HYDROLOGIC ASSESSMENT OF THE SALT LAKES AREA

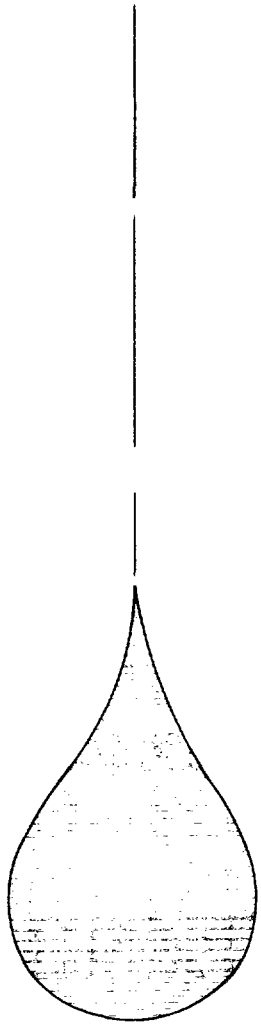
WESTERN LEA COUNTY, NEW MEXICO

by

Geohydrology Associates, Inc.

for

Pollution Control, Inc.
Lovington, New Mexico



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T. E. Kelly

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In February 1969, Pollution Control, Inc., of Hobbs, New Mexico, requested that a hydrologic study be conducted in the vicinity of the salt lakes in western Lea County, New Mexico. The study was conducted by Ed L. Reed of Midland, Texas. The purpose of this study was to determine the suitability of Laguna Gatuna, Laguna Plata, and Laguna Tonto as sites for disposal of oil-field brine. The results of the work by Mr. Reed were presented on a single illustration (Plate 1), and his interpretations were largely contained in his testimony before the New Mexico Oil Conservation Commission. This testimony and cross examination were presented at the March 19, 1969, regular hearing of the Commission, Case No. 4047.

Approval of the application was granted by the Commission on April 16, 1969, as Order No. R-3725 (Appendix A).

In December 1983, Pollution Control, Inc., requested that Geohydrology Associates, Inc., of Albuquerque, New Mexico, review that original work of Mr. Reed and prepare an update of that work. The purpose of this study was (1) to provide documentation for expansion of the original disposal system, and (2) to request a variance in order to dispose of other oil field waste products in addition to brine.

The present study was based on a thorough literature and file search of existing data; it also drew heavily from earlier reports by Geohydrology Associates, Inc. (GAI) which were prepared for the Bureau of Land Management, the Sandia Corporation, and other clients. A field reconnaissance was made which included a visual inspection of the area of Ts. 19 and 20 S., Rs. 32 and 33 E. Well data was collected for a somewhat larger area (fig. 1). An analysis of these data and the resulting conclusions are presented in this report.

GEOLOGY OF THE PROJECT AREA

A number of studies of the geology of western Lea County have been made. These include the work by King (1942), Vine (1963), and Brokaw and others (1972). Studies related to water resources in the area include Hendrickson and Jones (1952), Nicholson and Clebsch (1961), and Geohydrology Associates, Inc. (1978, 1978a, 1979). Mercer and Gonzalez (1981) and Mercer (1983) evaluated the hydrologic conditions in the vicinity of the Waste Isolation Pilot Plant (WIPP) which is located only a few miles south of the project area.

There are three formations in the vicinity of the salt lakes and Laguna Gatuna that are directly concerned by this study. These are the Dewey Lake Redbeds, the Triassic deposits, and the surficial alluvial material (fig. 2). In addition, imported water from the Ogallala Formation is widely used in the project area.

Logs of test holes drilled in the area are included in Table 1.

Geologic Structure

The basic tectonic structure of the salt lakes area is a simple homoclinal dip of about 2^{o} to the east which developed mainly in pre-Pliocene

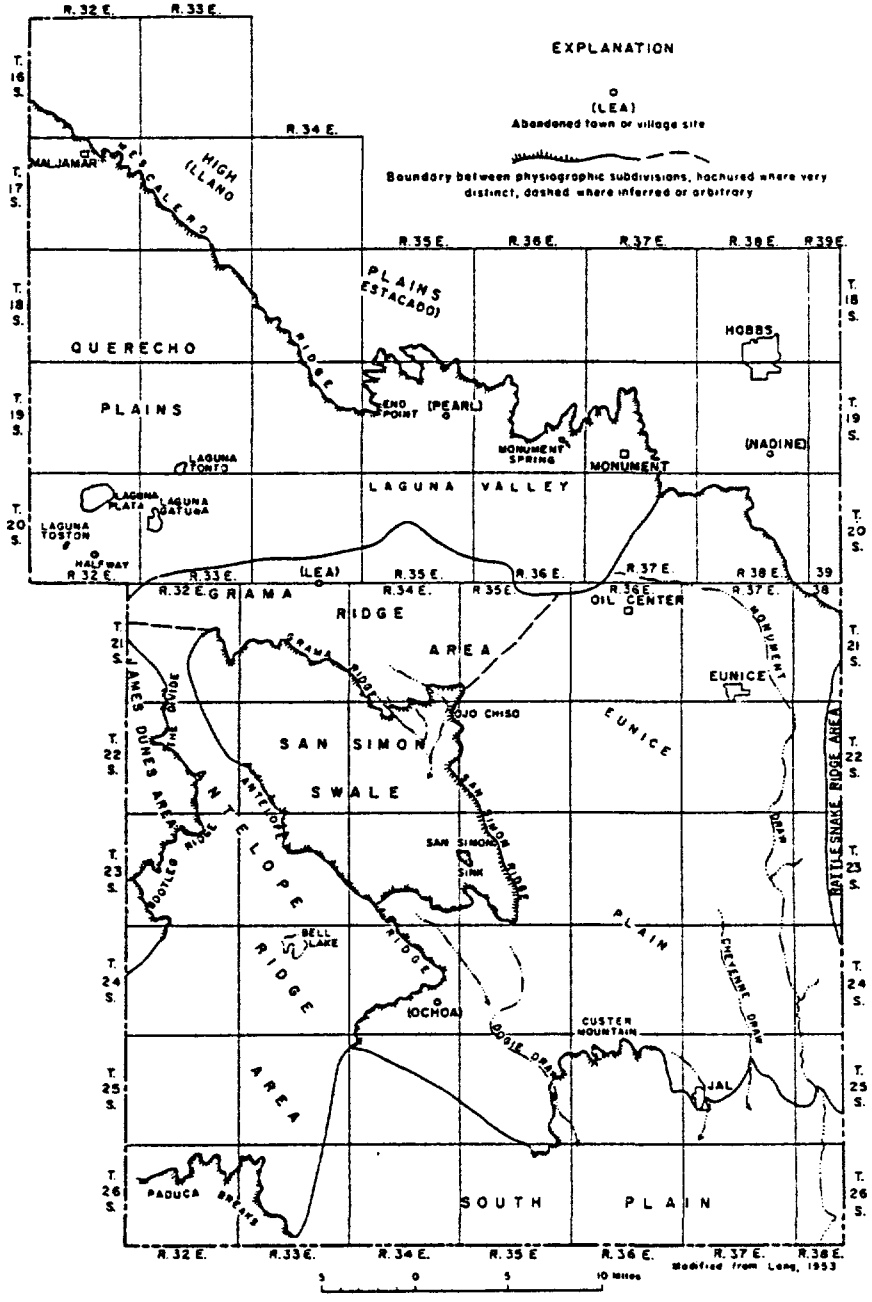

Figure 1.--Map of southern Lea County showing location of project area (Nicholson and Clebsch, 1961, p. 8).

