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STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION COMPLIANCE AND ENFORCEMENT BUREAU FOR:

A COMPLIANCE ORDER AGAINST OWL SWD OPERATING, LLC FOR THE MARALO SHOLES B WELL NO. 2

Case No.15753

PRE-HEARING STATEMENT

This pre-hearing statement is submitted by an additional party presenting evidence as required by the Oil Conservation Division under 19.15.4.13 (B) NMAC.

APPEARANCES

APPLICANT	APPLICANT'S ATTORNEY
Oil Conservation Division	David K. Brooks
OPPONENTS	OPPONENT'S ATTORNEY
OWL SWD Operating, LLC	Dalva L. Moellenberg and Rikki-lee Chavez
ADDITIONAL PARTY PRESENTING EVIDENCE	ADDITIONAL PARTY PRESENTING EVIDENCE'S ATTORNEY
New Mexico State Land Office	Katherine M. Moss

STATEMENT OF THE CASE

APPLICANT

Case No. 15753: The New Mexico Oil Conservation Division, Compliance and Enforcement Bureau ("OCD") filed an application for a compliance order (1) determining operator OWL SWD Operating LLC ("Operator") is out of compliance with 19.15.16.9 NMAC and 19.16.15.10

(2) requiring Operator to return its well to compliance with 19.15.16.9 (3) in the event of non-compliance, requiring Operator to suspend injection operations and to plug and abandon pursuant to 19.16.16.11 NMAC. The Application dealt specifically with Operator's violation of OCD rules regarding the proper construction of an injection well. On information and belief Owl currently injects into the Maralo Sholes B Well No. 2. The well has a total depth of approximately 3,055 feet, for injection of water into the Yates Seven River's formation and is located SW of Jal, NM.

OPPONENT NEW MEXICO STATE LAND OFFICE

The SLO is opposed to this well being used as a SWD well into this formation because at 3,055 feet the Tansill, Yates Seven River's zones, as well as the Capitan Reef, contain protectable groundwater of the State of New Mexico. In addition the Maralo Sholes B Well No. 2 is in poor condition as evidenced by reports filed in 2016 with the OCD and the Application brought by OCD in Case No. 15753.

PROPOSED EVIDENCE

APPLICANT

The State Land Office has not received notice of witnesses or exhibits that will be presented by the Applicant.

STATE LAND OFFICE

WITNESSES	EST. TIME	EXHIBITS
Anchor Holm	1 hour	8

The State Land Office incorporates by reference the Position Statement it filed in Case No. 15723 and reserves the right to present any evidence it presents on August 1, 2017 in Case No. 15723.

OTHER OPPONENTS

The State Land Office has received notice of witnesses and exhibits that will be presented by OWL OPERATING, LLC.

PROCEDURAL MATTERS

No procedural matters have been identified that are to be resolved prior to the hearing.

Respectfully submitted,

Katherine M. Moss
Associate General Counsel
New Mexico State Land Office
P.O. Box 1148
Santa Fe, NM 87504-1148
(505) 827-5713

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing pleading was served upon the following counsel of record this 27th day of July, 2017 by email:

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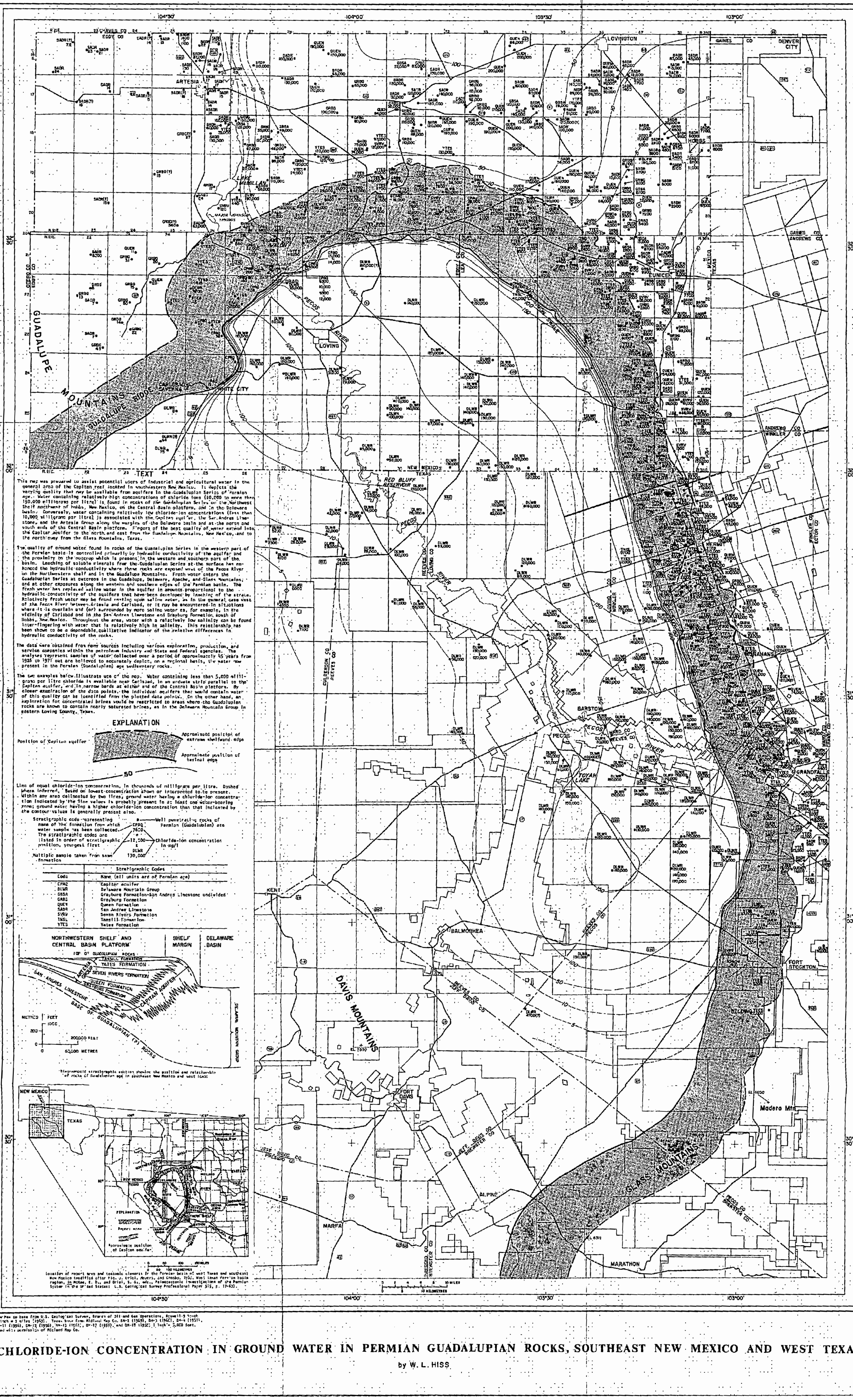
Published by
NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES
A DIVISION OF NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY
1975

Prepared by
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
In cooperation with
NEW MEXICO STATE ENGINEER

RESOURCE MAP 4



TEXT

This map was prepared to assist potential users of industrial and agricultural water in the general area of the Capitan reef located in southeastern New Mexico. It depicts the varying quality that may be available from aquifers in the Guadalupian Series of Permian age. Water containing relatively high concentrations of chloride ions (10,000 to more than 150,000 milligrams per litre) is found in rocks of the Guadalupian Series on the Northwest Shelf northwest of Hobbs, New Mexico, on the Central Basin platform, and in the Delaware basin. Conversely, water containing relatively low chloride-ion concentrations (less than 10,000 milligrams per litre) is associated with the Capitan aquifer, the San Andres Limestone, and the Artesia Group along the margins of the Delaware basin and at the north and south ends of the Central Basin platform. Fingers of the best quality of water extend into the Capitan aquifer to the north and east from the Guadalupe Mountains, New Mexico, and to the northeast from the Glass Mountains, Texas.

The quality of ground water found in rocks of the Guadalupian Series in the western part of the Permian basin is controlled primarily by hydraulic conductivity of the aquifer and the proximity to the outcrop which is present in the western and southern part of the basin. Leaching of soluble minerals from the Guadalupian Series at the surface has enhanced the hydraulic conductivity where these rocks are exposed west of the Pecos River on the Northwestern shelf and in the Guadalupe Mountains. Fresh water enters the Guadalupian Series at outcrops in the Guadalupe, Delaware, Apache, and Glass Mountains, and at other exposures along the western and southern edges of the Permian basin. The fresh water has replaced saline water in the aquifer in amounts proportional to the hydraulic conductivity of the aquifers that have been developed by leaching of the strata. Relatively fresh water may be found resting upon saline water, as in the general case west of the Pecos River between Artesia and Carlsbad, or it may be encountered in situations where it is overlain and (or) surrounded by more saline water as, for example, in the vicinity of Carlsbad and in the San Andres Limestone and Grayburg Formation, south of Hobbs, New Mexico. Throughout the area, water with a relatively low salinity can be found inter-fingering with water that is relatively high in salinity. This relationship has been shown to be a dependable qualitative indicator of the relative differences in hydraulic conductivity of the rocks.

The data were obtained from many sources including various exploration, production, and service companies within the petroleum industry and State and Federal agencies. The analyses represent samples of water collected over a period of approximately 45 years from 1926 to 1971 and are believed to accurately depict, on a regional basis, the water now present in the Permian (Guadalupian) age sedimentary rocks.

The two examples below illustrate use of the map. Water containing less than 5,000 milligrams per litre chloride is available near Carlsbad, in an arcuate strip parallel to the Capitan aquifer, and in narrow bands at either end of the Central Basin platform. By closer examination of the data points, the individual aquifers that would contain water of this quality can be identified from the plotted data points. On the other hand, an exploration for concentrated brines would be restricted to areas where the Guadalupian rocks are known to contain nearly saturated brines, as in the Delaware Mountain Group in eastern Loving County, Texas.

EXPLANATION

Position of Capitan aquifer

Approximate position of extreme shelfward edge

Approximate position of basinal edge

50

Line of equal chloride-ion concentration, in thousands of milligrams per litre. Dashed where inferred. Based on lowest-concentration shown or interpreted to be present. Within any area delineated by two lines, ground water having a chloride-ion concentration indicated by the line values is probably present in at least one water-bearing zone; ground water having a higher chloride-ion concentration than that indicated by the contour values is generally present also.

Stratigraphic code representing name of the formation from which water sample has been collected. The stratigraphic codes are listed in order of stratigraphic position, youngest first

Well penetrating rocks of Permian (Guadalupian) age

CPAQ
7620
12,000
DLWR
170,000

Chloride-ion concentration in mg/l

Multiple sample taken from same formation

Code	Stratigraphic Codes — Name (all units are of Permian age)
CPAQ	Capitan aquifer
DLWR	Delaware Mountain Group
GBSA	Grayburg Formation-San Andres Limestone undivided
GRBG	Grayburg Formation
QUEN	Queen Formation
SADR	San Andres Limestone
SVRV	Seven Rivers Formation
TNSL	Tansill Formation
YTES	Yates Formation

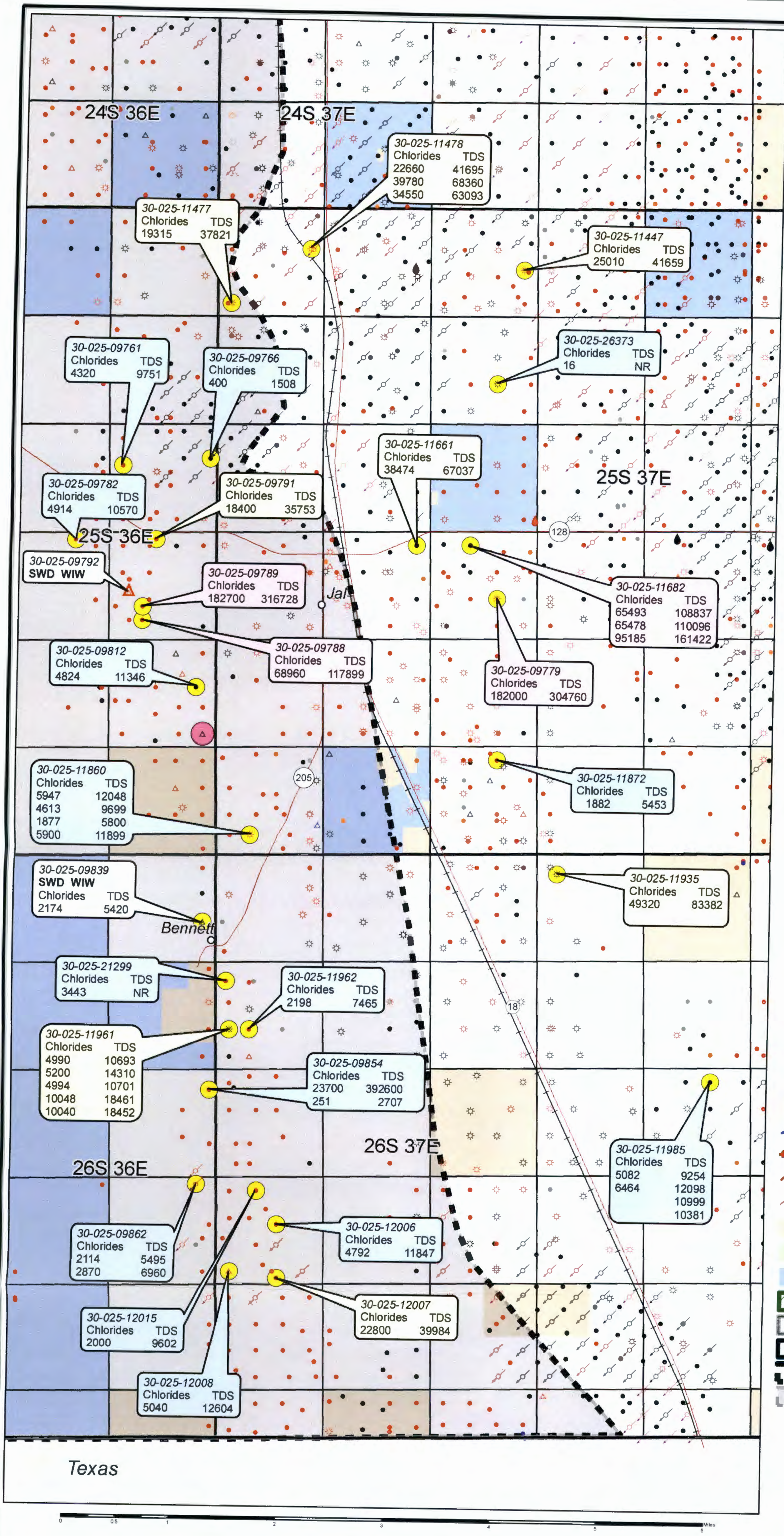
Location of report area and tectonic elements in the Permian basin of west Texas and southeast New Mexico (modified after Fig. 7, Oriel, Myers, and Crosby, 1967, West Texas Permian basin region, in McKee, E. D., and Oriel, S. S., eds., Paleotectonic investigations of the Permian System in the United States: U.S. Geological Survey Professional Paper 515, p. 17-60).

New Mexico base from U.S. Geological Survey, Bureau of Oil and Gas Operations, Roswell-9 South 1 inch = 2 miles (1963). Texas base from Midland Map Co. BN-2 (1969), BN-3 (1960), BN-4 (1951), BN-11 (1956), BN-12 (1956), BN-13 (1961), BN-17 (1955), and BN-18 (1950) 1 inch = 5,000 feet, used with permission of Midland Map Co.

CHLORIDE-ION CONCENTRATION IN GROUND WATER IN PERMIAN GUADALUPIAN ROCKS, SOUTHEAST NEW MEXICO AND WEST TEXAS

by W. L. HISS

NMOCD Case No. 1572
NMSLO Exhibit



Aubrey Dunn
Commissioner of Public Lands
505-827-5761
www.nmstatelands.org

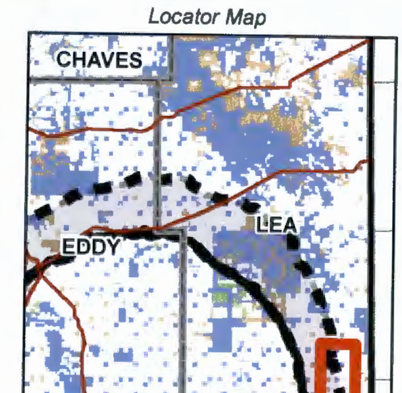
Groundwater Quality (T-Y-7R-CAP)

Legend

NMOCD Wells March 2017

- CO2 Active
- CO2 Cancelled
- CO2, New
- CO2, Plugged
- CO2, Temporaily Abandoned
- Gas, Active
- Gas, Cancelled
- Gas, New
- Gas, Plugged
- Gas, Temporarily Abandoned
- Injection, Active
- Injection, Cancelled
- Injection, New
- Injection, Plugged
- Injection, Temporarily Abandoned
- Oil, Active
- Oil, Cancelled
- Oil, New
- Oil, Plugged
- Oil, Temporarily Abondoned
- Salt Water Injection, Active
- Salt Water Injection, Cancelled
- Salt Water Injection, New
- Salt Water Injection, Plugged
- Salt Water Injection,Temp. Abandoned
- Water, Active
- Water, Cancelled
- Water, New
- Water, Plugged
- Water, Temporaily Abandoned
- Proposed SWD
- Focus Wells
- Rivers
- Interstate
- US Highway
- NM Highway
- Subsurface Estate
- Surface Estate
- Both Estates
- Agricultural Leases
- County Lines
- Aquifer Boundary
- Leaky Boundary
- Capitan Reef Zone

Locator Map



N

- Lower Chlorides/TDS
- Moderate Chlorides/TDS
- Higher Chlorides/TDS
- Salt Water Injection

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V:\LOGIC\GIS SHARED\EleanoreProjects\CAPITAN REEF\CapitanReefAquifer201706_EXH_2_11X17.
Save Date: June 9, 2017 Print Date: June 9, 2017.
Created by: Eleanore Nestlerode enestlerode@slo.state.nm.us 505-827-5727

NMOCD Case No. 15723
NMSLO Exhibit # 2

OCD Case No. 15723 ppm ppm NM SLO AEH 6/8/2017

PRODUCED WATER QUALITY DATA SUMMARY

API No.	T	R	S	Lot		Chloride	TDS	Field (Formations)
30-025-09761	25S	36E	13	E		4320	9751	Jalmat (Tansill/Yates/SevenRivers)
30-025-09766	25S	36E	13	H		400	1508	Jalmat (Tansill/Yates/SevenRivers)
30-025-09779	25S	36E	21	F		182000	304760	Jalmat (Tansill/Yates/SevenRivers)
30-025-09782	25S	36E	23	B		4914	10570	Jalmat (Tansill/Yates/SevenRivers)
30-025-09788	25S	36E	24	N		68960	117899	Jalmat (Tansill/Yates/SevenRivers)
30-025-09789	25S	36E	24	K		182700	316728	Jalmat (Tansill/Yates/SevenRivers)
30-025-09791	25S	36E	24	C		18400	35753	Jalmat (Tansill/Yates/SevenRivers)
30-025-09812	25S	36E	25	H		4824	11346	Jalmat (Tansill/Yates/SevenRivers)
30-025-11447	25S	37E	4	O		25010	41659	Jalmat (Tansill/Yates/SevenRivers)
30-025-11477	25S	37E	6	M		19315	37821	Jalmat (Tansill/Yates/SevenRivers)
30-025-11478	25S	37E	6	B		22660	41695	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	6	B		39780	68360	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	6	B		34550	63093	Jalmat (Tansill/Yates/SevenRivers)
30-025-11661	25S	37E	20	A		38474	67037	Jalmat (Tansill/Yates/SevenRivers)
30-025-11682	25S	37E	21	C		65493	108837	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	21	C		65478	110096	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	21	C		95185	161422	Jalmat (Tansill/Yates/SevenRivers)
30-025-11860	25S	37E	31	N		5947	12048	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	31	N		4613	9699	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	31	N		1877	5800	Jalmat (Tansill/Yates/SevenRivers)
30-025- "	25S	37E	31	N		5900	11899	Jalmat (Tansill/Yates/SevenRivers)
30-025-11872	25S	37E	33	B		1882	5453	Jalmat (Tansill/Yates/SevenRivers)
30-025-11935	26S	37E	3	D		49320	83382	Jalmat (Tansill/Yates/SevenRivers)
30-025-26373	25S	37E	9	J		16		Jalmat (Tansill/Yates/SevenRivers)
30-025-09839	26S	36E	1	I	SWD WIW	2174	5420	Jalmat (Tansill/Yates/SevenRivers)
30-025-09854	26S	36E	13	A		23700	392600	Scarborough (Yates/Seven Rivers)
30-025- "	26S	36E	13	A		251	2707	Scarborough (Yates/Seven Rivers)
30-025-09862	26S	36E	24	A		2114	5495	Scarborough (Yates/Seven Rivers)
30-025- "	26S	36E	24	A		2870	6960	Scarborough (Yates/Seven Rivers)
30-025- ?	26S	37E	7	D	(Reef)	3443		Scarborough (Yates/Seven Rivers)
30-025-11961	26S	37E	7	L		4990	10693	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	7	L		5200	14310	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	7	L		4994	10701	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	7	L		10048	18461	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	7	L		10040	18452	Scarborough (Yates/Seven Rivers)
30-025-11962	26S	37E	7	K		2198	7465	Scarborough (Yates/Seven Rivers)
30-025-11985	26S	37E	8	J		5082	9254	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	8	J		6464	12098	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	8	J			10999	Scarborough (Yates/Seven Rivers)
30-025- "	26S	37E	8	J			10381	Scarborough (Yates/Seven Rivers)
30-025-12006	26S	37E	19	G		4792	11847	Scarborough (Yates/Seven Rivers)
30-025-12007	26S	37E	19	O		22800	39984	Scarborough (Yates/Seven Rivers)
30-025-12008	26S	37E	19	M		5040	12604	Scarborough (Yates/Seven Rivers)
30-025-12015	26S	37E	19	C		2000	9602	Scarborough (Yates/Seven Rivers)

Data Sources: OCD Online query for Produced Water Quality in SENM.
Water Sample Analyses submited to OCD in C-108 SWD Applications.

NM OCD Case No. 15723
EXHIBIT 2a

NMOCD Case No. 15723

GRAYBURG

API Number	Operator	Lease name	well number	county	township	range	section	Footage call	Longitude	Latitude	Field/pool	stratigraphic unit of sample	alternate stratigraphic designation	TDS (mg/L)	Chloride (mg/L)
30-025-05875		G/SA UNIT	011K	Lea	19S	37E	21	1650FSL/1650FWL	-103.25948	32.64274	Monument	Artesia	Artesia Group	12749	7394
30-025-05983		BARBER GAS COM	002	Lea	20S	37E	07	990FSL/660FEL	-103.28389	32.58266	Monument	Artesia	Artesia Group	28588	15956
30-025-06123		GENERAL G STATE	001	Lea	20S	37E	16	660FNL/660FWL	-103.26237	32.57818	Monument	Artesia	Artesia Group	129354	78800
30-025-10213		LOU WORTHAN	004	Lea	22S	37E	11	1980FNL/1980FEL	-103.13117	32.40805	Paddock	Artesia	Artesia Group	30310	13040
30-025-10213		LOU WORTHAN	004	Lea	22S	37E	11	1980FNL/1980FEL	-103.13117	32.40805	Paddock	Artesia	Artesia Group	31097	16620
30-025-20358		STATE Q	004	Lea	20S	37E	16	1980FSL/660FEL	-103.24954	32.57089	Monument	Artesia	Artesia Group	16324	
30-015-00359	L R Barton	Barton Mobil Fed	001	Eddy	21S	26E	24	1980FNL/1980FWL	-104.24767	32.46724	Carlsbad	Capitan		34884	
30-015-00359	L R Barton	Barton Mobil Fed	001	Eddy	21S	26E	24	1980FNL/1980FWL	-104.24767	32.46724	Carlsbad	Capitan		26176	
30-015-02406		EDDY STATE AD	001	Eddy	20S	28E	19	1980FNL/660FWL	-104.22330	32.56035		Capitan		22198	11170
30-015-10817		N CEDAR HILLS	001	Eddy	21S	27E	05	3060FNL/1993FEL	-104.20969	32.51378		Capitan		28000	13800
30-015-10817		N CEDAR HILLS	001	Eddy	21S	27E	05	3060FNL/1993FEL	-104.20969	32.51378		Capitan		29392	18020
30-015-10817		N CEDAR HILLS	001	Eddy	21S	27E	05	3060FNL/1993FEL	-104.20969	32.51378		Capitan		27900	13500
30-015-10817		N CEDAR HILLS	001	Eddy	21S	27E	05	3060FNL/1993FEL	-104.20969	32.51378		Capitan		27400	13200
30-015-10817		N CEDAR HILLS	001	Eddy	21S	27E	05	3060FNL/1993FEL	-104.20969	32.51378		Capitan		28700	14800
30-015-10817		N CEDAR HILLS	001	Eddy	21S	27E	05	3060FNL/1993FEL	-104.20969	32.51378		Capitan		28200	14000
30-025-23871		SUPPLY WELL	001	Lea	23S	36E	07	660FNL/660FWL	-103.31040	32.32451	water supply well	Capitan		44270	23400
30-015-00971		GORMAN JP FEDERAL	001	Eddy	18S	27E	28	1980FSL/330FWL	-104.29081	32.71699	Dayton East	Grayburg	Artesia Group	112842	66970
30-015-02769		SIMMONS FED COM	002	Eddy	18S	29E	24	2310FSL/2310FWL	-104.02894	32.90599	Henshaw West	Grayburg	Artesia Group	95588	57600
30-015-03563		JONES-WATKINS ST	001	Eddy	19S	29E	05	2310FNL/2310FWL	-104.09743	32.69059	Turkey Track West	Grayburg	Artesia Group	200307	118600
30-015-04487		YATES A	012	Eddy	18S	30E	06	990FNL/330FEL	-104.00321	32.78062	Loco Hills	Grayburg	Artesia Group	130307	
30-015-05667		STATE	001	Eddy	18S	31E	32	1650FNL/2310FEL	-103.88994	32.70642	Shugart	Grayburg	Artesia Group	145207	86300
30-015-05708		STATE 36	001	Eddy	18S	31E	36	330FNL/330FWL	-103.82949	32.71011	Shugart	Grayburg	Artesia Group	136380	82930
30-015-05708		STATE 36	001	Eddy	18S	31E	36	330FNL/330FWL	-103.82949	32.71011	Shugart	Grayburg	Artesia Group	132956	
30-025-01562		MCA UNIT BATTERY 2	198	Lea	17S	33E	30	1969FSL/660FWL	-103.70867	32.80339	Maljamar	Grayburg	Artesia Group	143000	83300
30-025-04928		GRAYBURG UNIT	142	Lea	21S	36E	36	660FSL/1980FWL	-103.22079	32.42994	Arrowhead	Grayburg	Artesia Group	210458	
30-025-04939		GRAYBURG UNIT	133	Lea	21S	36E	36	1980FSL/660FWL	-103.22507	32.43355	Arrowhead	Grayburg	Artesia Group	8156	3276
30-025-06435	APACHE CORPORATION	HAWK B 1	012	Lea	21S	37E	08	660FSL/1980FEL	-103.18260	32.48788	Penrose Skelly	Grayburg	Artesia Group	18553.1	11206.1
30-025-06624		E	005	Lea	21S	37E	16	2310FNL/330FEL	-103.16010	32.47974	Penrose Skelly	Grayburg	Artesia Group	198705	
30-025-06637		LOCKHART A 17	002	Lea	21S	37E	17	1980FSL/660FEL	-103.17832	32.47700	Penrose Skelly	Grayburg	Artesia Group	147051	89880
30-025-06644		W W WEATHERLY	001	Lea	21S	37E	17	1980FSL/1980FWL	-103.18689	32.47696	Penrose Skelly	Grayburg	Artesia Group	14238	4702
30-025-06644		W W WEATHERLY	001	Lea	21S	37E	17	1980FSL/1980FWL	-103.18689	32.47696	Penrose Skelly	Grayburg	Artesia Group	11484	4241
30-025-06645		W W WEATHERLY	002	Lea	21S	37E	17	1980FSL/1980FEL	-103.18260	32.47697	Penrose Skelly	Grayburg	Artesia Group	15453	7280
30-025-06657		H T MATTERN NCT C	001	Lea	21S	37E	18	1980FSL/660FEL	-103.19525	32.47699	Penrose Skelly	Grayburg	Artesia Group	23006	10150
30-025-06665		L G WARLICK B	001	Lea	21S	37E	19	1980FNL/660FEL	-103.19526	32.46611	Penrose Skelly	Grayburg	Artesia Group	134673	79530
30-025-06746	APACHE CORPORATION	TURNER	004	Lea	21S	37E	22	660FSL/330FWL	-103.15791	32.45886	Penrose Skelly	Grayburg	Artesia Group	95428.8	59121
30-025-06753	APACHE CORPORATION	TURNER	011	Lea	21S	37E	22	915FSL/1650FWL	-103.15363	32.45958	Penrose Skelly	Grayburg	Artesia Group	106450	67813.8
30-025-06837		EUNICE KING	001	Lea	21S	37E	28	1980FNL/660FWL	-103.17392	32.45161	Penrose Skelly	Grayburg	Artesia Group	16028	6981
30-025-06839		EUNICE KING	003	Lea	21S	37E	28	1980FNL/1980FWL	-103.16965	32.45161	Penrose Skelly	Grayburg	Artesia Group	14405	6347
30-025-06884		H S TURNER	002	Lea	21S	37E	29	330FSL/330FWL	-103.19206	32.44341	Penrose Skelly	Grayburg	Artesia Group	15574	7136
30-025-06907		V M HENDERSON	001	Lea	21S	37E	30	2319FNL/330FEL	-103.19432	32.45070	Penrose Skelly	Grayburg	Artesia Group	12182	3794
30-025-07746		UNIT	004	Lea	20S	38E	07	1650FSL/330FWL	-103.19514	32.58462	Skaggs	Grayburg	Artesia Group	17926	9300
30-025-07801		SEMU PERMIAN	074	Lea	20S	38E	18	660FSL/1980FWL	-103.18963	32.56731	Skaggs	Grayburg	Artesia Group	176600	100500
30-025-07836		B M MARCUS	001	Lea	20S	38E	20	660FNL/1980FWL	-103.17246	32.56371	Skaggs	Grayburg	Artesia Group	19930	9241
30-025-08723		GRAYBURG UNIT	169	Lea	22S	36E	01	1980FNL/1980FWL	-103.22073	32.42268	Arrowhead	Grayburg	Artesia Group	7382	2849
30-025-08733		GRAYBURG UNIT	149	Lea	22S	36E	01	660FNL/660FWL	-103.22506	32.42630	Arrowhead	Grayburg	Artesia Group	250367	160700
30-025-08744		OXY STATE N	002	Lea	22S	36E	02	2310FSL/2310FWL	-103.23663	32.41987	Arrowhead	Grayburg	Artesia Group	16557	8195
30-025-08747		STATE J 2	008	Lea	22S	36E	02	1980FNL/2310FWL	-103.23666	32.42263	Arrowhead	Grayburg	Artesia Group	7810	3073
30-025-08748		GRAYBURG UNIT	158	Lea	22S	36E	02	1980FNL/1980FEL	-103.23357	32.42264	Arrowhead	Grayburg	Artesia Group	6894	3076
30-025-08896		STATE 157 D	008	Lea	22S	36E	12	330FSL/990FWL	-103.22385	32.39997	Arrowhead	Grayburg	Artesia Group	5759	
30-025-09915		ARGO	007	Lea	21S	37E	15	2310FSL/990FEL	-103.14509	32.47789	Penrose Skelly	Grayburg	Artesia Group	123162	75000
30-025-09915		ARGO	007	Lea	21S	37E	15	2310FSL/990FEL	-103.14509	32.47789	Penrose Skelly	Grayburg	Artesia Group	123777	
30-025-09974		R L BRUNSON TR 2	005	Lea	22S	37E	03	2080FSL/1980FWL	-103.15260	32.41918	Penrose Skelly	Grayburg	Artesia Group	18329	7714
30-025-09983		BRUNSON	002	Lea	22S	37E	03	2310FSL/990FWL	-103.15582	32.41982	Penrose Skelly	Grayburg	Artesia Group	199041	120879
30-025-10029		R L BRUNSON TR 2	002	Lea	22S	37E	04	1650FSL/990FEL	-103.16222	32.41603	Penrose Skelly	Grayburg	Artesia Group	62738	37368
30-025-10119		SKELLY UNIT	181	Lea	22S	37E	08	660FSL/1980FWL	-103.18684	32.40105	Penrose Skelly	Grayburg	Artesia Group	16937	8600
30-025-10119		SKELLY UNIT	181	Lea	22S	37E	08	660FSL/1980FWL	-103.18684	32.40105	Penrose Skelly	Grayburg	Artesia Group	14556	
30-025-10128		GREENWOOD	007	Lea	22S	37E	09	1980FSL/1980FEL	-103.16539	32.40448	Penrose Skelly	Grayburg	Artesia Group	16598	7700
30-025 0128		GREENWOOD	007	Lea	22S	37E	09	1980FSL/1980FEL	-103.16539	32.40448	Penrose Skelly	Grayburg	Artesia Group	11135	3820
30-0?-10128		GREENWOOD	007	Lea	22S	37E	09	1980FSL/1980FEL	-103.16539	32.40448	Penrose Skelly	Grayburg	Artesia Group	11140	3820
0197	CORP.	LOU WORTHAM	003	Lea	22S	37E	11	660FNL/1800FWL	-103.13620	32.41166	Penrose Skelly	Grayburg	Artesia Group	7401.83	4398.23
0200	CORP	LOU WORTHAM	002	Lea	22S	37E	11	1650FNL/330FWL	-103.14096	32.40692	Penrose Skelly	Grayburg	Artesia Group	14287.7	8810.5
0340		CHRISTMAS C	001	Lea	22S	37E	17	1980FNL/660FEL	-103.17827	32.39362	Penrose Skelly	Grayburg	Artesia Group	148536	87593
393		HUGH	009	Lea	22S	37E	14	330FNL/330FWL	-103.14094	32.39811	Penrose Skelly	Grayburg	Artesia Group	36250.4	18170.7
		HUGH	009	Lea	22S	37E	14	330FNL/330FWL	-103.14094	32.39811	Penrose Skelly	Grayburg	Artesia Group	20090.9	10210.9
		HUGH	011	Lea	22S	37E	14	1650FNL/1775FWL	-103.13625	32.39449	Penrose Skelly	Grayburg	Artesia Group	25637.8	13356.2
		HUGH	012	Lea	22S	37E	14	330FNL/1650FWL	-103.13666	32.39811	Penrose Skelly	Grayburg	Artesia Group	24590.2	12464.8
	RATION	HAWK B 1	016	Lea	21S	37E	08	660FSL/1980FWL	-103.18684	32.48786	Penrose Skelly	Grayburg	Artesia Group	13255.5	7328.9
		TEXACO	001	Lea	21S	37E	03	1730FSL/660FWL	-103.15709	32.50534	Penrose Skelly	Grayburg	Artesia Group	54027.4	26650
		ANDERSON STATE	001	Eddy	17S	29E	02	1980FSL/660FWL	-104.05144	32.86165	Square Lake	Grayburg/San Andres		1406	780
		GULF STATE	002	Eddy	17S	29E	03	330FNL/990FWL	-104.06746	32.86987	Square Lake	Grayburg/San Andres		109000	63070
		FEDERAL E	002	Eddy	16S	30E	31	660FSL/1875FWL	-104.01324	32.87257	Square Lake	Grayburg/San Andres		323721	200400
		FEDERAL	001	Eddy	16S	31E	27	1980FNL/660FWL	-103.86323	32.89435	Square Lake	Grayburg/San Andres		94094	57350
		VALENTINE	001	Eddy	16S	31E	27	660FSL/660FWL	-103.86317	32.88717	Square Lake	Grayburg/San Andres		131064	22000
		SHELDON FED	001	Eddy	16S	31E	28	1980FSL/1980FWL	-103.87619	32.89072	Square Lake	Grayburg/San Andres		191620	115000
		STATE R	001	Eddy	16S	31E	32	660FNL/660FWL	-103.89755	32.88348	Square Lake	Grayburg/San Andres		18642	11359
		PUCKETT B	013	Eddy	17S	31E	25	660FSL/1980FEL	-103.82049	32.80015	Maljamar	Grayburg/San Andres	Artesia Group	25537	12460
		TRIMBLE A	003	Lea	17S	32E	11	3300FNL/660FEL	-103.73000	32.84697	Maljamar	Grayburg/San Andres		19817	9306
		STATE O	013	Lea	17S	32E	12	660FNL/660FWL	-103.72576	32.85424	Maljamar	Grayburg/San Andres		190078	113000
		UNIT	014	Lea	17S	32E	13	1980FSL/660FEL	-103.71284	32.83244	Maljamar	Grayburg/San Andres		144611	83090
		LYNX FEDERAL	007	Lea	17S	32E	15	1980FSL/840FWL	-103.76036	32.83270	Maljamar	Grayburg/San Andres		127874	78000
		MITCHELL B	009	Lea	17S	32E	17	660FSL/1980FEL	-103.78622	32.82915	Maljamar	Grayburg/San Andres		109034	84740
		MITCHELL B	009	Lea	17S	32E	17	660FSL/1980FEL	-103.78622	32.82915	Maljamar	Grayburg/San Andres		189390	118000
		MITCHELL B	009	Lea	17S	32E	17	660FSL/1980FEL	-103.78622	32.82915	Maljamar	Grayburg/San Andres		239100	137800

