Revised March 23, 2017

RECEIVED:	REVIEWER:	TYPE:	APP NO:
1/24/2018	MAM	SWD	pMAM18360 29684

ABOVE THIS TABLE FOR OCD DIVISION USE ONLY

NEW MEXICO OIL CONSERVATION DIVISION
- Geological & Engineering Bureau –
1220 South St. Francis Drive, Santa Fe, NM 87505

ADMINISTRATIVE APPLICATION CHECKLIST

THIS CHECKLIST IS MANDATORY FOR ALL ADMINISTRATIVE APPLICATIONS FOR EXCEPTIONS TO DIVISION RULES AND REGULATIONS WHICH REQUIRE PROCESSING AT THE DIVISION LEVEL IN SANTA FE

Applicant: ~~Hayden Holub~~ Rice MM **OGRID Number:** 019174
Well Name: Alice Paddock #4 **API:** 30-025-09940
Pool: _____ **Pool Code:** _____

SUBMIT ACCURATE AND COMPLETE INFORMATION REQUIRED TO PROCESS THE TYPE OF APPLICATION INDICATED BELOW

1) **TYPE OF APPLICATION:** Check those which apply for [A] SWD-1877
A. Location – Spacing Unit – Simultaneous Dedication
☐NSL ☐NSP (PROJECT AREA) ☐NSP (PRORATION UNIT) ☐SD

B. Check one only for [I] or [II]
[I] Commingling – Storage – Measurement
☐DHC ☐CTB ☐PLC ☐PC ☐OLS ☐OLM
[II] Injection – Disposal – Pressure Increase – Enhanced Oil Recovery
☐ WFX ☐PMX ☒SWD ☐IPI ☐EOR ☐PPR

FOR OCD ONLY
☑ Notice Complete
☑ Application Content Complete

2) **NOTIFICATION REQUIRED TO:** Check those which apply.
A. ☒ Offset operators or lease holders
B. ☐ Royalty, overriding royalty owners, revenue owners
C. ☒ Application requires published notice
D. ☒ Notification and/or concurrent approval by SLO
E. ☐ Notification and/or concurrent approval by BLM
F. ☒ Surface owner
G. ☒ For all of the above, proof of notification or publication is attached, and/or,
H. ☐ No notice required

3) **CERTIFICATION:** I hereby certify that the information submitted with this application for administrative approval is **accurate** and **complete** to the best of my knowledge. I also understand that **no action** will be taken on this application until the required information and notifications are submitted to the Division.

Note: Statement must be completed by an individual with managerial and/or supervisory capacity.

12-20-2018
Date

Hayden Holub
Print or Type Name

(575)393-9174
Phone Number

Signature

hholub@riceswd.com
e-mail Address

RICE *Operating Company*

112 West Taylor • Hobbs, New Mexico 88240
Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018

Oil Conservation Division
Attention: Michael McMillan
1220 South St. Francis Dr.
Santa Fe, NM 87505

RE: Allice Paddock #4 SWD
U/L G, Section 1, T22S, R37E
1980' FNL and 1980' FEL
Lea County, NM

To Whom it May Concern:

In accordance with the Rules and Regulations of the Oil Conservation Division of the State of New Mexico, you are being provided a copy of the C-108 Application for Authorization to Inject into the above captioned well.

Any questions about the permit can be directed to Hayden Holub at 575-393-9174. Any objections or request for hearing must be filed with the Oil Conservation Division within fifteen (15) days from the date received. The OCD address is 1220 S. St. Francis Dr., Santa Fe, NM 87505.

Thank You,

Hayden Holub
Manager
Rice Operating Company

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, New Mexico 87505

FORM C-108
Revised June 10, 2003

APPLICATION FOR AUTHORIZATION TO INJECT

I. PURPOSE: _____Secondary Recovery _____Pressure Maintenance ___X___Disposal _____Storage
Application qualifies for administrative approval? _____Yes _____No

II. OPERATOR: Rice Operating Company

ADDRESS: 112 W Taylor Hobbs, NM 88240

CONTACT PARTY: Hayden Holub PHONE: (575)393-9174

III. WELL DATA: Complete the data required on the reverse side of this form for each well proposed for injection. Additional sheets may be attached if necessary.

IV. Is this an expansion of an existing project? _____Yes ___X___ No
If yes, give the Division order number authorizing the project: _____

V. Attach a map that identifies all wells and leases within two miles of any proposed injection well with a one-half mile radius circle drawn around each proposed injection well. This circle identifies the well's area of review.

VI. Attach a tabulation of data on all wells of public record within the area of review which penetrate the proposed injection zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of completion, and a schematic of any plugged well illustrating all plugging detail.

VII. Attach data on the proposed operation, including:

1. Proposed average and maximum daily rate and volume of fluids to be injected;
2. Whether the system is open or closed;
3. Proposed average and maximum injection pressure;
4. Sources and an appropriate analysis of injection fluid and compatibility with the receiving formation if other than reinjected produced water; and,
5. If injection is for disposal purposes into a zone not productive of oil or gas at or within one mile of the proposed well, attach a chemical analysis of the disposal zone formation water (may be measured or inferred from existing literature, studies, nearby wells, etc.).

*VIII. Attach appropriate geologic data on the injection zone including appropriate lithologic detail, geologic name, thickness, and depth. Give the geologic name, and depth to bottom of all underground sources of drinking water (aquifers containing waters with total dissolved solids concentrations of 10,000 mg/l or less) overlying the proposed injection zone as well as any such sources known to be immediately underlying the injection interval.

IX. Describe the proposed stimulation program, if any.

*X. Attach appropriate logging and test data on the well. (If well logs have been filed with the Division, they need not be resubmitted).

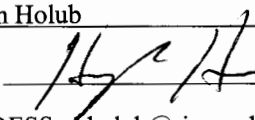
*XI. Attach a chemical analysis of fresh water from two or more fresh water wells (if available and producing) within one mile of any injection or disposal well showing location of wells and dates samples were taken.

XII. Applicants for disposal wells must make an affirmative statement that they have examined available geologic and engineering data and find no evidence of open faults or any other hydrologic connection between the disposal zone and any underground sources of drinking water.

XIII. Applicants must complete the "Proof of Notice" section on the reverse side of this form.

XIV. Certification: I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

NAME: Hayden Holub TITLE: Operations Manager

SIGNATURE:  DATE: 12-20-2018

E-MAIL ADDRESS: hholub@riceswd.com

* If the information required under Sections VI, VIII, X, and XI above has been previously submitted, it need not be resubmitted. Please show the date and circumstances of the earlier submittal: number X. 8-6-1963 Identifying possible production attached

DISTRIBUTION: Original and one copy to Santa Fe with one copy to the appropriate District Office

ALICE PADDOCK #4 (Re-Entry)

I. Disposal

II. Operator: Rice Operating Co. Address: 112 W Taylor, Hobbs, Nm 88240

Contact Party: Hayden Holub Phone: 575-393-9174

III. Attached

IV. No

V. Attached

VI. Attached is the Tabulation of all wells that penetrate the Injection Interval within the AoR.

VII.

1. Average rate expected is 350 bbls/hr (8,400/day) Maximum rate 800 bbls/hr (20K/day)
2. Closed
3. Average pressure 0, maximum pressure 1000 PSI or the max allowed by the OCD.
4. All fluid is oilfield produced water
5. No known disposal zone formation water available within the one mile AoR of the proposed swd well. Attached is analysis of closest known formation water location approx. 1.5 miles West of the SWD well. The Rice Operating SWD well C-2, located approx. 1.2 miles West in UL-C - Sec 2 - 22S - 37E, has been disposing millions of barrels of produced water into the San Andres formation per year since the early 1970s without problems.

VIII. Lithology record attached. Disposal zone is San Andres (Top @4128', next formation top is Glorieta @ 5288'). Ogallala is no deeper that 250'.
No known sources of drinking water underlying the injection zone

IX. Acidize w/5,000 gal HCL 15% NEFE as needed

X. Previously Submitted

XI. Analysis attached for two wells located within 1 mile AoR. The first well (Drinkard Ground H2O) is ½ mile NW in UL N Sec 36 T21S R37E, the second well (Cattle Trough) is located .65 miles SE in UL P Sec 1 T22S R37E.

XII. I, Hayden Holub, have examined all available geologic and engineering data and find no evidence of open faults or any other hydrologic connection between the disposal zones and any underground source of drinking water pertaining to this well. Geologic study attached.

XIII. Attached

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 South First, Artesia, NM 88210
District III
1000 Rio Brazos Rd., Aztec, NM 87410
District IV
2040 South Pacheco, Santa Fe, NM 87505

State of New Mexico
Energy, Minerals & Natural Resources Department

OIL CONSERVATION DIVISION
2040 South Pacheco
Santa Fe. NM 87505

Form C-102
Revised March 17, 1999

Submit to Appropriate District Office
State Lease - 4 Copies
Fee Lease - 3 Copies

☐ AMENDED REPORT

WELL LOCATION AND ACREAGE DEDICATION PLAT

[1] API Number	[2] Pool Code	[3] Pool Name
30-025-09940	86440	Tubb Oil & Gas

[4] Property Code	[5] Property Name	[6] Well Number
2703	Alice Paddock	4

[7] OGRID No.	[8] Operator Name	[9] Elevation
4323	Chevron U.S.A., Inc.	3358'

[10] Surface Location

UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
G	1	22S	37E		1980	North	1980	East	Lea

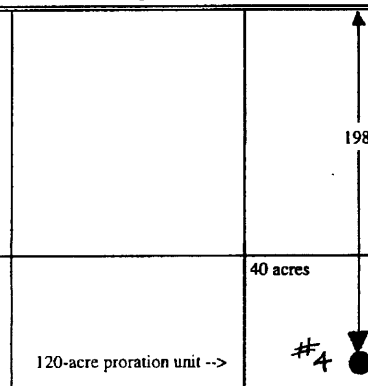
[11] Bottom Hole Location If Different From Surface

UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County

[12] Dedicated Acres	[13] Joint or Infill	[14] Consolidation Code	[15] Order No.
120			

NO ALLOWABLE WILL BE ASSIGNED TO THIS COMPLETION UNTIL ALL INTERESTS HAVE BEEN CONSOLIDATED OR A NON-STANDARD UNIT HAS BEEN APPROVED BY THE DIVISION

16



[17] OPERATOR CERTIFICATION

I hereby certify that the information contained herein is true and complete to the best of my knowledge and belief

A. M. Howell

Signature
A. M. Howell

Printed Name
Sr. Petroleum Engineer

Title
November 6, 2000

[18] SURVEYOR CERTIFICATION

I hereby certify that the well location shown on this plat was plotted from field notes of actual surveys made by me or under my supervision, and that the same is true and correct to the best of my belief.

Signature and Seal of Professional Surveyer:

Certificate Number

INJECTION WELL DATA SHEET

OPERATOR: RICE OPERATING COMPANY

WELL NAME & NUMBER: Alice Paddock #4

WELL LOCATION: 1980' FNL 1980' FEL G 1 22S 37E

FOOTAGE LOCATION UNIT LETTER SECTION TOWNSHIP RANGE

WELLBORE SCHEMATIC

WELL CONSTRUCTION DATA

SURFACE CASING

Hole Size: 17 1/4" Casing Size: 13 3/8" @ 298'

Cemented with: 500 sx. **or** ft3

Top of Cement: Surface Method Determined: Circ

Intermediate Casing

Hole Size: 12 ¼" Casing Size: 9 5/8" @2955'

Cemented with: 1300 sx. **or** ft3

Top of Cement: 1730' Method Determined: t.s.

Production Casing

Hole Size: 8 ¾" Casing Size: 7" @ 5263'

Cemented with: 450 sx. **or** ft3

Top of Cement: 2965' Method Determined: t.s.

Total Depth: 6300'

Injection Interval

4407' feet to 4950' Open Hole

(Perforated or Open Hole; indicate which)

INJECTION WELL DATA SHEET

Tubing Size: 5 ½" Lining Material: IPC

Type of Packer: Baker Model R

Packer Setting Depth: 4400'

Other Type of Tubing/Casing Seal (if applicable): N/A

Additional Data

1. Is this a new well drilled for injection? ____Yes __X__No

   If no, for what purpose was the well originally drilled? Oil Well

2. Name of the Injection Formation: San Andres

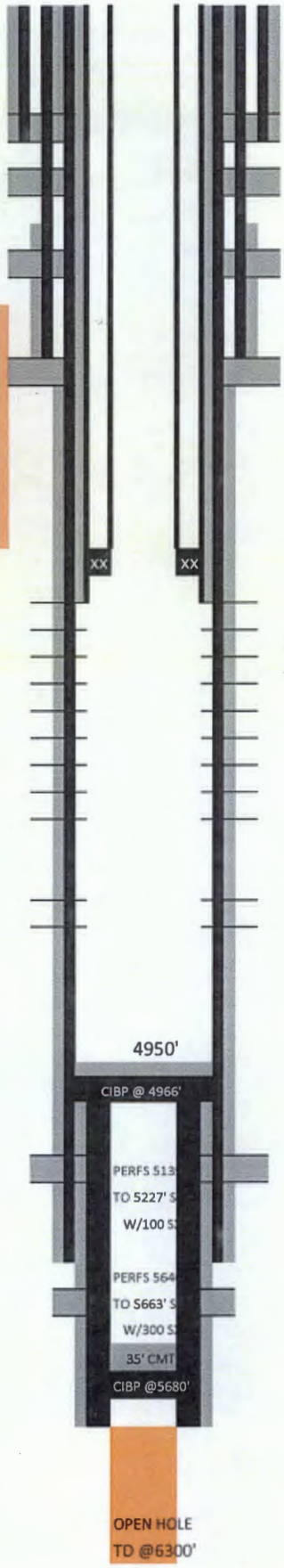
3. Name of Field or Pool (if applicable): Tubb Oil & Gas

4. Has the well ever been perforated in any other zone(s)? List all such perforated (Paddock) intervals and give plugging detail, i.e. sacks of cement or plug(s) used. 5139'-5227' sqz'd w/100 sx 5640'-5663' (Blinebry) Sqz'd w/300 sx Open Hole (Tubb) perf. OH 5700'-6300' CIBP @ 5680' w/ 35' cut on top

5. Give the name and depths of any oil or gas zones underlying or overlying the proposed Injection zone in this area: T. Grayburg 3314'-4127' T S.A. T. Glorieta 5288'-5593'

PROPOSED RE-ENTRY
Chevron
Alice Paddock #4
API # 30-025-09940
Sec 1 T-22-S R-37-E
1980' FNL 1980' FEL
Spud Date 2/1946
PA'd 2/2013

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



17 1/4" HOLE
SURF CSG 13 3/8" 48#@ 298'
500 SX TOC SURF

12 1/4" HOLE
INTMED CSG 9 5/8"36# @ 2955'
1300 SX TOC 1730' BY TS

8 3/4" HOLE
PROD CSG 7" 23# ID Drift Dia= 6.241" @ 5263'
450 SX TOC 2965' BY TS

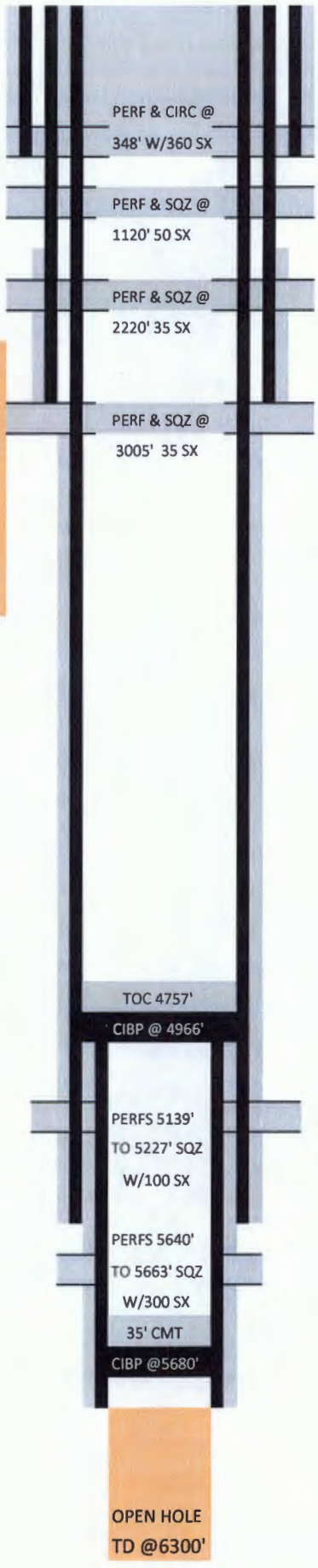
5 1/2" CSG liner inside 7" set @ 4400'
TOC Circ.

2 7/8" injection (IPC) TBG set @ 4398' W/
Baker Model R packer

INJECTION INTERVAL
4407' TO 4950'
4 SPF

6 1/4" HOLE
LINER 4 1/2" FROM 4996' TO 5710'
TOC 4996' BY CIRC.

Chevron
Alice Paddock #4
API # 30-025-09940
Sec 1 T-22-S R-37-E
1980' FNL 1980' FEL
Spud Date 2/1946
PA'd 2/2013



Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

17 1/4" HOLE
SURF CSG 13 3/8" @ 298'
TOC SURF

12 1/4" HOLE
INTMED CSG 9 5/8" @ 2955'
TOC 1730' BY TS

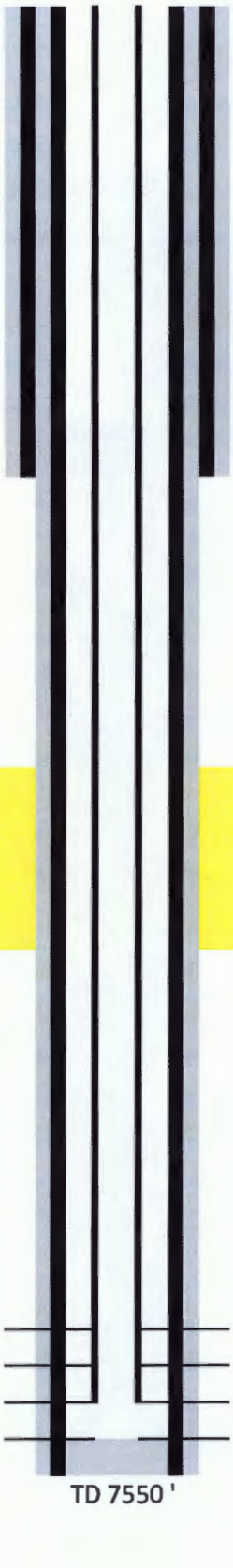
8 3/4" HOLE
PROD CSG 7" @ 5263'
TOC 2965' BY TS

LINER 4 1/2" FROM 4996' TO 5710'
TOC 4996' BY CIRC.

TABULATION OF WELLS
PENETRATING INJECTION INTERVALS

Operator	API Number	Well Name	Well #	Well Status	Well Type	Legal	Spud	PA/TA Date	Depth
Well to be Re-Entered									
Chevron USA Inc	3002509940	Alice Paddock	4	PA	Oil	G-1-22-37	2/1/1946	2/1/2013	6300'
Area of Review (Wells that Penetrate)									
Pierce Production Co	3002522980	L B Jones	3	Active	Oil	E-6-22-38	2/4/1969	NA	7350'
Pierce Production Co	3002538596	L B Jones	1	Active	Oil	L-6-22-38	10/29/2007	NA	7850'
Chevron USA Inc	3002529117	Alice Paddock	10	Active	Oil	I-1-22-37	8/1/1985	NA	7800'
Chevron USA Inc	3002509939	Alice Paddock	2	PA	Oil	J-1-22-37	8/2/1945	11/11/2009	5700'
Chevron USA Inc	3002526286	Alice Paddock	8	Active	Gas	J-1-22-37	4/19/1979	NA	7647'
Southwest Royalties Inc	3002509942	Walter Lynch	1	Active	Oil	K-1-22-37	4/1/1974	NA	7525'
Apache Corp	3002525131	Walter Lynch	6	Active	Oil	F-1-22-37	10/28/1975	NA	7491'
Exxon Corp	3002509946	Paddock Unit	22	PA	Oil	F-1-22-37	10/1/1945	6/25/1979	5235'
Apache Corp	3002537556	Walter Lynch	12	TA	Oil	F-1-22-37	12/29/2005	3/27/2017	4626'
Apache Corp	3002537555	Walter Lynch	11	PA	Oil	E-1-22-37	12/15/2005	6/17/2015	4615'
Apache Corp	3002525644	Walter Lynch	8	Active	Oil	E-1-22-37	9/7/1977	NA	7550'
Apache Corp	3002539550	Walter Lynch	10	Active	Oil	C-1-22-37	4/10/2010	NA	7741'
Marathon Oil Co	3002509950	Walter Lynch	5	PA	Oil	C-1-22-37	4/8/1947	9/23/2008	7574'
Apache Corp	3002540014	Walter Lynch	14	Active	Oil	C-1-22-37	2/9/2011	NA	6864'
Chevron USA Inc	3002509941	Alice Paddock	5	PA	Oil	B-1-22-37	6/4/1957	1/9/2001	6710'
Chevron USA Inc	3002525045	Alice Paddock	7	Active	Oil	B-1-22-37	6/10/1975	NA	7801'
Possibly Out of Area of Review									
Exxon Corp	3002509947	Paddock Unit	21	PA	Oil	E-1-22-37	12/1/1945	6/25/1979	5207'
Chevron USA Inc	3002509938	Alice Paddock	1	PA	Gas	O-1-22-37	8/27/1962	1/6/2004	5843'
Chevron USA Inc	3002524815	Alice Paddock	6	PA	Oil	O-1-22-37	7/31/1974	9/3/2013	7504'

Apache Corp
Walter Lynch # 8
API 30-25-25644
S1 T22S R37E
1880' FNL 760' FWL
Spud 9/1977
ACTIVE OIL WELL



12 1/4" HOLE
SURF CSG 9 5/8" @ 1246'
CMT W/ 600 SX
TOC CIRC.

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

INJECTION INTERVAL
4407' TO 4950'

TBG 2 3/8" @ 7451'

PERFS 5455' TO 7518'

8 3/4" HOLE
PROD CSG 7" @ 7549'
CMT W/2300 SX
TOC CIRC.

TD 7550 '

Apache Corp
Walter Lynch # 14
API 30-25-40014
S1 T22S R37E
330' FNL 1650' FWL
Spud 2/2011
ACTIVE OIL WELL

12 1/4" HOLE
SURF CSG 8 5/8" @ 1289'
CMT W/ 665 SX
TOC CIRC.

