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No.	Transfer Date	Release Date	Title
7.	A	A	"The Biota of Redondo Creek Canyon, Sandoval County, New Mexico, with Emphasis on Big Game Species and Rare, Endangered or Threatened Species", by Southwest Environmental Research and Development Corporation, October 1974.
8.	A	A	"Report on Reconnaissance of Redondo Creek, Redondo Border, Sulfur Canyon, Alamo Canyon and Valle Seco Areas with Proposals and Budget Estimates for Biological Baseline Studies", Whitford Ecological Consultants, May 1975.
9.	B	B	"Winter Activity and Habitat Use by Elk in the Redondo Creek Area with Comments on Activities and Relative Abundance of Other Species", by Whitford Ecological Consultants, August 1975.
10.	B	B	"The Biota of the Baca Geothermal Site", by Whitford Ecological Consultants, November 1975.
.1.	B	B	"Studies of Rare and/or Endangered Species on the Union-Baca Geothermal Lease and Surrounding Area with Discussion of Other Species", by Whitford Ecological Consultants, 1975(?).
12.	B	B	Hydrology of the Region Surrounding the Valles Caldera by Water Resources Associates - 1977.
13.	B	B	Appendices II and III to Hydrology of the Region Surrounding the Valles Caldera, Water Resources Associates - 1977.
14.	B	B	Model of Streamflow Depletion of the Jemez River by Geothermal Development in the Valles Caldera, New Mexico by Water Resources Associates, Inc. - 1977 - Addendum to Hydrology, Jemez Mountains, New Mexico - 1977.

HYDROLOGY
JEMEZ MOUNTAINS, NEW MEXICO

UNION OIL CO.

WATER RESOURCES ASSOCIATES, INC.
3009 North 67th Place
Scottsdale, Arizona

HYDROLOGY
JEMEZ MOUNTAINS, NEW MEXICO

PROJECT OF
UNION GEOTHERMAL DIVISION
UNION OIL COMPANY

WATER RESOURCES ASSOCIATES, INC.
3009 North 67th Place
Scottsdale, Arizona
March 1977

WATER RESOURCES ASSOCIATES, INC.
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J. R. ERICKSON, P.E.

March 31, 1977

Mr. Richard Engebretsen
Project Engineer
Union Geothermal Division
Union Oil Company
Mountain Route Box 76
Jemez Spring, New Mexico 87025

Dear Mr. Engebretsen:

Transmitted herewith is our report on the Hydrology of the Jemez Mountains of north-central New Mexico. Special emphasis has been given to the geothermal reservoir and possible connection with the Rio Grande hydrologic system.

Preliminary computations are included which begin to delimit the time and quantity parameters of effects on the Rio Grande system caused by withdrawals from the geothermal reservoir.

Sincerely,

John R. Erickson, P.E.

JRE:jc
Enclosure

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I Streamflow Data

II Basic Data

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Part 2 Selected Wells, Springs and Surface Water Gaging Stations

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III Chemical Diagrams

Synopsis

Hydrologic data collected since October 1975 have been compiled and analyzed. Because of unavoidable circumstances, streamflow records are broken and of poor quality. Subsequent investigation has shown that stream flow analysis within the Caldera is not needed in the hydrologic solution being sought. Valuable data collected by the State of New Mexico at the springs and wells of the area and by Union Geothermal Division have been utilized in this evaluation.

The hydrology of the area strongly supports the evidence of some discharge of deep Caldera reservoir water into the Jemez River. It is assumed that the hydrologic system is in dynamic equilibrium and that there is recharge into the reservoir of an equal amount. The investigation shows that:

1. Fluid levels in the Caldera reservoir are 800 to 1200 feet below regional groundwater levels.
2. Water surface profiles support evidence deduced from the water chemistry of the region that little opportunity exists for movement of water out of the Caldera reservoir, except through faults and sediments of low permeability to the south-southwest along the Jemez River.
3. Chemical characteristics of the Caldera reservoir water, when compared to that of springs and base River flow, suggest dilution by fresher meteoric waters.
4. Discharge of waters with high concentrations of dissolved solids has persisted down the Jemez River and along the San Diego Canyon for a long period of time. Quantities now moving in that direction are calculated in the magnitude of 150 to 200 gallons per minute.
5. It is believed that the early drainage was of very poor quality water which could have been deposited

in part in the rocks of the canyon and which may still be contributing to the low grade quality of the general Jemez Valley system.

6. Groundwater hydraulics of the region, based on knowledge of the formations and the fundamental hydrology of the area around the Caldera, suggest that the lowering of water levels in the Caldera reservoir due to production of steam, might be felt in extremely small quantities almost from the beginning of the operation. Preliminary computations indicate that stream diminution in 50 years might be in the amount of 30 gallons per minute.

Recommendations

It is recommended that

1. The stream gaging program be discontinued.
2. The program of sampling and measuring the springs and wells of the area be reduced to once or twice a year.
3. A refinement of some of the areas of calculations suggested by this report might be undertaken.

All of the above recommendations would be contingent upon, at least, tacit approval by the State Engineer.

Introduction

In early August 1975, the Project Coordinator, Geothermal Division of Union Oil Company, contacted Water Resources Associates, Inc. (WRAI) regarding evaluation of the hydrology of the region surrounding the Valles Caldera, an area of geothermal potential located in north central New Mexico in the Jemez Mountains, about 40 miles northwest of Santa Fe.

The primary reason for retaining outside consulting assistance was to evaluate the effects of geothermal energy production on the hydrology of the Rio Grande system. The consulting firm would also provide (1) assistance in establishing and operating a hydrologic monitoring program, (2) professional personnel familiar with the State and the Jemez Mountains region, and with the legal and administrative procedures and problems within the State, and (3) professional expertise available in the event of legal action.

For the pilot project, Union Oil drilled eleven geothermal test wells in Redondo Canyon. Several other geothermal wells have been drilled in the Sulphur Creek drainage. A recent interference and re-injection test was done in the Redondo Canyon area.

Water Resources, by letter of September 5, 1975, proposed to the Project Coordinator, a hydrologic monitoring program which might aid in the necessary evaluation of possible hydrologic effects of the geothermal project. It was recognized at the outset that effects of the interference test might not be apparent in a short period of time, and possibly might never be detected.

The monitoring program laid out at that time consisted of surface water measuring stations on East Fork of the Jemez, Redondo Creek, Sulphur Creek and San Antonio Creek. East Fork of the Jemez and San Antonio Creek are the major sources of water being measured by the U.S.G.S. at the Jemez River station near the town of Jemez. Measurement of the discharge of the thermal springs in the area was recommended, together with a regular program of chemical analysis of the water, both surface and undergound.

WRAI was then asked to make suggestions about the installation of gaging stations to measure the surface flows and to provide basic instruction to Union Oil personnel to carry out the surface water measuring program. The State of New Mexico undertook the measuring and water sample collecting program at the thermal springs. The New Mexico District office of the U. S. Geological Survey cooperated by loaning equipment until it could be replaced by Union Oil, in order that the measuring program could be expedited.

After the program was initiated, one field trip was made by WRAI personnel to review the installations and make further suggestions. After the field trip of October 23, 1975, no further assistance was asked of WRAI until late October 1976. At that time WRAI was asked to work up the surface water records from data that had been collected since early October 1975 at the four new gaging stations. After the initial request, further information was supplied to WRAI by Union Oil concerning the geology and fluid levels in the Caldera, quality of the geothermal waters, and other data pertinent to the hydrology and geohydrology of the area.

In preparing the initial recommendation for the monitoring program, WRAI gathered all the information that could be found on the area in the U.S. Geological Survey technical bulletins and water supply papers, the New Mexico Geological Society Guidebooks, and from the Los Alamos Scientific Laboratory. These data sources and reports have been relied on, in part, in the preparation of this report.

The purpose of this report is to present the results of the monitoring program and to evaluate regional and local groundwater conditions and water quality, in their relation to the hydrologic problems. A preliminary evaluation of the effects of the steam production in the Valles Caldera on the hydrology of the Rio Grande Basin is presented. Recommendations as to the monitoring and evaluation program are included.

Monitoring Program

Surface Water Measurements

The program initiated in October 1975 was designed to measure possible changes in surface water flows in Redondo and Sulphur Creeks. Also, through records at the gaging stations on San Antonio Creek and East Fork of the Jemez, changes could possibly be detected, in base flow periods, between the upper gaging stations on Redondo and Sulphur Creeks and the established long term station on the Jemez River below the mouth of the East Fork. It was intended that there would be continuing sampling of the quality of those waters to assist in evaluating the separation of the several water sources.

The program was started before there was time to do a great deal with the general hydrology of the area. Considerable reliance was placed on the existing reports of the U.S. Geological Survey and on the ideas of staff members of the Survey and of the State Engineer Office, some of whom have been studying the problems of the area for a number of years.

The surface water measurement program, together with the sampling and analysis of hot springs, was intended to isolate and segregate, as much as possible, the area above the long term gaging station on the Jemez River.

New Gaging Stations

Approval to implement the program that was recommended was given in late September 1975. A field trip was made to estimate the range of flows that might be measured in the two smaller streams, Redondo Creek and Sulphur Creek, where Parshall flumes would be used. Gaging station sites were selected on San Antonio Creek and East Fork of the Jemez. At that time arrangements were made for flumes, recorders and other necessary equipment to carry out the stream gaging program.

Arrangements were made with the U.S.G.S to borrow flumes for the two small stations on a replacement basis. That agency also provided recorders until replacements could be purchased. A ·rent meter was loaned by this office until one could be purchased.

After assessing the discharges, which were at low stage in September 1975, it was decided to install a one foot Parshall flume for the measurement of Redondo Creek. This flume will measure flows ranging from 10 gallons per minute (0.02 cfs) to about 100 gallons per minute (0.22 cfs). A six inch Parshall flume was selected for use on Sulphur Creek where the measurements would be approximately one-half of those on Redondo Creek, ranging from 5 to 50 gpm.

Plans for standard gaging station installations on the other two streams were submitted to the Project Engineer. Verbal instructions were given as to how the stations could be installed and pertinent installation literature and references were provided.

Due to unforeseeable circumstances, the records could not be obtained as originally planned. All of the data collected at ·e gaging stations have been converted to discharges and are compiled in Tables I-1 through I-4 in Appendix I and are shown as hydrographs on Figure 1. Initially, it had been felt that the flow periods could be analyzed to establish trends of groundwater discharge in the stream system. This base flow can be analyzed to establish the effects of groundwater use on surface flow, if those effects occur within a reasonable time frame.

In order to analyze the effects of groundwater use, the water quality records must be examined in relation to the surface water flows. That portion of the study is discussed in the section on hydrochemistry.

Conclusion Regarding The Stream Gaging Stations

Analyses in later sections of the report support the conclusion that the operation of the four gaging stations should not be continued. It will be shown that the waters of East Fork of the Jemez and San Antonio Creek are, to a very large degree,

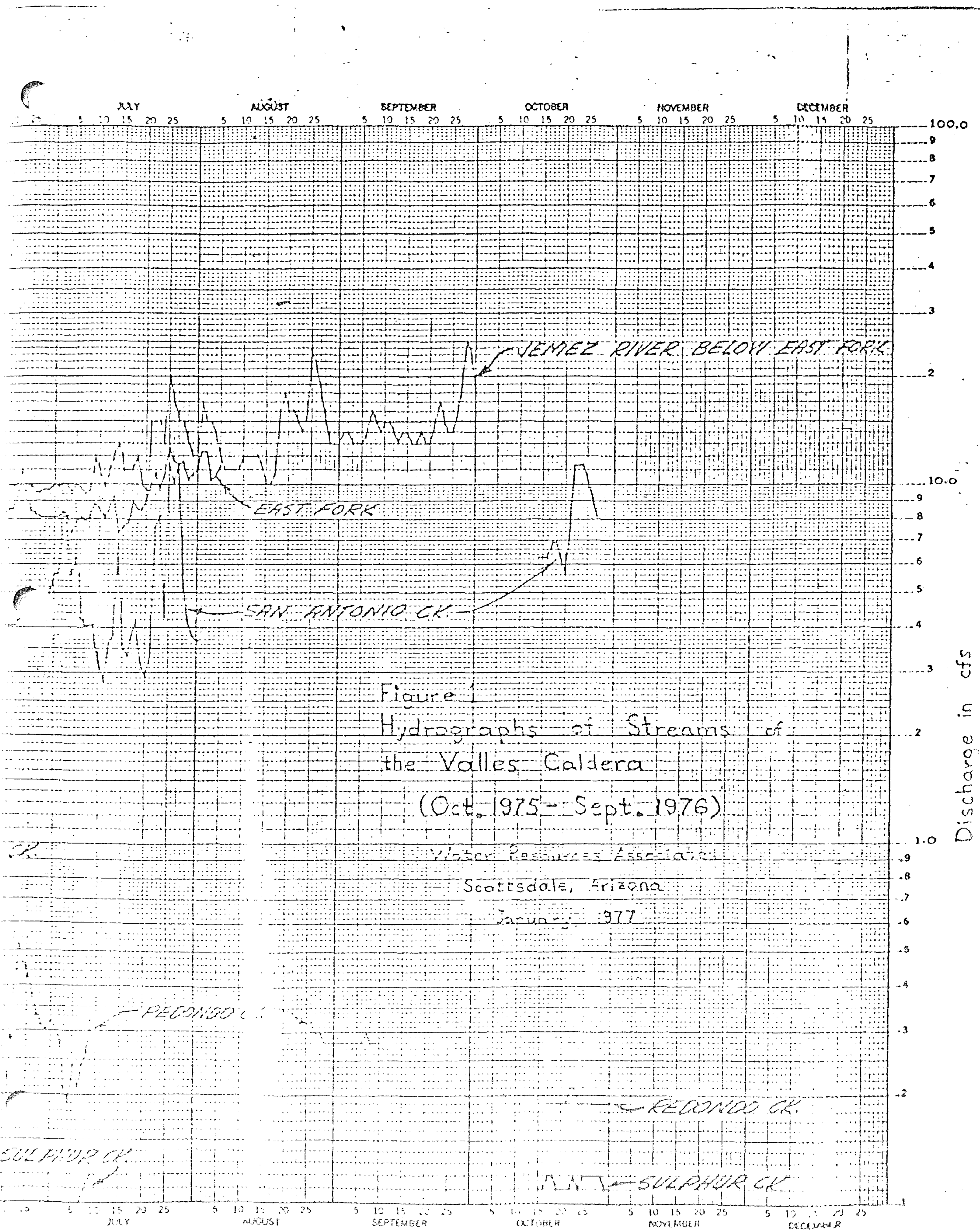


Figure 1
Hydrographs of Streams of the Valles Caldera
(Oct. 1975 – Sept. 1976)
Water Resources Associates
Scottsdale, Arizona
January 1977

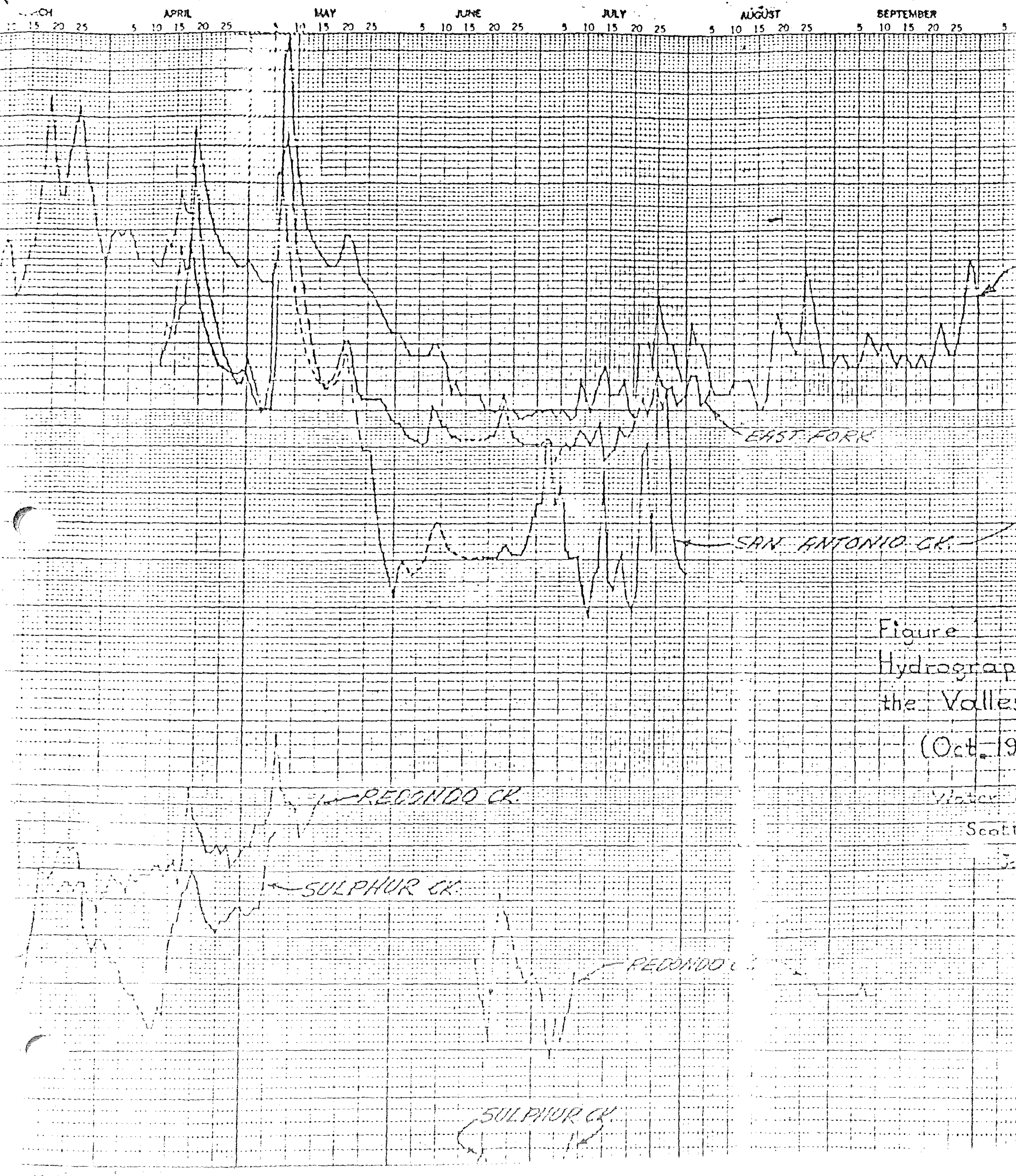
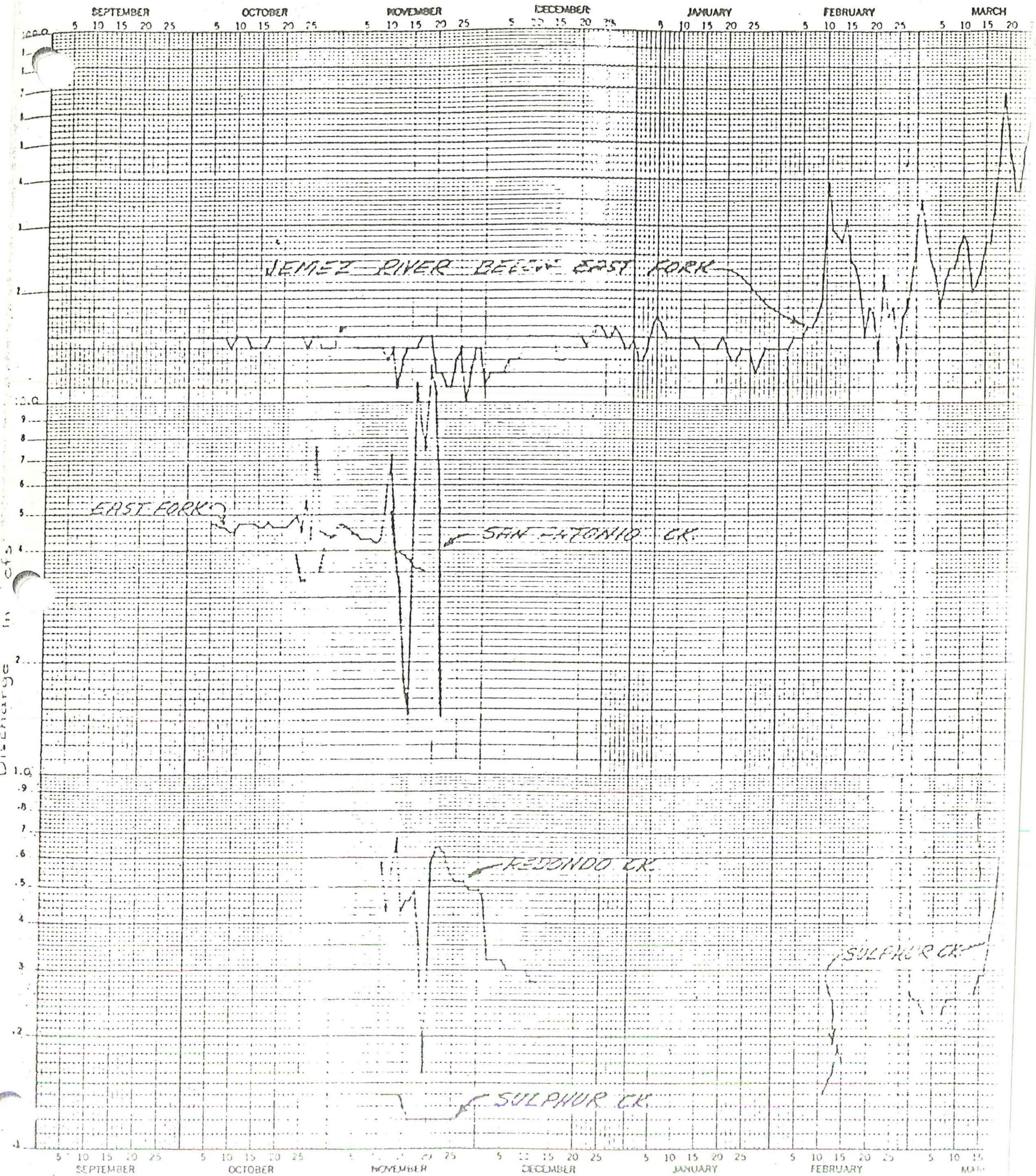


Figure 1
Hydrograph
the Valles
(Oct. 197
Scotts


SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
JEMEZ RIVER
EAST FORK
SULPHUR CK.
SULPHUR CK.

1975

good quality waters which have little or no significance in the determination of potential diminution of geothermal waters into the Rio Grande hydrologic system.

It is also apparent that the geothermal hydrologic system has no connection with the waters of Redondo Creek. Sulphur Springs is a solfatara area, where hydrothermal alternation has taken place. The Springs contribute no direct flow to the stream. However, a somewhat higher level of dissolved solids than is found in other streams of the locality suggests a contribution of subsurface flows. Tritium levels indicate that the base flows are from shallow groundwaters.

It has been concluded from the studies that the stream gaging program can be eliminated.

Monitoring of Thermal Springs and Wells

Data on thermal springs and selected wells in the region have been collected on a regular basis by R. L. Borton of the New Mexico State Engineer Office since August 1975. Water levels were observed in fifteen wells (including four observations holes drilled by LASL), discharge and water temperatures were taken at seven flowing wells, and samples were collected for water quality determinations at six of the flowing wells. Discharge and temperature readings were made at San Antonio Hot Springs, Spence Springs, and at McCauley and Soda Dam Springs (all thermal springs).

These data are all listed in Part 2, Appendix II of this report.

Hydrologic Setting

Valles Caldera and its associated peaks and rim constitutes the highest area of the Jemez Mountains.

The Caldera is drained by San Antonio Creek, Redondo Creek, Sulphur Creek, and East Fork of the Jemez River. The East Fork of the Jemez and the main stem of the Jemez River flow through breaches in the rim of the Caldera at its southwestern extremity. Redondo Creek flows into Sulphur Creek, which then joins the San

Antonio, inside the rim of the Caldera near the head of San Diego Canyon, to form the Jemez River.

The Jemez River, which is the principal surface water feature of the entire area, flows southward, through San Diego Canyon, from the junction of the two streams to the town of San Ysidro and then southeasterly to join the Rio Grande some 20 miles north of Albuquerque. Settlements along the River are at Jemez Springs, the town of Jemez in the Jemez Pueblo Grant, San Ysidro, Zia Pueblo, and Santa Ana Pueblo.

To the west of the Caldera, the Jemez Mountains are drained by the Rio Cebolla and Rio de Las Vacas which join northwest of the town of Jemez Springs, to form the Guadalupe River. The Guadalupe then flows southward to join the Jemez River near the town of Jemez. The western divide of the Jemez River Basin is formed by the Sierra Nacimiento, which is also a geologic barrier between the Jemez and San Juan River Basins.

The northern portion of the Jemez Mountains drains from the northern rim of the Caldera to the Chama River in the general vicinity of Abiquiu. Cañones, Frijoles and Abiquiu Creeks are the principal streams draining the north slope. These streams and their upper tributaries are sustained by the groundwater moving northward from the rim of the Caldera.

To the east the Sierra de Las Valles, which borders the east side of the Caldera, slopes into the Pajarito Plateau which borders the Rio Grande. Except for Santa Clara Creek, which is a live stream, these slopes are bisected by canyons which have little or no streamflow. These canyons form what are locally called finger mesas, along the entire Pajarito Plateau.

On the southern flank of the Jemez range, the region is characterized by rugged topography for about half the distance to the Rio Grande. It then breaks into more uniform slopes intersected by canyons which are larger than the ones to the north, and with fewer finger mesas.

Between the southeasterly slopes and the Jemez Canyon, lies Paliza Canyon. This drainage originates outside of the Caldera on the south slopes of the rim and trends southwestward into the valley of the Jemez River. Vallecitos Creek flows through Paliza Canyon and is fed by groundwaters of the region.

The Chama River and the Rio Grande completely surround the Jemez Mountains on the north, northeast, east, and southeast. The drainage of the Jemez Basin completes the circle.

One other area has been included in the scope of this investigation. The Rio Salado, a tributary which joins the Jemez near San Ysidro, drains the southwestern flank of the Sierra Nacimiento. There is evidence of geothermal acitivity near the mouth of Rio Salado.

Numerous springs occur throughout the region. Most of these are cold water springs. Thermal springs of varying temperature are found in the Valle San Antonio and in the upper reaches of San Diego Canyon. A few thermal springs also occur near the town of San Ysidro in the Rio Salado drainage.

The entire region is spotted with wells from which valuable chemical and water level data have been obtained.

A breakdown of the drainage areas, and the locations of all data collection sites, can be found on Plate I, which serves as a location and a water level map.

Geology

The geology of the Jemez Mountains region has been a matter of interest for many years. Detailed mapping of the area by the U.S.G.S. was commenced in 1946. A number of reports are available, dealing with the geology, geochemistry, geohydrology, and geothermal aspects of the region (see References). An evaluation of the geothermal reservoir has been made by employees of Union Geothermal Division. New geologic information has been developed from the Company drilling program, and the geology of the Caldera is described in a report prepared by Union geologists, and details are not included in this report.

Of importance to this study is the fact that the top of the drainage, flowing away from the Caldera on all sides, is the rim of the depression formed when the roof and sides of the volcanic magma chamber collapsed. The chamber afterward was filled with the various local materials which were heated and metamorphosed. The U.S. Geological Survey is of the opinion that the present cover of the Caldera is esentially impermeable, having been sealed by migration of fine sediments into the fractures and cemented from below by chemical deposition of materials left as the hot mineral fluids were cooled or evaporated. Around the edges of the Caldera, in the ring fractures and radial faults, the sealing may be incomplete.

Other geologic conditions which could have an effect on the hydrology of the region are (1) the deep fault system within the region of the Caldera, and the lateral faults mainly trending southward into San Diego Canyon and beyond, (2) the presence of the Santa Fe formation in the vicinity of the Caldera and beneath the Los Alamos area, (3) the presence of granitic rock near the surface west of Rio San Antonio, and at the surface west of Rio de las Vacas, and (4) the obscure possibility of the Santa Fe formation draining from the Caldera to the north, and the fault system extending north-northeast to the vicinity of Cañones.

Also of significance is the geology in the vicinity of the Jemez River, where a greater probability of discharge from the Caldera reservoir may exist. Exposed in the valley of the Jemez are Paleozoic and Mesozoic rocks which include limestone of the Magdalena group, while sandstone, siltstone and shale of Permian and Triassic age are also exposed in the area. From Battleship Rock north-northeastward, these rocks are overlain by Tertiary valley-fill deposits and by lavas and tuffs.

Since the geology of the area is complex, the conditions stated above are somewhat of a simplification of the total picture. They are indicative of the possible problems associated with an analysis of the effects of withdrawing geothermal waters from the Caldera.

A pragmatic approach to the elements of surface and groundwater hydrology, and to geochemical evaluations, was used in forming preliminary conclusions in answer to questions surrounding the possibility of interconnections between the Caldera and the Rio Grande system.

Water Bearing Characteristics of Geologic Formations

Moderate to low permeability characterizes most of the rocks of the area. Layers and bedding of the sedimentary rocks accentuate the differences in permeability which greatly influence the movement of groundwater.

Low discharge rates of the springs of the area are indicative of low permeabilities of the formation.

Water level profiles to the north, east and south (Figures 2, 3, and 4) through Caldera and beyond are indicative of the differences in permeability of the rocks of the region. A shallow circulatory system of fairly high permeability is indicated by the relatively flat gradient of the near-surface system in Valles Caldera. Down the slopes of the Jemez Mountains, outside the Valles, extremely steep water level gradients suggest very low permeabilities associated with moderately deep to very deep circulation systems.

Springs either occur along the contacts of the formations, or in the fault zones. Many of the springs flow only a few gallons per minute. The largest discharge is reported by Trainer[14] to be 300 gpm at Soda Dam Springs. Only 59 to 75 gpm can be measured directly at Soda Dam Springs, but a study of the streamflow suggests the larger flow. The next largest discharge is from Jemez Springs where Trainer[14] estimates 200 gpm.

Groundwater Movement Jemez Mountains Region

Data from wells and springs in the Jemez Mountains region form the basis for preparing a groundwater contour map (Plate I). Basic data pertaining to this portion of the study is compiled in Part 2 of Appendix II.

Data have been compiled in Part 2 of Appendix II for 248 observation points. These data are arranged in the Table in sequence according to Township, Range, Section and subdivision of section, commencing in Township 12 North, Range 2 East, N.M.P.M., and Section 14. The sequence is carried through Township 23 North, Range 5 East, Section 15.

If the location of the data point has been corrected during editing, or other corrections have been made, the change is footnoted in the Table.

Groundwater elevations are at their highest levels in the rim of the Valles Caldera on all sides except for the points where the Jemez River and East Fork of the Jemez penetrate the Caldera rim. From the high contours around the rim, groundwater levels indicate flow paths generally into the Valles of the Caldera and away from the Caldera on all sides, except to the southwest, where the pattern moves down the Canyons of the Jemez and East Fork, from the Valles through the breaches, to the lower elevations of San Diego Canyon, with indications of groundwater moving into the valleys of the Guadalupe and Jemez Rivers and Vallecito Creek.

Water level data for some of the Baca geothermal wells, obtained from well pressure surveys made by Union Geothermal Division, show levels to be 800 to 1200 feet below the upper groundwater levels. The data are summarized in Table 1. Field data are included in Appendix II as Part 1. These deeper water levels are shown as an area of red on Plate I.

TABLE 1

ELEVATION OF TOP OF WATER
IN BACA GEOTHERMAL WELLS WITH WELL HEAD PRESSURE ZERO

Well No.	Survey Date	Depth To Water (feet)	Well Head Elevation (feet)	Elevation Of Water Surface (feet)
Baca 4	5/28/73	1600	9318	7718
Baca 5	5/29/73	2000	9320	7320
Baca 7	7/31/74	1100	8720	7620
Baca 10	10/18/76 4/14/76	1000	8735	7735
Baca 12	8/24/76	950	8430	7480
Baca 14	2/9/75	1100	8605	7505
Baca 16	9/16/75	2000	9622	7622

To better illustrate the relations in and around the Valles Caldera, three water level profiles have been prepared, utilizing Plate I and data from Appendix II.

The first profile (Figure 2) is plotted from San Ysidro Springs to Sulphur Springs, a distance of about 29 miles, with a rise in elevation of 3000 feet. Water levels in the Baca wells are offset in their proper positions and distances in relation to the profile..

From the vicinity of Sulphur Springs to Soda Dam, the gradient of the water table is in the magnitude of 250 feet per mile (4.7%). Gradients in the Valles are approximately the same as the surface of the valley floors (0.5 to 1.0%). Below Soda Dam the gradient gradually flattens, ranging from 65 to 25 feet per mile.

The steep slopes above Soda Dam are indicative of the low permeabilities of the limestone and sandstone formations present in that area.

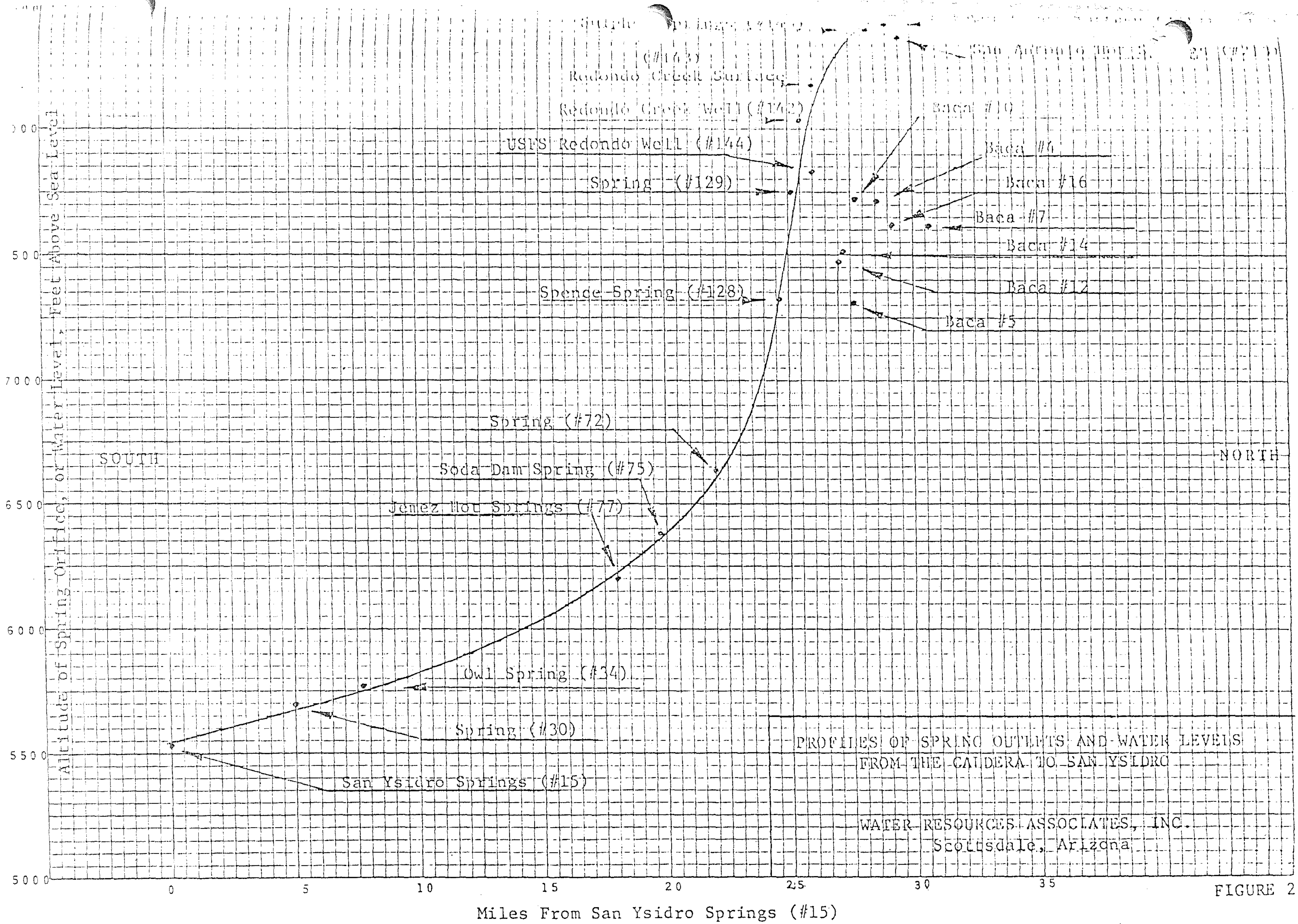

Altitude of Spring Orifice, or Water Level, Feet Above Sea Level
Miles From San Ysidro Springs (#15)
SOUTH
NORTH
Redondo Creek Surface
Redondo Creek Well (#142)
USFS Redondo Well (#144)
Spring (#129)
Spende Spring (#128)
Spring (#72)
Soda Dam Spring (#75)
Jemez Hot Springs (#77)
Owl Spring (#34)
Spring (#30)
San Ysidro Springs (#15)
Baca #10
Baca #6
Baca #16
Baca #7
Baca #14
Baca #12
Baca #5
PROFILES OF SPRING OUTLETS AND WATER LEVELS
FROM THE CALDERA TO SAN YSIDRO
WATER RESOURCES ASSOCIATES, INC.
Scottsdale, Arizona

FIGURE 2

Of considerable importance is the position of the water levels in the Baca Wells. It is at once evident that water from the deep Caldera reservoir cannot discharge at Sulphur Springs or San Antonio Hot Springs. The nature of Sulphur Springs has been discussed earlier (page 5). San Antonio Springs is evidence that thermal springs can be the result of water in a relatively shallow circulation system, becoming warmed by hot rocks below, then discharging at spring openings.

Chemical interpretation suggests that a very small quantity of water from the Caldera reservoir could be discharging at Spence and McCauley Springs. Figure 2 indicates that there is a gradient, and with the possibility of connhection, probably by way of faults, small quantities of water from the deep reservoir could move to those springs.

