BW - 2

BRINE PRODUCTION

2018

From:	Cory Walk
To:	Chavez, Carl J, EMNRD
Cc:	Griswold, Jim, EMNRD; Wade, Gabriel, EMNRD; Ames, Eric, EMNRD; Hull, Jason; Pritchett, Gary
Subject:	[EXT] Re: BW-2 Cavern Configuration Follow-up Communication: CAVERN MATURITY RATIO (D/H)
Date:	Thursday, March 19, 2020 11:16:51 AM
Attachments:	Eunice 1 - Salt Cavern Characterization v2.pdf

Good Morning Carl,

Please see the attached document which includes a revised Salt Cavern Characterization diagram (page 1), a detailed explanation of how estimates were calculated for missing data (pages 2-3), and a compilation of all brine production from 1980 - 2020 which was used in the cavern volume/radius calculations (pages 4-10). Please note that brine production was recorded quarterly from 1980 - 2006 and monthly from 2006 - present. Yellow highlighted dates indicate where data was missing and estimates were used.

Also included in the characterization diagram (page 1) is a calculation of cavern maturity which resulted in a ratio of 0.24, falling below NMOCD's 0.5 threshold and therefore classifies this cavern as "immature".

Please review this document completely and let me know if you have any questions or need any additional information. I am happy to provide an excel spreadsheet of the compiled brine production records upon request.

Thank you,

On Wed, Mar 18, 2020 at 11:17 AM Chavez, Carl J, EMNRD <CarlJ.Chavez@state.nm.us> wrote:

> Cory:
>
> Good morning! As a follow-up to our morning call today, the figure should include the D/H Ratio to assess the maturity of the brine well cavern.
>
> Cavern Maturity = D/H
>
> D = Estimated diameter of the salt cavern (ft.)
>
> H = Depth from land surface to the casing shoe (ft.)
>
> For a mature cavern, a D/H approaching a 0.5 ratio is of concern to the OCD.
>
> Please include this calculation in the figure or in your E-mail communication to the OCD. You indicated Harcrow Surveying is working on the Surface Subsidence Plan to be

submitted in April. You also indicated the spreadsheet with brine production volumes and volume estimation for missing years would be forthcoming soon. I am working on the new discharge permit application and admin. completeness for BW-2 this week.

Please contact me if you have questions.

Thank you.

Mr. Carl J. Chavez, CHMM (#13099)

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“Why not prevent pollution, minimize waste to reduce operating costs, reuse or recycle, and move forward with the rest of the Nation?” (To see how, go to: http://www.emnrd.state.nm.us/OCD and see “Publications”)

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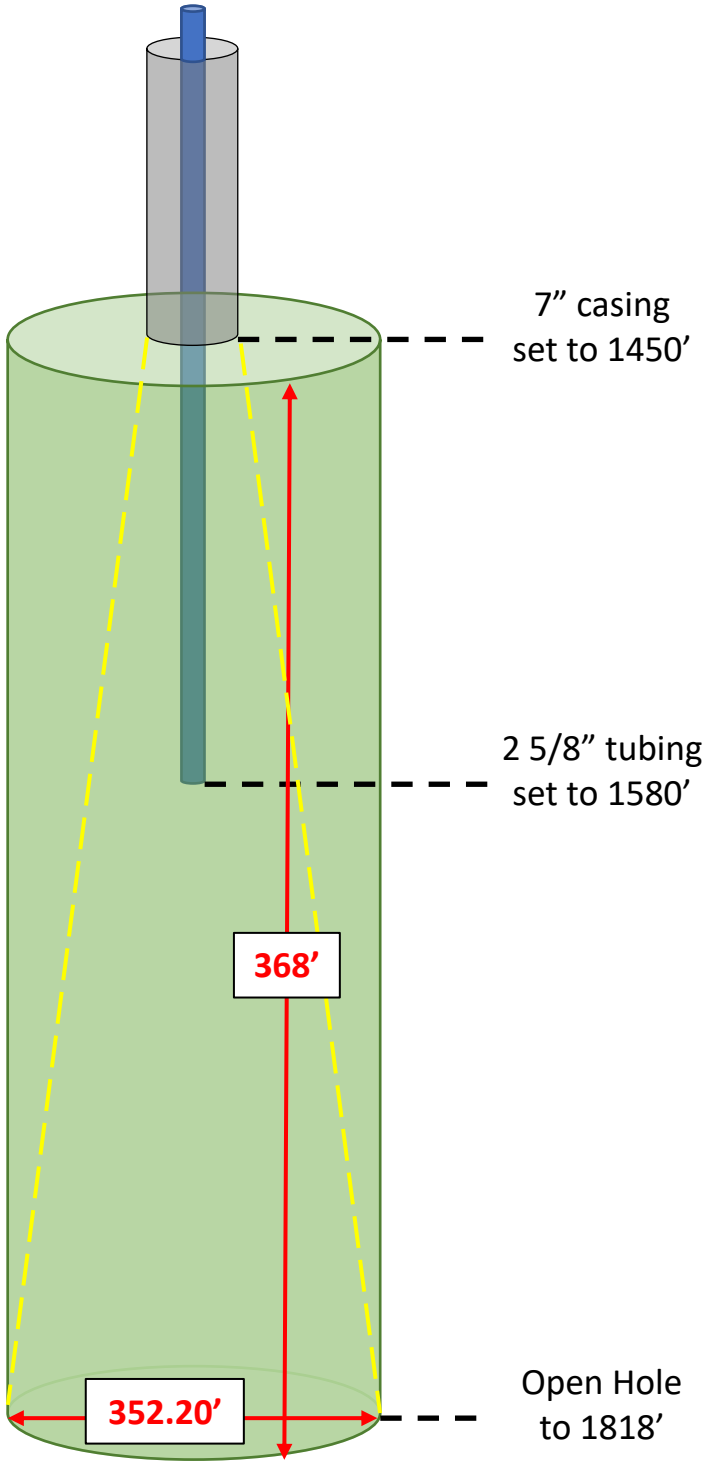
SALT CAVERN CHARACTERIZATION

