

**GOODLANDS UNIT NO. 1  
WATERFLOOD EOR PROJECT**

**ANNUAL WATERFLOOD PROGRESS REPORT FOR 2015**

**June 30, 2016**

**Tundra Oil and Gas Partnership**

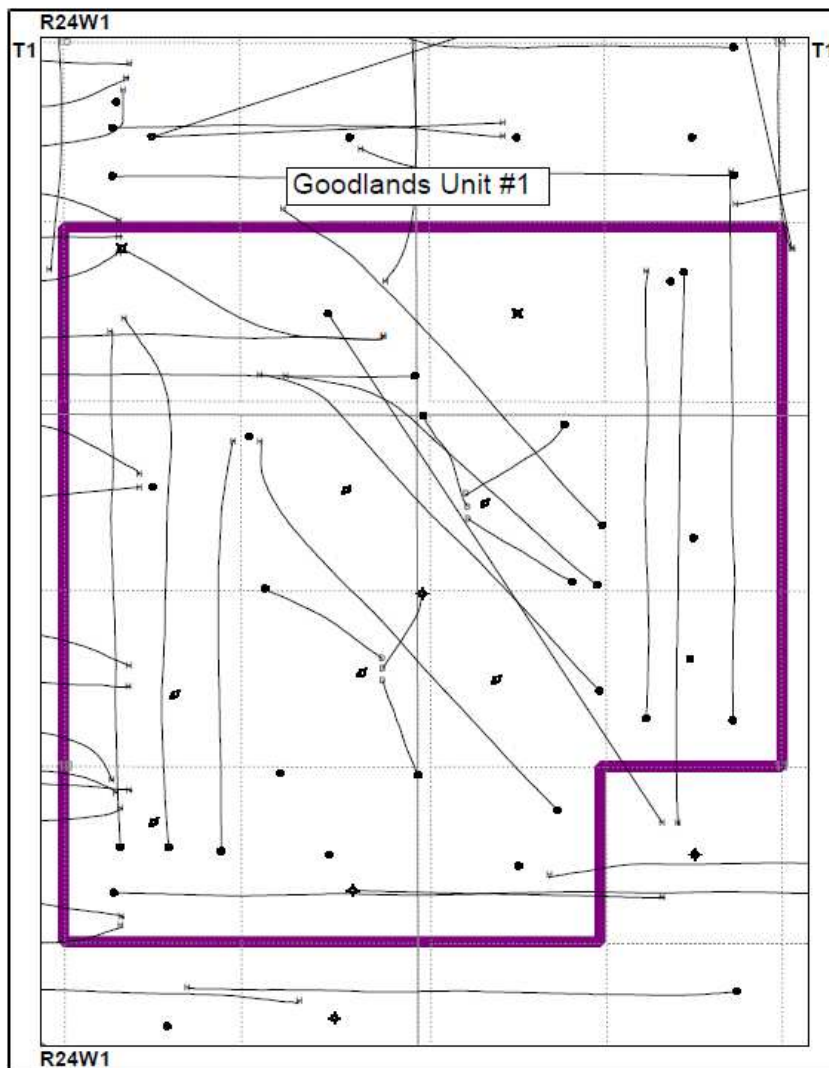
## Table of Contents

Introduction	3.
Discussion	4.
Production History	4.
Waterflood EOR Operating Strategy and Performance	5.
Water Source and Quality	5.
Injection Wellhead Pressures	5.
Reservoir Pressure	6.
Well Servicing	6.
Waterflood Performance Discussion	6.
List of Appendices	7.
Table 1: Goodlands Unit No. 1 Well List and History	
Table 2: Goodlands Unit No. 1 Voidage Replacement Ratio Calculation	
Table 3: Goodlands Unit No. 1 Monthly Injection Table	
Table 4: Summary of Producing Wells	

## **INTRODUCTION**

Goodlands Unit No. 1 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 13 effective August 2002. The Unit area contains 2 abandoned wells, including 1 abandoned injector, 26 producing/inactive wells, and 6 active/inactive injectors in 15 LSDs in Township 1, Range 24 W1 as shown in the figure below.

**Figure 1: Goodlands Unit 1 Area Outline**



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra hereby submits the following 2015 Annual Progress Report for Goodlands Unit No. 1.