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

INJECTION INTERVAL
4407' TO 4950'

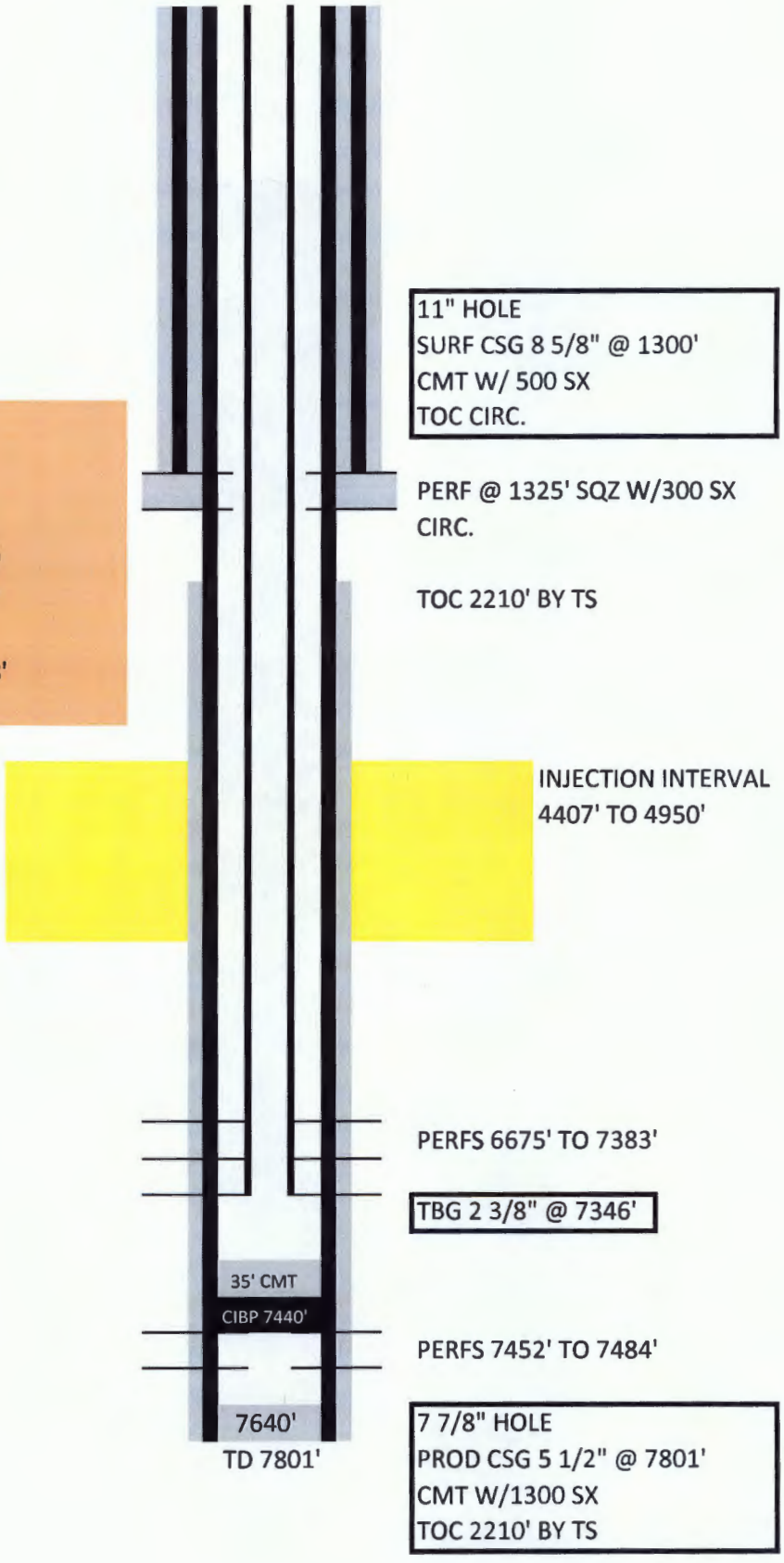
PERFS 5497' TO 6274'

TBG 2 7/8" @ 6393'

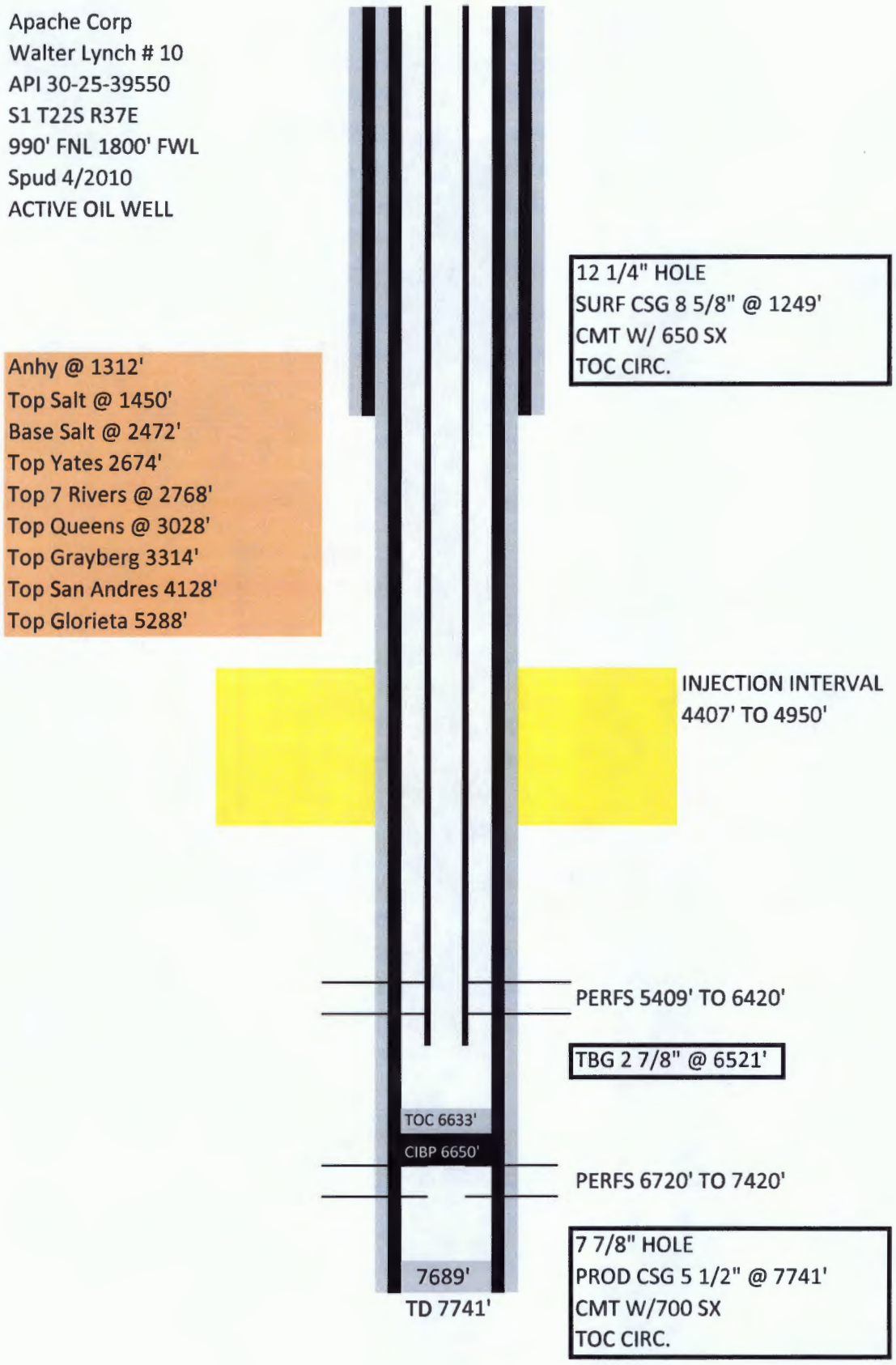
6816'
TD 6864'

7 7/8" HOLE
PROD CSG 5 1/2" @ 6864'
CMT W/1370 SX
TOC CIRC.

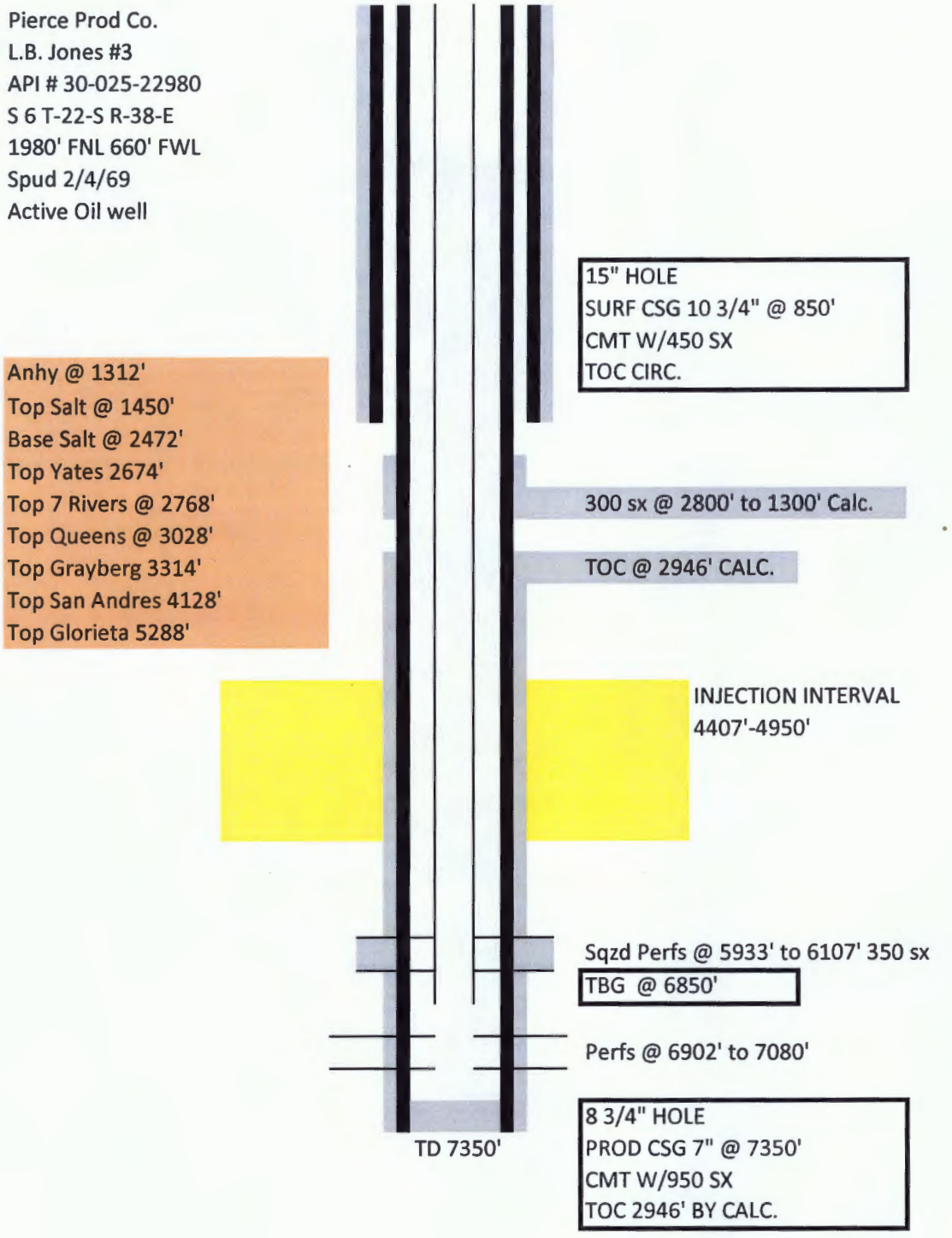
Chevron USA
Alice Paddock #7
API 30-25-25045
S1 T22S R37E
750' FNL 2310' FEL
Spud 6/1975
ACTIVE OIL WELL



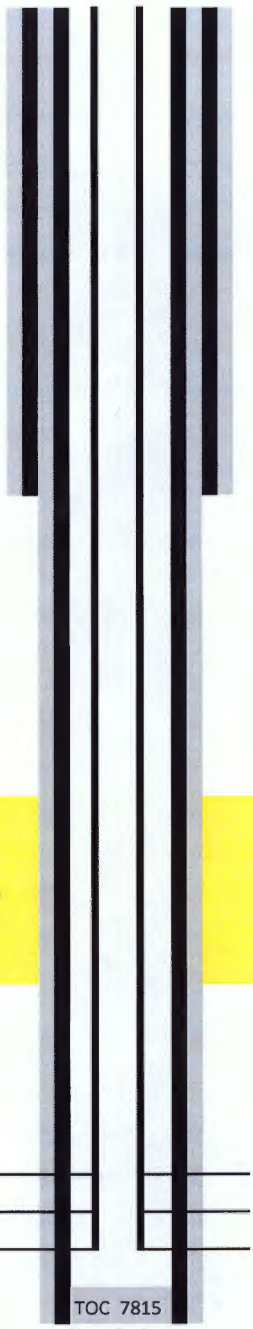
Apache Corp
Walter Lynch # 10
API 30-25-39550
S1 T22S R37E
990' FNL 1800' FWL
Spud 4/2010
ACTIVE OIL WELL



Pierce Prod Co.
L.B. Jones #3
API # 30-025-22980
S 6 T-22-S R-38-E
1980' FNL 660' FWL
Spud 2/4/69
Active Oil well



Pierce Prod Co.
L.B. Jones #1
API # 30-025-38596
S 6 T-22-S R-38-E
1980' FSL 330' FWL
Spud 10/29/07
Active Oil well



12 1/4" hole
9 5/8" @ 1342'
CMT W/485 SX
TOC CIRC.

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

INJECTIN INTERVAL
4407' TO 4950'

TBG 2 7/8" @ 7263'

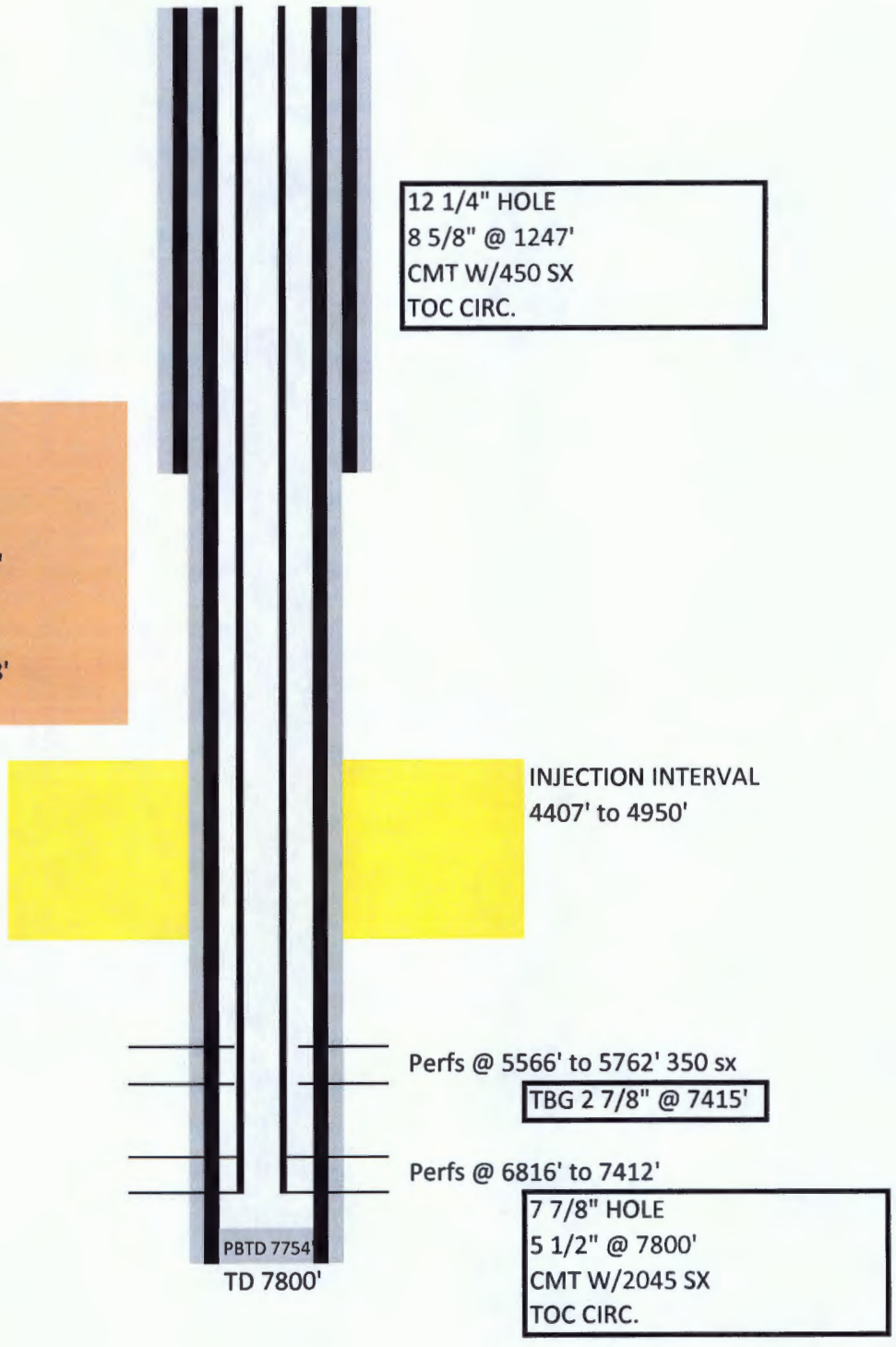
Perfs @ 6874' to 7150'

TOC 7815

TD 7850'

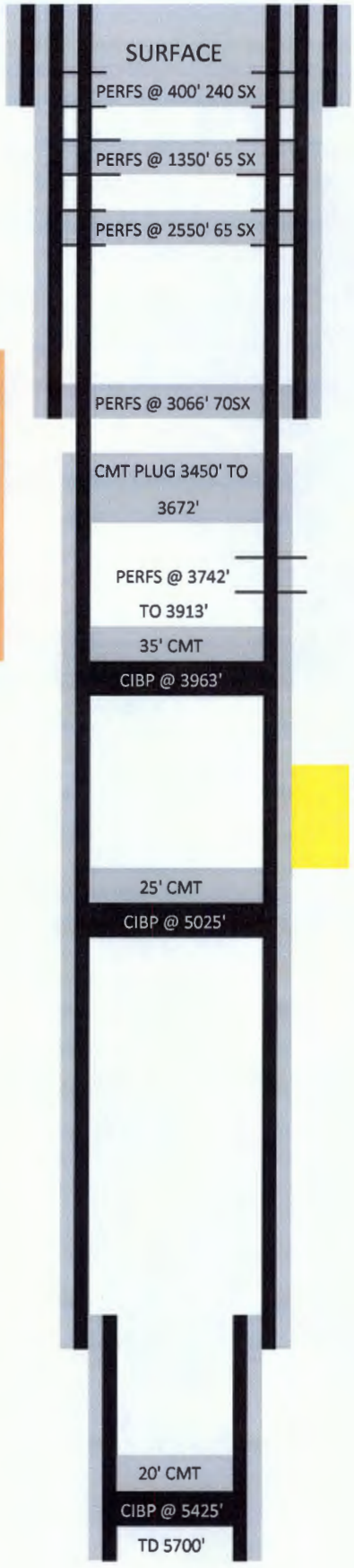
8 3/4" HOLE
5 1/2" @ 7850'
CMT W/2595 SX
TOC CIRC.

CHEVRON USA
Alice Paddock #10
API # 30-025-29117
S1 T-22-S R-37-E
1980' FSL 660' FEL
Spud 8/85
Active Oil well



Chevron
Alice Paddock #2
API # 30-025-09939
Sec 1 T-22-S R-37-E
1980" FSL 1980' FEL
Spud Date 8/1945
PA'd 11/2009

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



Inj Interval 4407' TO 4950"

17" HOLE
Surf Csg 13 3/8"
Set @ 312' w/300 sx
TOC by Circ.

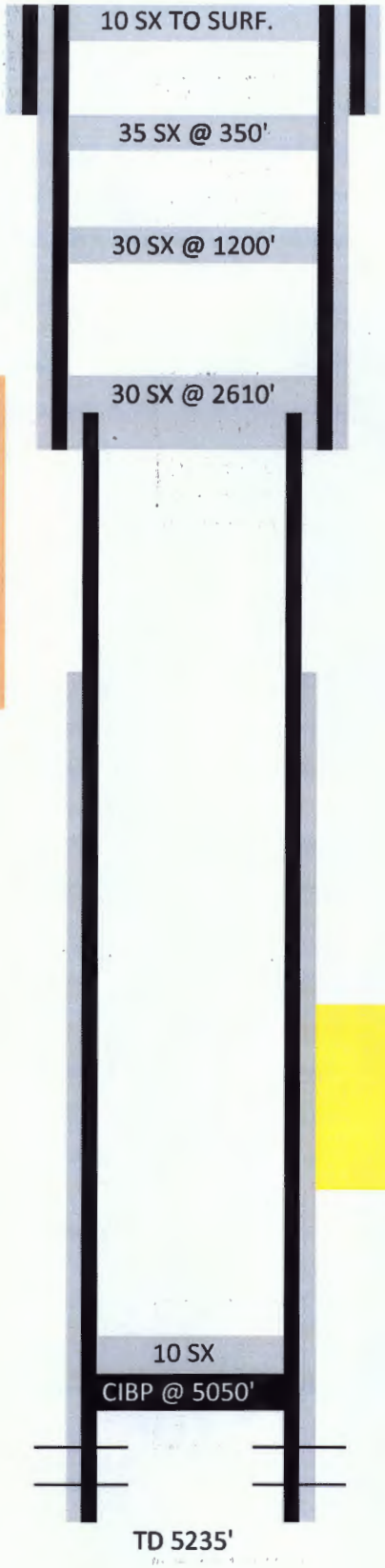
12 1/4" HOLE
Intermed. Csg 9 5/8"
Set @ 2966'
TOC by Circ.

8 3/4 HOLE
Prod Csg 7"
Set @ 5157' w 400 sx
TOC 3415' by TS

Liner 4 1/2"
From 5040' to 5700'
CMT W/75 SX
TOC TOP OF LINER

Exxon Corp.
Paddock unit #22
API # 30-025-09946
Sec 1 T-22-S R-37-E
1980" FNL 1980' FWL
Spud Date 10/1945
PA'd 6/79

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



17 1/2" HOLE
SURF CSG 13 3/8" @ 303'
CMT W/300 SX
TOC CIRC.

11" HOLE
INTERMED CSG 8 5/8" @ 2848'
CMT W/2500 SX
TOC CIRC.

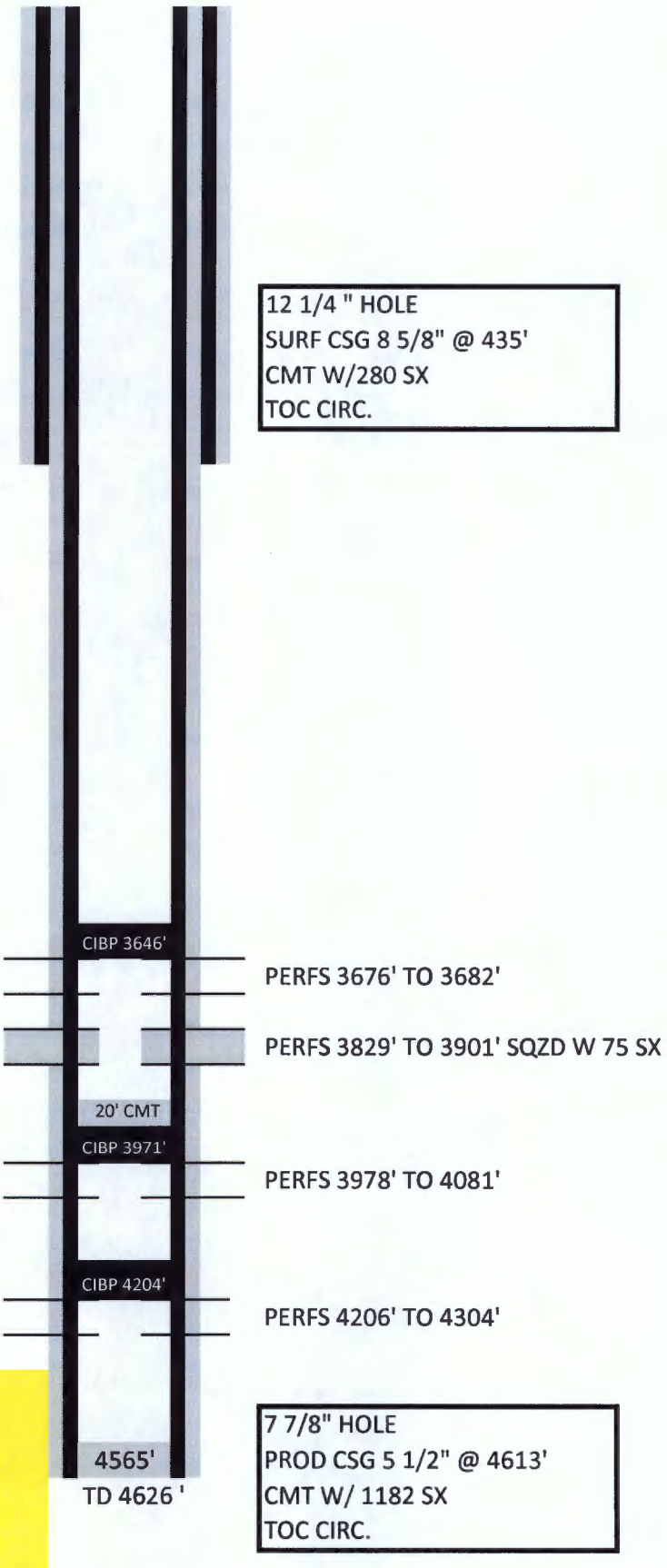
5 1/2" CUT & PULLED @ 2570'

INJECTION INTERVAL
4407' TO 4950"

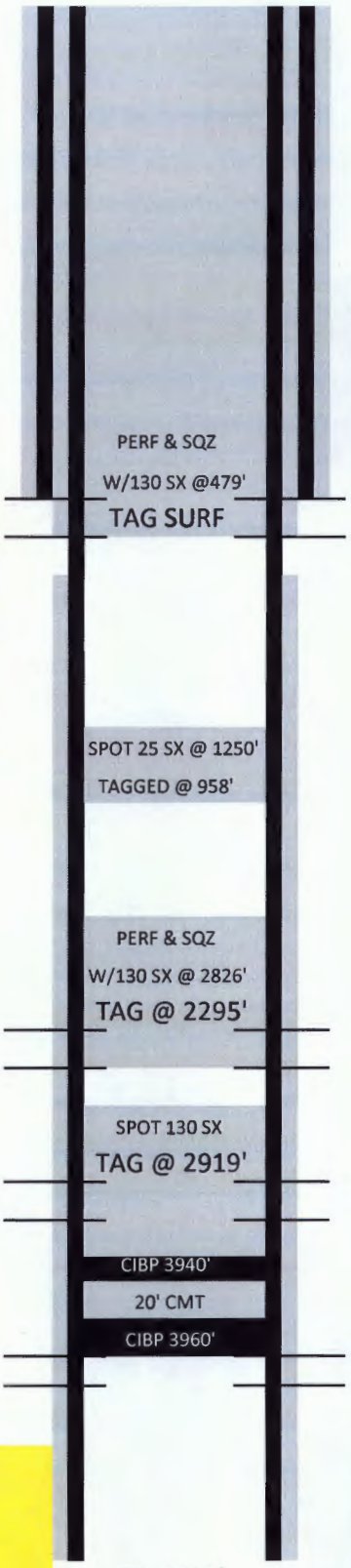
7 7/8" HOLE
PROD CSG 5 1/2" @ 5235'
CMT W/300 SX
TOC 3937' by CALC.

