

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

APPLICATION OF OXY USA INC. FOR APPROVAL OF A PRESSURE  
MAINTENANCE PROJECT, EDDY COUNTY, NEW MEXICO.

EP7 01/20/19 4:11:59

CASE NO. 20449

APPLICATION

OXY USA Inc. (“OXY”), through its undersigned attorneys, hereby files this application with the Oil Conservation Division for an order approving a pressure maintenance project in the Bone Spring formation underlying a project area comprised of the S/2 N/2 and the S/2 of Section 15, Township 24 South, Range 29 East, NMPM, Eddy County, New Mexico. In support of its application, OXY states:

1. OXY USA Inc., (OGRID No. 16696) is the operator of the following horizontal wells drilled and completed in the Pierce Crossing Bone Spring, East Pool (Pool Code 96473) underlying Section 15, Township 24 South, Range 29 East, NMPM, Eddy County, New Mexico:

- The Cedar Canyon 15 2H well (30-015-41032) dedicated to the S/2 S/2 of Section 15;
- The Cedar Canyon 15 3H well (30-015-41594) dedicated to the N/2 S/2 of Section 15; and
- The Cedar Canyon 15 4H well (30-015-41291) dedicated to the S/2 N/2 of Section 15.

2. OXY seeks approval to inject produced gas, produced water and carbon dioxide into the Bone Spring formation through the **Cedar Canyon 15 3H well** at total vertical depth of approximately 8736 feet to approximately 8810 feet along the horizontal portion of the wellbore. Oxy anticipates injection into this well will provide pressure maintenance support for the offsetting Cedar Canyon 15 2H and Cedar Canyon 15 4H wells.

3. Oxy seeks authority to inject produced gas, produced water and carbon dioxide at the following maximum surface injection pressures:

Produced gas:	4,350 psi
Produced water:	1,745 psi
Carbon dioxide:	2,300 psi

The source of the produced gas and the produced water will be the Bone Spring and Delaware formations. The source of the carbon dioxide is unknown.

4. Oxy seeks permission to place the packer in the vertical portion of the production casing at a depth of approximately 7,900 feet. This location will be below the top confining barrier of the injection interval, but more than 100-foot above the first perforations in the horizontal portion of the wellbore.

5. Oxy requests allowance to use unlined tubing during gas injection. During water injection, lined tubing will be utilized. This relief has previously been approved by the Division for a similar injection project. *See* Order R-14322.

6. A copy of the Form C-108 for this injection project is provided with this application as Attachment A.

7. A copy of this Application has been provided to all affected parties as required by Division Rules and notice of the hearing on this application will be provided in a newspaper of general circulation in Eddy County.

8. Approval of this pressure maintenance project will result in the production of substantially more hydrocarbons from the project area than would otherwise be produced, will prevent waste and will not impair correlative rights.

WHEREFORE, OXY USA, Inc. requests that this application be set for hearing before an Examiner of the Oil Conservation Division on May 2, 2019, and, after notice and hearing as required by law, the Division approve this application.

Respectfully submitted,

HOLLAND & HART LLP

By: 

Michael H. Feldewert

Adam G. Rankin

Julia Broggi

Post Office Box 2208

Santa Fe, New Mexico 87504-2208

(505) 988-4421

(505) 983-6043 Facsimile

[mfeldewert@hollandhart.com](mailto:mfeldewert@hollandhart.com)

[agrarkin@hollandhart.com](mailto:agrarkin@hollandhart.com)

[jbroggi@hollandhart.com](mailto:jbroggi@hollandhart.com)

**ATTORNEYS FOR OXY USA, INC.**

20149  
Case No.: **Application of OXY USA Inc. for Approval of a Pressure Maintenance Project, Eddy County, New Mexico.** Applicant in the above-styled cause seeks an order approving a pressure maintenance project in the Bone Spring formation (Pierce Crossing, Bone Spring, East Pool (96473)) underlying a project area comprised of the of the S/2 N/2 and the S/2 of Section 15, Township 24 South, Range 29 East, NMPM, Eddy County, New Mexico. Produced gas, produced water and carbon dioxide may be injected into the Bone Spring formation through the **Cedar Canyon 15 3H well** (API No. 30-015-41594) at total vertical depth of approximately 8736 feet to approximately 8810 feet along the horizontal portion of the wellbore. Oxy seeks approval to inject at the following surface injection pressures:

Produced gas:	4,350 psi
Produced water:	1,745 psi
Carbon dioxide:	2300 psi

The source of the produced gas and produced water will be the Bone Spring and Delaware formations. The source of the carbon dioxide is unknown. Oxy also seeks an exception to the packer setting depth for these injection wells and for allowance to use unlined tubing. The proposed project is located approximately nine miles southeast of Loving, New Mexico.

**APPLICATION FOR AUTHORIZATION TO INJECT**

- I. PURPOSE: \_\_\_\_\_ Secondary Recovery  Pressure Maintenance \_\_\_\_\_ Disposal \_\_\_\_\_ Storage  
Application qualifies for administrative approval? \_\_\_\_\_ Yes  No
- II. OPERATOR: OXY USA INC  
ADDRESS: P.O. Box 4294 HOUSTON, TX 77260  
CONTACT PARTY: KELLEY MONTGOMERY PHONE: 713-366-5716
- 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  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: KELLEY MONTGOMERY TITLE: REGULATORY MGR.

SIGNATURE: Kelley Montgomery DATE: 2/22/19

E-MAIL ADDRESS: Kelley-montgomery@oxy.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: \_\_\_\_\_

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

ATTACHMENT A

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C-108 Application  
OXY USA Inc.  
Cedar Canyon 15 3H  
Eddy County, NM

- I. This is a pressure maintenance injection project.
- II. OXY USA Inc.  
P.O. Box 4294  
Houston, TX 77210  
Contact Party: Kelley Montgomery, Oxy (713) 366-5716
- III. Injection well data sheet and wellbore schematic diagram has been attached for the injection well covered by this application.
- IV. This is not an expansion of an existing project.
- V. The map with a two-mile radius surrounding this injection well and a one-half mile radius for area of review is attached.
- VI. The tabular format of the area of review is attached.
- VII. The proposed operations data sheet is attached.
- VIII. Please see attached signed statement on geologic data for the Bone Spring formation.
- IX. The injection well is an existing horizontal producing well that was hydraulically fractured with 308,883 gal of slick water, 34,444 gal of 15% HCL and 2,425,247 gal of 15# BXL with 3,578,420# of sand.
- X. Logs were filed for the existing well at the time of drilling.

