Pelican Lake
SAGD Pilot
AER Approval 11469C

AER D054 Annual Update
January 1, 2015 – December 31, 2015

April 13, 2016
Disclaimer

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Agenda

- Project Overview
- Geological Overview
- Resource Recovery
- Facility Update
- Compliance
Subsection 3.1.1

1) Scheme Overview
Cenovus SAGD Pilot Lease

Section 3.1.1 (1)
Scheme Description & Overview

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Base of Grand Rapids ‘A’</td>
<td>357-363 m Subsea</td>
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<tr>
<td>Average Gross Thickness</td>
<td>22 m</td>
</tr>
<tr>
<td>Average SAGD Pay Thickness</td>
<td>18 m</td>
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<tr>
<td>Average Porosity</td>
<td>36 %</td>
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<tr>
<td>Average Water Saturation</td>
<td>44 % (Gross)</td>
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<td></td>
<td>38 % (SAGD Pay Zone)</td>
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<tr>
<td>Average Permeability</td>
<td>2.9 D</td>
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<tr>
<td>OBIP (2015 Cenovus internal estimate)</td>
<td>45 MMbbl</td>
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<td>Drilled well pairs</td>
<td>3</td>
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<tr>
<td>Source water well</td>
<td>1</td>
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<tr>
<td>Disposal well</td>
<td>1</td>
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<tr>
<td>Oil Viscosity</td>
<td>1,000,000 cp+</td>
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<tr>
<td>Oil Gravity</td>
<td>7.5-8.5 API</td>
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<tr>
<td>Initial Reservoir Pressure</td>
<td>1300 kPa</td>
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<tr>
<td>Fracture Gradient</td>
<td>21.3 kPa/m</td>
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<tr>
<td>Fracture Closure Pressure</td>
<td>4.75 MPa</td>
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</table>

* not to scale
Subsection 3.1.1

2) Geology/Geoscience
Geology & Geoscience

<table>
<thead>
<tr>
<th>AGE</th>
<th>Northeast Alberta</th>
<th>Athabasca East</th>
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<tbody>
<tr>
<td>ALBIAN</td>
<td>La Biche Fm</td>
<td>La Biche Fm</td>
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<tr>
<td></td>
<td>Pelican Fm</td>
<td>Pelican Fm</td>
</tr>
<tr>
<td></td>
<td>Joli Fou Fm</td>
<td>Joli Fou Fm</td>
</tr>
<tr>
<td></td>
<td>Grand Rapids Fm</td>
<td>Grand Rapids Fm</td>
</tr>
<tr>
<td></td>
<td>Clearwater Fm</td>
<td>Clearwater Fm</td>
</tr>
<tr>
<td></td>
<td>Wabiskaw Mbr</td>
<td>Wabiskaw Mbr</td>
</tr>
<tr>
<td></td>
<td>McMurray Mbr</td>
<td>McMurray Mbr</td>
</tr>
</tbody>
</table>

**Targeted Formation**

- Oil Sands
- Barren Sands
- Mudstones
- Carbonates & Shales

Section 3.1.1 (2)
Grand Rapids ‘A’ Type Log

- **Viking/Pelican Fm sands contain a non saline aquifer**
- **Joli Fou Fm marine shale is the cap rock**
- **Grand Rapids ‘A’ Mbr are bitumen charged reservoir sands**
- **Grand Rapids ‘A’ shale forms the base seal**
- **Grand Rapids ‘B’ Mbr sands contain a non saline aquifer**
Bitumen Accumulation

- Grand Rapids bitumen is a plug within the Grand Rapids ‘A’ non-saline aquifer
- Minimal bottom water in the project area except on the structural flanks to the NW and SE
- Bitumen trapping is a combination of stratigraphic and degradation mechanisms
- Regional dip is SW to NE
Well Pair 1 Trajectories/Cross-Section

I01 UWI: 100/12-02-082-23W4
P01 UWI: 102/12-02-082-23W4
Well Pair 2 Trajectories/Cross-Section

I02 UWI: 102/09-03-082-23W4
P02 UWI: 103/09-03-082-23W4
Well Pair 3 Trajectories/Cross-Section

I03 UWI: 105/09-03-082-23W4, spud date February 5, 2015
P03 UWI: 104/09-03-082-23W4, spud date January 26, 2015
Surface Heave Monitoring (InSAR)

- Since March 26, 2013 < 8 mm total vertical displacement observed
- 8 RADARSAT-2 scenes were acquired in 2015
- Measurements to December 29, 2015 do not indicate incremental displacement.
- Very little ground motion has been observed. Most of the Corner Reflectors are relatively stable since the beginning of the monitoring program.
4D Seismic Lines

- **Baseline 3D - January 2011**
- **4D Shoots:**
  - 1st - January 2012
  - 2nd - March 2013
  - 3rd - January 2014
  - 4th - January 2015
- **4D seismic shows the areas of steam chamber development and connection to the lean zone**
Subsection 3.1.1

