# Waskada Unit No. 16

## Waterflood Progress Report 2016

## January 1st through December 31st 2016

**Prepared for:**

**Manitoba Industry, Economic Development and Mines**

**Petroleum Branch**

**Prepared by:**

**Tundra Oil and Gas Partnership**

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# TABLE OF CONTENTS

**Table of Contents**

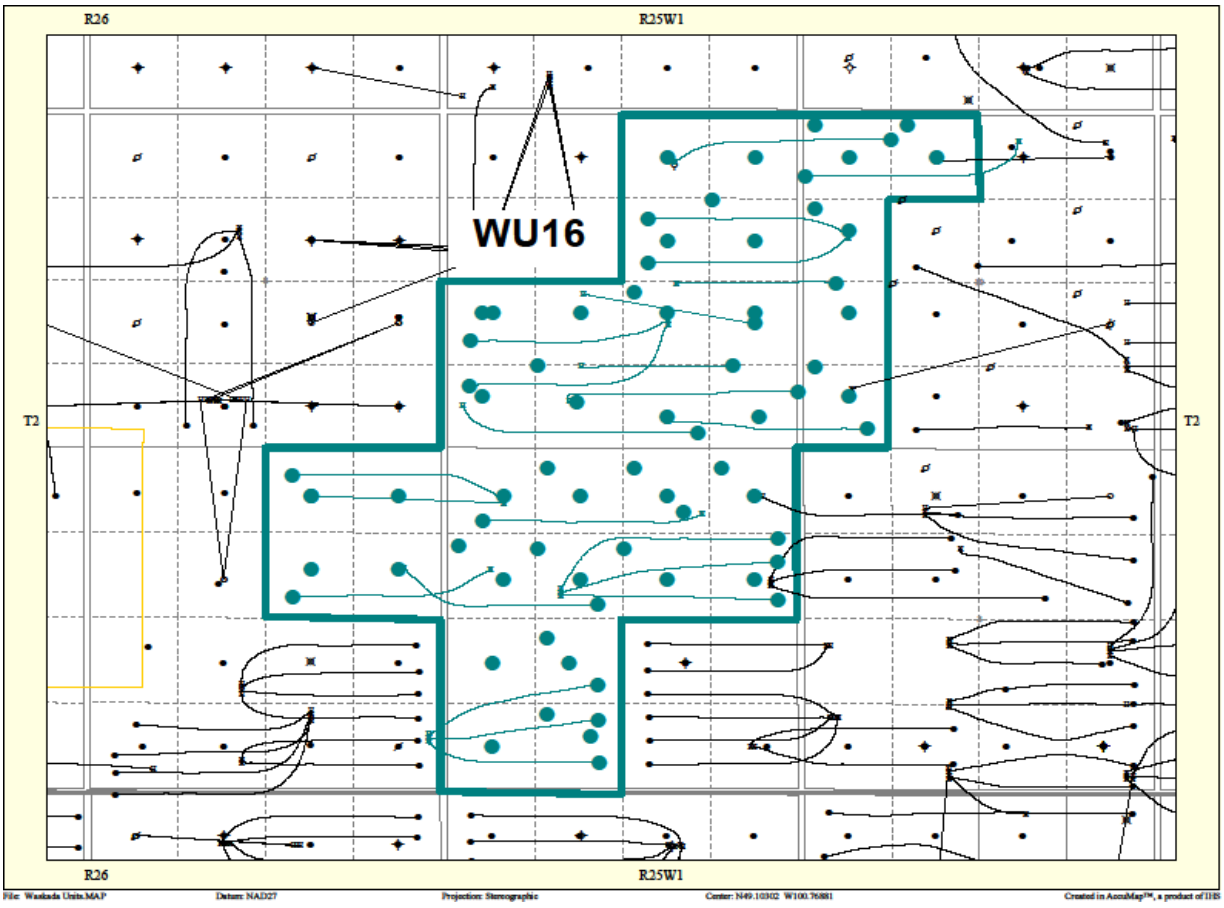

| | |
|---|---|
| Introduction | 3 |
| Production History | 3 |
| Waterflood History | 5 |
| Waterflood Performance | 6 |
| Injection Wellhead Pressures | 7 |
| Reservoir Pressure | 7 |
| Well Servicing | 7 |
| Corrosion and Scale Prevention | 7 |
| Conclusion | 7 |
| List of Tables | 8 |

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.16 pressure maintenance project commenced water injection into the Lower Amaranth A pool in accordance with Manitoba Energy and Mines Order No. PM 57, dated May 1, 1987. This unit was enlarged on October 1, 1988 to its current boundary. Waskada Unit No. 16 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 green in Figure 1, contains 73 wells over 33 LSDs in Township 2, Range 25W1 (Table 1).

**Figure 1: Waskada Unit No. 16 Area Outline**




## PRODUCTION HISTORY

For the wells included in Waskada Unit No. 16, production started in July 1984 with the 00/04-09-002-25W1/00 well. From 1985 – 1989, 33 wells were drilled. Oil production peaked at 106.88 $m^3$/d in April 1988. From 2012-2014, 18 new producers were added to the unit, resulting in a peak in oil production of 257.75 $m^3$/d in October 2014. There are currently 38 producing wells in Waskada Unit No. 16.

The average production for the unit was 42.3 $m^3/d$ of oil and 124.9 $m^3/d$ of water and the average WOR was 2.9 $m^3/m^3$ at the end of December 2016 (Table 4). The rates and WOR are presented in Figure 2.

