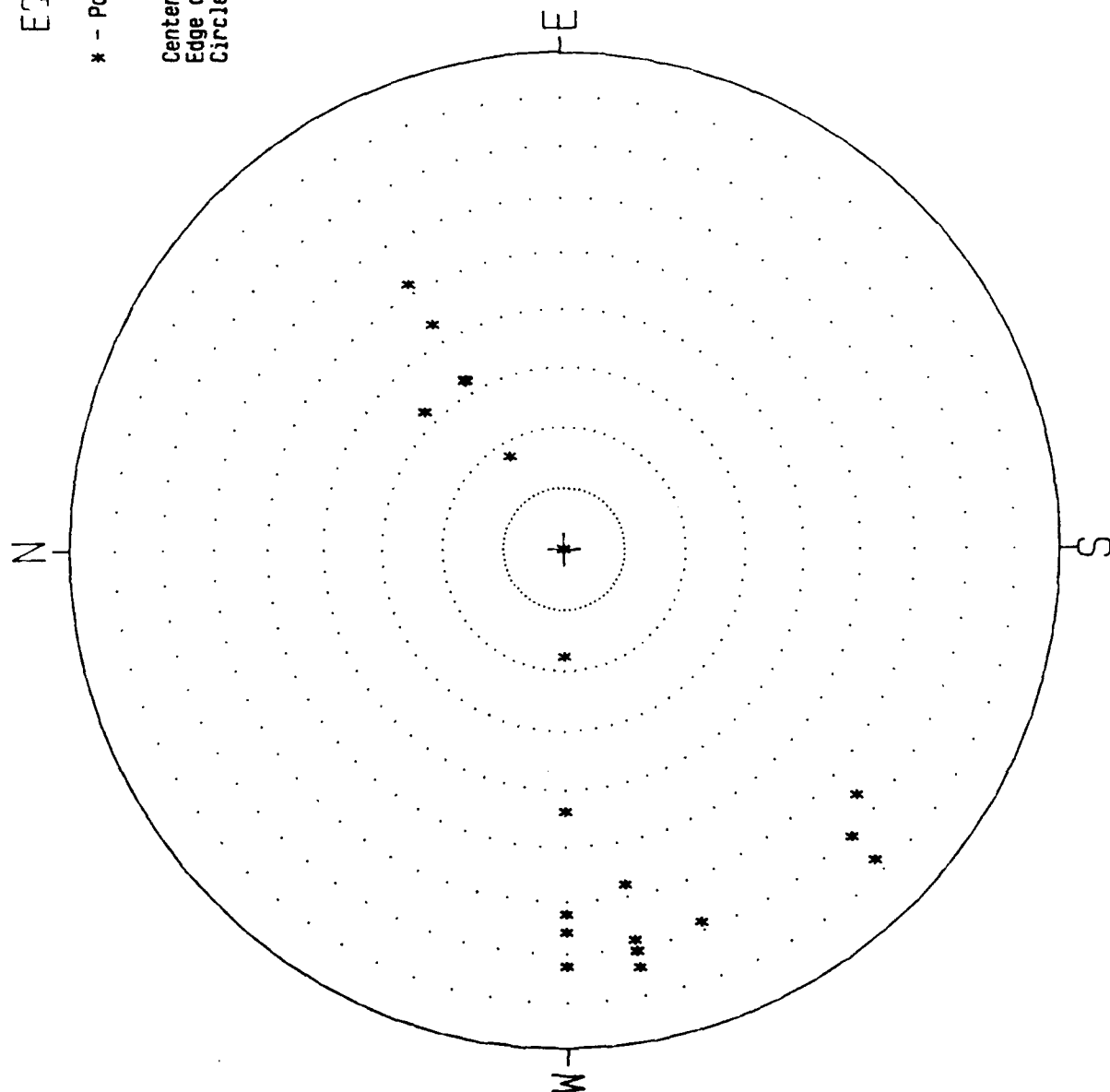
Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : 15 Hole Size : HQ

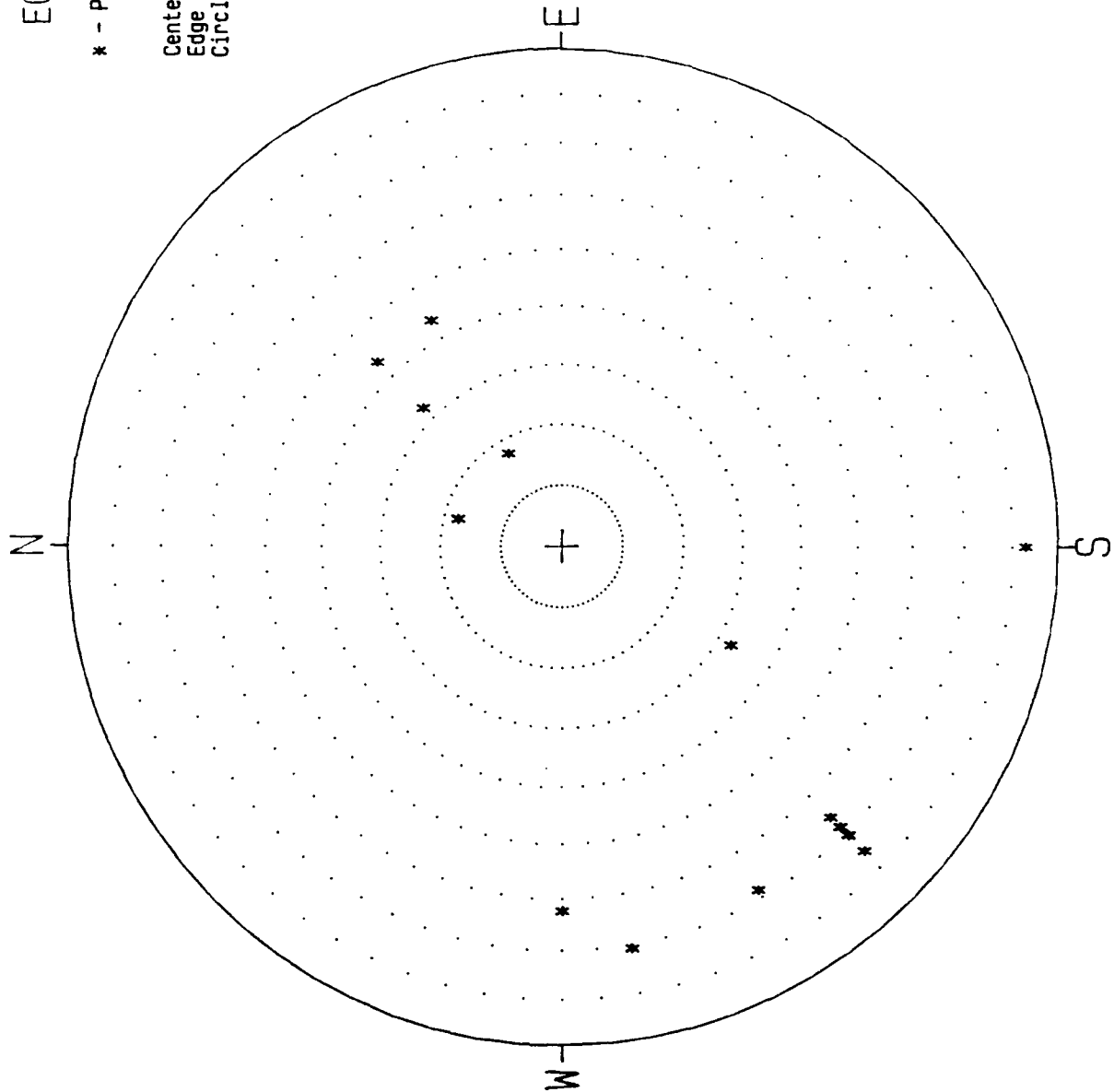
Orientation : Vertical

Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLCT

- * - Pole representing dip direction and dip of planar features.
- Center of plot equals 0 degrees dip
- Edge of plot equals 90 degrees dip
- Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : 16 Hole Size : HQ

Orientation : Vertical

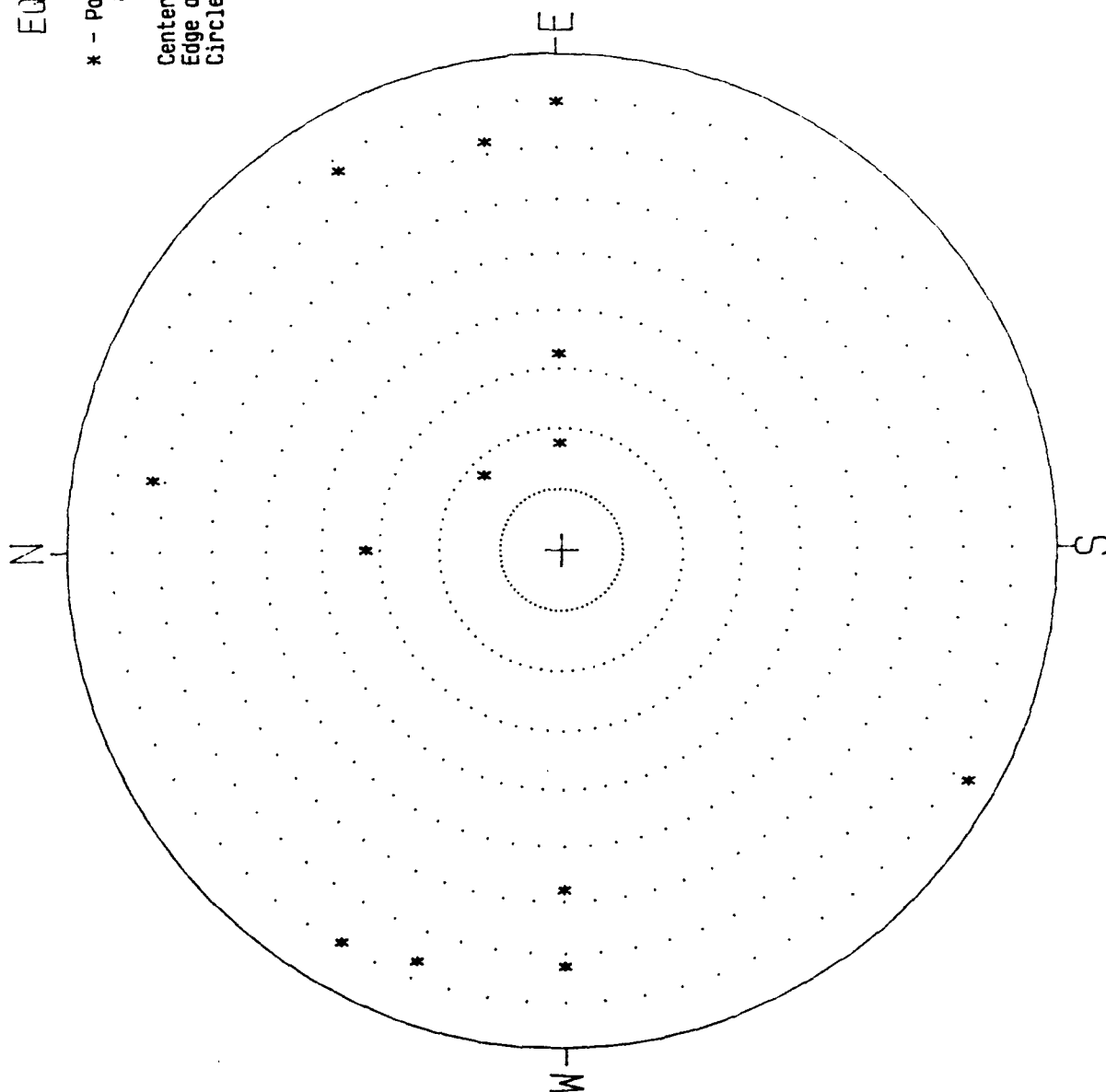
Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : 17 Hole Size : HQ

Orientation : Vertical

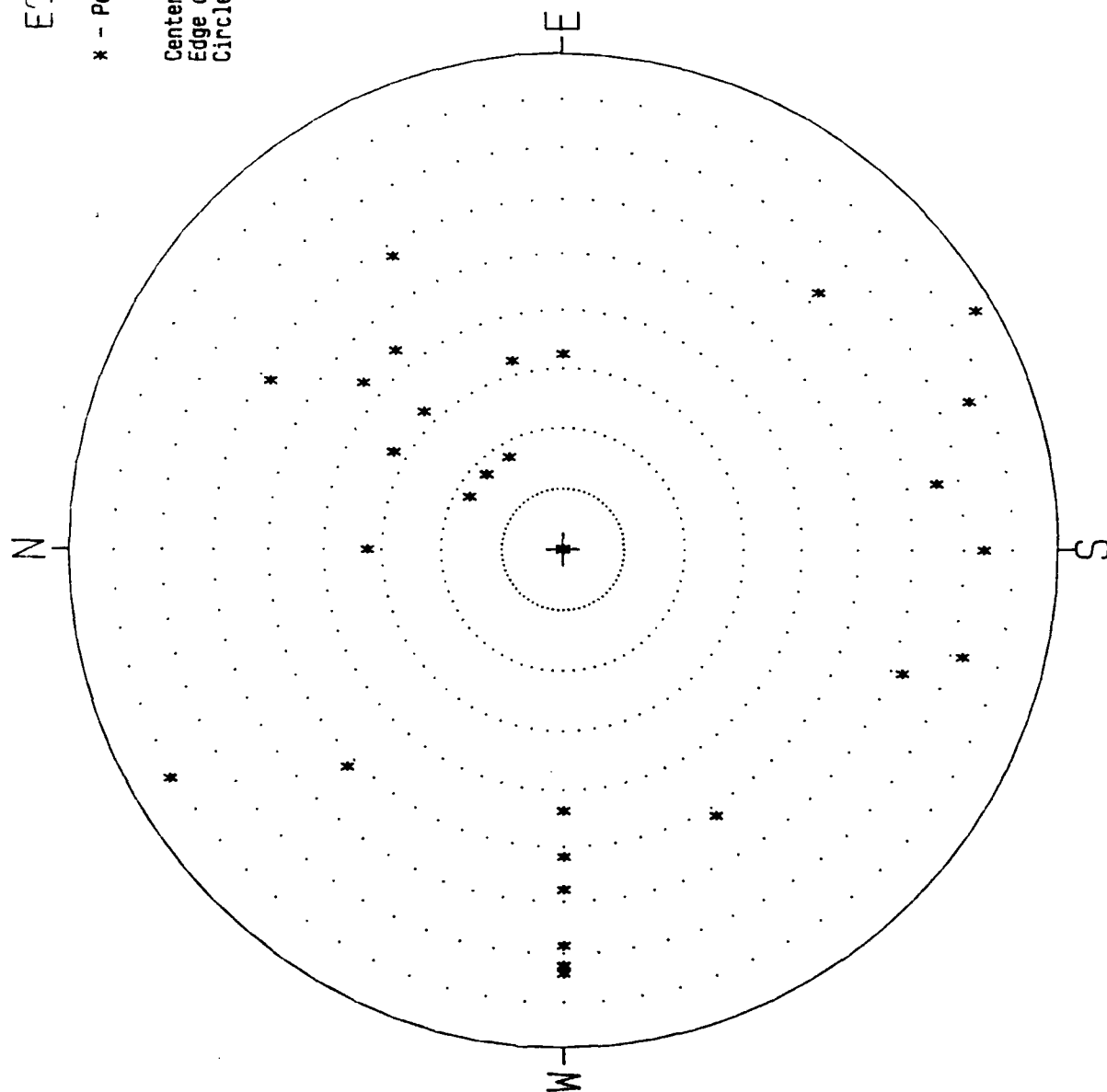
Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : 18 Hole Size : HQ

Orientation : Vertical

Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14683-1 (6 pages)

PROJECT: CUCHILLO NEGRO DAM SITE : Contract No.
Feature: VIDEO INVESTIGATIONS OF SELECTED :
BOREHOLES :

TEST REQUEST NO.: E8680027 : From: Chief
Dated: 18 March 1988 : Geotechnical Branch
Received: 25 March 1988 : Albuquerque District

Identification:

BOREHOLE 9.

Dates: 14 June 1988

REMARKS:

SEE ATTACHED PAGES.

Report sent to: : Copy furnished:
Albuquerque District :
:

Date: : Name and title: : Signature
: WILLIAM R. TANNER :
: Director :
: SWD Laboratory : 

BOREHOLE ANALYSIS Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
3.0	3.0				Bottom of overburden.
5.0	5.5	80	0.1250	Open	Fracture on one side of hole only.
14.0	15.3	180	0.2500	Open	Appears open, may be broken by drilling action.
18.4	19.0	0	0.0625	Open	Opens into cavity below.
19.0	19.0				Top of cavity. Goes beyond camera range.
20.0	20.0				Bottom of cavity.
22.7	22.9	90	0.0625	Healed	Light mineral filling.
23.3	23.3	0	0.0625	Open	
23.8	24.7	0	0.0625	Open	Appears broken by drilling action.
24.7	26.0	270	0.2500	Open	Appears broken by drilling action.
26.3	27.1	270	0.2500	Open	
27.1	27.6	10	4.0000	Open	Fracture very wide. Bottom goes beyond limits of camera lights.
34.2	34.5	40	0.0413	Healed	Light mineral filling.
35.3	36.1	180	0.2500	Open	Filled with light mineral.
37.3	38.5	270	0.7500	Open	Partly filled with lt min.
39.5	39.5	0	2.0000	Open	Broken zone about 2 inches deep.
40.7	41.9	270	0.0050	Closed	Partly filled with lt min.
43.6	43.9	45	0.0050	Healed	Light mineral filling.
43.9	44.0	45	0.0050	Healed	Light mineral filling.
44.6	45.1	45	0.0050	Tight	
45.6	45.7	70	0.0050	Tight	
46.0	46.3	15	0.0625	Tight	
46.7	46.9	0	0.0050	Open	
46.8	47.1	0	0.0050	Tight	
50.6	50.9	80	3.0000	Open	
53.3	53.5	135	0.0625	Open	
56.6	56.7	135	0.0625	Open	Partially filled with lt. mineral, fracture is irregular.
56.6	56.8	135	0.0625	Open	Fracture is vuggy. Partially open.
58.0	58.3	60	0.0050	Healed	Light mineral filling.
58.7	58.7	0	0.0625	Open	Horizontal.
58.7	59.1	0	0.0625	Open	Merges with above fracture.
59.4	59.8	135	0.0625	Open	

BOREHOLE ANALYSIS

Input Data

Project Name : Cuchillo Negro Dam
 Drill Hole Name : CND9
 Drill Hole Size : NX
 Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
59.8	60.2	135	0.0625	Open	Same as above.
61.1	61.2	225	0.1250	Healed	Light mineral filling.
62.9	62.9				Top of broken zone.
63.2	63.2				Bottom of broken zone.
70.2	70.3	45	0.0625	Open	
73.6	74.3	180	0.2500	Open	
74.4	75.0	315	0.0625	Open	Irregular dip.
75.1	75.4	180	0.6250	Open	Partly filled with lt min.
76.0	76.1	45	0.2500	Open	Rock broken along fracture plane.
76.2	76.2				Top of broken zone.
76.8	76.8				Bottom of broken zone.
79.3	79.8	315	0.0312	Open	
80.4	80.9	45	0.5000	Open	
83.0	83.3	45	0.5000	Open	
83.4	83.4				Fracture zone: numerous hairline fractures with random strike and dip. Irregular and open.
87.6	87.6				Bottom of above zone.
87.6	87.9	30	2.0000	Open	Filled with broken material.
91.7	92.1	315	1.5000	Open	Filled with broken material.
92.3	92.7	60	0.0625	Open	
93.3	93.5	300	0.0625	Open	
100.0	100.9	315	0.0050	Open	Partially open and healed. Vertical. Fracture enters and exits from same side of hole.
101.3	101.4	90	0.0050	Open	Partially open and healed.
102.1	102.4	315	0.1250	Open	Discontinuous.
105.0	105.0				End of videotaping.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
3.0					Bottom of overburden.
5.3	80	64	0.0556	Open	Fracture on one side of hole only.
14.6	180	79	0.0469	Open	Appears open, may be broken by drilling action.
18.7	0	68	0.0239	Open	Opens into cavity below.
19.0					Top of cavity. Goes beyond camera range.
20.0					Bottom of cavity.
22.8	90	39	0.0487	Healed	Light mineral filling.
23.3	0	0	0.0625	Open	
24.3	0	75	0.0166	Open	Appears broken by drilling action.
25.5	270	81	0.0383	Open	Appears broken by drilling action.
26.7	270	73	0.0741	Open	
27.4	10	64	1.7793	Open	Fracture very wide. Bottom goes beyond limits of camera lights.
34.3	40	50	0.0263	Healed	Light mineral filling.
35.7	180	73	0.0741	Open	Filled with light mineral.
37.9	270	78	0.1520	Open	Partly filled with lt min.
39.5	0	0	2.0000	Open	Broken zone about 2 inches deep.
41.3	270	78	0.0010	Closed	Partly filled with lt min.
43.8	45	50	0.0032	Healed	Light mineral filling.
44.0	45	22	0.0046	Healed	Light mineral filling.
44.8	45	64	0.0022	Tight	
45.7	70	22	0.0046	Tight	
46.2	15	50	0.0399	Tight	
46.8	0	39	0.0039	Open	
47.0	0	50	0.0032	Tight	
50.8	80	50	1.9130	Open	
53.4	135	39	0.0487	Open	
56.7	135	22	0.0580	Open	Partially filled with lt. mineral, fracture is irregular.
56.7	135	39	0.0487	Open	Fracture is vuggy. Partially open.
58.2	60	50	0.0032	Healed	Light mineral filling.
58.7	0	0	0.0625	Open	Horizontal.
58.9	0	58	0.0330	Open	Merges with above fracture.
59.6	135	58	0.0330	Open	

BOREHOLE ANALYSIS
Output Data

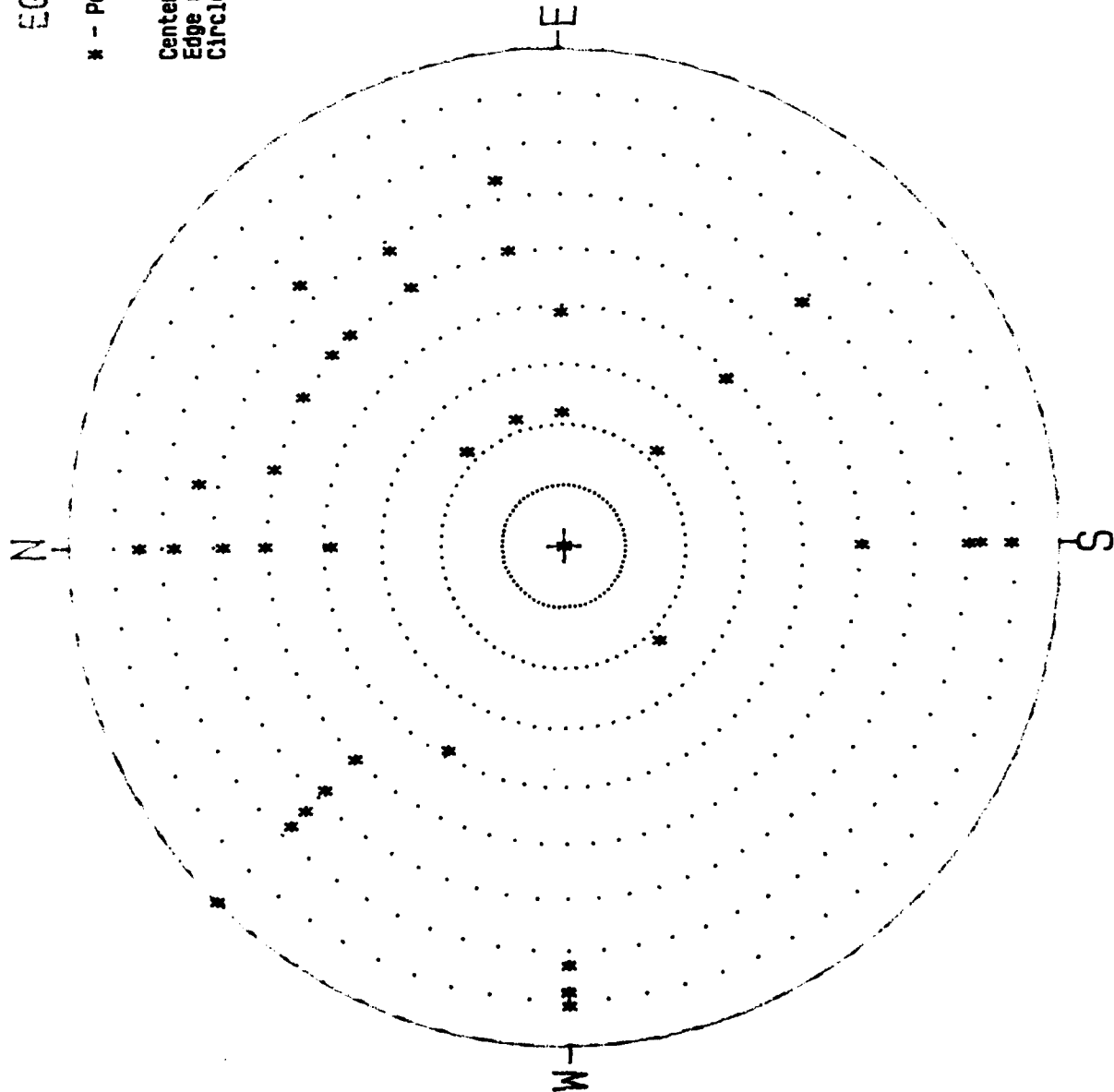
Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
60.0	135	58	0.0330	Open	Same as above.
61.2	225	22	0.1160	Healed	Light mineral filling.
62.9					Top of broken zone.
63.2					Bottom of broken zone.
70.3	45	22	0.0580	Open	
73.9	180	70	0.0836	Open	
74.7	315	68	0.0239	Open	Irregular dip.
75.3	180	50	0.3985	Open	Partly filled with lt min.
76.1	45	22	0.2319	Open	Rock broken along fracture plane.
76.2					Top of broken zone.
76.8					Bottom of broken zone.
79.6	315	64	0.0139	Open	
80.7	45	64	0.2224	Open	
83.2	45	50	0.3188	Open	
83.4					Fracture zone: numerous hairline frac- tures with random strike and dip. Irreg- ular and open.
87.6					Bottom of above zone.
87.8	30	50	1.2753	Open	Filled with broken material.
91.9	315	58	0.7912	Open	Filled with broken material.
92.5	60	58	0.0330	Open	
93.4	300	39	0.0487	Open	
100.4	315	90	0.0013	Open	Partially open and healed. Vertical. Fracture enters and exits from same side of hole.
101.3	90	22	0.0046	Open	Partially open and healed.
102.3	315	50	0.0797	Open	Discontinuous.
105.0					End of videotaping.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam

Drill Hole : CND9 Hole Size : NX

Orientation : Vertical

Direction : 0 Made : 0

Photographed and Interpreted by the
Southwest Division Lab



DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
BUILDING 602, CITY-COUNTY AIRPORT
WALLA WALLA, WASHINGTON 99362

REPLY TO
ATTENTION OF:

CENPWEN-GB (1110-2-1906a)

25 March 1988

MEMORANDUM FOR: Commander, U.S. Army Corps of Engineers, Albuquerque District,
ATTN: CESPK-G (Mr. Jim MacAdoo), Post Office Box 1580, Albuquerque, New Mexico
87103-1580

SUBJECT: Results of Borehole Photography, Cuchillo Damsite

1. Enclosed are the results of borehole photography performed on three drill holes located at the Cuchillo Damsite.
2. Results of interpretation include fracture orientation and equal area polar plots of joints for each drill hole. A composite plot representing all drill holes is also included.
3. Included with the report are the video tapes of the borehole photography. This completes the requested work on this project.
4. If you have any questions or need future assistance, please call Mr. John Roadifer, telephone No. 509-522-6776.

FOR THE COMMANDER:

Encl


MARVIN G. BRAMMER, P.E.
Chief, Engineering Division

Cuchillo Damsite, New Mexico
Borehole Photography

Prepared for

Albuquerque District
U.S. Army Corps of Engineers

By

Walla Walla District
U.S. Army Corps of Engineers

March 1988

CUCHILLO DAMSITE, NEW MEXICO
BOREHOLE PHOTOGRAPHY

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B. Authorization	1
II. Site Description	1
III. Borehole Photography	1
IV. Evaluation	1
V. Conclusions	2

APPENDIXES

A. Borehole Photography Plots for Drill Holes

CUCHILLO DAMSITE, NEW MEXICO
BOREHOLE PHOTOGRAPHY

I. PURPOSE AND AUTHORIZATION

A. Purpose.

The purpose of this study was to determine the orientations and apertures of the joints and fractures at the proposed Cuchillo Damsite. The results of the borehole photography are to be used to aid in the design of the proposed dam.

B. Authorization.

The borehole photography work was authorized by the Albuquerque District, U.S. Army Corps of Engineers.

II. SITE DESCRIPTION

Cuchillo damsite is located approximately 130 miles south southwest of Albuquerque, New Mexico. The general geology of the site is carbonate rocks that dip in a north-easterly direction at 20 to 30 degrees. A plan view of the site is shown in Plate 1. The names of the drill holes used for the photography appear under the actual drill hole designations in parenthesis.

III. BOREHOLE PHOTOGRAPHY

The borehole photography was performed during the week of 28 September 1988. Photography of six drill holes was attempted with three of those drill holes being successfully photographed. The photography was accomplished in all of the drill holes by using the high resolution video camera for direct downhole views of the walls and oriented video logs were obtained with the video camera in combination with a conical mirror and compass. No water was encountered in any of the drill holes. The following are the drill holes that were photographed:

<u>Drill Hole</u>	<u>Attitude</u>	<u>Direction</u>	<u># Degrees from Vertical</u>
CN-CH-1	Vertical	-	-
CN-CH-9	Vertical	-	-
CN-CH-11	Vertical	-	-

IV. EVALUATION

The video logs were analyzed and the results of the interpretation are shown in Appendix A. Each drill hole is represented by the following:

- table of output data
- equal area polar plot showing joint poles and bedding

features

- contour plot of percent poles per 1% area
- fracture frequency plots of all fractures and open fractures
- aperture distribution plot

Following the drill hole results there are a group of plots representing the composite of all of the drill holes. These plots include the following:

- equal area polar plot of all joint poles
- equal area polar plot of the poles of only the open fractures
- equal area polar plot of the bedding features
- equal area polar plot of the percent of joint poles present in each 1% counting circle used.

The plots indicate that there are two joint sets at the site. The orientations of the two joint sets are:

	<u>Dip Direction</u>	<u>Dip</u>
Set 1	270 +/- 25 degrees	70 +/- 10 degrees
Set 2	60 +/- 30 degrees	25 +/- 15 degrees

Joint set 2 is the same as the bedding direction and therefore it is possible that a number of the joints that lie in that set are actually bedding features that have been interpreted as joints. The outcrops at the project site appear to display two very steep nearly perpendicular joint sets that are themselves nearly perpendicular to the bedding orientation. The results of the photography do not clearly reflect this. There are a scattering of steep joints present throughout the three holes that could be part of the second steep joint set. These joints all have orientations that are generally dipping to the south at about 70 degrees. Since the holes are all vertical it is possible that not enough joints were intersected to effectively show this joint set.

The fracture frequency and aperture distribution plots should be used as information only type data. The fracture frequency plot can be utilized to see what the fracture spacing in the ground looks like and the aperture plot provides some information on the tightness of the rock to groundwater movement through open fractures. As can be seen on the fracture frequency plots for the open fractures the rock at the Cuchillo Damsite is generally widely spaced and in the ground RQD measurements would be very close to 100%. The aperture distribution plots indicate that the rock is very tight with most of the fractures having openings of .01 to .03 inches. This combined by the relatively wide spacing of the open fractures should combine to produce low hydraulic conductivity values. It is important to remember that the fracture frequency plots are only indicative of the vertical direction and that the fracture spacing could be much closer in a direction normal to the orientation of the joint sets.

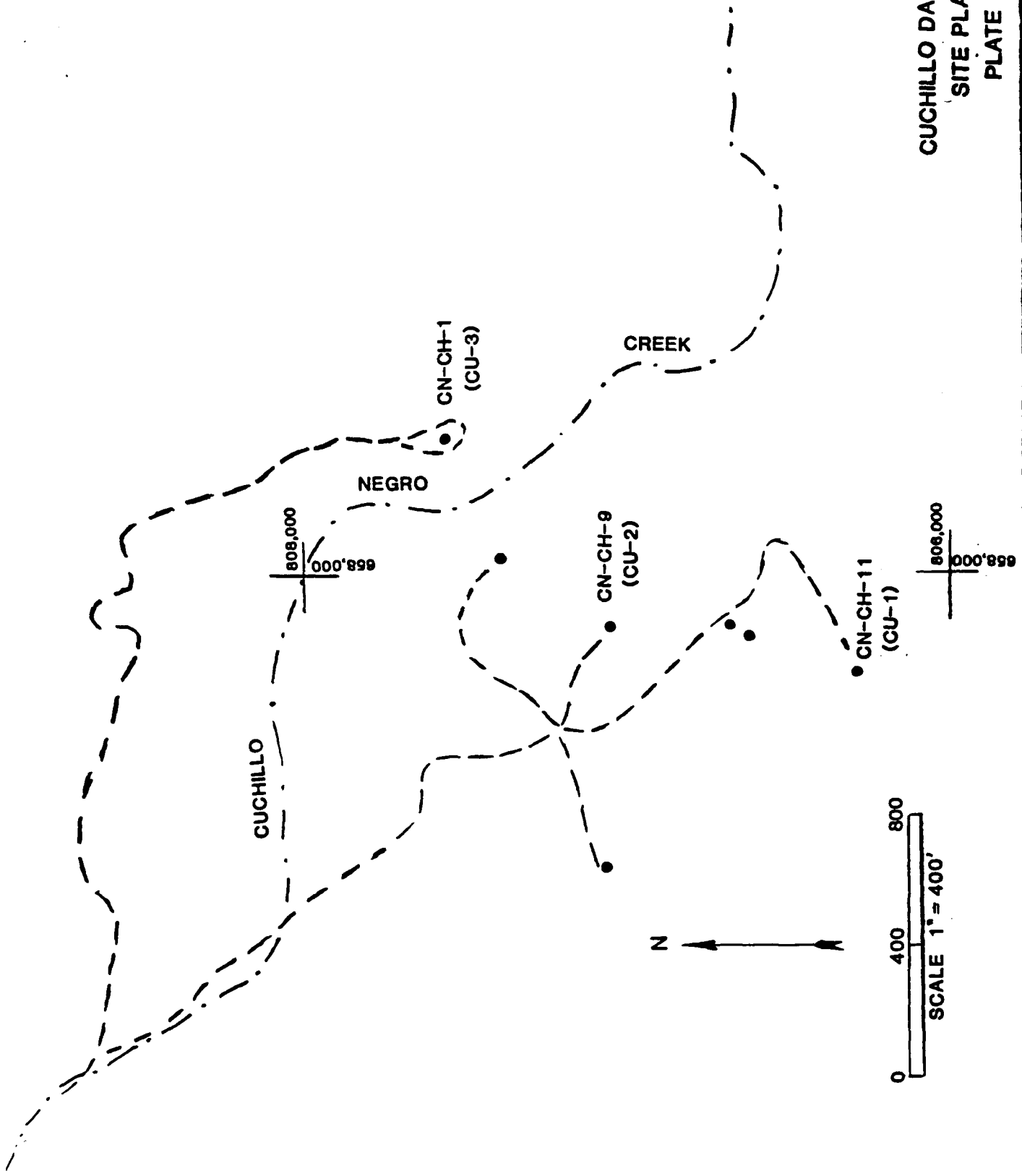
V. CONCLUSIONS

The borehole photography of the three holes clearly reflects two joints and shows some indications of a third set with the following orientations:

	<u>Dip Direction</u>	<u>Dip</u>
Set 1	270 +- 25 degrees	70 +- 10 degrees
Set 2	60 +- 30 degrees	25 +- 15 degrees
Set 3	180 +- 40 degrees	70 +- 20 degrees

The borehole photography would have provided much better results with particular regards to the third joint set if there had been some angled drill holes present at the site. Vertical drill holes tend to not intersect enough fractures or joints in near vertical sets to clearly define them.

CUCHILLO DAMSITE
SITE PLAN
PLATE 1



APPENDIX A

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperture Fracture (Inches)	Joint Type	Remarks
						Photography begins at 120.5 feet
						No water present in drill hole
1	120.61	266.00	78.87	0.0232	Healed	Light mineral filling.
1	119.62	296.00	60.44	0.0296	Healed	Light mineral filling.
1	118.28	76.00	31.60	0.0307	Healed	Light mineral filling.
1	118.20	61.00	40.73	0.0455	Open	
1	117.62	96.00	31.60	0.0102	Healed	Light mineral filling.
1	117.43	61.00	7.01	0.0357	Healed	Light mineral filling.
						Several small healed fractures.
1	117.07	266.00	61.00	0.0029	Healed	Light mineral filling.
1	116.52	88.00	26.20	0.0108	Healed	Light mineral filling.
						2 parallel fractures.
1	115.52	281.00	56.61	0.0264	Healed	Light mineral filling.
1	109.65	271.00	82.45	0.0236	Open	
1	106.08	83.00	29.86	0.0416	Healed	Light mineral filling.
						Maybe a bedding feature.
1	105.56	336.00	69.72	0.0083	Healed	Light mineral filling.
1	105.41	256.00	64.00	0.5786	Open	Partly filled with lt min.
1	103.70	116.00	26.20	0.0108	Open	Partly filled with lt min.
1	102.61	43.00	31.60	0.0102	Healed	Light mineral filling.
1	100.98	201.00	64.00	0.0158	Open	Partly filled with lt min.
1	100.12	91.00	22.30	0.0555	Open	Partly filled with lt min.
1	99.37	58.00	40.73	0.0273	Open	Mostly filled with lt min.
1	99.23	356.00	90.00	0.0331	Healed	Vertical fracture.
1	98.40	221.00	44.54	0.0086	Healed	Light mineral filling.
1	98.29	51.00	31.60	0.0204	Healed	Light mineral filling.
1	97.18	56.00	22.30	0.0555	Open	Mostly filled with lt min.
1	95.81	71.00	31.60	0.0204	Open	Mostly filled with lt min.
1	93.10	111.00	37.92	0.0947	Open	Mostly filled with lt min.
1	92.38	46.00	34.88	0.1477	Open	Maybe a bedding feature
1	91.38	191.00	51.81	0.2226	Open	Partly filled with lt min.
6	90.97	46.00	39.36	1.1134	N/A	Bedding feature
1	90.74	241.00	50.89	0.0038	Healed	Light mineral filling.
1	89.09	281.00	62.07	0.0056	Healed	Light mineral filling.
1	86.43	61.00	24.28	0.0109	Open	Partly filled with lt min.
1	84.80	16.00	24.28	0.0219	Healed	Light mineral filling.

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	84.82	236.00	59.86	0.0030	Healed	Light mineral filling.
1	84.46	31.00	36.43	0.0193	Open	Mostly filled with lt min.
1	84.12	76.00	52.69	0.0182	Healed	Light mineral filling.
1	83.73	231.00	49.94	0.0077	Healed	Light mineral filling.
1	83.30	246.00	24.28	0.0219	Open	Partly filled with lt min.
1	82.19	56.00	39.36	0.9279	Open	Maybe a bedding feature.
1	78.51	161.00	64.44	0.0518	Open	Partly filled with lt min.
1	74.93	38.00	31.60	0.0204	Healed	Light mineral filling.
1	73.93	26.00	70.27	0.0405	Open	Fracture splits
1	73.03	206.00	68.21	0.2227	Open	
1	70.60	346.00	20.26	0.0023	Healed	Light mineral filling.
1	68.37	271.00	51.81	0.0074	Healed	Light mineral filling. Bottom of fracture is estimated
1	66.25	263.00	77.50	0.0013	Healed	Light mineral filling.
1	65.53	321.00	29.86	0.0520	Healed	Light mineral filling.
1	62.74	41.00	40.73	0.1819	Healed	Light mineral filling.
1	61.23	76.00	34.88	0.0984	Healed	Light mineral filling.
1	60.26	36.00	26.20	0.0323	Open	Partly filled with lt min.
1	59.93	78.00	36.43	0.0483	Healed	Light mineral filling.
1	59.34	51.00	37.92	0.0284	Open	Partly filled with lt min. Rock appears broken
1	58.10	361.00	55.13	0.1715	Open	
1	57.31	56.00	45.71	0.0168	Healed	Light mineral filling.
1	55.47	44.00	9.32	0.1184	Healed	Light mineral filling.
1	55.16	231.00	36.43	0.0483	Healed	Light mineral filling.
1	55.23	176.00	66.09	0.0195	Healed	Light mineral filling.
1	54.90	61.00	13.82	0.0233	Healed	Light mineral filling.
1	54.61	156.00	16.02	0.0577	Healed	Light mineral filling.
1	53.32	81.00	52.69	0.0073	Healed	Light mineral filling.
1	51.70	31.00	37.92	0.0189	Open	Partly filled with lt min. 2 parallel fractures
1	49.07	71.00	55.13	0.0549	Open	
1	48.15	81.00	33.27	0.0502	Open	Mostly filled with lt min. Numerous small healed fractures
1	47.65	46.00	28.06	0.0318	Healed	Light mineral filling.
1	47.57	106.00	31.60	0.0409	Healed	Light mineral filling.

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature of Fracture (Inches)	Joint Type	Remarks
1	47.29	206.00	56.61	0.0013	Healed	Light mineral filling.
1	48.99	41.00	18.16	0.0114	Healed	Light mineral filling.
1	48.55	76.00	44.54	0.0171	Open	Partly filled with lt min.
1	48.54	276.00	18.16	0.0171	Healed	Light mineral filling.
1	48.32	81.00	44.54	0.0086	Healed	Light mineral filling.
1	48.17	221.00	13.82	0.1165	Healed	Light mineral filling.
1	48.16	76.00	34.88	0.0098	Healed	Light mineral filling.
1	45.79	141.00	55.13	0.1372	Open	Mostly filled with lt min.
1	45.49	56.00	37.92	0.0142	Healed	Light mineral filling.
1	45.25	71.00	55.13	0.0137	Healed	Light mineral filling.
1	44.97	61.00	33.27	0.0201	Healed	Light mineral filling.
1	44.33	68.00	36.43	0.0965	Open	Partly filled with lt min.
1	44.40	141.00	74.34	0.0648	Open	Partly filled with lt min.
1	43.89	256.00	59.86	0.0060	Healed	Light mineral filling.
1	43.25	61.00	34.88	0.0246	Healed	Light mineral filling.
1	43.01	81.00	29.86	0.0104	Healed	Light mineral filling.
1	42.51	46.00	29.86	0.1041	Healed	Light mineral filling.
1	42.29	231.00	22.30	0.0056	Healed	Light mineral filling.
1	41.66	51.00	31.60	0.0204	Healed	Light mineral filling.
1	41.41	131.00	33.27	0.0100	Healed	Light mineral filling.
1	40.97	51.00	42.06	0.0045	Healed	Light mineral filling.
1	40.28	51.00	28.06	0.0318	Healed	Light mineral filling.
1	40.67	266.00	77.04	0.0538	Open	Mostly filled with lt min.
1	40.08	51.00	39.36	0.0186	Healed	Light mineral filling.
1	39.64	51.00	29.86	0.0104	Healed	Light mineral filling.
6	39.15	41.00	24.28	0.0109	N/A	Dark bedding plane
1	38.43	66.00	22.30	0.0111	Healed	Light mineral filling.
1	37.65	276.00	67.54	0.1834	Open	Partly filled with lt min.
1	35.08	156.00	73.44	0.6841	Open	Partly filled with lt min.
1	33.72	53.00	46.83	0.0657	Healed	Light mineral filling.
1	33.12	51.00	33.27	0.0401	Healed	Light mineral filling.
1	29.45	11.00	0.00	0.0120	Open	
1	28.86	71.00	55.13	1.3720	Open	
1	28.27	121.00	76.16	0.086	Open	
1	26.39	161.00	34.88	0.0394	Open	
1	25.70	21.00	28.06	0.1059	Open	Partly filled with lt min.

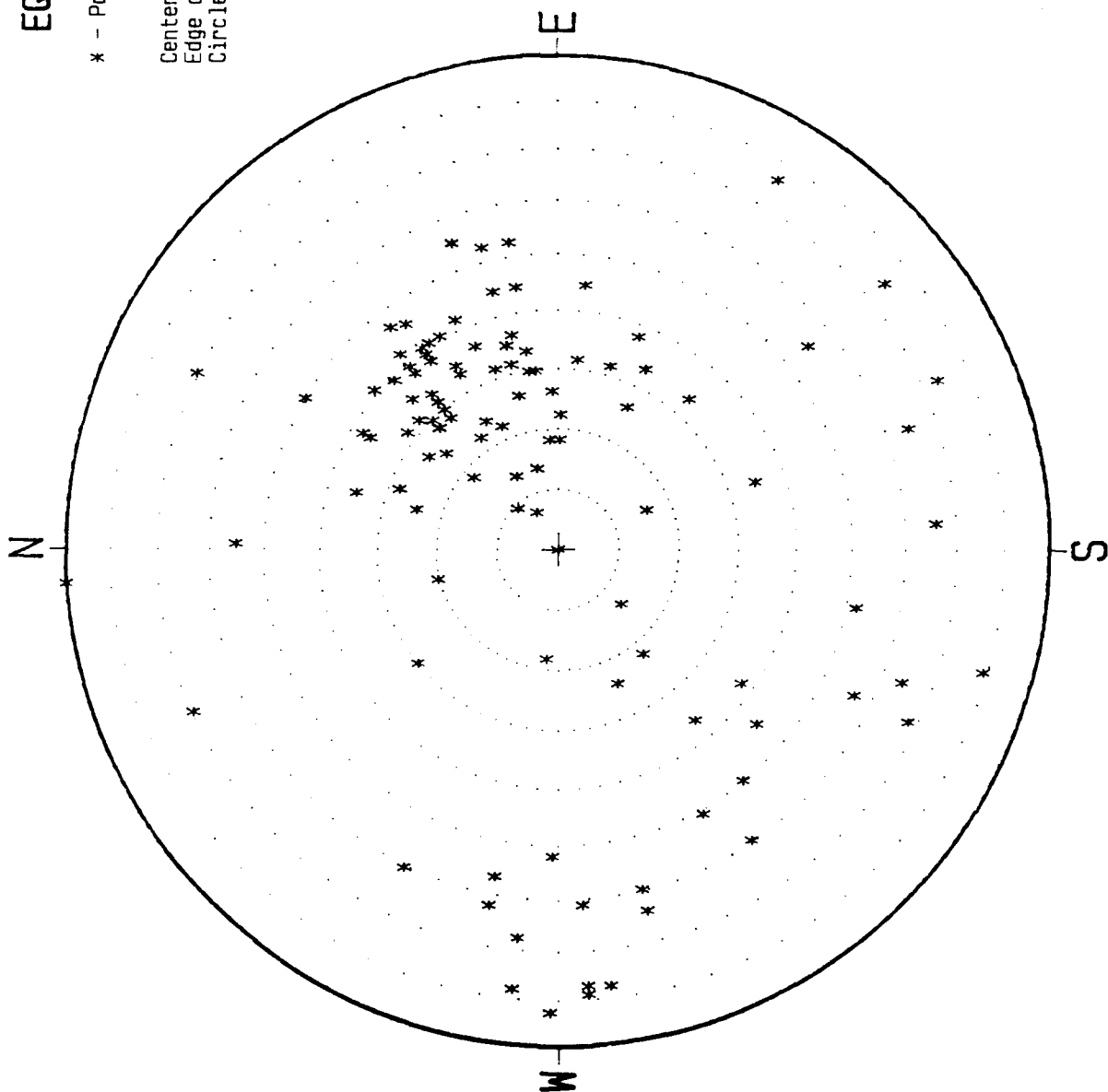
BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	24.23	16.00	34.88	0.0049	Healed	Light mineral filling.
1	23.95	116.00	33.27	0.0100	Healed	Light mineral filling.
1	23.79	276.00	77.93	0.0753	Open	Mostly filled with lt min.
1	23.21	56.00	40.73	0.0091	Healed	Light mineral filling.
1	22.94	86.00	18.16	0.1140	Open	
1	22.62	46.00	28.06	0.0529	Healed	Light mineral filling.
1	22.41	66.00	42.06	0.0446	Healed	Light mineral filling.
1	21.90	76.00	26.20	0.0431	Open	Partly filled with lt min. 19.55 - 18.66 is a cavity
1	18.16	31.00	49.94	0.1545	Open	
1	14.29	196.00	79.05	0.1824	Open	
1	12.38	216.00	37.92	0.0095	Open	
1	8.52	96.00	44.54	0.0855	Healed	Light mineral filling.
1	7.81	76.00	13.82	0.0233	Healed	Light mineral filling.
1	6.82	91.00	18.16	0.0114	Open	Partly filled with lt min. Photography ends at 6.3 feet.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.
Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name: Cuchillo Damsite

Drill Hole: CU-1 Hole Size: NX

Orientation: Vertical

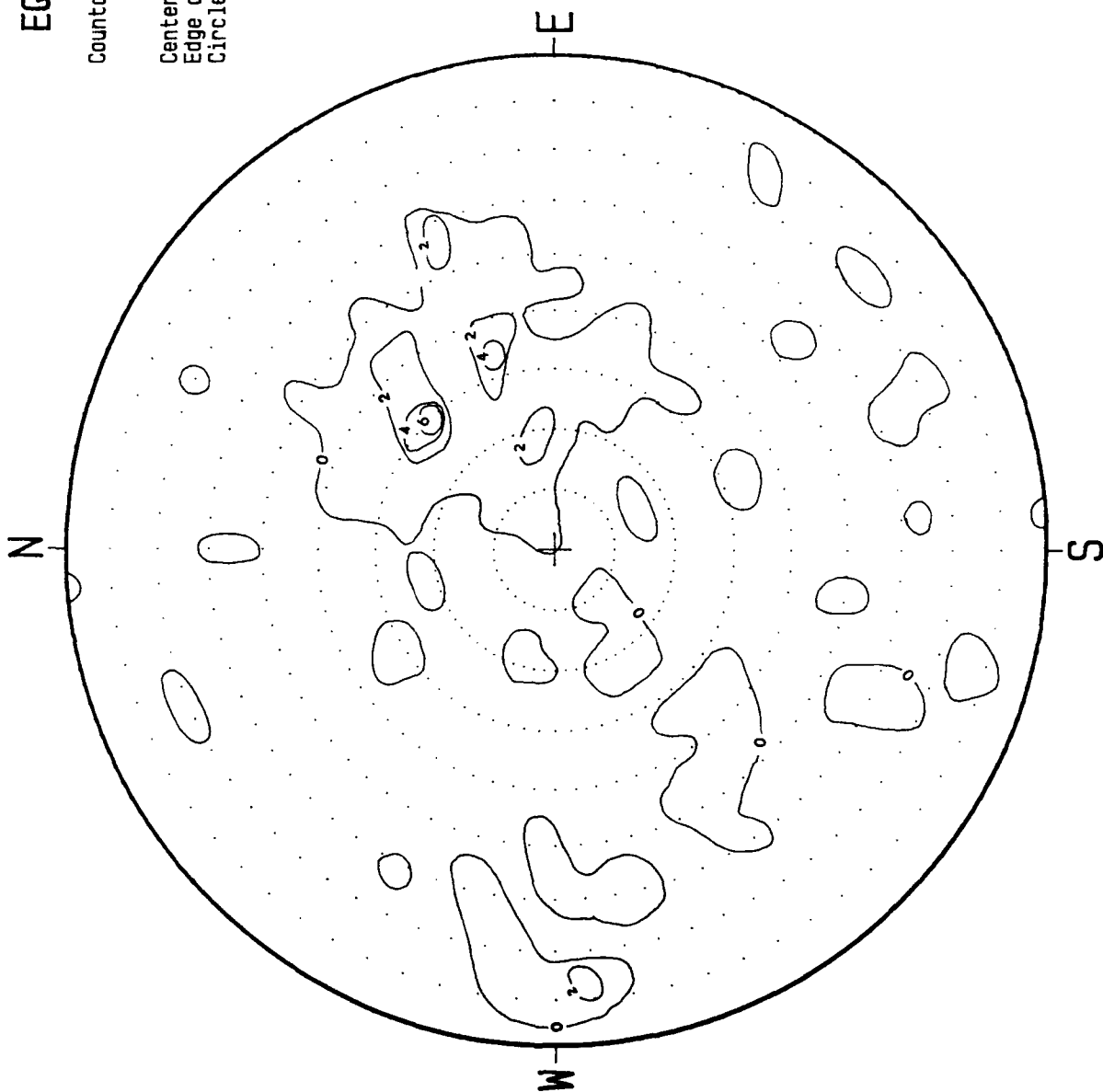
Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

EQUAL AREA POLAR PLOT

Countours represent percent of poles
per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.



Project Name: Cuchillo Damsite

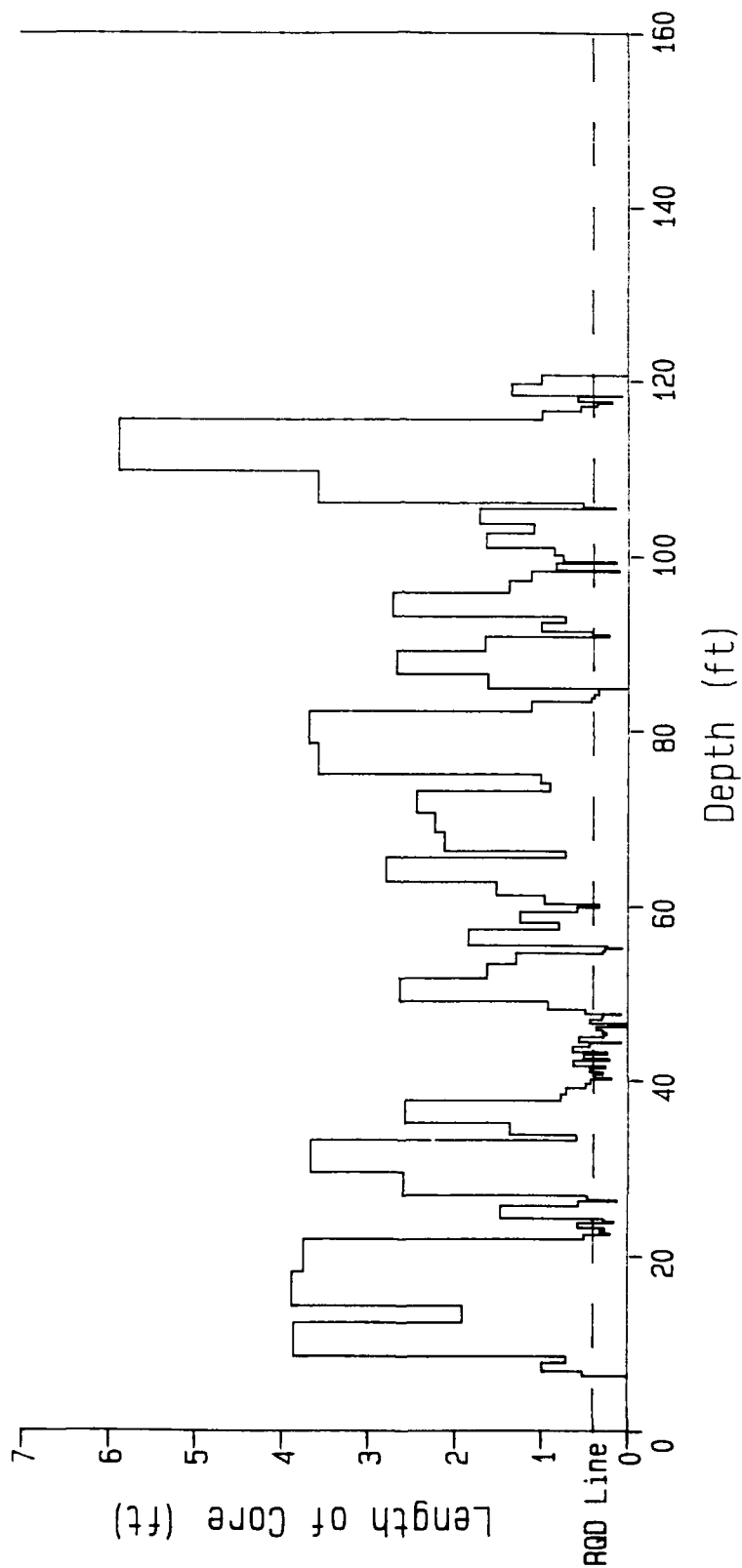
Drill Hole: CU-1 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

FRACTURE FREQUENCY PLOT



NOTE - All fractures

Project Name: Cuchillo Damsite

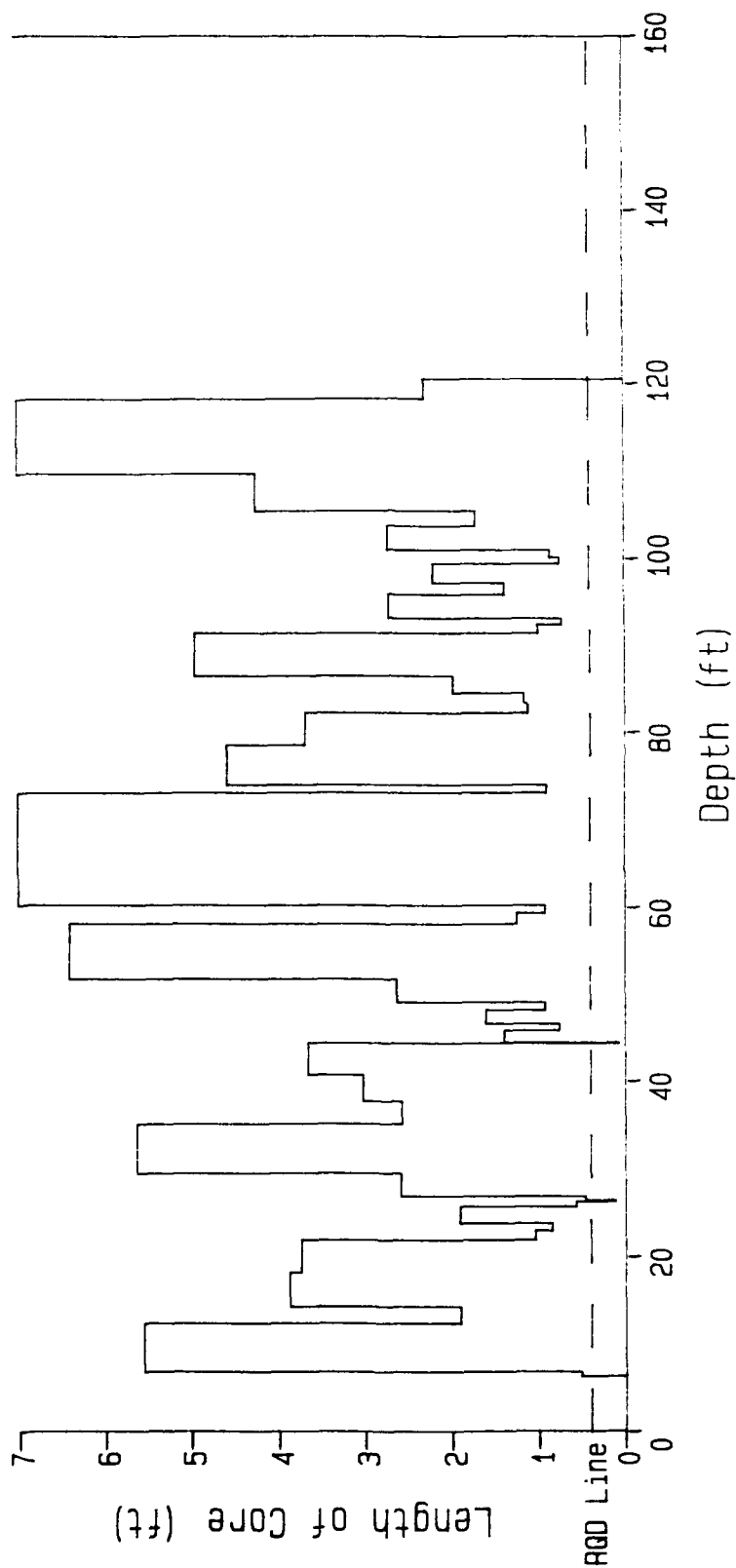
Drill Hole: CU-1 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

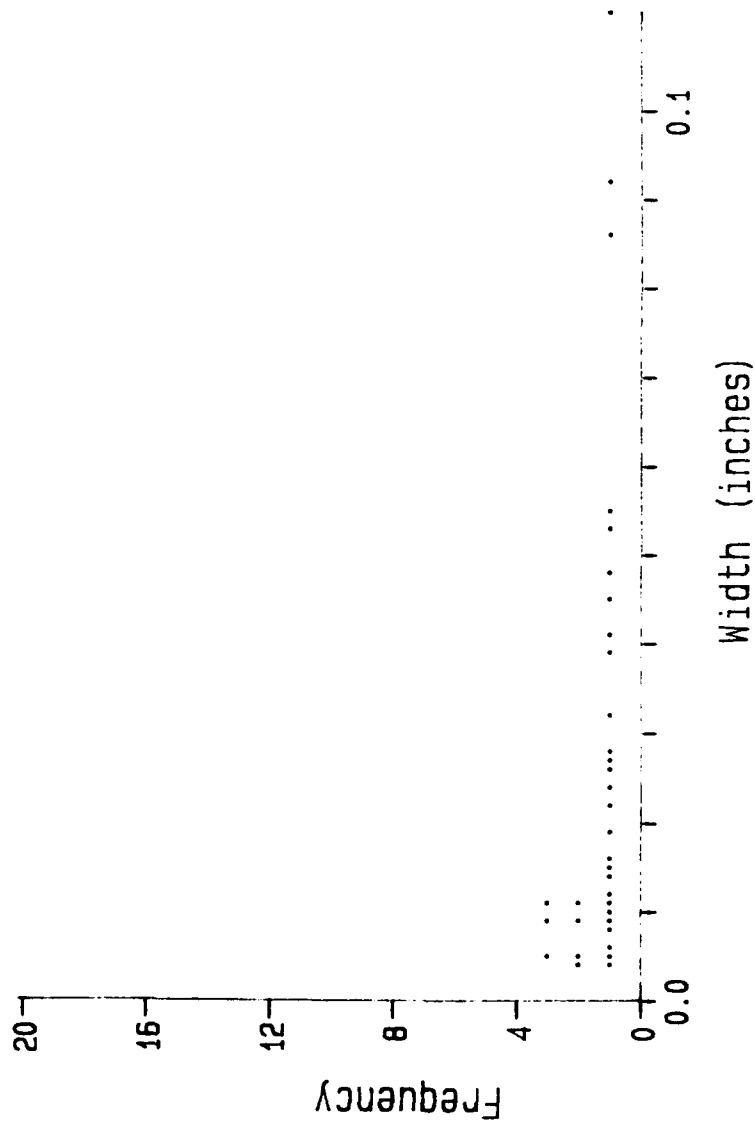
FRACTURE FREQUENCY PLOT



NOTE - Open fractures

Project Name: Cuchillo Damsite	
Drill Hole: CU-1	Hole Size: NX
Orientation: Vertical	
Direction: 0	Grade: 0
Photographed and Interpreted by the Walla Walla District	

APERATURE DISTRIBUTION



There are 10 fractures not graphed.
 Largest aperture width = 1.37 inches.
 Median aperture width = .026 inch.

Project Name: Cuchillo Dam site

Drill Hole: CU-1 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
 Walla Walla District

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature of Fracture (Inches)	Joint Type	Remarks
						Bottom of photography is 110.2 Rock appears broken
1	107.16	73.00	18.16	0.0114	Open	
1	106.90	271.00	76.03	0.0116	Healed	Light mineral filling.
6	105.72	66.00	18.16	0.0114	N/A	Bedding feature
1	104.28	136.00	22.30	0.0444	Healed	Light mineral filling.
1	103.83	69.00	20.26	0.0225	Healed	Light mineral filling.
1	103.50	91.00	31.60	0.0409	Open	Partly filled with lt min.
1	103.08	79.00	22.30	0.0555	Open	Partly filled with lt min.
1	102.46	86.00	24.28	0.1094	Healed	Light mineral filling.
1	102.26	46.00	24.28	0.0875	Open	
1	102.10	91.00	31.60	0.1533	Open	Direction varies
1	101.93	66.00	28.06	0.0847	Healed	Light mineral filling.
1	101.28	79.00	28.06	0.0212	Healed	Light mineral filling.
						2 // fractures as above
1	100.85	73.00	24.28	0.0547	Open	Partly filled with lt min.
1	100.20	71.00	22.30	0.0222	Open	
1	99.82	81.00	20.26	0.0450	Open	Partly filled with lt min.
1	99.30	91.00	33.27	0.0201	Open	
1	99.01	336.00	24.28	0.0875	Open	Mostly filled with lt min.
1	98.91	46.00	18.16	0.0342	Open	Partly filled with lt min.
1	98.50	53.00	22.30	0.0222	Open	
1	98.15	86.00	22.30	0.0167	Open	Fracture irregular
6	97.72	79.00	24.28	0.1641	N/A	Bedding feature
1	96.74	316.00	78.79	0.0023	Healed	Light mineral filling.
						Generator stability problems making tape hard to interpret. Some fractures thru here but cannot interpret them.
1	93.65	66.00	24.28	0.0219	Open	
1	91.81	61.00	26.20	0.0323	Open	
1	90.88	96.00	26.20	0.1077	Healed	Light mineral filling.
1	85.44	66.00	29.86	0.0208	Healed	Light mineral filling.
6	81.37	56.00	20.26	0.0113	N/A	Bedding feature
1	80.57	58.00	28.06	0.3177	Healed	Light mineral filling.
1	79.56	146.00	70.27	0.0041	Healed	Light mineral filling.

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	79.51	71.00	18.16	0.0228	Open	Partly filled with lt min. Numerous fine healed fractures
1	78.72	66.00	22.30	0.0111	Healed	Light mineral filling.
1	78.62	76.00	13.82	0.0583	Open	Partly filled with lt min.
1	78.11	188.00	72.21	0.0073	Healed	Light mineral filling.
6	77.71	73.00	24.28	0.0109	N/A	Bedding feature
6	76.62	76.00	33.27	0.0201	N/A	Bedding features
6	75.08	51.00	20.26	0.0113	N/A	Contact (Bedding feature)
1	73.03	56.00	16.02	0.0115	Open	
1	72.26	241.00	73.99	0.0662	Open	Vertical fracture 71.4 - 65.0 appears broken
1	64.34	53.00	22.30	0.0111	Healed	Light mineral filling.
1	64.21	71.00	22.30	0.0111	Healed	Light mineral filling.
1	64.13	61.00	20.26	0.0225	Healed	Light mineral filling.
1	63.96	66.00	28.06	0.0053	Healed	Light mineral filling.
1	63.63	46.00	26.20	0.0108	Healed	Light mineral filling. 4 // fractures as above
1	62.54	281.00	77.72	0.0383	Healed	Light mineral filling.
1	62.21	61.00	20.26	0.1126	Open	
1	62.06	69.00	16.02	0.0115	Healed	Light mineral filling.
1	61.73	71.00	64.44	0.0104	Open	Partly filled with lt min.
1	61.51	61.00	18.16	0.0228	Open	Partly filled with lt min.
1	61.21	63.00	24.28	0.0547	Healed	Light mineral filling.
1	58.34	233.00	73.05	0.0035	Healed	Light mineral filling.
1	58.40	66.00	33.27	0.0502	Open	Mostly filled with lt min.
1	57.91	253.00	74.84	0.0314	Healed	Light mineral filling.
1	57.17	291.00	73.99	0.0331	Healed	Light mineral filling.
6	57.12	96.00	28.06	0.2118	N/A	May be a open fracture
1	55.90	269.00	68.53	0.0044	Healed	Light mineral filling.
1	54.71	49.00	9.32	0.0118	Open	Partly filled with lt min.
1	53.80	296.00	80.45	0.0398	Open	Mostly filled with lt min.
1	53.68	96.00	33.27	0.0201	Open	
1	52.81	241.00	46.83	0.0041	Healed	Light mineral filling.
1	51.66	91.00	83.65	0.0066	Open	Vertical fracture Partly filled with lt min. Fracture splits

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	51.16	151.00	26.20	0.0323	Open	Partly filled with lt min.
6	49.68	69.00	45.71	0.2514	N/A	May be an open fracture
1	48.63	101.00	22.30	0.2221	Healed	Light mineral filling.
1	47.88	56.00	29.86	0.0208	Healed	Light mineral filling.
1	47.55	291.00	71.76	0.0038	Healed	Light mineral filling.
1	47.00	71.00	26.20	0.1077	Healed	Light mineral filling.
1	46.46	46.00	18.16	0.0570	Healed	Light mineral filling.
1	45.79	66.00	26.20	0.1077	Healed	Light mineral filling.
1	45.65	53.00	24.28	0.0328	Healed	Light mineral filling.
1	45.49	61.00	22.30	0.1110	Healed	Light mineral filling.
1	44.58	59.00	31.59	0.0204	Healed	Light mineral filling.
1	43.48	46.00	37.92	0.0189	Open	Partly filled with lt min.
1	42.88	96.00	28.06	0.0106	Open	
1	42.57	86.00	20.26	0.0338	Healed	Light mineral filling. 2 // fractures as above
1	42.17	66.00	20.26	0.1126	Healed	Light mineral filling. 2 // fractures as above
1	39.09	71.00	28.06	0.0212	Healed	Light mineral filling.
1	37.05	53.00	13.82	0.2330	Healed	Light mineral filling.
1	36.62	91.00	62.58	0.0166	Healed	Light mineral filling.
1	36.49	81.00	64.44	0.0052	Healed	Light mineral filling.
1	36.51	68.00	20.26	0.0225	Healed	Light mineral filling.
1	36.16	56.00	24.28	0.0219	Healed	Light mineral filling. Some very faint healed fracs
1	35.46	351.00	18.16	0.0057	Healed	Light mineral filling.
1	34.90	366.00	36.43	0.1448	Healed	Light mineral filling.
1	34.21	61.00	36.43	0.0097	Healed	Light mineral filling.
1	32.78	281.00	65.70	0.0247	Healed	Light mineral filling. Numerous // fractures; closely spaced
6	29.82	221.00	52.69	0.0073	N/A	Contact (Bedding feature)
1	29.61	36.00	26.20	0.1077	Open	
1	25.92	63.00	26.20	0.0215	Open	Partly filled with lt min.
1	25.44	166.00	9.32	0.0355	Healed	Light mineral filling.
1	25.30	56.00	26.20	0.0108	N/A	Bedding feature
1	23.70	56.00	22.30	0.0222	Open	Partly filled with lt min.

BOREHOLE ANALYSIS Output Data

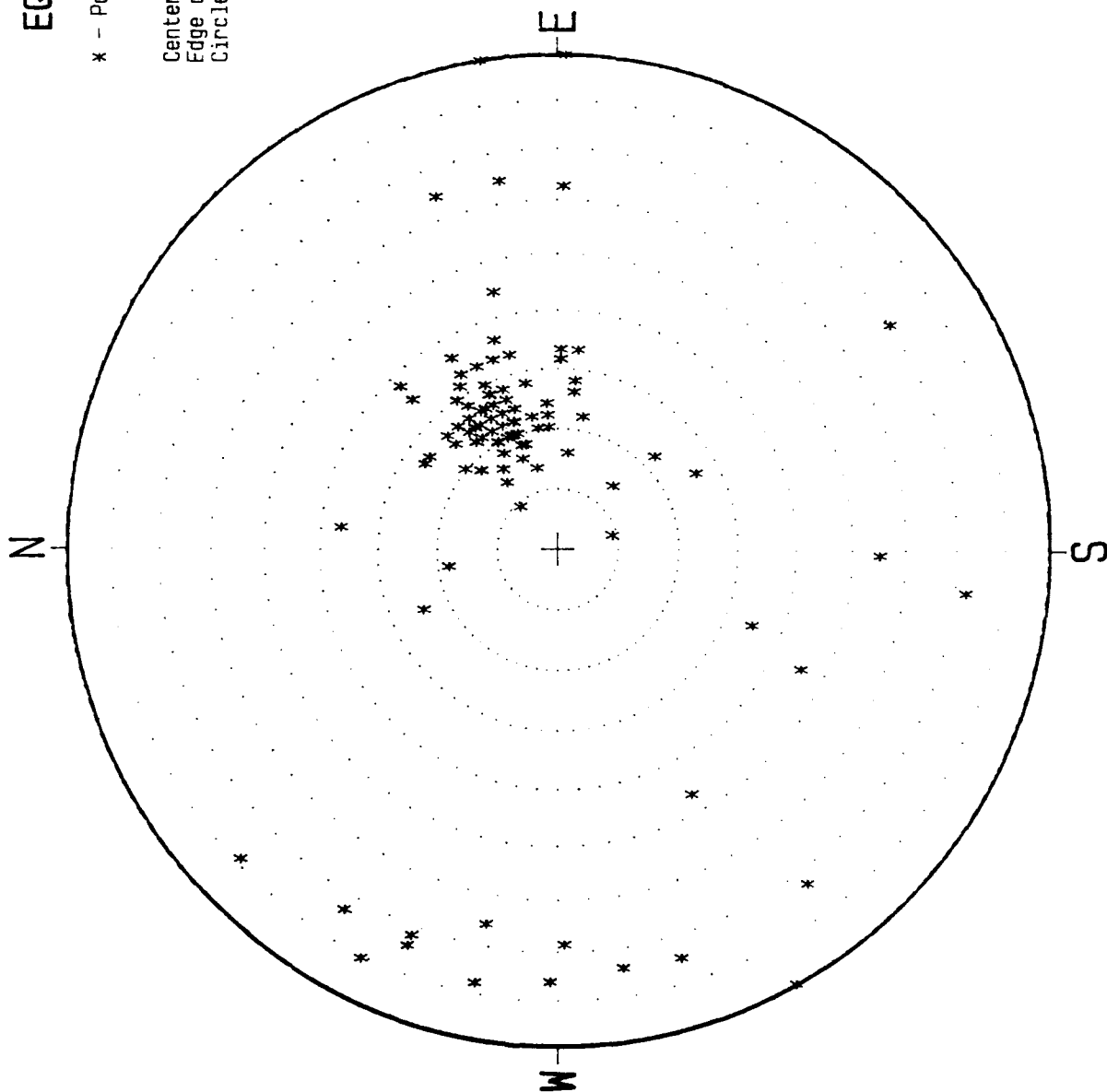
Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	22.32	261.00	74.17	0.0033	Healed	Light mineral filling.
1	20.59	71.00	22.30	0.0111	Open	20.1 - 18.2 appears broken
6	17.37	66.00	18.16	0.0114	N/A	Bedding feature
1	16.60	46.00	34.88	0.0197	Open	Mostly filled with lt min.
1	16.22	33.00	26.20	0.0215	Open	Partly filled with lt min.
1	15.25	96.00	16.02	0.1730	Healed	Light mineral filling.
1	14.96	206.00	45.71	0.0168	Healed	Light mineral filling.
1	14.54	76.00	44.54	0.0086	Healed	Light mineral filling.
1	14.19	41.00	20.26	0.0056	Healed	Light mineral filling.
1	13.97	201.00	34.88	0.0098	Healed	Light mineral filling.
1	13.95	131.00	13.82	0.0117	Healed	Light mineral filling.
1	13.87	71.00	20.26	0.0113	Healed	Light mineral filling.
1	13.59	181.00	55.13	0.1372	Open	Mostly filled with lt min.
6	12.92	71.00	26.20	0.0108	N/A	Bedding feature
1	12.20	61.00	33.27	0.0201	Open	
1	12.07	81.00	59.26	0.1227	Open	Vertical fracture Partly filled with lt min.
1	11.00	51.00	26.20	0.0215	Open	
1	10.72	58.00	24.28	0.0109	Open	
6	9.74	61.00	13.82	0.0117	N/A	Bedding feature
1	8.15	73.00	36.43	0.0097	Open	
1	7.92	76.00	33.27	0.0201	Open	
1	5.29	71.00	33.27	0.0803	Healed	Light mineral filling.
1	4.62	301.00	73.24	0.0346	Open	Partly filled with lt min. Photography ends at 4.0 ft

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name: Cuchillo Damsite

Drill Hole: CU-2 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

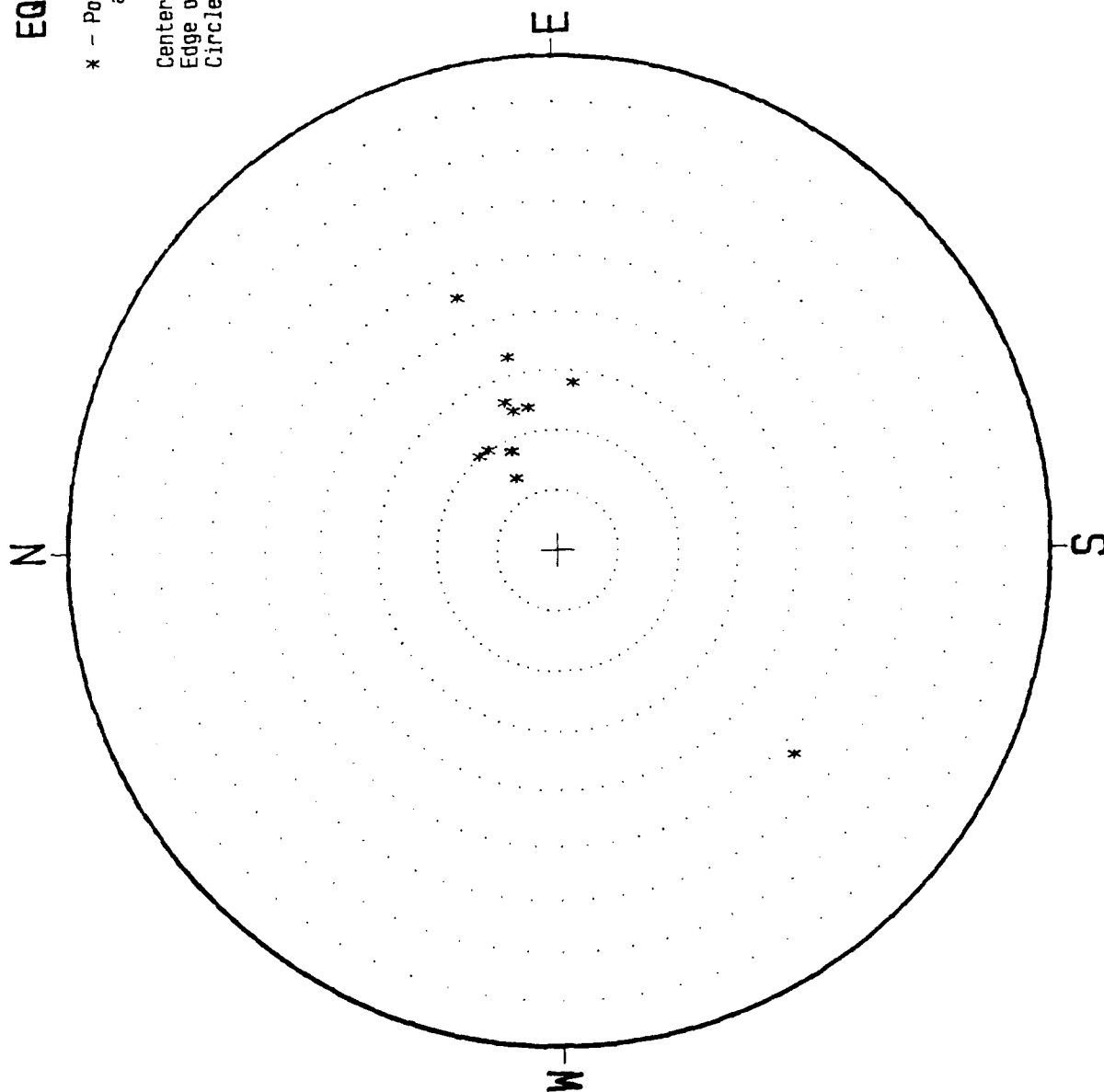
Photographed and Interpreted by the
Walla Walla District

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

NOTE - Bedding features



Project Name: Cuchillo Damsite

Drill Hole: CU-2 Hole Size: NX

Orientation: Vertical

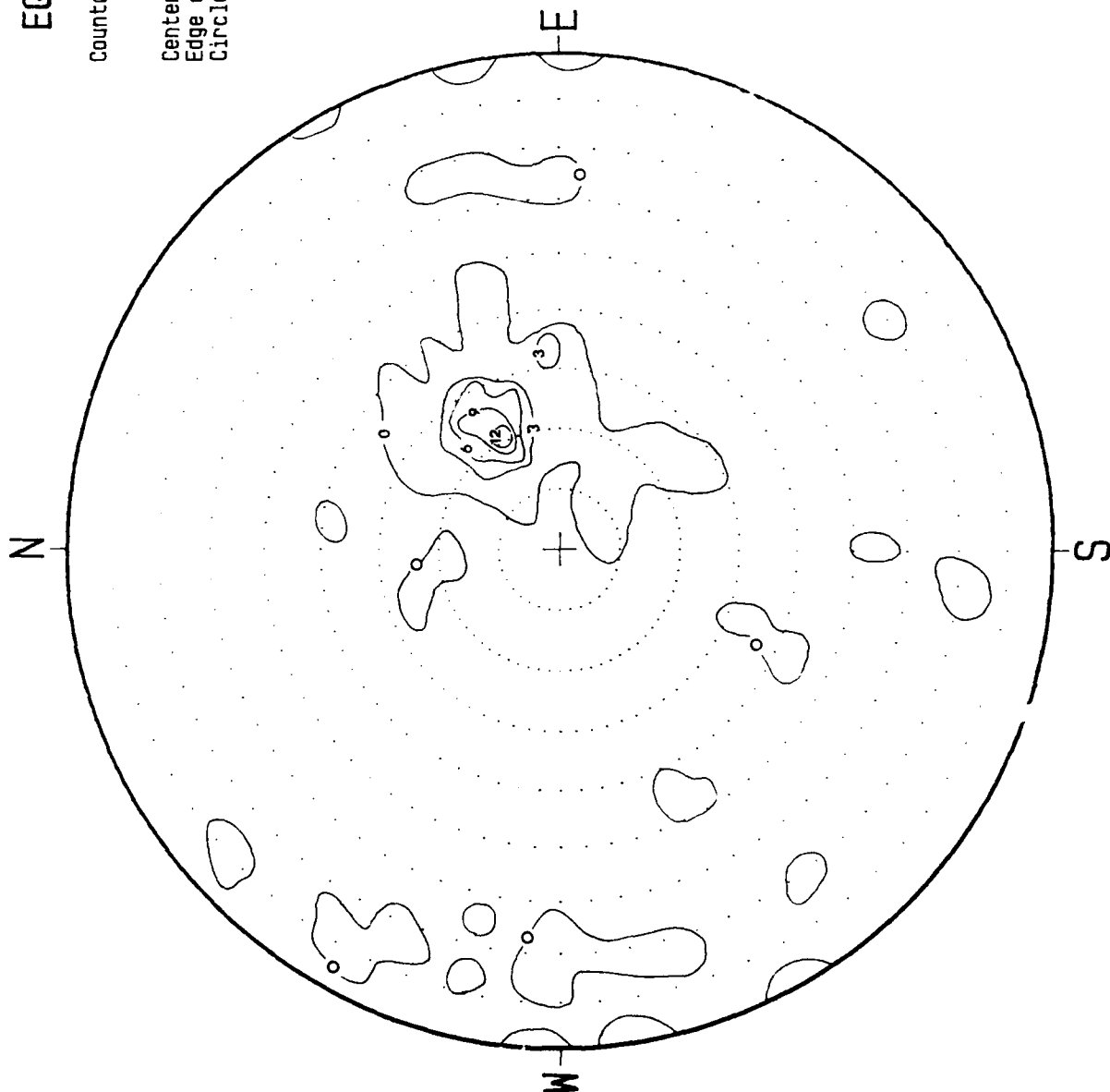
Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

EQUAL AREA POLAR PLOT

Countours represent percent of poles
per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.



Project Name: Cuchillo Damsite

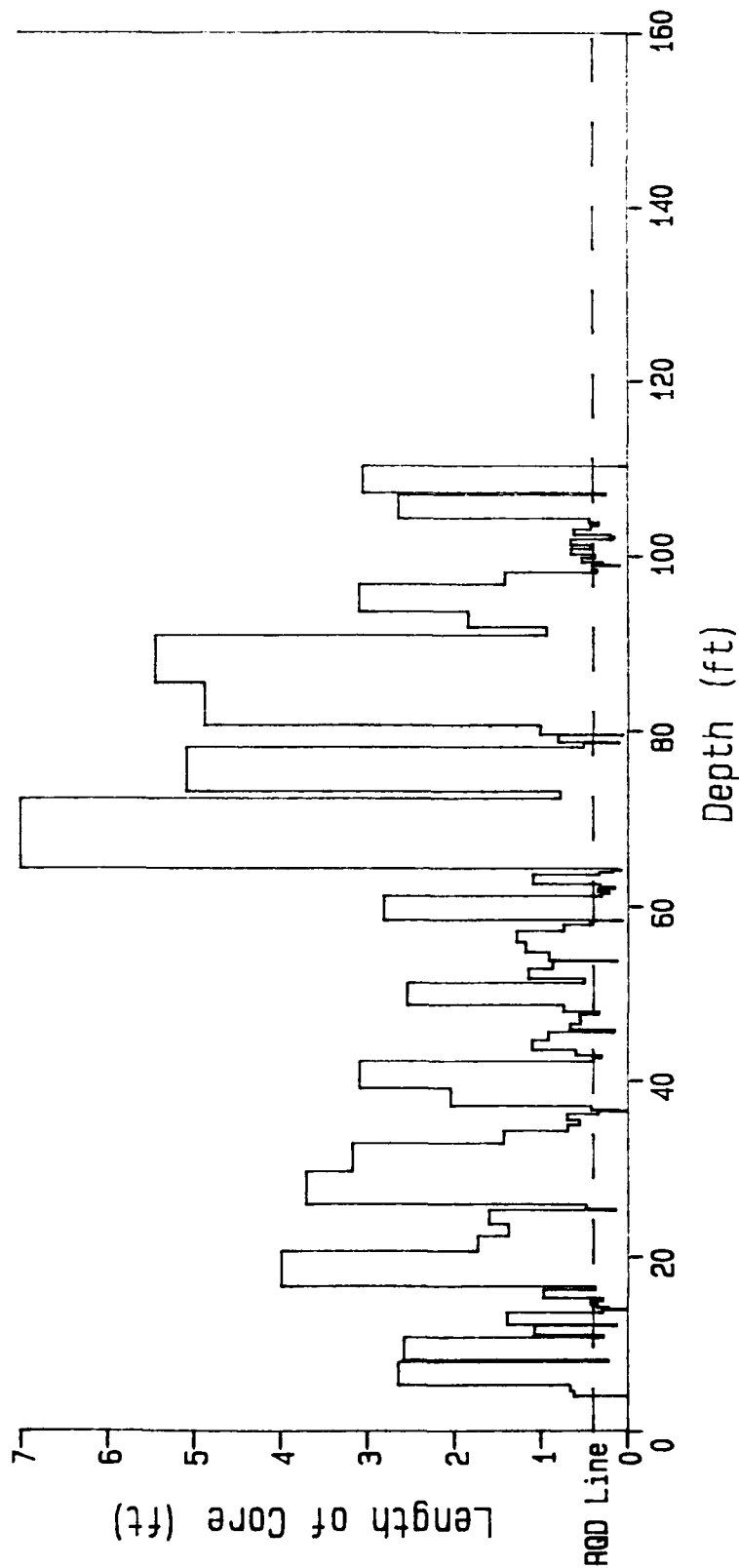
Drill Hole: CU-2 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

FRACTURE FREQUENCY PLOT



NOTE - All fractures

Project Name: Cuchillo Damsite

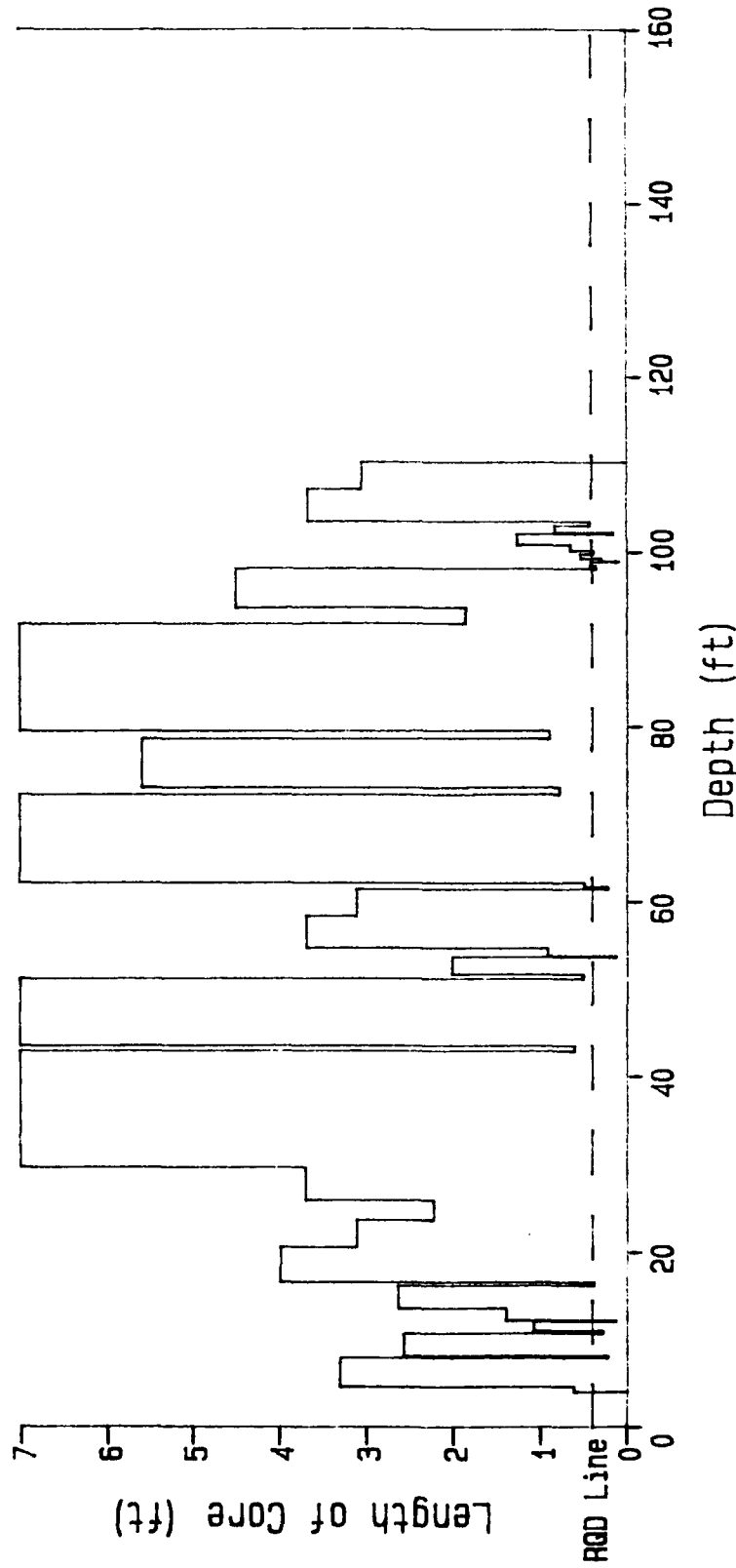
Drill Hole: CU-2 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

FRACTURE FREQUENCY PLOT



NOTE - Open fractures

Project Name: Cuchillo Damsite

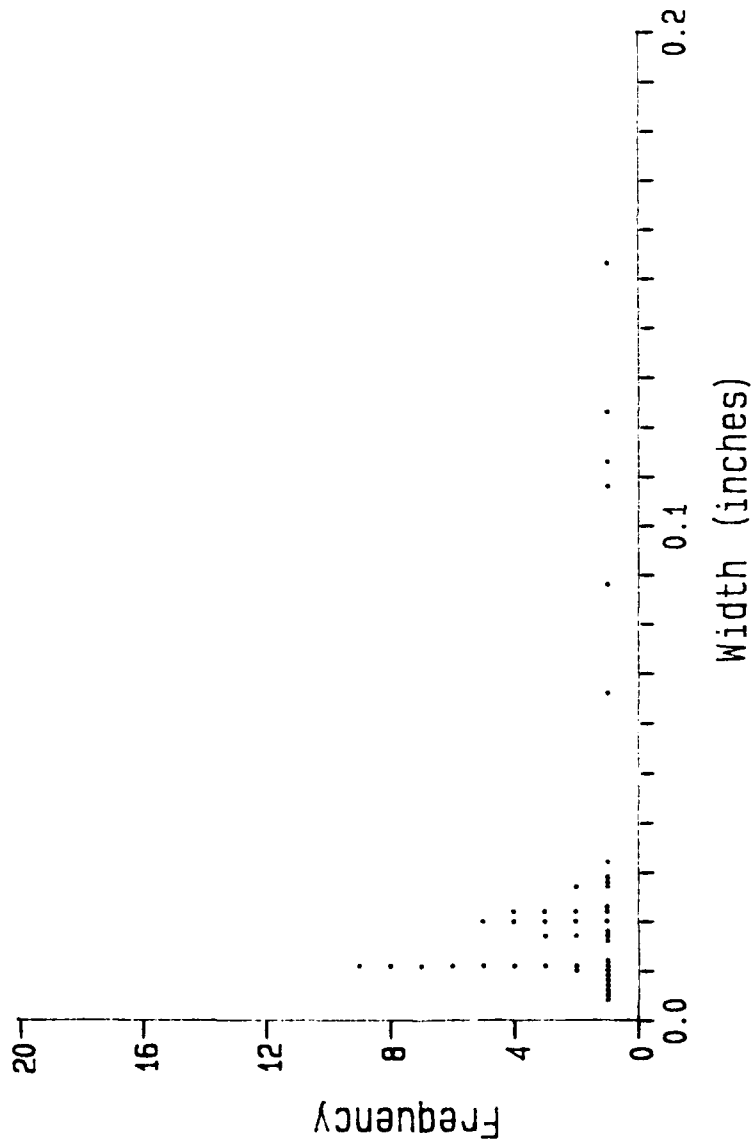
Drill Hole: CU-2 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

APERATURE DISTRIBUTION



There are 0 fractures not graphed.
 Largest aperature width = .15 inches.
 Median aperature width = .017 inch.

