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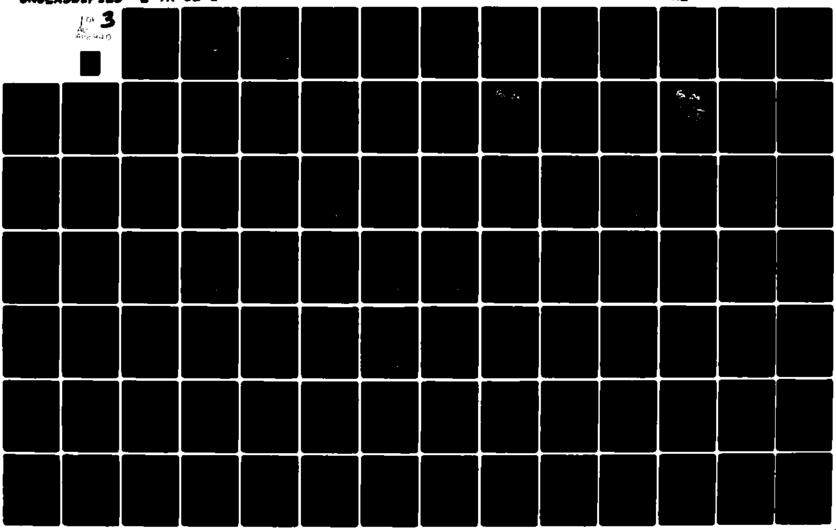

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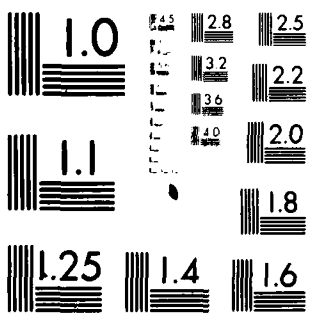

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E-TR-52-I

MX SITING INVESTIGATION
WATER RESOURCES PROGRAM

TECHNICAL SUMMARY REPORT

VOLUME I

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 November 1981

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Results of hydrologic studies in 36 proposed MX deployment valleys within the Nevada-Utah siting area and the proposed Main and Auxiliary Operating Base sites in Coyote Spring Valley, Nevada and Escalante Desert, Utah show that ground water is available for construction and operation of the MX project. Most of the valleys within the [illegible]

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FOREWORD

This report was prepared for the Department of the Air Force, Ballistic Missile Office, in compliance with Contract No. F04704-80-C-0006. It presents a comprehensive overview of hydrologic conditions and water-supply options in the proposed Nevada-Utah MX siting area. Information, results, and conclusions contained in this report are based on MX Water Resources Program activities conducted during Fiscal Years 1979, 1980, and 1981. The report covers 36 deployment area valleys. Hydrologic conditions in the two Operational Base site valleys were described in a previous Water Resources Program report.

This report consists of two volumes organized as follows:

Volume I

- An overall summary of results, conclusions, and recommendations of the Water Resources Program; and
- Appendices providing: 1) the objectives and scope of activities of the Water Resources Program; and 2) a summary, by valley, of MX water-use estimates.

Volume II

- Summary discussions of the hydrologic conditions and water-supply options for each of the 36 deployment valleys; and
- Appendices containing potentiometric maps of each valley and basic data on ground-water levels, spring and stream discharge, and water quality.

Note "A"

This report was well into preparation when the President made the decision on 02 October 1981 not to proceed with the MPS MX basing option. It was intended that more detailed valley geohydrologic reports follow this general evaluation. The original objective of the report was to provide interim data to the many users of MX geohydrologic data until these more detailed evaluations could be produced.

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EXECUTIVE SUMMARY

INTRODUCTION

Deployment of the MX missile system in the Nevada-Utah siting area would require the development of construction and domestic water supplies on a regional scale. To assess the potential for water-supply development in this relatively arid region, the MX Water Resources Program was initiated in June of 1979. The program has included hydrologic investigation of 36 proposed MX deployment valleys within the Nevada-Utah siting area and proposed Main and Auxiliary Operating Base sites (MOB, AOB) in Coyote Spring Valley, Nevada, and Escalante Desert, Utah. Investigations have focused on the following issues:

- o Physical and legal availability of surface and ground water for the construction and operation of the MX missile system;
- o Chemical suitability of water for construction and domestic purposes;
- o Identification of water-supply problem areas and recommendations for alternative water-supply sources;
- o Impacts of water-supply development.

The purpose of this report is to summarize the results and conclusions of the Water Resources Program to date. The hydrologic conditions and water-supply alternatives in each of the deployment valleys is described in brief in Volume II of this report.

The scope of MX Water Resources Program activities has involved both field and office studies. Field studies have included the collection of ground-water level measurements, spring and stream discharge measurements, and collection of surface and ground-water samples for water-quality analysis. Exploratory drilling, to date, consists of the construction of 29 test wells and 25 observation wells in a total of 20 MX deployment valleys and the MOB and AOB sites. A total of 43,751 feet (13,335 m) of exploratory drilling has been completed, including 8913 feet (2717 m) of exploratory drilling in the regional carbonate aquifer. Aquifer tests were conducted for periods ranging from three to 30 days and included step-drawdown, constant discharge, and recovery tests.

Field data have been supplemented by data from published sources and an extensive survey of the private sector. To assess the potential impact of various MX water-supply alternatives upon the environment and local water users, development of numerical simulation models of ground-water systems in deployment valleys was initiated. Five of these models have been completed.

RESULTS AND CONCLUSIONS

MX Water Requirements

Water will be required during all phases of construction and operation of the MX system. The primary uses of water will be for revegetation of disturbed areas, dust control, domestic water use in construction camps and other support facilities, and road compaction. Lesser amounts of water will be required for aggregate washing, shelter excavation and backfill, landscaping, and concrete for the missile shelters.

The construction period in individual deployment valleys will last for five to seven years. Present schedules call for construction to begin in certain valleys in 1982 and to be completed in all valleys by 1990. Based on estimates by the U.S. Army Corps of Engineers (COE) (1981), peak annual water requirements in the deployment area will range from 341 acre-feet (0.4 hm^3) in Pahroc Valley in 1984 to 3697 acre-feet (4.6 hm^3) in Railroad Valley in 1985. The peak-year requirements for the MOB in Coyote Spring Valley, Nevada, and the AOB in Escalante Desert, Utah, are estimated to be 9865 acre-feet (12.2 hm^3) in 1986 and 4198 acre-feet (5.2 hm^3) in 1985, respectively.

Detailed estimates of the water requirement for MX operation are unavailable. Preliminary estimates developed by Ertec indicate that operational water requirements in deployment valleys will range from 20 to 390 acre-ft/yr (0.02 to 0.5 hm^3/yr). This water will be used for road maintenance, fire protection, and personnel use. The range of values presented is based on the number of clusters and miles of road in deployment valleys. Operational water requirements for the AOB and MOB are estimated to be 2900 and 4400 acre-ft/yr (3.6 and 5.4 hm^3/yr), respectively (COE, 1981).

In FY 80, Ertec, on behalf of the Air Force, filed a total of 104 ground-water appropriation applications with state engineers offices in Nevada and Utah. In FY 81, an additional 23 applications were filed.

Amounts of ground water requested in individual deployment valleys ranged from 1388 acre-ft/yr (1.7 hm^3/yr) in Pahroc Valley to 5687 acre-ft/yr (7.0 hm^3/yr) in Snake Valley. The amounts filed for are generally in excess of peak-year requirements because applications were filed before reliable water-use estimates were available.

Water Availability

In general, surface water is not an adequate water-supply source for MX purposes. Development of ground water from valley-fill aquifers is the preferred water-supply source for MX construction and operation. Alternative water-supply sources include the purchase or lease of ground-water and/or surface-water rights from existing owners, the importation of water from adjacent valleys, or development of the regional carbonate aquifer. Valley-specific hydrologic conditions determine which water-supply sources are viable. All water-supply sources are evaluated in the individual valley descriptions contained in Volume II of this report.

Most of the valleys within the Nevada-Utah siting area have adequate unappropriated ground-water supplies in the valley-fill aquifers to meet estimated MX water requirements. Where current ground-water appropriations exceed the perennial yield of the valley, the state engineers have classified the valleys as "designated" (Nevada) or "closed" (Utah) ground-water basins. Further development of ground-water supplies in these valleys is at the discretion of the State Engineer. Valleys within the deployment area which have been designated or closed are Antelope, Big Smoky, Lake, Penoyer, Ralston, Steptoe, and Stone Cabin valleys in Nevada and Escalante Desert, Whirlwind Valley, and Sevier Desert in Utah. The state engineers may approve Air Force ground-water appropriations in these valleys on a temporary basis for the construction period with reduced appropriations for the operational lifetime of the system. If temporary appropriations are not granted for these valleys, it will be necessary to develop alternative sources of water.

Based upon available data and results of valley-fill aquifer drilling and testing, only five MX siting valleys have been identified in which the valley-fill aquifer may not be capable of providing sufficient well yields to meet MX water requirements. These valleys are Coyote Spring, Dugway, Muleshoe, Pahroc, and Whirlwind.

The water-supply potential of the regional carbonate aquifers in the deployment area has been evaluated by exploratory drilling and aquifer testing in Coal, Steptoe, Dry Lake, and Coyote Spring valleys. Results suggest that development potential is site-specific and is dependent on occurrence of specific carbonate hydrostratigraphic units, faulting and fracturing in the carbonate rocks, and regional ground-water flow patterns. A yield of 3400 gpm (215 l/s) has been obtained from a 17.5-inch (44-cm) diameter carbonate aquifer test well in Coyote Spring Valley.

Water Quality

Water quality will not be a significant constraint to development of water supplies from either the valley-fill or regional carbonate aquifers. In the northern Utah siting area, ground-water quality often exceeds construction and drinking water criteria. Valleys identified as having generally poor ground-water quality include Fish Springs Flat, Dugway, Sevier Desert, Sevier Lake, and Whirlwind. In these areas, it may be necessary to treat the ground water in order to meet the state water-quality criteria for domestic consumption. In all other deployment valleys, ground-water quality in the vicinity of playas may be unsuitable for construction or domestic purposes. Water quality away from central playa areas generally meets applicable construction and drinking water criteria.

Impacts of MX Water Development

The hydrologic impacts of MX construction and operation within the Nevada-Utah deployment area will be variable based on valley-specific hydrologic conditions and the water-supply source alternative implemented. Because of the temporary nature of water use for MX construction, the limited amount of water required in any individual valley, and the application of basic water management techniques, it is not anticipated that significant impacts will occur in any deployment valley.

There will be a lowering of ground-water levels in the vicinity of MX water-supply wells in all valleys. If proper setback distances from existing springs and wells are maintained, no significant impact to existing uses or hydrologic features can be avoided. Aquifer test results and numerical modeling of ground-water systems in five valleys indicate that at a distance of 1 mile (2 km) from MX water-supply wells, maximum water level declines will be on the order of 6 feet or less (2 m) during the construction period, and in most cases, at a distance of 3 miles (5 km), no measureable water-level declines will occur.

A reduction of some spring discharge rates may occur as the result of localized water table lowering during MX withdrawals from the valley-fill aquifers for construction use. The majority of springs in the MX siting area are located at elevations above the valley floor and therefore should not be impacted by withdrawals from the valley fill. Those springs that are located on the valley floor will be avoided in the siting of MX production wells. Minimum setback distances of at least 1 mile (2 km) and/or locating wells down gradient from the springs will minimize potential impacts. Presently there are insufficient data available to assess the potential impact on local and regional springs of ground-water withdrawals from the regional carbonate aquifers.

A reduction of interbasin ground-water flow may occur due to MX ground-water withdrawals from the valley-fill or regional carbonate aquifers in source valleys. Because of the relatively short duration of significant MX ground-water use, it is expected that impacts of this type will be minor. Uncertainty regarding the degree of hydraulic communication between the valley fill and regional carbonate aquifers precludes a quantitative evaluation of this potential regional impact.

Diversion of surface runoff because of road and shelter construction may reduce the quantity of water that normally recharges the valley-fill aquifer. This impact is expected to be insignificant, however, because the diversion of water is seasonal and captures much of the water that would normally become runoff to the playas and lost via evaporation.

Construction of roads and shelters is expected to slightly increase the quantity of surface water runoff. The compaction of soil for road construction will alter moisture holding and runoff characteristics. This may cause higher flood peaks at downstream locations, such as road crossings. At these road crossings, culvert designs may have to be enlarged to accommodate increased runoff.

Any construction project which involves clearing of vegetation and earth-moving activities can have effects on surface water quality. Disturbance of soil can expose fresh mineral surfaces to weathering effects and promote their dissolution when in contact with water. The percentage of disturbed land will be small and the expected increase in dissolved solids from surface runoff is expected to be minor.

Localized land subsidence around Operational Base (OB) production wells may occur as a result of long term MX pumping of alluvial aquifers. In the deployment valleys, MX pumping will be of short duration and measurable subsidence is not anticipated.

Mitigating Measures

To avoid, minimize, or mitigate the potential hydrologic impacts, the following measures can be utilized: 1) careful well site selection; 2) storage of water in reservoirs in advance of the year it is required; 3) alteration of pumping patterns if detrimental changes in the ground-water system are detected; 4) reduction in the rate of construction by extending the overall construction period in a particular valley to reduce the peak annual quantity of water required; 5) utilization of an alternative source of water; and 6) compensation to an impacted water user.

1.0 INTRODUCTION

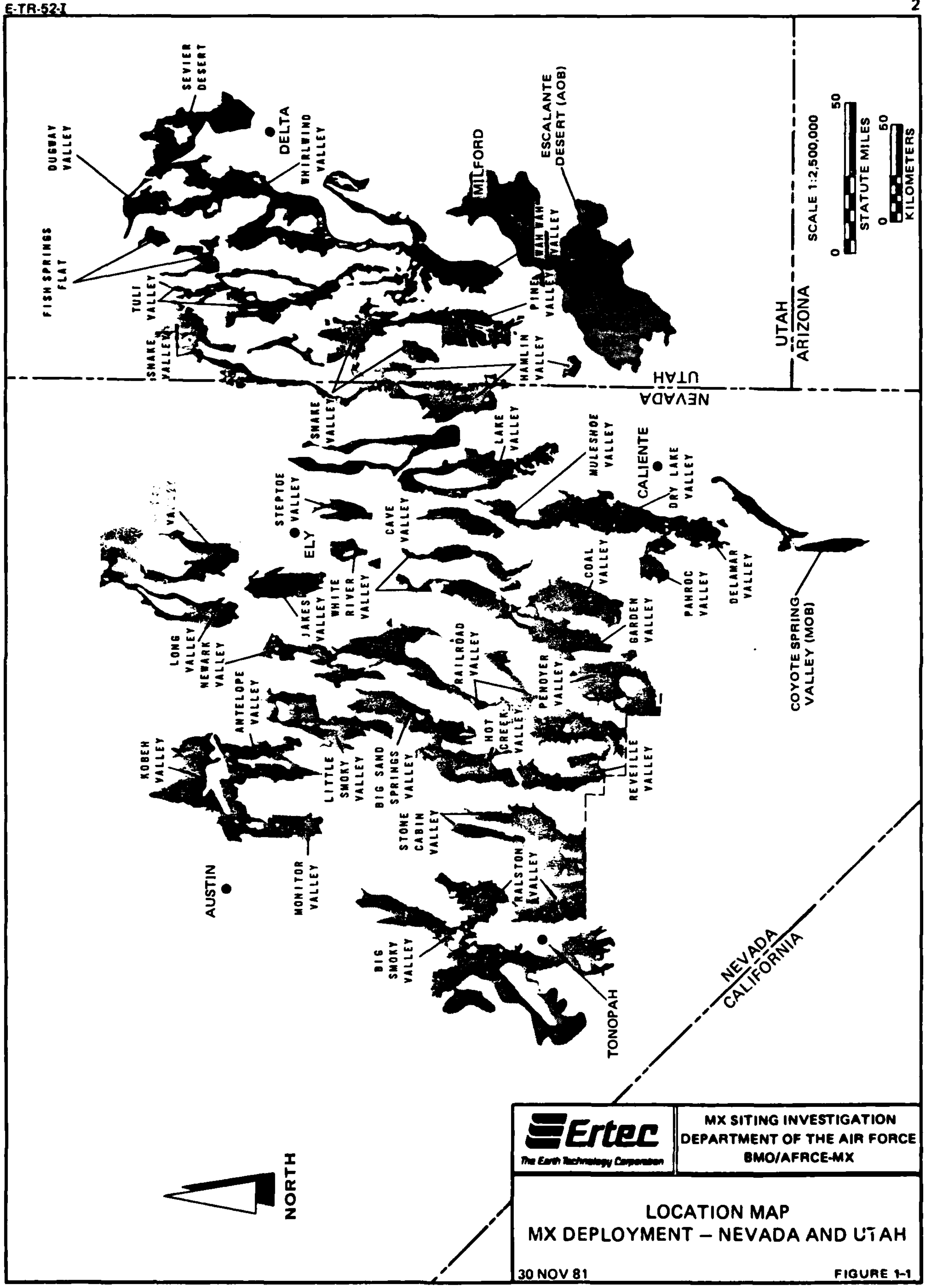
Based on a variety of geotechnical, hydrological, and geographic siting criteria, a total of 26 valleys in Nevada and 10 valleys in Utah have been identified for deployment of the MX missile system. In addition, Main and Auxiliary Operating Base (MOB and AOB) sites have been proposed for Coyote Spring Valley, Nevada, and Escalante Desert, Utah, respectively. Figure 1-1 shows the valleys in the proposed Nevada-Utah MX deployment area.

The MX Water Resources Program was initiated in fiscal year 1979 (FY 79) and has the following primary objectives:

- o Determine the availability of water in the deployment and base site valleys and the effects of MX ground-water withdrawals on local water users and the environment;
- o Determine the most viable and alternative water-supply sources for each valley; and
- o Provide the necessary data and documentation to support Air Force water-appropriation applications.

The program included field reconnaissance surveys of each deployment valley and base site, exploratory drilling and testing in the valley-fill and regional carbonate aquifers, water use and industry activity surveys, assessment of state water law, and development of water management plans. A more comprehensive description of the MX Water Resources Program and program activities is provided in Appendix A.

The purpose of this report is to present an overview of the hydrologic conditions in the proposed Nevada-Utah MX deployment area with emphasis on the issues to follow.



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LOCATION MAP
MX DEPLOYMENT – NEVADA AND UTAH

30 NOV 81 FIGURE 1-1

- The physical and legal availability of surface and ground water for the construction and operation of the MX missile system;
- The chemical suitability of water for construction and domestic purposes;
- The identification of water-supply problem areas and recommendation of alternative water supply sources for these areas; and
- The impacts of development of the local valley-fill and regional carbonate aquifers.

The results, conclusions, and recommendations of the Water Resources Program are summarized in this report. Volume II of this report presents summary discussions of the hydrologic conditions and water-supply options for each of the 36 deployment valleys. These summaries are based upon the analysis and interpretation of data collected in each of the proposed deployment valleys and evaluation of regional hydrologic conditions. The MOB and AOB sites were addressed in a previous report entitled "MX Siting Investigation, Water Resources Program, Operational Base Studies Report" (E-TR-51-I and II, May 1981) and are not discussed in Volume II.

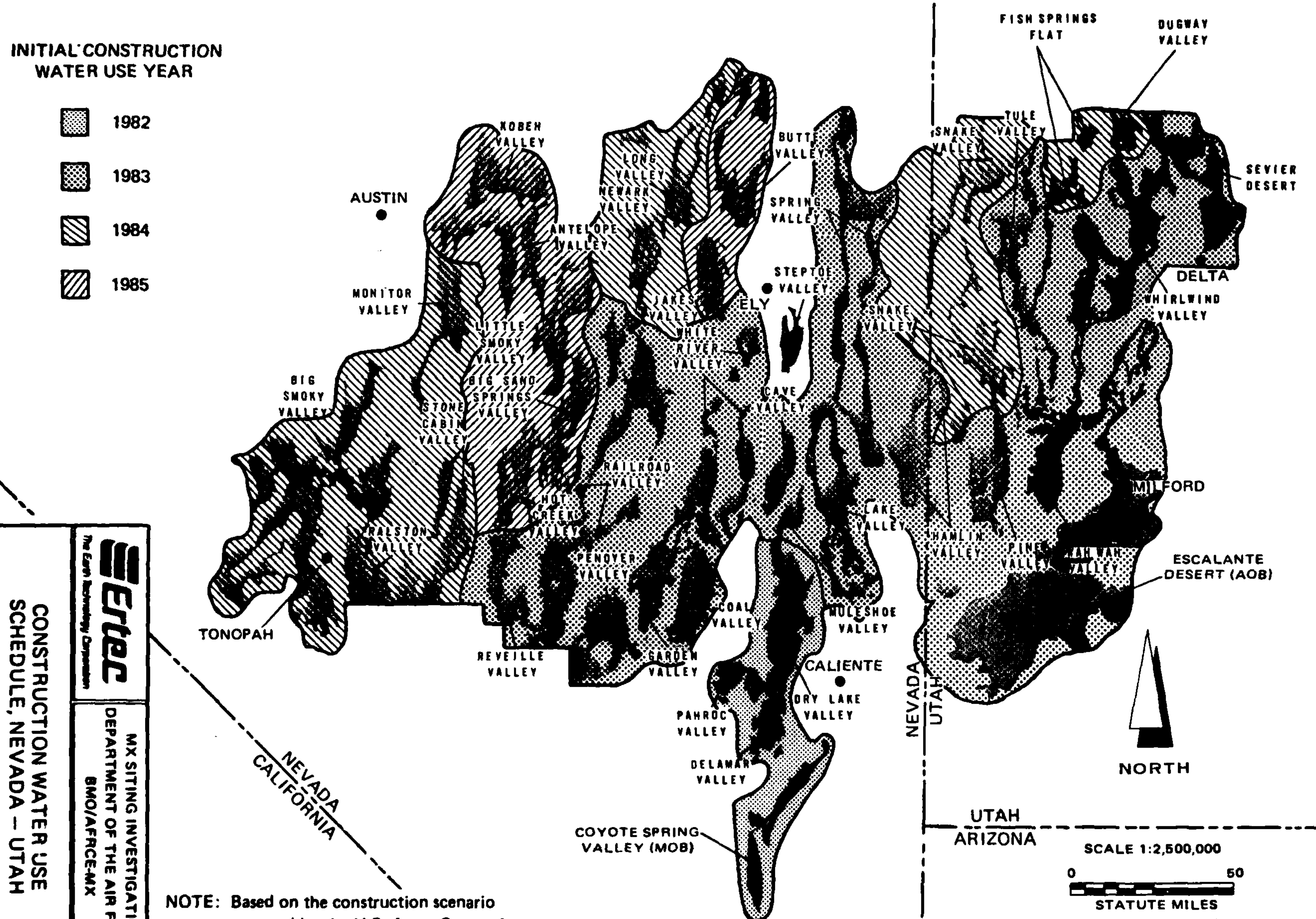
Note:
This report was well into preparation when the President made the decision on 02 October 1981 not to proceed with the MPS MX basing option. It was intended that more detailed valley geohydrologic reports follow this general evaluation. The original objective of the report was to provide interim data to the many users of MX geohydrologic data until these more detailed evaluations could be produced.

2.0 MX WATER REQUIREMENTS

2.1 OVERVIEW

Water will be required for nearly all aspects of the construction and operation of the proposed MX missile system. The U.S. Army Corps of Engineers (COE) has estimated the construction water requirements and construction period for each deployment valley. These requirements are based upon estimated water usage for road and shelter construction, revegetation of disturbed areas, support facilities such as life support camps and area support camps, and aggregate washing. The total quantities of water required within a given deployment valley range from 1 acre-foot (0.001 hm^3) in Tule Valley in 1983 to 3697 acre-feet (4.6 hm^3) in Railroad Valley in 1985. The construction phase is currently scheduled to begin in 1982 and be completed in 1990. Figure 2-1 indicates the initial year for construction water use in the MX siting area.

In most of the deployment valleys, there is a low initial water requirement during the first year of construction, a build-up to a peak water-demand year, and then a subsequent decline. However, as shown in Table 2-1, the annual construction water requirements in some of the deployment valleys fluctuates rather than building up to a peak-year requirement and then tapering off. In Coal Valley, for example, the water requirements are 2285, 1384, and 1909 acre-feet (2.8, 1.7, and 2.4 hm^3) for 1984, 1985, and 1986, respectively. The peak-year requirement occurs in 1984 due to the construction and revegetation of



NOTE: Based on the construction scenario prepared by the U.S. Army Corps of Engineers in, March 1981

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CONSTRUCTION WATER USE SCHEDULE, NEVADA – UTAH

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FIGURE 2-1

VALLEY	82	83	84	85	86	87	88	89	90
Antelope				252	1198	1474	1872	1969	343
Big Smoky			435	1447	2040	568	1204	811	40
Big Sand Springs				145	493	573	422	208	
Butte				350	745	128	1005	690	257
Cave		183	916	259	358	207			
Coal		647	2285	1384	1909	1424	250		
Coyote Spring *	866	2343	2010	7322	9685	7025	4685	4635	965
Delamar	116	141	679	340	252				
Dry Lake	196	427	3411	2533	2113	250			
Dugway			509	1100	1901	1661	1595	289	
Escalante Desert *		34	264	4198	3242	2772	3802	3599	970
Fish Springs Flat			218	497	596	410	241		
Garden		287	1508	417	625	436			
Hamlin		406	2620	795	1020	344	200	110	
Hot Creek				218	1011	1748	1683	1271	
Jakes				293	603	100	801	546	232
Kobeh				138	986	972	714	424	
Lake		570	2389	1541	2009	939			
Little Smoky				90	742	648	549	586	1
Long			139	614	124	1110	1086	961	792
Monitor			15	483	1761	2031	2141	1789	96
Muleshoe		251	968	282	341	183			
Newark			238	592	268	1279	1486	591	
Pahroc	70	126	341	168	117				
Penoyer		86	174	1778	656	718	543		
Pine		661	2209	1522	1867	922			
Railroad		361	1131	3697	2811	2558	1883	23	
Ralston			508	1905	2038	1805	2222	2027	430
Reveille		99	269	1108	548	488	335	25	
Sevier Desert		311	1870	540	866	331	369		
Sevier Lake		217	616	257	262	23	10		
Snake			720	2453	3094	3007	1903	741	
Spring		136	629	298	253	72			
Stone Cabin			556	1155	2534	1774	1070	334	
Tule		1	417	730	2447	1933	2045	1694	296
Wah Wah		666	3228	2001	2349	620			
Whirlwind		794	2712	1616	1595	923	123	171	
White River		380	2384	688	838	907	15		

NOTE:

All units are in acre-feet.

These figures may vary for some valleys from those previously reported due to difference in calculations within the ACOE MX Water Requirement Document.

Source: U.S. Army Corps of Engineers, 1981

* Operational Base Location

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CONSTRUCTION
WATER USE SUMMARY

30 NOV 81

TABLE 2-1

cluster roads. In 1985, the initial construction of shelters is scheduled to begin, but revegetation requirements are low. In 1986, the remaining shelters will be constructed and revegetated resulting in a higher water requirement than in 1985.

During operation of the missile system, significantly less water will be required than during construction. The exact quantities of water required for the operational phase have not been finalized but have been estimated by Ertec to be between 20 and 390 acre-ft/yr (0.02 and 0.5 hm^3/yr) in the deployment valleys (does not include MOB and AOB valleys). The amount of operational water use is dependent on the number of clusters and support facilities located in each valley. The water will be used for road maintenance, fire protection, and potable drinking supply for support personnel.

2.2 CONSTRUCTION REQUIREMENTS

Total construction water use requirements estimated by the COE and listed in Table 2-1 are based on the following assumptions:

- o Full deployment of the MX system in the Nevada-Utah siting area with a total of 200 clusters being constructed in 36 valleys. The cluster layouts used in this scenario are preliminary and, if the number of clusters proposed for a given valley is revised, the water requirement for that valley will also change.

- o Life Support Camps (LSCs) will be located in Dry Lake, Lake, Pine, Wah Wah, Snake, Whirlwind, Tule, Dugway, Coal, Railroad, Hot Creek, Stone Cabin, Ralston, Long, Newark, Antelope, and Monitor valleys and at the MOB and AOB sites.

- o Precast yards will be located in Dry Lake, Lake, Wah Wah, Hamlin, Snake, Whirlwind, Tule, Dugway, White River, Railroad (2), Hot Creek, Stone Cabin, Ralston, Jakes, Newark, Antelope, and Monitor valleys.

- Area Support Centers (ASCs) will be located in Dry Lake, Whirlwind, Stone Cabin, and Little Smoky valleys.
- Water-usage rates for LSCs are assumed to be 100 gallons per capita per day (gpcd) if there are no in-camp dependents and 200 gpcd if dependents are included.
- The water requirements for revegetation assume that a hydro-mulch containing native grass seed, fertilizer, and cellulose mulch will be applied by spraying.

The COE construction water-use estimates were calculated on the basis of the total number of clusters, miles of Designated Transportation Network (DTN) and support roads, and the number and type of support facilities in each valley. These estimates divide water use within a deployment valley into the following categories:

1. Domestic Water Use
   a. Life Support Camps
   b. Independently Housed Workers
2. Revegetation
3. Landscaping
4. Dust Control
   a. Roadways
   b. Work Sites
   c. In Camps
5. Road Construction
   a. Soil Recompaction
   b. Construction Roads
   c. Regrading from Construction to Operation
6. Shelter Excavation and Backfill
7. Concrete for Designated Deployment Area (DDA)-Precast Plants
8. Concrete for MOB, AOB, Designated Assembly Areas (DAA) and Operational Base Test Site (OBTS)
9. Concrete Aggregate Wash

Appendix B presents estimates of total annual construction water requirements for each valley by the water-use categories listed above.

Domestic water use at the LSCs and revegetation are the primary MX water requirements. Water demand estimates for LSCs assume water usage 365 days per year at a rate of 200 gpcd if dependents of construction workers are included. The population of the LSCs (including dependents) is expected to range from about 4300 at the Newark Valley LSC to 6560 at the Dry Lake LSC. At the MOB and AOB, population estimates for LSCs are 25,670 and 15,982 respectively. Exclusive of the Operational Base (OB) sites, the peak water-use estimates for LSCs range from 485 acre-feet (0.6 hm^3) in Railroad Valley in 1987 to 1179 acre-feet (1.5 hm^3) in Dry Lake in 1985.

Revegetation of disturbed areas will be performed throughout the construction period. The largest water requirements for revegetation are for shelters, DTN, cluster roads, and support roads. Lesser amounts are required for LSCs, precast plants, construction support yards and material source sites. The peak annual water requirements for revegetation range from 135 acre-feet (0.2 hm^3) in Pahroc Valley in 1984 to 1563 acre-feet (1.9 hm^3) in Snake Valley in 1986.

Water for landscaping will be required at the MOB, AOB, and the LSCs. The LSC water requirement for landscaping is small, generally totaling less than 100 acre-ft/yr (0.1 hm^3/yr). The maximum landscaping water requirement is for Coal Valley and totals 378 acre-feet (0.5 hm^3) over a five-year period with a peak requirement of 114 acre-feet (0.1 hm^3) in 1986.

Moderate quantities of water will be required for dust control during road construction and in work areas. The peak annual water requirements for dust suppression in the deployment valleys range from 64 acre-feet (0.1 hm^3) in Pahroc Valley in 1984 to 827 acre-feet (1.0 hm^3) in Snake Valley in 1987. Moderate to large quantities of water are required for road construction purposes including initial road compaction. The peak annual requirements for road construction range from 140 acre-feet (0.2 hm^3) in Pahroc Valley in 1984 to 1977 acre-feet (2.4 hm^3) in Railroad Valley in 1985.

Small quantities of water will be needed for shelter excavation and backfill, concrete mixing, and aggregate wash. The peak annual requirements of water for these purposes range from 15 acre-feet (0.02 hm^3) in Pahroc Valley in 1985 to 334 acre-feet (0.4 hm^3) in Snake Valley in 1987.

2.3 OPERATION REQUIREMENTS

Although precise estimates of the operational water requirements are not yet available, it is assumed that the major use will be for domestic purposes at the MOB, AOB, and the ASCs. A minor amount, estimated by Ertec to be between 20 and 390 acre-ft/yr (0.2 to 0.5 hm^3/yr) will be used in each of the deployment valleys for road maintenance, fire protection, and support personnel. At present, it is assumed that the water requirements for the ASC will be 85 gpcd. The number of personnel at each

ASC has not been determined and thus the total operational requirement for valleys which have ASCs (Dry Lake, Whirlwind, Stone Cabin, and Little Smoky valleys) is unknown.

3.0 MX WATER APPROPRIATIONS

In October 1979, Ertec, on behalf of the Air Force, initiated filing of ground-water appropriation applications with the State Engineers' offices of Utah and Nevada. Appropriation applications were not filed for surface water because, as is shown in subsequent sections of this report, surface water in the deployment valleys is a very limited resource and often is not a dependable year-round source of supply. Reliable surface water sources that do exist are, for the most part, fully appropriated.

The quantity of ground water requested in each deployment valley is listed in Table 3-1. The quantities requested were based upon the number of clusters proposed for each valley at the time of filing and upon water-use estimates available at the time. Because the applications were filed well in advance of the detailed water-use analyses performed by the COE, a contingency factor of 62.5 percent (a 25 percent increase in the clusters in each valley and a subsequent 30 percent overall increase) were added to each application. It is anticipated that water rights will be granted only for the actual amount of water required in each valley. The appropriation applications filed to date will, if granted, give the Air Force adequate ground-water rights to meet the MX water requirements outlined in the preceding section of this report.

As required by the water rights laws of Nevada and Utah, the Air Force's applications have been published to allow interested or

VALLEY	TOTAL QUANTITY OF GROUND WATER REQUESTED (ACRE - FT/YR)	NUMBER OF POINTS OF DIVERSION	DATE OF FILING
DRY LAKE	3810	1	1-30-80
DELAMAR	1585	1	1-30-80
WHITE RIVER	3810	1	1-30-80
SNAKE	5687	5	10-25-79 & 7-15-80
REVEILLE	2770	5	7-11-80
HOT CREEK	3115	5	7-11-80
LITTLE SMOKY	2076	3	7-11-80
ANTELOPE	3805	5	7-11-80
RAILROAD	4148	4	7-11-80
GARDEN	3456	8	7-11-80
COAL	3456	9	7-11-80
PAHROC	1388	4	7-11-80
MULESHOE	1731	3	7-11-80
CAVE	2076	6	7-11-80
SPRING	2425	5	7-11-80
HAMLIN	3464	5	7-11-80
PINE	2421	5	7-11-80
TULE	4146	8	7-11-80
FISH SPRINGS FLAT	2537	8	7-11-80
WAH WAH	3801	7	7-11-80
WHIRLWIND	3685	8	7-11-80
DUGWAY	3111	5	7-11-80
SEVIER	2076	3	7-11-80
STONE CABIN	4152	8	7-15-80
RALSTON	4152	8	7-15-80
BIG SAND SPRINGS	2076	4	7-15-80
PENOYER	2422	2	7-15-80
LAKE	3805	5	7-15-80
BIG SMOKY	4146	3	7-15-80
BUTTE	2464	4	11-18-80 & 6-8-81
JAKES	1758	3	11-18-80
KOBEH	3530	5	11-18-80
NEWARK	1404	2	11-18-80
MONITOR	2112	3	11-18-80
LONG	1404	2	5-25-81
OB SITES			
COYOTE SPRING	19370 *	2	5-25-81 & 7-24-81
STEPTOE**	9685	1	11-18-80
ESCALANTE DESERT***	–	–	–

* Two applications presently on file for 9685 acre-ft./yr. each. Only one will be acted upon.

** The quantity requested for this valley was based on the assumption that it was a potential OB site. At this time Steptoe Valley is being considered for missile deployment only.

*** No applications filed.

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GROUND–WATER APPROPRIATION APPLICATIONS

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TABLE 3-1

potentially affected parties to protest the filings. To date, all appropriation applications that have been published and for which the protest period (30 days subsequent to final publication of the application) has officially closed have been protested. These protests have been filed by environmental groups, agricultural and industrial interests, native Americans and individuals who live within the potentially affected areas.

In accordance with the established water-rights application procedures, the State Engineers' offices of each state will conduct public hearings for individual valleys in FY 82. The purpose of the hearings is to argue the impact of additional water appropriations upon the existing water users and upon the state's water resources. It is anticipated that all applications filed by the Air Force will ultimately be protested following their publication.

The appropriation of ground water in the states of Nevada and Utah is primarily based on the concept of perennial yield. Perennial yield is loosely defined as the amount of ground water that can be annually withdrawn from a valley or ground-water basin without causing a long-term undesirable result such as widespread significant drawdown, water-quality degradation, etc. (see Glossary - Volume IIB, Appendix G). Perennial yield values, although estimates, have been defined for all ground-water basins in Nevada and Utah.

In general, the State Engineer will grant additional ground-water appropriations within a given hydrographic basin or valley unless one of the following conditions occurs:

1. There is no unappropriated ground water available within the estimated perennial yield;

2. The appropriation will impair the value of existing surface-water or ground-water rights; or

3. The proposed appropriation will be detrimental to the state's general welfare.

The respective State Engineers are not legally bound to disallow all appropriation applications in excess of the estimated perennial yield. It would be at their discretion to permit permanent or temporary use in excess of the estimated perennial yield if conditions 2 and 3 above would not occur. The finding that a proposed appropriation will be detrimental to the state's general welfare will normally occur only when the proposed appropriation would cause ground-water overdrafting resulting in significant adverse consequences.

4.0 WATER AVAILABILITY

The Nevada-Utah siting area is generally deficient in surface water. In most valley however, sufficient ground-water is available from the valley-fill aquifers to provide an adequate source of construction and operational water for the MX missile system. In those valleys where adequate ground water is not available from the valley-fill, it will be necessary to develop alternative sources of water to meet the estimated MX water requirements.

4.1 SURFACE WATER

The Nevada-Utah siting area is within one of the most arid regions of the United States and surface-water supplies are extremely limited. Occurrence of surface water is limited to widely separated springs, intermittent streams, seasonal accumulations of surface water runoff in small manmade impoundments, and in playa (dry lake) areas and a few small perennial streams. Dependable surface-water supplies in the deployment area have been fully appropriated. It may be possible, however, for the Air Force to lease or purchase existing surface-water rights and divert the water to supplement ground-water supplies in some deployment valleys. It should be noted that the use of surface water for domestic consumption may require costly water treatment to meet established drinking water standards.

4.1.1 Springs

Springs in the deployment area can be grouped into four categories on the basis of their hydrologic characteristics: 1) regional; 2) possible regional; 3) local valley-fill; and 4) meteoric.

Regional springs discharge ground water from the regional carbonate aquifers which underlie much of the siting area. Discharge from these springs is usually large and constant in comparison to local or meteoric springs and the water temperature is generally elevated due to deep circulation. Regional springs in the siting area have been identified on the basis of water chemistry, temperature, and discharge rate. Possible regional springs are herein defined as those springs which exhibit characteristics similar to regional springs but do not meet all the classification criteria. Regional and possible regional springs and the classification criteria used are listed in Table 4-1.

Springs derived from local valley-fill aquifers generally have smaller discharge than the regional springs and are subject to seasonal discharge fluctuations in response to changing climatic conditions. Local valley-fill springs may be derived from the main valley-fill aquifer or a much more limited perched aquifer. Meteoric springs are fed by shallow recharge derived from snowmelt and rainwater runoff and generally occur in the mountains above the adjacent valley floor. The majority are small springs with significant seasonal fluctuation in discharge, however, meteroic springs with significant discharge are not uncommon. Valley-fill and meteroic springs with discharge greater than 100 gpm (6 l/s) and which display minor seasonal fluctuation are listed in Table 4-2.

LOCATION	NAME	DISCHARGE (gpm)	TEMPERATURE (°C)	CHEMICAL CLASSIFICATION**	STATUS
Antelope Valley 18N/50E-28d	Hot Spring	100[1]	70[1]	Regional	Regional
Big Smoky Valley 1S/41E-26a	Alkali Spring	40[2]	60[2]	Regional	Possible Regional*
Clayton Valley*** 2S/39E-22a	Waterworks Spring	240[2]	18[2]	Regional	Regional
Dry Lake Valley 3N/65E-31cc	—	3E	24	Regional/Local	Possible Regional*
Fish Springs Flat Valley	Fish Springs Flat Group	150-5400[3]	20-27[3]	Regional	Regional
(C-10-14)33cdc	Wilson Hot Spring	1-60[3]	56[3]	Regional	Possible Regional*
(C-12-12)10cbc	Wildhorse Spring	<1[3]	22[3]	Regional	Possible Regional*
Hamlin Valley 5N/70E-11daa	Hermitage Spring	100E	16	Regional	Possible Regional*
Hot Creek Valley 8N/49E-25ba	Old Dugan Place Hot Spring	500[4]	36[5]	Regional	Regional
8N/49E-21cdc	Upper Warm Spring	30[6]	35[5]	Regional	Possible Regional*
8N/50E-29dda	Hot Creek Ranch Spring	760[7]	63[5]	Regional	Regional
8N/50E-29da	Upper Hot Creek RanchSpring	280[4]	67[5]	Regional	Regional
4N/50E-20cc	Warm Spring	670[7]	60[5]	Regional	Regional

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REGIONAL SPRINGS
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TABLE 4-1

LOCATION	NAME	DISCHARGE (gpm)	TEMPERATURE (°C)	CHEMICAL CLASSIFICATION **	STATUS
Lake Valley					
9N/65E-4c1	Geyser Spring	200 - 225****[8]	20[8]	Local	Possible Regional*
Little Smoky					
16N/53E-8b	Fish Creek Springs	2400[7]	17	Regional	Possible Regional*
Long Valley					
23N/58E-36c	Spring	300 E	4	Regional	Possible Regional*
Moapa Valley ***	Muddy River Springs Group	110-3875	29 - 33	Regional	Regional
Newark Valley					
23N/56E-36ddc	Warm Springs	1800 E	9	Regional/Local	Possible Regional*
Pahranagat Valley ***					
6S/61E-6bb	Ash Spring	8700 E	32	Regional	Regional
5S/60E-10aca	Crystal Spring	3500 E	24	Regional/Local	Regional
4S/60E-14acd	Hiko Spring	4300 E	23	Regional	Regional
Penoyer Valley					
2S/55E-26dda	Sand Spring	0.2[9]	30[9]	Regional	Possible Regional*
Railroad Valley					
13N/56E-32bac	Big Warm Spring	5800 ****[9]	33[9]	Regional	Regional
12N/56E-5ac	Little Warm Spring	200[9]	16[9]	Regional	Possible Regional*
8N-55E-15b	Locke's Big Spring	480****[9]	36	Regional	Regional
6N-54E-23bd	Abel Spring	25[9]	46[9]	Regional	Possible Regional*
2S/51E-21da	Cedar Spring	2.5[9]	25[9]	Regional	Possible Regional*
Sevier Desert					
(C-9-7) 35b	–	100 E[10]	19[10]	Regional	Regional
(C-10-7) 5c	–	–	19[10]	Regional	Possible Regional*
(C-10-8) 2dba	–	100 E[10]	10[10]	Regional	Possible Regional*

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TABLE 4-1

LOCATION	NAME	DISCHARGE (gpm)	TEMPERATURE (°C)	CHEMICAL CLASSIFICATION **	STATUS
Sevier Desert cont.					
(C-10-8) 3abb	Indian Spring	2000 E[10]	16[10]	Regional	Possible Regional*
Snake Valley					
(C-15-19) 31bc	Warm Spring	3600[18]	27[18]	Regional	Regional
(C-16-18) 22cab	Twin Spring	1800E[18]	20	Regional	Regional
Steptoe Valley					
21N/63E-24	Monte Neva Hot Spring	630[13]	79	Local	Possible Regional*
18N/64E-21bdd	Mc Gill Spring	4600[13]	17	Regional	Possible Regional*
Stone Cabin Valley					
2N/47E-14ac	—	1E	21	Regional	Possible Regional*
5N/46E-28cd	Warm Spring	4E	27	Regional	Possible Regional*
Tule Valley					
(C-16-15) 13bab	Coyote Spring	100E[14]	28[14]	Regional	Possible Regional*
(C-17-15) 10aab	Tule Spring	—	27[11]	Regional	Possible Regional*
Wah Wah Valley					
(C-27-15)11aba	Wah Wah Spring	450E[15]	20[16]	Regional	Regional
White River Valley					
9N/61E-32d	Morman Hot Spring	1900[12]	36	Regional	Regional
9N/62E-19ac	Emigrant Spring	1350[12]	20	Local	Possible Regional*
6N/60E-25b	Moon River Spring	700E	33	Regional	Regional
6N/61E-18da	Hot Creek Spring	6885[12]	27[16]	Regional	Regional
12N/61E-12bc	Cold Spring	780[12]	21[17]	No data	Possible Regional*
12N/61E-12d	Nicholas Spring	1125[12]	22[17]	No data	Possible Regional*
12N/61E-12dc	Arnold Spring	1380[12]	22[17]	No data	Possible Regional*

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REGIONAL SPRINGS
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TABLE 4-1

NOTES:

* Possible Regional Spring — Meets two out of the three criteria described below
** Based on chemical characterization diagram as referenced below
*** Discharge from groundwater flow system within the MX deployment valleys
**** Average of discharge measurements
E Estimated discharge
Ertec measurement unless otherwise noted
List is subject to change as new data becomes available

Chemical characterization diagrams, temperatures, and spring discharge data were used to distinguish whether a spring is discharging from a local or a regional source. A regional spring in this report is defined on the basis of the following criteria:

1) The water temperature is 18°C or greater. This is approximately 10° above the average air temperature for the MX deployment valleys. Regional springs should be warmer than local springs because the water is assumed to circulate at depth.
2) The discharge is 100 gpm (0.22 cfs) or greater. Known regional springs typically have large discharges due to the amount of water available in the carbonate aquifer and the hydraulic conditions at depth.
3) Chemical characterization diagrams as developed by Mifflin (1967) show a regional source.

