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Hammer Drill Evaluation

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16. ABSTRACT

This report summarizes the findings of a space-financed research project to gather information on equipment, initial and operating costs, and results of the use of the hammer drill.

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November 2005, Division of Research and Innovation

State of California 3901 Business and Transportation Agency

Memorandum

To : Mr. J. L. Beaton

Date: June [illegible], [illegible]

From: Mr. [illegible] W. Mearns

File : Lab. [illegible]

From : Department of Public Works—Division of Highways
Materials and Research Department

Subject: Hammer Drill Evaluation

This report summarizes the findings of a state-financed research project to gather information on equipment, initial and operating costs, and results of the use of the hammer drill.

The hammer drill was found to be easy to use and to drill very rapidly in hard rock. The cuttings were of such size as to permit identification of the material with reasonable confidence. Although surveying and visual inspection of the test boring could only be partially completed because of blockage of the borings, the work that was done indicates the holes are as straight as a rotary drilled boring and the sidewalls are probably smoother and less disturbed.

Based on this study, we recommend the hammer drill for obtaining subsurface information in those areas where the rock is too hard to permit economic coring or where time is a factor. Our drill rig could be modified to perform this type of operation.

District 08 has drilled three exploratory borings in an effort to develop a source of water for a proposed Maintenance Station. This work was done under Contract No. 08-486144 by the Howard Pump Co. of Barstow, California.

The area in which the work was done is approximately 12 miles north of Amboy adjacent to the future Ste. 40. The general appearance of the area can be seen in Plates 1 and 2.

The first exploratory boring encountered hard fresh quartz diorite at a depth of 7[illegible] feet after drilling in alluvial fan deposits. These first 7[illegible]' were drilled using normal rotary drilling methods with drill mud as a circulating medium. The drilling time was

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The rotary drill rates ranged from about 5' to nearly 15 feet per hour and for the hammer drill from about 11 to 42 feet per hour. The hammer drill had a decided advantage for the contractor since his bid was based on linear feet of hole. The bid prices were $7 per foot for drilling in alluvium and $12 per foot for drilling in hard rock.

The rock cuttings from the rotary drill operation are of a satisfactory size and condition for material identification and description. On the basis of the data already presented it would seem reasonable to use a hammer drill to complete borings in very hard rock where normal rotary methods become too expensive.

To provide further information for evaluating the hammer drill, it was decided to survey these two borings to establish how straight they were and also to inspect the boring walls with the borehole TV camera.

Plates 14 through 18 show the surveying instrument of the Eastman Oil Well Surveying Company. The surveying was performed by Eastman and the data was interpreted and reported by them. A copy of their report is attached. Unfortunately both of the borings had blocked off at relatively shallow depths and only a partial profile of the borings could be obtained.

In general the data shows Hole 1 to be slightly more vertical probably because of the more homogeneous material but possibly because of the use of the rotary drill in Hole 2. The deviation in both borings seems small and very consistent. The deflection in both borings is in the same direction and may be related to geologic structure. Based on data from these two borings, it seems that even under adverse conditions the hammer drill produced a regular and nearly straight boring at least to the depths we could survey.

The boring walls were inspected down to the depth at which the borings were blocked by using the TV borehole camera which belongs to the Department of Water Resources. Plates 19 through 22 show the equipment and set up of this operation.

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The walls of Hole 1 were generally smooth and clean. The material was clearly recognizable as a granitic rock and veins, fractures (or joints), and discolorations could be readily identified. Some fracture zones exhibited cavities and one of these was probably the source of the material which blocked the boring. Water was seeping from a fracture at 160 feet and the boring walls were wet to the depth of our inspection.

The walls of Hole 2 were not as smooth as Hole 1 and the drilling mud used in the rotary drilling had formed a good wall cake and only at a few depths (usually where water was seeping into the boring) could the in-place material be observed. It was impossible to identify either material or structure due to wall cake and the variability of the material.

No evaluation was made on Hole 3 because it was still being drilled at the time we did the field portion of this study.

R W Mearns

R. W. Mearns
Assoc. Engineering Geologist

RWM:ic

Attachments
cc:Research Coordination
CC Peterson-4
M&R Library-10
TW Smith
GA Hill

A P P R O V E D

8/9, 1971

John L. Beaton
Materials and Research Engr.