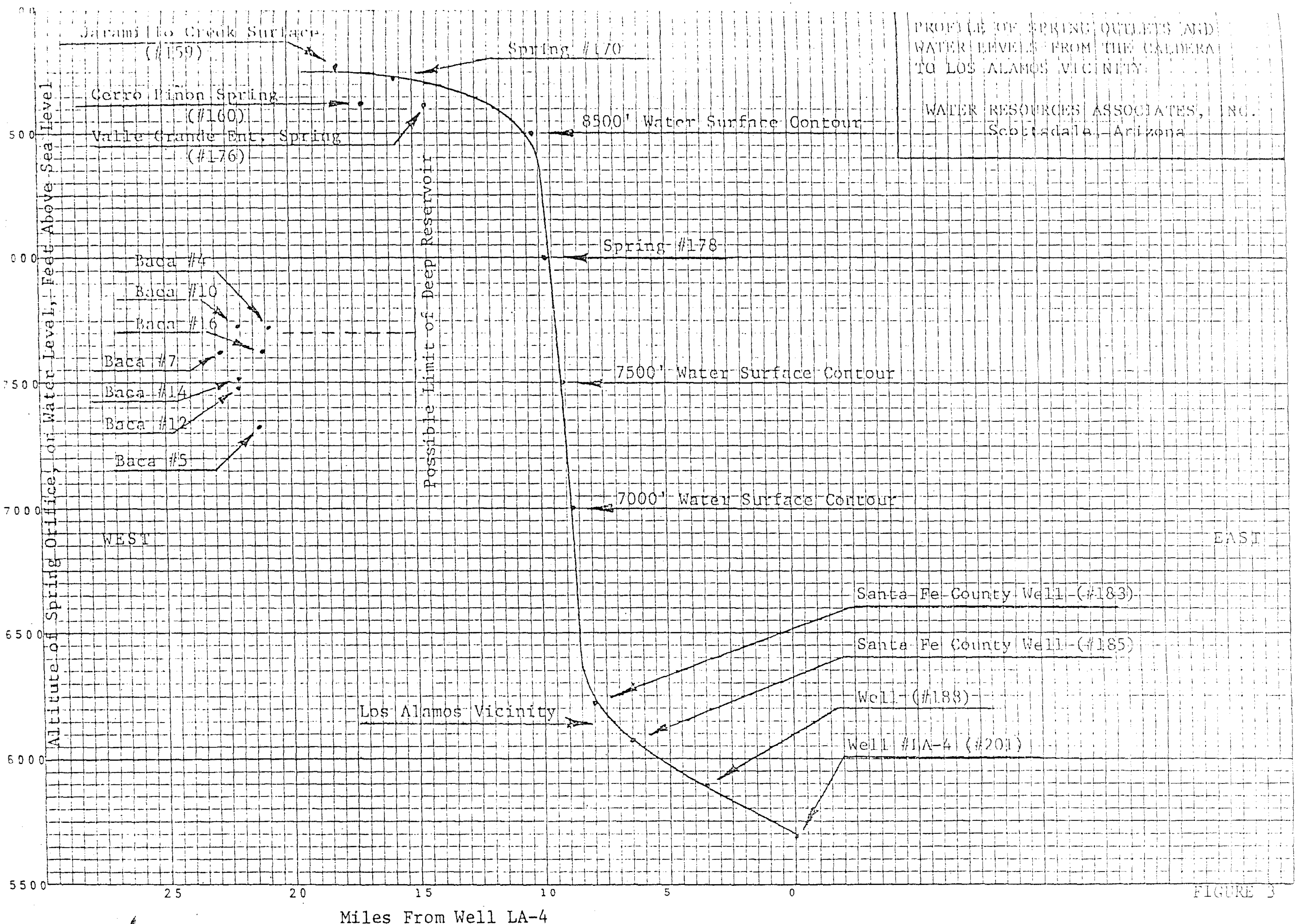
Warm springs at Soda Dam are fault controlled and issue from fractured rock. The water is moderately mineralized, and is high in both sodium chloride and calcium bicarbonate. This suggests that deep Caldera reservoir water may be present, but is highly diluted with shallower circulation water, and that the combination has dissolved the calcium and bicarbonate from the limestone formation.

A low ridge of travertine ($CaHCO_3$) across the floor of San Diego Canyon forms the Soda Dam and was built by the waters of the warm springs. The flow of the springs has been diverted by highway construction and building of the dam has practically ceased.

Thermal springs along the Jemez River have a generally increasing temperature gradient downstream from McCauley and Spence Springs to the Jemez Hot Springs, with lower temperatures at Indian Springs and in the San Ysidro vicinity.

Figure 3 is a water level profile extending from the Los Alamos well field to within two or three miles of the Baca well field. Position of the water level measurements in the Baca well is shown.

Probable eastern limit of the deep reservoir as suggested by geologists of Union Geothermal Division is approximately



PROFILE OF SPRING OUTLETS AND WATER LEVELS FROM THE CALDERA TO LOS ALAMOS VICINITY
WATER RESOURCES ASSOCIATES, INC.
Scottsdale, Arizona
Altitute of Spring Orifice, or Water Level, Feet Above Sea Level
Miles From Well LA-4
WEST
EAST
Jaramillo Creek Surface (#159)
Spring #170
Cerro Pinon Spring (#160)
Valle Grande Ent. Spring (#176)
8500' Water Surface Contour
Possible Limit of Deep Reservoir
Spring #178
Baca #4
Baca #10
Baca #16
Baca #7
Baca #14
Baca #12
Baca #5
7500' Water Surface Contour
7000' Water Surface Contour
Santa Fe County Well (#183)
Santa Fe County Well (#185)
Well (#188)
Los Alamos Vicinity
Well #LA-4 (#201)
5500
6000
6500
7000
7500
25
20
15
10
5
0

FIGURE 3

six miles east of Redondo Canyon near the west flank of Cerro del Medio. It has been suggested that geologic conditions in the vicinity of Cerro del Medio probably inhibits flow eastward from the deep reservoir.

This profile supports conclusions by Conover and others[1] and Purtymun and Cooper[4], that the Valle Grande is the recharge area for the Los Alamos well field. It also supports the conclusion that deep Caldera reservoir water is not moving eastward either to the Los Alamos area or the Rio Grande.

Figure 4 is a similar profile from the vicinity of Cañones to the Sulphur Creek area. This profile indicates the possibility of a groundwater divide along the northern rim of the Valles Caldera, with none of the shallow circulating water moving out of the Valles in that direction. It also indicates that the possibility of water moving from the deep Caldera reservoir to the north is precluded by the low permeability of the formation making up the north slope and the lack of gradient required, assuming that there could be seepage out of the deep reservoir in that direction.

To the west, a groundwater ridge lies between the San Antonio drainage and that of Rio Cebolla and Rio Guadalupe. There are no geothermal springs nor springs with waters having unusual chemical characteristics in the Rio Guadalupe drainage. Tentatively, it is concluded that westward movement from the Valles Caldera is not possible. Other investigators raise the possibility of very deep circulation from the Caldera reservoir to the areas of geothermal activity in Rio Salado drainage.

The only other area on the southern slopes of the Jemez Mountains, where the contours indicate that groundwater is discharging into and supporting a live stream is along Vallecito Creek, which drains out of the Paliza Canyon area. This tributary heads outside of the Caldera on the south slopes of the Jemez Mountains. Chemical quality indicates a shallow circulation system in this area.

Other than the conditions described in the west and south-southwest portion of the Jemez Mountains, groundwater contours

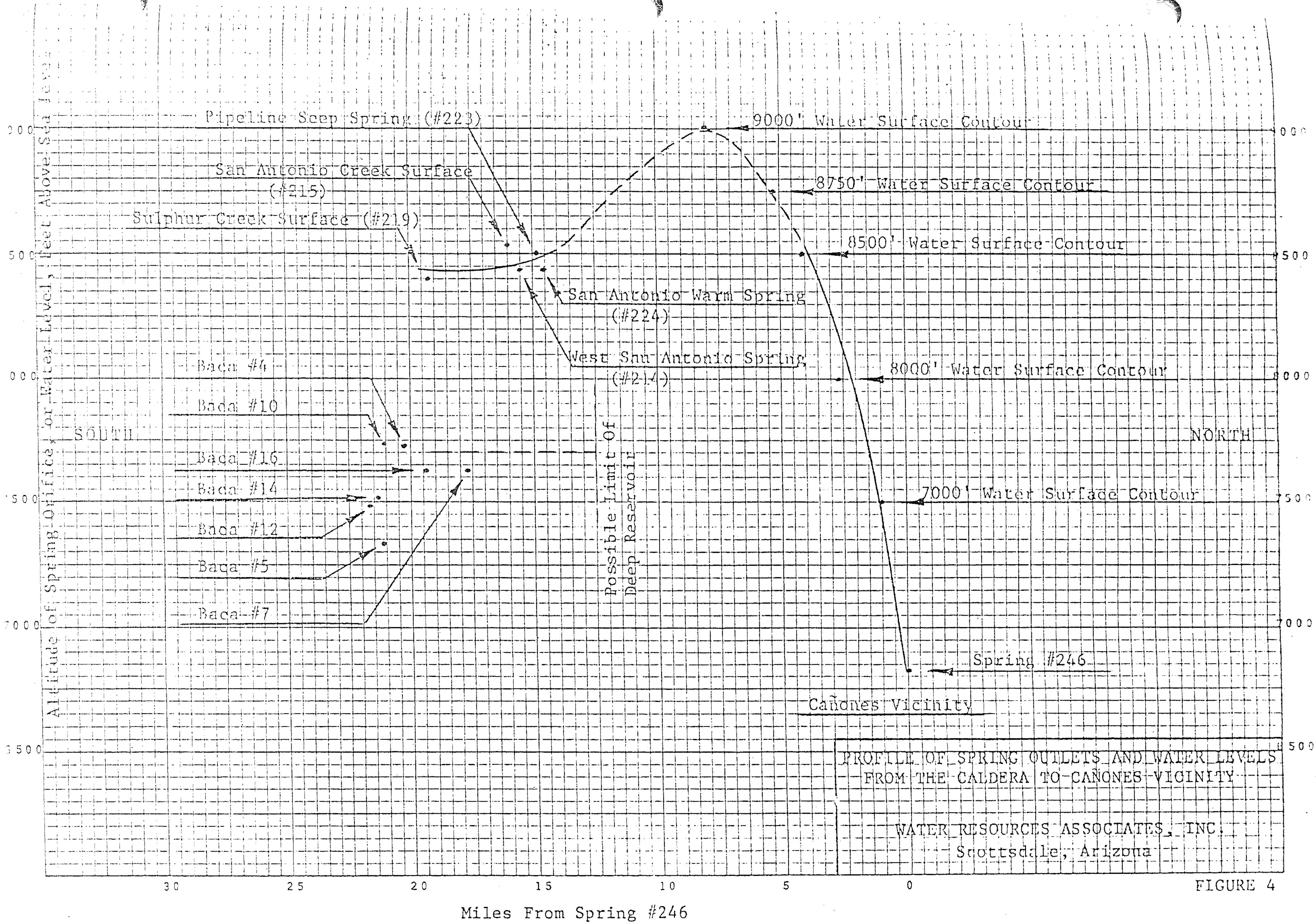

Altitude of Spring Orifice, or Water Level, Feet Above Sea Level
Pipeline Seep Spring (#223)
San Antonio Creek Surface (#215)
Sulphur Creek Surface (#219)
9000' Water Surface Contour
8750' Water Surface Contour
8500' Water Surface Contour
San Antonio Warm Spring (#224)
West San Antonio Spring (#214)
8000' Water Surface Contour
Baca #4
Baca #10
SOUTH
NORTH
Baca #16
Baca #14
Baca #12
Baca #5
Baca #7
Possible Limit Of Deep Reservoir
7000' Water Surface Contour
Spring #246
Cañones Vicinity
PROFILE OF SPRING OUTLETS AND WATER LEVELS FROM THE CALDERA TO CAÑONES VICINITY
WATER RESOURCES ASSOCIATES, INC.
Scottsdale, Arizona
30
25
20
15
10
5
0
Miles From Spring #246

FIGURE 4

generally respond to the gradient of the slopes along the flanks of the Jemez range.

Water levels in the vicinity of the Los Alamos well field indicate that there has been a net withdrawal of water from that region which is causing some modification of groundwater contours in that area.

Hydrochemistry

The term hydrochemistry has a somewhat broader implication than the term geochemistry. Natural waters issuing from or flowing on the earth all have chemical constituents. Rain or snow falling on the earth is almost, but not quite, free of chemical constituents. When precipitation reaches the earth, most of it (before flowing into the surface streams) passes through soil or earth to varying degrees. The length of time which the water is in the soil or earth, and the types of formations that it comes in contact with, determine the concentration and type of constituents found in the water when it reaches the surface.

The longer the water is in circulation in the earth, the higher the concentration of dissolved solids is apt to be. Also, the type of formation it is in contact with over extended periods of time influence the chemical character of the water; that is, th relationship of the ions to one another, which determines the character of the water.

Within the Jemez Mountains region there is a wide range of chemical characteristics of the waters. Because of the differences in character, the investigator is provided a tool for evaluating both qualitatively and quantitatively the sources of water, how they mix, and the relations of one to another.

As a means of classification of the mineral content of the springs, wells and surface flows in the area, Stiff diagrams of the chemical composition were prepared for each site (Appendix III). Of the many possible tools for identification of water types(3), this system permits easy appraisal of the balance of the cations and anions in the analyses and enables partial analysis to be utilized when needed. These diagrams involve plotting of the millequivalent parts of the cations (sodium plus potassium, calcium, and magnesium) on one side, opposite the millequivalent parts of the anions (chloride, bicarbonate plus carbonate, and sulphate) on the other side.

The spread of the diagram is a function of the concentration, but the pattern itself is the actual classification. Although other ions are often present in waters of the region, most chemical analyses include only the above cations and anions which represent more than 95 percent of the constituents.

In the region surrounding the Valles Caldera, several patterns of both the cations and anions occur and are show in Figure 5. The deep, slowly circulating waters are those with high sodium and chloride and/or sulphur ions predominating. The shallow circulating waters are predominately bicarbonate waters with high calcium and/or sodium concentrations.

The above classification does not conflict with other investigators or publications covering the area, as their concern was with the location of the occurrence of the water types rather than the circulation system.

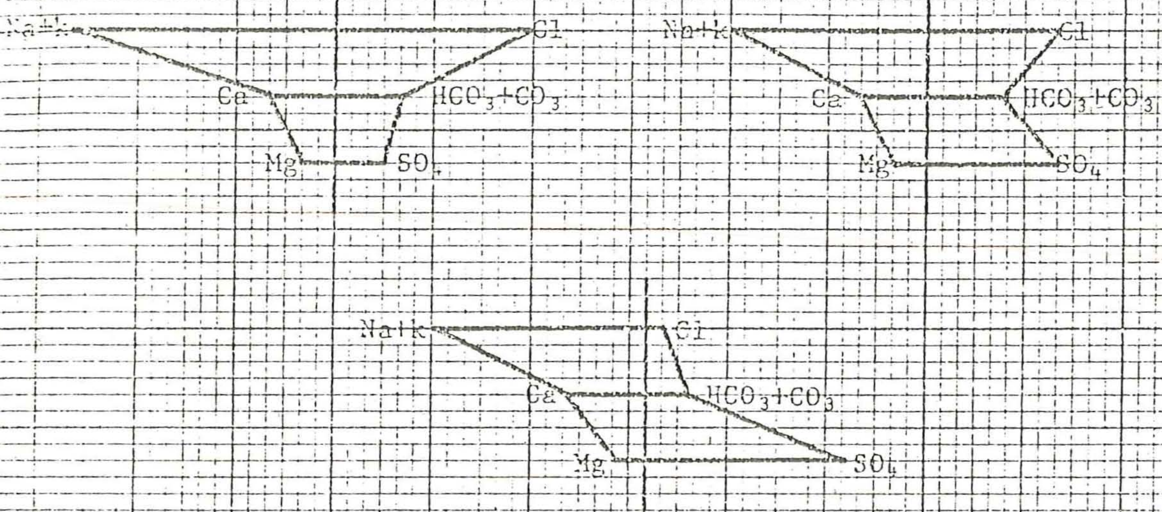
On the assumption that an unknown amount of leakage does occur into the Caldera and that it drains into either the groundwater or streamflow drainage system, the quality of water in the region was examined to determine what changes occur and where the discharge of such water would take place.

The complex series of rocks in the Caldera suggest a complex mineral water effluent from the region. Examination of the mineral content of water in each geologic formation and in the surface streams shows a wide variation of mineral content and concentration, indicating shallow, intermediate and deep sources of circulation.

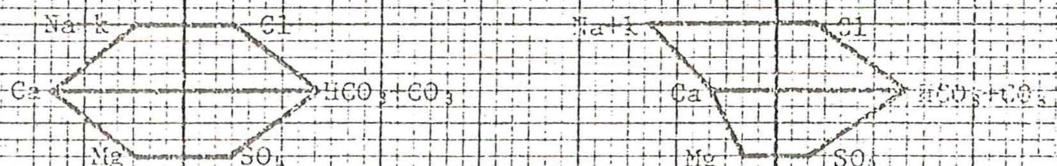
The type of circulation system permits, in general terms, the time for effects to be felt on surface flows by groundwater use. Effects through the shallow system could be within a few years to several tens of years. In the intermediate system, it

TYPES OF WATER IN JEMEZ MOUNTAINS
AS INDICATED BY STIFF DIAGRAMS

DEEP WATERS



SHALLOW CIRCULATING WATERS



WATER RESOURCES ASSOCIATES, INC.
Scottsdale, Arizona
January 1977

FIGURE 5

may require from a few tens of years to hundreds of years; while in the deep circulation system, it is probably in the order of several hundred to many tens of thousands of years.

The quality evaluation coupled with the groundwater flow pattern provides evidence as to the source and movement of water in the Jemez Mountains region. There are a number of different ways to develop this concept, only a few of which have been used in this study. The parameters that have been used are the total dissolved solids, the sodium ion, and one trace element, arsenic. General patterns, as shown on Figure 5, in the relationship to shallow, intermediate and deep circulation systems and particularly to geothermal waters, have been studied.

Evaluation of Water Quality

Separation of that water in the shallow circulation system which flows in the active hydrologic cycle (precipitation, temporary groundwater storage, and runoff to stream flow) and that in the deep, slowly circulating system is based on the mineral constituents of the water. Water from geothermal regions and deep mines contain minerals from the host rocks in varying amounts.

Waters circulating in Precambrian granite contain large amounts of sodium with minor quantities of calcium and magnesium as cations, and considerable amounts of chloride and/or sulphate with small quantities of bicarbonate as anions. Other trace elements, their number depending on the mineralization of the host, are contained in the water. Concentrations of these trace elements will range from a few parts per million to a few parts per billion.

In the Jemez Mountains, the water quality fits these patterns, except that there is considerable mixing of calcium bicarbonate components with other types in certain areas. In other words, there are three types of water, a shallow circulation system of calcium bicarbonate water, an intermediate zone of mixed water, and a deep zone of very low circulation which are predominately sodium-chloride/sulphate waters.

Few uncontaminated waters from deep sources have been analyzed for identification of the pattern. In this determination, most weight has been given to deep sample analysis of LASL Hole A at a depth of 2,410 feet, and the fluid production of the Baca steam wells. Groundwater having this pattern also occurs in deep wells 30 to 50 miles west of the Caldera in the Rio Puerco drainage basin, and their overflow may occur in the Rio Salado.

Special attention has been given in all aspects of the chemistry, to the area in the vicinity of San Ysidro where Rio Salado joins the Jemez River. The reason for this consideration is that V. C. Renick[9] suggested that that particular area was a discharge point for waters originating in the Valles Caldera. More recently, investigators, including Trainer,[14] are keeping the possibility open that geothermal activity in the Rio Salado and near San Ysidro may be associated with the deep Caldera reservoir.

Dissolved Solids Measured by Conductivity

The electric conductivity (EC) of water is frequently used as a measure of the total dissolved constituents. It is roughly 1.5 times the dissolved solids in parts per million. All data points where electric conductivity has been reported were plotted on the location map and is presented as Plate II.

Water with EC of less than 1,000, for the most part, are fairly representative of shallow groundwater in the northern New Mexico area from which a substantial portion of the potable supplies are derived. On Plate II, areas where groundwaters have less than 1,000 EC have been left unshaded. The area where the conductivities range generally from 1,000 to 5,000 have been shaded green. Concentrations of dissolved solids resulting in conductivities of greater than 5,000 have been shaded red.

The red areas in the vicinity of the Valles Caldera are for the deep Caldera reservoir (Baca wells) and the LASL test holes. In the vicinity of San Ysidro, the high concentration waters are found in wells and springs of the area. The analyses from the Shell deep test may not be representative of formation waters and it is presumed that the TDS at that location and depth may be somewhat higher than reported.

Surface flows are highly diluted by good quality water from the Valles and are not represented by Plate II.

Plate II supports the conclusions drawn from Plate I, Groundwater Contours, in that it shows that waters of higher concentration do not move out of the Caldera except along the Jemez River Valley. It shows that the highest concentrations are in the deep wells in Redondo Canyon and Sulphur Creek and to the west in the deep wells of LASL. The only other areas having waters of that high concentration are in the vicinity of San Ysidro and to the southeast of San Ysidro in a deep well drilled by Shell Oil Company.

Plate II also supports preliminary conclusions that the water along the Jemez Valley in San Diego Canyon and below, are highly dilute mixtures of deep, slowly circulating Caldera waters with more rapidly circulating waters of the upper formation.

There are evidences that over a long period of time the Caldera has been gradually sealing. Evidence of prehistoric springs in the San Ysidro area support that, together with the fact that the mineral springs in that area have gradually been drying up in recent years. It is possible that the sealing process may be well advanced in the Caldera area, and the mixing process evident in the Jemez Valley is a combination of leaching of formerly deposited salts from earlier drainage of the Caldera, together with remaining leakage from the Caldera.

Waters of Shallow and Deep Circulation

In order to illustrate the occurrence of moderate to deep circulation systems described above, waters which are predominately sodium have been plotted on Plate III. It shows that the high concentrations of sodium chloride, which are characteristic of deep Caldera reservoir waters, occur only in wells mostly of considerable depth, or at springs along the Jemez River. There is no evidence of water of this character at the surface. It occurs in the Baca well field, in the Sulphur Springs wells, and at three other wells (LASL tests) on the perimeter of the Caldera. Otherwise it is found at the springs or in wells nearby the springs, or in deep wells, such as the Shell Oil test.

The only exception of surface water occurrence is at stream gaging stations which have been maintained at the mouth of the Jemez River. All the rest of the waters for which there are analyses in the area fall within the classification of shallow groundwater circulation systems. The springs display evidence of being in the intermediate system where mixing occurs in varying degrees.

Mixed Waters

The preceding presentation has shown that probably most of the waters in the Jemez Valley are mixed waters. The deep water is coming either through contact zones of the sediments or faults. Trainer[14] has suggested that the mixture of the deep and shallow waters at springs in the Jemez region might vary in the ratio of 10 to as much as 60 at the springs. If this is the case, the mixing ratio in the surface supply at measuring points in the Jemez Valley would be many times greater. This means that the quantity of water coming from the Caldera into the stream system is probably very small. Two questions would have to be answered. One, how much is draining from the Caldera at the present time, and, two, how much may be redissolved in the circulation of the shallow water from formerly deposited salts?

Trace Elements and Determination of Water Sources

Many elements are found in the ground and surface waters in the region surrounding the Caldera. Most occur in concentrations from a few parts to many tens of parts per billion, and seem to be related to the mineralization of the entire Rocky Mountain Range. Radioactivity in the form of Alpha and Beta activity as well as dissolved uranium occurs in minute amounts throughout northern New Mexico.

Dissolved uranium in parts per billion is highest in Sulphur Creek (0.7), lowest in Redondo Creek (0.1) and intermediate in

San Antonio Creek above Sulphur Creek (0.4). However, radioactivity and dissolved uranium cannot be used as tracers of groundwater movement or indicators of sources of groundwater in that highest radioactivity is associated with hot systems dominated by calcium carbonate or bicarbonate, and much lower activity associated with siliceous and tuffaceous rocks. Fast movement of water in rocks of greater permeability have lower activity than slow moving flows in rocks of low permeability.

Dissolved Silica

Concentrations of SiO_2 in groundwater is more representative of temperature in the host rock, than an ingredient of magmatic or deep seated water sources. Assuming the silica content of the groundwater is derived entirely from quartz, and not decreased by dilution nor concentrated through boiling or escape of steam, a water containing 100 mg/L of SiO_2 would have originated in a host rock having a temperature of about 220°F.

Few springs or water supply wells in the region have silica concentrations exceeding 100 mg/L and therefore most are assumed to be derived from or possibly diluted in shallow circulation systems. Three springs at the resort of Jemez Springs report silica content from 146 to 324 ppm and, using the silica geothermometer, the host rock may have had a temperature as high as 380°F.

However, fluid production from the Baca steam wells have SiO_2 concentrations ranging from 160 to 963 mg/L indicating a hotter host and possibly a deeper circulation system. Least concentrations occur at Baca No. 4 and strongest at Baca No. 13.

Silica has not been used as an indicator of the deep circulation system in this investigation.

Arsenic

The occurrence of arsenic in the waters of the region was investigated because of its wide distribution as a minor element, its stability in ionic exchange and its association essentially with Precambrian rocks. Plate IV shows the concentration of arsenic, where known, as numbers (parts per billion). Except for the area in the Jemez River Canyon, and the San Ysidro Spring area, the concentrations are low. Waters containing fairly high concentrations of arsenic are also found in the Rio Salado and Rio Puerco drainages.

The occurrence of trace amounts of arsenic is not unusual. Although it is not always tested for in water samples, there are enough analyses to indicate how minor it is in most areas. Included with the basic data in Appendix II, Part 4, are reported occurrences of Arsenic and Chloride in areas of New Mexico where geothermal anamolies exist. The data are shown on a map produced by the New Mexico State Bureau of Mines and Mineral Resources (compiled by W. K. Summers, January 1972), and reproduced as Plate V of this report. These data are in mg/L.

It shows the wide spread occurrence of Arsenic, mostly in the valley of the Rio Grande and the Mimbres and Upper Gila River basins. Except in the Jemez area, concentrations range from less than 10 to about 40 parts per billion, as compared with the 4,000 to 4,500 ppb in the Baca wells.

Because of the very high concentrations of arsenic in the deep Caldera reservoir, its relative stability and available analyses at the springs of the Jemez, mixing ratios have been computed and applied to spring discharge quantities to provide an estimate of possible discharge from the deep reservoirs to the Jemez valley.

Table 2 presents a preliminary computation of discharge from the deep reservoir to the surface waters of Jemez River.

TABLE 2

	Arsenic (ppb)		Deep Source (gpm)
Baca wells	4,000		
Jemez Springs 200 gpm	780		
Ratio		.195	39
Soda Dam 300 gpm	1,100	.275	82
McCauley Springs 500 gpm	17	.00425	2
Spence Springs 56 gpm	70	.0175	1
Estimated from other sources			40
			164
Base Flow Of Jemez River Near Jemez	50		
Q = 27 cfs			
= 12,150 gpm		.0125	152

For the purposes of computing effects on the River of withdrawals from the deep reservoir, 164 gpm was taken as deep Caldera reservoir water reaching the Jemez River.

Groundwater Hydraulics

To arrive at a preliminary estimate of the effect of withdrawals of hot water from the deep Caldera reservoir, a mathematical model was set up, based on a flow net of idealized boundaries and conditions.

Derivation of the model is not presented. The result is as follows:

$$\tfrac{1}{2}Q = T\left[\Sigma\left(\frac{rg}{\sin\theta} - rg\right)\left(\frac{\tan\theta(\Delta\theta)}{(\pi-\theta)}\right)\right]$$

For θ in radians

or in words

$$\tfrac{1}{2}Q = T\left[\Sigma\left(\frac{\Delta\text{ head}}{\text{streamline length}}\right)(\Delta\text{ arc length})\right]$$

start with initial elevation of water table at Caldera rim.

Where:

T = Transmissivity in ft^2/day

r = Radius of Caldera

g = Gradient of stream channel

θ = Angle measured from a line perpendicular to the direction of flow of the stream source.

Using $T = 14\ ft^2/day$

$\theta \rightarrow 33° \text{ to } 89.5° \rightarrow 1117.702$

$\theta \rightarrow 76° \text{ to } 89.5° \rightarrow 82.115$

$\Sigma \rightarrow 1199.82$ cfd

$= 6.23$ gpm

$T = 14 \times \frac{163}{6.23} = 366.103\ ft^2/day$

Results of the computation, based on net withdrawal of water to supply one 55 megawatt unit are as follows:

Year	Arg	Discharge From Caldera (gpm)	Depletion (gpm)
0	0	164	0
71	10	132.75	-31.25
143	20	115.92	-48.08
214	30	107.10	-55.90

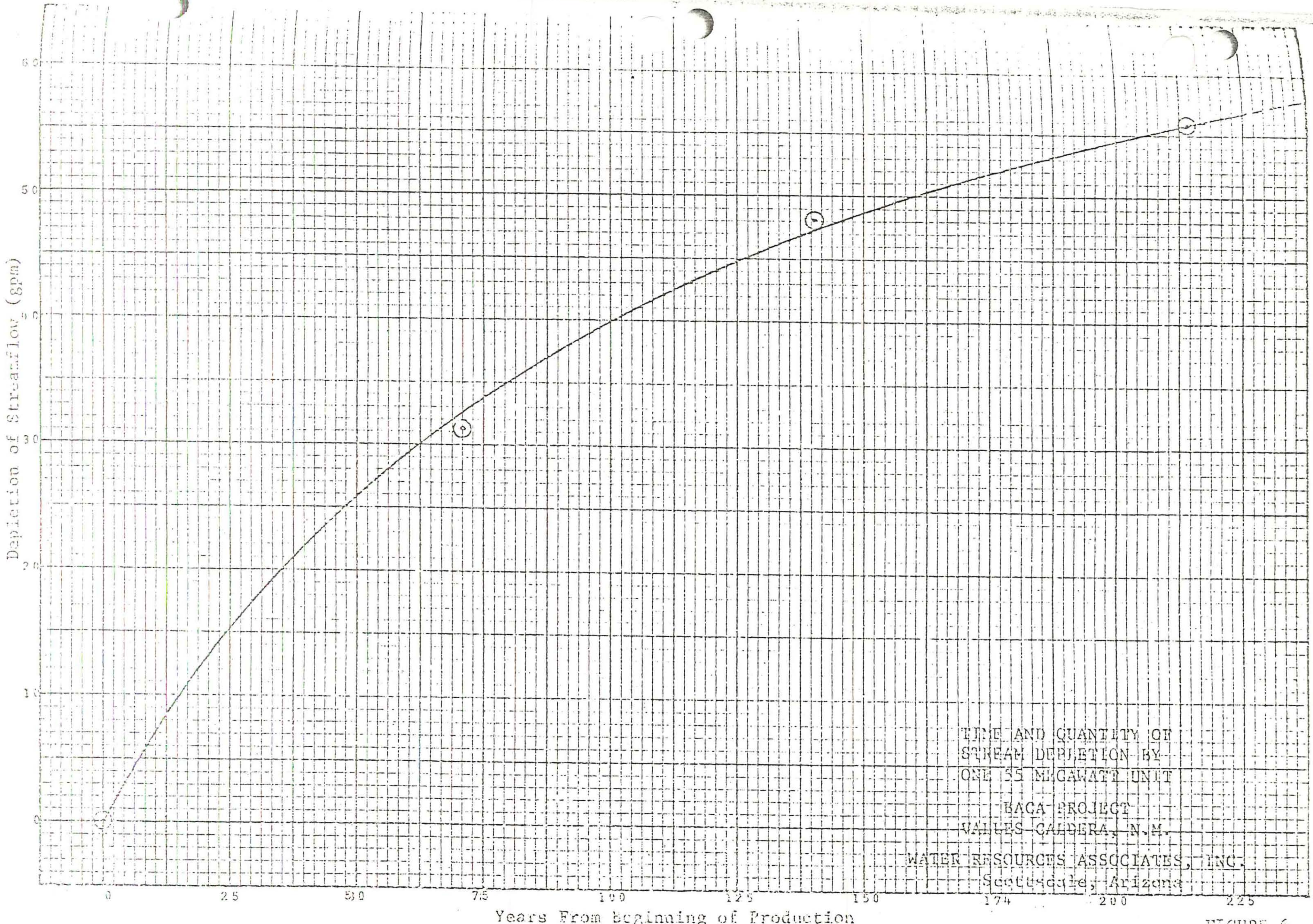
Figure 6 presents the results of the above computations.

No account was made in this computation for induced recharge to the Caldera because of this depletion.

The above computation should be considered as a first approximation to the problem. However, it is felt to be of the right dimension, as is the magnitude of deep Caldera water reaching the stream system.

Utilizing Figure 6, it appears that stream depletion in 25 years by one 55 megawatt unit might be about 15 gpm (24 af/yr) and by 50 years would be approximately 26 gpm, or 42 acre feet per year. On that basis, it might be necessary to retire approximately 19 acres of irrigated land in 25 years and 38 acres in 50 years.

Heavy industries, particularly mining companies, in New Mexico, are purchasing irrigated lands and banking them, for later transfer of water. That procedure is permissible and desirable.



Depletion of Streamflow (gpm)
60
50
40
30
20
10
0
0
25
50
75
100
125
150
174
200
225
Years From Beginning of Production
TIME AND QUANTITY OF
STREAM DEPLETION BY
ONE 55 MEGAWATT UNIT
BACA PROJECT
VALLES CALDERA, N.M.
WATER RESOURCES ASSOCIATES, INC.
Scottsdale, Arizona

FIGURE 6

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APPENDIX I

Streamflow Data

TABLE I-1. San Antonio Creek, Near Mouth — UOC Station

Days	Oct. '75 depth	Oct. '75 cfs	Nov. '75 depth	Nov. '75 cfs	Dec. '75 depth	Dec. '75 cfs	Jan. '76 depth	Jan. '76 cfs	Feb. '76 depth	Feb. '76 cfs	Mar. '76 depth	Mar. '76 cfs
1												
2												
3					1.33	16.94						
4					1.34	17.56						
5					1.35	18.19						
6					1.16	6.27						
7					0.93	2.22						
8			Clock stopped		0.90	1.97						
9					0.87	1.72						
10					0.78	1.06						
11			1.14	5.02	0.64	0.42						
12			1.12	4.27	0.34	0.01						
13			1.02	3.12	0.07	0						
14			0.88	1.80	0.01	0						
15			0.84	1.46	0.0	0						
16			1.25	11.92	0.01	0					Frozen	
17			1.20	8.78	0.04	0			Frozen			
18			1.18	7.53	0.12	0.01	Frozen					
19			1.26	12.54	0.18	0.01						
20			1.23	10.66	0.20	0.01						
21			1.14	5.02								
22			0.76	0.77								
23	1.09	3.92	0.42	0.02								
24	1.04	3.34	0.48	0.08								
25	1.04	3.34	0.58	0.26	Clock stopped							
26	F		0.83	1.38								
27	F		0.82	1.32								
28	1.06	3.57										
29	1.10	4.04										
30	Clock stopped		Frozen		Frozen							
31												

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TABLE I-1 (cont.) San Antonio Creek, Near Mouth — UOC Station

Day	Apr. '76 depth	Apr. '76 cfs	May '76 depth	May '76 cfs	June '76 depth	June '76 cfs	July '76 depth	July '76 cfs	Aug. '76 depth	Aug. '76 cfs	Sept. '76 depth	Sept. '76 cfs
1			1.26	12.54	1.08	3.80	1.15	5.64	1.41	*21.95		
2			1.24	11.29		(3.95)	1.19	8.15	1.39	20.70		
3			1.22	10.04		(3.75)	1.19	8.15	1.24	11.29		
4			1.22	10.04		(3.65)	1.15	5.64	1.17	6.90		
5			1.22	10.04		(3.7)	1.16	6.27	1.12	4.27		
6			1.29	14.43		(3.9)	1.12	4.27				
7	Frozen		1.82	47.67		(4.1)	1.10	4.04				
8			1.90	52.70		(4.7)	1.10	4.04				
9			1.68	38.89		(5.0)	1.10	4.04				
10				(29.5)		(4.9)	1.03	3.22				
11				(24.0)		(4.5)	0.99	2.82				
12	1.27	13.17		(19.0)		(4.2)	1.06	3.57				
13	1.33	16.94		(16.8)		(4.1)	1.08	3.80				
14	1.32	16.31		(14.0)	Clock stopped	(4.1)	1.17	6.90				
15	1.37	19.44		(12.5)		(4.0)	1.06	3.57				
16	1.49	26.97		(11.4)		(4.0)	1.04	3.34				
17	1.43	23.21		(11.4)		(4.0)	1.08	3.80				
18	1.44	23.84		(11.8)		(4.0)	1.11	4.16				
19	1.73	42.03		(12.3)	1.10	4.04	1.03	3.22				
20	1.57	31.99	Clock stopped	(13.2)	1.10	4.04	1.00	2.92				
21	1.46	25.09		(14.0)	1.10	4.04	1.04	3.34				
22	1.39	20.70		(11.6)	1.10	4.04	1.18	7.53				
23	1.35	18.19		(9.9)	1.12	4.27	1.19	8.15				
24	1.32	16.31		(8.0)	1.13	4.39	1.12	4.27				
25	1.29	14.43		(7.8)	1.11	4.16	1.24	11.29				
26	1.27	13.17	1.18	7.53	1.11	4.16	1.22	10.04				
27	1.26	12.54	1.15	5.64	1.11	4.16	1.24	11.29				
28	1.25	11.92	1.13	4.39	1.13	4.39	1.16	6.27				
29	1.25	11.92	1.10	4.04	1.14	5.02	1.12	4.27				
30	1.28	13.80	1.06	3.57	1.15	5.64	1.08	3.80				
31			1.03	3.22			1.07	3.69				
Total				463.23		126.7		165.5				
Mean				14.94		4.22		5.34				
A.F.				919		251		328				

TABLE I-1 (cont.) San Antonio Creek, Near Mouth — UOC Station

	Oct. '76	
Day	Depth	cfs
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14	1.16	6.27
15	1.16	6.27
16	1.16	6.27
17	1.17	6.90
18	1.17	6.90
19	1.16	6.27
20	1.15	5.65
21	1.18	7.53
22	1.24	11.29
23	1.24	11.29
24	1.24	11.29
25	1.22	10.04
26	1.21	9.41
27	1.19	8.15
28		
29		
30		
31		

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TABLE I-2. Redondo Creek, Near Mouth — UOC Station

12 Inch Parshall Flume

	Nov. '75		Dec. '75		Jan. '76		Feb. '76		Mar. '76		Apr. '76	
Day	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs
1			0.24	0.46							0.26	0.52
2			0.18	0.32							0.26	0.52
3			0.18	0.32							0.28	0.58
4			0.18	0.32							0.27	0.55
5			0.18	0.32							0.27	0.55
6			0.17	0.30							0.26	0.52
7			0.17	0.30							0.28	0.58
8			F								0.27	0.55
9			0.17	0.30							0.28	0.58
10	0.28	0.58	0.17	0.30							0.28	0.58
11	0.23	0.43	0.16	0.28							0.28	0.58
12	0.27	0.55	0.16	0.28							0.29	0.61
13	0.31	0.67									0.29	0.61
14	0.23	0.43									0.28	0.58
15	0.24	0.46							clock stopped		0.29	0.61
16	0.24	0.46									0.30	0.64
17	0.25	0.49									0.27	0.55
18	0.20	0.35									0.30	0.64
19	0.09	0.16					Frozen				0.40	0.99
20	0.28	0.58									0.36	0.84
21	0.30	0.64									0.35	0.80
22	0.30	0.64			Frozen						0.33	0.74
23	0.29	0.61							0.26	0.52	0.31	0.67
24	0.27	0.55	Frozen						0.27	0.55	0.31	0.67
25	0.26	0.52							0.27	0.55	0.32	0.70
26	0.26	0.52							0.26	0.52	0.31	0.67
27	0.26	0.52							0.27	0.55	0.30	0.70
28	0.25	0.49							0.27	0.55	0.29	0.61
29	0.25	0.49							0.25	0.49	0.30	0.64
30	0.25	0.49							0.25	0.49	0.31	0.78
31									0.24	0.46		

TABLE I-2 (cont.) Redondo Creek, Near Mouth — UOC Station

	May '76		June '76		July '76		Aug. '76		Sept. '76		Oct. '76	
Day	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs
1	0.32	0.70			0.17	0.30			0.16	0.28		
2	0.32	0.70			0.16	0.28			0.16	0.28		
3	0.35	0.80			0.12	0.21			0.16	0.28		
4	0.35	0.80			0.11	0.19			0.16	0.28		
5	0.35	0.80			0.14	0.24			0.16	0.28		
6	0.37	0.88			0.12	0.21			0.16	0.28		
7	0.50	1.39			0.14	0.24			0.17	0.30		
8	0.40	0.99			0.15	0.26			0.16	0.28		
9	0.38	0.91			0.18	0.32			0.16	0.28		
10	0.38	0.91							0.16	0.28		
11	0.37	0.88										
12	0.33	0.74	Clock stopped								Frozen	
13	0.34	0.77										
14	0.35	0.80										
15	0.37	0.88										
16	0.38	0.91										
17	0.39	0.95									0.11	0.19
18			0.20	0.35							0.11	0.19
19			0.16	0.28			Clock stopped				0.11	0.19
20			0.14	0.24					Frozen		0.11	0.19
21			0.12	0.21							0.11	0.19
22			0.21	0.38							0.12	0.21
23			0.26	0.52	Clock stopped						0.12	0.21
24			0.24	0.46							0.11	0.19
25			0.23	0.43							0.11	0.19
26			0.21	0.38			0.18	0.32			0.11	0.19
27	Clock stopped		0.19	0.33			0.17	0.30	0.17	0.30	0.11	0.19
28			0.18	0.32			0.17	0.30	0.17	0.30	0.11	0.19
29			0.17	0.30			0.16	0.28			0.11	0.19
30			0.18	0.32			0.16	0.28	Frozen		0.11	0.19
31							0.16	0.28			0.11	0.19

