

**North Pierson Unit No. 1**

**Waterflood Progress Report 2019**

**January 1<sup>st</sup> through December 31<sup>st</sup> 2019**

**Prepared for:**

**Manitoba Industry, Economic Development and Mines**

**Petroleum Branch**

**Prepared by:**

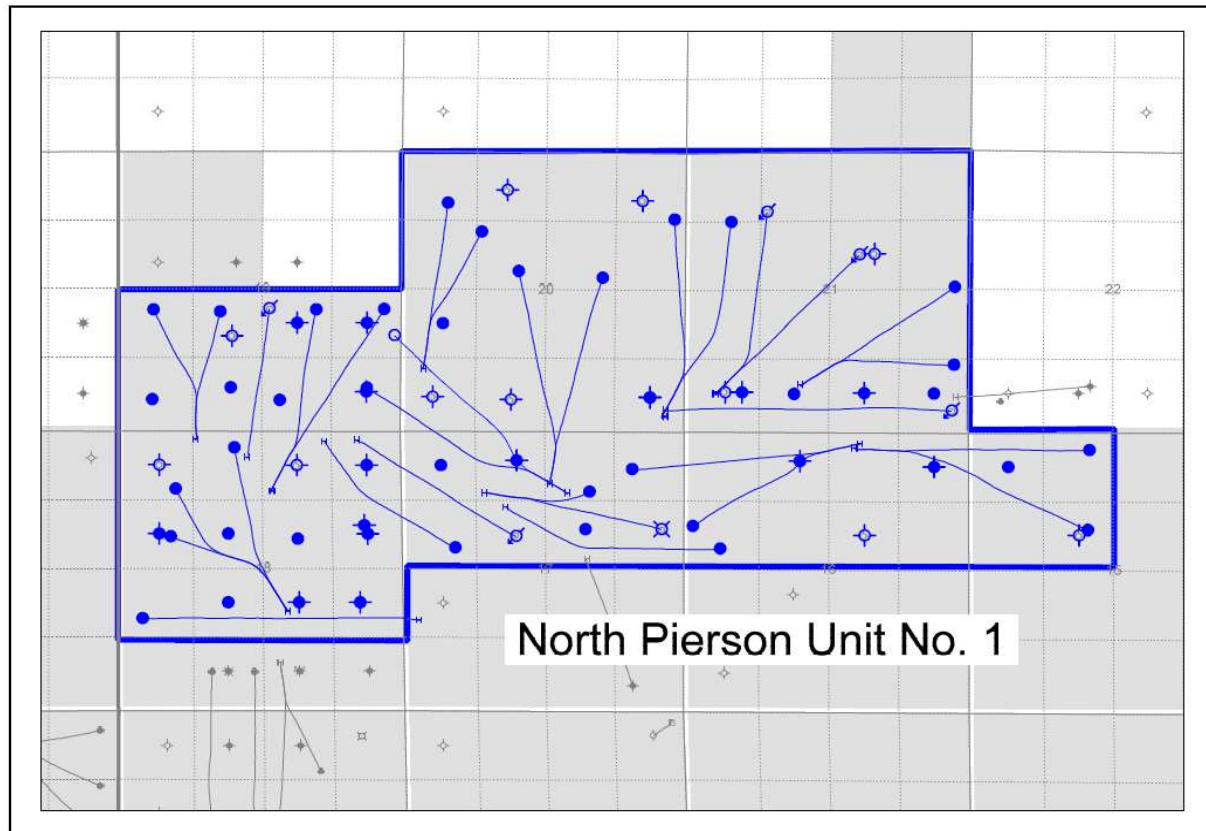
**Tundra Oil and Gas**

**April 22, 2020**

## INTRODUCTION

North Pierson Unit No. 1 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 31, effective January 1st, 2014 with Tundra Oil and Gas as Operator. The EOR project area, outlined in blue in Figure 1, contains 28 abandoned wells, 11 producing vertical wells, 27 producing horizontal wells and 6 injection wells in 72 LSDs in Township 3, Range 28W1.

