3.1.1. Subsurface Issues – Table of Contents

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6. 4D Seismic – slide 44
7. Scheme Performance – slide 47
8. Future Plans – slide 78
1. Brief Background
Project Overview

- ERCB Approval #9835
- 30,000 BOPD SAGD Project
- Clearwater and Grand Rapids Reservoirs
- 9-10º API Bitumen
- Integrated w/ Husky Pipeline & Upgrader
- Project completed in 24 months
- First Steam August 20, 2006
- First Production November 29, 2006
Husky Tucker Project Development Area

- Approval Area:
  - Sections 28, 29, 32 and N/2 of 21 in 064-04 W4M
  - SE ¼ Section 23, SW ¼ Section 21, Section 17 LSD 16 and Section 16 LSD 13
- Initial SAGD development area (Clearwater):
  - Pads A, B, and C
- Project Life Development:
  - Over 140 well pairs
  - 35 year life
- Lower Grand Rapids (LGR) Development Sec 32:
  - Pad GA - 6 well pairs
- D-East:
  - Completed drilling of 5 well pairs
  - 10 additional well pairs to be drilled by end of 2014
Site Overview

- 70 horizontal well pairs:
  - 32 original well pairs
  - 8 well pairs added in 2007
  - 20 well pairs added between 2009 – 2011
  - 5 well pairs added in 2012-2013
  - 5 well pairs added in Q2 of 2014
- Field Facilities – Five well pads, infield pipelines & central pump station
- Central Plant:
  - Emulsion treating
  - Water Treatment – 120,000 bbl/day
  - Steam Generation – 90,000 bbl/day CWE
  - Utilities and Offsites
- Water Source & Disposal Wells
- Metering and Export Pipelines to Cold Lake Terminal
2. Geology / Geosciences
## Average Reservoir Characteristics and OBIP

### CLEARWATER

<table>
<thead>
<tr>
<th>OBIP (X10^6 m³)</th>
<th>Thickness (m)</th>
<th>Φ</th>
<th>So</th>
</tr>
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<tbody>
<tr>
<td>Approval area</td>
<td>72</td>
<td>45</td>
<td>0.31</td>
</tr>
<tr>
<td>Operating portion</td>
<td>27</td>
<td>45</td>
<td>0.31</td>
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</table>

### LOWER GRAND RAPIDS

<table>
<thead>
<tr>
<th>OBIP (X10^6 m³)</th>
<th>Thickness (m)</th>
<th>Φ</th>
<th>So</th>
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</thead>
<tbody>
<tr>
<td>Pad GA</td>
<td>3</td>
<td>30</td>
<td>0.29</td>
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### COLONY

<table>
<thead>
<tr>
<th>OBIP (X10^6 m³)</th>
<th>Thickness (m)</th>
<th>Φ</th>
<th>So</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN Approval Area</td>
<td>2.8</td>
<td>10</td>
<td>0.30</td>
</tr>
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</table>

**Calculation:**

OBIP interval: Top of Formation → oil water contact

\[
OBIP = \text{Area} \times \text{Thickness} \times \Phi \times S_o
\]
Marginal marine deposits consisting of stacked incised valley and shoreface deposits.
Isopach Map of Clearwater SAGD Net Pay

Definition of Net Pay:
Top Clearwater – Top of Transition Zone (So > 50%, $/Φ > 27%)

C.I. = 5 m

Approval Boundary
Lease Boundary
Colony Approval Boundary
2014 well
Structure Map of the Clearwater Base of Net Pay

Approval Boundary
Lease Boundary
Colony Approval Boundary
2014 well
C.I. = 5 mASL
Isopach of Clearwater Bottom Water

Lease Boundary
Colony Approval Boundary
C.I. = 5 m
2014 well
Isopach of Clearwater Transition zone

Lease Boundary
Approval Boundary
Colony Approval Boundary

C.I. = 5 m

2014 well
Isopach Map of Lower Grand Rapids SAGD Net Pay

Definition of Net Pay:
Top Sparky – Base of Pay
(So >50%, Φ >27%)
C.I. = 5 m
Structure Map of the Lower Grand Rapids

- Approval Boundary
- Lease Boundary
- Colony Approval Boundary
- 2014 well

C.I. = 5 mASL
Isopach Lower Grand Rapids Bottom Water

- Approval Boundary
- Lease Boundary
C.I. = 5m
Isopach Lower Grand Rapids Transition Zone
Isopach Map of Colony SAGD Net Pay

Definition of Net Pay:
Colony Top Pay - Colony Channel Base Pay (So >50%, Φ >27%)
C.I. = 2 m
Clearwater Formation Type Log

**Grand Rapids** sand and shale

D Valley
- Dominated by tidal-fluvial channel facies

C Valley
- Dominated by sand flat facies

B Valley
- Dominated by sand flat facies

**Bottom Water**

**Transition Zone**

**Bitumen Zone**

**McMurray** Silt, Sand, Clay

**Correlation**

**Depth**

**Resistivity**

**Porosity**

**GR**

**TV/D**

**Res(S/LOR)**

**MDD**

**SP**

**Res(INH/2)**

**DP**

**Calcite cemented zones**

**Cored Interval**

100/14-28-064-4W400

KB 619.5m

0.75 m
# Sparky Formation Type Log

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Density</th>
<th>Resistivity</th>
<th>Porosity</th>
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<tbody>
<tr>
<td>GR</td>
<td>SP</td>
<td>SP</td>
<td>SP</td>
</tr>
<tr>
<td>0</td>
<td>GAPR 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>10000</td>
<td>0.2</td>
<td>0.000</td>
</tr>
<tr>
<td>600</td>
<td>0.2</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td>0.2</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

---

**Upper Grand Rapids**

- **Colorado Group**: 0 m

---

**Lower Grand Rapids**

- **Clearwater**: 0 m

---

**103/10-32-064-04W400**

- **KB = 623.7 m**

---

**Bitumen saturated channel sand**

- **Top**: 0.75 m

---

**Calcite**

---

**Water sand**

---

**Transition**

---

**Cored Interval**
Cored Wells & Special Core Analysis

- Approval Boundary
- Lease Boundary
- Colony Approval Boundary
- Cored Wells

64-4-W4
Petrographic Analysis – 2013 Update

- Clearwater intervals have been cored at 100/11-26-64-5 and 100/10-25-64-5.
- Grand Rapids interval have been cored at 100/11-26-64-5.

