

# Sinclair Unit No. 16: EOR Report 2017

## Overview

Note: Vermilion Energy has assumed operatorship of Sinclair Unit No.16 through the acquisition of Red River Oil Inc. effective Feb 15, 2018. Within the 2017 EOR Report, operations undertaken by Red River in 2017 will be reported as so.

The Sinclair Unit No. 16 is a two section, two pattern waterflood in the three forks formation operated by Red River Oil Inc. ("Red River" or the "Company"). Pattern #1, located in Section 19-7-29 W1M and the west half of Section 20-007-29W1, consists of four active injectors at 00/13-19, 00/03-19, 00/15-19 and 02/14-20, nine horizontal producers at 00/04-19, 02/03-19, 02/15-19, 00/01-19, 02/01-19, 00/13-20 and 00/14-20. 00/01-19 is a planned future injection well. There is also one abandoned vertical well at 02-19. Pattern #2 is in Section 18-7-29 W1M and consists of three horizontal producers at 00/12-18, 00/13-18 and 02/13-18 and one planned future drill at 03/13-18. 02/13-18 is a planned future injection well. There is also one abandoned vertical well at 10-18 and a Manville water source well at 15-18. Figure 1 below is a map of the Unit and surrounding area showing the wellbore layouts.

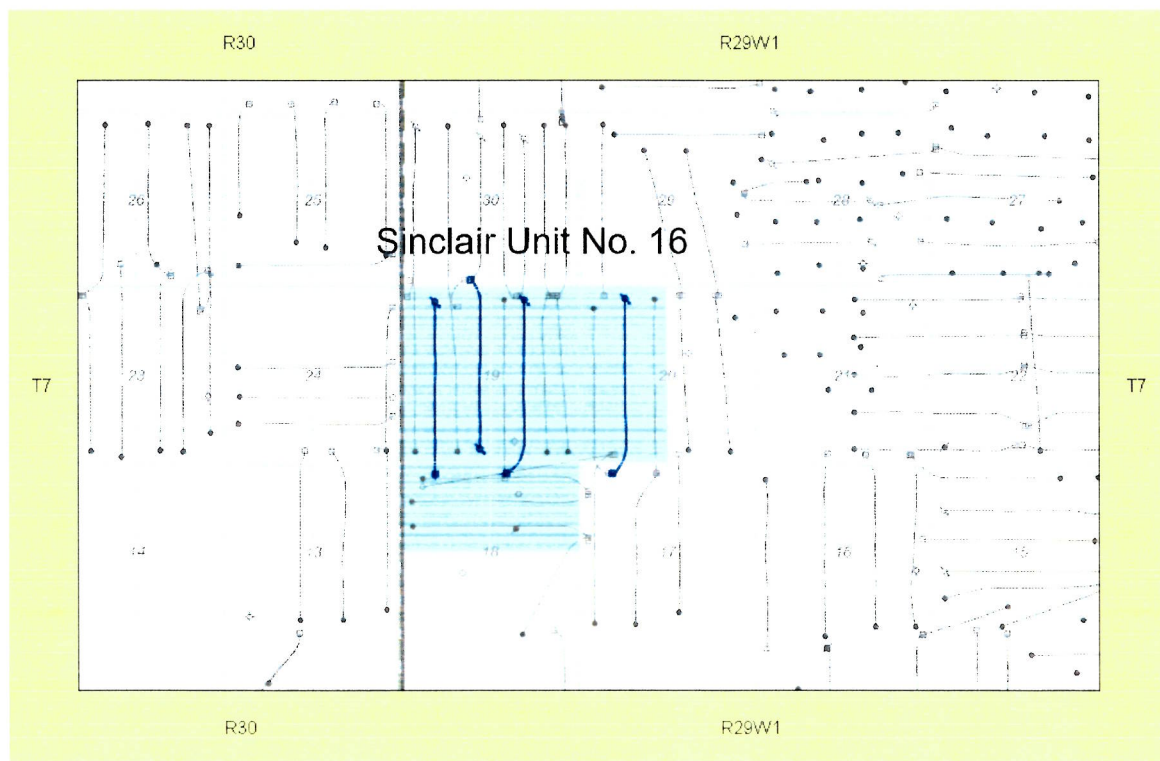


Figure 1: Sinclair Unit No. 16 Map

Producing zones of interest in the Unit are the Upper Devonian Lyleton A Member of the Three Forks Formation and the immediately overlying Mississippian Middle Bakken Siltstones. Horizontal wells have undulated through both the Three Forks Lyleton A Member and the Bakken Siltstones over the length of the laterals.