**Figure 1: North Pierson Unit No. 1 Area Outline**



## North Pierson Unit No. 1

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

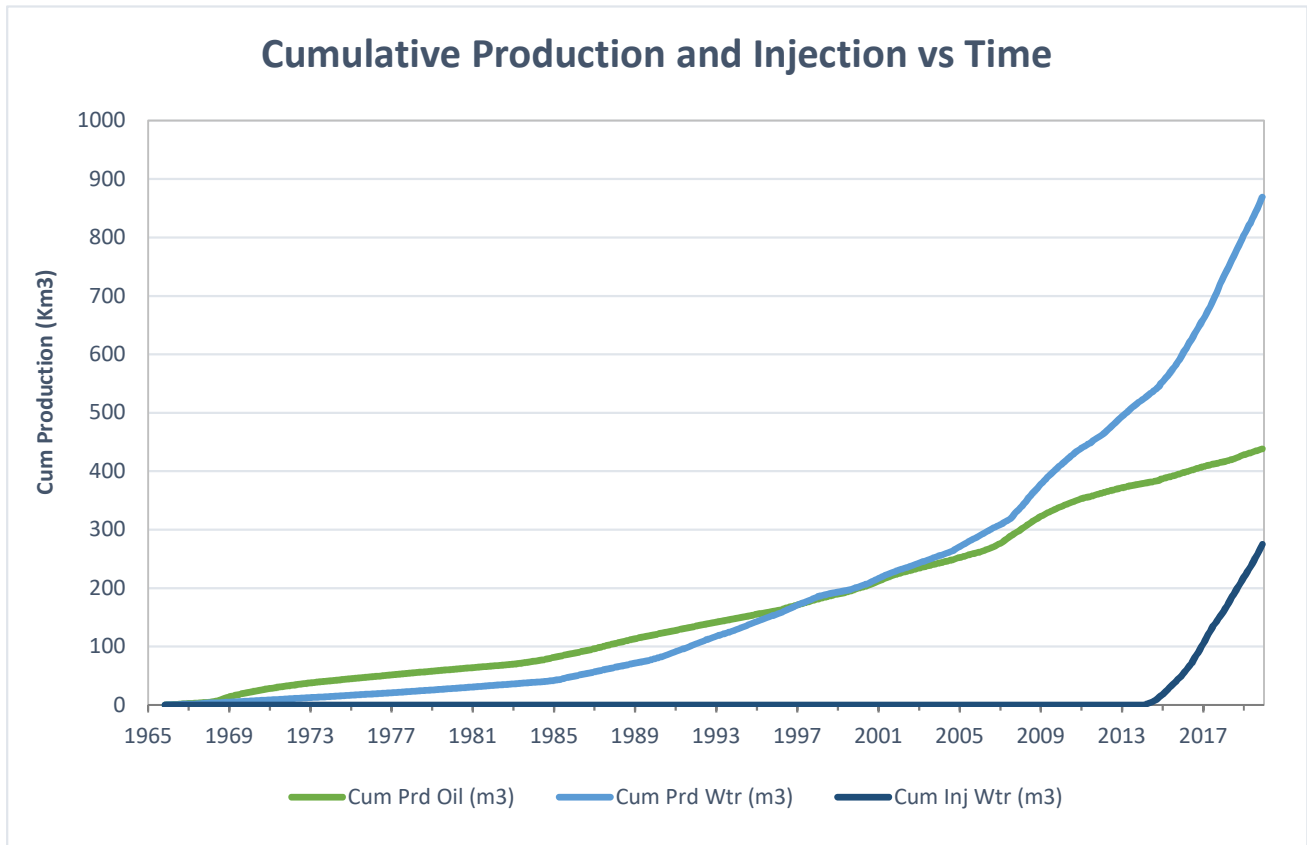
**a) Monthly oil and water production rates, injection rate, GOR and WOR**

MONTH	Cal Dly Oil m <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-2019	36.23	208.83	161.84	5.76	9.44
Feb-2019	33.12	196.05	152.29	5.92	10.89
Mar-2019	31.74	176.59	152.26	5.56	10.67
Apr-2019	31.73	204.07	153.47	6.43	0
May-2019	22.15	137.83	155.06	6.22	0
Jun-2019	32.20	206.72	156.60	6.42	0
Jul-2019	30.82	183.44	159.87	5.95	0
Aug-2019	32.27	190.93	181.32	5.92	0
Sep-2019	29.61	208.29	178.63	7.03	0
Oct-2019	27.70	209.08	179.61	7.55	0
Nov-2019	34.34	225.10	184.50	6.55	0
Dec-2019	32.33	212.45	195.87	6.57	0

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

2019 PRODUCTION	
Produced Oil (m <sup>3</sup> )	11,374
Produced Gas (m <sup>3</sup> )	31
Produced Water (m <sup>3</sup> )	71,708
Fluid Injected (m <sup>3</sup> )	61,221
CUMULATIVE PRODUCTION	
Produced Oil (m <sup>3</sup> )	438,268
Produced Water (m <sup>3</sup> )	869,193

