

Birdtail Unit No. 1

Waterflood Progress Report 2019

January 1st through December 31st 2019

Prepared for:

Manitoba Industry, Economic Development and Mines

Petroleum Branch

Prepared by:

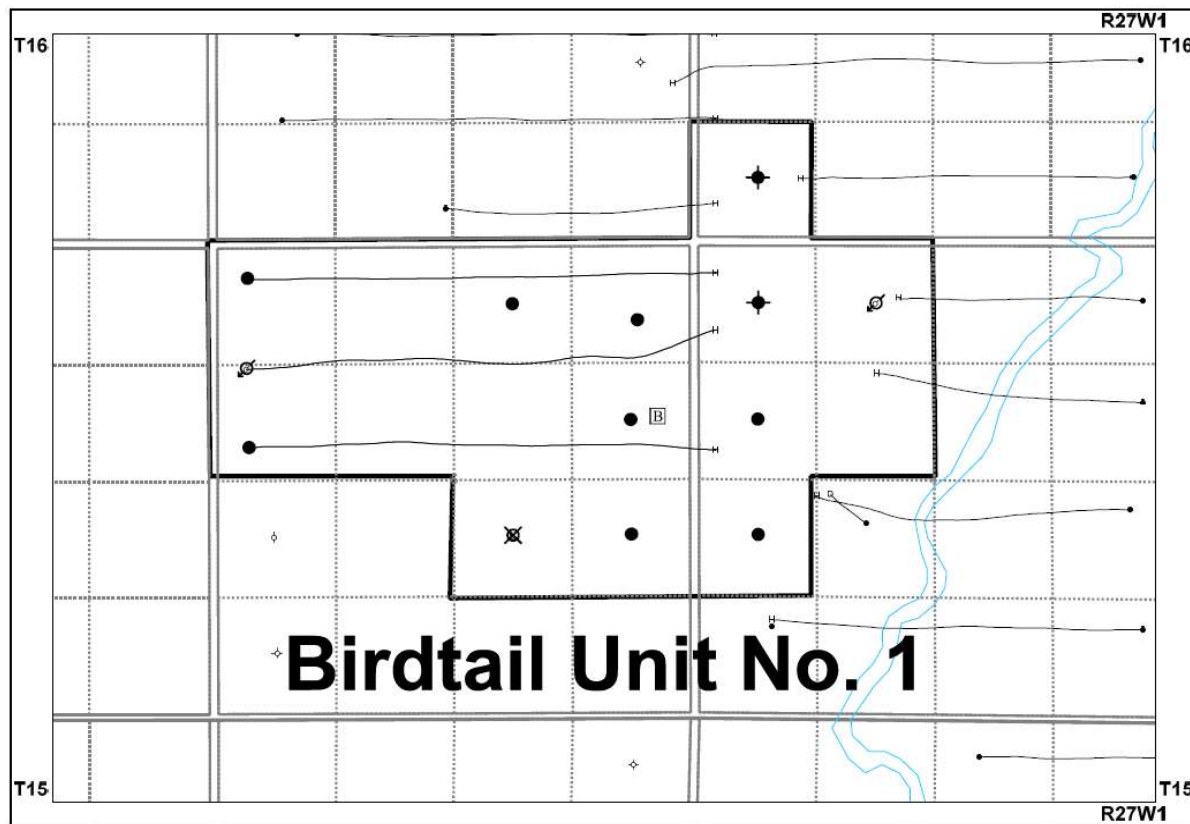
Tundra Oil and Gas

March 30, 2020

INTRODUCTION

Birdtail Unit No. 1 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 7 effective August 1, 1999 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 13 wells (10 vertical, 3 horizontal) in 16 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. 1 Area Outline



Birdtail Unit No. 1

Tundra Oil and Gas (Tundra), as the operator of the Birdtail Unit No. 1 Enhanced Oil Recovery (EOR) project hereby submits the 2019 EOR report as per section 73 of the Drilling and Production Regulations.