Well Name	Date Submitted
Cedar Canyon 15 3H	09/23/2014
- XI. Per our field personnel, no fresh water wells were found within one-mile of this well.
- XII. N/A. This is not a disposal well.
- XIII. Attached please find the Proof of Notice.

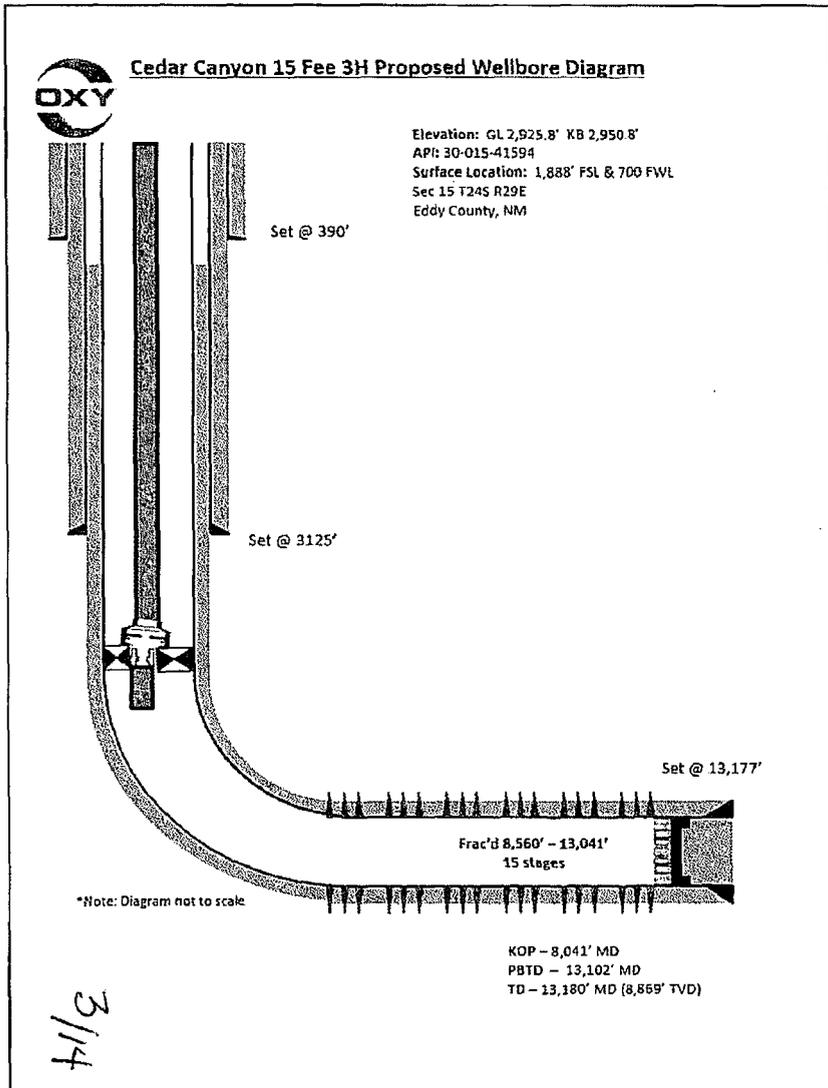
INJECTION WELL DATA SHEET

OPERATOR: OXY USA Inc.

WELL NAME & NUMBER: Cedar Canyon 15 3H

WELL LOCATION: 1888' FSL 700' FWL      L      15      24S      29E  
 FOOTAGE LOCATION      UNIT LETTER      SECTION      TOWNSHIP      RANGE

WELBORE SCHEMATIC



WELL CONSTRUCTION DATA

Surface Casing

Hole Size: 14 3/4"      Casing Size: 11 3/4"  
 Cemented with: 550 sx.      or \_\_\_\_\_ ft<sup>3</sup>  
 Top of Cement: Surface      Method Determined: Circulated

Intermediate Casing

Hole Size: 10 5/8"      Casing Size: 8 5/8"  
 Cemented with: 890 sx.      or \_\_\_\_\_ ft<sup>3</sup>  
 Top of Cement: Surface      Method Determined: Circulated

Production Casing

Hole Size: 7 7/8"      Casing Size: 5 1/2"  
 Cemented with: 1300 sx.      or \_\_\_\_\_ ft<sup>3</sup>  
 Top of Cement: 478'      Method Determined: CBL  
 Total Depth: 13,180' MD\_8810' TVD

Injection Interval

9,152' MD/8736' TVD feet To 13,041' MD/8810' TVD  
 (Perforated)

INJECTION WELL DATA SHEET

Tubing Size: 2 7/8" PH6 7.90# L-80 tubing Lining Material: None (Will use lined tubing on water injection)

Type of Packer: 5-1/2" Weatherford 10k AS1X Nickel coated retrievable packer

Packer Setting Depth: 100' below top of barrier at approximately 7900'

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

Additional Data

1. Is this a new well drilled for injection?      Yes   X   No

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

\_\_\_\_\_

2. Name of the Injection Formation:   Bone Spring  

3. Name of Field or Pool (if applicable):   Pierce Crossing Bone Spring, East  

4. Has the well ever been perforated in any other zone(s)? List all such perforated intervals and give plugging detail, i.e. sacks of cement or plug(s) used.   No  

5. Give the name and depths of any oil or gas zones underlying or overlying the proposed injection zone in this area:     

  Brushy Canyon Formation (Delaware) (overlying) (5078')  

  Wolfcamp Formation (underlying) (10,098')  

\_\_\_\_\_

Item VII  
Proposed Operations

**Gas Injection**

1.

Well Name	Average Daily Rate of Gas to be Injected	Maximum Daily Rate of Gas to be Injected
Cedar Canyon 15 3H	9,000 MCFD	20,000 MCFD

2. This will be a closed system.

3.

