

Waskada Unit No. 19
Waterflood Progress Report 2016
January 1st through December 31st 2016

Prepared for:
Manitoba Industry, Economic Development and Mines
Petroleum Branch

Prepared by:
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TABLE OF CONTENTS

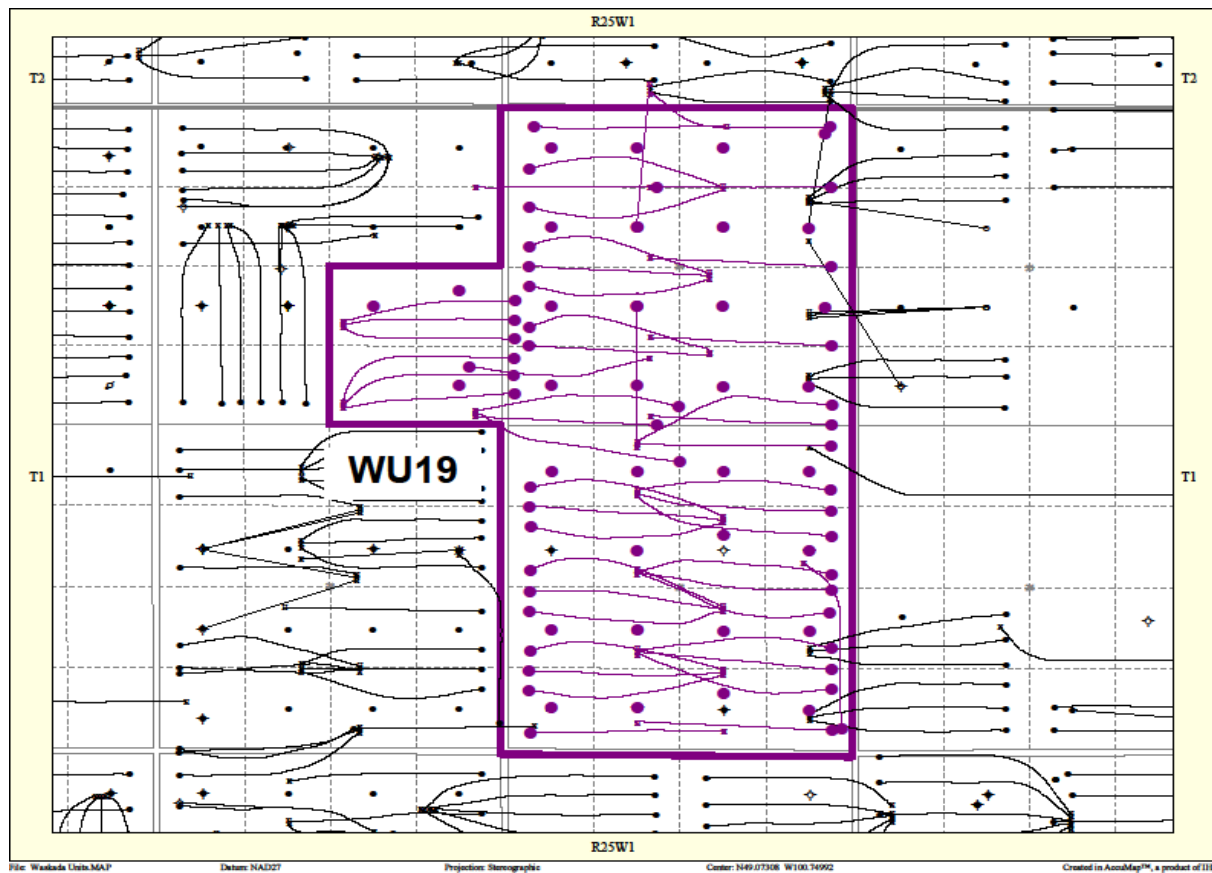
Table of Contents

Introduction	3
Production History	4
Waterflood History	5
Waterflood Performance	6
Injection Wellhead Pressures	6
Reservoir Pressure	6
Well Servicing	6
Corrosion and Scale Prevention	6
Conclusion	7
List of Tables	8
Table 1: Well List and Well Status	
Table 2: Voidage Replacement Ratio Calculation	
Table 3: Summary of Injection Wells	
Table 4: Summary of Producing Wells	
Table 5: Summary of Injection Pressures	

INTRODUCTION

The Waskada Unit No. 19 pressure maintenance project commenced water injection into the Lower Amaranth A pool in accordance with Manitoba Energy and Mines Order No. PM 14, dated August 1, 2003. Waskada Unit No. 19 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 purple in **Figure 1**, contains 81 wells over 36 LSDs in Township 1, Range 25W1 (**Table 1**).