Eunice Brine #001 (BW-2)
Basic Energy Services L.P.
API: 30-025-26884
Sec. 34, T. 21S, R. 37E
Lat: 32.42983 Long: -103.15015

Notes:

1) *There are several gaps in Basic Energy's brine production records. Specifically, there are no records from October 1982 - December 1987, July 1989 - December 1996, October 1999 – December 1999 and April 2006 – July 2006. Under NMOCD direction, estimates were used for the times when data was missing. See pages 2-3 of this document for a detailed explanation of how estimates were calculated.*
2) *Basic Energy does not have well logs that go beneath the casing shoe. Therefore, a height from the casing shoe to the TD of the open hole was used in the radius calculation below.*
3) *See pages 4-10 of this document for cumulative brine production records from 1980 – 2020.*



Total Brine = 7,827,873 bbl.
122.136 lbs/bbl = 956,065,097 lbs halite
V= (956,065,097 lbs) / (80 lbs/ft^3)
= **11,950,814 ft^3**

$V = \pi r^2 h / 3$
11,950,814 ft^3 = (3.14159 x r^2) x (368') / 3
r = 176.10'

Est. cavern height = 368'
Est. cavern floor diameter = 352.20'

Cavern Maturity = D/H
D = estimated diameter = 352.20'
H = depth from surface to csg shoe = 1450'
352.20' / 1450'
Cavern Maturity = 0.24 (immature)

Estimate Calculation

Throughout the life of the Eunice Brine #1 well (1980-2020) there have been 4 periods of time in which brine production was not recorded and/or is not found in NMOCDs online records. To characterize the cavern, I estimated brine production during those times. Some gaps in the data were for years at a time and others were for only a couple months. Different methods were used based on the span of data missing. Below is a detailed explanation of how each estimate was calculated.

Data Gap 1: October 1982 – December 1987

Method: Quarterly average of production from the 4 quarters *before* and 4 quarters *after* the gap in data.

Time	Production
1981 Q4	90367
1982 Q1	50531
1982 Q2	50531
1982 Q3	50531

Gap = 1982 Q4 - 1987 Q4

Time	Production
1988 Q1	83210
1988 Q2	42471
1988 Q3	41923
1988 Q4	26034

Average = (90367 + 50531 + 50531 + 50531 + 83210 + 42471 + 41923 + 26034)/8

Quarterly Average = 54450 BBL

Data Gap 2: July 1989 – December 1996

Method: Quarterly average of production from the 4 quarters *before* and 4 quarters *after* the gap in data.

Time	Production
1988 Q3	41923
1988 Q4	26034
1989 Q1	51728
1989 Q2	35531

Gap = 1989 Q3 - 1996 Q4

Time	Production
1997 Q1	55297
1997 Q2	48999
1997 Q3	79618
1997 Q4	64553

Average = (41923 + 26034 + 51728 + 35531 + 55297 + 48999 + 79618 + 64553)/8

Quarterly Average = 50460 BBL

Data Gap 3: October 1999 – December 1999

Method: Quarterly average of production from 1 quarter *before* and 1 quarter *after* the gap in data.

