Suncor Firebag
2013 ERCB Performance Presentation
Commercial Scheme Approval No. 8870

May 1st and 2nd, 2013

Report Period March 1, 2012 to February 28, 2013
Section 3.1.1 – Subsurface Issues Related to Resource Evaluation and Recovery
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• Safety Moment – Alan Keller
• Introduction – Doug Castellino
• Geoscience – Tim Boyler
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• Drilling and Completions – Micaela Streeter
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• 4-D Seismic – Tim Boyler
• Scheme Performance – Alan Keller
• Future Plans – Vicki Werner
Journey to Zero fundamental beliefs

Safety is a critical part of Suncor’s culture—it’s how we do business.

Safety is everyone’s responsibility and a leadership performance accountability.

The safety and health of team members, the environment, communities and operations are our top priorities.

No job is so urgent or routine that it can’t be done safely—if we can’t do it safely, we don’t do it.
Expectations for all employees

- Be a leader in safety no matter what your job title is. YOUR Family expects this.
- Protect yourself and your coworkers from harm and speak up for safety
- Always follow procedures and if you aren’t sure about a job, ask
- Be safety minded even if you have done a job hundreds of times and you think you are in a safe environment
- If you see a hazard you are expected to report it if you can’t immediately fix it yourself
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The Firebag Project is a commercial Steam Assisted Gravity Drainage (SAGD) scheme.

- Supplies bitumen to the Oil Sands Upgrader and sales to market
- Stage 4 start-up Sept 2012
- Current production capacity of 180,000 bbl/d (28,617 m³/day) of bitumen with a Steam to Oil Ratio (SOR) of 3.2
Firebag Approval 8870
As of February 2013

- Change during report period due to ERCB approval of Pads
  - 109 (8870II)
  - 114 (8870KK)
  - 117 (8870JJ)
Composite Aerial Photo of Firebag
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Type Well Location Map

- **Type Wells**
  - 1AA/01-01-095-06W4
  - 1AA/16-01-095-06W4
- **Type Horizontal Well**
  - Pad 101 Pair 7
- McMurray Fm 83.9 m
- Shoreface 5.4 m
- Tidal Flat 15.6 m
- Channel Complex 48.9 m
  - Net Pay 47.8 m
  - NTG 0.977
  - Core Porosity 35.7%
  - Core Sw 21.9%
  - Kh 8-10 D
  - Kv 4-5 D
- Continental 14 m
- 45 m west of Pad 1 Pair 7
Continental Unit  Non Reservoir

SUNCOR ENERGY INC.
SUNCOR FIREBAG 1AA/01-095-06W4/00
RC8113

TOP CORE# 4 332.00m

Beaverhill Lake Group

McMurray/Devonian Contact

Continental Sand

Steam Injector
Bitumen Producer

Mud
Sand

Shoreface

Clearwater Formation

Continental Unit Non Reservoir

3.1.1 2e)
Channel Complex Oil Sands Reservoir

SUNCOR ENERGY INC. FEB., 1999
SUNCOR FIREBAG 1AA/01-01-095-06W4/00
RC8113

TOP CORE# 30 305.05 m

Estuarine Channel Sand

89% bitumen saturation
Kh 8400 md; Kv 7000 md

Steam Injector
Bitumen Producer

3.1.1 2e)
Tidal Flat / Channel Complex Contact

3.1.1 2e)

Sandy Tidal Flat

Channel Margin/I.H.S Sand

Steam Injector

Bitumen Producer

McMurray Formation

BHL Group

Clearwater Formation

Continental
**Tidal Flat Unit**

**SUNCOR ENERGY INC.**
SUNCOR FIREBAG 1AA/01-01-095-06W4/00
RC8113

**TOP CORE# 9 259.85m**

**TOP CORE#10 261.35m**

**BOTTOM 261.35m**

**BOTTOM 265.75m**

**Muddy Tidal Flat**

**Mixed Tidal Flat**

**SUNCOR FIREBAG 1-1-95-6**

**TD 352.10 m**

**Lith Log**

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**SUNCO**

**RESISTIVITY**

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**TD 352.10 m**

**Steam Injector**

**Bitumen Producer**

**BHL Group**

**Clearwater Formation**

**McMurray Formation**

**Shoreface**

**Continental**

**Tidal Flat Complex**

**Hole**
Pad 1 Pair 7 Structural Cross Section

- Clearwater Formation (Shale)
- Shoreface
- Tidal Flat
- Type Well 1AA/01-01-095-06W4/00
- Channel Complex (Reservoir)
- Continental
• Middle McMurray Tidal Flat / Abandoned Channel
• Reservoir quality within McMurray varies and can present challenges
Structure Map of Base of Gross Bitumen Pay Interval