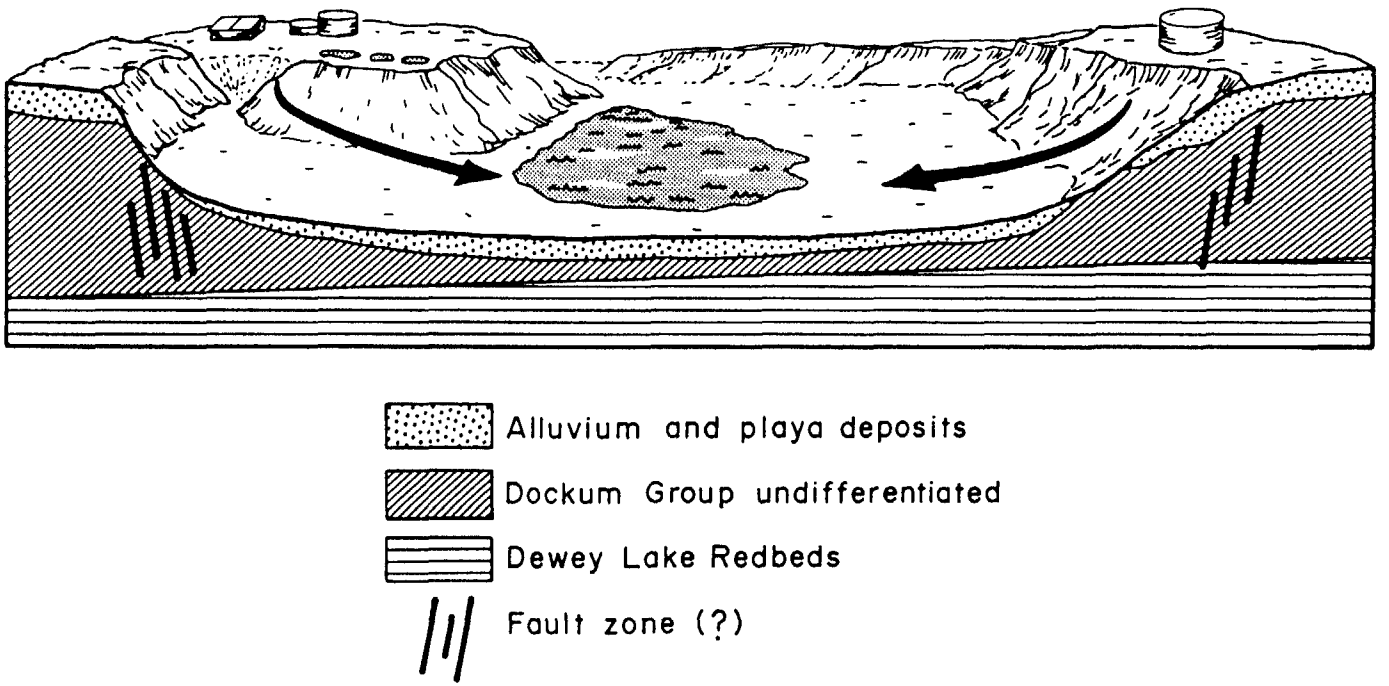

Figure 2.--Diagrammatic section of Laguna Gatuna showing geologic features.

Table 1.--Sample logs and descriptions of test holes in project area.

Top and Thickness figures are given in feet.

Well 19.21.29.32; drilled November 8, 1978.

Top	Thickness	Description
0	11	caliche, white, moderate to strong formation
11	19	sand, brown-buff, unconsolidated aeolian, medium to fine texture
30	10	sand, buff, fine texture, weakly consolidated
40	10	as above, but lighter in color and has some silty laminae, small caliche nodules
50	10	shale, maroon, clayey, has greenish gray inclusions (elongated), concentrated along bedding, slightly moist
60	10	as above, but fewer greenish inclusions and contains rounded limestone fragments (aphanitic, red)
70	10	shale, variegated red-buff, very clayey, also has limestone fragments mentioned above
80	10	limestone, crystalline (fine), mottled maroon to gray, has a few laminae of grayish-green, silty shale
90	10	limestone, fine crystalline, silty, maroon, has some greenish gray silty shale laminae and some minor clayey shale (red) laminae

Total Depth - 100'

Wet sediments encountered at 50'
Bailing test - dry ?
Casing perforated - 80-100' below LSD
Footage subtotal - 2,610'
Footage subtotal - 2,610'
Dry, March 15, 1979

Table 1, continued.

Well 20.31.2.34; drilled November 13, 1978.

Top	Thickness	Description
0	6	sand, buff, medium-fine texture (aeolian)
6	6	caliche, white medium formation
12	8	sand, brownish-buff medium-fine texture, secondary carbonate cement
20	10	shale, reddish brown, clayey
30	10	shale, brown, silty, has a bed of green silty shale
40	10	shale, reddish brown, silty
50	10	shale, brown,silty, has greenish gray inclusions
60	10	shale, maroon, silty, has clayey laminae, greenish gray laminae
70	10	shale, brown, silty
80	15	shale, maroon-brown, silty
95	8	limestone, mottled gray-white, red, fine crystalline
103	7	shale, brown, clayey-silty greenish gray inclusions
110	20	shale, brown, clayey
130	10	as above, but with minor laminae of green silty shale
140	10	shale, reddish brown, silty-sandy, has a bed of green silty shale, slightly moist
150	10	sandstone, brown, medium-fine texture, calcareous cement

Total Depth - 160'

Bailing test - estimates less than 1 gpm
Encountered moist sediments - 145' below LSD
Water level - 150' below LSD
Measurement: January 19, 1979: Water level - 137.0' below LSD

Table 1, continued.

Well 20.31.17.33; drilled November 14, 1978.

Top	Thickness	Description
0	12	caliche, white-gray medium to strong formation
12	9	sand, brown, medium-fine texture, calcareous cement
21	11	shale, reddish brown silty
32	8	shale, brown, silty with clayey laminae
40	9	shale, brownish red, clayey, with silty laminae and greenish gray silty laminae
49	11	shale, brown, clayey, has greenish gray laminae and is fissile with micaceous partings
60	10	shale, reddish brown, clayey
70	18	shale, dark brown, very clayey, has chloritic partings, has laminae of green clayey shale
88	20	shale, brown, silty, has greenish gray inclusions
108	20	as above, but more clay
128	20	as above, but has laminae of greenish-gray silty-clayey shale
148	12	shale, reddish brown, silty, has clayey laminae
160	10	as above, but no clay
170	10	shale, brown, silty, has clayey laminae, has green clayey laminae, has fine crystalline gray anhydrite laminae
180	10	shale, reddish brown, silty has some green inclusions has some laminae of clear satin spar gypsum
190	10	shale, reddish brown, clayey, has some fine crystalline gray anhydrite
200	10	shale, reddish brown, silty, has greenish gray inclusions, has some thin clear satin spar gypsum
210	20	as above, but has some gray fine crystalline anhydrite
230	10	as above, but has some greenish gray inclusions and some clayey laminae

Total Depth - 240'

Bailing results - estimates ½ gpm
Casing perforations - 220-240' below LSD

Measurement: March 1, 1979: Water level - 227.0' below LSD

Table 1, continued.

Well 20.31.27.24; drilled November 1, 1978.

Top	Thickness	Description
0	4	sand, brownish-buff, fine to medium
4	8	strong caliche formation forms thick continuous bed
12	16	sand, dark brown, medium texture, slightly calcareous from overlying carbonate mineralization
28	12	as above, but less calcareous and finer texture
40	11	shale, dark reddish brown, very clayey
51	10	sandstone, greenish gray, fine to medium texture, with a lens of very clayey green shale
61	10	as above, but with lenses of mottled brown and green fine sandstone
71	9	shale, reddish brown, texture mostly coarse silt but with lenses of very clayey brown shale
80	10	as above, but with no clayey lenses
90	20	shale, silty, reddish brown. minor clayey laminae
110	14	shale, brownish red, silty with clayey laminae
124	7	shale, reddish brown, clayey, slightly silty
131	10	shale, reddish brown, silty
141	9	shale, reddish brown, silty with some clayey laminae and some greenish gray silty laminae

Total Depth - 150'

Casing perforated - 130-150' below LSD
Bailing test - 3-4' water in hole after casing placement-bailer removed it in 4 trips (producing less than 1 gpm)
Measurement: February 28, 1979: Water level - 114' below LSD

Table 1. continued.

Well 20.31.30.44; drilled October 31, 1978.

Top	Thickness	Description
0	10	sand, caliche, very strong, constituting major volume of sample, buff
10	10	sandstone, reddish brown, calcareous, calcite cement from strong caliche profile above
20	7	sandstone, fine to medium texture, mottled brownish red to gray (gray grains inside red) non- calcareous
27	21	as above, but containing minor lenses of red silty shale and greenish-white siltstone
48	3	shale, silty, bluish-green
51	8	resumes characteristics of silty sandstone, see above
59	11	dolomitic sandstone, silty, mottled brown to greenish gray; thin lenses show vigorous effervescense
70	10	silt, reddish brown, unconsolidated except minor lenses which have some clay and are darker in color, slightly calcareous
80	20	siltstone, reddish brown, slightly calcareous, moderate consolidation
100	10	shale, red, silty, with some minor laminae of greenish gray shale (silty)
110	8	shale, mottled brown to gray, silty with notable laminae of dark reddish brown zones of very clayey composition
118	17	silt, reddish brown, very loosely consolidated
135	8	shale, brown, very clayey
143	7	shale grayish, green, clayey, loosely consolidated in silt strata
150	50	shale, reddish brown, very clayey
200	10	shale, dark brown subequal amounts of silt and clay with some thin layers of green claystone
210	10	shale, brown, silty
220	10	as above, but containing minor lenses of green siltstone
230	10	shale, brown, silty
240	10	as above, but with minor lenses of green siltstone
250	20	shale reddish brown, clayey thin lenses of green siltstone, traces of satin spar gypsum concentrated in bedding (white to clear)
270	10	as above, but with traces of selinite gypsum (clear)
280	20	shale, reddish brown, clayey, laminae of satin spar gypsum, has a small number of limestone fragments (white)
300	8	shale, red, silty has thickish laminae of satin spar gypsum and minor amounts of greenish gray anhydrite, fine crystalline
308	12	shale, brownish red, clayey small amounts of greenish gray anhydrite

Total Depth - 320'

Casing perforated - 300-320' below LSD
Water standing in well upon completion - 3-4' (316' below LSD)
Bailing test - negligible
Measurement: February 27, 1979: Water level - 228' below LSD

Table 1, continued.