## **DISCUSSION**

### **Production History**

For the wells included in Goodlands Unit No. 1, production started in December 1992 with the 00/12-11-001-24W1/0 Vertical well. Average oil production peaked for the first time at 5.6 m<sup>3</sup>/d per well in December 2012. This production was coming from 26 wells and totaled 147.0 m<sup>3</sup>/d for the whole Unit. The production at the end of December 2015 averaged 1.1 m<sup>3</sup>/d per well, totaling 23.4 m<sup>3</sup>/day for the Unit. Water injection commenced in Goodlands Unit No. 1 in August 2002. The rates and WOR are presented in Figure 2. The Unit had 48.5 e3m<sup>3</sup> of water injection through 2015.

**Figure 2: Goodlands Unit No. 1 Production/Injection Rates and WOR vs Time**

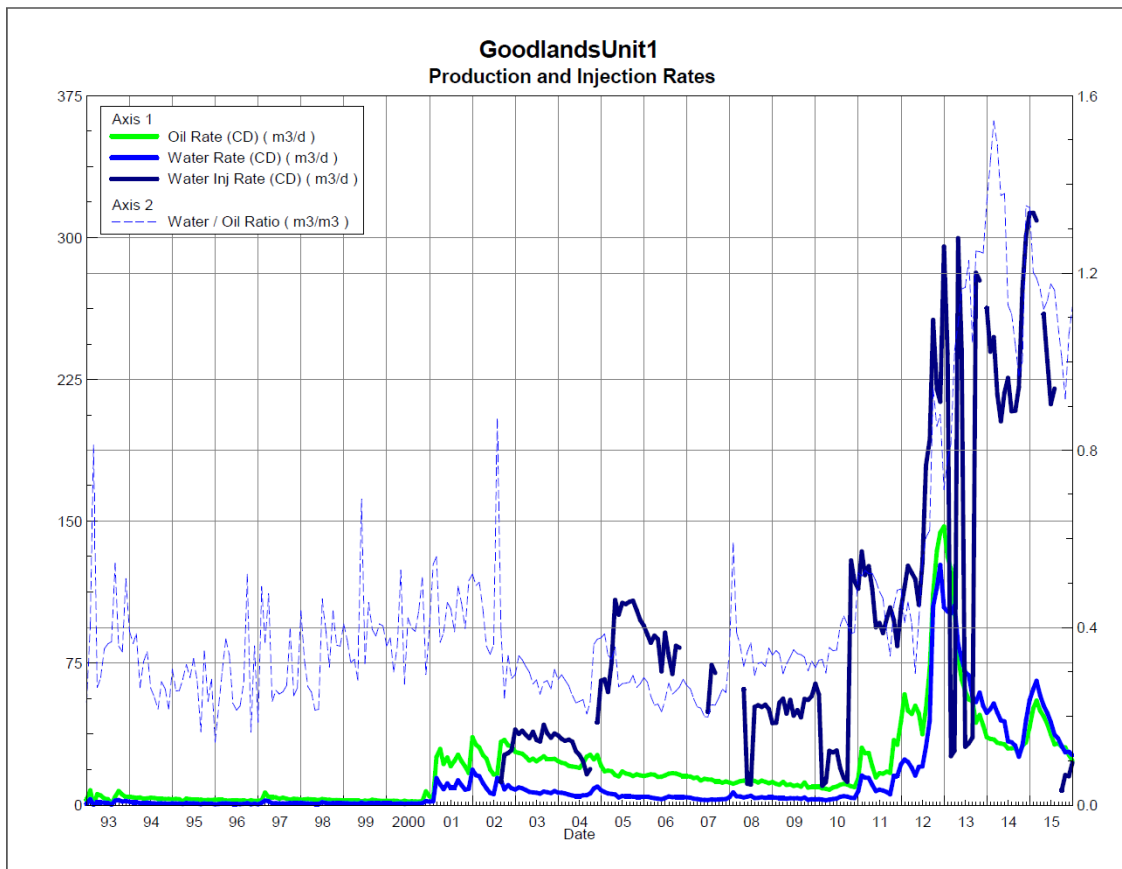
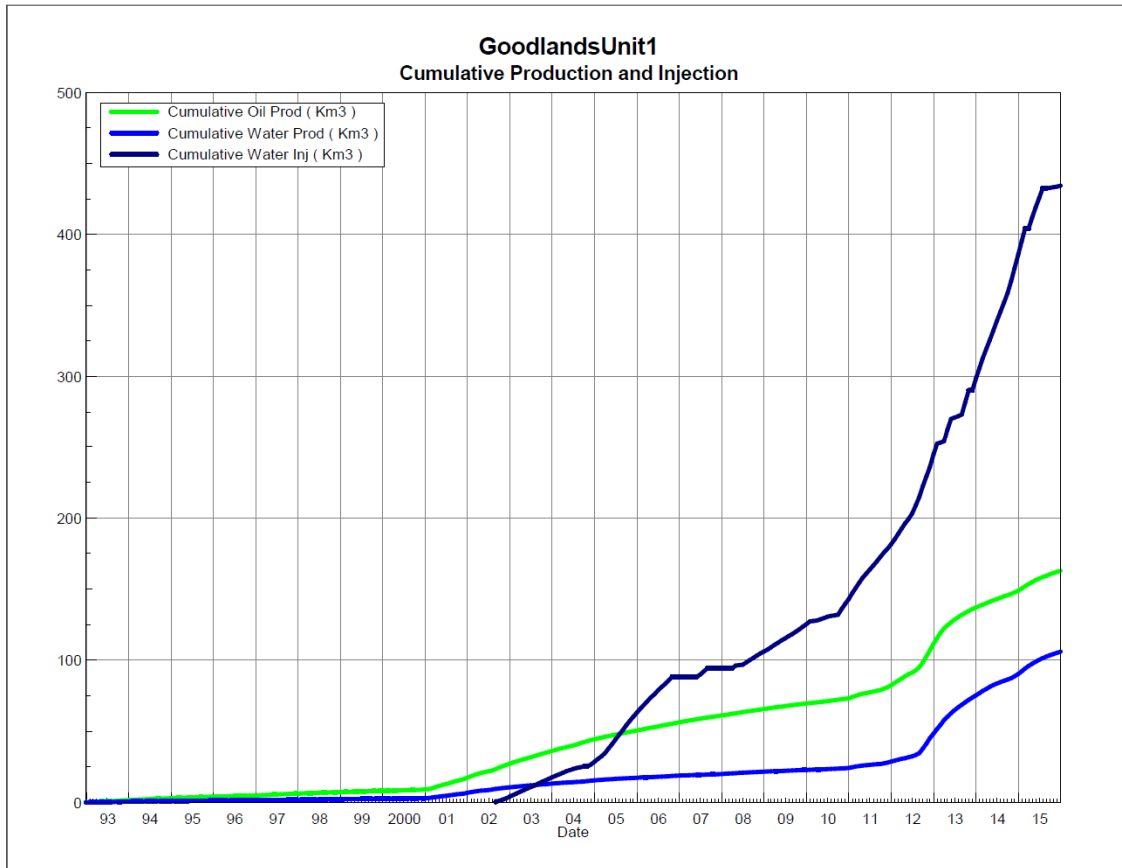