REFERENCES:

1. Robinson et. al., 1967
2. Rush, 1968
3. Bolke and Sumsion, 1978
4. Fiero et. al., 1968
5. Garside and Schilling, 1979
6. Thordarson and Robinson, 1971
7. Rush and Everett, 1966
8. Rush and Eakin, 1963
9. Van Denburgh and Rush, 1974
10. Stephens and Sumsion, 1978
11. U.S.G.S., 1979
12. Hess and Mifflin, 1978
13. Mifflin, 1968
14. Stephens, 1977
15. Stephens, 1974
16. Eakin, 1966
17. Maxey and Eakin, 1949
18. Hood and Rush, 1965

VALLEY	LOCATION	NAME	DATE MEASURED	DISCHARGE* (GPM)	REFERENCE
Antelope	15N/49E-24d	Copenhagen Stream	5/64	900	1
	16N/50E-25	Nine Mile Creek	5/64	670	1
	17N/49E-14cad	Stream	9/80	990	Ertec
	17N/50E-30	Allison Creek	4/64	450	1
Big Smoky	9N/42E-19b	Peavine Creek	8/79	130	Ertec
	9N/42E-30a	Peavine Creek	/68	1900	2
Butte	25N/62E-21	Paris Creek	10/65	790	3
	26N/62E-15c1	Stratton Spring	7/68	250	3
	26N/62E-22db	Spring	11/80	100	Ertec
Cave	9N/64E-16bad	Cave Valley Spring	3/80	1000 E	Ertec
Garden	3N/56E-23a	Pine Creek	6/80	750	Ertec
	3N/56E-33c	Cottonwood Creek	6/80	850	Ertec
	3N/57E-16c	Cherry Creek	6/80	1000 E	Ertec
Hamlin	10N/70E-33bad	Big Spring	8/79	4200	Ertec
	12N/70E-12c	Snake Creek	7/79	3000	Ertec
	12N/70E-18daa	Snake Creek	7/79	2400	Ertec
	13N/69E-10dd	Baker Creek	9/66	1900	4
	13N/69E-13dcb	Lehman Creek	8/79	3600	Ertec
	13N/69E-14bbd	Roland Spring	8/79	2800	Ertec
	(C-22-20)1b	Stream	7/79	2000	Ertec
Hot Creek	8N/50E-12cdd	6-Mile Canyon Stream	7/80	510	Ertec
Kobeh	19N/49E-20	Willow Creek	5/64	450 E	1
	19N/51E-5	Slough Creek	5/64	850	5
	19N/51E-7	Daggett Creek	5/64	670 E	1
	20N/47E-25	Ackerman Cyn. Stream	5/64	220 E	1
	20N/49E-23	Coils Creek Tributary	5/64	450 E	1

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STREAMS AND NON-REGIONAL SPRINGS WITH DISCHARGE GREATER THAN 100 GPM

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TABLE 4-2

VALLEY	LOCATION	NAME	DATE MEASURED	DISCHARGE* (GPM)	REFERENCE
Kobeh (Cont)	21N/48E-11	Ferguson Creek	5/64	1800 E	1
	22N/49E-27	Coils Creek	5/64	3600 E	5
	22N/49E-31	Snow Water Canyon	5/64	1100 E	6
	22N/50E-12ba	Roberts Creek	10/80	390	Ertec
Lake	5N/68E-17a1	Cottino Spring	8/63	100	7
	10N/65E-29c1	Little N. Creek Spring	8/63	770	7
Little Smoky	14N/51E-23cca	Pine Spring	3/80	180	Ertec
	16N/53E-12abd	Fish Creek	3/80	680	Ertec
Monitor	9N/46E-8	Meadow Creek	4/64	180 E	1
	9N/47E-16ab	Barley Creek	10/80	560	Ertec
	9N/47E-16	Barley Creek	4/64	900 E	1
	10N/46E-28bc	Corcoran Canyon	10/80	270	Ertec
	11N/45E-13add	Pine Creek	10/80	500	Ertec
	11N/46E-16	Pine Creek	5/64	900 E	2
	11N/47E-4db	Mosquito Creek	10/80	250	Ertec
	12N/47E-32ac	Mosquito Creek	10/80	800 E	Ertec
	14N/47E-22c	Stream	10/80	650	Ertec
	15N/47E-14	Stoneberger Creek	4/64	670 E	1
	15N/47E-25	Willow Creek	4/64	220	1
	15N/47E-35dd	Stream	10/80	400	Ertec
	15N/48E-29	Willow Creek Tributary	5/64	450	1
Newark	21N/56E-9bd	Deadman Creek	11/80	304	Ertec
	21N/56E-16cd	Stream	11/80	149	Ertec
	23N/55E-26b	Cold Spring	11/80	575	Ertec
Railroad	3N/52E-3d	Stream	3/80	1500	Ertec
	8N/55E-14bcb	Hay Corral Spring	3/72	450	8
	8N/55E-15aa	North Spring	3/72	170	8
	8N/55E-15ad	Reynolds Spring	3/72	330	8

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STREAMS AND NON-REGIONAL SPRINGS WITH DISCHARGE GREATER THAN 100 GPM
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TABLE 4-2

VALLEY	LOCATION	NAME	DATE MEASURED	DISCHARGE* (GPM)	REFERENCE
Railroad (con't)	8N/57E-11aa	Tom Spring	11/66	250	4
	8N/57E-11dd	Blue Eagle Spring	3/72	1900	Ertec
	8N/57E-27da	Butterfield Spring	11/66	200	4
	9N/57E-5cc	Stream	2/80	1500	Ertec
	10N/58E-9bc	Spring	10/71	200	8
	10N/58E-8adb	Current Creek	2/80	3200	Ertec
	11N/58E-32bbc	Pastroni Spring	10/71	300	8
	14N/56E-14ddc	Big Bull Spring	11/70	400	8
	14N/56E-25bdc	Bull Creek spring		230	8
	15N/57E-33cdb	Green Spring	11/70	100	8
Reveille	1N/50E-4aad	Eden Creek	7/80	100	Ertec
Sevier Desert	(C-10-8)5dba	Coyote Springs-N	1955	250	9
Spring	11N/67E-1cd	Shoeshone Spring		300 E	10
	11N/67E-12da	Minena Spring	6/80	300 E	Ertec
	11N/68E-4c	Wallow Spring	6/80	42,000 E	Ertec
	11N/68E-5ca	Spring	6/80	360	Ertec
	13N/68E-17cb	Pine Creek	6/80	2600	Ertec
	13N/68E-32db	Williams Creek	6/80	4600 E	Ertec
	15N/66E-21ac	Bastian Creek	6/80	1700 E	Ertec
	16N/66E-34ba	Cleave Creek	6/80	12,000	Ertec
	17N/66E-3ab	McCoy Creek	6/80	8500	Ertec
	17N/66E-15ac	Taft Creek	6/80	5800	Ertec
	17N/67E-25ca	South Mulick Spring		200	10
	18N/66E-10	Bassett Creek	1/80	1400	11
	20N/66E-7	Muncy Creek	7/64	1900	6
	20N/66E-30c	Kalamazoo Creek	6/80	1800	Ertec
	21N/65E	North Creek	7/64	1000	6
	22N/66E	Seigel Creek	7/64	890	6

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TABLE 4-2

VALLEY	LOCATION	NAME	DATE MEASURED	DISCHARGE* (GPM)	REFERENCE
Snake	17N/70E-9a	Smith Creek	8/79	850	Ertec
	(C-12-18)9db	Granite Creek	8/79	450	Ertec
	(C-12-18)28cb	Stream	8/79	970	Ertec
	(C-13-19)12ab	Woods Creek	8/79	850	Ertec
	(C-17-19)21	Kell Springs	1964	120 E	12
	(C-18-20)36	Hendrys Creek	8/79	380	Ertec
Steptoe	14N/63E-35a	Willow Creek Springs	9/65	630 E	13
	15N/64E-12ada	Steptoe Creek	6/80	15,000	Ertec
	15N/64E-28b1	Comins Lake Springs	9/65	160	13
	15N/65E-5c	N. Fork Steptoe Creek	9/65	2400	13
	15N/65E-10bdd	Cave Springs	6/80	100 E	Ertec
Stone Cabin	4N/48E-8dd	Stream	9/80	280	Ertec
Whirlwind	(C-16-13)34ad	Antelope Spring	11/79	160	Ertec
White River	6N/59E-18da	Forest Home Spring	11/66	400	Ertec
	7N/62E-28ad	Butter Field Spring	11/66	1100	4
	7N/62E-33bc	Flag Spring	7/75	1100	4
	10N/62E-4aa	Six Mile Springs	11/66	180	4
	12N/59E-18cd	Current Spring	11/66	150	4

* Discharge at time of measurement; not indicative of perennial flow at this rate.
E - Estimated

References:

1. Robinson et. al, 1967
2. Rush, 1968
3. Glancy, 1968
4. Hess and Mifflin, 1978
5. Rush and Everett, 1964
6. Rush et. al., 1965
7. Rush and Eakin, 1963
8. Van Denburgh and Rush, 1974
9. Stephens and Sumsion, 1978
10. Miffin, 1968
11. U.S.G.S. personal communications, 1980
12. Hood et. al., 1965
13. Eakin et. al., 1967

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STREAMS AND NON-REGIONAL SPRINGS WITH DISCHARGE GREATER THAN 100GPM
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Springs in Nevada and Utah have varying water quality depending upon their origin. The chemistry of water from regional springs varies with the distance traveled and time spent in the regional system as well as the rock types through which flow occurs. For example, the water chemistry of springs issuing from the White River regional flow system changes from a calcium-bicarbonate type at the northern end (beginning) to a sodium-calcium-bicarbonate or sulfate type at the terminus of the system, the Muddy River Springs. Water from regional springs generally meets state and federal drinking water standards and is suitable for construction uses. Fluoride is the most prevelant exception to drinking water standards. Water-chemistry data for regional and possible regional springs are presented in Table 4-3.

Water from meteoric and local valley-fill springs is generally of good quality. This is, however, dependent upon their location with respect to other activity in the valleys. Although there are localized exceptions, most spring discharge in the MX deployment area is suitable for domestic and construction water uses. Water-chemistry data for springs in deployment valleys are listed in Appendix F, Volume IIB of this report.

4.1.2 Streams

The streams in the deployment area may be classified as either perennial or ephemeral. Sevier River, north of Delta, Utah, in Sevier Desert, is the only major perennial stream within the deployment area. Several valleys have small streams which are perennial for a limited distance from the mountain front. Each

SAMPLE LOCATION	OWNER OR WATER USER	DATE OF COLLECTION (mo - yr)	TEMPERATURE °C *	pH *	SPECIFIC CONDUCTANCE (µmhos/cm @ 25 °C) *	BICARBONATE (HCO_3) *	CARBONATE (CO_3) *	DISSOLVED SOLIDS (see note)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (as N)	SILICA (SiO_2)	TRITIUM (pCi/ml)	REFERENCES	REMARKS
PAHRANAGAT VALLEY																				
6S/61E-6bb		3-81	32	7.8	530	214	0	295	45	18	27	6.1	36	8.2	0.5	0.25	30		1	Ash Spring
5S/60E-10aca		3-81	24	8.0	490	216	0	285	43	22	24	5.0	36	7.6	0.4	0.32	25		1	Crystal Spring
4S/60E-14acd		3-81	23	7.5	562	215	0	342	46	23	26	7.4	28	8.6	0.4	.45	36		1	Hiko Spring
PENOYER VALLEY																				
2N/55E-26dda		10-71	30	8.0	609	357	0	334	36	22	67***		25	5	-	-	-		7	Sand Spring
RAILROAD VALLEY																				
13N/56E-32bac		6-67	33	8.0	587	321	0	358	62	22	28	6.5	47	8.6	0.6	0	-		7	Big Warm Spring[a]
12N/56E-5ac		10-71	-	8.0	704	368	0	403	39	25	83***		62	10	-	-	-		7	Little Warm Spring
8N/55E-15acd		3-80	36	7.2	440	381	0	410	61	22	50	10	63	8.9	1.1	<0.1	3.0		1	Locke's Big Spring
6N/54E-21bd		9-68	46	7.5	1100	673	0	696	100	26	120	22	51	15	2.7	0.2	-		7	Abel Spring
2S/51E-21da		8-67	25	7.7	533	240	-	346	62	5.9	47	2.5	48	23	-	-	-		7	Cedar Spring
SEVIER DESERT																				
(C-9-7) 35b		7-64	19	7.6	421	189	0	253	50	8.0	28	2.8	17	38	0.1	0.3	14		8	
(C-10-7) 5c		8-64	19	7.9	492	212	0	283	40	16	43	1.1	14	54	0.2	0.1	8.4		8	
(C-10-9) 2dba		7-64	10	7.6	698	348	0	417	70	27	46	0.7	28	55	0.3	0.2	16		8	
(C-10-8) 3abb		9-65	16	8.4	492	192	8	251	38	19	33	-	19	40	-	0.2	5.6		8	Indian Spring
SNAKE VALLEY																				
(C-16-18) 22cab		8-79	20	6.8	520	297	0	435	61	30	60	5.8	58	50	0.56	0.6	21		1	Twin Spring
(C-15-19) 31bc		11-64	27	7.8	505	250	-	298**	50	19	33***	-	24	24	0.8	2.7****	-		14	Warm Spring
STEPTOE VALLEY																				
21N/63E-24		6-80	79	6.1	730	344	0	360	68	20	16	6.0	23	6.5	1.1	0	49		1	Monte Neva Hot Spring
18N/64E-21bdd		6-80	17	8.0	380	168	0	284**	45	18	19	6.7	70	17	0.6	0.23	16		1	McGill Spring
STONE CABIN VALLEY																				
2N/47E-14ac		9-80	21	6.5	1250	733	0	986**	43	26	280	30	242	4.2	6.1	0	25		1	
5N/46E-28cd		9-80	27	10	295	80	24	184**	0.5	0.2	63	2.6	26	10.5	1.2	0.1	69		1	Warm Spring
TULE VALLEY																				
(C-16-15) 13bab		9-74	28	-	2400	266	0	1633	71	38	350	37	330	450	1.1	0.12	21		11	Coyote Spring
(C-17-15) 10aab		4-79	27	7.4	2400	220*****	-	969	71	35	200	21	230	280	-	-	22		10	Tule Spring
WAH WAH VALLEY																				
(C-27-15) 11aba		11-79	17	7.6	410	259	0	323	32	47	16	2.0	18	65	0.1	1.8	13		1	Wah Wah Spring
WHITE RIVER VALLEY																				
9N/61E-32d		8-79	36	7.3	720	293	0	348	61	19	26	5.6	50	9.4	1.3	0.1	29		1	Norman Hot Spring
9N/62E-19ac		8-79	20	7.1	520	303	0	274	59	24	5.6	1.3	16	3.0	0.19	0.8	11		1	Emigrant Spring
6N/60E-25b		8-79	33	7.4	640	268	0	312	53	21	22	4.2	42	9.0	0.78	<0.1	26		1	Moon River Spring
6N/61E-18ad		4-63	27	7.6	546	300	-	345	60	24	24	5.1	43	9.0	1.0	0.6	28		12	Hot Creek Spring

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TABLE 4-3

SAMPLE LOCATION	OWNER OR WATER USER	DATE OF COLLECTION (mo. - yr.)	TEMPERATURE °C*	pH*	SPECIFIC CONDUCTANCE (µmhos/cm @ 25 °C)*	BICARBONATE (HCO_3)*	CARBONATE (CO_3)*	DISSOLVED SOLIDS (see note)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (as N)	SILICA (SiO_2)	TRITIUM (pCi/liter)	REFERENCES	REMARKS
ANTELOPE VALLEY																				
18N/50E-28d		5-64	70	9.0	315	94	26	173**	0	0	71***		22	7.1	-	-	-		2	Hot Spring
BIG SMOKY VALLEY																				
1S/41E-26a		1-67	60	8.1	1840	348	-	1134	46	4.6	349***		492	68	-	-	-		3	Alkali Spring
CLAYTON VALLEY																				
2S/39E-22a		1-67	18	-	2820	207	-	1486	154	59	340***		55	774	-	-	-		3	Waterworks Spring
DRY LAKE VALLEY																				
3N/65E-31cc		8-79	24	6.8	470	214	0	262	40	10	21	2.5	21	17	0.2	0.4	43		1	
FISH SPRINGS FLAT																				
(C-10-14)33cdc		8-76	56	7.2	34700	187	0	21738	>40	220	7600	250	1500	12000	1.8	0.09	33		4	Wilson Hot Spring
(C-11-14)3dbd		8-76	24	7.3	5000	297	0	2812	120	69	800	53	400	1200	1.1	0.15	20		4	North Spring
(C-11-14)23ddc		8-76	27	7.3	3120	311	-	1910	100	54	480	45	390	670	-	-	19		4	Middle Spring
(C-12-12)10cbc		8-76	22	7.3	8400	227	0	4777	690	170	870	18	380	2500	2.9	1.9	31		4	Wildhorse Spring
HAMLIN VALLEY																				
5N/70E-11daa		8-79	16	-	490	310	0	373	80	11	27	2.4	19	23	0.23	<0.1	55		1	Hermitage Spring
HOT CREEK VALLEY																				
8N/49E-25ba		5-77	36	7.7	699	358	0	444	70	22	49	6.8	55	19	1.0	<0.1	32		5	Old Dugan Place Hot Spring
8N/49E-21cdc		7-67	35	7.6	192	80	0	148	4.7	0.1	38	0.8	19	7.0	0.4	1.3	46		5	Upper Warm Spring
8N/50E-29dda		9-73	63	8.0	1101	545	0	823	51	15	197	13	86	42	8	<0.1	135		5	Hot Creek Ranch Spring
8N/50E-29da		7-67	67	8.1	1010	501	0	721	33	9.5	193	1.4	64	37	8.3	0.2	0.16		5	Upper Hot Creek Ranch Spring
4N/50E-20cc		5-67	60	7.3	1300	708	0	876	73	17	194	23	96	32	3.0	0.1	50		5	Warm Spring
LAKE VALLEY																				
9N/65E-4c1		8-63	20	8.0	181	103	0	115**	30	3.4	3.0	1.0	5.0	3.0	0	0.6	13		6	Geyser Spring
LITTLE SMOKY VALLEY																				
16N/53E-8b		3-80	17	7.6	550	388	0	365	60	32	27	6.1	37	8.4	0.59	0.3	<0.1		1	Fish Creek Spring
LONG VALLEY																				
23N/58E-36c		11-80	4	8.2	425	227	0	309**	48	23	15	4.0	48	15	0.4	<0.1	10.6		1	
NEWARK VALLEY																				
23N/56E-36ddc		11-80	9	8.0	450	292	0.5	323**	56	24	18	5.9	36	7.0	0.5	0.1	16.5		1	Warm Spring Pond

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TABE 4-3

SAMPLE LOCATION	OWNER OR WATER USER	DATE OF COLLECTION (mo. - yr.)	TEMPERATURE °C *	pH *	SPECIFIC CONDUCTANCE (µmhos/cm @ 25 °C) *	BICARBONATE (HCO_3) *	CARBONATE (CO_3) *	DISSOLVED SOLIDS (see note)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (as N)	SILICA (SiO_2)	TRITIUM (pCi/liter)	REFERENCES	REMARKS
								UPPER MOAPA VALLEY (MUDDY RIVER SPRINGS)												
14S/65E-9ccc		6-71	33	8.1	855	262	-	600**	62	27	91	12	177	66	-	-	32		12	Baldwin House Spring South
14S/65E-9ccc		6-71	33	8.0	850	266	-	600**	62	27	92	11	179	66	-	-	32		12	Baldwin House Spring North
14S/65E-15ccc		6-71	33	8.1	885	270	-	610**	64	26	97	11	182	68	-	-	29		12	Iverson Spring
14S/65E-16adb		6-71	33	8.1	910	270	-	635**	65	28	98	12	196	69	-	-	30		12	Muddy (Big) Spring
14S/65E-16bca		6-71	33	8.2	880	269	-	620**	63	28	96	11	184	66	-	-	32		12	Baldwin Cut Spring
14S/65E-16db		6-71	33	8.2	830	267	-	610**	62	27	94	12	181	66	-	-	31		12	Jones Spring
14S/65E-16ddc		7-75	32	6.6	1000	277	-	720**	65	29	101	10	193	61	2.1	0.5****	29		12	Pederson (Warm) Spring
14S/65E-8dd		11-80	29	8.2	1100	278	0	591**	65	27	95	14	172	61	1.3	0.5	25		1	Lewis Spring
14S/65E-21aa		9-63	32	-	964	274	0	620	70	26	101	11	179	64	2.3	2.2****	29		13	Iverson (Warm) Spring

All units are mg/l except as noted
Dissolved solids by sum of determined constituents unless otherwise noted.
* Ertec data are field determinations
Data from literature sources may be field or lab determinations.
** Dissolved solids determined by evaporation.
*** Sodium plus potassium.
**** Nitrate as NO_3.
***** HCO_3 determinated by TDS difference.

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1. Ertec
2. Robinson and others, 1967
3. Rush, 1968
4. Bolke and Sumsion, 1978
5. Garside and Schilling, 1979
6. Rush and Eakin, 1963
7. Van Denburgh and Rush, 1974
8. Stephens and Sumsion, 1978
9. U.S.G.S., 1979
10. Stephens, 1977
11. Eakin, 1966
12. Bateman, 1976
13. Eakin, 1964
14. Hood and Rush, 1965

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siting valley has numerous ephemeral streams which flow for short periods in response to snowmelt runoff in the late spring and early summer and the intense thunderstorms which occur mainly in late summer. Streams in the deployment valleys with measured discharges in excess of 100 gpm (6 l/s) are listed in Table 4-2.

The quality of the surface flow in ephemeral streams is usually poor due to a high concentration of suspended solids. Water quality in perennial streams is generally suitable for construction purposes but may require treatment, primarily bacteriological, prior to use as a drinking water source. Water-chemistry data for streams in deployment valleys are listed in Appendix F, Volume IIB of this report.

4.1.3 Surface Runoff

Rainfall or snowmelt runoff will occasionally accumulate in playas, and can represent a significant quantity of unused and unappropriated water. For example, Mud Lake in Ralston Valley, Nevada, has been observed with greater than 4 inches (10 cm) of water accumulated over its surface of approximately 25 mi^2 (65 km^2). This would represent about 5300 acre-feet (6.5 hm^3) of water. This water source is entirely dependent on climatic conditions and would be limited to valleys with significantly large playas such as Ralston, Dry Lake, Railroad, and Delamar.

Due to the high evaporation rates in the siting area, the chemical quality of the water which accumulates in the playa areas is usually quite poor. The water is commonly high in salinity (total dissolved solids [TDS]) and may not be suitable for domestic consumption, concrete mixing, or revegetation without expensive treatment prior to use. It should be possible to use untreated surface runoff for dust control and road compaction.

4.1.4 Source

The significant springs, perennial streams, and ephemeral streams within the deployment area have already been fully appropriated for domestic, stock, agricultural, or industrial use. The utilization of these sources for MX construction and operation would require the lease or purchase of the existing water right and a subsequent diversion of the water. In siting valleys such as White River and Hot Creek Valleys, a significant portion of the MX water requirement could be obtained by leasing or purchasing rights to a portion of the considerable spring discharge in the valley. In other areas, notably Delamar and Pahroc valleys, only minor surface-water rights are available and there is, as a consequence, very little potential for the use of surface water for MX purposes.

If spring or stream water rights are leased or purchased, it will be necessary, in many cases, to treat the water prior to usage. In Fish Springs Flat, for example, the water discharging from Fish Springs, though from the regional carbonate aquifer, is unsuitable for domestic purposes and costly water treatment techniques would be required. The accumulations of surface water in playa areas, as mentioned previously, is typically of very poor quality and may also require treatment prior to use.

Although there is some potential for using surface water to meet a portion of MX water requirements, the limited nature of the resource and water-quality constraints suggest that its use should be minimized.

4.2 GROUND WATER

In most of the siting valleys, there are sufficient supplies of ground water in the valley-fill aquifers to provide an adequate source of water for the construction and operation of the MX missile system. There are, however, valleys where development potential of the valley-fill aquifer is limited and it may be necessary to develop alternative sources of water to meet MX requirements. These include valleys where the valley-fill aquifer shows low yield potential (Pahroc, Coyote Spring, Muleshoe, Whirlwind, and Dugway valleys), fully appropriated valleys (Big Smoky, Ralston, Penoyer, Stone Cabin, Antelope, Steptoe, Lake, Escalante Desert, Sevier Desert, and Whirlwind) where further ground-water development is at the discretion of the State Engineers Office, and areas where water quality may be a constraint such as in the northern portion of the Utah deployment area.

Due to the size of the deployment area (about 10,000 mi^2 [26,000 km^2]), the development of ground-water supplies for the MX project will be widespread. However, the total amount of water required in individual deployment valleys is not excessive. The largest annual water requirement for any deployment valley is 3697 acre-feet (4.6 hm^3) in Railroad Valley in 1985. Another important aspect of the proposed MX ground-water development is the schedule and duration of use. MX water requirements for construction are for a five- to seven-year period in each valley after which much smaller quantities of water are needed for the operation of the missile system.

Two sources of ground-water have been identified within the deployment area: 1) local valley-fill aquifers, and 2) regional carbonate aquifers. The legal and physical water availability, aquifer capabilities, water quality, and environmental constraints for each of the aquifers are discussed in detail in the following sections.

4.2.1 Regional Hydrology

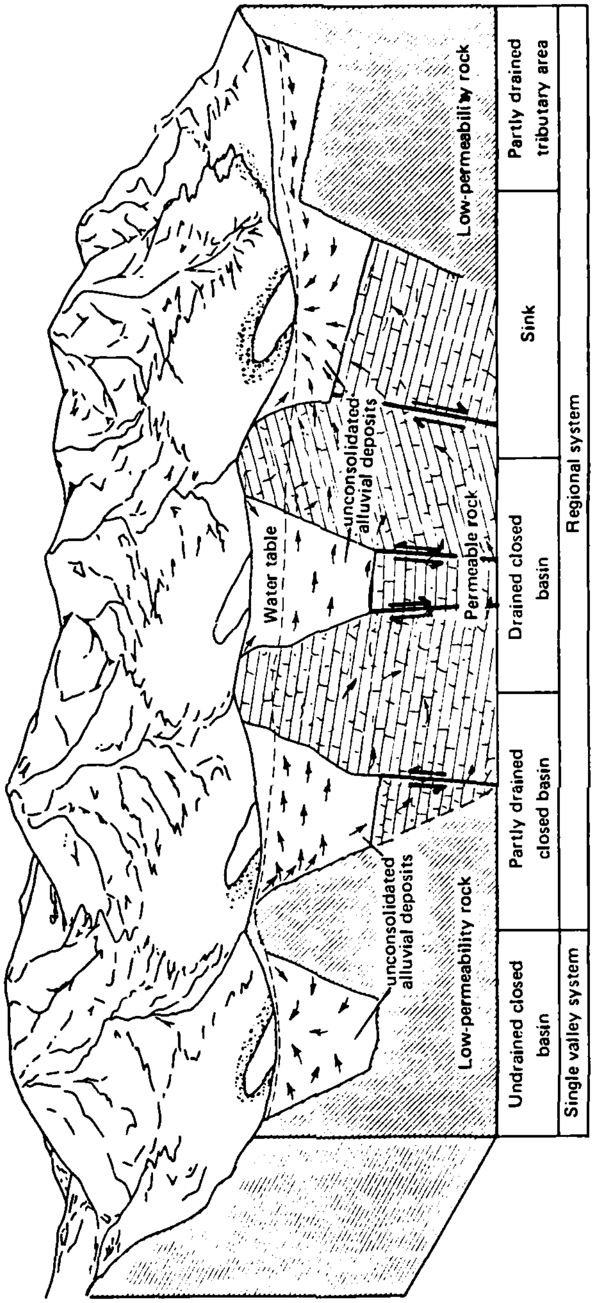
The MX siting area is within the Great Basin section of the Basin and Range Physiographic Province (Fenneman, 1931). Except for White River and Coyote Spring valleys, which drain into the Colorado River Basin via Muddy River, the MX siting area is characterized by internal drainage and north and northeast trending mountain ranges separated by wide valleys filled with unconsolidated alluvial deposits, typical of the Great Basin.

The general ground-water appraisal of the region by Eakin, Price, and Harrill (1976) characterized the area as deficient in surface water but with large volumes of water stored in valley ground-water reservoirs. In water resouces reconnaissance reports published by the Nevada Department of Conservation and Natural Resources for many of the valleys in the siting area, two distinct aquifers are identified: valley-fill aquifers comprised of unconsolidated alluvial deposits and bedrock aquifers comprised of fractured carbonate rocks of Paleozoic age. These two aquifer types and their generalized intercommunication are shown in Figure 4-1.

A number of valleys within the MX siting area have been shown to be hydraulically connected via the underlying carbonate aquifers (Eakin, 1966; and Mifflin, 1968). Though exact flow boundaries are, in places, ill-defined, these "regional flow systems" are generally delineated on the basis of variations in the topographic relief and potentiometric surfaces, water-budget imbalances, and water-chemistry trends. Within these flow systems, the available water-level data suggest that there is communication between the valley-fill and carbonate aquifers. Drawing 4-1 is an inferred regional potentiometric map for the entire deployment area.

The regional potentiometric map is highly interpretive and is based upon data from a number of sources. The potentiometric data base is from Ertec's field reconnaissance studies, previously published data, and a preliminary water-level contour map of Nevada provided by the U.S. Geological Survey. The flow system boundaries on the map are based upon observed potentiometric levels and interpretations of geologic data. Water-level data for carbonate aquifers are based upon the results of the exploratory carbonate drilling program and the elevations of regional springs identified in Section 4.1.1.

The impact of development of ground-water supplies in one valley in a flow system upon other valleys in the same system has not



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GENERALIZED CROSS–SECTION
OF VALLEY FILL AND
CARBONATE AQUIFERS

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FIGURE 4-1

been documented. This potential impact is, however, an important consideration in planning MX water-supply development from either the valley-fill or carbonate aquifers. Eakin (1966) noted that the valley-fill aquifers, when viewed on a regional scale, resemble isolated aquifers separated by the thick sequences of Paleozoic carbonates and, in places, Tertiary volcanics. Hess and Mifflin (1978) discussed extensive zones within the carbonate rocks which are highly permeable (in places even cavernous) and may transfer water to areas of higher permeability and areas of lower elevation. Eakin (1966) estimated the regional transmissivity to be 26,800 ft^2/day (2484 m^2/day). Results from four Air Force carbonate aquifer test wells show estimated transmissivities ranging from 200 to 40,000 ft^2/day (18 to 3700 m^2/day). Little is known, however, about the rate at which ground water is transmitted through the carbonate aquifers or the degree of hydraulic communication between the carbonate aquifers and the valley-fill aquifers.

4.2.2. Valley-Fill Aquifers

Each of the proposed siting valleys contains accumulations of valley-fill sediments derived from weathering processes in the adjacent mountains and deposited by fluvial and lacustrine processes. These materials form thick interbedded sequences of gravel, sand, silt, and clay with occasionally intercalated volcanic rock. In Dry Lake Valley, for example, gravity surveys conducted by Ertec have shown accumulations of over 10,000 feet (3048 m) of valley-fill sediments.

In most valleys, recent unconsolidated (Quaternary) valley-fill sediments overlie older (Tertiary) semiconsolidated materials. The younger sediments have significant porosity and, when saturated, the coarse-grained gravels and sands form aquifers that readily transmit water. The finer-grained materials also have significant porosity but act as aquitards as they do not readily transmit water. The distribution and thickness of these interbedded aquifers and aquitards are quite variable in each valley as are the hydrologic interrelationships between the various units. The younger valley-fill sediments are capable of storing great quantities of ground water. In Railroad Valley for example, the total ground water in storage in the upper 500 feet (152 m) of saturated sediments are estimated to be 7.4 million acre-feet (9124 hm^3) of which an estimated 3.7 million acre-feet (4562 hm^3) could be recovered with conventional water wells (see Table 4-4 for ground-water storage estimates for all MX siting valleys).

The valley-fill sediments of Tertiary age usually exhibit a higher degree of consolidation and are capable of storing and transmitting much smaller quantities of ground water than the younger sediments. For Sevier Desert, Mower and Feltis (1968) reported well yields of up to 3200 gpm (202 l/s) from the Quaternary alluvial sediments and maximum well yields of only a few hundred gpm from the Tertiary sediments. In some areas, however, the older Tertiary sediments may be capable of producing higher well yields than the younger materials. In Wah Wah Valley, for example, the fine-grained sediments of the Wah

Wah hardpan are relatively impermeable but the sediments which underlie the hardpan are capable of well yields of several hundred gallons per minute.

Current ground-water development within the siting area is generally limited to shallow aquifers, i.e., aquifers at depths of 500 feet (152 m) or less. Accordingly, the hydrology of shallow, valley-fill aquifers is much better defined than intermediate (500 to 1000 feet [152 to 305 m]) or deep (>1000 feet [>305 m]) valley-fill aquifers. The distribution of available data is variable. In agricultural valleys such as Steptoe, White River, Snake, Tule, and Hamlin, a significant amount of well and pumping data exists. In less developed valleys, notably Cave, Pahroc, Pine, Jakes, Big Sand Spring, Coyote Spring, Penoyer, Garden, Muleshoe, and Coal, little ground-water data are available.

4.2.2.1 Legal Availability

Valleys in Nevada where present allocations of ground water equal or exceed the perennial yield have been designated as critical ground-water basins and further ground-water withdrawal is not permitted except at the discretion of the Nevada State Engineer. In Utah, overdraft in several irrigated areas has also resulted in the closing of basins to additional ground-water withdrawal except at the discretion of the Utah State Engineer. The terms "designated" and "closed" refer to those basins where further ground-water withdrawals are prohibited or restricted in Nevada and Utah, respectively.

Listed in Table 4-4 are the perennial yield, water in storage, amount of current use, pending and approved appropriations, calculated availability, and estimated peak-year MX requirements for each siting valley. Figure 4-2 shows closed and designated valleys and those valleys where current use plus peak-year MX construction requirements will exceed perennial yield.

Available ground-water rights listed in Table 4-4 (column 11) are defined as the perennial yield less certificated and permitted water rights and, for planning purposes, do not take into consideration prioritized pending applications. Other pending or potential uses of ground water within the siting area also were not considered in calculating ground-water availability. The State Engineer will consider these factors along with the construction schedule and associated timing of peak water requirements in each siting valley in evaluating Air Force ground-water appropriation applications.

Table 4-4 and Figure 4-2 show that of the 36 deployment valleys, nine are presently designated or closed to further ground-water appropriations. These are Antelope, Big Smoky, Lake, Penoyer, Ralston, Sevier Desert, Steptoe, Stone Cabin, and Whirlwind valleys. Also, Escalante Desert, one of the OB siting valleys, is closed. If only current ground-water use is considered, peak year MX water requirements would cause total ground-water use to temporarily exceed perennial yield in one additional deployment valley, that being Dry Lake.

VALLEY	1 BASIN NUMBER	2 PERENNIAL YIELD AF/Y	3 PERENNIAL YIELD REFERENCES	4 G W STORAGE UPPER 100' ×10⁶ AF/Y	5 G W STORAGE REFERENCE	6 CUR G W DIVERSION AF/Y	7 POTENTIAL ADDITIONAL G W DIVERSION AF/Y (24)	8 PERMITTED G W RIGHTS ROUNDED TO NEAREST AF/Y	9 CERTIFICATED G W RIGHTS ROUNDED TO NEAREST AF/Y	10 PENDING G W APPLICATIONS ROUNDED TO NEAREST AF/Y	11 LONG-TERM G W RIGHTS AVAILABLE AF/Y (2 8 AND 9)	12 REFERENCES FOR COLUMNS 8, 9, AND 10	13 AIR FORCE APPROPRIATIONS AF/Y	14 PEAK CONST WATER REQ COE 17 MAR (ACCOMP) AF/Y	15 DRI PERMITS AND APPS G W AF/Y	16 DRI CERTS AND PROOFS (G W) AF/Y
Antelope (Incl. Stevens)	151,152	4,000	D	1.2	C	437	>3,563	0	1,832	0	2,168	A	3,805	1,969	1,356	993
Beryl-Enterprise	U52,U53	30,000	B	4.5	B	78,450	-48,450	-	-	-	-	-	-	-	-	-
Big Sand Springs (So. Little Smoky	155C	1,000	D	0.94	C	0	1,000	0	0	0	-	-	2,076	573	-	-
Big Smoky (Tonopah Flat & Alkali Springs)	137A,142	9,000	D	8.3	C	30,660	-21,666	4,204	7,665	64,085	-	B	4,146	2,040	-	-
Butte (Southern)	178B	14,000	D	2.2	C	-	-	-	-	-	-	-	2,464	1,005	0	-
Cave	180	2,000	D	1.0	C	0	2,000	0	31	0	2,000	A	2,076	916		32
Coal	171	6,000	D	1.5	C	0	6,000	0	0	6,516	6,000	A	3,456	2,285	6,515	
Coyote O.B.	210	2,600/18,000	A/D	1.8	C	-	-	-	-	-	-	-	9,685	9,685	18,859	0
Delamar	182	3,000	D	1.2	C	7	2,993	0	16	0	2,984	A	1,585	679	-	7
Dry Lake/Muleshoe	181	3,000	D	2.8	C	0	3,000	8	11	20	2,981	A	3,810/1,731	3,411/968	361	0
Dugway	U8	<12,000	C	<3.8	B	3,286	<8,714	-	-	-	-	-	3,111	1,901	384	423
Fish Springs Flat	U7	35,000	C	0.55	B	393	34,607	-	-	-	-	-	2,537	596	831	94
Garden	172	6,000	D	1.5	C	91	5,909	0	370	7,060	5,630	A	3,456	1,508	5,760	377
Hamlin	196	25,000	D	In Progress	A	852	24,148	16/	602/	12/	-	-	3,464	2,620	31,136	3,504
Hot Creek	156	6,000	D	2.3	C	297	5,703	859	193	84,260	4,948	A	3,115	1,748	25,293	3,813
Jakes	174	12,000	D	0.98	C	-	-	-	-	-	-	-	1,758	801	-	-
Kobeh	139	16,000	D	2.7	C	3,342	12,658	3,284	11,667	9,968	1,049	A	3,530	986	1,337	12,615
Lake (Incl. Patterson)	183,202	17,000	D	3.6	C	14,166	2,834	3,176	22,157	26,484	-8,333	A/B	3,805	2,389	62,868	2,572
Little Smoky (Central & Northern)	155A,B	>5,000	D	>1.5	C	0	>5,000	0	781	1,448	-	-	2,076	742	-	-
Long	175	6,000	D	1.6	C	-	-	-	-	-	-	-	1,404	1,110	-	-
Milford	U50	33,000	C	5.2	B	58,300	-28,300	-	-	-	-	-	-	4,198	-	1,100
Monitor	140A,B	18,000	D	2.0	C	338	17,662	-	-	-	-	-	2,112	2,141	30,071	266
Newark	154	18,000	D	1.5	C	6,507	11,493	-	-	-	-	-	1,404	1,486	24,897	42
Pahroc	in 209	In Progress	B	In Progress	A	Minor	-	-	-	-	-	-	1,388	341	-	-
Penoyer	170	4,000	D	2.2	C	5,691	-1691	8,327	12,941	50,000	-16,268	B	2,422	1,778	36,153	15,164
Pine	U5	7,000	C	1.2	B	18	6,982	-	-	-	-	-	2,421	2,209	17,266	221
Railroad	173A,B	75,000	E	8.1	C	4,206	70,794	3,162	7,430	147,780	64,406	A	4,148	3,697	190,591	5,714
Ralston	141	6,000	D	2.7	C	1,005	4,995	0	2,023	17,920	3,977	B	4,152	2,222	52,519	1,276
Reveille	in 156,173A	In Progress	B	In Progress	A	Minor	-	-	-	-	-	-	2,770	1,108	-	-
Sevier/Whirlwind/ Delta O.B.	U46	24,500	B	8.2	B	49,237	-24,761	-	-	-	-	-	2,076/ 3,685/7,000	2,486/ 2,712	939,993	42,442
Snake (Incl. Pleasant Valley)	194,195,U4	49,000	C	12.0	B	15,756	33,244	7/	2,703/	67,588/	-	A	5,687	3,094	46,185	10,421
Spring	184	100,000	D	4.2	C	4,781	95,219	14,627	7,185	2,594	78,188	A	2,425	629	43,912	11,451
Steptoe	179	70,000	D	5.0	C	12,497	57,503	11,646	37,552	102,429	20,802	B	9,685	-	45,923	37,073
Stone Cabin	149	2,000	D	2.2	C	970	1,030	16	2,673	3,520	-689	A	4,152	2,534	29,620	3,897
Tule	U6	32,000	C	0.68	B	20	31,980	-	-	-	-	-	4,146	2,447	53	50
Wah Wah	U54	<10,000	C	0.8	B	2	<9,998	-	-	-	-	-	3,801	3,228	32,576	34
White River	207	37,000	D	4.9	C	5,262	31,738	4,964	16,183	144,382	15,853	A	3,810	2,384	140,772	31,577

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TABLE 4-4

GENERAL NOTES:

A. Valley boundaries delineated by Ertec may or may not encompass all of the hydrographic basin.

B. Hydrologic parameter estimates and water right inventories are based on hydrographic basins as identified in column 1, except where noted.

C. Dashes indicate no data is available at this time.

NOTES:

COLUMN 1:

A. All Nevada valley numbers are from: Nevada, State of, 1971, Map: Water Resources and Interbasin Flows, Division of Water Resources, State Engineers Office, scale 1:750,000.

B. All Utah valley numbers (U prefix) are from: Price, Don, 1979, Summary appraisal of the water resources of the Great Basin in RMAG-UGA-1979 Basin and Range Symposium, p. 353-360.

NOTES:

COLUMN 2:

A. Coyote Valley - lower estimate based on recharge from precipitation within the valley; upper estimate also includes subsurface recharge through regional carbonate aquifer system.

B. Dugway Valley - estimate in Price, 1979, is [illegible],000 acre-feet/year and includes Government Creek area. Perennial yield for area defined as Dugway Valley in Ertec reports is likely to be considerably lower.

C. Hamlin Valley - estimate based on 74,000 acre-feet/year figure for Snake and Hamlin valleys in Price, 1979, divided based on Ertec boundaries.

D. Reveille Valley - currently included in Hot Creek and Railroad valleys.

F. Snake Valley - see note for Hamlin Valley (above).

[illegible] Beryl-Enterprise - estimated by Ertec.

[illegible] Milford - estimated by Ertec.

COLUMN 3:

A. Eakin, T. E., 1964, Ground-water appraisal of Coyote Spring and Kane Springs valleys and Muddy River Spring area, Lincoln and Clark counties, Nevada: State of Nevada, Ground Water Resources Reconnaissance Series, Report 25.

B. Ertec, Inc., Sevier/Whirlwind estimate derived using the Hill Method as described in Todd, D. K., 19[illegible], Ground water hydrology, New York: John Wiley and Sons, p. 206-207.

________, Beryl-Enterprise and Milford estimates derived from computer numerical models, projecting amount of evapotranspiration under natural conditions.

________, Pahroc and Reveille in progress using the method of estimating average annual recharge as described in Eakin, T. E., and others, 1951, Contributions to the hydrology of eastern Nevada: Nevada State Engineer Water Resources Bulletin 12, p. 79-80.

C. Price, Don, 1979, Summary appraisal of the water resources of the Great Basin in RMAG-UGA-1979 Basin and Range Symposium, p. 353-360.

D. Nevada, State of, 1971, Map: Water resources and interbasin flows, Division of Water Resources, State Engineers Office, scale 1:750,000.

E. Van Denburgh, A., and Rush, F., Eugene, 1974, Water resources appraisal of Railroad and Penoyer valleys, east-central Nevada: Nevada Department of Conservation and Natural Resources, Water Resources Reconnaissance Series, Report 60, p. 61.

COLUMN 4:

A. Dugway Valley - estimate in Price, 1979, is 3,800,000 acre-feet and includes Government Creek area. Ground water in storage for area defined as Dugway Valley in Ertec reports is likely to be considerably lower.

B. Hamlin Valley - currently included in Snake Valley.

C. Reveille Valley - currently included in Hot Creek and Railroad valleys.

D. Snake Valley - see not for Hamlin Valley above.

COLUMN 5:

A. Ertec, Inc., Hamlin, Pah[illegible] and Reveil[illegible] areas based on [illegible] aquifer.

B. Price, Don, 1979, Summary appraisal of [illegible] of the Great Basin in RMAG-UGA-1979 Bas[illegible] sium, p. 353-360.

C. Nevada, State of, 1971, Map: Water reso[illegible] flows, Division of Water Resources, Sta[illegible] scale 1:750,000.

COLUMN 6:

A. [illegible] current annual ground-water diversi[illegible] withdrawal is very minor; however, a smal[illegible] water diversion may occur in these valle[illegible]

B. Unless otherwise noted, all figures a[illegible] Activity Inventory: Nevada MX siting a[illegible] Institute, University of Nevada System i[illegible] MX siting investigation, industry activi[illegible]

C. Beryl-Enterprise and Milford valleys - [illegible] estimates are from: Price, Don and oth[illegible] water conditions in Utah, Spring of 197[illegible] of Natural Resources, Cooperative Invest[illegible] [illegible], 66 p.

D. Pahroc Valley - included in Pahranagat [illegible] 2896 acre-feet/year.

E. Reveille Valley - included in estimates [illegible] Railroad valleys.

F. Minor - less than 1000 acre-feet/year. [illegible] included in figures for hydrographic b[illegible] these valleys.

COLUMN 7:

A. Derived by substracting column 6 from col[illegible]

B. Negative numbers indicate possible ove[illegible] depending on accuracy of perennial yield [illegible]

C. Dugway Valley - perennial yield estimate [illegible] Creek valley. Therefore, the potential [illegible] may be significantly less based on a lo[illegible] for Dugway Valley.

COLUMNS 8, 9, and 10:

A. Big Smoky Valley - data are for souther[illegible] (137 A) only.

B. Hamlin Valley - data are only for the Neva[illegible] valley.

C. Pleasant Valley - not included in invento[illegible]

D. Little Smoky Valley - data are for nort[illegible] Valley (155 A) only.

E. Snake Valley - data are only for the Neva[illegible] valley.

F. Certified rights (column 9) do not include [illegible]

COLUMN 11:

A. Additional long-term ground-water rights a[illegible] on perennial yield minus certified and [illegible] water rights (2-8 and 9).

B. Negative numbers indicate current over-[illegible] ground-water rights.

COLUMN 12:

A. Woodburn and others, 1981, Analysis of [illegible] tions for water in Nevada: Woodburn, [illegible] Jeppson Attorneys at Law, PIIN F04704-80-[illegible]

B. Nevada, State of, Engineers Office, in Wo[illegible] 1981.

COLUMN 13:

A. Beryl-Enterprise and Milford valleys - [illegible] ground-water appropriation submitted.

COLUMN 14:

A. Estimates are not given for [illegible] Oper[illegible] in Beryl-Enterprise and Ste[illegible] valleys.

Inc., [illegible]
based [illegible]
.

Don, 1979, [illegible] water [illegible]
Great [illegible]
. 353-[illegible].

State of, 1977, [illegible]
Division of Water Resources, [illegible] Office,
1750,000.

rrent [illegible] numbers [illegible]
ual is very minor; however, a small amount of ground-
iversion may [illegible] valleys.

otherwise [illegible], all figures are from: Industry
y Inventory: Nevada MX Siting area Desert Research
te, University of Nevada System in Ertec, Inc., 1980,
ng investigation, industry activity inventory.

nterprise and Milford valleys - portions of these
es are from: Price, Don and others, 1979, ground-
onditions in Utah, Spring of 1979: Utah Department
ral Resources, Cooperative Investigation Report No.
.

Valley - included in Pahranagat Valley estimate of
re-feet/year.

Valley - included in estimates for Hot Creek and
valleys.

less than 1000 acre-feet/year. Actual diversion
in figures for hydrographic basins encompassing
lleys.

by substracting column 6 from column 2.

numbers indicate possible overdraft conditions
g on accuracy of perennial yield estimate.

alley - perennial yield estimate includes Government
lley. Therefore, the potential additional diversion
significantly less based on a lower perennial yield
y Valley.

, and 13:

y Valley - data are for southern Big Smoky Valley
only.

alley - data are only for the Nevada portion of the

Valley - not included in inventory.

oky Valley - data are for northern Little Smoky
155 A) only.

lley - data are only for the Nevada portion of the

rights (column 9) do not include proofs.

l long-term ground-water rights available are based
ial yield minus certified and permitted ground-
hts (2-8 and 9).

numbers indicate current over-appropriation of
er rights.

and others, 1981, Analysis of Air Force applica-
water in Nevada: Woodburn, Wedge, Blakey and
torneys at Law, PIIN F04704-80-D-0035, 38 p.

tate of, Engineers Office, in Woodburn and others,

erprise and Milford valleys - no applications for
er appropriation submitted.

are not given for [illegible] operational base sites
nterprise and [illegible] valleys.

COLUMNS 15 and 16:

A. From:

Water rights in Nevada and Utah: an inventory within the MX area, Desert Research Institute, University of Nevada System in Ertec, Inc., 1980, MX siting investigation, water rights inventory, Nevada-Utah.