**Figure 2: Waskada Unit No. 16 Production/Injection Rates and WOR vs Time**

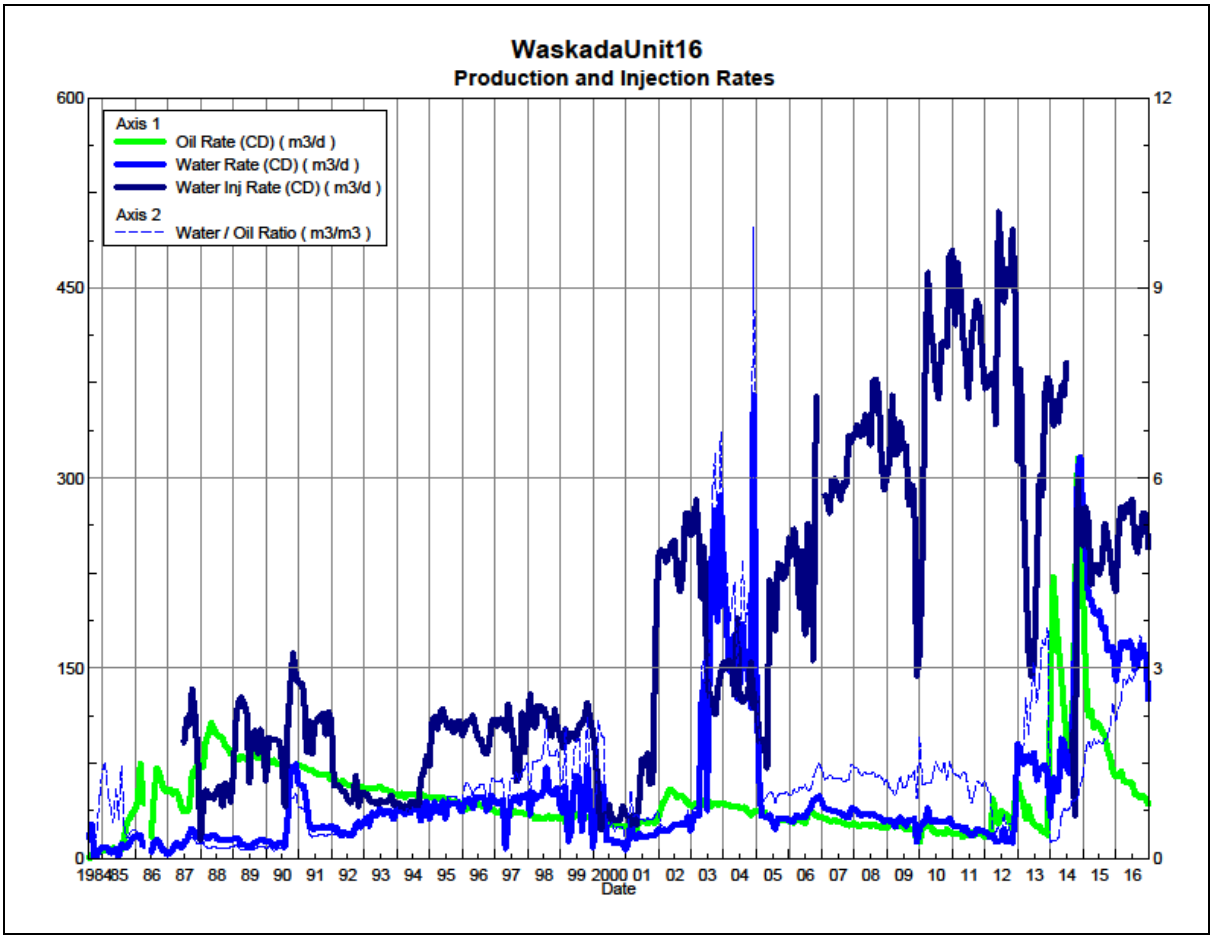
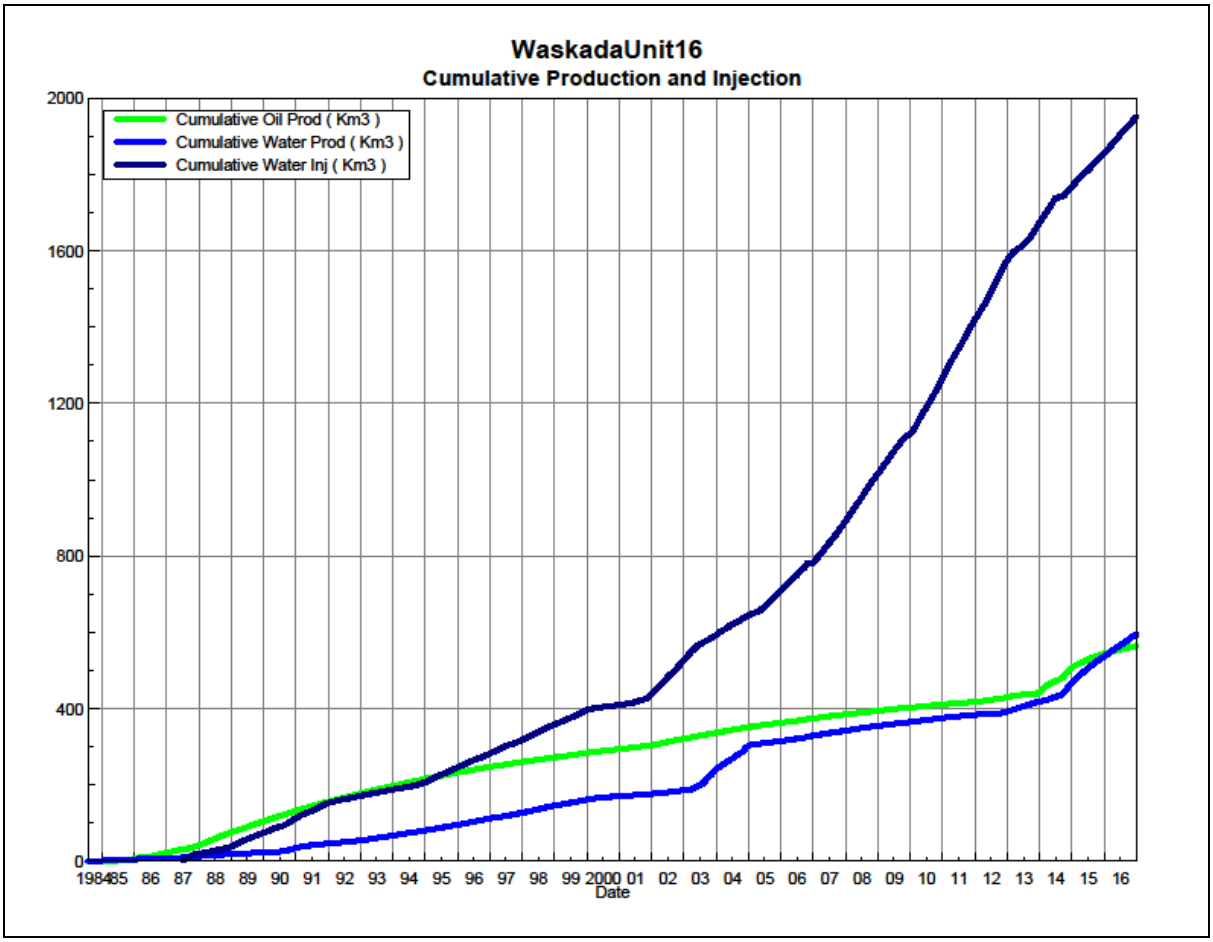



