Agenda

- Background
- Project Overview
- Geological Update
- Scheme Performance
- Facility Performance
- Compliance
Saleski Thermal Pilot - AER Approval 11337

Subsection 3.1.1
Subsurface Issues Related to Resource Evaluation and Recovery

September 2014
## Background Section 3.1.1 (1)

<table>
<thead>
<tr>
<th>Application No. and Date</th>
<th>Application Summary</th>
<th>Approval No. and Date</th>
<th>Expiry Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>AER-1764650 June 2013</td>
<td>Temporary pressure tank and incinerator at the well pad</td>
<td>11337H June 2013</td>
<td>June 30, 2019</td>
</tr>
<tr>
<td>AER-1769821 August 2013</td>
<td>Horizontal top injector well in the Grosmont C Formation</td>
<td>11337I September 2013</td>
<td>June 30, 2019</td>
</tr>
<tr>
<td>1778319 November 2013</td>
<td>P1C sidetrack (P1C-s) well in the Grosmont C Formation*</td>
<td>11337J November 2013</td>
<td>June 30, 2019</td>
</tr>
<tr>
<td>1789440 February 2014</td>
<td>P3D well relocation in the Grosmont D Formation</td>
<td>11337K February 2014</td>
<td>June 30, 2019</td>
</tr>
</tbody>
</table>

*Note – P1C sidetrack drilled to utilize balanced pressure drilling and attempt to replicate production performance observed in P2C well*
Project Description

• Saleski Pilot project
  – 1,800 bpd facility, approved
  – Initially SAGD with transition to SC-SAGD in stage 2
  – Currently using cyclic thermal process (C-SAGD)
    ➢ Steam injection and production through the same well
    ➢ Alternate between injection and production phases
    ➢ Increasing steam injection volumes in subsequent cycles
    ➢ Longer production periods in subsequent cycles

• Solvent Injection
  ➢ Co-injection test performed in the C in 2012

  – 4 well pairs and 1 single cyclic well
    ➢ 2 well pairs in Grosmont D
    ➢ 1 single cyclic well in Grosmont D
    ➢ 2 well pairs in Grosmont C
    ➢ Grand Rapids water for steam generation

  – Grosmont and Cooking Lake disposal zones
  – Facility operating since Dec. 2010
• Areal extent of Grosmont bitumen resource relative to the Wabiskaw-McMurray bitumen resource

• Laricina acreage is in the heart of a significant resource
Structural Cross Section  Section 3.1.1 (2h)

1AA/08-27-085-19W4/00  1AA/07-26-085-19W4/00  1AA/10-26-085-19W4/00

GR  Neutron (Dol)  Core Sw  Medium Res  Deep Res
0  150  Density (Dol)  0  0.2  0

-CD Marl-

September 25, 2014  NEXT STEPS
Saleski Pilot 2C & 2D Well Pairs
Section 3.1.1 (2e,i)
Saleski Pilot P3D Well
Section 3.1.1 (2e,i)
Top Grosmont C Structure and Net Pay Map
Section 3.1.1 (2c,d)
Top Grosmont D Structure and Net Pay Map
Section 3.1.1 (2c,d)

Net Pay Map:
Includes lean zones (<50%So) within the thermal interval.
No saturation cut-off was used.
## Grosmont D and C OBIP Calculations for Approval Area

### Table: Grosmont OBIP Calculations for Approval Area

<table>
<thead>
<tr>
<th>Interval</th>
<th>Grosmont C</th>
<th>Grosmont D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay</td>
<td>21.0</td>
<td>31.2</td>
</tr>
<tr>
<td>Oil Saturation</td>
<td>0.810</td>
<td>0.830</td>
</tr>
<tr>
<td>Average Porosity</td>
<td>0.183</td>
<td>0.243</td>
</tr>
<tr>
<td>Area (m²)</td>
<td>2,589,988</td>
<td>2,589,988</td>
</tr>
<tr>
<td>OBIP, (MM m³)</td>
<td>8.1</td>
<td>16.3</td>
</tr>
</tbody>
</table>

### Table: Original reservoir conditions

<table>
<thead>
<tr>
<th>Interval</th>
<th>Grosmont C</th>
<th>Grosmont D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Pressure (kPa)</td>
<td>1300</td>
<td>1050</td>
</tr>
<tr>
<td>Permeability (mD)</td>
<td>5,000 - 15,000</td>
<td>500 - 5,000</td>
</tr>
<tr>
<td>Bitumen Viscosity (cp)</td>
<td>5,700,000</td>
<td>5,700,000</td>
</tr>
</tbody>
</table>
2013/2014 Activity  Section 3.1.1 (3a)

- P1C-s and P3D wells drilling, completion, and acidization.

- First block steaming in Grosmont C wells.
  - Liquid communication between C wells was impacting production, so simultaneous steaming of the C wells was pursued.

- Utilization of mini-steam cycles at 1D.

- Larger, more dedicated steam volumes injected at I2D well.
OBIP and Reservoir Parameters for Pilot Area

<table>
<thead>
<tr>
<th>Interval</th>
<th>Grosmont C</th>
<th>Grosmont D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay (m)</td>
<td>18.3</td>
<td>32.4</td>
</tr>
<tr>
<td>Oil Saturation</td>
<td>0.810</td>
<td>0.799</td>
</tr>
<tr>
<td>Average Porosity</td>
<td>0.185</td>
<td>0.252</td>
</tr>
<tr>
<td>Area (m²)</td>
<td>145,000</td>
<td>270,000</td>
</tr>
<tr>
<td>OBIP (m³)</td>
<td>397,600</td>
<td>1,761,400</td>
</tr>
</tbody>
</table>

Grosmont OBIP Calculations for Pilot Area

Well Pair (or Well) | Length (m)
---|---
1D | 800
1C (original) | 800
2D | 800
2C | 450
P3D | 800
P1C-s | 700

September 25, 2014
NEXT STEPS
Heave Monuments or Other Surface Monitoring Section 3.1.1 (2k)

- 42 corner reflectors placed over pilot area
- 3 baseline monuments outside well pattern
- Displacements <20 mm
- No evidence of a sustained linear uplift trend
- Will continue to monitor and analyze

Cumulative Vertical Deformation from May 4, 2010 to March 20, 2014

Baseline monument #42 located potentially shifting due to frost heave in local area
3D Seismic Lines Section 3.1.1 (2I)

- Seismic map from 2011-2014 seismic programs

- Acquired time lapse monitors in February 2012, December 2012, and February 2014. All 4D monitors covered the same area (All outlined in red box).
Producer Drilling Experience  Section 3.1.1 (3)

• Drilled P1C-s well in December 2013
  – Drilled with foam at near balanced pressure to minimize fluid/cuttings losses and all cuttings circulated back to surface
  – Liner-less production section with selective (packer isolated) acid stimulation
  – Industry first on P1C-s of drilling in a hot, under pressured, Grosmont reservoir

• Drilled P3D in March 2014
  – Drilled with foam at near balanced pressure to minimize fluid/cuttings losses and all cuttings circulated back to surface
  – Stimulated with selective (packer isolated) acid stimulation prior to installing perforated liner
A fourth disposal well is connected to the Pilot at 100/02-31-084-22 W4M (truck ing only)
Well Layout/Location Map  Section 3.1.1 (3a)

- 7 Observation wells in place at the Pilot
- See Appendix A for observation well completions
P1D Well Completion Section 3.1.1 (3b)

- **Pump**
  - 114 mm Hydrl 503 L-80 to PCP ~ 525 m
  - Kudu metal PCP – 500 to 600 m³/d capacity
  - 89 mm tubing for tail pipe – two joints

- **Toe tubing/instrumentation guide string**
  - 60 mm flush joint tubing from wellhead to heel (below pump) for start-up steam and instrumentation.
  - 73 mm swedge up in horizontal running to the toe.