Figure 1: Waskada Unit No. 19 Area Outline



PRODUCTION HISTORY

For the wells included in Waskada Unit No. 19, production started in December 2001 with the 00/13-34-001-25W1/00 well. Oil production peaked at 505.9 m³/d in December 2010. There are currently 42 producing wells in Waskada Unit No. 19. The average production for the unit was 47.3 m³/d of oil and 300.8 m³/d of water and the average WOR was 6.36 m³/m³ at the end of December 2016 (Table 4). The rates and WOR are presented in Figure 2.

Figure 2: Waskada Unit No. 19 Production/Injection Rates and WOR vs Time

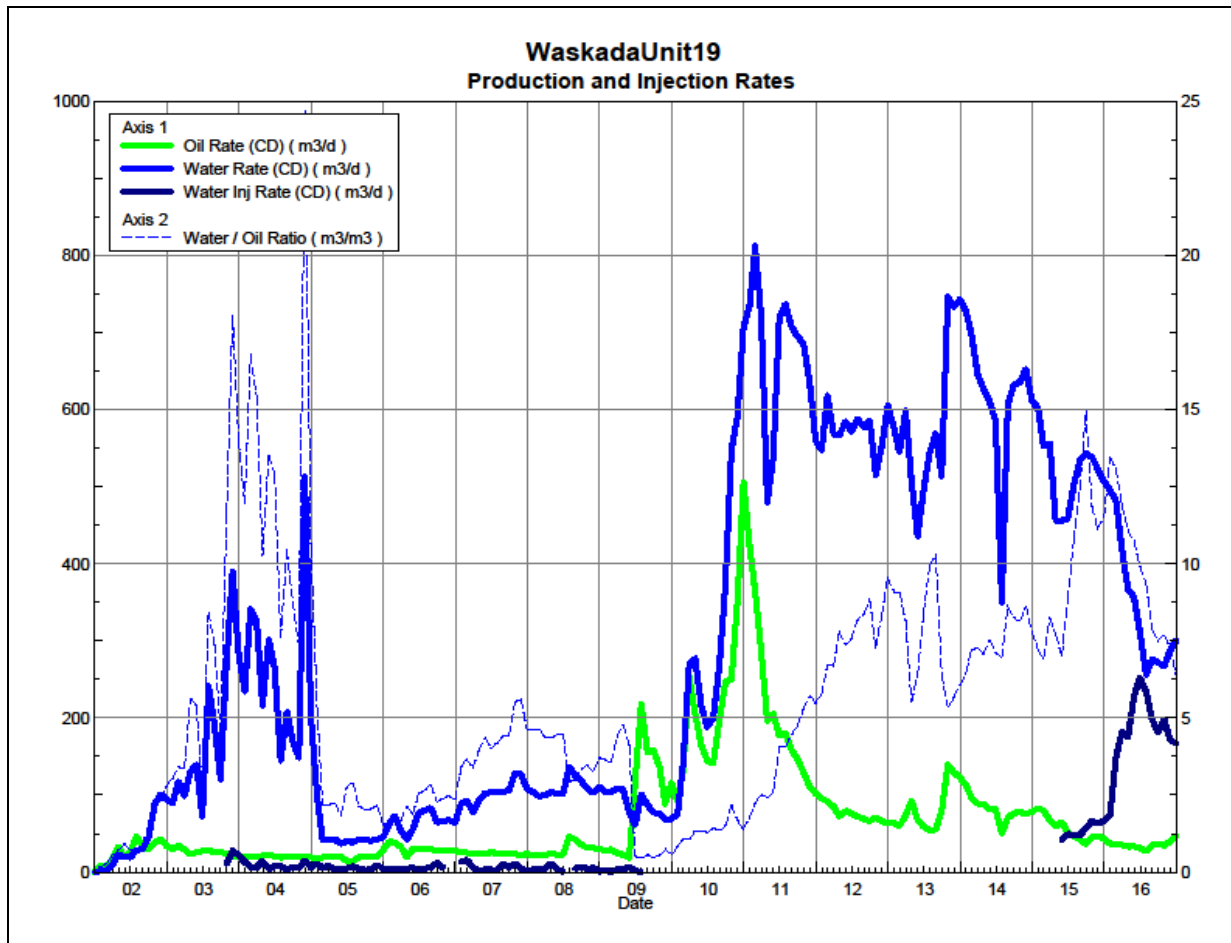
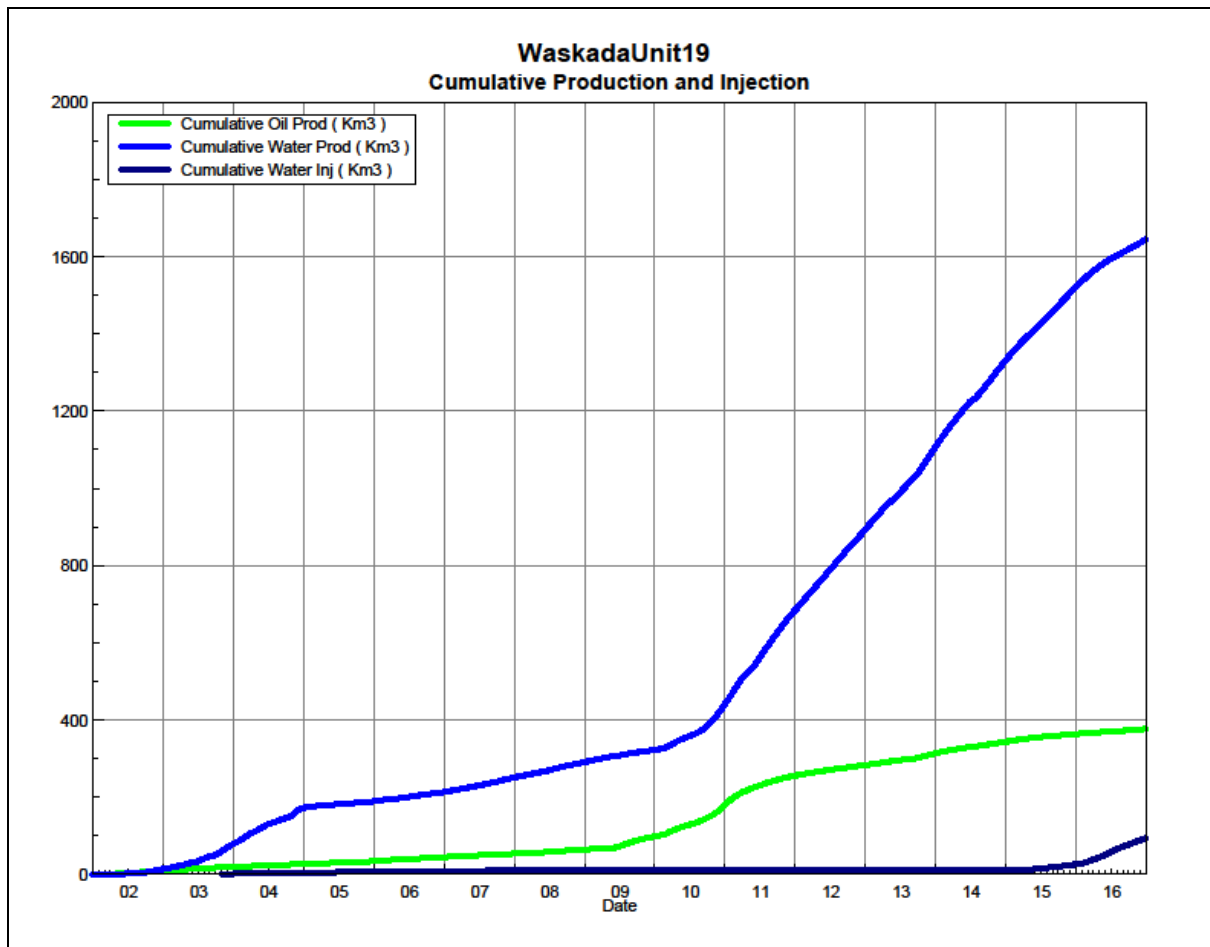