Time	Production
1999 Q3	20150

Gap = 1999 Q4

Time	Production
2000 Q1	55370

Average = (20150 + 55370)/2

Quarterly Average = 37760 BBL

Data Gap 4: April 2006 – July 2006

Method: Monthly average of production from 3 months *before* and 3 months *after* the gap in data.

Time	Production
2006 Jan	19775
2006 Feb	
2006 Mar	

Gap = April 2006 - July 2006

Time	Production
2006 Aug	9590
2006 Sept	5490
2006 Oct	3580

Average = (19775 + 9590 + 5490 + 3580)/6

Monthly Average = 6406 BBL

Note: Exact same amounts for each quarter is suspicious/unlikely but it's all we have. Well spudded in July		Produced Brine (BBLs)
1980	January	
	February	
	March	
	April	
	May	
	June	
	July (spud well)	
	August	62573
	September	
	October	
	November	62573
	December	
Annual Production (BBLs)		125146

Note: Exact same amounts for each quarter is suspicious/unlikely but it's all we have.		Produced Brine (BBLs)
1981	January	
	February	90367
	March	
	April	
	May	90367
	June	
	July	
	August	90367
	September	
	October	
	November	90367
	December	
Annual Production (BBLs)		361468

Note: Exact same amounts for each quarter is suspicious/unlikely but it's all we have. Yellow = estimated production data.		Produced Brine (BBLs)
1982	January	
	February	50531
	March	
	April	
	May	50531
	June	
	July	
	August	50531
	September	
	October	
	November	54450
	December	
Annual Production (BBLs)		206043

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1983	January	
	February	54450
	March	
	April	
	May	54450
	June	
	July	
	August	54450
	September	
	October	
	November	54450
	December	
Annual Production (BBLs)		217800

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1984	January	
	February	54450
	March	
	April	
	May	54450
	June	
	July	
	August	54450
	September	
	October	
	November	54450
	December	
Annual Production (BBLs)		217800

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1985	January	
	February	54450
	March	
	April	
	May	54450
	June	
	July	
	August	54450
	September	
	October	
	November	54450
	December	
Annual Production (BBLs)		217800

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1986	January	54450
	February	
	March	
	April	54450
	May	
	June	
	July	54450
	August	
	September	
	October	54450
	November	
	December	
Annual Production (BBLs)		217800

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1987	January	54450
	February	
	March	
	April	54450
	May	
	June	
	July	54450
	August	
	September	
	October	54450
	November	
	December	
Annual Production (BBLs)		217800

		Produced Brine (BBLs)
1988	January	83210
	February	
	March	
	April	42471
	May	
	June	
	July	41923
	August	
	September	
	October	26034
	November	
	December	
Annual Production (BBLs)		193638

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1989	January	51728
	February	
	March	
	April	35531
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		188179

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1990	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1991	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1992	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1993	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1994	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1995	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1996	January	50460
	February	
	March	
	April	50460
	May	
	June	
	July	50460
	August	
	September	
	October	50460
	November	
	December	
Annual Production (BBLs)		201840

		Produced Brine (BBLs)
1997	January	55297
	February	
	March	
	April	48999
	May	
	June	
	July	79618
	August	
	September	
	October	64553
	November	
	December	
Annual Production (BBLs)		248467

		Produced Brine (BBLs)
1998	January	81123
	February	
	March	
	April	37546
	May	
	June	
	July	48160
	August	
	September	
	October	9243
	November	
	December	
Annual Production (BBLs)		176072

Note: Yellow = estimated production. See details on the estimate calculation sheet above.		Produced Brine (BBLs)
1999	January	10846
	February	
	March	
	April	34050
	May	
	June	
	July	20150
	August	
	September	
	October	37760
	November	
	December	
Annual Production (BBLs)		102806

		Produced Brine (BBLs)
2000	January	55370
	February	
	March	
	April	41456
	May	
	June	
	July	22741
	August	
	September	
	October	42109
	November	
	December	
Annual Production (BBLs)		161676

		Produced Brine (BBLs)
2001	January	88369
	February	
	March	
	April	121508
	May	
	June	
	July	47347
	August	
	September	
	October	28055
	November	
	December	
Annual Production (BBLs)		285279

		Produced Brine (BBLs)
2002	January	17158
	February	
	March	
	April	32433
	May	
	June	
	July	48302
	August	
	September	
	October	59464
	November	
	December	
Annual Production (BBLs)		157357

		Produced Brine (BBLs)
2003	January	50146
	February	
	March	
	April	45977
	May	
	June	
	July	46413
	August	
	September	
	October	49345
	November	
	December	
Annual Production (BBLs)		191881

