AD-A112 959 ERTEC WESTERN INC LONG BEACH CA F/G 13/2

MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE--ETC(U)

SEP 81 F04704-80-C-0006

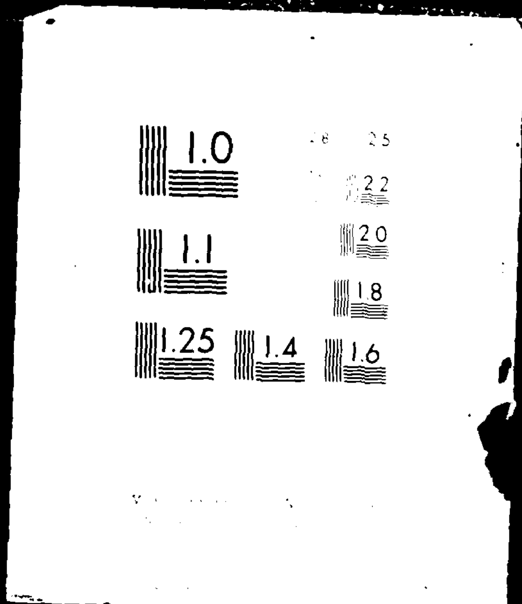
UNCLASSIFIED E-TR-53-2 NL

1 OF 3

AD A
112959

1 OF 3

AD A 112959



E-TR-53

PHOTOGRAPH THIS SHEET

DTIC ACCESSION NUMBER: AD A113 389

LEVEL: III

INVENTORY: 1

E-TR-53-II

DOCUMENT IDENTIFICATION

This document has been approved for public release and sale; its distribution is unlimited.

DISTRIBUTION STATEMENT

ACCESSION FOR		
NTIS	GRA&I	[X]
DTIC	TAB	[ ]
UNANNOUNCED		[ ]
JUSTIFICATION		
BY		
DISTRIBUTION /		
AVAILABILITY CODES		
DIST	AVAIL AND/OR SPECIAL	
A		

DISTRIBUTION STAMP

DTIC COPY INSPECTED 3

DTIC
APR 0 5 1982
E

DATE ACCESSIONED

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DTIC FORM OCT 79 70A

DOCUMENT PROCESSING SHEET

Ertec

The Earth Technology Corporation

MX SITING INVESTIGATION
WATER RESOURCES PROGRAM
REVIEW DRAFT
WATER APPROPRIATIONS HEARING
PRESENTATION AND SUPPORT
DOCUMENTATION

DRY LAKE VALLEY, NEVADA

VOLUME II

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office
Norton Air Force Base, California 92409

Prepared by:

Ertec Western, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

30 September 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: E-TR-53-II	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): Water Resources Program Review Draft Water Appropriations Hearing Presentation + Support Documentation Dry Lake Valley, NV Vol. II	5. TYPE OF REPORT & PERIOD COVERED: Draft
	6. PERFORMING ORG. REPORT NUMBER: E-TR-53-II
7. AUTHOR(s): Ertec	8. CONTRACT OR GRANT NUMBER(s): FO4704-80-C-0006
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Ertec Western Inc. (formerly Fugro National) P.O. Box 7765 Long Beach Ca 90807	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 64312 F
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Department of the Air Force Space and Missile Systems Organization Norton AFB Ca 92409 (SAMSO)	12. REPORT DATE: 30 Sep 81
	13. NUMBER OF PAGES: 62
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report)
	15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Distribution Unlimited

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Well logs, Well Design, Gravity Surveys, [illegible]

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report represents integration of two years of intensive MX Water Resources Program activities in NV-UT siting area

DD FORM 1473 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LIST OF APPENDICES

A1.0

DRY LAKE VALLEY SECTION: MX SITING INVESTIGATION, WATER MANAGEMENT REPORT

4.5 DRY LAKE VALLEY

4.5.1 Hydrologic Summary

Dry Lake Valley is a topographically open basin in Lincoln County, Nevada. Of the approximately 700 mi^2 (1813 km^2) of valley area, 310 mi^2 (802.9 km^2) are suitable for MX deployment (Table 4-10).

Dry Lake Valley is hydrologically connected with Muleshoe Valley, and the two valleys are considered as a single hydrographic unit by the Nevada State Engineer. Ground water in Dry Lake and Muleshoe valleys is essentially undeveloped, however, there are 20 acre-ft/yr (0.02 hm^3/yr) of pending applications and 19 acre-ft/yr (0.02 hm^3/yr) of certificated or permitted rights (Woodburn and others, 1981) for ground-water withdrawal. In addition, there is 21 acre-ft/yr (0.02 hm^3/yr) of surface water use (DRI, 1980) in the valley.

The perennial yield is estimated at 3000 acre-ft/yr (3.70 hm^3/yr) for the Dry Lake-Muleshoe basin (State of Nevada, 1971). The combined peak-year MX water requirements in the two valleys, 3373 acre-ft/yr (4.16 hm^3/yr) for Dry Lake and 968 acre-ft/yr (1.19 hm^3/yr) for Muleshoe, in 1984 would exceed the Dry Lake-Muleshoe basin perennial yield by 1341 acre-feet (1.65 hm^3). However, the combined total ground water in storage within the upper 100 feet (30 m) of saturated sediments in Dry Lake and Muleshoe valleys is estimated at 2.8 million acre-feet (3452.4 hm^3) (State of Nevada, 1971). This suggests that the ground-water basin could sustain the peak MX water demand if temporary overdraft is allowed by the Nevada State Engineer.

GENERAL PHYSIOGRAPHY

Valley Area	Valley Length	Avg. Valley Width	Suitable Area	Avg. Valley Floor Elevation
700 sq mi	38 mi	18 mi	310 sq mi	4800 ft

GENERAL HYDROLOGY

Aquifer	Depth to Water	Potentiometric Elevation Range	Transmissivity	Storativity
Valley-fill	300-800 ft	4200-5000 ft	3300 sq ft/day	0.06
Carbonate	850 ft	–	13,000 sq ft/day	–

Perennial Yield	Ground-Water Recharge (ppt)	Interbasin Recharge	Interbasin Discharge	ET	Surface Discharge
3000	2700	2100	5000	minor	–

WATER QUALITY

Total Samples	Suitable for Consumption	Exceeds (1) Standards	Suitable for Construction	Exceeds * Standards
6	5	1	6	0

WATER USE AND APPROPRIATIONS (2)

Source	Current Use	Applications	Certificates/ Proofs/Permits	Availability (3)
Ground Water	0	20	19	3000/2981
Surface Water	21	2596	–	–

MX WATER REQUIREMENTS

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Construction Operation	196	414	3373	2458	2014	225	0	0	0

(1): Well near Bristol Silver Mine - exceeds state primary standard for nitrate
(2): Dry Lake and Muleshoe valleys combined
(3): Perennial Yield - Current Use / Perennial Yield - Certificated Use
* : Portland Cement Association recommendations (1966).

Note: All units are in acre-feet per year unless otherwise noted.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

HYDROLOGIC SUMMARY
DRY LAKE VALLEY, NEVADA

28 SEPT 81

TABLE 4-10

Surface water supplies are limited to ephemeral streamflow and springs. The springs are located mostly in the mountains, are generally unaccessible, and have low discharge (less than 2 gpm [0.13 l/s]).

A 10-day aquifer pump test conducted by Ertec in the southern part of the valley (3S-64E-12ca) (number 40433) indicates a generally unconfined valley-fill aquifer having an average transmissivity of 3300 ft^2/day (306.6 m^2/day) and a storativity of 0.06. Confined or semiconfined conditions are, however, expected in other portions of the valley due to the complex nature of the valley fill which was found to be composed of variable thicknesses of clay, silt, sand, and gravel.

The regional carbonate aquifer underlying and adjacent to the valley fill is considered to have a high potential for development. Data from an aquifer test performed by Ertec in the northern part of the valley (3N-63E-27cc) indicate a transmissivity in the carbonate aquifer of 13,000 ft^2/day (1208 m^2/day). The test well was pumped at a sustained rate of 106 gpm (7 l/s) with a drawdown of only 2 feet (0.6 m). The hydrostratigraphic unit (Guilmette Formation and Simonson Dolomite) penetrated at the test site is considered to be a high-yield aquifer based on these investigations.

Water-chemistry tests on water samples collected by Ertec from both the valley-fill and carbonate aquifers show that all but one well, 3N-65E-21dba, meet primary and secondary drinking water standards for the State of Nevada (Appendix D). This well, located in the northeastern part of Dry Lake Valley was found to have a nitrate concentration of 32 mg/l, which exceeds the 10 mg/l standard for nitrate. This well was, however, used for mining operations by the Bristol Silver Mine and is thought to be contaminated by mining-related activity.

4.5.2 Water-Supply Sources

Development of the valley-fill aquifer is the preferred source for the MX water supply in Dry Lake Valley (Table 4-11). Development of the valley-fill aquifer is projected to have the least potential impact on local water users and the environment, the highest physical development potential, and to be the least costly and the most timely to develop of the four water-supply options. The legal availability of ground water from the valley-fill aquifer was ranked second to importation because the estimated perennial yield of the hydrographic basin can supply only about 70 percent of the peak-year requirements. The quantity of ground water presently available for development, based on certificated and permitted water rights, is 2981 acre-ft/yr (3.68 hm^3/yr). The estimated combined peak-year water requirement for Dry Lake and Muleshoe valleys is 4341 acre-feet (5.35 hm^3) during 1984. However, there is essentially no ground-water use in Dry Lake Valley, and the State Engineer need not limit his decisions on the approval of ground-water applications to a comparison of approved water rights versus the perennial yield of the basin. Quantity, distribution, and type and length of

Criteria	Weight	Valley-fill Aquifer Score	Valley-fill Aquifer Wt. Score	Carbonate Aquifer Score	Carbonate Aquifer Wt. Score	Lease/ Purchase Score	Lease/ Purchase Wt. Score	Importation Score	Importation Wt. Score
Legal Water Availability	10	7	70	7	70	0	0	8	80
Impacts on Man or Environment	10	9	90	8	80	7	70	6	60
Development Potential (Physical Availability)	10	10	100	8	80	7	70	10	100
Cost	4	10	40	3	12	5	20	0	0
Timeliness	6	10	60	2	12	7	42	1	6
Water Quality	2	10	20	10	20	10	20	10	20
Final Weighted Score			380 *		274 +		222		266

* Recomended source of water supply
\+ First alternative source of water supply

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WATER-SUPPLY SOURCE MATRIX
DRY LAKE VALLEY, NEVADA

28 SEPT 81

TABLE 4.11

current and proposed ground-water use is considered as well as the quantity of water in storage in the aquifer.

The development of the carbonate aquifer in Dry Lake Valley is considered a much more feasible alternative source of water supply than importation of water, even though it ranked only slightly higher than importation in the matrix evaluation. The results of a carbonate aquifer test conducted by Ertec near the northwest margin of the valley indicate that the carbonate aquifer has a high potential for development; however, development of the carbonate aquifer would be about three times more costly than the valley-fill aquifer and would require four times more time to construct the supply wells. The relatively high yield potential indicated by the existing carbonate test well suggests that some combination of pumping from the valley-fill and the carbonate aquifers may be viable.

Importation of water is ranked third among the four options, although it compares favorably with development of the carbonate aquifer. Importation ranked high because of the legal and physical water availability in the source valley, which would be Spring Valley. The matrix evaluation is weighted more toward legal and environmental considerations of water use and less toward MX water-supply system construction. However, importation of water from the nearest valley where it is plentiful is estimated to cost as much as 40 times development of the valley-fill aquifer and 14 times development of the carbonate aquifer.

Lease or purchase of existing water rights is presently not recommended because there are only 19 acre-ft/yr (0.02 hm^3/yr) of approved ground-water rights (Woodburn and others, 1981) and 21 acre-ft/yr (0.03 hm^3/yr) of surface-water rights (DRI, 1980). These total less than one percent of the MX peak-water requirement for Dry Lake and Muleshoe valleys combined in 1984.

4.5.3 Suitable Areas for Water-Supply Well Locations

Two large areas in Dry Lake Valley have been identified as primary areas for development of the valley-fill aquifer (Drawing 4-5). In the northern part of the valley, there is an extensive primary area in the central valley and flanking alluvial fans. In the central and southern part of the valley, a 0.25- to 3-mile (0.4- to 5-km) wide strip of primary areas occurs between the lacustrine sediments in the valley floor and the edge of the valley. In Township 3S, these strips coalesce into one and extend southward into Delamar Valley.

The primary area for development of the valley-fill aquifer in Dry Lake Valley is extensive and is capable of providing well locations for the construction and operation of the MX missile system.

Due to the extensive deposition of lacustrine deposits in central and southern Dry Lake Valley, a large area is classified as secondary. This area extends from the north-central part of Township 1N to the central part of Township 3S and is 5 to 6 miles (8 to 10 km) wide.

Additional small secondary areas have been delineated on the western flank of the valley in Township 1S and on the southwest flank of the mountains in Township 3S. These areas are classified as secondary on the basis of geophysical and water-level data which indicate that only thin saturated thicknesses of valley-fill sediments occur. There is only one Air Force water-appropriation application point of diversion in the valley, and it lies in a secondary water-supply well development area at 3S-64E-12ac (number 40433).

There is only one cultural exclusion within the valley-floor area in Dry Lake Valley which is located in Township 1S near the east side of the valley. There are, however, four water-appropriation exclusions in the northern part of the valley floor and two water-appropriation exclusions in the central portion of the valley floor. These exclusions include the area within 1 mile (1.6 km) of an existing ground-water or surface-water appropriation. Other water-appropriation exclusions are found in the mountains adjacent to the valley. A possible regional spring occurs in Dry Lake Valley at 3N-65E-31cc.

4.5.4 Water-Supply System Alternatives

Based upon the available hydrologic data and the matrix analyses conducted as part of this investigation, there are three feasible MX water-supply alternatives for Dry Lake Valley. The alternative which can be ultimately used is largely dependent upon the decision of the State Engineer regarding temporary overdraft of the Dry Lake Valley ground-water basin. The three alternatives, listed in order of priority from a technical standpoint, are discussed below.

4.5.4.1 Alternative I

The first alternative involves splitting the pending Air Force water-appropriation point of diversion at the existing Air Force test well at 3S-64E-12ca (number 40433) into multiple points of diversion, use of the existing test well at 3S-64E-12ca and the carbonate test well at 3N-63E-27cc, and the construction of two additional water-supply wells in the valley-fill aquifer. This approach will require the amendment of the pending application. This process should be initiated early in FY 82 to ensure that there is available water for the initial MX construction activities scheduled to begin in mid-1982.

The proposed LSC, presumed to be located in 3S-64E, will require from 230 to 1050 acre-ft/yr (0.28 to 1.29 hm^3/yr) with the peak requirement in 1986. Based upon an estimated well yield of 750 gpm (47 l/s), only one water-supply well will be required to deliver the 651 gpm (41 l/s) needed for peak water use at the LSC. The existing Air Force test well at 3S-64E-12ca has been pumped at a maximum rate of 750 gpm (47 l/s) and, if a sustained yield of 651 gpm (41 l/s) is possible, no additional MX water-supply wells will be required. During the period from 1983 to 1985, and during 1987, surplus water from the existing well could be utilized for DTN and cluster construction in the southern end of the valley.

The development of MX water-supply wells for DTN and cluster construction, operation, and reclamation will require the use of the existing Air Force valley-fill well at 3S-64E-12ca, the use of the existing carbonate exploration well at 3N-63E-27cc, and the construction of two additional MX water-supply wells.

In 1982 and 1983, the entire MX water requirement in Dry Lake Valley can be met through the operation of the existing Air Force valley-fill well. In 1984, however, the existing Air Force carbonate exploration well located at 3N-63E-27cc and three additional wells will be required to deliver the 3373 acre-feet (4.16 hm^3) which will be required. It is recommended that one additional valley-fill well be constructed in the primary area in the southern part of the valley and one valley-fill well be constructed in the primary area in the northern part of the valley. Assuming well yields of 650 gpm (41 l/s) or 1047 acre-ft/yr (1.29 hm^3/yr) if pumped continuously, these wells should be capable of supplying more than the MX water requirement (3373 acre-feet [4.16 hm^3]) during the peak-construction year. For the period from 1985 to 1986, the MX water requirements for nondomestic purposes decrease and a reduction in the pumping rates of the water-supply wells can occur.

4.5.4.2 Alternative II

If the State Engineer restricts MX ground-water withdrawal from the valley-fill aquifers of Dry Lake hydrographic basin (Dry Lake and Muleshoe valleys) to the perennial yield of 3000 acre-ft/yr (3.70 hm^3/yr) but allows additional water to be withdrawn from the carbonate aquifer, as much as 1341 acre-feet (1.65 hm^3) may have to be withdrawn from the carbonate aquifer in 1984. This alternative would then involve splitting the pending Air Force water-appropriation point of diversion at the existing Air Force test well at 3S-64E-12ca (number 40433) into multiple points of diversion, use of the existing valley-fill aquifer test well at 3S-64E-12ca, increasing the diameter of the carbonate aquifer test well at 3N-63E-27cc, and the construction of an additional valley-fill and carbonate aquifer well.

Although the carbonate test well at 3N-63E-27cc had a sustained yield of 106 gpm (7 l/s), the drawdown in the well was only 2 feet (0.6 m). Discharge from the well was limited by the greater than 800 feet (244 m) water depth and by small well diameter. A larger capacity pump, necessitating a larger diameter well, can be expected to increase the well yield to at least 450 gpm (28 l/s) or 725 acre-ft/yr (0.89 hm^3/yr) pumped continuously.

The entire MX water requirement in Dry Lake Valley can be met through the operation of the existing Air Force test well at 3S-64E-12ca in 1982, 1983, and 1987. In 1984, however, two carbonate wells, including the existing carbonate well at 3N-63E-27cc with an increased diameter, and one additional well in the valley-fill aquifer would be used to supply the required water. In 1985, most of the required water can be supplied by two wells tapping the valley-fill aquifer and only minimal water will be needed from a well in the carbonate aquifer. No water will be required from the carbonate aquifer in 1986.

4.5.4.3 General Well Characteristics

An Air Force well constructed in the valley-fill aquifer at 3S-64E-12ca (number 40433) was pumped at a constant discharge rate of 500 gpm (32 l/s), and results suggest that a higher sustained yield is possible. The valley-fill well was constructed with a 16-inch (41-cm) borehole and a 10-inch (25-cm) ID casing to a total depth of 1012 feet (308 m). Larger diameter wells may be capable of greater sustained yields if the same favorable aquifer is penetrated. Although the depth to water ranges from about 800 feet (244 m) below land surface in the northern part of the valley to over 300 feet (91 m) in the southernmost part of the valley, the depth to productive aquifer may be substantially greater. Therefore, it is recommended that MX water-supply wells be constructed to depths of at least 1200 feet (366 m). Due to the lack of hydrologic data for aquifer characteristics and well yields for much of Dry Lake Valley, it is recommended that exploratory drilling be conducted to verify the proposed locations of other MX water-supply wells.

4.5.5 Additional Investigations

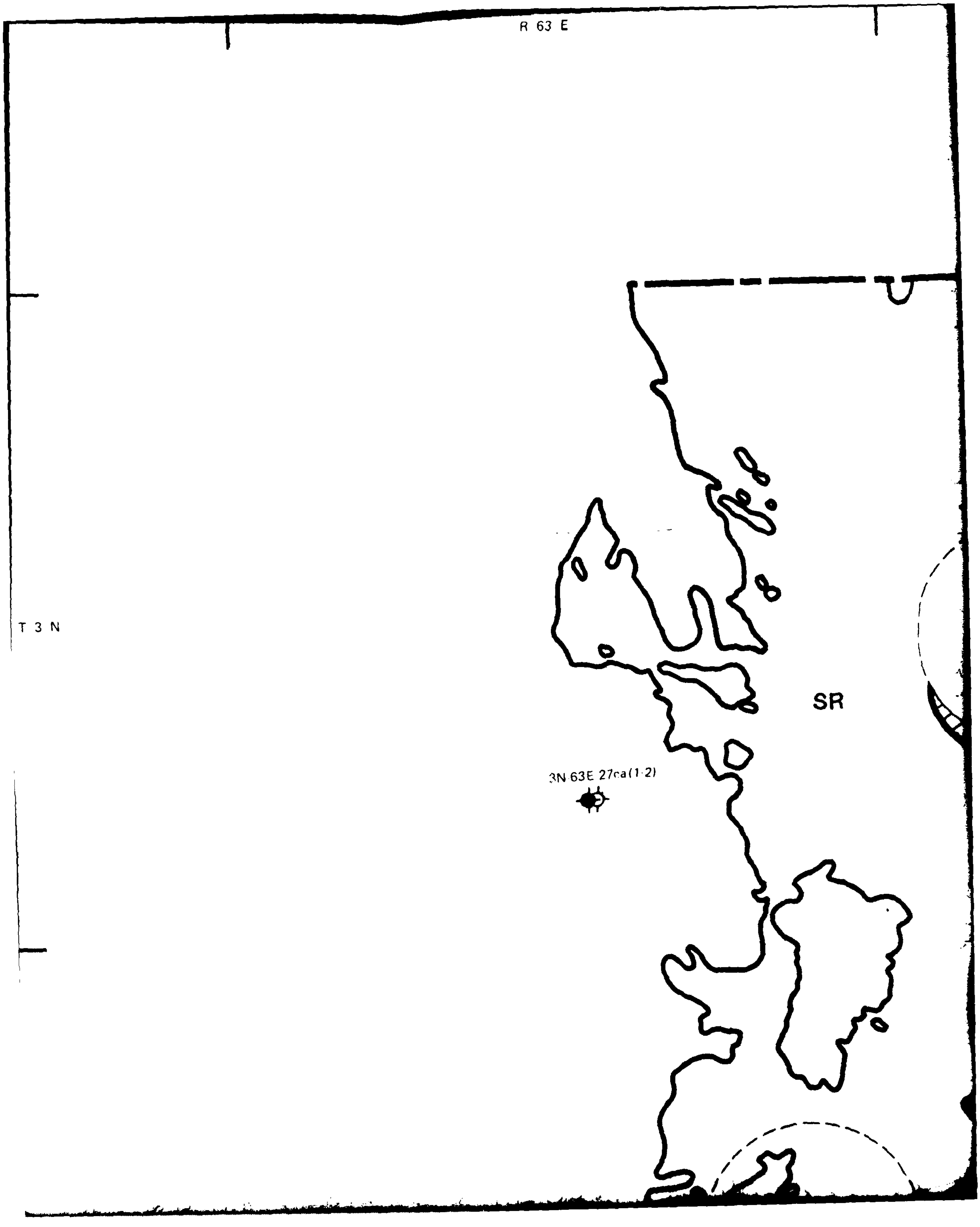
Suggested possible sites for additional drilling and testing prior to operational development of the water-supply system are identified in Drawing 4-5.

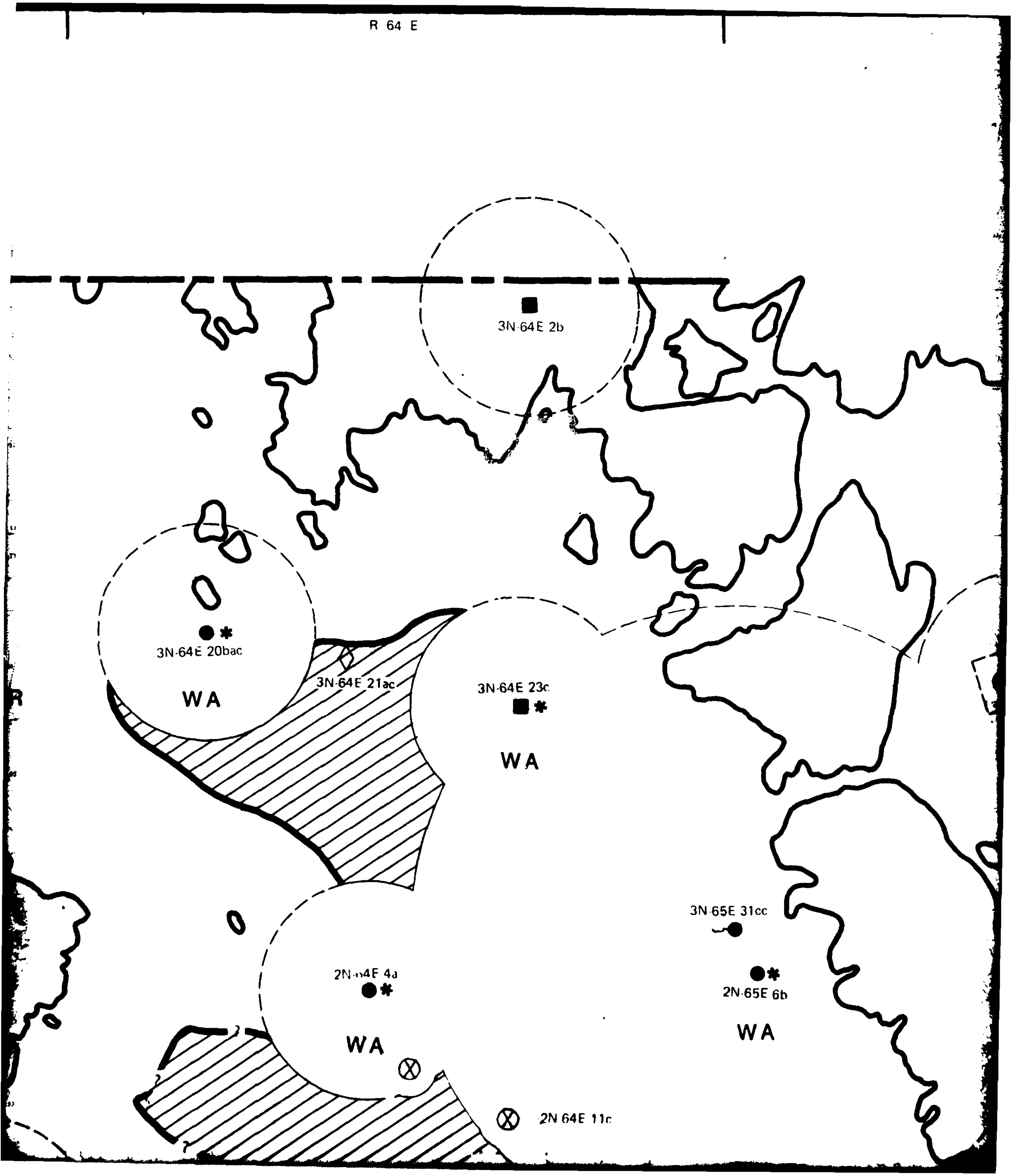
An application was filed for only one point of diversion in Dry Lake Valley at 3S-64E-12ca (number 40433). The request for water at this point of diversion was sufficient to meet the peak MX water requirement for construction in the valley.

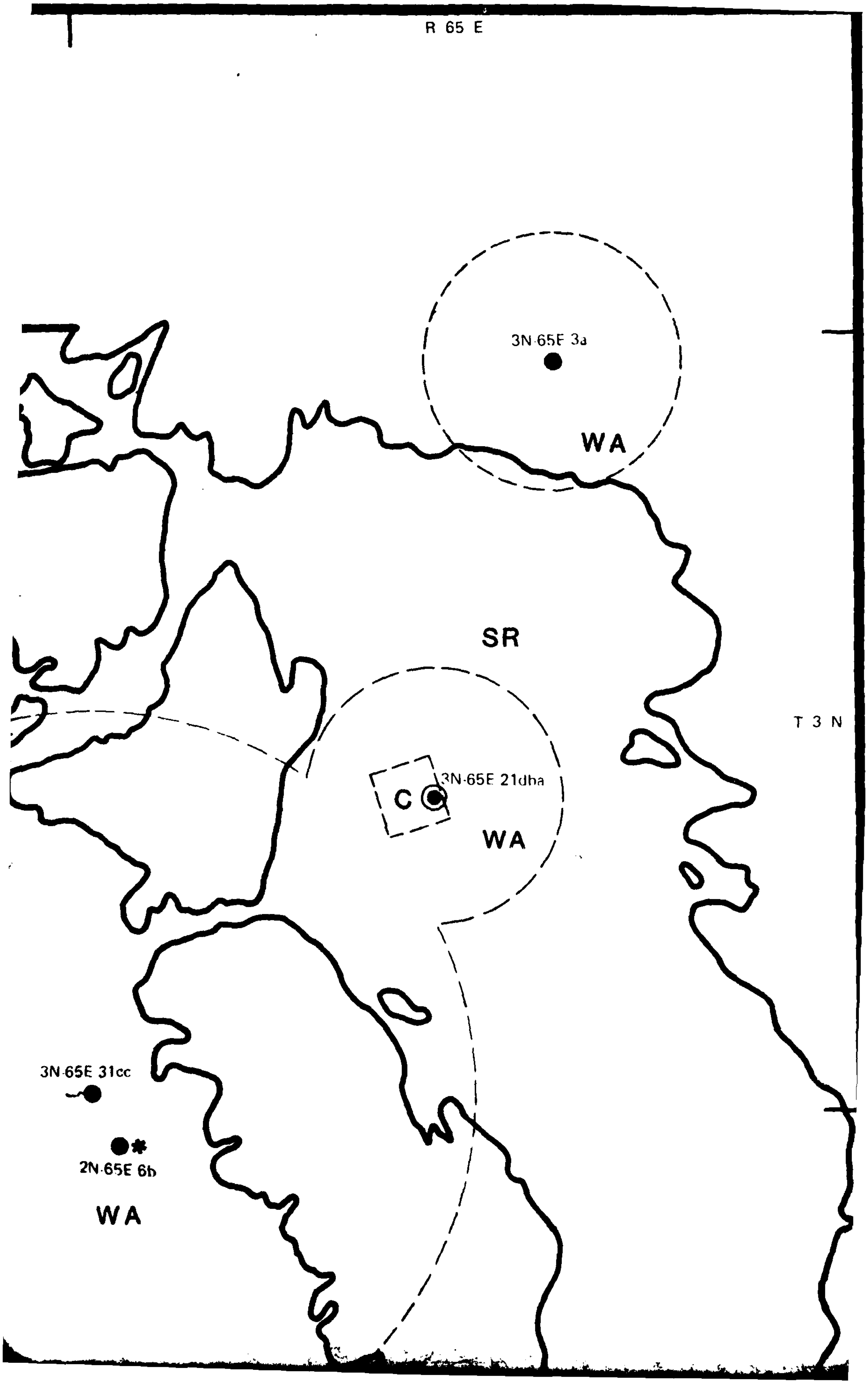
Two additional drilling sites have been identified beyond the application point of diversion in Dry Lake Valley. These sites were selected along existing roads in primary water-supply areas delineated in Drawing 4-5.

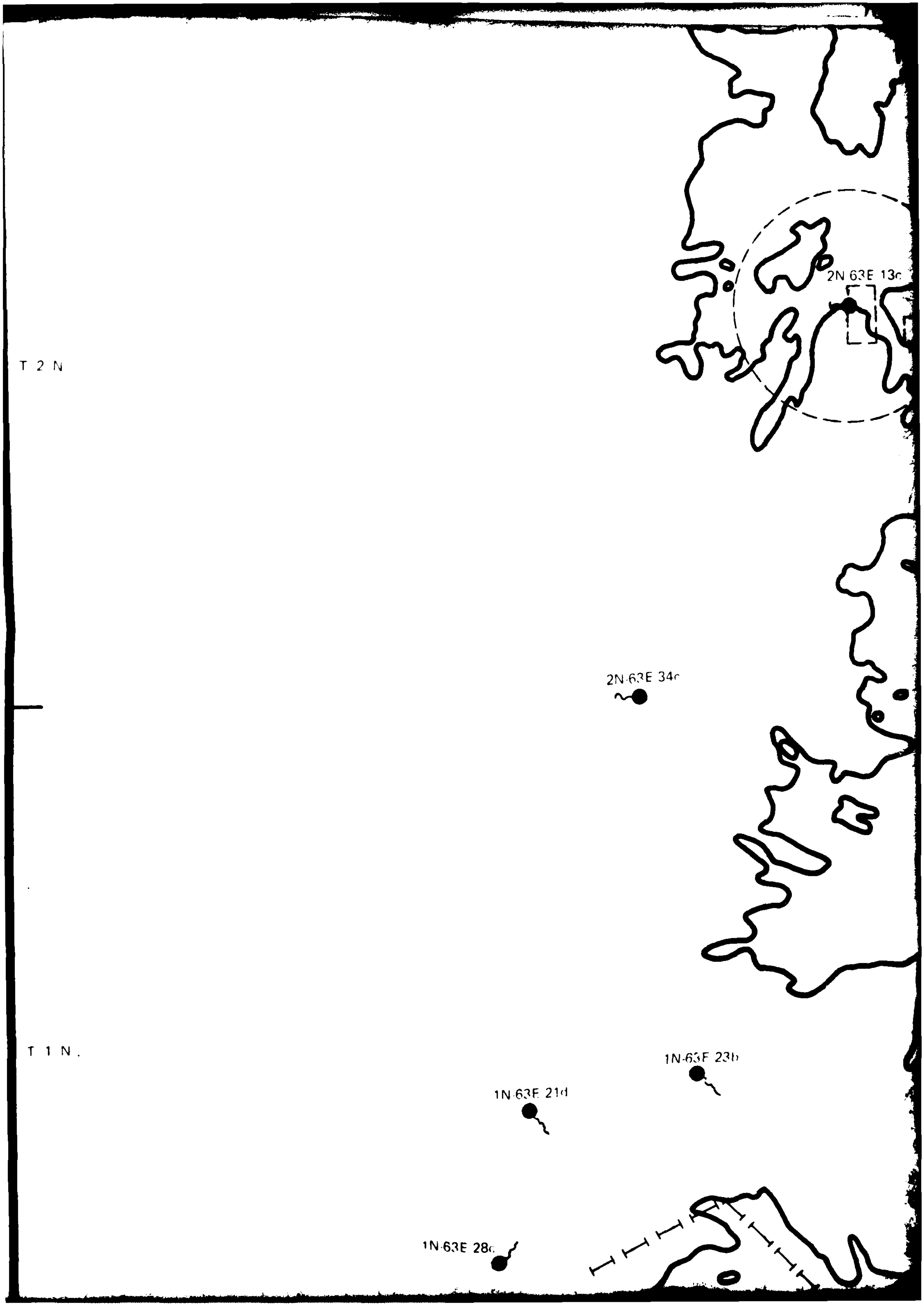
The drilling site located at 3N-64E-2ac in the northern part of the valley is the first priority. The site is located 3 miles (5 km) south of the proposed construction camp at the northern end of Dry Lake Valley. A well at this location could provide data on water quantity and quality, both of which will be necessary for planning domestic water supply at the construction camp. This site is also strategically located with respect to clusters and is approximately 1 mile (1.6 km) from the DTN in an area where little or no aquifer performance data exist.

The drilling site at 2N-64E-36cc is centrally located with respect to the DTN and the clusters. The site at 2N-64E-36cc in north-central Dry Lake Valley is approximately 12 miles (19 km) south of a proposed construction camp. Aquifer data within a 5-mile (8-km) radius are limited to one stock well.

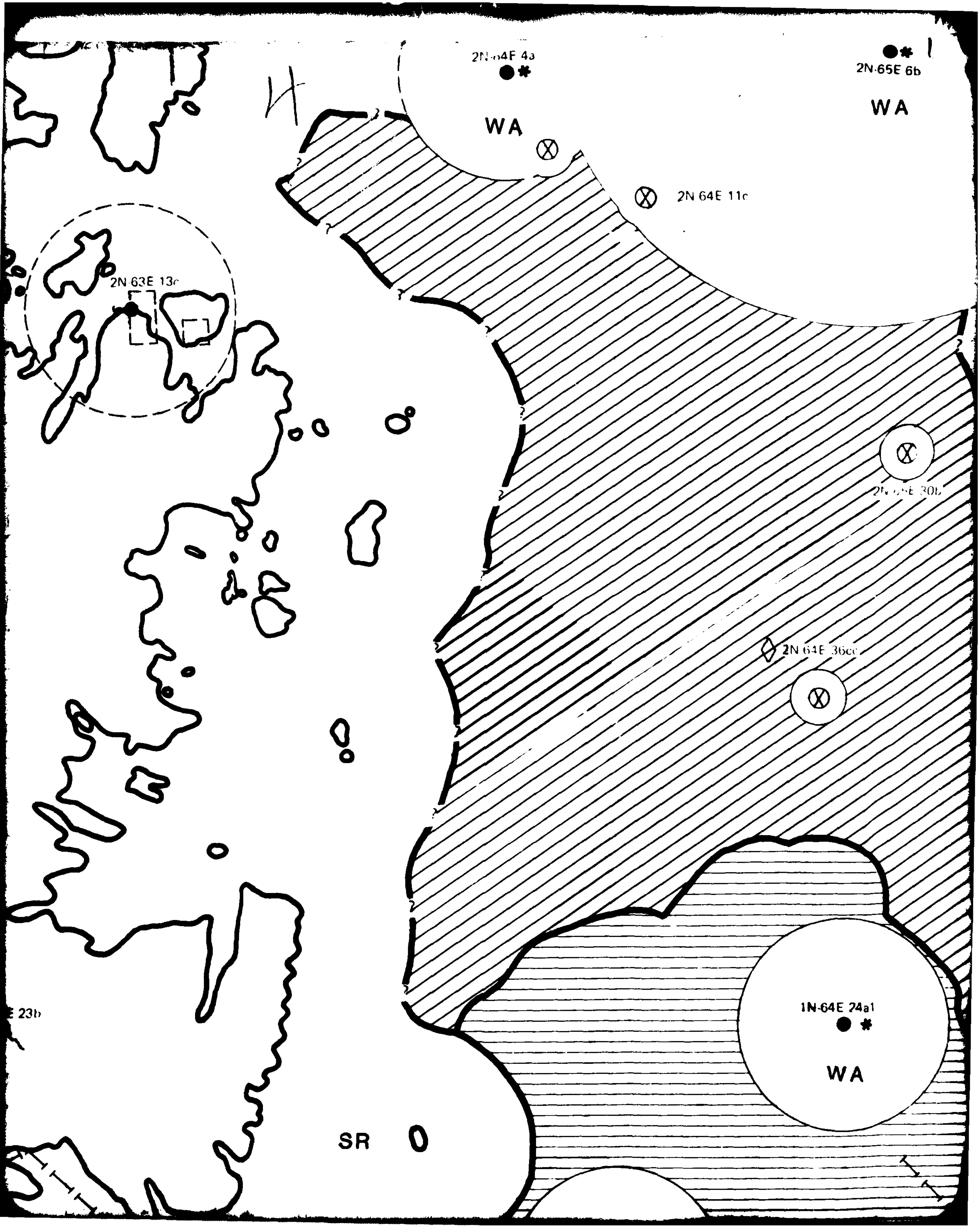

R 63 E
T 3 N
SR
3N 63E 27ca(1-2)


R 64 E
3N-64E 2b
3N-64E 20bac
WA
3N-64E 21ac
3N-64E 23c
WA
3N-65E 31cc
2N-64E 4a
2N-65E 6b
WA
WA
2N 64E 11c

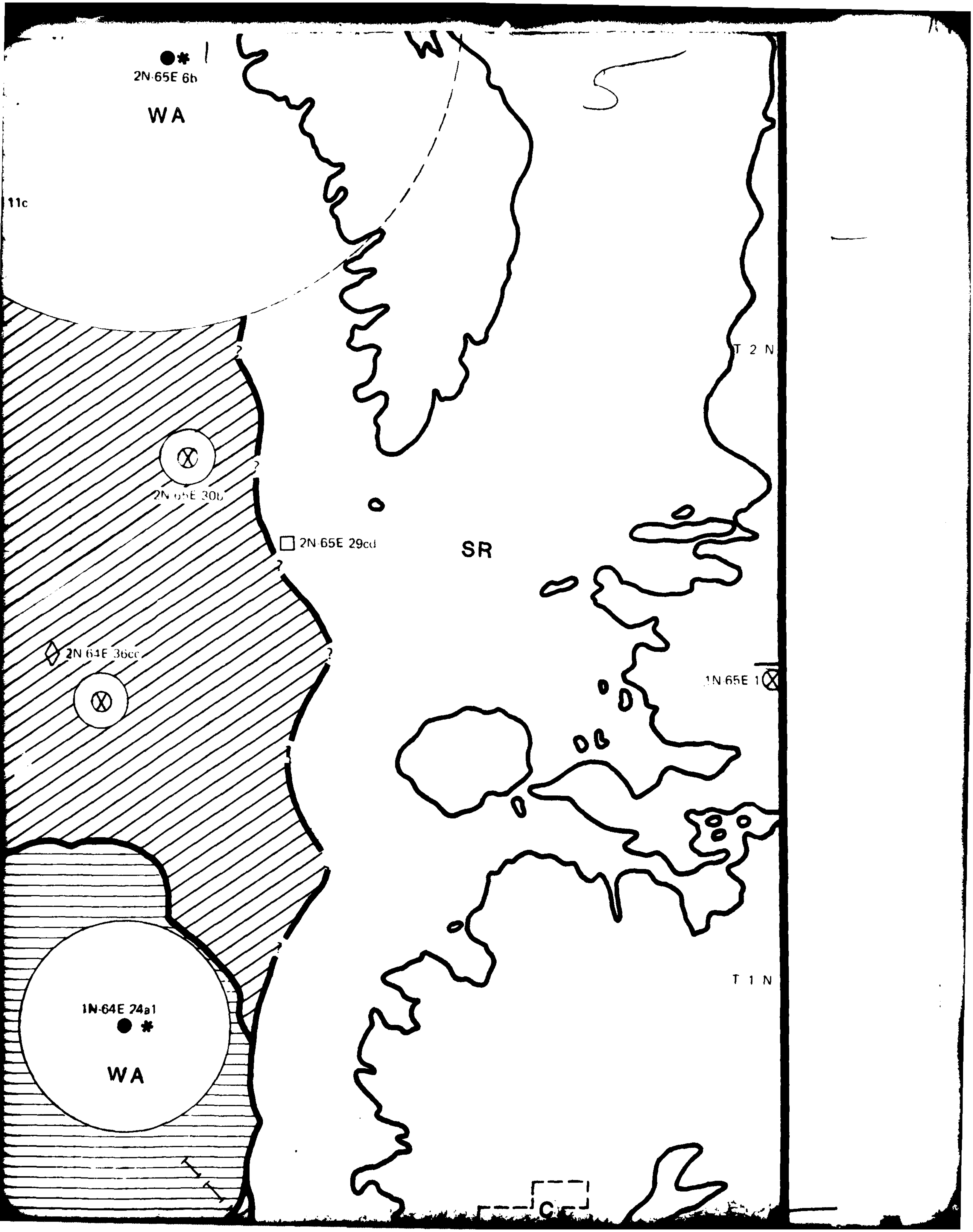

R 65 E
3N-65E 3a
WA
SR
T 3 N
C
3N-65E 21dba
WA
3N-65E 31cc
2N-65E 6b
WA

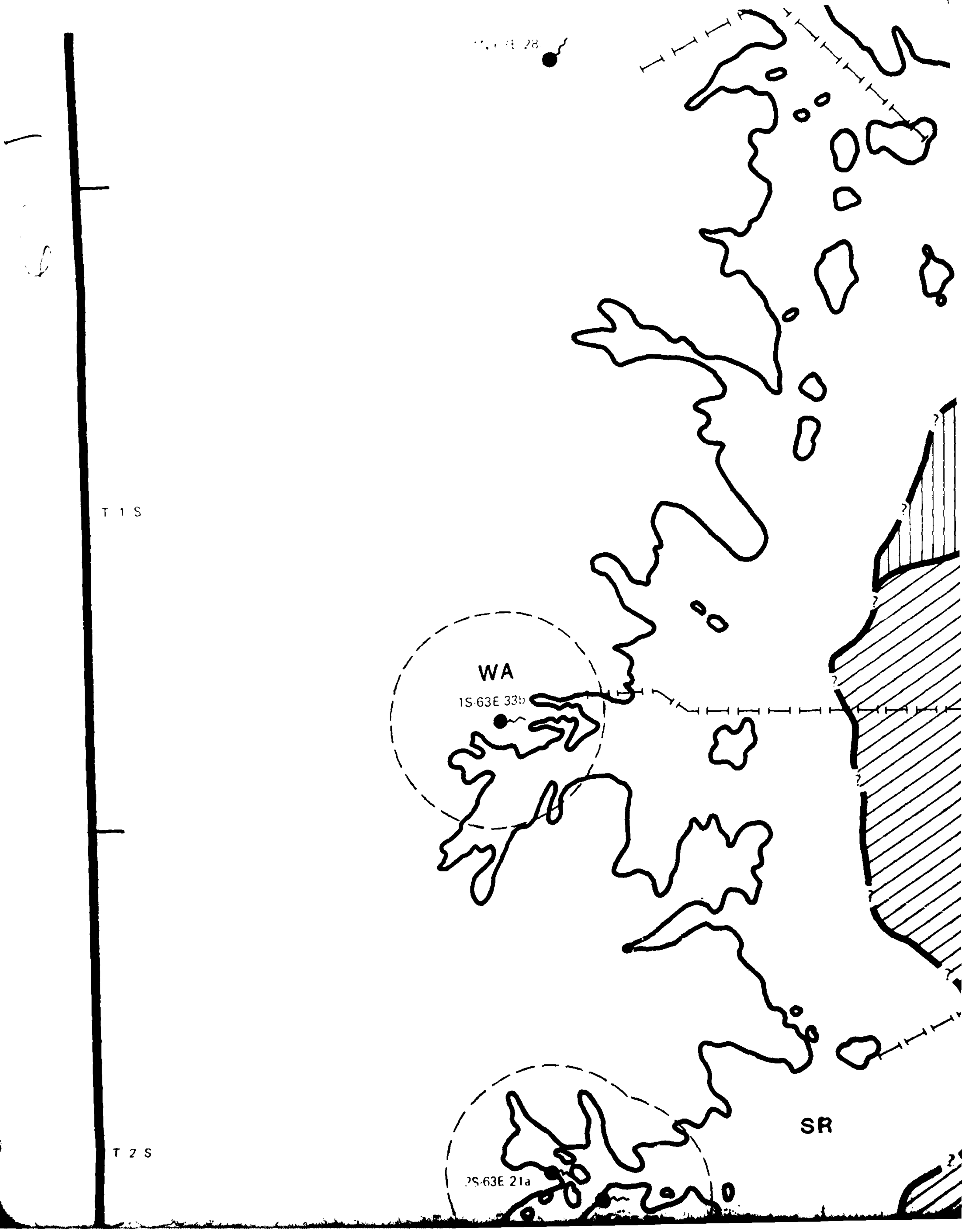


T 2 N
2N 63E 13c
2N-63E 34c
T 1 N.
1N-63E 23b
1N-63E 21d
1N-63E 28c

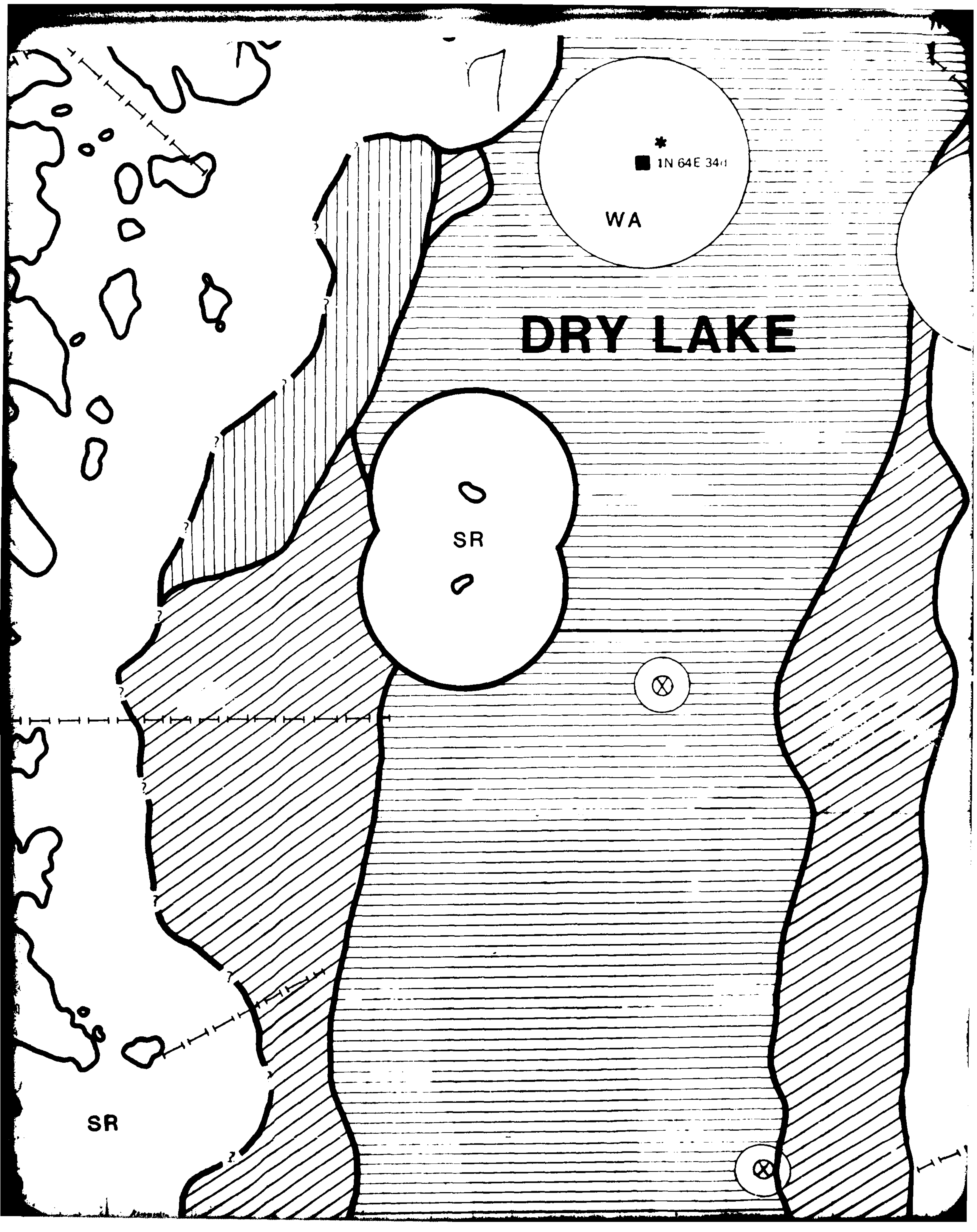


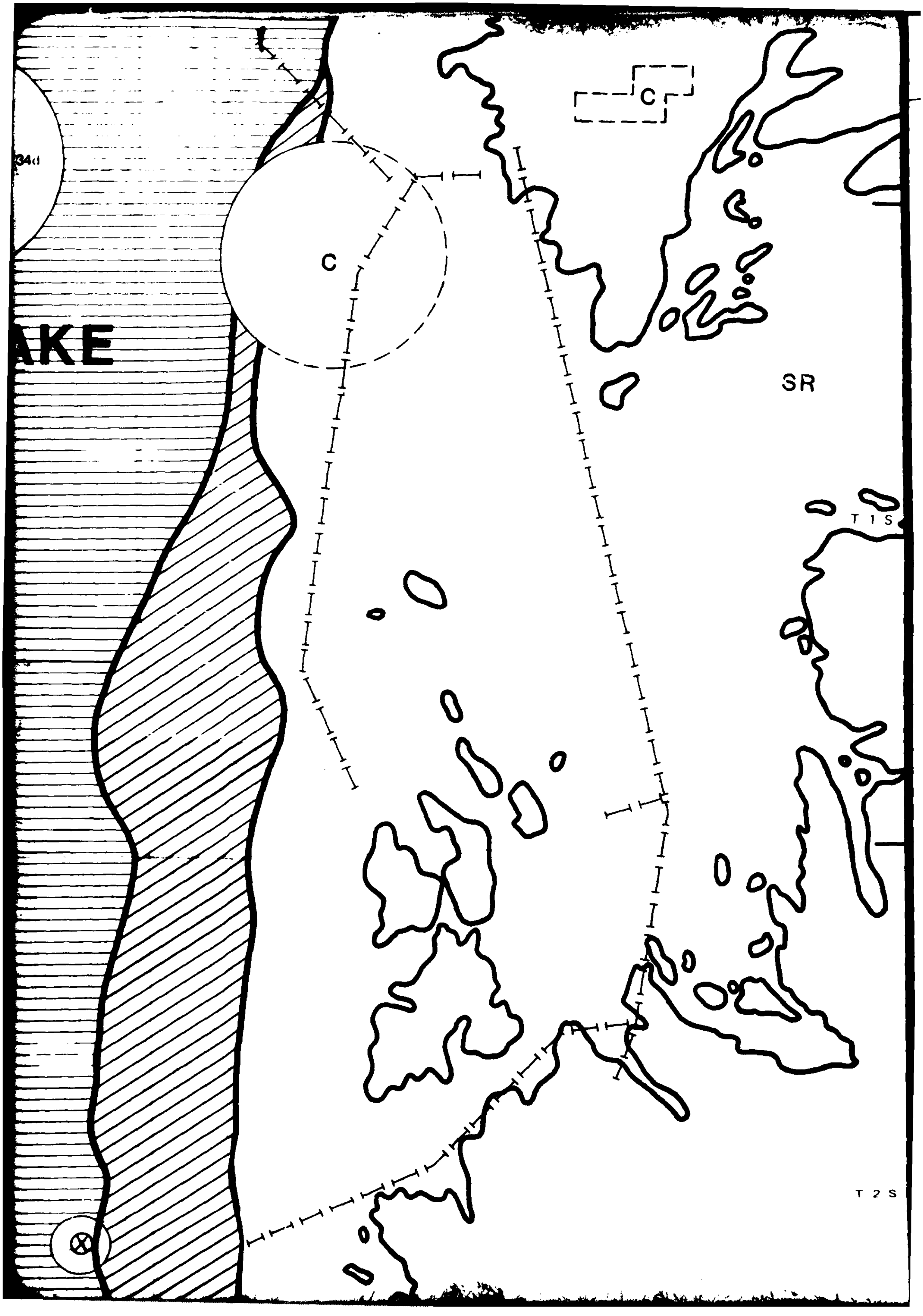
2N-64E 4a
2N-65E 6b
WA
WA
2N 64E 11c
2N-63E 13c
2N 64E 36cc
1N-64E 24a1
WA
SR
E 23b


2N-65E 6b
WA
11c
T 2 N
2N-65E 30b
2N-65E 29cd
SR
2N-64E 36cc
1N-65E 1
T 1 N
1N-64E 24a1
WA
C

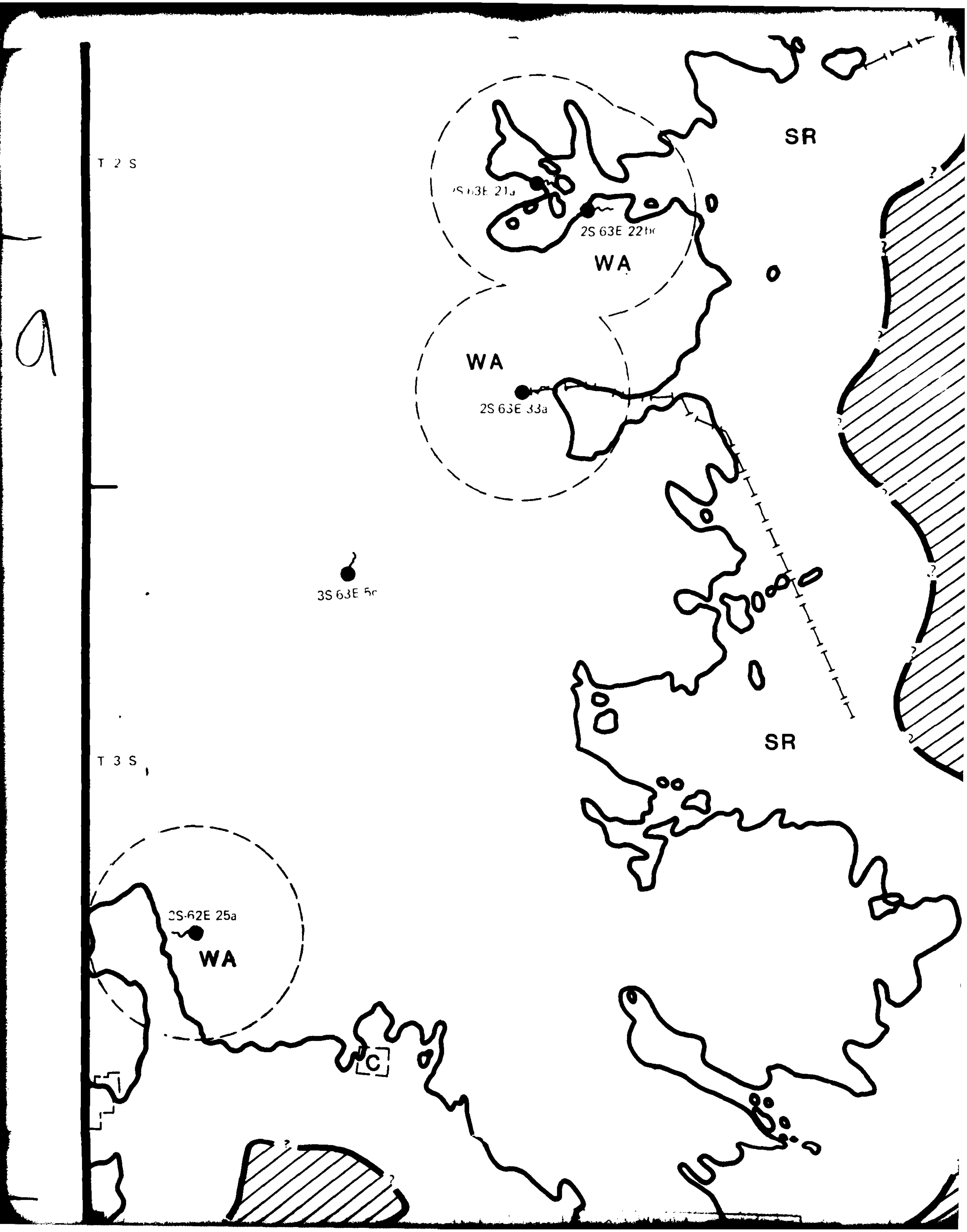


T 1 S
WA
1S-63E 33b
SR
T 2 S
2S-63E 21a

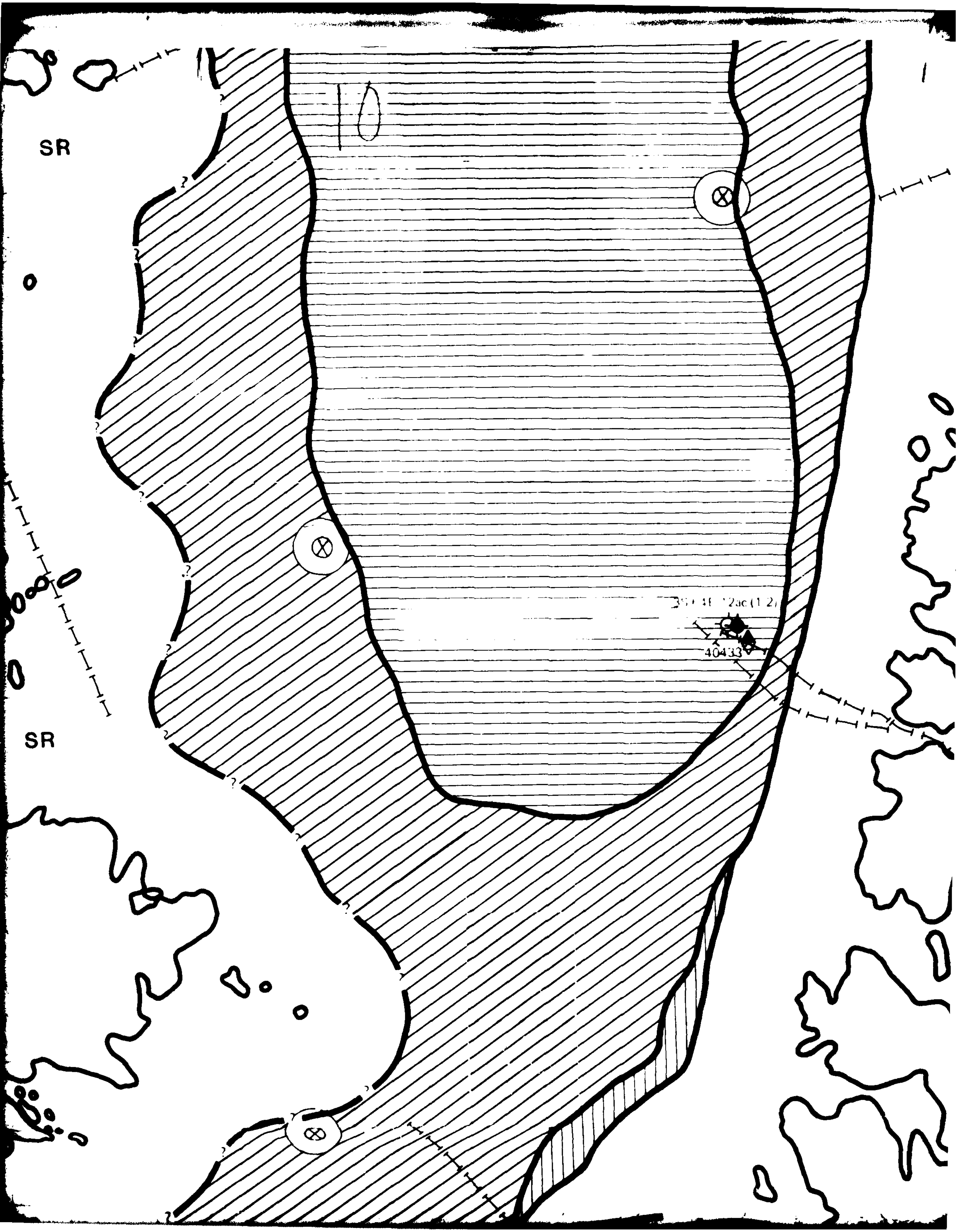

1N 64E 34d
WA
DRY LAKE
SR
SR

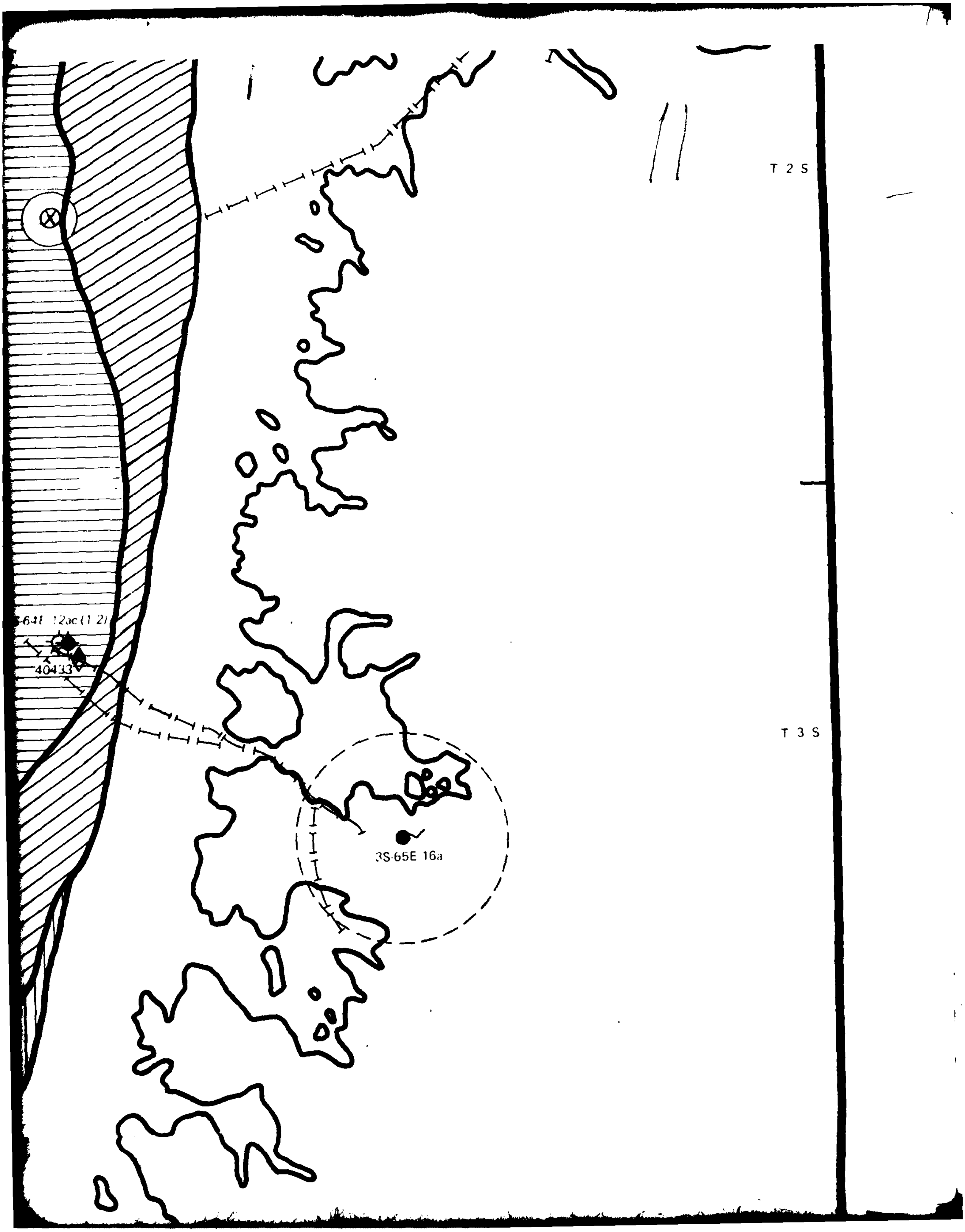


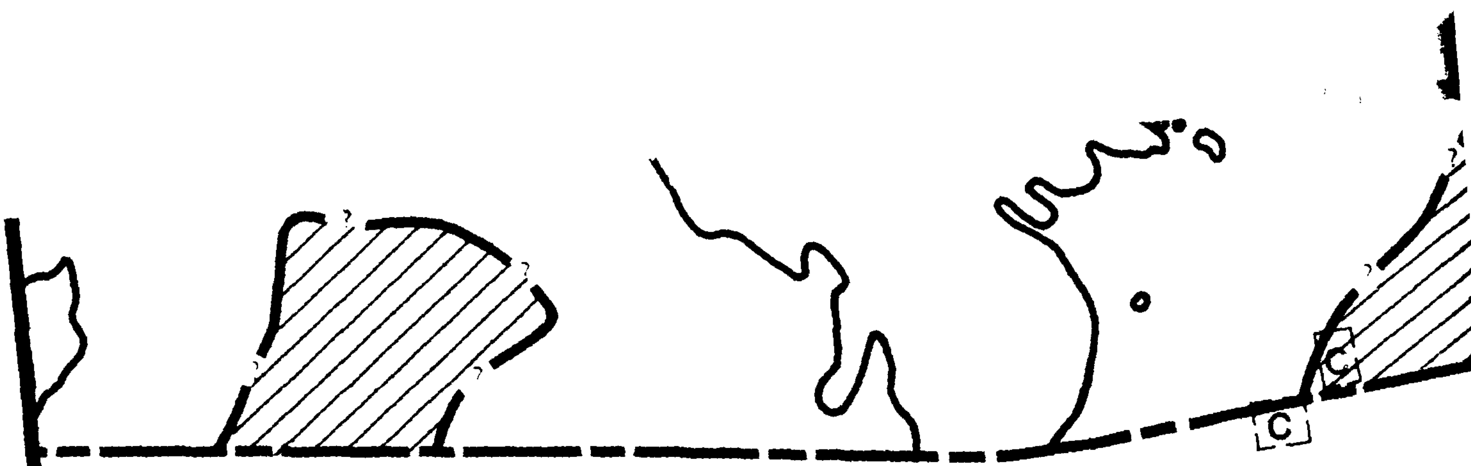
34d
AKE
C
C
SR
T 1 S
T 2 S



T 2 S
SR
2S 63E 21a
2S 63E 22bc
WA
WA
2S 63E 33a
3S 63E 5c
SR
T 3 S
2S-62E 25a
WA
C


SR
SR
40433


T 2 S
64E 12ac (1 2)
40433
T 3 S
3S-65E 16a

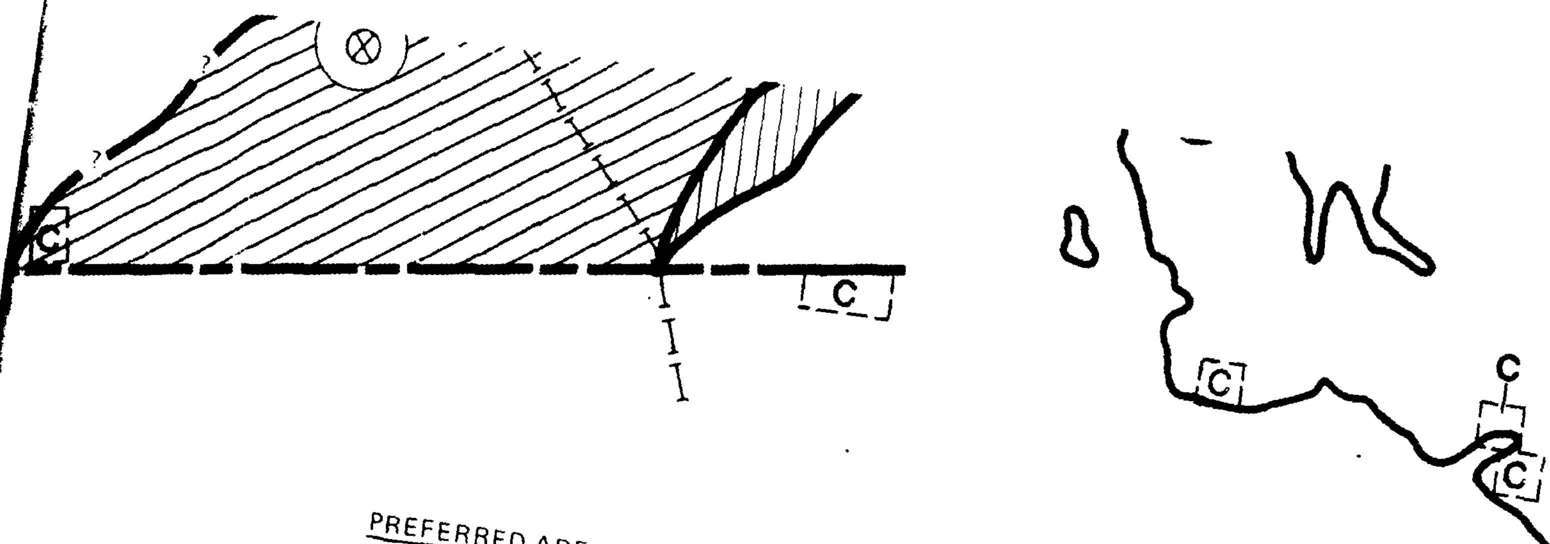


EXPLANATION

SYMBOLS

- POWERLINE(S)
- TELEPHONE/TELEGRAPH
- PIPELINE
- DRAINAGE DIVIDE
- VALLEY BOUNDARY
- ROCK - VALLEY-FILL CONTACT
- PREFERRED AREA BOUNDARY; QUERIED WHERE GEOPHYSICAL AND/OR WATER LEVEL DATA IS SUBJECT TO GREATER MARGIN OF ERROR
- CULTURAL OR WATER APPROPRIATION EXCLUSION BOUNDARY, DASHED IN AREAS OF OTHER EXCLUSIONS
- 41222 AIR FORCE WATER APPROPRIATION (APPLICATION NUMBER SHOWN)
- 41221 AIR FORCE WATER APPROPRIATION: ADDITIONAL DRILLING/TESTING RECOMMENDED (APPLICATION NUMBER SHOWN)
- ADDITIONAL DRILLING/TESTING RECOMMENDED LOCATION

- AIR FORCE OBS. WELL
- AIR FORCE TEST WELL
- DOMESTIC/STOCK WELL
- MUNICIPAL/IRRIGATION WELL
- UNDESIGNATED WELL
- ABANDONED WELL
- SPRING
- STREAM APPROPRIATION
- UNDESIGNATED APPROPRIATION
- RESERVOIR
- POSSIBLE EXISTING WELL, UNVERIF WATER APPROPRIATION



LL

LL

EL'

ION WELL

LL

TION

ROPRIATION

WELL, UNVERIFIE:)
ION

PREFERRED AREAS

PRIMARY

SECONDARY: LACUSTRINE

SECONDARY: LIMITED SATURATED THICKNESS

AREAS OF EXCLUSION

WA : WATER APPROPRIATION

C : CULTURAL

SR : SHALLOW ROCK

REFERENCE

Desert Research Institute, 1980, Water rights in Nevada and Utah: an inventory within the MX area, Water Resources Center, University of Nevada System, un-published report.