WATER RESOURCES ASSOCIATES INC.
SCOTTSDALE, ARIZONA

TABLE I-3. Sulphur Creek, Near Mouth — UOC Station

6 Inch Flume

	Nov. '75		Dec. '75		Jan. '76		Feb. '76		Mar. '76		Apr. '76	
Day	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs
1									0.26	0.25	0.35	0.39
2									0.26	0.25	0.34	0.37
3									0.25	0.23	0.32	0.34
4											0.32	0.34
5									Frozen		0.30	0.31
6											0.29	0.29
7							Frozen		0.25	0.23	0.28	0.28
8									0.26	0.25	0.28	0.28
9									0.26	0.25	0.27	0.26
10									0.26	0.25	0.26	0.25
11	0.08	0.04					0.08	0.04			0.25	0.23
12	0.08	0.04					0.10	0.05	Frozen		0.25	0.23
13	0.07	0.04					0.11	0.06			0.27	0.26
14	0.07	0.04					0.14	0.09	0.27	0.26	0.26	0.25
15	0.06	0.03					0.12	0.07	0.29	0.29	0.34	0.37
16	0.05	0.02							0.29	0.29	0.37	0.43
17	0.05	0.02		Frozen					0.33	0.36	0.38	0.44
18	0.04	0.02							0.37	0.43	0.42	0.52
19	0.05	0.02							0.46	0.60	0.43	0.54
20	0.05	0.02	Frozen						0.44	0.56	0.46	0.60
21	0.05	0.02							0.46	0.60	0.44	0.56
22	0.05	0.02							0.49	0.67	0.40	0.48
23	0.05	0.02							0.51	0.71	0.38	0.44
24	0.05	0.02							0.49	0.69	0.37	0.43
25	0.05	0.02					Frozen		0.50	0.69	0.36	0.41
26	0.05	0.02							0.48	0.65	0.38	0.44
27									0.43	0.54	0.38	0.44
28	Frozen								0.37	0.43	0.39	0.46
29							0.27	0.26	0.35	0.39	0.40	0.48
30									0.33	0.36	0.40	0.48
31									0.35	0.39		

TABLE I-3 (cont.) Sulphur Creek, Near Mouth — UOC Station

Day	May '76 depth	May '76 cfs	June '76 depth	June '76 cfs	July '76 depth	July '76 cfs	Aug. '76 depth	Aug. '76 cfs	Sept. '76 depth	Sept. '76 cfs	Oct. '76 depth	Oct. '76 cfs
1	0.39	0.46			0.01	0						
2	0.39	0.46			0.01	0						
3	0.40	0.48			0	0						
4	0.40	0.48			0	0						
5	0.45	0.58			0	0						
6	0.52	0.73			0	0						
7	0.53	0.76			0.01	0						
8					0.02	0.01					clock stopped	
9					0.03	0.02						
10												
11												
12												
13			No record									
14												
15											0.02	0.01
16											0.02	0.01
17											0.03	0.02
18									clock stopped		0.03	0.02
19			0.01	0							0.02	0.01
20			0.02	0.01							0.02	0.01
21			0.01	0							0.02	0.01
22			0.01	0			Clock stopped				0.02	0.01
23			0.01	0							0.03	0.02
24	No record		0	0							0.02	0.01
25			0	0	Clock stopped						0.03	0.02
26			0	0							0.03	0.02
27			0	0							0.03	0.02
28			0	0							0.03	0.02
29			0	0							0.03	0.02
30			0.01	0							0.02	0.01
31											0.02	0.01

TABLE I-4. East Fork of Jemex River — UOC Station

4 Miles Above Mouth (1500' Above N.M. State Highway 4)

	Oct. '75		Nov. '75		Dec. '75		Jan. '76		Feb. '76		Mar. '76	
Day	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs	depth	cfs
1			1.40	4.74								
2			1.39	4.63								
3			1.38	4.52								
4			1.37	4.42								
5	1.40	4.74	1.36	4.31								
6	1.40	4.74	1.36	4.31								
7	1.39	4.63	1.36	4.31								
8	1.39	4.63	1.35	4.20								
9	1.38	4.52	1.36	4.31								
10	1.38	4.52	1.44	5.58								
11	1.40	4.74	1.52	7.25								
12	1.40	4.74	1.33	3.98							Clock stopped	
13	1.40	4.74	1.33	3.98								
14	1.40	4.74	1.32	3.88								
15	1.39	4.63	1.31	3.77								
16	1.39	4.63	1.29	3.59								
17	1.40	4.74	1.29	3.59								
18	1.39	4.63	1.28	3.52								
19	1.39	4.63							Clock stopped		1.12	2.46
20	1.39	4.63									1.18	2.83
21	1.39	4.63					Frozen				0.52	0.40
22	1.40	4.74									0.54	0.40
23	1.41	4.98									1.48	6.65
24	1.38	4.52			Frozen						1.79	14.03
25	1.43	5.45									1.73	12.60
26	1.36	4.31	Frozen								1.82	14.75
27	1.52	7.60										
28	1.38	4.52										
29	1.37	4.42									Clock stopped	
30	1.36	4.31										
31	1.37	4.42										

...LE I-4 (cont.) East Fork of Jemez River — UOC Station

4 Miles Above Mouth (1500' Above N.M. State Highway 4)

Day	Apr. '76 depth	Apr. '76 cfs	May '76 depth	May '76 cfs	June '76 depth	June '76 cfs	July '76 depth	July '76 cfs	Aug. '76 depth	Aug. '76 cfs	Sept. '76 depth	Sept. '76 cfs
1			1.67	11.17	1.59	9.27	1.54	8.08	1.71	12.13		
2			1.64	10.46	1.57	8.79	1.55	8.31	1.71	12.13		
3			1.62	9.98	1.56	8.55	1.54	8.08	1.63	10.22		
4			1.63	10.22	1.55	8.31	1.51	7.36	1.64	10.46		
5			1.74	12.84	1.55	8.31	1.53	7.84	1.67	11.17		
6			2.97	42.15	1.54	8.08	1.54	8.08				
7			3.01	43.10	1.55	8.31	1.53	7.84				
8			2.40	28.57	1.63	10.22	1.54	8.08				
9			2.19	23.56	1.62	9.98	1.57	8.79				
10			2.01	19.27	1.58	9.03	1.56	8.55				
11				(17.0)	1.58	9.03	1.54	8.08				
12	1.78	13.79		(14.7)	1.56	8.55	1.56	8.55				
13	1.83	14.98		(13.2)	1.56	8.55	1.59	9.27	clock stopped			
14	1.89	16.41	clock stopped	(12.5)	1.55	8.31	1.51	7.36				
15	1.87	15.94		(11.9)		(8.3)	1.52	7.60				
16	1.98	18.56		(11.8)		(8.3)	1.53	7.84				
17	2.00	19.04	1.70	11.89	clock stopped	(8.3)	1.58	9.03				
18	2.36	27.61	1.71	12.13		(8.3)	1.56	8.55				
19	2.22	24.28	1.76	13.32	1.55	8.31	1.56	8.55				
20	2.07	20.70	1.84	15.22	1.56	8.55	1.58	9.03				
21	1.92	17.13	1.84	15.22	1.56	8.55	1.62	9.98				
22	1.86	15.70	1.75	13.08	1.59	9.27	1.65	10.70				
23	1.80	14.27	1.68	11.41	1.63	10.22	1.61	9.74				
24	1.76	13.32	1.65	10.70	1.60	9.50	1.65	10.70				
25	1.75	13.08	1.65	10.70	1.56	8.55	1.73	12.60				
26	1.74	12.84	1.65	10.70	1.55	8.31	1.69	11.65				
27	1.72	12.36	1.65	10.70	1.54	8.08	1.67	11.17				
28	1.72	12.36	1.65	10.70	1.54	8.08	1.68	11.41				
29	1.73	12.60	1.63	10.22	1.54	8.08	1.63	10.22				
30	1.72	12.36	1.60	9.50	1.54	8.08	1.64	10.46				
31			1.59	9.27			1.66	10.93				
Total				467.18		260.07		284.43				
Mean				15.07		8.67		9.18				
Ac Ft.				927		516		564				

APPENDIX II

Basic Data

APPENDIX II

Part 1

Pressure Survey Data
Union Geothermal Division

GEOTHERMAL DIVISION

R. O. ENGEBRETSEN

34-56PT

SUBSURFACE PRESSURE SURVEY

FEB 25 1977

COPY

Company: Union Oil Co. of Calif. FIELD: ______ WELL NAME: Baca No. 4

Lease No.: ______ ELEV.: ______ DATE: May 28, 1973

Well Description: ______ ZERO POINT: ______

DEPTH: ______

Tubing Description: ______

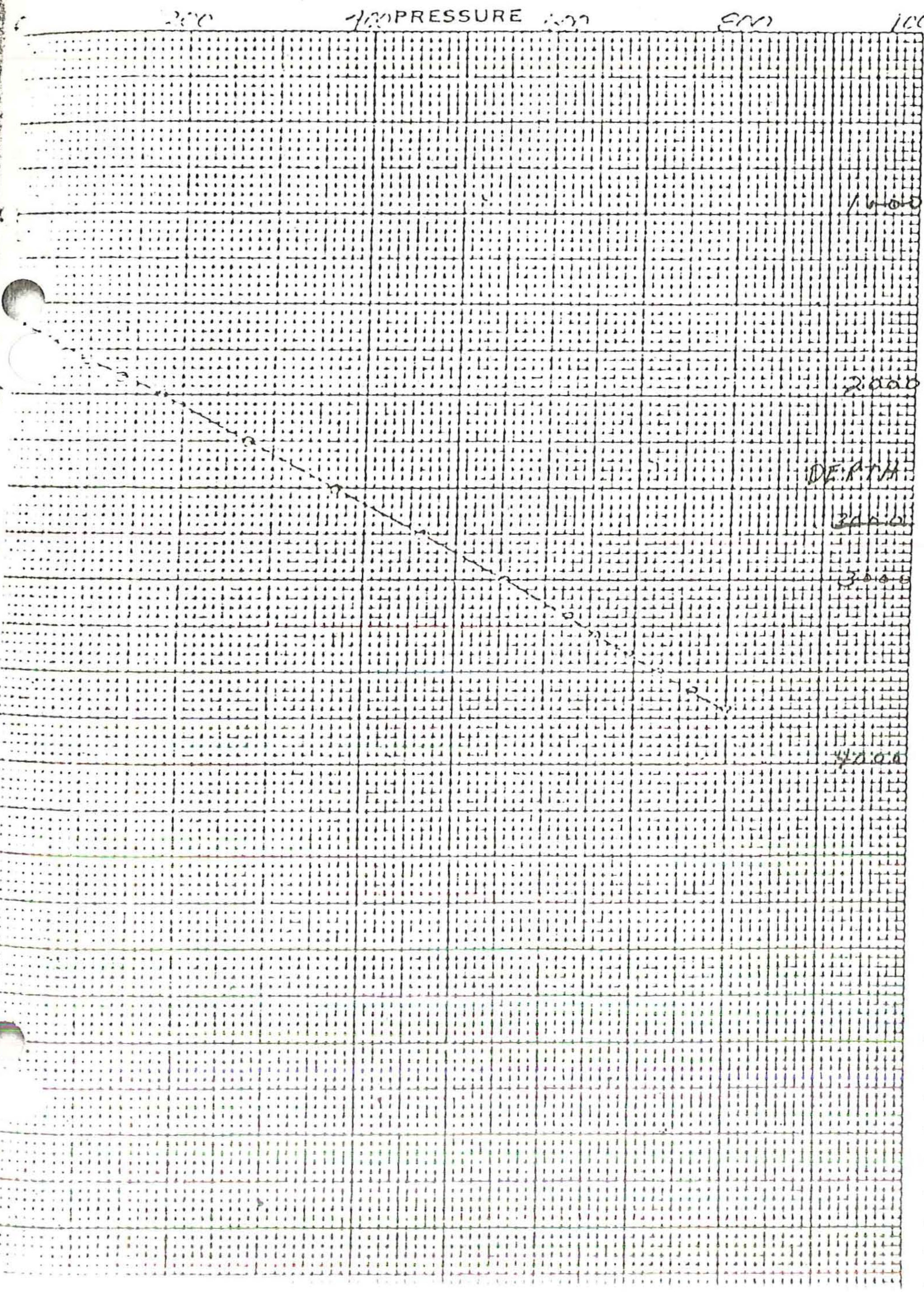
INSTRUMENT: 0-2400

SERIAL NO.: 6604N

MAX TEMP: ______ °F @ ______

Remarks: ______

STABILIZATION PERIOD: ______



PRESSURES, CASING, PSI	GAUGE	BOMB

DEPTH	PRESSURE	GRADIENT
1000	Nil	
1600	15.92	0.159
1700	57.55	0.416
1800	96.73	0.392
1900	137.14	0.404
2000	178.18	0.416
2250	275.51	0.387
2500	369.69	0.377
2750	462.99	0.373
3000	553.99	0.364
3200	627.55	0.367
3300	658.53	0.310
3400	694.65	0.357
3500	727.39	0.333
3600	761.90	0.345
3700	800.00	0.381

GEOTHERMAL DIVISION

B5-59PT

SUBSURFACE PRESSURE SURVEY

O. ENGEBRETSEN

FEB 25 1977

OWNER *Union Oil Co of Calif.* FIELD ______ WELL NAME *Baca No. 5*

CASING ______ ELEV. ______ DATE *May 29, 1973*

LINER DESCRIPTION: ______ ZERO POINT ______

DEPTH *6900*

HOLE DESCRIPTION: ______

INSTRUMENT *0-2100*

SERIAL NO *660411*

MAX TEMP ______ °F @

PURPOSE ______

REMARKS: ______

STABILIZATION PERIOD ______

PRESSURES	GAUGE	BOM
CASING. PSI		

DEPTH	PRESSURE	GRADIENT
1000	2.15	0.002
2000	9.80	0.007
2100	51.15	0.416
2200	88.16	0.371
2300	129.80	0.416
2400	171.15	0.413
2500	209.39	0.382
2600	247.35	0.380
2900	328.55	0.405
3000	405.64	0.410
4000	801.19	0.392
4400	954.74	0.389
4600	1041.09	0.423
5000	1197.41	0.391
5500	1391.24	0.357
6000	1561.60	0.361
6300	1696.80	0.354
6400	1737.60	0.405
6500	1776.00	0.354
6600	1814.43	0.354
6700	1853.64	0.390
6800	1891.44	0.378
6900	1929.27	0.378

[signature]

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

RECEIVED GHEL... PRESS

FEB 25 1977

OWNER: Union Oil Co of Calif. FIELD: Valle Grande WELL NAME: BACA #7

CASING: 13 3/8" to 504, 9 5/8" - 2909 ELEV.: 9000 ? DATE: 7/31/74

LINER DESCRIPTION: 7" - 2697' - 5515' ZERO POINT: GL+8'

SLOT INTERVALS - 3202' - 5515' (TORCH CUT) DEPTH: 5445

HOLE DESCRIPTION:

INSTRUMENT: 0 - 4250 PSI

SERIAL NO: 7198

PURPOSE: REQUESTED BY GEOLOGISTS. MAX TEMP: 403.8 °F @

REMARKS:

STABILIZATION PERIOD

PRESSURES.	GAUGE	BOMB
CASING, PSI	0	0

DEPTH	PRESSURE	GRADIENT
2000	359.7	0
3000	742.6	.383
3500	917.7	.386
4000	1069.9	.365
4500	1213.2	.297
4750	1253.5	.161
5000	1307.2	.194
5250	1364.4	.229
5445	1411.0	.239

R. O. ENGEBRETSEN

GEOTHERMAL DIVISION

FEB 25 1977

SUBSURFACE SURVEY
Field Work Sheet

BH10-SH8-P/T.

[illegible] CAL. CALIF FIELD VALLE GRANDE WELL NAME BACA 10
[illegible] 2455'; 13 3/8" @ 2794' ELEV. 8734 DATE: 10-18-76
[illegible] 9 5/8" @ 4118 ZERO POINT GL+101
7" @ 4275' - 5959' DEPTH 5959'

[illegible]

[illegible] 4650 PSIG. 9222 12 hr 15
[illegible]-793°F SERIAL NO. 10098 CLOCK 12 hr 15 TURN STABILIZATION PERIOD
STYLUS P-1130 T-1132 DISENGAGE STYLUS P-1530 - T-1535
[illegible] 6.
[illegible] 5959' TIME ON BOTTOM 1443-1500 MAX. °F 543 @ 5500'
[illegible] SHUT IN.
ON PRODUCTION:

PRESSURE TEMPERATURE

DEFL.	P·P	GRAD.	[illegible]	TIME	DEPTH	DEFL.	P·T	GRAD.	/D	TIME	DEPTH	DEFL.	P·T	GRAD.	/D
[illegible]	2		-	1215	120	0	0								
[illegible]	14		-	1227	1100	.295	218								
[illegible]	330		-.001	1239	2000	.855	418								
[illegible]	736		-	1251	3000	1.126	507								
[illegible]	885		-	1302	3250	1.144	513								
[illegible]	913		-	1313	3500	1.151	515								
[illegible]	998		-	1324	3750	1.136	510								
[illegible]	1035		-	1335	4000	1.124	506								
[illegible]	1109		-	1344	4250	1.120	505								
[illegible]	1250		-	1357	4500	1.128	507								
[illegible]	1343		-	1408	4750	1.141	512								
[illegible]	1427		-	1419	5000	1.155	516								
[illegible]	1514		-	1430	5250	1.210	534								
[illegible]	1603		-	1441	5500	1.237	543								
[illegible]	1718		+.001	1500	5959	1.182	525								

[illegible]TS:

BY: J.M. / J.B.

R. O. ENGEBRETSEN

UNION

GEOTHERMAL DIVISION

FEB 25 1977

SUBSURFACE SURVEY

Field Work Sheet

310 547 P/T

…: UNION OIL COMPANY FIELD VALLE GRANDE WELL NAME BACA 416

…: 20" AT 553'; 13 3/8 2794 ELEV. 8734 DATE: 4/18/76

… DESCRIPTION: 9 5/8 AT 4443' ZERO POINT GLF 10'

7" AT 4275 DEPTH 5959

… DETAIL: PERFORATIONS - 3000 - ?

…POSE

…ARKS:

…ENT- 0-4000 PSI SN 7193 CLOCK - 12 HR 15 TURN

…ENT 80°-646°F SERIAL NO. 10052 CLOCK 12 HR 15 TURN STABILIZATION PERIOD

…AGE STYLUS P 1637 T 1503 DISENGAGE STYLUS P 1750 T 1732

…HEAD 1

…D 5959 TIME ON BOTTOM 1627-1657 MAX. °F 532

… STATUS

…TN. 5/21/76 ON PRODUCTION:

PRESSURE TEMPERATURE

DEFL.	P-T	GRAD.	ID	TIME	DEPTH	DEFL.	P-T	GRAD.	ID	TIME	DEPTH	DEFL.	P-T	GRAD.	ID
—	—		—	1452	100	.343	187								
.022	4.5		0	1505	1000	.469	226								
.177	401		-.003	1517	2000	1.095	410								
.382	757		-.003	1529	3000	1.437	504								
.560	1111		+.001	1541	4000	1.425	501								
.675	1457		+.004	1553	5000	1.445	506								
.750	1637		+.005	1555	5500	1.546	532								
.750	1637		+.005	1610	5500	1.546	532								
.750	1637		+.005	1625	5500	1.546	532								
.831	1786		+.009	1627	5959	1.408	496								
.831	1786		+.009	1642	5959	1.408	496								
.831	1786		+.009	1657	5959	1.408	496								

…MENTS: RUN SURVEY AFTER SPERRY-SUN pulled 1/4" tubing

BY:

GEOTHERMAL DIVISION

R. O. ENGEBRETSEN

SUBSURFACE PRESSURE SURVEY FEB 25 1977

612 529 P

Union Oil Company FIELD Valle Grande WELL NAME Baca #12

ELEV. 8430 DATE: 8/24/76

DESCRIPTION: ZERO POINT GL+5'

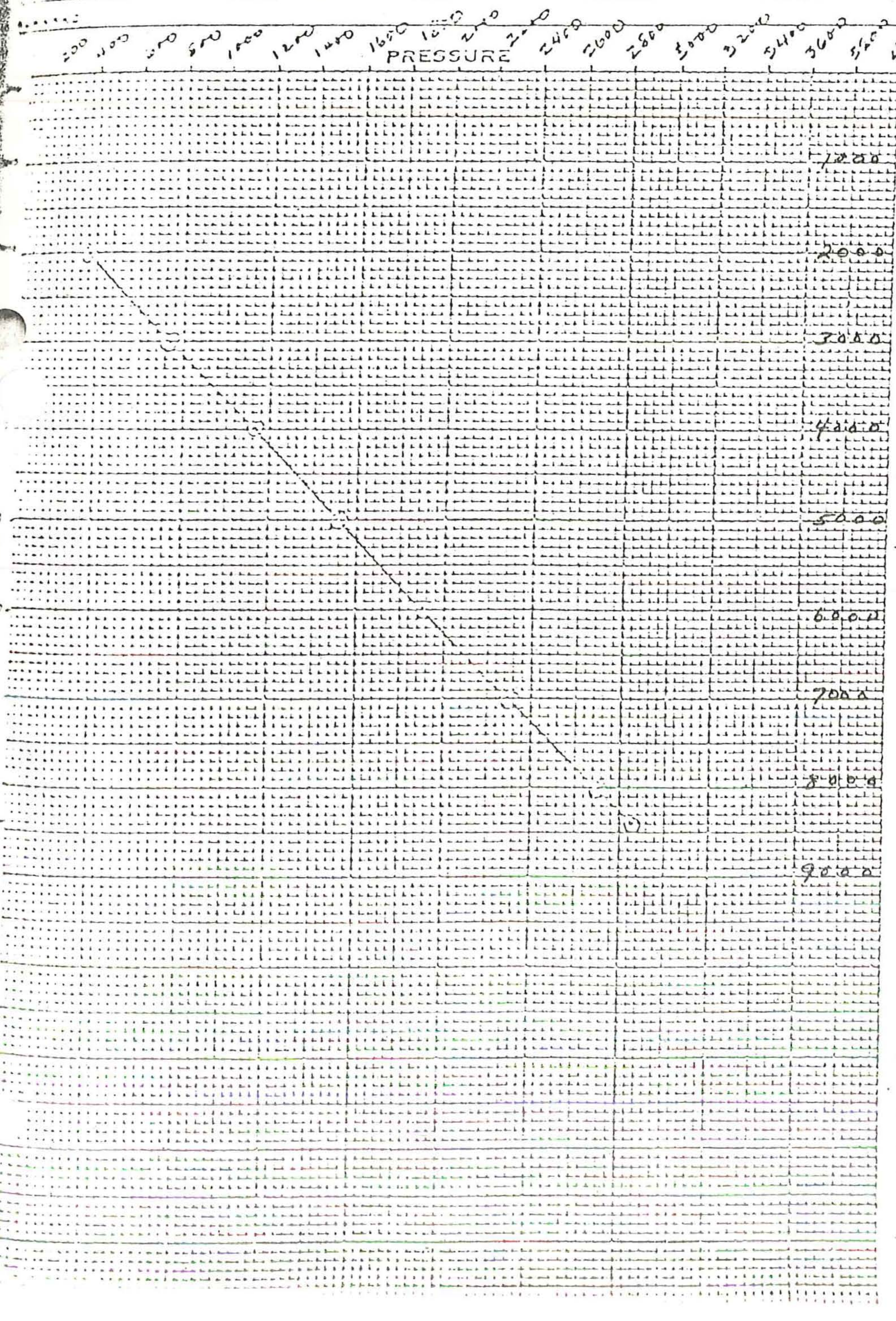
DEPTH 9211

DESCRIPTION:

INSTRUMENT 0 - 4700 PSI

SERIAL NO. 15012

MAX. TEMP 579 °F @ 8400



STABLIZATION PERIOD

PRESSURES,	GAUGE	BOND
CASING, PSI		

DEPTH	PRESSURE	GRADIENT
0	0	
100	0	
1000	0	
2000	365	
3000	751	
4000	1134	
5000	1521	
6000	1911	
7000	2293	
8000	2688	
8400	2847	

GEOTHERMAL DIVISION

R. O. ENGEBREIGH

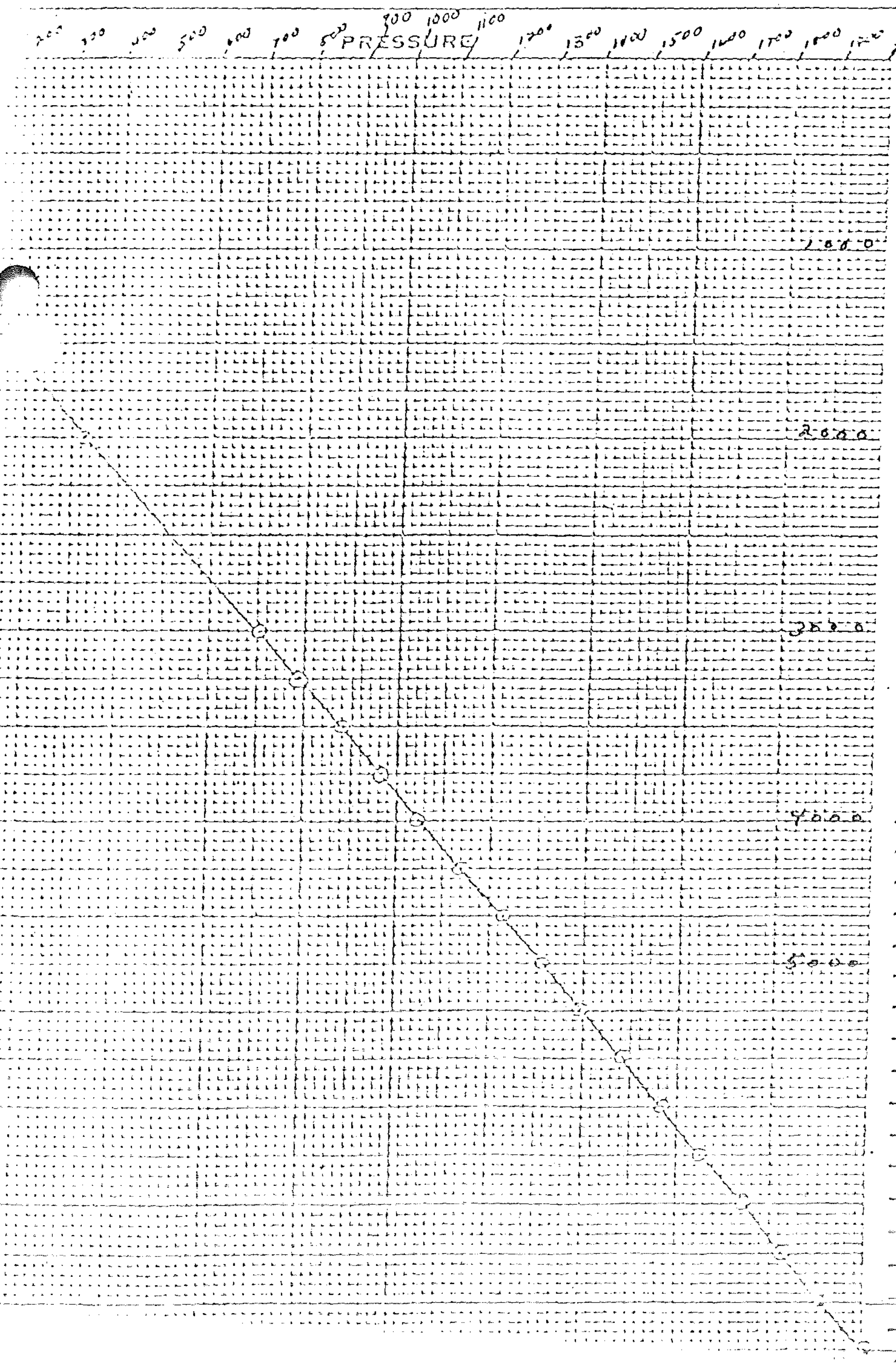
FEB 25 1977

SUBSURFACE PRESSURE SURVEY

B14-53-P/T

... OIL CO. OF CALIF	FIELD VALLE GRANDE	WELL NAME	BACA #14
...' @ 193', 13 3/8" @ 1450'	ELEV. 8604.8'	DATE:	2/9/75
...RIPTION: 9 5/8" HUNG - 1152' - 3074' OPEN HOLE - 3074' - 6832'		ZERO POINT	R.T.
		DEPTH	6824'
...RIPTION: —			
		INSTRUMENT	0-4250
		SERIAL NO.	7198
RIG SURVEY		MAX TEMP	529.6 °F @ 6824'

STABLIZATION PERIOD



PRESSURES	GAUGE	BOMB
CASING, PSI	0	0

DEPTH	PRESSURE	GRADIENT
1000	0	0
2000	331	0
3000	701.3	.370
3250	790.3	.356
3500	881.4	.364
3750	966.1	.339
4000	1050.4	.337
4250	1140.8	.362
4500	1229	.353
4750	1315	.344
5000	1399.2	.337
5250	1481.1	.327
5500	1570	.356
5750	1652.5	.330
6000	1746	.374
6250	1824.2	.313
6500	1911	.347
6750	2002	.364
6824	2030	.378

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

FEB 25 1977

B-16 S13 P

[illegible] Union Oil Company — FIELD Valle Grande — WELL NAME Baca #16

[illegible] 9 5/8 AT 2905' — ELEV. 9672' — DATE: 9/16/75

[illegible] DESCRIPTION: 2905 - TD = OPEN HOLE — ZERO POINT C.L.+10'

DEPTH 6950'

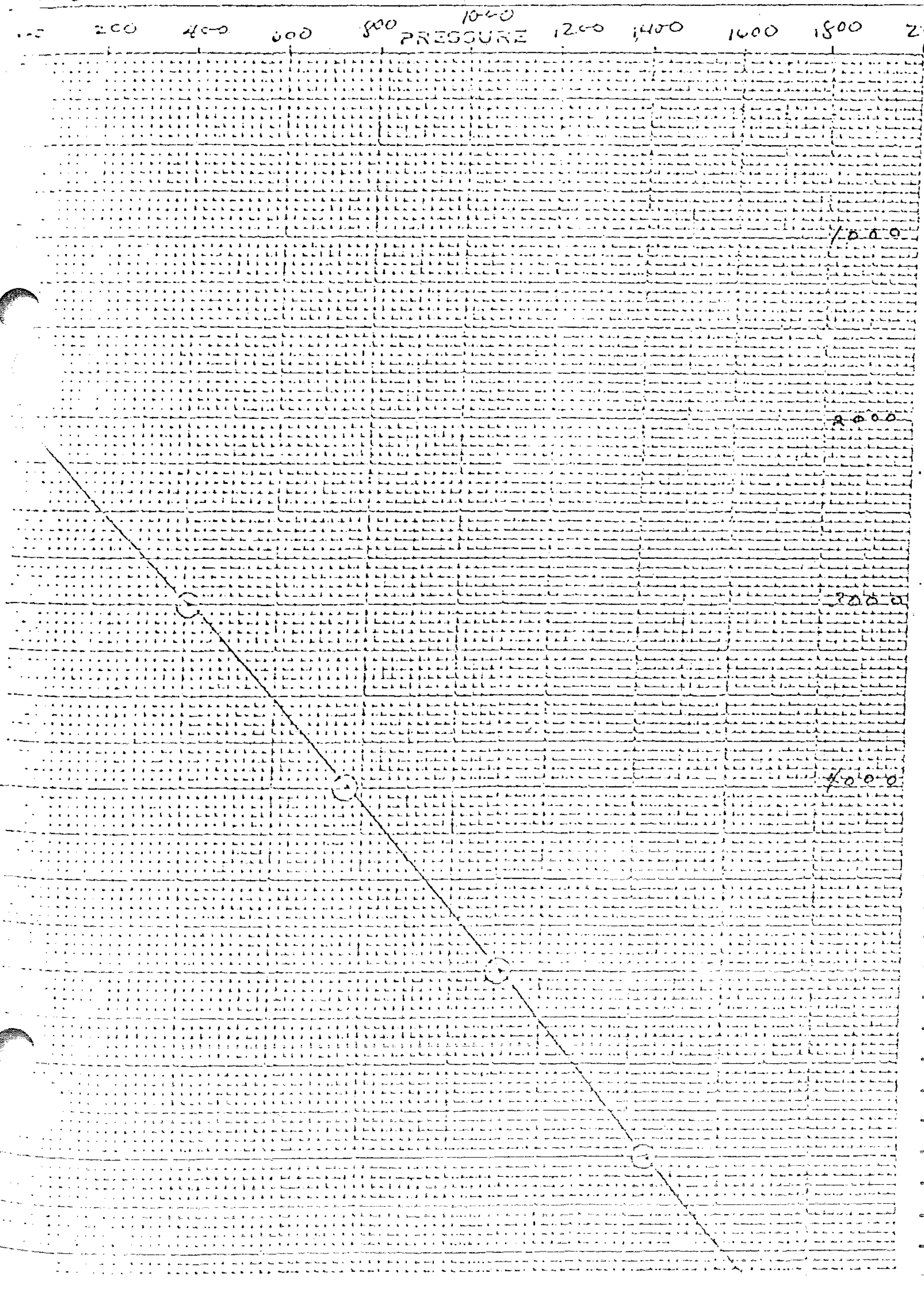
[illegible] DESCRIPTION:

INSTRUMENT 0-4250

SERIAL NO 7193

MAX. TEMP ? °F

STABILIZATION PERIOD



PRESSURES	GAUGE	[illegible]
CASING, PSI		

DEPTH	PRESSURE	GRADIENT
150	13.6	
1000	16.8	
2000	20.2	
3000	409.9	
4000	769.1	
5000	1115.5	
6000	1443.3	
6950	1735.2	
6950	1743.6	
6950	1743.6	

[signature]

APPENDIX II

Part 2

Selected Wells, Springs and Surface Water Gaging Stations

…For Selected Wells, Springs and
…ed Data At Surface Water Gaging Stations
… Mountains Area, New Mexico

	Name	Type	Township & Range	Total Dissolved Solids (ppm)	Electric Conductivity µmhos	pH	Rate of Flow (gpm)
	Baca #8 Well	Well		197	164	7.5	
	Pipeline Seep	Spring	,				
	San Antonio Warm Spring	Spring	20N4E	(a)		(b)	
				113	81	7.0	
	Puerto D'Abringo	Spring		108	86		
	San Antonio Creek	Surface	20N4E	98	80		800
		Spring	20N4E	90	85		
		Well	20N4E	123	107		
		Well	20N4E	(c)		(d)	
…A	Valle Toledo #1	Well	20N4E	124	100		
	Valle Toledo H-6	Well		124	100		
		Well	20N5E	(c)		(f)	10.3
…A	Valle Toledo #6	Well	20N5E	90	85		Flows
	Valle Toledo H-4	Well		143	122		
…A		Well	20N4E	94		8.2	
…B	Big Well Toledo	Well		125	110		
	Valle Toledo H-3	Well		111	85		
	Valle Toledo H-2	Well		103	80		
…A	Valle Toledo H-1	Well					25
		Spring	20N5E				40
		Spring	20N5E				15
		Spring	20N5E				
	Rio Arriba County	Well	20N7E				
	Rio Arriba County	Well	20N7E				
	Rio Arriba County	Well	20N8E	358	539	8.0	
		Spring	21N1W	332	570	7.1	
		Well	21N2E				
	Rio Chama near Chamita	Surface		263	430	7.4	
		Well	22N3E	112	120	6.8	
		Spring	22N5E	188	147	8.0	
	Agua Caliente	Spring		124	141	7.8	
…A		Well	22N5E				
	Rio Chama Below Abiquiu Dam	Surface	23N5E	2,390	3,190	7.5	
		Well	23N5E				

(e) 88 to 158
(f) 7.3 to 8.1

...or Selected Wells, Springs and
...ed Data At Surface Water Gaging Stati...
... Mountains, New Mexico

Name	Type	Township & Range	Total Dissolved Solids	Electric Conductivity	pH	Rate of Flow
				µmhos		(gpm)
G-4	Well	19N7...				
G-6	Well	19N7...				
G-5	Well	19N7...				
G-3	Well	19N7...				
G-1A	Well	19N7...				
G-2	Well	19N7...				
G-1	Well	19N7...				
LA-1	Well	19N7...				
LA-1B	Well	19N7...				
LA-2	Well	19N7...				
LA-3	Well	19N7...				
	Well	19N7...	173	251		
LA-5	Well	19N7...				
LA-6	Well	19N7...				
LA-4	Well	19N7...				
	Spring	19N7...	(183)	292	7.1	
	Spring	19N7...	(183)	292	7.1	
Santa Fe County	Well	19N7...				
Rio Grande at Otowi Bridge	Surface	19N8...				
	Well	20N1...	344	580	7.2	
Rio del Las Vacas	Surface	20N1...				
Calaveras Spring	Spring	20N2...	102	95	7.4	32
	Spring	20N2...	99	105	7.4	
Calaveras Campground	Spring	20N2...	102	80	7.2	32
USFS Spring	Spring	20N3...	150	105	7.3	
LASL Well B	Well	20N3...				
LASL Well C	Well	20N3...	138	200	8.6	
Seven Springs	Spring	20N3...	114	90	7.5	
San Antonio Hot Springs	Spring	20N3...	(a)	120	(b)	(c)
	Spring	20N3...	150	122	7.7	
West San Antonio Sp.	Spring		168	94	8.0	
San Antonio Creek	Surface		105	80		
San Antonio Creek	Surface		152	220	8.5	
Baca #7	Well					
Baca #1...	Well	(same	2,970	2,225	8.0	
Sulphur Creek	Surface		1,800	2,270		
Baca #2	Well					
Sulphur Springs	Spring					

) 272-332

For Selected Wells, Springs and
ed Data At Surface Water Gaging S
Mountains Area, New Mexico

Name	Type		Total Dissolved Solids (ppm)	Electric Conductivity µmhos	pH	Rate of Flow (gpm)
Valle Grande H-10	Well					
East Jemez Creek	Surface	9	165	160		Flows
~~Wet Weather Creek~~	~~Surface~~		90	79	8.5	
American Springs	Spring	1	~~108~~	~~132~~	~~7.0~~	
Valle Grande H-7	Well					5
Valle Grande H-2	Well	9	125	90		Flows
Valle Grande H-5	Well	9	142	110		Flows
Valle Grande #7	Well	1	142	125		Flows
	Spring	1	(a)		(b)	6.6
South Medio Spring	Spring	1	108	84		900
	Spring	1	127	104	7.4	
S.W. Medio Spring	Spring					5
	Spring	1	109	88	7.2	
West Medio Spring	Spring	)				5
	Well	1	111	77	7.7	
	Well	1	142	126		
	Well	1	142	109		
Valle Grande #12	Well	19	121	94		
Valle Grande Ent. Spring	Spring					
East Fork	Surface		94	68	7.7	
	Spring	19	108	85		
	Spring	19				20
	Spring	19				25
	Spring	19				4
Armstead Spring	Spring	19				4
	Spring	19				2
Santa Fe County	Well	19				90
	Spring	19				
Santa Fe County	Well	19	(229)	370	7.2	
Santa Fe County	Well	19				
Santa Fe County	Well	19				
	Well	19				
	Well	19	(123)	194	7.4	
	Well	19				
PM-2	Well					
PM-1	Well	19				
Santa Fe County	Well	19				

ation is in the Tewa Group
member of the Bandelier Tuff
i Puye are members of the
oup

: Selected Wells, Springs and
: Data At Surface Water Gaging Stations
Mountains Area, New Mexico

Name	Type	Township & Range		issolved Solids	Electric Conductivity	pH	Rate of Flow
				m)	µmhos		(gpm)
Hofein Fire Prot.	Well	19N3E	17.3				
Hofein Sub Artesian	Well	19N3E	17.3				
Hofein Artesian	Well	19N3E	17.3	a)		(b)	40±
LASL Well A	Well	19N3E	18.3				
LaCueva Spring	Spring	19N3E	17.3	230	180	7.4	
Laudermilk Spring	Spring	19N3E	17.3	209	180	7.6	
	Spring	19N3E	17.4	599	912	7.5	
Eckert Well	Well	19N3E	17.1				
Brown's Cabin	Well	19N3E	17.11	322	380	7.2	
Glass Well	Well	19N3E	4/5				
	Well	19N3E	4.00	240	17,300	1.4	
San Antonio Campground	Well	19N3E	8.33				
San Antonio Creek	Surface	19N3E	17.0	164	130		
Sulphur Creek	Surface	19N3E	17.44	700	662		
Sulphur Creek	Surface	19N3E	20.22	850	1,165	3.5	
Redondo Creek	Well	19N3E	20.44	294	320	7.5	
Redondo Creek	Surface			157	176	7.5	
USFS Redondo Well	Well	19N3E	16.43				
Sulphur Springs	Spring						
Baca #1 Well	Well						
Baca #16 Well	Well						
Baca #11 Well	Well						
Baca #15 Well	Well						
Baca #6 Well	Well						
Baca #9 Well	Well						
Baca #14 Well	Well						
Baca #12 Well	Well						
Baca #5 Well	Well						
Baca #10 Well	Well						
Baca #4 Well	Well						
Baca #13 Well	Well						
Jaramillo Head Spg.	Spring			131	107	6.3	
Redondo Head East	Spring			50	67	7.0	
Jaramillo Creek	Surface			94	67	7.5	
Cerro Pinon Spring	Spring			89	88	7.0	
San Antonio Head	Spring	20N4E	14.424				
	Well	19N4E	26.222	165	157		

...elected Wells, Springs and
...ata At Surface Water Gaging Stations
...ntains Area, New Mexico

Name	Type	Township & Range	Total Dissolved Solids (ppm)	Electric Conductivity µmhos	pH	Rate of Flow (gpm)
	Spring	18N7E				
	Spring					
	Spring					50
	Spring	18N7E	(135)	132	7.3	
	Spring	18N7E				
	Spring					
	Spring					
Rio del Las Vacas	Surface	19N1E	130	105	7.3	16
Spring Canyon	Spring		164	160	7.0	
Testhole Fenton Lake	Well	19N2E				
Fenton Lake	Surface	19N2E	143	140	7.8	
Lakefork Canyon	Spring		1,528	2,000	6.9	16
Battleship Rock	Spring	19N3E	2,362	2,940	7.0	
Shaver Spring	Spring	19N3E	728	1,210	6.9	
	Well	19N3E	1,130	1,800	6.8	
	Well		2,260	3,250	6.8	
	Well		2,500	3,660	8.2	
	Well	19N3E				
Forest Service	Well	19N2E				
LASL Well D	Well	19N2E	188	120	6.7	
Barley Springs	Spring	19N2E				
GT-1 Well	Well	19N2E	2,500	(a)		
GT-2 Well	Well	19N2E	16,800	22,900	8.8	
	Well		9,380	18,100	7.7	
	Well		1,730	2,720	7.2	
	Well		204	220	7.5	
Hazlett Well	Well	19N3E	151	166	7.9	
	Well	19N3E	933	1,470	8.5	
	Spring	19N3E	1,160	1,780	8.4	
	Spring	19N3E				
USGS Battleship Rock	Well	19N3E				
" Upper Fm	Well	19N3E				
" Lower Fm	Well	19N3E				
Jemez River below			144	176	7.7	
Jemez Spring	Surface		104	110		
East Fork	Surface	18N3E	206	170		
San Antonio Creek	Surface	19N3E	(b)	280	(c)	(d)
Spence Spring	Spring	19N3E	210	130	7.4	
	Spring	19N3E	264	230	8.0	
Horseshoe Springs	Spring	19N3E	299	230	7.6	
	Spring	19N3E				

...Puye and Puye are members of
...ta Fe Group.