Figure 3 shows the cumulative production for Waskada Unit No. 16 to the end of December 2016 as 564.4 $e^3m^3$ of oil, and 595.1 $e^3m^3$ of water. The cumulative water injected is over 1951.7 $e^3m^3$.

**Figure 3. Waskada Unit No. 16 Cumulative Oil, Water and Water Injected vs. Time**




## WATERFLOOD HISTORY

Water injection commenced with 4 injector wells on June 1987. The unit was then enlarged and 5 more injection wells were added in December 1988. Fourteen injector wells were added in November 2001, and 3 more were added October 2002. Three more wells were converted to injection on 2015. Of the 26 injector wells operating in 2015, 22 were active at the end of 2016.

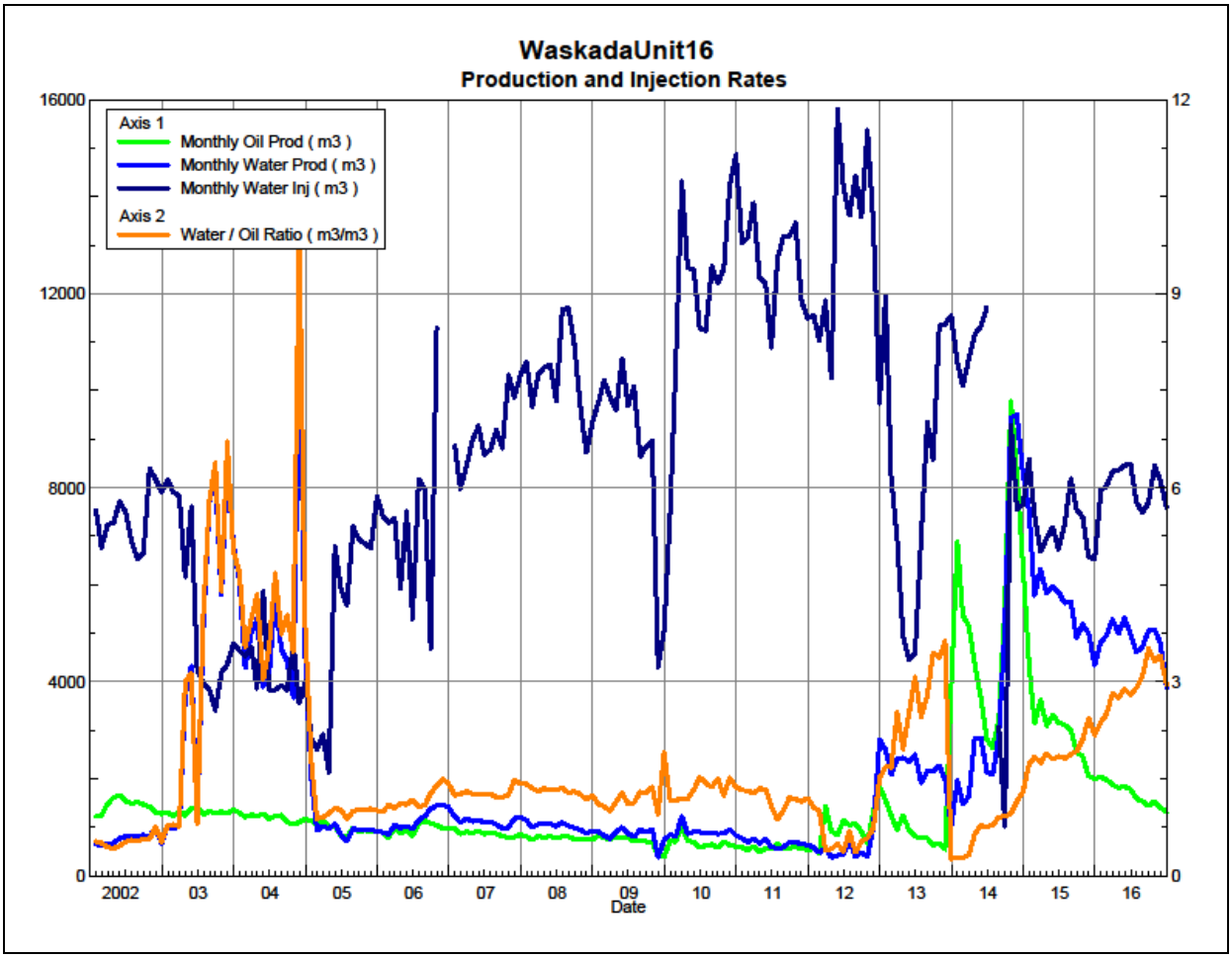
Any future revisions to the waterflood development or surveillance plan would be based on new production or performance response data, technical studies or observed reservoir behavior and reserves recovery interpretations.

