AER 2014 Annual Presentation

Germain Grand Rapids Commercial Demonstration Project (Phase 1)
AER Approval 11509

September 16, 2014
Agenda

- Background / History
- Project Overview
- Geological Update
- Resource Recovery
- Facility Update
- Compliance
Germain Phase 1- AER Approval 11509

Subsection 3.1.1
Subsurface Issues Related to Resource Evaluation and Recovery

September 16, 2014
Background

- Amendment No. 1786518 filed Jan 24, 2014
  - Approval No. 11509F received Jan 26, 2014
  - WP 7 solvent soak start-up strategy

- Addition of a temporary centrifuge unit March 3, 2014

- Amendment No. 1780786 filed Nov 27, 2013
  - Approval No. 11509G received Mar 13, 2014
  - NCG injection for upper transition zone (UTZ) pressure management

- Amendment No. 1800526 filed Jun 26, 2014
  - Approval No. 11509H received Jul 29, 2014
  - Well trajectory modifications of well-pairs 1, 2, 3, 4, 5, 6
Scheme Description

• Commercial Demonstration Project (Phase 1)
  – 5,000 bpd facility using Laricina’s SC-SAGD process
  – Incorporates water recycle
• Delineation at Germain provides a high degree of geological confidence
  – **Grand Rapids** (primary target): 172 delineation wells and 11.2 km$^2$ 3D seismic
  – **Winterburn** (secondary target): 20 delineation wells and 90.1 km 2D seismic

Total Laricina Germain resource:

<table>
<thead>
<tr>
<th>Formation</th>
<th>2P Reserves (bn bbl$^1$)</th>
<th>Best Estimate Contingent Resources (bn bbl$^1$)</th>
<th>Project Design Capacity (bbl/d)$^{(1)}$</th>
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<tbody>
<tr>
<td>Grand Rapids</td>
<td>0.4</td>
<td>0.9</td>
<td>203,000</td>
</tr>
<tr>
<td>Winterburn</td>
<td>-</td>
<td>0.4</td>
<td>55,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.4</strong></td>
<td><strong>1.3</strong></td>
<td><strong>258,500</strong></td>
</tr>
</tbody>
</table>

$^{(1)}$ GLJ Report, effective year end, 2013. "bn" means billion.

Key components of the Germain Project

• Central processing facility
• Single pad with 10 SAGD well-pairs
• Equipment lay down and staging area
• Observation wells, groundwater monitoring wells, water source and disposal wells
• Electrical substation, utility corridor including roads, gathering lines and power lines
• Associated infrastructure such as storage tanks, surface run-off pond, flow lines and construction and operations camps
Phase 1 Overview

- Drilled well-pairs: 10
- Started well-pairs: 7
- Bitumen Rate: 795 m³/day
- Dry Steam Injection: 1,670 m³/day
- Produced Water Recycle: Yes, HLS
- Source Water Wells: 4
- Make-up water (Steady-state): 176 m³/day
- Disposal wells: 3 wells total 338 m³/day
- Steam Generators: 4 x 50 mmBtu/hr
- Well-pair Spacing: 60 m
Geology and Geoscience

Stratigraphic Relationship of the Grand Rapids in the Athabasca Area

Upper Grand Rapids Sand

- ~ 225 m depth
- ~ 7 m thick Joli Fou shale caprock
- Additional ~ 100 m of overlying Colorado (La Biche) shales
- 3 to 8 m thick basal shale

Section 3.1.1(2)
Type Well

**Cutoffs**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Gamma Ray</td>
<td>75 API</td>
</tr>
<tr>
<td>Resistivity</td>
<td>45 ohm-m</td>
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<tr>
<td>Porosity</td>
<td>30% density</td>
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</table>

**Properties (from Core)**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Porosity (%)</th>
<th>Oil Saturation (%)</th>
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<tbody>
<tr>
<td>Upper Transition</td>
<td>33</td>
<td>20-50</td>
</tr>
<tr>
<td>Bitumen Pay</td>
<td>34</td>
<td>50-80</td>
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<tr>
<td>Effective Basal Water</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>Non-assoc. Basal Water</td>
<td>32</td>
<td>0</td>
</tr>
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</table>

**New base of effective basal water**

Section 3.1.1(2e)
Isopach with OBIP

Development Area
- OBIP = 47.2 mmbbl (7.8 \times 10^6 m^3)
- Area = 480 acres
- Avg h = 16.7 m

Operating Portion
- OBIP = 12.9 mmbbl (2.1 \times 10^6 m^3)
- Area = 128 acres
- Avg h = 17.1 m

Average Reservoir Properties
- Porosity = 34%
- So = 68%
- Depth = 225 m
- Initial Pressure = 1200kPa
- Initial Temperature = 10^{\circ}C
- k_v = 1.8D
- k_h = 2.5D

Contour interval = 2 m

Section 3.1.1(2a,2b)
Structure on Porosity Top

Section 3.1.1(2c,2d)

Contour interval = 2 m
Structure on Porosity Base

Section 3.1.1(2c,2d)

September 16, 2014

Contour interval = 2 m

- Project Area
- Developable Area
- Operating Area
Upper Transition Zone Thickness

Section 3.1.1(2c,2d)

Contour interval = 1 m
Top of Bitumen - Subsea Elevation

Contour interval = 2 m

- Project Area
- Developable Area
- Operating Area

Section 3.1.1(2c,2d)
Base of Bitumen - SS Elevation

Section 3.1.1(2c,2d)

Contour interval = 2 m
Effective Basal Water Thickness
(based on tight layer)

Contour interval = 2 m

Section 3.1.1(2c,2d)
Wells Cored

- No wells cored in 2013/2014
- 19 wells with core over Upper Grand Rapids (UGR)
  - 8 wells have particle size analysis (PSA)
  - 5 wells have XRD and thin sections

Section 3.1.1(2f)
Well placement in the Grand Rapids
• Production wells P1-P6 were targeted above the basal shale with injection wells 5 m above the production wells.