Well Name	Average Injection Pressure	Maximum Injection Pressure
Cedar Canyon 15 3H	4000 psi	4350 psi

4. The source of the injected gas will be produced gas from the Cedar Canyon Central Delivery Point integration system which is comprised of nearby Delaware, 1<sup>st</sup> and 2<sup>nd</sup> Bone Spring wells. Please see the attached gas analysis.

5. N/A

**Water Injection**

1.

Well Name	Average Daily Rate of Water to be Injected	Maximum Daily Rate of Water to be Injected
Cedar Canyon 15 3H	5,000 BWIPD	10,000 BWIPD

2. This will be a closed system.

3.

Well Name	Average Injection Pressure	Maximum Injection Pressure
Cedar Canyon 15 3H	1450 psi	1745 psi

4. Water used for injection will be treated produced water from wells drilled in the Bone Springs and Delaware Formations. Water is treated chemically to reduce scale. Please see the attached water compatibility study.

5. N/A

**CO2 Injection**

1.

Well Name	Average Daily Rate of Water to be Injected	Maximum Daily Rate of Water to be Injected
Cedar Canyon 15 3H	9,000 MCFD	20,000 MCFD

2. This will be a closed system.

Item VII  
Proposed Operations

3.

Well Name	Average Injection Pressure	Maximum Injection Pressure
Cedar Canyon 15 3H	2000 psi	2300 psi

4. Oxy currently does not have a source for CO2 for this project area. However, Oxy would like to have the ability to inject CO2 when a source becomes available.

5. N/A

**Calculation for Surface Injection Pressure Limits**

For Water Injection:

Calculation for surface pressure limit:

- $0.2 \text{ psi/ft} * 8736 \text{ ft (TVD of first perf)} = 1745 \text{ psi}$

Produced Gas and CO2 Injection:

Based on the surface pressure limit for water and assuming a fresh water gradient of 0.433 psi/ft. The bottom hole pressure (BHP) limit is:

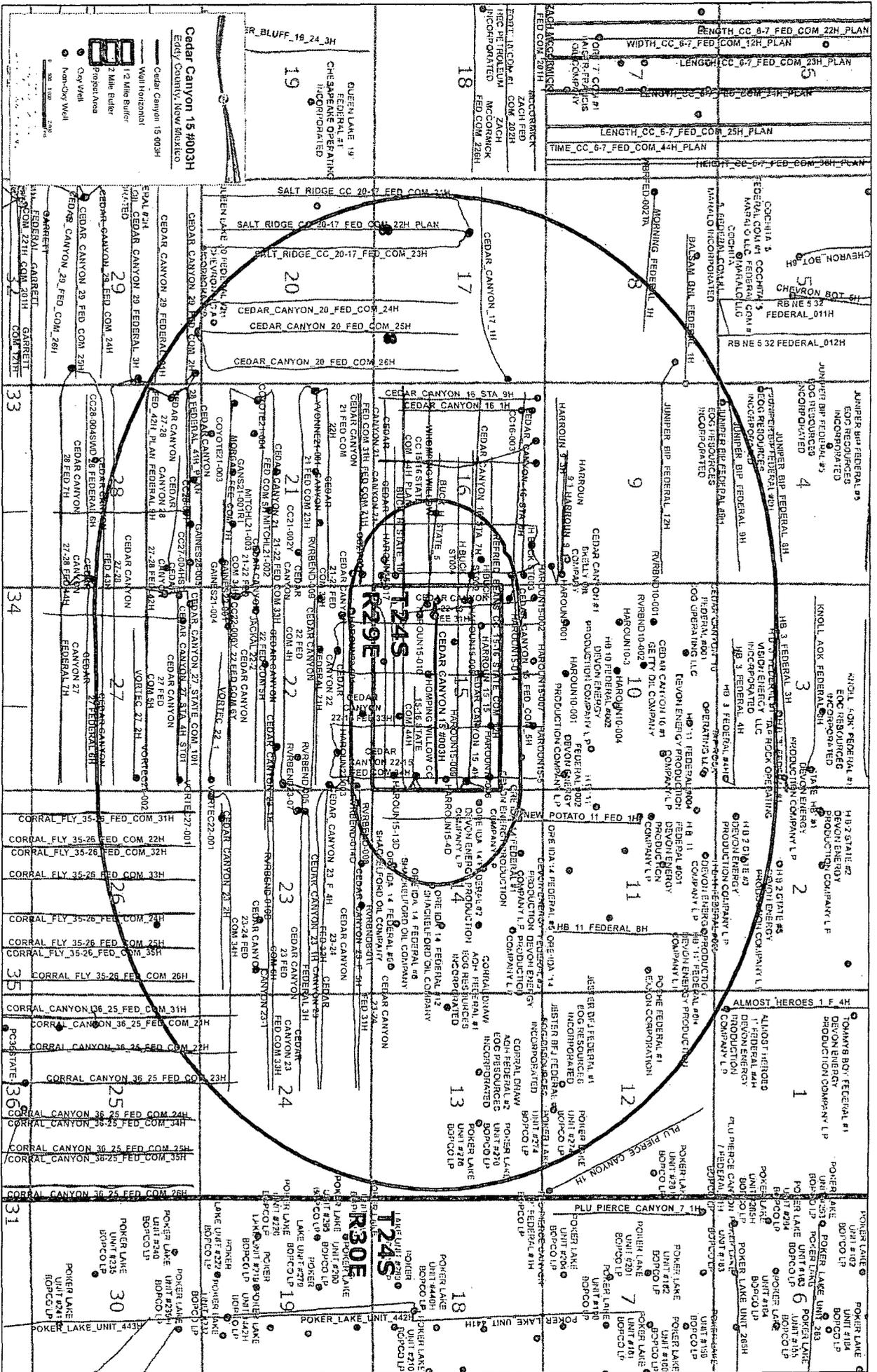
- $1745 + 0.433 * 8736 = 5527 \text{ psi (or } 0.633 \text{ psi/ft)}$

A Petroleum Expert Prosper Model was used to calculate the surface pressure with 2.875" tubing, reservoir depth, injection gas composition and the BHP limit shown above.