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														TDS	Cl
30-015-04632		LEBOW FEDERAL	004	Eddy	19S	30E	25	2310FNL/990FEL	-103.91959	32.63167	Hackberry North	Yates/Seven Rivers	Artesia Group	16669	8605
30-015-04634		LEBOW FEDERAL	006	Eddy	19S	30E	25	2310FSL/660FEL	-103.91851	32.62988	Hackberry North	Yates/Seven Rivers	Artesia Group	15840	8698
30-015-04723		GULF FEDERAL	001	Eddy	20S	30E	33	1980FNL/1980FWL	-103.97873	32.53120	Dos Hermanos	Yates/Seven Rivers	Artesia Group	32500	18250
30-015-05773		READ FED	001	Eddy	19S	31E	20	1980FSL/1980FWL	-103.89267	32.64352	Hackberry North	Yates/Seven Rivers	Artesia Group	187620	115000
30-015-05803		CEM FEDERAL	001	Eddy	19S	31E	29	660FNL/1980FEL	-103.88838	32.63628	Hackberry North	Yates/Seven Rivers	Artesia Group	20540	11130
30-015-05806		SOUTHERN FEDERAL	002	Eddy	19S	31E	30	1650FNL/1650FEL	-103.90440	32.63351	Hackberry North	Yates/Seven Rivers	Artesia Group	146255	88710
30-025-00895		FEDERAL	001	Lea	19S	32E	13	2310FSL/330FEL	-103.71188	32.65852	Tonto West	Yates/Seven Rivers	Artesia Group	239594	145300
30-025-00923		BOWMAN FEDERAL	001	Lea	19S	32E	28	666FNL/650FWL	-103.77721	32.63655	Lusk East	Yates/Seven Rivers	Artesia Group	15821	7812
30-025-01742		ATLANTIC STATE	001	Lea	20S	33E	16	990FNL/1980FWL	-103.66989	32.57682	Teas West	Yates/Seven Rivers	Artesia Group	13495	7002
30-025-01744		LEA 886 STATE	002	Lea	20S	33E	16	560FNL/1980FEL	-103.66567	32.57771	Teas West	Yates/Seven Rivers	Artesia Group	133829	82525
30-025-01744		LEA 886 STATE	002	Lea	20S	33E	16	660FNL/1980FEL	-103.66567	32.57771	Teas West	Yates/Seven Rivers	Artesia Group	133741	82536
30-025-02439		MUSE	001	Lea	20S	34E	21	660FNL/660FEL	-103.55814	32.58348	Lynch Middle	Yates/Seven Rivers	Artesia Group	9610	3760
30-025-02449		R AND B FEDERAL	001	Lea	20S	34E	22	330FSL/2310FEL	-103.54652	32.55175	Lynch	Yates/Seven Rivers	Artesia Group	20395	9800
30-025-02478		WILLS A FEDERAL	001	Lea	20S	34E	29	330FNL/330FWL	-103.58944	32.54979	Teas	Yates/Seven Rivers	Artesia Group	31894	17830
30-025-02511		NEAL	001	Lea	20S	34E	35	1650FSL/2310FEL	-103.52942	32.52834	Lynch	Yates/Seven Rivers	Artesia Group	18174	7932
30-025-02545		STATE BATTERY 4	040	Lea	21S	34E	13	990FSL/2310FWL	-103.42416	32.47436	Wilson	Yates/Seven Rivers	Artesia Group	13956	6090
30-025-02545		STATE BATTERY 4	040	Lea	21S	34E	13	990FSL/2310FWL	-103.42416	32.47436	Wilson	Yates/Seven Rivers	Artesia Group	19284	8888
30-025-02545		STATE BATTERY 4	040	Lea	21S	34E	13	990FSL/2310FWL	-103.42416	32.47436	Wilson	Yates/Seven Rivers	Artesia Group	19597	9292
30-025-02587		STATE P	003	Lea	21S	34E	24	330FNL/330FWL	-103.43056	32.47073	Wilson	Yates/Seven Rivers	Artesia Group	9127	4402
30-025-02587		STATE P	003	Lea	21S	34E	24	330FNL/330FWL	-103.43056	32.47073	Wilson	Yates/Seven Rivers	Artesia Group	29241	17340
30-025-02587		STATE P	003	Lea	21S	34E	24	330FNL/330FWL	-103.43056	32.47073	Wilson	Yates/Seven Rivers	Artesia Group	10118	5217
30-025-02595		STATE BATTERY 2	024	Lea	21S	34E	24	1650FSL/330FWL	-103.43061	32.46158	Wilson	Yates/Seven Rivers	Artesia Group	12590	5180
30-025-02595		STATE BATTERY 2	024	Lea	21S	34E	24	1650FSL/330FWL	-103.43061	32.46158	Wilson	Yates/Seven Rivers	Artesia Group	17860	8332
30-025-02595		STATE BATTERY 2	024	Lea	21S	34E	24	1650FSL/330FWL	-103.43061	32.46158	Wilson	Yates/Seven Rivers	Artesia Group	12560	4960
30-025-02595		STATE BATTERY 2	024	Lea	21S	34E	24	1650FSL/330FWL	-103.43061	32.46158	Wilson	Yates/Seven Rivers	Artesia Group	16050	6747
30-025-02595		STATE BATTERY 2	024	Lea	21S	34E	24	1650FSL/330FWL	-103.43061	32.46158	Wilson	Yates/Seven Rivers	Artesia Group	12540	5000
30-025-02620		STATE B	001	Lea	21S	33E	01	2311FNL/330FWL	-103.53312	32.51545	Lynch	Yates/Seven Rivers	Artesia Group	5350	
30-025-09462		PERRY FEDERAL	001	Lea	20S	34E	22	330FSL/990FEL	-103.54224	32.55161	Lynch	Yates/Seven Rivers	Artesia Group	19994	10950
30-025-09829		FEDERAL	005	Lea	26N	35E	01	1980FSL/660FEL	-103.21218	32.07021	salt water disposal well	Yates/Seven Rivers	Artesia Group	5420	2174
30-025-09854		FEDERAL	001	Lea	26N	36E	13	990FNL/330FEL	-103.21118	32.04757	Scarborough	Yates/Seven Rivers	Artesia Group	392600	232700
30-025-09854		FEDERAL	001	Lea	26N	36E	13	990FNL/330FEL	-103.21118	32.04757	Scarborough	Yates/Seven Rivers	Artesia Group	2797	158
30-025-09862		MCCALLISTER A	002	Lea	26N	36E	24	330FNL/990FEL	-103.21326	32.03484	Scarborough	Yates/Seven Rivers	Artesia Group	5495	2114
30-025-09862		MCCALLISTER A	002	Lea	26N	36E	24	330FNL/990FEL	-103.21326	32.03484	Scarborough	Yates/Seven Rivers	Artesia Group	6960	2870
30-025-11961		FEDERAL	005	Lea	26N	37E	07	1980FSL/660FWL	-103.20794	32.05573	Scarborough	Yates/Seven Rivers	Artesia Group	10693	4990
30-025-11961		FEDERAL	005	Lea	26N	37E	07	1980FSL/660FWL	-103.20794	32.05573	Scarborough	Yates/Seven Rivers	Artesia Group	14310	5200
30-025-11961		FEDERAL	005	Lea	26N	37E	07	1980FSL/660FWL	-103.20794	32.05573	Scarborough	Yates/Seven Rivers	Artesia Group	10701	4994
30-025-11961		FEDERAL	005	Lea	26N	37E	07	1980FSL/660FWL	-103.20794	32.05573	Scarborough	Yates/Seven Rivers	Artesia Group	16461	10048
30-025-11961		FEDERAL	005	Lea	26N	37E	07	1980FSL/660FWL	-103.20794	32.05573	Scarborough	Yates/Seven Rivers	Artesia Group	16452	10040
30-025-11962		FEDERAL	003	Lea	26N	37E	07	1980FSL/1650FWL	-103.20474	32.05572	Scarborough	Yates/Seven Rivers	Artesia Group	7495	2198
30-025-11965		FEDERAL	001	Lea	26N	37E	08	1980FSL/1980FEL	-103.18234	32.05572	Rhodes	Yates/Seven Rivers	Artesia Group	9254	5082
30-025-11965		FEDERAL	001	Lea	26N	37E	08	1980FSL/1980FEL	-103.18234	32.05572	Rhodes	Yates/Seven Rivers	Artesia Group	12098	6464
30-025-11965		FEDERAL	001	Lea	26N	37E	08	1980FSL/1980FEL	-103.18234	32.05572	Rhodes	Yates/Seven Rivers	Artesia Group	10999	
30-025-11965		FEDERAL	001	Lea	26N	37E	08	1980FSL/1980FEL	-103.18234	32.05572	Rhodes	Yates/Seven Rivers	Artesia Group	10381	
30-025-12006		EAVES B 1	017	Lea	26N	37E	18	2310FNL/2310FEL	-103.20043	32.02941	Scarborough	Yates/Seven Rivers	Artesia Group	11847	4792
30-025-12007		EAVES A	001	Lea	26N	37E	19	330FSL/2310FEL	-103.20043	32.02218	Scarborough	Yates/Seven Rivers	Artesia Group	39984	22806
30-025-12008		EAVES A	002	Lea	26N	37E	19	660FSL/660FWL	-103.20795	32.02306	Scarborough	Yates/Seven Rivers	Artesia Group	12604	6040
30-025-12015		EAVES B 1	018	Lea	26N	37E	19	660FNL/1980FWL	-103.20387	32.03394	Scarborough	Yates/Seven Rivers	Artesia Group	9802	2900
30-025-12075		FEDERAL NCT 2	003	Lea	26N	37E	28	1980FSL/660FEL	-103.16100	32.01222	Rhodes	Yates/Seven Rivers	Artesia Group	283600	176800
30-025-12076		EAVES A	011	Lea	26N	37E	30	660FNL/660FEL	-103.19511	32.01948	Scarborough	Yates/Seven Rivers	Artesia Group	34845	20300
30-025-12078		EAVES A	011	Lea	26N	37E	30	660FNL/660FEL	-103.19511	32.01948	Scarborough	Yates/Seven Rivers	Artesia Group	5463	2002
30-025-12082		EAVES A	014	Lea	26N	37E	30	660FNL/660FWL	-103.20795	32.01944	Scarborough	Yates/Seven Rivers	Artesia Group	35637	20760
30-025-20001		EAVES B	008	Lea	26N	37E	30	660FSL/330FEL	-103.19410	32.00863	Scarborough	Yates/Seven Rivers	Artesia Group	201553	125800
30-025-20001		EAVES B	008	Lea	26N	37E	30	660FSL/330FEL	-103.19410	32.00863	Scarborough	Yates/Seven Rivers	Artesia Group	5758	1172
30-025-20001		EAVES B	008	Lea	26N	37E	30	660FSL/330FEL	-103.19410	32.00863	Scarborough	Yates/Seven Rivers	Artesia Group	138209	85150
30-025-20745		SINCLAIR STATE	001	Lea	21S	33E	02	1650FSL/1650FEL	-103.53947	32.50465	Lynch	Yates/Seven Rivers	Artesia Group	27135	11850
30-025-21346		FEDERAL	006	Lea	20S	34E	22	1650FSL/990FWL	-103.55293	32.55531	Lynch	Yates/Seven Rivers	Artesia Group	15685	5925
30-025-23861	DAKOTA	WALLEN FEDERAL	001	Lea	20S	34E	20	330FNL/330FWL	-103.58974	32.58427	Teas	Yates/Seven Rivers	Artesia Group	33296.1	20219.7
30-025-26625	FULFER OIL & CATTLE	FEDERAL	001	Lea	20S	34E	19	330FSL/1650FEL	-103.59590	32.55163	Teas	Yates/Seven Rivers	Artesia Group	24818.5	14918.5
30-025-26625	G P M GAS CORPORATION	FEDERAL	001	Lea	20S	34E	19	330FSL/1650FEL	-103.59560	32.55163	Teas	Yates/Seven Rivers	Artesia Group	4910.55	268,268
30-025-32032	BASS ENTERPRISES	ANASAZI 4 STATE	003	Lea	20S	33E	04	1650FSL/1980FEL	-103.66582	32.59867	Teas West	Yates/Seven Rivers	Artesia Group	17898.7	9882.25
30-025-03361		LEA 688 STATE	001	Lea	20S	35E	25	660FNL/660FEL	-103.40405	32.54898	Eumont	Yates/Seven Rivers/Queen	Artesia Group	174035	106839
30-025-03459		STATE 12	001	Lea	21S	35E	12	1980FSL/990FWL	-103.32609	32.49155	Eumont	Yates/Seven Rivers/Queen	Artesia Group	119405	71740
30-025-03506		ATLANTIC STATE	002	Lea	21S	35E	25	2310FSL/1650FEL	-103.31760	32.44888	Eumont	Yates/Seven Rivers/Queen	Artesia Group	39900	21000
30-025-03506		ATLANTIC STATE	002	Lea	21S	35E	25	2310FSL/1650FEL	-103.31760	32.44888	Eumont	Yates/Seven Rivers/Queen	Artesia Group	51000	20700
30-025-03506		ATLANTIC STATE	002	Lea	21S	35E	25	2310FSL/1650FEL	-103.31760	32.44888	Eumont	Yates/Seven Rivers/Queen	Artesia Group	40000	21000
30-025-03508		ATLANTIC STATE	002	Lea	21S	35E	25	2310FSL/1650FEL	-103.31760	32.44888	Eumont	Yates/Seven Rivers/Queen	Artesia Group	40200	20700
30-025-04099		EUMONT UNIT	158	Lea	19S	36E	33	2310FNL/330FEL	-103.35159	32.61728	Eumont	Yates/Seven Rivers/Queen	Artesia Group	68631	38110
30-025-04130		COM	001	Lea	20S	36E	01	330FNL/330FEL	-103.29998	32.60854	Eumont	Yates/Seven Rivers/Queen	Artesia Group	13609	4934
30-025-04152		STATE NCT-1	002	Lea	20S	36E	01	660FSL/1980FWL	-103.30989	32.59644	Eumont	Yates/Seven Rivers/Queen	Artesia Group	14980	
30-025-04152		STATE NCT-1	002	Lea	20S	36E	01	660FSL/1980FWL	-103.30969	32.59844	Eumont	Yates/Seven Rivers/Queen	Artesia Group	33835	17060
30-025-04374		STATE WEI 32	001	Lea	20S	36E	32	660FSL/1980FEL	-103.37389	32.52392	Eumont	Yates/Seven Rivers/Queen	Artesia Group	177450	
30-025-04465	CONOCO INC.	MEYER B 4	004	Lea	21S	36E	04	1980FSL/1980FWL	-103.27189	32.50587	Eumont	Yates/Seven Rivers/Queen	Artesia Group	15448.6	9355.94
30-025-04529	CHEVRON USA INC.	GAS COM	003	Lea	21S	36E	06	1980FSL/1980FEL	-103.30192	32.50590	Eumont	Yates/Seven Rivers/Queen	Artesia Group	22819.2	12767.8
30-025-04529	CHEVRON USA INC.	GAS COM	003	Lea	21S	36E	08	1980FSL/1980FEL	-103.30192	32.50590	Eumont	Yates/Seven Rivers/Queen	Artesia Group	19868.9	11002.3
30-025-04534		COM A	003	Lea	21S	36E	06	1980FNL/1980FEL	-103.30190	32.51651	Eumont	Yates/Seven Rivers/Queen	Artesia Group	11315	5196
30-025-04536		SHELL E STATE COM	001	Lea	21S	36E	08	3300FNL/1980FEL	-103.30190	32.51288	Eumont	Yates/Seven Rivers/Queen	Artesia Group	8175	3608
30-025-04591		A J ADKINS COM	001	Lea	21S	36E	10	1980FSL/660FWL	-103.25925	32.49148	Eumont	Yates/Seven Rivers/Queen	Artesia Group	7368	3120
30-025-04613		M S BERRYMAN	001	Lea	21S	36E	11	330FSL/1650FEL	-103.23247	32.48690	Eumont	Yates/Seven Rivers/Queen	Artesia Group	15728	9204
30-025-04707	ARCO PERMIAN	STATE 176	003	Lea	21S	36E	19	2310FSL/1650FEL	-103.30096	32.46332	Eumont	Yates/Seven Rivers/Queen	Artesia Group	5019.22	2352.67
30-025-04710	ARCO PERMIAN	STATE 176	004	Lea	21S	36E	19	1650FNL/2310FEL	-103.30309	32.46719	Eumont	Yates/Seven Rivers/Queen	Artesia Group	1660.69	832.49
30-025-04723		STATE C 20	006	Lea	21S	36E	20	660FNL/1980FWL	-103.28918	32.46989	Eumont	Yates/Seven Rivers/Queen	Artesia Group	7585	3293
30-025-04725		STATE C 20	008	Lea	21S	36E	20	1980FSL/660FWL	-103.29347	32.46241	Eumont	Yates/Seven Rivers/Queen	Artesia Group	7800	
30-025-04725		STATE C 20	008	Lea	21S	36E	20	1980FSL/660FWL	-103.29347	32.46241	Eumont	Yates/Seven Rivers/Queen	Artesia Group	8759	3940
30-025-04728		DEVONIAN STATE	005	Lea	21S	36E	20	1980FNL/1980FEL	-103.28476	32.46825	Eumont	Yates/Seven Rivers/Queen	Artesia Group	82730	48060

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NMSLO Exhibit #2C

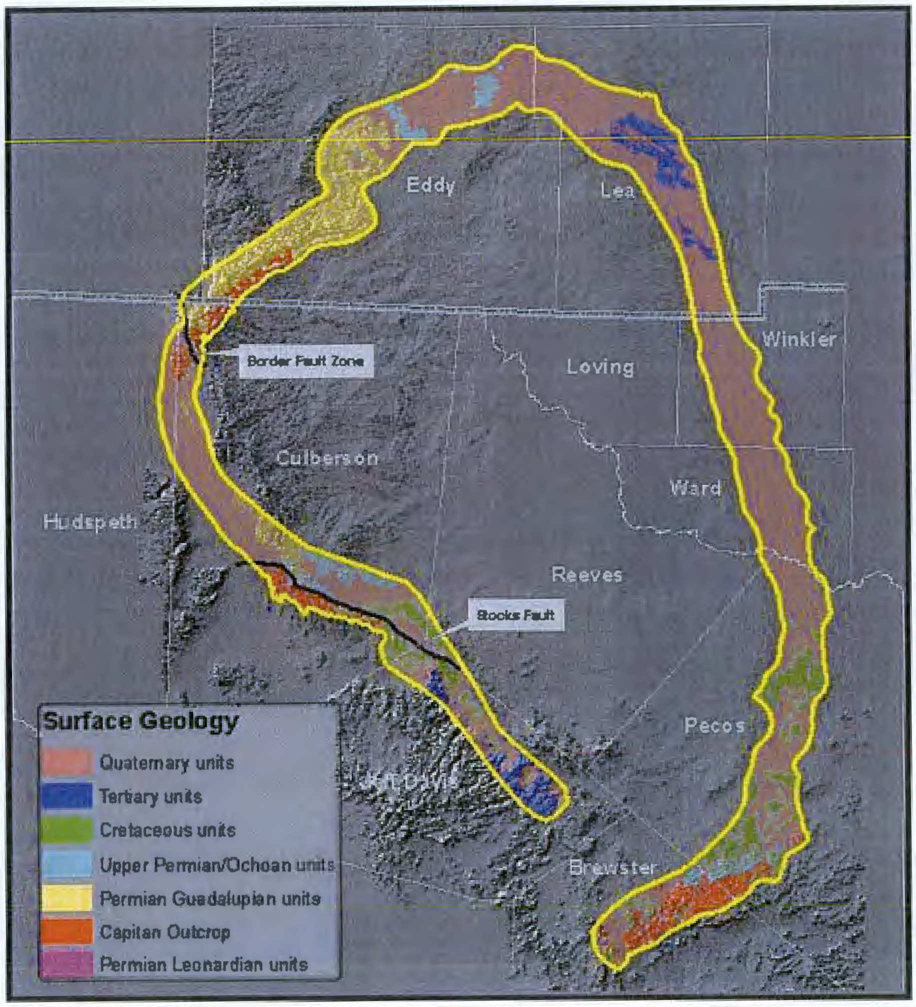
														TDS	Cl
30-025-09766		JALMAT YATES UNIT	022	Lea	25S	36E	13	1650FNL/330FEL	-103.21106	32.13280	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	1506	409
30-025-09779		EXXON	001	Lea	25S	37E	21	1980FSL/1980FEL	-103.16519	32.11370	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	304760	162000
30-025-09782		H M WILSON	001	Lea	25S	36E	23	330FNL/1650FEL	-103.23244	32.12207	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	10570	4914
30-025-09788		FEDERAL	001	Lea	25S	36E	24	990FSL/1650FWL	-103.22176	32.11108	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	117899	68860
30-025-09789		FEDERAL	002	Lea	25S	36E	24	1650FSL/1650FWL	-103.22176	32.11289	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	316728	182700
30-025-09791		ASCARTA FEDERAL	001	Lea	25S	36E	24	330FNL/2310FWL	-103.21966	32.12204	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	35753	18400
30-025-09812		SHOLES B 25	001	Lea	25S	36E	25	2310FNL/990FEL	-103.21314	32.10197	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	11346	4824
30-025-10793		FARNEY A 17	003	Lea	23S	36E	17	1650FNL/990FWL	-103.29223	32.30717	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	123722	79130
30-025-10809		FEDERAL 714	004	Lea	23S	36E	20	1980FSL/1980FWL	-103.28886	32.28807	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	16978	9513
30-025-11047		MYERS B FEDERAL	010	Lea	24S	37E	07	1980FNL/1980FEL	-103.19966	32.23341	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	41659	25010
30-025-11447		SMITH	003	Lea	25S	37E	04	2310FSL/660FEL	-103.16107	32.15813	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	37821	18315
30-025-11477		GROUP 3	001	Lea	25S	37E	06	660FSL/646FWL	-103.20790	32.15367	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	41695	22690
30-025-11478		GROUP 3	002	Lea	25S	37E	08	1963FNL/843FEL	-103.19518	32.16086	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	68360	39760
30-025-11479		GROUP 3	002	Lea	25S	37E	08	1963FNL/843FEL	-103.19518	32.16086	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	63093	34552
30-025-11681		JOHNS FEDERAL	001	Lea	25S	37E	20	660FNL/660FEL	-103.17797	32.12107	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	67037	38474
30-025-11682		B T LANEHART	003	Lea	25S	37E	21	660FNL/1980FWL	-103.16944	32.12107	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	108837	65493
30-025-11692		B T LANEHART	003	Lea	25S	37E	21	660FNL/1980FWL	-103.16944	32.12107	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	110096	68478
30-025-11692		B T LANEHART	003	Lea	25S	37E	21	660FNL/1980FWL	-103.16944	32.12107	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	101422	55165
30-025-11860		L W GREGORY A	022	Lea	25S	37E	31	990FSL/1650FWL	-103.20473	32.08212	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	12048	5947
30-025-11860		L W GREGORY A	022	Lea	25S	37E	31	990FSL/1650FWL	-103.20473	32.08212	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	9899	4613
30-025-11860		L W GREGORY A	022	Lea	25S	37E	31	990FSL/1650FWL	-103.20473	32.08212	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	5900	1877
30-025-11860		L W GREGORY A	022	Lea	25S	37E	31	990FSL/1650FWL	-103.20473	32.08212	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	11899	5900
30-025-11872		SHAHAN	001	Lea	25S	37E	33	660FNL/1980FEL	-103.16521	32.09200	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	5453	1862
30-025-11935		O C CAGLE O	001	Lea	26S	37E	03	990FNL/990FWL	-103.15558	32.07665	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	83382	49320
30-025-12761		STATE 157 F	002	Lea	23S	36E	17	1980FNL/660FEL	-103.28023	32.30628	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	4761	2622
30-025-20245		STATE A A/C 3 COM A	008	Lea	23S	36E	10	660FSL/660FEL	-103.24626	32.31341	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	16011	6179
30-025-20645		POOL UNIT	012	Lea	22S	35E	24	1615FNL/830FWL	-103.32670	32.37952	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	27070	13470
30-025-24622		JACK B 17	004	Lea	24S	37E	17	990FNL/1980FWL	-103.18678	32.22164	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	308000	201000
30-025-24622		JACK B 17	004	Lea	24S	37E	17	990FNL/1980FWL	-103.18678	32.22164	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	293000	196000
30-025-25469		A L CHRISTMAS	003	Lea	22S	36E	25	330FSL/2310FEL	-103.21748	32.35643	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	201909	124386
30-025-25571		MYERS B FEDERAL	003	Lea	24S	36E	26	660FNL/2130FEL	-103.23408	32.19347	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group	19713	9500
30-025-26373		FEDERAL	001	Lea	25S	37E	09	1980FSL/1980FEL	-103.16626	32.14291	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group		15
30-025-30591	Southland Royalty	COOPER	003	Lea	24S	36E	14	1650FNL/2310FWL	-103.23662	32.21979	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group		727.2
30-025-32295		CHRISTMAS A	004	Lea	22S	36E	23	1980FNL/1980FWL	-103.23771	32.37535	Jalmat	Tansill/Yates/Seven Rivers	Artesia Group		2803
30-015-01068		WELCH FEDERAL	006	Eddy	21S	27E	05	990FSL/2310FEL	-104.21073	32.50396	Cedar Hills	Yates	Artesia Group	10050	4050
30-015-01069		WELCH FEDERAL	003	Eddy	21S	27E	05	2970FSL/990FEL	-104.20644	32.50945	Cedar Hills	Yates	Artesia Group	11260	4553
30-015-01091		EXXON STATE	001	Eddy	21S	27E	15	1650FSL/1650FEL	-104.17434	32.47750	Magruder	Yates	Artesia Group	11800	5250
30-015-02335		CROSBY	001	Eddy	20S	28E	01	2326FNL/1658FEL	-104.12869	32.60328		Yates	Artesia Group	32300	14800
30-015-02352		WILLS FEDERAL	001	Eddy	20S	28E	13	1980FSL/660FWL	-104.13663	32.57172	Russell	Yates	Artesia Group	50610	29400
30-015-02353		TURNER FEDERAL	003	Eddy	20S	28E	18	1980FSL/1968FEL	-104.12830	32.57168	Russell	Yates	Artesia Group	36600	17600
30-015-02356		WILLS FEDERAL	003	Eddy	20S	28E	13	1980FNL/1980FEL	-104.12833	32.57516	Russell	Yates	Artesia Group	81000	45500
30-015-02361		TURNER FEDERAL	007	Eddy	20S	28E	13	990FSL/2310FEL	-104.12941	32.56896	Russell	Yates	Artesia Group	29100	14400
30-015-02381		TURNER FEDERAL	009	Eddy	20S	28E	13	990FNL/2310FWL	-104.13176	32.57782	Russell	Yates	Artesia Group	40200	17400
30-015-02390		TURNER FEDERAL	016	Eddy	20S	28E	13	1658FNL/2339FWL	-104.13153	32.57599	Russell	Yates	Artesia Group	24308	12310
30-015-02395		TURNER FEDERAL	018	Eddy	20S	28E	13	1658FNL/2339FWL	-104.13153	32.57599	Russell	Yates	Artesia Group	27048	13330
30-015-02419		TURNER FEDERAL	023	Eddy	20S	28E	13	1658FNL/1689FWL	-104.13371	32.57595	Russell	Yates	Artesia Group	28980	14640
30-015-03615		VICKERS	001	Eddy	20S	28E	23	660FNL/660FEL	-104.14104	32.56448	Russell	Yates	Artesia Group	25500	11500
30-015-03615		PAN AMERICAN	001	Eddy	19S	29E	34	330FSL/330FEL	-104.05443	32.61021		Yates	Artesia Group	152678	82800
30-015-03615		PAN AMERICAN	001	Eddy	19S	29E	34	330FSL/330FEL	-104.05443	32.61021		Yates	Artesia Group	66591	35200
30-015-03642		PAN AMERICAN	001	Eddy	19S	29E	34	330FSL/330FEL	-104.05443	32.61021		Yates	Artesia Group	51629	25250
30-015-04544		MCKEE	001	Eddy	20S	29E	11	2310FSL/2310FWL	-104.04581	32.58663	Getty	Yates	Artesia Group	29411	14350
30-015-04675		WATERFLOOD UNIT	023	Eddy	18S	30E	25	1650FSL/1650FEL	-103.92178	32.71652	Shugart	Yates	Artesia Group	214722	124200
30-015-05567		KEYS	002	Eddy	20S	30E	15	1980FNL/1980FEL	-103.95723	32.57457	PCA	Yates	Artesia Group	32186	16350
30-015-05621		QUEEN UNIT	009	Eddy	18S	31E	20	990FSL/660FEL	-103.88469	32.72807	Shugart	Yates	Artesia Group	163467	114000
30-015-05621		FEDERAL	002	Eddy	18S	31E	28	1980FSL/660FEL	-103.88034	32.71645	Shugart	Yates	Artesia Group	212963	131900
30-015-05774		FEDERAL	002	Eddy	18S	31E	28	1980FSL/660FEL	-103.88034	32.71645	Shugart	Yates	Artesia Group		157000
30-015-05796		TENNESSEE FEDERAL	001	Eddy	19S	31E	21	1980FSL/660FEL	-103.86684	32.64359		Yates	Artesia Group	18119	10450
30-015-05814		BARBARA FED	001	Eddy	18S	31E	29	2310FSL/2310FWL	-103.89154	32.62991	Hackberry North	Yates	Artesia Group	39586	19400
30-015-05824		BROOKE-ADAMS FE	001	Eddy	19S	31E	31	330FNL/330FWL	-103.91530	32.62262	Hackberry North	Yates	Artesia Group	22672	12090
30-015-10002		ZORICHAK	001	Eddy	20S	31E	07	1980FSL/660FWL	-103.91418	32.58543		Yates	Artesia Group	35513	17770
30-015-20247	Yates Petroleum Corp.	TRIGOOD ST	001	Eddy	20S	29E	02	1980FNL/660FWL	-104.05120	32.60366		Yates	Artesia Group	23526	8526
30-015-20289		CREEK AL FEDERAL	004	Eddy	18S	30E	24	330FSL/1980FEL	-103.92287	32.72629	Shugart	Yates	Artesia Group	39656	36000
30-025-01701		CREEK AL FEDERAL	006	Eddy	18S	30E	25	1650FNL/2310FWL	-103.92590	32.72086	Shugart	Yates	Artesia Group		21300
30-025-03023	GILLESPIE OIL COMPANY	MAGNOLIA STATE	001	Lea	19S	33E	32	660FNL/1980FEL	-103.68287	32.62156	Gem	Yates	Artesia Group	8771	4301
30-025-03023	GILLESPIE OIL COMPANY	STATE M	008	Lea	17S	35E	34	1986FNL/1889FWL	-103.44783	32.79255	Vacuum	Yates	Artesia Group	236745	160322
30-025-03523		STATE M	008	Lea	17S	35E	34	1986FNL/1889FWL	-103.44783	32.79255	Vacuum	Yates	Artesia Group	214661	145447
30-025-03524		STATE NCT 6	003	Lea	21S	35E	29	1980FNL/660FWL	-103.39566	32.45176	San Simon North	Yates	Artesia Group	117601	70410
30-025-03526		STATE NCT 6	004	Lea	21S	35E	29	1980FNL/1980FWL	-103.39137	32.45175	San Simon North	Yates	Artesia Group	145491	88610
30-025-08961		STATE EW	001	Lea	21S	35E	31	330FNL/330FEL	-103.39894	32.44193	San Simon North	Yates	Artesia Group	22610	11200
30-025-09236		CLOSSON B FEDERAL	018	Lea	22S	36E	19	660FSL/660FWL	-103.31023	32.37170	salt water disposal well	Yates	Artesia Group	37646	23580
30-025-09236		STATE A A/C 1	043	Lea	23S	36E	03	660FSL/660FWL	-103.25919	32.32809	Langlie Mattix	Yates	Artesia Group	247652	149800
30-025-20216		STATE A A/C 1	043	Lea	23S	36E	03	660FSL/660FWL	-103.25919	32.32809	Langlie Mattix	Yates	Artesia Group	174624	105400
30-025-20462		BAISH A	009	Lea	17S	32E	21	1650FNL/1650FEL	-103.76791	32.82270	Baish	Yates	Artesia Group	332366	203200
30-025-20462		WILSON G	001	Lea	21S	34E	02	1980FSL/660FWL	-103.44672	32.50596	Wilson West	Yates	Artesia Group	305848	179100
30-025-20489		WILSON G	001	Lea	21S	34E	02	1980FSL/660FWL	-103.44672	32.50596	Wilson West	Yates	Artesia Group	145214	81910
30-025-20769		HANSON FEDERAL	001	Lea	18S	32E	35	660FSL/660FWL	-103.74304	32.69785	wildcat	Yates	Artesia Group	210927	
30-025-20769		PLAINS	006	Lea	19S	32E	21	1980FNL/660FWL	-103.77719	32.64734	Lusk East	Yates	Artesia Group	135266	84150
30-025-20769		PLAINS	006	Lea	19S	32E	21	1980FNL/660FWL	-103.77719	32.64734	Lusk East	Yates	Artesia Group	163755	101000
30-025-22567		PLAINS	006	Lea	19S	32E	21	1980FNL/660FWL	-103.77719	32.64734	Lusk East	Yates	Artesia Group	137149	84930
30-025-26091		BATE FEDERAL	003	Lea	19S	33E	35	330FNL/1980FWL	-103.63581	32.62235	salt water disposal well	Yates	Artesia Group	117622	66700
30-025-30589	EPNG	NELLIS FEDERAL	003	Lea	19S	33E	06	1980FNL/1980FWL	-103.70432	32.69037	Buffalo	Yates	Artesia Group	70660	42600
30-015-03645		TIFFANY	001	Lea	19S	38E	26	1980FNL/660FWL	-103.12519	32.63275	wildcat	Yates	Artesia Group	9283.72	1090
30-015-04624		TEXACO FED	001	Eddy	20S	29E	13	660FNL/1980FWL	-104.02968	32.57843	Getty	Yates/Seven Rivers	Artesia Group	26017	12160
		YATES UNIT	104	Eddy	19S	30E	24	2310FNL/660FWL	-103.93126	32.64656	Hackberry North	Yates/Seven Rivers	Artesia Group	70458	41140