- **Instrumentation to the heel (P&T) for pump monitoring**
  - Fibre optics to the toe inside 31.8mm coil tubing for ongoing temperature measurement, 40 point measured with 8 in build section and 32 distributed evenly along horizontal.
  - 19mm Coil tubing bubble tube for heel pressure measurement.
K-55 surface casing set from 0 - 355 mKB

L-80 Intermediate casing set from 0 - 572.5 mKB

L-80 Hydril 503 Production Tubing, 28.6 mm Coiled rod and Kudu all metal PCP.

L-80 Guide string set from 0 - 1020 mKB

31.8 mm coil housing 40 pt. fiber optics set inside 60.3 mm guide string from 0 - 1020 mKB. Pressure measurement at toe.

60.3 mm 8.63 kg/m L-80 Guide string set from 0 - 1020 mKB

216 mm open hole from 572.5 - 1030 mKB
I2D Well Completion Section 3.1.1 (3b)

- **339.7 mm 81.105 kg/m** K-55 Surface casing set from 0 - 404 mKB
- **244.5 mm 59.53 kg/m** L-80 Intermediate casing set from 0 - 579.5 mKB
- **114.3 mm 18.97 kg/m** L-80 Hydril 503 Production Tubing, 28.6mm coiled rod and NOV all metal PCP landed at 525mKB
- **177.8 mm** slotted liner from 555.79 - 1371 mKB
- **114.3 mm 18.97 kg/m** L-80 Hydril 503 Production Tubing, 28.6mm coiled rod and NOV all metal PCP landed at 525mKB
- **Fiber optic P/T gauge above pump, 6.4 mm capillary line clamped to production tubing.**
- **60.3 mm 6.85 kg/m** Hydril 511 J-55 Guide string set from 0 - 1360 mKB
- **31.8 mm coil housing 40 pt. fiber optics set inside 60.3 mm Hydril 511 J-55 guide string from 0 - 1342 mKB. Pressure measurement at toe.**

Note: Temperature fiber to be installed in October 2013

September 25, 2014

NEXT STEPS
339.7mm 71.43kg/m K-55 Surface casing set from 0m-361mKB

244.5mm 59.53kg/m L-80 Intermediate casing set from 0m-574.0mKB. Thermal PBP top at 548mKB. 216mm whipstock and window cut from 542.2mKB to 548.0mKB.

216mm open hole sidetrack from 542.2mKB to 1251mKB

28.6mm coiled rod and rotor set from 0-529.27mKB

114.3mm Hydril 503 production tubing and Kudu 220MET750 Solid metal PCP. Tag bar landed at 531.51 mKB.

60.3mm 6.85kg/m L-80 FJ-150 set from 0-1236mKB. (Single 3m joint of 52.4mm tubing below hanger)

31.8mm Instrumentation coil set from 0-1236mKB. 40 point temp fiber and toe pressure gauge.

222mm original lateral lined with 177.8mm 34.23kg/m K-55 Slotted Liner

216mm open hole sidetrack from 542.2mKB to 1251mKB
P3D Well Completion  Section 3.1.1 (3b)

Surface Casing
339.7 mm 81.105 kg/m K-55
BT&C from 0 – 386 mKB.  
ID=320.4 mm

Intermediate Casing
244.5 mm 59.53 kg/m L-80 QB2  
from 0 – 595 mKB. ID = 224.4 mm

Liner
177.8 mm 34.228 kg/m L-80 set 
from 572.71 – 1390 mKB.  
ID=161.7 mm

Production String
114.3 mm OD 18.97 kg/m Hydrl 503 L-80 set from 0 - 566.30 mKB. ID=100.5 mm.

28.6mm OD coiled rod run inside production string from 0 – 555 mKB.

Pump & Rods
NOV all metal PCP
28.6 mm 960M High Strength Prorod to pump (525 m)

Toe String
60.3 mm OD 6.85 kg/m Hunting FJ-150 L-80 set from 0 - 1376.98 mKB. ID = 50.7 mm.

31.8 mm OD Instrumentation coil run inside guide string from 0 – 1375 mKB.
Artificial Lift Section 3.1.1 (4a,b)

- Pilot has relied strictly on all-metal progressive cavity pumps (PCPs) to date
  - Originally selected for their robust design and high turndown capabilities which can accommodate the wide range of cyclic operating conditions at the Pilot
  - Two different pump designs from 2 different vendors have been utilized
  - PCP run life challenges and advancements in ESP (electrical submersible pump) technology have warranted an ESP test trial, is underway (P1C-s well)
  - Quench water has been permanently tied into the wells and is utilized to reduce hydraulic back pressure on the casing due to excessive steam flashing. This is typically only an issue during the very early stages of a production cycle, and when other wells are producing (common header)
Well Instrumentation  Section 3.1.1 (5a)

- Well instrumentation for the Pilot observation, water source wells and disposal wells have been attached as Appendix A and B

  - An example of observation Well P1-Obs1 (102/07-26-085-19W4) has been provided
4D Seismic  Section 3.1.1 (6)

- Time lapse monitors (4D) were acquired on February 8, 2012, December 13, 2012, and February 5, 2014
4D Seismic Section 3.1.1 (6)

- Time slice from the Feb. 5, 2014 4D monitor showing the effect of steaming on acoustic impedance

At the time of seismic acquisition
Summary of All Wells  Section 3.1.1 (7a)

- 4 well pairs operating as of August 31, 2013. (1D, 1C, 2C and 2D)
  - 1D first steam in December, 2010
  - 1C first steam in January, 2011
  - 2C first steam in May, 2012
  - I2D first steam in August, 2012
  - P1C-s first steam in December 2013
  - P3D first steam in May 2014

<table>
<thead>
<tr>
<th>Cumulative Injection/Production as of August 31, 2014</th>
<th>Steam Injected (m³)</th>
<th>Total Fluid Produced (m³)</th>
<th>Oil Produced (m³)</th>
<th>Water Produced (m³)</th>
<th>CSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1D Well Pair</td>
<td>101,413</td>
<td>118,220</td>
<td>17,326</td>
<td>100,894</td>
<td>5.9</td>
</tr>
<tr>
<td>1C Well Pair and P1C-s Well</td>
<td>181,945</td>
<td>103,541</td>
<td>24,872</td>
<td>78,669</td>
<td>7.3</td>
</tr>
<tr>
<td>I2D Well</td>
<td>84,592</td>
<td>20,670</td>
<td>2,396</td>
<td>18,274</td>
<td>35.3</td>
</tr>
<tr>
<td>2C Well Pair</td>
<td>125,797</td>
<td>118,429</td>
<td>27,427</td>
<td>91,002</td>
<td>4.6</td>
</tr>
<tr>
<td>P3D Well</td>
<td>11,893</td>
<td>7,048</td>
<td>2,148</td>
<td>4,899</td>
<td>5.5</td>
</tr>
<tr>
<td>Pilot Total</td>
<td>505,640</td>
<td>367,908</td>
<td>74,169</td>
<td>293,738</td>
<td>6.8</td>
</tr>
</tbody>
</table>