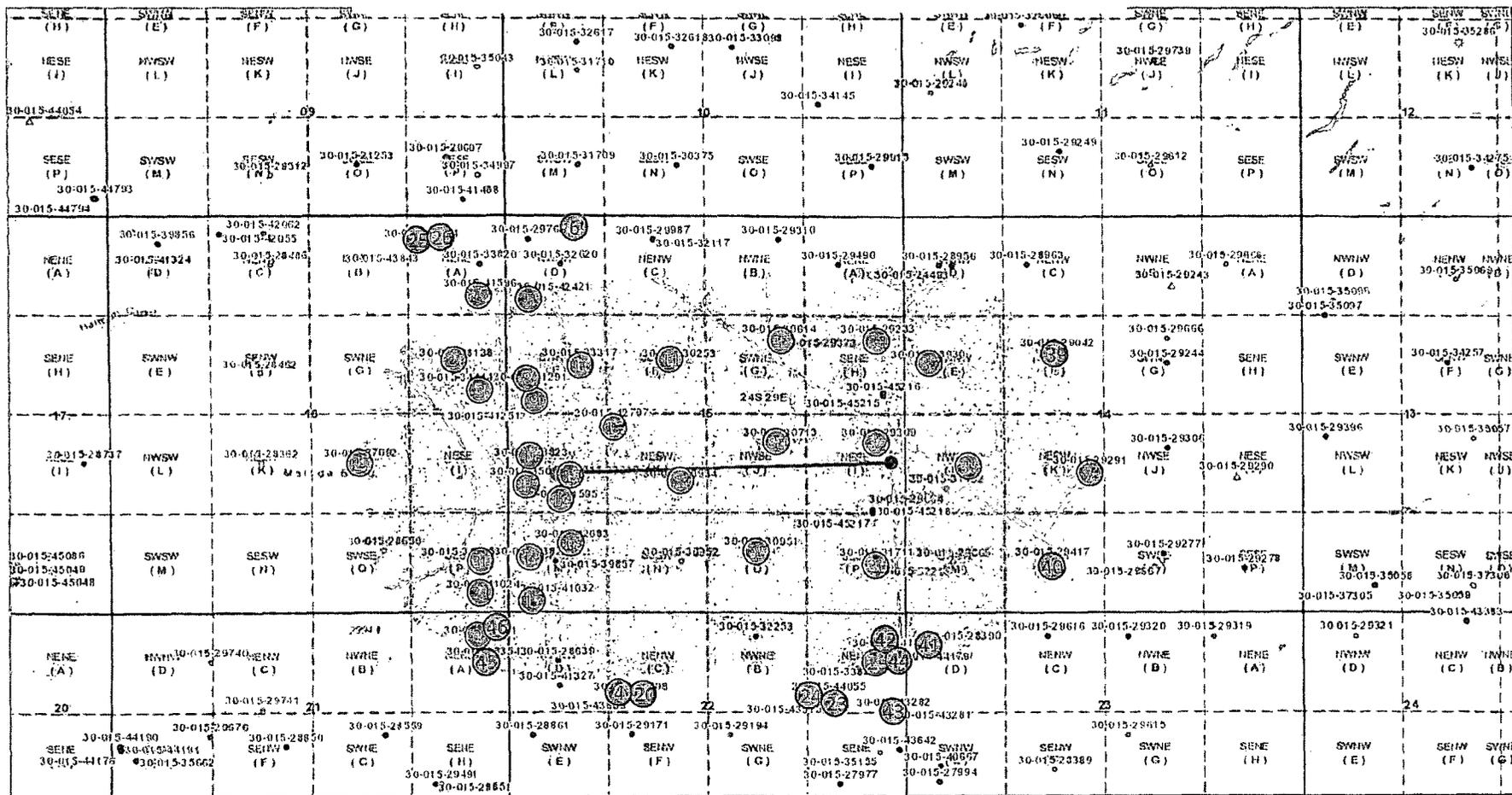
\*Prosper Model is an industrial standard nodal analysis software for pressure calculation and includes phase behavior change and friction loss.

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# CEDAR CANYON 15 #3H AOR MAP



11/9/2018 5:20:41 PM

- |                                |                                |                                 |                              |                                    |  |
|--------------------------------|--------------------------------|---------------------------------|------------------------------|------------------------------------|--|
| — Override 1                   | • Plugged                      | ☼ CO2 New                       | ⊙ Gas, Plugged               | ⊙ Injection, Temporarily Abandoned | ▲ Gas Water Injection, Active                |
| ▲ Override 2                   | • Cancelled                    | ☼ CO2, Plugged                  | ⊙ Gas, Temporarily Abandoned | • Oil, Active                      | ▲ Gas Water Injection, Cancelled             |
| ■ Well Locations - Large Scale | • Temporarily Abandoned        | ☼ CO2, Temporarily Abandoned    | ⊙ Injection, Active          | • Oil, Cancelled                   | ▲ Gas Water Injection, New                   |
| • Active                       | • Well Locations - Small Scale | ☼ Gas Active                    | ⊙ Injection, Cancelled       | • Oil, New                         | ▲ Gas Water Injection, Plugged               |
| • New                          | • Horizontal                   | ☼ Gas, Cancelled, Never Drilled | ⊙ Injection, New             | • Oil, Plugged                     | ▲ Gas Water Injection, Temporarily Abandoned |
|                                | ☼ CO2 Active                   | ☼ Gas, New                      | ⊙ Injection, Plugged         | • Oil, Temporarily Abandoned       | • Water, Active                              |
|                                | • CO2 Cancelled                |                                 |                              |                                    |  |

1/2 Mile Area of Review

Well ID on AOR Table

Cedar Canyon 15 #3H

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AOR for Injector: Cedar Canyon 15 #3K (APN# 30-615-41591)

