Martin, Dugan & Martin

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W. T. Martin, Jr. *
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Lane T. Martin
Mark Horton
(* Also licensed in Texas

VIA FEDERAL EXPRESS

May 22, 2013

NM Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, NM 87505

Re: Application of Cimarex Energy Co.

Dear clerk:

Enclosed please find an original and six copies of George Ross Ranch's Response in Opposition to Cimarex's Application and Pre-hearing Statement and Exhibits.

If you have any questions, please call.

Thank you,

Martin, Dugan & Martin

Carla Galloway

Carla Galloway,
Legal Assistant to W.T. Martin, Jr.

xc: James Bruce

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF CIMAREX ENERGY CO. OF COLORADO TO REINSTATE INJECTION AUTHORITY, EDDY COUNTY, NEW MEXICO	))))	CASE # 14994

GEORGE ROSS RANCH'S RESPONSE IN OPPOSITION TO CIMAREX'S APPLICATION AND PRE-HEARING STATEMENT

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COMES NOW Applicant, **George Ross Ranch, LLC**, by and through its attorney, W. T. Martin, Jr., of Martin, Dugan & Martin, and presents its ***Response in Opposition to Cimarex's Application and Pre-Hearing Statement.*** In support of its Application and for purposes of its ***Pre-Hearing Statement***, George Ross Ranch states :

1. **Name of Party & Address:** The Objector, George Ross Ranch, LLC, is a limited liability company that has an address of 3710 Rawlins Street, Suite 850, Dallas, Texas 75219.
2. **Name(s) of Party's Attorney(s):** The attorneys for George Ross Ranch, LLC are Martin, Dugan & Martin (W. T. Martin, Jr., Lane T. Martin, Kenneth D. Dugan and Mark Horton). Martin, Dugan & Martin has an address of P.O. Box 2168 Carlsbad, New Mexico 88221-2168.
3. **Concise State of Case:** A statement of the case is as follows:.
    a. On or about October 27, 1989, the OCD entered Administrative Order SWD-380. That Order allowed injection of produced water.
    b. The applicant, Mellon Oil Company, failed to give written notice of the application to the surface owner.
    c. Ross Ranch filed an Application to have Administrative Order SWD-380 revoked because of Mellon Oil's failure to give written notice of its application to the surface owner. The Docket Number was Case No. 14888.
    d. The OCD subsequently entered its Order No. R-13699 revoking its prior Administrative Order SWD-380. Administrative Order SWD-380 was held to be void and was rescinded.
    e. Cimarex has filed its application to reinstate Administrative Order SWD -380 effective as of October 27, 1989.

f. Ross Ranch objects to Cimarex's Application on the following grounds:

i. Administrative Order SWD-380 has been ruled as void. As a matter of law, an application some 23 ½ years later cannot operate to validate illegal injections into the well for all those years. Cimarex's application to inject, if granted, must be treated prospectively and not retroactively. The application must be treated and presented as though no application had been filed in the past.

ii. The application must present current, complete and accurate data regarding the proposed injection well, affect on existing water wells and affect on the surface.

iii. The burden of proof and compliance with Federal and State application requirements rests with Cimarex, not Ross Ranch, the surface owner.

iv. The data Cimarex has submitted with its application is in virtually all instances approximately 24 years old. By way of example, its attachments for water analyses for fresh water are from 1988. Cimarex has submitted no current data. Cimarex has presented no current data but instead relies upon 24-year-old data. An application for an injection well should not be granted based upon 24-year-old data.

v. Cimarex has made no attempt to comply with New Mexico's Surface Owner's Protection Act in relation to its proposed use of the well for injection of produced water. As a matter of law, Cimarex must comply with the Surface Owner's Protection Act before it can proceed with its application.

vi. The Cimarex application states that the average daily injection rate will be 800 BWPD to a maximum of 1,600 BWPD. The historical data regarding the amount of water injected into the well under the voided permit exceeds Cimarex's proposed amounts in very large multiples. Cimarex presents no current data addressing the extreme variances.

vii. Cimarex does not address operating pressures. Under the voided permit, the authorized maximum pressure was 804 psi. A review of data from the time the well was used under the voided permit shows peak pressures routinely going above 900 psi. Cimarex has presented no permit(s) authorizing increased pressure. Cimarex presents no information showing current studies and testing that the well is within safety margins required by the State of New Mexico and the BLM.

viii. Cimarex has provided no data that its proposed injection satisfies the Safe Drinking Water Act of 1974 or in the alternative, the Act is inapplicable.

ix. There exist water wells on the Ross Ranch within the area of the proposed injection well. The Well Numbers are C-1354, C-1354-X, C-1354-X-2, C-1354-X-3, C-1354-X-4, C-1354-X-5, C-1354-X-6, C-1354-X-7. Cimarex has provided no data regarding those water wells nor does it show the existence of the wells in its application.

x. The produced water Cimarex intends to inject into the well comes from leasehold operations on BLM land. For such to take place authorization must be obtained from the BLM under Onshore Order No. 7. This approval must be obtained from the BLM before the injection operations

proceed. Cimarex has not presented data showing the existence of such approval.

xi. In Section VI. of Cimarex's Application, wells shown to be within one half mile from the proposed SWD (specifically wells called out by number's #1, #2, #4, #5, #6, #7 ,#8, #9) have calculated cement tops, which is not allowed. This may allow for the ingression of water into those wells putting water into the production zones, which is prohibited. Cimarex has not addressed that issue in its application.

xii. Cimarex has not shown any plan of projected road use/construction, land use, pipeline routings, ingress egress points, gates, etc. that will be required. This would be a change in the Master Surface Use Plan if it even exists that would have been required in the original voided permit.

xiii. Because produced water will be coming from leasehold operations on BLM land, and because formations in question in the injection well enter into BLM land, Cimarex must show compliance with BLM requirements. See BLM Pamphlet/Document entitled ***Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development-The Gold Book-4th Ed. Revised 2007***. In its application, Cimarex shows no such compliance. In the alternative, if Cimarex contends it is not subject to such requirements, it makes no showing in its application.

g. Cimarex has attached documents to its application that presumably are exhibits supporting its application. The documents relate to information from

approximately 23 ½ years ago. Based on what Cimarex has attached to its application, the application should be summarily denied. However:

i. If Cimarex intends to introduce documents, data and testimony from witnesses that are current in nature, then Ross Ranch should be accorded time for sufficient review, analysis and possible discovery. With a hearing date of May 28, 2013, it is impossible for Ross Ranch to be accorded sufficient time for review, analysis and discovery. Ross Ranch cannot even determine necessary additional witnesses unless it is accorded sufficient time.

ii. If Cimarex intends to introduce additional documents, data and testimony, then the hearing date of May 28, 2013 should be vacated and the hearing reset at a time that accords Ross Ranch sufficient time for the necessary review, analysis and possible discovery.

iii. If Cimarex intends to introduce additional documents, data and testimony, those items will of necessity affect Ross Ranch's decisions as to exhibits it needs to present at the hearing. Ross Ranch cannot make that decision at this time or up to the date of the hearing when it does not know if Cimarex intends to introduce additional documents, data and testimony.

iv. If Ross Ranch is not accorded the additional time, Ross Ranch's due process rights as a surface owner will be violated.

v. If Cimarex intends to introduce additional documents, data and testimony that is not attached to the application, then this Pre-Hearing Statement should also be considered a Motion to Vacate the Hearing.

4. **Witnesses:** The witnesses George Ross Ranch, LLC may call are: Worth Ross and David Meyer. Worth Ross is an heir and managing member of the LLC. David Meyer is married to an heir and has been active in issues relating to management of the LLC and the issue before the Hearing Officer.

5. **Exhibits:** For the reasons stated in Paragraph 3 above, Ross Ranch is limited in determining what exhibits might be relevant and needed. Ross Ranch has determined that several Exhibits exist that show the Cimarex application to be incorrect. Those exhibits accompany this Response and Pre-hearing Statement.

6. **Approximate Time Needed to Present Case:** Approximately three (3) hours.