PERFS 5178' TO 5210'

Apache Corp
Walter Lynch # 12
API 30-25-37556
S1 T22S R37E
1830' FNL 1980' FWL
Spud 12/2005
TA'd



Apache Corp
Walter Lynch # 11
API 30-25-37555
S1 T22S R37E
1980' FNL 810' FWL
Spud 12/2005
PA'd 6/2015



12 1/4 " HOLE
SURF CSG 8 5/8" @ 429'
CMT W/280 SX
TOC CIRC.

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

PERFS 3810' TO 3880'

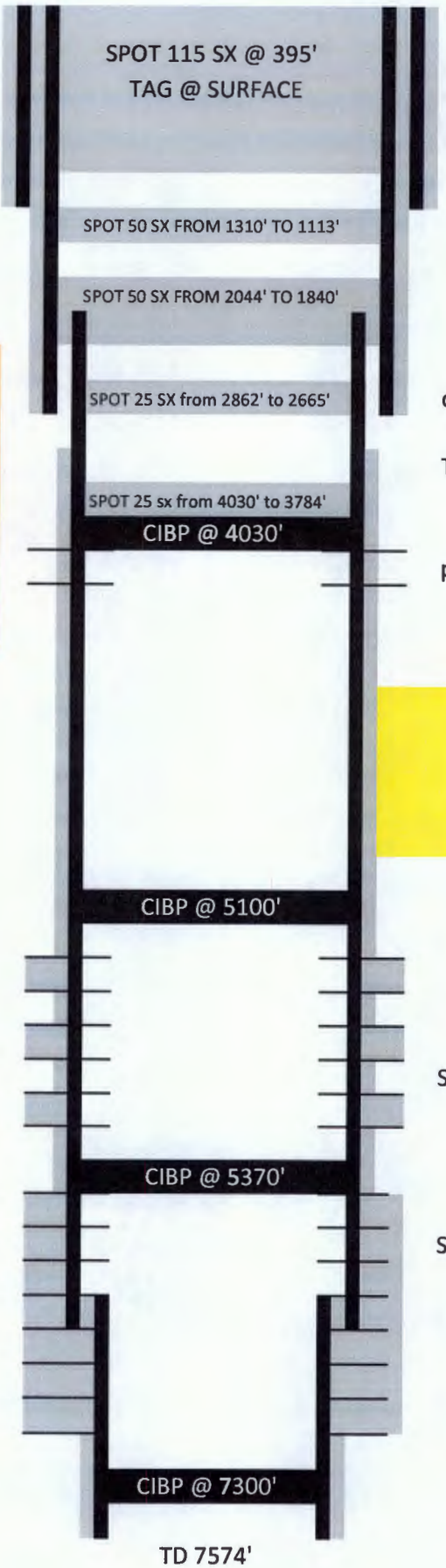
PERFS 3970' TO 4048'

INJECTION INTERVAL
4407' TO 4950'

7 7/8" HOLE
PROD CSG 5 1/2" @ 4603'
CMT W/ 1200 SX
TOC CIRC. (fell to 600')

Marathon Oil Co.
Walter Lynch #5
API # 30-025-09950
Sec 1 T-22-S R-37-E
2310' FNL 1980' FWL
Spud Date 4/8/47
PA'd 5/07

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



17" HOLE
13 3/8" @ 300'
CMT W/250 SX
TOC CIRC

11 " HOLE
8 5/8" @ 2800'
CMT W/1500 SX
TOC CIRC

cut and pull 5 1/2" from 1995'

TOC 2680' BY TS

perfs @ 4050 to 4257'

INJ INT 4407'to 4950'

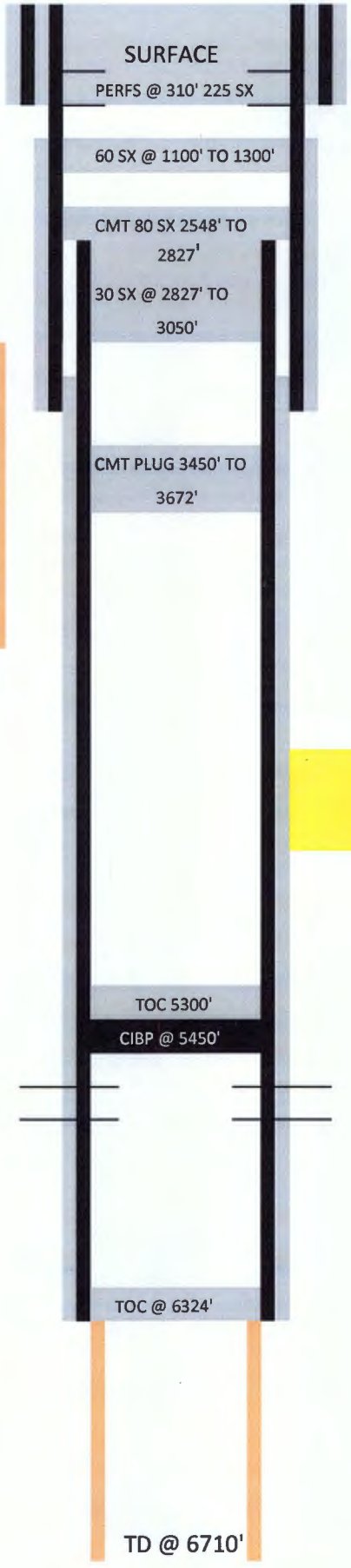
Sqzd Perfs @ 5173' to 5234

Sqzd Perfs @ 5434' to 6575'

6 3/4" HOLE
5 1/2" @ 6440'
CMT W/500 SX
TOC 2680' BY TS

4" liner @ 6315' to 7571'
CMT W/56 SX CIRC

Chevron USA
Alice Paddock #5
API # 30-025-09941
Sec 1 T-22-S R-37-E
990' FNL 2310' FEL
Spud Date 6/1957
PA'd 1/2004



17 1/4" HOLE
SURF CSG 13 3/8" @ 257'
CMT W/375 SX
TOC CIRC.

5 1/2 " CUT & PULLED @ 2763'

11 " HOLE
Intermed. Csg 9 5/8" @ 2966'
CMT W/1100 sx
TOC 595'by TS

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

INJECTION INTERVAL
4407' TO 4950'

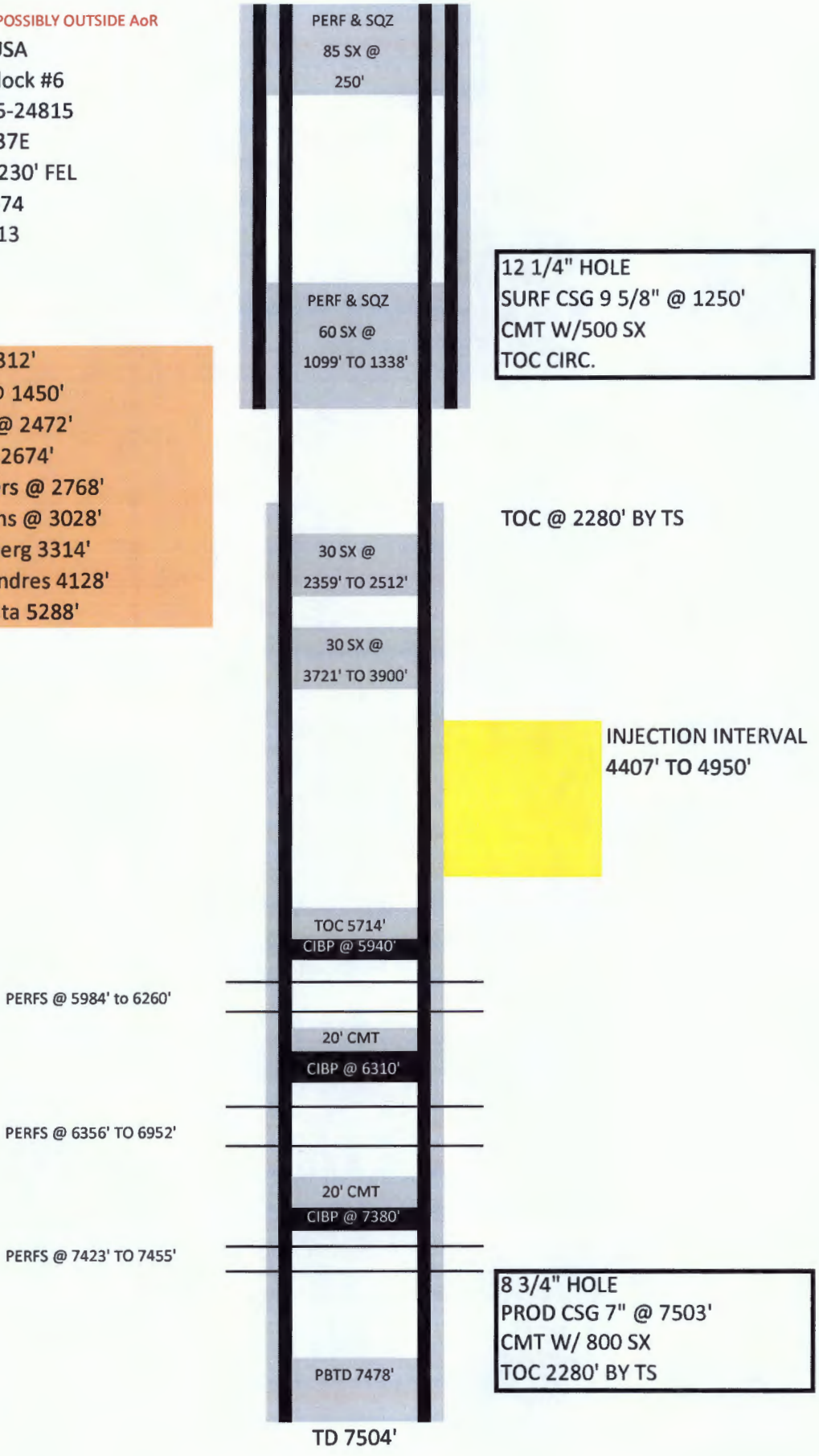
PERFS 5517' TO 6249'

7 7/8" HOLE
Prod Csg 5 1/2" @ 6350'"
CMT W/775 SX
TOC 2935' by TS

THIS WELL IS POSSIBLY OUTSIDE AoR

Chevron USA
Alice Paddock #6
API 30-025-24815
S1 T22S R37E
660' FSL 2230' FEL
Spud 7/1974
PA'd 9/2013

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



12 1/4" HOLE
SURF CSG 9 5/8" @ 1250'
CMT W/500 SX
TOC CIRC.

TOC @ 2280' BY TS

INJECTION INTERVAL
4407' TO 4950'

8 3/4" HOLE
PROD CSG 7" @ 7503'
CMT W/ 800 SX
TOC 2280' BY TS

THIS WELL POSSIBLY OUTSIDE AoR

Chevron USA
Alice Paddock #1
API # 30-025-09938
Sec 1 T-22-S R-37-E
660" FSL 1980' FEL
Spud Date 8/1962
PA'd 1/2004

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

17 1/2" HOLE
SURF CSG 13 3/8" @ 313'
CMT W/300 SX
TOC CIRC.

11" HOLE
INTERMED CSG 8 5/8" @ 2883'
CMT W/975 SX
TOC CIRC.

5 1/2" CUT & PULLED @ 2300'

INJECTION INTERVAL
4407' TO 4950"

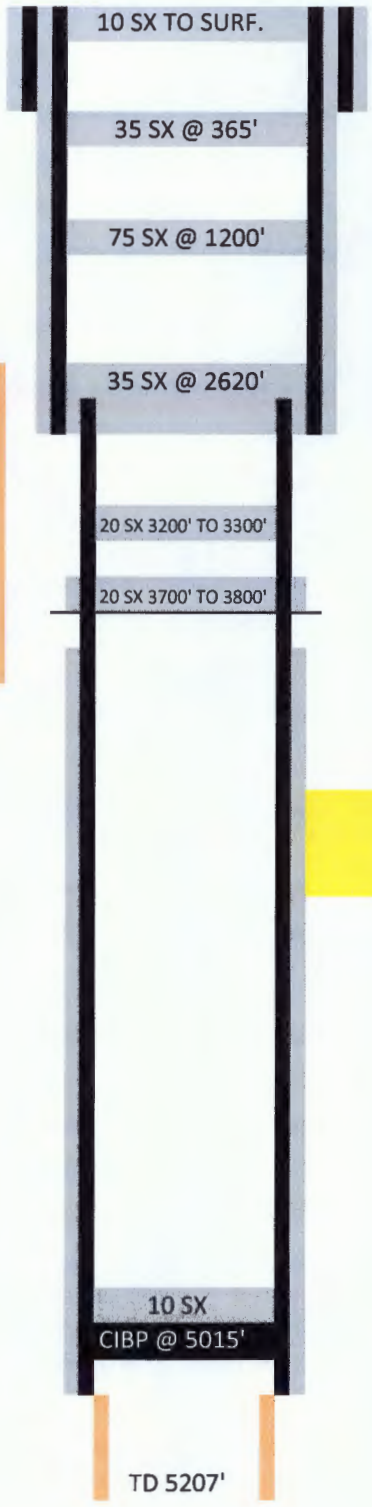
PERFS 5461' TO 5541' SQZD 150 SX

7 7/8" HOLE
PROD CSG 5 1/2" @ 5795'
CMT W/600 SX
TOC 2330' by TS

THIS WELL POSSIBLY OUTSIDE AoR

Exxon Corp.
Paddock unit #21
API # 30-025-09947
Sec 1 T-22-S R-37-E
1980'' FNL 660' FWL
Spud Date 12/1945
PA'd 6/79

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



17 1/2" HOLE
SURF CSG 13 3/8" @ 313'
CMT W/300 SX
TOC CIRC.

11" HOLE
INTERMED CSG 8 5/8" @ 2850'
CMT W/2500 SX
TOC CIRC.

5 1/2" CUT & PULLED @ 2570'
(FREE @ 2577' Possible TOC)

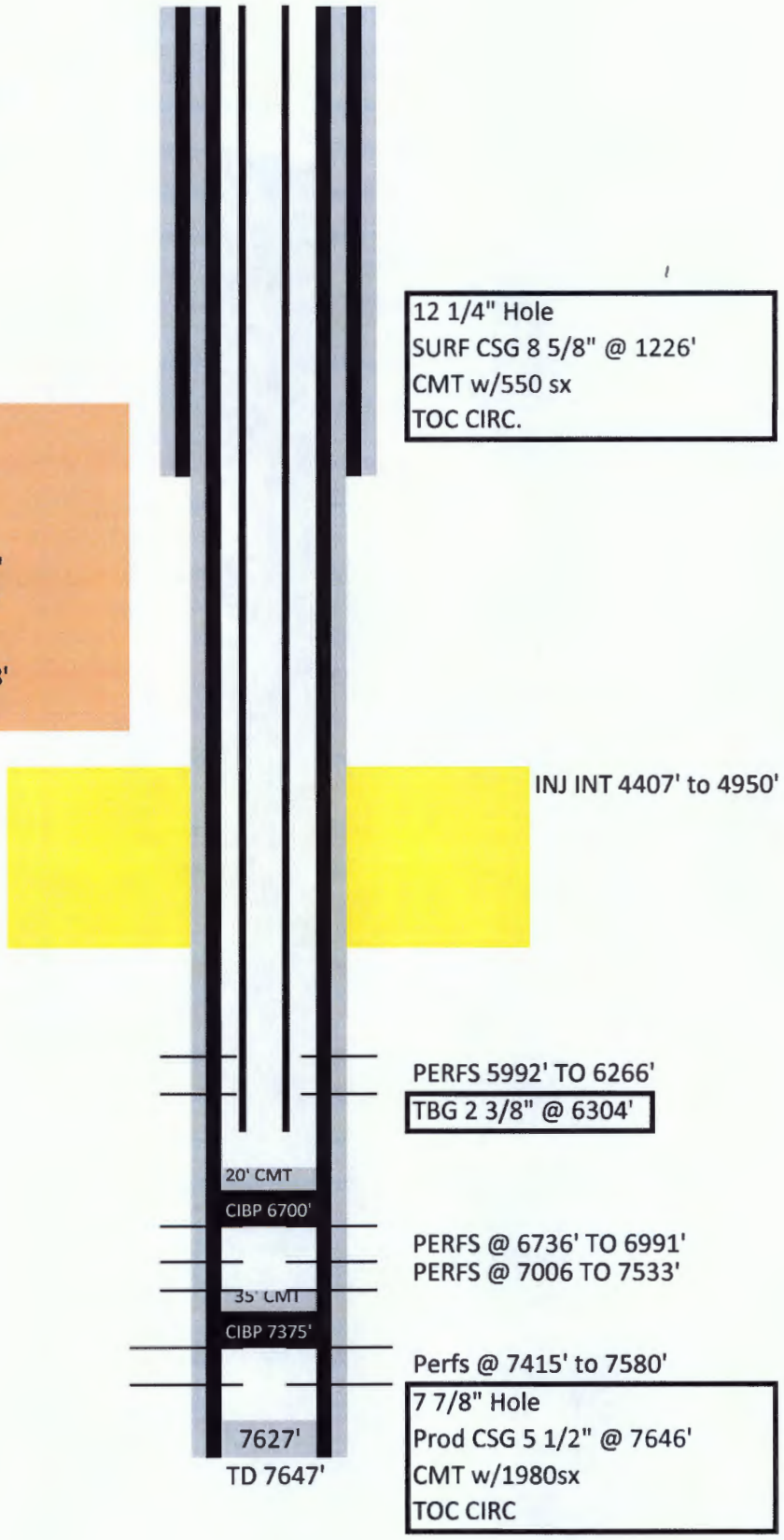
5 1/2" CUT @ 3810' (couldn't pull)
TOC @ 3980' CALC. (reported)

INJECTION INTERVAL
4407' TO 4950''

PROD CSG 5 1/2" @ 5133'
CMT W/300 SX
TOC 3980' by CALC.
(TOC indicated by stuck pipe to 2577')

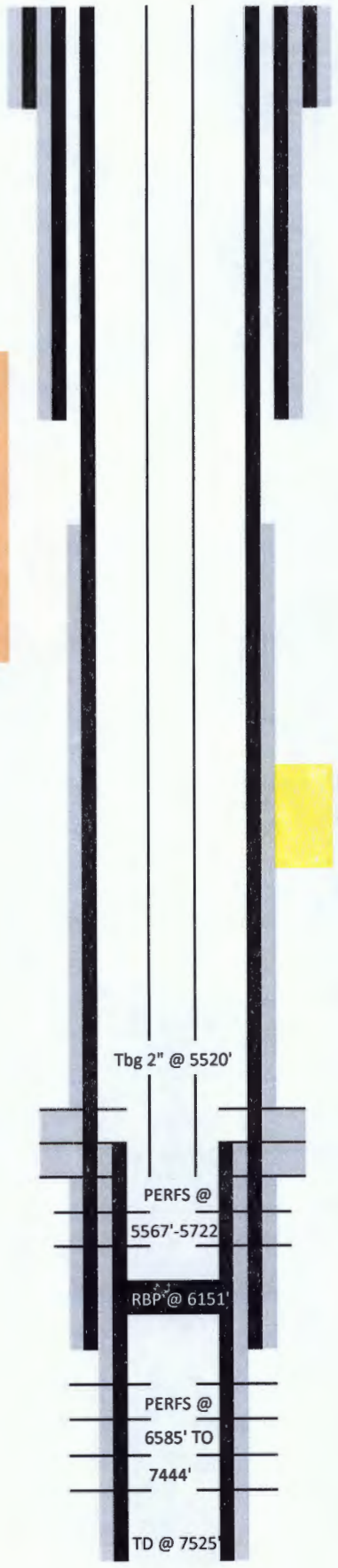
BLK. A-39
BLI
32°25'
PADDOCK (SAN ANGELO) UNIT
J.H. HENDRIX (OPER.)
DRINKARD
T.E. Dunaway
Flag Dev
Deerwood Expl
Imp Amer Walker
Lula Jones etal
Featherstone
Paul Wallach
U.S., MI
P Wallach (S)
Elliott Oil
Chevron H.B.P. B-4467
Apache
JTD Res.
Opal Res.
Johnny Cope, et al
C.B.Snow HBP 029029
Lea Co Solid Waste (S)
U.S. M.I.
L.V. Sims, etal (S)
Alice Paddock
Chevron
Pierce Prod
Imp Amer Jones
L.B. Jones
Chesapeake
"Paddock"
Ruby Rodgers
G.W. Sims
Doyle Hartman etal
Penrose Zachary HBP 029029
Geo. W. Sims, S, etal
OXY
U.S. MI Waste Control Spec (S)
R.G. Barton
Exxon
Avenger Ene.
Endura Ener.
Yates Drlg. etal
Davison Hldgs.
Davison Holdings
Oxy USA
Chevron U.S.A
Solar Oil Lambert TD 7400
Cities Serv MI
State

Chevron USA
Alice Paddock #8
API # 30-025-26286
S1 T-22-S R-37-E
1980' FSL 2250' FEL
Spud 4/79
Active gas well



SW Royalties
Walter Lynch #1
API # 30-025-09942
Sec 1 T-22-S R-37-E
1980" FSL 1980' FWL
Spud Date 4/1974
Active Oil well

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'



17 " HOLE
SURF CSG 13 3/8" @ 326'
CMT W/350 sx
TOC CIRC

12 " HOLE
INTERMED CSG 9 5/8" @ 2848'
CMT W/2500 sx
TOC CIRC

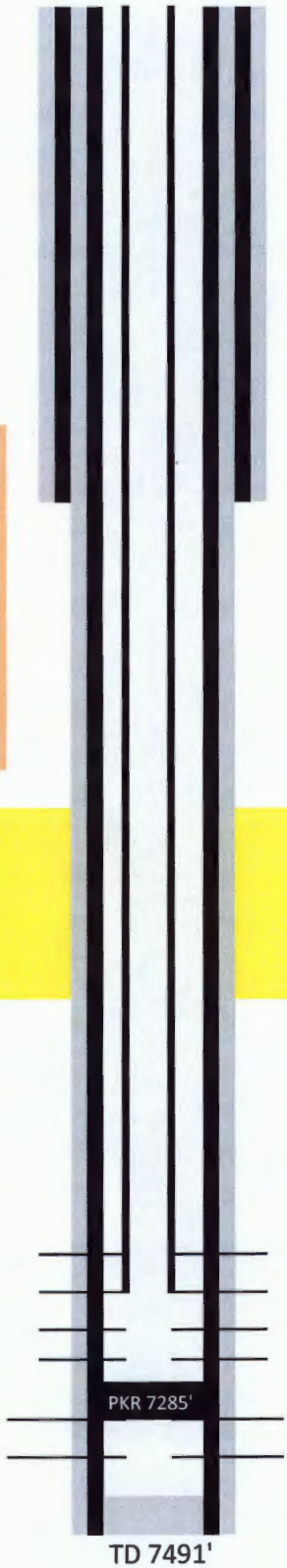
INJECTION INTERVAL
4407' TO 4950'

Sqzd PERFS @ 5070' TO 5215'

8 1/2" HOLE
PROD CSG 7" @ 5254'
CMT W/350 sx
TOC 3700' by T.S.

5" liner @ 5122' to 7523'
CMT W/200 sx
TOC CIRC

Apache Corp
Walter Lynch #6
API # 30-025-25131
S1 T-22-S R-37-E
2310" FNL 1980' FWL
Spud 10/75
Active Oil well



12 1/4" Hole
SURF CSG 9 5/8" @ 1250'
CMT w/650 sx
TOC CIRC.