Base of the McMurray Channel Complex
Approved Development Area In Blue
Topology Map of Top of Gross Bitumen Pay Interval

Contour Int = 5m

GF Surface = ACTIVE_7_MCMCHTOP grid = CHANNEL TOP

Top of McMurray Channel Complex
Approved Development Area In Blue
Isopach Map of Cumulative Net Bitumen Pay

- Cumulative Net Pay Cut-Offs: Gamma <60API, Porosity > 22%, Sw< 50%
- Continuous Pay Cut-Offs being developed

- 2012-2013 Drilling Program (RR <= Feb 28, 2013) Wells in Green
- Planned SAGD Wells in Red
- Approved Development Area In Blue
### Original Bitumen in Place (OBIP) & Average Reservoir Properties

<table>
<thead>
<tr>
<th>Area (m²)</th>
<th>Gross Thickness (m)</th>
<th>Gross Rock Volume (e³ m³)</th>
<th>Net-to-Gross Ratio¹</th>
<th>Net Pay Thickness (m)</th>
<th>Porosity</th>
<th>Oil Saturation</th>
<th>Formation Volume Factor</th>
<th>OBIP² (e³ m³)</th>
<th>OBIP² (e³ bbl)</th>
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</tr>
</tbody>
</table>

| Firebag Approved Project Area | 193,970,483 | 35.9 | 5,970.1 | 0.74 | 26.7 | 0.31 | 0.84 | 1 | 1,299.3 | 8172.6 |

¹ Net-to-Gross Ratio: Net pay cutoffs applied are GR>60 API, Porosity < 0.22, and Sw > 0.50.
² OBIP: Original Bitumen in Place
³ Only the eight east well pairs are included since Pad 114 replaces the Pad 115 north well pairs

*From Pad 118 D23 Application*
2012 Winter Delineation Program and 3D Seismic Program

- Existing wells in black
- New wells 2012-2013 Drilling Program (RR <= Feb 28, 2013) in green
- Wells typically obtained core across the McMurray Formation; followed by routine photography and analysis
- Existing 3D seismic in orange
- Approved Project Area in green
<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
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</thead>
<tbody>
<tr>
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<td>Future Plans</td>
<td>Vicki Werner</td>
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</tbody>
</table>
• Max rise +28.4 cm; max fall -0.6 cm; average displacement +11.7 cm
• Greatest elevation changes occurring at south half of Pad 101
• No immediate plans to develop bitumen resource below the plant site
• There is a correlation between surface deformation contours and 4D seismic generated production chamber map
2012/13 Winter Drilling Program

- **New Observation Wells**
  - OB 182 was drilled for caprock core and pressure monitoring for Pad 115
    * Was mini-frac’d in the Clearwater but the well stops above the McMurray sand
    * Has external casing thermocouples above the Clearwater mini-frac interval
    * Pressure monitoring to be inside casing at Clearwater and McMurray Tidal Flats
  - Three Firebag Pad 101 Wind-Down observation wells
    * These wells are equipped with five piezometers each. The first meter is landed in the muddy shoreface sand sequence below the Clearwater caprock and the remaining four piezometers are placed in McMurray Bitumen zone
    * These wells have thermocouples across the entire McMurray section
      * 2 wells have 1 TC every 2 m along the string (40 total per well)
      * 1 well has 1 TC every 3.5 m along the string (24 total in well)

- **New 2013 Fracture Characterization Wells**
  - Five full caprock / McMurray Sandstone cores were recovered for fracture characterization. Coring started 20 metres above the base of Quaternary

- **Mapping**
  - Ongoing lease wide mapping and characterization of the Clearwater and Grand Rapids formations; incorporating new data as they become available
Five New Caprock Monitoring Wells

Pressure Instrumentation
Piezometers
1. OB182 will have 2 piezometers – Tidal Flats and Clearwater
2. The 3 Wind-down OB wells have 5 piezometers each within the McMurray SS and Tidal Flats

Note: OB182 will have two piezometers run inside of the casing with pressure isolation using Thermal swell packers

Temperature Instrumentation
Reservoir Thermocouple (TC) String:
• OB 182 has a Clearwater TC string
• The three Wind-down OB wells have TC’s at 2.0 (40 pts) or 3.5 metre spacing (24 pts)