Figure 3 shows the cumulative production for Waskada Unit No. 19 to the end of December 2016 as 377.1 e³m³ of oil, and 1,645.5 e³m³ of water. The cumulative water injected is over 93.9 e³m³.

Figure 3. Waskada Unit No. 19 Cumulative Oil, Water and Water Injected vs. Time



WATERFLOOD HISTORY

Water injection commenced with 4 injector wells on October 2003. Four more injectors were added in November 2003. In 2011, EOG received permission to convert 3 Spearfish injection wells into Mississippian SWD wells. The wells converted were 00/06-27, 00/14-27 and 02/02-27-001-25W1.

Four wells were converted in 2015. In early 2016, six more injectors were added to the Unit. As of the end of December 2016, there are currently 10 active injection wells in Waskada Unit No. 19.

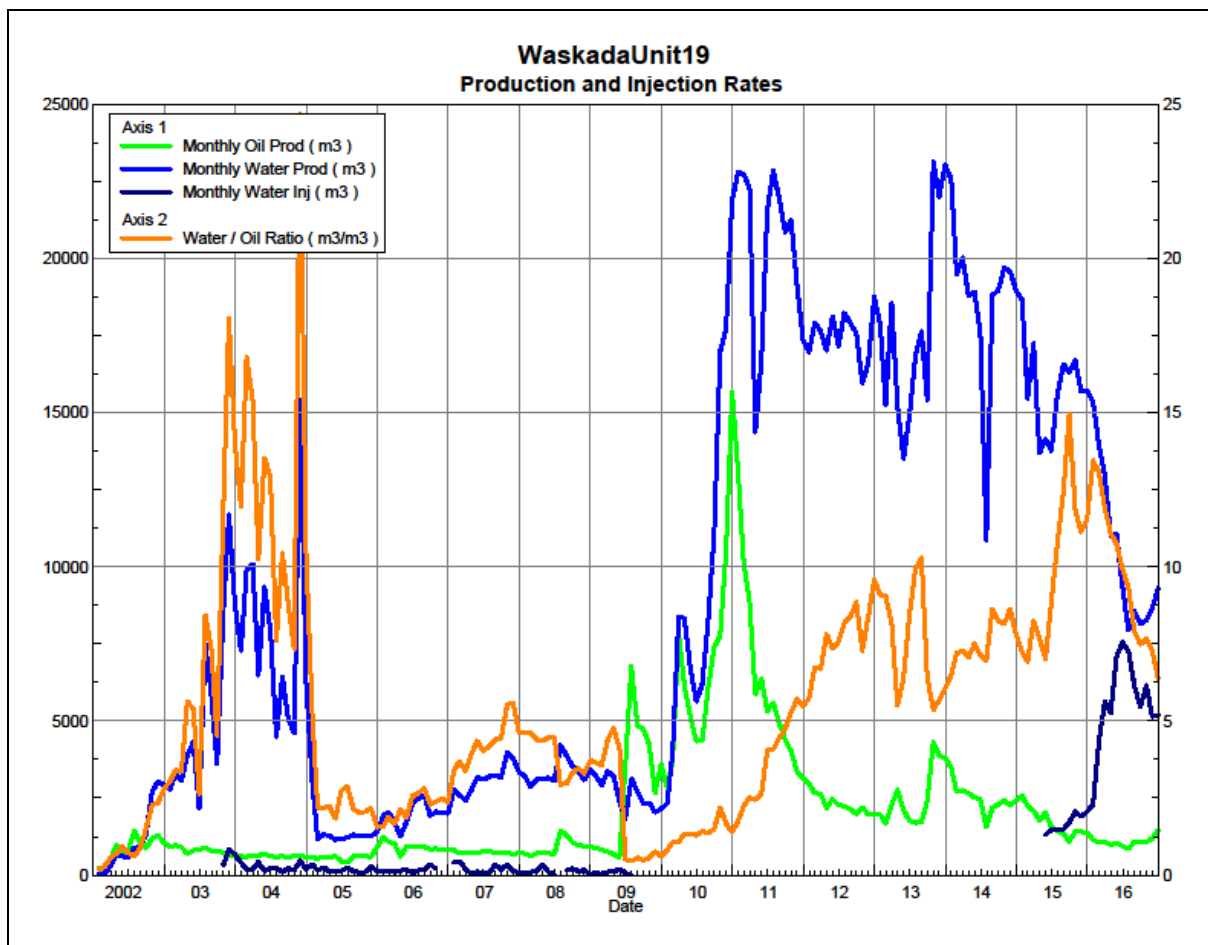
Any future revisions to the waterflood development or surveillance plan would be based on new production or performance response data, technical studies or observed reservoir behavior and reserves recovery interpretations.

WATERFLOOD PERFORMANCE

From January 1 to December 31 in 2016, Waskada Unit No. 19 produced 137,619 m³ of total fluids (13,019 m³ oil, 126,600 m³ water), and injected 67,424. The cumulative VRR since injection commenced in October 2003 is presently at 0.044. **Table 2** summarizes the yearly and cumulative VRR for Waskada Unit No. 19.

When water injection commenced in 2003, there was no visible effect on production. This was due to the fact injection rates were insignificant, and the amount of new wells being brought on production at the same time masked any possible benefits from injection. Until 2009, injection pressures remained high which limits injection rates. As a result, EOG discontinued injection into Waskada Unit No. 19 in August 2009. In 2015, water injection was resumed with the conversion of 3 existing wells. In 2016, a positive effect was seen on the oil production due to increasing the water injector well count to 10.

Figure 4. Waskada Unit No. 19 Production and Injection Rates from 2002-2016



INJECTION WELLHEAD PRESSURES

Individual injection pressure averages for 2016 can be found in **Table 5**.

RESERVOIR PRESSURE

There have been no pressure surveys done on the reservoir.

Gas volumes from the field are measured at the 15-9-2-25W1M battery. There is no individual well gas volume measurement. It is not possible to separate out the gas production from only the wells in Unit 16, so the effectiveness of the pressure maintenance program cannot be evaluated on the GOR.