Well 20.32.17.13; drilled November 8, 1978.

Top	Thickness	Description
0	3	sand, fine buff-brown aeolian, 3" organics
3	10	calcareous ooze, white (lacustrine)
13	7	as above, but with sand laminae, calcified (caliche)
20	15	sandstone, brown, fine texture, loosely consolidated
35	5	shale, brown, sandy, silty, has gypsum, selenite and fine crystalline (gray)
40	10	shale, reddish brown, clayey with silt, has green clayey laminae
50	10	shale, reddish brown, silty with clay, has green silty laminae
60	23	as above, but reddish color
83	7	shale, brown, silty, has greenish-gray silty laminae
90	10	shale, brown, sand (fine)

Total Depth - 100'

Casing perforated - 20-40' below LSD
Bailing test - estimates 15 gpm
Encountered water at 18' below LSD
Water very salty (maybe with potassium)

Measurement: February 28, 1979; Water level - 9' below LSD

Table 1, continued.

Well 20.32.22.33; drilled November 8, 1978.

Top	Thickness	Description
0	3	sand, brownish-buff, medium-fine texture (aeolian) 6" organic profile
3	9	caliche, white, medium to strong formation
12	18	sand, pinkish buff, medium-fine texture, calcareous cement
30	10	shale, brown, clayey with laminae of greenish-gray medium crystalline, anhydrite
40	20	shale, brown, silty
60	10	shale, red-brown, silty, clayey, has minor amount thin laminae of green silty shale
70	10	as above, but no green shale
80	20	shale, red-brown, clayey with laminae of green clayey-silty shale
100	10	as above, but no green shale
110	30	shale, brown, silty
140	10	shale, brown-silty, clayey, has laminae of gray silty shale
150	10	shale, brown, clayey, has laminae of greenish gray silty shale
160	10	shale, reddish brown, silty-clayey, has greenish gray inclusions, has small nodules of maroon limestone

Total Depth - 170'

Driller encountered water at 35' (probably perched brine from Laguna Toston)
Casing perforated - 150-179' below LSD
Bailing results - estimates 12-15 gpm
Tastes fresh

Measurement: February 28, 1979: Water level - 30' below LSD

Table 1, continued.

Well 20.32.31.13: drilled November 8, 1978

Top	Thickness	Description
0	10	sand, buff medium to fine texture, moderate caliche formation
10	13	sand, brown-buff, fine to medium texture, leached carbonate
23	13	shale, reddish brown, silty with clayey laminae
36	4	shale, greenish gray, silty, sandy
40	30	shale, brown, silty-clayey shale, reddish brown
70	10	silty-clayey, has a bed of greenish-gray siltstone
80	20	shale, brown, clayey
100	20	as above, but more silt
120	30	shale, brown, clayey, interbedded with limestone, brown, fine crystalline
150	10	shale, brown, clayey-silty
160	10	as above, but reddish brown
170	10	shale, brown, silty-clayey, has zones of superior cementation along bedding, probably calcite
180	10	shale, brown, clayey, fairly cohesive from cementation
190	10	shale, brown, varigated clayey to silty, has greenish gray inclusions
200	20	shale, greenish to gray, silty, interbedded with brown silty shale
220	20	shale, reddish brown silty zones of calcite cementation along bedding
240	10	shale, reddish brown, clayey

Total Depth - 250'

Water level-drilled dry, never encountered moist sediments
Casing perforated - 230-250' below LSD
Bailing results - bailing showed about 8' water in hole (probably residual from drilling) - dry ; DTW 135.12' March 15, 1979

Table 1, continued.

Well 21.29.2.14; drilled November 16, 1978.

Top	Thickness	Description
0	5	sand, brown-buff, medium-fine texture (aeolian) has 3-6" of organics
5	15	caliche, white, formed in sand, medium formation
20	10	sand, brownish buff, medium-fine texture, sub-angular to rounded quartz grains
30	10	as above, but has some pebbles (quartz) 6 mm in diameter
40	20	as above, but pebbles increase in size to 1.5 cm
60	10	sand, reddish brown medium-fine small quartz pebbles
70	10	shale, red clayey
80	20	shale, red, clayey-silty, has laminae of greenish gray clayey shale and greenish gray inclusions
100	20	as above, but no inclusions green-gray laminae
120	10	shale, red, silty with clayey laminae
130	20	as above, but has greenish gray inclusions
150	10	shale, brownish-red, silty, clayey
160	10	shale, reddish brown, clayey, has greenish gray inclusions
170	10	as above, but silty
180	10	shale, brown, clayey, has greenish gray inclusions
190	20	as above, but reddish brown and silty
210	10	shale, brown, silty, has same greenish gray inclusions
220	10	as above, but very loosely consolidated
230	10	shale, red, silty
240	20	as above, but has some clay, has greenish gray inclusions
260	34	gypsum, light gray, fine crystalline
294	21	shale, red, silty-clayey, has greenish gray inclusions
315	25	gypsum, white, aphanitic, has laminae of silty red shale
340	10	as above, but gypsum is light gray
350	16	above, but no shale
366	24	shale, light red, silty, has laminae of gypsum, light gray to white, fine crystalline, gypsum in small rounded fragments, well mixed
390	40	as above, but redder in color (mixture of red clayey shale and gypsum)
430	30	mixture of red shale, silty-clayey, gypsum, soft dark gray, fine crystalline, also has selenite gypsum in small amounts

Total Depth - 460'

Bailing results - estimates more than 20 gpm
Casing perforated - 420-460' below LSD
Water level - 350' below LSD
Water tastes salty

Measurement: March 1, 1979: Water level 273.0' below LSD

Table 1, concluded.

Well 21.31.3.22; drilled November 9, 1978.

Top	Thickness	Description
0	18	caliche, white, moderate to strong formation
18	12	sand, brown-buff, medium-fine texture, calcareous cement
30	10	shale, buff-red, silty, calcareous laminae
40	10	shale, red, clayey with some silt
50	10	shale, mottled red, greenish gray, has sandy laminae but mostly silt
60	10	shale, brown, silty, with clayey laminae, has greenish gray inclusions
70	10	shale, reddish, brown, silty, has good cement, some laminae (calcite) (these laminae are gray-red)
80	10	as above, but subequal amounts of silt and clay
90	10	shale, red, silty, ahs clayey laminae
100	20	shale, brownish red, silty, has laminae with calcite cement
120	10	as above, but more calcite zones (mineralized with crystalline calcite)
130	10	shale, brownish red, silty
140	10	as above, but has clayey laminae
150	10	shale, brownish red, silty, has calcite mineralized laminae
160	10	shale, red, clayey, has laminae of silty greenish gray shale
170	10	shale, reddish brown, silty
180	10	as above, but has laminae of greenish gray shale
190	10	shale, brownish red, subequal amounts of silt and clay, has greenish gray laminae, silty

Total Depth - 200'

Driller encountered water at 150' below LSD
Casing perforated 140-160' below LSD
Bailing results - estimates 8 gpm
Water level on completion - 128' below LSD
Measurement: February 28, 1979: Water level - 142' below LSD

time. It is superimposed on Permian and Delaware basins. The more complex surficial structure near Nash Draw exerts a more immediate effect on the hydrology of the area. This area is typified by collapse of the Rustler Formation and overlying beds due to solution within the Rustler and at the top of the Salado Formation. Beds of the Rustler generally dip toward the larger depressions (Vine, 1963). In addition, hydration of anhydrite to gpysum causes localized doming. Sinkholes and domes influence the direction of ground-water movement, which in turn controls the development of collapse structures.

It is possible that the salt lakes of Laguna Gatuna, Laguna Plata, Laguna Tonto, and Laguna Toston occupy collapse structures associated with a northeastward extension of the "brine aquifer". Robinson and Lang (1938) described the "brine aquifer" as an important conduit of natural brine beneath Nash Draw. However, recent work at the WIPP site has shown that ". . . along the eastern side, the boundary is very irregular and in places extends farther east than previously indicated by Robinson and Lang " (Mercer, 1983, p. 50). Likewise, these depressions are located in a geographic location very similar to other depressions, sinks, and collapse structures in southeastern New Mexico and west Texas (Anderson, 1981, fig. 2). A hydraulic connection between the "brine aquifer" and the salt lakes would explain the origin of the depressions and the presence of highly mineralized spring discharge along the boundary of Laguna Gatuna and Laguna Plata.

Dewey Lake Redbeds

The Dewey Lake Redbeds underlie all of the project area (Brokaw and others, 1972), but they have not been identified in surface exposures. These deposits consist entirely of siltstone and fine-grained sandstone. The reddish-orange

to reddish-brown sandstone and siltstone are thinly laminated with very small scale cross-laminae. Ripple marks are present in the upper part of the formation. No evaporite deposits have been reported in the Dewey Lake sequence which is locally 500 feet thick. Although the Redbeds are not generally considered to be an aquifer, it is possible that some wells located north and east of the salt lakes may produce small quantities of water from these deposits.