3) Drilling/Completions
## 2015 New Wells

<table>
<thead>
<tr>
<th>Well</th>
<th>Purpose</th>
<th>2015 Activity</th>
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<tbody>
<tr>
<td>04/09-03-082-23W4/0</td>
<td>Producer 26P03</td>
<td>Drilled &amp; Completed</td>
</tr>
<tr>
<td>05/09-03-082-23W4/0</td>
<td>Injector 26I03</td>
<td>Drilled &amp; Completed</td>
</tr>
<tr>
<td>03/16-3-082-23W4/0</td>
<td>Observation Well</td>
<td>Completed with thermocouple</td>
</tr>
</tbody>
</table>

2015 New Completion

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Section 3.1.1 (3)

April 2016
26I01 Injector Completion Schematic

100/12-02-082-23

No change in 2015

Section 3.1.1 (3) April 2016
26P01 Producer Completion Schematic

Conductor
508.0 mm

Surface Casing
339.7 mm

Intermediate Casing
244.5 mm

Bubble Tube

Fiber optic temperature string

Production Tubing

ESP

Slotted Liner

*Producer perforated

No change in 2015

Section 3.1.1 (3)
In April 2015, splitter #4 opened.
26P02 Producer Completion Schematic

Intermediate Casing
244.5 mm

Slotted Liner Packer

Bubble Tube

Production Tubing

ESP

Fiber optic temperature string

Conductor
508.0 mm

Surface Casing
339.7 mm

Intermediate Casing
244.5 mm

Bubble Tube

Fiber optic temperature string

Production Tubing

ESP

Inflow Control Device

Packer

Slotted Liner

August 2015: ESP change

Section 3.1.1 (3)
26I03 Injector Circulation Completion Schematic

Conductor
558.0 mm

Surface Casing
339.7 mm

Intermediate Casing
244.5 mm

Insulated Inner Tubing

Outer Tubing

Bubble tube

Fiber optic temperature string

Sand screen

March 2015 initial completion

Section 3.1.1 (3) 2016
26P03 Producer Circulation Completion Schematic

Conductor
558.0 mm

Surface Casing
406.4 mm

Intermediate Casing
298.4 mm

Insulated Inner Tubing

Outer Tubing

Bubble tube

Fiber optic temperature string

Sand screen

March 2015 initial completion

Section 3.1.1 (3)
Subsection 3.1.1

4) Artificial Lift
Artificial Lift – 26P01, 26P02, 26P03 SAGD

- All production and source wells use Electric Submersible Pumps (ESPs)
- **Pump Sizing Range:** 50-350 m³/d
- **Intake Pump Pressure:** 600-1200 kPag (P01, P02), 1,500-2,500 kPag (P03)
- **Pump Control:** Variable Frequency Drives (VFD)
- **Max Operating Temperature:** 218-250°C
- **Limitations:** Low pump efficiency under saturation conditions
- **Performance monitoring:** standard deviation of ESP amp draw, run life
Subsection 3.1.1

5) Well Instrumentation
## Well Instrumentation

<table>
<thead>
<tr>
<th>Well</th>
<th>Pressure</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>26I01</td>
<td>Casing annulus bubbler</td>
<td>None</td>
</tr>
<tr>
<td>26P01</td>
<td>Bubble tube</td>
<td>Fiber optic</td>
</tr>
<tr>
<td>26I02</td>
<td>Casing annulus bubbler</td>
<td>None</td>
</tr>
<tr>
<td>26P02</td>
<td>Bubble tube</td>
<td>Fiber optic</td>
</tr>
<tr>
<td>26I03</td>
<td>Bubble tube, Sensor at end of fiber</td>
<td>Fiber optic</td>
</tr>
<tr>
<td>26P03</td>
<td>Bubble tube, Sensor at end of fiber</td>
<td>Fiber optic</td>
</tr>
<tr>
<td>Observation Wells</td>
<td>Piezometer</td>
<td>Thermocouple</td>
</tr>
</tbody>
</table>
Subsection 3.1.1

6) 4-D Seismic
Well Pair 1: Steam Chamber in the Reservoir

Baseline

2011 2012 2013 2014 2015

- Temperature Observation Well
- Steam Chamber Outline (amplitude cut-off)
Well Pair 2: Steam Chamber in the Reservoir

- Temperature Observation Well
- Steam Chamber Outline (amplitude cut-off)
Subsection 3.1.1

7) Scheme Performance
Well Pair 1
Pilot Monitoring Network

- Thermocouples
- Piezometers
- Ground Water Obs
- 100/5-11 (Swab/Inj test)

All wells not labelled are GR A
Well Pair 1: 2015 Summary

- I01/P01 drawdowns were lower due to P01 perforation in Q4 2014 with no significant sand production issues
- Continued to improve thermal conformance
- Results from six day temperature fall-off in April 2015 (facility turnaround) for 26P01 shows steam chamber growth at the toe
102/05-11-082-23W4/0 Observation Well Temperature

Top GR A = 221.0  
Base GR A = 247.3  
Base Pay = 247.0  
Top Pay = 224.3  
Top GR B = 249.3
*There are 5 time-series plots in the graph above, some are overlapping.
Well Pair 1 Producer Temperature Profiles