Yates

Water Sample Analysis

Pool	Section	Location Township	Range	Chlorides
North Justis Montoya	2	25S	37E	45440
North Justis McKee	2	25S	37E	58220
North Justis Fusselman	2	25S	37E	68533
North Justis Ellenburger	2	25S	37E	34151
Fowler Blinebry	22	24S	37E	116085
Skaggs Grayburg	18	20S	38E	84845
Warren McKee	18	20S	38E	85910
Warren Abo	19	20S	38E	91600
DK Drinkard	30	20S	39E	106855
Littman San Andres	8	21S	38E	38695
East Hobbs grayburg	29	18S	39E	6461
Halfway Yates	18	20S	32E	14768
Arkansas Junction San Andres	12	18S	36E	7171
Pearl Queen	28	19S	35E	114310
Midway Abo	17	17S	37E	36494
Lovinton Abo	31	16S	37E	22933
Lovington San Andres	3	16S	37E	4899
Lovington Paddock	31	16S	37E	93720
Mesa Queen	17	16S	32E	172530
Kemnitz Wolfcamp	27	16S	34E	49345
Hume Queen	9	16S	34E	124960
Anderson Ranch Wolfcamp	2	16S	32E	11040
Anderson Ranch Devonian	11	16S	32E	25702
Anderson Ranch Unit	11	16S	32E	23786
Caudill Devonian	9	15S	36E	20874
Townsend Wolfcamp	6	16S	36E	38695
Dean Permo Penn	5	16S	37E	44730
Dean Devonian	35	15S	36E	19525
South Denton Wolfcamp	26	15S	37E	54315
South Denton Devonian	36	15S	37E	34080
Medicine Rock Devonian	15	15S	38E	39760
Little Lucky Lake Devonian	29	15S	30E	23288
Wantz Abo	26	21S	37E	132770
Crosby Devonian	18	25S	37E	58220
Scarborough Yates Seven Rivers	7	26S	37E	3443(Reef)
Teague Simpson	34	23S	37E	114685
Teague Ellenburger	34	23S	37E	120345
Rhodes Yates 7 Rivers	27	26S	37E	144485
House SA	11	20S	38E	93365
House Drinkard	12	20S	38E	49700
South Leonard Queen	24	26S	37E	115375
Elliot Abo	2	21S	38E	55380
Scharb Bone Springs	5	19S	35E	30601
EK Queen	13	18S	34E	41890
East EK Queen	22	18S	34E	179630
Maljamar Grayburg SA	22	17S	32E	46079
Maljamar Paddock	27	17S	32E	115375
Maljamar Devonian	22	17S	32E	25418

Capitan Reef Complex Structure and Stratigraphy



Report
by
Allan Standen, P.G.
Steve Finch, P.G.
Randy Williams, P.G.,
Beronica Lee-Brand, P.G.
Assisted by Paul Kirby

Texas Water Development Board
Contract Number 0804830794

September 2009

NMOCD Case No. 15723

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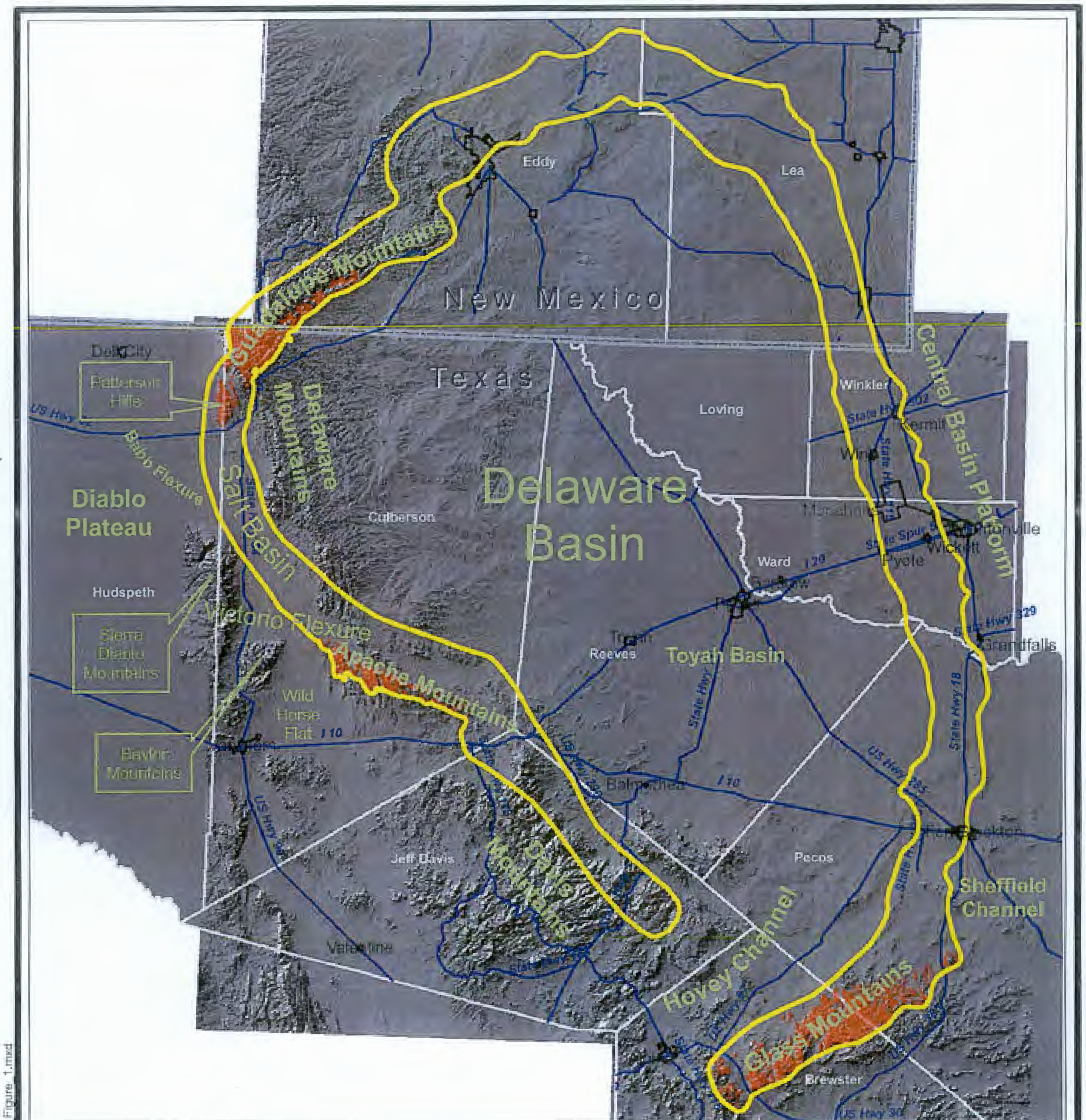
TABLES

APPENDICES

1. Executive summary

The Daniel B. Stephens & Associates, Inc. (DBS&A) team, consisting of DBS&A, John Shomaker & Associates, Inc., Bar-W Groundwater Exploration, and the Texas Bureau of Economic Geology, was contracted (Contract # 0804830794) by the Texas Water Development Board (TWDB) to construct a stratigraphic and structural framework of the Capitan Reef Complex. The purpose of the work is to develop a geologic framework that can serve as the foundation of a future groundwater availability model (GAM) of the Capitan Reef Complex Aquifer. The study area covers approximately 22,000 square miles in far west Texas and southeastern New Mexico and consists of all or portions of Winkler, Loving, Ward, Pecos, Reeves, Jeff Davis, Culberson, Brewster, and Hudspeth counties in Texas and Eddy and Lea Counties in New Mexico. The project consisted of compiling surface and subsurface geological data and information, constructing a geodatabase, and building a stratigraphic geologic model.

A total of 726 geophysical logs, driller's reports (oil, gas and water), and scout tickets were compiled into a geographical information system (GIS) geodatabase that was used to create Capitan Reef Complex surface, thickness, and base shapefiles and grids. An additional sand thickness grid was created of the subsurface sand-filled erosional channels between Capitan Reef Complex highs. The extent of the TWDB's Capitan Reef Complex Aquifer outline has been modified based on available data. The DBS&A team also compiled GIS shapefiles of the formations overlying and underlying the Capitan Reef Complex.



Explanation

- Capitan Reef Complex outline (revised)
- Capitan Reef Complex outcrop
- Cities
- Major roads
- Texas/New Mexico border
- County boundary

N

0 10 20 30 Miles

CAPITAN REEF COMPLEX

Study Area and Geological Features

Daniel B. Stephens & Associates, Inc.

08/28/2009 JN WR08.0039

Figure 1

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Table 1. Summary of geologic formations and groups forming the Capitan Reef Complex and Delaware Basin

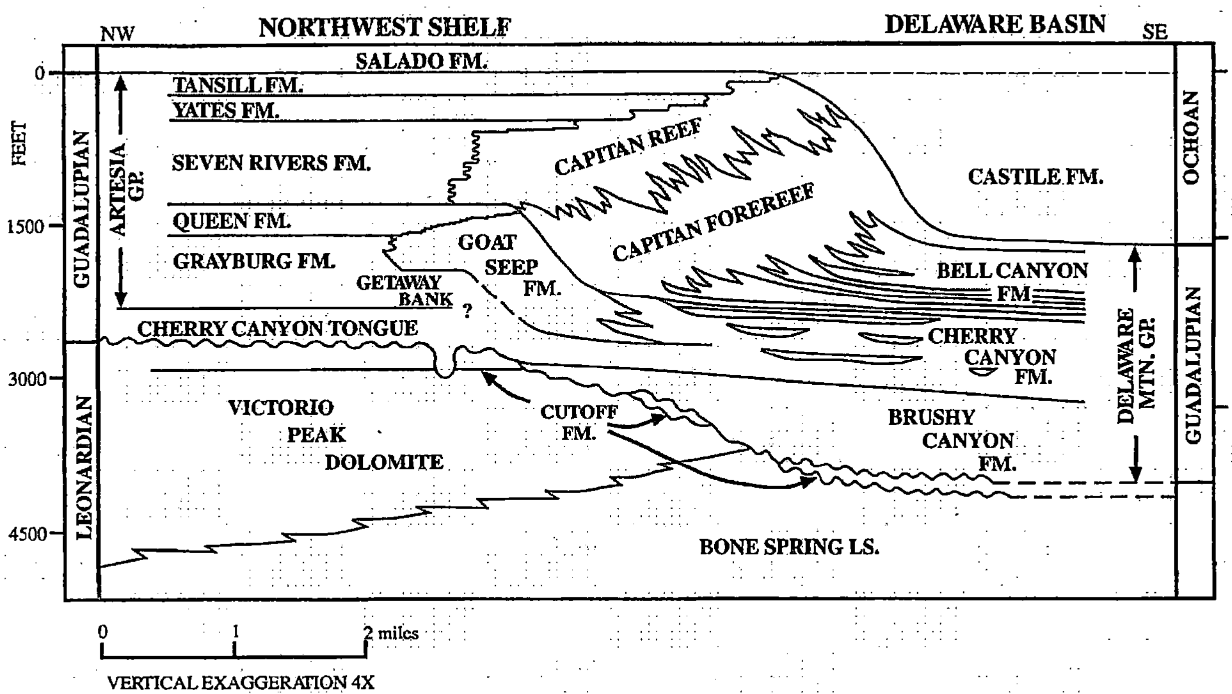
Period/Epoch or Series	Apache Mountains (Wood, 1968; Uliana, 2001)		Guadalupe Mountains (King, 1948; Hiss, 1975; Kerans and others, 1994; Kerans and Tinker, 1999)		Glass Mountains (King, 1930; Hill, 1999)		Delaware Basin
	Back Reef	Reef	Back Reef	Reef	Back Reef	Reef	
Quaternary to Tertiary	Quaternary Tertiary Deposits		Quaternary Tertiary Deposits		Quaternary Tertiary Deposits		Quaternary Tertiary Deposits
Cretaceous					Cretaceous		
Triassic					Bissett		
Permian/Ochoan				Rustler[a]			Rustler
				Salado[a]			Salado
				Castile[a]			Castile
Permian/ Guadalupian	Artesia Group: Tansill	Capitan Reef Complex; Capitan Limestone	Artesia Group: Tansill	Capitan Reef Complex; Carlsbad and Capitan Limestones	Gilliam	Capitan Reef Complex; Tessey	Delaware Mountain Group: Bell Canyon
	Artesia Group: Yates	Capitan Reef Complex; Capitan Limestone	Artesia Group: Yates	Capitan Reef Complex; Carlsbad and Capitan Limestones	Gilliam	Capitan Reef Complex; Vidrio	Delaware Mountain Group: Cherry Canyon
	Artesia Group: Seven Rivers	Capitan Reef Complex; Capitan Limestone	Artesia Group: Seven Rivers	Capitan Reef Complex; Carlsbad and Capitan Limestones	Gilliam	Capitan Reef Complex; Vidrio	Delaware Mountain Group: Cherry Canyon
	Artesia Group: Munn		Artesia Group: Queen/ Grayburg	Capitan Reef Complex; Goat Seep Dolomite	Gilliam	Capitan Reef Complex; Vidrio	Delaware Mountain Group: Cherry Canyon
	Cherry Canyon		Upper San Andres; Lower San Andres (equivalent to Brushy Canyon)	Cherry Canyon	Word Formation (Cherry and Brushy Canyon Equivalent)		Delaware Mountain Group: Brushy Canyon
	Cutoff Shale (Member of Bone Spring Limestone)				Word Formation (Cherry and Brushy Canyon Equivalent)		Delaware Mountain Group: Pipeline Shale Member
Permian/ Leonardian	Yeso	Victorio Peak (Member of the Bone Spring Limestone)			Leonard and Hess Member of Leonard Formation		Bone Spring Limestone

Note: Cell sizes are not to scale for formation thickness

Sources: Modified after King, 1930, 1948; Wood, 1968; Hiss, 1975; Uliana, 2001; Hill, 1999; Kerans and others, 1994; Kerans and Tinker, 1999

[a] Formations overlie Capitan Reef Complex between the Guadalupe and Glass Mountains

ClientWater Resources/Capitan Aquifer/GIS/MXDs/New figures 082509/Figure 3.mxd



Source: Melim and Scholle, 1999

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CAPITAN REEF COMPLEX

Stratigraphic Cross-Section

3.1.1 Bone Spring Limestone

The Bone Spring Limestone is part of the Leonard Series, and consists predominantly of thin beds of cherty black limestone. Total thickness of the Bone Spring Limestone ranges between 1,500 and 2,000 feet. In general, these rocks are located basin-side and below the Capitan Reef Complex. In the western part of the study area, the distribution of the Bone Spring Limestone is complicated by the faulting associated with the Salt Basin. As a result of this faulting, rocks of the Bone Spring Limestone crop out along the western side of the Delaware Mountains. In Culberson County where the formation commonly crops out, the thickness of the Bone Spring Limestone varies from 900 to 1,700 feet (Dietrich and others, 1983).

West of the Capitan Reef Complex and toward the Delaware Basin fringe, the Bone Spring Limestone grades into the Victorio Peak Limestone (gray limestone) and the time-equivalent Yeso, Leonard and Hess Member of the Leonard Formation. The Bone Spring Limestone has been subdivided into two members, the Victorio Peak Member and the overlying Cutoff Shale Member. The Cutoff Shale Member is a black, platy, siliceous shale and shaly sandstone ranging from 50 to 150 feet in thickness (King, 1948). The Cutoff Shale Member forms a low permeability barrier between the underlying Victorio Peak Limestone and the overlying San Andres or Delaware Mountain Group stratigraphic equivalent (Table 1, Figure 3).

3.1.2 San Andres Formation

The San Andres Formation was deposited during Guadalupian time. The San Andres has been subdivided into the Upper and Lower San Andres formation (Ward and others, 1986; Kerans and others, 1994). The lower half is called the lower cherty limestone member and the top half is referred to as the upper non-cherty limestone member. Total thickness of the San Andres Formation is 700 to 1,000 feet. The San Andres Formation is a widespread shelf carbonate deposit found throughout most of New Mexico and west Texas. The lower member of the San Andres Formation grades downward forming an unconformity with the Cutoff Shale Member of the Bone Spring Limestone, Cherry Canyon, and Brushy Canyon Formations of the Delaware Mountain Group (Hill, 1996; Hiss, 1975; Kerans and others, 1994; Kerans and Tinker, 1999; Ward and others, 1986).

In the Delaware Basin, the San Andres Formation transition from shelf carbonate to reef environments is approximately 3 miles long and trends parallel to the Capitan Reef front (Hill, 1996; Hiss, 1975). In the reef margin, the San Andres Formation grades up into the Capitan Reef Complex (Table 1).

3.1.3 Delaware Mountain Group

The Delaware Mountain Group consists of several formations and members of the Guadalupe Series. Most of the Delaware Mountain Group includes formations that were deposited in the Delaware Basin at the same time that the Capitan Reef complex was being deposited on the basin margin (Table 1). Units include the Brushy Canyon, Cherry Canyon, and Bell Canyon Formations. Parts of the Brushy Canyon and Bell Canyon Formations were deposited prior to the formation of the Capitan Reef Complex (Hill, 1996; Hiss, 1975).

aquifers (Hill, 1996; Hiss, 1975). For example, the uplifted Guadalupe Mountains divide the Capitan Reef Complex Aquifer into two separate disconnected aquifers (Figure 1): one that trends to the northeast and discharges to the Pecos River in New Mexico and one that originates along the western flank of the Guadalupe Mountains and flows south from the Patterson Hills southeast toward the Apache Mountains (Hiss, 1975; King, 1948).

3.1.5 Artesia Group

The Artesia Group includes the back-reef (youngest to oldest) Tansill, Yates, Seven Rivers, Queen, and Grayburg Formations (Table 1, Figures 2 and 3). (The term *Artesia Group* replaced the older Carlsbad Group nomenclature.) All of these formations gradually grade into the Capitan Reef Complex. The formations that make up the Artesia Group have rapid lateral facies changes with cyclic deposits of sandstone, sandy dolomite, and dolomite (Hill, 1996; Hiss, 1975). The Grayburg and Queen Formations grade into the Goat Seep Limestone, whereas the Seven Rivers, Yates, and Tansill Formations grade into the Capitan Limestone. Characteristics of these formations are:

- The basal formation of the Artesia Group is the Grayburg Formation, which overlies the San Andres Formation and underlies the Queen Formation, and consists of interbedded dolomite with thin layers of fine-grained sandstone. Total thickness of this formation is approximately 300 to 400 feet (Hill, 1996; Hiss, 1975).
- The Queen Formation is similar to the Grayburg Formation, but with a 100-foot-thick sandstone layer near the top of the formation with thin interbedded dolomite and shale. Because of this upper sand unit, the contact between the Queen and overlying Seven Rivers Formation is often identifiable (Hill, 1996; Hiss, 1975). This formation is up to 420 feet thick.
- The Seven Rivers Formation is a thin-bedded dolomite sandwiched between the upper Queen sandstone and the Yates sand. This formation laterally grades from evaporite to a carbonate facies as it grades into the Capitan Reef Complex. The bedding disappears as it grades into the Capitan Limestone. This formation is up to 500 feet thick (Hiss, 1975)
- The Yates Formation was named after the Yates Oil Field in Pecos County, and it is the most widespread horizon used for structure contouring in the Delaware Basin. The Yates Formation consists of siltstone and sandstone beds totaling approximately 300 to 400 feet in thickness near the reef margin (Hill, 1996; Hiss, 1975).
- The Tansill Formation conformably overlies the Yates Formation near the reef margin. East of the Guadalupe Mountains, the formation is overlain by the Ochoan time evaporites (Salado Formation). The Tansill Formation consists of gypsum, red clay, and silt (evaporite facies) that laterally grades into dolomite near the reef margin. The thickness increases from 100 to 300 feet near the reef margin (Hill, 1996; Hiss, 1975).

3.1.6 Castile and Salado Formations

During the Ochoan epoch, the Delaware Basin began to fill with evaporite deposits of the Castile and Salado Formations. In places, these evaporite deposits overlie the Capitan Reef Complex.

and was then modified with oil and gas exploration data by Veldhuis and Keller (1980). The Salt Basin sediments are reported by Collins and Raney (1997) to be up to 3,000 feet thick, but the thickness varies according to geologic structures within the bolson (Veldhuis and Keller, 1980).

Bolson deposits consist of alluvial, lacustrine, and evaporite sediments that reflect the rocks from the surrounding mountains (King, 1965). Alluvial fan deposits of sand, gravel, silt, and clay are found along the margins of the Salt Basin. The alluvial fan deposits typically become finer-grained away from the mountains, where the coarser-grained deposits along the mountain front readily infiltrate recharge from stormwater runoff (Scanlon and others, 2001).

The salt flats north of the Baylor Mountains (Figure 1) are in the center of the Salt Basin, in which the sediments consist of clay, silt, and sand probably deposited in a Pleistocene lake or succession of lakes. The salt flats represent an area of groundwater discharge by evaporation.

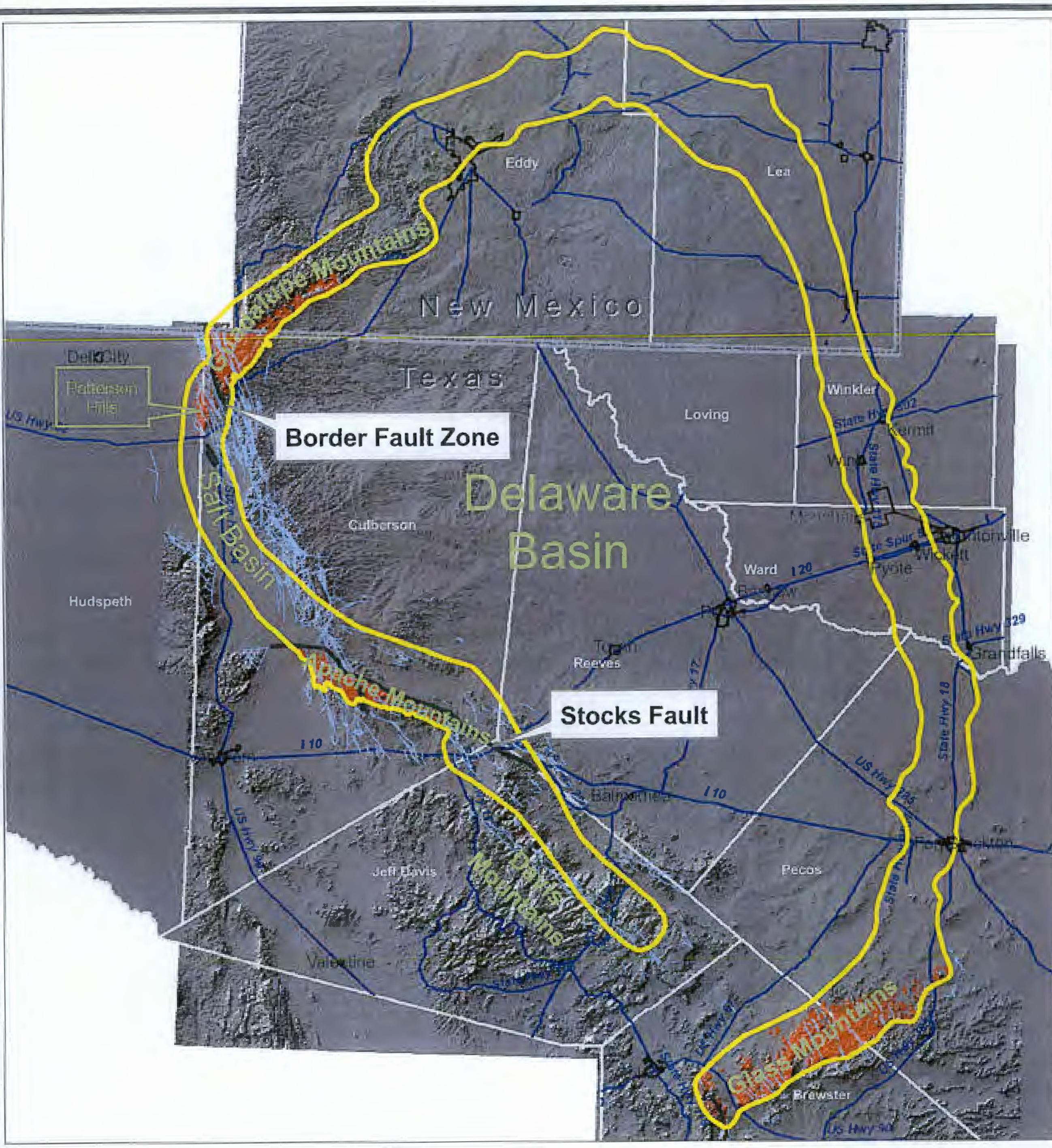
The volcanic rocks from the Davis Mountains consist of lavas, welded and ash flow tuffs, ignimbrites, and volcaniclastics ranging from Eocene to Miocene in age. The thickness of the volcanic rocks overlying the back-reef area of the Capitan Reef Complex is unknown. Volcanic rocks have highly variable groundwater flow characteristics, with some volcanic rocks (e.g., welded tuffs) generally serving as barriers to groundwater flow, while others (e.g., fractured lavas) are generally preferential conduits for groundwater flow.

3.2 Geologic History of the Delaware Basin and the Capitan Reef Complex

Structurally the Delaware Basin was a foreland basin created when the Ouachita Mountains were uplifted as the southern continent Gondwana collided with Laurasia during the Pennsylvanian period. By earliest Permian time, the subsiding ovoid-shaped Delaware Basin extended over 10,000 square miles. A narrow outlet called the Hovey Channel supplied seawater (Figure 1). This period of deposition left a thickness of 1,600 to 2,200 feet of limestone interbedded with dark-colored shale (Harris and others, 1997).

The Delaware Basin temporarily stopped subsiding in the Leonardian epoch at the start of the mid-Permian age. Small banks along its margin developed along with small discontinuous patch reefs in the shallow water just offshore. The first formation that resulted was the Yeso, which consists of alternating beds of dolomite limestone, gypsum, and sandstone. The sediments responsible for creating the Yeso were deposited in near-shore areas that graded into the carbonate banks of the Victorio Peak Formation in the deeper waters. Thin beds of Bone Spring Limestone accumulated as limy ooze in the stagnant deepest part of the basin (Harris and others, 1997).

Subsidence of the Delaware Basin restarted in mid-Permian time, and by the Guadalupian epoch of the upper Permian, the patch reefs had grown larger. Sediments deposited close to the shore during this period are now the cherty dolomites of the San Andres Formation, while deposition a little further out formed the quartz sandstone and scattered patch reefs of the Brushy Canyon Formation (Figure 3). Rapid subsidence of the basin started in the middle Guadalupian epoch of the upper Permian. Patch reefs responded by rapid (mostly vertical) growth, resulting in the Goat Seep Reef (Harris and others, 1997).



Explanation

- Capitan Reef Complex outline (revsied)
- Named major faults
- Geologic Atlas of Texas faults
- Capitan Reef Complex outcrop
- Cities
- Major roads
- Texas/New Mexico border
- County boundary

N

0 10 20 30 Miles

CAPITAN REEF COMPLEX
Study Area Faults

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Figure 5

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The Capitan Reef Complex has fissures parallel and perpendicular to the reef face. During deposition, the Capitan Reef was incised by submarine canyons that eventually filled with low-permeability material. Hiss (1975) believes that these submarine canyons restrict groundwater flow through the reef carbonates.

All relevant TWDB and Texas Board of Water Engineers (TBWE) reports and bulletins were reviewed for this study. A total of 7 locations from TWDB Report 125 (White, 1971), 1 location from TBWE Bulletin 6106 (Armstrong and McMillion, 1961), and 4 locations from TBWE Bulletin 5916 (Garza and Wesselman, 1959) were added to the *Capitan_Dataset* based on satisfactory location, depth, and lithologic information. Available consultant reports were also used to provide guidance in the subsurface interpretations, including Finch and Armour (2001), Finch and Bennett (2002), and Reed (1965).

4.1.2 Oil and gas geophysical logs and scout tickets

Numerous geophysical logs were obtained from the TBEG geophysical log library and the Texas Commission on Environmental Quality (TCEQ) Surface Casing department. The TBEG log library was the source of the majority of the additional geophysical logs used in this study. Harris and Saller's (1999) Figure 6 provided guidance for type geophysical log signatures that could be used to identify the Capitan Reef Complex and other formations in the subsurface.

Approximately 89 geophysical logs were initially selected based on location. Of this initial data set, 70 geophysical logs passed screening criteria for the *Capitan_Dataset*, based on details of location data, well depth, and log quality. TBEG also maintains an oil and gas industry scout ticket library, and an additional 82 locations were added to the *Capitan_Dataset* from this source. These data were also screened based on location, total depth, and lithologic information provided on each scout ticket.

The DBS&A team also researched the TBEG's oil and gas driller's reports library, indexed by county and operator, which included detailed cable tool drilling reports back to the early 1900s. These older, detailed lithologic descriptions occasionally included stratigraphic top and base selections, which were often useful in the interpretation of geophysical logs.

A total of 74 geophysical logs were pulled from the TCEQ's Surface Casing department. These logs were also screened for log quality, depth, and location information, and 33 of the log locations were added to the *Capitan_Dataset.*

4.1.3 Online well records and logs

Online websites were searched for available Capitan Reef Complex subsurface well data. The TWDB's Water Information Integration and Dissemination (WIID) web service (http://wiid.twdb.state.tx.us; two layers, *Groundwater Database* and *Submitted Driller's Reports*) was investigated as another source for subsurface driller's report descriptions. A total of 177 driller's reports were initially selected based on location criteria; of these, 69 met additional screening criteria and were added to the *Capitan_Dataset.*

The New Mexico Office of the State Engineer website database (http://www.ose.state.nm.us/ waters_db_index.html) and the New Mexico Oil Conservation Division (OCD) database (http://ocdimage.emnrd.state.nm.us/imaging/default.aspx) were searched for available subsurface data in the vicinity of the Capitan Reef Complex. A review of the New Mexico OCD website yielded another 144 possible well locations, of which 124 locations passed screening criteria and were added to the *Capitan_Dataset.*

Detailed discussions of database construction, descriptions of GIS attribute columns, data screening, location and elevation correction procedures, and quality assurance/quality control of the database (*Capitan_Dataset*) and other GIS files for this study are discussed in Appendix A; Appendix B provides GIS attribute definitions.

4.1.4 Revised aquifer outline

A revised Capitan Reef Complex Aquifer outline was delineated based on 667 geophysical logs, driller's reports, and scout tickets with identified Capitan Reef Complex carbonates, and 59 locations that were identified to be within the back-reef, fore-reef, and Delaware Basin formations. Figure 7 illustrates the geographic distribution of the well data used to construct the structure, stratigraphy, and extent of the Capitan Reef Complex. In addition, the revised Capitan Reef Complex Aquifer outline also considered the digital Geologic Atlas of Texas (GAT) geology outcrops of the upper San Andres, Goat Seep, Capitan, and Carlsbad Formations according to Hiss's 1975 definition of the Capitan Reef Complex.

4.2 Geology and fault data sources

Digital files of the GAT sheets were obtained from a compact disc available from TBEG (Anderson and others, 1995; Dietrich and others, 1983; Eifler and Barnes, 1976; Twiss and Barnes, 1979). The digital GAT file includes surface geology and mapped faults for the entire state of Texas, but was clipped to include only the study area and surrounding counties. The resulting GIS file is named *TX_geology_clipped.*

A digital file of New Mexico surface geology (fault files were not available) was downloaded from the New Mexico Resource Geographic Information System (RGIS) website (http://rgis.unm.edu/intro.cfm). The downloaded file was clipped using the GIS shapefile *New_Mexico_Counties,* and the resultant GIS file is named *NM_Geology_clipped.* Unfortunately, the Texas GAT geology shapefiles did not match well with the available New Mexico digital geology shapefiles; the scale and detail of mapping was different between the GIS datasets.

Investigation confirmed that there were no mapped fault files available for the New Mexico portion of the study area. The fault file from the digital GAT sheet was determined to be adequate for use in this study. These faults were posted over the digital geology. A buffer polygon was created which extended 5 miles out from the existing boundary. This buffer polygon was used to clip the GAT faults file such that only faults that fell within the buffer's boundaries were kept. This clipped GAT fault file is called *GAT_faults_Clip1.*

Additional sources of fault information include King (1948), Wood (1965, 1968), Hill (1996), Goetz (1980), and Collins and Raney (1997).

4.3 Stratigraphic interpretation

The geological nomenclature and formation interpretation have varied over time as more field and subsurface analyses of the study area were made. For example, the Capitan Reef Complex was not generally recognized as a separate geologic formation or unit until after 1950. Hiss

(1975) considers the Capitan Reef Complex to include the Goat Seep, Capitan, and Carlsbad Limestones, where present on the reef margin. Since the delineation of these individual limestone units is not possible using available geophysical logs (due to non-unique limestone geophysical log signatures and resolution issues) or drillers' reports, Hiss's stratigraphic top picks for the Capitan Reef Complex were used to build the initial stratigraphic framework for this study. Another example of changing nomenclature and formation interpretation is the identification of the San Andres Formation by Ward and others (1986) in the vicinity of the Guadalupe Mountains, which redefined the earlier work by King (1948).

Delineation of the Ochoan evaporites (Rustler, Salado and Castile Formations), the Artesia Group (Tansill, Yates, Seven Rivers, Queen, Grayburg and Munn Formations), the Delaware Mountain Group (Bell Canyon, Cherry Canyon, Brushy Canyon and Pipeline Shale Formations), the San Andres Formation, the Word Formation and the Cutoff Shale was not completed for this project. These individual formations were not differentiated due to complex interbedded stratigraphy, lack of unique marker beds within each formation, facies changes within a formation, poor and highly variable quality and resolution of log signatures on the geophysical logs, and project budget constraints. All oil and gas geologist's comments on the geophysical logs concerning geologic formation or group tops and bases were captured in the dataset compiled, *Capitan_Dataset*.