Instrumentation strapped outside of casing string
Caprock Integrity Assurance

• **Mini-Fracs in 2013**
  - OB182 Clearwater mini-frac was the only zone tested in 2013
  - Data were analyzed in-house and is consistent with SPE Paper 157843 presented at the June 2012 SPE Heavy Oil Conference Canada

• **Lab Testing in 2012/13**
  - U of A lab work is ongoing – scope increased to include Waterways
  - Testing of a Commercial Lab’s capability was performed

• **Suncor Geomechanical Modeling**
  - Models are being updated as lab data comes in
  - Heave monitoring program and 4-D seismic useful for calibrating geomechanical models
  - New surface heave survey commissioned for Pads 106 and 116
  - Geomechanical modeling in 2010 matched heave measurements within 4-5 cm
No change recommended to currently approved injection pressures:
- 4040 kPag during start up
- 3570 kPag during production phase

<table>
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<tr>
<th>Date</th>
<th>Well</th>
<th>Well Alias</th>
<th>Perforated Interval (mTVD)</th>
<th>Target</th>
<th>Minimum Stress (kPaa)</th>
<th>Fracture Closure Gradient (kPaa/m)</th>
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• Casing injection pressure will be limited to 4040 kPag during circulation and 3570 kPag during the production phase
  • Friction losses will provide an extra margin of safety for protecting the reservoir

• All existing injection wells are set up to monitor downhole pressure

• Producer – during mechanical lift conversion, pressure monitoring, bubble tubes/pressure gauges, thermocouples (Fiber installed on some Producers)
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SAGD Well Layout
Typical SAGD Injector

- **18 5/8” Surface Casing** typically landed at 80 m Thermally cemented
- **10 3/4” Slave String** typically landed at 480 m (Premium Connections) with blanket gas behind
- **13 3/8” Intermediate Casing** typically landed at 530 m (Premium Connections) Thermally cemented
- **3 1/2” Injection Tubing** typically landed at 1510 m
  Or: **5½” crossed over to 4½”**

**13 3/8” x 10 3/4” Debris Seal**
**10 3/4” Slotted Liner** for the first ~275 m

**9 5/8” or 8 5/8” Slotted Liner** for the final 750 m typically landed at 1530 m
Typical Producer Circulation Setup

18 5/8” Surface Casing typically landed at 80 m Thermally cemented

13 3/8” or 11 3/4” Intermediate Casing typically landed at 530 m (Premium Connections) Thermally cemented

3 1/2” or 2 7/8” Production Tubing typically landed at 500 m

5 1/2” or 4 1/2” Production Tubing at 1500 m

9 5/8” or 8 5/8” Slotted liner typically landed at 1530 m
13 3/8” x 10 3/4” liner hanger Debris Seal
Typical Concentric Producer ML-SAGD

(includes infills)

18 5/8” Surface Casing typically landed at 80 m
Thermally cemented

13 3/8” Intermediate Casing typically landed at 530 m
(Premium Connections) Thermally cemented

5 1/2” Production Tubing with Pump typically landed at 480 m

9 5/8” or 8 5/8” Slotted liner typically landed at 1530 m
13 3/8” x 10 3/4” liner hanger Debris Seal
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Artificial Lift Wells

- Wells labeled are operating on mechanical lift (115 wells) as of Feb 28, 2013
- Wells 3P3 and 3P4 abandoned due to wellbore issues
  - Wells 3P3B and 3P4B re-drilled to access reserves
- Pad 106/116 Currently in mechanical lift conversion process
Mechanical Lift