## WATERFLOOD PERFORMANCE

From January 1 to December 31 in 2015, Unit No. 16 produced 78,612 $m^3$ of total fluids (20,132 $m^3$ oil, 58,481 $m^3$ water), and injected 96,676 $m^3$ of source water, giving an annual oil and water voidage replacement ratio (VRR) of 1.184 for this reporting period. The cumulative VRR since injection commenced in May 1987 is presently at 1.569. Table 2 summarizes the yearly and cumulative VRR for Waskada Unit No. 16.

Since 2007, the injection rate averaged 10,000 $m^3/d$ but has little effect on oil production, as can be seen in Figure 4. The injection rates have been steadily increased since 2002. There was an associated increase in oil and water production with the increase in injected water in 2002, but since then oil production has declined despite the increased injection rates. The increases in production in 2012-14 can be attributed to the addition of 18 new producers (3 in 2012, 4 in 2013 and 11 in 2014).

**Figure 4. Waskada Unit No. 16 Production and Injection Rates From 2002-2016**



## INJECTION WELLHEAD PRESSURES

Individual injection average pressures 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

The following table illustrates the maintenance done on the Waskada Unit No. 16 wells in 2016:

| UWI | Date | Job |
|---|---|---|
| 100.05-04-002-25W1.00 | 5-Dec-16 | Vertical WIW Packer Repair |
| 103.06-04-002-25W1.00 | 5-Jan-16 | Pump Change |
| 1C0.12-04-002-25W1.00 | 11-Jan-16 | Workover |
| 1C0.15-04-002-25W1.00 | 10-Dec-16 | Repair Injection Packer Failure |
| 102.10-05-002-25W1.00 | 26-Mar-16 | Pump change |
| 102.15-05-002-25W1.00 | 19-Jul-16 | Pump Change |
| 100.16-05-002-25W1.00 | 25-Jan-16 | Re-Perf and Stimulate Water Injection Well |

## CORROSION AND SCALE PREVENTION

The facilities in Unit 16 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 a positive effect on oil production in Waskada Unit No. 16. 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 2017.