- RF (Pilot Area) = 3.4%
## Summary of All Wells Section 3.1.1 (7a)

### C Well Pairs

<table>
<thead>
<tr>
<th><strong>1C Well Pair Activity</strong></th>
<th><strong>SAGD</strong></th>
<th>Apr - May 2011 (SAGD Warm-up)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAGD/Cycle #1</strong></td>
<td></td>
<td>Nov - Dec 2011</td>
</tr>
<tr>
<td><strong>SAGD</strong></td>
<td></td>
<td>Dec 2011 - Jan 2012 (SAGD Test)</td>
</tr>
<tr>
<td><strong>Cycle #2</strong></td>
<td></td>
<td>Jan - Apr 2012</td>
</tr>
<tr>
<td><strong>Cycle #3</strong></td>
<td></td>
<td>May - Aug 2012</td>
</tr>
<tr>
<td><strong>Cycle #4</strong></td>
<td></td>
<td>Aug 2012 - Mar 2013</td>
</tr>
<tr>
<td><strong>Cycle #5</strong></td>
<td></td>
<td>Mar – Dec 2013</td>
</tr>
</tbody>
</table>

### P1C-s Well Activity

| **Cycle #6** | Dec 2013 – Continuing past Aug 2014 |

### 2C Well Pair Activity

<table>
<thead>
<tr>
<th><strong>Cycle #1/Warm-Up</strong></th>
<th>May 2012 - Jun 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cycle #2</strong></td>
<td>Jun - Oct 2012</td>
</tr>
<tr>
<td><strong>Cycle #3</strong></td>
<td>Oct 2012 - May 2013</td>
</tr>
<tr>
<td><strong>SAGD Test</strong></td>
<td>Jun - Jul 2013</td>
</tr>
<tr>
<td><strong>Cycle #4</strong></td>
<td>Jul - Nov 2013</td>
</tr>
<tr>
<td><strong>Cycle #5</strong></td>
<td>Nov 2013 – Continuing past Aug 2014</td>
</tr>
</tbody>
</table>

### D Well Pairs

<table>
<thead>
<tr>
<th><strong>1D Well Pair Activity</strong></th>
<th><strong>SAGD</strong></th>
<th>Dec 2010 - Jan 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cycle #1</strong></td>
<td></td>
<td>Feb - May 2012</td>
</tr>
<tr>
<td><strong>Cycle #2</strong></td>
<td></td>
<td>Jul - Sept 2012</td>
</tr>
<tr>
<td><strong>Cycle #3</strong></td>
<td></td>
<td>Oct - Dec 2012</td>
</tr>
<tr>
<td><strong>SAGD Test</strong></td>
<td></td>
<td>Dec 2012 - Jan 2013</td>
</tr>
<tr>
<td><strong>Cycle #4</strong></td>
<td></td>
<td>Jan 2013 - Continuing past Aug 2014</td>
</tr>
</tbody>
</table>

### I2D Well Activity

<table>
<thead>
<tr>
<th><strong>Cycle #1/Warm-Up</strong></th>
<th>Aug 2012 - Nov 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cycle #2</strong></td>
<td>Nov - Jan 2013</td>
</tr>
<tr>
<td><strong>Cycle #3</strong></td>
<td>Jan 2013 - May 2013</td>
</tr>
<tr>
<td><strong>Cycle #4</strong></td>
<td>Aug 2013 – Jan 2014</td>
</tr>
<tr>
<td><strong>Cycle #5</strong></td>
<td>Jan – Continuing past Aug 2014</td>
</tr>
</tbody>
</table>

### P3D Well Activity

<table>
<thead>
<tr>
<th><strong>Cycle #1/Warm-Up</strong></th>
<th>May – Jul 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cycle #2</strong></td>
<td>Jul – Aug 2014</td>
</tr>
<tr>
<td><strong>Cycle #3</strong></td>
<td>Sept – continuing past Sept 2014</td>
</tr>
</tbody>
</table>
Scheme Performance Section 3.1.1 (7a)

Saleski Pilot Total

- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
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- P1Cs D&C
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- 1C & 1D on Cyclic Production
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- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
- 1C & 1D on Cyclic Production
- Solvent Injection
- Plant Turnaround
- P1Cs D&C
- C Block Steaming
- P3D D&C
- P1Cs Acid Job
- P3D Cycle 1
- P2C Cycle 1
Scheme Performance  Section 3.1.1 (7a)

1D Well Pair

- SAGD Warm-up
- SAGD
- Acid Stimulations
- Observation Period
- Cycle 1
- Cycle 2
- Cycle 3
- SAGD Test
- Cycle 4 (Continues past August 2014)
- Mini Cycles
- Plant Turnaround

Rate (m³/d)

Date


Green line: Bitumen
Red line: Steam
Scheme Performance Section 3.1.1 (7a)
Scheme Performance Section 3.1.1 (7a)
Scheme Performance Section 3.1.1 (7a)

1C Well Pair/P1C-s Well

- Acid Stimulation
- SAGD
- Cycle 1
- Cycle 2
- Cycle 3
- Cycle 4
- Cycle 5
- Sidetrack Drilling
- Preparing reservoir for sidetrack drilling
- Cycle 6
- (Continues past August 2014)
- Plant Turnaround

Legend:
- Bitumen
- Net Water
- Net Emulsion
- CSOR

Rate (m³/d)

Date

December 2010 to June 2014
Scheme Performance Section 3.1.1 (7a)
Scheme Performance Section 3.1.1 (7a)

2C Well Pair

- Cycle 1
- Cycle 2
- Cycle 3
- SAGD Test
- Cycle 4
- Cycle 5
- Plant Turnaround

Date:
- May-12
- Aug-12
- Nov-12
- Feb-13
- May-13
- Aug-13
- Nov-13
- Feb-14
- May-14
- Aug-14

Rate (m³/d):
- 0
- 100
- 200
- 300
- 400
- 500
- 600
- 700
- 800

CSOR:
- 0
- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 20

Graph Legend:
- Green: Bitumen
- Blue: Net Water
- Orange: Net Emulsion
- Dotted: CSOR
Well trajectory has resulted in production challenges from this well
Scheme Performance Section 3.1.1 (7a)

P3D Well

Cycle 1

Cycle 2

Rate (m$^3$/d)

Date

May-14
Jun-14
Jul-14
Aug-14

Bitumen
Steam
Scheme Performance Section 3.1.1 (7a)
Summary of Key Insights Section 3.1.1 (7f)

• Production estimation by manual cut and coriolis meter has proven reliable for monthly prorating.

• Progressive cavity pumps can remain in the well during steam injection reducing the need for a workover prior to production.

• Near balanced drilling reduces losses and formation damage in the lateral section and increases overall injectivity and productivity.

• C-SAGD operation is a more efficient early life recovery method than SAGD in the Grosmont.

• Horizontal wells in the Grosmont produce with minimal fines production both from lined and open hole horizontal wells.

• Production rates from the Pilot demonstrate commercial viability of the Grosmont.

