Final Contract Report

PRELIMINARY EVALUATION OF THE EAGLE FLAT REGION, HUDSPETH COUNTY, TEXAS

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EXECUTIVE SUMMARY

Preliminary evaluation of the Eagle Flat region, as designated by the Texas Legislature, indicates several areas that may have geologic and hydrologic conditions favorable for further evaluation as potential siting areas for the Texas low-level radioactive waste repository. This determination is based on a review of available data regarding surface drainage, thickness and character of alluvial fill, depth to ground water, and apparent presence or absence of such features as late Cenozoic faults, fissures, known natural resources, and evidence of erosion.

Some general siting areas have been identified that contain several sections that appear to have favorable characteristics. Examples of apparently favorable general siting areas are east of Yucca Mesa, south of Eagle Flat Mountain, and north of Little Hills. Our preliminary assessment is that, of the three areas cited above, the Yucca Mesa location should be given priority consideration.

Initial flooding and drainage analysis indicates that the Yucca Mesa site includes sufficient surface areas unaffected by flooding. There are no known fissures or late Cenozoic faults. Depth to ground water may be in excess of 500 ft, and the water quality may be poor. Shallow alluvium may be somewhat finer grained than at other settings, and the surface appears to be relatively stable and devoid of major incision by existing drainages. Although each of these characteristics needs to be investigated by further work, the most critical unanswered question is the thickness of alluvial fill. Available gravity data, including recent work by The University of Texas at El Paso, indicates that 100 ft or more of alluvial fill may be present in the area. Other areas may be present that are of equal or similar merit, but the preliminary analysis and available information suggest that the Yucca Mesa location apparently has the most favorable characteristics of those general siting areas identified currently.

Smaller potential siting areas, generally about 400 to 800 acres in size, also may exist locally throughout the region where alluvial fill may be of sufficient thickness and drainage characteristics may be appropriate. These smaller potential siting areas would require additional site-specific evaluation of surface drainage characteristics before drill testing could be recommended. Any potential siting area is unique and would require site-specific evaluation activities to assess its suitability for characterization.

INTRODUCTION

Staff of the Bureau of Economic Geology conducted studies from late June to early August 1991, to support the evaluation of the Eagle Flat region by the Texas Low-Level Radioactive Waste Disposal Authority (Authority). The term "Eagle Flat region," as used in this report, refers to the area in Hudspeth County designated by the Texas Legislature in HB 2665 as the geographical area within which the Authority is to attempt to locate a disposal site. The objective of the ongoing evaluation is to locate a siting area of sufficient merit to justify proceeding with site-specific and regional characterization activities.

Our work included a preliminary compilation of published data, a review of available aerial photographs, limited field reviews, and interactions with other contractors investigating flooding potential and conducting geophysical (gravity) surveys. This preliminary evaluation attempted to identify potential siting areas that had limited upstream drainage (to reduce the potential for flooding) and a sufficient depth of alluvial fill (to reduce construction costs and to facilitate performance assessment). Other favorable characteristics included a deep water table, poor water quality, an absence of fissures, a lack of nearby faults of probable late Cenozoic displacement, the presence of relatively fine-grained alluvium, and a stable geomorphic surface. Results were presented to members of the Authority's board of directors in August 1991. This presentation was supported by map compilations at scales of 1:250,000 and 1:24,000. These maps have been reproduced as slides and are appended to this report.

DESCRIPTION OF MAP COMPILATIONS

The following discussion presents a brief synopsis of the map compilations, which were prepared as a major part of the preliminary evaluation. Overlays were prepared for a 1:24,000-scale base map composed of the six quadrangles of the Eagle Flat region. Each of these quadrangles is shown, with each overlay, in the slides that accompany this report. These compilations are a preliminary review of some of the major factors that should be considered in selecting any location for further evaluation as a potential siting area. They also provide a basis for understanding the geologic and hydrogeologic setting of the Eagle Flat region. A somewhat more detailed description of the results of the hydrogeologic review follows this discussion.

Slide 1 - Regional Geologic Map

Slide 1 is a regional geologic map of the portion of Trans-Pecos Texas that includes the Eagle Flat region. The Van Horn-El Paso and Marfa sheets of the Geologic Atlas of Texas have been combined to show the regional geologic setting of the Eagle Flat region. The Eagle Flat region lies on the boundary between the relatively little disturbed Diablo Plateau to the north and the more intensely deformed rocks of the Laramide thrust sheets to the south. East and west of the Eagle Flat region are the extensional basins of the Salt Flat graben and the Hueco Bolson, respectively. The main basin of the Eagle Flat region, which extends from Hot Wells to Grayton Lake and to the north of Sierra Blanca, may be related to this same period of extension that formed the Salt Flat graben and the Hueco Bolson. However, the inferred boundary faults are not known to have any surficial expression and they are not known to be capable faults.

Slide 2 - Faults, Fissures, and Earthquakes

Slide 2 presents a preliminary compilation of faults, fissures, and historic earthquake epicenters. Some of the fault traces are somewhat generalized and may be composed of multiple fault strands. Those shown in black are the traces of probably capable faults with evidence of late Cenozoic displacement. Faults shown in red include some that could be active in the present stress regime but no direct evidence of late Cenozoic displacement is available. Long red dashes indicate faults that may have a somewhat higher probability of late Cenozoic activity than those with short red dashes. All faults shown are primarily of normal displacement with hachures drawn on the downthrown block. No faults believed to have only Mesozoic or older displacements are shown.

Approximate locations of fissures are shown with red triangles. Most of these have been observed in the field or on aerial photographs and some additional localities are now known to be present in the eastern Eagle Flat region. Fissures are present in most of the major basins that contain thick deposits of alluvial sediments.

Earthquake epicenters are approximately located as red circles. Only one location is shown for each major event and the locations of related foreshocks or aftershocks are not shown. It should also be noted that we have arbitrarily selected the location for the epicenter of the 1931 Valentine event from several locations suggested by various authors.

Slide 3 - Bedrock-Alluvium Contacts

Slide 3 is a map of approximate bedrock-alluvium contacts compiled from published geologic maps of the Eagle Flat region and from interpretations of available aerial photographs. Black lines delineate areas where bedrock is in outcrop or where bedrock has only very thin alluvial cover. The base map for this and subsequent slides was made by splicing together the six USGS 7.5-minute topographic quadrangles that compose the Eagle Flat region.

Slide 4 - Generalized Bedrock-Alluvium Map

Slide 4 is a map derived from the map shown in slide 3. A green line has been drawn approximately 1,000 ft from the outer margins of the mapped bedrock-alluvium contacts to indicate areas in which alluvial fill may be more than 100 ft thick.

Slide 5 - Surface drainage

Slide 5 was derived from analysis of the topography as shown on the six USGS 7.5-minute topographic quadrangles of the Eagle Flat region and from analysis of available aerial photographs. The 1:12,000 aerial photos were unavailable during our analysis. The bold orange line indicates the major drainage divide between the internally drained Grayton Lake drainage basin and adjacent drainages to the Rio Grande, to the southwest, and Lobo Flat, to the east. Dashed orange lines indicate some of the internal drainage divides. Blue lines indicate some of the ephemeral streams shown on the published topographic maps, the long black lines indicate drainages inferred from the topographic maps, and the short black lines are those drainages inferred from the aerial photographs. The drainage analysis is less complete in the bedrock areas and in the Rio Grande drainage as these were viewed as less favorable potential siting areas.

