

Birdtail Unit No. 2

Waterflood Progress Report 2019

January 1st through December 31st 2019

Prepared for:

Manitoba Industry, Economic Development and Mines

Petroleum Branch

Prepared by:

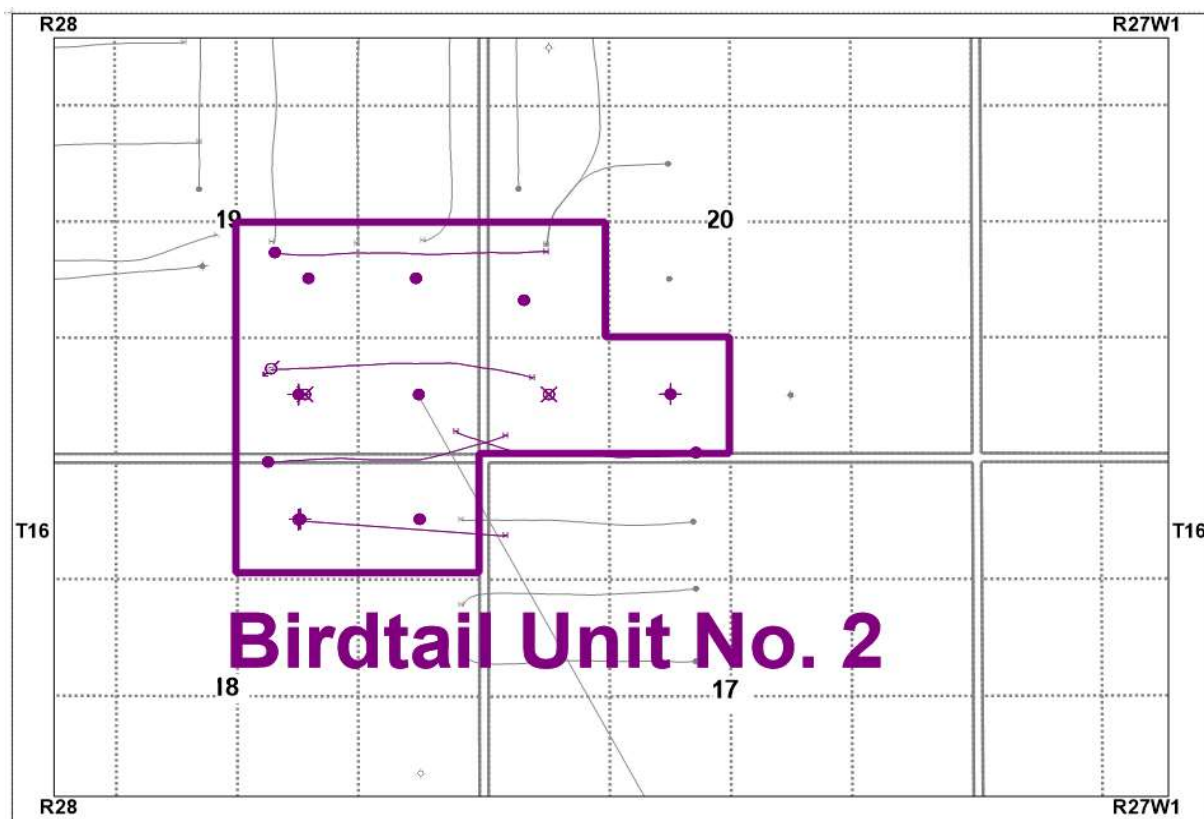
Tundra Oil and Gas

March 30, 2020

INTRODUCTION

Birdtail Unit No. 2 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 8 effective December 1, 2000 with Progress Energy Production Partnership as Operator. Tundra acquired the unit from Progress Energy Production Partnership and became operator in October 2003. The EOR project area contains 15 wells in 9 LSDs in Township 16, Range 27 W1 as shown in the figure below. This unit currently has only 1 horizontal well on injection.

Figure 1: Birdtail Unit No. 2 Area Outline



Birdtail Unit No. 2

Tundra Oil and Gas (Tundra), as the operator of the Birdtail Unit No. 2 Enhanced Oil Recovery (EOR) project hereby submits the 2019 EOR report as per section 73 of the Drilling and Production Regulations.