The Lyleton A Member of the Three Forks Formation was deposited in an evaporitic, shallow marine tidal flat / sabkha setting. Three distinct cleaning upward cycles make up the Lyleton A section in this area. These cycles grade upward from green shale/dolomitic siltstone breccias (poorer grade reservoir core Phi 0.12-0.19, Kmax 0.3-1.5mD) into cleaner, more massive ripple bedded dolomitic siltstones (best reservoir core Phi 0.12-0.19, Kmax 1.0-15.0mD). These cycles can also be correlated across the entire Sinclair area and represent excellent continuous reservoir units in which to efficiently sweep oil via waterflood. The Lyleton A member is the primary oil producing horizon in this area and is approximately 8m thick with net pay in the order of 3-4m. The Middle Bakken Siltstones unconformably overlie the Three Forks in this area. Bakken silts were deposited in a shallow marine setting and in this area are made up finely laminated quartzose siltstones, very fine sands and shales. Core porosities of 0.09-0.18 and permeabilities of 0.3-5mD are characteristic of this zone. The silts vary in thickness from less than 1m to 4m across the Unit.

The current recovery of the OOIP (14,038 mstb) for Unit No. 16 is approximately 4.0% (568.4 mstb). Primary recovery was originally estimated at 5% (702 mstb). This is consistent with estimated recovery factors in the pool whereby the primary recovery factor is generally estimated between 5% and 8% at approximately 200m wellbore spacing. Derived from both analogous project performance and third party reservoir simulation work completed on Red River's land, Red River estimates that incremental secondary recovery of 10 to 15% is a reasonable projection. This brings the total estimated recovery factor to 15-20%.

### **Performance Discussion**

Injection into the Unit commenced in September 2015 in the 00/03-19 and 00/13-19 injection wells and has expanded in 2017 to include the 00/15-19 and 02/14-20 injection wells. Response to date in the producing wells directly offset injection has been very encouraging.

It can be observed in figures 2 and 3 within the appended data that that oil and fluid rates have been flat to slightly inclining throughout the year dating back to mid 2016, while oil cuts have remained flat to slightly improving. This performance trend is consistent with analogous projects in that quantifiable response typically occurs in a period of six to 12 months after commencement of injection. This positive waterflood response within Sinclair Unit No. 16's active area strongly supports Red River in its plans for future waterflood expansion.

### **73(1) (a-c)(f) Production and Injection Data**

The requested data referred to in clauses 1(a) to (c) and (f) of subsection 73(1) of the Oil and Gas Act (C.C.S.M. c. 034) is attached in appendix A as follows:

1. Figure 2: Unit No. 16 Monthly produced fluids and ratios in graphical and tabular format
2. Figure 3: Pattern #1 data in graphical and tabular format
3. Figure 4: Pattern #2 data in graphical and tabular format
4. Table 1: Sinclair Unit No. 16 monthly and cumulative production fluid and ratio data in tabular form
5. Individual injection well rate and pressure profiles:
  - a. 00/03-19
  - b. 00/13-19
  - c. 00/15-19
  - d. 02/14-20
6. Table 2: Monthly average injection rate and pressure data

### **73(1)(d) Reservoir Pressure Surveys**

There were no pressure surveys executed in Unit No. 16 in 2017.

### **73(1)(e) Well Servicing**

In June 2017 the injection packer in the 00/03-19 injection well failed. During the workover to repair the packer, Red River completed a Packers Plus frac liner drillout on this well.

Injection pressure reduction combined with increased injectivity strongly indicate this operation was a success.

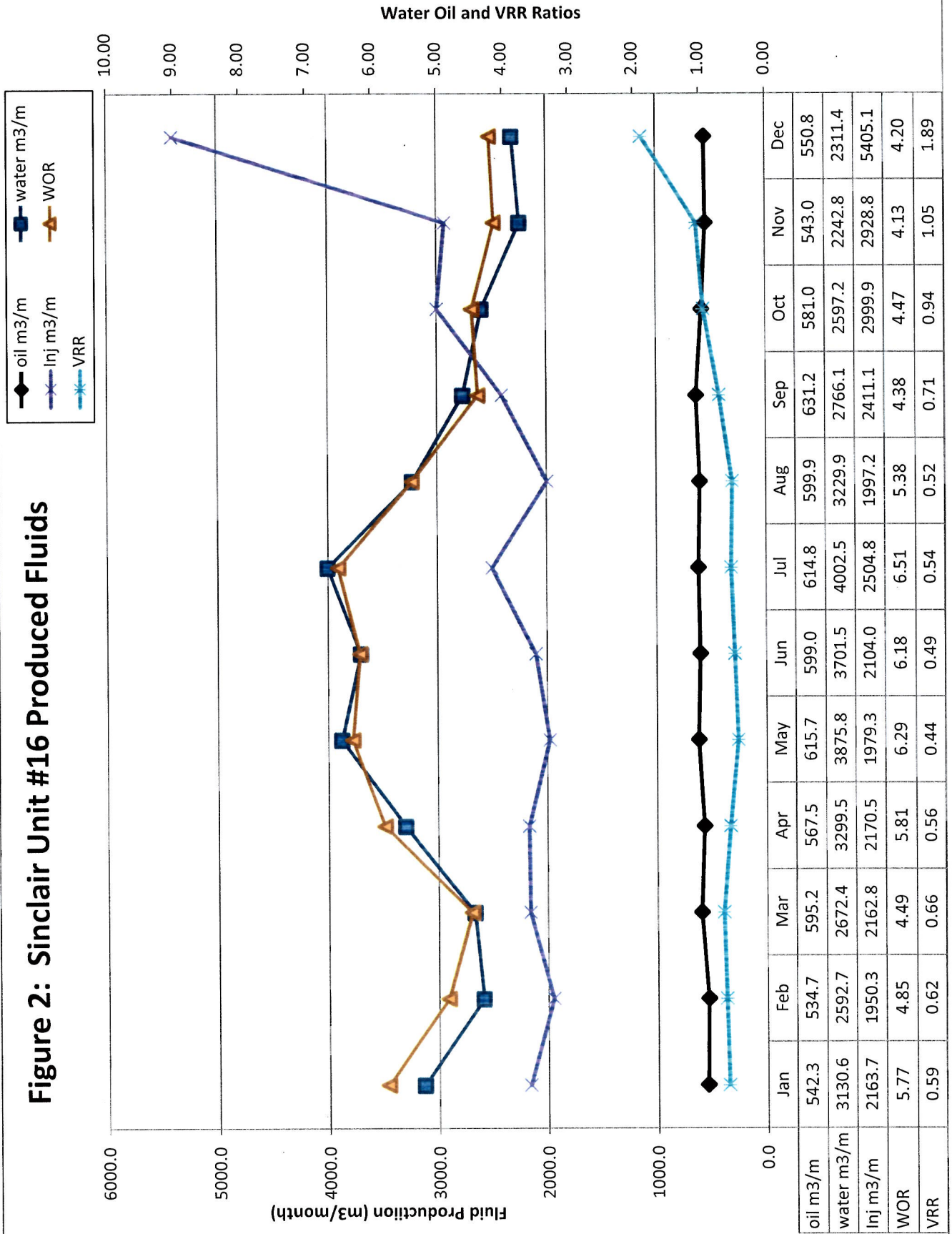
Other than the 00/03-19 injection packer repair and other routine maintenance such as downhole pump changes, there were no well servicing operations completed within Unit No. 16 in 2017.