Dockum Group, Undifferentiated (Triassic)

The Dockum Group unconformably overlies the Dewey Lake Redbeds (Brokaw and others, 1972). In some areas this Group is divisible into the Santa Rosa Sandstone and the Chinle Formation; however, the distinction cannot be made in western Lea County because of lithologic similarities and poor exposures (Nicholson and Clebsch, 1961, p. 35). Reed simply referred to these deposits as "Triassic" (plate 1).

Coarse-grained clastic deposits in the Dockum Group are generally fine to coarse-grained sandstone with minor shale layers. Locally these deposits range from siltstone to conglomerate. Although red is the predominant color, white, gray, and greenish-gray sands are present. Red and green claystone may be present in the eastern part of the project area.

The Dockum Group is exposed at several locations around the perimeter of Laguna Gatuna. Some of these were originally mapped by Reed; others have subsequently been exposed by highway construction, particularly on the south and east sides of the playa.

According to Hendrickson and Jones (1952, p. 75), the Dockum Group and underlying Dewey Lake Redbeds produce water to wells in eastern Eddy County. Also, Reed (1969) assumed that most of the wells in the vicinity of the salt lakes produce from the Triassic rocks.

Alluvium and Playa Deposits

The surficial deposits are composed mostly of locally derived sediments, including reworked Dockum and fragments of caliche and gypsum. Dune sands are common in the northern part of the project area and along the boundaries of the salt lakes. The sand is fine to medium grained and unconsolidated; it is present throughout the area, but in most areas has been stabilized by mesquite and other vegetation.

Playa deposits generally consist of fine sand, silt, and clay that has been reworked by intermittent lakes that are present after heavy rainfall. The interior of Laguna Gatuna and Laguna Plata contain abundant gypsum crystals and other salt deposits.

There is no evidence that the alluvium or playa deposits are water bearing. According to Nicholson and Clebsch (1961, p. 59), ". . . there does not seem to be a continuous saturated zone in the thin cover of alluvium. . ." of western Lea County. They attribute this to the limited precipitation in the area, and to the permeability of the Dockum Group which underlies the alluvium.

Ogallala Formation

The Ogallala is the principal water-bearing formation in southeastern New Mexico and much of eastern Lea County. The western edge of the formation is locally known as The Caprock or Mescalero Ridge which is approximately 11 miles northeast of Laguna Gatuna (fig. 1). Although the Ogallala Formation is not present in the vicinity of salt lakes, water from the Formation is piped across the area by potash refineries located in Nash Draw.

As a concession for right-of-way for the pipelines, most ranch owners obtained the right to tap these water lines for normal ranching operations. The

Snyder Ranches have made extensive use of this water source north of Highway 62-180. According to Mr. Smith at the Bingham Ranch, all of the water used south of the highway is obtained from the Kerr-McGee pipeline. Consequently, many of the windmills in the area are no longer in use and have fallen into disrepair. Some of the wells in use during Reed's 1969 study are no longer serviceable.

Potable water was reported by Reed near Halfway in section 23, T. 20 S., R. 32 E., and also from two wells located in sections 17 and 18, T. 19 S., R. 33 E. However it should be noted that the wells at Halfway have been abandoned since the Reed report has been completed. The two wells in sections 17 and 18 are used only for stock watering.

In his testimony before the Oil Conservation Division, Case No. 4047 on March 19, 1969, Mr. Larry C. Squires stated that there was no fresh water in the vicinity of the salt lakes.

Although somewhat brackish water can be used for stock watering, most of the water near Laguna Gatuna would be classified as brine. Spring samples collected by Reed contained sulfate concentrations greater than 11,000 ppm (parts per million) and chloride concentrations greater than 7,400 ppm. One spring at Laguna Gatuna (Reed's No. 55) contained 37,979 ppm sulfate and 27,657 ppm chloride. A 1969 sample from the bed of the playa contained 125,000 ppm sulfate and 158,000 ppm chloride.

The origin of these brines in Laguna Gatuna are difficult to explain. Although potash refiners dispose of saturated brines in Williams' Sink, Laguna Plata, and Laguna Toston, the direction of ground-water flow would carry the potash waste away from Laguna Gatuna. Laguna Gatuna is more than 20 feet higher than Laguna Toston and at least 60 feet higher than Laguna Plata and Williams' Sink.

GROUND-WATER MOVEMENT

The regional flow systems in Nash Draw, west of the project area, have been described by numerous workers, including Robinson and Lang (1938), Cooper and Glanzman (1971), Brokaw and others (1972), and Geohydrology Assoc., Inc. (1978, 1982), and Mercer (1983). Most of these studies conclude that, with some local variation, the ground-water flow in the shallow aquifers is from north toward the south. Nash Draw is one of the major flow paths. Recharge areas are the sand dunes of Chaves and Lea Counties; ground-water discharges into the Pecos River along most of its length (Geohydrology Assoc., Inc., 1978, p. 16).

Data were collected from a variety of sources in order to determine the local flow systems in Ts. 19-20 S., Rs. 32-33 E. A number of test-hole logs and water levels were obtained from an earlier study (Geohydrology Assoc., Inc., 1979) and are included in Tables 1 and 2 of this report. Land-surfacing elevations were used at well-documented springs located at Laguna Gatuna and Laguna Plata. These data were used to construct the water-level contours shown in Figure 3. Existing contour maps from outside the area were used for control where appropriate.

Most of the water-level data in T. 20 S, which includes Laguna Gatuna and other playas, shows a well defined flow system. The highest water-level elevations are present south to Highway 62-180 and in the vicinity of Laguna Tonto. The 3425-foot contour defines this area. Ground-water movement away from this contour would be west-northwest towards Laguna Plata and Williams' Sink.

This flow system is within the Dockum Group. The alluvial sediments are quite thin, as described in the preceeding section of this report. The

Table 2.--Records of wells in vicinity of Laguna Gatuna.

Explanation: Location-See Introduction for explanation of well-numbering system.
Depth of Well and Depth to Water-Reported depths are given to nearest foot; measured depths are given to nearest tenth or hundredth of a foot.
Aquifer-Qtal=Quaternary; Ogll=Ogallala; Trsc=Triassic; Rslr=Rustler; Dckm=Dockum; Trcl=Tertiary; Cplm=Capitan lime.
Remarks-S.C.=Specific Conductance; est=estimated; gpm=gallons per minute

Location	Well Status	Altitude (feet)	Depth of Well (feet)	Depth to Water(ft)	Aquifer	Date of Measurement	Remarks
18.31. 1.44432	Windmill	3797		460.42	Trcl	04/07/71	
12.223	Stock	3795	480+	453.39		10/18/77	
12.23144	Stock	3775	600	435.34	Trcl	04/07/71	
14.22133	Open cased hole	3731	400	377.30	Trcl	04/06/71	
35.31324	Domestic	3631	300	261.08	Trcl	04/05/71	
18.32.16.22433	Uncased open hole	3793	100	84.18	Ogll	03/18/68	
20.13311	Domestic	3470	270.0	179.35	Trcl	02/23/71	
22.32322	Oil test	3763		434.41	Trcl	04/06/71	
34.22241	Windmill	3721		117.46	Trcl	04/06/71	
18.33. 3.34133	Open cased hole	4015		60.10	Qtal	04/05/66	
3.343	Domestic/Stock	4012	64	59.18	Qtal	02/19/71	
10.23244	Domestic	4005	75	41.64	Qtal	02/09/71	
10.44211	Stock	3985	60	41.64	Ogll	02/09/71	
11.4433	Irrigation	3986		42.40	Qtal	02/09/71	
12.44211	Windmill	4089		137.48	Qtal	02/05/71	
13.13144	Open cased hole	3968		31.85	Qtal	02/08/71	
13.44244	Open cased hole	3973		46.66	Qtal	02/08/71	
14.111	None	3965	40.0	35.8	Qtal	06/03/54	
14.1114	Windmill	3976		35.20	Qtal	02/09/71	
14.11140	Stock	3976	46.0	35.84	Qtal	03/06/68	
19.142	Stock	3820		140+	Trsc?	12/09/58	
23.23140	Open cased hole	3881	58	45.65	Qtal	02/09/71	
34.133	None	3760	200.0	177.4	Trsc	12/09/58	

Table 2, continued.