7. **Identification of Any Procedural Matters Needing Resolution Before Hearing:** None

Martin, Dugan & Martin

By_____

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Attorney for George Ross Ranch, LLC

CERTIFICATE OF SERVICE

Martin, Dugan & Martin certifies that on the 22nd day of May 2013 a copy of the foregoing ***RESPONSE IN OPPOSITION TO CIMAREX'S APPLICATION AND PRE-HEARING STATEMENT*** was served on the following persons or entities:

James Bruce
P.O. Box 1056
Santa Fe, NM 87504
Attorney for Applicant, Cimarex Energy of Colorado

Bureau of Land Management
620 East Greene St.
Carlsbad, NM 88220

Shenandoah Petroleum Corporation
3817 W. Wadley, Bldg. O, Suite 950
Midland, Texas 79702

RKI Exploration & Production, Inc.
3817 NW Expressway, Ste. 490
Oklahoma City, Oklahoma 73112

Ralph E. Williamson
8282 IH 35 North. Ste. 490
San Antonio, Texas 78239

GP II Energy, Inc.
P.O. Box 50682
Midland, Texas 79710

Quantum Resources Management, LLC
3817 NW Expressway, Ste. 950
Oklahoma City, Oklahoma 731123

W. T. Martin, Jr.

New Mexico Office of the State Engineer

Water Right Summary

WR File Number: C 01354
Primary Purpose: SRO SECONDARY RECOVERY OF OIL
Primary Status: CAN CANCELLED
Total Acres:
Total Diversion: 0
Owner: RECOVERY WATER COMPANY

Documents on File

Trn #	Doc	File/Act	Status 1	Status 2	Transaction Desc.	From/ To	Acres	Diversion	Consumptive
128227	APPRO	1966-12-19	CAN	CAN	CONVERSION C 01354	T		13400	

---For more Infomation on Conversion Transactions, please see Help---

Current Points of Diversion

(NAD83 UTM in meters)

POD Number	Source	Q Q Q 64 16 4	Sec	Twsp	Rng	X	Y	Other Location Desc
C 01354		1 4	27	26S	29E	597263	3542160*	
C 01354 X		3 1	26	26S	29E	598093	3542499*	
C 01354 X-2		1 4	26	26S	29E	598895	3542093*	
C 01354 X-3		2 1 3	23	26S	29E	598323	3543837	
C 01354 X-4		4 4	22	26S	29E	597713	3543339*	
C 01354 X-5		3 3 3	22	26S	29E	596462	3543354	SEE COMMENT SCREEN
C 01354 X-6		1 4	22	26S	29E	597297	3543769*	
C 01354 X-7		1 2	27	26S	29E	597289	3542964*	

*An (*) after northing value indicates UTM location was derived from PLSS - see Help

AQUIFER CHACTERISTICS OF THE RUSTLER FORMATION ROSS RANCH

PREPARED FOR

GEORGE ROSS

PECOS, TEXAS

BY

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS
MIDLAND, TEXAS

APRIL 1973

AQUIFER CHARACTERISTICS OF THE RUSTLER FORMATION
ROSS RANCH
EDDY COUNTY, NEW MEXICO

INTRODUCTION

The Ross Ranch lies in southern Eddy County, New Mexico just east of the Pecos River. The area of particular interest to this study includes Sections 22, 23, 26 and 27, Township 26 South and Range 29 East. This study has included a review of previous work done by this office on the ranch in 1966 plus additional work performed in 1973.

The report Groundwater Report No. 3 of the New Mexico Bureau of Mines and Mineral Resources, 1952, and a report on "Possible Improvement of Quality of Water of Water of the the Pecos River by Diversion of the Brine at Malaga Bend" (Hale, Hughes and Cox), for the Pecos River Commission by the U.S.G.S. were reviewed.

GEOLOGY

The Rustler (upper Permian) limestones and dolomites are the rocks of major interest in this study. West of the Pecos River these rocks have been badly slumped and eroded by underground solution activity particularly along major tributaries to the Pecos River. However on the east side of the river and in the vicinity of the Ross Ranch the beds of limestone and dolomite are normal with a northeast trending dip toward a structural low located northeast in the area of Township 25 South Range 30 East. These beds dip

northeast about 50 to 100 feet per mile on the west side of the Ross Ranch to about 300 feet per mile along the eastern side of the property. The area of proposed well development lies on a monocline east of the river dipping about 75 feet per mile. The Rustler crops out along the river about 1 mile west of the area to be developed and for some distance up river. The river at the outcrop is at elevation 2848 feet while the elevation of the top of the porous interval in Well C-1354-X-5 is about 2817 feet.

The porosity of the Rustler is apparently best developed in the carbonate beds. The thickness of the porosity varies up to 120 feet or more as in an oil test in Section 3, T-26S, R-30E which has 120 feet of porous interval in the Rustler. An oil test in the northwest corner of Section 18 T-26S, R-30E has 50 feet and an oil test in the northwest corner of Section 14, T-26S, R-29E has 125 feet of porosity. This porosity is apparently confined locally to those areas where the Rustler is in a relatively undisturbed position.

HYDROLOGY

Groundwater is contained under water table and artesian conditions in the porous dolomites and limestones of the middle and lower portion of the formation. In the outcrop, solution cavities are found 1/2 inch and larger in diameter. The wells drilled and completed on the Ross Ranch exhibit the same porosity in drilling and this porosity is evident in high well capacities.

The water levels in the three large diameter irrigation wells are 18 to 27 feet lower than the river-Rustler elevation. (See Ross Ranch USGS Quadrangle map - 1968). It appears that at least locally the river is recharging the Rustler across the Ross property under study.

Aquifer Characteristics

Two pumping tests have been conducted on the large diameter ranch wells; a third test was also attempted but discontinued. The results of these tests are discussed by well below.

Well C-1354-X-5. This well was the first large diameter wells to be drilled on the property. Three observation wells were drilled around this well at a radius of from 324 feet to 451 feet. On July 14, 1966 a detailed pumping test was conducted on this well for 1000 minutes at a flow rate of 1780 gallons per minute. The three observation wells were measured during this test. Measurement problems were encountered in the pumped well, but the total drawdown was about 1.1 feet. Good results were obtained on the three observation wells. The values for transmissibility and storage coefficient are given below based upon both the Jacob and Thies methods of calculation. The curves are included at the end of this report.

Observation Well	Radius from Pumped Well	Thies		Jacob	
		T(gpd/ft)	S	T(gpd/ft)	S
1	451'	755,500	0.135	1,118,900	0.103
2	359'	1,251,460	0.20	1,424,000	0.17
3	324'	927,200	0.184	1,044,270	0.154

The transmissibilities from these tests are high and not considered to be typical of the entire area. However the storage coefficients are considered to be in the right order of magnitude for the highly porous Rustler and reflect the water table conditions known to exist in this area.

Well C-1354-X-3. This well was tested March 26, 1973, for over 1000 minutes at a measured rate of 1080 gallons per minute. The engine failed after 1056 minutes of pumping. The results of the drawdown test indicate at least 3 boundaries near the pumped well. However for the last eight hours of the test the curve held constant and probably represents the long term pumping level decline for the well at the rate tested. Based upon this data the transmissibility is estimated to be 79,900 gpd/ft. The pumping level after almost 2 years of continuous pumping at 1080 gpm is projected to be about 114.7 feet or 12.8 feet below present static level absent interception of recharge. Extensive development with additional wells will have some additional bearing on the projected pumping levels however.

Well C-1354-X. This well was tested about mid-March, 1973 and was estimated to produce 200 to 300 gpm. A small test pump was not readily available and the high capacity pump was transferred to Well C-1354-X-3 for testing. We recommend that this well be acidized and retested in the near future.

SUMMARY

Based upon our studies to date it is our opinion that two of the three wells tested on the Ross Ranch are capable of sustaining production rates of 730 gpm per well. The third well, C-1354-X, will probably be acidized in the near future and retested.

If you should require additional information we will be happy to try to furnish it to you.