- Electric submersible pumps (ESP)
- 12 – 36 Stages depending on application
- Total fluid lift capacity ranges from 200 to 3000 m³/d depending on pump size
- Averaged 900 m³/d total fluid production per well over reporting time frame
- Maximum operating temperatures ~ 250°C, as measured at the pump. Pumps generally run between 135°C and 220°C (UHT and SA-3)
- Pump mean time to failure since day 1 is 543 days
- Run-life is increasing as operational practices and pump technology improves
<table>
<thead>
<tr>
<th>Section</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Artificial Lift</td>
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</tr>
<tr>
<td>Instrumentation in Wells</td>
<td>Micaela Streeter</td>
</tr>
<tr>
<td>4-D Seismic</td>
<td>Tim Boyler</td>
</tr>
<tr>
<td>Scheme Performance</td>
<td>Alan Keller</td>
</tr>
<tr>
<td>Future Plans</td>
<td>Vicki Werner</td>
</tr>
<tr>
<td>Pad #</td>
<td>Temperature</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pad 101</td>
<td>- 3 pt. Thermocouple</td>
</tr>
<tr>
<td>(including infills)</td>
<td>- Fiber</td>
</tr>
<tr>
<td>Pad 102</td>
<td>- 2-3 pt. Thermocouple</td>
</tr>
<tr>
<td>(including infills)</td>
<td>- Fiber</td>
</tr>
<tr>
<td>Pad 103/104</td>
<td>- 3 pt. Thermocouple</td>
</tr>
<tr>
<td>Pad 107/108</td>
<td>- 3 pt. Thermocouple</td>
</tr>
<tr>
<td>Pad 105</td>
<td>- 3 pt. Thermocouple</td>
</tr>
<tr>
<td>Pad 106</td>
<td>- 2 pt. Thermocouple</td>
</tr>
<tr>
<td>Pad 106</td>
<td>- 6 pt. Thermocouple</td>
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<tr>
<td>Pad 106</td>
<td>- 6P2/4/6/8 Fiber</td>
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<tr>
<td>Pad 106</td>
<td>- 6P5 2 pt. Combo Line Thermocouple</td>
</tr>
<tr>
<td>Pad 116</td>
<td>- 2 pt. Thermocouple</td>
</tr>
<tr>
<td>Pad 116</td>
<td>- 6 pt. Thermocouple</td>
</tr>
<tr>
<td>Pad 116</td>
<td>- 16P5/6/9/13/15/16/18 Fiber</td>
</tr>
<tr>
<td>All Injectors</td>
<td>- 106/116 6 pt. Thermocouple</td>
</tr>
<tr>
<td></td>
<td>- 8S1/5/7 6 pt. Thermocouple</td>
</tr>
<tr>
<td></td>
<td>- 5S14/15 Fiber</td>
</tr>
</tbody>
</table>

Items in red indicate temporary instrumentation used during startup.
Typical SAGD Producer Well – Instrumentation Locations

- Instrumentation is located at the heel of the well
  - Continuous monitoring in the horizontal being tested in select wells on Pad 2 North infills, Pad 105, and Pad 106/116
- Measures pump intake pressure and temperature
  - Additional thermocouples monitor the ESP motor

Pressure Instrumentation

2 - 3 Thermocouple Points
New Technology Testing Program in 2012

- Fiber optic and 6 Point Thermocouples temperature monitoring – Pad 102 infills, Pad 105, Pad 106 and Pad 116
- Vacuum insulated tubing – 5S13
- Toe pressure gauge – 5P14 and 5P15
- Testing ported subs and steam diversion devices
- Dual bore packer system – 2N1/2
- Vx meters – Pad 102 infills, Pad 105, Pad 106 and Pad 116
- New generation high temperature pumps rated to 250 °C - Ultra High Temperature Pump (UHT) and Hotline 3 Pump (HL3)
Future SAGD Well Instrumentation Plans

• Suncor Firebag is currently reviewing the following downhole pressure and temperature measurement schemes against their technical and economic merit. These technologies will be given consideration against the current pressure and temperature monitoring requirements for both producers and injector wells.

• Integrated pressure and temperature sensors with the ESP
  • Pad 101 infills
  • Future testing on Pad 103 infills and Pad 104 infills

• Instrumentation configuration with reduced liner sizes
• Thermocouples/fiber on select wells in horizontal section
### Instrumentation – SAGD Observation Wells