P01 April 20, 2015 144 hour temp fall-off

- Liner hanger
- Shoe

Section 3.1.1 (7)
Well Pair 1 Production

![Graph showing production rates for different fluids over time. The graph includes lines for Oil, Steam, Water, and CSOR. The x-axis represents months from January 2015 to January 2016, while the y-axis represents rates in Sm³/d.]
Subsection 3.1.1

7) Scheme Performance
Well Pair 2
Well Pair 2: 2015 Summary

- Successful workover in April 2015 to open a shiftable steam splitter
- Sought to maintain pressure balance with lean zone
- Continued to improve thermal conformance
- Continued to evaluate effect of steam splitter shift and tubing-deployed Inflow Control Devices (ICDs) installed in P02
100/01-10-082-23W4/0 Observation Well Temperature

**Section 3.1.1 (7)**

**Top GR A = 221**

**Base GR A = 247**

**Base Pay = 245**

**Top Pay = 224**

**Top SAGD Pay**

**Transition Zone = 229**

**Base SAGD Pay = 243**

**Base Pay = 245**

**Base GR A = 247**

**Top GR B = 248**

April 2016
Top GR A = 217.0
Top Pay = 221.0
Transition Zone = 223.0
Base SAGD Pay = 240.0
Base Pay = 241.0
Base GR A = 241.0
Top GR B = 244.2

April 2016
Section 3.1.1 (7)
Well Pair 2 Temperature Profiles

P02 April 20, 2015 144 hour temp fall-off

- 0 h
- 24 h
- 48 h
- 72 h
- 96 h
- 120 h
- 144 h

Temperature (°C) vs Depth (MD)

Liner hanger

Shoe

April 2016
Lean Zone Pressure

Initial lean zone pressure

Section 3.1.1 (7)
Subsection 3.1.1
7) Scheme Performance
Well Pair 3
Well Pair 3 Startup

Description
• Proprietary Closed Circuit conductive heating startup (patent pending)
• Permits operation at higher temperatures compared with existing circulation practice
• Promotes uniform temperature distribution along lateral

Timeline
• 26P03 and 26I03 initial completions in February 2015
• 26P03 began circulation May 4, 2015
• 26I03 began circulation June 9, 2015
• 26P03 converted to SAGD mode November 18, 2015
Operating Configuration for WP3 Startup

Section 3.1.1 (7)
2015 Casing Fluid Volumes During WP3 Startup

- Total oil produced in 2015 during WP3 startup is 746 m³
- Total water produced in 2015 during WP3 startup is 893 m³

<table>
<thead>
<tr>
<th></th>
<th>May 4 - November 13</th>
<th>November 13 – December 31</th>
<th>2015 Total</th>
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<tbody>
<tr>
<td><strong>P03 water</strong></td>
<td>48 m³</td>
<td>0</td>
<td>48 m³</td>
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<tr>
<td><strong>P03 oil</strong></td>
<td>431 m³</td>
<td>0</td>
<td>431 m³</td>
</tr>
<tr>
<td><strong>I03 water</strong></td>
<td>387 m³</td>
<td>458 m³</td>
<td>845 m³</td>
</tr>
<tr>
<td><strong>I03 oil</strong></td>
<td>161 m³</td>
<td>154 m³</td>
<td>315 m³</td>
</tr>
</tbody>
</table>
Field Data – I03 Shut-in Temperatures

I03 48h shut-in profile

Temp (°C)

Depth (mKB)

Liner hanger

Shoe

Section 3.1.1 (7)
Field Data – Observation Well 102/08-10-082-23W4
WP3 Startup Learnings

• Operated at higher temperatures compared with existing circulation practice
• Achieved uniform temperature distribution along lateral
• Fluids were produced as a result of bottomhole fluid expansion
• Temperature profiles, wellbore dynamics, and pace of heating within design expectations
Subsection 3.1.1

8) Future Plans
Future Plans

- Temporary suspension of SAGD pilot in Q1 2016
- No drilling plans for 2016
Subsection 3.1.2

1) Facilities
2015 Pad 26 Plot Plan
2015 Facility Summary

Facility Updates
• Completed 26I03 and 26P03 facility tie-ins
• Added temporary steam condensate returns tank (T-330) for WP3 startup
• Flue gas O₂ analyzers installed in the radiant section of two of the OTSGs (H-800 and H-850) to improve combustion efficiency
• No major changes to existing facility

Plant Performance
• Annual plant turnaround executed April 19-27
• No lost production exceeding 1 day from unplanned plant outages
• Steam quality at the injection wellheads estimated at 95-99%
• Flue gas O₂ Analyzers have not been installed long enough to quantify the improved boiler controls
Subsection 3.1.2

2) Measurement and Reporting
MARP (Measurement, Accounting and Reporting Plan)
Measurement and reporting

**Estimated well production (oil and water)**

- Coriolis meters have proven to be effective measurement tools at the pad
- 26P02 & 26P03 oil production is estimated by applying manual wellhead cuts to measured fluid production
- 26P01 oil production is estimated by applying manual wellhead cuts to measurement by difference:
  - 26P01 fluid = Pad 26 total fluid – 26P02 fluid – 26P03 (SAGD) fluid
- Produced oil and water is transferred to Pelican Lake 11-7 battery (AB BT0058285) for separation and all produced water is used for injection within scheme approval no. 9404V