### **73(1)(g) Injection Fluid Quality Control and Treatment**

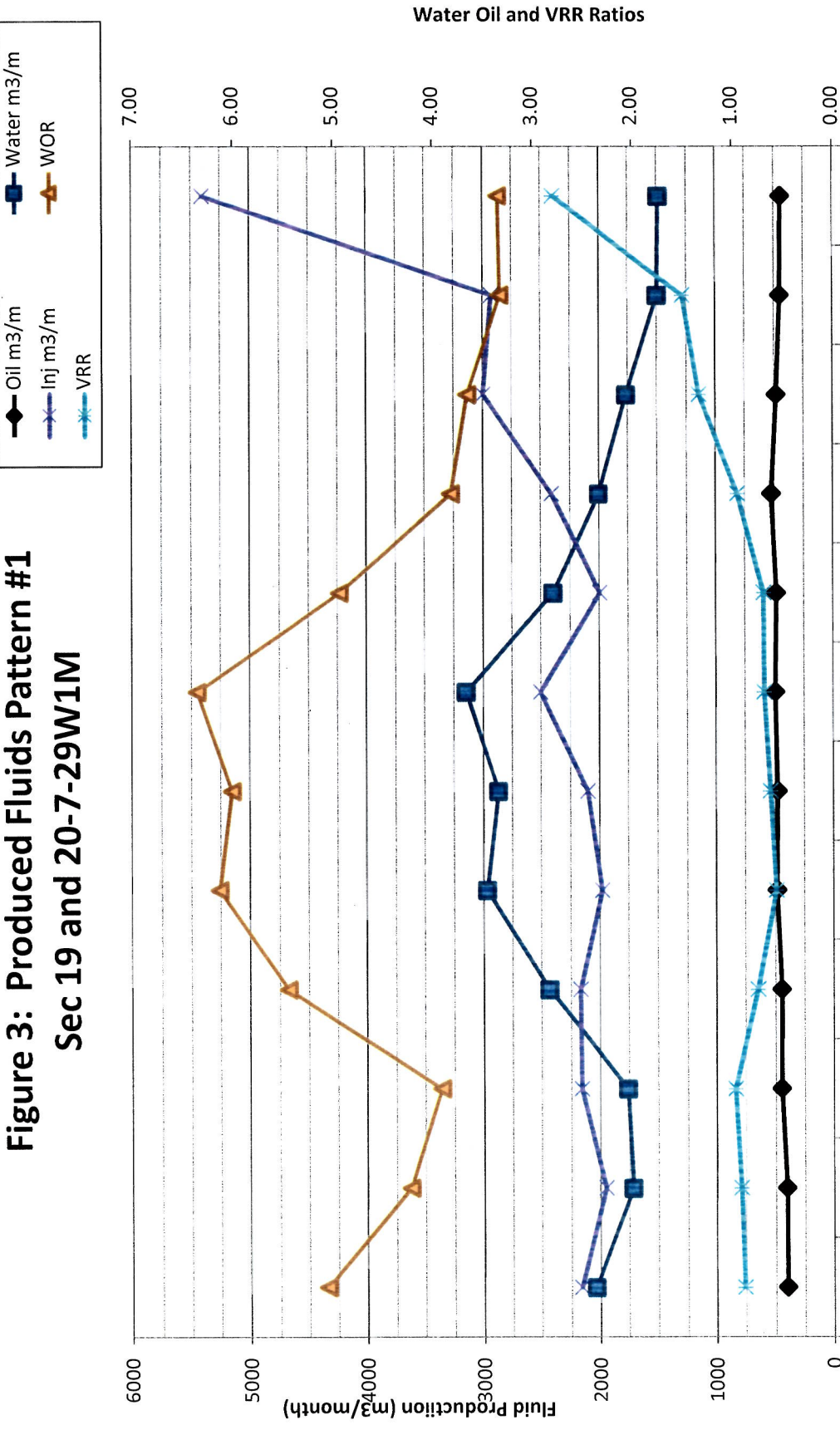
Injection fluid for Sinclair Unit No. 16 is sourced from the Manville formation in the 100/15-18-007-29W1 water source well. The 15-18 well is on the same lease as the 15-18 injection facility and is pipeline connected. At the 15-18 facility the water is pumped through a filtration skid where it completes three stages of filtration. The primary filter stage is a 1-micron nominal bag filter, secondary is a 1-micron absolute bag filter and a tertiary 0.5-micron polisher cartridge filter. After the water is filtered it enters the injection pipeline system via a positive displacement pump. The surface injection pressure is limited to 6,300 kPa. All water is treated with scale and biocide inhibitors prior to being injected into Unit No. 16.