		Produced Brine (BBLs)
2004	January	88658
	February	
	March	
	April	74340
	May	
	June	
	July	84471
	August	
	September	
	October	58793
	November	
	December	
Annual Production (BBLs)		306262

		Produced Brine (BBLs)
2005	January	41958
	February	
	March	
	April	82679
	May	
	June	
	July	65161
	August	
	September	
	October	67696
	November	
	December	
Annual Production (BBLs)		257494

Note: Monthly production began to be reported starting August 2006. Yellow = estimated production.		Produced Brine (BBLs)
2006	January	19775
	February	
	March	
	April	6406
	May	6406
	June	6406
	July	6406
	August	9590
	September	5490
	October	3580
	November	5550
	December	16465
Annual Production (BBLs)		86074

		Produced Brine (BBLs)
2007	January	23133
	February	9341
	March	4276
	April	10968
	May	11365
	June	15278
	July	15430
	August	12664
	September	1908
	October	30
	November	1080
	December	2600
Annual Production (BBLs)		108073

Note: 0's were reported instead of just leaving it blank. I assume that was intentional and nothing was actually produced during this time.		Produced Brine (BBLs)
2008	January	10032
	February	5986
	March	0
	April	2215
	May	721
	June	0
	July	0
	August	0
	September	5600
	October	29282
	November	24316
	December	23963
Annual Production (BBLs)		102115

		Produced Brine (BBLs)
2009	January	2923
	February	10055
	March	7735
	April	13180
	May	3308
	June	10840
	July	10143
	August	5575
	September	13203
	October	9872
	November	9316
	December	4320
Annual Production (BBLs)		100470

Note: 0's were reported instead of just leaving it blank. I assume that was intentional and nothing was actually produced during this time.		Produced Brine (BBLs)
2010	January	25225
	February	8546
	March	9111
	April	10840
	May	18508
	June	5740
	July	1790
	August	0
	September	0
	October	0
	November	0
	December	0
Annual Production (BBLs)		79760

		Produced Brine (BBLs)
2011	January	1740
	February	11501
	March	6431
	April	10067
	May	12984
	June	12124
	July	12591
	August	8446
	September	18479
	October	20363
	November	10104
	December	2803
Annual Production (BBLs)		127633

		Produced Brine (BBLs)
2012	January	6229
	February	10713
	March	10165
	April	14340
	May	11742
	June	15939
	July	16878
	August	11076
	September	18479
	October	11572
	November	19345
	December	26217
Annual Production (BBLs)		172695

		Produced Brine (BBLs)
2013	January	16575
	February	22037
	March	35052
	April	19564
	May	20053
	June	29144
	July	36429
	August	51184
	September	37076
	October	40250
	November	32977
	December	34096
Annual Production (BBLs)		374437

		Produced Brine (BBLs)
2014	January	11477
	February	14943
	March	10624
	April	22163
	May	22800
	June	29824
	July	21420
	August	48383
	September	40596
	October	66617
	November	66684
	December	55300
Annual Production (BBLs)		410831

		Produced Brine (BBLs)
2015	January	43769
	February	32350
	March	40794
	April	28208
	May	27115
	June	37609
	July	42883
	August	18388
	September	26863
	October	24070
	November	22182
	December	22349
Annual Production (BBLs)		366580

		Produced Brine (BBLs)
2016	January	19185
	February	13170
	March	7310
	April	9629
	May	5582
	June	5148
	July	14649
	August	11375
	September	11347
	October	9014
	November	5860
	December	20217
Annual Production (BBLs)		132486

		Produced Brine (BBLs)
2017	January	10699
	February	11399
	March	16581
	April	17070
	May	12049
	June	3210
	July	8211
	August	6966
	September	25140
	October	6789
	November	5688
	December	9249
Annual Production (BBLs)		133051

		Produced Brine (BBLs)
2018	January	13917
	February	8263
	March	6319
	April	21897
	May	20777
	June	7978
	July	12062
	August	9847
	September	17366
	October	16897
	November	22225
	December	12472
Annual Production (BBLs)		170020

Note: Shut-In		Produced Brine (BBLs)
2019	January	0
	February	0
	March	0
	April	0
	May	0
	June	0
	July	0
	August	0
	September	0
	October	0
	November	0
	December	0
Annual Production (BBLs)		0

Note: Shut-In		Produced Brine (BBLs)
2020	January	0
	February	0
	March	0
	April	
	May	
	June	
	July	
	August	
	September	
	October	
	November	
	December	
Annual Production (BBLs)		0

Cumulative Brine Production

7,827,873 BBL