• P1-P6 wells were drilled in this configuration to optimize resource recovery.
• As authorized by AER Approval No. 11509D, the production wells for well-pairs (WP’s)7-10 were placed in the bitumen approximately 1 m above the oil water contact.

• Laricina drilled the WP 7-10 wells in this configuration in order to mitigate the potential effect of swelling clays in the basal water.
Surface Heave Monitoring

- Results from monitoring period May 2012 to May 2014
- Network of 42 corner reflectors
- Initial heave observed near well pad prior to start of steaming
  - Likely to due frost jacking
- Reference reflector CR-REF-5 subsiding since Oct 2013
  - Not due to operations as the reflector is 400 m from the nearest well subject to steam injection
- Historical monthly monitoring
- Quarterly monitoring going forward

Section 3.1.1(2k)
Cap Rock Integrity

- In 2007, a pressure gradient of 15.3 kPa/m was determined based on an injection and leak off test. A gradient of 13 kPa/m was approved.
- A micro-fracture test conducted in winter 2013 measured a minimum stress of 3,200 kPa resulting in a pressure gradient of 18.4 kPa/m.
- Cap rock tests conducted by other operators proximal to the Germain Project provide similar results.

<table>
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<tr>
<th>Project</th>
<th>Test Location</th>
<th>Pressure Gradient (kPa/m)</th>
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<tr>
<td>Laricina Germain</td>
<td>01-06-085-22 W4M</td>
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<td>Koch Muskwa</td>
<td>13-13-84-23 W4M</td>
<td>18.6</td>
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<tr>
<td>Cenovus Pelican</td>
<td>103/06-11-082-23 W4M</td>
<td>21.3</td>
</tr>
<tr>
<td>Cavalier Hoole</td>
<td>100/3-25-81-24 W4</td>
<td>16.7</td>
</tr>
</tbody>
</table>
Grand Rapids Cap Rock Test Summary

- Cap rock tests proximal to the Germain Project Expansion

Section 3.1.1(2m)
Existing Wells

Section 3.1.1(3a)
Seismic Acquisition

- 3D baseline shot in for the project areas in winter of 2012-2013
- First monitor acquired on March 2014
- Subsequent monitor planned for winter 2014-2015

Section 3.1.1(2i, 6a)
Artificial Lift

• Electric Submersible Pumps (ESP)
  – P3/P5/P6 supplied by Baker Hughes
    • Variable frequency drives
    • Pump range between 125-600 m³/d
    • Design temperature of 230°C
  – P7/P8/P9/P10 supplied by GE Oil & Gas
    • Variable frequency drives
    • P8/P9/P10 pump range between 175-600 m³/d
    • Smaller pump installed in P7 with more gas handling equipment
    • Pump range between 100-400 m³/d
    • Design temperature of 230 °C
  – Pump performance has been improving as production ramped up
  – Gas production from the well is greater than originally expected

• No pump failures to date

Section 3.1.1(4a,4b)
Well Instrumentation

• Pressure
  – During warm-up Bottom Hole Pressure (BHP) measurement in injectors and producers via pressure transmitters on casing lines
  – Casing lines are equipped with fuel gas blankets
  – BHP measured at well toe in producers via pressure gauge at the end of the temperature fiber string
  – BHP measured at well heel in producers via pressure gauge at ESP suction

• Temperature
  – Forty point temperature fiber in producer lateral section
  – A single thermocouple is located at the pump suction
Scheme Performance
Project Activities

- Germain Phase 1 started up in Jun 2013, with initial conversion in Sep 2013
- Start-up and ramp-up in production delayed due to
  - Third party natural gas line break in Oct 2013
  - Subsequent turnaround due to emulsion and water treatment sludge incursion into the de-oiling train
- Plant operations have been steady since Jan 2013
- Ramped-up steam to seven well-pairs
  - 3 producer in basal water: WP 3, 5 & 6
  - 4 with producers in bitumen: WP 7-10
- Well-pairs with basal water producers have been inactive since end of May due to placement
- Four well-pairs with producers in the bitumen are producing after conversion to SAGD

Section 3.1.1(7)
Total Production

Germain Project Performance

- TCPL pipeline rupture & plant shut-down (7 days)
- Plant turnaround (20 days)
- Plant turnaround (7 days)

Next steps:
- Plant turnaround (20 days)
- TCPL pipeline rupture & plant shut-down (7 days)
- Plant turnaround (7 days)

Section 3.1.1(7)
September 16, 2014
Well-pair Start-Up

- Seven well-pairs have been started-up
- To mitigate potential clay swelling, wet steam was injected into P5 & P6
  - OTSG blowdown was injected with steam
  - No signs of swelling apparent in these wells
- Up to 60% fluid losses in WP 7-10 during circulation
- Conversion criteria was conformance & flow/pressure communication

<table>
<thead>
<tr>
<th></th>
<th>WP 3</th>
<th>WP 5</th>
<th>WP 6</th>
<th>WP 7</th>
<th>WP 8</th>
<th>WP 9</th>
<th>WP 10</th>
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<td>Circulate</td>
<td>Circulate</td>
<td>Circulate</td>
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<tr>
<td>Producer Warm Up Method</td>
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<td>Circulate</td>
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<td>Warm Up Duration (Days)¹</td>
<td>97</td>
<td>60</td>
<td>57</td>
<td>162</td>
<td>217</td>
<td>123</td>
<td>176</td>
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<tr>
<td>Warm Up Steam Injected (Sm³ CWE)</td>
<td>10,900</td>
<td>12,500</td>
<td>11,200</td>
<td>27,000</td>
<td>36,100</td>
<td>20,000</td>
<td>27,000</td>
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<tr>
<td>Solvent Injection During Warm Up (m³)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>110</td>
<td>30</td>
<td>0</td>
<td>35</td>
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</tbody>
</table>

Notes:
1. Exclusive of plant outage durations and includes recovery time after outages
Basal Water Well-pair Performance

Basal Water Wells Performance

- TCPL pipeline rupture & plant shut-down (7 days)
- Plant turnaround (20 days)
- Wells inactive

Rate (m$^3$/d)

CSOR & FSR (%) and Well Count

- Steam
- Oil
- Water
- CSOR
- FSR
- Active Basal Water Production Well Count

Section 3.1.1(7)