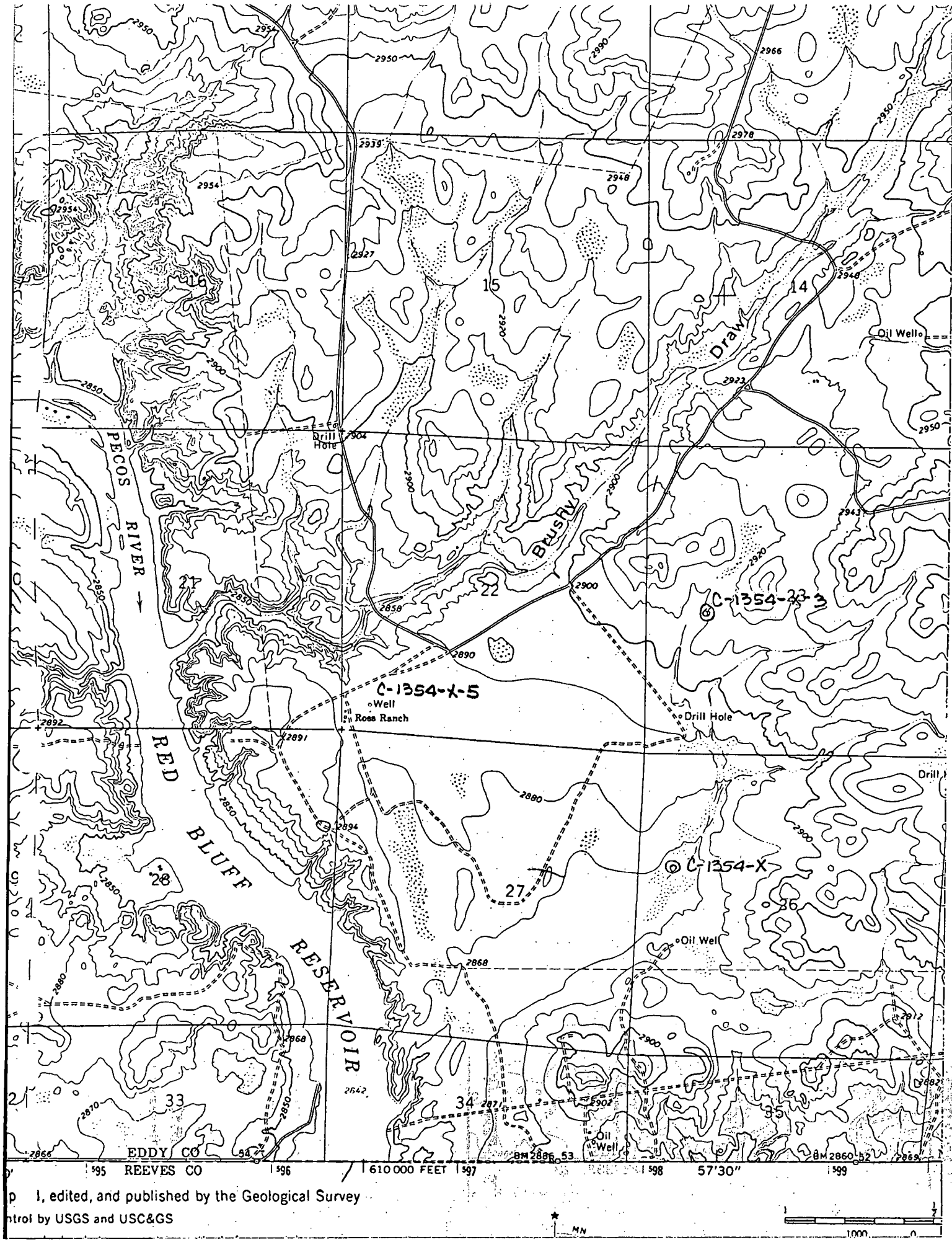
Respectfully submitted:

ED L. REED & ASSOCIATES

A. Joseph Reed

A. Joseph Reed

AJR:lb



p I, edited, and published by the Geological Survey

ntrol by USGS and USC&GS

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT George Ross Eddy Co N. M. S.W.L. 73.70

LOCATION 500 FSL 500 FWL Sec 22 T-26S R 29E DISCH. PIPE ____ ORIFICE ____

DATE 7/14/66 PUMP SETTING ____

WELL NUMBER C-1354-X-5 Irrigation Canal - Concrete - used to measure flow

DRAWDOWN AND RECOVERY

TIME	t	t'	t/t'	DEPTH TO WATER	DRAWDOWN	CAPACITY	REMARKS
				73.70		Static Level	Base pump
1321							Pump on
No readings 1321 to 1536 - measure ment problems							
1536				74.36			
1636				74.48			
1751				74.68			
2022				74.52			
2245				74.33			
7-15-66							
0210				74.65			
0600	999 min			74.80		1780 gpm	Pump off
Recovery							
0601				74.60			
0602				74.60			
0603				74.60			
0605				74.55			
0606				74.55			
0607				74.55			
0608				74.52			
0609				74.52			
0610				74.47			
0613				74.47			
0615				74.45			
0616				74.45			
0618				74.45			
0620				74.44			
0625				74.44			
0630				74.44			
0635				74.44			
0640				74.44			
0645				74.44			
0655				74.40			

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT George Ross Eddy County N.M. S.W.L. 74.85

LOCATION 451 Feet NW C-1354-X-5 DISCH. PIPE ____ ORIFICE ____

DATE 7/14/66 PUMP SETTING ____

WELL NUMBER Observ. Well No. 1

DRAWDOWN AND RECOVERY radius = 451' Northwest

TIME	t	t'	t/t'	DEPTH TO WATER	DRAWDOWN	CAPACITY	REMARKS
1321	0						Pump On
1326	5			74.85	0		
1331	10			74.87	0.02		
1336	15			74.84	0.04	C-1354-X-5 pumping	
1341	20			74.87	0.02		
1346	25			74.87	0.02		
1351	30			74.86	0.01		
1356	35			74.86	0.01		
1401	40			74.86	0.01		
1406	45			74.88	0.03		
1411	50			74.88	0.03		
1416	55			74.88	0.03		
1421	60			74.88	0.03		
1431	70			74.89	0.04		
1441	80	t/mins	t²/t	74.89	0.04		
1453	92	6.39×10^{-2}	3.18×10^{6}	74.90	0.05		
1501	100	6.94	2.93	74.92	0.07		
1511	110	7.64	2.66	74.94	0.09		
1521	120	8.33	2.44	74.94	0.09		
1531	130	9.03	2.25	74.95	0.10		
1546	145	101×10^{-1}	2.01	74.97	0.12		
1601	160	1.11	1.83	74.97	0.12		
1616	175	1.22	1.67	74.98	0.13		
1631	190	1.32	1.54	74.99	0.14		
1650	209	1.45	1.40	75.01	0.16		
1701	220	1.53	1.33	75.02	0.17		
1716	235	1.63	1.25	75.02	0.17		
1731	250	1.74	1.17	75.03	0.18		
1841	320	2.22	9.16	75.28	0.43		
1901	340	2.36	8.62	75.10	0.25		
1948	387	2.69	2.56	75.20	0.35		
2013	412	2.86	7.11	75.20	0.35		
2225	544	3.78	5.37	75.22	0.37		
2400	639	4.46	4.58	75.20	0.35		
0100	649	4.84	4.20	75.30	0.45		
0150	749	5.20	3.91	75.27	0.42		
0345	844	6.00	3.39	75.30	0.46		
0540	979	6.80	2.99	75.25	0.41		

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT George Doss Eddy County N.M. S.W.L. 74.05

LOCATION 359' S.W. C-1354-X-5 DISCH. PIPE ____ ORIFICE ____

DATE 7/14/66 PUMP SETTING ____

WELL NUMBER Observ. Well #2

DRAWDOWN AND RECOVERY radius = 359' S.West

TIME	t	t'	t/t'	DEPTH TO WATER	DRAWDOWN	CAPACITY	REMARKS
1221	0						Pump on
1225	4			74.05	0		
1230	9			74.05	0	C-1354-X-5	pumping
1235	14			74.05	0		
1240	19			74.05	0		
1245	24			74.05	0		
1250	29			74.05	0		
1255	34			74.05	0		
1400	39			74.14	0.09		
1405	44			74.14	0.09		
1410	49			74.14	0.09		
1415	54			74.14	0.09		
1420	59			74.14	0.09		
1425	74			74.14	0.09		
1442	81			74.14	0.09		
1450	89	t/days	r^2/t	74.14	0.09		
1500	99	6.08×10^{-2}	1.87×10^{6}	74.15	0.10		
1512	111	7.71	1.67	74.15	0.10		
1520	119	8.26	1.56	74.18	0.13		
1548	147	1.02×10^{1}	1.26	74.18	0.13		
1603	162	1.11	1.15	74.18	0.13		
1616	175	1.22	1.06	74.19	0.14		
1626	185	1.28	1.01	74.19	0.14		
1645	204	1.42	9.08×10^{5}	74.20	0.15		
1706	225	1.56	8.26	74.23	0.18		
1720	239	1.66	7.76	74.23	0.18		
1842	321	2.23	5.78	74.26	0.21		
1905	344	2.39	5.39	74.26	0.21		
2012	411	2.85	4.58	74.26	0.21		
2150	569	3.95	3.26	74.31	0.26		
2415	654	4.54	2.84	74.38	0.33		
0110	709	4.92	2.62	74.38	0.33		
0203	762	5.29	2.44	74.38	0.33		
0350	849	6.03	2.14	74.42	0.37		
0550	989	6.87	1.88	74.41	0.36		

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT George Ross Eddy Co. N.M. S.W.L. 71.74