Selected Wells, Springs and
Data At Surface Water Gaging Stations
ntains Area, New Mexico

Name	Type	Township & Range	Total Dissolved Solids (ppm)	Electric Conductivity µmhos	pH	Rate of Flow (gpm)
Jemez River	Surface		(a)	(b)		
	Spring	18N3E	1,480	2,276		
	Spring			1,140		16
Russel Springs	Spring	18N3E	984	1,280	7.4	16
Agua Durme Spring	Spring		178	130	7.8	
Soda Dam Spring	Spring	18N2E	2,400	5,500	6.1	36
Soda Dam Spring	Spring	18N2E	4,200	6,500	7.5	27
Jemez River	Surface		424	60		
Jemez Hot Springs	Spring		2,611	3,200	7.5	200
Bell Well	Well			1,140		
	Spring	18N2E	626	1,030	7.5	
Morgan Well	Well		634	6,000	8.1	
U.S.G.S. Testhole	Well		2,190	2,500	8.2	
	Spring	18N2E	2,170	3,210	7.6	
Jemez River	Surface		480	807	7.8	
San Diego Canyon	Spring					
	Spring		2,140	3,550	6.7	
Via Coeli Well	Well		625	925	7.3	
	Well		1,960	3,460	7.1	
	Well	18N2E	580	1,340	8.0	
Church Canyon Sprg.	Spring	18N3E	178	184	7.5	
	Spring		856	1,380	8.2	
Russel Well	Well		402	580	7.6	
	Well	18N3E	952	1,430	6.6	
	Well	18N3E	393	560	7.3	
U.S.G.S. Testhole	Well	18N3E	2,258	2,500	7.4	
Camp Shaver Well	Well	19N3E	134	140	7.1	
	Well	18N3E	149	165	8.0	
	Well	18N3E	179	255		
McCauley Spring	Spring	18N3E	(a)	162	(d)	(e)
East Fork	Surface	18N3E	58	95		
	Spring	18N3E	161	187	7.1	
East Fork	Surface	18N4E	96	90		
Santa Fe County	Well					
Santa Fe County	Well					
Santa Fe County	Well					
	Spring					
	Spring					

2 to 396

... Selected Wells, Springs and
... Data at Surface Water Gaging Stat...
... Mountains Area, New Mexico

Name	Type	Township & Range	Total Dissolved Solids ppm	Electric Conductivity µmhos	pH	Rate of Flow (gpm)
			3,780	5,694	8.0	
	Spring	16N2		980		
Jemez Pueblo Well	Well	16N2	628	1,014	8.0	
	Spring	16N2				
			1,570	2,550	7.6	
	Spring	16N2	324	527	7.7	
	Spring	16N2	245	367	7.5	
Ojo Chamisa Spring	Spring	16N3				
Rio Grande Below Cochiti Dam	Surface	16N6				
Ojo del Esperito Santo	Spring		396	--	--	
	Spring	17N1	335	549	8.0	
	Spring	17N1	164	254	7.9	
Rio Guadalupe	Surface		284	390	8.0	
U.S.G.S. Testhole	Well		638	984	8.0	
	Spring	17N2	638	100	7.6	
Jemez School Spring	Spring		292	472	8.2	
	Spring	17N2	350	584	7.4	
Jemez River	Surface		1,960	3,200	8.4	
	Spring		647	1,090	7.5	
	Spring	17N2	1,964	2,320	8.4	
Abandoned Well	Well		692	1,000	7.6	
Redwood Grove	Well		364	571	7.4	
	Spring	17N2	205	241	7.2	
	Spring	17N3	350	370		
Vallecitos Creek	Surface	17N3	104	190	7.8	
Paliza Spring	Spring	17N3	159	182	6.8	
	Spring	17N3	155	161	7.6	
	Spring	17N4	153	179	6.7	
	Spring	17N4	161	194	7.5	
	Spring	17N4	365	636	7.2	
	Spring	18N1	398	500	7.2	
U.S.G.S. Testhole	Well		230	383	7.7	
	Spring	18N1	172	212	8.2	
	Spring	18N1	2,080	3,290	8.5	
	Spring	19N3	1,520	2,540	6.7	
	Spring		814	1,360	6.9	
	Spring					
Jemez River below			135	164	7.2	
East Fork	Surface		188	135	7.4	
Sino Springs	Spring					

... Selected Wells, Springs and
... Data at Surface Water Gaging Stations
... Mountains Area, New Mexico

No.	Name	Type	Township & Range	Total Dissolved Solids ppm	Electric Conductivity µmhos	pH	Rate of Flow (gpm)
	Rio Grande At Albuquerque	Surface					
		Well	12N2E	265	367	--	1,000
		Well	12N2E	267	352	7.4	650
		Well	21N3E	343	501	7.8	
		Well	12N3E	255	348	7.5	1,000
		Well	12N3E	598	878	7.5	
		Well	12N4E	457	666	7.5	
		Well	12N4E	421	642	--	
		Well	13N3E	2,460	3,140	9.5	
0	Jemez River Below ...emez Canyon Dam	Surface	13N4E				
1	"	Surface					
2		Well	13N4E	548	749	6.6	
3		Well	13N4E	780	1,050	--	
3A		Well	13N4E	1,420	1,880	6.4	
4		Well	14N5E	(691)	1,020	7.5	
5	San Ysidro Group	Spring	15N1E	10,960	(16,800)	--	
6	Indian Springs	Spring	16N2E	3,470	5,680	8.0	
7		Well	15N1E	--	20,000	--	
8	San Ysidro Group	Spring	15N1E	7,320	11,200	--	
8A		Spring	15N1E	6,650	9,950	6.5	
9		Well	15N2E	330	519	7.6	
0		Well	15N2E	332	490	7.9	
		Well	15N5E	(872)	1,190	7.3	
		Spring	16N1W	7,760	10,100	8.5	2
		Spring	16N1W	11,100	15,700	6.8	85
		Spring	16N1E	599	960	7.9	
	Hot Well	Well	16N1W	11,000	15,300	7.3	
	Kaseman Well	Well		11,120	--	--	2,450
	Penasco Spring	Spring	16N1E	7,510	(11,500)	--	
	Log Spring	Spring	16N1E	310	487	7.6	
		Spring	16N1E	418	651	7.6	
		Spring	16N1E	1,840	2,440	6.4	2
		Spring	16N2E	2,350	3,190	7.0	
		Spring	16N2E	4,150	6,420	6.4	
		Spring	16N2E	674	1,070	7.0	
	Owl Spring	Spring	16N2E		1,270		32
A		Spring	16N2E	482	788	7.3	
5		Well	16N2E	589	946	7.6	

*Corrected location. Not correctec

DATA SOURCES

1. Informal Report LA-5595-MS, Preliminary Study of The Quality Of Water In The Drainage Area of the Jemez River and Rio Guadalupe, Los Alamos Scientific Laboratory, Los Alamos, N.M., April 1974.

   Data Numbers: 16, 34, 37, 48, 50, 55, 55A, 58, 59, 65, 70, 71, 72, 73, 73A, 74, 75, 76, 77, 78, 80, 81, 85, 89, 92, 94, 95, 97, 110, 111, 112, 113, 114, 117, 118, 122, 126, 127, 128, 129, 130, 131, 133, 134, 138, 139, 140, 142, 145, 162, 163, 167, 167A, 167B, 168, 177, 207, 208, 209, 210, 211, 212 213, 215, 219, 224, 227, 228, 230, 231, 233, 234, 235, 235A

2. Water Supply Paper 620, Geology and Ground-Water Resources of Western Sandoval County, New Mexico, U.S. Dept. of Interior, Geological Survey, 1931.

   Data Numbers: 15, 18, 26, 27, 44, 75, 77, 84.

3. Water Resources Data for New Mexico, Part 2, Water Quality Records, U.S. Dept. of the Interior, Geological Survey, 1964-1975.

   Data Numbers: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 13A, 14, 17, 18A, 19, 20, 21, 22, 23, 24, 28, 29, 30, 31, 32, 33, 34A, 35, 36, 38, 40, 41, 42, 46, 47, 49, 51, 52, 53, 54, 56, 57, 60, 61, 62, 63, 64, 66, 67, 68, 68A, 68B, 69, 79, 82, 83, 84A, 85A, 86, 87, 88, 90, 91, 93, 93A, 96, 106A, 115, 115B, 115C, 121, 121A, 121B, 123, 124, 124A, 134B, 137, 184, 187, 202, 204, 205, 207A, 213A, 242, 243, 244, 245, 246, 247A, 249.

4. Informal Report LA-5780-MS, Geology of Geothermal Test Hole TI-2, Fenton Hill Site, July 1974, Los Alamos Scientific Laboratory, Los Alamos, N.M., Nov. 1974.

   Data Numbers: 75, 114.

5. Water Supply Paper 1753, Geology and Ground-Water Resources of The Los Alamos Area, New Mexico, U.S. Dept. of Interior, Geological Survey, 1964

   Data Number: 169A, 193, 195, 196, 197, 198, 199, 199B, 199C, 200A, 201, 227, 232, 233A.

Data Sources (cont.)

6. Results of Laboratory Analysis Done For Union Oil Co. by Smith-Emergy Lab.

   Data Numbers: 31, 75, 77, 94, 114A, 128, 130, 134A, 141, 143, 157, 158, 159, 160, 165, 169A, 171, 172A, 176, 213, 214, 216, 223, 226, 233B.

7. Results of Laboratory Analysis Done For Union Oil Co. by C.E.P. Lab.

   Data Numbers: 75, 94, 128, 132, 148, 151A, 152, 155, 156, 168, 213, 224, 230A, 232A.

APPENDIX II

Part 3
Water Quality Data

WATER [illegible] DATA
Jemez Basin and Vicinity

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	SO_4^{--}	Cl	TDS	Ec	pH	Temp °F
1												
2	12/12/74	18.0	3.5	53.0	5.0	127.0	43.0	6.8	265.0	367	--	67
3	12/12/74	28.0	5.0	36.0	7.6	156.0	35.0	7.3	267.0	352.0	7.4	55
4	4/27/65	57.0	10.0	29.0	--	134.0	58.0	51.0	343.0	501.0	7.8	--
5	12/12/74	31.0	5.9	30.0	6.4	142.0	37.0	7.4	255.0	348.0	7.5	61
6	2/26/65	112.0	17.0	60.0	--	357.0	143.0	22.0	598.0	878.0	7.5	--
7	1/21/65	60.0	11.0	69.0	--	248.0	85.0	37.0	457.0	666.0	7.5	--
8	9/25/74	41.0	6.8	79.0	7.9	200.0	40.0	72.0	421.0	642.0	--	81
9 *	8/26/72	1.2	0.3	740.0	22.0	334/226	49.0	97.0	2,460.0	3,140.0	9.5	90
10	10/ 9/73	80.0	14.0	330.0	16.0	348.0	290.0	280.0	1,220.0	1,950.0	8.1	54
11	3/10/66	54.0	7.4	175.0	--	274.0	90.0	161.0	662.0	1,110.0	7.6	--
11	6/22/66	79.0	9.5	278.0	15.0	330.0	266.0	228.0	1,070.0	1,720.0	7.5	--
12	9/25/74	65.0	15.0	77.0	11.0	394.0	29.0	35.0	548.0	749.0	6.6	78
13	9/25/74	150.0	22.0	50.0	3.0	193.0	350.0	24.0	780.0	1,050.0	--	67
13A	9/25/74	210.0	51.0	180.0	11.0	514.0	580.0	53.0	1,420.0	1,880.0	6.4	71
14	2/ 4/65	117.0	22.0	88.0	--	388.0	218.0	19.0	(691.0)	1,020.0	7.5	--
15	9/15/24	494.0	91.0	3,310.0	--	1,969.0	3,401.0	2,500.0	10,960	--	--	86
16	8/30/62	100.0	9.0	--	--	1,280.0	286.0	1,140.0	3,470.0	5,680.0	8.0	95
17	10/18/74	--	--	3,900.0	140.0	--	--	2,800.0	--	20,000.0	--	64
18	9/15/24	368.0	85.0	2,219.0	--	1,757.0	1,712.0	1,940.0	7,320.0	--	--	68
18A	5/ 2/73	300.0	68.0	2,000.0	81.0	1,970.0	1,300.0	1,900.0	6,650.0	9,930.0	6.5	63
19	2/27/65	48.0	9.0	46.0	--	158.0	66.0	36.0	330.0	519.0	7.6	--
20	4/ 4/74	49.0	1.5	56.0	5.5	228.0	57.0	4.2	332.0	490.0	7.9	63
21	1/21/65	147.0	25.0	92.0	--	205.0	450.0	22.0	(872.0)	1,190.0	7.3	--
22	6/ 5/73	120.0	9.0	2,400.0	6.6	241.0	4,500.0	580.0	7,760.0	10,100.0	8.5	70
23	6/ 5/73	380.0	61.0	3,500.0	88.0	1,410.0	3,300.0	3,100.0	11,100.0	15,700.0	6.8	126
24	10/ 2/73	77.0	26.0	100.0	5.5	335.0	120.0	82.0	599.0	960.0	7.9	79
25												
26	9/29/26	400.0	73.0	3,450.0	--	1,498.0	3,645.0	2,660.0	11,120.0	--	--	115
27	9/14/24	260.0	70.0	2,400.0	--	1,301.0	1,728.0	2,370.0	7,510.0	--	--	70
28	5/23/73	57.0	13.0	28.0	2.6	217.0	63.0	9.3	310.0	487.0	7.6	60
29	5/23/73	96.0	15.0	24.0	1.7	331.0	72.0	11.0	418.0	651.0	7.6	54
30	9/ 5/73	210.0	37.0	310.0	14.0	171.0	990.0	160.0	1,840.0	2,440.0	6.4	60

( ) estimated

* Deep test; Shell Oil - sample may not be representative of formation water.

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3	SO_4	Cl	TDS	Ec	pH	Temp. °F
31	9/ 5/73	270.0	62.0	420.0	26.0	594.0	850.0	410.0	2,350.0	3,190.0	7.0	66
31	10/15/71	292.3	53.5	1,820.0	90.0	1,197.2	1,221.3	1,900.0	6,737.7	9,100.0	6.8	
32	5/24/73	110.0	18.0	1,400.0	63.0	1,320.0	470.0	1,400.0	4,150.0	6,420.0	6.4	59
33	5/24/73	100.0	15.0	120.0	7.3	416.0	91.0	96.0	674.0	1,070.0	7.0	66
34	5/ 1/53	102.0	19.0	144.0	1,220.0	436.0	90.0	133.0	--	1,220.0	--	--
34A	5/24/73	88.0	12.0	69.0	4.1	338.0	55.0	60.0	482.0	788.00	7.3	61
35	1/19/65	68.0	16.0	118.0	--	385.0	49.0	87.0	589.0	946.0	7.6	--
36	8/30/73	110.0	21.0	1,300.0	73.0	1,440.0	270.0	1,200.0	3,780.0	5,694.0	8.0	73
37	1967	59.0	18.0	122.0	--	374.00	44.0	116.0	597.0	980.0	--	--
38	8/30/73	73.0	15.0	120.0	15.0	419.0	40.0	100.0	628.0	1,014.0	8.0	68
40	5/24/73	60.0	11.0	520.0	41.0	788.0	220.0	290.0	1,570.0	2,550.0	7.6	77
41	5/25/73	21.0	4.0	87.0	12.0	281.0	38.0	7.2	324.0	527.0	7.7	57
42	6/ 8/73	31.0	4.0	46.0	3.3	211.0	20.0	3.0	245.0	367.0	7.5	--
44	9/22/24	90.0	12.0	29.0	--	259.0	99.0	4.0	396.0	--	--	60
46	8/31/73	85.0	15.0	11.0	2.0	326.0	26.0	4.4	335.0	549.0	8.0	57
47	11/14/74	40.0	3.4	10.0	2.0	152.0	7.1	2.5	164.0	234.0	7.9	37
48	11/ 2/73	50.0	12.0	37.0	--	216.0	--	10.0	284.0	390.0	8.0	55
49	8/21/73	32.0	5.7	190.0	8.2	366.0	120.0	49.0	638.0	984.0	8.0	66
50	8/21/73	30.0	8.0	185.0	--	296.0	--	48.0	660.0	780.0	7.8	--
51	11/ 2/73	50.0	9.9	38.0	4.9	263.0	25.0	5.9	292.0	472.0	8.2	55
52	11/14/74	48.0	5.1	60.0	9.8	203.0	15.0	71.0	350.0	584.0	7.4	39
53	10/26/73	7.2	2.7	790.0	7.4	1,470.0	97.0	300.0	1,960.0	3,200.0	8.4	61
54	10/ 5/73	78.0	14.0	120.0	16.0	362.0	52.0	130.0	647.0	1,090.0	7.5	82
55	10/26/73	6.0	7.0	600.0	--	1,156.0	--	290.0	1,964.0	2,320.0	8.4	61
55A	6/ 8/73	85.0	18.0	128.0	--	284.0	--	176.0	692.0	1,000.0	7.6	59
56	6/ 6/73	63.0	14.0	37.0	3.7	218.0	87.0	11.0	364.0	571.0	7.4	64
57	10/ 2/73	27.0	5.8	14.0	2.1	129.0	9.8	7.9	205.0	241.0	7.6	59
58	6/ 8/73	48.0	11.0	37.0	--	188.0	--	6.0	350.0	370.0	--	--
59	6/ 8/73	26.0	10.0	12.0	--	108.0	--	6.0	104.0	190.0	7.8	--
60	9/18/73	19.0	5.9	7.3	5.9	91.0	17.0	2.4	159.0	182.0	6.8	54
61	8/28/73	15.0	4.2	13.0	1.8	97.0	4.9	2.5	155.0	161.0	7.6	55
62	9/18/73	18.0	5.1	7.5	7.0	79.0	16.0	3.6	153.0	179.0	6.7	59
63	8/28/73	20.0	5.9	7.0	5.5	88.0	22.0	3.7	161.0	194.0	7.5	51
64	10/30/73	100.0	11.0	14.0	5.8	367.0	21.0	13.0	365.0	636.0	7.2	51
65	10/30/73	101.0	14.0	14.0	--	300.0	--	16.0	398.0	500.0	7.7	52
66	11/30/70	66.0	4.6	9.1	1.6	238.0	6.5	2.4	230.0	383.0	7.7	55

Water [illegible]y Data, Jemez Basin and Vicinity

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3	SO_4	Cl	TDS	Ec		Temp. °F
67	11/30/73	28.0	3.2	11.0	1.6	116.0	7.3	3.7	172.0	212.0	8.2	59
68	9/24/73	19.0	44.0	720.0	66.0	1,550.0	150.0	120.0	2,080.0	3,290.0	8.5	63
68A	1/17/73	140.0	13.0	390.0	51.0	761.0	32.0	470.0	1,520.0	2,540.0	6.7	66
68B	5/17/73	96.0	8.7	180.0	26.0	490.0	38.0	180.0	814.0	1,360.0	6.9	65
69	5/ 5/65	12.0	2.4	8.3	2.8	48.0	16.0	2.8	104.0	124.0	7.1	--
69	3/ 5/66	16.0	2.4	18.0	--	74.0	21.0	4.4	146.0	185.0	7.0	--
69	6/16/66	17.0	2.3	18.0	2.9	91.0	10.0	7.1	153.0	183.0	7.2	--
70	5/ 8 73	16.0	6.0	12.0	--	88.0	3.0	6.0	188.0	135.0	7.4	70
71	4/ 1/71	16.0	9.0	14.0	--	64.0	--	<1.0	120.0	145.0	--	--
71	11/11/71	16.0	4.0	17.0	--	72.0	--	4.0	158.0	140.0	--	--
71	5/10/71	14.0	6.0	18.0	--	72.0	--	4.0	132.0	155.0	--	--
71	9/23/72	18.0	4.0	17.0	--	76.0	--	6.0	126.0	155.0	--	--
71	10/ 4/72	14.0	6.0	19.0	--	72.0	--	4.0	144.0	150.0	--	--
71	8/ 8/73	19.0	3.0	4.0	--	72.0	--	8.0	176.0	180.0	--	--
71	Avg.	15.0	2.4	16.0	--	73.0	15.0	4.4	137.0	164.0	--	--
71	Max.	20.0	3.0	21.0	--	90.0	36.0	7.8	158.0	207.0	--	--
71	Min.	12.0	1.7	8.3	--	21.0	7.6	0.6	98.0	88.0	--	--
72	4/20/50	313.0	30.0	--	--	872.0	196.0	6.0	1,480	--	--	--
73	3/19/73	174.0	22.0	59.0	--	640.0	--	12.0	922.0	1,140.0	7.5	48
73A	3/19/73	157.0	31.0	105.0	--	752.0	--	140.0	984.0	1,280.0	7.4	39
74	5/ 8/73	18.0	5.0	13.0	--	88.0	3.0	6.0	178.0	130.0	7.8	59
75	10/20/76	193.0	16.5	990.3	182.2	951.0	42.0	--	2,436.0	--	7.0	103
75	6/28/49	327.0	27.0	--	--	1,400.0	51.0	1,080.0	3,060.0	5,160.0	6.8	97
75	6/28/49	344.0	29.0	--	--	1,580.0	42.0	1,500.0	3,880.0	6,520.0	6.9	--
75	1/16/73	299.0	24.0	940.0	--	1,236.0	36.0	1,450.0	3,962.0	5,000.0	6.7	115
75	8/21/24	328.0	23.0	1,000.0	--	1,440.0	70.0	1,320.0	3,458.0	--	--	104
75	3/29/74	320.0	16.0	850.0	--	1,200.0	38.0	1,480.0	4,000.0	5,900.0	--	115
75	10/15/71	328.3	14.6	930.0	180.0	1,158.8	41.2	1,480.0	4,256.2	5,770.0	7.0	110
75	4/ 6/76	159.0	21.1	1,140.0	144.3	966.0	39.9	--	3,580.0	--	7.6	101
75	11/ 6/75	312.6	30.6	991.0	186.2	1,150.0	38.4	--	3,870.0	--	7.5	--
76	9/23/72	43.0	5.0	69.0	--	164.0	--	106.0	424.0	600.0	--	--
77	10/15/71	1,121.0	15.1	650.0	110.0	599.8	51.4	940.0	2,611.8	3,200.0	7.5	157
77	4/15/47	18.0	6.0	12.0	--	94.0	15.0	4.0	1,530.0	1,840.0	--	--
77		47.0	14.0	14.0	--	228.0	15.0	4.0	2,700.0	3,510.0	--	--
77		138.0	7.0	572.0	--	735.0	49.0	795.0	2,150.0	3,560.0	7.2	159
77	4/ 3/56	136.0	10.0	618.0	--	716.0	44.0	870.0	2,190.0	3,860.0	6.7	192

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	SO_4	Cl	TDS	E.	pH	°F
77	1/16/73	126.0	7.0	650.0	--	600.0	42.0	900.0	2,364.0	3,000.0	7.2	156
77	8/21/24	166.0	9.0	645.0	--	791.0	42.0	820.0	2,184.0	--	--	125
78	10/14/54	117.0	17.0	--	--	465.0	81.0	106.0	--	1,140.0	--	--
79	9/27/73	75.0	13.0	120.0	19.0	387.0	21.0	120.0	626.0	1,030.0	7.5	64
80	9/27/73	70.0	14.0	92.0	--	308.0	--	116.0	634.0	1,000.0	8.1	64
81	10/24/73	14.0	13.0	600.0	--	1,292.0	--	200.0	2,190.0	2,500.0	8.2	63
82	10/26/73	12.0	10.0	860.0	8.5	1,640.0	250.0	200.0	2,170.0	3,210.0	7.6	62
83	1/29/74	51.0	4.7	98.0	17.0	230.0	17.0	120.0	480.0	807.0	7.9	48
(84)	8/31/24	303.0	33.0	157.0	--	0	6,156.0	54.0	7,887.0	--	--	110
(84)	8/31/24	316.0	51.0	127.0	--	0	3,159.0	1.0	4,344.0	--	--	76
(84)	8/31/24	41.0	16.0	52.0	--	0	2,337.0	20.0	2,562.0	--	--	99
84A	5/18/73	170.0	9.2	550.0	68.0	800.0	49.0	800.0	2,140.0	3,550.0	6.7	120
85	10/14/54	93.0	12.0	--	--	370.0	28.0	129.0	--	995.0	--	63
85A	5/30/74	160.0	6.6	510.0	63.0	773.0	43.0	700.0	1,960.0	3,460.0	7.0	58
86	5/28/74	68.0	9.8	170.0	24.0	--	22.0	220.0	580.0	1,340.0	8.0	63
87	1/20/65	17.0	3.3	18.0	--	91.0	11.0	4.2	178.0	184.0	7.5	--
88	6/21/73	180.0	34.0	75.0	8.9	844.0	71.0	14.0	856.0	1,330.0	7.2	61
89	6/ 1/73	99.0	9.0	23.0	--	292.0	--	14.0	402.0	580.0	7.6	--
90	7/13/73	250.0	23.0	67.0	6.1	937.0	76.0	12.0	952.0	1,430.0	6.6	60
91	7/18/74	38.0	4.4	70.0	5.5	254.0	18.0	40.0	393.0	560.0	7.3	--
92	10/24/73	172.0	53.0	400.0	--	1,156.0	--	300.0	2,258.0	2,500.0	7.4	59
92A	5/ 8/73	22.0	5.0	9.0	--	84.0	11.0	6.0	134.0	140.0	7.1	--
93	1/16/73	8.7	4.7	19.0	0.9	94.0	6.6	3.8	149.0	165.0	8.0	--
93A	12/13/74	12.0	4.8	25.0	1.4	88.0	6.8	28.0	179.0	255.0	--	88
94	10/15/71	8.8	8.3	25.0	0	117.8	0	10.0	179.9	162.0	8.2	83
94	1/16/73	44.0	5.0	22.0	0	92.0	6.0	8.0	180.0	140.0	7.8	86
94	10/20/76	9.6	3.0	20.8	0.8	68.9	6.0	--	121.0	--	8.3	89
94	4/19/76	7.0	1.9	20.0	0.8	66.0	6.2	--	149.0	--	8.2	88
94	11/ 6/75	4.6	4.5	20.0	1.2	68.6	7.2	--	130.0	--	8.3	--
95	9/23/72	13.0	3.0	10.0	--	52.0	--	2.0	58.0	95.0	--	--
96	9/18/73	18.0	4.8	9.6	7.8	98.0	12.0	2.6	161.0	187.0	7.1	50
97	9/23/72	11.0	4.0	11.0	--	48.0	--	4.0	96.0	90.0	--	--
106A	9/28/65	13.0	2.8	10.0	--	72.0	2.6	2.8	(135.0)	132.0	7.3	--
110	9/13/73	11.0	1.0	9.0	--	60.0	--	6.0	130.0	105.0	7.3	55
111	10/9/73	22.0	4.0	11.0	--	84.0	--	8.0	164.0	160.0	7.0	--
112	10/ 9/73	11.0	3.0	8.0	--	52.0	--	4.0	118.0	95.0	--	--

() estimated

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3	SO_4	Cl	TDS	Ec	pH	Temp °F
113	8/14/73	19.0	5.0	7.0	--	68.0	2.0	4.0	148.0	140.0	6.8	52
114	3/29/74	115.0	10.0	210.0	--	464.0	30.0	290.0	1,100.0	1,300.0	--	61
114	1/17/73	130.0	19.0	390.0	--	597.0	27.0	442.0	1,528.0	2,000.0	6.9	--
114A	10/15/71	169.0	14.1	520.0	50.0	661.5	102.9	670.0	2,362.0	2,940.0	7.0	58
115	3/21/74	130.0	25.0	100.0	11.0	662.0	32.0	61.0	728.0	1,210.0	6.9	62
115A	8/15/73	130.0	12.0	250.0	35.0	606.0	32.0	320.0	1,130.0	1,880.0	6.8	61
115B	10/24/73	210.0	59.0	570.0	34.0	1,530.0	290.0	300.0	2,260.0	3,250.0	6.8	59
115C	5/25/73	35.0	46.0	840.0	45.0	1,810.0	280.0	330.0	2,500.0	3,660.0	8.2	57
117	1/22/73	6.0	17.0	70.0	--	140.0	<1.0	60.0	272.0	400.0	8.6	48
118	1/23/73	14.0	4.0	12.0	--	64.0	5.0	6.0	188.0	120.0	6.7	48
120		78.0	42.0	550.0	--	1,230.0	200.0	400.0	2,500.0	2,920.0	--	133
121	4/23/74	1.7	2.1	6,300.00	350.0	6,820.0	2,100.0	3,500.0	16,800.0	22,900.0	8.8	--
121A	5/ 3/74	7.3	13.0	4,800.0	180.0	--	1,600.0	2,600.0	9,380.0	18,100.0	7.7	169
121B	7/17/74	30.0	3.6	580.0	35.0	993.0	160.0	320.0	1,730.0	2,720.0	7.2	
122	6/ 8/73	35.0	5.0	14.0	--	124.0	--	2.0	204.0	220.0	7.5	48
123	5/31/73	16.0	3.7	8.4	6.0	39.0	33.0	3.4	151.0	166.0	7.9	47
124	6/29/73	12.0	4.7	360.0	4.6	905.0	59.0	5.7	933.0	1,470.0	8.5	63
124A	7/ 3/73	9.8	6.2	470.0	4.9	1,150.0	35.0	6.6	1,160.0	1,780.0	8.4	70
126	9/23/72	14.0	6.0	23.0	--	64.0	--	4.0	104.0	110.0	--	--
126		15.0	3.0	17.0	2.8	71.0	13.0	6.4	133.0	176.0	7.7	40
126A		5.6	3.4	8.0	T	55.5	0	0	90.5	79.0	8.5	54
127	9/23/72	19.0	6.0	18.0	--	84.0	--	8.0	206.0	170.0	--	--
128	8/1/47	8.0	2.0	--	--	139.0	17.0	11.0	234.0	293.0	7.3	136
128	1/17/73	8.0	6.0	53.0	--	120.0	17.0	8.0	250.0	240.0	8.1	100
128	10/15/71	6.4	3.4	56.0	2.0	173.3	0	9.0	300.1	263.0	8.4	100
128	10/20/76	6.8	1.1	64.5	0.4	111.0	44.0	--	228.0	--	8.1	105
128	4/19/76	4.8	0.5	57.7	1.2	107.0	15.8	--	215.0	--	8.3	105
128	11/ 6/75	6.6	1.7	52.4	1.6	107.0	18.3	--	200.0	--	8.1	--
129	4/30/73	11.0	3.0	16.0	--	64.0	7.0	4.0	210.0	130.0	7.4	61
130	11/23/72	18.0	1.0	31.0	--	100.0	4.0	6.0	299.0	200.0	7.6	--
130	10/15/71	14.4	4.9	39.0	0	172.1	0	0	264.4	230.0	8.0	44
131	8/14/73	34.0	9.0	162.0	--	480.0	5.0	4.0	652.0	880.0	7.5	68
132	10/26/76	29.9	6.4	121.0	5.0	394.0	7.0	--	461.0	--	7.6	66.5
132	4/ 6/76	29.5	5.7	43.4	3.9	352.0	4.8	--	460.0	--	7.9	64
132	11/ 5/75	29.3	7.5	136.0	12.5	368.0	9.1	--	458	--	7.8	--
133	8/25/72	6.0	1.0	170.0	--	124.0	34.0	176.0	566.0	760.0	7.4	--

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	$SO_4^=$	Cl^-	TDS	Ec	pH	Temp. °F
133	5/24/73	3.0	2.0	167.0	--	356.0	<1.0	22.0	498.0	700.0	9.1	88
134	6/ 8/73	19.0	5.0	20.0	--	68.0	--	<1.0	230.0	180.0	7.4	--
134A	10/15/71	18.4	5.3	10.0	7.5	79.9	32.9	--	209.0	180.0	7.6	48
134B	8/14/73	32.0	9.1	170.0	6.9	604.0	11.0	5.5	599.0	912.0	7.5	68
135A		62.0	7.0	15.0	--	200.0	6.0	13.0	322.0	380.0	7.2	--
137	7/21/67	72.0	18.0	25.0	34.0	0	4,520.0	20.0	4,240.0	17,300.0	1.4	178
138		22.0	5.0	12.0	--	68.0	--	8.0	220.0	170.0	7.3	54
139	9/23/72	16.0	4.0	15.0	--	64.0	--	2.0	164.0	130.0	--	--
140	9/23/72	78.0	15.0	48.0	--	16.0	--	164.0	662.0	700.0	--	--
141	10/15/71	100.1	19.9	45.0	23.0	0	551.4	50.0	850.1	1,165.0	3.5	--
142	6/ 5/73	48.0	11.0	10.0	--	156.0	18.0	14.0	294.0	320.0	7.5	--
143	10/15/71	19.2	0.5	11.0	2.5	94.0	--	--	157.2	176.0	7.5	48
145	8/31/49	168.0	23.0	14.0	--	0	614.0	8.0	967.0	1,270.0	3.1	--
145	8/31/49	185.0	52.0	7.0	--	0	1,570.0	4.0	1,950.0	4,570.9	1.9	160
145	8/31/49	110.0	11.0	24.0	--	0	2,740.0	20.0	2,960.0	8,510	1.6	--
145	8/31/49	101.0	23.0	10.0	--	0	3,280.0	3.0	3,160.0	12,700	1.4	--
145	11/ 4/63	7.0	10.0	24.0	--	0	35,100.0	24.0	--	13,800.0	1.8	189
148		30.0	0.1	1,959.0	456.0	99.0	68.0	3,453.0	6,895.0	--	7.2	--
151A		22.0	0.1	2,123.0	528.0	112.0	107.0	3,828.0	7,533.0	--	7.4	--
152		16.0	0.2	2,152.0	443.0	144.0	93.0	3,627.0	7,203.0	--	7.6	--
155		6.3	0.3	1,473.0	300.0	182.0	42.0	2,495.0	5,100.0	--	6.7	--
156		6.8	0.5	1,733.0	329.0	214.0	164.0	2,783.0	6,477.0	--	7.6	--
157	10/15/71	14.4	2.4	6.0	5.0	79.9	0	0	130.7	107.0	6.3	42
158	10/15/71	3.2	0	8.0	0	31.1	0	0	50.3	67.0	7.0	46
159	10/15/71	7.2	2.9	6.0	1.5	54.9	--	--	93.5	67.0	7.5	41
160	10/15/71	5.6	1.5	8.0	0	45.8	0	0	88.9	88.0	7.0	44
~~160~~		~~8.5~~	~~0.1~~	~~1,721.0~~	~~322.0~~	~~84.0~~	~~30.0~~	~~3,082.0~~	~~6,018~~			
162	10/26/49	13.0	2.4	19.0	--	87.0	9.3	2.0	165.0	157.0	--	--
163	10/26/49	13.0	2.4	--	--	87.0	9.3	2.0	165.0	160.0	--	54
~~165~~	~~10/15/71~~	~~14.4~~	~~2.9~~	~~7.0~~	~~2.0~~	~~25.0~~	~~16.5~~	~~20.0~~	~~107.8~~	~~132.0~~	~~7.0~~	~~46~~
167	10/26/49	6.0	2.2	19.0	--	73.0	2.5	1.0	142.0	126.0	--	--
167	10/12/49	6.0	0.9	--	--	55.0	2.0	1.5	125.0	90.0	--	63
167A	10/26/49	10.0	2.7	--	--	75.0	4.1	2.0	142.0	110.0	--	61
167B	10/26/49	6.0	2.2	--	--	73.0	2.5	1.0	142.0	125.0	--	57
168	10/26/49	10.0	2.7	16.0	--	57.0	4.1	2.0	142.0	109.0	--	--
168	10/22/76	5.2	0.2	12.2	0.4	39.7	3.0	--	129.0	--	8.0	64