WELL SERVICING

No maintenance was required on the 81 wells in Waskada Unit No. 19 in 2016.

UWI	Date	Workover
103.01-27-001-25W1.00	25-May-16	Pump Change
103.04-27-001-25W1.00	25-Jan-16	Cemented Liner Cleanout + Injector Conversion
104.05-27-001-25W1.00	3-Aug-16	Pump Change
100.07-27-001-25W1.00	6-Jan-16	Vertical Producer to Injector Conversion
102.14-27-001-25W1.00	13-Oct-16	Upsize Lift Equipment
104.16-27-001-25W1.00	2-Sep-16	Cemented Liner Cleanout
104.04-34-001-25W1.00	6-Jun-16	Pump Change
103.05-34-001-25W1.00	2-Dec-16	Repair Failed Injection Packer
102.08-34-001-25W1.00	15-Nov-16	Cemented Liner Cleanout
102.09-34-001-25W1.00	21-Nov-16	Cemented Liner Cleanout
103.13-34-001-25W1.00	10-Aug-16	Pump Change
102.14-34-001-25W1.00	25-Nov-16	Injection Packer Repair

CORROSION AND SCALE PREVENTION

The facilities in Unit 19 are currently using cathodic protection and chemicals to protect against corrosion and scale. 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.

Biocide chemical is added to the injection water to prevent any sulfide producing bacteria from forming.

CONCLUSION

The current pressure maintenance program is having little effect on oil production in Waskada Unit No. 19. Tundra will maintain the current pressure maintenance program, and continue to monitor production and pressure performance. Plans for future injection conversions and acid treatments to improve unit performance are being considered for 2016.