LOCATION 324' SE. C-1354-X-5 DISCH. PIPE ____ ORIFICE ____

DATE 7/14/66 PUMP SETTING ____

WELL NUMBER Obser. Well 3 radius = 324' s.east

DRAWDOWN AND RECOVERY p.1

TIME	t	t'	t/t'	DEPTH TO WATER	DRAWDOWN	CAPACITY	REMARKS
1321							Pump On.
1323	2			71.80	0.06		
1328	7			71.81	0.07	C-1354-X-5 pumping	
1332	11			—			
1335	14			71.82	0.08		
1339	17			71.84	0.10		
1342	21			—			
1345	24			—			
1349	28			—			
1353	32			71.87	0.13		
1356	35			71.87	0.13		
1401	40			71.87	0.13		
1404	43			71.87	0.13		
1407	46			71.87	0.13		
1411	50			71.88	0.14		
1415	54			71.88	0.14		
1420	59			71.90	0.16		
1428	67			71.89	0.15		
1430	69			71.89	0.15		
1440	79			71.89	0.15		
1450	89	0 days	∞	71.89	0.15		
1502	101	2.01×10^{-2}	1.50×10^{6}	71.91	0.17		
1510	109	7.57	1.39	71.91	0.17		
1523	122	8.47	1.24	71.93	0.19		
1553	152	1.06×10^{-1}	9.60×10^{5}	71.95	0.21		
1606	165	1.15	9.13	71.96	0.22		
1618	177	1.23	8.53	71.96	0.22		
1631	190	1.32	7.95	71.97	0.23		
1650	209	1.45	7.24	71.98	0.24		
1705	224	1.56	6.73	71.99	0.25		
1725	244	1.69	6.21	71.99	0.25		
1840	319	2.22	4.73	72.03	0.29		
1900	339	2.35	4.47	72.03	0.29		
1923	362	2.51	4.18	72.04	0.30		
2005	404	2.81	3.74	72.08	0.34		
2253	572	3.97	2.64	72.11	0.37		
2415	1654	4554	2.31	72.16	0.42		
0112	711	4.96	2.12	72.18	0.44		

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT _____ S.W.L. _____

LOCATION _____ DISCH. PIPE _____ ORIFICE _____

DATE _____ PUMP SETTING _____

WELL NUMBER Obser. Well 3

DRAWDOWN AND RECOVERY p.2

TIME	t	t'	t/t'	DEPTH TO WATER	DRAWDOWN	CAPACITY	REMARKS
		t/days	ft²/t				
0215	774	5.38	1.65 x 10⁻⁴	72.18	0.44		
0251	870	6.04	1.74	72.22	0.48		
0557	992	6.89	1.52	72.24	0.50		

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT George Rose Eddy Co. N.M. S.W.L. 101.88 Top Casing Mp 1.38 From

LOCATION 1155' FWL 2475' FSL Sec 23 T-26S R 29E DISCH. PIPE 10" ORIFICE 8"

DATE 3/26&27/73 PUMP SETTING 158'

WELL NUMBER C-1254-X-3

DRAWDOWN AND RECOVERY p.1

TIME	t	t'	t/t'	DEPTH TO WATER *	DRAWDOWN	CAPACITY	REMARKS
							10" Column pipe
							2-12" holes
							Total Depth well 170'
							* Thru 3/4" monitor pipe
1135 (3/12/73)				98.77			Top Casing
1807 (3/22/73)				99.77			Base pump
							10 with Suction
1530 3/26/73				101.93			monitor pipe
1536				101.88			
1537							Start Pump
1540	3			101.94		1120	Clear 5/4 gal cans
1542	5			101.92		1080	Clear
1544	7					1080	
1545	8			101.93	0.05	1090	
1550	13			101.93		1080	
1603	26			101.94	0.06	1080	Temp 68.5°F
1605	28						Inc. rpm -
1609	32			101.93	0.05	1130	
1622	45			101.97	0.09	1120	
1642	65			102.01	0.13	1120	
1652	75			102.03	0.15		
1724	107			102.09	0.21	1060	
1728							lower rpm
1730	113			102.10	0.22	1120	
1750	133			102.15	0.27	1135	
1800	143			102.20	0.30	1130	
1816	159			102.23	0.33	1122	Clear
1850	193			102.30	0.40	1120	
1917	220			102.36	0.46	1120	
2003	266			102.45	0.55	1120	
2103	326			102.60	0.70	1120	
2155	378			102.74	0.86	1110	Becoming V. Windy
2300	443			102.89	1.01		
2330	473			102.95	1.07	1080	
3/27/73							