# Figure 2: Sinclair Unit #16 Produced Fluids



**Figure 3: Produced Fluids Pattern #1**  
**Sec 19 and 20-7-29W1M**



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oil m3/m	402.2	405.3	448.9	445.8	484.0	477.5	495.1	485.5	524.6	482.5	450.7	444.7
Water m3/m	2036.1	1714.0	2162.8	2430.6	2969.3	2870.3	3146.9	2395.5	2003.7	1763.3	1498.6	1487.6
Inj m3/m	2163.7	1950.3	2162.8	2170.5	1979.3	2104.0	2504.8	1997.2	2411.1	2999.9	2928.8	5405.1
WOR	5.06	4.23	3.92	5.45	6.13	6.01	6.36	4.93	3.82	3.65	3.33	3.35
VRR	0.89	0.92	0.98	0.75	0.57	0.63	0.69	0.69	0.95	1.34	1.50	2.80

**Figure 4: Produced Fluids Pattern #2**  
**Sec 18-7-29W1M**

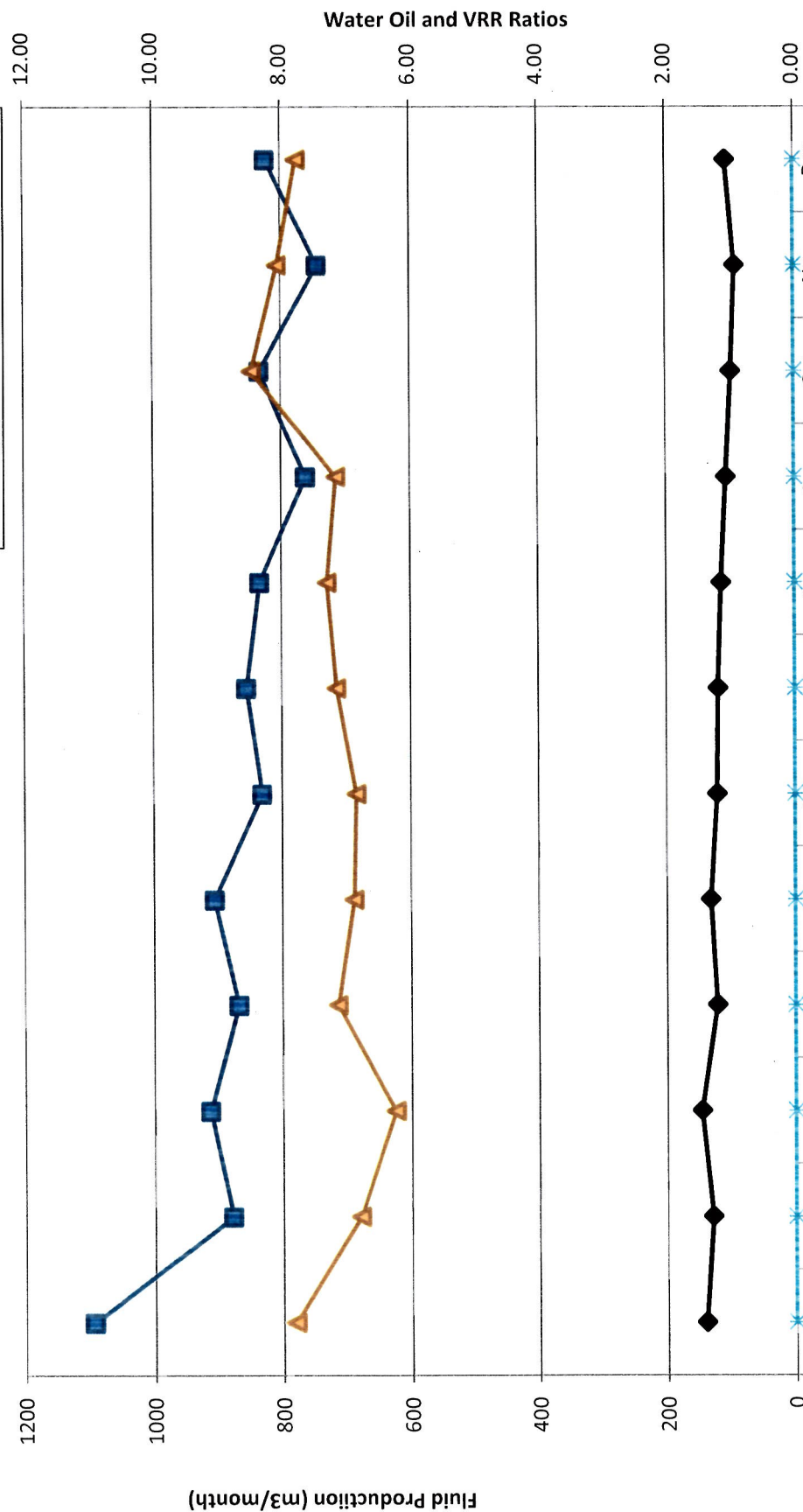


Table 1: Sinclair Unit #16 Produced Fluids

2017 Oil Production m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2017	CTD
Pattern #1 Sec 19&20-007-29W1	71257.0	402.2	405.3	448.9	445.8	484.0	477.5	495.1	485.5	524.6	482.5	450.7	444.7	5546.7	76803.7
Pattern #2 Sec 18-007-29W1	12145.5	140.1	129.4	146.3	121.8	131.7	121.4	119.7	114.4	106.6	98.5	92.3	106.1	1428.4	13573.8
Unit #16 Total Production	83402.4	542.3	534.7	595.2	567.5	615.7	599.0	614.8	599.9	631.2	581.0	543.0	550.8	6975.1	90377.5