Slide 6 - Potentiometric Surface

Slide 6 shows the potentiometric surface inferred from available well data in the Eagle Flat region. The red dots represent wells used to constrain this interpretation. Note the absence of well control over large parts of the region, especially in the central part of the study area near Grayton Lake. Wells in adjacent quadrangles were used to provide additional data points to control interpretations at the margins of the Eagle Flat region. The hydrogeology of the region is discussed in more detail in the following section of this report.

HYDROGEOLOGY OF THE EAGLE FLAT REGION

Available published data on the hydrogeology of the Eagle Flat region and surrounding areas were reviewed. This preliminary review will serve as the basis for the well inventory and initial hydrogeologic data collection activities to be conducted during the coming months. These hydrologic and hydrochemical interpretations are preliminary but are important as guides for future work in this region.

WELL DATA

Water well data were collected from the Eagle Flat region and adjacent areas depicted in the following 11 USGS topographic 7.5-minute quadrangles: Lasca, Sierra Blanca, Dome Peak, Bean Hills, Sierra Blanca SW, Devil Ridge, Grayton Lake, Allamoore, Hackett Peak, Eagle Mtns. NE, and Bass Canyon. This area includes the Blanca Draw subregion, the Allamoore subregion, the North Eagle Mountains subregion, and the Red Light Draw subregion. Hydrologic data (Tables 1-4) from each of these subregions reveal unique hydrologic or hydrochemical characteristics. Tables 1-4 include the available well data from Texas Department of Water Resources (TDWR) Report 259, including well location, hydrologic information (depth to water, potentiometric surface elevation, well yield), and water-chemistry analyses. Available water-chemistry data are limited to basic ionic analyses; no trace element or isotopic data are available. There are significantly more hydrologic data than hydrochemical data. Limited production data are available. Well locations in the Eagle Flat region are shown on slide 6.

HYDROLOGIC DATA

Geologic Distribution of Ground Water

Ground water occurs in four different geologic settings: (1) Precambrian rocks, (2) Cretaceous carbonate rocks, (3) Cretaceous sandstones (Cox sandstone), and (4) bolson fill.

Ground Water in Carbonates--Ground water is produced from Cretaceous carbonates in the Blanca Draw subregion, the Red Light Draw subregion, and the northern Eagle Mountains subregion. According to TDWR Report 256, several wells in the Sierra Blanca subregion yielded 200-1000 gpm when the wells were completed in the early 1970's. Production data indicate lower yields from other wells.

Ground Water in Sandstones--Ground-water production from sandstones is limited to production from the Cretaceous Cox sandstone in the upper reaches of Red Light Draw and the Blanca Draw subregion. Well yields appear to be less than 20 gpm.

Ground Water in Precambrian Bedrock--Ground-water production from Precambrian bedrock occurs in the Allamoore subregion. Well yields are only a few gallons per minute.

Ground Water in Bolson Fill--Ground-water production is limited to only a few wells in the bolson fill from Red Light Draw and the eastern part of the Eagle Flat region. Those wells that do produce from these basins are in the lower reaches of the basins. A review of available data indicates very limited production from bolson fill.

Potentiometric Surfaces

The potentiometric surface (Slide 6) shows two major ground water flow systems; (1) flow in the Blanca Draw/eastern Eagle Flat region and (2) flow in the Red Light Draw subregion. In both flow systems ground-water flow appears to be to the southeast. Recharge occurs in the mountains on either side of the basins, flows down the bedrock outcrop or subcrop to the axis of the basin (valley), and then appears to flow parallel to the basin axis. The discharge zones are unknown.

Recharge to the Blanca Draw/eastern Eagle Flat region is occurring in the Eagle Mountains, the Carrizo Mountains, and the Allamoore area, as suggested by the shallower depth to ground water in these areas (approximately 200 ft below land surface) (fig. 1) and the linear relationship between land surface elevation and elevation of the potentiometric surface (fig. 2).

This recharge results in ground-water mounding in the mountains, which implies an absence of interbasinal ground-water flow beneath the mountains. This type of interbasinal flow may occur in the arid basins of Nevada and other western regions and complicates the interpretation of ground-water flow systems. Ground-water flow direction within a basin may be restricted to a narrow zone along the axis of the basin.

Well records show that the water table is characteristically below the base of the bolson fill. Ground-water flow appears to be restricted to recharge in bedrock in the mountains and stays within bedrock beneath the bolson sediments. This implies that the permeability of the bedrock, which is predominantly carbonate, is higher than that in the overlying bolson sediments. Only in the lower elevation areas of these basins does the potentiometric surface rise into the bolson fill.

Depth to Ground Water

Depth to water provides an estimate of the thickness of the unsaturated section and also provides an indication of general permeabilities and recharge potential. A plot of water elevation versus surface elevation for Red Light Draw, Blanca Draw, and the eastern Eagle Flat region is shown in figure 2. A direct linear relationship, suggesting that recharge occurs in the mountains on either sides of the basins and that the aquifers are of moderate permeability, is present for data from Red Light Draw and the eastern Eagle Flat region. In contrast, the Blanca Draw subregion shows much less variation in water elevation in comparison with land-surface elevation, a factor that implies high permeabilities (flat gradient) and/or limited vertical recharge. This relationship is also seen in figure 1, which shows the depth to water versus land surface elevation. In the eastern Eagle Flat region, depth to water is generally 200 ft or less, again implying moderate aquifer permeability and recharge from land surface. In contrast the depth to water in the Blanca Draw subregion varies from 300 to 1100 ft, with greater depth at higher elevations. This indicates high permeabilities and potentially limited recharge.

HYDROCHEMICAL DATA

The hydrochemical data have been divided into three groups to determine if there are unique signatures to the water chemistry and whether hydrochemical changes occur concurrently as ground water flows down gradient. These groups are the Blanca Draw subregion, the eastern Eagle Flat region, and the Red Light Draw subregion. Except for one well the total dissolved ions for Red Light Draw and eastern Eagle Flat are all less than 1,000 mg/L, indicating good water quality. In contrast, the chemistry for ground water in the Blanca Draw subregion indicates total dissolved ion concentrations of as much as 3,000 mg/L. The city of Sierra Blanca does not use local ground water but pipes higher quality water from Van Horn.

Water Chemistry of Red Light Draw

A Piper diagram of water chemistry of the Red Light Draw data (fig. 3) indicates a chemical change in the ground water from a $Ca\text{-}HCO_3$ toward a $Na\text{-}SO_4\text{-}HCO_3$ type water as it flows down the potentiometric gradient. This change may result from rock/water reactions along flow or it may represent mixing of ground water from the Quitman and Eagle Mountains as water flows down Red Light Draw. A plot of Na, Ca, HCO_3, and SO_4 versus water table elevation (fig. 4) shows that Ca and HCO_3 are decreasing, whereas Na and SO_4 are increasing down the "flow gradient." This may suggest mixing of an original water with a lower TDS water.