***TABLE NO. 1: WASKADA UNIT NO. 16 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* |
|---|---|---|---|---|---|---|---|---|---|
| 100/03-04-002-25W1/0 | Vertical | Injection | 7/10/1986 | 7238.0 | 177.9 | 9/30/2014 | | 146.6 | 2/29/2016 |
| 103/03-04-002-25W1/0 | Horizontal | Producing | 12/6/2013 | 5169.1 | 2712.5 | 12/31/2016 | | 0.0 | |
| 104/03-04-002-25W1/0 | Horizontal | Producing | 12/6/2013 | 5093.2 | 3566.4 | 12/31/2016 | | 0.0 | |
| 1C0/03-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 10/1/2002 | 34308.4 | 12/31/2016 |
| 100/04-04-002-25W1/0 | Vertical | Producing | 2/14/1986 | 18482.8 | 5330.5 | 8/31/2011 | | 0.0 | |
| 100/05-04-002-25W1/0 | Vertical | Injection | 8/27/1985 | 3887.5 | 303.9 | 4/30/1987 | 6/1/1987 | 115197.3 | 12/31/2016 |
| 100/06-04-002-25W1/0 | Vertical | Producing | 2/17/1986 | 25788.4 | 15470.8 | 6/30/2011 | | 0.0 | |
| 103/06-04-002-25W1/0 | Horizontal | Producing | 7/16/2014 | 3948.1 | 13646.4 | 12/31/2016 | | 0.0 | |
| 1C0/06-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 10/1/2002 | 27747.4 | 12/31/2016 |
| 100/09-04-002-25W1/0 | Vertical | Injection | 8/29/1987 | 7883.1 | 358.2 | 7/31/2012 | | 2080.1 | 12/31/2016 |
| 102/09-04-002-25W1/0 | Horizontal | Producing | 1/7/2014 | 9791.4 | 1339.5 | 12/31/2016 | | 0.0 | |
| 103/09-04-002-25W1/0 | Horizontal | Producing | 12/18/2013 | 7357.8 | 794.9 | 12/31/2016 | | 0.0 | |
| 104/09-04-002-25W1/0 | Horizontal | Producing | 11/30/2013 | 6682.2 | 2034.0 | 12/31/2016 | | 0.0 | |
| 100/10-04-002-25W1/0 | Vertical | Producing | 8/28/1987 | 17547.6 | 386.7 | 12/31/2016 | | 0.0 | |
| 1C0/10-04-002-25W1/0 | Vertical | Abandoned | N/A | 0.0 | 0.0 | | 11/1/2001 | 1829.3 | 10/31/2003 |
| 100/11-04-002-25W1/0 | Vertical | Injection | 2/5/1986 | 755.1 | 34.0 | 4/30/1987 | 6/1/1987 | 26705.2 | 11/30/2015 |
| 103/11-04-002-25W1/0 | Horizontal | Producing | 9/20/2014 | 3804.4 | 11121.4 | 12/31/2016 | | 0.0 | |
| 1C0/11-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 16051.9 | 12/31/2016 |
| 100/12-04-002-25W1/0 | Vertical | Producing | 2/3/1986 | 17424.8 | 6434.9 | 12/31/2016 | | 0.0 | |
| 1C0/12-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 10/1/2002 | 14876.6 | 12/31/2016 |
| 100/13-04-002-25W1/2 | Vertical | Producing | 9/27/1985 | 10172.9 | 11917.4 | 11/30/2016 | | 0.0 | |
| 102/13-04-002-25W1/0 | Horizontal | Producing | 11/10/2012 | 9792.0 | 11373.2 | 12/31/2016 | | 0.0 | |
| 100/14-04-002-25W1/0 | Vertical | Producing | 2/12/1986 | 13806.0 | 6056.2 | 12/31/2015 | | 0.0 | |
| 1C0/14-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 30961.6 | 12/31/2016 |
| 100/15-04-002-25W1/0 | Vertical | Injection | 8/30/1985 | 391.5 | 48.7 | 4/30/1987 | 6/1/1987 | 33725.4 | 12/31/2015 |
| 102/15-04-002-25W1/0 | Vertical | Producing | 3/1/2006 | 3420.7 | 427.6 | 12/31/2016 | | 0.0 | |
| 1C0/15-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 9587.8 | 12/31/2016 |
| 100/16-04-002-25W1/0 | Vertical | Producing | 9/10/1987 | 10096.7 | 2680.1 | 12/31/2016 | | 0.0 | |
| 1C0/16-04-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 2246.6 | 12/31/2016 |
| 100/09-05-002-25W1/0 | Vertical | Producing | 11/14/1985 | 44599.2 | 5465.0 | 12/31/2016 | | 0.0 | |
| 100/10-05-002-25W1/0 | Vertical | Abandoned | 12/8/1985 | 6507.8 | 112810.4 | 8/31/2003 | | 0.0 | |
| 102/10-05-002-25W1/0 | Horizontal | Producing | 1/4/2014 | 14203.8 | 2641.7 | 12/31/2016 | | 0.0 | |
| 100/15-05-002-25W1/0 | Vertical | Abandoned Zone | 12/19/1985 | 7401.5 | 708.3 | 9/30/2013 | | 0.0 | |
| 102/15-05-002-25W1/0 | Horizontal | Producing | 3/28/2014 | 5767.4 | 23466.5 | 11/30/2016 | | 0.0 | |
| 103/15-05-002-25W1/0 | Horizontal | Drilled & Cased | N/A | 0.0 | 0.0 | | | 0.0 | |
| 100/16-05-002-25W1/0 | Vertical | Injection | 7/24/1985 | 1181.1 | 425.4 | 4/30/1987 | 6/1/1987 | 71574.4 | 12/31/2016 |
| 100/01-09-002-25W1/0 | Vertical | Injection | 8/14/1987 | 394.3 | 507.9 | 7/31/1988 | 12/1/1988 | 24188.3 | 12/31/2016 |
| 102/01-09-002-25W1/0 | Horizontal | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 15084.1 | 12/31/2016 |
| 103/01-09-002-25W1/0 | Horizontal | Producing | 9/22/2014 | 9104.6 | 6398.4 | 12/31/2016 | | 0.0 | |
| 100/02-09-002-25W1/0 | Vertical | Producing | 7/3/1986 | 18756.0 | 1508.2 | 12/31/2016 | | 0.0 | |
| 102/02-09-002-25W1/0 | Horizontal | Producing | 3/7/2012 | 8950.6 | 2632.9 | 12/31/2016 | | 0.0 | |
| 100/03-09-002-25W1/0 | Vertical | Producing | 8/25/1987 | 37594.0 | 23746.3 | 2/28/2014 | | 0.0 | |
| 1C0/03-09-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 15543.9 | 12/31/2016 |
| 100/04-09-002-25W1/2 | Vertical | Producing | 11/4/1982 | 12262.2 | 110213.5 | 12/31/2016 | | 0.0 | |
| 102/04-09-002-25W1/0 | Horizontal | Producing | 9/13/2014 | 4718.9 | 7160.3 | 12/31/2016 | | 0.0 | |
| 100/05-09-002-25W1/0 | Vertical | Abandoned | 2/22/1985 | 772.7 | 3250.5 | 2/28/1989 | | 0.0 | |
| 102/05-09-002-25W1/0 | Vertical | Pumping | 11/19/1989 | 8182.6 | 1262.4 | 10/31/2015 | | 0.0 | |
| 103/05-09-002-25W1/0 | Horizontal | Producing | 9/14/2014 | 4132.4 | 6368.6 | 12/31/2016 | | 0.0 | |
| 100/06-09-002-25W1/0 | Vertical | Injection | 11/8/1987 | 850.5 | 40.0 | 8/31/1988 | 12/1/1988 | 49480.8 | 12/31/2016 |
| 100/07-09-002-25W1/0 | Vertical | Producing | 11/9/1987 | 27015.0 | 16683.2 | 3/31/2014 | | 0.0 | |
| 1C0/07-09-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 15195.2 | 12/31/2016 |