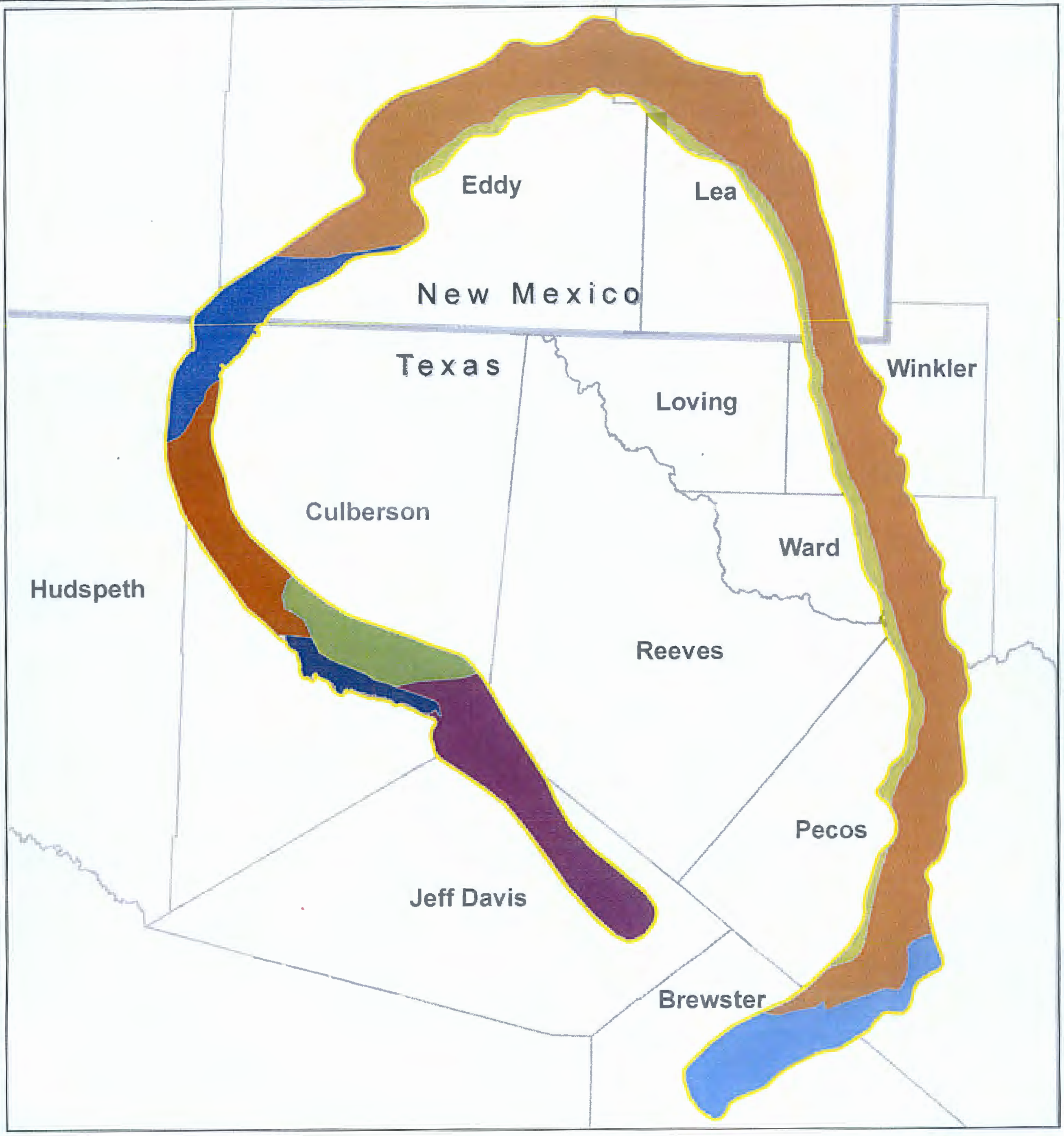
Geologic formation and group top and base information compiled by Hiss (1975, 1976), King (1930, 1937, 1948), Wood (1965, 1968), Finch and Armour (2001), and Finch and Bennett (2002) were used as a guide for all stratigraphic interpretations. The Ochoan evaporites, and the Artesia and Delaware Mountain Groups were generally undifferentiated in this study unless differentiated by the above authors or by geologist's comments on the geophysical logs or driller's reports.

4.4 Lithologic and driller's logs interpretations

Many of the early cable tool oil and gas exploration wells were drilled before geophysical logging was available. The older driller's reports occasionally included stratigraphic descriptions with detailed lithologic descriptions. Lithologic and driller's logs were more commonly found for water supply wells drilled along the western side of the Delaware Basin.

The lithologic and driller's logs (reports) were generally difficult to interpret without stratigraphic markers from the well site geologist or use of local geologic subsurface mapping. The DBS&A team's lithologic interpretation of the Capitan Reef Complex was based on reports of massive white fossiliferous limestone beds and lost circulation. All comments on the driller's reports made by oil and gas geologists concerning geologic formation or group tops and/or bases were captured in the dataset compiled, *Capitan_Dataset*.

A concerted effort was made to interpret and integrate as many lithologic descriptions from driller's reports as possible into the geophysical log stratigraphic framework. However, there is a large area in the western portion of the Capitan Reef Complex, from the northern Guadalupe Mountains to Apache Mountains, for which few driller's reports and geophysical logs exist (Figure 7).



Explanation

- Capitan Reef Complex outline (revised)
- Texas/New Mexico border

Overlying units

- Salt Basin sediments
- Quaternary deposits and Cretaceous formations
- Artesia Group
- Castile and Salado formations
- Castile or Salado formations
- Capitan Outcrop with overlying Permian, Triassic, Cretaceous, and Quaternary deposits
- Capitan Outcrop with overlying Quaternary deposits
- Capitan Outcrop, with overlying Artesia and Quaternary deposits
- Erosional Base of Capitan Reef Complex

0 10 20 30 Miles

N

Source: Modified after King, 1937, 1948; Woods, 1968; Hiss, 1975.

CAPITAN REEF COMPLEX

Geologic Formations Overlying the Capitan Reef Complex

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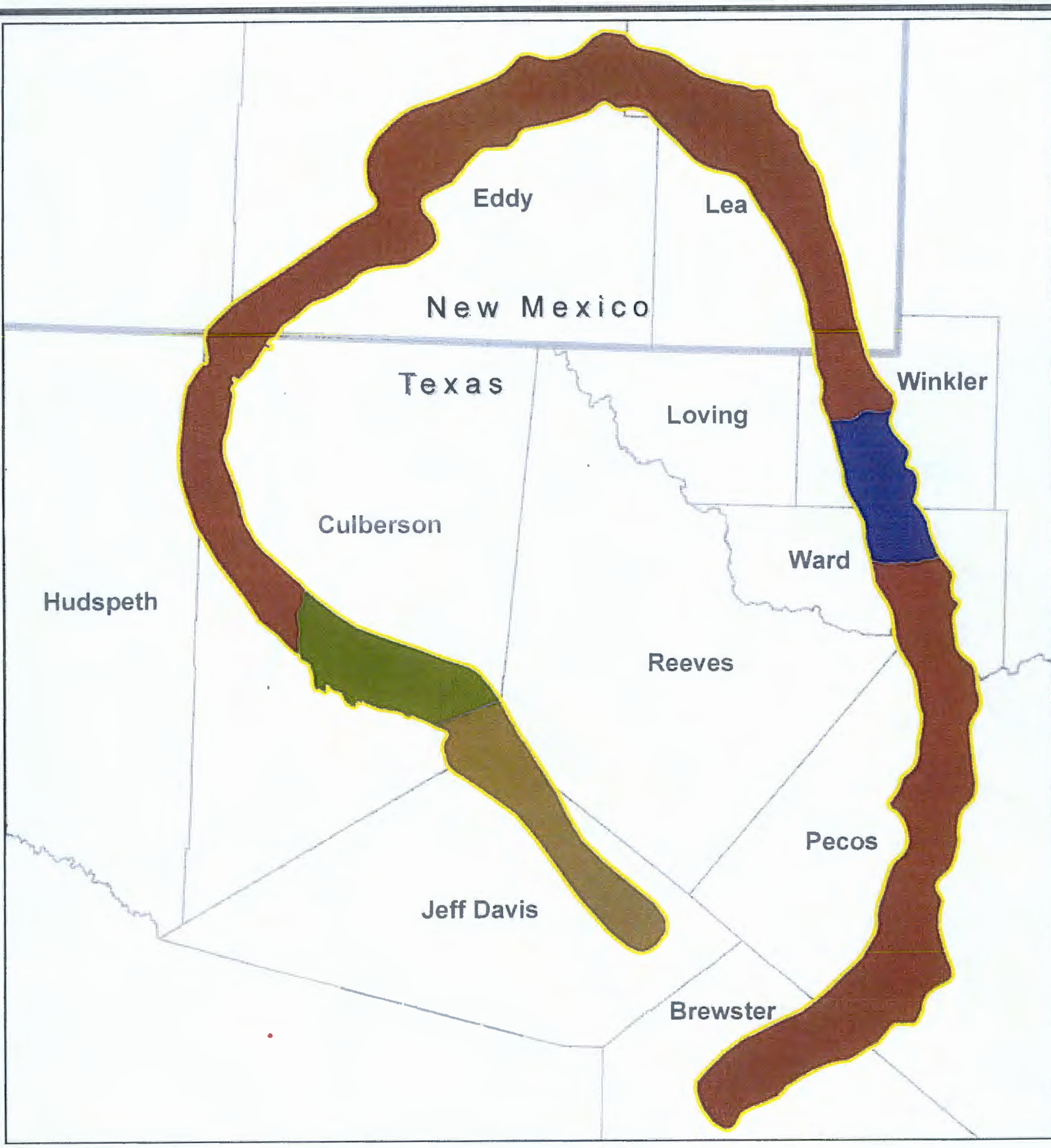
Figure 8



Explanation

- Capitan Reef Complex outline (revised)
- Texas/New Mexico border

Underlying units

- Delaware Mountain group
- Delaware Mountain group (assumed)
- Munn formation
- San Andres limestone

0 10 20 30 Miles

N

Source: King, 1937, 1948; Woods, 1968; Hiss, 1975.

CAPITAN REEF COMPLEX

Geologic Formations Underlying the Capitan Reef Complex

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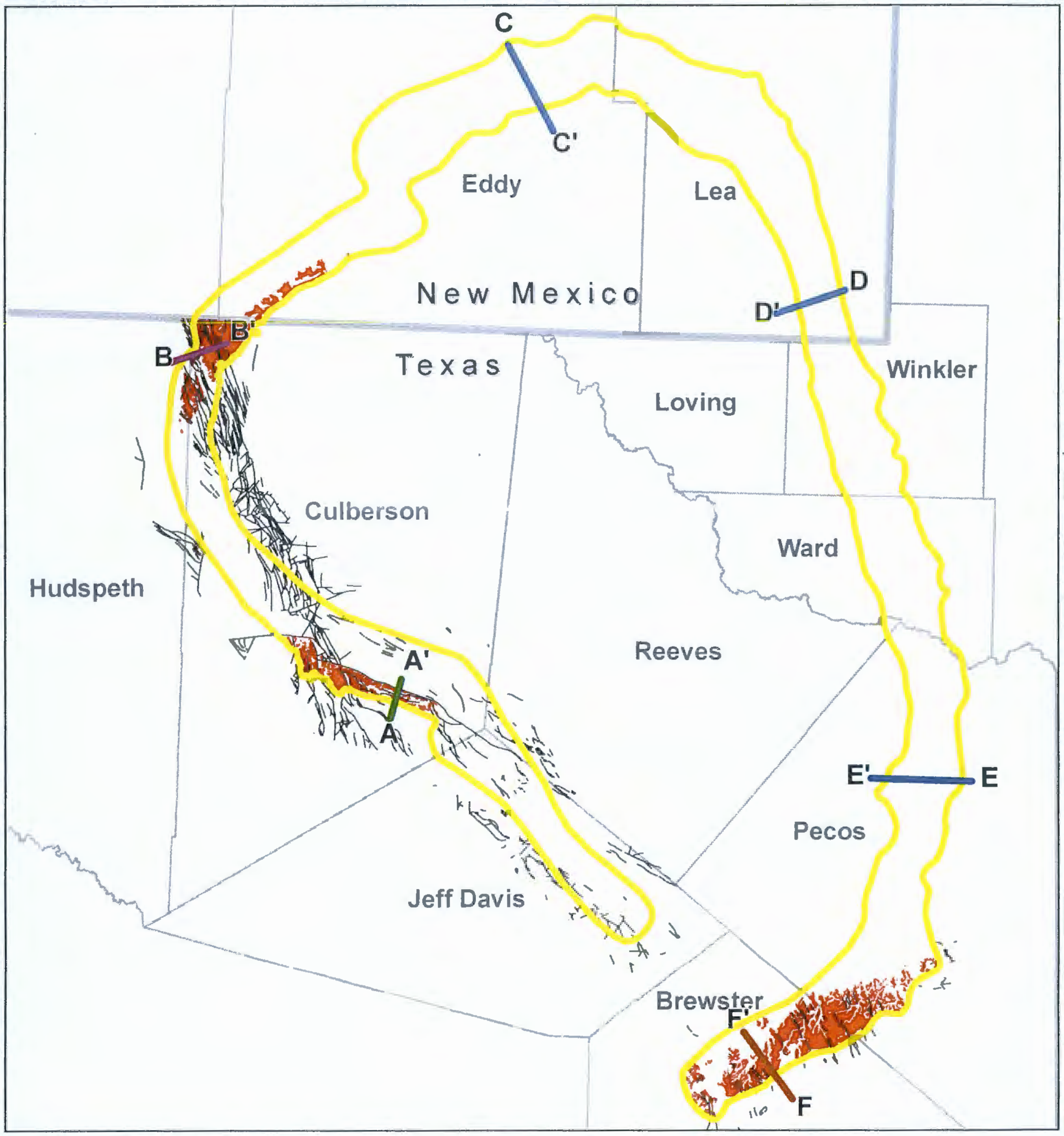
Figure 9



Explanation

- Capitan Reef Complex outline (revised)
- Capitan Reef Complex outcrop
- Geologic Atlas of Texas faults

Cross-sections

Source

- Hiss (1975)
- King (1938)
- King (1948)
- Wood (1968)

0 10 20 30 Miles

N

Source: After King, 1937, 1948; Woods, 1968; Hiss, 1975.

CAPITAN REEF COMPLEX

Cross-Section Key

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Figure 10

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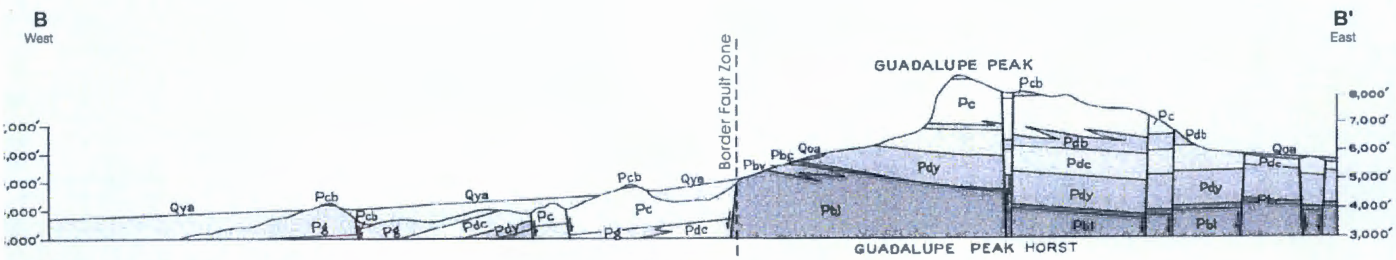

SCALE 1:48,000

Explanation

Qoa/Qya = Alluvium
Pcb = Carlsbad limestone
Pc = Capitan limestone
Pg = Goat Seep limestone
— **Capitan Reef Complex** (Pcb, Pc, Pg)
Pdb = Bell Canyon formation (of Delaware Mountain Group)
Pdc = Cherry Canyon formation
Pdy = Brushy Canyon formation
— San Andres equivalent of Delaware Mountain Group (Pdc, Pdy)
Pbc = Bone Spring limestone (Cutoff shaly member)
Pbv = Bone Spring limestone (Victorio Peak gray member)
Pbl = Bone Spring limestone (Black limestone beds)

Source: Modified after King, 1948; Kerans and others, 1994; Kerans and Tinker, 1999; Ward and others, 1986.

CAPITAN REEF COMPLEX
Guadalupe Mountains, Texas

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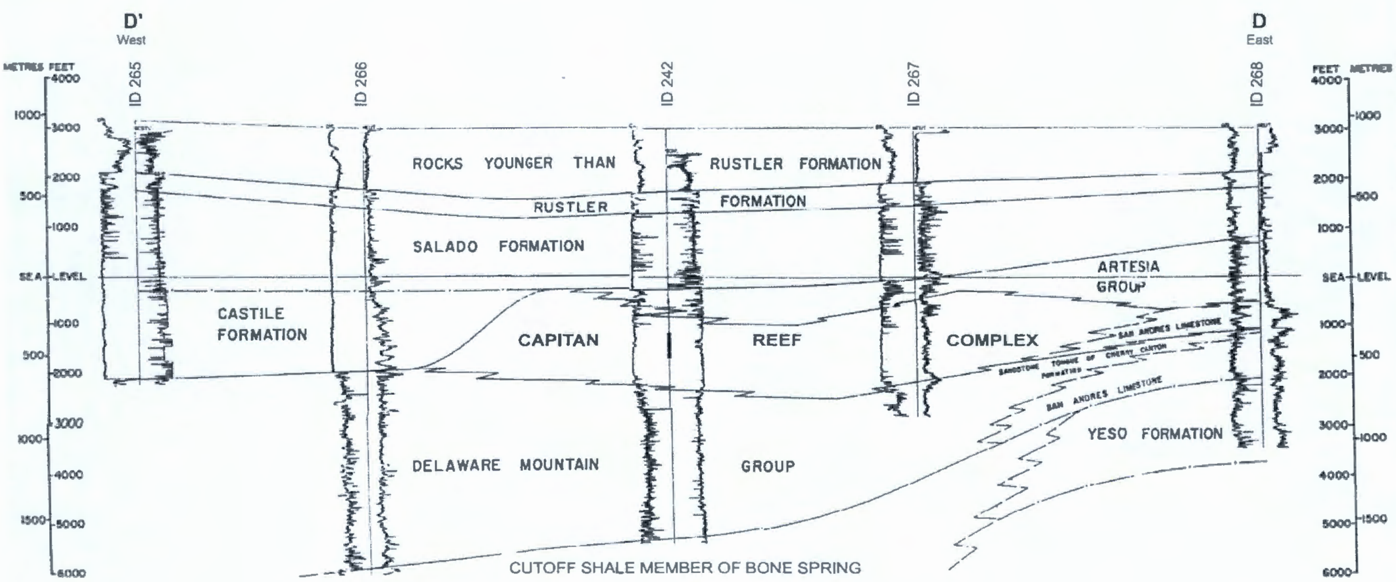
Figure 12



SCALE 1:68,568

Source: after Hiss, 1975.

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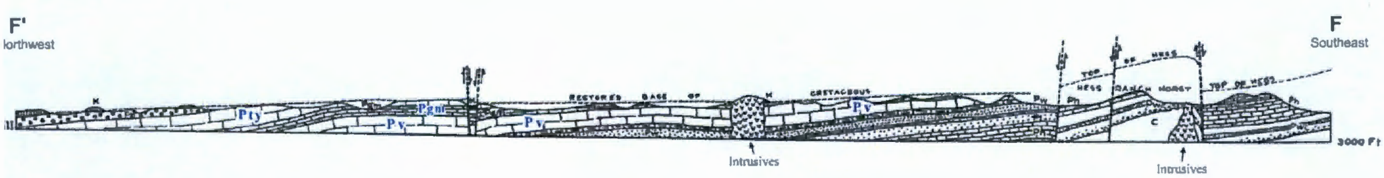
CAPITAN REEF COMPLEX
Lea County, New Mexico

Figure 14



SCALE 1:60,000

Explanation

K = Comanche Series
Pb = Bissett Conglomerate
Pty = Tessey
Pgm = Gilliam
Pv = Vidrio
— **Capitan Reef Complex equivalent** (Pty, Pgm, Pv)
Pw = Word (Cherry Canyon and Brushy Canyon equivalent)
Pl = Leonard
Ph = Hess
Pwc = Wolfcamp
— Bone Spring limestone equivalent (Pl, Ph, Pwc)

Source: Modified after King, 1930, 1937.

CAPITAN REEF COMPLEX
Glass Mountains, Texas

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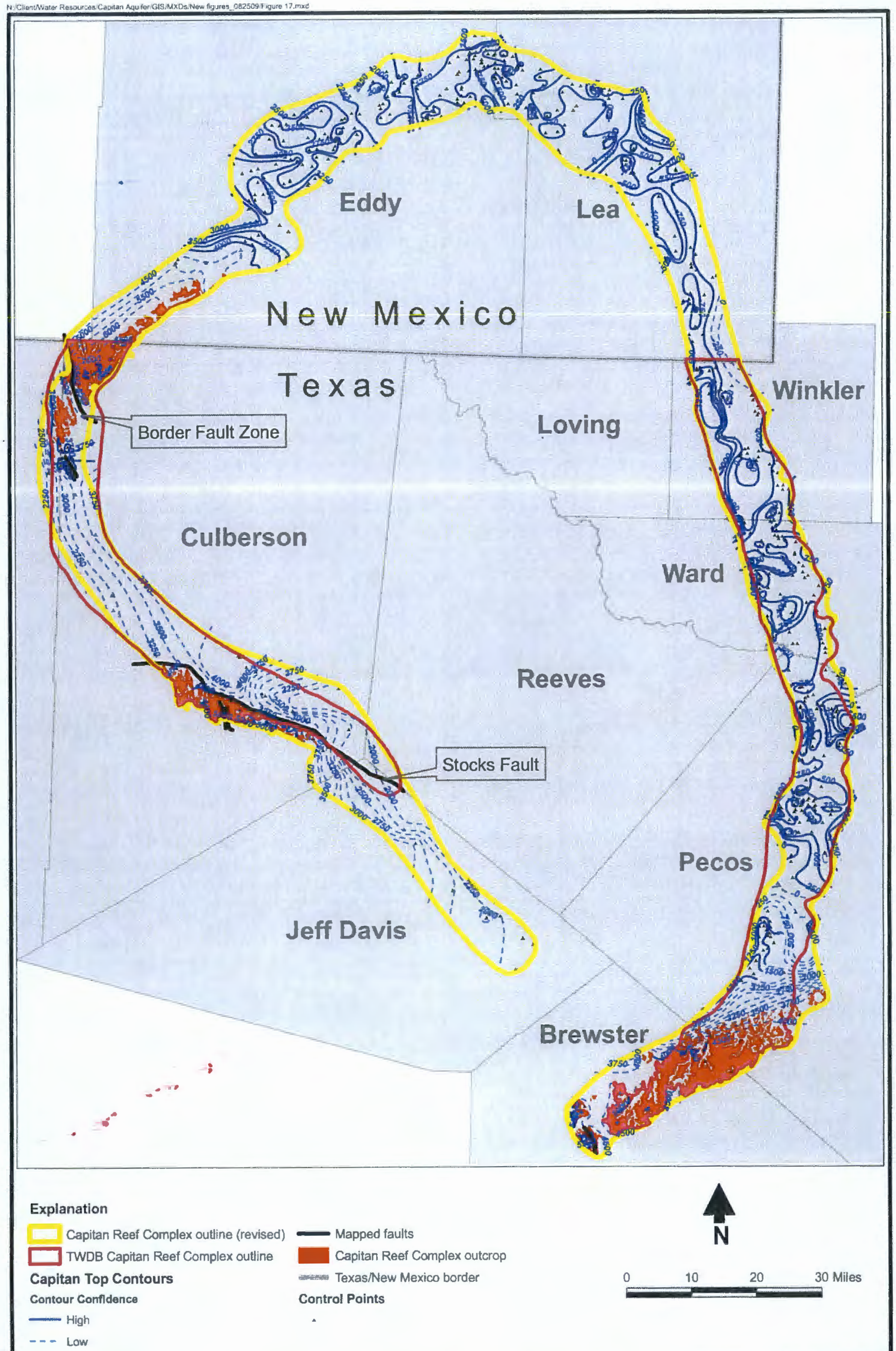
Figure 16



CAPITAN REEF COMPLEX

Capitan Reef Complex Top Contours, Mapped Faults, and Aquifer Extent Comparison

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Figure 17

$$\sin(A) = Z/Y$$

where A = measured dip in degrees
Z = true thickness in feet
Y = apparent thickness (measured distance across the outcrop) in feet

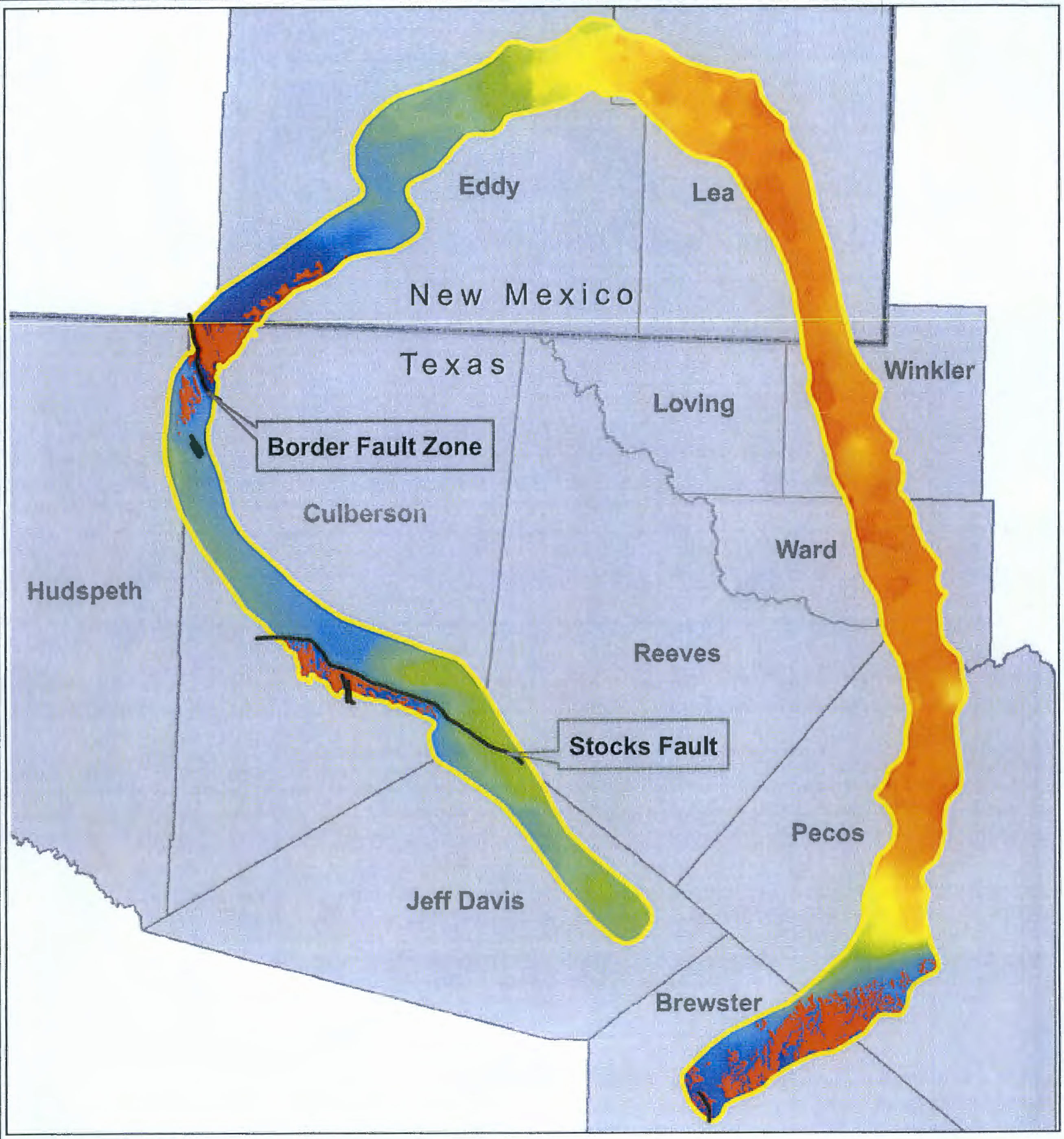
The calculated outcrop true thickness was used to supplement thickness data from the *Capitan_Dataset* to construct the *Cap_Isopach* contour shapefile (Figure 18).

4.8.1 Faults identified during structural contouring

The Capitan Reef Complex top surface was contoured based on available data points, while considering the local GAT fault information. If the available data points in an area did not support the existence of a fault, even if a GAT fault had been mapped, a fault was not integrated into the Capitan Reef Complex surface. A GIS mapped fault file was created named *mapped_faults.*

A total of seven normal GAT faults were confirmed by subsurface well data (*Capitan_Dataset)* and are included in the GIS file *mapped_faults.* The areas with abundant mapped faults generally had poor well control and limited subsurface data (Figures 4 and 5). Two major faults were delineated with the combination of subsurface well data and available surface geology:

- The largest fault confirmed was the northwest-southeast trending Border Fault Zone, which separates the Guadalupe Mountains and Patterson Hills with a fault throw ranging from 1,000 to more than 2,000 feet (Figure 17).
- The second confirmed fault is the Stocks Fault in the Apache Mountains which is a west northwest-east southeast trending fault with a mapped fault throw of more than 1,000 feet (Figure 17). Note that the existence of the Stocks Fault has been the subject of much debate (Hill, 1996), and the GAT (including digital geologic maps) does not contain the Stocks Fault; however, detailed mapping by Wood (1968) combined with the data analysis in this study supports the existence of the Stocks Fault.



Explanation

- Capitan Reef Complex outline (revised)
- Capitan Reef Complex outcrop
- Mapped faults

Top Surface Elevation (feet above msl)

- High : 8689.6
- Low : -1500
- Texas/New Mexico border
- Counties

N

0 10 20 30 Miles

CAPITAN REEF COMPLEX

Top Surface Elevation Grid of Capitan Reef Complex

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Figure 19

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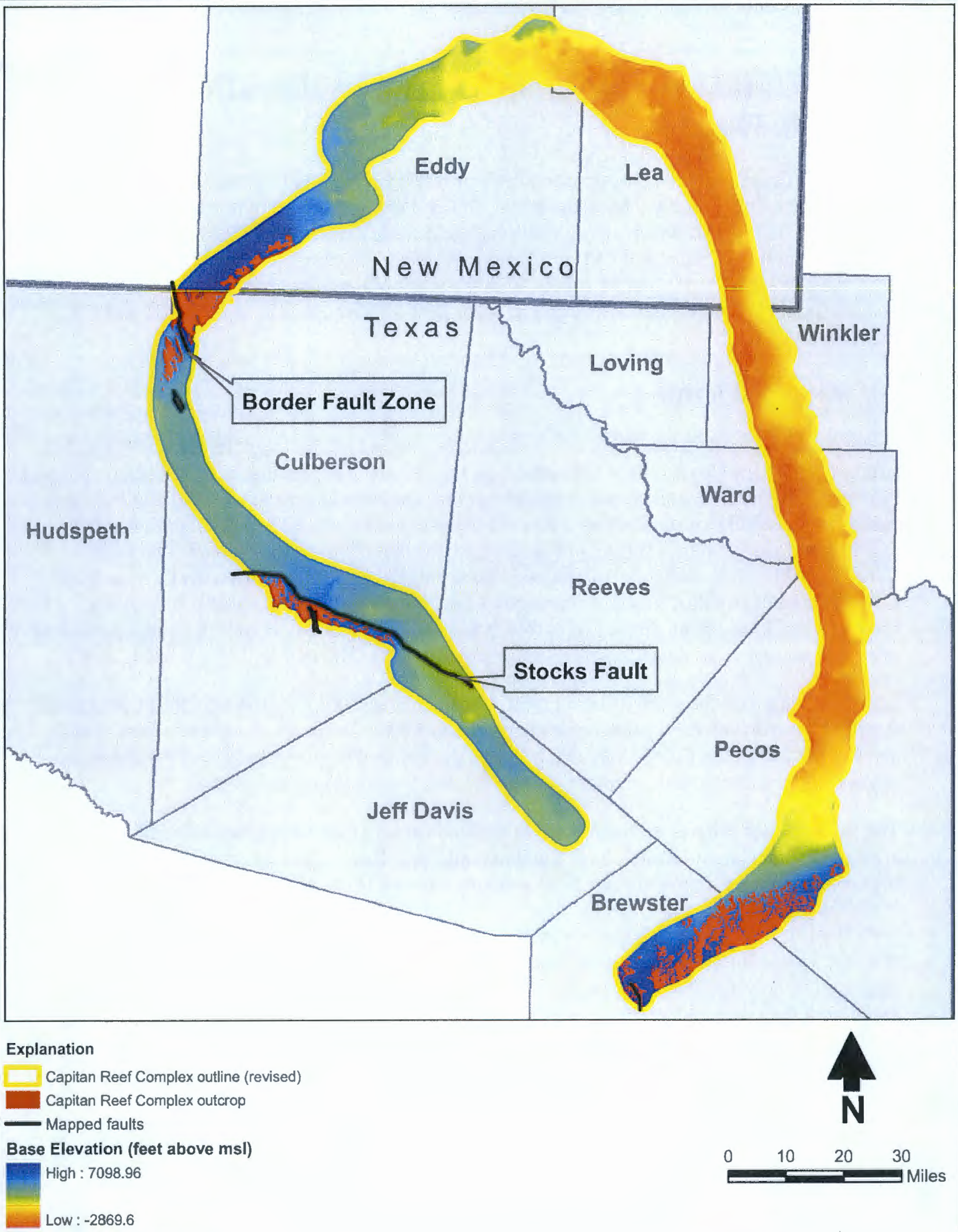

CAPITAN REEF COMPLEX

Base Elevation Grid of Capitan Reef Complex

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Figure 21

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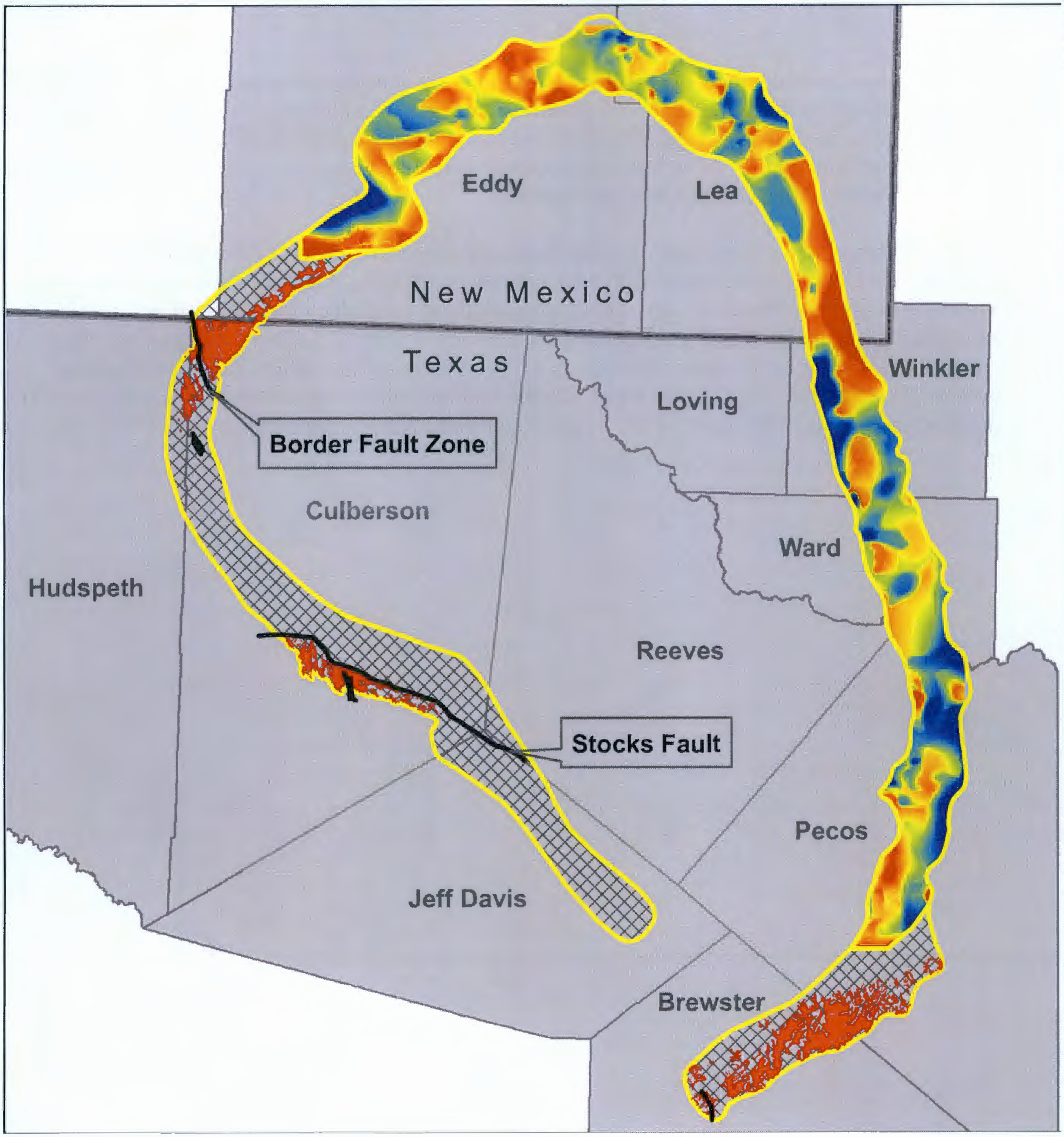

CAPITAN REEF COMPLEX

Gross Isopach Grid of Interbedded Fine Sand, Silt, and Clay within the Capitan Reef Complex

Daniel B. Stephens & Associates, Inc.
08/28/2009 JN WR08.0039

Figure 23

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potentially low hydrogeologic properties. Since there was minor sand within this clastic facies, the proposed net sand interpolation was determined to be of no value and was not completed. Instead, a gross isopach thickness of the interval was created (Figure 23). Until additional research or information for these intervals becomes available, groundwater contained within this gross interval should be considered semiconfined.