Water Chemistry of the Eastern Eagle Flat Region

Water from the eastern Eagle Flat region is predominantly from Precambrian bedrock. Total dissolved ions remains low. According to the Piper diagram of the eastern Eagle Flat data (fig. 5), a general evolution occurs from a Ca-HCO_3 water toward a Na-Mg-SO_4HCO_3 (fig. 6) water, similar to the pattern observed in Red Light Draw.

Water Chemistry of Blanca Draw

Water chemistry from Blanca Draw (fig. 7) shows a significant increase in total dissolved ions with most of the increase resulting from higher concentrations of Na and Cl. HCO_3 is also higher. The water chemistry in this region is different from that in Red Light Draw (fig. 4) and eastern Eagle Flat (fig. 6).

HYDROGEOLOGIC SETTING

The potentiometric data indicate two flow systems, one in Red Light Draw and the other in Blanca Draw/eastern Eagle Flat. The water chemistry from Blanca Draw/eastern Eagle Flat should complement the hydrologic data by showing a chemical evolution as the ground water flows down the potentiometric surface. According to limited water-level data in Blanca Draw/eastern Eagle Flat, ground water may be flowing from Blanca through eastern Eagle Flat and off to the southeast, although well data are absent in the Grayton Lake area. Ground water also appears to be recharged from the Carrizo Mountains and in the Devil Ridge/Eagle Mountain area. Cretaceous strata in the Eagle Mountains dip generally to the southwest, and much of the recharge from these uplands may move into Red Light Draw. Increased Na and Cl, however, are not seen in the eastern Eagle Flat data, as would occur if Blanca Draw waters were flowing through the eastern Eagle Flat region. This may be the result of (1) incomplete data or (2) recharge waters from the Eagle Mountains and the Carrizo Mountain diluting waters from the Sierra Blanca region so that they are no longer chemically identifiable. The chemical data from the eastern Eagle Flat region are largely from the flanks of the Carrizo Mountains and north of Allamoore, and therefore they represent recharge from this region alone.

Well-yield data from the Blanca Draw subregion indicate that carbonate aquifers have the potential for significant ground water production. Fault zones may also have high-yield production. In bolson sediments, in contrast, production is more limited, and the water table, where noted, typically is below the base of the bolson sediments. The bolson sediments, therefore, are mostly in the unsaturated section. Although an active flow system exists, ground water appears to be recharged in bedrock mountainous terrains, flows in bedrock down the topographic gradient of these uplands where bedrock crops out and where bedrock may be buried beneath an apron of alluvial material, and then flows down the axes of the basins within bedrock. Recharge and flow through the bolson sediments does not appear to be an important process in these basins.

ACKNOWLEDGMENTS

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SLIDES

The following set of slides is based on the series of maps and overlays used to present the results of our investigations to the Authority's board of directors. These slides are described in more detail on pages 4-6 of this report.

Slide 1 (A to C) - Regional geologic map.

1A, North half of geologic map.
1B, South half of geologic map.
1C, Closeup of Eagle Flat portion of geologic map.

Slide 2 (A and B) - Faults, fissures, and earthquakes.

2A, North half of faults, fissures, and earthquakes.
2B, South half of faults, fissures, and earthquakes.

Slides 3 to 6, Eagle Flat region. Each slide set contains six slides, lettered A to F. Each slide encompasses one of the six 7.5-minute topographic quadrangles that compose the Eagle Flat region.

A = Sierra Blanca quadrangle.
B = Dome Peak quadrangle.
C = Bean Hills quadrangle.
D = Devil Ridge quadrangle.
E = Grayton Lake quadrangle.
F = Allamoore quadrangle.

Slide 3 (A to F) - Bedrock-alluvium contacts.

Slide 4 (A to F) - Generalized bedrock-alluvium map.

Slide 5 (A to F) - Surface drainage.

Slide 6 (A to F) - Potentiometric surface.

FIGURE CAPTIONS

Figure 1. Depth to water versus land surface, Eagle Flat region.

Figure 2. Potentiometric surface versus land-surface elevation.

Figure 3. Piper diagram, Red Light Draw.

Figure 4. Chemical concentrations (Ca, Na, HCO_3, and SO_4) versus water elevation, Red Light Draw.

Figure 5. Piper diagram, Eagle Flat.

Figure 6. HCO_3 and Cl versus total dissolved solids, eastern Eagle Flat.

Figure 7. HCO_3 and Cl versus total dissolved solids, Sierra Blanca.

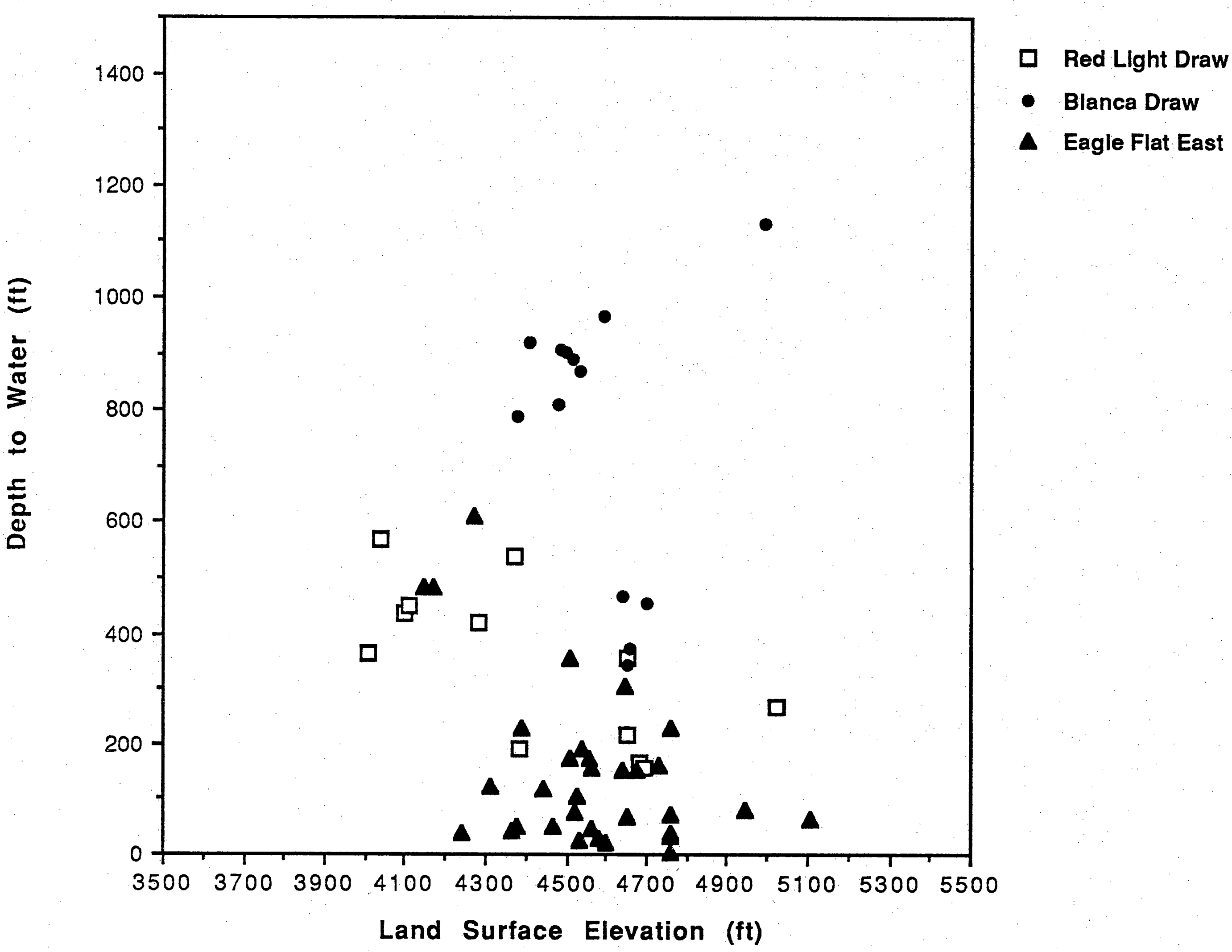

Red Light Draw
Blanca Draw
Eagle Flat East
1400
1200
1000
800
600
400
200
0
Depth to Water (ft)
3500 3700 3900 4100 4300 4500 4700 4900 5100 5300 5500
Land Surface Elevation (ft)