Figure 3 shows the cumulative production for Goodlands Unit No. 1 to the end of December 2015 as 162.7 e<sup>3</sup>m<sup>3</sup> of oil, and 106.0 e<sup>3</sup>m<sup>3</sup> of water.

**Figure 3: Goodlands Unit No. 1 Cumulative Oil, Water and Water Injected vs Time**



## **Waterflood EOR Operating Strategy and Performance**

### **Corrosion and Scale Prevention**

The facilities in Goodlands Unit 1 are currently using cathodic and chemical protection against corrosion and scale in the new horizontal wells. All facilities are monitored every 3 months to assess the corrosion and ensure that proper electrical current is being supplied. There have been no issues with corrosion or scale to date.

### **Injection Wellhead Pressures**

Due to Tundra recently re-acquiring the Unit, no injection pressure data was available for 2015.

## Reservoir Pressure

Where practical, Tundra is committed to collecting pressure data from newly drilled injection wells. Since no new wells were drilled in the Unit, therefore, no pressure surveys were conducted in 2015.

## Well Servicing

No well servicing was performed in 2015 for Goodlands Unit No. 1.

## Waterflood Performance Discussion

From January 1 to December 31 in 2015, Goodlands Unit No. 1 produced 29.5 e3m3 of fluid (13.9 e3m3 of Oil, 15.6 e3m3 of Water), and injected 48.5 e3m3 of source water. The cumulative VRR increased in 2015, up to 1.396.

Table 2 summarizes the yearly and cumulative VRR for Goodlands Unit No. 1.