Areas with large fault offsets may result in the stratigraphic alignment of more permeable Capitan Reef Complex carbonates with adjacent less permeable subsurface formations (Delaware Mountain Group or Artesia Group). This juxtaposition of subsurface formations may significantly impact local and regional groundwater flow systems. Areas with large fault offsets where the Capitan Reef Complex carbonates are in communication with different stratigraphy include (1) the eastern edge of Salt Basin, (2) the southern edge of the Border Fault Zone, and (3) the stratigraphic sequence north of the Stocks Fault in the Apache Mountains.

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Appendix A

Database Development

Appendix A. Database Development

A.1. Geo-referencing and Location Verification

Project work began with georeferencing several large structural and location maps from Hiss's 1975 doctoral dissertation titled "Stratigraphy and Ground-Water Hydrology of the Capitan Aquifer, Southeastern New Mexico and Western Texas." DBS&A staff digitized Hiss's aquifer outline as well as structural top and isopach thickness maps of the Capitan Reef Complex. In addition, Hiss's well locations were digitized from his base map. A digital 30-meter digital elevation model (DEM) was used to assign a land surface elevation to each of Hiss's well locations, and the digitized information described above was used to calculate a thickness and a base of the Capitan Reef point file dataset for all of Hiss's wells using ArcGIS Spatial Analysis tools.

The following sources were investigated for additional data:

- Geophysical logs, scout tickets, and driller's reports from the Bureau of Economic Geology

- Geophysical logs from the surface casing department of the Texas Commission on Environmental Quality

- The WIID database maintained by the Texas Water Development Board

- The USGS report *Geology and water resources of the Carlsbad area, Eddy County, New Mexico* (Bjorklund and Motts, 1959)

- New Mexico State Engineer Technical Report 38, *Capitan aquifer observation-well network, Carlsbad to Jal, New Mexico* (Hiss, 1973)

- The New Mexico Oil Conservation Division (OCD) web site

- Bulletin 6106, *Geology and ground-water resources, Pecos County, Texas,* Volumes I & II (Texas Board of Water Engineers, October 1961)

- Report 125, *Water resources of Ward County, Texas* (Texas Water Development Board, February 1971)

- Bulletin 5916, *Geology and ground-water resources of Winkler County, Texas* (Texas Board of Water Engineers, November 1959).

The next step was to enter location points for data gathered from the additional sources. To do this, the team would attempt to locate the well using any land survey, attached map, or directional information provided in the source document. In rare cases, latitude and longitude coordinates were provided. Most often, however, the team used the given information and attempted to locate the point in ArcMap using the state well grid layer, county land survey data, and county roads. If the source document had sufficient information to locate the point, it was digitized and then assigned an accuracy value from 1 to 3 based on the detail level of the location information provided:

- A value of 1 corresponds to those points that were plotted using latitude and longitude and represents an estimated location error of less than 0.5-mile radius.

- A value of 2 was initially assigned to most points digitized and represents a location error between 0.5- and 1-mile radius.

- A value of 3 represents a location error of 1 to 1.5 miles and was assigned to points that the team had difficulty locating with some amount of certainty.

A 30-meter DEM was added and georeferenced for the study area to allow the team to extract DEM elevation values for all points that fell within its boundaries. Because the study area is too large to allow for downloading from the USGS seamless server one single DEM that covers the entire area, the DEM was downloaded in sections and "stitched" together using the ArcGIS Spatial Analyst tool "Mosaic to New Raster." The new single raster was then compared with the individual parts to ensure that it was created properly. Following this, Raster Calculator was used to convert the DEM units from meters to feet using the conversion factor of 1 meter = 3.28084 feet. QA/QC checks were performed subsequent to this conversion to ensure that the calculation performed properly.

A.2. Data Screening Criteria

Selected data for the database were originally entered into an Excel spreadsheet that was then imported into ArcGIS and added to the geodatabase prior to product delivery. This original Excel spreadsheet has undergone numerous iterations and corrections. Most of the work in building the dataset was simple data capture of information provided by the source materials. Unit tops and bottoms were entered from geophysical logs, driller's reports, scout tickets, and other previously identified reports and publications data sources.

Data were rigorously pre-screened prior to data entry. Screening criteria included depth of the well, location information, and whether the document in question provided useful lithologic information that could be used to pick out the Capitan and/or overlying or underlying units.

Elevations from the 30-meter DEM were extracted for each point that lies within its boundaries. These were the elevations used to calculate top and bottom unit elevations with reference to sea level for each applicable unit pick, with the notable exception of the Hiss (1975) data points. Hiss's data provided Capitan picks with reference to sea level, rather than depth-to-unit from surface. Further, the Hiss data did not include elevation information for each point from source data. Thus, the team had no way to recalculate elevations for the Hiss data. Research into Hiss's source data by Steven Finch, Jr., of John Shomaker & Associates, Inc., revealed that Hiss closely guarded his data and that, upon completion of his report, Hiss returned all the information that he had used to the data originator(s), as it appears to have been proprietary and not to be made public. The data to support Hiss's picks is thus not available for examination or publishing.

For many digitized points, no latitude and longitude information was provided. The team used ArcGIS to obtain X and Y coordinate values for these points once they had been digitized. These points were later reprojected in a layer using the NAD83 decimal degree geographic coordinate system, which allowed the team to get latitude and longitude values for these points. Shapefiles were also reprojected into GAM projection so that X and Y coordinates could be added for this projection system. Thus, each point used in the project has X/Y State Plane Texas Central FIPS 4203 (feet) coordinates, latitude/longitude decimal degree coordinates, and GAM X/Y coordinates.

A.3. Quality Assurance of Database

Quality assurance (QA) and quality control (QC) were ongoing during the construction of the dataset and geodatabase and included the following:

- Data were regularly compared between the most current dataset and reference datasets to catch any sorting errors that might have occurred. This was performed by copying several columns such as ID, LAT, DEM_ELEV, and T_CPT_ELEV from both datasets into a new spreadsheet and comparing them to ensure that the data entered for each unique ID number matched both datasets. Any discrepancies were thoroughly investigated and repairs to the dataset initiated. Further, to minimize sorting errors or other data manipulation errors that can occur when working with data in Excel, the dataset was manipulated while in ArcGIS to the extent practicable.
- With data coming from so many varied sources, the team suspected that duplicate points existed. Duplicates were found by sorting the dataset by *Total Depth* (TD) and looking for duplicates. If duplicate TDs were found, the rest of the data for those points was examined. If a duplicate was found, the one with the least information was deleted from the dataset. Additionally, clusters of points on the map were examined in ArcGIS to determine if any of the points located close to one another might be duplicates. Since some oil and gas wells have been re-entered and deepened, it was possible that duplicate entries would exist for the same well, but would have different TDs and not be detected by the TD comparison screening method. Duplicate points found using this map-query method were treated in a similar fashion to those found with the TD comparison method with the least useful point being removed from the dataset.
- Picks for the bottom of the Capitan sometimes were equivalent to the well TD. The team believed it highly unlikely that the bottom of the Capitan would correspond to the well TD except upon rare chance occurrences. In the case that wells were found to have a TD measurement that corresponded to a bottom of Capitan pick, the bottom pick was deleted for that point and a note made in the Comment section indicating that the well TD occurs in the Capitan.
- Structural contour maps were generated to provide another layer of QA/QC. Anomalies identified during contouring were investigated in ArcMap, and hard copies of the well report, if available, were examined to check the accuracy of the stratigraphic top and or base selection. In many cases, data density in the area in question was sufficient to exclude the anomalous point and it was removed from the dataset. More rarely, an anomaly would manifest in an area with sparse data coverage. Unfortunately, the questionable data often

was for the top and/or base selections of the Capitan Reef Complex. If review of the hard copy (when available) didn't provide any clarification for the anomaly, the point was removed from the dataset.

Appendix B

GIS Attribute Definitions

Appendix B. GIS Attribute Definitions

Attribute	Definition
Point Files Data Sources: *Capitan_Dataset, Geophysical_logs, Geophysical_logs_select, NM_JSAI_dataset, TCEQ_Qlogs, Hiss_crs_sects_GAM, Hiss_wells_dem_GAM, Top_elev_sand, TX_NM Border, Boundary_Wells_GAM*	
ID	Unique identification number assigned to that point or, for some files (e.g. *TX_NM Border*), it is the number in the attribute column generated by ArcGIS when the shapefile was created;
LAT	Latitude in decimal degrees;
LONG	Longitude in decimal degrees;
LOC_ACCUR	The location accuracy value assigned to that point's location on a scale of one (1) to three (3) where 1 is accurate to less than a 1/2 mile radius (lat/long given), 2 is accurate to within 1/2 to 1 mile radius (good map or survey information provided), and 3 is accurate to within 1 to 1.5 mile radius;
PICK_RELIA	A reliability value assigned to each point's geologic interpretation on a scale of 1 to 3 where 1 is excellent data such as that provided by geophysical logs, 2 is good data such as that provided by descriptive scout tickets or driller's logs, and 3 is fair data such as that provided by Hiss' datapoints or other data that is less than ideal in description;
SOURCE_REF	The Source or Reference that provided information about that specific point;
API_NO	The API Identification number assigned to the log associated with that point, if applicable;
COUNTY	The County in Texas or New Mexico where the point is located;
OP_WELL_NO	The Operator and Well Number of that well, if provided in source data;
SURVEY	The Land Survey information for either Texas or New Mexico for that well, if provided by the source data;
ELEV	The given elevation with reference to sea level for that point from its source data;
DEM_ELEV	Elevation with reference to sea level for that point extracted from the Digital Elevation Model based on that point's location;
TD	Total Depth of well, if given;
T_RUSTLER	Depth to top of the Rustler Formation, if applicable;
T_RUS_ELEV	Elevation with reference to sea level to the top of the Rustler Formation, if applicable;
T_CPTN_RF	Depth to top of the Capitan Formation, if applicable;
T_CPT_ELEV	Elevation with reference to sea level to the top of the Capitan Formation, if applicable;
B_CPTN_RF	Depth to bottom of the Capitan Formation, if applicable;
B_CPT_ELEV	Elevation with reference to sea level to the bottom of the Capitan Formation, if applicable;
T_TANSILL	Depth to top of the Tansill Formation, if applicable;

Appendix B. GIS Attribute Definitions (continued)

Attribute	Definition
T_TAN_ELEV	Elevation with reference to sea level to the top of the Tansill Formation, if applicable;
T_CRLSBAD	Depth to top of the Carlsbad Formation, if applicable;
T_CRL_ELEV	Elevation with reference to sea level to the top of the Carlsbad Formation, if applicable;
T_YATES	Depth to top of the Yates Formation, if applicable;
T_YTS_ELEV	Elevation with reference to sea level to the top of the Yates Formation, if applicable;
T_7_RIVERS	Depth to top of the Seven Rivers Formation, if applicable;
T_7RV_ELEV	Elevation with reference to sea level to the top of the Seven Rivers Formation, if applicable;
T_DEL_LIME	Depth to top of the Delaware Formation (limestone portion), if applicable;
T_DELM_ELE	Elevation with reference to sea level to the top of the Delaware Formation (limestone portion), if applicable;
T_DEL_SAND	Depth to top of the Delaware Formation (sand portion), if applicable;
T_DESD_ELE	Elevation with reference to sea level to the top of the Delaware Formation (sand portion), if applicable;
T_DELUNDIF	Depth to top of the Delaware Formation (undifferentiated), if applicable;
T_DEUN_ELE	Elevation with reference to sea level to the top of the Delaware Formation (undifferentiated), if applicable;
T_QUEEN	Depth to top of the Queen Formation, if applicable;
T_QN_ELEV	Elevation with reference to sea level to the top of the Queen Formation, if applicable;
T_GRAYBURG	Depth to top of the Grayburg Formation, if applicable;
T_GRBG_ELE	Elevation with reference to sea level to the top of the Grayburg Formation, if applicable;
T_SAN_ANDR	Depth to top of the San Andres Formation, if applicable;
T_SNDR_ELE	Elevation with reference to sea level to the top of the San Andres Formation, if applicable;
T_SAN_ANGE	Depth to top of the San Angelo Formation, if applicable;
T_SNGL_ELE	Elevation with reference to sea level to the top of the San Angelo Formation, if applicable;
T_CHY_CNYN	Depth to top of the Cherry Canyon Formation, if applicable;
T_CHCNYN_E	Elevation with reference to sea level to the top of the Cherry Canyon Formation, if applicable;
T_BRY_CNYN	Depth to top of the Brushy Canyon Formation, if applicable;
T_BRCNYN_E	Elevation with reference to sea level to the top of the Brushy Canyon Formation, if applicable;
T_GLORIETA	Depth to top of the Glorieta Formation, if applicable;

Appendix B. GIS Attribute Definitions (continued)

Attribute	Definition
T_GLOR_ELE	Elevation with reference to sea level to the top of the Glorieta Formation, if applicable;
T_CLRFRK	Depth to top of the Clear Fork Formation, if applicable;
T_CLRFRK_E	Elevation with reference to sea level to the top of the Clear Fork Formation, if applicable;
T_BONE_SPR	Depth to top of the Bone Spring Formation, if applicable;
T_BNSPR_EL	Elevation with reference to sea level to the top of the Bone Spring Formation, if applicable;
T_LEONARD	Depth to top of the Leonard Series, if applicable;
T_LEONRD_E	Elevation with reference to sea level to the top of the Leonard Series, if applicable;
COMMENT	Comments that are pertinent to that point;
THICK_CAP	Thickness of the Capitan at that point; if applicable;
TOP_UNIT	Name of the formation overlying the Capitan, if it can be determined;
JSAI_NUM	Unique identification number assigned to points that came from John Shomaker & Associates, Inc.;
SP_X	The X-coordinate position in State Plane Texas Central FIPS 4203 (feet) projected coordinate system;
SP_Y	The Y-coordinate position in State Plane Texas Central FIPS 4203 (feet) projected coordinate system;
GAM_X	The X-coordinate position in GAM projected coordinate system;
GAM_Y	The Y-coordinate position in GAM projected coordinate system;
FILE__	The M# assigned to individual geophysical logs by the Bureau of Economic Geology;
OPERATOR	The Company or Companies listed as the operator of the well;
LEASE	The name of the oil or gas lease associated with each geophysical log;
FIELD_NAME	The name of the oil or gas field where the well was drilled, if applicable;
LOG_TYPES	The types of wireline logs run in the applicable hole;
TOP_AVAIL	The available top of the geophysical log, or where the log starts;
BOT_AVAIL	The available bottom of the geophysical log, or where the log ends;
LOG_DATE	The date the geophysical log was made;
HOLE_TYPE	The type of hole from the geophysical log, if given;
UTM27X_M	The X-coordinate position in UTM Zone 13N, NAD 1927, meters projection;
UTM27Y_M	The Y-coordinate position in UTM Zone 13N, NAD 1927, meters projection;
RASTERVALU	The elevation of that point as extracted from the DEM.
The following attributes are unique to the *Top_elev_sand* shapefile:	
POINT_X	GIS generated lateral spatial location;
POINT_Y	GIS generated longitudinal spatial location;
CAPR_T_ELV	Elevation with reference to sea level to the top of the Caprock;

Appendix B. GIS Attribute Definitions (continued)

Attribute	Definition
CAPR_BS_EL	Elevation with reference to sea level to the bottom of the Caprock;
CAPR_THICK	Thickness of Caprock, in feet;
CAP_T_ELV	Elevation with reference to sea level to the top of the Capitan Formation;
CAP_BS_ELV	Elevation with reference to sea level to the bottom of the Capitan Formation;
CAP_THICK	Thickness of the Capitan Formation, in feet.
The following attributes are unique to *Hiss_crs_sects_GAM* and *Hiss_wells_dem_GAM* shapefiles:	
BOT_CAP	Bottom of Capitan at that point calculated by subtracting the given thickness from the given top;
WELL	The lease name of the well as given in the source information;
CRS_SEC	The field that identifies which cross-section(s) of Hiss' to which this well belongs;
F7	Number of feet from section line;
F8	Section line to which F7 refers;
F9	Number of feet from section line;
F10	Section line to which F9 refers;
F11	Survey section information;
F12	Land survey township or survey block information;
F13	Land survey range information or survey name;
LGRD	Elevation of point, as given in source data from Hiss' cross-sections;
T_TSY_ELEV	Elevation with reference to sea level to the top of the Tessy Formation, if applicable;
B_TSY_ELEV	Elevation with reference to sea level to the bottom of the Tessy Formation, if applicable;
T_RUST_ELE	Elevation with reference to sea level to the top of the Rustler Formation, if applicable;
B_RUST_ELE	Elevation with reference to sea level to the bottom of the Rustler Formation, if applicable;
T_SLDO_ELE	Elevation with reference to sea level to the top of the Salado Formation, if applicable;
B_SLDO_ELE	Elevation with reference to sea level to the bottom of the Salado Formation, if applicable;
T_ART_ELEV	Elevation with reference to sea level to the top of the Artesia Group, if applicable;
B_ART_ELEV	Elevation with reference to sea level to the bottom of the Artesia Group, if applicable;
T_CSTILE_E	Elevation with reference to sea level to the top of the Castile Formation, if applicable;
B_CSTILE_E	Elevation with reference to sea level to the bottom of the Castile Formation, if applicable;

Appendix B. GIS Attribute Definitions (continued)

Attribute	Definition
T_CPTN_ELE	Elevation with reference to sea level to the top of the Capitan Formation, if applicable;
B_CPTN_ELE	Elevation with reference to sea level to the bottom of the Capitan Formation, if applicable;
T_SALS_ELE	Elevation with reference to sea level to the top of the San Andres limestone, if applicable;
B_SALS_ELE	Elevation with reference to sea level to the bottom of the San Andres limestone, if applicable;
T_DLMTNG_E	Elevation with reference to sea level to the top of the Delaware Mountain Group, if applicable;
B_DLMTNG_E	Elevation with reference to sea level to the bottom of the Delaware Mountain Group, if applicable;
B_BNSPR_EL	Elevation with reference to sea level to the bottom of the Bone Spring Formation, if applicable;
B_CHCNYN_E	Elevation with reference to sea level to the bottom of the Cherry Canyon Formation, if applicable;
T_YESSO_EL	Elevation with reference to sea level to the top of the Yesso Formation, if applicable;
B_YESSO_EL	Elevation with reference to sea level to the bottom of the Yesso Formation, if applicable.
Polyline Files Data Sources: *Capitan Reef Outline, mapped_faults, Cap_Isopach, Cap_Top_Contours, Published_Lines_of_Section*	
THICK_CONT	Thickness of Capitan (in feet);
CONTOUR	Contour lines (in feet) indicating the top of the Capitan referenced to mean sea level;
ID	Unique fault identification number assigned to faults in the *mapped_faults* shapefile or identification number attribute column generated by ArcGIS when the shapefile (*Capitan Reef Outline, Cap_Isopach, Cap_Top_Contours, Published_Lines_of_Section)* was created;
FAULT_NAME	The name associated with a particular fault in the *mapped_faults* shapefile;
CONFIDENCE	Used in the *Cap_Top_Contours* polyline file. A value of 1 corresponds to contour lines that have good well control. A value of 2 corresponds to contour lines that have poor well control;
Source	The published source information for the applicable line of section;
Shape_Length	The length of each respective polyline in the shapefile.

Appendix B. GIS Attribute Definitions (continued)

Attribute	Definition
Polygon Files Data Sources: *Capitan_Outline_Poly, Sand_Channel_Outline, No_data_area, Capitan_overlying_units, Capitan_underlying_units*	
Id	Identification number attribute column generated by ArcGIS when the shapefile was created;
GEOLOGI_ID	Attribute column generated by ArcGIS during shapefile creation and renamed, but not used;
AREA	Area of specific formation, if known;
DESCRIPTIO	Geologic name and/or description of area represented by polygon;
Shape_Length	Length of the polygon in the shapefile;
Shape_Area	Area of the polygon in the shapefile;
Units	Formation name represented by the polygon.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

CASE NO. 8405
Order No. R-7935

APPLICATION OF P & O TREATING PLANT FOR AN AMENDMENT OF ADMINISTRATIVE ORDER SWD-272, LEA COUNTY, NEW MEXICO

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 8 a.m. on November 14, 1984, at Santa Fe, New Mexico, before Examiner Gilbert P. Quintana.

NOW, on this 4th day of June, 1985, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS THAT:

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

(2) The applicant, P & O Treating Plant, is the owner and operator of the Meador "A" Well No. 1, located in Unit G of Section 10, Township 25 South, Range 36 East, NMPM, Lea County, New Mexico.

(3) Administrative Order SWD-272 dated May, 1984, authorized P & O Treating Plant to utilize the Meador "A" Well No. 1 to dispose of produced salt water into the Delaware formation from a depth of approximately 5406 feet to 5426 feet in said well.

(4) The applicant now proposes to utilize said well to dispose solely Seven Rivers formation waters produced from certain wells as shown on Exhibit "A" attached to this order and to change the injection interval to the Seven Rivers formation at an approximate depth of 3690 feet to 3700 feet.

NMOCD Case No. 15723
NMSLO Exhibit #4

(5) Administrative procedures for the approval to dispose of additional produced waters into said well should be established.

(6) The injection wells or injection pressurization system should be so equipped as to limit injection pressure at the wellhead to no more than 250 psi, but the Division Director should have authority to increase said pressure limitation, should circumstances warrant.

(7) The injection should be accomplished through 2 3/8-inch plastic lined tubing in a packer set at approximately 3600 feet; the casing-tubing annulus should be filled with an inert fluid; and a pressure gauge or approved leak detection device should be attached to the annulus in order to determine leakage in the casing, tubing, or packer.

(8) The operator should notify the supervisor of the Division's Hobbs district office of the date and time of the plugging of the Delaware interval and installation of disposal equipment so that the same may be witnessed.

(9) The operator should take all steps necessary to ensure that the injection water enters only the proposed injection interval and is not permitted to escape to other formations or onto the surface.

(10) Approval of the subject application will prevent the drilling of unnecessary wells and otherwise prevent waste and protect correlative rights.

(11) Administrative Order SWD-272 should be superseded.

IT IS THEREFORE ORDERED THAT:

(1) The applicant, P & O Treating Plant, is hereby authorized to utilize its Meador "A" Well No. 1, located in Unit G of Section 10, Township 25 South, Range 36 East, NMPM, Lea County, New Mexico, to dispose of produced Seven Rivers water from the wells described on Exhibit "A" to this order, into the Seven Rivers formation; injection to be accomplished through 2 3/8-inch tubing installed in a packer set at approximately 3600 feet, with injection into the interval from approximately 3690 feet to 3700 feet;

PROVIDED HOWEVER, the tubing shall be plastic-lined; the casing-tubing annulus shall be filled with an inert fluid; and a pressure gauge shall be attached to the annulus or the annulus shall be equipped with an approved leak detection device in order to determine leakage in the casing, tubing, or packer.

(2) The disposal waters shall be transported directly to said well through a pipeline.

(3) The injection wells herein authorized and/or the injection pressurization system shall be so equipped as to limit injection pressure at the wellhead to no more than 250 psi, provided however, the Division Director may authorize a higher surface injection pressure upon satisfactory showing that such pressure will not result in fracturing of the confining strata.

(4) The operator shall notify the supervisor of the Division's Hobbs District Office of the date and time of the plugging of the Delaware perforations in said well and the installation of disposal equipment so that the same may be witnessed.

(5) The operator shall immediately notify the supervisor of the Division's Hobbs district office of the failure of tubing, casing, or packer in said well or the leakage of water from or around said well and shall take such steps as may be necessary to correct such failure or leakage.

(6) The Supervisor of the Division's Hobbs District Office shall have the authority to administratively approve the disposal of additional produced waters from other formations into said well, provided that the applicant can demonstrate such additional disposal waters shall not adversely affect the well or endanger fresh waters. Notice of such a request by the applicant shall be mailed to the Santa Fe office of the Oil Conservation Division.

(7) The applicant shall conduct disposal operations and submit monthly reports in accordance with Rules 701 through 708 and 1120 of the Division Rules and Regulations.

(8) Division Administrative Order SWD-272 is hereby superseded.

(9) Jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

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

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

R. L. STAMETS,
Director

S E A L

EXHIBIT "A"
CASE NO. 8405
ORDER NO. R-7935

WELLS AUTHORIZED TO DISPOSE PRODUCED WATER INTO THE MEADOR "A" WELL NO. 1

CONVEST ENERGY CORPORATION

Cities Services Federal Well No. 2
NE/4 SE/4, Sec. 35, T-24S, R-36E,
Lea County, NM

Cities Services Federal Well No. 4
SE/4 SE/4, Sec. 35, T-24S, R-36E,
Lea County, NM

Everett Well No. 2
SE/4 SW/4, Sec. 35, T-24S, R-36E,
Lea County, NM

Everett Well No. 4
SW/4 SW/4, Sec. 35, T-24S, R-36E,
Lea County, NM

Arnett Ramsey State Well No. 1
NE/4 NW/4, Sec. 2, T-25S, R-36E,

Arnett Ramsey State Well No. 2
NW/4 NE/4, Sec. 2, T-25S, R-36E,
Lea County, NM

Arnett Ramsey State Well No. 3
NE/4 NE/4, Sec. 2, T-25S, R-36E,
Lea County, NM

Arnett Ramsey State Well No. 4
NE/4 SE/4, Section 2, T-25S,
R-36E, Lea County, NM

Arnett Ramsey State Well No. 5
SW/4 NE/4, Sec. 2, T-25S, R-36E,
Lea County, NM

TENNECO OIL COMPANY

E. J. Wells No. 1
SE/4 NW/4, Sec. 12, T-25S,
R-36E, Lea County, NM

E. J. Wells No. 3
SW/4 NW/4, Sec. 12, T-25S,
R-36E, Lea County, NM

WORLDWIDE ENERGY CORPORATION

E. J. Wells No. 3
SE/4 NE/4, Sec. 12, T-25S,
R-36E, Lea County, NM

DOYLE HARTMAN

Etz Well No. 1
NW/4 NW/4, Sec. 7, T-25S,
R-37E, Lea County, NM

Etz Well No. 2
SW/4 NW/4, Sec. 7, T-25S,
R-37E, Lea County, NM

Etz Well No. 3
SW/4 NW/4, Sec. 7, T-25S,
R-27E, Lea County, NM

Etz Well No. 4
NW/4 NW/4, Sec. 7, T-25S,
R-37E, Lea County, NM

BOREHOLE COMPENSATED SONIC LOG

G-10-T25S-R36E 1980FN 1980FE
CHANGE PROPERTIES COMPANY
WEST JAL DISPOSAL # 1
30-025-26676

COUNTY LEA

COMPANY PHILLIPS PETROLEUM COMPANY

WELL MEADOR "A" #1

FIELD WILDCAT

COUNTY LEA STATE NEW MEXICO

LOCATION 1980' FNL & 1980' FEL

SERIAL NO.	SEC	TWP	RANGE
	10	25-S	36-E

Other Services: DIL, TEMP, FIL, CNL/FDC

Permanent Datum: G.L. ; Elev.: 3160.6
Log Measured From K.B. 16.1 Ft. Above Perm. Datum
Drilling Measured From K.B.

Elev.: K.B. 3176.7
D.F.
G.L. 3160.6

Date	5-18-80	6-19-80		
Run No.	ONE	TWO		
Depth—Driller	5188	9550		
Depth—Logger (Schl.)	5206	9541		
Btm. Log Interval	5201	9528		
Top Log Interval	1070	3450		
Casing—Driller	13 3/8@1640	9 5/8@ 5200	@	@
Casing—Logger	1629	5196		
Bit Size	12 1/4	7 7/8		
Type Fluid in Hole	F.W. GEL	GEL/DRISPAC		
Dens. / Visc.	8.5 / 45	9.1 / 37		
pH / Fluid Loss	ml	9 / 12 ml	ml	ml
Source of Sample	SUPPLY TANK	PIT		
Rm @ Meas. Temp.	2.05 @60 °F	1.47@ 86 °F	@ °F	@ °F
Rmf @ Meas. Temp.	1.52 @60 °F	1.10@ 86 °F	@ °F	@ °F
Rmc @ Meas. Temp.	3.1 @60 °F	2.21@ 86 °F	@ °F	@ °F
Source: Rmf / Rmc	M / C	M / C		
Rm @ BHT	1.39 @105 °F	1.00@ 127°F	@ °F	@ °F
TIME Circulation Stopped	1230	0210		
TIME Logger on Bottom	2130	1700		
Max. Rec. Temp.	105 °F	127 °F	°F	°F
Equip. / Location	8185 / HOBBS	8141 / HOBBS		
Recorded By	SEVOUGIAN	MOBARAK		
Witnessed By Mr.	WILLIAMS	PICKETT		

FOLD HERE The well name, location and borehole reference data were furnished by the customer.

Run No.	ONE	TWO		
Service Order No.	126174			
Fluid Level	1000	FULL		

EQUIPMENT DATA

Sonic Panel No.	451	519		
Sonic Cart No.		1168		
Sonic Sonde No.		132		
Mem. Panel No.	1054	CSU		
G.R. Cart. No.	665	2350		
G.R. Panel No.	623	482		
Caliper No.				
TTR No.	965	CSU		
Centralizers: No.	2	2		
Type	CME-Z	CME-Z		
Standoffs: No.				
Type				
Time Const.-Sec.		1		
Speed - F.P.M.	40-50	50		

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA

Porosity Selectors				Depth	
Δt_m	Δt_f	Cp	Ø Scale	From	To

REMARKS

Velocity (ft/sec) = 1,000,000 / Interval Transit Time (microseconds per foot)

CALIBRATION DATA

GR	BKG. CPS		SEE CAL
	Source CPS		FILM
	Tc Sec		

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 4 of our General Terms and Conditions as set out in our current Price Schedule.