B. Revised with the Desert Research Institute Supplementary Analysis dated 6 October 1980.

C. Hamlin Valley - revised based on Ertec boundaries.

D. Snake Valley - revised based on Ertec boundaries. Includes Pleasant Valley.

E. Revielle Valley - included in Railroad and Hot Creek valleys.

F. Pahroc Valley - revised based on Ertec boundaries.

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TABLE 4-4

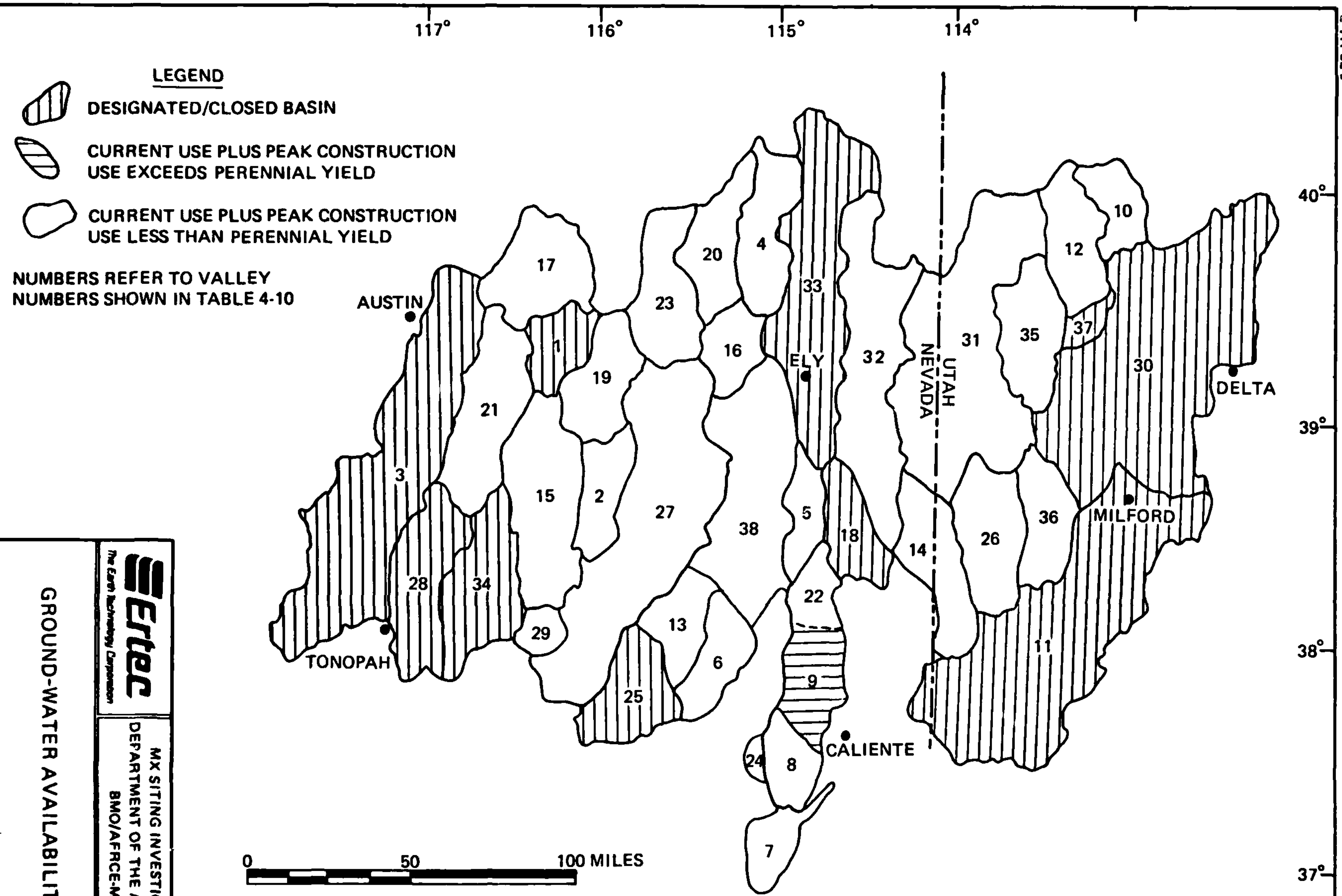

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FIGURE 4-2

Although the state engineers of Nevada and Utah are not legally bound to deny appropriation applications in designated or closed valleys or in valleys where additional use would cause temporary exceedance of the perennial yield, it is uncertain how they will rule on Air Force appropriation applications in the valleys identified above. The short duration of the MX peak water demand will be an important consideration in the appropriation process.

In valleys where MX water requirements cannot be appropriated, it will be necessary to:

- Lease and/or purchase water rights;
- Develop the regional carbonate aquifer (if viewed as a separate appropriation source); and/or
- Import water from other areas.

In valleys where the amount of available ground water significantly exceeds the MX requirement, additional available water might be used to supply or supplement nearby valleys in the same state which have insufficient water supplies. It is not certain at this time if the State Engineer will allow transportation of water across state lines. Depending on actual water requirements, it may be necessary to apply for additional ground-water appropriations in those valleys identified for water exportation. Another supply option for water deficient valleys may be to import water from areas outside the present study area. This would require additional appropriations and an amendment to the MX Environmental Impact Statement and would only be considered if other available options could not be implemented.

4.2.2.2 Aquifer Capabilities

Valley-fill aquifer capabilities in the siting area are highly variable. As shown in Table 4-5, the transmissivities calculated from aquifer tests performed by Ertec on wells drilled as part of the MX Water Resources Program range from 60 to 19,000 ft^2/day (6 to 1760 m^2/day); storativity ranged from 0.00001 to 0.14. Within Table 4-5, the methods of analysis identified with asterisks are those considered to provide the most reliable results for each of the tests.

Most values were determined from aquifer tests of relatively short duration, and it is anticipated that storativity values will be higher during long-term pumping of MX production wells. Storativity values achieved during production pumping will, at a minimum, equal or exceed the values listed under "Delayed Storativity" in Table 4-5.

Although it is cost effective, in general, to locate wells where ground water is nearest the surface, existing data and exploratory well results suggest that the highest aquifer transmissivity values in siting valleys are obtainable near the toe and in the central sections of alluvial fans. The central portions of valleys where fine-grained playa deposits are commonly found and the upper reaches of alluvial fans are not optimum locations for production wells. Drilling deeper wells away from the central portions of valleys may increase the cost per well but may also reduce the number of wells required thereby lowering total ground-water production costs.

WELL NUMBER[1]	VALLEY	LOCATION[2]	COMPLETION INTERVAL (FT BLS)[3]	DEPTH OF WELL (FT)	WELL CASING ID (IN)	STATIC WATER LEVEL (FT BLS)	DURATION OF TEST (HR)	DIST TO OB WELL (FT)	DIS-CHARGE (GPM)	MAX DRAWDOWN (FT BLS)	TRANS-MISSIVITY (SQ FT PER DAY)	STORATIVITY INITIAL[4]	STORATIVITY DELAYED[5]	METHOD OF ANALYSIS	LITHOLOGIC COND[6]
BL-VF-T1	BERYL, UTAH														
BL-VF-T1	BERYL	(C-33-17)21DD2	180-240 260-340	353	10	185.4	240P[7] 47R[8]	500	600	14.1	13000	DNA[9]	DNA	RECOVERY[10]	U
BL-VF-O-1S	BERYL	(C-33-17)21DD1	189-231	236	2	175.6	240P 47R			0.0	NC[11]	NC	NC	NONE[12]	U
BL-VF-O-1D	BERYL	(C-33-17)21DD1	259-322	332	2	193.2	240P 47R			0.2	NC	NC	NC	SEVERAL[13]	U
BG-VF-T1	BIG SAND SPRINGS														
BG-VFT-1	BIG SAND SPRINGS	8N/53E-29DA2	487-547 553-573	573	10	467.8	240P 36.5R	470 490	435 410	64.4	2600 7800	DNA DNA	DNA DNA	JACOB[14] RECOVERY	U
BG-VFO-1-S	BIG SAND SPRINGS	8N/53E-29DA1	472-493	493	2	471.6	240P 36.5R			0.0	NC	NC	NC	NONE	U
BG-VFO-1-D	BIG SAND SPRINGS	8N/53E-29DA1	607-649	649	2	468.4	240P 36.5R			0.0	NC	NC	NC	NONE	U
CV-I-T-1	CAVE, NEVADA														
CV-I-T-1	CAVE	7N/63E-14AB2	210-250 375-435	435	10	229.0	160P 20R	550	225	114.8	8800	DNA	DNA	RECOVERY	C
CV-1-O-1-S	CAVE	7N/63E-14AB1	200-263	273	2	231.2	160P 20R			3.6	2400	9.2E-5[15]	1.3E-2	NEUMAN[16]	C[17]
CV-1-O-1-D	CAVE	7N/63E-14AB1	380-422	422	2	230.6	160P 20R			0.0	NC	NC	NC	NONE	
CL-VF-T-1A	COAL, NEVADA														
CL-VF-T-1A	COAL	1S/59E-34CB2	1111-1315	1315	10	845.4	240P 75R	550	450	69.4	3200	DNA	DNA	RECOVERY	U
CL-VF-O-1	COAL	1S/59E-34CB1	1142-1452	1452	2	862.4	240P 75R			6.1	3700 7000	4.0E-4 DNA	1.3E-3 DNA	NEUMAN[9] RECOVERY	U
DM-TW-2	DELAMAR, NEVADA														
DM-TW-2	DELAMAR	6S/63E-12AD2	920-980 1040-1180	1195	10	871.0	63P 26.6R	500	85	85.3	NC	DNA	DNA	SEVERAL	U
DM-OW-2-S	DELAMAR	6S/63E-12AD1	540-630	640	2	DRY[18]	83P 26.6R			0.0	NC	NC	NC	NONE	U
DM-OW-2-D	DELAMAR	6S/63E-12AD1	816-847 877-940 950-971	981	2	867.3	83P 26.6R			5.3	1100 1300	NC DNA	NC DNA	JACOB[9] RECOVERY	U
DL-TW-2	DRY LAKE, NEVADA														
DL-TW-2	DRY LAKE	3S/64E-12AC2	600-620 650-670 700-720 750-770 800-820 850-870 900-920 950-970	990	10	395.0	239P 155R	475	500	44.8	2700 NC	DNA DNA	DNA DNA	JACOB RECOVERY	U
DL-OW-2-S	DRY LAKE	3S/64E-12AC1	765-785	795	2	383.3	239P 155R			7.5	3400 5200	5.3E-4 DNA	1.3E-2 DNA	NEUMAN[9] RECOVERY	U
DL-OW-2-D	DRY LAKE	3S/64E-12AC1	1270-1290	1300	2	383.3	239P 155R			4.4	3700 6500	3.9E-3 DNA	5.1E-2 DNA	NEUMAN RECOVERY	U
GN-IT-2	GARDEN, NEVADA														
GN-IT-2	GARDEN	2N/57E-22BA2	600-620 650-670 700-720 750-770 800-820 850-870 900-920 950-970	1010	10	422.0	720P 72R	500	510	23.0	3200 13000	DNA DNA	DNA DNA	JACOB RECOVERY	U
GN-IO-1-S	GARDEN	2N/57E-22BA1	273-294	315	2	DRY	720P 72R			0.0	NC	NC	NC	NONE	
GN-IO-1-D	GARDEN	2N/57E-22BA1	820-841 890-911 930-951 990-1011	1032	2	431.1	720P 72R			4.0	12000 15000	6.4E-4 DNA	2.5E-3 DNA	NEUMAN[9] RECOVERY	U
HM-ST-1	HAMLIN, NEVADA														
HM-ST-1	HAMLIN	8N/69E-35DC2	320-440	475	10	157.6	120P 24R	500	110	82.5	62 60	NC DNA	NC DNA	JACOB RECOVERY	U
HM-SO-1	HAMLIN	8N/69E-35DC1	320-420	435	2.5	175.6	120P 24R			1.6	2500 10000	1.9E-4 DNA	1.0E-2 DNA	NEUMAN[9] RECOVERY	U
HC-ST-1	HOT CREEK, NEV														
HC-ST-1	HOT CREEK	7N/51E-10AD1	80-100 160-180 200-220 240-260 280-320 340-360 380-400 420-460	480	10 BT[19]	237.1	97P 19R	500	235	45.0	8100	DNA	DNA	RECOVERY	U
HC-SO-1	HOT CREEK	7N/51E-10AD2	220-240 300-320 340-360 380-400 420-460	480	2.5	256.1	97P 19R			0.6	19000	1.3E-3	2.0E-2	NEUMAN	U
HC-S-T-2	HOT CREEK, NEVADA														
HC-S-T-2	HOT CREEK	6N/50E-27AC1	325-345 365-405 425-485	505	10	292.1	120P 6R	500	375	126.1	2500	DNA	DNA	RECOVERY	U
HC-S-O-2	HOT CREEK	6N/50E-27AC2	286-433	455	2.5	303.5	120P 6R			10.3	1600 9100	1.4E-4 DNA	4.1E-3 DNA	NEUMAN[9] RECOVERY	U U
MD-VFT-1	MILFORD, UTAH														
MD-VFT-1	MILFORD	(C-31-13)5BB1	99-139 173-193	374	10	30.7	240P 87R	326	350	87.2	2700	DNA	DNA	RECOVERY	U
MD-VFO-1-S	MILFORD	(C-31-13)5BB2	95-138	138	2.5	31.0	240P 87R			4.9	3400 6600	4.5E-4 DNA	8.0E-2 DNA	NEUMAN[9] RECOVERY	U
MD-VFO-1-D	MILFORD	(C-31-13)5BB2	300-342	342	2.5	DRY	240P 87R			0.0	NC	NC	NC	NONE	
MS-VFT-1	MULESHOE, NEVADA														
MS-VFT-1	MULESHOE	4N/64E-7DC2	1050-1150	1170	10	268.4	144P 48R	330	50	314.6	15 44	DNA DNA	DNA DNA	JACOB RECOVERY	U
MS-VFO-1S	MULESHOE	4N/64E-7DC1	630-672	672	2	270.0	144P 49R			0.0	NC	NC	NC	NONE	U
MS-VFO-1D	MULESHOE	4N/64E-7DC1	1071-1134	1134	2	264.2	144P 48R			34.9	39 126	1.0E-4 DNA	6.2E-4 DNA	NEUMAN RECOVERY	U
PI-IT-1	PINE	(C-26-17)10AA2	560-630 660-680 710-740 750-770 800-820 830-850	870	10	443.0	167P 120R	452	75	105.3	320	DNA	DNA	RECOVERY	U
PI-IO-1	PINE	(C-26-17)10AA1	640-661 760-802 840-861	882	2	434.0	167P 120R			9.2	330 420	2.2E-4 DNA	1.6E-3 DNA	NEUMAN[9] RECOVERY	U

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WELL AND AQUIFER TEST DATA

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TABLE 4-6

WELL NUMBER	VALLEY	LOCATION	COMPLETION INTERVAL (FT BLS)	DEPTH OF WELL (FT)	WELL CASING ID (IN)	STATIC WATER LEVEL (FT BLS)	DURATION OF TEST (HR)	DIST TO OB WELL (FT)	DISCHARGE (GPM)	MAX DRAWDOWN (FT BLS)	TRANSMISSIVITY (SQ FT PER DAY)	STORATIVITY INITIAL	STORATIVITY DELAYED	METHOD OF ANALYSIS	LITHOLOGIC COND
HR-S-T-1	RAILROAD, NEVADA														
HR-S-T-1	RAILROAD	3N/52E-20A1	302-382 404-444	461	10	233.2	216P 24R	411	735	19.0	17000	DNA	DNA	RECOVERY	U
HR-S-O-1	RAILROAD	3N/52E-20A2	325-495	495	2.5	234.9	216P 24R			3.2	11000 17000	1.5E-4 DNA	[illegible]E-2 DNA	NEUMAN* RECOVERY	[illegible]
HR-S-T-2	RAILROAD, NEVADA														
HR-S-T-2	RAILROAD	10N/58E-17BD2	278-329 380-420 441-560	580	10	280.6	676P 103R	480	705	66.7	31000	DNA	DNA	RECOVERY	U
HR-S-O-2-S	RAILROAD	10N/58E-17BD1	94-200	220	2	DRY	676P 103R								
HR-S-O-2-D	RAILROAD	10N/58E-17BD1	308-328 349-370 391-412 453-474 510-526 556-578	600	2	280.0	676P 103R			8.0	7900 28000	3.3E-4 DNA	1.1E-3 DNA	NEUMAN* RECOVERY	U
RE-VE-T1	REVEILLE, NEVADA														
RE-VE-T1	REVEILLE	3N/50E-13CA2	398-418 458-478 499-519 559-579 618-658	680	10	316.5	170P 73R	500	550	90.3	11200	DNA	DNA	RECOVERY	U
RE-VE-O1D	REVEILLE	3N/50E-13CA1	660-702.6	702.6	2	321.1	170P 73R			6.4	10000 11400	2.2E-4 DNA	1.6E-3 DNA	NEUMAN* RECOVERY	[illegible]
RE-VE-O1S	REVEILLE	3N/50E-13CA1	384-405	405	2	321.1	170P 73R			6.4	5000 15900	1.2E-4 DNA	1.2E-2 DNA	NEUMAN* RECOVERY	U
SP-S-T-1	SPRING, NEVADA														
SP-S-T-1	SPRING	9N/68E-30AB1	559-679	699	10	229.8	120P 48R	560	600	14.0	NC	DNA	DNA	RECOVERY	U
SP-S-O-1S	SPRING	9N/68E-30AB2	163-247	247	2	DRY	120P 48R			0.0	NC	NC	NC	NONE	U
SP-S-O-1D	SPRING	9N/68E-30AB1	553-700	700	2	219.5	120P 48R			0.7	NC	NC	NC	SEVERAL	U
TL-S-T-1	TULE, UTAH														
TL-S-T-1	TULE	(C-20-14)16DD1	500-600	620	10	84.3	72.1P 36.7R	500	50	296.5	NC	DNA	DNA	SEVERAL	C
TL-S-O-1	TULE	(C-20-14)16DD2	500-600	620	2.5	88.8	72.1P 36.7R			2.2	NC NC	NC DNA	NC DNA	JACOB RECOVERY	C
TL-S-T-2	TULE, UTAH														
TL-S-T-2	TULE	(C-17-15)17CA1	100-180 260-280 360-380	400	10	47.3	120P 24R	300	255	1.0	NC	DNA	DNA	RECOVERY	U
TL-S-O-2	TULE	(C-17-15)17CA2	56-276	296	2.5	53.0	120P 24R			0.2	NC NC	NC DNA	NC DNA	JACOB RECOVERY	U
WA-IT-2	WAH WAH, UTAH														
WA-IT-2	WAH WAH	(C-27-14)28DD2	905-945 995-1015 1110-1190 1220-1300 1310-1330	1390	10	970.4	239.7P 24.0R	505	375	193.9	NC	DNA	DNA	RECOVERY	U
WA-IO-2	WAH WAH	(C-27-14)28DD1	693-987	987	2	969.0	239.7P 24R			1.1	12000 16000	1.8E-3 DNA	1.4E-1 DNA	NEUMAN* RECOVERY	U
WW-IT-1	WHIRLWIND, UTAH														
WW-IT-1	WHIRLWIND	(C-15-12)19AD2	710-730 825-905 925-1005	1025	10	797.6	96P 24R	500	7	101.3	4.0	DNA	DNA	RECOVERY	U
WW-IO-1	WHIRLWIND	(C-15-12)19AD1	1044-1086 1107-1170	1191	2	794.4	96P 24R			0.0	NC	NC	NC	NONE	U

(1) A "T" OR AN "O" IN THE SECOND OR THIRD PORTION OF THE WELL NUMBER INDICATES THE WELL IS EITHER A TEST WELL OR AN OBSERVATION WELL. THE PRESENCE OF A "D" OR "S" NEAR THE END OF THE WELL NUMBER INDICATES THE WELL IS EITHER A DEEP OR SHALLOW PIEZOMETER.
(2) THE LAST DIGIT OF THE "LOCATION" REFERS TO THE ORDER OF DRILLING AT THIS LOCATION.
(3) FEET BELOW LAND SURFACE (FT BLS)
(4) INTIAL COMPRESSIBLE STORAGE
(5) MINIMUM VALUE OF SPECIFIC YIELD BASED ON LAST DATUM POINT. THE THIRD "LEG" OF THE SEMILOG GRAPH MAY NOT BE PRESENT.
(6) LITHOLOGIC CONDITIONS WERE INTERPRETED FROM GEOPHYSICAL AND DRILLER'S LOGS. A "C" IN THIS COLUMN INDICATES CONFINED AQUIFER CONDITIONS AND "U" INDICATES UNCONFINED CONDITIONS.
(7) DURATION OF PUMPING
(8) DURATION OF RECOVERY
(9) DOES NOT APPLY
(10) REFERS TO THE ANALYSIS OF A SEMILOG GRAPH OF RESIDUAL DRAWDOWN VERSUS TIME AS OUTLINED BY THEIS (1935)
(11) NOT CONCLUSIVE
(12) BECAUSE DRAWDOWN WAS NOT OBSERVED IN THE OBSERVATION WELL, NO ANALYSIS WAS PERFORMED
(13) SEVERAL METHODS WERE APPLIED INCLUDING THE THEIS RECOVERY, NEUMAN, AND JACOB STRAIGHTLINE PROCEDURES
(14) REFERS TO THE SEMILOG STRAIGHTLINE ANALYSIS OF DRAWDOWN VERSUS TIME JACOB (1946)
(15) ALL EXPONENTS OF 10 ARE REPRESENTED AS "E" (e.g. 9.9E-5 = 9.9X10-5)
(16) REFERS TO THE LOG-LOG ANALYSIS OF DRAWDOWN VERSUS TIME FOR UNCONFINED AQUIFERS CONSIDERING DELAYED DRAINAGE (NEUMAN, 1975)
(17) LITHOLOGIC LOGS INDICATE THAT CONFINED CONDITIONS MAY BE PRESENT IN THE VALLEY-FILL AQUIFER AT THIS TEST SITE. HOWEVER, DRAWDOWN VERSUS TIME DATA COLLECTED DURING THE AQUIFER TEST INDICATES SEMICONFINED TO UNCONFINED CONDITIONS ARE PRESENT. AS A RESULT, THE NEUMAN METHOD OF ANALYSIS WAS USED.
(18) AFTER WELL DEVELOPMENT, A WATER-LEVEL MEASUREMENT OF THE PIEZOMETER INDICATED THE WELL WAS DRY
(19) WELL CASING TELESCOPED TO THIS DIAMETER AT THE CORRESPONDING COMPLETION INTERVAL

* NOT ADDRESSED IN TECHNICAL SUMMARY

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TABLE 4-5

Based on published information, hydrologic reconnaissance data, and the results of exploratory drilling and testing presented in Table 4-5, aquifer capabilities pose no significant constraints to the development of MX water supplies except in Pahroc, Coyote Spring, Muleshoe, Whirlwind, and Dugway valleys. In Pahroc and Dugway valleys, the depth to ground-water and limited thicknesses of saturated valley-fill sediments severely restrict the areas in which productive valley-fill wells can be sited. In Pahroc Valley, it may be possible to develop ground-water supplies from the volcanic rocks which underlie the valley-fill sediments. Additional exploratory drilling is recommended in Dugway, Muleshoe, and Whirlwind valleys to determine if there are suitable areas for valley-fill aquifer development. In Coyote Spring Valley, the carbonate aquifer which underlies the valley has been shown to be an adequate alternative source of MX water.

4.2.2.3 Water Quality

In order to assess the chemical suitability of ground water within the valley-fill aquifers, existing data have been compiled and additional samples collected from all deployment valleys except Jakes and Lake valleys. Water-chemistry data for individual valleys are presented in Appendix F, Volume IIB of this report and are discussed in the text of Volume II.

Evaluation of available data indicates that, although water quality is quite variable throughout the siting area, there are few areas where suitable quality water cannot be obtained. Only in areas in and adjacent to major plays such as Alkali Flat in Big Smoky Valley and in the northern region of the Utah deployment area (Whirlwind, Dugway, and Fish Springs Flat valleys) is water quality a significant limiting factor for water availability.

Water quality has been assessed based on standards for drinking water established by the states of Nevada and Utah (Tables 4-6 and 4-7). Generally water which exceeds these standards is high in total dissolved solids (TDS) and chloride. High TDS concentrations generally occur beneath and near playas where evapotranspiration concentrates minerals. High TDS and chloride concentrations may also occur where ground water has traveled a considerable distance from the recharge area as in the northern Utah siting area.

Some localized areas contain ground-water of poor or unacceptable quality for drinking purposes because of high calcium, magnesium, and/or fluoride concentrations. Moderate to high concentrations of calcium and magnesium are usually associated with water discharging from or flowing through carbonate terrain, whereas; high fluoride concentrations may be associated with water discharging from or flowing through either sedimentary or igneous terrain. Water analysis from one carbonate aquifer well in Coyote Spring Valley, CE-DT-4, indicates fluoride concentration slightly exceeding primary standards set by the U.S. Environmental Protection Agency (1976).

PRIMARY STANDARDS MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

CONTAMINANT	LEVEL, mg/l
ARSENIC	0.05
BARIUM	1.
CADMIUM	0.010
CHROMIUM	0.05
LEAD	0.05
MERCURY	0.002
NITRATE (AS N)	10.
SELENIUM	0.01
SILVER	0.05
FLUORIDE	TEMPERATURE DEPENDENT – IDENTICAL TO U.S. ENVIRONMENTAL PROTECTION AGENCY (1976)

SECONDARY STANDARDS CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

CONTAMINANT	LEVEL, mg/l *	MAXIMUM LEVEL, mg/l **
CHLORIDE	250	400
COLOR	15 COLOR UNITS	–
COPPER	1.	–
FOAMING AGENTS	0.5	–
IRON	0.3	0.6
MAGNESIUM	125	150
MANGANESE	0.05	0.1
ODOR	3 THRESHOLD ODOR NUMBER	–
pH	6.5 - 8.5	–
SULFATE	250	500
TDS (Total Residue dried at 103 - 105° C)	500	1000
ZINC	5.	–

* These chemical substances should not be present in a public water supply in excess of the listed levels where, in the judgement of the health authority, other more suitable supplies are or can be made available. Such alternate supplies must be economically feasible, available under law in sufficient quantities and of a significantly higher quality.

** These chemical substances shall not be present in a public water supply in excess of the listed levels.

Reference: Nevada State Division of Health, 1977.

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NEVADA DRINKING WATER STANDARDS

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TABLE 4-6

PRIMARY STANDARDS MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

CONTAMINANT	LEVEL, mg/l
ARSENIC	0.05
BARIUM	1.0
CADMIUM	0.01
CHROMIUM	0.05
LEAD	0.05
MERCURY	0.002
NITRATE (AS N)	10.0
SELENIUM	0.01
SILVER	0.05
SULFATE	500
T D S	2000[1]
FLUORIDE	1.6[2]

SECONDARY STANDARDS MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

CONTAMINANT	LEVEL, mg/l
CHLORIDE	250
COLOR	15 COLOR UNITS
COPPER	1.
CORROSIVITY	NON-CORROSIVE
FOAMING AGENTS	0.5
IRON	0.3
MANGANESE	0.05
ODOR	3 THRESHOLD ODOR NUMBER
pH	6.5 – 8.5 pH UNITS
ZINC	5.

1. If T D S is greater than 1000 mg/l, "the supplier shall show (to the Utah State Bureau of Environmental Health) that no better water is available. The (state) shall not allow the use of an inferior source of water if a better source of water (i.e. lower in T D S) is available".

2. Recommended fluoride levels vary with annual average daily maximum air temperature. As this average has not been calculated for each valley, the lower limit set by the U.S. Environmental Protection Agency (1976) has been used.

Reference: Utah State Division of Environmental Health, 1980.

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UTAH DRINKING WATER STANDARDS

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In addition to the natural conditions leading to reduced water quality discussed above, there are at least two man-made types of water-quality degradation occurring in the siting area. High nitrate concentrations are frequently found in areas where live-stock or agriculture are present. In areas where mining or ore processing have occurred or are on-going, high concentrations of cyanide, mercury, silver, selenium and other metals may be present in the ground water. Although these constituents have not been detected in significant concentrations, valleys where this may occur include portions of Big Smoky, Reveille, and Penoyer valleys.

The quality of water associated with valley-fill aquifers is significant to MX construction not only for its suitability for drinking purposes but also for mixing of concrete. Requirements for process water in concrete mixing are not as rigorous as those for drinking water. General water-quality criteria for concrete mixing are listed in Table 4-8, however, the actual quality requirements to produce the high strength product re-quired by the Air Force may be more stringent.

4.2.3 Carbonate Aquifers

Carbonate rocks of Paleozoic age occur extensively throughout the MX deployment area in Nevada and Utah. These rock units are found in the majority of the mountain ranges and are presumed to underlie most of the intervening valleys. Extensive secondary permeability has developed in certain of these rocks due to folding, fracturing, and faulting and subsequent dissolution

CONSTITUENT		mg/l
Total Dissolved Solids	<	2000
Suspected Solids	<	2000
Iron	<	20
Sodium Sulphide	<	100
Sodium-Potassium Carbonates and Bicarbonates	<	1000
Sodium Chloride	<	20,000
Sodium Sulphate	<	10,000
Magnesium Sulphate	<	40,000
Magnesium Chloride	<	40,000

Reference: Portland Cement Association (1966)

NOTE: Waters with HCO_3 concentrations of 550 mg/l are listed as suitable for concrete manufacture. No upper limit was established by Portland Cement Association research (Mr. Frank Randall – Portland Cement Assoc. (1981) Per. Comm.).

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QUALITY CRITERIA FOR MIXING WATER FOR CONCRETE

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TABLE 4-8

along the physically formed openings. These regional carbonate aquifers (hereafter "carbonate aquifers") provide hydraulic connection and transmit water at depth between many of the valleys within the MX deployment area. The resulting hydrologic units, or groups of interconnected valleys, are termed "ground-water flow systems." These systems encompass from as few as two to as many as 13 valleys, the latter being the number believed linked in the White River regional ground-water flow system of southeastern Nevada (Eakin, 1966).

Large quantities of ground water are known to move through the carbonate aquifers comprising these systems. Consequently, these aquifers were viewed as a potential alternative to valley-fill aquifers as a water source for MX construction and operation. Because little was known about the nature of the carbonate aquifers, the well development potential, or the impacts of such development, a study was initiated by Ertec in July 1980 at the direction of the Air Force. Preliminary results of this program are summarized in the following sections.

4.2.3.1 Legal Availability

At present, no wells are known to be producing water from the carbonate aquifers within the MX siting area. The only use of regional flow occurs where it discharges naturally from the flow systems as springs. Discharge from these regional springs is a reliable water source, and, as indicated in Section 4.1.1 of this report, their flow is fully appropriated in most, if not all, cases.

The regional nature of the carbonate aquifers and the statutory procedures in effect in Nevada and Utah for appropriating ground water pose some potential uncertainties. Within both states, the availability of ground water for appropriation within any given valley is based on the perennial yield of that valley as defined by the respective State Engineers. In estimating the perennial yield of certain valleys, the amount of water moving through the valleys as underflow within the carbonate aquifers has been included. If such water were appropriated and withdrawn in an up-gradient valley within a flow system, a reduction of water availability in down-gradient valleys in the system may occur in the long term. These may be valleys where carbonate underflow is or is not considered in the perennial yield. They may also be valleys where some portion or all of the water within the flow system discharges as springs and is subject to prior appropriation and use. Because of these factors, the legal basis for appropriation of water in the carbonate aquifers is somewhat undefined. The approach that the respective State Engineers may take to resolve these problems is uncertain.

4.2.3.2 Aquifer Capabilities

Based on field reconnaissance and literature survey, 10 major hydrostratigraphic units, five aquifers and five aquitards, have been identified within the Paleozoic carbonate section. Evaluation of flow-system behavior and detailed analysis of structural features suggests that permeability development associated with faulting is a major factor controlling ground-water movement, and consequently well development potential, within the identified aquifer zones. This conclusion is supported by results of the exploratory drilling program.

Exploratory drilling conducted to date consists of individual wells located in four MX siting valleys. Results of this program are summarized in Table 4-9. Well yields obtained range from 95 gpm (6 l/s) in Coal Valley to 540 gpm (34 l/s) in Coyote Spring Valley. Well yields were constrained by the diameter of the exploration wells. Well yields at the Dry Lake and Coyote Spring valleys sites could be significantly increased by installing larger diameter wells in which higher capacity pumps could be emplaced. Recent testing of a large diameter ([illegible].5 inch [44.5 cm]) carbonate well (CE-DT-5) drilled near the site of CE-DT-4 in Coyote Spring Valley produced a yield of 3400 gpm (214 l/s) with approximately 12 feet (3.6 m) of drawdown. Specific results from testing of this carbonate exploration well were not available for inclusion in this report but will be presented in a subsequent report.

Variation is due to the different hydrostratigraphic sequences and the varying structural conditions encountered at each site. This suggests that well siting criteria, and especially the interpretation of subsurface hydrostratigraphic and structural conditions, will be a critical factor if significant well yields are to be achieved.

Based on information developed from literature surveys and field reconnaissance studies and the results of exploratory drilling

CARBONATE EXPLOR

WELL	LOCATION	WELL CHARACTERISTICS		FO
CV - DT - 1	COAL VALLEY	DEPTH (FT.) - 1837	DIAMETER (INCHES)	0
	NYE CO., NEVADA	0 - 118	13 3/4	1
	3 N / 59 E - 10	118 - 1837	7 7/8	
		STATIC WATER LEVEL	803 ft	
		TEMPERATURE	26 °C	4
		AVERAGE T.D.S.	260 mg/l	
SV - DT - 2	STEPTOE VALLEY	DEPTH (FT.) - 2447	DIAMETER (INCHES)	0
	WHITE PINE CO., NEVADA	0 - 50	12	
	12 N / 63 E - 12 ba	50 - 2447	7 7/8	
		STATIC WATER LEVEL	427 ft	9
		TEMPERATURE	12 °C	
		AVERAGE T.D.S.	302 mg/l	
DL - DT - 3	DRY LAKE VALLEY	DEPTH (FT.) - 2395	DIAMETER (INCHES)	0
	LINCOLN CO., NEVADA	0 - 347	13 3/4	1
	3 N / 63 E - 27 ca	347 - 2395	9 7/8	3
		STATIC WATER LEVEL	853 ft	2
		TEMPERATURE	27 °C	
		AVERAGE T.D.S.	366 mg/l	
CE - DT - 4	COYOTE SPRING VALLEY	DEPTH (FT.) - 669	DIAMETER (INCHES)	0 -
	CLARK CO., NEVADA	0 - 53	13 3/4	30
	13 S / 63 E - 23 dd	53 - 669	9 7/8	
		STATIC WATER LEVEL	353 ft	30
		TEMPERATURE	34 °C	58
		AVERAGE T.D.S.	491 mg/l	

ONATE EXPLORATION WELLS

ISTICS	FORMATIONS PENETRATED - DEPTH IN FEET		PRELIMINARY AQUIFER TEST RESULTS	
METER (INCHES) 13 3/4 7 7/8 803 ft 26 °C 260 mg/l	0 - 103 103 - 455 455 - 1835	ALLUVIUM CHAINMAN SHALE (MISSISSIPPIAN) FAULT GUILMETTE FORMATION (DEVONIAN)	TYPE TEST TEST DISCHARGE DRAWDOWN SPECIFIC CAPACITY TRANSMISSIVITY	STEP-DRAWDOWN CONSTANT DISCHARGE 95 gpm 63 ft 1.5 gpm/ft. 400 ft.^{2}/day (estimated)
METER (INCHES) 12 7 7/8 427 ft 12 °C 302 mg/l	0 - 920 920 - 2447	ELY LIMESTONE (PENNSYLVANIAN) THRUST FAULT CHAINMAN SHALE (MISSISSIPPIAN)	TYPE TEST TEST DISCHARGE DRAWDOWN SPECIFIC CAPACITY TRANSMISSIVITY	STEP-DRAWDOWN CONSTANT DISCHARGE 100 gpm 124 ft 0.8 gpm/ft. 200 ft.^{2}/day (estimated)
METER (INCHES) 13 3/4 9 7/8 853 ft 27 °C 366 mg/l	0 - 195 195 - 335 335 - 2060 2060 - 2395	ALLUVIUM VOLCANICS GUILMETTE FORMATION (?) (DEVONIAN) SIMONSON DOLOMITE (?) (DEVONIAN)	TYPE TEST TEST DISCHARGE DRAWDOWN SPECIFIC CAPACITY TRANSMISSIVITY	STEP-DRAWDOWN CONSTANT DISHCARGE 106 gpm 2 ft 50 gpm/ft. 13,400 ft.^{2}/day (estimated)
ETER (INCHES) 13 3/4 9 7/8 353 ft 34 °C 491 mg/l	0 - 30 30 - 669 30 - 580 580 - 669	ALLUVIUM MONTE CRISTO LIMESTONE (MISSISSIPPIAN) ANCHOR MEMBER DAWN MEMBER	TYPE TEST TEST DISCHARGE DRAWDOWN SPECIFIC CAPACITY TRANSMISSIVITY	STEP-DRAWDOWN CONSTANT DISCHARGE 540 gpm 3.5 ft 155 gpm/ft. 40,000 ft^2/day (estimated)

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CARBONATE EXPLORATION WELLS

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TABLE 4-

and testing, a qualitative assessment of the development potential of the carbonate aquifers in individual siting valleys is possible. Several criteria have been evaluated to define high, moderate, or low development potential. These criteria are:

- o Thickness of Paleozoic carbonate hydrostratigraphic aquifer units exposed or anticipated at drillable depths;
- o Thickness of Paleozoic carbonate hydrostratigraphic aquitard units exposed or anticipated at drillable depths;
- o Density of faulting or other structural deformation;
- o Occurrence of volcanic or intrusive rocks;
- o Association with a regional flow system known to have significant ground-water underflow; and
- o Land-use restrictions on potential drilling areas.

Results of this evaluation are listed in Table 4-10. Figure 4-3 shows the distribution of development potential within the siting area. Moderate to high potential areas are in the central and eastern portions of the siting area where extensive carbonate sequences occur. The western region has a generally low potential because of a predominance of volcanic rock and the more clastic nature of the carbonate rock in the area.

Table 4-10 also indicates that valleys with significant potential for carbonate aquifer development do not correlate well with valleys defined as water short. This, in conjunction with the restrictive well location criteria, suggests that the carbonate aquifers will be a viable water-supply source in a limited number of siting valleys.

MX VALLEYS	RATING CRITERIA 1	2	3	4	5	6	RATING	WATER SHORT VALLEYS**
1 ANTELOPE	–	–	–	–	–	+	LOW	X
2 BIG SAND SPRINGS	–	–	–	+	–	+	LOW	
3 BIG SMOKY	–	–	–	+	–	–	LOW	X
4 BUTTE	+	+	+	+	–	+	HIGH	
5 CAVE	+	+	+	–	+	+	HIGH	
6 COAL	+	+	+	+	+	+	HIGH	
7 COYOTE SPRING*	+	+	+	+	+	–	HIGH	X
8 DELAMAR	–	–	–	+	+	+	MODERATE	
9 DRY LAKE	+	+	–	+	+	+	HIGH	X
10 DUGWAY	–	–	–	+	+	?	LOW	X
11 ESCALANTE*	–	–	–	–	–	+	LOW	X
12 FISH SPRINGS FLAT	–	+	+	–	+	–	MODERATE	
13 GARDEN	+	+	+	+	+	–	HIGH	
14 HAMLIN	+	+	+	+	+	+	HIGH	
15 HOT CREEK	+	+	–	+	–	–	MODERATE	
16 JAKES	–	–	–	–	+	+	LOW	
17 KOBEH	+	+	+	+	?	+	HIGH	
18 LAKE	–	–	+	–	–	–	LOW	X
19 LITTLE SMOKY	–	–	–	+	–	+	LOW	
20 LONG	–	–	+	–	+	+	MODERATE	
21 MONITOR	–	–	–	+	–	–	LOW	
22 MULESHOE	+	+	–	+	+	+	HIGH	X
23 NEWARK	–	–	+	–	–	+	LOW	
24 PAHROC	+	+	–	+	+	+	HIGH	X
25 PENOYER	–	–	+	–	–	+	LOW	X
26 PINE	+	–	–	–	–	+	LOW	
27 RAILROAD (NORTH)	+	+	–	+	?	+	HIGH	
28 RALSTON	+	–	–	–	–		LOW	X
29 REVEILLE	–	–	–	–	?	–	LOW	
30 SEVIER	–	–	–	–	?	+	LOW	X
31 SNAKE	–	–	+	+	?	+	MODERATE	
32 SPRING	–	–	+	+	+	+	MODERATE	
33 STEPTOE	–	–	+	+	?	+	MODERATE	X
34 STONE CABIN	–	–	–	–	?	+	LOW	X
35 TULE	+	–	+	–	?	+	MODERATE	
36 WAH WAH	+	–	–	–	?	+	LOW	X
37 WHIRLWIND	+	+	+	–	?	–	?	X
38 WHITE RIVER	+	+	+	+	+	+	HIGH	

* Operational Base

** Defined on the basis of perennial yield, current use, designated or closed valley status, or alluvial aquifer capability vs. projected MX water requirements.

(+) Favorable
(–) Unfavorable
(?) Uncertain

CRITERIA – LISTED IN ORDER OF SIGNIFICANCE

1. The presence of thick hydrostratigraphic units consisting of aquifers 2, 4, and 6 either exposed at the surface or at drillable depths
2. The lack of thick hydrostratigraphic units consisting of aquitards 3, 5, 7, and 9 which would be expected at drillable depths
3. The lack of, or minor occurrences of volcanic and/or intrusive rocks
4. Areas of high density faulting, especially within Devonian – middle Cambrian rocks
5. Valleys within known "Regional Flow Regimes".
6. Minimal land use restrictions on favorable drilling areas

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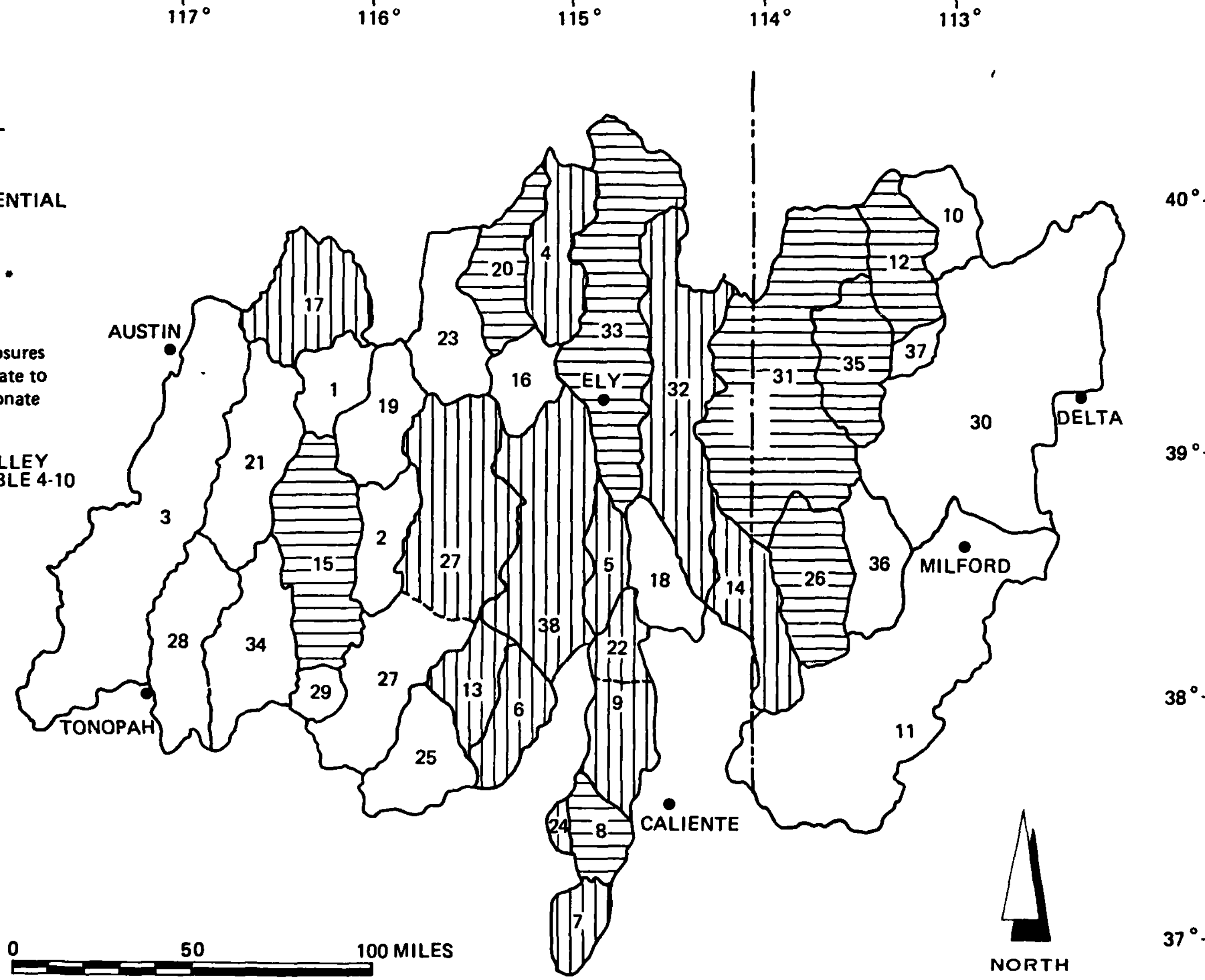
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

ESTIMATED POTENTIAL FOR CARBONATE AQUIFER DEVELOPMENT

30 NOV 81 TABLE 4-10



LEGEND

HIGH POTENTIAL

MODERATE POTENTIAL

LOW POTENTIAL *

* Area contains scattered exposures of thick sequences of moderate to possibly high potential carbonate strata.

NUMBERS REFER TO VALLEY NUMBERS SHOWN IN TABLE 4-10

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DISTRIBUTION OF CARBONATE AQUIFER DEVELOPMENT POTENTIAL

30 NOV 81

FIGURE 4-3

The following sections on the Paleozoic stratigraphy, hydrostratigraphy, and structural controls are presented to further clarify characteristics and water-supply potential of the carbonate aquifers.

4.2.3.3 Paleozoic Stratigraphy

The depositional history of the Paleozcic Era in the siting area is characterized by three distinct suites of sedimentary rocks. In eastern Nevada and western Utah, roughly between longitudes 113°W and 116°W, the Paleozoic rocks from Middle Cambrian to Middle Mississippian age consist mostly of limestone and dolomite with varying minor amounts of clastic sedimentary rocks. These rock units thicken from several hundred feet in western Utah to 15,000+ feet (4570 m) in east-central Nevada. The second suite of rocks, between longitudes 116° W and 117° W in central Nevada, is characterized by a combination of clastic, volcanic, and carbonate rock with an aggregate thickness of 10,000+ feet (3048 m). The proportion of carbonate rocks within this area is generally less than 40 percent of the total thickness. In western Nevada, the Paleozoic section is comprised predominantly of clastic sedimentary rocks and chert with layered volcanic rock and minor amounts of carbonate rock. This suite is probably more than 50,000 feet (15,000 m) thick.

A composite stratigraphic column of bedrock units in the eastern half of the siting area is presented in Table 4-11.