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped

ED L. REED AND ASSOCIATES
CONSULTING HYDROLOGISTS

CLIENT _____ S.W.L. _____

LOCATION _____ DISCH. PIPE ____ ORIFICE ____

DATE _____ PUMP SETTING _____

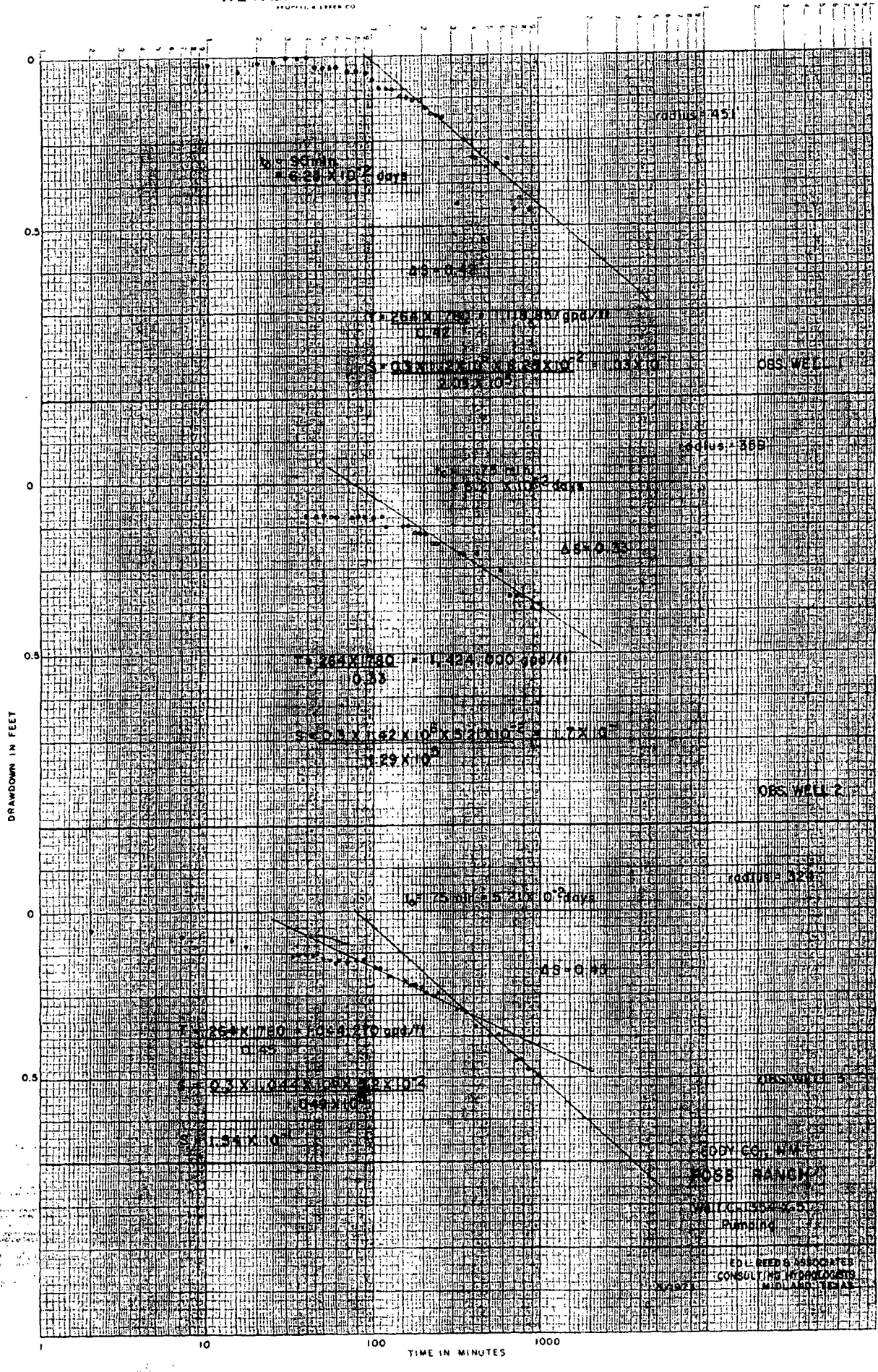
WELL NUMBER C-1354-X-3

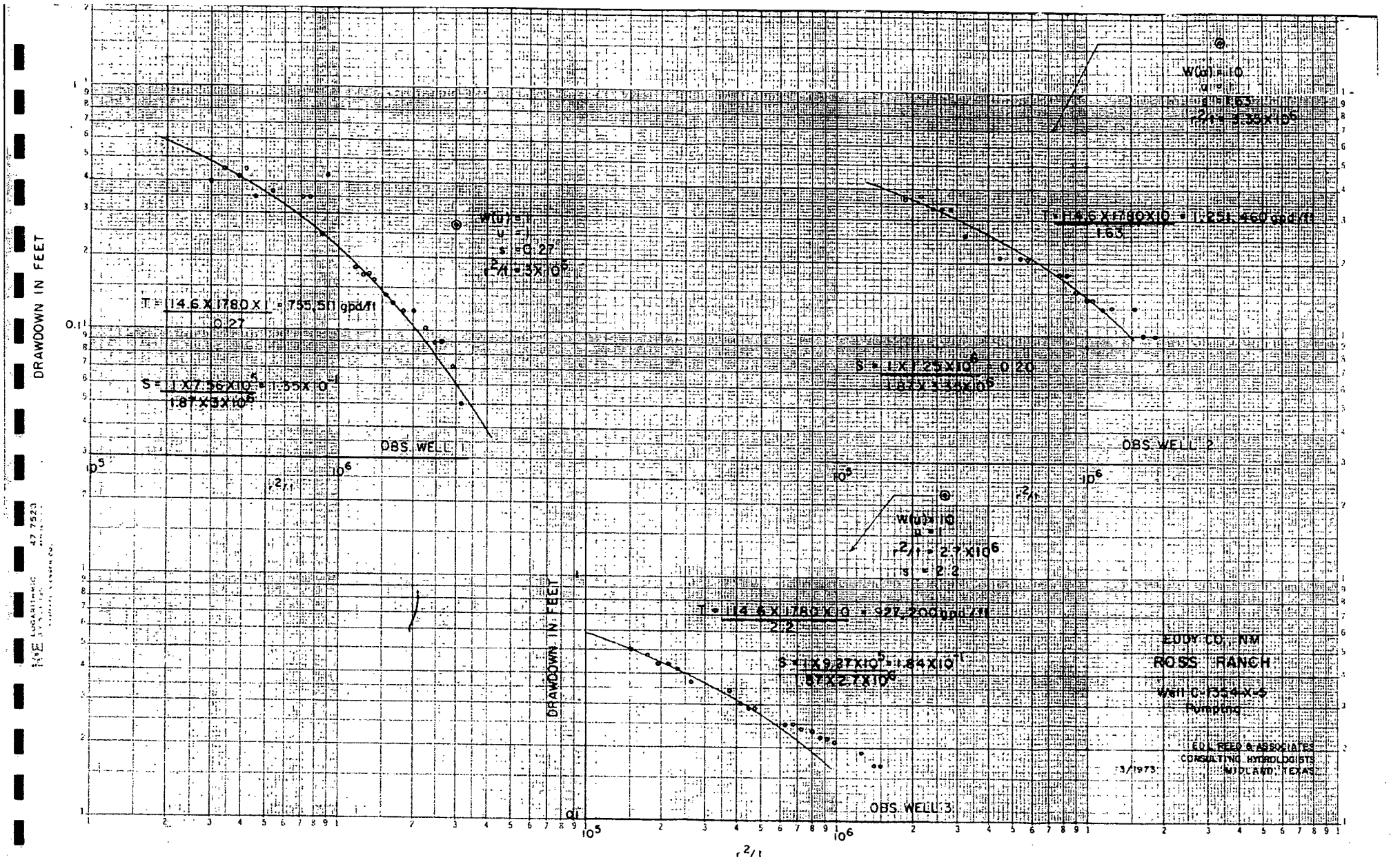
DRAWDOWN AND RECOVERY

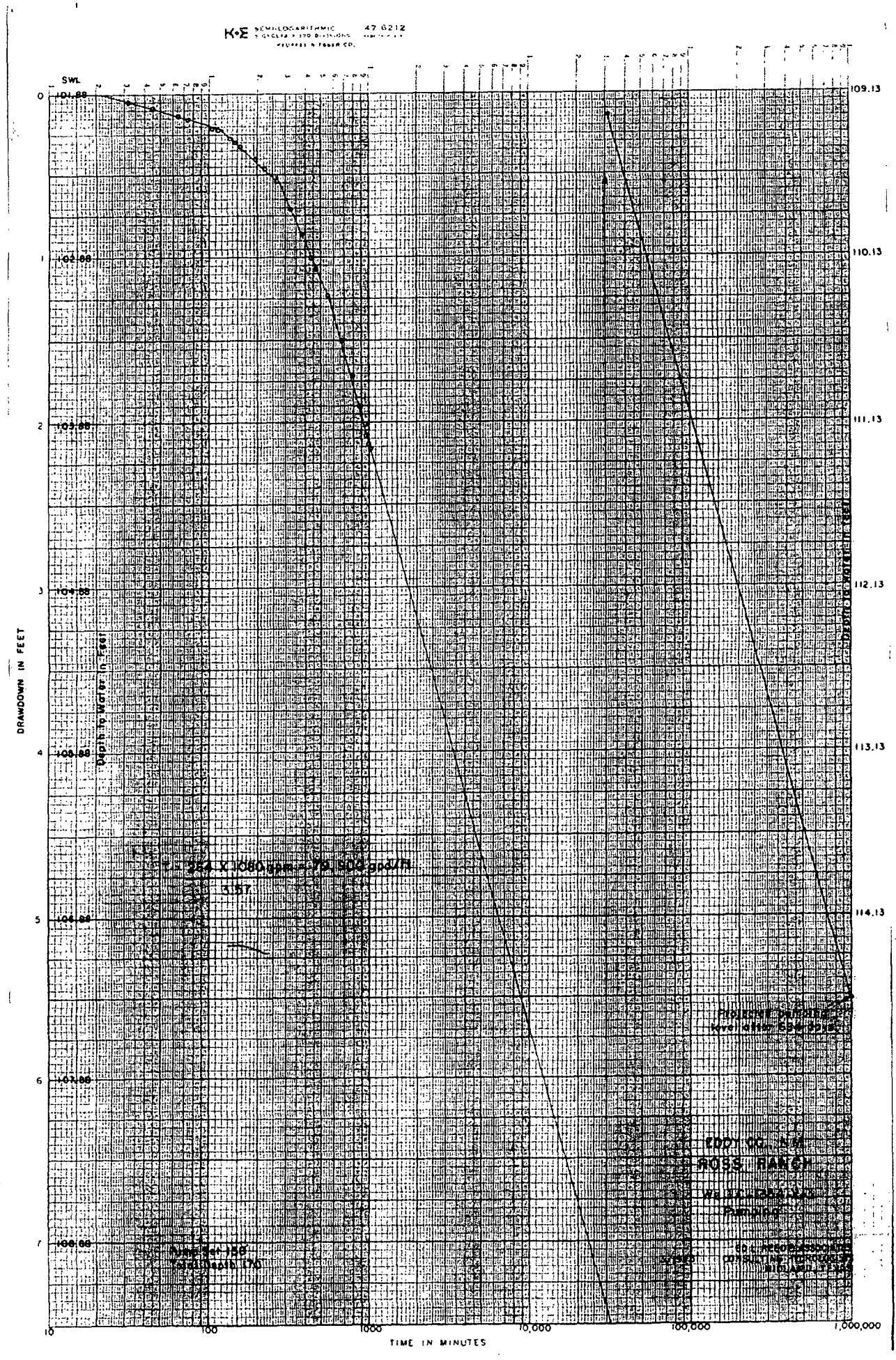
p.2

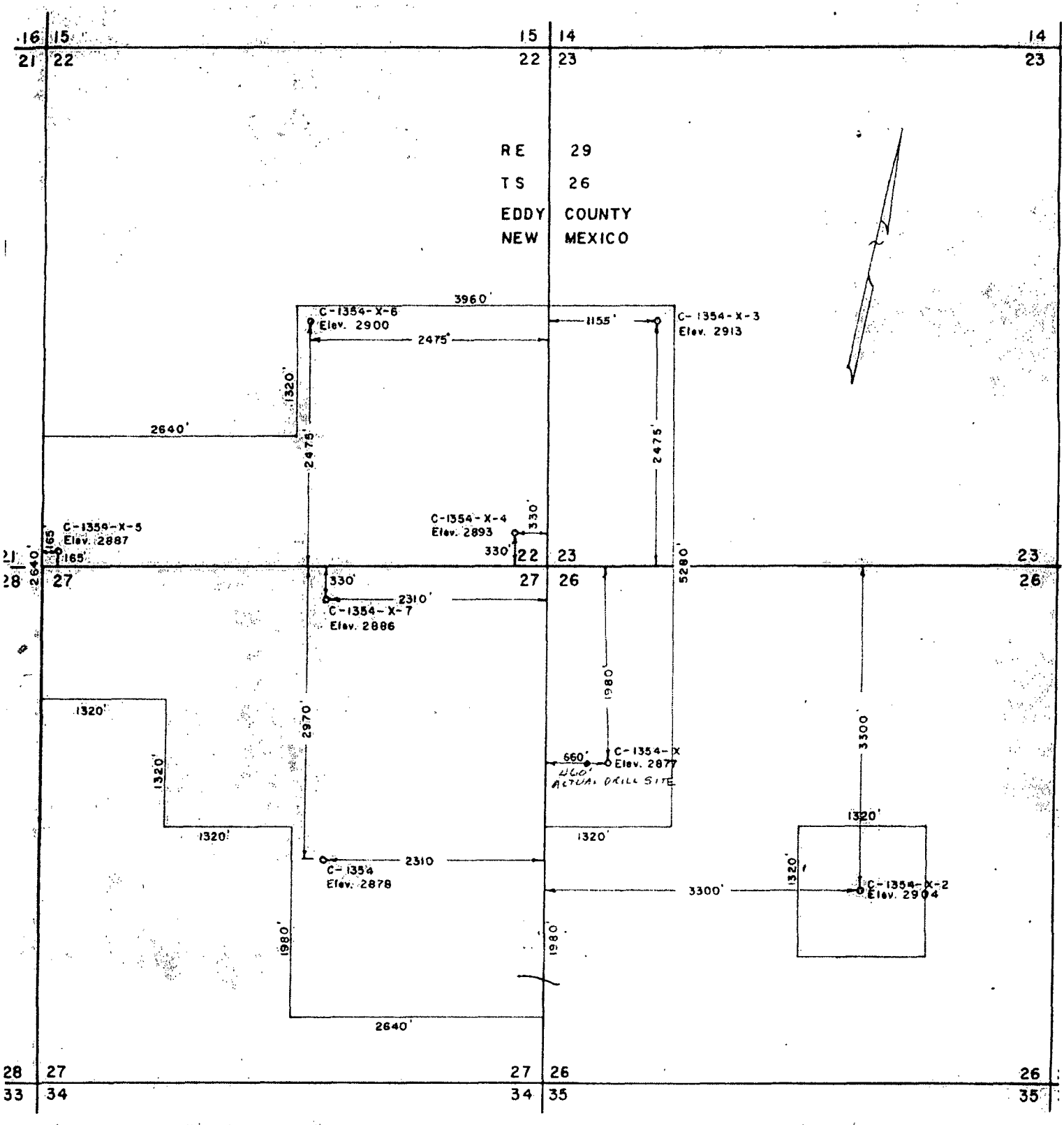
TIME	t	t'	t/t'	DEPTH TO WATER	DRAWDOWN	CAPACITY	REMARKS
0055	558			103.11	1.23	1080	
0255	678			103.39	1.51	1080	
0455	798			103.54	1.71	1070	
0620	888			103.79	1.91	1070	
0715	943			103.90	2.02	1070	
0755	978			103.96	2.08	1070	
0830	1013			104.01	2.13		
0835							100 rpm
0840	1023			104.03	2.15	1080	
0913	1056						Engine failed
							Recovery
0917		1		104.13			
0918		5		104.10			
0919		6		104.09			
0920		7		104.09			
0922		9		104.085			Wind increasing
0925		12		104.09			
0930		17		104.085			
0935		22		104.13			
0945		32		104.09			
0955		42		104.09			
1010		57		104.08			
1025		72		104.09			
1040		87		104.09			meas. 3X
1058		105		104.08			
1107		114		104.34			Changed from
1110		117		104.32			electrode to
1121		128		104.33			steel line tape
1202		169		104.76			
1207		174		104.76			
1220		187		104.64			
1224		191		104.64			
1305		232		104.55			
1320		247		104.65			

t = Time Since Pumping Started
t' = Time Since Pumping Stopped
t/t' = Time Since Pumping Started/Time Since Pumping Stopped


K+E SEMI-LOGARITHMIC 47 5212
DRAWDOWN IN FEET
TIME IN MINUTES
1
10
100
1000
0
0.5
radius = 451'
OBS. WELL 1
radius = 385'
OBS. WELL 2
radius = 329'
OBS. WELL 3
EDDY CO., N.M.
ROSS RANCH
Running
EDL. REED & ASSOCIATES
CONSULTING HYDROLOGISTS
MIDLAND, TEXAS


DRAWDOWN IN FEET
W(u) = 1.0
s = 1.63
r²/t = 3.33x10⁶
T = 14.6 X 1780 X 1.0 / 1.63 = 1,251,460 gpd/ft
S = 1 X 1.25 X 10⁻¹ / 1.87 X 3.33 X 10⁶ = 0.20
OBS. WELL 2
W(u) = 1.0
s = 0.27
r²/t = 3X10⁵
T = 14.6 X 1780 X 1.0 / 0.27 = 755,511 gpd/ft
S = 1 X 7.56 X 10⁻⁵ / 1.87 X 3 X 10⁵ = 1.35 X 0⁻¹
OBS. WELL 1
W(u) = 1.0
s = 2.2
r²/t = 2.7 X 10⁶
T = 14.6 X 1780 X 1.0 / 2.2 = 927,200 gpd/ft
S = 1 X 9.27 X 10⁻⁵ / 1.87 X 2.7 X 10⁶ = .84 X 10⁻¹
OBS. WELL 3
DRAWDOWN IN FEET
r²/t
EDDY CO. NM
ROSS RANCH
Well C-1354-X-5
Pumping
ED L. REED & ASSOCIATES
CONSULTING HYDROLOGISTS
MIDLAND, TEXAS
3/1973


K&E SEMI-LOGARITHMIC 47 6212
SWL
DRAWDOWN IN FEET
Depth to Water in Feet
TIME IN MINUTES
0
1
2
3
4
5
6
7
101.88
102.88
103.88
104.88
105.88
106.88
107.88
108.88
109.13
110.13
111.13
112.13
113.13
114.13
10
100
1000
10,000
100,000
1,000,000
T = 264 X 1080 gpm = 79,500 gpd/ft
s = 3.57
EDDY CO., N.M.
ROSS RANCH
Pump Set @ 150'
Total Depth 170'