Ertec Western, Inc., 1981, MX water resources, potentiometric map - Dry Lake Valley, Nevada, unpublished map, 1: 62,500 scale.

Fugro National, Inc., 1980, MX siting investigation, gravity survey – Dry Lake Valley, Nevada, FN-TR-33-DL, unpublished report, 30 January 1980

__________ 1980, MX siting investigation, non-geotechnical map – Dry Lake Valley, Nevada, unpublished map, 1: 62,500 scale, July 1980

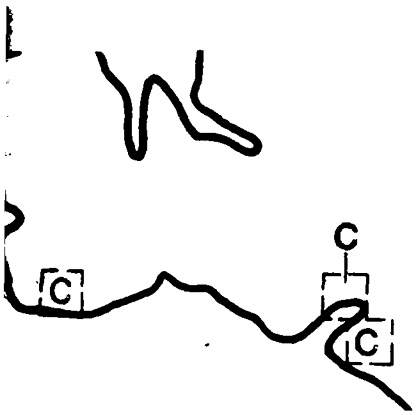
__________ 1980, verfication study, Dry Lake Valley, Nevada, FN TR 27 DL V. I, V. II

13

Ert
The Earth Technolog

D
PR

28 SEPT 81



E

Water rights in Nevada
the MX area, Water
of Nevada System, un-

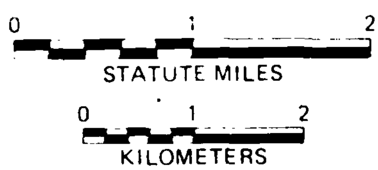
er resources,
ke Valley, Nevada,
ale.

ting investigation,
ley, Nevada,
port, 30 January 1980.

ting investigation,
Lake Valley, Nevada,
ale, July 1980.

tion study, Dry
7-DL V. I, V. II.

SCALE 1:62,500



Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

DRY LAKE VALLEY, NEVADA
PREFERRED AREAS FOR MX
WATER-SUPPLY WELLS

28 SEPT 81

DRAWING 4-5

14

B1.0

NUMERICAL MODELING STUDIES,
DRY LAKE VALLEY

C1.0

RESULTS OF AQUIFER TESTING, DRY LAKE VALLEY

D1.0

DRY LAKE VALLEY SECTION: MX SITING INVESTIGATION, TECHNICAL SUMMARY REPORT

2.8 DRY LAKE VALLEY

2.8.1 GENERAL PHYSIOGRAPHY AND HYDROLOGY

Dry Lake Valley is a north-trending basin in Lincoln County, Nevada. The valley is topographically open to Muleshoe Valley to the north and is separated from Delamar Valley to the south by a low alluvial divide. Dry Lake and Muleshoe valleys are considered one hydrologic basin by the Nevada State Engineer. Dry Lake Valley is 38 miles (61 km) long, 21 miles (34 km) across at its widest point, and encompasses 700 mi^2 (1812 km2), of which 310 mi^2 (803 km^2) are suitable for MX deployment. The average valley floor elevation is 4800 feet (1463 m). The valley is bordered by the North Pahroc Range on the west and the Burnt Springs, Highland and Bristol ranges on the east. The mountain crests range in elevation from about 7000 feet (2134 m) to over 9000 feet(2743 m).

Perennial streamflow is absent in Dry Lake Valley there is some ephemeral surface-water inflow from Muleshoe Valley, however, total runoff from the mountains at the apex of the alluvial fans is estimated to be 9000 acre-ft/yr (11.1 hm^3/yr) (Nevada State Engineer, 1971). This estimate is for the combined Dry Lake, Muleshoe, and Delamar valleys hydrographic areas. Small springs in or near the base of the mountains surrounding Dry Lake Valley issue from the clastic rocks of Paleozic age and the volcanic and clastic rocks of Tertiary age. Four springs discharged from 0.5 to 2 gpm (0.03 to 0.1 l/s), when measured in May 1980 by Ertec personnel.

Ground-water recharge is from the infiltration of precipitation in stream channels and surface runoff on the alluvial fans. The average annual recharge for Dry Lake/Muleshoe valleys is estimated to be 4800 acre-ft/yr (5.9 hm^3/yr) (Eakin, 1963). Of this amount, approximately 2100 acre-ft/yr (2.6 hm^3/yr) is derived from precipitation in the mountains around Muleshoe Valley with the remainder from sources within Dry Lake. Evapotranspiration and water discharged by wells is less than 100 acre-ft/yr (0.1 hm^3/yr). Evapotranspiration only occurs in limited areas near small springs.

The Dry Lake Valley basin is a hydrologically open system with underlfow to the south or southwest and possibly to the west through the carbonates of Paleozoic age. Total discharge by underflow is estimated to be 5000 acre-ft/yr (6.2 hm^3/yr) (Nevada State Engineer, 1971) This is considered in agreement with Eakin's (1963) estimate of 4800 acre-ft/yr (5.9 hm^3/yr) recharge because the State Engineer°s figure is rounded to the nearest thousand acre-foot. The hydraulic gradient in the valley fill aquifer is southward at 16 ft/mi (3 m/km) from central Dry Lake Valley to central Delamar Valley (Figure B1.8). The potentiometric surface ranges in elevation from 5000 feet in the north to 4200 feet in the south (1524 to 1280 m) based on the regional potentiometric map. The depth to ground water in Dry Lake Valley is in excess of 300 feet (91 m), thus, there is no evapotranspiration of ground water by phreatophytes. The valley-fill aquifer in Dry Lake Valley is probably over

10,000 feet (3048 m) thick in the central part of the valley and is composed of alluvial fan, fluvial, playa, and lacustrine deposits (FN-TR-33DL, FN-TR-26E). Eakin (1963 describes the valley-fill sediments as clay, silt, sand, and gravel of Tertiary to Quaternary age deposited under subaerial and lacustrine conditions.

Carbonate rocks of Paleozoic age are exposed in the mountains and are believed to partially underlie the valley-fill sediments. The mountains bordering Dry Lake Valley to the west contain ash flow tuffs of Tertiary age with some carbonate rocks of Paleozoic age. The mountains to the east contain carbonates of Paleozic age with minor amounts of ash flow tuffs of Tertiary age (Stewart and Carlson, 1978).

2.8.2 MX WATER REQUIREMENTS

The peak annual demand for ground water in Dry Lake Valley during the construction phase is expected to be 3411 acre-ft (4.2 hm^3) in 1984 according to preliminary figures from the U.S.Army Corps of Engineers (1981) as revised by Ertec (1981). Construction should begin in 1982 and conclude in 1987. Water demand for the operational phase of the MX project is expected to be less than 300 acre-ft/yr (0.4 hm^3/yr) for the 30 year life of the project.

The Air Force has requested 3810 acre-ft/yr (4.7 hm^3/yr) for appropriation in Dry Lake Valley. It should be noted that the amount of water needed in Dry Lake Valley for construction and operation is expected to be less than this because the applications were filed before the latest cluster layouts and water requirements were determined.

2.8.3 WATER SUPPLY LIMITATIONS

2.8.3.1 Perennial Yield, Use, and Appropriations

The combined perennial yield for Dry Lake/Muleshoe valleys is estimated to be 3000 acre-ft/yr (3.7 hm^3/yr) (Nevada State Engineer, 1971). This was apparently based on Eakin's (1963) estimate of 6000 acre-ft/yr (7.4 hm^3/yr) discharge for the combined Muleshoe, Dry Lake, and Delamar valleys. The discharge was divided, and a combined perennial yield of 3000 acre-ft/yr (3.7 hm^3/yr) was assigned to Dry Lake/Muleshoe valleys.

Surface-water use, primarily for stock watering, is estimated to be 21 acre-ft/yr (0.03 hm^3/yr)in Dry Lake Valley. Surface-water appropriations in the appropriation and permit phase total 2596 acre-ft/yr (3.2 hm^3/yr) (DRI, 1980). At the present time, ground-water use is minor in Dry Lake Valley. Current ground-water permits total 8 acre-ft/yr (0.01hm^3/yr), certificates total 11 acre-ft/yr (0.01 hm^3/yr), and there are a total of 20 acre-ft/yr (0.03 hm^3/yr) of pending applications for ground-water rights in the valley (Woodburn, et al, 1981).

The quantity of ground water available for MX use is approximately 3000 acre-ft/yr (3.7 hm^3/yr)when considering existing use. The water availability is 2981 acre-ft/yr (3.7 hm^3/yr) when considering approved appropriations and 2961 acre-ft/yr (3.7

hm^3/yr) when considering both existing and pending applications. The peak MX demand of 3411 acre-ft/yr (4.2 hm^3/yr) for ground water will exceed the reported perennial yield by 411 acre-ft/yr (0.5 hm^3/yr). When considering existing appropriations, the perennial yield will be exceeded by 430 acre-ft/yr (0.5 hm^3/yr). Because the State Engineer considers Muleshoe Valley as part of Dry Lake Valley for perennial yield estimates, its ground-water demand must also be considered. Peak year MX demand for Muleshoe Valley is 968 acre-ft (1.2 hm^3) in 1984. Therefore, the combined peak construction water demand in 1984 and the existing appropriations will exceed the perennial yield by 1398 acre-ft/yr (1.7 hm^3/yr). However, if Dry Lake/Muleshoe valleys are hydrologically connected with Delamar Valley as previously discussed, and the perennial yield of Delamar Valley (3000 acre-ft/yr, 3.7 hm^3/yr) and its peak MX demand (679 acre-ft/yr; 0.8 hm^3/yr) is considered, the total peak year demand for construction water in 1984 is 5058 acre-ft (6.2 hm^3/yr) compared to a combined perennial yield of 7000 acre-ft/yr (7.4 hm^3/yr). The combined existing appropriations for the three valleys totals 35 acre-ft/yr (0.04 hm^3/yr), therefore sufficient water would be available from the combined basins to meet peak year MX requirements. It should also be noted that the construction period in the three valleys is from 1982 to 1987, and that the quantity of water needed for the operational phase after that period will be considerably less than that required during construction.

2.8.3.2 Source Capabilities

Surface water is limited to ephemeral steamflow and spring discharges in Dry Lake Valley. The springs in Dry Lake Valley are not believed to be a dependable source of water for the MX project because they are generally in the mountains above the valley floor, are relatively inaccessible, and have low discharge (less than 2 gpm; 0.1 l/s).

Data from an aquifer test performed by Ertec in the southern part of the valley (3S/64E-12ac) indicate a transmissivity and storativity for the valley-fill aquifer of about 3100 ft^2/day (287 m^2/day) and 0.04, respectively. These aquifer characteristics indicate that, in this area of the valley, the valley-fill aquifer is capble of yielding water in sufficeient quantities and rates required to meet MX needs.

A carbonate aquifer test conducted by Ertec Western in the northern part of the valley (3N/63E-27ca) indicated a transmissivity in the carbonate aquifer of about 13,500 ft^2/day (1250 m^2/day) and a specific capacity of 50 gpm/ft.

2.8.3.3 Water Quality

Water quality data for Dry Lake Valley is shown in Appendix F1.8. Chemical analyses of water samples from the two test wells drilled by Ertec Western, one which penetrates the valley-fill aquifer and one which penetrates the carbonate aquifer, one existing well, and six springs indicate that, for the constituents analyzed, water quality are within criteria for construction water (Appendix E1.1). The chemical analyses of samples from six springs and three wells indicate that all but one well, at 3N/65E-21dba, meet Primary and Secondary Drinking Water Stand ards for the State of Nevada (Appendix E1.2). This well, located in the northeastern portion of the valley was found to have a nitrate concentration of 32 mg/l, which exceeds the 10 mg/l Primary Drinking Water Standards for nitrate. This well was used when the Bristol Silver Mine was in operation and could be contaminated from surface sources. Although the valleywide water quality cannot be accurately predicted from the limited data available, it is expected that the ground water should be suitable for construction and drinking water purposes.

2.8.4 PRIMARY WATER SUPPLY ALTERNATIVES

2.8.4.1 Lease or Purchase of Existing Water Rights

It will not be possible to obtain MX water supplies through the lease or purchase of water rights in Dry Lake Valley because approved and pending ground-water appropriations total only 39 acre-ft/yr (0.05 hm^3/yr). Because of the limited current use, substantial water is available for appropriation.

2.8.4.2 Valley-Fill Aquifer

The valley-fill aquifer represents a satisfactory source of water for MX construction and operation because: a) little ground water in Dry Lake Valley has been appropriated; and b) the aquifer tests and studies performed indicate that it is capable of supplying water at the rate necessary and insufficient quantity and quality to meet MX requirements.

2.8.4.3 Carbonate Aquifer

The aquifer test mentioned previously indicates that the carbonate aquifer has a high potential for development in Dry Lake Valley. However, it is considered only as alternative for development because the valley-fill aquifer appears adequate for MX water requirements.

2.8.4.4 Interbasin Transfer

Interbasin transfer will not be necessary in Dry Lake Valley because the valley-fill aquifer is capabable of meeting MX requirements. However, the transfer of water from Dry Lake Valley to Muleshoe and/or Delamar valleys is being considered.

2.8.5 IMPACTS OF DEVELOPMENT

2.8.5.1 Intrabasin Effects

Computer simulation of a well field in Dry Lake/Muleshoe withdrawing water for six years at rates estimated by the U.S. Army Corps of Engineers (1981) for both valleys was performed. A transmissivity of 1300 ft^2/day (120 m^2/day) and storativity of 0.05 were used in the simulation. Those values were found to be representative of the average aquifer characteristics of all types of sediments in the valley. Pumping rates were varied according to annual MX needs and reached a maximum of one well pumping in Muleshoe at 600 gpm (38 l/s) and five wells in Dry Lake pumping at 420 gpm (26 l/s). Maximum drawdown effects occurred after five years and averaged about 4.1 feet

(1.2 m) at a distance of one mile (2 km) from the wells in Dry Lake Valley. Because of the lack of vertical recharge on the valley floor and the absense of recharge from underlying sediments, complete recovery after cessation of pumping will occur after at least 30 years.

At the present time ground-water use in Dry Lake Valley consist of widely separated stock watering wells, so MX ground-water withdrawals should be able to avoid significant impacts to these users. The lowered water levels will have no effect on vegetation because the ground water is more than 300 feet (91 m) below the land surface and well beyond all root systems.

There should be little effect on spring discharge in Dry Lake Valley because the majority of the springs are in the hills and mountains and probably discontinuous with the valley-fill aquifer. There is a spring in Dry Lake Valley, (3N/65E-31cc) that may be considered a regional spring connected with the regional flow regime through carbonate rocks. MX wells will be located at appropriate distances from this spring to avoid any impacts.

2.8.5.2 Interbasin Effects

Water levels and spring discharge could be affected in Pahranagat and Delamar valleys because they are downgradient from Dry Lake Valley and receive underflow through the carbonate aquifer. The regional springs which could be affected include Ash, Crystal, and Hiko springs in Pahranagat Valley. However, there is not enough data available to quantify what, if any, the effects will be. Because of the great distances from the pumped wells, ~~however~~ the effects will probably be undetectable.

2.8.6 MITIGATING MEASURES

A well field design was modeled for Dry Lake Valley which consisted of two simulations, one with a single pumping well and one with five pumping wells. Results from modeling indicate that MX ground-water withdrawals will probably require five or more wells to obtain water in sufficient quantity with the least amount of drawdown. Additonal wells in Dry Lake Valley may be required to meet MX water requirements for Delamar and Muleshoe valleys.

The primary suitable for MX production wells is about 96 mi^2 (249 km^2) along the margin of the valley. The criteria used in determining this area includes consideration of land status, environmentally sensitive areas, existing water appropriations, areas containing Tertiary sediments (which are generally fine grained), and low transmissivity zones.

Pumping schedules could be adjusted to avoid MX construction withdrawals exceeding the perennial yield of Dry Lake Valley. early storage of ground water in reservoirs prior to the construction period is a practical alternative. Another option would be to extend the construction period (reduce the rate of construction), which would reduce the peak year quantity of water required.

There are an additional 71 m^2 (184 km^2) that are considered secondarily suitable in the center of the valley. This area is considered secondary because of the presence of generally low transmissivity lacutrine deposits and/or less than 200 feet of thickness.

DISCHARGE MEASUREMENTS, DRY LAKE VALLEY

ID. NO.	TOWNSHIP RANGE-SECTION	SOURCE	STATION NAME	MO/YEAR MEASURED	DISCHARGE (GPM)	LAND ELEV (FT)	REMARKS	DATA SOURCE
1	3N/65E-31CC	SP		8/1979	3.0	5100		ERTEC 79
2	2N/63E-13CBA	SP	COYOTE SPRING	8/1979	1.0		ERTEC 79	
3	2S/63E-22BC	SP	WHEATGRASS SPR.	5/1980	2.0	5400		ERTEC 80
4	4S/64E-24BA	SP	SEVEN OAK SPR.	5/1980	0.5	5730		ERTEC 80
5	4S/64E-25DD	SP	RED ROCK SPR.	5/1980	1.0	6100	DISCHARGE <1GPM	ERTEC 80

SELECTED WATER QUALITY DATA FOR DRY LAKE VALLEY

ID. NO.	TOWNSHIP RANGE-SECT	SRCE	MO YR	STATION NAME	TEMP DEG C	SP. COND	PH	DISS. SOLIDS	SILICA (SIO2)	CALCIUM (CA)	MAGNESIUM (MG)	SODIUM (NA)
1	3N/63E-27CA	WE	12-30	USAF TEST WELL	--	650	7.3	366	24	76	30	15
2	3N/63E-21DBA	WE	-15	BRISTOL WELL	--	NC	--	--	49	76	33	37
3	3N/65E-31CC	SP	8-79		24.0	470	6.8	--	43	40	10.0	21
4	2N/63E-13CBA	SP	5-79	COYOTE SPRING	20.0	550	6.8	--	79	82	13	49
5	2S/63E-22BC	SP	5-80	WHEATGRASS SPR.	13.0	415	7.0	--	--	--	--	--
6	2S/64E- 28DB	SP	8-79		26.0	443	6.9	--	44	83	10.0	53
7	3S/63E- 5CB	SP	5-80	LITTLE BOULDER SPR.	13.0	250	6.8	--	19	28	7.9	12
8	3S/64E-12AC	WE	4-80	USAF TEST WELL	--	480	7.9	292	1.4	20	10	75
9	4S/64E-24BA	SP	5-80	SEVEN OAK SPR.	8.0	815	7.6	--	--	--	--	--

SELECTED WATER QUALITY DATA FOR DRY LAKE VALLEY

ID. NO.	POTASSIUM (K)	CARBONATE (CO3)	BICARB. (HCO3)	CHLORIDE (CL)	SULFATE (SO4)	FLUORIDE (F)	NITRATE (N)	BORON (B)	IRON (FE)	MANGANESE (MN)	REMARKS	REFERENCE
	6.5	0	404	5.0	20	.6	ND	--	--	--		ERTEC 79
2	.0	0	137	110	71	--	32	--	--	--	*5	EAKIN 63
3	2.5	0	214	17	21	.2	.4	--	--	--	*1	ERTEC 79
	7.6	0	252	25	25	.5	ND	--	--	--		ERTEC 79
	--	0	351	--	--	--	--	--	--	--		ERTEC 80
	7.1	0	320	30	54	.4	1.4	--	--	--	*1	ERTEC 79
7	3.0	0	137	8.0	15	.1	.2	--	--	--	*1	ERTEC 80
8	5.2	1	213	21	44	--	6.7	--	--	--	*1,4	ERTEC 80
9	--	0	303	--	--	--	--	--	--	--		ERTEC 80

NOTE: SAMPLES FOR WATER QUALITY ANALYSIS COLLECTED BY ERTEC EXCEPT WHERE NOTED. ALL ANALYSIS REPORTED IN MG/L EXCEPT AS NOTED BELOW. ERTEC ANALYSES FOR DISSOLVED SOLIDS DETERMINED BY RESIDUE -ON- EVAPORATION AT 180 DEGREE C METHOD. METHODS. NEVADA LOCATIONS BASED ON MT. DIABLO BASELINE. UTAH LOCATIONS BASED ON SALT LAKE BASELINE AND MERIDIAN.

THE FOLLOWING CONSTITUENTS ARE REPORTED IN MICROGRAMS/LITER:
BORON IRON MANGANESE

EQUI NOTES:
*1 NITRATE REPORTED AS N.
*2 NITRATE REPORTED AS NO3
*3 NITRITE + NITRATE REPORTED AS N
*4 DISSOLVED SOLIDS BY SUM OF DETERMINED CONSTITUENTS
*5 NA+K AS NA
*6 HCO3+CO3 AS HCO3
ND = NOT DETECTED

ACTIVITY	82	83	84	85	86	87	88	89	90
1 DOMESTIC									
a LIFE SUPPORT CAMPS		200	593	1179	1000				
b INDEPENDENT WORKERS		1	2	4	4				
2 REVEGETATION		115	995	520	733	250			
3 LANDSCAPING		21	93	125	106				
4 DUST CONTROL									
a ROADWAYS	37	50	311	311	156				
b WORK SITES		40	278	80	40				
c IN CAMPS	-------------------- INCLUDED ABOVE --------------------								
5 ROAD CONSTRUCTION									
a RECOMPACTION	125		1120						
b CONSTRUCTION ROADS	34		17						
c REGRADING				125					
6 SHELTER EXCAVATION				140	70				
7 CONCRETE FOR DDA			1	23	2				
8 CONCRETE FOR MOB, AOB, DAA, OBTS									
9 CONCRETE AGGREGATE WASH			1	26	2				
*TOTALS (ACRE-FEET / YEAR)	196	427	3411	2533	2133	250			

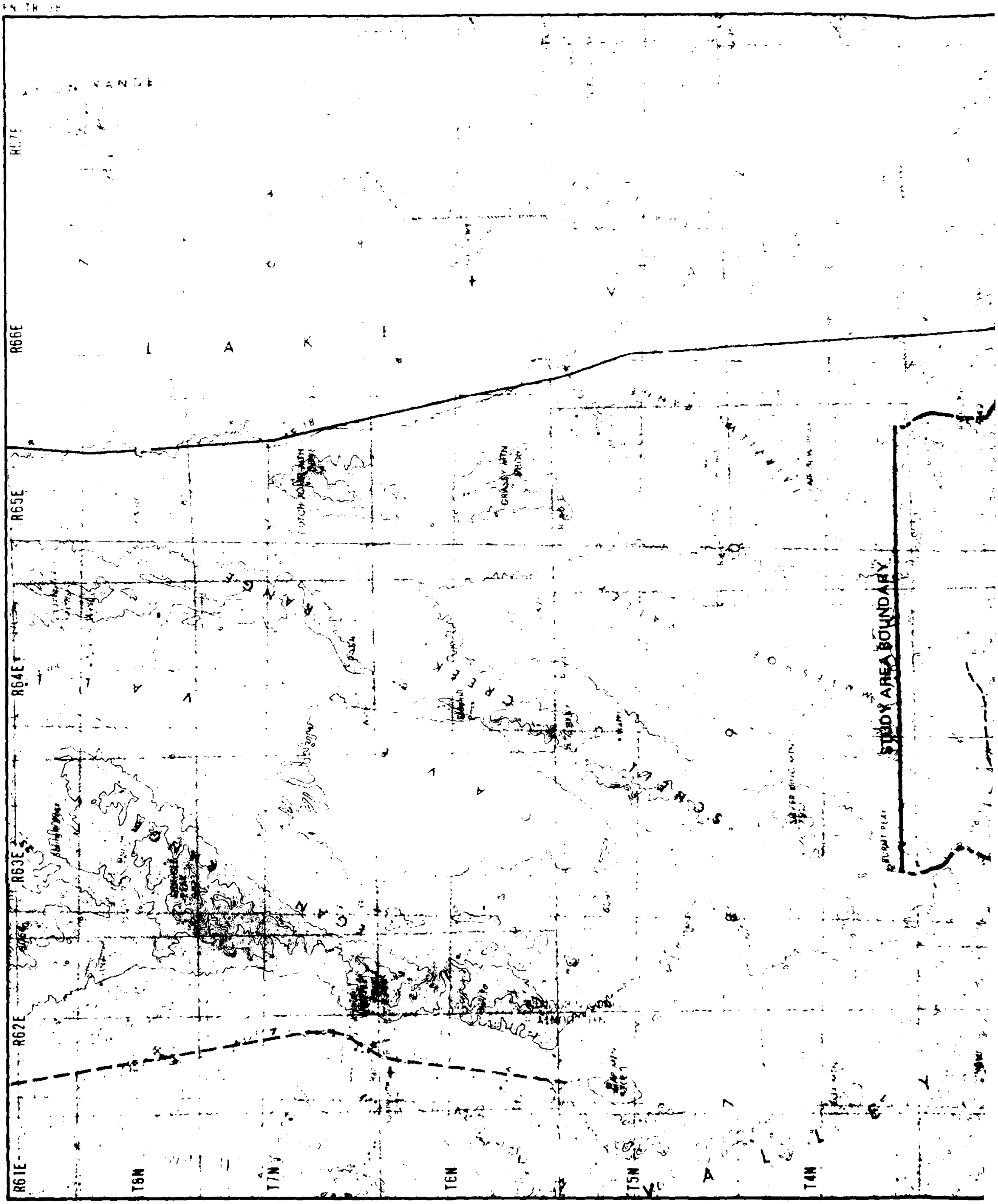
* These figures are a little higher than those in Table 4 - 13 due to difference in calculations within the COE MX water requirement document, 17 March 1981

MX WATER USE
ESTIMATES
DRY LAKE VALLEY, NEVADA
SEPTEMBER, 81 TABLE

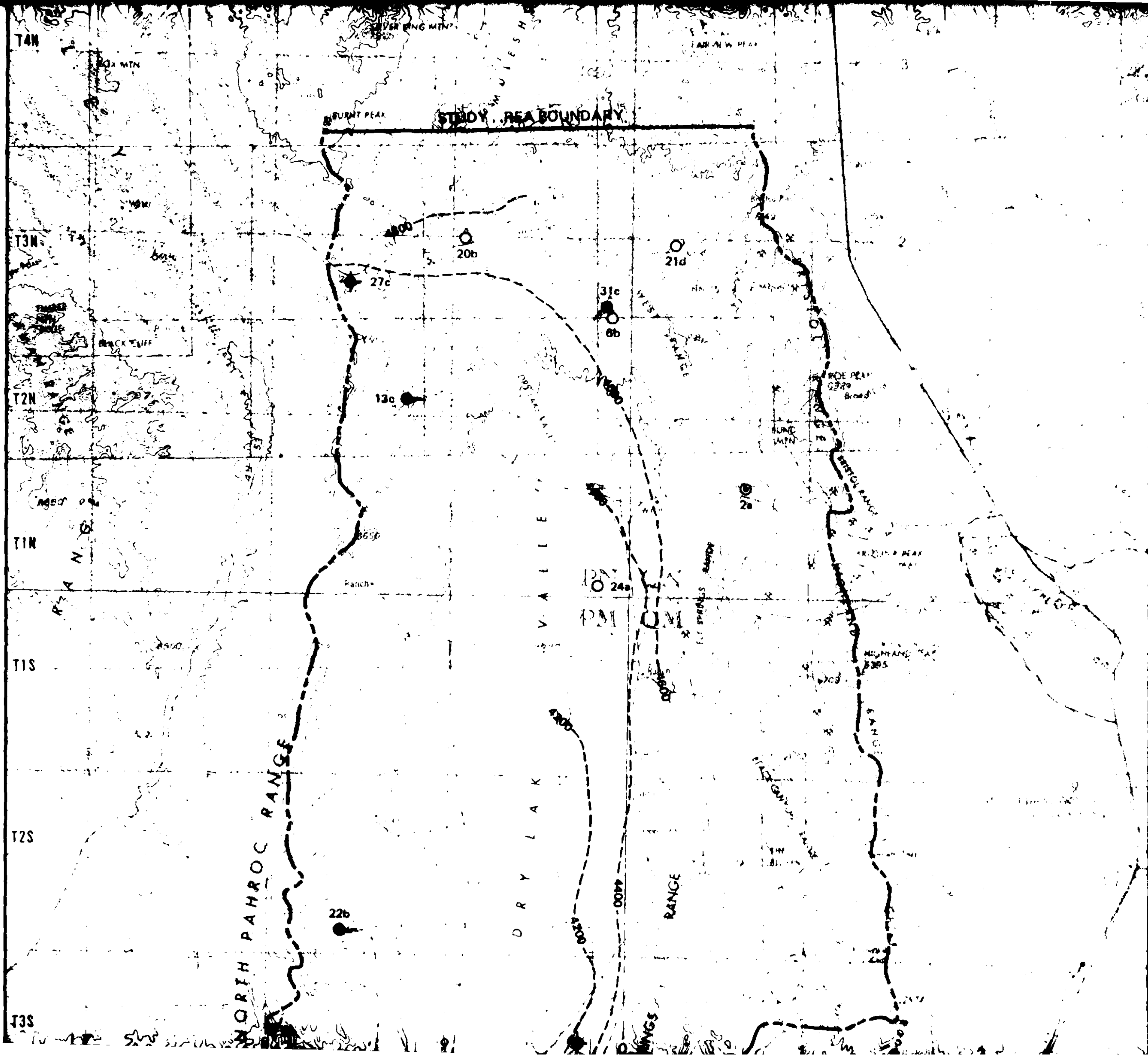
ERTEC WESTERN, INC.

WELL AND WATER LEVEL DATA IN DRY LAKE VALLEY

	Well Description						Water Level Measurements			Remarks	Data Source
ID. NO.	TOWNSHIP RANGE-SECTION	WELL OWNER	YEAR DRILLED	WELL DEPTH (FT)	CASING ID (IN)	LAND ELEV (FT)	MO/YEAR	DEPTH-BELOW SURFACE (FT)	ELEV (FT)		
1	3N/63E-27CA	U.S.AIR FORCE	1980	2395	10	5390	2/1981	851	4539	CARB.TEST WELL	ERTEC
2	3N/64E-20BAC	BLM	1960	380	6	5067	/1960	317	4750		EAKIN 63
3	3N/65E-21DBA	DELMUE	1962	51		5451	/1962	45	5406		USGS 79
4	2N/65E- 6B1			376		5075		--		DRY	EAKIN 63
5	1N/64E-24A1	LYTLE & OTHERS	1959	515	5	4700	1/1959	398	4302		EAKIN 63
6	1N/65E- 2AAC			12	48	5660		10	5650	DUG WELL	EAKIN 63
7	3S/64E-12AC1	U.S.AIR FORCE	1980	1305	2	4645	2/1981	383	4262	OBSERVATION WELL	ERTEC
8	3S/64E-12AC2	U.S.AIR FORCE	1980	1012	10	4645	2/1981	395	4250	TEST WELL	ERTEC

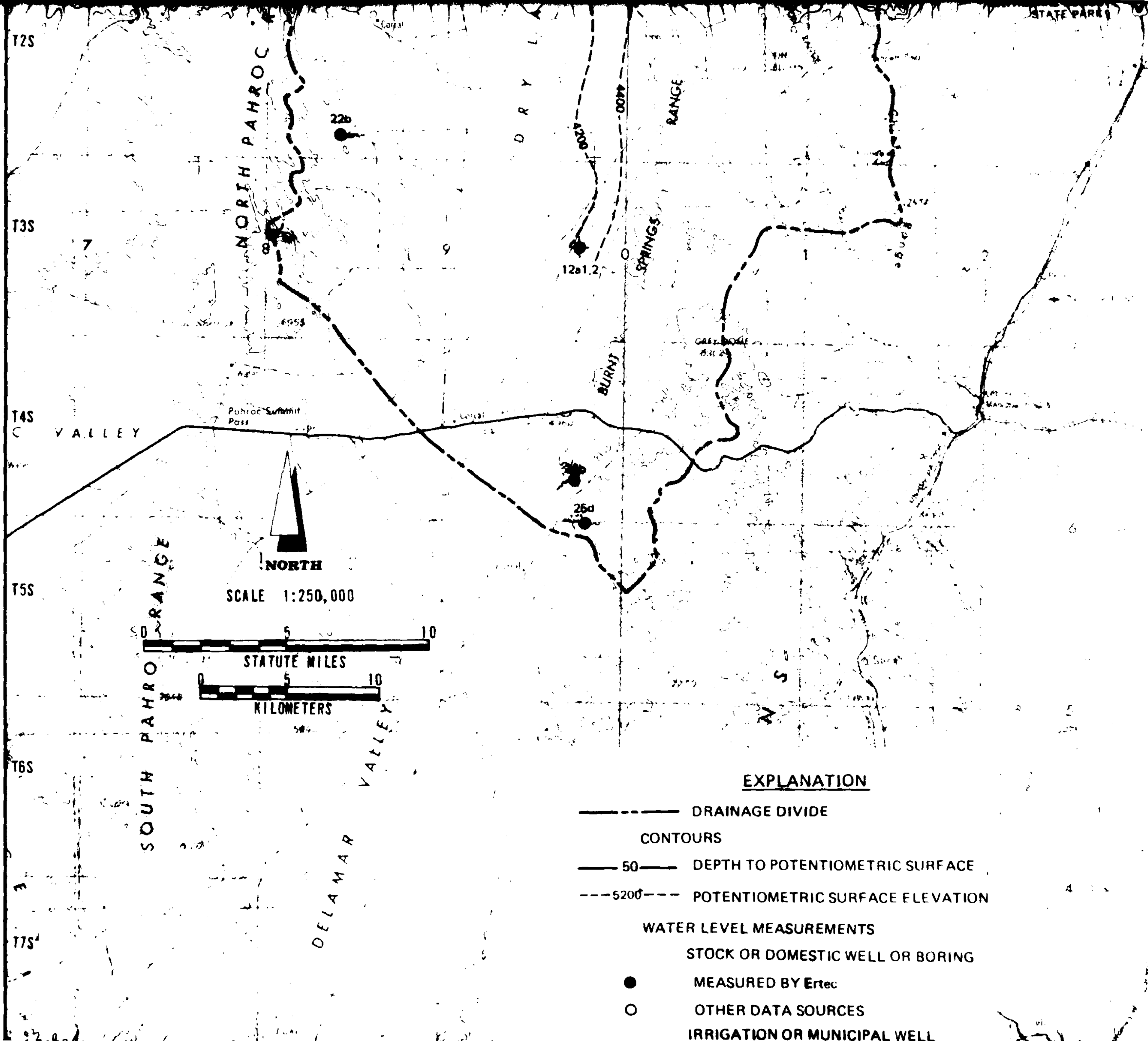

R67E
R66E
R65E
R64E
R63E
R62E
R61E
T6N
T7N
T6N
T5N
T4N
STUDY AREA BOUNDARY
L A K E
V A L L E Y

1 AUG 80

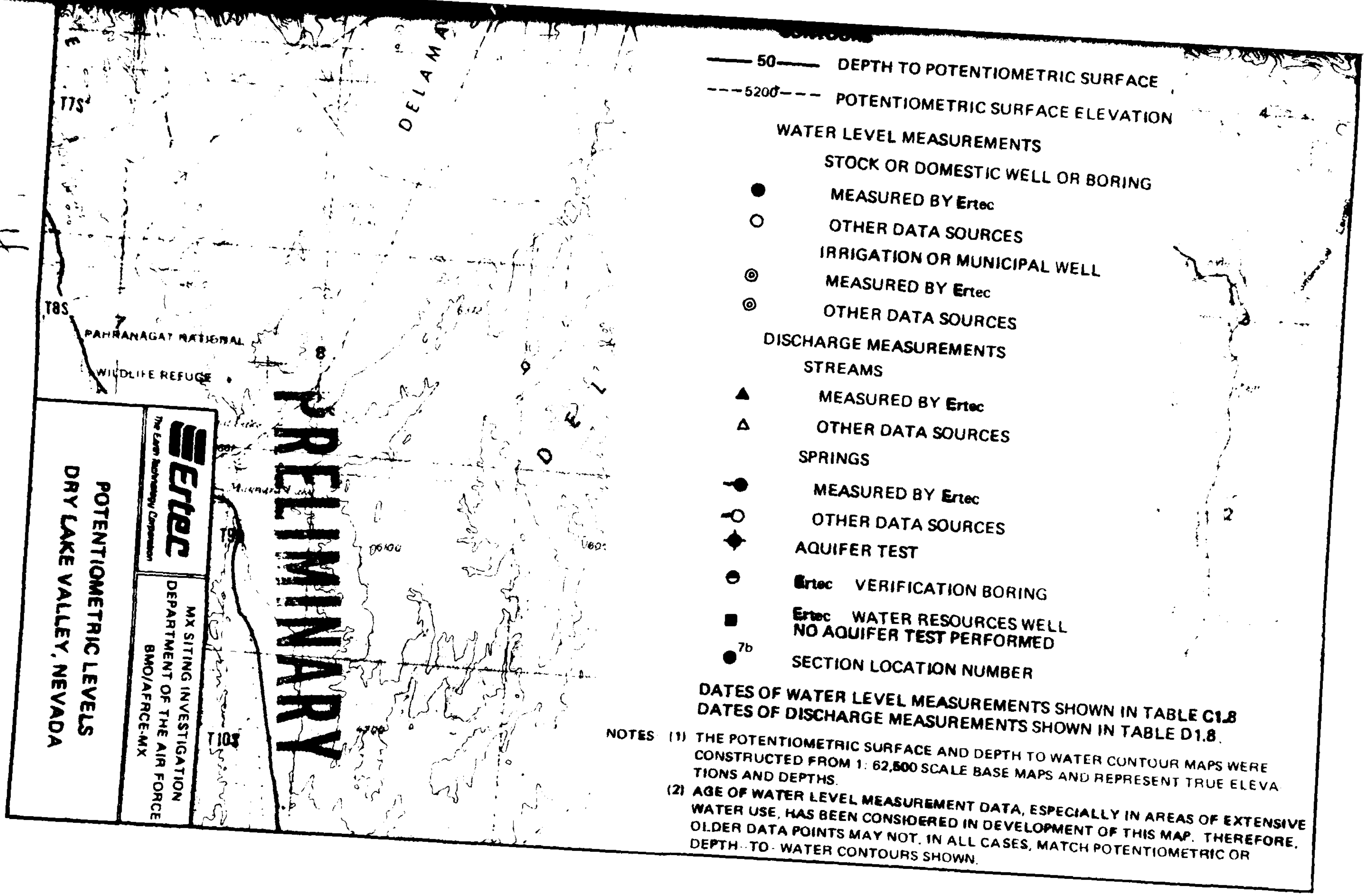


STUDY AREA BOUNDARY
BURNT PEAK
T4N
T3N
T2N
T1N
T1S
T2S
T3S
BOX MTN
BLACK CLIFF
20b
21d
27c
31c
6b
13c
2a
24a
22b
4600
4400
4200
ROE PEAK
BRISTOL RANGE
HIGHLAND PEAK
9395
VALLEY
DRY LAKE
RANGE
NORTH PAHROC RANGE
Ranch

12

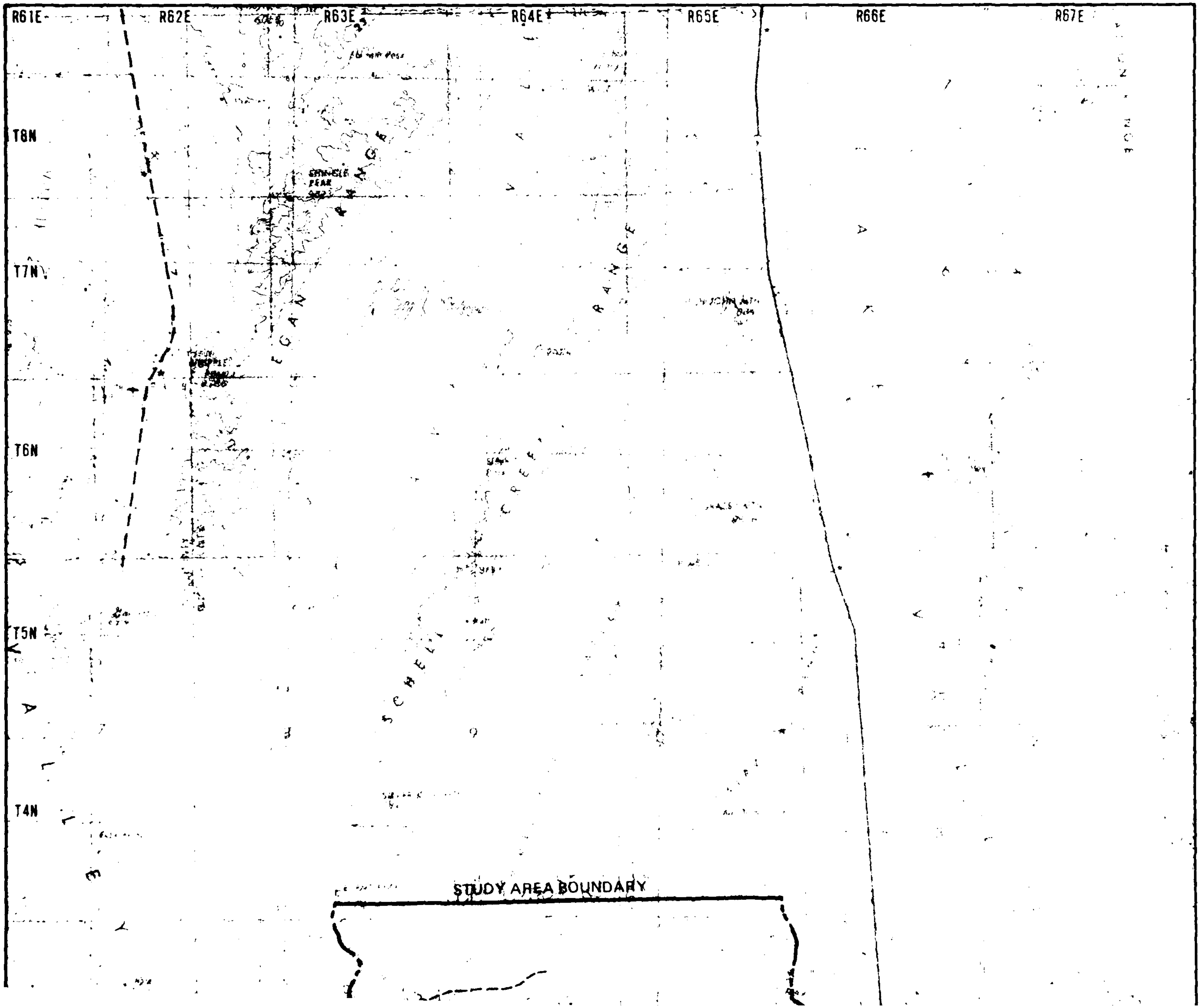


T2S
T3S
T4S
T5S
T6S
T7S
NORTH PAHROC
DRY LAKE
RANGE
SPRINGS
BURNT
VALLEY
Pahroc Summit Pass
SOUTH PAHROC RANGE
DELAMAR VALLEY
STATE PARK
22b
8
12a1,2
25d
4200
4400
NORTH
SCALE 1:250,000
STATUTE MILES
KILOMETERS
EXPLANATION
DRAINAGE DIVIDE
CONTOURS
50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
STOCK OR DOMESTIC WELL OR BORING
MEASURED BY Ertec
OTHER DATA SOURCES
IRRIGATION OR MUNICIPAL WELL

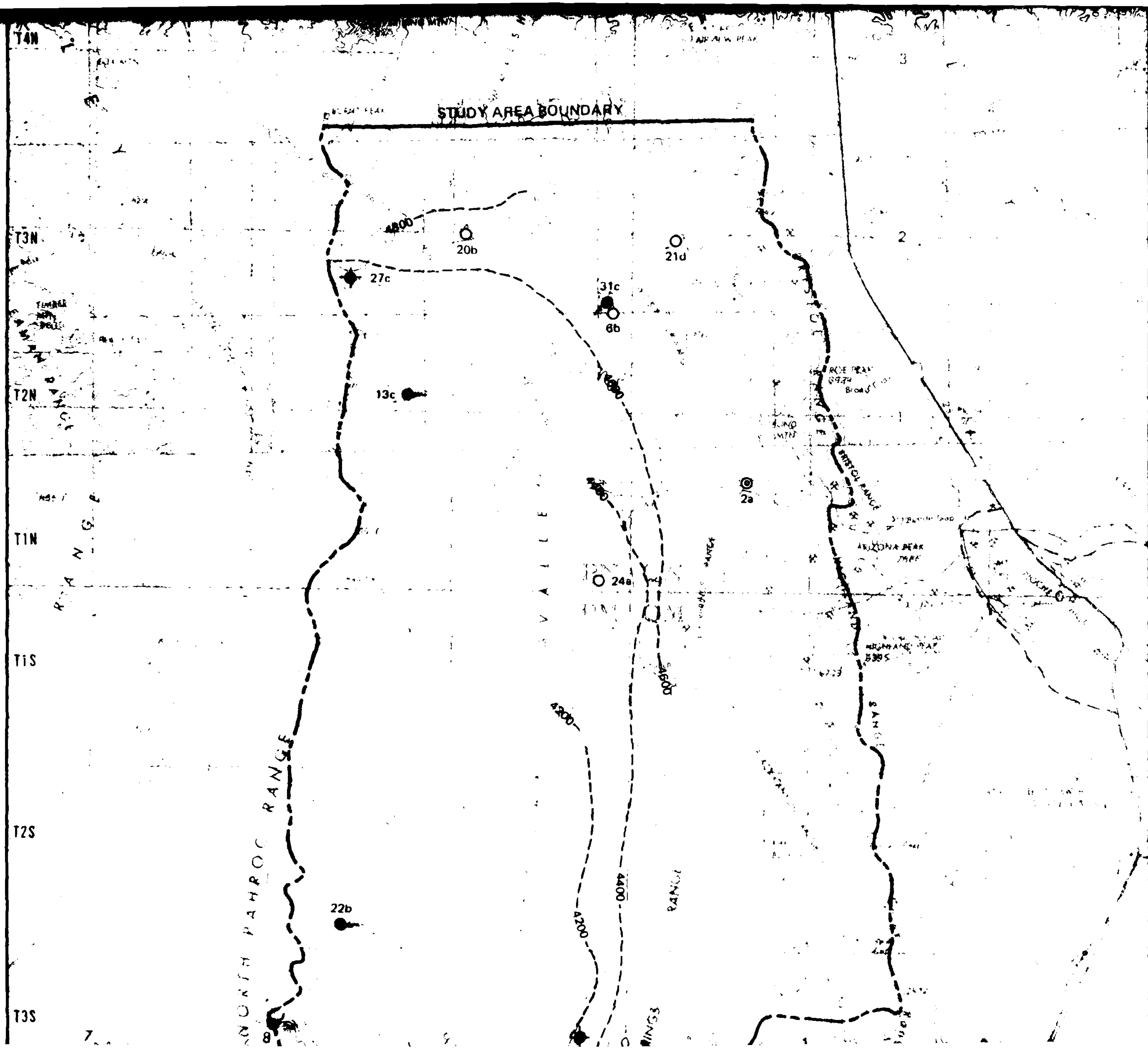


50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
STOCK OR DOMESTIC WELL OR BORING
MEASURED BY Ertec
OTHER DATA SOURCES
IRRIGATION OR MUNICIPAL WELL
MEASURED BY Ertec
OTHER DATA SOURCES
DISCHARGE MEASUREMENTS
STREAMS
MEASURED BY Ertec
OTHER DATA SOURCES
SPRINGS
MEASURED BY Ertec
OTHER DATA SOURCES
AQUIFER TEST
Ertec VERIFICATION BORING
Ertec WATER RESOURCES WELL NO AQUIFER TEST PERFORMED
7b SECTION LOCATION NUMBER
DATES OF WATER LEVEL MEASUREMENTS SHOWN IN TABLE C1.8
DATES OF DISCHARGE MEASUREMENTS SHOWN IN TABLE D1.8.
NOTES (1) THE POTENTIOMETRIC SURFACE AND DEPTH TO WATER CONTOUR MAPS WERE CONSTRUCTED FROM 1: 62,500 SCALE BASE MAPS AND REPRESENT TRUE ELEVATIONS AND DEPTHS.
(2) AGE OF WATER LEVEL MEASUREMENT DATA, ESPECIALLY IN AREAS OF EXTENSIVE WATER USE, HAS BEEN CONSIDERED IN DEVELOPMENT OF THIS MAP. THEREFORE, OLDER DATA POINTS MAY NOT, IN ALL CASES, MATCH POTENTIOMETRIC OR DEPTH-TO-WATER CONTOURS SHOWN.
PRELIMINARY
T7S
T8S
T9S
T10S
PAHRANAGAT NATIONAL WILDLIFE REFUGE
DELAMAR
Ertec
The Earth Technology Corporation
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX
POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

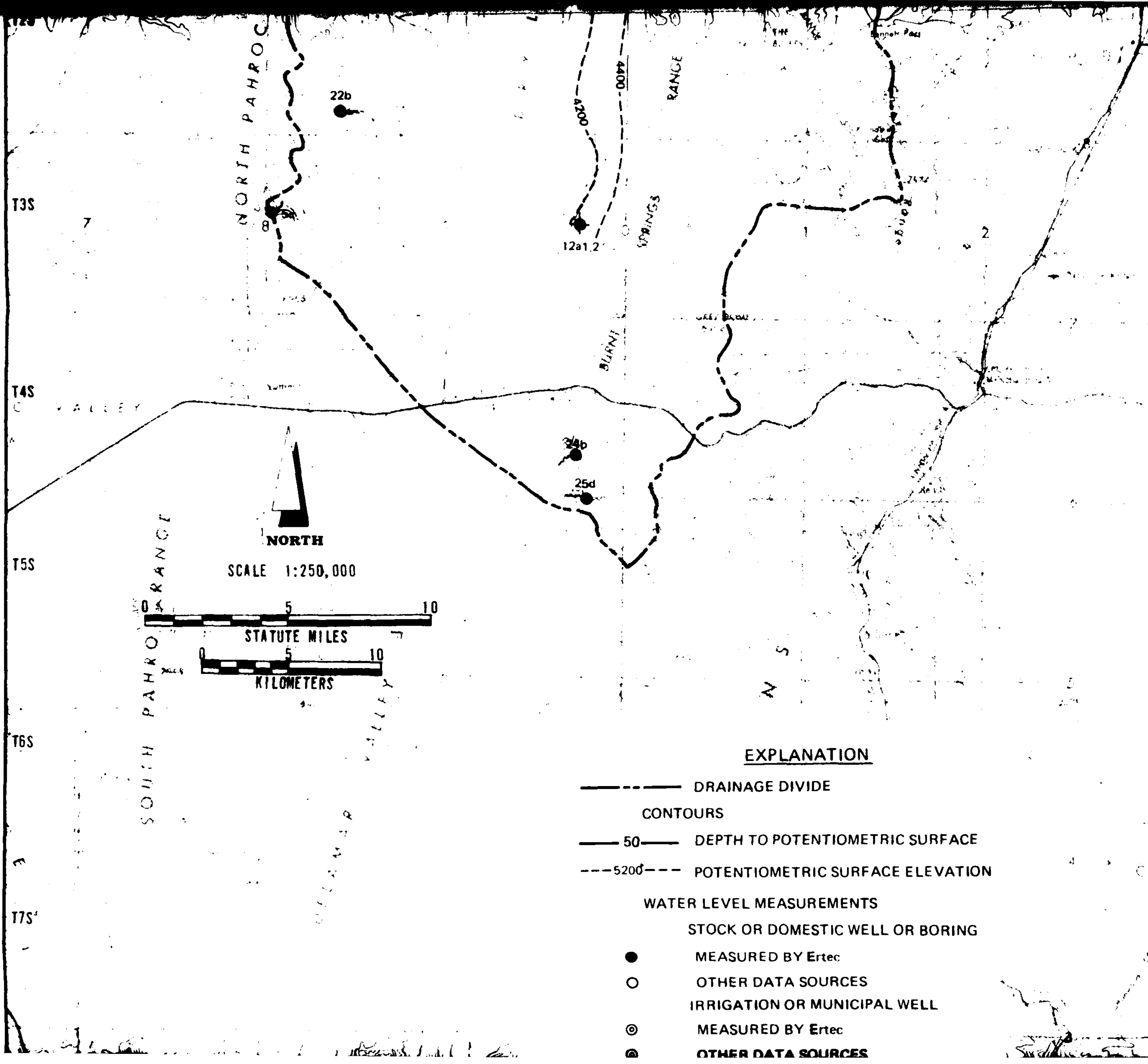
4

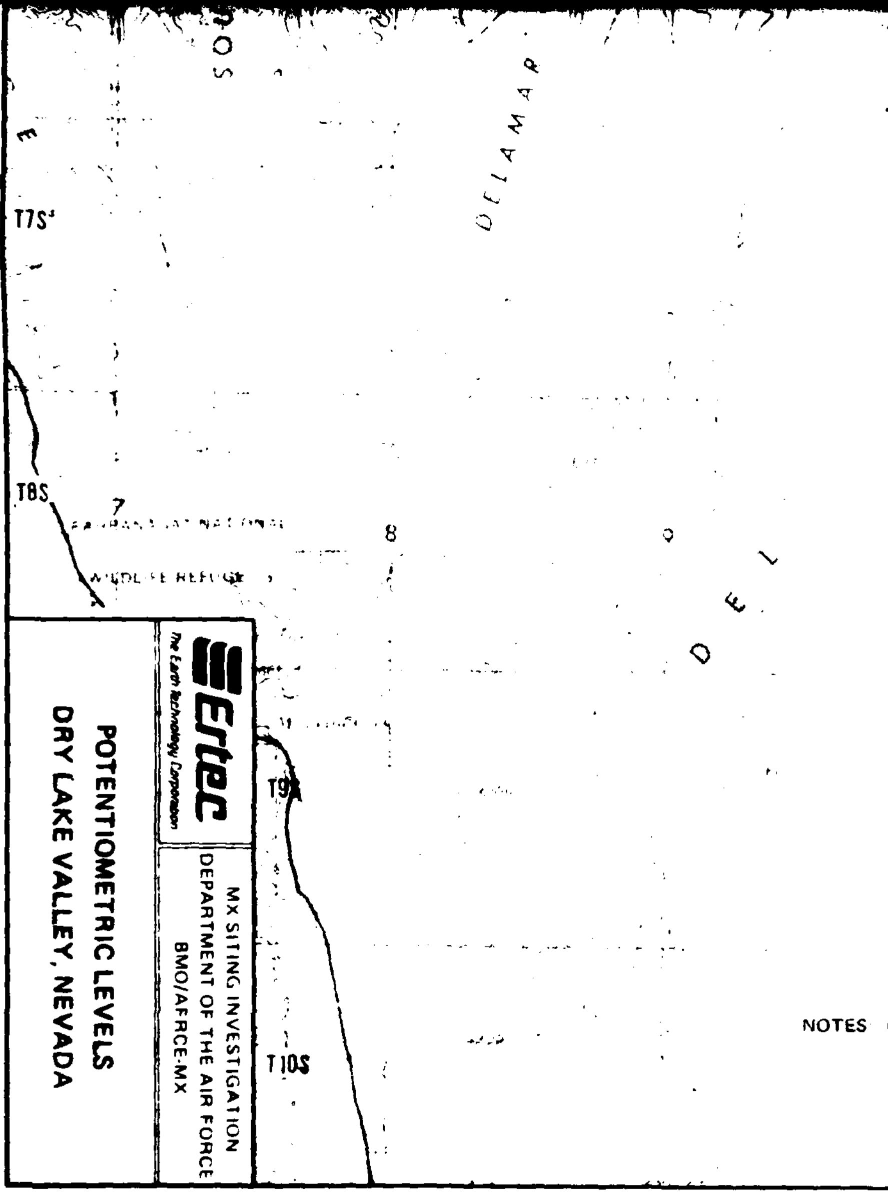


R61E
R62E
R63E
R64E
R65E
R66E
R67E
T8N
T7N
T6N
T5N
T4N
SPINDLE PEAK
STUDY AREA BOUNDARY


STUDY AREA BOUNDARY
T4N
T3N
T2N
T1N
T1S
T2S
T3S
4800
4600
4400
4200
20b
21d
27c
31c
6b
13c
2a
24a
22b
8
NORTH PAHROC RANGE
BRISTOL RANGE
ARIZONA PEAK
VALLEY
RANGE

12


T3S
T4S
T5S
T6S
T7S
NORTH PAHROC
RANGE
SPRINGS
BURNT
4400
4200
22b
8
12a1.2
24b
25d
VALLEY
SOUTH PAHROC RANGE
NORTH
SCALE 1:250,000
0 5 10
STATUTE MILES
0 5 10
KILOMETERS
EXPLANATION
DRAINAGE DIVIDE
CONTOURS
50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
STOCK OR DOMESTIC WELL OR BORING
MEASURED BY Ertec
OTHER DATA SOURCES
IRRIGATION OR MUNICIPAL WELL
MEASURED BY Ertec
OTHER DATA SOURCES



DRAINAGE DIVIDE

CONTOURS

50 — DEPTH TO POTENTIOMETRIC SURFACE

5200 - - - POTENTIOMETRIC SURFACE ELEVATION

WATER LEVEL MEASUREMENTS

STOCK OR DOMESTIC WELL OR BORING

● MEASURED BY Ertec

○ OTHER DATA SOURCES

IRRIGATION OR MUNICIPAL WELL

◎ MEASURED BY Ertec

◎ OTHER DATA SOURCES

DISCHARGE MEASUREMENTS

STREAMS

▲ MEASURED BY Ertec

△ OTHER DATA SOURCES

SPRINGS

MEASURED BY Ertec

OTHER DATA SOURCES

AQUIFER TEST

Ertec VERIFICATION BORING

■ Ertec WATER RESOURCES WELL NO AQUIFER TEST PERFORMED

● 7b SECTION LOCATION NUMBER

DATES OF WATER LEVEL MEASUREMENTS SHOWN IN TABLE C1.8
DATES OF DISCHARGE MEASUREMENTS SHOWN IN TABLE D1.8.

NOTES
(1) THE POTENTIOMETRIC SURFACE AND DEPTH TO WATER CONTOUR MAPS WERE CONSTRUCTED FROM 1:62,500 SCALE BASE MAPS AND REPRESENT TRUE ELEVATIONS AND DEPTHS.
(2) AGE OF WATER LEVEL MEASUREMENT DATA, ESPECIALLY IN AREAS OF EXTENSIVE WATER USE, HAS BEEN CONSIDERED IN DEVELOPMENT OF THIS MAP. THEREFORE, OLDER DATA POINTS MAY NOT, IN ALL CASES, MATCH POTENTIOMETRIC OR DEPTH TO WATER CONTOURS SHOWN.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

E1.0

DRY LAKE/DELAMAR VALLEYS SECTION: MX SITING INVESTIGATION, WATER RESOURCES PROGRAM, SUMMARY FOR DRAFT ENVIRONMENTAL IMPACT STATEMENT north of township 6 with total dissolved solids concentrations ranging from about 130 to about 280 mg/l. Two springs (7N/64E-33cc; 6N/63E-19da), analyzed by the BLM have moderately high bicarbonate concentrations (more than 250 mg/l). This condition is probably due to the solution of carbonate rocks by the ground water.

Cave Valley Spring located at 9N/64E-16bdb also originates from the carbonates but has low bicarbonate concentration (80 mg/l) and low total dissolved solid concentrations (127 mg/l). This is probably due to a short resident time of the ground water with the rocks which suggests that it is related to precipitation and snowmelt. Thus it is not connected to the regional carbonate aquifer. The discharge in Cave Spring ranges from a few hundred gallons per minute to less than 10 gallons per minute. Table C1-3 lists the chemical analysis of the water samples and Drawing D1-2 shows the area of good water quality. As can be seen on the Drawing, all of the valley is estimated to contain ground water of good quality.

3.3 DRY LAKE/DELAMAR VALLEYS

3.3.1 Physiography and Geology

Dry Lake and Delamar valleys are believed to be hydrologically connected through valley-fill aquifers and are treated essentially as the same ground-water basin in the ensuing discussions. The Dry Lake/Delamar drainage basin lies within central Lincoln County in east-central Nevada (Figure 1). The basin is approximately 82 miles (132 km) long and 20 miles (32 km) wide at the widest point, and encompasses an area of 1300 mi^2 (3367 km^2). Of that area, 497 mi^2 (1287 km^2) are suitable for MX siting including 315 mi^2 (815 km^2) in Dry Lake Valley and 182 mi^2 (417 km^2) in Delamar Valley.

The valley-fill deposits are up to 10,000 feet (3 km) thick along the axis of the valleys and thin toward the margins. Based on detailed gravity maps constructed by Fugro National, (FN-TR-33-DL), the volume of valley-fill in Dry Lake Valley is estimated to be 635,000,000 acre-ft (732,955 hm^3). The estimated volume of valley-fill in Delamar Valley is 200,000,000 acre-ft (246,600 hm^3). These substantial potential aquifer volumes provide tremendous storage capacity for ground water.

Mountain crests bounding the valleys range in elevation from about 7000 feet (2134 m) to over 9000 feet (2743 m). Highland Peak, on the east side of Dry Lake Valley, has an elevation of 9395 feet (2864 m), and is the highest point in the basin. The playa, in the extreme south end of Delamar Valley, has an elevation of less than 4400 feet (1341 m) and is the lowest point in the basin. The two valleys are separated by a low, broad alluvial fan that extends across the basin just south of Dry Lake playa.

Dry Lake and Delamar valleys exhibit typical Basin and Range structure, consisting of high angle, north-south trending, normal basement faults that border the Pahroc ranges on the west and the Bristol, Highland, Chief, and Delamar ranges on the east. The area between the ranges is faulted downward. A north-south trending fault on the eastern side of the basin displaces surface alluvium and forms a prominent scarp. Additionally, Shawe (1965) shows east-west trending faults that transect the basin and displace deep valley-fill deposits. This interpretation is supported also by gravity surveys (Fugro National, FN-TR-26E).

The mountains on the western side of the valley are predominantly composed of ash flow tuffs of Tertiary age with some carbonate rocks of Paleozoic age. Conversely, the eastern mountains are composed primarily of carbonate rocks of Paleozoic age with minor amounts of ash flow tuffs of Tertiary age (Stewart and Carlson, 1978).

Coarse-grained alluvial and fine-grained lacustrine deposits make up the majority of sediments in the valleys. Although playa deposits cover only a small percentage of the valley surface, they are thought to be of great thickness and interfinger with alluvial deposits in the subsurface (Fugro National, FN-TR-27). These playa deposits are located in the south-central portions of the valleys. From the central part of the valleys, the grain size and grading of alluvial deposits progressively increase towards the mountains.

3.3.2 General Hydrology

Dry Lake and Delamar valleys form closed surface drainage basins. There are no perennial streams in the valleys, and streamflow only occurs in the mountain ravines and alluvial fans after high-intensity rains and as snowmelt runoff.

Springs in the Dry Lake and Delamar valley area occur in volcanic rocks composed predominantly of tuffs along the basin margins. The springs are recharged by meteoric waters (precipitation and snowmelt) and are not associated with the deep regional carbonate aquifer. They generally have low yields (less than 20 gpm) and are used primarily to supply stock ponds in the area.

The ground-water table in the basin aquifer occurs at considerable depths (Drawings B1-3 and B1-4). In Dry Lake Valley, ground-water levels are about 400 feet (122 m) below ground surface, and in Delamar Valley, levels are generally greater than 800 feet (244 m) below ground surface. Some water wells in the northern and western part of Dry Lake Valley tap perched aquifers with water levels significantly higher than the underlying basin aquifer. Water use in the valleys is limited to a few isolated stock ponds fed by infrequent surface runoff and nearby springs with waters of meteoric origin.

Ground-water recharge to the basin is primarily from precipitation occurring in the mountains along the northwest and east flanks of the valleys (Eakin, 1963). From these areas, ground water moves laterally and downward toward the central part of the valleys as indicated on the ground-water level contour map (Drawing B1-3 and B1-4). Generally, the ground water moves from Dry Lake Valley toward Delamar Valley. An annual (recharge based on a percentage of average annual precipitation) of about 6000 acre-ft (7.4 hm^3) for the valleys has been estimated by

Eakin (1963). Discharge occurs primarily as deep underflow to the south through carbonate rocks. Alluvial ground-water gradients between Dry Lake Valley and Delamar Valley closely resemble the carbonate aquifer gradient between White River Valley and Pahranagat Valley. This suggests that the valley-fill aquifers of the basin and the regional carbonate aquifers are hydraulically connected (Eakin, 1963).

3.3.3 Aquifer Characterisitics

The considerable depth to ground water (Drawing B1-3 and B1-4) has precluded much development in these valleys and, therefore, very little has been published about specific aquifer characteristics. However, all wells in the basin tap valley-fill aquifers with little indication of confinement. Existing wells produce less than 100 acre-ft of water annually for use by livestock. During Furgo National's field investigations in 1979, none of the wells were found to be suitable for aquifer testing because of pumping limitations. In 1980, two intermediate depth test wells (3S/64E-12ca and 6S/63E-12ad) were drilled in Dry Lake/ Delamar valleys (lithologic and geophysical logs are presented in Appendices H1-3 and H1-34). At each site, observation and test wells were constructed.

Aquifer tests in Dry Lake Valley were conducted for ten days at 500 gpm (31.5 l/s) followed by an aquifer recovery test. The maximum well yield during development was approximately 750 gpm (47.3 l/s). Maximum drawdown at the pumping well during the pump test was about 50 feet (15 m). These tests indicated an aquifer transmissivity of about 45,000 gpd/ft (155 cm^2/sec) and a storage coefficient of 3×10^{-4}. Because the well only partly penetrated the aquifer, the transmissivity of the total thickness of the aquifer is probably much higher. The unusually low storage coeffiecient in the valley-fill aquifer is probably due to the tremendous thickness of the aquifer.

Aquifer tests in Delamar Valley were conducted for ten days at 85 gpm (5.3 l/s) followed by an aquifer recovery test. Maximum drawdown during the test was 85 feet (26 m). Transmissivity was calculated at 5000 gpd/ft (7 cm^2/sec) with a storage coefficient of 4.0×10^{-4}.

Potential well yields in Dry Lake Valley are expected to be high in the unconsolidated valley-fill deposits around the valley periphery. However, a significant portion of the basin is probably composed of fine-grained lacustrine deposits near the central valley areas. These areas probably have relatively low hydraulic conductivities. The extent and depth of the low yield deposits are not fully known. However, there appears to be sufficient water for development of the MX system within the basin.

Because of the great depths to water in Delamar Valley [870 ft (265 m) in test well 6S/63E-12ad], well yields are expected to be less than 100 gpm (6.3 l/s). Well yields may increase slightly away from the central valley axis, but any yield increase due to higher aquifer permeability will probably be offset by the corresponding increase in pumping lift.

3.3.4 Water Quality Limitations

Because there are very few wells in Dry Lake Valley, only four ground-water quality analyses are available. The well and spring sample locations are shown in Drawing D1-3. Four of these samples were collected by Fugro National in 1979 and 1980 and one sample was collected by Carpenter (1915) and reported by Eakin in 1963.

Based on the water quality critieria listed in Appendix C1-1, all of the water analyzed is of good quality and is acceptable for drinking. All ground-water samples contained moderately high bicarbonate levels ranging from 187 to 320 mg/l, which result in hardness levels of about 100 mg/l. Calcium concentrations range from about 40 to 83 mg/l and were generally in the poor range. In addition, the sample collected at 3N/65E-21dbd and analyzed by Carpenter also contained relatively high chloride (110 mg/l) and nitrate (32 mg/l) concentrations.

Ground water in the northern part of Dry Lake Valley is of the calcium-magnesium/chloride-bicarbonate type. As the ground water migrates from the fans toward the central valley area, the concentrations of calcium and chloride increase slightly and sodium concentrations decrease, yielding water of the sodium-calcium/bicarbonate type. The higher calcium and chloride concentrations in the central valley area may be related to the soil chemistry of the playa deposits.