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Boring 1

Generalized Log

0 - 78 feet	-	fine to coarse grained sand containing quartz, feldspar, biotite, magnetite, calcite and some rhyolite fragments.
78 - 1002 feet	-	relatively fresh hard gray fine to medium grained quartz diorite. This formation is locally fractured and iron stained.

Boring 2

Generalized Log

0 - 120 feet	-	granitic sand, quartz, feldspar, some biotite, and rhyolite.
120 - 100 feet	-	same as above, cemented.
100 - 400 feet	-	rhyolite and rhyolite tuff, feldspar, quartz, biotite, volcanic glass and local copper.
400 - 495 feet	-	hornblende andesite and andesite breccia, locally altered.
495 - 730 feet	-	granitic and volcanic sand grains, fine to coarse grained, with quartz, feldspar biotite and magnetite. Some relatively thin layers of clay, volcanics and tuff.
730 - 750 feet	-	rhyolite
750 - 753 feet	--	basalt
753 - 765 feet	-	rhyolite
765 - 735 feet	-	basalt
735 - 820 feet	-	rhyolite
820 - 850 feet	-	granitic and volcanic sand with quartz, feldspar, magnetite, calcite, hornblende and biotite.

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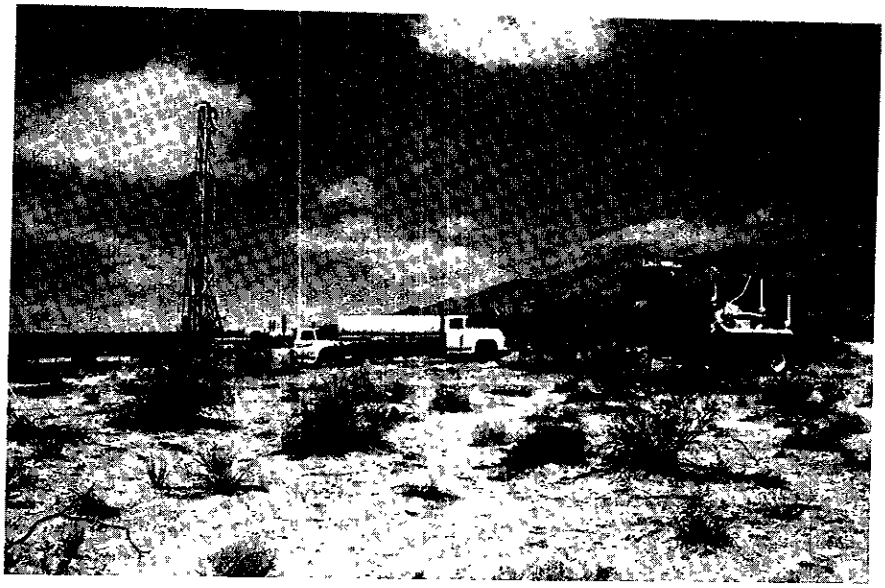