PLAT OF WATER WELL LOCATIONS IN SECTIONS 22, 23, 26, & 27, TOWNSHIP 26 SOUTH, RANGE 29 EAST, EDDY COUNTY, NEW MEXICO

AVAILABILITY OF GROUNDWATER

RUSTLER FORMATION

ROSS RANCH

EDDY COUNTY, NEW MEXICO

BY

ED L. REED

CONSULTING HYDROLOGIST

MIDLAND, TEXAS

NOVEMBER, 1966

AVAILABILITY OF GROUND WATER

RUSTLER FORMATION

ROSS RANCH

EDDY COUNTY, NEW MEXICO

By

ED L. REED

Consulting Hydrologist
Midland, Texas

November, 1966

ED L. REED
CONSULTING
GROUNDWATER HYDROLOGIST
GEOLOGICAL ENGINEER
1109 N. BIG SPRING
MIDLAND, TEXAS

Phone MU 2-2670
Registered Professional Engineer
Fellow GSA
Member ASCE

November, 1966

Mr. George Ross
P. O. Box 1291
Pecos, Texas

Re: Availability of Ground Water
Rustler Formation
Ross Ranch
Eddy County, New Mexico

Dear Mr. Ross:

The purpose of this report is to present the results of an investigation into the occurrence and availability of ground water from the Rustler formation under the Ross Ranch with particular attention to availability in Sections 22, 23, 26 and 27, Township 26 South, Range 29 East, Eddy County, New Mexico.

METHOD OF INVESTIGATION.

This study has consisted of a review of the surface and near-surface geology of Southern Eddy County; a review of previous publications in the area, including Ground Water Report No. 3 of the New Mexico Bureau of Mines and Mineral Resources, 1952, a report on "Possible Improvement of Quality of Water of the Pecos River by Diversion of Brine at Malaga Bend" (Hale, Hughes & Cox), for the Pecos River Commission by the U.S.G.S., 1954; an examination of flow records and seepage investigations of the Pecos River; an analysis of formation samples obtained in the drilling of four test holes; and a pumping test of a Rustler well located in the southwest corner of Section 22, Township 26 South, Range 29 East, together with the data from three observation wells drilled near

the pumped well. Sample and radiation logs of all oil tests in the area were examined for structural and stratigraphic data.

GEOLOGY.

In the area covered by this study bedrock exposed at the surface consists of dolomites and limestones of Rustler (Upper Permian) age. A small outcrop of Triassic red sandy clays occurs near the south boundary of the Ross Ranch in Sections 27 and 34, T 26S-R29E.

The Rustler which is here considered to be uppermost Permian in age outcrops extensively on the west side of the River and to a more limited extent on the east side. The Rustler is composed of alternating beds of dolomites, anhydrite, gypsums, sands and sandy clays. In the area of immediate interest the formation reaches a thickness of about 500 feet.