## North Pierson Unit No. 1



c) Monthly wellhead injection pressure for each injection well

	00/11-17 Inj		02/07-19 Inj		03/01-21 Inj		02/10-21 Inj		02/08-18 Inj		NPU1	
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-2019	1568.0	2522	1520.0	2142	912.0	1390	1017.0	2985	0.0	0	5017.0	2260
Feb-2019	1414.0	2477	1370.0	2193	588.0	2933	892.0	2985	0.0	0	4264.0	2647
Mar-2019	1575.0	2477	1526.0	2193	657.0	2982	962.0	2985	0.0	0	4720.0	2659
Apr-2019	1524.0	2468	1475.0	2150	702.0	2986	903.0	2985	0.0	0	4604.0	2647
May-2019	1586.0	2465	1532.0	2145	753.0	2986	936.0	2985	0.0	0	4807.0	2645
Jun-2019	1538.0	2397	1486.0	2159	785.0	2986	889.0	2989	0.0	0	4698.0	2633
Jul-2019	1486.0	2230	1381.0	1893	804.0	2852	899.0	2955	386.0	1030	4956.0	2307
Aug-2019	1647.0	2352	1536.0	2025	907.0	2985	925.0	2983	606.0	1955	5621.0	2460
Sep-2019	1577.0	2386	1483.0	2035	891.0	2987	876.0	2982	532.0	1988	5359.0	2476
Oct-2019	1617.0	2386	1523.0	2035	922.0	2987	896.0	2982	610.0	1988	5568.0	2476
Nov-2019	1568.0	2383	1477.0	1993	897.0	2594	876.0	2983	717.0	2179	5535.0	2426
Dec-2019	1671.0	2435	1523.0	1828	927.0	2425	1016.0	3184	935.0	3273	6072.0	2629
<b>Total</b>	18771.0		17832.0		9745.0		11087.0		3786.0		61221.0	
<b>Avg Inj P</b>		2415		2066		2758		2999		1034		2522

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
<b>Total m3</b>	5017.0	4264.0	4720.0	4604.0	4807.0	4698.0	4956.0	5621.0	5359.0	5568.0	5535.0	6072.0
<b>Daily (m<sup>3</sup>/d)</b>	161.84	152.29	152.26	153.47	155.06	156.60	159.87	181.32	178.63	179.61	184.50	195.87

2019 AVG. ANNUAL DAILY INJECTION =	167.61 m3/d
CUMULATIVE INJECTION TO Dec 31, 2018 =	213,672 m3
TOTAL 2019 ANNUAL INJECTION =	61,221 m3
CUMULATIVE INJECTION TO Dec 31, 2019 =	274,893 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

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

**VOIDAGE CALCULATIONS**

OIL FORMATION VOLUME FACTOR (Rm3/Sm3) = 1.24

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	1123.0	428.02	6473.7	803.96	5017.0	218.69	0.638	0.164
Feb-2019	927.4	428.94	5489.3	809.45	4264.0	222.95	0.642	0.166
Mar-2019	983.9	429.93	5474.2	814.92	4720.0	227.67	0.705	0.169
Apr-2019	951.9	430.88	6122.2	821.04	4604.0	232.28	0.630	0.171
May-2019	686.8	431.57	4272.6	825.32	4807.0	237.08	0.938	0.174
Jun-2019	966.1	432.53	6201.5	831.52	4698.0	241.78	0.635	0.177
Jul-2019	955.4	433.49	5686.5	837.20	4956.0	246.74	0.721	0.179
Aug-2019	1000.3	434.49	5918.7	843.12	5621.0	252.36	0.785	0.183
Sep-2019	888.4	435.38	6248.8	849.37	5359.0	257.72	0.729	0.186
Oct-2019	858.6	436.24	6481.6	855.85	5568.0	263.29	0.738	0.188
Nov-2019	1030.3	437.27	6753.1	862.61	5535.0	268.82	0.689	0.191
Dec-2019	1002.1	438.27	6585.9	869.19	6072.0	274.89	0.776	0.195

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

Injection water for NPU1 is supplied from the Mannville formation in the 100/03-18-03-28W1 well.

Mannville water is pumped from the 100/03-18 source well to the Pierson 01-18-03-28W1 battery, where it is filtered and then pumped up to injection system pressure.