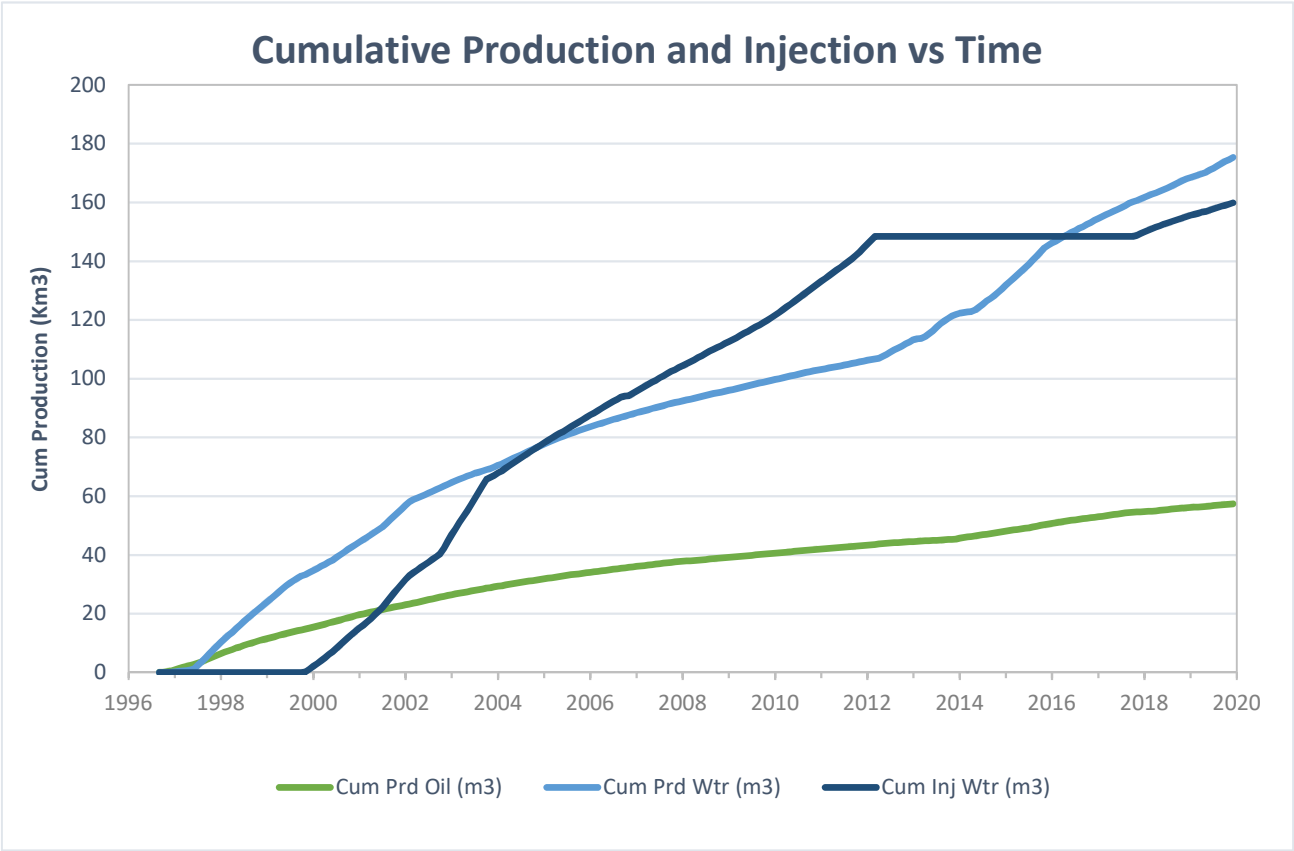
a) Monthly oil and water production rates, injection rate, GOR and WOR

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	2.13	15.38	13.52	7.21	0
Feb-2019	2.88	13.53	13.36	4.70	0
Mar-2019	2.87	15.13	10.39	5.26	0
Apr-2019	3.19	14.02	13.90	4.40	0
May-2019	3.04	14.94	8.52	4.91	0
Jun-2019	4.37	24.48	14.13	5.61	0
Jul-2019	4.57	22.65	13.42	4.95	0
Aug-2019	4.97	23.37	13.29	4.70	0
Sep-2019	4.32	25.29	13.33	5.85	0
Oct-2019	4.25	24.55	13.29	5.78	0
Nov-2019	3.88	23.51	13.30	6.05	0
Dec-2019	2.94	23.11	13.19	7.86	0

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

2019 PRODUCTION	
Produced Oil (m ³)	1,322
Produced Gas (m ³)	0
Produced Water (m ³)	7,311
Fluid Injected (m ³)	4,668
CUMULATIVE PRODUCTION	
Produced Oil (m ³)	57,416
Produced Water (m ³)	175,340