<table>
<thead>
<tr>
<th>Well</th>
<th>Temperature</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>OB111, OB113-114</td>
<td>1 Point Thermocouple</td>
<td>1 Piezometer</td>
</tr>
<tr>
<td>ETS OB2</td>
<td>1 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>ETS1, P5S2-4 OB</td>
<td>10 Point Thermocouple</td>
<td>N/A</td>
</tr>
<tr>
<td>OB8, OB10-11, OB19, OB37-40, OB67-69, OB74-75, OB107, OB109-110</td>
<td>2 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>ETS OB1, ETS OB3, OB6-7, OB9, OB12-14, OB17-18, OB20-23, OB27-36, OB42-45, OB47</td>
<td>24 Point Thermocouple</td>
<td>N/A</td>
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<tr>
<td>OB48</td>
<td>24 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB49, OB51, OB54, OB56, OB62</td>
<td>24 Point Thermocouple</td>
<td>1 Piezometer</td>
</tr>
<tr>
<td>OB63</td>
<td>24 Point Thermocouple</td>
<td>3 Piezometers</td>
</tr>
<tr>
<td>OB118-119, OB131, OB134</td>
<td>40 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB128, OB135-138, OB147</td>
<td>40 Point Thermocouple</td>
<td>1 Piezometer</td>
</tr>
<tr>
<td>OB122-127, OB129-130, OB132-133, OB143</td>
<td>40 Point Thermocouple</td>
<td>N/A</td>
</tr>
<tr>
<td>OB DS4</td>
<td>43 Point Thermocouple</td>
<td>4 Piezometers</td>
</tr>
<tr>
<td>OB57</td>
<td>46 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB59</td>
<td>54 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB66, OB70-73, OB76-98, OB101-103, OB105-106</td>
<td>56 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB60-61</td>
<td>58 Point Thermocouple</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB3-5</td>
<td>56 Point Thermocouple</td>
<td>N/A</td>
</tr>
<tr>
<td>QW1-2, QW4</td>
<td>N/A</td>
<td>1 Piezometer</td>
</tr>
<tr>
<td>OB DS2</td>
<td>N/A</td>
<td>2 Piezometers</td>
</tr>
<tr>
<td>OB DS1, OB DS5</td>
<td>N/A</td>
<td>3 Piezometers</td>
</tr>
</tbody>
</table>
Includes 2012-2013 Observation Well Drilling Program
Typical SAGD Observation Wells

Pressure Instrumentation
Two Piezometers
Location:
1. Middle of Shoreface
2. 15 m above base of McMurray

Temperature Instrumentation
Standard Obs well:
- Base to top of McMurray
- 20-24 TC spaced every 3 to 4 m

Clearwater Obs well (2010):
- Base of Shoreface to top of Clearwater
- 26-34 TC spaced every 2 m

Instrumentation strapped to outside of casing string

Approx 30 Thermocouple points evenly spaced
Approx 22 Thermocouple points evenly spaced
Observation wells 5P2, 5P3 and 5P4 also have 10 point thermocouples placed in horizontal sections.

**Instrumentation**
Temperature Monitoring
- 10 thermocouples spaced every 130 m
- TC’s span from 330 mKB to 1500 mKB
Five wells were drilled as per regulatory standards in 1981

- The wells were cemented with Oilwell G cement, not Thermal 40
- Following a detailed risk assessment and discussion with the ERCB, the decision was made to monitor the wells for any noticeable changes along with yearly inspections
- Field visits have been conducted at these locations and there have been no noticeable changes
### 1981 Inactive Wells Locations

<table>
<thead>
<tr>
<th>UWI</th>
<th>License #</th>
<th>Spud Date</th>
<th>Distance to Planned Steam Operations (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-02-095-06W4</td>
<td>A0088049C</td>
<td>2/4/1981</td>
<td>Approx. 4.3</td>
</tr>
<tr>
<td>11-03-095-06W4</td>
<td>A0088049D</td>
<td>1/27/1981</td>
<td>Approx. 22</td>
</tr>
<tr>
<td>10-11-095-06W4</td>
<td>A0088049E</td>
<td>2/14/1981</td>
<td>Approx. 365</td>
</tr>
<tr>
<td>11-32-094-06W4</td>
<td>A0088049B</td>
<td>1/18/1981</td>
<td>Approx. 965</td>
</tr>
<tr>
<td>11-33-094-06W4</td>
<td>A0088049E</td>
<td>1/28/1981</td>
<td>Approx. 1000</td>
</tr>
</tbody>
</table>
All 1981 Inactive Wells were inspected March 9th, 2013

- 10-11-95-06-W4M
- 10-02-95-06-W4M
- 11-32-94-06-W4M
- 11-33-94-06-W4M
- 11-03-95-06-W4M
1964 Vintage Wells

- Seven evaluation wells were drilled and abandoned in 1964 within the Firebag thermal recovery area.
- These wells could pose an environmental and safety risk because of the method and type of cement used to abandon them. (standard in 1964 – No casing or cement)

