

**Waskada Unit No. 17**

**Waterflood Progress Report 2018**

**January 1<sup>st</sup> through December 31<sup>st</sup> 2018**

**Prepared for:**

**Manitoba Industry, Economic Development and Mines**

**Petroleum Branch**

**Prepared by:**

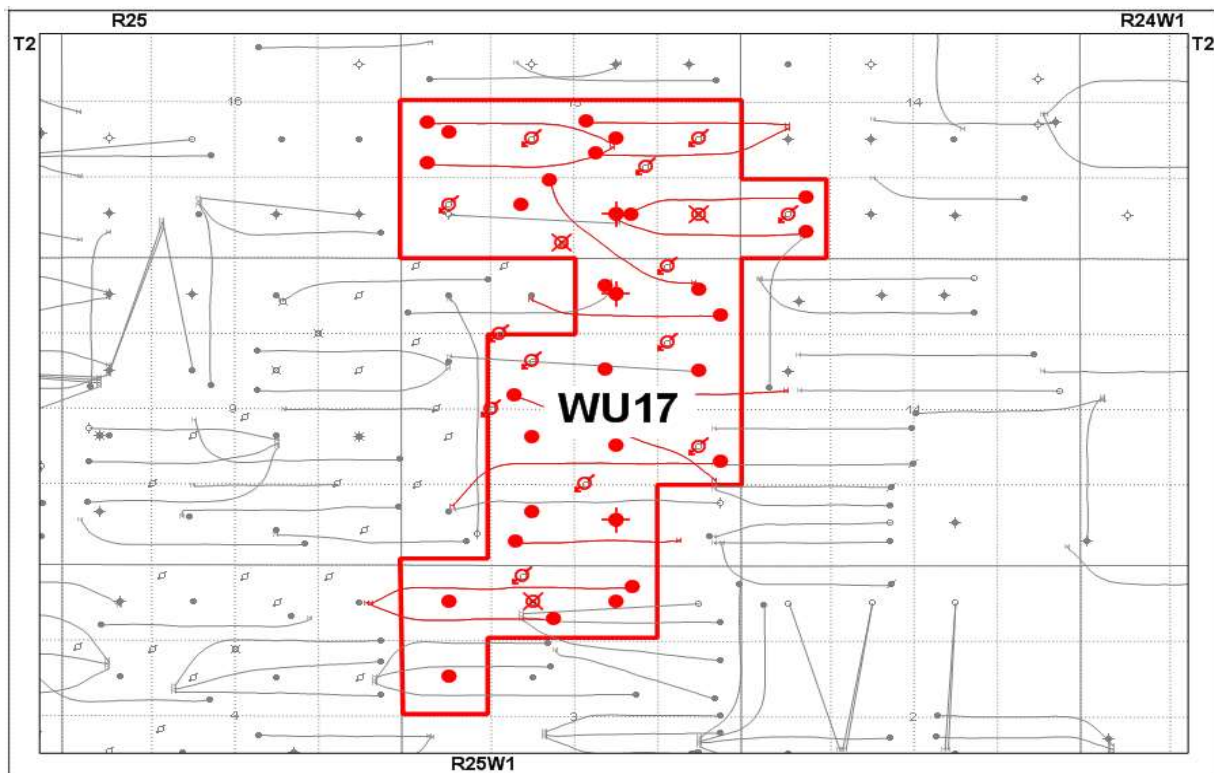
**Tundra Oil and Gas**

**June 24, 2019**

## INTRODUCTION

The Waskada Unit No.17 pressure maintenance project commenced water injection into the Lower Amaranth A pool in accordance with Manitoba Energy and Mines Order No. PM 66, dated October 1, 1991. Waskada Unit No. 17 was acquired from EOG Resources Canada Inc. effective October 1, 2014 (closing date December 1, 2014) with Tundra Oil and Gas (Tundra) as the new operator. The EOR project area, outlined in red in Figure 1, contains 51 wells over 23 LSDs in Township 2, Range 25W1.

**Figure 1: Waskada Unit No. 17 Area Outline**



## Waskada Unit No.17

Tundra Oil and Gas (Tundra), as the operator of the Waskada Unit 17 Enhanced Oil Recovery (EOR) project hereby submits the 2018 EOR report as per section 73 of the Drilling and Production Regulations.