Figure 1

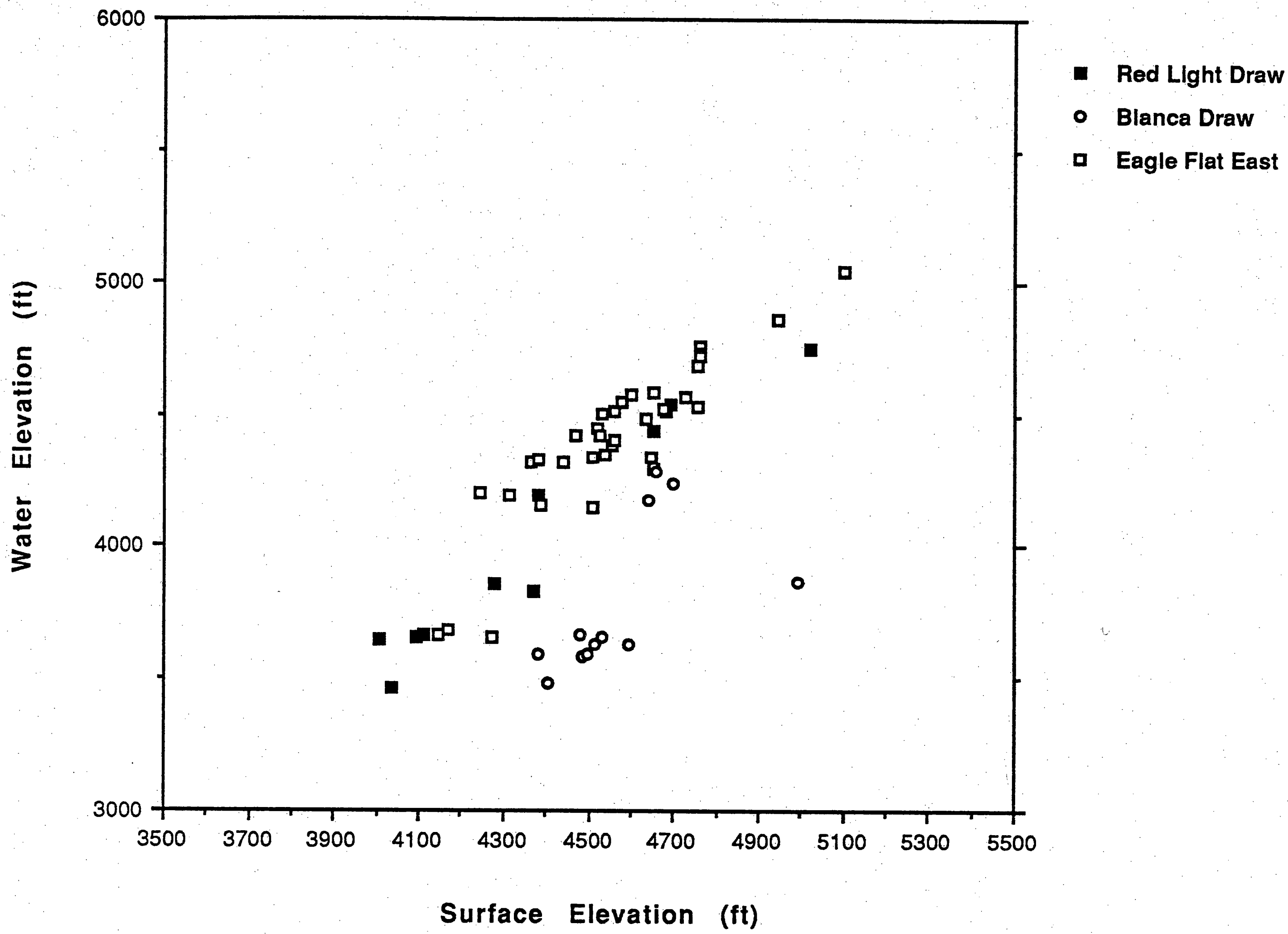
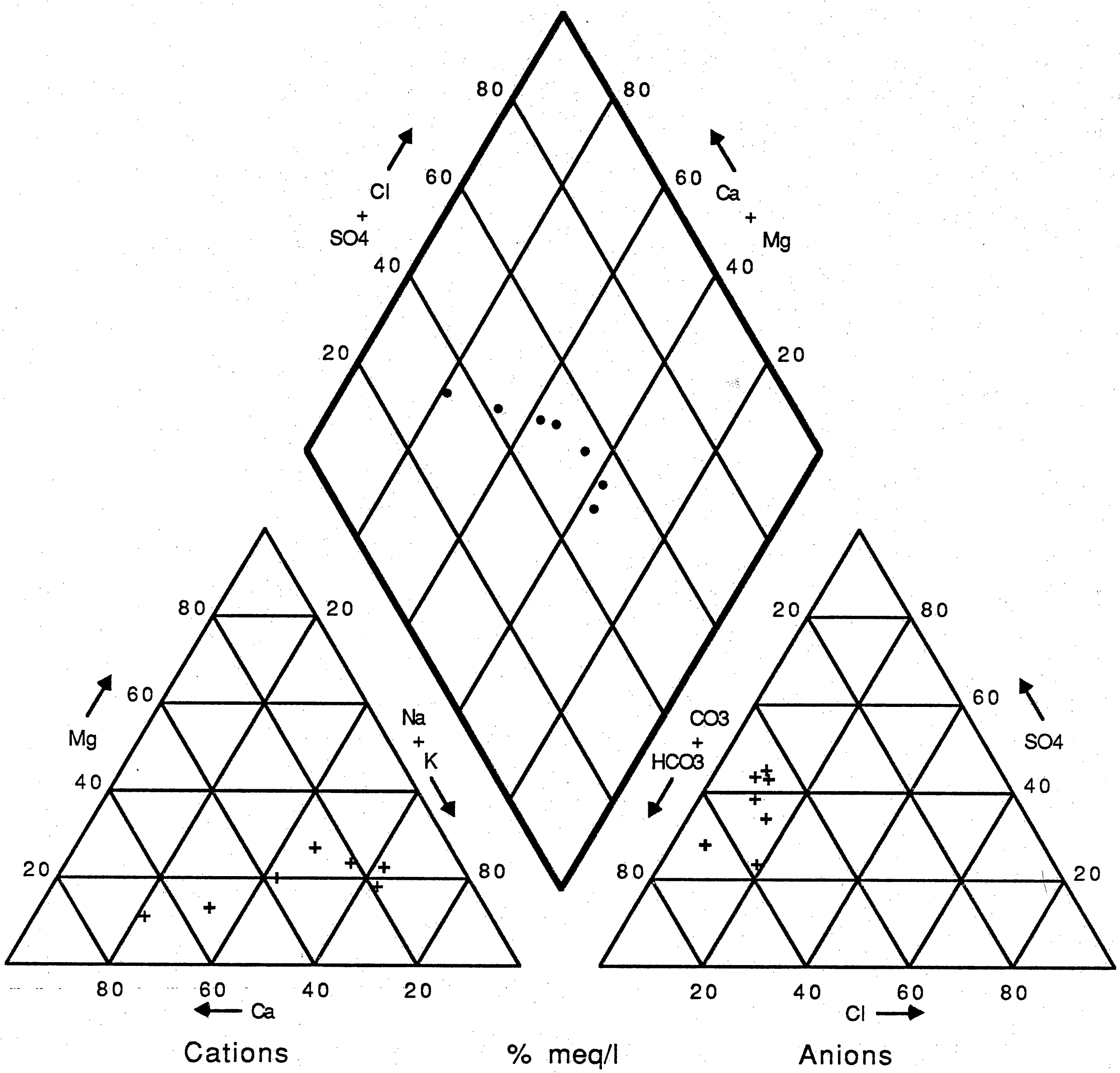