Project Name: Cuchillo Damsite

Drill Hole: CU-2 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
 Walla Walla District

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature of Fracture (Inches)	Joint Type	Remarks
						Start photography at 96.7 feet.
1	96.37	241.00	61.55	0.0114	Open	Mostly filled with lt min.
6	95.59	46.00	28.06	0.0106	N/A	Bedding Feature
1	94.93	221.00	53.54	0.0143	Open	Mostly filled with lt min.
1	92.65	264.00	69.44	0.0084	Healed	Light mineral filling.
1	91.58	271.00	63.07	0.0544	Healed	Light mineral filling.
1	91.04	251.00	62.58	0.0829	Open	Mostly filled with lt min.
1	88.83	259.00	70.79	0.0197	Open	Mostly filled with lt min.
1	83.43	251.00	69.44	0.1686	Open	This is bottom of a cavity. Cavity to 82.08 feet.
1	79.37	256.00	64.87	0.0510	Open	Mostly filled with lt min.
6	79.03	49.00	29.86	0.0208	N/A	Bedding feature
1	79.03	49.00	29.86	0.2602	Open	Partly filled with lt min.
6	74.19	49.00	39.36	0.0093	N/A	Bedding feature Appears broken
1	72.06	261.00	69.72	0.0042	Healed	Light mineral filling. Bottom estimated
1	70.78	271.00	67.88	0.0090	Healed	Light mineral filling.
1	65.53	291.00	74.84	0.0031	Healed	Light mineral filling.
1	64.49	59.00	34.88	0.0098	Healed	Light mineral filling.
1	64.06	59.00	76.30	0.0028	Healed	Light mineral filling.
1	57.75	273.00	42.06	0.2228	Open	Mostly filled with lt min.
1	57.30	311.00	67.54	0.1604	Open	Mostly filled with lt min.
1	56.37	216.00	70.79	0.0987	Open	Mostly filled with lt min.
1	55.36	73.00	33.27	0.0100	Healed	Light mineral filling.
1	53.21	56.00	24.28	0.0022	Healed	Light mineral filling.
1	51.55	66.00	33.27	0.0050	Healed	Light mineral filling.
1	50.88	119.00	46.83	0.0164	Open	Partly filled with lt min.
1	50.24	271.00	72.64	0.1432	Healed	Light mineral filling.
1	48.12	46.00	39.36	0.0186	Open	
1	46.75	281.00	75.15	0.0769	Open	
1	45.89	91.00	31.60	0.0307	Open	
1	41.31	231.00	57.31	0.0130	Healed	Light mineral filling.
1	39.98	43.00	28.06	0.0318	Open	
1	39.65	261.00	67.54	0.0023	Healed	Light mineral filling.
1	38.55	96.00	28.06	0.0053	Healed	Light mineral filling.

BOREHOLE ANALYSIS Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

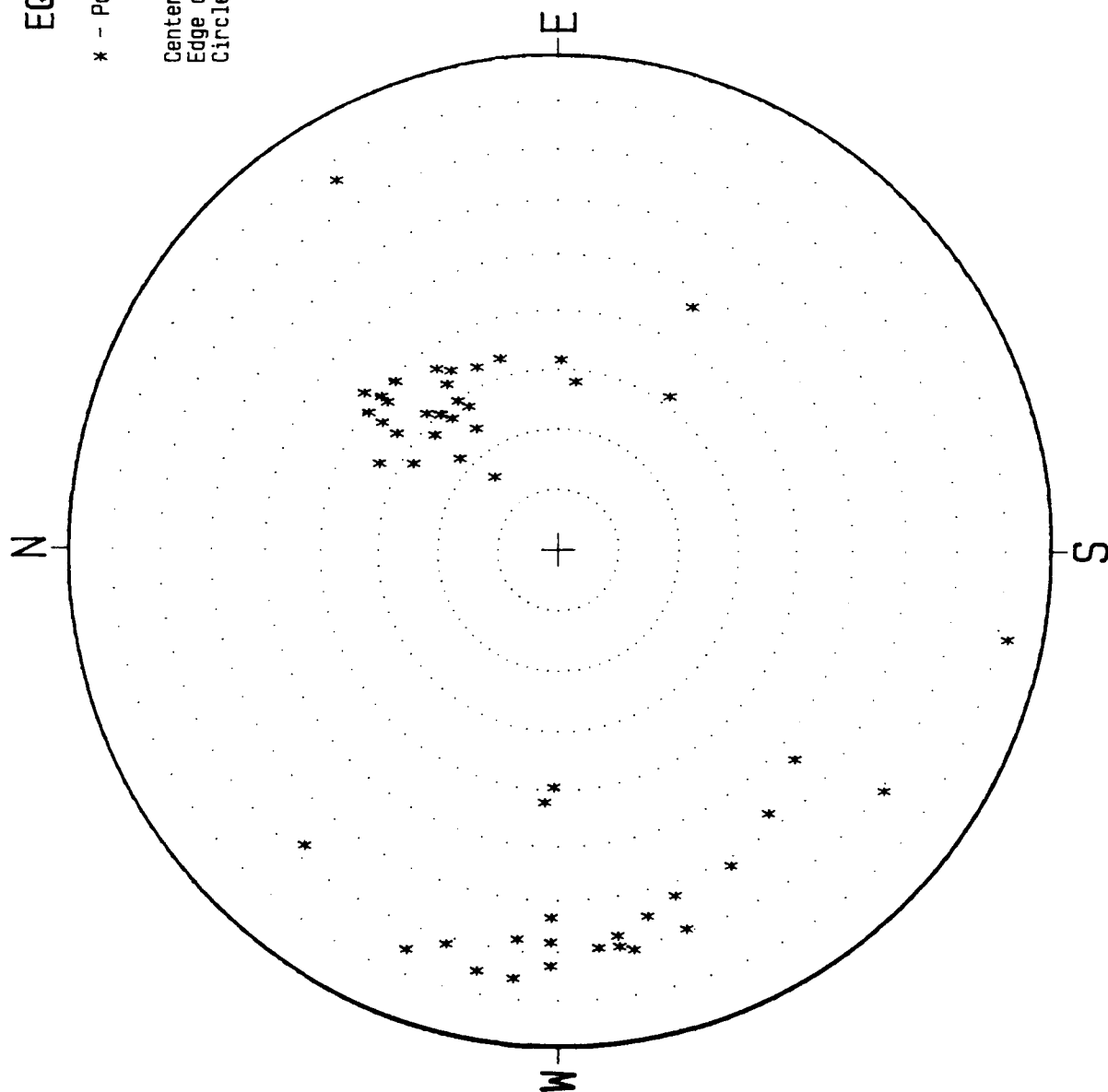
Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	37.57	276.00	67.54	0.0046	Open	Partly filled with lt min. Fracture splits
1	37.15	41.00	37.92	0.0189	Open	
1	35.96	39.00	42.05	0.0089	Open	Partly filled with lt min.
1	34.35	56.00	29.86	0.0208	Healed	Light mineral filling. 2 parallel fractures
1	33.75	58.00	28.06	0.0318	Healed	Light mineral filling.
1	32.47	49.00	16.02	0.0231	Open	Partly filled with lt min.
1	31.31	41.00	39.36	0.0371	Healed	Light mineral filling. 2 parallel fractures
1	29.38	26.00	33.27	0.1003	Healed	Light mineral filling.
1	28.88	56.00	33.27	0.0201	Healed	Light mineral filling.
1	27.66	56.00	36.43	0.0965	Healed	Light mineral filling.
1	26.92	49.00	29.86	0.0520	Healed	Light mineral filling. 2 parallel fractures
1	26.29	51.00	28.06	0.0529	Healed	Light mineral filling.
1	24.59	36.00	36.43	0.0193	Healed	Light mineral filling.
1	24.16	36.00	39.36	0.0464	Healed	Light mineral filling.
1	22.84	46.00	31.60	0.1022	Healed	Light mineral filling.
1	21.01	31.00	28.06	0.0847	Healed	Light mineral filling. 2 parallel fractures
1	20.44	36.00	33.27	0.0100	Healed	Light mineral filling.
6	20.09	36.00	40.73	0.2728	N/A	Bedding feature
1	19.21	286.00	71.29	0.1925	Open	Mostly filled with lt min.
1	18.81	276.00	75.46	0.1205	Open	Mostly filled with lt min.
6	16.89	49.00	31.60	0.1533	N/A	Bedding feature
1	12.88	191.00	82.20	0.0814	Open	
1	9.93	271.00	39.36	0.0928	Open	
1	9.43	43.00	22.30	0.0555	Open	
1	8.11	126.00	31.60	0.1022	Open	

Rock appears broken
End photography at 3.0 feet.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name: Cuchillo Damsite

Drill Hole: CU-3 Hole Size: NX

Orientation: Vertical

Direction: 0 Made: 0

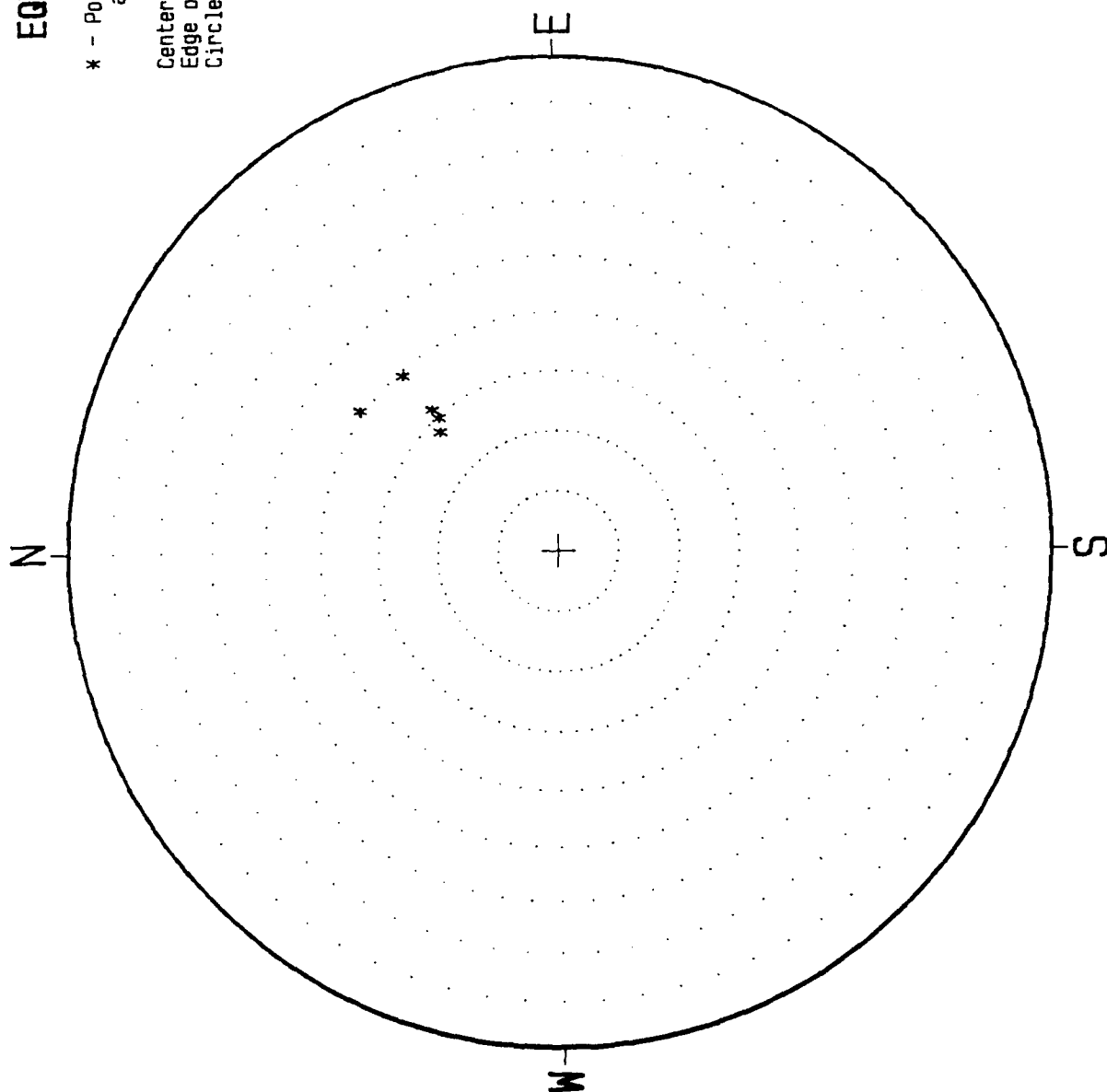
Photographed and Interpreted by the
Walla Walla District

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

NOTE - Bedding feature



Project Name: Cuchillo Damsite

Drill Hole: CU-3 Hole Size: NX

Orientation: Vertical

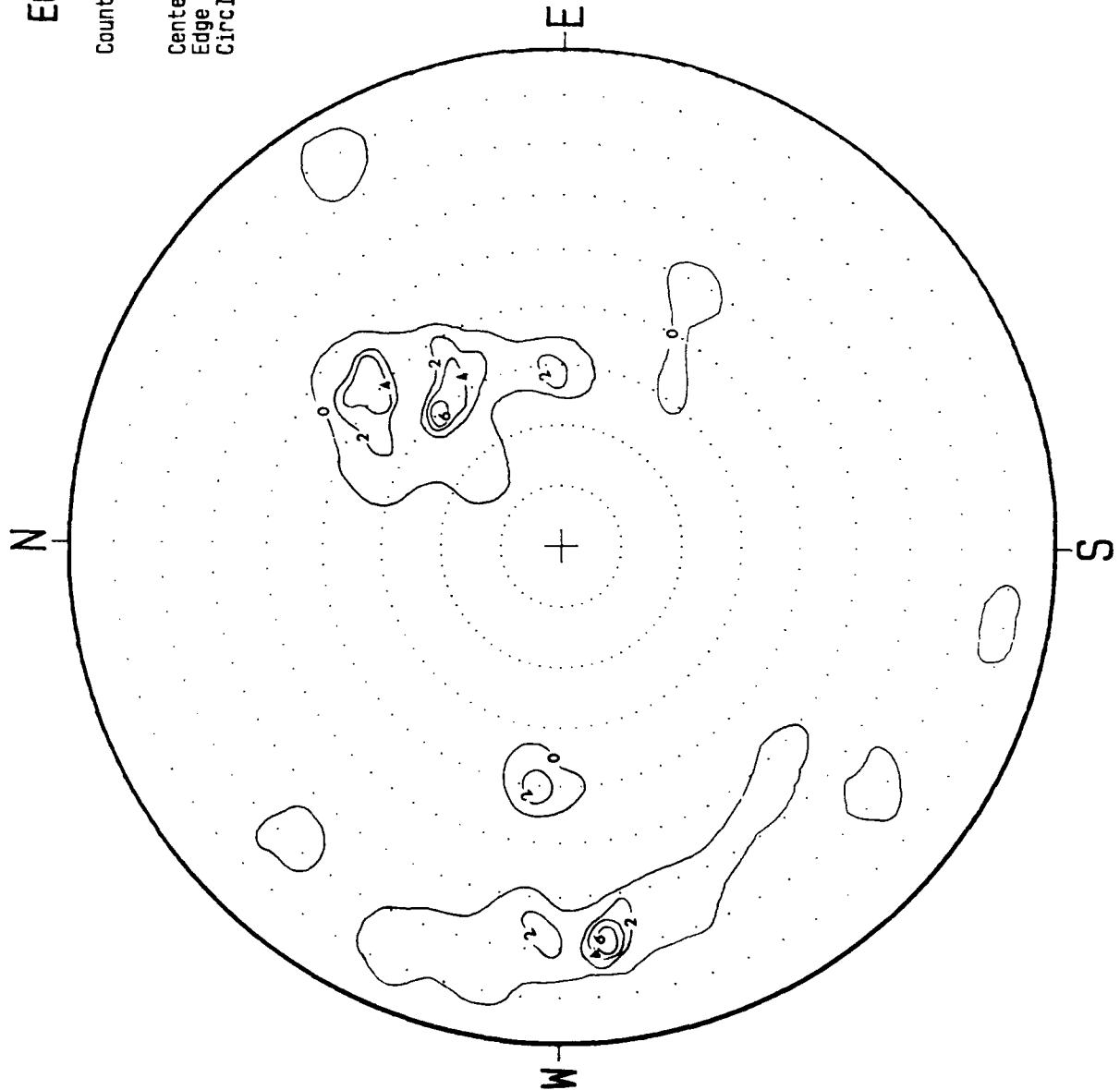
Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

EQUAL AREA POLAR PLOT

Countours represent percent of poles
per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.



Project Name: Cuchillo Damsite

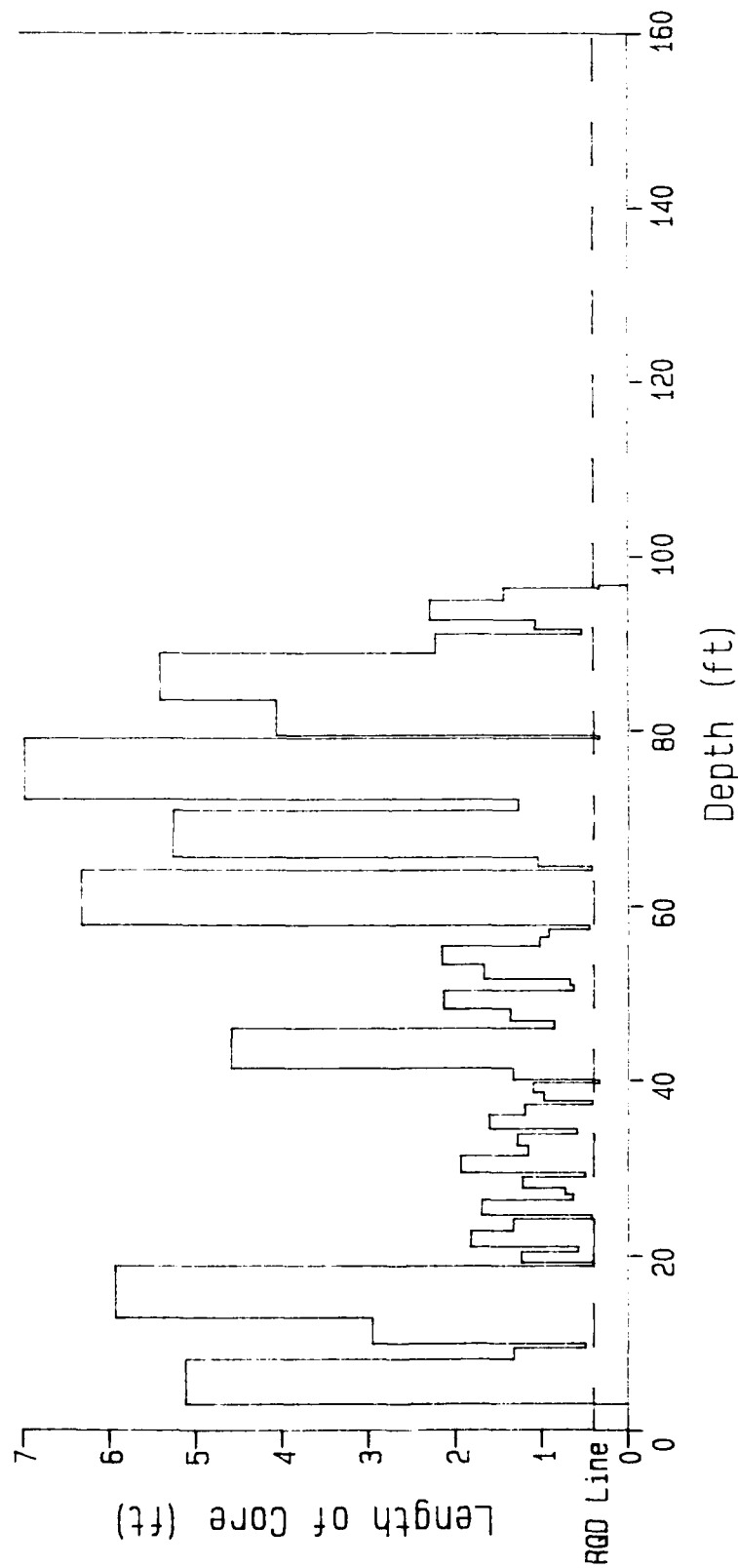
Drill Hole: CU-3 Hole Size: NX

Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the
Walla Walla District

FRACTURE FREQUENCY PLOT



NOTE - All fractures

Project Name: Cuchillo Damsite

Drill Hole: CU-3 Hole Size: NX

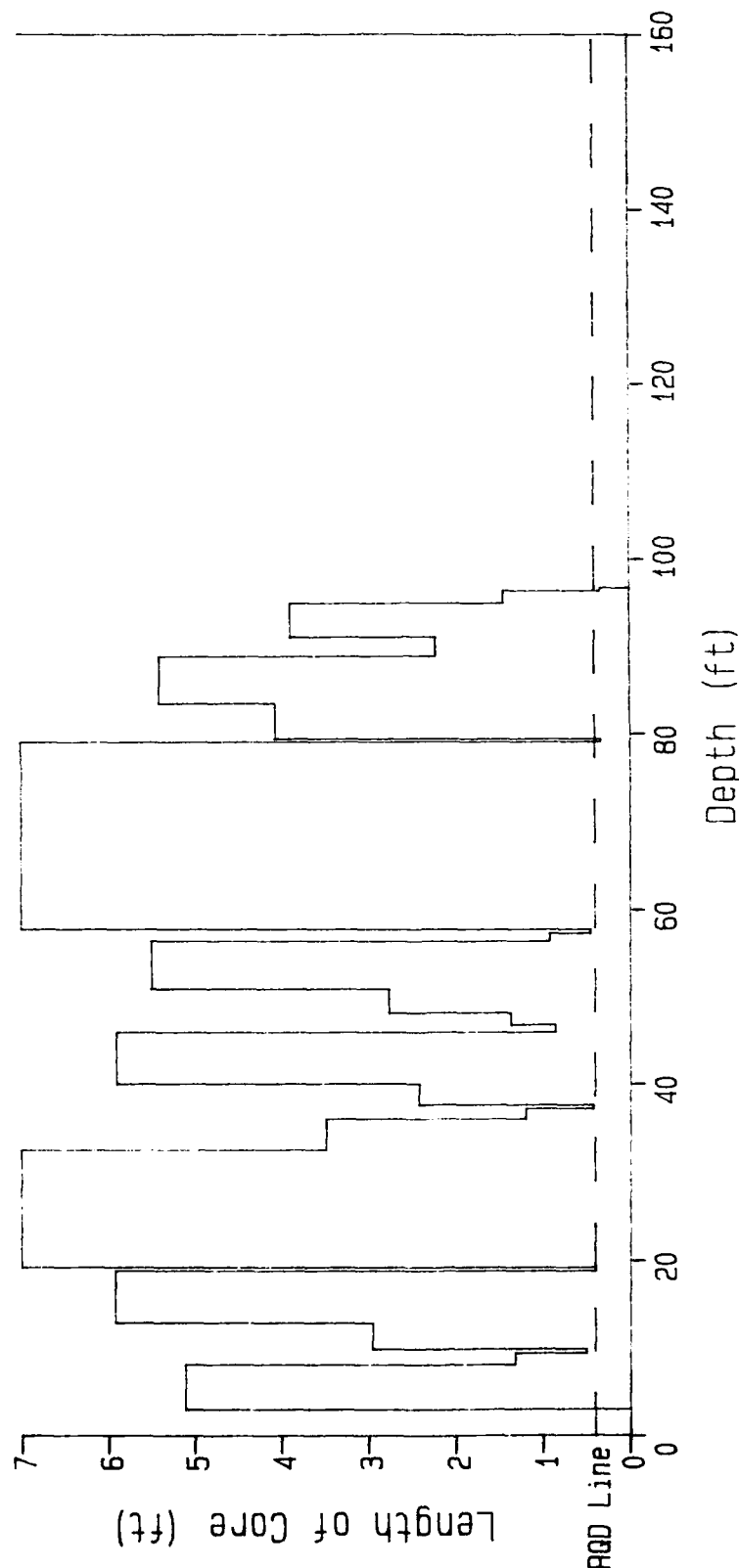
Orientation: Vertical

Direction: 0 Hade: 0

Photographed and Interpreted by the

Walla Walla District

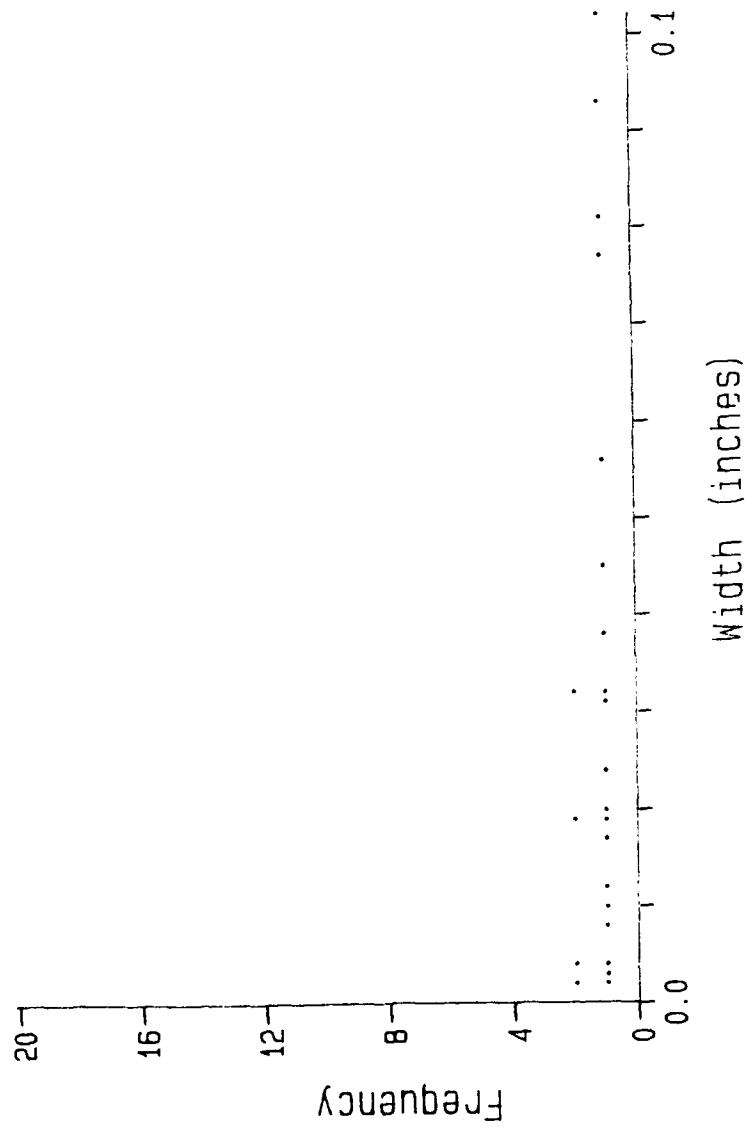
FRACTURE FREQUENCY PLOT



NOTE - Open fractures

Project Name: Cuchillo Damsite	
Drill Hole: CU-3	Hole Size: NX
Orientation: Vertical	
Direction: 0	Head: 0
Photographed and Interpreted by the Walla Walla District	

APERATURE DISTRIBUTION



There are 2 fractures not graphed.
 Largest aperture width = .17 inches.
 Median aperture width = .024 inch.

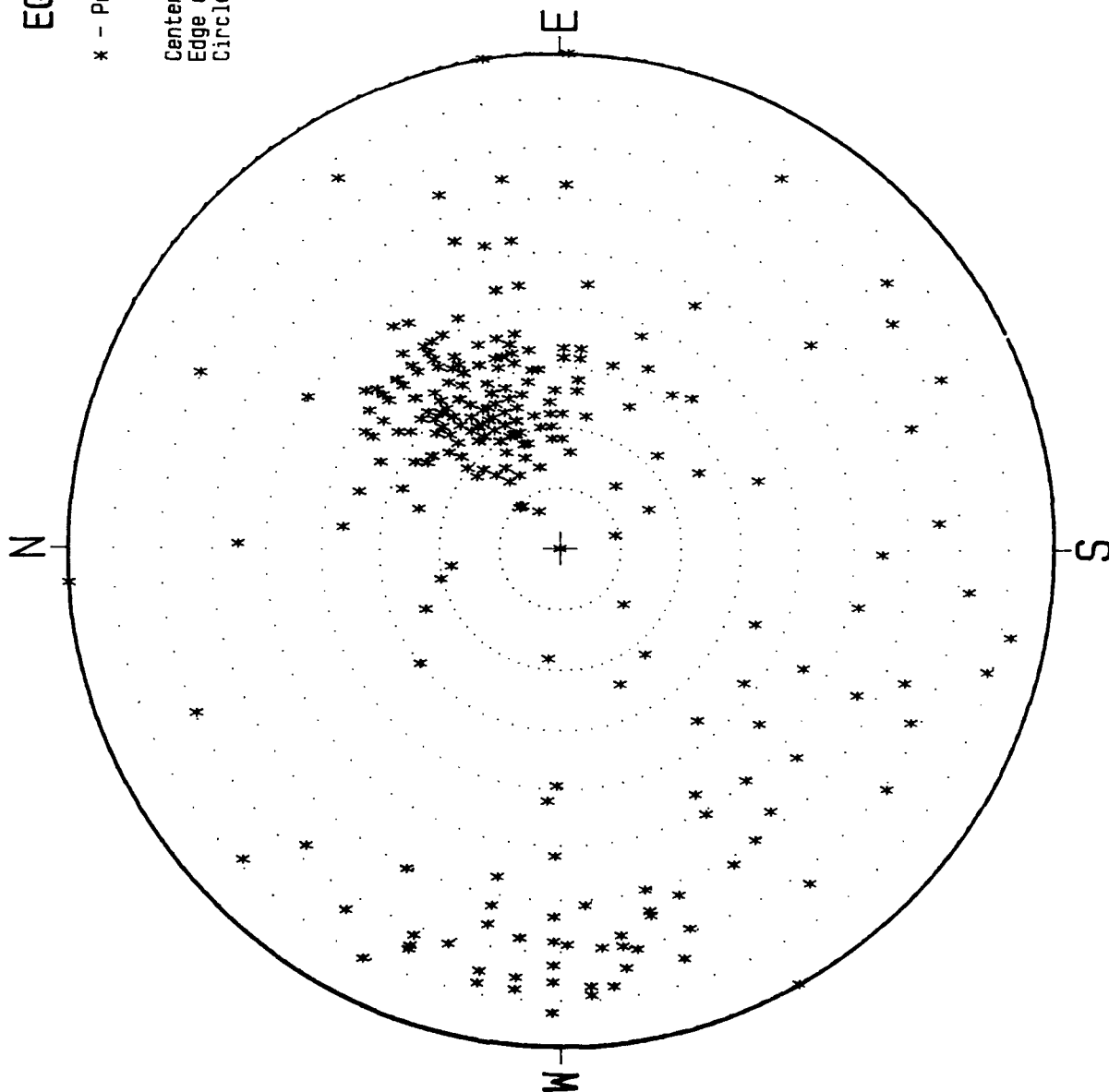
Project Name: Cuchillo Damsite	
Drill Hole: CU-3	Hole Size: NX
Orientation: Vertical	
Direction: 0	Grade: 0
Photographed and Interpreted by the Walla Walla District	

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

COMPOSITE GROUP
CU-1 CU-2
CU-3



Project Name: Cuchillo Damsite

Drill Hole: Composite Hole Size: N/A

Orientation: N/A

Direction: N/A Made: N/A

Photographed and Interpreted by the
Walla Walla District

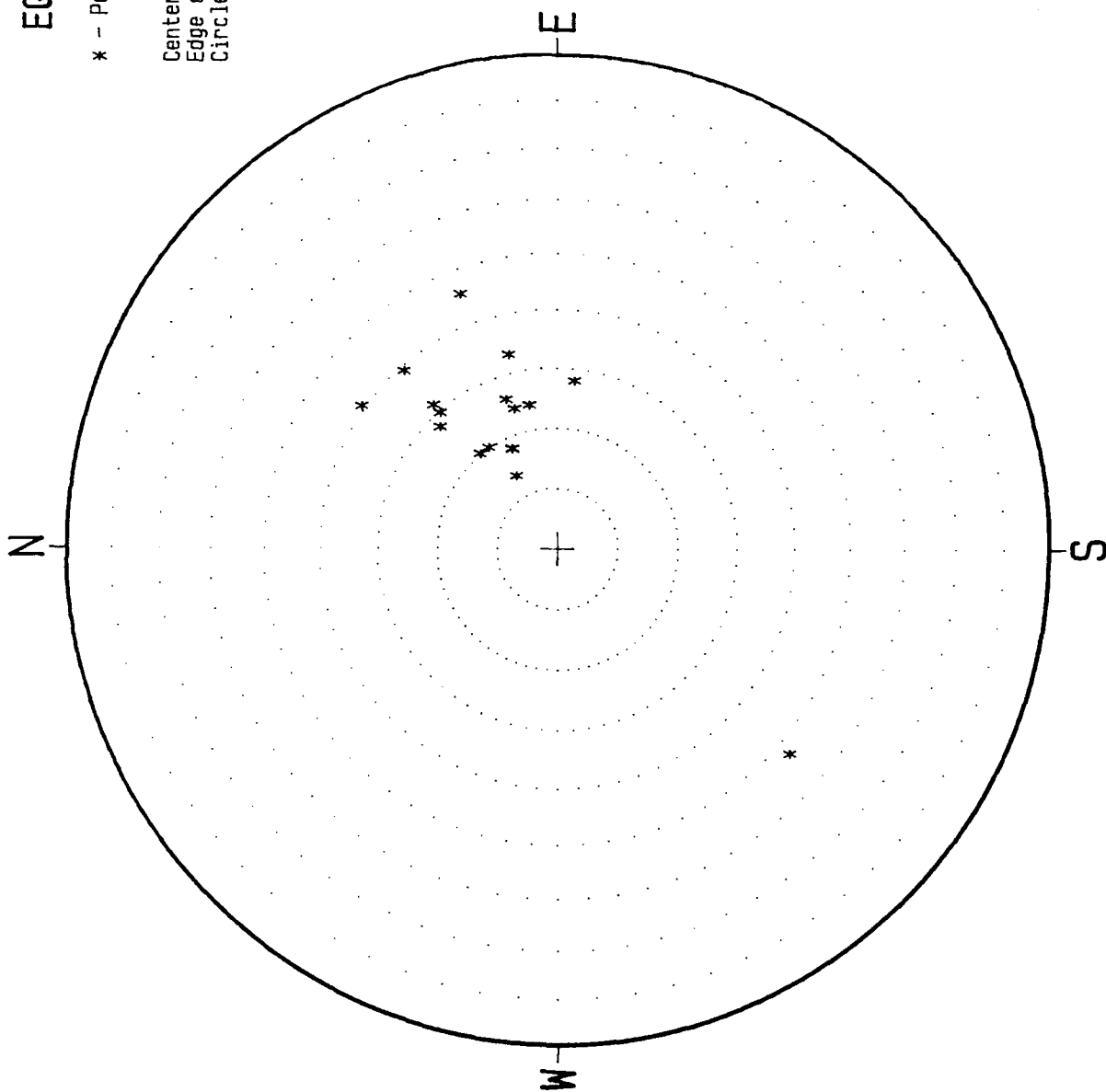
EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

COMPOSITE GROUP
CU-3 CU-2
CU-3

NOTE - Bedding features



Project Name: Cuchillo Damsite

Drill Hole: Composite Hole Size: N/A

Orientation: N/A

Direction: N/A Hade: N/A

Photographed and Interpreted by the
Walla Walla District

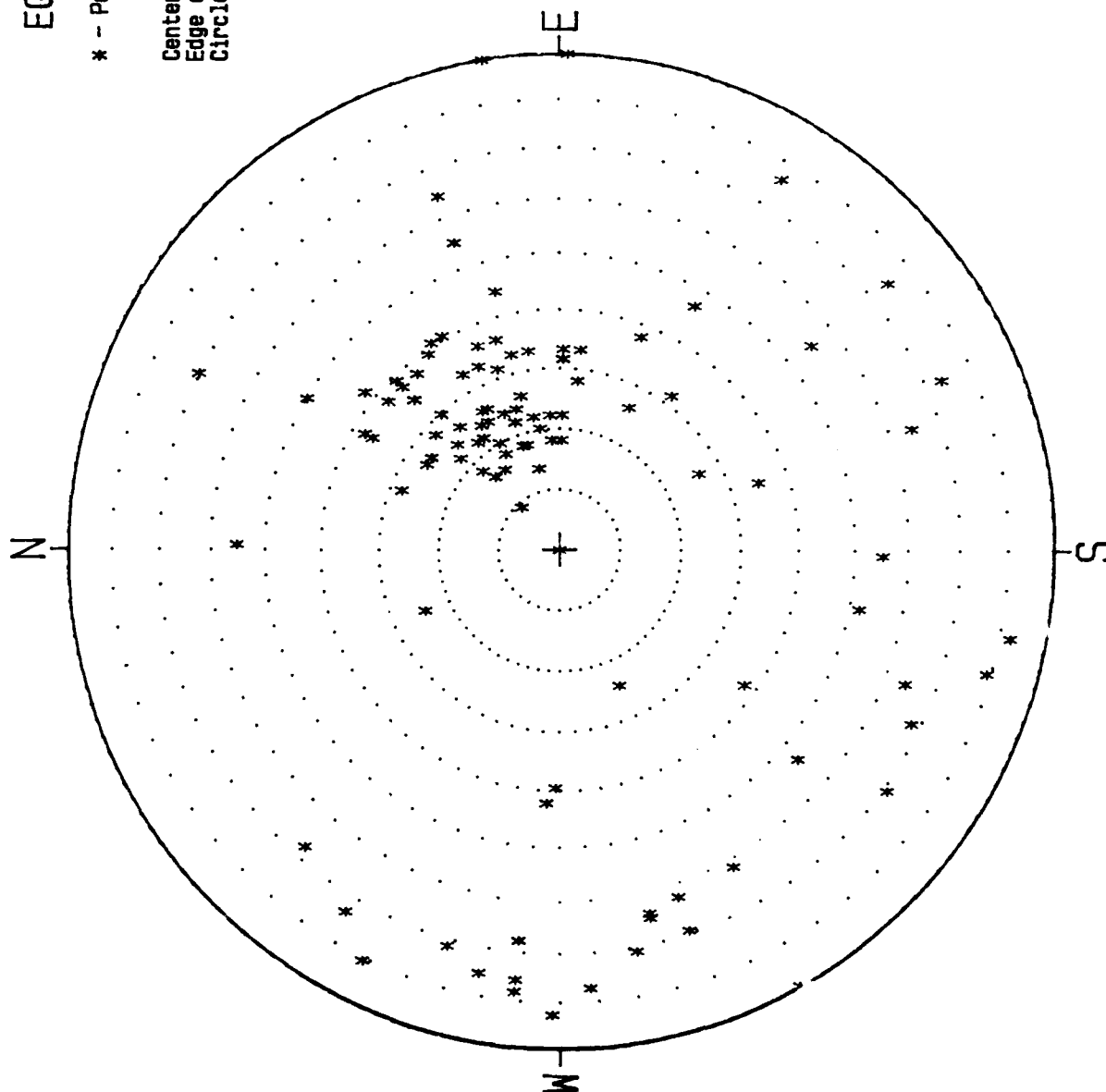
EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

COMPOSITE GROUP
CU-1 CU-2
CU-3

NOTE - Open fi actures only !!



Project Name: Cuchillo Damsite

Drill Hole: Composite Hole Size: N/A

Orientation: N/A

Direction: N/A Hade: N/A

Photographed and Interpreted by the
Walla Walla District

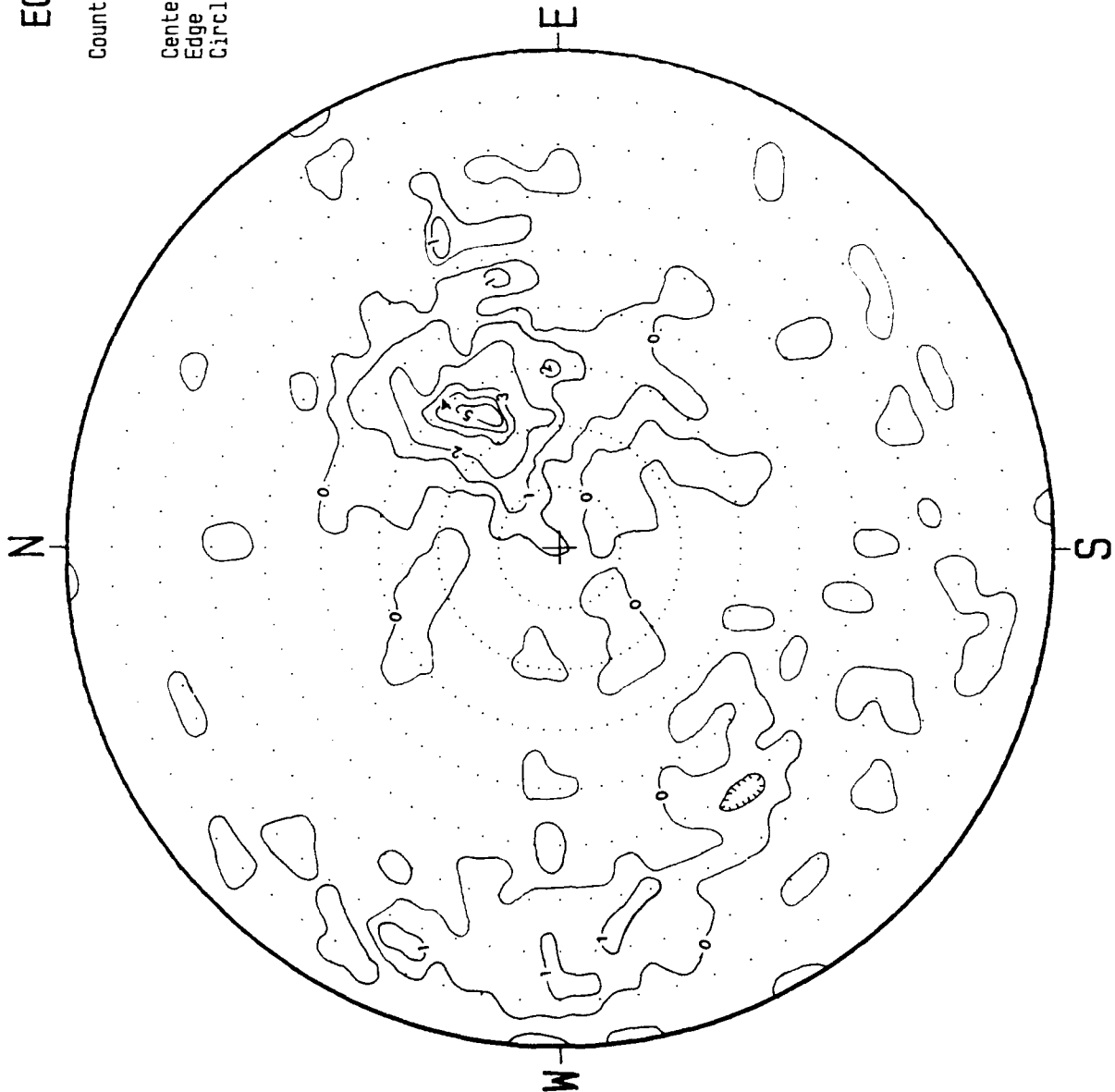
EQUAL AREA POLAR PLOT

Countours represent percent of poles
per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.

COMPOSITE GROUP

CU-1 CU-2
CU-3



Project Name: Cuchillo Damsite

Drill Hole: Composite Hole Size: N/A

Orientation: N/A

Direction: N/A Hade: N/A

Photographed and Interpreted by the
Walla Walla District

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14843-1 (11 pages)

PROJECT: CUCHILLO NEGRO DAM SITE : Contract No.
Feature: VIDEO INVESTIGATIONS OF SELECTED :
BOREHOLES :

TEST REQUEST NO.: E86890041 : From: Chief
Dated: 13 March 89 : Geotechnical Branch
Received: 15 March 1989 : Albuquerque District

Identification:

BOREHOLES CH-29, CH-30 and D-1

REMARKS:

SEE ATTACHED PAGES.

Report sent to: : Copy furnished:
Albuquerque District :

Date: : Name and title: : Signature
15 May 89 : WILLIAM R. TANNER :
: Director :
: SWD Laboratory :

CUCHILLO NEGRO DAM SITE
ALBUQUERQUE DISTRICT
VIDEO CAMERA INVESTIGATION
SWDED-GL REPORT NO. 14843-1

1. REFERENCE: Reference is made to Albuquerque District test request E86890041, dated 13 March 1989, requesting video camera investigations of selected borings.

2. REPORT: Attached are the results of the findings of this field investigation.

BOREHOLE ANALYSIS Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
0.0					Start video. Orientation data not available because rough hole walls only allowed use of the downward viewing camera head.
41.4					Bottom of casing.
42.0					Top of breakout.
42.8					Bottom of breakout.
44.0					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
46.1					End of broken zone.
46.5					Top of breakout.
47.0					Bottom of breakout.
48.4					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
50.5					Bottom of broken zone, top of sound rock, no open joints.
51.7					zone; rock broken, fragmented and Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
54.2					Bottom of broken zone, top of sound rock, no open joints.
57.1					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
60.9					Bottom of broken zone, top of sound rock, no open joints.
61.5					Bottom of sound rock, top of broken

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
63.4					Bottom of broken zone, top of sound rock, no open joints.
63.8					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
70.4					Bottom of broken zone, top of sound rock, no open joints, argillaceous zone 71.2'-71.6'.
72.2					Bottom of sound zone, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
74.4					Bottom of broken zone, top of argillaceous zone, boring walls intact, no open fractures.
75.2					Bottom of argillaceous zone, top of sound rock, no open joints.
76.2					Open joints appear, almost horizontal.
77.2					Open low angle joints.
77.4					Open low angle joints.
77.8					Open low angle joints.
78.5					Open low angle joints.
78.7					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
83.5					Bottom of broken zone.
81.8					Top of argillaceous zone, boring wall intact, rock appears competent.

BOREHOLE ANALYSIS Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
84.4					Open appearing joints.
85.4					Open appearing joints.
87.6					Open appearing joints.
89.0					Open appearing joints.
89.1					Rock becoming darker, not as weathered, but still argillaceous and sound.
89.2					Breakout along open joint.
89.4					Breakout along open joint.
90.1					Joint, appears open.
92.1					Top of three parallel joints, possibly open.
92.5					Bottom of joints.
97.3					Tight joint.
98.1					Bottom of argillaceous zone, top of transition zone, alternating argillaceous and nonargillaceous zones.
100.0					Bottom of transition zone, top of argillaceous zone, boring walls intact but rough.
103.3					Rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
104.5					Bottom of argillaceous and broken zones.
105.5					Tight joint.
105.8					Rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
109.4					Bottom of broken zone, top of sound rock.
109.8					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
113.4					Bottom of broken zone.
114.0					Joints, possibly open.

BOREHOLE ANALYSIS

Output Data

Project Name : CUCHILLO NEGRO DAM
 Drill Hole Name : BORING CH-29
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
114.4					Joints, possibly open.
115.3					Joints, possibly open.
115.5					Joints, possibly open; top of argillaceous zone, boring walls intact but rough.
117.6					Breakout, bottom of argillaceous zone.
119.1					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
138.2					Bottom of broken zone, top of argillaceous limestone, boring walls intact but rough, breakout at 140.5 .
143.7					Bottom of limestone, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-30
Drill Hole Size : 4
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					Boring drilled with air; 0.0'-2.5', 6 inch diameter, 2.5'-bottom, 4 inch diameter.
2.5					Bottom of casing.
10.9					Top of breakout, boring enlarged, probably due to drilling action.
11.6					Bottom of breakout.
14.5					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
18.2					Bottom of cavity.
21.5					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
23.2					Bottom of cavity.
26.1					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
28.0					Bottom of cavity.
32.0	120	61	0.0291	Healed	Light mineral filling.
34.5					Top of broken zone.
34.7					Bottom of broken zone.
34.0	75	86	0.0090	Healed	Light mineral filling.
39.8	90	72	0.0190	Healed	Light mineral filling.
43.6	0	50	0.0192	Healed	Light mineral filling.
55.5	45	50	0.0832	Healed	Light mineral filling.
62.3	45	42	0.0966	Healed	Light mineral filling.
63.3	270	70	0.0868	Healed	Light mineral filling.
67.9	290	56	0.0111	Healed	Light mineral filling.
69.2	45	42	--	Tight	Hairline.
73.4	295	67	0.0115	Healed	Light mineral filling.
81.2					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-30
Drill Hole Size : 4
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					extremely rough, jagged and cavitated, no orientation.
86.7					Bottom of cavity.
89.7					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
93.0					Bottom of cavity.
94.0					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
96.4					Bottom of cavity, top of dark argillaceous zone, boring walls rough, some breakouts noted, numerous hairline tight fractures to 0.03 inch wide with dip azimuths around 45 degrees.
130.6					Top of cavity.
132.0					Bottom of cavity.
136.0					Bottom of dark argillaceous zone, top of lithology change, lighter color and different texture, chalky appearance.
141.7					Boring becomes enlarged, rock broken.
145.0					Bottom of broken zone and light zone, lithology changes to dark argillaceous limestone.
145.9	180	83	0.0037	Healed	Light mineral filling.
149.1	30	56	0.1387	Healed	Light mineral filling.
151.0					Bottom of limestone, lithology changes, lighter color and different texture, chalky appearance.
155.0					Bottom of light zone, end of video.

BOREHOLE ANALYSIS
Output Data

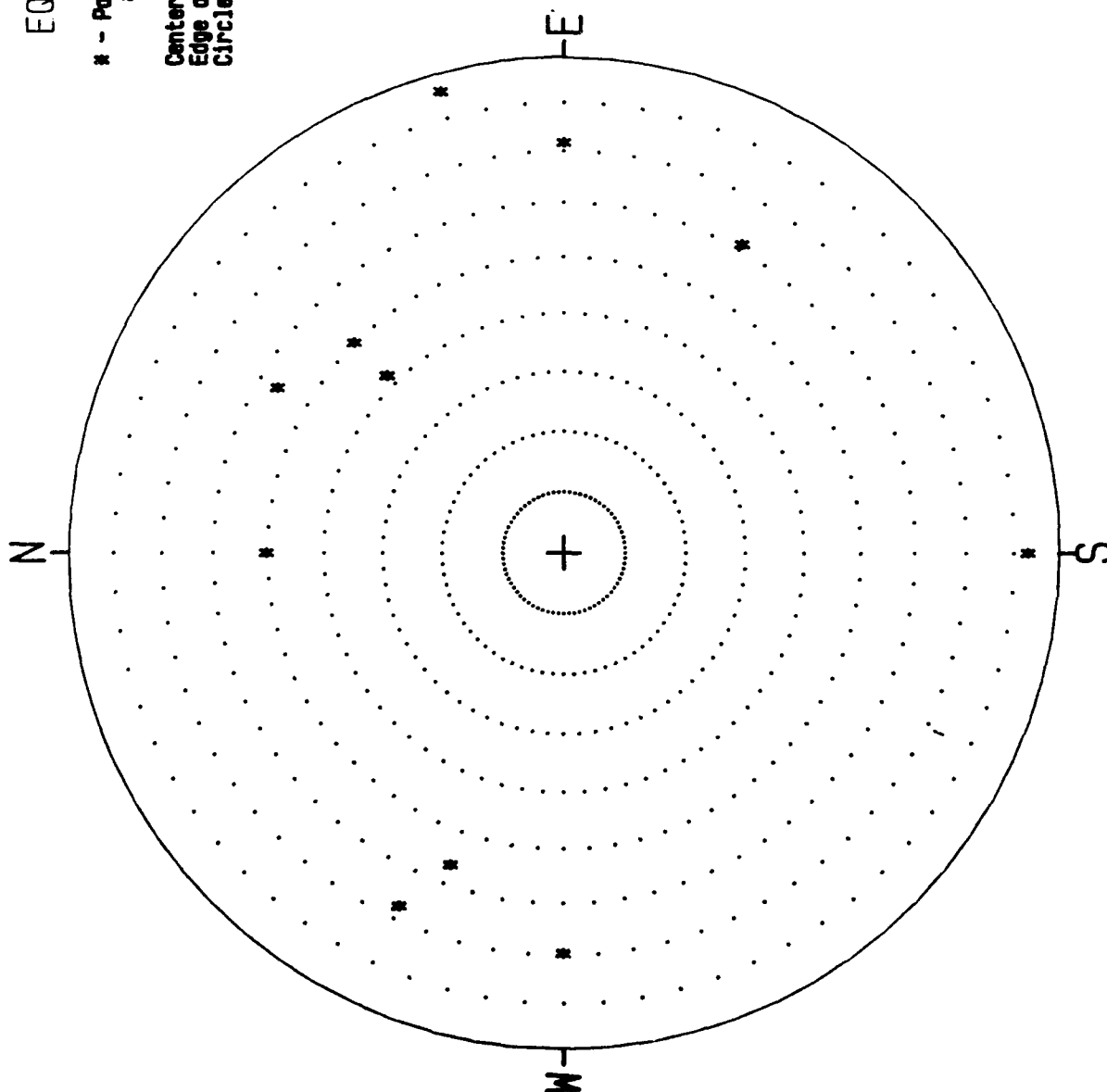
Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING D-1
Drill Hole Size : 6
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
9.6					Bottom of casing.
11.3	150	22	--	Tight	Hairline.
14.9	30	45	--	Tight	Hairline.
25.7	45	50	--	Tight	Hairline.
31.8					Top of rough argillaceous zone.
36.0					Bottom of rough argillaceous zone.
32.1	40	50	--	Tight	Hairline.
34.7	45	39	--	Tight	Hairline.
49.1					Top of breakout.
49.8					Bottom of breakout zone.
56.6	45	39	--	Tight	Hairline.
58.1	45	39	--	Tight	Hairline.
59.2					Top of breakout on SW side of boring.
61.3					Bottom of breakout on SW side of boring.
63.6					Top of cavity, boring enlarged, rock weathered, broken and fractured.
65.2					Bottom of cavity.
65.0	45	39	--	Tight	Hairline.
66.1	45	39	0.3904	Healed	Dark mineral filling.
67.1	210	31	0.0514	Healed	Dark mineral filling.
67.6	75	31	0.4287	Healed	Dark mineral filling.
71.7	45	50	--	Tight	Hairline.
73.6	45	45	--	Tight	Hairline.
75.8	45	39	0.1015	Healed	Dark mineral filling.
76.3	45	45	--	Tight	Hairline.
77.8	270	75	0.0153	Healed	Light mineral filling.
77.2	45	39	--	Tight	Hairline.
79.8	0	31	0.2144	Healed	Light mineral filling.
81.8	45	54	--	Tight	Hairline.
85.4	45	31	--	Tight	Hairline.
85.8					Top of cavity.
87.6					Bottom of cavity.
88.4					Top of cavity, boring enlarged, rock weathered, broken and friable.
94.0					Bottom of cavity, end of video.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHITILLO NEGRO DAM

Drill Hole : CH-30 Hole Size : 4

Orientation : Vertical

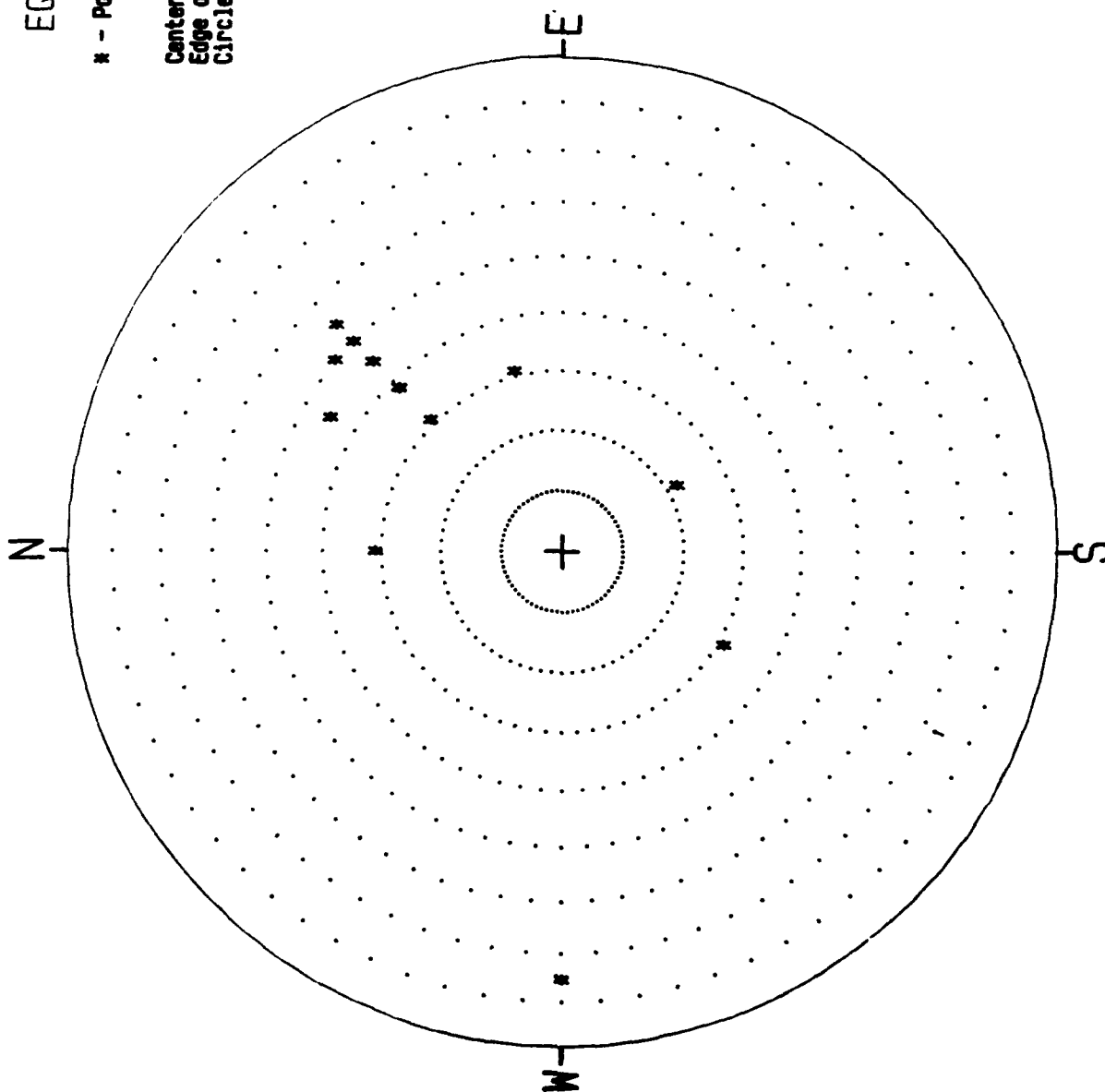
Direction : 0 Hade : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : D-1 Hole Size : 6

Orientation : Vertical

Direction : 0 Hade : 0

Photographed and Interpreted by the
Southwest Division Lab

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14843 (28 pages)

PROJECT: CUCHILLO NEGRO DAM SITE : Contract No.
Feature: VIDEO INVESTIGATIONS OF SELECTED :
BOREHOLES :

TEST REQUEST NO.: E86890041 : From: Chief
Dated: 13 March 89 : Geotechnical Branch
Received: 15 March 1989 : Albuquerque District

Identification:

BOREHOLES 19, 20, 21, 22, 23 and 26.

REMARKS:

SEE ATTACHED PAGES.

Report sent to: : Copy furnished:
Albuquerque District :
:

Date: : Name and title: : Signature
18 Apr 89 : WILLIAM R. TANNER :
: Director :
: SWD Laboratory :

BUCHILLO NEGRO DAM SITE
ALBUQUERQUE DISTRICT
VIDEO CAMERA INVESTIGATION
SWDED-GL REPORT NO. 14843

1. REFERENCE: Reference is made to Albuquerque District test request E86890041, dated 13 March 1989, requesting video camera investigations of selected borings.

2. REPORT: Attached are the results of the findings of this field investigation.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
1.3	1.3				Start video
19.5	19.9	60	0.1300	Closed	Light mineral filling.
23.2	23.4	265	0.0100	Tight	
23.4	23.7	50	0.0200	Closed	Light mineral filling.
27.1	27.5	45	0.0600	Open	
19.5	19.5				Rough zone, argillaceous, weathered
30.1	30.1				Bottom of rough zone, top of sound rock
38.0	38.5	280	0.0600	Closed	Light mineral filling.
40.9	41.4	280	0.0600	Closed	Light mineral filling.
41.0	41.3	50	0.0600	Closed	Light mineral filling.
41.5	41.9	80	0.0600	Closed	Light mineral filling.
43.4	44.4	180	0.1300	Closed	Light mineral filling.
51.9	51.9				Rough zone, weathered, argillaceous
54.2	54.2				Bottom of rough zone
55.9	55.9				Top of cavity
57.0	57.0				Bottom of cavity
58.6	59.0	45	0.0000	Tight	Hairline
60.7	61.3	240	0.0000	Tight	Hairline
61.2	61.2				Top of cavity.
63.5	63.5				Bottom of cavity.
63.6	63.8	210	0.0000	Closed	Hairline.
63.6	63.8	255	0.0000	Closed	Hairline.
63.8	64.2	45	0.0600	Closed	Light mineral filling.
					Bedding noted.
64.3	64.7	45	0.0300	Closed	Light mineral filling.
65.1	65.4	45	0.0300	Closed	Light mineral filling.
65.9	66.3	45	0.0300	Closed	Light mineral filling.
67.0	67.6	35	0.2500	Closed	Light mineral filling.
67.8	68.9	260	0.0300	Open	Breakout, boring enlarged.
69.8	70.2	45	0.0300	Open	Broken along fracture plane.
69.8	70.2	45	0.0300	Open	Broken along fracture planes.
70.8	71.4	255	0.0600	Closed	Light mineral filling.
71.1	71.7	250	0.1300	Closed	Light mineral filling.
73.2	73.5	45	0.0600	Closed	Light mineral filling.
74.5	74.8	45	0.0600	Closed	Light mineral filling.
75.9	76.2	45	0.0600	Closed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
 Drill Hole Name : BORING 19
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
77.7	78.2	45	0.5000	Tight	Light mineral filling. Some rock broken due to drilling.
79.0	79.6	270	0.4000	Tight	Light mineral filling. Rock broken, some missing along plane.
80.3	80.8	30	0.3000	Open	
82.2	82.2				Top of cavity.
85.0	85.0				Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
1.3					Start video
19.7	60	52	0.0805	Closed	Light mineral filling.
23.3	265	32	0.0084	Tight	
23.5	50	44	0.0145	Closed	Light mineral filling.
27.3	45	52	0.0371	Open	
19.5					Rough zone, argillaceous, weathered
30.1					Bottom of rough zone, top of sound rock
38.3	280	58	0.0320	Closed	Light mineral filling.
41.2	280	58	0.0320	Closed	Light mineral filling.
41.2	50	44	0.0435	Closed	Light mineral filling.
41.7	80	52	0.0371	Closed	Light mineral filling.
43.9	180	73	0.0391	Closed	Light mineral filling.
51.9					Rough zone, weathered, argillaceous
54.2					Bottom of rough zone
55.9					Top of cavity
57.0					Bottom of cavity
58.8	45	52	0.0000	Tight	Hairline
61.0	240	62	0.0000	Tight	Hairline
61.2					Top of cavity.
63.5					Bottom of cavity.
63.7	210	32	0.0000	Closed	Hairline.
63.7	255	32	0.0000	Closed	Hairline.
64.0	45	52	0.0371	Closed	Light mineral filling. Bedding noted.
64.5	45	52	0.0186	Closed	Light mineral filling.
65.3	45	44	0.0217	Closed	Light mineral filling.
66.1	45	52	0.0186	Closed	Light mineral filling.
67.3	35	62	0.1163	Closed	Light mineral filling.
68.3	260	74	0.0083	Open	Breakout, boring enlarged.
70.0	45	52	0.0186	Open	Broken along fracture plane.
70.0	45	52	0.0186	Open	Broken along fracture planes.
71.1	255	62	0.0279	Closed	Light mineral filling.
71.4	250	62	0.0605	Closed	Light mineral filling.
73.3	45	44	0.0435	Closed	Light mineral filling.
74.7	45	44	0.0435	Closed	Light mineral filling.
76.1	45	44	0.0435	Closed	Light mineral filling.

BOREHOLE ANALYSIS

Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
77.9	45	58	0.2666	Tight	Light mineral filling. Some rock broken due to drilling.
79.3	270	62	0.1860	Tight	Light mineral filling. Rock broken, some missing along plane.
80.6	30	58	0.1600	Open	
82.2					Top of cavity.
85.0					Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
6.3	6.3				Bottom of casing.
8.1	8.4	135	0.0200	Open	
10.5	10.8	0	0.0200	Ptly Open	
20.3	21.5	100	0.0600	Ptly Open	Rock broken and some missing.
21.7	22.3	180	0.0600	Ptly Open	Rock broken and some missing.
29.0	29.0				Rock broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
50.3	50.3				Bottom of broken zone.
51.6	52.0	90	0.0600	Tight	Bedding visible.
52.2	52.2				Rough zone, argillaceous.
52.6	52.6				Bottom of rough zone.
54.1	54.7	40	0.0100	Tight	
54.7	54.7				Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
60.8	60.8				Bottom of broken zone.
61.7	62.0	45	0.0200	Tight	
62.7	62.7				Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
66.2	66.2				Bottom of rough zone.
66.3	67.0	45	0.0100	Tight	Fractures, rock broken along fracture plane.
67.6	67.6				Boring walls intact, but rough, argillaceous zone.
71.7	71.7				Bottom of argillaceous zone, top of cavity on SE side of boring wall.
75.6	75.6				Bottom of cavity, boring walls intact, but rough with some small break outs, probably due to drilling rock, argillaceous.
81.3	81.3				Bottom of argillaceous zone, rock is

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
 Drill Hole Name : BORING 20
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
89.0	89.0				highly broken, boring enlarged walls are extremely rough, jagged and cavitated, no orientations. Bottom of broken zone, blocked, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
6.3					Bottom of casing.
8.3	135	44	0.0145	Open	
10.6	0	44	0.0145	Ptly Open	
20.9	100	75	0.0152	Ptly Open	Rock broken and some missing.
22.0	180	62	0.0279	Ptly Open	Rock broken and some missing.
29.0					Rock broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
50.3					Bottom of broken zone.
51.8	90	52	0.0371	Tight	Bedding visible.
52.2					Rough zone, argillaceous.
52.6					Bottom of rough zone.
54.4	40	62	0.0047	Tight	
54.7					Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
60.8					Bottom of broken zone.
61.8	45	44	0.0145	Tight	
62.7					Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
66.2					Bottom of rough zone.
66.7	45	66	0.0041	Tight	Fractures, rock broken along fracture plane.
67.6					Boring walls intact, but rough, argillaceous zone.
71.7					Bottom of argillaceous zone, top of cavity on SE side of boring wall.
75.6					Bottom of cavity, boring walls intact, but rough with some small break outs, probably due to drilling rock, argillaceous.
81.3					Bottom of argillaceous zone, rock is

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
89.0					highly broken, boring enlarged walls are extremely rough, jagged and cavitated, no orientations. Bottom of broken zone, blocked, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
19.7	19.7				Bottom of casing.
20.0	20.0				Cavity, rock broken, weathered, no orientation.
21.1	21.1				Bottom of cavity.
24.3	25.1	270	0.0100	Tight	
25.1	25.5	45	0.0100	Tight	
30.4	30.6	45	0.0100	Tight	Bedding visible.
31.0	31.3	45	0.0100	Tight	
32.6	32.8	45	0.0100	Tight	
42.8	43.1	45	0.0300	Ptly Open	
42.8	42.8				Numerous light mineral filled stringers and hairline tight fractures dip azimuths 45 and 270 degrees.
50.0	50.2	45	0.0300	Ptly Open	
52.3	52.6	0	0.0200	Ptly Open	
53.0	54.7	300	0.1300	Open	
61.6	62.1	250	0.1300	Closed	Light mineral filling.
63.1	63.6	45	0.0200	Ptly Open	
63.8	64.5	70	0.0200	Ptly Open	
64.6	64.9	45	0.0100	Tight	
64.8	65.2	45	0.0100	Tight	
66.7	67.0	30	0.0100	Tight	
74.1	74.3	45	0.0200	Ptly Open	
77.1	77.5	35	0.4000	Ptly Open	Top of broken zone.
77.5	77.9	35	0.0000	Open	Bottom of broken zone, boring enlarged.
85.0	85.0				Top of cavity.
87.8	87.8				Bottom of cavity.
88.4	88.8	45	0.1300	Closed	Light mineral filling.
94.9	95.1	45	0.2500	Closed	Light mineral filling.
98.1	99.0	225	0.4000	Closed	Light mineral filling.
98.8	99.1	45	0.1300	Closed	Light mineral filling.
100.2	100.7	90	0.0600	Ptly Open	Light mineral filling.
101.8	102.1	45	0.0300	Ptly Open	
104.5	104.8	45	0.0200	Ptly Open	Light mineral filling.
105.7	106.0	65	0.6000	Open	Rock broken.
109.2	111.0	225	0.7000	Ptly Open	Light mineral filling.

BOREHOLE ANALYSIS Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
113.2	113.5	40	0.0100	Tight	
117.6	117.9	45	0.0100	Tight	Rough due to drill action.
125.1	126.5	45	0.0100	Tight	Rough zone, possibly argillaceous, some rock missing.
126.6	126.6				Top of cavity, rock broken, 45 degree dip azimuth.
127.6	127.6				Bottom of cavity.
127.8	127.8				Rough zone, some rock broken and miss- ing, possibly argillaceous.
128.4	128.8	45	0.0200	Open	Complex numerous hairline tight connect- ing fractures.
128.7	130.0	45	0.0300	Tight	To partially open.
130.0	130.0				Top of cavity.
131.0	131.0				Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
19.7					Bottom of casing.
20.0					Cavity, rock broken, weathered, no orientation.
21.1					Bottom of cavity.
24.7	270	68	0.0037	Tight	
25.3	45	52	0.0062	Tight	
30.5	45	32	0.0084	Tight	Bedding visible.
31.1	45	44	0.0072	Tight	
32.7	45	32	0.0084	Tight	
43.0	45	44	0.0217	Ptly Open	
42.8					Numerous light mineral filled stringers and hairline tight fractures dip azimuths 45 and 270 degrees.
50.1	45	32	0.0253	Ptly Open	
52.5	0	44	0.0145	Ptly Open	
53.8	300	79	0.0237	Open	
61.8	250	58	0.0693	Closed	Light mineral filling.
63.3	45	58	0.0107	Ptly Open	
64.2	70	66	0.0082	Ptly Open	
64.8	45	44	0.0072	Tight	
65.0	45	52	0.0062	Tight	
66.8	30	44	0.0072	Tight	
74.2	45	32	0.0169	Ptly Open	
77.3	35	52	0.2476	Ptly Open	Top of broken zone.
77.7	35	52	0.0000	Open	Bottom of broken zone, boring enlarged.
85.0					Top of cavity.
87.8					Bottom of cavity.
88.6	45	52	0.0805	Closed	Light mineral filling.
95.0	45	32	0.2111	Closed	Light mineral filling.
98.6	225	71	0.1322	Closed	Light mineral filling.
98.9	45	44	0.0942	Closed	Light mineral filling.
100.4	90	58	0.0320	Ptly Open	Light mineral filling.
101.9	45	44	0.0217	Ptly Open	
104.7	45	44	0.0145	Ptly Open	Light mineral filling.
105.8	65	44	0.4346	Open	Rock broken.
110.1	225	80	0.1207	Ptly Open	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
113.3	40	44	0.0072	Tight	
117.8	45	44	0.0072	Tight	Rough due to drill action.
125.8	45	77	0.0022	Tight	Rough zone, possibly argillaceous, some rock missing.
126.6					Top of cavity, rock broken, 45 degree dip azimuth.
127.6					Bottom of cavity.
127.8					Rough zone, some rock broken and missing, possibly argillaceous.
128.6	45	52	0.0124	Open	Complex numerous hairline tight connecting fractures.
129.4	45	76	0.0071	Tight	To partially open.
130.0					Top of cavity.
131.0					Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
 Drill Hole Name : BORING 22
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
0.0	0.0				Bottom of casing, boring walls sound, no broken zones or cavities.
54.3	54.6	45	0.2500	Ptly Open	Rock broken.
91.5	92.4	45	0.2500	Open	Rock broken along fracture plane.
93.9	93.9				Cloudy water, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
 Drill Hole Name : BORING 22
 Drill Hole Size : HQ
 Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
0.0					Bottom of casing, boring walls sound, no broken zones or cavities.
54.5	45	44	0.1811	Ptly Open	Rock broken.
91.9	45	71	0.0826	Open	Rock broken along fracture plane.
93.9					Cloudy water, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : CH-23
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
25.4	25.4				Start video.
27.9	27.9				Bottom of casing.
28.7	28.9	45	0.0000	Tight	Hairline.
27.9	27.9				Boring walls rough, weathered and argillaceous.
33.0	33.0				Bottom of rough zone.
36.8	37.1	45	0.0000	Tight	Hairline.
39.9	40.6	210	0.0600	Tight	Light mineral filling.
42.0	42.7	255	0.0600	Tight	Light mineral filling.
45.4	45.7	45	0.0300	Open	
47.5	48.9	265	0.0600	Closed	Light mineral filling.
48.2	49.6	265	0.0600	Closed	Light mineral filling.
51.8	52.2	45	0.0000	Tight	Hairline.
52.9	52.9				Top of cavity.
59.8	59.8				Bottom of cavity.
60.5	60.9	90	0.0300	Open	
64.0	64.3	45	0.0000	Tight	Hairline.
64.6	65.0	65	0.0300	Ptly Open	
65.1	65.5	270	0.0000	Tight	Hairline.
65.4	65.8	150	0.0000	Tight	Hairline.
65.4	65.9	150	0.0000	Tight	Hairline.
65.7	65.7				Top of cavity.
67.5	67.5				Bottom of cavity.
68.9	69.7	195	0.1300	Closed	Light mineral filling.
85.4	85.4				Top of cavity.
86.0	86.0				Bottom of cavity.
85.9	86.1	225	0.0000	Tight	Hairline.
87.6	87.6				Cloudy water.
88.4	88.8	30	0.0000	Tight	Hairline.
89.6	89.9	180	0.2500	Closed	Light mineral filling.
94.6	94.6				End video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : CH-23
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
25.4					Start video.
27.9					Bottom of casing.
28.8	45	32	0.0000	Tight	Hairline.
27.9					Boring walls rough, weathered and argillaceous.
33.0					Bottom of rough zone.
37.0	45	44	0.0000	Tight	Hairline.
40.3	210	66	0.0246	Tight	Light mineral filling.
42.3	255	66	0.0246	Tight	Light mineral filling.
45.5	45	44	0.0217	Open	
48.2	265	77	0.0132	Closed	Light mineral filling.
48.9	265	77	0.0132	Closed	Light mineral filling.
52.0	45	52	0.0000	Tight	Hairline.
52.9					Top of cavity.
59.8					Bottom of cavity.
60.7	90	52	0.0186	Open	
64.2	45	44	0.0000	Tight	Hairline.
64.8	65	52	0.0186	Ptly Open	
65.3	270	52	0.0000	Tight	Hairline.
65.6	150	52	0.0000	Tight	Hairline.
65.7	150	58	0.0000	Tight	Hairline.
65.7					Top of cavity.
67.5					Bottom of cavity.
69.3	195	68	0.0477	Closed	Light mineral filling.
85.4					Top of cavity.
86.0					Bottom of cavity.
86.0	225	32	0.0000	Tight	Hairline.
87.6					Cloudy water.
88.6	30	52	0.0000	Tight	Hairline.
89.8	180	44	0.1811	Closed	Light mineral filling.
94.6					End video.