WELL ID NUMBER	LPI NUMBER	OPERATOR	LEASE NAME	WELL NO.	WELL TYPE	STATUS	Surface Location			DATE DRILLED	TOTAL	TOTAL	HOLE SIZE		CIG SIZE		DEPT	CK	CMT	HOW	DVT	CURRENT PROD	CURRENT COMPLETION	ADDITIONAL INFORMATION							
							FUG N/E	FUG E/W	UTM		HP	RNG.	FTD	FTD	IN	OUT									IN	OUT					
1	30-015-30934	OXY USA INC.	HARROUN 18	10	OIL	ACTIVE	1700	FNL	2310	FWL	K	18	24	5	29	E	02/23/2000	8880	6880	14 3/4"	10 3/4"	593'	640'	Surf	Circ	8497'	CEAR CANYON, DELAWARE	8232' - 6417'			
2	30-015-44181	OXY USA INC	CEDAR CANYON 21 FEDERAL COM	21H	OIL	Active	369	FNL	369	FEL	A	21	24	5	29	E	11/03/2017	8550	13603	9 7/8" 5 3/4" 14 7/8"	7 5/8" 4 1/2" 10 3/4"	2875' 6880' 463'	800' 1115' 329'	Surf Surf Surf	Circ Calc Circ	8497'	Colten Draw B5 (2nd BS)	8761' - 13302'			
3	30-015-34444	OXY USA INC	H BUCK STATE	4H	OIL	ACTIVE	2310	FNL	330'	FEL	H	18	24	5	29	E	02/21/2006	7808'	10686'	9 7/8" 6 3/4" 17 1/2"	7 5/8" 4 1/2" 13 3/8"	2885' 13488' 254'	1991' 700' 350'	Surf Surf Surf	Circ Circ Circ	3016'	PIERCE CROSSING; BONE SPRING, EAST	7879' - 10326'	Top of liner at 7713'		
4	30-015-43808	OXY USA INC.	CEDAR CANYON 23 16 FEE	32H	OIL	ACTIVE	1108	FNL	1633'	FWL	C	22	24	5	29	E	08/29/2016	9935'	16078'	12 1/4" 8 1/2" x 7 7/8" 14 3/4"	9 5/8" 5 1/2" 10 3/4"	2830' 10686' 443'	900' 2050' 470'	Surf Surf Surf	Circ CBL Circ		PIERCE CROSSING; BONE SPRING, EAST	8994' - 15862'	BHL IS IN THE AOR.		
5	30-015-42431	OXY USA INC.	CEDAR CANYON 16 FEDERAL COM	6H	OIL	ACTIVE	1095'	FNL	290'	FWL	D	16	24	5	29	E	12/11/2014	8809'	13808'	9 7/8" 8 3/4" 14 3/4"	7 5/8" 5 1/2" 11 1/2" x 4 1/2"	8277' 16053' 443'	9130' 470'	Surf Surf Surf	Circ CBL Circ	3065'	PIERCE CROSSING; BONE SPRING, EAST	9563' - 13319'			
6	30-015-43809	OXY USA INC.	CEDAR CANYON 23 16 FEE	31H	OIL	ACTIVE	1108'	FNL	1603'	FWL	C	22	24	5	29	E	03/29/2016	8906'	16090'	14 3/4"	11 3/4"	380'	786'	Surf	Circ		PIERCE CROSSING; BONE SPRING, EAST	10004' - 15972'	BHL IS IN THE AOR.		
7	30-015-29291	SHACKELFORD OIL CO	ORE IDA 14 FEDERAL	12	OIL	ACTIVE	1880'	FSL	2460'	FWL	K	14	24	5	29	E	04/29/1987	8332'	8338'	9 7/8" 8 7/8" 17 1/2"	7 5/8" 8 1/2" 13 3/8"	9188' 16071' 377'	1915' 470' 425'	Surf Surf Surf	Circ CBL Circ		PIERCE CROSSING; BONE SPRING, EAST	7815' - 7899'			
8	30-015-41251	OXY USA INC	CEDAR CANYON 18	4H	OIL	ACTIVE	2310'	FNL	330'	FWL	E	18	24	5	29	E	08/01/2013	8783'	13111'	14 3/4" 10 5/8" 7 7/8"	11 3/4" 8 5/8" 5 1/2"	357' 3091' 13108'	880' 960' 1420'	Surf Surf Surf	Circ Calc CBL		PIERCE CROSSING; BONE SPRING, EAST	9000' - 12900'			
9	30-015-41251	OXY USA INC	CEDAR CANYON 16 STATE	7H	INJECTION	ACTIVE	2485'	FNL	330'	FWL	E	15	24	5	29	E	04/19/2013	8644'	13762'	14 3/4"	11 3/4"	339'	680'	Surf	Circ		PIERCE CROSSING; BONE SPRING, EAST	9200' - 13560'			
10	30-015-33317	OXY USA INC	HARROUN 18	16	OIL	ACTIVE	1880'	FNL	990'	FWL	E	15	24	5	29	E	10/21/2004	7808'	10192'	10 5/8" 7 7/8" 17 1/2"	8 5/8" 5 1/2" 13 3/8"	3095' 13725' 645'	1000' 1970' 800'	Surf Surf Surf	Circ Circ Circ		PIERCE CROSSING; BONE SPRING, EAST	8249' - 10100'			
11	30-015-30283	OXY USA INC	HARROUN 18	8	OIL	ACTIVE	1980'	FNL	2310'	FWL	F	15	24	5	29	E	12/07/1998	6885'	6885'	14 3/4"	10 3/4"	835'	600'	Surf	Circ		CEAR CANYON, DELAWARE	4660' - 6078' 8448' - 6466' 6620' - 6688'	Shallower Delaware perfs added 3/2001. Middle set of Delaware perfs added 1/1999. Deepest Delaware perfs were original perfs.		
12	30-015-42797	OXY USA INC	CEDAR CANYON 15 SWD	1	SWD	ACTIVE	2800'	FSL	1400'	FWL	K	16	24	5	29	E	06/05/2016	16014'	16014'	24" 17 1/2" 12 1/4" 8 1/2"	18 5/8" 13 3/8" 9 8/8" 1	277' 903' 3107' 14842'	903' 2720' 3450' 630'	Surf Surf Surf Surf	Circ Circ Surf & CBL Circ	5485'	Devonian - Silurian	14842' - 15994' (OR)	CBL ran 4/18/2016, verified TOC Top of liner at 9755'		
13	30-015-41894	OXY USA INC	CEDAR CANYON 15	3H	OIL	ACTIVE	1888'	FSL	700'	FWL	L	15	24	5	29	E	08/30/2014	8810'	13180'	14 3/4"	11 3/4"	390'	550'	Surf	Circ		PIERCE CROSSING; BONE SPRING, EAST	9152' - 13041'			
14	30-015-41899	OXY USA INC	CEDAR CANYON 16 STATE	8H	OIL	ACTIVE	1430'	FSL	710'	FWL	L	15	24	5	29	E	06/10/2014	8500'	13768'	14 3/4"	11 3/4"	364'	580'	Surf	Circ		PIERCE CROSSING; BONE SPRING, EAST	9116' - 13625'			
15	30-015-33842	OXY USA INC	H BUCK STATE	5	OIL	ACTIVE	1880'	FSL	430'	FWL	L	18	24	5	29	E	09/30/2006	7630'	10792'	10 5/8" 7 7/8" 17 1/2"	8 5/8" 5 1/2" 13 3/8"	3144' 13786' 822'	890' 1410' 459'	Surf Surf Surf	Circ Circ Circ		PIERCE CROSSING; BONE SPRING, EAST	8244' - 10800'			
16	30-015-33823	OXY USA INC	HARROUN 16	16	OIL	ACTIVE	1880'	FSL	330'	FWL	L	18	24	5	29	E	05/02/2006	10800'	10800'	12 1/4" 8 1/2" x 7 7/8" 17 1/2"	9 5/8" 8 1/2" 13 3/8"	2884' 10792' 614'	600' 2700' 900'	Surf Surf Surf	Circ CBL Circ		PIERCE CROSSING; BONE SPRING, EAST	8053' - 10760'			
17	30-015-41032	OXY USA INC	CEDAR CANYON 16	2H	OIL	ACTIVE	170'	FSL	360'	FWL	M	16	24	5	29	E	05/08/2013	8789'	12980'	14 3/4"	11 3/4"	354'	250'	Surf	Circ		PIERCE CROSSING; BONE SPRING, EAST	8800' - 12800'	After running and cementing 5 1/2", ran CBL, found TOC at 4420', perforated at 4406' and squeezed cement. Est TOC @ 1001'		
18	30-015-42683	OXY USA INC	CEDAR CANYON 16 STATE	18H	OIL	ACTIVE	900'	FSL	860'	FWL	M	18	24	5	29	E	11/07/2016	8624'	14422'	10 5/8" 7 7/8" 17 1/2"	8 5/8" 5 1/2" 13 3/8"	2965' 14417' 319'	890' 1870' 580'	Surf Surf Surf	Circ Calc Circ		PIERCE CROSSING; BONE SPRING, EAST	8704' - 14214'			
19	30-015-33822	OXY USA INC	HARROUN 16	17	OIL	ACTIVE	660'	FSL	330'	FWL	M	18	24	5	29	E	09/07/2008	10887'	10887'	12 1/4" 8 1/2" 17 1/2"	9 5/8" 5 1/2" 13 3/8"	2880' 14417' 319'	1000' 1870' 580'	Surf Surf Surf	Circ Calc Circ	n/a	PIERCE CROSSING; BONE SPRING, EAST	8405' - 10740'	DV tool run but no depth provided		
20	30-015-43809	OXY USA INC	CEDAR CANYON 22 16 FEE	31H	OIL	ACTIVE	1108'	FNL	1603'	FWL	C	22	24	5	29	E	08/29/2016	8908'	16090'	14 3/4"	10 3/4"	443'	470'	Surf	Circ		PIERCE CROSSING; BONE SPRING, EAST	10004' - 15972'			
21	30-015-41024	OXY USA INC	CEDAR CANYON 16 STATE	2H	OIL	ACTIVE	230'	FSL	330'	FEL	P	16	24	5	29	E	08/08/2013	8626'	13240'	9 7/8" 6 3/4" 16"	7 5/8" 5 1/2" 13 3/8"	9189' 16031' 358'	1915' 470' 685'	Surf Surf Surf	Circ CBL Circ		PIERCE CROSSING; BONE SPRING, EAST	8860' - 13000'	BHL IS IN THE AOR.		