Plate 1 Drilling Site Appearance

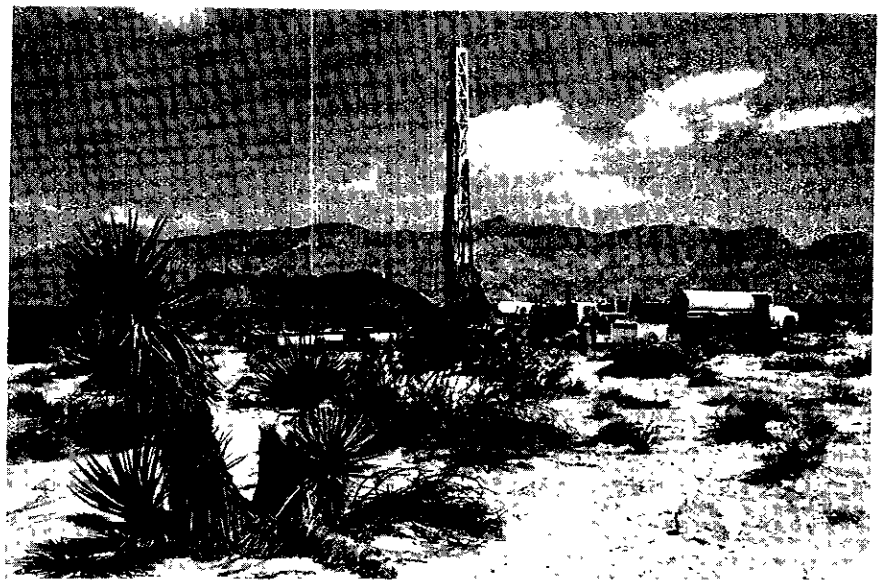

Plate 2 Drilling Site Appearance

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Plate 3 Mast Crown

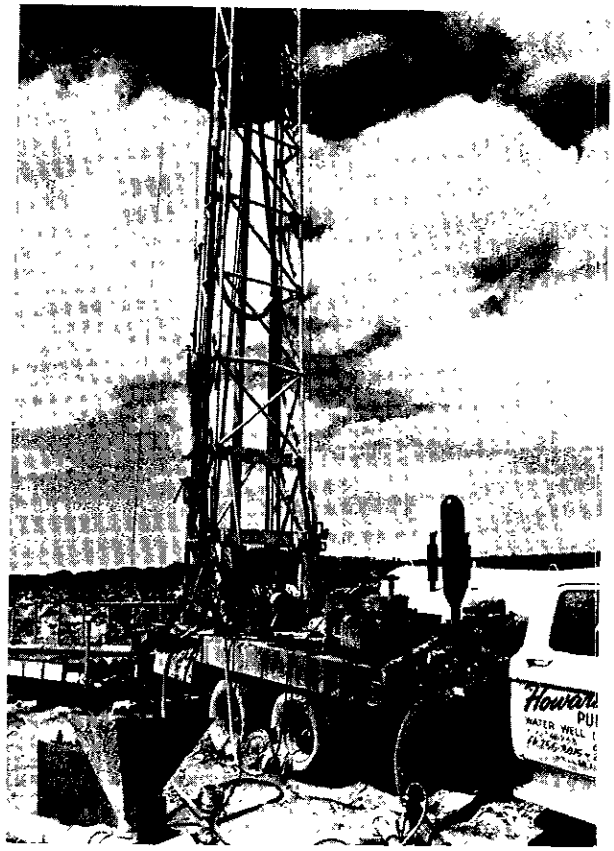

Plate 4 Mast Base and Drill Rig

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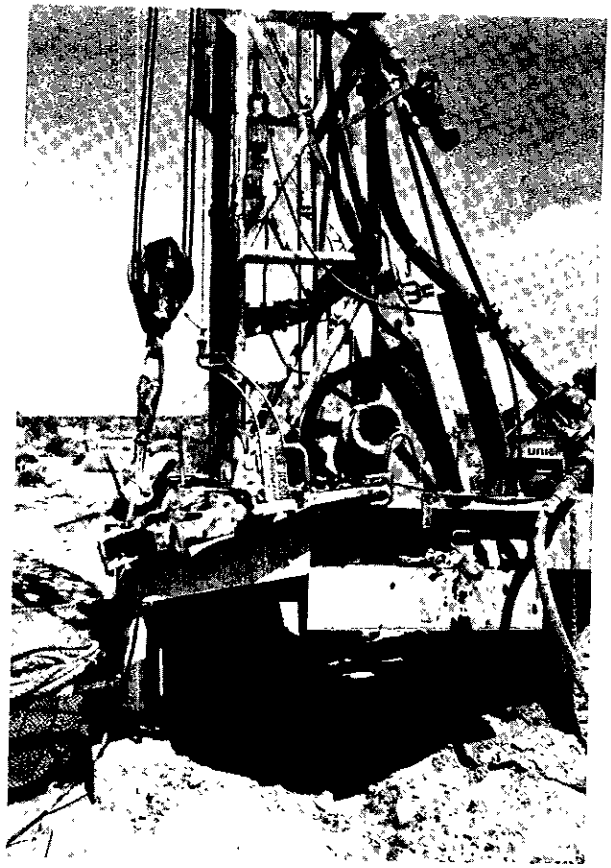