September 16, 2014

NEXT STEPS
Basal Water Well-pair Performance

• Basal producer well-pairs have not met expectations
• A review of well placement, cuttings and logs from the horizontals, and the 4D seismic indicate the following:
  – Well-pairs are likely located 1-2 m lower than surveyed
  – There is a continuous mudstone/tight sand layer across Phase 1
  – Producers appear to go in/out of this layer with most of the lateral below the mudstone
  – This mudstone/tight sand layer has acted as a barrier and prevented bitumen production
• Laricina obtained approval to re-drill the basal water well-pairs above this layer
Horizontal Barriers at Observation Wells
WP 5 Producer Placement & Tight Layer

Injector/Producer location based on horizontal well log interpretation

Injector/Producer location based on survey TVD at OBS

Section 3.1.1(7)
Scheme Performance
Thermal Growth at Observation Wells

A convective layer flanked by sharp conduction front below, demonstrating a barrier.

- Injector/Producer location based on horizontal well log interpretation
- Injector/Producer location based on survey TVD at observation well
Producer Horizontal Temperature Profiles

- Well-pair 6
- Well-pair 5
- Well-pair 3

Section 3.1.1(7b)

September 16, 2014
4D Seismic Along Basal Water Well-pairs

- Monitor March 2014
- Chamber conformance is excellent along wells
- Limited to 2-3 m vertical growth at the injectors
- Chamber not reaching producers, there is a barrier in the bitumen between the producer and injector
• Observations/interpretation
  – An identifiable zone attributed to the appearance of a gas/vapour phase
  – Lateral spreading of the zone between well-pairs along an interface
  – The lateral portions of the zone is likely gas and not steam as steam temperatures are not observed at the observation wells near well-pair 5
Well-pair 6 Performance

Section 3.1.1(7)

~ 200m of well producing

Cold water below barrier dominating flow

Shut-in Temperature Profile
(Reservoir Temperature Behind Pipe)

Production based on delta T

Clean Orange Sand

Flowing Temp.

NEXT STEPS

September 16, 2014
Basal Water Well-pair Conclusions

- Mudstone/tight sand layer is a flow barrier
- Producers go in/out of this layer with majority of the laterals below it
- Clean sand zones where no barriers exist show production; evidence that basal producers work
- The mudstone/tight sand layer is the new base of SAGD

Section 3.1.1(7b)
Bitumen Producer Well-pairs

• WPs 8, 9, & 10 are on SAGD and WP 7 was converted to SAGD in August 2014

• Circulation and start-up times have been impacted by plant downtime, key observations during start-up include:
  – Circulation pressures were higher than desired due to facility limitations
  – Pressures were higher than original pressure, resulting in fluid leak off, wells showed 40-60% fluid loss
  – Higher pressures results in lower bitumen production during circulation
  – There was a measurable benefit from the solvent soaks

• Well-pairs showed early communication with the UTZ, evidenced by lower than expected fluid returns

• Improved fluid returns through:
  – Starting NCG co-injection to limit steam losses to the UTZ
  – Reduced chamber pressures to equalize between the chamber and adjacent zones in order to limit steam losses to the UTZ

Section 3.1.1(7)
Bitumen Producer Well-pairs

**Bitumen Wells Performance**

- **TCPL pipeline rupture & plant shut-down (7 days)**
- **Temp. logs on WP 8 and WP 10, WP 9 converted to SAGD**
- **WP 8 and WP 10 converted to SAGD**
- **Plant turnaround (7 days)**
- **Plant turnaround (20 days)**

**Section 3.1.1(7)**

September 16, 2014
WP 9 Performance - Improved with Gas Co-Injection

WP 9 Performance

Section 3.1.1(7)

September 16, 2014

NEXT STEPS
WP 10 Performance

WP 10 Performance

TCPL pipeline rupture & plant shut-down (7 days)

Temperatures Logs

Converted to SAGD

Plant turnaround (7 days)

Plant turnaround (20 days)

TCPL pipeline rupture & plant shut-down (7 days)

Temperature Logs

Converted to SAGD

Plant turnaround (7 days)

Plant turnaround (20 days)

Steam

Oil

Water

CSOR

FSR

ISOR

Section 3.1.1(7)

September 16, 2014

NEXT STEPS
WP 8 Performance

**WP 8 Performance**

- TCPL pipeline rupture & plant shut-down (7 days)
- Plant turnaround (20 days)
- Temperature Logs
- Converted to SAGD

**NEXT STEPS**

- Plant turnaround (7 days)
- Temperature Logs

**Section 3.1.1(7)**

September 16, 2014
4D Seismic- Well-pairs above OWC

- Well-pairs above the oil-water-contact (OWC)
  - Early in the process in March, limited chamber growth
  - Suggestions of connection to upper transition zone (UTZ) in WP 8

**WP 8**

![Gas/vapour chamber](image)

**WP 9**

**WP 10**
Communication with UTZ

WP 8

Gas/vapour chamber into UTZ

Cross Section

Gas/vapour chamber into UTZ

WP 10 WP 9 WP 8 WP 3

Pockets of gas indicated connection of WP 8 to UTZ

Section 3.1.1(6b)
Well-pair Horizontal Temperatures

Well-pair 9

Well-pair 10

Well-pair 8

Note: WP7 converted in August

Section 3.1.1(7d)
Reservoir Pressure

- Chamber pressures were reduced to minimize steam losses to the UTZ
  - Balance pressures between UTZ and basal water
Bitumen Well-pairs - Production vs Forecasts

- Production continues to ramp-up in well-pairs 8, 9, and 10
- Production volumes and SOR tracking current forecast
- Daily production per well-pair ~230+ bbl/d
- iSOR per well-pair ~3.5 – 6.0
- Co-injecting methane gas into the upper transition zone in two well-pairs to manage pressure and improve fluid-to-steam ratio

* Laricina forecast and monthly average production as at August 31, 2014. WP refers to well-pair.
Steam Properties and Co-injection