2017 Water Production m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2017	CTD
Pattern #1 Sec 19&20-007-29W1	181180.1	2036.1	1714.0	1758.7	2430.6	2969.3	2870.3	3146.9	2395.5	2003.7	1763.3	1498.6	1487.6	26074.5	207254.5
Pattern #2 Sec 18-007-29W1	51019.0	1094.6	878.7	913.7	868.9	906.5	831.2	855.6	834.4	762.4	833.8	744.1	823.8	10347.7	61366.7
Unit #4 Total Production	232199.1	3130.6	2592.7	2672.4	3299.5	3875.8	3701.5	4002.5	3229.9	2766.1	2597.2	2242.8	2311.4	36422.2	268621.3

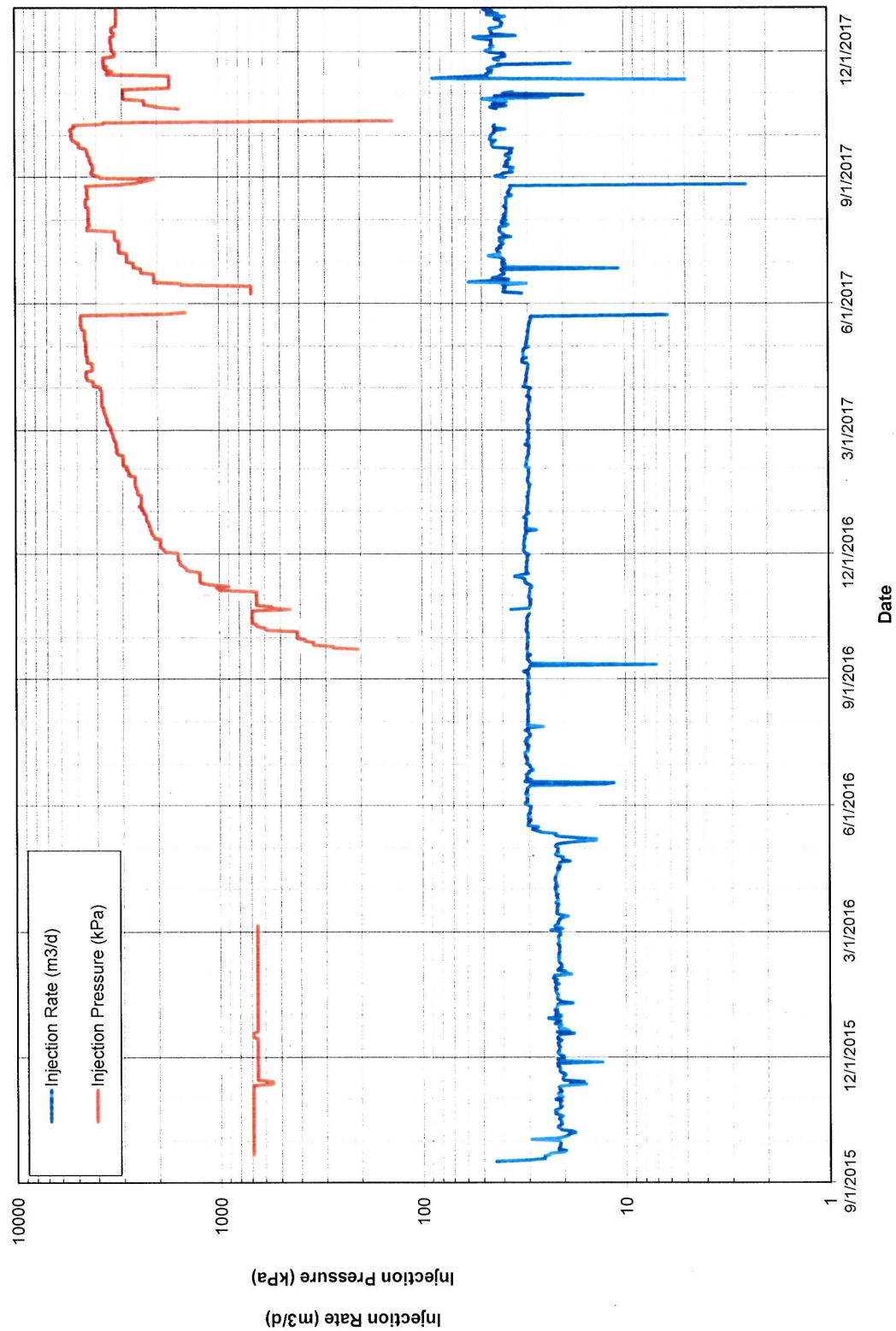
Unit #16 WOR	2.78	5.77	4.85	4.49	5.81	6.29	6.18	6.51	5.38	4.38	4.47	4.13	4.20	5.22	2.97
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2017 Water Injection m3/month	Prior CTD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2017	CTD
Pattern #1 Sec 19&20-007-29W1	24287.8	2163.7	1950.3	2162.8	2170.5	1979.3	2104.0	2504.8	1997.2	2411.1	2999.9	2928.8	5405.1	30777.5	55065.3
Pattern #2 Sec 18-007-29W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unit #16 Injection	24287.8	2163.7	1950.3	2162.8	2170.5	1979.3	2104.0	2504.8	1997.2	2411.1	2999.9	2928.8	5405.1	30777.5	55065.3