The only ground-water samples for chemical quality testing from Delamar Valley was from the Fugro National test well. However, the analyses were not completed at the time of publication of this report.

3.4 DUGWAY VALLEY

3.4.1 Physiography and Geology

Dugway Valley is located in Tooele and Juab counties in west-central Utah (Figure 1) and has a total area of 890 mi^2 (2300 km^2). Of the total area only 182 mi^2 (471 km^2) are suitable for MX siting.

Dugway Valley trends north-south and is approximately 30 miles (48 km) long and varies in width from 1 to 8 miles (2 to 13 km). The valley is bordered on the west by the Dugway Mountains and the Thomas Range, on the south by the Drum Mountains, and on the east and northeast by Keg Mountain and Slow Elk Hills. The northern boundary of the valley is the Great Salt Lake Desert. Valley floor elevations range from 4480 feet (1365 m) at the north end to 5080 feet (1548 m) in the central-southern portion of the valley. The valley is bounded by peaks on the northwest that reach elevations of nearly 9000 feet (2700 m). Most of the area below about 4600 feet (1400 m) is nearly flat as a result of planation and deposition by ancient Lake Bonneville (Stephens and Sumsion, 1978).

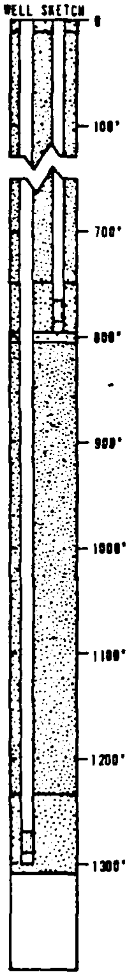
Valley-fill deposits consist mainly of alluvial fan deposits along the margins of the valley which interfinger with lake and playa deposits in and near the center of the valley. These deposits consist mainly of clay, silt, sand, and minor amounts

FUGRO WELL CONSTRUCTION

WELL NO OW-2 SHEET 1 OF 1
LOGGED BY JFW, SC AND LG PROJECT NO 79-290-45
DATE (S) JAN 3-22, 1980 PROJECT NAME MX
VALLEY DRY LAKE

ELEVATION
GROUND LEVEL 4843'
LOCATION OR COORDINATES 3S/64E-12ca TOP OF CASING 4845'

WELL SKETCH



DRILLING SUMMARY

TOTAL DEPTH DRILLED 1305'
ROTARY REVERSE CORE
DRILLING CONTRACTOR DEYLIN
BIT (S) USED BUCKET AUGER 0' TO 40' 40' TD TO REVERSE ROTARY
SIZE (S) AND TYPE (S) OF BITES 18 5/8" DRAG AND CLUSTER BITS
DRILLING FLUID WATER AND 4 SACKS POLYMER
SAMPLING METHOD COLLECTED FROM DISCHARGE PIPE
SURFACE CASING 0' TO 40' 22" DIA
COMMENTS (PROBLEMS, SHUTDOWNS, ETC)

DESIGN

BASIS DRILLER'S LOG
GEOLOGIC LOG ✓
GEOPHYSICAL LOG ✓
COPIES ATTACHED __ YES __ NO

STEEL CASING STRING 1
FROM 0' TO 1270 BLANK
FROM 1270' TO 1290' PERF
FROM 1290' TO 1300' BLANK
FROM TO
FROM TO

STEEL CASING STRING 2
FROM 0' TO 765' BLANK
FROM 765' TO 785' PERF
FROM 785' TO 795' BLANK
FROM TO
FROM TO

CASING	STEEL	PVC
DIMENSIONS	2" I D.	
SCREEN		
DIMENSIONS	2" I D	
SLOT SIZE	3/4" MACHINED SLOTS	

PACKERS
CENTRALIZERS
PEA GRAVEL 0'-750' 805'-1230'
WELL PACK 750'-785' 1230'-1305
CEMENT (MIX) DEPTH (S) 0' - 10' 795'-805'
BENTONITE
PELLETS
SLURRY

DEVELOPMENT METHOD (S)

AIR LIFT 19 HOURS

TIME LOG

	START	FINISH	ELAPSED TIME	% OF TOTAL
DRILLING				
LOGGING				
CASING				
GRAVEL PACKING				
CEMENTING				
BENTONITE PELLETS				
SLURRY				
DEVELOPMENT				

MISCELLANEOUS

A 22" DIAMETER STEEL CONDUCTOR CASING WAS INSTALLED TO 40' BELOW THE GROUND SURFACE

F-8-3 2-21-79

EXPLANATON

- BLANK CASING
- PERFORATED CASING
- CEMENT
- GRAVEL PACK
- SAND PACK

WELL CONSTRUCTION LOG
OBSERVATION WELL
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE H1.4-3

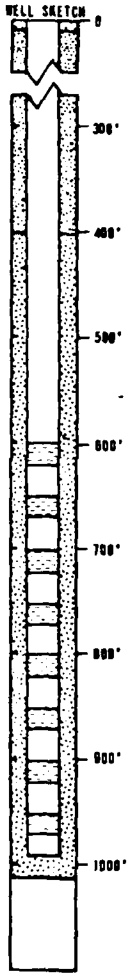
FUGRO NATIONAL, INC.

FUGRO WELL CONSTRUCTION

WELL NO TD-1 SHEET 1 OF 1
LOGGED BY JFB, LO PROJECT NO 79-299-45
DATE (S) JAN 29-FEB 12,1980 PROJECT NAME MX
VALLEY DRY LAKE

ELEVATION
GROUND LEVEL 4845'
LOCATION OR COORDINATES 3S/64E-12cd TOP OF CASING 4846'

WELL SKETCH



DRILLING SUMMARY

TOTAL DEPTH DRILLED 1010'
ROTARY REVERSE CORE
DRILLING CONTRACTOR LAYLIN

RIG (S) USED BUCKET AUGER 0'-40' REVERSE ROTARY 40'-TD
SIZE (S) AND TYPE (S) OF BITES 18 5/8" DRAG TRICONE & CLUSTER BITS
DRILLING FLUID POLYMER (5 SACKS) AND WATER

SAMPLING METHOD COLLECTED FROM DISCHARGE PIPE
SURFACE CASING 0'-40' 22" DIAMETER
COMMENTS (PROBLEMS, SHUTDOWNS, ETC)

DESIGN

BASIS DRILLER'S LOG
GEOLOGIC LOG ✓
GEOPHYSICAL LOG ✓
COPIES ATTACHED __ YES __ NO

STEEL CASING SCREEN

FROM	600'	TO	620'
FROM	650'	TO	670'
FROM	700'	TO	720'
FROM	750'	TO	770'
FROM	800'	TO	820'
FROM	850'	TO	870'
FROM	900'	TO	920'
FROM	950'	TO	970'
FROM		TO	
FROM		TO	

	STEEL	PVC
CASING DIMENSIONS	10" I.D.	
SCREEN DIMENSIONS	10" I.D.	
SLOT SIZE	80	

PACKERS

CENTRALIZERS EVERY 100'

PEA GRAVEL 10-400'
WELL PACK 400'-1010
CEMENT (MIX) DEPTH (S) 0'-10'

BENTONITE
PELLETS
SLURRY

DEVELOPMENT METHOD (S)

SWABBING AND BAILING, 32 HOURS.
PUMP SURGING FOR 12 HOURS

TIME LOG

	START	FINISH	ELAPSED TIME	% OF TOTAL
DRILLING				
LOGGING				
CASING				
GRAVEL PACKING				
CEMENTING				
BENTONITE PELLETS				
SLURRY				
DEVELOPMENT				

MISCELLANEOUS

10" I.D. BLANK CASING INSTALLED ABOVE AND BELOW EACH SCREENED INTERVAL. A 22" DIAMETER STEEL CONDUCTOR CASING WAS INSTALLED AND GROUTED TO 40' BELOW THE GROUND SURFACE

F-8-2 2-21-79

EXPLANATION

- ☐ BLANK CASING
- ⊟ PERFORATED CASING
- CEMENT
- GRAVEL PACK
- SAND PACK

WELL CONSTRUCTION LOG
TEST WELL
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE H1.4-4

FUGRO NATIONAL, INC.

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

(4)

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290-45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12ca

EQUIPMENT USED 0-40' Bucket Auger/ 90-1300' Reverse Rotary

LOGGED BY JM & SC DATE 1-8-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR Jim Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
0	Silt: Tan silt with occasional gravel to 1½".
10	Silt: Tan Silt
20	Silt & Sand with Gravel: Tan silt with ± 25% med colored, fine to coarse, ± poorly sorted, subrounded to subangular sand, with ± 10% med colored subrounded to angular gravel to 1½".
30	Gravel with Cobbles - Med to dark colored, subrounded to subangular ½" gravel up to cobbles to 4".
40	Fine Gravel with Sand: Brown color, well sorted, subrounded gravel with less than 25% coarse sand, gravel up to 3/4".
50	Gravel with Coarse Sand: Brown color, subangular, well sorted gravel up to 3/4" with coarse, angular sand (less than 25%).
60	Gravel with Sand: Brown color, well sorted, subrounded gravel up to 1½" with less than 25% coarse sand.
70	Gravel with Sand: Same as above (60').
80	Coarse Sand with Gravel: Dark color, well sorted, subrounded sand with less than 25% gravel up to ½".
90	Fine to Medium Gravel with Sand: Brown color, well sorted, subrounded gravel with less than 10% coarse sand.
100	Gravel with Sand: Dark color, well sorted, subangular gravel up to 3/4" with less than 30% coarse sand.

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Circulation
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T35, R64E, Sect. 12 ac
LOGGED BY S C & JM DATE 1-8-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
100	Gravel with Coarse Sand: Dark color, well sorted, subangular, max gravel 1" with less than 25% coarse sand.
110	Gravel with Coarse Sand: Same as above (100'-110'). Max size for gravel ½".
120	Gravel with Coarse Sand: Same as above (100'-120'). Max gravel 1½".
130	Gravel with Coarse Sand: Less than 25% sand. Max gravel 1½". Most less than 1".
140	Gravel with Coarse Sand: Less than 10% sand. Same as above (130-140').
150	Gravel with Coarse Sand: Dark, subrounded, well sorted max size 1" gravel with less than 40% very coarse, subangular sand.
160	Gravel with Coarse Sand: Brown, subrounded, well sorted gravel with less than 25% coarse sand. Max size 3/4".
170	Gravel with Coarse Sand: Brown, subangular, well sorted gravel with less than 25% coarse sand. Max size 3/4".
180	Gravel with Coarse Sand: Much coarser than 170-180', 33% of sample greater than 1" size. Brown subrounded, subangular, well sorted with less than 10% sand.
190	Very Coarse Gravel with Coarse Sand: Dark, well sorted subangular. Greater than 2" sized gravel. Less than 5% coarse sand.
200	

WOODWARD-CLYDE NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290-45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Circulation
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12~~ea~~ 6
LOGGED BY JM & SC DATE 1-8-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
200	Gravel with Coarse Sand: Brown, well sorted, subangular gravel. Max size 1" with less than 40% subangular, coarse sand.
210	Gravel with Coarse Sand: Gray, subangular, well sorted. Max size 1½". Less than 10% subangular, coarse sand.
220	Gravel with Coarse Sand: Gray-black, subangular, well sorted. Max size 2½". Less than 10% coarse, subangular sand.
230	Gravel with Coarse Sand: Gray-black, subangular, well sorted. Max size 1". Less than 40% subrounded, coarse sand.
240	Gravel with Sand and Some Clay: Subangular, poorly sorted, max gravel size 3/4". Less than 10% sand. Less than 20% silt and clay.
250	Gravel with Coarse Sand: Gray-brown, subangular, well sorted, max size 1". Less than 20% coarse sand.
260	Gravel with Coarse Sand: Gray, subangular, well sorted. Max size 2½" gravel. Less than 20% coarse, subangular sand.
270	Gravel with Sand and Silt: Gray color, subangular, poor to medium sorted, max ½" gravel. Less than 25% fine- to coarse-grained sand. Less than 5% silt.
280	Gravel with Coarse Sand: Gray color, subangular, well sorted. Max 3/4" gravel. Less than 20% coarse, subangular sand.
290	Gravel with Coarse Sand: Gray, subangular, well sorted, max size gravel 1". Less than 20% subangular coarse sand.
300	

FUGRO NATIONAL, INC.

DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Circulation

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T3S, R64E, Sect. 12 ~~cc~~ 0C

LOGGED BY JM & SC DATE 1/8/80

CHECKED BY JAG DATE 4/10/80

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
300	Fine Gravel with Coarse Sand: Gray-brown, subrounded, well sorted, max size ½". Less than 40% coarse, subrounded sand.
310	
320	Gravel with Coarse Sand: Gray-brown, subrounded, well sorted, max size ½" gravel, less than 40% coarse, subrounded sand.
	Gravel with Coarse Sand: Well sorted, brown gray, subrounded, max ½" gravel with less than 30% coarse, subrounded sand.
330	
340	Gravel with Sand, Silt & Clay: Poorly sorted, gray-black, subangular to subrounded, less than 40% sand. Less than 10% silt and clay, ½" gravel.
350	Gravel with Sand, Silt & Clay: Poorly sorted, brown subangular-subrounded. 40% sand, 10% silt and clay, ½" gravel.
360	Gravel with Trace Sand, Silt & Clay: Less than 20% sub-gravel size, gray-black, subangular, poorly sorted ½" gravel.
370	Gravel with Medium to Coarse Sand: Brown-black, subrounded-subangular well sorted less than 30% sand.
380	Gravel: Poorly sorted, ½" gravel, subangular, less than 20% coarse sand.
390	Gravel: Medium sorted, gray-black-brown, subangular, less than 10% sand, ½" gravel.
400	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Circulation
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12~~ca~~ ac
LOGGED BY JM & SC DATE 1/14/80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
400	Gravel with Sand, Silt & Clay: Poorly sorted, gray-black, subangular-subrounded, less than 30% sand, 20% silt and clay, ½" gravel.
410	Gravel with Sand, Silt & Clay: Poorly sorted, subangular to subrounded, gray-black, less than 20% sand, less than 10% silt and clay.
420	Gravel with Sand, Silt & Clay: Poorly sorted, subangular, brown-gray, less than 40% sand, less than 10% silt and clay, 2½" gravel.
430	Gravel with Sand, Silt & Clay: Poorly sorted, brown-black, subangular, 3/4" gravel, less than 20% sand, less than 10% silt and clay.
440	Gravel with Sand, Silt & Clay: Poorly sorted, blue-black, subangular, 3/4" gravel, less than 15% sand, less than 10% silt and clay.
450	Gravel with Sand, Silt & Clay: Poorly sorted, subangular, gray-black, ½" gravel, less than 40% sand, less than 10% silt and clay.
460	Gravel with Sand, Silt, & Clay: Poorly sorted, subangular, gray-brown, ½" gravel, less than 40% sand, 10% silt and clay.
470	Gravel with Sand, Silt and Clay: Brown-gray poorly sorted subrounded, max 2" gravel, less than 20% sand, less than 10% silt and clay.
480	Gravel with Sand and Clay: Gray-black colored, poorly sorted subangular gravel with less than 30% coarse to fine-grained sand with less than 10% silty clay. Max grain size 3/4".
490	Gravel with Sand: White, gray-black colored moderately sorted subangular gravel with less than 20% coarse subangular sand grains. Maximum grain size 1".
500	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Circulation

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T3S, R64E, Sect. 12ac

LOGGED BY JM & SC DATE 1-14-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
500	Gravel with Sand: Gray, black colored moderately sorted subrounded to subangular gravel with less than 15% coarse subangular sand. Maximum gravel size approximately 2"
510	Gravel with Trace Coarse Sand: Brown, subangular, well sorted, gravel to 1½", less than 10% sand.
520	Gravel with Trace Sand and Silt: Same as 510' with less than 10% sand and silt.
530	Gravel with Trace Coarse Sand: Same as 510'.
540	
550	Gravel with Sand and Silt: Brown-gray, subangular, moderate sorting. Less than 25% sand and silt.
560	Gravel with Trace Coarse Sand: Same as 510'.
570	
580	
590	
600	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Mud Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12 ~~DA~~ DC
LOGGED BY SC & JM DATE 1/15/80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
600	
610	Gravel with Trace Coarse Sand: Brown, subangular, well sorted, gravel to 1½", less than 10% sand.
620	
630	Gravel with Trace Coarse Sand: Same as 610', but max size ½".
640	Gravel with Sand and Silt: Brown, subangular, poorly sorted, less than 30% sand, less than 10% silt, gravel size to ½".
650	
660	
670	
680	
690	
700	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12 ~~ca~~ a

EQUIPMENT USED Reverse Mud Rotary

LOGGED BY SC DATE 1/17/80

COMPANY Beylik

CHECKED BY JAG DATE 4/10/80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
700	Gravel with Some Coarse Sand: Brown, subangular, well sorted gravel size to 3/4", less than 20% sand.
710	Gravel with Some Coarse Sand: Same as 700' but with gravel to 2".
720	Gravel with Some Coarse Sand: Same as 700'.
730	Gravel with Sand, Silt, & Clay: Brown, subangular gravel to ½" size with 20% sand, 20% silt & clay.
740	Gravel with Some Coarse Sand: Same as 700'.
750	Gravel with Trace Coarse Sand: Same as 700' but less than 10% sand, & gravel to 3".
760	Gravel with Trace Coarse Sand: Same as 750'.
770	Gravel with Some Coarse Sand: Same as 700'.
780	
790	
800	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T3S, R64E, Sect. 12~~ca~~ ac

LOGGED BY SC & JM DATE 1-18-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
800	Coarse Sand Trace Gravel & Silt: Brown subangular, well sorted, coarse sand, less than 10% gravel, less than 10% silt.
810	Gravel with Some Coarse Sand: Brown, subangular, well sorted, gravel size to 1", 20% sand.
820	
830	
840	
850	
860	
870	
880	
890	
900	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12 20
LOGGED BY JM & SC DATE 1-19-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
900	Sand with Some Gravel & Silt: Brown subangular, poorly sorted, sand with 10% silt & clay, 20% gravel.
910	
920	
930	
940	Gravel with Trace Coarse Sand: Brown subangular, well sorted, gravel to 3/4", 10% sand.
950	
960	
970	
980	
990	
1000	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T3S, R64E, Sect. 12 2C

LOGGED BY JM & SC DATE 1-20-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1000	
1010	Gravel with Cobbles: Dark colored, poorly sorted subangular to angular (predominantly angular) gravel with less than 5% broken cobbles up to 3".
1020	Gravel with Cobbles: As above (1010'), more darker rocks, medium to dark color.
1030	Gravel with Sand: Medium color, poorly sorted, subangular to angular gravel up to 1", with less than 20% fine- to coarse-grained, angular to subangular sand.
1040	Gravel: Medium color, poorly sorted, subangular to angular gravel with 20% cobbles up to 2½", with 20% medium to coarse, subangular to angular sand.
1050	Gravel: Light to dark colored, poorly sorted, subrounded to angular gravel up to 1½".
1060	Gravel with Sand: Light to dark color, medium sorted, subangular to angular gravel up to 3/4".
1070	Gravel: Medium to dark color, well sorted, angular to subangular fine-grained gravel up to ¼".
1080	Gravel with Sand: Medium to dark color, poorly sorted, subangular to angular gravel up to 1" with less than 25% coarse- to medium-grained, subangular to angular sand.
90	
[illegible]	Gravel: as above (1080'), but medium sorted.

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake Valley
LOCATION NUMBER T3S, R64E, Sect. 12ac
LOGGED BY JM & LB DATE 1-21-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1100	
1110	Gravel: Dark colored, well sorted, angular gravel up to 3/8".
1120	Gravel: Medium color, poorly sorted, subrounded to angular gravel up to ½" with less than 20% sand.
1130	Gravel with Sand: Light to dark color, poorly sorted, subrounded to rounded gravel up to 1" with 20% coarse to fine sand.
1140	Gravel with Sand: As above (1130') with occassional broken cobbles up to 4".
1150	Gravel with Sand: Medium to dark color, medium sorted subangular to angular gravel up to 1" with less than 20% medium to coarse sand.
1160	Gravel with Sand: Light to dark color, well sorted angular to subangular, fine gravel with 20% coarse sand.
1170	Gravel: Medium color, poorly sorted, subangular to angular, fine to 1½" gravel.
1180	
1190	Gravel: Dark colored, poorly sorted, angular to subangular fine up to 2" gravel.
1200	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12ac
LOGGED BY JM & LB DATE 1-22-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1200	
1210	Gravel: Medium to dark color, poorly sorted angular to subangular, fine up to 1½" gravel.
1220	Gravel: Medium to dark color, medium sorted, subrounded to subangular, fine to ½" gravel.
1230	
1240	Sand with Gravel: Light to medium color, medium sorted, subrounded to subangular, medium to coarse sand with less than 10% gravel up to ½".
1250	Sand and Gravel: Light to dark color, well sorted, angular to subangular, fine gravel with 50% coarse sand.
1260	Gravel with Sand: Light to medium colored medium sorted, subangular to angular gravel with less than 25% coarse sand.
1270	Gravel: Light to dark colored, well sorted, angular to subangular gravel up to 3/8".
1280	Sand & Gravel: Light to dark colored, well sorted, angular to subangular, fine gravel with ± 50% coarse sand.
1290	Gravel with Sand: Medium to dark colored, poorly sorted, angular to subangular gravel up to 3/4" with ± 25% coarse sand.
1300	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

(4)

T Well PAGE 1 OF 11

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Bucket Auger 0'-40' Reverse Rotary 40' - TD
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY JM DATE 2-6-80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
0	Silt: Tan silt with occasional gravel up to 1½".
10	Silt: Tan silt.
20	Silt: Tan silt with less than 25% medium colored, fine- to coarse-grained, poorly sorted, subrounded to subangular sand with less than 10% gravel up to 1½".
30	Gravel with Cobbles: Medium to dark colored, subrounded to subangular, medium gravel with cobbles up to 4".
40	Gravel: Medium colored, moderately sorted, angular to subrounded, fine to coarse gravel up to 1½".
50	- - - Gravel up to 1".
60	Gravel: Medium colored, moderately sorted, subangular to subrounded, fine to coarse gravel up to 1½" with less than 5% coarse-grained sand.
70	- - - Gravel up to 3/4".
80	
90	- - - Gravel up to 1½".
100	

FUGRO NATIONAL, INC.

DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sect. 12

LOGGED BY JFM DATE 2-6-80

CHECKED BY JAG DATE 4/1_/80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
100	Gravel: Dark brown colored, well sorted, subangular to subrounded, gravel up to ½".
110	- - - - Very well sorted gravel up to ¼".
120	- - - - Gravel up to 3/4".
130	Gravel: Light to dark colored, very well sorted, subangular to subrounded gravel up to ¼".
140	Gravel: Light to dark colored, poorly sorted, subangular to subrounded gravel with occasional cobbles up to 2". Less than 20% medium- to coarse-grained sand.
150	Gravel: Light to dark colored, well sorted, subangular to subrounded, fine to medium gravel, occasionally up to 1", with less than 10% coarse-grained sand.
160	Gravel with Cobbles: Light to dark colored, poorly sorted, angular to subrounded, fine to coarse gravel, with cobbles up to 3" and less than 5% coarse-grained sand.
170	
180	Gravel: Light to dark colored, moderately sorted, subangular to subrounded, fine to coarse gravel, with occasional cobbles up to 1½" and less than 5% coarse sand.
190	- - - - Cobbles up to 2".
200	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45	VALLEY NAME Dry Lake
PROJECT NAME MX SITING INVESTIGATION	LOCATION NUMBER T6S, R63E, Sec. 12d
EQUIPMENT USED Reverse Rotary	LOGGED BY JFM DATE 2-06-80
COMPANY Beylik	CHECKED BY JAG DATE 4-10-80
OPERATOR J. Clyde	TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
200	Gravel: Light to dark colored, poorly sorted, angular to subangular, fine to coarse gravel with less than 20% cobbles up to 2½" and less than 5% coarse-grained sand.
210	Gravel: Light to dark colored, moderately sorted, angular to subangular, fine to coarse gravel, with occasional cobbles up to 4" and less than 5% medium- to coarse-grained sand.
220	Gravel: Light to dark colored, well sorted, subangular to subrounded, fine to coarse gravel up to 2½", with less than 10% medium- to coarse-grained sand.
230	Gravel: Light to dark colored, moderately sorted, subangular to subrounded, fine to coarse gravel up to 1", with less than 10% medium- to coarse-grained sand.
240	- - - - Gravel up to 2".
250	
260	Sand: Medium colored, well sorted, fine-grained sand, with less than 25% medium-grained sand to coarse gravel up to 2".
270	Gravel: Medium to dark colored, medium sorted, subangular to subrounded, fine to coarse gravel up to 2½", with less than 10% coarse-grained sand.
280	Gravel with Sand: Medium to dark colored, poorly sorted, subrounded to angular, fine to coarse gravel up to 1½", and approximately 25% medium colored, fine- to coarse-grained sand.
290	Gravel: Medium to dark colored, moderately sorted, subrounded to subangular, fine to medium gravel up to ½", with approximately 10% fine- to coarse-grained sand.
300	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12d-fc

LOGGED BY LB DATE 2-07-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
300	Gravel: Medium to dark colored, moderately sorted, subrounded to angular, fine to medium gravel up to 1/3", with approximately 10% fine- to coarse-grained sand.
310	Gravel: Medium to dark colored, poorly sorted, subangular to angular, fine to 2½" gravel.
320	Gravel: Dark colored, poorly sorted, subrounded to angular, fine to 2" gravel (less than 10% sand).
330	Gravel: Dark colored, poorly sorted, subrounded to angular, fine to 2½" gravel (less than 5% sand).
340	Gravel with Sand: Dark colored, poorly sorted, subangular to angular, fine to 2" gravel, with less than 20% medium colored, medium-to coarse-grained sand.
350	Gravel: Dark colored, poorly sorted, subangular to angular, fine to 3/4" gravel with less than 10% sand.
360	Gravel: Dark colored, moderately sorted, subangular to angular, fine to ½" gravel.
370	Gravel: Dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 1" gravel.
380	Gravel: Dark colored, poorly sorted, subangular, fine to ½" gravel (with less than 10% sand).
390	Gravel: Medium to dark colored, poorly sorted, subangular to angular, 1/3"-diameter gravel with less than 15% sand.
400	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY LB , JM DATE 2-07-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
400	Gravel: Light to dark color, medium sorted, subangular to subrounded gravel up to ¼" with less than 15% medium- to coarse-grained sand.
410	Gravel with Sand & Clay: Medium colored, poorly sorted, subangular to subrounded gravel up to 3/8", with less than 50% fine- to coarse-grained sand and clay.
420	
430	Gravel: Medium to dark colored, well sorted, subangular to subrounded gravel up to ½", with less than 20% coarse-grained sand.
440	- - - Gravel up to 1".
450	- - - Less than 10% coarse sand.
460	Gravel with Sand: Light to dark colored, poorly sorted, subangular to subrounded, fine to coarse gravel up to 1", with less than 30% fine to coarse-grained sand.
470	Gravel with Sand: Medium to dark colored, poorly sorted, subrounded to subangular, fine to 1" gravel with less than 25% medium- to coarse-grained sand.
480	
490	- - - Gravel up to 3/4".
500	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45		VALLEY NAME	Dry Lake
PROJECT NAME	MX SITING INVESTIGATION	LOCATION NUMBER	T6S, R63E, Sec. 12dc
EQUIPMENT USED	Reverse Rotary	LOGGED BY	LB, JFM DATE 2/08/80
COMPANY	Beylik	CHECKED BY	JAG DATE 4/10/80
OPERATOR	J. Clyde	TOTAL WELL DEPTH	1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
500	Gravel with Sandy Silt: Medium to dark colored, poorly sorted, subrounded to angular, fine to 1" gravel with less than 30% tan colored, coarse-grained sand to silt.
510	Gravel: Medium to dark colored, moderately sorted, angular, fine to 1½" gravel.
520	- - - 5% fine- to coarse-grained sand.
530	
540	Gravel: Light to dark colored, poorly sorted, angular to subangular, fine to 2¼" gravel with less than 10% sand.
550	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to 1" gravel with less than 25% medium colored, fine- to coarse-grained sand.
560	Gravel and Sand: Medium to dark colored, poorly sorted, angular to subangular, fine to ½" gravel with less than 40% medium to dark colored sand.
570	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to 1" gravel with less than 20% fine- to coarse-grained sand.
580	Gravel: Dark colored, moderately sorted, subrounded to subangular gravel with less than 10% sand.
590	- - - Sand content up to about 25%.
600	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12[illegible]ac
LOGGED BY LB DATE 2-08-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
600	Sand and Gravel with Silt: Dark colored, moderately sorted, fine-grained to ½" sand and gravel with less than 50% tan silt.
610	Gravel: Dark colored, moderately sorted, subangular to angular, fine to 1" gravel.
620	Gravel: Dark colored, moderately sorted, subrounded to subangular, fine to 2" gravel with less than 10% sand.
630	Gravel: Dark colored, moderately sorted, subangular to angular, fine to 1" gravel with less than 5% coarse-grained sand.
640	Gravel: Dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 2" gravel.
650	Gravel: Medium to dark colored, well sorted, subangular to angular, fine to 1/3" gravel.
660	Gravel: Medium to dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 1½" gravel, with less than 10% sand.
670	Gravel: Medium to dark colored, moderately sorted, subangular to angular, fine to 1/3" gravel.
680	- - - *Increasing fine-grained gravel.*
690	Gravel: Medium to dark colored, well sorted, subrounded to angular, fine to ½" gravel.
700	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY LB, JFM DATE 2/09/80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
700	
710	Gravel: Dark colored, well sorted, subangular to angular, fine to 1½" gravel.
720	Gravel: Dark colored,well sorted,subangular to angular (predominantly angular), fine to 1" gravel.
730	Gravel: Dark colored, poorly sorted, subangular, fine to medium gravel up to ½" with less than 25% fine- to coarse-grained sand.
740	Gravel: Dark colored, poorly sorted, angular to subangular, fine to medium gravel up to 1" with less than 10% fine- to coarse-grained sand.
750	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to medium gravel, occasionally up to 1½", with less than 10% fine- to coarse-grained sand.
760	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 3/4" (predominantly fine gravel), with less than 10% medium- to coarse-grained sand.
770	Gravel with Sand: Medium to dark colored, poorly sorted, angular to subangular, fine to medium gravel up to 3/4" with less than 35% fine- to coarse-grained sand.
780	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to ½" with less than 10% medium- to coarse-grained sand.
790	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1" (predominantly 1/8" to 1/4").
800	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY JFM DATE 2-10-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
800	Gravel: Light to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1".
810	Gravel: Medium to dark color, poorly sorted, angular to subangular, fine to medium gravel (predominantly less than ¼" and up to 3/4"), with less than 10% coarse-grained sand.
820	Gravel: Medium to dark color, well sorted, angular to subangular, fine to medium gravel (predominantly fine, occasionally up to ½"), with less than 10% coarse-grained sand.
830	Gravel: Dark colored, moderately sorted, angular to subangular, fine to medium with occasional coarse gravel up to 2-3/4", with less than 5% coarse-grained sand.
840	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to medium, occasionally up to 1".
850	
860	- - - - Gravel up to 1¼", with less than 5% coarse sand.
870	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1" with less than 5% coarse-grained sand.
880	Gravel: Medium to dark colored, moderately sorted, angular, fine to medium gravel up to 1¼".
890	Gravel: Medium to dark colored, moderately to well sorted, angular to subangular, fine to medium gravel up to 3/4".
900	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake (DL)

LOCATION NUMBER T6S, R63E, Sec. 12

LOGGED BY JFM, LB DATE 2/10/80

CHECKED BY JAG DATE 4/10/80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
900	Gravel: Medium to dark colored, well sorted, angular to subangular, fine gravel up to ¼", with less than 5% coarse-grained sand.
910	Gravel: Medium to dark colored, well sorted, angular to subangular, fine to medium gravel, occasionally up to 1", with less than 5% coarse-grained sand.
920	Gravel: Medium to dark colored, moderately well sorted, angular to subangular, fine to medium gravel up to 3/8", with less than 5% coarse-grained sand.
930	
940	Gravel and Sand: Dark colored, well sorted, subangular to angular, fine gravel and coarse-grained sand.
950	Gravel: Dark colored, poorly sorted, subangular to angular, fine to 2" gravel, with less than 10% medium- to coarse-grained sand.
960	
970	Gravel: Dark colored, well sorted, subrounded to subangular, fine to 1/3" gravel, with less than 20% fine- to coarse-grained sand.
980	Gravel: Dark colored, poorly sorted, subrounded to angular, fine to 3" gravel, with less than 10% sand.
990	Gravel: Dark colored, moderately well sorted, subangular to angular, fine to 1½" gravel, with less than 5% sand.
1000	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12 AC

LOGGED BY JFM, LB DATE 2-10-80

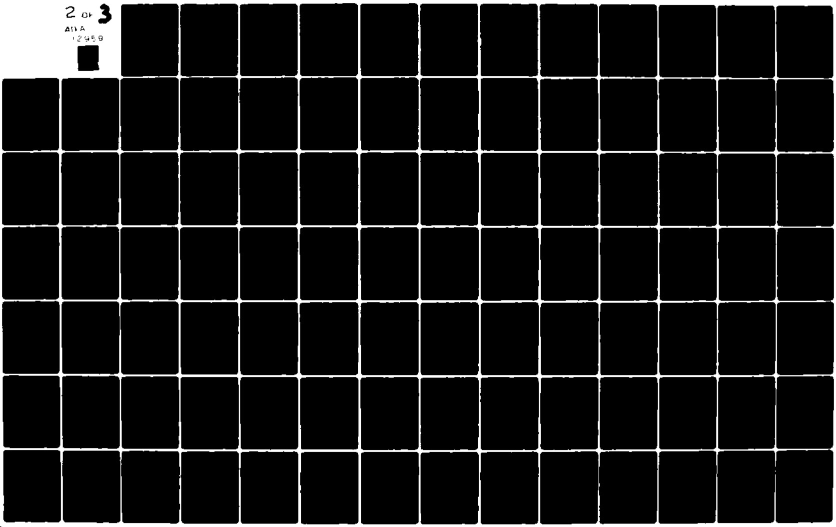
CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1010 feet

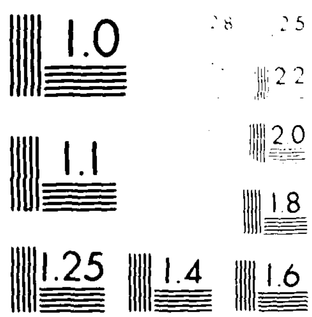
DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1000	Gravel and Cobbles: Medium to dark colored, poorly sorted, subangular to angular gravel to 3". Broken cobbles to 6".
1010	
	T.D.: 1010'
20	
30	
40	
50	
60	
70	
80	
90	
00	

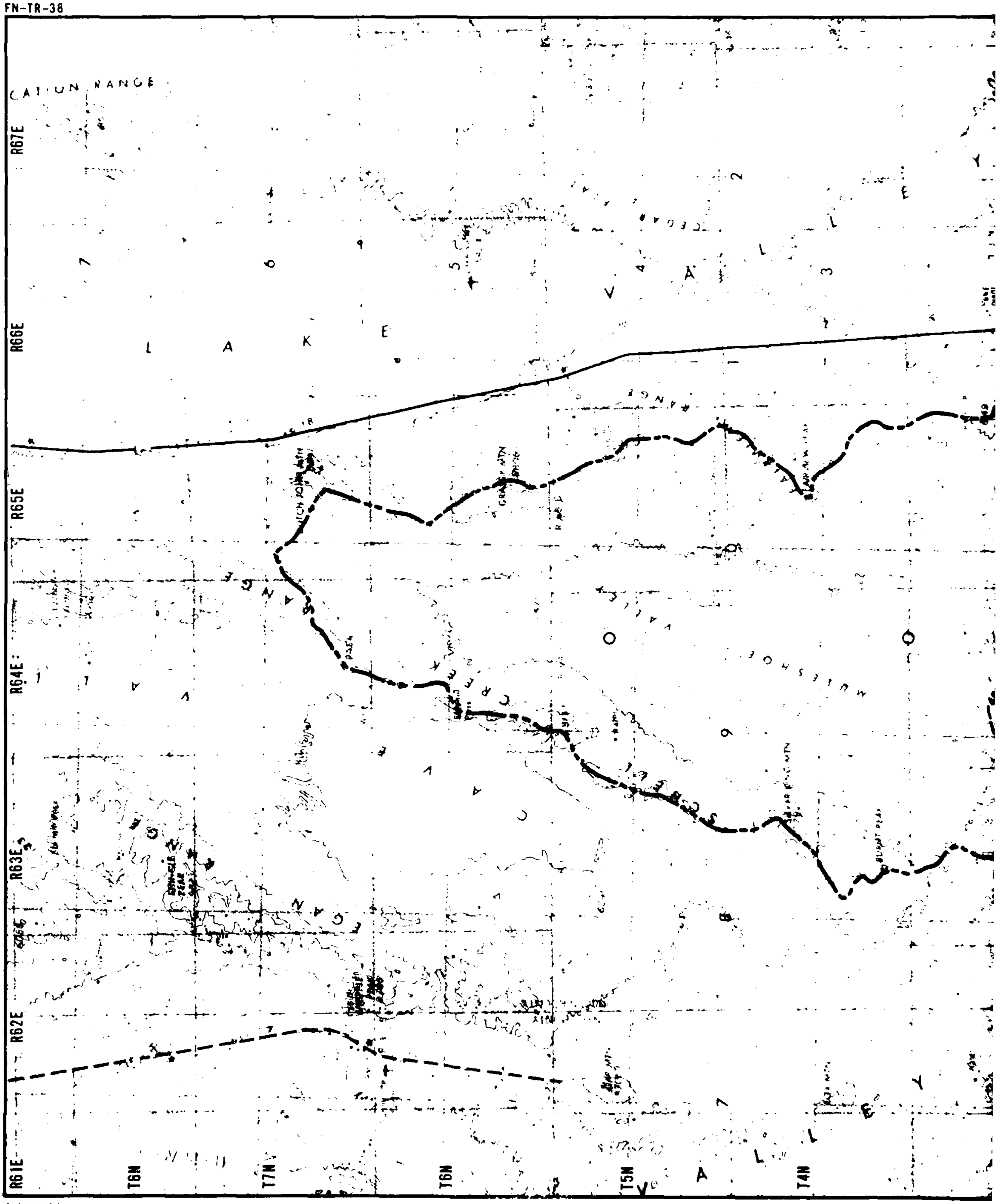
AD-A112 959 ERTEC WESTERN INC LONG BEACH CA F/G 13/2
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE--ETC(U)
SEP 81 F04704-80-C-0006
UNCLASSIFIED E-TR-53-2 NL

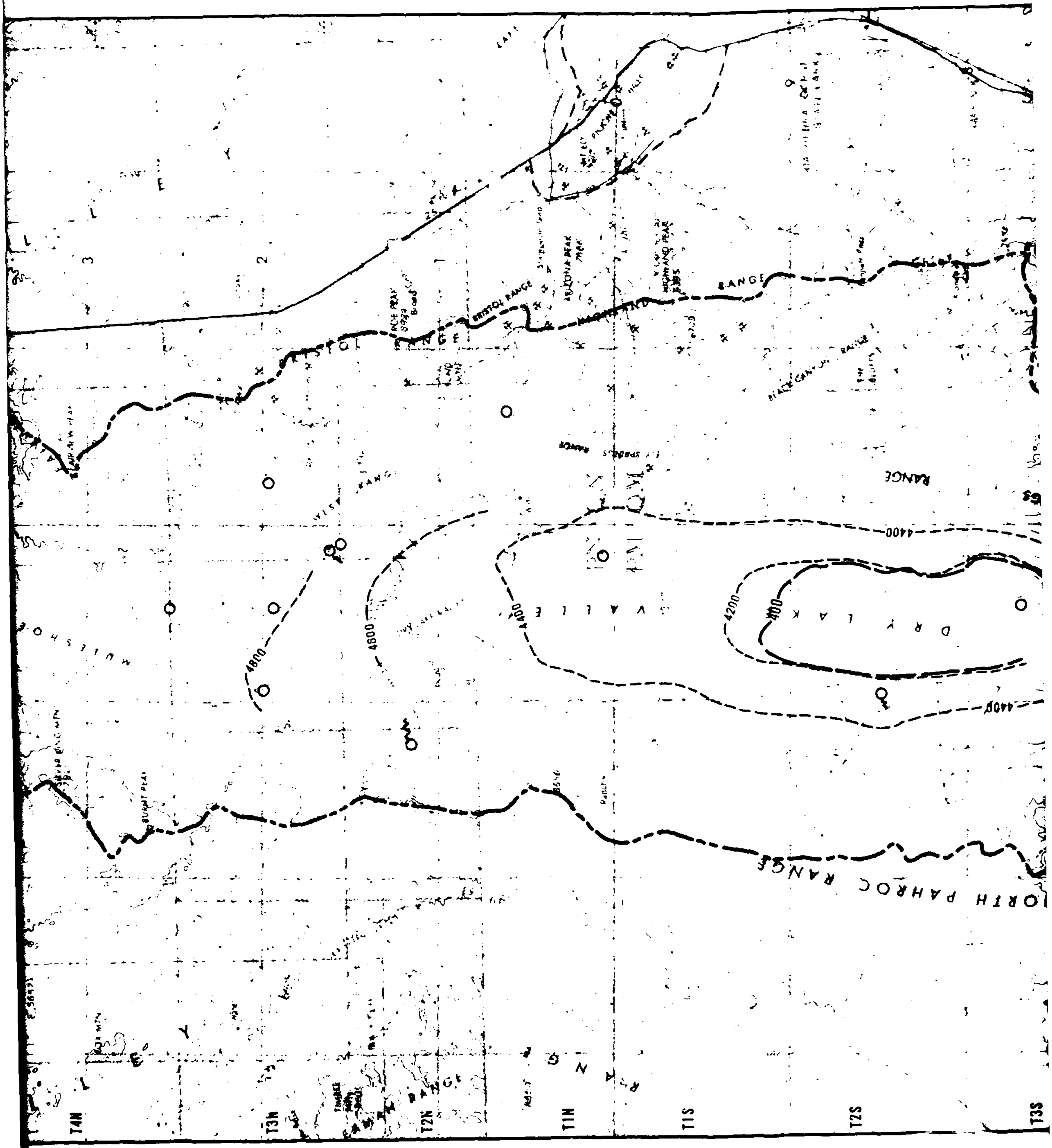
2 of 3
AD A
112959



2959

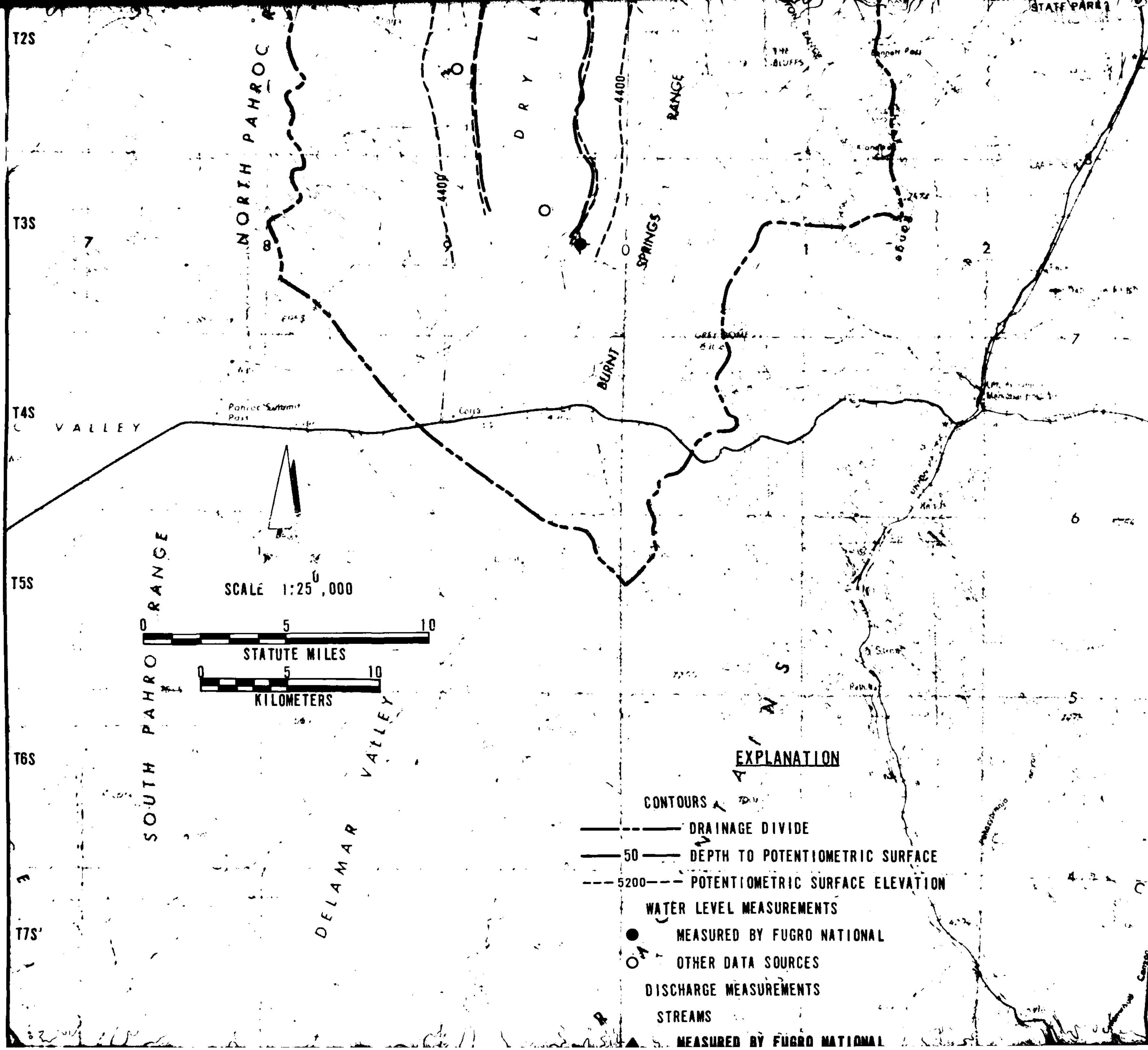



CATION RANGE
R67E
R66E
R65E
R64E
R63E
R62E
R61E
T6N
T7N
T6N
T5N
T4N
L A K E
V A L L E Y

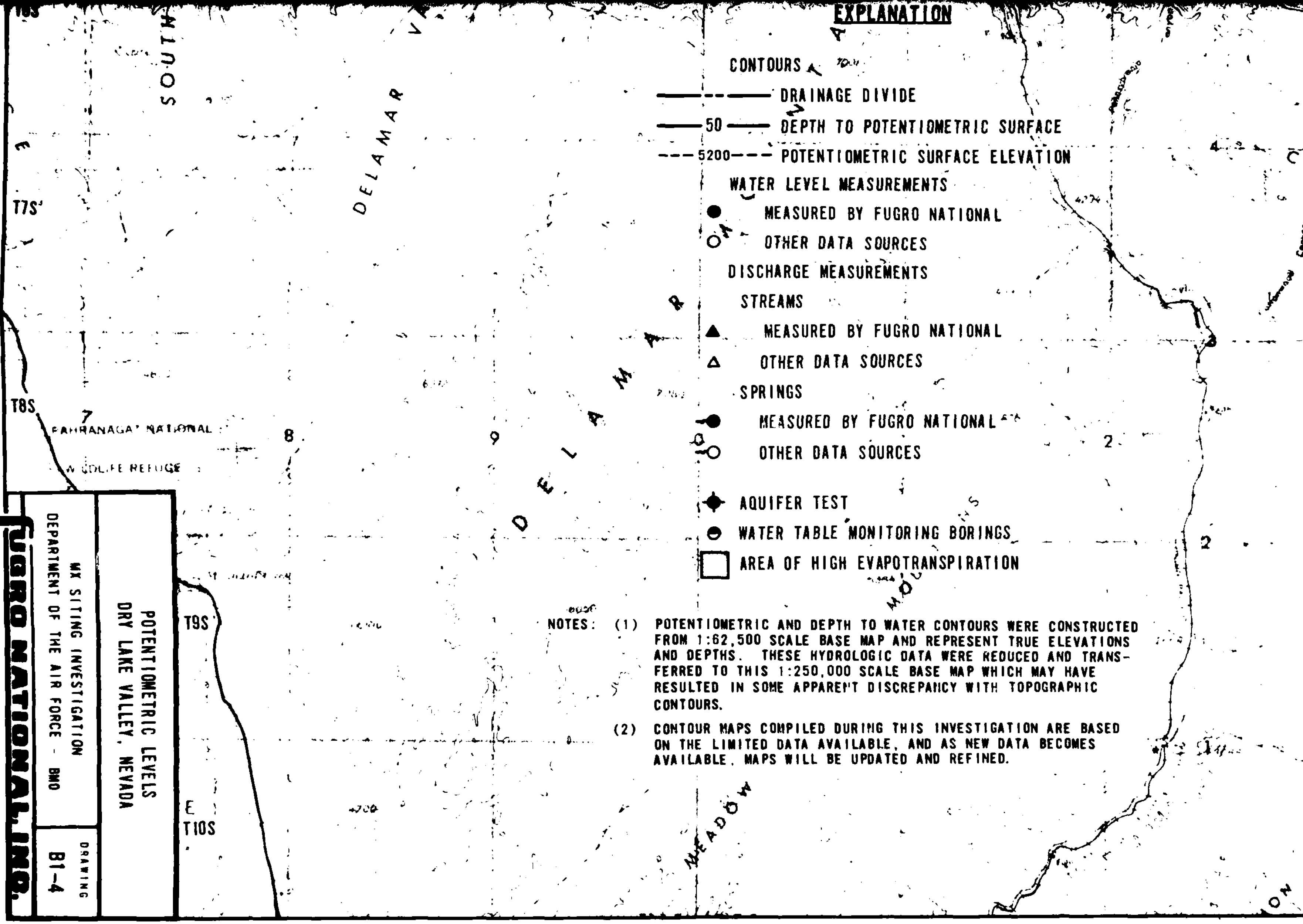


BRISTOL RANGE
HIGHLAND RANGE
WEST RANGE
BLACK CANYON RANGE
ARIZONA PEAK
4800
4600
4400
4200
DRY LAKE
VALLEY
NORTH PAHROC RANGE
T4N
T3N
T2N
T1N
T1S
T2S
T3S

12


T2S
T3S
T4S
T5S
T6S
T7S'
NORTH PAHROC
DRY LAKE
RANGE
SPRINGS
BURNT
4400
VALLEY
SOUTH PAHRO RANGE
DELAMAR VALLEY
STATE PARK
THE BLUFFS
Pahroc Summit Pass
SCALE 1:250,000
0 5 10
STATUTE MILES
0 5 10
KILOMETERS
EXPLANATION
CONTOURS
DRAINAGE DIVIDE
50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
MEASURED BY FUGRO NATIONAL
OTHER DATA SOURCES
DISCHARGE MEASUREMENTS
STREAMS
MEASURED BY FUGRO NATIONAL

E-3



EXPLANATION

CONTOURS

- —·—·— DRAINAGE DIVIDE
- —50— DEPTH TO POTENTIOMETRIC SURFACE
- ---5200--- POTENTIOMETRIC SURFACE ELEVATION

WATER LEVEL MEASUREMENTS

- ● MEASURED BY FUGRO NATIONAL
- ○ OTHER DATA SOURCES

DISCHARGE MEASUREMENTS

STREAMS

- ▲ MEASURED BY FUGRO NATIONAL
- △ OTHER DATA SOURCES

SPRINGS

- MEASURED BY FUGRO NATIONAL
- OTHER DATA SOURCES

- AQUIFER TEST
- WATER TABLE MONITORING BORINGS
- □ AREA OF HIGH EVAPOTRANSPIRATION

NOTES: (1) POTENTIOMETRIC AND DEPTH TO WATER CONTOURS WERE CONSTRUCTED FROM 1:62,500 SCALE BASE MAP AND REPRESENT TRUE ELEVATIONS AND DEPTHS. THESE HYDROLOGIC DATA WERE REDUCED AND TRANSFERRED TO THIS 1:250,000 SCALE BASE MAP WHICH MAY HAVE RESULTED IN SOME APPARENT DISCREPANCY WITH TOPOGRAPHIC CONTOURS.

(2) CONTOUR MAPS COMPILED DURING THIS INVESTIGATION ARE BASED ON THE LIMITED DATA AVAILABLE, AND AS NEW DATA BECOMES AVAILABLE, MAPS WILL BE UPDATED AND REFINED.

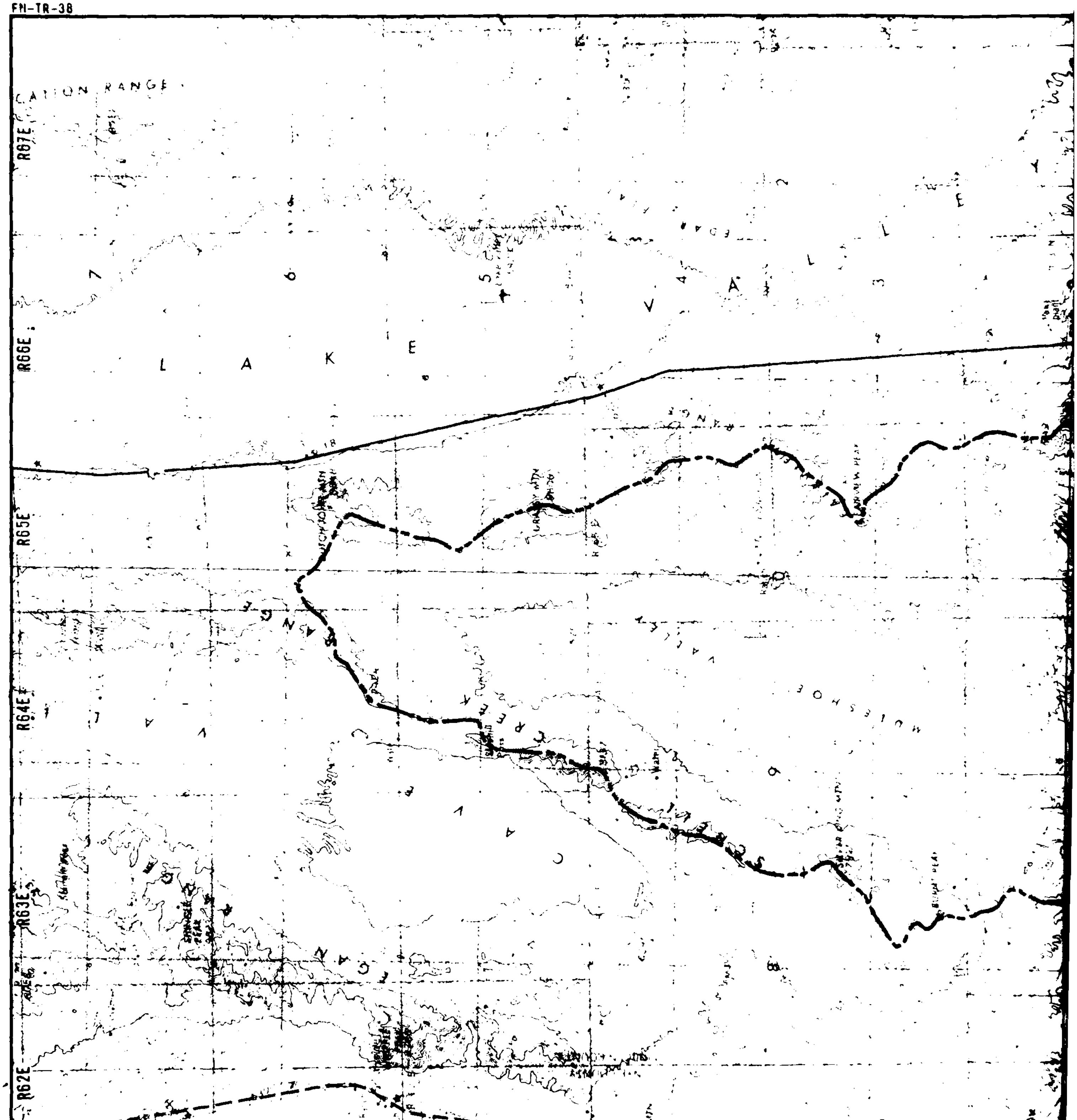
POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

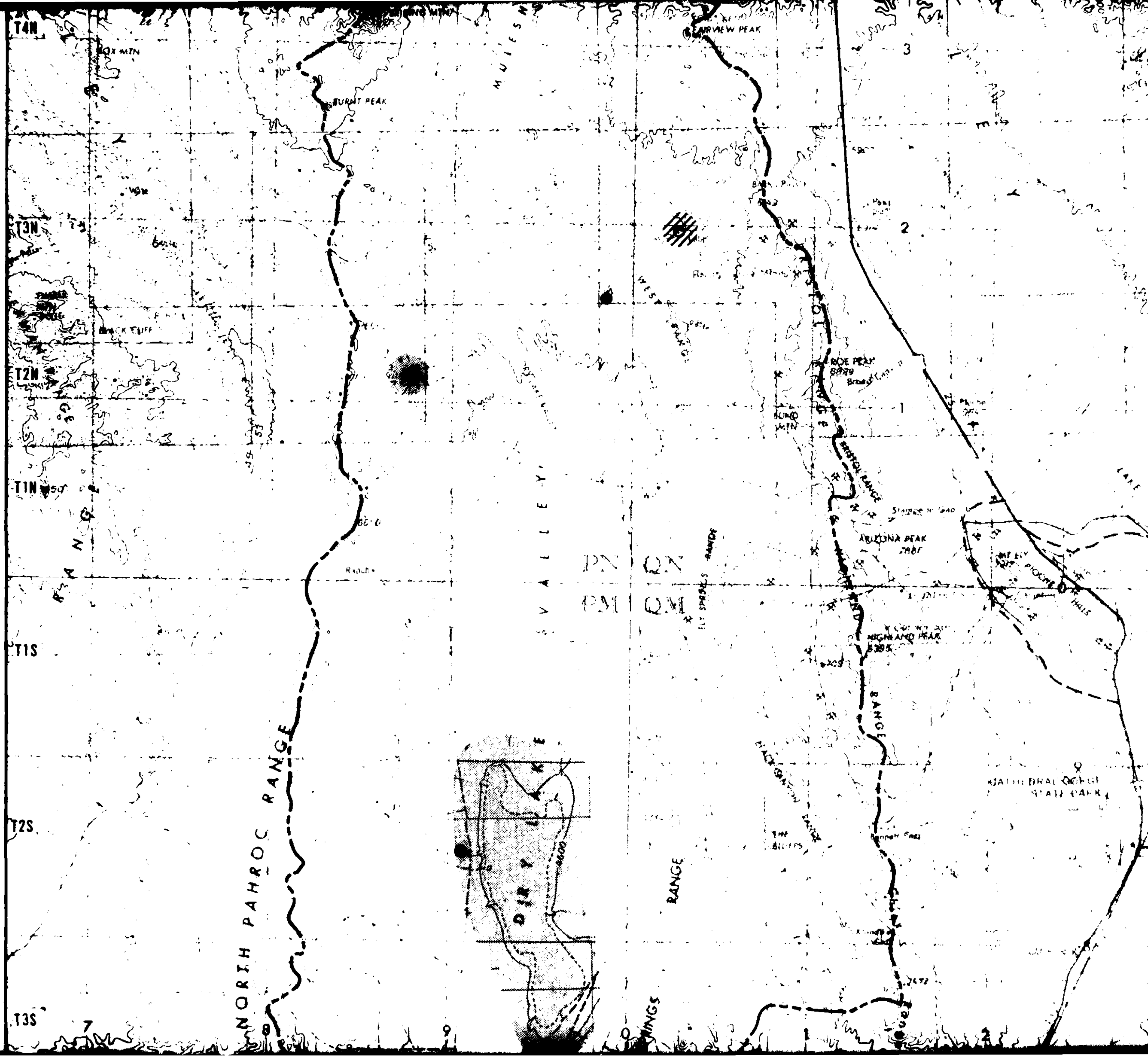
DRAWING
B1-4

FUGRO NATIONAL, INC.

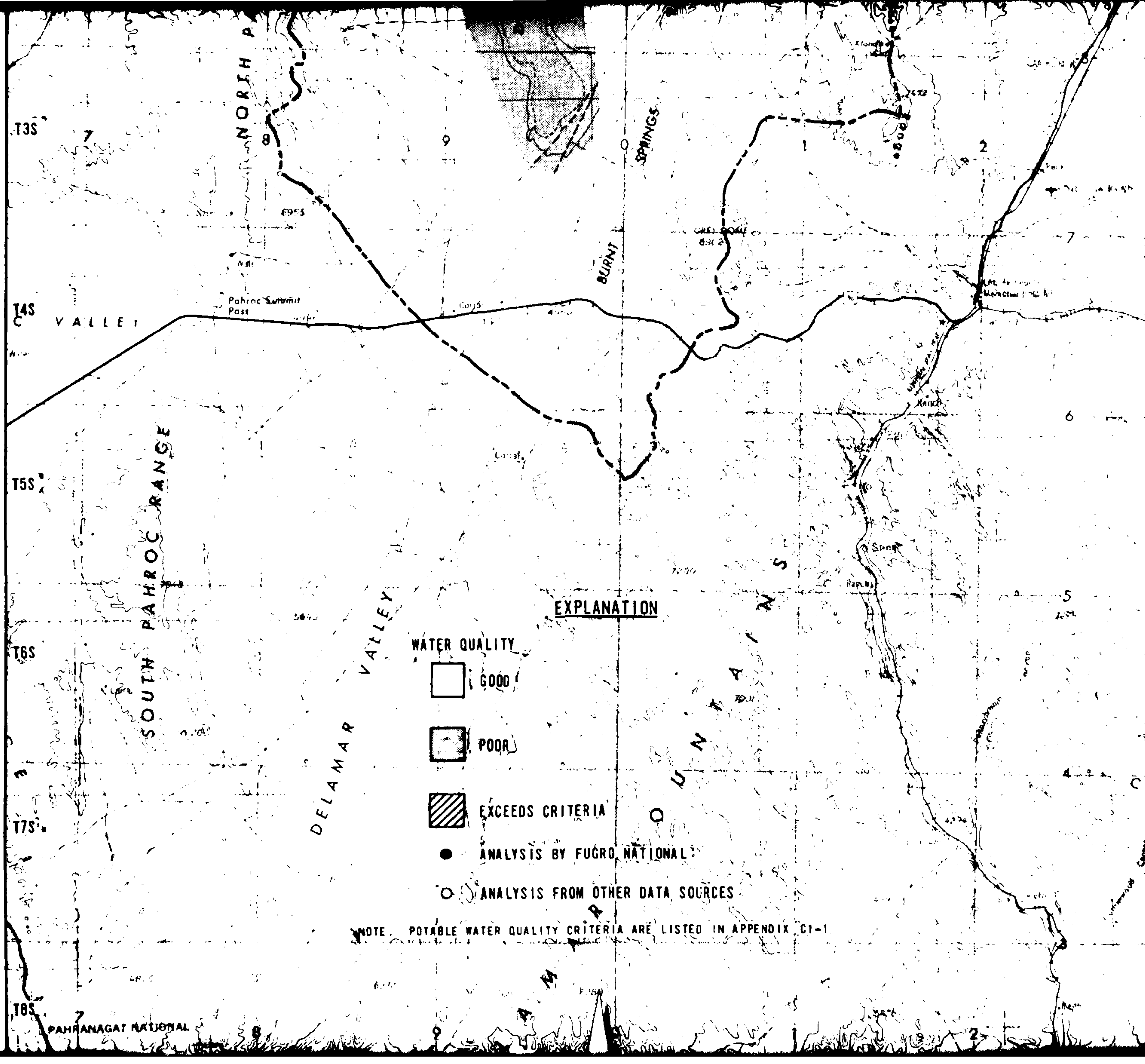
4


CATION RANGE
L A K E V A L L E Y
R67E
R66E
R65E
R64E
R63E
R62E
R61E
T8N
T7N
T6N
T5N
T4N

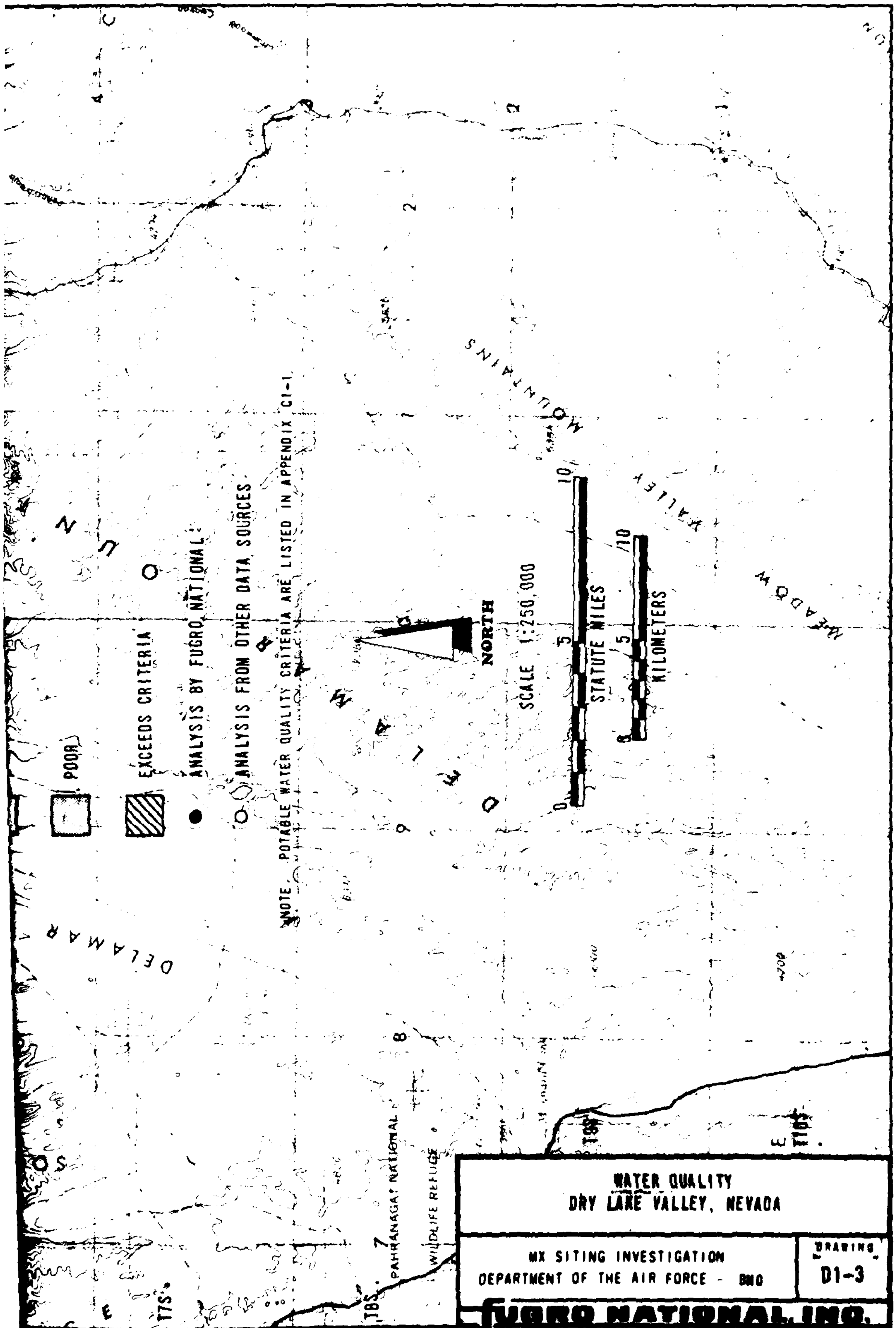
1 2



T4N
BOX MTN
BURNT PEAK
FAIRVIEW PEAK
T3N
T2N
T1N
T1S
T2S
T3S
NORTH PAHROC RANGE
VALLEY
WEST RANGE
ROE PEAK
ARIZONA PEAK
HIGHLAND PEAK
BRISTOL RANGE
RANGE
DRY LAKE
CATHEDRAL GORGE STATE PARK


T3S
T4S
T5S
T6S
T7S
T8S
NORTH P
SOUTH PAHROC RANGE
Pahroc Summit Pass
VALLEY
BURNT SPRINGS
DELAMAR VALLEY
DELAMAR MOUNTAINS
PAHRANAGAT NATIONAL
EXPLANATION
WATER QUALITY
GOOD
POOR
EXCEEDS CRITERIA
ANALYSIS BY FUGRO NATIONAL
ANALYSIS FROM OTHER DATA SOURCES
NOTE. POTABLE WATER QUALITY CRITERIA ARE LISTED IN APPENDIX C1-1.

13



WATER QUALITY
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

DRAWING D1-3

FUGRO NATIONAL, INC.

4

F1.0

MX SITING INVESTIGATION, GRAVITY
SURVEY-DRY LAKE VALLEY, NEVADA

FN-TR-33-DL

MX SITING INVESTIGATION

GRAVITY SURVEY - DRY LAKE VALLEY

NEVADA

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office (BMO)
Norton Air Force Base, California 92409

Prepared by:

Fugro National, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

17 March 1980

FOREWORD

Methodology and Characterization Studies during fiscal years 1977 and 1978 included gravity surveys in ten valleys in Arizona (five), Nevada (two), New Mexico (two), and California (one). The gravity data were obtained for the purpose of estimating the gross structure and shape of the basins and the thickness of the valley fill. There was also the possibility of detecting shallow rock in areas between boring locations. Generalized interpretations from these surveys were included in Fugro National's Characterization Reports (FN-TR-26a through e).

During the FY 77 surveys, the measurements were made to form an approximate one-mile grid over the study areas, and contour maps showing interpreted depth to bedrock were made. In FY 79, the decision was made to concentrate the available funds on the basic Verification Program to verify and refine suitable area boundaries. This decision resulted in a reduction in the gravity program. Instead of obtaining gravity data on a grid, the reduced program consisted of obtaining gravity measurements along profiles across the valleys where Verification Studies were also performed.