BOREHOLE ANALYSIS Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
10.6	10.6				Bottom of casing.
17.3	17.9		0.0000	Open	Rock broken, no orientation.
20.8	21.1	105	0.0100	Tight	Rock broken and fractured.
22.6	22.8	90	0.0100	Tight	Rock broken and fractured.
22.7	23.0	90	0.0100	Tight	Rock broken and fractured.
29.9	30.2	90	0.0200	Closed	Light mineral stringer.
32.3	37.8	90	0.0200	Tight	Light mineral filling, hairline, numerous fractures and stringers.
33.6	33.7	90	0.1300	Closed	Light mineral filling.
38.3	38.3				Rough sound argillaceous zone, breakout at top contact.
42.6	42.6				Bottom of rough zone, top of sound limestone.
46.8	46.8				Bottom of limestone, top of rough, sound argillaceous limestone.
48.1	48.4		0.2500	Ptly Open	Fracture discontinuous, no orientation.
56.3	56.3				Bottom of rough sound limestone.
59.4	59.6	50	0.1300	Ptly Open	Partly filled with light mineral.
62.8	62.8				Rough argillaceous zone; at 64.2', boring becomes enlarged, some rock missing, boring walls very rough and jagged; 65.6' walls no longer enlarged or broken, but still have rough argillaceous appearance.
66.6	66.6				Bottom of rough zone, top of sound rock.
67.1	67.1				Bottom of sound rock, top of cavity, rock broken, rough and weathered.
68.8	68.8				Bottom of cavity, top of sound limestone.
69.3	69.3				Bottom of limestone, top of rough argillaceous zone.
70.8	70.8				Bottom of rough zone, top of sound limestone.
71.0	71.0				Bottom of limestone, top of cavity, rock is rough, broken out and weathered.
72.3	72.3				Bottom of cavity, top of rough

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
74.8	74.8				argillaceous zone. Bottom of rough zone, top of sound limestone.
74.7	74.9	65	0.0200	Tight	
76.4	76.4				Bottom of limestone, top of rough, sound argillaceous zone.
76.9	76.9				Breakout, enlarged.
77.1	77.1				Bottom of rough zone and breakout, top of sound limestone.
78.8	78.8				Breakout.
79.2	79.2				Breakout.
79.7	79.7				Breakout.
80.1	80.1				Bottom of limestone, top of rough, broken argillaceous zone, boring enlarged.
90.4	90.4				Bottom of rough zone, top of sound limestone.
91.7	91.7				Bottom of limestone, top of cavity, rock is rough and argillaceous.
94.0	94.0				Bottom of cavity.
93.4	94.4	315	0.1300	Open	
94.5	94.5				Top of sound limestone.
95.3	95.3				Bottom of sound limestone, one side of boring broken out into cavity.
96.3	96.3				Bottom of cavity.
96.8	96.8				Breakout.
97.3	97.3				Breakout.
98.1	98.1				Top of cavity.
99.0	99.0				Bottom of cavity, honey bees crawling on bottom, end video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
10.6					Bottom of casing.
17.6		62	0.0000	Open	Rock broken, no orientation.
21.0	105	44	0.0072	Tight	Rock broken and fractured.
22.7	90	32	0.0084	Tight	Rock broken and fractured.
22.9	90	44	0.0072	Tight	Rock broken and fractured.
30.0	90	44	0.0145	Closed	Light mineral stringer.
35.0	90	87	0.0011	Tight	Light mineral filling, hairline, numerous fractures and stringers.
33.7	90	18	0.1239	Closed	Light mineral filling.
38.3					Rough sound argillaceous zone, breakout at top contact.
42.6					Bottom of rough zone, top of sound limestone.
46.8					Bottom of limestone, top of rough, sound argillaceous limestone.
48.3		44	0.1811	Ptly Open	Fracture discontinuous, no orientation.
56.3					Bottom of rough sound limestone.
59.5	50	32	0.1098	Ptly Open	Partly filled with light mineral.
62.8					Rough argillaceous zone; at 64.2', boring becomes enlarged, some rock missing, boring walls very rough and jagged; 65.6' walls no longer enlarged or broken, but still have rough argillaceous appearance.
66.6					Bottom of rough zone, top of sound rock.
67.1					Bottom of sound rock, top of cavity, rock broken, rough and weathered.
68.8					Bottom of cavity, top of sound limestone.
69.3					Bottom of limestone, top of rough argillaceous zone.
70.8					Bottom of rough zone, top of sound limestone.
71.0					Bottom of limestone, top of cavity, rock is rough, broken out and weathered.
72.3					Bottom of cavity, top of rough

BOREHOLE ANALYSIS
Output Data

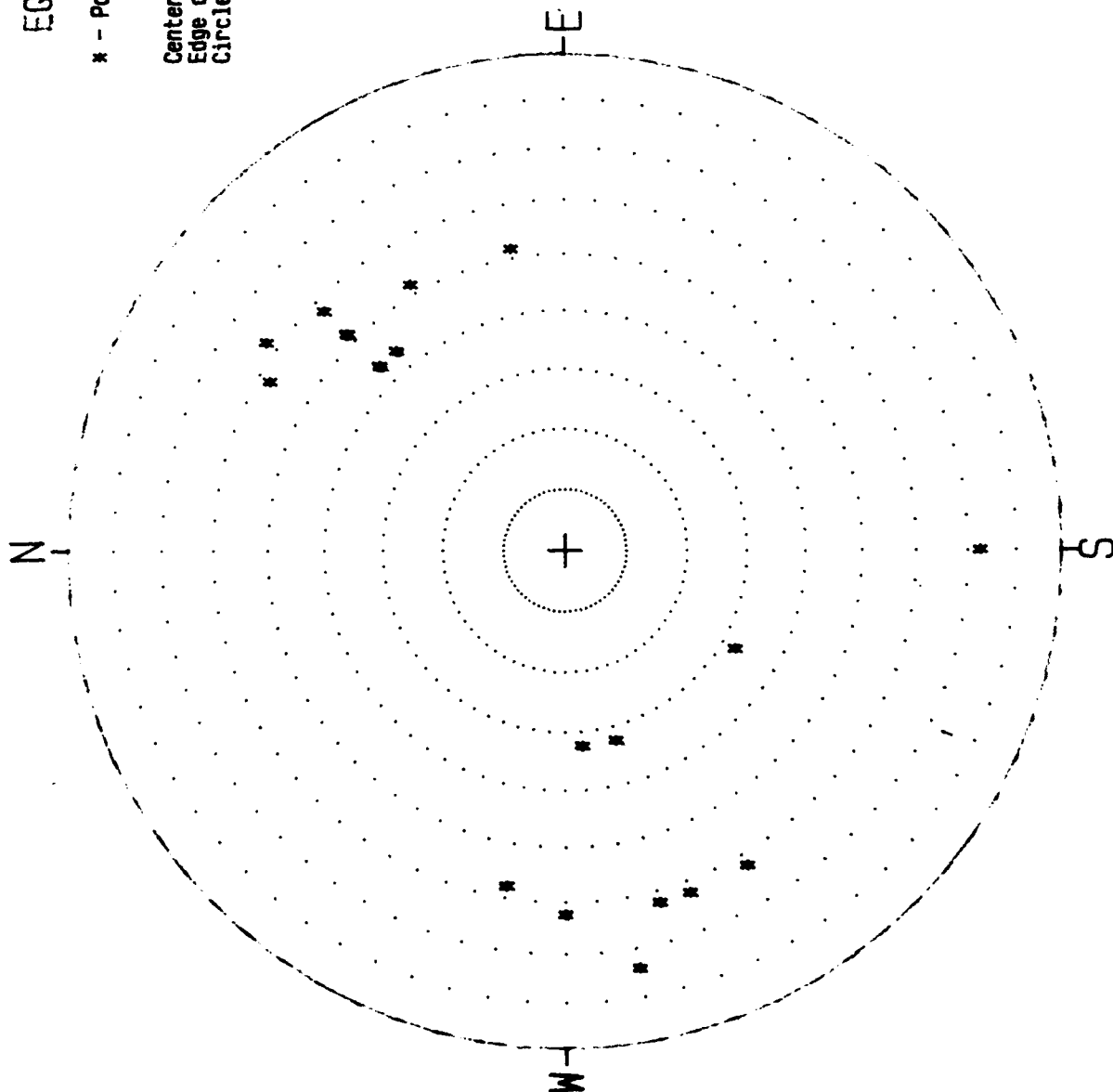
Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
74.8					argillaceous zone. Bottom of rough zone, top of sound limestone.
74.8 76.4	65	32	0.0169	Tight	Bottom of limestone, top of rough, sound argillaceous zone. Breakout, enlarged. Bottom of rough zone and breakout, top of sound limestone.
76.9 77.1					Breakout. Breakout.
78.8 79.2 79.7 80.1					Breakout. Breakout. Bottom of limestone, top of rough, broken argillaceous zone, boring enlarged.
90.4					Bottom of rough zone, top of sound limestone.
91.7					Bottom of limestone, top of cavity, rock is rough and argillaceous. Bottom of cavity.
94.0 93.9 94.5 95.3	315	73	0.0391	Open	Top of sound limestone. Bottom of sound limestone, one side of boring broken out into cavity. Bottom of cavity.
96.3 96.8 97.3 98.1 99.0					Breakout. Breakout. Top of cavity. Bottom of cavity, honey bees crawling on bottom, end video.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 19 Hole Size : HQ

Orientation : Vertical

Direction : 0

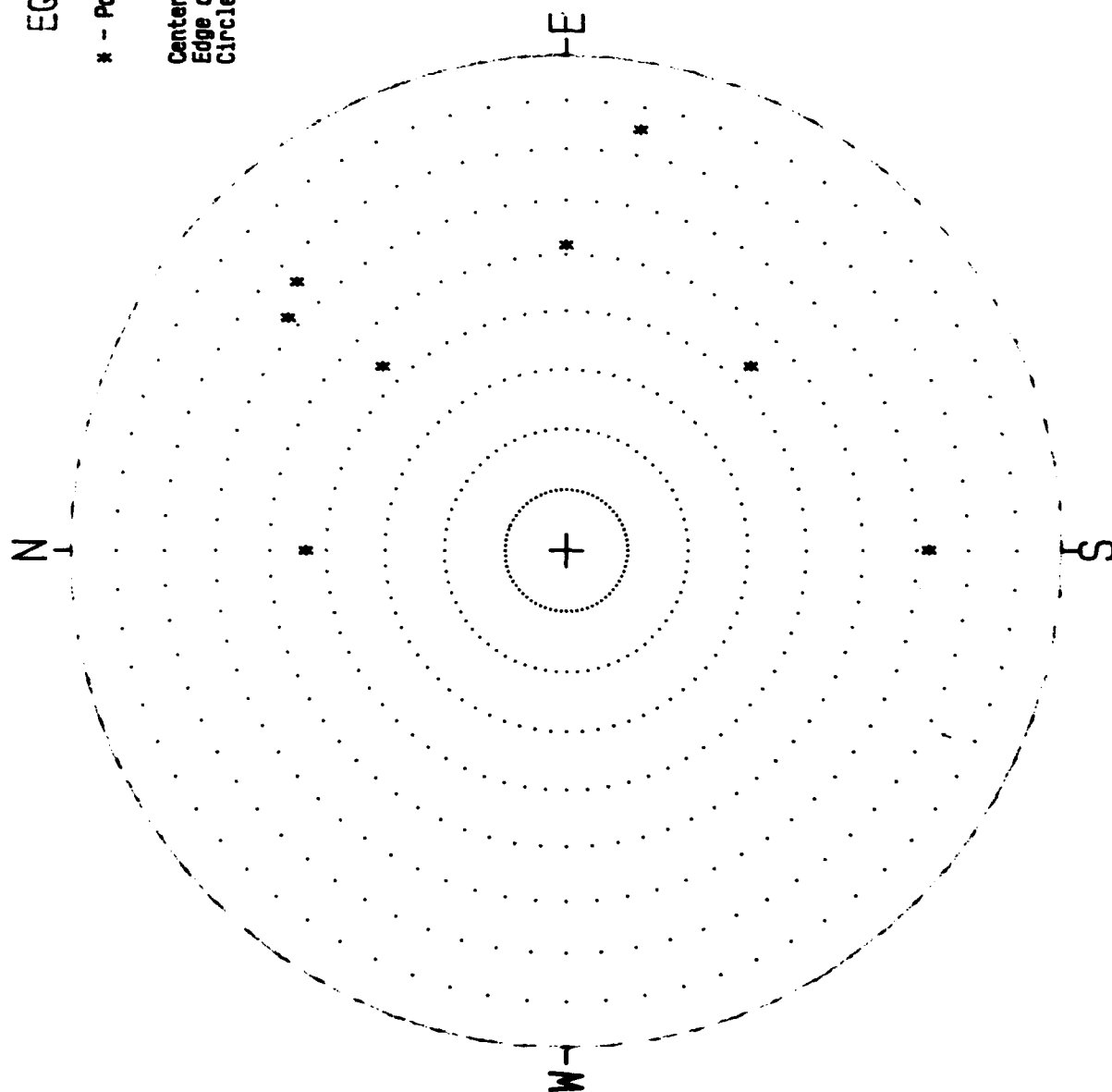
Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 20 Hole Size : HQ

Orientation : Vertical

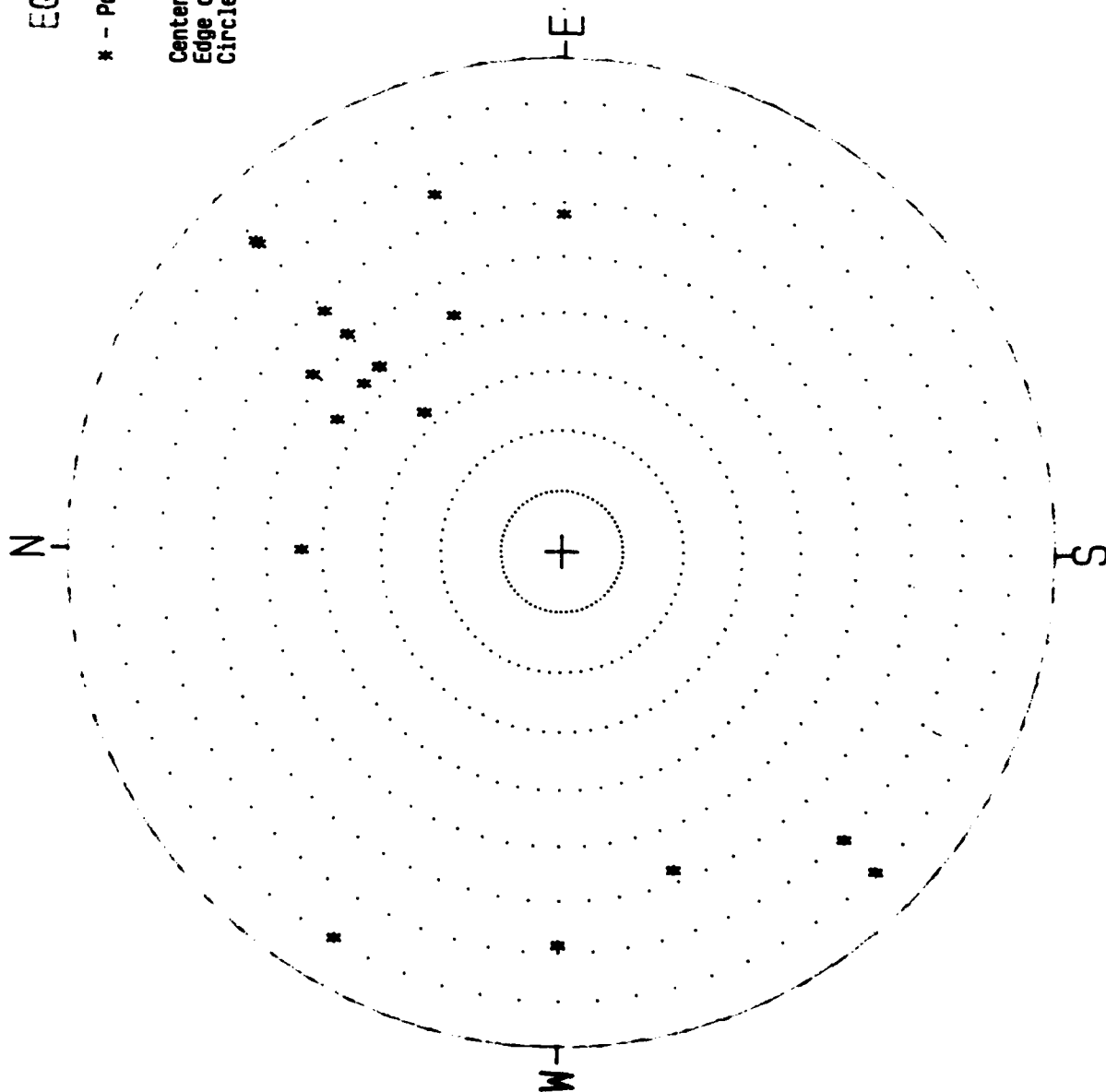
Direction : 0

Made : 0
Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORINGS 21 Hole Size : HQ

Orientation : Vertical

Direction : 0

Mode : 0

Photographed and Interpreted by the
Southwest Division Lab

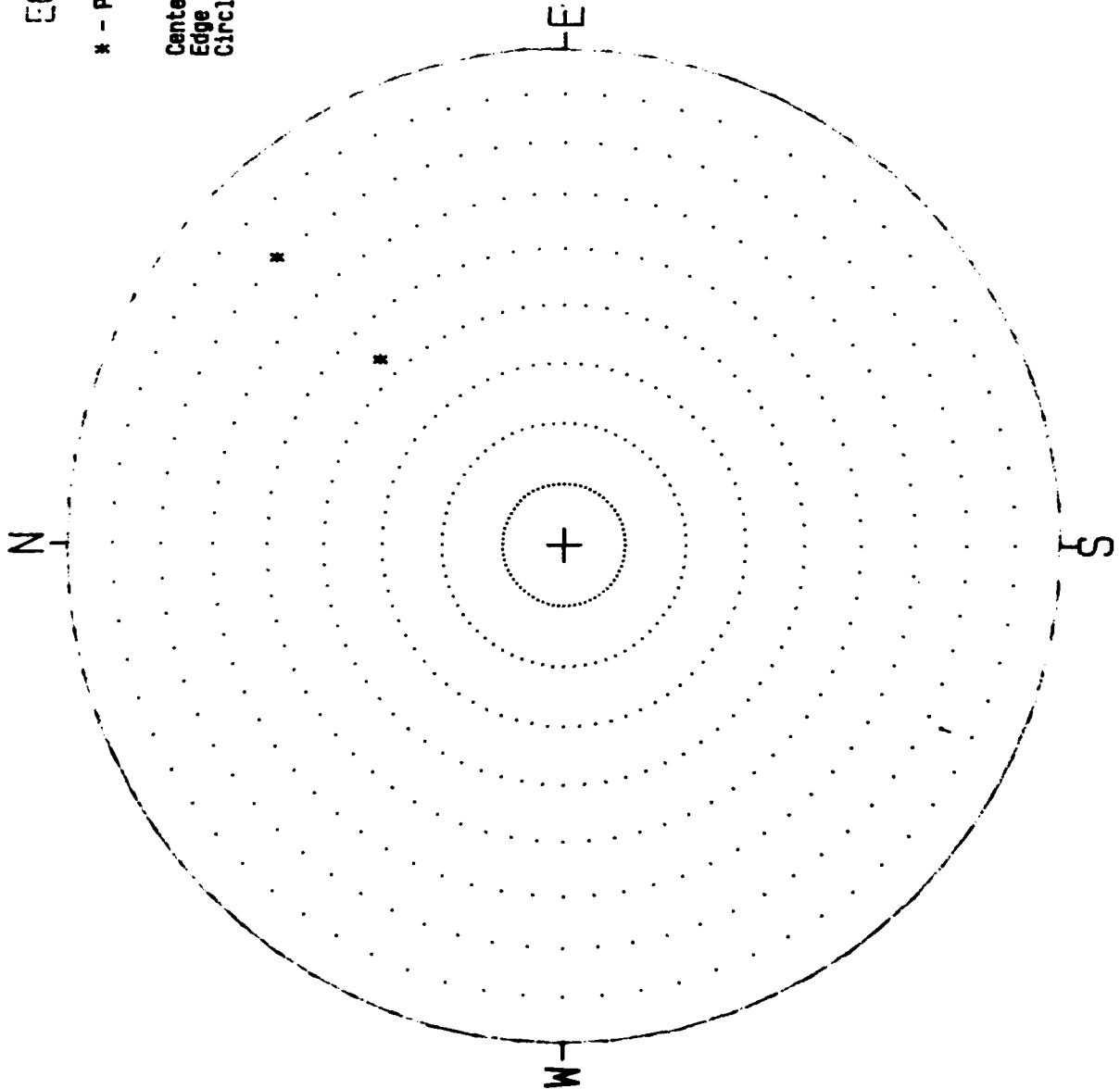
EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip

Edge of plot equals 90 degrees dip

Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 22 Hole Size : HQ

Orientation : Vertical

Direction : 0

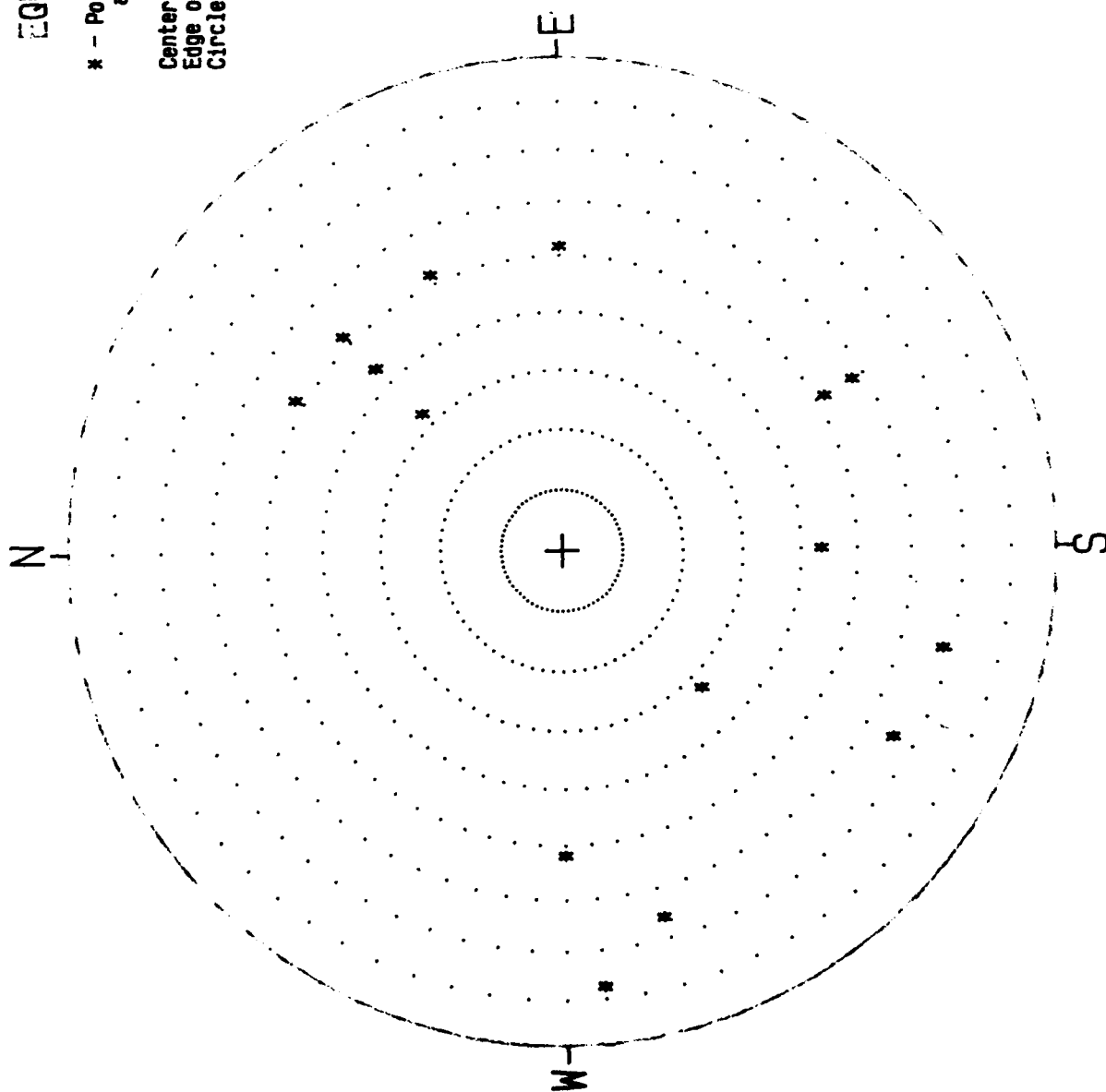
Made : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : CH-23 Hole Size : HQ

Orientation : Vertical

Direction : 0

Made : 0

Photographed and Interpreted by the
Southwest Division Lab

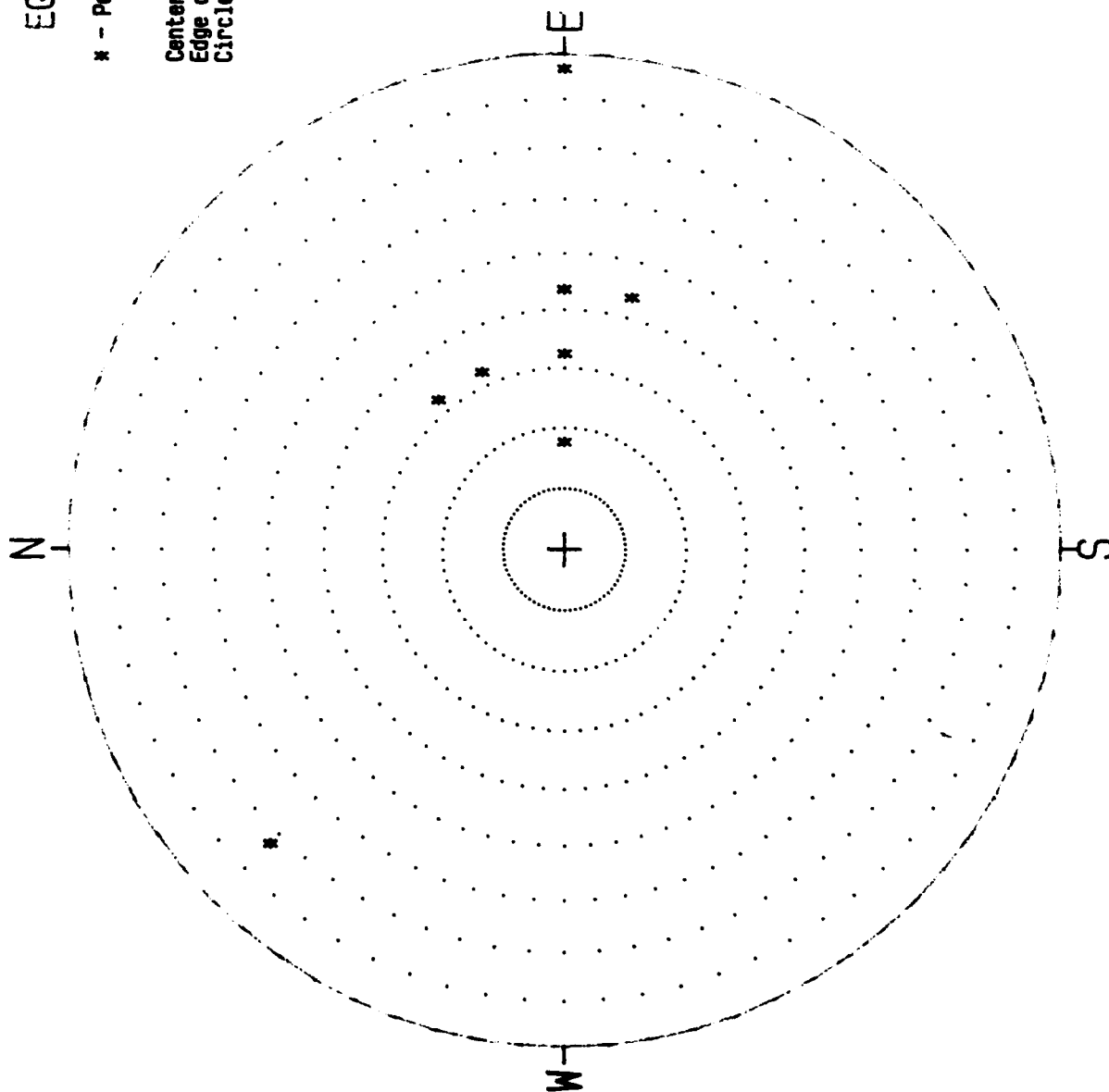
EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip

Edge of plot equals 90 degrees dip

Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 26 Hole Size : HQ

Orientation : Vertical

Direction : 0

Made : 0

Photographed and Interpreted by the
Southwest Division Lab

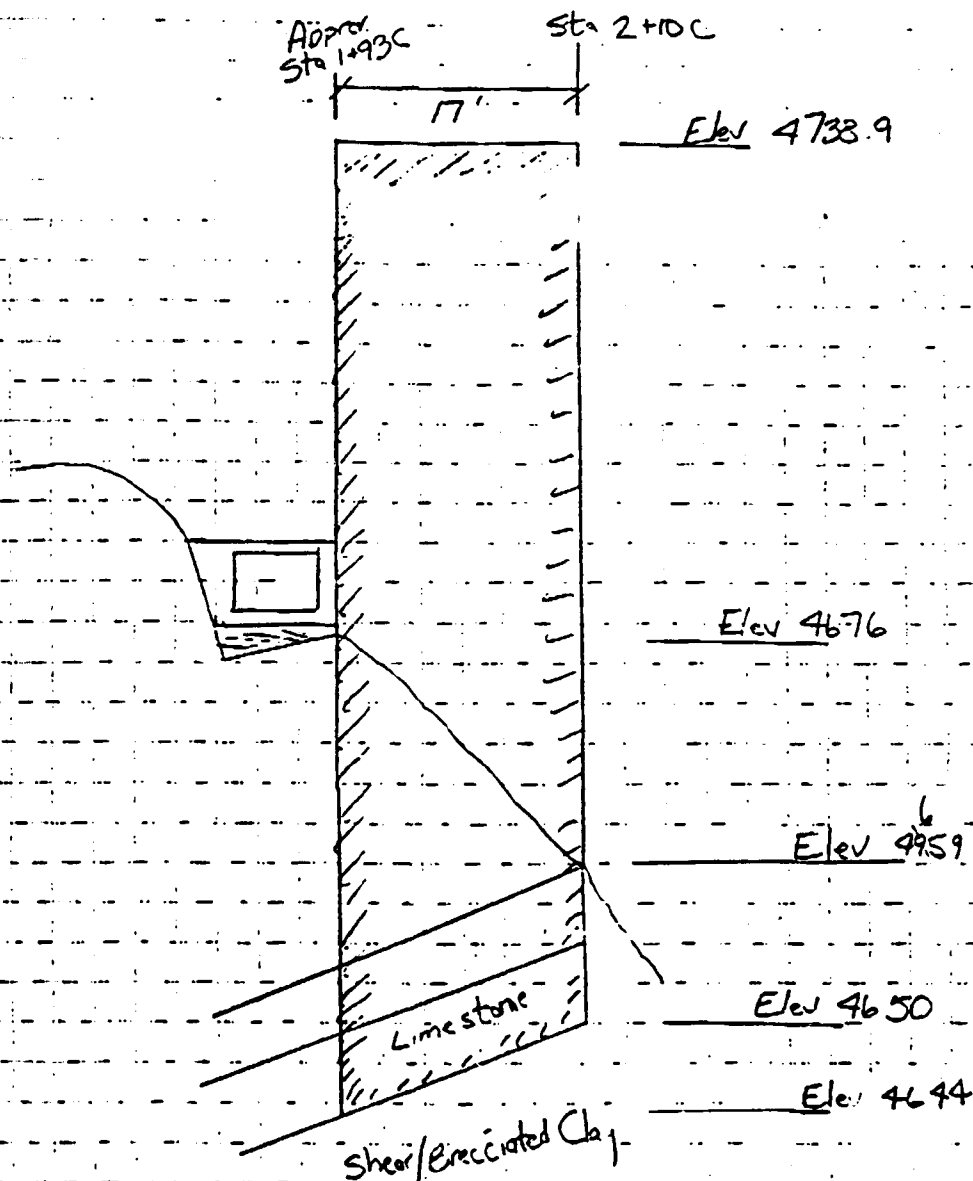
Stability Analysis on Left Abutment

BOYLE ENGINEERING CORPORATION

Project Cuchillo Negro Dam
 Job No. AL-C99-303-09
 By BSP Date 3/9/91

Description Sliding Stability @
Excavated Clay

SHEET 1



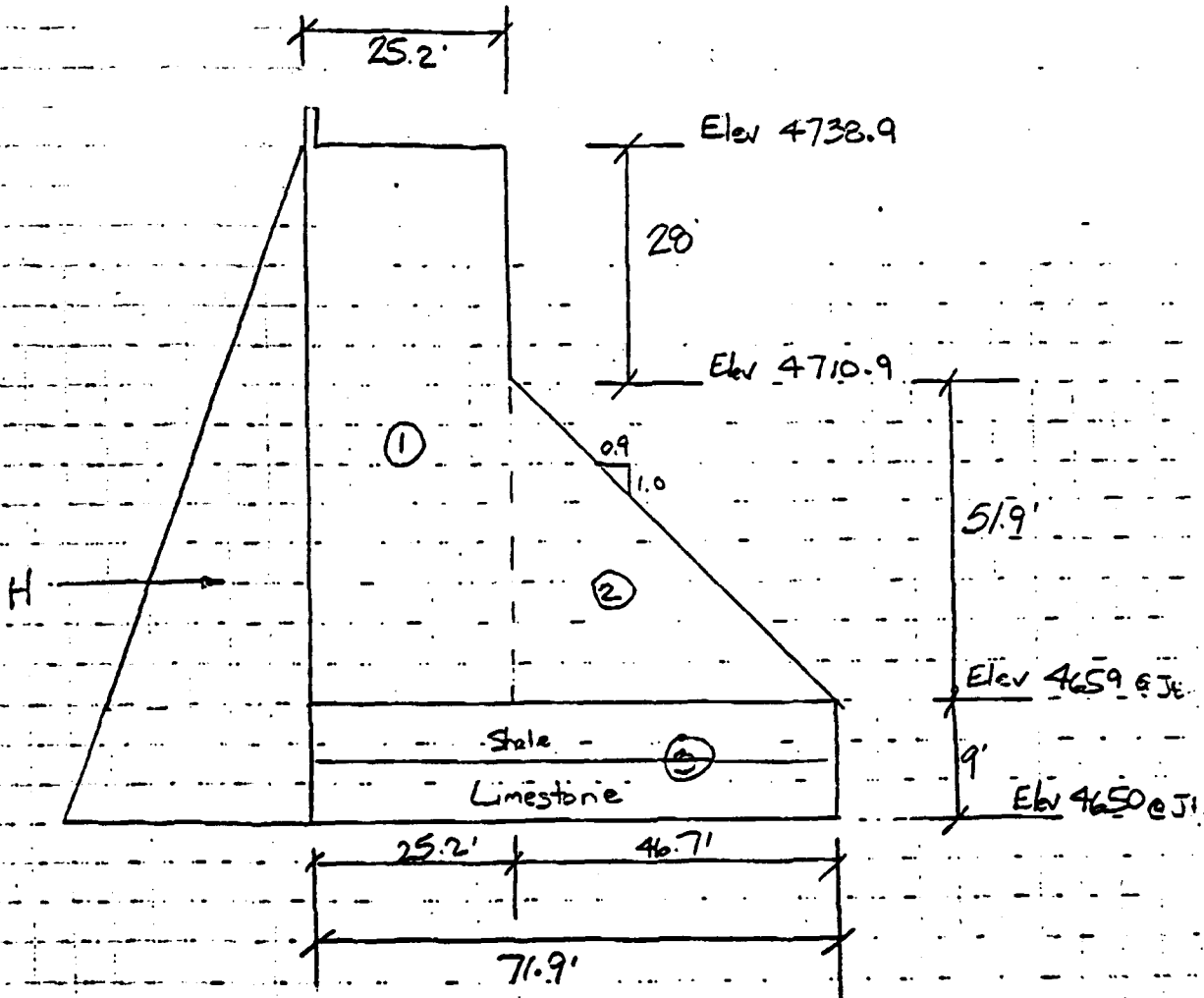
Design: Check Sliding Stability of shade section from Approx Sta 1+93 To Sta 2+10. Use ϕ angle of 11° @ Limestone / Excavated Clay interface. Also Use $C = 3 \text{ Ksf}$ @ Vertical interface of Section @ Sta 1+93. Achieve F.S. = 2.0.
 Use Load Case 16B: Gravity + Hydraulic + Uplift + Silt

BOYLE ENGINEERING CORPORATION

Project Cuchillo Negro Dam
 Job No. AI-C99-303-09
 By BSP Date 3/9/91

Description Sliding Stability @
Presaturated Clay Layer

2
 SHEET

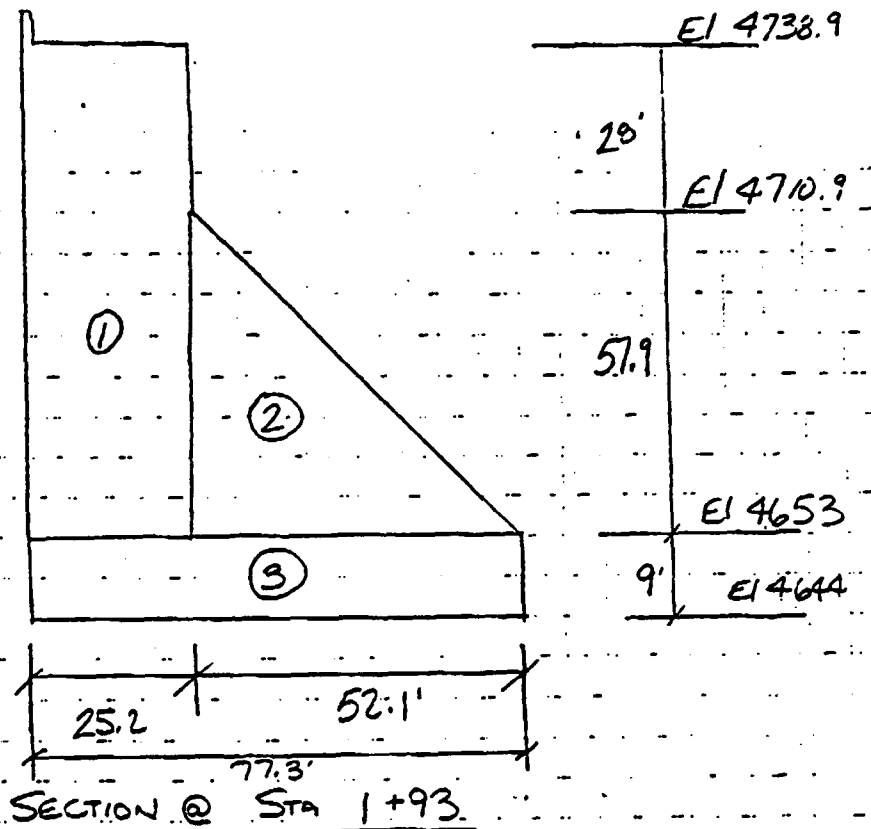


SECTION @ Sta 2+10

BOYLE ENGINEERING CORPORATION

Project Cuchillo Negro Dam
 Job No. AL-C99-303-09
 By RSP Date 3/9/91

Description Sliding Stability @
Brecciated Clay Layer
 2A
 SHEET



BOYLE ENGINEERING CORPORATION

Project Cuchillo Negro Dam
 Job No. AL-C99-303-09
 By RSP Date 3/9/91

Description Sliding Stability @
Brecciated Clay

3
 SHEET

GRAVITY LOADS

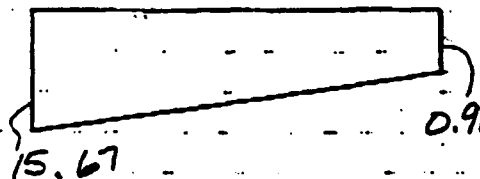
$$\begin{aligned} \textcircled{1} &= \frac{[(25.2')(79.9') + (25.2')(85.9')]}{2} (17') (0.150 \text{ KCF}) = 5327.2' \\ \textcircled{2} &= \frac{1}{2} \left[\frac{1}{2} (51.9')(46.7') + \frac{1}{2} (52.1')(57.9') \right] (17') (0.150 \text{ KCF}) = 3463.2' \\ \textcircled{3} &= \frac{1}{2} [(9')(71.9') + (9')(77.3')] (17') (0.150 \text{ KCF}) = 1712.1' \end{aligned}$$

$$\text{Total } W_t = 10,507.5'$$

$$\begin{aligned} \text{Σ Me Upstream Force} &= (5327.2') \left(\frac{25.2'}{2} \right) + (3463.2') \left(25.2' + \left(\frac{46.7' + 52.1'}{2} \right) \right) \\ &\quad + (1712.1') \left(\frac{71.9' + 77.3'}{2} \right) = 67,122.7 + 144,508 + 63,861.3 \\ &= 275,492 \text{ ft-k} \end{aligned}$$

$$\begin{aligned} \text{Resultant Location} &= \frac{275,492}{10,507.5} \quad \text{Avg length} = \frac{71.9' + 77.3'}{2} = 74.6' \\ &= 26.22' \text{ from upstream face} \end{aligned}$$

$$\begin{aligned} \text{CONTACT PRESSURE} &= \frac{10,507.5'}{(17')(74.6')} \pm \frac{6(10,507.5') \left(\frac{74.6'}{2} - 26.22' \right)}{(17')(74.6')^2} \\ &= 8.29 \pm 7.38 = 15.67 \text{ Ksf @ Upstream} \text{ \& } 0.91 \text{ Ksf @ downstream} \end{aligned}$$



(Cont'd)

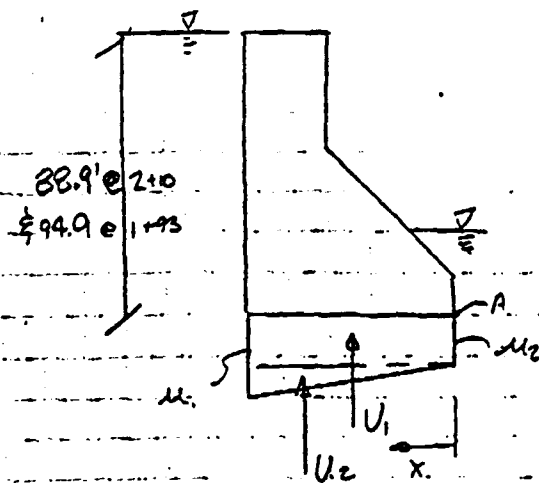
E-279

BOYLE ENGINEERING CORPORATION

Project Cuchillo
 Job No. AL-99-303-09
 By RSP Date 3/9/91

Description _____
 SHEET 5

Uplift Loads



$$u_1 = \left(\frac{38.9 + 94.9}{2} \right) (0.0624 \text{ KCF}) = 5.73 \text{ Ksf}$$

$$u_2 = \left(\frac{21 + 27}{2} \right) (0.0624) = 1.50 \text{ Ksf}$$

$$U_1 = (1.50 \text{ Ksf}) (74.6') (17') = 1902.3'$$

$$U_2 = \frac{1}{2} (5.73 - 1.50) (74.6') (17') = 2682.2'$$

$$OTMA = \frac{1902.3' \left(\frac{74.6'}{2} \right) + 2682.2' \left(\frac{74.6'}{3} \right)}{4584.5'} = 204,350.5'$$

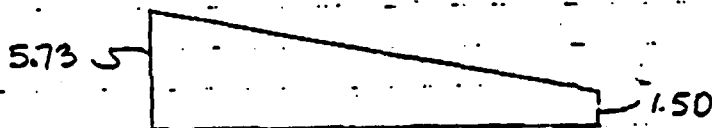
$$X_{(\text{location of resultant})} = \frac{204,350.5'}{4584.5'} = 44.57'$$

$$e = 44.57' - \frac{74.6'}{2} = 7.27' \text{ 1c ft of } e$$

$$\text{CONTACT Pressure} = \frac{-4584.5}{17(74.6')} + \frac{6(4584.5)(7.27')}{(17)(74.6')^2}$$

$$= -3.62 \pm 2.12 = -5.73 \text{ Ksf @ Upstream}$$

$$\text{ \& } -1.50 \text{ Ksf @ downstream}$$



(Contd)

BOYLE ENGINEERING CORPORATION

Project Cuchillo
 Job No. AL-C97-302-09
 By BSP Date 3/9/91

Description _____

6
SHEETSILT LOAD (T₁₀ Flow 4601)

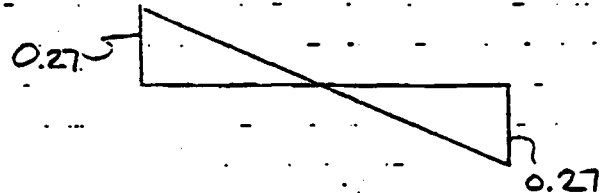
$$\gamma_{\text{moist}} = 115 \text{ pcf}$$

$$\text{Silt Load} = K_s (\gamma_{\text{moist}}) h_{\text{soil}} = (0.93)(115 \text{ pcf}) \left(\frac{3 \cdot 37}{2} \right) / 1000 = 1.29 \text{ ksf}$$

$$R_1 = \frac{1}{2} (1.29 \text{ ksf}) (34') (17') = 372.9 \text{ k}$$

$$\text{Contact Pressure} = \pm \frac{6 (372.9) \left(\frac{34'}{3} \right)}{(17') (74.6')^2} = \pm 0.27 \text{ ksf}$$

(+ @ downstream)
(- @ upstream)



BOYLE ENGINEERING CORPORATION

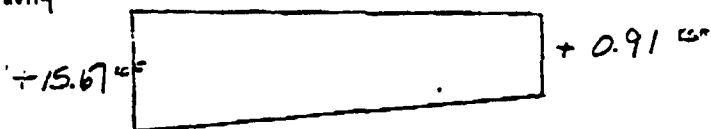
Project Cuchillo
 Job No. AL-C9-303-09
 By RSP Date 3/9/91

Description _____

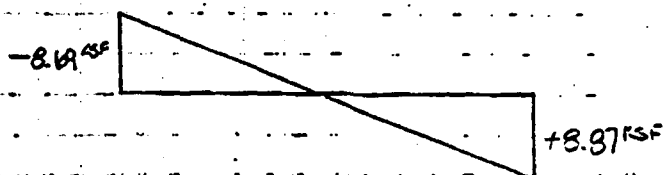
7
 SHEET

COMBINING LOAD CASES

1) Gravity



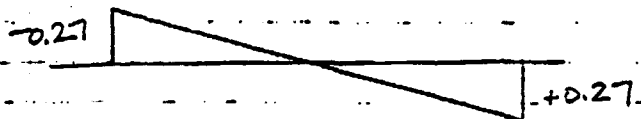
2) Hydraulic Load



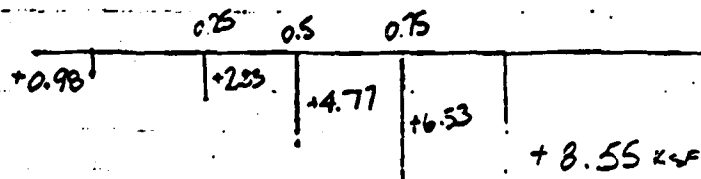
3) Uplift



4) Silt



Composite



Try Straight line approximation
 for Straight line

@ 0.25 → 2.86

@ 0.50 → 4.71

@ 0.75 → 6.56

∴ Close enough to Straight line

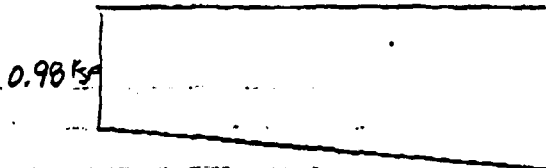
BOYLE ENGINEERING CORPORATION

Project Cuchillo
 Job No. AL-C99-303-09
 By BSP Date 8/9/91

Description _____

8
 SHEET

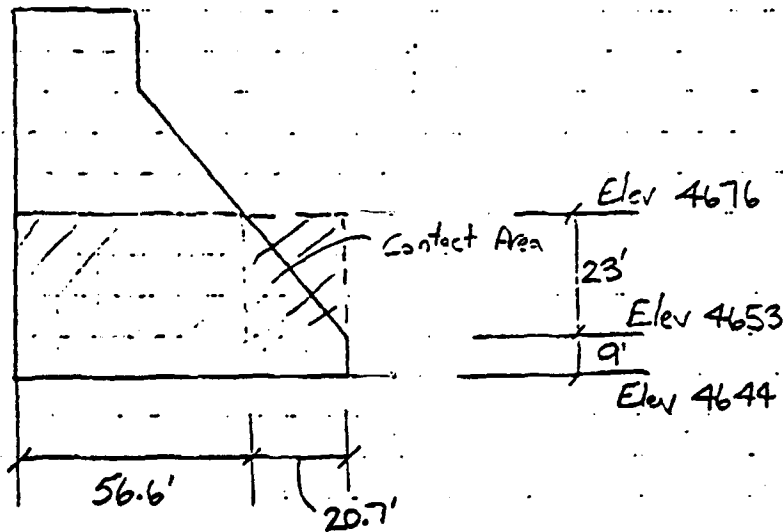
Contact Pressure Diagram



8.55 ksf

Total Contact
 Force = $\frac{1}{2}(0.98 + 8.55)$
 $(17')(74.6')$
 $= 6,043^k$

CALCULATION OF AREA @ VERTICAL FACE FOR Cohesion



CONTACT AREA = $(56.6' + 20.7')(32') = 2473.6 \text{ S.F.}$

BOYLE ENGINEERING CORPORATION

Project Cuchillo
 Job No. AL-C99-303-09
 By RSP Date 3/9/91

Description _____

9
 SHEET

SLIDING STABILITY

$$\text{TOTAL Horiz Force} = 4479.6^k - 305.5^k - 572.9^k = 4547^k \rightarrow$$

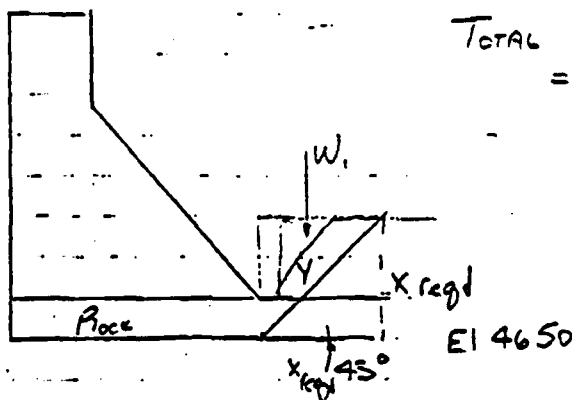
$$\text{Required Resisting Force} = 4547^k \times 2.0 = 9094^k$$

FS

- Resistance due to Internal ϕ of Friction $\rightarrow (\text{Force}) \tan \phi$
 $= (6043^k)(\tan 11^\circ) = 1148^k$
 Resistance

- Resistance due to cohesion @ Vertical Face
 $= (2473.6 \text{ S.F.})(3 \text{ Ksf})$
 $= 7420^k$ Resistance

- Use passive block @ downstream face



$$\text{TOTAL RESISTANCE (Cohesion + Int. } \phi)$$

$$= 7420 + 1148 = 8568.8^k$$

$$F.S. = \frac{8568.8^k + X}{4547} = 2$$

$$X = 525.2^k$$

Reqd Due to passive

$$W_1 = \frac{1}{2}(K_a)^2(17')(0.15 \text{ Ksf}) = 525.2^k \rightarrow X_{\text{regd}} = 20.3'$$

OK

$$F.S. = 2'$$

Water Pressure Test Results

CUCHILLO NEGRO DAMSITE
PRESSURE TEST SUMMARY

CORE HOLE	DEPTH (FEET)	PRESSURE (PSI)	WATER TAKE (CFM)	ELAPSED TIME (MINUTES)
CN-CH-09	8.0	7.0	1.50	11
CN-CH-09	50.0	19.0	1.47	12
CN-CH-10	23.0	17.0	1.49	11
CN-CH-10	58.0	17.0	1.49	11
CN-CH-11	12.0	8.0	1.11	11
CN-CH-11	25.0	19.0	1.53	12
CN-CH-11	50.0	14.0	1.48	11
CN-CH-12	6.0	6.0	1.73	11
CN-CH-12	20.0	12.0	1.75	11
CN-CH-12	50.0	15.0	1.70	11
CN-CH-15	34.1	14.0	1.33	10
CN-CH-15	73.8	32.0	0.25	10
CN-CH-16	33.0	19.0	0.83	10
CN-CH-16	53.0	33.0	0.80	10
CN-CH-16	54.1	23.0	1.18	10
CN-CH-16	73.0	36.0	0.11	10
CN-CH-17	48.3	26.0	5.88	10
CN-CH-17	59.7	36.0	0.74	10
CN-CH-17	64.7	38.0	0.32	10
CN-CH-18	16.5	10.0	0.86	10
CN-CH-18	24.4	15.0	0.13	10
CN-CH-18	33.4	19.0	0.03	10
CN-CH-18	43.4	24.0	0.40	10
CN-CH-18	73.4	37.0	0.29	10

Page No. 2
03/17/92

CUCHILLO NEGRO DAMSITE
PRESSURE TEST SUMMARY

CORE HOLE	DEPTH (FEET)	PRESSURE (PSI)	WATER TAKE (CFM)	ELAPSED TIME (MINUTES)
CN-CH-19	32.5	19.0	6.23	10
CN-CH-19	48.5	28.0	6.28	10
CN-CH-19	58.5	28.0	3.66	10
CN-CH-19	73.5	32.0	3.77	10
CN-CH-20	30.0	0.0	3.87	10
CN-CH-20	52.5	0.0	23.0	10
CN-CH-21	43.6	19.0	22.0	10
CN-CH-21	70.5	36.0	3.45	10
CN-CH-21	93.8	43.0	4.25	10
CN-CH-21	117.5	54.0	3.69	10
CN-CH-22	43.8	22.0	1.84	10
CN-CH-22	73.5	35.0	1.87	10
CN-CH-22	87.5	46.0	0.94	10
CN-CH-23	37.0	0.0	4.41	10
CN-CH-23	62.0	0.0	4.32	10
CN-CH-23	82.0	15.0	0.70	10
CN-CH-25	13.0	1.0	5.25	8
CN-CH-25	20.0	3.0	4.71	10
CN-CH-25	40.0	5.0	3.98	10
CN-CH-25	60.0	15.0	0.94	10
CN-CH-26	14	10	1.19	15
CN-CH-26	30	20	3.14	15
CN-CH-26	58	19	4.3	15
CN-CH-27	19	12	0.51	15

Page No. 3
03/17/92

CUCHILLO NEGRO DAMSITE
PRESSURE TEST SUMMARY

CORE HOLE	DEPTH (FEET)	PRESSURE (PSI)	WATER TAKE (CFM)	ELAPSED TIME (MINUTES)
CN-CH-27	34	22	1.12	16
CN-CH-28	27	20	0.91	15
CN-CH-28	5.5	5	0.21	15
CN-CH-28	51	32	1.19	20
CN-CH-29	23	19	3.55	12
CN-CH-29	50	35	4.79	18
CN-CH-29	92	28	5.3	20
CN-CH-30	45	35	1.93	15
CN-CH-30	8	5	0.33	10
CN-CH-30	91	40	2.30	20
CN-CH-31	30	25	0.90	15
CN-CH-31	9	5	0.71	15
CN-CH-31	95	45	0.30	22
CN-CH-32	11	8	1.30	15
CN-CH-32	31	20	0.91	20
CN-CH-32	75	50	1.13	20

APPENDIX F

APPENDIX F

TABLE OF CONTENTS

Description	Page
Contractor's Excavation Plan	F-1
Contractor's RCC Foundation Preparation Plan	F-7
Contractor's Dewatering Plan	F-14
Contractor's Plan to Remove Differing Site Condition Material	F-23
Government's Directive to Remove Differing Site Condition Material	F-35
Contractor's Wire Mesh Installation Plan	F-41
Contractor's Rock Bolt Information	F-45

Contractor's Excavation Plan



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Recd 31 Nov 89

[Signature]

November 30, 1989

Serial Letter No.: 050/02219/1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Excavation Plan

Gentlemen:

Pursuant to Technical Provision 02219, Paragraph 1, four (4) copies of PCL Civil Constructors Excavation Plan are herewith transmitted to the contracting officer for review.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PCL CIVIL CONSTRUCTORS, INC.

EXCAVATION PLAN
FOR
RIO GRANDE FLOODWAY
CUCHILLO DAM
CONTRACT NO: DACW47-89-C-0056

1. Common Excavation:

During the common excavation phase of the project, PCL Civil Constructors will utilize the following equipment to perform the required excavation:

2 - D-8K Dozer
2 - D-9H Dozer
4 - Cat 631C Scraper
1 - 4500 Gallon Water Truck

Other support equipment may be added to the above if warranted by field conditions. PCL Civil Constructors Material Utilization and Flow Diagram for common excavation is represented on the attached drawings EX-1 and EX-2

2. Rock Excavation:

Drilling and blasting for the required rock excavation will be performed by the following subcontractor:

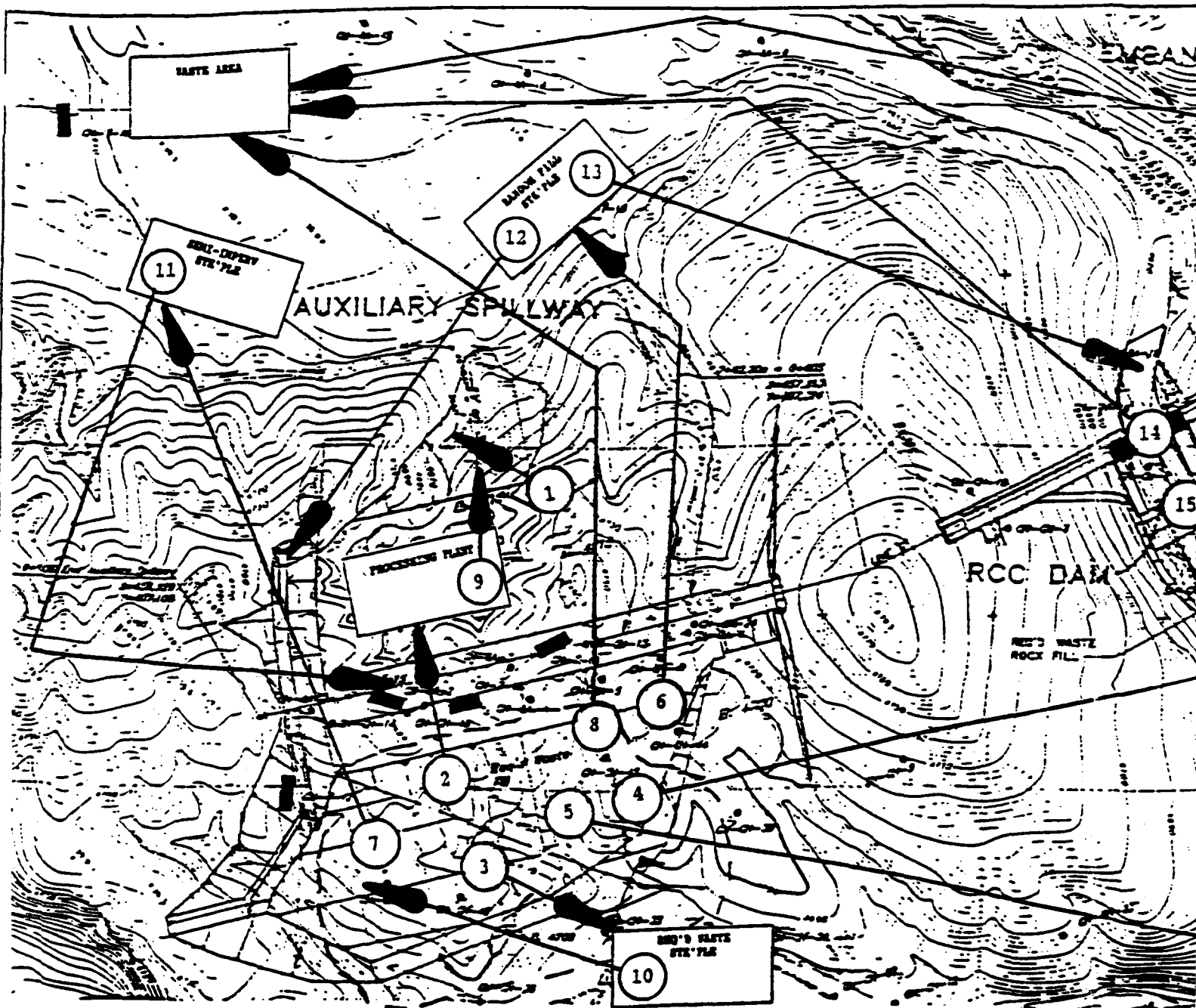
McCaw's Drilling (USA), Inc.,
1645 Court Place, Suite 315
Denver, Colorado, 80202

McCaw's Drilling (USA), Inc. will have competent and experienced personnel familiar with all aspects of blasting on the project site. Explosive products will be supplied by Ireco, Incorporated and the Ensign - Bickford Company. A formal submittal of our blasting operations will be made under Technical Provision 02219, Paragraph 7, titled "Blasting", prior to the start of this work.

Removal of shot rock will be performed according to the Material Utilization and Flow Diagram for rock excavation which is represented on attached drawings EX-3 and EX-4. PCL Civil Constructors will utilize the following equipment in the removal of shot rock:

1 - Cat 988B Loader
1 - Cat 245 Excavator
4 - Cat 769 Off-Highway End Dumps (35T)

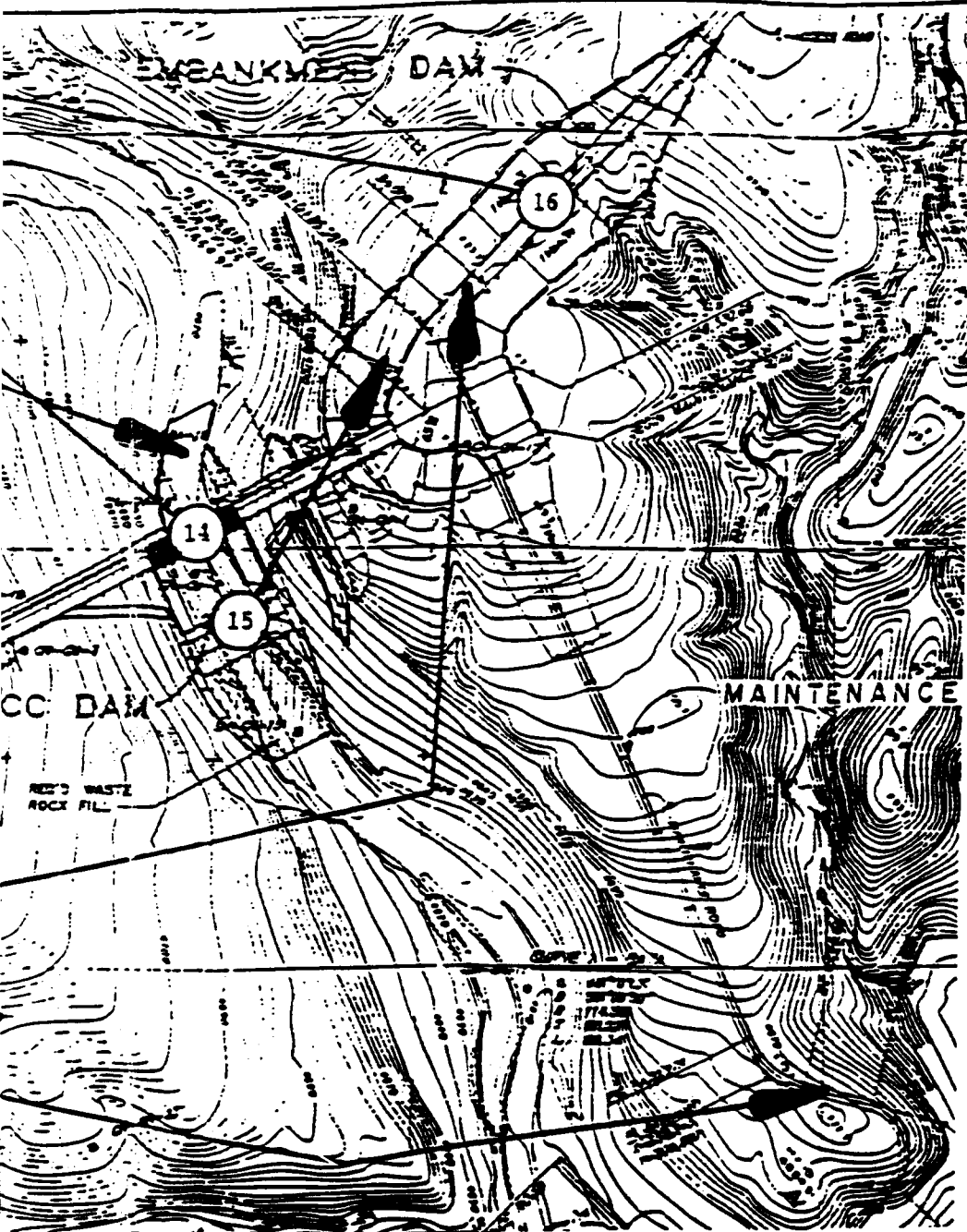
Other support equipment may be added to the above if warranted by field conditions.



PROCESSED MATERIAL SUPPLY
(CRUSHER QUANTITIES)

NOTE: SEE DWG EX-2 FOR LABELS &
QUANTITIES FOR ARROWS

NO.	DESCRIPTION	PCL WEAT QTY (TCT)	PLACEMENT & STOCKPILE LOSS		STOCKPILE QTY (CT)	CRUSHER WASTE		WASTE QTY TO CRUSHER (TCT)
			LOSS QTY (CT)	FACTOR		WASTE QTY (CT)	FACTOR	
6	FILTER MATERIAL	4,300	0.25	1,075	4,300	0.25	1,075	7,375
7	GRAVEL SURFACING	7,900	0.25	1,975	9,875	0.25	2,469	12,344
10	SEDIMENT SAND	1,300	0.25	325	2,100	0.25	525	2,625
20	RCC DAM AGGREGATE	N/A	N/A	N/A	79,200	0.25	19,800	99,000
21	RCC SPILLWAY AGGREGATE	N/A	N/A	N/A	24,000	0.25	6,000	24,000
TOTALS					132,125		28,339	160,464



RANDOM FILL
 BID ITEM NO. 4
 BID QTY = 15,000 CY

LOCATION	HEAT QTY (CY)	SHRINK FACTOR	BANK QTY (BCY)
EMBANKMENT DAM	15,000	1.15	13,043
RCC DAM BACKFILL	3,000	1.15	2,609
SPELLWAY BACKFILL	1,500	1.15	1,304
MAINTENANCE ROAD	22,700	1.15	19,739
TOTALS	42,200		36,905

SERIAL-IMPERVIOUS FILL
 BID ITEM NO. 5
 BID QTY = 18,000 CY

LOCATION	HEAT QTY (CY)	SHRINK FACTOR	BANK QTY (BCY)
EMBANKMENT DAM	18,000	1.25	14,400
SPELLWAY BACKFILL	2,400	1.25	1,920
TOTALS	20,400		16,320

REQUIRED WASTE FILL
 BID ITEM NO. 17
 BID QTY = 174,000 CY

LOCATION	HEAT QTY (CY)	SHRINK FACTOR	BANK QTY (BCY)
NORTH SPELLWAY	148,500	1.25	118,800
SOUTH SPELLWAY	25,500	1.25	20,400
TOTALS	174,000		139,200

COMMON EXCAVATION SUPPLY
 BID ITEM NO. 2
 BID QTY = 509,300 CY

STOCKPILE QTY (CY)	CRUSHER WASTE FACTOR	WASTE QTY (CY)	WHL. DI QTY TO CRUSHER (BCY)
9,300	1.10	1,300	7,800
9,375	0.10	400	10,963
2,160	0.10	432	2,992
79,200	0.15	11,880	91,380
24,900	0.15	3,735	48,115
132,135		20,336	152,670

LOCATION	HEAT QTY (CY)
RCC DAM AREA	32,536
STRIPPING @ EMBANKMENT DAM	7,560
INSPECTION TRENCH @ EMBANKMENT DAM	7,123
SPELLWAY - LINE 5	492,143
TOTALS	549,362

P C I CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCUILLO DAM)

Common Excavation
 Material Flow
 Diagram

EX-1

PCL CIVIL CONSTRUCTORS
COMMON EXCAVATION FLOW CHART SUMMARY
BID ITEM NO. 2

LABEL NO	DESCRIPTION	BID NO.	FROM	BID NO.
1	SPILLWAY EXCAV TO SPILLWAY NORTH REQ'D WASTE FILL	2	SPILLWAY	37 S
2	SPILLWAY EXCAV TO PROCESSING PLANT (CRUSHER)	2	SPILLWAY	NP P
3	SPILLWAY EXCAV TO REQ'D WASTE STOCKPILE	2	SPILLWAY	NP S
4	SPILLWAY EXCAV TO EMBANKMENT DAM SEMI-IMPERV FILL	2	SPILLWAY	5 E
5	SPILLWAY EXCAV TO MAINTENANCE ROAD RANDOM FILL	2	SPILLWAY	4 M
6	SPILLWAY EXCAV TO RANDOM FILL STOCKPILE	2	SPILLWAY	NP S
7	SPILLWAY EXCAV TO SEMI-IMPERV STOCKPILE	2	SPILLWAY	NP S
8	SPILLWAY EXCAV TO WASTE AREA	2	SPILLWAY	NP W
9	PROCESSING PLANT WASTE TO SPILLWAY NORTH REQ'D WASTE FILL	NP	PROCESS PLT	37 S
10	REQ'D WASTE STOCKPILE TO SPILLWAY SOUTH REQ'D WASTE FILL	NP	STOCKPILE	37 S
11	SEMI-IMPERV STOCKPILE TO SPILLWAY BACKFILL	NP	STOCKPILE	5 S
12	RANDOM FILL STOCKPILE TO SPILLWAY RIGHT ABUTMENT FILL	NP	STOCKPILE	4 S
13	RANDOM FILL STOCKPILE TO RCC DAM NORTH FILL	NP	STOCKPILE	4 R
14	RCC DAM EXCAVATION TO WASTE AREA	2	RCC DAM	NP W
15	RCC DAM EXCAVATION TO EMBANKMENT DAM RANDOM FILL	2	RCC DAM	4 E
16	EMBANKMENT DAM STRIPPING & INSPEC TRENCH TO WASTE AREA	2	EMB DAM	NP W

TOTALS:

COMMON 1
REH.

AVERAGE HAUL FOR COM

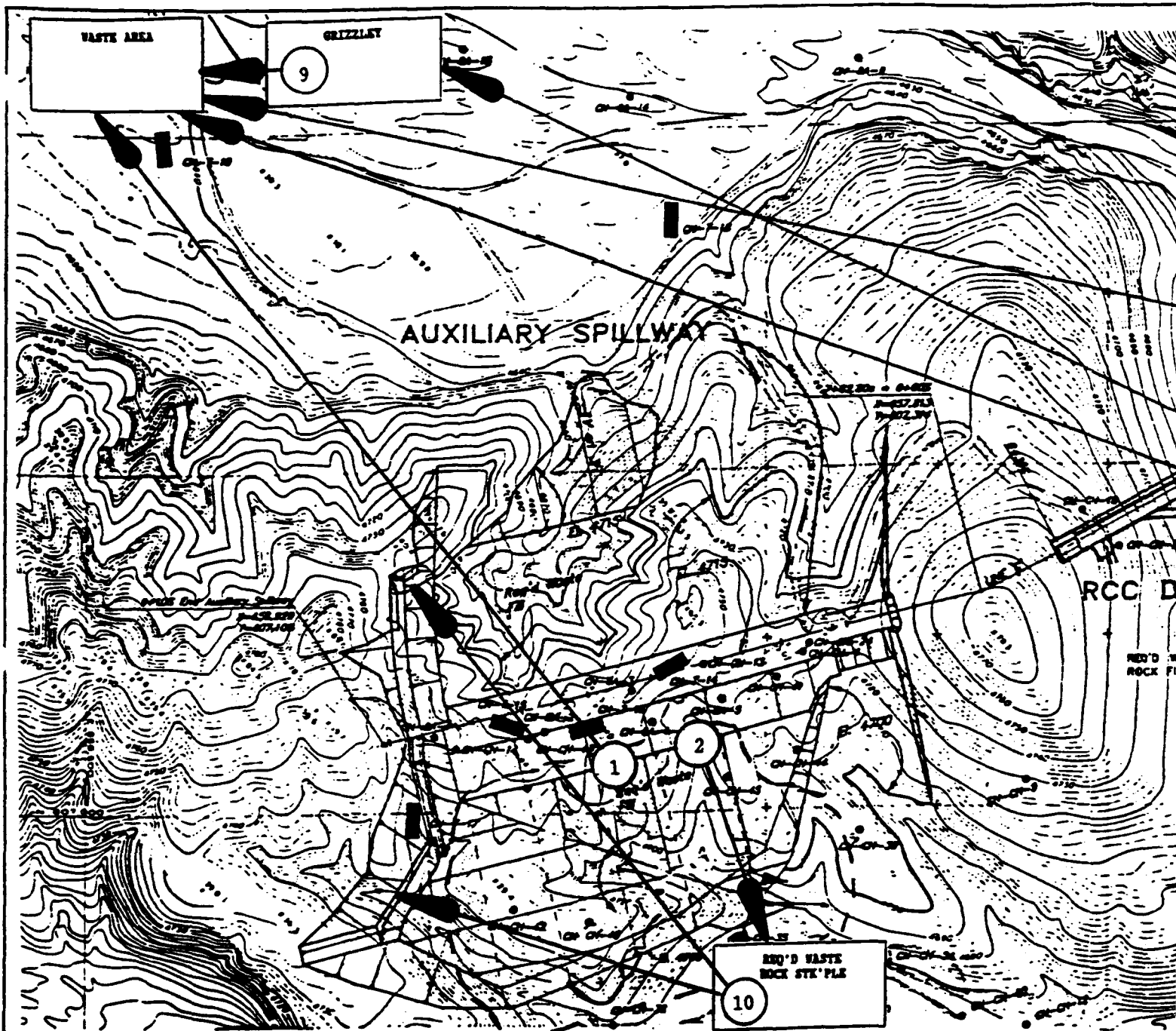
FROM	BID NO.	TO	HAUL		BCY-FT
			QUANTITY (BCY)	DISTANCE (FT)	
SPILLWAY	37	SPILLWAY	30,674	200	6134800
SPILLWAY	NP	PROCESS PLT	152,470	400	60983000
SPILLWAY	NP	STOCKPILE	126,420	350	44247000
SPILLWAY	5	EMB DAM	23,208	2900	67303200
SPILLWAY	4	MAINT RD	37,605	1700	63923500
SPILLWAY	NP	STOCKPILE	11,270	1100	12397000
SPILLWAY	NP	STOCKPILE	2,904	1050	3049200
SPILLWAY	NP	WASTE	107,592	1300	139869600
PROCESS PLT	37	SPILLWAY	20,335	200	4067000
STOCKPILE	37	SPILLWAY	126,420	350	44247000
STOCKPILE	5	SPILLWAY	2,904	650	1887600
STOCKPILE	4	SPILLWAY	1,840	700	1288000
STOCKPILE	4	RCC DAM	9,430	1150	10844500
RCC DAM	NP	WASTE AREA	3,636	1850	6726600
RCC DAM	4	EMB DAM	29,900	1400	41860000
EMB DAM	NP	WASTE	14,683	1900	27897700

701,291 536,735,700

COMMON EXCAV = 540,362
 REHANDLE = 160,929

AVERAGE HAUL FOR COMMON EXCAVATION (FT): 765.4 FT

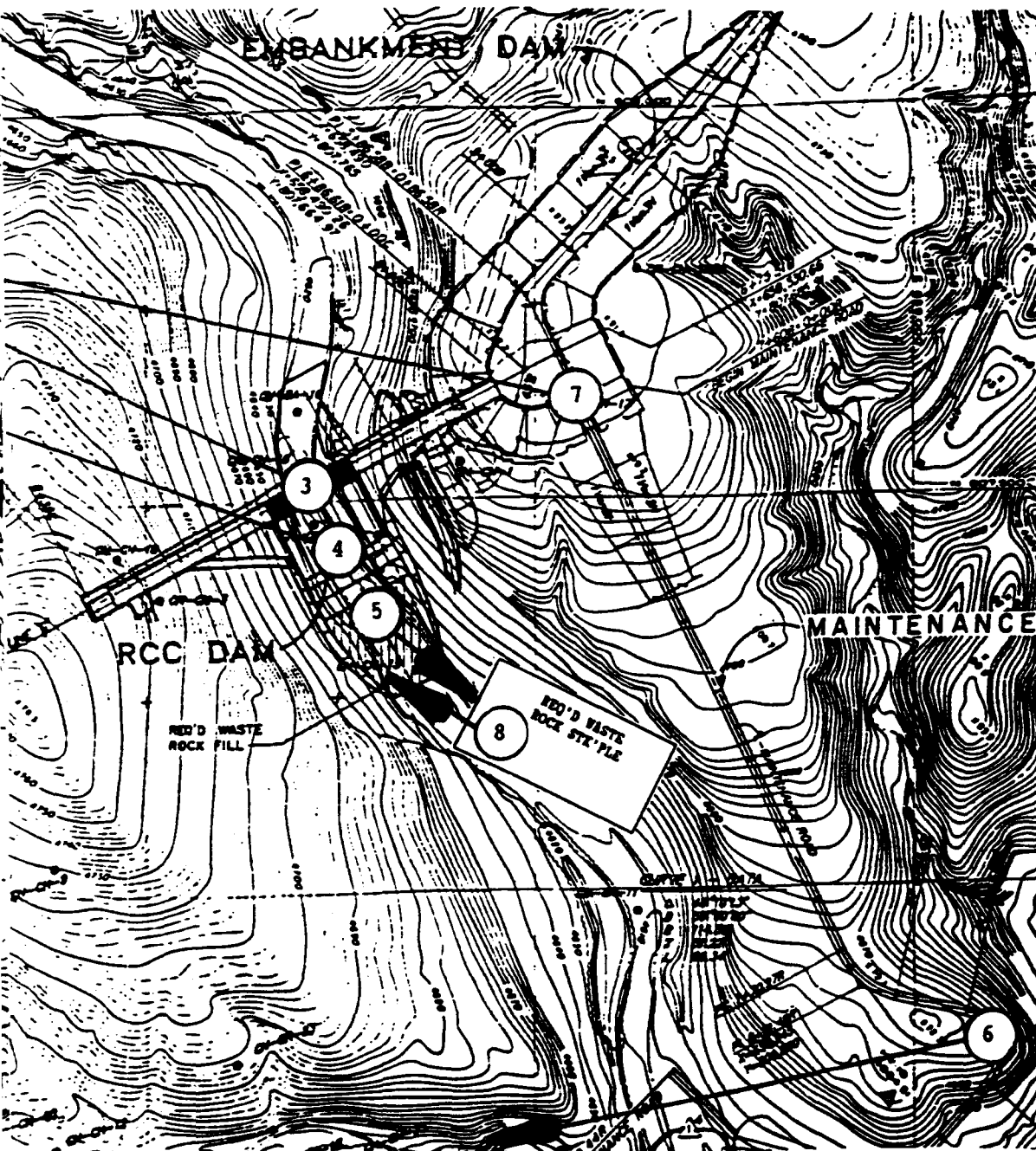
P C L CIVIL CONSTRUCTORS	
RIO GRANDE FLOODWAY (CUCHILLO DAM)	
	Common Excavation Material Flow Diagram Summary
	EX-2



NOTE: SEE DWG EX-4 FOR LABELS & QUANTITIES FOR ARROWS

PROCESSED MATERIAL SUMMARY
(GRIZZLEY QUANTITIES)

SID ITEM	DESCRIPTION	POL WEAT QTY (CFT)	FACTOR	PLACEMENT & STOCKPILE LBS	
				LOSS QTY (CFT)	
3	SHIPPED ROCK - 12"	1,700	0.25		
9	SHIPPED ROCK - 18"	2,800	0.25		
TOTALS					



REQUIRED WASTE ROCK FILL
 BID ITEM NO. 36
 BID QTY = 3,400 CY

LOCATION	WEAT QTY (CY)	SHRINK FACTOR	BANK QTY (BCY)
RCC DAM BACKFILL	5,983	1.00	5,983
SPILLWAY BACKFILL	1,158	1.00	1,158
TOTALS	8,341		8,341

ROCK EXCAVATION SUMMARY
 BID ITEM NO. 3
 BID QTY = 90,000 CY

LOCATION	WEAT QTY (CY)	BANK QTY (BCY)
RCC DAM AREA	34,552	
SPILLWAY - LINE 3	27,399	
MAINTENANCE ROAD	2,024	
INSPECTION TRENCH @ EMBANKMENT DAM	200	
TOTALS	64,175	

NOTE: RCC DAM ROCK QUANTITIES INCLUDE
 BOTH OUTLET WORKS.

PART

SECTION	PLACEMENT & STOCKPILE LOSS			SHRINKAGE WASTE			TOTAL QTY TO GRIZZLEY (BCY)
	WEAT QTY (CY)	LOSS QTY (CY)	STOCKPILE QTY (CY)	FACTOR	WASTE QTY (CY)		
1-1	1,700	0.25	425	2.125	1.20	630	2,763
1-2	1,300	0.25	750	1.500	1.20	1,350	4,590
			5,625		1,680		7,313

P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DAM)

Rock excavation
 material flow
 diagram

7/20/72
 EX-3

PCL CIVIL CONSTRUCTORS
 ROCK EXCAVATION FLOW CHART SUMMARY
 BID ITEM NO. 3

LABEL NO	DESCRIPTION	BID NO.	FROM	BID NO.	TO
1	SPILLWAY EXCAV TO WASTE AREA	3	SPILLWAY	NP	WASTE
2	SPILLWAY EXCAV TO REQ'D ROCK WASTE STOCKPILE	3	SPILLWAY	NP	STOCKPI
3	RCC DAM EXCAV TO WASTE AREA	3	RCC DAM	NP	WASTE
4	RCC DAM EXCAV TO GRIZZLEY (PROCESSING PLANT)	3	RCC DAM	NP	GRIZZLE
5	RCC DAM EXCAV REQ'D ROCK WASTE STOCKPILE	3	RCC DAM	NP	STOCKPI
6	MAINTENANCE ROAD EXCAV TO WASTE AREA	3	MAINT RD	NP	HAUL RO
7	EMBANKMENT DAM INSPEC TRENCH TO WASTE AREA	3	EMB DAM	NP	WASTE
8	REQ'D ROCK WASTE STOCKPILE TO RCC DAM BACKFILL	NP	STOCKPILE	36	RCC DAM
9	GRIZZLEY PLANT WASTE TO WASTE AREA	NP	GRIZZLEY	NP	WASTE
10	REQ'D ROCK WASTE STOCKPILE TO SPILLWAY BACKFILL	NP	STOCKPILE	36	SPILLWA

TOTALS:

ROCK EXCAV =
 REHANDLE =

AVERAGE HAUL FOR ROCK EXCA

FROM	BID NO.	TO	QUANTITY (BCY)	HAUL DISTANCE (FT)	BCY-FT
LLWAY	NP WASTE		26,541	1300	34503300
LLWAY	NP STOCKPILE		1,358	600	814800
DAM	NP WASTE		20,236	1850	37436600
DAM	NP GRIZZLEY		7,313	1850	13529050
DAM	NP STOCKPILE		6,983	450	3142350
NT RD	NP HAUL ROADS		2,314	600	1388400
DAM	NP WASTE		220	1900	418000
CKPILE	36 RCC DAM		6,983	450	3142350
ZZLEY	NP WASTE		1,688	0	0
CKPILE	36 SPILLWAY		1,358	600	814800
			74,994		95,189,650
ROCK EXCAV =			64,965		
REHANDLE =			10,029		

RAGE HAUL FOR ROCK EXCAVATION (FT): 1269.3 FT

P C L CIVIL CONSTRUCTORS	
RIO GRANDE FLOODWAY (CUCUILLO DAM)	
	Rock excavation material flow diagram summary
	7-10-11-22-69
	EX-4

Contractor's RCC Foundation Preparation Plan



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

January 15, 1990

Serial Letter No.: 121/03360/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Roller Compacted Concrete Foundation Preparation &
Joint Treatment Plan, Amendment No. 1

Gentlemen:

Reference is made to your Serial Letter No. 42/03360/10.1 and PCL Civil Constructor's Serial Letter No. 89/03360/10.1, all pertaining to the afore said subject matter. This letter and the information contained herein will serve as Amendment No. 1 to PCL Civil Constructor's Roller Compacted Concrete Foundation Preparation and Joint Treatment Plan.

1. The following is hereby added under Paragraph IB:
"Low pressure water jets will have 1-inch nozzles"
2. PCL Civil Constructors acknowledges and accepts your statement regarding the truck mounted vacuum pickup system as being a contractual requirement. Hence, during the foundation clean-up, the specified model 2045 vactor or equal will be on the project site.
3. The following is hereby added under Paragraph II:
"The bedding mix will be covered with the designated RCC mix within 15 minutes after placement of the bedding mix."



Mr. Wiley S. Isom
RE: RCC Foundation Preparation &
Joint Treatment Plan, Amendment No. 1
January 15, 1990
Page Two of Two

4. The following is hereby added under Paragraph II:

"Vertical Cold Joints:

When it becomes apparent that placement of RCC will be terminated before the entire lift has been completed across the surface area, the RCC edge shall be flattened to a tapered slope no steeper than 3 horizontal on 1 vertical. The tapered edge shall be compacted with the vibratory rollers to the required density. These joints shall be treated as Type I or Type II cold joints and bedding mix applied accordingly. Such occurrences are likely when a breakdown of equipment takes place or when a shutdown is necessary due to climatic factors."

5. The continuous clock temperature recording devices will be furnished by our material testing subcontractor, Western Technologies. Descriptive literature on the type of recorders will be forwarded to the Contracting Officer no later than February 15, 1990. The recorders will be placed where directed or approved and all records will be turned in with the Quality Control Reports.

I trust the information presented above will satisfy the Contracting Officers remaining concerns regarding foundation preparation and joint treatment and lead to an expedient approval of our plan. Should any questions arise concerning the above, please feel free to contact the undersigned at this office.

Sincerely,

A handwritten signature in cursive script, reading "T. R. O'Donnell", is written over the typed name.

Thomas R. O'Donnell
Project Engineer

TRO:deo



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

JUN 1 1990

May 31, 1990

Serial Letter No.: 315/03360/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Roller Compacted Concrete Foundation Preparation

Gentlemen:

Reference is made to the Government's serial letter no. 133/03360/10.1, dated May 25, 1990, which is the latest piece of correspondence concerning the aforesaid subject matter.

In response to the Government's letter, PCL Civil Constructors offers the following:

1. Truck Mounted Vacuum Pick-Up System:

In order to facilitate our clean-up operations, PCL Civil Constructors will utilize a truck mounted vacuum pick-up system. However, due to the steep grades at the left and right abutments of the RCC Dam, PCL Civil Constructors and the vacuum truck's manufacturer feel that employing this type of equipment in these areas would be impractical. Hence, PCL Civil Constructors proposes to use high volume, low pressure washing and high pressure water jetting at the abutments. The loose material will be washed to the bottom of the foundation where it would be collected by the specified vacuum truck.

2. Plan for Waste Disposal:

PCL Civil Constructors plan for waste disposal was originally submitted under serial letter no. 089/03360/10.1 on December 22, 1989. The plan is as follows:

All of the rock fragments and loose rock pieces will be loaded, hauled and disposed of in the waste area as depicted in the contract documents. Wash water and small granular particles will be directed into sumps and pumped through a header system as shown on our Dewatering Plan.



Mr. Wiley S. Isom
RE: RCC Foundation Preparation
May 30, 1990
Page Two of Two

3. Equipment List:

The following equipment will be utilized on the RCC foundation preparation:

1. International 4000 gallon Water Truck
2. John Deere 310 Backhoe
3. Cat 235 Backhoe
4. Vactor 2045 Vacuum Truck or equivalent
5. Lanada PG4 2500 High Pressure Water Jet
6. 190 CFM Air Compressor

I hope the above information addresses all of the Contracting Officer's concerns as related to foundation preparation. Should any questions arise, please contact the undersigned at this office.

Sincerely,

A handwritten signature in cursive script, appearing to read "T. R. O'Donnell", is written over the typed name.

Thomas R. O'Donnell
Project Engineer

TRO:deo



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Read & File 10
[Signature]

December 22, 1989

Serial Letter No.: 089/03360/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Roller Compacted Concrete Foundation Preparation
Joint Treatment Plan

Gentlemen:

Reference is made to Technical Provision 03360, Paragraph 10.1, titled "Preparations for RCC placement", and your Serial Letter No. 28/3360/10.1 and 11.3. Transmitted herewith are four (4) copies of PCL Civil Constructor's Roller Compacted Concrete Foundation Preparation and Joint Treatment Plan for the Contracting Officer's Review.

Our plan for conveying RCC, which was requested by your letter, is still under design. Presently, we have two (2) conveyor companies, Rotec Industries and Morgan Manufacturing, designing custom systems for this project. Once their designs are finalized, our plan will be forwarded to the Contracting Officer for approval. This submittal will be made no later than February 1, 1990.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure



PCL CIVIL CONSTRUCTORS, INC

RIO GRANDE FLOODWAY, T OR C UNIT

CUCHILLO DAM

CONTRACT NO.: DACW47-89-C-0056

ROLLER COMPACTED CONCRETE FOUNDATION PREPARATION
AND JOINT TREATMENT PLAN

The information contained herein will serve as PCL Civil Constructors plan for foundation preparation and joint treatment for roller compacted concrete.

I Foundation Preparation:

Prior to placing any concrete, PCL Civil Constructors will clean the rock foundation surface of loose, unkeyed, and deteriorated rock, all accumulations of soil, vegetation, grease, spilled oils, all frozen materials, loose fragmented rock pieces, puddles or ponds of free surface water, and other detrimental materials. The removal of the above materials will consist of the following methods:

A. Shaping and Filling:

Shaping by minor rock excavation (trimming) of obtrusive high points, vertical faces, and overhangs will be performed prior to the placement of any concrete. Depending on the location, size, shape and the quality of the rock, trimming and shaping will be accomplished by one or a combination of the following methods:

1. Mechanical Ripping and Excavation:

Mechanical ripping and excavation will be performed by either a Cat D-9 Ripper, Cat D-8 Ripper or a Cat 245 Backhoe.

2. Hand Pry Bar and Jackhammer:

There may be some instances where mechanical ripping is not feasible or practical. In these instances, PCL Civil Constructors will employ the use of hand pry bars and jack hammers. Presently, there are two (2) jackhammers on the project site.

B. High Volume Low Pressure Washing:

After the area has been shaped and trimmed to grade and all of the large materials have been removed, then PCL Civil Constructors will perform high volume low pressure water washing. High volume low pressure water washing will be accomplished by an International 4,500 gallon water truck equipped with exterior hoses for on-the-ground use. The truck has the capacity of more than 200 gallons per minute.



Roller Compacted Concrete Foundation
Preparation and Joint Treatment Plan
December 22, 1989
Page 2 of 2

C. Truck Mounted Vacuum Pick-up System:

At the present time, PCL Civil Constructors does not see the need for a truck mounted vacuum pick-up system for use in our foundation clean-up. Conventional washing, power sweeping, and other general techniques commonly used in foundation preparation will be employed in lieu of the vacuum truck. If a situation arises that necessitates the use of a vacuum truck, then PCL Civil Constructors will employ the model 2045 Vactor or equal as specified in Technical Provision 02219, Paragraph 6.3.3.

D. Waste Disposal:

All of the rock fragments and loose rock pieces will be loaded, hauled and disposed of in the waste area as depicted in the contract documents. Wash water and small granular particles will be directed into sumps and pumped through a header system as shown on our Dewatering Plan.

II Joint Treatment:

As specified in Technical Provision 03360, Paragraph 14.5, titled, "Horizontal RCC Cold Joints", there are two (2) Types of cold joints. A Type I cold joint occurs when more than 2,000 degree hours have passed before placement of a successive layer of RCC. Preparation of a Type I cold joint will include cleaning the joint at the time when a subsequent lift of RCC is about to be placed. A nominal 1 inch thickness of RCC bedding mortar will be spread over the lift joint before placement of the next RCC layer.

A Type II cold joint is defined as a joint where more than 120 hours (5 days) have passed before placement a successive layer of RCC. Treatment of a Type II joint will consist of removing all laitance, loose debris, and contaminants by high-pressure water jetting (water blasting). After this initial treatment of waterblasting, a Type II cold joint will be prepared in the same fashion as a Type I cold joint. PCL Civil Constructors does not anticipate Type II cold joint being formed on this project. However, a water blaster, Hydro Broom Double Nozzle, capable of 1,500 psi, will be available on the project site if the need for such equipment arises.

Contractor's Dewatering Plan



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Read ZENSON
ER

November 27, 1989

Serial Letter No.: 044/01565/2.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C Unit, NM

Subject: Dewatering Plan

Gentlemen:

Pursuant to Section 01565 of the Technical Provisions, four (4) copies of PCL Constructors Dewatering Plan are herewith transmitted for the contracting officers approval.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PCL CIVIL CONSTRUCTORS, INC.

DEWATERING PLAN
FOR
CUCHILLO DAM PROJECT
CONTRACT NO.: DACW47-89-C-0056

This proposed plan for dewatering is to show locations and capacity of dewatering pumps, sumps, collection, and discharge lines to control ground water and surface water.

The temporary dam shown on the plan is designed to divert up to 250 cubic feet per second (CFS.) of ground water and surface water through the lower level outlet works. This will keep the construction area at the dam structure free from water. The lower level outlet works consists of a 60" pipe which is capable of 250 CFS.

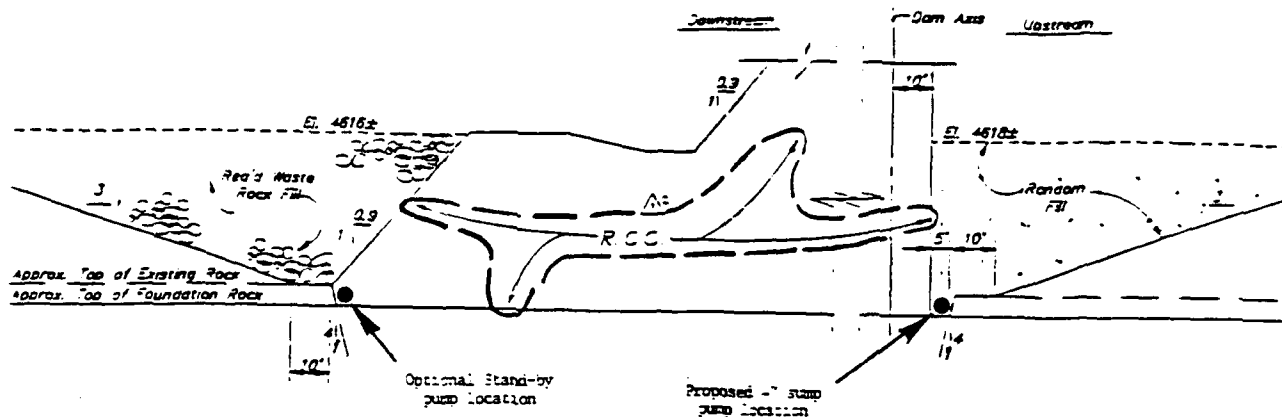
As per Section 01565 Dewatering and Care of Water, Paragraph 3, flow in excess of 250 CFS will be considered cause for equitable adjustment. The 250 CFS would be measured at the U.S.B.R. gaging station shown on the plans and as indicated in the specifications.

Excess water shall flow through the existing channel during construction of the lower level outlet works, then, upon completion, the temporary diversion dam shall divert water through the low level outlet works. The dewatering operations shall pump ground water encountered during the foundation excavation.

The three dewatering pumps shown on the standard work drawings submitted herewith are used for dewatering at the dam structure during construction.

Collection and discharge lines are shown on standard work drawing SW-9 and are as follows:

1. Discharge lines #1, #2, and #3 are approximately 200 feet long and discharges excess water which may pass through the temporary diversion dam to keep the construction area free from water. Discharge pump #1 is a 4 inch sump pump which will be used as the main dewatering pump. Pump #2 is a 6 inch trash pump and pump #3 is a 3 inch trash pump which will be used on a stand-by basis.
2. Discharge line #4 transports water from the storage pond approximately 25 feet to the crusher and batch plant site.
3. Collection line #2 pumps water from the existing well, which will be used as the primary water source, to the storage pond and to the batch plant site. The line is approximately 600 feet and the well is approximately 100 feet deep.