Anhy @ 1312'
Top Salt @ 1450'
Base Salt @ 2472'
Top Yates 2674'
Top 7 Rivers @ 2768'
Top Queens @ 3028'
Top Grayberg 3314'
Top San Andres 4128'
Top Glorieta 5288'

INJ INT 4407' to 4950'

TBG 2 3/8" @ 6547'

PERFS @ 5476' TO 6458'
PERFS @ 6670' TO 7266'

PKR 7285'

PERFS @ 7404' TO 7455'

TD 7491'

8 3/4" Hole
PROD CSG 7" @ 7490'
CMT w/3450 sx
TOC CIRC

FORMATION WATER EXPECTED FOR DISPOSAL INTO ALICE PADDOCK #4

BONE SPRING

DELAWARE

MORROW

SEVEN RIVERS

UPPER WOLFCAMP

YESO-ABO


fresh water well cattle trough
ALICE PADDOCK #4
fresh water well
© 2018 Google
Google Earth

DownHole SAT™ Water Analysis Report

French Creek Software

SYSTEM IDENTIFICATION

Rice Operating
State "S" Flowline

Sample ID#: 0
ID:

Sample Date: 11-09-2018 at 2043
Report Date: 11-14-2018

WATER CHEMISTRY

CATIONS

Calcium(as Ca)	534.00
Magnesium(as Mg)	242.00
Barium(as Ba)	0.400
Strontium(as Sr)	22.00
Sodium(as Na)	4013
Potassium(as K)	139.00
Iron(as Fe)	23.00
Manganese(as Mn)	0.100

ANIONS

Chloride(as Cl)	6799
Sulfate(as SO_4)	118.00
Dissolved CO_2(as CO_2)	250.00
Bicarbonate(as HCO_3)	1805
H_2S (as H_2S)	274.00

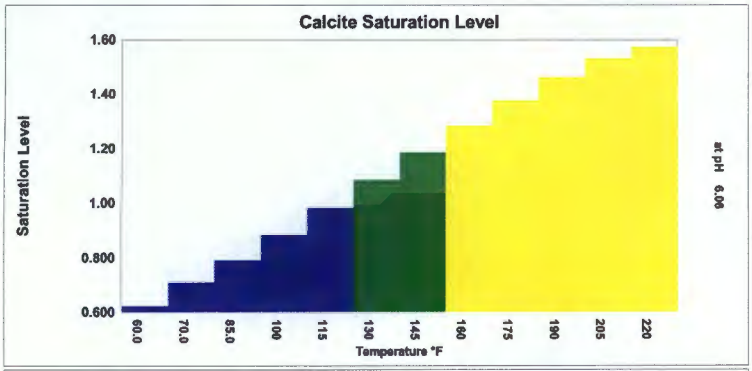
PARAMETERS

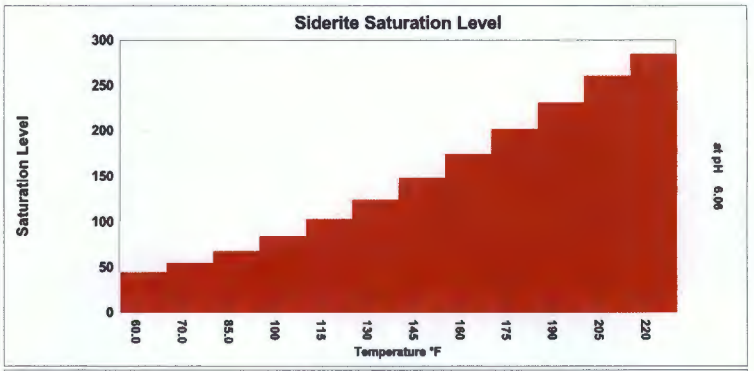
Temperature(°F)	77.00
Sample pH	6.00
Conductivity	18390
T.D.S.	14993
Resistivity	54.38
Sp.Gr.(g/mL)	1.01

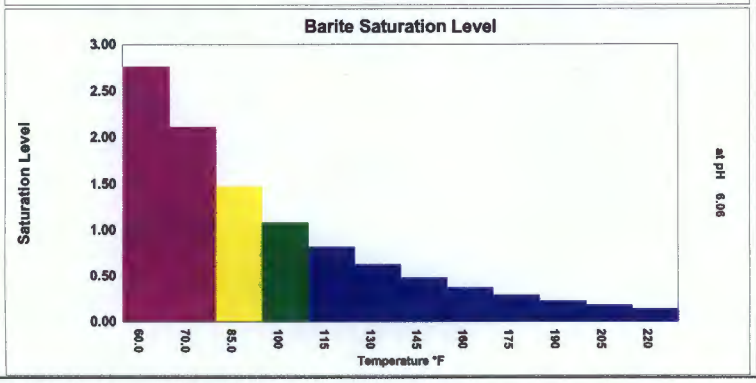
SCALE AND CORROSION POTENTIAL

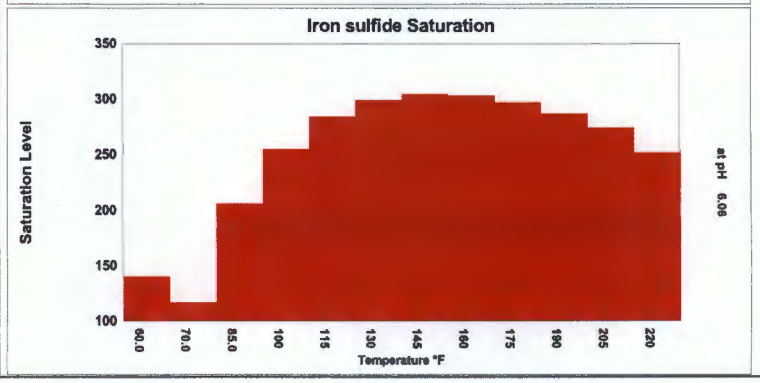
Temp. (°F)	Press. (bars)	Calcite $CaCO_3$		Anhydrite $CaSO_4$		Gypsum $CaSO_4*2H_2O$		Barite $BaSO_4$		Celestite $SrSO_4$		Siderite $FeCO_3$		Mackawenite FeS		CO_2 (mpy)	pCO_2 (atm)
60.00	>-0.001	0.623	-0.0599	0.0201	-821.43	0.0350	-639.48	2.76	0.151	0.0747	-75.96	44.11	0.112	140.30	3.86	0.180	0.561
70.00	-0.013	0.710	-0.0427	0.0197	-820.22	0.0332	-653.80	2.11	0.124	0.0725	-77.02	54.44	0.119	116.66	3.82	0.435	0.553
85.00	1.387	0.791	-0.0276	0.0199	-796.98	0.0310	-669.15	1.47	0.0754	0.0714	-76.83	67.77	0.119	206.20	3.79	1.04	1.33
100.00	2.787	0.883	-0.0140	0.0210	-751.36	0.0296	-676.50	1.07	0.0162	0.0721	-75.31	83.84	0.120	255.17	3.74	1.79	2.10
115.00	4.187	0.982	-0.00197	0.0232	-689.15	0.0316	-632.80	0.812	-0.0548	0.0733	-73.42	102.69	0.122	284.29	3.68	2.21	2.88
130.00	5.587	1.08	0.00826	0.0265	-616.25	0.0344	-582.89	0.619	-0.145	0.0741	-71.90	124.12	0.124	299.10	3.62	2.35	3.65
145.00	6.987	1.18	0.0170	0.0313	-537.83	0.0371	-540.14	0.476	-0.259	0.0744	-70.74	148.02	0.125	304.53	3.55	2.42	4.43
160.00	8.387	1.28	0.0242	0.0381	-458.34	0.0397	-503.49	0.368	-0.403	0.0742	-69.89	174.00	0.127	303.15	3.49	2.56	5.20
175.00	9.787	1.38	0.0302	0.0474	-381.32	0.0421	-472.09	0.287	-0.581	0.0737	-69.33	201.72	0.128	296.96	3.41	2.64	5.98
190.00	11.187	1.46	0.0350	0.0604	-309.44	0.0442	-445.31	0.225	-0.803	0.0727	-69.05	230.52	0.128	286.93	3.33	1.09	6.75
205.00	12.587	1.53	0.0388	0.0786	-244.51	0.0462	-422.52	0.177	-1.08	0.0715	-69.03	259.97	0.129	274.20	3.25	0.886	7.53
220.00	13.987	1.57	0.0410	0.103	-191.21	0.0473	-410.07	0.138	-1.43	0.0689	-70.23	285.08	0.130	251.96	3.14	1.15	8.30
		xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels		

Saturation Levels (xSAT) are the ratio of ion activity to solubility, e.g. $\{Ca\}\{CO_3\}/K_{sp}$. pCO_2 (atm) is the partial pressure of CO_2 in the gas phase.
Lbs/1000 Barrels scale is the quantity of precipitation (or dissolution) required to instantaneously bring the water to equilibrium.









DownHole SAT(tm)

SURFACE WATER CHEMISTRY INPUT

Rice Operating — State "S" Flowline

Report Date: 11-14-2018 — Sampled: 11-09-2018 at 2043
Sample ID:

CATIONS		ANIONS	
Calcium (as Ca)	534.00	Chloride (as Cl)	6799
Magnesium (as Mg)	242.00	Sulfate (as SO_4)	118.00
Barium (as Ba)	0.400	Dissolved CO_2 (as CO_2)	250.00
Strontium (as Sr)	22.00	Bicarbonate (as HCO_3)	1805
Sodium (as Na)	4013	H_2S (as H_2S)	274.00
Potassium (as K)	139.00		
Iron (as Fe)	23.00		
Manganese (as Mn)	0.100		

PARAMETERS

Calculated T.D.S.	14993
Molar Conductivity	18390
Resistivity	54.38
Sp.Gr.(g/mL)	1.01
Pressure(bars)	1.00
Temperature (^oF)	77.00
pH	6.00

CORROSION RATE PREDICTION

CO_2 - H_2S Rate(mpy)	0.527

FRENCH CREEK SOFTWARE, INC.
1220 VALLEY FORGE ROAD, SUITE 21, VALLEY FORGE, PA 19460

DownHole SAT(tm)

SURFACE WATER
DEPOSITION POTENTIAL INDICATORS

Rice Operating — State "S" Flowline

Report Date: 11-14-2018 — Sampled: 11-09-2018 at 2043
Sample ID:

SATURATION LEVEL		MOMENTARY EXCESS (Lbs/1000 Barrels)	
Calcite ($CaCO_3$)	0.769	Calcite ($CaCO_3$)	-0.0323
Aragonite ($CaCO_3$)	0.711	Aragonite ($CaCO_3$)	-0.0436
Witherite ($BaCO_3$)	< 0.001	Witherite ($BaCO_3$)	-12.43
Strontianite ($SrCO_3$)	0.120	Strontianite ($SrCO_3$)	-1.06
Calcium oxalate (CaC_2O_4)	0.00	Calcium oxalate (CaC_2O_4)	-0.0711
Magnesite ($MgCO_3$)	0.282	Magnesite ($MgCO_3$)	-0.230
Anhydrite ($CaSO_4$)	0.0196	Anhydrite ($CaSO_4$)	-811.78
Gypsum ($CaSO_4*2H_2O$)	0.0321	Gypsum ($CaSO_4*2H_2O$)	-661.26
Barite ($BaSO_4$)	1.77	Barite ($BaSO_4$)	0.103
Celestite ($SrSO_4$)	0.0718	Celestite ($SrSO_4$)	-77.08
Fluorite (CaF_2)	0.00	Fluorite (CaF_2)	-9.53
Calcium phosphate	0.00	Calcium phosphate	>-0.001
Hydroxyapatite	0.00	Hydroxyapatite	-272.80
Silica (SiO_2)	0.00	Silica (SiO_2)	-41.12
Brucite ($Mg(OH)_2$)	< 0.001	Brucite ($Mg(OH)_2$)	< 0.001
Magnesium silicate	0.00	Magnesium silicate	-94.22
Iron hydroxide ($Fe(OH)_3$)	< 0.001	Iron hydroxide ($Fe(OH)_3$)	< 0.001
Strengite ($FePO_4*2H_2O$)	0.00	Strengite ($FePO_4*2H_2O$)	>-0.001
Siderite ($FeCO_3$)	62.12	Siderite ($FeCO_3$)	0.122
Halite (NaCl)	< 0.001	Halite (NaCl)	-170977
Thenardite ($Na2SO_4$)	< 0.001	Thenardite ($Na2SO_4$)	-52670
Iron sulfide (FeS)	105.59	Iron sulfide (FeS)	3.79

SIMPLE INDICES		BOUND IONS	TOTAL	FREE
Langelier	-0.0116	Calcium	534.00	479.33
Ryznar	6.02	Barium	0.400	0.400
Puckorius	2.85	Carbonate	0.864	0.185
Larson-Skold Index	6.63	Phosphate	0.00	0.00
Stiff Davis Index	-0.206	Sulfate	118.00	82.41
Oddo-Tomson	-0.363			

OPERATING CONDITIONS

Temperature (^oF)	77.00
Time(mins)	3.00

FRENCH CREEK SOFTWARE, INC.
1220 VALLEY FORGE ROAD, SUITE 21, VALLEY FORGE, PA 19460

API # 38596 .5 m. SE of Alice Paddock #4 proposed re-entry

INSTRUCTIONS

This form is to be filed with the appropriate District Office of the Division not later than 20 days after the completion of any newly-drilled or deepened well. It shall be accompanied by one copy of all electrical and radio-activity logs run on the well and a summary of all special tests conducted, including drill stem tests. All depths reported shall be measured depths. In the case of directionally drilled wells, true vertical depths shall also be reported. For multiple completions, items 25 through 29 shall be reported for each zone. The form is to be filed in quintuplicate except on state land, where six copies are required. See Rule 1105.

INDICATE FORMATION TOPS IN CONFORMANCE WITH GEOGRAPHICAL SECTION OF STATE

Southeastern New Mexico			Northwestern New Mexico	
T. Anhy	1312'	T. Canyon	T. Ojo Alamo	T. Penn "B"
T. Salt	1450'	T. Strawn	T. Kirtland-Fruitland	T. Penn. "C"
B. Salt	2,472'	T. Atoka	T. Pictured Cliffs	T. Penn. "D"
T. Yates	2,674'	T. Miss	T. Cliff House	T. Leadville
T. 7 Rivers	2,768'	T. Devonian	T. Menefee	T. Madison
T. Queen	3,028'	T. Silurian	T. Point Lookout	T. Elbert
T. Grayburg	3,314'	T. Montoya	T. Mancos	T. McCracken
T. San Andres	4,128'	T. Simpson	T. Gallup	T. Ignacio Otzte
T. Glorieta	5,288'	T. McKee	Base Greenhorn	T. Granite
T. Paddock	5,594'	T. Ellenburger	T. Dakota	T.
T. Blinebry	5,702'	T. Gr. Wash	T. Morrison	T.
T.Tubb	6,202'	T. Delaware Sand	T.Todilto	T.
T. Drinkard	6,498'	T. Bone Springs	T. Entrada	T.
T. Abo	6,798'	T.	T. Wingate	T.
T. Wolfcamp		T.	T. Chinle	T.
T. Penn		T.	T. Permian	T.
T. Cisco (Bough C)		T.	T. Penn "A"	T.

OIL OR GAS SANDS OR ZONES

No. 1, from.....to..... No. 3, from.....to.....

No. 2, from.....to..... No. 4, from.....to.....

IMPORTANT WATER SANDS

Include data on rate of water inflow and elevation to which water rose in hole.

No. 1, from.....to.....feet.....

No. 2, from.....to.....feet.....

No. 3, from.....to.....feet.....

LITHOLOGY RECORD (Attach additional sheet if necessary)

From	To	Thickness In Feet	Lithology	From	To	Thickness In Feet	Lithology
0	1342	1342'	Surface rock, redbed, anhydrite				
1342	2472'	1130'	Anhydrite and salt				
2472'	3314	842'	Lime, sand, dolomite				
3314'	4128'	814'	Sand and dolomite				
4128'	6202'	2074'	Dolomite and lime				
6202'	6498	296'	Sand and dolomite				
6498'	7850'	1352'	Dolomite				

API #09940 Alice Paddock #4 re-entry

FORMATION RECORD

FROM	TO	THICKNESS IN FEET	FORMATION
0	15		Floor to cellar
	325		Surface hole
	389		Red bed shale & shells
	655		Red bed shale
	773		Red rock & shells
	883		Red bed and shells
	976		Shale and shells
	1087		Red rock & shale
	1192		Red bed & shells
	1232		Red bed shale
	1240		Shale and shells
	1291		Anhy. & red rock
	1311		Anhy. & gyp
	1372		Anhy. red bed & shells
	1502		Salt and shells
	1564		Salt & potash & gyp
	1740		Anhy. & salt brakes
	1835		Anhy. & salt
	2331		Anhy. & salt brakes
	2429		Salt
	2588		Anhydrite
	2607		Anhydrite & gyp
	2618		Anhydrite
	2832		Red bed shell
	2980		Anhydrite
	3005		Sand
	3058		Anhy. & sand
	3165		Anhy. & shale
	3245		Anhy. & lime shells
	3293		Shale & shells & lime
	3553		Anhy. & lime
	3597		Shale, lime & sand
	3672		Lime
	3708		Anhy. & lime
	3771		Shale and lime
	4283		Lime
	4651		Lime sandy
	4689		Lime
	4742		Sandy lime
	4794		Lime
	4852		Broken sandy lime
	5245		Lime
	5263		Lime TOTAL DEPTH
ED 4-22-46			

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WESTERN COMPANY

GAMMATRON

Simultaneous Nuclear Log

1980FN 1980FE
G-1-T22S-R37E
CHEVRON U S A INC
ALICE PADDOCK #4
30-025-09940

COMPANY GULF OIL CORPORATION

WELL ALICE PADDOCK #4

FIELD BLINEBRY

COUNTY LEA STATE NEW MEXICO

LOCATION 1980'FN & E LINE

SEC. TWP. 22S RGE. 37E

OTHER SERVICES

ELEVATIONS: KB. DF. GL.

PERMANENT DATUM	GROUND LEVEL ELEV. 3358	
LOG MEASURED FROM	10 FT. ABOVE PERMANENT DATUM	
DRILLING MEASURED FROM	KELLY BUSHING	
DATE	8-6-63	8-6-63
RUN NO.	ONE	ONE
TYPE LOG	GAMMA RAY	NEUTRON
DEPTH—DRILLER	5675	5675
DEPTH—LOGGER	5671.5	5671.5
BOTTOM LOGGED INTERVAL	5662.5	5670
TOP LOGGED INTERVAL	4950	4950
TYPE FLUID IN HOLE	NO-BLOCK	NO-BLOCK
SALINITY PPM CL.		
DENSITY		
LEVEL	FULL	FULL
MAX. REC. TEMP. DEG. F		
OPR. RIG TIME		
RECORDED BY	JAMES	
WITNESSED BY		

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	WGT.	FROM	TO
				13 3/8	48	SURF	298
				9 5/8	36	SURF	2955
				7	23	SURF	5263
				4½	11.6	5000.5	5710

THIS HEADING AND LOG CONFORMS TO API RECOMMENDED STANDARD PRACTICE RP-33

EQUIPMENT DATA

	GAMMA RAY	NEUTRON
RUN NO.	ONE	ONE
TOOL MODEL NO.	500	N-N(THERM)
DIAM.	3 1/2"	500
DETECT. MODEL NO.	5PA12	3 1/2"
TYPE	SCINT	6A07
LENGTH	3"	SCINT
DIST. TO N. SOURCE	104"	1 3/4"
SOURCE MODEL NO.		RB-300
SERIAL NO.		
SPACING		13.5"
TYPE		RA-BE
STRENGTH		4.0 X 10⁶

LOGGING DATA

	GENERAL	GAMMA RAY					NEUTRON			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED FT./MIN.	T.C. SEC.	SENS. SETTINGS	ZERO DIV. L on R.	API G.R. UNITS PER LOG DIV.	T.C. SEC.	SENS. SETTINGS	ZERO DIV. L on R.	API N. UNITS PER LOG DIV.
	5670	4550	20	2	220	0	8 API	2	100	14L	40 API

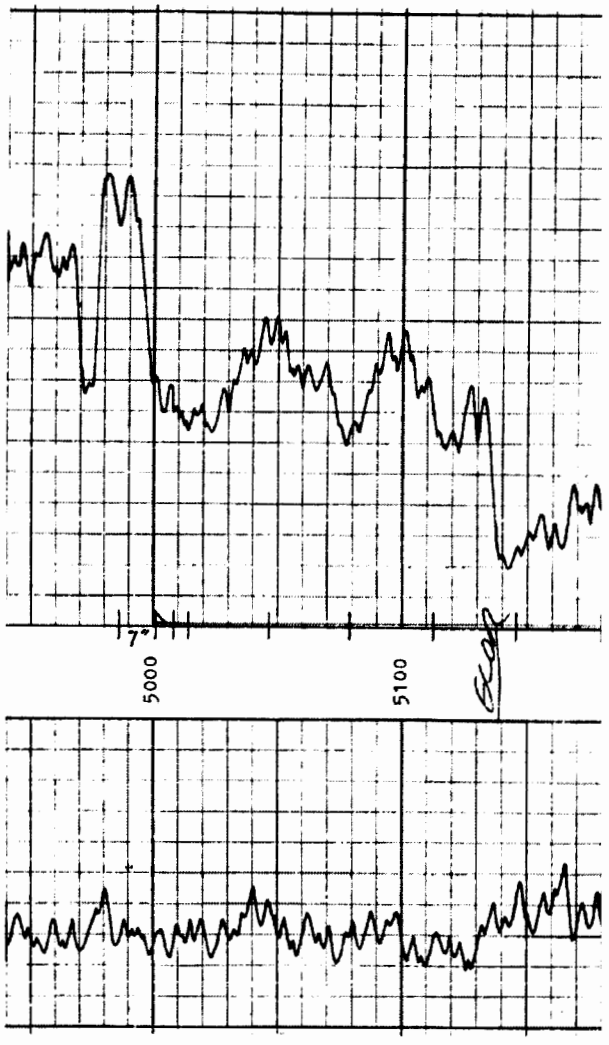
GENERAL

HOIST TRUCK NO.	6212
INST. TRUCK NO.	6212
TOOL SERIAL NO.	#15
LOG TICKET NO.	

REMARKS:

REFERENCE LITERATURE:

Oil Conservation Commission
Box 2045
Hobbs, New Mexico



DownHole SAT™ Water Analysis Report

French Creek Software

SYSTEM IDENTIFICATION

Rice Operation
Drinkard Ground H2O WH

Sample ID#: 0
ID:

Sample Date: 11-15-2018 at 2043
Report Date: 11-28-2018

WATER CHEMISTRY

CATIONS

Calcium(as Ca)	305.00
Magnesium(as Mg)	191.00
Barium(as Ba)	0.00
Strontium(as Sr)	9.00
Sodium(as Na)	365.00
Potassium(as K)	19.00
Iron(as Fe)	16.00
Manganese(as Mn)	0.00

ANIONS

Chloride(as Cl)	1556
Sulfate(as SO_4)	125.00
Dissolved CO_2(as CO_2)	10.00
Bicarbonate(as HCO_3)	97.00
H_2S (as H_2S)	3.00

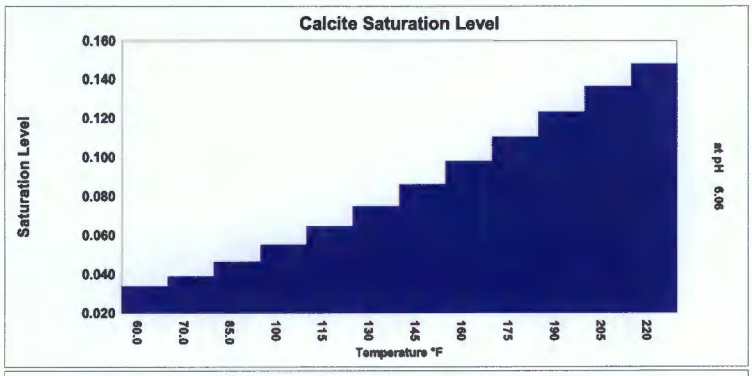
PARAMETERS

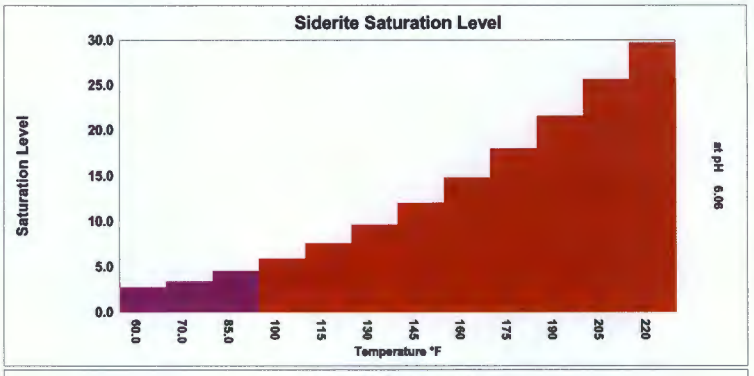
Temperature(°F)	77.00
Sample pH	6.00
Conductivity	4219
T.D.S.	2749
Resistivity	237.00
Sp.Gr.(g/mL)	1.00