General Petroleum samples are very fine to fine litharenite
- Rex samples are fine to medium grained feldspathic litharenite
- Clearwater samples are very fine to fine grained feldspathic litharenite to litharenite

Clearwater samples are very fine to fine grained litharenite to feldspathic litharenite
Representative Structural N-S Cross-section through the Approval Area
Representative Strike Cross-section through the Sparky Channel
Representative Strike Cross-section through the Colony Channel
Clearwater:
• No issues to date

• Capping shale fracture pressure never exceeded:
  • Shale depth ~ 426 m
  • Measured fracture gradient = 21.8 kPa/m
  • Measured fracture pressure = 9,280 kPa
  • Horizontal fracture regime

• Sandstone dilation pressure properties:
  • Dilation pressure = fracture pressure in sandstone
  • Sand depth ~ 446 m
  • Measured fracture gradient = 16.0 kPa/m
  • Measured fracture pressure = 7,140 kPa
  • Vertical fracture regime

Lower Grand Rapids:
• No issues to date

• Capping shale fracture pressure never exceeded:
  • Shale depth ~ 357 m
  • Measured fracture gradient = 19.9 kPa/m
  • Measured fracture pressure = 7,120 kPa
  • Horizontal fracture regime

• Sandstone dilation pressure properties:
  • Dilation pressure = fracture pressure in sandstone
  • Sand depth ~ 375 m
  • Measured fracture gradient = 16.96 kPa/m
  • Measured fracture pressure = 6,360 kPa
  • Vertical fracture regime
Cap Rock Integrity

- 6 minifrac tests were conducted at 7-31-64-4W4M
- Results in agreement with regional Cold Lake area stress regime
- The Colorado Group shales, the Sparky and Clearwater capping shales are in a horizontal fracture regime
- The Colony MOP was calculated as 80% of the capping shale fracture

<table>
<thead>
<tr>
<th></th>
<th>Depth, m</th>
<th>Min. stress</th>
<th>MPa</th>
<th>kPa/m</th>
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<tr>
<td>Clwt</td>
<td>446.0</td>
<td>7.14</td>
<td>16.01</td>
<td></td>
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<tr>
<td>Clwt Shale</td>
<td>426.2</td>
<td>9.28</td>
<td>21.8</td>
<td></td>
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<tr>
<td>Sparky</td>
<td>375.0</td>
<td>6.36</td>
<td>16.96</td>
<td></td>
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<tr>
<td>Sparky Shale</td>
<td>357.2</td>
<td>7.12</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td>Westgate</td>
<td>252.0</td>
<td>5.22</td>
<td>20.71</td>
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<tr>
<td>Belle Fourche</td>
<td>207.0</td>
<td>4.32</td>
<td>20.87</td>
<td></td>
</tr>
</tbody>
</table>
Surface Heave Monitoring Programs

- No surface heave monitoring programs have been conducted
- Operating near reservoir pressure, therefore unlikely to be any surface heave
- Husky is committed to further investigate the possible extent of surface heave if a change in operating conditions warrant
To delineate the Colony channel, 6.8 km² of seismic data was acquired as an extension to the south of the existing 3D survey.
3. Drilling and Completions
D- East:
- 5 SAGD well pairs were drilled by June 2014
- 10 additional SAGD well pairs will be drilled by the end of 2014

One delineation well (9-26-64-5W4)
SAGD WELL AS-BUILT STICK DIAGRAM - PRODUCER

Well Name: HUSKY A14P COLD LK 13-32-64-4
Updated by GL Shomody - June 19, 2011

Wellhead Data
- KB elevation: 624.53 m
- Ground elevation: 619.77 m
- GL to KB: 4.76 m
- Wellhead Flange

Drilling Data
- True vertical depth ICP (TVD): 477.41 m
- Total measured depth (TMD): 1765 m
- Reservoir zone: Clearwater
- License No.: 0415233

Downhole Equipment

<table>
<thead>
<tr>
<th>ID</th>
<th>OD</th>
<th>Weight</th>
<th>Grade</th>
<th>LT</th>
<th>Top</th>
<th>Bottom</th>
<th>Length</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>kg/m</td>
<td></td>
<td>mKB</td>
<td>mKB</td>
<td>m</td>
<td>dB</td>
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<tr>
<td>1.0</td>
<td>123</td>
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<td>61.11</td>
<td>J55</td>
<td>BTC</td>
<td>175.37</td>
<td>178.01</td>
<td>2.64</td>
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<tr>
<td>3.44</td>
<td>234</td>
<td>59.53</td>
<td>Blue</td>
<td>K55</td>
<td></td>
<td>718.34</td>
<td>719.00</td>
<td>0.66</td>
</tr>
<tr>
<td>1.0</td>
<td>177.1</td>
<td>157.1</td>
<td>Blue</td>
<td>K55</td>
<td>B-SAGD</td>
<td>699.97</td>
<td>699.97</td>
<td>1.00</td>
</tr>
<tr>
<td>0.75</td>
<td>177.8</td>
<td>157.1</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>724.12</td>
<td>1752.25</td>
<td>103.15</td>
</tr>
<tr>
<td>0.75</td>
<td>177.8</td>
<td>157.1</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>1752.63</td>
<td>1752.63</td>
<td>0.00</td>
</tr>
<tr>
<td>0.75</td>
<td>177.8</td>
<td>157.1</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>1752.63</td>
<td>1753.00</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Tubing Strings:
- Primary string: 68.9, 76.0, 13.68, L-60, Hydril 511, 4.76, 1734.09, 1719.22, 176
- Secondary string: 73.0, 62.0, 8.88, L-60, Hydril 511, 4.76, 642.80, 641.63, 66
- Combo coil: Gaslift / LX Data combo coil, 40 sensor points from 729.0 to 1739.0 mKB every 25 m
- Gaslift port: 613.0 mKB

Wellbore Completion:
- 0.56” x 7” Liner Hanger @ 699 m
- 0.014” x 7” K-55, 63.16 kg/m, Blue SAGD Wire Wrapped Screen, 1753.00 m

Upstream:
- 12-1/2” J-55, 81.1 kg/m
- BTC Surface Casings Land @ 198 m

SAGD Well As-Built Diagram: Producer
SAGD Well Planned Diagram: Injector

339.7 mm (13 3/8"), 81.1 kg/m J-55 Surface csg. Landed at +/- 170 m KB

244.5 mm (9 5/8"), 59.53 kg/m, L-80, Intermediate csg. set at 700 m KB +/- 50 m.