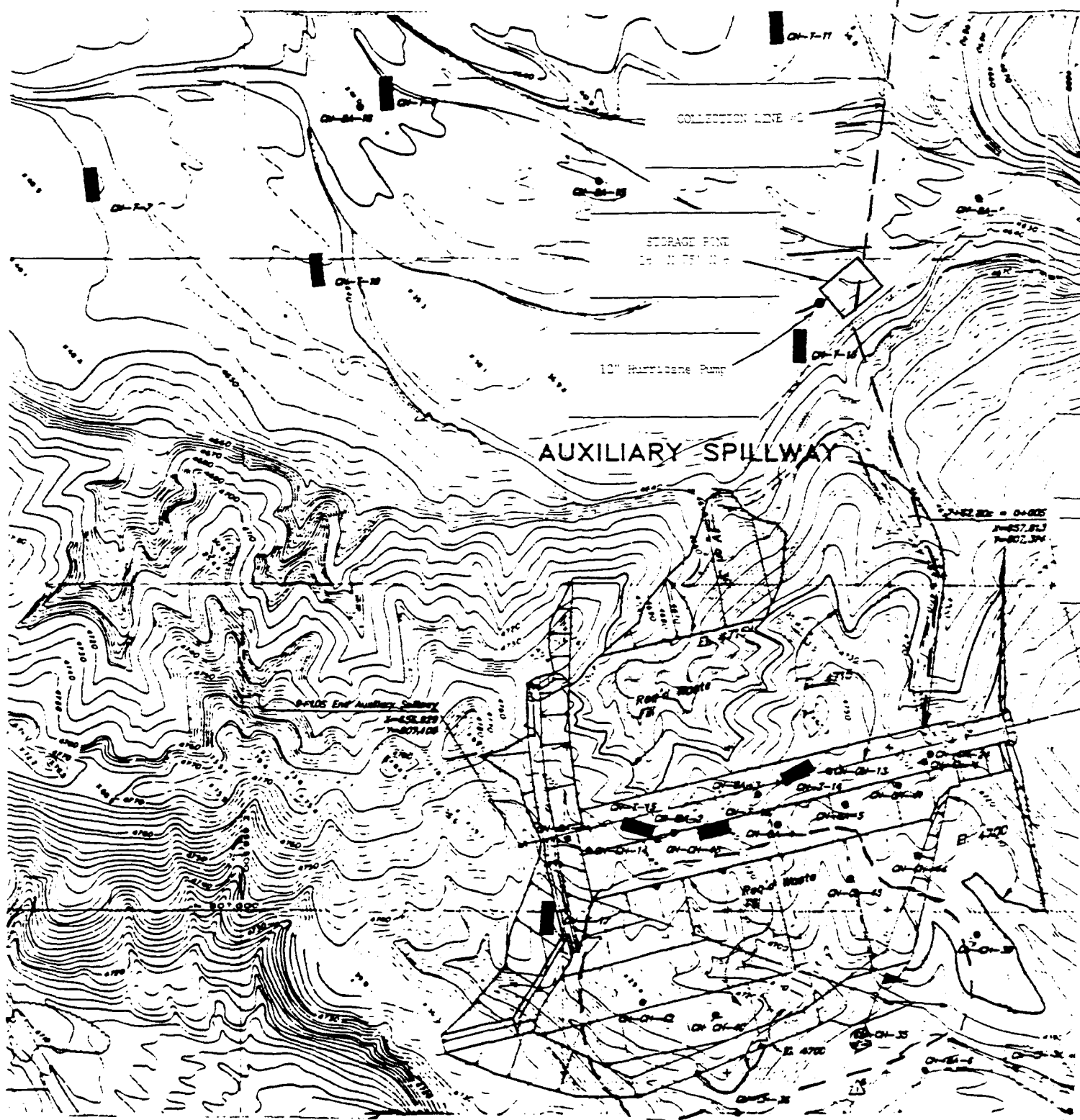
DAM STRUCTURE SECTION

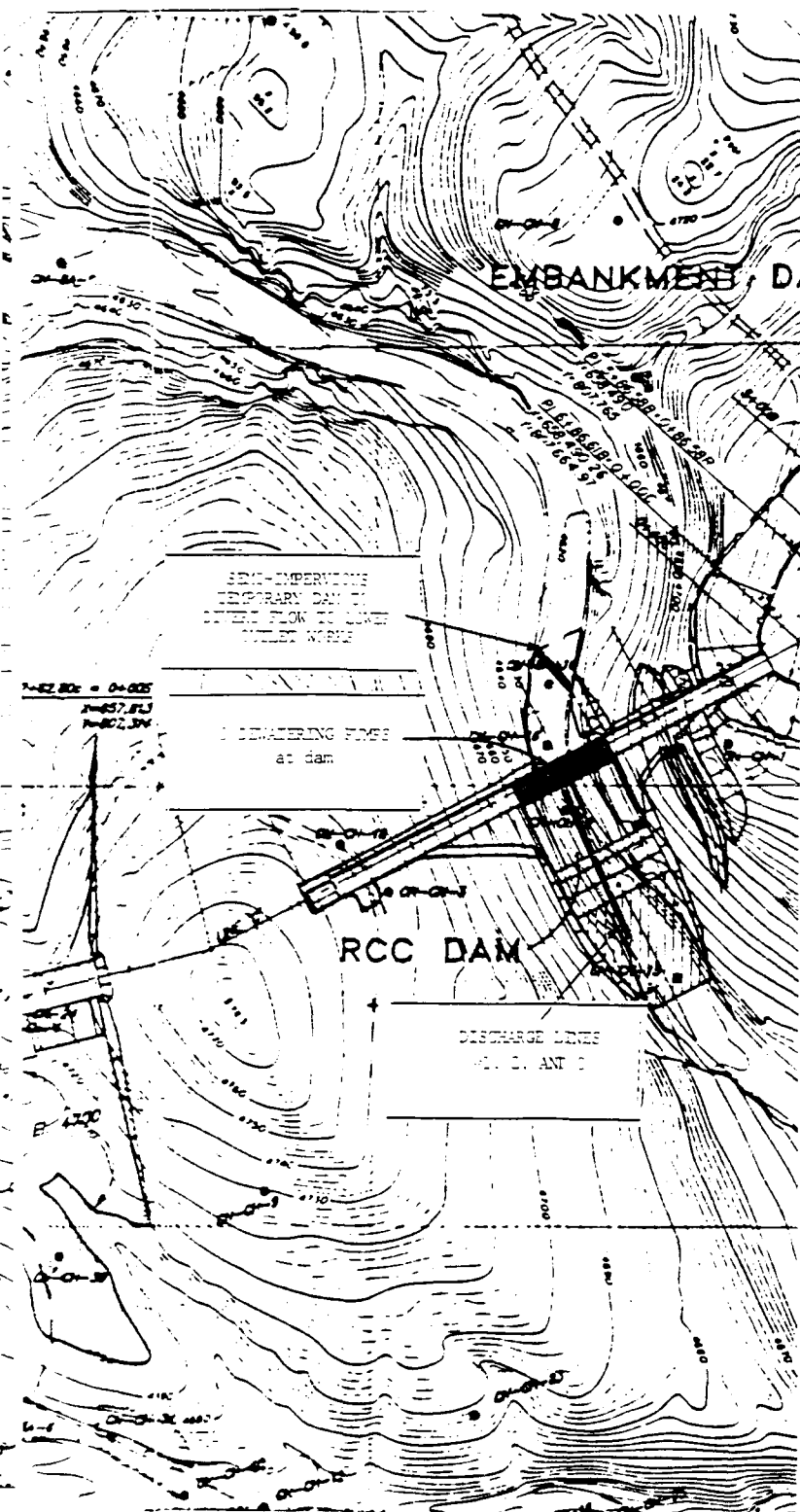
Notes:

Notes:

1. The temporary diversion dam will be approximately 75 feet long. Actual length shall be determined in field at time of construction.
2. Locations are tentative and are subject to changes.
3. The temporary diversion dam shall be constructed using acceptable semi-impervious fill material.
4. Stand-by pump locations will be dictated by actual field locations.
5. Rock rip rap shall be placed at outlet of dewatering pumps for erosion control.

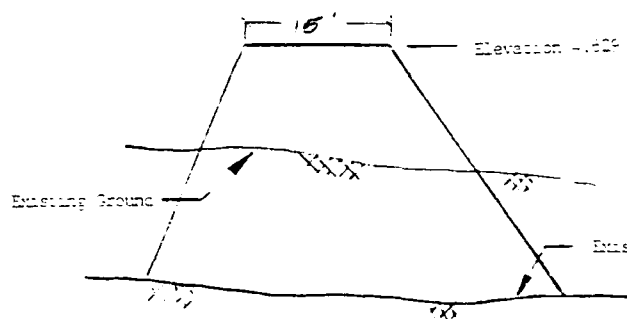
P C L CIVIL CONSTRUCTORS	
RIO GRANDE FLOODWAY (CUCHILLO DAM)	
Dewatering Pump Locations at Dam Structure	
DATE: 11-27-89 BY: Jm SCALE: 1/4"=10'	DATE: 11-27-89 BY: Tm





NOTES:

1. Locations are tentative and are subject to change.
2. Nuisance water from dewatering may be pumped to storage pond if needed.
3. Temporary dam shown will divert river to lower outlet works. The lower outlet works will handle 250 cubic feet per second.
4. Three dewatering pumps will remove excess water during construction of dam structure as secondary dewatering.
5. Prior to the installation of pumps, manufacturer's literature will be forwarded to the contracting officer for approval.
6. An additional well may be drilled if quantity of water from existing well is insufficient to supply construction needs.



P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DAM)

DACIA 7-89-C-0056

Dewatering and care of water operations

DES. Jm DATE 11-22-89 CHK. Tho
 Dwg No. 51-4



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

December 22, 1989

Serial Letter No.: 057/01565/2.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Dewatering Plan

Gentlemen:

As per your Serial Letter Number 14/01565/2.1, the enclosed is additional information to be incorporated into the Dewatering Plan

Discharge pump #1 is a 4 inch sump pump designed to pump 400 gallons per minute which will be the main dewatering pump. Pump #2 is a 6 inch trash pump with capacity of 1,500 gallons per minute and pump #3 is a 3 inch trash pump with capacity of 600 gallons per minute. Both pumps #2 and #3 will be used as optional stand-by pumps. All discharge lines shall be aluminum quick coupling irrigation type or standard flexible hose.

The existing well is to house a 7-1/2 hp. pump capable of 300 gallons per minute.

The plan for diverting water to the small arroyos to the south of the dam is to set rip rap or various size rock into a pit to control erosion. The discharge into the rip rap is to slow the outlet rush of water to the south of the dam, and to allow seepage into the existing gravel as ground water. This shall create close to an existing condition downstream.



Page 2 of 2
Dewatering Plan
December 22, 1989

As per Section 01565 Dewatering and Care of Water, Paragraph 3, flow in excess of 250 cfs that damage permanent work or previously prepared foundations will be considered cause for equitable adjustment. The 250 cfs would be measured at the U.S.B.R. gaging station shown on the plans and as indicated in the specification.

The temporary diversion dam shall be used to divert water from the Cuchillo Negro creek channel through the lower level outlet works during construction of the dam structure. The diversion dam will be constructed as follows:

1. The required random fill will be backfilled on the upstream face of the dam to the invert elevation of the lower outlet works pipe. (elev. 4618).
2. The diversion dam will be constructed of semi-impervious materials in the following dimensions:

Length = 110 ft.
Height = 10 ft.
Top Width = 10 ft
Side Slopes = 1V or 1H

Please note all locations, materials and sizes of pumps and lines are subject to change depending on availability, source and final conditions.

Sincerely,

A handwritten signature in black ink, appearing to read "T. R. O'Donnell", is written over the "Sincerely," line.

Thomas R. O'Donnell
Project Engineer

JM:deo



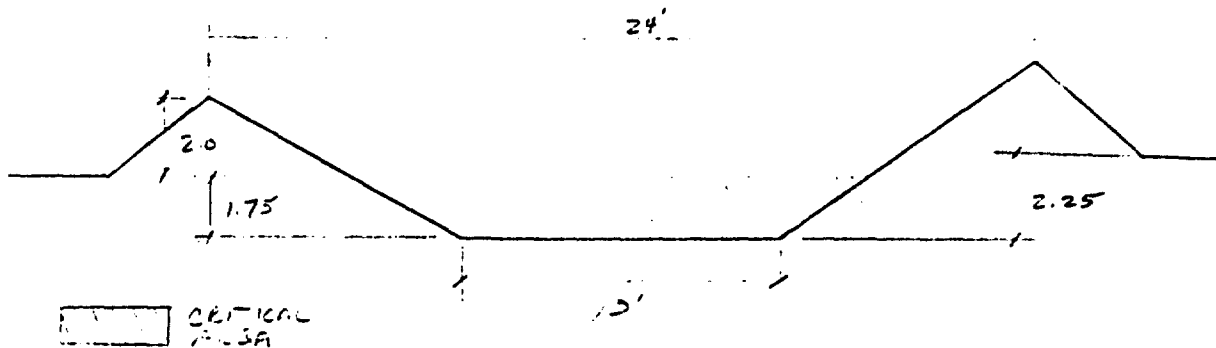
PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

MAY 21 1990

J. R. Smith

OPEN CHANNEL FLOW CALCULATIONS

DISAGREES TO USE THE FOLLOWING AT SHALLOWEST LOCATION
ITS FOLLOWS:



$$A = \text{AREA} = (10 + 1.75') \cdot 1.75' = 23.3 \text{ ft}^2$$

$$S = \text{SLOPE} = \frac{4.2'}{840} = 0.005$$

$$r = \text{RADIUS} = 10' + (1.75' \cdot 3.3') (2) = 17.5'$$

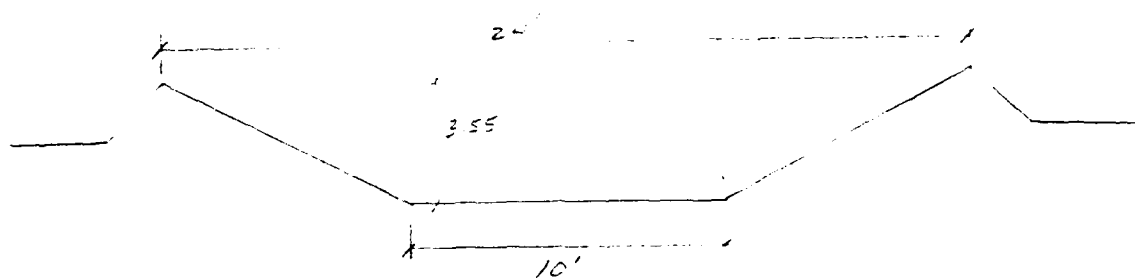
$$Q = A \cdot V = \frac{1.48}{n} \cdot A \cdot r^{2/3} \cdot S^{1/2} = \frac{1.48}{0.05} \cdot 23.3 \cdot (17.5')^{2/3} \cdot (0.005)^{1/2}$$

$$Q = 23.3 \cdot 1.48 \cdot 6.75 \cdot 0.07 = 277 \text{ CFS}$$

$$Q = 23.3 \cdot \frac{1.48}{0.05} \cdot (17.5')^{2/3} \cdot \sqrt{0.005}$$

$$= 23.3 \cdot 29.6 \cdot 6.75 \cdot 0.07 = 277 \text{ CFS}$$

1. CHANNEL WIDTH AT CRITICAL = 17.5' 3.3' 3.3'
2. CHANNEL BED = 1.75' 3.3' 3.3'
3. CHANNEL BED = 10'



CONSIDER AREA - 0 TOP OF BERM:

$$A = (10' + 3.55' + 17' + 3.55') = 60.4' = 2$$

$$S = 0.005$$

$$r_h = 10' + (\sqrt{3.55^2 + 1^2}) (2) = 25.7 \text{ ft}$$

$$Q = AV = 60.4' = 2 \cdot \frac{1.49}{5.06} \cdot (25.7')^{2/3} \cdot \sqrt{0.005}$$

$$Q = 60.4 \cdot 24.8 \cdot 8.7 \cdot 0.071 = 925 \text{ CFS.}$$

Contractor's Plan to Remove Differing Site Condition Material



PCL CIVIL CONSTRUCTORS, INC.
RIO GRANDE FLOODWAY, T OR C UNIT
CONTRACT NO.: DACW47-89-C-0056 (CUCHILLO DAM)
CHANGE ITEM 24, CORPS FILE C-37
REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF OPERATION



PCL CIVIL CONSTRUCTORS, INC.
CONTRACT NO.: DACW47-89-C-0056
CHANGE ITEM NO. 24: REMOVAL OF DIFFERING SITE CONDITION MATERIAL
PLAN OF OPERATION

INDEX TO CONTENTS

PLAN OF EXCAVATION	PART I
BLASTING PROPOSAL (McCAWS DRILLING)	PART II
PLAN TO PROTECT OUTLET STRUCTURES	PART III



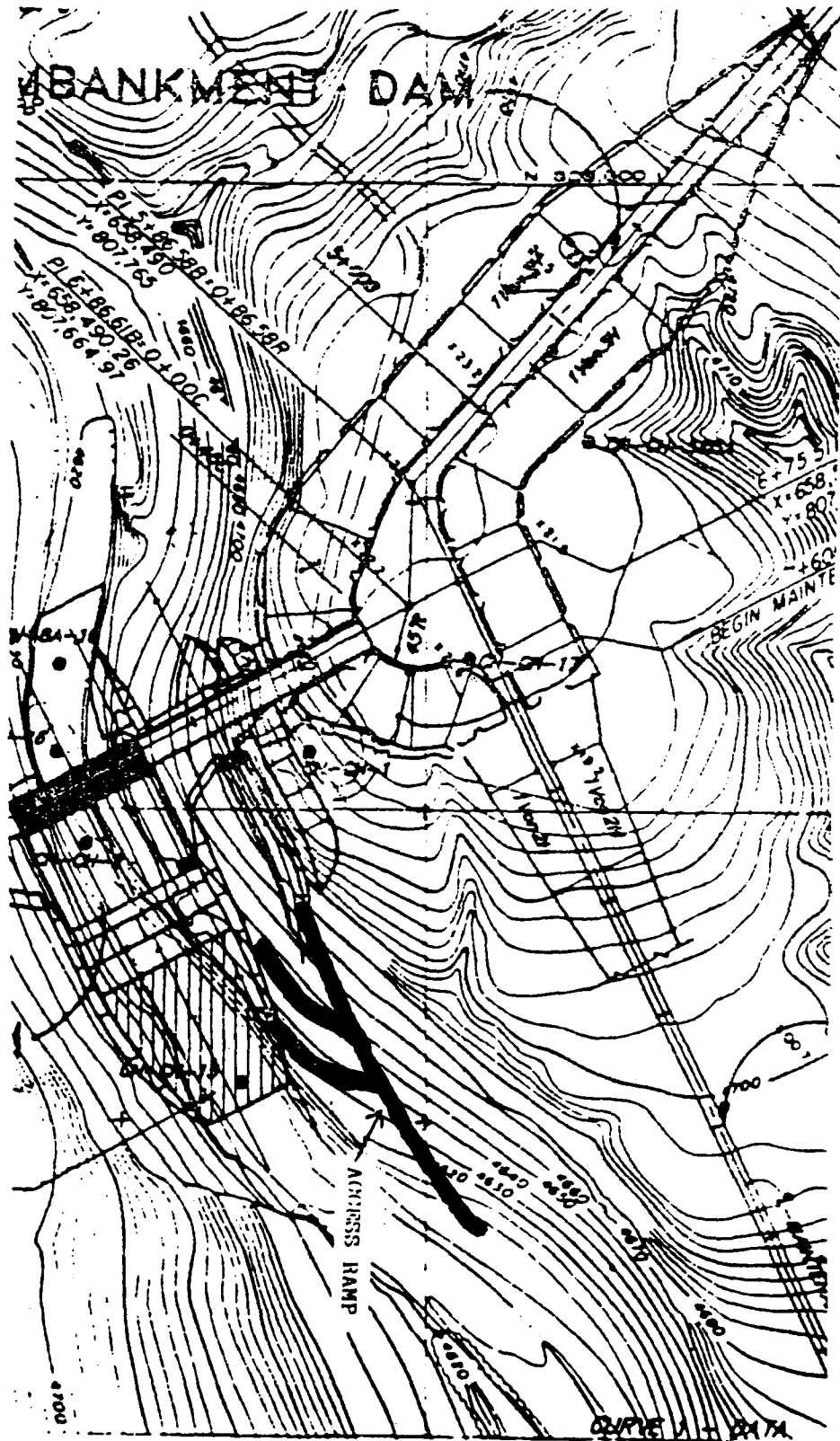
CHANGE ITEM NO: 24

REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF OPERATION

PART I

PLAN OF EXCAVATION



P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CICUITO DAM)

RFP "C-37"
Elevation Plan

Access Ramp

Scale 1" = 100'



PCL CIVIL CONSTRUCTORS, INC
RIO GRANDE FLOODWAY, T OR C UNIT

CHANGE ITEM NO. 24: REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF EXCAVATION

=====

The first step in the removal of the differing site condition material is to remove certain safety features at the High Level Outlet Works which will hinder the drilling operations. These safety features include the wire mesh at the left abutment of the RCC Dam, the safety handrail, the stairway to the High Level Outlet Works and other miscellaneous equipment and supplies. The removal of these items will be performed while the drilling and blasting equipment is being mobilized to the project site.

In order to gain access to the left abutment of the RCC Dam, an access ramp will be constructed downstream of the excavation as shown on the Corps of Engineers sketches. This ramp will allow the drilling equipment and excavation equipment to access each stage of the excavation. The ramp will be constructed as shown on the enclosed drawing "C37-1" with an approximate width of 10 feet and a grade of approximately 17 percent.

The removal of the differing site condition material at the left abutment of the Roller Compacted Concrete Dam will be accomplished in two benches. The first bench will start at the top of slope at the High Level Outlet Works, which will be marked by the C.O.E. Geologist, and proceed to a total depth of excavation of approximately 15 feet. The drilling, shooting and excavation will commence at the downstream limits (Sta. 3-50D -) and progress upstream. The second bench will continue to the bottom limits of the excavation which is the well defined limestone band at the approximate elevation of 4640. Drilling and blasting will be performed by McCaw's Drilling (USA), Inc., which is PCL Civil Constructors subcontractor for this specialized work. Techniques of controlled blasting which will be employed in the prosecution of this change is presented in Part II of this plan.

Mucking of the shot rock at each bench level will follow the drilling and shooting in as much as possible. The shot material at the first bench will be "backcasted" to the second bench using a Cat EL 300 Backhoe. The shot material at the second bench will then be "backcasted" to the Low Level Outlet Works bench using the same hydraulic excavator. All the shot material at the Low Level Outlet Works bench will then be rehandled again to the dam foundation floor. Once the material is deposited on the dam foundation floor, it will be loaded and hauled to the waste area, as shown on the original contract documents, using Caterpillar 769 Off Highway Trucks.



CHANGE ITEM NO: 24

REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF OPERATION

PART II

BLASTING PROPOSAL (McCAW'S DRILLING)

Table of Contents

<u>Description</u>	<u>Section</u>
General Procedures -----	1
Initiation System -----	2
Blast Design -----	3
Product -----	4
MSDS Data Sheets -----	5
Magazine Location & Specifics -----	6
Safety -----	7

GENERAL PROCEDURES

- 1) All blasting will be done by experienced and competent personnel employed by McCaw's Drilling (USA) Inc. Technical assistance will be supplied by:
 - a) Woodard Explosives
P.O. Box 12356, Station F
Albuquerque, NM 07195
Phone: (505)877-2400
 - b) Atlas Powder Company
6851 South Holly Circle
Suite 100
Englewood, CO 80112
Phone: (303)779-1200
- 2) Resumes of the on-site personnel for McCaw's Drilling (USA) Inc. (Mr. Kevin Joe and Mr. Kevin Stevenson) were submitted earlier in the project and subsequently approved by the contracting officer.
- 3) Explosives products will be stored at a location within the project boundaries as approved by the contracting officer. The location will be selected to comply with all local, state and federal laws, as well as, the United States Army Corps of Engineers Manual - EM385.1-1, section 25.A-19. Magazines have been federally inspected and meet the requirements of the Bureau of Alcohol, Tobacco & Firearms, as outlined in 27 CFR55, subpart K.
- 4) Explosives products and accessories will be supplied by Woodard Explosives of Albuquerque, NM - (505)827-2400. The explosives products that we anticipate using on this project are as follows.
 - a) Atlas High Explosives
 - i) Gelmax (1", 1 1/2" & 2" diameter)
 - b) Ensign Bickford Products
 - i) Short period electric caps (period 1 to 20)
 - ii) E-Cord (35 grains per foot)
 - iii) Primacord (200 grains per foot)

- 5) Our firm will be submitting detailed blasting reports for each blast per section 7-21-5 and section 7-6 of the contract documents. In addition to this, we will have three VMS 500 seismographs which will be used to measure and record peak particle velocity, amplitude, frequency and overpressure (air blast) in the vicinity of the blast and the structures at risk per section 25-C of Corps manual - EM 385-1-1.

INITIATION SYSTEM

- 1) For this portion of the work, we will be using an electric system of initiation, in-hole detonators and tie-in. For precise blasting operations where delayment is critical, it has been our experience that electric systems tend to give the more precise control required for this type of work.

BLAST DESIGN

- 1) Our general approach to this portion of the work will be as follows:

The left abutment will be blasted in two benches. The first bench will be at a height of 15'.

The second bench will be to the bottom of the well defined limestone band or the top of the clay infill material (approximate elevation - 4644.0).

Blasting will begin at the downstream limit of the excavation and progress upstream. The delayment, patterns and tie-in sequences will be determined in the field by trial blasts and the results of the seismograph monitoring. Generally, our patterns for production blasting will be 4' X 4' and 5' X 5' and hole diameters shall not exceed 3".

The spacing for wall control holes will be 24" c/c or as approved by the Contracting Officer.

The column loads will be determined by the results of our trial blasts and will be detailed on our preliminary blast proposal forms as required per section 7.2-1.5 and section 7-6 of the contract documents.

MAGAZINE LOCATION & SPECIFICATIONS

1) Specifications

a) High Explosives Magazine

Type: Type 2 with skids
Dimensions: 8 X 8 X 10
Capacity: 12,500 lbs
Construction: 1/4" steel with interior lining of 2" of hardwood, and 1/2" plywood or particle board.
Ventilation: Adequate
Locks: Two American locks with 7/16" shackles. The locks have hooded covers.

b) Detonator Magazine

Type: Type 2 portable with skids
Dimensions: 3' X 3' X 5'
Capacity: 2000 caps (approximately 5 lbs explosives)
Construction: 1/4" steel with interior lining of 2" of hardwood, and 1/2" plywood or particle board.
Ventilation: Adequate
Locks: Two American locks with 7/16" shackles. The locks have hooded covers.

2) Security of Magazines

The magazines will have locks in accordance with ATF Publication - Page 5400.7 (11/82). The magazines will be kept locked at all times while unattended. "No Trespassing" signs will be posted at appropriate locations around the magazine site.

SAFETY

- 1) On this project, we will be following the safety program established by the general contractor, including testing for substance abuse.

In addition, to this we will have an orientation with each new employee specifically tailored to working with explosives.

The receiving, transporting, handling and use of explosives will be in accordance with all applicable local, state and federal laws and the United States Army Corps of Engineers Manual EM 385-1-1, Section 25.A-19.

Prior to commencement of blasting, a survey will be made at the blast site to check for extraneous electricity. During loading operations, we will have a model 350 lightning detector set up to monitor atmospheric static electricity. The detector is equipped with two warning systems - "Light and Sound", each blast will be covered with 10' X 15' rubber blasting mats to prevent fly rock. During loading operations, persons not directly involved in the blasting operations will not be allowed in the blast area. All blasting operations will be conducted with maximum emphasis on safety and in accordance with the Corps of Engineers publication EM285-1-1.



PCL CIVIL CONSTRUCTORS, INC.
RIO GRANDE FLOODWAY, T OR C UNIT
CHANGE ITEM NO. 24 - REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN TO PROTECT OUTLET STRUCTURES

I Low Level Outlet Work:

The first step in the protection of the Low Level Outlet Works is to salvage all of the removable components of the structure without subjecting PCL Civil Constructors employees to the slope stability hazard of the left abutment of the RCC Dam. Concrete formwork and reinforcing steel will be removed and salvaged at the intake structure, 60" pipe encasement and the stilling basin. In addition, all safety handrail, lumber walkways and miscellaneous supplies will be removed from the Low Level Outlet Works area. Some components of this structure are either impossible to remove or are hindered due to safety considerations. These components will remain and be replaced after the changed work is completed.

The next step in the protection of the Low Level Outlet Works is to cover the structure with a protective layer of sand. PCL Civil Constructors will use a screened 3/8-inch minus sand, meeting the gradation requirements of the Roller Compacted Concrete fine aggregate. This material will be loaded and hauled from our present stockpile area to the top of the left abutment of the RCC Dam using Caterpillar 769 Off Highway Trucks. Placement of the protective sand will be accomplished using a Manitowoc 4100 Series 2 Crane and two yard concrete buckets. The concrete buckets will be filled using a Michigan L70 Front End Loader and lowered to the Low Level Outlet Works using the Manitowoc Crane.

After the differing condition material is excavated and removed from the left abutment of the RCC Dam. Bulk clean-up of the protective sand will commence. Bulk clean-up will consist of machine and hand removal. Approximately two thirds of the material will be removed using a John Deere 310 C Backhoe which will leave approximately one third to be removed by hand. Final clean-up of the protective sand will consist of vacuuming, air/water jetting and high pressure washing of the Low Level Area floor, walls, 60" pipe and pipe pedestals.

II High Level Outlet Works:

Protection of the High Level Outlet from the affects of blasting will be accomplished using blasting mats and seismographs which will be used to measure peak particle velocity, amplitude, frequency and air blast at this structure. All blasting will be controlled to keep the maximum peak particle velocity at this structure to 2 inches/second. The technique which will be employed to minimize the effects of blasting on the structures is explained in detail in The Blasting Proposal Section of this plan (Part II).

Government's Directive to Remove Differing
Site Condition Material



DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
SOUTHERN AREA OFFICE
P.O. BOX 6006, FORT BLISS, TEXAS 79906
FAX (815)588-1348

REPLY TO
ATTENTION OF:

November 26, 1990

Construction-Operations Division

Serial Letter No. 239/P00024

SUBJECT: Contract No. DACW47-89-C-0056, Cuchillo Dam, Rio Grande Floodway,
T or C Unit, Sierra County, NM; Modification P00024 and Direct of Work

PCL Civil Constructors, Inc.
P.O. Box 2270
Truth or Consequences, NM 87901

Gentlemen:

As a result of a meeting at the job site on November 21, 1990 to discuss the scope of work necessary to remove material on the left dam abutment, I have determined it to be in the best interest of the Government to direct some aspects of your work. You are directed to proceed with removing the material on the left abutment as previously directed in Modifications P00022 and P00024, however your performance shall conform to the following:

A. Do not construct a temporary road from the HLOW bench, downstream to the canyon floor. Drilling equipment can be placed by crane. It is anticipated that this is the only equipment necessary at the HLOW bench.

B. Drill and blast pre-split holes at 2 foot centers along the HLOW bench to a depth of approximately 30 - 35 feet. It is the intent to construct an intermediate bench at approximate elevation 4655, just above the lower-most ledge of limestone. Due to the type of material in this area, production drilling and blasting is not believed necessary. All drilling and mucking shall progress from downstream to the dam axis.

C. A temporary haul road should be constructed from the downstream canyon floor up to the intermediate bench. This road should be wide enough (20' +/-) to safely allow for backing of hauling equipment. A low berm constructed on the downslope edge of this road would provide an added measure of safety.

D. Excavation of the material above the intermediate bench shall be accomplished by equipment located on the intermediate bench, placing material from the excavation directly into hauling equipment located on the intermediate haul road/bench. A waste area downstream of the spillway will be located by the Resident Engineer in the field. In the event any oversize material is encountered, it can be pushed over the bench and down into the canyon. In the meeting, Mr. O'Donnell expressed a safety concern with putting equipment on the intermediate bench. It is anticipated that the bench will

have a minimum width of 25 feet. Since the hauling equipment is approximately 14 feet wide, and your excavator requires a minimum of 16.5 feet to swing, I believe the bench will be wide enough. Another concern is with the integrity of the limestone underlying the bench itself. Although this item will be closely watched by all parties while equipment is on the bench, I believe the situation will be safe. It appears from the exposed face of this ledge that the material is competent. Equipment will only be on portions of the bench from which the heavy load of overburden has been removed. The rock units exposed on this face dip inward towards the face of the excavation.

E. After excavating the material above the intermediate bench, drill and blast the remaining limestone ledge from the intermediate bench. It is believed that production holes will be required. Excavation from this area should be removed in a fashion similar to the process used above the intermediate bench.

F. Removal of LLOW protection sand shall be by vacuum truck.

G. Excavation above the intermediate bench should begin as soon as pre-split drilling proceeds a sufficient distance along the bench. This will allow for the minimum of lost time if this method of work does not progress as anticipated.

H. The necessity of having a blasting consultant on site at all times is questionable. The cost of \$600/day is also questionable since this service is usually provided by blasting-material manufacturers at no cost. A blasting consultant shall only be used for a maximum of two days, unless otherwise directed by the Resident Engineer.

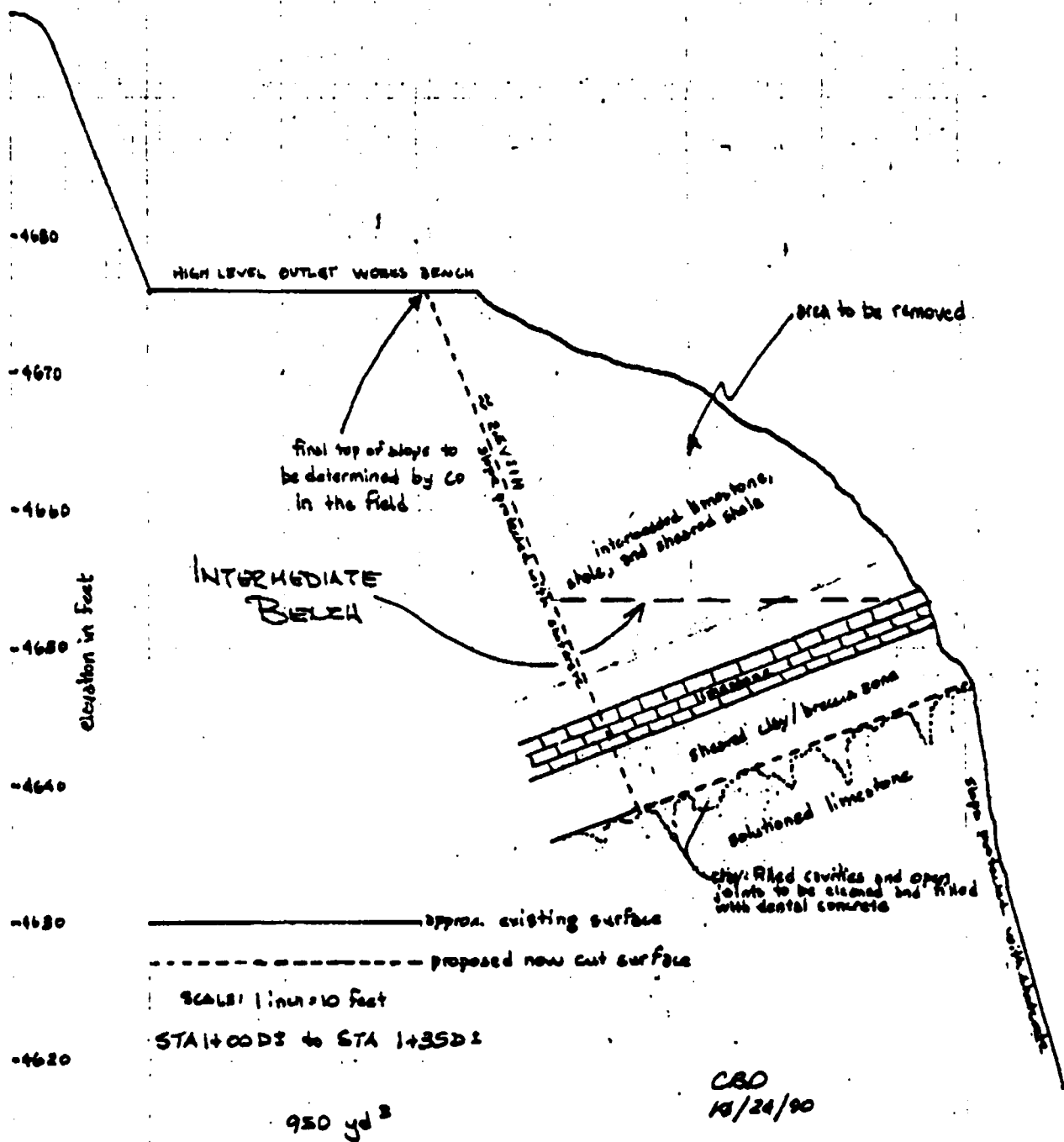
The above direction-of-work may be modified by the Resident Engineer as conditions warrant. This direction has been developed by my staff after discussions with Mr. O'Donnell. Although we are directing some items of work, we still appreciate PCL's input and ideas on this matter. Although I believe the above direction will result in the most efficient method of accomplishing this additional work, I would hope that any ideas which PCL may have to minimize delays as the work progresses will be shared with us. Although you may not agree with the Government's approach as being the best, I am confident that PCL and its staff will cooperate in a professional manner to accomplish this work in the most expedient and efficient manner possible, mitigating any delays to either party.

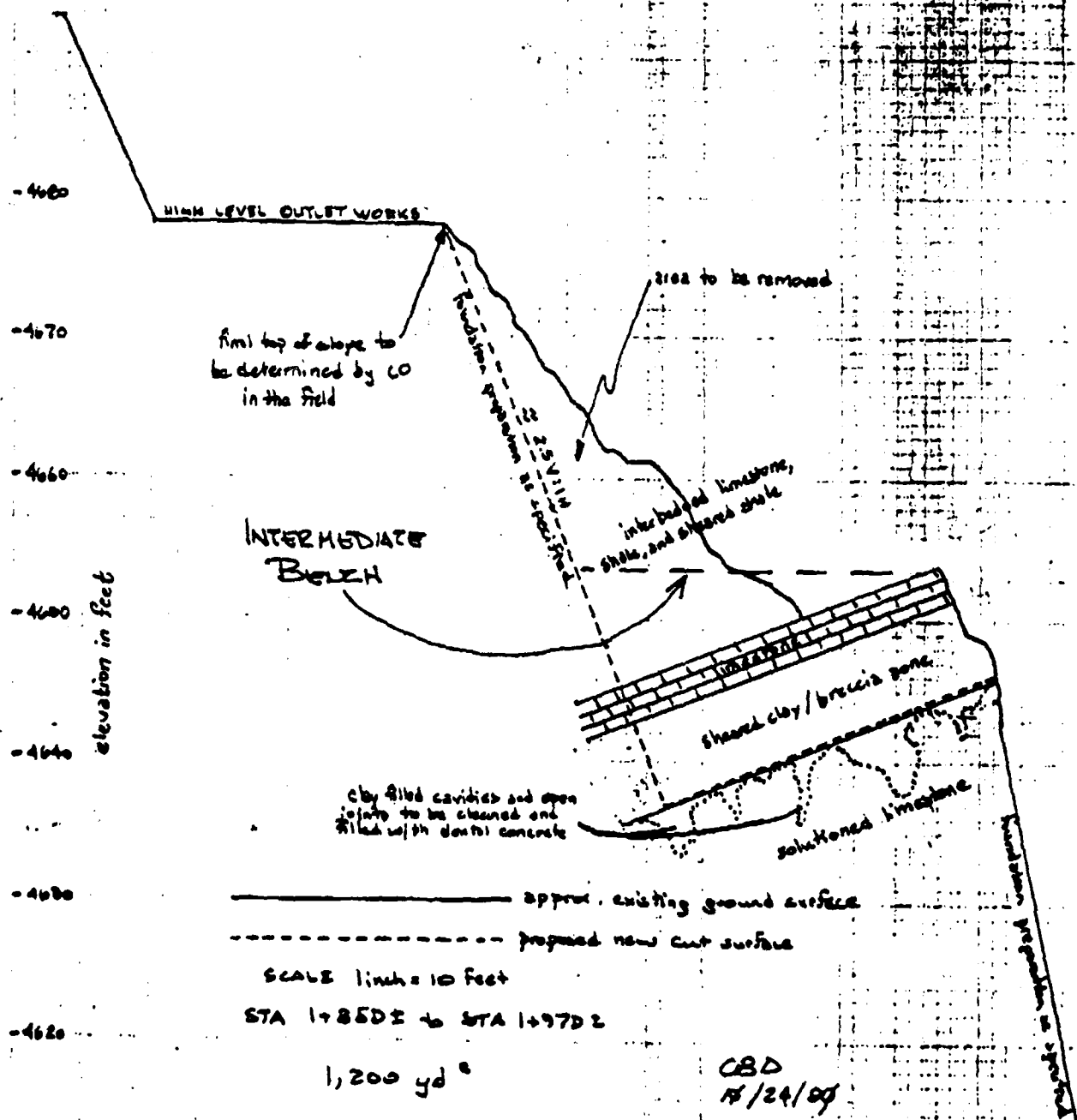
Sincerely,

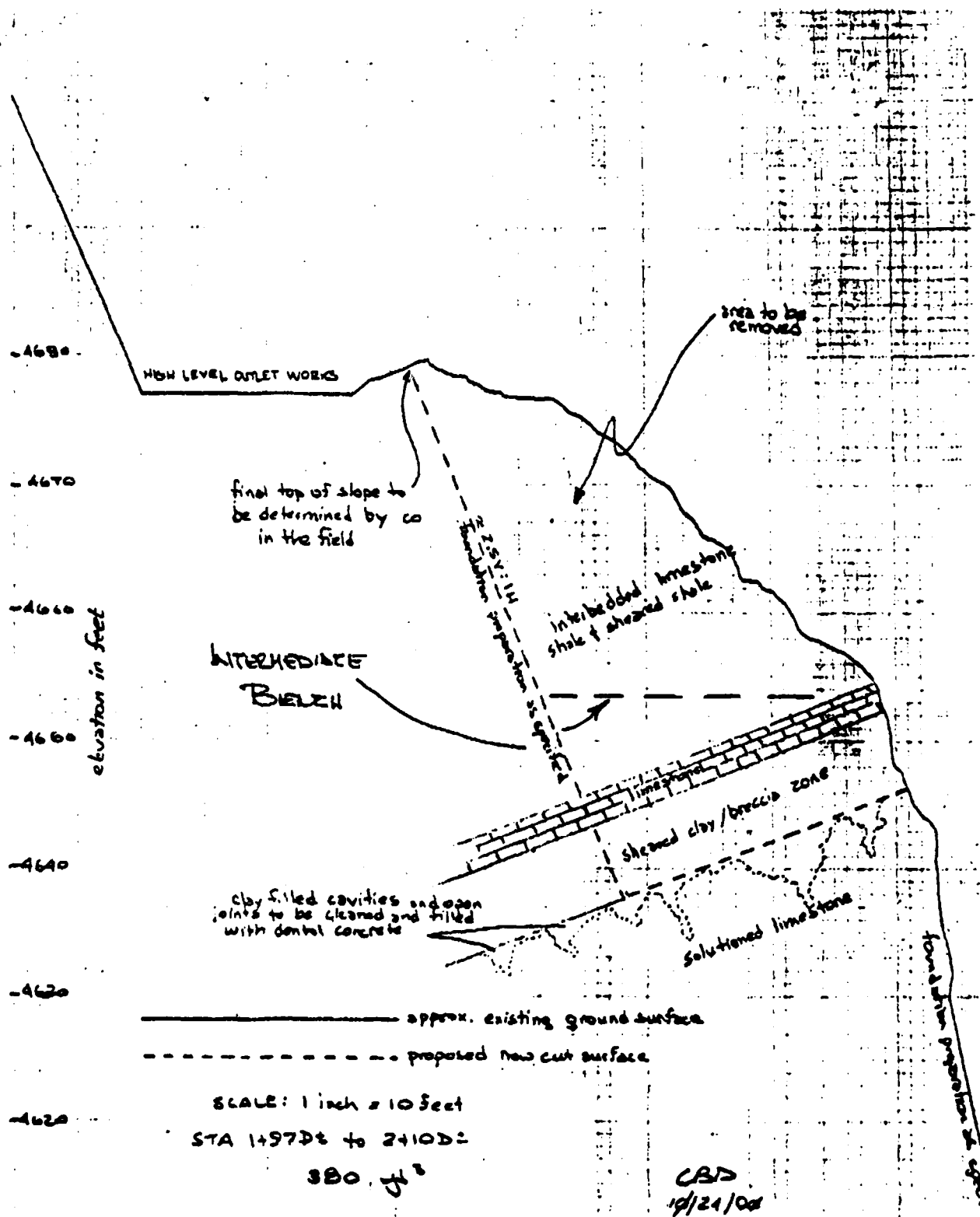


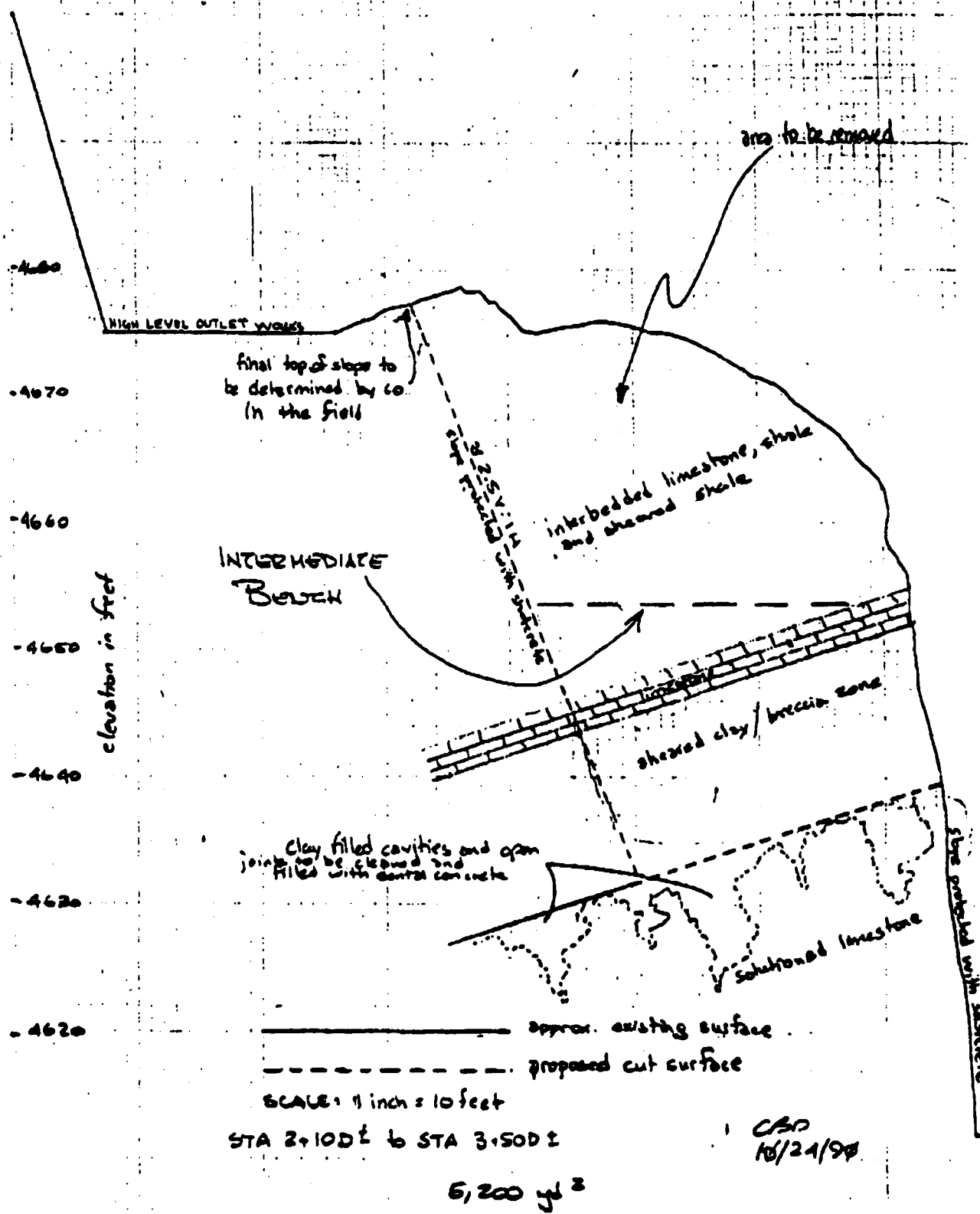
Donald A. Pfister, PE
Administrative Contracting Officer

Copy Furnished:
N.C. Tennock Dist. Manager
DAP/slr









Contractor's Wire Mesh Installation Plan



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Rec'd 18 Dec 89
W

December 15, 1989

Serial Letter No.: 080/02219/10.2

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Wire Mesh Installation Plan

Gentlemen:

Pursuant to Section 02219 of the Technical Provisions, four (4) copies of PCL Civil Constructors wire mesh installation plan are herewith transmitted for the Contracting Officers approval.

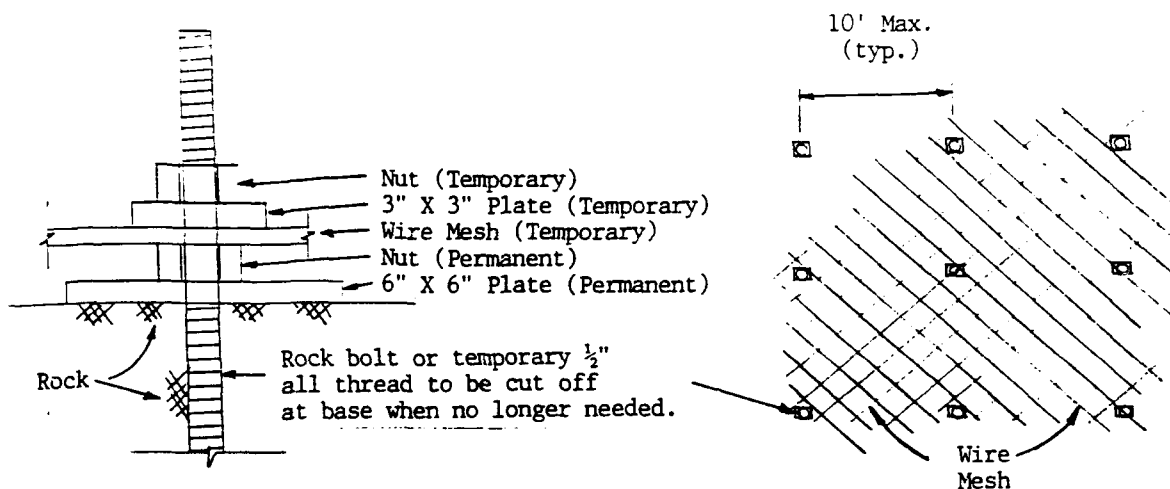
Sincerely,

A handwritten signature in dark ink, appearing to read "T. R. O'Donnell", is written over a horizontal line.

Thomas R. O'Donnell
Project Engineer

JM:deo

enclosure



WIRE MESH MOUNTING DETAILS
NOT TO SCALE

NOTE:

1. The nut and plate shown to hold wire mesh in place is temporary and shall be attached to a permanent rock bolt or a temporarily installed allthread rod.
2. Allthread installed where rock bolts are not required shall be cut off at ground level when wire mesh is no longer needed.
3. Maximum spacing shall be 10 feet for allthread rod needed. Spacing for rock bolt shall be as directed by the Contracting Officer.
4. The temporary nut and plate used for securing the wire mesh shall not conform to the nut and plate specification for rock plating due to the temporary nature in which they are used.
5. Wire mesh shall conform to specification Section 02219-10.2 of the contract specifications.
6. Allthread used to mount wire mesh temporarily shall be imbedded into the rock 2.5 feet using the same method as rock bolts, with 6 inches protruding to place temporary plate and nut.

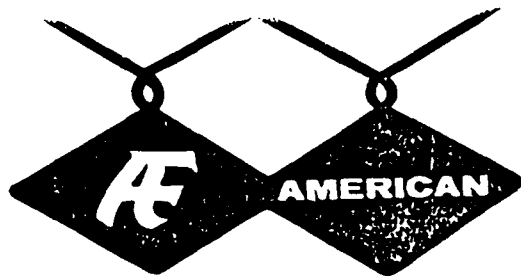
P C L CIVIL CONSTRUCTORS	
RIO GRANDE FLOODWAY (CUCHILLO DAM)	
	INSTALLATION PLAN OF WIRE MESH ON ROCK SLOPES
	SW-14

For Field Use

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE (Read instructions on the reverse side prior to initiating this form)		DATE January 29, 1990	☒ NEW SUBMITTAL ☐ RESUBMITTAL	
TO: Construction Branch USAED Albuquerque P.O. Box 1580 Albuquerque, NM 87103-1580		02 FEB 1990 (This section will be initiated by the contractor)		
FROM: PCL Civil Constructors P.O. Box 2270 Truth or Consequences, NM		CONTRACT NO. DACW47-89-C-0056		TRANSMITTAL NO. 11.00 PREVIOUS TRANS. NO. (If any)
SPECIFICATION SEC. NO. (Cover only one section with each transmittal) 02219		PROJECT TITLE AND LOCATION Rio Grande Floodway (Cuchillo Dam), Truth or Consequences, NM		
ITEM NO.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)	MFG. OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction No. 8)	CONTRACT REFERENCE DOCUMENT	FOR C E USE CODE
1	Wire Mesh	Cert.	SPEC. PARA. NO. 10.2	DRAWING SHEET NO. 10.2
U.S. ARMY ENGINEER DISTRICT, ALBUQUERQUE, NM CERTIFIED FOR APPROVAL AS INDICATED BELOW				
A. APPROVED AS SUBMITTED B. APPROVED, EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEET(S) C. APPROVED, EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEET(S) D. NOT APPROVED E. DISAPPROVED F. DISAPPROVED G. DISAPPROVED				
NOTE: IF A DISAPPROVAL IS INDICATED, THE DRAWING(S) AND/OR ATTACHED SHEET(S) MUST BE REVISED AND RE-SUBMITTED TO THE ENGINEER FOR APPROVAL.				
REMARKS: <i>[Signature]</i> 7 MAR 90				
I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated. Michael B. Beer <i>[Signature]</i> NAME AND SIGNATURE OF CONTRACTOR				

APPROVAL ACTION NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY <i>[Signature]</i>		DATE 07 MAR 1990
INCLOSURES RETURNED (List by Item No.)		SHEET ____ OF ____

PHOENIX ARIZONA
 DEER VALLEY ARIZONA
 MESA ARIZONA
 TUCSON ARIZONA
 SHOWLOW ARIZONA
 PRESCOTT ARIZONA
 TUMA ARIZONA
 SAN MARCOS CALIFORNIA
 ALPHEFIELD CALIFORNIA
 EL CENTRO CALIFORNIA
 SANTEE CALIFORNIA
 SATECOTY CALIFORNIA
 HONOLULU HAWAII
 WAILUKU HAWAII
 HILO HAWAII
 HAWAII HAWAII
 KONA HAWAII
 WICHITA KANSAS
 EL PASO TEXAS
 ODESSA TEXAS
 LONGVIEW TEXAS
 OGDEN UTAH
 OREM UTAH
 SALT LAKE CITY UTAH
 KANSAS CITY MISSOURI
 ALBUQUERQUE NEW MEXICO
 GALLUP NEW MEXICO
 LAS CRUCES NEW MEXICO
 ARMINGTON NEW MEXICO



FENCE COMPANY, INC.

9634 2ND N.W. • ALBUQUERQUE, NEW MEXICO • TELEPHONE 897-3103

PCL CONSTRUCTION
 P.O. BOX 2270
 TRUTH OR CONSEQUENCES, NM 87901

Non restrictive chain link fence specification

Materials

Fence fabric shall be new and free of defects, from recognized and reputable manufacturers, unless otherwise specified. Materials will be hot dipped galvanized with zinc coating measured in accordance with ASTM A-90. Materials shall be American-made and certified by the manufacturer in accordance with the Buy-American Act of April, 1984. Fabric shall be 2" mesh, 11 gauge, hot dipped galvanized.

REFERENCES

RR-F-191/1C Chain Link Fence Fabric

Contractor's Rock Bolt Information



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Rec'd & Jan 90

December 22, 1989

Serial Letter No.: 090/02219/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Rock Bolts

Gentlemen:

Pursuant to Technical Provision 02219, Paragraph 10.1, titled, "Rock Bolts", the following information is herewith transmitted in four (4) copies, to the contracting officer for review:

1. Manufacturers written installation procedure for rock bolts
2. Drawing IB-JR-1124 showing rock bolt installation
3. Technical data on 1-inch diameter rock bolts
4. Drill hole fill chart for anchorage
5. Technical Data on 1-1/2 inch O.D. coupling
6. Technical data on WIL-X non-shrink grout
7. Laboratory certification for WIL-X non-shrink grout
8. Technical data of T72 tension jack
9. Manufacturers data on CG-600 colloidal grout plant

Our rock bolt supplier, Williams Form Engineering Corp., has proposed the use of rock bolts in 15 ft. lengths with a coupling to join two (2) sections of steel bringing the total length to 30 ft. as required by the contract documents. McCaw Drilling and Blasting will be our subcontractor for the installation of the rock bolts.

Sincerely,

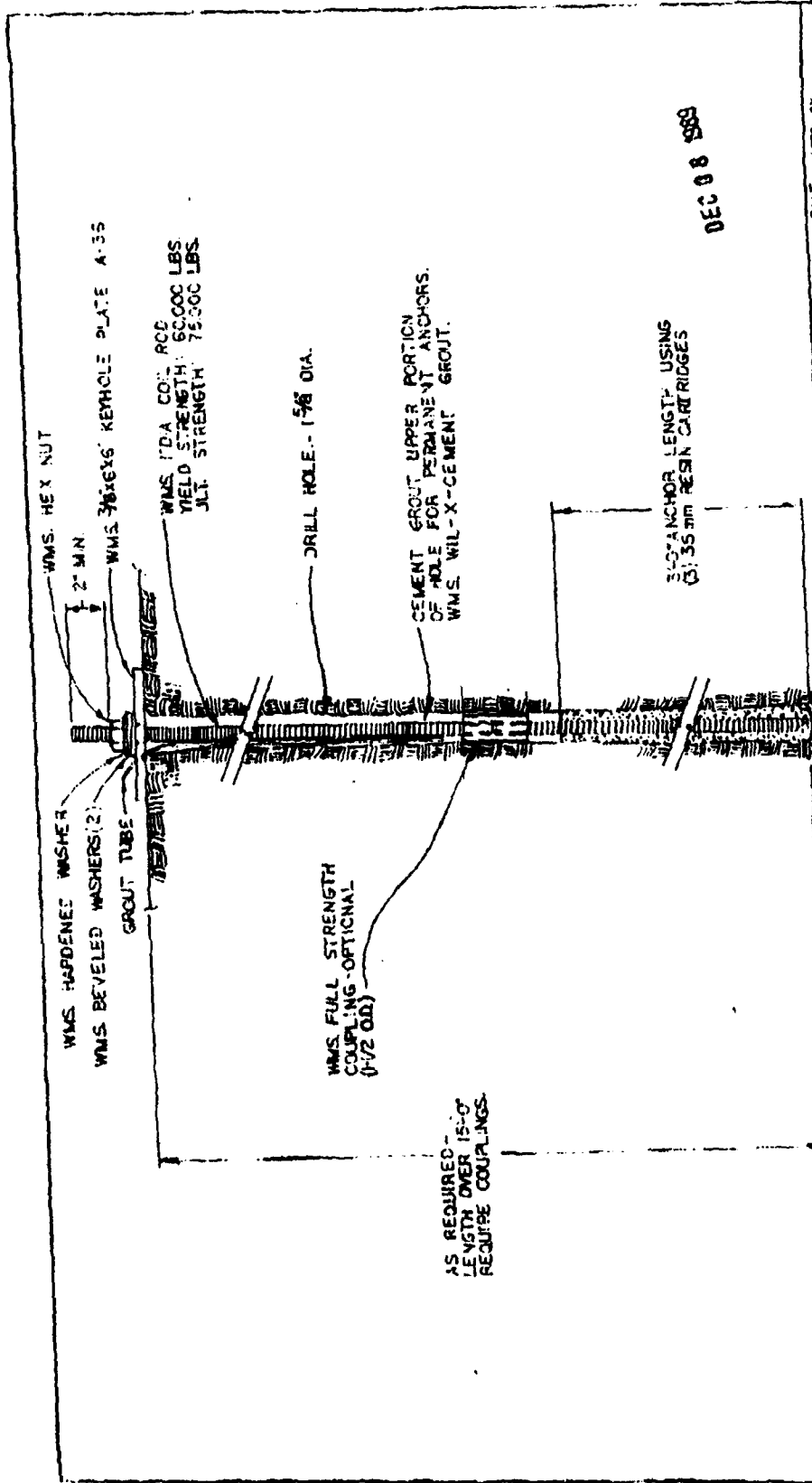
Thomas R. O'Donnell
Project Engineer

TRO:deo

Enclosure

P.O. Box 2270, Truth or Consequences, N.M. 87901 Telephone 505-743-7834 Rapidfax 505-743-7836

"AN EQUAL OPPORTUNITY EMPLOYER"



DEC 08 1989

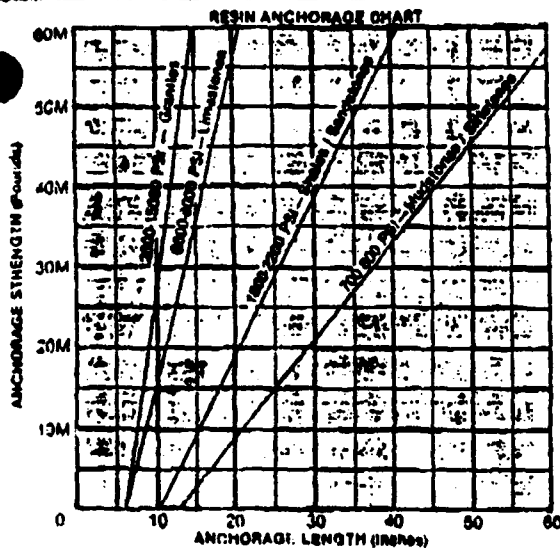
WILLIAMS FORM ENGINEERING CORP. 1111 N. 10th St. - Grand Rapids, Mich. 49503 616-233-2000 • FAX 616-233-2001		DRAWING: 241T SCALE: 1/4" = 1' DATE: 12-8-89 SHEET NO: 1 OF 1 PRINT NO: B-JR-1124
CUSTOMER: PCL CIVIL CONSTRUCTION INC. PROJECT: 1" ANCHOR BOLT WITH OPTIONAL COUPLING		DEC 89



INSTALLATION PROCEDURE

- Drill 1-5/8" diameter hole to a depth 2" less than overall rod length to be used. Use rotary percussive equipment.
- Clean hole of dust and debris using high pressure air.
- Insert proper number of 35mm cartridges to bottom of hole. Precautions should be taken to prevent bursting.
- Insert bar and rotate 200-250 RPM through cartridges. Bar should spin for 20-30 seconds after full insertion and reach a minimum of 75 revolutions.
- Installation of rod through resin cartridges should be completed within 6 hours of drilling of hole.
- Place plate, (2) bevel washers, hardened washer and hex nut on bar and position bar in center of hole until full cure of resin.
- Attach test jack assembly to top of bolt and tension to required load not to exceed 37,500 lbs.
- Tighten nut against plate using proper wrench and release jack pressure. Then remove jack.
- Cement grouting of top portion of hole to be done on permanent bolts. Insert grout tube thru keyhole in plate to top of resin elevation. Inject grout at steady flow thru tube to fill hole and slowly extract tube. Top up hole as necessary.

In addition to the above procedure, all requirements set forth in the job specifications are to be followed.



When fully cured, the resin is stronger than rock and most other materials into which it is likely to be used. Please refer to the following test data which is based on our standard resin cartridge. WILLIAMS FORM can supply higher or lower resin strengths to suit the application. Please contact a WILLIAMS representative for further information.

Uniaxial Compressive Strength	103.33N/mm ² (15,000 lb/in ²)
Tensile Strength (beam test)	22.1N/mm ² (3,200 lb/in ²)
Unconfined Shear Strength	52N/mm ² (7,500 psi)

This chart is intended as a guide for on site trials which will establish the working specifications in the actual ground conditions.

DRILL HOLE FILL CHART — (Per cartridge)

	Metric	CARTRIDGE SIZE Diameter by standard length 308 mm (12 inches)							
		1 1/8" (28mm)	1 3/8" (35mm)	1 1/2" (38mm)	1 5/8" (41mm)	1 3/4" (44mm)	1 7/8" (47mm)	2" (51mm)	2 1/4" (60mm)
BOLT DIAMETER REBAR SIZE ASTM A 315 GRADE 60	No. 6 3/4"	20mm	20"	15" 12"	14" 12"				
			(508)	(381) (305)	(356) (308)				
	No. 7 7/8"			21" 18"	18" 14"	14"			
				(533) (458)	(457) (366)	(368)			
	No. 8 1"	25mm			21" 13"	18" 13"	15" 12"		
					(533)	(457) (330)	(381) (308)		
	No. 9 1-1/8"					18" 12"	20" 14"	14" 12"	
						(408) (305)	(508) (396)	(368) (305)	
BOLT DIAMETER REBAR SIZE ASTM A 315 GRADE 60		30mm				19" 13"	23" 15"	15" 12"	
						(483) (330)	(584) (381) (308)	(381) (308)	
	No. 10 1-1/4"					18"	19" 13"	17" 13"	
						(408)	(483) (330)	(432) (330)	
	No. 11 1-3/8"	36mm					18"	21" 18"	18"
							(457)	(533) (381) (305)	(408)
	No. 14 1-3/4"	48mm						22"	18"
								(559)	(408)
BOLT DIAMETER REBAR SIZE ASTM A 315 GRADE 60	1-1/4" Non...					18" 13"	18"	23" 18"	18"
						(408) (330)	(457)	(584) (408) (308)	(381)
	1-3/8" Non...							19" 14"	17" 12"
								(483) (330)	(432) (305)
DRILL HOLE DIAMETER		1"	1-1/8" 1-3/16"	1-3/16" 1-1/4"	1-1/4" 1-1/2" 1-5/8"	1-1/2" 1-5/8" 1-3/4"	1-3/4" 1-7/8" 2"	2" 2-1/4"	

SET TIMES AVAILABLE:

- Two-Four Minutes — This is a standard gel time and used when insertion and rapid mixing can be achieved.
- Fifteen-Thirty — This is normally used with WILLIAMS fast gelling cartridges to ensure complete grouting when pre-tensioned fully grouted bolts are required.

ORDERING INFORMATION:

WILLIAMS resin cartridges are ordered by size and type. Stock sizes manufactured can be found in the usage chart. The size of the cartridge required is the ordering part number. The Type refers to the gel time required.

EXAMPLE 58R-33-305-02-74

dia. length gel time (of cartridge)

HIGH TENSILE STEEL Williams B1S High Tensile Tie Rods, B2S Pigtail Anchors, B7S and B8S Continuous Thread Rod					
Thread Dia.	Thread Pitch		Safe Working Load	Maximum Working Load to elastic limit	Ultimate Strength
Inches mm	Coil Thd.	V Thd.	Lbs. Kn	Lbs. Kn	Lbs. Kn
5/16"		18 DL	4,180	5,000	8,280
8			18.5	22.2	37.6
3/8"	8	18 NC	6,500	7,500	9,800
10			28.9	33.4	43.6
1/2"	6	13 NC	12,000	13,000	16,000
13			53.4	57.8	69.1
5/8"	4-1/2	11 NC	18,660	21,000	25,000
16			74.1	93.3	111.2
3/4"	4-1/2	10 NC	25,300	30,000	36,000
19			112.5	133.5	160.0
7/8"	4-1/2	9 NC	38,860	46,000	56,000
22			172.0	204.8	258.0
1"	3-1/2	8 NC	50,000	60,000	75,000
25			224.4	266.8	333.5
1-1/8"	3-1/2	7 NC	60,000	72,000	90,000
29			266.9	320.3	400.4
1-1/4"	3-1/2	6 NC	80,000	90,000	120,000
32			355.8	400.4	533.7
1-3/8"		8 UN	90,000	110,000	135,000
35			400.4	489.2	600.4
1-1/2"	3-1/2	6 NC	95,000	112,000	140,000
38			422.8	498.2	622.8
2"		8 UN	206,850	255,000	310,000
51			919.3	1134.3	1379.0

*Based on approximate 1.5 to 1 Safety Factor

H4R NEOPRENE WATER SEAL WASHER

Designed to prevent water leakage along the tie rod. Available in tie-rod sizes 1/2"-1-1/4". Special sizes available upon request.



H4R Neoprene Water Seal Washer	
Size	Size
1/2"	1"
3/4"	1-1/4"
1"	1-1/2"
1-1/8"	1-5/8"
1-1/4"	1-7/8"

B7G CONTINUOUS MILD STEEL COIL ROD

WILLIAMS B7G Coil Rod is manufactured in mild steel. It is available in 3/4", 1" and 1-1/4" diameters. Standard lengths: 10'0". Stocked in all diameters. See chart below for strengths.



B7G Mild Steel Continuous Coil Thread Rod		
Size	Working Load	Ultimate Strength
3/4" - 4-1/2"	12,000 lbs.	18,000 lbs.
1" - 3-1/2"	24,000 lbs.	36,000 lbs.
1-1/4" - 3-1/2"	36,000 lbs.	54,000 lbs.

Based on 1.5 to 1 Safety Factor
Mild steel 10' standard length.

WILLIAMS

Coil thread Couplings

Rod Diameter (inches)	O.D.	Length	Safe Working Load (1.5:1 S.F.)	Ultimate Strength
3/8"-8	3/4"	1-1/2"	7,900 lbs.	11,900 lbs.
1/2"-8	3/4"	2"	17,000 lbs.	26,000 lbs.
5/8"-4-1/2	1"	2-1/2"	26,000 lbs.	39,000 lbs.
3/4"-4-1/2	1-1/8"	3"	31,000 lbs.	46,000 lbs.
7/8"-4-1/2	1-1/4"	3-1/2"	39,000 lbs.	58,000 lbs.
1"-3-1/2	1-1/2"	4"	54,000 lbs.	81,000 lbs.
1-1/8"-3-1/2	1-5/8"	4-1/2"	61,000 lbs.	91,000 lbs.
1-1/4"-3-1/2	1-7/8"	5"	83,000 lbs.	125,000 lbs.
1-1/2"-3-1/2	2-1/4"	6"	99,800 lbs.	149,000 lbs.



WHEN ORDERING COUPLINGS PLEASE SPECIFY:

- Type - C1T or C2T etc.
- Rod Diameter or Diameters
- Thread Type or Types

S5Z WIL-X CEMENT GROUT (B)

CONFORMS TO ASTM C 845-76 T

Wil-X is chemically compensated for shrinkage. It has a high bond value and is crack resistant for permanent installations and more durable grout. Because it is a cement-grout, it is non-explosive and has a long shelf life when kept dry.

Wil-X may be used to build up leveling pads by simply mixing with sand or pea gravel. This mixture should not be run through the grout pump.

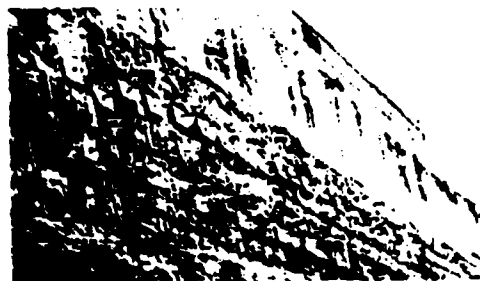
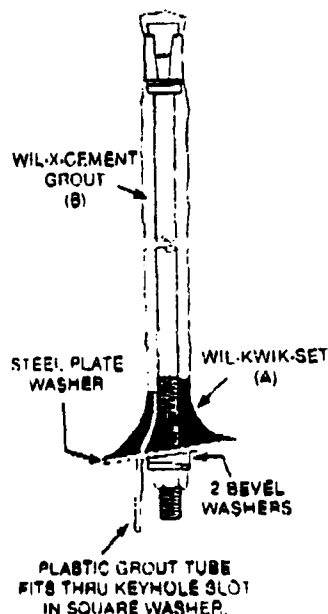
SETTING TIME: Gilmore Needles (ASTM C 266). Initial set: 45 minutes; final set 10 hours.

COMPARATIVE COMPRESSIVE STRENGTH TEST IN PSI (modified ASTM C 109)*
3 days in moist air/4 days in water 2800. Actual strengths as mixed according to Williams instructions range from 6000 to 9000 PSI depending on water content.

* Copy of ASTM Modification available upon request.

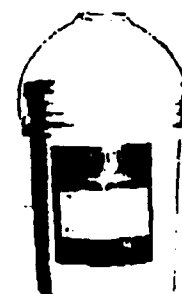


- Available in
- 5 gallon
- resealable
- moisture proof
- polypropylene parts



S4Z WIL-KWIK-SET (A)

A fast setting cement with an initial set time from 3 to 6 minutes. It's primary use is to hold the de-air tube in place and seal off the entrance to the drill hole around the Williams Hollow Core Rock Bolt. Mix Wil-Kwik-Set with water until a soft paste is obtained which can be formed into a 4" to 6" ball. Place grout tube in drill hole next to rock and press ball of Wil-Kwik-Set around bolt and tube, making sure entire drill hole is closed off. Place bearing plate over end of rock bolt and grout tube and press firmly against rock and Wil-Kwik-Set until plate is well seated against rock. Bolt may immediately be tensioned and grouted with Wil X-Cement grout. New Wil-Kwik-Set is also recommended for patching leaks, cracks, cone and tie holes or calking around pipes in masonry or concrete walls or floors.



- Available in
- 5 gallon
- resealable
- moisture proof
- polypropylene parts



SOUTHWESTERN PORTLAND CEMENT COMPANY

EASTERN DIVISION • 506 EAST KENNA DRIVE • P.O. BOX 191 • FAIRBORN, OHIO 45124
513-874-8041 • RUM 762-0040 (OHIO)

CERTIFICATION

February 22, 1989

Consignee:
Williams Form Engineering Corporation
1501 Madison Ave., SE
P. O. Box 7389
Grand Rapids, Michigan 49510

Carrier	No.	Tons	Date Shipped

Williams Form Engineering Corp.
This Quality Assurance document has been
received and deemed acceptable as noted.

Expansive Cement, Type E-1(K)**
A.S.T.M. Designation C845-87
Federal Specification --

by: _____ on _____
Quality Assurance Mgr (date)

PHYSICAL DATA

Specific Surface:
(Blaine) Sq. Cm. per Gram 4020
(Wagner) Sq. Cm. per Gram --
Soundness:
Autoclave Expansion * %
Restrained Expansion; 7 days 0.075 %
Time of Setting:
Gillmore Initial 1 Hrs. 00 Min.
Gillmore Final 3 Hrs. 15 Min.
Vicat Initial -- Hrs. -- Min.
Vicat Modified 1 Hrs. 42 Min.

Air Entrainment, % by Volume 8.6

Compressive Strength Lbs. per Sq. In.
(2-inch Mortar Cubes)

1-Day	<u>2500</u>
3-Days	<u>3630</u>
7-Days	<u>4300</u>
28-Days	<u>--</u>

Chemical Composition: Percent

Silicon Dioxide (SiO ₂)	<u>18.7</u>
Aluminum Oxide (Al ₂ O ₃)	<u>5.5</u>
Ferric Oxide (Fe ₂ O ₃)	<u>2.9</u>
Magnesium Oxide (MgO)	<u>4.5</u>
Sulfur Trioxide (SO ₃)	<u>4.8</u>
Loss on Ignition	<u>1.6</u>
Insoluble Residue	<u>0.18</u>
Tricalcium Silicate	<u>*</u>
Tricalcium Aluminate	<u>*</u>
Alkalies, Eqv. Na ₂ O	<u>*</u>

*Not required by specification.

We hereby certify that the cement contained in this shipment conforms to all of the Standard requirements for Portland Cement in the above Specification, for the type specified.

Subscribed and sworn to before me
this 22nd day of February 1989

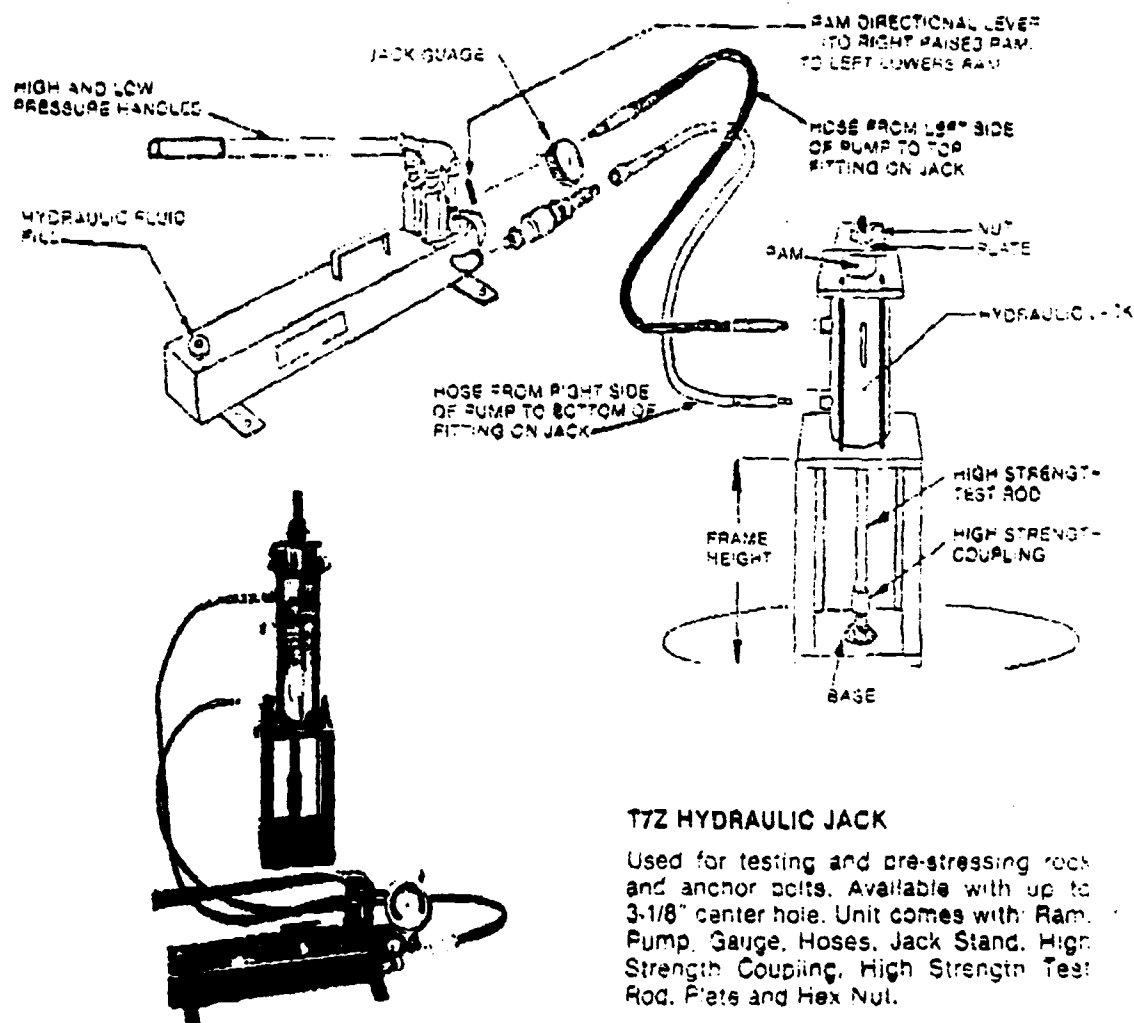
Joyce A. Smith
Joyce A. Smith, Notary Public
In and for the State of Ohio
My commission expires Sept. 28, 1990
Recorded in Greene County

SOUTHWESTERN PORTLAND CEMENT COMPANY
EASTERN DIVISION FAIRBORN, OHIO

By Karl S. Getson
Karl S. Getson, Chief Chemist
Authorized Company Representative

**Track name: Williams Wil-X Cement Grout

PLANTS • FAIRBORN, OHIO • LEAMINGTON, UTAH • LYONS, COLORADO • BOESSA, TEXAS • VICTORVILLE, CALIFORNIA



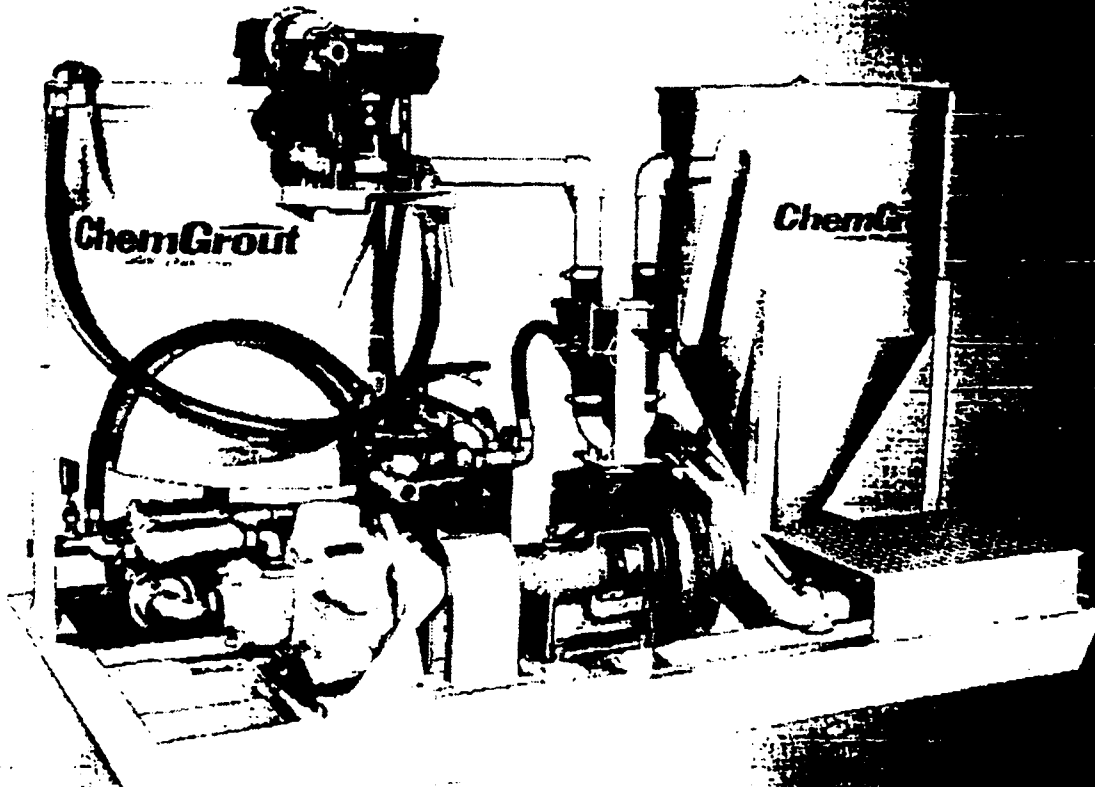
T7Z HYDRAULIC JACK

Used for testing and pre-stressing rock and anchor bolts. Available with up to 3-1/8" center hole. Unit comes with: Ram, Pump, Gauge, Hoses, Jack Stand, High Strength Coupling, High Strength Test Rod, Plate and Hex Nut.

JACK CAPACITY (TONS)	JACK HEIGHT	BASE SIZE	RAM TRAVEL	MINIMUM TOTAL HEIGHT OF RAM AND FRAME	MAX TEST ROD SIZE	RAM AREA IN SQ. IN.	APPROX. TOTAL WT. OF RAM & FRAME
30 air-hand pump	5"	8"x8"	2"	17"	1"x16"	8.53	60 lbs.
60 air-hand pump	9-5/8"	8"x8"	3"	26"	1-3/8"x27"	13.75	122 lbs.
80 air-hand pump	15-1/2"	9"x9"	10"	35"	1-3/8"x36"	13.75	225 lbs.
100 air-hand powered pump	18"	9"x9"	10"	36"	2"x37"	21.20	243 lbs.
160 air-hand powered pump	22-1/2"	12"x12"	12"	41"	2"x42"	40.89	610 lbs.

CG-600 Colloidal Grout Plant

Complete colloidal mixing and pumping plant
for high volume cement grouting



Two large tanks permit high production rates

High speed colloidal mixing pump thoroughly wets all particles

Non-pulsing, positive displacement pump

Unit can be cleaned in less than 10 minutes

All controls positioned for operation by one man

ChemGrout

TAC46

M. mag. Pump 60 psi. normogenic ng

S. 30 GR 1 x 23-1/2 x 23-1/2

Equipped with two 4000 gallon water tanks, a 4000 gallon oil tank

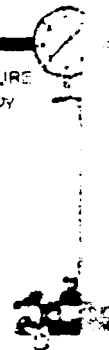
Not suitable for sanded grouts.

100 Indian groups use model CG-530

SOME 'DIPLOMATS' ARE BUSY TO CHANGE WITHOUT FIGHTING

10-31-68

7/1



"Experience in Grouting for 25 Years"



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

19 APR REC'D

April 19, 1990

Serial Letter No.: 247/02219/10.1.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Calibration of Rock Bolt Test Jack

Gentlemen:

Reference is made to Technical Provision 02219, Paragraph 10.1.1, which states "Rock bolt tensioning shall be by an approved calibrated center hole hydraulic jack". Enclosed please find a letter from the Williams Form Engineering Corporation which states that the 30-ton test jack on this project was calibrated on April 5, 1990.

Should any questions arise concerning the above, please contact the undersigned at this office.

Sincerely,

Thomas R. McDonnell
Project Engineer

TRM:deo

LOAD OR SPRING RETURN



25,000 LBS = 5,360 PSI GAUGE

P.O. BOX 7343 • GRAND RAPIDS, MICH. 49510
(616) 452-3107 • TX. 22-6416

THIS DRAWING IS THE PROPERTY OF THE WILLIAMS FORM ENGINEERING CORP. AND IS SUBMITTED TO THE CONTRACTOR SOLELY AS A SUGGESTED DESIGN. FOR APPROVAL BY HIS JOB DESIGN AGENCY. IT IS SUBJECT TO RECALL AND MUST NOT BE REPRODUCED OR ITS CONTENTS DIVULGED WITHOUT WRITTEN PERMISSION. ALL WILLIAMS PRODUCTS ARE PATENTED OR HAVE PATENTS APPLIED FOR.

869-3



April 17, 1990

Attn: Tom O'Donnell
P.C.L. Civil Constructors
P O Box 2270
Trust or Consequences, NM 87901

Ref: 30 ton test jack complete, rental
Your purchase order no. P37020
Cuchillo Dam Site, Cuchillo, NM

Gentlemen:

This is to certify that gauges used on Williams test jacks are checked against a master gauge that is calibrated and tested on a regular basis. The gauge shipped with your jack was checked against the master gauge the day of shipment, April 5, 1990.

Sincerely,


Charles Miller
Quality Assurance Manager

sds

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE 10 JAN 1990:				DATE January 5, 1990	NEW SUBMITTAL ☒ RESUBMITTAL ☐	
REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)						
TO: Construction Branch USAED Albuquerque P.O. Box 1580 Albuquerque, NM 87103-1580		FROM: PCL Civil Constructors, Inc. P.O. Box 2270 Truth or Consequences, NM 87901		CONTRACT NO. _____		
SPECIFICATION SEC. NO. (Cover only one section with each transmittal) 02219		PROJECT TITLE AND LOCATION Rio Grande Floodway (Chichillo Dam), Truth or Consequences, NM		TRANSMITTAL NO. 700 PREVIOUS TRANS. NO. (If any) _____		
ITEM NO.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)	MFG. OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction No. 8)	NO. OF COPIES	CONTRACT REFERENCE DOCUMENT		FOR C E USE CODE
				SPEC. PARA. NO.	DRAWING SHEET NO.	
1	Williams Form Engineering - Rock Bolts	Certs	4	10.1		
2	Williams Form Engineering - Rock Bolts	Lab Report	4	10.1		
REMARKS						
I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated. Michael B. [Signature] NAME AND SIGNATURE OF CONTRACTOR						
Section II				APPROVAL ACTION		
ENCLOSURES RETURNED (List by item No.)				NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY DATE		
ENG FORM 4025, Oct 84 (SER 415-1-10) EDITION OF JUL 81 IS OBSOLETE. (Proponent: DAEN.ECC-Q) SHEET ____ OF ____ U.S. GOVERNMENT PRINTING OFFICE: 1984-357-871/20020						



December 29, 1989

CERTIFICATE OF CONFORMANCE

Customer: PCL Civil Constructors
P O Box 2270
Truth or Consequences, NM 87901

Project: Cuchillo Dam Project

Purchase Order: No. P-37020
Williams S/O 51750

This is to certify that the material supplied on the above purchase order no. P-37020 meets the requirements of the specifications as stated. We further certify that all work performed was done in accordance with Williams Form Engineering Corporation manufacturing standards.

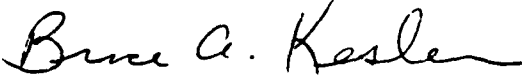
Description of Material

Bolts: 1"-3-1/2 dia. Williams S.H.T. Coil All Thread
Rod X 15'0" long. Conforms to ASTM A-108 and
ASTM A 663-82. Heat No. J43674 (copy
attached).

Grout: Wil-X-Cement Grout in 55 lb pails. Conforms
to ASTM C 845-80 and CRD-C-621.