Plate 5 Drill Rig
Draw Works

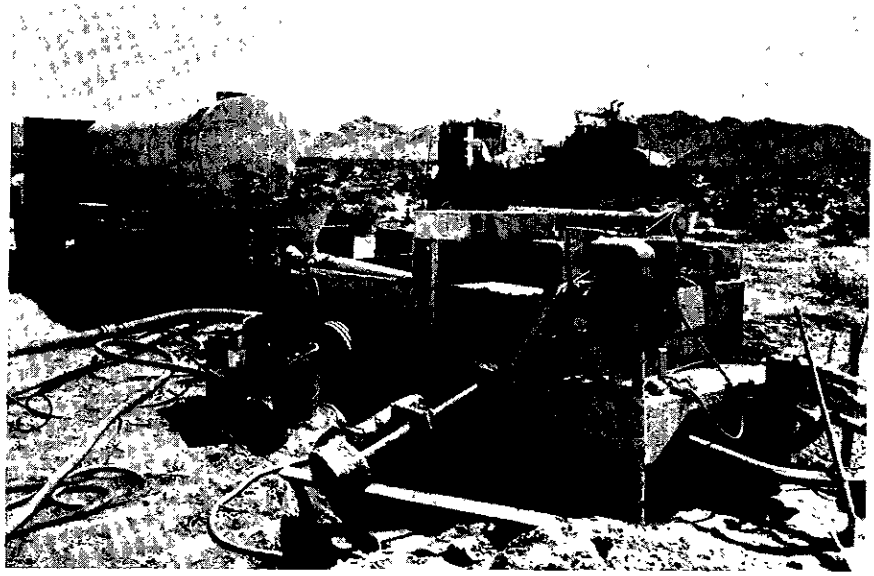

Plate 6 Trailer mounted mud pit with vibratory cutting screen

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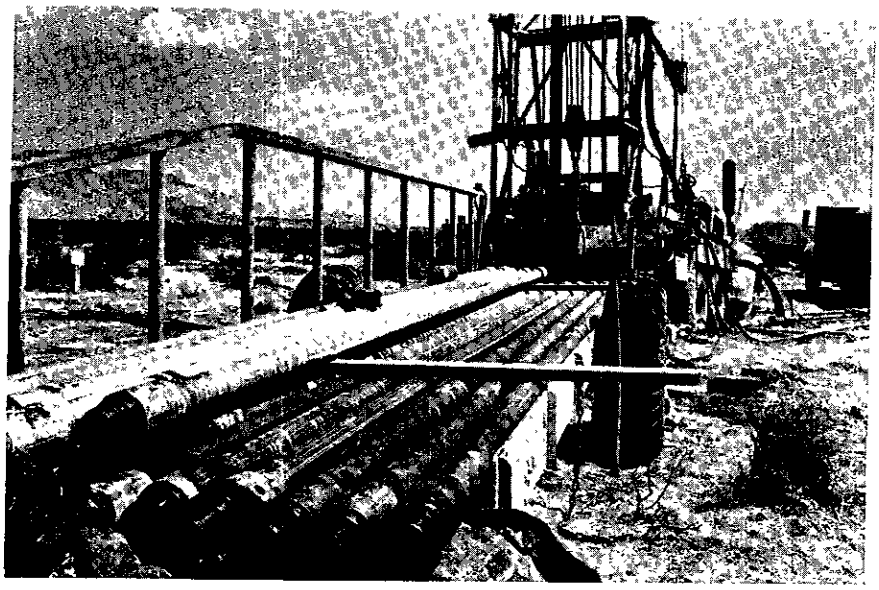