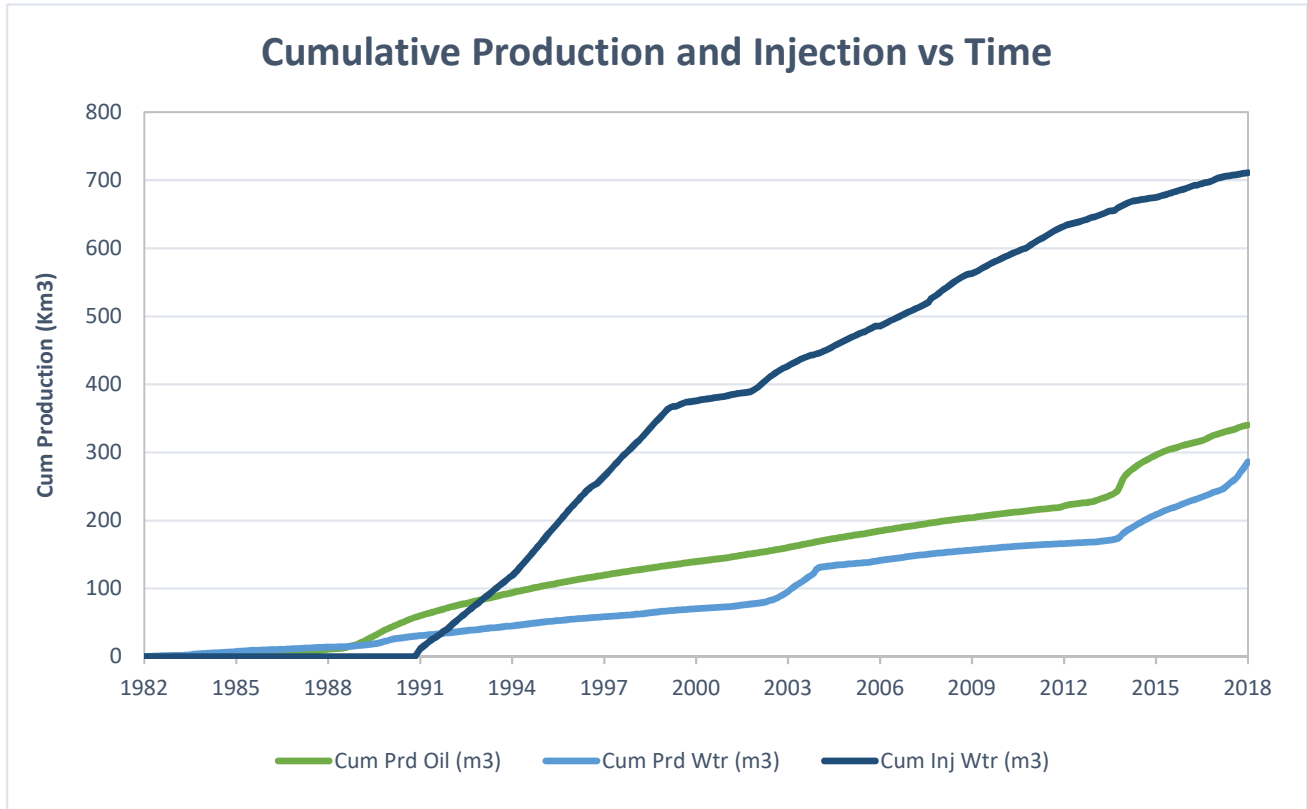
**a) Monthly oil and water production rates, injection rate, GOR and WOR**

MONTH	Cal Dly Oil m <sup>3</sup> /day	Cal Dly Wtr m <sup>3</sup> /day	Cal Inj Wtr m <sup>3</sup> /day	WOR m <sup>3</sup> /m <sup>3</sup>	GOR m <sup>3</sup> /m <sup>3</sup>
Jan-2018	38.81	47.37	43.56	1.22	0.00
Feb-2018	40.21	55.53	27.64	1.38	0.00
Mar-2018	41.71	79.00	27.22	1.89	0.00
Apr-2018	34.16	112.31	14.26	3.29	0.00
May-2018	28.31	111.43	17.68	3.94	0.00
Jun-2018	32.76	95.53	26.50	2.92	0.00
Jul-2018	32.11	89.06	10.04	2.77	0.00
Aug-2018	48.76	137.40	20.16	2.82	0.00
Sep-2018	45.76	164.13	27.69	3.59	0.00
Oct-2018	34.88	152.63	41.14	4.38	0.00
Nov-2018	28.52	175.65	53.54	6.16	0.00
Dec-2018	32.51	196.15	19.10	6.03	0.00