Location	Well Status	Altitude (feet)	Depth of Well (feet)	Depth to Water (ft)	Aquifer	Date of Measurement	Remarks
18.34. 1.12222	Industrial	3991		79.70	Ogll	03/06/61	
2.223333	Industrial	4009		98.03	Ogll	02/04/71	
4.11124	Open cased hole	4064		126.78	Ogll	02/04/71	
8.23213	Windmill	4042		104.20	Ogll	02/04/71	
11.43212	Industrial	4000	211.0	110.78	Ogll	02/23/71	
12.42333	Industrial	3982	204.0	111.01	Ogll	02/19/71	
15.24130	Windmill	4015		103.28	Ogll	02/05/71	
18.413212	Open cased hole	4076		143.30	Ogll	02/05/71	
20.323323	Windmill	4015		98.92	Ogll	02/05/61	
20.323333	Domestic/Stock	4020	111.0	100.19	Ogll	03/06/68	
22.343				109.92	Ogll	01/08/75	
25.13111	Uncased shot hole	3977		94.88	Qtal	03/09/61	
25.133232	Uncased shot hole	3947		97.16	Qtal	03/09/66	
27.33311	Windmill	3994		110.42	Ogll	02/05/71	
29.112.13	Open cased hole	3972		60.40	Qtal	02/05/71	
30.211224	Open cased hole	3955		44.03	Ogll	02/05/71	
19.31.27.21144	Open cased hole	3573		142.71	Trsc	02/01/71	
27.23344	Oil test	3573		143		02/01/71	Abandoned
28.330	Domestic	3480		180	Dckm	11/29/48	
28.333		3442		110.07		12/14/77	
28.3332	Domestic/Stock	3483	200.0	186.87		12/15/77	S.C. 2200
28.33433	Stock	3442	180	108.21	Trsc	02/01/71	Abandoned
31.132		3397	4103	632.55	Cplm	05/ /73	
33.110	Abandoned	3450	160	100.7	Dckm	11/29/48	North well of 3
33.142	Domestic/Stock	3455	250	140		09/30/59	
19.32. 8.200	Stock	3650		365.3	Trsc	12/09/58	
31.110		3518	4190	651.25	Cplm	09/ /74	
34.421424	Community	3960	575	252.49	Trsc	01/28/71	
34.42322	Community	3959	575	252.27	Trsc	01/28/71	
36.100	Domestic/Stock	3565	485		Trsc		

Table 2, continued.

Location	Well Status	Altitude (feet)	Depth of Well (feet)	Depth to Water (ft)	Aquifer	Date of Measurement	Remarks
19.33. 5.12322	Stock	3710		299+	Trsc	12/09/58	
17.11224	Stock	3650	131.0	117.67	Trcl	01/28/71	Abandoned
18.133223	Oil test	3635	800	211.86	Trsc	01/28/71	
26.244	Stock/Domestic	3600	101	92.9	Qtal	07/01/54	
19.34. 6.34143	Stock windmill	37777		234.71		03/18/68	Abandoned
9.114	Stock	3790	33	28.6	Trsc?	06/03/54	
16.33410	Oil test	3755		243.91		03/19/68	Abandoned
31.131	Stock	3625	66	58.6	Qtal	11/17/65	Yield-6gpm est; Reported dry 01/12/71
20.31.13.42	Stock;abandoned	3427	32.5	1.1		10/05/77	S.C. >8000; 70°F
13.440	Stock	3450		203.8	Dckm?	12/22/48	
15.130	Stock	3450	70 ?	63.1	Dckm?	12/22/48	
16.24	Stock	3458	110.0	61.0	Dckm?	10/05/77	Abandoned
20.32. 1.322	Stock	3510	30	21.8	Qtal	01/25/84	Water not potable
18.233	Industrial	3450	400	89.2	Trsc	03/24/54	
23.43312	Commercial	3551	78	38.03	Trsc	01/25/84	Abandoned
24.33333	Windmill	3555	65	38.72	Ogll	01/25/84	
25.111	Windmill	3555	67.5	35.07		12/16/77	Abandoned
27.144	None	3543	25	12.3	Qtal	06/11/54	
27.32322	Stock	3530		15.30	Ogll	03/29/65	
27.32411	Stock	3530	75	16.55	Ogll	02/02/71	Unused
30.142	None	3530		9.9	Qtal	06/11/54	
36.214	Domestic	3588	60	46.6	Qtal	06/06/55	Abandoned
36.21424	Windmill	3586	65	48.46	Qtal	01/25/84	
36.221	Windmill	3588	53.7	45.31		12/16/77	Abandoned; S.C. 2000

Table 2, continued.

Location	Well Status	Altitude (feet)	Depth of Well (feet)	Depth to Water (ft)	Aquifer	Date of Measurement	Remarks
20.33. 4.43211	Used windmill	3556	58	33.19	Ogll	03/19/68	Plugged 1/25/84
5.34321	Oil test	3550	680	278.57	Trsc	02/02/71	
18.12322	Open hole	3520		249.88	Trsc	03/19/68	Abandoned
21.111	Windmill	3536	47.5	35.42	Trsc	01/25/84	Inoperative
24.122	Stock	3630	700±	300±	Trsc		
24.124113	Stock	3633	676±	413.55	Trsc	02/03/71	Used
20.34. 4.44434	Stock	3635	200+	172.19	Trsc	02/03/71	
17.334	Stock	3635	200	140	Trsc	07/01/54	
22.222333	Stock	3656	250	214.98	Trsc	02/03/71	
22.223	Stock	3655	235		Trsc		
21.31. 2.221	Abandoned	3569	31.87	30.15		10/19/77	
7.331		3350	367.0	192.1	Rslr	09/14/72	S.C. 3500
18.411	Windmill	3310		158+	Rslr	03/17/76	S.C. 3200
21.32. 6.11131	Stock	3597	55	44.04	Ogll	02/03/71	Used windmill
21.33. 2.231	Domestic	3810	1150		Trsc		
2.24141	Domestic	3792	120	104.54	Trsc	11/16/65	Abandoned
2.24233	Open hole	3791	120	104.01	Trsc	11/16/65	Abandoned
2.42214	Open cased hole	3785	150	85.32	Trsc	02/04/71	
2.422334	Used windmill	3768	100	79.13	Trsc	11/16/65	
2.42233	Stock/Domestic	3768	102	83.20	Trsc	02/04/71	
2.442	Stock	3800		72.9	Ogll	06/28/54	
11.11144	Stock	3820	195	144.52	Ogll	02/04/71	
18.112	Stock	3900		143	Ogll	06/21/54	
18.11410	Used windmill	3892	160	148.43	Ogll	11/16/65	
18.12314	Used windmill	3855	123	117.50	Ogll	02/04/71	

Table 2, concluded.

Location	Well Status	Altitude (feet)	Depth of Well (feet)	Depth to Water (ft)	Aquifer	Date of Measurement	Remarks
21.33.25.42322	Used windmill	3666		58.95	Ogll	02/04/71	
28.12443	Used windmill	3688	224	178.62	Trsc	02/04/71	
21.34. 1.24122	Used windmill	3662		68.92	Trsc	02/10/71	
8.422	Stock	3705	120	105.8	Ogll	06/30/54	
8.42341	Stock	3706		105.64	Ogll	02/10/71	Used windmill
13.324	Domestic	3655	335	200	Trsc	1943	
21.13141	Open cased hole	3677	196	99.61	Trsc	02/10/71	
23.223	Industrial/Domestic	3660	220	150	Ogll	1954	
23.310		3717		1151.96	Cplm	09/ /74	
24.222	Domestic	3655	125		Trsc?	02/10/71	
25.13141	Open cased hole	3677	196	99.61	Trsc	02/19/71	
33.233441	Used windmill	3641	92	64.45	Ogll	02/04/71	