CALIPER DIAM. IN INCHES 6 — 16

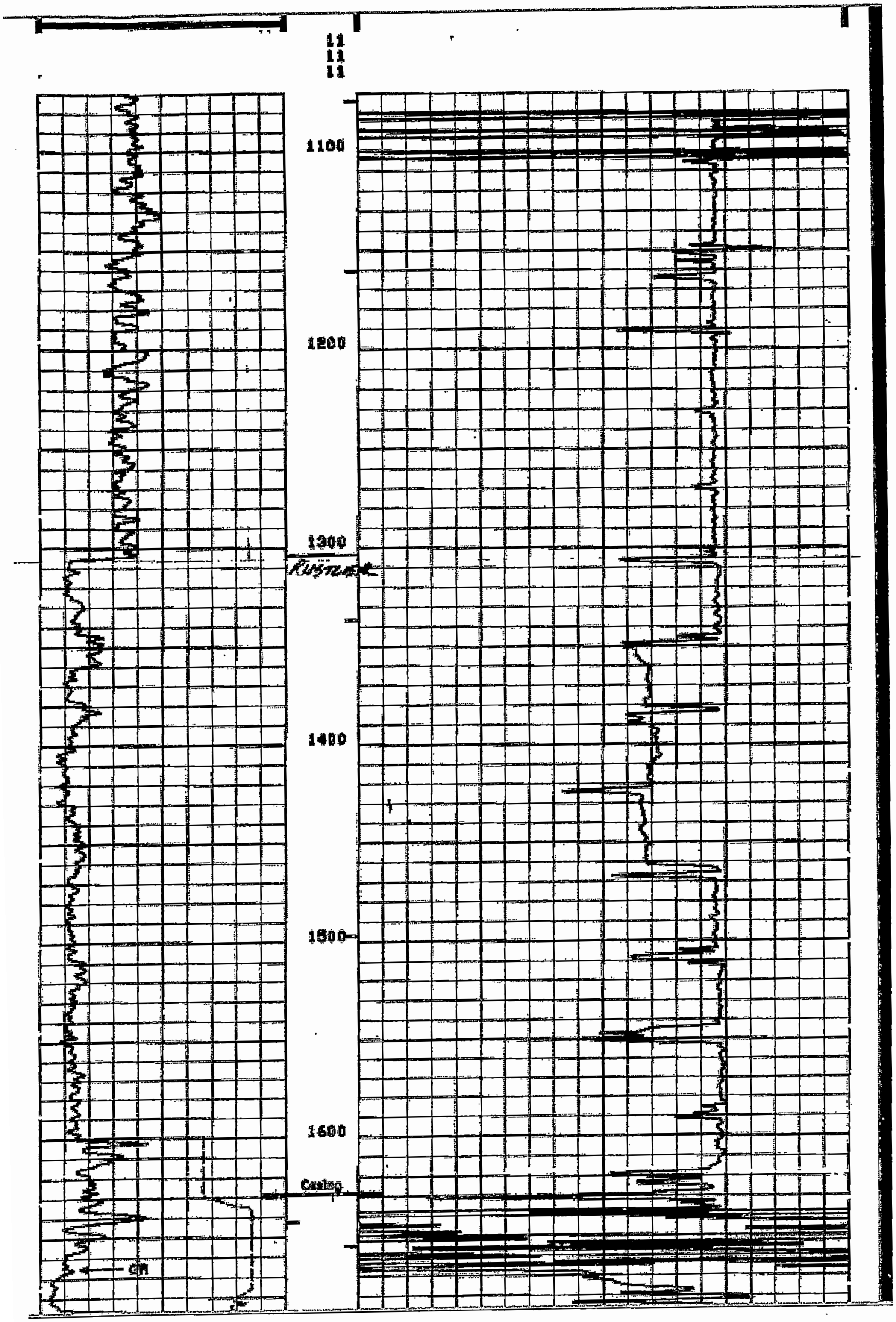
GAMMA RAY API UNITS 0 — 100; 100 — 200

DEPTH RUN 1

INTERVAL TRANSIT TIME MICROSECONDS PER FOOT 13 R2 R2
100 — 70 — 40
160 — 130 — 100

INTEGRATED TRAVEL TIME

NMOCD Case No. 15723
NMSLO Exhibit #5



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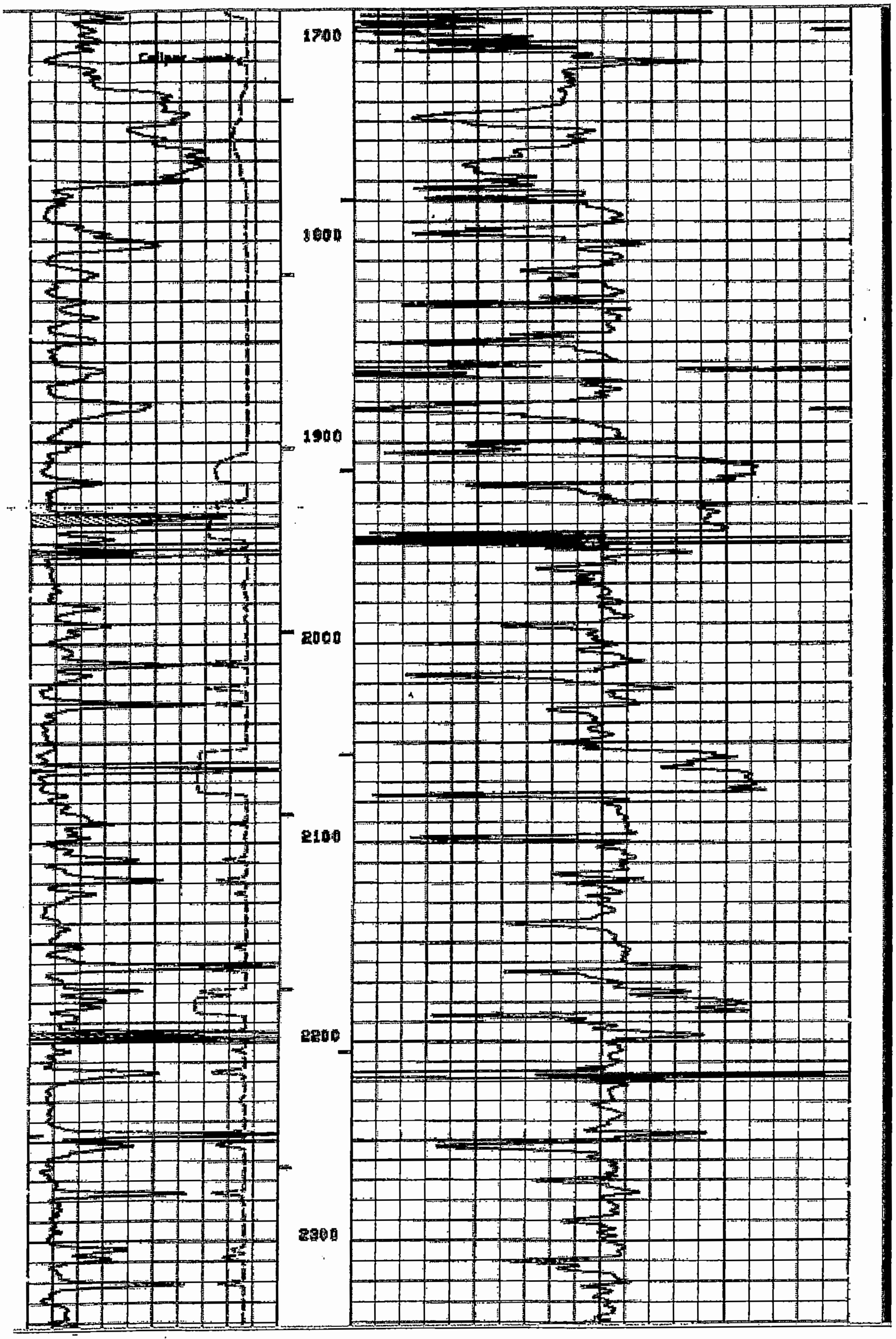
1300
RUSTLER
1400
1500
1600
Casing
GR



Caliper
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1800
1900
2000
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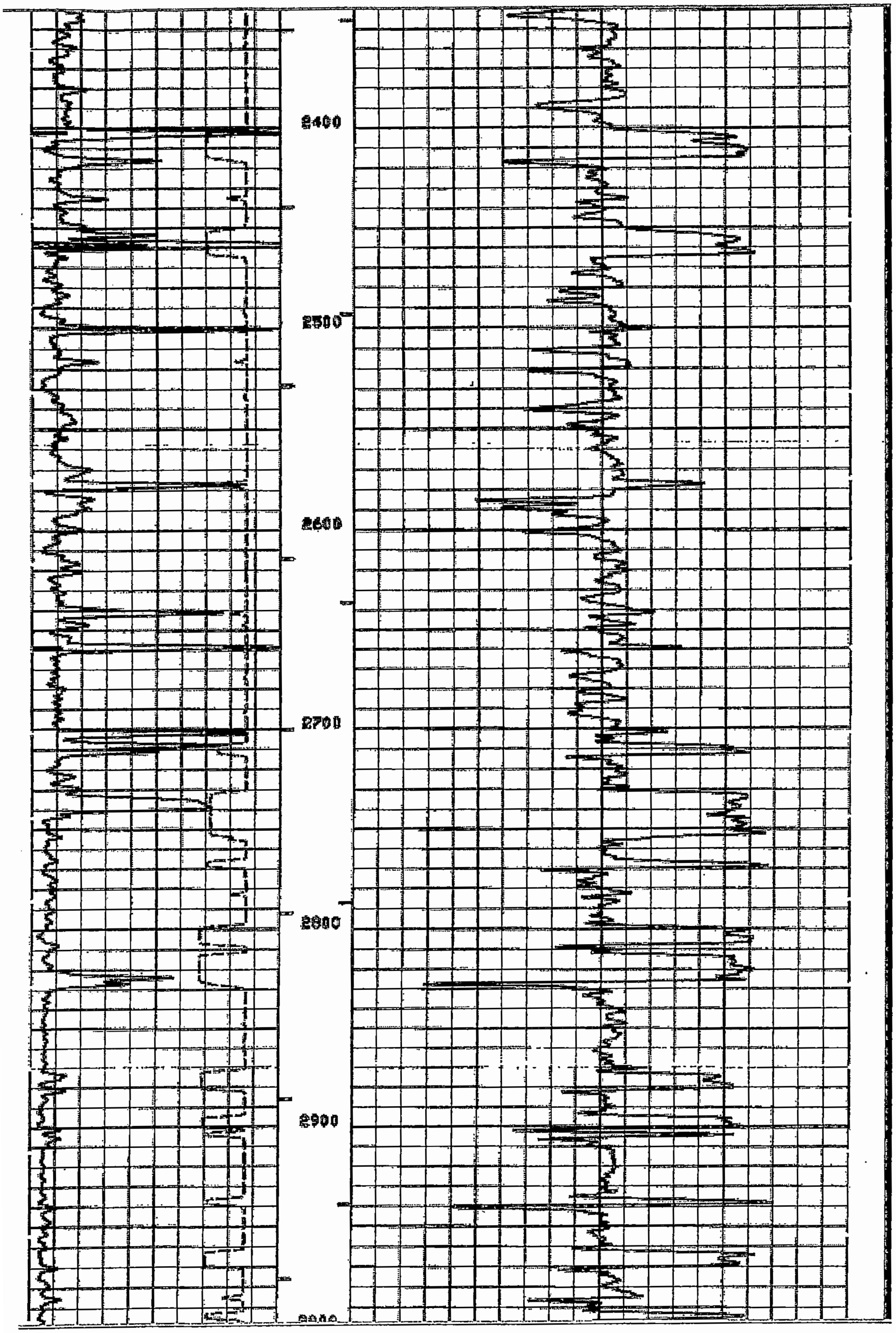
2200
2300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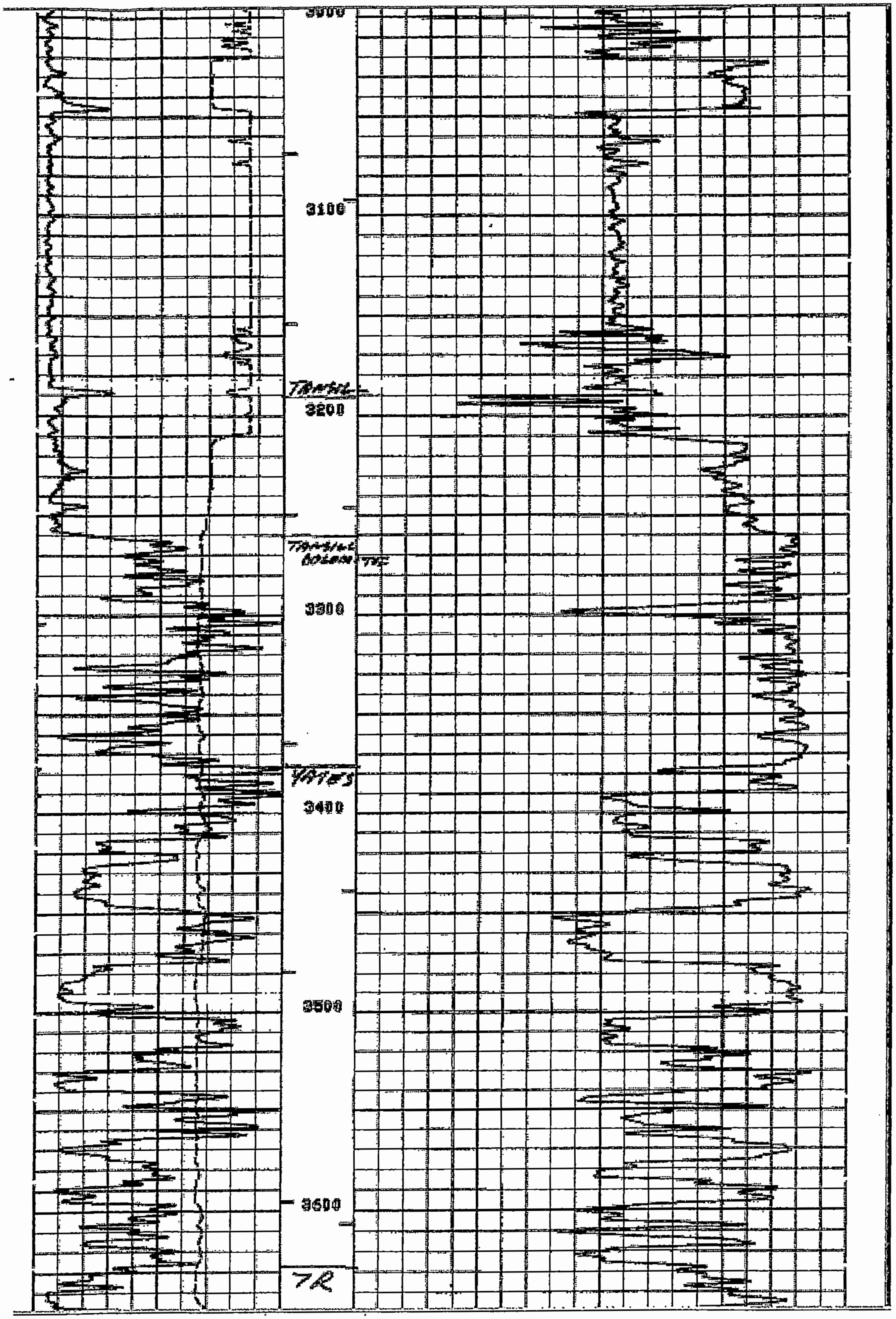
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YATES
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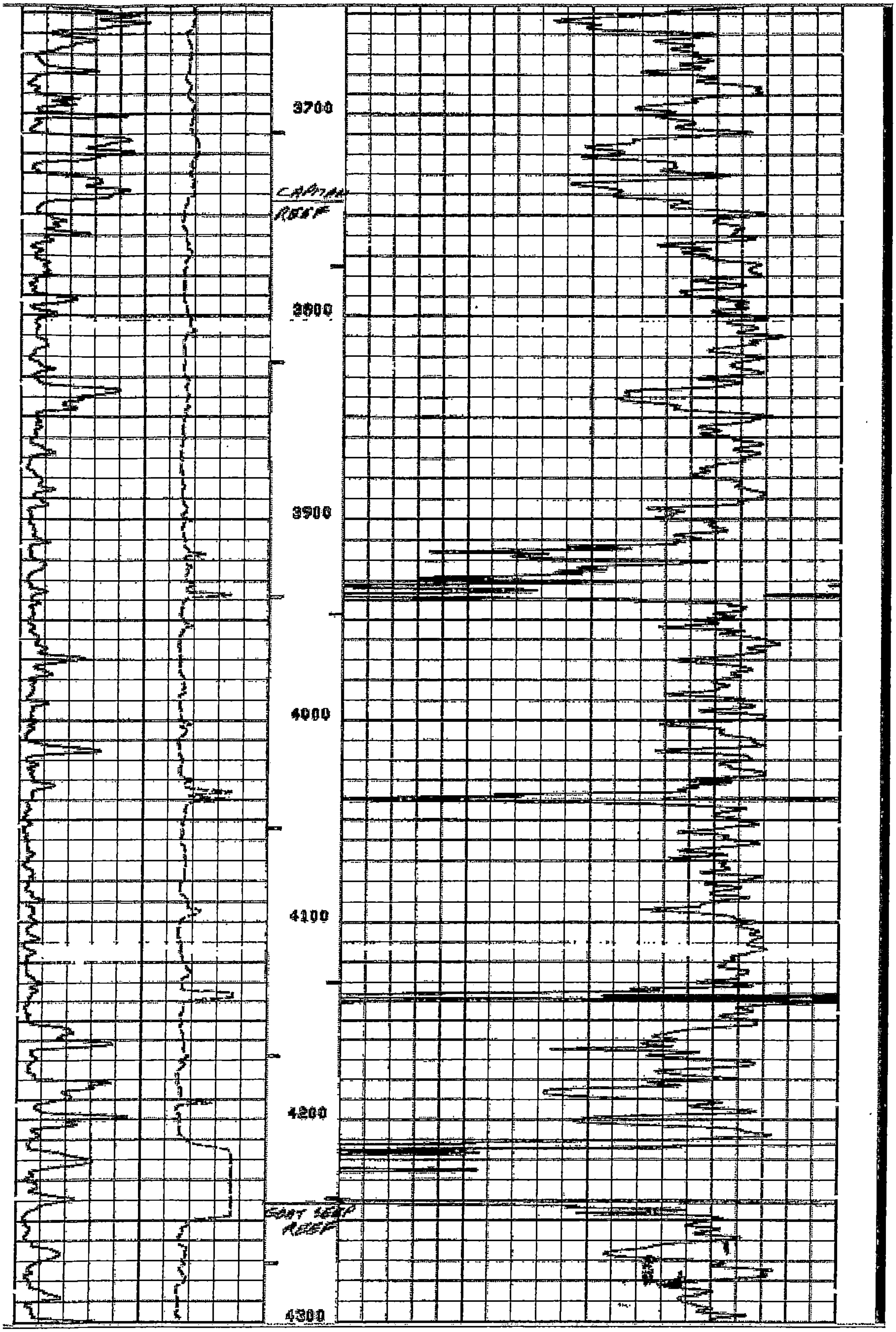
3500
3600
7R


3700
CAPITAN REEF
3800
3900
4000
4100
4200
GOAT SEEP REEF
4300

THE WESTERN COMPANY
GAMMATRON
Simultaneous Nuclear Log

FILE NO. 76015

COMPANY: RALPH LOWE
WELL: SHOLES # 2
FIELD: JAL   30-025-09806
COUNTY: LEA   STATE: NEW MEXICO

LOCATION: 660'FS & WL'S, OF SE/4

OTHER SERVICES:

SEC 25   TWP -25-S   RGE. -36-E

ELEVATIONS: KB — DF 3023 GL 3021

PERMANENT DATUM: GROUND LEVEL   ELEV 3021
LOG MEASURED FROM: 2 FT. ABOVE PERMANENT DATUM
DRILLING MEASURED FROM: DERRICK FLOOR 3023

DATE	7-18-60	7-18-60
RUN NO.	ONE	ONE
TYPE LOG	GAMMA-RAY	NEUTRON
DEPTH—DRILLER	2955	2955
DEPTH—LOGGER	2944	2944
BOTTOM LOGGED INTERVAL	2935	2942.5
TOP LOGGED INTERVAL	SURF.	SURF.
TYPE FLUID IN HOLE	OIL	OIL
SALINITY PPM CL		
DENSITY		
LEVEL	238	238
MAX. REC. TEMP. DEG. F		
OPR. RIG TIME	TWO HOURS	TWO HOURS
RECORDED BY	BIGBIE	BIGBIE
WITNESSED BY	MR. SMITH	MR. SMITH

RUN NO.	BIT	BORE HOLE RECORD FROM	TO	CASING SIZE	WGT	FROM	TO
				10 3/4		SURF.	410
	8 7/8	SURF.	2935	7"		SURF.	2935
	6 1/4	2935	2955	O.H.			

NMOCD Case No. 15723
NMSLO Exhibit #6

EQUIPMENT DATA

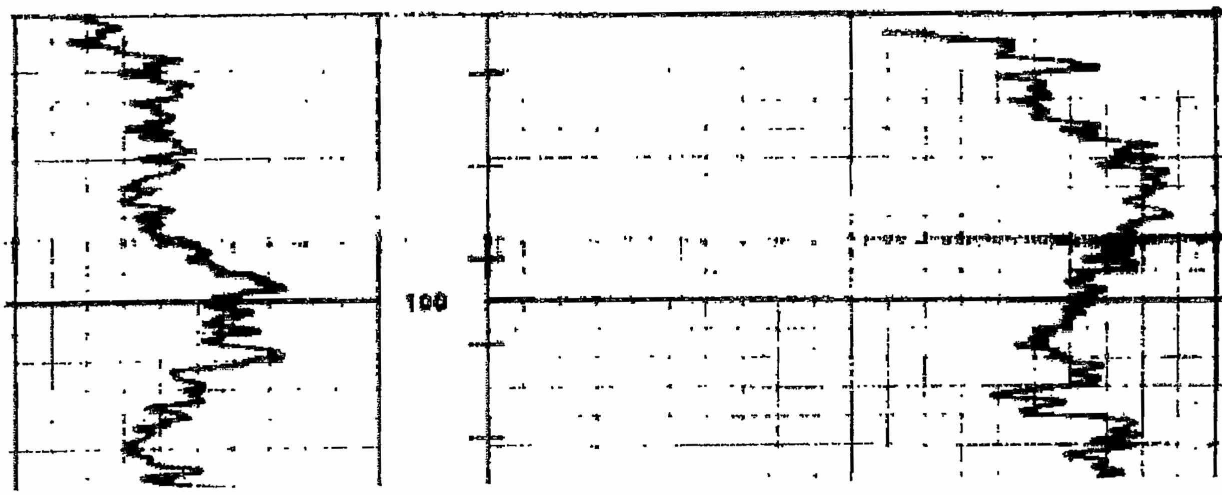
GAMMA RAY		NEUTRON	
RUN NO	ONE	RUN NO.	ONE
TOOL MODEL NO	500	LOG TYPE	N-N (THERM)
DIAM	3 1/2	TOOL MODEL NO.	500
DETECT MODEL NO	SPA12	DIAM	3 1/2
TYPE	SCINT.	DETECT MODEL NO.	6167
LENGTH	3"	TYPE	SCINT.
DIST TO N SOURCE	104"	LENGTH	1 3/4
		SOURCE MODEL NO	RB-300
GENERAL		SERIAL NO.	171560
HOIST TRUCK NO	6213	SPACING	15.5
INST TRUCK NO	6213	TYPE	RA-BE
TOOL SERIAL NO	25	STRENGTH	4.5 X 10^6
LOG TICKET NO	27462		

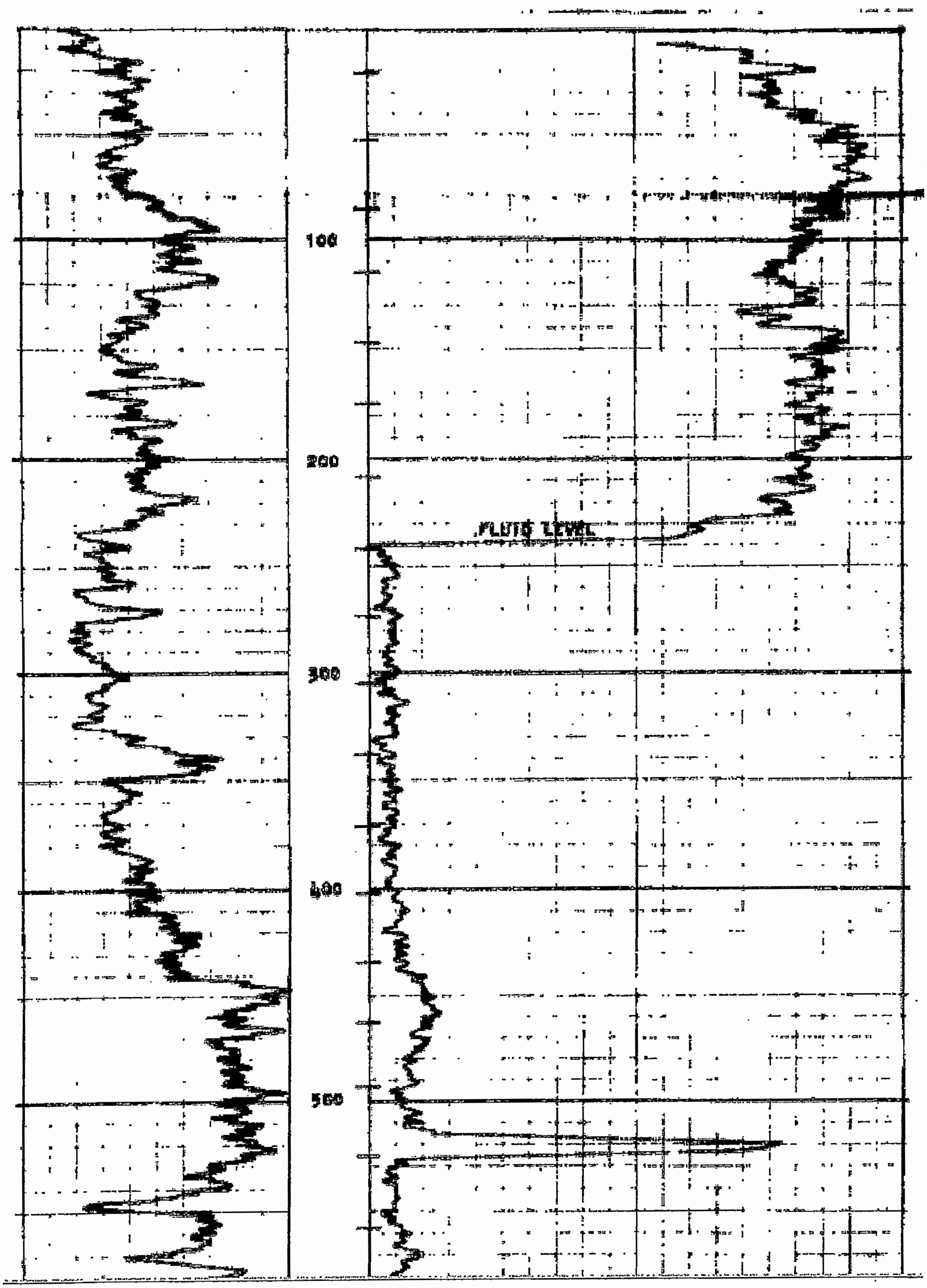
LOGGING DATA

GENERAL				GAMMA RAY				NEUTRON			
RUN NO	DEPTHS FROM	DEPTHS TO	SPEED FT/MIN	T.C. SEC	SENS SETTINGS	ZERO DIV L or R	API GR UNITS PER LOG DIV	T.C. SEC	SENS SETTINGS	ZERO DIV L or R	API N UNITS PER LOG DIV.
ONE	SURF.	2942.5	30/60	2.0	266	0	8	4.0	85	5 L	50

REFERENCE LITERATURE

REMARKS

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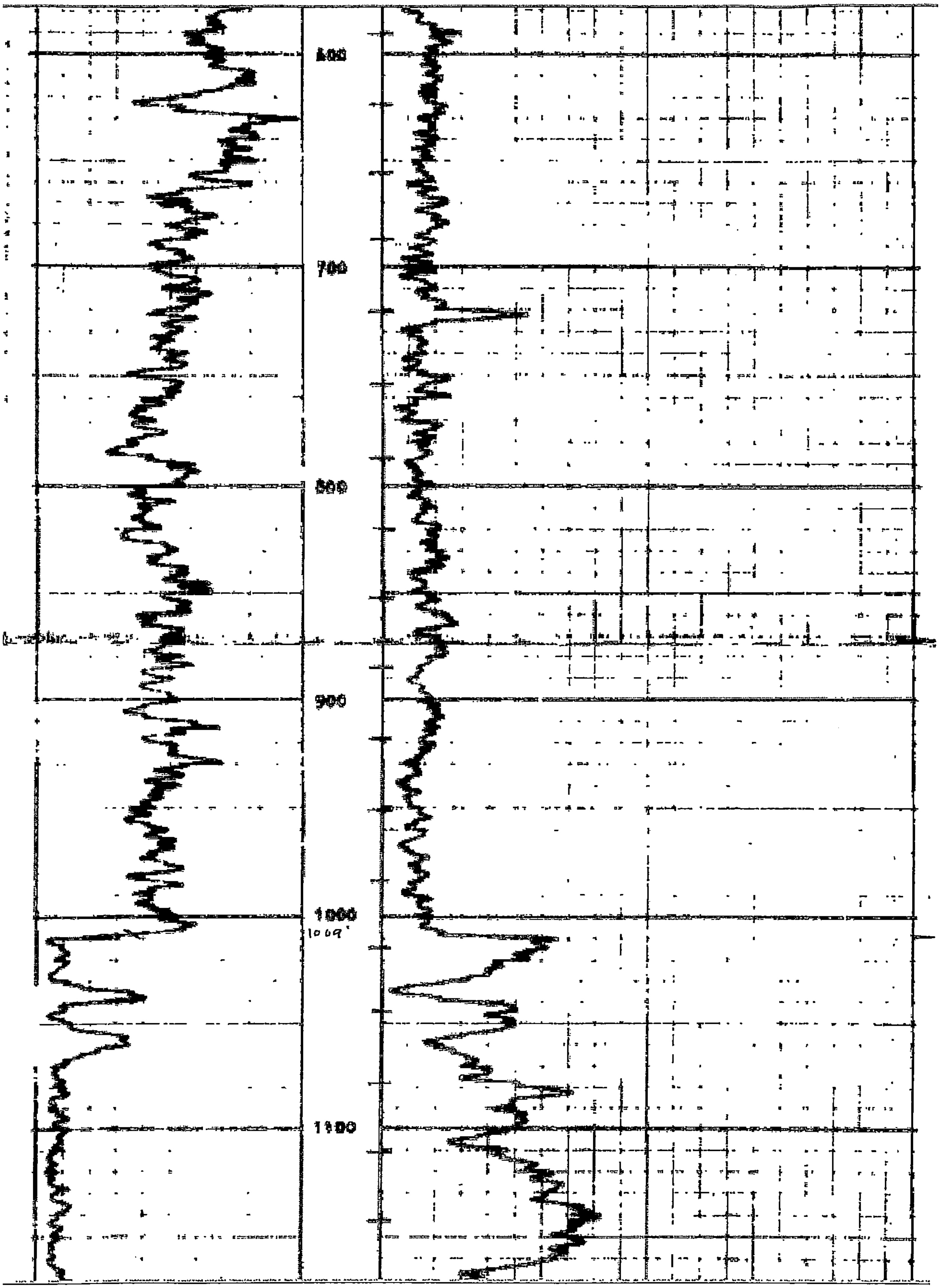
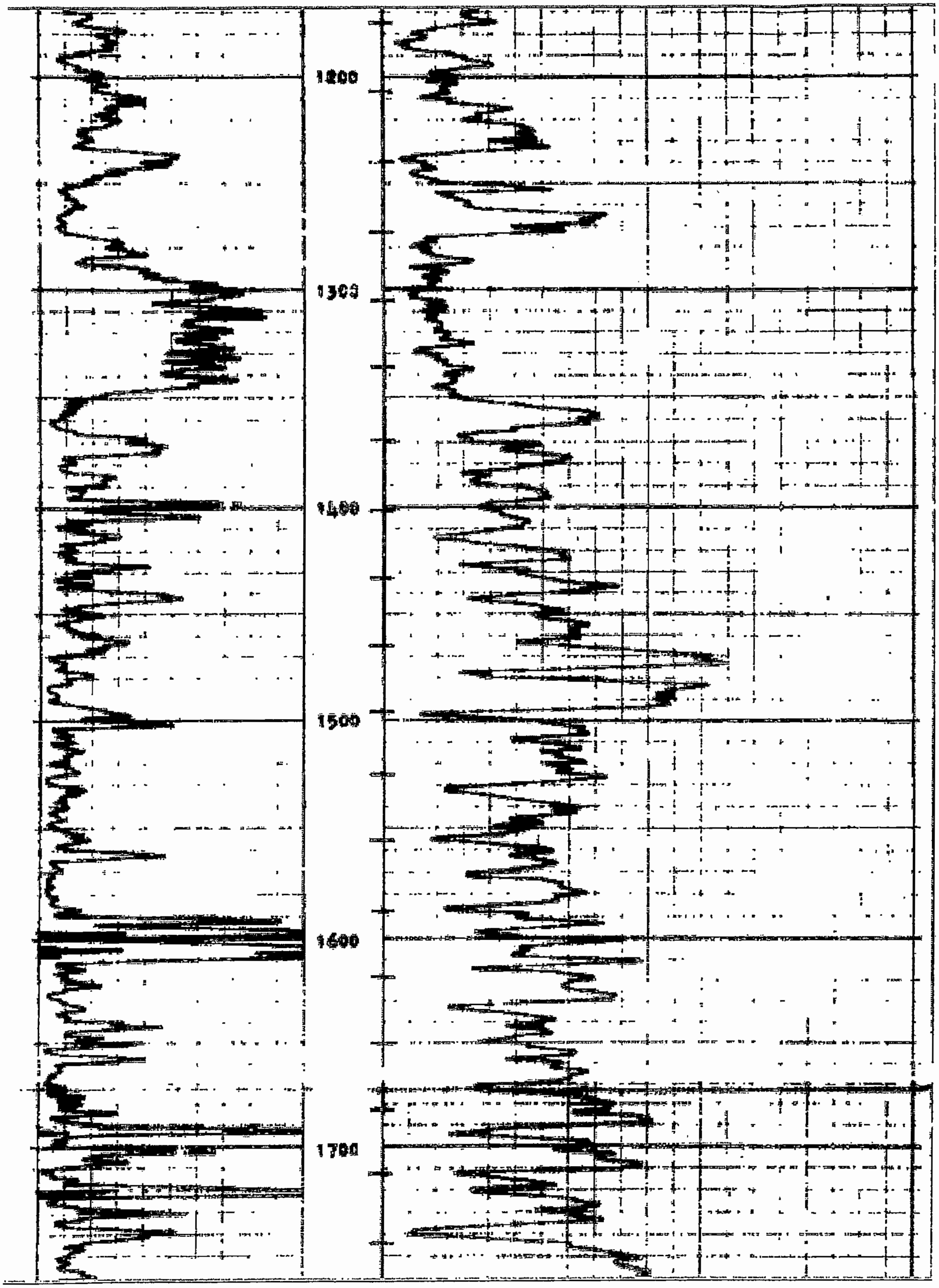
FLUID LEVEL
300
400
500



(Correlating to Jal [illegible] #1)
[illegible] Top picks

Rustler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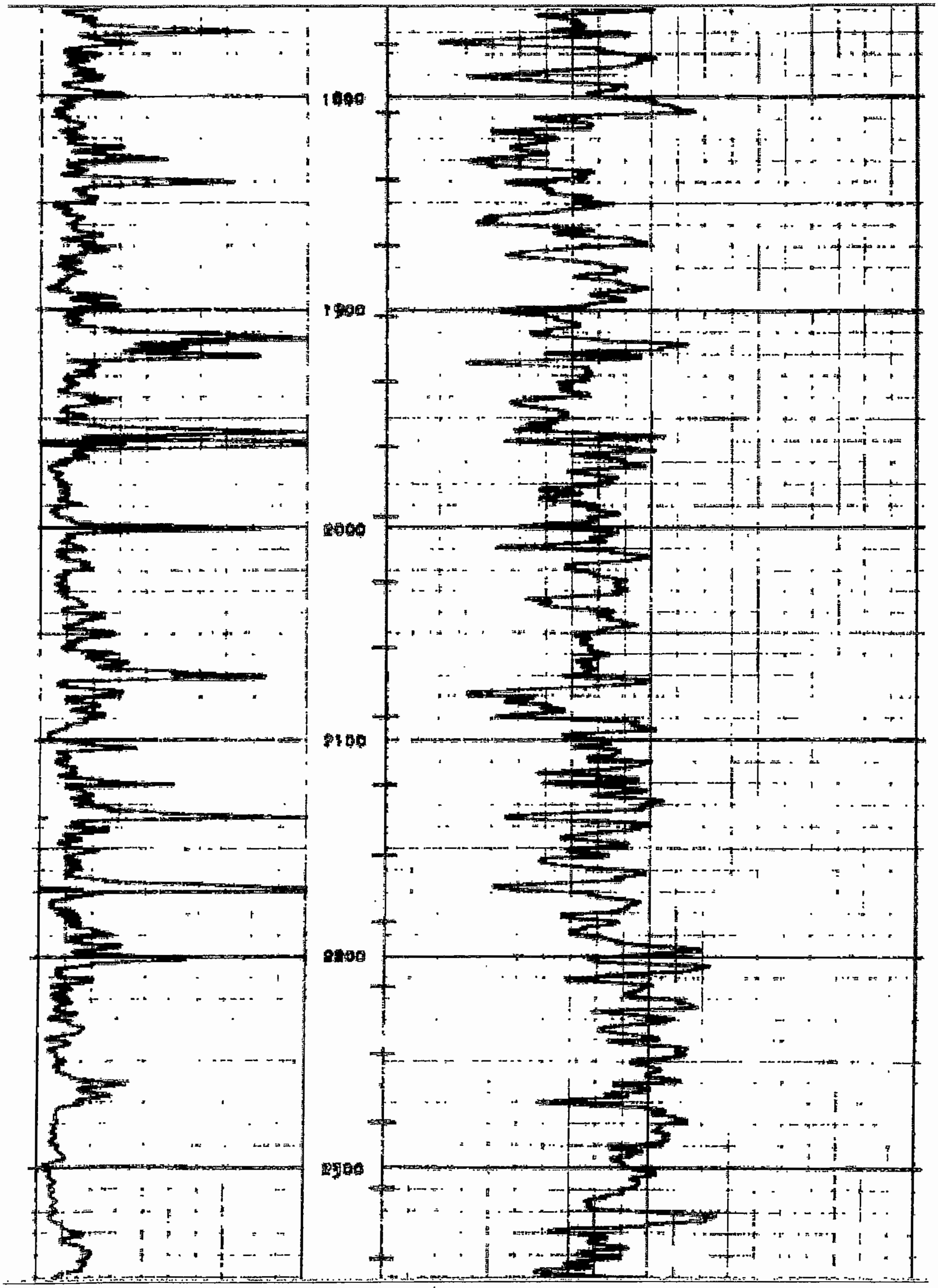
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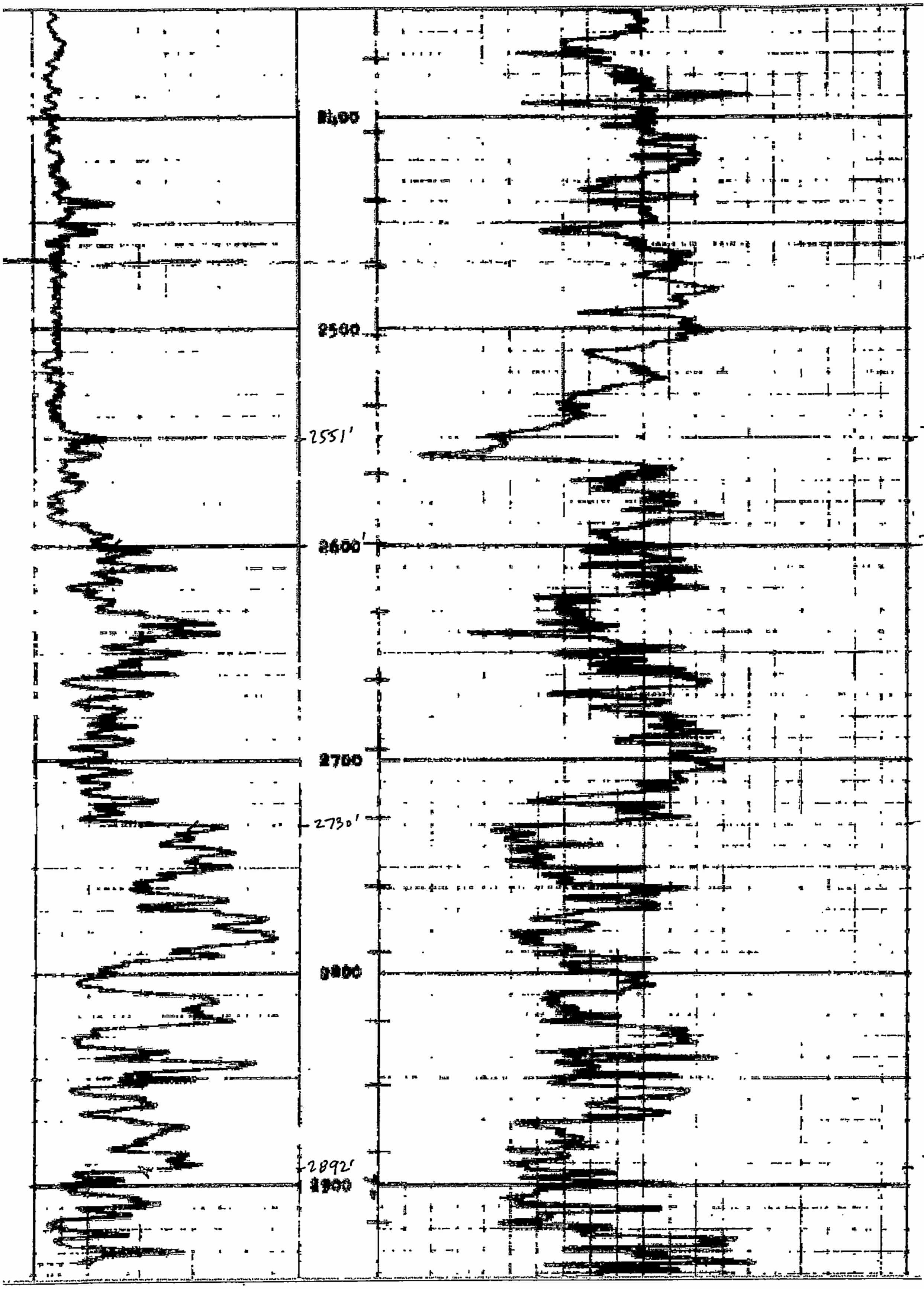