- Steam Injected properties: 3,000 kPag @ 235ºC header conditions, 99% quality
- Non-condensable gas co-injection
  - Methane @ 0.7-1.5% mole fraction

**Graph:**

**Total Steam Usage**

- Axis X: Month (May-13 to Aug-14)
- Axis Y: Rate (m³/d)

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Section 3.1.1(7d,7e)
Summary of Key Scheme Insights

• Basal water producer well-pairs
  – No signs of swelling clays as evidenced by no localized injectivity issues
  – Start-up within 60 days as evidenced by pressure communication
  – Wells appear to be landed lower than planned and did not perform due to a tight layer located between the injector and producer
  – Portion of well-pairs located in clean basal water sand between injector and producer show production
  – Lessons learned are being used in characterization of a new base of SAGD

• SAGD production with bitumen producers is ramping up

• Upper transition zone is being managed through changes in operating pressure and using gas co-injection

• After establishing a SAGD baseline production, well-pairs will be converted to SC-SAGD with diluent injection
Future Plans

• Ramp-up production/injection rates to operating wells
  – Target SAGD injection rates per well is 240-280 m$^3$/d

• Convert WP 7 to SAGD (completed Aug 9$^{th}$)

• Commence SC-SAGD (solvent injection)
  – SC-SAGD has started in August into WP 10
  – Solvent injection will start in other well-pairs contingent upon well-pair performance

• Short-term plan is to re-drill one or two of the well-pairs drilled with producers in the basal water
Subsection 3.1.2
Surface Operations, Compliance, and Issues Not Related to Resource Evaluation and Recovery

September 16, 2014
Section 3.1.2(1a)
Facility – Key Events

- Plant started-up June 2013
- TCPL line break October 2013
- Emulsion excursion into the water treatment train in November 2013
- Unplanned turnaround in December 2013 as a direct result of the emulsion excursion
- Steaming re-started in late December 2013
- Ramping up bitumen treating and water treating operations throughout 2014
- Plant turnaround June 2014, repaired hot lime softener (HLS)
- WAC liner replacement planned for September
- Implement dirty backwash water recycle planned for October
Facility Performance

Bitumen treating
- Consistent treatment of produced bitumen was achieved with BS&W of <0.5 % and density of 960 kg/m³

Water treatment
- HLS commissioned October 2013
  - Currently treating 800-900 m³/d
- HLS design & operating issues
  - Emulsion incursion into the water treating system
  - Cold source water impacted performance
  - Issues with forming and maintaining the HLS bed
  - Modifications completed to improve operating performance
- Poor HLS performance increased the carryover volumes available for disposal
- Source water contains solution gas (with no detectable H2S) that negatively impacted WAC performance
  - Source water is directed to the Produced Water Tank (PWT) and any evolved gas is collected by the VRU

Section 3.1.2(2a-c)
Facility Performance

Steam Generation

• 4th OTSG commissioned Oct 2013
  – Total capacity = 1,667 tonnes/day
• Currently operating 2 OTSG’s as only 4 WP’s are operating

Additional challenges include:

• Glycol heat trace system balancing issues resulted in freezing of lines
Plant Modifications Section

• Diluent Recovery Unit (DRU) installed spring 2014
• Start-up Tank modifications have been completed to deal with emulsion carry-over
• Water treatment modifications
  – Modified HLS internals to help stabilize bed formation
  – Increased the temperature of the source water entering the Produced Water Tank
• Installation of a bypass line around the disposal stream meter as per the MARP
• Installation of Magnetic Resonance water cut meter for testing
## Facility Power

<table>
<thead>
<tr>
<th>Year</th>
<th>Power Imports (kWh)</th>
<th>Power Generation (kWh)</th>
<th>Power Exports (kWh)</th>
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<tr>
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<td>1,100,350</td>
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<td>October</td>
<td>1,159,620</td>
<td>15,360</td>
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<tr>
<td>November</td>
<td>1,270,340</td>
<td>7,680</td>
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<tr>
<td>December</td>
<td>1,419,950</td>
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<td>January</td>
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<td>March</td>
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<td>July</td>
<td>1,126,030</td>
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Section 3.1.2(2d)
## Facility Gas Production

<table>
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<tr>
<th>2013/2014</th>
<th>Produced Bitumen (m³)</th>
<th>Purchased Gas (10³m³)</th>
<th>Produced Gas (10³m³)</th>
<th>Flared Gas (10³m³)</th>
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<td>0</td>
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<tr>
<td>September</td>
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<td>October</td>
<td>66</td>
<td>1,472</td>
<td>0</td>
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<td>November</td>
<td>69</td>
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<td>December</td>
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<td>March</td>
<td>1,137</td>
<td>3,798</td>
<td>103.5</td>
<td>1.31</td>
</tr>
<tr>
<td>April</td>
<td>1,832</td>
<td>3,376</td>
<td>289.4</td>
<td>3.53</td>
</tr>
<tr>
<td>May</td>
<td>2,254</td>
<td>2,813</td>
<td>375.4</td>
<td>4.48</td>
</tr>
<tr>
<td>June</td>
<td>1,721</td>
<td>1,473</td>
<td>199.1</td>
<td>6.94</td>
</tr>
<tr>
<td>July</td>
<td>3,112</td>
<td>1,837</td>
<td>104.6</td>
<td>0</td>
</tr>
</tbody>
</table>

- Produced gas is recovered and utilized as OTSG fuel

Section 3.1.2(2e)
Summary of Environmental Greenhouse Gas Emissions

- Phase 1 GHG threshold for reporting both provincially & federally is 50 ktonnes CO$_2$e per year
- Laricina added this facility and its emissions in its annual participation in NPRI and CAPP Responsible Canadian Energy reporting
- In 2013 Laricina reported both provincially & federally 28.22 ktonnes CO$_2$e
Measurement and Reporting

- All well-pairs have individual flow measurement installed at the wellhead (Coriolis mass meter) and a manual sample point for water cut determination.
- Each well is deemed to be “on-test” at all times when it is producing.
- Water cuts are measured daily and averaged to estimate the daily produced water and bitumen for each well.
- On-line Magnetic Resonance (MR) water cut meter installed March 2014 to develop a comparison against manual water cuts and evaluate its future use instead of manual cuts.