Plate 7 Drill Rod

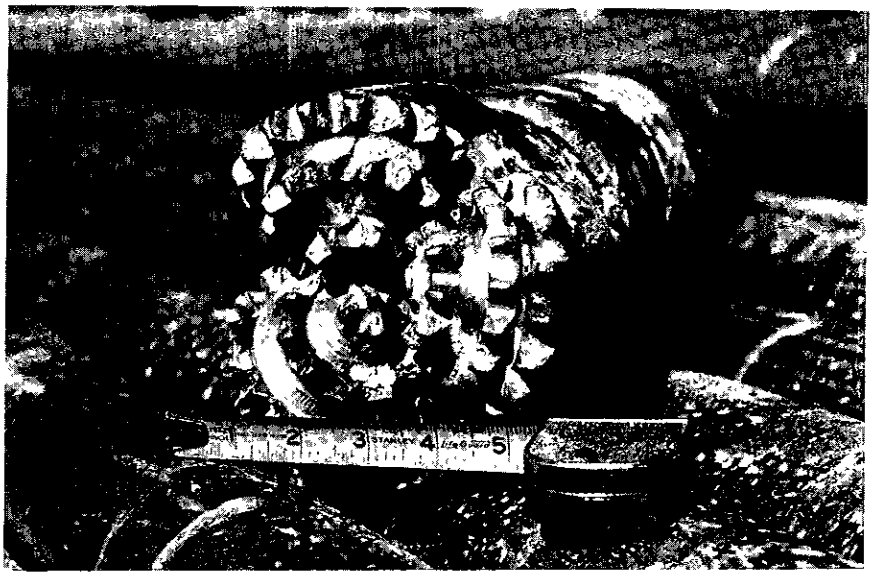

Plate 8 Rotary Bit

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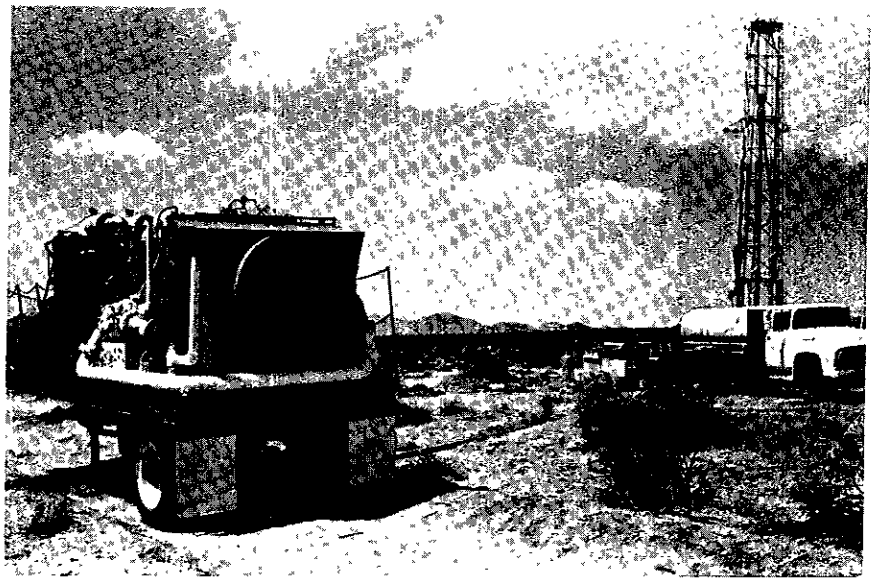

Plate 9 Air Compressor

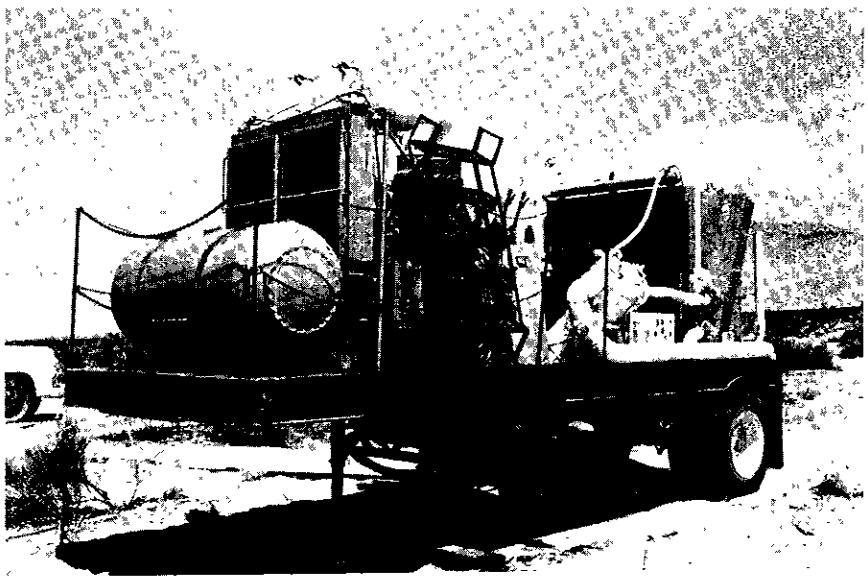

Plate 10 Air Compressor

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Plate 11 Drill collar with internal air activated hammer