Water C[illegible] Data, Jemez Basin and Vicinity

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	SO_4^{--}	Cl^-	TDS	Ec	pH	Temp. °F
168	4/28/76	4.0	0.1	197.0	0.4	36.2	1.0	--	118.0	--	7.7	65
168	11/ 6/75	5.2	0.5	13.3	0.4	38.0	4.3	--	122.0	--	8.0	--
169A	10/15/71	6.4	2.4	18.0	1.3	81.1	--	--	127.2	104.0	7.4	46
169A	6/20/50	6.0	2.0	11.0	--	48.0	2.1	1.5	108.0	84.0	--	--
171	10/15/71	6.4	2.9	10.0	3.5	66.5	0	0	109.3	88.0	7.2	40
172A	10/15/71	4.0	2.4	7.0	4.0	48.8	0	T	111.2	77.0	7.7	42
176	10/15/71	4.0	1.0	17.0	T	62.2	0	0	94.2	67.5	7.7	52
177	6/20/50	6.0	2.0	--	--	48.0	2.1	1.5	108.0	85.0	--	--
184	9/23/65	24.0	3.2	48.0	13.0	179.0	15.0	14.0	(229.0)	370.0	7.2	--
187	9/23/65	18.0	5.4	13.0	--	104.0	4.4	5.4	(123.0)	194.0	7.4	--
193	6/ 7/51	16.0	2.6	19.0	--	96.0	4.9	4.5	146.0	177.0	--	79
195	4/ 1/52	19.0	4.4	12.0	--	96.0	4.4	4.5	139.0	176.0	--	78
195	5/14/52	10.0	0.5	54.0	--	140.0	6.9	3.0	192.0	254.0	--	62
196	4/ 1/52	13.0	2.1	25.0	--	103.0	4.8	3.0	156.0	172.0	--	82
197	3/29/52	13.0	1.4	54.0	--	166.0	8.2	4.8	220.0	281.0	--	85
198	4/ 4/52	13.0	1.1	25.0	--	97.0	4.9	3.5	163.0	169.0	--	78
199	5/14/52	7.4	1.0	80.0	--	177.0	20.0	18.0	244.0	383.0	--	63
199B	5/14/52	5.8	1.0	84.0	--	185.0	18.0	2.0	251.0	379.0	--	65
199C	5/14/52	16.0	0.5	32.0	--	117.0	7.5	4.0	152.0	200.0	--	58
200A	5/14/52	2.9	0.4	63.0	--	138.0	6.9	4.0	188.0	273.0	--	78
201	5/14/52	9.2	0.3	27.0	--	91.0	3.5	2.5	125.0	151.0	--	73
202	9/23/65	31.0	7.7	13.0	--	104.0	23.0	15.0	(183.0)	292.0	7.1	126
204	10/17/73	34.0	6.2	19.0	2.8	126.0	43.0	6.8	198.0	305.0	8.2	53
205	8/ 5/75	50.0	12.0	65.0	5.2	374.0	9.7	4.8	344.0	580.0	7.2	51
207	1/17/73	11.0	3.0	10.0	--	60.0	3.0	6.0	94.0	95.0	7.4	54
207A	5/22/73	13.0	1.6	8.1	2.2	54.0	10.0	2.1	99.0	109.0	7.4	55
208	1/17/73	6.0	6.0	10.0	--	52.0	3.0	2.0	102.0	80.0	7.2	57
209	9/13/73	11.0	3.0	21.0	--	56.0	--	6.0	150.0	105.0	7.3	48
210	5/24/73	5.0	2.0	101.0	--	92.0	5.0	120.0	406.0	480.0	9.0	88
211	1/22/73	8.0	6.0	40.0	--	68.0	<1.0	32.0	138.0	200.0	8.6	64
212	1/17/73	16.0	2.0	9.0	--	64.0	4.0	2.0	114.0	90.0	7.5	48
213	10/20/76	3.0	0.1	25.0	0.8	42.3	7.0	--	147.0	--	7.9	105
213	4/19/76	10.4	0	22.8	1.2	42.3	7.2	--	145.0	--	7.9	105
213	11/ 5/75	2.8	0.1	23.2	2.0	43.4	8.2	--	160.0	--	8.1	--
213	10/15/71	4.0	1.9	26.0	2.0	90.3	0	2.0	186.2	119.0	8.2	100
213A	5/16/73	4.7	0.3	23.0	2.0	61.0	8.8	2.3	150.0	122.0	7.7	105

() estimated

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3	SO_4^{--}	Cl^{-}	TDS	Ec	pH	Temp. °F
214	10/15/71	6.4	2.4	13.0	3.0	62.9	0	5.0	167.7	94.0	8.0	80
215	10/16/49	8.0	2.0	--	--	45.0	2.9	2.0	105.0	80.0	--	--
216	10/15/71	10.4	3.4	13.0	2.0	43.3	--	25.0	152.1	220.0	8.5	54
218		28.0	1.2	83.0	--	623.0	335.0	121.0	2,970.0	2,225.0	8.0	--
219	10/22/49	164.0	24.0	16.0	--	0	1,160.0	4.0	1,630.0	2,270.0	--	--
223	10/15/71	21.6	6.3	9.0	5.0	129.4	--	--	197.3	164.0	7.5	55
224	10/22/76	5.4	0.2	28.8	3.9	54.3	2.0	--	184.0	--	7.7	99
224	4/22/76	5.0	0.1	27.8	3.1	52.4	12.0	--	187.0	--	7.7	99
224	11/ 6/75	5.4	0.3	28.7	4.3	54.2	15.4	--	182	--	7.8	--
224	7/28/49	4.0	0.3	--	--	59.0	7.0	3.0	149.0	122.0	--	106
213	7/28/49	6.0	0.5	--	--	76.0	14.0	3.0	199.0	164.0	--	81
213	5/24/73	3.0	1.0	22.0	--	58.0	8.0	6.0	202.0	110.0	7.5	72
213	5/28/73	6.0	2.0	16.0	--	52.0	<1.0	6.0	206.0	110.0	7.4	70
226	10/15/71	6.1	2.4	8.0	4.0	58.0	--	7.0	113.5	81.0	7.0	36
227	6/20/50	7.2	0.6	12.0	--	45.0	2.1	1.8	108.0	86.0	--	--
227	10/16/49	10.0	1.6	7.2	--	42.0	3.5	3.0	90.0	85.0	--	--
228	7/ 6/49	6.0	0.9	11.0	--	38.0	2.1	2.0	98.0	80.0	--	--
230	10/16/49	15.0	1.1	16.0	--	49.0	3.3	1.0	123.0	107.0	--	--
230A	10/22/76	6.4	0.2	9.5	0.4	29.3	7.0	--	106.0	--	8.0	58
230A	4/22/76	5.0	0.1	10.1	0.4	28.8	1.0	--	85.0	--	7.8	59
230A	11/ 6/75	6.6	0.3	10.1	0.8	35.1	5.3	--	78.0	--	8.2	--
231		10.0	1.9	--	--	70.0	3.3	2.0	124.0	100.0	--	63
232	10/16/49	10.0	1.9	16.0	--	70.0	3.3	2.0	124.0	100.0	--	--
232A	10/22/76	6.8	0.2	8.9	0.4	33.7	13.0	--	103.0	--	7.7	52
232A	4/22/76	5.8	0.2	10.1	0.4	31.1	1.0	--	110.0	--	8.1	53
232A	11/ 6/75	6.4	0.5	10.1	0.4	31.7	3.4	--	88.0	--	7.3	--
233	10/16/49	10.0	1.6	--	--	42.0	3.5	3.0	90.0	85.0	--	64
233A	7/27/49	11.0	2.5	19.0	--	68.0	13.0	2.0	143.0	122.0	--	62
233B	10/15/71	4.0	0	17.0	0.3	59.3	0	0	93.5	870.0	8.2	53
234	10/16/49	15.0	1.1	--	--	77.0	3.3	1.0	125.0	110.0	--	63
235	10/16/49	8.0	0.9	--	--	48.0	3.7	2.0	111.0	85.0	--	55
235A	7/ 6/49	6.0	0.9	--	--	40.0	2.6	1.5	103.0	80.0	--	50
242	1/ 7/65	54.0	17.0	35.0	--	170.0	131.0	3.7	358.0	539.0	8.0	--
243	6/19/74	88.0	19.0	8.4	2.2	381.0	9.0	2.6	332.0	570.0	7.1	51
244	5/30/73	28.0	5.1	11.0	2.0	96.0	38.0	3.7	175.0	233.0	7.3	50
245	3/ 7/74	30.0	7.7	50.0	6.9	247.0	20.0	2.5	263.0	430.0	7.4	51
246	6/19/74	11.0	3.0	7.7	1.0	60.0	4.1	1.5	112.0	120.0	6.8	61
247A	3/ 7/74	12.0	4.8	9.9	1.1	80.0	2.1	1.9	124.0	141.0	7.8	64
249	3/ 7/74	340.0	70.0	330.0	13.0	362.0	1,100.0	330.0	2,390.0	3,190.0	7.5	--

Supplement To Water Quality Data, Jemez Basin and Vicinity

Data No.	Date	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	SO_4^{--}	Cl^-	TDS	Ec	pH	Temp.
75	9/23/75	297.0	25.9	1050.0	192.0	1369.0	39.9	1470.0	3620.0		7.5	
75	1/29/76	300.0	32.5	1020.0	213.0	1176.0	36.0	1500.0	3603.0		7.4	
94	8/ 8/75	6.5	1.8	19.6	1.0	77.7	2.9	3.5	202.0		7.9	
94	1/29/76	8.6	1.7	19.6	0.9	64.2	1.0	3.7	151.0		8.4	
128	8/ 8/75	4.8	0.4	52.6	1.5	126.0	11.9	8.0	236.0		8.0	
128	1/29/76	5.7	0.4	53.0	1.2	103.0	14.0	7.8	223.0		8.3	
132	8/ 8/75	206.0	4.2	107.0	4.6	392.0	<1.0	4.6	4.9		8.0	
132	1/30/76	27.6	5.6	127.0	5.2	377.0	3.0	4.2	458.0		7.6	
168	9/25/75	4.0	0	12.3	0.4	43.1	<1.0	1.0	164.0		7.7	
168	1/30/76	4.9	0.1	12.5	0.4	36.4	<1.0	0.6	132.0		8.1	
213	9/24/75	2.7	0	22.3	2.0	51.5	2.5	3.1	234.0		7.8	
213	1/29/76	2.5	0	22.1	1.5	40.7	2.0	2.6	146.0		8.3	
230A	8/14/75	5.1	0.1	10.4	0.6	32.6	1.6	1.3	160.0		7.7	
232A	8/14/75	5.2	0.1	10.0	0.4	30.0	<1.0	1.2	158.0		7.5	
233B	8/14/75	6.3	0.1	8.5	0.5	32.2	<1.0	1.8	178.0		7.4	

Source of Supplement to Water Quality Data: CEP, Santa Fe, New Mexico for Union Oil Co.

APPENDIX II

Part 4
Trace Elements

TRACE ELEMENT ANALYSES
(Concentration In ppb)

Data No.	Date	Arsenic	Boron	Iron	Lithium	Manganese
2	12/12/74	20	150	110	100	0
3	12/12/74	7	80	80	100	0
9	8/26/72	110	2,200	800	---	--
13	9/25/74	4	210	3,000	200	70
17	10/18/74	190	8,200	---	7,100	--
18	5/ 2/73	210	20	800	---	740
20	4/ 4/74	4	110	1,700	60	0
22	6/ 5/73	0	1,800	30	1,200	20
23	6/ 5/73	360	7,500	1,400	---	90
24	10/ 2/73	2	290	0	210	13
28	5/23/73	3	50	60	---	20
29	5/23/73	0	20	30	---	0
30	9/ 5/73	2	--	15,000	640	260
31	9/ 5/73	5	1,200	80	1,100	630
32	5/24/73	86	5,800	1,500	>2,800	340
33	5/24/73	8	320	400	---	210
34	5/24/73	0	170	40	---	0
[illegible]	8/30/73	17	990	540	890	750
35	8/30/73	69	8,200	50	6,700	1,300
[illegible]	5/24/73	20	3,300	30	---	70
[illegible]	5/25/73	43	670	90	---	80
42	6/ 8/73	15	50	20	---	0
46	8/31/73	0	40	--	50	--
49	8/21/73	67	380	140	---	80
51	11/ 2/73	0	210	60	140	250
52	1/29/74	50	1,000	30	960	120
54	10/ 5/73	68	1,300	90	1,500	80
56	6/ 6/73	1	60	450	---	380
57	10/ 2/73	5	20	20	10	8
61	8/28/73	1	10	10	10	0
64	10/30/73	0	60	10	60	10
66	10/30/73	2	10	20	20	0
67	10/30/73	0	10	80	30	0
69	6/ 7/73	6	2,200	--	--	--
72	7/18/74	26	370	10	560	0
75	3/ 8/73	1,100	14,000	--	--	--
77	5/30/74	780	7,400	450	7,800	300
78	1/29/74	120	85	50	1,300	30
79	9/27/73	150	1,200	30	1,400	0
82	7/ 3/74	5	2,100	--	370	--
85	5/28/74	230	1,900	750	2,300	820
88	6/21/73	5	180	9	--	20
[illegible]	7/13/73	4	140	30	--	0
95	9/18/73	1	20	110	0	0
[illegible]	3/ 8/73	3	3,300	--	--	--

Trace Element Analyses (Cont.)

Data No.	Date	Arsenic	Boron	Iron	Lithium	Manganese
121	5/14/74	39	15,000	30	12,000	340
122	5/31/73	0	70	140	--	0
124	6/29/73	8	490	10	--	0
125	3/21/74	3	510	2,000	690	240
126	11/14/74	6	40	60	80	0
152	--	4,500	--	--	--	--
204	6/27/74	3	20	890	--	0
205	8/ 5/74	0	90	50	100	20
207	5/22/73	4	20	260	--	0
213	5/16/73	3	40	160	--	0
243	6/19/74	2	20	20	20	20
244	1/10/74	4	60	5	20	<3
244	3/19/73	4	50	40	5	<4
245	6/19/74	1	110	40	100	0
246	6/19/74	2	10	30	10	0
247	3/ 7/74	7	10	80	20	0
249	3/ 7/74	0	150	10	130	1,200
Baca Wells						
148	12/22/73	4,600	30,000	400	--	--
148	1/12/76	4,000	--	90	--	100
148	2/24/76	3,300	25,000	70	--	30
148	4/ 8/76	3,500	29,000	100	27,000	200
149	10/14/76	4,500	27,000	180	27,000	nd<20
151A	1/22/76	3,300	32,000	1,000	33,000	200
151A	2/25/76	4,200	30,000	190	31,000	60
151A	4/ 7/76	4,000	30,000	70	31,000	90
152	1/22/76	2,400	23,000	300	32,000	80
152	2/25/76	4,500	29,000	160	31,000	60
152	4/ 7/76	4,000	30,000	70	31,000	90
156	1/11/76	2,900	20,000	70	--	30
156	2/26/76	3,100	22,000	100	--	25
156	4/ 7/76	2,900	21,000	50	24,000	20
Stream Water						
139	10/14/76	3		200		nd<20
140	10/14/76	<1		400		40
143	10/15/76	5		44,000		2,600

GEOTHERMAL SOURCE ANALYSES

		Cl	As	TDS	Max. Temp. °F
San Ysidro Springs	T15N R1E	2,500	.2RFD	10,960	
Indian Springs	T15N R1E	1,400	.086	3,114	123
Montezuma (Las Vegas) Hot Spr.	T16N R16E	160	.04	530	131
Kaseman 1	T16N R1W	2,705		11,274	
Warm Springs (flowing well)	T16N R1W	2,940	--	12,870	128
Jemez Springs.	T17N R2E	700– 870	1. – .78	1,752– 2,190	169
Soda Dam Spring	T18N R2E	1,540	.08– 1.5	3,950	115
McCauley Spring	T18N R3E	3	.017	179	90
LASL GT-2 Well	T19N R2E	400	--	2,500	
Spence Hot Spring	T19N R3E	8–14	.01– .07	180– 250	111
Sulphur Springs (water)	T19N R3E	2–241	.01– 1.0	2,000– 5,400	180
San Antonio Hot Spring	T20N R3E	2.3	.003	150	106
San Antonio Warm Spring	T20N R3E	8	.015	206	101
Ojo Caliente	T24N R8E	246	.06	2,438	132
Ponce de Leon Hot Spring	T24N R13E	78	.007	486	95
Manby (American) Hot Spring	T26N R12E	59	0	520	100
	T27N R11E	55	.011	505	99
Socorro Thermal Area	T3S R1W	8–16	.01– .05	210– 318	95
Socorro Thermal Area	T3S R1W	14	--	242	95
Socorro Thermal Area	T3S R1W	12	.05	298	95
Socorro Thermal Area	T3S R1W	14	--	49	95
Socorro Thermal Area	T3S R1W	42	--	3,440	95
Upper Frisco Hot Spring	T5S R19W	12	.007	223	98
The Meadows	T11S R14W	10		150	90.
Low Frisco Hot Springs	T12S R20W	460	.011	1,020	121
Gila Hot Springs	T13S R13W	104	.011	496	152
Truth or Consequences Thermal Area	T14S R4W	1,300	.006	2,500	114
Barney Iorio No. 1	T14S R5W	262	.015	4,931	91
Cliff-Gila Riverside Area	T16S R17W	20	.018	439	95
Derry Warm Springs	T17S R4W	257	.011	823	93
Rincon Well	T19S R2W	477	--	1,171	132
Apache Tejo	T19S R12W	16	.002	868	
Warm Springs	T20S R11W	11	.006	320	94
Faywood Hot Spring	T20S R11W	22	.011	384	131
Radium Springs	T21S R1W	1,700	.009	3,600	142
Las Alturas Estates	T23S R2E	580	.011	1,000	113
"Animas Valley Hot Spot"	T25S R19W	6–244	.01– –.02	247– 1,786	216

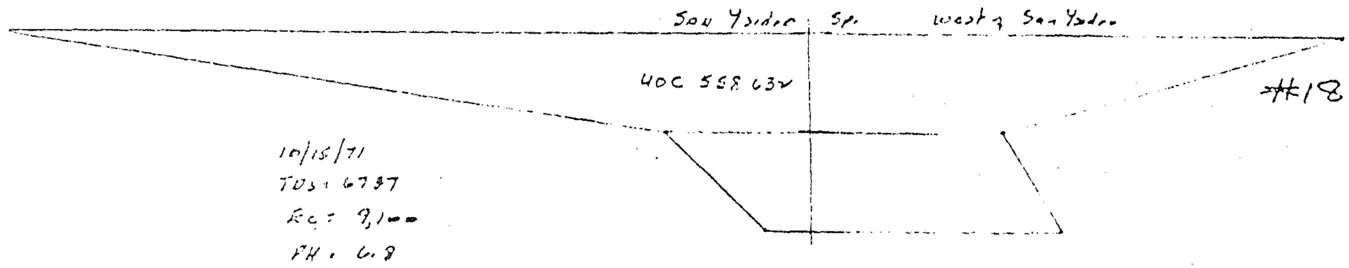
Source: Geothermal Resources of New Mexico
New Mexico State Bureau of Mines and Minerals

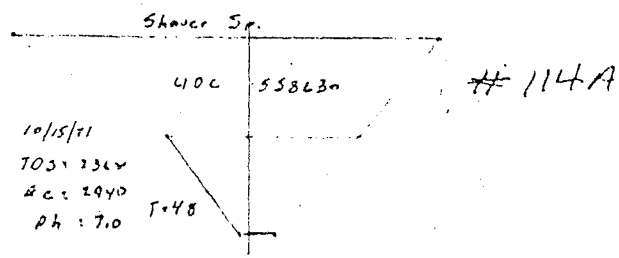
APPENDIX III

Chemical Diagrams

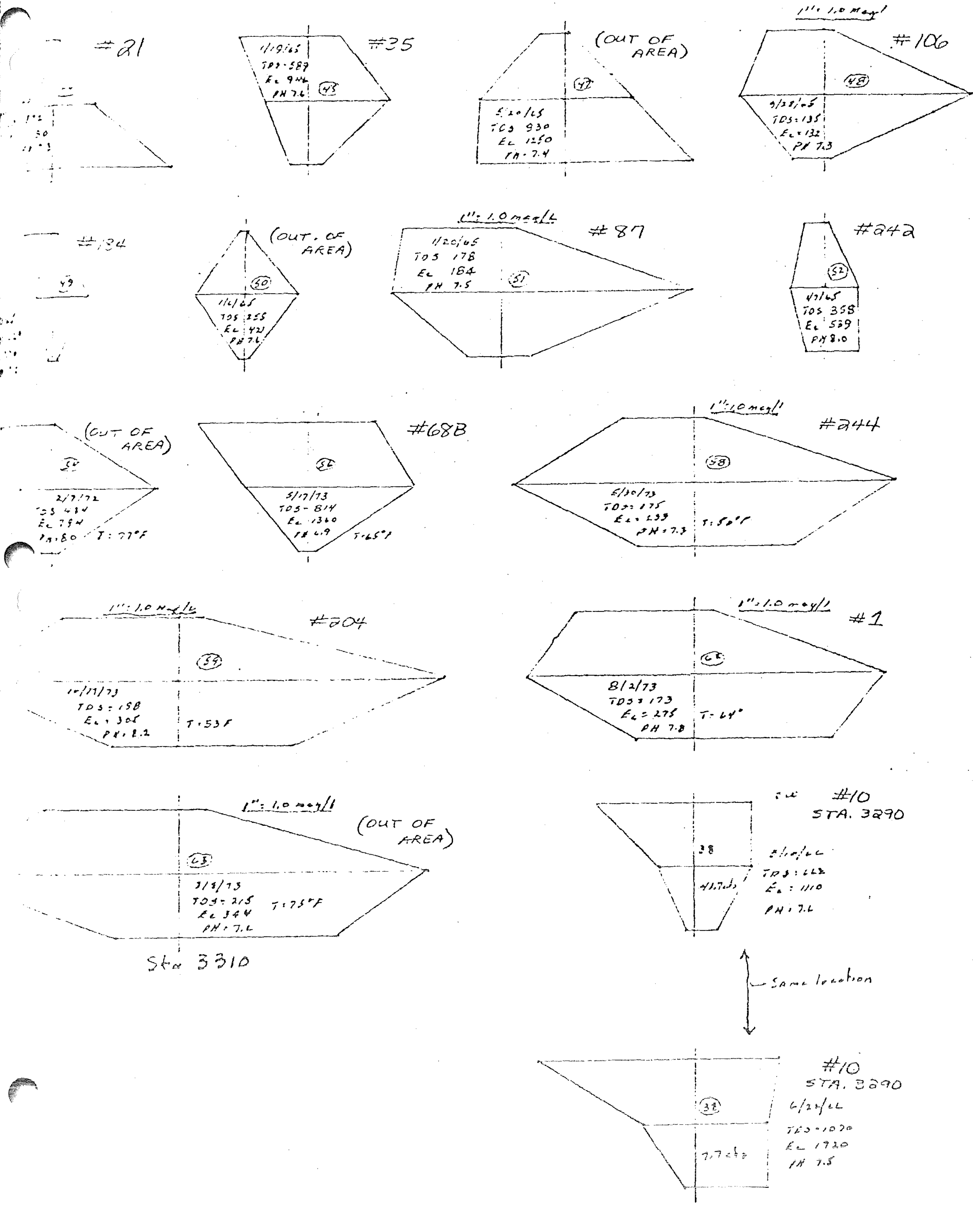
TDS: 5,510
Hc: 3,560
pH: 7.6

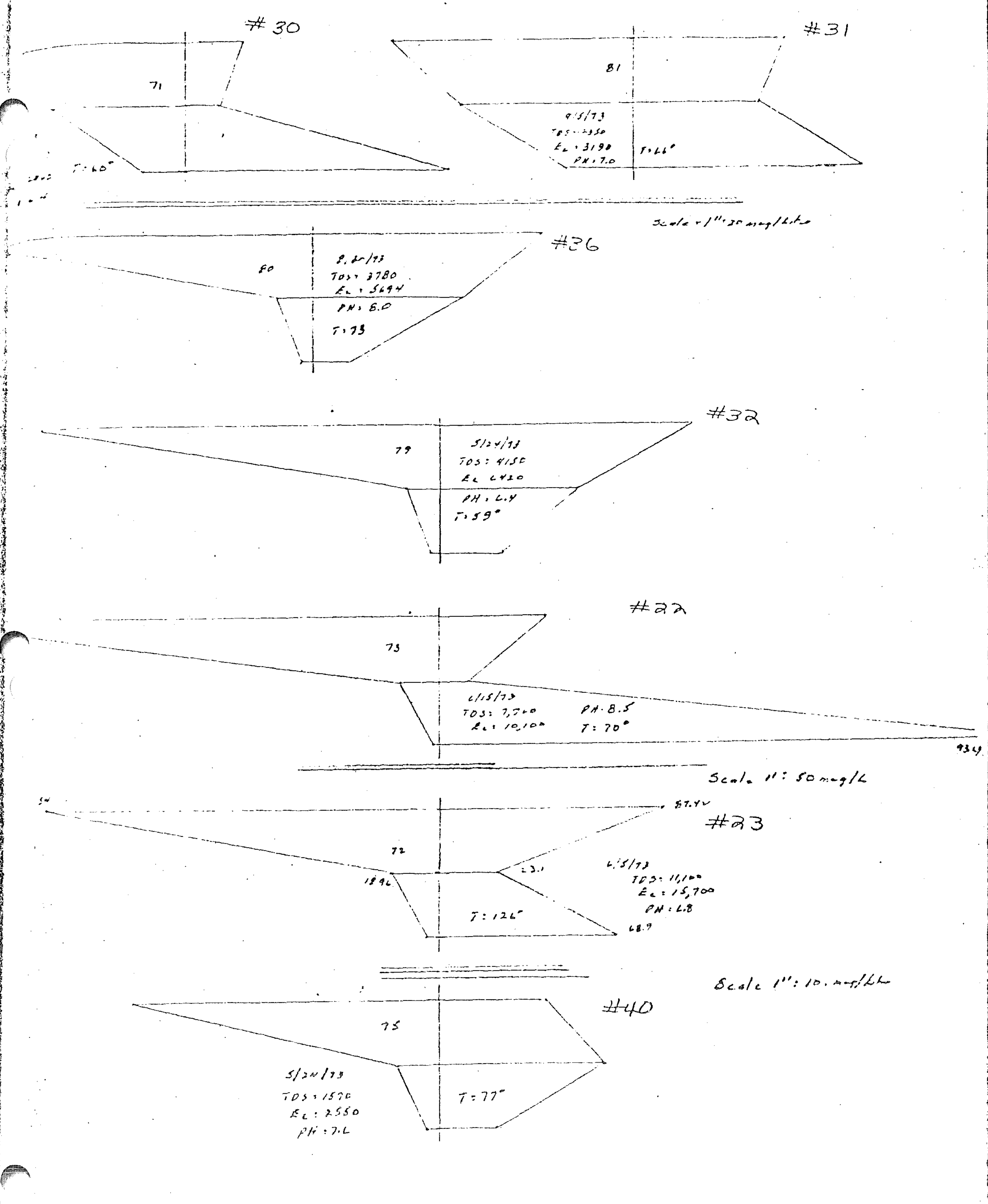
T: 75°F





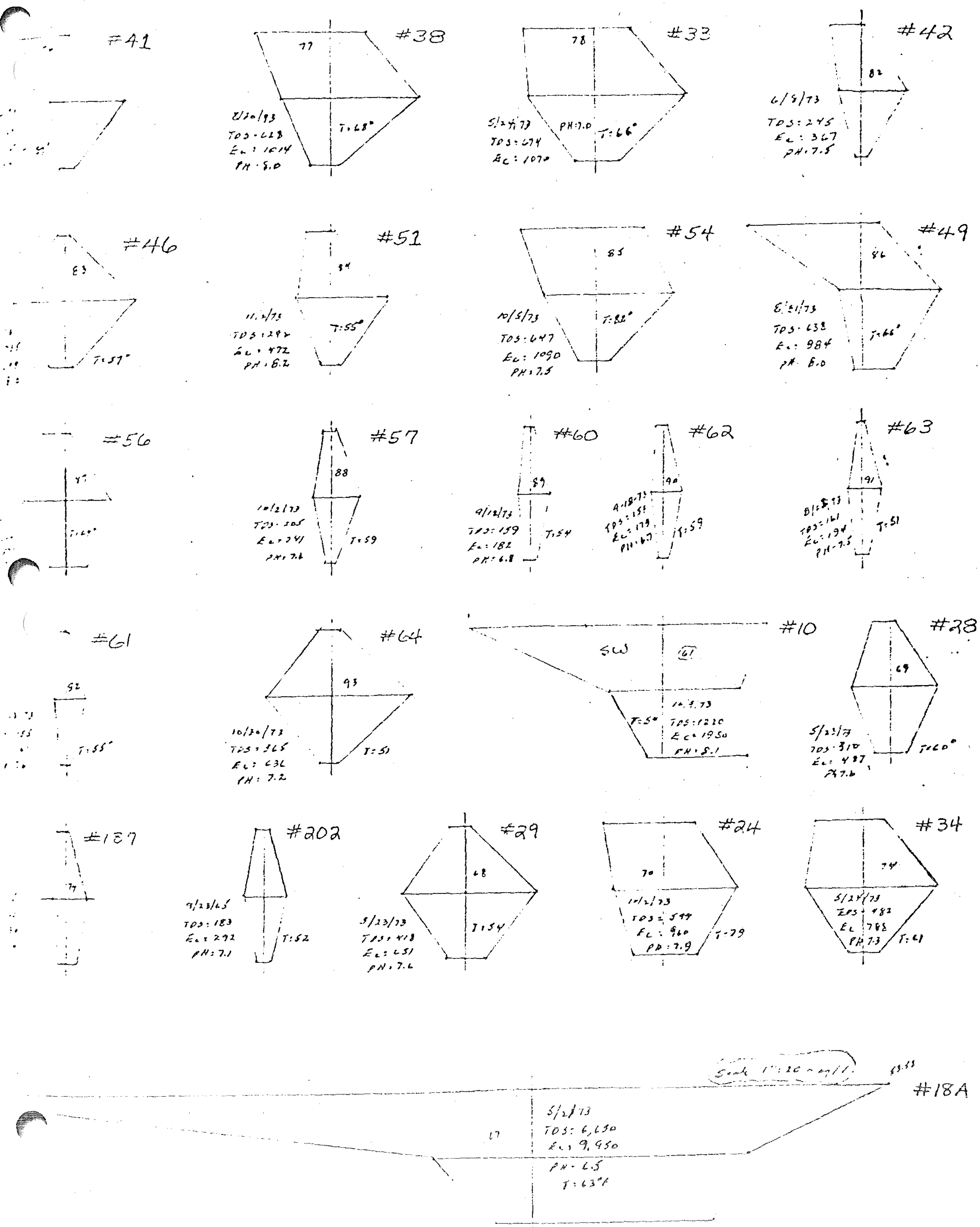
Scale 1" = 10 meq/l





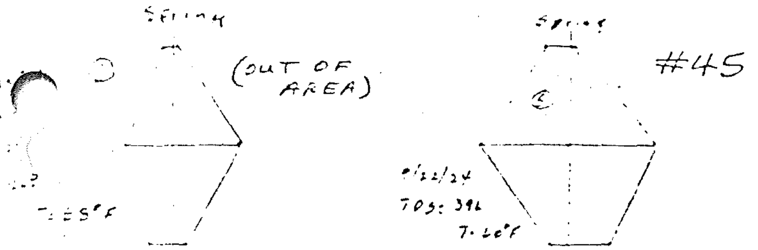
#30
71
T: 60°
#31
81
9/5/73
TDS: 2350
EL: 3190
PH: 7.0
T: 66°
#36
80
8/21/73
TDS: 3780
EL: 5694
PH: 8.0
T: 73
#32
79
5/24/73
TDS: 4150
EL 6420
PH: 6.4
T: 59°
#22
73
6/15/73
TDS: 7,700
EL: 10,100
PH: 8.5
T: 70°
Scale 1": 50 mg/L
#23
72
6/15/73
TDS: 11,100
EL: 15,700
PH: 6.8
T: 126°
Scale 1": 10 mg/L
#40
75
5/24/73
TDS: 1570
EL: 2550
PH: 7.6
T: 77°

Scale 1" = 10 mag/l



& Springs

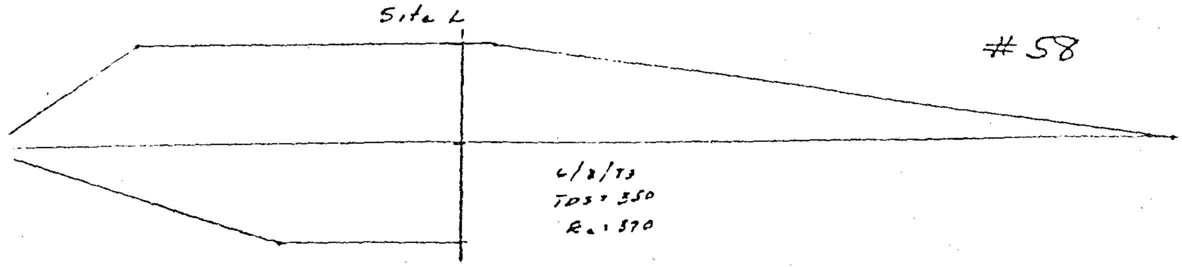
Scale 1": 10 mg/Lit



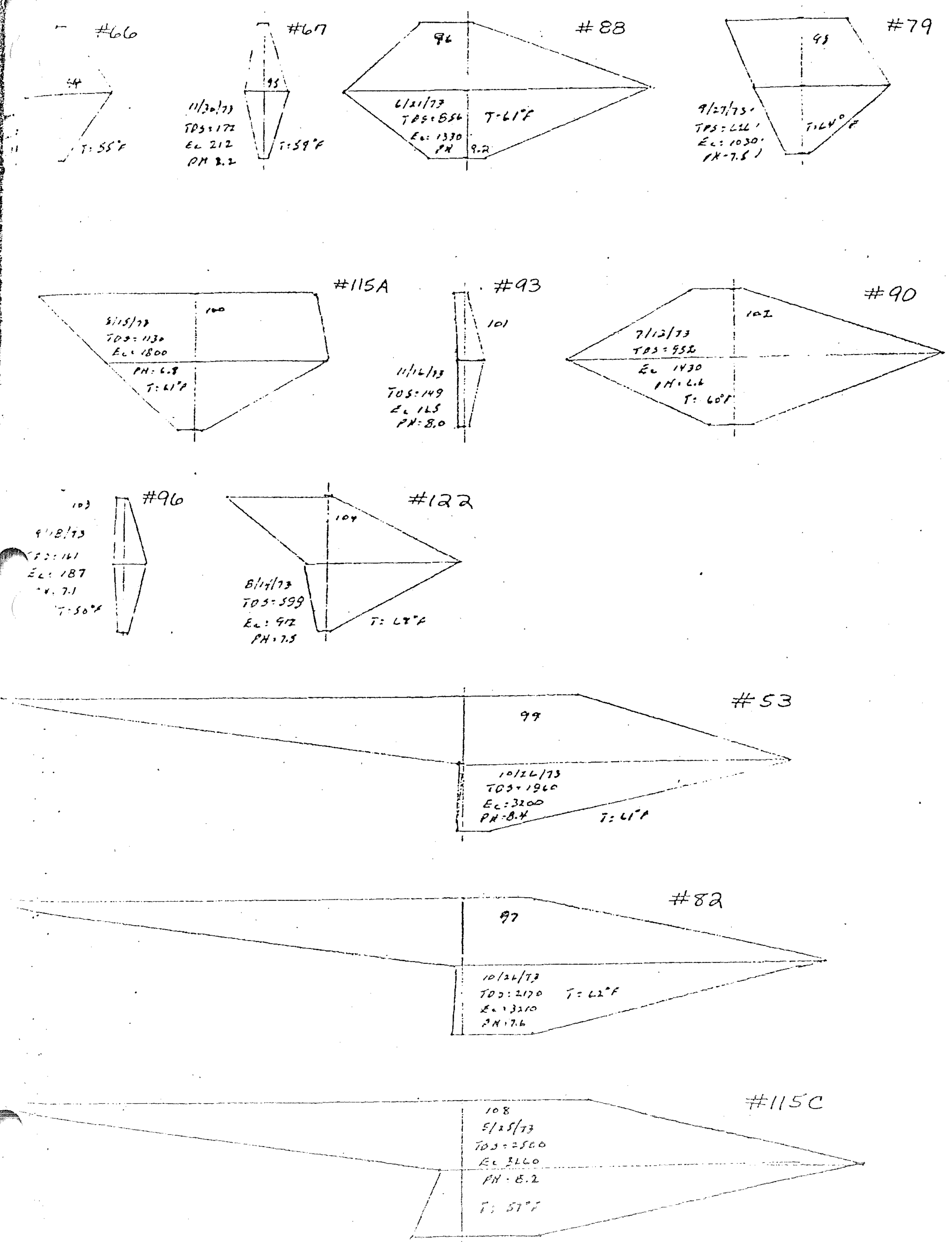
Vallecitos Creek

1" = 1.0 meq/Lt.

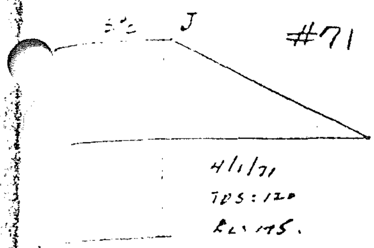
#58

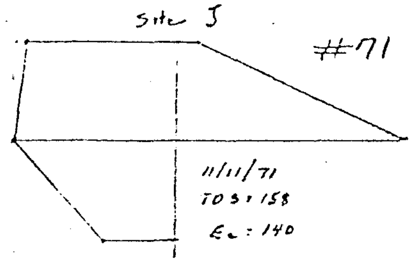


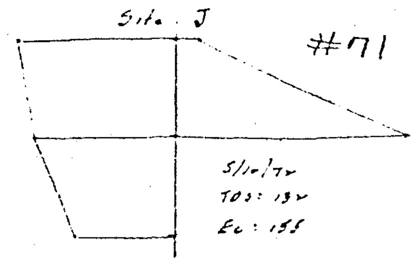
Scale 1" = 15 mg/l

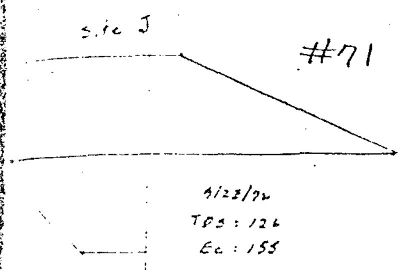


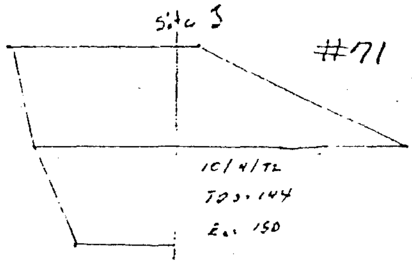
Jemez River — Scale 1" = 1 Meq/Lt.