TABLE NO. 1: WASKADA UNIT NO. 19 WELL SUMMARY

UWI	Type	Status	On Prod Date	Cum Prd Oil (m3)	Cum Prd Water (m3)	Last Prod Date	On Inj Date	Cum Inj Water (m3)	Last Inj Date
100/01-27-001-25W1/0	Vertical	Abandoned Zone	2/1/2003	1,672	7,285	10/31/2015		0	
102/01-27-001-25W1/0	Horizontal	Producing	2/1/2010	4,280	145,080	12/31/2016		0	
103/01-27-001-25W1/0	Horizontal	Producing	12/1/2010	7,441	18,376	12/31/2016		0	
104/01-27-001-25W1/0	Horizontal	Producing	10/1/2013	2,793	2,526	12/31/2016		0	
102/02-27-001-25W1/0	Vertical	Producing	1/1/2006	1,114	32,319	7/31/2011		0	
100/03-27-001-25W1/0	Vertical	Abandoned	2/1/2003	24	741	3/31/2003		0	
100/04-27-001-25W1/0	Vertical	Injection	N/A	0	0		Nov-2003	1,423	10/31/2008
102/04-27-001-25W1/0	Horizontal	Producing	11/1/2010	9,857	34,256	12/31/2016		0	
103/04-27-001-25W1/0	Horizontal	Injection	12/1/2010	7,192	43,178	1/31/2016	Feb-2016	8,489	12/31/2016
100/05-27-001-25W1/0	Vertical	Abandoned Zone	10/1/2002	5,659	3,956	12/31/2015		0	
102/05-27-001-25W1/0	Horizontal	Producing	12/1/2010	6,802	10,555	12/31/2016		0	
103/05-27-001-25W1/0	Horizontal	Producing	12/1/2010	4,066	49,285	4/30/2016		0	
104/05-27-001-25W1/0	Horizontal	Producing	9/1/2010	9,498	128,304	12/31/2016		0	
100/06-27-001-25W1/0	Vertical	SWD	N/A	0	0		Nov-2003	1,403	7/31/2009
100/07-27-001-25W1/0	Vertical	Injection	2/1/2003	3,696	1,837	7/31/2013	Feb-2016	3,341	12/31/2016
100/08-27-001-25W1/0	Vertical	Producing	1/1/2006	1,925	507	7/31/2014		0	
102/08-27-001-25W1/0	Horizontal	Producing	12/1/2010	5,138	31,124	6/30/2016		0	
103/08-27-001-25W1/0	Horizontal	Producing	12/1/2010	5,282	3,487	12/31/2016		0	
104/08-27-001-25W1/0	Horizontal	Producing	10/1/2010	4,374	41,070	12/31/2016		0	
100/09-27-001-25W1/0	Vertical	Abandoned	10/1/2002	226	6,620	10/31/2003		0	
102/09-27-001-25W1/0	Horizontal	Injection	10/1/2010	4,876	8,770	11/30/2015	Jan-2016	7,878	11/30/2016
103/09-27-001-25W1/0	Horizontal	Producing	10/1/2010	5,975	7,667	12/31/2016		0	
104/09-27-001-25W1/0	Horizontal	Injection	8/1/2010	3,223	38,778	3/31/2014	Jan-2016	8,963	12/31/2016
102/10-27-001-25W1/0	Vertical	Abandoned	N/A	0	0			0	
100/11-27-001-25W1/0	Vertical	Pumping	10/1/2002	3,432	66,979	2/28/2015		0	
102/12-27-001-25W1/0	Horizontal	Producing	9/1/2010	8,534	79,548	4/30/2015		0	
103/12-27-001-25W1/0	Horizontal	Producing	9/1/2010	6,686	53,513	12/31/2016		0	
104/12-27-001-25W1/0	Horizontal	Injection	9/1/2010	5,535	25,660	12/31/2015	Dec-2015	5,349	12/31/2016
100/13-27-001-25W1/0	Vertical	Abandoned Zone	8/1/2002	3,061	111,529	9/30/2013		0	
102/13-27-001-25W1/0	Horizontal	Producing	9/1/2010	8,471	45,010	12/31/2016		0	
103/13-27-001-25W1/0	Horizontal	Producing	9/1/2010	2,622	46,382	12/31/2016		0	
100/14-27-001-25W1/0	Vertical	SWD	N/A	0	0		Nov-2003	942	12/31/2008
102/14-27-001-25W1/0	Horizontal	Producing	11/1/2010	6,454	13,982	12/31/2016		0	
100/15-27-001-25W1/0	Vertical	Abandoned Zone	8/1/2002	4,128	1,976	5/31/2012		0	
100/16-27-001-25W1/0	Vertical	Producing	1/1/2006	1,842	752	7/31/2012		0	
102/16-27-001-25W1/0	Horizontal	Suspended	8/1/2010	5,298	28,210	3/31/2016		0	
103/16-27-001-25W1/0	Horizontal	Producing	8/1/2010	5,228	6,781	7/31/2016		0	
104/16-27-001-25W1/0	Horizontal	Producing	3/1/2013	2,696	1,911	12/31/2016		0	
100/01-33-001-25W1/0	Vertical	Abandoned Zone	3/1/2002	4,823	49,476	6/30/2014		0	
100/07-33-001-25W1/0	Vertical	Pumping	3/1/2002	3,473	5,858	12/31/2013		0	