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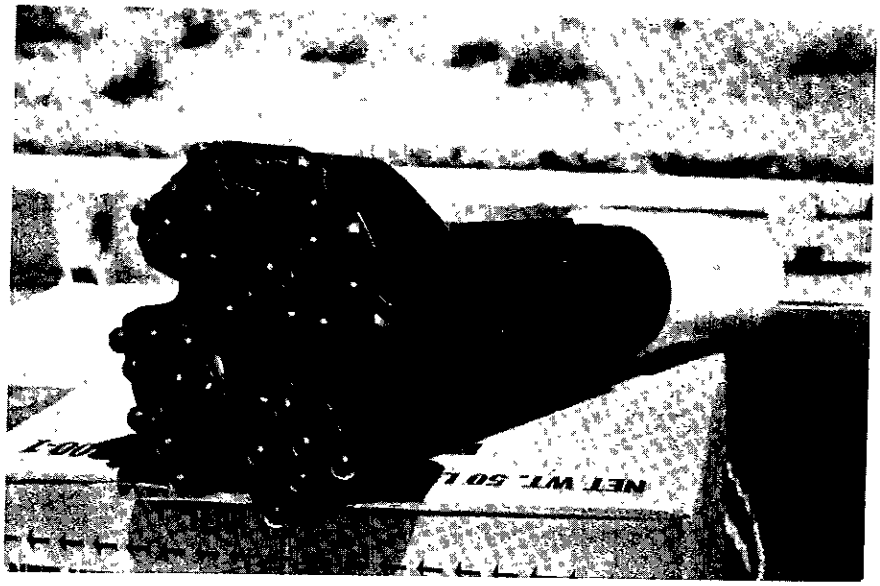

Plate 12 Hammer Drill Bit

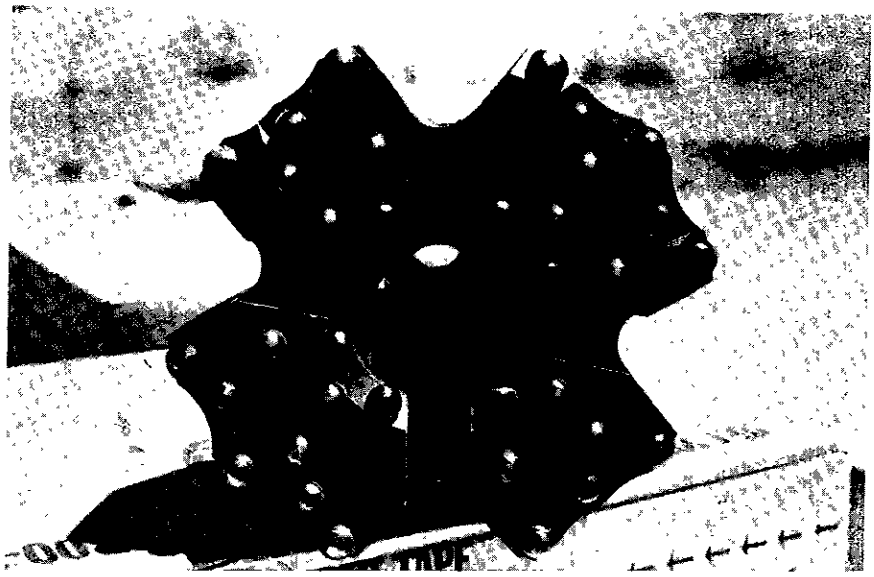

Plate 13 Hammer Drill Bit

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Plate 14

Boring Survey Instrument -
Timing mechanism and position
sensors.