Birdtail Unit No. 1



c) Monthly wellhead injection pressure for each injection well

MONTH	02/12-05 Inj		Birdtail Unit 1	
	Inj Water (m ³)	Avg Inj P (kPa)	Inj Water (m ³)	Avg Inj P (kPa)
Jan-2019	419.0	3978	419.0	3978
Feb-2019	374.0	3981	374.0	3981
Mar-2019	322.0	3567	322.0	3567
Apr-2019	417.0	3829	417.0	3829
May-2019	264.0	2766	264.0	2766
Jun-2019	424.0	3981	424.0	3981
Jul-2019	416.0	3952	416.0	3952
Aug-2019	412.0	3979	412.0	3979
Sep-2019	400.0	3978	400.0	3978
Oct-2019	412.0	3979	412.0	3979
Nov-2019	399.0	3980	399.0	3980
Dec-2019	409.0	3980	409.0	3980
Total	4668.0		4668.0	
Avg Inj P		3829		3829

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	419.0	374.0	322.0	417.0	264.0	424.0	416.0	412.0	400.0	412.0	399.0	409.0
Daily (m³/d)	13.52	13.36	10.39	13.90	8.52	14.13	13.42	13.29	13.33	13.29	13.30	13.19

2019 AVG. ANNUAL DAILY INJECTION = 12.80 m3/d

CUMULATIVE INJECTION TO Dec 31, 2018 = 155,204 m3

TOTAL 2019 ANNUAL INJECTION = 4,668 m3
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CUMULATIVE INJECTION TO Dec 31, 2019 = 159,872 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
100.12-05-016-27W1.00	Pump Change	5/16/2019
100.13-05-016-27W1.00	Pump Change	5/15/2019

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	66.1	56.16	476.8	168.51	419.0	155.62	0.765	0.681
Feb-2019	80.6	56.24	378.9	168.88	374.0	156.00	0.804	0.681
Mar-2019	89.1	56.33	469	169.35	322.0	156.32	0.570	0.681
Apr-2019	95.6	56.43	420.5	169.77	417.0	156.74	0.797	0.681
May-2019	94.3	56.52	463.1	170.24	264.0	157.00	0.468	0.680
Jun-2019	131.0	56.65	734.4	170.97	424.0	157.42	0.485	0.680
Jul-2019	141.8	56.79	702	171.67	416.0	157.84	0.487	0.679
Aug-2019	154.2	56.95	724.4	172.40	412.0	158.25	0.463	0.678
Sep-2019	129.6	57.08	758.6	173.16	400.0	158.65	0.446	0.677
Oct-2019	131.7	57.21	761.2	173.92	412.0	159.06	0.457	0.676
Nov-2019	116.5	57.33	705.2	174.62	399.0	159.46	0.481	0.676
Dec-2019	91.1	57.42	716.4	175.34	409.0	159.87	0.502	0.675

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

The injection water for Birdtail Unit No. 1 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. 1 Well List

<i>UWI</i>	<i>Type</i>	<i>Status</i>	<i>Future Plans</i>
100/05-04-016-27W1/0	Vertical	Producing	-
100/12-04-016-27W1/0	Vertical	Pumping	-
100/13-04-016-27W1/0	Vertical	Abandoned	-
100/14-04-016-27W1/0	Vertical	Abandoned	-
100/07-05-016-27W1/0	Vertical	Abandoned	-
100/08-05-016-27W1/0	Vertical	Producing	-
100/09-05-016-27W1/0	Vertical	Pumping	-
100/12-05-016-27W1/0	Horizontal	Producing	-
102/12-05-016-27W1/0	Horizontal	Injection	-
100/13-05-016-27W1/0	Horizontal	Producing	-
100/15-05-016-27W1/0	Vertical	Producing	-
100/16-05-016-27W1/0	Vertical	Pumping	-
100/04-09-016-27W1/0	Vertical	Abandoned	-

k) Discussion

Water injection started in November 1999 in the two injectors at 00/14-04 and 00/07-05-016-27W1 (00/07-05). The 00/07-05 injector has been abandoned since July 2003. In April 2012, injection into the 00/14-04 well was suspended.

Tundra is in the process of redeveloping this unit. Tundra no longer wants to use produced water for injection in this Unit, so they currently have in place a new source of water at 00/02-32-016-27W1. As part of the redevelopment of this unit, Tundra drilled a horizontal producer at 00/13-05-016-27W1/0 in the north part of the unit in 2013 along with the construction of a new injection line coming from the Birdtail battery located at 09-05-016-27W1. This line will supply filtered source water to the unit.

In September 2014, Tundra drilled another horizontal producer at 00/12-05-016-27W1/0. Tundra also applied to expand the Unit to include the NE/4 of Sec 05-016-27W1/0 in 2014. In July 2015, a produce first horizontal injector between the 00/12-05 and 00/13-05 producers was drilled at 02/12-05-016-27W1/0. Tundra also plans to convert a couple of vertical wells into injectors to improve the sweep efficiency of the waterflood.