• Communication between the Grosmont C and D continues to be enhanced through C-SAGD.
Production Forecast and Future Plans – Subsurface Section 3.1.1 (8)

• Continue to utilize C-SAGD operation.

• Continue use and optimization of mini-cycles at P1D.

• Continue testing of block steaming C wells.

• Future diluent co-injection in the Grosmont D to understand enhanced recovery.

• Addition of top injection in the C to understand later life recovery mechanism post C-SAGD.

• Testing of electrical submersible pump(s).

• Drilling of top injector (T1C) will provide opportunity to optimize near balanced and lost circulation drilling strategy prior to Phase 1.
Subsection 3.1.2
Surface Operations, Compliance, and Issues Not Related to Resource Evaluation and Recovery

September 2014
Detailed Plot Plan  Section 3.1.2 (1a)

- Addition of Quench Water Lines
- Addition of P3D Well
- MR Version 2.0 Install
- Cathodic Protection System

September 25, 2014  NEXT STEPS
Saleski Pilot Plant Progress

• Plant construction is complete with solvent capabilities
• Block flow diagram is the same as submitted in the application with the exception of a few minor material balance corrections.
Rationale for Modifications  Section 3.1.2 (1b)

- Cathodic protection system added to protect underground piping for several lines, most notably the new steel disposal line to 5-23, and the fuel gas line.

- Quench water system installed and tied in for each producing well to help manage downhole subcool issues and steam flashing up the casing.

- Replaced original version installed in 2011 of MR (Magnetic Resonance) water cut meter with second generation.

- Construction of P3D surface piping, installation of wellhead, and tie in to rest of surface facility.
Facility Performance  Section 3.1.2 (2)

- Plant has been operating since December 2010.
- No major facilities issues encountered during August 2013 - August 2014. Plant has been operating smoothly.
Plant Performance Section 3.1.2 (2 a-b)

a: Bitumen Treatment
   - Consistent treatment of produced bitumen has been achieved with BS&W of <0.5 % and density of 960 kg/m³.

b: Water Treatment
   - Treatment of source water has been as expected.
Plant Performance Section 3.1.2 (2 c-d)

c: Steam Generation

- Two 50 MMBTU OTSG on site
  » Second OTSG started in December 2011 and operated at full capacity in April 2012.
- Total output of 1,000 m$^3$/d CWE (800 m$^3$/d CWE dry steam, 78-80% quality).
- Continued utilization of dry steam injection for C-SAGD wells.
- Utilization of OTSGs are intermittent due to cyclic operation.

d: Power Generation/Consumption

- Laricina generates its own power on site.
- 2 x 1,400 kW natural gas driven generators.
- Only running one generator (approx. $160 \times 10^3$ m$^3$/month).
- Fuel gas transfer from Saleski Pilot to Germain Commercial Development during TransCanada Pipeline (TCPL) fuel gas line breakage and repair.
Energy Intensity; GJ/m³ bitumen produced

Energy Intensity

Date

Intense (GJ/m³ bitumen)


Energy Intensity

NEXT STEPS
Plant Flared Volumes

- Temporary approval in March 2014 to flare 5,000 m³/d
- Amended licence in July 2014 to flare 11,000 m³/d

*Total purge fuel gas is ~6,000-10,000 m³ per month*
Summary of Environmental Greenhouse Gas Emissions Section 3.1.2 (2f)

• Laricina Saleski GHG threshold for reporting both provincially & federally is 50,000 tonnes CO$_2$e per year.

• GHG emissions reported to NPRI for 2013:
  – NO$_x$ - 28 tonnes/year
  – CO – 27 tonnes/year

• Laricina has once again participated in NPRI and CAPP Responsible Canadian Energy reporting
Measurement and Reporting  Section 3.1.2 (3a,b)

- Production Measurement
  - Reconciled according to approved MARP (using inventory change, receipts and dispositions)
  - Prorated to daily water cut and coriolis emulsion flow meters
  - Multiple manual water cuts taken each day per producing well to prorate daily production.

- Proration Factors:

<table>
<thead>
<tr>
<th>Monthly</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Proration</td>
<td>1</td>
<td>1.03</td>
</tr>
<tr>
<td>Oil Proration</td>
<td>1.02</td>
<td>1.03</td>
</tr>
</tbody>
</table>
Measurement and Reporting continued
Section 3.1.2 (3c,d)

Optimization

• Currently conducting trials of Perm Inc.’s Magnetic Resonance (MR) continuous BS&W meter and AGAR’s Multiphase Flow Meter (MPFM-50).
  – Meters are installed in series on a test loop coming off the main emulsion header shared by 3 wells (P1D, P1C-s, and P2C).
  – Test times optimized per number of producing wells at one time (*target* 12 and 24 hour tests).
Measurement and Reporting continued
Section 3.1.2 (3c,d)

- Water transferred from the Saleski Facility to Germain:
  - Total of 1,100 m³ of disposal water was requested and approved from Alberta Environment and Water Act for transfer from the Saleski Pilot to the Germain Phase 1 CPF over a 120 day start-up period commencing June 7, 2013.
  - In November and December 2013 Laricina received a TDL to divert up to 10,000 m³ of boiler feed water from Saleski to the Germain to assist with Germain steam generation. The TDL expired in February 2014.
  - In March 2014 Laricina applied and received a TDL to divert up to 15,000 m³ of boiler feed water from Saleski to the Germain. The licence expires in March 2015. No fluids under this approval have been transferred to Germain as of yet.

*TransCanada Fuel Gas Pipeline outage
Licensed Source Water Volumes:
5-23 – 392 m³/day
13-23 – 221 m³/day
14-24 – 711 m³/day
10-26 – 336 m³/day
07-20 – 264 m³/day
1F1/02-26 – 91 m³/day
1F2/02-26 – 75 m³/day

Total Annual License: 401,000 m³
average of 1,100 m³/day
**Update: 1F2/02-26-085-19-W4M  GW Sampling**

- Groundwater samples were taken to establish a baseline average
  - 95% confidence interval of baseline average is the target limit
  - Test results in red are exceedances of target limit
  - Target limit is a statistically determined range and is the expected background concentration
  - Threshold is the highest of either Target Limit or Tier 1 Guidelines

|-------------------|-------------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------------|-----------------------|----------------|
Possible Source of BTEX

- Exceedance of BTEX was observed before commencement of operations at the Pilot (December 2010).
  - Two possible sources:
    » From lubricants introduced during well completion and or maintenance.
    » Due to sampling methods (purging of well not possible).
Monitoring Plans: 1F2/02-26-085-19-W4M

- 1F2/2-26 will be sampled twice a year and tested for BTEX
  - Sampling results are submitted to AER annually.
  - Will be flagged for “attention to trends” where exceedences occur the in annual report to AER.
  - If BTEX levels exceed threshold limits then the GMP Response Plan will be activated.