Plate 15

Boring Survey Instrument
Indicator lights

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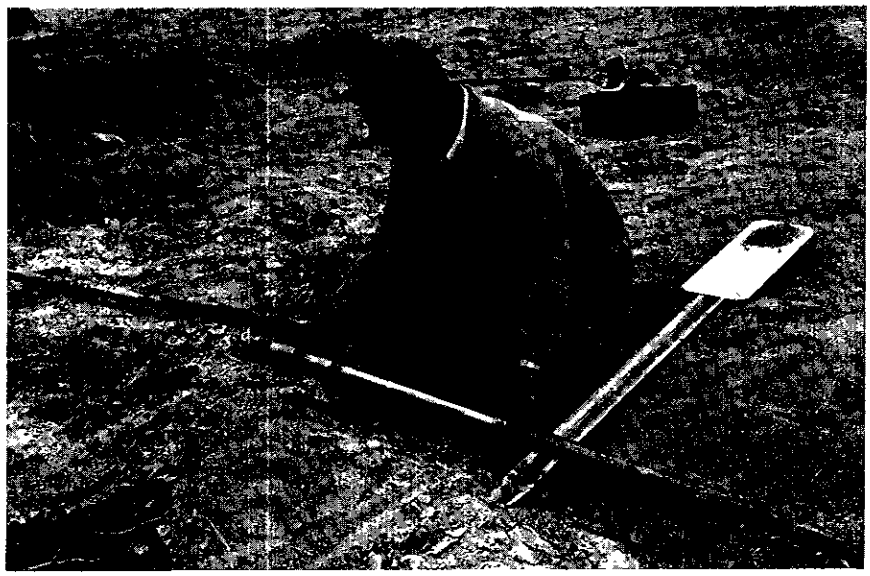

Plate 16 Assembly of Boring Survey Instrument

Plate 17 Assembly of Boring Survey Instrument

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Plate 18 Lowering Boring Survey Instrument

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Plate 19 Equipment Layout for Borehole TV Camera