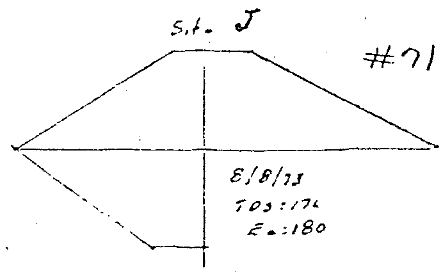


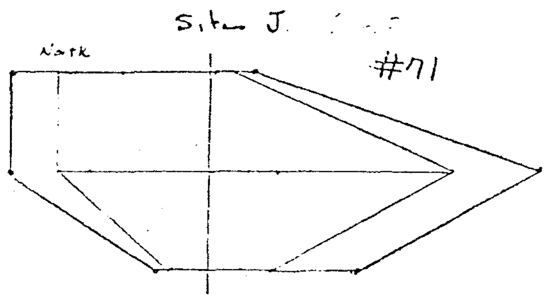








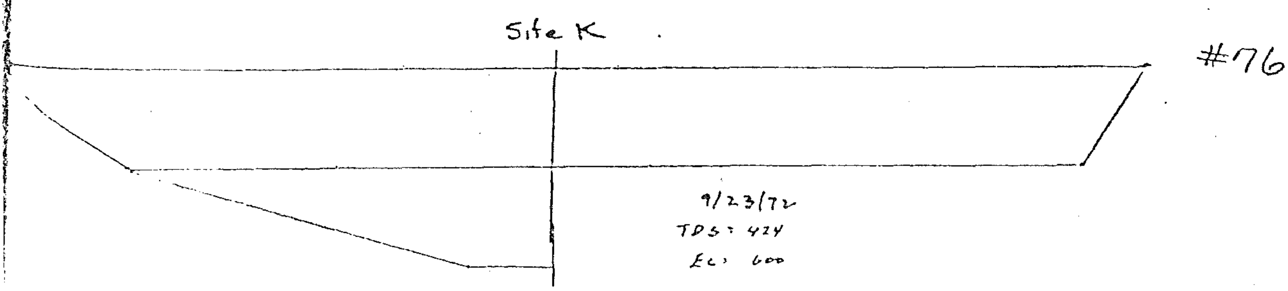




Average 17 cfs.

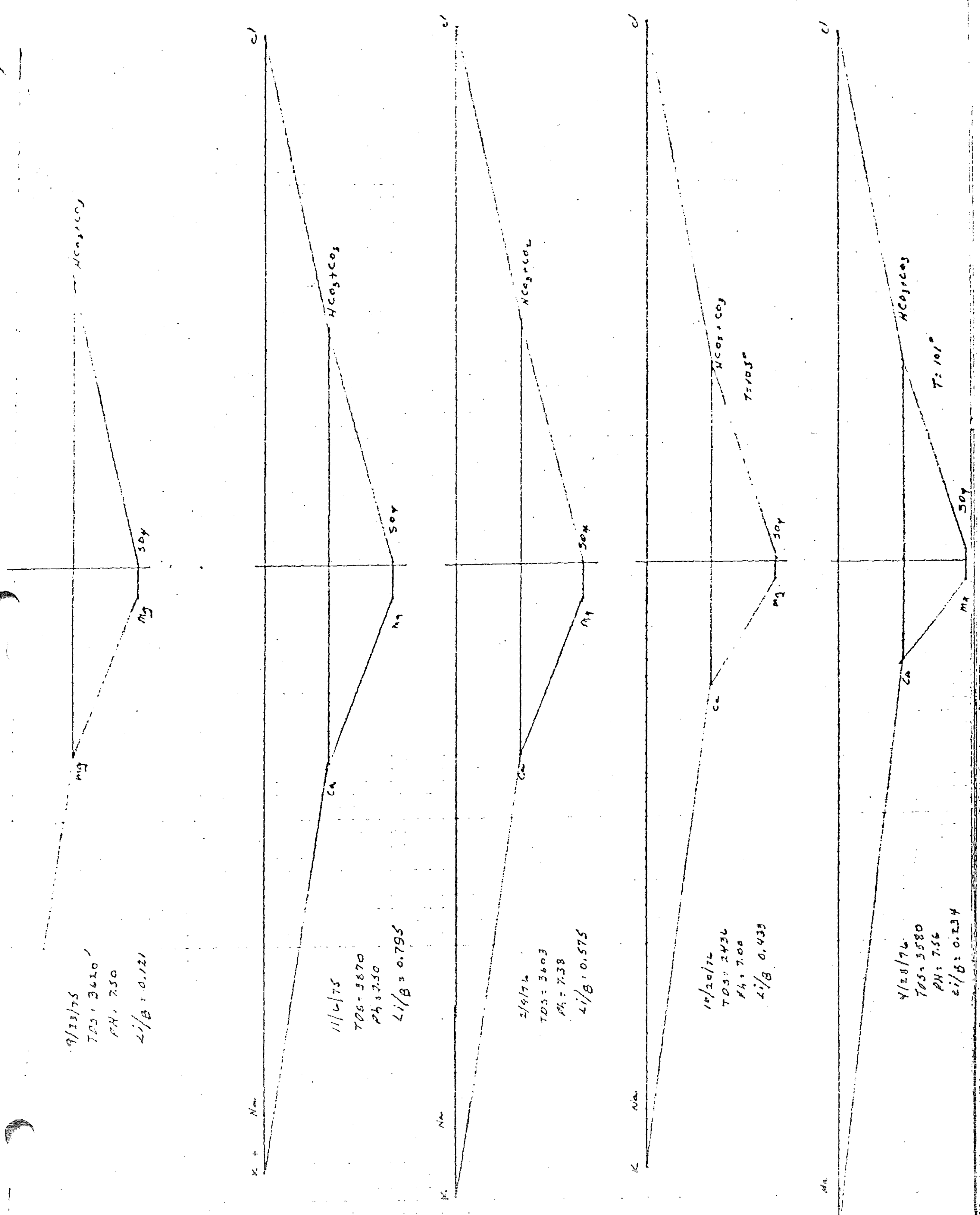
Max Conc : Min. Flow = 7 cfs

Min Conc : Max Flow 58 cfs



T 18N R2E Sec 14 #75 (ALL)

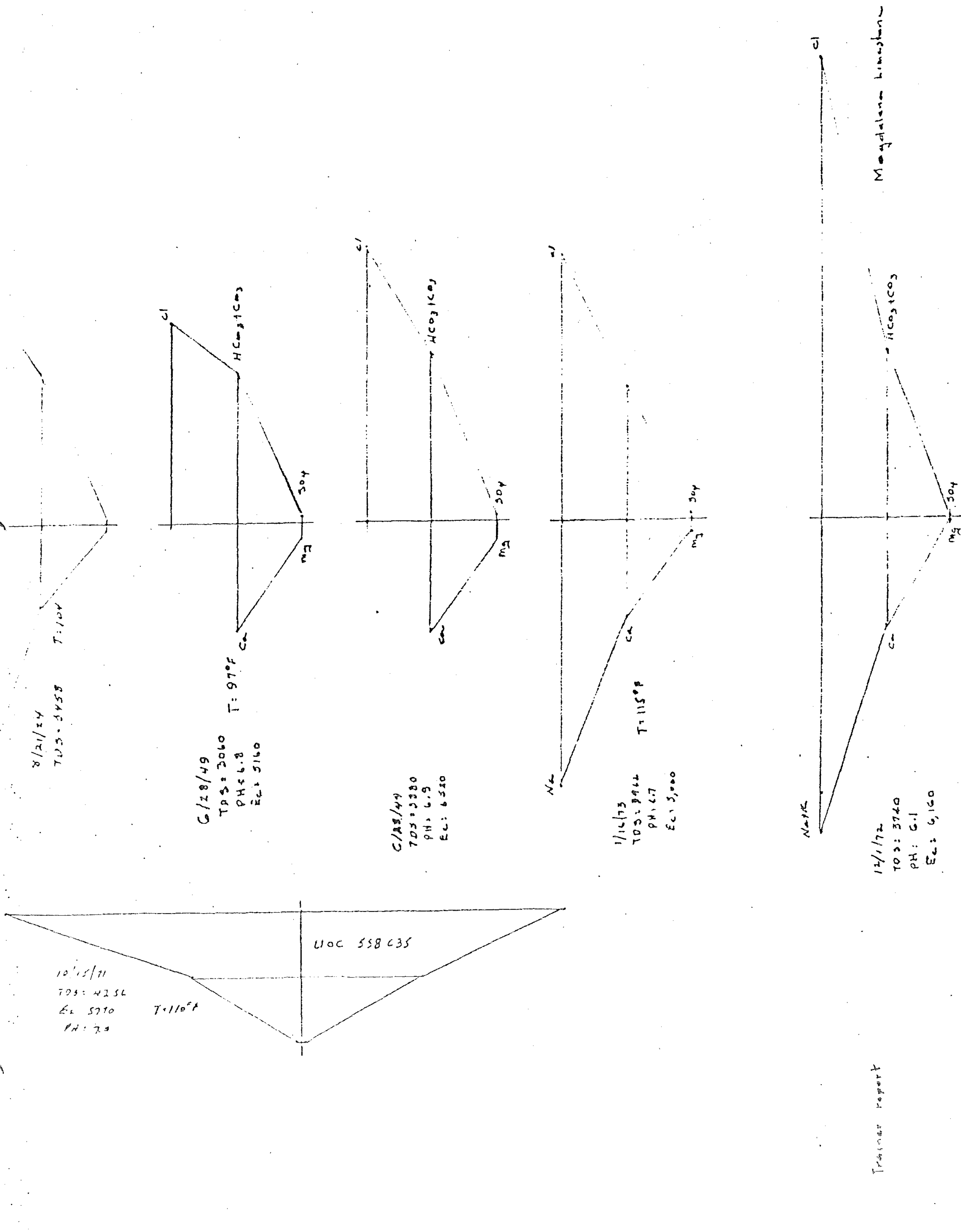
Scale 1/10
1": 10 meq/l (A1)



Soda Dam Springs Scale 1": 20 meq/L

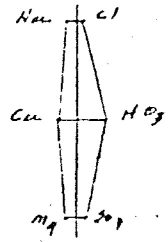
A1

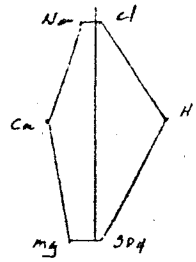
#75 (ALL)



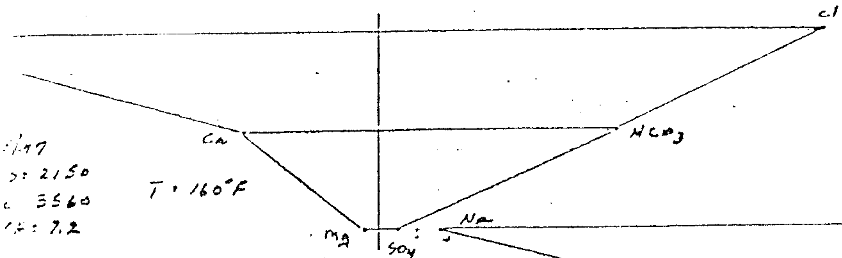
#77 (ALL)

4/15/47
TDS = 1580
Ec = 1840

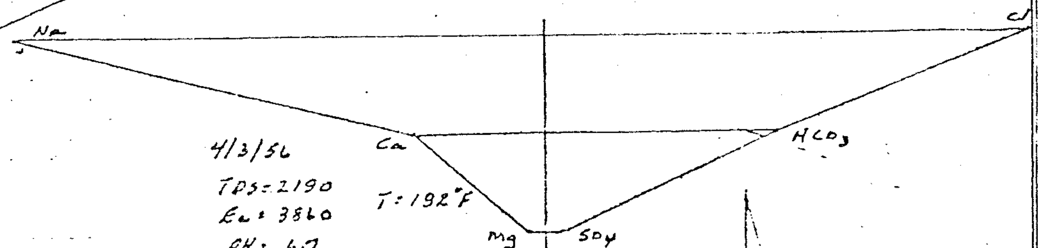




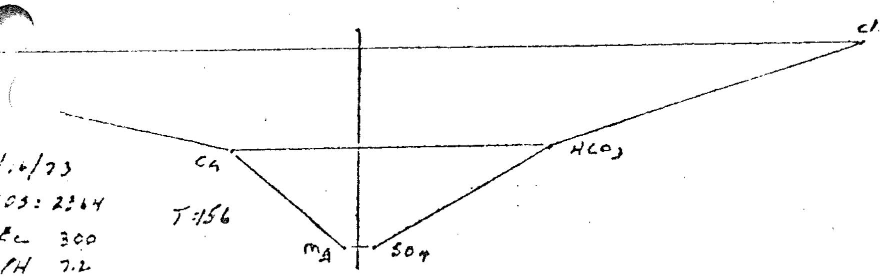
4/15/47
TDS - 2700
Ec = 3510



/47
S: 2150
Ec 3560
pH: 7.2
T = 160°F

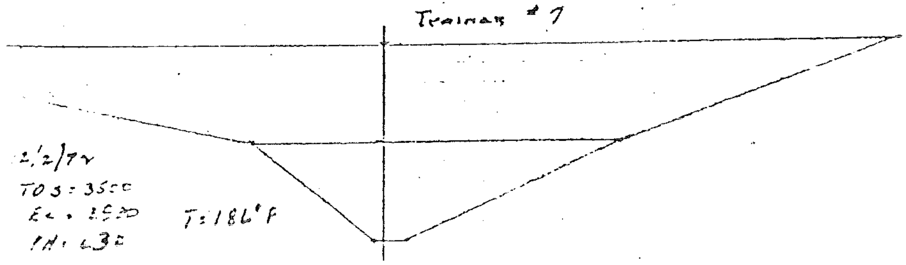


4/3/56
TDS: 2190
Ec = 3860
pH = 6.7
T: 192°F

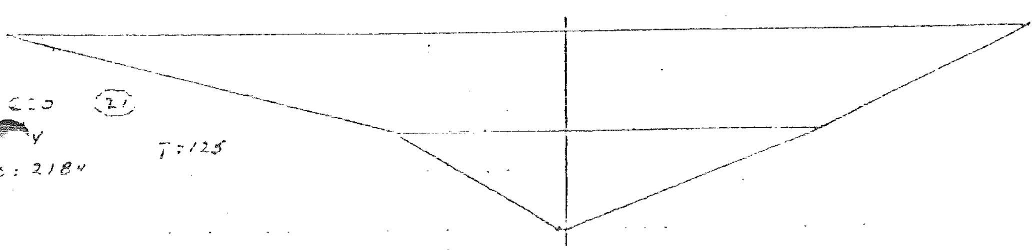


/6/73
TDS: 2364
Ec 300
pH 7.2
T: 156

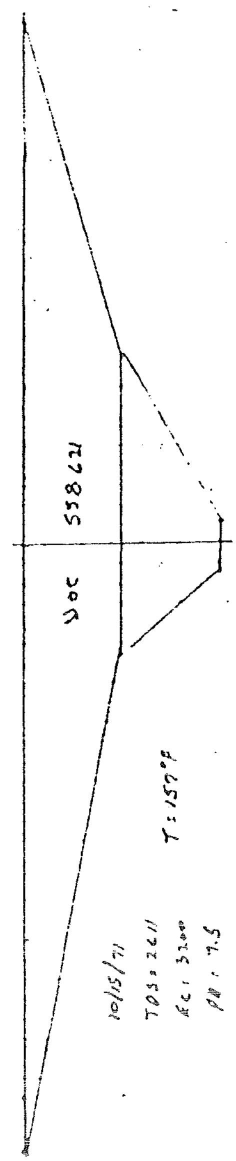
Trainas # 7



2/2/72
TDS = 3500
Ec = 3500
pH = 6.30
T: 186°F



F C20 (21)
Y
S: 2184
T: 125

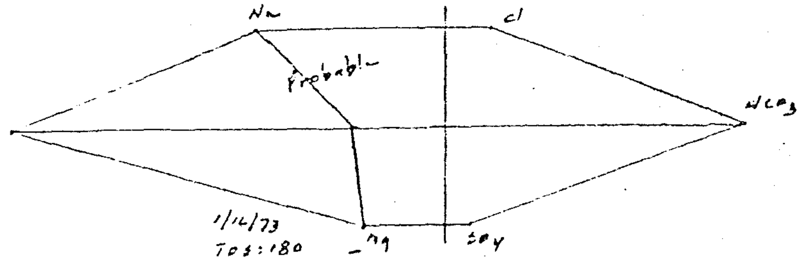


T: 157°F
10/15/71
TDS = 2611
Ec = 3200
pH = 7.5

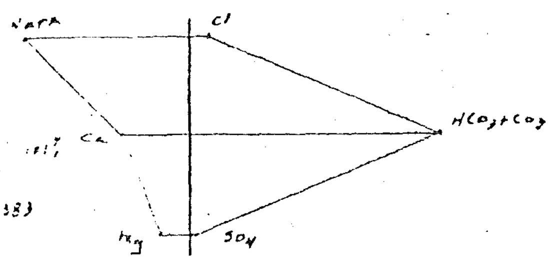
Mc Cauley Spring
T18N R3E Sec 4.144

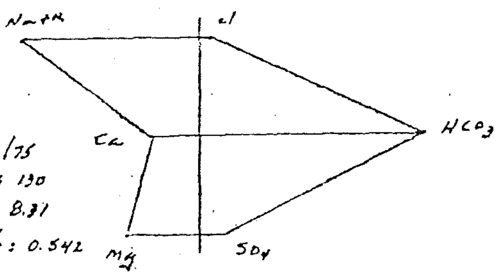
Scale 10A
1" = 1meq/l

#94 (ALL)

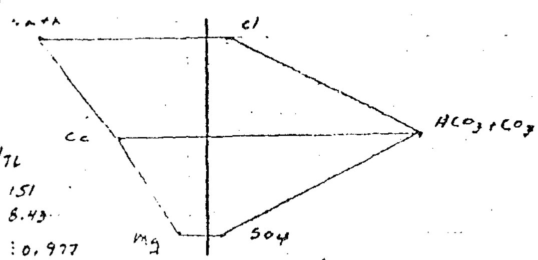


1/16/73
TDS: 180
Ec: 140
pH: 7.8
T: 86°F

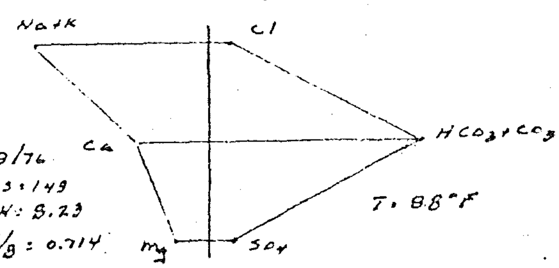




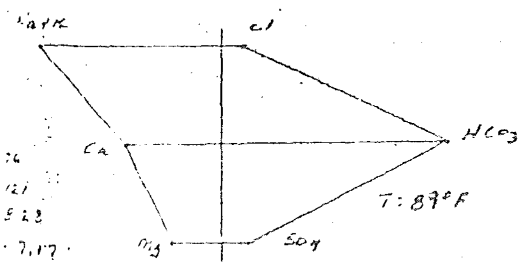
11/6/75
TDS 130
pH - 8.31
Li/B: 0.542



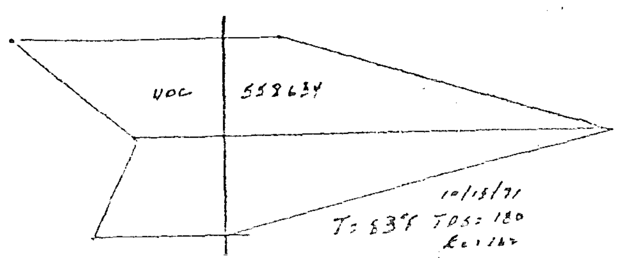
/76
TDS 151
pH 8.43
Li/B: 0.977



4/19/76
TDS: 149
pH: 8.23
Li/B = 0.714
T: 88°F



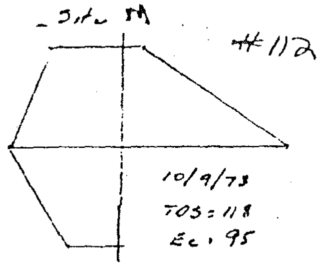
T: 89°F



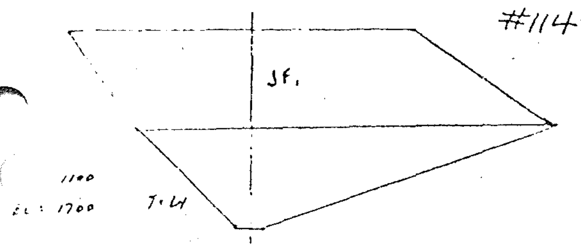
10/13/71
T: 83°F TDS: 180
Ec: 162
pH: 8.2

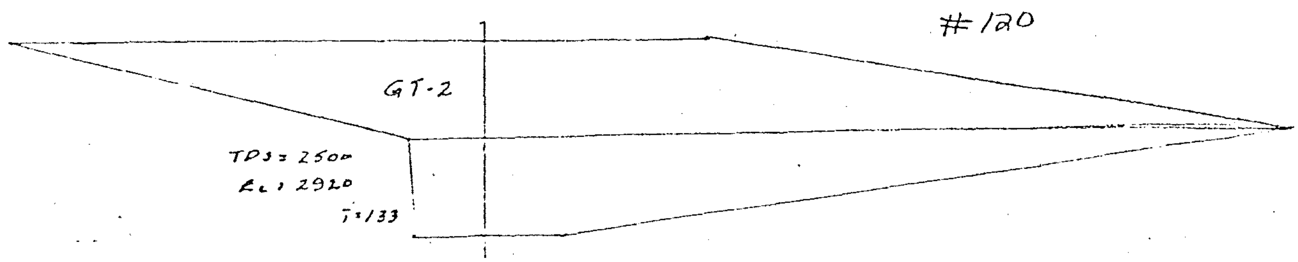
Fenton Lake

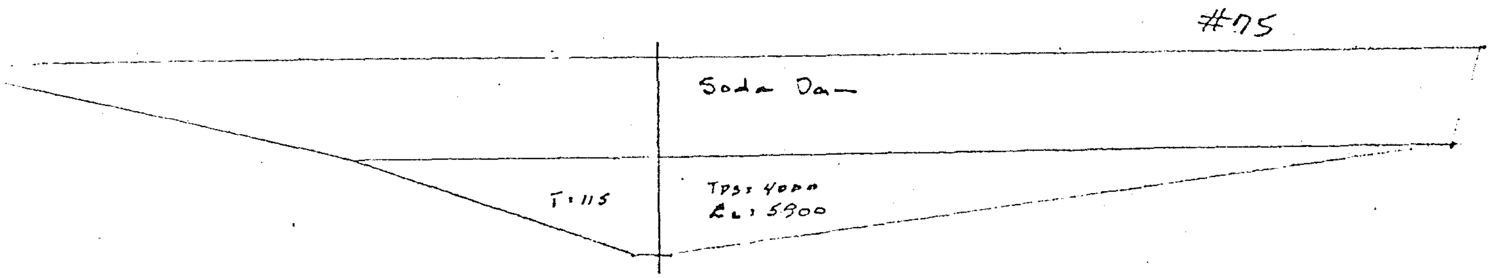
Scale 1" = 1.0 meq/l.



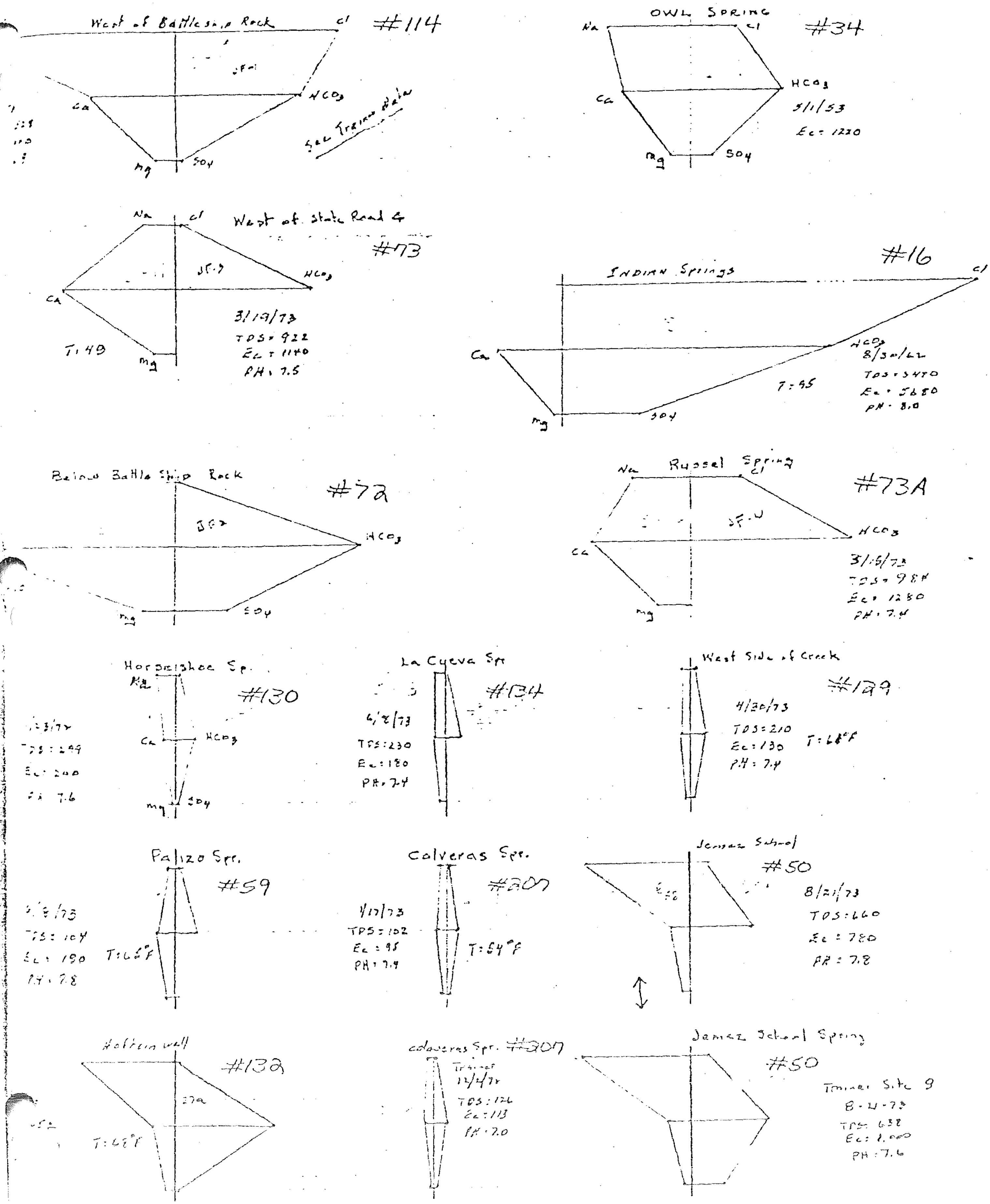
Scale 1" = 10 mag/l.l.





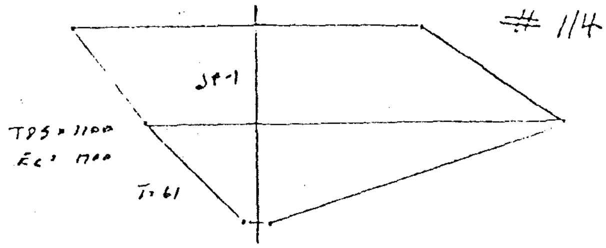


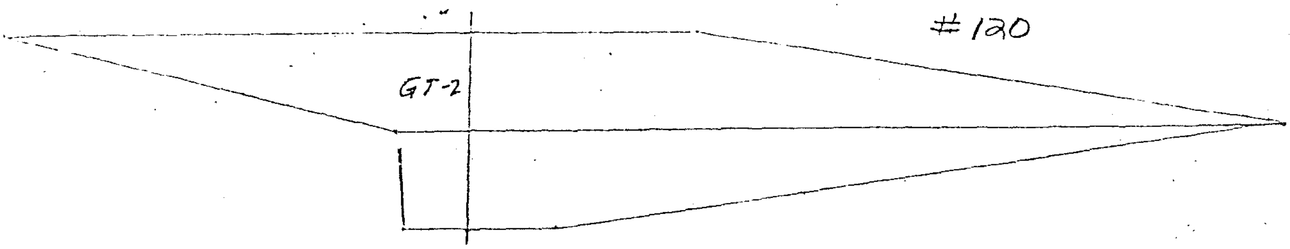
Misc Springs Scale 1" = 10 meq/L

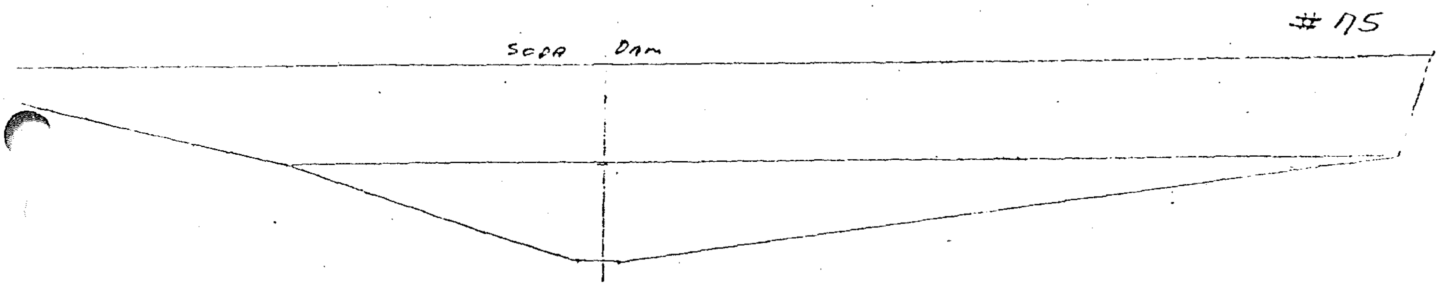


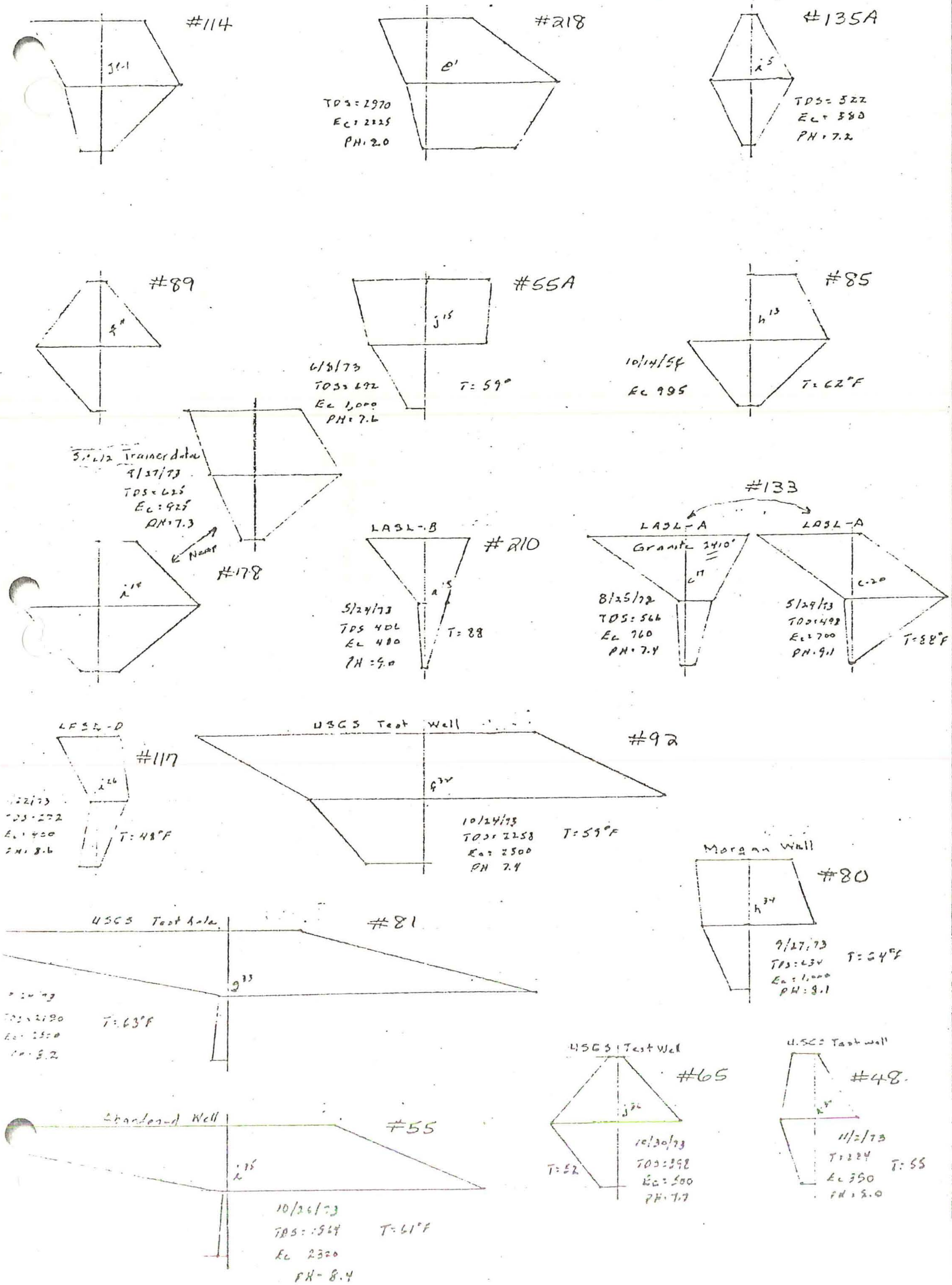
Misc LA 5790-MS

Scale 1" = 10. Horz/Lit

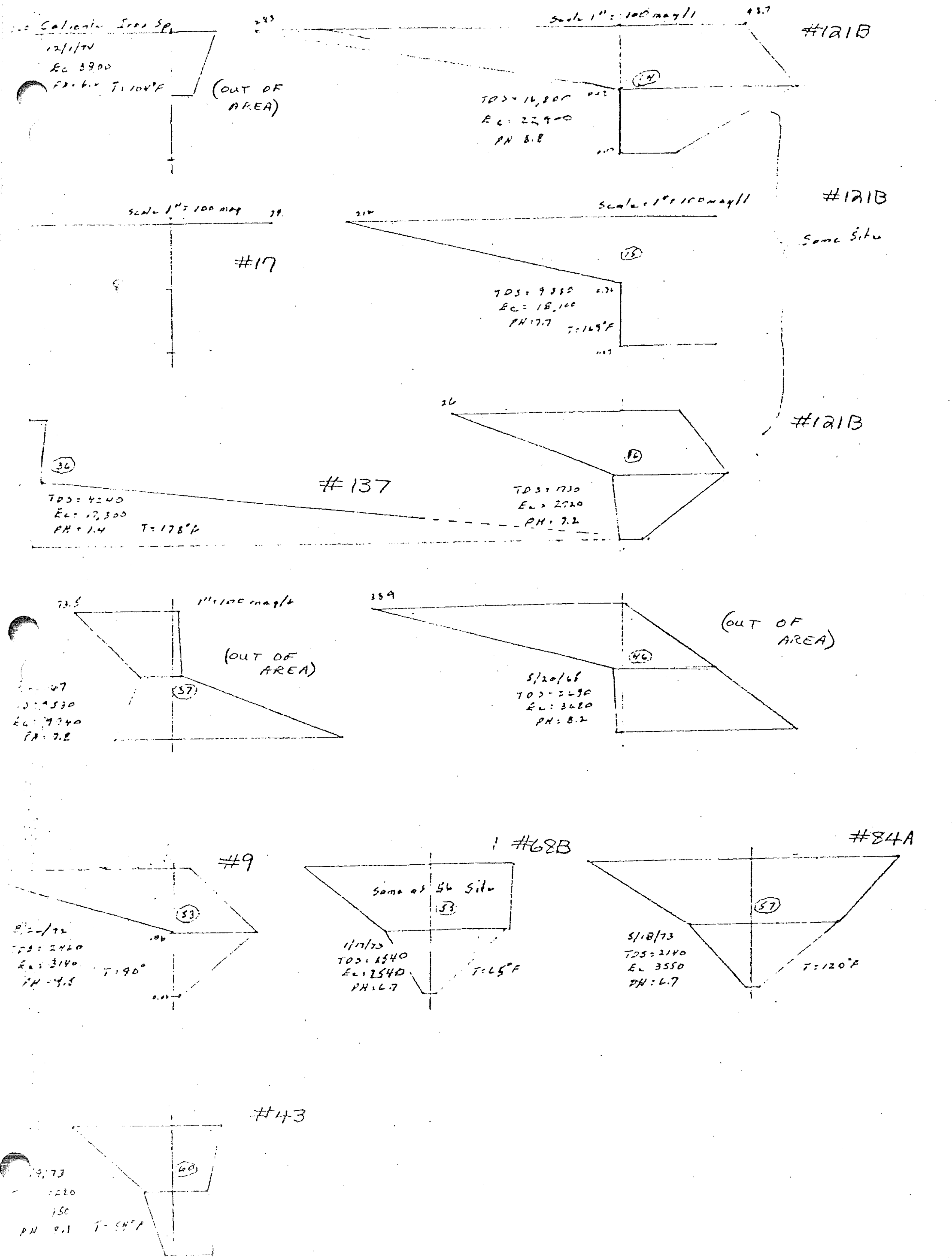




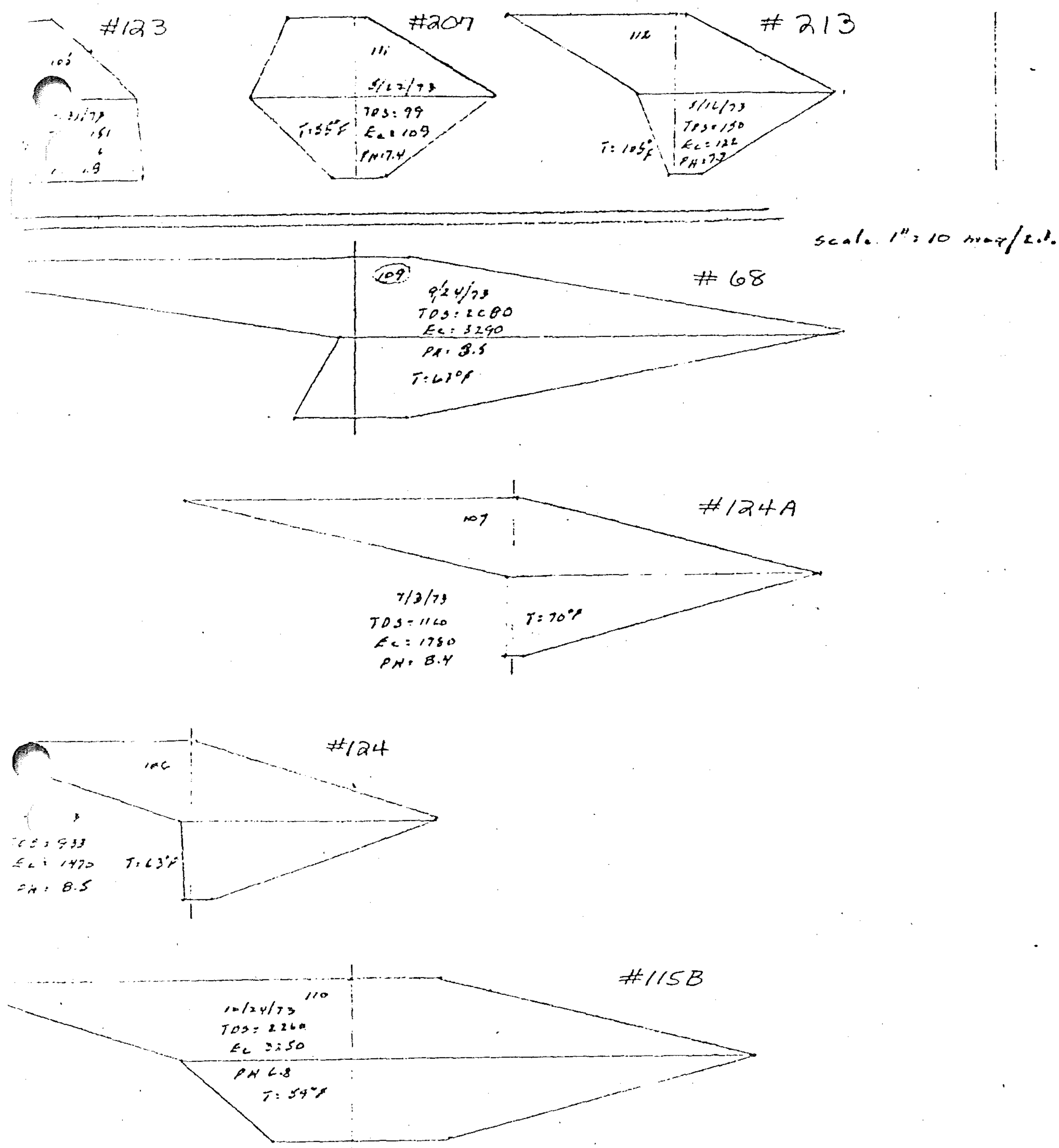




#114
#218
TDS = 2970
Ec = 2225
PH = 8.0
#135A
TDS = 522
Ec = 380
PH = 7.2
#89
#55A
6/8/73
TDS = 692
Ec 1,000
PH = 7.6
T: 59°
#85
10/14/58
Ec 995
T: 62°F
Trainer data
9/27/73
TDS = 625
Ec : 925
PH = 7.3
Near
#178
#133
LASL-B
#210
5/24/73
TDS 406
Ec 480
PH = 9.0
T: 88
LASL-A
Granite 2410'
8/25/72
TDS: 566
Ec 760
PH = 7.4
LASL-A
5/29/73
TDS = 498
Ec = 700
PH = 9.1
T = 88°F
#117
T: 48°F
USGS Test Well
#92
10/24/73
TDS = 2258
Ec = 2500
PH 7.4
T: 59°F
Morgan Well
#80
9/27/73
TDS = 634
Ec = 1,000
PH = 8.1
T: 64°F
USGS Test hole
#81
T: 63°F
USGS Test Well
#65
10/30/73
TDS = 392
Ec = 500
PH = 7.7
T: 52
USGS Test well
#48
11/2/73
T = 224
Ec 350
PH = 8.0
T: 55
Standard Well
#55
10/26/73
TDS = 1564
Ec 2320
PH = 8.4
T: 61°F