**Estimated well production (gas)**

- Total gas production is obtained from a meter measuring the amount of produced gas going to the incinerator
- Gas proration for each production well is calculated using the gas-steam ratio determined from partial pressures
Measurement and reporting (continued)

**Proration Factor**
- Proration Factor reported to Petrinex on a monthly basis
  - Proration Factor (PF) for oil & water = \( \frac{\text{Total pad production}}{P01 + P02 + P03 \text{ production}} \)

**Meter Calibration**
- Annual MARP meter calibrations were completed in Q3 2015, as per D017 requirements
Water Balance

**GR Battery (AB BT 0113349)**

**In:**
- Produced water (26P01, 26P02, 26P03)
- Pad 9 source water for quench (1F1/13-07-082-22W4/0)
- Pelican Lake produced water for quench (AB BT 0058285)
- WP3 startup steam condensate
- WP3 casing fluid returns

**Out:**
- Produced/quench water to Pelican Lake (AB BT 0058285)
- WP3 startup steam condensate to T-330 (AB IF 0112734)
- Truck out (WP3 casing fluid returns)
Water Balance

Injection Facility (AB IF 0112734)

In:
- Inventory open
- Source water (1F1/01-15-082-23W4/0)
- Source water (1F1/13-07-082-22W4/0) [upset conditions]
- Truck in [upset conditions]

Out:
- Inventory close
- Disposal (regen waste, boiler blowdown, T-330 WP3 startup steam condensate)
- Steam injection (26I01, 26I02, 26I03, 26P03)
- Truck out [upset conditions]
Gas Balance

GR Battery (AB BT 0113349)
In:
• Produced gas (26P01, 26P02, 26P03, 26I03)
Out:
• Produced gas to incinerator
• Vent to atmosphere (WP3 startup)

Injection Facility (AB IF 0112734)
In:
• Fuel gas from TCPL via Pelican Lake main gas line (AB MS 00094854)
Out:
• Fuel gas to OTSGs
• Fuel gas to incinerator
Subsection 3.1.2

3) Fresh and Brackish Water
Water Source Wells

- Source water from Grand Rapids B water well (1F1/01-15-082-23W4/0) is used to generate steam for injection wells

- Source water from Grand Rapids B water well (1F1/13-07-082-22W4/0) is used for management of emulsion temperature in pipelines and primary source water upsets

- No brackish water wells
Source Water Well Rates

--- 1F1/01-15-082-23W4/0

--- 1F1/13-07-082-23W4/0
Subsection 3.1.2

4) Water Treatment Technology
Water Treatment Overview

- Media Filtering
- Primary Strong Acid Cation (SAC) Exchange
- Secondary SAC polisher
- Source water for brine regeneration
- Low concentrations of Acid Producing Bacteria (APB) were identified in the sand filters in December 2015
Subsection 3.1.2

5) Waste Disposal
Disposal

- Disposed fluids injected into a Class 1B disposal well (102/09-10-082-23W4/0)
- Disposed fluids include boiler blowdown, ion exchange regeneration waste, and WP3 steam condensate
Disposal Well Rates (102/09-10-082-23W4)
Subsection 3.1.2

6) Air Emissions
2015 Air Emissions Reporting

- Sulphur emissions generated from incineration of casing gases
  - $\text{SO}_2$ calculated from $\text{H}_2\text{S}$ level in monthly casing gas analysis
  - Based on the calculated sulphur content, the facility is not required to complete quarterly sulphur emissions reporting

- Oxides of nitrogen ($\text{NO}_x$) emissions generated from boiler combustion

- During 2015:
  - Total $\text{SO}_2$ emissions were 0.011 tonnes
  - Total $\text{NO}_x$ emissions ($\text{NO}_2$ equivalent) were 11.35 tonnes
Subsection 3.1.2

7-9) Environmental & Compliance
Environmental Summary

- No environmental events to report
Non-compliance

**WP3 startup venting**

- Venting started on May 4, 2015 for 26P03 and June 9, 2015 for 26I03
- Venting ceased on December 31, 2015 for 26P03 and January 20, 2015 for 26I03
- Total vent volumes in 2015 from 26I03 and 26P03 is 6.0 $e^{3}m^{3}$

- AER notified of venting May 22, 2015
- Met all reporting requirements following initial notification
- No regulatory enforcement as a result of the non-compliance
Subsection 3.1.2

10) Future Plans
Future Plans

- Temporary suspension and preservation of SAGD pilot facility in Q1 2016
  - Plans to restart SAGD Pilot in the future

- May require additional facility tie-ins for WP3 restart

- OTSG compliance with the updated CSA B.149.3 code
  - Upgrades to Burner Management Systems (BMS), PLC, valving, and instrumentation required
  - Boiler and economizer inspections
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**ECA ECOG A8 BRINT 8-10-82-23**