BEDROCK STRATIGRAPHY AND HYDROSTRATIGRAPHY UNITS OF MX DEPLOYMENT AREA, UTAH, AND LINCOLN, NYE AND WHITE PINE COUNTIES, NEVADA

System	Series	Stratigraphic unit	Major lithology	Minimum-Maximum Thickness	Unit	Water-bearing characteristics
Quaternary-Tertiary		Undifferentiated Volcanics	Flow basalt, welded tuff	Unknown	Aquitard	Water movement controlled by cooling fractures; controls local and regional groundwater movement.
		Undifferentiated Intrusives	Crystalline igneous rock			Complexly fractured but nearly impermeable.
Permian		Park City Group	Limestone, siltstone, minor sandstone	0-2500 ft	Aquifer No. 10	Complexly fractured aquifer; coefficient of transmissivity ranges from 130 to perhaps as much as 6600 ft^2/day; inter crystalline porosity and permeability negligable; supplies local recharge water; many springs and some caves present.
		Arcturas Group	Limestone, siltstone, minor sandstone			
Pennsylvanian		Ely Group	Limestone, minor siltstone			
Mississippian		Scotty Wash Quartzite	Quartzite	0-600 ft	Aquitard No. 9	Complexly fractured but nearly impermeable, interstitial permeability negligable, poor hydraulic connection between fractures; major aquitard; controls regional groundwater movement.
		Chainman Shale	Shale, siltstone	680-2000 ft		
		Joanna Limestone	Limestone	80 1100 ft	Aquifer No. 8	Commonly fractured, intercrystalline porosity and permeability negligable, some caves and springs; minor aquifer
		Pilot Shale	Calcareous siltstone, minor shale	0 850 ft	Aquitard No. 7	Generally fractured, porosity and fracture permeability is negligable.
	Upper	Guilmette Formation	Limestone, dolomite, minor sandstone	1600 3500 ft		

		Pilot Shale	Calcareous siltstone, minor shale	0-850 ft	Aquitard No. 7	**Generally fractured; porosity** and fracture permeability is negligable.
Devonian	Upper	Guilmette Formation	Limestone, dolomite, minor sandstone	1600-3500 ft	Aquifer No. 6	Complexly fractured aquifer; negligable intercrystalline porosity; excellent fracture transmissivity, many caves, supplies water to major springs; coefficient of transmissivity ranges from 930 to perhaps as much as 13 300 ft^2/day; major aquifer.
	Middle	Simonson Dolomite	Dolomite	550-1200 ft		
	? Lower	Sevy Dolomite	Dolomite	250-1580 ft		
Silurian		Laketown Dolomite	Dolomite	75-1900 ft		
Ordovician	Upper	Ely Springs Dolomite	Dolomite	150-850 ft		
		Eureka Quartzite	Quartzite	100-600 ft	Aquitard No. 5	Complexly fractured; impermeable.
	Middle ? Lower	Pogonip Group	Limestone, shale, minor chert	2000-4700 ft	Aquifer No. 4	Complexly fractured aquifer; negligable intercrystalline porosity and permeability, solution caverns present locally, supplies some springs.
Cambrian	Upper	Undifferentiated	Limestone, dolomite	3000-6000 ft		
			Shale and limestone with occasional thick shale sequences		Aquitard No. 3	Complexly fractured, negligable fracture permeability; saturated beneath most of study area.

						present locally, supplies some springs.
Cambrian	Upper	Undifferentiated	Limestone, dolomite	3000-6000 ft		
			Shale and limestone with occasional thick shale sequences		Aquitard No. 3	Complexly fractured, negligable fracture permeability; saturated beneath most of study area.
	Middle	Pole Canyon–Limestone	Limestone, minor siltstone, shale		Aquifer No. 2	Complexly fractured aquifer; negligable intercrystalline porosity; excellent fracture permeability; many caves and springs; major aquifer; staturated beneath most of study area.
	Lower	Pioche Shale	Shale, siltstone, minor limestone	150 - 800 ft	Aquitard No. 1	Complexly fractured and jointed, negligable permeability, major hydraulic groundwater barrier; saturated beneath most of study area.
		Prospect Mountain Quartzite	Quartzite	400-12,000 ft		

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TABLE 4-11

4.2.3.4 Hydrostratigraphy

As a portion of field studies related to the carbonate program, a regional hydrostratigraphic reconnaissance of Paleozoic carbonate and clastic rocks within the MX siting area was undertaken to identify 1) dissolution potential of particular formations and rock types based on surface exposures; 2) stratigraphic position of springs emanating from carbonate rocks as well as the water's physical and chemical parameters; 3) geologic structures associated with major and minor springs; and 4) aquifers and aquitards within the Paleozoic section based on results of exploratory drilling.

The results of these studies indicate that the Paleozoic section within the siting area can be broken down into 10 hydrostratigraphic units (Table 4-11). Each aquifer hydrostratigraphic unit is separated from the next by an aquitard unit comprised predominantly of clastic rocks. Lateral and vertical continuity of aquifer and aquitard units is controlled primarily by facies or depositional changes within the Paleozoic section and secondarily by structural modification.

Hydrostratigraphic boundaries are most consistent between longitudes 113°W and 116°W and latitudes 37°N and 40°N. West of longitude 116°W, hydrostratigraphic boundaries are variable due to overlap of contrasting lithologies in central Nevada. South of latitude 37°N, several hydrostratigraphic units, primarily aquitards, are absent due to changes in Paleozoic depositional patterns. The distribution of hydrostratigraphic units within the siting area are shown in Drawing 4-2. A description of individual hydrostratigrphic units follows.

Unit 1 - Aquitard

East of longitude 116°W, Unit 1, the basal or lowermost aquitard unit, consists of lower Cambrian Prospect Mountain Quartzite and Pioche Shale. West of longitude 116° this unit consists of the upper Precambrian clastic rocks of the Wyman Formation and lower Cambrian clastic strata of the Gold Hill, and Campito Formations. Also included would be the lower parts of the Harkless and Poleta formations and undifferentiated lower Cambrian clastics. Assuming vertical continuity, all the abovementioned units appear to represent terminal depth horizons on the vertical, and to a lesser degree, lateral movement of ground water within the deployment area. Although generally highly fractured, both primary and secondary permeability of this unit is negligible. Winograd and Thordarson (1975) have reported transmissivities from rocks of this unit in the Nevada test site to be less than 135 ft^2/day (13 m^2/day).

Unit 2 - Aquifer

Unit 2 is the lowermost aquifer within the Paleozoic sequence. East of longitude 116°W, Unit 2 aquifer is composed predominantly of carbonate strata of the Pole Canyon Limestone, Eldorado Limestone, Highland Peak Formation, and undifferentiated carbonate strata of equivalent age. Carbonate rocks of this unit, which are mostly limestones, display negligible primary permeability. Secondary permeability of this unit is generally well developed by fractures, solution-enhanced fractures, and solution caverns of phreatic origin. A significant number of large springs discharge from this unit.

Unit 2 reaches a maximum thickness of 4000+ feet (1220 m) in the vicinity of Pioche, 3000+ feet (915 m) in the vicinity of Ely, and about 5000 feet (1525 m) in western Utah.

West of longitude 116°W, an equivalent age aquifer is represented within portions of uppermost Precambrian carbonate strata of the Reed Dolomite, and lower Cambrian Deep Springs Formation. These formations, like their counterparts to the east, have well-developed secondary permeability and negligible primary permeability. The overall hydraulic conductivity of these units, however, appears variable due to severe metamorphism accompanied by structural discontinuity and intrusive rocks which locally pervade these formations. This equivalent aquifer unit displays a variable thickness. It is about 2500 to 3000 feet (760 to 915 m) thick in the vicinity of Tonopah.

Unit 3 - Aquitard

Unit 3 is an aquitard composed primarily of shale, siltstone, and to a lesser degree, thinly interbedded limestone of late-middle Cambrian age. Formations which characterize this unit, east of longitude 116°W, are the Cambrian Patterson Pass Shale and Dunderburg Shale and the Ordovician Swan Peak and Orr Formations which consist of quartzite and shale, siltstone and limestone, respectively. All these formations are highly fractured, however, due to poor interconnection of fractures; the unit functions as an effective aquitard.

Unit 3 displays a variable thickness throughout most of the siting area, reaching a maximum thickness of 2110 feet (643 m) in the southern Egan Range.

West of longitude 116°W, equivalent formations that comprise this aquitard unit are the Cambrian Campito and Poleta formations which consist of quartzite, siltstone, shale, and minor limestone. These formations, like those which underly them, have often been severely deformed, metamorphosed, and invaded by igneous rocks. Hydraulic conductivity of these rocks is probably considerably less than their counterparts in eastern Nevada and western Utah. The thickness of these rocks is variable, attaining a maximum aggregate thickness of 4000 feet (1220 m) in the vicinity of Tonopah.

Unit 4 - Aquifer

Unit 4 consists of carbonate rocks of Upper Cambrian through Middle Ordovician age. Carbonate formations east of longitude 116°W include, in ascending order, undifferentiated Upper Cambrian carbonate rocks, Orr Formation, Notch Peak Formation, undifferentiated Lower Ordovician carbonate rocks, and carbonate and silty carbonate strata of the Middle Ordovician Pogonip Group. Carbonate rocks within this unit consist of thin- to massively bedded limestone and dolomite which, based on surface exposures, have moderate to excellent dissolution potential.

These rocks are generally complexly jointed and fractured and have developed solution caverns within and adjacent to faults.

Unit 4 aquifer is widely distributed throughout the eastern portion of the siting area. The thickness of this unit ranges from 3500 to 7000 feet (1066 to 2133 m) in western Utah and approximately 4500 feet(1370 m) in the Pahranagat and Arrow Canyon ranges, 7000 feet (2133 m) in the Egan Range, and 3000 feet (915 m) in the Hamilton district of White Pine County. Although this unit has not been penetrated by exploratory drilling in the siting area, Winograd and Thordarson (1975) reported a transmissivity from formations in the Nevada Test Site equivalent to the lower half of this unit of 1470 ft^2/day (136 m^2/day). The upper half, primarily within the Pogonip Group, yielded a transmissivity of 175 ft^2/day (16 m^2/day) (Winograd and Thordarson, 1975). Springs which emanate from this unit in the study area often have discharges greater than 200 gpm (13 l/s).

Unit 5 - Aquitard

Unit 5 consists of the Middle Ordovician Eureka Quartzite. The formation is highly fractured but displays negligible secondary permeability due to the insoluble nature of the rock, thus preventing solution enlargement of fractures. The Eureka Quartzite is widely distributed in the siting area east of longitude 116° 30'W. It reaches a maximum thickness of 600+ feet (182 m) in western Utah, ranges from 350 to 500+ feet (106 to 162 m) in eastern Nevada, and thins to 100 feet (30 m) in the Arrow Canyon Range in northern Clark County.

Unit 6 - Aquifer

Unit 6 is comprised primarily of dolomite with varying amounts of limestone in the upper part. This unit consists of rocks that range in age from Upper Ordovician through Upper Devonian and includes the following formations: Ely Springs Dolomite, Laketown Dolomite, Sevy Dolomite, Simonson Dolomite, and Guilmette Formation. These carbonate strata are characterized by medium- to massively bedded dolomite and limestone which display high dissolution potential and excellent secondary permeability, especially within rocks of Devonian age.

This unit occurs throughout the siting area east of longitude 116° 30'W. The unit ranges in thickness from 3000 feet (915 m) in Clark County to 7000 feet (2133 m) in Lincoln County, 6200 feet (1890 m) in Nye County, and 6000+ feet (1828 m) in White Pine County and in western Utah.

Hess and Mifflin (1978) reported 42 major springs which issue from this unit, four from Silurian rocks, and 38 from Devonian rocks. Typical springs are Ash and Crystal springs in Pahranagat Valley, Hot Creek Springs in White River Valley, and Warm Springs in Hot Creek Valley. Several other regional springs are known to emanate from alluvial material in close proximity to Devonian age strata, presumably along high-angle faults.

Of the four carbonate exploration wells drilled by Ertec, two have penetrated this unit, CV-DT-1 and DLV-DT-3. Transmissivity values estimated for CV-DT-1 and DLV-DT-3 are 400 and 13,400 ft^2/ day (37 and 1242 m^2/day), respectively. This wide range of values is due to the differing subsurface structures present at the sites. The DL-DT-3 borehole is believed to have penetrated a fault zone, whereas CV-DT-1 is believed to have penetrated a number of small water-bearing fractures. These results suggest that faulted portions of this unit, as well as other aquifer units, will yield considerable water to wells due to greater fracture density and interconnection. In the Nevada Test Site, Winograd and Thordarson (1975) report transmissivity values for equivalent Devonian formations of from 320 to 3600 ft^2/day (30 to 334 m^2/day).

Based on this units aggregate thickness, wide distribution, stratigraphic position, involvement in regional flow as evidenced by spring discharge, and the results of exploratory drilling and testing, it is considered the most significant carbonate aquifer unit in the MX siting are .

Unit 7 - Aquitard

Unit 7 consists of the Upper Devonian-Lower Mississippian Pilot Shale Formation. Lithologically, the formation is characterized by thin, interbedded shale and lesser amounts of limestone. The Pilot Shale attains a maximum thickness of 850 feet (260 m) in the House and Confusion ranges in Utah and averages 350 feet (106 m) in Lincoln, Nye, and White Pine counties. It is absent in Clark and southwest Lincoln counties.

Unit 8 - Aquifer

Unit 8 consists of the Lower Mississippian Joana Limestone and its equivalent in Clark County, the Monte Cristo Limestone, which is lithologically similar to the upper part of the Joana. The dissolution potential of this unit is generally low, however, it increases in areas of fault activity. With the exception of the lower massive limestone, the upper part of the Joana and the entire section of the Monte Cristo are commonly highly fractured.

The Joana Limestone ranges from 80 to 350 feet (24 to 106 m) thick in western Utah, 200 to 390 feet (61 to 118 m) in White Pine County, is approximately 250 feet (76 m) thick in eastern Nye County, and ranges from 650 to 1100 feet (198 to 335 m) thick in Lincoln County. The Monte Cristo Limestone located in southernmost Lincoln and Clark counties is 1300+ feet (396 m) thick.

At present, there are no available transmissivity values for the Joana Limestone, however, the Silver King Mining Company (Ely, Nevada) reported that a horizontal adit which penetrated the Joana in the Egan Range (elevation 8000 feet [2438 m]) yielded approximately 100 gpm (6 l/s) for 12 hour. after which flow decreased to about 10 gpm (1 l/s) (Silver King Mining Company, personal communication, 1980). In drill hole CE-DT-4 in Coyote Spring Valley, the lowest part of the Monte Cristo Limestone was penetrated. Subsequent aquifer testing yielded a transmissivity estimate of 40,000 ft^2/ day (3708 m^2/day). This drill hole, like DL-DT-3, is located within a fault zone. The majority of the Monte Cristo would not be considered a good aquifer due to the considerable amount of chert and siliceous material present.

Unit 9 - Aquitard

Unit 9 consists of the Mississippian Chainman Shale and Scotty Wash Quartzite-Diamond Peak Formation. Lithologically, the Chainman Shale is almost entirely shale with subordinate amounts of interbedded limestone and quartzite. The Scott Wash quartzite is composed of fine- to coarse-grain quartzite and sandstone with minor amounts of interbedded siltstone. The Diamond Peak Formation consists of siltstone, claystone, and sandstone. Together these formations attain an aggregate thickness ranging from 1800 to 2400 feet (548 to 731 m) in western Utah, 1000 to 5750 feet (304 to 1752 m) in White Pine County, and 200 to 1800 feet (61 to 548 m) in Lincoln and Nye counties. This unit is absent in Clark and southernmost Lincoln counties.

Rocks of this unit are generally complexly fractured but are highly impermeable because of the dominant shale, siltstone, and claystone lithology. Due to stratigraphic position and significant thickness, this unit forms an extensive aquitard which controls regional and local ground-water movement over a great portion of the siting area.

Unit 10 - Aquifer

Unit 10 consists of a heterogeneous assemblage of limestone, dolomite, sandstone, and lesser amounts of shale and siltstone. Formations in this unit are the Pennsylvanian Ely Limestone and Bird Spring Formations and the Permian Carbon Ridge Formation, Arcturus Group, and Park City Group. Although the Arcturus Group contains a significant sandstone aquitard, it has been grouped into this unit for convenience.

The majority of rocks in this unit are complexly fractured. The unit supplies water to a significant number of springs. In several cases, these springs emanate from the Ely Limestone-Scotty Wash Quartzite contact which suggests that ground water in Unit 10 may be perched.

In Clark and southernmost Lincoln counties, this unit is approximately 5000 feet (1524 m) thick; it decreases to 3500+ feet (1066 m) in most of Lincoln County, increases to 7600+ feet (2316 m) in White Pine County, and averages 5250 feet (1600 m) in western Utah.

Located in the southeastern foothills of the Egan Range, well SV-DT-2 penetrated the lowermost part of Unit 10, the Ely Limestone. Aquifer testing yielded a transmissivity estimate of 200 ft^2/day (18 m^2/day). The majority of ground-water production occurred within the lowermost 350 feet (106 m) of the Ely Limestone.

Extrusive and Intrusive Rocks

Throughout the siting area, Paleozoic rocks are often unconformably overlain by extrusive volcanic rocks consisting mainly of welded tuffs and basalt flows. The thickness of these rocks is highly variable with some sequences attaining an aggregate thickness of as much as 5000 feet (1524 m). Ground-water flow in these rocks is controlled primarily by cooling fractures. The welded tuffs display negligible secondary permeability and serve to form interlayered aquitards below the jointed basalts.

In most cases, due to the lack of hydraulic connection between fractures, these rocks collectively form aquitards.

Intrusive rocks have a marked influence on regional and local ground-water flow patterns because they are generally impervious to ground-water flow. This is best displayed in the western half of the siting area where intrusive igneous rocks commonly form hydrogeologic divides between valleys.

In the eastern half of the siting area, intrusive rocks occur as isolated bodies, as volcanic centers, and are often associated with lineament zones. Where they occur as isolated bodies, they serve to deflect or impede ground-water flow within the carbonate rocks. Lineaments are most effective as ground-water barriers if igneous rocks occur along these zones.

4.2.3.5 Structural Controls

Geologic structure is thought to exert significant control on the movement of ground water within Paleozoic carbonate rocks of the Great Basin. Extensive hydrogeological investigations have been conducted by the U.S. Geological Survey at the Nevada Test Site and surrounding areas to evaluate structural control on the movement of ground water in carbonate rocks. Other studies have noted that thrust faults, normal faults, folds, and lineaments (surface expression of deep-seated structural zones) to some degree, control the movement of interbasin ground-water flow within Paleozoic carbonate rocks in southern and central Nevada.

Basin and Range Faults and East-West Lineaments

Within the study area the predominant structural pattern consists of generally north-south trending linear subparallel mountain ranges and basins. The basins and ranges are horst and graben and/or tilt block geologic structures separated by high-angle, normal faults. Regional ground-water flow, in general, follows the usual north-south trend of these faults. In most of the siting area, regional flow is to the south following the regional topographic gradient (see Drawing 4-1).

Regional springs in the siting valleys commonly emanate from or near high-angle, north-south trending faults hydraulically upgradient from major east-west lineaments. In effect, the structures represented by these lineaments act as hydraulic barriers or discontinuities along the flow paths of the regional ground-water systems and force ground-water to the surface. Examples of such associations in Nevada are Ash and Crystal Springs in Pahranagat Valley, upgradient from the Pahranagat Shear System; Hot Creek and Mormon Springs in White River Valley, upgradient from the Timpahute Lineament; and Warm Springs in Hot Creek Valley, upgradient from the Warm Spring-Blue Ribbon Lineament.

The Muddy River Springs, located just to the southeast of Coyote Spring Valley, discharge water from the White River regional flow system. These springs occur as a result of localized high-density faulting which allows regional ground-water to rise upward from underlying carbonate rocks to its unconfined static

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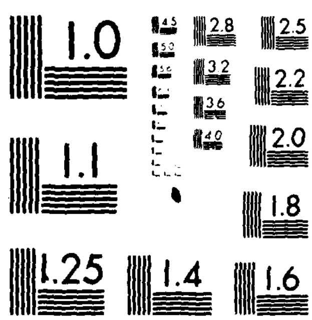

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

level. In effect, where two or more faults intersect, there is created an area of high fracture density which creates a highly soluble avenue for vertical transport of ground water within the carbonate rocks.

Range bounding faults have, in numerous instances, uplifted lowermost Cambrian and Precambrian clastic rocks. Mountain ranges containing appreciable amounts of these impervious rocks form prominent barriers to interbasin ground-water flow. Mountain ranges which display this character include the Delamar Mountains, Bristol Range, Grant Range, southern and northern Schell Creek and Snake ranges in eastern Nevada and the Frisco, Cricket, and Wah Wah mountains in western Utah.

Thrust Faults and Folds

Thrust faulting and associated folding of Paleozoic carbonate and clastic rocks have occurred throughout the siting area. In western Utah, older Paleozoic rocks have been thrust over younger rocks in a complex pattern of imbricate faulting, in some instances placing clastic rocks above carbonate rocks forming prominent ground-water barriers. The resulting deformation has caused both thickening and thinning of carbonate aquifer and/or clastic aquitard units. Several major thrust planes in this region have been intruded by siliceous igneous rocks which form hydraulic discontinuities within adjacent carbonate units. Examples of this occur in the Frisco District and along portions of the Mineral Range thrust in west-central Utah.

In eastern Nevada, tectonism has produced intraformational thrust faulting and folding as well as shearing along formational boundaries of contrasting lithologies (i.e., shale and limestone). This tectonism has produced several avenues for ground-water movement. Due to a greater accumulation of stress along the axes of folded carbonate strata, splitting and fracturing occur during uplift and relaxation, thereby increasing the dissolution potential within these areas. Thrust fault planes may themselves be avenues for ground-water movement. Well SV-DT-2, which yielded significant amounts of ground water, is believed to have penetrated several intraformational thrust faults.

A major avenue for ground-water movement may occur where thrust faults are intersected by younger basin-range faults. Due to the brittle style of deformation associated with such an occurrence, secondary or fracture permeability would be greatly enchanced along the intersecting structures.

4.2.3.6 Water Quality

Chemical quality of water in the regional carbonate aquifers has been evaluated using data from regional springs and the four carbonate exploration wells installed by Ertec. Water-quality data from regional springs were discussed in Section 4.1.1 and listed in Table 4-3. Water-quality data from the carbonate exploration wells are listed in Table 4-12. These waters are also of calcium-magnesium-bicarbonate type and, except for fluoride in CE-DT-4, water from all wells meets state drinking

SAMPLE LOCATION	OWNER OR WATER USER	DATE OF COLLECTION (mo. - yr.)	TEMPERATURE °C *	pH *	SPECIFIC CONDUCTANCE (µmho/cm @ 25 °C) *	BICARBONATE (HCO_3) *	CARBONATE (CO_3) *	DISSOLVED SOLIDS (see note)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (as N)	SILICA (SiO_2)	TRITIUM (pCi/liter)	REFERENCES	REMARKS
COAL VALLEY																				
3N/59E-10BD		1-81	26	8.2	440	227	1	260**	35	20	19	45	25	6.5	0.4	0.6	36			CV-DT-1
COYOTE SPRING VALLEY																				
13S/63E-23DD1		12-80	34	7.7	730	306	-	491**	51	20	83	11	102	37	2.1	0.2	34			CE-DT-4
DRY LAKE VALLEY																				
3N/63E-27ca		12-80	27	7.3	650	404	0	366**	77	30	18	6.5	20	5	0.6	0	25			DL-DT-3
STEPTOE VALLEY																				
12N/63E-12BA1		1-81	12	8.1	495	223	1	302**	62	14	15	4.3	50	17	0.3	1.3	26			SV-DT-2

All units in mg/l except as noted

* Field determination
** Dissolved solids determined by evaporation

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WATER CHEMISTRY DATA CARBONATE AQUIFER TEST WELLS

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TABLE 4-12

water standards. Total dissolved solids range from 260 to 491 mg/l and appear to increase with distance traveled through the flow system. Individual major inorganic constituents do not show a similar pattern of increase suggesting ionic exchange or recharge and mixing within a flow system. Although limited data are available, trace elements have not been detected in significant amounts.

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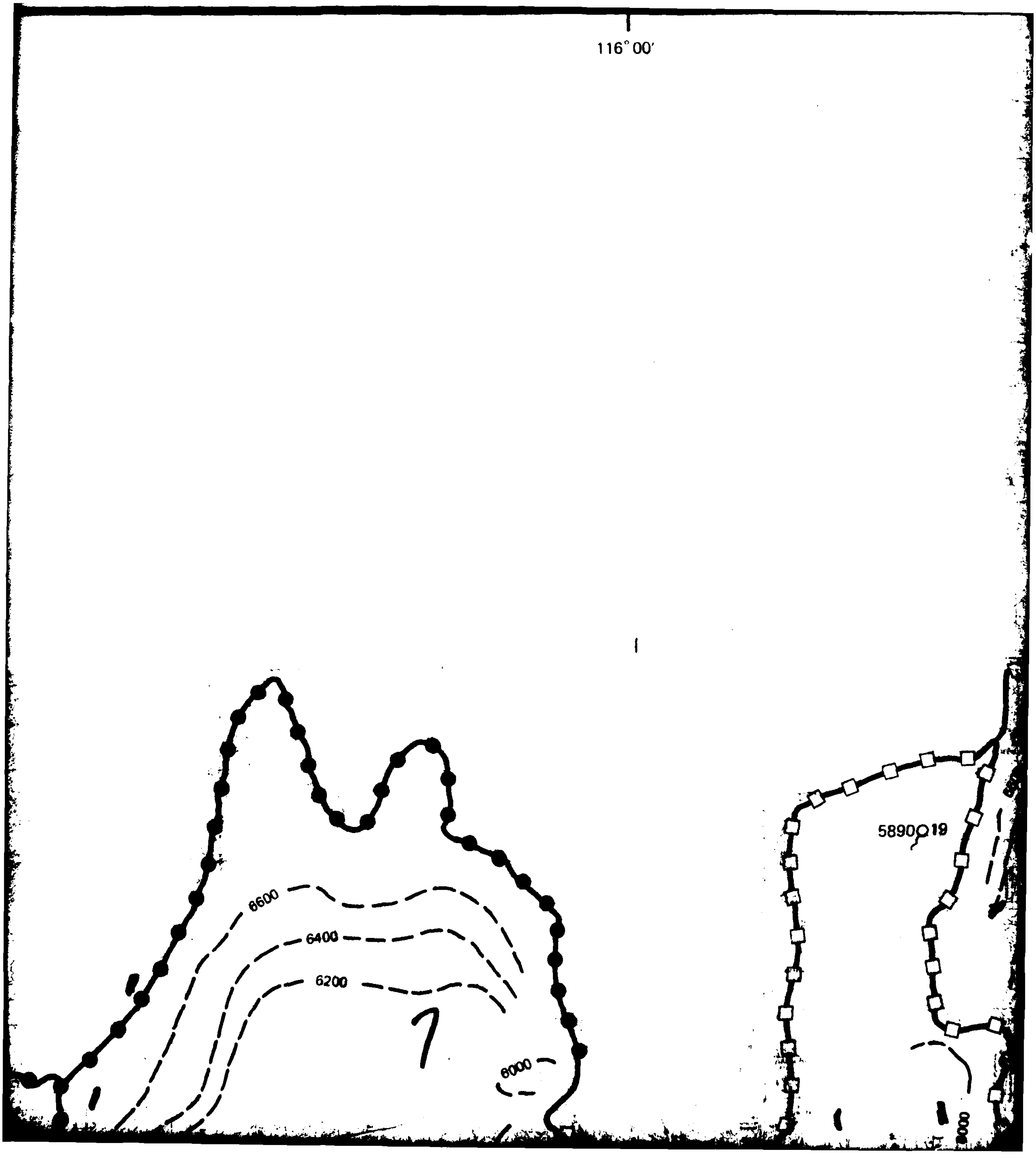

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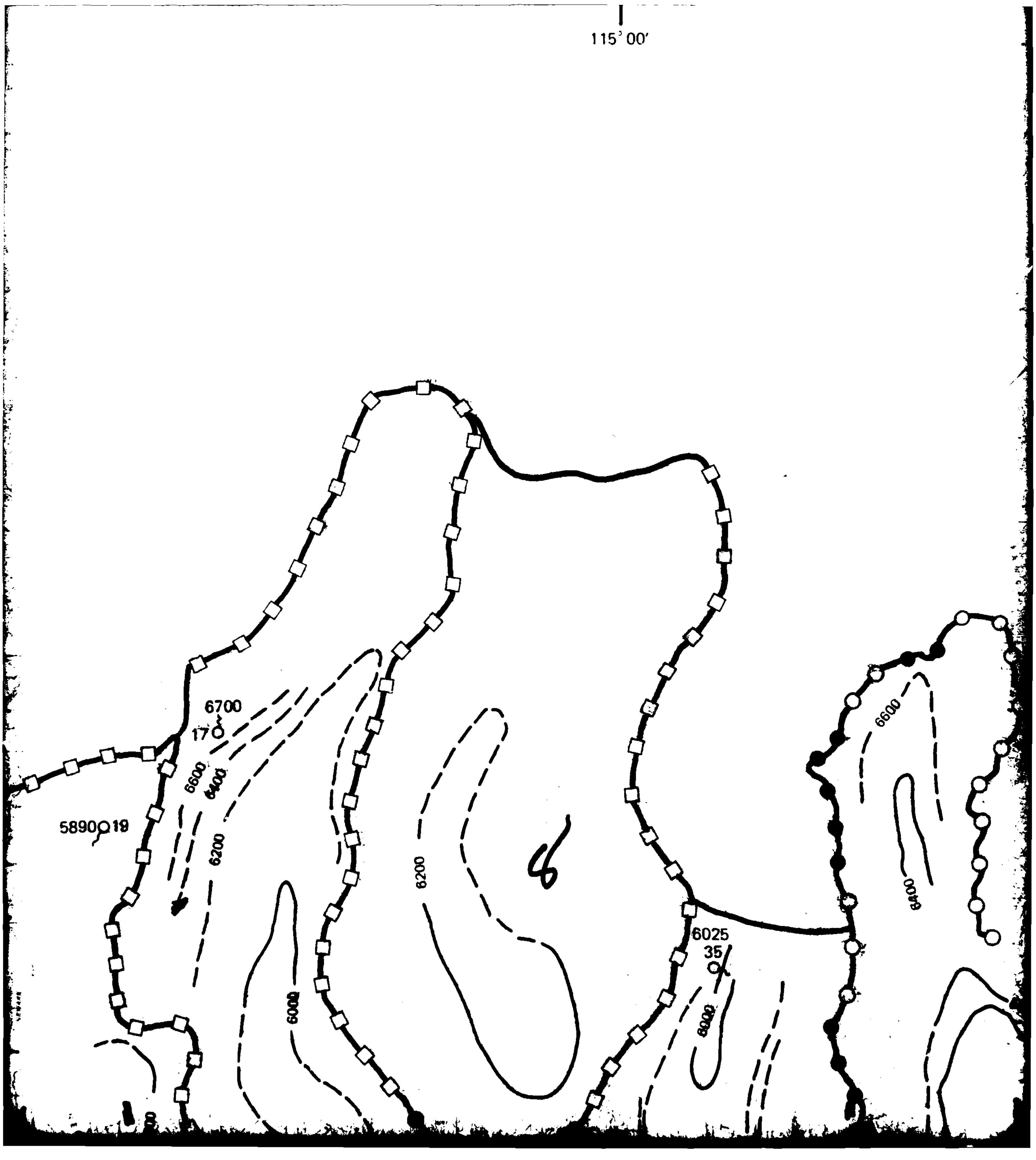

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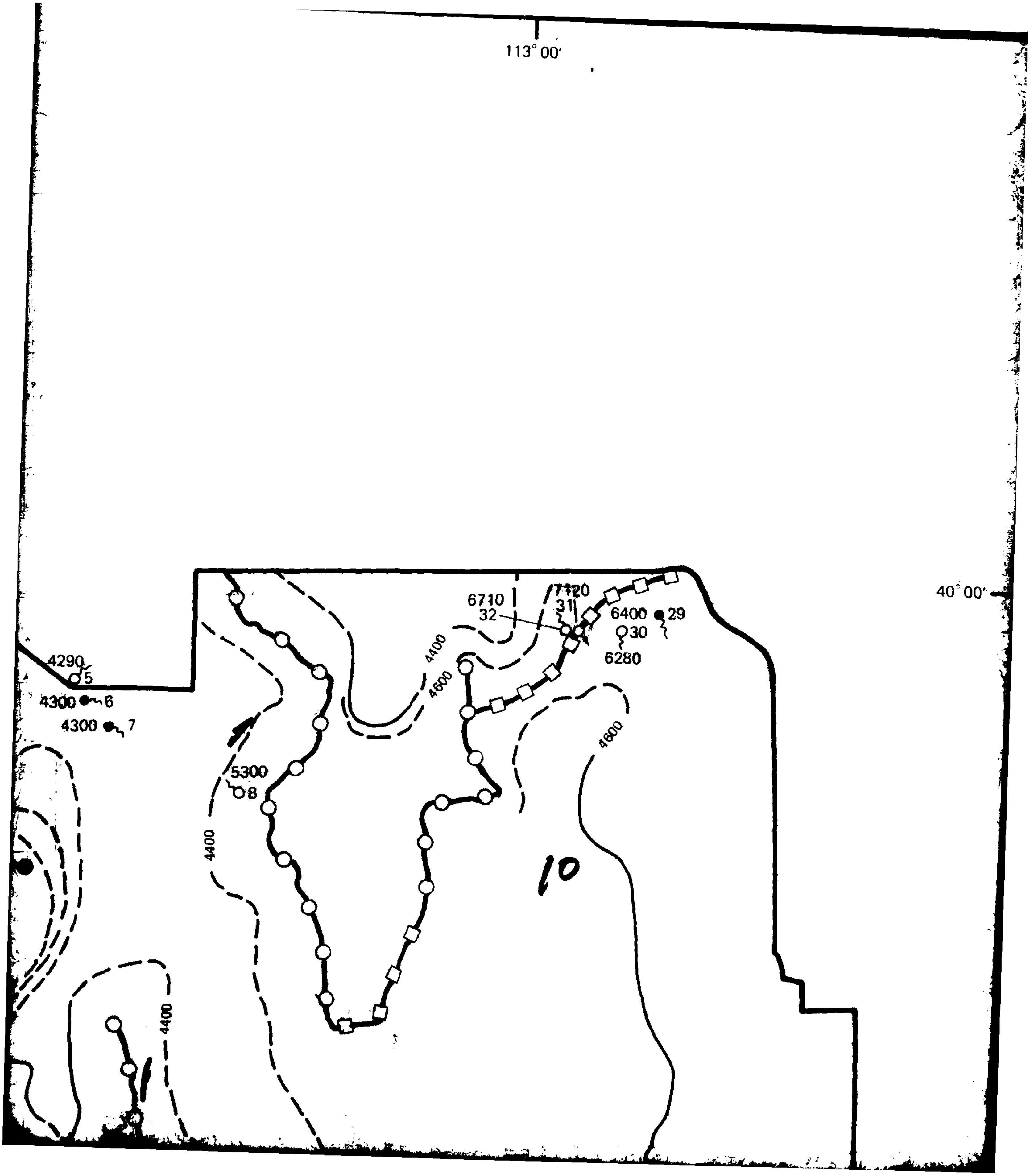

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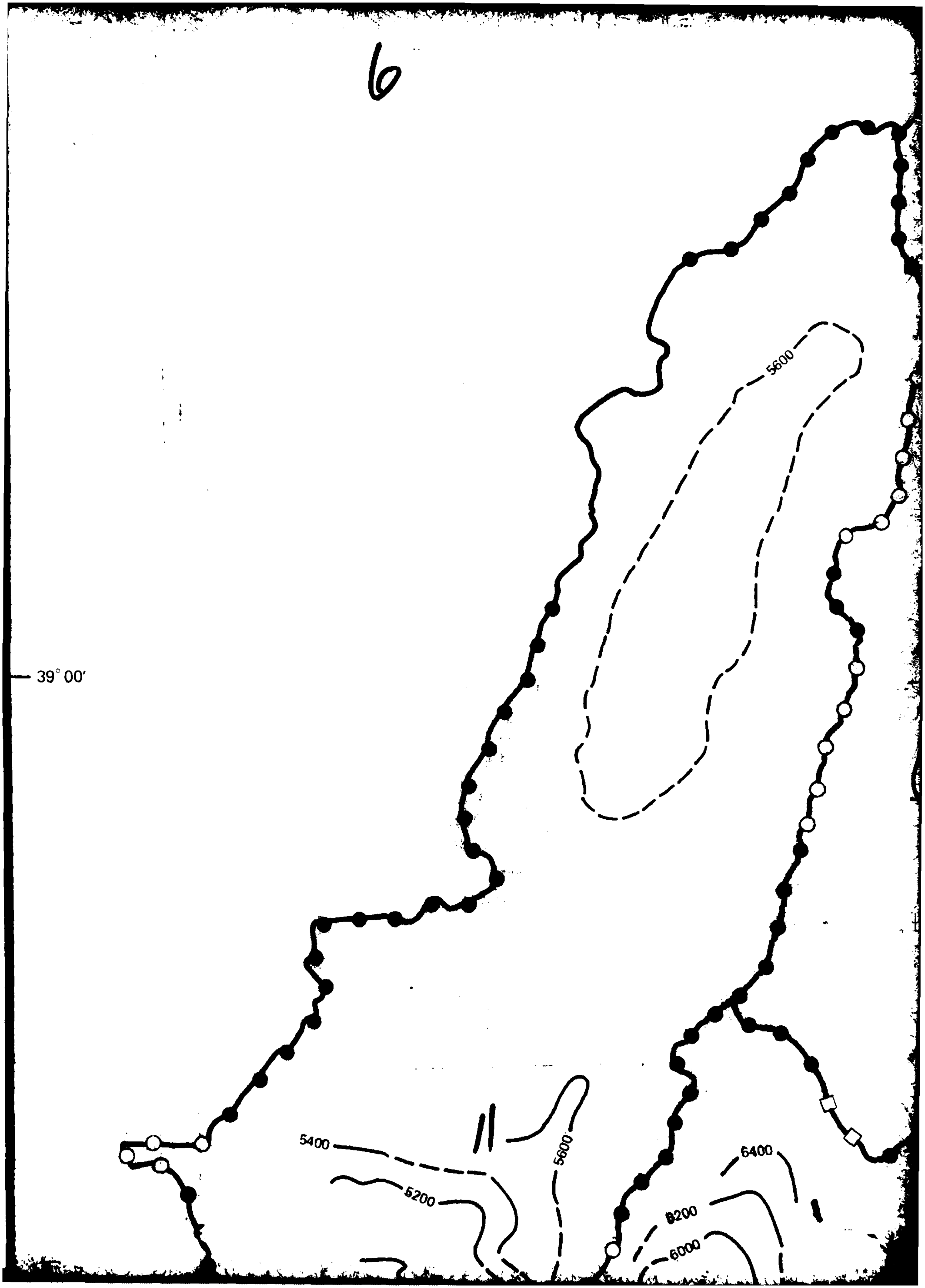