**Figure 4: Goodlands Unit No. 1 Production and Injection Rate**

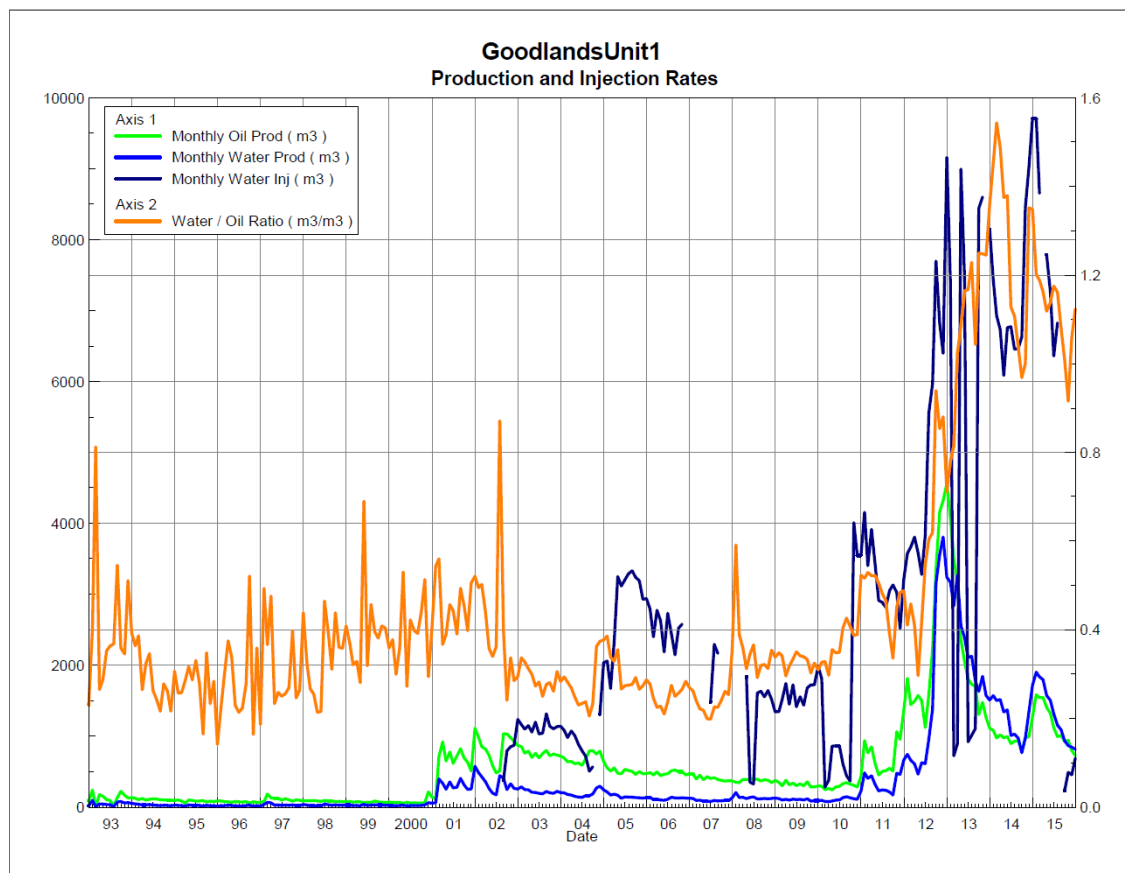


TABLE NO. 1: GOODLANDS UNIT NO. 1 WELL SUMMARY

UWI	Type	Status	On Prod Date	Cum Prd Oil (m3)	Cum Prd Water (m3)	Last Prod Date	Cum Inj Water (m3)	Last Inj Date
100/07-10-001-24W1/0	Vertical	Injection	12/2/2001	1568.8	503.8	9/30/2004	16190.7	8/31/2014
102/07-10-001-24W1/0	Horizontal	Producing	10/5/2011	10677.8	6058.1	12/31/2015	0	
103/07-10-001-24W1/0	Horizontal	Producing	9/12/2012	1837.3	1963.2	12/31/2015	0	
104/07-10-001-24W1/0	Horizontal	Producing	8/10/2012	7821.8	6209.5	12/31/2015	0	
105/07-10-001-24W1/0	Horizontal	Producing	11/22/2014	3889.9	2829.8	12/31/2015	0	
100/08-10-001-24W1/0	Vertical	Pumping	7/14/2001	5033.1	1771.6	12/31/2015	0	
1C0/08-10-001-24W1/0	Vertical	Producing	8/10/2004	3367.9	702.3	8/31/2014	0	
1D0/08-10-001-24W1/0	Dir/Dev	Pumping	7/25/2002	3607.1	1257.9	12/31/2012	0	
100/09-10-001-24W1/0	Vertical	Injection	2/2/2001	1976.1	662.4	7/31/2002	24390.4	1/31/2010
1W0/09-10-001-24W1/0	Dir/Dev	Abandoned	7/26/2002	6108	1353.7	12/31/2012	0	
100/10-10-001-24W1/0	Vertical	Injection	12/2/2001	1430	540.5	9/30/2004	19428.3	4/30/2016
100/15-10-001-24W1/0	Vertical	Pumping	12/1/2001	4985.2	1912.5	12/31/2015	0	
100/16-10-001-24W1/0	Vertical	Injection	1/14/1997	2161.5	846.2	7/31/2002	28739.3	4/30/2016
1B0/16-10-001-24W1/0	Dir/Dev	Pumping	7/19/2002	6425.5	1285.4	9/30/2014	0	
1C0/16-10-001-24W1/0	Vertical	Producing	7/9/2004	4737	1521.4	12/31/2015	0	
100/05-11-001-24W1/0	Vertical	Pumping	12/3/2001	1696.2	1415.5	1/31/2014	0	