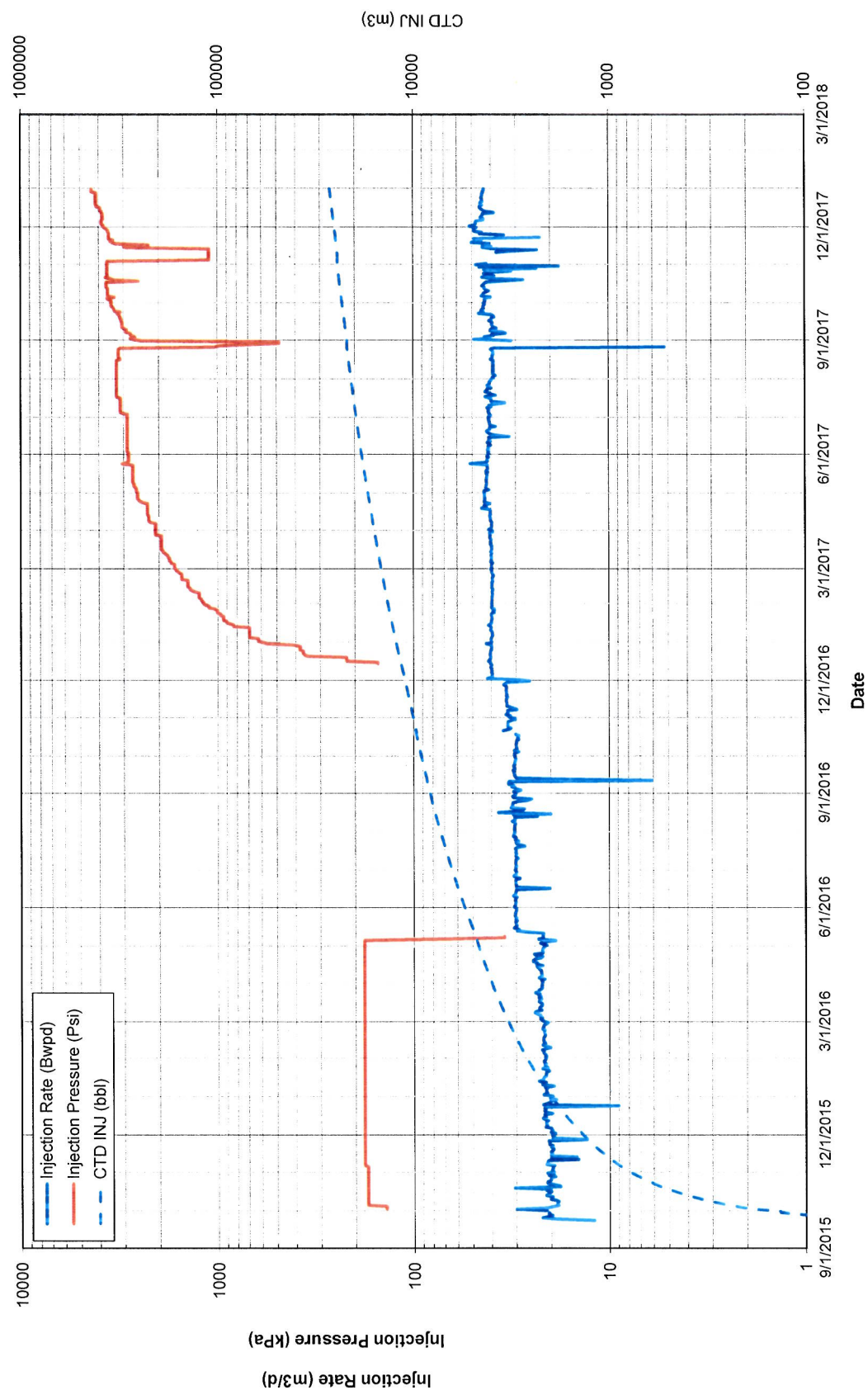
Unit #16 VRR	0.08	0.59	0.62	0.66	0.56	0.44	0.49	0.54	0.52	0.71	0.94	1.05	1.89	0.71	0.15