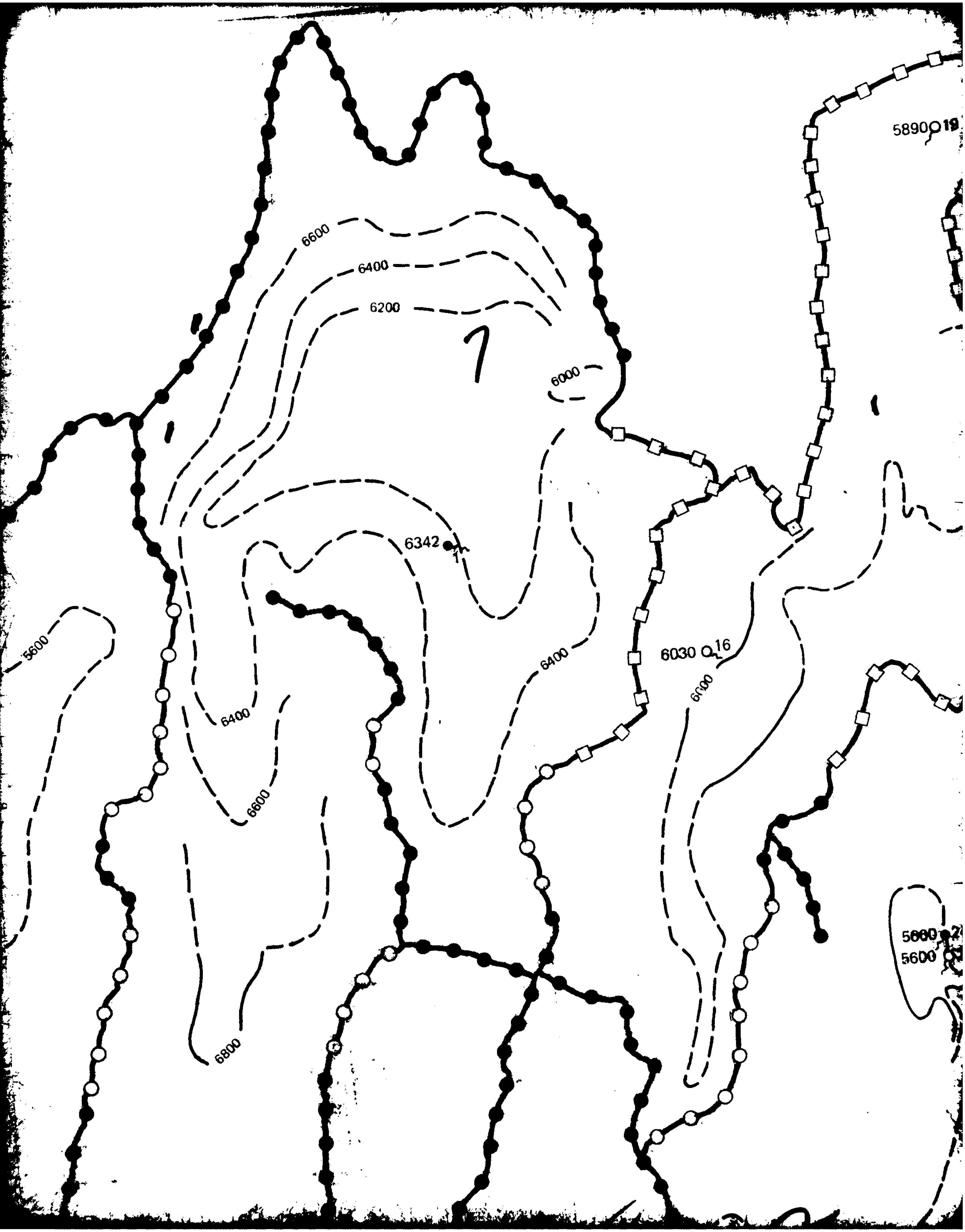

6600
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16
6400
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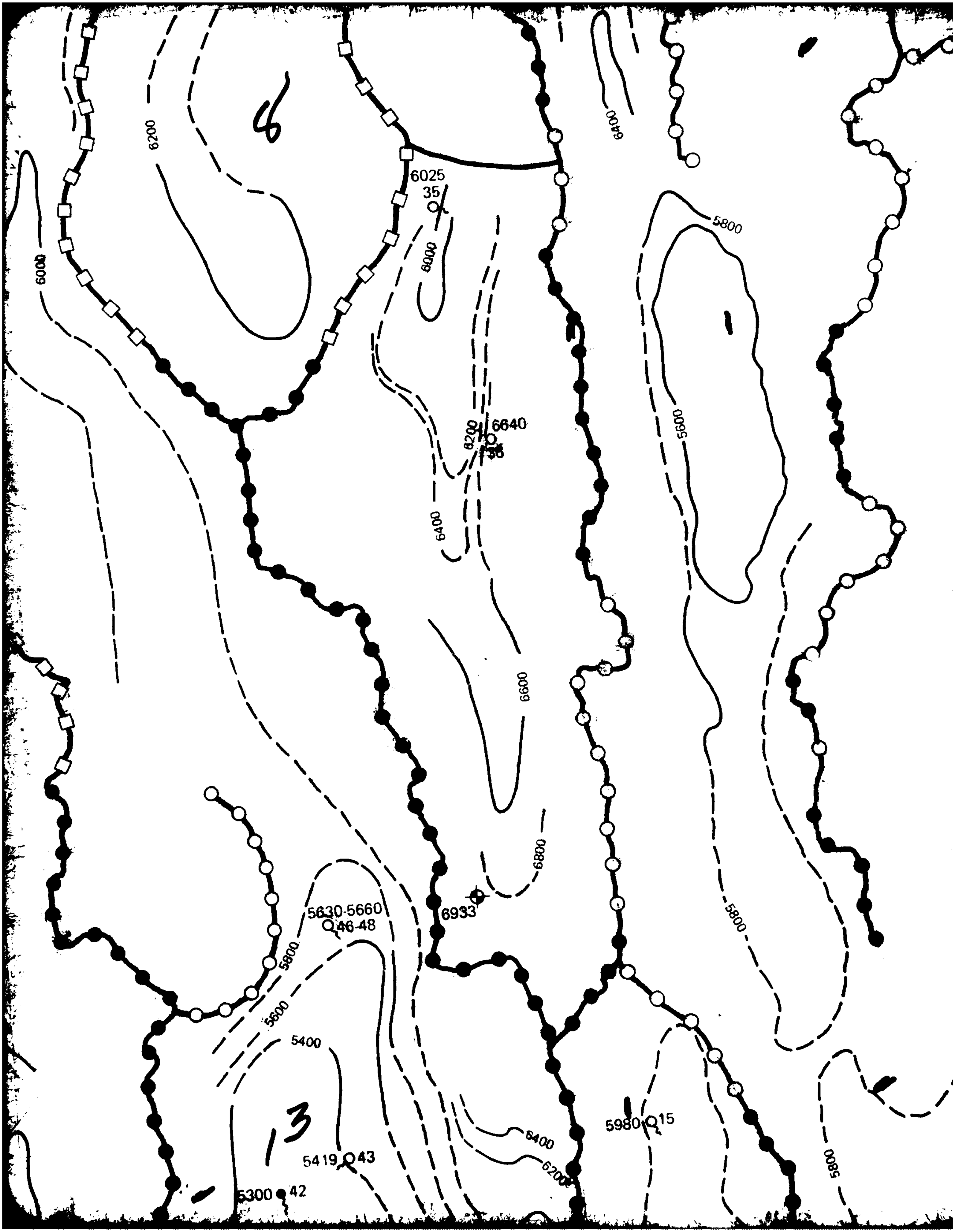
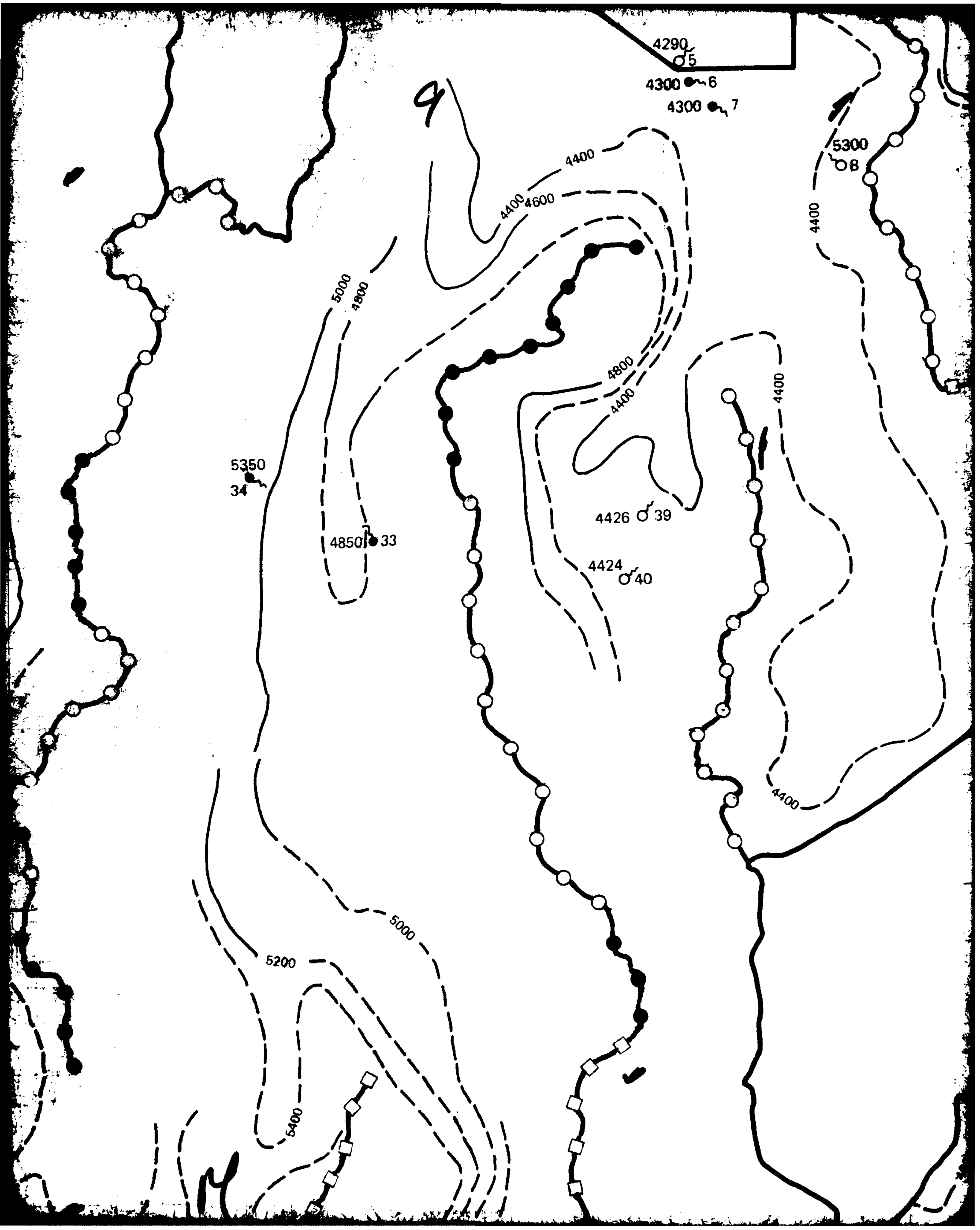
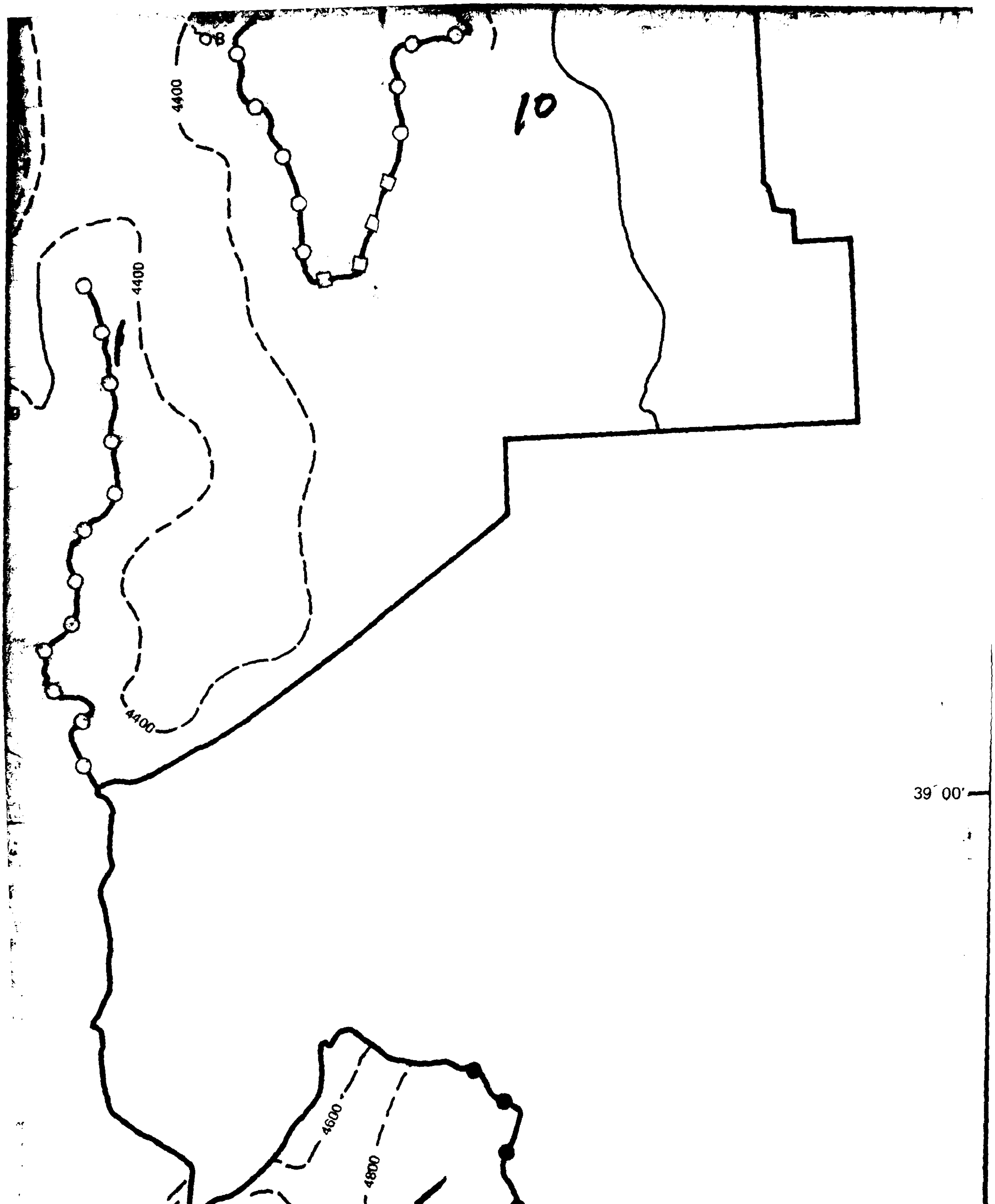
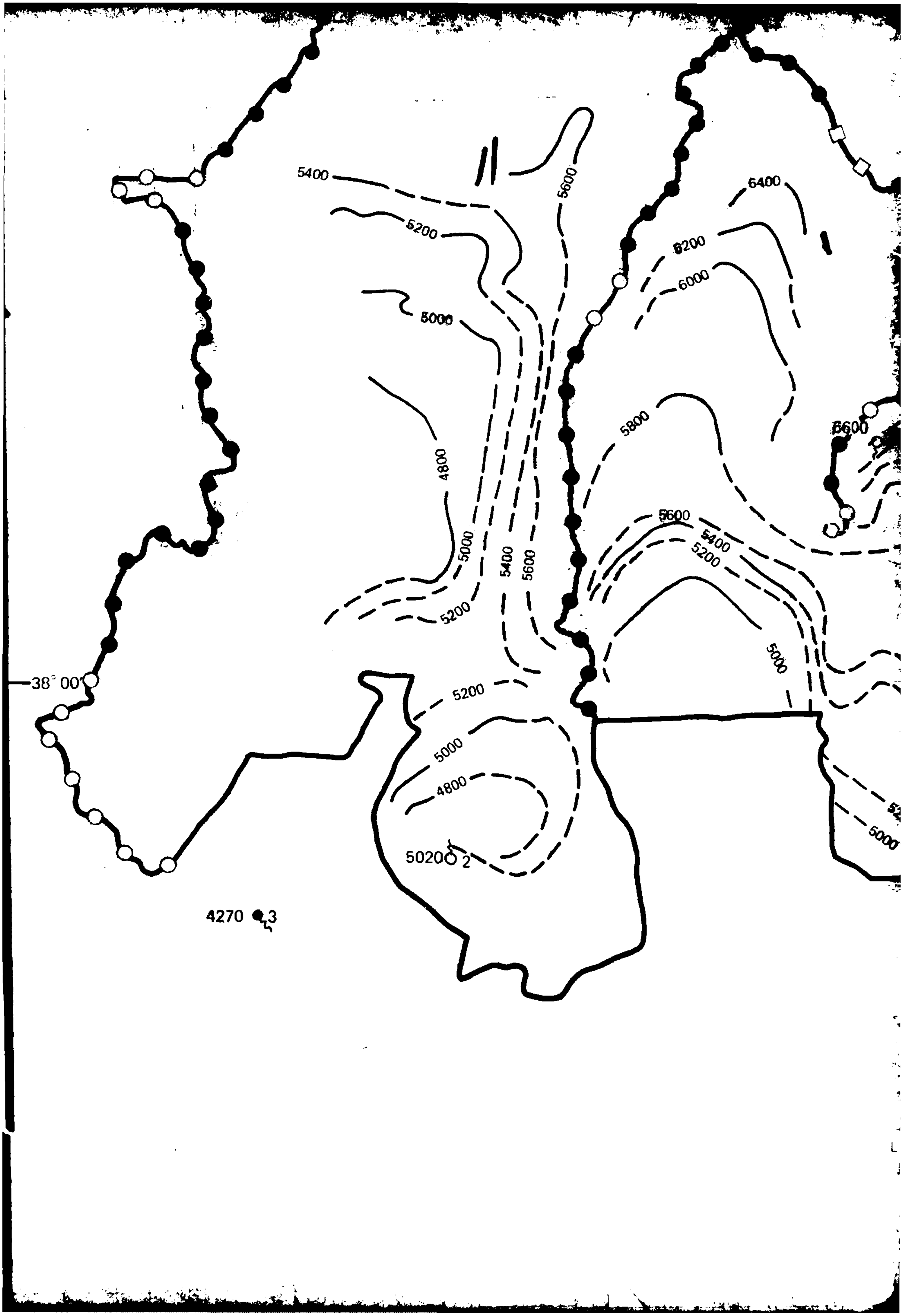
6800
5600


6
6200
6025
35
6000
6000
5800
6400
6200
6640
36
5600
6400
6600
6800
6933
5630-5660
46-48
5800
5800
5600
5400
13
6400
6200
5980
15
5419
43
6300
42
5800

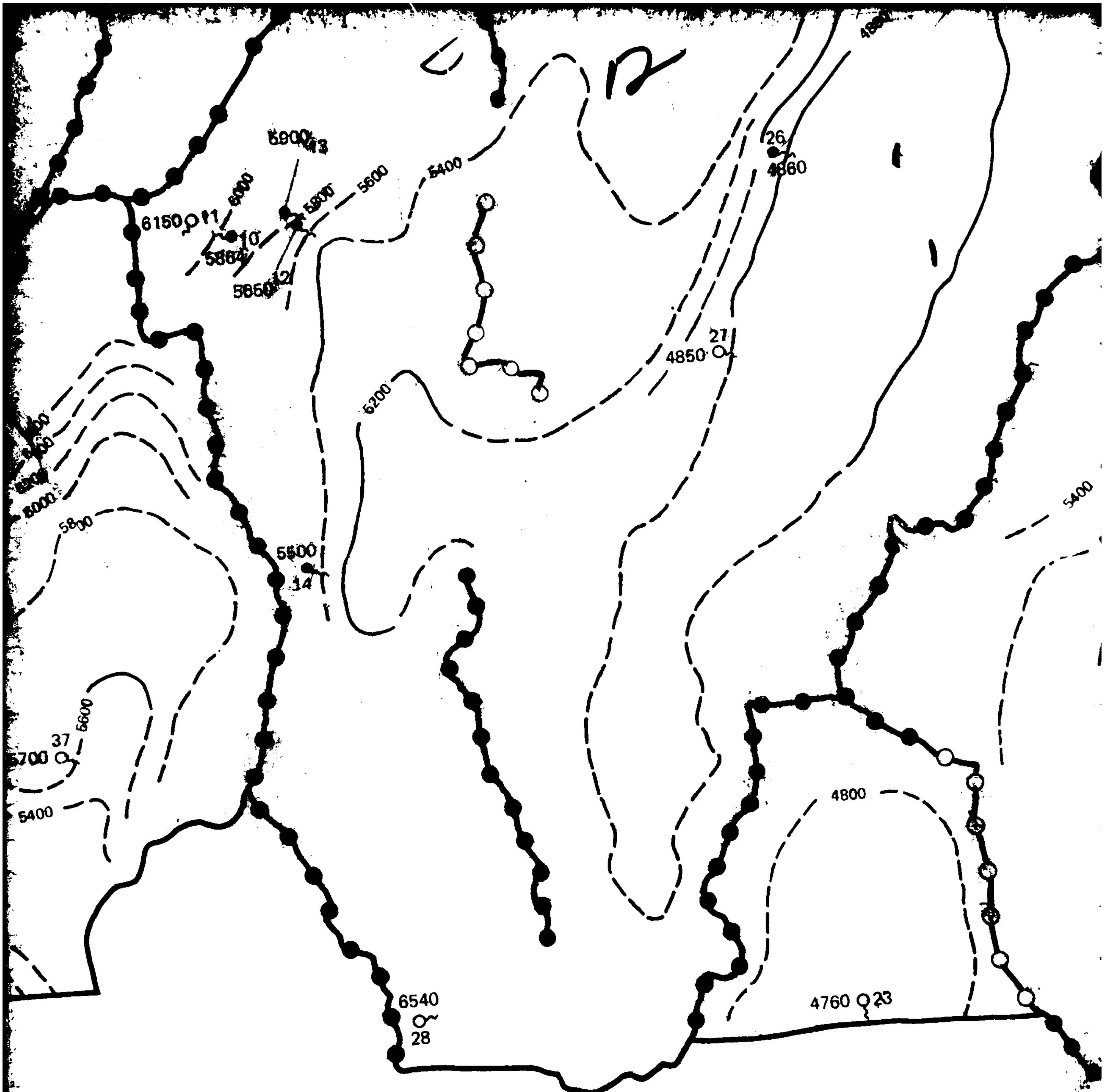


9
4290
5
4300
6
4300
7
5300
8
4400
4600
5000
4800
4400
4800
4400
4400
5350
34
4426
39
4850
33
4424
40
4400
5000
5200
5400

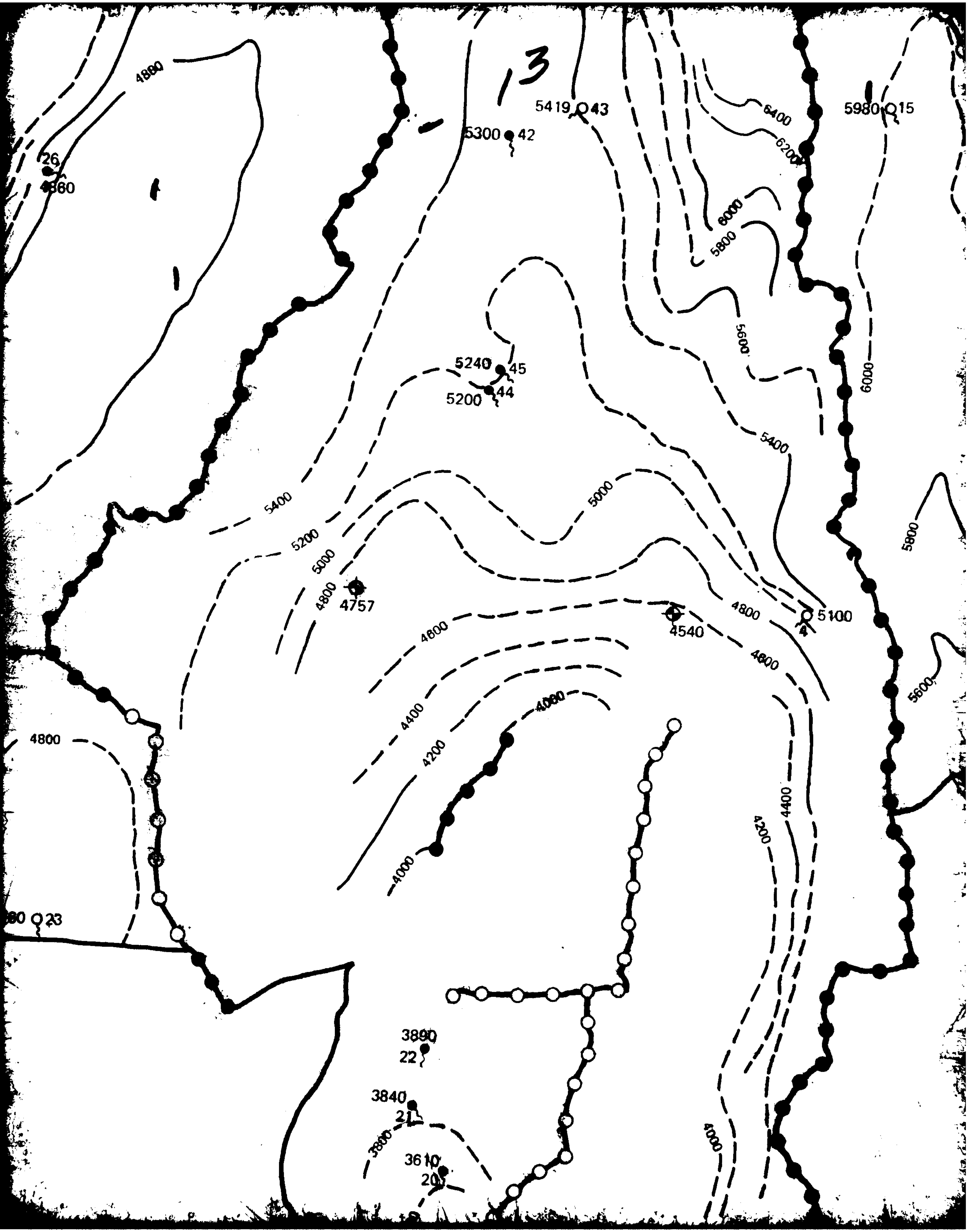

4400
4400
4400
4600
4800
10
15
39° 00'

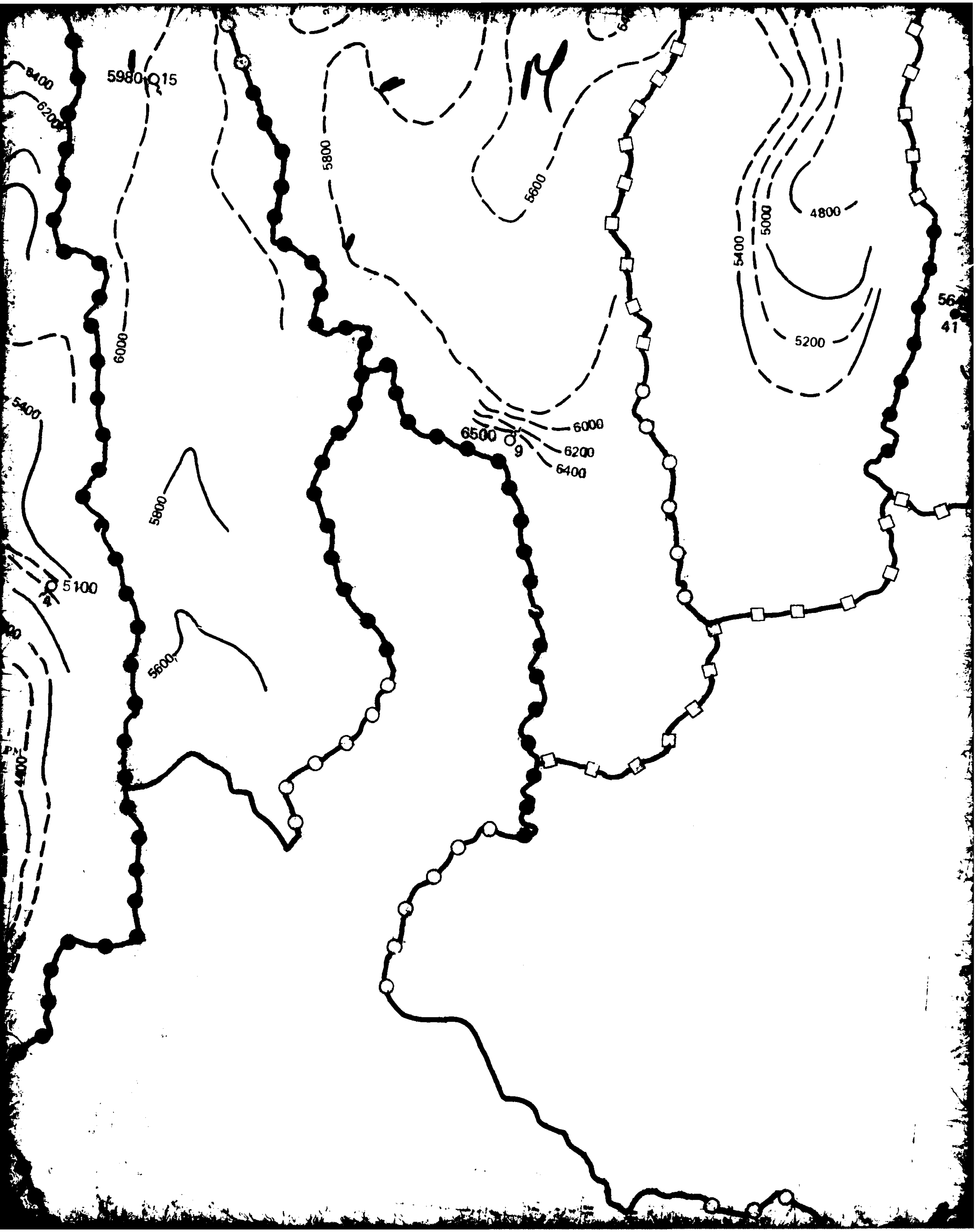


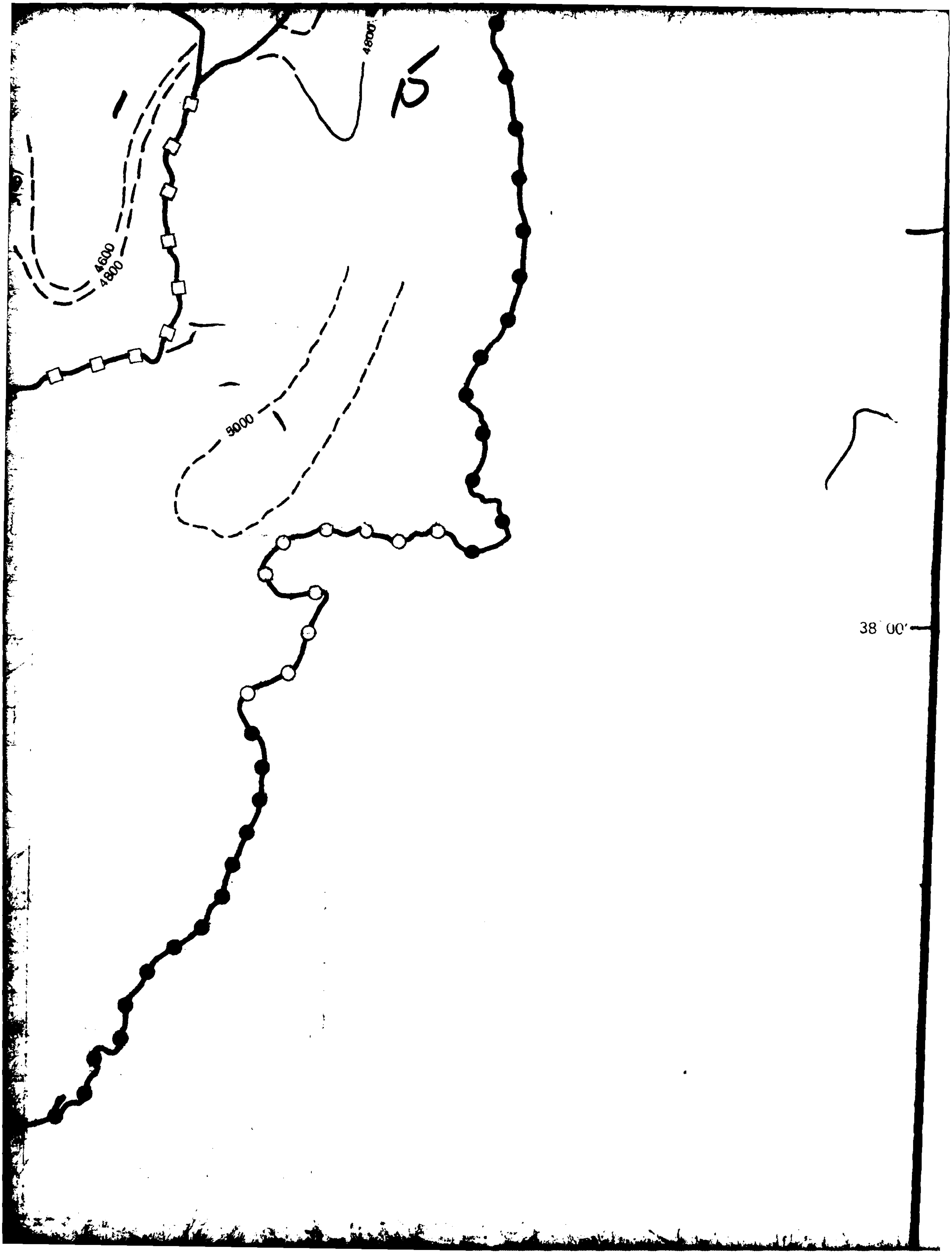
5400
5200
5000
4800
5600
6400
6200
6000
5800
5600
5400
5200
5000
5600
5400
5000
5200
38° 00'
5200
5000
4800
5020
2
4270
3
5000



5900
13
6000
5800
5600
5400
6150
11
10
5864
5850
12
26
4860
21
4850
5200
5500
14
5800
6000
5600
5700
37
5400
4800
6540
28
4760
23
5400


13
4880
26
4860
5419 43
5300 42
6400
6200
5980 15
6000
5800
5600
5400
5240 45
5200 44
5400
5200
5000
5000
4800
4757
4540
4800
5100
4
4600
4800
6000
5800
5600
4400
4200
4000
4060
4400
4200
4800
80 23
3890
22
3840
21
3800
3610
20
4000


5980 15
6200
6000
5800
5600
5400
5100
4
6500
9
6000
6200
6400
5800
5600
4800
5000
5400
5200
41


4800
4600
4800
5000
38°00′

117° 00′

REGIONAL SPRINGS

REFERENCE NUMBER	SPRING	VALLEY	DISCHARGE (gpm)	TEMPERATURE (°C)
1	HOT SPRING	ANTELOPE	100	70
2	ALKALI SPRING	BIG SMOKY	40	60
3	WATERWORKS SPRING	CLAYTON	240	18
4	3N/65E-31cc	DRY LAKE	3 (E)	24
5	WILSON HOT SPRING	FISH SPRINGS FLAT	<1	56
6	NORTH SPRING	FISH SPRINGS FLAT	3140	24
7	(C-11-14) 23ddc	FISH SPRINGS FLAT	4500	27
8	WILDHORSE SPRING	FISH SPRINGS FLAT	<1	22
9	HERMITAGE SPRING	HAMLIN	100	16
10	OLD DUGAN PLACE HOT SPRING	HOT CREEK	500	36
11	UPPER WARM SPRING	HOT CREEK	30	35
12	HOT CREEK RANCH SPRING	HOT CREEK	760	63
13	UPPER HOT CREEK RANCH SPRING	HOT CREEK	280	67
14	WARM SPRING	HOT CREEK	670	60
15	GEYSER SPRING	LAKE	200	20
16	FISH CREEK SPRINGS	LITTLE SMOKY	2400	17
17	23N/58E-36c	LONG	300 (E)	4
18	MUDDY SPRINGS AREA	MOAPA	22,000 (E)	32
19	WARM SPRINGS	NEWARK	1800 (E)	9
20	ASH SPRING	PAHRANAGAT	8700	32
21	CRYSTAL SPRING	PAHRANAGAT	3500 (E)	24
22	HIKO SPRING	PAHRANAGAT	4300 (E)	23
23	SAND SPRING	PENOYER	0.2	30
24	BIG WARM SPRING	RAILROAD	5800	33
25	LITTLE WARM SPRING	RAILROAD	200	16
26	LOCKE'S BIG SPRING	RAILROAD	480	36
27	ABEL SPRING	RAILROAD	25	46
28	CEDAR SPRING	RAILROAD	2.5	25
29	(C-9-7) 35b	SEVIER DESERT	100 (E)	19
30	(C-10-7) 5c	SEVIER DESERT	–	19
31	(C-10-8) 2dba	SEVIER DESERT	100 (E)	10
32	INDIAN SPRING	SEVIER DESERT	2000 (E)	16
33	TWIN SPRING	SNAKE	1800 (E)	20
34	WARM SPRING	SNAKE	3600	27
35	MONTE NEVA HOT SPRING	STEPTOE	630	79
36	McGILL SPRING	STEPTOE	4600	17
37	2N/47E-14ac	STONE CABIN	1 (E)	21
38	WARM SPRING	STONE CABIN	4	27
39	COYOTE SPRING	TULE	10-100 (E)	28
40	TULE SPRING	TULE	–	27
41	(C-27-15) 11aba	WAH WAH	450 (E)	20
42	MORMON HOT SPRING	WHITE RIVER	1900	36
43	EMIGRANT SPRING	WHITE RIVER	1350	20
44	MOON RIVER SPRING	WHITE RIVER	700	33
45	HOT CREEK SPRING	WHITE RIVER	6885	2[illegible]
46	COLD SPRING	WHITE RIVER	780	21
47	NICHOLAS SPRING	WHITE RIVER	1125	22
48	ARNOLD SPRING	WHITE RIVER	1380	22

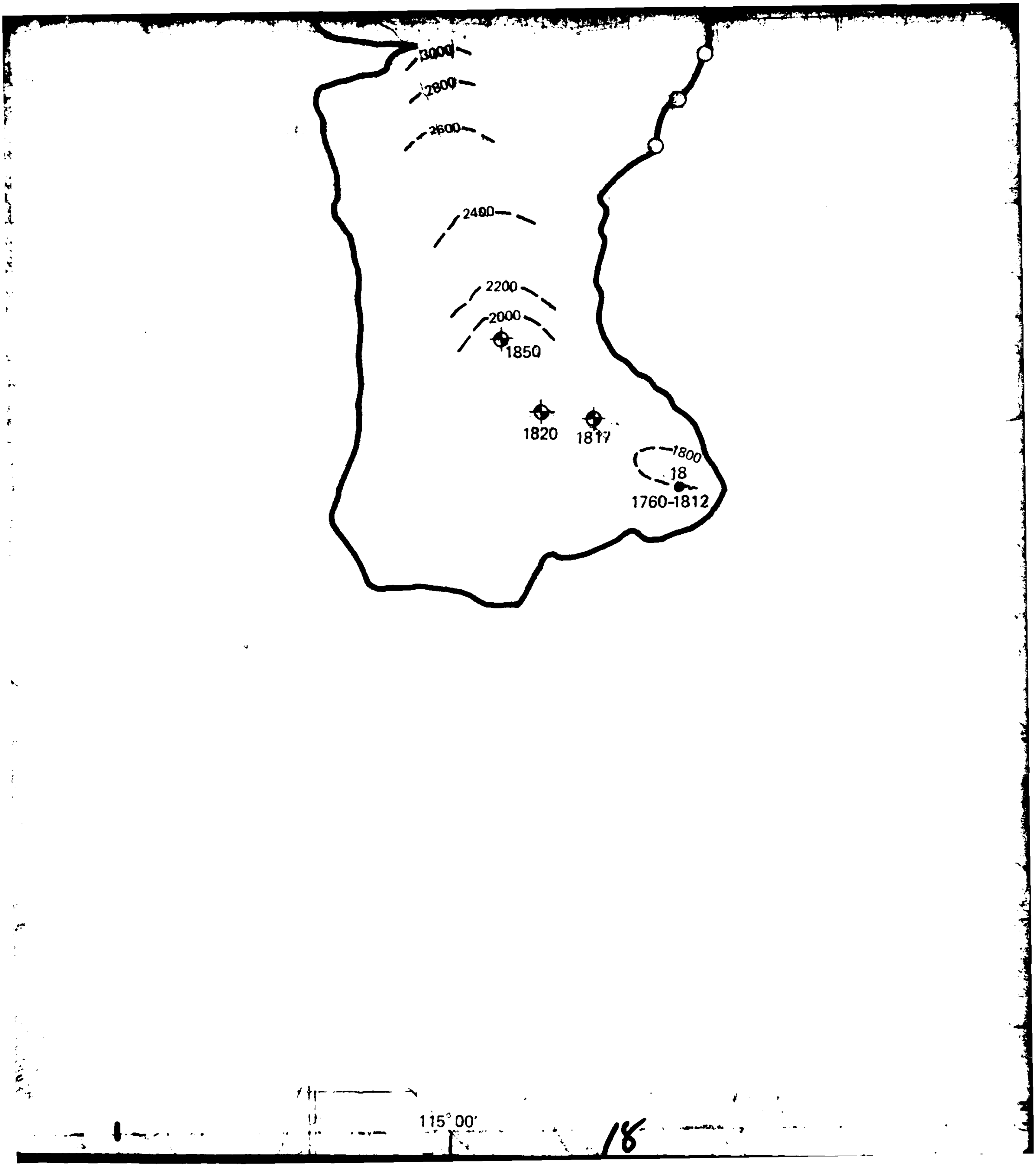
NOTE: Refer to Table 4-1 for source of data.

MPERATURE (°C)	ELEVATION (feet)	STATUS
70	6342	REGIONAL
60	5020	POSSIBLE REGIONAL
18	4270	REGIONAL
24	5100	POSSIBLE REGIONAL
56	4290	POSSIBLE REGIONAL
24	4300	REGIONAL
27	4300	REGIONAL
22	5300	POSSIBLE REGIONAL
16	6500	POSSIBLE REGIONAL
36	5864	REGIONAL
35	6150	POSSIBLE REGIONAL
63	5650	REGIONAL
67	5900	REG[illegible]
60	5500	RE[illegible]AL
20	5980	[illegible] REGIONAL
17	6030	[illegible] REGIONAL
4	6700	PO[illegible]E REGIONAL
32	1760	[illegible]ONAL
9	5890	POSSIBLE REGIONAL
32	3610	REGIONAL
24	3840	REGIONAL
23	3890	REGIONAL
30	4760	POSSIBLE REGIONAL
33	5600	REGIONAL
16	5600	POSSIBLE REGIONAL
36	4860	REGIONAL
46	4850	POSSIBLE REGIONAL
25	6540	POSSIBLE REGIONAL
19	6400	REGIONAL
19	6160	POSSIBLE REGIONAL
10	6900	POSSIBLE REGIONAL
16	6280	POSSIBLE REGIONAL
20	7120	REGIONAL
27	5350	REGIONAL
79	6710	POSSIBLE REGIONAL
17	4850	POSSIBLE REGIONAL
21	5700	POSSIBLE REGIONAL
27	6600	POSSIBLE REGIONAL
28	6025	POSSIBLE REGIONAL
27	4422	POSSIBLE REGIONAL
20	5240	REGIONAL
36	5300	REGIONAL
20	5419	POSSIBLE REGIONAL
33	5200	REGIONAL
27	5240	REGIONAL
21	5660	POSSIBLE REGIONAL
22	5630	POSSIBLE REGIONAL
22	5630	POSSIBLE REGIONAL

37° 00′

17

116° 00′



3000
2800
2600
2400
2200
2000
1850
1820
1817
1800
18
1760-1812
115° 00'

114° 00'

37° 00'

EXPLANATION

GROUND-WATER BARRIER	
INFERRED GROUND-WATER BARRIER	
GROUND-WATER DIVIDE	
INFERRED GROUND-WATER DIVIDE	
HYDROGRAPHIC BASIN OR STUDY AREA BOUNDARY	
POTENTIOMETRIC ELEVATION CONTOURS	5600
INFERRED POTENTIOMETRIC ELEVATION CONTOURS	5000
REGIONAL SPRING ELEVATION (FEET ABOVE MSL) AND REFERENCE NUMBER (REFER TO TABLE IN LOWER LEFT CORNER OF MAP)	5420 17
POSSIBLE REGIONAL SPRING ELEVATION (FEET ABOVE MSL) AND REFERENCE NUMBER (REFER TO TABLE IN LOWER LEFT CORNER OF MAP)	6500 13
CARBONATE WELL POTENTIOMETRIC ELEVATION (FEET ABOVE MSL) (FOR DATA ON THESE WELLS REFER TO TABLE 4-9 OF THIS REPORT AND REPORT NO. E-TR-57 REGIONAL CARBONATE EVALUATION COYOTE SPRING VALLEY, NEVADA [IN PROGRESS]).	4757

NOTE

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30 NO

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5600

5000

FEET
UMBER
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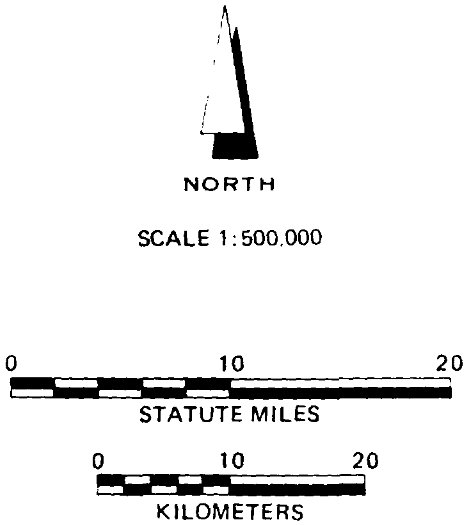
5420
17

EVATION
NCE NUM-
LEFT

6500
13

TRIC
FOR
D TABLE
T NO.
EVALUA-
EVADA

4757



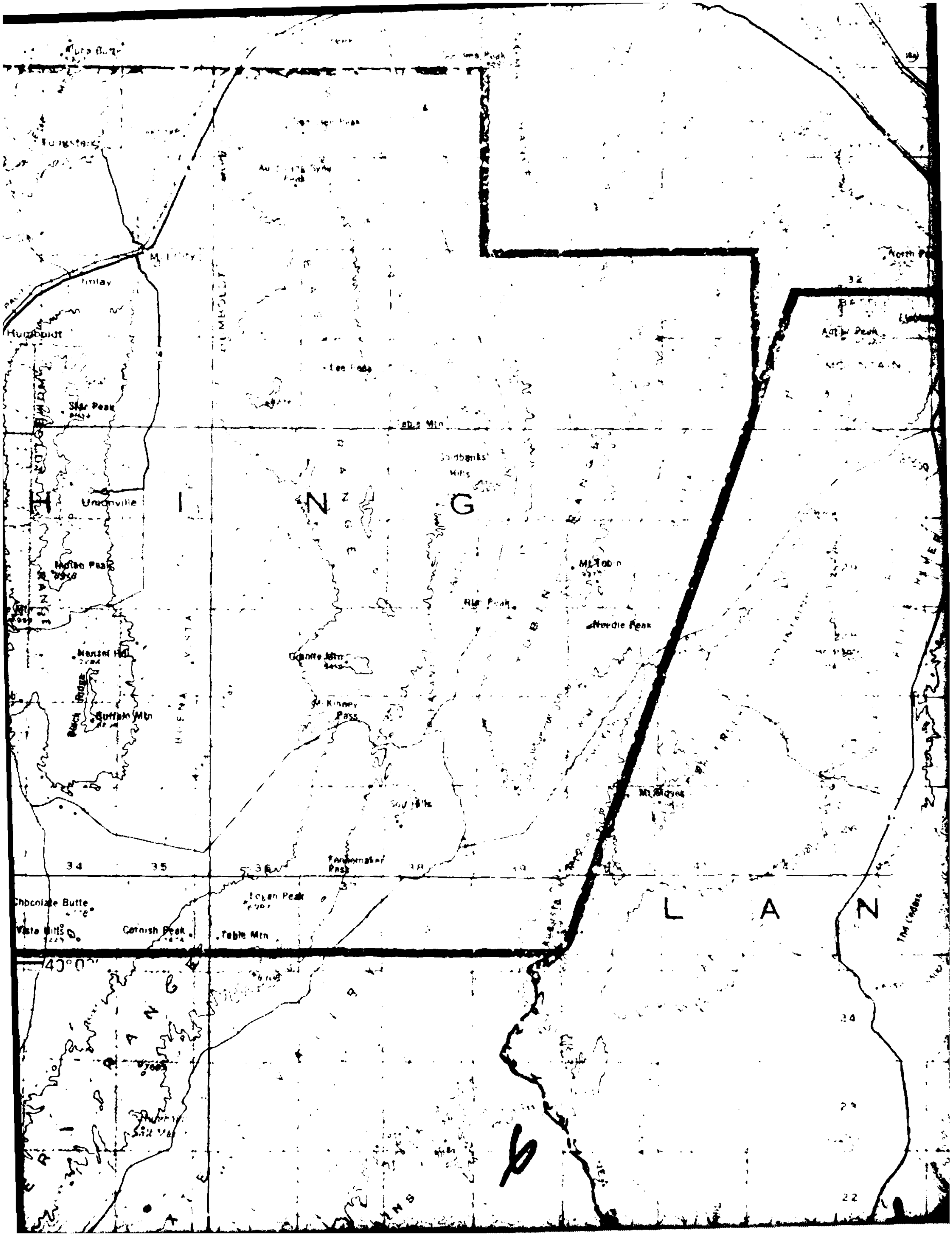
NOTE:

Potentiometric elevations and flow system boundaries shown are inferred from hydrologic and geologic data.

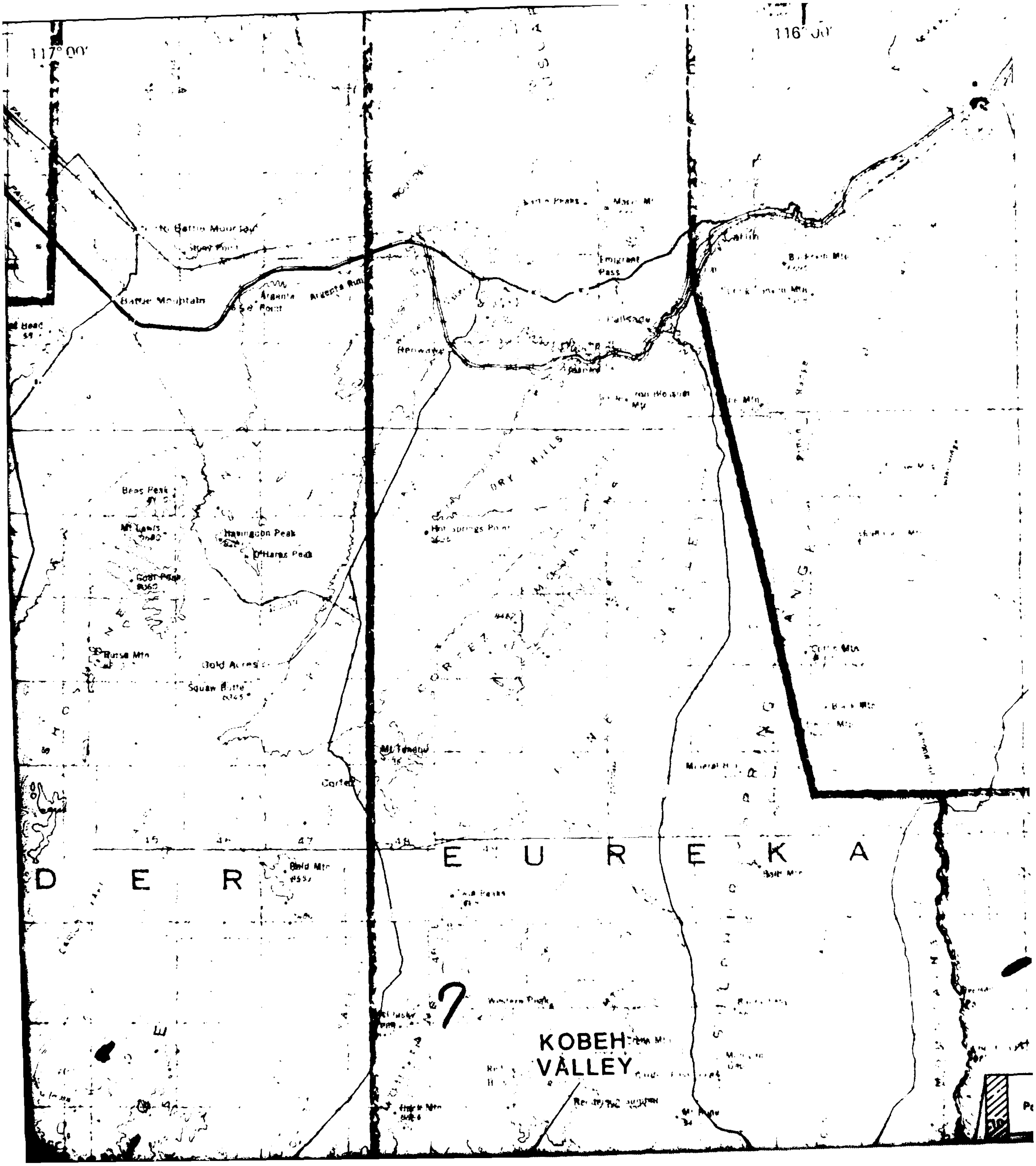
Ertec The Earth Technology Corporation	MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE BMO/AFRCE-MX

REGIONAL POTENTIOMETRIC MAP

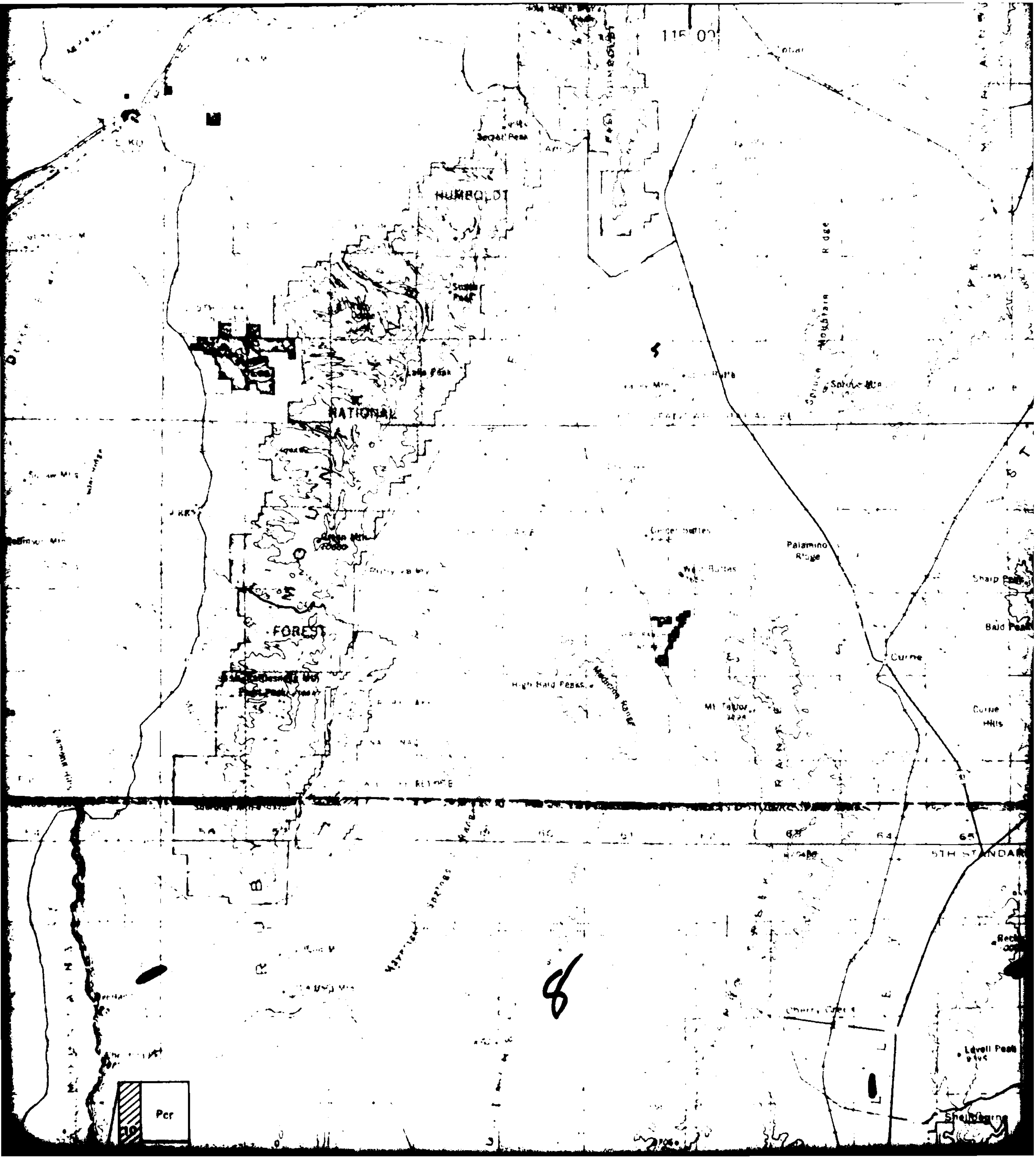
30 NOV 81 DRAWING 4-1



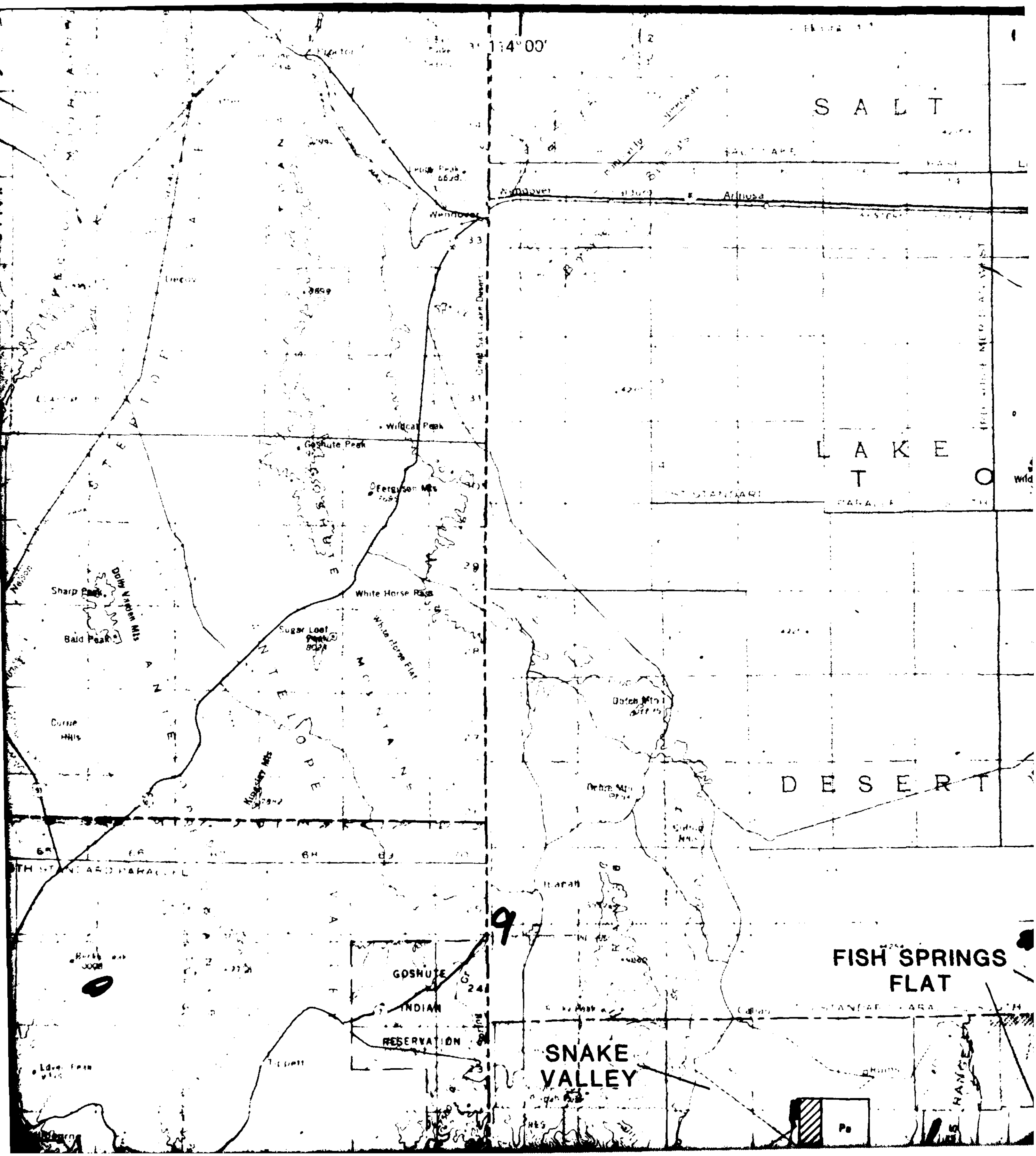
Tungsten
Mill City
Imlay
Humboldt
Star Peak
Unionville
Indian Peak
Nenzel Hill
Black Ridge
Buffalo Mtn
Table Mtn
Mt Tobin
Needle Peak
Granite Mtn
McKinney Pass
Mt Moses
Chocolate Butte
Vista Hills
Cornish Peak
Logan Peak
Table Mtn
H I N G
L A N
6