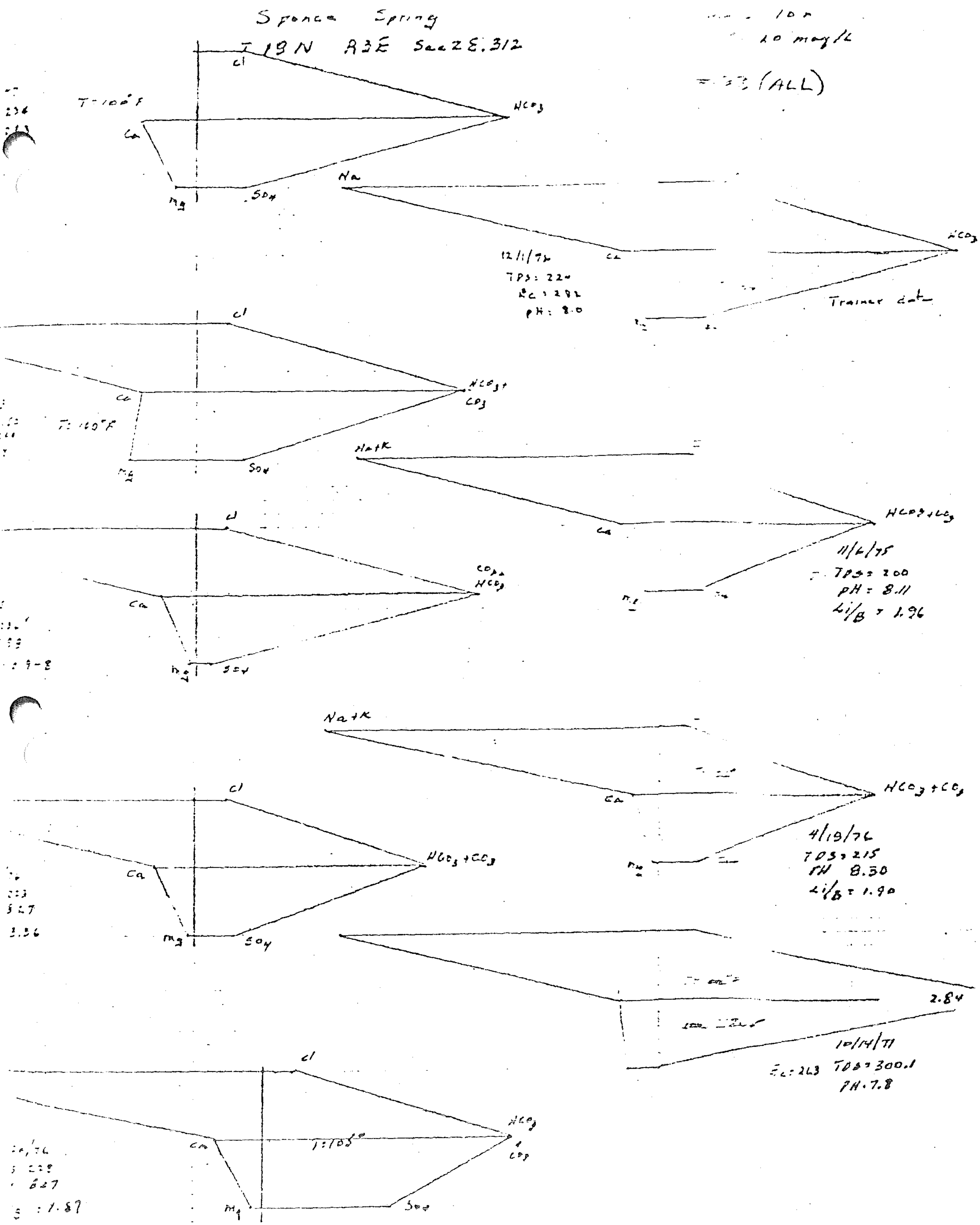
Caliente Springs
12/1/74
Ec 3900
T: 104°F
(OUT OF AREA)
Scale 1" = 100 meq/l
#121B
TDS = 16,800
Ec: 22,900
PH 8.8
#17
Scale 1" = 100 meq/l
#121B
Same Site
TDS = 9350
Ec = 18,100
PH: 7.7
T: 165°F
#121B
#137
TDS = 4240
Ec = 17,300
PH = 7.4
T = 178°F
TDS = 1730
Ec = 2720
PH: 7.2
1" = 100 meq/l
(OUT OF AREA)
5/20/66
PH: 8.2
(OUT OF AREA)
#9
TDS = 2460
Ec = 3140
T: 90°
#68B
Same as 56 Site
1/17/73
TDS = 1540
Ec = 2540
PH: 6.7
T: 65°F
#84A
5/18/73
TDS = 2140
Ec 3550
PH: 6.7
T: 120°F
#43
PH 9.1



#123
#207
111
5/22/73
TDS: 99
Ec: 109
PH 7.4
T: 55°F
#213
112
5/16/73
TDS: 150
Ec: 122
PH: 7.3
T: 105°F
scale. 1" = 10 meq/l.
#68
109
9/24/73
TDS: 2080
Ec: 3290
PH: 8.5
T: 67°F
#124A
107
7/3/73
TDS: 1160
Ec: 1780
PH: 8.4
T: 70°F
#124
106
TDS: 933
Ec: 1470
PH: 8.5
T: 63°F
#115B
110
10/24/73
TDS: 2260
Ec 3250
PH 6.8
T: 54°F

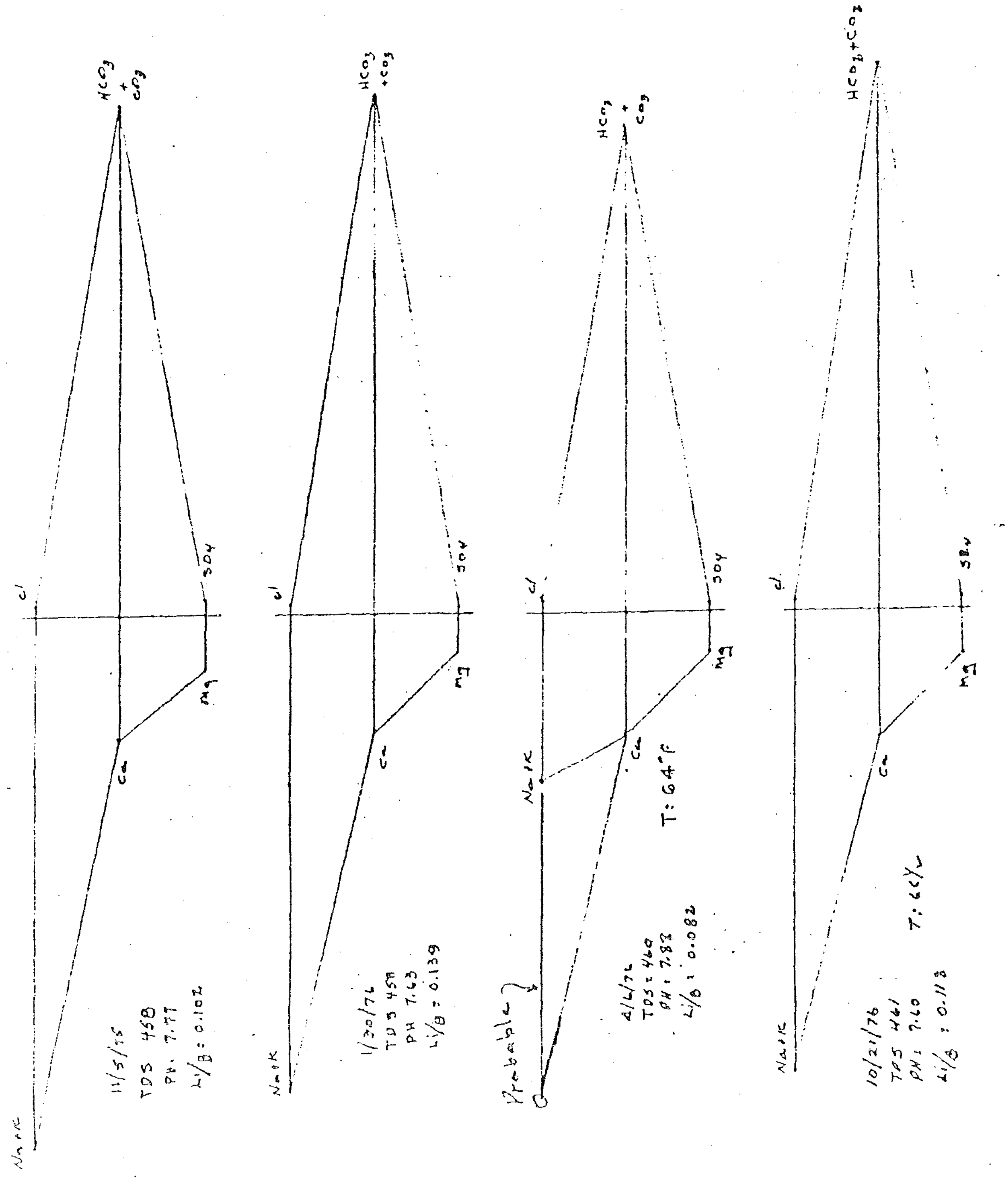
Spence Spring

T 13N R3E Sec 2E.312



T19N R3E Sec 17.342

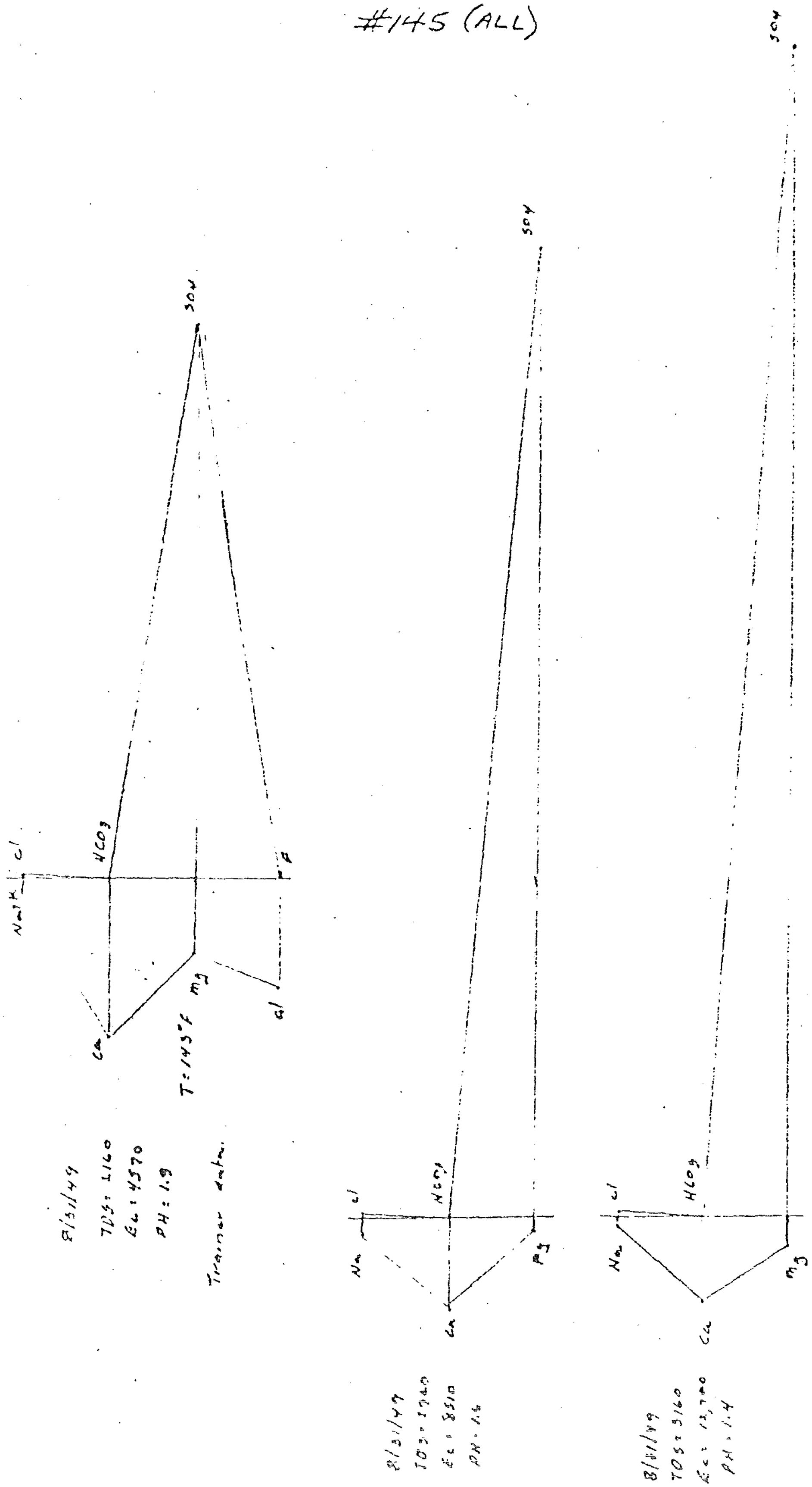
#132 (ALL)



SULPHUR SPRINGS   Scale 1": 10 meq/l

(C1)

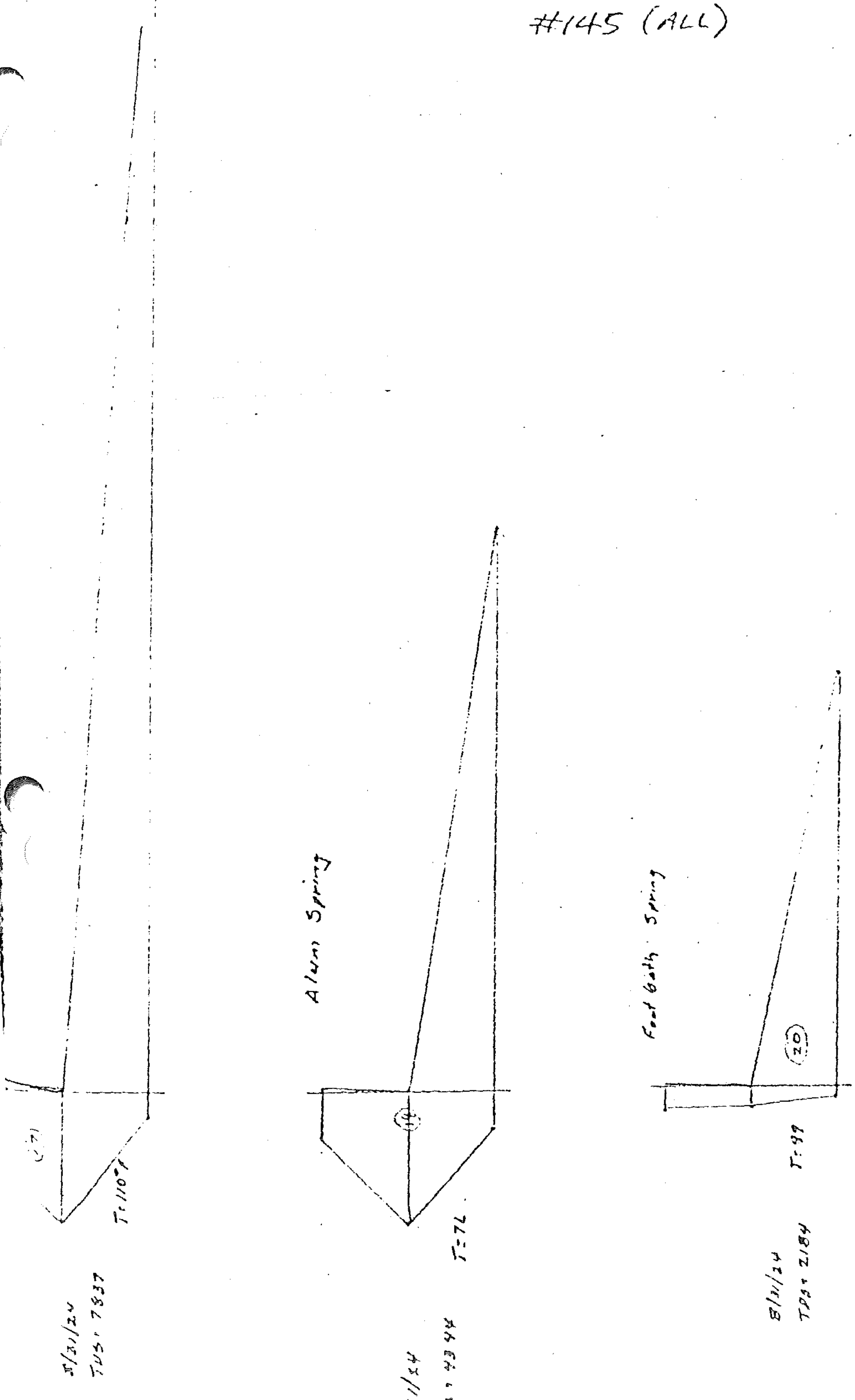
#145 (ALL)

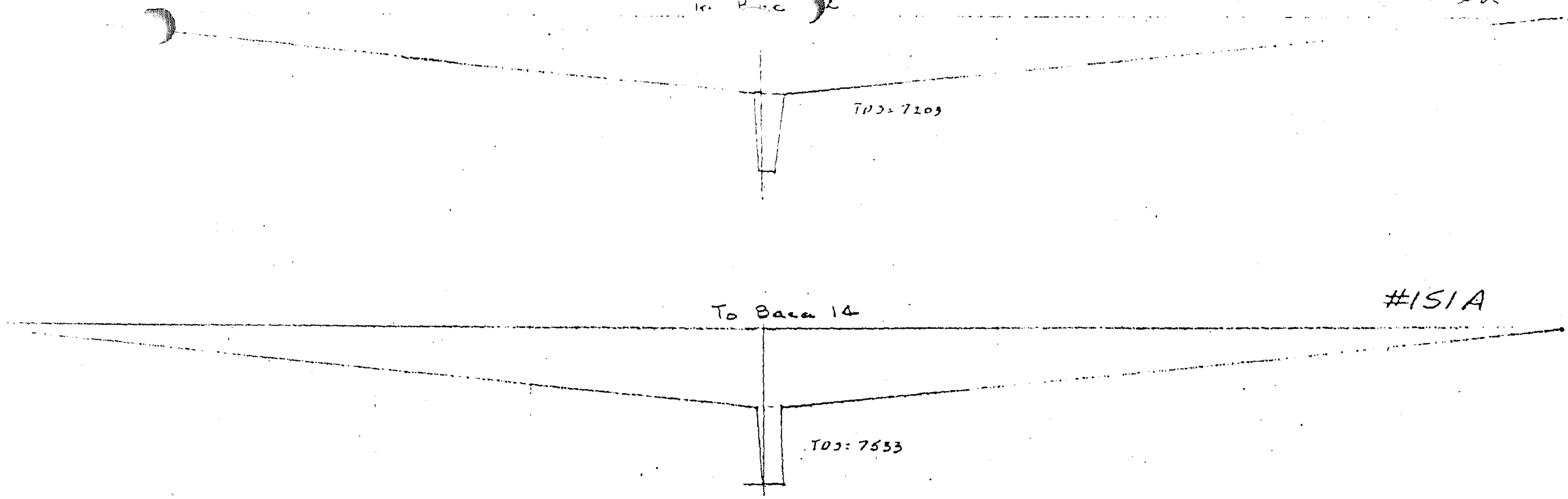


SULFUR SPRINGS   WSP 620   1" = 20 mag/ct.

(C1)

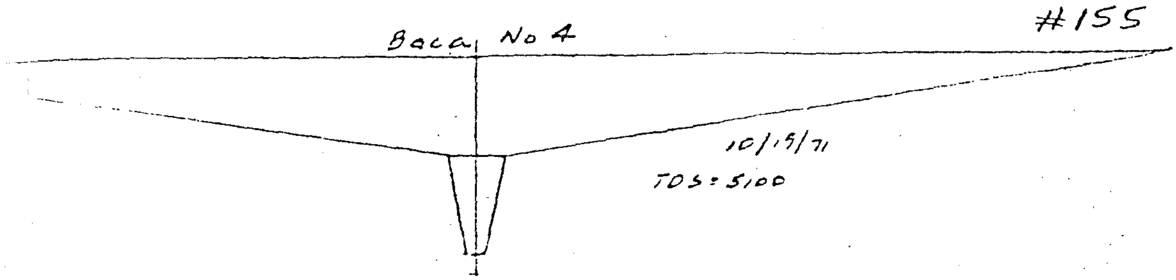
#145 (ALL)

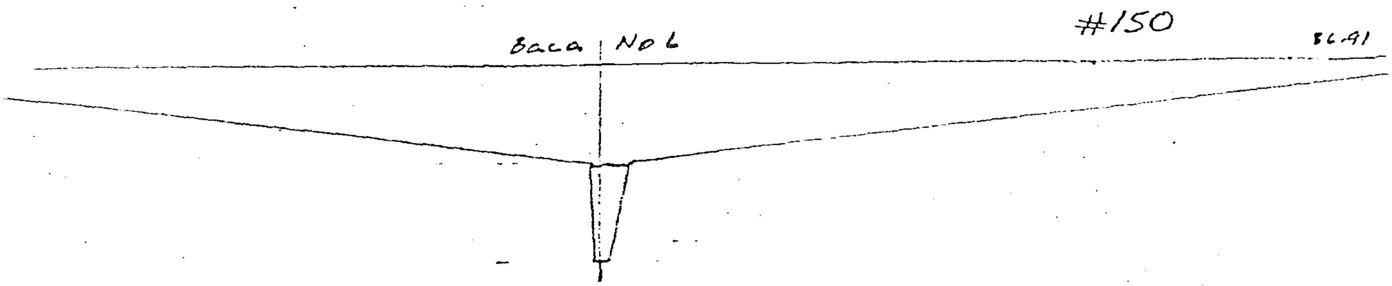


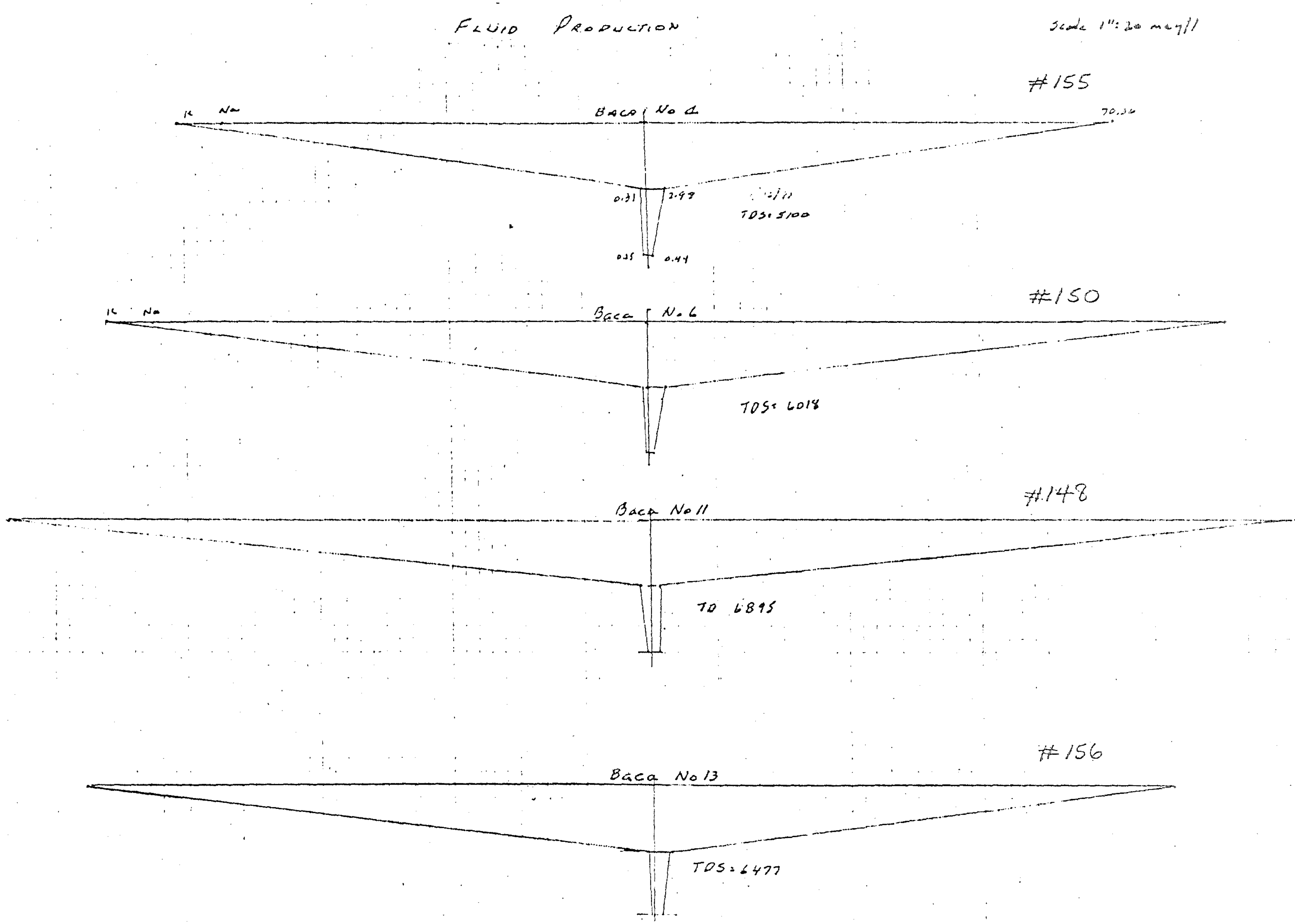

TD: 7209
To Baca 14
#151A
TD: 7553

Scale 1" : 20 meq/l

FLUID PRODUCTION





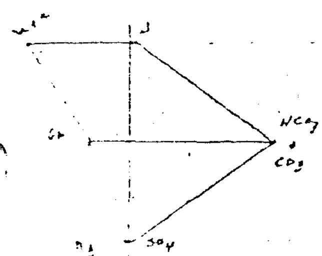

FLUID PRODUCTION
Scale 1": 20 meq/l
#155
Baca No 4
K
Na
0.31
2.98
0.35
0.44
TDS: 5100
#150
Baca No 6
TDS: 6018
#148
Baca No 11
TD 6895
#156
Baca No 13
TDS: 6477

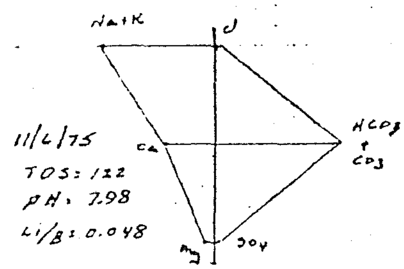
Valle Grande Well No 7
Dunnigan - owner
T 19N R 5E Sec 19.134

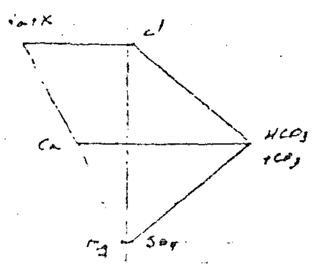
#168 (ALL)

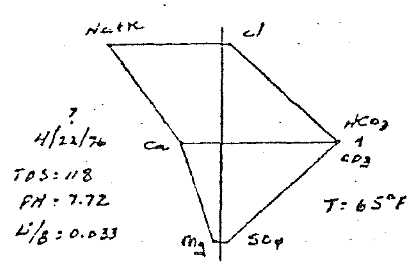
Scale 10x
1" = 1.0 meq/l.

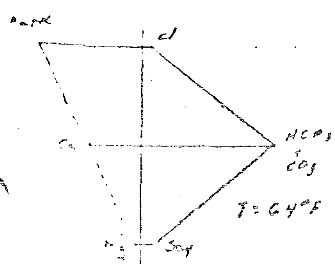
A3



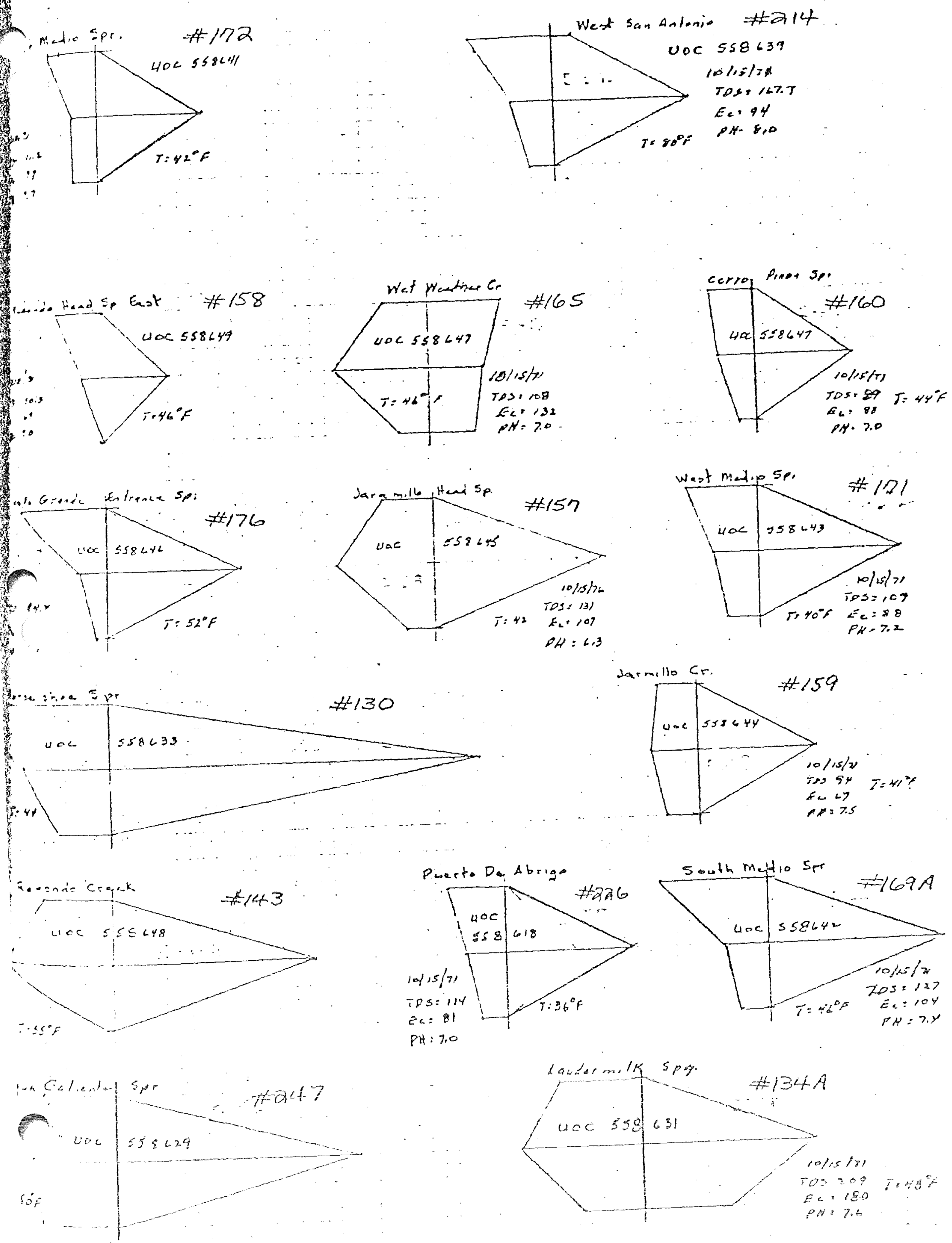






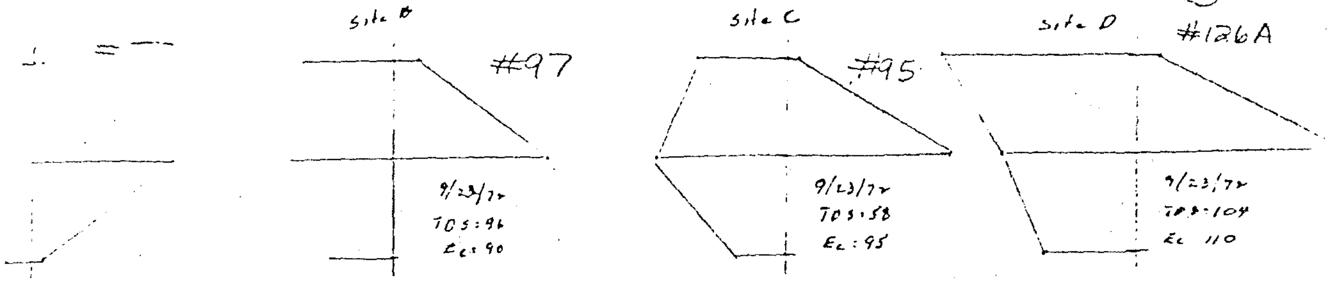


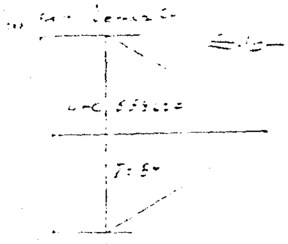
1" = 1.0 meq/l


Medio Spr.
#172
UOC 558641
T: 42°F
West San Antonio
#214
UOC 558639
10/15/71
TDS: 167.7
Ec: 94
pH- 8.0
T: 80°F
Head Sp East
#158
UOC 558649
T: 46°F
Wet Weather Cr
#165
UOC 558647
10/15/71
TDS: 108
Ec: 132
pH: 7.0
T: 46°F
Cerro Pinos Sp
#160
UOC 558647
10/15/71
TDS: 89
T: 44°F
Ec: 88
pH: 7.0
Grande Entrance Sp
#176
UOC 558646
T: 52°F
Jaramillo Head Sp
#157
UOC 558645
10/15/71
TDS: 131
Ec: 107
PH: 6.3
T: 42
West Medio Sp
#171
UOC 558643
10/15/71
TDS: 109
Ec: 88
PH: 7.2
T: 40°F
Horse shoe Spr
#130
UOC 558633
Jarmillo Cr.
#159
UOC 558644
10/15/71
TDS 94
Ec 67
PH: 7.5
T: 41°F
Redondo Creek
#143
UOC 558648
T: 55°F
Puerto De Abrigo
#226
UOC 558618
10/15/71
TDS: 114
Ec: 81
PH: 7.0
T: 36°F
South Medio Spr
#169A
UOC 558642
10/15/71
TDS: 137
Ec: 104
PH: 7.4
T: 46°F
Caliente Spr
#247
UOC 558629
55°F
Laudermilk Spr
#134A
UOC 558631
10/15/71
TDS 209
Ec: 180
PH: 7.6
T: 45°F

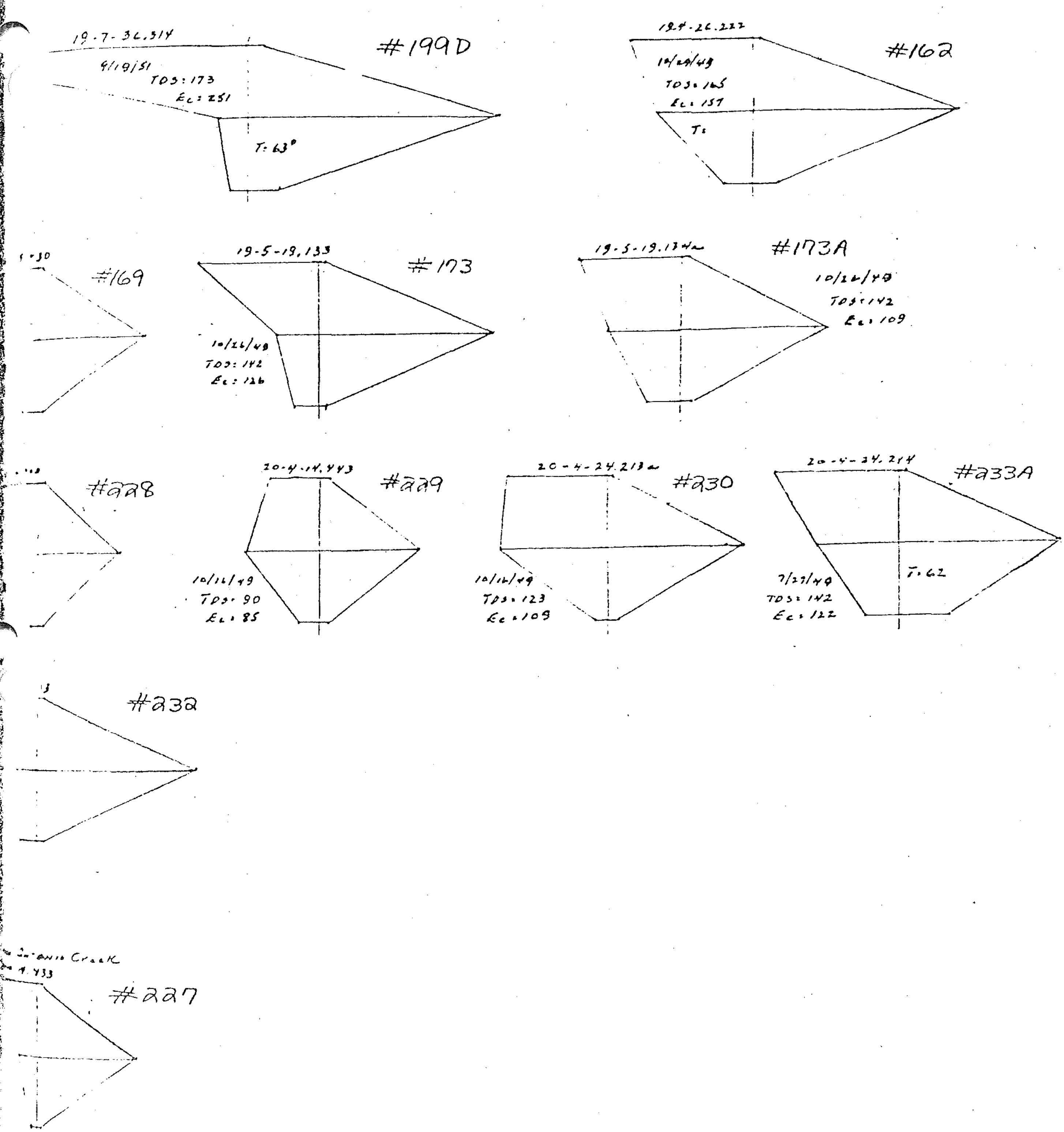
Es- FORM Jemes River Scale 1" = 1.0 mag/cm