The Defense Mapping Agency (DMA), St. Louis, was also requested to provide gravity data from their library to supplement the gravity profiles. For Big Smoky, Reveille, and Railroad valleys, a sufficient density of library data is available to permit construction of interpreted contour maps instead of two-dimensional cross sections.

In late summer of FY 79, supplementary funds became available to begin data reduction. At this time, inner zone terrain corrections began on the library data and the profiles from Big Smoky Valley, Nevada, and Butler and La Posa valleys, Arizona. The profile data from Whirlwind, Hamlin, Snake East, White River and Garden Coal valleys, Nevada were available from the field in early October, 1979.

A continuation of gravity interpretations has been incorporated into the FY 80 contract and the results are being summarized in a series of valley reports. The reports covering Nevada-Utah gravity studies will be numbered, "FN-TR-33-", followed by the abbreviation for the subject valley. In addition, more detailed reports of the results of FY 77 surveys in Dry Lake and Ralston valleys, Nevada are being prepared. Verification Studies are continuing in FY 80 and gravity studies are included in the program. DMA will continue to obtain the field measurements and it is planned to return to the grid pattern. The interpretation of the grid data will allow the production of contour maps which will be valuable in the deep basin structural analysis needed for computer modeling in the Water Resources Program. The gravity interpretations will also be useful in the Nuclear Hardness and Survivability (NH&S) evaluations.

The basic decisions governing the gravity program are made by BMO following consultation with TRW Inc., Fugro National and the (DMA). Conduct of the gravity studies is a joint effort between DMA and Fugro National. The field work, including planning, logistics, surveying, and meter operation is done by the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC), headquartered in Cheyenne, Wyoming. DMAHTC reduces the data to Simple Bouguer Anomaly (see Section A1.4, Appendix A1.0). The Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, calculates outer zone terrain corrections.

Fugro National provides DMA with schedules showing the valleys with the highest priorities. Fugro National also recommended locations for the profiles in the FY 79 studies within the constraints that they should follow existing roads or trails. Any required inner zone terrain corrections are calculated by Fugro National prior to making geologic interpretations.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 OBJECTIVES

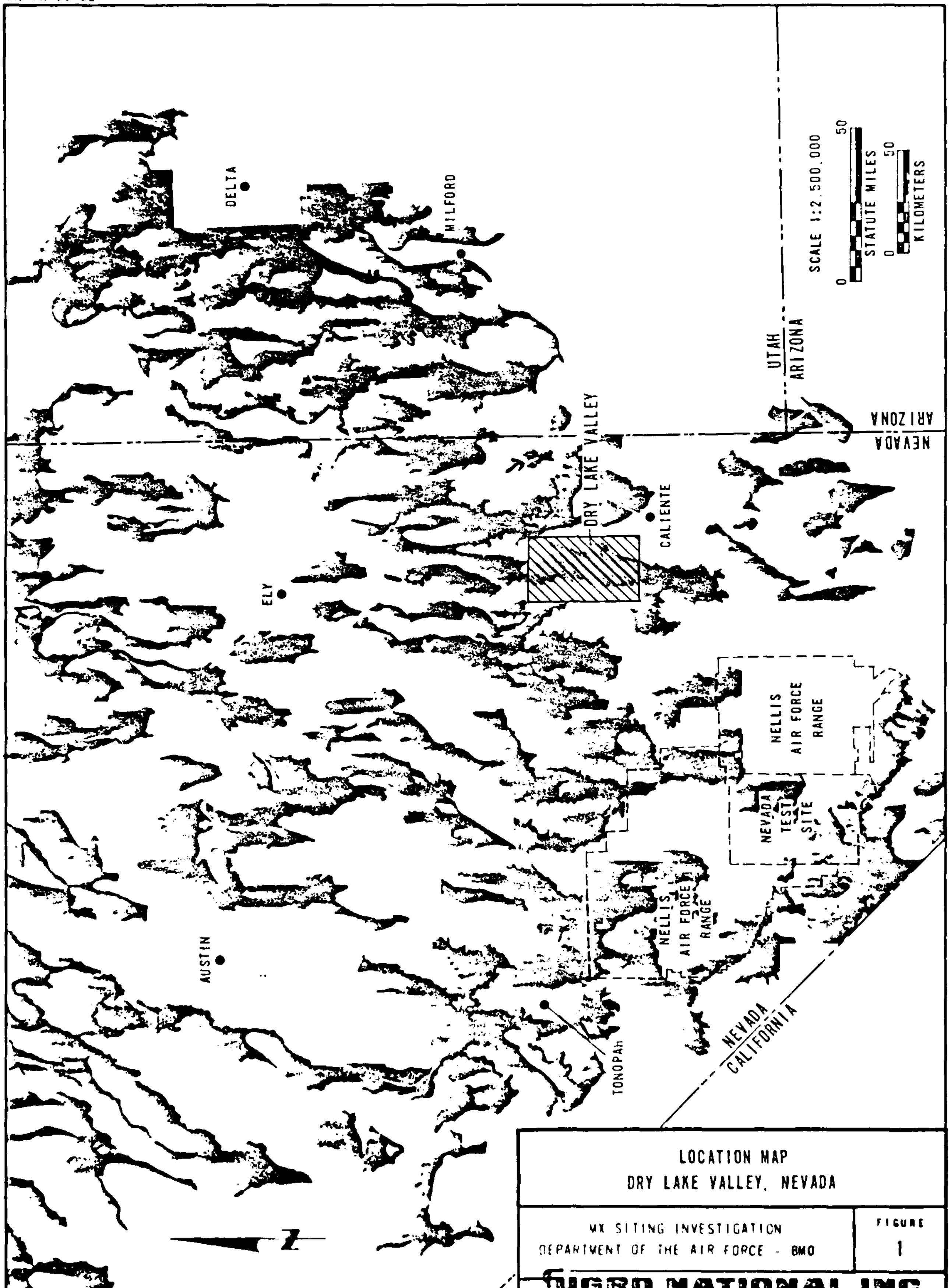
Measurements of the gravitational field were made in Dry Lake Valley for the purpose of estimating the overall shape of the structural basin and the thickness of alluvial fill in the basin. These estimates are expected to be useful to the Nuclear Survivability and Hardness (NH&S) community in modeling dynamic response to nuclear detonations and to geohydrologists in evaluating ground water regimes.

1.2 LOCATION

Dry Lake Valley is located in central Lincoln County, Nevada, approximately 106 miles (170 km) NNE of Las Vegas (see Figure 1). The portion of Dry Lake Valley included in this study is approximately 40 miles (65 km) long and 13 miles (22 km) wide, comprising an area of approximately 520 square miles (1347 km^2). As shown in Figure 2, Dry Lake Valley is bounded by mountain ranges on three sides and is open to Delamar Valley on the south. U.S. Highway 93, which is the only paved road in the vicinity, crosses the southern end of the valley.

1.3 SCOPE OF STUDY

The Defense Mapping Agency Hydrographic-Topographic Center/Geodetic Survey Squadron (DMAHTC/GSS) obtained gravitational field measurements at 1069 stations in and around Dry Lake Valley during June and July, 1977. Approximately one-half of these stations were distributed throughout the valley with about 1 mile (1.6 km) between stations. The rest of the stations were



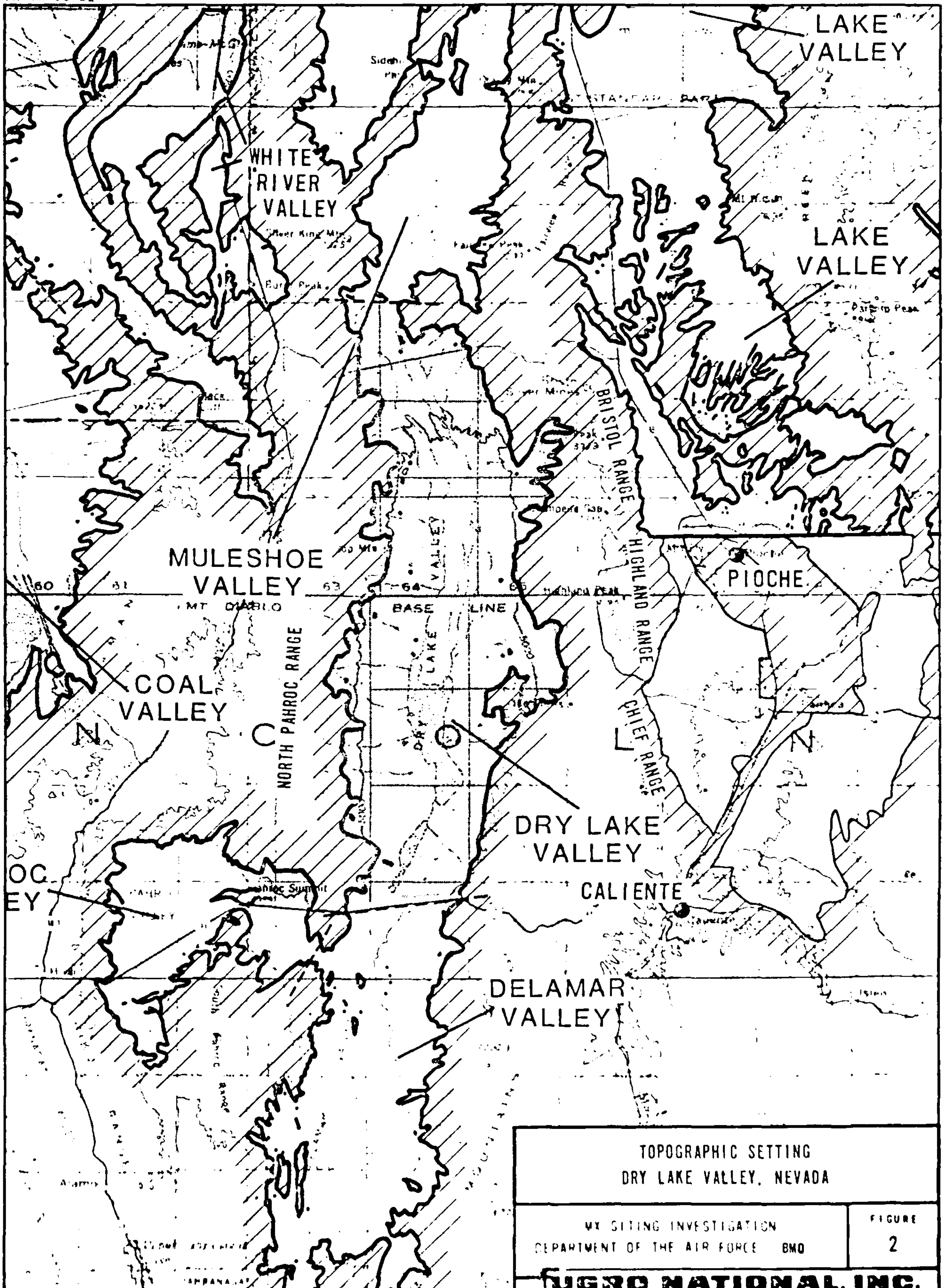
LOCATION MAP
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 1

FUGRO NATIONAL, INC.

31 JAN 80



TOPOGRAPHIC SETTING
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 2

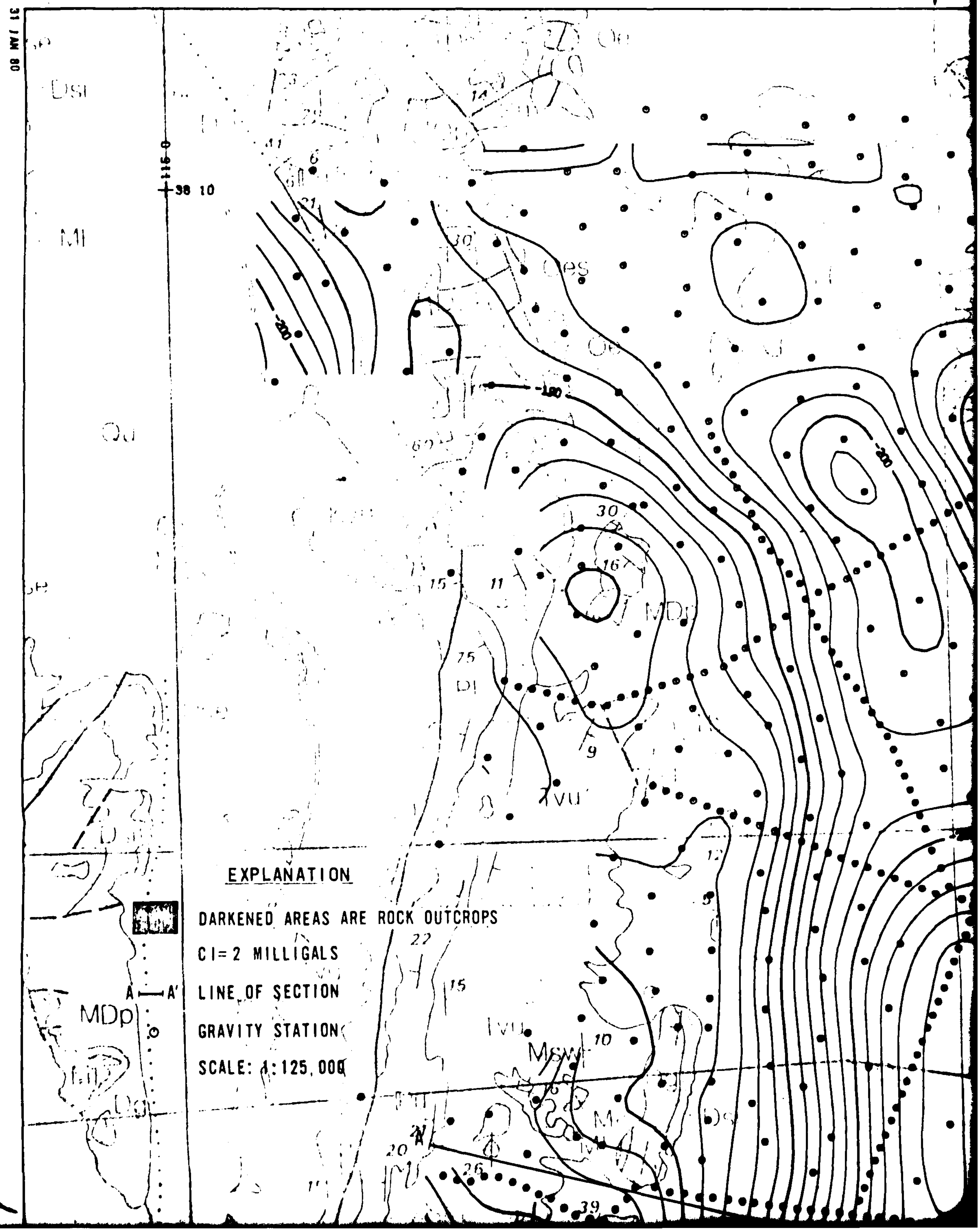
FUGRO NATIONAL, INC.

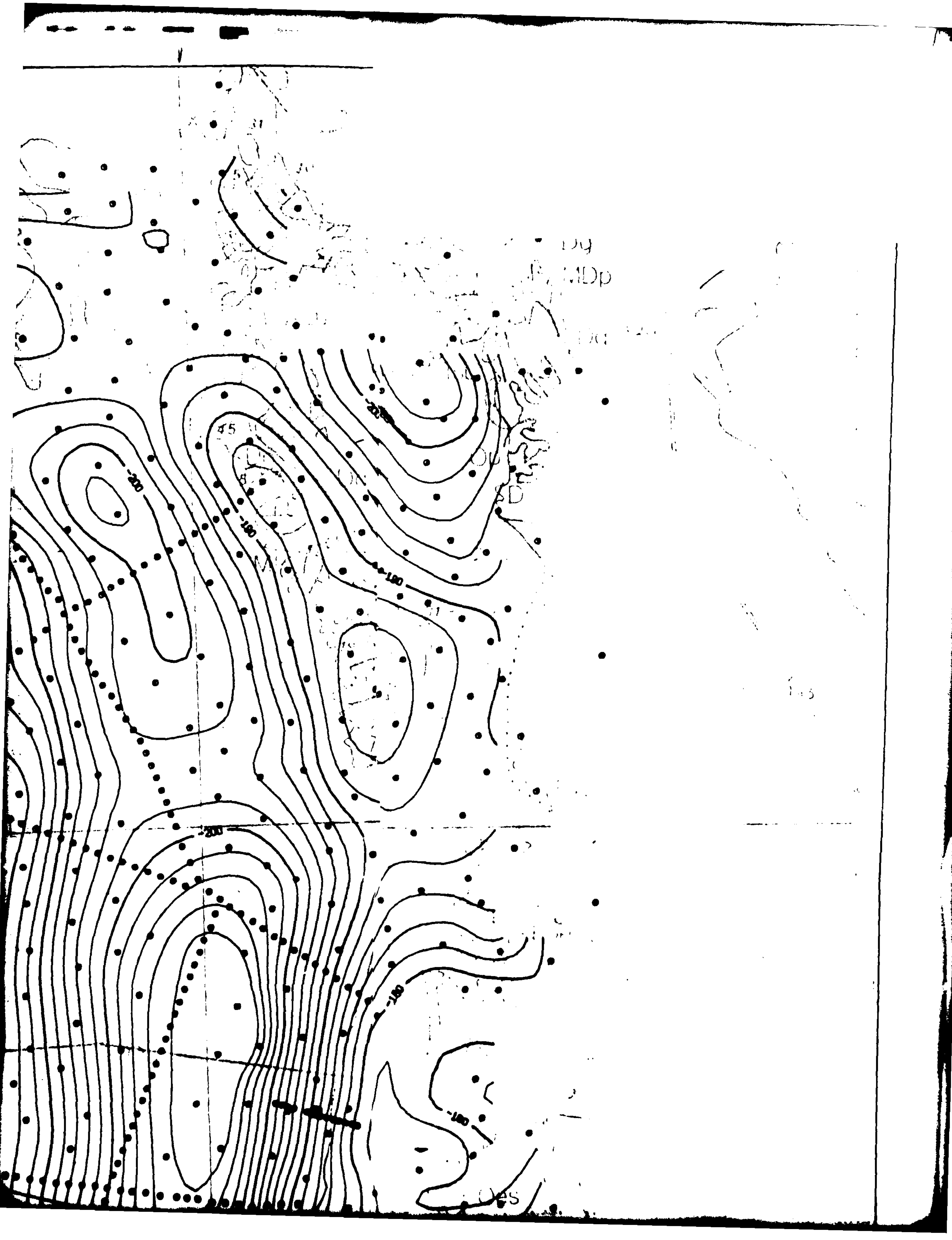
placed either at 1/4-mile (0.4 km) intervals along roads and trails or around the perimeter of the valley on rock outcrops. The station locations are shown on Figures 3 and 6. Station elevations were determined within a tolerance of 5 feet (1.5 m). With this elevation tolerance, the gravity precision is no smaller than 0.3 milligals. The principal facts for all stations are listed in Appendix A2.0.

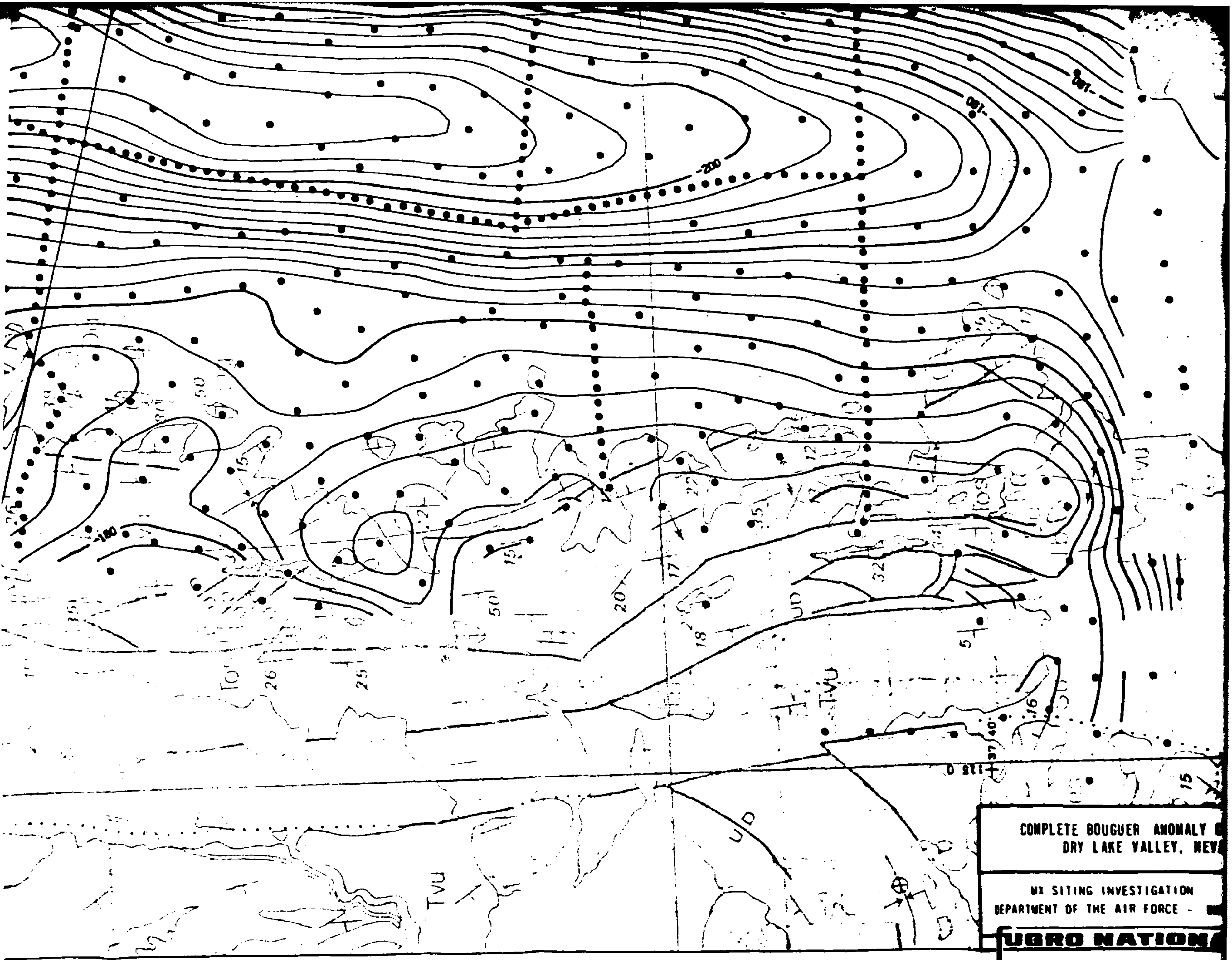
In addition to the gravity data in Dry Lake Valley, information from two relatively long seismic refraction lines in the northern part of the valley was available. These seismic lines were recorded during Characterization studies by Fugro National in June, 1977 (FN-TR-26e).

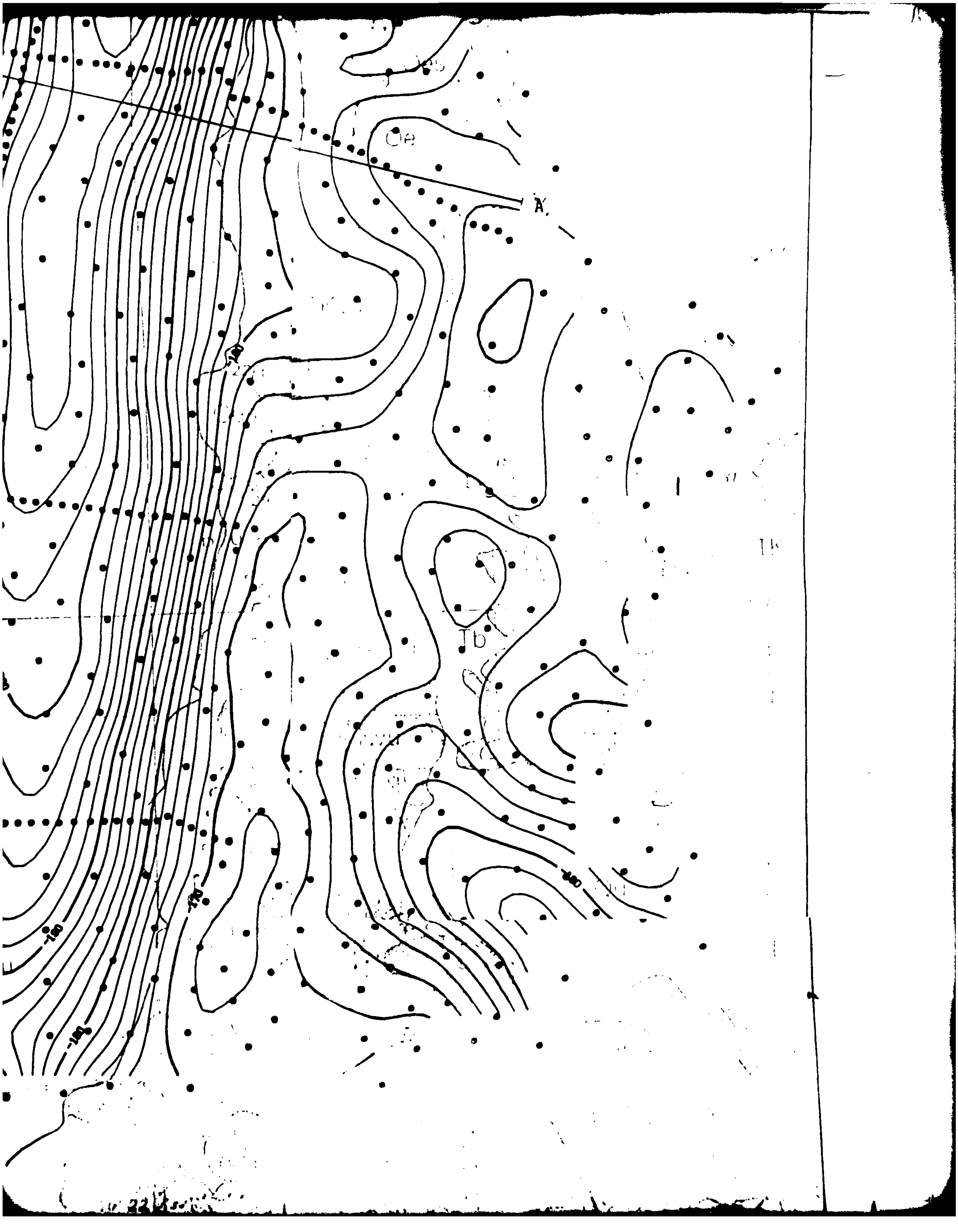
2.0 GRAVITY DATA REDUCTION

DMAHTC/GSS obtained the basic observations and reduced them to simple Bouguer Anomalies (SBA) for each station as described in Appendix A1.0. Up to three levels of terrain corrections were applied to convert the SBA to the complete Bouguer Anomaly (CBA). First, the Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, used its library of digitized terrain data and a computer program to calculate corrections for all stations to account for terrain to 104 miles (167 km) from the station. The second level of terrain corrections was necessary because the computer program has limitations in accounting for terrain effects near the stations. This made it necessary, for some stations, to use a ring template to calculate the effect of terrain within approximately 3000 feet of these stations. The third level of terrain corrections was applied to those stations where 10 feet or more of relief was observed within 130 feet of the station. For these stations, elevation differences were measured in the field at a distance of 130 feet along six directions from the stations. These data were used to calculate the effect of the very near relief. Figure 3 is a contour map of the CBA which also shows the locations of the gravity stations and approximate rock outcrop line at the edges of the valley.


31 JAN 80
EXPLANATION
DARKENED AREAS ARE ROCK OUTCROPS
CI=2 MILLIGALS
A—A' LINE OF SECTION
GRAVITY STATION
SCALE: 1:125,000
115 0
38 10
-200
-190
-200
Dsl
Ml
Ou
MDp
Tvu
Msw
Oes


200
200
180
180
200
180
180
MDp
SD


-200
-180
-180
-180
Tvu
Tvu
Tvu
Tvu
UD
UD
Tos
Tos
115 0
37 40'
15
15
15
17
17
18
20
22
25
26
26
32
35
50
50
12
5
16
COMPLETE BOUGUER ANOMALY
DRY LAKE VALLEY, NEV
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE -
UGRO NATION

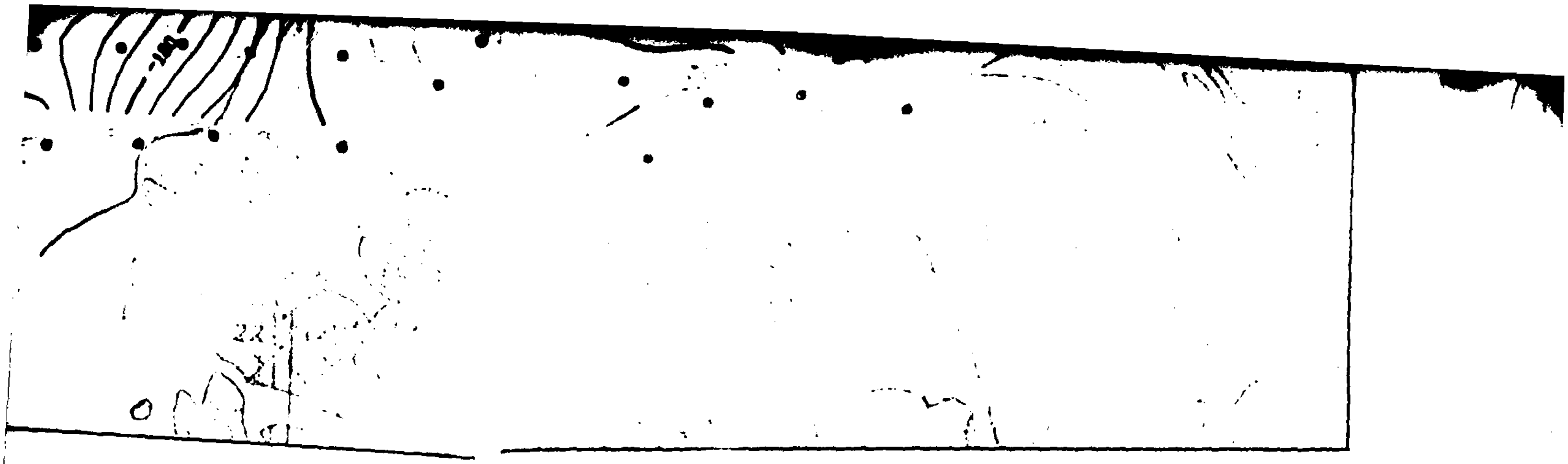

A'
Tb

PLETE BOUGUER ANOMALY CONTOURS
DRY LAKE VALLEY, NEVADA

SITING INVESTIGATION
NT OF THE AIR FORCE - BMO

FIGURE 3

RO NATIONAL, INC.



6

3.0 GEOLOGIC SUMMARY

The structural geologic setting, major rock types, and depositional regime of the valley-fill material are important considerations in the interpretation of the gravitational field data. Dry Lake Valley exhibits typical basin and range structure; high angle, normal basement faults, oriented north-south, probably border the North Pahroc Range on the west, and the Bristol, Highland, and Chief ranges on the east. The area between was faulted downward. Stewart, and Carlson (1978) indicate that a north-south trending fault on the eastern side of the valley cuts through the surface alluvium. This is further substantiated by Shawe (1965) and Fugro National, Inc. (1978, FN-TR-26E). Shawe (1965) also mentions transverse faults, near the Dry Lake area, occurring at large angles to the major north-south structural trends.

The outcrops in the mountains on the western side of the valley are predominantly Tertiary ash flow tuffs with some Paleozoic carbonate rocks. Conversely, the eastern mountains are composed primarily of Paleozoic carbonates with minor amounts of Tertiary ash flow tuffs (Stewart, and Carlson, 1978). The Paleozoic carbonate rocks in Nevada are generally reported to be relatively high density, on the order of 2.8 g/cm^3. The volcanic rocks in Nevada are highly variable in density. In general, their density ranges fall between 2.2 and 2.5 g/cm^3.

At the surface, the total valley fill is composed of young and intermediate age alluvial fan deposits (72 percent of surface area), fluvial and stream terrace deposits (16 percent), playa and older lacustrine deposits (six percent), and undifferentiated fluvial, alluvial, and lacustrine deposits (six percent), (*Fugro National, Inc.* 1978, FN-TR-26e). Except for younger stream channel and playa deposits, the valley fill is late Tertiary and early Quaternary in age. Eakin (1963) describes, the valley fill as consisting of unconsolidated to partly consolidated silt, sand, and gravel derived from adjacent highlands, and including some rocks of volcanic origin.

4.0 INTERPRETATION

The gravitational effect of the light weight material filling the Dry Lake structural basin dominates the CBA map in Figure 3. The CBA values become increasingly negative toward the center of the valley.

4.1 REGIONAL-RESIDUAL SEPARATION

A fundamental step in gravity interpretation is evaluation of the portion of the CBA which represents the geologic feature of interest, in this case, the relatively low density valley fill. The part of the gravity field which is of interest is called the "residual" anomaly. The magnitude of the residual anomaly is a product of: 1) the thickness of alluvial fill; and 2) the contrast in density between the fill and bedrock.

The residual anomaly was isolated by first estimating the way the CBA field would have appeared if there had been no valley fill present. This estimated field is called the "regional" gravity. For this study, the regional field was calculated by fitting (by least squares) a second-order polynomial surface to the CBA values at the bedrock stations around the valley. The regional field was then subtracted from the CBA. The remainder was the residual anomaly.

4.2 DENSITY SELECTION

To calculate the thickness of alluvium which caused the residual anomaly, it is necessary to know the density contrast between the alluvial fill and the bedrock. Only very generalized information on densities is available, and, for calculation, they were treated as if they are constant throughout the valley. Upon consideration of these factors, it becomes clear that the thickness of alluvium (or depth to rock) interpretation is a coarse approximation.

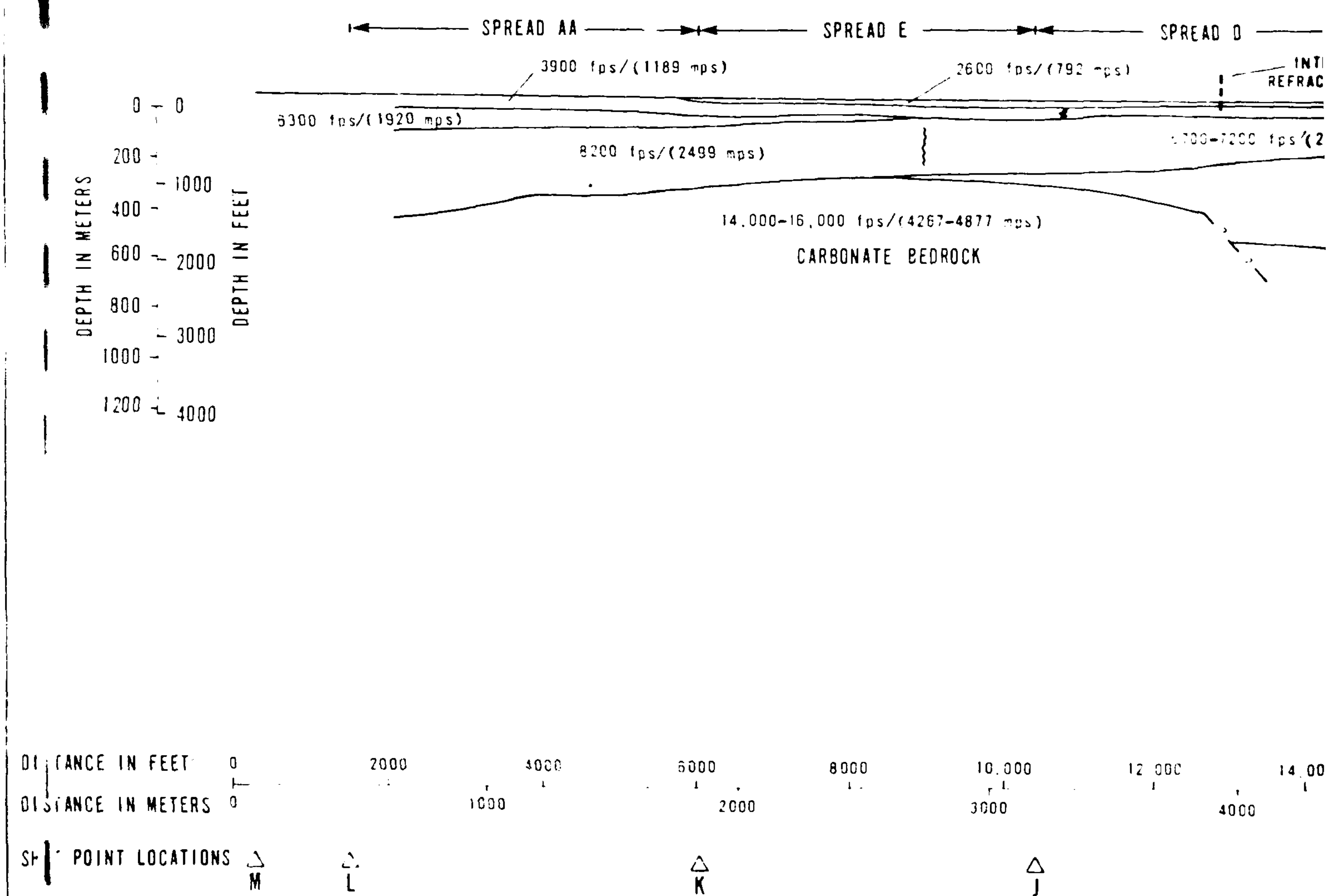
Interpretations from the two seismic refraction lines in the northern end of the valley were used to constrain the selection of the density contrast. These interpretations are shown in Figures 4 and 5. The highest velocities in the profiles are on the order of 15,000 fps (4572 mps). These were interpreted to represent carbonate bedrock. By "trial and error" calculations, it was found that use of a density contrast of 0.45 g/cm^3 caused the depth calculated from the gravity to approximately agree with the seismic interpretation.

The density measured for samples of alluvial fill obtained from shallow borings in Dry Lake Valley range from 2.1 g/cm^3 to 2.4 g/cm^3. Published values for carbonate rocks typically range between 2.6 and 2.8 g/cm^3. The contrast of 0.45 g/cm^3 appears to be reasonable in light of these typical values. This contrast should be considered a maximum, because the average density of the alluvial materials will become greater as the depth of burial increases.

4.3 MODELING

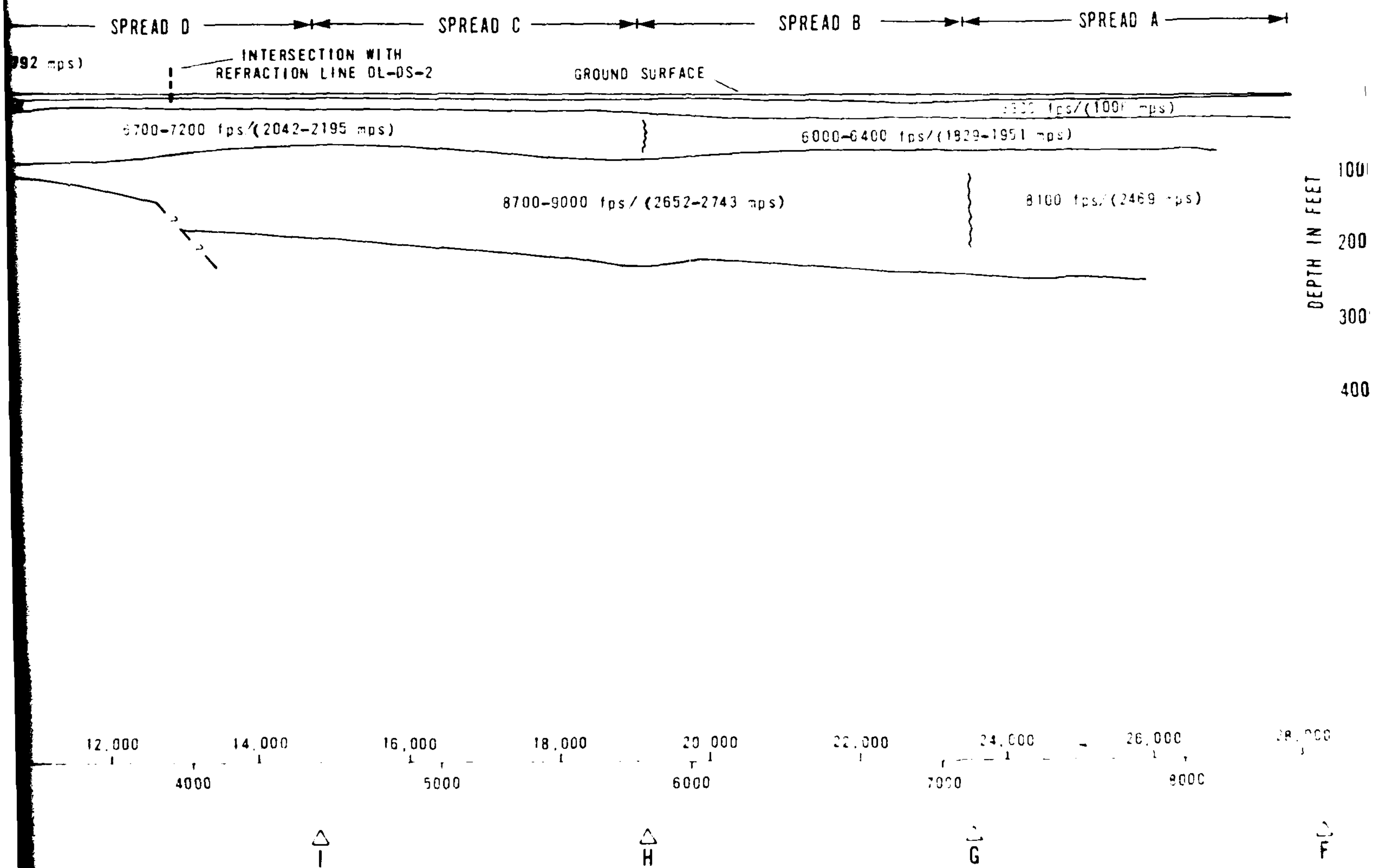
For computation and contouring, values for surface elevations and CBA were interpolated at the nodes of a regular 1 mile (1.6 km) grid over the valley. Portions of the grid, where

VELOC
SEISMIC REFRA



VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-1

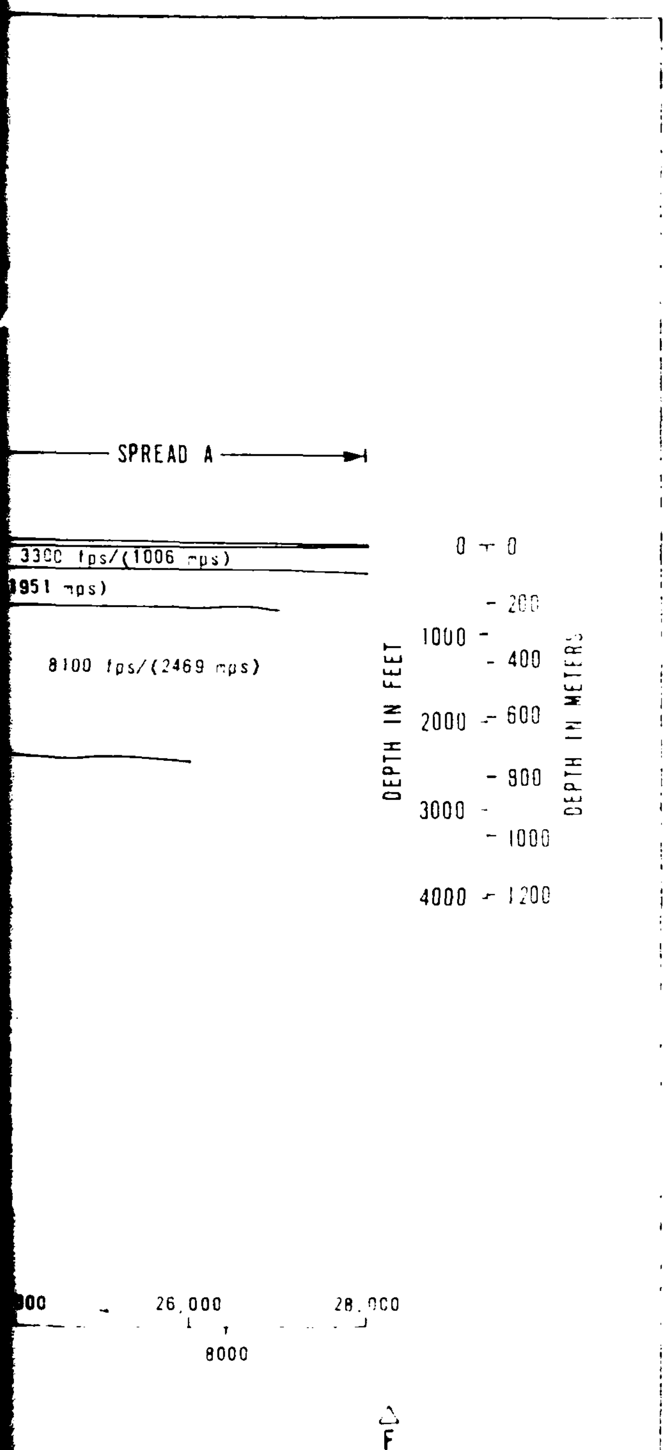
S 28 E



VELOCITY PROFIL
SEISMIC REFRACTION LIN
DRY LAKE VALLEY N

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE

FUGRO NATION



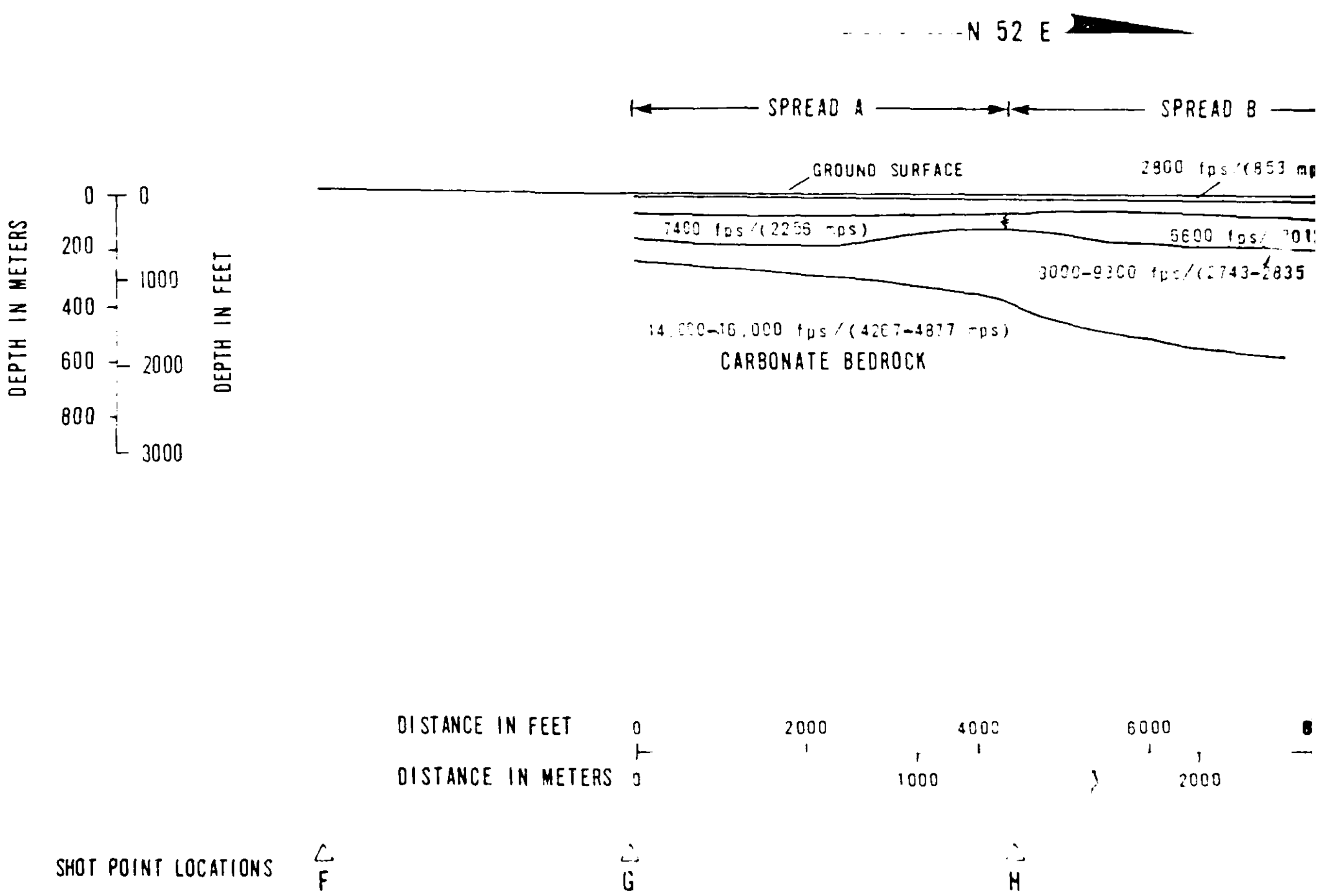
VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-1
DRY LAKE VALLEY NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE   BMO

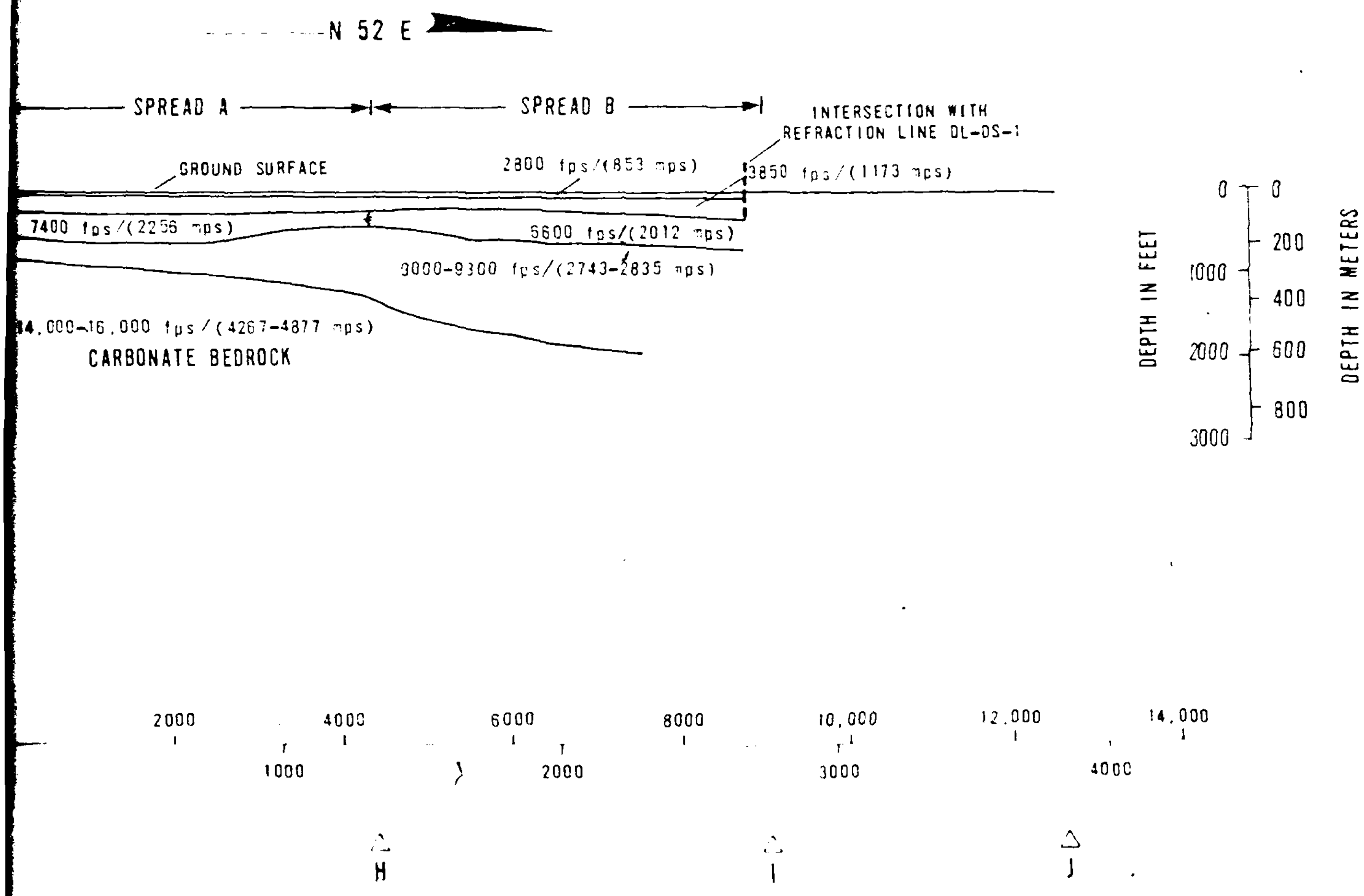
FIGURE 4

FUGRO NATIONAL, INC.

VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2



VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2



VELOCITY PROFILE SEISMIC REFRACTION LINE DL-DS-2 DRY LAKE VALLEY, NEVADA
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SAMSO
FIGURE 5
FUGRO NATIONAL, INC.

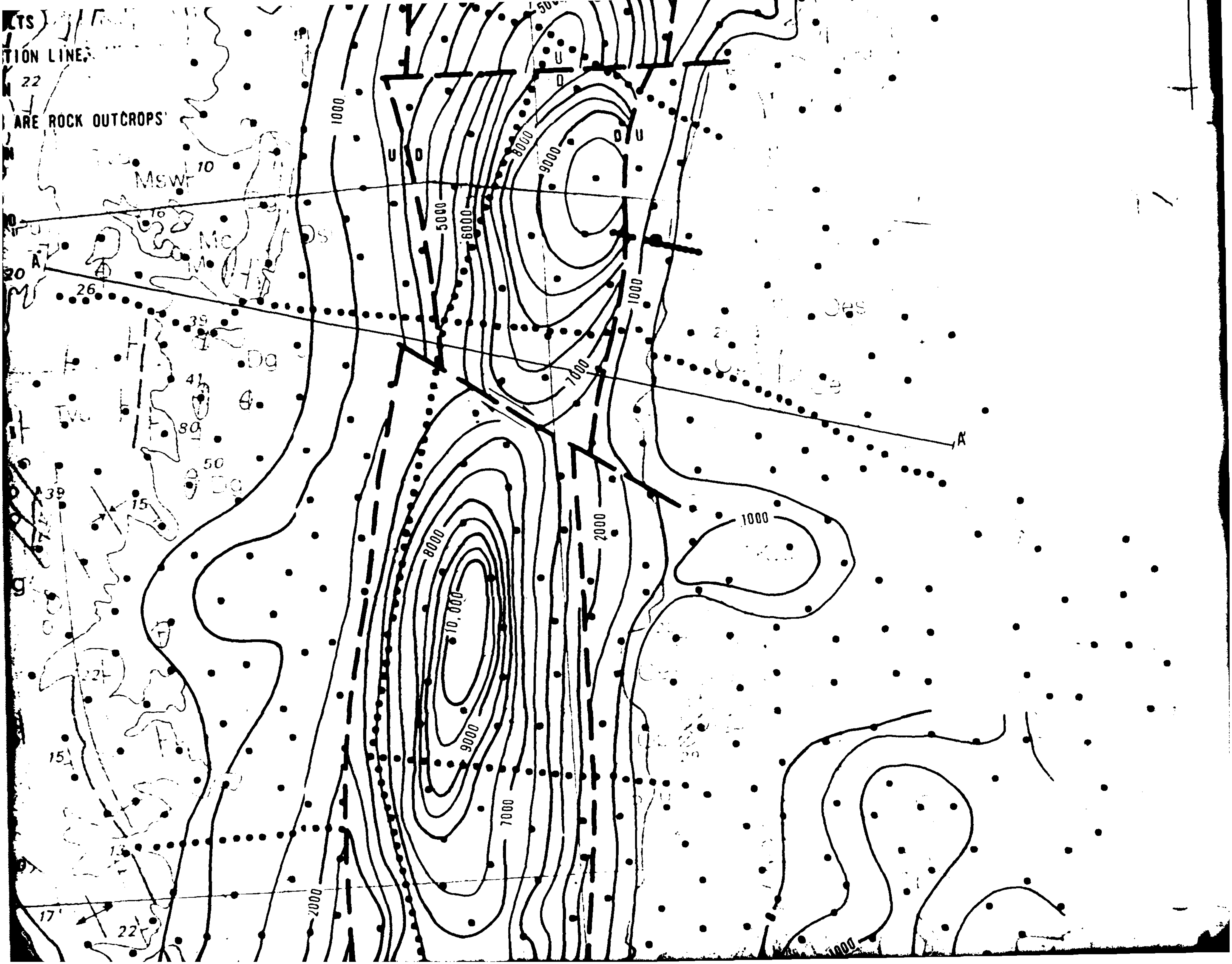
there were insufficient station data to establish reliable nodal values, were masked out.

Bedrock depths at each node were computed by iterative computer programs that considered the gravity effect from the model at the other nodes as well as beneath the node in question. Contours showing the interpreted depth to bedrock are displayed in Figure 6. The CBA contours in Figure 3 show linear gradients along both sides of the valley. These gradients range from 10 to 14 milligals per mile. These gradients are thought to be produced by large, steep bedrock faults. The second vertical derivative of the CBA field was calculated to guide the placement of the faults shown in Figure 6. Since the zero contour of the second vertical derivative marks the steepest part of the input CBA field, the faults were placed along the zero contour. This places the trace of the eastern boundary fault slightly more than 1 mile (1.6 km) west of surface cracks in the alluvium mapped as a fault along the eastern boundary of Dry Lake Valley.

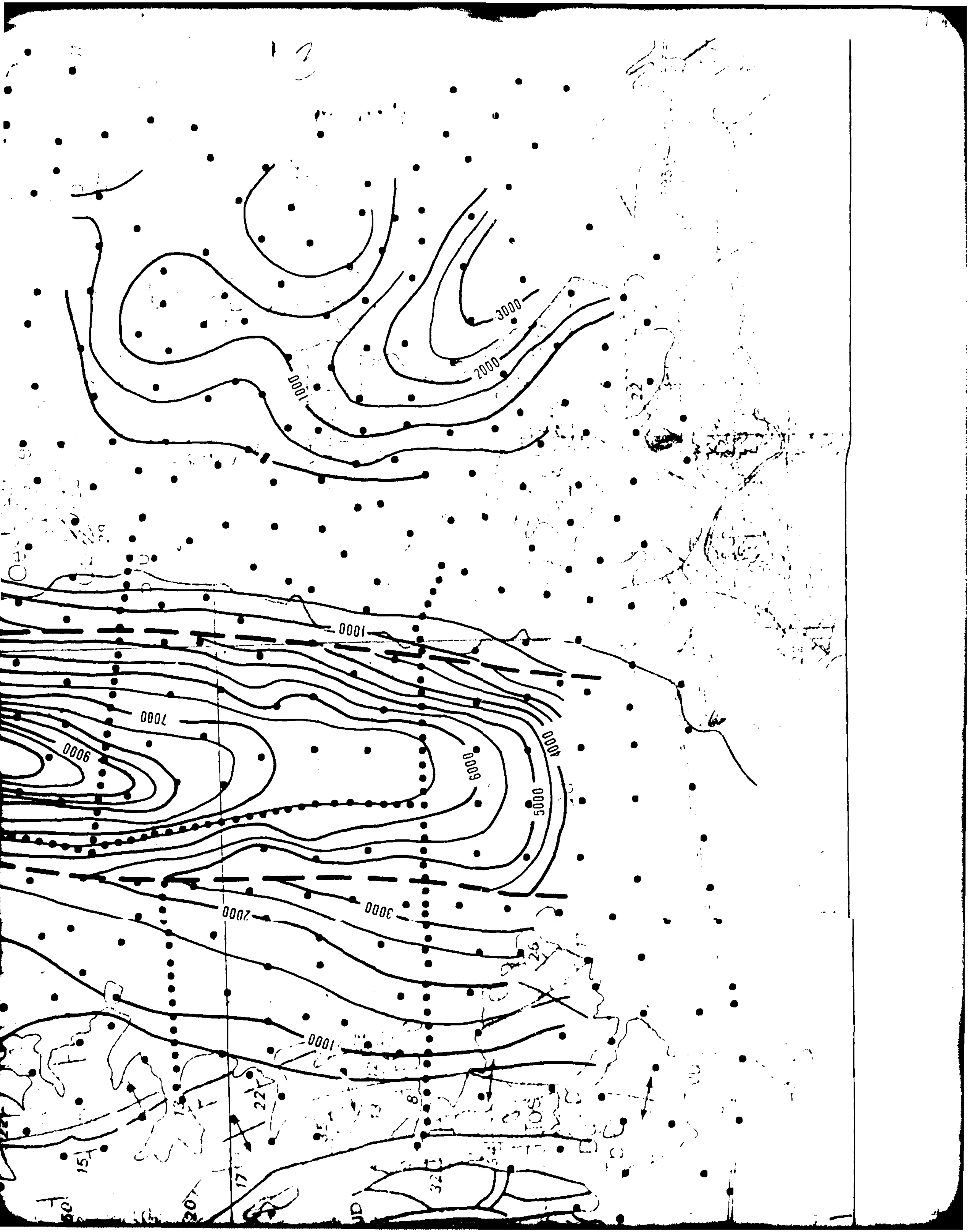
The two faults interpreted to cross the valley are not so clearly defined as the boundary faults. They are positioned where changes in strike of the major gravity gradients and the axis of the valley occur. There is significant change in bedrock elevation associated with the northern transverse fault, but little, if any vertical change across the southern fault.

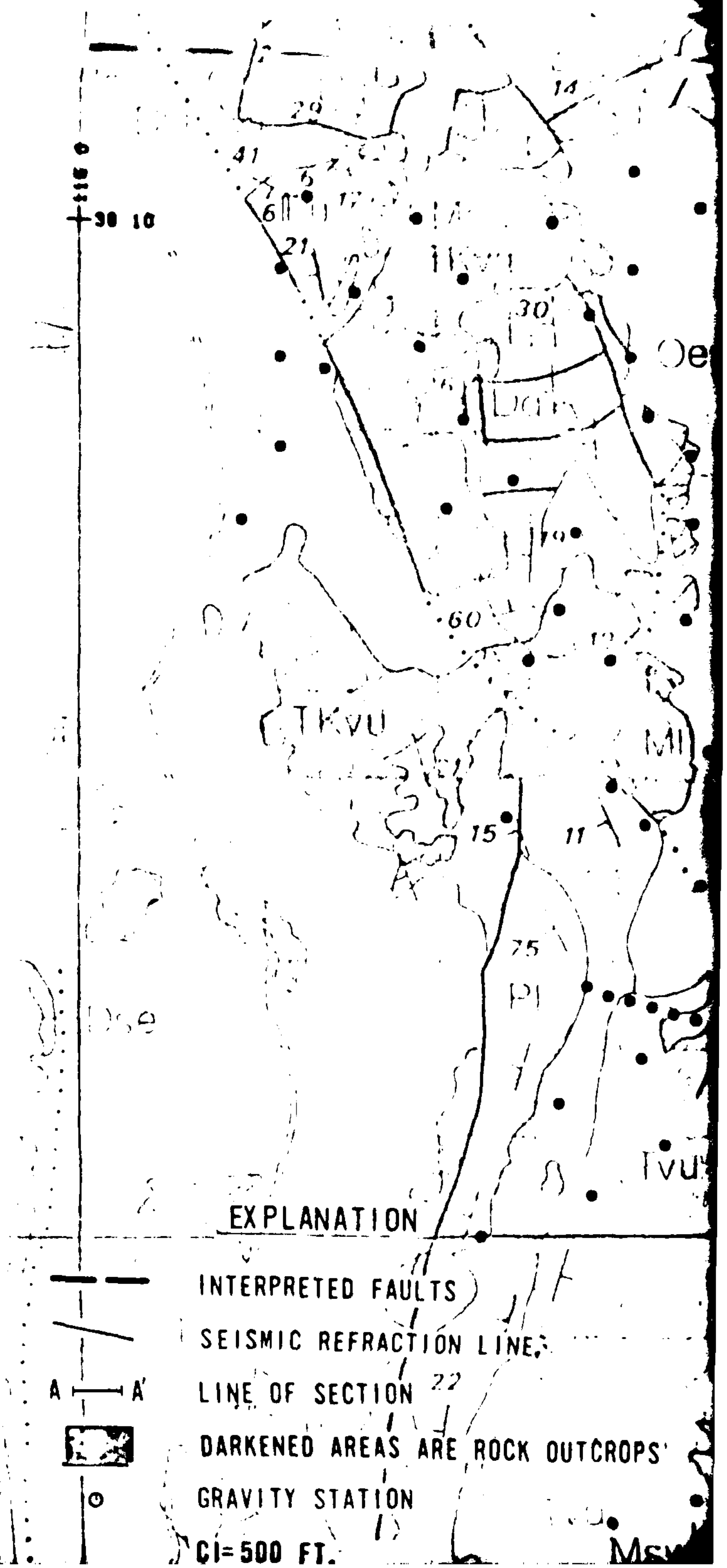
A cross-section view across the central part of the valley (Section AA', Figures 3 and 6) is shown in Figure 7. The top part of the figure shows the shape of the CBA profile along this section. The lower part shows the surface profile and the interpreted bedrock profile.

DL-DS-1
DL-DS-2
1000
2000
3000
4000
5000
8000
9000
ULTS
TION LINES
ARE ROCK OUTCROPS

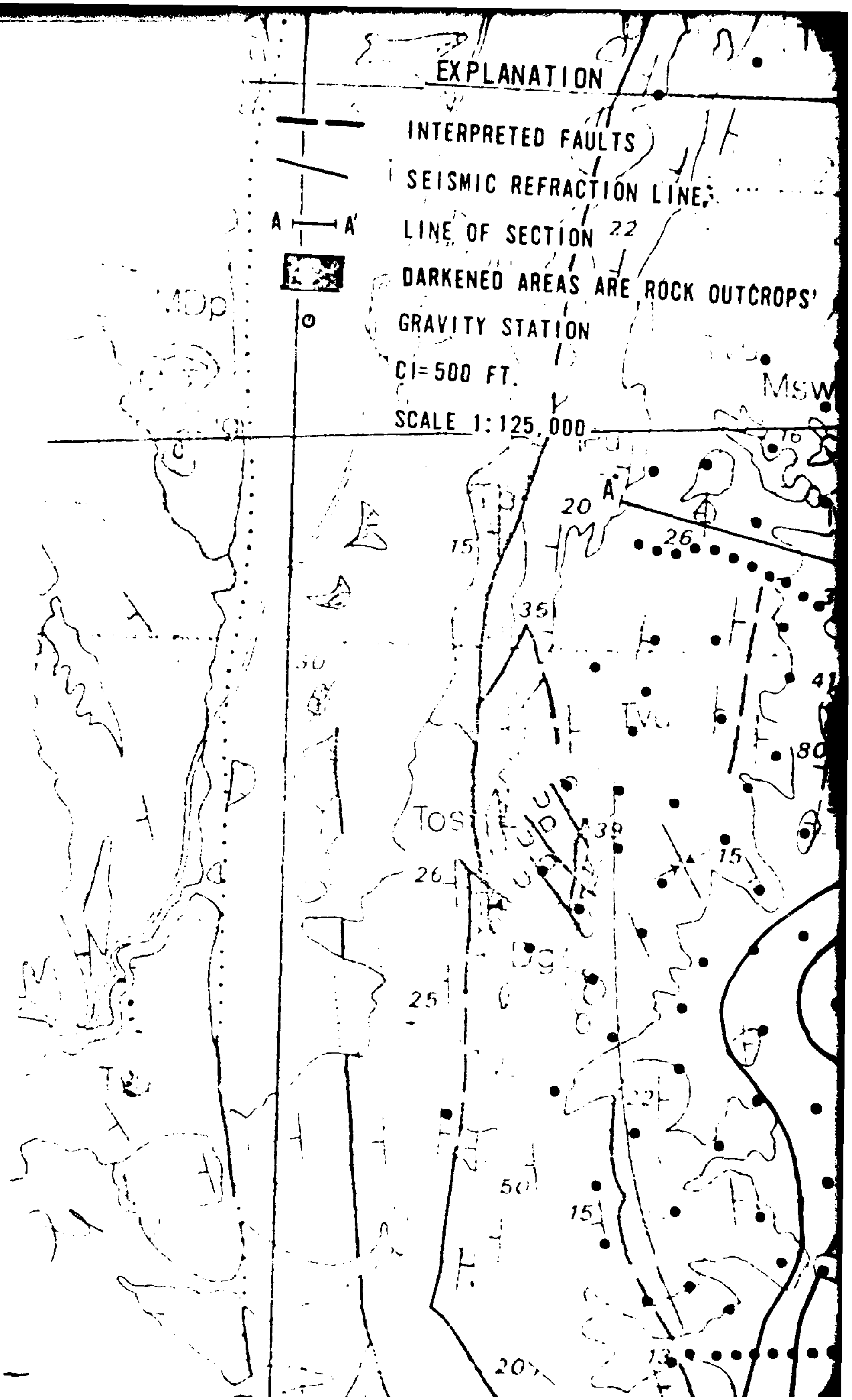


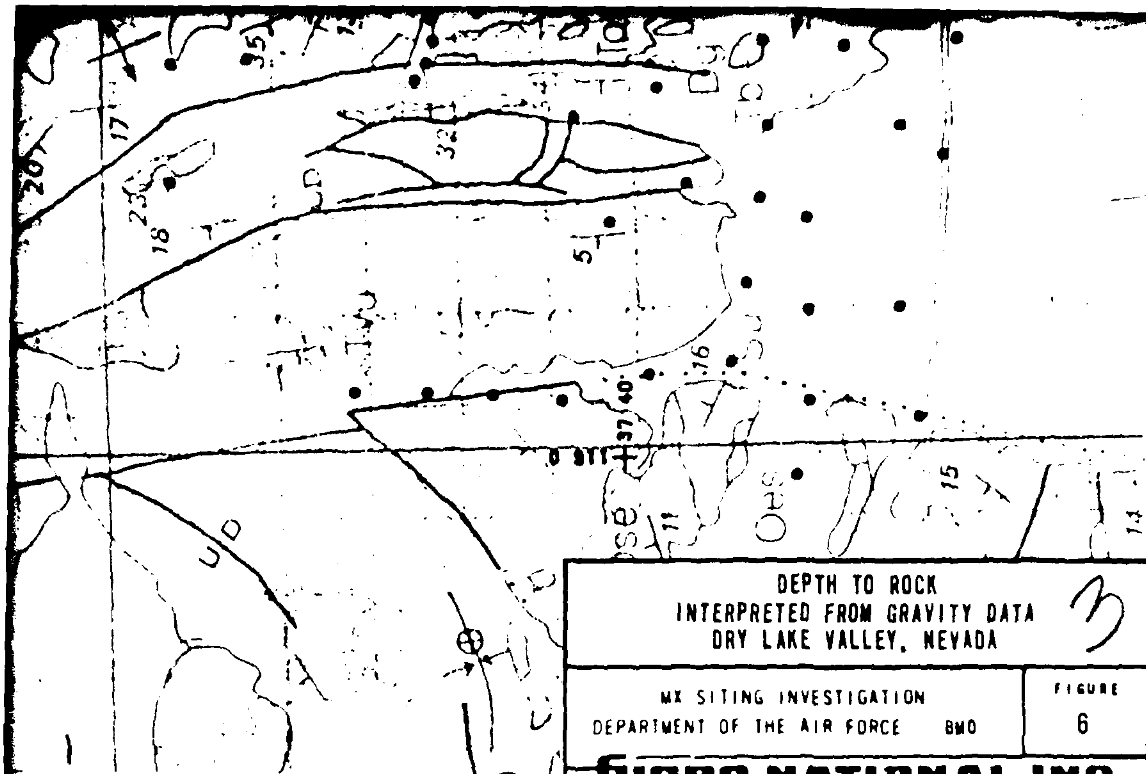
TS)
TION LINE
ARE ROCK OUTCROPS
A
A'
U
D
1000
2000
5000
6000
7000
8000
9000
10,000
Msw
Mc
Ds
Dg
10
15
17
22
26
39
41
50
80


3000
2000
1000
1000
7000
9000
6000
5000
4000
3000
2000
1000



116 0
30 10
Oe
TKvu
Ml
Pl
Tvu
Dse
Ms
EXPLANATION
INTERPRETED FAULTS
SEISMIC REFRACTION LINE
A A' LINE OF SECTION
DARKENED AREAS ARE ROCK OUTCROPS
GRAVITY STATION
CI=500 FT.