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WELL NUMBER	OPERATOR	LEASE NAME	WELL ID	WELL TYPE	STATUS	FIG #	STAGE	W	UNIT	DIR	HP	ENG	DATE	TOTAL TVD	TOTAL LMD	HOLES	SIZE	CSG	SIZE	BT	CM	TOP	MEASURE	HOW	DVT	CURRENT PROD	CURRENT COMPLETION	ADDITIONAL INFORMATION
22	30-015-41696 OXY USA INC	CEDAR CANYON 16 STATE	3H	OIL	ACTIVE	1040	FNL 330	FEL	A	16	24	S	29	E	06/29/2014	8616'	15560'	14 3/4"	11 3/4"	394'	639'	Surf	Circ		PIERCE CROSSING BONE SPRING,	5017'-13407'		
23	30-015-44085 OXY USA INC	Cedar Canyon 22 18 FEDERAL COM	34H	OIL	ACTIVE	1107	FNL 1022	FEL	A	22	24	S	29	E	05/24/2017	9970'	16100'	14 3/4"	10 5/8"	8 5/8"	3118'	890'	Surf	Circ		PIERCE CROSSING BONE SPRING EAST	9980' - 15931'	Lateral goes through the AOR.
24	30-015-43915 OXY USA INC	Cedar Canyon 22 18 FEE	33H	GAS	ACTIVE	1107	FNL 1092	FEL	A	22	24	S	29	E	05/24/2017	10080'	16336'	14 3/4"	8 7/8"	8 3/4"	9491'	1350'	Surf	Circ		PURPLE SAGE WOLF CAMP GAS	10252' - 16170'	Top of liner at 9355' Lateral goes through the AOR.
25	30-015-43944 OXY USA INC	CEDAR CANYON 16 STATE	33H	GAS	ACTIVE	402	FNL ##	FEL	A	16	24	S	29	E	12/04/2016	10034'	14693'	14 3/4"	9 7/8"	6 3/4"	9982'	2614'	46'	Temp Surv	PURPLE SAGE WOLF CAMP GAS	10100' - 14518'	BHL IS IN THE AOR.	
26	30-015-43943 OXY USA INC	CEDAR CANYON 16 STATE	34H	GAS	ACTIVE	402	FNL ##	FEL	A	16	24	S	29	E	12/04/2016	10036'	14646'	14 3/4"	6 3/4"	5 1/2"	14679'	942'	9841'	Circ	PURPLE SAGE WOLF CAMP GAS	10125' - 14389'	Top of liner at 9841' BHL IS IN THE AOR.	
27	30-015-27092 OXY USA INC	H BUCK STATE	1	OIL	ACTIVE	1892	FSL ##	FEL	J	16	24	S	29	E	08/26/1992	7850'	7850'	12 1/4"	9 7/8"	8 3/4"	8985'	2325'	Surf	Circ		CEDAR CANYON; DELAWARE	6122'-7680'	Top of liner at 9882' SQZ @ 7610 & 7220 in 1894
28	30-015-29136 OXY USA INC	H BUCK STATE	2	OIL	ACTIVE	1890	FNL 660	FEL	H	16	24	S	29	E	11/09/1994	7950'	7950'	17 1/2"	11"	7 7/8"	8 5/8"	2805'	1200'	Surf	Circ	CEDAR CANYON; DELAWARE	5216'-5246'	
29	30-015-33821 OXY USA INC	Harroun 22	3	OIL	ACTIVE	660	FNL 330	FEL	A	22	24	S	29	E	03/24/2009	7785'	10664'	17 1/2"	12 1/4"	8 1/2" x 7 7/8"	13 3/8"	605'	460'	Surf	Circ	PIERCE CROSSING BONE SPRING EAST	7863'-10720'	Lateral goes through the AOR.
30	30-015-34695 OXY USA INC	H BUCK STATE	10	OIL	ACTIVE	660	FSL 330	FEL	P	16	24	S	29	E	05/21/2016	7691'	10865'	17 1/2"	12 1/4"	8 1/2" x 7 7/8"	13 3/8"	288'	1030'	Surf	Circ	PIERCE CROSSING BONE SPRING,	8386' - 10710'	
31	30-015-28233 OXY USA INC	Harroun 16	3	SWD	ACTIVE	1657	FNL 330	FEL	H	16	24	S	29	E	01/14/1997	8055'	8056'	14 3/4"	12 1/4"	8 1/2" x 7 7/8"	10 3/4"	2910'	1300'	Surf	Circ	SWD, DELAWARE	5041' - 3766'	