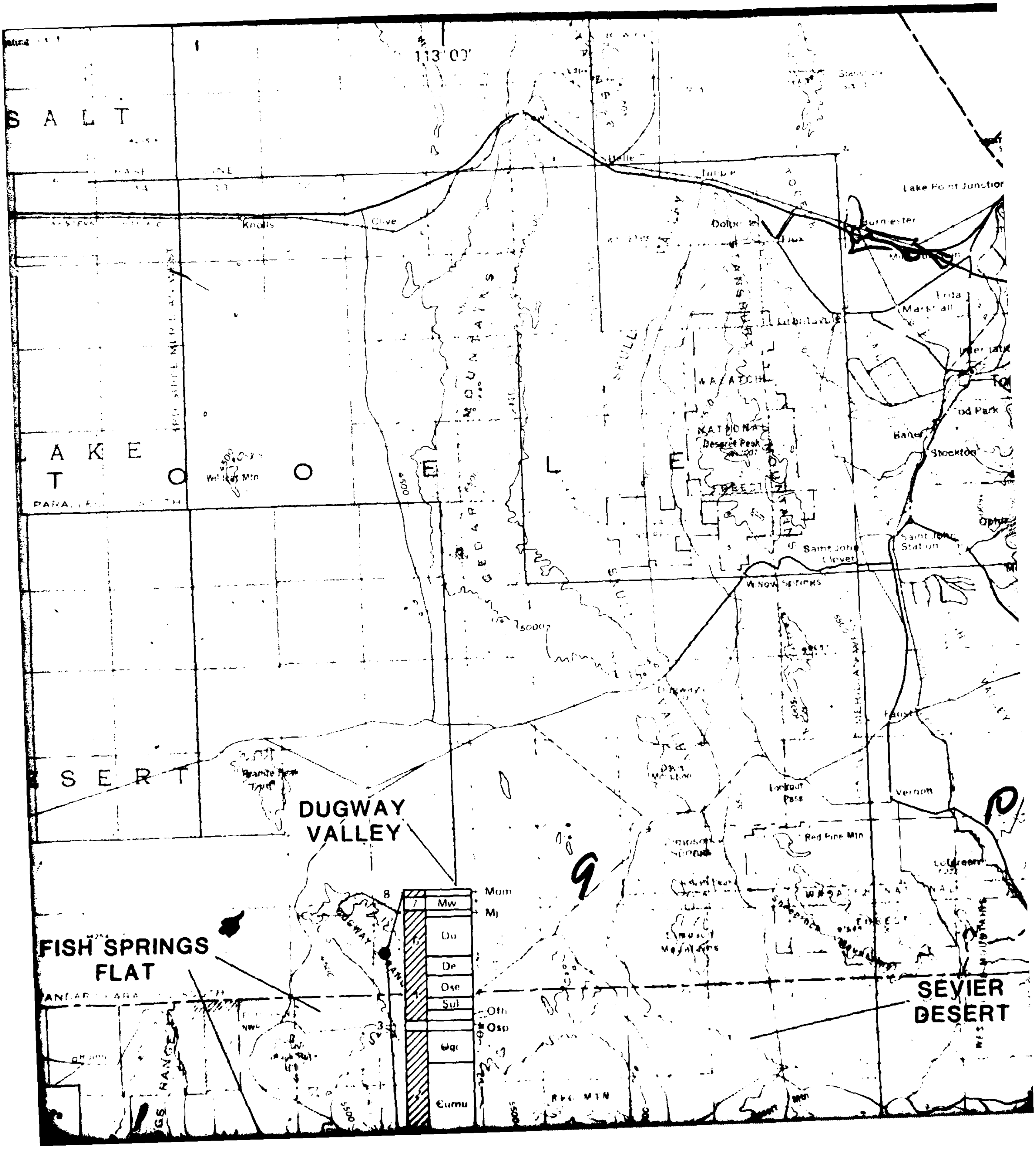
117° 00'
116° 00'
Battle Mountain
Argenta
Emigrant Pass
Palisade
Beowawe
DRY HILLS
Hot Springs Point
O'Haras Peak
Goat Peak
Gold Acres
Squaw Butte
Mt Tenabo
Cortez
Bald Mtn
D E R
E U R E K A
KOBEH
VALLEY



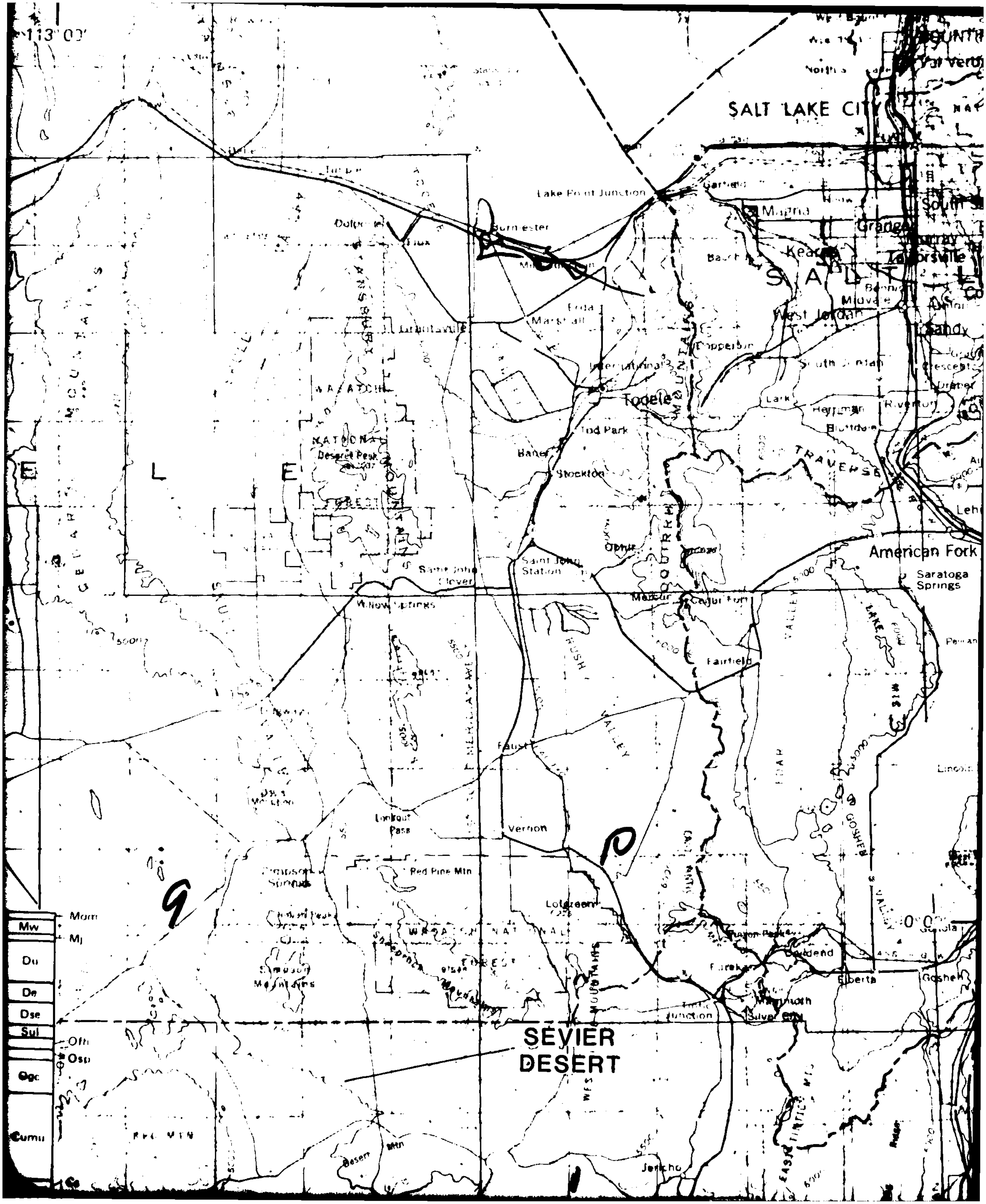
HUMBOLDT
NATIONAL
FOREST
Secret Peak
Lake Peak
Palamino
Ridge
West Buttes
Sharp Peak
Bald Peak
Currie
Currie
Hills
High Bald Peaks
Mt Tabor
Cherry Creek
Lovell Peak
Shellbourne
5TH STANDARD
64
65
Per



114°00'
SALT
LAKE
DESERT
Wendover
Arinosa
Wildcat Peak
Goshute Peak
Ferguson Mts
GOSHUTE
White Horse Pass
White Horse Flat
Sugar Loaf Peak
Sharp Peak
Bald Peak
Dolly Varden Mts
Currie Hills
Kinsley Mts
ANTELOPE
Dutch Mtn
Gold Hill
Ibapah
GOSHUTE INDIAN RESERVATION
Tippett
FISH SPRINGS FLAT
SNAKE VALLEY
9

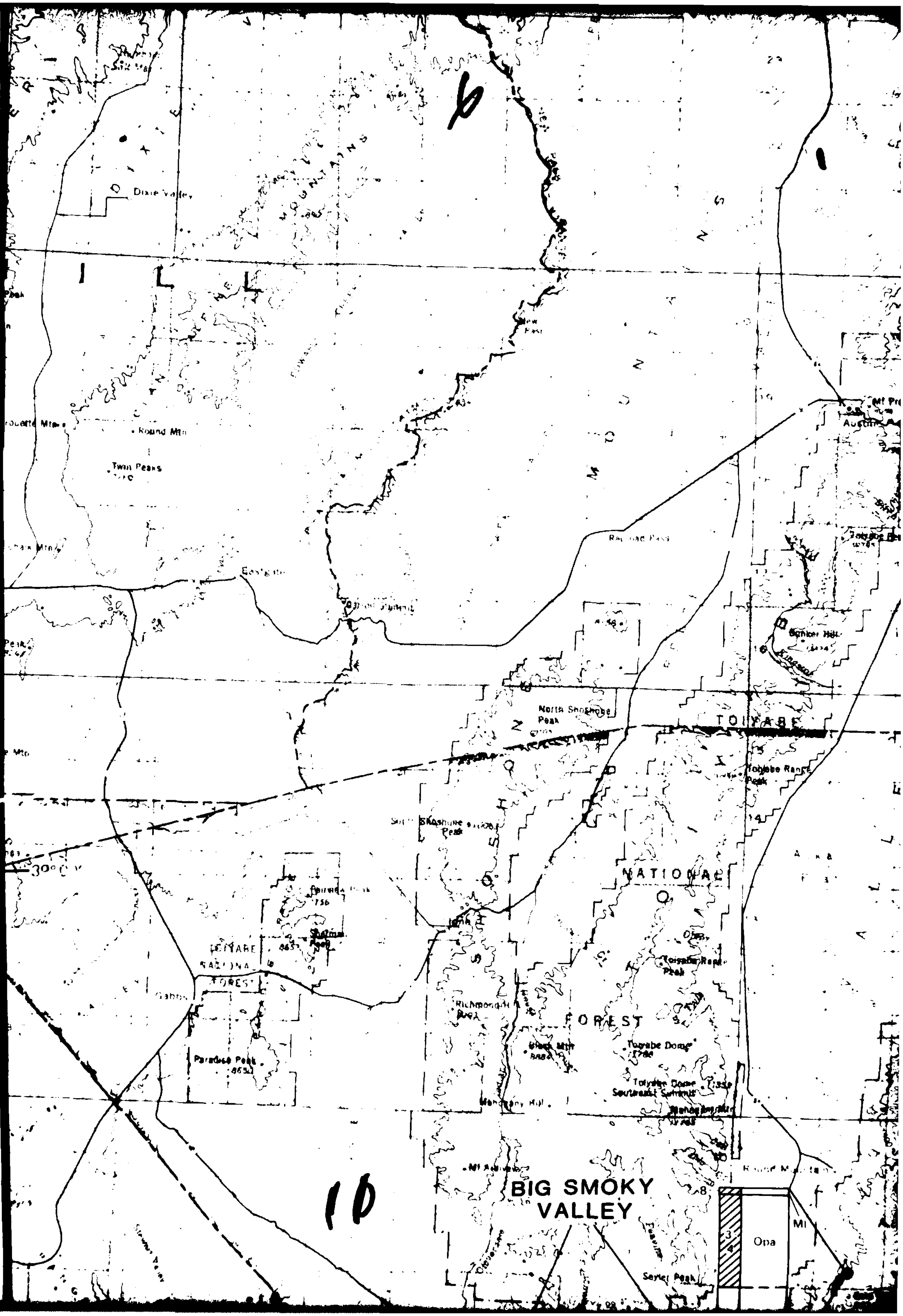


S A L T
L A K E
D E S E R T
T O O E L E
113°00'
Lake Point Junction
Knolls
Olive
Burmester
Erda
Marshall
Stockton
Deseret Peak
WASATCH
NATIONAL
FOREST
CEDAR MOUNTAINS
Saint John
Clover
Willow Springs
Dugway
Faust
Lookout Pass
Vernon
Red Pine Mtn
DUGWAY VALLEY
FISH SPRINGS FLAT
SEVIER DESERT
8
Mw
Mom
Mj
Du
De
Ose
Sul
Oth
3
Osp
Cumu
9

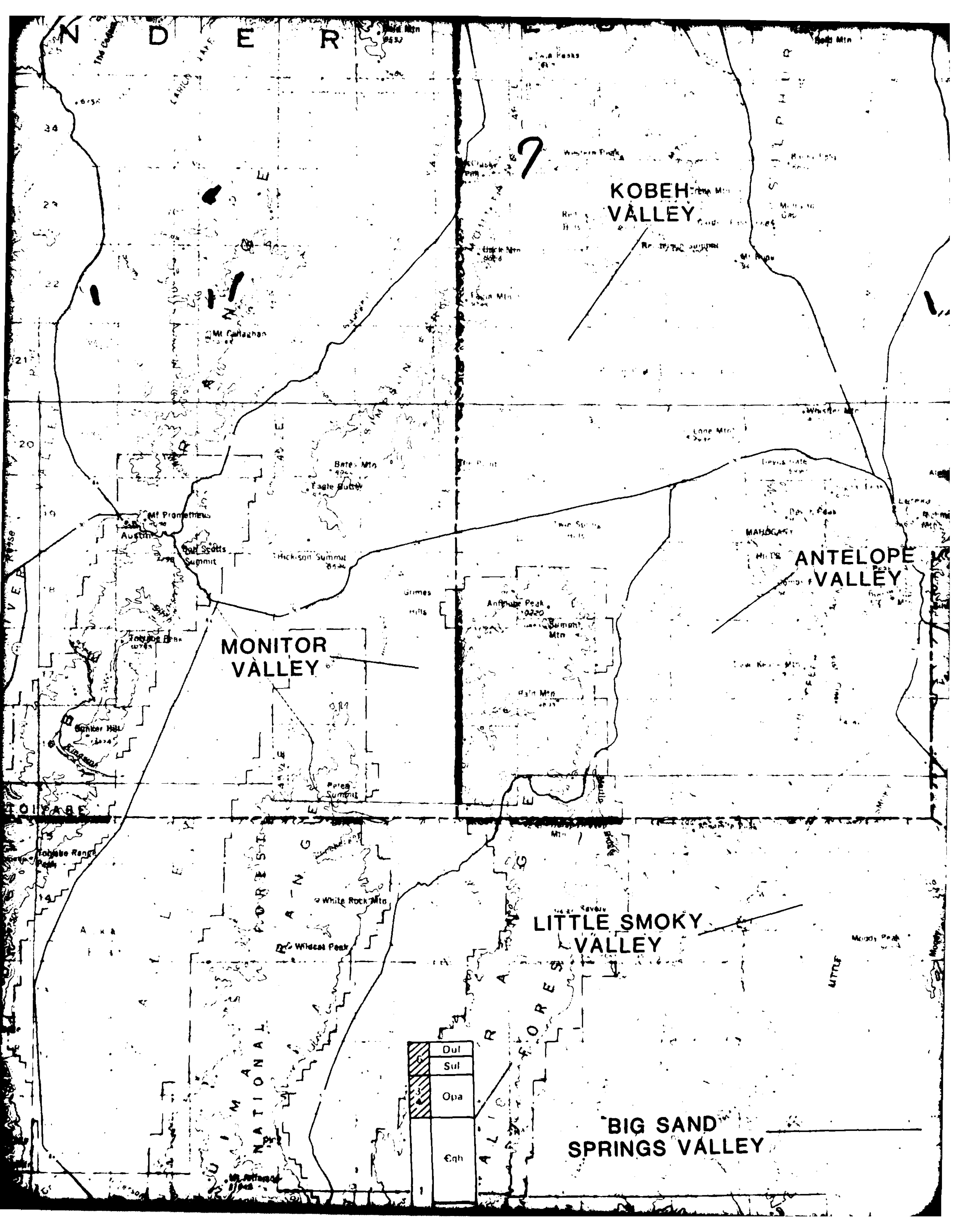


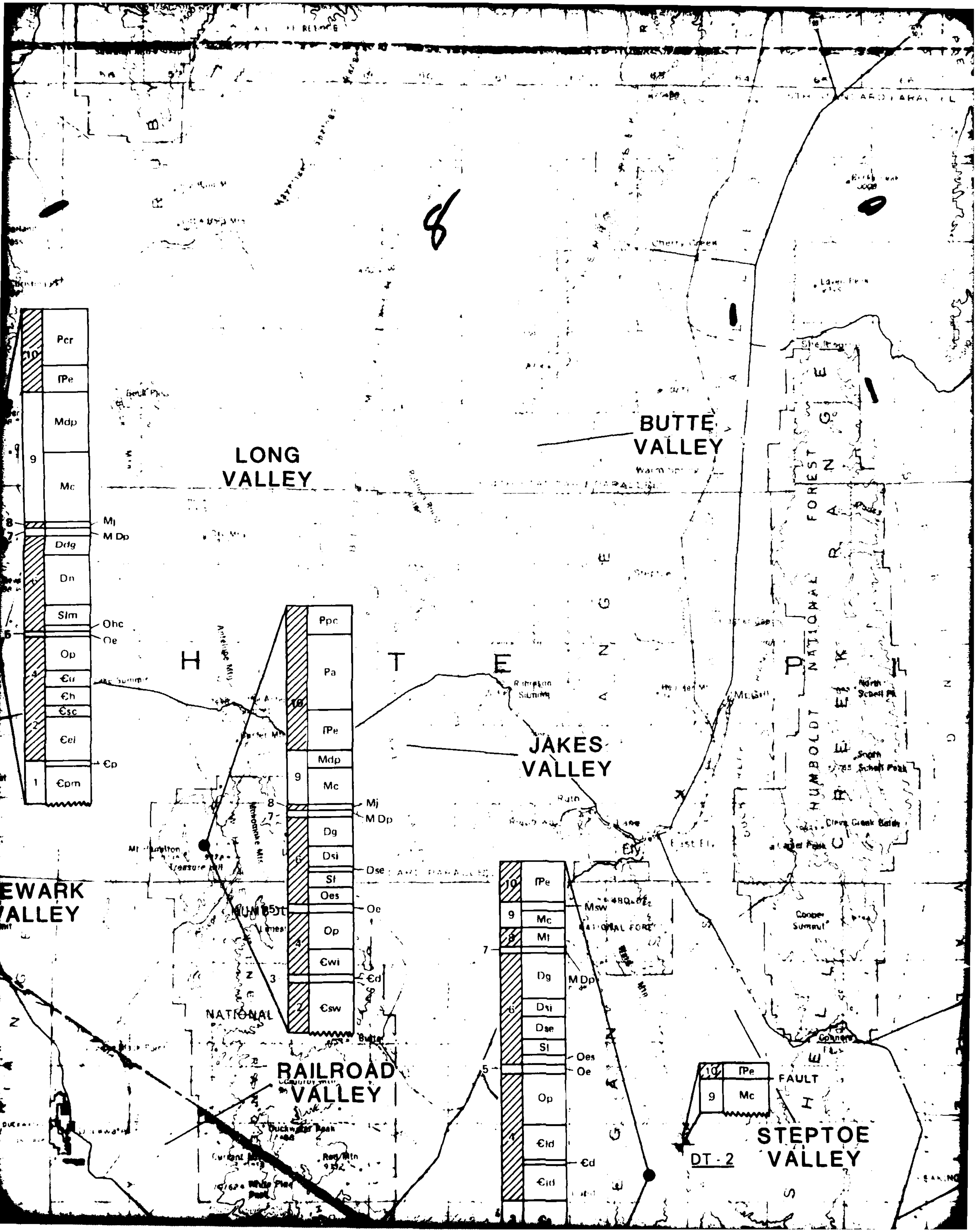
113° 00'
SALT LAKE CITY
Lake Point Junction
Garfield
Magna
Burmester
Dolomite
Flux
Grantsville
Erda
Marshall
Tooele
Kearns
West Jordan
Midvale
Sandy
South Jordan
Lark
Herriman
Riverton
Bluffdale
Tod Park
Bauer
Stockton
Ophir
Saint John Station
Willow Springs
Mercur
Cedar Fort
Fairfield
American Fork
Saratoga Springs
Faust
Vernon
Lookout Pass
Red Pine Mtn
Lofgreen
Eureka
Mammoth
Silver City
Tintic Junction
Elberta
Goshen
Jericho
SEVIER DESERT
Mw
Du
Dse
Sul
Osp
Ogc

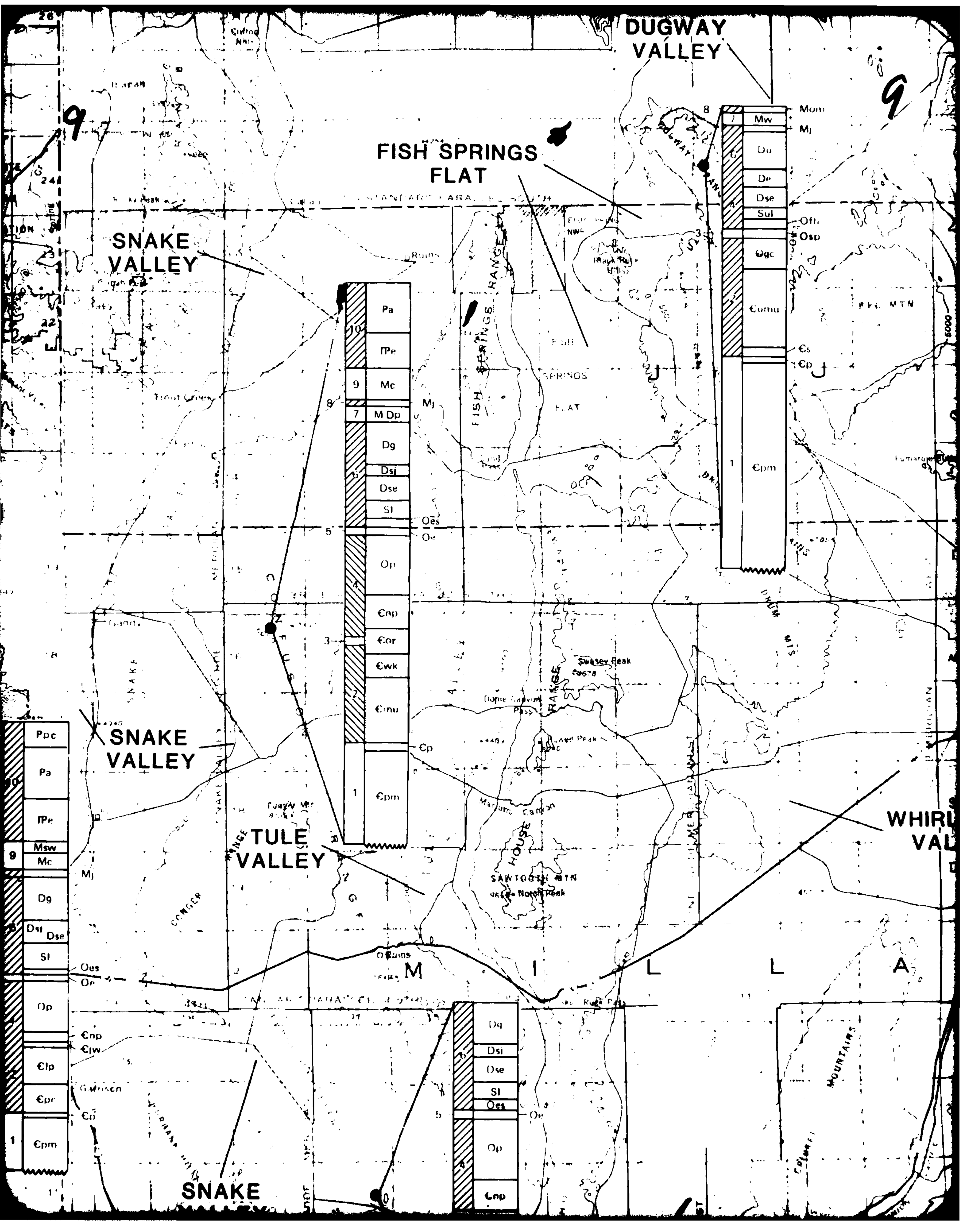
4

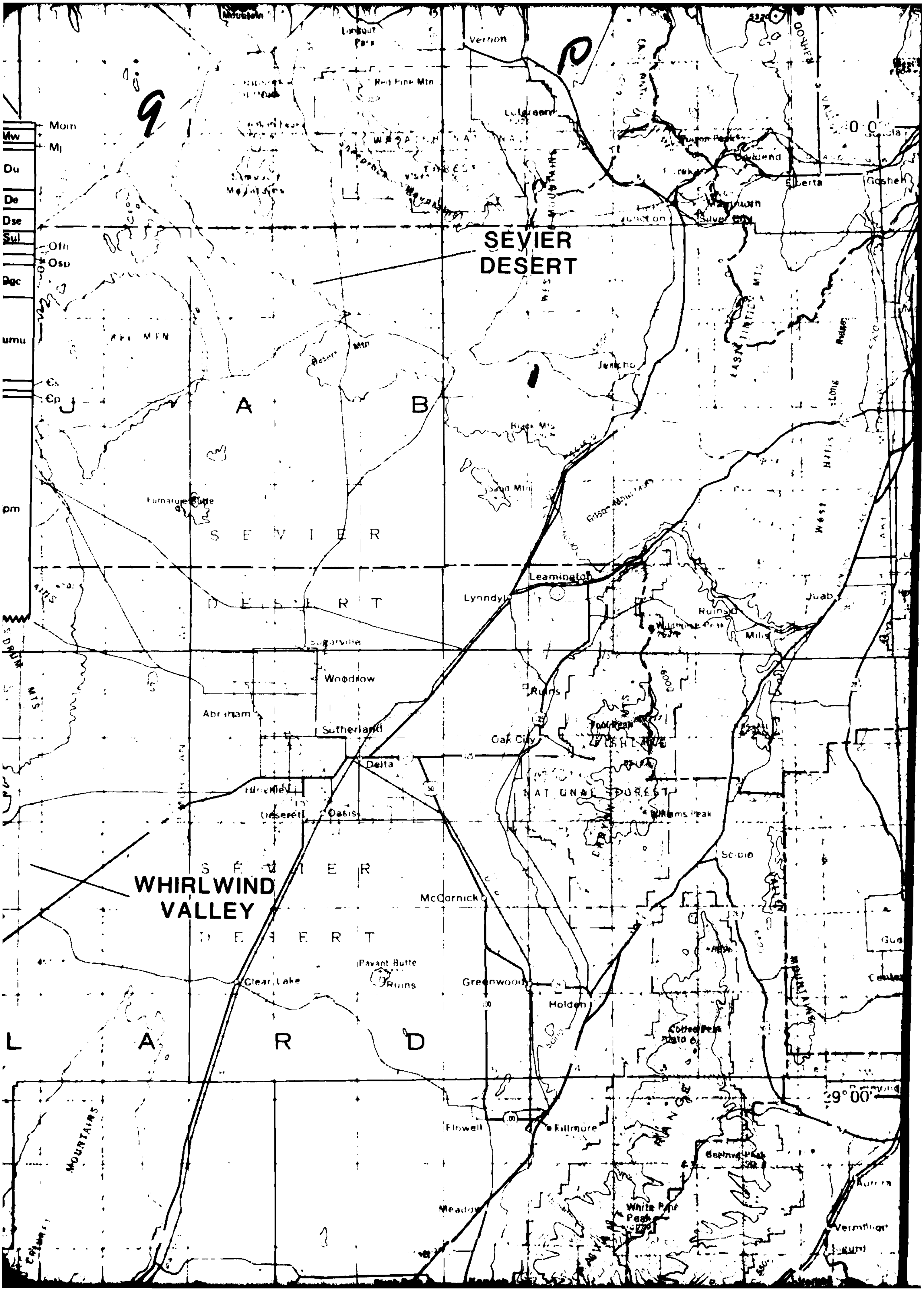


6
Dixie Valley
Round Mtn
Twin Peaks
Eastgate
Railroad Pass
North Shoshone Peak
TOIYABE
Toiyabe Range Peak
South Shoshone Peak
NATIONAL
FOREST
Paradise Peak
Richmond Peak
Black Mtn
Toiyabe Dome
Toiyabe Dome Southeast Summit
Mahogany Hill
BIG SMOKY VALLEY
Seyler Peak
Opa
Austin
Bunker Hill
Gabbs
10
1

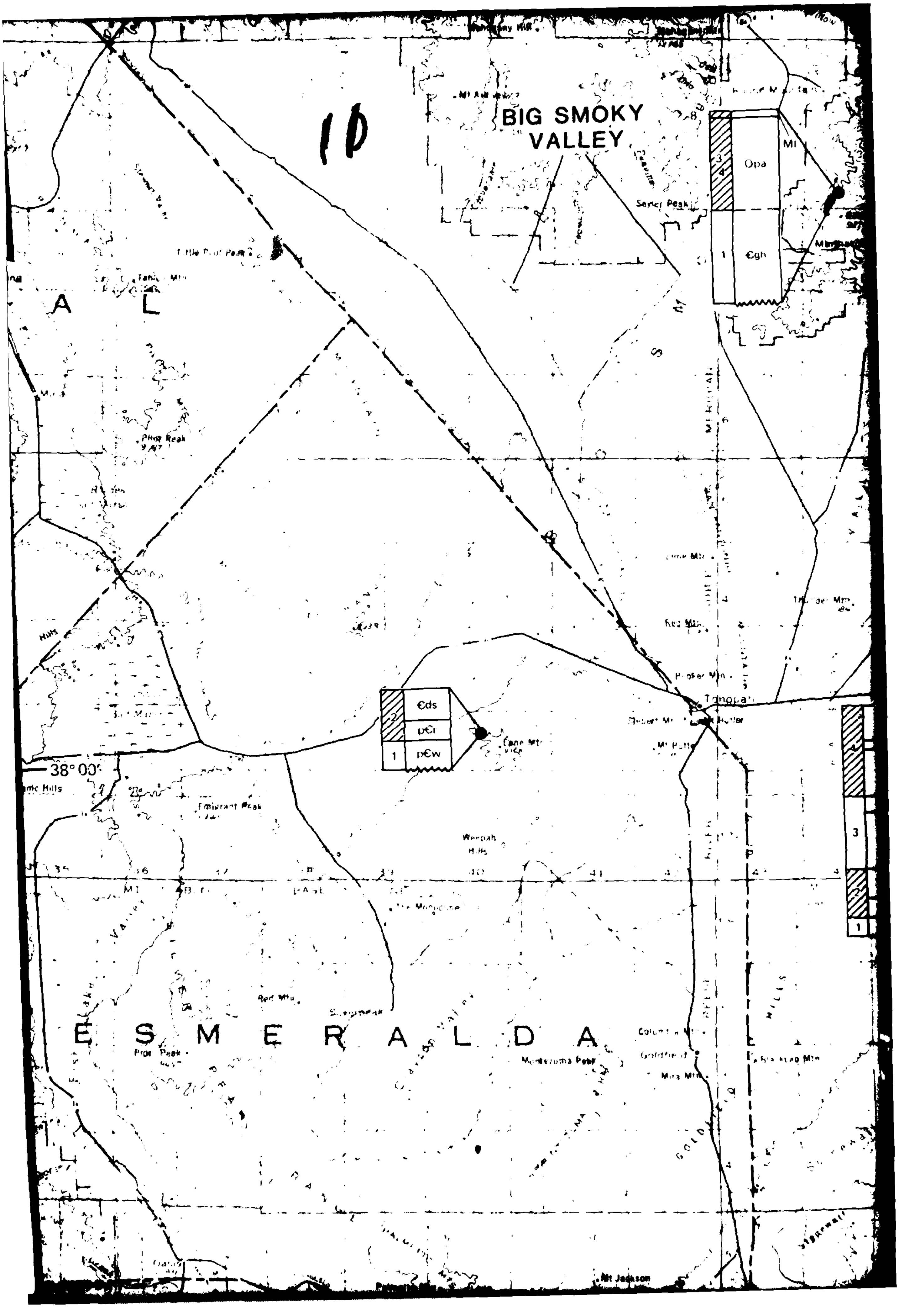

KOBEH VALLEY
MONITOR VALLEY
ANTELOPE VALLEY
LITTLE SMOKY VALLEY
BIG SAND SPRINGS VALLEY
Austin
Mt Prometheus
Bob Scotts Summit
Hickison Summit
Mt Callaghan
Bates Mtn
Eagle Butte
Antelope Peak
Summit Mtn
Bald Mtn
Lone Mtn
Grimes Hills
Toiyabe Peak
Bunker Hill
Pete's Summit
White Rock Mtn
Wildcat Peak
Toiyabe Range Peak
Moody Peak
MAHOGANY HILLS
TOIYABE
NATIONAL FOREST
Dul
Sul
Opa
€qh

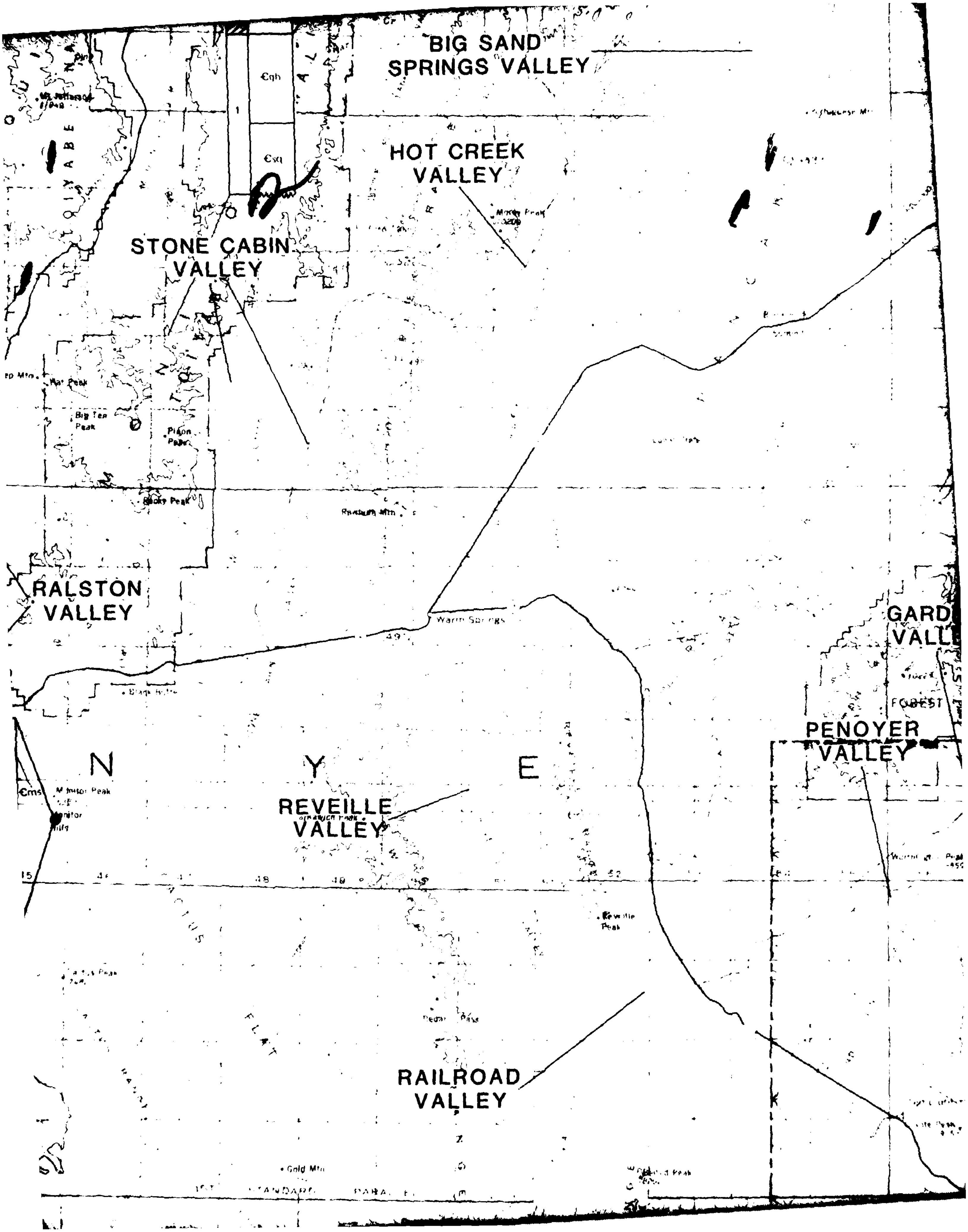

LONG VALLEY
BUTTE VALLEY
JAKES VALLEY
RAILROAD VALLEY
STEPTOE VALLEY
EWARK VALLEY
HUMBOLDT NATIONAL FOREST
DT - 2
FAULT
Pcr
IPe
Mdp
Mc
Mj
M Dp
Ddg
Dn
Slm
Ohc
Oe
Op
Єu
Єh
Єsc
Єel
Єp
Єpm
Ppc
Pa
Dg
Dsi
Dse
Sl
Oes
Єwi
Єd
Єsw
Msw
Ml
Єld
Ely
McGill
Cherry Creek
Mt Hamilton
Treasure Hill
Duckwater Peak
Currant Mtn
White Pine Peak
Cooper Summit
North Schell Pk
Schell Peak
Cleve Creek Baldy
Ward Mtn

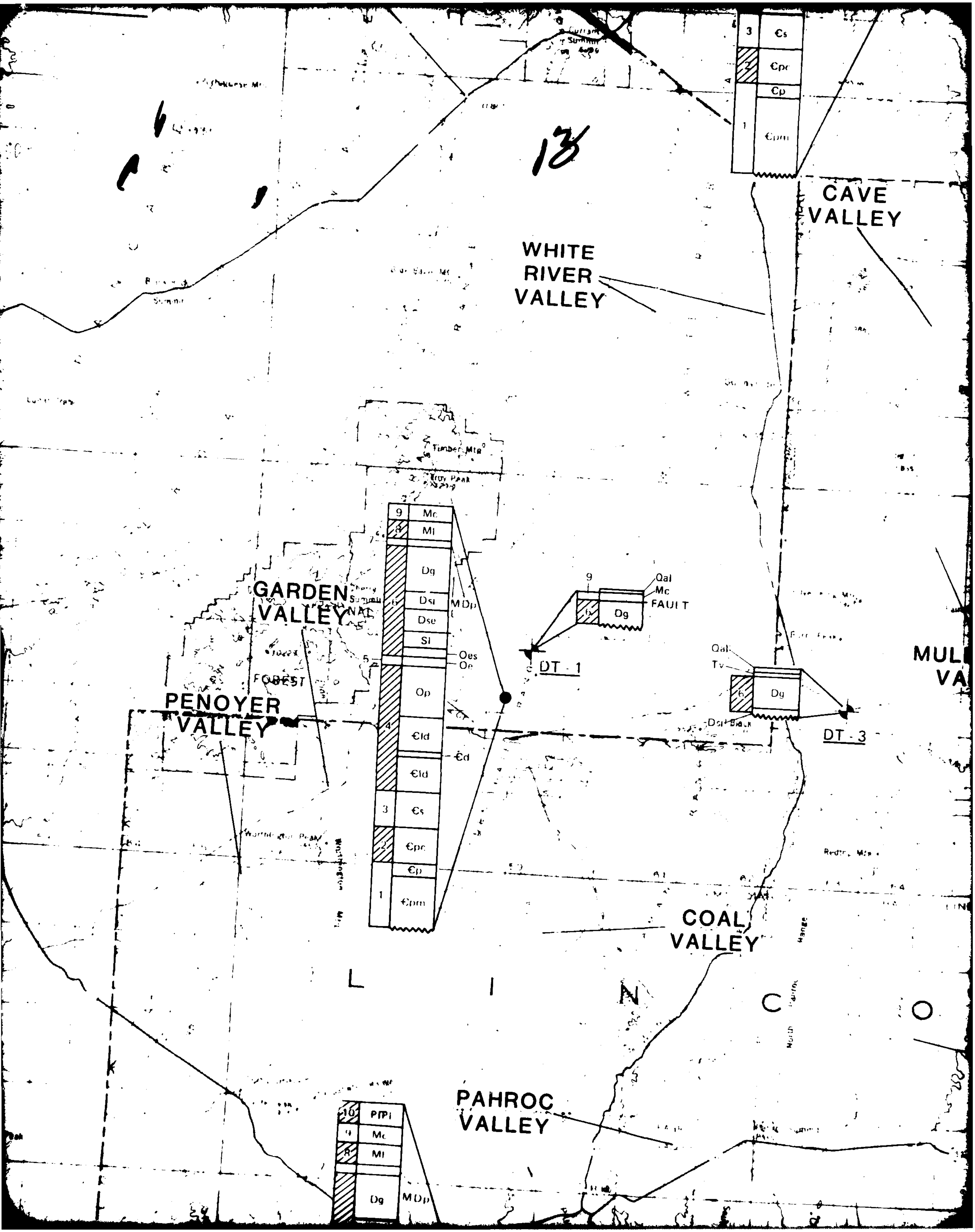

DUGWAY
VALLEY
FISH SPRINGS
FLAT
SNAKE
VALLEY
SNAKE
VALLEY
TULE
VALLEY
WHIRL
VAL
SNAKE
M I L L A
FISH SPRINGS RANGE
FISH
SPRINGS
FLAT
HOUSE RANGE
SAWTOOTH MTN
Notch Peak
Swasey Peak
Dome Canyon Pass
Marjum Canyon
CONFUSION RANGE
CONGER
Trout Creek
Gandy
Garrison
Ruins
Fumarole
MOUNTAINS
Mom
Mw
Mj
Du
De
Dse
Sul
Ofh
Osp
Ogc
Cumu
Cs
Cp
Cpm
Pa
IPe
Mc
M Dp
Dg
Dsj
Dse
Sl
Oes
Oe
Op
Cnp
Cor
Cwk
Cmu
Cp
Cpm
Ppc
Pa
IPe
Msw
Mc
Mj
Dg
Dst
Dse
Sl
Oes
Oe
Op
Cnp
Cjw
Clp
Cpr
Cp
Cpm
Dg
Dsi
Dse
Sl
Oes
Oe
Op
Cnp
9
9



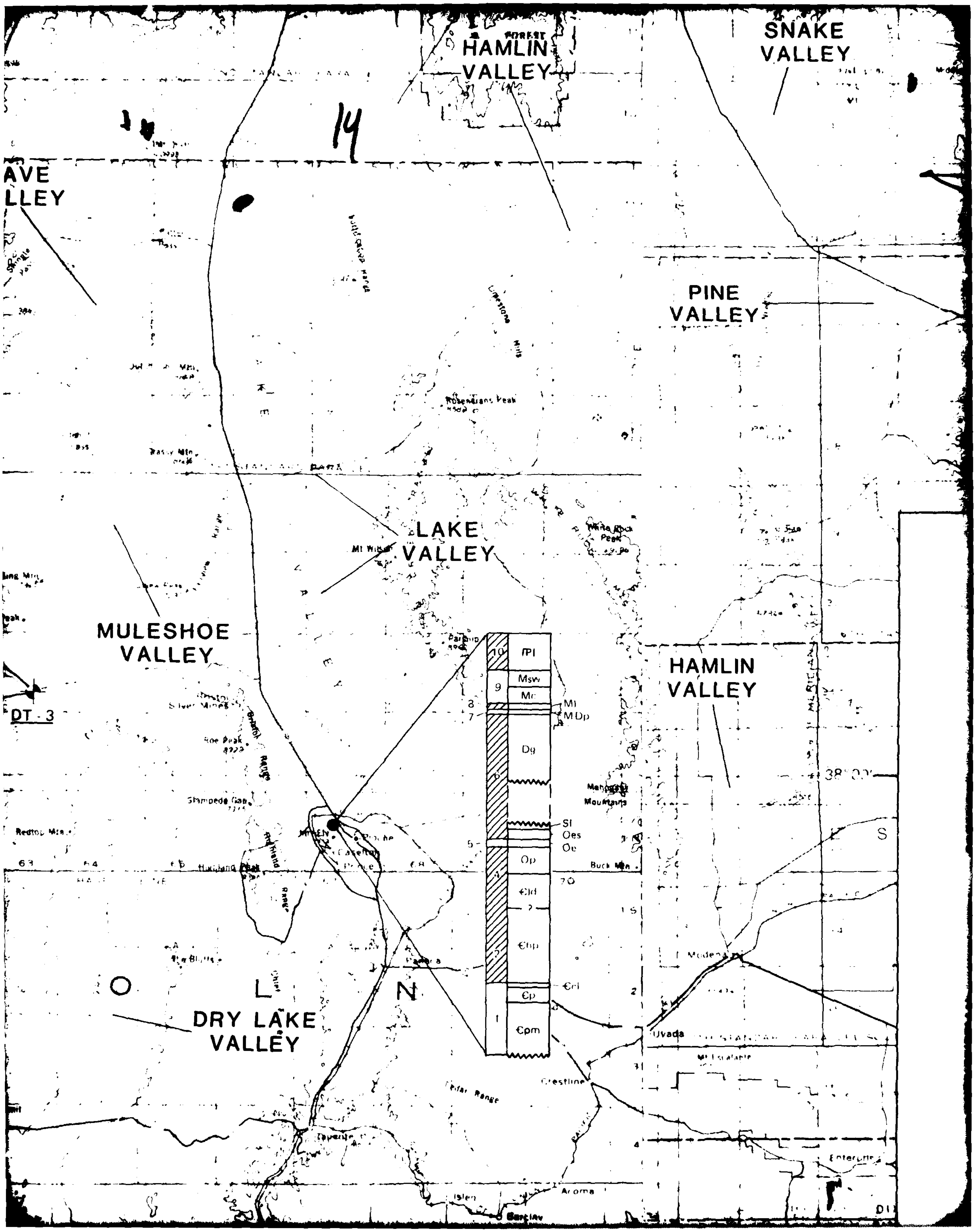
SEVIER
DESERT
WHIRLWIND
VALLEY
J A B
S E V I E R
D E S E R T
M I L L A R D
Vernon
Red Pine Mtn
Lofgreen
Eureka
Mammoth
Silver City
Elberta
Goshen
Jericho
Sand Mtn
Fumarole Butte
Desert Mtn
Leamington
Lynndyl
Juab
Mills
Sugarville
Woodrow
Abraham
Sutherland
Delta
Oak City
Hinckley
Deseret
Oasis
Scipio
McCornick
Pavant Butte
Clear Lake
Greenwood
Holden
Flowell
Fillmore
Meadow
Vermillion
Aurora
NATIONAL FOREST
39°00'
Mom
Mw
Mj
Du
De
Dse
Sul
Ofh
Osp
umu
Cs
Cp
pm