100/08-10-082-23W4  LSD 8-10-82-23W4M

**Conductor:**
Landed at 20 m KB / 244.5mm

**Intermediate Casing:**
139.7 mm, 25.30 kg/m, K-55
Landed at 342.5 mKB
Cemented to surface with Thermal Cement 2.0m3 of returns

**Secondary Intermediate Casing:**
88.9 mm, 13.84 kg/m, J-55
Landed at 327.26 mKB
Cemented to surface with Thermal Cement 6.1m3 of returns

**Tubing String:**
31.8mm, 1.697kg/m, Galvanized Steel
Landed at 193.21mKB
ESP Pump - 193.21-194.21mKB (Pressure/Temperature sensor for fluid level calculation @ 193.75mKB)

**Perforations:**
254-256mKB
263-267 mKB
276-280 mKB

**PBTD Cement Top in Secondary Intermediate Casing @ 326.9 mKB**

**Intended Purpose:**
Pressure (Fluid Level), Temperature, Water quality monitoring of Grand Rapids B aquifer
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

ECA ECOG A9 BRINT 9-10-82-23

100/09-10-082-23W4 LSD 9-10-82-23W4M

KB = 608.9 mKB
GRD = 605.1 mKB
PBTD = 308.4 mKB

Conductor:
Landed at 20 m KB / 244.5mm

Intermediate Casing:
139.7 mm, 25.30 kg/m, K-55
Landed at 337.0 mKB
Cemented to surface with Thermal Cement 2.0m³ of returns

Secondary Intermediate Casing:
88.9 mm, 13.84 kg/m, J-55
Landed at 321.30 mKB
Cemented to surface with Thermal Cement 2.0m³ of returns

Tubing String:
31.8mm, 1.697kg/m, Galvanized Steel
Landed at 188mKB
ESP Pump - 193.21-196.78mKB (Pressure/Temperature sensor for fluid level calculation @ 196.32mKB)
Pressure/Temperature sensor for fluid level calculation suspended on cable and landed @ 257.0mKB

Perforations:
257-259mKB
266-270 mKB
276-280 mKB

PBTD Cement Top in Secondary Intermediate Casing @ 308.4 mKB

Intended Purpose:
Pressure (Fluid Level) and Temperature monitoring of Grand Rapids B aquifer

April 2016
**Conductor:**
Landed at 20 m KB / 406.4mm

**Surface Casing:**
- 177.8 mm, 25.30 kg/m, H-40
- Landed at 99.5 mKB
- Cemented to surface with Thermal Cement 1.0m3 of returns

**Intermediate Casing:**
- 114.3 mm, 17.26 kg/m, L-80
- Landed at 335.9 mKB
- Cemented to surface with Thermal Cement 4.0m3 of returns

**Tubing String:**
- 31.8mm, 1.697kg/m, Galvonomized Steel
- Landed at 194.35mKB
- ESP Pump - 194.35 - 195.35mKB (Pressure/Temperature sensor for fluid level calculation @ 193.89mKB)

**Perforations:**
- 253-255 mKB
- 263-267 mKB
- 277-281 mKB

**Intended Purpose:**
- Pressure (Fluid Level), Temperature, Water quality monitoring of Grand Rapids B aquifer
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE 2C13 BRINT 13-2-82-23**

**103/13-02-082-23W4**  **LSD 13-2-82-23W4M**

<table>
<thead>
<tr>
<th>KB=</th>
<th>601.2 mKB</th>
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<tbody>
<tr>
<td>GRD=</td>
<td>596.9 mKB</td>
</tr>
<tr>
<td>PBTD=</td>
<td>328.0 mKB</td>
</tr>
</tbody>
</table>

**Conductor:**
- Landed at 20 m KB / 406.4mm

**Surface Casing:**
- 177.8 mm, 25.30 kg/m, H-40
- Landed at 86.25 mKB
- Cemented to surface with Thermal Cement 1.5m³ of returns

**Intermediate Casing:**
- 114.3 mm, 17.26 kg/m, L-80
- Landed at 328.0 mKB
- Cemented to surface with Thermal Cement 4.0m³ of returns

**Tubing String:**
- 31.8mm, 1.697kg/m, Galvanized Steel
- Landed at 194.05mKB
- ESP Pump - 194.05 - 195.05mKB (Pressure/Temperature sensor for fluid level calculation @ 193.77mKB)

**Perforations:**
- 246-248 mKB
- 256-260 mKB
- 279-277 mKB

**Intended Purpose:**
- Pressure (Fluid Level), Temperature, Water quality monitoring of Grand Rapids B aquifer

April 2016
### ECA ECOG B3 BRINT 3-11-82-23

#### 102/03-11-082-23W4 LSD 3-11-82-23W4M

<table>
<thead>
<tr>
<th>KB</th>
<th>611.7 mKB</th>
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</thead>
<tbody>
<tr>
<td>GRD</td>
<td>607.9 mKB</td>
</tr>
<tr>
<td>PBTD</td>
<td>326.0 mKB</td>
</tr>
</tbody>
</table>