  - GMP Response Plan includes:
    » Wells that exceed threshold will be re-sampled and re-tested.
    » If Threshold Limits continue to be exceeded then a time series review is conducted to determine any trends.
    » If a trend is detected then a source identification study is initiated to determine the source and source mitigation.
Water Sources and Uses Section 3.1.2 (4a-d)

- Diversion licence (# 00246458-00-00) from AER for 7 Grand Rapids source water wells:

<table>
<thead>
<tr>
<th>Water Source Well Volumes (m³)</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aug</td>
<td>Sep</td>
</tr>
<tr>
<td>14-24-085-20W4</td>
<td>13,648</td>
<td>13,940</td>
</tr>
<tr>
<td>13-23-085-20W4</td>
<td>2,366</td>
<td>1,936</td>
</tr>
<tr>
<td>05-23-085-20W4</td>
<td>7,971</td>
<td>8,479</td>
</tr>
<tr>
<td>10-26-085-20W4</td>
<td>5,829</td>
<td>7,750</td>
</tr>
<tr>
<td>1F1/02-26-085-19W4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1F2/02-26-085-19W4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>07-20-085-19W4/00</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Total Water source volumes are below the annual allocation of 401,000 m³.
- 02-26 SW well’s statuses to be suspended.
- Produced water or blowdown is not recycled at the Pilot.
Total disposal volumes are at times greater than produced water volumes

- There were several periods when additional BFW was required to cool the process in the plant due to heat balance issues associated with non-alignment of cyclic steam injection and production cycles.

- Some BFW was circulated through offline OTSGs for freeze protection.

- These extra BFW volumes were not converted into steam and sent directly to disposal.
### Disposal Well UWIs, Volumes, Pressures and Temperatures

**Section 3.1.2 (h)**

- 4 Class 1b Disposal Wells; Scheme Approval 11544

<table>
<thead>
<tr>
<th>UWI</th>
<th>Disposal Zone</th>
<th>Maximum Wellhead Pressure (kPag)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/05-23-085-20W4</td>
<td>Cooking Lake</td>
<td>3,600</td>
</tr>
<tr>
<td>102/05-23-085-20W4</td>
<td>Cooking Lake</td>
<td>3,550</td>
</tr>
<tr>
<td>02-26-085-19W4</td>
<td>Grosmont A</td>
<td>3,000</td>
</tr>
<tr>
<td>02-31-084-22W4</td>
<td>Grosmont A</td>
<td>3,500</td>
</tr>
</tbody>
</table>

### Disposal Well Volumes (m³)

<table>
<thead>
<tr>
<th>Disposal Well Volumes (m³)</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aug</td>
<td>Sep</td>
</tr>
<tr>
<td>100/05-23-085-20W4</td>
<td>18,811</td>
<td>16,035</td>
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<tr>
<td>102/05-23-085-20W4</td>
<td>9,909</td>
<td>7,808</td>
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<tr>
<td>02-26-085-19W4</td>
<td>770</td>
<td>308</td>
</tr>
<tr>
<td>02-31-084-22W4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Disposal Well UWIs, Pressures and Temperatures  Section 3.1.2 (h)

*Note: Temperatures reported are from disposal tank not from each individual well. Temperature at well is 5-10°C cooler depending on the season.*

September 25, 2014 NEXT STEPS
Water Quality Assessments Section 3.1.1 (4)

- Typical water quality assessments for produced water, source water and disposal fluids have been provided as Appendix E.
Sulphur Production  Section 3.1.2 (5b-d)

- Project is approved for 0.08 SO$_2$ tonnes/day. To date the facility has ranged from 0.002 to 0.01 SO$_2$ tonnes/day.

- Passive sampling monitors continue to demonstrate that the Saleski Pilot is well within allowable limits for SO$_2$ and H$_2$S.
Summary of Environmental Issues
Section 3.1.2 (6)

- Compliance issues related to regulatory approvals (e.g., EPEA, Sustainable Resource Development (SRD), Department of Fisheries and Oceans (DFO)).

- In the table on the next slide are all the Q3/4 2013 and Q1/2 2014 non-compliance issues related to regulatory approvals.

- Over this time period 6 events have been reported to the AER.

- All the action items with respect to the non-compliances have been closed with the exception of 20130573. This was a release of methanol during initial integrity testing of a Laricina pipeline. Laricina has been working with the AER field office to bring closure to this incident, with one more sampling event to be completed in September 2014.
## Summary of Environmental Issues cont'd

### Section 3.1.2 (6)

<table>
<thead>
<tr>
<th>AER FIS Incident Number/AESRD</th>
<th>Volume of Material Released</th>
<th>Brief Description of Non-compliance</th>
<th>Actions completed to correct the Non-compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>/275004</td>
<td>150L</td>
<td>Amine release from a tote inside containment.</td>
<td>Release material removed and 7 day letter completed</td>
</tr>
<tr>
<td>/279147</td>
<td>N/A</td>
<td>Incorrect LSD on TDL</td>
<td>TDL revised and updated to reflect correct LSD</td>
</tr>
<tr>
<td>/279784</td>
<td>7m³</td>
<td>OSUM (JV partner) used 7m³ of disposal water from facility for rig water - no TDL obtained to complete this activity</td>
<td>TDL obtained for disposal water use in this activity.</td>
</tr>
<tr>
<td>/281027</td>
<td>20m³</td>
<td>BFW release on lease at the facility</td>
<td>Free water removed, 7 day letter completed and incident reviewed to identify areas for improvement</td>
</tr>
<tr>
<td>20141512/286024</td>
<td>16m³</td>
<td>Disposal water release on and off lease - valve left open by operator</td>
<td>Free water removed, post sampling completed, 7 day letter submitted and incident reviewed to identify areas for improvement</td>
</tr>
<tr>
<td>20130573/</td>
<td>300L</td>
<td>Release of methanol water during liner hydrotect</td>
<td>Final sampling event required by AER in 2014. Working with Bonnyville AER on final closure</td>
</tr>
</tbody>
</table>
Summary of Environmental Issues cont'd
Section 3.1.2 (6)

• Laricina continues to be very proactive in communications with regulatory agencies to maintain transparency and provide self disclosures and reporting of non-compliances where applicable.

• On February 14, 2014, Laricina received a letter from AER requesting an “Oil Facility Detailed Operational Inspection (A1TY) Laricina Saleski Location: 03-26-085-19W4 Licence No.: F 41193”.

• Laricina sent the information requested in a response on March 5th, 2014.

• March 11th and 12th AER personnel conducted a detailed operations inspection of the Saleski Pilot Plant.
Summary of Environmental Issues cont'd
Section 3.1.2 (6)

• On March 27th and 28th Laricina received both high and low risk non-compliances from the detailed operations inspection as well as a number of follow up questions requesting further information.

• April 25th and 30th Laricina submitted the responses to the questions and actions for compliance to the high and low risk non-compliances and the follow up questions.

• August 8th, 2014 Laricina received the AER review and follow-up comments.