Section 3.1.2(3a)
Measurement and Reporting

- Proration Factors:
  - Well and facility ramp-up encountered a number of issues
  - Proration accuracy improved as production ramped-up
  - Bitumen well-pair conversion began in February

<table>
<thead>
<tr>
<th>Monthly</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Proration</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Bitumen Proration</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

- Optimization
  - Manual water cuts have been giving monthly proration factors ranging between 0.97 and 1.22
  - Continue to compare MR meter to manual cuts and evaluate this meter as a replacement of manual water cuts

Section 3.1.2(3a,3b)
Measurement and Reporting

- On-line Magnetic Resonance water cut meter comparison against manual water cuts
  - Operator factor represents manual cuts obtained by the operator and demonstrate greater variance
  - The meter allows for real time monitoring of water cuts minimizing error associated with slug flow and operator error in sample collection
  - Goal is to demonstrate that the MR meter is more appropriate for determining water cuts than manual cuts and will eventually replace manual sampling

Section 3.1.2(3c,3d)
As part of our annual MARP update the Phase 1 MARP was submitted February 28, 2014

- Plant metering and instrumentation is being verified and calibrated through commissioning, start-up, and SAGD ramp-up
- An additional update was provided for the MARP in August 2014 to reflect the addition of the Project diluent recovery unit
UWI’s of Source Water Wells and Water Disposal Wells

- Diversion licence (# 00330267-00-00) from ESRD for 4 Grand Rapids source water wells:
  - 07-04-085-22W4, 08-5-085-22W4, 09-04-085-22W4, 02-31-084-22W4
- One Class 1b Disposal Well Approval No. 11544
  - 100/02-31-084-22W4 (Grosmont A Formation)
- Two additional wells have been drilled and approved as 1b wells for disposal Approval No. 11799A
  - 100/07-04-085-22W4 (Grosmont A Formation)
  - 100/09-04-085-22W4 (Grosmont A Formation)
Water Sources and Uses

Produced Water % Recycle, FW Make, Produced Water, and Steam Injected

Initial well steaming operations, produced water returns were too low to load the HLS

80% Annual Recycle Requirement

Section 3.1.2(4b-f)
Disposal Wells Performance

• Both disposal wells 00/07-04-085-22W4/00 and 00/09-04-085-22W4/00 completed in the Grosmont A disposal zone are operating at low pressures and are often under vacuum conditions.

• Intermittent sludge disposal from the HLS began end of August 2013 with no pressure increase noted at the disposal wellhead.

• The 100/02-31-084-22W4 well was not utilized in 2013/2014.

Section 3.1.2(4h)
Sulphur Production

- Project is approved for 0.2 tonnes/day SO$_2$. To date the facility has emitted from 0 to <0.06 tonnes/day SO$_2$
- Emission monitoring – Stack Sampling & Analysis occurred in March 2014 and again in July 2014 due to a NOx rate issue with the glycol trim heater - sampling and verification of emission rates met approval criteria
- Passive sampling monitors continue to demonstrate that the Germain Phase 1 is well within allowable limits for SO$_2$ and H$_2$S
- Sulphur production remains well below the 1 t/cd

<table>
<thead>
<tr>
<th>Sulphur Compliance</th>
<th>Total Monthly Production (kg/month)</th>
<th>Average daily Production (kg/cd)</th>
<th>Average daily Production (t/cd)</th>
<th>Quarterly Sulphur Production (t/cd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul-13</td>
<td>561</td>
<td>19.3</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Aug-13</td>
<td>753</td>
<td>24.3</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Sep-13</td>
<td>867</td>
<td>28.9</td>
<td>0.03</td>
<td></td>
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<tr>
<td>Oct-13</td>
<td>710</td>
<td>22.9</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Nov-13</td>
<td>668</td>
<td>22.3</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Dec-13</td>
<td>526</td>
<td>17.0</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Jan-14</td>
<td>1331</td>
<td>42.9</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Feb-14</td>
<td>1376</td>
<td>49.1</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Mar-14</td>
<td>1741</td>
<td>56.2</td>
<td>0.06</td>
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<td>Apr-14</td>
<td>1501</td>
<td>50.0</td>
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</tr>
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<td>May-14</td>
<td>1256</td>
<td>40.5</td>
<td>0.04</td>
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<td>Jun-14</td>
<td>574</td>
<td>19.1</td>
<td>0.02</td>
<td>0.04</td>
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<td>Jul-14</td>
<td>767</td>
<td>24.7</td>
<td>0.02</td>
<td></td>
</tr>
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</table>

Section 3.1.2(5b-d)
Summary of Environmental Issues

• 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 21 events had been reported to AER
• All action items with respect to non-compliances have been finalized
• Laricina continues to be proactive in communications with regulatory agencies to maintain transparency and provide self disclosures where applicable
Environmental Issues

• Water Act Licence # 00330267-00-00 from ESRD for 4 Grand Rapids source water wells:
  – Maximum annual diversion of 300,000 m³
  – 07-04-85-22W4, 08-5-85-22W4, 09-04-85-22W4, 02-31-084-22W4
  – In 2013 the facility utilized 148,000 m³ of water withdrawn from the water source wells

• Groundwater sampling continues as per the management plan with no changes in water quality observed to date

• The 2013 Annual Groundwater Monitoring Program Summary Report was submitted for review in March of 2014. All sampling was completed as per the submitted report.

Section 3.1.2(6b, 6c)
Environmental Issues

• The 2013 Annual Groundwater Monitoring Program Summary Report was submitted for review in March of 2014.

• Following recompletion in the 01-04 well, sampling identified non-representative chemistry in the Viking Formation and the MGR Formation as a result of drilling and completion activities.

• This issue was discussed with the AER in March 2012.