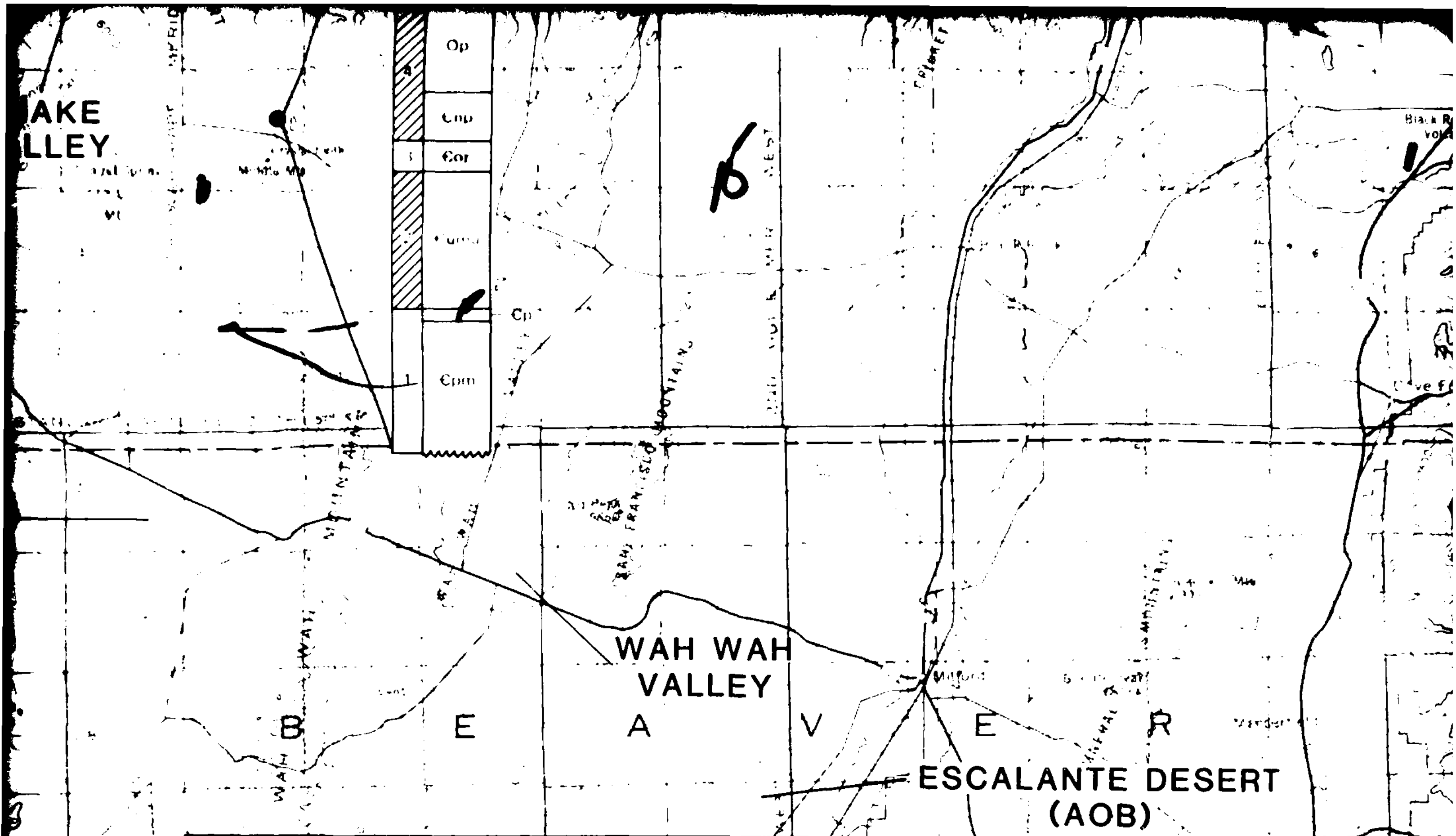

10
BIG SMOKY
VALLEY
Seyler Peak
Opa
Ml
Єgh
A L
Pilot Peak
Tonopah
Єds
pЄr
pЄw
Weepah
Hills
38°00'
Emigrant Peak
Red Mtn
Thunder Mtn
E S M E R A L D A
Pilot Peak
Montezuma Peak
Goldfield
Mt Jackson


BIG SAND
SPRINGS VALLEY
HOT CREEK
VALLEY
STONE CABIN
VALLEY
RALSTON
VALLEY
N Y E
REVEILLE
VALLEY
RAILROAD
VALLEY
PENOYER
VALLEY
GARD
VALL
FOREST
Warm Springs
Big Ten
Peak
Reveille
Peak
Gold Mtn
Cedar Pass
Monitor Peak
Cms



13
WHITE
RIVER
VALLEY
CAVE
VALLEY
GARDEN
VALLEY
PENOYER
VALLEY
COAL
VALLEY
PAHROC
VALLEY
Timber Mtn
Troy Peak
FOREST
DT - 1
DT - 3
Qal
Mc
FAULT
Tv
Dg
MDp
Dsl
Dse
Sl
Oes
Oe
Op
€ld
€d
€s
€pc
€p
€pm
Mc
Ml
PPPl
L I N C O


14
HAMLIN VALLEY
SNAKE VALLEY
AVE
LLEY
PINE VALLEY
LAKE VALLEY
MULESHOE VALLEY
DT - 3
HAMLIN VALLEY
DRY LAKE VALLEY
Rosencrans Peak
Limestone Hills
White Rock Peak
Mt Wilson
Parsnip Peak
Silver Mines
Roe Peak
Stampede Gap
Redtop Mtn
Pioche
Caselton
Prince
Highland Peak
Buck Mtn
Mahogany Mountains
Panaca
Modena
Uvada
Crestline
Cedar Range
Barclay
Islen
Acoma
Mt Escalante
Enterprise
38°00'
10 IPl
9 Msw
Mc
8 Ml
7 MDp
Dg
6
Sl
Oes
Oe
5 Op
4 Єld
Єhp
3
Єcl
2 Єp
1 Єpm
O L N
S



EXPLANATION OF SYMBOLS

Quaternary

- Qal — Alluvium

Tertiary

- Tv — Tertiary Volcanics

PERMIAN

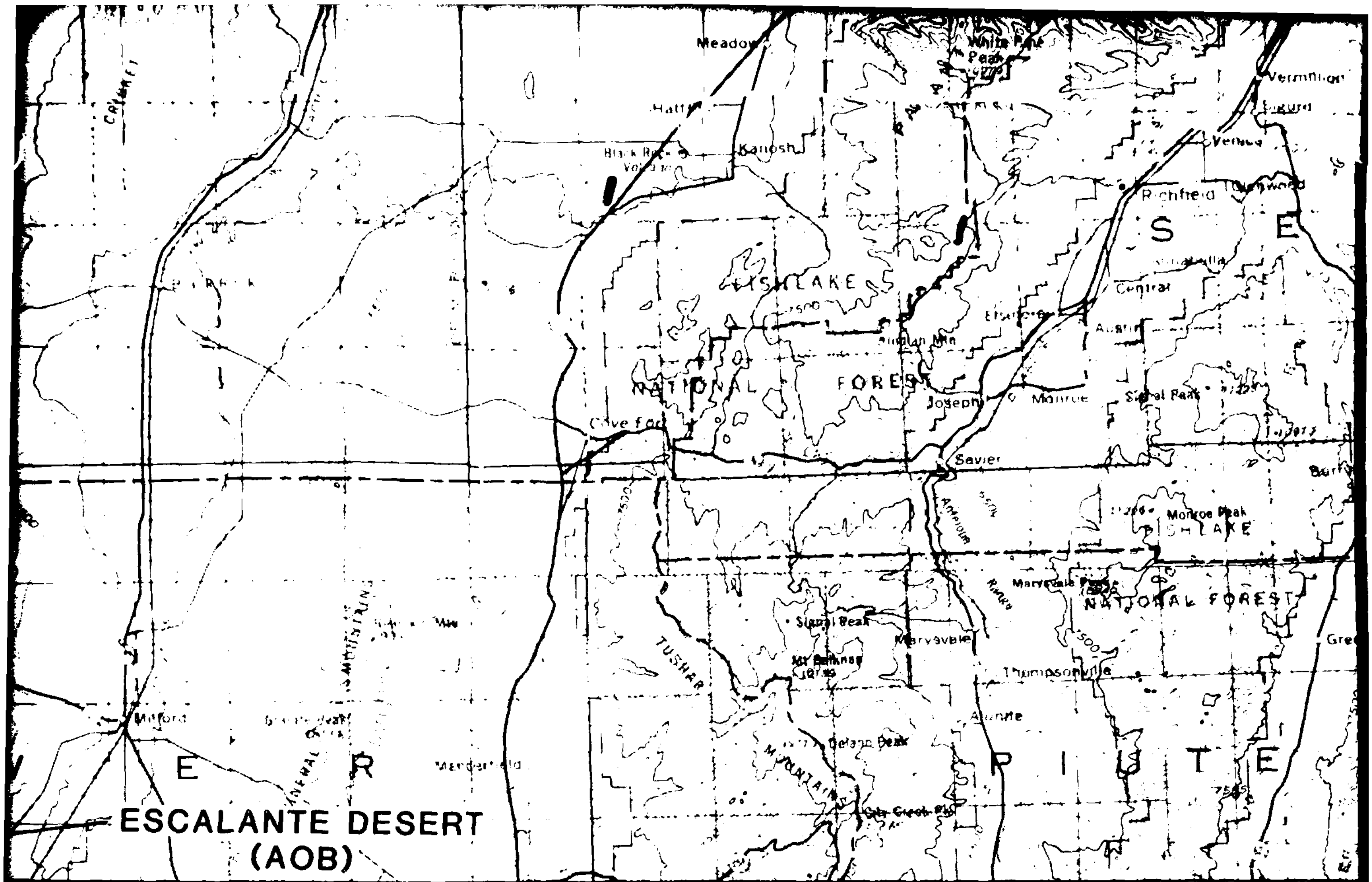
- Pc — Park City Group: Limestone.
- Pa — Arcturas Group: Limestone, siltstone, quartzite.
- Pcr — Carbon Ridge Formation: Cherty limestone, limestone pebble conglomerate.

PENNSYLVANIAN

- PPl — Permian Pennsylvan[ian] limestone
- IPe — Ely Limestone: Limestone, cherty limestone.
- PIPbs — Bird Springs Formation: Limestone, dolomite, shale.
- IPl — Pennsylvanian limestone

MISSISSIPPIAN

- Msw — Scotty Wash Quartzite
- Mdp — Diamond Peak Formation: Quartzite.
- Mc — Chainman Shale
- Mom — Ochre Mountain Limestone
- Mw
- Mj — Joanna Limestone
- Ml — Mississippian limestone, undifferentiated
- MDp — Pilot Shale: Shale, limestone



EXPLANATION OF SYMBOLS

Pcr — Carbon Ridge Formation
Cherty limestone, limestone pebble conglomerate.

PPl — Permian-Pennsylvanian limestone

PPbs — Bird Springs Formation
Limestone, dolomite, shale.

Pl — Pennsylvanian limestone

Mom — Ochre Mountain Limestone

Formation

Mc — Chainman Shale

Mw — Woodman Formation
Limestone, siltstone, quartzite.

Mm — Monte Cristo Limestone

Ml — Mississippian limestone, undifferentiated

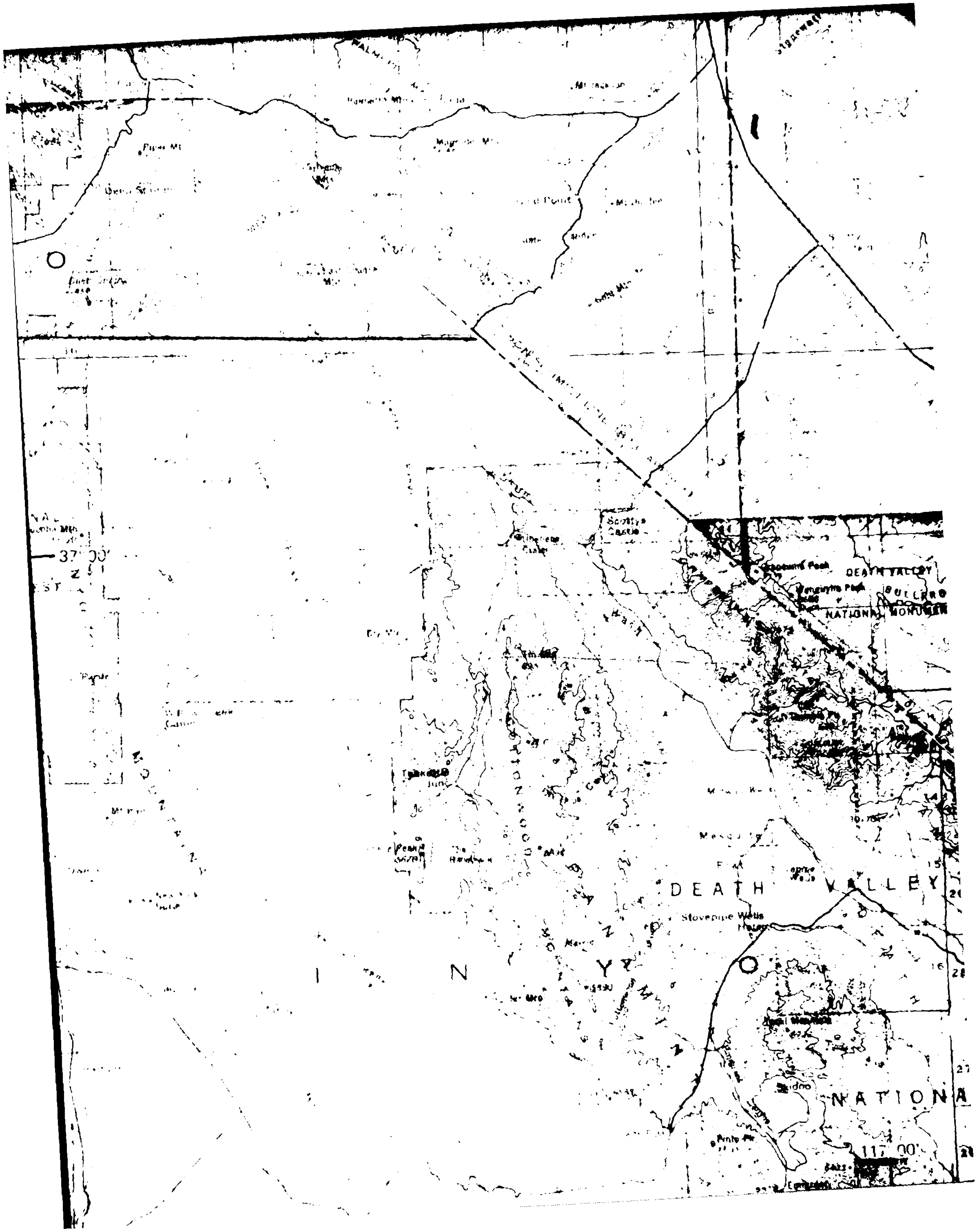
VERTICAL SCALE IN FEET

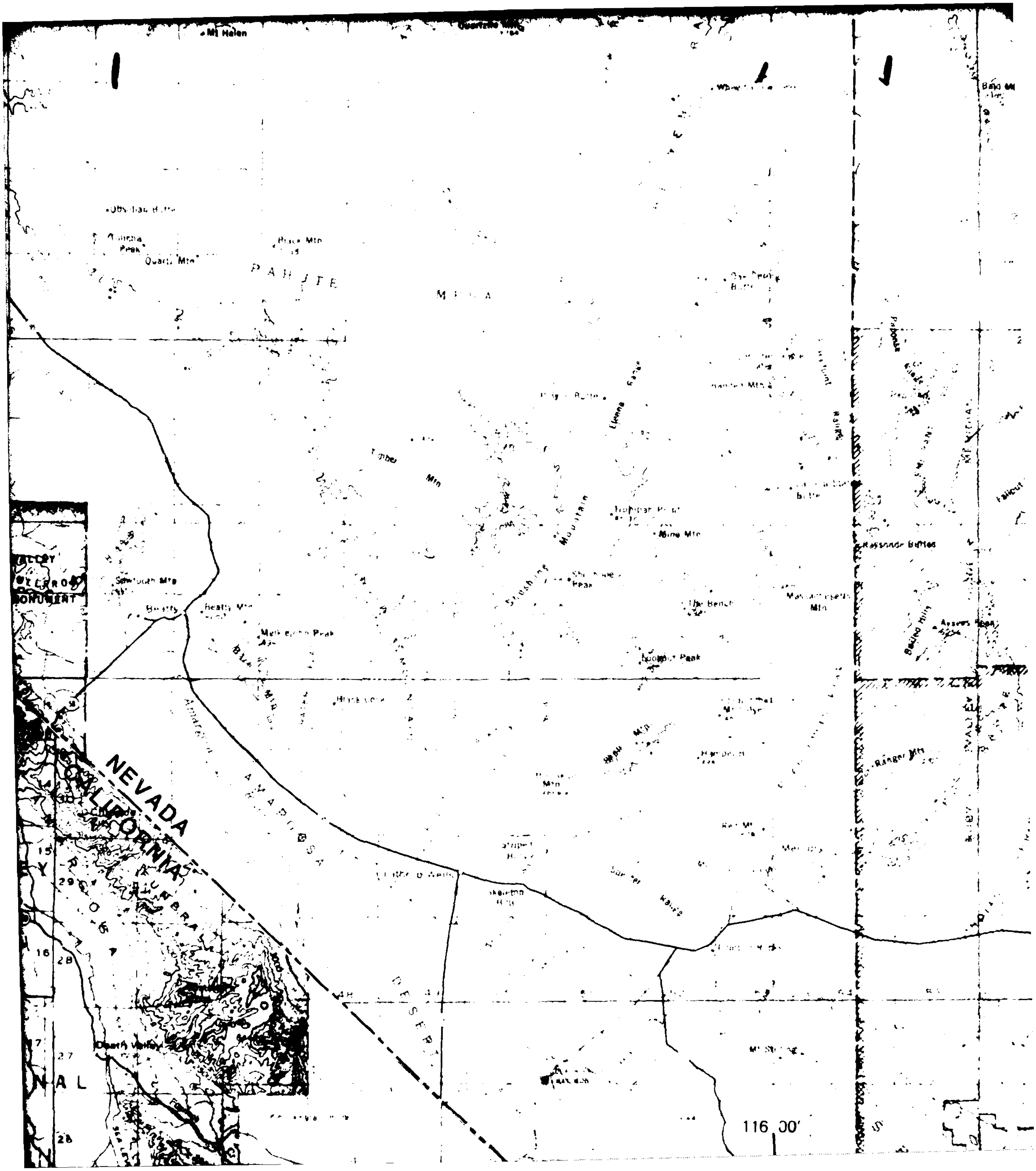
0
1000
2000
5000
10,000
20,000

HYDROSTRATIGRAPHIC UNITS*

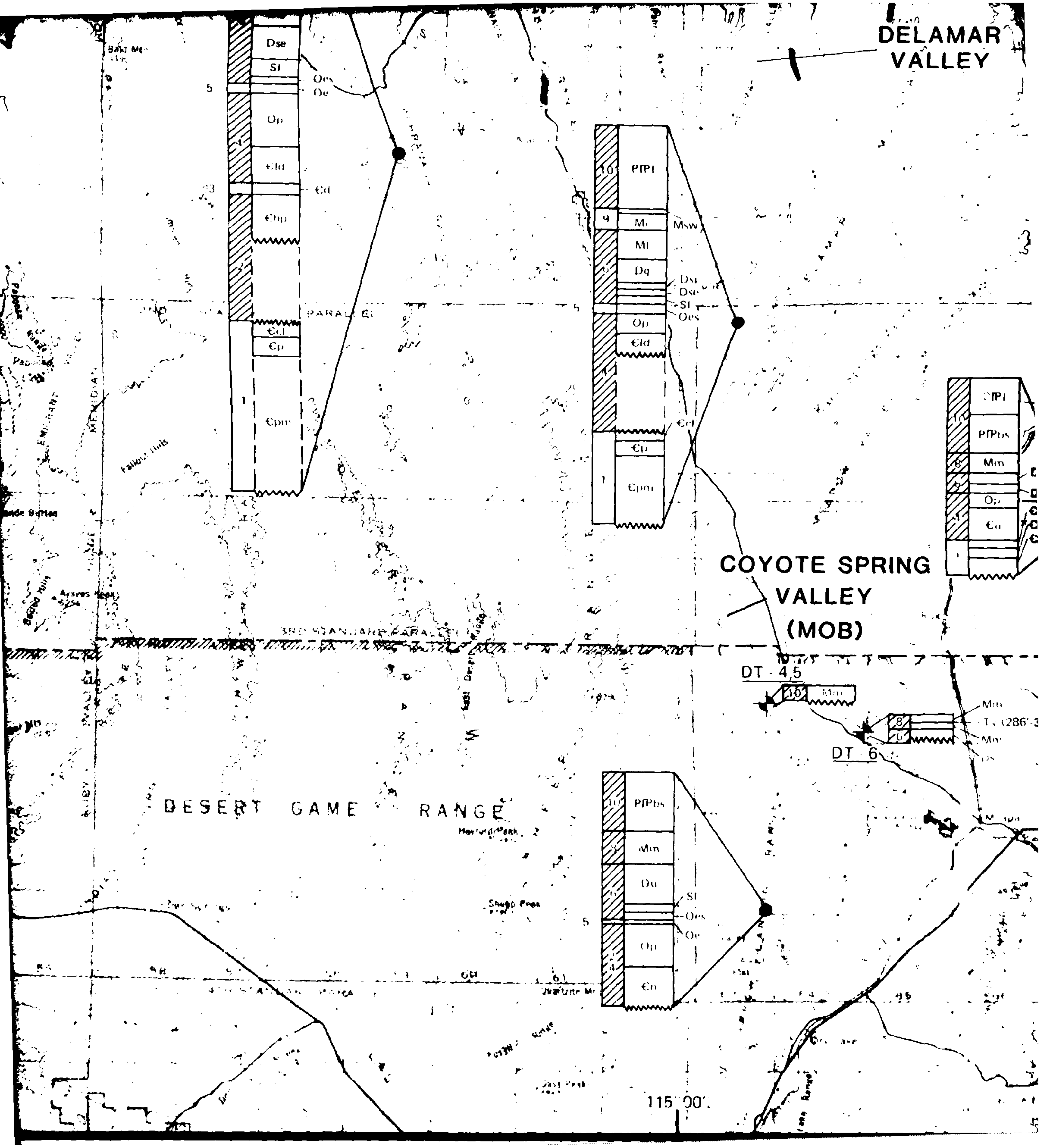
	Volcanic Aquitard
10	Aquifer No. 10
9	Aquitard No. 9
8	Aquifer No. 8
7	Aquitard No. 7
6	Aquifer No. 6
5	Aquitard No. 5
4	Aquifer No. 4
3	Aquitard No. 3
2	Aquifer No. 2
1	Aquitard No. 1

*See text for explanation

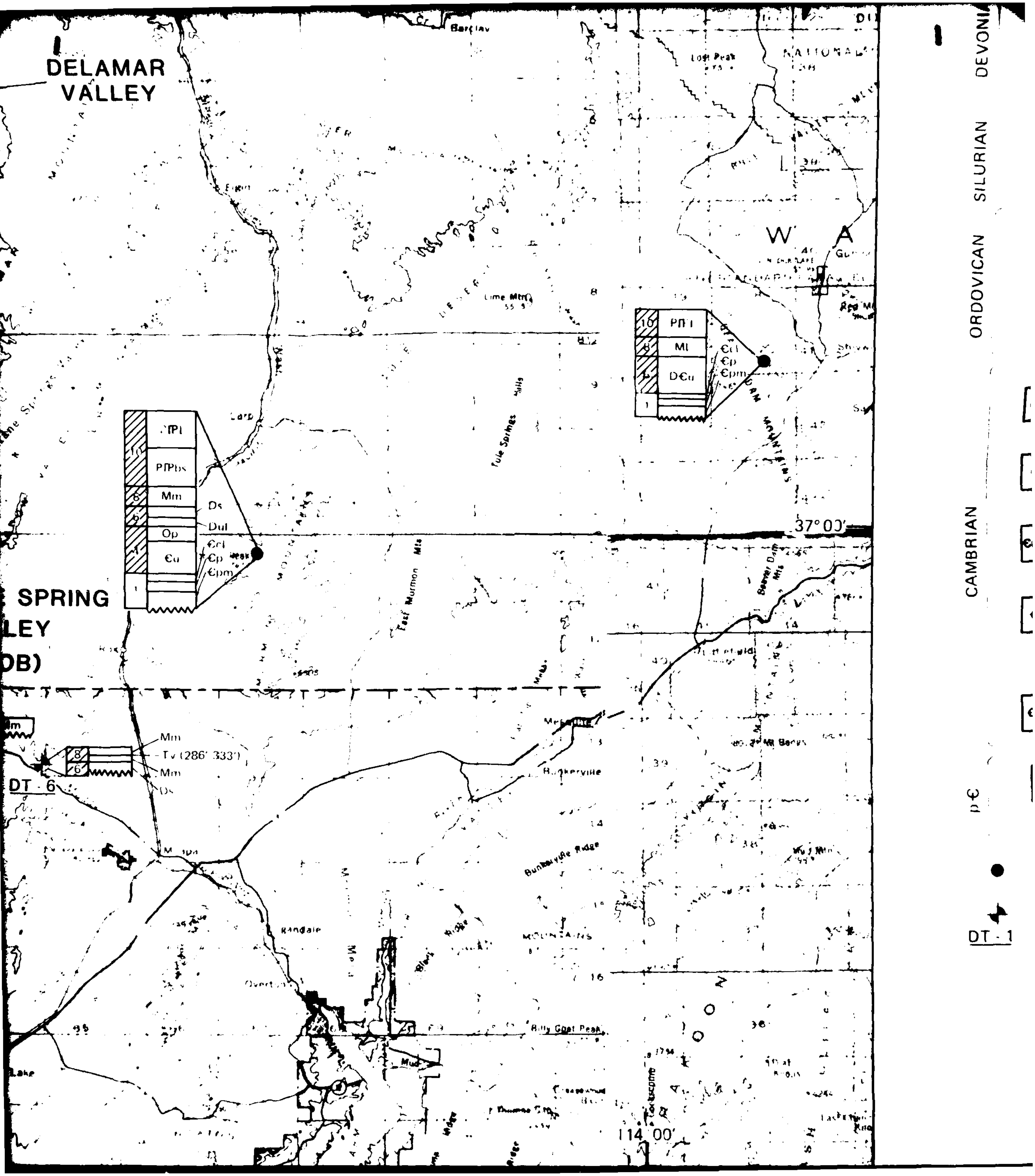

Scottys Castle
DEATH VALLEY
NATIONAL MONUMENT
DEATH VALLEY
Stovepipe Wells
NATIONA
37°00'
117°00'



Mt Helen
Obsidian Butte
Black Mtn
Quartz Mtn
PAHUTE
Timber Mtn
Mine Mtn
Sawtooth Mtn
Beatty
Beatty Mtn
Skull Mtn
Ranger Mts
NEVADA
CALIFORNIA
AMARGOSA
DESERT
Death Valley
116 00'



DELAMAR VALLEY
COYOTE SPRING VALLEY (MOB)
DESERT GAME RANGE
DT - 4,5
DT - 6
115°00'
Dse
Sl
Oes
Oe
Op
Cld
Cd
Chp
Cd
Cp
Cpm
PPl
Ms
Msw
Ml
Dq
Dsi
Dse
Sl
Oes
Op
Cld
Cd
Cp
Cpm
PPbs
Mm
Op
Cu
Mm
Tv (286'-3
PPbs
Mm
Du
Sl
Oes
Oe
Op
Cu
3RD STANDARD PARALLEL



DELAMAR
VALLEY
SPRING
LEY
DB)
Lime Mtn
Tule Springs Hills
East Mormon Mts
PPl
PPbs
Mm
Ds
Dul
Op
Єu
Єcl
Єp
Єpm
PPl
Ml
DЄu
Єcl
Єp
Єpm
Mm
Tv (286' 333')
Mm
Ds
DT - 6
37° 00'
Beaver Dam Mts
Mesquite
Bunkerville
Bunkerville Ridge
MOUNTAINS
Overton
Billy Goat Peak
114° 00'
Lost Peak
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
pЄ
DT - 1

DEV

Engelmann Formation
Dolomite limestone

Simonson Do...

Dse
Sevy Dolomite

Dn
Nevada Formation
Dolomite, limestone.

Du
Undifferentiated limestone
and dolomite

SILURIAN

Sl
Laketown Dolomite

Slm
Lone Mountain Dolomite

Sul
Undifferentiated limestone and dolomite

ORDOVICIAN

Oes
Ely Springs Dolomite

Ofh
Fish Haven Dolomite

Ohc
Hanson Creek Formation
Dolomite.

Opa
Palme...
Sla...

Oe
Eureka Quartzite

Op
Pogonip Group
Limestone, siltstone, shale.

Osp
Swan Peak Formation
Quartzite

Ogc
Garden City Formation
Limestone, limestone pebble
conglomerate.

CAMBRIAN

€np
Notch Peak Limestone

€wi
Windfall Formation
Limestone,
dolomite.

€or
Orr Formation
Limestone, shale,
siltstone.

€d
Dunderberg Shale

€n
Nopah Formation
Dolomite, limestone, shale.

€ld
Upper Cambrian
limestone and
dolomite

€u
Upper Cambrian,
undifferentiated

€jw
Johns Wash Limestone

€wk
Weeks Formation
Limestone, dolomite.

€umu
Upper and Middle Cambrian,
undifferentiated

€lp
Lincoln Peak Formation
Limestone, shale.

€hp
Highland Peak Limestone

€e
Emigrant Formatio...
Limestone, che...

€s
Patterso...

€el
Eldorado Dolomite

€pc
Pole Canyon
Limestone

€sh
Shadscale Formation
Shale, siltstone, limestone,
dolomite.

€cl
Chisholm Shale and
Lyndon Limestone

€mu
Middle Cambrian,
undifferentiated

€gh
Gold Hill Formation
Quartzite, shale,
minor limestone

€p
Pioche Shale

€pm
Prospect Mountain Quartzite

€ms
Mule Spring Limestone

€h
Harkless Formation
Siltstone, quartzite,
limestone.

€po
Poleta Formation
Limestone, shale,
quartzite.

€c
Campito Formation
Quartzite, siltstone,
shale.

p€

p€r
Reed Dolomite

p€w
Wyman Formation
Siltstone.

● Location of Section Source:
Nevada Bureau of Mines, 1973.

DT - 1
Air Force Carbonate Well Source
Refer to Table 4-9 of this report and
Report No. E-TR-57 Regional Carbonate
Evaluation, Coyote Spring Valley, Nevada
(In Progress)

NORTH

SCALE 1:500,000

0 10 20
STATUTE MILES

0 10 20
KILOMETERS

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D...

DISTR...
BEDROCK HYDR...
WITHIN MX D...

30 NOV 81

in Dugway-Thomas Ranges

Simonson Dolomite

Dn — Nevada Formation
Dolomite, limestone.

Oul — Undifferentiated limestone and dolomite

Sul — Undifferentiated limestone and dolomite

Ohc — Hanson Creek Formation
Dolomite.

Oe — Eureka Quartzite

Opa — Palmetto Formation
Slate, chert, quartzite, limestone.

Ogc — Garden City Formation
Limestone, limestone pebble conglomerate.

...mation
...one, shale,
...ne.

€d — Dunderberg Shale

€n — Nopah Formation
Dolomite, limestone, shale.

€ld — Upper Cambrian limestone and dolomite

€sw — Swarbrick Limestone

€jw — Johns Wash Limestone

€wk — Weeks Formation
Limestone, dolomite.

€Du — Cambrian-Devonian, undifferentiated

€hp — Highland Peak Limestone

€s — Patterson Pass Shale

...mation
...ale.

€e — Emigrant Formation
Limestone, chert, claystone, shale, sandstone

...tion
..., limestone,

€cl — Chisholm Shale and Lyndon Limestone

€mu — Middle Cambrian, undifferentiated

€gh — Gold Hill Formation
Quartzite, shale, minor limestone.

€sq — Cambrian siltstone, shale, quartzite

€h — Harkless Formation
Siltstone, quartzite, limestone.

€po — Poleta Formation
Limestone, shale, quartzite.

€c — Campito Formation
Quartzite, siltstone, shale.

€ds — Deep Springs Formation
Siltstone, sandstone, dolomite, limestone

NORTH
SCALE 1:500,000

10 20
STATUTE MILES

10 20
KILOMETERS

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

DISTRIBUTION OF BEDROCK HYDROSTRATGRAPHIC UNITS WITHIN MX DEPLOYMENT AREA

30 NOV 81

DRAWING 4-2

5.0 WATER-SUPPLY DEVELOPMENT

There are four primary water-supply sources for MX construction and operation in the Nevada/Utah siting area. These are 1) development of ground water from valley-fill aquifers; 2) development of ground water from regional carbonate aquifers; 3) lease or purchase of existing water rights; and 4) interbasin transfer of water. Each of these water-supply sources has certain advantages and disadvantages in terms of hydrologic feasibility, economics, and political and environmental sensitivity. The merits of each source vary according to water availability and suitability in each MX siting valley. The water-supply sources and their primary advantages and disadvantages are listed in Table 5-1. A listing of the preferred and alternative water-supply sources for each MX siting valley is presented in Table 5-2. Characteristics of each water-supply source are described in the following sections.

5.1 VALLEY-FILL AQUIFER

In most MX siting valleys, sufficient supplies of unappropriated ground water are available from the valley-fill aquifers to meet MX water requirements. Development of these supplies will occur through the construction of conventional water-supply wells. Based on hydrologic field testing, the average well yield is expected to be between 500 and 700 gpm (31 and 44 l/s) but may vary from 150 to 2000 gpm (10 to 126 l/s) depending upon the aquifer characteristics in an individual valley.

MX WATER SUPPLY SOURCES

SOURCE	CHARACTERISTICS
Valley-Fill Aquifer	Advantages: Dependable source in most valleys, short construction period, sufficient suitable area for development in most valleys. Disadvantages: High cost, politically sensitive, problems may be encountered in obtaining appropriations.
Carbonate Aquifer	Advantages: Dependable source in certain valleys, very high well yields can be obtained, short construction period. Disadvantages: Very high cost and high risk, special well construction techniques may be required, not available in all valleys.
Lease/Purchase of Existing Water Rights	Advantages: Dependable source will decrease new appropriations, low cost. Disadvantages: New wells may be required, agricultural land may be retired and may alter life styles.
Interbasin Transfer of Ground Water	Advantages: Dependable source, minimal hydrologic impact in use valley, temporary in nature. Disadvantages: Very high cost, may require extensive environmental clearances, long construction period, compounds impacts in source valleys.

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MX WATER SUPPLY SOURCES

30 NOV 81 TABLE 5-1

VALLEY	VALLEY–FILL AQUIFER	CARBONATE AQUIFER	LEASE/ PURCHASE	INTERBASIN TRANSFER
Antelope	P	+	+	+
Big Sand Springs	P	+	–	+
Big Smoky	+	+	P	–
Butte	P	+	–	+
Cave	P	+	+	–
Coal	P	+	–	+
Coyote Spring	–	P	–	+
Delamar	P	+	–	+
Dry Lake	P	+	–	–
Dugway	+	+	–	P
Escalante Desert	–	–	P	+
Fish Springs Flat	P	+	+	+
Garden	P	+	+	+
Hamlin	P	+	+	+
Hot Creek	P	+	+	–
Jakes	P	+	–	+
Kobeh	P	+	+	–
Lake	+	+	P	+
Little Smoky	P	+	+	–
Long	P	+	–	+
Monitor	P	+	+	–
Muleshoe	P	+	–	–
Newark	P	+	+	+
Pahroc	P	+	+	+
Penoyer	+	+	P	+
Pine	P	–	+	+
Railroad	P	+	+	–
Ralston	P	+	+	–
Reveille	P	–	+	+
Sevier	–	–	P	–
Snake	P	+	+	–
Spring	P	+	+	–
Steptoe	+	+	P	+
Stone Cabin	+	–	P	+
Tule	P	+	–	+
Wah Wah	P	–	–	+
Whirlwind	+	+	P	–
White River	P	+	+	+

P = Preferred water supply source

+ = Alternative water supply source for all or a portion of MX water requirements

– = Not considered as a water-supply source.

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WATER SUPPLY SOURCES FOR THE MX SITING VALLEYS

30 NOV 81 TABLE 5-2

To ensure the production of sufficient ground water from the valley-fill aquifers while minimizing the number of wells needed and the potential impact of MX ground-water withdrawals, specific well location criteria should be followed. These criteria include a minimum 1-mile (2-km) setback from existing wells, springs, residences, water rights, and environmentally sensitive areas; the exclusion of all nonpublic domain and wilderness lands; and the avoidance of hydrologically unsuitable areas such as playas and the low transmissivity zones adjacent to the contact between valley fill and bedrock at the mountain fronts.

5.2 CARBONATE AQUIFER DEVELOPMENT

In many MX siting valleys, the regional carbonate aquifers have potential for development as a water-supply source. Except for regional spring discharge, ground water in the carbonate aquifers has not been developed. However, the ability of the carbonate aquifers to store and transmit water has been amply demonstrated. It has also been shown that well siting criteria are critical if development of the carbonate aquifers is to be done in a cost-effective manner. The land status criteria for well siting should be the same as for the valley-fill wells. Hydrologic siting criteria include proximity to fault zones and existence of carbonate aquifer units at drilling depths. A minimum 3-mile (5-km) setback from regional springs is recommended.

5.3 LEASE/PURCHASE OF EXISTING WATER RIGHTS

In designated or closed valleys and in valleys where MX water requirements would cause exceedence of the perennial yield, it may be possible to lease or purchase existing surface- or ground-water rights. Procedures for such transactions have been established by the State Engineers' office in Nevada and Utah. Any change in the point of diversion, point of beneficial use, or manner of use will require that an "Application of Change to an Existing Water Appropriation" be filed with, and approved by, the State Engineer.

Water rights purchased or leased from the agricultural sector may cause croplands to be retired and thus create secondary impacts. Also, few existing wells are located adjacent to proposed missile clusters or construction sites, and the drilling of new wells will probably be required at more suitable points of diversion. The lease or purchase of existing surface-water rights, while offering a potential source of water in certain valleys, may be constrained if treatment of the water is required to meet water-quality criteria for human consumption.

5.4 INTERBASIN TRANSFER OF WATER

In siting valleys where no in-valley water-supply sources are available, it may be possible to transfer water from nearby valleys. For example, ground water from Dry Lake Valley could be transferred to Delamar and Muleshoe valleys. This type of development would require the installation of pipelines, lift pumps, and holding reservoirs.

Although the cost of interbasin transfer is great, there are a number of off-setting economic factors that could increase the feasibility of importing water supplies. For example, it is projected that four or more deep valley-fill wells will be required to meet MX water requirements in Delamar Valley. The piping of water into Delamar Valley from southern Dry Lake Valley would eliminate the need for these wells. The cost of installing a pipeline system may be substantially less than the cost of developing deep production wells and pumping water from considerable depth (>800 feet [244 m]), thus a cost savings would result. Pipelines would be designed and constructed so that they could be dismantled and reused elsewhere.

The development of the few "water-rich" valleys as source areas for distribution to surrounding valleys will be considered during development of the water management plan.

5.5 OTHER SOURCES

The construction of surface water impoundments to collect and store unappropriated, intermittent surface runoff could be used to augment MX water supplys. Questions regarding appropriation of such water will need to be resolved.

Importation of water from outside of the siting area could be considered where transport distances and lift are within reason. Importation of water from the Colorado River has been considered for OB construction and operation in Coyote Spring Valley. Importation of water from the Colorado River to more distant siting valleys would not be economically realistic.

6.0 IMPACTS OF GROUND-WATER DEVELOPMENT

6.1 WATER TABLE DRAWDOWN AND RECOVERY

To assess the long-term impacts of MX ground-water withdrawals upon local water levels, numerical models of the valley-fill aquifer systems are being constructed. A two-dimensional finite difference model (Trescott and others, 1976) has been completed for five MX siting valleys; Muleshoe, Dry Lake, and Delamar valleys in Nevada, and Pine and Wah Wah valleys in Utah.

In order to implement the model, it is first calibrated to observed values of head in each valley and to known or estimated recharge and discharge fluxes. This is followed by assigning a single value for transmissivity and storativity which closely approximates calculated values from aquifer tests or would be expected based on hydrogeologic conditions in the valley. Once the model has been satisfactory calibrated, estimated MX pumpage requirements are imposed. Projections of response to MX pumping will be maximized in that all water is required to come from storage with no inflow to or outflow from the system.

Model results indicating drawdowns at production well sites and at a distance of 1 mile (2 km) from these sites are summarized in Table 6.1. Projections for residual drawdown at the production well sites and at a distance of 1 mile (2 km) from the wells were also generated from the models for periods of 1.9, 8.3, and 30 years of recovery. These projections are also summarized in Table 6.1. These results are indicative of drawdowns that will occur in other siting valleys. The ranges of physical

VALLEY	MX PRODUCTION WELL SITE				ONE MILE FROM PRODUCTION WELL SITE			
	PUMPING	RECOVERY			PUMPING	RECOVERY		
	MAXIMUM DRAWDOWN (ft)	RESIDUAL DRAWDOWN (ft) AFTER:			MAXIMUM DRAWDOWN (ft)	RESIDUAL DRAWDOWN (ft) AFTER:		
		1.9 YEARS	8.3 YEARS	30 YEARS		1.9 YEARS	8.3 YEARS	30 YEARS
DELAMAR	11.5	1.0	0.5	0.4	1.8 (1)	1.0 (1)	0.5 (1)	0.4 (1)
DRY LAKE/ MULESHOE	118.2	5.1	2.7	1.6	6.0	4.8	2.7	1.6
PINE	51.9	3.6	1.5	0.8	3.9	3.1	1.6	0.8
WAH WAH	6.0	0.6	0.4	0.4	0.8	0.6	0.4	0.4

(1) THESE ESTIMATES ARE FOR A DISTANCE OF ONE-HALF MILE FROM THE PRODUCTION WELL SITES IN DELAMAR VALLEY BECAUSE OF THE LIMITED SIZE OF THE VALLEY

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SUMMARY OF DRAWDOWN EFFECTS FROM NUMERICAL MODEL SIMULATIONS

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TABLE 6-1

parameters (transmissivity, storativity, and recharge/discharge fluxes) used in the models are representative of those found throughout the Nevada/Utah siting valleys.

6.2 SPRING INTERFERENCE

Springs within the MX siting area are classified as meteoric, local valley-fill, and regional. MX ground-water withdrawals will have little, if any, effect on meteoric springs. These springs occur within the mountains or around the periphery of valleys at the valley-fill bedrock contact. They are fed by local recharge to perched ground-water systems which are not in hydraulic continuity with either the valley-fill or regional carbonate aquifers.

Discharge from local valley-fill springs may be impacted if MX ground-water withdrawals occur in close proximity to spring sites. The extent of impact depends on site-specific hydrologic conditions and cannot be generalized. To minimize impacts to valley-fill springs, it is recommended that MX production wells be located a minimum of 1 mile (2 km) from spring sites.

Because of a lack of historical data or test results, the potential impact of MX water withdrawals from the carbonate aquifers on regional springs cannot be assessed at this time. Regional spring discharge within the 13 valleys of the White River flow system in Nevada appears to be unaffected by local ground-water withdrawal from valley-fill aquifers. The impact of carbonate aquifer development on regional springs in down-gradient valleys in the same flow system is also unknown. The extent of communication between the valley-fill and carbonate aquifers is the major uncertainty in evaluating the regional impact of the MX system.

Because of the uncertainty of regional spring impacts, it is recommended that all MX production wells be set back a minimum of 3 miles (5 km) from any regional spring. In addition, regional springs should be emphasized in any hydrologic monitoring program implemented.

6.3 OTHER IMPACTS

The lease or purchase of water rights to obtain a water supply for MX construction and operation may improve the water quality in certain siting valleys. Diversion of irrigation water to MX purposes may slow the leaching action of irrigation water on salts in the soil, thus reducing the percolation of poorer quality water into the aquifers. In valleys where additional appropriations and ground-water development are allowed, water quality may deteriorate. Such impacts will be very localized and of limited, if measureable, magnitude.

Localized land subsidence around OB production wells may occur as a result of long-term MX pumping of alluvial aquifers. The amount of subsidence in any given area is dependent upon a combination of interrelated factors which include 1) lowering of the water table; 2) an interbedded aquifer-aquitard system; 3) the compressability of the effected materials, which is governed by the type of material (i.e. sand or clay) and the hydrostatic and lithostatic heads; and 4) percentage of compressible clays.

In the deployment valleys, MX pumping will be of short duration, and measurable subsidence is not anticipated. Subsidence resulting from long-term pumping of OB production wells can be minimized by establishing proper well field management and monitoring programs.

Diversion of surface runoff for MX use may reduce the quantity of water that normally recharges valley-fill aquifers. This impact is expected to be insignificant, however, because the diversion of water would be seasonal and capture water that normally is runoff to the playas and is subsequently lost through evaporation.

Construction of roads and shelters is expected to slightly increase the surface-water runoff within the siting valleys. Impervious surfaces constructed in the valleys, such as shelter roof tops, create more runoff than would occur under natural conditions. The compaction of soil for road construction will reduce infiltration and thereby increase runoff. The net result will be greater surface runoff at locations such as road crossings downstream of MX facilities. Culverts and other hydraulic structures should be designed to accommodate the higher runoff.

The removal of vegetation, excavating, and other earth-moving activities will impact the water quality of surface runoff in the area. The potential for erosion is increased and thereby the possibility of larger quantities of suspended and dissolved material being carried in surface runoff. Implementing a construction schedule that takes advantage of periods of low rainfall will minimize the potential for erosion. To reduce sedimentation problems during infrequent, intense thunderstorms, settling basins, designed to retain the runoff for a sufficient period of time to allow for deposition of suspended sediments, should be constructed and maintained during the construction phase.