6000
5000
4000
3000
3500
3700
3900
4100
4300
4500
4700
4900
5100
5300
5500
Water Elevation (ft)
Surface Elevation (ft)
Red Light Draw
Blanca Draw
Eagle Flat East

Figure 2



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80
Cl
+
SO4
60
60
Ca
+
Mg
40
40
20
20
80
20
60
Mg
40
20
Na
+
K
80
80
60
40
20
Ca
20
80
60
SO4
CO3
+
HCO3
40
80
20
20
40
60
80
Cl
Cations
% meq/l
Anions

Figure 3

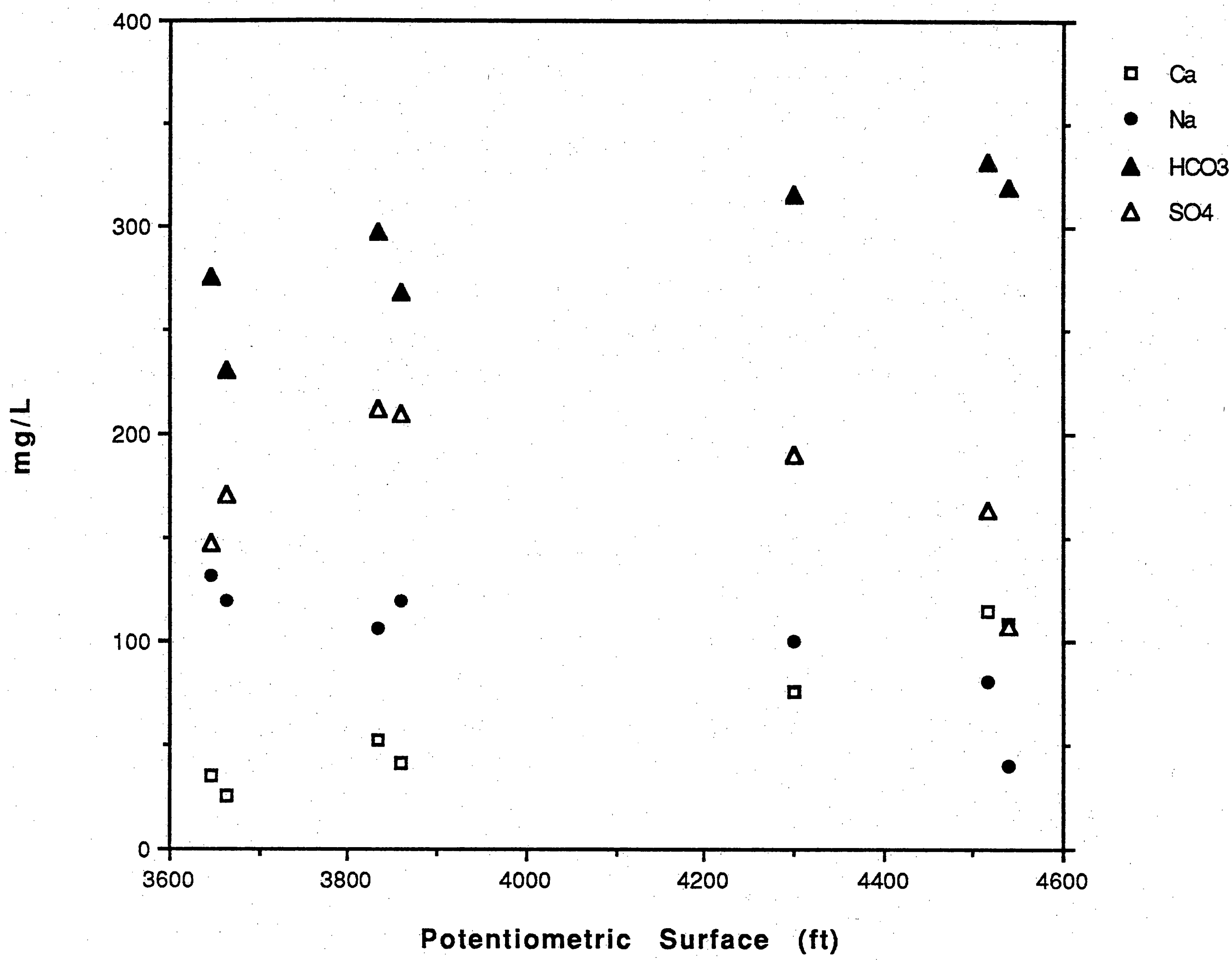
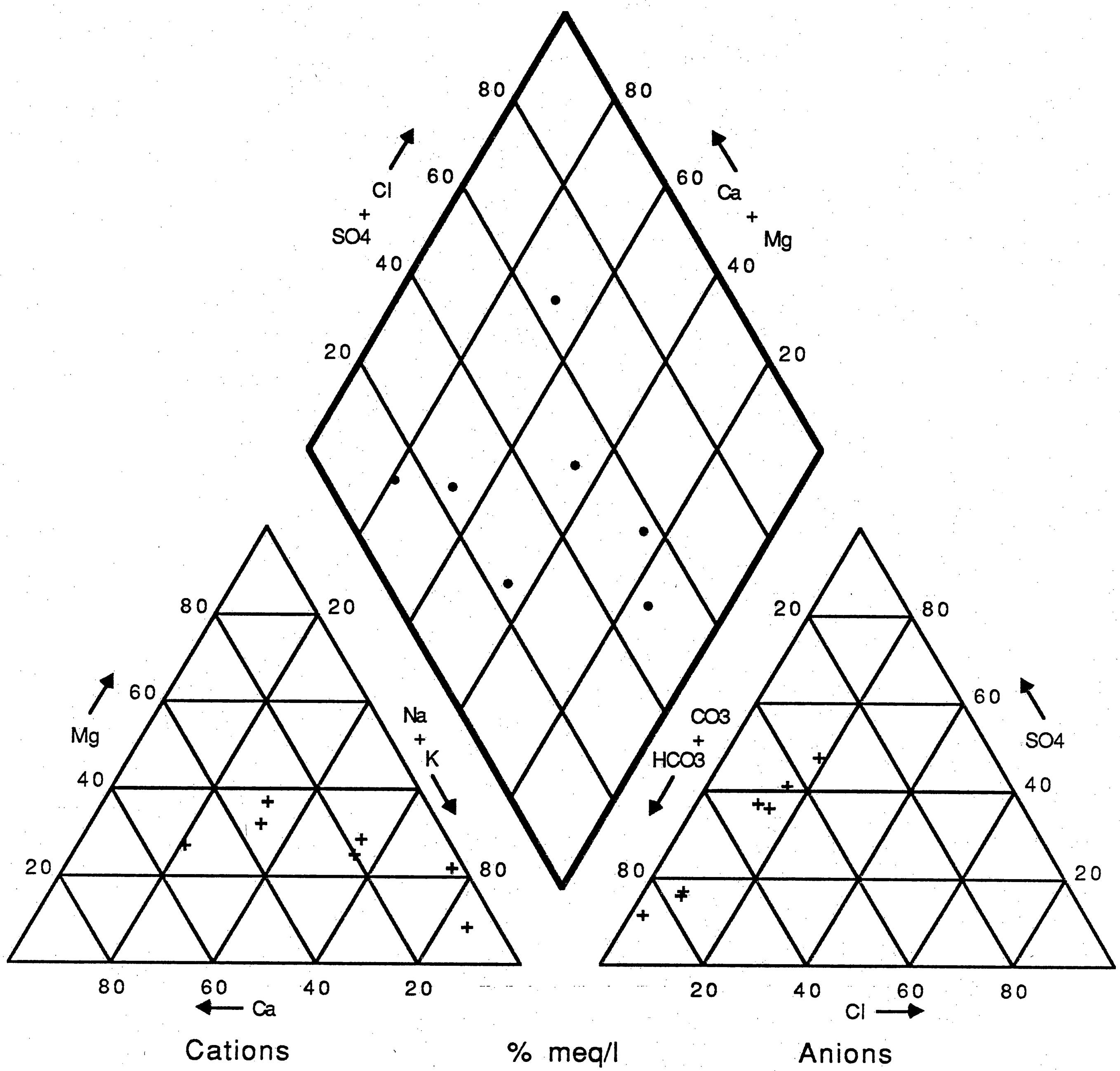