EXPLANATION
INTERPRETED FAULTS
SEISMIC REFRACTION LINE
A A' LINE OF SECTION
DARKENED AREAS ARE ROCK OUTCROPS
GRAVITY STATION
CI=500 FT.
SCALE 1:125,000
Msw
Tvu
Tos
MDp

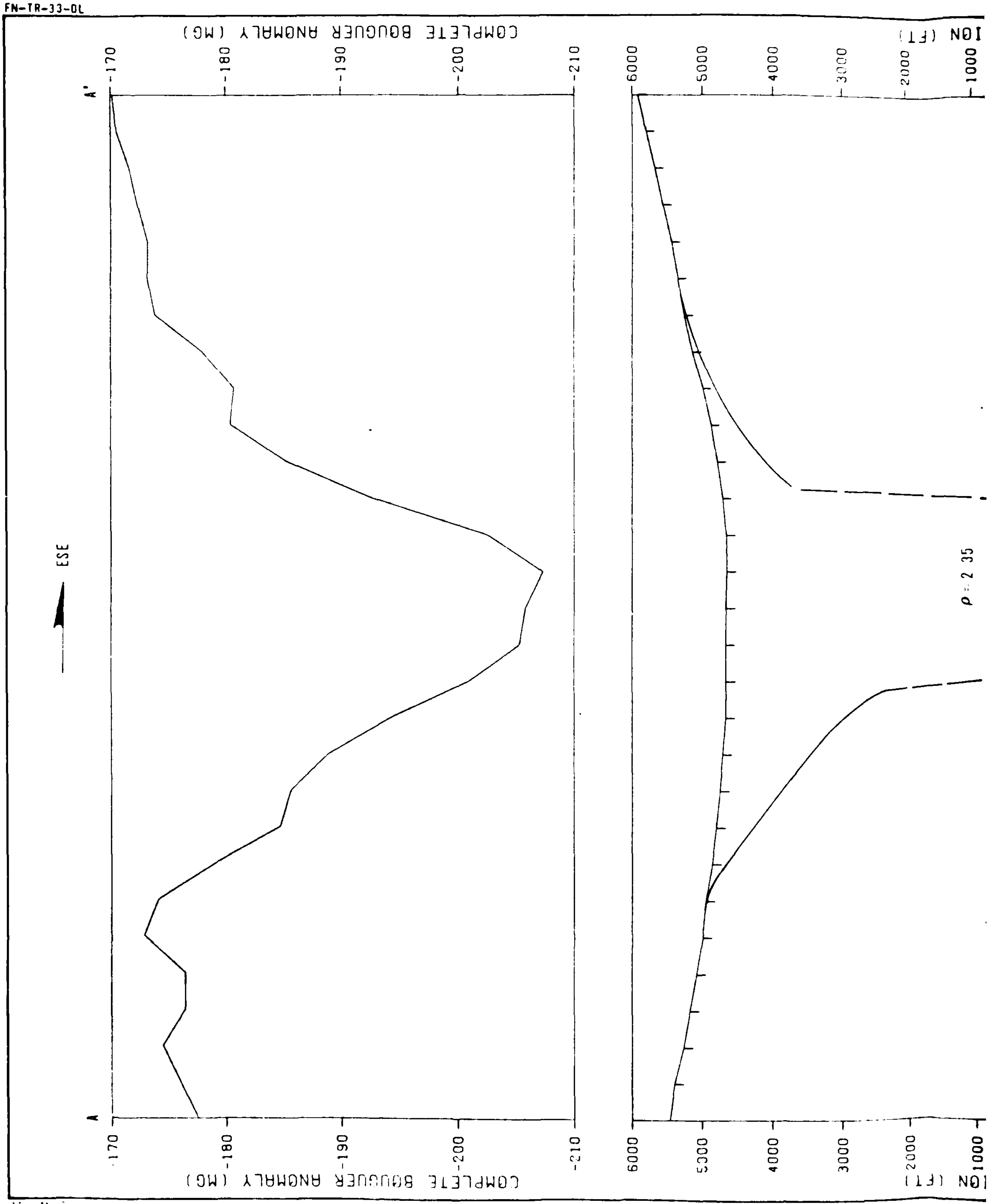


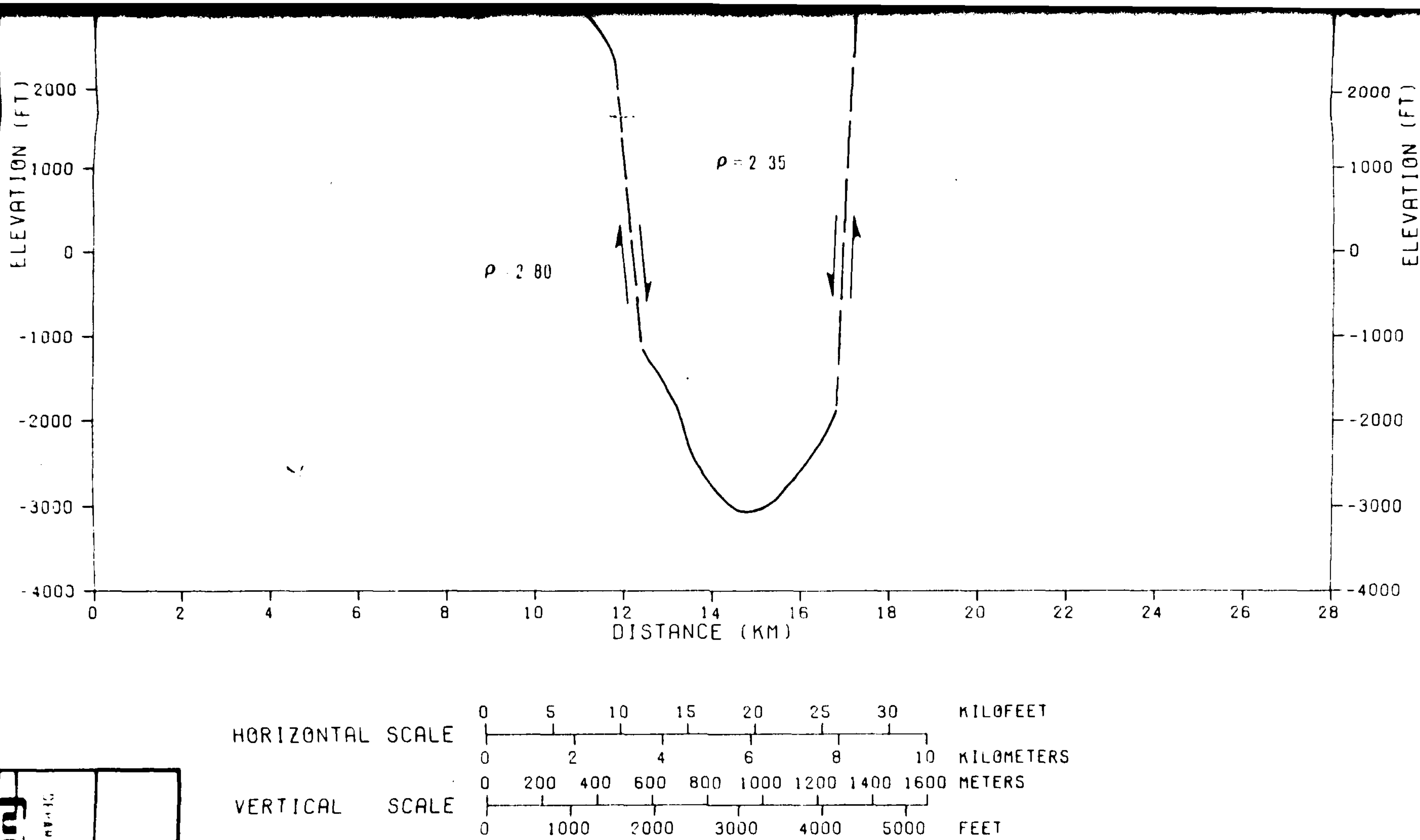
DEPTH TO ROCK
INTERPRETED FROM GRAVITY DATA
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 6

FUGRO NATIONAL INC


COMPLETE BOUGUER ANOMALY (MG)
-170
-180
-190
-200
-210
A
A'
ESE
ION (FT)
6000
5000
4000
3000
2000
1000
ρ = 2.35



EXPLANATION

TOP COMPLETE BOUGUER ANOMALY (INTERPOLATED)

BOTTOM ELEVATION: INTERPOLATED SURFACE ELEVATIONS

MODEL OF BEDROCK SURFACE

DENSITY VALUES (ρ 2.3) g/cm^3

DISTANCE SCALE 1:125,000

CROSS-SECTIONAL VIEW, PROFILE AA'
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 7

FUGRO NATIONAL, INC.

5.0 CONCLUSIONS

The interpretation of the gravity survey of Dry Lake Valley indicates that there are major range bounding normal faults on both sides of the valley. The graben between the boundary faults is calculated to be on the order of 10,000 feet deep. The northern third of the valley is substantially shallower than the southern part.

There is a large, well defined negative gravity anomaly associated with Dry Lake Valley. An average density contrast of 0.45 g/cm^3 between the alluvium and bedrock was used to calculate the thickness of alluvium which would create such an anomaly. If a smaller contrast had been used, the calculated thickness would have been greater. Conversely, if a larger contrast had been used, the calculated thickness would have been smaller.

Additional modeling with other density contrasts was not justified because so little is known about the actual density distribution in and around the valley.

If future studies acquire better density data or actual thicknesses of alluvium in relatively deep parts of the basin, the gravity interpretation can be refined and made more accurate.

BIBLIOGRAPHY

Eakin, T.E., 1963, Ground Water Appraisal of Dry Lake and Delamar Valleys: U.S. Geol. Survey, Ground Water Resources - Reconnaissance Series, Report 16, 24 p.

Fugro National, Inc. 1978, MX siting investigation geotechnical summary prime characterization sites, Great Basin Candidate Siting Province Report, 70 p., 4 appendices (FN-TR-26e).

Shawe, D.R., 1965, Strike-slip control of basin-range structure indicated by historical faults in Western Nevada: Geological Society of America Bulletin, Vol. 76, pp. 1361-1378.

Stewart, J.H., and Carlson, J.E., 1978, Geologic Map of Nevada: U.S. Geol. Survey, 1:500,000.

APPENDIX A1.0

GENERAL PRINCIPLES OF THE GRAVITY EXPLORATION METHOD

A1.0 GENERAL PRINCIPLES OF THE GRAVITY EXPLORATION METHOD

A1.1 GENERAL

A gravity survey involves measurement of differences in the gravitational field between various points on the earth's surface. The gravitational field values being measured are the same as those influencing all objects on the surface of the earth. They are generally associated with the force which causes a 1 gm mass to be accelerated at 980 cm/sec^2. This force is normally referred to as a 1 g force.

Even though in many applications the gravitational field at the earth's surface is assumed to be constant, small but distinguishable differences in gravity occur from point to point. In a gravity survey, the variations are measured in terms of milligals. A milligal is equal to 0.001 cm/second^2 or 0.00000102 g. The differences in gravity are caused by geometrical effects, such as differences in elevation and latitude, and by lateral variations in density within the earth. The lateral density variations are a result of changes in geologic conditions. For measurements at the surface of the earth, the largest factor influencing the pull of gravity is the density of all materials between the center of the earth and the point of measurement.

To detect changes produced by differing geological conditions, it is necessary to detect differences in the gravitational field as small as a few milligals. To recognize changes due to geological conditions, the measurements are "corrected" to account for changes due to differences in elevation and latitude.

Given this background, the basic concept of the gravitational exploration method, the anomaly, can be introduced. If, instead of being an oblate spheroid characterized by complex density variations, the earth were made up of concentric, homogeneous shells, the gravitational field would be the same at all points on the surface of the earth. The complexities in the earth's shape and material distribution are the reason that the pull of gravity is not the same from place to place. A difference in gravity between two points which is not caused by the effects of known geometrical differences, such as in elevation, latitude, and surrounding terrain, is referred to as an "anomaly."

An anomaly reflects lateral differences in material densities. The gravitational attraction is smaller at a place underlain by relatively low density material than it is at a place underlain by a relatively high density material. The term "negative gravity anomaly" describes a situation in which the pull of gravity within a prescribed area is small compared to the area surrounding it. Low-density alluvial deposits in basins such as those in the Nevada-Utah region produce negative gravity anomalies in relation to the gravity values in the surrounding mountains which are formed by more dense rocks.

The objective of gravity exploration is to deduce the variations in geologic conditions that produce the gravity anomalies identified during a gravity survey.

A1.2 INSTRUMENTS

The sensing element of a LaCoste and Romberg gravimeter is a mass suspended by a zero-length spring. Deflections of the mass from a null position are proportional to changes in gravitational attraction. These instruments are sealed and compensated for atmospheric pressure changes. They are maintained at a constant temperature by an internal heater element and thermostat. The absolute value of gravity is not measured directly by a gravimeter. It measures relative values of gravity between one point and the next. Gravitational differences as small as 0.01 milligal can be measured.

A1.3 FIELD PROCEDURES

The gravimeter readings were calibrated in terms of absolute gravity by taking *readings twice daily at nearby* USGS gravity base stations. Gravimeter readings fluctuate because of small time-related deviations due to the effect of earth tides and instrument drift. Field readings were corrected to account for these deviations. The magnitude of the tidal correction was calculated using an equation suggested by Goguel (1954):

$$C = P + N\cos\phi\,(\cos\phi + \sin\phi) + S\cos\phi\,(\cos\phi - \sin\phi)$$

where C is the tidal correction factor, P, N, and S are time-related variables, and ϕ is the latitude of the observation point. Tables giving the values of P, N, and S are published annually by the European Association of Exploration Geophysicists.

The meter drift correction was based on readings taken at a designated base station at the start and end of each day. Any difference between these two readings after they were corrected for tidal effects was considered to have been the result of instrumental drift. It was assumed that this drift occurred at a uniform rate between the two readings. Corrections for drift were typically only a few hundredths of a milligal. Readings corrected for tidal effects and instrumental drift represented the observed gravity at each station. The observed gravity values represent the total gravitational pull of the entire earth at the measurement stations.

A1.4 DATA REDUCTION

Several corrections or reductions are made to the observed gravity to isolate the portion of the gravitational pull which is due to the crustal and near-surface materials. The gravity remaining after these reductions is called the "Bouguer Anomaly." Bouguer Anomaly values are the basis for geologic interpretation. To obtain the Bouguer Anomaly, the observed gravity is adjusted to the value it would have had if it had been measured at the geoid, a theoretically defined surface which approximates the surface of mean sea level. The difference between the "adjusted" observed gravity and the gravity at the geoid calculated for a theoretically homogeneous earth is the Bouguer Anomaly.

Four separate reductions, to account for four geometrical effects, are made to the observed gravity at each station to arrive at its Bouguer Anomaly value.

a. Free-Air Effect: Gravitational attraction varies inversely as the square of the distance from the center of the earth. Thus corrections must be applied for elevation. Observed gravity levels are corrected for elevation using the normal vertical gradient of:

$$FA = -0.09406 \text{ mg/ft } (-0.3086 \text{ milligals/meter})$$

where FA is the free-air effect (the rate of change of gravity with distance from the center of the earth). The free-air correction is positive in sign since the correction is opposite the effect.

b. Bouguer Effect: Like the free-air effect, the Bouguer effect is a function of the elevation of the station, but it considers the influence of a slab of earth materials between the observation point on the surface of the earth and the corresponding point on the geoid (sea level). Normal practice, which is to assume that the density of the slab is 2.67 grams per cubic centimeter was followed in these studies. The Bouguer correction (B_c), which is opposite in sign to the free-air correction, was defined according to the following formula.

$$B_c = 0.01276\ (2.67)\ h_f \text{ (milligals per foot)}$$

$$B_c = 0.04185\ (2.67)\ h_m \text{ (milligals per meter)}$$

where h_f is the height above sea level in feet and h_m is the height in meters.

c. <u>Latitude Effect</u>: Points at different latitudes will have different "gravities" for two reasons. The earth (and the geoid) is spheroidal, or flattened at the poles. Since points at higher latitudes are closer to the center of the earth than points near the equator, the gravity at the higher latitudes is larger. As the earth spins, the centrifugal acceleration causes a slight decrease in gravity. At the higher latitudes where the earth's radii are smaller, the centrifugal acceleration diminishes. The gravity formula for the Geodetic Reference System, 1967, gives the theoretical value of gravity at the geoid as a function of latitude. It is:

$$g = 978.0381\ (1 + 0.0053204 \sin^2 \phi - 0.0000058 \sin^2 2\phi) \text{ gals}$$

where g is the theoretical acceleration of gravity and ϕ is the latitude in degrees. The positive term accounts for the spheroidal shape of the earth. The negative term adjusts for the centrifugal acceleration.

The previous two corrections (free air and Bouguer) have adjusted the observed gravity to the value it would have had at the geoid (sea level). The theoretical value at the geoid for the latitude of the station is then subtracted from the adjusted observed gravity. The remainder is called the Simple Bouguer Anomaly (SBA). Most of this gravity represents the effect of material beneath the station, but part of it may be due to irregularities in terrain (upper part of the Bouguer slab) away from the station.

d. Terrain Effect: Topographic relief around the station has a negative effect on the gravitational force at the station. A nearby hill has upward gravitational pull and a nearby valley contributes less downward attraction than a nearby material would have. Therefore, the corrections are always positive. Corrections are made to the SBA when the terrain effects were 0.1 milligal or larger. Terrain corrected Bouguer values are called the Complete Bouguer Anomaly (CBA). When the CBA is obtained, the reduction of gravity at individual measurement points (stations) is complete.

A1.5 INTERPRETATION

The first step in interpretation is to separate the portion of the CBA that might be caused by the lightweight, basin-fill material overlying the heavier bedrock material which forms the surrounding mountains and presumably the basin floor. Since the valley-fill sediments are absent at the stations read in the mountains, the CBA values at these bedrock stations are used as the basis for constructing a regional field over the valley. A regional field is an estimation of the values the CBA would have had if the light weight sediments (the anomaly) had not been there.

The difference between the CBA and the regional field is called the "residual" field or residual anomaly. The residual field is the interpreter's estimation of the gravitational effect of the geologic anomaly. The zero value of the residual anomaly is not exactly at the rock outcrop line but at some distance on the "rock" side of the contact. The reason for this is found in the explanation of the terrain effect. There is a component of gravitational attraction from material which is not directly beneath a point.

If the "regional" is well chosen, the magnitude of the residual anomaly is a function of the thickness of the anomalous (fill) material and the density contrast. The density contrast is the difference in density between the alluvial and bedrock material. If this contrast were known, an accurate calculation of the thickness could be made. In most cases, the densities are not well known and they also vary within the study area. In these cases, it is necessary to use typical densities for materials similar to those in the study area.

If the selected average density contrast is smaller than the actual density contrast, the computed depth to bedrock will be greater than the actual depth and vice-versa. The computed depth is *inversely proportional to the density contrast*. A *ten* percent error in density contrast produces a ten percent error in computed depth. An iterative computer program is used to calculate a subsurface model which will yield a gravitational field to match (approximately) the residual gravity anomaly.

APPENDIX A2.0

LISTS OF GRAVITY DATA

FN-TR-33-DL

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL1	+38 767	+1145234	5377Y	0	127422193	68649148289200331	98562	60349
DL2	+38 771	+1145117	5225Y	0	107422204	68620149343200338	98179	80465
DL3	+38 793	+1145015	51591T	0	103422249	68966149601200370	97963	80490
DL4	+38 833	+1144907	51509T	0	119422323	68993149694200428	97943	80495
DL5	+38 808	+1144852	5634Y	0	194422282	69206147022200391	99654	80536
DL6	+38 807	+1144744	5279B	0	111422284	69364149231200390	98522	80628
DL7	+38 798	+1144630	5342B	0	114422271	69530148685200377	98583	80477
DL8	+38 751	+1144505	5548Y	0	114422189	69715147527200306	99434	80625
DL9	+38 861	+1144550	5665Y	0	115422391	69045146910200469	99757	80551
DL10	+38 880	+1144672	5600C	0	112422421	69465147333200497	99540	80552
DL11	+38 892	+1144773	5584Y	0	111422440	69317147360200515	99594	80465
DL12	+38 899	+1144698	5251C	0	106422449	69135149690200525	98584	80780
DL13	+38 914	+1144999	51860T	0	133422473	68986149923200547	98182	80627
DL14	+38 869	+1145118	5304Y	0	110422386	68614148775200480	98212	80231
DL15	+38 846	+1145199	5365C	0	110422344	68697149051200450	99286	81023
DL16	+38 929	+1145105	5438Y	0	122422494	68699148263200569	98673	80447
DL17	+38 955	+1145116	5354Y	0	126422545	68614148625200607	98406	80271
DL18	+38 939	+1144934	5565Y	60	152422521	69080147274200584	99253	80423
DL19	+38 960	+1144537	5409Y	0	94422575	69221148317200623	99165	80606
DL20	+38 944	+1144069	5826Y	0	131422540	69467145931200591	100172	80432
DL21	+38 946	+1144558	5934Y	0	175422547	69629145199200594	100454	80390
DL22	+38 991	+1144572	5847Y	0	110422630	69607145911200659	100281	80457
DL23	+381024	+1144058	5628Y	0	97422688	69480147027200706	99287	80186
DL24	+381013	+1144752	5449Y	0	128422605	59343148410200691	99001	80544
DL25	+381034	+1144876	5632Y	47	112422699	69161146677200723	99159	80106
DL26	+381003	+1144982	5225Y	0	129422638	69007149752200677	98249	80557
DL27	+381011	+1145128	5424Y	0	123422646	68794145377200689	98735	80359
DL28	+381012	+1145223	5580Y	0	137422647	68055147812200690	99637	80743
DL30	+381104	+1145069	5445Y	0	128422622	68876148536200825	98958	80514
DL31	+381090	+1144957	5271Y	0	126422600	69040149615200805	97618	79960
DL32	+381074	+1144762	5697Y	0	114422777	69325148401200781	99297	79961
DL33	+381084	+1144672	5534Y	0	121422799	69456147850200795	99147	80573
DL34	+381079	+1144570	5711Y	0	104422793	69636147216200788	100171	80796
DL36	+38 55	+1145100	5153Y	0	158420881	68676149419199290	99124	81707
DL38	+38 80	+1145084	5163C	0	113420928	68896149925199327	99188	81691
DL39	+38 71	+1145059	5090C	0	163420912	68935150360199313	98919	81796
DL40	+38 63	+1145033	5043C	0	124420698	68973150511199302	98659	81535
DL41	+38 55	+1145006	5000C	0	116420684	69013150512199290	98277	81339
DL42	+38 46	+1144980	4962C	0	113420668	69052150960199277	98265	81475
DL43	+38 38	+1144954	4922C	0	108420654	69090151582199265	98038	81956
DL44	+38 30	+1144928	4925Y	0	105420640	69128151714199253	98610	82117
DL45	+38 21	+1144902	4858B	0	108420625	69167152018199240	98496	82035
DL46	+38 13	+1144870	4848S	0	111420811	69202151697199228	93293	81969
DL47	+38 4	+1144850	4842S	0	103420795	69244151647199216	98000	81588
DL48	+38 63	+1144883	4874Y	0	104420903	69193151345199302	98412	81693
DL49	+38 125	+1144937	4942C	0	98421016	69111151365199396	99502	81744
DL50	+38 134	+1145032	5134Y	0	94421029	68972150059199405	98960	81540
DL51	+38 169	+1145109	5192Y	0	113421091	68858150659199456	99465	[illegible]
DL52	+38 211	+1145229	5257B	0	110421165	68680149577199516	99531	81723
DL53	+38 205	+1145198	5229B	0	115421155	68726149825199509	99529	81610
DL54	+38 203	+1145168	5203Y	0	119421152	68770150190199506	99546	81913
DL55	+38 215	+1145141	5178-	0	106421175	68804150344199523	99552	81497
DL56	+38 219	+1145114	5147B	0	121421184	68846150510199530	99419	81935
DL57	+38 225	+1145088	5122B	0	132421196	68886150686199538	99273	81405
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG	MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL59	+38	237+1145034	5072B	0	98421220	68964159581199556	98758	81556
DL60	+38	243+1145007	5050B	0	95421232	69004150046199565	99607	81476
DL61	+38	249+1144979	5026B	0	96421244	69044150076199573	98403	81356
DL62	+38	257+1144942	5002Y	0	92421260	69098150725199585	98214	81245
DL63	+38	195+1145003	5050B	0	100421143	69012150607199495	98636	81514
DL64	+38	214+1144897	4957Y	0	93421182	69166151136199523	98264	81450
DL65	+38	166+1144857	4912Y	0	99421094	69226151595199452	95370	81715
DL66	+38	113+1144796	4865S	0	99420998	69318151073199375	97070	81106
DL67	+38	23+1144780	4846S	0	96420833	69345150793199243	97155	80723
DL68	+38	9+1144672	4834S	0	97420810	69504150257199223	96527	80137
DL69	+38	90+1144719	4865S	0	97420959	69432150340199341	96783	80287
DL70	+38	1+1144558	4823S	0	107420800	69671150326199211	96504	80161
DL71	+38	21+1144567	4828S	0	110420836	69657150394199240	96590	80233
DL72	+38	42+1144577	4836S	0	106420875	69642150[illegible]4199271	96666	80296
DL73	+38	62+1144587	4842S	0	103420911	69626150456199300	96721	80316
DL74	+38	83+1144597	4847S	0	104420950	69610150463199330	96747	80319
DL75	+38	103+1144607	4855S	0	104420987	69595150622199360	96752	80297
DL76	+38	124+1144617	4867S	0	107421025	69579150536199391	96749	80256
DL77	+38	144+1144626	4878S	0	106421062	69562150243199420	96673	80199
DL78	+38	163+1144643	4887S	0	109421096	6954[illegible]199448	967[illegible]	[illegible]
DL79	+38	181+1144657	4897S	0	102421129	6951[illegible]199474	96726	80127
DL80	+38	200+1144672	4904S	0	99421164	69496150[illegible]199502	967[illegible]	[illegible]
DL81	+38	219+1144686	4911U	0	95421196	694741501[illegible]199533	96791	80150
DL82	+38	237+1144705	4922S	0	96421231	69440150[illegible]199556	96916	80227
DL83	+38	256+1144719	4930S	0	96421266	694241501[illegible]19958[illegible]	97[illegible]	80262
DL84	+38	275+1144732	4937S	0	94421300	69404150[illegible]199612	970[illegible]	80310
DL85	+38	294+1144747	4945S	0	95421335	69382150[illegible]199639	97157	80360
DL86	+38	313+1144760	4957S	0	92421370	69362150[illegible]199667	97293	80476
DL87	+38	334+1144771	4966S	0	90421408	69345150[illegible]199696	97367	[illegible]
DL88	+38	355+1144782	4972U	0	91421447	69328150421199729	974[illegible]	80613
DL89	+38	330+1144621	4968Y	0	90421399	69272150588199692	97549	80795
DL90	+38	315+1144646	4966S	0	91421370	69236150[illegible]7[illegible]5199670	9777[illegible]	80923
DL91	+38	297+1144477	4958U	0	94421336	69191151[illegible]199644	96[illegible]	[illegible]
DL92	+38	284+1144900	4972S	0	92421311	69153151[illegible]199625	962[illegible]1	[illegible]
DL93	+38	270+1144922	4980C	0	93421284	69127150864199604	98212	81289
DL94	+38	174+1144758	4961S	0	98421113	69371150656199464	97317	80069
DL95	+38	251+1144814	4937S	0	94421253	69286150796199577	97582	80037
DL96	+38	93+1144521	4844S	0	114420971	69721150516199345	96757	81559
DL97	+38	164+1144525	4859Y	0	115421102	69712150452199449	96624	80335
DL98	+38	239+1144594	4900Y	0	109421235	69606150293199559	96646	81044
DL99	+38	308+1144657	4935Y	0	102421364	69513150046199661	96632	80102
DL100	+38	349+1144561	4978C	0	113421443	69651149861199720	96946	80122
DL101	+38	365+1144756	4952S	0	97421466	69365150[illegible]199745	97364	80515
DL102	+38	374+1144730	4971S	0	96421483	69403150179199756	97244	80346
DL103	+38	385+1144702	4967U	0	98421505	69444150[illegible]5199773	97468	80225
DL104	+38	396+1144682	4970S	0	101421526	69472150029199786	97013	80156
DL105	+38	406+1144661	4982Y	0	100421545	69503149944199803	97026	80154
DL106	+38	419+1144635	4994S	0	106421570	69540149821199822	96997	80070
DL107	+38	432+1144611	5009S	0	108421595	69574149711199841	97010	80034
DL108	+38	445+1144564	5023S	0	109421620	69013149[illegible]199860	97116	79993
DL109	+38	455+1144558	5037C	0	113421039	69651149[illegible]199875	97069	[illegible]
DL110	+38	467+1144532	5005C	0	110421062	69686149[illegible]7199892	97262	80096
DL111	+38	481+1144504	5992C	0	123421089	69729149464199913	97473	80226
DL112	+38	379+1144702	4982S	0	91421491	69312150485199764	97617	80706
DL113	+38	391+1144813	4988S	0	92421514	69281150570199786	97726	80805
DL114	+38	413+1144832	5000S	0	92421552	69255150649199813	97[illegible]	80427
DL115	+38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL116	+38 448+1144664	5020S	0	91421616	69204150615199665	97993	80962
DL117	+38 468+1144676	5027S	0	94421652	69185150481199894	97896	80845
DL118	+38 488+1144883	5033S	0	92421689	69174150286199923	97729	80655
DL119	+38 510+1144893	5041S	0	90421729	69159150142199955	97028	80524
DL120	+38 528+1144911	5051S	0	90421762	69132150049199982	97602	80455
DL121	+38 548+1144918	5060S	0	91421799	69121149979200011	97568	80421
DL122	+38 568+1144932	5063S	0	95421835	69099149920200040	97528	80354
DL123	+38 586+1144947	5075S	0	92421668	69077149651200060	97546	80329
DL124	+38 607+1144957	5090S	0	92421907	69061149870200096	97576	80407
DL125	+38 629+1144962	5101U	0	94421947	69053149922200130	97798	80494
DL126	+38 700+1145232	5300Y	0	125422069	68055149396200234	99042	81091
DL127	+38 676+1145134	5160Y	0	106422028	68799149778200196	98141	80648
DL128	+38 603+1145241	5243Y	0	125421690	68046150020200091	99272	81514
DL129	+38 601+1145151	5170Y	0	103421689	68778150065200088	98635	81104
DL130	+38 537+1145168	5174Y	0	120421770	68756150257199995	98946	81421
DL131	+38 473+1145212	5278Y	0	116421650	68694149693199902	99664	81779
DL132	+38 504+1145112	5124Y	0	133421711	68839150577199947	98653	81509
DL133	+38 443+1145141	5732Y	0	242421597	68799146975199857101065		81757
DL134	+38 415+1145212	5297Y	0	120421543	68696149921199816	99956	82009
DL135	+38 342+1145223	5248Y	0	126421407	68063150165199709	99845	82072
DL136	+38 263+1145191	5186Y	0	124421262	68734150350199594	99563	81999
DL137	+38 310+1145107	5120B	0	125421352	66054150770199663	99292	81954
DL138	+38 325+1145018	5038C	0	101421383	68984150452199684	98681	81596
DL139	+38 350+1144910	4965S	0	93421433	69141151038199721	98231	81321
DL140	+38 420+1144943	5008Y	0	97421561	69090151205199823	98511	81527
DL141	+38 444+1145021	5032C	0	112421503	68974151110199859	98507	81556
DL142	+38 495+1144956	5037S	0	97421599	69067150666199934	98136	81053
DL143	+38 531+1145026	5070S	0	98421764	68963150334199986	98062	80866
DL144	+38 619+1145034	5087U	0	106421926	68946150251200115	98010	80766
DL145	+38 716+1145057	5140 1T	0	105422105	68910149637200257	97953	80527
DL146	+38 685+1145003	5113Y	0	102422049	68990150026200212	97934	80597
DL147	+38 738+1144907	5191Y	0	94422151	69126149720200289	98264	80673
DL149	+38 575+1144812	5038S	0	94421852	69274149741200051	97291	80134
DL150	+38 494+1144769	5018S	0	97421704	69341149750199932	97043	80025
DL151	+38 445+1144720	4993S	0	97421615	69415149601199860	96930	79997
DL152	+38 517+1144064	5057C	0	98421750	69493149577199960	97003	79853
DL153	+38 597+1144702	5092B	0	101421897	69434149325200083	97164	79897
DL154	+38 675+1144675	5180 1T	0	102422042	69470149210200197	97762	80197
DL155	+38 735+1144663	5248B	0	104422153	69465149172200284	98277	80482
DL156	+38 721+1144760	5171Y	0	106422124	69344149720200264	98121	80590
DL157	+38 658+1144783	5116 1T	0	96422007	69313149705200172	97674	80520
DL158	+38 692+1144561	5252 9T	0	108422078	69630149314200222	98551	80725
DL159	+38 606+1144592	5167B	0	101421917	69595149195200096	97727	80208
DL160	+38 526+1144555	5115C	0	106421771	69655149352199979	97511	80171
DL161	+374592+1143692	5537S	0	137418059	7101014650719702210 1492		82737
DL163	+374574+1143720	5485S	0	123418191	7095014651419712710 1609		82424
DL165	+374617+1143638	5495Y	0	149418273	7108314674719718910 1274		82661
DL166	+374679+1143674	5416Y	0	164418387	7102814771019728010 1404		83494
DL167	+374677+1143571	5558Y	0	152418387	7117914615419727710 1185		82581
DL168	+374665+1143445	5759S	0	165418370	7136414551919725910 2377		82930
DL169	+374597+1143417	6071S	0	220418232	7140914345419715010 3443		82457
DL170	+374517+1143430	5962S	13	176418096	7135514375419704410 2624		82676
DL171	+374740+1143458	5784Y	0	154418508	7134214540619736910 2533		82952
DL172	+374745+1143518	5722Y	0	144418515	7125414572519737610 2205		82052
DL174	+374782+1143562	5641S	0	155418581	7118714563119743010 1491		82406
DL176	+374786+1143275	5507S	0	176419000	7160814709119743610 1403		82677
DL178	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL179	+374819+1143351	5657S	0	193418656 71495146298197484102055	62953
DL180	+374823+1143422	5763S	0	178418663 71391145624197490102370	62642
DL181	+374880+1143174	5433S	0	184418778 71752146531197573100090	81743
DL182	+374901+1143356	5918Y	0	235418809 71484144706197604102797	82649
DL183	+374899+1143476	5947Y	0	211418801 71308144286197601102657	62585
DL184	+374860+1143578	5631Y	0	184418725 71160144955197544102290	62557
DL187	+374939+1143289	5787Y	0	284418882 71580145474197659102284	82825
DL190	+374983+1143524	6228S	0	290418955 71233142648197723103728	82776
DL191	+375013+1143640	6067S	0	259419006 71053144002197767103336	82902
DL193	+375062+1143555	6473S	34	346419100 71184141449197639104535	82838
DL199	+375099+1143712	5904Y	0	297419162 70952145116197893102792	82952
DL200	+375114+1143734	5827Y	0	297419189 70919145046197915102572	82995
DL202	+375214+1143616	6513S	0	504419378 71087141131198061104372	82662
DL205	+38 9+1144375	4830S	0	127420821 69939150244199223 96477	80136
DL206	+38 48+1144470	4830S	0	117420690 69793150415199280 96591	80234
DL207	+38 78+11443804644	2T	0	144420948 69928150545199323 96612	80435
DL208	+38 123+1144454	4861Y	0	128421029 69816150413199389 96770	80318
DL209	+38 86+1144286	4940C	0	137420967 70065150268199335 97423	80711
DL210	+38 41+1144177	5160Y	0	152420887 70227149986199270 98713	81470
DL211	+38 19+1143951	5582Y	0	229420855 70559146621199238 99919	81109
DL212	+38 57+1143794	6296Y	0	433420931 70787142632199293102797	81756
DL213	+38 90+1143900	5758Y	0	275420988 70630145509199341100360	80996
DL214	+38 108+1144005	5445Y	0	207421017 70476147618199367 99495	81131
DL215	+38 81+1144090	5249Y	0	177420964 70352148954199328 99025	81299
DL216	+38 81+1144200	5075Y	0	155420960 70192150049199328 98482	81326
DL218	+38 148+1143827	6150Y	0	414421098 70734143127199426101583	81022
DL219	+38 150+1143918	5734S	0	262421098 70601145636199429100193	80698
DL220	+38 169+1144090	5370Y	0	186421127 70346148590199456 99672	81542
DL221	+38 169+1144200	5098Y	0	212421123 70187150227199456 98750	81575
DL222	+38 167+1144310	4861Y	0	170421115 70027150616199454 97697	80619
DL223	+38 172+11443884	6871T	0	133421122 69912150164199461 95694	80159
DL225	+38 199+1144460	4905C	0	117421169 69506150029199501 95689	80077
DL226	+38 260+11443054	94591	0	129421284 69697149979199590 96936	80196
DL227	+38 279+1144408	4947C	0	119421316 69747149656199617 96805	80051
DL228	+38 237+1144273	4971Y	0	185421246 70078150650199556 97876	81107
DL229	+38 218+1144127	5836Y	0	275421216 70292145596199526100995	81365
DL230	+38 199+11440185	50201	0	199421185 70452147064199501 99945	81373
DL231	+38 213+1143936	5756Y	0	237421214 70572145624199521100280	80605
DL232	+38 240+1143067	6008C	0	292421267 70671144182199560101168	80968
DL234	+38 302+1143092	5976Y	0	240421380 70632144493199651101086	80945
DL235	+38 289+1144000	5600Y	2	187421352 70475146009199632100446	81330
DL236	+38 273+1144074	5715Y	0	163421320 70367146576199609100754	81425
DL237	+38 276+1144181	5655Y	0	327421322 70210146960199613100569	81604
DL238	+38 297+1144306	5024Y	0	167421356 70027150370199644 99018	81139
DL239	+38 351+11444035	62001	0	131421452 69682149654199725 97358	80367
DL240	+38 399+1144475	5055C	0	111421539 69775149537199793 97317	80197
DL241	+38 444+11444105	1010T	0	130421624 69568149770199859 97912	80541
DL242	+38 416+1144307	5451Y	0	175421576 70020148386199818 99069	81452
DL243	+38 350+1144242	5453Y	0	193421456 71110148574199721 99973	81567
DL244	+38 345+1144159	6216Y	0	168421450 70239143353199714102126	81597
DL245	+38 330+1143953	5826C	0	194421448 70541145922199706101 45	81568
DL246	+38 366+1144023	5733Y	0	150421494 70437146315199745101527	81152
DL247	+38 377+1144081	5880Y	0	163421512 70352145358199761101022	81100
DL248	+38 420+1144123	5506C	9	142421590 70289147409197623 99951	81124
DL249	+38 355+1143655	6114Y	0	253421480 70664143087199729101562	80902
DL251	+38 408+1143967	5653C	0	173421574 70517144992199696100272	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL253	+38 412+1144195 6055Y	0	345421573 7018414400199812101176	80869
DL254	+38 475+1144152 5465C	0	146421691 70244147624199904 99353	80659
DL255	+38 497+1144228 5454Y	0	122421729 70132148358199937 99751	81271
DL256	+38 491+1144335 5501Y	0	129421714 69976148152199927100004	81363
DL257	+38 465+1143790 6443Y	0	305421086 70773142023199890102775	81105
DL258	+38 448+1143900 6050Y	0	208421650 70613143952199865101026	80601
DL259	+38 468+1143975 5855Y	0	173421684 70503144932199894100143	80346
DL260	+38 515+1143875 6169Y	17	217421775 70647143565199963101063	80656
DL261	+38 538+1144004 5748Y	0	158421813 70457145595199996 99696	80245
DL262	+38 520+1144074 5589Y	0	138421777 70356146721199970 99351	80427
DL263	+38 531+1144142 5463Y	0	133421795 70256147021199986 99049	80550
DL265	+38 582+1143844 6343Y	0	281421900 70689142443200061102087	80734
DL266	+38 575+1143929 5856Y	0	187421584 70565145167200051100231	80445
DL269	+38 663+1143923 5892Y	0	174422047 70570144449200179 99723	79801
DL270	+38 740+1143524599111T	0	184422193 70711144842200292100938	80636
DL271	+38 730+1143918582811T	0	150422171 70574145069200277 99642	79915
DL272	+38 692+1144026 5604Y	0	141422097 70416146056200222 98576	79635
DL273	+38 604+11439905660T	0	149422066 70472145723200180 98866	79632
DL274	+38 627+114406255600T	0	135421975 70366146718200127 98921	80092
DL275	+38 593+1144025 5628Y	0	145421914 70424146515200077 99204	80154
DL276	+38 711+1144121 5622Y	0	121422128 70276146583200249 99614	80196
DL278	+38 602+1144175540621	0	129421925 70204147917200096 98793	80394
DL282	+38 564+114427452880T	0	136421851 70061149563200034 99295	81595
DL285	+38 562+1144356 5258B	20	124421644 69941149759200031 99207	81418
DL286	+38 546+1144382 5221B	0	153421614 69904149863200008 99110	81456
DL287	+38 531+1144405 5170B	0	128421785 69871150032199986 98892	81316
DL288	+38 516+1144435 5161B	0	122421756 69826149722199964 98329	80646
DL289	+38 504+1144458 5140B	0	116421733 69795149613199947 98040	80625
DL290	+38 492+1144482 5116B	0	116421710 69760149465199929 97663	80350
DL291	+38 560+1144455 5171B	0	138421837 69797149662200029 98599	81100
DL292	+38 613+1144291 5602Y	0	113421941 70034147047200106 99664	80670
DL293	+38 628+1144381 5736Y	94	146421966 69902146579200126102435	81111
DL294	+38 623+1144491 5250C	0	121421952 69741149622200121 99914	81129
DL295	+38 705+114443553930T	0	124422106 69822146596200241 99110	80541
DL296	+38 710+114432655230T	0	130422119 69987147465200248 99216	80594
DL297	+38 687+114423755000T	1	122422080 70110147258200214 98806	80170
DL298	+373818+1144437 5693S	157	260416767 69946144533196024102089	83089
DL299	+373793+1144314 5845S	81	262416725 70128143465195986102449	82696
DL300	+373808+1144186 6147S	166	355416757 70316141594196004104740	83235
DL301	+373802+1144078 6229S	0	252416750 70475141555196001104081	83087
DL302	+373778+1143971 5965Y	0	171416709 70635145122195966102732	82753
DL303	+373781+1143849 5923S	0	166416719 70813143281195970103057	83021
DL304	+373818+1143790 5876S	0	164416790 70886143155196024102413	82542
DL305	+373904+1143769 5825S	0	153416949 709951451141961 101766	82376
DL306	+373849+1143900 5922Y	0	164416843 70731143516196070103251	83195
DL307	+373846+1143978 6072S	0	199416835 70620142557196065103421	82901
DL308	+373838+1144259 5707S	0	204416810 70207144673196055102332	83371
DL309	+373888+1144422 5928S	0	776416897 69965142048196127102526	83363
DL310	+373869+1144343 5618S	0	298416864 70082145348196098102120	83250
DL311	+373921+1144359 5180Y	0	160416960 7095014857196179102925	83416
DL312	+373959+1144406 5070Y	0	155417028 6998214887619623510353	83226
DL313	+373982+1144312 5202S	0	159417074 70122148157196263100851	83211
DL314	+373916+1144264 5594S	0	210416954 70196145644196167101436	83106
DL315	+373900+1144190 5890S	0	285416927 70306143554196144102845	83141
DL316	+373884+1144077 6598S	0	570416902 70472138721196120104772	82836
DL317	+373917+1144015 5904S	0103	116965 70562136522196169105337	82921
DL318	+373927+1143806 605[illegible]	0	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL319	+373984+1143763	5744Y	0	141417098	70930143106196266100960	81510
DL320	+374000+1143840	5801S	5	144417125	70807143175196290101482	81846
DL321	+374020+1143955	5902S	0	160417158	70640143052196319102281	82311
DL322	+373993+1144034	6207S	0	283417105	70531141568196280103729	82841
DL323	+373962+1144101	6376S	0	384417045	70434140518196234104306	82944
DL324	+373994+1144188	5352S	174	541417101	70304139967196280103492	82542
DL325	+374036+1144395	5418S	0	251417171	69996146562196342101211	82983
DL326	+374059+1144246	5278Y	0	172417219	70216147769196376101086	83256
DL327	+374078+1144160	5660S	0	223417257	70342145237196403102103	83022
DL328	+374038+1144066	6138S	0	293417187	70482141744196345103169	82527
DL329	+374071+1143644	5798S	0	135417256	70806143511196393101486	81845
DL330	+374102+1143930	5801Y	0	142417310	70679143407196438101566	81922
DL331	+374166+1143755	5725S	0	129417435	70933144332196531101682	82284
DL332	+374180+1143888	5778S	0	134417456	70737143709196552101537	81964
DL333	+374110+1144073	6026S	0	293417320	70466142512196450102779	82519
DL334	+374114+1144253	5221S	0	150417321	70203148182196455100663	83295
DL335	+374095+1144359	5559S	0	431417282	70046145581196420101472	82942
DL336	+374169+1144493	4773Y	0	121417414	69848149836196536 98221	82062
DL337	+374176+1144471	4800S	0	121417427	69880149902196540 98527	82270
DL338	+374165+1144447	4849Y	0	122417408	69916149925196530 99029	82612
DL339	+374156+1144422	4898Y	0	134417392	69953149909196517 99487	82915
DL340	+374147+1144397	4942Y	0	134417376	69990149744196504 99750	83028
DL341	+374137+1144374	4985Y	0	139417359	70024149492196489 99917	83054
DL342	+374132+1144345	5035S	0	138417351	70067149244196482100147	83112
DL343	+374181+1144278	5138S	0	138417444	70163148612196553100613	83227
DL344	+374154+1144161	5388Y	0	158417398	70537147154196514101348	83139
DL345	+374202+1144126	5551Y	0	178417488	70383146206196584101665	83110
DL346	+374180+1144053	6103S	0	395417450	70494141038196552102727	82306
DL347	+374172+1143999	5889S	0	172417437	70574143293196541102178	82204
DL348	+374242+1143708	5764Y	0	131417574	70860144253196642101865	82536
DL349	+374242+1143805	5712S	0	132417570	70724144516196642101614	82271
DL350	+374256+1144432	4992S	0	135417577	69934150253196663 98782	82539
DL351	+374237+1144376	4959S	0	141417544	70017149779196635 99814	83041
DL352	+374226+1144217	5659S	0	247417533	70251145565196622102136	83115
DL353	+374265+1144224	6014S	0	656417601	70239142751196676102077	82821
DL354	+374265+1144136	6298S	0	736417604	70365140823196676103423	82679
DL355	+374251+1144063	6001S	59	234417581	70476142674196655102696	82524
DL356	+374256+1143998	5970S	39	205417592	70572142002196663102327	82209
DL357	+374301+1143933	5798S	0	164417678	70665144126196726101966	82555
DL358	+374307+1143826	5770S	0	148417693	70822144546196738102114	82545
DL359	+374381+1143759	5695S	0	131417832	70917145607196845101761	82400
DL360	+374473+1143779	5456Y	0	126418002	70883146361196979100750	82257
DL361	+374441+1143632	5431Y	0	134417941	71007146036196933100817	82427
DL362	+374370+1143900	5673S	0	138417807	70697144991196829101554	82545
DL363	+374458+1143955	5601S	0	139417968	70625140656195957102412	83[illegible]
DL364	+374415+1143944	5505S	0	125417887	70585146[illegible]0196895101490	82624
DL365	+374325+1143972	5700S	0	138417721	70607144937196763101819	82510
DL366	+374325+1144061	5999S	70	272417718	70476142000196763102498	82579
DL367	+374370+1144054	5785S	82	229417809	70484144592196835102263	82774
DL368	+374442+1144099	5457S	0	132417933	70415147172196934101408	82976
DL369	+374491+1144131	5956S	0	521418022	70365143191197005102536	82506
DL370	+374401+1144179	5219Y	0	150417554	70312148607196874100650	83149
DL371	+374323+1144168	6110S	0	574417710	70319142295196760103042	82676
DL372	+374324+1144267	5208S	0	150417708	70173148451196762100703	83590
DL373	+374289+1144319	5879S	156	649417642	70096143464196711102162	82625
DL374	+374345+1144389	4771Y	0	112417743	69993150880196792 99996	82566
DL375	+37[illegible]+11[illegible]371	48[illegible]	0	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV / FAA	CBA +1000
DL376	+374345+1144497	4609S	0	112417739	69834150050196792 97232	81624
DL378	+374459+1144446	4650S	0	109417952	69901150970196959 97772	82021
DL379	+374437+1144341	4855S	2	129417915	70059150558196927 99322	82496
DL380	+374480+1144255	5500S	0	286417997	70184146404196990101236	82765
DL381	+374401+1144259	5025Y	0	168417351	70181149689196874100106	83135
DL384	+373763+1143716	5700S	0	155416671	71009143382195944101084	81796
DL385	+373871+1143654	5728S	0	161416893	71095142694196102100702	81327
DL386	+374002+1143635	5681Y	0	132417134	71043143440196292100611	81367
DL387	+374007+1143574	5355B	0	151417148	71206145924196300100022	81919
DL388	+373960+1143486	5223S	0	176417054	71335146738196231 99661	82022
DL389	+373904+1143370	5250S	0	132416965	71511146591196149 99651	82076
DL393	+373984+1143357	5494S	0	156417113	71527145176196266100619	82036
DL394	+374027+1143428	5577D	0	155417190	71420144724196329100681	82014
DL395	+374073+1143516	5642Y	0	156417272	71289145390196396102094	83006
DL396	+374108+1143463	5843S	0	186417339	71365143598196447102143	82400
DL397	+374068+1143634	5560B	0	134417258	71115144907196386100646	82016
DL398	+374083+1143736	5703B	0	128417282	70965143746196410101010	81657
DL399	+374149+1143681	5687B	0	135417406	71012144419196507101436	82174
DL400	+374148+1143618	5667B	0	147417407	71135144575196505101466	82226
DL401	+374214+1143698	5767B	0	138417526	71014144744196602102419	82666
DL402	+374267+1143729	5784S	0	136417623	70966144583196679102341	82749
DL403	+374245+1143620	5670S	0	159417586	71127144492196647103092	83256
DL404	+374236+1143561	6055S	12	198417572	71215143047196634103402	82960
DL408	+374095+1143373	5820S	0	204417318	71498143767196428102135	82486
DL411	+374157+1143529	5836B	0	179417427	71265143874196519102283	82557
DL412	+374191+1143632	5802S	0	155417486	71112144632196568102069	82435
DL413	+374332+1143679	5883S	0	174417745	71037144510196773103105	83214
DL414	+374361+1143605	5853S	0	161417801	71144144906196816102078	82676
DL415	+374410+1143068	6039S	0	264417889	71049143576196886103330	82997
DL416	+374486+1143587	5838S	0	156417959	71166144437196940102443	82587
DL417	+374491+1143409	5865S	0	163418046	71294143995197005102378	82468
DL418	+374402+1143521	6122S	0	225417660	71265142507196876103251	82596
DL422	+373729+1144435	6002S	111	366416692	69953142416195895103013	83019
DL423	+373717+1144137	5865S	0	195416590	70377143557195677102876	83001
DL424	+373724+1144049	6026Y	0	179416607	70521142364195688103213	82637
DL425	+375290+1145506	5829S	0	227419434	66514145235198157101938	82284
DL426	+375257+1145305	5422S	0	172419398	66609147154198123100059	81736
DL427	+375296+1145382	6061S	0	622419468	66495142705198180101569	81519
DL428	+375345+1145288	5113S	0	142419561	66630110725198252 [illegible]	82297
DL429	+375384+1145392	5712S	0	224419630	66670145965198309101415	82157
DL430	+375401+1145298	5094Y	0	161419065	66613149956198334 99572	82359
DL431	+375324+1145488	5835S	0	270419516	68336145415198221102110	82475
DL432	+375382+1145477	5915S	0	263419624	66352144772198530102136	82225
DL433	+375436+1145272	5004Y	0	116419730	66650150079198385 99501	82291
DL434	+375451+1145296	5134Y	0	121419757	66614149761198407 99671	82281
DL435	+375456+1145320	5175Y	0	118419769	66579149571198417 99856	8252[illegible]
DL436	+375468+1145344	5193Y	0	123419787	66543149575198432100015	82426
DL437	+375477+1145370	5224Y	0	144419803	66505149506198445100227	82555
DL438	+375485+1145396	5257Y	0	122419817	66466149369198457100388	82586
DL439	+375487+1145421	5299Y	0	114419819	66425149061198459 [illegible]0477	82547
DL440	+375480+1145456	5355Y	0	144419806	66387146654198449100631	82537
DL441	+375483+1145477	5421Y	0	153419816	66348148147198454100713	82376
DL442	+375490+1145503	5423Y	0	144419822	66309148011198466100675	82525
DL443	+375514+1145340	5142Y	0	125419860	66547150046198505 99971	82558
DL444	+375600+1145321	5245S	0	123420032	66571149492198625100229	82465
DL445	+375560+1145411	5536S	0	125419992	66440147596198595101106	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL453	+375312+1145229	51730	50	115419502	6871814960919820410089		82611
DL454	+375295+1145110	47960	0	109419475	6893151795196179	96750	82502
DL455	+375363+1145144	48770	0	108419599	68841151361198276	99000	82474
DL456	+375303+1145024	47540	0	95419493	69019151309198191	97856	81736
DL457	+375350+1144925	4720S	0	87419583	69162151194198259	97356	81342
DL458	+375262+1144923	4675S	0	88419420	69169151469198131	97354	81496
DL459	+375313+1144836	4647S	0	88419517	69294150943198205	96520	80756
DL460	+375260+1144065	4624S	0	90419425	69547149753198128	95160	79459
DL461	+375308+1144006	46360	0	95419516	69632149735198196	95166	79449
DL462	+375310+1144515	46330	0	110419523	69764149606198201	95205	79513
DL463	+375388+1145023	48110	0	95419650	69017150947198315	97908	81594
DL464	+375426+1145250	5038S	1	116419712	68683150422198376	99464	82396
DL465	+375419+1145223	4993S	0	116419700	68723150916198360	99545	82631
DL466	+375416+1145197	49630	0	111419696	68761151190198356	99536	82719
DL467	+375432+1145174	4954S	0	111419726	68794151136198379	99370	82595
DL468	+375447+1145151	4939S	0	108419755	68827151217198401	99297	82559
DL469	+375464+1145135	49530	0	108419787	68850151239198426	99426	82645
DL470	+375464+1145097	4896S	0	110419788	68905151501198426	99151	82562
DL471	+375455+1145068	4860S	0	103419772	68946151479198413	98603	82331
DL472	+375452+1145040	4836S	0	105419768	68989151194198409	98297	81907
DL473	+375446+1145012	480120T	0	98419757	69031151150198400	97940	81625
DL474	+375445+1144986	4784S	0	95419756	69069151097198396	97720	81498
DL475	+375441+1144956	4758S	0	92419750	69113151225198392	97610	81474
DL476	+375438+1144929	4742S	0	90419745	69153151290198388	97529	81445
DL477	+375435+1144906	472601	0	89419741	69186151331198384	97442	81405
DL478	+375431+1144876	4711S	0	88419734	69226151314198378	97271	81291
DL479	+375428+1144851	4697S	0	88419730	69267151235198373	97064	81132
DL480	+375424+1144824	4676S	0	89419723	69307151144198367	96781	80922
DL481	+375422+1144798	466401	0	89419720	69345151034198365	96562	80745
DL482	+375419+1144770	4655S	0	90419716	69386150660198360	96307	80520
DL483	+375414+1144718	46489T	0	91419708	69463150346198353	95750	79964
DL484	+375409+1144690	4645S	0	95419700	69504150110198345	95508	79760
DL485	+375407+1144666	4614S	0	93419697	69539149976198343	95337	79590
DL486	+375404+1144638	4648S	0	95419693	69581149783198338	95186	79426
DL487	+375399+1144608	46499T	0	96419684	69625149652198331	95081	79316
DL488	+375396+1144574	4650S	0	102419680	69675149562198327	94995	79237
DL489	+375394+1144553	4649S	0	102419677	69706149541198323	94968	79213
DL490	+375392+1144530	4649S	0	104419674	69739149543198321	94973	79221
DL491	+375386+1144501	46489T	0	113419664	69782149577198312	95016	79272
DL492	+375378+1144500	46480	0	110419649	69775149596198300	95036	79256
DL493	+375545+1144528	4660S	0	106419957	69735149416198545	94916	79060
DL494	+375461+1144594	46630	0	98419800	69642149320198422	94857	79081
DL495	+375266+1144762	4621S	0	88419433	69405151063198137	95513	79641
DL496	+375286+1144755	4623S	0	86419470	69414150213198169	95550	79672
DL497	+375307+1144749	4625S	0	89419509	69426150254198197	95593	79697
DL498	+375329+1144743	4630S	0	89419550	69430150292198229	95636	79735
DL499	+375350+1144736	4634S	0	90419589	69439150315198259	95665	79750
DL500	+375372+1144730	4640S	0	90419630	69447150336198291	95710	79774
DL501	+375392+1144724	4645S	0	90419667	69455150344198321	95737	79784
DL502	+375430+1144705	4652S	0	92419746	69481150240198352	95645	79670
DL503	+375453+1144695	4654S	0	91419781	69495150189198410	95566	79789
DL504	+375473+1144684	4658S	0	94419819	69510150107198439	95523	79715
DL505	+375493+1144073	4660S	0	96419856	69525150062198469	95488	79659
DL506	+375512+1144063	4669S	0	93419892	69539150004198496	95407	79615
DL507	+375531+1144052	4674S	0	94419927	69554149961198524	95424	79576
DL508	+375553+1144041	4679S	0	96419966	6957014994198556	95371	79559
DL509	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	F.A.	CBA +1000
DL510	+375593+1144620	4690S	0	99420043	695991497911986 15	95314	79417
DL511	+375612+1144610	4699S	0	98420078	696121497081986 42	95287	79356
DL512	+375633+1144599	4705S	0	98420118	696281496491986 73	95255	79305
DL513	+375652+1144589	4716S	0	99420153	696411495621987 01	95187	79221
DL514	+375672+1144579	4715S	0	101420190	696551495341987 30	95176	79196
DL515	+375692+1144568	4717S	0	103420228	696701495291987 59	95161	79175
DL516	+375711+1144558	4720S	0	105420263	696841495091987 87	95141	79146
DL517	+375731+1144547	4732S	0	103420301	696991494661988 16	95162	79140
DL518	+375752+1144536	4742S	0	104420340	697151494151988 47	95195	79125
DL519	+375771+1144526	4741S	0	106420375	697281494491988 75	95191	79127
DL520	+375791+1144515	4745S	0	108420413	697441494691989 04	95220	79144
DL521	+375811+1144505	4753S	0	109420450	697571494751989 33	95272	79170
DL522	+375912+1144516	4765S	0	109420637	697371498951990 80	95844	79652
DL523	+375941+1144530	4798S	0	107420690	697151500651991 23	96095	79838
DL524	+375965+1144547	4810S	0	107420739	696891502051991 63	96309	80010
DL525	+375901+1144542	4799S	0	104420615	696991496921990 65	95906	79672
DL527	+375918+1144594	4801S	0	100420645	696221501571990 90	96249	79974
DL528	+375910+1144568	4795S	0	102420631	696611500251990 76	96073	79821
DL529	+375927+1144620	4804S	0	100420661	695841502371991 02	96344	80059
DL530	+375936+1144646	4808S	0	102420676	695461502711991 16	96403	80106
DL531	+375945+1144672	4813S	0	97420692	695071502751991 29	96441	80122
DL532	+375952+1144696	4816S	0	97420704	694711503221991 39	96506	80177
DL533	+375961+1144723	4822S	0	96420720	694311503071991 52	96614	80264
DL534	+375969+1144748	4826S	0	102420734	693951505051991 64	96758	80400
DL535	+375979+1144774	4831S	0	97420751	693561507451991 79	97030	80650
DL536	+375987+1144799	4835S	0	100420765	693191510541991 91	97356	80975
DL537	+375996+1144826	4830S	0	108420781	692791513701992 04	97706	81311
DL538	+375940+1144679	4824S	0	105420676	692041516051991 22	98082	81735
DL539	+375932+1144770	4815S	0	98420665	693641505971991 16	96090	80476
DL540	+375878+1144873	4805S	0	103420561	692101515581990 31	97746	81401
DL541	+375846+1144779	4766S	0	93420505	693551505281989 84	96584	81354
DL542	+375860+1144688	4793S	0	95420571	694861502921990 34	96365	80112
DL543	+375820+1144617	4771S	0	96420463	695931496931989 46	95846	79676
DL544	+375795+1144685	4762S	0	93420414	694941501441989 09	96049	79901
DL545	+375772+1144767	4768S	0	92420369	693751504341988 76	96404	80261
DL546	+375801+1144869	4762S	0	98420419	692251515711989 19	97456	81244
DL547	+375727+1144879	4771S	0	96420282	692131512771988 10	97386	81209
DL548	+375724+1144613	4733S	0	95420298	695591496621988 06	95597	7955
DL549	+375681+1144775	4732S	0	92420200	693681502711987 43	96499	80452
DL550	+375642+1144871	4729S	0	98420125	692291515021986 46	97320	81209
DL551	+375636+1144693	4711S	0	93420120	695041501611986 77	95818	79883
DL552	+375609+1144809	4711S	0	92420066	693211519351986 36	96790	80814
DL553	+375586+1144908	4711S	0	101420020	691771515971986 04	97326	81391
DL554	+375531+1144757	4687S	0	90419923	694011508311985 24	96416	80526
DL555	+375526+1144886	4747S	0	89419916	692151514071985 16	97564	81462
DL556	+375476+1144794	4675S	0	91419824	693491512811984 46	96790	80936
DL557	+375502+1145005	4738S	0	107419861	690391514041984 81	97981	81759
DL558	+375562+1144993	4734S	0	136419973	690531518011985 70	97762	81772
DL559	+375621+1144985	4758S	0	138420082	690631515151986 55	97937	81816
DL560	+375702+1144989	4859S	0	127420232	690551514671987 73	98422	81477
DL561	+375746+1144985	4882S	0	112420313	690571515121988 38	98614	81577
DL562	+375981+1145030	5019S	0	115420766	689811504871991 81	98540	81534
DL563	+375906+1144977	4909S	0	109420605	690621511941990 72	98321	81665
DL564	+375818+1144973	4861S	0	109420447	690641515161989 43	98498	81959
DL566	+375970+1145162	5332S	0	155420721	687891489441991 66	99959	81926
DL567	+375997+1145003	5080S	0	127420807	688971505951992 75	99029	81667
DL568	+3759[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM / EAST UTM	OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL569	+375820+1145097	5064U	0	120420446	66890150108198946	99008	81788
DL570	+375778+1145189	5245S	0	132420365	68757149356198685	99833	82076
DL571	+375760+1145088	5059U	0	115420336	68906150291198859	98959	81849
DL572	+375704+1145047	5436U	0	241420233	68968147919198777	100302	82003
DL573	+375722+1145231	5271S	0	163420260	68696149196198603	100001	82184
DL574	+375686+1145132	5251U	0	112420197	68645149034198750	99702	81964
DL575	+375650+1145249	5210S	11	124420127	68675149723198698	100057	82422
DL576	+375620+1145080	5812U	228	563420077	68924145114196654	101161	82129
DL577	+375600+1145164	5695U	0	287420037	68801145960198625	100940	81803
DL578	+375542+1145244	5078S	0	130419927	68687150235198540	99485	82295
DL579	+375529+1145196	5254U	0	108419905	68757148439198521	99305	81553
DL580	+375525+1145076	5079U	0	132419901	68935149701198515	98985	81794
DL582	+374570+1144778	4580U	0	85418145	69412149339197121	95319	79783
DL583	+374578+1144596	4601U	0	88418166	69079149595197133	95762	80157
DL584	+374616+1144698	4582S	0	85418233	69527149513197186	95406	79903
DL585	+374653+1144604	4579U	0	85418298	69370149301197242	95151	79618
DL586	+374500+1144861	4580S	0	92418013	69293149458197019	95555	80026
DL587	+374522+1144865	4580S	0	91418056	69286149511197051	95561	80031
DL588	+374543+1144870	4580S	0	92418092	69278149541197081	95561	80032
DL589	+374563+1144874	4581S	0	90418129	69271149556197111	95556	80022
DL590	+374585+1144879	4580S	0	89418170	69265149616197143	95574	80042
DL591	+374609+1144882	4580S	0	89418216	69257149657197177	95561	80049
DL592	+374627+1144889	4580S	0	90418247	69246149721197204	95619	80068
DL593	+374646+1144894	4580S	0	89418286	69238149508197234	95675	80143
DL594	+374669+1144896	4580S	0	89418324	69231149865197265	95723	80191
DL595	+374691+1144902	4580S	0	89418365	69224149869197296	95693	80161
DL596	+374712+1144917	4581S	0	91418403	69202150171197326	95990	80465
DL597	+374734+1144910	4581S	0	90418444	69211150163197360	95914	80383
DL598	+374755+1144904	4583S	0	89418463	69219150157197391	95896	80554
DL599	+374775+1144899	4583S	0	88418520	69225150159197420	95869	80525
DL600	+374797+1144893	4582S	0	88418561	69235150147197452	95615	80275
DL601	+374818+1144887	4583S	0	87418600	69241150179197483	95321	80277
DL602	+374841+1144881	4584S	0	87418643	69249150205197510	95826	80250
DL603	+374861+1144875	4565S	0	87418686	69257150226197545	95834	80242
DL604	+374883+1144869	4588S	0	86418721	69265150208197577	95808	80245
DL605	+374907+1144869	4566S	0	87418765	69264150366197613	95911	80357
DL606	+374933+1144856	4567S	0	86418814	69281150255197651	95752	80193
DL607	+374955+1144850	4587S	0	86418855	69289150160197683	95645	80086
DL608	+374976+1144844	4587S	0	86418894	69297150236197715	95692	80133
DL609	+374998+1144836	4589S	0	87418935	69305150227197745	95668	80135
DL610	+375019+1144832	4593S	0	84418974	69313150285197776	95734	80152
DL611	+375046+1144826	4596S	0	84419024	69321150196197816	95633	80041
DL612	+375068+1144820	4598S	0	85419065	69326150094197846	95517	79921
DL613	+375089+1144813	4601S	0	85419104	69336149955197876	95376	79766
DL614	+375111+1144809	4603S	0	85419145	69343149915197910	95322	79706
DL615	+375133+1144802	4605S	0	85419186	69352149920197942	95314	79692
DL616	+375157+1144798	4618S	0	86419230	69363149946197977	95335	79704
DL617	+375178+1144789	4611S	0	86419269	69369149979198009	95364	79723
DL618	+375200+1144783	4616S	0	86419310	69377150055198041	95416	79765
DL619	+375222+1144775	4617S	0	86419351	69386150275198073	95451	79789
DL620	+375246+1144769	4616S	0	87419396	69395150121198108	95471	79614
DL621	+375231+1144531	4626S	0	100419376	69745149947198066	95536	79755
DL622	+375204+1144695	4629U	0	92419324	69561149717199046	95148	79183
DL623	+375176+1144696	4610U	0	87419269	69520149556198605	94966	79316
DL624	+375003+1144750	4596U	0	83418947	69434149439197752	94938	79345
DL625	+374989+1144849	4597U	0	87419925	69553149433197732	94962	79571
DL626	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL627	+375063+1144591	4606S	0	90419064	69665149812197841	95317	79696
DL628	+375080+1144702	4606S	0	85419091	69501149379197865	94660	79236
DL629	+375133+1144604	4613U	0	90419193	69642149724197942	95194	79550
DL630	+374946+1144789	4591S	0	85418840	69379149579197670	95115	79541
DL631	+374908+1144629	4591S	0	87418776	69615149433197614	95024	79452
DL632	+374914+1144522	4612S	0	93418791	69772150201197623	95981	80345
DL633	+374891+1144736	4593U	0	84418740	69459149186197589	94820	79239
DL634	+374827+1144792	4562S	0	84418620	69380149387197496	95012	79406
DL635	+374778+1144722	4562S	0	84418532	69485149210197424	94926	79302
DL636	+374760+1144813	4560U	0	85418496	69352149427197398	95131	79594
DL637	+374751+1144654	4564S	0	86418484	69586149206197385	95158	79609
DL638	+374829+1144637	4566S	0	86418629	69607149400197498	95059	79503
DL639	+374829+1144524	4605S	0	92418633	69773150000197498	95838	80224
DL640	+374747+1144565	4602S	0	89418480	69717149617197379	95546	79939
DL641	+374709+1144691	4560S	0	88418379	69240149896197323	95074	80141
DL642	+374706+1144863	4580S	0	87418394	69281149642197320	95425	79891
DL643	+374703+1144836	4580S	0	85418389	69321149417197315	95206	79670
DL644	+374700+1144809	4580S	0	85418385	69361149505197310	95096	79560
DL645	+374696+1144781	4580S	0	84418378	69402149279197305	95076	79539
DL646	+374693+1144755	4580S	0	84418374	69440149310197300	95113	79576
DL647	+374690+1144729	4580S	0	85418369	69478149341197296	95147	79611
DL648	+374687+1144702	4562U	0	85418364	69516149396197291	95227	79684
DL649	+374684+1144675	4583S	0	85418360	69556149453197286	95295	79749
DL650	+374681+1144640	4585S	0	86418355	69598149519197283	95365	79833
DL651	+374678+1144620	4590S	0	86418351	69639149568197278	95485	79916
DL652	+374674+1144593	4597S	0	87418344	69679149627197273	95616	80024
DL653	+374671+1144566	4605S	0	88418340	69719149676197268	95746	80126
DL654	+374668+1144539	4613S	0	89418335	69756149771197264	95919	8027[illegible]
DL655	+374664+1144512	4633S	0	90418328	69798149826197258	96169	80457
DL656	+374548+1144901	4654U	0	97418097	69100150213197089	96922	81146
DL657	+374640+1144980	4628U	0	94418268	69112150015197223	96946	81255
DL658	+374727+1144968	4610U	0	93418429	69126150776197350	96608	81177
DL659	+374813+1144972	4616U	0	92418588	69116151026197475	96491	81337
DL660	+374899+1144983	4640U	0	92418747	69097151452197601	97517	81784
DL661	+374986+1144995	4602U	0	92418907	69075151539197728	97680	81875
DL662	+375072+1145007	4683U	0	92419066	69054151728197853	97945	82065
DL663	+375130+1145014	4691U	0	94419173	69041151742197936	97950	82045
DL664	+375215+1145018	4707U	0	95419330	69032151539198063	97792	81826
DL665	+375199+1144895	4645S	0	87419305	69213151656198039	97321	81565
DL666	+375130+1144916	4635U	0	88419176	69155151496197936	97179	81459
DL667	+375064+1144911	4622U	0	87419054	69195151394197841	97049	81372
DL668	+374978+1144910	4603S	0	88418895	69200151192197716	96794	81162
DL669	+374519+1145093	4760S	0	103418040	68951150326197046	96069	81937
DL670	+374596+1145151	4833U	0	109418170	68865150[illegible]29197150	96357	81962
DL671	+374639+1145051	4691U	0	104418264	69008150903197221	97526	81932
DL672	+374672+1145107	4748S	0	108418323	68924150658197270	96281	82195
DL673	+374683+1145219	5072U	0	137418339	68759148625197286	99372	82210
DL674	+374735+1145168	4765S	0	125418437	68832150954197362	98435	82308
DL675	+374782+1145217	4835S	0	131418522	68756150632197430	99364	81944
DL676	+374868+1145236	4891U	0	131418674	68727151591197559	[illegible]	82329
DL677	+374809+1145092	4712U	0	106418560	68940151241197456	[illegible]	82103
DL678	+374754+1145075	4679U	0	128418475	68966151142197389	97626	81976
DL679	+374885+1145049	4678U	0	100418719	69014151295197580	97738	81653
DL680	+374875+1145161	4865U	5	110418696	68832150704197566	98358	82064
DL682	+374953+1145104	4702S	0	101418043	68917150780197680	97915	81775
DL683	+371980+1145216	4595S	0	100418889	68760151419197720	98497	81919
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN / ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM / EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1[illegible]
DL685	+375050+1145147 4817S	0	102419020 68650150550197821	98061	81733
DL686	+375139+1145165 4848L	0	108419184 68619150729197952	98462	81975
DL687	+375207+1145116 4862S	0	109419312 68688151221198651	98362	82095
DL688	+375245+1145199 4910S	0	117419379 68765150765198106	98667	82237
DL690	+375266+1144454 4623Y	0	116419444 69856150439198137	95909	80157
DL691	+375250+1144534 4746C	0	116419419 70133150756198113	97457	81399
DL692	+375319+1144407 4657C	0	120419544 69923150536198214	96148	80384
DL693	+375385+1144474 4647C	0	113419063 69822149656198311	95077	79340
DL694	+375381+1144445 4647C	0	120419057 69864149620198305	95248	79516
DL695	+375376+114441946519T	0	125419049 69903150497198298	95579	79636
DL696	+375379+1144387 4682C	0	123419055 69950150460198302	96224	80374
DL697	+375380+1144357 4710C	0	124419058 69993150771198303	96793	80652
DL698	+375380+114432247401T	0	128419059 70045151003198303	97364	81304
DL699	+375361+1144303 4772C	0	128419025 70073151042198276	97575	81526
DL700	+375335+1144293 4789Y	0	127419577 70089151059198236	97890	81685
DL701	+375331+1144260 4834Y	0	132419571 70129151013198232	98274	81913
DL702	+375325+1144240 4873Y	0	136419557 70166150771198220	98411	81928
DL703	+375313+1144215 4921Y	0	140419539 70205150481198205	98587	[illegible]
DL704	+375305+1144188 4974Y	0	147419526 70245150864198194	98681	81653
DL705	+375299+1144162 5024Y	0	151419515 70283149629198185	98925	81941
DL706	+375292+1144135 5075Y	0	160419503 70323149585198175	99173	82026
DL707	+375284+1144109 5126Y	0	165419490 70361149435198163	99514	82195
DL708	+375274+1144083 5177Y	0	175419472 70400149313198148	99887	82404
DL709	+375264+1144063 5219Y	9	162419454 70430149236198134100220		82590
DL710	+375255+1144037 5265C	0	167419439 70468148964198121100394		82605
DL711	+375284+1143942 5462C	0	240419496 70660147774198163101014		82520
DL712	+375313+1143836 5769Y	0	272419553 70757145713198205101991		82516
DL713	+375270+1143768 5972Y	0	327419476 70862144475198143102540		82496
DL714	+375372+1143767 6107Y	0	350419665 70859143913198291103100		82620
DL715	+375381+1143956 5596Y	0	216419075 70576146652198305101156		82538
DL716	+375381+1143880 5806Y	0	254419677 70693145446198305101785		82237
DL719	+375307+1144134 5040Y	0	192419005 70522150175198255	99351	82553
DL720	+375404+1144146 5063Y	0	197419710 70302150048198336	99359	82287
DL721	+375370+1144217 4890Y	0	153419045 70195150052198289	98363	81658
DL722	+375440+1144052 5315C	36	216419780 70438148544198391100274		82596
DL723	+375462+1143939 5829Y	0	227419825 70602145247198423101064		82033
DL725	+375496+1143810 6216Y	0	286419692 70781143047198473103078		82105
DL726	+375523+1143919 6174Y	0	296419939 70630142006198513102405		81645
DL735	+375730+1143881 5722Y	0	269420323 70675140665198815101069		82596
DL736	+375732+1143953 5560C	0	253420324 70569147031198818100591		81462
DL739	+375776+1143760 6059C	0	314420412 70681144735198882102175		81623
DL740	+375795+1143876 5775Y	0	280420411 70679145491198909100935		81476
DL741	+375807+1143999 5442Y	0	237420461 70496147613198927100103		81749
DL742	+375775+1144131 5220Y	0	197420398 70355149324198880	99571	81365
DL743	+375834+1144109 5879Y	0	021420507 70378144422198960100734		81555
DL744	+375881+1144125 5160Y	0	181420593 70513149263199035	98613	81394
DL745	+375896+1144041 5308Y	0	184420624 70433148137199057	99335	81614
DL746	+375915+1143995 5584C	0	229420063 70575140615199085100082		81265
DL747	+375874+114391655450T	0	243420588 70617146505199025100034		81257
DL749	+375964+1143841 5979Y	0	247420757 70722148259199157101575		81205
DL750	+375991+1144056 5269	0	135420799 70009146265199196	98766	[illegible]
DL751	+375946+1144113 5101[illegible]	0	159420713 70241149576199130	98253	81014
DL752	+375994+1144239 4963Y	0	142420798 70138149972199201	97409	80624
DL753	+375954+1144240 4962Y	0	139420724 70139149756199142	97304	80525
DL754	+375906+1144311 4866Y	0	131420636 70037149066199075	96404	79931
DL755	+375933+1144370 4815Y	0	131420681 69919149932199112	96131	[illegible]
DL756	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	BA +1000
DL757	+375891+1144493	4777S	0	109420598	697711497381990 50	95644	79460
DL758	+375876+1144470	4772U	0	111420575	696051496741990 31	95551	79366
DL759	+375853+1144481	4764S	0	109420529	697911495591989 95	95396	79256
DL760	+375831+1144490	4756S	0	109420488	697761495951989 63	95301	79166
DL761	+375859+1144360	4798 9T	0	127420544	699671496351990 03	95794	79555
DL762	+375864+1144236	4961Y	0	142420558	701491497241990 11	97397	80616
DL763	+375805+1144339	4803 1T	0	132420445	700011496541989 24	96125	79675
DL764	+375787+1144422	4746S	0	119420409	699601495531988 96	95319	79250
DL765	+375701+1144439	4720S	0	121420249	696591494571987 73	95114	79126
DL766	+375727+1144333	4794 0T	0	133420301	700131500601986 10	96360	80156
DL767	+375789+1144224	4966S	0	150420419	701791494351989 01	97657	81091
DL768	+375727+1144204	4963Y	0	170420306	702021501961986 10	98261	81455
DL769	+375653+1144219	4909Y	0	166420168	701831507301987 02	98226	81069
DL770	+375648+1144303	4764 1T	0	149420156	700601507691986 95	96997	80667
DL771	+375636+1144392	4698Y	0	131420130	699311497171986 77	95254	79506
DL772	+375625+1144481	4711Y	0	108420197	696311493291986 61	95003	79083
DL773	+375542+1144420	4677S	0	124419956	699941495761985 40	95653	79225
DL774	+375528+1144337	4670S	0	151419933	701015126891985 20	95719	79941
DL775	+375579+1144276	4731 0T	0	177420029	701031512051985 94	97133	81170
DL776	+375491+1144254	4754 9T	0	186419967	701391511221984 66	97719	81676
DL777	+375472+1144481	4668S	0	113419624	696061494411984 36	94696	79131
DL779	+375456+1144374	4667S	0	142419802	699651502561984 17	95762	79956
DL770	+375420+1144303	4746 1T	0	138419734	700711510681983 62	97390	81541
DL780	+38 762+1144385	5618Y	0	108422213	699901470062003 24	09556	80502
DL781	+38 761+1144303	5775Y	0	126422214	700101455642003 23	100693	81122
DL782	+38 771+1144225	5627Y	0	124422236	701231465582003 36	99976	79911
DL783	+38 815+1144274	5687Y	0	126422315	700501463852004 02	99566	80235
DL784	+38 807+1144421	5856Y	0	146422295	696351454792003 96	100204	80375
DL785	+38 819+1144491	5702Y	0	122422315	697331465372004 06	99794	80466
DL786	+38 873+1144352	5747Y	10	122422420	699331463492004 87	99947	80477
DL787	+38 922+1144445	5665Y	0	136422507	697951466892005 59	99635	80581
DL788	+38 755+1144039	5712U	0	128422213	703961454502003 14	93694	79591
DL789	+38 798+1144118	5761U	0	139422282	702791453862003 71	99233	7971-
DL790	+38 794+1143968	5762Y	0	146422286	704981450862003 71	99738	80231
DL793	+38 834+1143876	5647Y	0	202422365	706271461122004 36	100712	80972
DL795	+38 930+1143983	6304Y	0	155422539	704701433502005 70	102142	80795
DL800	+38 892+1144276	6034Y	0	149422458	700451447132005 15	100966	80555
DL801	+381022+1144485	5749U	0	117422691	697351462952007 05	99697	80275
DL803	+38 997+1144409	6073Y	0	150422647	699571447942006 66	101264	80726
DL804	+38 963+1144323	6117Y	0	164422587	699711447062006 19	101601	80566
DL805	+381005+1144263	6658Y	0	356422657	701571411232006 80	103199	80787
DL811	+38 957+1143703	6153Y	0	124422596	707461435532006 91	101466	80672
DL819	+381060+1144425	5953Y	0	125422778	696011457342007 72	100989	80614
DL820	+381149+1144439	6165Y	79	161422927	697941437862007 89	102957	80161
DL826	+381213+1144420	5872Y	0	125423006	690101453312009 84	100186	80281
DL829	+375339+1147674	6509S	0	504419607	709651421831972 44	100465	82760
DL839	+374176+1145261	5031Y	0	121417400	687191486121965 36	99283	82205
DL840	+374174+1145289	5073Y	0	127417396	686741460851965 43	99465	82309
DL841	+374173+1145315	5111Y	0	133417393	686401481661965 41	99767	82426
DL842	+374175+1145342	5157Y	0	139417396	686011470561965 45	99965	825
DL843	+374177+1145365	5191Y	0	159417399	685661471661965 46	100170	82626
DL844	+374180+1145395	5233Y	0	182417403	685221477661965 61	100483	82917
DL845	+374179+1145423	5266U	0	196417400	684811477591965 51	100789	83026
DL846	+374181+1145454	5330Y	0	220417403	684351475101965 53	101125	83150
DL847	+374180+1145482	5372Y	0	232417400	683941473321965 52	101332	83267
DL848	+374186+1145509	5412U	0	223417411	683561471241965 61	101497	83267
DL8[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV / F.A.	CBA +1000
DL850	+374090+1145431	5564S	0	167417236	68473146010196421101396	62784
DL851	+374093+1145303	5055Y	0	145417285	68661146457196425 99606	62509
DL855	+373952+1145313	5120Y	0	115416984	68652147895196220 99861	62513
DL856	+373971+1145418	5310S	0	143417016	68497146009196247100536	62506
DL857	+373960+1145542	5599S	0	196416992	68315145330196231101794	82693
DL858	+373872+1145328	5050Y	0	118416636	68633148205196103 99622	62516
DL859	+373891+1145439	5268S	0	121416667	68469147650196130101309	63462
DL860	+373936+1145665	5638S	45	280416943	68135148346196196101215	62510
DL861	+373820+1145273	4974S	0	101416742	68716148657196027 98681	61977
DL862	+373802+1145383	5059Y	0	105416765	68555147479196001 99689	61939
DL863	+373857+1145489	5211S	0	120416603	68397147608196081100769	63116
DL864	+373779+1145408	5113Y	0	110416658	68387147635195967 99187	61656
DL865	+373856+1145596	5208B	0	141416797	68240145610196080100299	62472
DL866	+373866+1145686	5247S	0	186416613	68104147055196095100363	62653
DL867	+373821+1145714	5155S	0	141416729	68062147227196029 99713	62272
DL868	+373880+1145791	5219S	0	199416630	67952147424196115100433	62631
DL869	+373820+1145624	5072S	0	138416724	67906147779196027 99466	62312
DL870	+373896+1145886	5162S	0	209416662	67612147574196136100626	62629
DL871	+373820+1145934	5058S	0	123416720	67744147787196027 99362	62233
DL874	+374043+1145577	6018S	0	332417144	68260142435196352102723	62536
DL878	+374221+1145343	5304S	0	147417461	68597147023196612100579	62566
DL881	+374310+1145274	5012S	0	150417648	68686149063196741 99476	62526
DL882	+374313+1145376	5308S	12	156417650	66544147624196746100433	62497
DL883	+374373+1145265	4980	0	145417764	68705149277196834 99311	62476
DL886	+374434+1145272	5034S	0	132417677	68692149080196925 99533	82495
DL887	+374430+1145330	5132S	0	152417868	68607148544196916 99926	62574
DL888	+374414+1145423	5294S	0	207417835	68471147729196893100656	62606
DL889	+374432+1145514	5614S	0	197417665	68337146130196920102047	63096
DL890	+374465+1145379	5202S	0	164417931	68534148175196966100165	62557
DL891	+374495+1145467	5399Y	0	228417983	68403147306197012101106	62920
DL892	+373619+1144335	4866U	0	108416755	69364144472196026 97664	61387
DL893	+373907+1144634	4720U	0	103416917	69358144742196154 97607	61312
DL894	+373996+1144635	4668U	0	101417082	69353148677196284 96523	60793
DL895	+374083+1144634	4659U	0	96417243	69351148975196410 96220	60494
DL896	+374170+1144835	4617U	0	94417404	69363149154196536 96067	60415
DL897	+374193+1144834	4612S	0	95417446	69346149203196571 96035	60400
DL898	+374213+1144833	4609U	0	93417485	69346149235196602 96006	60361
DL899	+374235+1144832	4602S	0	94417524	69347149258196632 95934	60352
DL900	+374259+1144831	4596U	0	94417568	69347149284196667 95869	60265
DL901	+374289+1144828	4593U	0	93417624	69351149269196711 95600	60225
DL902	+374315+1144829	4590S	0	94417672	69348149295196746 95742	60160
DL903	+374347+1144829	4567U	0	92417731	69347149316196795 95688	60135
DL904	+374369+1144834	4566S	0	93417772	69338149320196827 95651	60112
DL905	+374391+1144839	4564S	0	93417812	69330149359196859 95659	60097
DL906	+374411+1144842	4564S	0	92417849	69325149381196889 95631	60069
DL907	+374432+1144848	4564S	0	92417886	69315149414196920 95634	60091
DL908	+374454+1144851	4581S	0	93417928	69310149117196952 95576	60045
DL909	+374476+1144856	4580S	0	93417967	69301149436196984 95548	60020
DL911	+374167+1144517	4735S	0	111417409	69913149635196533 97663	61424
DL912	+374169+1144548	4660S	0	109417412	69767149351196536 97454	61505
DL913	+374170+1144576	4646S	0	106417413	69726149620196536 97105	61305
DL914	+374170+1144602	4650S	0	104417412	69688149711196536 96746	61055
DL915	+374175+1144631	4615S	0	102417411	69645149492196535 96366	60747
DL916	+374170+1144665	4610S	0	99417410	69595149235196534 96081	61457
DL917	+374169+1144696	4607S	0	97417407	69550149133196536 95953	60536
DL918	+374171+1144725	4607U	0	96417409	69510149091196539 95908	60490
[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN	TER-COR. OUT / NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL920	+374171+1144780	4609S	0	94417407	69420149118196539	95953	80327
DL921	+374171+1144807	4612S	0	95417406	69386149134196539	95995	80562
DL922	+374172+1144876	4628S	0	95417406	69285149157196541	96171	80481
DL923	+374171+1144902	4644S	0	94417403	69247149154196539	96519	80574
DL924	+374173+1144926	4660S	0	96417406	69209149165196541	96478	80680
DL925	+374174+1144957	4662S	0	94417407	69160149221196543	96739	80665
DL926	+374172+1144983	4702S	0	95417402	69128149307196541	97017	81075
DL927	+374172+1145011	4729S	0	95417401	69080149349196541	97313	81280
DL928	+374172+1145037	4754U	0	98417400	69046149340196541	97540	81423
DL929	+374173+1145057	4778U	0	100417402	69019149265196541	97589	81493
DL930	+374174+1145083	4798S	0	101417403	68981149232196543	97642	81579
DL931	+374171+1145119	4830U	0	104417396	68941149125196539	98042	81672
DL932	+374176+1145134	4854S	0	105417405	68906149055196546	98190	81740
DL933	+374172+1145162	4890U	0	108417396	68665148682196541	98364	81797
DL934	+374177+1145204	4949U	0	112417404	68603148642196546	98670	81902
DL935	+374177+1145231	4964S	0	113417403	68763148567196546	98924	82043
DL936	+373819+1144556	5038U	0	147416764	69771148214196026	99602	82560
DL937	+373825+1144643	4927U	0	124416772	69043148259196034	98592	81911
DL938	+373819+1144722	4850U	0	117416758	69527148570196026	98188	81765
DL939	+373895+1144609	4863S	0	122416903	69690148730196137	98359	81695
DL940	+373907+1144502	4980U	0	162416929	69861149080196154	99793	82470
DL941	+373907+1144724	4754U	0	109416921	69520148691196154	97477	81371
DL942	+373939+1144586	4827U	0	120416985	69719149092196201	98518	81974
DL943	+373994+1144502	4892U	0	127417090	69843149349196280	99107	82549
DL944	+373994+1144614	4752U	0	112417086	69676149147196280	97587	81491
DL945	+373995+1144724	4671U	0	106417084	69516148989196282	96740	80607
DL946	+374081+1144510	4772S	0	114417250	69015149794196408	98295	82155
DL947	+374082+1144675	4668S	0	105417248	69056149302196409	96023	81007
DL948	+374083+1144723	4654U	0	100417247	69514149052196410	96251	80546
DL949	+374211+1144533	4675S	0	108417490	69787150232196597	97631	81793
DL950	+374232+1144637	4566U	0	100417525	69634149410196628	95971	80429
DL951	+374259+1144721	4584U	0	94417572	69509149179196667	95652	80111
DL952	+374278+1144561	4598S	0	104417613	69743150306196695	96862	81303
DL954	+374346+1144607	4580U	0	97417737	69673149475196794	95754	80260
DL955	+374346+1144717	4560U	0	92417733	69511149217196794	95525	79996
DL956	+374405+1144625	4579U	0	94417846	69644149423196880	95635	80111
DL957	+374430+1144521	4595S	0	102417895	69795150159196916	96485	80915
DL958	+374432+1144731	4580S	0	89417892	69487149245196920	95427	79495
DL959	+374495+1144785	4560S	0	89418006	69405149309197012	95395	79667
DL960	+374495+1144588	4557S	0	93418013	69694149621197012	95777	80225
DL961	+374499+1145212	4912S	0	124417909	68777149764197017	98974	82345
DL962	+374457+1145003	46699T	0	100417929	69086150176196956	97163	81555
DL963	+374432+1144918	4619S	0	96417885	69212149013196920	96077	80451
DL964	+374432+1145062	4731U	0	105417880	69001150284196920	97666	81357
DL965	+374432+1145142	4854S	0	113417877	68654149305196920	98426	81904
DL966	+374316+1144910	4638U	0	96417729	69185149547196797	95598	80675
DL967	+374363+1145015	46890T	0	101417758	69073149916196819	97226	81334
DL968	+374348+1145105	4776U	0	111417724	68941149607196797	98018	81159
DL969	+374340+1145161	4835U	0	118417722	68459149065196797	98574	82101
DL970	+374289+1145025	47119T	0	100417617	69061149784196711	97417	81445
DL971	+374262+1144926	4651S	0	95417571	69208149303196672	96592	80629
DL972	+374218+1145120	4813S	0	111417538	68923149516196651	98160	81055
DL973	+374218+1145227	4949U	0	124417479	68767148785196607	98751	81996
DL974	+374114+1145041	47720T	0	98417300	69045149126196462	97574	81595
DL975	+374087+1144930	4672S	0	100417247	69201149111196416	96563	80728
DL976	+374001+1144943	4660S	0	100417087	69194149284196291	96636	8097[illegible]
DL977	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL978	+374087+1145139	4868S	0	110417240	68902148741196416	98137	81044
DL979	+374105+1145222	4964S	0	122417270	68779148556196443	98630	82021
DL980	+374017+1145140	4921U	0	126417119	68904148339196314	98365	81097
DL982	+373912+1144949	4712S	0	102416923	69169149219196161	97402	81455
DL983	+373949+1145060475397		0	130416987	69024149099196215	97624	81539
DL984	+373907+1145162	4969U	0	115416906	68876148019196154	98544	81742
DL985	+373896+1145217	4990S	0	110416884	68796148154196138	98978	82060
DL986	+373862+114507348041T		0	102416826	69009148589196086	97711	81428
DL987	+373820+1144996	4755S	0	104416751	69124148725196027	97447	81335
DL988	+373820+1145158	4862U	0	101416745	68085148213196027	96130	81560
DL989	+373776+114508648100T		0	101416066	68993148630195963	97333	81029
DL990	+373674+114522548629T		0	100416473	68793147425195814	97366	80693
DL991	+373692+114508946090T		0	114416511	68992147649195841	97066	80776
DL992	+373699+114501948461T		0	105416526	69095147567195851	97322	80598
DL993	+373706+114491849671T		0	108416543	69243147276195861	97595	80955
DL994	+373722+114481449459T		0	117416576	69396147407195884	98070	81517
DL995	+373726+1144696	4995Y	0	139416587	69569148045195890	99166	82266
DL996	+373736+114460051191T		0	159416609	69710147787195905100659		82759
DL997	+373714+1145955	4971U	0	99416523	67717147950195873	98860	82005
DL998	+373732+1145822	5090U		109416561	67912147197195899	99201	81644
DL999	+373687+114560049961T			96416484	68182147027195834	98212	81172
DL1000	+373728+1145602	5052S		101416561	68236146962195893	98014	81363
DL1001	+373670+1145494	4992S		95416457	68397147100195809	98271	81245
DL1002	+373661+1145371	4942S	0	99416444	68579147127195795	97641	81064
DL1003	+373672+1145259	4881U	0	99416468	68743147415195812	97539	80990
DL1004	+373729+1145273	4920U	0	97416573	68720147414195895	97822	81139
DL1006	+38 776+1145748	5537Y	0	102422193	67896146546200345	98714	79931
DL1007	+38 864+1145749	5678Y	0	114422356	67693146508200473	99553	80301
DL1008	+38 952+1145749	5815Y	0	125422518	67889146200206602100325		80616
DL1009	+381023+1145715	6371Y	0	265422651	67936143097200706102354		80669
DL1010	+38 928+1145655	5891Y	0	139422477	66026145096200567100773		80619
DL1011	+38 853+1145693	5768Y	0	114422337	67975146654200457100270		80643
DL1013	+38 874+1145574	5903Y	0	138422380	68148145816200486100885		80869
DL1014	+38 803+1145520	5722Y	0	125422250	68230146974200384100442		81 51
DL1015	+381001+1145578	6144Y	0	173422615	68137144679200674101431		81049
DL1016	+38 902+1145520	6150Y	0	152422507	68220144412200588101707		80663
DL1020	+38 805+1145289	5467Y	0	132422262	68567148051200387	99300	80722
DL1021	+38 864+1145310	5560Y	0	163422379	68534147828200473	99482	80661
DL1022	+38 906+1145362	5852Y	0	136422466	68457146056200535100600		80776
DL1023	+38 951+1145308	5659Y	0	160422531	68533146679200601	99537	80196
DL1024	+38 998+1145408	6039Y	0	175422615	68385144735200670100992		80669
DL1027	+381048+1145307	5823Y	0	179422710	68531145057200743100717		81036
DL1029	+38 36+1145359	5616Y	0	130420337	68497146996199262100569		81564
DL1030	+38 87+1145266	5413Y	0	125420934	68626146292199337	99696	81557
DL1031	+38 128+1145400	5563Y	0	133421006	68434147309199397100456		81547
DL1033	+38 173+1145297	5354Y	0	137421092	68582146766199465	99693	81369
DL1034	+38 217+1145256	5290C	0	123421175	68640149299199527	99557	81658
DL1035	+38 224+1145283	5342H	0	124421187	68601148989199537	99727	81631
DL1036	+38 239+1145311	5395H	2	117421197	68559148639199546	99667	81585
DL1037	+38 234+1145336	5976H	0	129421204	68520148177199552100162		81616
DL1038	+38 244+1145364	5576H	0	140421221	68481147643199560100555		81663
DL1042	+38 402+1145291	5366Y	0	128421516	68561149242199790100077		81656
DL1043	+38 439+1145333	5446Y	2	99421583	68519148700199856100103		81629
DL1046	+38 563+114533553369T		1	111421512	68510149135200033	99335	81244
DL1047	+38 563+114543754659T		2	93421609	68361148264200035	99673	81125
DL1049	+38 614+1145399	5516Y	0	96121965	68415148025200106	99650	81125
DL1051	+38 [illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL1052	+38 743+1145457	5566C	0	130422141	68325147956200296100044	81199
DL1053	+38 715+1145540	5562C	0	101422087	66204147772200255 99862	82993
DL1054	+374509+1143837	5393Y	0	120418066	70796146766197032100492	82215
DL1055	+374504+1143989	5815Y	0	309418051	70573144606197024102312	82738
DL1056	+374540+1144286	4935Y	0	148418107	70136150419197077 99785	83101
DL1057	+374515+1144401	4676Y	0	112418057	69968151361197041 98546	82509
DL1058	+374527+1144491	4640C	0	97418076	69635150108197056 96716	80987
DL1059	+374586+1144489	4650C	0	94418185	69635149916197144 96533	80767
DL1060	+374590+1144414	4697Y	0	102418195	69945150762197150 97519	81991
DL1061	+374601+1144520	4761Y	0	116418219	70083151409197166 99048	82926
DL1062	+374563+1144159	5621Y	0	253418154	70321146090197111101882	82963
DL1063	+374576+1144077	5441Y	0	128418181	70441147012197130101090	82661
DL1064	+374592+1143963	5466Y	0	129418215	70607147655197153101345	82831
DL1065	+374568+1143698	5301Y	0	125418173	70719147447197116100218	82263
DL1066	+374576+1143792	5421Y	0	118418192	70659146593197130100482	82111
DL1067	+374619+1143653	5258Y	0	132418269	70766147716197192100006	82207
DL1068	+374696+1143763	5416Y	0	142418415	70696147649197305101316	82966
DL1069	+374713+1143680	5273Y	0	167418442	70724148141197330100437	82626
DL1070	+374694+1143980	5281Y	0	123418403	70576148120197302100520	82631
DL1071	+374665+1144075	5121Y	0	128418346	70440149455197259100596	83052
DL1072	+374625+1144139	5575Y	0	243418270	70347146479197201101747	82975
DL1073	+374620+1144236	4928Y	0	140418257	70205150541197194 99724	83055
DL1074	+374637+1144279	4837C	0	122418287	70141151196197219 99216	82943
DL1075	+374642+1144318	4795C	0	109418295	70084151086197226 98988	82743
DL1076	+374646+1144345	4773C	0	105418301	70044151058197232 98745	82571
DL1077	+374648+1144372	4744C	0	107418304	70004150926197234 98337	82203
DL1078	+374652+1144398	4723C	0	98418310	69960150706197241 97913	81902
DL1079	+374660+1144424	4694Y	0	98418324	69928150457197252 97360	81406
DL1080	+374660+1144458	4671C	0	93418323	69876150111197252 96817	80979
DL1081	+374661+1144485	4651C	0	92418324	69838149933197254 96449	80678
DL1082	+374699+1144171	4937Y	0	137418405	70297150442197309 99595	82894
DL1083	+374729+1144241	5424Y	0	513418458	70193146902197355100596	82669
DL1084	+374735+1144354	4744C	0	101418465	70027150954197362 98238	82156
DL1085	+374745+1144439	4673Y	0	93418481	69902150123197376 96696	80661
DL1086	+374749+1144079	5031Y	0	118418501	70430149686197382 99851	82810
DL1087	+374789+1144156	4964Y	0	107418572	70315150020197441 99296	82472
DL1088	+374782+1143764	5490Y	0	174418574	70691147392197430101632	83081
DL1089	+374798+1143828	6369Y	0	862418601	70796141098197453103590	82729
DL1090	+374861+1143755	5870Y	0	195418720	70903145100197545102601	82975
DL1091	+374871+1143645	5942Y	232	330418735	70706144069197560102435	82730
DL1092	+374789+1143957	5130Y	0	155418580	70607149275197441100114	82773
DL1093	+374859+1143945	5196Y	0	155418709	70616148973197542100536	82709
DL1094	+374810+1144076	4987Y	0	119418614	70431150022197471 99484	82574
DL1095	+374683+1144071	4987Y	0	122418749	70435149796197577 99151	82252
DL1096	+374931+1143751	5642Y	38	254418850	70903146005197648102657	83106
DL1097	+374950+1143852	5417Y	0	212418881	70754147687197675101190	82927
DL1100	+375120+1143760	5772Y	0	290419190	70881145909197923102510	82913
DL1101	+375126+1143785	5728Y	4	255419209	70844146125197932102104	82631
DL1102	+375152+1143824	5642S	0	255419656	70785146573197970101772	82714
DL1103	+375219+1144555	[illegible]	0	241419379	70737146771198066101555	82645
DL1104	+375165+1143858	5577Y	0	231419279	70741147021197989101518	82722
DL1105	+375191+1143892	5694Y	0	218419307	70684147436198013101131	82611
DL1106	+375195+1143921	5444Y	0	204419332	70641147042198035101044	82680
DL1107	+375208+1143944	5467Y	0	210419355	70607146678198052100913	82681
DL1108	+375224+1143965	5373Y	0	197419384	70575148379198076100871	82742
DL1109	+375234+1143992	5321Y	0	191419401	70535148655198090100655	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL1111	+375131+1143870	5527Y	0	222419215	70719147253197940101310	82681
DL1112	+375120+1143951	5343Y	0	185419192	70601148249197923100610	82571
DL1113	+375167+1143989	52808	0	181419278	70543148799197992100490	82562
DL1114	+375195+1144088	5106Y	0	150419326	70396149253198033 99273	82906
DL1115	+375138+1144059	5136Y	0	147419221	70441149406197950 99794	82424
DL1116	+375083+1144054	5104Y	0	144419120	70451149233197873 99402	82136
DL1117	+375012+1144033	5072Y	0	140418989	70485149034197766 99008	81849
DL1118	+374910+1144002	5096Y	0	139418802	70535149033197617 99375	82133
DL1119	+374981+1143922	5257Y	0	183418936	70650148230197720 99976	82229
DL1120	+375052+1143951	5259Y	0	181419066	70604148281197824 99950	82194
DL1121	+375229+1144227	49195	0	127419384	70191150510198083 98720	82070
DL1123	+375200+1144428	4638S	0	112419323	69897150904198041 96511	80804
DL1124	+375194+1144326	4752Y	0	112419315	70047150916198031 97605	81510
DL1125	+375143+1144215	46978	0	122419225	70212150488197957 98617	82037
DL1126	+375068+1144177	4901Y	0	123419088	70271150316197848 98593	82006
DL1127	+374963+1144164	4829Y	0	123418894	70295150450197695 98201	81654
DL1128	+374874+1144170	4925Y	0	111418729	70291150267197564 99049	82363
DL1129	+374949+1144227	4849Y	0	109418866	70204150626197674 98586	82156
DL1130	+375026+1144235	4821Y	0	112419012	70188150789197789 98370	82039
DL1131	+375081+1144230	4945Y	0	124419110	70193150117197866 98788	82046
DL1132	+375108+1144316	4751OT	0	108419157	71066150565197906 97076	81582
DL1133	+375137+1144391	4666Y	0	108419208	69955151152197946 97115	81306
DL1134	+375147+1144494	4617S	0	105419222	69603150403197963 95690	80247
DL1135	+375050+1144392	4674Y	0	101419047	69957151024197821 97189	81346
DL1136	+375059+1144493	4625C	0	98419060	69808150427197634 96117	80441
DL1137	+374975+1144446	4652C	0	96418906	69881150626197712 96690	80926
DL1138	+374995+1144333	4727Y	0	101418947	70046150946197741 97690	81606
DL1139	+374952+1144335	4736Y	0	100418867	70045150876197678 97769	81716
DL1140	+374875+1144280	4806Y	21	104418727	70129150423197566 98640	82300
DL1141	+374875+1144391	4696Y	1	96418723	69966150576197566 97503	81553
DL1142	+374824+1144403	4696Y	0	95418628	69951150769197491 97471	81559
DL1143	+374917+1144447	4648C	0	95418799	69882150646197627 96769	81002
DL1144	+374805+1144291	4854Y	0	105418597	70116150950197464 98979	82597
DL1145	+374508+1145335	5111Y	0	167418012	68596148952197030100622	82757
DL1146	+374575+1145427	5305Y	0	218418133	68459147646197126100645	82769
DL1147	+374587+1145287	50715	0	135418160	68664149240197145 99618	82656
DL1148	+374636+1145347	51583	0	169418248	68574148923197217100249	82825
DL1149	+374662+1145403	55013	0	184418294	68490148654197255101060	82481
DL1150	+374644+1145463	58105	0	231418259	68403148391197229101366	81760
DL1151	+374691+1145277	51283	0	136418352	68674148678197296 99861	82487
DL1152	+374741+1145308	50483	0	207418444	68626149625197370 99762	82752
DL1153	+374745+1145427	59163	0	330418447	68452144722197376[illegible]	[illegible]
DL1154	+374706+1145524	62865	0	395418372	68311141055197320[illegible]	[illegible]
DL1155	+374771+1145539	6708S	0	844418492	[illegible]	[illegible]
DL1156	+374831+1145486	57355	0	211418604	[illegible]	82518
DL1157	+374819+1145366	5395S	0	158418586	[illegible]	[illegible]
DL1158	+374871+1145317	5010S	0	195418684	[illegible]	[illegible]
DL1159	+374904+1145126	52145	0	171418741	[illegible]	[illegible]
DL1160	+374936+1145521	53665	[illegible]	160418797	[illegible]	82925
DL1161	+374675+1145[illegible]	56023	2	202418082	[illegible]	[illegible]
DL1163	+375000+1145552	55615	51	188418915	[illegible]	[illegible]
DL1164	+374971+1145425	5198[illegible]	0	154418765	[illegible]	[illegible]
DL1165	+375023+1145307	5171Y	0	133418962	[illegible]	[illegible]
DL1166	+375038+1145328	5079Y	0	121418992	66585149482197804 9944[illegible]	82252
DL1167	+375055+1145259	49523	0	115419026	[illegible]	[illegible]
DL1168	+375053+1145[illegible]	57[illegible]	0	187419015	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM / EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL1170	+375109+1145457	5478S	0	149419119 68592147464197908101112		62577
DL1171	+375104+1145322	5404S	0	201419115 68591147146197906100107		61676
DL1172	+375160+1145371	5422S	0	144419216 68516147446197982100495		62146
DL1173	+375169+1145262	5069S	0	117419237 68676150126197995	99636	62664
DL1174	+375220+1145342	5169S	0	153419328 68556146997198070	99767	62222
DL1175	+375199+1145444	5617S	0	162419286 68408146577198039101403		62407
DL1176	+375212+1145522	5822S	0	226419308 68293145542198058102278		62647
DL1177	+375147+1145521	5668S	0	200419187 68297145575197963100957		61625
DL1178	+375217+1145597	6917S	0	1207419314 68183136461198065103501		61116
DL1179	+375119+1145627	6502S	236	554419132 68143139624197922103099		61712
DL1180	+375033+1145642	6498S	0	691418973 68124139627197797103190		61718
DL1181	+374949+1145312	5029S	1	121418828 68612149787197674	99443	62413
DL1913	+38 505+1145090	5141B	0	111421713 68071150949199946	99363	61959
DL1914	+38 640+114489250951T		0	92021970 69155149937200145	97741	80455
DL1918	+375417+1144743	4652S	0	90419713 69426150632198357	96054	80277
DL1919	+374203+114503747520T		0	95417458 69047143599196585	97535	61425
DL1961	+374525+1144684	4580U	0	87418065 69552149522197055	95568	80034
DL2000	+374595+1144984	4640U	0	94418185 69106150362197157	96909	81103
DL2001	+374598+1145011	4666Y	0	97418189 69066150496197162	97245	81426
DL2002	+374599+1145038	4654Y	0	101418190 69029150603197163	97521	81646
DL2003	+374601+1145064	4715Y	0	100418193 68990150621197160	97627	81646
DL2004	+374593+1145089	4774Y	0	100418177 68954150561197155	98374	62151
DL2005	+374592+1145115	4776Y	0	112418175 68916150389197153	98163	62065
DL2006	+374590+1145178	4873Y	0	121418169 66824149805197150	98515	62016
DL2007	+374590+1145204	4918Y	0	115418168 68785149626197150	98762	62103
DL2008	+374589+1145232	4962Y	0	126418165 68744149501197146	99050	62252
DL2009	+374588+1145260	5010Y	0	125418162 68703149432197147	99435	62472
DL2010	+374586+1145313	5118Y	0	137418157 68626149013197144100035		82716
DL2011	+374585+1145338	5163Y	0	149418154 68589146685197143100132		62672
DL2012	+374583+1145365	5211Y	0	179418150 68549148376197140100260		82686
DL2013	+374585+1145402	5266S	0	175418152 68495147959197143100594		82740
DL2060	+373975+1145699	5260Y	0	283417008 67789147053196253100503		62646
DL2061	+374060+1145930	5552B	0	347417164 67741145373196377101249		62659
DL2062	+374127+1145921	5683B	0	248417286 67751144702196475101713		82576
DL2063	+374190+1145916	5549B	0	240417405 67755145026196566101499		62313
DL2064	+374360+1145506	5545Y	0	230417732 68349146229196614101601		82916
DL2065	+374272+1145324	5087U	0	158417576 68622146091196686	99676	62083
DL2066	+375864+1144950	4754S	0	115420550 69835149608199211	95476	79357
DL2067	+375852+1144427	4766S	0	117420529 69676149614198993	95473	79335
DL2068	+375839+1144402	4773S	0	121420506 69907149603198974	95547	79369
DL2069	+375827+1144381	4775S	0	126420484 69936149662198956	95643	79483
DL2070	+375813+1144357	4790C	0	127420459 69974149767198930	95910	79699
DL2071	+375730+1144316	4832C	0	136420418 70035149962198902	96533	80189
DL2072	+375779+1144294	4866C	0	136420398 70066149962198885	96675	80214
DL2073	+375766+1144272	4906C	0	141420375 70106149971198867	97217	80660
DL2074	+375754+1144250	4932C	1	146420354 70133150016198850	97577	80902
DL2075	+375742+1144229	4962C	0	154420332 70165150006198832	97911	81141
DL2076	+375716+1144182	5020C	0	184420285 70235150672198795	98721	61784
DL2077	+375704+1144160	5073C	0	201420265 70267150096198777	99648	61947
DL2078	+375691+1144137	5161C	1	227420241 70302149616198756	99456	62172
DL2222	+36 741+1113770	6368Y	0	228422197 70791146197200294102027		80467
DL3001	+373951+1143210	5301S	1	153417058 71733146503196216100759		16205
DL3002	+374312+1143457	6724S	161	471417716 71364138675196745105219		62920
DL3003	+374715+1143314	6037S	251	234418467 71556143527197332103134		63012
DL3004	+374990+1143344	6778S	7	581418974 71497139620197734105062		62553
DL3006	+375587+1143934	6464Y	5	544420056 70504141124198605103171		61262
DL3007	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TERR-COR. IN/OUT	NORTH UTM	EAST UTM – OBSV GRAV – THEO GRAV – FAA	CBA +1000
DL3008	+38 277	+1143657	7778S	2	971421343	70977153257199615106850	81301
DL3009	+38 691	+1143650	6155S	1	201422109	70967145+39200220101149	80354
DL3010	+36 741	+1143706	6048S	0	154422199	7068314445220029411081	60607
DL3011	+381026	+1144003	6872Y	8	446422715	70636139183200711103154	80169
DL3014	+38 704	+1145796	5377Y	0	96422058	07031147777200239 98143	79899
DL3015	+38 409	+1145464	5773Y	8	129421523	68326146289199606100815	81262
DL3016	+375996	+1145497	6059S	115	318420758	68297144156199204101960	81747
DL3017	+375701	+1145334	5702S	16	174420218	08546146371198773101263	82005
DL3018	+375612	+1145657	5262S	1	128420043	68079148694198642 99574	81755
DL3019	+375350	+1145561	6660S	313	709419562	58230138747198259103172	01479
DL3021	+374846	+1145751	5808S	7	164418623	67972144615197523101755	82116
DL3022	+374434	+1145661	6590S	413	579417864	68121138318196923103422	61937
DL3023	+374011	+1145712	6955S	2821	130417080	66063135029196305104187	61877
DL3024	+374260	+1145916	5533S	249	169417534	67753145620196069101272	82001
DL3025	+373833	+115 25	4988Y	.0	122416741	67010140314196046 99207	82316
DL3500	+375522	+1144277	4707B	0	178419924	70104151386198511 97166	81291
DL3501	+375522	+1144277	4707B	0	178419924	70104151389198511 97178	81301
DL3502	+375522	+1144277	4707B	0	178419924	70104151399198511 97189	81311
DL3503	+375522	+1144276	4708B	0	178419924	70106151405198511 97201	81321
DL3504	+375522	+1144276	4709B	0	178419924	70106151406198511 97209	813[illegible]
DL3505	+375522	+1144275	4709B	0	179419924	70107151411198511 97220	8133[illegible]
DL3506	+375522	+1144275	4710B	0	179419924	70107151415198511 97232	81345
DL3507	+375521	+1144275	4711B	0	179419922	70107151417198509 97242	81353
DL3508	+375521	+1144274	4712B	0	180419922	70109151422198509 97255	81365
DL3509	+375521	+1144274	4713B	0	180419922	70109151422198509 97264	81370
DL3510	+375521	+1144273	4713B	0	180419922	70110151426198509 97274	81379
DL3511	+375521	+1144273	4714B	0	179419922	70110151429198509 97283	81384
DL3512	+375521	+1144273	4715B	0	179419922	70110151431198509 97293	81392
DL3513	+375521	+1144272	4715B	0	181419922	70112151437198509 97302	81401
DL3514	+375521	+1144272	4716B	0	181419922	70112151439198509 97310	81406
DL3515	+375521	+1144271	4717B	0	180419922	70113151436198509 97320	81412
DL3516	+375521	+1144271	4719B	0	180419922	70113151441198509 97332	81420
DL3517	+375520	+1144271	4719B	0	179419920	70113151440198508 97343	81426
DL3518	+375517	+1144257	4751B	0	189419915	70134151596198503 97603	81585
DL3519	+375514	+1144244	4792B	0	182419910	70153151277198499 97879	81715
DL3520	+375511	+1144231	4831B	0	188419905	70172151165198495 98135	81845
DL3521	+375508	+1144218	4867B	0	199419900	70191151133198491 98343	81993
DL3522	+375505	+1144205	4906B	0	215419895	70211150675198486 98556	82046
DL3523	+375502	+1144192	4955-	0	234419890	70230150659198481 98610	82144
DL3524	+375522	+1144278	4706B	0	177419924	70103151380198511 97161	81285
DL3525	+375522	+1144278	4706B	0	177419921	70103151373198511 97139	81275
DL3526	+375522	+1144279	4705B	0	177419924	70101151360198511 97136	81266
DL3527	+375522	+1144279	4705B	0	177419924	70101151360198511 97126	81256
DL3528	+375523	+1144279	4704B	[illegible]	178419925	70101151353198513 97119	81246
DL3529	+375523	+1144280	4704B	0	176419925	70100151349198513 97105	81237
DL3530	+375523	+1144280	4703B	0	176419925	70100151338198513 97089	81225
DL3531	+375523	+1144281	4703B	[illegible]	175419925	70096151331198513 97079	81213
DL3532	+375523	+1144281	4703B	0	175419925	70096151323198513 97066	81202
DL3533	+375523	+1144281	4702B	0	175419925	70096151317198513 97056	81195
DL3534	+375523	+1144282	4702B	0	175419925	70097151305198513 970[illegible]	81179
DL3535	+375523	+1144282	4701B	0	175419925	70097151298198513 97026	81171
DL3536	+375523	+1144283	4701B	0	174419925	70095151291198513 97019	81159
DL3537	+375523	+1144283	4700B	0	174419925	70095151284198513 97008	81150
DL3538	+375521	+1144283	4700B	0	174419927	70095151277198513 96995	81139
DL3539	+375524	+1144284	4699B	0	174419927	70094151271198513 96984	81129
DL3540	+375524	+1144284	4699B	0	174419927	70094151256198513 96975	81121