• September 5th, Laricina filed a response to the letter received on August 5th and awaits further instruction.
Progress and Results of Reclamation Programs  Section 3.1.2 (6e)

• Plant began operation in 2010 and there are no plans at this time for any pad abandonment

• All areas outside the CPF/well pad at Saleski have been successfully interim reclaimed
Statement Confirming Compliance
Section 3.1.2 (7&8)

- The Saleski Pilot Project is currently operating in accordance with approvals and regulatory requirements of the AER, AESRD, and DFO
- Previous non-compliance events and self-disclosures are listed under 3.1.2 (6)
Future Plans – Surface Section 3.1.2 (9)

- Tie-in of top injector to Pilot facility
- Further testing of BS&W test devices
- Modifications of facility to accommodate ESP testing
This Laricina Energy Ltd. (the “Company”) presentation contains certain forward-looking statements. Forward-looking statements may include, but are not limited to, statements concerning estimates of exploitable original-bitumen-in-place, predicted recovery factors, steam-to-oil ratios and well production rates, estimated recoverable resources as defined below, expected regulatory filing, review and approval dates, construction and start-up timelines and schedules, company project potential production volumes as well as comparisons to other projects, statements relating to the continued overall advancement of the Company’s projects, comparisons of recoverable resources to other oil sands projects, estimated relative supply costs, potential cost reductions, recovery and production increases resulting from the application of new technology and recovery schemes, estimates of carbon sequestration capacity, costs for carbon capture and sequestration and possible implementation schedule for carbon capture and sequestration processes or related emissions mitigation or reduction scheme and other statements which are not historical facts. You are cautioned not to place undue reliance on any forward-looking statements as there can be no assurance that the plans, intentions or expectations upon which they are based will occur. By their nature forward-looking statements involve numerous assumptions, known and unknown risks and uncertainties, both generally and specific, that contribute to the possibility that the predictions, forecasts, projections and other forward-looking statements will not occur. Although the Company believes that the expectations represented by such forward-looking statements are reasonable, there can be no assurance that such expectations will prove to be correct and, accordingly that actual results will be consistent with the forward-looking statements. Some of the risks and other factors that could cause results to differ materially from those expressed in the forward-looking statements contained in this presentation include, but are not limited to geological conditions relating to the Company’s properties, the impact of regulatory changes especially as such relate to royalties, taxation and environmental changes, the impact of technology on operations and processes and the performance of new technology expected to be applied or utilized by the Company; labour shortages; supply and demand metrics for oil and natural gas; the impact of pipeline capacity, upgrading capacity and refinery demand; general economic business and market conditions and such other risks and uncertainties described from time to time in the reports and filings made with security regulatory authorities, contained in other disclosure documents or otherwise provided by the Company. Furthermore the forward-looking statements contained in this presentation are made as of the date hereof. Unless required by law the Company does not undertake any obligation to update publicly or to revise any of the included forward-looking statements, whether as a result of new information, future events or otherwise. The forward-looking statements contained in this presentation are expressly qualified by this advisory and disclaimer.
Significant Definitions

In this presentation the reserve and recoverable resource numbers, along with the net present values given, are as defined in the report of GLJ Petroleum Consultants Ltd. (“GLJ”) regarding certain of Laricina’s properties effective December 31, 2013, referred to herein (the “GLJ Report”). “Exploitable OBIP” or “Expl. OBIP” refers to original-bitumen-in-place that is targeted for development using thermal recovery technologies. The best and high estimate of the Company’s resources include contingent and prospective resources. “Cont.” or “2C” and “Pros.” refer to contingent and prospective bitumen resources, respectively. Contingent resource values have not been risked for chance of development while prospective resource values have been risked for chance of discovery but not for chance of development. There is no certainty that it will be commercially viable to produce any portion of the contingent resources. There is no certainty that any portion of the prospective resources will be discovered or, if discovered, if it will be commercially viable to produce any portion of the prospective resources. “2P” means proved plus probable reserves and “3P” means proved plus probable plus possible reserves. “SAGD” means steam-assisted gravity drainage. “C-SAGD” means cyclic SAGD. “SC-SAGD” means solvent-cyclic SAGD. “CSS” means cyclic steam stimulation. The SC-SAGD best estimate technology sensitivity (Laricina technology sensitivity) net economic forecasts were prepared on Saleski-Grosmont and Germain-Grand Rapids based on SC-SAGD technology. “SOR” means steam-oil ratio. “CSOR” means cumulative steam-oil ratio. “CDOR” means calendar day oil rate. “bbl” means barrel. “bn” means billions. “m” means metres. “mmbbl” means millions of barrels. “bbl/d” means barrels per day. “EIA” means Energy Information Administration. “NPV” means net present value. “m³” means cubic metres. “m³/d” means cubic metres per day. “kPa” means kilopascal. “Dk eff” means Darcy’s effective permeability. “km²” means square-kilometres. “NPV10” means net present value, before tax, 10 percent discount. “US$” means United States dollars. “U.S.” means United States of America. “WTI” means West Texas Intermediate. “WCS” means Western Canadian Select. “PV10” means net present value before tax, 10 percent discount.

Unless otherwise stated, all dollar amounts are shown in Canadian dollars (C$).
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laricina@laricinaenergy.com
• Appendix A:

Wellbore schematics and completions for observation wells including positioning relative to the trajectories of the production and injection wells.
Well Completions and Schematics
Section 3.1.1 (3b and 5a)

Laricina Observation Well P1-Obs1
102/07-26-085-19W4
Grosmont ‘C’ & ‘D’ Formations

Observation Well Construction Details
102/07-26-085-19W4 (P1Obs1)
As of July 2009

ELEV (masl) | DEPTH (mKB)
--- | ---
597.05 | 4.27

Piezometer
Thermocouple

Borehole Diameter: 311 mm
Surface Casing: 244.5 mm
Thread: ST&C
Grade: H40
Thermal Cement

Casing Shoe 266.05 | 335.27
Piezometer #3
Grosmont ‘D’ 262.05 | 339.27
Thermocouple Spacing: 3.0m
316m to 343m GL

Borehole Diameter: 200 mm
Thermocouple Spacing: 1m
346m to 356m GL
Thermocouple Spacing: 2m
356m to 366m GL

Piezometer #2
Grosmont ‘D’ 239.05 | 362.27
Thermocouple Spacing: 1m
368m to 378m GL

Piezometer #1
Grosmont ‘C’ 227.05 | 374.27
Production Casing: 114 mm
Thread: Tenaris Blue
Grade: L80
Thermal Cement

TD 192.05 | 409.27
Borehole TD

NEXT STEPS
Laricina Observation Well P1-Obs2
104/10-26-085-19W4
Grosmont ‘C’ & ‘D’ Formations

**Observation Well Construction Details**
104/10-26-085-19W4 (P1Obs2)
As of March 2010

| Casing Shoe | 277.51 | 314.13 |
| Piezometer #5 | 274.64 | 317.00 |
| Grosmont ‘D’ | |
| Piezometer #4 | 260.64 | 331.00 |
| Grosmont ‘D’ | |
| Piezometer #3 | -354 | 354.00 |
| Grosmont ‘D’ | |
| Piezometer #2 | 230.64 | 361.00 |
| Grosmont ‘C’ | |
| Piezometer #1 | 218.64 | 373.00 |
| Grosmont ‘C’ | |
| TD | 178.14 | 413.50 |

- Borehole Diameter: 311 mm
- Surface Casing: 177.8 mm
- Thread: ST&C
- Grade: H40
- Thermal Cement
- Borehole Diameter: 200 mm
- Thermocouple Spacing: 3.0m
- 320m to 347m GL
- Thermocouple Spacing: 1m
- 350m to 360m GL
- Thermocouple Spacing: 2m
- 360m to 370m GL
- Thermocouple Spacing: 1m
- 372m to 382m GL
- Production Casing: 114 mm
- Thread: Tenaris Blue
- Grade: L80
- Thermal Cement
- Borehole TD