<table>
<thead>
<tr>
<th>UWID</th>
<th>Licence #</th>
<th>Spud Date</th>
<th>Distance from steam operations</th>
<th>Re-Abandonment Approved by ERCB</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1AA/11-22-095-06W4/00</td>
<td>0025561D</td>
<td>3/24/1964</td>
<td>Approximately 3000m</td>
<td>Yes</td>
<td>Located &amp; Abandoned 2009</td>
</tr>
<tr>
<td>1AA/05-28-094-06W4/00</td>
<td>0026040A</td>
<td>3/9/1964</td>
<td>Approximately 3000m</td>
<td>Yes</td>
<td>Located &amp; Abandoned 2009</td>
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<tr>
<td>1AA/06-08-095-06W4/00</td>
<td>0026038A</td>
<td>3/15/1964</td>
<td>Approximately 4000m</td>
<td>Yes</td>
<td>Located &amp; Abandoned 2010</td>
</tr>
<tr>
<td>1AA/15-32-095-06W4/00</td>
<td>0025561E</td>
<td>3/28/1964</td>
<td>Approximately 6000m</td>
<td>Yes</td>
<td>Located &amp; Abandoned 2010</td>
</tr>
<tr>
<td>1AA/14-32-093-06W4/00</td>
<td>Y0002251</td>
<td>2/18/1964</td>
<td>Approximately 10000m</td>
<td>Yes</td>
<td>Located in 2011, Abandoned in 2012</td>
</tr>
<tr>
<td>1AA/08-22-093-06W4/00</td>
<td>0026039A</td>
<td>2/22/1964</td>
<td>Approximately 10000m</td>
<td>Yes</td>
<td>Located in 2011, Abandoned in 2012</td>
</tr>
<tr>
<td>1AA/16-15-096-06W4/00</td>
<td>0025561F</td>
<td>3/30/1964</td>
<td>Approximately 10000m</td>
<td>Yes</td>
<td>1 of 2 wells located in 2011, other to be located and both to be abandoned in 2013-2014 program</td>
</tr>
</tbody>
</table>

- 11-22, 6-8, 5-28, 15-32, 14-32, and 08-22 were abandoned with thermal cement and cut and capped according to current Directive 20 standards.
- Approval received from ERCB to re-enter the wellbores and bring them into compliance.
- 2 joints of casing were cemented in place to ensure future identification.
- 16-15 had two wellbores drilled originally.
  - Have located the shallower of the two, planning to abandon in Q4 2013 or Q1 2014.
  - Will locate and abandon second one in Q4 2013 or Q1 2014.
  - Access to location has been built.
<table>
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</tr>
<tr>
<td>Future Plans</td>
<td>Vicki Werner</td>
</tr>
</tbody>
</table>
Suncor places a high value on 4D seismic. Data were collected in the year indicated and reported the following year due to time required to process and interpret.
Pad 107 early days in the life of the pad, up to 10 m of steam chamber growth

Variations due to mud baffles or barriers

Pad 104 is demonstrating the medium recovery case

Pad 107 first images of chamber development
Pad 104 4D Seismic – OB20 Difference Volume

(Monitor versus Baseline)

4D seismic continues to be an important tool at Firebag
• Safety Moment – Alan Keller
• Introduction – Doug Castellino
• Geoscience – Tim Boyler
• Surface Heave and Cap Rock Integrity – Ken Powless
• Drilling and Completions – Micaela Streeter
• Artificial Lift – Micaela Streeter
• Instrumentation in Wells – Micaela Streeter
• 4-D Seismic – Tim Boyler
• Scheme Performance – Alan Keller
• Future Plans – Vicki Werner
Methodology for Predicting Performance

- At Firebag, future performance is predicted by leveraging multiple tools
  - **Analytical Models:**
    - Modified Butler’s Tandrain equations
    - Water balance to monitor well communication
  - Analytical models and flow simulations are history matched on a well pair, pattern and field level
  - CSOR and ISOR are calibrated to historic volumes
- **Constraints are applied to the forecast**
  - Plant turnarounds
  - Well downtime
  - New plant expansion and development pad schedule / availability
- **Continual improvement of numerical and analytical tools**
Firebag Production Data
Full Field

- Steam, Oil Rates (m3/cd)
- Produced Gas (E3m3/Cd)
- Oil (m3/Cd)
- Water Injected (m3/Cd)
- Water Produced (m3/Cd)

Scheme Performance – Well Production History
Scheme Performance – Well Production History

Firebag Production Data
Full Field

Steam, Oil Rates (m3/Cd)

Oil (m3/Cd)  Water Injected (m3/Cd)  Producing Well Count  SOR*10

0  10,000  20,000  30,000  40,000  50,000  60,000  70,000  80,000
0  10  20  30  40  50  60  70  80  90  100  110  120