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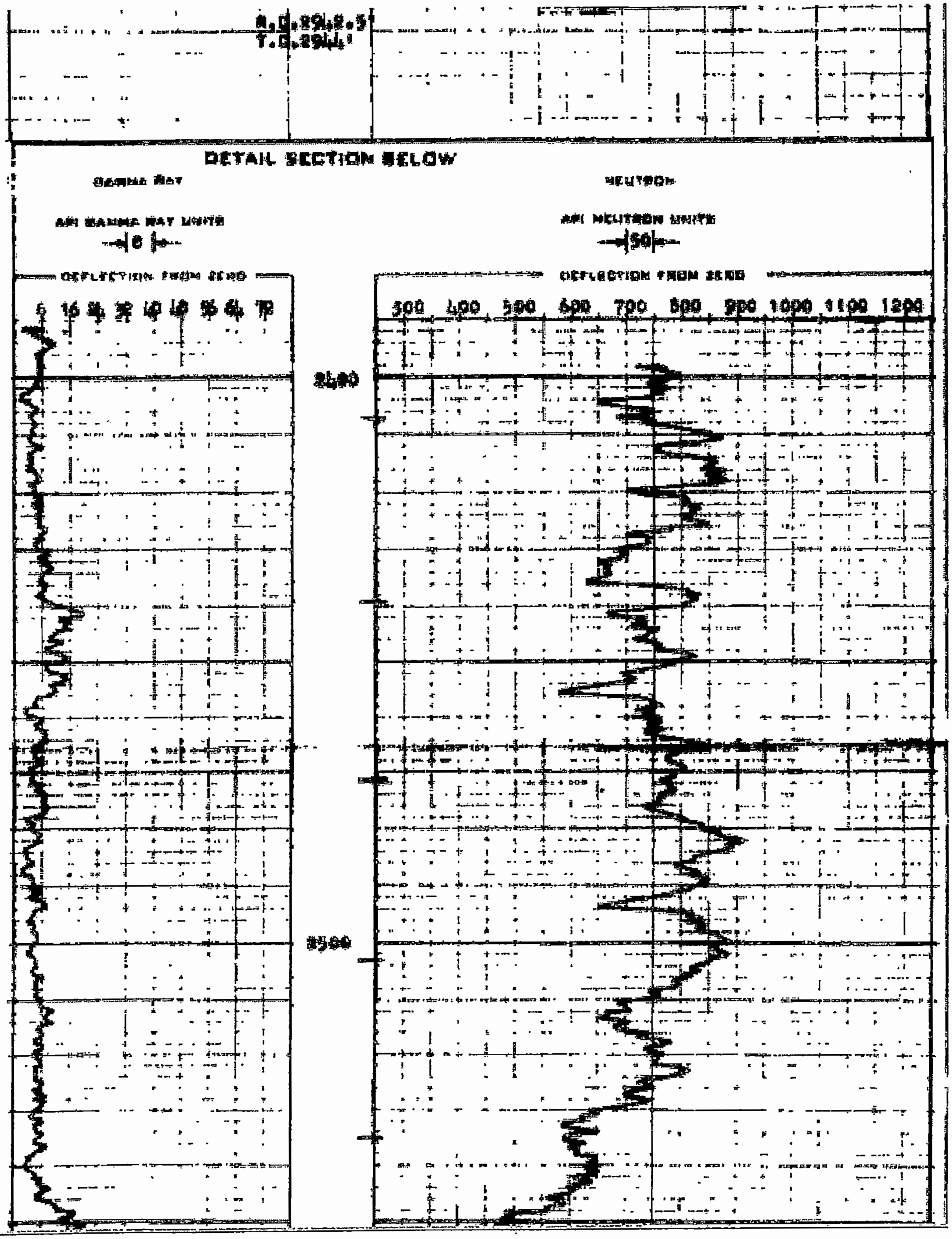
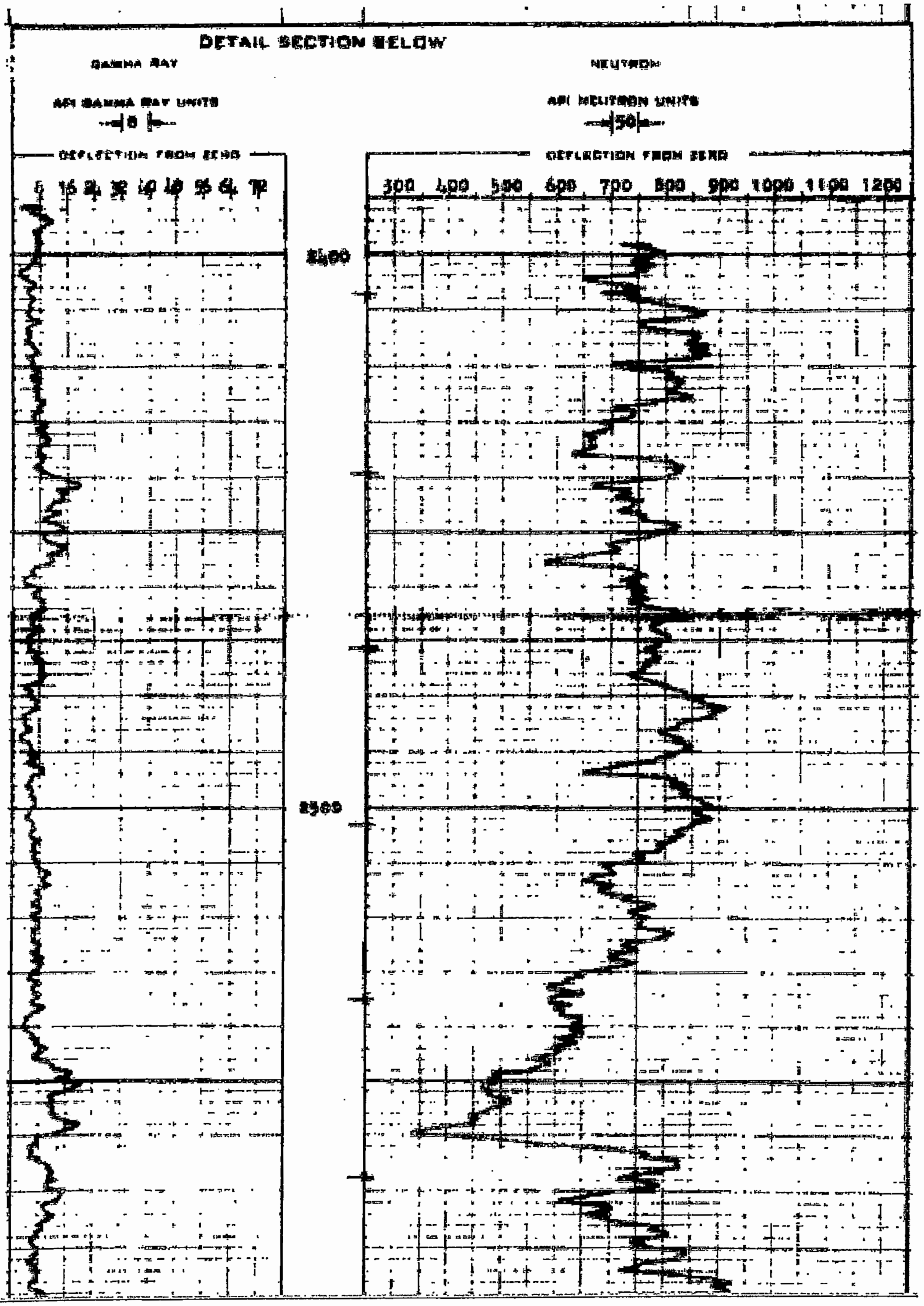
2500
2551'
2600'
2700
2730'
2800
2892'
2900


R.D.2942.5'
T.D.2944'
DETAIL SECTION BELOW
GAMMA RAY
NEUTRON
API GAMMA RAY UNITS
API NEUTRON UNITS
DEFLECTION FROM ZERO
DEFLECTION FROM ZERO
300 400 500 600 700 800 900 1000 1100 1200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GAMMA RAY
API GAMMA RAY UNITS
8
DEFLECTION FROM ZERO
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NEUTRON
API NEUTRON UNITS
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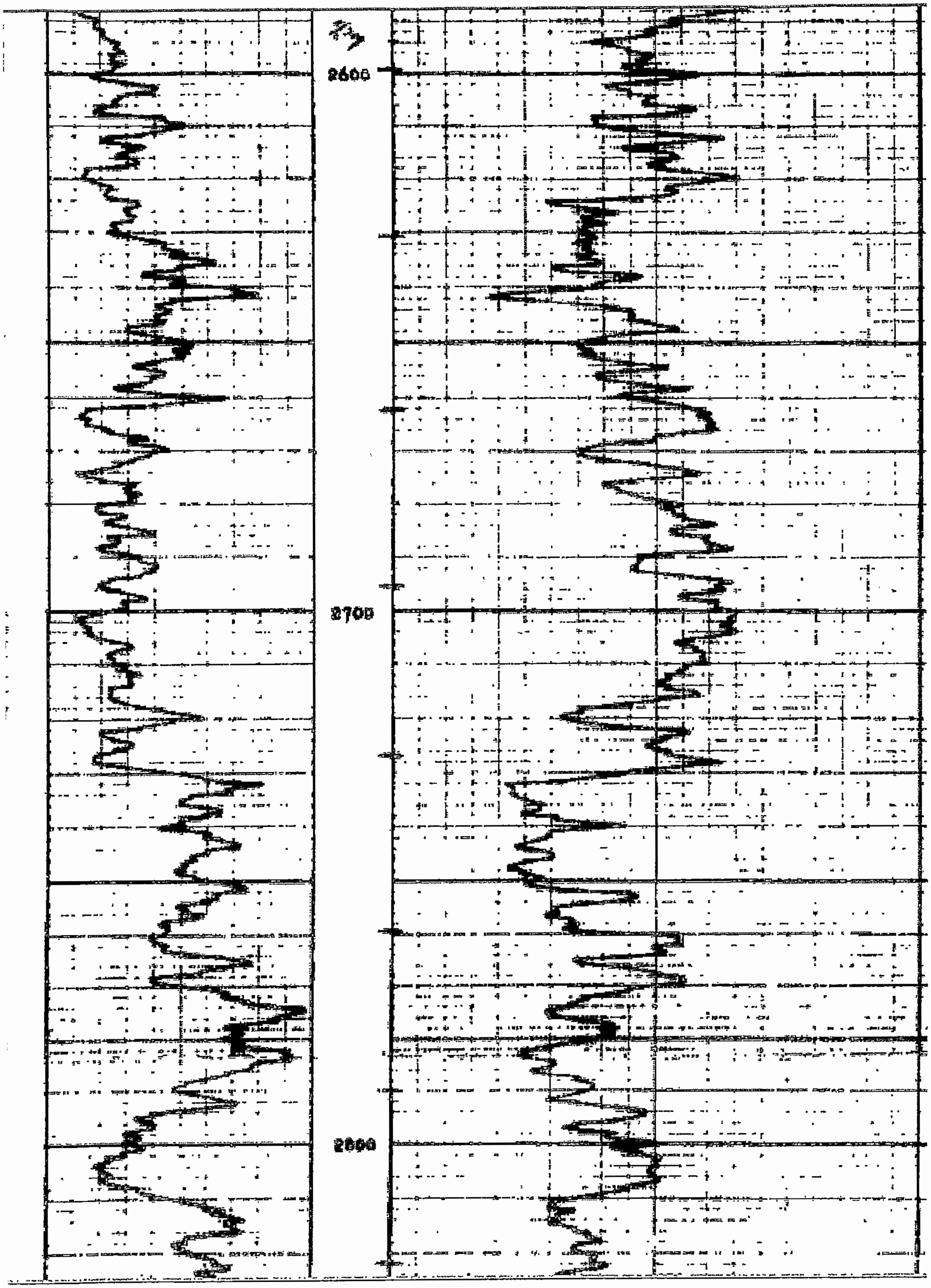
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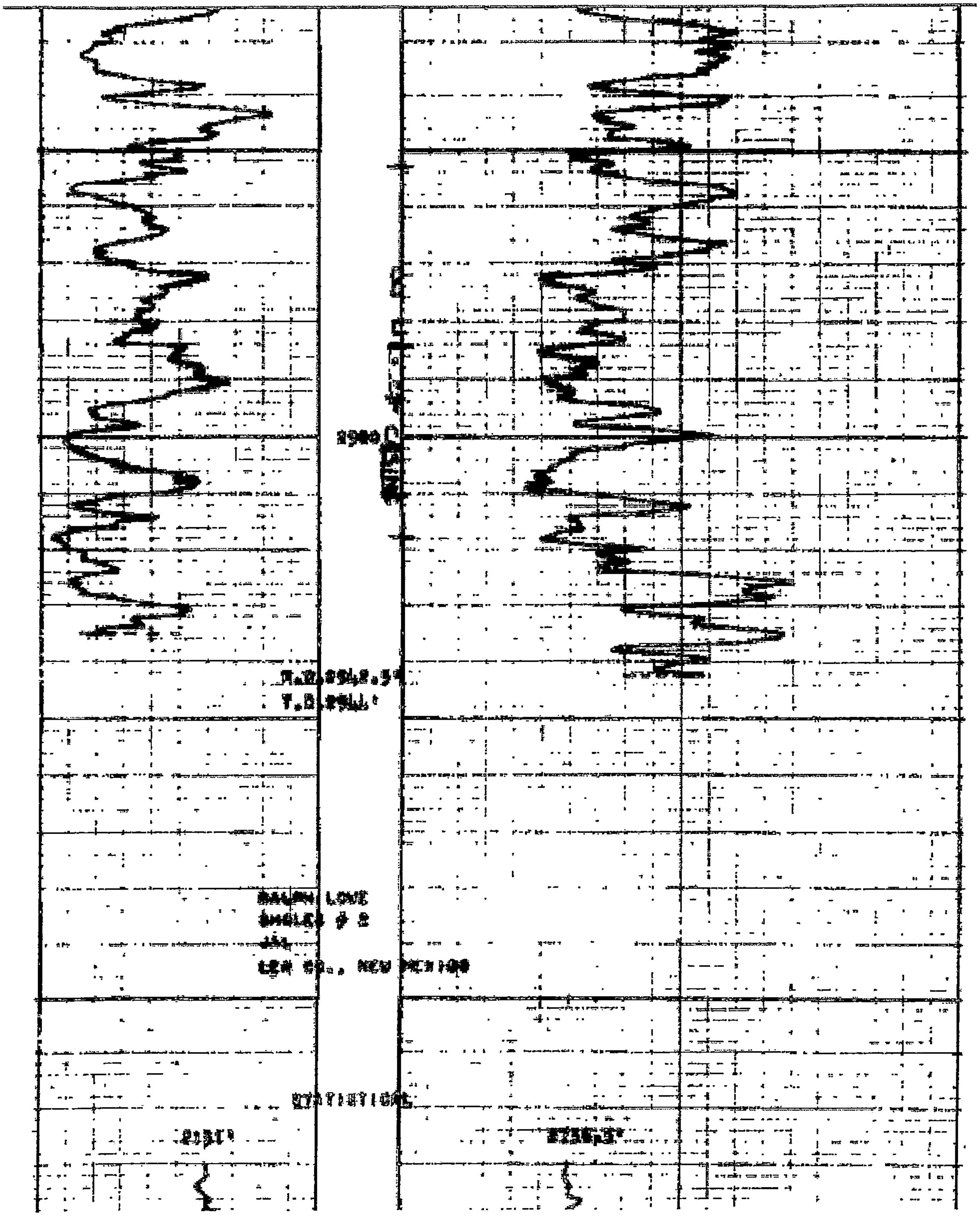

LEA CO., NEW MEXICO

RENEGADE SERVICES

TEMP SURVEY W/ TRACER AND CHANNEL CHECKS

Company	OWL SWD OPERATING , LLC
Well	MARLO SHOLES B WELL #2
Field	N/A
County	LEA
State	NEW MEXICO

Company OWL SWD OPERATING , LLC
Well MARLO SHOLES B WELL #2
Field N/A
County LEA State NEW MEXICO

Location: API # : 30-025-09806
660' FSL & 660' FEL
UNIT P, NMPM
SEC 25 TWP 25S RGE 36E

Other Services

Permanent Datum GL Elevation 3021'
Log Measured From Z
Drilling Measured From DF

Elevation
K.B. N/A
D.F. 3023'
G.L. 3021'

Date	6-2-2016	1.375" TOOLS
Run Number	ONE	
Depth Driller	3055'	
Depth Logger	3005'	
Bottom Logged Interval	3006'	
Top Log Interval	SURFACE	
Open Hole Size	N/A	
Type Fluid	WATER	
Density / Viscosity	N/A	
Max. Recorded Temp.	89.5 DEG.	
Estimated Cement Top	N/A	
Time Well Ready	RDA	
Time Logger on Bottom	1:05 PM	
Equipment Number	HU 608	
Location	SNYDER TEXAS	
Recorded By	HAGINS, T.	
Witnessed By	MR. JIM WARD	

Borehole Record / Tubing Record

Run Number	Bit	From	To	Size	Weight	From	To
				4.5"	IPC	0	2952'

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	10.75"	38#	0	410'
Prot. String	8.625"	22#	0	1227'
Production String	7"	20#	0	2935'
Liner				

<<< Fold Here >>>

All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

LOG CORRECTED TO DEPTH OF 7" CASING SHOE AT 2935'.

PERFORATIONS

SQUEEZED: 2733-2824', 2871-2910.
OPEN HOLE: 2935-3055'

INJECTION WELL:
SHUT-IN DATE N/A HOUR N/A TOTAL S.I. TIME N/A S.I. PRESS N/A
METERED INJ. RATE 6300 BPD PRESSURE VACUUM TEMP N/A FLUID TYPE WATER
TOTAL VOLUME TO DATE N/A FLUID LEVEL TUBING N/A

PRODUCER:
FLOWING PUMPING CHOKE SETTING HOURS PROD.
FLUID LEVEL CSG. TBG. RATE B/W B/O
FLUID TYPE

FRAC OR ACID WELLS:
TIME FINISHED FRAC OR ACID ACID FLUID - GALS SAND #
RATE - BPM PRESSURE

CONCLUSIONS

THIS SURVEY WAS RAN TO DETERMINE THE ZONES OF INJECTION AND TO DETECTED ANY CHANNEL OR PACKER LEAKS.

NO CHANNELS OR PACKER LEAKS WERE DETECTED AT TIME OF SURVEY. THE CHANNEL AND PACKER CHECKS HAVE BEEN PRESENTED ON THIS LOG.

NOTE: INJECTION TRACER INTENSITY LOSS CALCULATIONS INDICATED THAT 20% WAS EXITING THE WELL BORE AT 2935-2955'. THE REMAINING 80% WAS EXITING THE WELL BORE FROM 2955' TO BELOW THE DEPTH GAMMA OF 3002'.

THE TEMPERATURE AND TRACER INDICATED THAT FLUID IS MOVING BELOW DEPTH LOGGER AT 3005'.

NMOCD Case No. 15723
NMSLO Exhibit #7

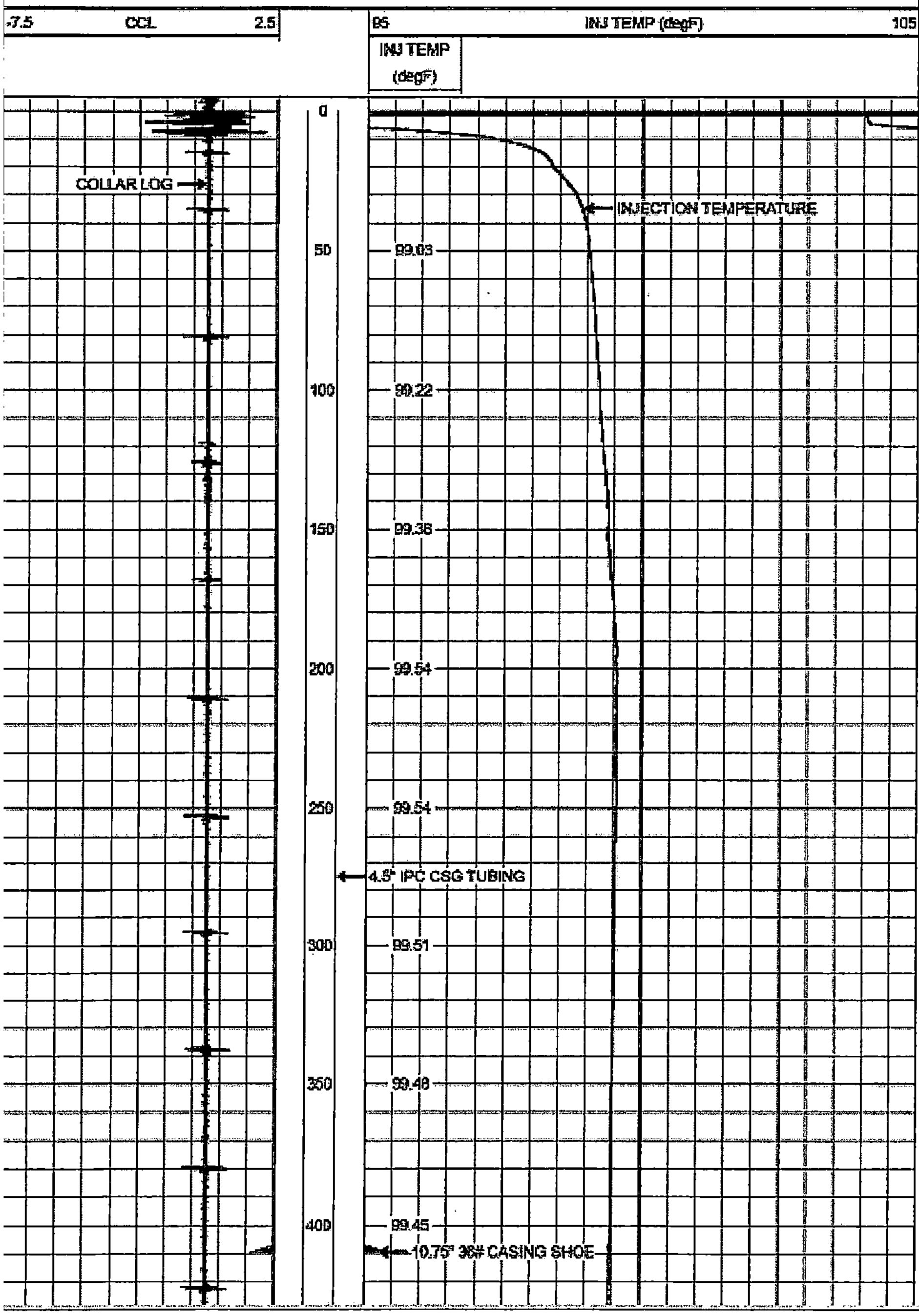
TRACER RESULTS

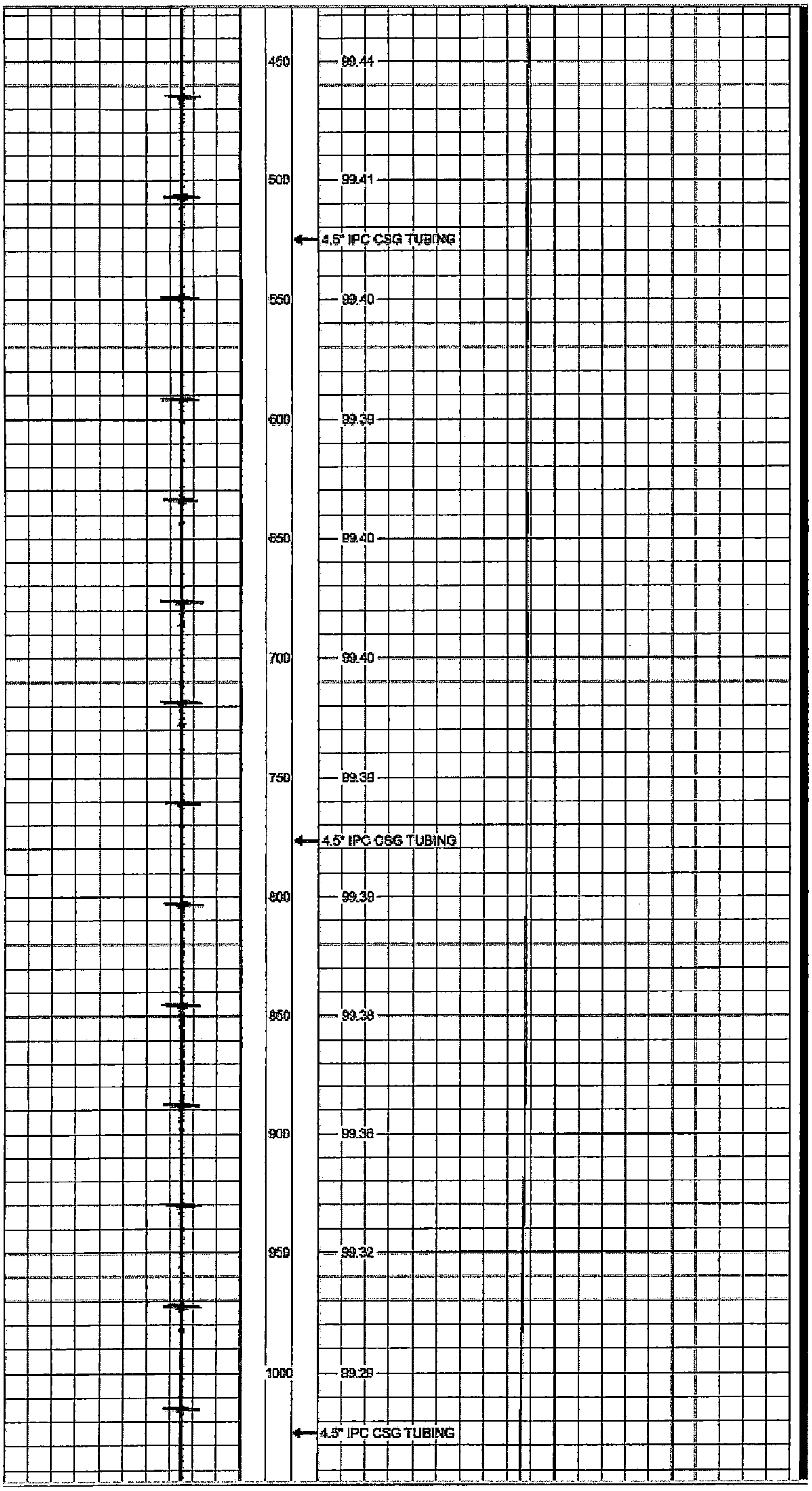
#	Depth (ft)	Time	Integration	Flow (%)	Delta (%)	Comment
1	2874.50	13:26:24	349943.00	99.99		
2	2924.22	13:28:49	349979.00	100.00	-0.01	
3	2955.57	13:29:15	282989.00	80.86	19.14	
4	2999.88	13:29:46	149440.00	42.70	38.16	

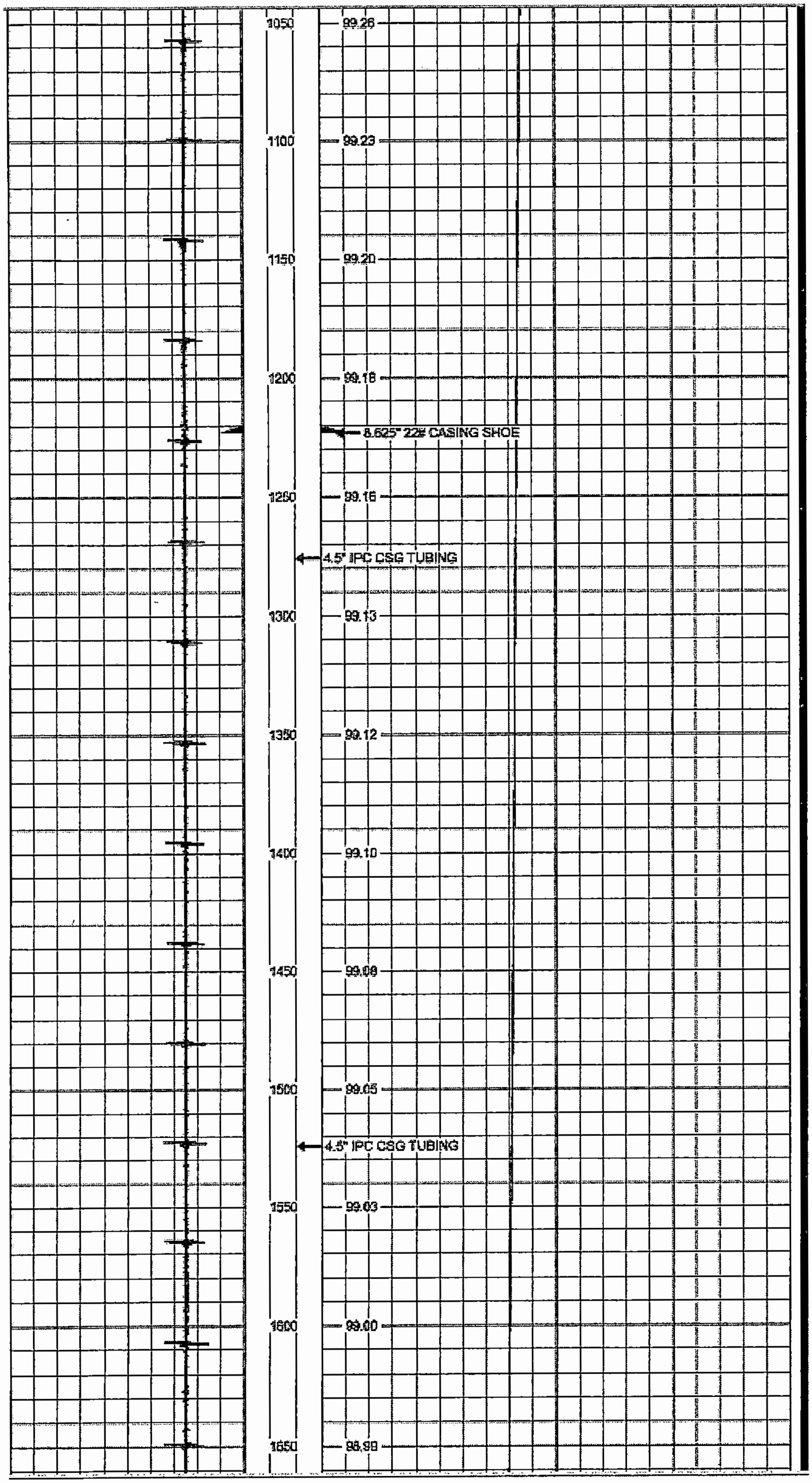
RENEGADE SERVICES

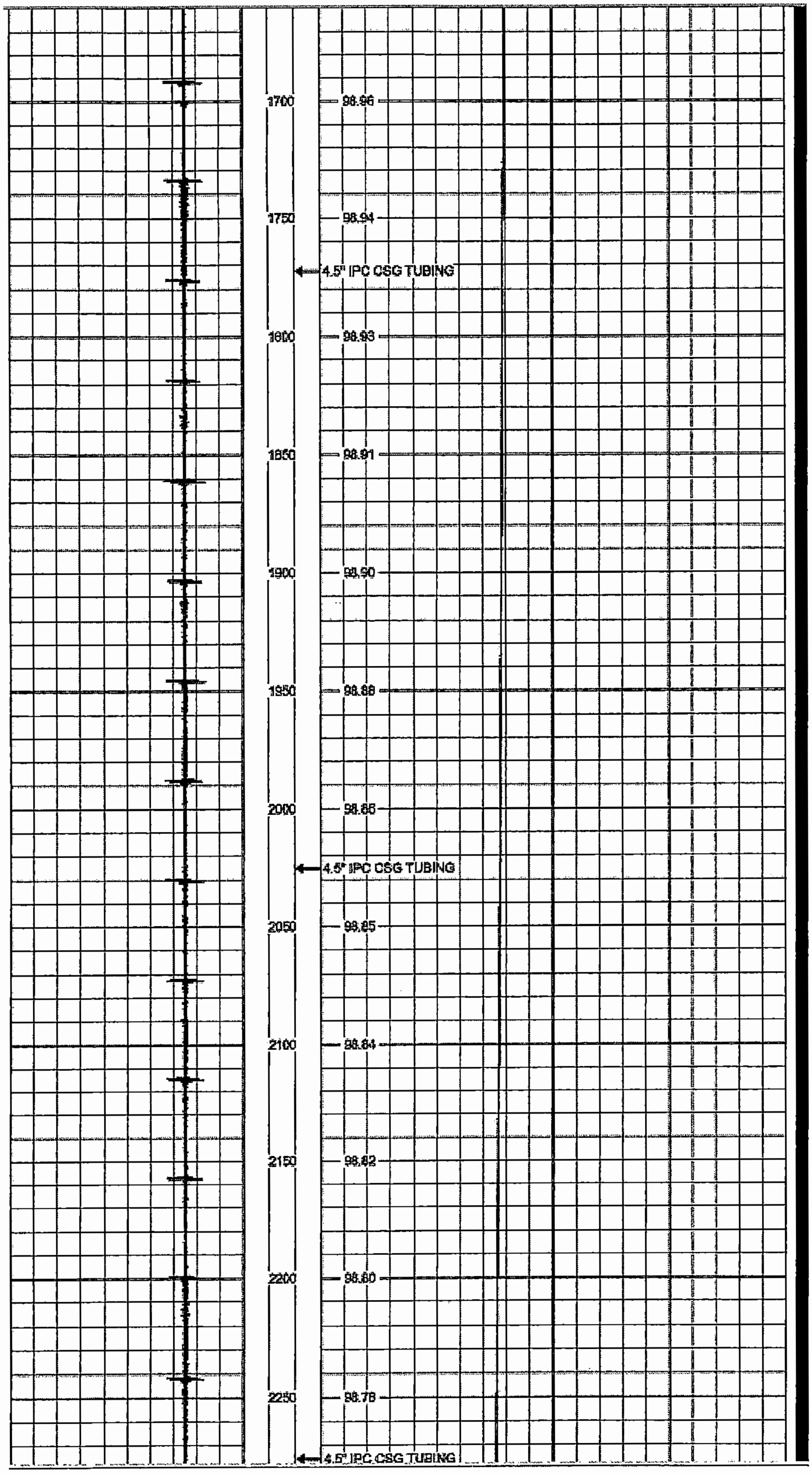
INJECTION TEMPERATURE
SURFACE TO DEPTH LOGGER

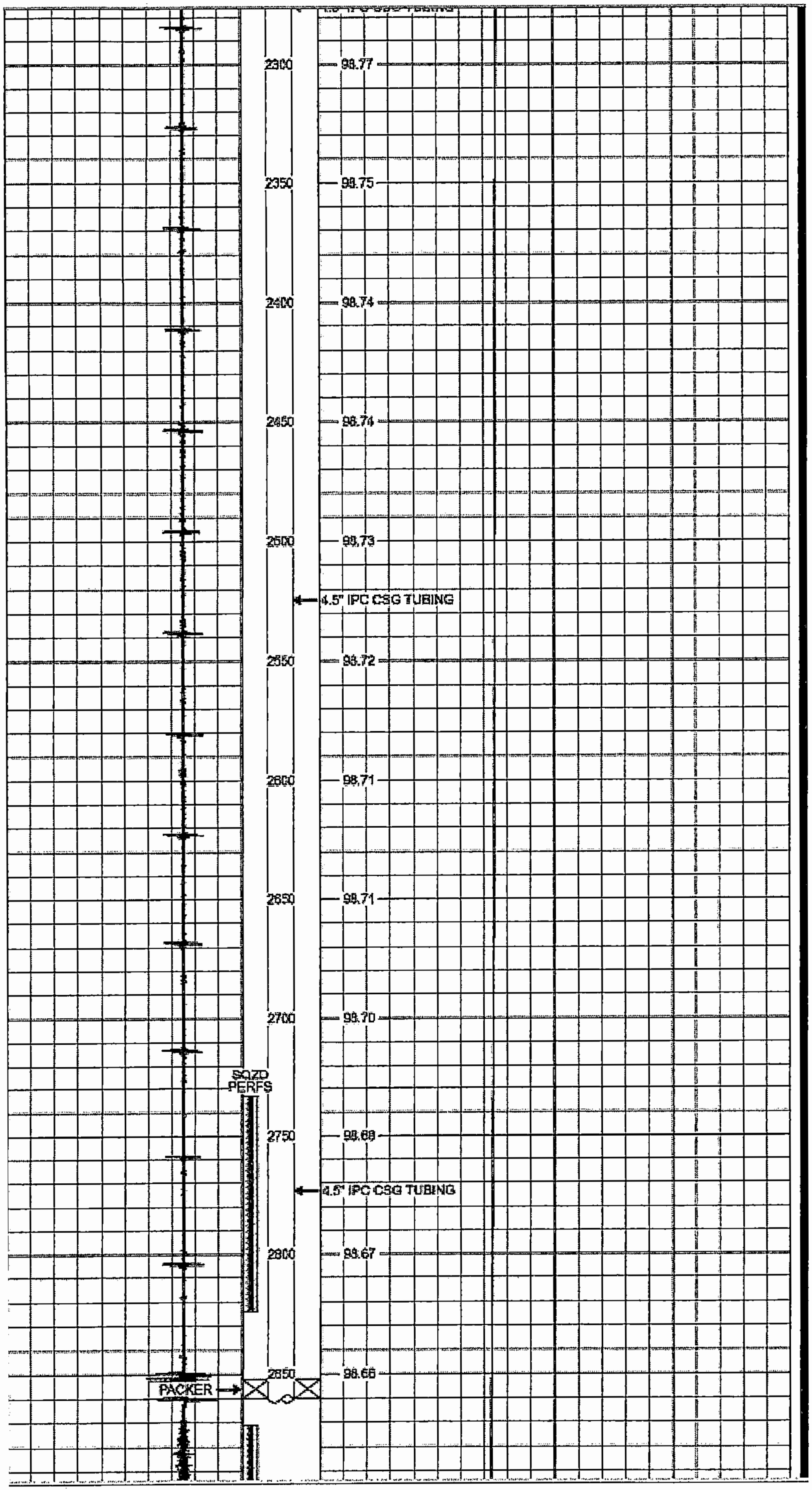
Database File: mab#2.db
Dataset Pathname: TEMP
Presentation Format: trccompb
Dataset Creation: Fri Sep 02 18:31:31 2016
Charted by: Depth in Feet scaled 1:480