The Rustler in a normal sequence overlies the Salado formation, which is composed of massive beds of salt and anhydrite with interbeds of sands, clays and gypsums. On the west side of the river substantial amounts of the soluble salts in the Salado have been removed by percolating ground waters, resulting in extensive slumping and contortion of the overlying Rustler sequence. Additionally, portions of the Rustler appear to have been removed either by solution or by collapse into the underlying Salado. The result is the development of a karst topography characterized by steeply dipping beds and semi-circular collapsed domes.

The slumping of the Rustler appears to be confined for the most part to the area west of the river and further seems to be localized in the vicinity of the major tributaries of the Pecos River. On the east side of the river the Rustler appears to be present in a normal relatively undisturbed sequence. This is

believed to be due in part at least to the absence of major tributaries to the Pecos River on the east side.

As shown on Figure 1 and as depicted graphically on the east-west cross section, (Fig. 3) the Rustler dips generally from southwest to northeast across the Ross property. Regionally the Rustler appears to be dipping in several directions into a trough located in or east of T25S-R30E. The rate of dip on the west side of the Ross Ranch and on the east side of the river ranges from 50 to 100 feet per mile. On the eastern side of the property the dip increases to something more than 300 feet per mile. The area of interest in this particular study occupies the monocline east of the river, where the rate of dip averages some 75 feet per mile.

As stated in the Hale, et al report on "Possible Improvement of Quality of Water of the Pecos River by Diversion of Brine at Malaga Bend, Eddy County, New Mexico", at Page 18, the Rustler consists largely of gypsum, anhydrite and sandstone with two persistant dolomitic limestone members. The dolomite members referred to in this report do seem to be persistant over wide areas, but regional studies indicate that the dolomite facies of the Rustler roughly parallels the strike of the Delaware Basin with the dolomites grading laterally in the direction of the shelf to anhydrites and gypsums. This relationship is illustrated in the north-south cross section(Fig. 4) where it can be seen that as the Capitan Reef is approached the dolomites are absent.

The regional occurrence of the dolomite or limestone facies of the Rustler is considered to be important to this study since it is apparent that the principal development of porosity and permeability in the Rustler sequence is limited to the carbonate beds.

The degree of slumping of the Rustler also seems to be a factor in the occurrence of porosity and permeability. Thus, it is

seen that there is little to no development of porosity in the Rustler on the west side of the river. This fact was evident in my previous study of a salinity alleviation project for the Red Bluff Water Power Control District, (August, 1966) and was also discussed in the Hale Report described above in which it is stated at Page 19, "It appears that, in general, with the leaching of soluble rocks in the Rustler formation, the clays and residue in the formation together with the recementation of the remaining gypsum has made the formation relatively watertight."

However, on the east side of the river where the Rustler is present in an undisturbed sequence, persistant development of porosity in the dolomites is found. On the Rustler structure map (Fig. 1) the thickness of porosity in the Rustler has been indicated in those wells where the data could be extrapolated. For example, an oil test in the southwest corner of Section 3, T26S-R30E, has 120 feet of porosity in the Rustler, an oil test in the northwest corner of Section 18, T26S-R30E, has 50 feet, and an oil test in the northwest corner of Section 14, T26S-R29E, has 125 feet of porosity. Similar data is posted for all wells where the records were available and could be interpreted. It is apparent from this study that the areal distribution of porosity and permeability in the Rustler ~~is~~ confined to a north-south belt of dolomite facies and further, is locally confined to those areas where the Rustler is in a relatively undisturbed position.

HYDROLOGY.

Ground water in the Rustler is contained under both artesian and water table conditions in the porous dolomites and limestones of the middle and lower portions of the formation. The thickness of the porous zone appears to be related to the thickness of the dolomite facies as indicated on the west-east cross section.

Locally both the porosity and permeability in the Rustler have very high values. Outcrop samples of the Rustler exhibit large secondary solution openings, one-half inch or more in diameter. Rotary drilling operations frequently experience serious problems of lost circulation in drilling the dolomite sequence.

An attempt has been made to determine the attitude of the water level in the Rustler formation in the southeastern portion of Eddy County. Figure 2, a copy of Plate 3 of Ground Water Report 3 of the New Mexico Bureau of Mines and Mineral Resources, has been modified to the extent of selecting those water levels which appear to relate to the Rustler formation and further, by the addition of data obtained from the Hale Report and collected during the course of this investigation. Contouring of the resulting data indicates a general southeastward dip on the piezometric or water table surface and the development of a distinct trough aligned in a northwest-southeast direction within which the rate of dip is substantially less locally than that found on either limb. The average rate of dip of the water surface along the axis of the trough appears to be of the order of 10 feet per mile as compared with 22 feet per mile across the northeast limb, and 14 or 15 feet per mile across the southwest limb. The data in the western part of the contoured area is subject ~~to~~ considerable doubt as to whether the water is derived from the Rustler or from the Castile formation.

Locally it would appear that the water level in the Rustler is at a higher level than either the younger or older formations. Also, at least in the Malaga Bend area, the water in the Rustler formation is under sufficient head ..."to rise above the river level in the bend..."[1]

[1]W. E. Hale et al Report to the Pecos River Commission, 1954, P. 21

A pumping test was conducted on July 14 and 15, 1966, in an irrigation well located in the SW/4 of the SW/4 of Section 22, T26S-R29E. Prior to the running of this pumping test three observation wells were drilled into the Rustler formation as follows:

Observation Hole No. 1
451' Northwest of the irrigation well
Total Depth 100'
Top of the Rustler 83'
Static Water Level 74.85'

Observation Hole No. 2
359' Southwest of the pumped well
Total Depth 100'
Top of the Rustler 84'
Static Water Level 74.05'

Observation Hole No. 3
324' Southeast of pumped well
Total Depth 120'
Top of the Rustler 96'
Static Water Level 71.74'

The pumped well was drilled in 1956 to a total depth of 115 feet with 20-inch casing set to a depth of 20 feet and completed in the open hole. The apparent top of the Rustler is at 70 feet and the static level prior to the pumping test was 73.7 feet.

The irrigation well was pumped at an average rate of 1780 gallons per minute for a total of 16 hours and 40 minutes. Although water level measurements in the pumped well were difficult to obtain, the data indicates a total drawdown of 1.10 feet at the end of the test. This data is confirmed by steel line measurements during the recovery showing a static water level of 74.60 feet four minutes after shutting the well off.

During the pumping of the irrigation well, Observation Hole No. 1 declined from 74.85 feet to 75.25 feet, a total of 0.40 feet; Observation Hole No. 2 declined from 74.05 feet to 74.41 feet, a total of 0.36 feet; and Observation Hole No. 3 declined from 71.74 feet to 72.24 feet, a total of 0.50 feet. From the above it would

appear that the apparent decline in the pumped well is in the right order of magnitude for the declines in the observation wells. An analysis of this data would indicate a coefficient of transmissibility in excess of 1,000,000 gallons per day per foot. It is my opinion that this test is not representative of the average conditions in the Rustler in this area and that subsequent testing will indicate a lower transmissibility figure. However, the result of additional test drilling indicates the presence of high permeabilities in the area adjacent to the pumped well. Test Hole No. 6 (see attached log) located about 2100 feet FNL and 600 feet FEL of Section 22 and approximately 5000 feet northeast of the pumped well, found the top of the Rustler at 98 feet, composed of white to tan limestone which continued to total depth of 160 feet. This section exhibited coarse porosity and circulation was lost in the lower part of the hole. The static water level in this well was 77.25 feet below the land surface on October 26, 1966. A six-foot zone of porous limestone between the depths of 46 and 50 feet has the appearance of Rustler material and may represent an erratic deposited during the erosion of the Rustler nearby.

Test Hole No. 7, located 1620 feet FSL and 130 feet FEL of Section 23, T26S-R29E, found the top of the Rustler at 120 feet, which again consisted of porous light colored limestone to the total depth of 162 feet. Circulation was lost at 150 feet and again at 162 feet. The static water level measured on October 26, 1966, was 78.7 feet.

Finally, a siesmograph test hole drilled on August 10, 1966, in the northwest corner of Section 22, T26S-R29E, encountered a cavity at 75 to 80 feet and lost circulation. The drilling of this siesmograph test hole was observed by this office and it is believed that the zone of lost circulation occurred in the Rustler formation.