Sep-03 Jan-04 May-04 Sep-04 Jan-05 May-05 Sep-05 Jan-06 May-06 Sep-06 Jan-07 May-07 Sep-07 Jan-08 May-08 Sep-08 Jan-09 May-09 Sep-09 Jan-10 May-10 Sep-10 Jan-11 May-11 Sep-11 Jan-12 May-12 Sep-12 Jan-13
Issues and Milestones

Daily Rates

- Plant Trip
- Plant 92 Cogen Turnaround
- Plant 91/92 Maintenance and Plant 94 Startup
- Pad 105 First oil
- Pad 106 First Steam
- Pad 116 First Steam
- Pad 101 infills First oil
- Pad 106 First oil
- Pad 116 First oil
Firebag Production

- Highest monthly average bitumen production over reporting period was 138,979 bopd (22,096 m³/cd) and occurred in February 2013
  - Stages 1, 2, 3, and 4 currently on production
  - Producing well count up by 60% over reporting period

- SOR Discussion
  - As of Feb 28, 2013 cumulative SOR at Firebag is 3.38 m³/m³
  - SOR over the reporting period was 3.40 m³/m³
    - Pad 105, 106, 116 startup steaming negatively impacted SOR over the reporting period
    - Pad 101 and 102 infill well startups positively impacted SOR
Steam Chamber Discussion – 8WP1 / 1WP2

- OB6 located near the toe of 8WP1
  - 16.5 m N of 8WP1
  - 165 m SE of 1WP2

- OB ETS1 is located at the midpoint, between 8WP1 and 8WP2
  - 69.5 m S of 8WP1
  - 32.6 m N of 8WP2

- 8WP1 first steam in October 2011

- 1WP2 first steam in October 2003
Steam Chamber Discussion – 8WP1 / 1WP2

OB6 – Toe of 8WP1, and riser section of 1WP2

- 16.5 m north of 8WP1, near the toe
- Mid way along 1WP2 build section, 165m SE of 1WP2
- Temp began increasing Sept 2010, 8WP1 first steam Oct 2011
- Steam chamber expanding past the heel of 1WP2
- Steam chamber top interpreted at 298 mKB
  - 30m from Channel Top
OB ETS 1 – between 8WP2 and 8WP1

- 69.5 m S of 8WP1
- 32.6 m N of 8WP2
- No steam chamber development yet at this location
• OB87 is located 25.5 m West of 7WP1

• Located near the heel of the well pair

• OB87 is instrumented with 56 thermocouples covering the entire McMurray channel and into the caprock
Steam Chamber Discussion – P7WP1

OB87 – Heel of P7WP1, 25.5 m West

• Heating from virgin reservoir temperature (10°C) to near steam temperature (215°C) over the last year

• Initial temperature growth appeared limited to below shale at 312 mKB

• Since January 2013 it appears that steam is finding a way above the shale at 312 mKB

![Temperature Graph](image-url)
Steam Chamber Discussion – P4WP10

• P4WP10 has two observation wells nearby:

• OB85
  - near the heel of 4WP10 horizontal
  - 56 thermocouples covering the entire McMurray channel and into the caprock

• OB92
  - near the toe of 4WP10 horizontal
  - 56 thermocouples covering the entire McMurray channel and into the caprock
OB85 – midway in between 4WP10 and 5WP12

OB85 located midway between pads 104/105:
• 73.8 m E of 5P12
• 78.8 m W of 4P10

Temperature of 175°C indicates steam chamber is close to OB85 as of February 2013

Chamber development attributed to 4WP10 based on 4D seismic
• 4WP10 first steam Oct 08
• 5WP12 first steam Dec 11
Steam Chamber Discussion – P4WP10