**Well Completions and Schematics**
Section 3.1.1 (3b and 5a)
# Well Completions and Schematics

## Section 3.1.1 (3b and 5a)

### Laricina Observation Well P1-Obs3

**103/10-26-085-19W4**

Grosmont ‘C’ & ‘D’ Formations

### Observation Well Construction Details

<table>
<thead>
<tr>
<th>Observation Well Construction Details</th>
<th>103/10-26-085-19W4 (P1Obs3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEV (masl)</td>
<td>DEPTH (mKB)</td>
</tr>
<tr>
<td>589.8</td>
<td>4.20</td>
</tr>
</tbody>
</table>

- **Piezometer**
- **Thermocouple**

- **Surface Casing**: 244.5 mm
- **Thread**: ST&C
- **Grade**: H40
- **Thermal Cement**

### Observation Well Construction Details

- **Casing Shoe**: 284.8 309.20
- **Piezometer #5**
  - Grosmont ‘D’
  - 277.8 316.20
- **Piezometer #4**
  - Grosmont ‘D’
  - 264.80 329.20
- **Piezometer #3**
  - Grosmont ‘D’
  - 255.8 338.20
- **Piezometer #2**
  - Grosmont ‘C’
  - 235.80 358.20
- **Piezometer #1**
  - Grosmont ‘C’
  - 223.8 370.20
- **TD**: 188.2 405.80

- **Borehole Diameter**: 311 mm
- **Thermocouple Spacing**: 3.0m
  - 316m to 343m GL
- **Thermocouple Spacing**: 1m
  - 346m to 355m GL
- **Thermocouple Spacing**: 2m
  - 356m to 366m GL
- **Thermocouple Spacing**: 1m
  - 368m to 378m GL
- **Production Casing**: 114 mm
  - Thread: Tenaris Blue
  - Grade: L80
- **Thermal Cement**
- **Borehole TD**
Well Completions and Schematics
Section 3.1.1 (3b and 5a)

Laricina Observation Well P2-Obs1
100/07-26-085-19W4
Grosmont ‘C’ & ‘D’ Formations

<table>
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<th>Observation Well Construction Details</th>
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<td>100/07-26-085-19W4 (P2Obs1)</td>
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<table>
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<th>DEPTH (mKB)</th>
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</thead>
<tbody>
<tr>
<td>589.54</td>
<td>2.64</td>
</tr>
</tbody>
</table>

Piezometer
Thermocouple

Surface Casing: 244.5 mm
Thread: ST&C
Grade: H40

Thermal Cement

Casing Shoe 286.18 306.00
Borehole Diameter: 200 mm
Thermocouple Spacing: 3.0m
316m to 343m GL

Piezometer #5 282.68 309.50
Grosmont ‘D’
Thermocouple Spacing: 1m
346m to 355m GL

Piezometer #4 274.68 317.50
Grosmont ‘D’
Thermocouple Spacing: 2m
356m to 366m GL

Piezometer #3 255.68 336.50
Grosmont ‘C’
Thermocouple Spacing: 1m
368m to 378m GL

Piezometer #2 244.68 347.50
Grosmont ‘C’
Production Casing: 114 mm
Thread: Tenaris Blue
Grade: L80

Piezometer #1 233.68 358.50
Grosmont ‘C’
Thermal Cement

TD 198.18 394.00
Borehole TD
Well Completions and Schematics
Section 3.1.1 (3b and 5a)

Laricina Observation Well P2-Obs2
106/10-26-085-19W4
Grosmont ‘C’ & ‘D’ Formations

Observation Well Construction Details
106/10-26-085-19W4 (P2Obs2)
As of March 2010

<table>
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<th>DEPTH (mKB)</th>
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<tbody>
<tr>
<td>590.34</td>
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</table>

- **Piezometer**
- **Thermocouple**

**Casing Shoe:** 288.29 306.00
**Borehole Diameter:** 200 mm
**Thermocouple Spacing:** 3.0 m
318 m to 348 m GL

**Piezometer #5 Grosmont 'D':** 269.29 325.00
**Thermocouple Spacing:** 1 m
348 m to 358 m GL

**Piezometer #4 Grosmont 'D':** 245.29 349.00
**Thermocouple Spacing:** 2 m
358 m to 368 m GL

**Piezometer #3 Grosmont 'D':** 240.29 354.00
**Thermocouple Spacing:** 1 m
348 m to 358 m GL

**Piezometer #2 Grosmont 'C':** 228.29 366.00
**Thermocouple Spacing:** 1 m
370 m to 380 m GL

**Piezometer #1 Grosmont 'C':** 219.29 375.00
**Production Casing:** 114 mm
Thread: Tenaris Blue
Grade: L80

**TD:** 188.29 406.00
**Borehole TD**

**Surface Casing:** 177.8 mm
Thread: ST&C
Grade: H40

**Thermal Cement**

September 25, 2014
NEXT STEPS
### Observation Well Construction Details

102/10-26-085-19W4 (P2Obs3) As of July 2009

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- **Laricina Observation Well P2-Obs3**
- **102/10-26-085-19W4**
- **Grosmont ‘C’ & ‘D’ Formations**

**NEXT STEPS**

- September 25, 2014
Well Completions and Schematics
Section 3.1.1 (3b and 5a)

Laricina Observation Well P1-2-Obs2
105/10-26-085-19W4
Grosmont ‘C’ & ‘D’ Formations

Observation Well Construction Details
105/10-26-085-19W4 (P1-2 Obs2)
As of March 2010

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- Borehole Diameter: 311 mm
- Surface Casing: 177.8 mm
- Thread: ST&C
- Grade: H40
- Thermal Cement
- Borehole Diameter: 200 mm
- Thermocouple Spacing: 3.0 m
- 318m to 348m GL
- Thermocouple Spacing: 1m
- 348m to 358m GL
- Thermocouple Spacing: 2m
- 358m to 368m GL
- Production Casing: 114 mm
- Thread: Tenaris Blue
- Grade: L80
- Thermal Cement
- Borehole TD

Laricina Energy Ltd.
• Appendix B:

Disposal and source water wellbore schematics and completions.
Well Completions and Schematics
Section 3.1.1 (3b and 5a)

Laricina Disposal Well
100/05-23-085-20W4
Cooking Lake Formation

**Disposal Well Construction and Completion Details**

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Ground Elev.

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Base of Groundwater Protection for Grand Rapids

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Casing Shoe

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Cooking Lake Formation

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PBTD

- Borehole Diameter: 311 mm
- Surface Casing: 244.5 mm
  - Thread: ST&C
  - Grade: H40
- Thermal Cement
- Injection Tubing 89mm Fiberglass
- Inhibited Fluid in annulus
- Borehole Diameter: 222 mm
- QDG Retrievable Packer
- Double Grip Production Packer
  - 646.85 - 648.52 mKB
- Perforations 653 - 669 m
  - 26 spm, 12 mm diameter
- Production Casing: 177.8 mm
  - Thread: Tenaris Blue
  - Grade: L80
- Thermal Cement
- Borehole TD
Well Completions and Schematics
Section 3.1.1 (3b and 5a)

Laricina Disposal Well
102/05-23-085-20W4
Cooking Lake Formation
Laricina Disposal Well
100/02-26-085-19W4
Grosmont ‘A’ Formation
Laricina Disposal Well
100/02-31-084-22W4
Grosmont ‘A’ Formation

Disposal Well Construction and Completion Details
100/02-31-84-22W4 (Disposal Well)