#### Conductor:
- Landed at 20 m KB / 244.5mm

#### Intermediate Casing:
- 139.7 mm, 25.30 kg/m, K-55
- Landed at 345.0 mKB
- Cemented to surface with Thermal Cement 2.0m³ of returns

#### Secondary Intermediate Casing:
- 88.9 mm, 13.84 kg/m, J-55
- Landed at 329.66 mKB
- Cemented to surface with Thermal Cement 2.0m³ of returns

#### Tubing String:
- 38.1mm, 1.697kg/m, Galvanized Steel
- Landed at 149.1mKB
- ESP Pump - 149.1-150.0mKB (Pressure/Temperature sensor for fluid level calculation @ 149.5mKB)

#### Perforations:
- 228-230mKB

#### PBTD Cement Top in Secondary Intermediate Casing @ 326.0 mKB

#### Intended Purpose:
- Pressure (Fluid Level), Temperature, Water quality monitoring of Grand Rapids A aquifer

---

Section 3.1.1 (5c) April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**Conductor:**
Landed at 22 m KB / 244.5mm

**Intermediate Casing:**
177.8 mm, 38.69 kg/m, L-80
Landed at 335.0 mKB
Cemented to surface with Thermal Cement 2.0m³ of returns

**Tubing String:**
31.8mm, 1.697kg/m, Galvanized Steel
Landed at 150.0mKB
ESP Pump - 149.0 - 150.0mKB (Pressure/Temperature sensor for fluid level calculation @ 150.4mKB)

**Perforations:**
196-198 mKB

**Intended Purpose:**
Pressure (Fluid Level), Temperature, Water quality monitoring of Viking aquifer

April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE BRINT 4-27-82-22**

**100/04-27-082-22W4 LSD 4-27-82-22W4M**

**Surface Casing:**
- 177.8 mm, 25.30 kg/m, H-40
- Landed at 166.0 mKB

**Intermediate Casing:**
- 114.3 mm, 22.471 kg/m, L-80
- Landed at 341.0 mKB
- Cemented to surface with Thermal Cement 2.0m³ of returns

**Tubing String:**
- 33.4mm, 2.53kg/m, C-75 Galvanized Steel
- Landed at 111.4 mKB
- ESP Pump - 111.4 mKB (Pressure/Temperature sensor for fluid level calculation @ 110.4mKB)

**Perforations:**
- 197.0-202.0 mKB

**Intended Purpose:**
- Pressure (Fluid Level), Temperature, Water quality monitoring of Tertiary aquifer

April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE WS2 BRINT 13-7-82-22**

**1F2/13-07-082-22W4**  **LSD 13-7-82-22W4M**

**KB= 623.9 mKB**

**GRD= 620.4 mKB**

**PBTD = 191.0 mKB**

---

**Conductor:**
Landed at 20 m KB / 406.4mm

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**Intermediate Casing:**
219.1 mm, 35.72 kg/m, J-55
Landed at 152.0mKB
Cemented to surface with Thermal Cement 2.0m³ of returns

---

**Tubing String:**
88.9mm, 13.69kg/m, J-55
Landed at 132.65mKB
PCP landed @ 127.0mKB (Pressure/Temperature sensor for fluid level calculation @ 97.0mKB)

---

**Liner:**
139.7mm, 29.48kg/m, J-55
0.381mm slot size (15 thou)
Set depth 142.13 - 183 mKB (open hole from 183 - 191 mKB)

---

**Intended Purpose:**
Pressure (Fluid Level), Temperature, Water quality monitoring of Quaternary/Tertiary aquifer (well pumping consistently as it provides fresh water for current Wabiskaw polymer flood in the area)

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April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**2003 Camp Water Supply Well No. 16-07**

**1F1/16-07-082-22W4**  **LSD 16-7-82-22W4M**

**Intermediate Casing:**
- 152.4 mm, Plastic (PVC)
- Landed at 112.2mKB
- Bentonite Chips/Tablets to 106.68mKB

**Tubing String:**
- 31.75mm, Plastic (PVC)
- Landed at 140.0mKB
- ESP landed @ 100.6mKB (Pressure/Temperature sensor for fluid level calculation @ 95.0mKB)

**Liner:**
- 152.4mm, Stainless Steel
- 0.381mm slot size (15 thou)
- Set depth 112.2 - 116.7mKB

**Intended Purpose:**
- Pressure (Fluid Level), Temperature, Water quality monitoring of Quaternary aquifer (well pumping consistently as it provides fresh water Pelican Lake Camp)

April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

CVE BRINT 8-10-82-23

102/08-10-082-23W4 LSD 8-10-82-23W4M

KB= 607.8 mKB
GRD= 603.6 mKB
PBTM = 334.0 mKB

Conductor:
Landed at 22 m KB / 406.4mm

Surface Casing:
219.1 mm, 35.72 kg/m, J-55
Landed at 69.5 mKB
Cemented to surface with Thermal Cement 2.0m3 of returns

Intermediate Casing:
114.3 mm, 17.26 kg/m, L-80
Landed at 333.85 mKB
Cemented to surface with Thermal Cement 4.5m3 of returns