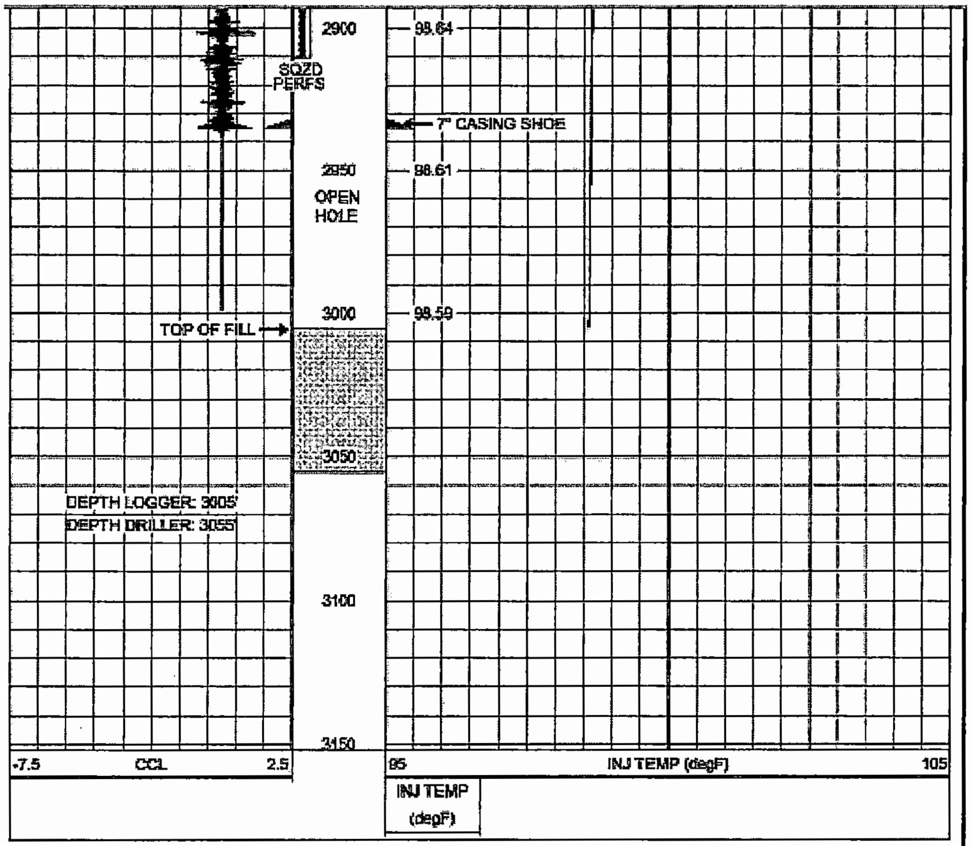



450
99.44
500
99.41
4.5" IPC CSG TUBING
550
99.40
600
99.39
650
99.40
700
99.40
750
99.39
4.5" IPC CSG TUBING
800
99.39
850
99.38
900
99.36
950
99.32
1000
99.29
4.5" IPC CSG TUBING


1050
99.26
1100
99.23
1150
99.20
1200
99.18
8.625" 22# CASING SHOE
1250
99.16
4.5" IPC CSG TUBING
1300
99.13
1350
99.12
1400
99.10
1450
99.08
1500
99.05
4.5" IPC CSG TUBING
1550
99.03
1600
99.00
1650
98.98


1700
98.96
1750
98.94
4.5" IPC CSG TUBING
1800
98.93
1850
98.91
1900
98.90
1950
98.88
2000
98.86
4.5" IPC CSG TUBING
2050
98.85
2100
98.84
2150
98.82
2200
98.80
2250
98.78
4.5" IPC CSG TUBING


2300
98.77
2350
98.75
2400
98.74
2450
98.74
2500
98.73
4.5" IPC CSG TUBING
2550
98.72
2600
98.71
2650
98.71
2700
98.70
SQZD PERFS
2750
98.69
4.5" IPC CSG TUBING
2800
98.67
2850
98.66
PACKER

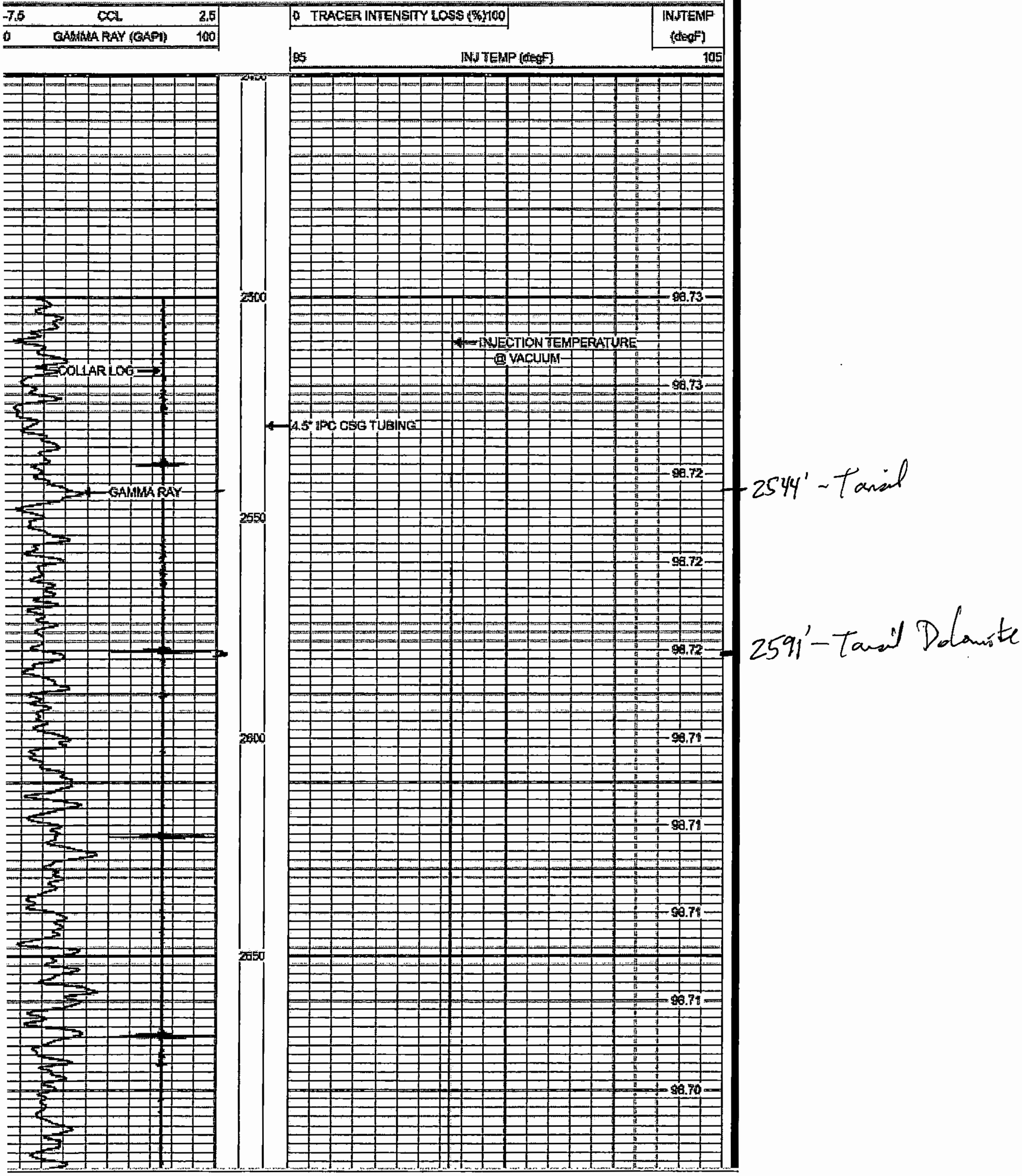


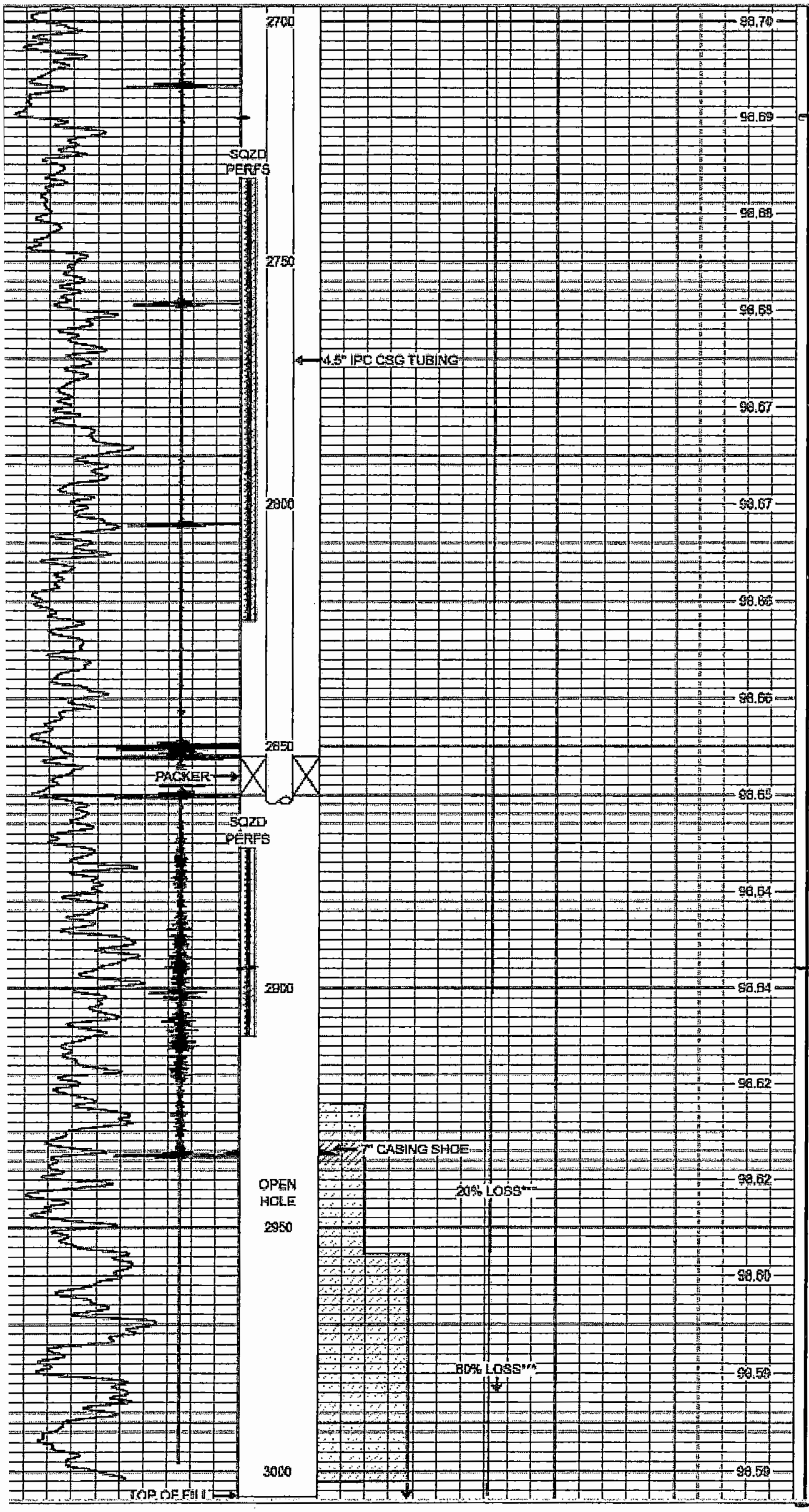
RENEGADE SERVICES

COMPOSITE

COMPOSITE

Database File: msb#2.db
Dataset Pathname: COMPOSITE
Presentation Format: trecomp
Dataset Creation: Fri Sep 02 18:53:19 2016
Charted by: Depth in Feet scaled 1:240

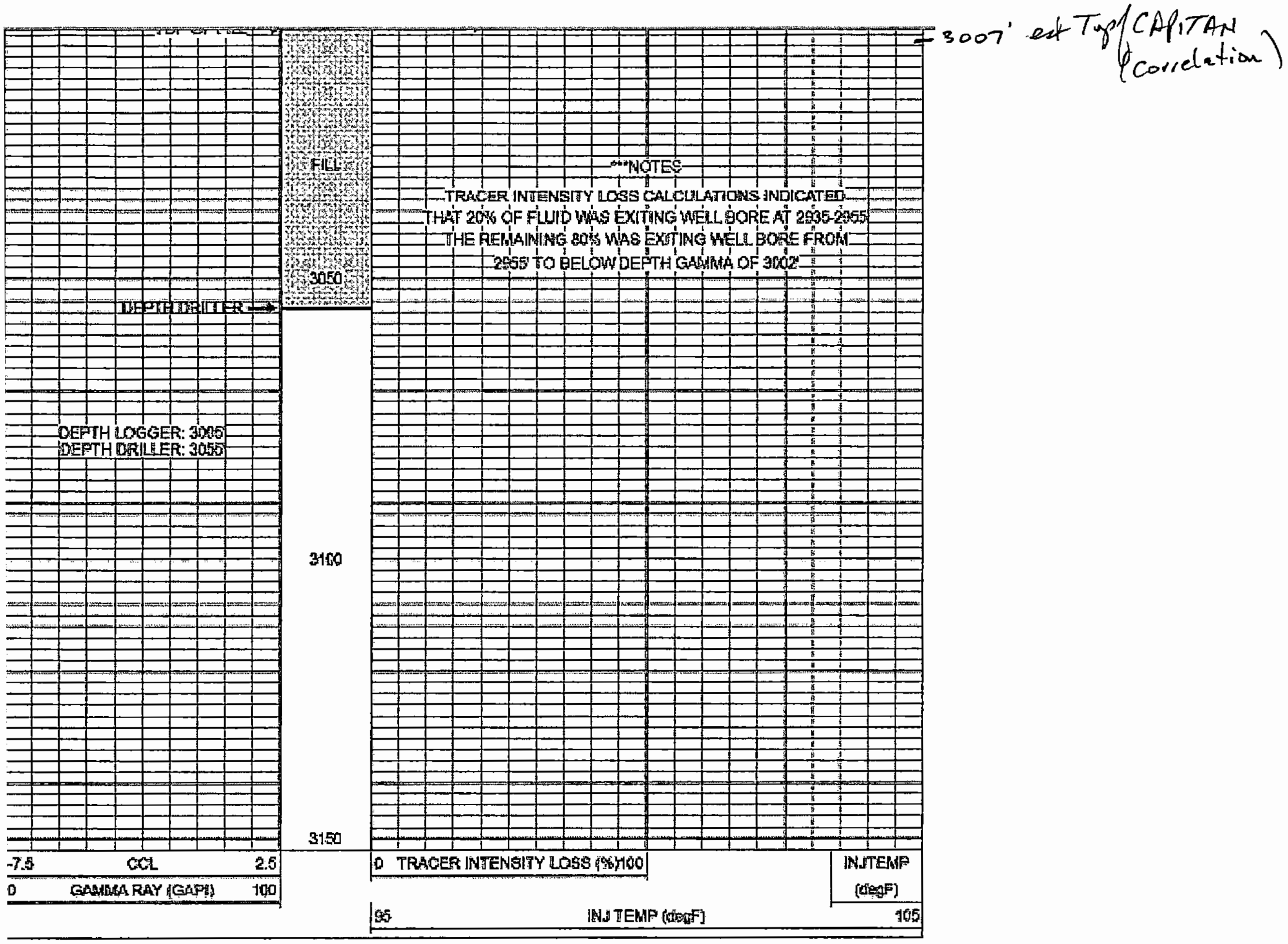




2720' Yates

2896' 7 Rivers

3007' est CAPITAN correlation to West Jal Disposal #1



1200 SEC UPWARD CHANNEL CHECK AT 2925'
NO CHANNEL DETECTED WITH R/A

Database File:	msb#2.db
Dataset Pathname:	VEL/pass1
Presentation Format:	tracer
Dataset Creation:	Fri Sep 02 13:33:52 2016 by Log PIP Casedhole Loggi
Charted by:	Time scaled 30"/hour

0 DET 1 (GAPI) 1000

-0.5 eject 1.5

TOD (sec)

DECLARATION OF OWNERSHIP OF UNDERGROUND WATER RIGHT AND PLANS FOR ITS DEVELOPMENT

This statement is made by Skelly Oil Company, Tulsa, Oklahoma ("Skelly"), to be attached to its twelve (12) Declarations of Owner of Underground Water Right which are hereby filed with the State Engineer of New Mexico. These Declarations are for a total combined appropriation under all such Declarations of 7,200 acre feet per annum of non-potable water from the hereinafter described twelve (12) wells located within the boundary of the Capitan Underground Water Basin in Lea and Eddy Counties, New Mexico.

This statement is made in accordance with those portions of Chapter 251 of 1959 Session Laws of New Mexico which accord with the law of New Mexico. It should be noted, however, and notice is hereby given to the State Engineer of New Mexico, and to others who might be concerned, that compliance with portions of Chapter 251 which are in accordance with law shall never be deemed a statement or admission by Skelly that other portions of the Act, which attempt to impair the legal status and rights of a declarant, as compared to such status and rights prior to enactment of Chapter 251, are valid.

Prior to 1958, Skelly began an investigation of water sources and applicable New Mexico water law in order to acquire such water and water rights as would enable it to undertake the operation and further development for secondary recovery purposes of certain oil pools in southeast Lea County, New Mexico. It was apparent that the nature and extent of such operations would require a substantial quantity of water. In this connection, Skelly obtained opinions from resident legal counsel and discussed such need and appropriate methods of meeting it (see Exhibit #1).

In April, 1958, in anticipation of the need for water for its West Dollarhide Queen Sand Unit (which is located in Township 24 South, Range 38 East, Lea County,) Skelly began a search for a source of water which would provide no less than 12,000 barrels of water per day for the life of the Unit. Concurrently, local counsel for Skelly drafted an instrument whereby Charles Whitten, the owner of surface rights in All of Section 3, the E½ and SW¼ of Section 4, the W½ NW¼ and the NW¼ SW¼ of Section 9, All of Section 10, All of Section 15 (except the West 100 acres of the NW¼ thereof) and All of Section 16, Township 24 South, Range 36 East, N.M.P.M. granted unto Skelly the right to explore for, obtain and use

NMOCD Case No. 15723
NMSLO Exhibit #8

ORIGINAL DOCUMENT IS OF POOR QUALITY FOR LEGIBLE MICROFILM

would provide a source of water which was acceptable both quantitatively and qualitatively. Consequently, Skelly did not conclude its negotiations with Mr. Whitten, but, instead, drilled four (4) additional Santa Rosa water supply wells in the immediate vicinity of said Well No. 65. These five (5) wells had an initial capacity of 11,524 barrels per day; however, the decline rate of all five (5) wells was immediate and sharp. The present capacity of all of these wells is 3,000 per day - far below the 12,000 barrels per day necessary to achieve optimum recovery of oil.

Concurrent with Skelly's development of Santa Rosa water in the West Dollarhide Area, Gulf Oil Corporation, as Unit Operator of the West Dollarhide Devonian Unit (in which Skelly has a substantial working interest) likewise drilled six (6) Santa Rosa water supply wells within its Unit. Performance reports of these wells indicate a lack of adequate productive capacity similar to Skelly's Santa Rosa wells.

Skelly and its royalty owners' economic interest in waterflooding operations in Southeast Lea County is readily demonstrable; Skelly owns a substantial working interest in each of the eleven (11) secondary recovery projects described below (the first four / 4 / are presently operative under appropriate orders of the Oil Conservation Commission, the balance being in various stages of negotiation). These projects are described as follows:

water flood in operation

1. Skelly West Dollarhide Queen Sand Unit, situate in Townships 24 and 25 South, Range 38 East.

2. Skelly Penrose "B" Unit, situate in Townships 22 and 23 South, Range 37 East.

3. Gulf West Dollarhide Devonian Unit, situate in Townships 24 and 25 South, Range 38 East.

4. Anadarko Production Company (formerly Ambassador) Langlie Mattix Penrose Sand Unit, situate in Township 22 South, Range 37 East.

5. Skelly Penrose "A" Unit, situate in Townships 22 and 23 South, Range 37 East.

6. Skelly West Dollarhide Drinkard Unit, situate in Townships 24 and 25 South, Range 38 East.

7. Skelly Penrose "C" Unit, situate in Township 23 South, Range 37 East.

10. Continental Oil Company Langlie Jack Unit, situate in Township 24 South, Range 37 East.

11. Pan American Myers Langlie Mattix Unit, situate in Townships 23 and 24 South, Ranges 36 and 37 East.

In terms of production taxes and royalty, the estimated revenue accruing to the State of New Mexico from consummation of these unitized waterflooding operations is in excess of $12,500,000; while the estimated royalty income to the United States is in excess of $6,500,000.

Confronted on the one hand with a substantial economic interest in the success of the above mentioned waterflooding projects, and on the other by a demonstrable lack of water, other than in the Capitan Reef, in quantities sufficient to meet its needs, Skelly reverted to its 1958 concept of obtaining water and water rights from the Capitan Reef underlying the Whitten premises in Township 24 South, Range 36 East. On September 4, 1964, Skelly began the drilling of a well which tested the Seven Rivers formation and the Capitan Reef for water. This well, designated as the Hobbs "O" Well No. 1, is located 660 feet from the north line and 1980 feet from the west line of Section 16, Township 24 South, Range 36 East, and was drilled to a total depth of 4,212 feet. The top of the Capitan Reef was encountered in this well at an approximate depth of 3,884 feet and a Halliburton drill stem test of the interval 4,012 feet to 4,212 feet was taken to confirm the water producing capabilities of the Reef (see Exhibit #3). This test indicated that the Capitan Reef contained non-potable water in sufficient quantities to warrant use of the Hobbs "O" No. 1 as a water supply well. Therefore, 9-5/8" OD casing was run, set and cemented at 3,870 feet. This well is presently completed as a Seven Rivers oil well through perforations at 3,733 feet to 3,747 feet.

Under date of October 12, 1964, Mr. L. C. Case, of Tulsa, Oklahoma - a consultant in oil field water problems - reported his analysis of Capitan Reef water to Skelly as follows:

Milligrams per liter	Sulfate, SO_4	940
	Chloride, Cl	1,683
	Bicarbonate, HCO_3	372
	Carbonate, CO_3	Nil
	Hydrogen sulfide, H_2S	Present
	Barium, Ba	Nil
	pH Value (Beckman)	7.4

Capitan Basin Declared 9-28-65

Upon confirming that the Capitan Reef contained an adequate supply of non-potable water, and in December 1964, counsel for Skelly drafted a new water grant from the Whittens which was executed under date of January 1, 1965, by the Charles Whitten heirs and Skelly (see Exhibit #4).

As a necessary adjunct to locating and developing a source of water for waterflooding purposes and acquiring valid rights to use such water after locating it, and in January 1965, Skelly formulated plans for a water distribution system of a size adequate to assure that its requirements would be met at any given time (see Exhibit #5). In the furtherance of these plans, and in March and April, 1965, prior negotiations with numerous landowners resulted in the execution and delivery to Skelly of instruments granting to it easements and rights of way for the Northeast leg of the water distribution system (see Exhibit #6). Such Northeast leg is approximatel 7.4 miles in length and Skelly is currently proceeding with the construction thereof using 12-3/4 inch OD steel pipe internally coated with cement and externally wrapped and coated. It is estimated that construction of the 10.7 mile Southeast leg of such system will commence within nine (9) months from date.

Upon completion of the water pipe lines, pumping station, and other components of Skelly's water system, the aforementioned Hobbs "Q" No. 1 well will be placed in production of water from the Capitan Reef, using an electric Reda 240 HP submergible pump. Skelly's plans include the drilling of the following eleven (11) additional wells which will be drilled and equipped similarly to the Hobbs "Q" No. 1 well at or near the following described locations:

Proposed wells

1. Center of SW¼ of Section 16-24-36.
2. Center of NW¼ SW¼ of Section 9-24-36.
3. Center of SW¼ of Section 4-24-36.
4. Center of NE¼ of Section 4-24-36.
5. Center of SW¼ of Section 10-24-36.
6. Center of SW¼ of Section 15-24-36.
7. Center of NE¼ of Section 16-24-36.
8. Center of SE¼ of Section 16-24-36.
9. Center of SE¼ of Section 4-24-36.
10. Center of NW¼ of Section 3-24-36.
11. Center of NW¼ of Section 10-24-36

Under the twelve (12) Declarations hereby filed, the amount (7,200 acre feet per annum from all twelve (12) wells described above), source, and use of the water to be appropriated are as described above. The entire project will be completed and the water put to beneficial use within four (4) years. The life of the project, and the limit of the intended appropriation with respect to the Units which are hereinabove described, is estimated to be eighteen (18) years. Any other information required by the State Engineer will be furnished, in accordance with law.

Description of Exhibits

Many written exhibits are available with which to document this Declaration. Selected exhibits have therefore been chosen and attached hereto as follows:

1. Exhibit 1 is a copy of intra-company correspondence in 1958 reflecting early consideration of the need for waterflooding, and discussion of source of supply and procedure.

2. Exhibit 2 is a copy of the instrument referred to in Exhibit 1 and drafted in April, 1958, for use in acquiring surface and other rights on the Charles Whitten premises.

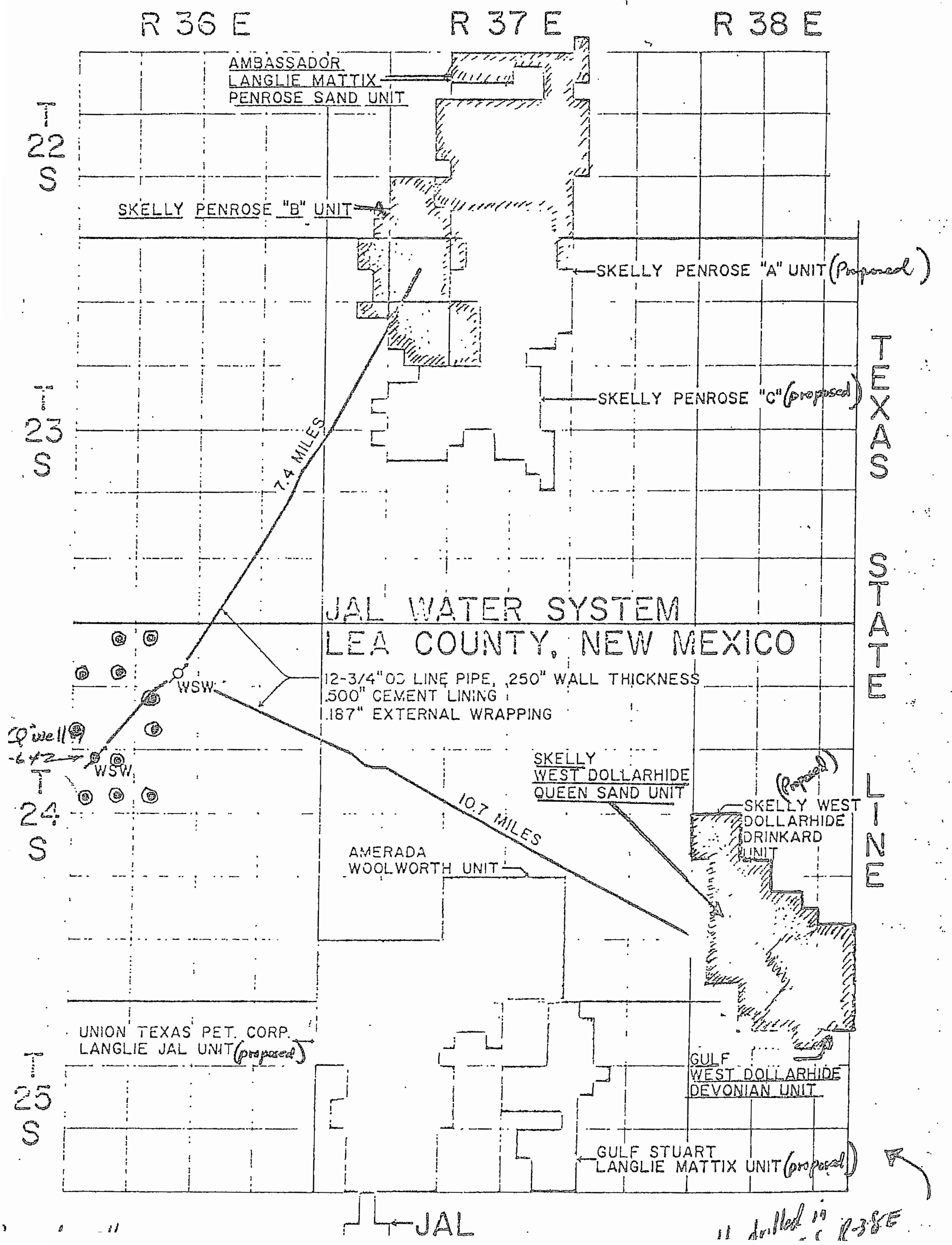
3. Exhibit 3 reflects a Halliburton drill stem test form showing data about the drill stem test of the Capitan Reef in the Hobbs "Q" No. 1.

4. Exhibit 4 is a copy of the instrument executed by the Charles Whitten heirs, January 1, 1965.

5. Exhibit 5 is a general plat showing the area of work.

6. Exhibit 6 is a typical easement or right of way grant which was purchased by Skelly.

7. Exhibit 7 is the AFE for $291,652 submitted August 6, 1965, and approved August 23, 1965, for installation of the northeast lateral pipeline and the water handling plant for the system.



R 36 E
R 37 E
R 38 E
T 22 S
T 23 S
T 24 S
T 25 S
AMBASSADOR LANGLIE MATTIX PENROSE SAND UNIT
SKELLY PENROSE "B" UNIT
SKELLY PENROSE "A" UNIT (Proposed)
SKELLY PENROSE "C" (proposed)
TEXAS STATE LINE
7.4 MILES
JAL WATER SYSTEM
LEA COUNTY, NEW MEXICO
12-3/4" OD LINE PIPE, .250" WALL THICKNESS
.500" CEMENT LINING
.187" EXTERNAL WRAPPING
WSW
WSW
10.7 MILES
SKELLY WEST DOLLARHIDE QUEEN SAND UNIT
(Proposed)
SKELLY WEST DOLLARHIDE DRINKARD UNIT
AMERADA WOOLWORTH UNIT
UNION TEXAS PET. CORP. LANGLIE JAL UNIT (proposed)
GULF WEST DOLLARHIDE DEVONIAN UNIT
GULF STUART LANGLIE MATTIX UNIT (proposed)
JAL