**b) Cumulative volume of oil, gas and water produced and fluid injected**

2018 PRODUCTION	
Produced Oil (m <sup>3</sup> )	13,331
Produced Gas (m <sup>3</sup> )	0
Produced Water (m <sup>3</sup> )	43,188
Fluid Injected (m <sup>3</sup> )	8,243
CUMMULATIVE PRODUCTION	
Produced Oil (m <sup>3</sup> )	340,307
Produced Water (m <sup>3</sup> )	286,294

## Waskada Unit No.17



c) Monthly wellhead injection pressure for each injection well

	00/04-14 Inj		00/06-15 Inj		00/08-10 Inj		00/08-15 Inj		00/11-10 Inj		02/04-15 Inj	
MONTH	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)
Jan-2018	40.5	4936	151.8	4810	115.1	5000	307.7	553	418.2	3216	0.0	2000
Feb-2018	31.0	4956	138.2	4764	104.3	5000	278.4	540	0.0	3050	0.0	2000
Mar-2018	28.3	4901	157.2	5010	115.6	4974	297.3	487	0.0	3050	0.0	2000
Apr-2018	22.9	4964	127.3	5100	89.3	4982	0.0	461	0.0	3050	0.0	2000
May-2018	18.9	4966	145.0	5058	97.7	5000	136.9	471	0.0	3050	0.0	2000
Jun-2018	14.1	4968	173.2	5000	116.0	5000	273.4	359	0.0	3050	0.0	2000
Jul-2018	7.2	4852	100.2	4782	60.0	4884	28.4	380	0.0	3050	0.0	2000
Aug-2018	22.0	4749	155.5	4705	106.0	4898	197.4	417	0.0	3050	0.0	2000
Sep-2018	13.3	4824	173.3	4880	116.7	4880	287.6	281	0.0	3050	0.0	2000
Oct-2018	12.3	4894	134.5	4945	94.3	4906	223.7	278	0.0	3050	0.0	2000
Nov-2018	6.5	4975	143.7	4920	119.7	4958	297.4	284	0.0	3050	0.0	2000
Dec-2018	2.9	4976	51.8	5000	44.3	5000	109.1	269	0.0	0	0.0	0
<b>Total</b>	219.9		1651.7		1178.7		2437.3		418.2		0.0	
<b>Avg Inj P</b>		4913		4915		4957		398		2810		1833

	02/14-03 Inj		A0/07-15 Inj		C0/02-10 Inj		C0/06-10 Inj		C0/08-10 Inj		C0/09-10 Inj	
MONTH	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)
Jan-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	115.5	4832	71.4	4905
Feb-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	103.7	4886	0.0	4900
Mar-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	114.1	4923	0.0	4900
Apr-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	87.2	4903	0.0	4900
May-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	60.5	4963	0.0	4900
Jun-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	93.6	5000	0.0	4900
Jul-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	52.4	4870	0.0	4900
Aug-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	55.1	4863	0.0	4900
Sep-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	110.4	4850	0.0	4900
Oct-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	74.0	4884	0.0	4900
Nov-2018	0.0	5000	0.0	4800	0.0	0	0.0	4850	113.2	4927	0.0	4900
Dec-2018	0.0	0	0.0	0	0.0	0	0.0	0	41.2	5000	0.0	0
<b>Total</b>	0.0		0.0		0.0		0.0		1021.0		71.4	
<b>Avg Inj P</b>		4583		4400		0		4446		4908		4492