Sensors:
8 Piezometers Cemented to Casing
Pressure/Temperature Sensor Set Depths:
225.0 mKB
228.2 mKB
231.3 mKB
234.4 mKB (Pressure sensor failed)
237.6 mKB (Pressure sensor failed)
240.7 mKB
243.8 mKB
247.0 mKB

Intended Purpose:
Pressure and Temperature through Grand Rapids A steam chamber

Section 3.1.1 (5c) April 2016
### Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE 2B BPRINT 5-11-82-23**

<table>
<thead>
<tr>
<th>103/05-11-082-23W4</th>
<th>LSD 5-11-82-23W4M</th>
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<tbody>
<tr>
<td>KB= 606.4 mKB</td>
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<tr>
<td>GRD= 602.4 mKB</td>
<td></td>
</tr>
<tr>
<td>PBTD = 333.0 mKB</td>
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</tr>
</tbody>
</table>

**Conductor:**
- Landed at 20 mKB / 406.4mm

**Surface Casing:**
- 219.1 mm, 35.72 kg/m, J-55
- Landed at 98.70 mKB
- Cemented to surface with Thermal Cement 3.0m3 of returns

**Intermediate Casing:**
- 114.3 mm, 17.26 kg/m, L-80
- Landed at 332.15 mKB
- Cemented to surface with Thermal Cement 4.0m3 of returns

**Sensors:**
- 8 Piezometers (Pressure) Cemented to Casing
- Pressure Measurement Depths:
  - 224.0 mKB (Pressure sensor failed)
  - 227.1 mKB (Pressure sensor failed)
  - 230.3 mKB
  - 233.4 mKB
  - 236.6 mKB
  - 239.7 mKB
  - 242.9 mKB
  - 246.0 mKB (Pressure sensor failed)

**Intended Purpose:**
- Pressure and Temperature through Grand Rapids A steam chamber
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE B6 BRINT 6-11-82-23**

103/06-11-082-23W4  LSD 6-11-82-23W4M

**Conductor:**
Landed at 25 m KB / 244.5mm

**Intermediate Casing:**
177.8 mm, 38.69 kg/m, L-80
Landed at 339.5 mKB
Cemented to surface with Thermal Cement 2.0m3 of returns

**Tubing String:**
73.0 mm, 9.67kg/m, J-55
Landed at 241.92mKB
Packer to isolate zones landed at 236.49mKB (above packer)
Pressure/Temperature Sensor deployed through tubing landed at 241.6mKB (below packer)

**Perforations:**
228-230 mKB
244-246 mKB

**Intended Purpose:**
Pressure (Fluid Level) and Temperature monitoring of Grand Rapids A zone
## Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

### ECA ECOG B5 BRINT 5-11-82-23

**102/05-11-082-23W4   LSD 5-11-82-23W4M**

<table>
<thead>
<tr>
<th>KB</th>
<th>606.9 mKB</th>
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<tr>
<td>GRD</td>
<td>603.1 mKB</td>
</tr>
<tr>
<td>PBTD</td>
<td>312.7 mKB</td>
</tr>
</tbody>
</table>

### Conductor:
- Landed at 20 mKB / 244.5mm

### Intermediate Casing:
- 139.7 mm, 25.30 kg/m, K-55
- Landed at 339.5 mKB
- Cemented to surface with Thermal Cement 2.0m³ of returns

### Secondary Intermediate Casing:
- 88.9 mm, 13.84 kg/m, J-55
- Landed at 317.9 mKB
- Cemented to surface with Thermal Cement 1.5m³ of returns

### Thermocouple String:
- WIKA 20 Point Thermocouple
- Landed 214.0 - 252.0 mKB
- Each Thermocouple is 2 m apart along the landing depth length

### Intended Purpose:
- Temperature monitoring of Grand Rapids A steam chamber

---

Section 3.1.1 (5c)
### ECA ECOG C13 BRINT 13-2-82-23

**Conductor:**
Landed at 23 mKB / 244.5mm

**Intermediate Casing:**
- Size: 177.8 mm, 38.69 kg/m, L-80
- Landed at 328.0 mKB
- Cemented to surface with Thermal Cement
- 2.0m3 of returns

**Thermocouple String:**
- WIKA 20 Point Thermocouple
- Landed 209.0 - 247.0 mKB
- Each Thermocouple is 2 m apart along the landing depth length

**Intended Purpose:**
- Temperature monitoring of Grand Rapids A steam chamber

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**Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic**

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**Section 3.1.1 (5c)**
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE BRINTNELL 12-2-82-23**

103/12-02-082-23W4   LSD 12-2-82-23W4M

- **Conductor:**
  - Landed at 24.2 m KB / 406.4mm

- **Surface Casing:**
  - 177.8 mm, 25.30 kg/m, H-40
  - Landed at 86.25 mKB
  - Cemented to surface with Thermal Cement 2.0m3 of returns

- **Intermediate Casing:**
  - 114.3 mm, 17.26 kg/m, L-80
  - Landed at 324.0 mKB
  - Cemented to surface with Thermal Cement 1.0m3 of returns