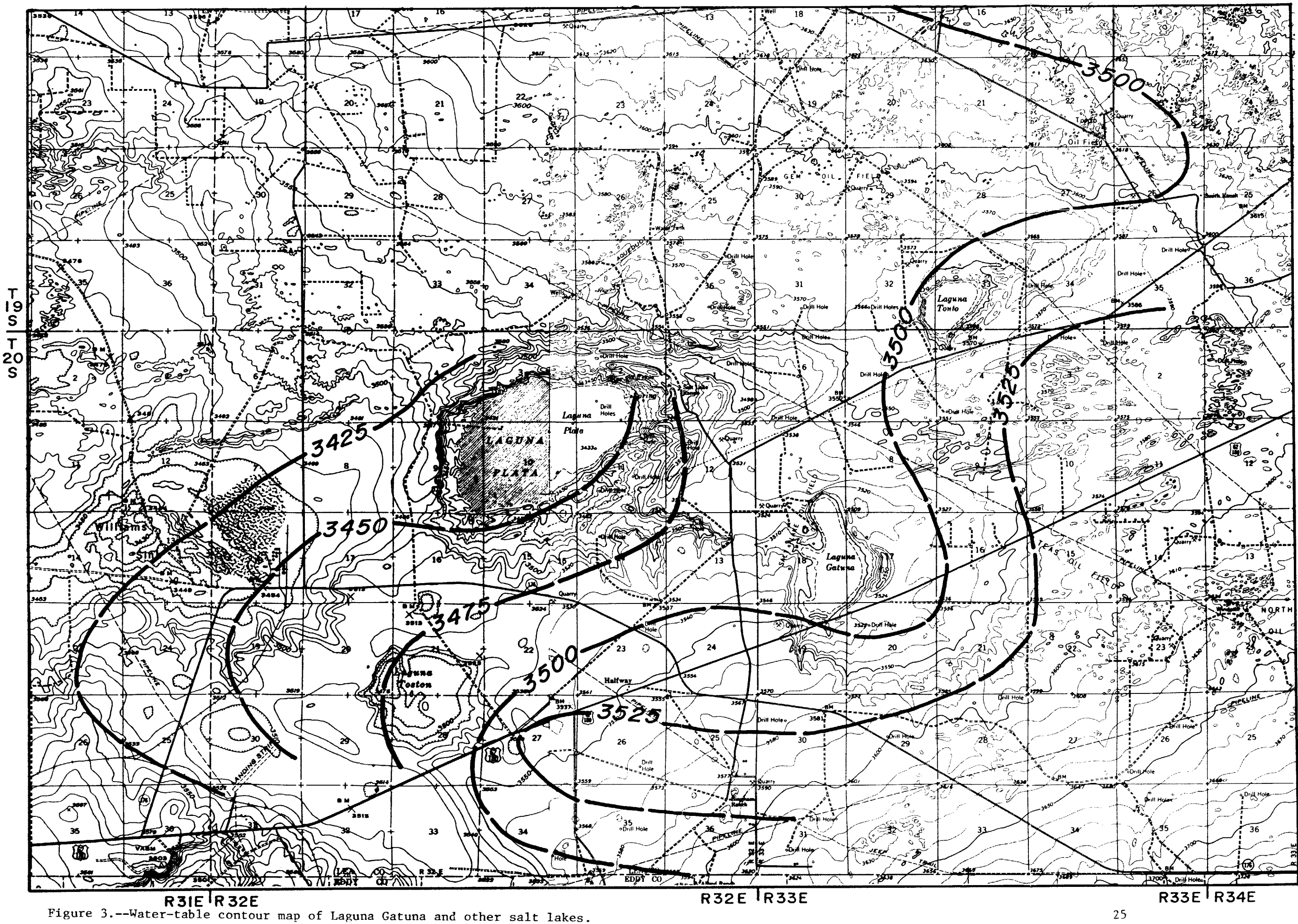

Figure 3.--Water-table contour map of Laguna Gatuna and other salt lakes.

ground-water movement would occur through the more permeable zones in the Dockum deposits, and in particular through the Santa Rosa sandstone.

Laguna Gatuna and Laguna Plata are natural ground-water discharge areas. Both lakes have intermittent springs along their borders, indicating that the bed of each lake is below the natural water table. No springs have been found at Laguna Tonto.

A second flow system is indicated by some of the water levels in the area north of Laguna Plata in T. 19 S. These water levels seem to be associated with a deeper flow system, perhaps in the Rustler Formation. Anomalous depths also were reported for wells in section 24, T. 20 S., R. 33 E. and section 3, T. 21 S., R. 32 E.

Water-quality data indicate that a deep, brine flow system exists also. This is discussed in the following section of this report.

WATER-QUALITY DATA

Reed (1969) collected chemical data at 14 different sites (Appendix B). These included samples from wells, springs, and soil samples from playas. The electrical conductivity was measured at several sites also. From these data, Reed concluded that there was very little potable water in the region.

The concentration of brine cannot be attributed to contamination from oil wells located near Laguna Gatuna. Work by Reed has shown that a water sample from a nearby oil well contained only 2,250 ppm sulfate and 5,900 ppm chloride, considerably less than found in springs and the lake itself. Evaporation of fresh water runoff into the playa would result in an increase in salt concentration, however this could not explain the high mineralization in the springs at higher elevations than the lake bottom. Also, there is no known source of brine up-gradient (or southeast) of Laguna Gatuna.

In the preceding section describing Geologic Structure, the similarity of Laguna Gatuna with other collapse structures in the region was pointed out. If Laguna Gatuna and the other playas in the area are the result of collapsing strata, normal faulting would be a consequence. These fault zones would serve as conduits for highly mineralized water in the brine aquifer. This seems to be the most plausible explanation for brine in Laguna Tonto. Inasmuch as there are no springs discharging into that lake, and it has a relatively small drainage area from which surface drainage would enter, a deep-seated brine source with movement along fault zones could account for brine on the lake surface.

SITE SUITABILITY

As shown in Appendix A (page 4), the original authorization for disposal of oil-field brines was granted to Mr. Larry C. Squires for the use of Laguna Plata and Laguna Gatuna. The application to utilize Laguna Tonto was denied. Since that time Pollution Control, Inc., has operated at a facility constructed on the northwest side of Laguna Gatuna in the north half of section 18, T. 20 S., R. 32 E. (fig. 4). Mr. Squires is President of Pollution Control, Inc. An additional facility has now been proposed for the SW¼, SW¼ of section 17, T. 20 S., R. 32 E. on land currently held by the Snyder Ranches under Bureau of Land Management lease BL-745.

Laguna Gatuna is a natural playa which has a surface area of approximately 383 acres within the lowest closing contour. The elevation of the bed is about 3,495 feet above mean sea level; the upper perimeter of the playa is generally defined by the 3,510-foot contour. The total drainage area for Laguna Gatuna is less than two square miles. One tributary channel enters the playa from the west directly south of the Pollution Control facility. A shorter tributary

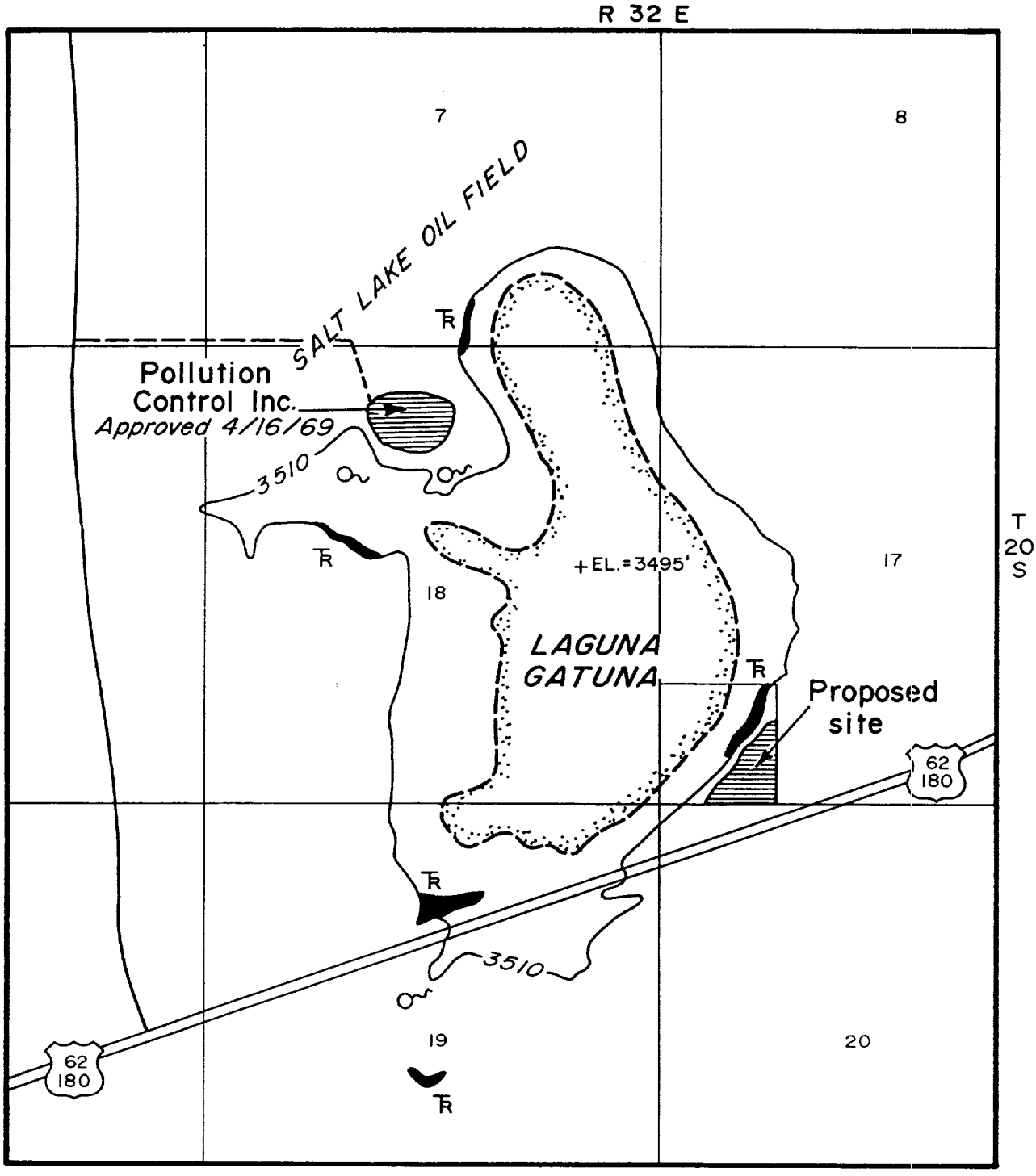

Figure 4.--Detailed map of Laguna Gatuna showing location of Pollution Control, Inc., facilities.

enters from the south in section 19. Assuming that only 10 percent of the annual precipitation enters the playa as runoff, Laguna Gatuna would entrap about 8,000 gallons of precipitation annually.

In most areas the steep-sided walls are covered by unconsolidated alluvium and slope wash; however there are at least five exposures of the Dockum Group. These unconsolidated sediments are composed primarily of hard reddish-brown shale and siltstone; thin laminae of very fine grained sandstone is locally present. Two exposures in sections 17 and 19 were developed by roadwork associated with Highway 62-180. These exposures show that the alluvial material is very thin; around the perimeter of the playa, the alluvial cover probably does not exceed five feet in thickness. Figure 2 is a generalized cross section of Laguna Gatuna.