It should be noted that the development of water resources for MX construction and operation may have a regional beneficial impact. In many cases, the principal constraint to developing the water resources of Great Basin valleys is the cost involved. The wells and pipelines installed for MX will have an operational life in excess of 40 years. The operational lifetime of the system is expected to be about 20 to 30 years. When MX is decommissioned, the water-supply system may be available for other uses including irrigation, municipal supplies, ranching, and fire control.

7.0 MITIGATING MEASURES

Ground-water withdrawals for MX construction may impact local water users and the environment if proper planning and appropriate precautionary measures are not employed. To avoid, minimize, or mitigate the potential impacts, the following measures can be utilized: 1) careful well site selection; 2) storage of water in reservoirs in advance of the year it is required, 3) alteration of pumping patterns if changes in the ground-water system are detected; 4) reduction in the rate of construction by extending the overall construction period in a particular valley to reduce the peak annual quantity of water required; 5) utilization of an alternative source of water supply; and 6) compensation to an impacted user.

7.1 WELL LOCATION

Well location is crucial to the proper management of the available ground-water resources of the siting area. MX production wells should be located a sufficient distance from existing wells, springs, and environmentally sensitive areas to avoid significant drawdown of the water levels, alteration of spring discharge, or a deterioration of water quality. Based on available information, setbacks of 1 mile (2 km) from existing wells and local springs and 3 miles (5 km) from regional springs and environmentally sensitive areas is recommended.

Considerations in well location include aquifer capabilities, interference effects among wells, and distance-drawdown effects of projected withdrawals from individual wells. Evaluation of the effects of MX water withdrawals through numerical modeling of the aquifer systems is essential to gain a realistic assessment of well locations, rates of withdrawal, and pumping duration that would not impact existing users and environmentally sensitive areas.

7.2 ADVANCE STORAGE

Advance storage involves the pumping and retention of water in surface reservoirs prior to use in a valley. This procedure could reduce peak-year construction ground-water withdrawals and thereby minimize impacts. This approach would not be appropriate for domestic water supplies because of water treatment requirements on water stored in open reservoirs.

7.3 ALTERATION OF PUMPING PATTERNS

It is anticipated that several wells may be required in many of the siting valleys to provide the required amounts and appropriate distribution of MX water supplies. The drawdown immediately surrounding each pumping well will vary from valley to valley depending upon the aquifer characteristics and amount of pumping. If the cone of depression surrounding an MX well affects the water level in existing stock wells or the discharge of nearby springs, the pattern of withdrawal in the valley could be altered. In such a situation, the rate of ground-water withdrawal would be reduced in certain areas or wells and increased in others to minimize impacts without altering construction schedules. Also, pumping wells for variable time periods with allowance for recovery of ground-water levels during interim periods could maintain the water in existing wells and springs at an acceptable level.

7.4 REDUCED CONSTRUCTION RATE

A reduction in the MX construction schedule would have nearly the same effect as advance storage of water since it would reduce the peak quantity of water required in a particular year. This approach would also extend the construction period and the duration of ground-water withdrawal in a valley.

7.5 ALTERNATIVE WATER-SUPPLY SOURCES

If impacts incurred from development of the preferred water-supply source are excessive and cannot be mitigated by any of the listed techniques, an alternative water-supply source, if available, may be developed. The viable alternative water supply sources for each siting valley are listed in Table 5-2 of Chapter 5.0, Water Supply Development.

7.6 COMPENSATION

Direct compensation of impacted water users is the most direct alternative method of mitigating impacts due to MX ground-water withdrawals. Compensation could be in the form of monetary reimbursement or direct delivery of water to impacted stock-watering ponds or water holding tanks.

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APPENDIX A

MX WATER RESOURCES PROGRAM

MX WATER RESOURCES PROGRAM

The MX Water Resources Program was initiated in June 1979 for the purpose of evaluating the availability of water for the construction and operation of the MX missile system in Nevada and Utah and to assess the effects of MX water withdrawals on local water users, the environment, and the aquifers.

The major elements of the Water Resources Program are outlined below.

Literature Review and Data Evaluation

- Review existing publications and data contained in agency files relating to water availability, local water use, regional ground-water flow systems, and aquifer characteristics.
- Contact state and federal agencies active in ground-water studies and regulation in Nevada and Utah for input to the program.

Field Hydrologic Reconnaissance

- Perform field studies in individual valleys to identify water users, measure ground-water levels, collect ground-water samples for chemical analyses, measure spring and stream discharges, conduct aquifer tests of existing wells, and examine general hydrogeologic conditions.

Exploratory Drilling and Testing

- Conduct a program of drilling and testing of valley-fill aquifers and carbonate (regional) aquifers to gather information about aquifer lithology and physical boundaries, the aquifer's ability to store and transmit water, and hydrologic characteristics of regional ground-water flow systems.

Water Appropriations

- Assess the quantity of water required for MX activities in each valley and submit applications for appropriation for the Air Force in accordance with state laws. Define points of diversion for ground-water withdrawal and survey diversion sites in Nevada. Provide technical support in field investigations and hearings associated with the water-appropriation process.

Numerical Modeling

o Develop numerical models of the ground-water systems in selected valleys to aid in assessing the effects of MX ground-water withdrawals on local water users and the environment.

Surface-Water

o Evaluate the surface-water flow regime in the deployment valleys to provide data on the availability of surface water and the rates and amounts of potential recharge to the ground-water systems.

Municipal Water-Supply Systems

o Assess municipal water-supply systems and wastewater treatment facilities for their capability to serve the increased demand and loads due to MX population influx. This study included towns within and immediately adjacent to the siting area with emphasis on Tonopah, Ely, Caliente, and Pioche in Nevada and Delta, Milford, and Cedar City in Utah. This study was conducted for Ertec by the Desert Research Institute, University of Nevada System, for Nevada and the Utah Water Research Laboratory for Utah.

Industry Activity

o Compile an industry activity inventory to identify the water requirements of existing and proposed industries in the siting area and determine how these requirements may interact with MX construction and operation activities. This study was conducted for Ertec by the Desert Research Institute, University of Nevada System, for Nevada and the Utah Water Research Laboratory for Utah.

Water Legal

o Review Nevada and Utah water laws and permitting procedures and conduct a water rights inventory. This study was conducted for Ertec by the Desert Research Institute, University of Nevada System.

Water Management

o Develop preliminary water management plans for siting valleys that will identify preferred and alternative water-supply sources, preferred and secondary well locations, aquifer capabilities, and a basic water-supply development plan which will minimize or avoid impacts to local water users and the environment.

To complete each element of the Water Resources Program, activities were performed in the various MX siting valleys. The following is an outline of the activities initiated and completed in each year of the Water Resources Program.

Fiscal Year 1979

- Field hydrologic reconnaissance was conducted in Big Smoky, Dry Lake, Hamlin, Snake, Tule, and White River valleys.
- "MX Siting Investigation, Geotechnical Summary, Water Resources Program FY 79," 21 December 1979. This report included the results of initial field studies in Big Smoky, White River, Dry Lake, Snake, Hamlin, and Tule valleys during FY 79.

Fiscal Year 1980

- Field hydrologic reconnaissance was conducted in Antelope, Big Sand Springs, Cave, Coal, Delamar, Dugway, Fish Springs Flat, Garden, Hot Creek, Lake, Little Smoky, Muleshoe, Pahroc, Penoyer, Pine, Railroad, Ralston, Reveille, Sevier Desert, Spring, Steptoe, Stone Cabin, Wah Wah, and Whirlwind valleys.
- Applications were filed for ground-water appropriations in Antelope, Big Sand Springs, Big Smoky, Cave, Coal, Delamar, Dry Lake, Dugway, Fish Springs Flat, Garden, Hamlin, Hot Creek, Lake, Little Smoky, Muleshoe, Pahroc, Penoyer, Pine, Railroad, Ralston, Reveille, Sevier Desert, Snake, Spring, Stone Cabin, Tule, Wah Wah, Whirlwind, and White River valleys.
- Valley-fill drilling was completed in Cave, Delamar, Dry Lake, Dugway (north), Dugway (south), Hamlin, Hot Creek (north), Hot Creek (south), Pine, Railroad (north), Railroad (south), Spring, Tule (north), Tule (south), Wah Wah (north), and White River valleys. In addition, drilling began in Garden, Wah Wah (south), and Whirlwind valleys.
- Valley-fill aquifer testing was completed in Delamar, Dry Lake, Hamlin, Pine, Railroad (south), Spring, Tule (north), and Tule (south). Aquifer testing was initiated in Hot Creek (north) and Hot Creek (south).
- Drilling in the carbonate aquifer was started in Coal Valley.
- Numerical modeling of ground-water systems began for Railroad, Snake, and White River valleys.

- o The following technical and water legal-related reports were completed:

  "MX siting Investigation, Water Resources Program, Summary for Draft Environmental Impact Statement," 15 May 1980 revised 1 August 1980 (FN-TR-38). This report summarized the results of the studies performed to date in 16 valleys in the siting area, including an update of the six previously reported valleys. The additional valleys studied were 1) Cave, 2) Delamar, 3) Dugway, 4) Fish Springs Flat, 5) Little Smoky, 6) Pine, 7) Railroad, 8) Sevier Desert, 9) Wah Wah, and 10) Whirlwind. The report also included a description of the general hydrology, details of the aquifer characteristics, the water-quality limitations of the subject valleys, and the potential impacts of MX ground-water withdrawals and mitigating meausres.

  "Overview of Nevada and Utah Water Law: Historical Development and Current Procedures for Rights Acquisition," revised 2 June 1980. This report provided baseline information for and description of the process for obtaining water rights with background on the water law of Nevada and Utah.

  "Municipal Water-Supply and Wastewater-Treatment Facilities in Selected Nevada and Utah Communities," 20 June 1980 (this report was also submitted to BMO as Volume III of the summary report for the Draft Environmental Impact Statement, 15 May 1980). This study was an assessment of the municipalities and towns within and adjacent to the MX siting area and their capacity for increasing their water-supply and wastewater-treatment facilities.

  "MX Siting Investigations, Water Resources Program, Industry Acitivity Inventory, Nevada-Utah," 2 September 1980. This report provided an assessment of present water use and projected future use by industry and other commercial users.

Fiscal Year 1981

- o Field hydrologic reconnaissance was conducted in Butte, Coyote Spring, Escalante Desert, Jakes, Kobeh, Long, and Newark valleys.
- o Applications were filed for ground-water appropriations in Butte, Coyote Spring, Jakes, Long, Monitor, and Newark valleys.
- o Valley-fill drilling was completed in Big Sand Springs, Coal, Coyote Spring, Escalante Desert, Garden, Muleshoe, Reveille, Wah Wah, and Whirlwind valleys.
- o Valley-fill aquifer testing was conducted in Big Sand Springs, Cave, Escalante Desert, Garden, Hot Creek (north),

Hot Creek (south), Muleshoe, Railroad (north), Reveille, Wah Wah, and Whirlwind valleys.

- Drilling was completed in the carbonate aquifer in Coal, Coyote Spring (3 wells), Dry Lake, and Steptoe valleys.
- Carbonate aquifer testing was completed in Coal, Coyote Spring (2 tests), Dry Lake, and Steptoe valleys.
- Numerical modeling of ground-water systems was completed for Delamar, Dry Lake, Muleshoe, Pine, Wah Wah, and Pahroc valleys. In addition, models were begun for Cave, Coyote Spring, Escalante Desert, Hamlin Lake, Long, White River, Snake, and Spring valleys.
- The following technical, water legal-related, and progress reports were completed:

  "MX siting Investigation, Water Resources Program, Interim Report," 31 October 1980 (FN-TR-40). The Interim Report was an extension of the technical summary report series and included the preliminary results of the investigation of the following valleys: Big Sand Springs, Coal, Garden, Lake, Muleshoe, Pahroc, Penoyer, and Spring. The information presented in the report is similar to that in the Summary for Draft Environmental Impact Statement.

  "MX Siting Investigation, Water Resources Program, Operational Base Studies Report, Volume I, Coyote Spring Operational Base, Nevada," 28 May 1981 (E-TR-52-I). This report presented a discussion of the water resources of the Coyote Spring Valley and results of testing performed to date.

  "MX Siting Investigation, Water Resources Program, Operational Base Studies Report, Volume II, Milford and Beryl Operational Bases, Escalante Valley, Utah," 28 May 1981 (E-TR-51-II). This report has a similar format and content as the Coyote Spring OB report.

  "MX Siting Investigation, Water Resources Program, Preliminary Water Management Report, Volumes I and II, 28 September 1981 (E-TR-53). This report presented preliminary water management planning information for 12 deployment areas and two Operational Base (OB) valleys in which MX construction is scheduled to begin in 1982 or 1983.

  "MX Siting Investigation, Water Rights Inventory, Nevada-Utah, Water Resources Program FY 80," 19 December 1980. This report presented a summary of surface- and ground-water rights in the siting area with a breakdown according to applications, permits, certificates, and proofs.

  "MX Siting Investigations, Water Resources Program, Progress Report," 13 February 1981. The Progress Report presented the status of Water Resources Program activities since the Interim Report of 31 October 1980 through 9 January 1981. It also discussed the preliminary results of field drilling, testing and reconnaissance programs, OB studies, and computer numerical model simulations of valley-fill aquifers in selected valleys.

The number of field activities performed in each deployment valley since the initiation of the Water Resources Program is listed in Table A1-1.

VALLEY	DRILLED WELLS(1)	AQUIFER PUMP TESTS(2)	WATER QUALITY ANALYSES	WATER LEVEL MEASUREMENTS (4)	DISCHARGE MEASUREMENTS	WATER TABLE MONITORING WELL
NEVADA						
ANTELOPE	0	0	4	38	6	6
BIG SAND SPRINGS	2	1	4	7	4	1
BIG SMOKY	0	2	5	23	2	0
BUTTE	0	0	5	21	6	5
CAVE	2	1	9	14	3	2
COAL	3	1	7	20	1	5
COYOTE SPRING (MOB)	5	3	7	6	9	0
DELAMAR	2	1	4	3	4	0
DRY LAKE	3	1	8	3	5	0
GARDEN	2	1	11	66	8	7
HOT CREEK	4	2	28	36	14	6
JAKES	0	0	3	2	8	0
KOBEH	0	0	8	49	13	5
LAKE	0	0	0	67	0	15
LITTLE SMOKY	0	0	4	20	3	3
LONG	0	0	6	23	3	6
MONITOR	0	0	17	12	22	0
MULESHOE	2	1	5	3	8	0
NEWARK	0	1	15	49	11	5
PAHROC	0	0	0	5	1	0
PENOYER	0	0	6	39	9	6
RAILROAD	4	2	12	64	15	19
RALSTON	0	0	2	24	6	3
REVEILLE	2	1	6	9	6	1
SPRING	2	2	15	88	10	13
STEPTOE	1	1	23	39	16	9
STONE CABIN	0	0	7	25	8	5
WHITE RIVER	1	4	22	112	3	11
UTAH						
DUGWAY	2	0	1	37	1	3
FISH SPRINGS FLAT	0	0	2	85	1	9
ESCALANTE DESERT (AOB)	4	2	32	86	4	0
PINE	2	1	6	3	2	0
SEVIER DESERT	0	1	7	79	0	14
SNAKE(3)	0	5	26	349	7	40
HAMLIN(3)	2	5	23	138	15	16
TULE	4	3	14	190	5	16
WAH WAH	3	1	5	3	0	0
WHIRLWIND	2	1	3	94	2	15
TOTAL	54	44	362	1931	241	246

NOTE:

1. Includes test and observation wells.
2. Includes both drilling and reconnaissance program
3. Straddles Nevada - Utah border
4. Includes multiple measurements at monitoring sites through March 1981
5. Total does not include 7 wells outside water resources study area boundaries

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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SUMMARY OF MX WATER RESOURCES PROGRAM FIELD ACTIVITIES

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APPENDIX B

MX WATER USE ESTIMATES *

* Based on U.S. Army Corps of Engineers, March 1981

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS					147	227	879	1000	107
INDEPENDENT WORKERS					1	1	5	5	1
REVEGETATION				15	150	750	420	613	224
LANDSCAPING					15	24	94	106	11
DUST CONTROL									
ROADWAYS				38	45	241	241	181	
WORK SITES						214			
IN CAMPS	----------	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------
ROAD CONSTRUCTION									
RECOMPACTION				165	840				
CONSTRUCTION ROADS				34		17			
REGRADING							94		
SHELTER EXCAVATION							95	60	
CONCRETE FOR DDA							21	2	
CONCRETE FOR MOB, ADB, DAA, OBTS									
CONCRETE AGGREGATE WASH							23	2	
TOTALS (ACRE FEET / YEAR)				252	1198	1474	1872	1969	343

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MX WATER—USE
ESTIMATES
ANTELOPE VALLEY, NEVADA

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TABLE B1-1

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS					1	3	4	3	
REVEGETATION				70	10	401	210	200	
LANDSCAPING									
DUST CONTROL									
ROADWAYS				20	62	111	111		
WORK SITES						33			
IN CAMPS	----------	INCLUDED	ABOVE	----------					
ROAD CONSTRUCTION									
RECOMPACTION				55	420				
CONSTRUCTION ROADS									
REGRADING							47		
SHELTER EXCAVATION						25	50	5	
CONCRETE FOR DDA									
CONCRETE FOR MOB, AGS, SAA, OSTE									
CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)				145	493	573	422	208	

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MX WATER–USE ESTIMATES
BIG SAND SPRING VALLEY, NEVADA

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TABLE B1-2

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE & AHORT CAMPS									
INDEPENDENT WORKERS				2	3	4	5	4	
REVEGETATION			225		1367	230	683	525	
LANDSCAPING									
DUST CONTROL									
ROADWAYS			45	45	371	37	371	187	
WORK SITES					299	40	40	40	40
IN CAMPS	----------	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------
ROAD CONSTRUCTION									
RECLAMATION			165	1400					
CONSTRUCTION ROADS									
RESURFACING						157			
SHELTER EXCAVATION						100	105	55	
CONCRETE FOR DDA									
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH									
TOTAL (ACRE FEET / YEAR)			435	1447	2040	568	1204	811	40

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MX WATER–USE
ESTIMATES
BIG SMOKY VALLEY, NEVADA

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TABLE B1-3

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS						1	3	4	2
REVEGETATION				140			699	315	250
LANDSCAPING									
DUST CONTROL									
ROADWAYS				45	45	127	208	208	
WORK SITES							55		
IN CAMPS	----------	----------	----------	INCLUDED	ABOVE	----------	----------	----------	----------
ROAD CONSTRUCTION									
RECOMPACTION				165	700				
CONSTRUCTION ROADS									
REGRADING								78	
SHELTER EXCAVATION							40	85	5
CONCRETE FOR DDA									
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH									
TOTAL (ACRE FEET / YEAR)				350	745	128	1005	690	257

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DEPARTMENT OF THE AIR FORCE
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MX WATER–USE
ESTIMATES
BUTTE VALLEY, NEVADA

30 NOV 81

TABLE B1-4

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS		1	2	2	3	1			
REVEGETATION		125	345	60	200	180			
LANDSCAPING									
DUST CONTROL									
ROADWAYS		17	115	115	115	21			
WORK SITES			34						
IN CAMPS	---	---	---	INCLUDED	ABOVE	---	---	---	---
ROAD CONSTRUCTION									
RECOMPACTION		40	420						
CONSTRUCTION ROADS									
REGRADING				47					
SHELTER EXCAVATION				35	40	5			
CONCRETE FOR DCA									
CONCRETE FOR MOB, AOB, DAA [illegible]									
CONCRETE AGGREGATE WASH									
TOTAL (ACRE-FEET / YEAR)		183	916	259	358	207			

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE
ESTIMATES
CAVE VALLEY, NEVADA

30 NOV 81

TABLE B1-5

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
[illegible] SUPPORT CAMPS		239	660	772	1067	820			
INDEPENDENT WORKERS		1	3	3	4	2			
REVEGETATION		150	575	120	380	341	250		
LANDSCAPING		25	70	82	114	87			
DUST CONTROL									
ROADWAYS		33	165	206	206	104			
WORK SITES		40	95	40	40	40			
IN CAMPS	INCLUDED ABOVE								
ROAD CONSTRUCTION									
RECOMPACTION		125	700						
CONSTRUCTION ROADS		34	17						
REGRADING				78					
SHELTER EXCAVATION				40	60	30			
CONCRETE FOR DDA				20	18				
CONCRETE FOR [illegible], [illegible], DAA [illegible]									
CONCRETE AGGREGATE WASH				23	20				
TOTAL (ACRE-FEET / YEAR)		647	2285	1384	1909	1424	250		

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

MX WATER-USE
ESTIMATES
COAL VALLEY, NEVADA

30 NOV 81

TABLE B1-6

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS	734	1620	1780	2674	4314	4595	4227	3986	113
B. INDEPENDENT WORKERS	8	16	18	27	43	46	42	40	2
2. REVEGETATION		160		100	50	150	197	400	805
3. LANDSCAPING	31	69	75	413	1183	1195	179	169	5
4. DUST CONTROL									
A. ROADWAYS	14	44	44	44	29	14			
B. WORK SITES	40	290	40	4040	4040	985	40	40	40
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION		125							
B. CONSTRUCTION ROADS	34								
C. REGRADING						21			
6. SHELTER EXCAVATION									
7. CONCRETE FOR DDA									
8. CONCRETE FOR MOB, AOB, DAA, DBTS	2	8	22	10	11	8			
9. CONCRETE AGGREGATE WASH	3	11	31	14	15	11			
TOTAL (ACRE FEET / YEAR)	866	2343	2010	7322	9685	7025	4685	4635	965

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MX SITING INVESTIGA
DEPARTMENT OF THE AIR
BMO/AFRCE-MX

MX WATER–USE
ESTIMATES
COYOTE SPRING VALLEY, NEVA

30 NOV 81

TAB

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS		1	2	4	4				
REVEGETATION		110	280	175	180				
LANDSCAPING									
DUST CONTROL									
ROADWAYS	21	30	95	95	48				
WORK SITES			22						
IN CAMPS	INCLUDED ABOVE								
ROAD CONSTRUCTION									
RECOMPACTION	95		280						
CONSTRUCTION ROADS									
REGRADING				31					
HOLE EXCAVATION				35	20				
CONCRETE FOR DAA									
CONCRETE FOR HOB, AOB, DAA, ...CTS									
CONCRETE AGGREGATE WASH									
TOTAL (ACRE-FEET / YEAR)	11[illegible]	141	679	340	252				

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

MX WATER–USE ESTIMATES
DELAMAR VALLEY, NEVADA

30 NOV 81 — TABLE B1-8

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS		200	593	1179	1000				
INDEPENDENT WORKERS		1	2	4	4				
REVEGETATION		115	995	520	733	250			
LANDSCAPING		21	93	125	106				
DUST CONTROL									
ROADWAYS	37	50	311	311	156				
WORK SITES		40	278	60	40				
IN CAMPS	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------	----------
ROAD CONSTRUCTION									
RECOMPACTION	159		1120						
CONSTRUCTION ROADS	34		17						
REGRADING				125					
SHELTER EXCAVATION				140	70				
CONCRETE FOR DDA			1	23	2				
CONCRETE FOR MOB. ADD. DAA COSTS									
CONCRETE AGGREGATE WASH			1	26	2				
TOTALS (ACRE-FEET / YEAR)	[illegible]	427	3411	2533	2133	250			

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

MX WATER–USE
ESTIMATES
DRY LAKE VALLEY, NEVADA

30 NOV 81

TABLE B1-9

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS			146	214	746	833	1046		
INDEPENDENT WORKERS			4	1	3	3	4		
REVEGETATION			120		700	330	330	289	
LANDSCAPING			15	23	79	89	111		
DUST CONTROL									
ROADWAYS			40	122	203	203	69		
WORK SITES			40	40	95	40			
IN CAMPS	-------	-------	-------	-------	INCLUDED	ABOVE	-------	-------	-------
ROAD CONSTRUCTION									
RECOMPACTION			110	700					
CONSTRUCTION ROADS			34		17				
REGRADING						78			
SHELTER EXCAVATION					30	65	35		
CONCRETE FOR DDA					13	10			
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH					15	10			
TOTALS (ACRE FEET / YEAR)			509	1100	1901	1661	1595	289	

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

MX WATER–USE
ESTIMATES
DUGWAY VALLEY, UTAH

30 NOV 81

TABLE B1-10

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS				2000	2106	2376	2866	2486	
B. INDEPENDENT WORKERS				20	21	24	29	25	
2. REVEGETATION					98	200	218	315	970
3. LANDSCAPING				85	89	101	621	705	
4. DUST CONTROL									
A. ROADWAYS			14	14	14	14	14	14	
B. WORK SITES			250	2040	895	40	40	40	
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION									
B. CONSTRUCTION ROADS		34							
C. REGRADING									
6. SHELTER EXCAVATION									
7. CONCRETE FOR DDA									
8. CONCRETE FOR MOB, AOB, DAA, OBTS				16	8	7	6	6	
9. CONCRETE AGGREGATE WASH				23	11	10	8	8	
TOTALS (ACRE FEET / YEAR)		34	264	4198	3242	2772	3802	3599	970

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER USE ESTIMATES ESCALANTE DESERT, UTAH

30 NOV 81

TABLE B1-11

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS			1	1	3	3	4		
REVEGETATION			110		415	195	175		
LANDSCAPING									
DUST CONTROL									
ROADWAYS			27	76	125	125	42		
WORK SITES					33				
IN CAMPS	---------- INCLUDED ABOVE ----------								
ROAD CONSTRUCTION									
RECOMPACTION			80	420					
CONSTRUCTION ROADS									
REGRADING						47			
SHELTER EXCAVATION					20	40	20		
CONCRETE FOR DDA									
CONCRETE FOR MOB, AGB, DAA, OBTS									
CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)			218	497	596	410	241		

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

MX WATER–USE ESTIMATES
FISH SPRINGS FLAT, UTAH

30 NOV 81

TABLE B1-12

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS		1	3	3	4	2			
REVEGETATION		150	595	100	370	300			
LANDSCAPING									
DUST CONTROL									
ROADWAYS		26	155	196	196	99			
WORK SITES			55						
IN CAMPS	---------- INCLUDED ABOVE ----------								
ROAD CONSTRUCTION									
RECOMPACTION		110	700						
CONSTRUCTION ROADS									
REGRADING				78					
SHELTER EXCAVATION				40	55	35			
CONCRETE FOR DDA									
CONCRETE FOR MOB, AOB, DAA, OSTS									
CONCRETE AGGREGATE WASH									
TOTAL (ACRE-FEET / YEAR)		287	1508	417	625	436			

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

MX WATER–USE ESTIMATES
GARDEN VALLEY, NEVADA

30 NOV 81

TABLE B1-13

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS		1	3	4	6	2			
REVEGETATION		195	995	215	608	275	200	110	
LANDSCAPING									
DUST CONTROL									
ROADWAYS		45	306	306	306	52			
WORK SITES			196	50					
IN CAMPS	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------	----------
ROAD CONSTRUCTION									
RECOMPACTION		165	1120						
CONSTRUCTION ROADS									
REGRADING				125					
SHELTER EXCAVATION				95	100	15			
CONCRETE FOR DDA									
CONCRETE FOR MOB, ADS, DAA, OSTS									
CONCRETE AGGREGATE WASH									
TOTALS (ACRE-FEET / YEAR)		406	2620	795	1020	344	200	110	

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

MX WATER–USE ESTIMATES
HAMLIN VALLEY, UTAH AND NEVADA

30 NOV 81

TABLE B1-14

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS					126	473	819	606	
INDEPENDENT WORKERS					1	3	4	3	
REVEGETATION				70	15	700	360	553	
LANDSCAPING					13	50	87	64	
DUST CONTROL									
ROADWAYS				34	116	197	197		
WORK SITES					40	243	40	40	
IN CAMPS	INCLUDED ABOVE								
ROAD CONSTRUCTION									
RECOMPACTION				80	700				
CONSTRUCTION ROADS				34		17			
REGRADING							78		
SHELTER EXCAVATION						40	85	5	
CONCRETE FOR DDA						12	6		
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH						13	7		
TOTALS (ACRE FEET / YEAR)				218	1011	1748	1683	1271	

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

MX WATER–USE
ESTIMATES
HOT CREEK VALLEY, NEVADA

30 NOV 81

TABLE 81-15

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS						1	3	4	2
REVEGETATION				150	10		555	250	225
LANDSCAPING									
DUST CONTROL									
ROADWAYS				33	33	99	164	164	
WORK SITES							44		
IN CAMPS	INCLUDED ABOVE								
ROAD CONSTRUCTION									
RECOMPACTION				110	560				
CONSTRUCTION ROADS									
REGRADING								63	
SHELTER EXCAVATION							35	65	5
CONCRETE FOR DDA									
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)				293	603	100	801	546	232

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

MX WATER–USE
ESTIMATES
JAKES VALLEY, NEVADA

30 NOV 81

TABLE B1-16

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS				1	1	1	5	5	
REVEGETATION					170	685	360	300	
LANDSCAPING									
DUST CONTROL									
ROADWAYS				27	115	196	196	99	
WORK SITES						55			
IN CAMPS	INCLUDED ABOVE								
ROAD CONSTRUCTION									
RECOMPACTION				110	700				
CONSTRUCTION ROADS									
REGRADING							78		
SHELTER EXCAVATION						35	75	20	
CONCRETE FOR DDA									
CONCRETE FOR MOB, AOB, DAA, ODTS									
CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)				138	986	972	714	424	

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE
ESTIMATES
KOBEH VALLEY, NEVADA

30 NOV 81

TABLE B1-17

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS		180	586	806	1093	313			
B. INDEPENDENT WORKERS		1	2	2	3	1			
2. REVEGETATION		115	600	185	476	500			
3. LANDSCAPING		19	62	86	116	33			
4. DUST CONTROL									
A. ROADWAYS		46	209	209	209	37			
B. WORK SITES		40	213	70	40	40			
C. IN CAMPS	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------	----------
5. ROAD CONSTRUCTION									
A. RECOMPACTION		135	700						
B. CONSTRUCTION ROADS		34	17						
C. REGRADING				78					
6. SHELTER EXCAVATION				55	60	15			
7. CONCRETE FOR DDA				23	4				
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH				27	6				
10. TOTALS (ACRE-FEET / YEAR)		570	2389	1541	2009	939			

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

MX WATER–USE
ESTIMATES
LAKE VALLEY, NEVADA

30 NOV 81

TABLE B1-18

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS					1	1	5	5	1
REVEGETATION					170	460	280	430	
LANDSCAPING									
DUST CONTROL									
ROADWAYS				10	11	141	141	106	
WORK SITES						44			
IN CAMPS	----------	INCLUDED	ABOVE	----------					
ROAD CONSTRUCTION									
RECOMPACTION				80	560				
CONSTRUCTION ROADS									
REGRADING							63		
SHELTER EXCAVATION							60	45	
CONCRETE FOR DDA						1			
CONCRETE FOR MOS, AOB, DAA SITE									
CONCRETE AGGREGATE WASH						1			
TOTALS (ACRE FEET / YEAR)				90	742	648	549	585	1

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

MX WATER–USE
ESTIMATES
LITTLE SMOKY VALLEY, NEVADA

30 NOV 81

TABLE B1-19

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS						153	506	767	446
INDEPENDENT WORKERS					1	3	5	1	
REVEGETATION				120		490	220	60	259
LANDSCAPING						46	54	82	47
DUST CONTROL									
ROADWAYS			25	24	83	132	110		
WORK SITES				40	40	261	40	40	40
IN CAMPS	----	----	----	----	INCLUDED ABOVE	----	----	----	----
ROAD CONSTRUCTION									
RECOMPACTION			80	420					
CONSTRUCTION ROADS			34				17		
REGRADING							47		
HELIPAD EXCAVATION						25	55		
CONCRETE FOR SSA							15	5	
CONCRETE FOR MOB, AGB, DAA, OBTS									
CONCRETE AGGREGATE WASH							17	6	
TOTALS (ACRE FEET / YEAR)			139	614	124	1110	1086	961	792

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

MX WATER-USE
ESTIMATES
LONG VALLEY, NEVADA

30 NOV 81

TABLE B1-20

AD-A112 940 ERTEC WESTERN INC .LONG BEACH CA F/G 13/2
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. TECHNICAL SUM--ETC(U)
NOV 81 F04704-80-C-0006
UNCLASSIFIED E-TR-52-1 NL

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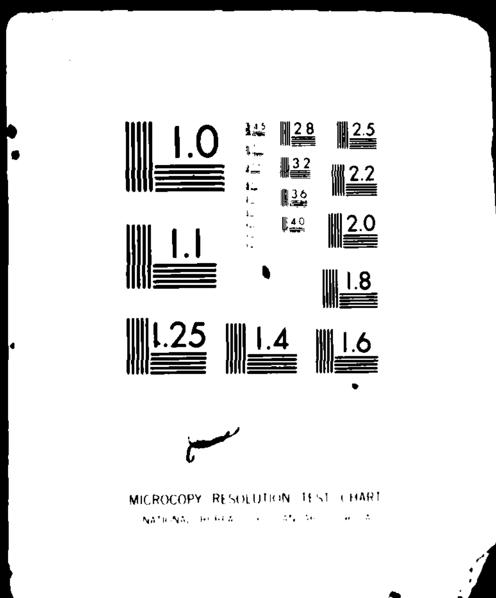

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS				180	193	281	960	1006	
B. INDEPENDENT WORKERS				1	1	1	5	5	
2. REVEGETATION			15		205	1180	460	420	96
3. LANDSCAPING				19	20	30	102	107	
4. DUST CONTROL									
A. ROADWAYS				44	182	313	313	156	
B. WORK SITES				40	40	128	40	40	
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION				165	1120				
B. CONSTRUCTION ROADS				34		17			
C. REGRADING							125		
6. SHELTER EXCAVATION						50	105	55	
7. CONCRETE FOR DDA						14	15		
8. CONCRETE FOR MOB, AOB, DAA, ODTS						17	16		
9. CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)			15	483	1761	2031	2141	1789	96

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

MX WATER–USE ESTIMATES MONITOR VALLEY, NEVADA

30 NOV 81

TABLE B1-21

ACTIVITY	82	83	84	85	86	87	88	89	90
1 DOMESTIC									
A LIFE SUPPORT CAMPS									
B INDEPENDENT WORKERS		1	2	2	3	1			
2 REVEGETATION		135	385	70	175	150			
3 LANDSCAPING									
4 DUST CONTROL									
A ROADWAYS		30	128	128	128	22			
B WORK SITES			33						
C IN CAMPS	----	----	----	INCLUDED ABOVE	----	----	----	----	----
5 ROAD CONSTRUCTION									
A RECOMPACTION		85	420						
B CONSTRUCTION ROADS									
C REGRADING				47					
6 SHELTER EXCAVATION				35	35	10			
7 CONCRETE FOR DDA									
8 CONCRETE FOR MOB, AOB, DAA, OBTS									
9 CONCRETE AGGREGATE WASH									
TOTALS (ACRE-FEET / YEAR)		251	968	282	341	183			

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

MX WATER–USE ESTIMATES MULESHOE VALLEY, NEVADA

30 NOV 81

TABLE B1-22

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS					114	447	859	260	
INDEPENDENT WORKERS					1	3	5	1	
REVEGETATION				120		490	260	263	
LANDSCAPING					12	48	91	27	
DUST CONTROL									
ROADWAYS			39	52	101	150	126		
WS SITES					40	73	40	40	
CAMPS	---------- INCLUDED ABOVE ----------								
ROAD CONSTRUCTION									
RECOMPACTION			165	420					
CONSTRUCTION ROADS			34			17			
REGRADING							47		
SHELTER EXCAVATION						25	55		
CONCRETE FOR DDA						12	2		
CONCRETE FOR MOB, ADB, DAA, DDTS									
CONCRETE AGGREGATE WASH						14	1		
TOTALS (ACRE FEET / YEAR)			238	592	268	1279	1486	591	

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

MX WATER–USE ESTIMATES
NEWARK VALLEY, NEVADA

30 NOV 81

TABLE B1-23

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS									
INDEPENDENT WORKERS		1	2	4	4				
REVEGETATION		105	135	80	75				
LANDSCAPING									
DUST CONTROL									
ROADWAYS	15	20	53	53	28				
WORK SITES			11						
IN CAMPS	INCLUDED ABOVE								
ROAD CONSTRUCTION									
RECOMPACTION	55		140						
CONSTRUCTION ROADS									
REGRADING				16					
SHELTER EXCAVATION				15	10				
CONCRETE FOR DDA									
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH									
TOTALS (ACRE-FEET / YEAR)	70	126	341	168	117				

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER—USE
ESTIMATES
PAHROC VALLEY, NEVADA

30 NOV 81

TABLE B1-24

ACTIVITY	82	83	84	85	86	87	88	89	90
1 DOMESTIC									
A. LIFE SUPPORT CAMPS									
B. INDEPENDENT WORKERS			1	2	3	4	3		
2 REVEGETATION			150	700	290	425	395		
3 LANDSCAPING									
4 DUST CONTROL									
A ROADWAYS		16	23	170	219	219	110		
B WORK SITES				66					
C. IN CAMPS	INCLUDED ABOVE								
5 ROAD CONSTRUCTION									
A. RECOMPACTION		70		840					
B. CONSTRUCTION ROADS									
C. REGRADING					94				
6 SHELTER EXCAVATION					50	70	35		
7 CONCRETE FOR DDA									
8 CONCRETE FOR MOB, AOB, DAA, OBTS									
9 CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)		86	174	1778	656	718	543		

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

MX WATER—USE ESTIMATES PENOYER VALLEY, NEVADA

30 NOV 81

TABLE B1-25

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS		180	573	747	1088	260			
B. INDEPENDENT WORKERS		1	3	4	6	2			
2. REVEGETATION		170	575	225	328	540			
3. LANDSCAPING		19	61	80	116	28			
4. DUST CONTROL									
A. ROADWAYS		52	215	215	215	37			
B. WORK SITES		40	65	70	40	40			
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION		165	700						
B. CONSTRUCTION ROADS		34	17						
C. REGRADING				78					
6. SHELTER EXCAVATION				55	60	15			
7. CONCRETE FOR DDA				21	8				
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH				27	6				
[illegible]TALS (ACRE-FEET / YEAR)		661	2209	1522	1667	922			

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

MX WATER—USE ESTIMATES PINE VALLEY, UTAH

30 NOV 81

TABLE B1-26

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS*			81	161	306	485	217		
B. INDEPENDENT WORKERS			2	4	8	14	3		
2. REVEGETATION			480	920	1290	816	1302	23	
3. LANDSCAPING			35	68	131	205	93		
4. DUST CONTROL									
A. ROADWAYS		57	149	399	611	611	183		
B. WORK SITES			80	168	146	80	40		
C. IN CAMPS	----	----	----	----	INCLUDED ABOVE	----	----	----	----
5. ROAD CONSTRUCTION									
A. RECOMPACTION		270	270	1960					
B. CONSTRUCTION ROADS		34	34	17	17				
C. REGRADING					125	94			
6. SHELTER EXCAVATION					120	195	45		
7. CONCRETE FOR DDA					27	33			
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH					30	25			
TOTALS (ACRE FEET / YEAR)		361	1131	3697	2811	2558	1883	23	

* The COE water use estimates do not include domestic water use for dependents in camps.

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER—USE ESTIMATES RAILROAD VALLEY, NEVADA

30 NOV 81

TABLE B1-27

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS				266	426	770	1033	840	
B. INDEPENDENT WORKERS				2	3	4	5	4	
2. REVEGETATION			225		1055	275	544	827	430
3. LANDSCAPING				28	45	83	110	89	
4. DUST CONTROL									
A. ROADWAYS			59	59	353	353	353	177	
B. WORK SITES				290	139	40	40	40	
C. IN CAMPS	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------	----------
5. ROAD CONSTRUCTION									
A. RECOMPACTION			190	1260					
B. CONSTRUCTION ROADS			34		17				
C. REGRADING						141			
6. SHELTER EXCAVATION						90	95	50	
7. CONCRETE FOR DDA						23	20		
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH						26	22		
TOTALS (ACRE FEET / YEAR)			508	1905	2038	1805	2222	2027	430

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

MX WATER–USE ESTIMATES RALSTON VALLEY, NEVADA

30 NOV 81

TABLE B1-28

ACTIVITY	82	83	84	85	86	87	88	89	90
1 DOMESTIC									
A. LIFE SUPPORT CAMPS									
B. INDEPENDENT WORKERS			2	3	7	9	6		
2 REVEGETATION			240	250	300	225	235	25	
3 LANDSCAPING									
4 DUST CONTROL									
A. ROADWAYS		19	27	125	158	158	79		
B. WORK SITES				170	22				
C. IN CAMPS	INCLUDED ABOVE								
5 ROAD CONSTRUCTION									
A. RECOMPACTION		80		560					
B. CONSTRUCTION ROADS									
C. REGRADING					31	31			
6 SHELTER EXCAVATION					30	65	15		
7 CONCRETE FOR DDA									
8 CONCRETE FOR MOB, AOB, DAA, ODTS									
9 CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)		99	269	1108	548	488	335	25	

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DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

MX WATER–USE ESTIMATES
REVEILLE VALLEY, NEVADA

30 NOV 81

TABLE B1-29

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS									
B. INDEPENDENT WORKERS		1	4	4	6	5	4		
2. REVEGETATION		100	645	105	480	260	350		
3. LANDSCAPING									
4. DUST CONTROL									
A. ROADWAYS		45	216	273	273				
B. WORK SITES			25	30	22				
C. IN CAMPS	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------	----------
5. ROAD CONSTRUCTION									
A. RECOMPACTION		165	980						
B. CONSTRUCTION ROADS									
C. REGRADING				78		31			
6. SHELTER EXCAVATION				50	85	35	15		
7. CONCRETE FOR DDA									
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)		311	1870	540	866	331	369		

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MX WATER–USE ESTIMATES SEVIER DESERT, UTAH

30 NOV 81

TABLE 81-30

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS			133	240	740	793	1026		
B. INDEPENDENT WORKERS			1	3	9	9	15	6	
2. REVEGETATION			435	190	1563	960	585	710	
3. LANDSCAPING			14	25	79	84	109		
4. DUST CONTROL									
A. ROADWAYS			23	135	447	447			
B. WORK SITES			40	40	139	380	40		
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION			40	1820					
B. CONSTRUCTION ROADS			34		17				
C. REGRADING						141	63		
6. SHELTER EXCAVATION					70	180	65	25	
7. CONCRETE FOR DDA					14	6			
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH					16	7			
TOTALS (ACRE FEET / YEAR)			720	2453	3094	3007	1903	741	

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE ESTIMATES
SNAKE VALLEY, NEVADA AND UTAH

30 NOV 81

TABLE B1-31

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS									
B. INDEPENDENT WORKERS		1	2	2	3	1			
2. REVEGETATION		60	240	155	140	50			
3. LANDSCAPING									
4. DUST CONTROL									
A. ROADWAYS		20	85	85	85	16			
B. WORK SITES			22						
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION		55	280						
B. CONSTRUCTION ROADS									
C. REGRADING				31					
6. SHELTER EXCAVATION				25	25	5			
7. CONCRETE FOR DDA									
8. CONCRETE FOR MOB, AGS, DAA, OBTS									
9. CONCRETE AGGREGATE WASH									
TOTALS (ACRE-FEET / YEAR)		136	629	298	253	72			

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE
ESTIMATES
SPRING VALLEY, NEVADA

30 NOV 81

TABLE B1-32

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS			113	113	727	865	553		
B. INDEPENDENT WORKERS			1	1	4	5	3		
2. REVEGETATION			125		900	310	410	334	
3. LANDSCAPING			12	12	118	92	59		
4. DUST CONTROL									
A. ROADWAYS			56	149	252	252			
B. WORK SITES			40	40	442	40	40		
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION			175	840					
B. CONSTRUCTION ROADS			34		17				
C. REGRADING						94			
6. SHELTER EXCAVATION					50	100	5		
7. CONCRETE FOR DDA					11	8			
8. CONCRETE FOR MOB, AOB, DAA, DSTS									
9. CONCRETE AGGREGATE WASH					13	8			
TOTALS (ACRE FEET / YEAR)			556	1155	2534	1774	1070	334	

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE
ESTIMATES
STONE CABIN VALLEY, NEVADA

30 NOV 81

TABLE B1-33

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS					140	220	927	1127	
B. INDEPENDENT WORKERS		1	2	3	5	2	5	6	
2. REVEGETATION			245	320	960	1173	460	200	296
3. LANDSCAPING					15	24	99	120	
4. DUST CONTROL									
A. ROADWAYS				72	137	333	333	166	
B. WORK SITES			170		40	106	40	40	
C. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
A. RECOMPACTION				245	1120				
B. CONSTRUCTION ROADS				34		17			
C. REGRADING				31			94		
6. SHELTER EXCAVATION				25	30	50	70	35	
7. CONCRETE FOR DDA									
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH						8	17		
TOTALS (ACRE FEET / YEAR)		1	417	730	2447	1933	2045	1694	296

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

MX WATER–USE ESTIMATES
TULE VALLEY, UTAH

30 NOV 81

TABLE B1-34

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
A. LIFE SUPPORT CAMPS		154	539	733	1012	280			
B. INDEPENDENT WORKERS		1	2	3	4	1			
2. REVEGETATION		140	940	500	740	269			
3. LANDSCAPING		16	57	78	108	30			
4. DUST CONTROL									
A. ROADWAYS		66	327	327	327				
B WORK SITES		40	226	90	40	40			
C. IN CAMPS	----------	----------	----------	INCLUDED ABOVE	----------	----------	----------	----------	----------
5 ROAD CONSTRUCTION									
A. RECOMPACTION		215	1120						
B. CONSTRUCTION ROADS		34	17						
C. REGRADING				125					
6. SHELTER EXCAVATION				100	110				
7. CONCRETE FOR DDA				21	4				
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH				24	4				
TALS (ACRE-FEET / YEAR)		666	3228	2001	2349	620 **			

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE ESTIMATES WAH WAH VALLEY, UTAH

30 NOV 81

TABLE 81-35

ACTIVITY	82	83	84	85	86	87	88	89	90
DOMESTIC									
LIFE SUPPORT CAMPS		154	746	746	833	400			
INDEPENDENT WORKERS		1	3	3	4	2			
REVEGETATION		300	595	285	320	433	123	171	
LANDSCAPING		16	79	109	89	43			
DUST CONTROL									
ROADWAYS		59	181	222	222				
WORK SITES		40	391	80	40	40			
IN CAMPS	----	----	----	INCLUDED ABOVE	----	----	----	----	----
ROAD CONSTRUCTION									
RECOMPACTION		190	700						
CONSTRUCTION ROADS		34	17						
REGRADING				78					
SHELTER EXCAVATION				50	75	5			
CONCRETE FOR DDA				20	6				
CONCRETE FOR MOB, AOB, DAA, OBTS									
CONCRETE AGGREGATE WASH				23	6				
TOTALS (ACRE FEET / YEAR)		794	2712	1616	1595	923	123	171	

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
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MX WATER–USE ESTIMATES WHIRLWIND VALLEY, UTAH

30 NOV 81

TABLE 81-36

ACTIVITY	82	83	84	85	86	87	88	89	90
1. DOMESTIC									
a. LIFE SUPPORT CAMPS									
b. INDEPENDENT WORKERS		1	3	3	3	2			
2. REVEGETATION		145	805	235	470	716			
3. LANDSCAPING									
4. DUST CONTROL									
a. ROADWAYS		44	223	280	280	141			
b. WORK SITES			373						
c. IN CAMPS	INCLUDED ABOVE								
5. ROAD CONSTRUCTION									
a. RECOMPACTION		190	980						
b. CONSTRUCTION ROADS									
c. REGRADING				110					
6. SHELTER EXCAVATION				60	85	40			
7. CONCRETE FOR DDA						8	15		
8. CONCRETE FOR MOB, AOB, DAA, OBTS									
9. CONCRETE AGGREGATE WASH									
TOTALS (ACRE FEET / YEAR)		380	2384	688	838	907	15		

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MX SITING INVESTIGATION
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MX WATER–USE ESTIMATES
WHITE RIVER VALLEY, NEVADA

30 NOV 81

TABLE 81-37

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