| 100/08-09-002-25W1/0 | Vertical | Abandoned Zone | 2/12/1988 | 13546.1 | 5674.3 | 12/31/2012 | | 0.0 | |
| 102/08-09-002-25W1/0 | Horizontal | Producing | 10/8/2014 | 8208.6 | 6043.9 | 12/31/2016 | | 0.0 | |
| 100/09-09-002-25W1/0 | Vertical | Injection | 2/12/1988 | 25231.2 | 12158.3 | 7/31/2012 | | 2302.1 | 12/31/2016 |
| 1C0/09-09-002-25W1/0 | Vertical | Abandoned | N/A | 0.0 | 0.0 | | 11/1/2001 | 20382.5 | 10/31/2004 |
| 100/10-09-002-25W1/0 | Vertical | Abandoned | 3/11/1986 | 1145.1 | 68.4 | 8/31/1988 | 12/1/1988 | 48805.8 | 8/31/2001 |
| 102/10-09-002-25W1/0 | Horizontal | Producing | 9/4/2014 | 5800.9 | 13970.1 | 12/31/2016 | | 0.0 | |
| 103/10-09-002-25W1/0 | Horizontal | Producing | 9/9/2014 | 6364.5 | 8217.2 | 12/31/2016 | | 0.0 | |
| 100/15-09-002-25W1/0 | Vertical | Producing | 1/30/1986 | 9779.1 | 318.1 | 12/31/2016 | | 0.0 | |
| 100/16-09-002-25W1/0 | Vertical | Injection | 7/16/1985 | 3365.2 | 203.2 | 8/31/1988 | 12/1/1988 | 427172.0 | 6/30/2014 |
| 100/04-10-002-25W1/0 | Vertical | Producing | 10/27/1987 | 6666.6 | 704.6 | 12/31/2016 | | 0.0 | |
| 103/04-10-002-25W1/0 | Horizontal | Producing | 9/30/2014 | 5044.3 | 1526.6 | 12/31/2016 | | 0.0 | |
| 1C0/04-10-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 6001.8 | 12/31/2016 |
| 100/05-10-002-25W1/0 | Vertical | Injection | N/A | 338.8 | 32.8 | 8/31/1988 | 12/1/1988 | 813948.9 | 12/31/2016 |
| 102/05-10-002-25W1/0 | Horizontal | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 49017.5 | 12/31/2016 |
| 100/12-10-002-25W1/0 | Vertical | Producing | 3/25/1988 | 34567.3 | 50442.0 | 9/30/2016 | | 0.0 | |
| 1C0/12-10-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 46241.3 | 12/31/2016 |
| 100/13-10-002-25W1/0 | Vertical | Producing | 2/4/1988 | 28328.4 | 3065.2 | 11/30/2016 | | 0.0 | |
| 103/13-10-002-25W1/0 | Horizontal | Producing | 11/9/2012 | 1087.5 | 64343.8 | 12/31/2016 | | 0.0 | |
| 104/13-10-002-25W1/0 | Horizontal | Producing | 3/22/2014 | 5683.8 | 5297.6 | 12/31/2016 | | 0.0 | |
| 1C0/13-10-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 5770.3 | 12/31/2016 |
| 100/14-10-002-25W1/0 | Vertical | Producing | 2/3/1986 | 8301.6 | 1522.9 | 11/30/2016 | | 0.0 | |
| 1C0/14-10-002-25W1/0 | Vertical | Injection | N/A | 0.0 | 0.0 | | 11/1/2001 | 25486.7 | 12/31/2016 |
| | | | | 564386.9 | 595093.7 | | | 1951659.8 | |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| **1984** | 774 | 0.774 | 1892 | 1.892 | 2.44 | | 0.000 | 0.000 | 0.000 |
| **1985** | 5932 | 6.706 | 3258 | 5.150 | 0.55 | | 0.000 | 0.000 | 0.000 |
| **1986** | 16130 | 22.836 | 3175 | 8.325 | 0.20 | | 0.000 | 0.000 | 0.000 |
| **1987** | 19644 | 42.480 | 5006 | 13.331 | 0.25 | 19770 | 19.770 | 0.716 | 0.318 |
| **1988** | 33617 | 76.097 | 5787 | 19.118 | 0.17 | 18857 | 38.627 | 0.424 | 0.362 |
| **1989** | 29005 | 105.102 | 4528 | 23.647 | 0.16 | 36119 | 74.746 | 0.953 | 0.517 |
| **1990** | 27089 | 132.191 | 11703 | 35.349 | 0.43 | 38515 | 113.262 | 0.899 | 0.604 |
| **1991** | 24743 | 156.935 | 11364 | 46.713 | 0.46 | 39653 | 152.914 | 0.996 | 0.673 |
| **1992** | 21330 | 178.265 | 8289 | 55.002 | 0.39 | 18966 | 171.880 | 0.578 | 0.661 |
| **1993** | 19754 | 198.019 | 12744 | 67.746 | 0.65 | 16521 | 188.401 | 0.466 | 0.638 |
| **1994** | 18064 | 216.083 | 13597 | 81.343 | 0.75 | 18862 | 207.263 | 0.549 | 0.628 |
| **1995** | 16721 | 232.804 | 14658 | 96.001 | 0.88 | 38999 | 246.262 | 1.151 | 0.677 |
| **1996** | 14843 | 247.647 | 16507 | 112.508 | 1.11 | 36447 | 282.709 | 1.086 | 0.712 |
| **1997** | 13016 | 260.663 | 15408 | 127.916 | 1.18 | 35740 | 318.449 | 1.177 | 0.745 |
| **1998** | 11726 | 272.389 | 18486 | 146.402 | 1.58 | 40470 | 358.919 | 1.266 | 0.781 |
| **1999** | 11715 | 284.104 | 15011 | 161.413 | 1.28 | 37339 | 396.258 | 1.311 | 0.812 |
| **2000** | 10087 | 294.190 | 8957 | 170.370 | 0.89 | 14073 | 410.331 | 0.685 | 0.807 |
| **2001** | 10124 | 304.314 | 6718 | 177.088 | 0.66 | 28196 | 438.527 | 1.536 | 0.832 |
| **2002** | 17231 | 321.545 | 9116 | 186.203 | 0.53 | 88619 | 527.146 | 3.063 | 0.948 |
| **2003** | 15739 | 337.284 | 54464 | 240.667 | 3.46 | 66491 | 593.638 | 0.916 | 0.944 |
| **2004** | 14340 | 351.624 | 62663 | 303.331 | 4.37 | 51375 | 645.013 | 0.649 | 0.911 |
| **2005** | 11626 | 363.250 | 12251 | 315.582 | 1.05 | 64324 | 709.337 | 2.511 | 0.967 |
| **2006** | 11598 | 374.848 | 13838 | 329.420 | 1.19 | 72897 | 782.234 | 2.682 | 1.029 |
| **2007** | 10417 | 385.265 | 13376 | 342.796 | 1.28 | 109531 | 891.765 | 4.320 | 1.135 |
| **2008** | 9323 | 394.587 | 12196 | 354.992 | 1.31 | 123488 | 1015.253 | 5.388 | 1.255 |
| **2009** | 8347 | 402.934 | 10000 | 364.992 | 1.20 | 105691 | 1120.944 | 5.393 | 1.353 |
| **2010** | 8225 | 411.160 | 10834 | 375.826 | 1.32 | 146328 | 1267.272 | 7.211 | 1.493 |
| **2011** | 6795 | 417.955 | 8052 | 383.878 | 1.19 | 151409 | 1418.681 | 9.543 | 1.641 |
| **2012** | 12252 | 430.206 | 8620 | 392.498 | 0.70 | 154869 | 1573.550 | 6.820 | 1.774 |
| **2013** | 14010 | 444.216 | 25834 | 418.332 | 1.84 | 100244 | 1673.794 | 2.390 | 1.801 |
| **2014** | 64161 | 508.380 | 50277 | 468.610 | 0.78 | 94153 | 1767.948 | 0.759 | 1.679 |
| **2015** | 35878 | 544.260 | 68004 | 536.613 | 1.90 | 87036 | 1854.984 | 0.797 | 1.596 |
| **2016** | 20132 | 564.387 | 58481 | 595.094 | 2.90 | 96676 | 1951.660 | 1.184 | 1.569 |