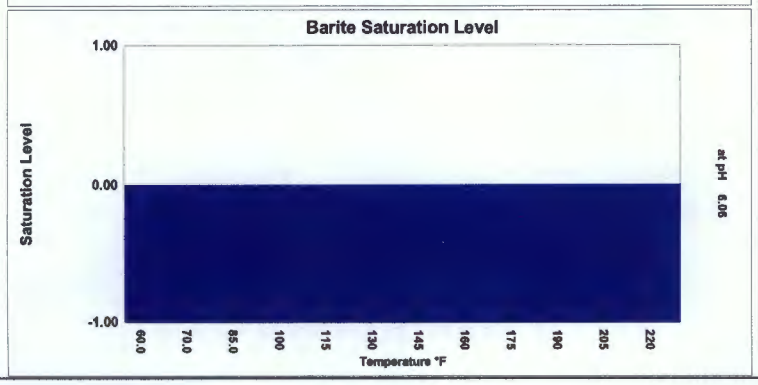
SCALE AND CORROSION POTENTIAL

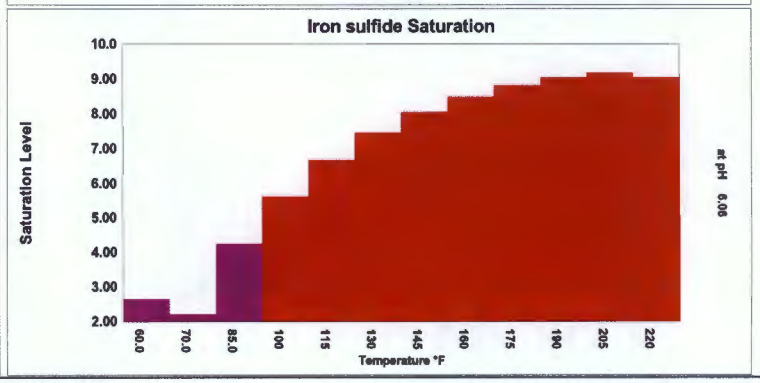
Temp. (°F)	Press. (bars)	Calcite $CaCO_3$		Anhydrite $CaSO_4$		Gypsum $CaSO_4*2H_2O$		Barite $BaSO_4$		Celestite $SrSO_4$		Siderite $FeCO_3$		Mackawenite FeS		CO_2 (mpy)	pCO_2 (atm)
60.00	>-0.001	0.0339	-0.116	0.0272	-549.39	0.0480	-423.80	0.00	-0.0358	0.0724	-44.16	2.75	0.00301	2.65	0.114	0.0599	0.0312
70.00	-0.013	0.0390	-0.106	0.0267	-545.57	0.0457	-430.76	0.00	-0.0469	0.0700	-44.87	3.39	0.00350	2.21	0.0921	0.0309	0.0308
85.00	1.387	0.0465	-0.0924	0.0270	-526.24	0.0428	-437.31	0.00	-0.0677	0.0687	-44.81	4.51	0.00406	4.24	0.279	0.160	0.0738
100.00	2.787	0.0551	-0.0815	0.0286	-492.42	0.0408	-438.67	0.00	-0.0930	0.0690	-43.91	5.89	0.00457	5.63	0.441	0.273	0.117
115.00	4.187	0.0646	-0.0724	0.0315	-448.09	0.0434	-406.80	0.00	-0.124	0.0698	-42.78	7.58	0.00502	6.67	0.587	0.332	0.160
130.00	5.587	0.0749	-0.0647	0.0359	-397.16	0.0472	-371.18	0.00	-0.163	0.0702	-41.86	9.62	0.00544	7.45	0.725	0.346	0.203
145.00	6.987	0.0861	-0.0583	0.0422	-343.18	0.0507	-340.49	0.00	-0.213	0.0700	-41.13	12.02	0.00583	8.05	0.856	0.349	0.246
160.00	8.387	0.0979	-0.0528	0.0511	-289.13	0.0540	-313.99	0.00	-0.276	0.0695	-40.58	14.81	0.00619	8.49	0.985	0.365	0.289
175.00	9.787	0.110	-0.0482	0.0634	-237.36	0.0571	-291.06	0.00	-0.355	0.0687	-40.17	18.00	0.00653	8.81	1.11	0.374	0.332
190.00	11.187	0.123	-0.0442	0.0806	-189.58	0.0599	-271.22	0.00	-0.454	0.0675	-39.90	21.61	0.00686	9.04	1.23	0.158	0.375
205.00	12.587	0.136	-0.0409	0.104	-146.94	0.0624	-254.04	0.00	-0.576	0.0661	-39.75	25.61	0.00718	9.17	1.35	0.132	0.418
220.00	13.987	0.148	-0.0386	0.137	-111.57	0.0641	-242.06	0.00	-0.731	0.0641	-40.05	29.70	0.00753	9.04	1.46	0.170	0.462
		xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels		

Saturation Levels (xSAT) are the ratio of ion activity to solubility, e.g. $\{Ca\}\{CO_3\}/K_{sp}$. pCO_2 (atm) is the partial pressure of CO_2 in the gas phase.
Lbs/1000 Barrels scale is the quantity of precipitation (or dissolution) required to instantaneously bring the water to equilibrium.









DownHole SAT(tm)

SURFACE WATER CHEMISTRY INPUT

Rice Operation — Drinkard Ground H2O WH

Report Date: 11-28-2018 — Sampled: 11-15-2018 at 2043
Sample ID:

CATIONS		ANIONS	
Calcium (as Ca)	305.00	Chloride (as Cl)	1556
Magnesium (as Mg)	191.00	Sulfate (as SO_4)	125.00
Barium (as Ba)	0.00	Dissolved CO_2 (as CO_2)	10.00
Strontium (as Sr)	9.00	Bicarbonate (as HCO_3)	97.00
Sodium (as Na)	365.00	H_2S (as H_2S)	3.00
Potassium (as K)	19.00		
Iron (as Fe)	16.00		
Manganese (as Mn)	0.00		

PARAMETERS

Calculated T.D.S.	2749
Molar Conductivity	4219
Resistivity	237.00
Sp.Gr.(g/mL)	1.00
Pressure(bars)	1.00
Temperature (^oF)	77.00
pH	6.00

CORROSION RATE PREDICTION

CO_2 - H_2S Rate(mpy)	0.0550

FRENCH CREEK SOFTWARE, INC.
1220 VALLEY FORGE ROAD, SUITE 21, VALLEY FORGE, PA 19460

DownHole SAT(tm)

SURFACE WATER
DEPOSITION POTENTIAL INDICATORS

Rice Operation — Drinkard Ground H2O WH

Report Date: 11-28-2018 Sampled: 11-15-2018 at 2043
Sample ID:

SATURATION LEVEL		MOMENTARY EXCESS (Lbs/1000 Barrels)	
Calcite ($CaCO_3$)	0.0427	Calcite ($CaCO_3$)	-0.0990
Aragonite ($CaCO_3$)	0.0395	Aragonite ($CaCO_3$)	-0.107
Witherite ($BaCO_3$)	0.00	Witherite ($BaCO_3$)	-8.22
Strontianite ($SrCO_3$)	0.00470	Strontianite ($SrCO_3$)	-1.13
Calcium oxalate (CaC_2O_4)	0.00	Calcium oxalate (CaC_2O_4)	-0.0528
Magnesite ($MgCO_3$)	0.0208	Magnesite ($MgCO_3$)	-0.175
Anhydrite ($CaSO_4$)	0.0267	Anhydrite ($CaSO_4$)	-538.12
Gypsum ($CaSO_4*2H_2O$)	0.0443	Gypsum ($CaSO_4*2H_2O$)	-434.14
Barite ($BaSO_4$)	0.00	Barite ($BaSO_4$)	-0.0559
Celestite ($SrSO_4$)	0.0691	Celestite ($SrSO_4$)	-44.94
Fluorite (CaF_2)	0.00	Fluorite (CaF_2)	-8.75
Calcium phosphate	0.00	Calcium phosphate	>-0.001
Hydroxyapatite	0.00	Hydroxyapatite	-199.94
Silica (SiO_2)	0.00	Silica (SiO_2)	-41.78
Brucite ($Mg(OH)_2$)	< 0.001	Brucite ($Mg(OH)_2$)	< 0.001
Magnesium silicate	0.00	Magnesium silicate	-80.71
Iron hydroxide ($Fe(OH)_3$)	< 0.001	Iron hydroxide ($Fe(OH)_3$)	< 0.001
Strengite ($FePO_4*2H_2O$)	0.00	Strengite ($FePO_4*2H_2O$)	>-0.001
Siderite ($FeCO_3$)	3.91	Siderite ($FeCO_3$)	0.00381
Halite (NaCl)	< 0.001	Halite (NaCl)	-155337
Thenardite ($Na2SO_4$)	< 0.001	Thenardite ($Na2SO_4$)	-41740
Iron sulfide (FeS)	2.00	Iron sulfide (FeS)	0.0807

SIMPLE INDICES		BOUND IONS	TOTAL	FREE
Langelier	-1.32	Calcium	305.00	293.08
Ryznar	8.63	Barium	0.00	0.00
Puckorius	7.31	Carbonate	0.0380	0.00760
Larson-Skold Index	29.30	Phosphate	0.00	0.00
Stiff Davis Index	-1.44	Sulfate	125.00	79.79
Oddo-Tomson	-1.45			

OPERATING CONDITIONS

Temperature (^oF)	77.00
Time(mins)	3.00

FRENCH CREEK SOFTWARE, INC.
1220 VALLEY FORGE ROAD, SUITE 21, VALLEY FORGE, PA 19460

DownHole SAT™ Water Analysis Report

French Creek Software

SYSTEM IDENTIFICATION

Rice Operating
Cattle Trough WH

Sample ID#: 0
ID:

Sample Date: 12-14-2018 at 2043
Report Date: 12-18-2018

WATER CHEMISTRY

CATIONS

Calcium(as Ca)	266.00
Magnesium(as Mg)	151.00
Barium(as Ba)	0.00
Strontium(as Sr)	8.00
Sodium(as Na)	351.00
Potassium(as K)	15.00
Iron(as Fe)	1.20
Manganese(as Mn)	0.00

ANIONS

Chloride(as Cl)	1281
Sulfate(as SO_4)	126.00
Dissolved CO_2(as CO_2)	80.00
Bicarbonate(as HCO_3)	171.00
H_2S (as H_2S)	5.00

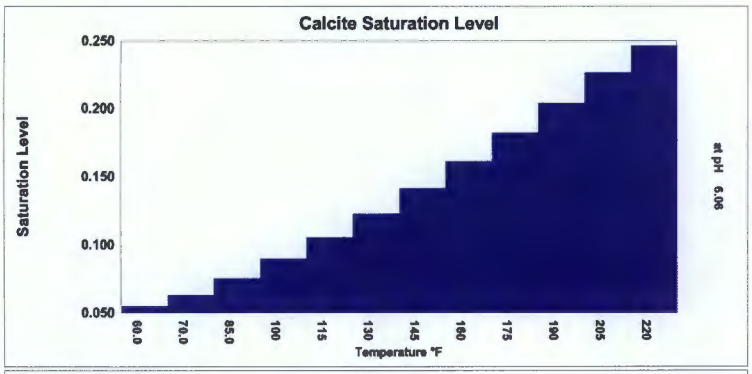
PARAMETERS

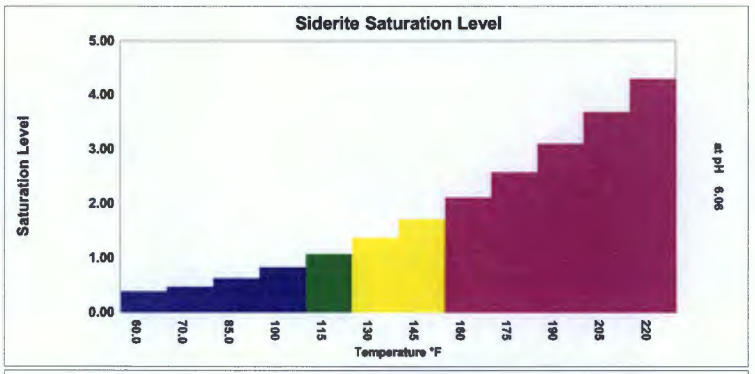
Temperature(°F)	77.00
Sample pH	6.00
Conductivity	3685
T.D.S.	2489
Resistivity	271.40
Sp.Gr.(g/mL)	1.00

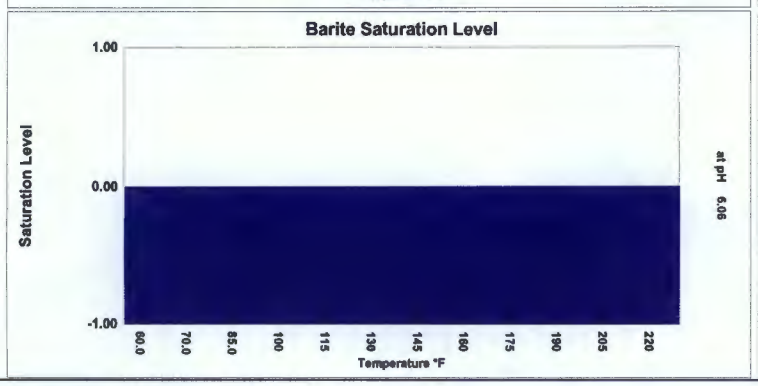
SCALE AND CORROSION POTENTIAL

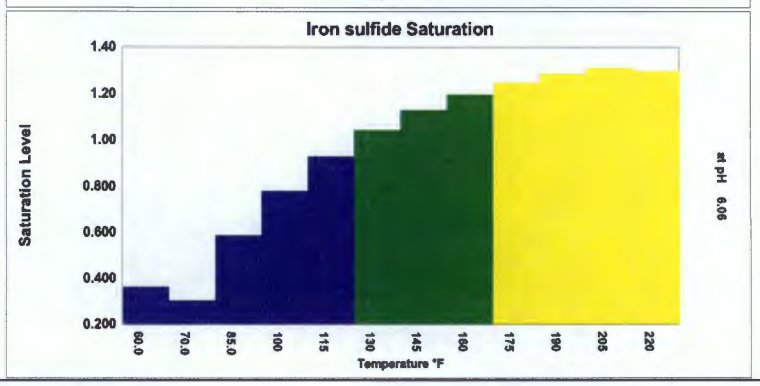
Temp. (°F)	Press. (bars)	Calcite $CaCO_3$		Anhydrite $CaSO_4$		Gypsum $CaSO_4*2H_2O$		Barite $BaSO_4$		Celestite $SrSO_4$		Siderite $FeCO_3$		Mackawenite FeS		CO_2 (mpy)	pCO_2 (atm)
		xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels	xSAT	Lbs per 1000 Barrels		
60.00	>-0.001	0.0550	-0.121	0.0268	-536.26	0.0474	-416.28	0.00	-0.0312	0.0738	-40.82	0.385	-0.0127	0.363	-0.203	0.207	0.0551
70.00	-0.013	0.0631	-0.109	0.0264	-532.37	0.0452	-422.81	0.00	-0.0408	0.0715	-41.45	0.476	-0.00921	0.304	-0.239	0.274	0.0544
85.00	1.387	0.0756	-0.0952	0.0269	-513.44	0.0425	-428.81	0.00	-0.0585	0.0705	-41.33	0.634	-0.00512	0.585	-0.127	0.641	0.131
100.00	2.787	0.0897	-0.0833	0.0285	-480.58	0.0407	-429.77	0.00	-0.0800	0.0712	-40.42	0.831	-0.00191	0.779	-0.0608	1.09	0.207
115.00	4.187	0.105	-0.0734	0.0316	-437.60	0.0436	-398.73	0.00	-0.106	0.0724	-39.29	1.07	< 0.001	0.929	-0.0180	1.27	0.283
130.00	5.587	0.123	-0.0650	0.0362	-388.29	0.0475	-364.06	0.00	-0.139	0.0732	-38.37	1.37	0.00279	1.04	0.00989	1.05	0.359
145.00	6.987	0.141	-0.0580	0.0427	-336.04	0.0514	-334.15	0.00	-0.180	0.0735	-37.63	1.71	0.00455	1.13	0.0288	0.735	0.435
160.00	8.387	0.161	-0.0519	0.0520	-283.68	0.0550	-308.25	0.00	-0.232	0.0734	-37.06	2.11	0.00604	1.20	0.0419	0.425	0.511
175.00	9.787	0.182	-0.0468	0.0648	-233.45	0.0584	-285.81	0.00	-0.298	0.0728	-36.63	2.58	0.00733	1.25	0.0508	0.761	0.587
190.00	11.187	0.204	-0.0423	0.0828	-186.97	0.0615	-266.33	0.00	-0.379	0.0720	-36.34	3.10	0.00846	1.29	0.0567	0.312	0.664
205.00	12.587	0.226	-0.0385	0.108	-145.33	0.0644	-249.42	0.00	-0.478	0.0709	-36.16	3.69	0.00946	1.31	0.0600	0.256	0.740
220.00	13.987	0.247	-0.0358	0.142	-110.53	0.0665	-237.37	0.00	-0.605	0.0690	-36.38	4.29	0.0104	1.30	0.0571	0.334	0.816

Saturation Levels (xSAT) are the ratio of ion activity to solubility, e.g. $\{Ca\}\{CO_3\}/K_{sp}$. pCO_2 (atm) is the partial pressure of CO_2 in the gas phase.
Lbs/1000 Barrels scale is the quantity of precipitation (or dissolution) required to instantaneously bring the water to equilibrium.









DownHole SAT(tm)

SURFACE WATER CHEMISTRY INPUT

Rice Operating | Cattle Trough WH

Report Date: 12-18-2018 | Sampled: 12-14-2018 at 2043
Sample ID:

CATIONS		ANIONS	
Calcium (as Ca)	266.00	Chloride (as Cl)	1281
Magnesium (as Mg)	151.00	Sulfate (as SO_4)	126.00
Barium (as Ba)	0.00	Dissolved CO_2 (as CO_2)	80.00
Strontium (as Sr)	8.00	Bicarbonate (as HCO_3)	171.00
Sodium (as Na)	351.00	H_2S (as H_2S)	5.00
Potassium (as K)	15.00		
Iron (as Fe)	1.20		
Manganese (as Mn)	0.00		

PARAMETERS

Calculated T.D.S.	2489
Molar Conductivity	3685
Resistivity	271.40
Sp.Gr.(g/mL)	1.00
Pressure(bars)	1.00
Temperature (^oF)	77.00
pH	6.00

CORROSION RATE PREDICTION

CO_2 - H_2S Rate(mpy)	0.331

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DownHole SAT(tm)

SURFACE WATER
DEPOSITION POTENTIAL INDICATORS

Rice Operating | Cattle Trough WH

Report Date: 12-18-2018 | Sampled: 12-14-2018 at 2043
Sample ID:

SATURATION LEVEL		MOMENTARY EXCESS (Lbs/1000 Barrels)	
Calcite ($CaCO_3$)	0.0693	Calcite ($CaCO_3$)	-0.102
Aragonite ($CaCO_3$)	0.0641	Aragonite ($CaCO_3$)	-0.111
Witherite ($BaCO_3$)	0.00	Witherite ($BaCO_3$)	-7.85
Strontianite ($SrCO_3$)	0.00789	Strontianite ($SrCO_3$)	-1.14
Calcium oxalate (CaC_2O_4)	0.00	Calcium oxalate (CaC_2O_4)	-0.0560
Magnesite ($MgCO_3$)	0.0306	Magnesite ($MgCO_3$)	-0.203
Anhydrite ($CaSO_4$)	0.0265	Anhydrite ($CaSO_4$)	-525.04
Gypsum ($CaSO_4*2H_2O$)	0.0439	Gypsum ($CaSO_4*2H_2O$)	-425.92
Barite ($BaSO_4$)	0.00	Barite ($BaSO_4$)	-0.0485
Celestite ($SrSO_4$)	0.0708	Celestite ($SrSO_4$)	-41.49
Fluorite (CaF_2)	0.00	Fluorite (CaF_2)	-9.05
Calcium phosphate	0.00	Calcium phosphate	>-0.001
Hydroxyapatite	0.00	Hydroxyapatite	-193.22
Silica (SiO_2)	0.00	Silica (SiO_2)	-41.81
Brucite ($Mg(OH)_2$)	< 0.001	Brucite ($Mg(OH)_2$)	< 0.001
Magnesium silicate	0.00	Magnesium silicate	-79.36
Iron hydroxide ($Fe(OH)_3$)	< 0.001	Iron hydroxide ($Fe(OH)_3$)	< 0.001
Strengite ($FePO_4*2H_2O$)	0.00	Strengite ($FePO_4*2H_2O$)	>-0.001
Siderite ($FeCO_3$)	0.549	Siderite ($FeCO_3$)	-0.00711
Halite (NaCl)	< 0.001	Halite (NaCl)	-153509
Thenardite ($Na2SO_4$)	< 0.001	Thenardite ($Na2SO_4$)	-40702
Iron sulfide (FeS)	0.276	Iron sulfide (FeS)	-0.261

SIMPLE INDICES		BOUND IONS	TOTAL	FREE
Langelier	-1.11	Calcium	266.00	252.70
Ryznar	8.21	Barium	0.00	0.00
Puckorius	6.53	Carbonate	0.0608	0.0131
Larson-Skold Index	13.86	Phosphate	0.00	0.00
Stiff Davis Index	-1.24	Sulfate	126.00	83.73
Oddo-Tomson	-1.22			

OPERATING CONDITIONS

Temperature (^oF)	77.00
Time(mins)	3.00

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TASMAN GEOSCIENCES

November 20, 2018

Scott Curtis
Rice Operating Company
122 W Taylor St.
Hobbs, New Mexico 88240

RE: Rice Operating Company Alice Paddock #4 SWD Well Permit

Mr. Curtis:

Tasman Geosciences, Inc. (Tasman) conducted a hydrogeologic investigation on behalf of Rice Operating Company (Rice) related to the proposed injection well Alice Paddock #4 SWD well permit located in Lea County, New Mexico (Site [Figure 1]). The scope of the investigation was to determine if there is a hydrologic connection between the proposed injection interval and local sources of underground drinking water. The basis of the investigation was in response to the well permit requirement that the applicant makes the following statement:

> *XII. Applicants for disposal wells must make an affirmative statement that they have examined available geologic and engineering data and find no evidence of open faults or any other hydrologic connection between the disposal zone and any underground sources of drinking water.*

During the investigation Tasman utilized four main sources to determine if there was evidence of open faults or other hydrologic connection between the injection zone, which is between 4,000 and 5,000 feet below ground surface (bgs) in the Permian-Guadalupe San Andreas Formation, and local sources of drinking water estimated to be derived from the Tertiary Ogallala Formation (High Plains aquifer) and the underlying Dockum group.

The sources utilized in the investigation are listed below and are included as attachments:

- Geologic Map of New Mexico (Anderson et al., 1996);
- Regional Cross Sections – Central Basin Platform, West Texas (Bebout et al., 1985);
- Geohydrology of the High Plains Aquifer in Southeastern New Mexico (Hart et al., 1985); and
- Ground-Water Report 6 - Geology and Ground-Water Conditions in Southern Lea County, New Mexico (Nicholson Jr., and Chelbsch, Jr., 1961).

HYDROGEOLOGIC EVALUATION AND RESULTS

Based on a review of these sources and information provided by Rice, the following lines of evidence indicates that there is not a "hydrologic connection between the disposal zone and underground sources of drinking water".

- All potable water in Southern New Mexico (Lea County) is derived from aquifers (High Plains, Dockum Group, Alluvial) above the Permian-Triassic unconformity, which is thousands of feet above the injection interval;

- Geologic map of New Mexico illustrates no major regional faults or structural features indicating a connection between the San Andreas Formation and the overlying potable water bearing units in the area (e.g., High Plains aquifer, Dockum group, and alluvial aquifer, etc.)

- Cross section B-B' at points 1, 2 and 3, which are near the injection Site, indicates there are no major faults that trend vertically between the Permian San Andreas Formation and the overlying Permian-Triassic unconformity; and

- Plate 1 – Geohydrology of the High Plains aquifer illustrates the contact between the base of the High Plains aquifer and the underlying bedrock is approximately 65 feet bgs and the southern extent of the aquifer is north of the injection Site.

SUMMARY

Based on these lines of evidence and as a licensed Professional Geologist, I am confident that Rice Operating Company can provide the affirmative statement for the Alice Paddock #4 location:

> "*that they have examined available geologic and engineering data and find no evidence of open faults or any other hydrologic connection between the disposal zone and any underground sources of drinking water*".

Please feel free to contact me with any questions or comments at (970) 317-0130.

Sincerely,

Brent Everett, PG
Tasman Geosciences, Inc.

Enclosures:
- Figure 1 – Site Location Map
- Geologic Map of New Mexico
- Cross Section Overview – Central Basin Platform, West Texas
- Regional Cross Section (B-B') – Central Basin Platform, West Texas
- Geohydrology of the High Plains Aquifer Southeast New Mexico
- Ground-water Report 6 – Geology and Ground-Water Conditions in Southern Lea County, New Mexico

TASMAN GEOSCIENCES

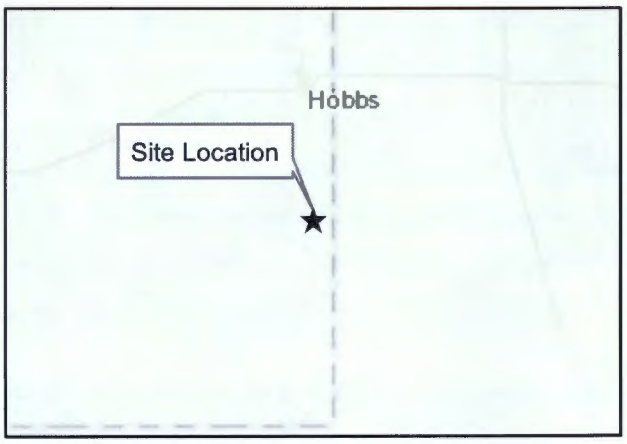
References:

Anderson, O.J., Jones, G.E., and Green, G.N., 1996, Geologic Map of New Mexico, Scale 1:500,000.