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**Part VIII- Geologic Information for Cedar Canyon 15 3H**

The Cedar Canyon 15 3H will be injecting into the 2<sup>nd</sup> Bone Spring Sandstone of the Bone Spring Formation. The well has a TVD of 8,810 ft. with a lateral length of approximately 4,370 ft. It will be injecting into a reservoir composed of tight siltstone. Core data indicates that the grain sizes range from coarse siltstone to very-fine-grained subarkose (Folk, 1980) sandstone. Samples show evidence of moderate compaction. Minor amounts of illite and smectite clays are found throughout the samples ranging from 5% to 15%. Cements are Fe-calcite, Fe-dolomite, with some quartz overgrowths. Minor amounts of pyrite (<1%) are present. The resulting reservoir rock has porosity of 8-18% with an average porosity of 11.7%. Permeability measured by injection fall-off tests conducted within the reservoir ranges from 0.02 millidarcies to 0.001 millidarcies.

The injection area for this well is bounded by two producing wells in the same reservoir interval that is 300 ft. thick. Low-permeability barriers act as seals above and below the reservoir. These barriers consist of carbonate mudstone and dolomudstone that are 565 ft. thick above and 800 ft. thick below. Laterally the injection will be primarily contained by the reservoir volume that has been previously and partially depleted by the adjacent producing wells. The tight low-permeability reservoir and the production from the adjacent wells will be the primary constraints on the conformance of the injection to the project area and are expected to contain the injected gas.

The top of the Bone Spring Formation is at 6,639 ft. (log depth) with over 2,000 ft. of carbonate mudstones and shales acting as permeability barriers to upward migration of injected gas. Above that the Delaware Mountain Group consists of connate-water bearing and hydrocarbon-bearing sands, with minor limestone and shale intervals and is 3,700 ft. thick. Above that is the Castile Formation consisting of very low permeability anhydrite, gypsum, and calcite that acts as another 1,500 ft. thick barrier to upward movement of fluids. The Salado overlies the Castile and forms a 1,000 ft. thick barrier of salt. The top of the Salado is at 552 ft. and the deep aquifers found just above the Salado at the base of the Rustler are saline water. The top of Rustler Formation is at approximately 370 ft. The Rustler top is a continuous anhydrite layer that acts as another permeability barrier creating a perched aquifer above it that is the lowest level where fresh water is known in the area. Water wells drilled in the area typically have not reached this depth. Because of the thickness of multiple impermeable rock layers above the injection reservoir there is no possible path for migration upward into freshwater aquifers where they exist.

**Locate freshwater wells within one mile:**

An investigation of existing shallow water wells has not found any freshwater wells within a one mile radius of this injector.

I hereby certify that the information presented above is true and correct to the best of my knowledge and belief.

  
\_\_\_\_\_  
Tony Troutman  
Geological Advisor

2/28/2019  
Date

11/14

## Water Compatibility Analysis

Scale precipitation due to incompatibility of mixing different waters is simulated using ScaleSoftPitzer™ (SSP) developed by Rice University Brine Chemistry Consortium. Compatibility simulations between (a) 1<sup>st</sup> Bone Spring (BS) formation water and treated produced water (TPW) from Cedar Canyon Water Treatment Facility (CC WTF), (b) 2<sup>nd</sup> BS formation water and TPW, and (c) 3<sup>rd</sup> BS formation water and TPW were performed. Table 1 shows the water analysis from the 4 waters.

Table 1. Water analysis from 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> BS water and TPW from CC WTF

Cations / Anions (mg/L)	1 <sup>st</sup> BS	2 <sup>nd</sup> BS	3 <sup>rd</sup> BS	CC15 SWD Treatment Facility
Na <sup>+</sup>	62,308	53,400	38,000	46,315
Mg <sup>2+</sup>	360	1,320	767	1,399
Ca <sup>2+</sup>	1,098	9,220	4,970	9,569
Sr <sup>2+</sup>	267	688	1,030	893
Ba <sup>2+</sup>	0.84	1.15	3.45	2.6
Fe <sup>2+</sup>	15.9	40.6	19.1	25.3
Cl <sup>-</sup>	90,167	98,451	74,630	97,632
SO <sub>4</sub> <sup>2-</sup>	531	417	236	389
HCO <sub>3</sub> <sup>-</sup>	561.2	146.4	109.8	119
TDS	155,309	165,620	119,767	157,193
pH	7	7	6.8	5.3

The various waters are input into SSP at different ratios to calculate scaling index (SI) and potential precipitation (ppt) in pound per thousand barrels (ptb). Bottom hole temperature of 122 F and bottom hole pressures of 5,000 psi were used in the modeling. Results are summarized in Tables 2 to 4.