400
300
200
100
0
mg/L
3600
3800
4000
4200
4400
4600
Potentiometric Surface (ft)
Ca
Na
HCO3
SO4

Figure 4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80
Cl
+
SO4
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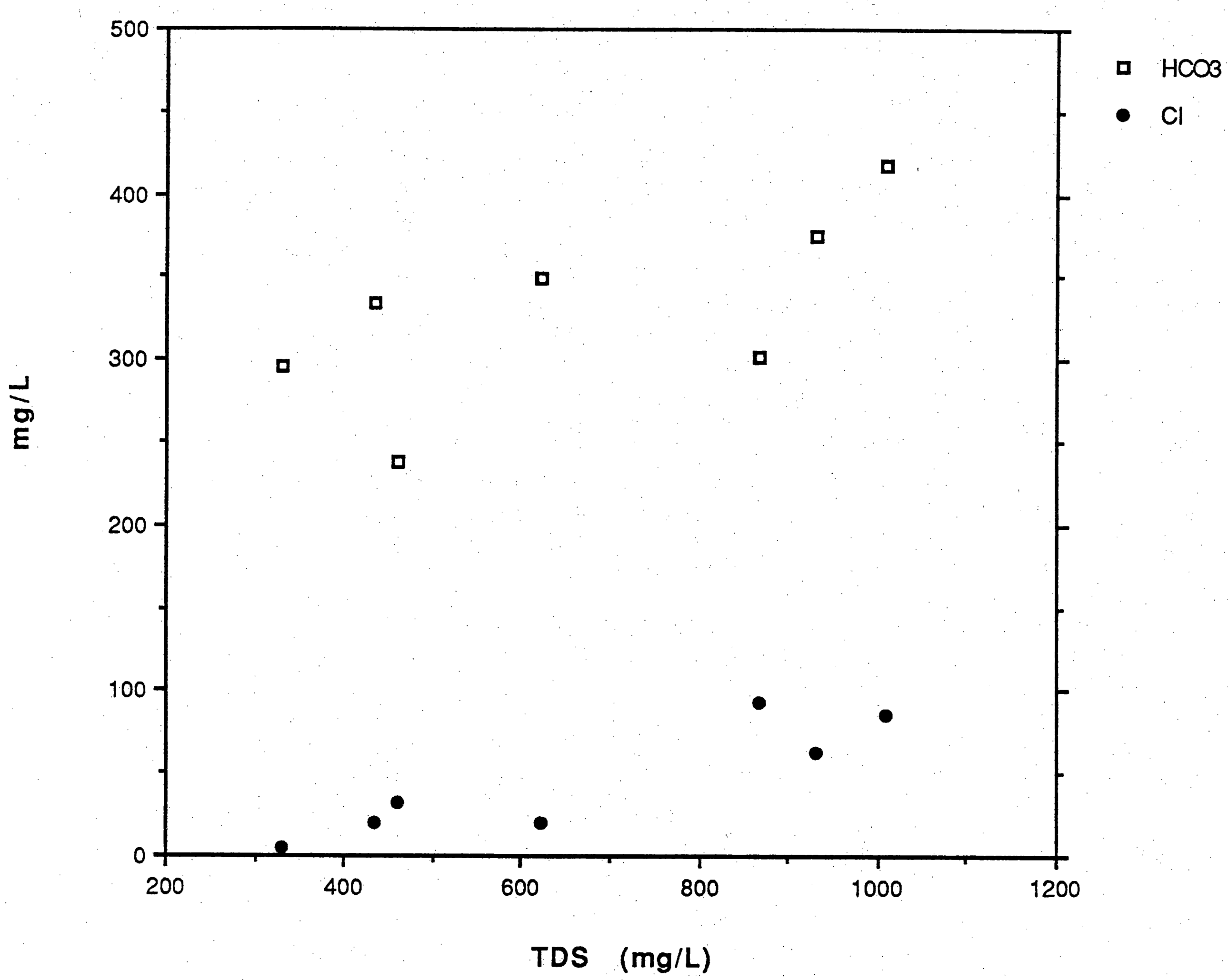
60
Ca
+
Mg
40
40
20
20
80
20
Mg
60
40
20
Na
+
K
80
80
60
40
20
Ca
Cations
% meq/l
CO3
+
HCO3
20
80
60
SO4
40
80
20
20
40
60
80
Cl
Anions