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- Borehole Diameter: 311 mm
- Surface Casing: 244.5 mm
- Thread: ST&C
- Grade: H40
- Thermal Cement

- Base of Groundwater Protection for Grand Rapids: 298.20 - 301.50
- Injection Tubing 89mm Fibreglass
- Inhibited Fluid in annulus
- Borehole Diameter: 222 mm

- Grosmont ‘A’ Formation
  - Perforations: 596.5 - 601.5mKB, 611.0 - 616.0mKB, 628.0 - 633.0mKB (26 spm, 12 mm diameter)
- Grosmont ‘C’ Production Casing: 177.8 mm
  - Thread: Tenaris Blue
  - Grade: L80
- Thermal Cement
- Borehole TD: -67.3 - 667.00
Laricina Water Source Wells
Typical Schematic
Lower Grand Rapids Formation

**UWIs:**
1F2/13-23-085-20W4/00
1F1/05-23-085-20W4/00
1F1/14-24-085-20W4/00
1F1/10-26-085-19W4/00
1F1/07-20-085-19W4/00
1F1/02-26-085-19W4
1F2/02-26-085-19W4

**Typical Water Source Well Construction and Completion Details**

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<th>ELEV (masl)</th>
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<td>4.2</td>
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- **Subsurface Seal Base:** 590, 34.2
- **Static Water Level:** 460, 164.2
- **Top of K-Packer:** 420, 204.2
- **Top of Screen:** 419, 205.2
- **Casing Shoe:** 415, 209.2
- **Bottom of Screen:** 359.5, 264.7
- **Total Depth:** 360, 265.2

**Notes:**
- Borehole Diameter: 438 mm
- Cement Grout
- Conductor Pipe Size: 324 mm
- Stickup: 1.2 m
- Borehole Diameter: 311.1 mm
- Thermal Cement
- Production Casing: 244.5 mm I.D.
  Grade: H-40
- Pre-Packed Sand: 16/30 Silica
- Screen Size: 0.018" - Slot
  Screen Open Area: 18%
- Stainless Steel
  Outer Screen: 217.2 mm (8.550") O.D.
  Base Pipe: 139.7 mm (5.500") O.D.
  Base Pipe Open Area: 9.8%
  Pre-Pack Sand: 16/30 Silica
- Borehole Diameter: 222.3 mm (8.75")
  *Borehole may be under-reamed to a larger diameter if difficulty installing screen.
- Circulation Valve
- Borehole TD
• Appendix C:

Observation well’s piezometer and temperature plots. Data in corresponding excel file

Monthly injection pressure data in corresponding excel file.
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P1Obs1

Value of 0 kPa is an error.
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P1Obs2
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P1Obs3

Value of 6000+ kPa is an error.
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P2Obs1
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P2Obs2

Value of 6000+ kPa is an error.
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P2Obs3

Value of 6000+ kPa is an error.

September 25, 2014
Observation Well’s Piezometer Data
Section 3.1.1 (5d i)

Pressures in Observation Well P12Obs2

TVD (m)

Pressure (kPa)

September 25, 2014
NEXT STEPS
Temperatures in Observation Well P1Obs1

Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)
Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)

Temperatures in Observation Well P1Obs2

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<thead>
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<th>Month</th>
<th>Date 1</th>
<th>Date 2</th>
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<td>-</td>
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<td>Oct</td>
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<td>-</td>
</tr>
<tr>
<td>Nov</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Dec</td>
<td>-</td>
<td>12</td>
</tr>
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<td>Jan</td>
<td>-</td>
<td>11</td>
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<td>-</td>
<td>10</td>
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<td>Mar</td>
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<td>9</td>
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<tr>
<td>Apr</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>May</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Jun</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Jul</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Aug</td>
<td>-</td>
<td>4</td>
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TVD (m)
Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)

Temperatures in Observation Well P1Obs3

Temperature (°C)

TVD (m)

September 25, 2014

NEXT STEPS
Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)

Temperatures in Observation Well P2Obs1

Temperature (°C)

TVD (m)
Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)

Temperatures in Observation Well P2Obs2

September 25, 2014
Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)

Temperatures in Observation Well P2Obs3

Temperature (°C)

TVD (m)

August 13
September 13
October 13
November 13
December 13
January 13
February 13
March 13
April 13
May 13
June 14
July 14
August 14

NEXT STEPS
Observation Well’s Thermocouple Data
Section 3.1.1 (5d ii)

Temperatures in Observation Well P12Obs2

Temperature (°C)

TVD (m)

September 25, 2014

NEXT STEPS
• Appendix D:

Scheme injection and production data.
## Monthly Injection and Production Data for 1D Well Pair

Section 3.1.1 (7a ii)

<table>
<thead>
<tr>
<th>Month</th>
<th>Steam Injected (Sm³)</th>
<th>Bitumen Produced (m³)</th>
<th>Water Produced (Sm³)</th>
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<tr>
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<td>3,541</td>
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<td>510</td>
<td>645</td>
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<td>1,129</td>
<td>937</td>
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<td>92</td>
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### Monthly Injection and Production Data for 1C Well Pair/P1C-s Well

Section 3.1.1 (7a ii)

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<td>2,983</td>
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<td>804</td>
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<td>Nov-13</td>
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<td>Aug-14</td>
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## Monthly Injection and Production Data for 2C Well Pair

Section 3.1.1 (7a ii)

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<th>Water Produced (Sm³)</th>
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<td>1,808</td>
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<td>Nov-13</td>
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<td>18,753</td>
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<td>7,779</td>
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### Monthly Injection and Production Data for I2D Well

**Section 3.1.1 (7a ii)**

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<td>15,553</td>
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<tr>
<td>Apr-14</td>
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<td>745</td>
</tr>
<tr>
<td>May-14</td>
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<td>472</td>
<td>988</td>
</tr>
<tr>
<td>Jun-14</td>
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<td>112</td>
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<tr>
<td>Jul-14</td>
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<td>Aug-14</td>
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### Monthly Injection and Production Data for P3D Well

Section 3.1.1 (7a ii)

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<th>Month</th>
<th>Steam Injected (Sm³)</th>
<th>Bitumen Produced (m³)</th>
<th>Water Produced (Sm³)</th>
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<td>0</td>
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<tr>
<td>Sep-13</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Oct-13</td>
<td>0</td>
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<tr>
<td>Nov-13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dec-13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jan-14</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Feb-14</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Mar-14</td>
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<td>0</td>
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<tr>
<td>Apr-14</td>
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<td>0</td>
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<td>May-14</td>
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<td>Aug-14</td>
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• Appendix E:

Water Quality Assessments
# Source Water Analysis

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<th>TEST DESCRIPTION</th>
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<th>UNITS</th>
<th>TEST METHOD</th>
<th>DATE ANALYZED</th>
<th>TECH</th>
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<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>1.20</td>
<td>mg/L</td>
<td>ICP</td>
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<td>Caig</td>
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<td>Caig</td>
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<td>Iron (Fe)</td>
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<td>Caig</td>
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<td>Strontium (Sr)</td>
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<td>Caig</td>
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<td>CD</td>
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<td>CD</td>
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<td>CD</td>
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<td>Resistivity @ 25 °C</td>
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## Disposal Water Analysis

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<th>TECH</th>
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*September 25, 2014*