c) Monthly wellhead injection pressure for each injection well

	C0/11-10 Inj		C0/16-10 Inj		WU17	
MONTH	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)	Inj Water (m <sup>3</sup> )	Avg Inj P (kPa)
Jan-2018	0.0	4900	130.3	4942	1350.5	3910
Feb-2018	0.0	4900	118.2	4950	773.8	3900
Mar-2018	0.0	4900	131.4	4924	844.0	4078
Apr-2018	0.0	4900	101.2	4907	427.9	4217
May-2018	0.0	4900	89.0	5000	547.9	4228
Jun-2018	0.0	4900	124.7	5000	794.9	4218
Jul-2018	0.0	4900	63.1	4865	311.3	4164
Aug-2018	0.0	4900	89.1	4898	625.0	4156
Sep-2018	0.0	4900	129.5	4825	830.8	4157
Oct-2018	0.0	4900	98.8	4876	637.7	4172
Nov-2018	0.0	4900	122.6	4920	803.1	4166
Dec-2018	0.0	0	46.8	5000	296.0	4207
<b>Total</b>	0.0		1244.7		8242.9	
<b>Avg Inj P</b>		4492		4926		4131

MONTH	Jan-2018	Feb-2018	Mar-2018	Apr-2018	May-2018	Jun-2018	Jul-2018	Aug-2018	Sep-2018	Oct-2018	Nov-2018	Dec-2018
<b>Total m3</b>	1350.5	773.8	844.0	427.9	547.9	794.9	311.3	625.0	830.8	637.7	803.1	296.0
<b>Daily (m<sup>3</sup>/d)</b>	43.56	27.64	27.23	14.26	17.68	26.50	10.04	20.16	27.69	20.57	26.77	9.55

2018 AVG. ANNUAL DAILY INJECTION = 22.64 m3/d
---

CUMULATIVE INJECTION TO Dec 31, 2017 = 702,784 m3
---

TOTAL 2018 ANNUAL INJECTION = 8,243 m3
--

CUMULATIVE INJECTION TO Dec 31, 2018 = 711,027 m3
---

d) Summary of the result of any survey of reservoir pressure conducted in 2018. N/A

e) **Date and type of any well servicing.**

Well	Service Description	Date
100.03-10-002-25W1.00	Pump Change	8/16/2018
100.03-10-002-25W1.00	Pump Change	9/11/2018
100.05-15-002-25W1.00	Rigless Acid Stimulation	1/25/2018
102.01-10-002-25W1.00	Broken Rod / Pump Change	4/3/2018
102.03-10-002-25W1.00	Cemented Liner Cleanout & Pressure Test	11/22/2018
102.05-15-002-25W1.00	Cemented Liner Clean Out	2/21/2018
102.09-10-002-25W1.00	Tubing Pump Install	10/19/2018
102.15-10-002-25W1.00	Pump Change/Acid Job	6/27/2018
103.04-15-002-25W1.00	Pump Change	8/24/2018
103.08-10-002-25W1.00	Cemented Liner Clean Out	2/11/2018
103.14-03-002-25W1.00	Cemented Liner Clean Out	12/10/2018

f) **Calculations of voidage replacement ratio on a monthly and cumulative basis**

**VOIDAGE CALCULATIONS**

OIL FORMATION VOLUME FACTOR (Rm3/Sm3) = 1.17

MONTH	Mth Oil Prod (m3)	Cum Oil Prod (Km3)	Mth Water Prod (m3)	Cum Water Prod (Km3)	Mth Water Inj (m3)	Cum Water Inj (Km3)	VRR	Cum VRR
Jan-2018	1203.1	328.18	1468.6	244.57	1350.5	704.13	0.470	1.120
Feb-2018	1125.8	329.30	1554.7	246.13	773.8	704.91	0.269	1.116
Mar-2018	1293.1	330.60	2449.0	248.58	843.9	705.75	0.213	1.111
Apr-2018	1024.7	331.62	3369.4	251.95	427.9	706.18	0.094	1.103
May-2018	877.5	332.50	3454.3	255.40	548.0	706.73	0.122	1.097
Jun-2018	982.7	333.48	2866.0	258.27	795.0	707.52	0.198	1.091
Jul-2018	995.4	334.48	2760.8	261.03	311.3	707.83	0.079	1.085
Aug-2018	1511.7	335.99	4259.4	265.29	625.1	708.46	0.104	1.076
Sep-2018	1372.7	337.36	4923.9	270.21	830.8	709.29	0.127	1.067
Oct-2018	1081.2	338.44	4731.4	274.94	637.7	709.93	0.106	1.058
Nov-2018	855.7	339.30	5269.6	280.21	803.1	710.73	0.128	1.050
Dec-2018	1007.8	340.31	6080.8	286.29	296.0	711.03	0.041	1.039

g) **An outline of the method used for quality control and treatment of the injected fluid**