Charles M. Miller
Quality Assurance Manager

Williams Form Engineering Corporation


Bruce A. Kesler
Notary Public, Kent County, MI
My Commission Expires: May 2, 1993

ACTION CODE RECOMMENDED				
☒ A	☐ B	☐ C	☐ D	☐ E
Checked by 				
Date: 1/17/90				

*** WALKER WIRE & STEEL COMPANY ***

ROYAL WIRE DIVISION
666 East Ten Mile Road
Ferndale, Michigan 48229

Order No. 49672
Acct. No. 1983
Salesman 12

9-4888
564-5849
Telex:
797193 WMS
Easyline Mailbox:
62905873

SHIPPER

Sold To: WILLIAMS FORM
ENGINEERING COMPANY
1501 MADISON SE
GRAND RAPIDS, MI 49509
Attn:
Phone: 616-452-3187

Ship To: WILLIAMS FORM ENGINEERING
1448 COLLEGE AVE. SE
GRAND RAPIDS, MI 49507

Williams Form Engineering Corp.
This Quality Assurance document has been
reviewed and deemed acceptable as noted:

Order Date 05/29/89
Terms 1/2 10 N
Ship Via ROYAL/TOM
F.O.B. PREPAID
Date Shipped 06/27/89
Shipment No. 1

Charles Miller on 7/10/89
Quality Assurance Mgr (date)
checked by: _____

NO. Ordered

Shipped

* CERTIFICATION OF INSPECTION AND TEST *

1 8000 lbs. 1541 INDUSTRIAL QUALITY WIRE FG SK
0.892 +0.0020 / -0.0020 STRAIGHT & CUT TO 240.000 +0.000 / -0.000 YOUR PART # AIS-C8
YOUR PO NUMBER: 4301

8767 lbs.
286 Pcs.

CHEMICAL ANALYSIS FOR Heat #: J43674

C:	.420	Ni:	.073
Mn:	1.570	Cr:	.095
P:	.025	Mo:	.024
S:	.017	Pb:	
Si:	.300	B:	
Cu:	.2000	Al:	

Ultimate Strength: 127,036
Yield Strength: 107,981
Elongation: 22.1%
Reduction of Area: 41.1%

Other

Walker Wire & Steel Company hereby certifies that the above materials have been inspected and tested in accordance with the methods prescribed in the applicable specifications and the results of such inspection and tests are as shown above. For properties or characteristics for which no methods of inspecting or testing are prescribed by said specifications, the standard inspection and testing practices of Walker Wire & Steel Company have been applied. Based upon such inspection and tests the above materials have been approved as fulfilling the requirements of said specifications.

WALKER WIRE AND STEEL COMPANY

by

State of Michigan/Illinois -
County of Oakland/Livingston

On this 27th day of June, 1989, before me, a Notary Public in and for said state and county, personally appeared the above who, being duly sworn according to law, did depose and say that she is duly authorized to execute the foregoing certificate on behalf of Walker Wire and Steel Company and that the facts there in contained are true and correct to the best of her/his knowledge, information and belief.

Laurence A. Moor
Notary Public
Laurence A. Moor
Notary Public, Michigan County of Livingston
My Comm. Expires January 21, 1991

File

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE				DATE		NEW SUBMITTAL ☒ RESUBMITTAL ☐	
REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)				January 5, 1990			
FROM: PCL Civil Constructors, Inc. P.O. Box 2270 Truth or Consequences, NM 87901 DACW-47-89-C-0056				CONTRACT NO.		TRANSMITTAL NO. 700 PREVIOUS TRANS. NO. (if any)	
PROJECT TITLE AND LOCATION Rio Grande Floodway (Cuchillo Dam), Truth or Consequences, NM				CONTRACT NO.		TRANSMITTAL NO.	
SPECIFICATION SEC. NO. (Cover only one section with each transmittal)				CONTRACT NO.		TRANSMITTAL NO.	
DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)				CONTRACT NO.		TRANSMITTAL NO.	
b.				CONTRACT NO.		TRANSMITTAL NO.	
c.				CONTRACT NO.		TRANSMITTAL NO.	
d.				CONTRACT NO.		TRANSMITTAL NO.	
e.				CONTRACT NO.		TRANSMITTAL NO.	
f.				CONTRACT NO.		TRANSMITTAL NO.	
g.				CONTRACT NO.		TRANSMITTAL NO.	
h.				CONTRACT NO.		TRANSMITTAL NO.	
1 Williams Form Engineering - Rock Bolts				4 10.1		A	
2 Williams Form Engineering - Rock Bolts				4 10.1		A	
REMARKS				I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.		Michael B. [Signature]	
SIGNATURE				DATE		NAME AND SIGNATURE OF CONTRACTOR	
[Signature]				23 Jan 90		Michael B. [Signature]	

U.S. ARMY ENGINEER DISTRICT ALBUQUERQUE RECORDS OF ENGINEERS
CERTIFIED FOR APPROVAL AS INDICATED BELOW
APPROVED AS SUBMITTED
RESUBMISSION FOR REVIEW
C. APPROVED EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEETS.
SHEET RETURNED TO CONTRACTOR
D. APPROVED EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEETS.
E. APPROVED EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEETS.
F. APPROVED EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEETS.
G. OTHER COMMENTS
NOTE: ITEMS APPROVED AS TO QUALITY LAYERS ONLY. DIMENSIONS & QUANTITIES MUST BE APPROVED BY THE CONTRACTOR.
SIGNATURE [Signature] DATE 23 Jan 90

Section 11
INCLOSURES RETURNED (List by Item No.)
APPROVAL ACTION
NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY
DATE
23 Jan 90
Michael B. [Signature]
(Proponent: DAEN-ECC O) SHEET OF

Phone:
313-399-4898
313-564-5849
Telex:
797193 WMS
Easyline Mailbox:
62985873

*** WALKER WIRE & STEEL COMPANY ***
ROYAL WIRE DIVISION
568 East Ten Mile Road
Ferndale, Michigan 48229

Order No. 1987
Acct. No. 1987
Salesman 12

SHIPPER

Sold To: WILLIAMS FORM
ENGINEERING COMPANY
1581 MADISON SE
GRAND RAPIDS, MI 49509
Attn:
Phone: 616-452-3197

Williams Form Engineering Corp.
This Quality Assurance document has been
reviewed and deemed acceptable as noted:

Order Date 05/25/89
Terms 1/2 10 N
Ship Via ROYAL/TOM
F.O.B. PREPAID
Date Shipped 06/27/89
Shipment No. 1

Ship To: WILLIAMS FORM ENGINEERING
1448 COLLEGE AVE. SE
GRAND RAPIDS, MI 49507

Charles Miller 7/10/89
Quality Assurance Mgr (date)
checked by: _____

NO. Ordered

Shipped

* CERTIFICATION OF INSPECTION AND TEST *

8000 lbs. 1541 INDUSTRIAL QUALITY WIRE FG SK
9.972 +0.0020 / -0.0020 STRAIGHT & CUT TO 240.000 +0.000 / -0.000 YOUR PART # AIS-C3
YOUR PO NUMBER: 4301

8767 lbs.
286 Pcs.

CHEMICAL ANALYSIS FOR Heat #: J43674
C: .429 Ni: .873
Mn: 1.578 Cr: .895
P: .025 Mo: .024
S: .017 Pb:
Si: .300 B:
Cu: .2990 Al:
Other

Ultimate Strength: 127,036
Yield Strength: 107,981
Elongation: 22.1%
Reduction of Area: 41.1%

Walker Wire & Steel Company hereby certifies that the above materials have been inspected and tested in accordance with the methods prescribed in the applicable specifications and the results of such inspection and tests are as shown above. For properties or characteristics for which no methods of inspecting or testing are prescribed by said specifications, the standard inspection and testing practices of Walker Wire & Steel Company have been applied. Based upon such inspection and tests the above materials have been approved as fulfilling the requirements of said specifications.

WALKER WIRE AND STEEL COMPANY

by

John H. Harkness

State of Michigan/Illinois -
County of Oakland/Livingston

On this 27th day of June, 1989, before me, a Notary Public in and for said state and county, personally appeared the above and, being duly sworn according to law, did depose and depose and say that she is duly authorized to execute the foregoing certificate on behalf of Walker Wire and Steel Company and that the facts there in contained are true and correct to the best of her/his knowledge, information and belief.

Lawrence A. Moor
Notary Public, Michigan
Notary Public, Michigan County, Michigan
My Comm. Expires August 24, 1991

December 29, 1989

CERTIFICATE OF CONFORMANCE

Customer: PCL Civil Constructors
P O Box 2270
Truth or Consequences, NM 87901

Project: Cuchillo Dam Project

Purchase Order: No. P-37020
Williams S/O 51750

This is to certify that the material supplied on the above purchase order no. P-37020 meets the requirements of the specifications as stated. We further certify that all work performed was done in accordance with Williams Form Engineering Corporation manufacturing standards.

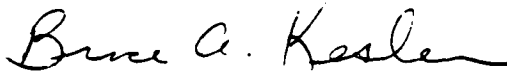
Description of Material

Bolts: 1"-3-1/2 dia. Williams S.H.T. Coil All Thread
Rod X 15'0" long. Conforms to ASTM A-108 and
ASTM A 663-82. Heat No. J43674 (copy
attached).

Grout: Wil-X-Cement Grout in 55 lb pails. Conforms
to ASTM C 845-80 and CRD-C-621.


Charles M. Miller
Quality Assurance Manager

Williams Form Engineering Corporation


Bruce A. Kesler
Notary Public, Kent County, MI
My Commission Expires: May 2, 1993

APPENDIX G

APPENDIX G
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Contractor's Blasting Proposals & Information



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

November 9, 1989

Serial Letter No: 023/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056
Rio Grande Floodway
T or C Unit, NM

Subject: Blasting Initiation System Deviation

Gentlemen:

Reference is made to Section 02219, Paragraph 7.10, Item #3 of the contract documents which states "All blasting shall be initiated with an approved electrical system (sequential timer), and controlled by use of MS delays". PCL Constructors proposes the use of a non-electrical initiation system for our blasting operations which is immune to extraneous electricity. The system will employ a self contained plastic tube containing reactive materials that transmit firing signals to various surface and in-hole MS delays. This proposal is made to increase the safety of our employees at the project site as a non-electrical system can not be initiated by high frequency radio transmissions, or stray electrical energy, flame, friction or impact found in normal conditions. Manufacturers literature for a typical non-electrical system is enclosed for your review.

This proposal is submitted at no additional cost to the government.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure



Ensign-Bickford

NONEL®

TECHNICAL BULLETIN

Primadets®

NOISELESS
TRUNKLINE
DELAYS (NTD)
LONG LEAD
HD NONEL®
PRIMADETS®
(LLHD)

BLASTING PRODUCTS DIVISION

**The
Ensign-Bickford
company**

**TOTAL NONELECTRIC
SEQUENTIAL BLAST INITIATION
FOR USE IN ALL SURFACE
BLASTING APPLICATIONS**

**A NONELECTRIC DELAY SYSTEM
SUITED FOR SURFACE COAL
MINING, QUARRIES, OPEN PIT
MINES AND CONSTRUCTION**

The Total Nonel® System serves as an excellent surface trunkline and down-line initiation system for the following reasons:

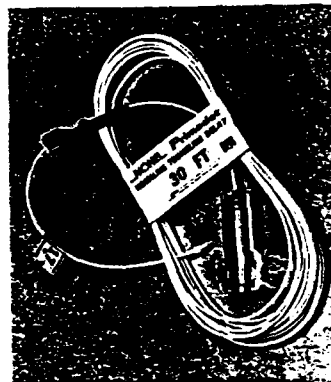
Safe Factory assembly of Nonel components is safer than field cutting and splicing of initiation components. Nonel tube can not be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction, or impact found in normal mining conditions. However, blasting caps are far more sensitive to these conditions.

Simple-Flexible Nonel components, both the NTD and the LLHD Nonel Primadets®, are factory assembled. They can be readily and simply connected to accommodate both basic and complex blast initiation patterns without complex circuitry.

Non-electric Requires no knowledge of electric circuitry. Completely non-electric—no need to instruct blasters on intricacies of electric circuits. No need for elaborate training and retraining of blasters. This is the simplest system available for applications requiring unlimited sequential delays.

Noiseless The Nonel initiation system is quiet. The signal moving through an initiated tube is so quiet that it can be called Noiseless.

Economical The Nonel system allows for a reduced inventory resulting from the elimination of stocking various lengths of a complete delay series.



NOISELESS TRUNKLINE DELAY



**LONG LEAD H.D. NONEL
PRIMADET**

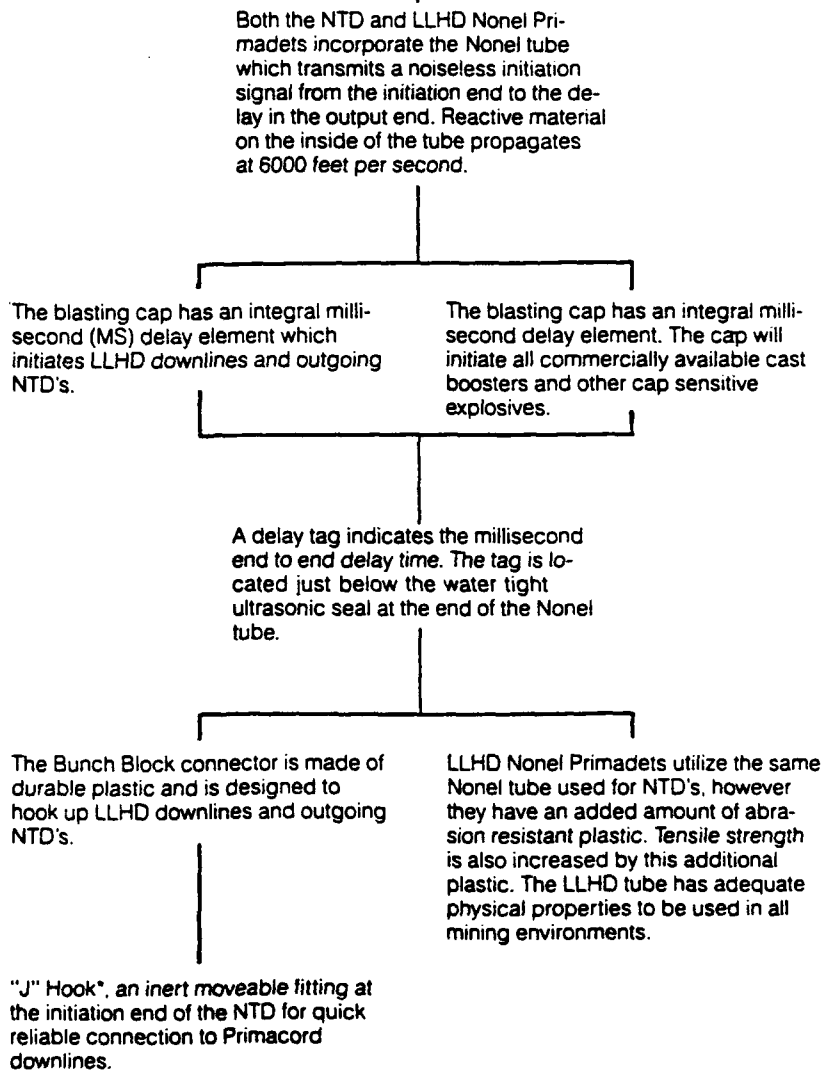
DESCRIPTION OF SYSTEM COMPONENTS

Nonel Primadets are nonelectric blasting caps using Nonel tube as a lead.

NTD units with Bunch Blocks and LLHD Nonels are Nonel Primadets whose lengths, delay times and hardware are suited for use as trunklines and downlines to inhole delays for surface blasting. The NTD and LLHD units are factory assembled with 5 and 3 components respectfully.

NOISELESS TRUNKLINE DELAYS WITH BUNCH BLOCKS

LONG LEAD HD NONEL PRIMADETS



***NOTE:** The "J" Hook is used only when the NTD is to be initiated by Primacord®. See separate bulletin on Noiseless Trunkline Delays. Nonel will not initiate another Nonel Line through a "J" Hook.

PRIMER ASSEMBLIES

In all cases the LLHD Nonel Primadet of appropriate delay period is inserted into a booster. Any cap sensitive booster can be used as the Nonel tube emits virtually no side energy. The primer on the top of the explosive column would be assembled as shown in Figure 1.

Cast boosters initiated with a blasting cap provide more energy from the end opposite the cap well due to the position of the cap and slight mass difference of the cast explosive on that end. The primer on the bottom of the column would be assembled as shown in Figure 2.

With a soft package booster, the Nonel lead can be half-hitched or taped around the cartridge with the Primadet inserted fully into the base of the booster (Figure 3).

When using paper cartridge boosters, it is best to tape the Nonel lead to the booster so if the assembly needs to be pulled from the hole, it will not hang up (Figure 4).

Figure 1

Long Lead HD/
Cast Booster
Assembly

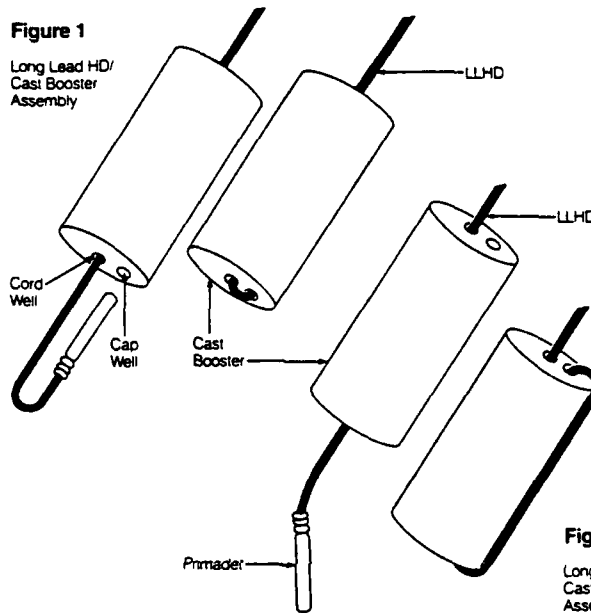


Figure 2 (Special Case)

Long Lead HD/
Cast Booster
Assembly

Figure 3

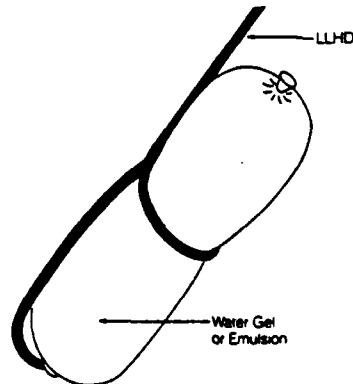
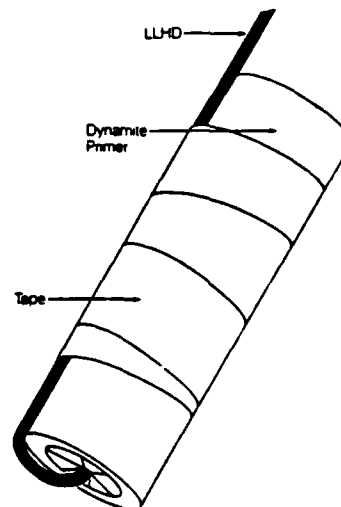


Figure 4



LOADING PROCEDURES

SOLID COLUMN LOADED HOLES

1. An LLHD Nonel Primadet/primer assembly is lowered into the borehole and the end of the Nonel tube is secured at the collar.
2. Explosive material is loaded into the borehole.
3. A second LLHD primer assembly is lowered to the top of the explosive column.

A Primacord upline may be used when loading wet bag material. Place the Nonel Primadet into the cap well of the primer; tape the Nonel tube to the outside of the primer; and run the upline through the primer as shown in Figure 6.

Figure 5

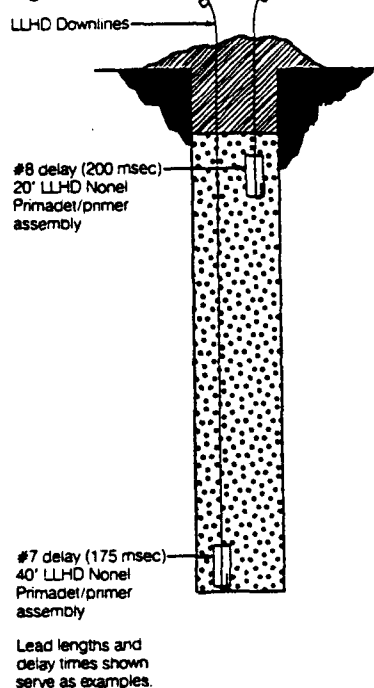
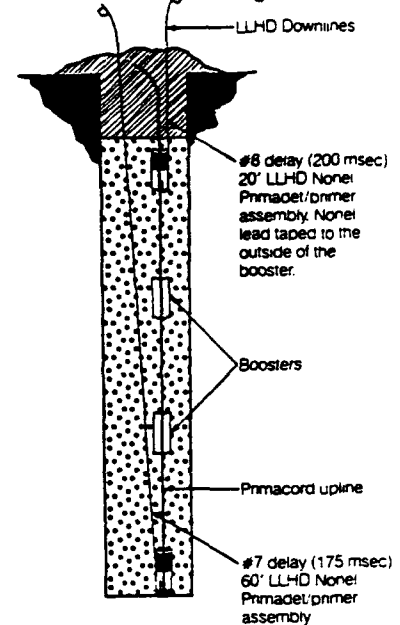


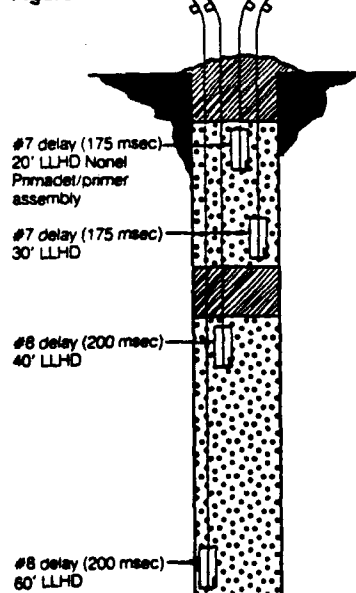
Figure 6



DECK LOADED HOLES

1. An LLHD Nonel Primadet/primer assembly is lowered into the borehole and the end of the Nonel tube is secured at the collar.
2. The explosive material is loaded into the borehole.
3. If the bottom charge is to be double primed, then a second LLHD Nonel Primadet/primer assembly of the same delay is lowered to the top of the explosive charge.
4. Stemming material for decking is loaded.
5. The above procedure is then repeated until the appropriate amount of decks are completed.

Figure 7



HOOKING UP THE SYSTEM

DELAY JUNCTION

The system in its simplest form has one or two LLHD Nonel Primadets down the hole, and one incoming and one or two outgoing NTD's (Figure 8).

The two Nonel tube ends of the outgoing NTD's and the two LLHD Nonel tube ends are placed into the Bunch Block (Figure 10). After the four outgoing Nonel tubes have been placed against the blasting cap in the Bunch Block snap the lid of the block closed (Figure 11).

When the hook-up is complete, place the assembly on the ground so the outgoing NTD tubes do not double back over or near the block. Cover the assembly with stemming material to minimize the noise from the blasting cap and to insure that the outgoing NTD tubes are not close enough to the Bunch Block to cause the tube to be damaged or cut off prior to initiation.

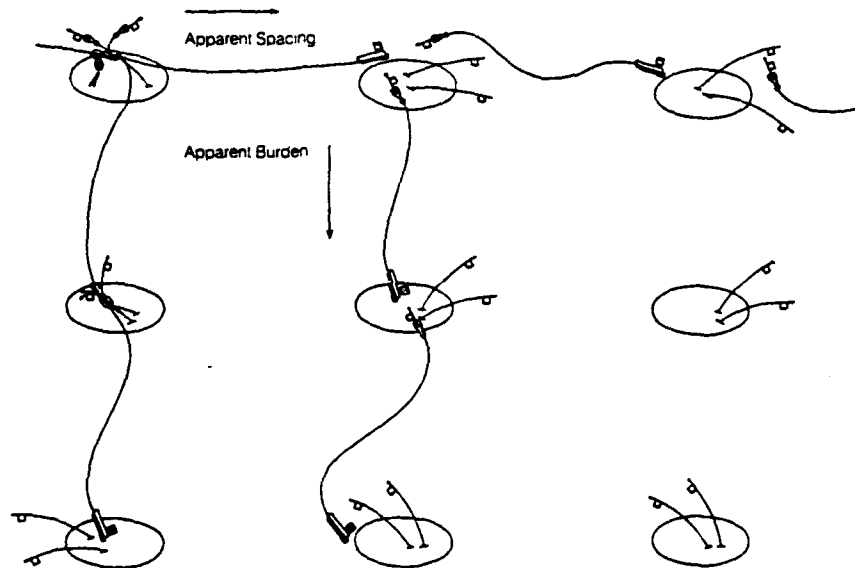


Figure 8 Blast pattern showing LLHD's and NTD's

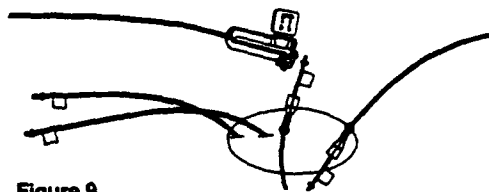


Figure 9
Note: The "J" Hook has no function in an all Nonel hook-up.

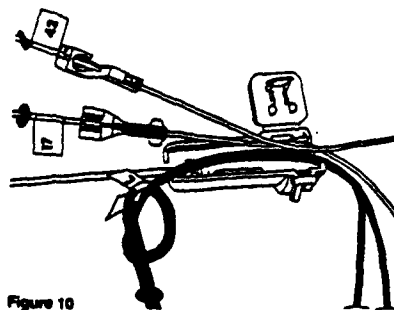


Figure 10

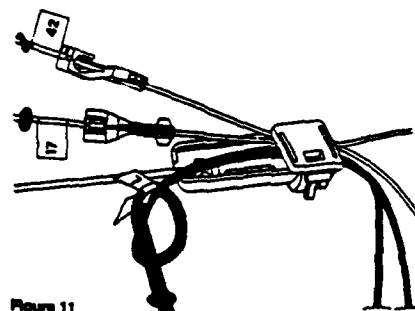


Figure 11

APPLICATIONS—DELAY PATTERNS

The Nonel System is best suited for those applications which require more delay intervals due to vibration limitations and cannot have detonating cord trunklines because of overpressure (air blast) restrictions. It is common to design blasts requiring 100 or more separate charges to be detonated with no less than 8 milliseconds between the charges. LLHD Nonel Primadets provide an unlimited number of constant, precise delay intervals when used with Nonel NTD's.

SEPARATE CHARGE FIRING—SAME DELAY EACH HOLE

A blast consisting of a single charge per hole normally has the same LLHD Nonel Primadet delay period in every hole. In some cases, the next higher delay period may be placed at the top of the column charge. Surface delay combinations of MS42 or MS25 and MS17 NTD's as shown by Figures 12 and 13 provide for two important functions:

1. The actual detonation time of the blasthole is greater than the surface activation time. Therefore, the risk of cutoff downlines or trunklines due to ground movement is minimized.
2. Blastholes detonate with a minimum of an 8 millisecond interval. An unlimited number of delays can be created with the proper selection of surface delay times and patterns.

VIBRATION CONTROL

In Figure 15 an echelon pattern is shown using 100MS NTD's across the front with 17MS on a diagonal. There are 4 decks shown per hole without duplicating inside 8 milliseconds for 3 rows. Up to 8 decks can be fired maintaining 8 millisecond minimum interval in a Three Row Pattern. To determine the surface delay across the front to accommodate a specific number of deck charges simply multiply the desired number of decks times 25MS.

For example: six separate charged decks would require $6 \times 25\text{MS}$ or 150MS minimum across the front. Always use 17MS NTD's straight back or on the diagonal (Figure 15).

Figure 12 Single row — one hole per deck

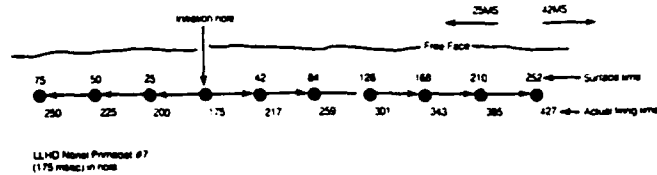


Figure 13 Multiple Row — one hole per delay

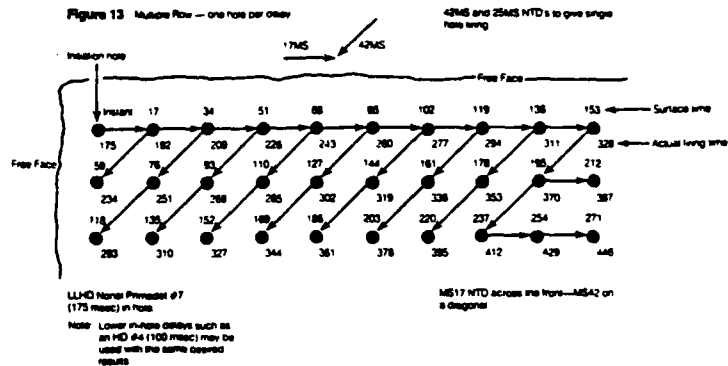


Figure 14

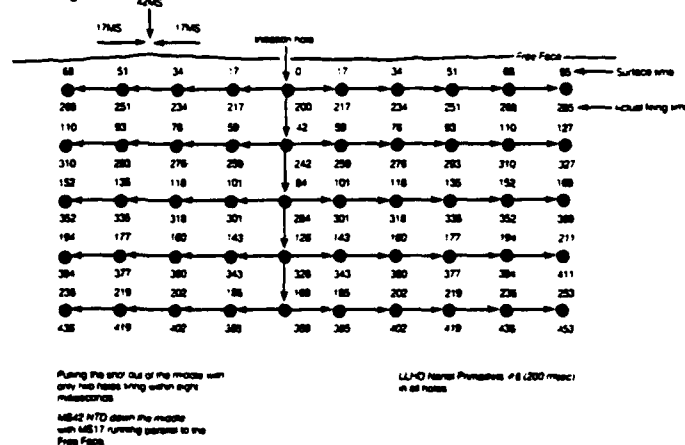
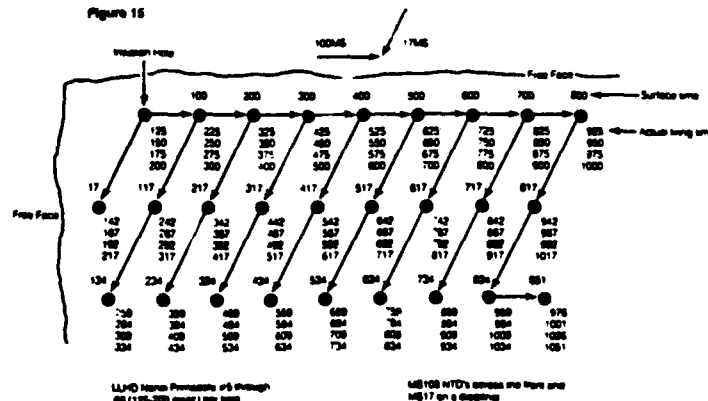


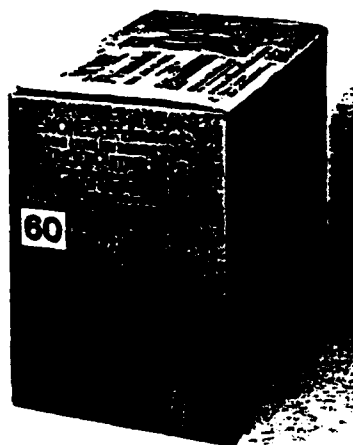
Figure 15



DELAY TIMES AND PACKAGING

LONG LEAD HD NONEL PRIMADETS DELAY TIMES AVAILABLE

LLHD Period	Time (milliseconds)
1	25
2	50
3	75
4	100
5	125
6	150
7	175
8	200
9	250
10	300
11	350
12	400
13	450
14	500
15	600



PACKAGING

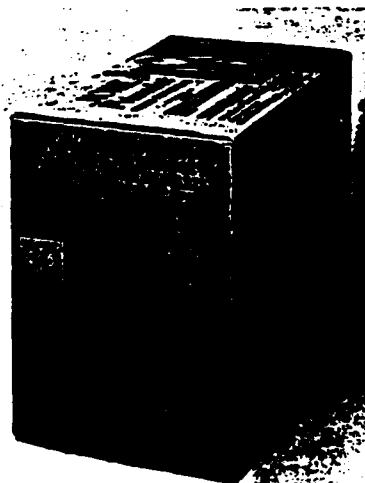
Length (ft.)	Units/case	Weight/case (lbs.)
20	200	39
30	150	41
40	125	44
50	100	47
60	100	49

Case dimensions 24" x 17" x 12"

80"	50	41
100"	50	46
120"	50	52

Case dimensions 22½" x 10" x 20"

*Each unit comes on a 4" x 3" spool.



NOISELESS TRUNKLINE DELAYS

DELAY TIMES AVAILABLE

Time (milliseconds)	Length (ft.)	Bunch Block Color
Instant	12-20	Black
5	30-40	Black
9	50-60	Green
17	12-20-30-40-50-60	Yellow
25	12-20-30-40-50-60	Red
42	12-20-30-40-50-60	White
100	30-50-60	Black
.00	50	Black

PACKAGING

Length (ft.)	Units/case	Weight/case (lbs.)
12	300	60
20	150	29
30	150	34
40	125	34
50	100	32
60	100	34

Case dimensions 24" x 17" x 12"

IMPORTANT INSTRUCTIONS

Use only factory assembled units.
Do not attempt to field-splice Nonel or knot different lengths of Nonel tube together.
Never splice Nonel tube to Nonel tube as it will not initiate itself. Do not trim ultrasonic seals from the tube since the entrance of moisture into the tube may cause misfires.
Never drive any vehicles over Nonel tube. Rupturing or damaging the tube may also cause misfires.

INITIATING THE NOISELESS TRUNKLINE SYSTEM

The primary initiating devices for the trunkline are (1) Nonel Noiseless Lead-in Lines, (2) electric blasting caps, and (3) cap and safety fuse assemblies. Never attach a blasting cap for the purpose of initiating a blast until everything and everybody are in a safe area.

Make the primary initiating device attachment the very last step in readying the blast. Attachment of the primary initiating device should be made to the first hole to fire in the blast. This hole fires which in turn fires outgoing noiseless trunklines.

DISCLAIMERS

ATTENTION

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed to be accurate, but no warranties are made, expressed or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact the Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold "as is" and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

Nonel Primadets are manufactured under U.S. Patent #3,590,739, U.S. Patent #3,125,024 and other patents pending.

The
Ensign-Bickford
company



Simsbury, Connecticut 06070

Ensign-Bickford Sales Offices:

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812/476-1329

Post Office Box 322
Wexford, PA 15090
412/935-5712

5036 Snapfinger Woods Drive
Decatur, GA 30035
404/987-1000

The words Primacord®, HD Primaline®, RX Primaline®, Detacord®, E-Cord®, PD-Cord®, Strip Mine Special®, Reinforced Primacord®, Primadet®, and Primaline®, are registered trademark names and are the sole property of The Ensign-Bickford Company. Nonel® is a trademark of Nitro Nobel AB of Gytfortp, Sweden.

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3000 - 8/84

#107-A



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Rec'd 4/11/89
A

December 1, 1989

Serial Letter No.: 052/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Blasting and Explosive Materials

Gentlemen:

Reference is made to Technical Provision 02219/7, and specifically your serial letter number 13, in which the Contracting Officer addressed his concerns regarding the transportation, storage, and use of explosive products on the project site. Enclosed please find four (4) copies of PCL Civil Constructors General Blast Plan which was prepared by our subcontractor, McCaw Drilling (USA) Inc. The General Blast Plan includes the resumes of the blasting supervisors, locations, dimensions, applicable distances, and security features of the storage magazines, as well as other pertinent aspects of the blasting operations. The Job Hazard Analysis for blasting and rock excavation has been previously submitted under PCL Civil Constructors serial letter number 047/01420/EM385/Appendix Y.

I trust the enclosed information will adequately address the Contracting Officer's concerns and subsequently grant written permission to allow explosive products to be transported onto the project site.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

MCCAW'S DRILLING (USA), INC.
CUCHILLO DAM PROJECT

BLASTING PROPOSAL

NOVEMBER, 1989

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SAFETY	5
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TECHNICAL SPECIFICATION SHEETS	.APPENDIX B
MAGAZINE LOCATION AND SPECIFICATIONS	.APPENDIX C
COPY OF BLASTING REPORT.	.APPENDIX D

1.

GENERAL PROCEDURE

1. All blasting will be done by experienced and competent personnel employed by McCaw's Drilling (USA), Inc. Technical assistance will be supplied by:
 - a. W.H. Burt Explosives, Inc.
P.O. Box 850
Moab, UT 84532
 - b. Ireco, Incorporated
Grand Junction, Colorado
2. Resumes and qualifications of the individuals who will be responsible for the blasting operations are presented in Appendix A. High explosives, blasting agents, detonators and accessories will be supplied by W.H. Burt Explosives, Inc. Moab, Utah. Technical Specifications sheets for the explosives products that we anticipate utilizing on this project are attached (Appendix B).
3. The explosives will be stored at a magazine location near the jobsite that will be selected to comply with all Local, State and Federal laws as well as the United States Army Corps of Engineers Manual EM 385.1.1, Section 25.A.19. Magazines for storing explosives will be provided by W.H. Burt Explosives, Inc. The magazines have been federally inspected and meet the standards of the Bureau of Alcohol, Tobacco and Firearms as outlined in 27 CFR 55, Subpart K. The explosives will be transported from the magazines to the blast site in a vehicle that meets the standards and specifications required by Local, State and Federal and United States Army Corps of Engineers Rules and Regulations. The magazine locations and dimensions are presented in Appendix C.
4. The explosives products that we anticipate using on this project are as follows:
 - a. Ireco High Explosives
 - (i) Unigel 2" X 8"
 - (ii) Unimax 2" X 16"
 - (iii) Iresplit D 7/8" X 24"
 - b. Engisn Bickford Products
 - (i) MS Nonel Primadets
 - (ii) MS Surface Connectors
 - (iii) E-Cord (35 grains per foot)
 - c. Blasting Agents
 - (i) Burtmix #1 (Ammonium Nitrate/Fuel Oil Mixture)
5. Our firm will be submitting detailed blasting reports for each blast per Section 7.2.1.5 and Section 7.6 of the Contract Documents. A copy of the proposed shot report form is presented in Appendix D.

2.

INITIATION SYSTEM

1. McCaw's Drilling (USA), Inc. will employ a totally non-electric initiation system on this project. By using the Nonel system we will eliminate safety concerns and problems commonly caused by extraneous electric current when using other than the Nonel system. Nonel tube cannot be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction, or impact commonly found in a construction environment.

2. Technical Description

Appearance Plastic Tube
Dimensions.....0.12 inches O.D.
.....X 0.05 inches I.D.
Powder Weight.....0.1 grains per foot
Detonation Velocity.....6000 feet per second

The Nonel plastic tube contains only one pound of explosives material per 70,000 feet of tube.

3.

PRE-SPLIT

1. Presplit holes will be 2 1/2" in diameter. The spacing of the drill holes shall be that which yields the most satisfactory results as determined by test blasting to be conducted on-site but in any case shall not exceed 30 inches. Alignment of the drill stem to the specified angle of pitch shall be accomplished by the use of a "degree rule" and/or plywood templates. The column load for presplit holes shall be Iresplit D (Appendix B). The actual firing of the pre-split holes shall be by one of the following methods as determined by the site conditions:
 - a. The pre-split holes are fired prior to drilling the production and buffer holes.
 - b. The pre-split holes are fired concurrent with but prior to the production and buffer holes on a millisecond delay system as per Section 7.2.1.3 of the contract documents.
 - c. Cushion Blasting - where the pre-split are fired with the general blast holes but delayed to detonate after the general blast holes per Section 7.3 of the Contract Documents.

4.

PRODUCTION

It is not possible nor practical at this stage to firmly state the patterns, delayment and powder factors that are to be used for each blast on this project because of the many variables that go into a blast design. It is our intention to proceed with test drilling as per Section 7.2.1.6 and 7.2.1.7 of the Contract documents. Our firm will submit a detailed proposal for the test blasts after examination of the test blast area and prior to the start of drilling.

Generally, our blast design will adhere to the following guidelines and Section 7 of the Contract documents:

- (a) Bore hole diameter will be three inches.
- (b) Burden shall not exceed spacing.
- (c) Spacing shall not exceed depth of the bore hole.
- (d) Collar shall be adjusted to suit the field conditions.
- (e) The powder factor shall be that which yields the best results based on fragmentation, control of fly rock and impact on the finished lines and grades.

We will use bottom detonation of the bore hole which will be achieved by inserting a primer with a Nonel detonator at the bottom of the bore hole prior to loading the column load. Surface tie-in will be detonating cord and MS connectors. A typical column load is shown on the sketch in Appendix B.

5.

SAFETY

Safety has always been a top priority with our firm and we are proud of our excellent safety record.

On this project we will be following the safety program established by the General Contractor including testing for substance abuse.

In addition to this we will have an orientation session with each employee at the time of hiring specifically tailored to working with explosives.

The receiving, transporting, handling and use of explosives will be in accordance with all applicable Local, State and Federal laws and the United States Army Corps of Engineers Manual EM 385-1-1, Section 25.A.19.

We request that only those persons directly involved with the blasting be allowed in the blasting area during the loading and tie-in of the blast. Prior to blasting a series of signals will be sounded on an air horn attached to a 800 CFM, 120 PSI Compressor as per Section 25.3.03 of the United States Army Corps of Engineers Manual Em385-1-1. The signals to be used will be posted at various locations around the jobsite.

APPENDIX A

RESUME

GERALD R. MCCAW

PERSONAL DATA:

Address: 3707 - 55 Street
Rocky Mountain House, AB T0M 1T0

Telephone: 345-3347 (Residence)

Marital Status: Married

Birthdate: Born in Nipawin, Saskatchewan
August 8, 1958

EXPERIENCE:

1979 - 1980 Dywidag Canada Ltd.

- * Job Supervision
- * Drilling Procedures
- * Grouting Procedures

1982 to Present: Partner in McCaw's Drilling & Blasting Ltd.
Held positions of driller, blaster, project
superintendent and Northern Operations
Manager.

MAJOR PROJECTS:

- * Fish Creek Sewage Treatment Plant 1982
Calgary, Alberta

Drilling, installation and testing of
560 anchors.
- * Deerfoot Trail and Southland Drive
Overpass 1981/1982
Calgary, Alberta

Installation, testing and grouting
- * Nipawin, Hydroelectric Project (1984)
Nipawin, Saskatchewan

Drilled and prepared holes for anchor
installatiuon done by Dywidag, while
assisting in installation for spillway.
- * CPR Project, Cana Construction (1984)
Rogers Pass, B.C.

Drilled and installed 130 anchors for
Ventilation Shaft.

... /2

MAJOR PROJECTS:
(continued)

- * Goodbrand Construction (1983,
Rogers Pass, B.C.

Drilled and installed 900 soil anchors
for retaining walls.
- * Synorude Canada (1984 - 1986)

Superintendent on a controlled
drill/blast project in Tar Sands. Seven
drills and compressors on site.
Approximated contract volume \$ 700,000.
- * Yellowknife, N.W.T. (1988 - 1989)

Operations Manager on numerous
controlled blasting projects including:
 - * three major quarry projects;
 - * two major road building projects;
 - * four major sub-division projects;
 - * numerous excavation projects.
Approximate volume of rock work loaded
after during this period \$ 4,500,000.
- * From 1982 to 1985 worked as a blaster on
a number of major pipeline projects
throughout Alberta.

QUALIFICATIONS:

Holds valid blasting tickets in Alberta,
Northwest Territories as well as a Quarry
Foreman's Ticket for Alberta.

Alberta

WORKERS' HEALTH, SAFETY
AND COMPENSATION

Occupational Health & Safety Division

Plaster's Certificate

This is to Certify that JOE McCAW
of ROCKY MOUNTAIN HOUSE, ALBERTA, upon

examination and the recommendation of the District Mine
Inspector is hereby granted this certificate

under The Quarries Regulation Act.

Dated at Edmonton, Alberta this 22nd day of March 19 84

No. B-007-

H. S. Henry
DIRECTOR OF MINES INSPECTION



Northwest
Territories

MINING INSPECTION SERVICES

No. 89-44

EXPLOSIVES PERMIT FORM B

I hereby certify that Joe G. McCAR

of P.O. Box 2250, Rocky Mountain House, Alberta

is authorized to handle and use explosives in the Northwest Territories. (Subject to such satures or limitations as are shown.)

Joe G. McCar
Permittee

Paul Dwyer
Inspector or Deputy Inspector

Limitations

1. Permit expires June 10 19 89

2. Other conditions

"SURFACE BLASTING ONLY"
NO TAPE FUSES ALLOWED IN THE NORTHWEST TERRITORIES

NWT 2281 80/0981

RESUME

KEVIN JOE

DATE OF BIRTH:

August 22, 1948

WORK HISTORY:

McCaw's Drilling (USA), Inc.
Denver, Colorado

October 1986 - Present

Responsible for blast design, receiving, transporting, loading and firing of explosives on various construction projects across Canada. Scope of projects ranged from demolition projects in the High Arctic (Baffin Island), highway projects in British Columbia, Alberta and Ontario and several pipeline projects. Types of blasting varied from controlled blasting as close as ten feet to sour gas lines under very high pressures to large quarry blasts.

Canadian Pacific Railways
Calgary, Alberta

1984 - 1985

Inspector on the Roger's Pass tunnel project in British Columbia. Monitored contractors progress and adherence to contract specifications with particular emphasis on the drill and blast operations.

Loram International Ltd.
Calgary, Alberta

1983 - 1984

Employed as foreman on two site grading projects in the Dallas-Forth Worth Area.

Northern Construction Ltd.
Vancouver, British Columbia

1983

Employed as foreman at the Ridley Island Grain Terminal Project in Prince Rupert, British Columbia. Supervised excavation crews, including drillers and blasters during the site grading phase of the project.

Loram International Ltd.
Calgary, Alberta

1968 - 1979

Worked on various large projects in Canada (up to \$100 million) in various capacities - surveyor, field engineer, foreman and superintendent. Involved in all phases of blasting from estimating to blast design, load and shoot.

... /2

PAGE 2

CERTIFICATES HELD:

1. Alberta Blasting Permit Number 20163.
2. Northwest Territories Blasting Permit #89-004.
3. Diploma - Applied Explosives Technology and Safety.
4. Certificate of Training "Transportation of Dangerous Goods".

RESUME

KEVIN JOE

DATE OF BIRTH:

August 22, 1948

WORK HISTORY:

McCaw's Drilling (USA), Inc.
Denver, Colorado

October 1986 - Present

Responsible for blast design, receiving, transporting, loading and firing of explosives on various construction projects across Canada. Scope of projects ranged from demolition projects in the High Arctic (Baffin Island), highway projects in British Columbia, Alberta and Ontario and several pipeline projects. Types of blasting varied from controlled blasting as close as ten feet to sour gas lines under very high pressures to large quarry blasts.

Canadian Pacific Railways
Calgary, Alberta

1984 - 1985

Inspector on the Roger's Pass tunnel project in British Columbia. Monitored contractors progress and adherence to contract specifications with particular emphasis on the drill and blast operations.

Loram International Ltd.
Calgary, Alberta

1983 - 1984

Employed as foreman on two site grading projects in the Dallas-Forth Worth Area.

Northern Construction Ltd.
Vancouver, British Columbia

1983

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Calgary, Alberta

1968 - 1979

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... 42

PAGE 2

CERTIFICATES HELD:

1. Alberta Blasting Permit Number 20163.
2. Northwest Territories Blasting Permit #89-004.
3. Diploma - Applied Explosives Technology and Safety.
4. Certificate of Training "Transportation of Dangerous Goods".

This permit expires on
MARCH 25 19 93
unless previously cancelled
or suspended.

No. 20163



Community and
Occupational Health
Occupational Health
and Safety Division

PERMIT

TO USE, HANDLE, PREPARE AND FIRE EXPLOSIVES

Issued to MCCAW'S DRILLING & BLASTING
EMPLOYER
of ROCKY MOUNTAIN HOUSE, ALBERTA

This permit authorizes KEVIN JOE
to use, handle, prepare and fire explosives for the employer named herein while
engaged in DRILLING & BLASTING - HEAVY CONSTRUCTION operations.
Dated this 25 Day of MARCH 19 88

This permit shall be retained in the possession of the
employer and must be returned to the Occupational
Health and Safety Division, Community and Occupational
Health immediately the worker terminates employment
with the employer named herein.

[Signature]
For EXECUTIVE DIRECTOR
WORK SITE SERVICES

June 26 19 89



MINING INSPECTION SERVICES

89-004

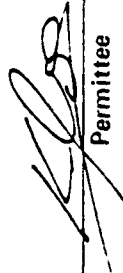
EXPLOSIVES PERMIT

FORM 8

I hereby certify that Kevin JOE

of 828 Lysander Drive S.E., Calgary, Alberta

is authorized to handle and use explosives in the Northwest Territories. (Subject to such structures or limitations as are shown.)


Permittee


Inspector or Deputy Inspector

Limitations

1. Permit expires N/A 19

2. Other conditions **"SURFACE BLASTING ONLY"**
NO TAPE FUSES ALLOWED IN THE NORTHWEST TERRITORIES

DU PONT CANADA INC.

APPLIED EXPLOSIVES TECHNOLOGY SEMINAR

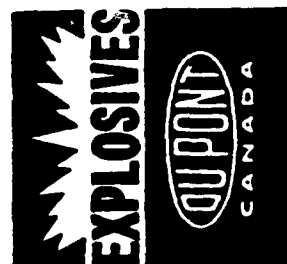
This is to certify that

K. Joe

has completed a short course on

APPLIED EXPLOSIVE TECHNOLOGY & SAFETY

Dated this 25 day of February, 1981



A. B. Kubo
ACE EXPLOSIVES TECHNICAL AND PLANNING MANAGER

Ch. Kurbat
TECHNICAL SERVICE SUPERVISOR

T. S. Law
WESTERN DISTRICT SALES MANAGER

Certificate of Training

This is to certify that

KEVIN JOE

NAME

is a trained person pursuant to Section 19.3 (a)(b) of the
TRANSPORTATION OF DANGEROUS GOODS REGULATIONS
and is authorized to serve as, or in the capacity of

FIELD ENGINEER

(DUTIES, TITLE OR AUTHORIZED ACTIVITY)

Date OCT 15-86

Certified by

EMPLOYER

McCaw's Drill & Blast
COMPANY

APPENDIX B

DETACORD®**13**

Core Load	Tensile Strength	Outside Diameter	Color and Identification	Intended Use
18 gr/ft 3.6 gm/m	150 lbs 68 kg	0.142 in 3.607 mm	Yellow with one black counterwinding yarn	Downline, Trunkline

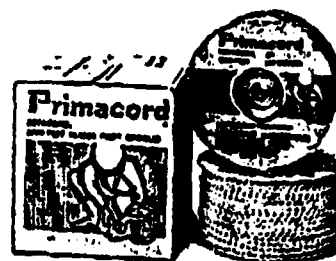
Application

Detacord will detonate through standard knot connections and will initiate other detonating cords. It will initiate nitroglycerin-based explosives and most other cap-sensitive products. It is of less rugged construction than most other Primacord products so it should be used in less rigorous applications. Detacord is flexible, easy to handle, and readily ties and holds knots.

It should be noted that Detacord may not be a reliable initiator of most cast boosters. The manufacturer of the boosters should be consulted before using Detacord in this manner.

Special Packaging

Detacord is available in either of two types of packages: two-1000 foot (305 m) spools per shipping container, or a 1,000 foot (305 m) spool in a "pull-out"-type box. The pull-out box is a heavy solid fiber carton with a 4-inch (10 cm) diameter "knock-out" section which, when removed, exposes the free end of the Detacord. The cord can then be withdrawn from the box by simply pulling on the free end.



Packaging	Package Size	Shipping Weight
2-1000 ft spools	9.75 x 9.75 x 10.5 (in)	17.0 lbs
2-305 m spools	24.8 x 24.8 x 26.7 (cm)	7.7 kg
1-1000 ft spool (pull-out)	10.75 x 4.88 x 11 (in)	8.5 lbs
1-305 m spool (pull-out)	27.3 x 12.4 x 26 (cm)	3.8 kg

IRESPLIT™ D Dynamites for Perimeter Control

IRESPLIT D products are explosives designed for open pit or underground blasting operations where precision overbreak control is desired. When used with presplitting or perimeter (smoothwall) blasting techniques, IRESPLIT D produces straight-lined, smooth-faced walls in reasonably homogeneous rock formations.

Advantages

Product Variety. IRECO offers IRESPLIT D, a semigelatin dynamite, and IRESPLIT D-1, a low-density, high ammonium nitrate dynamite. Both are packaged in 24-inch cartridges of various diameters.

Minimized Rock Overbreak. Rock overbreak behind the IRESPLIT blastholes is minimized. This results in less unpaid-for excavation and extra concrete being required.

Easy Assembly. IRESPLIT cartridges have connecting sleeves securely glued onto one end of each cartridge.



IRESPLIT D cartridges in case - note the sleeve glued onto each cartridge

Properties

Explosive Type	Diameter (in.)	Length (in.)	Weight (lb.)	Velocity (ft./sec.)	Pressure (psi)	Temperature (°F)
IRESPLIT D Semigelatin Dynamite	2 1/2	24	12.5	12,000	10,000	100
IRESPLIT D-1 High Ammonium Nitrate Dynamite	2 1/2	24	12.5	12,000	10,000	100

The Explosives Technology Company

Iresplit PG2¹⁹

IRECO Incorporated



Packaging

IRESPLIT D		IRESPLIT D-1	
Diameter x Length (inches)	Count	Diameter x Length (inches)	Count
1 7/8 x 24	80*	1 7/8 x 24	80**
1 1/8 x 24	65*	1 1/8 x 24	65**
1 1/4 x 24	43-47	1 1/4 x 24	43-47

* Packed to count

** 40 lb. case. All others are 50 lb.

Priming and Loading

The paper sleeve connector enables coupling of each IRESPLIT D or D-1 cartridge into a continuous explosive column. For loading into vertical holes the column is lowered into the borehole by a detonating cord downline. The detonating cord is commonly half-hitched or taped tightly around the first cartridge in the borehole. At approximately six-foot intervals, the detonating cord should be secured to the column of explosive so it remains in close contact to ensure propagation of the entire column. IRESPLIT D has good water resistance. IRESPLIT D-1 should not be exposed to other than minor amounts of borehole water.

For horizontal holes the cartridges are connected by the sleeves and primed with a separate cartridge of larger-diameter dynamite. Cord is not ordinarily used in horizontal applications unless the column consists of more than 3 IRESPLIT cartridges.

Transportation, Storage and Handling

Stock should be rotated. Avoid using new materials before the old. For recommended good practices in transporting, storing, handling, and using this product, see the Booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case, and the Safety Library publications of the Institute of Makers of Explosives.

The IRESPLIT D and D1 are classified as High Explosives and must be transported, stored, handled, and used in conformity with all applicable Federal, state, and local laws and regulations.

Product Disclaimer

IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

The Explosives Technology Company

UNIGEL® Semigelatin Dynamite

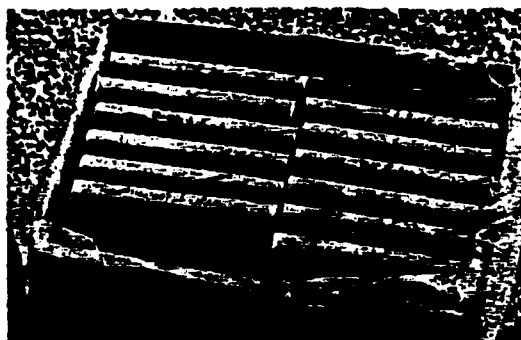
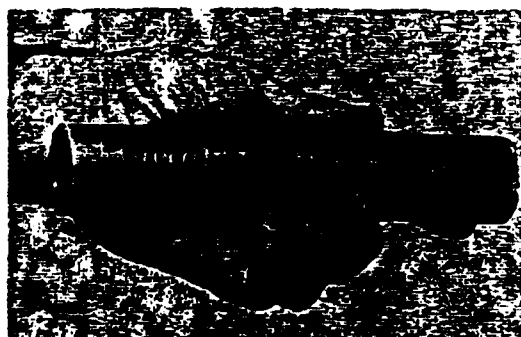
UNIGEL was specifically developed for all-purpose blasting applications, including underground and surface mining. It replaces more expensive specialty-grade dynamites that offer varying energy values with each grade. UNIGEL has excellent uniformity of mixture and plasticity, will perform satisfactorily under moderate water pressure, and is an excellent primer for ANFO.

Advantages

Universal Blasting Applications. UNIGEL is a single explosive grade for universal blasting applications, which simplifies inventory requirements.

Fumes. Afterblast fumes and smoke are at a minimum.

Cost-Saving. UNIGEL provides excellent performance for less cost per cubic yard.



Properties

Density (lb/cu ft)	Temp. 100°F (°C)	Weight (lb/cu ft)	B.L. (sec)	Impact (ft-lb)	Velocity (ft/sec)	Stability (lb/cu ft)
1.2	100 107	1.1	1.2	100 125	1100 1120	1.1

ANFO 1.10 (lb/cu ft) 1.10 (lb/cu ft) 1.10 (lb/cu ft) 1.10 (lb/cu ft) 1.10 (lb/cu ft) 1.10 (lb/cu ft) 1.10 (lb/cu ft)

Characteristics

Water Resistance
Fume Class
Sensitivity Restriction

Good
IME 1
As with all dynamites, will side-initiate when in contact with detonating cord of any coreload.

The Explosives Technology Company

UNIGEL-35L

IRECO Incorporated



Packaging

This table shows some of the cartridge sizes available:	
Diameter x Length (Inches)	Nominal Cartridge Count per 50 lb. Case
1-1/8 x 8	134-142
1-1/4 x 8	109-115
1-1/2 x 8	76-82
2 x 8	41-45
2 x 16	20-22
2-1/2 x 16	13-14
3 x 16	10

Notes:

1. The above is for count information only. Some sizes are non-standard (i.e. produced only to special order), and may involve a surcharge.
2. Other sizes are available, including king-size (to 24" length), large diameter tube shells, and DOT-23G shells having a minimum diameter of 4".

Transportation, Storage and Handling

UNIGEL has a D.O.T. classification as a High Explosive Class A and must be transported, stored and handled in conformity with applicable federal, state and local laws.

Refer to IME Safety Library Publications for information on proper explosives usage.

Product Disclaimer

IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

The Explosives Technology Company

IRECO Incorporated Technical Information IRECO

Eleventh Floor Crossroads Tower Salt Lake City, Utah USA 84144 Telephone: (801) 364-4800 Telex: 38-8353

EXTRA GELATIN Gelatin Explosives

EXTRA GELATIN
PG 1

EXTRA GELATIN explosives differ from regular gelatin explosives in that part of the sensitizer is replaced during manufacture by ammonium nitrate. Grade for grade, Extra Gelatin is more economical yet equivalent in weight strength, and only slightly less water resistant than straight gelatin explosives. Its gelatin consistency makes tamping easy, and it is sufficiently cohesive for use in loading drill holes with an upward slant. IRECO Extra Gelatin is available in marked strengths of 40%, 60% and 75%.

Advantages

Economy. Extra Gelatins maintain many of the superior qualities of a straight gelatin, at a lower cost.

Fume Class 1. All strengths meet IME Fume Class 1, making them suitable for most underground mining conditions.

High Detonation Rate. IRECO Extra Gelatins provide excellent results in those applications where a high detonation velocity is called for.

Excellent Water Resistance.



Properties

	Density (lb/cu ft)	Energy (cal/gm) (Btu/lb)	Weight Strength	Bulk Strength	Water Resistance (Days)	Detonation Velocity (ft/sec)
Extra Gelatin 40%	1.54	250 1100	1.09	2.01	175 1500	1500
Extra Gelatin 60%	1.57	280 1200	1.14	2.05	200 1600	1600
Extra Gelatin 75%	1.57	300 1300	1.15	2.09	210 1650	1650
Compressed (2000 psi) Extra Gelatin 40% 1.54 250 1.09 2.01 175 1500						

The Explosives Technology Company

G-37

IRECO Incorporated

Extra Gelatin PG2

Packaging

Cartridge count range per 50 lb. case:

Cartridge Size (Inches)	Extra Gelatin		
	40%	60%	75%
1/4 x 8	175-189	185-199	189-203
1 x 8	131-143	141-153	146-158
1 1/4 x 8	111-121	120-130	123-133
1 1/2 x 8	91-98	98-105	101-108
1 3/4 x 8	63-69	68-74	69-75
2 x 8	44-50	48-54	50-56
2 1/4 x 8	34-38	37-41	38-42
2 x 16	17-20	19-21	19-21
2 1/4 x 16	11-12	12-13	12-13
3 x 16	8	9	9

NOTES:

1. The above is for count information only. Some sizes are non-standard (i.e. produced only to special order), and may involve a surcharge.
2. Other sizes are available, including king-size (to 24" length), and DOT-23G shells having a minimum diameter of 4".

Transportation, Storage and Handling

Extra gelatin explosives are classified as high explosives, Class A, and must be transported, stored, handled, and used in conformity with applicable Federal, state and local laws and regulations.

Refer to IME Safety Library Publications for information on proper explosives usage.

Product Disclaimer

IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

The Explosives Technology Company

UNIMAX™ Extra Gelatin Dynamite

UNIMAX is a nitroglycerin-sensitized extra gelatin designed as a primer for insensitive blasting agents or for use alone in extremely wet conditions where a high density product with high energy may be required. UNIMAX has been formulated to give consistently high detonation velocity. It is a less expensive product than the regular gelatins, but has only slightly less water resistance.

Advantages

Universal Blasting Applications. UNIMAX is an excellent choice for use in difficult water conditions, including moderate pressures and potential dead-pressing situations. It also is an excellent primer for ANFO or other blasting agents.

Fumes. Afterblast fumes and smoke are at a minimum.

Cost-Saving. UNIMAX provides excellent performance for less cost per cubic yard of broken rock than the NG gelatin explosives.



Properties

Density (g/cc)	Energy (cal/gr) (cal/cc)	Weight Strength	Bulk Strength	Velocity (in/sec) (m/sec)	Velocity (in/sec) (m/sec)	Detonation Pressure (Kbars)
1.43	1,050 1,500	1.19	2.08	5,300 17,200	6,000 19,700	1.0
ANFO 1.00 at density 0.82 g/cc		1.14 inch diameter, unconfined			2 inch diameter, unconfined	

Characteristics

Fume Class
Water Resistance

IME 1
Excellent

The Explosives Technology Company

G-39



Packaging

UNIMAX is packaged in orange paper shells.

Cartridge Size (inches)	Nominal Cartridge Count per 50 lb. Case
7/8 x 8	185-199
1 x 8	141-153
1-1/8 x 8	120-130
1-1/4 x 8	98-105
1-1/2 x 8	68-74
1-3/4 x 8	48-54
2 x 8	37-41
2 x 16	19-21
2-1/2 x 16	12-13
3 x 16	9

NOTES:

1. The above is for count information only. Some sizes are non-standard (i.e. produced only to special order), and may involve a surcharge.
2. Other sizes are available, including king-size (to 24" length), large diameter tube shells, and DOT-23G shell having a minimum diameter of 4".

Transportation, Storage and Handling

UNIMAX has a D.O.T. classifications as a High Explosive Class A and must be transported, stored and handled in conformity with applicable federal, state and local laws.

Refer to IME Safety Library Publications for information on proper explosives usage.

Product Disclaimer

IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied. INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

The Explosives Technology Company



Technical Information

BURTMIX[®] 1 Blasting Agent

BURTMIX[®] 1 is a premixed, prilled ammonium nitrate/fuel oil-type, 65% weight-strength blasting agent⁽¹⁾ suitable for use under dry borehole conditions. It can be used for quarry, open-pit and construction, or underground blasting operations, and can be either blown into the borehole by pneumatic loading devices or poured.

This highly economical blasting agent has an average poured density of about 0.80 g/cm³, or 50 lbs/ft³. When holes are loaded pneumatically, average density is about 0.95 g/cm³, or 60 lbs/ft³.

BURTMIX 1 blasting agent, as packed and when used under dry borehole conditions, will produce Class I fumes.

⁽¹⁾Blasting agent: Any material or mixture consisting of a fuel and oxidizer, intended for blasting, not otherwise classified as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.

Typical Characteristics

Measured energy, ft-lbs/lb X 10 ⁶	1.10
Measured energy, ft-lbs/ft ³	54

APPROXIMATE LOADING DENSITY AND RATE OF DETONATION

Borehole Diameter, In. mm	Approximate Weight per Foot of Borehole When Poured,		Approximate Detonation Velocity (confined),	
	lbs	kg	fps	mps
2	1.1	0.50	10,700	3.261
3	2.4	1.09	10,300	3,322
4	4.4	2.00	11,800	3.597
5	6.8	3.08	12,400	3.780
6	9.8	4.44	12,800	3.901
7	13.3	6.02	13,100	3.993
8	17.4	7.88	13,300	4,054
9	22.0	9.97	13,400	4,084
10	27.2	12.32	13,500	4,115
11	32.9	14.90	13,600	4,145
12	39.2	17.76	13,650	4,160
13	46.0	20.80	13,700	4,176
14	53.3	24.14	13,700	4,176
15	61.2	27.72	13,750	4,191
16	69.8	31.53	13,750	4,191
17	78.6	35.61	13,750	4,191
18	88.1	39.91	13,750	4,191

(over)

We cannot anticipate all conditions under which this information and our products, or the products of other manufacturers in combination with our products, may be used. We accept no responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each such product or product combination for their own purposes. Unless otherwise agreed in writing, we sell the products without warranty, and buyers and users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combination with other products.

Packaging

BURT mix 1 blasting agent is furnished in 50-lb (22.7-kg) net polyethylene-lined, multiwall paper bags.

Transportation, Storage, and Handling

This blasting agent is not initiation-sensitive to No. 8 blasting caps or rifle bullets, and thus need not be stored in bullet-resistant magazines unless so required by relevant laws or regulations. Storage magazines should be located to conform to the American Table of Distances and the Table of Separation Distances of Ammonium Nitrate and Blasting Agents From Explosives or Blasting Agents.

BURT mix is classified by the U.S. Department of Transportation as Blasting Agent, and must be transported, stored, handled, and used in conformity with all applicable Federal, state, and local laws and regulations. The proper shipping description and hazard classification for **BURT** mix 1 as described in this bulletin is:

Ammonium Nitrate/Fuel Oil Mixture—Blasting Agent

This product should be kept dry, and stock should be rotated so that the oldest material is used first. Use only proper primers, and never load in wet holes or where there is not adequate confinement. If these restrictions are observed, the formation of toxic fumes will be minimized. This product, as manufactured, conforms to the Institute of Makers of Explosives Fume Class I rating.

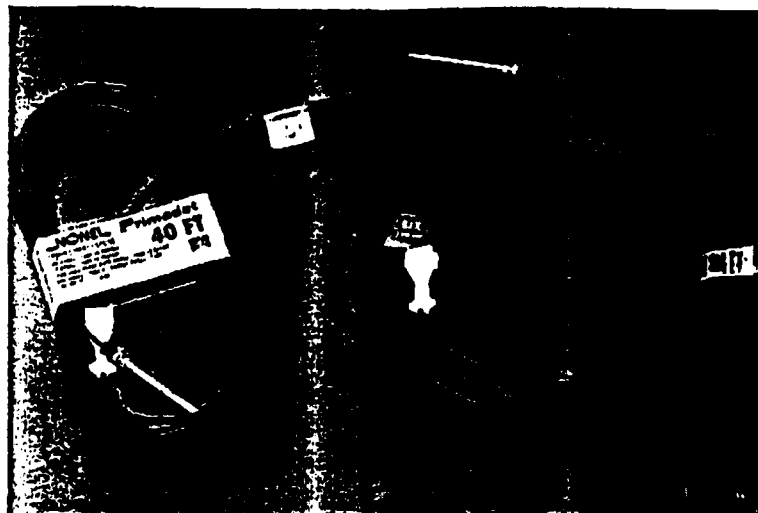
For additional recommended good practices in transporting, storing, handling, and using this product, consult the Safety Library Publications of the Institute of Makers of Explosives.



The
Ensign-Bickford
company

NONEL® **Primadet®** Nonelectric delay detonators MS SERIES

Precise nonelectric delay
blasthole initiation for all
surface mining, quarries
and construction needs.



DESCRIPTION

Nonei® Primadet® nonelectric delay detonators are comprised of four major components.

A Nonei® shock tube to transmit a signal to the delay cap. Nonei® shock tube is a small diameter plastic laminate tube coated with a very thin layer of reactive material; only one pound of material per 70,000 feet of tube. When initiated, Nonei® shock tube reliably transmits a low energy signal at approximately 6,500 feet per second from one point to another. This shock wave phenomenon, which is similar to a dust explosion, will propagate through most sharp bends, knots and kinks in the tube. The detonation is sustained by such a small quantity of reactive material, the outer surface of the tube remains intact during and after functioning.

A blasting cap with integral delay element.

A color-coded delay tag which indicates the MS delay period number and nominal firing time.

A "J" Hook to facilitate easy connection to a Primacord® detonating cord trunkline. These white plastic hooks are inert.

ADVANTAGES

Simple-Flexible Nonei® Primadet® components are factory assembled, no field cutting and assembly of initiation components is required. They can be readily and simply connected to accommodate both basic and complex blast initiation requirements.

Reliable Nonei® Primadet® nonelectric delay detonators are factory assembled under stringent quality specifications to insure reliable performance in the field blast after blast.

Nonelectric Nonei® shock tube cannot be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction or impact found in normal mining conditions. However, blasting caps are far more sensitive to these conditions. Requires no knowledge of electric circuitry. No need to instruct blasters on intricacies of electric circuits. No need for elaborate training and retraining of blasters.

Noiseless The Nonei® Primadet® initiation system is quiet. The signal moving through an initiated tube is so quiet that it can be called Noiseless.

Economical The Nonei® Primadet® system allows for a reduced inventory resulting from the elimination of stocking various lengths of a complete delay series.

MS None! pg 2

IMPORTANT INSTRUCTIONS

Use only factory assembled units. Do not knot different lengths of None!® shock tube together.

Do not trim ultrasonic seals from the tube since the entrance of moisture into the tube may cause misfires.

Never drive any vehicles over None!® shock tube. Rupturing or damaging the tube may also cause misfires.

Be sure all None!® shock tube connections are at right angles to detonating cord trunklines to prevent angle cutoffs.

The None!® lead must lead to the hole in a straight line and be taut. Tie the knots so that the None!® shock tube leading to the collar does not come in contact with the trunkline between the knot and borehole collar.

Place detonating cord trunkline hookups in closed loops and use with crossies. Two paths of initiation will then be available for each None!® shock tube connection.

Never attach the primary initiator to the round or shot until after all the connections have been made and the blasting area has been cleared.

DELAY TIMES AVAILABLE

MS None!® Primadet® nonelectric delay detonators are available in the following delay intervals:

MS Series**Orange Tube**

0-Instant	8-200 msec
1- 25 msec	9-250 msec
2- 50 msec	10-300 msec
3- 75 msec	11-350 msec
4-100 msec	12-400 msec
5-125 msec	13-450 msec
6-150 msec	14-500 msec
7-175 msec	15-600 msec

**PACKAGING**

Length (ft.)	Units/case	Weight/case (lbs.)
12	500	51
16	400	48
20	300	41
30	200	30
40	125	28
50	100	30
60	100	34
80	100	39
100	75	30
120	75	32

Case dimensions 24" x 17" x 12"

SPECIAL PACKAGE "B"-PACK

8	150	14
12	100	11
16	75	10
20	50	7

Case dimensions 14" x 12" x 7 1/4"

DISCLAIMERS**ATTENTION**

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed to be accurate, but no warranties are made, express or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact The Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold "as is" and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

None!® Primadet® nonelectric delay detonators are manufactured under U.S. Patent #3,590,739, U.S. Patent #3,125,024 and other patents pending.



The

Ensign-Bickford

COMPANY

Simsbury, Connecticut 06070

Ensign-Bickford Sales Offices:

660 Hopmeadow Street
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606/268-2690

5011 Washington Avenue
Evansville, IN 47715
812/476-1329

10288 West Chatfield Ave.
Suite 208
Littleton, CO 80127
303/972-3213

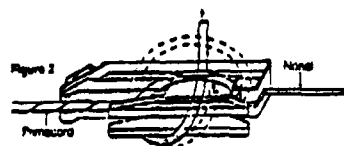
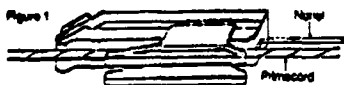
The words Primadet®, Detonator®, E-Cord®, PD Cord®, Safe Mine Section®, Primadet®, and Primadet®, are registered trademarks and are the sole property of The Ensign-Bickford Company.

None!® is a trademark of Nitro Nobel AB of Gylterp, Sweden. Zine Cord is a trademark of The Ensign-Bickford Company.

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TWO WAY CONNECTION

1. Select the location in the trunkline to insert the MS Connector and cut the detonating cord.
2. Place the groove of the connector block about six inches in from one end of the Primacord® detonating cord. The cut end of the trunkline must come out of the same end of the block as the Nonel. (Figure 1)
3. Loop the tail back 270° around the cleat block and lock in place. (Figure 2)
4. Place the tail over the top of the block and push down through the loop formed on the side, or cut the tail so it does not come in contact with the Nonel tube.
5. Pick up the other end of Primacord and connect to the second block in the same manner.
6. Be sure the tail of the cord does not contact the Nonel tube.



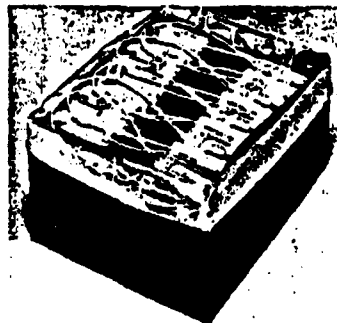
IMPORTANT INSTRUCTIONS

Do not attempt to disassemble the delay cap from the plastic connector block, or use the cap by itself without the block.

MS Connectors contain blasting caps and are subject to detonation caused by abuse, such as impact, the same as all caps.

The Nonel tube should not be damaged; moisture entering the tube will cause failure.

MS Connectors should be placed close to the hole being delayed to eliminate ground movement cutoffs from the preceding hole.



PACKAGING

Plastic blocks are color coded for delay times. Each shipping box contains 50 MS Connectors. The package weighs 10 lbs. and measures 14" x 12" x 7 1/2".

DISCLAIMERS

ATTENTION

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed to be accurate, but no warranties are made, expressed or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact The Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold AS IS and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

The
Ensign-Bickford
Company



Simsbury, Connecticut 06070

Ensign-Bickford Sales Offices:

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Simsbury, CT 06070
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5036 Snapfinger Woods Drive
Decatur, GA 30035
404/987-1000

1325 Airmotive Way
Reno, NV 89502
702/786-7822

The words Primacord®, MD Primeline®, Rx Primeline®, Detacord®, E-Cord®, PD Cord®, Strip Mine Special®, Reinforced Primacord®, Primeline®, and Primador® are registered trademark names and are the sole property of The Ensign-Bickford Company.

Nonel® is a trademark of Nitro Nobel AB of Gyltorp, Sweden.

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The MS Connector is manufactured under U.S. Patents #3,987,733 and #4,187,780. Nonel shock tube is manufactured under U.S. Patent #3,590,738.



Drilling & Blasting Ltd.

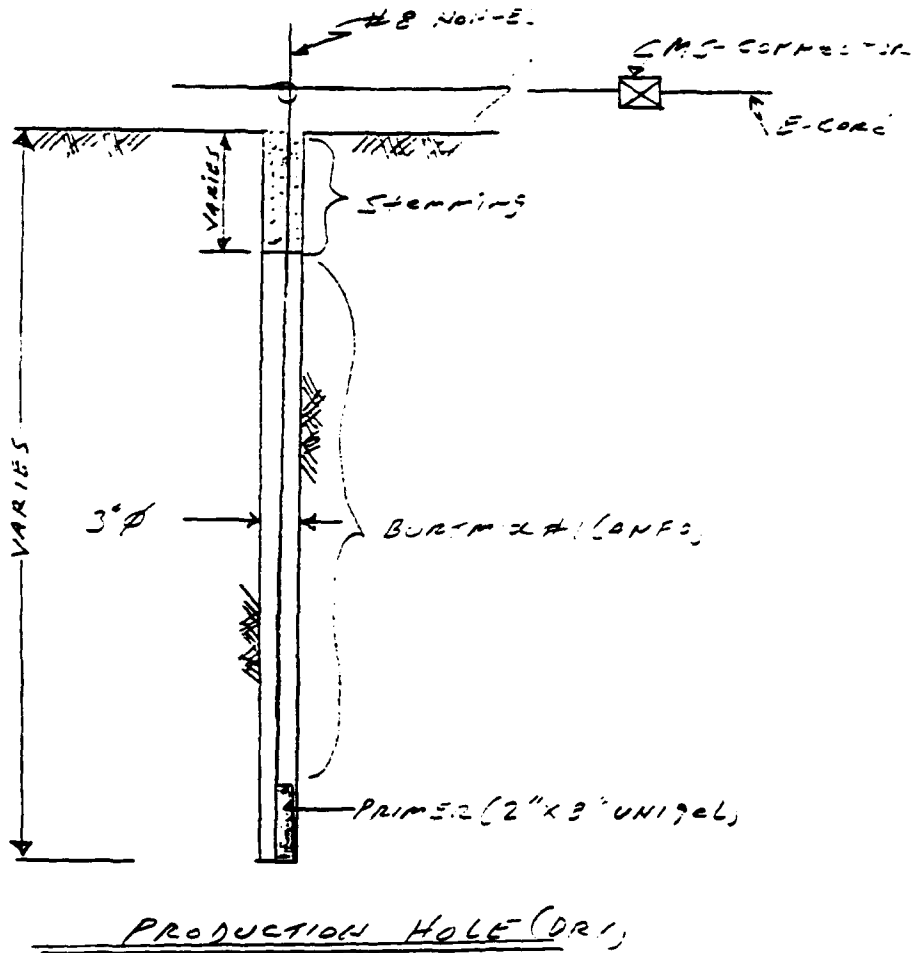
Reference: CUCK ... DAM Project
I OF E - 5 - 10110

Date: 11/17/2000

By: K...

TIP-TOE ...

Sheet 1 of 1



M018



Drilling & Blasting Ltd.

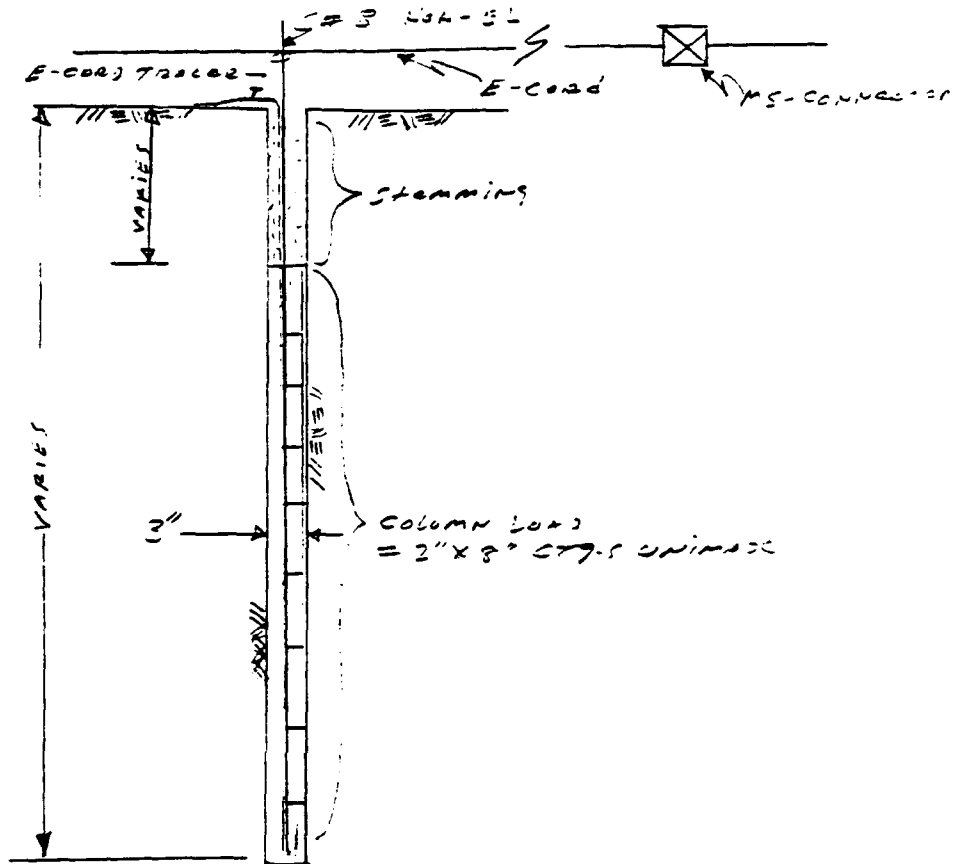
Reference: CUC-10 SAN PRO-01
- ONE NEW MIXED

Date: Nov 20 20

By: S. S.

TYPICAL COLUMN LOAD

Sheet ___ of ___



PRODUCTION HOLE

M018

APPENDIX C

MAGAZINE SPECIFICATIONS

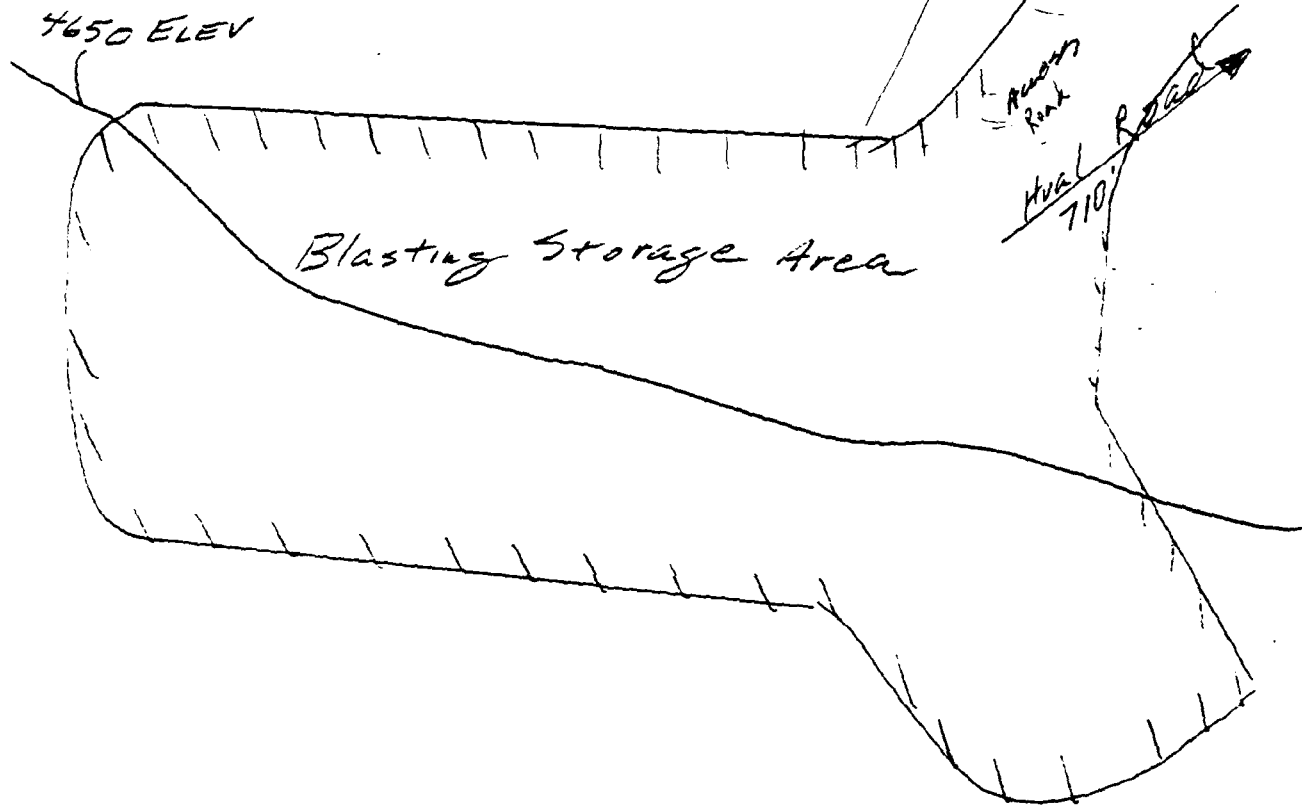
1. High Explosive Magazine:
Type: Type 2 Portable with skids
Dimensions: 6-1/2' X 7' X 8'
Capacity: 11,000 lbs.
Construction: 1/4" steel with interior lining of 2 inches of hardwood,
1-1/2" plywood or particle board.
Ventilation: Adequate
Locks: 2 master locks with 7/16" shackles
2. Detonator Magazine:
Type: Type 2 portable with skids
Dimensions: 6' X 6-1/2' X 7'
Capacity: 13,000 caps (approximately 25 lbs explosive)
Construction: 1/4" steel with interior lining of 2 inches hardboard,
1-1/2" plywood, or particle board.
Ventilation: Adequate
Locks: 2 master locks with 7/16" shackles
3. Anfo Trailer:
Type: Type 4 portable
Dimensions: 8' X 9' X 40'
Capacity: 45,000 lbs
Construction: Standard Semi-Trailer
Ventilation: Adequate
Locks: Immobilized by king pin lock with locking rear doors.
4. Security of Magazines:

As stated above, all magazines will have locks in accordance with ATF Publication P 5400.7 (11/82) and will be kept locked at all times while unattended. In addition, warning signs will be posted on all sides of the magazine storage location.