(A7)

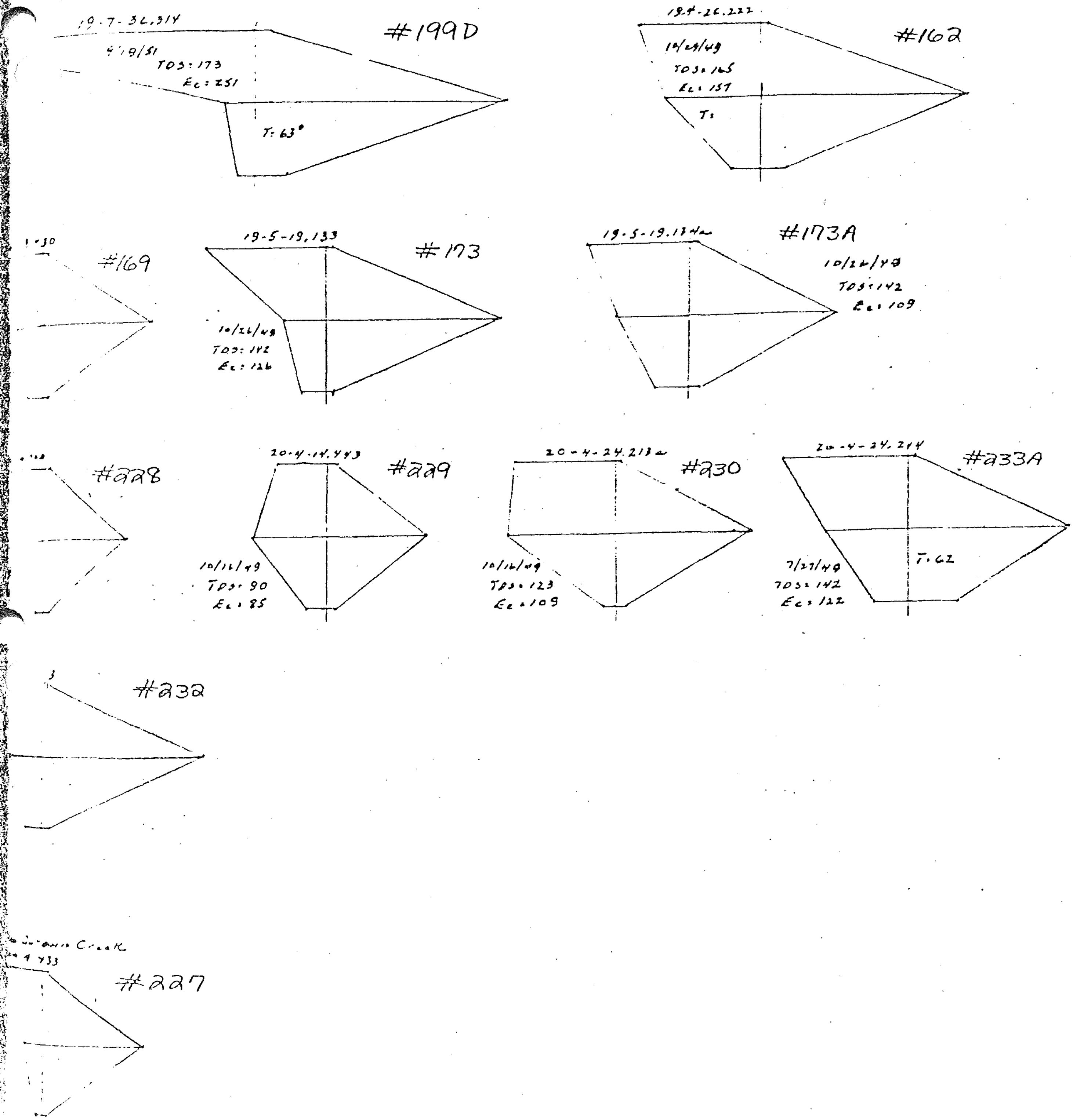




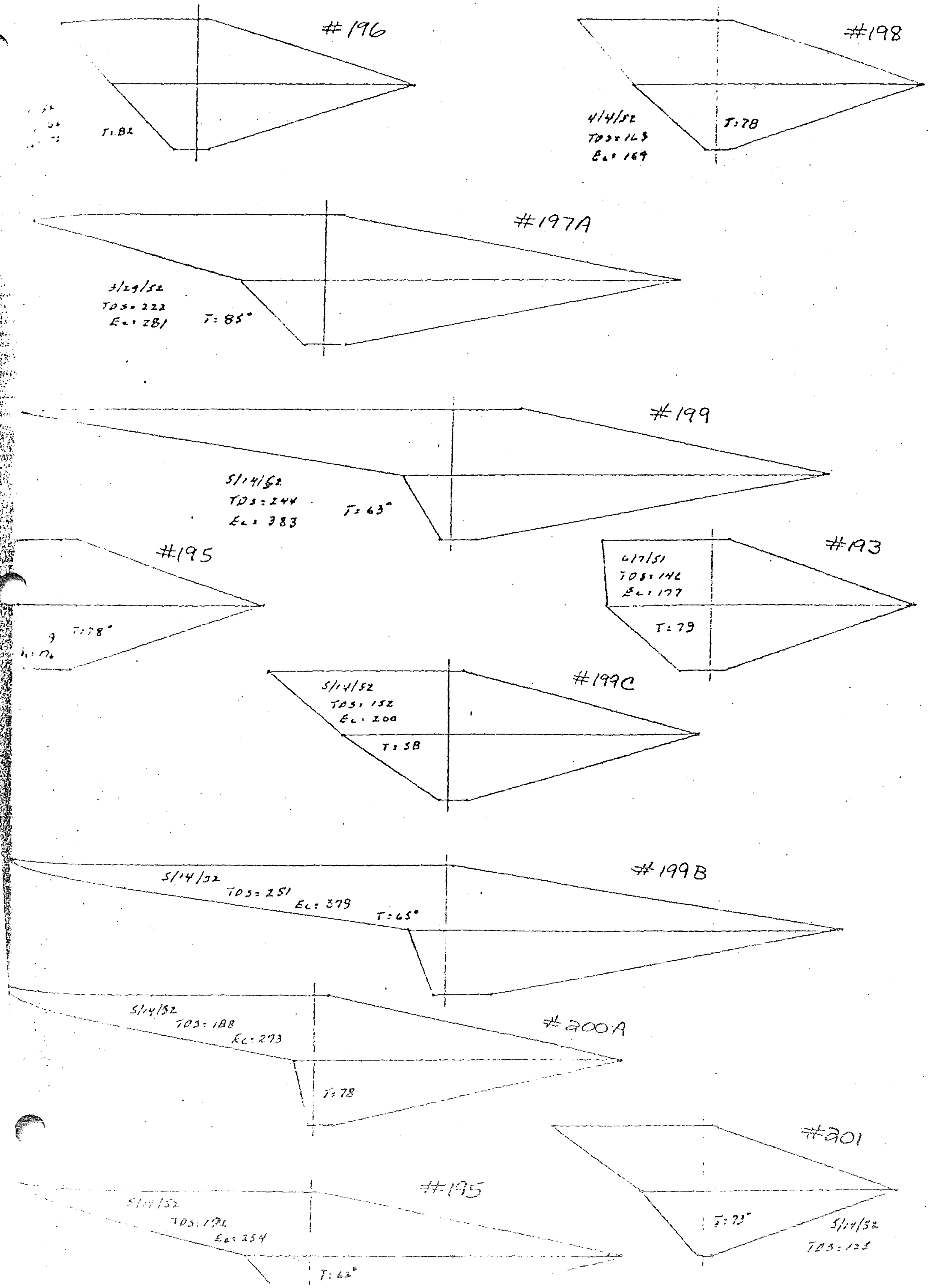
Los Alamos Area 1" = 1.0 mayll



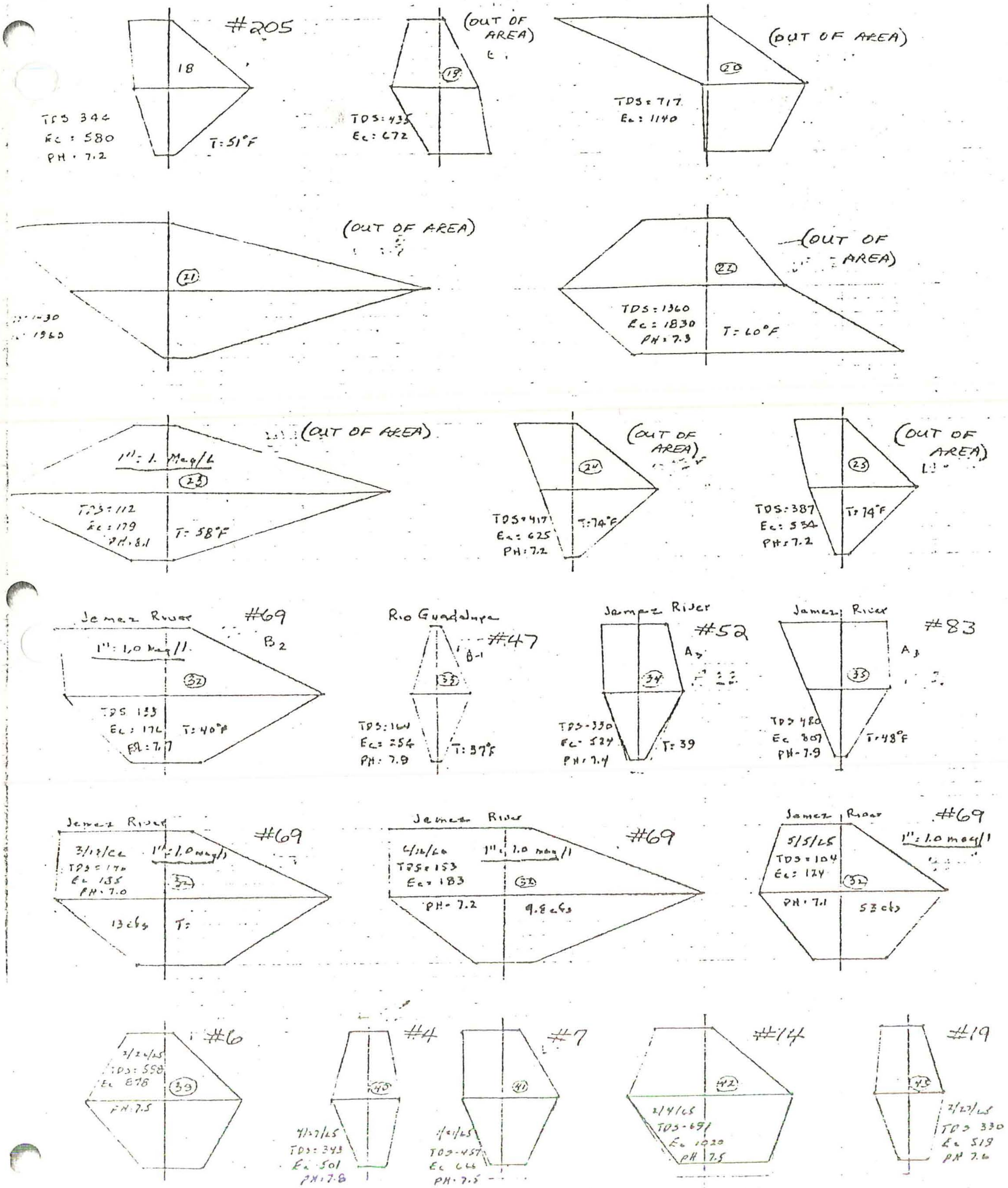
Los Alamos Area



Los Alamos
scale 1" = 1 mile

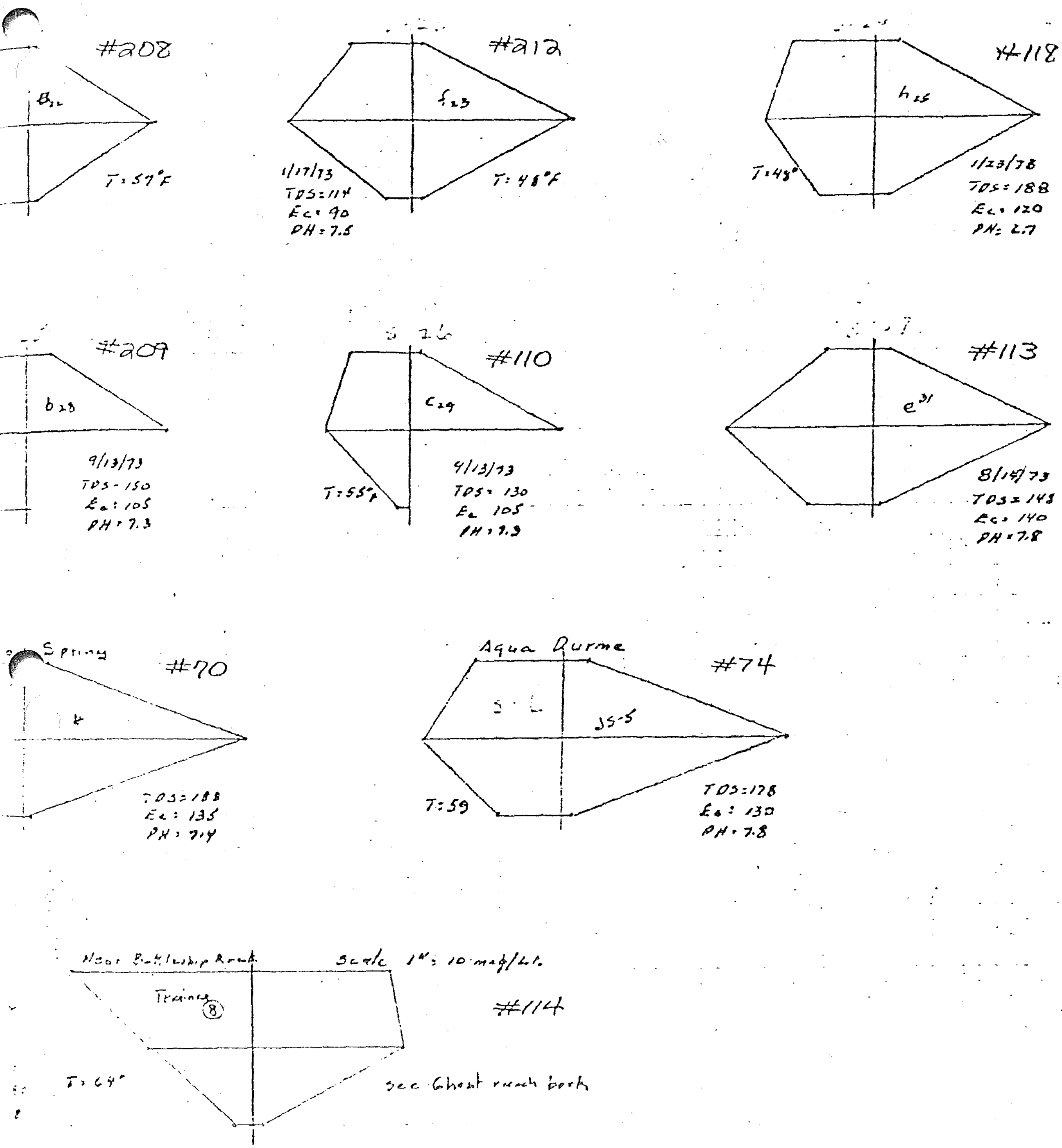


Scale: 1": 10 meq/L



Misc. Springs

Scale 1" = 1.0 meq/L



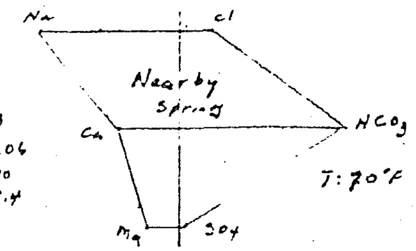
SAN ANTONIO HOT SPRING

T 20N R3E Sec 29.124

Scale – 10x

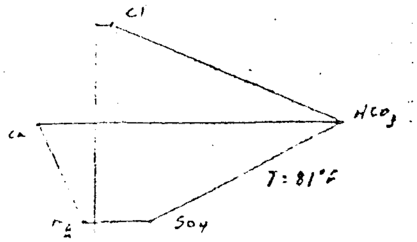
1": 1.0 meq/l

#213 (ALL)

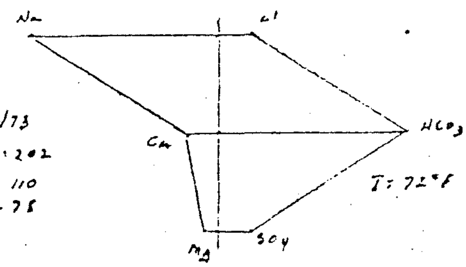


5/24/73
TDS: 206
Ec: 110
pH: 7.4

T: 70°F

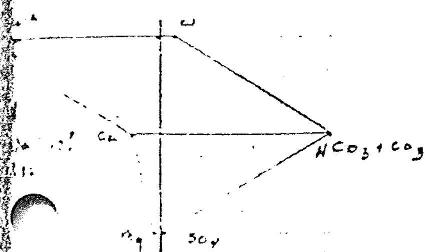


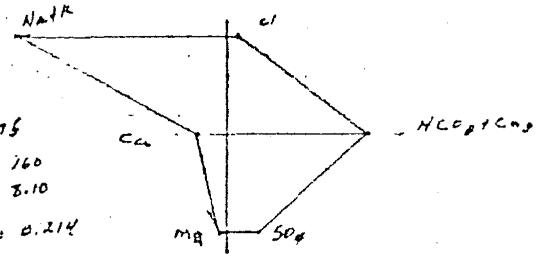
T: 81°F



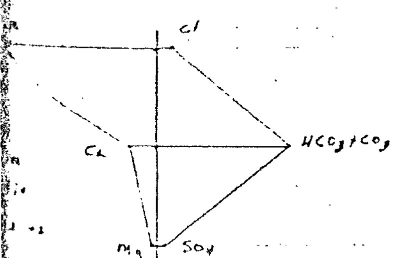
5/24/73
TDS: 202
Ec: 110
pH: 7.8

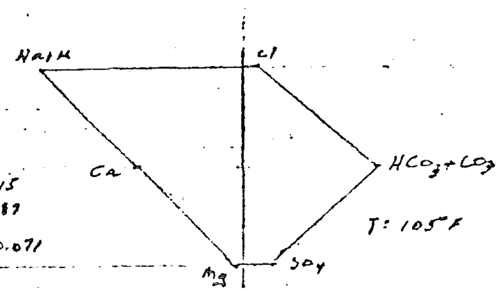
T: 72°F





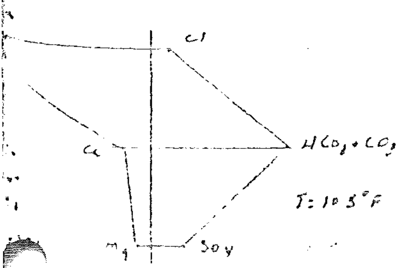
11/3/75
TDS 160
pH = 8.10
Li/B = 0.214



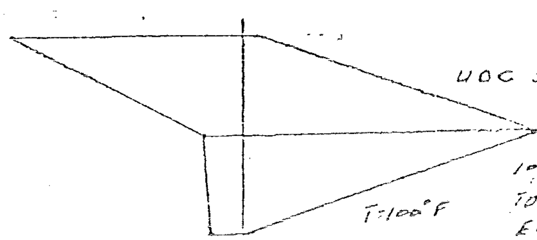


4/19/76
TDS: 145
pH: 7.87
Li/B = 0.071

T: 105°F



T: 103°F



UOC 583638

10/15/71
TDS: 186.2
Ec = 119
pH = 8.2

T: 100°F

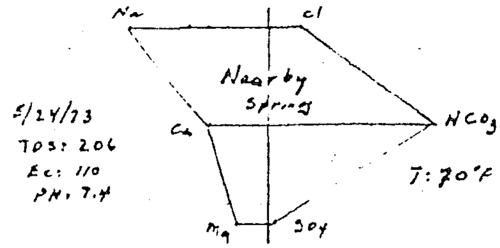
SAN ANTONIO HOT SPRING

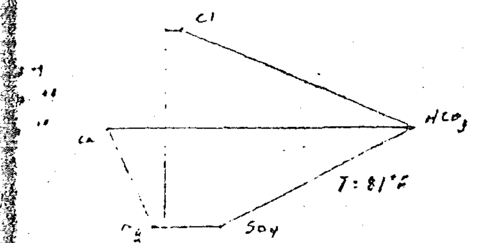
T 20N R3E Sec 29.124

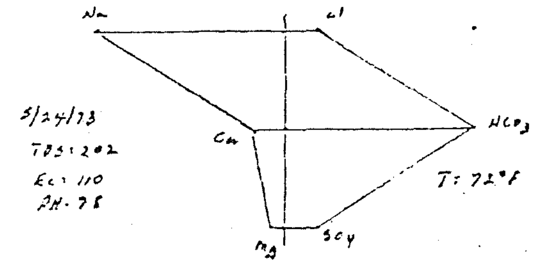
Scale 10x

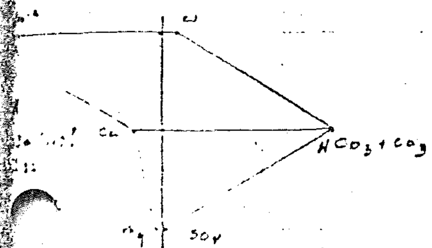
1": 1.0 meq/l

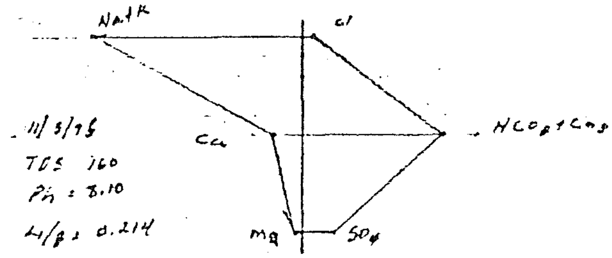
#213 (ALL)

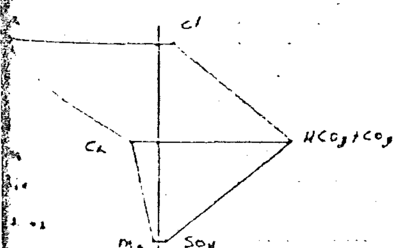


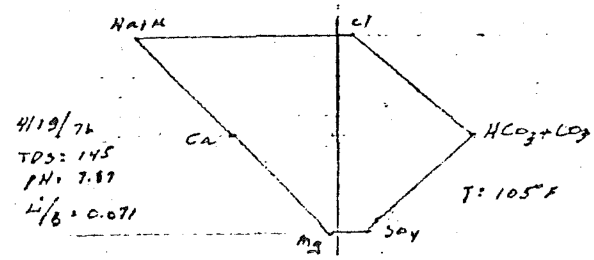


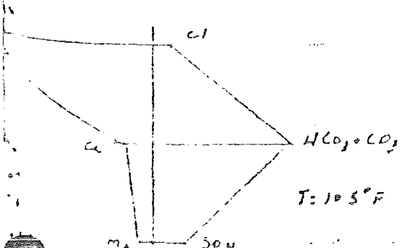


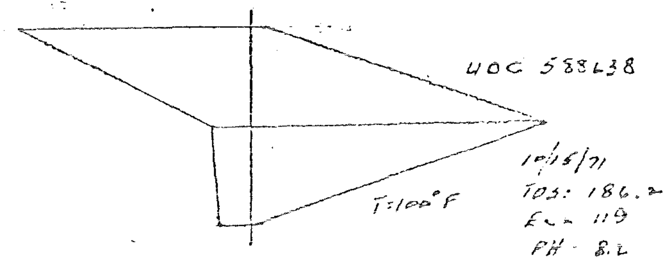






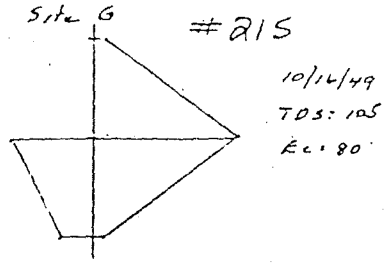


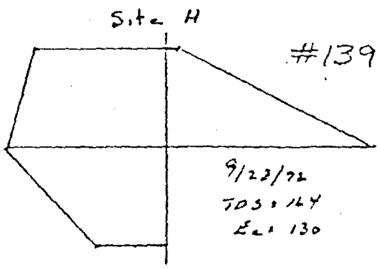


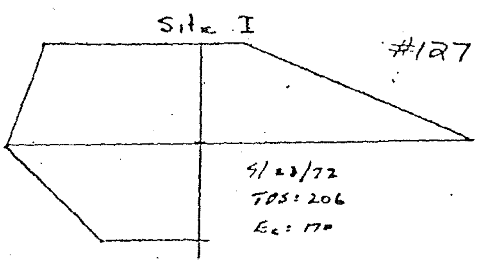


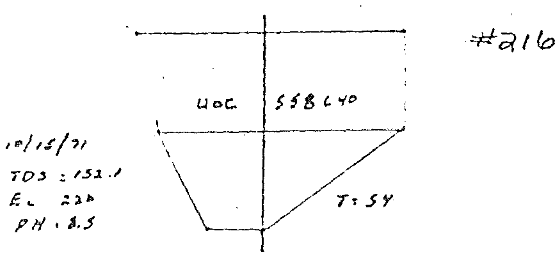
San Antonio Creek

Scale 1": 1.0 meq/lit.





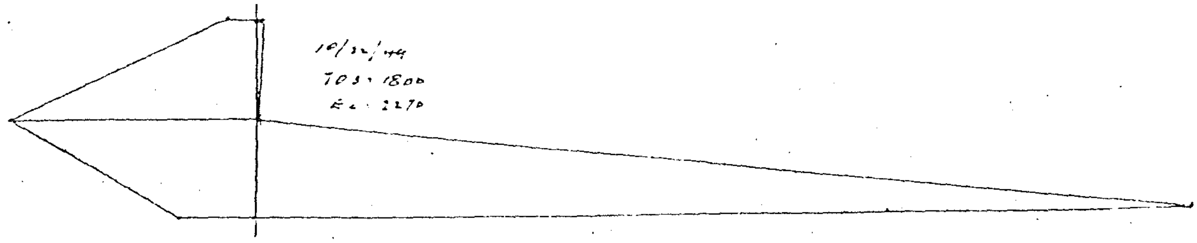




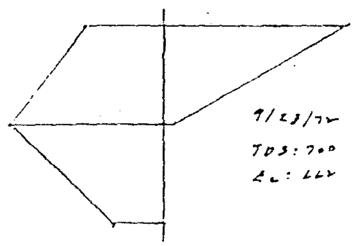
SULPHUR CREEK

Scale 1": 5 meq/L.

Site E #219

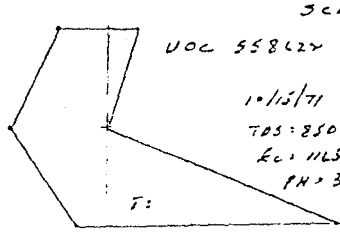


Site F #140



scale 1": 10 meq/l

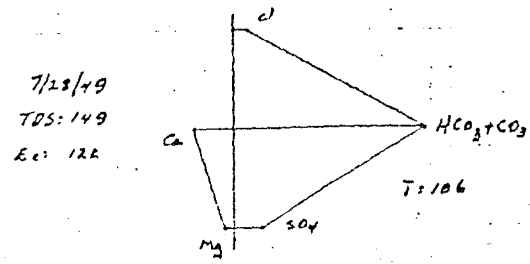
UOC 558622 #141

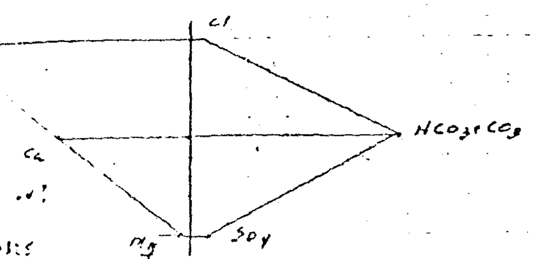


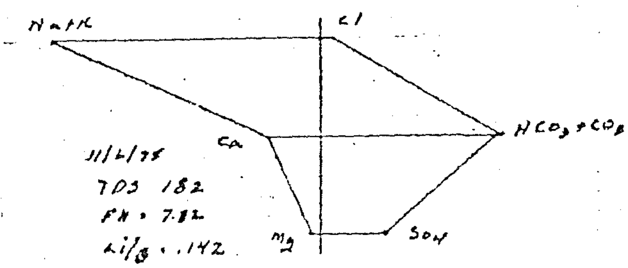
San Antonio Warm Spring
T 20N R 4E Sec 18.111

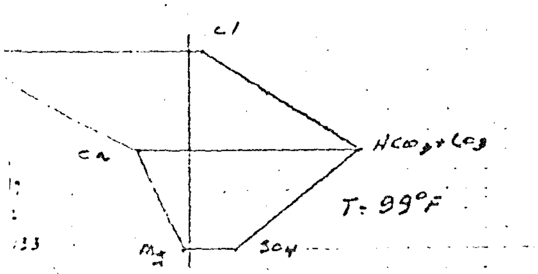
#224 (ALL)

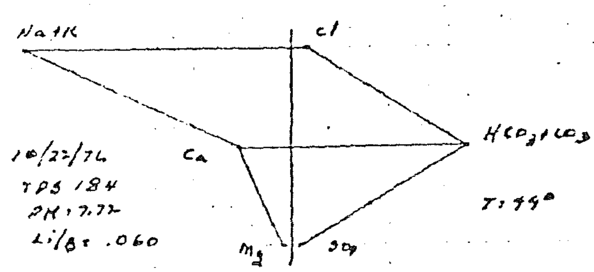
scale 10x
1" = 100 meq/l

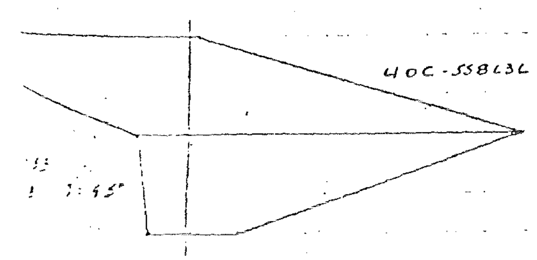








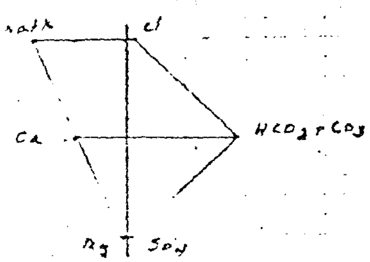


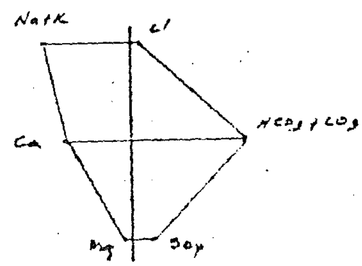


Valle Toledo No 1
T 20N R 4E Sec 24.214

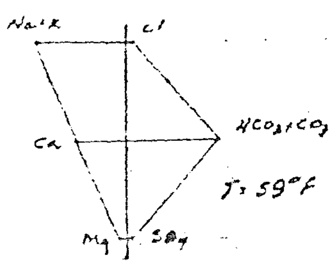
Scale 10X
1": 1.0 meq/l

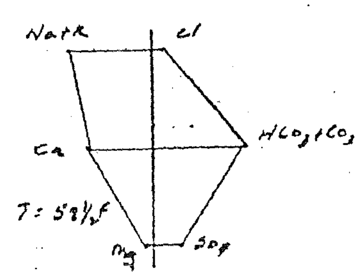
#330A (ALL)





11/4/75
TDS = 78
pH: 8.18
Li/B .091





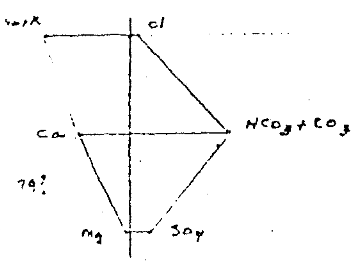
10/22/76
TDS: 106
pH: 8.01
Li/B: 0.??

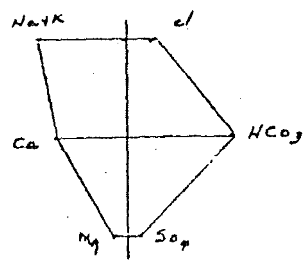
Valla ... No 6 Scale 10k

T 20N R5E Sec 19.333 1": 1.0 meq/l

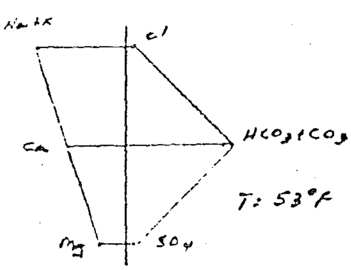
#232A (ALL)

50
8 79!
33



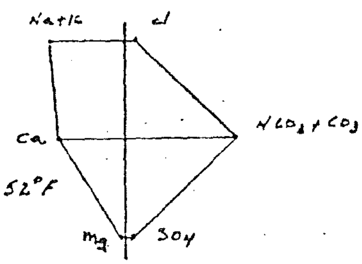


11/6/75
pH 7.32
TDS = 88
Li/B = 0.143



T: 53°F

T: 52°F

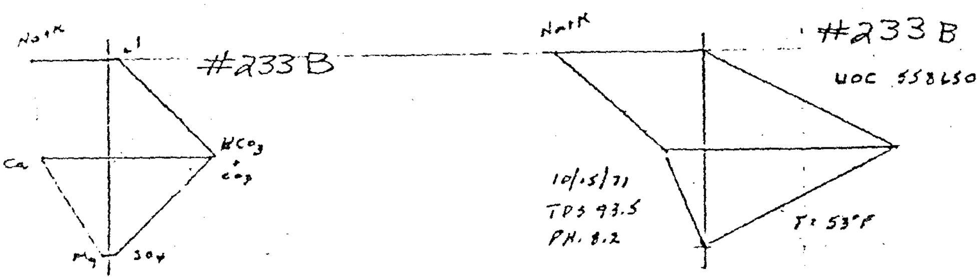


10/22/76
TDS = 103
Ph = 7.67
Li/B = 0.36

Big Well Toledo

35-57-27 406-28-45

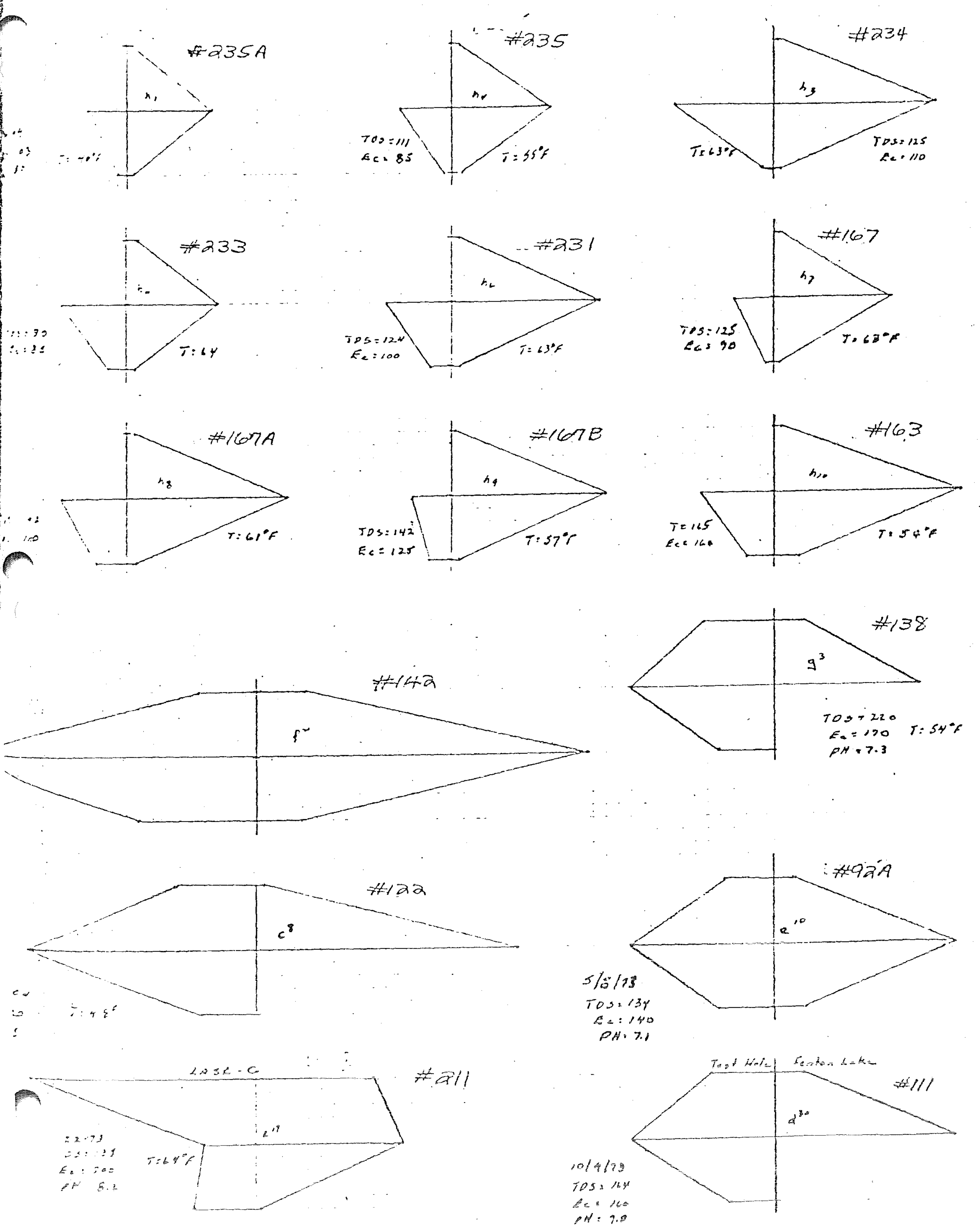
Scale 10x
1": 1.0 meq/liter



.5
89?
.41
0.0773

Misc Wells

Scale 1": 1.0 Meq/Ltr



Scale 1": 10meq/l