The presence of well-defined springs and seeps on the rim of the playa established that Laguna Gatuna is a natural ground-water discharge point. However the springs probably fluctuate with seasonal temperatures. According to Mr. Steve Foster, Vice President of Pollution Control, Inc., the playa remains dry except during periods of heavy rainfall and runoff.

Evaporation studies have been conducted in Nash Draw to determine the loss of water from a brine solution exposed on a free water surface (Geohydrology Assoc., Inc., 1979, p. 71). These studies showed that the summer evaporation rate was 6.69 gpm (gallons per minute) per acre or 229 barrels per acre per day. The winter loss was 0.37 gpm per acre or about 13 barrels per acre per day. Inasmuch as Laguna Gatuna has a minimum surface area of 383 acres, the seasonal evaporation from the playa would be about 87,700 barrels per day during the summer and about 5,000 barrels per day during the winter.

These evaporation rates support the original estimate by Reed (1969, p. 30) that Laguna Gatuna has a disposal rate of 30,000 barrels per day. During the

winter of 1983-1984, Pollution Control, Inc., disposed of an average of about 50,000 barrels per month, and the playa remained totally dry throughout the period, according to Mr. Steve Foster. Also, the maximum disposal to date occurred in 1981 when disposal of 150,000 barrels per month was not uncommon (fig. 5, Table 3). This is less than 20 percent of the recommended maximum suggested by Reed and approved by the Oil Conservation Division.

During the recent field investigations conducted for this study, several wells measured in 1969 were again measured. A well located in the northwest corner of section 21, T. 20 S., R. 33 E., has shown a decline of 0.82 feet between 1969 and 1984. This well is located about one mile east of Laguna Gatuna. The water level in a well located in the northwest corner of section 25, T. 20 S., R. 32 E., declined 0.12 feet during the same period. This second well is located about one and a half miles southwest of the lake. The elevation of these water levels is higher than the elevation of Laguna Gatuna; nevertheless, this indicated that 15 years of operation by Pollution Control, Inc., has not affected the water table in the immediate vicinity of the disposal site.

CONCLUSIONS

1. Laguna Gatuna is a natural ground-water discharge point. The playa probably occupies a collapse structure associated with Nash Draw and others in the region. There is a thin blanket of alluvium covering the less permeable Dockum Group below.

2. The salt springs and brine associated with Laguna Gatuna are more highly mineralized than water collected from oil wells in the immediate area. There are no known salt deposits in the Dockum Group or in shallow deposits up-gradient from the playa. It is possible that the brine originates in the Rustler Formation at depth with the fault zones associated with collapse

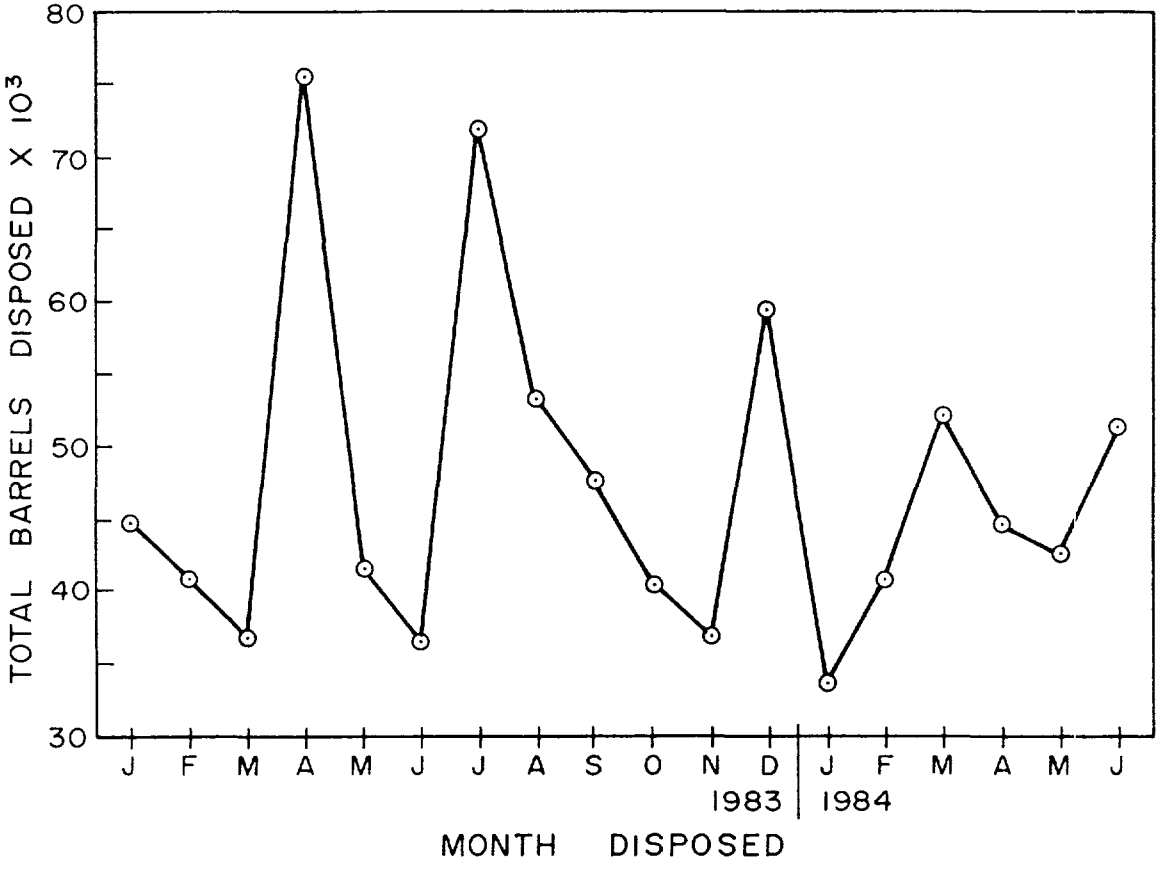

Figure 5.--Plot of monthly disposal volumes at Laguna Gatuna during 1983-1984.

Table 3.--Monthly discharges for 1983-1984 at Laguna Gatuna.

Month	Total Cumulative
January 1983	44,963 barrels
February	40,967
March	36,851
April	76,634
May	41,615
June	36,499
July	72,058
August	53,279
September	47,788
October	40,572
November	36,924
December	59,401
January 1984	33,521
February	40,777
March	52,119
April	44,720
May	42,623
June	51,200

structures acting as the conduit to the surface.

3. Laguna Gatuna is a suitable disposal site for as much as 30,000 barrels of brine per day.

4. There is no evidence to show that 15 years of operation by Pollution Control, Inc., has adversely impacted the hydrologic system in the vicinity of Laguna Gatuna. Continued operation of the existing facilities will not endanger the pre-1969 conditions.

5. Laguna Gatuna is a satisfactory repository for solid oil-field waste products, such as drill cuttings and drilling mud. Oil-contaminated waste products should be contained by earthern structures in order to maintain the aesthetic quality of the playa.

6. The proposed facility in the SW¼, SW¼ of section 17, T. 20 S., R. 32 E. will not adversely impact the hydrologic conditions in Laguna Gatuna provided that the combined discharge from both sites does not exceed 30,000 barrels of brine per day.

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A P P E N D I X A

Order of the Oil Conservation Commission, No. R-3725, Case No. 4047, dated April 16, 1969.

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE No. 4047
Order No. R-3725

APPLICATION OF LARRY C. SQUIRES
FOR AN EXCEPTION TO ORDER NO.
R-3221, AS AMENDED, LEA COUNTY,
NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 19, 1969, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this 16th day of April, 1969, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That effective January 1, 1969, Order (3) of Commission Order No. R-3221, as amended, prohibits in that area encompassed by Lea, Eddy, Chaves, and Roosevelt Counties, New Mexico, the disposal, subject to minor exceptions, of water produced in conjunction with the production of oil or gas, or both, on the surface of the ground, or in any pit, pond, lake, depression, draw, streambed, or arroyo, or in any watercourse, or in any other place or in any manner which would constitute a hazard to any fresh water supplies and said disposal has not previously been prohibited.

(3) That the aforesaid Order No. R-3221 was issued in order to afford reasonable protection against contamination of fresh

water supplies designated by the State Engineer through disposal of water produced in conjunction with the production of oil or gas, or both, in unlined surface pits.

(4) That the State Engineer has designated, pursuant to Section 65-3-11 (15), N.M.S.A., 1953 Compilation, all underground water in the State of New Mexico containing 10,000 parts per million or less of dissolved solids as fresh water supplies to be afforded reasonable protection against contamination; except that said designation does not include any water for which there is no present or reasonably foreseeable beneficial use that would be impaired by contamination.