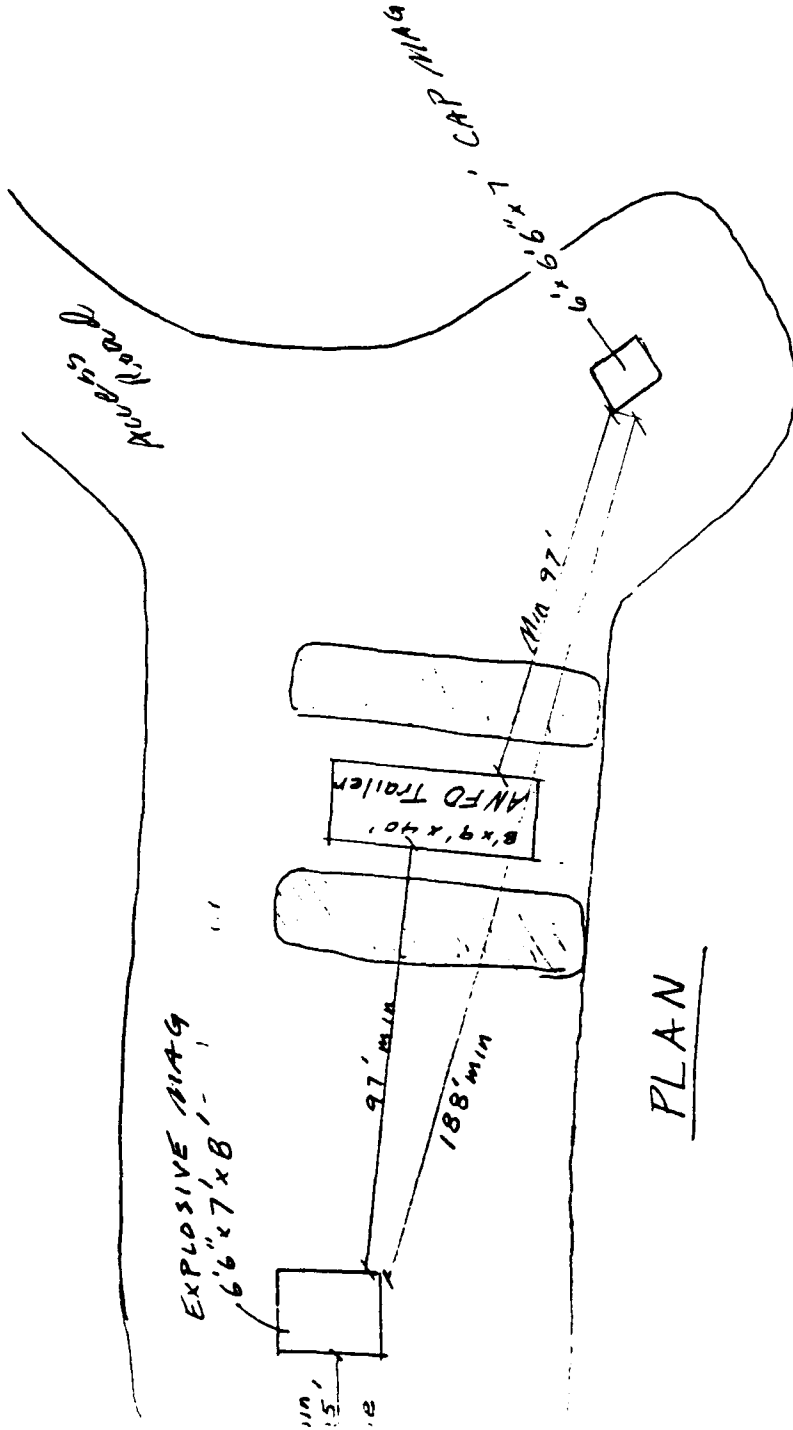
Blasting Storage Area		
SW-11	113	11/30/89



NOTE: Blasting Storage Area at
South-Central edge
of Waste Fill Area

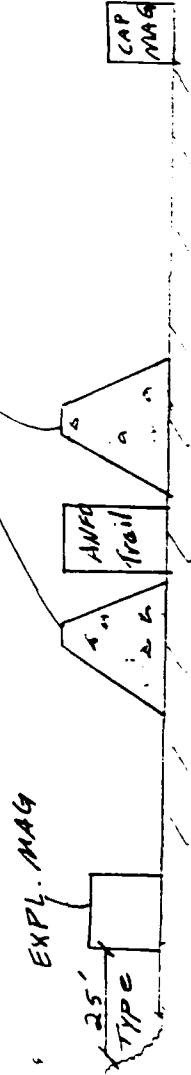


Blasting Storage Area /		
CW-15	WCS	11/20/20



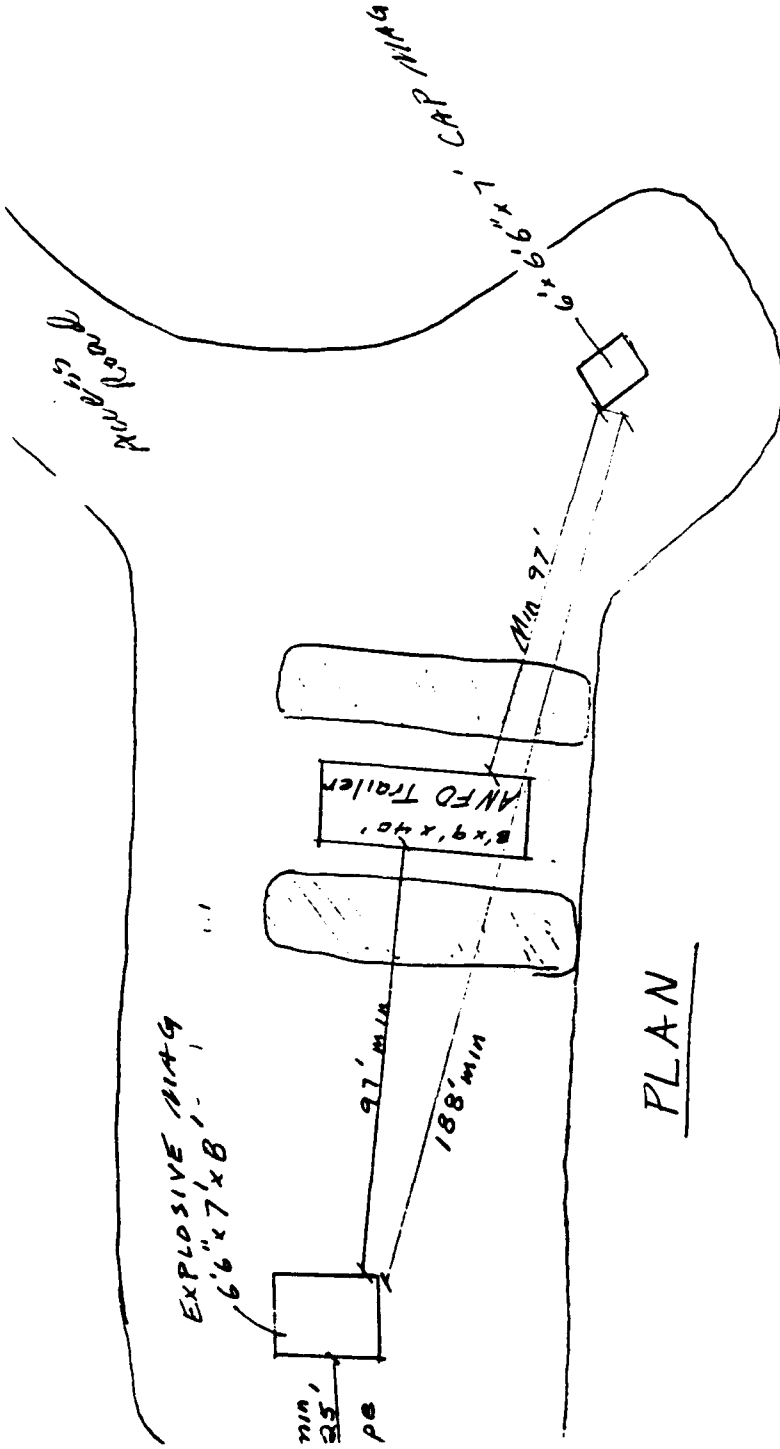
PLAN

Berm to match height of ANFO TRAILER

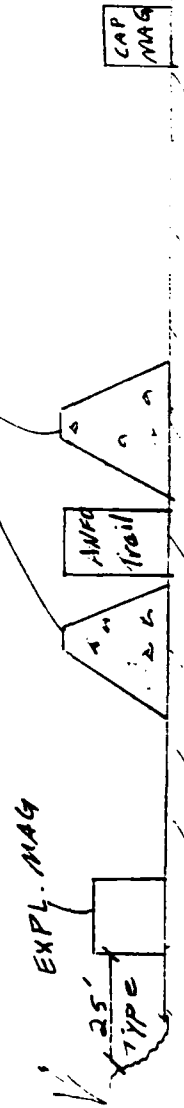


ELEVATION

Detail of Blasting Store 2		
SW-13	MS	11/30/89



Berm to match TRAILER



Detail of Blasting Storage		
SW-13	MS	11/30/89

APPENDIX D

PROJECT

SHOT NO. _____

CONTRACT NO.		CONTRACTOR	STATION AND RANGE	WORK FEATURE
ROCK TYPE		TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
LOADING START		LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
WIND AND WEATHER		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB- DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES				
STEMMING				
POWDER TYPE	LBS.			
HOLES	SIZE	DEPTH		
CAPS	LENGTH	EACH		
MAX. POUNDS/DELAY				
REMARKS, DAMAGE FLYROCK, EVALUATION				

BLASTING REPORT



PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

Rec'd 1/1/89
[Signature]

December 7, 1989

Serial Letter No.: 061/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Blasting and Explosive Materials

Gentlemen:

Reference is made to PCL Civil Constructors, Serial Letter No. 052/02219/7 and specifically your Serial Letter No. 019/02219/7, all of which addresses the above subject manner. This letter and the information contained herein will become part of PCL Civil Constructors General Blast Plan. The items are as follows:

Item 1 - Resumes:

At this time, our drilling and blasting subcontractor, McCaw's Drilling, Inc. does not anticipate persons other than Mr. Kevin Joe and Gerald McCaw being the blasters in charge. If for some unforeseen condition, another person is put in charge of the blasting operations that person's resume and list of qualifications will be submitted to the Contracting Officer.

Item 2 - General Procedures:

There was indeed a typographical mistake made in Paragraph 4b. It should read "Ensign".

Item 3 - General Procedures:

A new sentence is hereby incorporated into our General Blasting Plan which reads "No blasting will be performed during the hours of darkness".

Mr. Wiley Isom
RE: Blasting & Explosive Materials
December 7, 1989
Page 2 of 3

Item 4 - Pre-Split:

Paragraph 1, 2nd sentence after the words "shall be", the following is hereby inserted:

"24 inches or as approved by the Contracting Officer."

Item 5 - Cushion Blasting:

Pre-split Paragraph 3-C cushion blasting is hereby deleted. The following is added as Section 6, titled, Cushion Blasting.

SECTION 6 - Cushion Blasting

1. There may be instances where the "Cushion Blasting" technique may be used instead of the conventional per-split or pre-shear techniques to achieve wall control. It has been our experience that if there is less than four feet of burden in front of the pre-shear holes, inferior results are likely because of ground movement. Cushion blasting for wall control may be accomplished by one of the following methods.
 - A. The pre-split or line holes are fired concurrently with the production holes but delayed to detonate after the general blast holes per Section 7-3 of the contract documents.
 - B. The main cut area is removed prior to blasting the pre-split holes except for a "cushion" or buffer in front of the neat excavation line. The pre-split holes are then fired on an instantaneous delay to achieve the desired smooth wall at the neat excavation line.

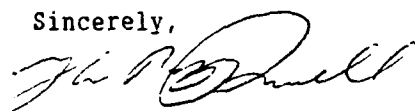
Field conditions will dictate which of the above methods will be used for wall control if the conventional pre-split or pre-shear methods are not feasible.

Mr Wiley S. Isom
RE: Blasting & Explosive Materials
December 7, 1989
Page 3 of 3

Pertinent Sections of "The Blasters' Handbook" by the Dupont Company and "The Blasters's Handbook", by Canadian Industries Limited, depicting both of the afore mentioned techniques are enclosed for the Contracting Officer reference.

I trust the additional information presented above will adequately address all of the items requested in Contracting Officers letter. Both PCL Civil Constructors and McCaw Drilling anxiously await written permission to bring explosive products onto the project site.

Sincerely,



Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PROPERTY OF

KEVIN JCE

BLASTERS' HANDBOOK



Prepared by the
Technical Service Section
Explosives Products Division
E. I. du Pont de Nemours & Co. (Inc.)
Wilmington, Delaware 19898

G-59

Controlled Blasting

blast holes the same amount with a 50 per cent reduction in explosives load. The explosives should be well distributed in the hole using decks and detonating cord downlines.

Line drilling is best suited to homogeneous formations where bedding planes, joints, and seams are at a minimum. Natural planes of weakness tend to promote shear through the line-drilled holes into the finished wall. Therefore, thin-bedded, sedimentary, foliated metamorphic formations are not well suited to line drilling for overbreak control unless drilling can be done perpendicular to the strike of the formation. This, however, is not practical in most excavation work.

Figure 22-E shows a typical pattern for line drilling. Best results are obtained when the primary excavation is removed to within one to three rows of holes of the neat excavation line. The last row, or rows, of holes is then slabbed away from the line drill holes using delay caps or MS Connectors. This procedure gives maximum relief in front of the finished wall, allows the rock to move forward, and creates less back pressure which could cause overbreak beyond the line drilling.

Line drilling is very limited in application. The only place where it is applicable is in areas where even the light explosive loads associated with other controlled blasting techniques may cause damage beyond the excavation limit, or where line drilling is used between loaded holes to promote shearing and guide the preshear line.

Some of the disadvantages are: (1) unpredictability except in very homogeneous formations; and (2) high drilling costs because of the close spacings required.

CUSHION BLASTING

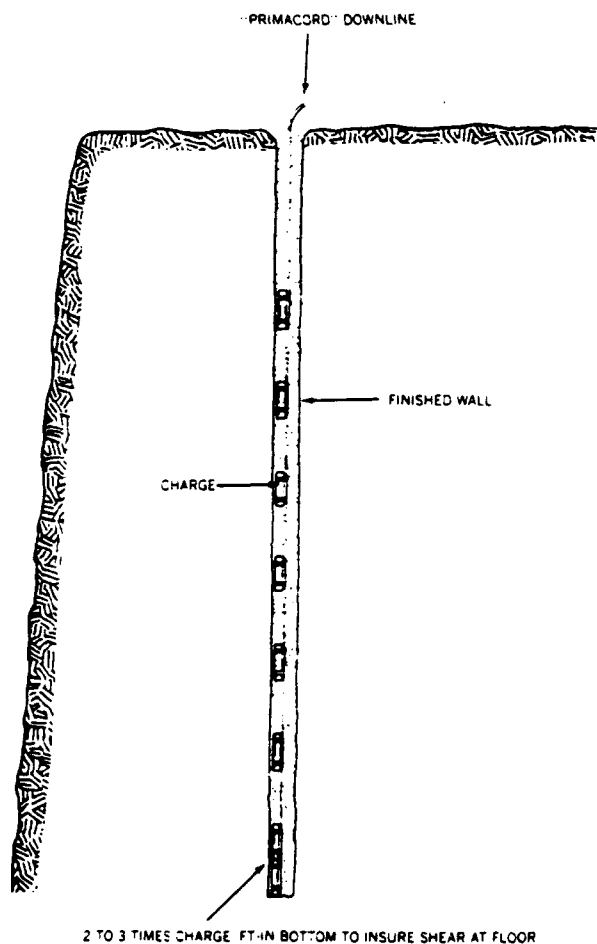
Principle. Cushion blasting — sometimes referred to as trimming, slabbing, or slashing — was introduced in Canada. Like smooth wall blasting, a single row of holes is drilled along the neat excavation line, loaded with light, well-distributed charges, and fired after the main excavation is removed. Unlike smooth wall blasting, the annular space in the holes is filled with crushed stone the entire column length. This "cushions" the shock from the finished wall as the berm is blasted and minimizes the stresses and fractures in the finished wall. This technique is seldom used today because the air annulus around the small-diameter charges generally produces equal results and reduces the loading time. The only application for cushion blasting today is in the situation where large-diameter cartridges are taped on detonating cord downlines at planned intervals. The cushion holes are fired with minimum delay between holes. This shears the rock web between holes and yields a smooth wall with minimum overbreak. Detonating cord trunk lines or instantaneous caps are used to initiate on detonating cord downlines if noise is a problem.

The fact that the main cut area is removed in cushion blasting

Chapter 22

leaves a minimum buffer (or berm zone) in front of the neat excavation line. The cushion holes can either be drilled prior to any primary blasting or by removing the final berm.

The burden and spacing will vary with the hole diameter being used. The burden-to-spacing relationship will vary with different for-



For maximum cushioning, place charges as close as possible to the excavation side.

Controlled Blasting

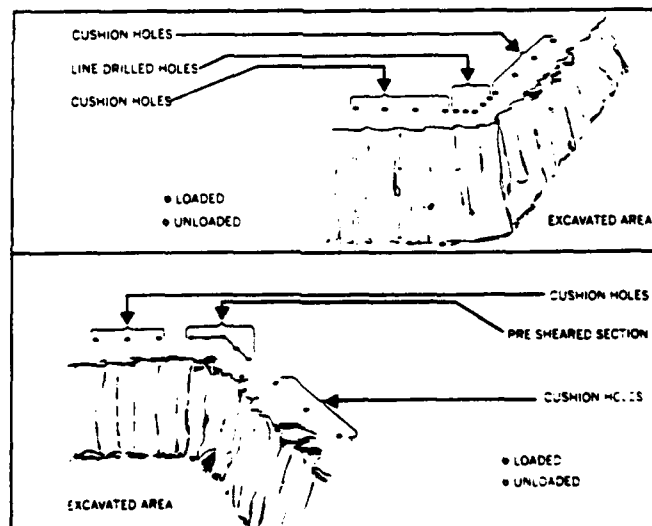
mations, but the spacing should always be less than the width of the berm being removed to obtain maximum shearing between holes.

When a full-length, detonating-cord downline is preassembled by taping the charges on it, the stemming is added after placement of the entire charge. In this case sand, crushed stone, or gravel can serve as stemming provided that it is sufficiently free flowing. Raising and lowering the downline slightly as the stemming is added will help fill the space between the cartridges. The top two or three feet of the hole should be completely stemmed and not loaded. How much top stemming is required will vary with the formation that is being shot.

When cushion blasting around curved areas or corners, closer spacings are required than when blasting a straight section. Guide holes also can be used to advantage when blasting nonlinear faces. On 90-degree corners a combination of controlled blasting techniques will give better results than straight cushion blasting.

In many sedimentary formations where it is difficult to hold a smooth wall, unloaded guide holes between cushion holes are recommended. Generally, small-diameter guide holes are employed to reduce drilling costs.

Where only the top of the formation is weathered, the guide holes need to be drilled only to that depth and not to the full depth of the cushion holes. This procedure is common on the first lift or bench since



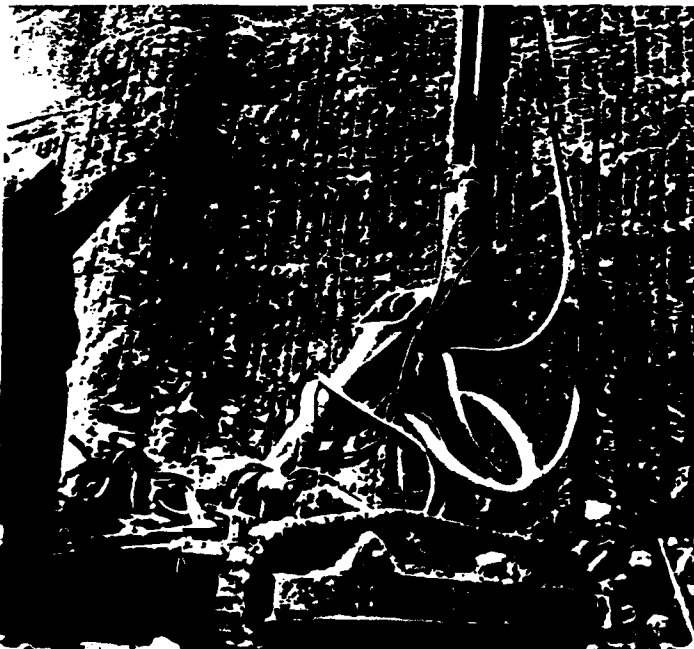
Guide holes can also be used to advantage when blasting nonlinear faces. On 90-degree corners a combination of controlled blasting techniques will provide better results.



Figure 22-F. Results of cushion blasting where guide holes are drilled to full depth. backbreak is more probable there than on lower benches. Figure 22-F shows results of a combination of cushion blasting and guide holes where the latter were drilled to full depth. Figure 22-G shows results of cushion blasting using smaller diameter holes and unloaded guide holes.

Cushion blasting in open work has application to inclined and vertical holes. In both cases good hole alignment is essential.

Figure 22-G. Results of cushion blasting with smaller holes and unloaded guide holes.



Blasters' **Handbook**

**Describing
Practical Methods of Using Explosives
for Various Purposes**

**Prepared by
TECHNICAL MARKETING SERVICES — EXPLOSIVES
Sixth Edition**

**CANADIAN INDUSTRIES LIMITED
Explosives Division
MONTREAL, QUE.**

G-64

USE OF EXPLOSIVES FOR SPECIAL PURPOSES

against injury to personnel or damage to equipment or installations.

Firing. Pre-Shear holes must be fired simultaneously to obtain the shearing action from hole to hole. Normally the PRIMACORD downline from each hole is connected to a PRIMACORD trunkline, then the required number of pre-shear holes is fired with a blasting cap attached to the end of the trunkline. If the pre-shearing is being carried out in an area where vibration control is critical, the pre-shear holes may be fired in groups of sufficient numbers to obtain the shearing action while not exceeding the maximum explosives load that may be fired on any one delay period.

Pre-shearing may be accomplished by shooting the pre-shear holes ahead of the main excavation or with the primary blasts. The location of the work will generally dictate which of these techniques is most applicable.

Pre-shearing ahead of the main excavation is used in the "solid" such as in highway cuts, power intake canals, foundations, etc., where it is useful to define the excavation limits before any other drilling and blasting is carried out. This method should not be used, however, if there is less than 40 feet of burden in front of the pre-shear holes since inferior results are likely because of ground movement. Under the latter conditions, the pre-shear holes should be fired with the primary blasts or the Cushion Blasting technique employed to trim the face after the primary blasting has been completed. *

Pre-shearing with the primary blasts is an essential technique in side hill cuts on highways or in quarries and open pit operations where ground movement is likely to occur as a result of firing the pre-shear holes. Ground movement can make drilling of the primary holes difficult or it can be the cause of inferior results if the burden on the pre-shear holes has been reduced to a point that the ground will move during their firing. This method is also used on many operations because it eliminates a step in the drill-blast cycle; it avoids drilling and blasting the pre-shear holes before the main excavation is started. The pre-shear holes are fired instantaneously, then the holes in the pri- *

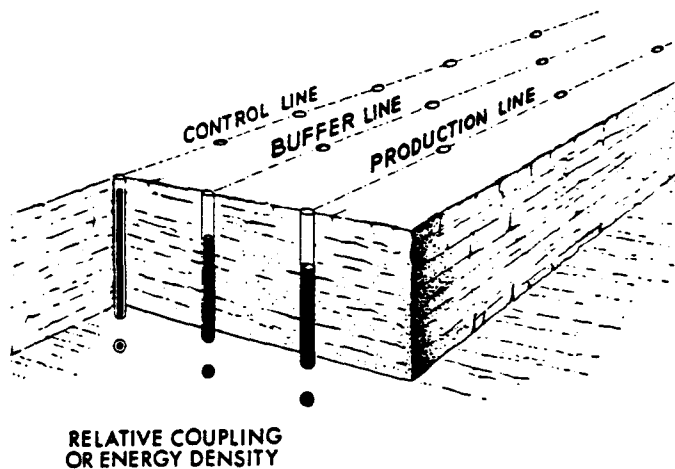


Fig. 296 Principles of wall control to protect a Pre-Shear face.

mary blasts follow, delayed on later firing periods to the open face retreating towards the pre-shearing.

Precautions should be taken to guard against cut-offs in the row of holes immediately in front of the pre-shear face when using this method of firing since ground movement can be severe in this area in blocky ground. The aforementioned row of primary holes should be top and bottom primed to provide adequate insurance against the possibility of cut-offs.

Protection of the Pre-Shear Face. Several steps can be taken to improve both pre-shearing results and the pre-shear face during removal of the primary excavation.

Normally a fillet or wedge is left at the toe of the pre-shear face. This can be reduced to a minimum by drilling the row of primary holes in front of the pre-shear face at the proper distance from it. This procedure will also protect the pre-shear face since the latter could be destroyed if the primary holes are placed too close. Conversely, if too great a burden is placed on the primary holes, a "monument" could result, presenting a dan-

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PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

Rec'd 15 Dec 89
[Signature]

December 15, 1989

Serial Letter No.: 081/SC-24

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Quality Control Representative

Gentlemen:

PCL Civil Constructors, Inc. is submitting for your approval, Mr. Kevin Joe, of McCaw Drilling and Blasting, as Quality Control Representative for drilling and blasting on the Cuchillo Dam Project. Mr. Joe will be under the direction of the Quality Control Systems Manager to assure all drilling and blasting complies with the requirements on the contract plans and specifications. See attached resume for Mr. Joe's qualifications.

Sincerely,

Thomas R. O'Donnell
Project Engineer

MBB:deo



PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

Rec'd 19 Feb 90
DM

February 16, 1990

Serial Letter No.: 164/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-0-0056 (Cuchillo Dam)
Rio Grande Floodway
I or C, NM

Subject: General Blast Plan
Blasting Supervisor

Gentlemen:

Reference is made to PCL Civil Constructors serial letter no. 052/02219/7, dated December 1, 1989, which transmitted our General Blast Plan to the Contracting Officer. PCL Civil Constructors hereby requests that the enclosed correspondence from McGraw's Drilling (USA), Inc., be incorporated into our plan.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo



SUITE 316
1646 COURT PLACE
DENVER, COLORADO
80202
FAX (403) 845-8410
TELEPHONE (303) 893 1303

February 15, 1990

PCL Civil Constructors
Cuchillo - Negro Dam Project
Truth or Consequences, New Mexico
Fax: 505-743-7836

ATTENTION: Mr. T. O'Donnell

Dear Sirs:

RE: Quality Control Representative in Charge
of Drilling and Blasting

In the event of my absence from site my replacement will be Mr. Kevin Stevenson. Mr. Stevenson has been with our firm for over ten years and has worked in every capacity from drilling to project supervision.

During the past five years, Mr. Stevenson has supervised drill and blast crews of up to forty men on various drill and blast projects across Canada including pipelines, highways, quarries and subdivisions.

Mr. Stevenson has worked mostly in Ontario and the Northwest Territories during the past five years. A blaster's certificate is not required in Ontario.

I am enclosing Mr. Stevenson's Northwest Territories blasting certificate with this transmittal.

If you have any questions or comments you may contact me at the site office.

Yours very truly,

McCaw's Drilling (USA), Inc.

Laurel Harris

for Kevin Joe
Quality Control Representative
Drilling and Blasting

KJ:ldh
Enclosure

G-69

June 26 1989



85-005

MINING INSPECTION SERVICES

EXPLOSIVES PERMIT

FORM B

I hereby certify that Kevin STEVENSON
of 5607 - 57th Avenue, Rocky Mountain House, Alberta

is authorized to handle and use explosives in the Northwest Territories. (Subject to such structures or limitations as are shown.)

Kevin Stevenson
Permittee

[Signature]
Inspector or Deputy Inspector

Limitations

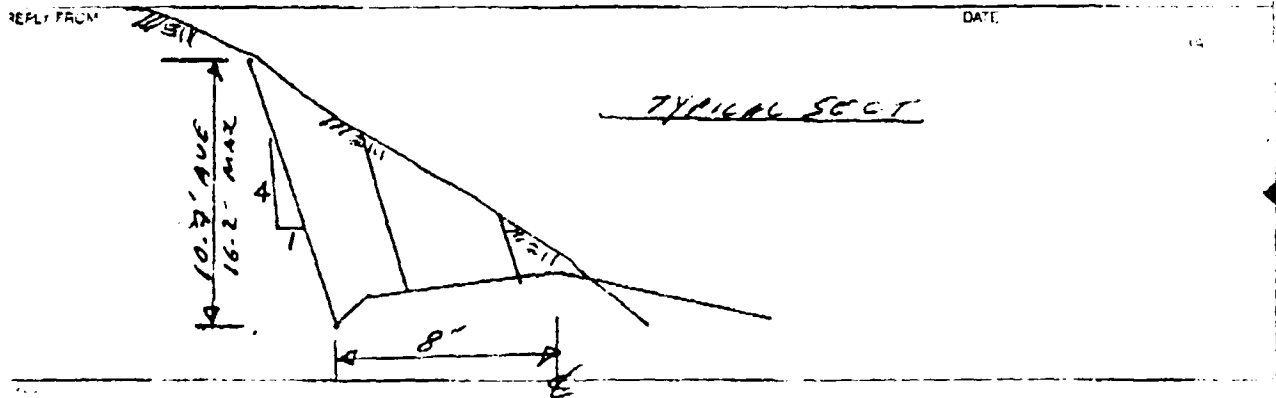
1. Permit expires N/A 19

2. Other conditions "SURFACE BLASTING ONLY"
NO TAPE FUSES ALLOWED IN THE NORTHWEST TERRITORIES

14W7281-80/0801

FROM K. Joe		REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
MR T. O'DONNELL PCL CONSTRUCTORS Cuchillo DAM		DATE DEC 21/89 SUBJECT BLASTING PROPOSAL MAINTENANCE RD.
MESSAGE		POSTAL CODE

- The Following is A BLASTING PROPOSAL FOR THE MAINTENANCE ROAD - REF. DWG. # 126-TC-A-6.1 plate 6.
- PRELIMINARY SITE INSPECTION INDICATES ROCK FROM 10+78 TO 11+50 & FROM 12+50 TO 15+80
- CUTS RANGE FROM 0' TO 16.2' WITH THE AVERAGE CUT ON THE PRE-SPLIT LINE AT 10.7' & DAY LIGHTING NEAR 4'.



KEEP PART 2 (YELLOW)

MEMO

RESPONDENT RETURN: PART 3 (PINK)

IS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

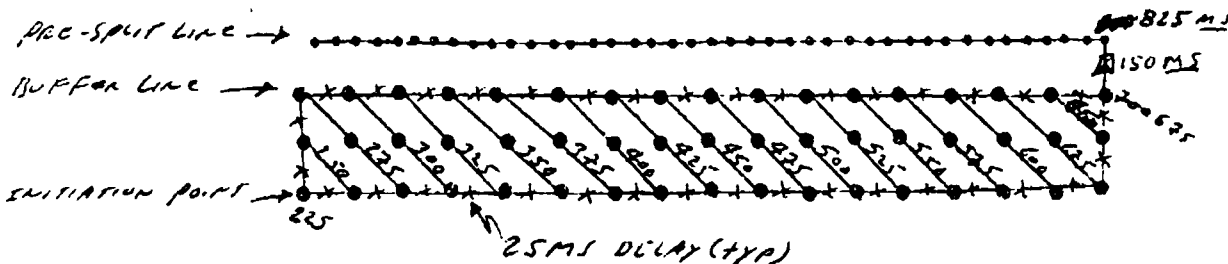
2249



PAGE 2 OF 2

1000 MOUNTAIN ROAD ALBERTA, CANADA
PHONE 845-3101 FAX 845-0410

FROM <u>K. JOE</u>		REPLY	URGENT ☐	AS SOON AS POSSIBLE ☒
TO <u>MR T. O'DONNELL</u>		DATE <u>DEC 21/89</u>	19	
SUBJECT <u>PCL CONSTRUCTORS</u>		SUBJECT <u>BLASTING PROPOSAL</u>		
CUCULLU DAM		MAINTAINENCE ROAD		
POSTAL CODE				



- TYPICAL TIE-IN DIAGRAM & DELAY SEQUENCE FOR MAINTAINENCE ROAD SHOT.
- MAXIMUM POUNDS PER DELAY SHALL NOT EXCEED 100LB.
- ALL HOLES SHALL BE DRILLED TO DESIGN GRADE IN AN EFFORT TO REDUCE OVERBREAK
- THE POWDER FACTOR SHALL BE REDUCED IN THE BUFFER ROW IN AN EFFORT TO REDUCE IMPACT ON THE PRE-SPLIT WALL.

ORDER KEEP PART 2 (YELLOW)	MEMO	RESPONDENT RETURN PART 3 (PINK)
AL MEMO FITS STANDARD NO 9 AND NO 10 WINDOW ENVELOPES	0.01116	ALPHA OFFICE E-81015



PAGE 3 OF 3

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE 845-3101 FAX 815-0410

FROM <i>K. JOE</i>		REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
MR T. O'DONNELL PCL CONSTRUCTION CUSHING DAM		DATE <i>DEC 21/89</i> SUBJECT <i>BLASTING PROPOSAL MAINTENANCE ROAD</i>
MESSAGE <i>5E-ent</i>		PERIOD 8, NUM-AL <i>8</i> CMS CONNECTION <i>8</i>
Powder Factor <i>= 0.0766/lb.</i>	Powder Factor on Buffer Row <i>= 0.4466/lb.</i>	Powder Factor <i>= 1.1366/lb.</i>
REPLY FROM	DATE	19
<u>PRE-SPLIT Hole - 2 1/2" Ø</u>	<u>Buffer holes - 3" Ø</u>	<u>Production holes - 3" Ø</u>
* FOR TECHNICAL Specs ON EXPLOSIVE PRODUCTS REFER TO GENERAL BLASTING PROPOSAL -		

SENDER KEEP PART 2 (YELLOW)

MEMO

RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO 9 AND NO 10 WINDOW ENVELOPES

2253

ALPHA OFFICE SYSTEMS

PAGE 1 of 1

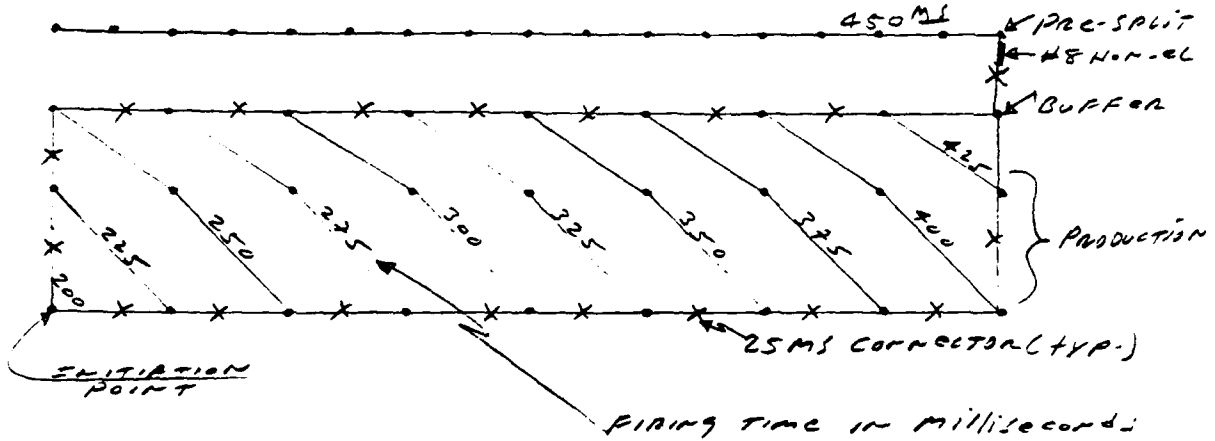
PROPOSAL H 90-02

TO	MR T. O'Donnell	FROM	K. Joe
	PEL CONSTRUCTORS	DEPT	McCaw Drilling
	Cuchillo DAM	DATE	JAN 7/90
RE	BLASTING PROPOSAL FOR THAT PORTION OF		
MESSAGE	THE SPILLWAY LIS OF THE DAM AXIS FROM		
	SPILLWAY STATION 2+43.7 TO 4+25		
FOLD	* PLEASE NOTE THAT THIS PROPOSAL IS FOR		
	THE RIGHT AND LEFT ABUTMENTS AT THE ABOVE		
	NOTED STATIONS & SUPERCEDES OUR PROPOSAL		
	FOR THE SPILLWAY LIS OF THE DAM AXIS ON		
	THE RIGHT ABUTMENT DATED DEC 21/89.		
REPLY	DATE <u>K. Joe</u> 19		
FOLD			

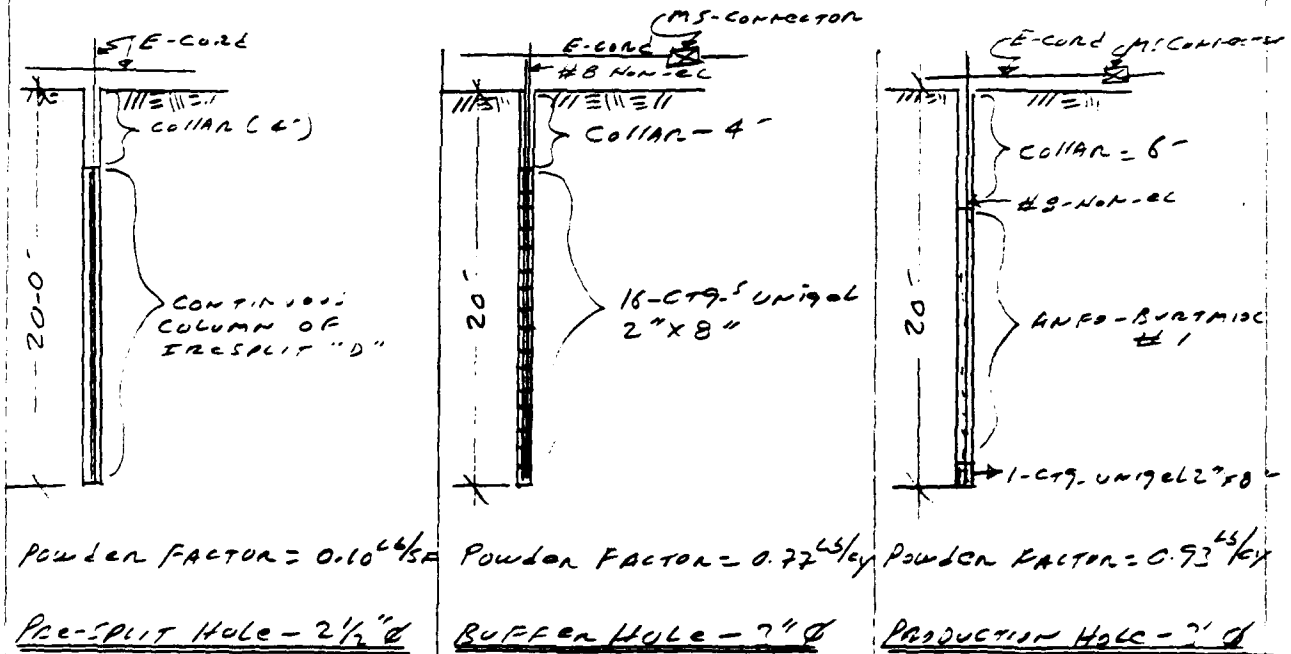
MILLER OFFICE GROUP - 458-4990

WHEN WRITING SNAP OFF PINK PART - SEND WHITE AND YELLOW INTACT

WHEN REPLYING SNAP AND RETURN YELLOW PART - RETAIN WHITE PART AND FILE



TYPICAL TIE-IN DIAGRAM





Reference: CUCHILLO DAM PROJECT
BLASTING PROPOSAL # 90-02

Date: JAN 7 '90

By: K.S.

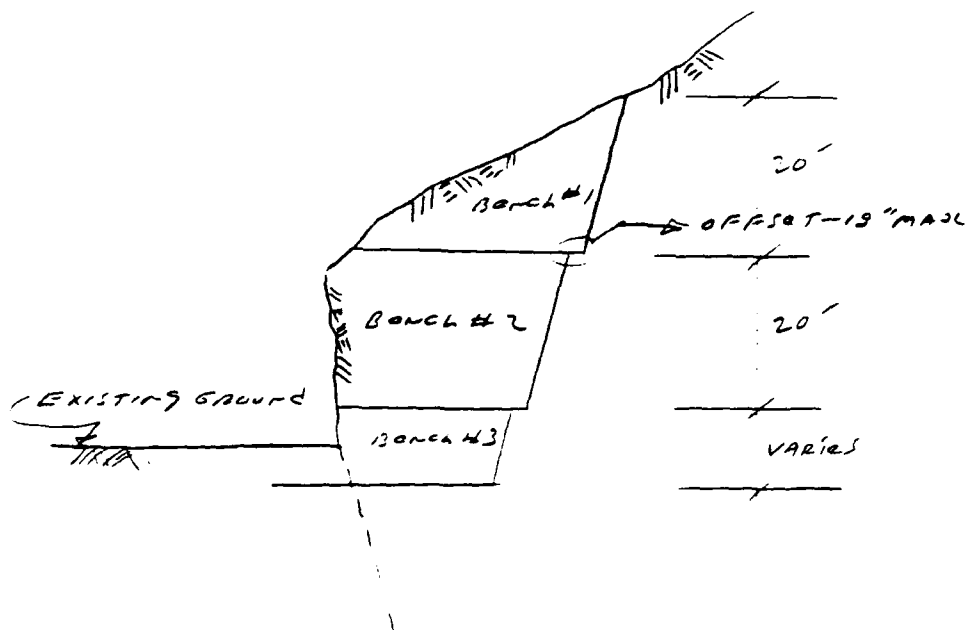
Sheet 3 of 4

- DRILL PATTERNS FOR PRODUCTION DRILLING WILL VARY WITH THE DEPTH OF CUT BUT WILL BE IN ACCORDANCE WITH SECT. 4 "PRODUCTION" OF OUR APPROVED GENERAL PROPOSAL & SHALL BE AS FOLLOWS:

3" Ø HOLES

<u>DEPTH</u>	<u>BURDEN</u>	<u>SPACING</u>
UP TO 5'	4'	4'
5' TO 10'	5'	5'
10' TO 15'	6'	6'
15' TO 20'	7'	7'

- THE AMOUNT OF SUB-DRILLING SHALL BE DETERMINED IN THE FIELD AND SHALL BE THAT WHICH YIELDS THE BEST BREAKAGE TO DESIGN GRADE
- THE PRE-SPLIT HOLES SHALL BE 2 1/2" Ø AND SHALL BE DRILLED ON 30" CENTERS OR AS APPROVED BY THE CONTRACTING OFFICER.
- FOR DETAILS OF EXPLOSIVES PRODUCTS USED REFER TO OUR APPROVED GENERAL BLASTING PROPOSAL



TYPICAL SECTION & BENCHING SEQUENCE

NOTE: THE GENERAL SEQUENCE SHALL BE AS FOLLOWS:

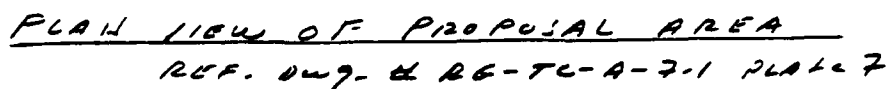
1. EXCAVATE FROM THE TOP DOWN IN MAXIMUM 20' LIFTS WORKING FROM THE DIS END TO UIS.
2. BLASTING SHALL BE BY THE "CUSHION BLASTING" TECHNIQUE OUTLINED IN OUR APPROVED GENERAL BLASTING PROPOSAL - SECT 6.1.A.
3. THE EXCAVATION BETWEEN STA'S 2+43.7 AND 4+25 SHALL BE COMPLETED TO EL. 4616 THEN THE BENCHES AT EL 4611 & EL. 4607 (2+43.7 TO 3+10.95) EXCAVATED TO DESIGN GRADE



Date: JAN 7-70

By: 145-

Sheet 1 of 4



MO18



ROCKY MOUNTAIN HOUSE ALBERTA
PHONE 845-3101 FAX 845-6410

FROM <i>K. JOE</i>		REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
TO <i>MR T. O'DONNELL</i> <i>PCL CONSTRUCTORS</i> <i>CUCHILLO DAM</i>		DATE <i>JAN 8, 1990</i> 19 SUBJECT <i>BLASTING PROPOSAL H90-03</i>
POSTAL CODE		

MESSAGE

ENCLOSED FOR SUBMITTAL TO THE ARMY CORPS
ADMINISTRATIVE CONTRACTING OFFICER IS OUR
BLASTING PROPOSAL H90-03 COVERING THE LEFT
ABUTMENT OF THE DAM, THE HIGH LEVEL OUTLET
WORKS & THE LOW LEVEL OUTLET WORKS.

K. JOE

REPLY FROM

DATE

19

SMC

SENDER KEEP PART 2 (YELLOW)

MEMO

RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO 9 AND NO 10 WINDOW ENVELOPES

8228775

92271

ALPHA OFFICE SYSTEMS



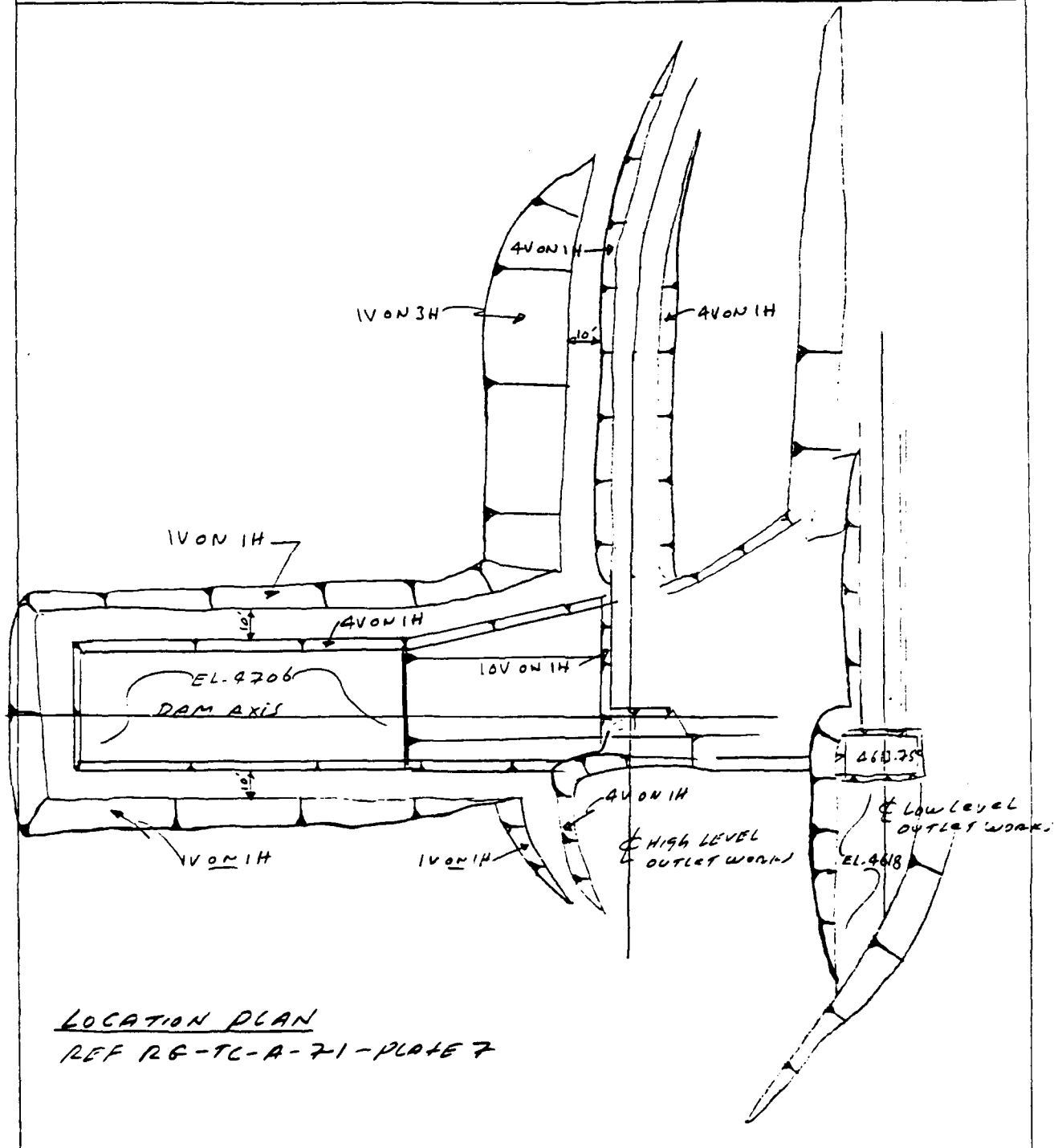
Drilling & Blasting Ltd.

Reference: CUCHILLO DAM
BLASTING PROPOSAL H 90-03

Date: JAN 8-90

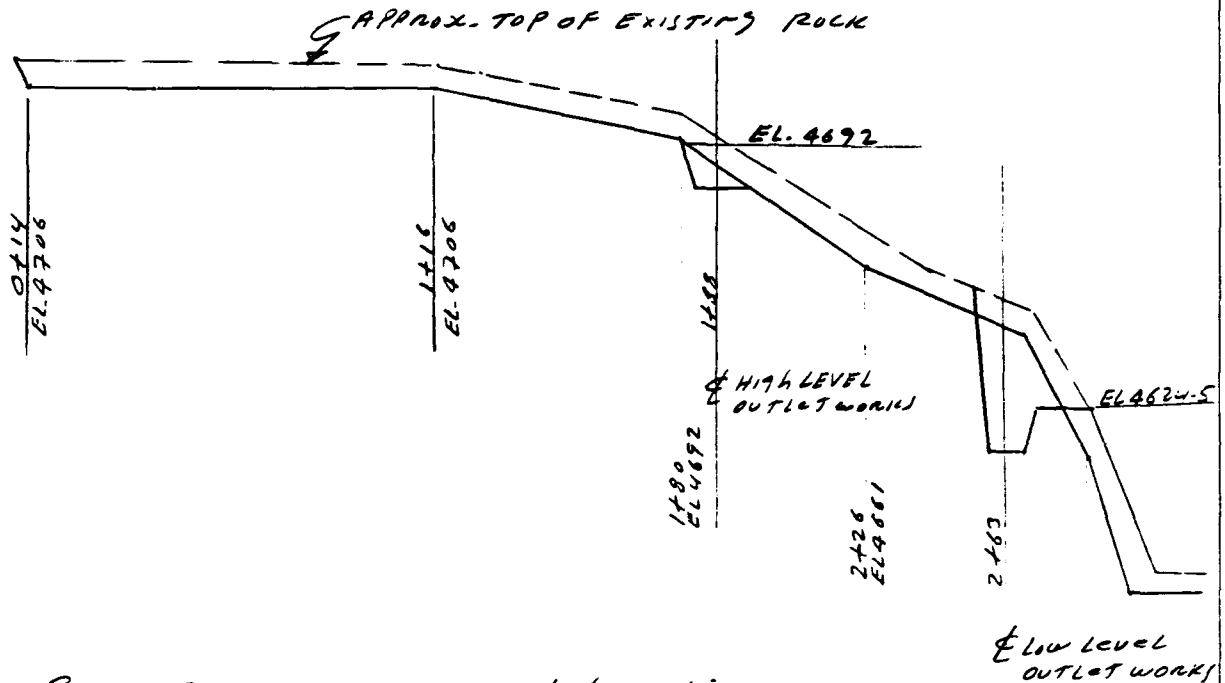
By: K.S.

Sheet 1 of 6



LOCATION PLAN
REF R6-TC-A-71-PLATE 7

M018



PROFILE OF AREA COVERED BY THIS PROPOSAL

SEQUENCE

- The presplit holes shall be drilled & shot prior to start of production blasting (dam abutment)
- The production blasting for the dam abutment shall commence at approximately station 1+91 to EL. 4692 and progress northward to 0+14
- Drilling & blasting of the high level outlet works shall be completed to design grade, including the outlet channel.
- When the drill & blast of the high level outlet works has been completed to design grade drilling & blasting of the dam abutment shall continue to approximately, elev. 4655
- Drilling and blasting of the low level outlet works shall be completed to design grade, including outlet channel



Drilling & Blasting Ltd.

Reference: CUCHILLO DAM

BLASTING PROPOSAL # 90-03

Date: JUNE 1990

By: K.S.

Sheet 3 of 6

SEQUENCE (CONT. FROM PAGE 2)

- WHEN THE DRILL & BLAST OF THE LOW LEVEL OUTLET WORKS HAS BEEN COMPLETED TO DESIGN GRADE DRILLING & BLASTING OF THE DAM ABUTMENT SHALL CONTINUE FROM EL 4624.5 TO EL. 4578 (+/-)

NOTES

- ALL DRILLING & BLASTING SHALL BE IN ACCORDANCE WITH OUR APPROVED GENERAL BLASTING PROPOSAL AND SECT 7. "BLASTING" OF THE CONTRACT DOCUMENTS.
- DRILL PATTERNS FOR PRODUCTION DRILLING WILL VARY WITH THE DEPTH OF CUT BUT WILL BE IN ACCORDANCE WITH SECT. 4. "PRODUCTION" OF OUR APPROVED GENERAL PROPOSAL AND SHALL BE AS FOLLOWS:

3" Ø HOLES

<u>DEPTH</u>	<u>BURDEN</u>	<u>SPACING</u>
UP TO 5'	4'	4'
5' TO 10'	5'	5'
10' TO 15'	6'	6'
15' TO 20'	7'	7'

- THE AMOUNT OF SUB DRILLING SHALL BE DETERMINED IN THE FIELD & SHALL BE THAT WHICH YIELDS THE BEST BREAKAGE TO DESIGN GRADE.

M018



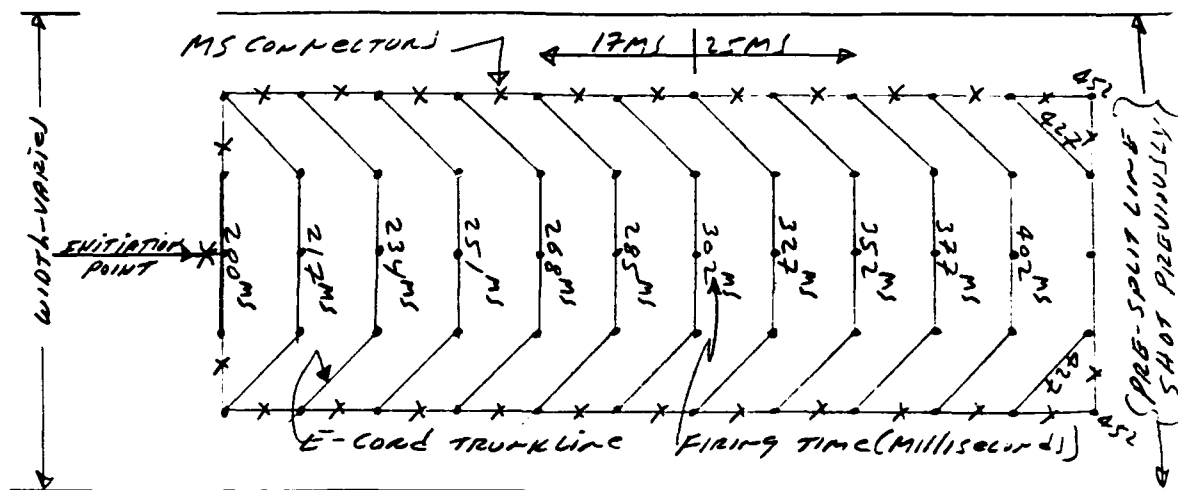
Drilling & Blasting Ltd.

Reference: CUCHILLO DAM
BLASTING PROPOSAL #90-03

Date: 1/21/90

By: J.C.S.

Sheet 4 of 6



- INITIATION by NON-CL SYSTEM
- PERIOD # 8 CAPS IN HOLE
- SURFACE TIE IN & DELAYMENT by E-CORD & MS CONNECTOR
- MAX 65.5 PER DELAY SHALL NOT EXCEED 2006-

TYPICAL TIE-IN DIAGRAM - PRODUCTION BLAST
(N.T.S)

* LEFT ABUTMENT OF THE DAM (MAX CUT 20')



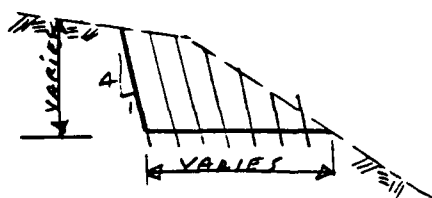
Drilling & Blasting Ltd.

Reference: CUCHILLO DAM
BLASTING PROPOSAL #90-03

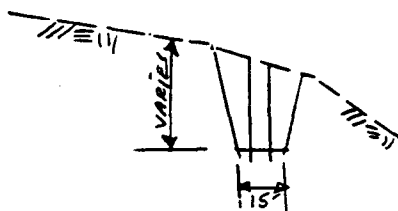
Date: JAN 8-90

By: K.S.

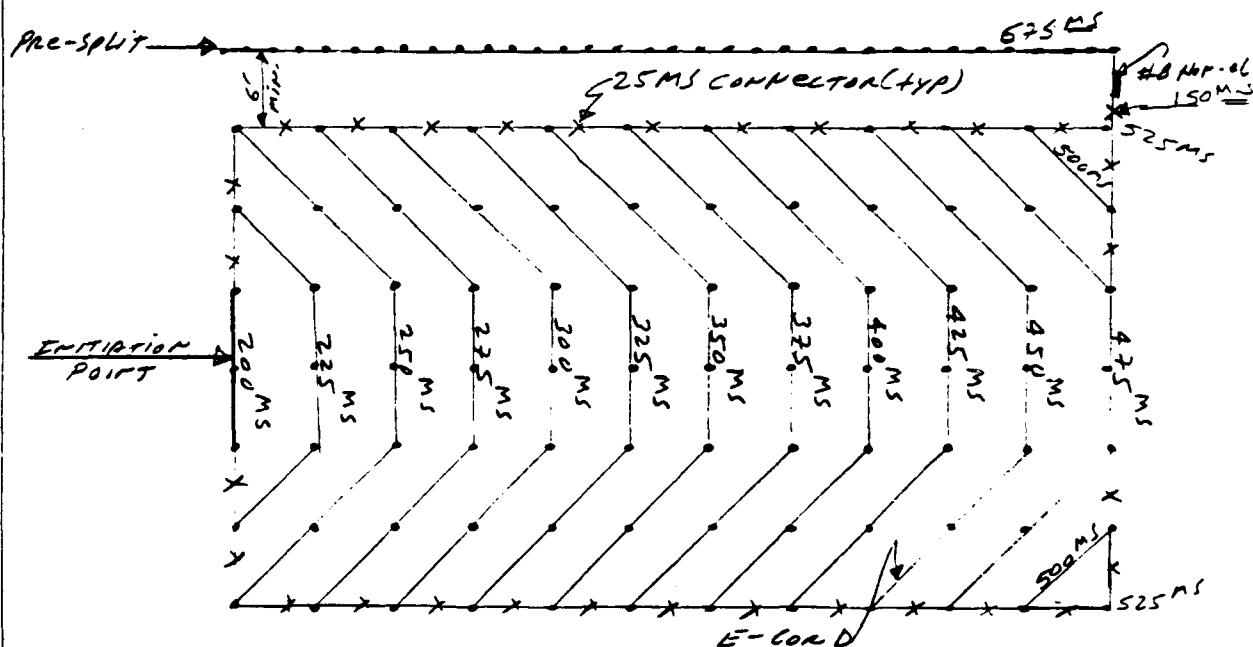
Sheet 5 of 6



TYPICAL SIDE-HILL SECTION
HIGH LEVEL OUTLET WORKS



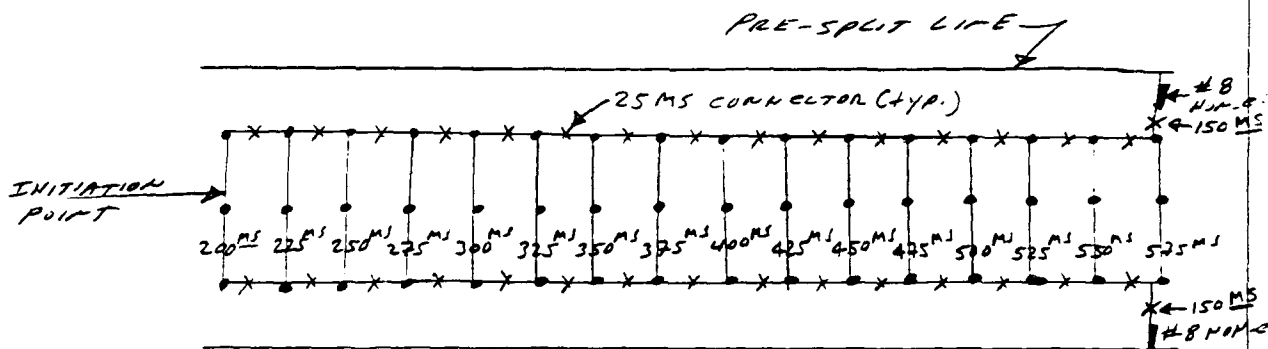
TYPICAL THRU-CUT SECTION
HIGH LEVEL OUTLET WORKS



* MAX POUNDS PER DELAY SHALL NOT EXCEED 250 LB.

TYPICAL TIE-IN DIAGRAM - SIDEHILL SHOT
HIGH LEVEL OUTLET WORKS
& LOW LEVEL OUTLET WORKS

M018



- * PATTERNS WILL VARY WITH DEPTH OF HOLE BUT IN ANY CASE WILL NOT EXCEED 5'X6'
- * PRE-SPLIT HOLES @ 30" C/C OR AS APPROVED BY CONTRACTING OFFICER
- * MAXIMUM DEPTH OF HOLE SHALL NOT EXCEED 20'
- * MAXIMUM POUNDS PER DELAY SHALL NOT EXCEED 125 LB.

TYPICAL TIE-IN DIAGRAM FOR THRU-CUT (SECT. PAGES)
FOR HIGH LEVEL & LOW LEVEL CUTLETWORKS

POWDER FACTORS

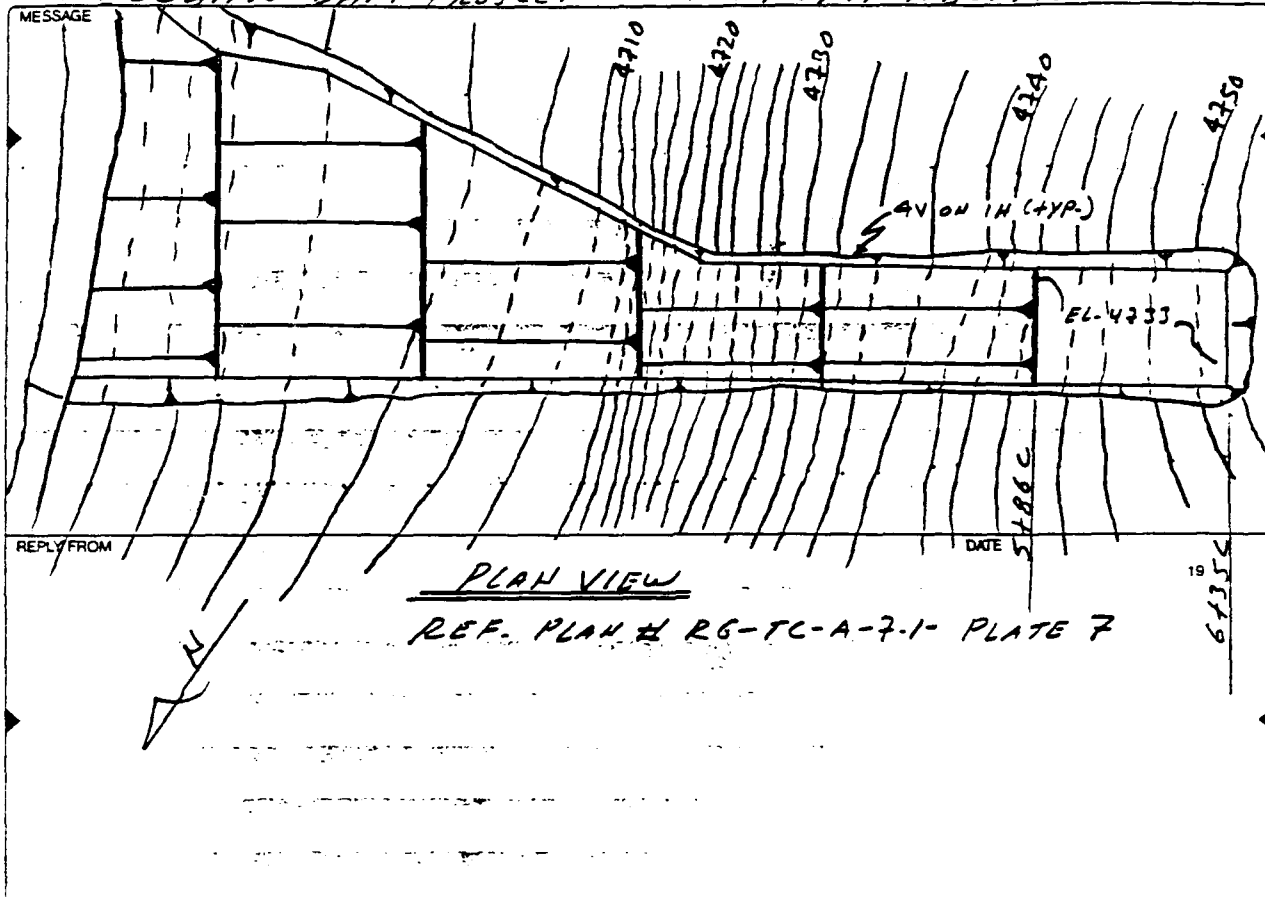
- POWDER FACTORS WILL VARY WITH PATTERN & DEPTH OF CUT BUT IN ANY CASE SHALL NOT EXCEED THE FOLLOWING LIMITS:
- (a) PRE-SPLIT HOLES — 0.10 LB/S.F.
- (b) BUFFER HOLE — 1.00 LB/CY
- (c) PRODUCTION HOLES — 1.50 LB/CY.



PAGE 1 OF 3
PROPOSAL # 90-01

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE: 845-3101 FAX: 845-6410

FROM K. JOE	REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
TO MR. T. O'DONNELL PCL CONSTRUCTORS CUEBILLO DAM PROJECT	DATE JAN 5 1990 SUBJECT BLASTING PROPOSAL RIGHT ABUTMENT-DAM



SMC

SENDER: KEEP PART 2 (YELLOW)

MEMO

RESPONDENT: RETURN PART 3 (PINK)

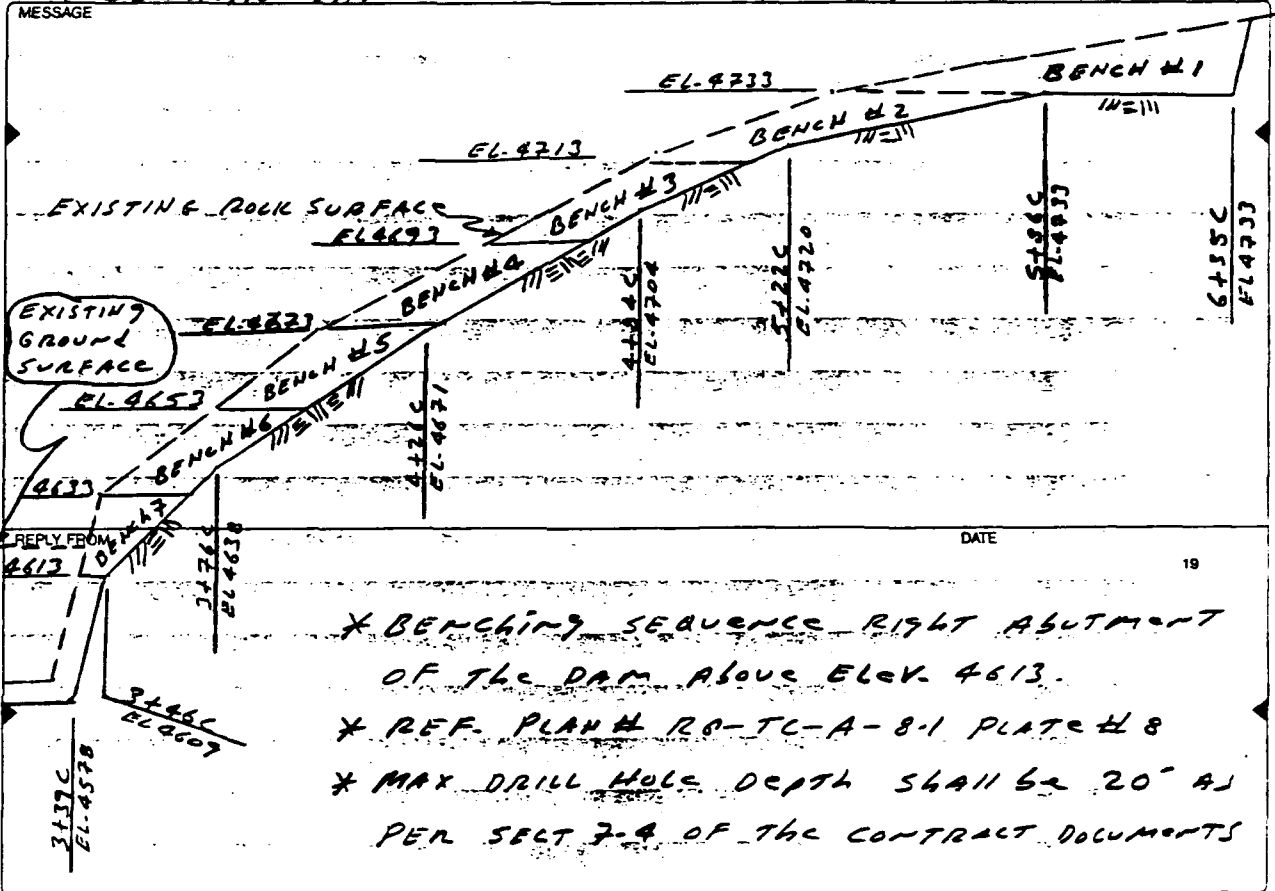
THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

0028776

2255

ALPHA OFFICE SYSTEMS

FROM K-JOE	REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
TO MR T. O'DONNELL PCL CONSTRUCTORS CUCULLA DAM	DATE JAN 5-1990 SUBJECT BLASTING PROPOSAL RIGHT ABUTMENT-DAM
POSTAL CODE	



SMC

SENDER: KEEP PART 2 (YELLOW)

MEMO

RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

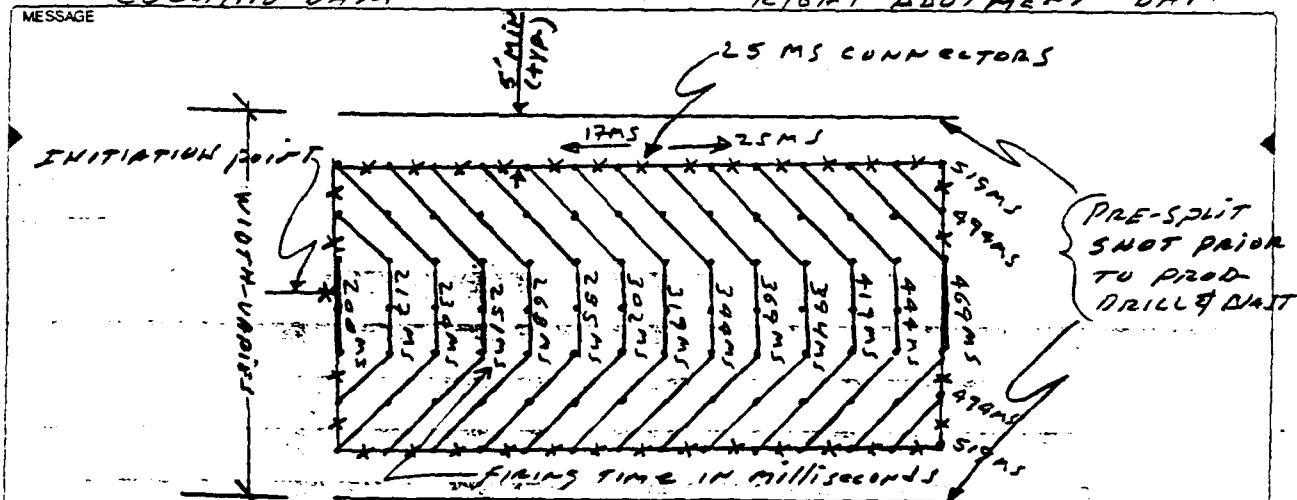
ALPHA OFFICE SYSTEMS



PAGE 3 H Z
PROPOSAL 890-01

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE 345-3101 FAX 345-8410

FROM K. JOE	REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
TO MR T.O' DONNELL PCL CONSTRUCTORS CUCHILLO DAM	DATE JAN 5-1990
POSTAL CODE	SUBJECT BLASTING PROPOSAL RIGHT ABUTMENT- DAM



REPLY FROM	DATE
TYPICAL PATTERN & TIE-IN DIAGRAM (H-T-S)	
AVERAGE CUT = 15"	
* MAX. LB. PER DELAY SHALL NOT EXCEED 200 LB.	

SMC
SENDER, KEEP PART 2 YELLOW, MEMO RESPONDENT RETURN PART 3 PINK.
THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES
ALPHA OFFICE SYSTEMS

TO	MR T-O'DONNELL	FROM	K-506
	PCL CONSTRUCTORS	DEPT.	MCLAWI DRILLING
	CUCHILLO DAM	DATE	JAN 5, 1990
RE	BLASTING PROPOSAL - RIGHT ABUTMENT - DAM		
MESSAGE	DRILL PATTERNS FOR PRODUCTION DRILLING		
FOLD	WILL VARY WITH THE DEPTH OF CUT BUT WILL		
	BE IN ACCORDANCE WITH SECT. 4, "PRODUCTION"		
	OF OUR GENERAL PROPOSAL AND SHALL BE AS		
	FOLLOWS:		
	2" Ø HOLES		
	DEPTH	BURDEN	SPACING
	UP TO 5'	4'	4'

REPLY	5' TO 10'	5'	5'	DATE	19
	10' TO 15'	6'	6'		
	15' TO 20'	7'	7'		
FOLD	THE AMOUNT OF SUB-DRILLING SHALL BE DETERMINED				
	IN THE FIELD AND SHALL BE THAT WHICH YIELDS				
	THE BIT BACKAGE TO DESIGN GRADE.				

MILLER OFFICE GROUP # 468-4590

WHEN WRITING SNAP OUT PINK PART - SEND WHITE AND YELLOW INTACT

WHEN REPLYING SNAP OUT PINK AND YELLOW PART - RETURN WHITE AND YELLOW INTACT

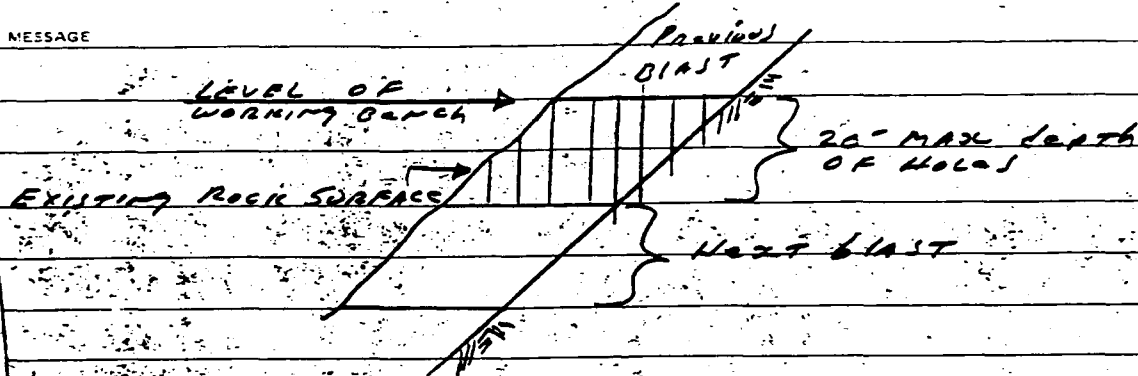
PAGE 5 of 7

PROPOSAL #90-01

TO: <u>MR. T. O'DONNELL</u>	FROM: <u>K. JOE</u>
<u>PCL CONSTRUCTORS</u>	DEPT: <u>MECAWIL DRILLING</u>
<u>CUCHILLO DAM</u>	DATE: <u>JAN 5, 1990</u>

RE: BLASTING PROPOSAL - RIGHT ABUTMENT - DAM

MESSAGE



REPLY

Profile Thru Typical Bench
See Page (2) This Proposal

MILITARY OFFICE GROUP - 480-4980

WHEN WRITING SNAP OUT PINK PART

SEND WHITE AND YELLOW STAG

WHEN REPLYING

USE YELLOW

WHITE

TO <u>MR T- O'DONNELL</u>		FROM <u>K. JOE</u>
<u>PCL CONSTRUCTORS</u>		DEPT <u>MCCAW'S DRILLING</u>
<u>CUCHILLO DAM</u>		DATE <u>JAN 5, 1990</u>
RE <u>BLASTING PROPOSAL - RIGHT ABUTMENT - DAM</u>		
E-CORD		
MESSAGE	MS CONNECTOR	MS CONNECTOR
11/21/84	11/21/84	11/21/84
COLLAR (4')	COLLAR	COLLAR
15'	15'	15'
UNIMAX 11/2" (11')	UNIMAX 11/2" (11')	UNIMAX 11/2" (11')
15'	15'	15'
2 1/2" Ø HOLE	3" Ø HOLE	3" Ø HOLE
POWDER FACTOR = 0.09	POWDER FACTOR = 0.83 LB/CY	POWDER FACTOR = 1.38 LB/CY
26/5F		
<u>PRE-SPLIT HOLES</u>	<u>BUFFER HOLES</u>	<u>PRODUCTION HOLES</u>
TYPICAL COLUMN LOAD FOR AVE. 15' HOLE (MAX 20')		

VILLER OFFICE GROUP - 48-490

WHEN WRITING SNAP OUT PINK PART - SEND WHITE AND YELLOW PART

WHEN REPLYING SNAP AND RETURN YELLOW PART - RETURN WHITE PART AND FILE

PAGE 7 OF 7

PROPOSAL #9001

TO	MR. T. O'Donnell	FROM	K. JOE
	PCL CONSTRUCTORS	DEPT.	MCCAW'S DRILLING
	CUCHILLO DAM	DATE	JAN 5-1990
RE	BLASTING PROPOSAL - RIGHT ABUTMENT - DAM		
MESSAGE	<u>SCOPE & SEQUENCE</u>		
FOLD	- THIS PROPOSAL COVERS DRILLING & BLASTING ON		
	THE RIGHT ABUTMENT (LOOKING D/S) OF THE DAM		
	ABOVE EL. 4613		
FOLD	- THE PRE-SPLIT HOLES SHALL BE DRILLED ON		
	30" CENTERS (OR AS APPROVED BY THE CONTRACTING		
	OFFICER) AND BLASTED PRIOR TO THE START		
FOLD	OF PRODUCTION BLASTING		
	REPLY		
	- THE PRE-SPLIT HOLES WILL BE KEPT AT LEAST		
FOLD	50' IN ADVANCE OF THE PRODUCTION BLASTING		
	AT ALL TIMES		
	- THE SEQUENCE FOR PRODUCTION REACHING		
FOLD	SHALL BE FROM TOP TO BOTTOM AS SHOWN		
	ON PAGE (2) OF THIS PROPOSAL		
	- FOR DETAILS OF EXPLOSIVE PRODUCTS REFER TO		
FOLD	OUR APPROVED GENERAL BLASTING PROPOSAL.		
	K. JOE		

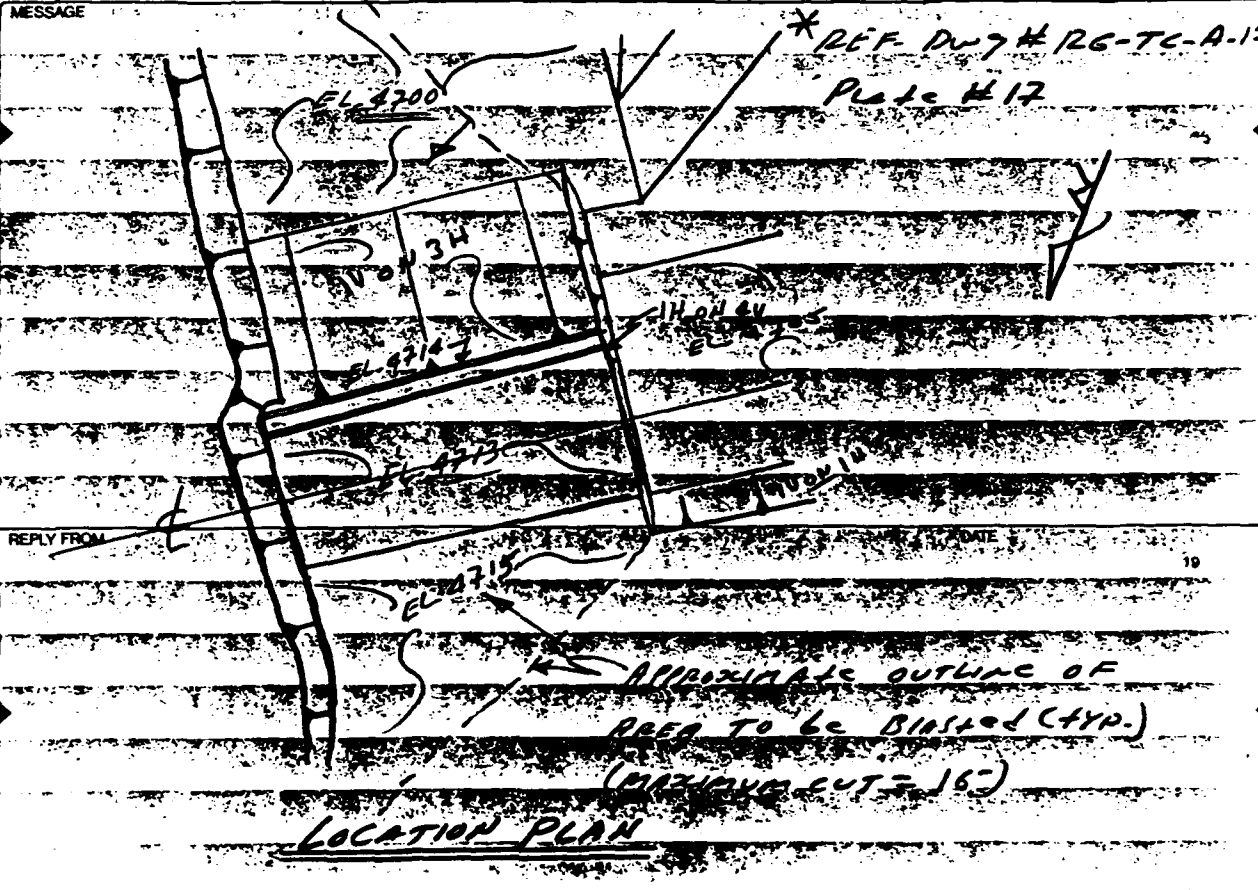
MILLER OFFICE GROUP - 400-9900

WHEN WRITING "SNAP OFF" PINK PART - SEND WHITE AND YELLOW PART

WHEN REPLYING "SNAP OFF" ON YELLOW PART - RETURN WHITE PART AND FILE

MEMO

FROM <i>K. JOE</i>		REPLY ☐ URGENT ☒ AS SOON AS POSSIBLE	
TO <i>MR. T. O'Donnell</i>		DATE <i>JAN 9-1990</i>	
PCL CONSTRUCTORS		SUBJECT <i>BLASTING PROPOSAL #900</i>	
Cuchillo Dam Project		AUXILIARY SPILLWAY	
POSTAL CODE			



SEEC

SENDER: KEEP PART 2 (YELLOW)

MEMO

RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO 9 AND 10 WINDOW ENVELOPES

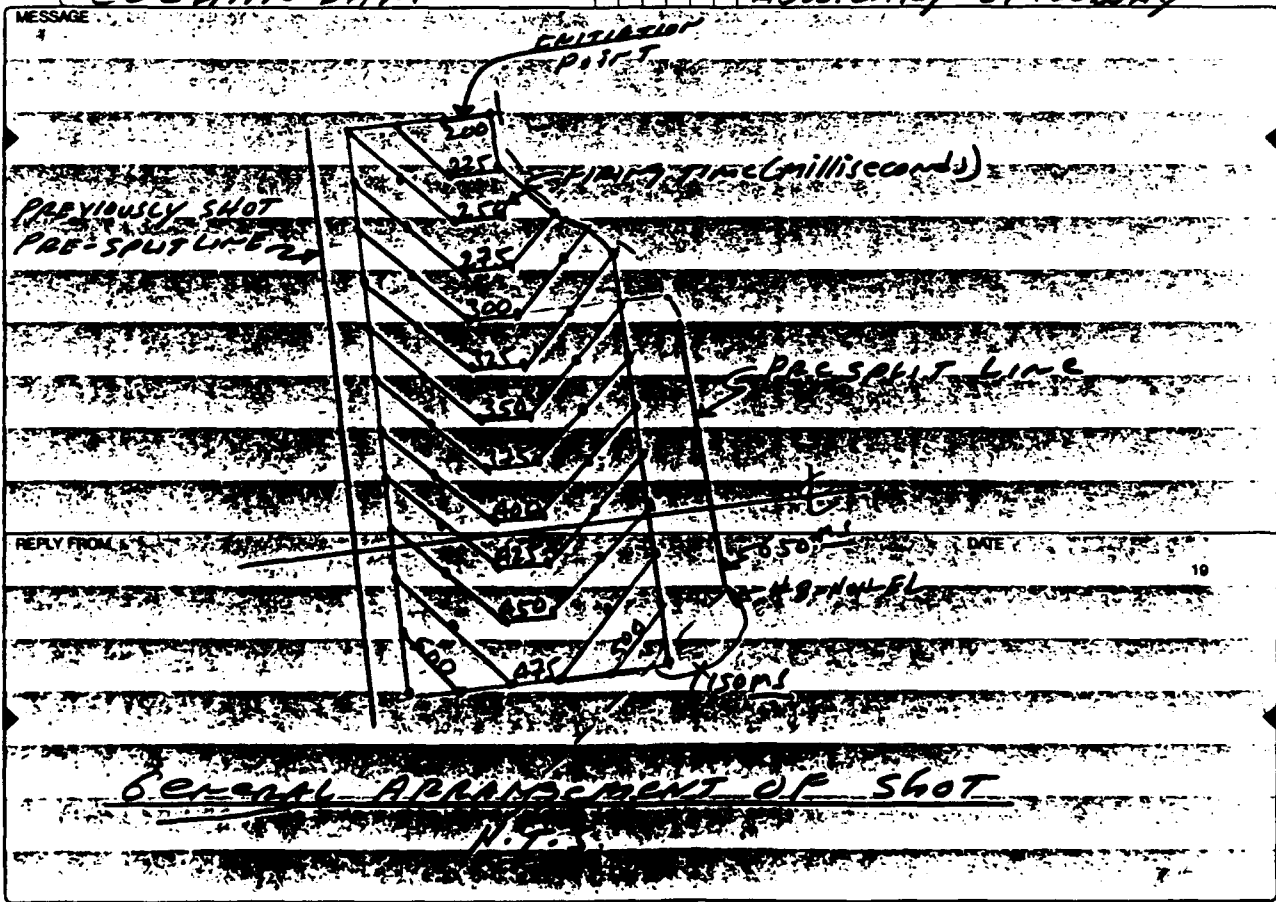
ALPHA OFFICE SYSTEMS



PAGE 2 of 3

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE: 845-3101 FAX: 845-6410

FROM K. JOE	REPLY URGENT ☐ AS SOON AS POSSIBLE ☒
TO MR. T. O'DONNELL PCL CONSTRUCTORS CUCHILLO DAM	DATE JAN 7/90
POSTAL CODE	SUBJECT BLASTING PROPOSAL # 90-04 AUXILIARY SPILLWAY



SENDER: KEEP PART 2 (YELLOW)

MEMO

RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO 9 AND NO. 10 WINDOW ENVELOPES

3277

ALPHA OFFICE SYSTEMS



PH 12 2-1 =

ROCKY MOUNTAIN HOUSE, ALBERTA, CANADA T0M 1T0
PHONE: 845-3101 FAX: 845-6410

FROM K. JOE	REPLY ☒ URGENT ☐ AS SOON AS POSSIBLE ☒
TO MR. T. O'DONNELL PCL CONSTRUCTORS CUCHILLA DAM	DATE JAN 9/90 SUBJECT BLASTING PROPOSAL H 90-04 AUXILIARY SPILLWAY
POSTAL CODE	



2 1/2" ϕ PRE-SPLIT HOLE
P.F. = 0.0766/5F

3" ϕ PRODUCTION HOLE
P.F. = 1.0066/5F

REPLY FROM

* PATTERN WILL VARY WITH DEPTH OF CUT BUT
IN ANY CASE SHALL NOT EXCEED 8'x8'-

* MAXIMUM LB. PER DELAY SHALL NOT EXCEED 250LB.

* FOR DETAILS OF EXPLOSIVE PRODUCT REFER TO
OUR APPROVED GENERAL PROPOSAL.

K. JOE

SENDER: KEEP PART 2 (YELLOW)	MEMO	RESPONDENT: RETURN PART 3 (PINK)
C C C C C C C C C C C C C C C C	C C C C C C C C C C C C C C C C	C C C C C C C C C C C C C C C C
THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES		ALPHA OFFICE SYSTEMS

Selected Blast Reports

PROJECT

*AS BOW

SHOT NO. 1

CONTRACT NO. DACW 47-89-C-0056		CONTRACTOR McCAUS Drilling	STATION AND RANGE 1435 (SPILLWAY) SOUTH OF E	WORK FEATURE PRE SPLIT
ROCK TYPE LIMESTONE		TOTAL POWDER LBS. 375 263	ROCK IN-PLACE S.F. 3100 S.F.	POWDER FACTOR 1.08 26.65 LBS/S.F.
LOADING START 10:30 AM		LOADING FINISH 2:30 PM	TIME AND DATE FIRED 3:00 PM DEC 14/89	SIGNATURE K. J. R.
WIND AND WEATHER SE @ 10 MPH - CLEAR		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES DRILL CUTTINGS ELKLE GRANUL				
STEMMING				
POWDER TYPE IDESPLIT-U		LBS. 375 263		
HOLES	SIZE	DEPTH		
60	2 1/2"	23' AVE.		
CAPS	LENGTH	EACH		
ONE NON-EL	6"			
MAX. POUNDS/DELAY 375 LBS - 263				
REMARKS, DAMAGE FLY ROCK, EVALUATION ROCK BROKE TO FREE FACE. SOME OVERSIZE				

STA 1435 (SPILLWAY)
CUT 35.0'

AUXILIARY SPILLWAY

4 VON 1H

12.5'

PRE SPLIT THIS AREA
2 1/2" Ø HOLES @ 24" C/C
DELAYMENT SHOULD BE INSTANTANEOUS

CUT 4.3'

PLAN (N.T.S.)

VARIOUS

EXPOSED ROCK FACE

1010

ROCK

SECTION (N.T.S.)

BLASTING REPORT

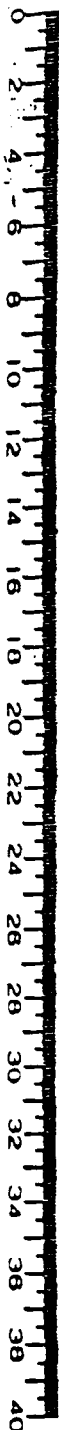
TYPICAL LOADED HOLE

E-COND DOWN HOLE - ...
HOLE TO HOLE ON SURFACE.
INITIATION BY NON-EL SYSTEM.

COLLAR 4' MINIMUM - EQUAL STAMMING
(MAY BE INCREASED TO SUIT FIELD CONDITIONS)
* ACTUAL COLLAR WAS 6' TO 8'

CONTINUOUS COLUMN LOAD
OF INSPLIT-D WITH E-COND TRACED
TO BOTTOM OF BORE HOLE.