Tapered Injection String
114.3x76.0 mm 30.95 kg/m, Hunting VIT to ~30 m from ICP
114.3 mm 17.26 kg/m, Tenaris BTL to ~40 m from FTD

Short Steam Circulation String
(Will not be used after steam circulation phase)
73.0 mm (2 7/8") 9.52 kg/m, J-55 HYDRIL 511 Wedge
C/w Perforated Pup at ~6.5m TVD above ICP, Landed ~30m MD above ICP

Weatherford Shiftable GDA Subs
114.3m m (4 1/2") x 86.9mm landed at ~40 m
& ~385 m MD past ICP

177.8 mm (7") 34.2 kg/m, K-55 Tenaris Blue Slotted liner from 718 to 1450 m KB
(0.020" Straight Cut Slots)

244.5 mm x 177.8 mm Weatherford Liner Hanger
Top Landed at +/- xxx m KB

4-1/2" 40/40 box X 4-1/2" Tenaris pin Cross-over.

TVD: ~467 m KB
MD: ~1510 m KB

Tucker Thermal Project
SAGD Injection Well
March 14, 2014
HUSKY D-PAD COLD LK
(INJECTOR STEAM CIRCULATION)
4. Artificial Lift
Artificial Lift

- All producer wells equipped with gas-lift:
  - Gas-lift operational parameters:
    - Pressure: 2,400 kPa – 4,000 kPa
    - Bottom hole Temperature: 200 – 240 ºC
    - Gas Injection rate: 1,200 – 10,800 m³/day

- Future considerations:
  - Rod pump planned for Colony
5. Instrumentation in Wells
38 OBS wells within approved area:
- 32 OBS Wells with Instrumentation
- 6 Planned OBS Wells in 2014/2015
Instrumentation in OBS & SAGD Wells

- 32 OBS Wells with Instrumentation:
  - 25 Wells: thermocouple only
    - 2 Wells: reinstalled covering Clearwater and Lower Grand Rapids
  - 7 Wells: both thermocouple & piezometer

- 6 Planned OBS Wells (convert existing wells):
  - 2 Wells for D-East:
    - 1 Well: thermocouple only
    - 1 Well: both thermocouple & piezometer
  - 4 Wells for Colony – thermocouples only

- SAGD Injectors – wells use blanket gas to estimate pressure and for insulation

- SAGD Producers – equipped with combo instrumentation coil (gas-lift & thermocouple or fiber)
6. 4D Seismic
4D Seismic Data: Time Lapse Map for 2014 Monitor

- 4D area covers approximately 8 km²
- 2005/2007 3D surveys constitute the baseline survey
- 2014 time delay map shows the “heated zones” after ~6 years of steam injection
- Steam conformance varies across the field
- Analysis of the 2014 monitor indicates a steam chamber height of up to 30m
4D Seismic Data: Time Lapse Map for 2014 Monitor

- 4D area covers approximately 3 km²
- 2005/2007 3D surveys constitute the baseline survey
- 2014 time delay map shows the “heated zones” after ~1.5 years of steam injection
- Steam conformance varies across the field
- Analysis of the 2014 monitor indicates a steam chamber height of up to 4m
7. Scheme Performance
Current performance prediction built on:

- Actual performance
- Analysis of analogous SAGD projects
- Updated geological model supplemented with simulation and analytical models
Production vs. Approval Capacity Variance

• Variable steam chamber development due to:
  • Wells being drilled into the transition zone
  • Poor start-up strategy

• Majority of initial wells were placed in the transition zone where oil saturation is low

• All new well pairs drilled above the transition zone:
  • B-North Infill
  • A-Pad Replacement and Infill
  • C-East
  • GA-Pad
  • D-East

• Initial startup strategy (bull-heading) was not adequate:
  • All new wells were circulated
Production vs. Approval Capacity Variance

- Revised completion of new wells:
  - Dual string completions in both injector and producer
  - Wire-wrapped screens for all new producers to increase open area
  - Blanket gas installed on all wells to provide
    - Insulation
    - Casing protection
    - Down hole pressure measurement
  - VIT will be installed in new injectors
B-North Performance – Low Recovery Example

![Graph showing daily rates and ISOR well count over time with annotations for plant turnarounds and maintenance shutdowns.]
B-North Toe Observation Well

Tucker Observation Well
Temperature vs Depth
110/16-32-064-04W4/00

BH Temperature (deg. C)

Clearwater Top

OWC

Clearwater Base

Vertical Depth (m)

GAMMA RAY (API)

23 meter East of B9 toe
Discussion of B-North Performance

• The producers were drilled in the transition zone

• B-North performance indicators as of 30 June 2014:
  • Cum. Oil : 76,940 m³
  • Cum. Steam Injected: 853,760 m³
  • Cum. Water Produced: 760,510 m³
  • CSOR: 11.10
C-West Performance - Medium Recovery Example

- 2007 plant turnaround
- 2009 plant turnaround
- 2010 plant turnaround
- 2011 plant shut down for maintenance
- Begin perforation
- 2012 plant shut down for maintenance
- 2013 plant shut down for maintenance

Graph showing Daily Rates [m³/d] over time with different events and markers.
C-West Heel Observation Well

Tucker Observation Well
Temperature vs Depth
100/10-29-064-04W4/06

BH Temperature (deg. C)

22 meter South of C3 heel

Clearwater Top

Clearwater Base

OWC

Vertical Depth (m)

GAMMA RAY (API)
Tucker Observation Well
Temperature vs Depth
105/11-29-064-04W4/00

BH Temperature (deg. C)

Vertical Depth (m)

GAMMA RAY (API)

OWC

Cleanwater Base

Clearwater Top

18 meter South of C3 mid

C-West Mid Observation Well
C-West Toe Observation Well

Tucker Observation Well
Temperature vs Depth
106/11-29-064-04W4/00

BH Temperature (deg. C)

19 meter South of C3 toe

Clearwater Top

OWC

Clearwater Base

GAMMA RAY (API)
Discussion of C-West Performance

- The OBS well 22m south of C3 Heel showing steam chamber development for this C-West well

- C-West performance indicators as of 30 June 2014:
  - Cum. Oil : 340,875m³
  - Cum. Steam Injected: 3217,844m³
  - Cum. Water Produced: 2525,491m³
  - CSOR: 9.4

- The producers for these wells were drilled near the oil-water contact
C-East Performance – High Recovery Example

The graph illustrates the daily rates (m³/d) over time from January 2008 to October 2014. Key events marked on the graph include:

- **2009 plant turnaround**
- **2010 plant turnaround**
- **Begin perforation**
- **2011 plant shut down for maintenance**
- **2012 plant shut down for maintenance**
- **2013 plant shut down for maintenance**

The graph also shows the ISOR, Well Count, and other relevant metrics.
C-East Mid Observation Well
C-East Toe Observation Well
Discussion of C-East Performance

- The OBS well 11m north of C13 toe is showing steam chamber development in both horizontal and vertical directions.