Bebout, D.G., and Meador, K.J., 1985, Regional Cross Sections – Central Basin Platform, West Texas: The University of Texas at Austin, Bureau of Economic Geology.

Hart, D.L., and McAda, D.P., 1985, Geohydrology of the High Plains Aquifer in Southeastern New Mexico, Hydrologic Atlas 679.

Nicholson, Jr. A., and Chelbsch, Jr. A., 1961, Ground-Water Report 6 - Geology and Ground-Water Conditions in Southern Lea County, New Mexico.



0 750 1,500 Feet

Figure 1

Proposed Site Location Map
Alice Paddock #4
UL G, Sec. 1-T22S-R37E
Lea County, New Mexico

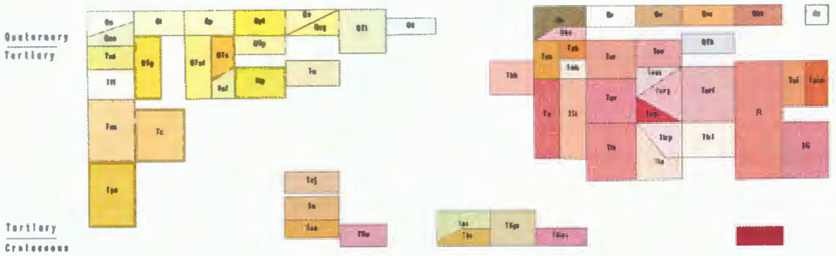
TASMAN GEOSCIENCES

Drawn By: DBA
Date: 11/14/2018

GEOLOGIC MAP
of
NEW MEXICO
compiled by
O.J. Anderson, G.E. Jones, and G.N. Green
[illegible]
[illegible]

New Mexico Bureau of Mines OFR 408B

[illegible]



QUATERNARY

- ds - disturbed ground
- Qa - Alluvium; upper and middle Quaternary
- Ql - Landslide deposits and colluvium
- Qe - Eolian deposits
- Qeg - Gypsiferous eolian deposits
- Qd - Glacial deposits; till and outwash; upper and middle Pleistocene
- Qpl - Lacustrine and playa-lake deposits; includes associated alluvial and eolian deposits of major lake basins; upper Quaternary
- Qp - Piedmont alluvial deposits; upper and middle Quaternary; includes deposits of higher gradient tributaries bordering major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans
- Qb - Basalt and andesite flows and locally vent deposits
- Qr - Silicic volcanic rocks
- Qv - Basaltic volcanics; tuff rings, cinders, and proximal lavas
- Qbo - Basalt or basaltic andesite; middle and lower Pleistocene
- Qvr - Valles Rhyolite; Jemez Mountains area only
- Qbt - Bandelier Tuff; Jemez Mountains area only
- Qoa - Older alluvial deposits of upland plains and piedmont areas, and calcic soils and eolian cover sediments of High Plains region; includes scattered lacustrine, playa, and alluvial deposits of the Tahoka, Double Lakes, Tule, Blanco, Blackwater Draw, and Gatuna Formations, the latter of which may be Pliocene at base; outcrops, however, are basically of Quaternary deposits; upper Quaternary to uppermost Pliocene(?)

QUATERNARY and TERTIARY

- QTp - Older piedmont alluvial deposits and shallow basin fill; includes Quemado Formation and in northeast, high level pediment gravels
- QTb - Basaltic and andesitic volcanics interbedded with Pleistocene and Pliocene sedimentary units
- QTt - Travertine
- QTg - Gila Group. Includes Mimbres Formation and several informal units in southwestern basins; Middle Pleistocene to uppermost Oligocene
- QTsf - Santa Fe Group, undivided. Basin fill of Rio Grande rift region; middle Pleistocene to uppermost Oligocene
- QTs - Upper Santa Fe Group. Includes Camp Rice, Fort Hancock, Palomas, Sierra Ladrones, Ancha, Puye, and Alamosa Formations; middle Pleistocene to uppermost Miocene

TERTIARY

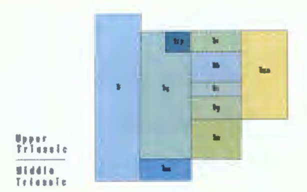
- Tus - Upper Tertiary sedimentary units; includes Bidahochi Formation, the Picuris Formation, and Las Feveros Formation, and locally fanglomerates; Pliocene to upper Miocene
- Tfl - Fence Lake Formation; conglomerate and conglomeratic sandstone, coarse fluvial volcanoclastic sediments, minor eolian facies, and pedogenic carbonates of the southern Colorado Plateau region; Miocene
- Tsf - Lower and Middle Santa Fe Group. Includes Hayner Ranch, Rincon Valley, Popotosa, Cochiti, Tesuque, Chamita, Abiquiu, and other Formations; Miocene and uppermost Oligocene
- To - Ogallala Formation, alluvial and eolian deposits, and petrocalcic soils of the southern High Plains; Lower Pliocene to middle Miocene (locally includes unit Qoa)
- Tlp - Los Pinos Formation of Lower Santa Fe Group (Miocene and upper Oligocene); includes Carson Conglomerate (Dane and Bachman, 1965) in Tusas Mountains–San Luis Basin area
- Tos - Mostly Oligocene and upper Eocene sedimentary and volcaniclastic sedimentary rocks with local andesitic to intermediate volcanics; includes Espinaso, Spears, Bell Top, and Palm Park Formations
- Thb - Hinsdale Basalt; northern Taos and eastern Rio Arriba Counties; basalt flows interbedded with Los Pinos Formation
- Tnb - Basalt and andesite flows; Neogene. Includes flows interbedded with Santa Fe and Gila Groups
- Tpb - Basalt and andesite flows; Pliocene
- Tmb - Basalt and andesite flows; Miocene

TERTIARY (continued)

- Tnr - Silicic to intermediate volcanic rocks; mainly quartz latite and rhyolite Neogene; may locally include flows interbedded with Santa Fe Group
- Tnv - Neogene volcanic rocks; primarily in Jemez Mountains
- Tc - Chuska Sandstone; restricted to Chuska Mountains
- Tv - Middle Tertiary volcanic rocks, undifferentiated
- Tif - Middle Tertiary felsic shallow-intrusive rocks; phonolites and trachytes of northeastern N.M.; includes the rhyolite of Ash Mountain
- Tuv - Volcanic and some volcaniclastic rocks, undifferentiated; lower Miocene and Upper Oligocene (younger than 29 Ma)
- Tlv - Lower Oligocene and Eocene volcanic rocks, undifferentiated; dominantly intermediate composition, with interbedded volcaniclastic rocks; (31-44 Ma)
- Tuau - Lower Miocene and uppermost Oligocene basaltic andesites (22-26 Ma). Includes Bearwallow Mountain Andesite and basaltic andesite of Mangas Mountain
- Tual - Upper Oligocene andesites and basaltic andesites (26-29 Ma); includes La Jara Peak Basaltic Andesite, Uvas Basalt, the basaltic andesite of Poverty Creek, and Squirrel Springs Andesite, the Razorback, Bear Springs Canyon, Salt Creek, Gila Flat, and Middle Mountain Formations, and the Alum Mountain Group; locally includes more silicic flows
- Turp - Upper Oligocene rhyolitic pyroclastic rocks (ash-flow tuffs); includes Davis Canyon Tuff, South Crosby Peak Formation, La Jencia, Vick's Peak, Lemitar, South Canyon, Bloodgood Canyon, Shelley Peak Tuffs, tuff of Horseshoe Canyon, Park Tuff, Rhyolite Canyon Tuff, Apache Springs Tuff, Diamond Creek, Jordan Canyon, Garcia Camp Tuffs, the Turkey Springs Tuff, the tuff of Little Mineral Creek, the Amalia Tuff, and others. Some contain volcaniclastic and reworked volcaniclastic rocks, and eolian sandstone; (24-29 Ma)
- Tlrp - Lower Oligocene silicic pyroclastic rocks (ash-flow tuffs); includes Hell's Mesa, Kneeling Nun, lower part of Bell Top Formation, Caballo Blanco, Datil Well, Lebya Well, Rock House Canyon, Blue Canyon, Sugarlump and Tadpole Ridge Tuffs, the tuffs of the Organ cauldron, Treasure Mountain Tuff (now known as Chiquito Peak Tuff), Bluff Creek Tuff, Oak Creek Tuff, tuff of Steins Mountain, tuff of Black Bill Canyon, tuff of Farr Ranch, Woodhaul Canyon, Gillespie and Box Canyon Tuffs, Cooney Tuff, and other volcanic and interbedded fluvial and pumiceous units; (31-36.5 Ma)
- Turf - Upper Oligocene silicic (or felsic) flows and masses and associated pyroclastic rocks; includes Taylor Creek, Fanney, and Rocky Canyon Rhyolites
- Tlrf - Lower Oligocene silicic (or felsic) flows, domes, and associated pyroclastic rocks and intrusions; includes Mimbres Peak Formation
- Ti - Tertiary intrusive rocks; undifferentiated
- Tui - Miocene to Oligocene silicic to intermediate intrusive rocks: dikes, stocks, plugs, and diatremes
- Tuim - Upper and Middle Tertiary mafic intrusive rocks
- Tli - Quartz monzonites (Eocene) in the Silver City and Los Pinos Range, intermediate intrusives of the Cooke's Range (Oligocene), and other intermediate to felsic dikes and plugs of Oligocene and Eocene age
- Tla - Lower Tertiary, (Lower Oligocene and Eocene) andesite and basaltic andesite flows, and associated volcaniclastic units. Includes Rubio Peak Formation, and andesite of Dry Leggett Canyon
- Tps - Paleogene sedimentary units; includes Baca, Galisteo, El Rito, Blanco Basin, Love Ranch, Lobo, Sanders Canyon, Skunk Ranch, Timberlake, and Cub Mountain Formations
- Tsj - San Jose Formation; Eocene, San Juan Basin
- Tn - Nacimiento Formation; Paleocene, San Juan Basin
- Toa - Ojo Alamo Formation; Paleocene, San Juan Basin
- Tpc - Poison Canyon Formation; Paleocene, Raton Basin

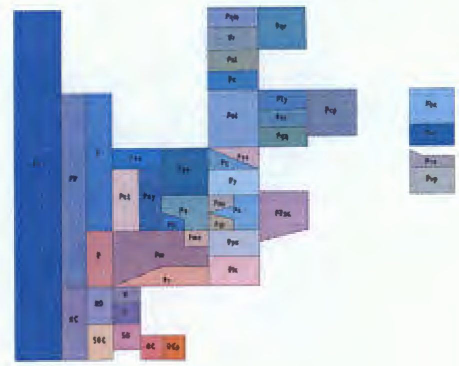
TERTIARY and CRETACEOUS

- TKr - Raton Formation; in Raton Basin; unit contains conformable K/T boundary
- TKpr - Poison Canyon and Raton Formations; undivided
- TKa - Animas Formation; in northeast San Juan Basin
- TKav - Andesitic volcanics
- TKi - Paleogene and Upper Cretaceous intrusive rocks; includes Hanover, Fierro, Tyrone, and Lordsburg granodiorite-quartz monzonite porphyries



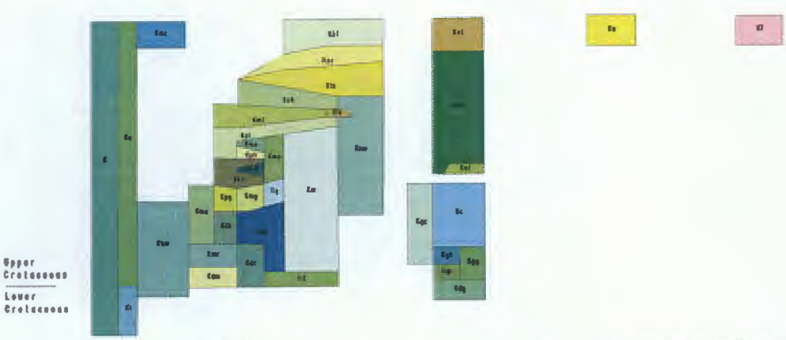
TRIASSIC

- TR - Triassic rocks, undivided; continental red beds
- TRrp - Rock Point Formation of Chinle Group; Upper Triassic. May locally include Lukachukai Member of Wingate Sandstone
- TRc - Chinle Group; Upper Triassic; includes Moenkopi Formation (Middle Triassic) at base in many areas; in eastern part of state the following five formations are mapped:
  - TRr - Redonda Formation
  - TRb - Bull Canyon Formation; Norian
  - TRt - Trujillo Formation; Norian
  - TRg - Garita Creek Formation; Carnian
  - TRs - Santa Rosa Formation; Carnian; includes Moenkopi Formation (Middle Triassic) at base in most areas
- TRcu - Upper Chinle Group, Garita Creek through Redonda Formations, undivided
- TRm - Moenkopi Formation; Middle Triassic



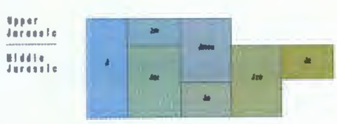
PALEOZOIC

- Pz - Paleozoic rocks, undivided
- P - Permian rocks, undivided
- Pqr - Quartermaster and Rustler Formations; Upper Permian
- Pqm - Quartermaster Formation; red sandstone and siltstone; Upper Permian
- Pr - Rustler Formation; siltstone, gypsum, sandstone, and dolomite; Upper Permian
- Psl - Salado Formation; evaporite sequence; Upper Permian
- Pc - Castile Formation; dominantly anhydrite sequence; Upper Permian
- Pat - Artesia Group; shelf facies forming broad south-southeast trending outcrop from Glorieta to Artesia area; includes Grayburg, Queen, Seven Rivers, Yates, and Tansill Formations; Guadalupian. May locally include Moenkopi Formation (Triassic) at top
- Pty - Yates and Tansill Formations; sandstone, siltstone, limestone, dolomite, and anhydrite; Guadalupian
- Psr - Seven Rivers Formation; gypsum, anhydrite, salt, dolomite, and siltstone; Guadalupian
- Pgq - Grayburg and Queen Formations; sandstone, gypsum, anhydrite, dolomite, and red mudstone; Guadalupian
- Pcp - Capitan Formation; Upper Guadalupian age limestone (reef facies)
- Pbc - Bell Canyon Formation; basin facies-sandstone, limestone, and shale; Guadalupian
- Pcc - Cherry Canyon Formation; basin facies-sandstone, limestone, and shale
- Psa - San Andres Formation; limestone and dolomite with minor shale; Guadalupian in south, in part Leonardian to north
- Pg - Glorieta Sandstone; texturally and mineralogically mature, high-silica quartz sandstone
- Psg - San Andres Limestone and Glorieta Sandstone; Guadalupian and Leonardian
- Pcu - Cutoff Shale; in Brokeoff Mountains only
- Pvp - Victoria Peak Limestone; in Brokeoff Mountains only
- Py - Yeso Formation; sandstones, siltstones, anhydrite, gypsum, halite, and dolomite; Leonardian
- Pa - Abo Formation; red beds, arkosic at base, finer and more mature above; Wolfcampian; may include limestone beds of Pennsylvanian age (Virgilian) in Zuni Mountains. In Robledo Mountains the Abo may be considered a member of the Hueco Formation
- Pau - Upper part of Abo Formation; Wolfcampian
- Pal - Lower part of Abo Formation; Wolfcampian, and in part Virgilian ?
- Pys - Yeso, Glorieta and San Andres Formations, undivided
- Pay - Abo and Yeso Formations, undivided
- Pct - Cutler Formation; used in northern areas and Chama embayment only
- Ph - Hueco Formation; limestone unit restricted to south-central area; Pendejo Tongue divides Abo Formation into upper and lower parts; Wolfcampian
- Pb - Bursum Formation; shale, arkose, and limestone; earliest Permian
- PP - Permian and Pennsylvanian rocks, undivided; includes Horquilla Limestone, Earp Formation, Epitaph and Scherrer Formations, and Concha Limestone
- PPsc - Sangre de Cristo Formation, in Sangre de Cristo Mountains
- P - Pennsylvanian rocks, undivided; in Sangre de Cristo Mountains may include Sandia Formation, Madera Limestone, La Pasada, Alamitos, and Flechado Formations; elsewhere may include Bar-B, Nakaye, Red House, Oswaldo, and Syrena Formations
- Pm - Madera Formation (Limestone, or Group); in Manzano Mountains includes Los Moyos Limestone and Wild Cow Formation; in Lucero Mesa includes Gray Mesa, Atrasado, and Red Tanks Members; in Sacramento Mountains includes Beeman and Holder Formations; may include strata lumped as Magdalena Group in a few areas
- Pme - Madera Limestone, exotic blocks; present only in the Chloride area of Sierra County
- Ps - Sandia Formation; predominately clastic unit (commonly arkosic) with minor black shales, and limestone in lower part; locally includes Osha Canyon Formation in Nacimiento Mountains
- Pps - Panther Seep Formation; Organ, Franklin, and San Andres Mountains
- Plc - Lead Camp Formation; San Andres and Organ Mountains
- M - Mississippian rocks, undivided; Arroyo Penasco Group in Sangre de Cristo Mountains, Sierra Nacimiento, San Pedro Mountain, and Sandia Mountains; Lake Valley Limestone in south-central New Mexico
- MD - Mississippian and Devonian rocks, undivided; includes the Lake Valley Limestone, Caballero, Las Cruces, Rancheria, and Helms Formations and Escabrosa Group; Mississippian; the Oñate, Sly Gap, Contadero Formations, and Percha Shale of south-central New Mexico, and Canutillo Formation of Northern Franklin Mountains and Bishops Cap area; Devonian
- MC - Mississippian through Cambrian rocks, undivided; includes Lake Valley Limestone; Mississippian; Devonian rocks, undivided; El Paso Formation and Montoya Group (or Formation); Ordovician; and Bliss Sandstone; Cambrian and Ordovician
- D - Percha Shale; southern Caballo Mountains; includes the Oñate and Sly Gap Formations
- SO - Silurian and Ordovician rocks, undivided
- SOC - Silurian through Cambrian rocks, undivided
- OC - Ordovician and Cambrian rocks, undivided; includes Bliss Sandstone, El Paso Formation, and Montoya Formation (or Group)
- OCp - Ordovician-Cambrian plutonic rocks of Florida Mountains



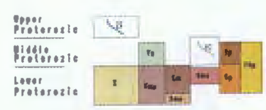
CRETACEOUS

- K - Cretaceous rocks, undivided
- Ki - Uppermost Cretaceous intrusive rocks; restricted to Copper Flats area in Sierra County
- Ka - Uppermost Cretaceous andesite flows; restricted to southwestern area
- Ku - Upper Cretaceous, undivided. Includes Virden Formation in northern Hidalgo County, Ringbone Formation in Hidalgo and Luna and Grant Counties, and locally Beartooth and Sarten, Mancos in Silver City area; Cenomanian – Maastrichtian for most part, although Beartooth is pre-Cenomanian
- Kmc - McRae Formation; Eagle basin – Cutter sag area; Maastrichtian
- Kvt - Vermejo Formation and Trinidad Sandstone; Maastrichtian
- Kkf - Kirtland and Fruitland Formations; coal-bearing, coal primarily in the Fruitland; Campanian to Maastrichtian
- Kpc - Pictured Cliffs Sandstone; prominent cliff-forming marine sandstone
- Kls - Lewis Shale; marine shale and mudstone
- Kpn - Pierre Shale and Niobrara Formation
- Knf - Fort Hays Limestone Member of Niobrara Formation
- Kmv - Mesaverde Group includes the Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone, Menefee Formation, and Cliff House Sandstone
- Kch - Cliff House Sandstone; transgressive marine sandstone; Campanian
- Klv - La Ventana Tongue of the Cliff House Sandstone
- Kmf - Menefee Formation; mudstone, shale, and sandstone; coal-bearing
- Kpl - Point Lookout Sandstone; regressive marine sandstone in McKinley and Sandoval Counties. The lower, Hosta Tongue, of Point Lookout is transgressive and is separated from main body by the Satan Tongue of Mancos Shale; Santonian – Campanian
- Kms - Satan Tongue of Mancos Shale
- Kph - Hosta Tongue of Point Lookout Sandstone; transgressive marine sandstone
- Kmm - Mulatto Tongue of Mancos Shale
- Kcc - Crevasse Canyon Formation; coal-bearing units are Dilco and Gibson Coal Members; other members are Bartlett Barren, Dalton Sandstone, and Borrego Pass Sandstone (or Lentil)
- Kg - Gallup Sandstone; generally regressive marine sandstone; Turonian
- Kmg - Gallup Sandstone and underlying D-Cross Tongue of the Mancos Shale; Turonian
- Kmr - Rio Salado Tongue of the Mancos Shale. Overlies Twowells Tongue of Dakota Sandstone; mapped only where Tres Hermanos Formation or the Atarque Sandstone is present; mapped as Kdr in parts of Socorro County; Turonian
- Kpg - Pescado Tongue of the Mancos Shale and Gallup Sandstone; in Zuni Basin only. Pescado is chrono-stratigraphic equivalent of Juana Lopez Member of Mancos Shale; Turonian
- Kth - Tres Hermanos Formation; formerly designated as Lower Gallup Sandstone in the Zuni Basin; Turonian
- Kma - Moreno Hill Formation and Atarque Sandstone; in Salt Lake coal field and extreme southern Zuni basin; Turonian
- Km - Mancos Shale; divided into Upper and Lower parts by Gallup Sandstone
- Kmu - Mancos Shale, Upper part
- Kml - Mancos Shale, Lower part
- Kdr - Dakota Sandstone and Rio Salado Tongue of the Mancos Shale. In northwest Socorro County locally includes overlying Tres Hermanos Formation
- Kgc - Greenhorn Formation and Carlile Shale, undivided; locally includes Graneros Shale
- Kc - Carlile Shale; limited to northeastern area; Turonian-Coniacian
- Kgg - Graneros Shale and Greenhorn Formation; limited to northeastern area; lower Turonian and Cenomanian
- Kgh - Greenhorn Formation; limited to northeastern area. The Upper member (Bridge Creek Limestone) can be traced into western area where it is commonly shown as a bed-rank unit in Mancos Shale on detailed maps
- Kgr - Graneros Shale; limited to northeastern area; Cenomanian
- Kdm - Intertongued Dakota-Mancos sequence of west-central New Mexico; includes the Whitewater Arroyo Tongue of Mancos Shale and the Twowells Tongue of the Dakota
- Kd - Dakota Sandstone; includes Oak Canyon, Cubero, and Paguate Tongues plus Clay Mesa Tongue of Mancos Shale; Cenomanian
- Kdg - Dakota Group of west-central and northeast New Mexico; in ascending order, Mesa Rica Sandstone, Pajarito Shale, and Romeroville Sandstone; includes the underlying Tucumcari Shale in Tucumcari area and Glencairn Formation in Union County. Encompasses both Upper and Lower Cretaceous rocks
- Kbm - Mancos Formation and Beartooth Quartzite (and Sarten Sandstone); Mancos includes what was formerly referred to as Colorado Shale which in turn may include equivalents of Tres Hermanos Formation
- Kl - Lower Cretaceous, undivided; in northern Lea and Roosevelt Counties includes equivalents of Tucumcari Shale. In Cornudas Mountains includes Campagrande, Cox and other Washita Group formations. At Cerro de Cristo Rey includes several Fredericksburg and Washita Group formations, and the Boquillas Formation; Cenomanian. In the southwest includes Hell-To-Finish, U-Bar, and Mojado Formations which are equivalent to Bisbee Group of Arizona



JURASSIC

- J - Jurassic rocks, Middle and Upper, undivided
- Jm - Morrison Formation; Upper Jurassic nonmarine rocks present only in northern one-third of state
- Jmsu - Morrison Formation and upper San Rafael Group
- Jz - Zuni Sandstone; consists of undivided equivalents of the Summerville Formation and Bluff Sandstone; restricted to Zuni Basin area
- Jze - Zuni and Entrada Sandstones, undivided
- Je - Entrada Sandstone, Middle Jurassic; Callovian
- Jsr - San Rafael Group; consists of Entrada Sandstone, Todilto and Summerville Formations, Bluff Sandstone, and locally Zuni Sandstone (or only Acoma Tongue of Zuni)



PRECAMBRIAN

- Zi - Upper Proterozoic; mafic dikes
- Yi - Middle Proterozoic; mafic dikes, diabase, metadiabase, metadiorite mainly of Burro Mountains; age not well constrained
- Ys - Middle Proterozoic sedimentary rocks of the Sacramento Mountains
- Yp - Middle Proterozoic plutonic rocks (younger than 1600 Ma)
- YXp - Middle and Lower Proterozoic plutonic rocks, undivided
- X - Lower Proterozoic rocks, undivided
- Xms - Lower Proterozoic metasedimentary rocks (1650-1700 Ma). Essentially equivalent to Hondo Group; locally includes high-grade quartzite-pelitic schist of unknown age
- Xm - Lower Proterozoic metamorphic rocks, dominantly felsic volcanic, volcaniclastic and plutonic rocks (1650-1700+ Ma); includes Vadito Group; locally includes high-grade felsic gneisses of unknown age
- Xp - Lower Proterozoic plutonic rocks (older than 1600 Ma)
- Xmo - Lower Proterozoic metamorphic rocks, dominantly mafic (1720-1760 Ma)
- Xmu - Lower Proterozoic metamorphic rocks, undivided