Figure 5



500
400
300
200
100
0
mg/L
200
400
600
800
1000
1200
TDS (mg/L)
HCO3
Cl

Figure 6

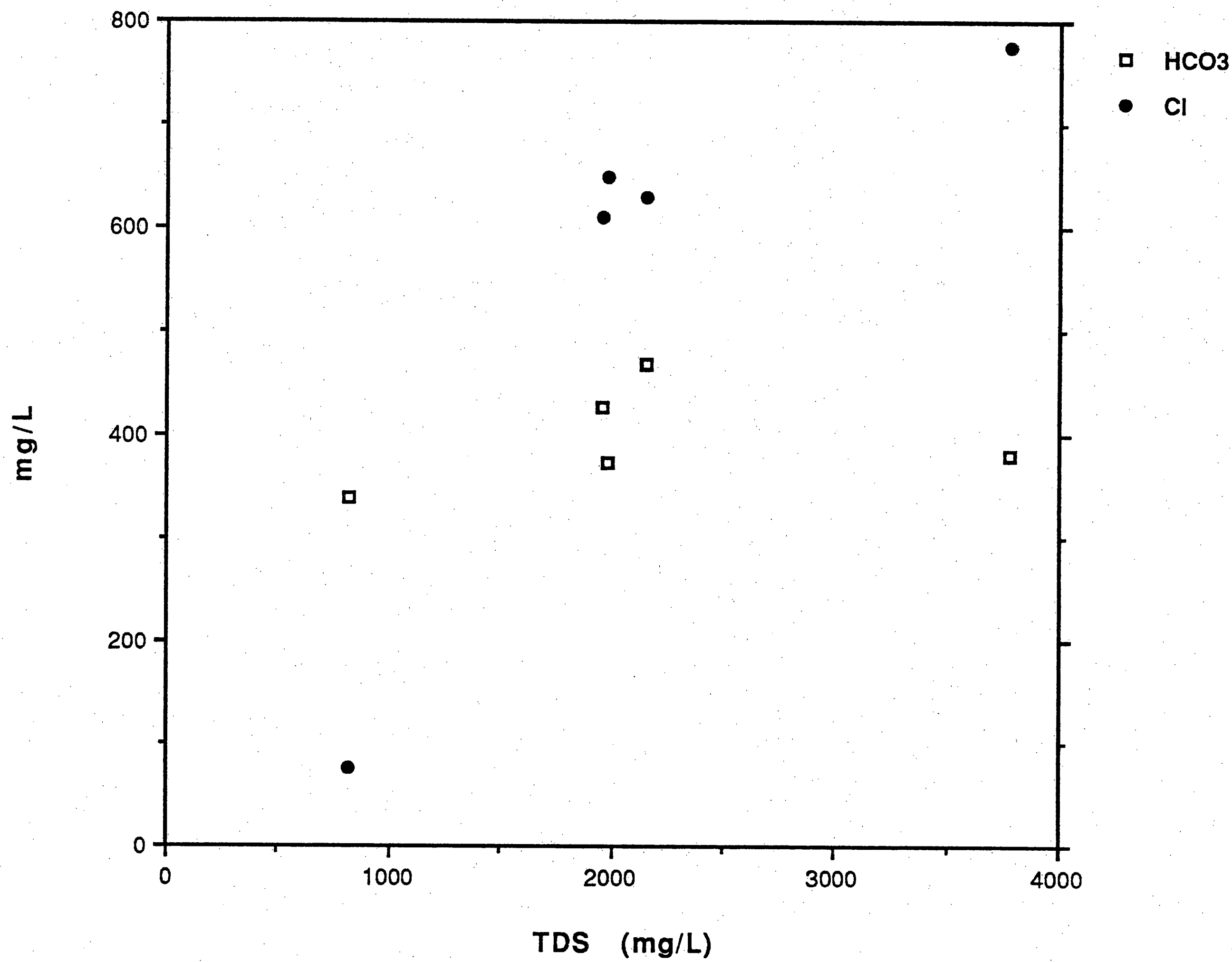


Figure 7

Table 1. Blanca Draw wells.

QUAD	COUNTY	TWD #	SURFACE ELEV. (FT)	G-WATER ELEV. (FT)	UNSATURATED THICKNESS (FT)	WELL DEPTH (FT)	STRAT. INTERVAL	TEMP (°C)	pH
Grayton Lake	Hudspeth	48-63-303	4730	4569	161	212	PCMB		
Grayton Lake	Hudspeth	48-63-302	4506	4152	354	212	PCMB	22	8
Lasca	Hudspeth	48-53-504	4643	4175	468	490	CRCS		
Lasca	Hudspeth	48-53-503	4698	4244	454	645	CRCS		
Lasca	Hudspeth	48-53-301	4993	3863	1130	1341	COX		
Sierra Blanca	Hudspeth	48-54-410	4530	3660	870	1226	COX		7.8
Sierra Blanca	Hudspeth	48-54-401	4595	3630	965	1102	CRCS		7.2
Sierra Blanca	Hudspeth								
Sierra Blanca	Hudspeth	48-54-404	4478	3668	810	1000	CRCS		
Sierra Blanca	Hudspeth	48-54-501	4445			1177	CRCS		
Sierra Blanca	Hudspeth	48-54-503	4445			1350	COX	28	7.8
Sierra Blanca	Hudspeth	48-54-701	4487	3582	905	920	COX		
Sierra Blanca	Hudspeth	48-54-602				945	CRCS		
Sierra Blanca	Hudspeth	48-54-801	4406	3486	920	945	CRCS	22	8
Sierra Blanca	Hudspeth	48-54-901	4380	3592	788	1150	CRCS		
Sierra Blanca	Hudspeth	48-54-201	4517	3628	889	947	CRCS		
Sierra Blanca	Hudspeth	48-54-202	4498	3596	902	906	CRCS		

STRATIGRAPHIC INTERVALS ARE THE FOLLOWING:
1. CRCS (CRETACEOUS SYSTEM, UNDIFFERENTIATED)
2. COX (CRETACEOUS COX SANDSTONE)

Table 1. (cont.)

	ION CONCENTRATIONS REPORTED IN MG/L									SPECIFIC	
SIO2	Ca	Mg	Na	HCO3	SO4	Cl	F	NO3	TDS	CONDUCTANCE	HARDNESS
	109	11	40	320	107	18	1.3	5	611	820	315
	115	17	81	332	164	62	1.6	4	777	1113	358
19	76	25	100	316	190	39	1.8	0.7	768	949	290
11	53	33	106	298	212	30	2.1	0.4	746	905	271
14	41	27	120	268	210	32	1.8	0.4	580	907	210
5	26	23	119	231	171	33	2.3	1.5	609	789	161
22	35	20	132	276	147	48	2.1	7.3	549	852	170

Table 2. Red Light Draw wells.