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA / CBA +1000
DL3542	+375530+1144210	46768	0	346419941	7020215068119852 3	96363 80762
DL3543	+375533+1144324	46726	0	162419942	70[illegible]50644198527	96081 80316
DL3544	+375536+1144337	46716	0	152419947	70[illegible]150417198531	95642 80064
DL3545	+375539+1144350	46728	0	145419953	69997150220198536	95057 79866
DL3546	+375542+1144363	46738	0	142419958	69977150063198540	95502 79705
DL3547	+375530+1144276	47078	0	179419939	70105151377198523	97153 81277
DL3548	+375530+1144276	47088	0	179419939	70105151381198523	97167 81287
DL3549	+375529+1144275	47096	0	180419937	70107151334198521	97181 81299
DL3550	+375529+1144275	47106	0	180419937	70107151337198521	97191 81306
DL3551	+375529+1144275	47116	0	180419937	70107151391198521	97203 81316
DL3552	+375529+1144274	47118	0	182419937	70108151397198521	97214 81327
DL3553	+375529+1144274	47128	0	181419937	70108151400198521	97225 81334
DL3554	+375529+1144273	47128	0	181419937	70110151409198521	97232 81342
DL3555	+375529+1144273	47138	0	181419937	70110151409198521	97244 81349
DL3556	+375529+1144273	47148	0	181419937	70110151414198521	97256 81359
DL3557	+375529+1144272	47158	0	182419937	70111151416198521	97266 81367
DL3558	+375530+1144277	47078	0	179419939	70104151372198523	97142 81268
DL3559	+375530+1144277	47066	0	180419939	70104151369198523	97133 81262
DL3560	+375530+1144277	47058	0	180419939	70104151363198523	97121 81253
DL3561	+375530+1144278	47058	0	178419938	70102151356198523	97110 81241
DL3562	+375530+1144278	47048	0	178419938	70102151347198523	97096 81230
DL3563	+375530+1144279	47046	0	179419938	70101151341198523	97085 81221
DL3564	+375530+1144279	47038	0	179419938	70101151336198523	97073 81211
DL3565	+375530+1144279	47028	0	179419938	70101151329198523	97061 81202
DL3566	+375530+1144280	47028	0	177419938	70099151321198523	97051 81190
DL3567	+375531+1144280	47028	0	178419940	70097151314198524	97037 81179

G1.0

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS, LINCOLN COUNTY, NEVADA

GROUND-WATER RESOURCES - RECONNAISSANCE SERIES

Report 16

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS, Lincoln County, Nevada

by

Thomas E. Eakin

Prepared cooperatively by the

Geological Survey

U. S. Department of the Interior

May
1963

FOREWORD

This is the 16th report in the series of reconnaissance ground-water studies which were initiated by action of the Legislature in 1960. In these sixteen reports, the ground-water resources of some nineteen valleys have been appraised and described.

The present appraisal of the ground-water resources of Dry Lake and Delamar Valleys in Lincoln County, Nevada, was made by Thomas E. Eakin, geologist, U. S. Geological Survey.

These reconnaissance ground-water resources studies make available pertinent information of great value to many State and Federal agencies. As development takes place in any area, demands for more detailed information will arise and studies to supply such information will be undertaken. In the meantime these reconnaissance type studies are timely and adequately meet the immediate needs for information on the ground-water resources of the areas on which reports are prepared.

Hugh A. Shamberger
Director
Department of Conservation
and Natural Resources

May, 1963

CONTENTS

ILLUSTRATIONS

TABLES

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS, LINCOLN COUNTY, NEVADA

by
Thomas E. Eakin

****

SUMMARY

The results of this reconnaissance of Dry Lake and Delamar Valleys suggest that average annual ground-water recharge from precipitation may be on the order of 6,000 acre-feet. Ground water is discharged largely by underflow through bedrock from the valleys, most probably to the southwest or south toward Pahranagat Valley.

The substantial depth to water, in excess of 300 feet in the topographically lower parts of the valleys, precludes low-cost development of substantial supplies of ground water. However, this apparently adverse feature for usual water-supply purposes may be desirable from the standpoint of possible special testing purposes required in modern technology.

The area roughly including Tps. 1 S. to 2 N., R. 64 E. may be most favorable for eventual interception of most of the recharge which is principally supplied from the mountains to the east and north. Here, perennial yield might closely approach the average annual recharge. It should be pointed out, however, that the depth to water, ranging from about 400 feet to 700 feet or more, probably precludes development of substantial water supplies for most purposes because of the high cost of pumping.

INTRODUCTION

Ground-water development in Nevada has shown a substantial increase in recent years. Part of the increased development is due to the effort to bring new land into cultivation, part is due to the effort to supplement surface-water supplies, and part is due to the general increased demands for water. In any case, as efforts to develop ground water increase, there is a corresponding increase in demand for information on the ground-water resources throughout the State.

Recognizing this need, the State Legislature enacted special legislation (Chapt. 181, Stats. 1960) for beginning a series of reconnaissance studies of the ground-water resources of Nevada. As provided in the legislation, these studies are being made by the U. S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources.

Interest in ground-water resources currently includes many areas and is extending to additional areas almost continuously. Thus, the emphasis of the reconnaissance studies is to provide as quickly as possible a general appraisal of the ground-water resources in particular valleys or areas where information is urgently needed. Ultimately, ground-water information will be available for practically all valleys of the State, at least at a reconnaissance level. For this reason each study is limited severely in time, field work for each area generally averaging about two weeks.

The Department of Conservation and Natural Resources has established a special report series to expedite publication of the results of the reconnaissance studies. Figure 1 shows the areas for which reports have been published in this series. A list of the titles of previous reports published in the series is given at the end of this report. This report is the sixteenth in the Reconnaissance Series.

The purpose of the Reconnaissance Series is to provide a general appraisal of the ground-water resources of virtually all valleys of the State for public information, and to provide a preliminary estimate of the amount of ground-water development that the areas might sustain on a perennial basis as an initial guide to possible requirements for administration of the areas under the State ground-water law.

The scope of this report is limited to a general description of the physical conditions of Dry Lake and Delamar Valleys, including observations of the interrelation of climate, geology, and hydrology as they affect ground-water resources; and possible movement of ground water between valleys is discussed. The report also includes a preliminary estimate of the average annual recharge to and discharge from the ground-water reservoir.

Location and General Features:

Dry Lake and Delamar Valleys are in central Lincoln County and lie within an area bounded by lat 37° 15' and 38° 28' N., and long 114° 33' and 115° W. The two valleys occupy a north-trending trough which is about 82 miles long and a maximum of about 20 miles wide between drainage divides. The combined area of the two valleys is nearly 1,300 square miles.

U. S. Highway 93 crosses the area in an eastward alinement about at the divide between Dry Lake Valley on the north and Delamar Valley on the south (fig. 2). Caliente lies along the highway about 20 miles east of the area.

A gravel road extends southward from U.S. Highway 93 to the former mining town of Delamar. State Highway 83 and improved roads connect formerly active mines on the western side of the Bristol Range with U.S. Highway 93 to the east in the vicinity of Pioche. Trails provide limited access to the lower parts of the valleys during fair weather.

The valleys are used principally for livestock range, although full use of the area may be somewhat limited by inadequate distribution of permanent watering points.

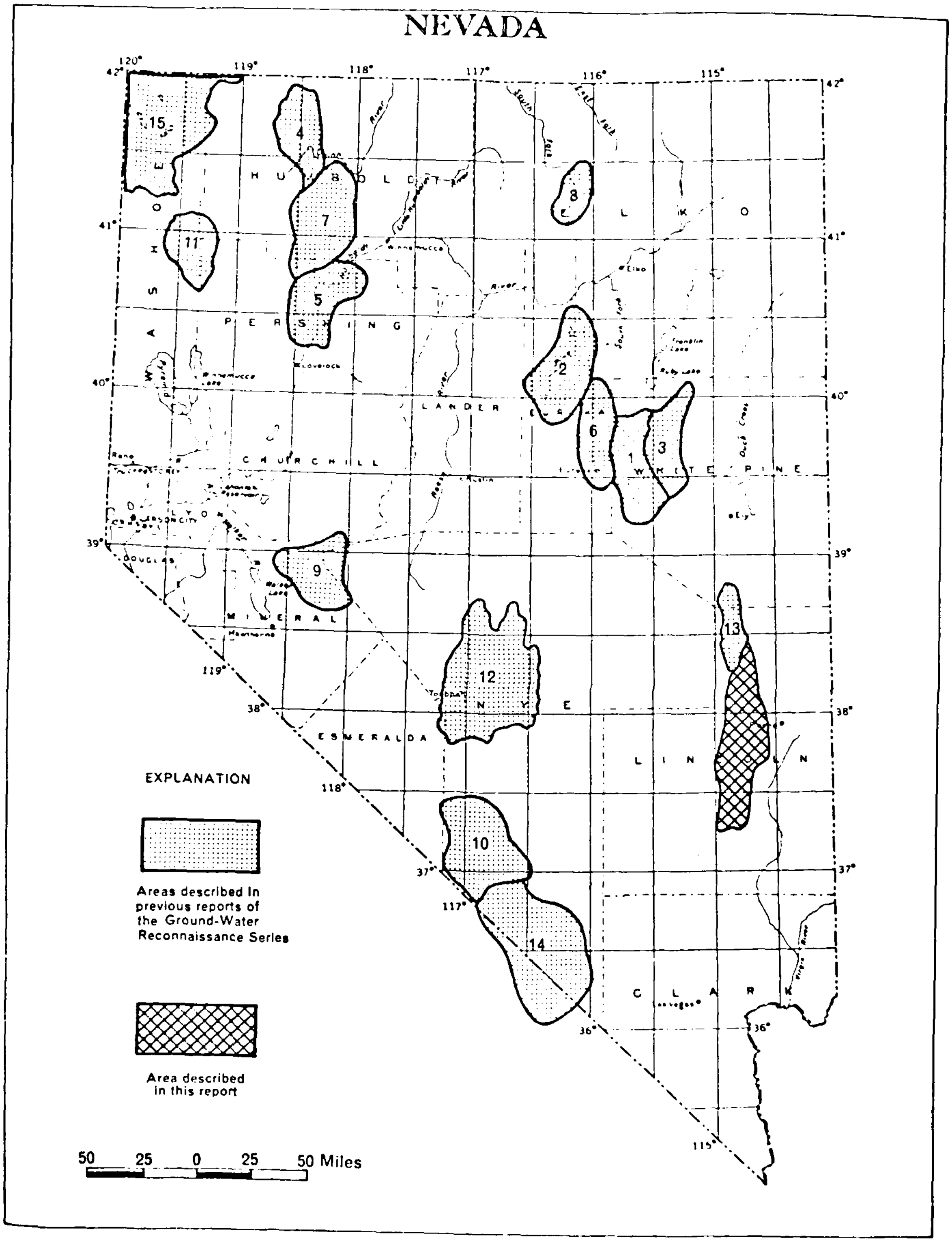


FIGURE 1. MAP OF NEVADA SHOWING AREAS DESCRIBED IN PREVIOUS REPORTS OF THE RECONNAISSANCE SERIES AND IN THIS REPORT.

Climate:

The climate of Dry Lake and Delamar Valleys is semi-arid. Precipitation and humidity generally are low, and summer temperatures and evaporation rates are high. Precipitation is irregularly distributed but generally is least on the valley floor and greatest in the mountains. Snow is common during the winter months and localized thundershowers provide much of the summer precipitation. The daily and seasonal temperature range is relatively large.

Records of precipitation are not available for Dry Lake and Delamar Valleys. However, the magnitude and distribution of precipitation in parts of the valleys probably are reasonably represented by the records for Alamo in Pahranagat Valley west of Delamar, and for Caliente and Pioche to the east (fig. 2). Table 1 lists the annual and the average monthly and average annual precipitation at Alamo, Caliente, and Pioche.

Maximum annual precipitation, in inches, during the period 1931-60 for Alamo, Caliente, and Pioche was 14.91 (1941), 18.73 (1941) and 22.38 (1941), respectively. Maximum monthly precipitation, in inches, for the same period was 6.15 (August 1945), 4.29 (October 1946), and 5.01 (August 1945), respectively. Minimum annual precipitation, in inches, for the respective stations was 1.23 (1956), 2.92 (1950), and 3.81 (1956). Minimum monthly precipitation has been zero a number of times at each of the stations.

Table 2 lists average monthly and annual temperature for the period 1931-60 at Alamo and Caliente and for the period 1939-60 at Pioche. Maximum and minimum temperatures recorded are: at Alamo, 115° F. on August 11, 1940, and -9°F. on January 21, 1937; at Caliente, 109°F. on June 22, 1948, and -31°F. on January 9, 1937; and at Pioche, 102°F. on June 22, 1954 and -5°F. on January 4, 1949.

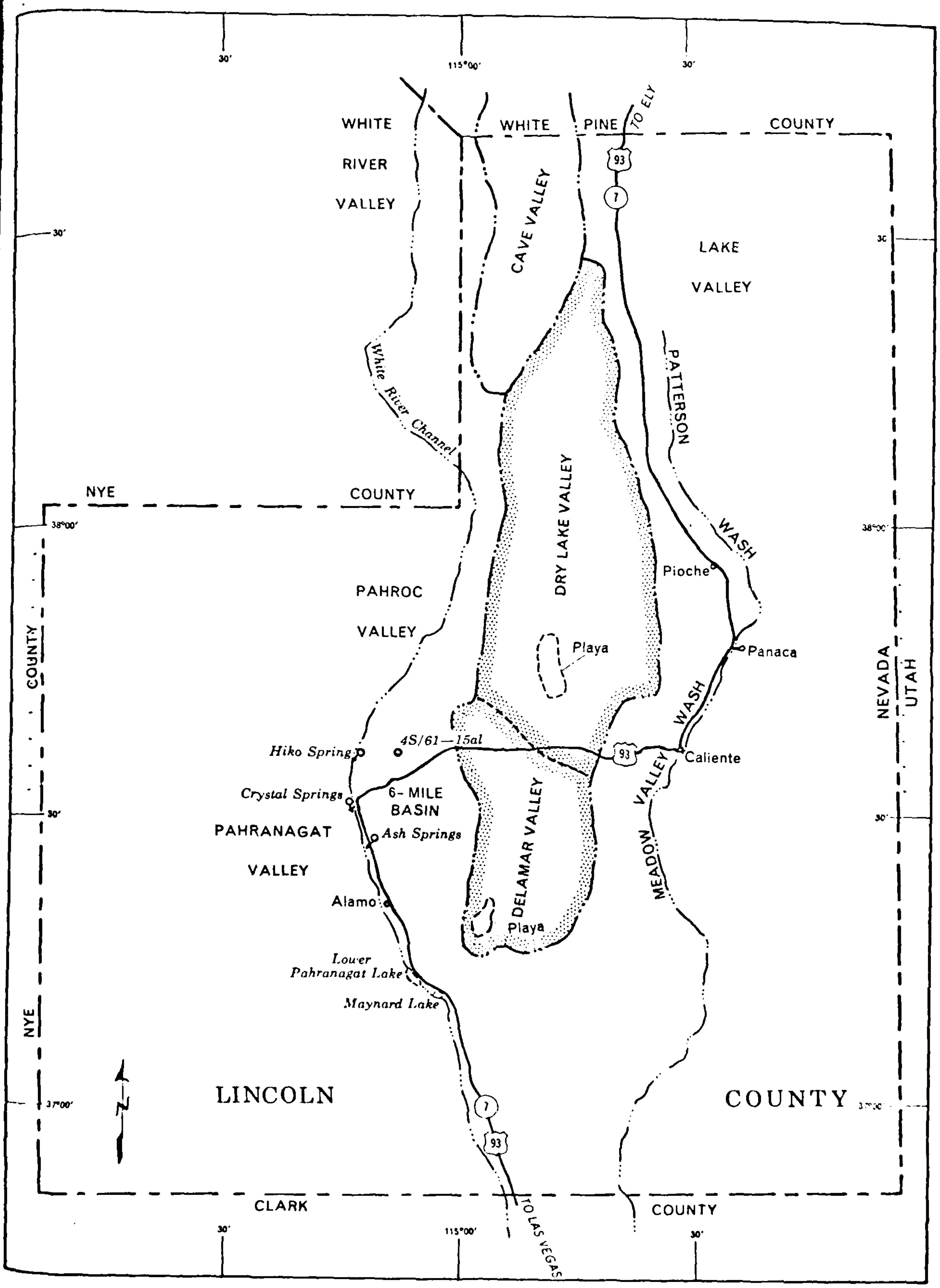


FIGURE 2. Sketch map showing relation of Dry Lake and Delamar Valleys to adjacent, areas

Table 1.--Summary of precipitation at Alamo, Caliente, and Pioche, Nev. (from published records of the U.S. Weather Bureau)

Average monthly and annual precipitation, in inches, (1931-60)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Alamo	.70	.68	.68	.57	.45	.15	.73	.77	.32	.43	.43	.60	6.60
Caliente	.83	.79	.85	.70	.56	.39	.76	.92	.49	.89	.75	.86	8.79
Pioche[1/]	1.55	1.26	1.46	1.19	.83	.33	.87	1.12	.69	1.18	.96	1.36	12.80

1/ Average for 1939-60.

Annual precipitation, in inches, (1931-61)

Year	Alamo	Caliente	Pioche	Year	Alamo	Caliente	Pioche
1931	9.60	9.49	--	1947	--	7.47	10.70
[illegible]	9.68	11.61	--	1948	2.75	5.23	8.39
[illegible]	7.29	8.16	--	1949	6.09	10.03	15.36
1934	3.01	7.14	--	1950	5.32	2.92	7.14
1935	5.58	9.43	--	1951	4.89	10.15	13.98
[illegible]	8.97	11.60	--	1952	6.88	11.52	16.32
1937	6.30	6.84	--	1953	1.98	4.66	7.26
[illegible]	11.15	--	--	1954	5.96	9.31	13.28
[illegible]	7.42	9.41	10.05	1955	5.65	7.13	14.09
1940	6.16	7.49	13.48	1956	1.23	4.78	3.81
1941	14.91	18.73	22.38	1957	7.43	10.88	17.14
[illegible]	2.94	6.63	7.18	1958	6.47	8.13	15.51
1943	--	11.70	16.08	1959	4.42	4.83	10.41
[illegible]	--	7.96	11.59	1960	6.02	9.77	12.85
[illegible]	10.65	11.60	20.60	1961	3.63	8.80	9.62
[illegible]	--	12.36	14.04				

Table 2.--Average monthly and annual temperature, in degrees Fahrenheit, at Alamo, Caliente, and Pioche, Nev. for the period 1931-60

(from published records of the U.S. Weather Bureau)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Alamo	36.6	41.1	47.2	56.1	62.9	71.9	79.2	76.9	69.7	58.6	46.8	39.3	57.1
Caliente	30.4	36.0	43.7	52.2	60.2	68.5	75.9	73.9	65.9	54.1	41.5	33.5	52.9
Pioche[1/]	29.5	33.6	39.3	48.6	57.0	66.3	73.9	71.7	64.8	52.8	40.3	34.0	51.0

1/ Average for 1939-60.

Low humidity and high temperatures are favorable for high rates of vaporation. Pan evaporation recorded at Caliente since 1956 is listed in ble 3. Evaporation from May through September accounts for most of the nual total and averages about 50 inches for the 6-year period of record.

The average growing season in Dry Lake and Delamar Valleys has not een determined. An approximation of the probable growing season may be tained by reference to the nearby Upper Meadow Valley Wash, which is 20 iles east of this area. Houston (1950, p. 19) lists an average growing season 157 days (May 2 to October 6), based on records at Caliente. Killing temperares vary according to type of crop. In recent years Weather Bureau records st freeze data rather than killing frosts; the dates are listed for the occurrence the last spring minimum and the first fall minimum for temperatures of 32°F. below, 28°F. or below, and 16°F. or below. From these data the number of ys between the last spring minimum and the first fall minimum occurrence for e respective temperature groups are given. The following tabulation lists the mber of days for the three temperature groups recorded for the period 1952-61 Alamo, Caliente, and Pioche.

Number of days between temperatures of:
(from published records of the U.S. Weather Bureau)

	32°F or below			28°F or below			24°F or below		
ear	Alamo	Caliente	Pioche	Alamo	Caliente	Pioche	Alamo	Caliente	Pioche
52	177	183	173	212	208	210	227	227	232
53	117	122	143	150	144	161	208	191	166
54	219	151	136	230	206	176	257	210	177
55	141	137	143	178	178	170	208	186	197
56	134	151	152	183	--	163	202	204	204
57	163	138	134	169	162	190	238	227	227
58	173	134	178	176	152	179	222	191	224
59	151	135	131	184	150	178	228	200	209
60	144	141	144	164	189	164	198	205	204
61	129	136	148	156	179	165	188	183	188
r-	154	142	148	180	174	175	217	202	180

Table 3.--Total evaporation at Caliente, Nev. (1956-61)

(from published records of the U.S. Weather Bureau)

Year	March	April	May	June	July	August	September	October	November
1956			7.42	[b]12.55	11.10	10.86	8.07	[b]4.65	2.05
1957	3.97	6.76	6.33	10.66	11.45	[b]11.60	7.54		
1958		[b]6.39	9.35	11.99	12.39	11.73	7.56	5.00	
1959		7.56	9.59	11.89	11.71	10.10	7.18		
1960			9.78	10.94	11.16	10.87	7.34	4.06	
1961		7.19	9.40	12.07	11.06	7.90	6.68	[b]4.07	
Average			8.64	11.67	11.48	10.51	7.39		

b/ Adjusted to full month by Weather Bureau.

hysiography and Drainage:

Dry Lake and Delamar Valleys occupy a surficially closed trough in the reat Basin section of the Basin and Range physiographic province of Fenneman 931, p. 328). The north-trending trough is bounded on the east successively om the north by the Ely, Bristol, Highland Peak, and Delamar Ranges. A uthwest-trending spur of the Ely Range forms the northwest boundary of Dry ake Valley. The Pahroc (also Pahrock) Range bounds the central part of the ough on the west. On the southwest unnamed ranges, commonly with poorly fined drainage divides, comprise the boundary. The south end of Delamar alley is separated from Pahranagat Valley by a low alluvial divide.