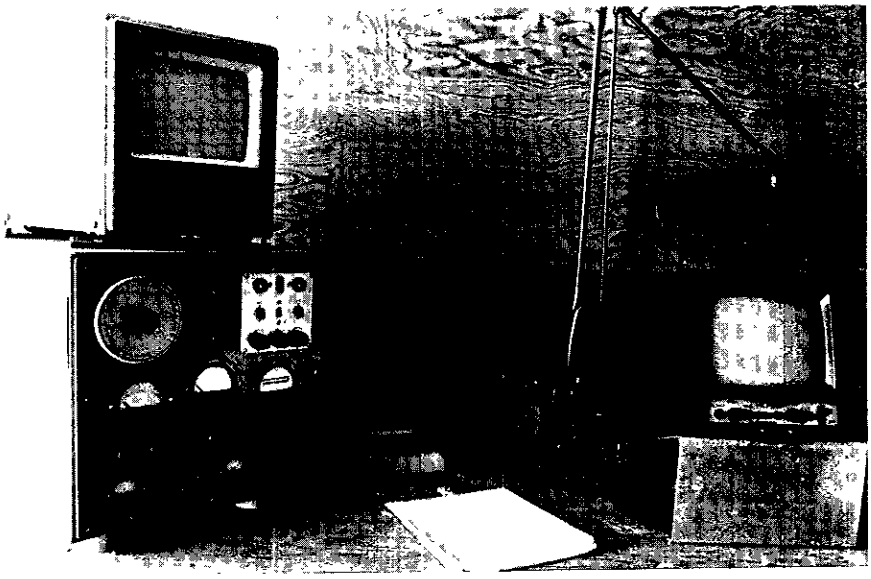

Plate 20 Borehole TV Camera Console

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Plate 21 Borehole TV Camera

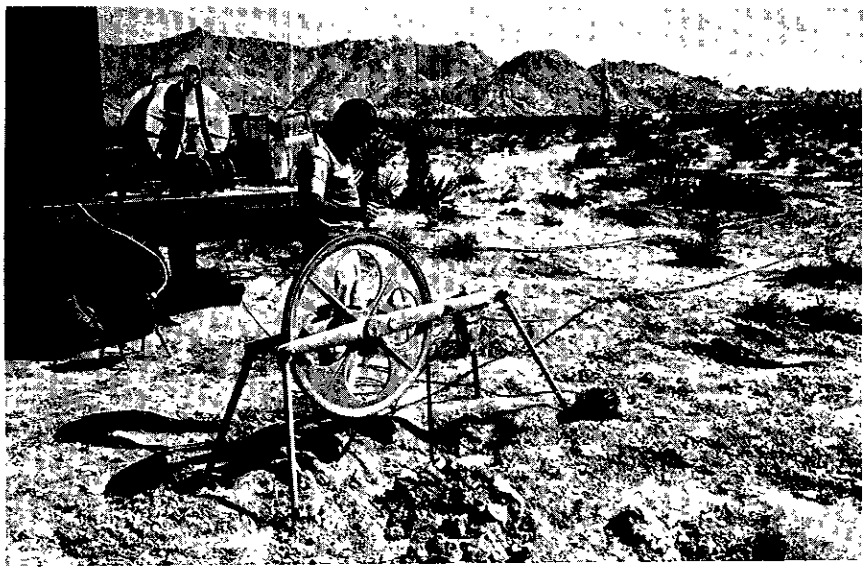

Plate 22 Lowering Camera into Boring

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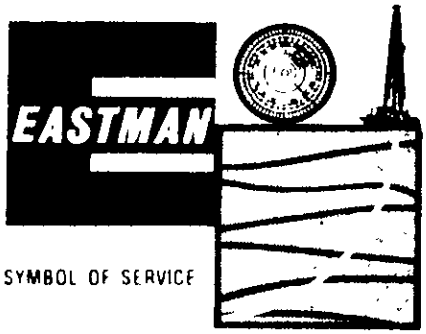

REPORT
of
SUB-SURFACE
DIRECTIONAL
SURVEY

DIVISION OF HIGHWAYS
COMPANY

AMBOY Nº 1&2
WELL NAME

AMBOY, CALIFORNIA
LOCATION

JOB NUMBER	TYPE OF SURVEY	DATE
L4-2871-A&B	MULTIPLE SHOT	21 APRIL '71

SURVEY BY LONG BEACH OFFICE

FORM D-303 R3

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EASTMAN
SYMBOL OF SERVICE

RECORD OF SURVEY

Dec'l. Correction 16°

JOB NO. L4-2871-A DATE April 21, 1971 CHECKED BY

STATION	MEASURED DEPTH	DRIFT ANGLE	TRUE VERTICAL DEPTH	COURSE DEVIATION	DRIFT DIRECTION	RECTANGULAR COORDINATES NORTH	SOUTH	EAST	WEST
1	100 00	00°15'	100 00	44	N 46°00'E	31		32	
2	150 00	00°15'	150 00	22	N 02°00'E	53		33	
3	200 00	01°30'	199 98	1 31	S 51°00'W		29		69
4	250 00	02°15'	249 94	1 96	S 59°00'W		1 30		2 37
5	300 00	02°30'	299 89	2 18	S 53°00'W		2 61		4 11
6	347 00	04°00'	346 78	3 28	S 35°00'W		5 30		5 99
			CLOSURE	8.00	S 48°30'W				

Well #1

FORM NO. C—303P

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EASTMAN

SYMBOL OF SERVICE

RECORD OF SURVEY

Dec'l. Correction 16°

JOB NO. L4-2871-B DATE April 21, 1971 CHECKED BY

STATION	MEASURED DEPTH	DRIFT ANGLE	TRUE VERTICAL DEPTH	COURSE DEVIATION	DRIFT DIRECTION	RECTANGULAR COORDINATES			
						NORTH	SOUTH	EAST	WEST
1	50 00	00°15'	50 00	22	S 84°00'E		02	22	
2	100 00	00°30'	50 00	44	S 14°00'W		45	11	
3	150 00	01°15'	149 99	1 09	S 66°00'W		89		89
4	200 00	02°45'	199 98	2 40	S 50°00'W		2 43		2 73
5	250 00	03°45'	249 87	3 27	S 42°00'W		4 86		4 91
6	275 00	04°15'	274 80	1 85	S 38°00'W		6 32		6 05
			CLOSURE	8.75	S 43°45'W				

Well #2

FORM NO. C—203P