GEOLOGIC MAP of NEW MEXICO

compiled by

O.J. Anderson, G.E. Jones, and G.N. Green

USGS Open-File Report OF-97-52

Digital data base by G.N. Green and G.E. Jones

New Mexico Bureau of Mines and Mineral Resources
U.S. Geological Survey, Department of the Interior

1997

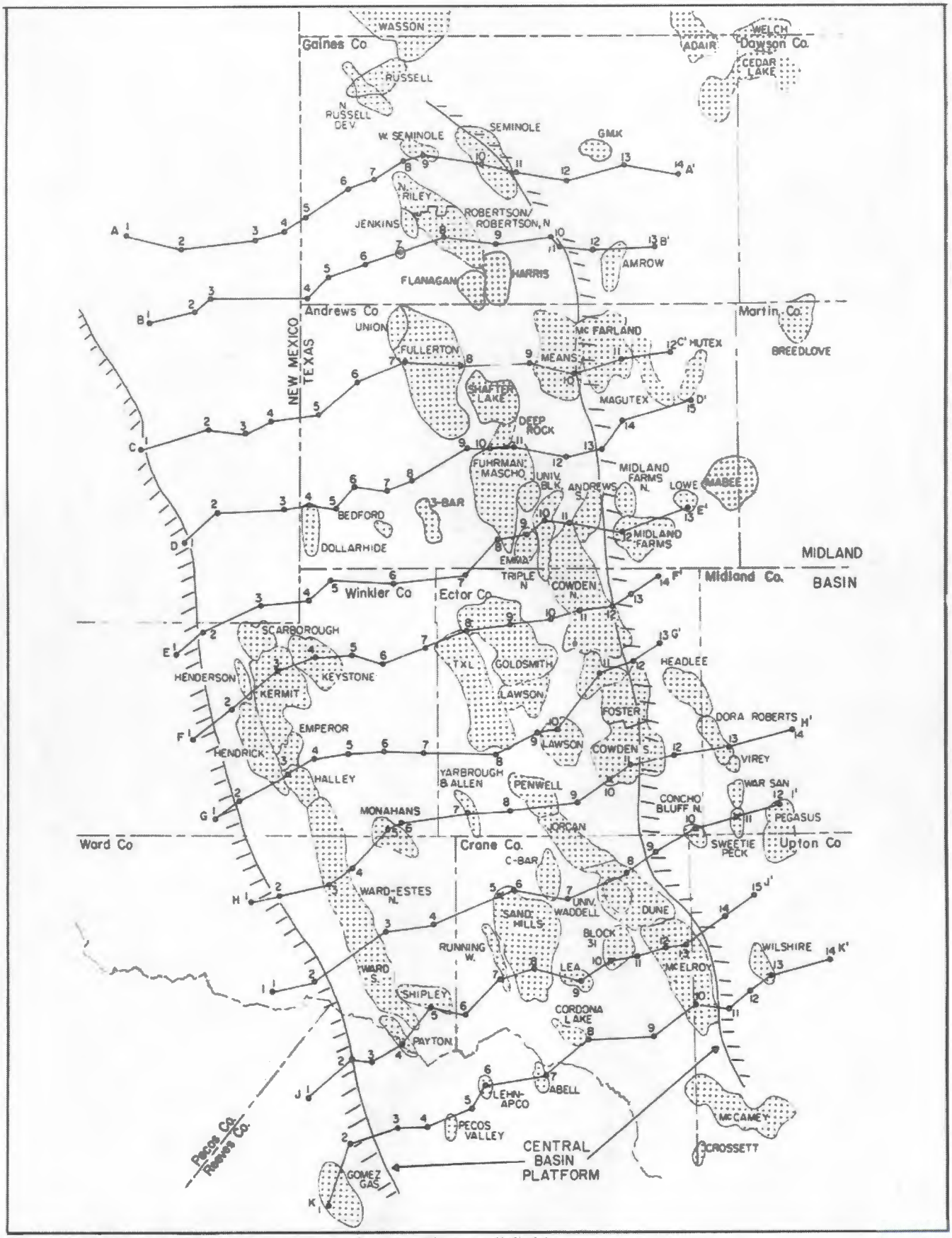
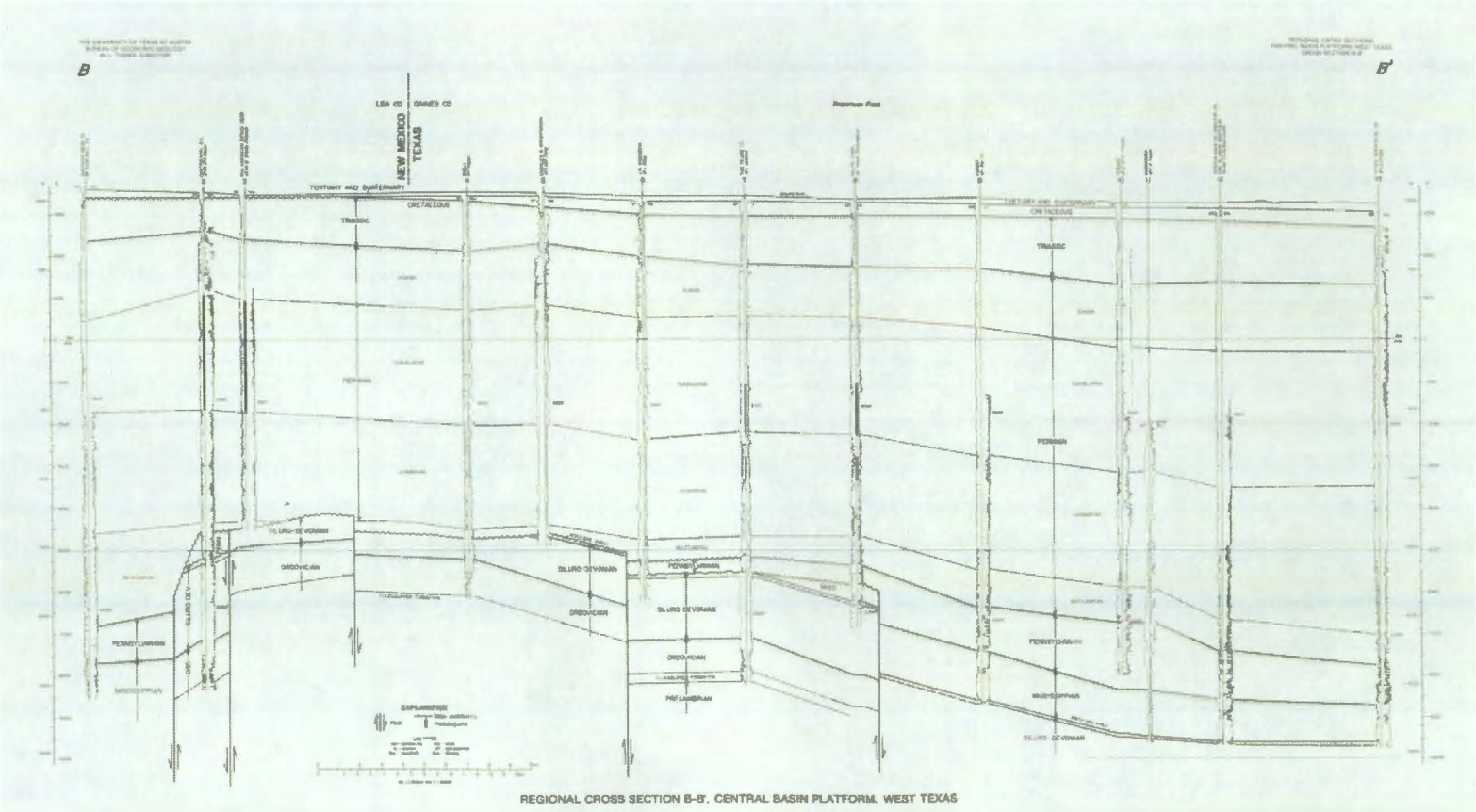


Figure 2. Location of cross sections and major Texas oil fields.



REGIONAL CROSS SECTION B-B', CENTRAL BASIN PLATFORM, WEST TEXAS

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-679

INTRODUCTION

The High Plains aquifer in southeastern New Mexico is part of a regional aquifer system extending from South Dakota on the north through Wyoming, Colorado, Nebraska, Kansas, and Oklahoma, to Texas and New Mexico on the south. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, primarily of Quaternary age. Alluvium and eolian deposits hydraulically connected with the Ogallala are included in the High Plains aquifer in New Mexico.

During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the regional effects of its long-term development and to develop and evaluate computer models for simulation of an aquifer response to alternative changes in ground-water management programs (Weeks, 1978). This report presents some of the hydrologic information compiled for the New Mexico part of that study.

The High Plains aquifer is the principal source of water in southeastern New Mexico because of its areal extent and the relatively large yields of water to wells completed in the aquifer. The aquifer commonly yields 100 to 500 gallons per minute and locally yields as much as 1,500 gallons per minute to wells. The agricultural economy that exists in the eastern one-third of southeastern New Mexico has expanded significantly because of this major source of water.

The increased use of water from the aquifer has created concern about its dependability for future supplies. If the water is to be used beneficially on a controlled period of time, water users and managers must understand the physical regime, the regional climate, and the effect of these elements on the system and manage the system accordingly.

LOCATION AND GENERAL FEATURES

The High Plains aquifer underlies most parts of the eastern one-fourth of New Mexico (index map) and is the principal aquifer in Lea, Roosevelt, and Curry Counties. The aquifer has an areal extent of about 7,900 square miles. Physiographically the area is mainly salient plains and intermontane slopes. Although locally the surface is irregular, the regional slope is upward at 5 to 30 feet per mile. Large areas on the upland plains are concentratedly flat, featureless, and undrained. Much of the surface has very broad gentle swells or low hills, shallow depressions, and some deep-rooted areas. Streams during the plains are all ephemeral flowing only for short periods during and after intense rainfall.

INDEX MAP SHOWING LOCATION OF THE HIGH PLAINS AQUIFER (SHADED) AND STUDY AREA IN NEW MEXICO

METRIC CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
inch	25.40	millimeter
foot	0.3048	meter
foot per mile	0.1894	meter per kilometer
foot per day	0.3048	meter per day
mile	1.609	kilometer
acre	0.4047	hectare
square mile	2.590	square kilometer
gallon per minute	0.06309	liter per second

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows: °C=5/9 (°F-32)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level." NGVD of 1929 is referred to as sea level in this report.

CLIMATE

The semiarid climate of the area is characterized by an average annual precipitation ranging from about 14 to 17 inches, a rapid rate of evaporation, little cultivated humidity, a relatively small cloudiness, warm summers days and cool nights, and moderate winters with some severe cold periods. Winter snowfalls and snow cover usually are light and of short duration.

Precipitation records indicate the precipitation usually decreases from east to west and from south to north across the study area. Altitude, precipitation, and temperature data at nearby area are shown in the following table:

Climatological data, 1966, for eastern slope Sierra de Sacramento

Station	Altitude at index above sea level	Average annual precipitation in inches	Average annual temperature, in degrees Fahrenheit
Carlsbad	3,380	12.07	67.4
Hermosa	4,240	15.40	60.0
White	4,350	17.55	57.2
Elkins	5,010	16.06	59.3

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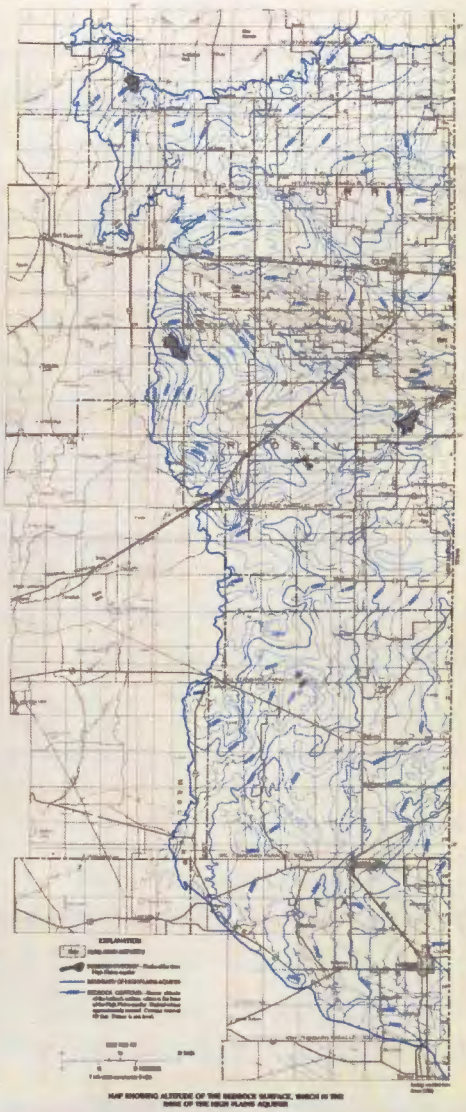


MAP SHOWING ALTITUDE OF THE BEDROCK SURFACE, WHICH IS THE BASE OF THE HIGH PLAINS AQUIFER

GEOLOGY

The High Plains aquifer in New Mexico is underlain by rocks of Triassic, Jurassic, and Cretaceous age. The surface depicted by contours on the adjacent map represents the configuration of the buried bedrock surface. The pre-Quaternary rocks underlying the basin of the High Plains aquifer and is useful in determining the thickness of the overlying deposits and in studying the erosional drainage pattern and mode of deposition of the materials that comprise the High Plains aquifer. Data from several thousand well and test hole logs were used in constructing the contours showing the base of the High Plains aquifer. In some areas, data are adequate to define in detail the complex surface of the rocks beneath the High Plains aquifer, but in other areas the surface is only approximately defined because detailed data are not available. The contours on the bedrock surface map are the generally smoothed-out surface of the bedrock surface and the modified-out structural relief of the pre-Tertiary drainage.

The configuration of the bedrock surface underlying the High Plains aquifer affected the depositional pattern and the thickness of the overlying strata and subsequently affected ground-water flow through the aquifer. The slope of the bedrock surface ranges from 10 to 30 feet per mile and averages about 15 feet per mile.

The Triassic, Jurassic, and Cretaceous rocks that directly underlie the High Plains aquifer are unexposed primarily of shale, sandstone, siltstone, and clay ground conditions. In addition, there are some Triassic rocks composed of caliche in rocky outcrop ground conditions, conglomerate, limestone, and gypsum.

The High Plains aquifer, as defined in this report consists of one or more hydraulically connected geologic units of the late Tertiary or Quaternary age. These units overlie the bedrock surface depicted on the adjacent map. The major of late Tertiary age consist of the Ogallala Formation, and the Quaternary deposits consist of alluvial, dune sand, and valley-fill deposits. The thickness of the High Plains aquifer ranges from 0 to about 600 feet. The Ogallala is the principal geologic unit in the High Plains aquifer, however, the alluvial deposits are significant in the southern part of Roosevelt County.

The Ogallala Formation is mostly unconsolidated clay, silt, fine- to coarse-grained sand, and gravel. Some caliche is present near the top and locally within the formation. Where the Ogallala was deposited, aggrading streams filled valleys eroded deep into pre-Ogallala rocks. Buried remnants thereof may exist from the mountains to central and southern New Mexico transporting rock debris, which was deposited as a heterogeneous mixture of unconsolidated material. There is evidence that the upper part of the Ogallala in southeastern New Mexico may contain a considerable thickness of caliche-like materials as well (C. V. Theis, U.S. Geological Survey, oral commun., 1968). In the upper part of the Ogallala Formation the materials have been cemented, chiefly by calcium carbonate, to form single or multiple beds of caliche. The degree of cementation varies greatly, and the thickness of the beds ranges from a few inches to 10 feet. Because the caliche is resistant to erosion, it forms the capping escarpment along the northern and western boundaries of the High Plains in this area.

The unconsolidated Quaternary alluvial and valley-fill deposits, like the Ogallala Formation, consist of clay, silt, sand, and gravel. These units primarily are derived from reworked Ogallala material. The alluvial channels are believed to have a maximum thickness of about 100 feet in the southwestward trending Portales Valley area in Roosevelt County. The valley is about 50 miles long and reaches a maximum width of about 20 miles. Although the basal fill valley is as much as 600 feet lower than the surrounding terrain, there is no surface valley. Low-gentle sloping the main stream system that cross alluvium of several cycles of valley-fill deposits may be located at successive sites on the High Plains, but these deposits generally are not thick enough to extend down to the water table and are thus poorly saturated.

Dune sand deposits of Quaternary age, consisting predominantly of very fine to medium-grained unconsolidated sand, are part of the High Plains aquifer. The most extensive area of dune sand is in northeastern Roosevelt and northern Curry Counties where the dune-sand deposits are parallel to and overlie the northern edge of the Portales Valley. The dune area is about 50 miles long and ranges from about 5 to 15 miles wide. A few of the dunes reach heights of 40 feet, but most are considerably lower. Many of the older dunes are stabilized and have some vegetation on them; however the active dunes have a typical dune topography with an absence of vegetation. The active dunes generally are less than 30 feet high.

GROUND WATER IN THE HIGH PLAINS AQUIFER

CONFIGURATION OF THE WATER TABLE

The configuration of the water table in the High Plains is shown on the adjacent map. The aquifer intersects on the map is the physical limit of the various geologic units comprising the High Plains aquifer. Water level data for this map were obtained during the winter of 1978, when the effects of seasonal pumping for irrigation were at a minimum.

Hydraulic interconnection between geologic units that comprise the High Plains aquifer is sufficient to permit maintaining a continuous water table throughout most of the area. The degree of hydraulic interconnection may vary from place to place, and, locally, water under confining beds may have a water level representative of an artesian-pressure surface because of clay lenses within the aquifer. However, from a regional aspect, water table conditions prevail in the aquifer.

The aquifer is not saturated in some areas, as the saturation relationship shown between with the principal water body. Isolated wells located in the shaded area on the water table map may penetrate saturated High Plains sediments or basal channels or caliche-like bedrock. As depicted on the map, the water table is discontinuous throughout an area of about 2,540 square miles.

The water table map shows a general southeastward slope of the water table across the High Plains. The general direction of ground-water movement is at right angles to the water table contours, in the direction of slope. Typically, the slope of the water table is between 20 and 30 feet per mile. The configuration of the water table is controlled by several factors, including: (1) Slope of the base of the aquifer, (2) changes in the thickness and hydraulic conductivity of the saturated materials, (3) natural discharge of ground water by springs and seeps, (4) withdrawal of ground water by wells, and (5) recharge by infiltration of water through permeable overlying beds. Typically, closely spaced contours indicate closely drawing water wells, which may be the result of less permeable aquifer material, decreased thickness of the water-bearing materials, steeply sloping bedrock surface, or a combination of these factors. Flattening of the gradient indicated by the widely spaced contours may be due to increased permeability of the aquifer materials, increased thickness of the water-bearing materials, or both.

Up-gradient fissures of water table contours generally are indicative of the effects of ground-water withdrawals as the aquifer becomes more nearly in fissured from areas of depression that disturb the general flow pattern. Up-gradient fissures may also be the result of zones of increased permeability like valley water to migrate through the zone and where the data were scarcely fissured from adjacent less permeable areas. An example of this condition is in the Portales Valley in Roosevelt County. This effect is magnified in the Portales Valley because a large concentration of irrigation wells creates a regional zone of depression.

Down-gradient fissures or increased quantity of water-bearing zones without recharged by collection of water through overlying beds. An example of this type of contour indication is shown on the eastern map and extends with the southern area in northeastern Roosevelt and southeastern Curry Counties. Because of the bedrock surface map. Down-gradient fissures also may be caused by a topographic high fold in the underlying bedrock surface. An example of this feature is shown in the area near Caprock in eastern Lea County on the bedrock surface map.

SATURATED THICKNESS

The saturated thickness in the High Plains aquifer ranges from 0 to slightly more than 300 feet. Areas having the greatest saturated thickness are northeast of Clovis in Curry and Roosevelt Counties and in the vicinity of Lovington and Tatum in Lea County. The saturated thickness at any point may be estimated by subtracting the altitude of the water table from the altitude of the water table at that point.

An area of about 2,100 square miles, mostly in southeast Lea County and southeast and southern Roosevelt Counties, does not have significant saturated thickness except in narrow Ogallala-filled bedrock channels and depressions. In these areas only the basin saturation in the High Plains aquifer underneath, well, cannot be relied with assurance of obtaining water from the aquifer.

HYDRAULIC PROPERTIES

Hydraulic conductivity and specific yield are two hydrologic properties that were estimated during the course of the study. The hydraulic conductivity may be defined as the volume of water at the existing prevailing viscosity that will move in unit time uniform unit hydraulic gradient through a unit area measured at right angles to the direction of flow. The specific yield may be defined by the volume of water that a saturated rock will yield by gravity divided by the volume of the rock.

Hydraulic properties of the aquifer were estimated by using existing aquifer-test data published in previous reports and by using the results of tests. Based on aquifer tests conducted in the High Plains aquifer and laboratory grain-size analysis, empirical relationships were developed to estimate values of hydraulic conductivity and specific yield for various grain-size materials in the aquifer. Lithologic logs were examined and values were assigned to the various intervals of clay, silt, sand, and gravel in that part of the log representing the saturated zone. Intervals of 127 fully penetrating logs and 1129 partially penetrating logs were made in this manner. The results indicated the High Plains aquifer in Lea County and the southern part of Roosevelt County has a hydraulic conductivity ranging from 25 to 125 feet per day with an average hydraulic conductivity of about 50 feet per day. The results also indicate that the aquifer in northern Roosevelt, Curry, and Quay Counties has a hydraulic conductivity ranging from 75 to 200 feet per day with an average hydraulic conductivity of about 90 feet per day. The evaluation of the lithologic logs indicated that the aquifer has a specific yield ranging from about 0.05 to .20 with an average of about 0.15.

RECHARGE

The quantity of annual recharge to the aquifer from precipitation was not determined; however, previous work by Theis (1937, 1938, 1963), which utilized annual rainfall, determined recharge to be less than 0.5 inch per year. Only 3 to 5 percent of the precipitation falling on the High Plains reaches the water table, the remainder is returned to the atmosphere by evapotranspiration.

MAP SHOWING ACTIVITIES AND CONFIGURATION OF THE WATER TABLE FOR THE HIGH PLAINS AQUIFER, 1978

IRRIGATION DEVELOPMENT AND WATER-LEVEL CHANGE

Irrigation began in the High Plains before 1900 by farmers irrigating small plots of land using centrally. Irrigation increased slowly and was relatively insignificant until about 1940. Rapid development of irrigated cropland began about 1940 and continued at a relatively constant rate until 1978 as indicated in the graph below. Irrigated cropland increased from about 15,000 acres during 1940 to about 400,000 acres during 1978. The total calculated irrigated during any year may be 20 to 40 percent less than the potentially available amounts due to crop rotation, precipitation during growing seasons, or economics.

The irrigated area, by counties, within the boundaries of the High Plains is shown in the adjacent graph. Curry County has developed about 200,000 acres of irrigation, Roosevelt County about 120,000, Lea County about 110,000, and Quay County about 12,000 acres. Records, the most rapid increase in irrigated land has been occurring in Curry and Roosevelt Counties.

Prior to large-scale development of irrigation, the High Plains ground-water system was in a state of dynamic equilibrium, with long-term recharge equal to long-term discharge. Irrigated farming on the High Plains has significantly increased the quantity of water discharged from the system. Increased discharge has resulted in a lowering of the water level as water is removed from storage in the aquifer. The removal of water from storage, or ground-water mining, is most evident in those greatest areas where irrigation wells are numerous and relatively extensive: (1) Portales Valley, (2) Portales Valley, and (3) southeastern Curry County.

The distribution of irrigated acreage and the decline in water level from predevelopment conditions in 1950 are shown on the water-level decline map, which illustrates the areal extent of water-level declines and the relative rate of irrigated areas to this decline. The greatest decline in water level is in southern County where wells have declined more than 100 feet since the New Mexico Texas border. Water levels in the Portales Valley and in eastern Lea County locally have declined more than 60 feet. Water level declines of 20 to 60 feet are common in all of these areas where irrigation wells are concentrated.

The water level is shallow Lea County, has been declining as much as 2 feet per year and is declining at an average rate of 1 foot per year. The water level in Portales Valley has declined as much as 2.5 feet in 1 year and is declining at an average rate of 2 feet per year. The water level in southeastern Curry County has declined as much as 4 feet in 1 year and is declining at an average rate of 1 foot per year.

Hydrographs, which are graphical representations of water level changes with time over a well, are shown adjacent to the water-level-decline map for wells in areas that are extensively developed for irrigation. Many of the wells exhibit continuing declines of water level and little or no continuous water level decline. The wells for which hydrographs are shown are located on the water level decline map.