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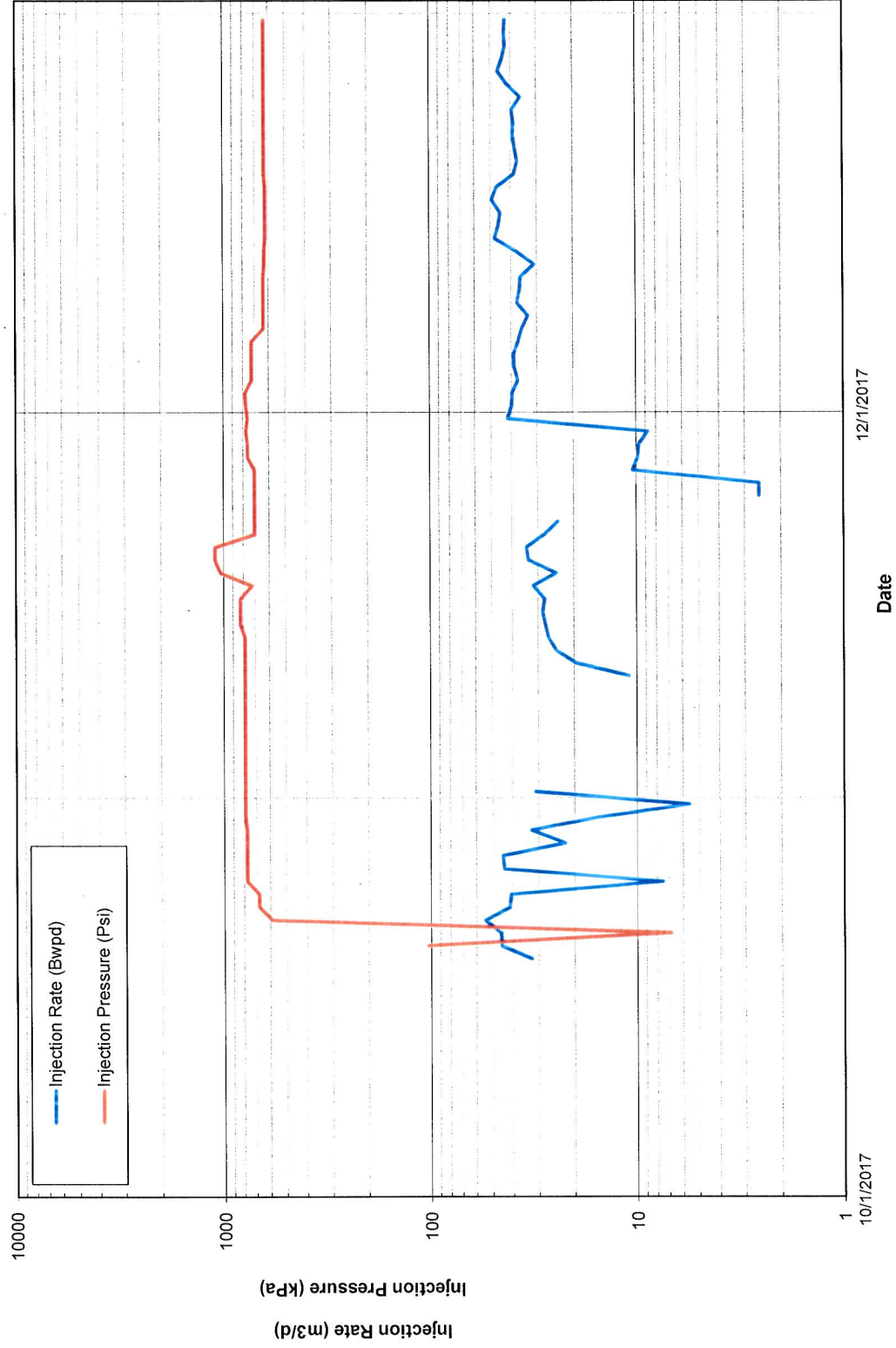
00/03-19-7-29 W1M