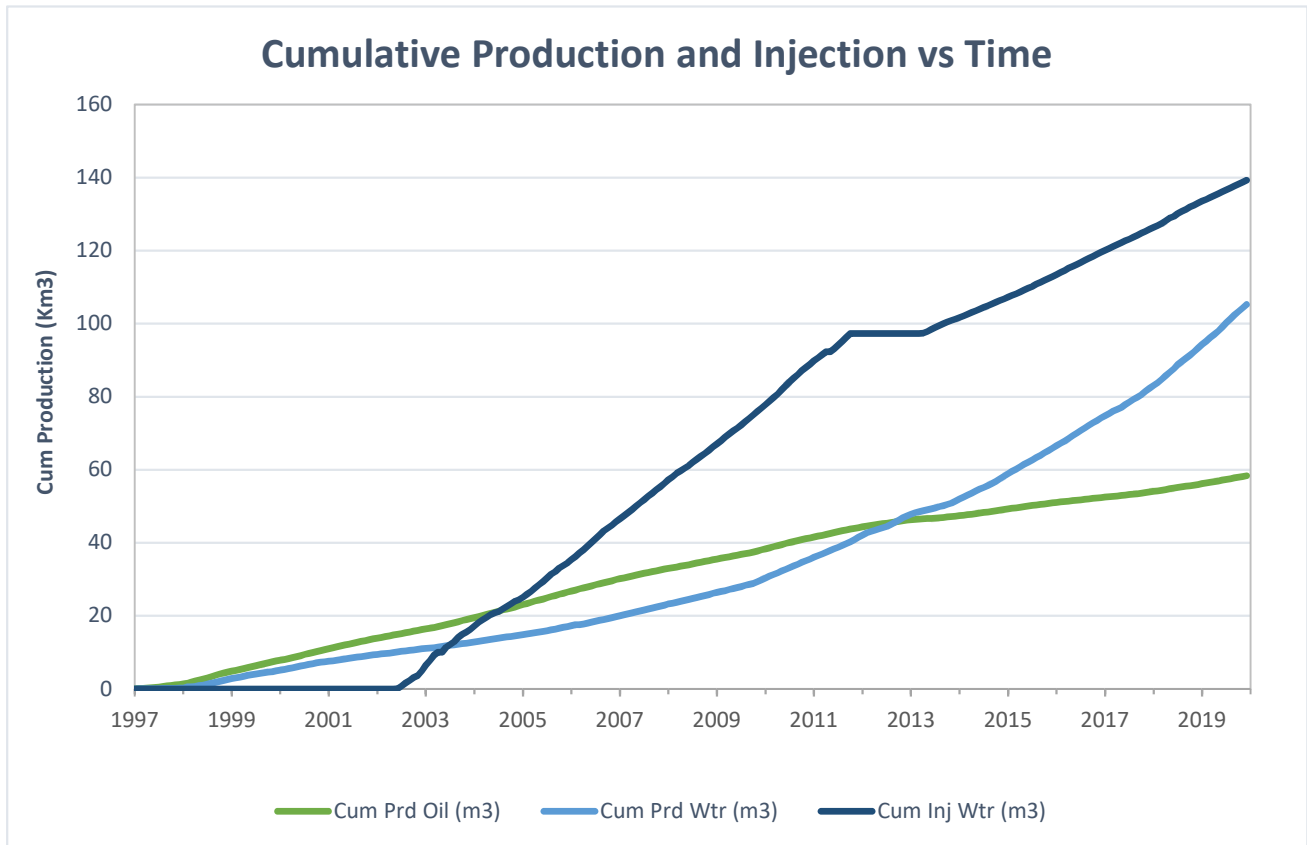
a) Monthly oil and water production rates, injection rate, GOR and WOR

MONTH	Cal Dly Oil m ³ /day	Cal Dly Wtr m ³ /day	Cal Inj Wtr m ³ /day	WOR m ³ /m ³	GOR m ³ /m ³
Jan-2019	6.32	32.05	17.48	5.07	0
Feb-2019	6.79	32.35	17.18	4.77	0
Mar-2019	6.72	31.05	16.87	4.62	0
Apr-2019	5.68	28.16	17.00	4.96	0
May-2019	6.33	30.75	16.84	4.86	0
Jun-2019	7.05	36.25	16.87	5.14	0
Jul-2019	6.71	38.14	17.13	5.69	0
Aug-2019	6.44	34.38	17.06	5.34	0
Sep-2019	6.74	34.16	17.27	5.07	0
Oct-2019	6.79	32.54	17.32	4.79	0
Nov-2019	6.26	31.01	17.13	4.95	0
Dec-2019	5.97	31.07	16.61	5.21	0

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

2019 PRODUCTION	
Produced Oil (m ³)	2,365
Produced Gas (m ³)	0
Produced Water (m ³)	11,923
Fluid Injected (m ³)	6,228
CUMULATIVE PRODUCTION	
Produced Oil (m ³)	58,353
Produced Water (m ³)	105,262

Birdtail Unit No. 2



c) Monthly wellhead injection pressure for each injection well

MONTH	03/02-19 Inj		Birdtail Unit 2	
	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2019	542.0	4179	542.0	4179
Feb-2019	481.0	4177	481.0	4177
Mar-2019	523.0	4180	523.0	4180
Apr-2019	510.0	4179	510.0	4179
May-2019	522.0	4178	522.0	4178
Jun-2019	506.0	4180	506.0	4180
Jul-2019	531.0	4137	531.0	4137
Aug-2019	529.0	4179	529.0	4179
Sep-2019	518.0	4179	518.0	4179
Oct-2019	537.0	4178	537.0	4178
Nov-2019	514.0	4179	514.0	4179
Dec-2019	515.0	4179	515.0	4179
Total	6228.0		6228.0	
Avg Inj P		4175		4175