The highest point in the mountains enclosing Dry Lake and Delamar alleys is Highland Peak with an altitude of about 9,500 feet. The crest of the ristol and Highland Peak Ranges is more than 8,000 feet above sea level for a stance of about 12 miles. The crest of the mountains along the northwest and st sides has an altitude of more than 7,000 feet for a combined distance of out 42 miles. Elsewhere the crests are less than 6,000 feet above sea level, cept for short segments whose altitudes are somewhat above 7,000 feet.

The lowest part of the trough of Dry Lake and Delamar Valleys is the aya or dry lake, in the southern part of Delamar Valley (see inside cover otograph) which has an altitude of slightly less than 4,400 feet. The altitude the playa in Dry Lake Valley is somewhat less than 4,600 feet. Dry Lake and elamar Valleys are separated by an alluvial divide whose saddle altitude is about 875 feet.

The trough of Dry Lake and Delamar Valleys is higher than those of hite River and Pahranagat Valleys on the west and Meadow Valley Wash on e east, which are tributary to the Colorado River (fig. 2). In Dry Lake and elamar Valleys the altitude decreases irregularly from about 5,400 feet at the titude of Fairview Peak in the north to about 4,400 feet at the north end of the elamar playa in a distance of about 55 miles, or an average decrease of 18 feet er mile. In the White River and Pahranagat Valleys to the west the altitude of e floor of the channel decreases from about 5,100 feet to 3,600 feet in the same stance, giving an average gradient of about 27 feet per mile. Similarily, in eadow Valley Wash and in Lake Valley to the east, the altitude decreases from ,900 feet to 3,900 feet in the same distance, giving an average gradient of about 6 feet per mile. Thus, the steeper gradients in the adjacent valleys result in e land surface altitude of the channels being substantially lower than the land urface altitude in the southern part of the trough of Dry Lake and Delamar alleys. In fact, the playa in Delamar Valley is nearly 1,200 feet higher than e floor of Pahranagat Valley in the vicinity of Maynard Lake. The topographic ositions and geology of these valleys largely control the occurrence and movement of ground water in the region. There are no perennial streams in Dry Lake nd Delamar Valleys, and the gross physiographic features of most of the stream hannels and washes probably were formed during periods of greater precipitaon--probably in Pleistocene time. Present-day streamflow occurs for short eriods only after high-intensity rains and from snowmelt runoff. Only runoff from high-intensity rains can provide large volumes of flow to cause local erosion and substantial transport of sediments in sufficient quantity to modify stream channels and washes.

The main channel along the axis of the northern part of Dry Lake Valley is contained between relatively steep banks about 25 feet below the general level of the valley. The floor of the channel is covered with white sage, and the soil is fine-grained as it is in adjacent parts of the valley floor. This feature suggests that flash-flood erosion in this channel is most uncommon. Farther south, channels draining the Highland Peak and Delamar ranges have somewhat steeper gradients. In this area flood flows occasionally transport relatively coarse gravel to the lower part of the alluvial apron. One example of this was noted along a wash crossing the trail about in sec. 22, T. 1 N., R. 65 E.

During Pleistocene time, lakes occupied the playa areas of Delamar and Dry Lake Valleys. Tschanz and Pampeyan (1961) mapped about 16 miles of beach or strand line along the west, south, and southeast sides of the Dry Lake playa, and about 14 miles along the equivalent segments of the Delamar playa. These represent the highest shore lines identified in these valleys.

Maximum depths of the Pleistocene lakes were on the order of 75 feet in Dry Lake Valley and perhaps 50 feet in Delamar Valley, according to Carpenter (1915, p. 65, 66). The surface areas of the lakes in Dry Lake and Delamar Valleys were about 30 and 16 square miles, respectively.

GENERAL GEOLOGY

The following discussion of geology is based largely on the reconnaissance geologic maps of Tschanz and Pampeyan (1961) and Tschanz (1960). Other reports that relate to the geology in and adjacent to Dry Lake and Delamar Valleys include those prepared by Westgate and Knopf (1932), Callaghan (1936, 1937), Reso and Croneis (1959), and Kellog (1960).

For the purposes of this report the rocks of Dry Lake and Delamar Valleys are divided into two general groups and further subdivided into four major units. The distribution of these four units is shown on plate 1. One group primarily represents bedrock in the mountains. It is divided into a Paleozoic carbonate unit and a Paleozoic clastic and Tertiary volcanic and clastic rock unit.

Tschanz (1960, p. 198) indicates that the total thickness of Paleozoic rocks exposed in northern Lincoln County is between 30,000 and 33,000 feet. As described, one may infer that carbonate rocks (limestone and dolomite) probably constitute about 60 percent of the total section. This is somewhat less than the 80 percent of carbonate rocks in a total section of about 30,000 feet noted by Kellog (1960, p. 189) in his study of the southern Egan Range, which is 10 to 15 miles northwest of the area. The second unit of the bedrock group includes Paleozoic shale, sandstone or quartzite, and conglomerate and Tertiary volcanic rocks, chiefly tuff and intravolcanic sedimentary rocks. Because of their importance to the ground-water hydrology of the region, the Paleozoic carbonate rocks are distinguished from Paleozoic clastic and Tertiary volcanic rocks on plate 1 as discussed subsequently in this report.

The second group is designated the valley fill and is divided into older and younger valley fill. The older deposit consists of unconsolidated to partly consolidated silt, sand, and gravel derived from adjacent highland areas, but also includes some rocks of volcanic origin. This unit was deposited largely under subaerial and lacustrine environments. Although data are not available, the maximum thickness of this unit probably is at least several hundred feet.

The younger valley fill includes clay, silt, sand, and gravel of Quaternary age and is largely restricted to stream channels and playa areas. As defined, this unit is relatively thin and probably is no more than a few tens of feet thick. The valley fill is underlain by bedrock, presumably similar in character to that exposed in the mountains.

Water-Bearing Properties of the Rocks:

The rocks of Paleozoic age generally have had their primary permeability, that is, permeability at the time of deposition, considerably reduced by consolidation, cementation, or other alteration. However, because they subsequently have been fractured repeatedly by folding and faulting, secondary openings have developed through which some ground water is transmitted. Further, fractures or joints in Paleozoic carbonate rocks locally have been enlarged by solution as water moves through them. Solution openings develop near sources of recharge where carbon dioxide carried by rain water penetrates the ground, where organic acids derived from decaying vegetation, or where otherwise derived acids may be carried by the water into contact with the carbonate rocks. Solution openings need not be restricted to the vicinity of present day recharge areas and outcrops of these rocks. Rather, they may occur wherever the requisite conditions have occurred anytime since the deposition of the carbonate rocks. The principal significance of solution openings is that they further facilitate movement of ground water through carbonate rocks.

Whether existing fractures or solution openings have extensive hydraulic connection or not is related to the overall geologic history of the rocks. In the absence of detailed information, ground-water movement through carbonate rocks in this region is assumed to occur both through fractures and solution openings. Certainly, the large quantity of ground water issuing from fractures and solution openings, such as those at Crystal and Ash Springs in Pahranagat Valley, is a dramatic demonstration that ground-water movement through Paleozoic carbonate rocks occurs in this region of Nevada.

The Paleozoic clastic rocks and the Tertiary volcanic and clastic rocks exposed in the mountains generally have little primary permeability. Secondary fractures probably are the principal means by which limited amounts of ground water are transmitted through them. Favorably disposed fractures in these rocks probably provide the network of openings through which water moves and is discharged at small springs in the mountains and which yield a few gallons per minute to wells penetrating these rocks. Under extremely favorable conditions the distribution of fracture openings in welded tuff, lava flows, or Paleozoic clastic rocks may permit the development of moderate yields of water from wells. However, these occurrences are likely to be so localized that the odds of a well encountering them are very small indeed.

The unconsolidated sand and gravel of the valley fill in Dry Lake and Delamar Valleys is capable of transmitting ground water freely. However, most of the valley fill probably is composed of deposits of fine sand and silt. Grains of this size generally have relatively low permeability and, where saturated, transmit water much more slowly than coarse sand and gravel. Deposits of silty clay and clay may transmit water so slowly to wells that they will not yield supplies adequate for stockwatering purposes. Various parts of the valley fill probably are moderately consolidated or cemented and this further reduces the capacity of these deposits to transmit useful supplies of water to wells.

GROUND-WATER APPRAISAL

Occurrence of Ground Water:

Ground-water recharge in ~~Dry Lake and~~ Delamar Valleys is derived principally from precipitation within the surficial drainage area of the valleys. In a general way, ground water moves from recharge areas in and bordering the mountains toward the central parts of the valleys, thence southward or southwestward to discharge through bedrock formations. This is in contrast with hydrologically closed valleys commonly found in the Basin and Range province. Carpenter (1915, p. 67) indicated that ground water in Bristol (Dry Lake) and Delamar Valleys probably finds an outlet in Pahranagat Valley. Snyder (1963, p. 400) refers to Dry Lake Valley as being a drained valley; that is, ground water moves out of the valley to discharge elsewhere.

In typical hydrologically closed valleys in the Great Basin, ground water is recharged from precipitation largely in the mountains enclosing the valley. Ground water moves from areas of recharge toward the ground-water reservoir in the valley fill underlying the central part of the valley. In or adjacent to the topographically lowest part of the valley, the water table, or upper surface of the zone of saturation, is within a few feet of land surface. Where the water table is close to land surface, ground water is discharged naturally by evaporation from the soil or from free-water surfaces and is transpired by plants (phreatophytes) which obtain most of their water from the zone of saturation or overlying capillary fringe.

Under long-term conditions in a hydrologically closed ground-water system, average annual recharge to the ground-water reservoir equals the average annual natural discharge. However, if a ground-water system in a topographically closed valley is hydrologically open, recharge from precipitation in the valley may be greater or less than the discharge within the valley. Where recharge from precipitation within the valley is greater than discharge in the valley, ground water must be discharging by underflow from the valley to an area to areas of lower hydraulic head. Where the recharge from precipitation within the valley is less than discharge in the valley, recharge in part must be entering the valley from an area or areas beyond the topographic divide having a higher hydraulic head.

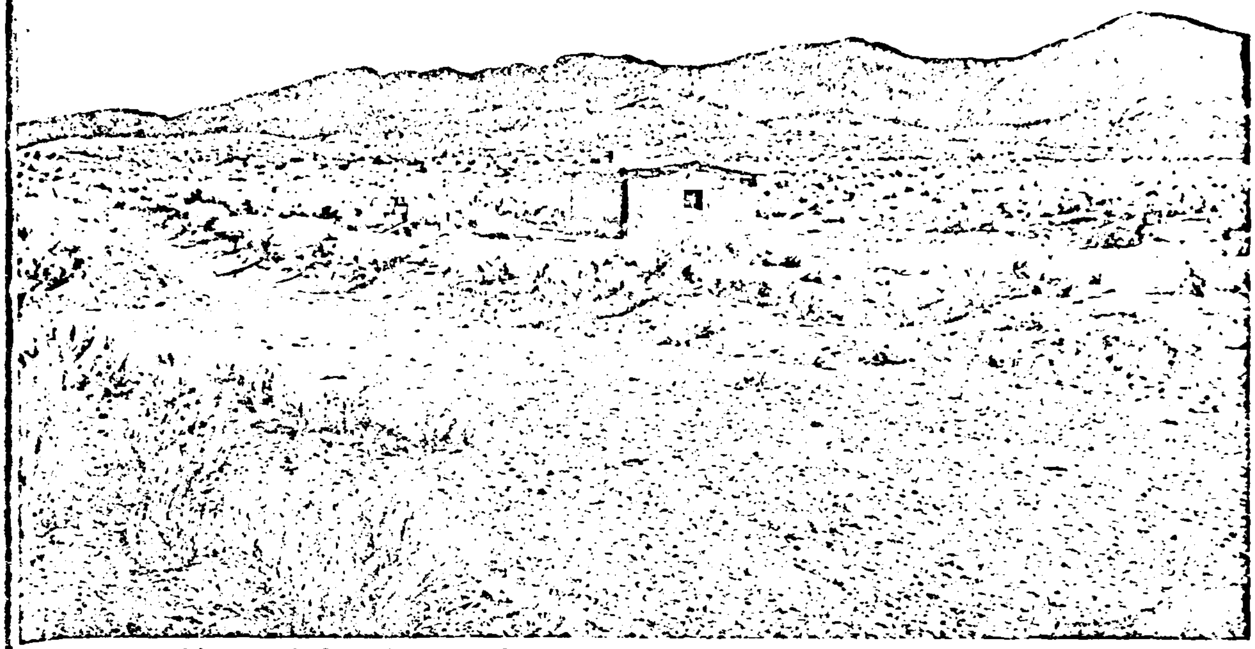
In addition to hydraulic controls, the water-bearing character of the rocks and their structure are important factors in the movement, or impedance to movement, of ground water. Where bedrock formations in the enclosing mountains are relatively impermeable, ground water normally is part of a closed hydrologic system in a topographically closed valley. Where the bedrock formations are at least locally permeable, the ground-water system may be hydrologically open. Winograd (1962, p. 110) has referred to this relationship in the vicinity of Yucca Flat in southern Nevada.

The chemical quality of the ground water is another factor that may be an aid in evaluating the nature of a ground-water system. Ordinarily, the concentration of chemical constituents shows considerable variation in different parts of a ground-water system. Generally, the concentration is least in areas of recharge and tends to be greatest in areas of natural discharge. Despite the normal variations that may be expected in the chemical constitutents in ground water in a given system, the character and concentration of one or more constituents may aid in identifying whether or not a given system is closed.

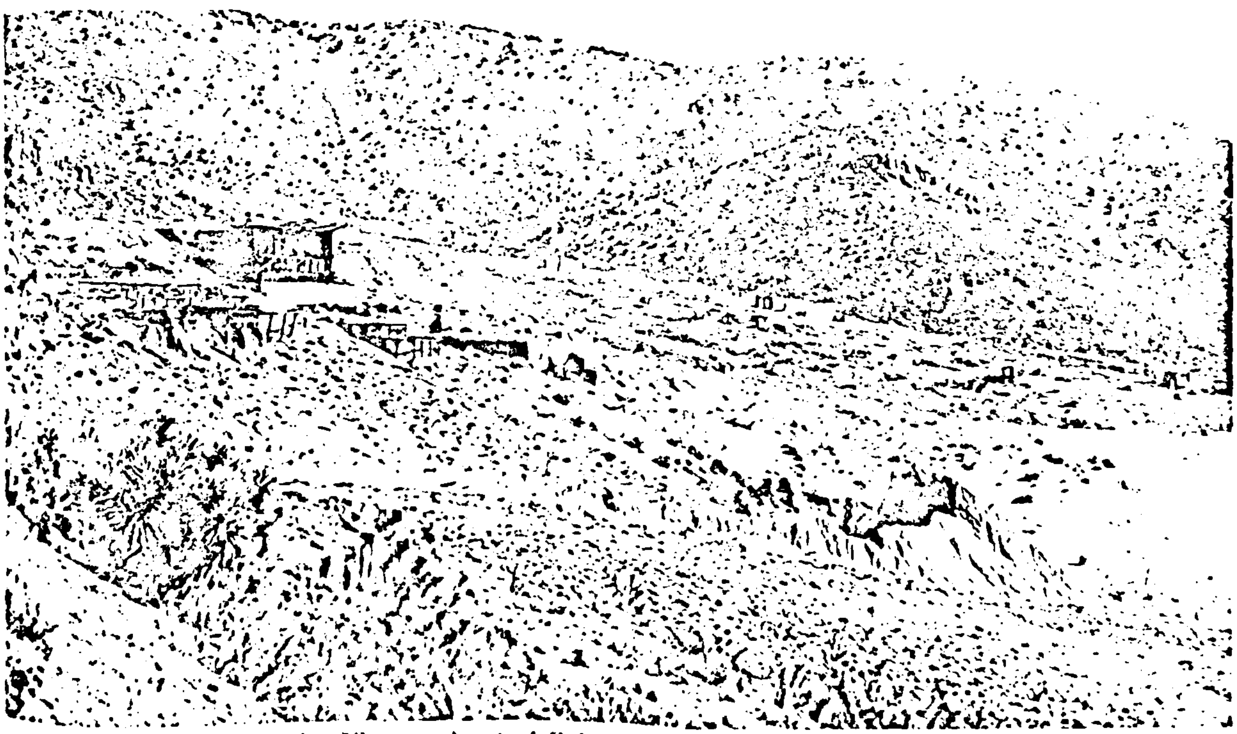
In summary, closed or open ground-water systems may be identified by the relationship of recharge to discharge within the valley, by potential hydraulic gradients between the reference valley and adjacent valleys, by the water-bearing character of geologic formations, including modifications by structural deformation, and by the chemical quality of the ground water with respect to that in adjacent areas.

In ~~Dry Lake and~~ Delamar Valleys, the principal areas of recharge are centered in the mountains along the northwest, northeast, and east sides of Dry Lake Valley. From the areas of recharge, ground water moves toward the central part of the valley. Along at least some of the stream canyons or washes ground water is not far below land surface, such as at Bristol wells (3N/65-21d3) (See cover photograph and photograph 3) and well 1N/65-2a1 where the depth to water is about 45 feet and 10 feet, respectively. Near the centers of the valleys the depths to water generally are substantial. For example, well 5N/64-14a1 is dry at a depth of about 240 feet, an altitude of roughly 5,385 feet; the depth to water in well 3N/64-20b1 is about 318 feet, altitude of about 4,820 feet; the depth to water in well 2N/64-3b1 is about 664 feet, altitude about 4,350 feet; and the depth to water in well 1N/64-24a1 is about 398 feet, altitude on the order of 4,300 feet.

In Delamar Valley, water for the mines and town of Delamar (photograph 4) was obtained from small springs and wells in the volcanic rocks in a nearby wash according to Callaghan (1937, p. 35). Callaghan further states that this supply was inadequate and that a well was drilled 900 feet deep in the alluvium of Delamar Valley which was dry throughout. The approximate well site is shown



Photograph 3. View east of stone cabin at Bristol Wells. Well 3N/65-21d2 is a short distance to the left of the cabin. The north end of the Bristol Range forms the skyline. Bristol Wells was an early water supply point for stock and travelers, it supported a small smelter operation and at least part of the water requirements of the Bristol Silver mine about 4 miles to the southeast, beyond the right side of the picture.

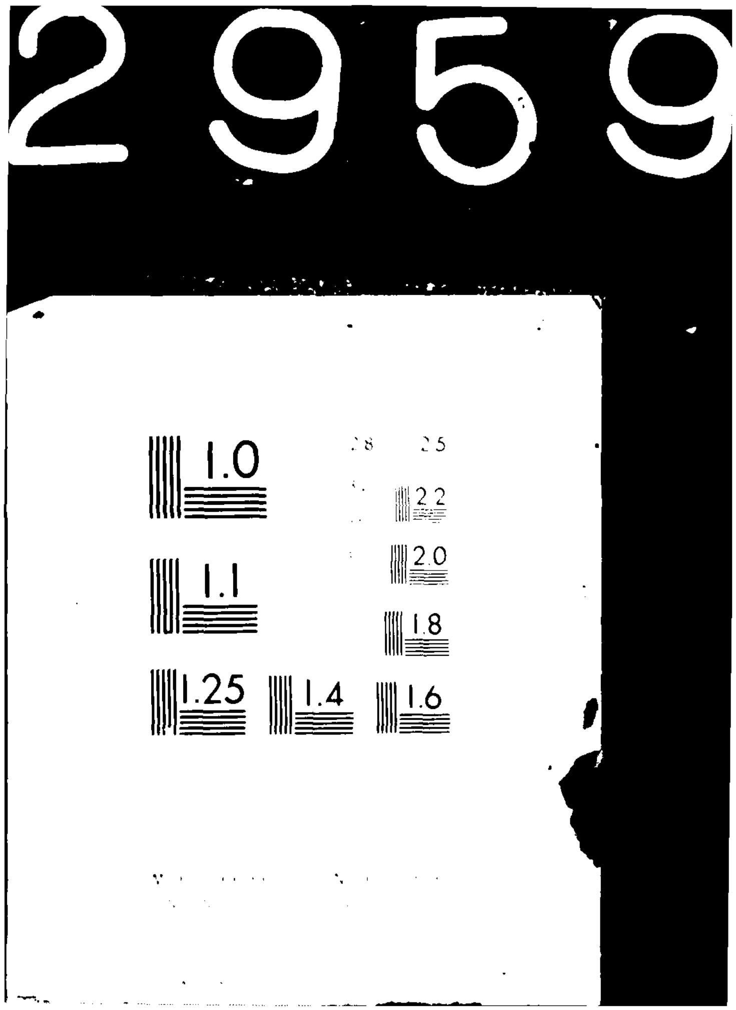


Photograph 4. View southeast of Delamar. Structure to left is remains of mill. Light colored band extending to right edge of picture is part of tailings. Wind action has heavily sculptured and removed a considerable volume of the tailings. In middle distance stone walls mark the principal area of Delamar townsite. Principal mining was in hill to left of left side of picture, although numerous prospect pits mark hill in background. Most of water supply for Delamar was brought in by pipeline from Meadow Valley Wash, 10 to 12 miles to the east.

AD-A112 959 ERTEC WESTERN INC LONG BEACH CA F/G 13/2
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE--ETC(U)
SEP 81 F04704-80-C-0006
UNCLASSIFIED E-TR-53-2 NL

3 OF 3
AD A
112959

END
DATE
FILMED
05-82
DTIC


2959
1.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

as 6S/63-12a1 on plate 1. However, the details of drilling are not known. If the well literally did not encounter water throughout the full 900 feet, the water-level altitude in this area may be below about 3,700 feet, subject of course to the accuracy of land-surface altitude and the location of the well site.

The great depth to water below the playa areas of Dry Lake and Delamar Valleys precludes evapotranspiration losses from the ground-water reservoir in these valleys, except for extremely small amounts adjacent to scattered springs in the mountains. Inasmuch as the average annual ground-water recharge to Dry Lake and Delamar Valleys is estimated to be several thousand acre-feet per year (p. 34-37), and as no equivalent ground-water discharge by evapotranspiration occurs in the valleys, virtually all the ground water is discharged from the valleys by underflow through bedrock.

That ground water is discharged outside these valleys is further confirmed by the hydraulic gradients between Dry Lake and Delamar Valleys and adjacent valleys. As noted previously the altitude of the ground-water levels in Dry Lake and Delamar Valleys decreases southward along the axial part of the valleys. Available control points do not precisely define the altitude of the ground-water levels in the valleys. However, an apparent gradient is indicated by the water-level altitudes at the several drilling sites; that is, less than about 5,385 feet in sec. 14, T. 5 N., R. 64 E., about 4,820 feet at well 3N/64-20b1, about 4,350 feet at well 2N/64-3a1, and somewhat below about 3,700 feet at well 6S/63-12a1 in Delamar Valley. Thus, the hydraulic gradient is southward at more than 35 feet per mile in the northern part of Dry Lake Valley, and southward at somewhat more than 18 feet per mile from the north-central part of Dry Lake Valley to the central part of Delamar Valley.

Valleys to the east and west of Dry Lake and Delamar Valleys surficially drain to the Colorado River. Along the White River channel in Pahranagat Valley, Hiko Spring issues from about the alluvial-carbonate bedrock contact at an altitude of about 3,890 feet. About 5 miles south of Hiko Spring, Crystal Springs issue from limestone and alluvium at an altitude of about 3,815 feet. About 5 miles farther south in Pahranagat Valley, Ash Springs issue from limestone at the alluvial-bedrock contact at an altitude of about 3,610 feet. About 30 miles farther south in the vicinity of Lower Pahranagat and Maynard Lakes, at the south end of Pahranagat Valley, ground water in the alluvium is near land surface and is at an altitude of about 3,150 feet. Additionally, the depth to water in well 4S/61-15a1, about 6 miles east of Hiko Spring, is about 678 feet or an altitude of about 3,700 feet. Land surface along the White River channel and known water-level altitudes south of Maynard Lake along the White River channel are lower still. Maynard Lake is only about 10 miles southwest of the playa in Delamar Valley. Thus, ground water from Dry Lake and Delamar Valleys could discharge to Pahranagat Valley by underflow to the west, south, or southwest, based in terms of the potential hydraulic gradient.

Along Meadow Valley Wash to the east, land-surface altitude in the wash is above 4,000 feet northward from a point about 10 miles south of Caliente. The depth to water in the wash is generally within a few tens of feet below land surface;

therefore, the water-level altitude in Meadow Valley Wash probably is equal to or higher than that in Dry Lake and Delamar Valleys at equivalent latitudes throughout most of their lengths. For most of the same distance, the mountain area probably provides sufficient recharge to maintain a hydraulic divide between the two areas. Thus, a major transfer of ground water between the two areas does not seem likely.

In further considering ground-water discharge by underflow from Dry Lake and Delamar Valleys, the Paleozoic carbonate rocks appear to be the most favorable rocks to transmit ground water. The springs in Pahranagat Valley demonstrate that ground water moves through solution openings and fracture systems in some quantity, at least locally. Ground-water movement through similar Paleozoic rocks in Cave Valley, northwest of Dry Lake Valley, has been described in a previous report (Eakin, 1962). Drilling at the Nevada Test Site, about 75 miles southwest of this area, has shown that the Paleozoic carbonate rocks transmit ground water more readily than do the Paleozoic clastic rocks and Tertiary tuff (Winograd, 1962, p. 110). Thus, the Paleozoic carbonate rocks probably afford the best opportunity for ground-water movement between valleys in this area.

Plate 1 shows the surficial distribution of Paleozoic carbonate rocks in Dry Lake and Delamar Valleys. They are exposed most extensively along the east and northwest sides of Dry Lake Valley. Along the west and south sides of Delamar Valley, younger volcanic rocks crop out. However, Paleozoic carbonate rocks undoubtedly underlie the volcanic rocks in this area and, further, are exposed along White River channel in Pahranagat Valley and southward (Tschanz and Pampeyan 1961, and Bowyer, Pampeyan, and Longwell, 1958). Accordingly, the distribution of Paleozoic carbonate rocks in this area in favorable to the movement of ground water southward or southwestward from Dry Lake and Delamar Valleys to Pahranagat Valley.

If the Paleozoic carbonate rocks are capable of transmitting ground water by underflow from Dry Lake and Delamar, the converse may be true; that is, ground water may move into Dry Lake and Delamar Valleys from the north through carbonate rocks from valleys upgradient from Dry Lake and Delamar Valleys. This may be evaluated roughly as follows: In the northern part of Dry Lake Valley the lowest known water-level altitude is about 4,820 feet at well 3N/64-20b1. Higher water-level altitudes occur in White River Valley to the west and northwest; in Cave Valley to the northwest, and in Lake Valley to the north and east. However, the mountains enclosing the northern part of Dry Lake Valley are areas favorable to recharge from precipitation. Because they are areas of recharge, the water levels, in these mountain blocks also must be assumed to be areas of relatively high water levels. Thus, although actual water levels are not available in these areas, it is strongly inferred that ground-water divides occur beneath the mountains and thus provide hydraulic barriers to ground-water movement from adjacent valleys into the northern part of Dry Lake Valley. Similarly, it is inferred that a hydraulic divide exists in the Bristol and Highland Peak Ranges on the east side of Dry

Lake Valley and provides a hydraulic barrier to ground-water movement between Dry Lake Valley and Meadow Valley Wash. The same condition probably occurs in the Delamar Range on the east and southeast sides of Delamar Valley, although this range probably receives less recharge from precipitation than do the ranges to the north.

The mountains bordering the west side of Dry Lake and Delamar Valleys apparently provide only meager recharge from precipitation. The amount probably is not sufficient in magnitude or time to maintain a hydraulic barrier between Dry Lake and Delamar Valleys and White River and Pahranagat Valleys.

In summary, most, if not all, of the ground-water recharged to Dry Lake and Delamar Valleys is believed to be derived from precipitation within their surficial drainage areas. Ground water moves from the areas of recharge toward the central part of the valleys, thence generally southward or southwestward. Ground water is discharged from the trough of Dry Lake and Delamar Valleys by underflow through Paleozoic carbonate rocks to areas downgradient from the trough; that is, most probably into Pahranagat Valley, southwest of Delamar.

The depth to water in the central part of the trough of Dry Lake and Delamar Valleys is deep--probably too deep for economic recovery of ground water for the usual uses in this region, except possibly for stock purposes. Depths to water in the lower parts of the valleys decrease from somewhat more than 300 feet in T. 3 N., R. 64 E., to about 400 feet in the south part of T. 1 N., R. 64 E., to possibly more than 1,000 feet beneath the playa area of Delamar Valley. Perched or semiperched ground water in the mountains and upper parts of the alluvial apron locally supply water to small springs and locally is at a sufficiently shallow depth to permit the development of small water supplies by wells, such as at Bristol wells and well 1N/65-2a1.

Estimated Average Annual Recharge:

The average annual recharge to the ground-water reservoir may be estimated as a percentage of the average annual precipitation within the valley (Eakin and others, 1951, p. 79-81). A brief description of the method follows: Zones in which the average precipitation ranges between specified limits are delineated on a map, and a percentage of the precipitation is assigned to each zone which represents the probable average recharge from the average precipitation for that zone. The degree of reliability of the estimate so obtained, of course, depends on the degree to which the values approximate [illegible] actual precipitation in the several zones, and the degree to which the a[illegible]d percentages represent the actual proportion of recharge to ground water. Neither of these factors is know precisely enough to assume a high degree of reliability of the recharge estimate for any one valley. However, the method has proved useful for reconnaissance estimates and experience suggests that in many areas the estimates probably are relatively close to the actual long-term average annual recharge.

The precipitation map of Nevada (Hardman and Mason, 1949, p. 10) has been adjusted (Hardman, oral communication, 1962) to the improved topographic base maps (scale 1:250,000) now available for the whole State. The base map for plate 1 of this report was prepared from the same series of topographic maps. The several zones of precipitation applicable to Dry Lake and Delamar Valleys are as follows: the boundary between the zones of less than 8 inches and 8 to 12 inches of precipitation was delineated at the 6,000-foot contour; between 8 to 12 inches and 12 to 15 inches, at the 7,000-foot contour; between 12 to 15 inches and 15 to 20 inches, at the 8,000-foot contour; between 15 to 20 inches and more than 20 inches at the 9,000-foot contour.

The average precipitation used for the respective zones, beginning with the zone of 8 to 12 inches of precipitation, is 10 inches (0.83 foot), 13.5 inches (1.12 feet), 17.5 inches (1.46 feet), and 21 inches (1.75 feet).

The percentages of the average precipitation assumed to represent recharge for each zone are: less than 8 inches, 0; 8 to 12 inches, 3 percent; 12 to 15 inches, 7 percent; 15 to 20 inches, 15 percent; and more than 20 inches, 25 percent.

Table 4 summarizes the computation of recharge for Dry Lake and Delamar Valleys. The recharge (column 5) for each zone is obtained by multiplying the figures in columns 2, 3, and 4. Thus, for the zone of 12 to 15 inches of precipitation in Dry Lake Valley the computed recharge is 16,000 (acres) times 1.12 (feet) times .25 (25 percent) = about 1,300 acre-feet. The estimated total average annual recharge to ground water in Dry Lake and Delamar Valleys is about 6,000 acre-feet.

Table 4.--Estimated average annual ground-water recharge from precipitation in Dry Lake and Delamar Valleys, Nev.

(1) Precipitation zone (in inches)	Dry Lake Valley) (2) Approximate area of zone (acres)	(3) Average annual precipitation (feet)	(4) Percent recharged	(5) Estimated recharge (acre-feet) (2x3x4)	Delamar Valley (2) Approximate area of zone (feet)	(3) Average annual precipitaion (feet)	(4) Percent recharged	(5) Estimated recharge (ac.-ft) (2x3x4)
20+	200	1.75	25	100	0	- -	- -	- -
15-20	3,200	1.46	15	700	0	- -	- -	- -
12-15	16,000	1.12	7	1,300	4,000	1.12	7	300
8-12	114,000	.83	3	2,700	35,000	.83	3	900
8 -	442,000	- -	0	- -	208,000	- -	0	- -
	575,400 about 900 sq. mi.	Estimated average annual recharge (rounded)		5,000	247,000 about 385 sq. mi.	Estimated average annual recharge (rounded)		1,000

Estimated Average Annual Discharge:

Only a very small amount of ground water is discharged from Dry Lake and Delamar Valleys by evaporation and transpiration. Areas where ground water evaporates from soil or from free-water surfaces or is transpired by vegetation are restricted to isolated areas adjacent to the few small springs. The largest of these occurs near the spring at the Meloy Ranch in the southern part of T. 5 N., R. 65 E. Discharge was estimated to be about 20 gpm in March 1963. The few wells in the valley are used largely to provide water for stock, and the total withdrawals are very small. In the past, Bristol wells have been used in part to supply water requirements for mine camps and travelers. Similarly, wells and springs in Cedar Wash were used for water supply at Delamar. However, neither of these supplies were adequate.

Because of the great depth to water, no large areas of evapotranspiration from ground water occur in the lower parts of Dry Lake and Delamar Valley. Most of the ground water apparently is discharged by underflow through bedrock from Dry Lake and Delamar Valleys, but the amount cannot be directly determined. However, to the extent that the estimate of ground-water recharge is correct, and because over a long period of time recharge equals discharge, ground-water discharge by underflow is about 6,000 acre-feet per year minus the small amount, probably less than a few hundred acre-feet discharged by wells and by evapotranspiration adjacent to spring areas.

Perennial Yield:

The perennial yield of a ground-water system is the amount of natural discharge that can be salvaged for beneficial use from the ground-water system. It is the upper limit of the amount of water that can be withdrawn economically from the system for an indefinite period of time without causing a permanent and continuing depletion of ground water in storage and without causing a deterioration of the quality of water. The average recharge from precipitation and streams, discharge by evapotranspiration, discharge to streams, and underflow from a valley are measures of the natural inflow and outflow from the ground-water system.

In an estimate of perennial yield, consideration should be given to the effects that ground-water development of wells may have on the natural circulation in the ground-water system. Development by wells may or may not induce recharge in addition to that received under natural conditions. Part of the water discharged by wells may re-enter the ground-water reservoir by downward percolation, especially if the water is used for irrigation. Ground water discharged from wells theoretically is offset eventually by a reduction of the natural discharge. In practice, however, it is difficult to offset fully the discharge from wells by a decrease in the natural discharge, except when the water table has been lowered to a level that eliminates both underflow and evapotranspiration in the area of natural discharge. The numerous pertinent factors are so complex that, in effect, specific determination of perennial yield of a valley requires a very extensive investigation, based in part on data that can be obtained economically only after there has been substantial development of ground water for several years.

The ground-water system in Dry Lake and Delamar Valleys, as presently understood, is such that economics probably is the controlling factor in the determination of perennial yield. The great depth to water in most of the valley more or less precludes large-scale withdrawals for most uses. Hydrologically, the saturated zone, or reservoir, underlying the floor of the valleys is the most likely area in which to develop substantial water supplies. At the depth of water indicated, the ground-water reservoir probably occurs largely in Tertiary rocks or in underlying Paleozoic carbonate rocks beneath the floor of the valleys.

Whether development occurs in the Tertiary or younger rocks of the valley fill or in the Paleozoic carbonate rocks, withdrawals for a long time would have to come largely from ground water in storage. The amount of stored ground water to be removed is many times the average annual recharge and undoubtedly would require many years of pumping. Pumping from storage would result in a lowering of water levels extending outward from the area of pumping farther and farther until the area of influence eventually would divert virtually all the water from areas of recharge to the area of pumping. After this was accomplished, pumping levels would tend to stabilize, providing that the average annual net withdrawals from pumping were equal to the recharge to the pumped area. The net withdrawals at that time would be equal to perennial yield. Thus, the perennial yield would be limited to the amount of inflow that could be diverted from the areas of recharge to the area of pumping influence.

Whether the magnitude of perennial yield ultimately equals total recharge to the valley depends upon the relative location of the area of pumping with respect to the several areas of recharge to the valley, the relation of the area of pumping with respect to the principal area of ground-water discharge or underflow from the valley, and the altitude of economic pumping levels with respect to altitude of natural discharge or underflow. In Dry Lake and Delamar Valleys, the costs of pumping relatively large quantities of ground water to modify appreciably the natural ground-water regimen to salvage all the natural discharge undoubtedly would be prohibitive for all but the most exceptional water requirements. However, to the extent that such development might occur, the area in and adjacent to Tps. 1 S. and 1 N., R. 64 E., is located favorably with respect to ground-water storage, and sufficient development might result ultimately in salvaging much of the discharge from Dry Lake Valley. However, it is conceivable that to salvage a large part of the estimated 6,000 acre-feet of average annual discharge from the valley, water levels might have to be drawn down as much as 1,500 feet below land surface.

Ground-Water in Storage:

The amount of ground water stored in the valley fill and underlying bedrock in Dry Lake and Delamar Valleys is substantial. It is many times the average annual recharge to and discharge from the ground-water reservoir in these valleys. To the extent that ground water may be developed, the volume of ground water in storage provides a reserve for maintaining an adequate supply for pumping during protracted periods of drought or for temporary periods of high demand under emergency conditions. This reserve, in effect, increases the reliability of ground water as a dependable source of supply and is an important asset in semiarid regions where surface-water supplies vary widely from year to year.

Chemical Quality:

The chemical quality of the water in most ground-water systems in Nevada varies considerably from place to place. In the areas of recharge the chemical concentration of the water normally is very low. However, as the ground water moves through the system to the areas of discharge, it is in contact with rock materials which have different solubilities. The extent to which the water dissolved chemical constituents from the rock materials is governed in large part by the solubility, volume, and distribution of the rock materials, by the time the water is in contact with the rocks, and by the temperature and pressure in the ground-water system.

The following analysis of water from Bristol well was reported by Carpenter (1915, p. 30). Constituents are listed in parts per million.

Silica	(SiO_2)	49	Carbonate	(CO_3)	0.0
Iron	(Fe)	.7	Bicarbonate	(HCO_3)	187
Calcium	(Ca)	76	Sulfate	(SO_4)	71
Magnesium	(Mg)	33	Nitrate	(NO_3)	32
Sodium plus			Chloride	(Cl)	110
Potassium	(Na + K)	37			
Total hardness as $CaCO_3$		325			
Total solids		509			

The analysis probably does not represent the typical chemical quality of ground water in Dry Lake Valley. However, it is somewhat suggestive of a mixed-water type found in the region. In some areas, ground water in Paleozoic carbonate rocks will contain a relatively high proportion of calcium magnesium, and bicarbonate due to solution of the carbonate rocks. As that water moves into Tertiary volcanic rocks or deposits derived from such rocks the proportion of sodium will increase partly by base exchange and partly by addition to the dissolved solids in the water until the water becomes a sodium-bicarbonate type. The relatively high chloride and nitrate in the analysis suggests local contamination, a condition that might well be expected from the local concentration of people and stock of the watering point when Bristol wells supplied water to the nearby mines and was the site of a small settlement and a smelter.

If it can be assumed that the analysis may be more or less representative of ground water in the lower part of Dry Lake Valley, with the exception of the high concentration of chloride and nitrate, the water would be suitable for domestic and stock purposes.

Development:

Small amounts of ground water from springs and wells are used to water livestock feeding on the range in Dry Lake Valley. Carpenter (1915, p. 66) reported that Bristol well (3N/65-21d1) formerly furnished the water supply for a smelter. He reported too, that several wells were dug in the vicinity and a small town sprung up around them. However, when Carpenter visited the area in 1912, only one well remained. This well had been in use to supply water to the traveling public and for miners at the Bristol mine a few miles east. The well could be pumped dry at that time during the filling of water tanks used to supply water at the mine. In October 1912 the well was 51 feet deep and water level was 43 feet below land surface. Seemingly the well has since been destroyed. There are three drilled wells in that area that are used to water stock. Reportedly, however, all three do not provide a sufficient supply to meet the needs.

Near Delamar, Carpenter (1915, p. 67) noted that water was piped from several springs, reported to be small seepages in the limestone and granite. Callaghan (1937, p. 35) also refers to the water supply of Delamar but refers to the earlier used springs and wells in a nearby wash as being developed in volcanic rocks. Carpenter also reported that well 6S/63-12a1, drilled 900 feet deep at the foot of the alluvial slope below Delamar, was dry. He further states that when the mine at Delamar was active, water supply was obtained from Meadow Valley Wash, which was pumped over the Meadow Valley Range (Delamar Range) through two 3 1/2-inch pipe lines.

Presently, ground water from wells and springs probably supplies less than 100 acre-feet per year and is used principally for watering stock in Dry Lake and Delamar Valleys. Development of ground water for irrigation probably would be prohibitive because of high pumping costs. Limited amounts of ground water could be developed, if the need were great enough.

The very substantial depths to water in the central parts of Dry Lake and Delamar Valleys, which makes the cost of development of ground water too high for usual purposes, may make the area attractive for some types of special testing or operation required in modern day technology. In turn, ground water probably could be developed to meet limited water requirements of such activities.

DESIGNATION OF WELLS

In this report the number assigned to a well is both an identification number and a location number. It is referenced to the Mount Diablo base line and meridian established by the General Land Office.

A typical number consists of three units. The first unit designates the township; "N" after the number identifies the township as north of the Mount Diablo base line; "S" after the number identifies the township as south of the Mount Diablo base line. The second unit, a number separated by a slant line from the first, is the range east of the Mount Diablo meridian. The third unit, separated from the second by a dash, is the number of the section in the township. The section number is followed by a lower case letter, which designates the quarter section, and finally, a number designating the order in which the well was recorded in the quarter section. The letters a, b, c, and d, designate, respectively, the northeast, northwest, southwest, and southeast quarters of the section.

Thus, well number 3N/64-20b1 indicates that this well was the first well recorded in the northwest quarter of sec. 20, T. 3 N., R. 64 E.

Wells on plate 1 are identified only by the section number, quarter section letter, and serial number. The township in which the well is located can be ascertained by the township and range numbers shown on the margin of plate 1. For example, well 3N/64-20b1 is shown on plate 1 as 20b1 and is within the rectangle designated as T. 3 N., R. 64 E.

Table 5.--Records of selected wells in Dry Lake and Delamar Valleys, Lincoln County, Nev.

1N/64-24a1. Owners R. Lytle, S. A. Hollinger, and A. Delmue. Drilled stock well; depth 515 feet, casing diameter 5 inches. Reported depth to water below land surface 398 feet, January 17, 1959. This well caved between 428 feet and 515 feet. Driller's log:

Material	Thickness (feet)	Depth (feet)
Clay	3	3
Gravel, sandy	12	15
Clay	45	60
Sand and gravel, stratified	29-	350
Sand, fine	70	420
Lime, cemented	8	428
Clay	87	515
Total depth		515

1N/65-2a1. Owner not determined. Dug well; depth 12 feet, diameter 48 inches. Reported depth to water 10 feet.

2N/64-3b1. Coyote well. Owner, Bureau of Land Management. Drilled stock well; depth 742 feet; diameter, 6 inches; casing perforated 702 to 742 feet with torch-cut 1/4- x 8-inch slots, 6 to the round. Equipped with pump jack and gasoline pump. Reported depth to water, 664 feet, March, 1963.

2N/65-6b1. Owner not determined. Abandoned drilled well; depth 376 feet. Dry.

3N/64-20b1. Owner Bureau of Land Management. Unused, drilled stock well; depth 380 feet, casing diameter 6 inches. Depth to water below land surface 304 feet, when drilled; measured depth to water 316.54 feet, Mar. 11, 196

3N/65-21d1. Bristol well. Destroyed dug stock and domestic well. Reported depth, 51 feet. Reported depth to water 43 feet.

3N/65-21d2. Bristol well. Drilled stock well; casing diameter, 8 inches. Equipped with pump jack. Reported depth to water about 45 feet.

3N/65-21d3. Bristol well. Drilled stock well; casing diameter, 6 inches. Equipped with windmill and cylinder pump. Reported depth to water, 45 feet.

3N/65-21d4. Bristol well. Drilled stock well; casing diameter, 5 inches. Equipped with pump jack and engine. Reported depth to water, 45 feet.

5N/64-14a1. Owner not determined. Drilled well; depth 239.5 feet. Dry.

REFERENCES CITED

Bowyer, Ben, Pampeyan, E. H., and Longwell, C. R., 1958, Geologic map of Clark County, Nevada: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-138.

Callaghan, Eugene, 1936, Geology of the Chief District, Lincoln County, Nevada: Univ. Nevada Bull., Geol. Mining Ser. 26, 32 p.

Callaghan, Eugene, 1937, Geology of the Delamar District, Lincoln County, Nevada: Univ. Nevada Bull., Geol. Mining Ser. 30A, 72 p.

Carpenter, Everett, 1915, Ground water in southeastern Nevada: U.S. Geol. Survey Water-Supply Paper 365, 86 p.

Eakin, Thomas E. and others, 1951, Contributions to the hydrology of eastern Nevada: Nevada State Engineer, Water Resources Bull. 12, 171 p.

Eakin, Thomas E., 1962, Ground-water appraisal of Cave Valley, Nevada: Nevada Dept. Conserv. Nat. Resources, Ground-Water Resources - Reconnaissance Ser. Rept. 13, 18 p.

Fenneman, N. M., 1931, Physiography of western United States: New York, McGraw - Hill, 534 p.

Hardman, George, and Mason, Howard G., 1949, Irrigated lands in Nevada: Univ. Nevada Agr. Expt. Sta. Bull. 183, 57 p.

Houston, Clyde E., 1950, Consumptive use of irrigation water by crops in Nevada: Nevada Univ. Agr. Expt. Sta. and Div. Irrigation and Water Conserv., Soil Conserv. Service, U.S.Dept. Agriculture Bull. 185, 27 p.

Kellog, Harold E., 1960, Geology of the southern Egan Range, Nevada: Intermountain Assoc. of Petroleum Geologists, Guidebook to the geology of east central Nevada, p. 189-97.

Reso, Anthony, and Croneis, Carey, 1959, Devonian system in the Pahranagat Range, southeastern Nevada: Geol. Soc. America Bull., v. 70, no. 9, p. 1249-1252.

Snyder, C. T., 1963, Hydrology of stock-water development in the Ely Grazing District, Nevada: U.S. Geol. Survey Water-Supply Paper 1475-L.

Tschanz, Charles M., 1960, Geology of northern Lincoln County, Nevada: Intermountain Assoc. of Petroleum Geologists, Guidebook to the geology of east central Nevada, p. 198-208.

Tschanz, C. M., and Pampeyan, E. H., 1961, Preliminary geologic map of Lincoln County, Nevada: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-206.

Westgate, Lewis G., and Knopf, Adolph, 1932, Geology and ore deposits of the Pioche District, Nevada: U.S. Geol. Survey Prof. Paper 171, 79 p., 8 pls., 13 figs.

Winograd, Isaac J., 1962, Interbasin movement of ground water at the Nevada Test Site, Nevada: U.S. Geol. Survey Prof. Paper 450-C, p. 108-111.

PREVIOUSLY PUBLISHED REPORTS OF THE GROUND-WATER RESOURCES RECONNAISSANCE SERIES

Rep. No.	
1	Ground-Water Appraisal of Newark Valley, White Pine County, Nevada. Dec. 1960, by Thomas E. Eakin.
2	Ground-Water Appraisal of Pine Valley, Eureka and Elko Counties, Nevada, Jan. 1961, by Thomas E. Eakin.
3	Ground-Water Appraisal of Long Valley, White Pine and Elko Counties, Nevada, June 1961, by Thomas E. Eakin.
4	Ground-Water Resources of Pine Forest Valley, Humboldt County, Nevada, Jan. 1962, by William C. Sinclair.
5	Ground-Water Appraisal of the Imlay Area, Humboldt River Basin, Pershing County, Nevada, Feb. 1962, by Thomas E. Eakin
6.	Ground-Water Appraisal of Diamond Valley, Eureka and Elko Counties, Nevada, Feb. 1962, by Thomas E. Eakin.
7	Ground-Water Resources of Desert Valley, Humboldt County, Nevada, April 1962, by William C. Sinclair,
8	Ground-Water Appraisal of Independence Valley, Western Elko County, Nevada, May 1962, by Thomas E. Eakin.
9	Ground-Water Appraisal of Gabbs Valley, Mineral and Nye Counties, Nevada, June 1962, by Thomas E. Eakin.
10	Ground-Water Appraisal of Sarcobatus Flat and Oasis Valley, Nye County, Nevada, Oct. 1962, by Glenn T. Malmberg and Thomas E. Eakin.
11	Ground-Water Resources of Hualapai Flat, Washoe, Pershing, and Humboldt Counties, Nevada, Oct. 1962, by William C. Sinclair.
12	Ground-Water Appraisal of Ralston and Stonecabin Valleys, Nye County, Nevada, Oct. 1962, by Thomas E. Eakin.
13	Ground-Water Appraisal of Cave Valley in Lincoln and White Pine Counties, Nevada, Dec. 1962, by Thomas E. Eakin.
14	Ground-Water Resources of Amargosa Desert, Nevada - California, March 1963, by George E. Walker and Thomas E. Eakin.
15	Ground-Water Appraisal of the Long Valley-Massacre Lake Region, Washoe County, Nevada, by William C. Sinclair; also including a section on The Soils of Long Valley by Richard L. Malchow.

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

EXPLANATION

Valley Fill

Unconsolidated clay, silt, sand, and gravel of Quaternary age

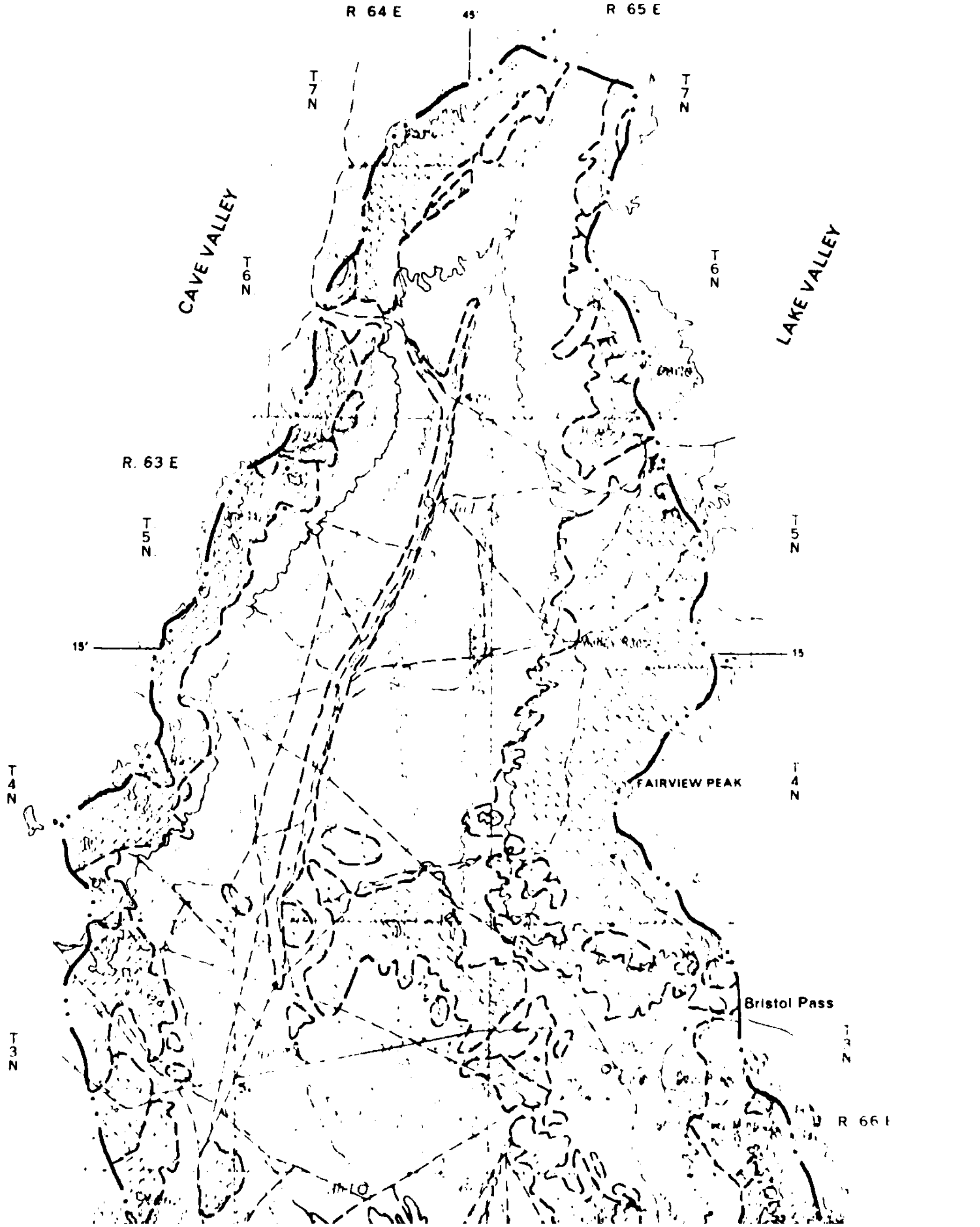
Unconsolidated and partly consolidated clastic rocks of Tertiary and Quaternary age

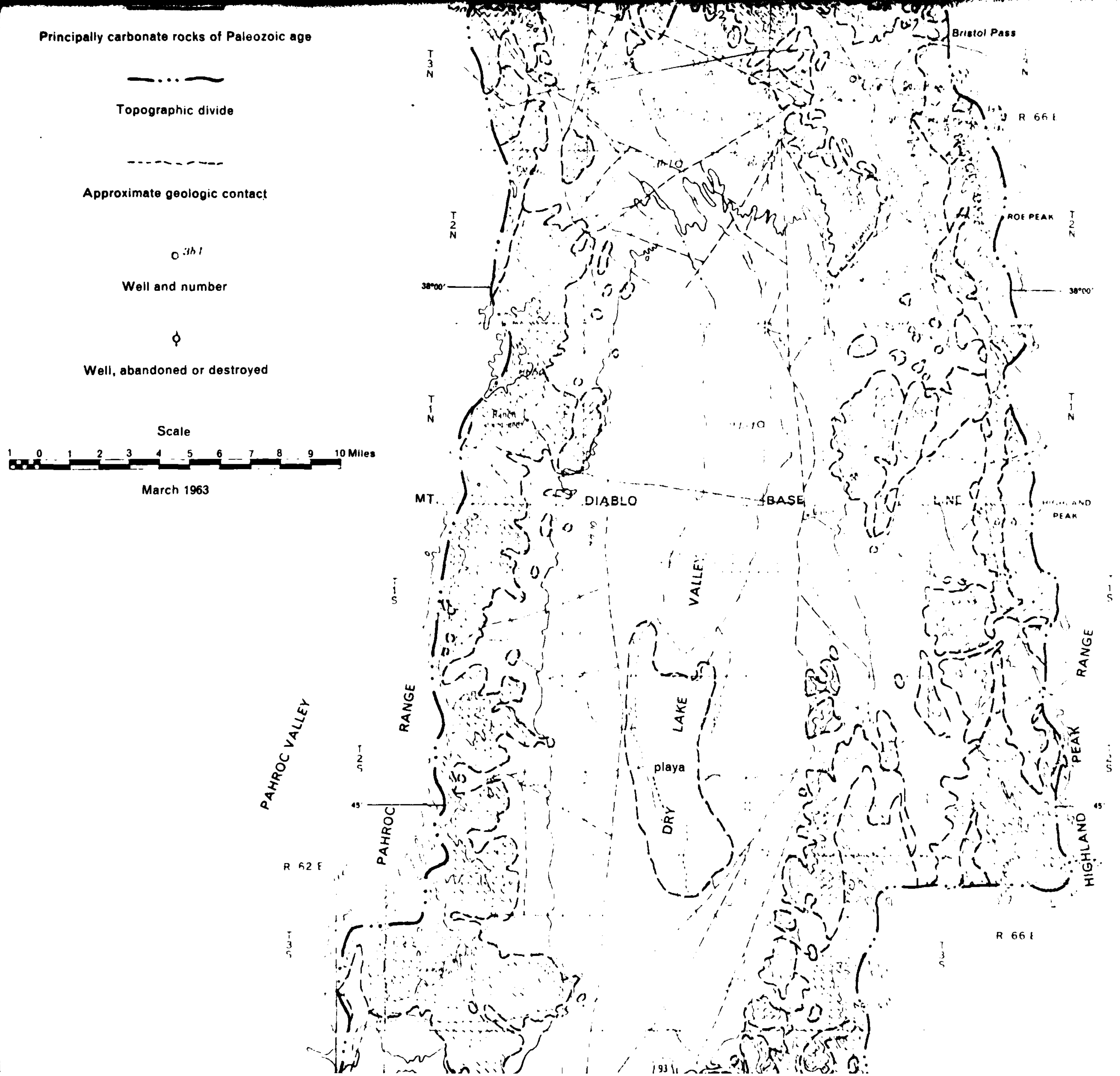
Bedrock

Principally clastic rocks of Paleozoic age and volcanic and clastic rocks of Tertiary age

Principally carbonate rocks of Paleozoic age

Topographic divide




Principally carbonate rocks of Paleozoic age
Topographic divide
Approximate geologic contact
Well and number
Well, abandoned or destroyed
Scale
0 1 2 3 4 5 6 7 8 9 10 Miles
March 1963
Bristol Pass
ROE PEAK
HIGHLAND PEAK
MT. DIABLO BASE LINE
VALLEY
LAKE
playa
DRY
RANGE
PEAK
HIGHLAND
PAHROC
RANGE
PAHROC VALLEY
R 62 E
R 66 E
38°00'
45'
T 3 N
T 2 N
T 1 N
T 1 S
T 2 S
T 3 S

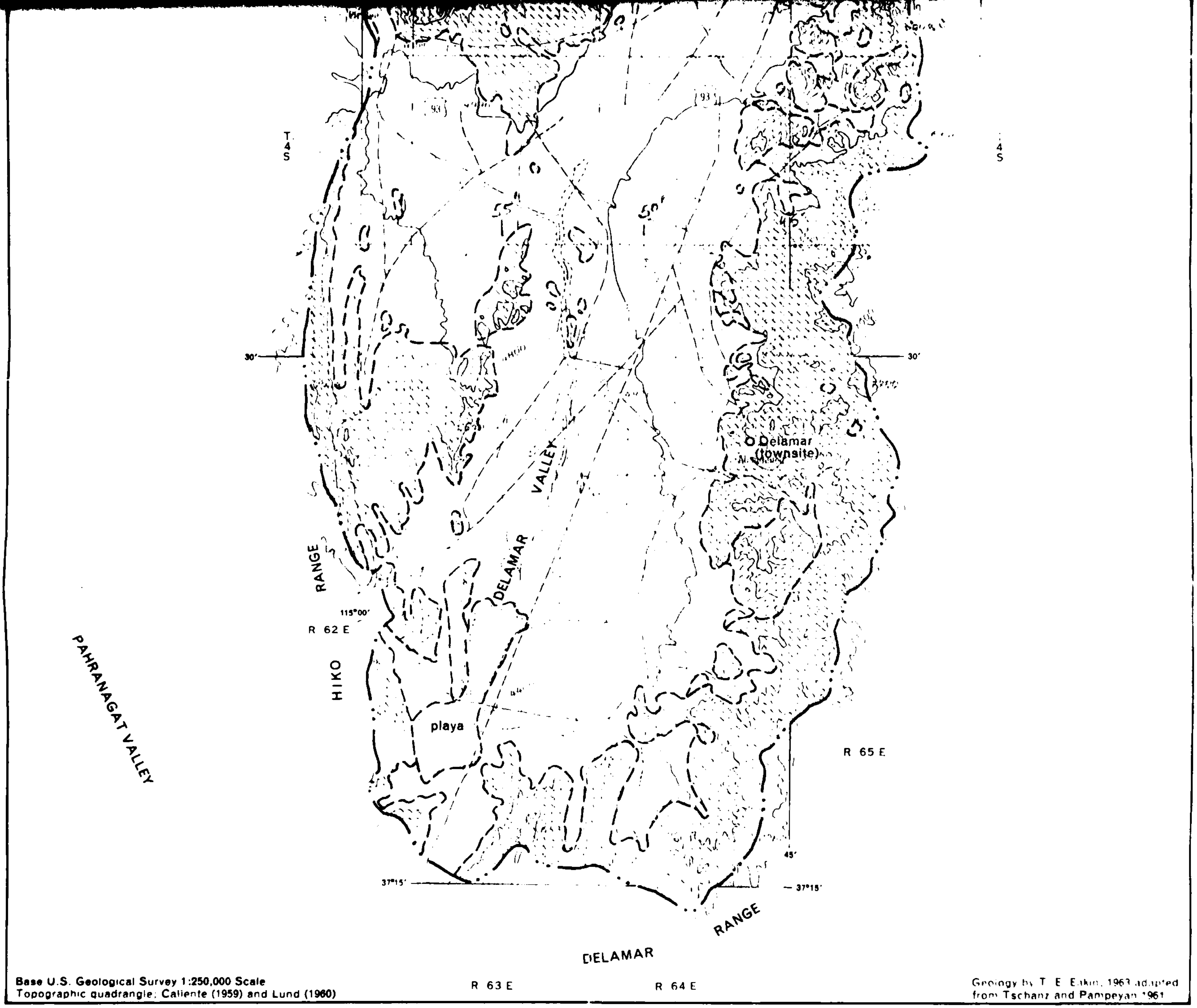


PLATE 1.—MAP OF THE DRY LAKE AND DELAMAR VALLEYS; LINCOLN COUNTY, NEVADA

SHOWING AREAS OF BEDROCK, VALLEY FILL, AND LOCATION OF WELLS

H1.0

MISCELLANEOUS WORKING DOCUMENTS

H1.1

WELL LOGS AND REPORTS TO THE STATE ENGINEER OF NEVADA

Dry Lake 3N/65-21

(5)

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 6834 X
Rec. Dec 4 1962
Well No.
Permit No.
Do not fill in

Owner [illegible] Driller [illegible]

Address % [illegible] Eagle Valley, Nev. Address [illegible] Lic. No. 30

Location of well: ¼ ¼ Sec. 21, T. 3 N/S, R 65 E, in [illegible] County (Unsurveyed sec)

or [illegible]

Water will be used for Stock Total depth of well 120'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 10 gauge Temp. of water

Diameter and length of casing 5" 50'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 17'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well November 28, 1962 Date of completion of well December 1, 1962

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	60	60	sand-gravel-boulders
60	120	60	Cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)
from 17' to 77 ft.

Other aquifers

First water at 17 feet.

Casing perforated
from 20' to 50 ft.

Size of perforations
1/8 x 6"

Log No. [illegible]
Rec. Dec. [illegible] 19 62
Well No. [illegible]
Permit No.
Do not fill in

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner [illegible] Driller [illegible]

Address [illegible] Address [illegible] Lic. No. [illegible]

Location of well: ¼ ¼ Sec. 21, T. 3 N/S, R. 63 E, in [illegible] County

or [illegible]

Water will be used for [illegible] Total depth of well 80'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing ¼" Temp. of water

Diameter and length of casing 6" 60'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 16'

If flowing well describe control works
(... and size of valve, etc.)

Date of commencement of well [illegible] 1962 ... completion of well [illegible] 1962

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	45	45	sand-gravel-boulders
45	50	5	sandy clay
50	80	30	cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)
from 16' to 50'

Other aquifers

First water at 16 feet.

Casing perforated
from 20' to 60

Size of perforations
½ x 12"

(#11)

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

31/65-21 (4)

Log No. [illegible]
Rec. Dec [illegible] 196[illegible]
Well No.
Permit No.
Do not fill in

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner [illegible] Driller [illegible]

Address [illegible] Address [illegible] Lic. No. 3

Location of well: ..... 1/4 ..... 1/4 Sec. 21, T. 31 N, R 65 E, in [illegible] Co. (Unsurveyed sec)

or [illegible]

Water will be used for [illegible] Total depth of well 120'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 10 gauge Temp. of water

Diameter and length of casing 5" 50'

(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diame[ter])

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 17'

If flowing well describe control works

(Type and size of valve, etc.)

Date of commencement of well November 28, 1962 Date of completion of well December 1, 1962

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	60	60	sand - gravel - boulders
60	120	60	Cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 17' to 77'

Other aquifers

First water at 17 feet.

Casing perforated

from 30' to 50'

Size of perforations

1/8 x 1 1/2"

(OVER)

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA 30/65-21

(6) dcb

Log No. ......
Rec. Dec 11 1959
Well No. ......
Permit No. ......
Do not fill in

Owner Albert Delmue Driller Darrell Free

Address Pioche, Nevada Address Pioche, Nevada Lic. No. 30

Location of well: ..... ¼ ..... ¼ Sec. ....., T. ..... N/S, R. ..... E, in Lincoln County

or Bristol Wells

Water will be used for Stock Total depth of well 79'

Size of drilled hole 8" Weight of casing per linear foot ......

Thickness of casing 10 gauge Temp. of water ......

Diameter and length of casing 7" 80'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure ......

If nonflowing well give depth of standing water from surface 23'

If flowing well describe control works ......
(Type and size of valve, etc.)

Date of commencement of well December 3, 1959 Date of completion of well December 9, 1959

Type of well rig Churn Drill

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	12	12	gravel
12	18	6	boulders
18	79	61	Cemented gravel very hard + tight

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 46 to 79 ft.

Other aquifers ......

First water at 46 feet.

Casing perforated

from 47 to 80 ft.

Size of perforations

1/8 x 12'

919

SN/65-22.

Log No. 1070~x
Rec. 19
Well No.
Permit No. 23978
Do not fill in BASIN

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Dry Lake

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner Charles Sideys Driller Nick McCarty

Address Address Beaver Utah Lic. No.

Location of well ¼ ¼ Sec. 29, T. N/S, R. E, in Lincoln Co.

or

Water will be used for Irragation Total depth of well 240

Size of drilled hole 24" Weight of casing per linear foot

Thickness of casing 1/4 Temp. of water

Diameter and length of casing 14" 240'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diamet

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 3'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well 1/1/66 Date of completion of well 2/1/66

Type of well rig Rotary

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	15	15	Soil
15	25	4	Gravel Sand
25	34	11	Clay Gravel
34	52		Clay
52	56		Gravel Sand
56	75		Clay
75	94		Gravel Sand
94	103		Clay
103	123		Sand
123	123		Clay
123	129		Sand Gravel
129	134		Clay
134	144		Sand
144	147		Sand Gravel
147	159		Boulder Clay
159	171		Sand Gravel
171	177		Clay
177	195		[illegible]
195	203		[illegible]
203	214		[illegible]
220	240		Sandy Clay

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 60 to 240 ft

Other aquifers

First water at 18 feet.

Casing perforated

from 60 to 240

Size of perforations

3/8

919

2

	To feet	Thickness	Type of material

CASING RECORD

...im. ...ing	From feet	To feet	Length	"Remarks"—Seals, Grouting, Etc.

GENERAL INFORMATION—Pumping Test, Quality of Water, Etc.

____

____

____

____

____

WELL DRILLER'S STATEMENT

...vell was drilled under my jurisdiction and the ... information is true to my best information and ...f.

Signed...
Well Driller

By...

License No...

...., 19..........

(Not to be filled in by Driller)

....

....

....

....

....

....

....

....

....

....

....

....

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

1N/64E-34 (20) CA

#5

Log No. ___ Basin ___ Well No. ___ Permit No. ___

Owner Lyllan Hollings - Delmue Driller Roaill Inc

Address Pioche, Nevada Address Box 1 - Pioche, Nevada No. 30

Location of well: Section 34 T1N R64E in Lincoln County

or Simpson Lincoln area

Water will be used for stock Total depth of well 515

Size of drilled hole 7 1/4" Weight of casing per linear foot ___

Thickness of casing 3/16" Temp. of water ___

Diameter and length of casing 5" 515'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure ___

If nonflowing well give depth of standing water from surface 398' TO WATER.

If flowing well describe control works ___
(Type and size of valve, etc.)

Date of commencement of well Dec. 15, 1958 Date of completion of well Jan. 17, 1959

Type of well rig Roaill Drill

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	3	3	Clay
3	15	12	sandy gravel
15	60	45	Clay
60	350	290	stratified sand & gravel
350	420	70	fine sand
420	428	8	Cemented lime
428	515	87	Clay

Water-bearing Formation, Casing Perforations, Etc.

CHIEF AQUIFER WATER BEARING
Chief aquifer (water-bearing formation)

From 428 to 515 ft.

Other aquifers ___

FIRST WATER AT 428 FEET.
First water at 428 feet.

Casing perforated
From 420 to 515 ft.

Size of perforations
1/8 x 10" 1/8" x 10" SLOT SIZE.

(32- 35/63-22db

Log No.	10064
Rec.	11-26-69 19
Well No.	
Permit No.	22477

Do not fill in.

(43)

WELL [...]T TO THE STATE ENGI[...]ER
[...] NEVADA

[...] THIS FORM IN ITS ENTIRETY

Owner CH[...] [...]ORROW Driller VICK McCANN

Address [...] NEVADA Address BEAVER Lic. No. 2381

Location of well [...] 22 [...], T 3 3½ S, R 63 E, in Lincoln Co.

Permit No. [...] 51 22477

Water will be used for [...]ATION Total depth of well

Size of drilled hole Weight of casing per linear foot

Thickness of casing [...]AGE Temp. of water

Diameter and length of [...] 230"

(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow [...] g.p.m. and pressure 3' 4"

If nonflowing well give d[...]ding water from surface

If flowing well describe c[...]ls

(Type and size of valve, etc.)

Date of commencement [...] [...]/13/66 Date of completion of well 3/3/66

Type of well rig [...]

[...] FORMATIONS

From feet	To feet		Type of material
0	8	8	GREY CLAY
8	12	4	BLUE CLAY
12	1[...]		GREY CLAY
125	132		GRAVEL
132	138		CLAY
138	155		GRAVEL
155	168		CLAY
168	174		GRAVEL
174	175		CLAY
177	190		SANDY CLAY
190	205		GRAVEL
205	207		SAND
207	222		SAND + GRAVEL
222	230		CLAY

Water-bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)

from 125 to 230

Other aquifers

First water at 8 feet.

Casing perforated

from 60 to 230

Size of perforations

3/8

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

Observation Well

STATE OF NEVADA
DIVISION OF WATER RESOURCES

3S/64E-12ac
M Gemmell 9-15-81

WELL DRILLERS REPORT

Please complete this form in its entirety

OFFICE USE ONLY
Log No. ....
Permit No. ....
Basin ....