- C-East performance indicators as of 30 June 2014:
  - Cum. Oil: 884,669 m³
  - Cum. Steam Injected: 4197,363 m³
  - Cum. Water Produced: 4386,869 m³
  - CSOR: 4.7

- The well placement in this pad was mainly above the transition zone.

- Circulation start-up strategy was successfully implemented.
A-Pad Replacement and Infill Performance

![Graph showing daily rates (m^3/d) and ISOR, Well Count from Jan-2011 to Oct-2014. Key events: 2011 plant shut down for maintenance, 2012 plant shut down for maintenance, 2013 plant shut down for maintenance. Graph lines represent Cal Dry Oil, Cal Dry Water, Cal Inj Steam, ISOR, and Well Count.]
Discussion of A-Pad Replacement and Infill Performance

- Replacement and infill wells have been drilled targeting the base of pay
- Original A-Pad wells (A-1 to A-8) were suspended
- Replacement and Infill well pairs (A9 – A24):
  - 8 replacement, 8 infill

A-Pad replacement and infill performance indicators as of 30 June 2014:
- Cum. Oil : 571,792 m³
- Cum. Steam Injected: 3918,576 m³
- Cum. Water Produced: 4451,410 m³
- CSOR: 6.9
GA-Pad Performance

2012 plant shut down for maintenance

2013 plant shut down for maintenance

Daily Rates (m³/d)

ISOR, Well Count

Date


Col Dly Oil

Col Dly Water

Col Inj Steam

ISOR

Well Count
Discussion of GA-Pad Performance

• GA-Pad performance indicators as of 30 June 2014:
  • Cum. Oil : 97,187 m³
  • Cum. Steam Injected: 566,841 m³
  • Cum. Water Produced: 799,685 m³
  • CSOR: 5.8
Original A-Pad Performance

2007 Plant turnaround

2009 Plant turnaround

2010 Plant turnaround and well shut-in as per drilling campaign
B-North Infill Performance

The diagram shows the performance of the B-North Infill from April 2010 to October 2014. The lines represent different categories:
- **Cal Diy Oil** (green)
- **Cal Diy Water** (blue)
- **Cal Inj Steam** (red)
- **ISOR** (magenta dotted)
- **Well Count** (blue dotted)

Key events noted in the chart:
- **2011 plant shut down for maintenance**
- **2012 plant shut down for maintenance**
- **2013 plant shut down for maintenance**
B-West Performance

![Graph showing B-West Performance with various key events and data points.]
C-North Performance
OBIP and Recoveries by Pad

- OBIP for each pad is calculated from the formula:

\[
OBIP = L \times W \times H \times (1-S_w) \times \Phi \times 1/B_o
\]

Where:
- \( L \) = Effective Average Length of wells
- \( W \) = Lateral Width covered by the wells
- \( H \) = Thickness from the top of pay to the producer elevation
- \( \Phi \) = Average Porosity in the Pay zone
- \( S_w \) = Average Water Saturation in the Pay zone
- \( B_o \) = Oil Volume factor/Shrinkage factor (taken as 1)
# OBIP and Recoveries by Pad

<table>
<thead>
<tr>
<th>PAD</th>
<th>OBIP (10^6 m³)</th>
<th>Recovery to date June 30, 2014 (10^3 m³)</th>
<th>Recovery Factor %</th>
<th>Estimated Ultimate Recovery (10^6 m³)</th>
<th>Ultimate RF%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (24 wells)</td>
<td>5.6</td>
<td>572</td>
<td>10.2%</td>
<td>3.1</td>
<td>54%</td>
</tr>
<tr>
<td>B (15 wells)</td>
<td>7.1</td>
<td>606</td>
<td>8.5%</td>
<td>3.0</td>
<td>42%</td>
</tr>
<tr>
<td>C (20 wells)</td>
<td>11.6</td>
<td>1,282</td>
<td>11.1%</td>
<td>5.3</td>
<td>46%</td>
</tr>
<tr>
<td>GA (6 wells)</td>
<td>2.0</td>
<td>97</td>
<td>4.9%</td>
<td>0.8</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26.3</strong></td>
<td><strong>2,557</strong></td>
<td><strong>9.7%</strong></td>
<td><strong>12.2</strong></td>
<td><strong>47%</strong></td>
</tr>
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</table>
5-Year Outlook of Expected Pad Abandonment

- No pad abandonment is anticipated in the next 5 years
Temperature, Pressure and Quality of Steam

- High pressure steam separator delivers steam at a 100% quality
- Steam quality losses are experienced during transportation to the pads
- Steam quality at the wellhead is estimated to be 95%
Composition of Other Injected/Produced Fluids

• Not applicable to Tucker Thermal Project
Summary of Key Learnings

• Well placement is a critical factor for well performance

• Circulation is the optimum startup procedure for establishing thermal communication in a SAGD process

• Wire-wrapped screens are better for avoiding scaling problem of the production liner

• Steady operating conditions are key to obtaining good steam chamber conformance

• Operating pressure should be constant and close to bottom water pressure to prevent water inflow and steady operations

• Live steam production is utilized for improving oil recovery rate
8. Future Plans
Future Plans (2014/2015)

• **D-East Development:**
  - Drill & Complete 15 SAGD well pairs
  - Commission & Start-up facilities
  - Drill 3 OBS wells

• **Colony Development:**
  - Scheme amendment to include the Colony development approved June 16th, 2014
  - Drill & Complete 6 SAGD well pairs, 2 ISS wells and 5 Infill wells
  - Commission & Start-up facilities

• **SAGD Operations:**
  - Continue to optimize SAGD operations
  - Temperature surveillance
  - OBS wells monitoring
3.1.2. Surface Issues - Table of Contents