~~165' OF HIGH EXPLOSIVE QUALITY AS~~
~~15' TO 11' HEAD~~
BOTTOM OF BORE HOLE



PRESPLIT

PRODUCTION
OR OTHER

BURDEN

24" c/c

FACING

"AS BUILT"

FOR TECHNICAL SPECS ON EXPLOSIVES
PRODUCTS REFER TO GENERAL BLASTING
PROPOSAL, SERIAL LETTER # 052/02219/2

SHOT NO. 11

LASTING REPORT

SHOT NO. 10

BLASTING REPORT

PROJECT

* AS BUILT

SHOT NO. 14

CONTRACT NO. DACW47-C-89-0056	CONTRACTOR McCAUS	STATION AND RANGE 2+43.7 TO 3+75	WORK FEATURE SPILLWAY-RT-SIDE DIS OF DAM P.A.
ROCK TYPE Limestone	TOTAL POWDER LBS. 925 LB.	ROCK IN-PLACE C. 1429 CY. 902 CY. 292 SY.	POWDER FACTOR See Notes Below
LOADING START 11:00AM	LOADING FINISH 2:45PM	TIME AND DATE FIRED JAN 24-90 3:30PM	SIGNATURE K-Joe

WIND AND WEATHER
Sunny - N15MPH

WATER IN HOLES
NIL

STEMMING
DRILL CUTTING

POWDER TYPE
IRRESPLT D
UNIMAX
2" X 8"
ANFO

LBS.
1000
500
1000
700

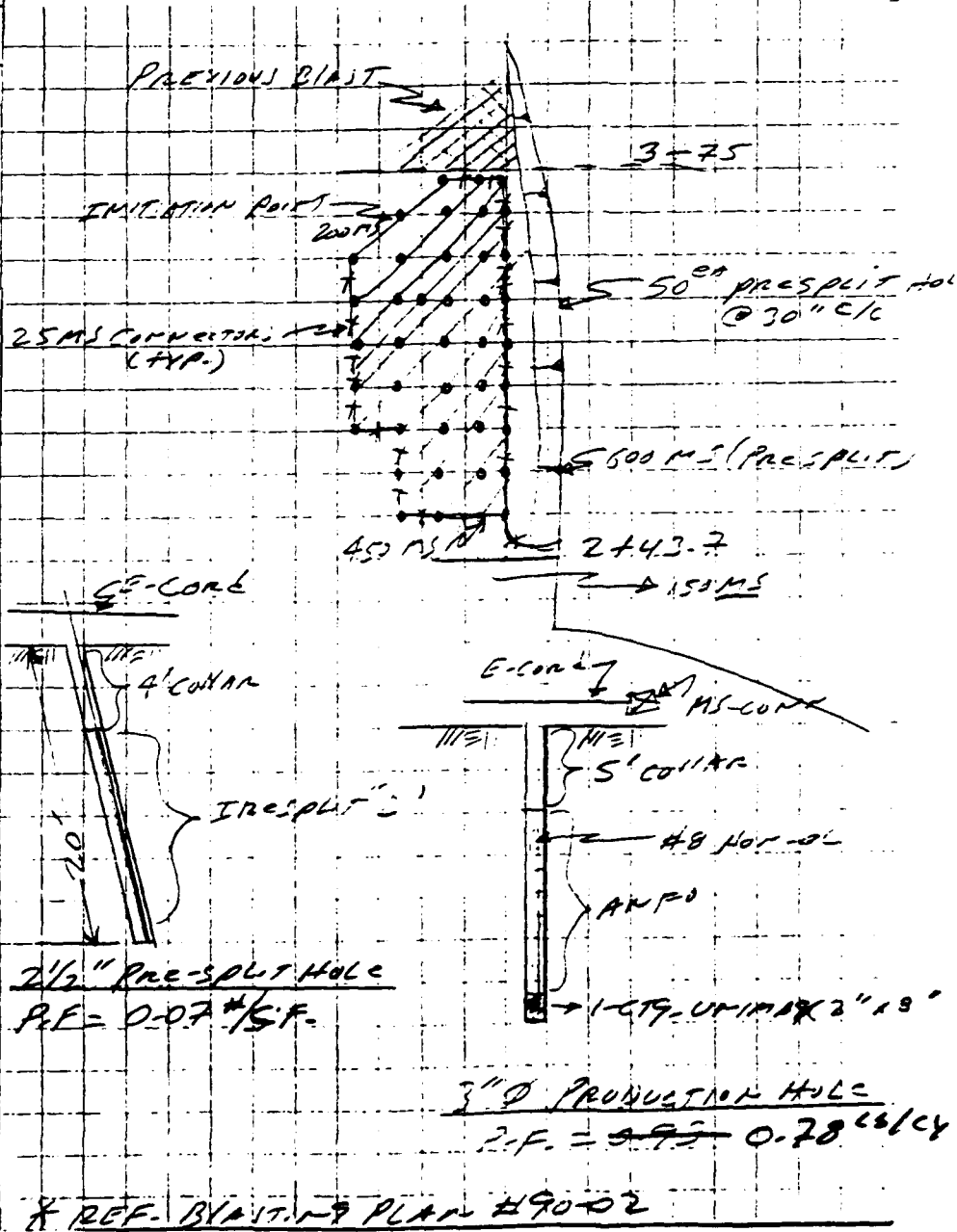
SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

HOLES	SIZE	DEPTH
50	2 1/2"	20'
40	3"	10' AVE.

CAPS	LENGTH	EACH
#8	20"	41

MAX. POUNDS/DELAY
180 LB.

REMARKS, DAMAGE
FLY ROCK, EVALUATION



BLASTING REPORT

PROJECT

SHOT NO. 18

CONTRACT NO. DAGW47C-89-0056	CONTRACTOR McLAW	STATION AND RANGE 4+26 line to 4+94 "C"	WORK FEATURE RT. Abutment keyway
ROCK TYPE Limestone	TOTAL POWDER LBS. 2450 1400	ROCK IN-PLACE C.Y. 1790 1063	POWDER FACTOR 1.20 1.32
LOADING START 2:00 PM	LOADING FINISH 5:00 PM	TIME AND DATE FIRED JAN 30-90 5:30 PM	SIGNATURE

WIND AND WEATHER
SUNNY-CALM

WATER IN HOLES
NIL

STEMMING
Drill Cutting

POWDER TYPE	LBS.
UNIMAX	150
2" x 9"	125
ANFO	200
	1275

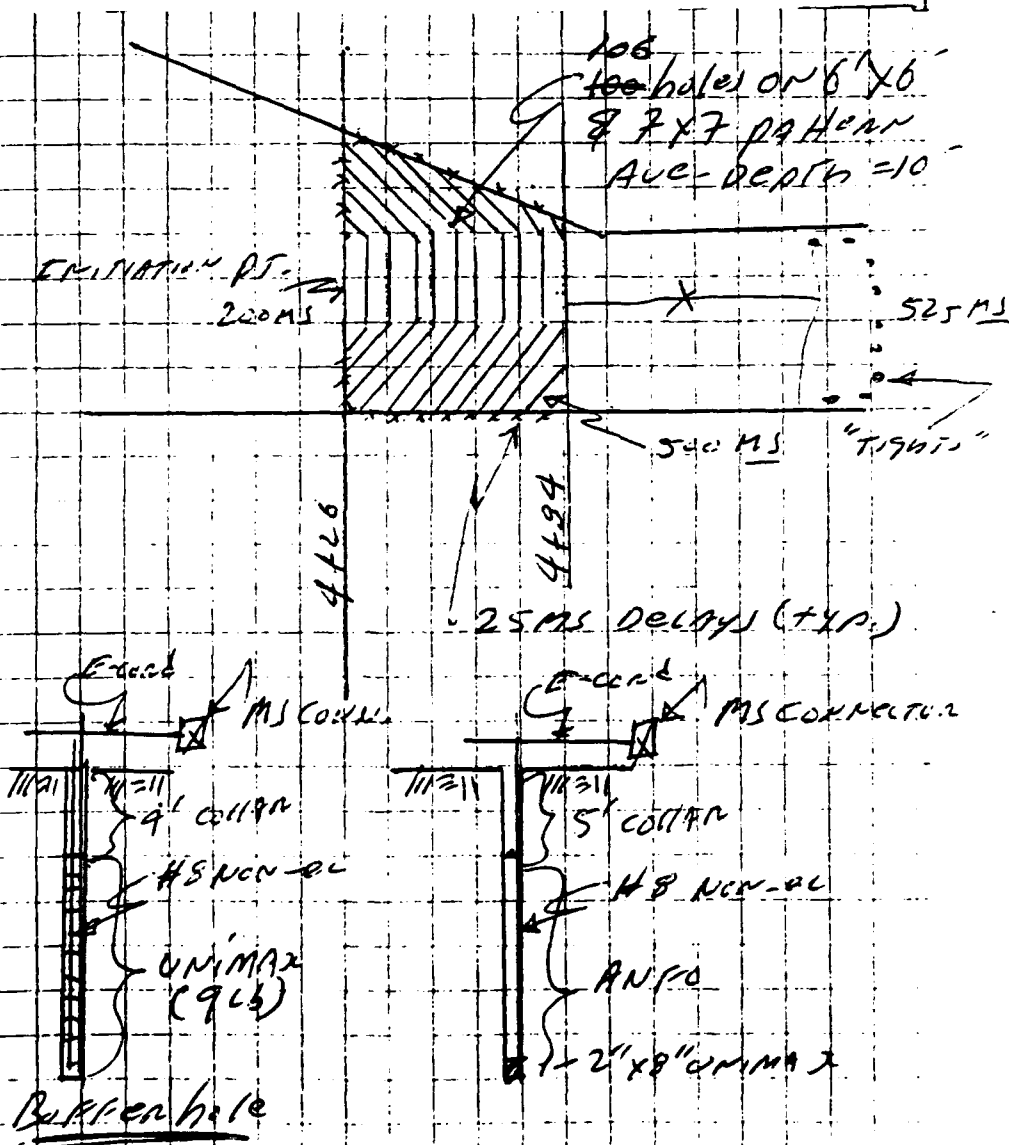
HOLES	SIZE	DEPTH
100	3"	10'
106		Ave

CAPS	LENGTH	EACH
#8	20'	107

MAX. POUNDS/DELAY
150 lbs

REMARKS, DAMAGE
FLY ROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

PROJECT

* H) 001-1

SHOT NO. ~~H-23~~ 23

CONTRACT NO. <i>JALW-476-37-20-5</i>	CONTRACTOR <i>M. CAN</i>	STATION AND RANGE <i>3475 TO 4235</i>	WORK FEATURE <i>RT. BENTONITE</i>
ROCK TYPE <i>LIME STONE</i>	TOTAL POWDER LBS. <i>2200 LB</i>	ROCK IN-PLACE C.Y. <i>1700 CY</i>	POWDER FACTOR <i>1.29 LB/CY</i>
LOADING START <i>1:00 PM</i>	LOADING FINISH <i>5:00 PM</i>	TIME AND DATE FIRED <i>FEB 6-90 5:35 PM</i>	SIGNATURE <i>[Signature]</i>

WIND AND WEATHER <i>SUNNY - CALM</i>	SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.	
WATER IN HOLES <i>N/A</i>		
STEMMING <i>DRILL CUT - 2'</i>		
POWDER TYPE		LBS.
<i>UNIMAX</i>		<i>150</i>
<i>2"x9"</i>	<i>1600</i>	
<i>ANFO</i>		

HOLES	SIZE	DEPTH
<i>120</i>	<i>3"</i>	<i>12"</i> <i>PJC</i>

CAPS	LENGTH	EACH
<i>#8</i>	<i>20"</i>	<i>60</i>
<i>#8</i>	<i>12"</i>	<i>60</i>

MAX. POUNDS/DELAY <i>120</i>
REMARKS, DAMAGE FLYROCK, EVALUATION

BLASTING REPORT

PROJECT

* HJ D01-1

SHOT NO. 27

CONTRACT NO. DACW-47-C-89-0055		CONTRACTOR MCCANN		STATION AND RANGE 2+40 +03+50 (+/-)		WORK FEATURE UPPER LEVEL OUTLET WORKS	
ROCK TYPE LAYARD SHALE & LIMESTONE		TOTAL POWDER LBS. 775 LB.		ROCK IN-PLACE C.Y. 160 CY 930 CY		POWDER FACTOR 0.18 LB/L.F. (PRE-SPLIT) 0.25 LB/L.F. (PRE-SPLIT) 0.25 LB/L.F. (PRODUCTION)	
LOADING START 8:00 AM		LOADING FINISH 12:00 Noon		TIME AND DATE FIRED FEB 12-90 12:30 PM		SIGNATURE K. Lee	
WIND AND WEATHER SUNNY-CALM		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB- DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.					
WATER IN HOLES NIL							
STEMMING DRILL CUTTING							
POWDER TYPE IRESPLIT "D" UNIGEL 2"X8" AIRFO		LBS. 75 50 LB. 150 LB.		40' x 2 1/2" PRE-SPLIT hole AT 12' depth 47° SLOPE INITIATION POINT			
HOLES 40 42		SIZE 2 1/2" 3"		DEPTH 12' 8' AVE		* INITIATION shall be "ROW BY ROW" because OF SIDEHILL SECTION (47° SLOPE) * THIS PROPOSAL IS FOR CUSHION BLASTING & IS PHASE (I) OF A PROPOSED TWO PHASE APPROACH TO THE UPPER LEVEL OUTLETWORKS BLASTING (See Sect. below)	
CAPS #8		LENGTH 12'		EACH 4		PHASE I PHASE II - PRE-SPLIT & PRODUCTION HOLES DRILLED @ 0.25 TO 1 SLOPE	
MAX. POUNDS/DELAY 200 LB.		BURDEN (IN DIRECTION OF FREE FACE) = 6.0 SPACING = 7.0					
REMARKS, DAMAGE FLY ROCK, EVALUATION		PHASE I PHASE II 47° (+/-) * PATTERN & DELAYMENT FOR PHASE II TO be determined AFTER PHASE I EXCAVATION IS COMPLETED.					

BLASTING REPORT

TYPICAL LOADED HOLE

PAGE 2 of 2



- EVERY 2ND PRE-SPLIT HOLE SHALL BE LOADED WITH A CONTINUOUS COLUMN LOAD OF IRESPLIT "D" TO A 40' COLLAR
- ALTERNATING PRE-SPLIT HOLES SHALL BE LOADED WITH TWO CARTRIDGES OF IRESPLIT "D" AS A TOE LOAD (1-24 LB)
- PRODUCTION HOLES SHALL BE PRIMED WITH A 2" X 9" CARTRIDGE OF UNIGEL & A COLUMN LOAD OF ANFO TO A 60' COLLAR

PRESPLIT

PRODUCTION
OR OTHER

BURDEN

PACING

G-104

CONTRACT NO. DREW-97-89-00056	CONTRACTOR McCaw	STATION AND RANGE 2+47 TO 3+07	WORK FEATURE Hwy Level OUTLET WORKS
ROCK TYPE Layered shale & lime stone	TOTAL POWDER LBS. 289 lb	ROCK IN-PLACE C.Y. 209 CY. 600 CY.	POWDER FACTOR 0.0525/3F-0.166/L-F. 0.4866/CY
LOADING START 1:00 PM	LOADING FINISH 3:00 PM	TIME AND DATE FIRED Feb 19-90 3:30 PM	SIGNATURE K. J. Lee

WIND AND WEATHER 10 MPS-South/Calm	SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.
WATER IN HOLES Nil	
STEMMING Drill Cuttings	
POWDER TYPE LBS. UNIMAX 92 lb 1 1/2" x 8" UNIGEL 150 lb 2" x 9" Inespit 94 lb	

HOLES	SIZE	DEPTH
20'	3"	15'
40	2 1/2"	15'

CAPS	LENGTH	EACH
#8	20'	22

MAX. POUNDS/DELAY 47 LB.
REMARKS, DAMAGE FLYROCK, EVALUATION Broke big min. fly wall looks OK.

20' PRE-SPLIT HOLES @ 36" C/C

150MS X 150MS 625MS X 150MS

50MS 525MS 50MS

200MS X 200MS

INITIATION POINT

THIS AREA SHOT PREVIOUSLY

20' PRE-SPLIT HOLES @ 36" C/C

240Z 340Z

Phase I

REF. SHOT PLAN #27

Phase II

5' 5' 5'

THIS ROW LOADED WITH 1 1/2" x 9" UNIMAX TO A 5' COLLAR

PRE SPLIT HOLES LOADED WITH INESPLIT TO A 6' COLLAR. EVERY 2ND HOLE LOADED WITH 3 CARTRIDGES OF INESPLIT AS A TIE LINE ONLY

BLASTING REPORT

SHEET NO. 38

G-106

PROJECT

SHOT NO. 42

CONTRACT NO. <u>DALW-476-89-0056</u>		CONTRACTOR <u>MCCAW</u>	STATION AND RANGE <u>477/6762</u>	WORK FEATURE <u>Production</u>
ROCK TYPE <u>LAYERED SHALE & LIMESTONE</u>		TOTAL POWDER LBS. <u>150 15466</u>	ROCK IN-PLACE C.Y. <u>1237 CY</u>	POWDER FACTOR <u>0.93</u>
LOADING START <u>10:00 AM</u>		LOADING FINISH <u>3:00 PM</u>	TIME AND DATE FIRED <u>MAR 20/90 3:45 PM</u>	SIGNATURE <u>K. 102</u>
WIND AND WEATHER <u>CALM / SUNNY</u>		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES <u>NIL</u>				
STEMMING <u>DRILL CUTTING</u>				
POWDER TYPE <u>UNIMAX 2" X 8" ANFO</u>				
LBS. <u>150 LB 1000 1346 LB</u>				
725MS				
4170				
6470				
HOLES	SIZE	DEPTH	— 127 HOLES ON A 5' X 5' PATTERN — 7' DEEP — PRODUCTION ONLY. DRILL TO EL 4622 (+/-)	
127	3"	7'		
CAPS	LENGTH	EACH		
#8	12'	128		
MAX. POUNDS/DELAY <u>74.2 LB.</u>			* P.F. = 1.25 LB/CY 3' COLUMN AREA 10.04 LB 1.079 UNIMAX 0.50 LB	
REMARKS, DAMAGE FLY ROCK, EVALUATION				
6006 FRAGMENTATION MIN. FLY.				

BLASTING REPORT

PROJECT

X AS BUILT

SHOT PLAN

SHOT NO. 45

CONTRACT NO. DACW 47-89-C-0056	CONTRACTOR MCCAUS	STATION AND RANGE 3400-5400 LT-SIDE LINE S	WORK FEATURE AUXILIARY SPILLWAY
ROCK TYPE Conglomerate (HARD)	TOTAL POWDER LBS. 3450-3650	ROCK IN-PLACE C.Y. 5357 CY ~~5173~~	POWDER FACTOR 0.67 0.68
LOADING START 10:00 AM	LOADING FINISH 5:15 PM	TIME AND DATE FIRED MARCH 29/90 5:40 PM	SIGNATURE K. J. R.
WIND AND WEATHER COOL-CLEAR		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB- DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.	
WATER IN HOLES NIL			
STEMMING DRILL CUTTING			
POWDER TYPE UNIMAX 1 1/2" X 8" ANFO	LBS. 250 300 3200 3350		
HOLES 338	SIZE 3"	DEPTH 8' AVE	
CAPS #8	LENGTH 12"	EACH 2	
MAX. POUNDS/DELAY 120			
REMARKS, DAMAGE FLY ROCK, EVALUATION Good Swell FACTOR. MINIMUM FLY			

BLASTING REPORT

PROJECT

April 11/12/97

SHOT NO. 51

CONTRACT NO. DACW 47-C-89-0056	CONTRACTOR McCAW DRILLING	STATION AND RANGE 2720 S AUXILIARY SPILLWAY	WORK FEATURE Production
ROCK TYPE HARD CONGLOMERATE ROCK	TOTAL POWDER LBS. 47.21 LBS	ROCK IN-PLACE C.Y. 60 CY	POWDER FACTOR 0.79 LBS/CY
LOADING START 7:30 AM	LOADING FINISH 8:30 AM	TIME AND DATE FIRED 8:40 AM April 13/97	SIGNATURE [Signature]

WIND AND WEATHER

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

WATER IN HOLES
NONE

STEMMING
DRILL CUTTINGS

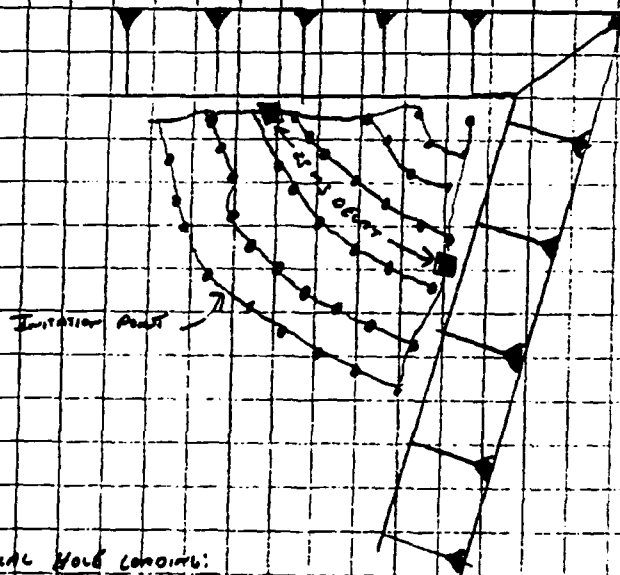
POWDER TYPE LBS.
UNIGEL 2x8 47.21

* BLAST TIGHTS AT AUXILIARY SPILLWAY
41 RANDOM HOLES

AVG LBS/HOLE 1.15 LBS/HOLE

HOLES SIZE DEPTH
41 3" 4.0' AVG

CAPS LENGTH EACH
25ms — 2



TYPICAL HOLE LOADING:

MAX. POUNDS/DELAY
23.1 LBS

REMARKS, DAMAGE
FLYROCK, EVALUATION

L. Tite Flyrock

BLASTING REPORT

PROJECT

Apr. 1 14/90 + 5 BLWIT

SHOT NO. 52

CONTRACT NO. DIACW 47-552056	CONTRACTOR MCCAW	STATION AND RANGE 2+90/4+10	WORK FEATURE PRESPLIT & PRODUCTION
ROCK TYPE Layered Shale & Limestone	TOTAL POWDER LBS. 1513 LBS.	ROCK IN PLACE C.Y. 586 SY. 1195 CY	POWDER FACTOR 0.94 LBS/CY 0.25 LBS/SF 0.25 LBS/FOOT
LOADING START 9:50 AM	LOADING FINISH 2:30 AM	TIME AND DATE FIRED 2:45 PM April 14/90	SIGNATURE <i>[Signature]</i>

WIND AND WEATHER

SUNNY

WATER IN HOLES

NIL

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

STEMMING

Drill Cuttings

POWDER TYPE	LBS.
UNIGEL	33 LBS.
2" x 8"	1130 LBS.
ANFO	350 LBS.
PRESPLIT D	350 LBS.

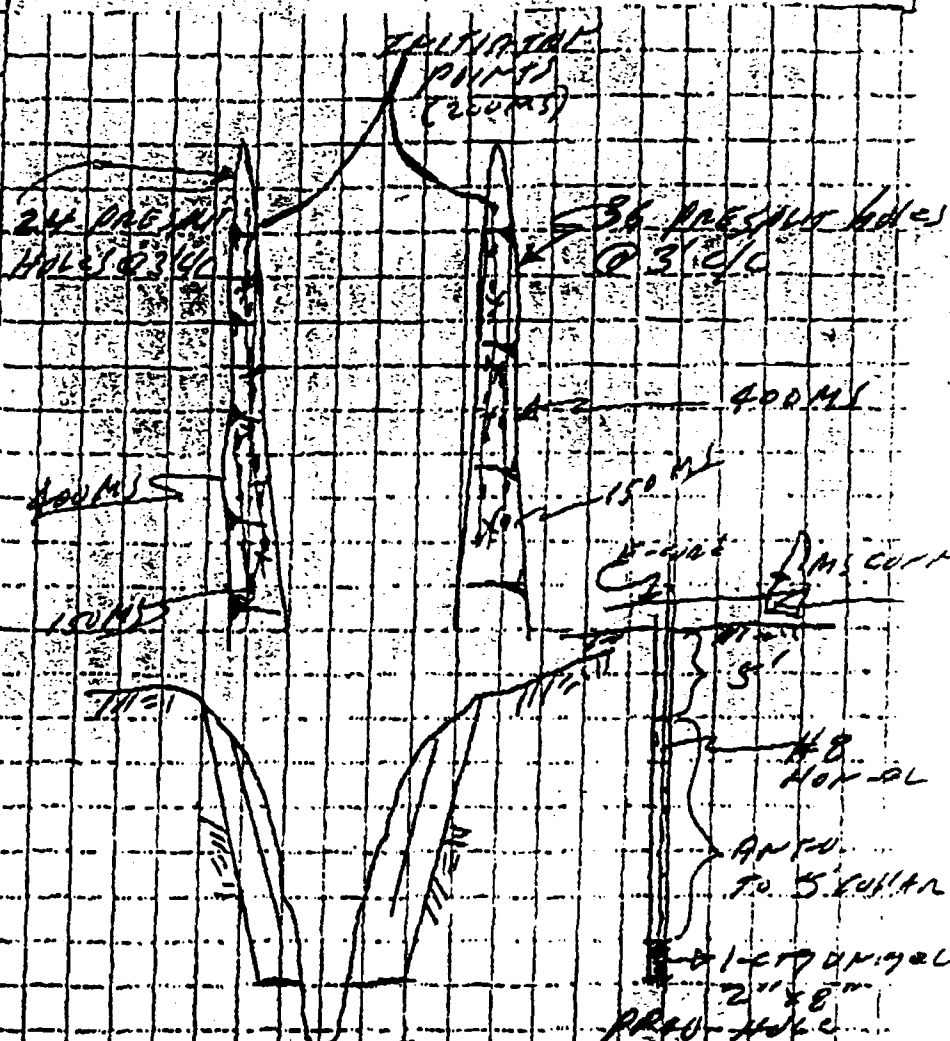
HOLES	SIZE	DEPTH
50	2 1/2"	30' AUG.
30	3"	20'

CAPS	LENGTH	EACH
#8	20'	30

MAX. POUNDS/DELAY
40.4

REMARKS, DAMAGE
FLY ROCK, EVALUATION

LITTLE Fly Rock
Good Breakage



TYPICAL SECTION

* PRE-SET Holes loaded with a continuous column load of PRESPLIT D to a 5' column

BLASTING REPORT

X AS BUILT

05/04/90

403 345 6410

MCCAW'S DRILLING

P. 01

PROJECT

May 4/90

SHOT NO. 57

CONTRACT NO. DRCW-42-C-89-0056	CONTRACTOR MCCAUS	STATION AND RANGE 1+37-2+25 LINE "D"	WORK FEATURE PRE-SPLIT & PRODUCTION Lt. Side
ROCK TYPE Layered Shale & Limestone	TOTAL POWDER LBS. 764	ROCK IN-PLACE C.Y. 313 SY. 782 CY	POWDER FACTOR 0.87 LBS/SA/0.20 LB/CY 0.73 LB/CY
LOADING START 8:00 AM	LOADING FINISH 12:00 Noon	TIME AND DATE FIRED May 7-90 12:30 PM	SIGNATURE

WIND AND WEATHER
SUNNY

WATER IN HOLES
NIL

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

STEMMING
Drill Cuttings

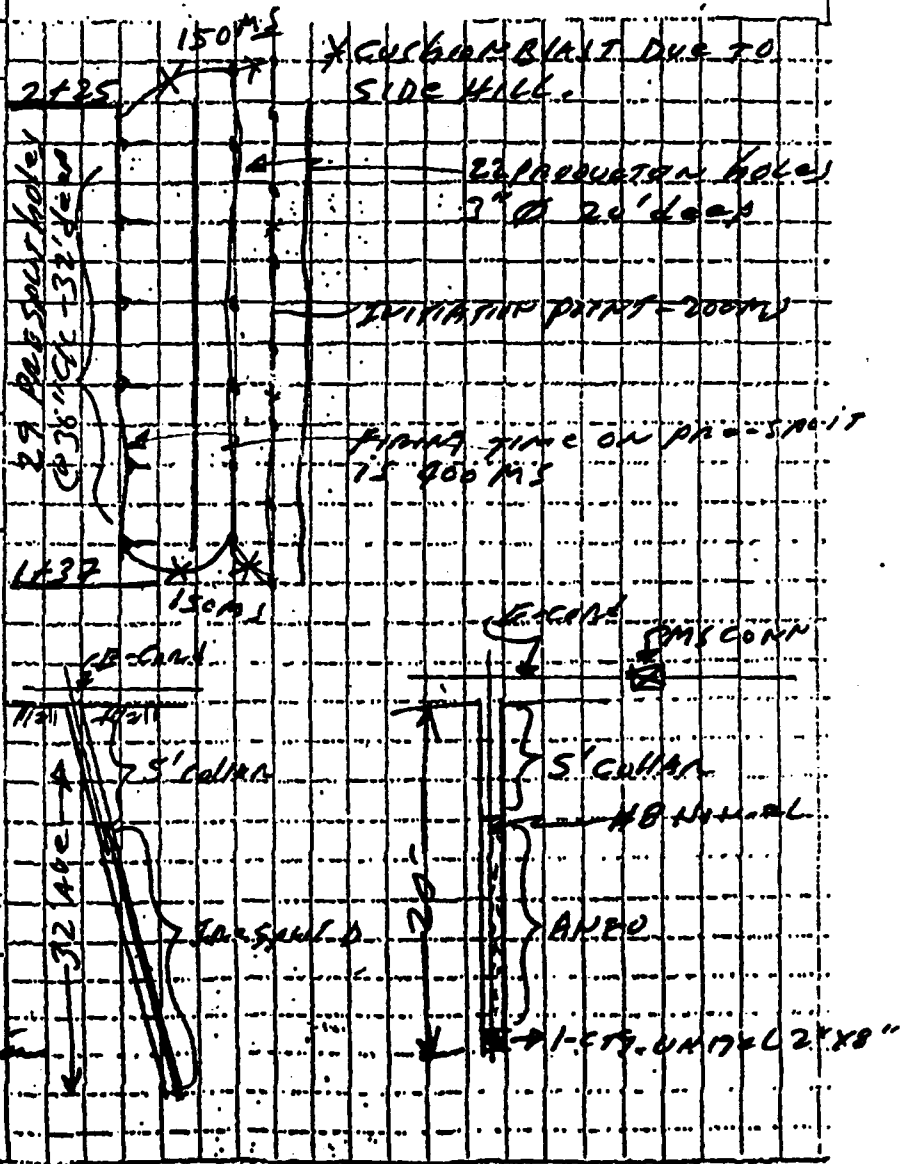
POWDER TYPE	LBS.
TRISULFID	190
ANFO	24
ANFO	350

HOLES	SIZE	DEPTH
29	2 1/2"	32'
22	3"	20'

CAPS	LENGTH	EACH
#8	20'	22

MAX. POUNDS/DELAY
190 LB - PRE-SPLIT

REMARKS, DAMAGE
TO ROCK, EVALUATION
Good
FRAGMENTATION



BLASTING REPORT

PROJECT

* HJ bu...

SHOT NO. 58

CONTRACT NO. <u>DACW47-95C-0056</u>	CONTRACTOR <u>McCAUS</u>	STATION AND RANGE <u>1400-2725</u> <u>LINE D</u>	WORK FEATURE <u>PRE-SPLIT</u> <u>SECONDARY BLASTING</u>
ROCK TYPE <u>LAYERED SHALE</u> <u>& LIMESTONE</u>	TOTAL POWDER LBS. <u>365 LB</u>	ROCK IN-PLACE C.Y. <u>408 CY</u> <u>375-694 CY</u>	POWDER FACTOR <u>0.25 LBS/L.F./0.08 LBS/CF</u> <u>1.65 LBS CY (600 LB)</u>
LOADING START <u>4:30 PM</u>	LOADING FINISH <u>6:30 PM</u>	TIME AND DATE FIRED <u>MAY 10-90</u> <u>7:00 PM</u>	SIGNATURE <u>[Signature]</u>

WIND AND WEATHER
0/CAST

WATER IN HOLES
NIL

STEMMING
Drill cutting

POWDER TYPE
IRCSPLIT D
UNFCL
2" x 8"

LBS.
304
6165

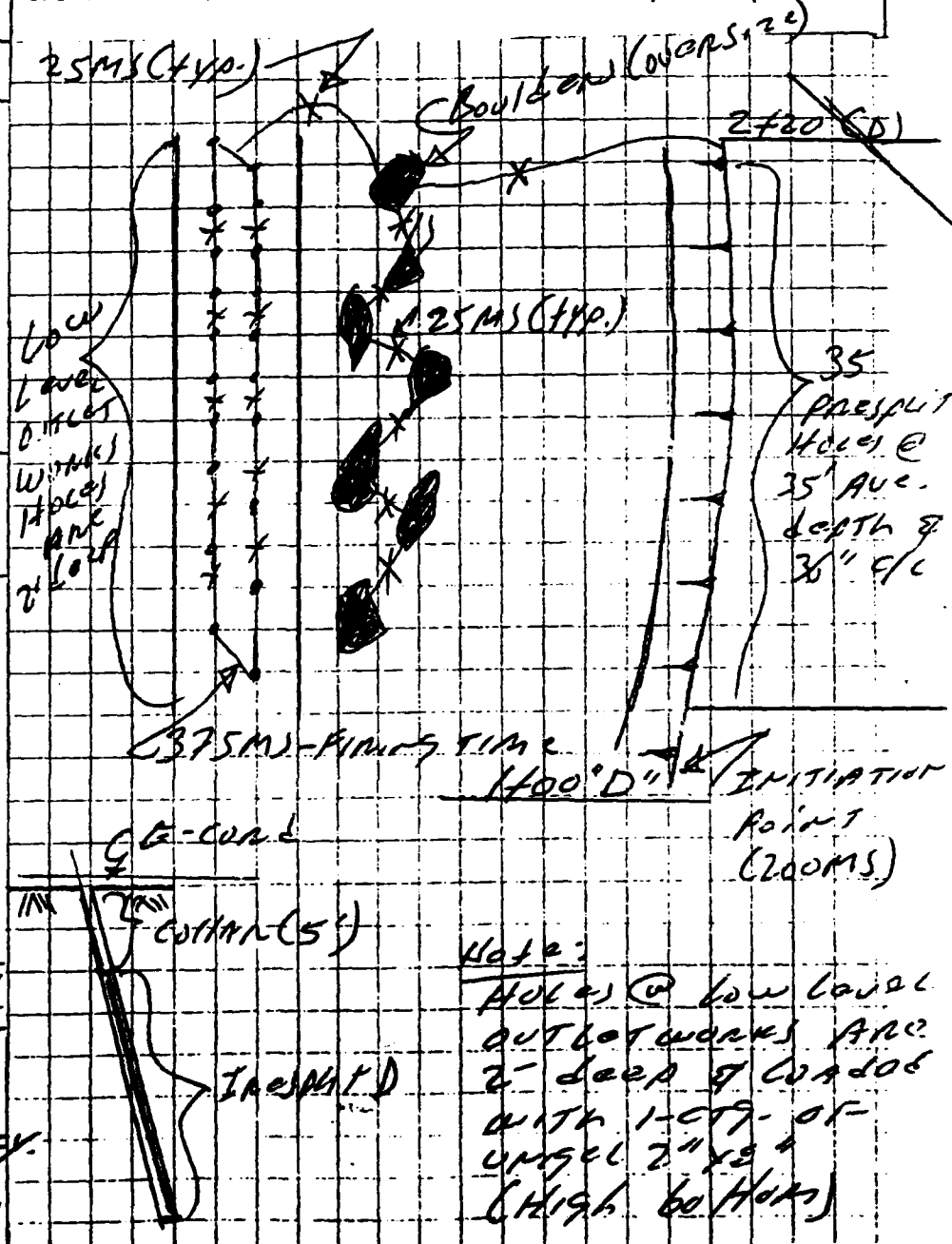
HOLES	SIZE	DEPTH
<u>20</u>	<u>2 1/2"</u>	<u>35'</u>
<u>35</u>	<u>2 1/2"</u>	<u>2'</u>

CAPS	LENGTH	EACH
<u>#8</u>	<u>12"</u>	<u>1</u>

MAX. POUNDS/DELAY
304 LB - Pre-split

REMARKS, DAMAGE
FLY ROCK, EVALUATION
6006 BREAKAGE
WALL LOOKS O.K.
ESTIMATED 694 CY
BRONER WITH
PRE-SPLIT HOLES

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS;
PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-
DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



* LAST PRODUCTION BLAST. BLASTING REPORT

PROJECT

June 11 1990

SHOT NO. 65

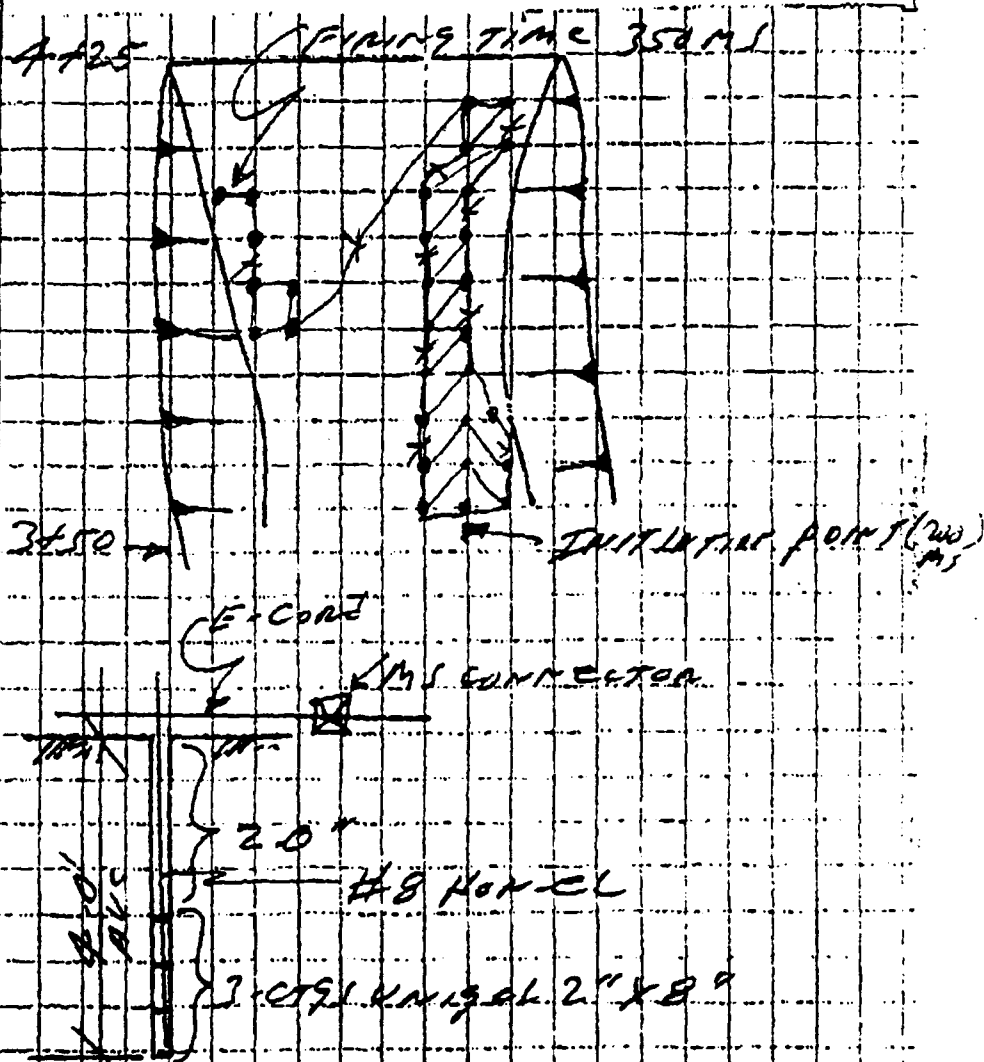
CONTRACT NO. DACW-47-89C-0056	CONTRACTOR MCCAW	STATION AND RANGE 3+50-4+25 LINE "D"	WORK FEATURE PRODUCTION
ROCK TYPE Limestone	TOTAL POWDER LBS. 10065	ROCK IN-PLACE C.Y. 160	POWDER FACTOR 0.635/4
LOADING START 5:00	LOADING FINISH 7:00	TIME AND DATE FIRED June 11 1990 7:30 PM June 11 1990	SIGNATURE [Signature]

WIND AND WEATHER
SUNNY

WATER IN HOLES
N/A

STEMMING
DRILL CUTTING
POWDER TYPE LBS.
Unigol 10065
2" x 8" Unigol 15065
OFFO 50065

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



HOLES	SIZE	DEPTH
30	3"	4' ALU

CAPS	LENGTH	EACH
31	12'	H8
61	12'	H8

MAX. POUNDS/DELAY
2065

REMARKS, DAMAGE
FLY ROCK, EVALUATION
Good No
No Fly Rock

BLASTING REPORT

PROJECT

HS Bu 17

June 16, 1990

SHOT NO. 68

CONTRACT NO. DACW-47-85-C-0056		CONTRACTOR McCAWS		STATION AND RANGE 1425-2725 LINED		WORK FEATURE PRODUCTION	
ROCK TYPE Limestone		TOTAL POWDER LBS. 500		ROCK IN-PLACE C.Y. 558		POWDER FACTOR 0.90	
LOADING START 2:00		LOADING FINISH 4:00		TIME AND DATE FIRED June 17, 1990 4:30		SIGNATURE [Signature]	
WIND AND WEATHER SUNNY		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.					
WATER IN HOLES NIL							
STEMMING DRILL CUTTING							
POWDER TYPE LBS. UN9AL 110 2" X 3" ANFO 390							
HOLES 100	SIZE 3"	DEPTH 6' AVE					
CAPS #8	LENGTH 12'	EACH 101					
MAX. POUNDS/DELAY 3065-							
REMARKS, DAMAGE FLY ROCK, EVALUATION							

BLASTING REPORT

PROJECT

12/4/90

SHOT NO. 037 - #3

CONTRACT NO. DACW 47-89-C0056	CONTRACTOR McCaw	STATION AND RANGE 3+20 - 3+40	WORK FEATURE PRE-SPLIT
ROCK TYPE LIMESTONE	TOTAL POWDER LBS. 20.41	ROCK IN-PLACE C.Y. 55.6 SY.	POWDER FACTOR 0.3715 - SY. 0.0815 - L.F.
LOADING START 2:30 10-15	LOADING FINISH 11:00	TIME AND DATE FIRED 2:02 Dec 4/90	SIGNATURE <i>[Signature]</i>

WIND AND WEATHER

SUNNY

WATER IN HOLES

NIL

STEMMING

DRILL CUTTING

POWDER TYPE

LBS.

GOLMAX
1 1/2" X 16"

14.7

200 GRAIN
CORD

5.71

HOLES

SIZE

DEPTH

10

2 1/2"

25'

CAPS

LENGTH

EACH

#1

24'

ONE

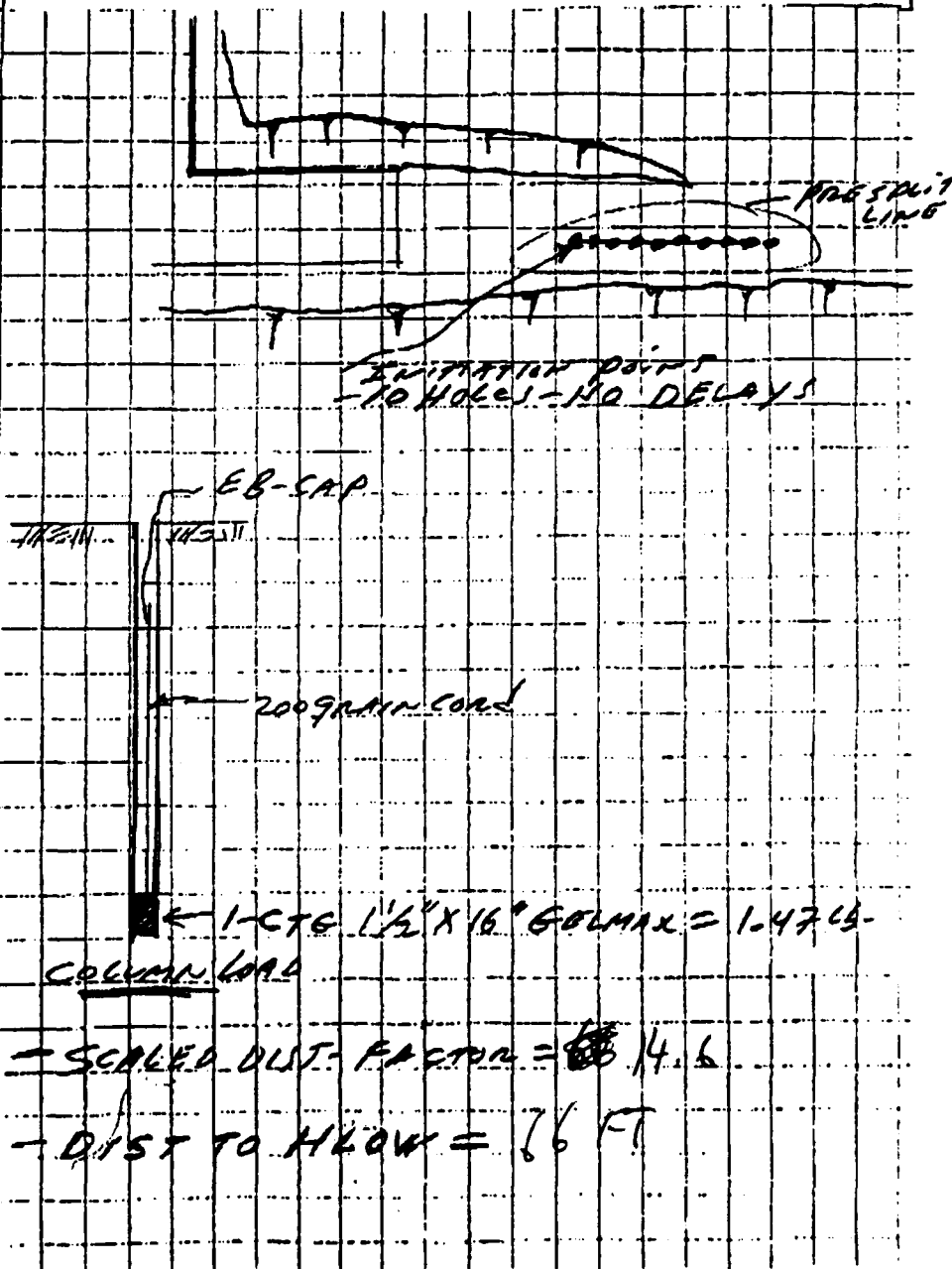
MAX. POUNDS/DELAY

20.41

REMARKS, DAMAGE
FLY ROCK, EVALUATIONNO FLY ROCK
MATED.

VIBES. OK

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS;
PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-
DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

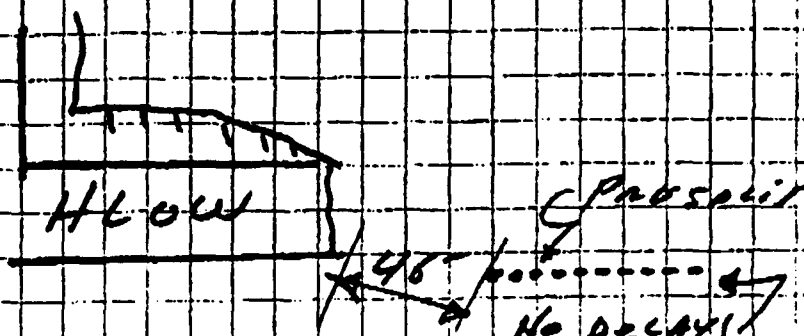
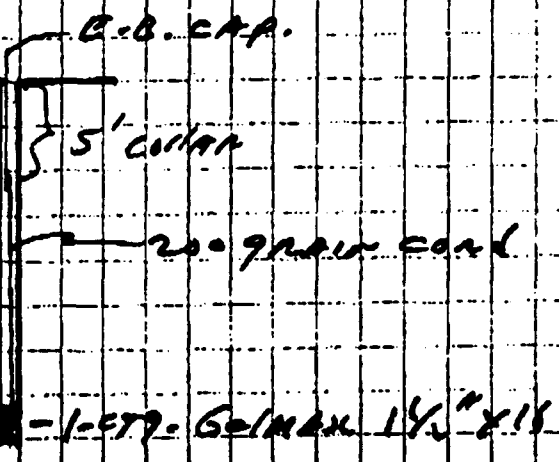


BLASTING REPORT

PROJECT

770 P411
12/6/90

SHOT NO. C37-5

CONTRACT NO. <u>DAW4749-C-0-56</u>		CONTRACTOR <u>McCAW</u>	STATION AND RANGE <u>3500 3120</u>	WORK FEATURE <u>PROSALIT</u>
ROCK TYPE <u>LIMESTONE</u>		TOTAL POWDER LBS. <u>20.41</u>	ROCK IN-PLACE C.Y. <u>27.85Y.</u>	POWDER FACTOR <u>0.08 # S.F.</u> <u>= 0.08 # L.F.</u>
LOADING START <u>10:30</u>		LOADING FINISH <u>12:00</u>	TIME AND DATE FIRED <u>2:20 PM</u> <u>12/6/90</u>	SIGNATURE <u>[Signature]</u>
WIND AND WEATHER <u>Sunny</u>		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES <u>NIL</u>				
STEMMING <u>DRILL CUTTINGS</u>		<u>DIST. TO STRUCTURE @ R.I.C. = 45'</u> <u>SCALED DIST. FACTOR = 10.18</u>		
POWDER TYPE LBS. <u>1 1/2" x 16" 14.7</u> <u>GoMAX</u> <u>200 grain 5.71</u> <u>cord</u>				
HOLES	SIZE	DEPTH		
<u>10</u>	<u>2 1/2"</u>	<u>25'</u>		
CAPS	LENGTH	EACH		
<u>1</u>	<u>24</u>	<u>1</u>		
MAX. POUNDS/DELAY <u>20.41</u>				
REMARKS, DAMAGE FLYROCK, EVALUATION <u>min Fly Rock</u>		<u>1- CAP = 2.30 ohms</u> <u>100' wire = 0.64 ohms</u> <u>TOTAL = 2.94 ohms</u>		

BLASTING REPORT

12/11/90

UNIT NO.

CONTRACT NO. DPR 97-05-C005	CONTRACTOR McCAUS	STATION AND RANGE 2+40/2+60 (+/-)	WORK FEATURE PRE-SPLIT PRODUCTION
ROCK TYPE LIMESTONE	TOTAL POWDER LBS. ~~750~~ 804	ROCK IN-PLACE C.Y. 233 CY. 56 SY.	POWDER FACTOR 0.055 lb/cy 0.046 lb/cy = 0.08 lb/cy
LOADING START 8:00 AM	LOADING FINISH 10:30 AM	TIME AND DATE FIRED 12-13-90 11:05 AM	SIGNATURE K. J. [Signature]
WIND AND WEATHER HIGH OVERCAST	SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES NIL			
STEMMING DRILL CUTTING	SCALED DIST. FACTOR = 2.05		
POWDER TYPE 2" X 16" 50.5 GELMAX 75.0 1 1/2" X 16" 14.7 GELMAX 2009 AIR COND 5.71 lb			
HOLES 10 2 1/2" 25' 7 3" 25'			
CAPS LENGTH EACH 1 24" 1 2 3 4 105 116 127 138 149 10 24" 1 16 24" 1 20 24" 1			
MAX. POUNDS/DELAY 10-21			
REMARKS, DAMAGE FLY ROCK, EVALUATION NO FLY ROCK POOR PARTICLES VELOCITY = V = 8.19 T = 1.84 T = 2.13			

0 APPARENT DAMAGE
0 EXISTING STRUCTURE

BLASTING REPORT

PROJECT

AS B4117.

SHEET NO. 2710

CONTRACT NO. DACW 47-59-C-0056	CONTRACTOR McCaw	STATION AND RANGE 2400-2400	WORK FEATURE PRE-SPLIT
ROCK TYPE Limestone	TOTAL POWDER LBS. 3366	ROCK IN PLACE C.Y. 178 CY 675 Y	POWDER FACTOR 0.19 LBS/FT. 0.05 LBS/SF = 0.08 LBS/
LOADING START 11:00 AM	LOADING FINISH 12:30	TIME AND DATE FIRED 200 2-90	SIGNATURE K. J. [Signature]
WIND AND WEATHER Sunny	SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES NIL			
STEMMING SAND	SCALED DIST. FACTOR = 5.58		
POWDER TYPE	SERIES RESISTANCE = 3742 GMS		
1 1/2" x 16" 14.7			
Gelmax			
1" x 8" 4.8			
Gelmax			
200 GRAIN COND 4.57			
HOLES	SIZE	DEPTH	
16	2 1/2"	25'	
CAPS	LENGTH	EACH	
1-16	24"	1	
REMARKS: DAMAGE FLY ROCK, EVALUATION			
NOFLY Good			
Bret Mayo			

1 1/2" x 16" 14.7
 Gelmax
 1" x 8" 4.8
 Gelmax
 200 GRAIN COND 4.57

HOLE #
 400MS 25MS
 PRE-SPLIT DRILL @ 18" C/C

C.B. CAP
 STAND STEMMING
 BURRER PLUG
 1-CTG. OF 1" x 8" GELMAX
 E-COLS
 10' OF 200 GRAIN COND
 1-CTG. 1 1/2" x 16" GELMAX
 PRE-SPLIT HOLES = 25' DEEP

BLASTING REPORT

PROJECT

11

SHOT NO. 5-3710

CONTRACT NO. DRCW 4789C-0056	CONTRACTOR MCCAW	STATION AND RANGE 1400-1440	WORK FEATURE production
ROCK TYPE limestone	TOTAL POWDER LBS. 50	ROCK IN-PLACE C.Y. 148 cy.	POWDER FACTOR 0.34 lb/cy.
LOADING START 16:30 hr	LOADING FINISH 1:00 pm	TIME AND DATE FIRED 01-03-91 2:10 pm	SIGNATURE K. [Signature]

WIND AND WEATHER

SUNNY

WATER IN HOLES

NIL

STEMMING

DRILL CUTTINGS

POWDER TYPE

2" X 16"
Gelmax

LBS.

50

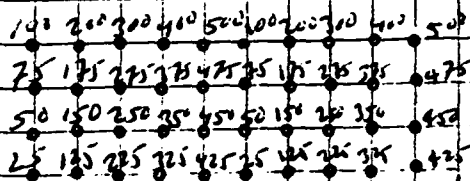
SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS;
PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-
DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

SCALED DRIFT FACTOR = 14-31

H.C.O.W.

HOLES	SIZE	DEPTH
40	3"	4'

CAPS	LENGTH	EACH
40	24'	1-20



Sens #1

Sens #2

$$\text{RESISTANCE} = \frac{20 \times 2.3}{2} + \frac{100}{1000} \times 64 = 23.64 \text{ ohms}$$

E-B-CAP

40" collar (stemmed)

MAX. POUNDS/DELAY

515

REMARKS, DAMAGE
FLY ROCK, EVALUATION

1/2 CTG 2" X 16" Gelmax

X MET BLAST ON 2ND Bench - G37

BLASTING REPORT

CONTRACT NO. DALW4789C0056		CONTRACTOR MCCAW'S		STATION AND RANGE 2+00-2+35		WORK FEATURES PRODUCTION PROSPLIT	
ROCK TYPE LIMESTONE		TOTAL POWDER LBS. 58.84		ROCK REPLACEMENT 75% 16.5%		POWDER FACTOR	
LOADING START 1:00		LOADING FINISH 2:30		TIME AND DATE FIRED 4:50 PM 11/11/91		SIGNATURE <i>[Signature]</i>	
WIND AND WEATHER		SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.					
WATER IN HOLES N/A							
STEMMING DRILL CUTTING							
POWDER TYPE LBS. 1 1/2" x 16" 8.8 60/1 MAX 2" x 16" 50.04 60/1 MAX							
HOLES SIZE DEPTH 40 3" 4' 20 2 1/2" 4'							
CAPS LENGTH EACH 1-20 24" 3		RESULTS: BOX 2-3 1.64 v. 46.64 chms 3					
MAX. POUNDS/DELAY 2.566		REMARKS, DAMAGE TO ROCK, EVALUATION Reading 944. NO FLY ROCK PROSPLIT PROD					

BLASTING REPORT

PROJECT

1/14/91

SHOT NO. 6-37-24

CONTRACT NO. DACW4787C0056	CONTRACTOR MCCAW'S	STATION AND RANGE 3750 +0 3775	WORK FEATURE PRODUCTION PRO SPLIT
ROCK TYPE LIMESTONE	TOTAL PORDER LBS. 32.54 LB.	ROCK SURFACE C.Y. 51 CY 45Y	POWDER FACTOR 0.64 LB-CY. 0.42 LB-SP 2.11 LB/LF
LOADING START 230	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE K. Soe

WIND AND WEATHER

WATER IN HOLES

NIL

STEMMING

DRILL CUTTINGS

POWDER TYPE

LBS.

14x8"

3.13 LB.

60 MAX

1 1/2 x 16"

4.41 LB.

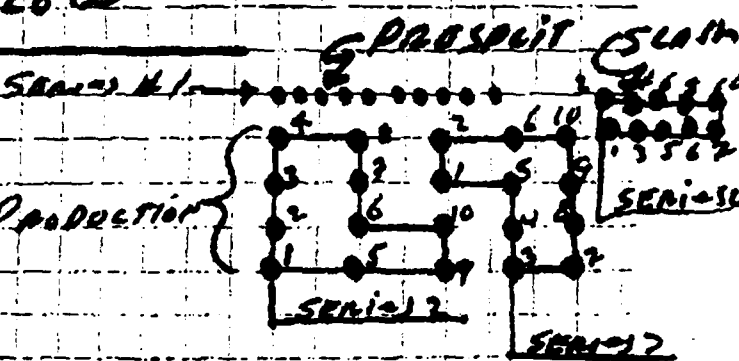
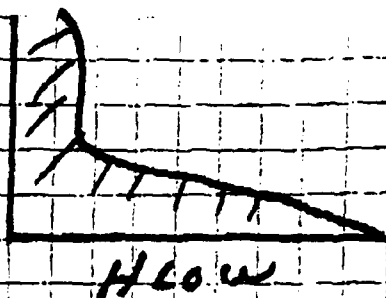
60 MAX

2" x 16"

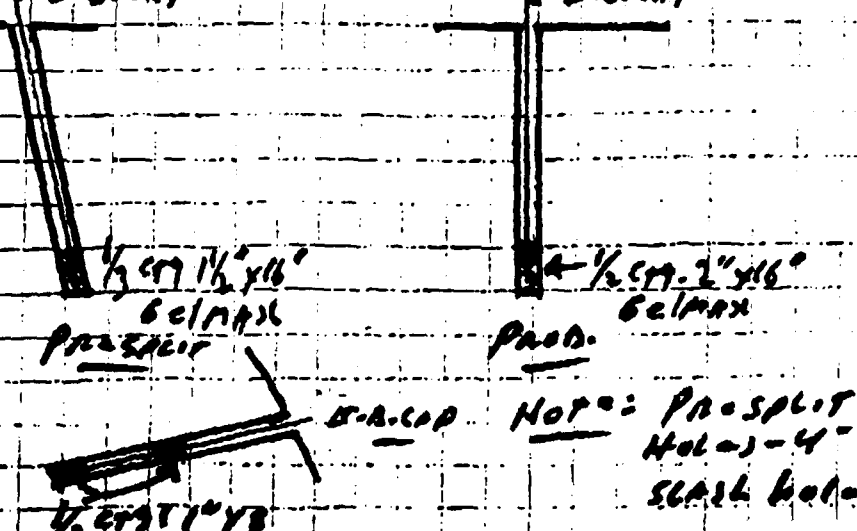
25 LB.

60 MAX

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS;
PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-
DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



RESISTANCES - 10x2.3 1.64-6.29 ohms



BLASTING REPORT

PROJECT

1/16/91

SHOT NO. 5127

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW 4789C0056	MCCAWS	2+60 TO 3400	PRODUCTION PRUSPLIT
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN PLACE C.Y.	POWDER FACTOR
LIMESTONE	3765	57 CY 7 SY.	0.8566-CY. 0.0745 SF = 0.1116/1
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
900	11:00	1150 AM 1/17/91	[Signature]
WIND AND WEATHER	SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.		
WATER IN HOLES	HIL		
STEMMING	DRILL CUTTINGS		
POWDER TYPE	-SS-		
1 1/2" x 16"	29.5		
6ELMAX			
2" x 16"	30		
6ELMAX			
HOLES	SIZE	DEPTH	
16	2 1/2"	4'	
24	3"	4'	
CAPS	LENGTH	EACH	
H12	24	2	
H16	24	1	
1-S	24	1	
MAX. POUNDS/DELAY	2.5		
REMARKS: DAMAGE FLY ROCK EVALUATION			
NO Reading			
FLY ROCK			
NO mats			

BLASTING REPORT

Seismograph Records and Selected Readouts



PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

DEC 5 1990

December 3, 1990

Serial Letter No.: 543/FAR 52.243/4

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
I or C, NM

Subject: Change Item No. 24: Remove Differing Site Condition Material
Corps File No. "C-37"
Seismograph Calibration Certificates

Gentlemen:

Enclosed please find copies of the Certificates of Calibration for the three (3) seismographs presently being employed in the prosecution of the aforesaid subject change.

Should any questions arise concerning this above please contact the undersigned at this office.

Sincerely,

Thomas R. O'Donnell
Project Manager

Certificate of Calibration

This certifies that this instrument has been calibrated according to methods established by Thomas Instruments Inc., and that the results are consistent with the specifications published regarding the instrument. Details regarding the calibration methods are available upon request. Thomas Instruments Inc. also recommends that this instrument be calibrated every twelve months to ensure the accuracy of measurements.

Test Equipment Utilized in Calibration

Bruel & Kjaer Uni-Gain Accelerometer Type 4370
Bruel & Kjaer Charge Amplifier Type 2635
Bruel & Kjaer Vibration Exciter Type 4809
Bruel & Kjaer Power Amplifier Type 2706
Bruel & Kjaer Pistonphone Type 4220
B & K (Dynascan Corp) Sweep Function Generator
Type 3030
Leader Digital Counter LDC-824S

S/N 1319148
S/N 1339766
S/N 1342915
S/N 1353929
S/N 1297540
S/N 46-23822
S/N 7090109

Instrument Model Number: VMS-500

Instrument Serial Number: V5-0250059

Joseph A. White
TECHNICIAN

25 JULY 1990

DATE

THOMAS
INSTRUMENTS INC.

SPOFFORD, NH 03462

Certificate of Calibration

This certifies that this instrument has been calibrated according to methods established by Thomas Instruments Inc., and that the results are consistent with the specifications published regarding the instrument. Details regarding the calibration methods are available upon request. Thomas Instruments Inc. also recommends that this instrument be calibrated every twelve months to ensure the accuracy of measurements.

Test Equipment Utilized in Calibration

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Bruel & Kjaer Charge Amplifier Type 2635
Bruel & Kjaer Vibration Exciter Type 4809
Bruel & Kjaer Power Amplifier Type 2706
Bruel & Kjaer Pistonphone Type 4220
B & K (Dynascan Corp) Sweep Function Generator
Type 3030
Leader Digital Counter LDC-824S

S/N 1319148
S/N 1339766
S/N 1342915
S/N 1353929
S/N 1297540
S/N 46-23822

S/N 7090109

Instrument Model Number: VMS-500

Instrument Serial Number: V5-I079008

Douglas E. White
TECHNICIAN

12 FEBRUARY 1990

DATE



SPOFFORD, NH 03462

Certificate of Calibration

This certifies that this instrument has been calibrated according to methods established by Thomas Instruments Inc., and that the results are consistent with the specifications published regarding the instrument. Details regarding the calibration methods are available upon request. Thomas Instruments Inc. also recommends that this instrument be calibrated every twelve months to ensure the accuracy of measurements.

Test Equipment Utilized in Calibration

Bruel & Kjaer Uni-Gain Accelerometer Type 4370

Bruel & Kjaer Charge Amplifier Type 2635

Bruel & Kjaer Vibration Exciter Type 4809

Bruel & Kjaer Power Amplifier Type 2706

Bruel & Kjaer Pistonphone Type 4220

B & K (Dynascan Corp) Sweep Function Generator
Type 3030

Leader Digital Counter LDC-824S

Instrument Model Number: VMS-500

Instrument Serial Number: V5-L069020

D. J. P. 5/15/90
TECHNICIAN

15 JUNE 1990

DATE

S/N 1319148
S/N 1339766
S/N 1342915
S/N 1353929
S/N 1297540
S/N 46-23822

S/N 7090109



SPOFFORD, NH 03462



Reference:

SEISMOGRAPH READINGS
BLAST C-37-3

Date: 11-04-90

By: K.J.

Sheet 1 of 1

ATT. J. MICHAELS
PCL CONSTRUCTIONS

SEISMOGRAPH RESULTS - BLAST C-37-3

(1) LOW LEVEL OUTLET WORKS
- MACHINE DID NOT TRIGGER

(2) HLOW - CONCRETE

PEAK VECTOR SUM - VIBRATION = 0.30" per Sec.

ENERGY RATIO - VERTICAL = .000216

" " - TRANSVERSE = .00006

" " - RADIAL = .00003

(3) HLOW - 6' FROM PROSPER LINE

- PEAK VECTOR SUM - VIBRATION = 7/23 mm/sec = 2.79 in./sec

ENERGY RATIO - VERTICAL = 0.0001

" " - TRANSVERSE = 0.0200

" " - RADIAL = 0.0300

PLEASE ATTACH TO SEISMOGRAPH PRINTOUTS
& FORWARD TO CONTRACTING OFFICE.

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .0029 psi 120 db
RECORD TIME: 2 second(s)

TRIGGERED at 14:01:09 12-04-1990

MEASUREMENTS

U	F	R
PPV, (in/s)	.25	.11
TIME (ms)	.3	.04
FREQ (Hz)	17	14
PPAL (g)	2.74	2.46
		.93

PUS (in/s) .3 (33 ms)
PSPL (psi) .0212708 (137 db)

SERIAL#: U5-1069020

CALIBRATED BY:
THOMAS INSTRUMENTS INC.

JUNE 15, 1990

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .00029 psi
RECORD TIME: 2 second(s)

START TIME: 13:04:45 12-04-1990
FINISH TIME: 09:57:58 11-29-1990

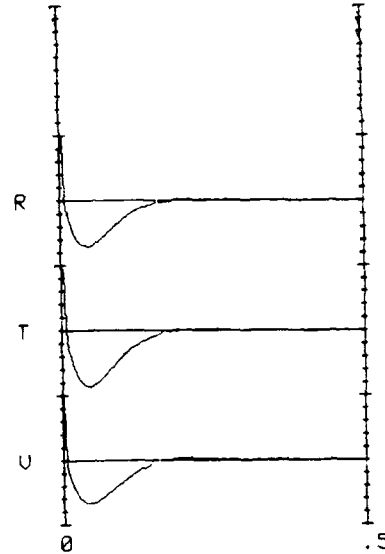
** TRIGGER LEVEL WAS NOT EXCEEDED **
-- ** DURING MONITORING INTERVAL **

SERIAL#: U5-1079008

CALIBRATED BY:

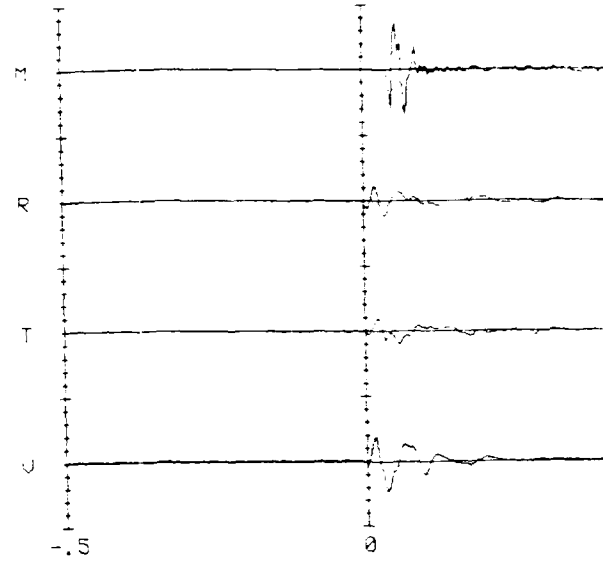
THOMAS INSTRUMENTS, SPOFFORD, NH USA
FEBRUARY 12, 1990

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CICHTILLO DAM
CLIENT
PCI



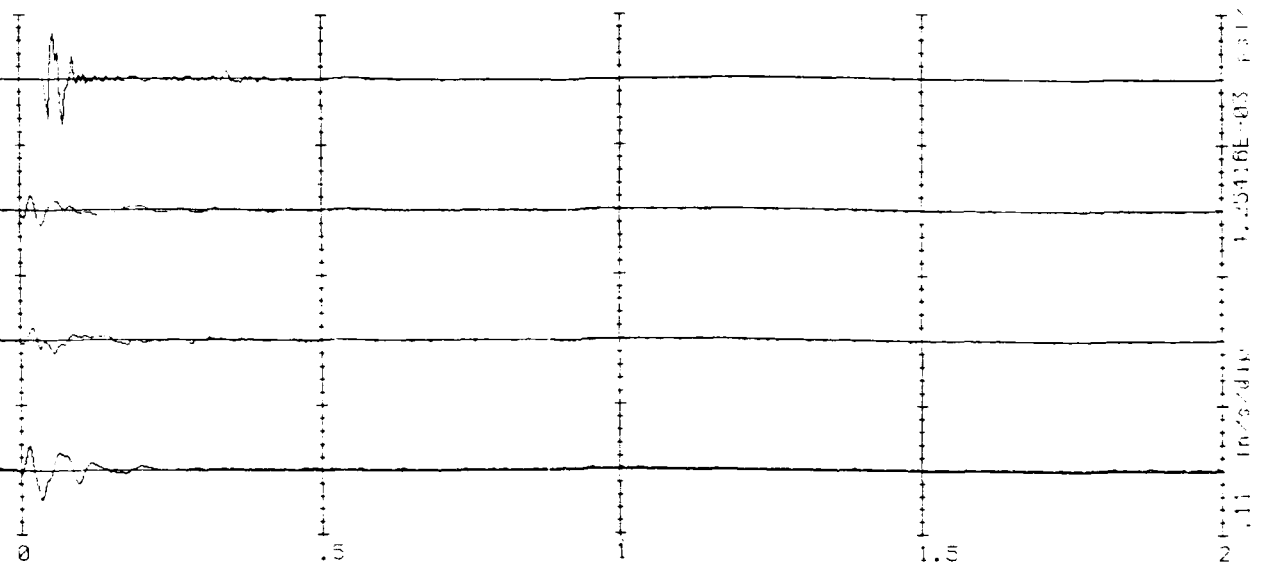


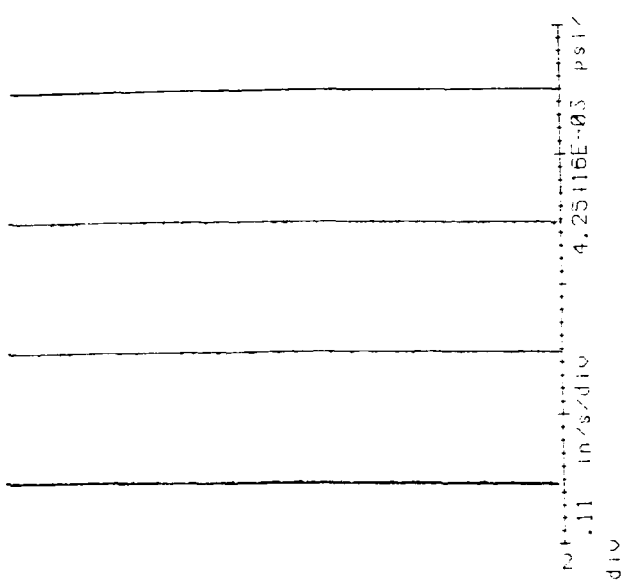
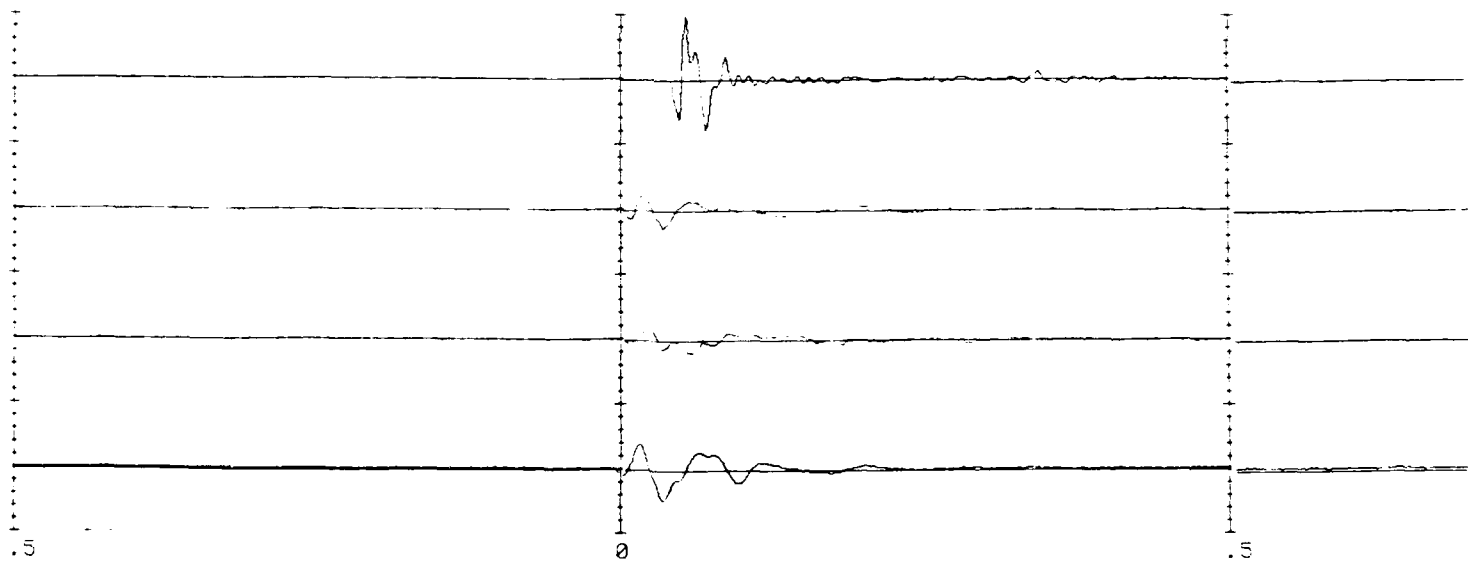
SEISMOGRAPH LOG

PROJECT
 CUICHILLO DAM
 CLIENT
 PCL
 OPERATOR
 KEVIN STEVENSON-MCCAW'S DRILLING (USA)
 SEISMOGRAPH LOCATION
 FLOW
 ^
 DISTANCE FROM SENSOR TO BLAST
 200
 NOTES
 BLAST

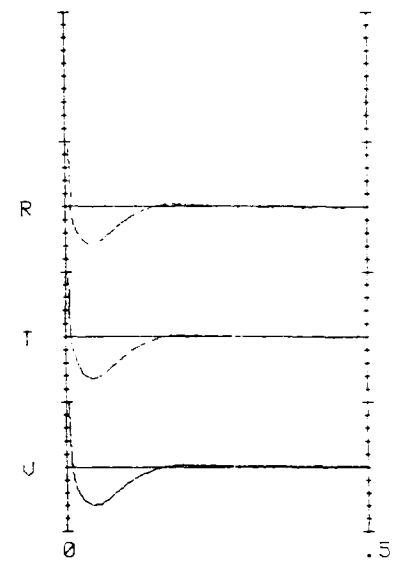
BLASTING LOG

EXPLOSIVES SPECIFICATIONS
 GELMAX 1.5 +16 200FT CORD 200 GRAIN
 TOTAL WEIGHT OF EXPLOSIVES USED
 13.5
 NUMBER OF CAPS
 1
 NUMBER OF DELAYS
 0
 MAX WEIGHT/DELAY
 13.5
 AVERAGE DEPTH OF HOLE
 25FT
 NUMBER OF HOLES
 10
 SPACING & BURDEN
 24 INCHS
 TYPE OF BLAST
 PRE SPLIT
 WEATHER
 SUNNY/CALM
 MATS, OVERBURDEN, SAND BLANKET
 MATS





SENSOR TEST



SEISMOGRAPH LOG

PROJECT CUMHILLO DAM
 CLIENT
 OPERATOR
 REVISION

SEISMOGRAPH LOG

PROJECT
 CUCHILLO DAM
 CLIENT
 JPL
 OPERATOR
 KEVIN STEVENSON
 SEISMOGRAPH LOCATION
 HILO
 DISTANCE FROM SENSOR TO BLAST
 65
 NOTES
 BLAST C-32-3

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
 JGELMAX 1.5+16
 TOTAL WEIGHT OF EXPLOSIVES USED
 13.5
 NUMBER OF CAPS
 1
 NUMBER OF DELAYS
 1
 MAX WEIGHT/DELAY
 10
 AVERAGE DEPTH OF HOLE
 25
 NUMBER OF HOLES
 10
 SPACING & BURDEN
 24 INCHS
 TYPE OF BLAST
 PRE SPLIT
 WEATHER
 SUNNY/CLEAR
 MATS, OVERBURDEN, SAND BLANKET
 MATS

SET-UP INFORMATION

MODE: Single Event
 SOURCE: Geophone or Microphone
 GLO TRIGGER LEVEL: .51 mm/s
 MIC TRIGGER LEVEL: 56.4 Pa 129 db
 RECORD TIME: 2 second(s)

TRIGGERED at 14:02:28 12-04-1990

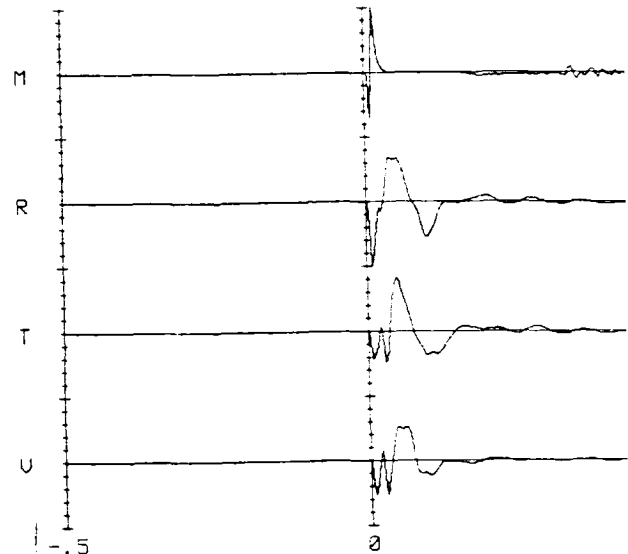
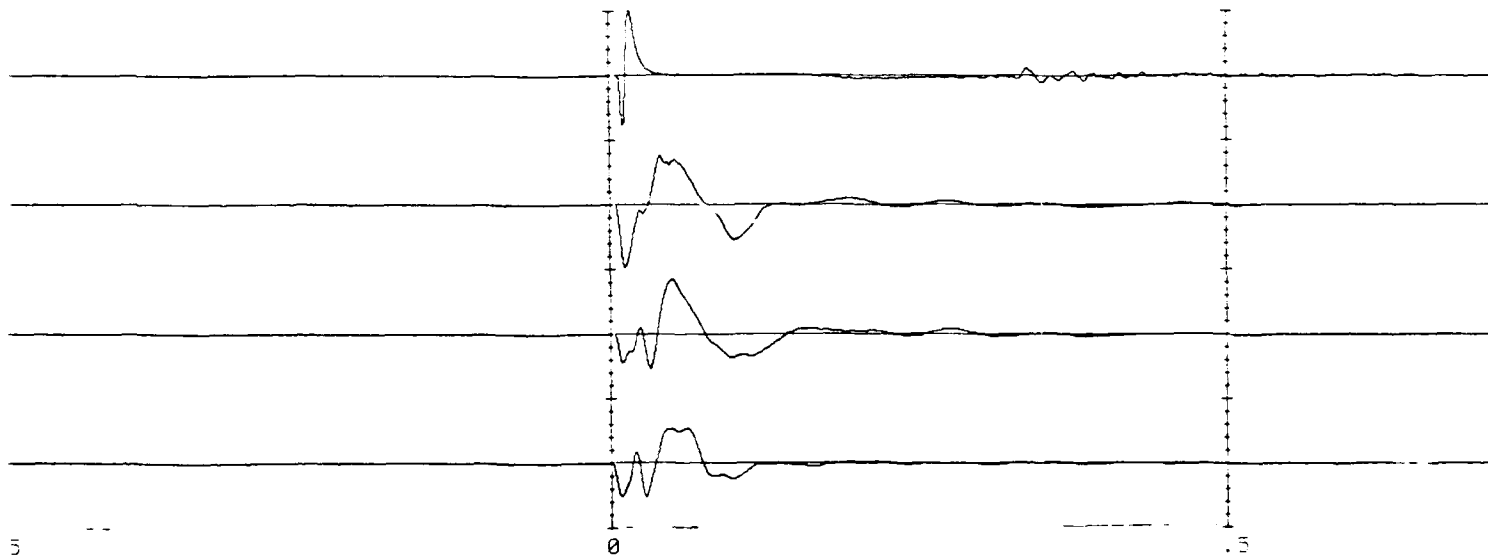
MEASUREMENTS

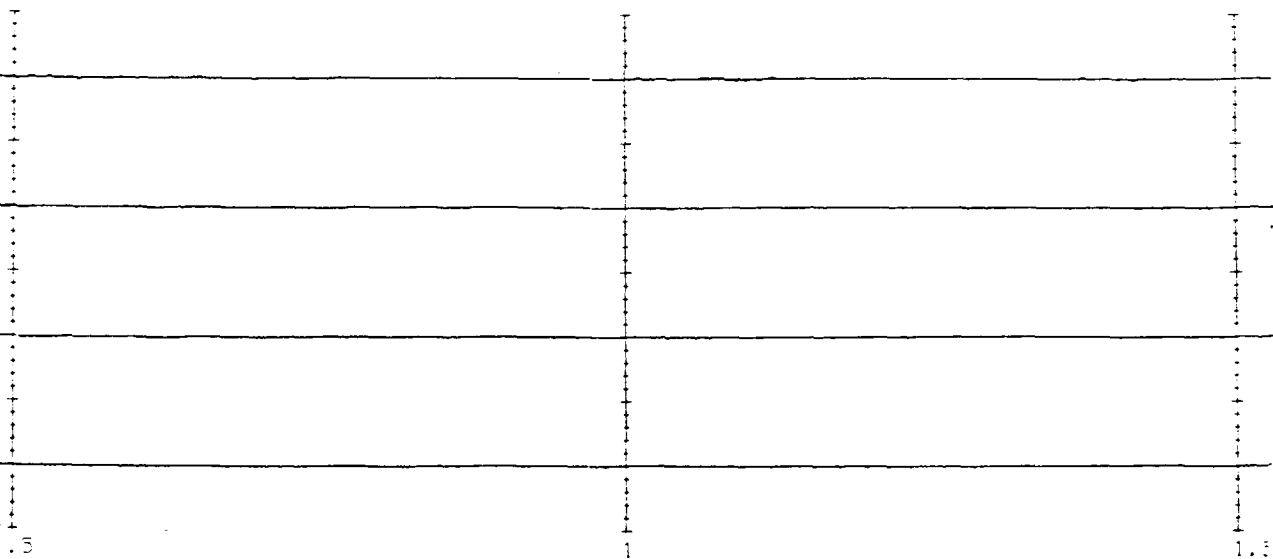
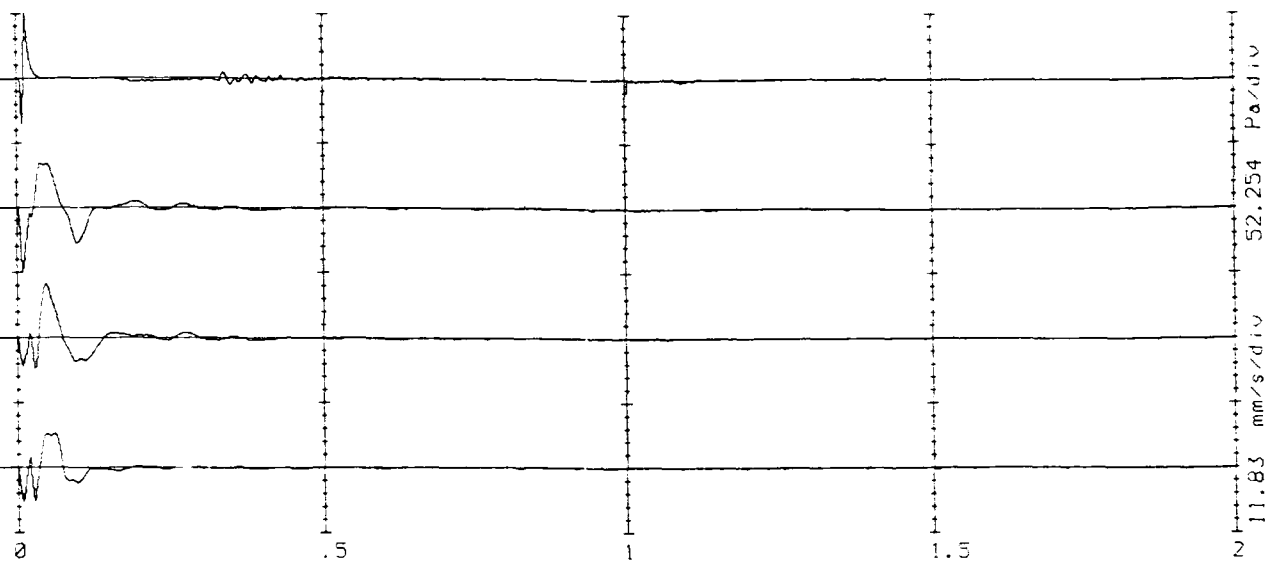
PPV (mm/s)	32.25	49.55	59.15
TIME (ms)	61	47	9
FREQ (Hz)	13	13	14
PPA (g)	2.68	.3	2.33
PVS (mm/s)	21.23	48 ms	
PSPL (Pa)	261.27	(142 db)	

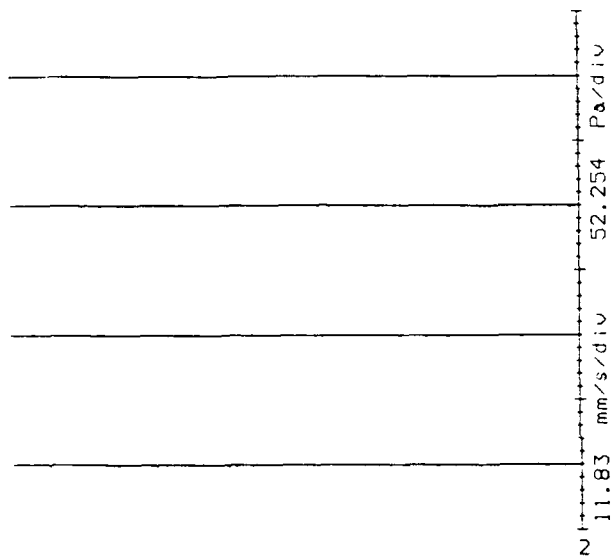
SERIAL#: U5-G250059

CALIBRATED BY:

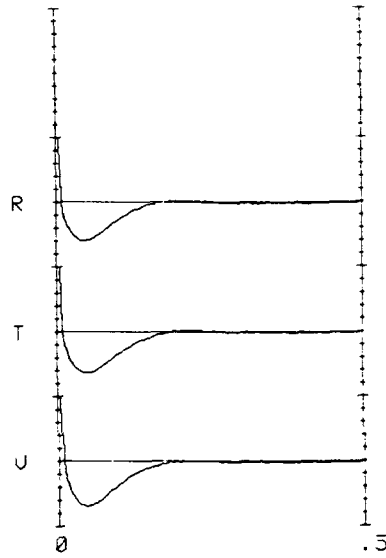
THOMAS INSTRUMENTS, SPOFFORD, NH
 JULY 25, 1990







SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION

SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
6FT
DISTANCE FROM SENSOR TO BLAST
0FT

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
GELINA 1.5x10
TOTAL WEIGHT OF EXPLOSIVES USED
13.5
NUMBER OF CAPS
1
NUMBER OF DELAYS
0
MAX WEIGHT/DELAY
13.5
AVERAGE DEPTH OF HOLE
25FT
NUMBER OF HOLES
10
SPACING & BURDEN
24 INCHES
TYPE OF BLAST
PRE SPLIT
WEATHER
SUNNY
MATS, OVERBURDEN, SAND BLANKET
MATS



Reference:

ATT. J. MICHAELS
Re: BLAST # C37-5
SEISMOGRAPH READINGS

Date: 12-06-90

By: K.J.

Sheet 1 of 1

(1) LOW LEVEL OUTLET WORKS

THIS MACHINE WAS FALSELY TRIGGERED
5 MIN ~~7~~ 1850L. BEFORE THE BLAST.