Continuous long-term withdrawals of water from the High Plains aquifer will result in a continuing decline in the water table. The annual likely to be most affected are those bordering the non-irrigated High Plains deposits and areas where well spacings relatively less dimensional water. Removal of ephemeral well yield and structural power costs. Irrigation may become uneconomical in some parts of the area.

WATER QUALITY IN THE HIGH PLAINS AQUIFER

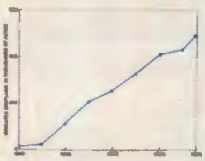
All natural water contains mineral matter dissolved from rock and soil with which it has come in contact. The quantity and kind of dissolved mineral matter in ground water depends on the type of rocks or soil through which the water has passed and the presence and properties. In addition to natural causes, water pollution from such points, improperly sealed wells, and irrigated cropping may affect the chemical quality of the ground water.

The chemical composition of water is an important factor in determining its utility because the quality of the water ideally should not adversely affect the use, product, or the land irrigated. The suitability of water for domestic, municipal, stock, industrial, or irrigation use is in part determined by the standard table concentration. Standards governing the chemical quality of water for public supplies have been established by the U.S. Environmental Protection Agency (1976, 1977). These standards place an upper limit of 500 milligrams per liter on the dissolved-solids concentration of drinking water unless more quality is not available. Such have also been placed on concentrations of numerous other selected chemical constituents. Chemical-quality diagrams and concentrations of dissolved substances entered wells are shown on the water-quality map.

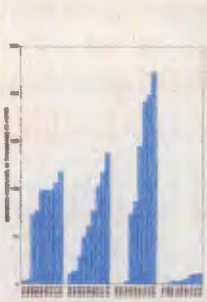
Water for stock also is subject to quality limitations. However most records apparently are tolerant water that would be considered unsatisfactory for people (Hem, 1970, p. 268).

The usefulness of water for irrigation is also governed by its chemical quality (Hem, 1970, p. 269-283). The chemical-quality characteristics, or the specific conductance, along with the relative proportion of sodium to calcium plus magnesium (called sodium-adsorption ratio or SAR) are used to evaluate the suitability of water for irrigation. Important factors other than salinity and/or sodium are the types and drainage characteristics of the soil, quantity of water applied, and salt-to-mineral tolerances of crops. Water that may not be chemically suitable for use on normal or relatively impermeable soil may be used on permeable, well-drained soils where rapid leaching is possible.

Water in the High Plains aquifer generally is suitable for domestic, municipal and irrigation use, but the water typically has large concentrations of calcium, magnesium, and bicarbonate and in some areas may contain objectionable large concentrations of fluoride or chloride. Where sulfate concentrations of dissolved-mineral constituents most commonly are present in some or areas where the underlying bedrock may be contributing small quantities of water encountered water to the aquifer. The water likely to occur in southeastern Lea and southern Roosevelt Counties where the High Plains aquifer overlies rocks of Cretaceous age.

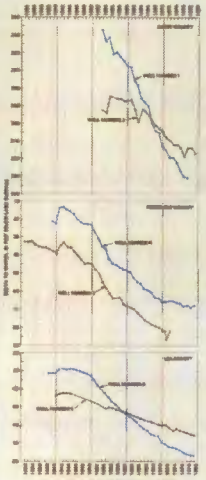


GRAPH OF ESTIMATED TOTAL IRRIGATED CROPLAND, INCLUDING FALLOW LAND IN CROP ROTATION, 1940–78



GRAPH OF ESTIMATED IRRIGATED CROPLAND, INCLUDING FALLOW LAND IN CROP ROTATION, BY COUNTIES 1940–78

MAP OF DISTRIBUTION OF 1978 IRRIGATED ACREAGE AND WATER-LEVEL DECLINE FROM PREDEVELOPMENT TO 1978



HYDROGRAPHS SHOWING WATER-LEVEL FLUCTUATIONS IN WELLS, 1952–78

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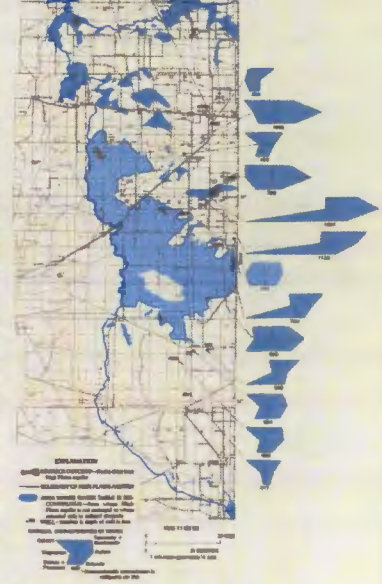
Weeks, J. B., and Gutentag, E. D. 1981, Bedrock geology, altitude of base, and 1980 saturated thickness of the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas HA-648, with 1:2,500,000, 3 sheets.



MAP SHOWING GENERALIZED WATER QUALITY IN THE HIGH PLAINS AQUIFER

GEOHYDROLOGY OF THE HIGH PLAINS AQUIFER IN SOUTHEASTERN NEW MEXICO

By

Donald L. Hart, Jr. and Douglas P. McAda

1985

Affidavit of Publication

STATE OF NEW MEXICO
COUNTY OF LEA

I, Daniel Russell, Publisher of the Hobbs News-Sun, a newspaper published at Hobbs, New Mexico, solemnly swear that the clipping attached hereto was published in the regular and entire issue of said newspaper, and not a supplement thereof for a period of 1 issue(s).

Beginning with the issue dated
December 05, 2018
and ending with the issue dated
December 05, 2018.

Publisher

Sworn and subscribed to before me this
5th day of December 2018.

Business Manager

My commission expires
January 29, 2019
(Seal)

OFFICIAL SEAL
GUSSIE BLACK
Notary Public
State of New Mexico
My Commission Expires 1-29-19

This newspaper is duly qualified to publish legal notices or advertisements within the meaning of Section 3, Chapter 167, Laws of 1937 and payment of fees for said

LEGALS

LEGAL NOTICE
DECEMBER 5, 2018

LEGAL NOTICE December 5, 2018 Public Notice for Alice Paddock #4 (API: 30-025-09940) Rice Operating Company, 122 West Taylor, Hobbs, Nm 88240 (575) 393-9174 Contact Party: Hayden Holub (575) 393-9174. The intended purpose of this well is for disposal of produced water associated with oil and gas production activities. This well is a permitted disposal well into the San Andres formation. This application is made to utilize the well for commercial use. The location of the well is 1980 feet from the North Line and 1980 feet from the East Line of Section 1, Township 22S, Range 37E, which is in the SW/4 of the NE/4 of the aforementioned section, Lea county. The formation name is the San Andres; injection intervals to be between a depth of 4,000' to 5,000'; a maximum injection rate of 20,000 barrels per day with maximum pressure of 1000 PSI, or maximum allowed by the NMOCD. Interested parties must file objections or request a hearing with the Oil Conservation Division, 1220 South St. Francis Dr., Santa Fe, New Mexico 87505, within 15 days, by Tuesday the 19th of December
#33502

01104367 00221923

BEGIE BONDS
RICE OPERATING COMPANY
112 WEST TAYLOR
HOBBS, NM 88240

SURFACE OWNER, GRAZING LESSEE, LEASE OWNER,

AND OFFSET OPERATORS

Alice Paddock #4

1980' FNL AND 1980' FEL, SEC. 1, T22S, R37E

LEA COUNTY, NM

Surface Owner of Well Site

State of New Mexico
Commissioner of Public Lands
Attention: Faith Crosby
PO Box 1148
Santa Fe, NM 87504

Walco Ranch, LLC
Attention: Bob Wallach
PO Box 790
Hobbs, NM 88241

Grazing Lessee of Well Site

Lease #GR-1855-0000
Walco Ranch, LLC
PO Box 790
Hobbs, NM 88241

Operators of Record

Chevron USA, Inc.
Attention: Linda McMurry
6301 Deauville Blvd.
Midland, TX 79706

Apache Corporation
Attention: Reesa Fisher
303 Veterans Airpark
Suite #1000
Midland, TX 79705

Marathon Oil Company
Attention: Frank Krugh
PO Box 552
Midland, TX 79701

Southwest Royalties, Inc.
Attention: Lindsay Livesay
PO Box 53570
Midland, TX 79710

Pierce Production Co., LLC.
PO Box 1969
Eunice, NM 88231

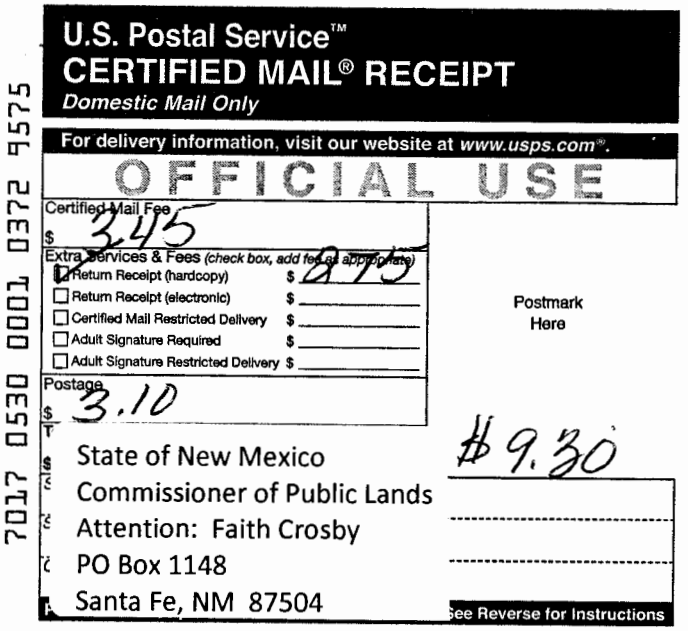
Oil & Gas Lessees of Record

Apache Corporation
Attention: Reesa Fisher
303 Veterans Airpark
Suite #1000
Midland, TX 79705

RICE *Operating Company*

112 West Taylor • Hobbs, New Mexico 88240
Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018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For delivery information, visit our website at www.usps.com®.
OFFICIAL USE
Certified Mail Fee $ 3.45
Extra Services & Fees (check box, add fee as appropriate)
Return Receipt (hardcopy) $ 2.75
Return Receipt (electronic) $
Certified Mail Restricted Delivery $
Adult Signature Required $
Adult Signature Restricted Delivery $
Postage $ 3.10
Total Postage and Fees $ $9.30
Postmark Here
State of New Mexico
Commissioner of Public Lands
Attention: Faith Crosby
PO Box 1148
Santa Fe, NM 87504
See Reverse for Instructions
7017 0530 0001 0372 9575

State of New Mexico
Commissioner of Public Lands
PO Box 1148
Santa Fe, NM 87504

RE: Allice Paddock #4 SWD
U/L G, Section 1, T22S, R37E
1980' FNL and 1980' FEL
Lea County, NM

To Whom it May Concern:

In accordance with the Rules and Regulations of the Oil Conservation Division of the State of New Mexico, you are being provided a copy of the C-108 Application for Authorization to Inject into the above captioned well.

Any questions about the permit can be directed to Hayden Holub at 575-393-9174. Any objections or request for hearing must be filed with the Oil Conservation Division within fifteen (15) days from the date received. The OCD address is 1220 S. St. Francis Dr., Santa Fe, NM 87505.

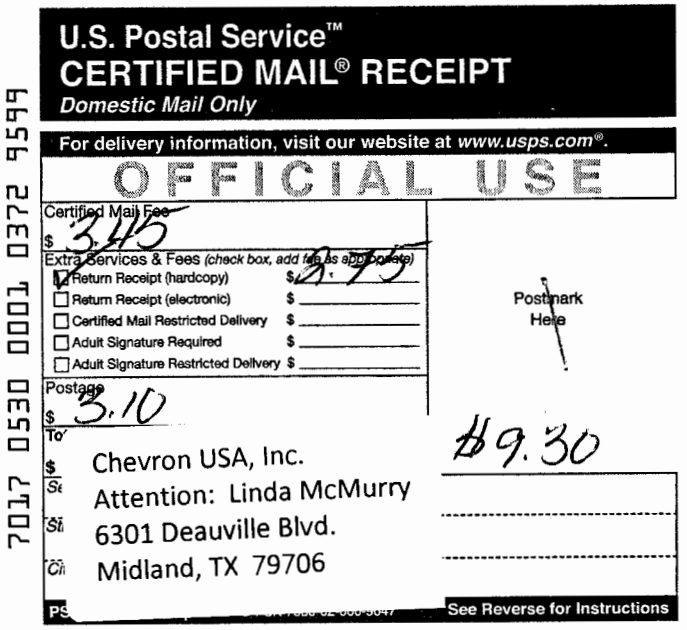
Thank You,

Hayden Holub
Manager
Rice Operating Company

RICE *Operating Company*

112 West Taylor • Hobbs, New Mexico 88240
Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018



Chevron USA, Inc.
Attention: Linda McMurry
6301 Deauville Blvd.
Midland, TX 79706

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Thank You,

Hayden Holub
Manager
Rice Operating Company

RICE *Operating Company*

112 West Taylor • Hobbs, New Mexico 88240
Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018

Walco Ranch, LLC.
Attention: Bob Wallach
PO Box 790
Hobbs, NM 88240

RE: Allice Paddock #4 SWD
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Hayden Holub
Manager
Rice Operating Company

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Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018

Apache Corporation
Attention: Reesa Fisher
303 Veterans Airpark
Suite #1000
Midland, TX 79705

RE: Allice Paddock #4 SWD
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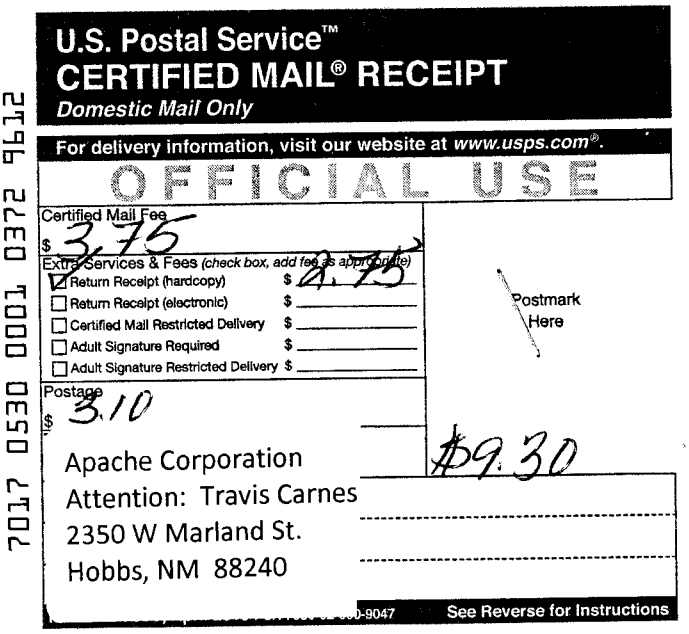
DECEMBER 20, 2018



Apache Corporation
Attention: Travis Carnes
2350 West Marland St.
Hobbs, NM 88240

RE: Allice Paddock #4 SWD
U/L G, Section 1, T22S, R37E
1980' FNL and 1980' FEL
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Thank You,

Hayden Holub
Manager
Rice Operating Company

wellname	api	section	township	range	unit	formation	ph	tds_mgL
SALADO DRAW 6 FEDERAL #001H	3002541293	6	26S	34E	M	BONE SPRING 3RD SAND	6.5	99612.7
RAGIN CAJUN 13 FEDERAL #001H	3002541259	13	26S	34E	N	DELAWARE-BRUSHY CANYON	6.2	194590.2
BELLOQ 2 STATE #002H	3001542895	2	23S	31E	C	WOLFCAMP	6.8	119471.8
HUGH #006	3002510262	14	22S	37E	H	TUBB	6.2	191032
WALTER LYNCH #002	3002509943	1	22S	37E	L	PADDOCK	7	75398
ANNIE CHRISTMAS #001	3002509937	1	22S	37E	N	BLINEBRY	5.8	133356
SOUTH PENROSE SKELLY #181	3002510119	8	22S	37E	N	GRAYBURG		16937
LANGLIE MATTIX PENROSE SAND UNIT	3002510497	28	22S	37E	J	QUEEN	9.01	50414.3
HAT MESA #001	3002524403	14	21S	32E	H	MORROW	6.4	271555
LOU WORTHAM #005	3002523606	11	22S	37E	C	SAN ANDRES	7.35	18587.3

RICE *Operating Company*

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DECEMBER 20, 2018

Marathon Oil Company
Attention: Frank Krugh
PO Box 552
Midland, TX 79701

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Thank You,

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Manager
Rice Operating Company

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Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018

Southwest Royalties
Attention: Lindsay Livesay
PO Box 53570
Midland, TX 79710

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U/L G, Section 1, T22S, R37E
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Manager
Rice Operating Company

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Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018

Pierce Production Co., LLC
PO Box 1969
Eunice, NM 88231

RE: Allice Paddock #4 SWD
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Manager
Rice Operating Company

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112 West Taylor • Hobbs, New Mexico 88240
Phone: (575) 393-9174 • Fax (575) 397-1471

DECEMBER 20, 2018

Oil Conservation Division
Attention: Michael McMillan
1220 South St. Francis Dr.
Santa Fe, NM 87505

RE: Allice Paddock #4 SWD
U/L G, Section 1, T22S, R37E
1980' FNL and 1980' FEL
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Thank You,

Hayden Holub
Manager
Rice Operating Company

C-108 Review Checklist: Received 12/24/2018 Add. Request: ______ Reply Date: ______ Suspended: ______ [Ver 15]

ORDER TYPE: WFX / PMX / (SWD) Number: ______ Order Date: ______ Legacy Permits/Orders: ______

Well No. 4 Well Name(s): Alice Paddock

API : 30-0 25-09946 Spud Date: JAN 22 1946 New or Old: O (*UIC Class II Primacy 03/07/1982*)

Footages 1980 FNL 1980 FEL Lot ___ or Unit G Sec 1 Tsp 22S Rge 37E County Lea

General Location: 2 miles SE/Eunice Pool: SWD; San Andres Pool No.: 96121

BLM 100K Map: JAL Operator: Rice Operating Company OGRID: 19174 Contact: Hayden Holub, operator

COMPLIANCE RULE 5.9: Total Wells: 14 Inactive: Ø Fincl Assur: OK Compl. Order? N/A IS 5.9 OK? ___ Date: ___

WELL FILE REVIEWED ✓ Current Status: P&A

WELL DIAGRAMS: NEW: Proposed ○ or **RE-ENTER:** Before Conv. ✓ After Conv. ✓ Logs in Imaging: Y

Planned Rehab Work to Well: Clean out plugs to 4966'

Well Construction Details	Sizes (in) Borehole / Pipe	Setting Depths (ft)		Cement Sx or Cf	Cement Top and Determination Method
Planned __or Existing __ **Surface**	17 1/2"/13 3/8"	258	**Stage Tool**	500	Surface/Visual
Planned__or Existing __ **Interm/Prod**	12 1/4/9 5/8"	2955		~~1321~~ 300	~~ES~~ /1300
Planned__or Existing __ **Interm/Prod**	8 3/4"/7"	5263		~~702~~ 765	TS /2365
Planned__or Existing __ **Prod/Liner**	6 1/4/7"	5710			4966 /CALC
** Planned__or Existing __ **Liner**					
Planned__or Existing __ **OH / PERF**	4000/5000		**Inj Length**		

Injection Lithostratigraphic Units:	**Depths (ft)**	**Injection or Confining Units**	**Tops**
Adjacent Unit: Litho. Struc. Por.		SA	4128
Confining Unit: Litho. Struc. Por.			
Proposed Inj Interval TOP:			
Proposed Inj Interval BOTTOM:			
Confining Unit: Litho. Struc. Por.			
Adjacent Unit: Litho. Struc. Por.			

Completion/Operation Details:

Drilled TD 6300 PBTD 4966

NEW TD ______ NEW PBTD 4[illegible]

NEW Open Hole ○ or NEW Perfs ✓

Tubing Size ______ in. Inter Coated? ______

Proposed Packer Depth 4307 ft

Min. Packer Depth 4400 (100-ft limit)

Proposed Max. Surface Press. ~~480~~ psi 1000 psi

Admin. Inj. Press. 881 (0.2 psi per ft)

AOR: Hydrologic and Geologic Information

POTASH: R-111-P N/A Noticed? ___ **BLM Sec Ord** ○ **WIPP** ○ *Noticed?* ___ **Salt/Salado** T/1450 B:2977 **NW: Cliff House fm** ___

FRESH WATER: Aquifer ______ Max Depth ______ **HYDRO AFFIRM STATEMENT By Qualified Person** ✓

NMOSE Basin: Capitan **CAPITAN REEF:** thru adj (NA) Permian **No. Wells within 1-Mile Radius?** 5 FW Analysis Y

Disposal Fluid: Formation Source(s) ______ Analysis? ______ On Lease ○ Operator Only ○ or Commercial ✓

Disposal Int: Inject Rate (Avg/Max BWPD): 4K/5K Protectable Waters? ______ Source: ______ System: Closed or Open

HC Potential: Producing Interval? ___ Formerly Producing? ___ Method: Logs/DST/P&A/Other ___ 2-Mile Radius Pool Map ○

AOR Wells: 1/2-M Radius Map? Y Well List? Y Total No. Wells Penetrating Interval: 14 Horizontals? N/A

Penetrating Wells: No. Active Wells 4 Num Repairs? ___ on which well(s)? ______ Diagrams? ___

Penetrating Wells: No. P&A Wells 10 (Include TA) (9) Num Repairs? ___ on which well(s)? ______ Diagrams? Y

NOTICE: Newspaper Date 12-05-2018 Mineral Owner NMSLO Surface Owner NMSLO N. Date 12-20-2018

RULE 26.7(A): Identified Tracts? ___ Affected Persons: SW Royalties, Pitch Production, Chevron, Apache, Marathon N. Date 12-20-2018

Order Conditions: Issues: Run a water test to determine TDS of water

Add Order Cond: ______

McMillan, Michael, EMNRD

From: Hayden Holub <hholub@riceswd.com>
Sent: Friday, January 11, 2019 12:18 PM
To: McMillan, Michael, EMNRD
Subject: [EXT] RE: Alice Paddock Well No. 4 API 30-025-09940

Mike,

Our plan, on completion, is now to do what we have done on majority of our swd wells. That is to turn down collars and slip 5 ½ csg to the inj int at 4407'and cement that in if OCD makes us.

We would love to inject through it if the 7" tests like we do at most of our facilities now. If anything ever happened we would NOT have to pull it and could cement it in place and that would act as the new casing and well bore, as well as fix any issue on the backside.

If that is an absolute no, then we really would appreciate running that 5 ½, with turn down collars, in as a brand new casing string (cement it in place) and have a new well bore. We would then mimic our other wells by running the 3 ½ IPC tubing and packer down to 4400'. Let me know what else you can use from me. Ill stick around the office.

To not slow up the permitting process do you prefer a WBD submitted today of that design or is Monday fine since you're in the process of confirming a few things. As you know there is only so much time to be had (lol) and I want to stay on top of this as much as possible and help you get through with this application.

Thank you and I appreciate working with you guys. You always seem to be pretty quick.

Hayden Holub
Rice Operating Co
575-441-0161

From: McMillan, Michael, EMNRD <Michael.McMillan@state.nm.us>
Sent: Friday, January 11, 2019 11:30 AM
To: Hayden Holub <hholub@riceswd.com>
Subject: RE: Alice Paddock Well No. 4 API 30-025-09940

http://octane.nmt.edu/gotech/

Go to this link

From: Hayden Holub <hholub@riceswd.com>
Sent: Friday, January 11, 2019 11:07 AM
To: McMillan, Michael, EMNRD <Michael.McMillan@state.nm.us>
Subject: [EXT] Re: Alice Paddock Well No. 4 API 30-025-09940

Is that meaning you want a 5 1/2" csg cemented into place and the tubing ran inside of that for injection?

As for as the inj, interval we were waiting to here back from the log reader for actual inj interval so we used a larger gap to be sure and cover our needs.

We de tend to drill back into that cement plug a touch and have good hole and out inj. interval will be 4407'-4950'

Once the well bore diagrams is resubmitted how long do you think it'll be before you guys will have approval on it?

By the way my heart is still racing from the initial email. I'll get ya back.

Sent from my iPhone

On Jan 11, 2019, at 10:41, McMillan, Michael, EMNRD <Michael.McMillan@state.nm.us> wrote:

> Hayden:
> OCD will not permit a 5-1/2-inch tubing inside the 7-inch casing.
> The OCD will permit a 4-1/2-inch tubing inside the 7-inch casing based on the well's spud date.
>
> Also, your newspaper ad states the injection interval from 4000-5000 feet.
> However, the top of the San Andres is 4128 feet.
>
> There is a cement plug at 4966 feet
> Your proposed packer setting depth is 4400 feet
>
> I assume your injection interval is from 4407-4950.
>
> Based on this you will be expected to submit a revised WBD
>
> Mike
>
> Mike
>
> Michael McMillan
> 1220 South St. Francis
> Santa Fe, New Mexico
> 505-476-3448
> Michael.mcmillan@state.nm.us