100/08-33-001-25W1/0	Vertical	Injection	N/A	0	0		Nov-2003	1,411	5/31/2009
100/01-34-001-25W1/0	Vertical	Pumping	3/1/2002	3,553	1,070	12/31/2016		0	
102/01-34-001-25W1/0	Horizontal	Producing	6/1/2009	9,035	1,504	2/29/2016		0	
103/01-34-001-25W1/0	Horizontal	Producing	3/1/2013	4,902	2,188	12/31/2016		0	
100/02-34-001-25W1/0	Vertical	Injection	N/A	0	0		Oct-2003	2,691	8/31/2015
100/03-34-001-25W1/0	Vertical	Pumping	3/1/2002	4,862	1,595	1/31/2015		0	
102/03-34-001-25W1/0	Horizontal	Injection	6/1/2009	11,281	83,848	11/30/2015	Jan-2016	8,111	12/31/2016
103/03-34-001-25W1/0	Horizontal	Producing	11/1/2010	7,178	2,775	12/31/2016		0	
100/04-34-001-25W1/0	Vertical	Abandoned Zone	12/1/2005	1,311	32,105	5/31/2010		0	
102/04-34-001-25W1/0	Horizontal	Injection	2/1/2010	6,526	1,971	12/31/2015	Feb-2016	5,263	12/31/2016
103/04-34-001-25W1/0	Horizontal	Producing	9/1/2013	5,088	30,796	12/31/2016		0	
104/04-34-001-25W1/0	Horizontal	Producing	9/1/2013	3,701	46,257	12/31/2016		0	
105/04-34-001-25W1/0	Horizontal	Producing	9/1/2013	5,848	4,358	12/31/2016		0	
100/05-34-001-25W1/0	Vertical	Pumping	6/1/2002	4,268	1,619	6/30/2013		0	
102/05-34-001-25W1/0	Horizontal	Producing	6/1/2009	8,128	2,599	12/31/2016		0	
103/05-34-001-25W1/0	Horizontal	Injection	2/1/2010	6,321	1,687	3/31/2015	Mar-2015	11,285	12/31/2016
104/05-34-001-25W1/0	Horizontal	Producing	3/1/2010	11,368	37,382	12/31/2016		0	
105/05-34-001-25W1/0	Horizontal	Producing	9/1/2013	3,507	52,436	12/31/2016		0	
106/05-34-001-25W1/0	Horizontal	Producing	9/1/2013	2,720	51,306	6/30/2016		0	
107/05-34-001-25W1/0	Horizontal	Producing	9/1/2013	8,428	6,402	12/31/2016		0	
100/06-34-001-25W1/0	Vertical	Producing	12/1/2005	2,271	536	6/30/2012		0	
100/07-34-001-25W1/0	Vertical	Pumping	3/1/2002	5,162	1,528	11/30/2014		0	
100/08-34-001-25W1/0	Vertical	Injection	N/A	0	0		Oct-2003	1,675	5/31/2015
102/08-34-001-25W1/0	Horizontal	Producing	6/1/2009	5,449	1,318	12/31/2016		0	
100/09-34-001-25W1/0	Vertical	Producing	6/1/2002	4,558	1,568	11/30/2012		0	
102/09-34-001-25W1/0	Horizontal	Producing	6/1/2009	7,266	1,097	12/31/2016		0	
100/10-34-001-25W1/0	Vertical	Injection	N/A	0	0		Oct-2003	3,206	5/31/2015
100/11-34-001-25W1/0	Vertical	Abandoned Zone	6/1/2002	4,500	1,984	10/31/2014		0	
100/12-34-001-25W1/0	Vertical	Abandoned Zone	12/1/2005	2,822	717	8/31/2013		0	
102/12-34-001-25W1/0	Horizontal	Injection	6/1/2009	7,656	3,742	2/28/2015	Mar-2015	14,342	12/31/2016
103/12-34-001-25W1/0	Horizontal	Producing	3/1/2010	5,000	2,138	12/31/2016		0	
104/12-34-001-25W1/0	Horizontal	Producing	3/1/2010	5,597	10,962	12/31/2016		0	
100/13-34-001-25W1/0	Vertical	Pumping	12/1/2001	5,272	1,836	5/31/2015		0	
102/13-34-001-25W1/0	Horizontal	Producing	3/1/2010	10,568	79,146	12/31/2016		0	
103/13-34-001-25W1/0	Horizontal	Producing	3/1/2010	7,974	3,270	12/31/2016		0	
100/14-34-001-25W1/0	Vertical	Abandoned Zone	12/1/2005	1,659	721	4/30/2012		0	
102/14-34-001-25W1/0	Horizontal	Injection	7/1/2008	8,110	10,093	6/30/2015	Sep-2015	7,677	12/31/2016
100/15-34-001-25W1/0	Vertical	Pumping	6/1/2002	4,204	1,446	7/31/2012		0	
100/16-34-001-25W1/0	Vertical	Abandoned	N/A	0	0		Oct-2003	479	8/31/2004
102/16-34-001-25W1/0	Horizontal	Producing	6/1/2009	7,723	2,071	12/31/2016		0	
103/16-34-001-25W1/0	Horizontal	Producing	8/1/2010	5,895	6,193	12/31/2016		0	
				377,105	1,645,547			93,927	