1. OWNER U.S. DEPT OF THE AIR FORCE Ballistics Missile Office ADDRESS Norton AFB, Calif. 92409

2. LOCATION NE ¼ Sw ¼ Sec. 12 T. 3 N/S R. 64 E. Nye County
PERMIT NO. none req. Exploratory well

3. TYPE OF WORK
New Well ☒ Reconditon ☐
Deepen ☐ Other ☐

4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☒
Municipal ☐ Industrial ☐ Stock ☐

5. TYPE WELL
Cable ☐ Rotary ☒ Reverse
Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
fine sand, some small rock		0	50 ft.	
sand and gravel		50	185	
gravel, coarse sand		185	240	
gravel, corse sand, some clay		240	275	
gravel, sand, some silt		275	340	
coarse sand, gravel, traces of silt and clay		340	370	
gravel with sand and silt and 1/2" rock		370	420	
sand, gravel, trace of silt & clay, rock from 1/2" to 3"		420	510	
gravel and coarse sand		510	610	
gravel, sand, small rock 1/2" to 2" and silt		610	1010	
sand, gravel streaks with rocks up to 6" size		1010	1300	

Date started December 20, 19 79
Date completed January 26, 19 80

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump
air lift	15 ±		4

not applicable

BAILER TEST
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours

8. WELL CONSTRUCTION
Diameter hole 18-5/8" inches Total depth 1300 feet
Casing record ....
Weight per foot .... Thickness ....

Diameter	From	To
2 inches	0 feet	1300 feet
2 inches	0 feet	798 feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet

Surface seal: Yes ☒ No ☐ Type grout
Depth of seal 40 ft. feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 0 feet to 1300 feet

Perforations:
Type perforation mill slot
Size perforation ....
From 1270 feet to 1290 feet
From 768 feet to 788 feet
From .... feet to .... feet
From .... feet to .... feet
From .... feet to .... feet

9. WATER LEVEL
Static water level 383 Feet below land surface
Flow .... G.P.M.
Water temperature cold °F. Quality ....

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name BEYLIK DRILLING, INC. (James L. Clyde Driller
Address 591 S.Walnut Street-La Habra, Ca.9063
Nevada contractor's license number 007055A
Nevada driller's license number 1169
Signed [signature]
Date Feb. 12, 1980

USE ADDITIONAL SHEETS IF NECESSARY

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

STATE OF NEVADA
DIVISION OF WATER RESOURCES

OFFICE USE ONLY
Log No. ....
Permit No ....
Basin............

35/64E-12ac
mGemmell 9-15-81 (Pumping Well)

WELL DRILLERS REPORT

Please complete this form in its entirety

1. OWNER U. S. DEPT. OF THE AIRFORCE ADDRESS Norton AFB, Calif. 92409
Ballistic Missile Dept.
(Well is: Dry Lake Valley Test Well No. TW-1)

2. LOCATION NE ¼ SW ¼ Sec. 12 T. 3S N/S R. 64E E. in Lincoln County
PERMIT NO. none required - Exploratory hole

3. TYPE OF WORK	4. PROPOSED USE	5. TYPE WELL
New Well ☒ Recondition ☐	Domestic ☐ Irrigation ☐ Test ☒	Cable ☐ Rotary ☐
Deepen ☐ Other ☐	Municipal ☐ Industrial ☐ Stock ☐	Other ☒ Reverse Circulation

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
gravel, clay, small rock		0	140	
gravel, small rock		140	150	
large rocks, 2" dia. gravel and fine sand		150	190	
large rocks, 2" dia. gravel		190	260	
gravel & small 1" dia. rocks		260	370	
fine sand & few small rocks		370	400	
gravel & small rocks/clay		400	440	
brown clay, small amt. gravel		440	520	
gravel and small rocks		520	600	
gravel, very little clay		600	630	
brown clay, small rocks		630	710	
gravel		710	760	
brown clay and gravel		760	780	
gravel and fine sand		780	800	
gravel, very little clay		800	830	
gravel & small rocks		830	850	
gravel, some small rocks		850	880	
small 1" dia. rocks, gravel		880	900	
rocks & gravel		900	1000	
gravel		1000	1005	
hard rock and some gravel		1005	1010	

Date started Feb. 6th, 19 80
Date completed April 20th, 19 80

7. WELL TEST DATA

Pump RPM	G P M	Draw Down	After Hours Pump
1800	500	41	70

BAILER TEST
None None
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours

8. WELL CONSTRUCTION

Diameter hole 18-1/2 inches Total depth 1,000 feet
Casing record ....
Weight per foot .... Thickness 5/16"

Diameter	From	To
22" x 1/4" wall inches	0 feet	40 feet
16 x 5/16" inches	+ 2 feet	1000 feet

Surface seal: Yes ☒ No ☐ Type grout
Depth of seal 40 ft. feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 10 feet to 1000 feet

Perforations:
Type perforation Johnson wire screen
Size perforation .060
From 970 feet to 950 feet
From 920 feet to 900 feet
From 870 feet to 850 feet
From 830 feet to 810 feet
From 770 feet to 750 feet
From 720 feet to 700 feet
From 670 feet to 650 feet
From 620 feet to 600 feet

9. WATER LEVEL

Static water level 422 Feet below land surface
Flow .... G.P.M.
Water temperature 82.5 ° F. Quality slightly cloudy

10. DRILLERS CERTIFICATION

This well was drilled under my supervision and the report is true to the best of my knowledge.

Name BEYLIK DRILLING, INC.
Address 591 S. Walnut Street
La Habra, Calif. 90631
Nevada contractor's license number 007055A
Nevada driller's license number 1168 and 1169
Signed James L. Clyde (James Clyde) Driller
Date April 21, 1980

USE ADDITIONAL SHEETS IF NECESSARY

WELL LOG AN[illegible] [illegible]ORT TO THE STATE EN[illegible] [illegible]
OF NEVADA

Log No. [illegible]
Rec. [illegible] 19
Well No.
Permit No. 22559
Do not fill in.

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner [illegible] Driller [illegible]

Address 350 [illegible] Address [illegible] Lic. No. [illegible]

Location of well: SE 1/4 SE 1/4 Sec. 23, T. 4 N/S, R. 63 E, in [illegible] C

Permit No. [illegible]

Water will be used for [illegible] Total depth of well 61'

Size of drilled hole 14" Weight of casing per linear foot

Thickness of casing [illegible] Temp. of water

Diameter and length of casing
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well [illegible] 17, 1966 Date of completion of well [illegible] 19, 196[illegible]

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	5	5	soil
5	12	7	sand
12	51	39	cemented gravel
51	61	10	gravel in boulders

Water-bearing Formation, Casi[ng] Perforations, etc.

Chief aquifer (water-bearing form[ation])

from .... to ....

Other aquifers

First water at .... f[t].

Casing perforated

from .... to ....

Size of perforations

(34) 40165-420

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Log No. 9636
Rec. Aug 8
Well No.
Permit No. 22858
Do not fill in.

#2

5

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

L 1051

Owner [illegible] Driller [illegible]

Address 350 Star Route [illegible] Address [illegible] Lic. No. 30

Location of well: S.E.¼ S.W.¼ Sec. 24, T. 4 N/S, R. 63 E, in [illegible]

Permit No. [illegible]

Water will be used for [illegible] Total depth of well 360'

Size of drilled hole 7¼" Weight of casing per linear foot

Thickness of casing [illegible] Temp. of water

Diameter and length of casing
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface NO WATER

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well July 24, 1967 Date of completion of well July 29, 1967

Type of well rig Cable Tool

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
~~0~~	~~65~~	~~65~~	~~drilled in 1966~~
65	226	161	Cemented sand
226	228	2	Clay
228	236	8	Cemented sand
236	238	2	Clay
238	240	2	Cemented sand
240	250	10	Clay with layers of sand
250	252	2	Cemented boulders
252	296	44	Layers of cemented sand in sand
296	297	1	Clay
297	326	29	Layers of cemented sand in sand
326	327	1	Clay
327	360	33	Sand

Water-Bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)

from .... to ....

Other aquifers

First water at .... feet

Casing perforated

from .... to ....

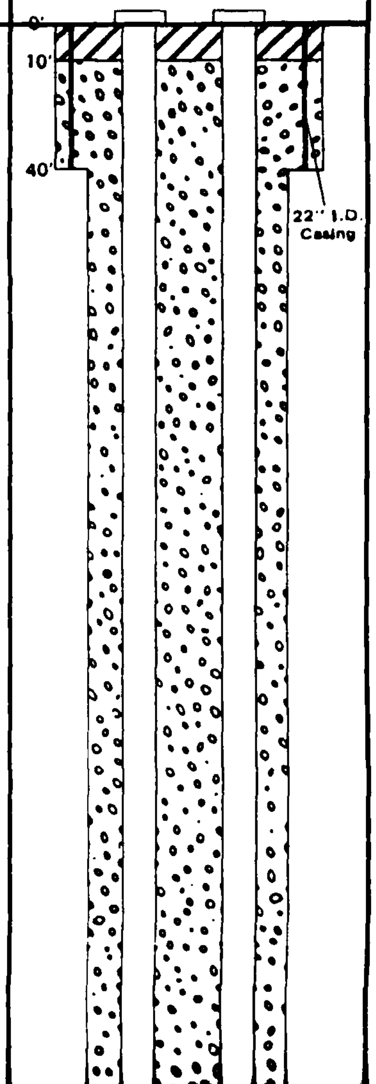
Size of perforations

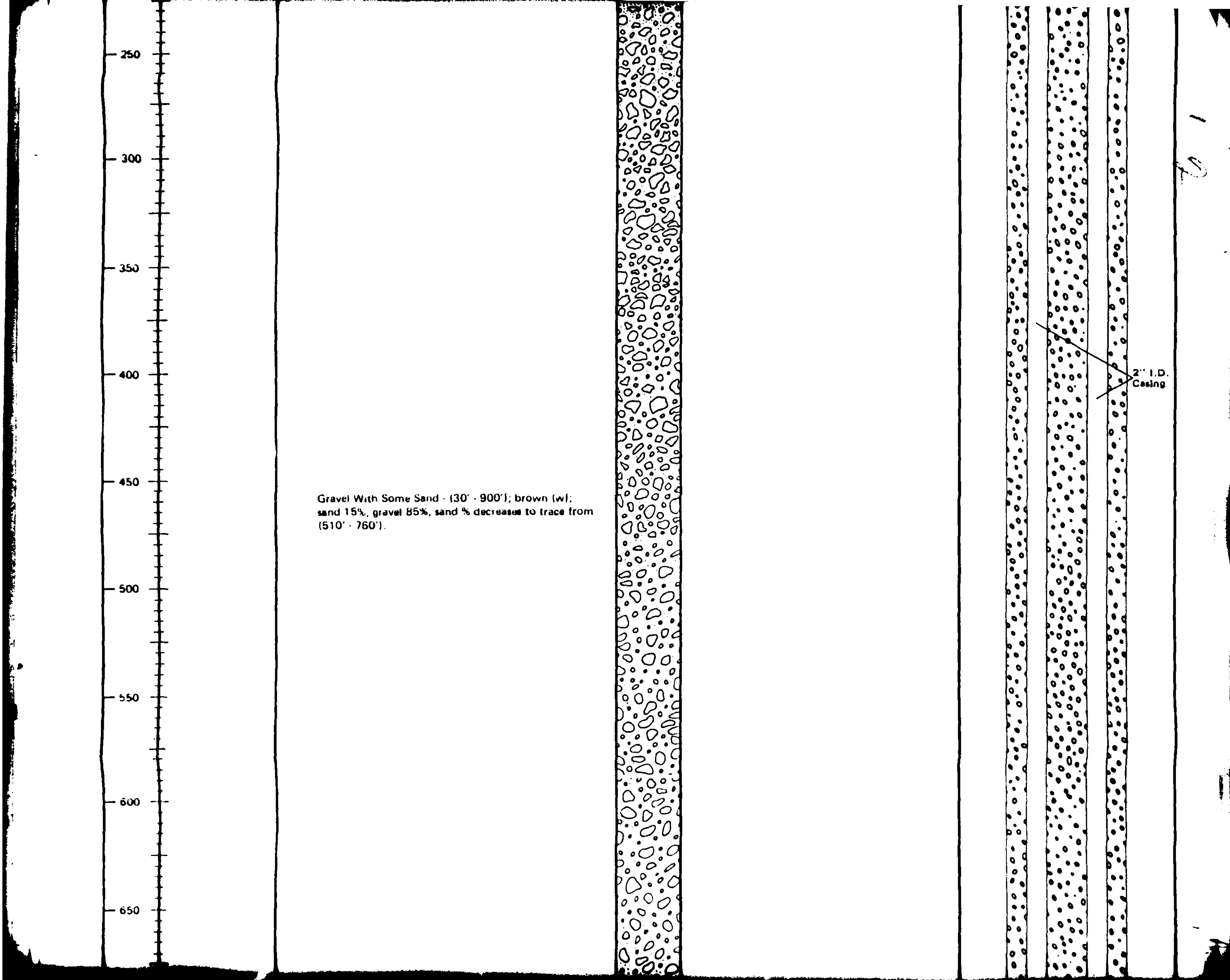
H1.2

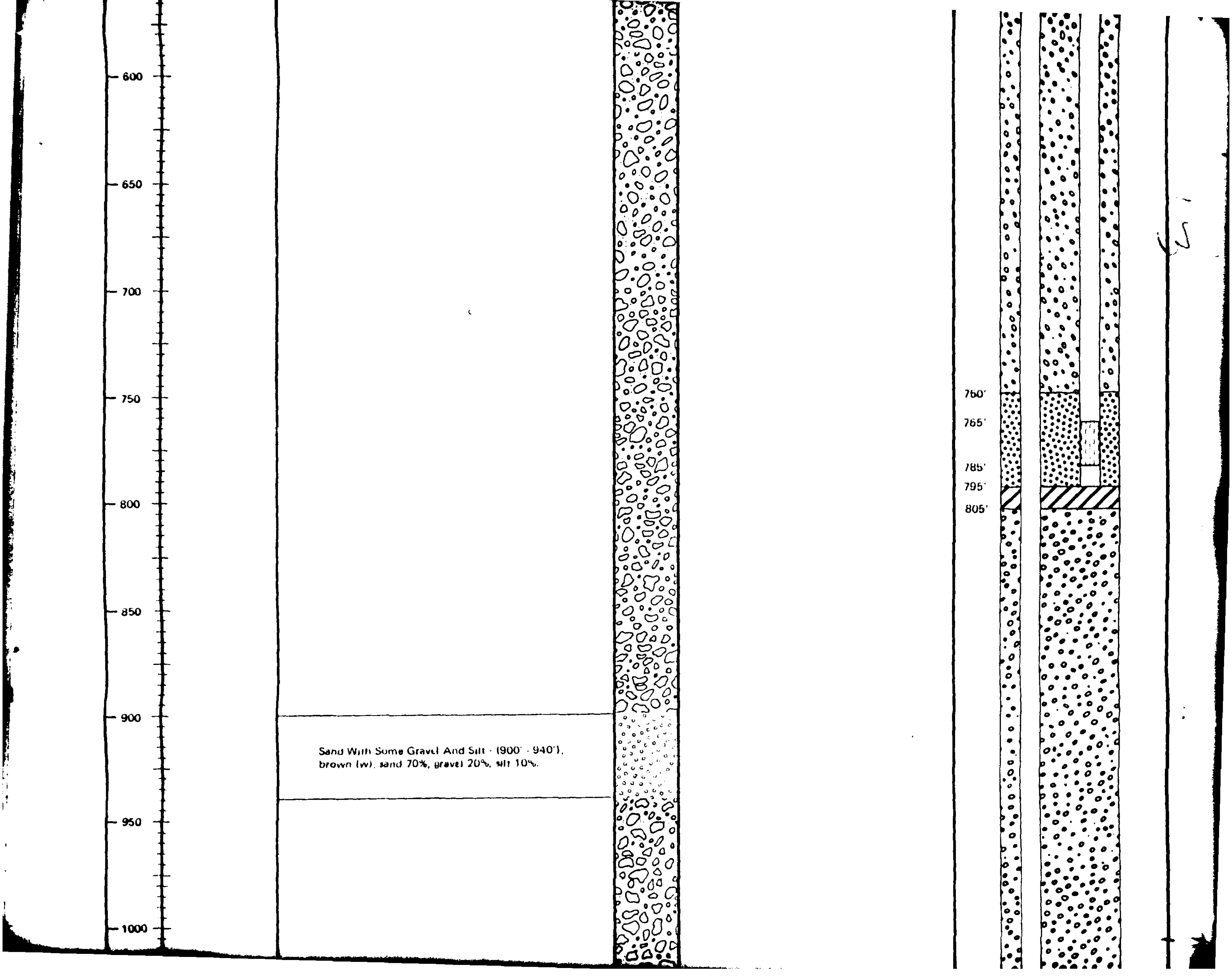
DRY LAKE VALLEY WELL LOG AND WELL DESIGN (VALLEY-FILL)

DRY LAKE VALLEY OBSERVATION WELL (DL-I-O-1) 3S/64E-12da

Depth	Penetra -tion **	Lithologic Log		Geophysical Log *	Well Design
Ft.	1" = 100 Min.	Description	Symbol	Gamma S.P. Res.	
50, 100, 150, 200, 250		Silt - (0' - 30'), tan (d); silt 90%, sand 10%.			



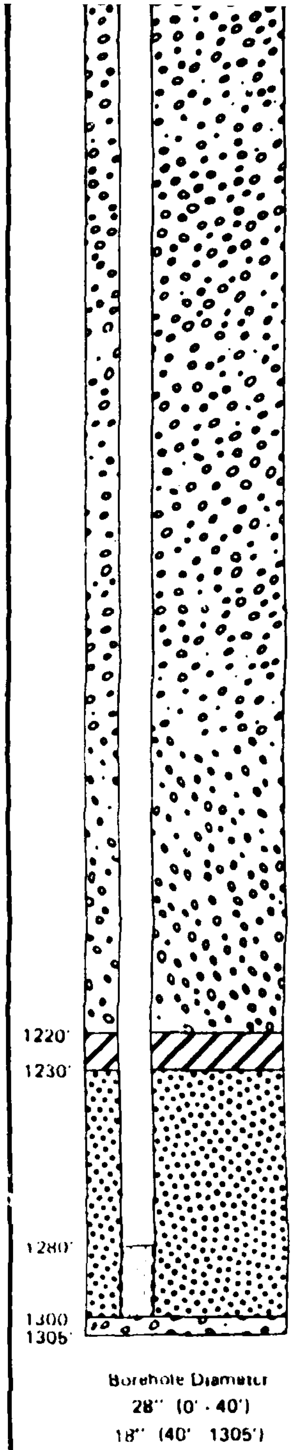

250
300
350
400
450
500
550
600
650
Gravel With Some Sand - (30' - 900'); brown (w);
sand 15%, gravel 85%, sand % decreases to trace from
(510' - 760').
2" I.D.
Casing

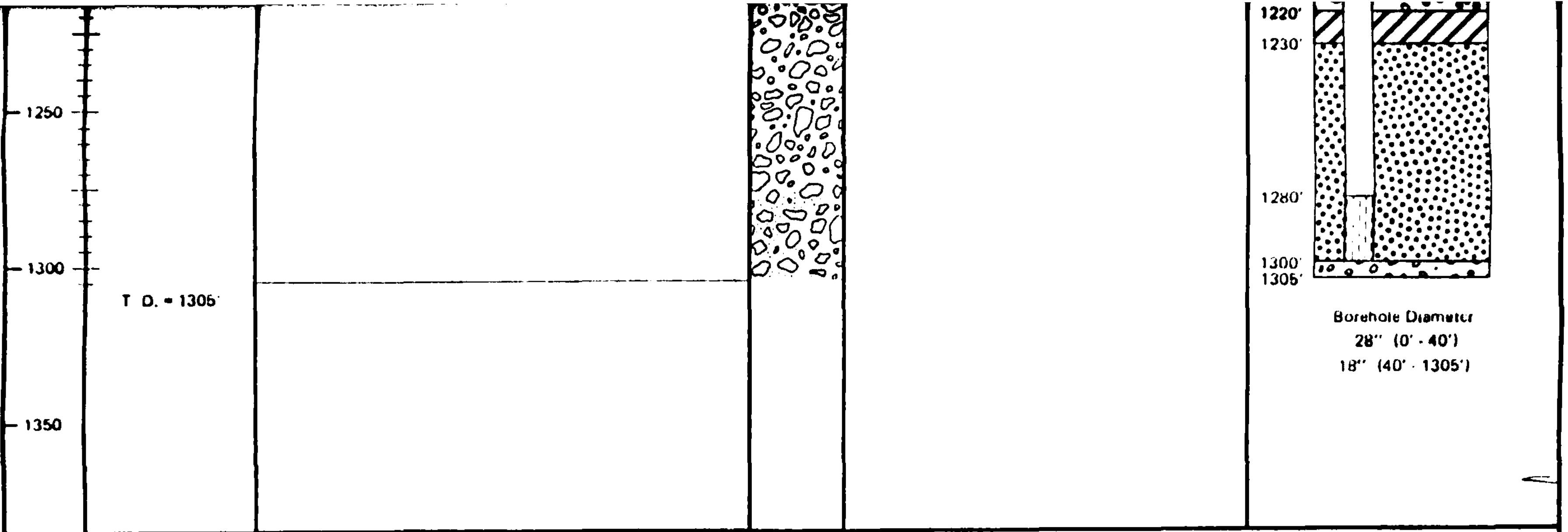

600
650
700
750
800
850
900
950
1000
Sand With Some Gravel And Silt - (900' - 940'),
brown (w), sand 70%, gravel 20%, silt 10%.
760'
765'
785'
795'
805'

950
1000
1050
1100
1150
1200
1250
1300
1350

T. D. = 1306

Gravel With Some Sand - (940' - 1305'); brown (w), sand 15%, gravel 85%.





LITHOLOGIC SYMBOLS

Clay
Clay Silt
Silt
Silt And Clay
(May also include modifiers of: with some gravel, and with very little gravel).

Sand With Gravel
Silt And Sand With Gravel
Silty Sand With Gravel
(May also include the modifier: and gravel).

Gravel With Sand
Gravel With Clay Sand
Gravel With Silty Clay Sand
Gravel With Silty Sand
Gravel With Clay And Sand
Gravel With Silt And Sand
(May also include modifiers of with some, and with very little).

* Geophysical logs not applicable for this format.

** Penetration rates were not recorded.

WELL DESIGN

Cement

Pea Gravel

Well Pack

Slotted Pipe

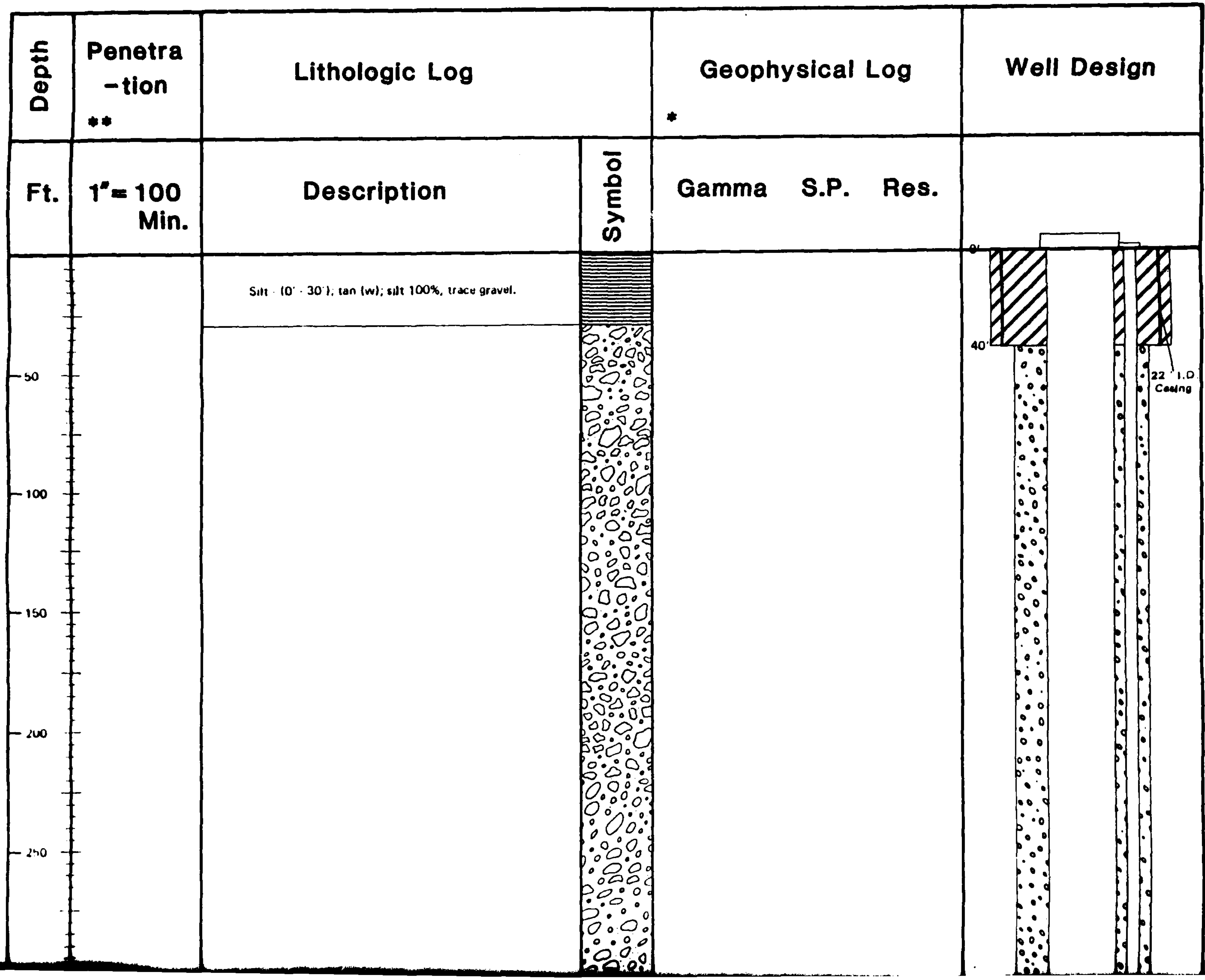
DRY LAKE VALLEY
(DL-I-O-1)

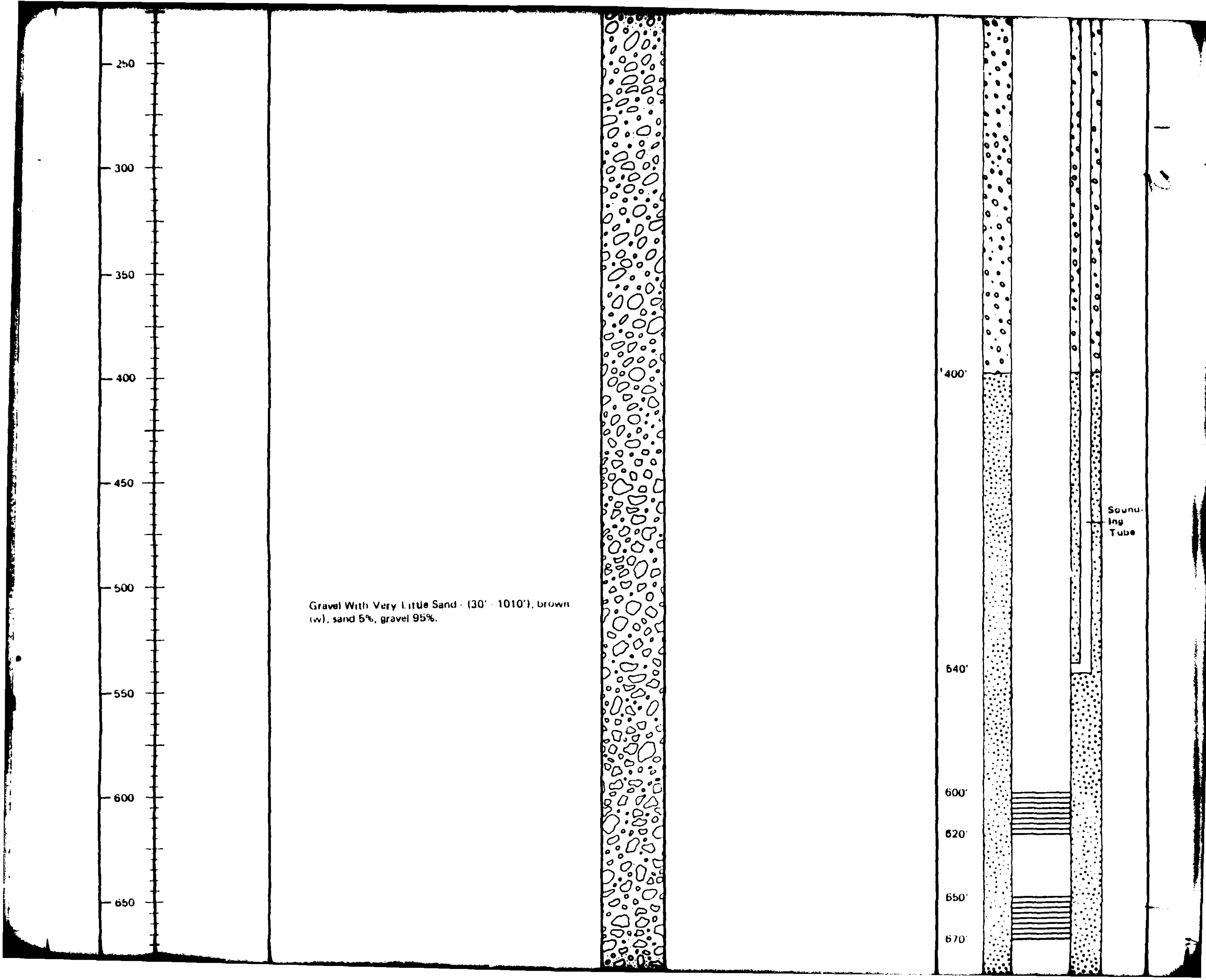
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

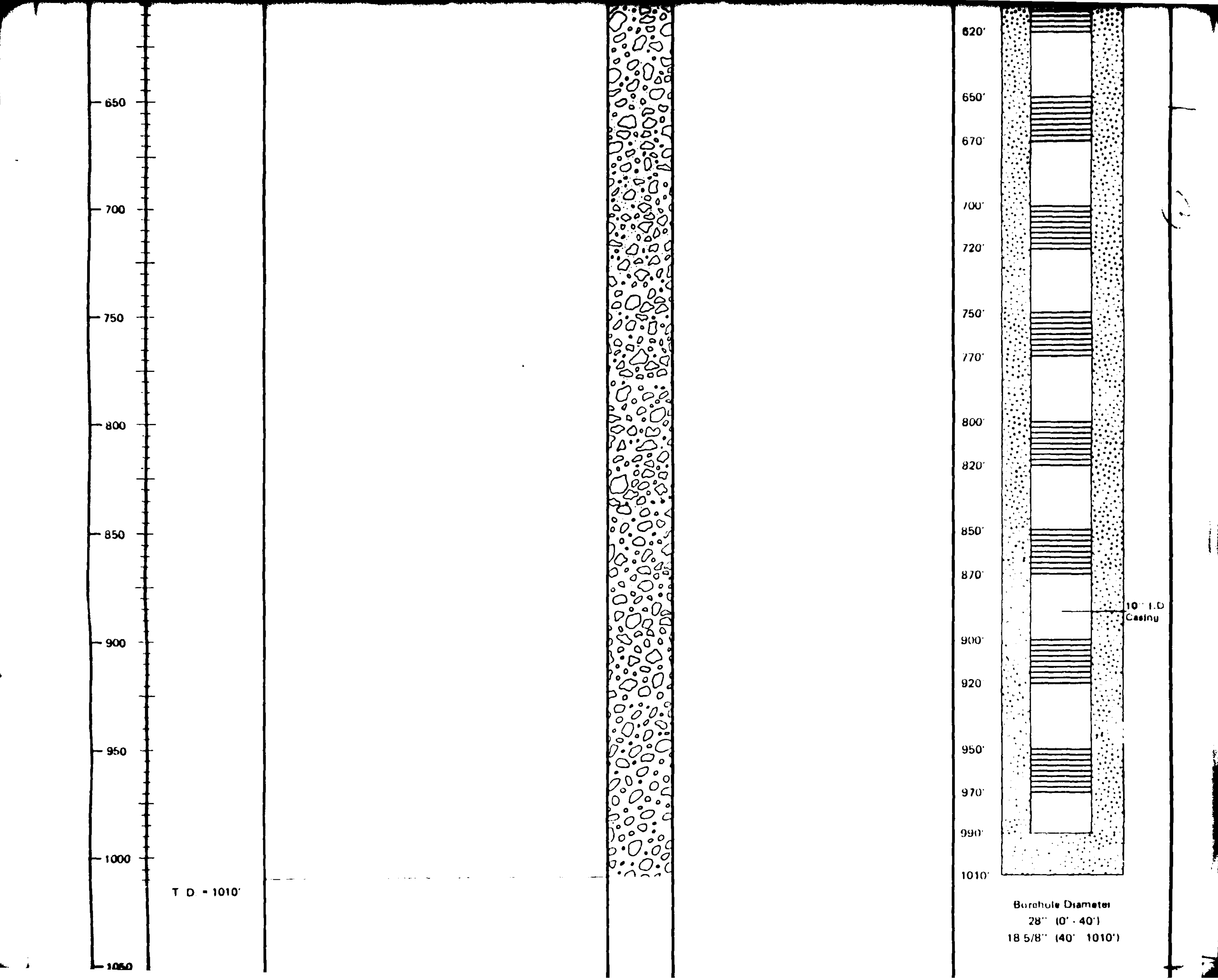
FIGURE

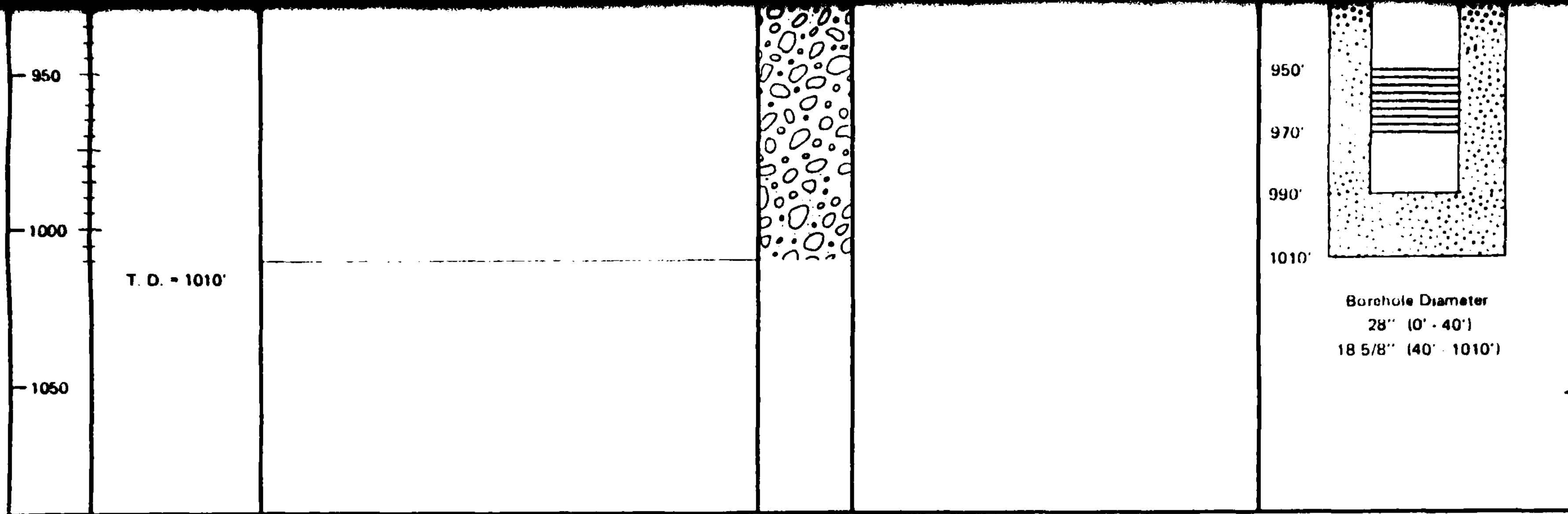
FUGRO NATIONAL, INC

DRY LAKE VALLEY TEST WELL (DL-I-T-1) 3S/64E-12da




250
300
350
400
450
500
550
600
650
Gravel With Very Little Sand - (30' - 1010'); brown (w), sand 5%, gravel 95%.
400'
540'
600'
620'
650'
670'
Sounding Tube


650
700
750
800
850
900
950
1000
1050
T D - 1010'
620'
650'
670'
700'
720'
750'
770'
800'
820'
850'
870'
10" I.D
Casing
900'
920
950'
970'
990'
1010'
Borehole Diameter
28" (0' - 40')
18 5/8" (40' 1010')



4

LITHOLOGIC SYMBOLS

- Clay
- Clay Silt
- Silt
- Silt And Clay
- (May also include modifiers of: with some gravel, and with very little gravel).

- Gravel With Sand
- Gravel With Clay Sand
- Gravel With Silty Clay Sand
- Gravel With Silty Sand
- Gravel With Clay And Sand
- Gravel With Silt And Sand
- (May also include modifiers of: with some, and with very little).

WELL DESIGN

- Cement
- 8 - 12 Sand
- Pea Gravel
- Screen

* Geophysical logs not applicable for this format.

** Penetration rates were not recorded

DRY LAKE VALLEY
(DL-I-T-1)

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE – BMO

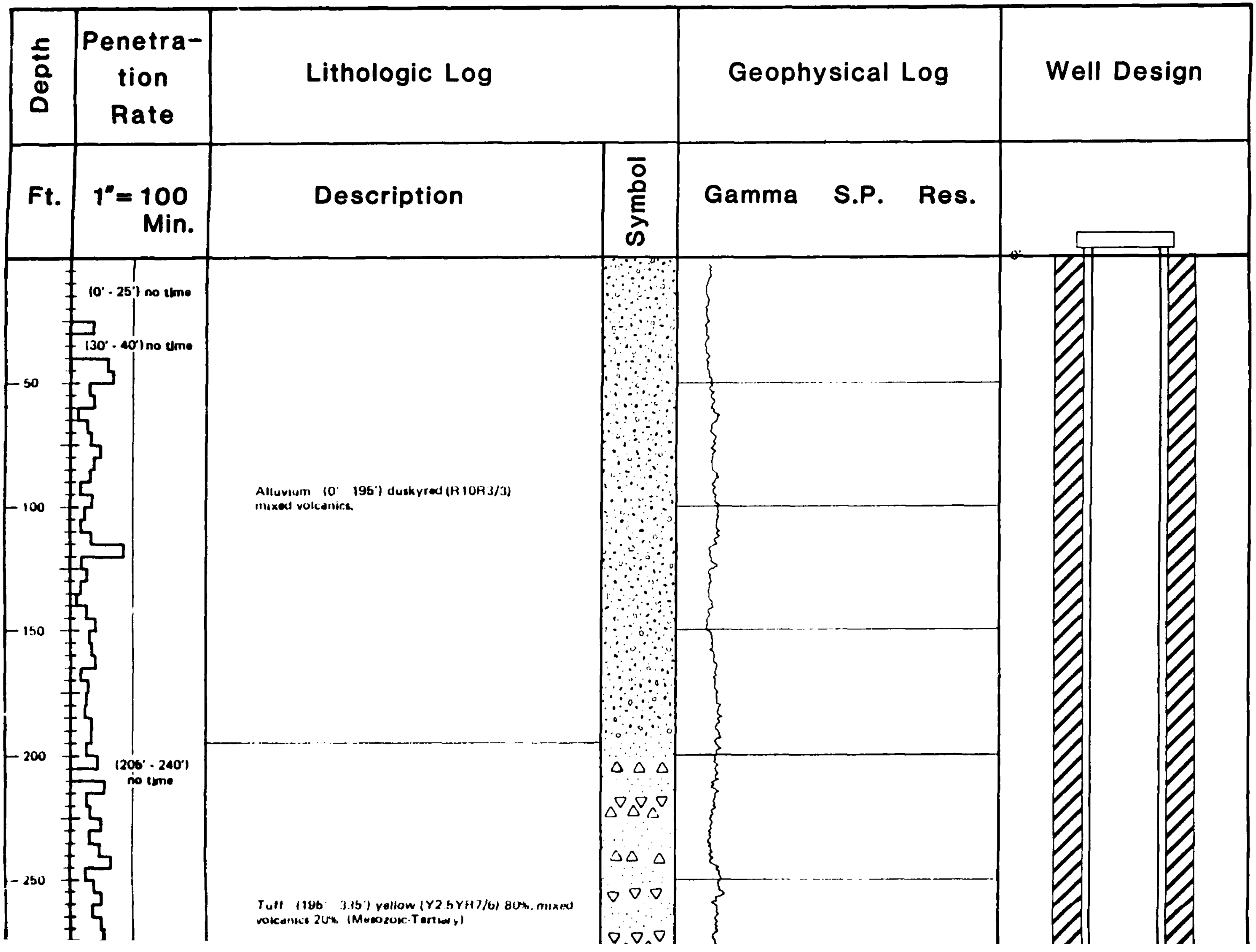
FIGURE

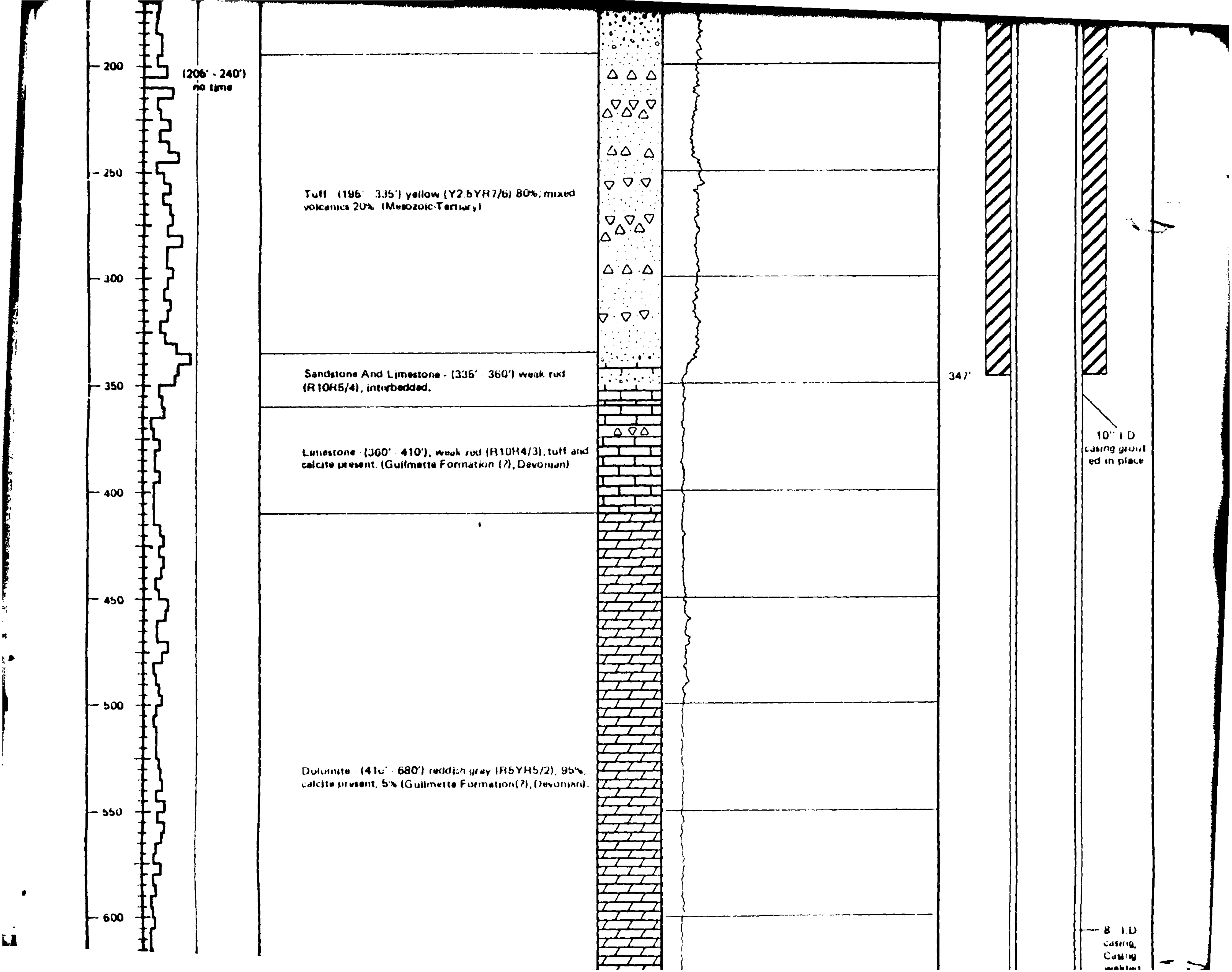
FUGRO NATIONAL, INC.

H1.3

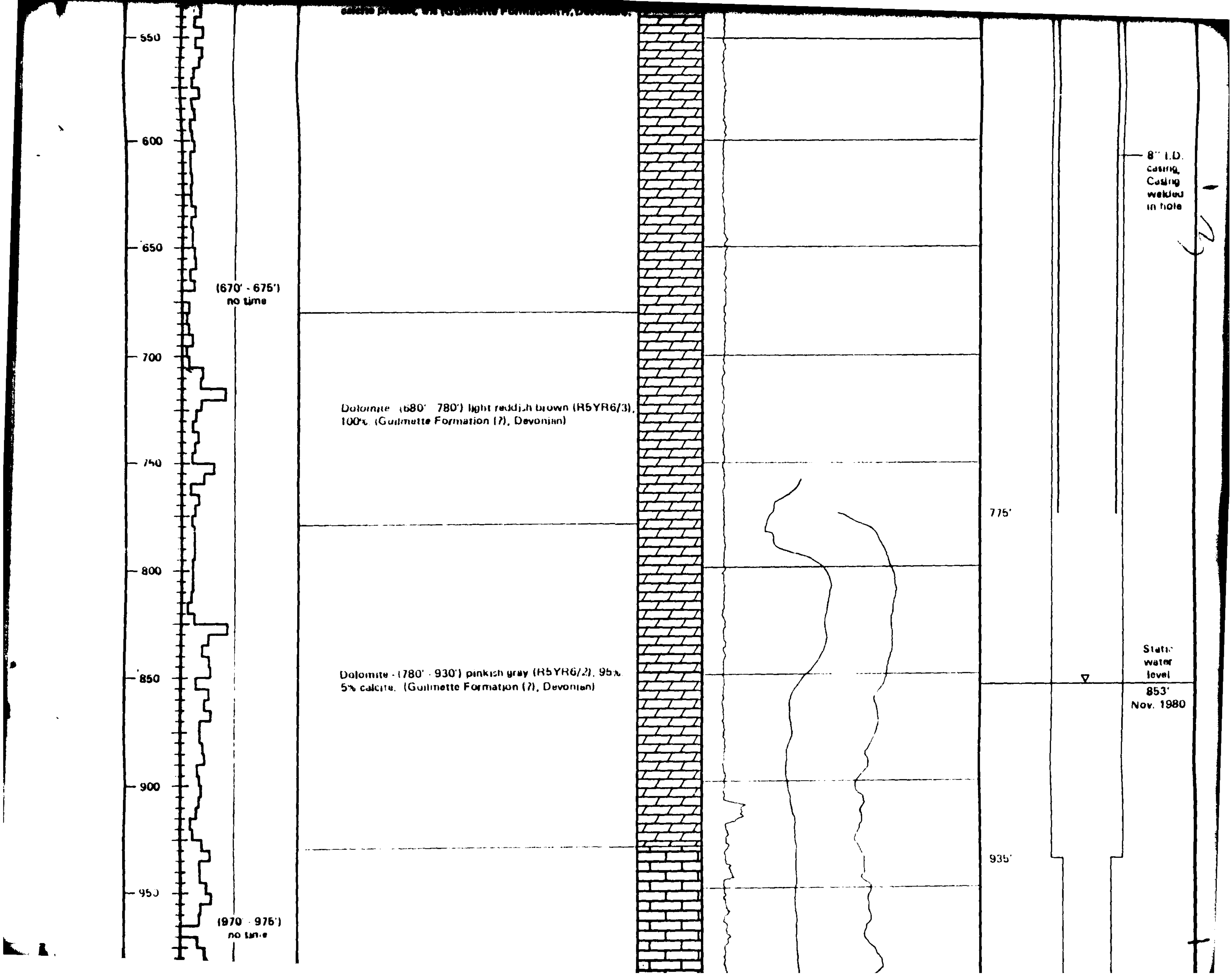
DRY LAKE VALLEY WELL LOG
AND WELL DESIGN (CARBONATE)

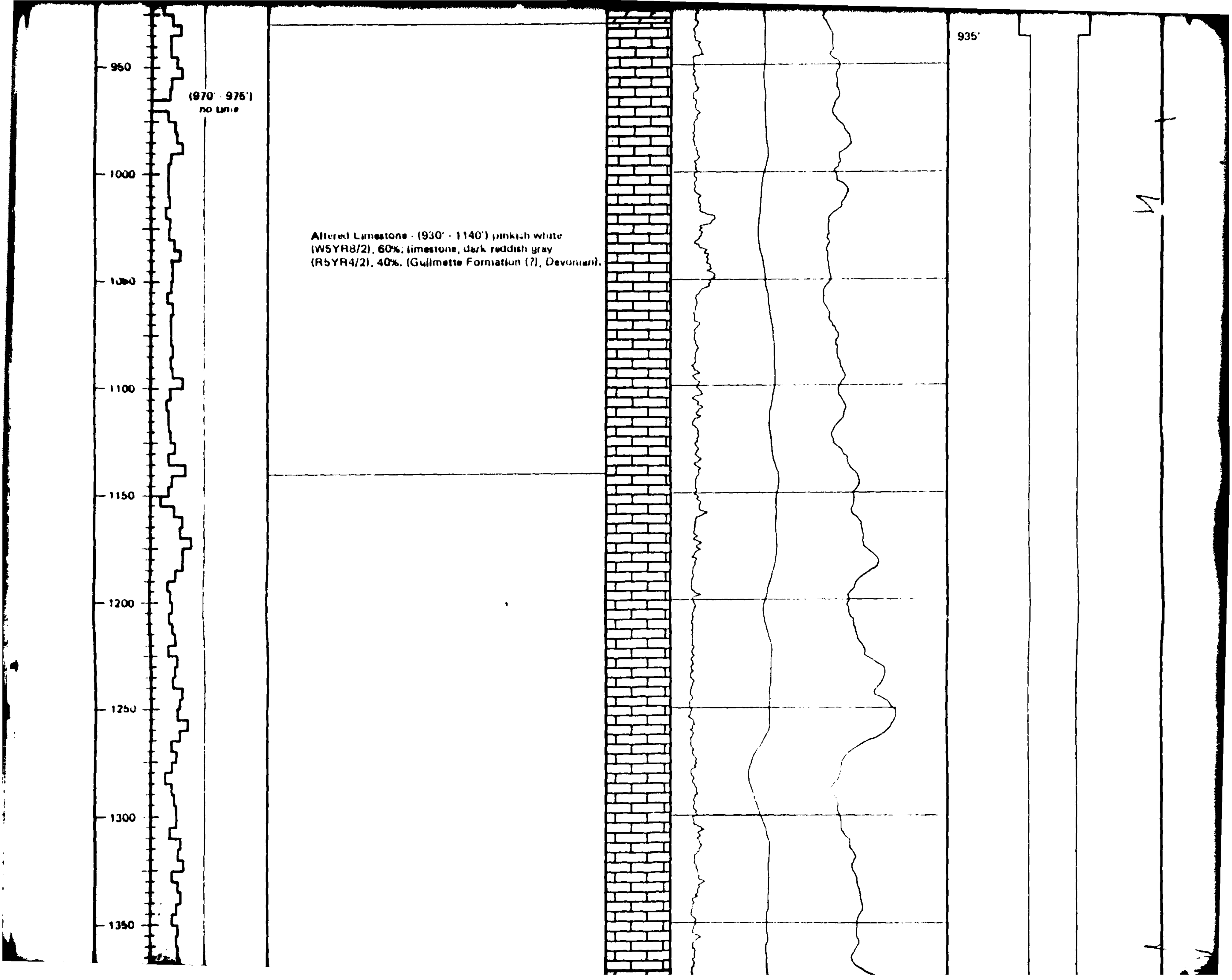
DRY LAKE VALLEY TEST WELL 3N/63E-27ca

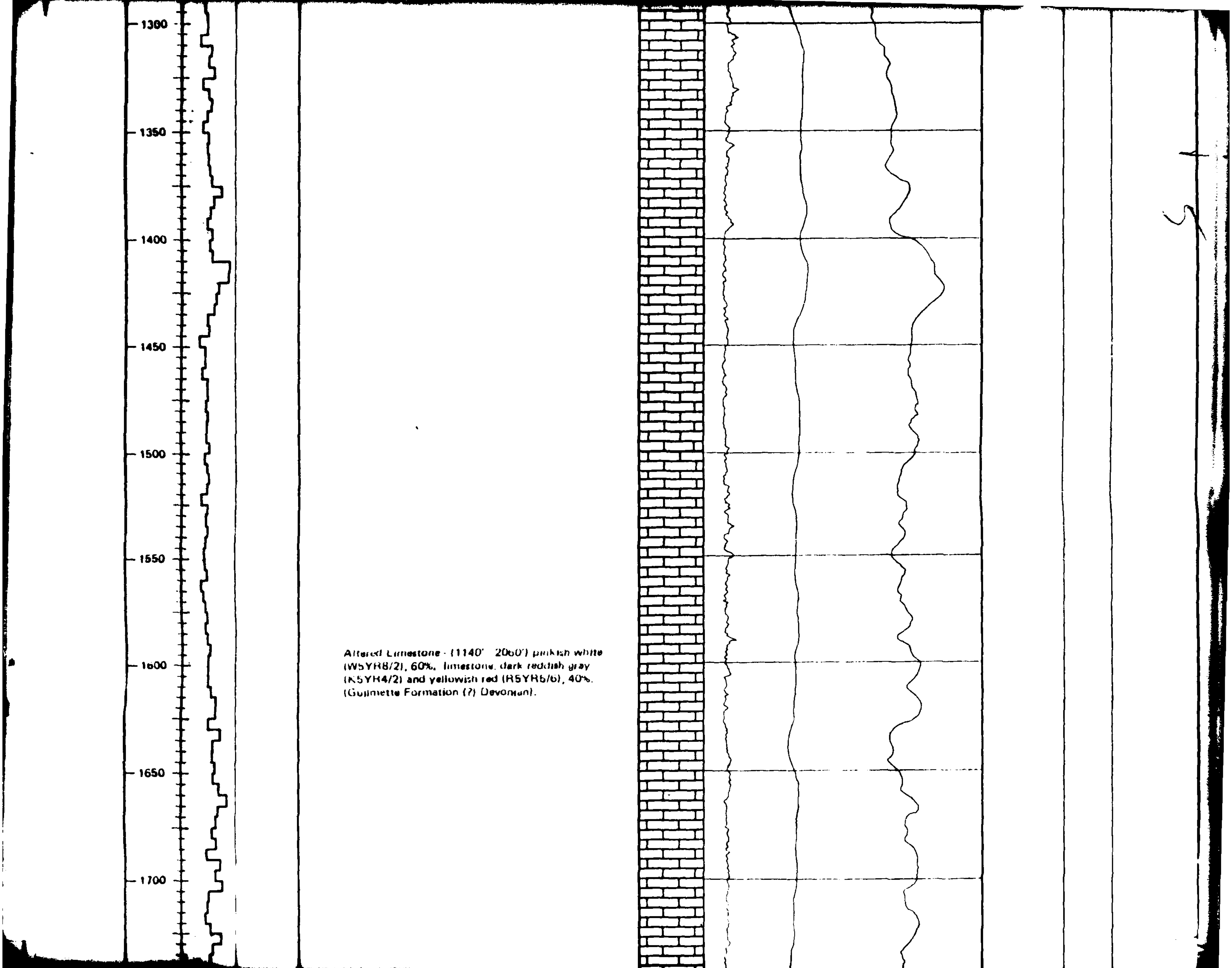




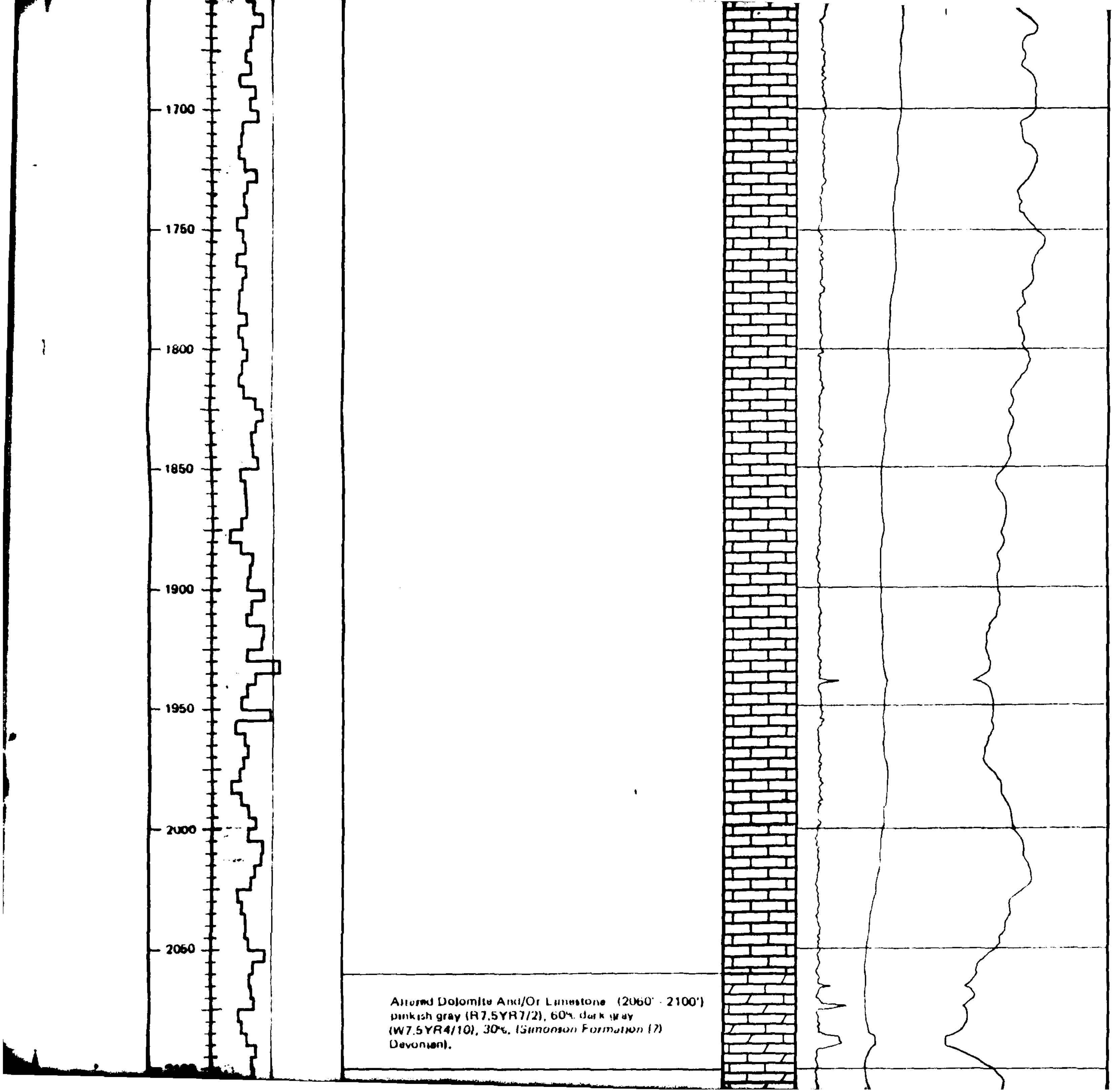
200
250
300
350
400
450
500
550
600
(206' - 240') no time
Tuff (196' - 335') yellow (Y2.5YR7/6) 80%, mixed volcanics 20% (Mesozoic-Tertiary)
Sandstone And Limestone - (335' - 360') weak red (R10R5/4), interbedded.
Limestone - (360' - 410'), weak red (R10R4/3), tuff and calcite present. (Guilmette Formation (?), Devonian)
Dolomite - (410' - 680') reddish gray (R5YR5/2), 95%, calcite present, 5% (Guilmette Formation(?), Devonian).
347'
10" I.D casing grouted in place
8" I.D casing, Casing

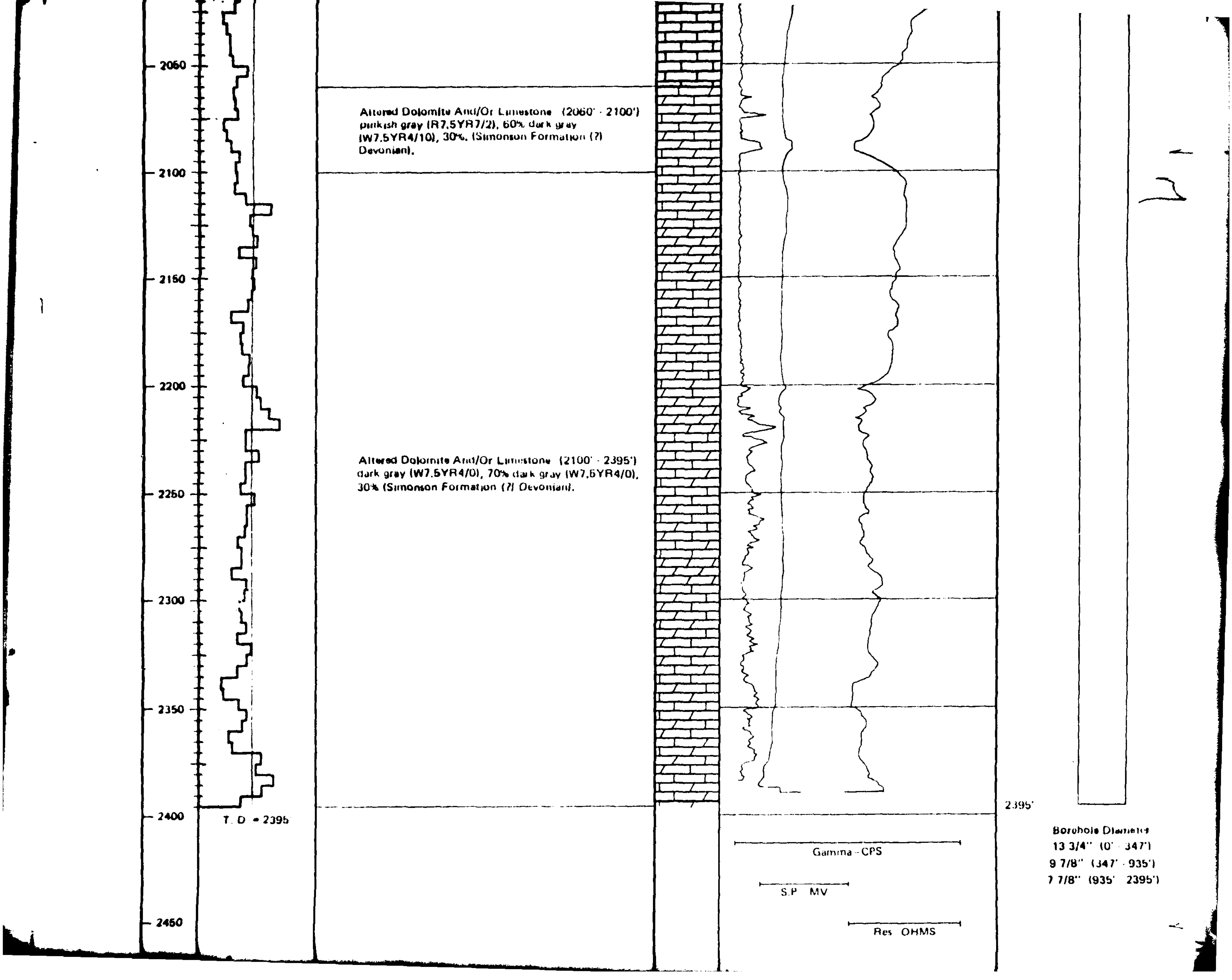

550
600
650
700
750
800
850
900
950
(670' - 675') no time
(970' - 975') no time
Dolomite (680' - 780') light reddish brown (R5YR6/3), 100%. (Guilmette Formation (?), Devonian)
Dolomite - (780' - 930') pinkish gray (R5YR6/2), 95%, 5% calcite. (Guilmette Formation (?), Devonian)
775'
935'
8" I.D. casing, Casing welded in hole
Static water level 853' Nov. 1980


950
1000
1050
1100
1150
1200
1250
1300
1350
(970' - 976')
no time
Altered Limestone - (930' - 1140') pinkish white (W5YR8/2), 60%; limestone, dark reddish gray (R5YR4/2), 40%. (Gullmette Formation (?), Devonian).
935'

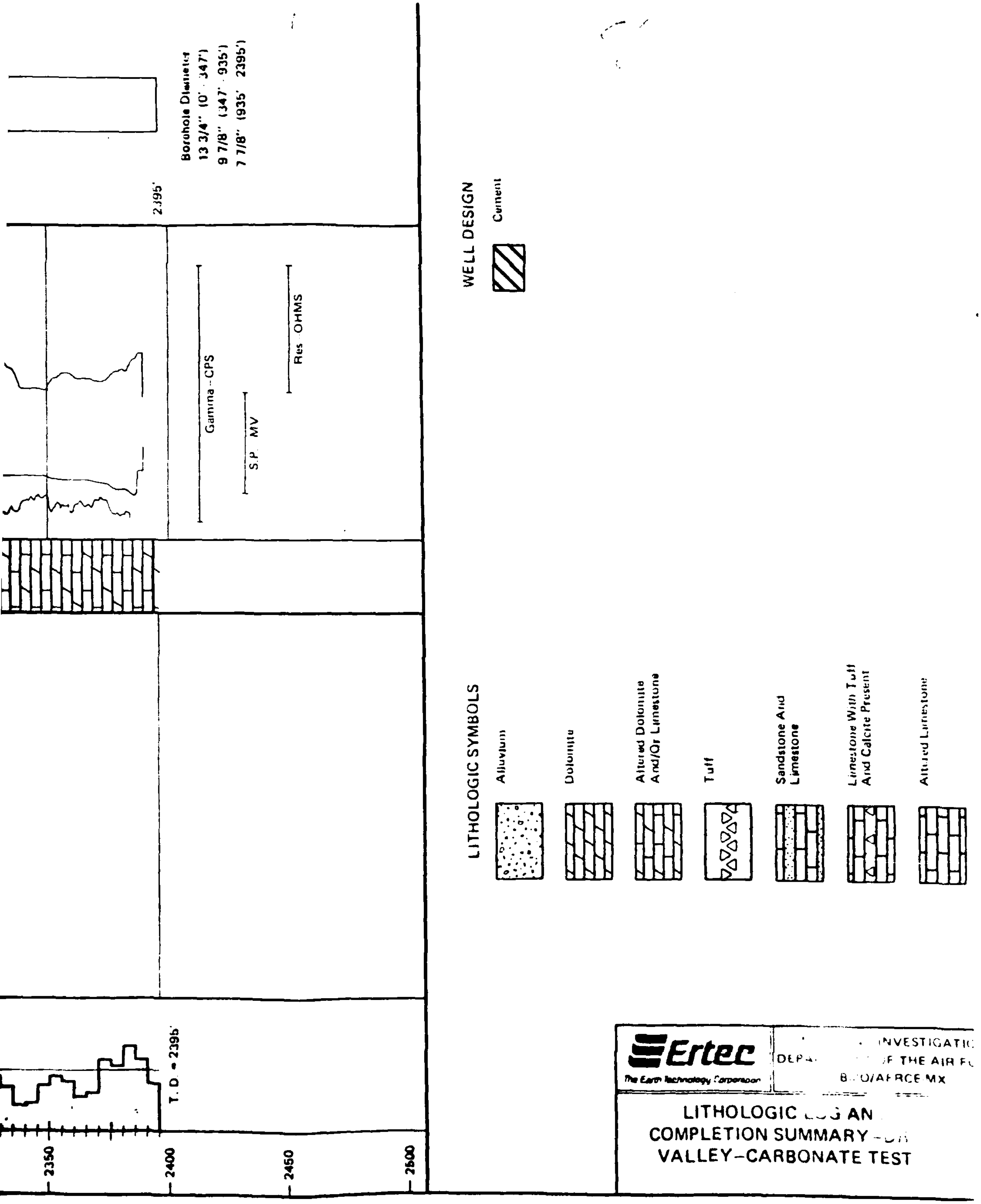


Altered Limestone - (1140' 2060') pinkish white (W5YR8/2), 60%, limestone, dark reddish gray (K5YR4/2) and yellowish red (R5YR6/6), 40%. (Guilmette Formation (?) Devonian).


1700
1750
1800
1850
1900
1950
2000
2050
Altered Dolomite And/Or Limestone (2060' - 2100') pinkish gray (R7.5YR7/2), 60% dark gray (W7.5YR4/10), 30%. (Simonson Formation (?) Devonian).



2050
2100
2150
2200
2250
2300
2350
2400
2450
T. D = 2395
Altered Dolomite And/Or Limestone (2060' - 2100') pinkish gray (R7.5YR7/2), 60% dark gray (W7.5YR4/10), 30%. (Simonson Formation (?) Devonian).
Altered Dolomite And/Or Limestone (2100' - 2395') dark gray (W7.5YR4/0), 70% dark gray (W7.5YR4/0), 30% (Simonson Formation (?) Devonian).
2395'
Gamma - CPS
S.P MV
Res OHMS
Borehole Diameter
13 3/4" (0' - 347')
9 7/8" (347' - 935')
7 7/8" (935' - 2395')



Ertec
The Earth Technology Corporation

INVESTIGATI
DEPA... OF THE AIR F...
B.../AFRCE-MX

LITHOLOGIC ... AN...
COMPLETION SUMMARY - ...
VALLEY-CARBONATE TEST

FILMED

05-8