102/05-11-001-24W1/0	Horizontal	Producing	9/6/2012	11473.6	8802.2	12/31/2015	0	
100/11-11-001-24W1/0	Vertical	Pumping	12/5/2001	2898.2	1143.1	9/30/2014	0	
102/11-11-001-24W1/0	Horizontal	Producing	12/20/2011	11002.4	6717.2	12/31/2015	0	
103/11-11-001-24W1/0	Horizontal	Producing	7/4/2012	5582.5	4183.4	12/31/2015	0	
100/12-11-001-24W1/0	Vertical	Injection	12/10/1992	5287.3	1472.9	7/31/2002	11548.2	12/31/2015
102/12-11-001-24W1/0	Horizontal	Producing	8/31/2012	9628.4	15014.3	12/31/2015	0	
100/13-11-001-24W1/0	Vertical	Injection	3/2/2001	1460.7	512.5	7/31/2002	12983.6	4/30/2016
105/13-11-001-24W1/0	Horizontal	Producing	9/5/2012	7571.1	14940.8	12/31/2015	0	
106/13-11-001-24W1/0	Horizontal	Producing	11/22/2014	833.4	1430.9	12/31/2015	0	
1A0/13-11-001-24W1/0	Dir/Dev	Pumping	7/23/2002	7302.2	1297.6	4/30/2011	0	
1C0/13-11-001-24W1/0	Dir/Dev	Pumping	7/23/2002	4275.7	1439.7	8/31/2011	0	
1D0/13-11-001-24W1/0	Dir/Dev	Producing	10/8/2004	4090.2	1813.8	12/31/2015	0	
100/14-11-001-24W1/0	Vertical	Producing	3/2/2001	4506	1949.8	9/30/2014	0	
100/03-14-001-24W1/0	Vertical	Producing	2/2/2001	4657	2109.7	9/30/2014	0	
102/03-14-001-24W1/0	Horizontal	Producing	10/18/2014	1914.1	2286.5	12/31/2015	0	
100/04-14-001-24W1/0	Vertical	Abandoned	8/17/1993	4842.9	2228.1	9/30/2004	35696.8	2/28/2010
100/01-15-001-24W1/0	Horizontal	Producing	12/23/2010	7032.5	5897.1	12/31/2015	0	
102/01-15-001-24W1/0	Horizontal	Producing	10/19/2014	1024.3	1895.5	12/31/2015	0	
				162705.7	105968.9	148977.3		