(5) That the applicant, Larry C. Squires, seeks an exception to the provisions of the aforesaid Order (3) to permit the disposal of water produced in conjunction with the production of oil or gas, or both, in three natural salt lakes located in Lea County, New Mexico, as follows:

> Laguna Plata, sometimes referred to as Laguna Grande, located in Sections 2, 3, 9, 10, and 11, Township 20 South, Range 32 East, NMPM;
>
> Laguna Gatuna, sometimes referred to as Salt Lake, located in Sections 7, 17, 18, 19, and 20, Township 20 South, Range 33 East, NMPM;
>
> Laguna Tonto, located in Sections 32 and 33, Township 19 South, Range 33 East, and Section 4, Township 20 South, Range 33 East, NMPM.

(6) That the subject lakes are situated within the confines of a synclinal feature.

(7) That the water in the aforesaid three lakes is not fresh water.

(8) That that portion of the Triassic red beds underlying said three lakes is virtually impermeable and therefore prevents seepage from said lakes into the sand stringers within said red beds which may contain fresh water.

(9) That as to sands that are in communication with said lakes, the evidence indicates that the major flow of surface and subsurface water within the boundaries of said synclinal feature is toward the subject lakes.

(10) That the evidence indicates that there is no leakage of water from said Laguna Plata and Laguna Gatuna into the adjoining formations.

(11) That the evidence indicates that there may be some leakage of water from said Laguna Tonto into the adjoining formations to the southeast, thence southwestward toward Laguna Gatuna.

(12) That the utilization of Laguna Plata and Laguna Gatuna for the disposal of water produced in conjunction with the production of oil or gas, or both, will not constitute a hazard to fresh water supplies that may exist in the vicinity of said lakes.

(13) That the utilization of Laguna Tonto for the disposal of water produced in conjunction with the production of oil or gas, or both, may constitute an additional threat of contamination of fresh water supplies as designated by the State Engineer existing to the southeast of said lake.

(14) That the evidence indicates that commercial deposits of sodium sulphate ($Na_2 SO_4$) may exist in and/or near the three subject lakes.

(15) That disposal of produced salt water into Laguna Plata and Laguna Gatuna will not interfere with the testing required to determine if there are commercial deposits of sodium sulphate in and/or near the said three lakes.

(16) That said disposal prior to actual mining operations will not impair the value of said sodium sulphate nor render its recovery more difficult.

(17) That this case should be reopened upon the motion of the Commission or any other interested party whenever tests have been conducted which indicate to a substantial degree that commercial deposits of sodium sulphate probably exist in and/or near the subject lakes, at which time all interested parties should be prepared to appear and show cause why continued disposal in said lakes should or should not be allowed.

(18) That the applicant should be authorized to utilize Laguna Plata and Laguna Gatuna for the disposal of water produced in conjunction with the production of oil or gas, or both.

(19) That the request of the applicant to utilize Laguna Tonto for the disposal of water produced in conjunction with the production of oil or gas, or both, should be denied.

IT IS THEREFORE ORDERED:

(1) That the applicant, Larry C. Squires, is hereby granted an exception to Order (3) of Commission Order No. R-3221, as amended, to dispose of water produced in conjunction with the production of oil or gas, or both, in two natural salt lakes located in Lea County, New Mexico, as follows:

Laguna Plata, sometimes referred to as Laguna Grande, located in Sections 2, 3, 9, 10, and 11, Township 20 South, Range 32 East, NMPM;

Laguna Gatuna, sometimes referred to as Salt Lake, located in Sections 7, 17, 18, 19, and 20, Township 20 South, Range 33 East, NMPM.

(2) That the application of Larry C. Squires to utilize Laguna Tonto, located in Sections 32 and 33, Township 19 South, Range 33 East, and Section 4, Township 20 South, Range 33 East, NMPM, Lea County, New Mexico, for the disposal of water produced in conjunction with the production of oil or gas, or both, is hereby denied.

(3) That the Commission may by administrative order rescind such authority whenever it reasonably appears to the Commission that such rescission would serve to protect fresh water supplies from contamination.

(4) That this case shall be reopened upon the motion of the Commission or any other interested party whenever tests have been conducted which indicate to a substantial degree that commercial deposits of sodium sulphate probably exist in and/or near the aforesaid lakes, at which time all interested parties should appear and show cause why continued disposal in said lakes should or should not be allowed.

(5) That the first person to determine to a substantial degree by tests that commercial deposits of sodium sulphate probably exist in and/or near said lakes shall so notify the Commission, setting forth in writing the supporting facts,

whereupon the Commission shall give notification for the reopening of this case.

(6) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

DAVID F. CARGO, Chairman

ALEX J. ARMIJO, Member

S E A L

A. L. PORTER, Jr., Member & Secretary

esr/

A P P E N D I X B

Chemical analyses of samples collected by Ed L. Read, February 1969.

SOUTHWESTERN LABORATORIES
FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Midland, Texas 2-13-69 File No. C-1902-R1

Report of tests on Water

To Mr. Ed L. Reed Date Rec'd. 2-12-69

Received from Mr. Ed L. Reed

Identification Marks Lea County, New Mexico, Larry Squires, sampled by Joe Reed, #16, Sec. 25-T20G, R32E, from waste trough, WL. - 39.58'.

	Mg/L
Chloride	85
Sulfate	82
Conductivity	837 Micromhos/cm @ 25° C.

Copies: 3cc Mr. Ed L. Reed

SOUTHWESTERN LABORATORIES
Jack H Ba...

Lab. No. C-5120

SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Midland, Texas 2-13-69 File No. C-1902-R1

Report of tests on Water

To Mr. Ed L. Reed Date Rec'd. 2-12-69

Received from Mr. Ed L. Reed

Identification Marks Lea County, New Mexico, Larry Squires, by Joe Reed, Spring #3, just North of #2, 200 ft., at head water.

	Mg/L
Chloride	7446
Sulfate	11755
Conductivity	10,000 ✓ Micromhos/cm @ 25° C.

Copies: 3cc Mr. Ed L. Reed

SOUTHWESTERN LABORATORIES

Jack H Baker

Lab. No. C-5124

SOUTHWESTERN LABORATORIES
FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Midland, Texas 2-13-69 File No. C-1902-R1

Report of tests on Water

To Mr. Ed L. Reed Date Rec'd. 2-12-69

Received from Mr. Ed L. Reed

Identification Marks Lea County, New Mexico, Larry Squires, sampled by Joe Reed, Spring #1, SE end of Laguna Plata at head water.

	Mg/L
Chloride	8864
Sulfate	11930
Conductivity	10,000 ± Micromhos/cm @ 25° C.

Copies: 3cc Mr. Ed L. Reed

SOUTHWESTERN LABORATORIES
Jack H Baker

Lab. No. C-5122

SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Midland, Texas 2-13-69 File No. C-1902-R1

Report of tests on Water

To Mr. Ed L. Reed Date Rec'd. 2-12-69

Received from Mr. Ed L. Reed

Identification Marks Lea County, New Mexico, Larry Squires, sampled by Joe Reed, Spring #2, due East of Laguna Plata at head water.

	Mg/L
Chloride	7446
Sulfate	12743
Conductivity	10,000 ✓ Micromhos/cm @ 25° C.

Copies: 3cc Mr. Ed L. Reed

SOUTHWESTERN LABORATORIES
Jack H Barton

Lab. No. C-5123

SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Midland, Texas 2-13-69 File No. C-1902-R1

Report of tests on Water

To Mr. Ed L. Reed Date Rec'd. 2-12-69

Received from Mr. Ed L. Reed

Identification Marks Lea County, New Mexico, Larry Squires, sampled by Joe Reed, Halfway Bar, from tap, 2 wells, WL. - 42.5'.

	Mg/L
Chloride	362
Sulfate	309
Conductivity	1861 Micromhos/cm @ 25° C.

Copies: 3cc Mr. Ed L. Reed

SOUTHWESTERN LABORATORIES

Jack H Barton

Lab. No. C-5121

SOUTHWESTERN LABORATORIES
FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Midland, Texas 2-25-69 File No. C-1902-R1

Report of tests on Water

To Mr. Ed L. Reed Date Rec'd. 2-18-69

Received from Mr. Ed L. Reed

Identification Marks As Shown

Lab. No.	Sample Description	Mg/L Chloride	Mg/L Sulfate
C-5151	No. 1-A, Soil sample, N end of Tonto (1:1 extract)	48931	37698
C-5152	No. 2, Spring, SW Gatuna, S of Highway	163105	24594
C-5153	No. 3, South side of Gatuna	66660	29728
C-5154	No. 4, Gatuna, in draw N of Highway	72333	24273
C-5155	No. 5, Gatuna, NW end at oil well, NW of well in Ravine	27657	37979
C-5156	No. 6, Gatuna, NW end, NE of oil well, ravine flowing South	10992	13771
C-5157	No. 7, Spring No. 4, Plata	7978	12643
C-5158	No. 1, Salt crystals, Tonto (Moist): Chloride (Cl) 4.20% by weight Sulfate (SO_4) 29.23% by weight		
------	No. 1-A --- No Sulfide or Sulfite detected.		

Copies: 3cc Mr. Ed L. Reed

SOUTHWESTERN LABORATORIES

Jack H Barton

Lab. No. ----