1. Facilities – slide 81
2. Facilities Performance – slide 93
3. Measurement and Reporting – slide 104
4. Water Production, Injection and Uses – slide 118
5. Sulphur Production – slide 132
7. Compliance Statement – slide 148
8. Non-Compliance Events – slide 151
9. Future Plans – slide 155
1. Facilities
Tucker Layout (Looking South)

- CPF
- C-Pad
- B-Pad
- GA-Pad
- A-Pad
Tucker Central Processing Facility (CPF)

- Water Treatment
- Process
- Control Complex
- Steam

- 5 OTSG’s
- 84,000 bbls/day steam to field
CPF and Recent Modifications

CPF

Flow Line Addition
CPF and C-Pad
CFF (Located at B-Pad)
Husky Tucker Facility Schematic
Facility Modifications – Steam and Lift Gas Deboottleneck

- Steam Deboottleneck:
  - The new system commissioned August 2013 to feed steam to the LGR wells
• Commissioned 4th aerial cooler at Central Field Facility in July 2013
2. Facilities Performance
Operating Issues and Limitations

• Operating issues:
  • Minimum flow from the HP BFW pumps discharged into the blow-down line and when mixed with steam from an OTSG on start up caused hammer issues. To rectify this, the minimum discharge from the blow-down line was moved to the suction of the pumps.

• Limitations:
  • Condensing the steam produced from the SAGD wells has been a limitation to production. To deal with the produced steam, the condensate pump capacity was increased and a 4th condenser and a 2nd condenser discharge scrubber were added at the CFF.
  • Steam utilization is currently at 80% of design
Process Water De-Oiling

• The de-oiling process consists of 2 Skim Tanks (in series), IGF and 2 Oil Removal Filters

• The performance of the de-oiling equipment has been close to spec and is performing well

• De-Oiling KPI’s are:
  • FWKO – 1000 ppm (average 381 ppm)
  • IGF Inlet – 100 ppm (average 81 ppm)
  • IGF Out – 40 ppm (average 48 ppm)
  • ORF Outlet – 20 ppm (average 33 ppm)
Water Treatment Technology

- Water Treatment Area
WLS - Warm Lime Softener

- Primary water treatment to produce boiler feedwater
- Feed sources:
  1. De-oiled produced water
  2. Brackish water make-up
  3. Sludge pond water
- Reduces water contaminants:
  1. Hardness - primarily Calcium and Magnesium
  2. Silica - main contaminant due to thermal recovery process
  3. Turbidity - suspended solids
- Produces sludge as waste product - stored in ponds
- Mechanical turbine, rake drives
- Main zones: Mixing, Reaction, Settling
- Produces water effluent with hardness ~20ppm and silica ~50ppm
WLS Chemistry

- Lime – primary hardness control
- Magnesium Oxide (MagOx) – primary silica reduction
- Caustic – water pH control, aids softening
- Sodium Carbonate (soda ash) – permanent hardness removal
- Polymer – coagulants and flocculants establish sludge bed control
WLS Performance

- The WLS has performed very well to date

- Key KPIs:
  - Soluble Hardness – 30 ppm (average 12 ppm)
  - Silica – 50 ppm (average 46 ppm)
  - Turbidity – 20 NTU (average 26 NTU)
Power Consumption

Month

KWh / Month

July 2013 to June 2014

Data points for each month from July 2013 to June 2014.
Gas Usage

![Bar chart showing gas usage by month from June 2013 to June 2014.](chart.png)

- **Total Purchased**
- **Total Produced**
Flaring and Venting

- No occurrence exceeded 30,000 m³/day
- No occurrence exceeded 4 hour in duration
- No Venting

<table>
<thead>
<tr>
<th>Date</th>
<th>Gas flare (E3m3)</th>
</tr>
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<tbody>
<tr>
<td>Jul-13</td>
<td>119.07</td>
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<tr>
<td>Aug-13</td>
<td>6.54</td>
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<tr>
<td>Sep-13</td>
<td>2.60</td>
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<td>Oct-13</td>
<td>1.91</td>
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<tr>
<td>Nov-13</td>
<td>0.01</td>
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<tr>
<td>Dec-13</td>
<td>0.03</td>
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<tr>
<td>Jan-14</td>
<td>0.04</td>
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<tr>
<td>Feb-14</td>
<td>3.37</td>
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<tr>
<td>Mar-14</td>
<td>0.02</td>
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<tr>
<td>Apr-14</td>
<td>1.58</td>
</tr>
<tr>
<td>May-14</td>
<td>1.34</td>
</tr>
<tr>
<td>Jun-14</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Green House Gas (GHG)

- Emission sources considered include stationary combustion associated with steam generators and glycol heaters, flaring, venting and fugitive emissions

- 530,970.28 tonnes of Carbon Dioxide Equivalent were emitted in 2013 (from the Tucker Green House Gas report submitted to AESRD under the Specified Gas Emitters Regulation)
3. Measurement and Reporting
Measurement and Reporting – Proposed Schematic
OIL & DILUENT METERING

OIL PRODUCTION TOTAL = (PIPELINE METER ± INVENTORY CHANGE) - NET DILUENT VOLUME ADDED + (SHRINKAGE AND FLASH VOLUME LOSS) 
1P ± Δ(2P + 3P) - 1D + (2D + 3D)

NOTE: OIL VOLUMES REPORTED TO THE ERCB ARE CORRECTED FOR SHRINKAGE AND FLASH IN ACCORDANCE WITH DIRECTIVE 17 SECTION 14.3 BY PRODUCTION ACCOUNTING
Measurement and Reporting – Produced Gas Schematic

**GAS METERING**

PRODUCED GAS = GAS FROM FIELD - GAS TO FIELD  
= 2G - 4G - 9G  

FLARED GAS = FLARE STACK METER TOTAL - FLARE SYSTEM PURGE GAS  
= (9G + 1G) - 10G

FUEL GAS = PURCHASED GAS + PRODUCED GAS - FLARED GAS  
= 1G + PRODUCED GAS - FLARED GAS

VENT GAS - THE TUCKER FACILITY WAS DESIGNED TO CAPTURE ALL GAS SOURCES FOR USE AS FUEL IN THE EVENT GAS IS VENTED TO ATMOSPHERE THE VOLUME WILL BE ESTIMATED USING GENERALLY ACCEPTED ENGINEERING PRACTICE
Measurement and Reporting – Water and Steam Schematic