TABLE NO. 2 - VRR Calculations

Date	Mth Oil Prod m3	Cum Oil Prod Km3	Mth Water Prod m3	Cum Water Prod Km3	Water Oil Ratio m3/m3	Mth Water Inj m3	Cum Water Inj Km3	VRR	Cum VRR
12/31/1992	87	87.400	20	20.200	0.23		0.000	0.000	0.000
12/31/1993	1599	1685.900	608	628.000	0.38		0.000	0.000	0.000
12/31/1994	1303	2988.900	378	1005.600	0.29		0.000	0.000	0.000
12/31/1995	1041	4030.300	275	1280.200	0.26		0.000	0.000	0.000
12/31/1996	896	4925.800	249	1529.500	0.28		0.000	0.000	0.000
12/31/1997	1345	6270.500	438	1967.200	0.33		0.000	0.000	0.000
12/31/1998	1033	7303.300	343	2310.600	0.33		0.000	0.000	0.000
12/31/1999	875	8178.600	339	2649.300	0.39		0.000	0.000	0.000
12/31/2000	986	9164.100	369	3017.800	0.37		0.000	0.000	0.000
12/31/2001	8283	17447.000	3767	6784.600	0.45		0.000	0.000	0.000
12/31/2002	9813	27259.900	3861	10645.800	0.39	4135	4135.300	0.273	0.098
12/31/2003	9040	36300.300	2632	13277.400	0.29	13567	17702.500	1.041	0.322
12/31/2004	8247	44547.000	2305	15582.800	0.28	10957	28659.600	0.929	0.429
12/31/2005	6025	50572.100	1822	17404.400	0.30	34514	63173.700	3.944	0.836
12/31/2006	5778	56350.000	1457	18861.400	0.25	25182	88355.800	3.108	1.056
12/31/2007	4830	61180.200	1161	20022.300	0.24	5935	94291.100	0.884	1.043
12/31/2008	4527	65706.900	1612	21634.100	0.36	11808	106098.800	1.732	1.092
12/31/2009	3847	69553.400	1261	22894.800	0.33	19289	125387.700	3.393	1.219
12/31/2010	3664	73217.400	1416	24310.900	0.39	17556	142944.000	3.119	1.317
12/31/2011	9088	82305.000	4356	28666.700	0.48	38425	181369.400	2.595	1.471
12/31/2012	29143	111447.500	19800	48466.300	0.68	63330	244699.500	1.188	1.385
12/31/2013	25519	136966.800	26765	75231.400	1.05	53704	298403.800	0.805	1.226
12/31/2014	11835	148801.800	15113	90344.600	1.28	87483	385886.300	2.417	1.380
12/31/2015	13904	162705.700	15624	105968.900	1.12	48481	434366.900	1.534	1.396



TABLE NO. 3

**Tundra Oil and Gas  
Goodlands Unit No. 1  
2015 Injection Volumes**

Well Location	Date	Hours On	H <sub>2</sub> O Inj Cal-d avg (m <sup>3</sup> /d)	Monthly Injected H <sub>2</sub> O (m <sup>3</sup> )
<b>Unit No. 1 Total:</b>				
	Jan-15	0	313.1	9705.00
	Feb-15	0	309.0	8653.00
	Mar-15	0	0.0	0.00
	Apr-15	0	259.6	7788.60
	May-15	0	234.4	7265.30
	Jun-15	0	212.2	6366.00
	Jul-15	0	220.4	6831.00
	Aug-15	0	0.0	0.00
	Sep-15	0	7.8	232.80
	Oct-15	0	15.9	491.20
	Nov-15	0	15.2	455.80
	Dec-15	0	22.3	691.90
<b>2015 Group Totals:</b>				<b>48480.60</b>