MONTH	Jan-2019	Feb-2019	Mar-2019	Apr-2019	May-2019	Jun-2019	Jul-2019	Aug-2019	Sep-2019	Oct-2019	Nov-2019	Dec-2019
Total m3	542.0	481.0	523.0	510.0	522.0	506.0	531.0	529.0	518.0	537.0	514.0	515.0
Daily (m³/d)	17.48	17.18	16.87	17.00	16.84	16.87	17.13	17.06	17.27	17.32	17.13	16.61

2019 AVG. ANNUAL DAILY INJECTION = 17.06 m3/d

CUMULATIVE INJECTION TO Dec 31, 2018 = 133,028 m3

TOTAL 2019 ANNUAL INJECTION = 6,228 m3
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CUMULATIVE INJECTION TO Dec 31, 2019 = 139,256 m3

d) Summary of the result of any survey of reservoir pressure conducted in 2019. N/A

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

Well	Service Description	Date
102.07-19-016-27W1.00	Pump Change / Inspect Tubing	5/14/2019
102.15-18-016-27W1.00	Pump Change	12/18/2019

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

VOIDAGE CALCULATIONS

OIL FORMATION VOLUME FACTOR (Rm3/Sm3) = 1.071

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-2019	195.9	56.18	993.7	94.33	542.0	133.57	0.450	0.865
Feb-2019	190.1	56.37	905.9	95.24	481.0	134.05	0.434	0.861
Mar-2019	208.4	56.58	962.5	96.20	523.0	134.57	0.441	0.858
Apr-2019	170.4	56.75	844.7	97.05	510.0	135.08	0.496	0.856
May-2019	196.1	56.95	953.4	98.00	522.0	135.61	0.449	0.853
Jun-2019	211.5	57.16	1087.5	99.09	506.0	136.11	0.385	0.849
Jul-2019	207.9	57.37	1182.4	100.27	531.0	136.64	0.378	0.845
Aug-2019	199.7	57.57	1065.9	101.33	529.0	137.17	0.413	0.842
Sep-2019	202.1	57.77	1024.9	102.36	518.0	137.69	0.417	0.838
Oct-2019	210.5	57.98	1008.8	103.37	537.0	138.23	0.435	0.835
Nov-2019	187.8	58.17	930.3	104.30	514.0	138.74	0.454	0.833
Dec-2019	185.0	58.35	963.1	105.26	515.0	139.26	0.443	0.830

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

The injection water for Birdtail Unit No. 2 is sourced from the 00/02-19-016-27W/2 well (Lodgepole formation). The water is treated at the 09-05-16-27W1 battery where it is filtered to 0.50 microns and has scale inhibitor added.

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**

j) Well List

Birdtail Unit No.2 Well List

<i>UWI</i>	<i>Type</i>	<i>Status</i>	<i>Future Plans</i>
100/15-18-016-27W1/0	Vertical	Abandoned	-
102/15-18-016-27W1/0	Horizontal	Producing	-
103/15-18-016-27W1/0	Horizontal	Producing	-
100/16-18-016-27W1/0	Vertical	Producing	-
100/01-19-016-27W1/0	Vertical	Abandoned Zone	-
100/02-19-016-27W1/0	Vertical	Abandoned Zone	-
102/02-19-016-27W1/0	Vertical	Abandoned	-
103/02-19-016-27W1/0	Horizontal	Injection	-
100/07-19-016-27W1/0	Vertical	Producing	-
102/07-19-016-27W1/0	Horizontal	Producing	-
100/08-19-016-27W1/0	Vertical	Producing	-
100/03-20-016-27W1/0	Vertical	Abandoned Zone	-
102/03-20-016-27W1/0	Horizontal	Producing	-
100/04-20-016-27W1/0	Vertical	Abandoned	-
100/05-20-016-27W1/0	Vertical	Pumping	-

k) Discussion

The vertical injectors at 02/02-19-016-27W1/0 (02/02-19) and 00/04-20-016-27W1/0 (00/04-20) were suspended in October 2011. The 03/02-19-016-27W1/0 (03/02-19) horizontal well was converted to a water injector in April 2013 after a short production period. Ultimately, it is expected that the 02/15-18-016-27W1/0 and 02/07-19-016-27W1/0 horizontal producers will benefit the most from the new 03/02-19 water injector. Tundra will continue to closely monitor the response of the reconfigured waterflood in this unit and make any appropriate changes as required to the injection targets and wells.