The injected fluid is treated by filtration.

h) **A report of any unusual performance problems and remedial measures taken or being considered. N/A**

i) **Any other information necessary to evaluate the project**

<i>UWI</i>	<i>Type</i>	<i>Status</i>	<i>Future Plans</i>
100/12-03-002-25W1/0	Vertical	Producing	-
100/13-03-002-25W1/0	Vertical	Pumping	-
100/14-03-002-25W1/0	Vertical	Abandoned	-
102/14-03-002-25W1/0	Vertical	Injection	-
103/14-03-002-25W1/0	Horizontal	Producing	WIW Conversion
100/15-03-002-25W1/0	Vertical	Pumping	-
102/15-03-002-25W1/0	Horizontal	Producing	-
100/02-10-002-25W1/0	Vertical	Abandoned Zone	-
1C0/02-10-002-25W1/0	Vertical	Abandoned	-
100/03-10-002-25W1/0	Vertical	Producing	-
102/03-10-002-25W1/0	Horizontal	Producing	-
100/06-10-002-25W1/0	Vertical	Producing	-
1C0/06-10-002-25W1/0	Vertical	Injection	-
100/07-10-002-25W1/0	Vertical	Pumping	-
100/08-10-002-25W1/0	Vertical	Injection	-
103/08-10-002-25W1/0	Horizontal	Producing	-
1C0/08-10-002-25W1/0	Vertical	Injection	-
100/09-10-002-25W1/0	Vertical	Pumping	-
102/09-10-002-25W1/0	Horizontal	Producing	-
1C0/09-10-002-25W1/0	Vertical	Injection	-
100/10-10-002-25W1/0	Vertical	Pumping	-
100/11-10-002-25W1/0	Vertical	Injection	-
103/11-10-002-25W1/0	Horizontal	Producing	-
104/11-10-002-25W1/0	Horizontal	Producing	-
1C0/11-10-002-25W1/0	Vertical	Injection	-
100/15-10-002-25W1/0	Vertical	Abandoned	-
102/15-10-002-25W1/0	Vertical	Pumping	-
100/16-10-002-25W1/0	Vertical	Pumping	-
103/16-10-002-25W1/0	Horizontal	Producing	-
1C0/16-10-002-25W1/0	Vertical	Injection	-
100/04-14-002-25W1/0	Vertical	Injection	-
102/04-14-002-25W1/0	Horizontal	Producing	-
103/04-14-002-25W1/0	Horizontal	Producing	-
100/01-15-002-25W1/0	Vertical	Abandoned	-
100/02-15-002-25W1/0	Vertical	Abandoned	-
102/02-15-002-25W1/0	Vertical	Pumping	-
100/03-15-002-25W1/0	Vertical	Producing	-
103/03-15-002-25W1/0	Horizontal	Producing	-
1A0/03-15-002-25W1/0	Vertical	Abandoned	-
102/04-15-002-25W1/0	Vertical	Injection	-
103/04-15-002-25W1/0	Horizontal	Producing	-
100/05-15-002-25W1/0	Vertical	Producing	-
102/05-15-002-25W1/0	Horizontal	Producing	-
103/05-15-002-25W1/0	Horizontal	Producing	-
100/06-15-002-25W1/0	Vertical	Injection	-



## j) Well List

## Waskada Unit No. 17 Well List

<i><b>UWI</b></i>	<i><b>Type</b></i>	<i><b>Status</b></i>	<i><b>Future Plans</b></i>
100/07-15-002-25W1/0	Vertical	Pumping	-
103/07-15-002-25W1/0	Horizontal	Producing	-
104/07-15-002-25W1/0	Horizontal	Producing	-
1A0/07-15-002-25W1/0	Vertical	Injection	-
100/08-15-002-25W1/0	Vertical	Injection	-