PRODUCED WATER

METHOD 1 – PRIMARY PRODUCED WATER MEASUREMENT
= STEAM TO FIELD + DISPOSAL WELL INJECTION - BRACKISH WATER
= PROCESS WATER INVENTORY ± TRUCK VOLUMES
= (15-25-65) + (75+85+95+W) - (45+W+65) ± (55+15+W+15+W+15+W+15+W+15+W+15+W+15) ± 22

METHOD 2 – SECONDARY PRODUCED WATER MEASUREMENT
= FWKO + TREAT WATER
= 15W4 (195+W+200)

STEAM METERING

METHOD 1 – PRIMARY STEAM TO FIELD
= BOILER FEED WATER - STEAM SEPARATOR CONDENSATE - BLOW DOWN TO LAGOON
= 15-25-65

METHOD 2 – SECONDARY STEAM TO FIELD
= BOILER FEED TO GENERATORS - STEAM SEPARATOR CONDENSATE - BLOW DOWN TO LAGOON
= (75+85+95+105+115) - 25-65
Estimating Well Production

- Oil and Water Estimated by Well Test:
  - Battery level measurement prorated to wells based on the estimates

- Two Test Separator Designs (Well Tests):
  1. Blow-Case (original A-Pad, B-Pad, C-East, C-West):
     - Loadcell or level
     - Vortex for steam + natural gas
     - AGAR water-cut analyzer
     - Steam fraction calculated (from $P_{sat} / P_{meas}$)
  2. Conventional (B-North, new A-Pad, GA-Pad):
     - Coriolis meter for liquid
     - Vortex for steam + natural gas
     - AGAR water-cut analyzer
     - Steam fraction calculated (from $P_{sat} / P_{meas}$)

- Gas Measured at the Battery (proration = 1):
  - GOR for 2013/2014 = 42.5 m$^3$/m$^3$

- Steam Injection:
  - Heel and toe vortex meters per well
  - Total steam to field measured at the battery
  - Steam Proration = 0.999 m$^3$/m$^3$
Water Balance

- Water Proration Factors (see next slide):
  - Average 12-Month Rolling Proration Factors
    - Water = 1.09
    - Oil = 1.08

- Water / Steam Meter Calibrations:
  - Metering equipment inspected / calibrated annually
  - Annual well steam injection meters inspection per Directive 17
  - Quarterly AGAR water cut analyzer calibration program
  - AER reviewed steam and water metering scheme during site visit

- Metering Accuracy:
  - Accounting meters conform to Directive 17 single point measurement accuracy
Estimating Well Production

Tucker Proration Factors June 2013-2014

Month

Proration Factor

PF oil

PF water
<table>
<thead>
<tr>
<th>Well Group</th>
<th>Average Test Frequency (tests/well/month)</th>
<th>Average Test Duration (hr/test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A09-A16</td>
<td>12.6</td>
<td>4.5</td>
</tr>
<tr>
<td>A17-A24</td>
<td>14.7</td>
<td>10.7</td>
</tr>
<tr>
<td>B01-B12</td>
<td>8.2</td>
<td>5.2</td>
</tr>
<tr>
<td>B9E – B11E</td>
<td>28.2</td>
<td>12.3</td>
</tr>
<tr>
<td>C01-C12</td>
<td>7.3</td>
<td>5.5</td>
</tr>
<tr>
<td>C13-C20</td>
<td>14.0</td>
<td>4.6</td>
</tr>
<tr>
<td>GA01-06</td>
<td>16.6</td>
<td>17.7</td>
</tr>
</tbody>
</table>
Solvents and Condensable Gas

- Bitumen production accounts for diluent flash and volumetric shrinkage
- No solvent injection to reservoir
- There is no non-condensable gas injection
Measurement Initiatives – Continuous Improvement

- Measurement, Accounting and Reporting Plan (MARP) submitted with follow-up meetings and site tour and meter inspection

- No technical issues identified with measurement equipment:
  - Meter accuracy verified
  - Ultrasonic meter installed on produced water

- Implemented improvements:
  - Truck tickets reporting for off-loaded material
  - Separator operating procedure change
    - Level set point change to reduce/eliminate gas blow through
  - Detailed review of measurement schematics and calculations

- Future opportunities:
  - Produced water meter installation
  - Radar level detection on Dilbit sales tanks
4. Water Production, Injection and Uses
Brackish Water

• Make-up water for steam generation

• McMurray Formation

• 3 Source Wells:
  • 1F1/11-30-064-04 W4M
  • 100/12-30-064-04 W4M
  • 1F1/08-25-064-04 W4M
Water Usage

• Using brackish water ~20,000 ppm Total Dissolved Solids (TDS) for steam generation (when required)

• No fresh water is used in our process
Brackish Water Consumption

Volume (m^3) / Month

Month

Jun-13, Jul-13, Aug-13, Sep-13, Oct-13, Nov-13, Dec-13, Jan-14, Feb-14, Mar-14, Apr-14, May-14, Jun-14

Legend:
- a) 1F1/12-30-064-04W4/00
- b) 1F1/11-30-064-04W4/00
- c) 1F1/08-25-064-05W4/00
Fresh Water

• Domestic use only:
  • Safety showers / eye-wash stations
  • Cleaning water
  • Washroom / kitchen uses

• Bonnyville Aquifer

• 12-28-064-04-W4
Fresh Water Consumption

Volume (m³) / Month

Month

Produced Water & Steam Injected

- Reservoir Water Retention (%)
- Steam Injected (m³)/month
- Produced Water (m³)/month

Graph showing the monthly produced water, steam injected, and reservoir water retention from July 2013 to July 2014.
Water Disposal Limits

- Directive 81:
  - No fresh water consumed in steam production
  - All produced water sent to water treatment for recycle

![Tucker Water Disposal 2014](image)
Monthly Injection Water Balance

Imbalance %: \[
\frac{(\text{Total Water IN} - \text{Total Water OUT})}{\text{Total Water IN}} \times 100
\]
OTSG Blow-down Recycle

• OTSG blow-down is recycled to the Warm Lime Softener (WLS) at a percentage that allows the total dissolved solids, out of the OTSG, to remain below 50,000 uS/cm