TABLE NO. 2 - Waskada Unit No. 19 VRR Calculations

Date	Monthly Oil Prod m3	Cum Oil Prod Km3	Monthly Water Prod m3	Cum Water Prod Km3	Water Oil Ratio m3/m3	Monthly Water Inj m3	Cum Water Inj Km3	VRR	Cum VRR
2001	4	0.004	0	0.000	0.00		0.000	0.000	0.000
2002	10,244	10.248	14,062	14.062	1.37		0.000	0.000	0.000
2003	9,591	19.839	65,411	79.473	6.82	1,818	1.818	0.024	0.018
2004	7,425	27.264	93,300	172.773	12.57	2,937	4.755	0.029	0.023
2005	7,093	34.357	16,885	189.658	2.38	2,138	6.893	0.085	0.030
2006	10,975	45.332	24,031	213.689	2.19	1,631	8.524	0.044	0.032
2007	8,780	54.112	37,568	251.257	4.28	2,421	10.945	0.051	0.035
2008	10,771	64.883	40,022	291.279	3.72	1,487	12.432	0.028	0.034
2009	34,114	98.998	31,617	322.895	0.93	579	13.011	0.008	0.030
2010	81,848	180.845	117,546	440.441	1.44	0	13.011	0.000	0.020
2011	75,155	256.000	243,772	684.213	3.24	0	13.011	0.000	0.013
2012	27,659	283.659	209,773	893.986	7.58	0	13.011	0.000	0.010
2013	30,379	314.038	213,317	1,107.303	7.02	0	13.011	0.000	0.009
2014	29,739	343.777	224,198	1,331.500	7.54	0	13.011	0.000	0.007
2015	20,310	364.090	189,446	1,520.946	9.33	13,492	26.503	0.063	0.012
2016	13,018	377.105	124,600	1,645.547	9.57	67,424	93.927	0.483	0.044