- **Thermocouple String:**
  - WIKA 20 Point Thermocouple
  - Landed 209.0 - 247.0 mKB
  - Each Thermocouple is 2 m apart along the landing depth length

- **Intended Purpose:**
  - Temperature monitoring of Grand Rapids A steam chamber

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Section 3.1.1 (5c)  
April 2016  
98
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE BRINT 1-10-82-23**

100/01-10-082-23W4   LSD 1-10-82-23W4M

**KB=** 607.1 mKB  
**GRD=** 603.0 mKB  
**PBTD =** 334.0 mKB

**Surface Casing:**
- 219.1 mm, 35.72 kg/m, J-55
- Landed at 117 mKB
- Cemented to surface with Thermal Cement 4.0m3 of returns

**Intermediate Casing:**
- 114.3 mm, 17.26 kg/m, L-80
- Landed at 334 mKB
- Cemented to surface with Thermal Cement 3.0m3 of returns

**Sensors:**
- 8 Piezometers Cemented to Casing
- Pressure/Temperature Sensor Set Depths:
  - 221.1.0 mKB
  - 225.8 mKB
  - 228.8 mKB
  - 231.9 mKB
  - 235.0 mKB
  - 237.7 mKB
  - 240.5 mKB
  - 243.0 mKB

**Intended Purpose:**
- Pressure and Temperature through Grand Rapids A steam chamber

Section 3.1.1 (5c)  
April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

CVE BRINT 16-3-82-23

102/16-03-082-23W4 LSD 16-3-82-23W4M

KB = 602.0 mKB
GRD = 597.9 mKB
PBT = 329.0 mKB

Surface Casing:
219.1 mm, 35.72 kg/m, J-55
Landed at 329.0 mKB
Cemented to surface with Thermal Cement 3.0m3 of returns

Intermediate Casing:
114.3 mm, 17.26 kg/m, L-80
Landed at 329.0 mKB
Cemented to surface with Thermal Cement 3.0m3 of returns

Sensors:
8 Piezometers Cemented to Casing
Pressure/Temperature Sensor Set Depths:
214.6 mKB
217.2 mKB
221.0 mKB
223.0 mKB
227.0 mKB
228.8 mKB
232.0 mKB
235.2 mKB

Intended Purpose:
Pressure and Temperature through Grand Rapids A steam chamber

Section 3.1.1 (5c)
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

CVE BRINT 9-3-82-23

100/09-03-082-23W4  LSD 9-3-82-23W4M

Surface Casing:
219.1 mm, 35.72 kg/m, J-55
Landed at 119.0 mKB
Cemented to surface with Thermal Cement 3.0m3 of returns

Intermediate Casing:
114.3 mm, 17.26 kg/m, L-80
Landed at 325.0 mKB
Cemented to surface with Thermal Cement 3.0m3 of returns

Sensors:
8 Piezometers Cemented to Casing
Pressure/Temperature Sensor Set Depths:
211.1 mKB
213.6 mKB
218.1 mKB
221.9 mKB
226.3 mKB
228.9 mKB
232.9 mKB
236.1 mKB

Intended Purpose:
Pressure and Temperature through Grand Rapids A steam chamber

Section 3.1.1 (5c)  April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**CVE BRINT 16-3-82-23**

**100/16-03-O82-23W4 LSD 16-3-82-23W4M**

Real Time Pressure & Temperature gauge at Wellhead

- **KB=** 602.0 mKB
- **GRD=** 598.1 mKB
- **PBTM =** 432.2 mKB

**Surface Casing:**
219.1 mm, 35.72 kg/m, J-55
Landed at 105 mKB
Cemented to surface with Thermal Cement

**Intermediate Casing:**
139.7mm, 23.067 kg/m, J-55
Landed at 432.2 mKB
Cemented to surface with Thermal Cement 3.0m³ of returns

**Sensors:**
- 10 points Acoustic fibre and 34 Thermocouples (Temperature) Hang off
- Temperature Sensor Set Depths:
  - 216.0 mKB - 250 mKB (Temperature every meter)
  - Acoustic Fibre Sensor Set Depths:
    - 0.0 mKB - 250 mKB (Acoustic point every 25 meter)

**Intended Purpose:**
Acoustic Fibre through out wellbore to measure noise and Temperature through Grand Rapids A steam chamber - Non thermal casing with thermal cement monitoring wellbore

April 2016
Appendix: Pelican Lake SAGD Pilot Observation Wellbore Schematic

**Conductor:**
Landed at 20 mKBD / 405.4mm

**Surface Casing:**
177.8 mm, 25.3 kg/m, H-40
Landed at 95.00 mKBD
Cemented to surface with Thermal Cement 3.0m³ of returns

**Intermediate Casing:**
101.6 mm, 17.25 kg/m, L-50
Landed at 945.00 mKBD
Cemented to surface with Thermal Cement 4.0m³ of returns

**Sensors:**
Pressure and Temperature Sensitive Depth:
Landed 204.0-248.0 mKBD.
Each thermocouple is 2 m apart along the landing depth.

**Intended Purpose:**
Pressure and Temperature through Grand Rapids A steam chamber

April 2016