• Brackish water make-up has a very high TDS and affects OTSG blow-down recycle

• We recycle approximately 10% of our blow-down back to the WLS
Disposal Wells

• AER Class 1 Wastewater Disposal Wells

• Boiler blow-down disposal:
  • AA/12-21-064-04 W4M (AER Approval 10591)
  • 1F1/11-28-064-04 W4M (AER Approval 10591)
  • 00/04-28-064-04W4/0 (AER Approval 10591A) – licensed

• Water treatment process disposal:
  • 00/14-29-064-04 W4M (AER Approval 10591)
Disposal Wellhead Injection Pressures & Volumes

- Approximate Injection Temperature: 60 ºC (Blow-down water); 47 ºC (Regen waste water)
Landfill Waste Handling

- No landfill within facility
- All landfill waste streams disposed offsite at licensed facilities
<table>
<thead>
<tr>
<th>ERCB Waste Code</th>
<th>Waste Description</th>
<th>Location Sent To</th>
<th>Final Handling Method</th>
<th>Total</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACID</td>
<td>Acid Solutions Unneutralized</td>
<td>Rbw Waste Management Ltd</td>
<td>Other (specify)</td>
<td>0.02</td>
<td>m3</td>
</tr>
<tr>
<td>CAUS</td>
<td>Caustic Solutions Unneutralized, Spent</td>
<td>Rbw Waste Management Ltd</td>
<td>Other (specify)</td>
<td>0.1</td>
<td>m3</td>
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<tr>
<td>COEMUL</td>
<td>Condensate/ Crude Oil Emulsions</td>
<td>Tervita - LINDBERGH</td>
<td>Cavern</td>
<td>1512.2</td>
<td>m3</td>
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<tr>
<td></td>
<td>Solids 0-20%, Heavy Oil 16-30%</td>
<td>Newalta Elk Point Service Centre</td>
<td>Oilfield Waste Processing Facility</td>
<td>17</td>
<td>m3</td>
</tr>
<tr>
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<td>Solids 0-5%, Heavy Oil 0-15%</td>
<td>Newalta Elk Point Service Centre</td>
<td>Oilfield Waste Processing Facility</td>
<td>40</td>
<td>m3</td>
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<td>Solids 6-20%, Heavy Oil 0-15%</td>
<td>Newalta Elk Point Service Centre</td>
<td>Oilfield Waste Processing Facility</td>
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<td>m3</td>
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<tr>
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<td>Solids 6-10%, Free Oil 41-100%</td>
<td>Newalta Redwater Service Centre</td>
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<td>m3</td>
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<td>DOMWST</td>
<td>Garbage Domestic Waste</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>70.42</td>
<td>m3</td>
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<td>EMTCON</td>
<td>Empty Used Containers</td>
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<td>EMTCON-A</td>
<td>Empty Aerosol Cans</td>
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<td>Recycling Facility (excluding used oil)</td>
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<td>m3</td>
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<td>FILOTH</td>
<td>Filters Other (Raw Fuel Gas, NGL's)</td>
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<td>m3</td>
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<td>FILWTT</td>
<td>Filters (Media) - Water Treatment</td>
<td>Tervita - LINDBERGH</td>
<td>Cavern</td>
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<td>INOCHM</td>
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<td>Rbw Waste Management Ltd</td>
<td>Other (specify)</td>
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<td>OILABS</td>
<td>Absorbents</td>
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<td>Recycling Facility (excluding used oil)</td>
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<td>m3</td>
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<td>OILRAG</td>
<td>Oily Rags</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
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<td>ORGCHM</td>
<td>Chemicals Organic</td>
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<td>m3</td>
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<td>SAND</td>
<td>Stung Sand Wet</td>
<td>Tervita - LINDBERGH</td>
<td>Cavern</td>
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<td>m3</td>
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<td>SLGHYD</td>
<td>Sludge</td>
<td>Tervita - LINDBERGH</td>
<td>Cavern</td>
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<td>m3</td>
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<td></td>
<td>Solids 0-20%, Heavy Oil 0-15%</td>
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<td>Oilfield Waste Processing Facility</td>
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<td>m3</td>
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<td>SOILCO</td>
<td>Contaminated Debris and Soil Crude Oil</td>
<td>Clean Harbors</td>
<td>Class Ia Landfill</td>
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<td></td>
<td>Condensate</td>
<td></td>
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<td>WSTFLQ</td>
<td>Waste Flammable Liquid</td>
<td>Rbw Waste Management Ltd</td>
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<td>m3</td>
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<td>WWOFLD</td>
<td>Waste Water</td>
<td>Tervita - LINDBERGH</td>
<td>Cavern</td>
<td>117</td>
<td>m3</td>
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</tbody>
</table>
5. Sulphur Production
Sulphur Dioxide (SO$_2$) Sources

- Five Once-Through Steam Generators (OTSG)
- One High Pressure Flare Stack
- One Low Pressure Flare Stack
# Quarterly SO₂ Emissions

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Period</th>
<th>Emissions (tonnes)</th>
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</thead>
<tbody>
<tr>
<td>2013 Q3</td>
<td>(July 1ˢᵗ – September 30ᵗʰ)</td>
<td>41.59</td>
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<tr>
<td>2013 Q4</td>
<td>(October 1ˢᵗ – December 31ᵗʰ)</td>
<td>55.23</td>
</tr>
<tr>
<td>2014 Q1</td>
<td>(January 1ˢᵗ – March 31ᵗʰ)</td>
<td>58.39</td>
</tr>
<tr>
<td>2014 Q2</td>
<td>(April 1ˢᵗ – June 30ᵗʰ)</td>
<td>62.48</td>
</tr>
</tbody>
</table>
SO₂ Emissions Trends

SO₂ Emissions - Daily Average Per Month

SO₂ Emission Limit: 1.96 tonnes/day

Average Daily Emission Rate (tonnes/day) / Month

Month

Peak and Average \( \text{SO}_2 \) Emissions

- July 1, 2013 to June 30\(^{th} \), 2014:

<table>
<thead>
<tr>
<th>SO(_2) Emissions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily (highest)</td>
<td>0.75 tonnes</td>
</tr>
<tr>
<td>Maximum Daily (highest)</td>
<td>0.96 tonnes</td>
</tr>
</tbody>
</table>

- Limit under EPEA Approval is 1.96 tonnes/day

- No exceedances
Ambient Air Monitoring

- Ambient air quality is currently monitored by the Lakeland Industry and Community Association (LICA) - Air Shed committee