The recharge-discharge relationships of the Rustler formation in Eddy County are imperfectly known. Attempts have been made to relate both recharge and discharge to the flows of the Pecos River without success. The water level in the Rustler through at least most of the reach of the Pecos River below Carlsbad is above the average level of the river and, therefore, cannot be receiving recharge from the river. The Rustler in the vicinity of Carlsbad and in most places west of the river has little if any porosity and does not appear to be contributing any measurable quantity of water to the river. Hale et al in the Malaga Bend Study has estimated that the lower Rustler brine aquifer in the Malaga Bend area is contributing some 0.4 cfs to the base flow of the Pecos River. Seepage investigations of the Pecos River between the Red Bluff gage (NW/4NE/4, Sec. 1, T26S-R28E) and the head of Red Bluff Reservoir in the NE/4 of the SE/4 of Section 28, T26S-R29E, indicates a total loss of 0.39 cfs on July 23, 1966. An analysis of eleven years of record between the Pierce Canyon gage in the west half of Section 27, T24S-R29E, and the Red Bluff gage indicates an average gain of 2.27 cfs, some of which is believed to represent underflow brought to the surface by temporary base leveling in the immediate vicinity of the Red Bluff gage.

From this study it would appear that the recharge of the Rustler occurs from runoff and infiltration into the drainage systems such as Nash Draw and Brushy Draw, and percolation, particularly in the sandier portion of the watershed during periods of above normal rainfall. In the immediate vicinity of the Ross irrigation well in Section 22, T26S-R29E, evidence of potential recharge is indicated by two sets of water level measurements made in July and October, 1966. On July 14th the static water level in the irrigation well was 73.70 feet below the pump base. On October 26th,

after a period of unusually heavy rainfall the static water level was 51.20 feet. In Observation Well No. 1, northwest of the irrigation well, the static water level on July 14th was 74.86 feet below ground and on October 26th the level was 52.2 feet. Observation Hole No. 2 southwest of the irrigation well had a static water level of 74.05 feet below ground on July 14th and 52.5 feet on October 26th. Since it is believed that the Rustler at this time was essentially full, this increase in the water level represents accretions to the alluvial section above the Rustler and would be available as a source of recharge water for the Rustler had the occurrence taken place at a time when pumping had reduced the water level in the Rustler formation.

QUALITY.

The quality of water found in the Rustler formation in South Eddy County varies over wide limits, both areally and from time to time in individual wells. In the irrigation well in Section 22, T26S-R29E, an analysis made on July 16, 1956, showed a chloride concentration of 950 parts per million, a sulfate of 836 parts per million, and total dissolved solids of 2978 parts per million. Another sample from this same well taken before the irrigation season on February 22, 1960, showed a chloride of 794 parts per million, sulfate of 644 parts per million and total salts of 2442 parts per million. At the end of the irrigation season on September 20, 1960, the chlorides had risen to 2100 parts per million, the sulfates to 1356 parts per million and total solids to 5481 parts per million.

At Malaga Bend the basal Rustler dolomite contains a brine exhibiting chloride concentrations as high as 158,000 parts per million, sulfates to 10,200 parts per million and total solids to the maximum of 275,000 parts per million.

A well in Section 2, T19S-R28E, has a chloride concentration of 1770 parts per million, sulfates of 1300 parts per million and total dissolved solids of 4740 parts per million. A well in Section 28, T20S-R28E, has a chloride concentration of 348 parts per million, sulfates of 1710 parts per million and total solids of 3110 parts per million. In Section 4, T20S-R30E, the Potash Company of America Rustler wells exhibit a chloride concentration of 86,700 parts per million and a specific conductance of 162,500 microms.

Coming farther south, a well in Section 18, T21S-R28E, has a chloride concentration of 642 parts per million, sulfates of 3530 parts per million and total solids of 6090 parts per million.

From the above it can be seen that the Rustler is generally of poor quality, ranging from brackish to a highly concentrated brine. It is believed that the 1956 analysis of the irrigation well in Section 22 represents a quality much better than average for the area and it is further believed that pumpage in this area will result in a marked deterioration in water quality. It is probable that the pumping of several wells as later recommended will result in a produced water with substantially higher solids than the September, 1960 analysis indicated.

The hydrology of the Rustler in the area north of the Ross Ranch would indicate that there is a possibility that intensive pumpage on the Ross property will intercept some of the brine in the basal Rustler in the vicinity of Nash Draw, which is now discharging into the Pecos River by upward leakage into the overlying alluvial section.

It is my opinion that pumpage in the amounts stated later in this report might result in the ultimate increase of total dissolved solids to a level approaching 8000 to 10,000 parts per million.

AVAILABILITY OF WATER.

Assuming an average coefficient of transmissibility of 500,000 gallons per day per foot and an average hydraulic gradient of 14 feet per mile, the inflow across a two-mile width of the aquifer in a southerly or southeasterly direction would amount to 14 million gallons per day. The degree to which this inflow can be intercepted depends upon the amount of modification of the hydraulic gradient which will accompany the discharge of water from the reservoir. Insufficient historical water level measurements preclude a firm estimate of the amount of rejected recharge available annually. However, it seems reasonable to assume that a combination of direct recharge and the salvage of 50 to 60 percent of the inflow will make available a diversion of about 9400 acre feet per year from eight wells located in Sections 22, 23, 26 and 27, T26S-R29E.

RECOMMENDATIONS.

1. It is recommended that applications be filed with the New Mexico State Engineer for permits in the following locations:

Section 22, T26S-R29E.....NW/4SE/4
SW/4SW/4
SE/4SE/4

Section 23, T26S-R29E.....NW/4SW/4

Section 26, T26S-R29E.....NW/4SE/4
SW/4NW/4

Section 27, T26S-R29E.....NW/4NE/4
SW/4SE/4

The applications should request a diversion of 1175 acre feet per well per year or 1,050,000 gallons per day per well.

2. At such time as the permits are granted a systematic drilling and testing program for the eight production wells should be commenced including the drilling and casing of a minimum of three observation wells. Each well should be thoroughly developed and

pump tested in order to determine the average aquifer characteristic of this reservoir, and to more adequately plan the withdrawal of water in a prudent manner.

3. All wells should be drilled and tested prior to further capital investment pertaining to this water resource.

Respectfully submitted:

Ed L. Reed

Ed L. Reed
Consulting Hydrologist

OBSERVATION HOLES

ROSS RANCH

Hole No. 1
Sec. 22, T26S-R29E
451' NW Irrigation well
TD 100'
Top of Rustler 83'
Static Water Level 74.85'

0-56	caliche (cemented) gravel
56-59	clay
59-100	cemented gravel, lime

Hole No. 2
Sec. 22, T26S-R29E
359' SW Irrigation well
TD 100'
Top of Rustler 84'
Static Water Level 74.05'

0-61	cemented gravel
61-70	sand-gravel
70-79	clay
79-83	gravel - cavity 83'
83-100	gravel

Hole No. 3
Sec. 22, T26S-R29E
324' SE Irrigation well
TD 120'
Top of Rustler 96'
Static Water Level 71.74'

0-20	clay-gravel
20-68	cemented gravel
68-73	clay
73-96	gravel & cavity
96-120	lime

TEST HOLES

ROSS RANCH

No. 5
Sec. 21, T26S-R29E
2400' FSL 1250' FEL
Approx. 3500' NE Irrigation well.

0-1	soil-sand
1-15	white, pink fine sand, gravel to 2" rounded & angular
15-40	gravel, med. to crs., loose rounded to angular up to 3/4" @ 25' tight cemented cong. bed
40-65	tan-cemented cong. & sand, gravel 2" to 5"
65-70	tan-cemented cong. & sand, & tan clay w/coarse cong. gravel
70-80	blind

No. 5-A
600' NE of No. 5

0-25	sand & gravels 3/4 to 1½"
25-60	dark gravels & limestone flakes & cemented cong. & sand

could not drill - slumping

No. 6
Sec. 22, T26S-R29E
2100' FNL 600' FEL
Approx. 5000' NE Irrigation well.

0-40	fine loose sand some fine gravel 1/2"
40-45	fine sand & gravel, pink fresh lime
45-50	tan-dense to med crystal., vuggy lime - lost circ. @ 48'
50-98	air, blind fine sand (driller)
98-106	white-tan limestone dense drilling 2 min. per foot.
106-140	white tan limestone-vuggy porous 2' per min. water @ 108' - good quantity
140-160	tan fine crystal. limestone

(could not drill deeper due to hole caving and lost circulation)

No. 7
Sec. 23, T26S-R29E
1620' FSL 130' FEL

0-75	fine red sand loose & clay streaks
75-95	sand & med. to crs. gravel up to 3/8"
95-115	Gravel inc. size up to 3/4" pink, gray, Qtz. lime.
115-120	red clay w/gravel embedded

losing some circ. in gravels

120-130	white chalky slight vuggy med. crys. lime-stone
130-140	d.o.
140-150	white lime & some brown crystal. lime
150-162	d.o.

Lost circ. 150-155
Lost circ. @ TD