• Groundwater sample analysis from the Viking Formation in 2013 indicate that the chemistry remains non-representative.
Environmental Issues

• Groundwater sample analysis from the Viking Formation in May 2013 indicates that the chemistry remains non-representative

• During August and October sampling, it became apparent that there was a mechanical issue with the sampling equipment for the MGR

• Resulted in limited sample volumes collected and the full suite of analysis not being completed for the Fall event

• Mechanical issues with the sampler and sampling from the MGR are being addressed in 2014
# Summary of Compliance Issues

<table>
<thead>
<tr>
<th>Brief Description</th>
<th>Corrective Actions Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Reportable Releases</td>
<td>Reported to the AER. Corrective action completed on all releases.</td>
</tr>
<tr>
<td>Start-up Tank Liner Integrity Issues</td>
<td>Reported to the AER and subsequently repaired.</td>
</tr>
<tr>
<td>Sheen on parking lot runoff water</td>
<td>Reported to the AER. Corrective action completed on parking lot runoff management.</td>
</tr>
<tr>
<td>NOx emissions issue during compliance testing</td>
<td>Reported to the AER. Corrective action completed on equipment to meet design output NOx.</td>
</tr>
<tr>
<td>Missed deadline for submission of the Fugitive Emissions Monitoring Proposal</td>
<td>Issued follow-up letter to the AER and working to complete corrective actions.</td>
</tr>
</tbody>
</table>

**Section 3.1.2(6)**
The Germain Phase 1 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)
Forward-looking Statements Advisory

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. “iSOR” means instantaneous steam-oil ratio. “CDOR” means calendar day oil rate. “bbl” means barrel. “bn” means billions. “m” means metres. “mm” means million. “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. “Dkeff” 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$).
Contact Us

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800, 425 – 1st Street SW
Calgary, Alberta T2P 3L8

403-750-0810

www.laricinaenergy.com
laricina@laricinaenergy.com
Injectors contain no instrumentation, injection pressure measured via casing blanket gas

Section 3.1.1(3c)
Producers contain no instrumentation during warm-up, injection pressure measured via casing blanket gas

Section 3.1.1(3c)
Production Well Schematic – Producing

Producer During SAGD and SC-SAGD

- 406.4 or 339.7mm Surface Casing
- 244.5mm Intermediate Casing
- Tubing to heel with ESP
- Slotted or Wire-Wrapped Screen
- Scab Liner (Option)
- Guide string to heel
- Coil tubing with fiber optic instrumentation string

Section 3.1.1(3c)
RST Log (100/10-33-084-22W4)
RST Log (100/15-33-084-22W4)
RST Log (102/10-33-084-22W4)
RST Log (102/15-33-084-22W4)
Scheme Performance
Thermal Growth at Observation Wells

Next Steps

Injector/Producer location based on horizontal well log interpretation

Injector/Producer location based on survey TVD at OBS

Section 3.1.2(7b)
Scheme Performance
Thermal Growth at Observation Wells

Section 3.1.2(7b)

- Injector/Producer location based on survey TVD at OBS
Scheme Performance
Thermal Growth at Observation Wells

Section 3.1.2(7b)

Injector/Producer location based on survey TVD at OBS
Scheme Performance
Pressure Response OBS Well

- Injector/Producer location based on horizontal well log interpretation
- Injector/Producer location based on survey TVD at OBS

Section 3.1.2(7b)
Scheme Performance
Pressure Response OBS Well

- Injector/Producer location based on horizontal well log interpretation
- Injector/Producer location based on survey TVD at OBS

Section 3.1.2(7b)
Scheme Performance
Pressure Response OBS Well

Section 3.1.2(7b)

Injector/Producer location based on survey TVD at OBS
Scheme Performance
Pressure Response OBS Well

Gamma Ray (API)
102/10-33-84-22W4

WP10 Toe Obs Well Pressure (1.2m away) 102/10-33-84-22W4

- Injector/Producer location
- based on survey TVD at OBS

Section 3.1.2(7b)
### Observation Well Construction Details

**100/16-33-084-22W4 - Midpoint on P1**

<table>
<thead>
<tr>
<th>ELEV (ma.s.l)</th>
<th>DEPTH (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Elevation</td>
<td>610.22</td>
</tr>
</tbody>
</table>

- **Piezometer**
  - Thermal Cement

- **Casing Shoe**: 516.29, 98.25

- **Piezometer #3**: 407.54, 207.00
  - Thermocouple Spacing: 1.5m, 207m to 218.5m

- **Piezometer #2**: 388.54, 226.00
  - Thermocouple Spacing: 1m, 220m to 234m

- **Piezometer #1**: 380.54, 234.00

- **TD**: 306.54, 308.00
  - Borehole Diameter: 251 mm
  - Surface Casing: 177.8 mm
  - Thread: ST&C
  - Grade: H40
  - Production Casing: 114 mm
  - Thread: QB2
  - Grade: L80
  - Thermal Cement
  - Borehole TD
## Observation Well Construction Details

09-33-084-22W4M - Toe P1

<table>
<thead>
<tr>
<th>Formation</th>
<th>ELEV (masl)</th>
<th>DEPTH (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR=Grand Rapids</td>
<td>610.55</td>
<td></td>
</tr>
</tbody>
</table>

**Piezometer**

**Thermocouple**

- **Borehole Diameter**: 251 mm
- **Surface Casing**: 177.8 mm
- **Thread**: ST&C
- **Grade**: H40
- **Thermal Cement**

<table>
<thead>
<tr>
<th>Casing Shoe</th>
<th>516.36</th>
<th>98.19</th>
</tr>
</thead>
</table>

- **Borehole Diameter**: 159 mm
- **Production Casing**: 114.3 mm
- **Thread**: QB2
- **Grade**: L80

- **Thermocouple Spacing**: 1.5m
  - 205m to 213m
- **Thermocouple Spacing**: 1m
  - 220m to 232m
- **Thermal Cement**

<table>
<thead>
<tr>
<th>Piezometer #3</th>
<th>Upper GR</th>
<th>408.55</th>
<th>206</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Piezometer #2</th>
<th>Upper GR</th>
<th>387.55</th>
<th>227</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Piezometer #1</th>
<th>Upper GR</th>
<th>382.55</th>
<th>232</th>
</tr>
</thead>
</table>

| TD              | 302.22      | 312.33      |

- **Borehole TD**
Observation Well Construction Details
100/02-04-085-22W4M - Heel on P5