(2) HIGH LEVEL OUTLET WORKS (8' FROM BLAST ON ROCK)

PVS (PEAK VECTOR SUM) - VIBRATION = $0.04''/\text{SEC}$

ENERGY RATIO - VERTICAL = .00006

" - TRANSVERSE = .00000008

" - RADIAL = .0000002

(3) HIGH LEVEL OUTLET WORKS - CONCRETE

PEAK VECTOR SUM - VIBRATION = $0.94''/\text{SEC}$

ENERGY RATIO - VERTICAL = .0015

" - TRANSVERSE = 1.00 *

" - RADIAL = .0001

PLEASE ATTACH PRINTOUTS & FORWARD TO
CONTRACTING OFFICER

THOMAS INSTRUMENTS
 SPOFFORD, NEW HAMBURGH, NY
 TELEPHONE: (516) 503-6000

SET UP INFORMATION

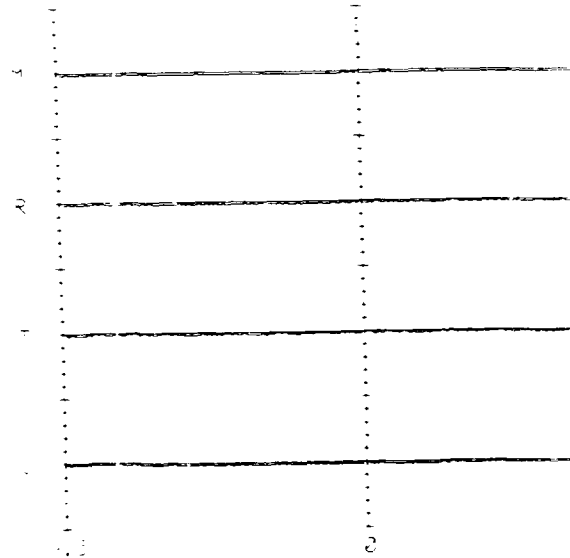
Model: Single Event
 Sensor: Telephone or Microphone
 Gain: 1000x
 Input Impedance: 100K ohms
 Filter: 120 dB
 Record Time: 2 seconds

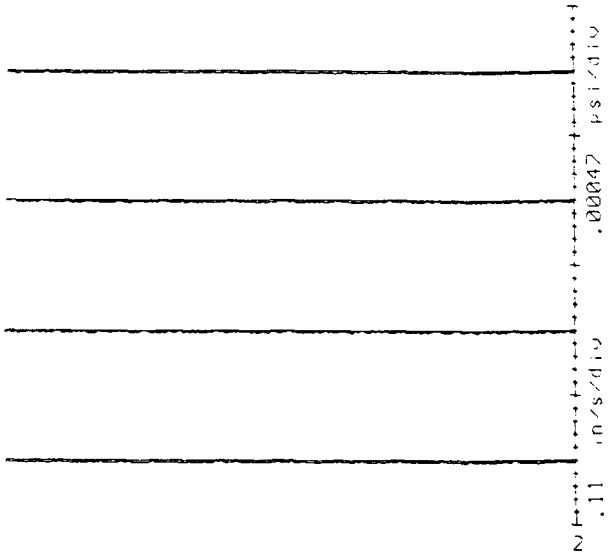
Triggered at 14:10:02 12-20-1994

MEASUREMENTS

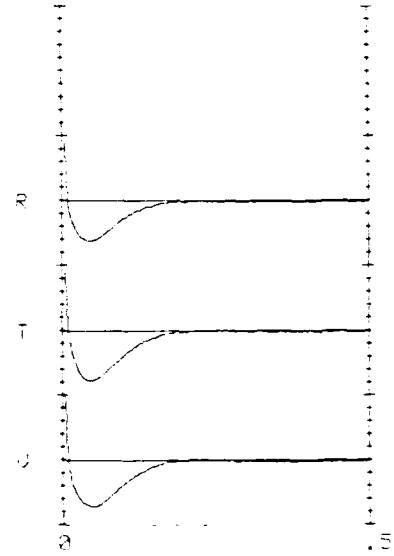
	U	I	R
PP0 (mV)	.03	.02	.02
TIME (ms)	0	42	38
FREQ (Hz)	4	25	45
PP0 (g)	3	.26	2.8
PP0 (m/s)	.04 (0 ms)		
PSPL (psi)	.0001310 (95 db)		

SERIAL #05-G250059
 CALIBRATED BY:
 THOMAS INSTRUMENTS, SPOFFORD, NY
 JUL 25, 1994





SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .00023 psi
RECORD TIME: 2 second(s)

TRIGGERED at 14:10:41 12-06-1990

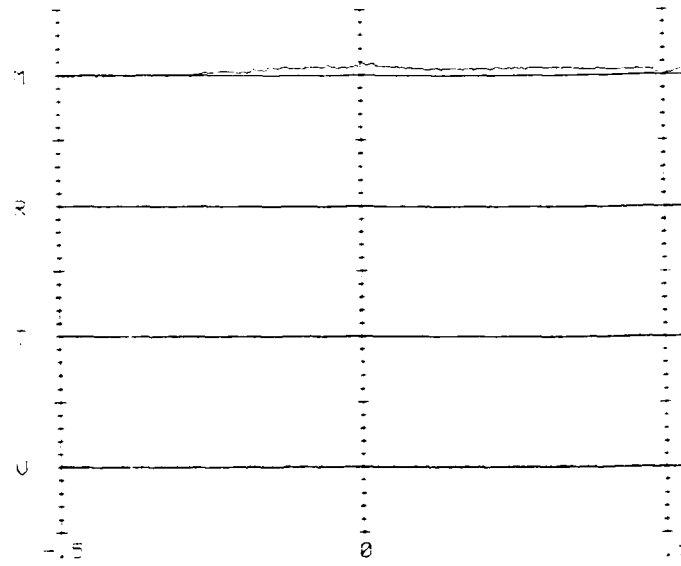
MEASUREMENTS

	U	T	R
PPALL(in/s)	.01	.01	.01
TIME (ms)	239	459	766
FREQ (Hz)	256	512	512
PPA (g)	.09	1.85	2.55
PUS (in/s)	.02 (1319 ms)		
PSPL (psi)	.0003256		

SERIAL#:05-1029008

CALIBRATED BY:

THOMAS INSTRUMENTS, SPOFFORD, NH USA
FEBRUARY 12, 1990

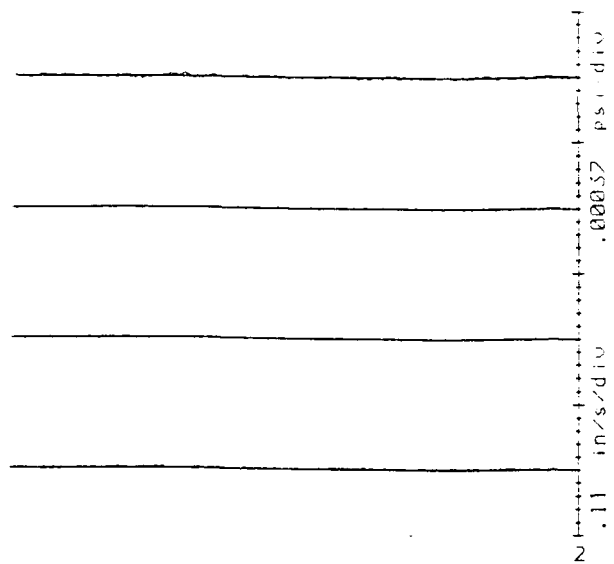


SEISMOGRAPH LOG

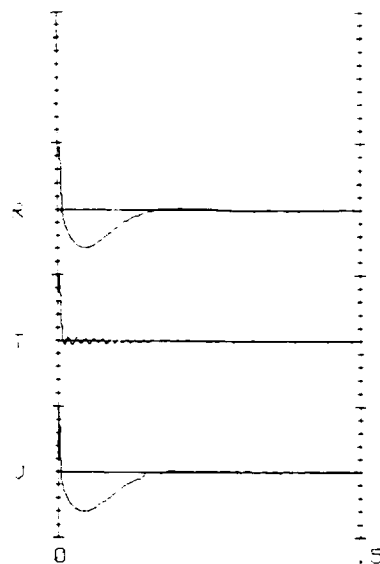
PROJECT
CUTTED DAM
CLIENT
FCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
8FT
46
DISTANCE FROM SENSOR TO BLAST
46
NOTES
BLAST C-32-5

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
GEI MAX 1.5+16
200GRAINCORD
TOTAL WEIGHT OF EXPLOSIVES USED
13.5
20.14
NUMBER OF CAPS
1
NUMBER OF DELAYS
0
MAX WEIGHT/DELAY
20.14
AVERAGE DEPTH OF HOLE
25FT
NUMBER OF HOLES
10
SPACING & BURDEN
24INCHES
TYPE OF BLAST
PRE SPLIT
WEATHER
SUNNY
MATS, OPERBUREN, SODIUM BUREN
DATE

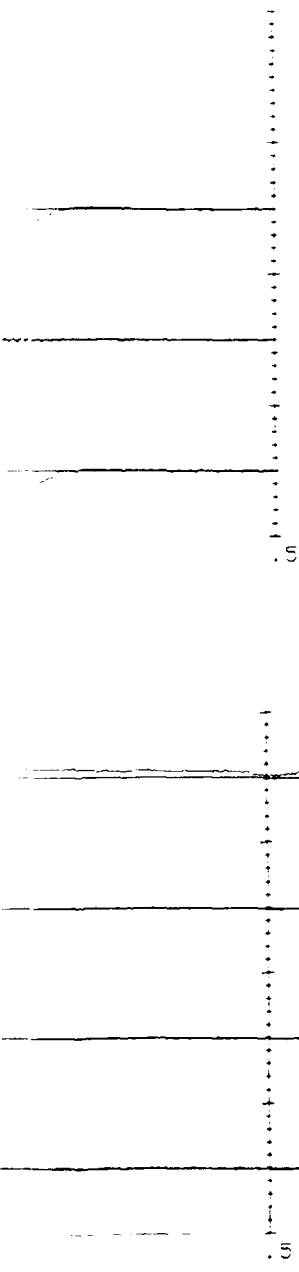


SENSOR TEST



SEISMIC RISK - CUB

PROJECT NUMBER: 14910-14911



SEISMOGRAPH LOG

PROJECT
 CUCHILLO DAM
 CLIENT
 PCL
 OPERATOR
 KEVIN STEVENSON-MCCRAUS DRILLING (USA)

SEISMOGRAPH LOCATION
 ULOU

DISTANCE FROM SENSOR TO BLAST
 200

NOTES
 BLAST C-32 5

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
 GEL MAX 1-1/2+16 200GRAIN COND
 TOTAL WEIGHT OF EXPLOSIVES USED
 20.41

NUMBER OF CAPS
 1
 NUMBER OF DELAYS
 5

MAX WEIGHT/DELAY
 20.14
 AVERAGE DEPTH OF HOLE
 25

NUMBER OF HOLES
 10

SPACING & BURDEN
 24IN

TYPE OF BLAST
 FREE SPILL

WEATHER
 WINDY / CLOUDY

SET UP INFORMATION

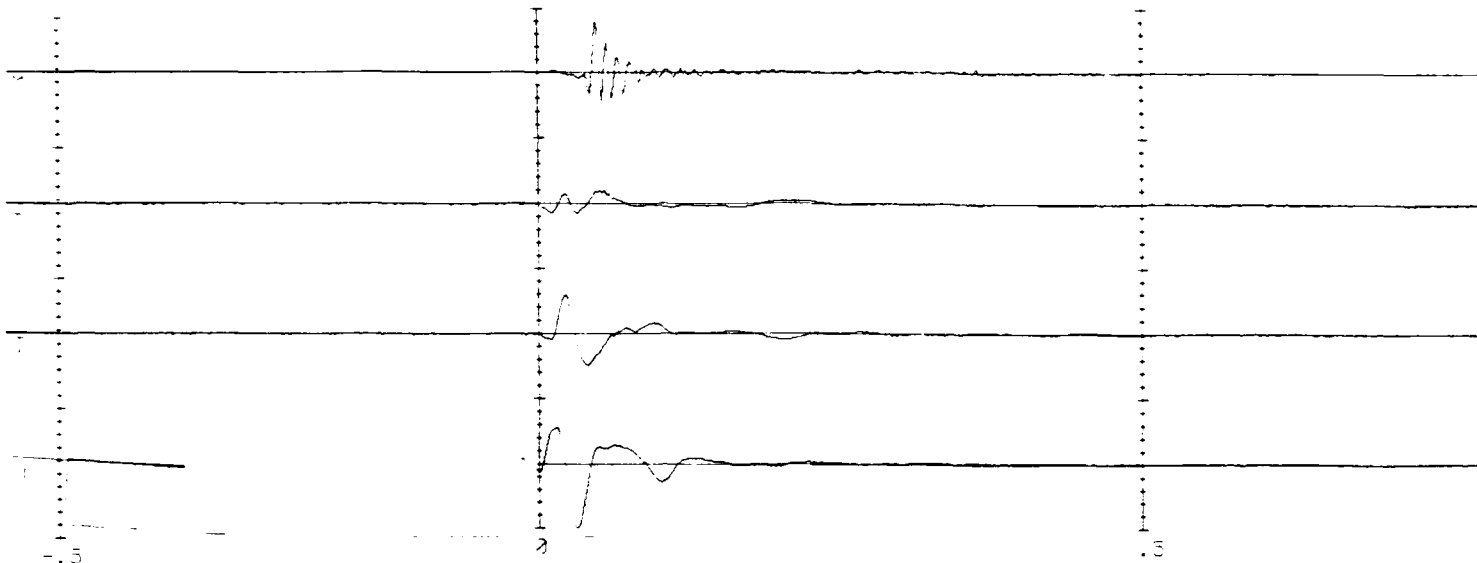
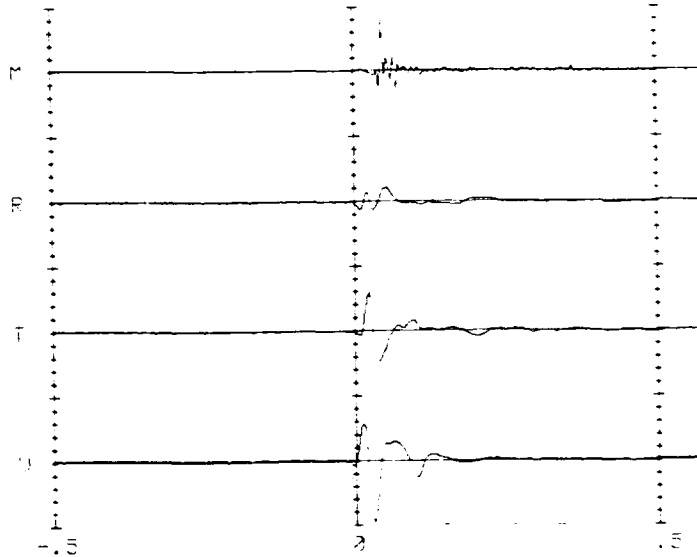
MODE: Single Event
 SOURCE: Geophone or Microphone
 GLO TRIGGER LEVEL: .002 in/s
 MTC TRIGGER LEVEL: .0025 psi 120 db
 RECORD TIME: 2 seconds

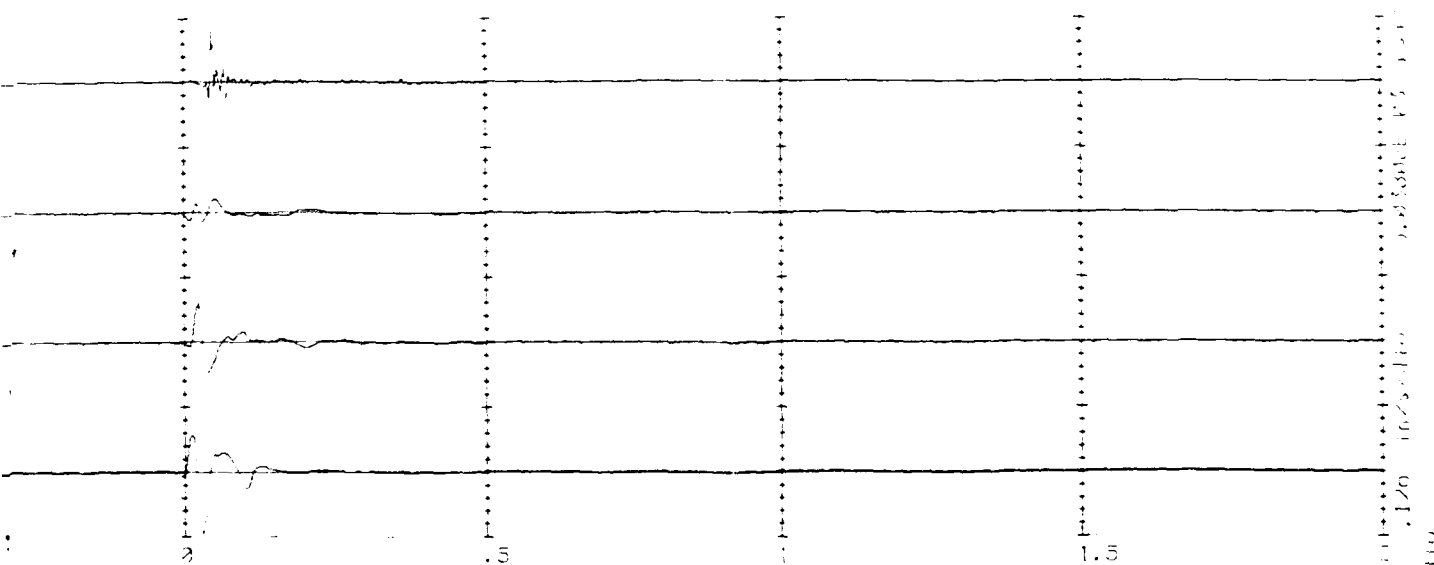
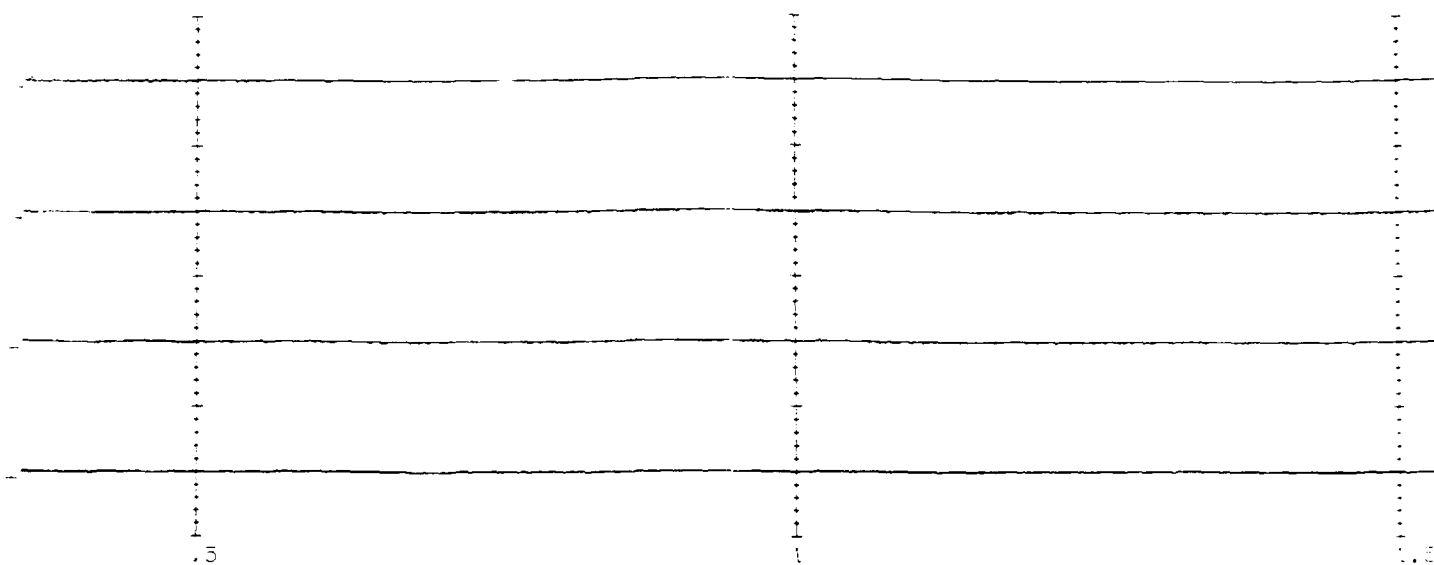
TRIGGERED at 14:10:00 12 db 1.00

MEASUREMENTS

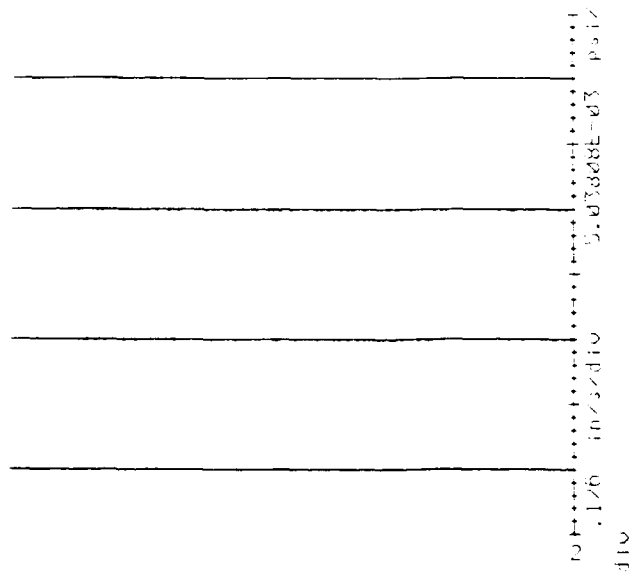
	D	F	R
PPO (in/s)	.88	.53	.18
TIME (ms)	34	22	51
FREQ (Hz)	23	50	10
PPI (g)	2.23	1.36	2.54
PPI (in/s)	.94 (35 ms)		
PPI (psi)	.0251904 (139 db)		

SERIAL# 05-L069020
 CALIBRATED BY:
 THOMAS INSTRUMENTS INC.
 JUNE 10, 1990

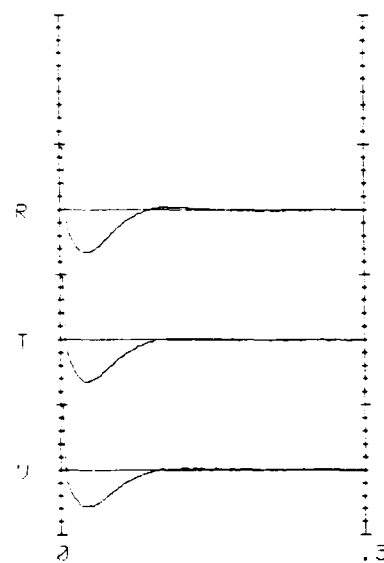




G-136



SENSOR TEST



SEISMOGRAPH 100

PROJECT
LIGHTING UNIT
CURRENT
PUL

DETAILED LOG

PROJECT
 CLIENT
 PLOT
 OPERATOR
 RECONSTRUCTION
 DETAIL LOCATION
 BLOCK
 DISTANCE FROM STATION TO BOUND
 401
 NOTES
 BLOS 0-325

BLOTTING LOG

EXPLOSIVES SPECIFICATIONS
 GELAX 1-1/2 6 2000000 TONN
 TOTAL WEIGHT OF EXPLOSIVES USED
 20.4
 NUMBER OF COPS
 1
 NUMBER OF DELAYS
 1
 MAX WEIGHT/DELTA
 24.14
 AVERAGE DEPTH OF HOLE
 25
 NUMBER OF HOLES
 15
 SPACING & BATTER
 2416
 TYPE OF BLOTT
 PRE-SHIFT
 WEATHER
 STATIONARY

CUCHILLO DAM PROJECT
BLAST #C37-8
11 DECEMBER 1990
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 8 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 1.72 in/sec.

ENERGY RATIO - VERTICAL = 0.0107
ENERGY RATIO - TRANSVERSE = 0.0018
ENERGY RATIO - RADIAL = 0.0030

2. LOW LEVEL OUTLET WORKS 160 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.08 in/sec.

ENERGY RATIO - VERTICAL = 0.000000003
ENERGY RATIO - TRANSVERSE = 0.00000244
ENERGY RATIO - RADIAL = 0.00000216

SET-UP INFORMATION

MODE: Single Event
SOURCE:

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

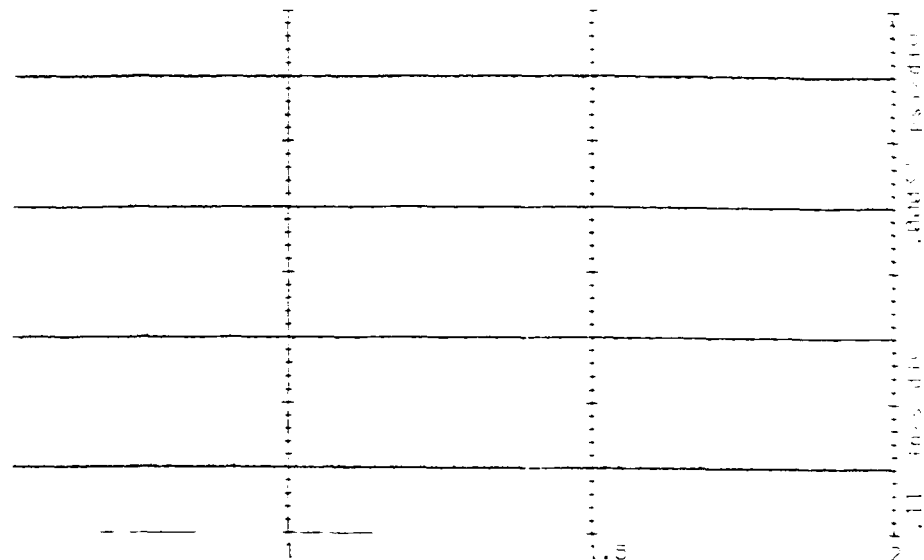
SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 2 second(s)

TRIGGERED at 12:44:47 12 11-1994

MEASUREMENTS

U T R



SET-UP INFORMATION

MODE: Single Event
 SOURCE: Geophone
 GEO TRIGGER LEVEL: .02 in/s
 RECORD TIME: 2 second(s)

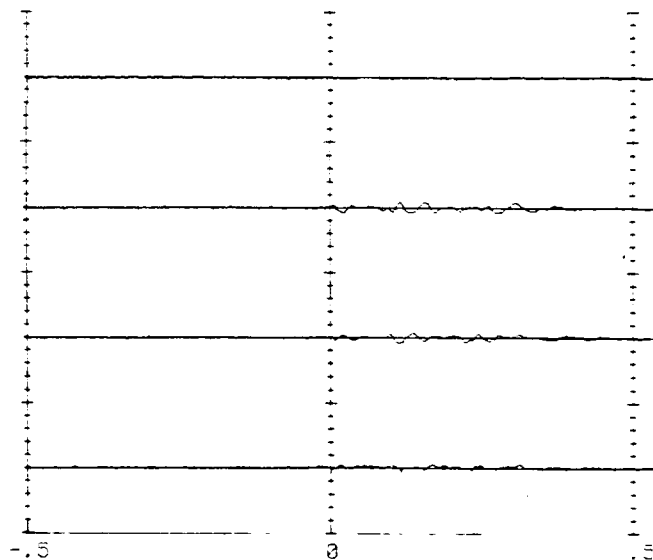
TRIGGERED at 12:44:42 12 11-1990

MEASUREMENTS

	U	T	R
PPU (in/s)	.03	.05	.05
TIME (ms)	117	115	115
FREQ (Hz)	512	32	34
PPH (g)	.29	1.65	2.95
PUS (in/s)	.08 (117 ms)		
PSPL (psi)	.000074		

SERIAL#:05-1079008
 CALIBRATED BY:
 THOMAS INSTRUMENTS, SPOFFORD, NH USA
 FEBRUARY 12, 1990

G-139



0.11 in/s/div
 .00032 psi/div

SET-UP INFORMATION

MODE: Single Event
 SOURCE: Geophone
 GEO TRIGGER LEVEL: .02 in/s
 RECORD TIME: 2 second(s)

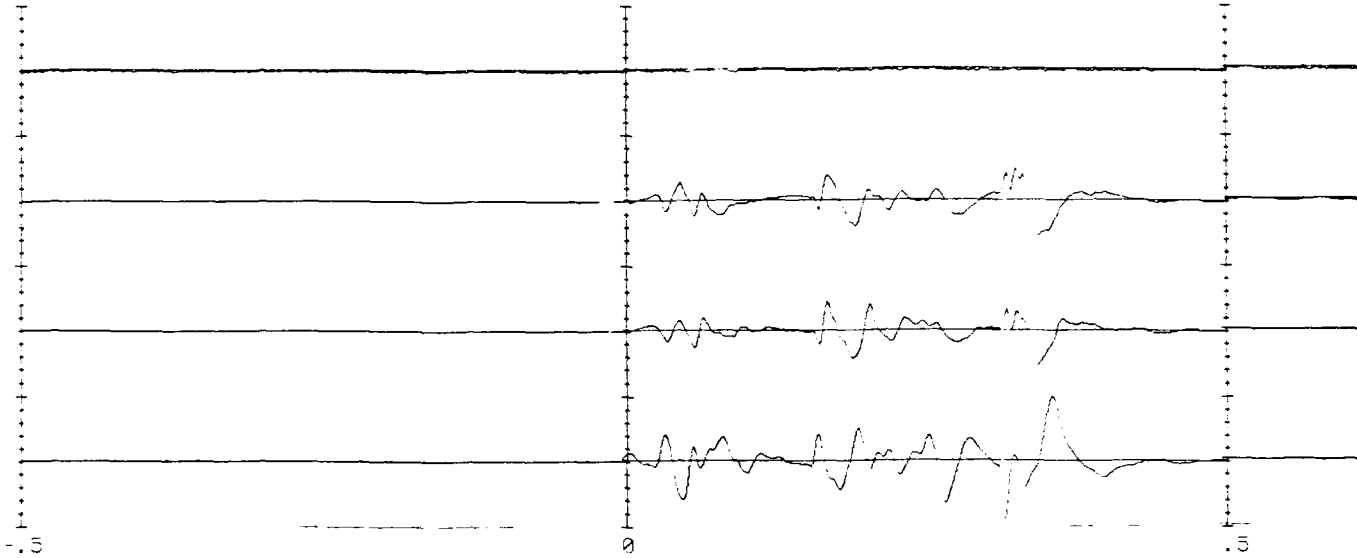
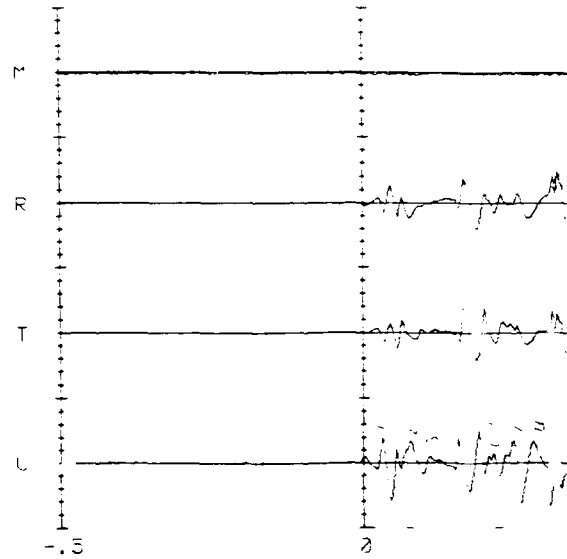
TRIGGERED at 12:53:43 12-11-1990

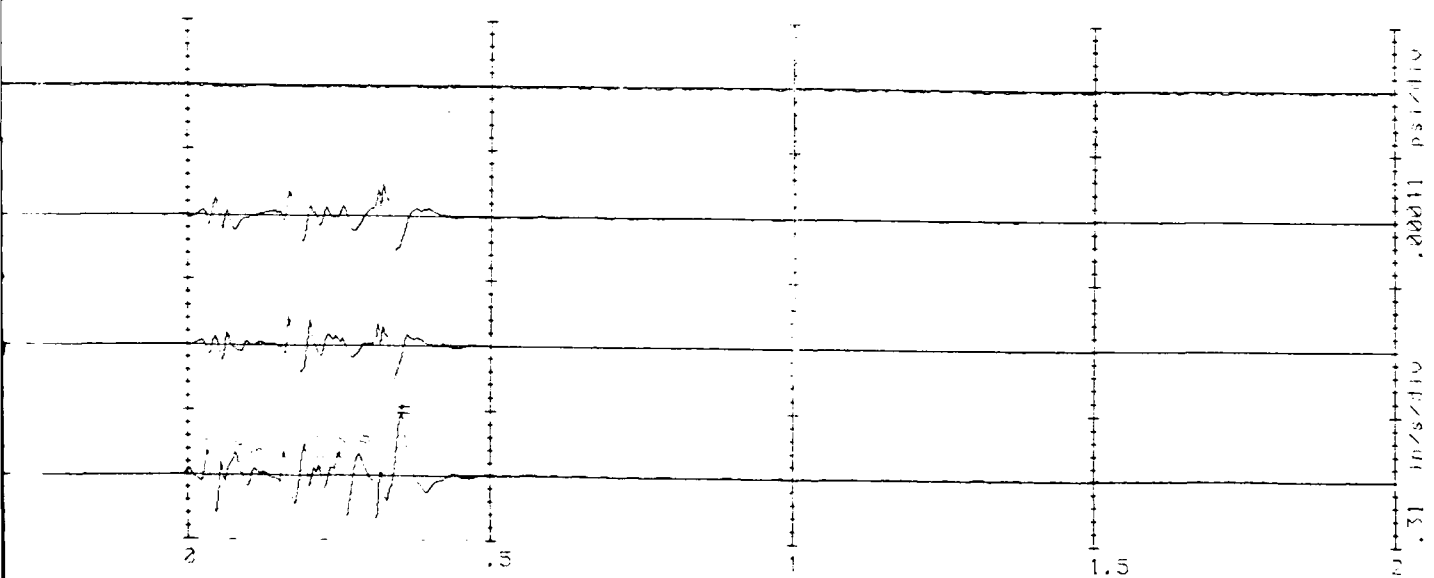
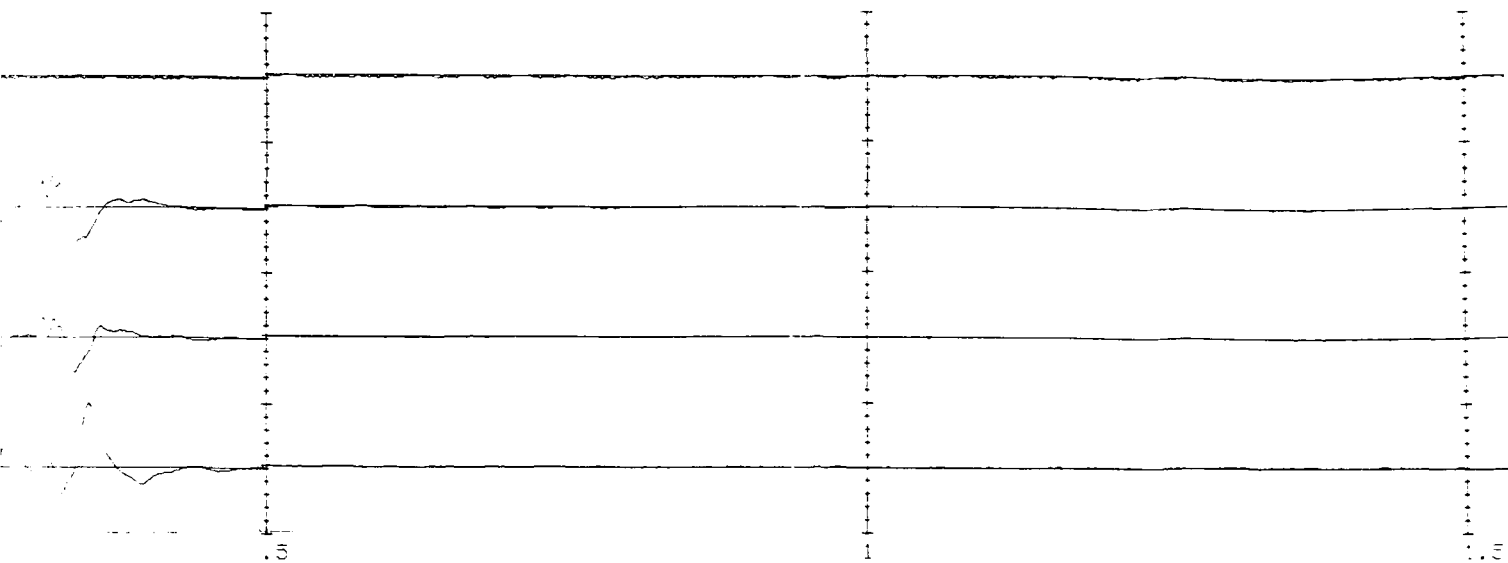
MEASUREMENTS

	U	T	R
PPV (in/s)	1.55	.85	.87
TIME (ms)	354	313	343
FREQ (Hz)	15	28	16
PPA (g)	2.72	2.52	1.01

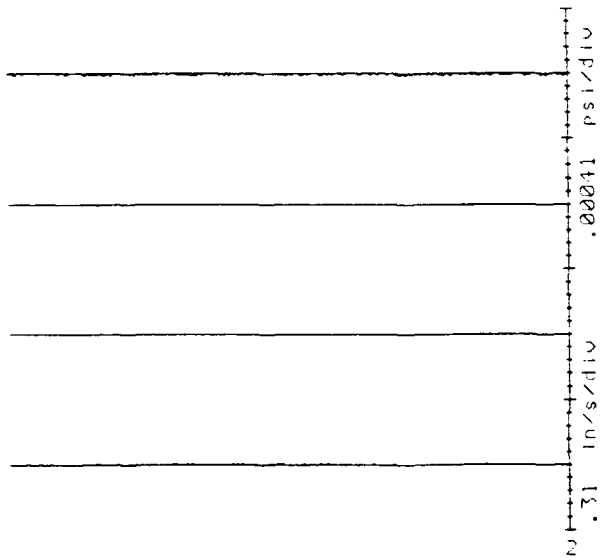
PUS (in/s) 1.72 (354 ms)
 PSPL (psi) .000082 (83 db)

SERIAL#:05-L069020
 CALIBRATED BY:
 THOMAS INSTRUMENTS INC.
 JUNE 15, 1990

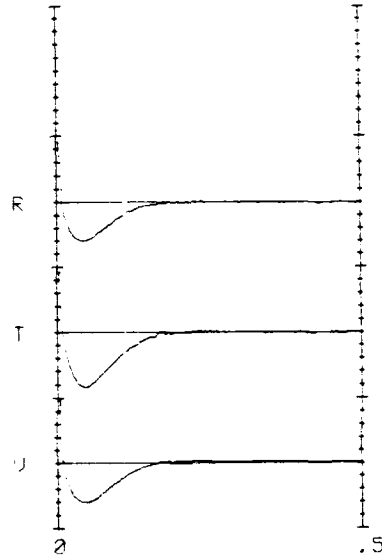




G-140

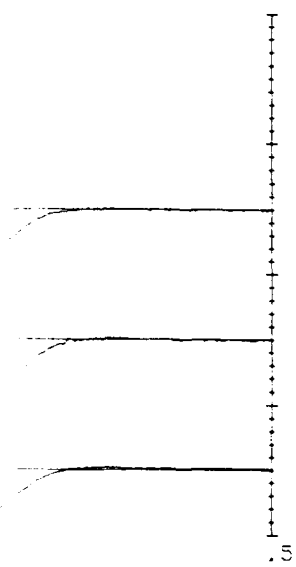


SENSOR TEST



SEISMOGRAPH LOG

PROJECT
 CLIENT
 OPERATOR
 KEVIN STEPHENSON
 SEISMOGRAPH LOG



SEISMOGRAPH LOG

PROJECT
 CLIENT
 PCL
 OPERATOR
 KEVIN STEVENSON
 SEISMOGRAPH LOCATION
 HLOW
 DISTANCE FROM SENSOR TO BLAST
 8
 NOTES
 BLAST C-32-8

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
 GELMAX11/2X16 200G 2X16 GELMAX
 TOTAL WEIGHT OF EXPLOSIVES USED
 90.4
 NUMBER OF CAPS
 9
 NUMBER OF DELAYS
 9
 MAX WEIGHT/DELAY
 10
 AVERAGE DEPTH OF HOLE
 25
 NUMBER OF HOLES
 17
 SPACING & BURDEN
 24IN PRE-SPLIT 5X5 PATTERN
 TYPE OF BLAST
 PRE-SPLIT PRODUCTION
 WEATHER
 SUNNY/CLEAR
 MATS, OVERBURDEN, SAND BLANKET
 NOTES

12-13-90

K.J. PAGE 1 of 2

ATTN: MR. T. O'DONNELL

SEISMOGRAPH RESULTS - BLAST # C37-~~19~~

X MACHINE @ LOW LEVEL OUTLET WORKS DID NOT TRIGGER

X HIGH LEVEL OUTLET WORKS

- PEAK PARTICLE VELOCITY - VERTICAL = 8.15 IN/SEC.
- " " - TRANSVERSE = 1.84 IN/SEC
- " " - RADIAL = 2.13 IN/SEC

- PEAK VECTOR SUM = 8.41 IN. PER SEC.

ENERGY RATIO - VERTICAL = 0.0304

" " - TRANSVERSE = 0.0010

" " - RADIAL = 0.0008

EXAMINATION OF THE PRINTOUT INDICATES THAT THE HIGH READING OCCURRED ON PERIOD #14 - WHICH WAS THE FIRST SET OF FIVE PRE-SPLIT HOLES (= 10.2166/DELAY) ADJACENT TO THE CONCRETE STRUCTURE AT A Scaled DISTANCE FACTOR OF 2.51.

IN AN EFFORT TO REDUCE THE VIBRATION WE PROPOSE THE FOLLOWING:

- 1) DRILL PRODUCTION HOLES ON A 4'x4' PATTERN & CONTINUE THE PRE-SPLIT HOLES AT 2.0' c/c.
- 2) REDUCE THE LB PER DELAY BY 50% BY "DECKING" THE COLUMN LOAD I.E. TWO DELAY PERIODS PER HOLE
- 3) MAX PRE-SPLIT HOLES PER DELAY TO BE REDUCED TO THREE
- 4) BLASTING OF THE PRODUCTION HOLES TO COMMENCE AT THE FREE FACE AND WORK BACK INTO THE BODY OF THE SHOT
- 5) THE FIRST PRODUCTION BLAST SHALL BE THREE HOLES (SIX DELAYS) WITH A MAXIMUM LB PER DELAY OF 5.066
- 6) THE NUMBER OF PRODUCTION HOLES PER DELAY SHALL BE DETERMINED BY

12-13-70

KIS-

PA 7-272

3. PRE-SPLIT holes shall be shot only AFTER the production holes have been shot and the material excavated to create a "free face"

8. INITIALLY the pre-split holes shall be drilled at 2 inches per hole

ADDITIONAL steps may have to be taken IF the above methods are not successful in REDUCING the peak particle velocities.

Those may include ANY OF the following:

- a. REDUCED Bench Height
- b. SMALLER ϕ bore holes & SMALLER ϕ dynamite
- c. TIGHTER PATTERNS
- d. DEERING
- e. SEQUENTIAL BLASTING
- f. GREATER Delayment

GENERALLY the MOST SIGNIFICANT FACTOR CONTRIBUTING TO PEAK PARTICLE VELOCITY IS the lb/ft^2 Delay. ALL OF the steps listed ABOVE ARE AIMED AT REDUCING the lb/ft^2 Delay TO achieve acceptable PEAK PARTICLE VELOCITIES.

C.C.
CONTRACTING OFFICER-



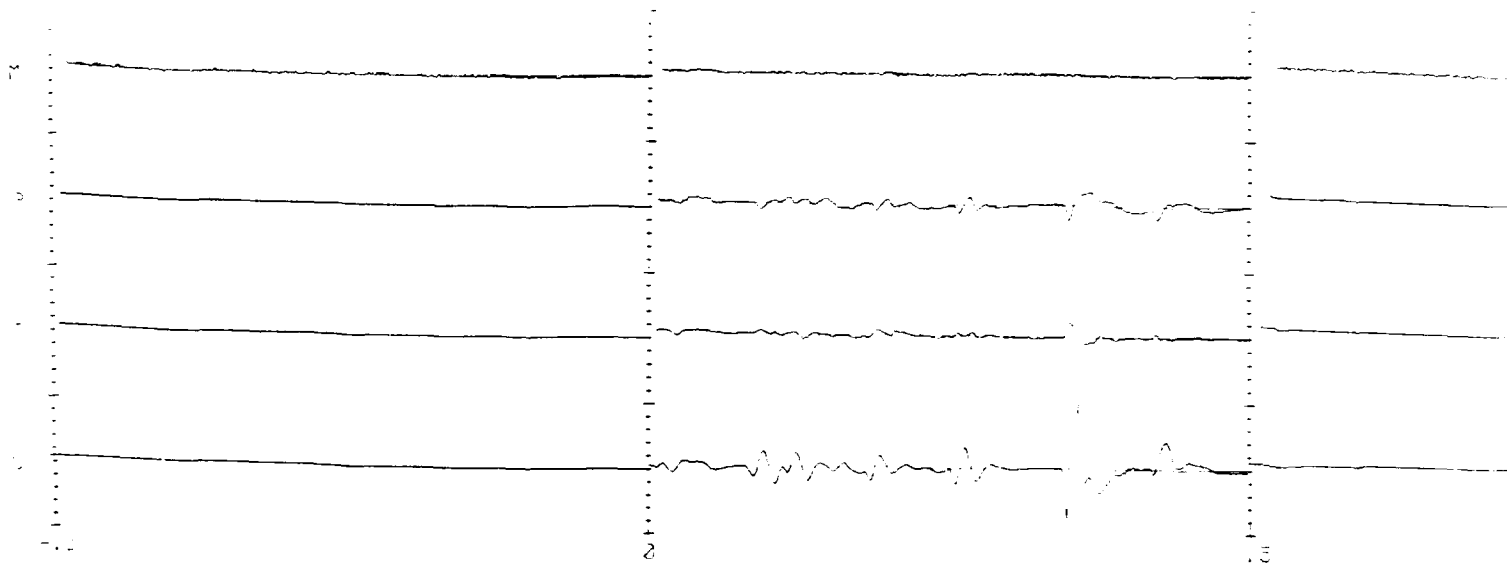
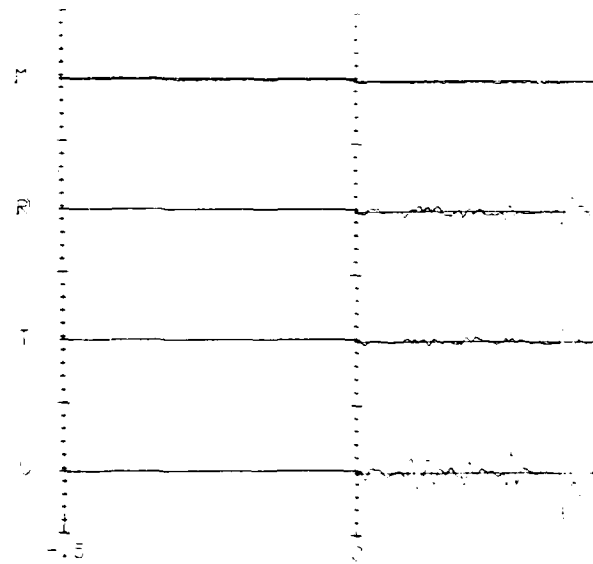
Title: Single Event
 Genre: Nonfiction
 Gen. Subject: 182: 105
 Publ. Info: 2: 100000

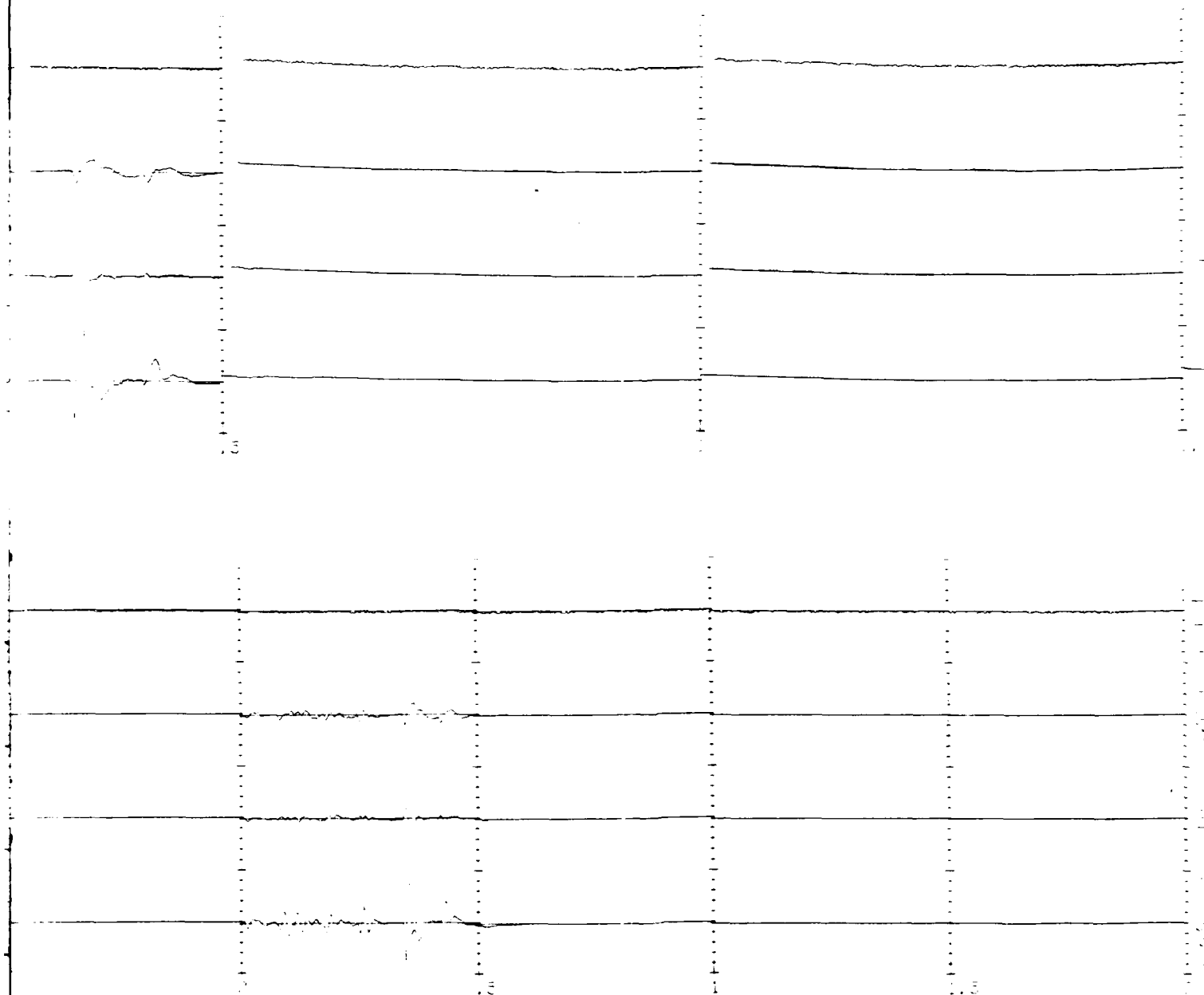
11:40:54 12-13-1961

	U	T	K
PPU (in %)	8.13	1.84	2.13
TIME (min)	30	350	343
PPU (10 ²)	1	0.1	0.1
PPU (g)	.80	.24	1.22

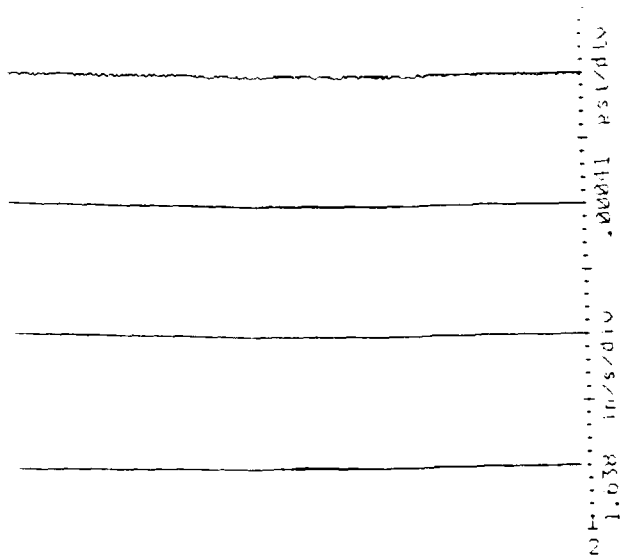
PUS (in/s) 8.41 (35 ms)
 PPH (psi) .00008? (83 lb)

SEK 161 #05-1069026
 CUBA LIBRE LTD.
 TRADING INTERNATIONAL INC.
 JUNE 15, 1990

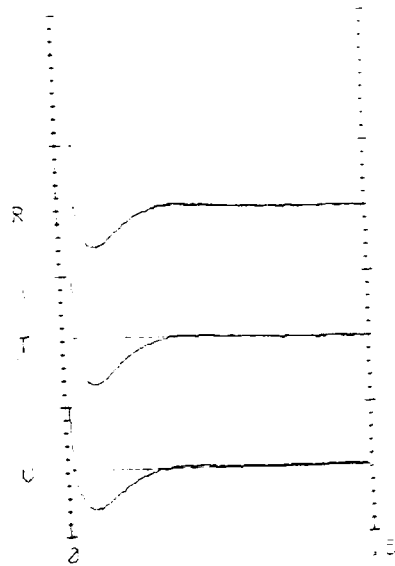




G-144



SENSOR TEST



SETPOINT LOG

PROJECT
 CIRCULAR TUB
 C-123
 TCU
 OPERATOR
 FLOYD STEVENSON
 SETPOINT LOG

SETBACK LOG

PROJECT
 LOCATION
 CLIENT
 VENDOR
 OPERATOR
 KEVIN STEVENSON
 SETBACK LOCATION
 FROM
 DISTANCE FROM SENSOR TO BLAST
 8
 NOTES
 BLAST C-32-S

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
 GELTAX 11/2X16 2000 2X16 BELLOX
 TOTAL WEIGHT OF EXPLOSIVES USED
 95.4
 NUMBER OF COPS
 12
 NUMBER OF DELAYS
 12
 MAX WEIGHT/DELAY
 14.21
 AVERAGE DEPTH OF HOLE
 2.7
 NUMBER OF HOLES
 240
 SPACING & BURDEN
 2400 PRE-CUT 11 5000 FORTUM
 TYPE OF BLAST
 PRE-SETT PRODUCTION
 REASON
 CLOSING ROAD
 LOCATION OF BLASTING OPERATIONS
 1000

CUCHILLO DAM PROJECT
BLAST #C37-16
3 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 32 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.58 in/sec.

ENERGY RATIO - VERTICAL	= 0.00027
ENERGY RATIO - TRANSVERSE	= 0.00156
ENERGY RATIO - RADIAL	= 0.00763

SET-UP INFORMATION

MODE: Single Event
 SOURCE: Geophone
 GEO TRIGGER LEVEL: .02 in/s
 RECORD TIME: 1 second(s)

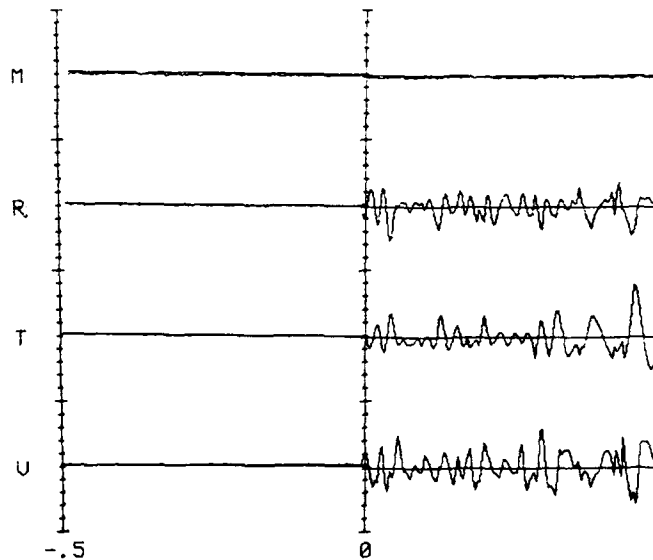
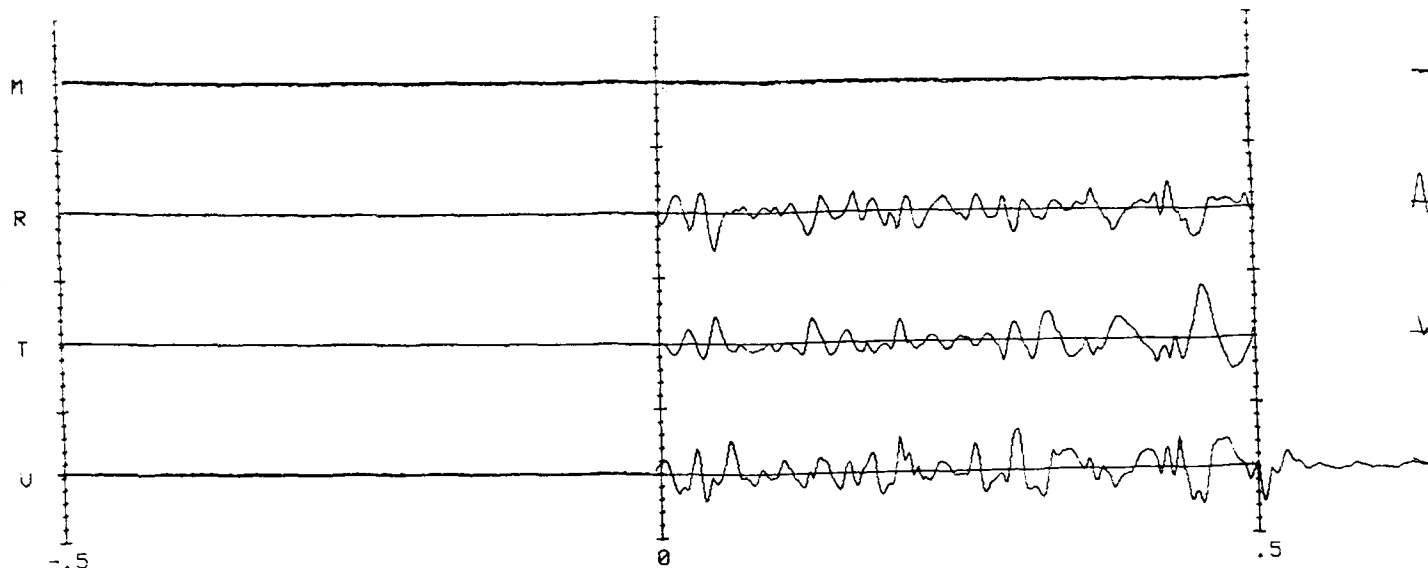
TRIGGERED at 14:07:46 01-03-1991

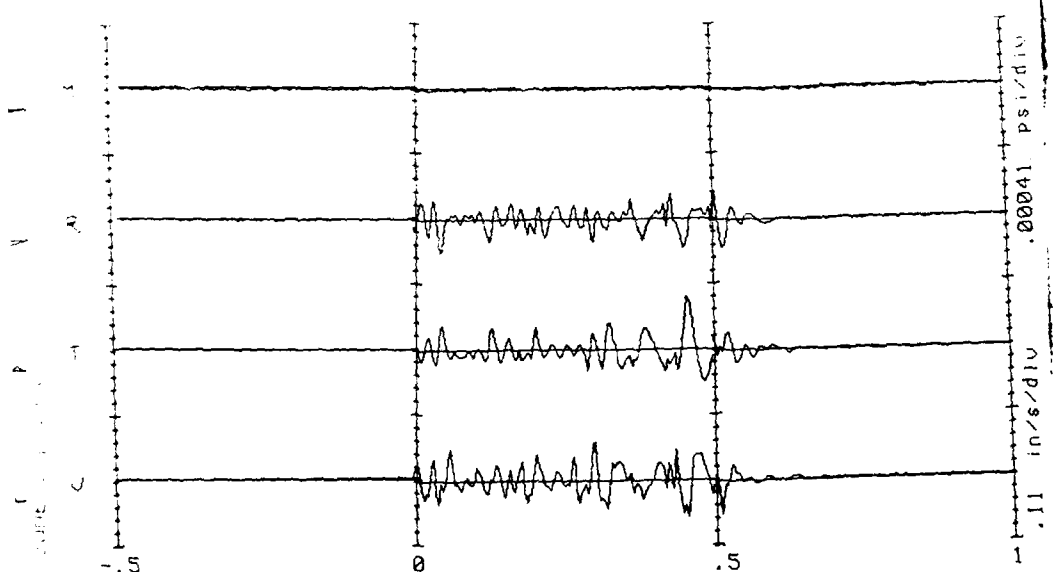
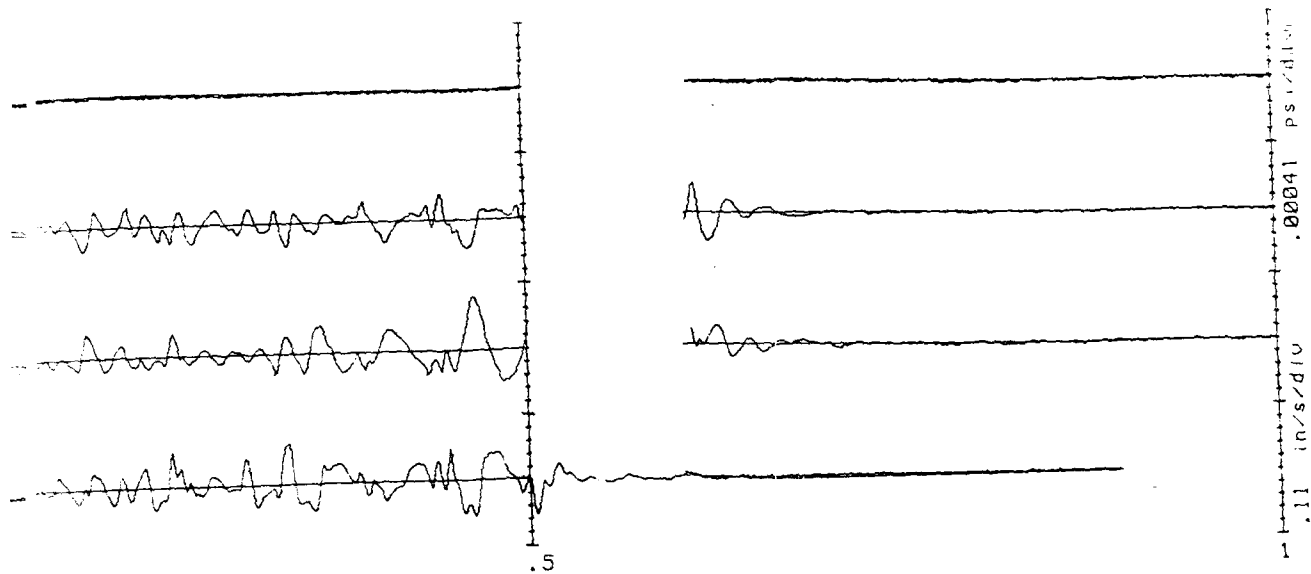
MEASUREMENTS

	U	T	R
PPU (in/s)	.34	.44	.32
TIME (ms)	300	454	49
FREQ (Hz)	43	20	34
PPA (g)	.7	.79	2.97

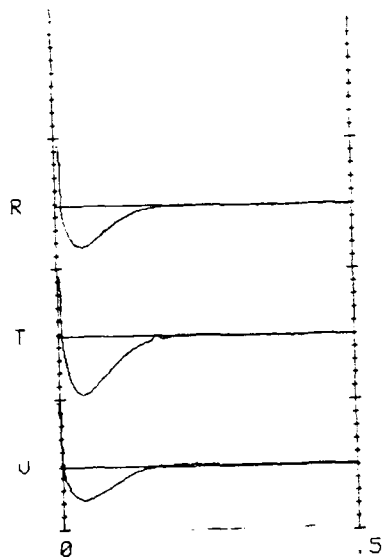
PUS (in/s) .58 (453 ms)
 PSPL (psi) .00082 (89 db)

SERIAL#: U5-L069020
 CALIBRATED BY:
 THOMAS INSTRUMENTS INC.
 JUNE 15, 1990





SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
HILWA
DISTANCE FROM SENSOR TO BLAST
32
NOTES
BLAST C-37-16

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
50
NUMBER OF CAPS
40
NUMBER OF DELAYS
20
MAX WEIGHT/DELAY
5
AVERAGE DEPTH OF HOLES
3.5
NUMBER OF HOLES
40
SPACING & BURDEN
3.5X3.5

PROJECT
CUCUILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
HILW
DISTANCE FROM SENSOR TO BLAST
32
NOTES
BLAST C-37-16

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
50
NUMBER OF CAPS
40
NUMBER OF DELAYS
20
MAX WEIGHT/DELAY
5
AVERAGE DEPTH OF HOLE
3.5
NUMBER OF HOLES
40
SPACING & BURDEN
3.5X3.5
TYPE OF BLAST
PROD
WEATHER
SUNNY
MATS, OVERBURDEN, SAND BLANKET
MATS

CUCHILLO DAM PROJECT
BLAST #C37-20
11 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 32 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.49 in/sec.

ENERGY RATIO - VERTICAL = 0.00038
ENERGY RATIO - TRANSVERSE = 0.00044
ENERGY RATIO - RADIAL = 0.00081

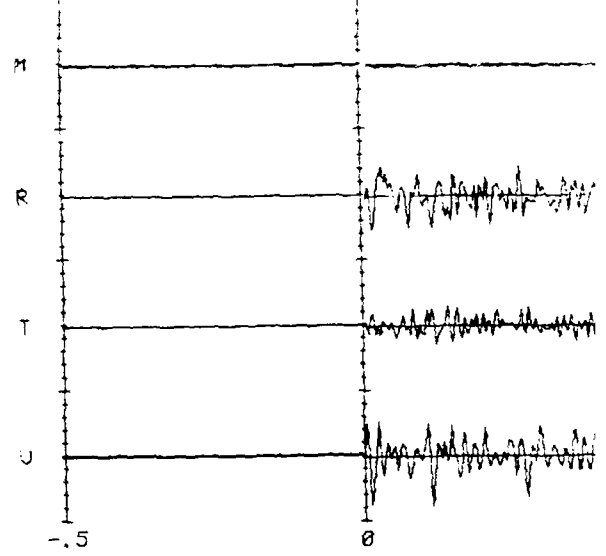
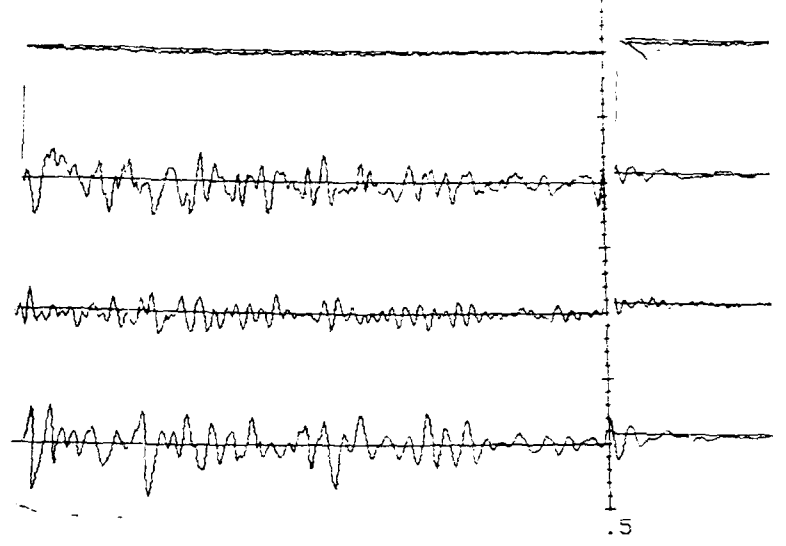
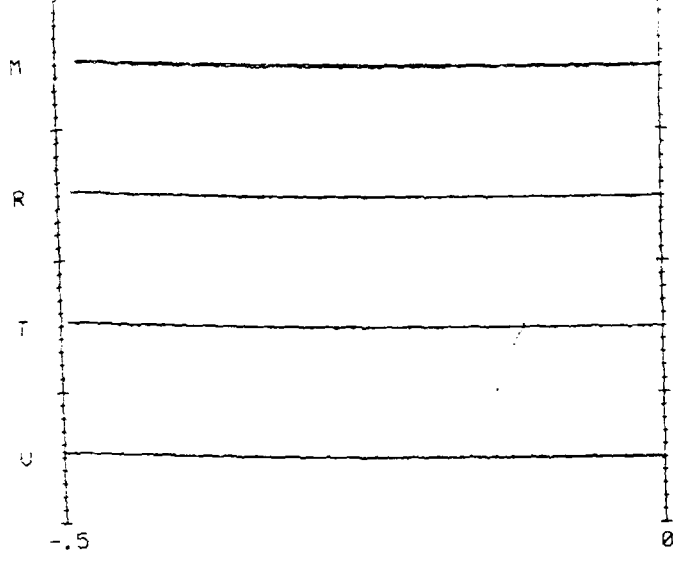
SET-UP INFORMATION

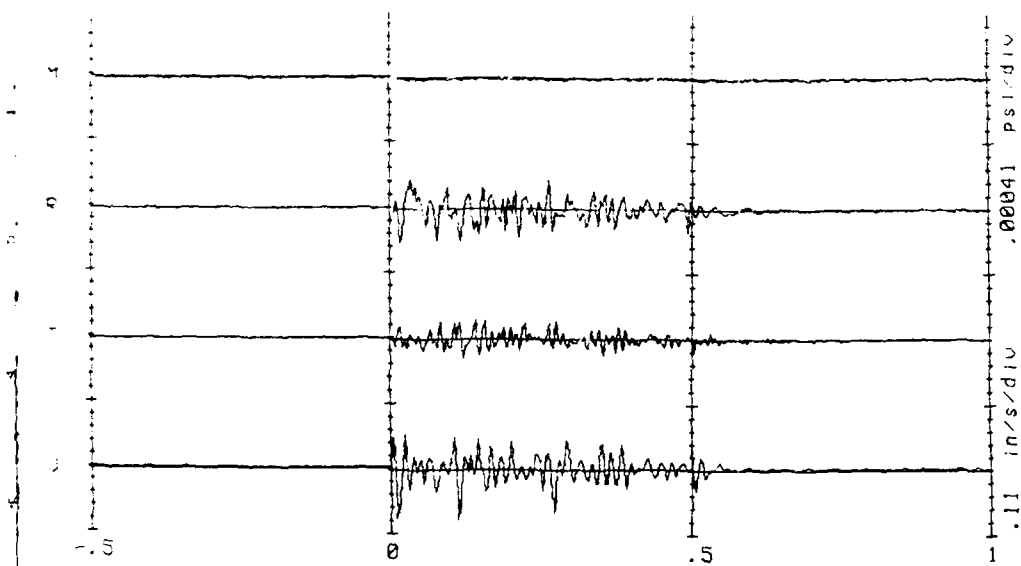
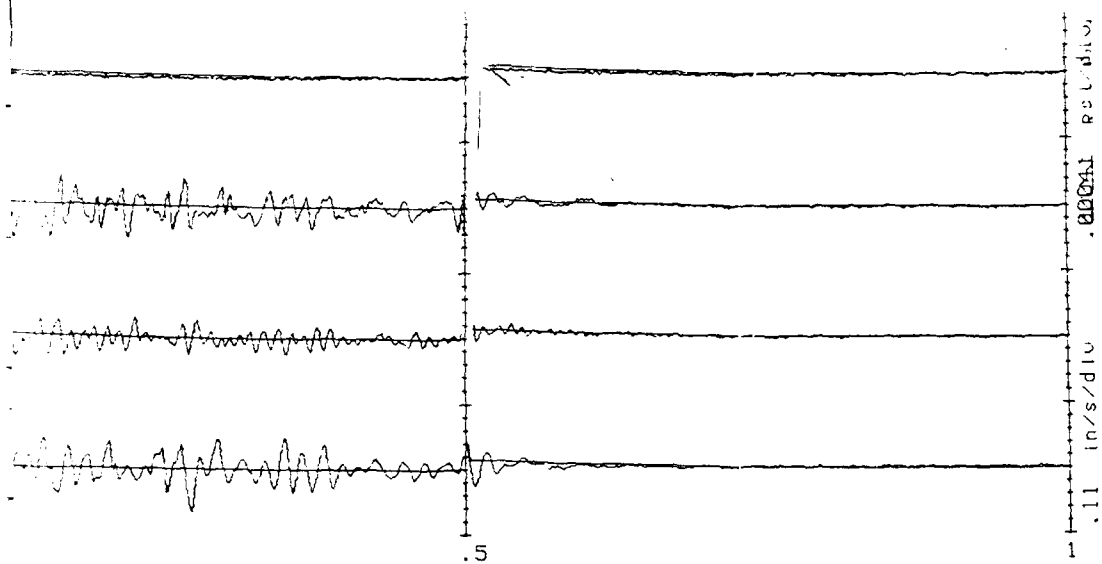
MODE: Single Event
 SOURCE: Geophone
 GEO TRIGGER LEVEL: .02 in/s
 RECORD TIME: 1 second(s)
 TRIGGERED at 16:35:33 01-11-1991

MEASUREMENTS

	U	T	K
PPU (in/s)	.46	.2	.3
TIME (ms)	116	14	14
FREQ (Hz)	47	85	47
PPA (g)	.92	1.78	1.34
PUS (in/s)	.49 (116 ms)		
PSPL (psi)	.000082 (89 db)		

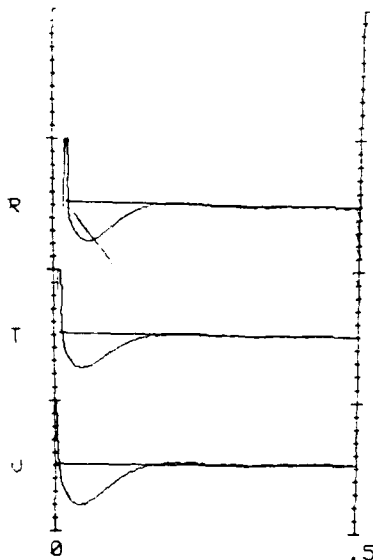
SERIAL#:U5-L069020
 CALIBRATED BY:
 THOMAS INSTRUMENTS INC.
 JUNE 15, 1990





G-150

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
HLOW
DISTANCE FROM SENSOR TO BLAST
BLAST C-37-20
NOTES
BLAST C-37-19

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
65
NUMBER OF CAPS
60
NUMBER OF DELAYS
20
MAX WEIGHT/DELAY
2.5
AVERAGE DEPTH OF HOLE
4
NUMBER OF HOLES
60
SPACING & BURDEN
3.5X3.5
TYPE OF BLAST
PRIM

SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
HLOW
DISTANCE FROM SENSOR TO BLAST
BLAST C-37-20
NOTES
BLAST C-37-19

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
65
NUMBER OF CAPS
60
NUMBER OF DELAYS
20
MAX WEIGHT/DELAY
2.5
AVERAGE DEPTH OF HOLE
4
NUMBER OF HOLES
60
SPACING & BURDEN
3.5X3.5
TYPE OF BLAST
PROD
& PRESPLIT
WEATHER
SUNNY
MATS, OVERBURDEN, SAND BLANKETS
MATS

CUCHILLO DAM PROJECT
BLAST #C37-21
12 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 32 FEET FROM BLAST.

TRIGGER LEVEL WAS NOT EXCEEDED DURING MONITORING INTERVAL.

THOMAS INSTRUMENTS
SPRINGFIELD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

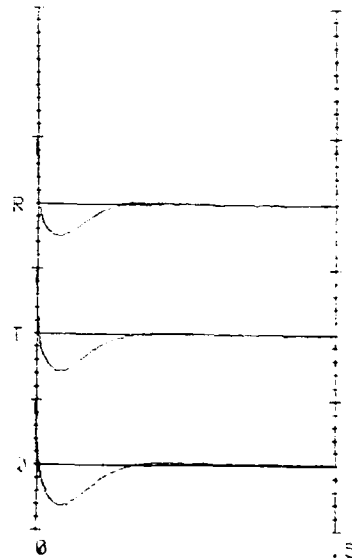
SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 1 second(s)
START TIME: 10:57:01 01-12-1991
FINISH TIME: 09:55:59 11-29-1990

** TRIGGER LEVEL WAS NOT EXCEEDED **
** DURING MONITORING INTERVAL **

SERIALIZED BY: JES-1069020
THOMAS INSTRUMENTS INC.
JUNE 15, 1990

SENSOR TEST

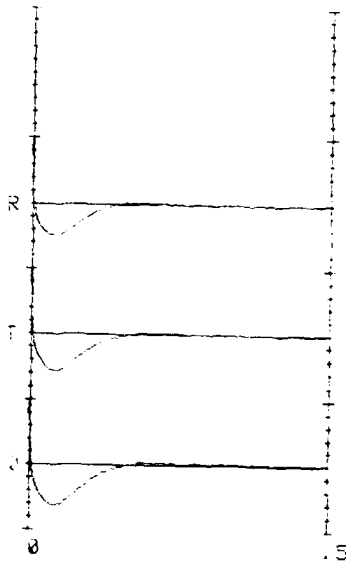


SEISMOGRAPH LOG

PROJECT: CUEHILL DAM
CLIENT: U.S. ARMY
OPERATOR: J. STEPHENSON
DATE: 06/15/1990

SEISMOGRAPH SYSTEM
 THOMAS INSTRUMENTS INC.
 JUNE 15, 1990

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
 CLIENT
 OPERATOR
 SEISMOGRAPH LOCATION
 DISTANCE FROM SENSOR TO BLAST

NOTES
 BLAST C-32-21

BLASTING LOG

EXPLOSIVES SPECIFICATION
 241600
 TOTAL WEIGHT OF EXPLOSIVES USED
 40
 NUMBER OF CAPS
 40
 NUMBER OF DELAYS
 40
 MAX. HEIGHT DELAY
 2
 AVERAGE DEPTH OF HOLE
 4
 NUMBER OF HOLES
 40
 SPACING X BURDEN
 7.5 X 3.0
 TYPE OF ROCKET
 1
 WEATHER
 PARTIAL CLOUDS
 PARTIAL CLOUDS

CUCHILLO DAM PROJECT
BLAST #C37-22
14 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 120 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.09 in/sec.

ENERGY RATIO - VERTICAL = 0.00424
ENERGY RATIO - TRANSVERSE = 0.00059
ENERGY RATIO - RADIAL = 0.00092

SPC dB

MODE: Single Event

SOURCE: Geophone

GEO TRIGGER LEVEL: .02 in/s

RECORD TIME: 1 second(s)

TRIGGERED at 16:17:57 01-14-1991

MEASUREMENTS

	U	T	R
PPI ₀ (in/s)	.05	.07	.07
TIME (ms)	329	464	442
FREQ (Hz)	77	23	30
PPA (g)	2.41	.56	.91

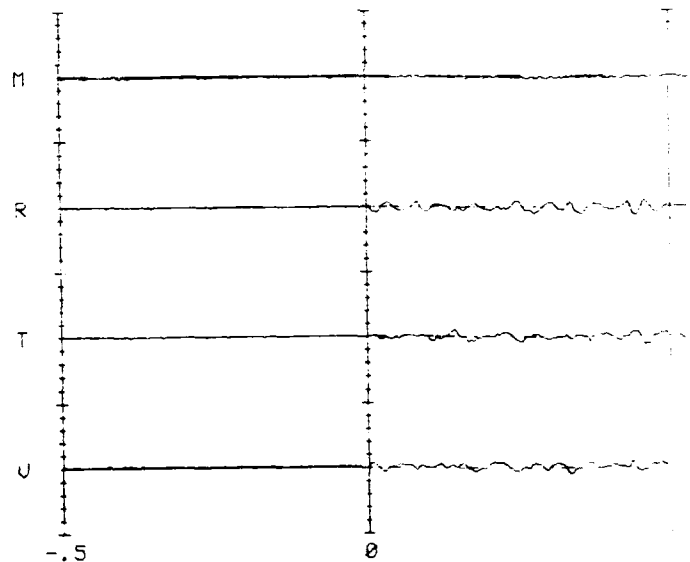
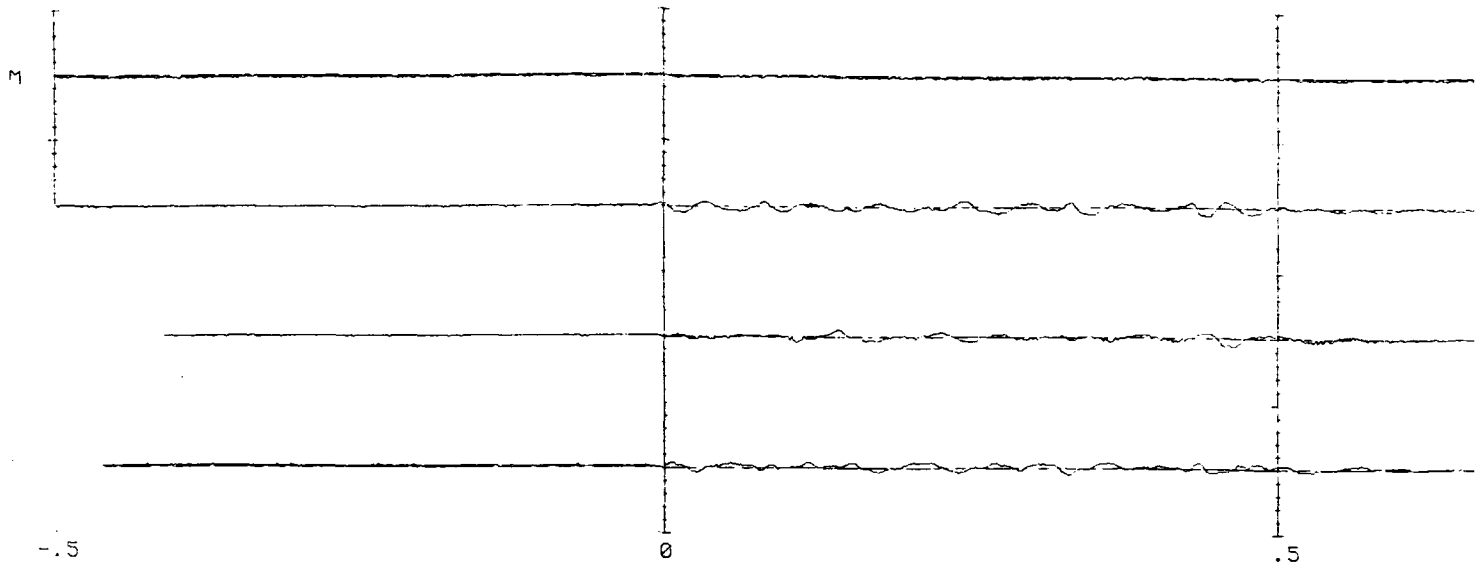
PUS (in/s) .09 (457 ms)
 PSPL (psi) .000002 (89 db)

SERIAL #: U5-L069020

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JUNE 15, 1990

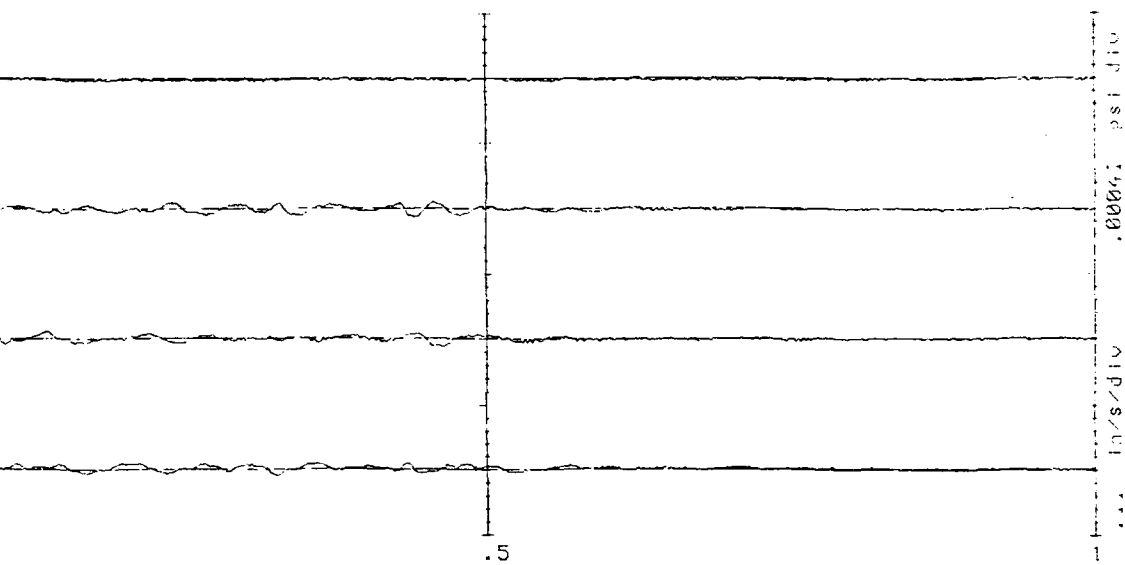
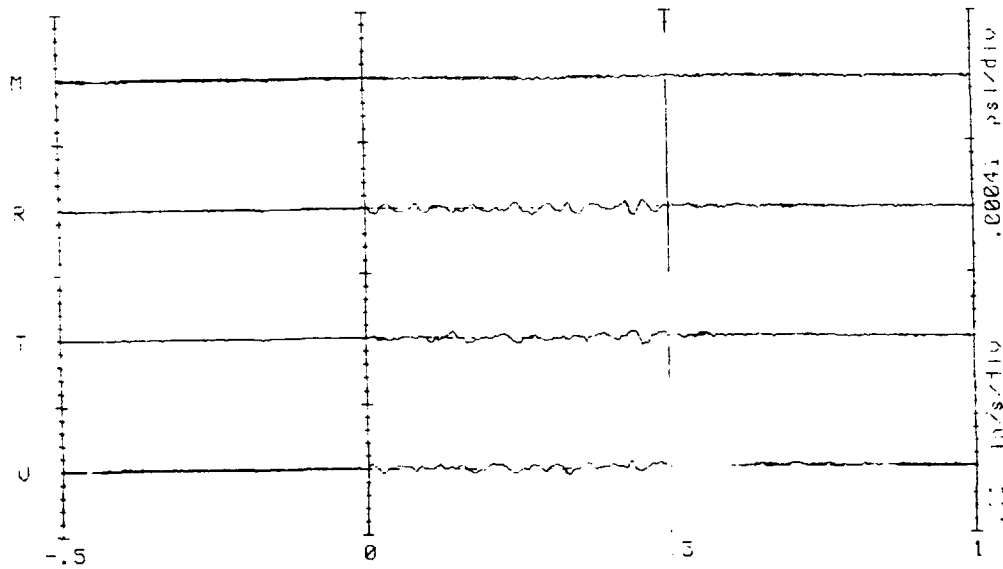


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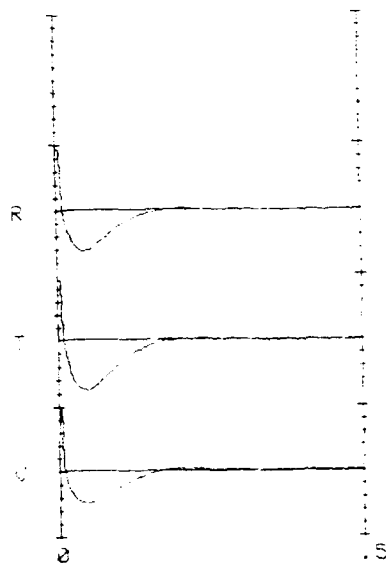
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JUNE 15, 1990



SEISMOPHOTO



SEISMOPHOTO LOG

PROJECT
 CUCUILLO DAM
 CLIENT
 PCL
 OPERATOR
 KEVIN STEVENSON
 SEISMOPHOTO LOCATION
 HI LOW
 DISTANCE FROM SENSOR TO BLAST
 120
 NOTES
 BLAST C-32-22

BLAST LOG

EXPLOSIVES SPECIFICATIONS
 2X18CM
 TOTAL WEIGHT OF EXPLOSIVES USED
 40
 NUMBER OF CAPS
 20
 NUMBER OF DELAYS
 30
 MAX DELAY/DELAY
 2.5
 AVERAGE DEPTH OF HOLE
 1
 NUMBER OF HOLES
 30
 SPACING & BURIED
 1.5X3.5
 TYPE OF BLAST
 FREE

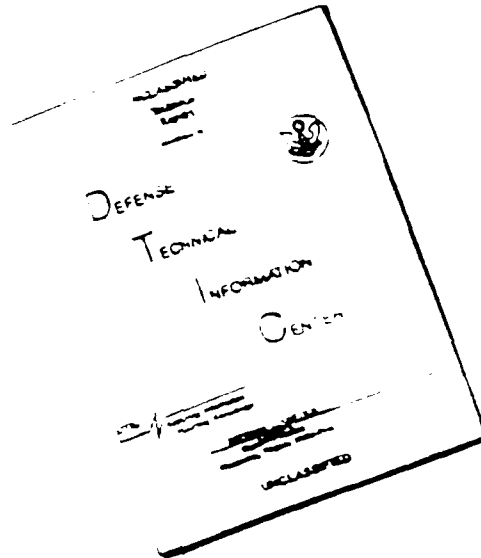
SEISMOGRAPH LOG

PROJECT
CUCUTLO DAM
CLIENT
PCL
OPERATOR
KEITH STEPHENSON
SEISMOGRAPH LOCATION
HI OM
DISTANCE FROM SENSOR TO BLAST
120
NOTES
BLAST 0-32-22

BLAST LOG

EXPLOSIVES SPECIFICATIONS
2X16CM
TOTAL WEIGHT OF EXPLOSIVES USED
40
NUMBER OF CAPS
20
NUMBER OF DELAYS
30
MAX WEIGHT/DELAY
2.5
AVERAGE DEPTH OF HOLE
3
NUMBER OF HOLES
30
SPACING X BURIED
3.5X3.5
TYPE OF BLAST
EPD
& PRESPLIT
WEATHER
SHINY
MATS, GUNPOWDER, SAND BLANKET
MATS

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