TABLE NO. 3

**Tundra Oil and Gas
Waskada Unit No. 19
2016 Injection Volumes**

Well Location	Date	Hours On	H ₂ O Inj Cal-d avg (m ³ /d)	Monthly Injected H ₂ O (m ³)
Unit No. 19 Total:				
	Jan-16	0	74	2,296
	Feb-16	0	148	4,278
	Mar-16	0	182	5,639
	Apr-16	0	175	5,255
	May-16	0	228.4	7,081
	Jun-16	0	252.0	7,560
	Jul-16	0	234.3	7,264
	Aug-16	0	197.8	6,131
	Sep-16	0	181.6	5,448
	Oct-16	0	198.5	6,153
	Nov-16	0	171.3	5,139
	Dec-16	0	167.1	5,180
2016 Group Totals:				67,424
Unit No. 19 Total:				
	2001	0		
	2002	0		
	2003	0	19.8	1,818
	2004	0	8.0	2,937
	2005	0	5.9	2,138
	2006	0	5.4	1,631
	2007	0	6.6	2,421
	2008	0	4.4	1,487
	2009	0	2.7	579
	2010	0	0.0	0
	2011	0	0.0	0
	2012	0	0.0	0
	2013	0	0.0	0
	2014	0	0.0	0
	2015	0	55.1	13,492
	2016	0	184.1	67,424
Group Totals:				93,927

TABLE NO. 4

**Tundra Oil and Gas
Waskada Unit No. 19
2016 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-16	26,088	36.80	1,141	494.87	15,341	13.45	35
Feb-16	23,400	36.85	1,069	482.50	13,993	13.09	34
Mar-16	22,272	35.15	1,090	418.39	12,970	11.90	30
Apr-16	19,728	33.08	992	367.22	11,017	11.10	27
May-16	20,808	33.23	1,030	356.79	11,061	10.74	28
Jun-16	18,912	31.39	942	311.38	9,341	9.92	26
Jul-16	16,440	27.49	852	256.23	7,943	9.32	22
Aug-16	18,552	34.97	1,084	276.03	8,557	7.89	25
Sep-16	18,072	36.30	1,089	271.76	8,153	7.49	25
Oct-16	18,048	34.79	1,079	266.75	8,269	7.67	24
Nov-16	18,984	39.51	1,185	287.75	8,632	7.28	26
Dec-16	21,048	47.28	1,466	300.76	9,324	6.36	28
	242,352		13,018		124,600		

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
2001	24	0.11	4	0.00	0	0.00	1
2002	68,280	28.07	10,244	38.53	14,062	1.37	9
2003	129,672	26.28	9,591	179.21	65,411	6.82	17
2004	132,144	20.29	7,425	254.92	93,300	12.57	16
2005	131,304	19.43	7,093	46.26	16,885	2.38	16
2006	187,747	30.07	10,975	65.84	24,031	2.19	23
2007	195,888	24.05	8,780	102.93	37,568	4.28	23
2008	201,480	29.43	10,771	109.35	40,022	3.72	24
2009	197,640	93.46	34,114	86.62	31,617	0.93	28
2010	308,304	224.24	81,848	322.04	117,546	1.44	41
2011	463,440	205.90	75,155	667.87	243,772	3.24	68
2012	447,576	75.57	27,659	573.15	209,773	7.58	62
2013	413,376	83.23	30,379	584.43	213,317	7.02	55
2014	410,280	81.48	29,739	614.24	224,198	7.54	49
2015	347,736	55.76	20,310	519.04	189,446	9.88	40
2016	242,352	35.57	13,018	340.87	124,600	9.68	28
	3,877,243		377,105		1,645,547		

TABLE NO. 5 - Average Injection Pressures

	00/02-34 Inj	00/04-27 Inj	00/06-27 Inj	00/07-27 Inj	00/08-33 Inj	00/08-34 Inj	00/10-34 Inj	00/14-27 Inj	02/03-34 Inj
Year	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)
2014	0.0	0.0	4575.8	0.0	0.0	0.0	0.0	3695.5	0.0
2015	3196.4	0.0	4099.7	0.0	2986.0	3156.2	3169.3	3282.6	0.0
2016	3163.4	0.0	4000.3	1722.9	2388.7	1059.3	4827.7	220.2	1333.2

	02/04-34 Inj	02/09-27 Inj	02/12-34 Inj	02/14-34 Inj	03/04-27 Inj	03/05-34 Inj	04/09-27 Inj	04/12-27 Inj
Year	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)	Inj Pressure (kPa)
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	50.2	0.0	0.0	51.3	0.0	0.0
2016	4384.3	933.1	1490.2	1115.1	2399.9	1889.4	882.5	1658.0