<table>
<thead>
<tr>
<th>Formation</th>
<th>ELEV (m asl)</th>
<th>DEPTH (m KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR=Grand Rapids</td>
<td>607.8</td>
<td>3</td>
</tr>
</tbody>
</table>

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

- **Casing Shoe**
  - ELEV: 502.80
  - DEPTH: 108

- **Piezometer #4 Viking Sandstone**
  - ELEV: 434.30
  - DEPTH: 176.5

- **Piezometer #3 Upper GR**
  - ELEV: 409.30
  - DEPTH: 201.5

- **Piezometer #2 Upper GR**
  - ELEV: 393.00
  - DEPTH: 217.8

- **Piezometer #1 Upper GR**
  - ELEV: 386.80
  - DEPTH: 224

- **TD**
  - ELEV: 309.00
  - DEPTH: 301.8

- Borehole Diameter: 251 mm
- Surface Casing: 177.8 mm
- Thread: ST&C
- Grade: H40
- Thermal Cement
- Borehole Diameter: 159 mm
- Production Casing: 114.3 mm
- Thread: QB2
- Grade: L60
- Thermocouple Spacing: 1.5m
- 202m to 215m
- Thermocouple Spacing: 1m
- 217m to 229m
- Thermal Cement
- Borehole TD
### Observation Well Construction Details

**100/15-33-84-22W4M - Midpoint on P5**

<table>
<thead>
<tr>
<th>Formation</th>
<th>ELEV (m)</th>
<th>DEPTH (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR=Grand Rapids</td>
<td>607.49</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Piezometer Thermocouple

- **Casing Shoe**: 515.68, 95.81
- **Piezometer #3 Upper GR**: 408.49, 203
- **Piezometer #2 Upper GR**: 388.49, 223
- **Piezometer #1 Upper GR**: 384.49, 227
- **TD**: 298.49, 313

- **Borehole Diameter**: 261 mm
- **Surface Casing**: 177.8 mm
- **Thread**: ST&C
- **Grade**: H40
- **Thermal Cement**

- **Borehole Diameter**: 159 mm
- **Production Casing**: 114.3 mm
- **Thread**: QB2
- **Grade**: L80
- **Thermocouple Spacing**: 1.5m (199m to 212m)
- **Thermocouple Spacing**: 1m (214m to 226m)

- **Thermal Cement**
- **Borehole TD**
Observation Well Construction Details
100/10-33-84-22W4M - Toe on P5

<table>
<thead>
<tr>
<th>Formation</th>
<th>ELEV</th>
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<tbody>
<tr>
<td>GR=Grand Rapids</td>
<td>608.72</td>
<td>4.2</td>
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</table>

Piezometer
Thermocouple

- Borehole Diameter: 250 mm
- Surface Casing: 177.8 mm
- Thread: ST&C
- Grade: H40
- Thermal Cement

- Borehole Diameter: 159 mm
- Production Casing: 114.3 mm
- Thread: QB2
- Grade: L80
- Thermocouple Spacing: 1.5m
  201m to 214m
- Thermocouple Spacing: 1m
  216m to 228m
- Thermal Cement
- Borehole TD

Casing Shoe
- 515.52
- 97.4

Piezometer #4  Upper GR | 409.92 | 203 |
Piezometer #3  Upper GR | 406.92 | 206 |
Piezometer #2  Upper GR | 389.92 | 223 |
Piezometer #1  Upper GR | 384.92 | 228 |
TD               | 308.18 | 304.74 |
Observation Well Construction Details
102-02-04-065-22W4M - Heel on P10

<table>
<thead>
<tr>
<th>Formation</th>
<th>ELEV (m.a.s.l.)</th>
<th>DEPTH (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR=Grand Rapids</td>
<td>607.3</td>
<td>3</td>
</tr>
<tr>
<td>Casing Shoe</td>
<td>510.55</td>
<td>99.75</td>
</tr>
<tr>
<td>Piezometer #3 Upper GR</td>
<td>408.30</td>
<td>202</td>
</tr>
<tr>
<td>Piezometer #2 Upper GR</td>
<td>392.30</td>
<td>218</td>
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<tr>
<td>Piezometer #1 Upper GR</td>
<td>386.80</td>
<td>223.5</td>
</tr>
<tr>
<td>TD</td>
<td>306.80</td>
<td>303.5</td>
</tr>
</tbody>
</table>

- Borehole Diameter: 251 mm
- Surface Casing: 177.8 mm
- Thread: ST&C
- Grade: H40
- Thermal Cement
- Borehole Diameter: 159 mm
- Production Casing: 114.3 mm
- Thread: GR2
- Grade: L80
- Thermocouple Spacing: 1.5m
  199m to 212m
- Thermocouple Spacing: 1m
  214m to 226m
- Thermal Cement
- Borehole TD
## Laboratory Test Results

**File Number:** 52136-2014-0536  
**Company:** Laricina Energy Ltd.  
**Location:** LEL Germain 9-4-85-22  
**Sample Description:** Source Well  
**Date Sampled:** 2014 04 10  
**Field Temp., °C:**  
**Laboratory ID:** 52136-2014-0536-7  
**Date Received:** 2014 04 11  
**Page No.:** 3

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Result</th>
<th>Units</th>
<th>Test Method</th>
<th>Date Analyzed</th>
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<td>Calcium (Ca)</td>
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<td>Strontium (Sr)</td>
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<td>Bicarbonate (HCO3)</td>
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<tr>
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<td>Hydroxide (OH)</td>
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<td>Sulphate (SO4)</td>
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<td>Nitrate (as N)</td>
<td>&lt;0.050</td>
<td>mg/L</td>
<td>APHA 4110 B</td>
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<td>Reactive Silica (SiO2)</td>
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<td>ALS</td>
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<td>Oil and Grease</td>
<td>1.0</td>
<td>mg/L</td>
<td>Gravimetric</td>
<td>ALS</td>
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<tr>
<td>pH @ 25.0 °C</td>
<td>8.7</td>
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<td>TSS</td>
<td>200</td>
<td>mg/L</td>
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<td>Specific Gravity @15.6 °C</td>
<td>1.0014</td>
<td>nD</td>
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<td>Refractive Index @ 22 °C</td>
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<td>refillometer</td>
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<td>Resistivity @ 25 °C</td>
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<td>Total Hardness as CaCO3</td>
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<td>Titrant Volume at pH 4.5</td>
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# LABORATORY TEST RESULTS