QUAD	COUNTY	TWD #	SURFACE ELEV. (FT)	G-WATER ELEV. (FT)	UNSATURATED THICKNESS (FT	WELL DEPTH (FT)	STRAT. INTERVAL	TEMP (°C)	pH
Lasca	Hudspeth	48-53-802	4695	4540	155	286	CRCS		7.5
Lasca	Hudspeth	48-53-803	4681	4516	165	357	CRCS		7.5
Lasca	Hudspeth	48-53-804	4655	4299	356	970	CRCS		7.6
Lasca	Hudspeth	48-53-902	4654	4439	215	263	CRCS		
Sierra Blanca	Hudspeth	48-61-101	5020	4751	269	442	IVIG		
Sierra Blanca	Hudspeth	48-61-201	4372	3834	538	690	CRCS	21	7.8
Sierra Blanca	Hudspeth	48-61-301	4300			766	CRCSL		
Sierra Blanca	Hudspeth	48-61-302	4280	3859	421	740	RLBL		8.2
Sierra Blanca	Hudspeth	48-61-501	4495			420	CRCS		
Sierra Blanca	Hudspeth	48-61-901	4383	4193	190	290	CRCS		
Devil Ridge	Hudspeth	48-62-501	4376				CRCS		
Devil Ridge	Hudspeth	48-62-701	4110	3662	448	525	RLBL		7.5
Devil Ridge	Hudspeth	48-62-802	4010	3645	365	540	RLBL	21	7.7
Devil Ridge	Hudspeth	48-62-805	4007			400	RLBL		
Devil Ridge	Hudspeth	48-62-806	4035	3469	566	433	CRCS		
Devil Ridge	Hudspeth	48-62-807	4095	3658	437	497	RLBL		

STRATIGRAPHIC INTERVALS ARE THE FOLLOWING
1. CRCS (CRETACEOUS SYSTEM, UNDIFFERENTIATED)
2. IVIG (INTRUSIVE IGNEOUS)
3. RLBL (RED LIGHT BOLSON)

Table 2. (cont.)

	ION CONCENTRATIONS REPORTED IN MG/L									SPECIFIC	
SIO2	CA	MG	NA	HCO3	SO4	CL	F	NO3	TDS	CONDUCTANCE	HARDNESS
	109	11	40	320	107	18	1.3	5	611	820	315
	115	17	81	332	164	62	1.6	4	777	1113	358
19	76	25	100	316	190	39	1.8	0.7	768	949	290
11	53	33	106	298	212	30	2.1	0.4	746	905	271
14	41	27	120	268	210	32	1.8	0.4	580	907	210
5	26	23	119	231	171	33	2.3	1.5	609	789	161
22	35	20	132	276	147	48	2.1	7.3	549	852	170

Table 3. Allamoore wells.

QUAD	COUNTY	TWD #	SURFACE ELEV. (FT)	G-WATER ELEV. (FT)	UNSATURATED THICKNESS (FT	WELL DEPTH (FT)	STRAT. INTERVAL	TEMP (°C)	pH	SIO2
Dome Peak	Hudspeth	48-55-901	4649	4342	307	397	PCMB			
Dome Peak	Hudspeth	48-55-902	4638	4487	151	190	PCMB	20	7.9	30
Dome Peak	Hudspeth	48-55-903					CRCS		8.3	27
Bean Hills	Hudspeth	48-56-802	4655	4588	67	186	PCMB			
Bean Hills	Hudspeth	48-56-803	4757	4683	74	130	PCMB			
Allamoore	Hudspeth	48-64-301	4676	4525	151	200	PCMB			
Allamoore	Hudspeth	48-64-302	4560	4402	158	193	PCMB			
Allamoore	Hudspeth	48-64-501	4388	4158	230	477	BLSN			
Allamoore	Hudspeth	48-64-601	4511	4337	174	177	BLSN			
Allamoore	Hudspeth	48-64-603	4442	4325	117	220	BLSN			
Allamoore	Hudspeth	48-64-605	4556	4383	173	236	BLSN			
Allamoore	Hudspeth	48-64-901	4271	3661	610	1001	BLSN			
Allamoore	Hudspeth	48-64-602	4538	4348	190	239	BLSN			
Hackett Peak	Hudspeth	47-57-401	4526	4420	106	257	PCMB	19	8.5	28
Hackett Peak	Hudspeth	47-57-403	4526	4420	106	110	PCMB			
Hackett Peak	Hudspeth	47-57-502	4598	4578	20	80	PCMB			
Hackett Peak	Hudspeth	47-57-501	4521	4446	75	400	PCMB			
Hackett Peak	Hudspeth	47-57-902	4364	4323	41	200	PCMB			
Hackett Peak	Hudspeth	47-57-803	4380	4329	51	335	PCMB			
Hackett Peak	Hudspeth	47-57-801	4578	4548	30	160	PCMB			
Hackett Peak	Hudspeth	47-57-703	4560	4512	48	180	PCMB			
Hackett Peak	Hudspeth	57-57-701	4470	4421	49		PCMB			
Eagle Mtns. N.E	Hudspeth	50-08-103	5105	5040	65	112	CRCS			
Eagle Mtns. N.E	Hudspeth	50-08-102	4761	4757	4		CRCS			
Eagle Mtns. N.E	Hudspeth	50-08-101	4944	4862	82	237	CRCS			
Eagle Mtns. N.E	Hudspeth	50-08-201	4762	4725	37	90	BLSN			
Eagle Mtns. N.E	Hudspeth	50-08-202	4762	4729	33	40	BLSN			

STRATIGRAPHIC INTERVALS ARE THE FOLLOWING:

1. BLSN (BOLSON FILL)
2. CRCS (CRETACEOUS SYSTEM, UNDIFFERENTIATED)
3. PCMB (PRECAMBRIAN)

Table 3. (cont.)

ION CONCENTRATIONS REPORTED IN MG/L									SPECIFIC	
Ca	Mg	Na	HCO3	SO4	Cl	F	NO3	TDS	CONDUCTANCE	HARDNESS
61	19	28	296	31	4.7	0.6	10.0	330	531	230
54	30	59	349	61	20	0.9	20.5	621	800	261
91	66	106	302	328	93		11.0	868	1330	498
10	8.2	151	238	135	32		6.9	460		
8	45	290	418	310	86	5.8	8.9	1010	1550	200

Table 4. North Eagle Mountains.

QUAD	COUNTY	TWD #	SURFACE ELEV. (FT)	G-WATER ELEV. (FT)	UNSATURATED THICKNESS (FT)	WELL DEPTH (FT)	STRAT. INTERVAL	TEMP (°C)	pH
Grayton Lake	Hudspeth	48-63-303	4730	4569	161	212	PCMB		
Grayton Lake	Hudspeth	48-63-302	4506	4152	354	212	PCMB	22	8
Grayton Lake	Hudspeth	48-63-701	4219						
Grayton Lake	Hudspeth	48-63-802	4314	4193	121	124	CRCS		
Grayton Lake	Hudspeth	48-63-803	4532	4507	25	213	CRCS		
Grayton Lake	Hudspeth	48-63-902	4757	4530	227	238	BLSN	21	8.2
Bass Canyon	Hudspeth	51-01-301	4242	4202	40	80	ALVM		
Bass Canyon	Hudspeth	51-01-502	4147	3662	485	500	BLSN		
Bass Canyon	Hudspeth	51-01-503	4166	3685	481	530	BLSN		

STRATIGRAPHIC INTERVALS ARE THE FOLLOWING:
1. PCMB (PRECAMBRIAN)
2. CRCS (CRETACEOUS SYSTEM, UNDIFFERENTIATED)
3. BLSN (BOLSON FILL)
4. ALVM (ALLUVIUM)

Table 4. (cont.)

	ION CONCENTRATIONS REPORTED IN MG/L									SPECIFIC	
SIO2	Ca	Mg	Na	HCO3	SO4	Cl	F	NO3	TDS	CONDUCTANCE	HARDNESS
26	43	43	156	375	216	63	2.1	6.9	931	1350	285
37	30	23	94	334	55	20	2.8	8	434	678	170