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>
100/11-15-003-28W1/0	Vertical	Abandoned	-
102/11-15-003-28W1/2	Horizontal	Producing	-
100/12-15-003-28W1/0	Horizontal	Producing	-
100/13-15-003-28W1/0	Vertical	Producing	-
100/14-15-003-28W1/0	Horizontal	Producing	-
100/10-16-003-28W1/0	Vertical	Abandoned	-
100/12-16-003-28W1/0	Horizontal	Pumping	-
102/12-16-003-28W1/0	Horizontal	Producing	-
100/14-16-003-28W1/0	Vertical	Abandoned	-
100/16-16-003-28W1/0	Vertical	Abandoned	-
100/09-17-003-28W1/2	Horizontal	Drain	-
100/10-17-003-28W1/0	Vertical	Pumping	-
100/11-17-003-28W1/0	Horizontal	Injection	-
100/12-17-003-28W1/0	Horizontal	Producing	-
100/13-17-003-28W1/0	Vertical	Producing	-
100/14-17-003-28W1/0	Vertical	Abandoned	-
100/15-17-003-28W1/0	Horizontal	Pumping	-
100/16-17-003-28W1/2	Horizontal	Producing	-
100/05-18-003-28W1/0	Horizontal	Producing	-
100/06-18-003-28W1/0	Vertical	Producing	-
100/07-18-003-28W1/0	Vertical	Abandoned	-
100/08-18-003-28W1/0	Vertical	Abandoned	-
102/08-18-003-28W1/0	Horizontal	Injection	-
100/09-18-003-28W1/0	Vertical	Abandoned	-
102/09-18-003-28W1/0	Vertical	Abandoned	-
100/10-18-003-28W1/0	Vertical	Producing	-
100/11-18-003-28W1/0	Vertical	Producing	-
100/12-18-003-28W1/0	Vertical	Abandoned	-
102/12-18-003-28W1/2	Horizontal	Producing	-
100/13-18-003-28W1/0	Vertical	Abandoned	-
102/13-18-003-28W1/3	Horizontal	Producing	-
100/14-18-003-28W1/0	Horizontal	Producing	-
100/15-18-003-28W1/0	Vertical	Abandoned	-
100/16-18-003-28W1/0	Vertical	Abandoned	-
100/01-19-003-28W1/0	Dir/Dev	Abandoned Zone	-
102/01-19-003-28W1/0	Horizontal	Producing	-
100/02-19-003-28W1/0	Vertical	Suspended	-
100/03-19-003-28W1/0	Vertical	Suspended	-
100/04-19-003-28W1/0	Vertical	Suspended	-
102/05-19-003-28W1/0	Horizontal	Producing	-
100/06-19-003-28W1/0	Vertical	Abandoned	-
100/06-19-003-28W1/2	Horizontal	Producing	-
100/07-19-003-28W1/0	Vertical	Abandoned	-
102/07-19-003-28W1/0	Horizontal	Injection	-
102/07-19-003-28W1/2	Horizontal	Producing	-

## j) Well List

## North Pierson Unit No. 1 Well List

<i><b>UWI</b></i>	<i><b>Type</b></i>	<i><b>Status</b></i>	<i><b>Future Plans</b></i>
100/08-19-003-28W1/0	Vertical	Abandoned	-
102/08-19-003-28W1/0	Horizontal	Producing	-
103/08-19-003-28W1/2	Horizontal	Potential	-
100/01-20-003-28W1/0	Vertical	Abandoned	-
100/01-20-003-28W1/2	Vertical	Abandoned	-
100/03-20-003-28W1/0	Vertical	Abandoned	-
100/04-20-003-28W1/0	Vertical	Abandoned	-
100/05-20-003-28W1/0	Vertical	Producing	-
100/07-20-003-28W1/2	Horizontal	Producing	-
100/11-20-003-28W1/0	Horizontal	Producing	-
102/11-20-003-28W1/2	Horizontal	Producing	-
100/13-20-003-28W1/0	Horizontal	Producing	-
100/14-20-003-28W1/0	Vertical	Abandoned	-
100/16-20-003-28W1/0	Vertical	Abandoned	-
100/16-20-003-28W1/2	Horizontal	Producing	-
100/01-21-003-28W1/0	Vertical	Producing	-
102/01-21-003-28W1/0	Horizontal	Producing	-
103/01-21-003-28W1/0	Horizontal	Injection	-
100/02-21-003-28W1/0	Vertical	Abandoned	-
100/03-21-003-28W1/0	Vertical	Abandoned Zone	-
100/04-21-003-28W1/0	Vertical	Abandoned	-
102/04-21-003-28W1/0	Vertical	Abandoned	-
100/09-21-003-28W1/2	Horizontal	Producing	-
100/10-21-003-28W1/0	Vertical	Abandoned	-
102/10-21-003-28W1/0	Horizontal	Injection	-
100/12-21-003-28W1/0	Horizontal	Producing	-
100/14-21-003-28W1/2	Horizontal	Injection	-