**FILE NUMBER:** 52136-2014-0459  
**COMPANY:** Laricina Energy Ltd.  
**LOCATION:** Laricina Germain 8-4 GCD Facility  
**SAMPLE DESCRIPTION:** Disposal Well 100/09-04-085-22W4/00  
**DATE SAMPL ED:** 2014 03 27  
**DATE RECEIVED:** 2014 03 28  
**FIELD TEMP., °C:**  

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<thead>
<tr>
<th>TEST DESCRIPTION</th>
<th>RESULT</th>
<th>UNITS</th>
<th>TEST METHOD/DETECTION LIMIT</th>
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<th>TECH</th>
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<td>Flash Point*</td>
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<td>°C</td>
<td>ASTM D-93M</td>
<td>09-Apr</td>
<td>ML</td>
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<td>Aluminum (Al)</td>
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<td>Antimony (Sb)</td>
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<td>Barium (Ba)</td>
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<td>Lead (Pb)</td>
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<td>Vanadium (V)</td>
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*Test discontinued, sample started boiling at 100°C
# Laboratory Test Results

**File Number:** 52136-2014-0459  
**Company:** Laricina Energy Ltd.

**Location:** Laricina German 8-4 GCD Facility  
**Sample Description:** Disposal Well 100/09-04-085-22W4/00  
**Date Sampled:** 2014-03-27  
**Field Temp, °C:**  

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<th>Result</th>
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<th>Date Analyzed</th>
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<td>Calg</td>
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<tr>
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<tr>
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<tr>
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<td>07-Apr-14</td>
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<td>Sulphate (SO4)</td>
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<td>TDS @ 110 °C</td>
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<td>TDS @ 180 °C</td>
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<td>Calculation</td>
<td>17-Mar-14</td>
<td>CD</td>
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*Core Laboratories*
4777-93 Avenue
EDMONTON, ALBERTA T5B 2T5
<table>
<thead>
<tr>
<th>TEST DESCRIPTION</th>
<th>RESULT</th>
<th>UNITS</th>
<th>TEST METHOD</th>
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<th>TECH</th>
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<td>Calg</td>
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<tr>
<td>Bicarbonate (HCO3)</td>
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<td>12-Aug-14</td>
<td>IG</td>
</tr>
<tr>
<td>Carbonate (CO3)</td>
<td>0</td>
<td>mg/L</td>
<td>APHA 2320-B</td>
<td>12-Aug-14</td>
<td>IG</td>
</tr>
<tr>
<td>Hydroxide (OH)</td>
<td>0</td>
<td>mg/L</td>
<td>APHA 2320-B</td>
<td>12-Aug-14</td>
<td>IG</td>
</tr>
<tr>
<td>Sulphate (SO4)</td>
<td>73</td>
<td>mg/L</td>
<td>APHA 4500-SO4</td>
<td>12-Aug-14</td>
<td>IG</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>51</td>
<td>mg/L</td>
<td>APHA 4500-ClB</td>
<td>12-Aug-14</td>
<td>IG</td>
</tr>
<tr>
<td>Hydrogen Sulphide (H2S)</td>
<td>N.D.</td>
<td>mg/L</td>
<td>Test Strip</td>
<td>07-Aug-14</td>
<td>IG</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>&lt; 1.0</td>
<td>mg/L</td>
<td>Gravimetric</td>
<td>10-Aug-14</td>
<td>ALS</td>
</tr>
<tr>
<td>Reactive Silica (SiO2)</td>
<td>98.7</td>
<td>mg/L</td>
<td>Color</td>
<td>13-Aug-14</td>
<td>ALS</td>
</tr>
<tr>
<td>pH @ 25.0 °C</td>
<td>8.2</td>
<td>pH units</td>
<td>APHA 4500-H</td>
<td>12-Aug-14</td>
<td>IG</td>
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<tr>
<td>TSS</td>
<td>4</td>
<td>mg/L</td>
<td>APHA 2540-D</td>
<td>07-Aug-14</td>
<td>IG</td>
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<tr>
<td>Specific Gravity @15.6 °C</td>
<td>1.0012</td>
<td>nD</td>
<td>APHA 2520-C</td>
<td>07-Aug-14</td>
<td>IG</td>
</tr>
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<td>Refractive Index @ 23 °C</td>
<td>1.3331</td>
<td>nD</td>
<td>APHA 2510-B</td>
<td>07-Aug-14</td>
<td>IG</td>
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<tr>
<td>Resistivity @ 25 °C</td>
<td>6.357</td>
<td>Ohm-Meters</td>
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<td>TDS @ 110 °C</td>
<td>1070</td>
<td>mg/L</td>
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<td>08-Aug-14</td>
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<tr>
<td>TDS @ 180 °C</td>
<td>965</td>
<td>mg/L</td>
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<td>08-Aug-14</td>
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<tr>
<td>Total Hardness as CaCO3</td>
<td>9.5</td>
<td>mg/L</td>
<td>Calculation</td>
<td>13-Aug-14</td>
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<tr>
<td>Total Alkalinity as CaCO3</td>
<td>785</td>
<td>mg/L</td>
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<td>Titrant Volume at pH 4.5</td>
<td>16.15</td>
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<td>IG</td>
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<td>P Alkalinity as CaCO3</td>
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<td>mg/L</td>
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</tr>
<tr>
<td>Titrant Volume at pH 8.3</td>
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<td>IG</td>
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<tr>
<td>MO Alkalinity as CaCO3</td>
<td>785</td>
<td>mg/L</td>
<td>Calculation</td>
<td>13-Aug-14</td>
<td>IG</td>
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</tbody>
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