- No exceedances were recorded during the last reporting period

- Airshed quality results available on LICA website or Clean Air Strategic Alliance Data Warehouse

  - [http://www.lica.ca/](http://www.lica.ca/)

  - [http://www.casadata.org/](http://www.casadata.org/)
6. Environmental Issues
Environmental – Compliance to Approvals

- EPEA Approval:
  - No compliance issues during this reporting period

- AER:
  - No compliance issues during this reporting period

- AESRD:
  - No compliance issues during this reporting period

- DFO:
  - No compliance issues during this reporting period
• Renewal application for EPEA approval 147753 was submitted January 2014 and is currently being worked on by AER EPEA approvals engineer
Environmental – Wildlife

- As part of the regulatory approval, Husky has developed and implemented a Wildlife Monitoring Program (WMP) for:
  - Canadian toad distribution, abundance and population status
  - Above Ground Pipeline (AGP) monitoring to ensure wildlife can cross under the lines
  - Wildlife Habitat Enhancement Program (WHEP)

- Annual WMP report describes the observations and results collected during the previous year
Environmental - Industrial Wastewater

- Disposal Locations:
  - Water treatment process disposal 14-29-064-04W4M
  - 130,385 m³ was disposed

- Domestic Wastewater:
  - Domestic waste sludge is disposed of at the Cold Lake Municipal Treatment Facility or the Bonnyville Municipal Treatment Facility

- Industrial Run-off (from 2013 Annual Waste Water Report):
  - Total of five discharge locations (Pads: A, B, C, GA and run-off retention pond located on CPF)
  - A total of 14,473 m³ surface water was discharged due to a very wet year
  - All discharges were in compliance with Tucker Thermal EPEA approval
The scope of work for the 2013 Soil Monitoring Program (SMP) included the following tasks:

- Completed a thorough ground disturbance program to locate and mark all underground utilities and infrastructure within the subject areas before the start of the drilling program.
- Collected soil sample from various locations at the sites to assess present soil conditions.
- Submitted soil samples to the laboratory for analysis of specified parameters.
- Prepared a report summarizing program results.
Environmental – Air

- Air related monitoring, reporting and studies are conducted by the Lakeland Industry Community association (LICA) in compliance with the Tucker EPEA approval 147753-00-02

- The LICA airshed monitoring network consists of 4 continuous monitoring stations, 26 passive monitoring stations, 2 volatile organic compound and polycyclic aromatic hydrocarbon samplers, and 2 soil acidification monitoring plots
Environmental – Ground Water

• The Tucker groundwater monitoring program includes:
  • CPF Groundwater: monitors shallow groundwater quality beneath the CPF
  • Pad Specific Groundwater: monitors possible impacts to groundwater quality
  • Regional Groundwater: monitors possible effects on regional groundwater quality between the project areas and the local lakes and streams

• 2013 Expansion to Groundwater Monitoring Program:
  • C-Pad: one monitoring well completed in the Muriel Lake Formation Aquifer
  • C-Pad: one Vibrating Wire Piezometer (VWP) installed at the Bonnyville Formation Unit 1 Aquifer
  • CPF: Additional monitoring well

• 2014/2015 Groundwater Drilling:
  • Colony-Pad: completion of a nested set of wells
  • D-Pad: addition of Bonnyville Formation Unit 1 Aquifer well with a thermocouple
Environmental – Initiatives

• Participation in the Lakeland Industry and Community Association (LICA)
  • Board of Directors
  • Beaver River Watershed Alliance (BRWA)
  • Airshed
Environmental – Reclamation

- Objectives of the Annual Report (demonstrate and document):
  - Compliance with the development and reclamation approval
  - Site conditions and successful reclamation
  - General project development (surface disturbances) and reclamation activities
  - Problem areas and resolution

- Site Clearing and Timber Salvage:
  - No new disturbances or clearing activities occurred during this reporting period
  - No Pre Disturbance Assessments (PDA) were conducted during this reporting period

- Vegetation Monitoring:
  - Annual weed monitoring and control as per Husky’s best practices

- Reclamation Activities:
  - No permanent reclamation activities were completed within the Tucker area during the last reporting period
7. Compliance Statement
Compliance

- **AER**
  - All conditions of AER License F-32143 as well as all scheme approvals for the project were met during the past reporting period
  - All conditions of the Tucker EPEA approval 147753-00-00 and amendments were met during the last reporting period
Self Declarations

- No self declaration were made for this reporting period
8. Non-Compliance Events
Non-Compliance Issues

• No non-compliance events occurred over the last reporting period
SCVF/GM Update – Summary

• No new SCVF/GM issues

• On-going, yearly monitoring of existing, non-serious vent flows

• Isotopic Investigation completed and results presented to the AER:
  • Source of the vent flows is likely the Colorado
  • Collecting mud gas cuttings across the Colorado this year

• C13S SCVF Update:
  • Installation of VIT and temp monitoring, Dec 20th, 2013
  • Resumed steaming to test remediation, Dec 24th, 2013
  • Results: No SCVF nor H2S since Dec 23rd, 2013
    • Update presentation to AER on May 29, 2014
  • Commitment:
    – Monthly monitoring of H2S and SCVF
    – Quarterly monitoring of temperature
    – Update in annual performance presentation
• C13S SCVF Summary:

Background:
• Oct 25, 2012: discovered and reported as “serious” SCVF at C13S
• Mar 2013: repaired (perforation, cement squeeze & patch)
• Dec 19/20, 2013: VIT and fiber optic temperature monitoring installed
• Dec 24, 2013: Steam injection started to test remediation

SCVF and H2S monitoring:
• Dec 23, 2013 to Jan 6, 2014, Daily
• Jan 6, 2014 to Feb 18, 2014, Bi-Weekly
• Mar 2014 to end of May 2014, Monthly

Results: No SCVF nor H2S since Dec 23\textsuperscript{rd}, 2013
• Update presentation to AER on May 29, 2014
• Commitment:
  • Monthly monitoring of H2S and SCVF
  • Quarterly monitoring of temperature
  • Update in annual performance presentation
8. Future Plans
Future Plans (2014/2015)

- Submit application for 6th OTSG
- Install, commission & start-up 6th OTSG and 3rd HP BFW pump
- Commission & start-up D-Pad facilities
- Construct Colony-Pad facilities
- CPF Maintenance Turn-around and 6th OTSG Tie-in, Q3 2015