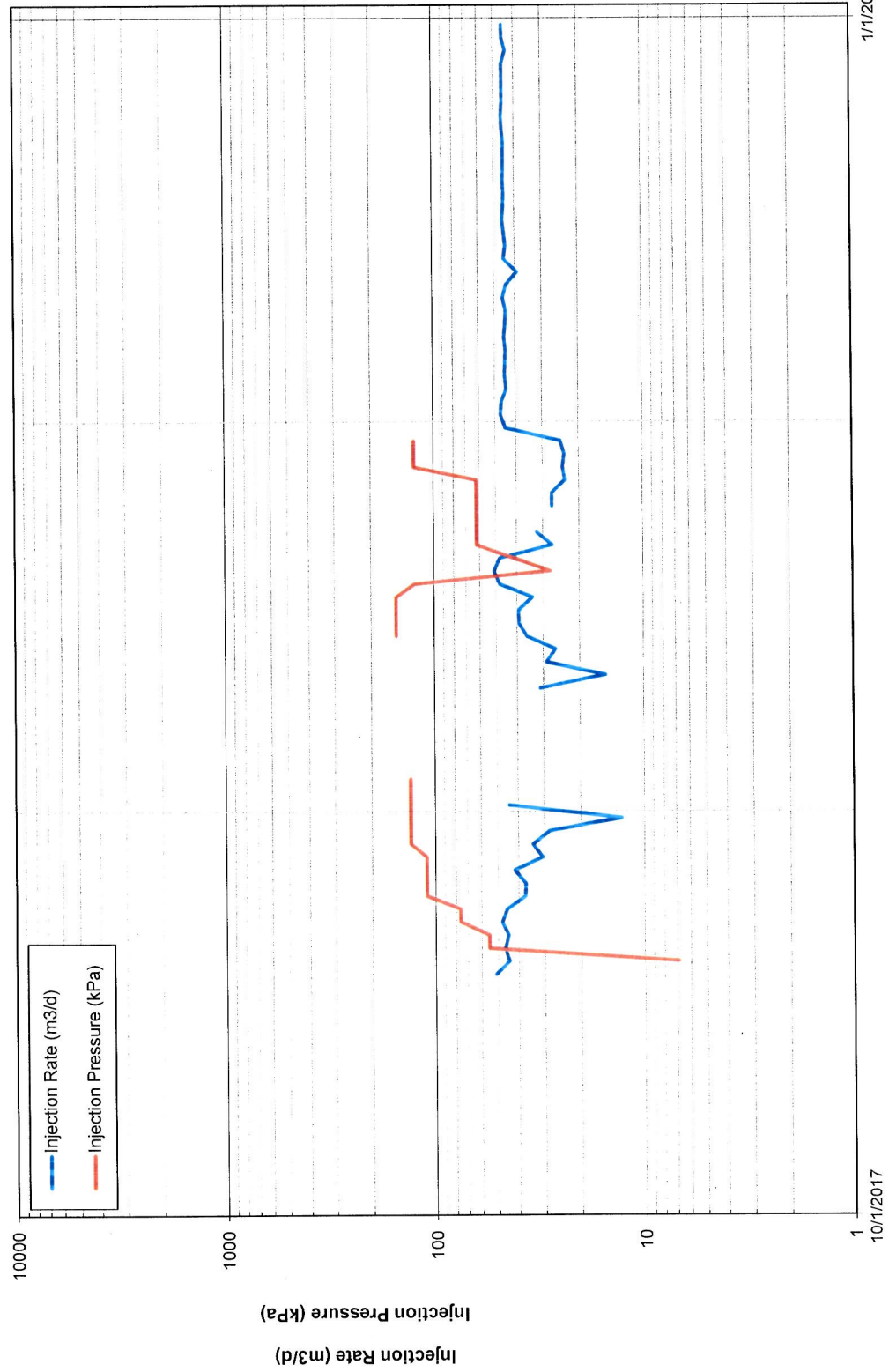
00/13-19-7-29 W1M



00/15-19-7-29 W1M



02/14-20-7-29 W1M





### Table 2: Sinclair Unit #16 Monthly Average Injection Data

Pattern #1 Monthly Averages	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
00/03-19 Injection Rate (m3/d)	30	30	30	31	21	29	40	32	39	26	30	44
00/03-19 Injection Pressure (kPa)	2541	3137	3653	4336	3541	1469	3394	4072	4474	2539	2850	3265
00/13-19 Injection Rate (m3/d)	40	40	40	42	43	41	41	33	41	40	29	45
00/13-19 Injection Pressure (kPa)	857	1387	1866	2291	2712	2859	3145	2781	3057	3547	2644	4008
00/15-19 Injection Rate (m3/d)										33	15	40
00/15-19 Injection Pressure (kPa)										575	798	649
02/14-20 Injection Rate (m3/d)										39	23	45
02/14-20 Injection Pressure (kPa)										85	65	0