**TABLE NO. 3**

**Tundra Oil and Gas**
**Waskada Unit No. 16**
**2016 Injection Volumes**

| Well Location | Date | Hours On | $H_2O$ Inj Cal-d avg ($m^3/d$) | Monthly Injected $H_2O$ ($m^3$) |
|---|---|---|---|---|
| **Unit No. 16 Total:** | | | | |
| | Jan-16 | 0 | 256.0 | 7935.30 |
| | Feb-16 | 0 | 277.2 | 8037.30 |
| | Mar-16 | 0 | 268.8 | 8333.00 |
| | Apr-16 | 0 | 278.8 | 8365.20 |
| | May-16 | 0 | 272.9 | 8458.70 |
| | Jun-16 | 0 | 283.2 | 8494.80 |
| | Jul-16 | 0 | 248.4 | 7701.50 |
| | Aug-16 | 0 | 241.3 | 7481.10 |
| | Sep-16 | 0 | 256.6 | 7697.30 |
| | Oct-16 | 0 | 272.6 | 8449.10 |
| | Nov-16 | 0 | 271.3 | 8138.60 |
| | Dec-16 | 0 | 244.7 | 7584.30 |
| **2016 Group Totals:** | | | | 96676.20 |
| **Unit No. 16 Total:** | | | | |
| | 1984 | 0 | 0.0 | 0.00 |
| | 1985 | 0 | 0.0 | 0.00 |
| | 1986 | 0 | 0.0 | 0.00 |
| | 1987 | 0 | 54.2 | 19,770.30 |
| | 1988 | 0 | 51.7 | 18,857.10 |
| | 1989 | 0 | 99.0 | 36,118.80 |
| | 1990 | 0 | 105.5 | 38,515.30 |
| | 1991 | 0 | 108.6 | 39,652.50 |
| | 1992 | 0 | 52.0 | 18,965.80 |
| | 1993 | 0 | 45.3 | 16,521.00 |
| | 1994 | 0 | 51.7 | 18,862.30 |
| | 1995 | 0 | 106.8 | 38,998.70 |
| | 1996 | 0 | 99.9 | 36,447.10 |
| | 1997 | 0 | 97.9 | 35,740.40 |
| | 1998 | 0 | 110.9 | 40,469.70 |
| | 1999 | 0 | 102.3 | 37,339.40 |
| | 2000 | 0 | 38.6 | 14,072.80 |
| | 2001 | 0 | 77.3 | 28,196.30 |
| | 2002 | 0 | 242.8 | 88,618.60 |
| | 2003 | 0 | 182.2 | 66,491.40 |
| | 2004 | 0 | 140.8 | 51,375.10 |
| | 2005 | 0 | 176.2 | 64,324.30 |
| | 2006 | 0 | 199.7 | 72,897.00 |
| | 2007 | 0 | 300.1 | 109,531.30 |
| | 2008 | 0 | 338.3 | 123,487.80 |
| | 2009 | 0 | 289.6 | 105,691.10 |
| | 2010 | 0 | 400.9 | 146,328.10 |
| | 2011 | 0 | 414.8 | 151,409.30 |
| | 2012 | 0 | 423.1 | 154,868.50 |
| | 2013 | 0 | 274.6 | 100,244.40 |
| | 2014 | 0 | 281.9 | 94,153.40 |
| | 2015 | 0 | 238.6 | 87,035.80 |
| | 2016 | 0 | 264.3 | 96,676.20 |
| **Group Totals:** | | | | 1,951,659.80 |

**TABLE NO. 4**

**Tundra Oil and Gas**
**Waskada Unit No. 16**
**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 | 22,968 | 65.51 | 2,031 | 155.49 | 4,820 | 2.37 | 31 |
| Feb-16 | 21,624 | 68.32 | 1,981 | 170.68 | 4,950 | 2.50 | 31 |
| Mar-16 | 22,872 | 60.45 | 1,874 | 170.60 | 5,289 | 2.82 | 31 |
| Apr-16 | 22,128 | 60.59 | 1,818 | 166.65 | 4,999 | 2.75 | 31 |
| May-16 | 23,304 | 59.29 | 1,838 | 171.30 | 5,310 | 2.89 | 31 |
| Jun-16 | 22,104 | 59.45 | 1,784 | 166.13 | 4,984 | 2.79 | 31 |
| Jul-16 | 22,752 | 51.17 | 1,586 | 148.78 | 4,612 | 2.91 | 31 |
| Aug-16 | 23,112 | 49.36 | 1,530 | 152.53 | 4,728 | 3.09 | 31 |
| Sep-16 | 22,296 | 47.94 | 1,438 | 168.34 | 5,050 | 3.51 | 31 |
| Oct-16 | 22,608 | 49.47 | 1,534 | 163.94 | 5,082 | 3.31 | 30 |
| Nov-16 | 20,616 | 46.86 | 1,406 | 159.44 | 4,783 | 3.40 | 29 |
| Dec-16 | 19,872 | 42.34 | 1,313 | 124.91 | 3,872 | 2.95 | 27 |
| | 266,256 | | 20,132 | | 58,481 | | |