### 1<sup>st</sup> BS + Treated Produced Water:

In general, there is a slight, inherent calcite scaling tendency with the 1<sup>st</sup> BS water itself. The predicted SI is 0.87 as shown in Table 2. Any scaling index above zero indicates a supersaturation condition of the scale. By mixing TPW with the 1<sup>st</sup> BS formation it is observed that the scaling index of calcite became slightly higher first at 25% TPW and 75% 1<sup>st</sup> BS and then becoming smaller as the ratio of TPW increases. However, the maximum, predicted precipitation is less than 50 ptb. Therefore, a slight amount of scale inhibitor is recommended for the injection of the TWP into the 1<sup>st</sup> BS. The exact amount of scale inhibitor can be determined by lab tests. Both Barite and Celestite are not expected to precipitate at all ratios of mixing.

Table 2. Prediction of Scaling Index (SI) and potential precipitation (PPT) of 3 common oilfield scales by mixing the 1<sup>st</sup> BS water and TPW at different ratios

% treated PW	Cypress 33-3H % 1st BS	Calcite		Barite		Celestite	
		SI	ppt (ptb)	SI	ppt (ptb)	SI	ppt (ptb)
100	0	-1.49	0.0	-0.28	0.0	-0.54	0.0
75	25	0.13	4.2	-0.22	0.0	-0.44	0.0
50	50	0.66	29.8	-0.18	0.0	-0.36	0.0
25	75	0.95	49.1	-0.18	0.0	-0.30	0.0
0	100	0.87	41.8	-0.22	0.0	-0.25	0.0

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## Water Compatibility Analysis

### 2<sup>nd</sup> BS + Treated Produced Water:

In general, there is an inherent calcite scaling tendency with the 2<sup>nd</sup> BS water itself. The predicted SI is 1.21 and the predicted precipitation is 18.6 ptb as shown in Table 3. By mixing TPW with the 2<sup>nd</sup> BS formation it is observed that the scaling index of calcite becomes smaller as the ratio of TPW increases. In other words, by injecting TPW we expect a reduction of incompatibility between the two waters. Both Barite and Celestite are not expected to precipitate at all ratios of mixing.

Table 3. Prediction of SI and potential PPT of 3 common oilfield scales by mixing the 2<sup>nd</sup> BS water and TPW at different ratios

% treated PW	CC20-25H	Calcite		Barite		Celestite	
	% 2nd BS	SI	ppt (ptb)	SI	ppt (ptb)	SI	ppt (ptb)
100	0	-1.49	0.0	-0.28	0.0	-0.54	0.0
75	25	-0.69	0.0	-0.56	0.0	-0.39	0.0
50	50	-0.15	0.0	-0.55	0.0	-0.26	0.0
25	75	0.43	7.7	-0.54	0.0	-0.15	0.0
0	100	1.21	18.6	-0.53	0.0	-0.05	0.0

### 3<sup>rd</sup> BS + Treated Produced Water:

In general, there is a slight, inherent calcite scaling tendency with the 3<sup>rd</sup> BS water itself. The predicted SI is 0.59 and the predicted precipitation is 8.8 ptb as shown in Table 4. By mixing TPW with the 3<sup>rd</sup> BS formation it is observed that the scaling index of calcite becomes smaller as the ratio of TPW increases. In other words, by injecting TPW we expect a reduction of incompatibility between the two waters. Both Barite and Celestite are not expected to precipitate at all ratios of mixing.

Table 4. Prediction of SI and potential PPT of 3 common oilfield scales by mixing the 3<sup>rd</sup> BS water and TPW at different ratios

% treated PW	CC22-15 32H	Calcite		Barite		Celestite	
	% 3rd BS	SI	ppt (ptb)	SI	ppt (ptb)	SI	ppt (ptb)
100	0	-1.49	0.0	-0.28	0.0	-0.54	0.0
75	25	-0.88	0.0	-0.56	0.0	-0.39	0.0
50	50	-0.44	0.0	-0.12	0.0	-0.28	0.0
25	75	0.02	0.3	-0.04	0.0	-0.18	0.0
0	100	0.59	8.8	0.05	0.2	-0.08	0.0

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**C-108 Injection Application  
Item XIII - Proof of Notice  
OXY USA Inc.  
Cedar Canyon 15 Federal 3H**

New Mexico Oil Conservation Division  
811 S. First St.  
Artesia, NM 88210

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

United State Dept of Interior  
Bureau of Land Management  
620 E. Greene Street  
Carlsbad, NM 88220

State of New Mexico  
P.O. Box 1148  
Santa Fe, NM 87504

Leopard Petroleum LP  
P.O. Box 51440  
Midland, TX 79710

Beryl Oil and Gas, LP  
P.O. Box 51440  
Midland, TX 79710

B. Jack Reed  
506 Charismatic  
Midland, TX 79705

DRW Energy, LLC  
400 W. Illinois, Suite 970  
Midland, TX 79701

M'lissa M. Schoening  
301 Sir Barton Parkway  
Midland, TX 79705

Devon Energy Production Co LP  
6100 N Western  
Oklahoma City, Oklahoma 73118

Rutter and Wilbanks Corporation  
P.O. Box 3186  
Midland, TX 79701

Shackelford Oil Company  
11417 W Country Road 33  
Midland, TX 79707

Mobil Producing Texas and New Mexico Inc.  
22777 Springwoods Village Pkwy  
Spring, TX 77389-1425

GD McKinney Investments LP  
300 N Marienfield, Ste 1100  
Midland, TX 79701

Oxy USA WTP LP  
5 Greenway Plaza Ste 110  
Houston, TX 77046

Oxy USA Inc  
5 Greenway Plaza Ste 110  
Houston, TX 77046