**Unit No. 1 Total:**

1992	0	0.0	0.00
1993	0	0.0	0.00
1994	0	0.0	0.00
1995	0	0.0	0.00
1996	0	0.0	0.00
1997	0	0.0	0.00
1998	0	0.0	0.00
1999	0	0.0	0.00
2000	0	0.0	0.00
2001	0	0.0	0.00
2002	0	27.0	4,135.30
2003	0	37.2	13,567.20
2004	0	32.7	10,957.10
2005	0	94.4	34,514.10
2006	0	82.9	25,182.10
2007	0	64.4	5,935.30
2008	0	43.0	11,807.70
2009	0	52.9	19,288.90
2010	0	47.8	17,556.30
2011	0	105.3	38,425.40
2012	0	172.9	63,330.10
2013	0	159.5	53,704.30
2014	0	239.7	87,482.50
2015	0	161.0	48,480.60
			434,366.90

TABLE NO. 4

**Tundra Oil and Gas  
Goodlands Unit No. 1  
2015 Production Volumes**

Date	Hours On	Oil Rate (CD) m3/d	Monthly Oil Prod m3	Water Rate (CD) m3/d	Monthly Water Prod m3	Water Oil Ratio m3/m3	Well Count
Jan-15	12,552	51.04	1,582	61.34	1,901	1	17
Feb-15	11,376	55.10	1,543	65.51	1,834	1	17
Mar-15	11,808	49.79	1,544	57.90	1,795	1	16
Apr-15	11,280	46.83	1,405	52.41	1,572	1	16
May-15	12,336	42.61	1,321	48.52	1,504	1	17
Jun-15	11,976	37.30	1,119	43.85	1,315	1	17
Jul-15	12,504	32.02	993	37.20	1,153	1	17
Aug-15	12,600	32.56	1,009	35.19	1,091	1	17
Sep-15	12,240	30.80	924	31.11	933	1	17
Oct-15	12,648	30.43	943	27.91	865	1	17
Nov-15	12,240	26.55	796	28.15	845	1	17
Dec-15	11,952	23.38	725	26.29	815	1	16
	145,512		13,904		15,624		

Date	Hours On	Oil Rate (CD) m3/d	Monthly Oil Prod m3	Water Rate (CD) m3/d	Monthly Water Prod m3	Water Oil Ratio m3/m3	Well Count
31/12/1992	216	2.82	87	0.65	20	0.23	0
31/12/1993	10440	4.35	1,599	1.66	608	0.42	1
31/12/1994	16968	3.57	1,303	1.04	378	0.29	2
31/12/1995	16656	2.86	1,041	0.76	275	0.27	2
31/12/1996	17376	2.45	896	0.68	249	0.28	2
31/12/1997	25224	3.70	1,345	1.21	438	0.33	3
31/12/1998	26112	2.83	1,033	0.94	343	0.33	3
31/12/1999	26112	2.40	875	0.93	339	0.39	3
31/12/2000	25512	2.70	986	1.01	369	0.39	3
31/12/2001	57696	22.69	8,283	10.34	3767	0.46	7
31/12/2002	109392	26.91	9,813	10.59	3861	0.41	13
31/12/2003	120864	24.78	9,040	7.22	2632	0.29	14
31/12/2004	123096	22.54	8,247	6.30	2305	0.28	14
31/12/2005	113496	16.52	6,025	5.00	1822	0.30	13
31/12/2006	119865	15.83	5,778	3.99	1457	0.25	14
31/12/2007	121,464	13.24	4,830	3.18	1161	0.24	14
31/12/2008	115,680	12.37	4,527	4.40	1612	0.36	13
31/12/2009	113,568	10.54	3,847	3.46	1261	0.33	13
31/12/2010	116,280	10.02	3,664	3.87	1416	0.38	13
31/12/2011	118,200	24.88	9,088	11.93	4356	0.47	14
31/12/2012	128,232	79.54	29,143	54.07	19800	0.60	15
31/12/2013	154,382	70.21	25,519	73.47	26765	1.12	18
31/12/2014	136,159	32.42	11,835	41.46	15113	1.27	16
31/12/2015	145,512	38.20	13,904	42.95	15624	1.11	17
	1,958,502		162,706		105,969		