| 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 |
|---|---|---|---|---|---|---|---|
| 1984 | 3,600 | 4.21 | 774 | 10.28 | 1,892 | 2.44 | 1 |
| 1985 | 29,952 | 16.27 | 5,932 | 8.93 | 3,258 | 0.55 | 3 |
| 1986 | 94,440 | 44.19 | 16,130 | 10.45 | 3,175 | 0.20 | 13 |
| 1987 | 155,280 | 53.82 | 19,644 | 13.71 | 5,006 | 0.25 | 18 |
| 1988 | 222,336 | 92.00 | 33,617 | 15.81 | 5,787 | 0.17 | 25 |
| 1989 | 196,344 | 79.47 | 29,005 | 12.41 | 4,528 | 0.16 | 22 |
| 1990 | 207,408 | 74.22 | 27,089 | 32.06 | 11,703 | 0.43 | 24 |
| 1991 | 208,224 | 67.79 | 24,743 | 31.13 | 11,364 | 0.46 | 24 |
| 1992 | 208,632 | 58.28 | 21,330 | 22.65 | 8,289 | 0.39 | 24 |
| 1993 | 207,792 | 54.12 | 19,754 | 34.92 | 12,744 | 0.65 | 24 |
| 1994 | 205,104 | 49.49 | 18,064 | 37.25 | 13,597 | 0.75 | 23 |
| 1995 | 207,888 | 45.81 | 16,721 | 40.16 | 14,658 | 0.88 | 24 |
| 1996 | 205,032 | 40.55 | 14,843 | 45.10 | 16,507 | 1.11 | 23 |
| 1997 | 204,408 | 35.66 | 13,016 | 42.21 | 15,408 | 1.18 | 23 |
| 1998 | 206,256 | 32.13 | 11,726 | 50.65 | 18,486 | 1.58 | 24 |
| 1999 | 192,864 | 32.09 | 11,715 | 41.13 | 15,011 | 1.28 | 22 |
| 2000 | 198,696 | 27.56 | 10,087 | 24.47 | 8,957 | 0.89 | 23 |
| 2001 | 193,728 | 27.74 | 10,124 | 18.40 | 6,718 | 0.66 | 22 |
| 2002 | 198,600 | 47.21 | 17,231 | 24.97 | 9,116 | 0.53 | 23 |
| 2003 | 195,480 | 43.12 | 15,739 | 149.22 | 54,464 | 3.46 | 22 |
| 2004 | 193,368 | 39.18 | 14,340 | 171.21 | 62,663 | 4.37 | 22 |
| 2005 | 194,040 | 31.85 | 11,626 | 33.57 | 12,251 | 1.05 | 22 |
| 2006 | 204,283 | 31.78 | 11,598 | 37.91 | 13,838 | 1.19 | 23 |
| 2007 | 207,552 | 28.54 | 10,417 | 36.65 | 13,376 | 1.28 | 24 |
| 2008 | 209,304 | 25.47 | 9,323 | 33.32 | 12,196 | 1.31 | 24 |
| 2009 | 186,696 | 22.87 | 8,347 | 27.40 | 10,000 | 1.20 | 21 |
| 2010 | 207,000 | 22.54 | 8,225 | 29.68 | 10,834 | 1.32 | 24 |
| 2011 | 188,712 | 18.62 | 6,795 | 22.06 | 8,052 | 1.19 | 22 |
| 2012 | 165,432 | 33.47 | 12,252 | 23.55 | 8,620 | 0.70 | 19 |
| 2013 | 169,488 | 38.38 | 14,010 | 70.78 | 25,834 | 1.84 | 19 |
| 2014 | 202,656 | 160.83 | 58,703 | 128.29 | 46,825 | 0.80 | 23 |
| 2015 | 270,072 | 98.32 | 35,878 | 186.40 | 68,004 | 1.93 | 31 |
| 2016 | 266,256 | 55.06 | 20,132 | 159.90 | 58,481 | 2.94 | 30 |
| | 6,206,923 | | 558,928 | | 591,641 | | |

**TABLE NO. 5 - Average Injection Pressures**

| | 00/01-09 Inj | 00/03-04 Inj | 00/05-04 Inj | 00/05-10 Inj | 00/06-09 Inj | 00/09-04 Inj | 00/09-09 Inj | 00/11-04 Inj | 00/14-10 Inj | 00/15-04 Inj | 00/16-05 Inj | 00/16-09 Inj | 02/01-09 Inj | 02/05-10 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) | Inj Pressure (kPa) | Inj Pressure (kPa) | Inj Pressure (kPa) | Inj Pressure (kPa) | Inj Pressure (kPa) |
| 2014 | 5000.0 | 0.0 | 1856.3 | 1685.9 | 5000.0 | 0.0 | 0.0 | 4903.1 | 5000.0 | 5000.0 | 5000.0 | 0.0 | 5143.8 | 950.0 |
| 2015 | 4875.1 | 0.0 | 2842.2 | 1383.3 | 4986.0 | 0.0 | 0.0 | 4789.6 | 4877.8 | 4948.2 | 1632.5 | 0.0 | 4964.4 | 3627.5 |
| 2016 | 4998.6 | 812.1 | 2142.3 | 2189.1 | 4891.8 | 2455.5 | 2097.2 | 773.8 | 4945.1 | 2800.0 | 1022.1 | 0.0 | 4986.6 | 4586.9 |

| | C0/03-04 Inj | C0/03-09 Inj | C0/04-10 Inj | C0/06-04 Inj | C0/07-09 Inj | C0/11-04 Inj | C0/12-04 Inj | C0/12-10 Inj | C0/13-10 Inj | C0/14-04 Inj | C0/15-04 Inj | C0/16-04 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) | Inj Pressure (kPa) | Inj Pressure (kPa) | Inj Pressure (kPa) |
| 2014 | 4609.4 | 4804.7 | 5000.0 | 2943.8 | 4709.4 | 5000.0 | 5000.0 | 0.0 | 0.0 | 5000.0 | 4790.6 | 0.0 |
| 2015 | 4556.7 | 4840.2 | 4823.4 | 4418.8 | 4975.3 | 4851.7 | 4341.1 | 3918.4 | 3591.5 | 4922.8 | 4758.3 | 3820.3 |
| 2016 | 3506.4 | 4995.9 | 413.4 | 3962.2 | 4679.5 | 1043.4 | 4833.2 | 4929.1 | 407.0 | 4999.2 | 2957.9 | 5001.9 |