OB92 – Midpoint of P4WP10

- 70.1 m east of 4WP10
- 91.5 m west of 4WP9

- Still cold as of February 2013

- Infill well proposed for midway between 4WP9 and 4WP10
### Pad Recoveries

<table>
<thead>
<tr>
<th>Pad</th>
<th>101</th>
<th>102</th>
<th>103</th>
<th>104</th>
<th>Stage 1 &amp; 2 Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery to Date, e³m³</td>
<td>7,846</td>
<td>6,103</td>
<td>5,500</td>
<td>3,104</td>
<td>22,553</td>
</tr>
<tr>
<td>Recovery Factor to Date, %</td>
<td>34%</td>
<td>26%</td>
<td>28%</td>
<td>17%</td>
<td>27%</td>
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<tr>
<td>Expected Ultimate Recovery, e³m³</td>
<td>13,275</td>
<td>13,116</td>
<td>10,811</td>
<td>12,242</td>
<td>49,445</td>
</tr>
<tr>
<td>Expected Ultimate Recovery Factor, %</td>
<td>57%</td>
<td>56%</td>
<td>54%</td>
<td>66%</td>
<td>58%</td>
</tr>
<tr>
<td>OBIP, e³m³</td>
<td>23,100</td>
<td>23,400</td>
<td>20,000</td>
<td>18,500</td>
<td>85,000</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Pad</th>
<th>105</th>
<th>106</th>
<th>107</th>
<th>108</th>
<th>116</th>
<th>Stage 3 &amp; 4 Totals</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery to Date, e³m³</td>
<td>701</td>
<td>33</td>
<td>1,115</td>
<td>341</td>
<td>2</td>
<td>2,191</td>
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<tr>
<td>Recovery Factor to Date, %</td>
<td>3%</td>
<td>0%</td>
<td>9%</td>
<td>2%</td>
<td>0%</td>
<td>2%</td>
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<tr>
<td>Expected Ultimate Recovery, e³m³</td>
<td>13,196</td>
<td>8,108</td>
<td>6,836</td>
<td>8,585</td>
<td>10,334</td>
<td>47,060</td>
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<tr>
<td>Expected Ultimate Recovery Factor, %</td>
<td>57%</td>
<td>44%</td>
<td>54%</td>
<td>49%</td>
<td>60%</td>
<td>53%</td>
</tr>
<tr>
<td>OBIP, e³m³</td>
<td>23,300</td>
<td>18,500</td>
<td>12,600</td>
<td>17,700</td>
<td>17,300</td>
<td>89,400</td>
</tr>
</tbody>
</table>

- infill wells are included
- 108 North wells are included
Pad 103 Performance – High Recovery

- Pad 103
  - 11 wells are currently on production
  - Monthly steam chamber pressures:
    - Average: 2279 kPag
    - Range: 2020 kPag - 2828 kPag
  - Performance as of Feb 28, 2013:
    - Cumulative steam injected is 18,565,508 m³
    - Cumulative oil produced is 5,500,322 m³
    - Recovery Factor of 28%
  - Production from 103 South lagging behind 103 West half. This could be due to local heterogeneities on the south half of the pad
Pad 103 Performance – High Recovery

Firebag Pad 103 Production

- **Oil Rate (m³/CD)**
- **Steam Rate (m³/CD)**
- **SOR (m³/m³)**
- **CSOR (m³/m³)**

Date:
- Mar-12, Apr-12, May-12, Jun-12, Jul-12, Aug-12, Sep-12, Oct-12, Nov-12, Dec-12, Jan-13, Feb-13

Productions:
- **Rate, m³/d**
- **SOR, m³/m³**

- **6.00**
- **5.00**
- **4.00**
- **3.00**
- **2.00**
- **1.00**
- **0.00**

Values:
- **12000**
- **10000**
- **9000**
- **8000**
- **7000**
- **6000**
- **5000**
- **4000**
- **3000**
- **2000**
- **1000**
- **0**
Pad 103 West Performance – High Recovery

Firebag Pad 103 West Production

- Jan-Feb 2006 Steam Shortage
- Feb 2007 Plant shut-in for cogent tie-ins
- Jun 2007: Plant Turnaround
- Nov 08 - Feb 09: New NL Wells Start
- Sep-Dec 09: Reduced steam availability due to plant upsets
- Sep 2010 Plant Turnaround
- Sep 2011 Plant Turnaround
- May 2012 Plant Turnaround

Date: Aug 05 to Dec 12

Rate, m³/d

SOR, m³/m³

Oil Rate (m³/CD) - Steam Rate (m³/CD) - SOR (m³/m³) - CSOR (m³/m³)
Pad 104 Performance – Medium Recovery

- Pad 104
  - 10 wells are currently on production
  - Monthly steam chamber pressures:
    - Average: 2404 kPag
    - Range: 1890 kPag - 2858 kPag
  - Performance as of Feb 28, 2013:
    - Cumulative steam injected is 10,230,079 m³
    - Cumulative oil produced is 3,103,998 m³
    - Recovery Factor of 17%
  - Performance up-trend started late 2010
  - Steam chamber thickness map from 2012 4D Seismic data shown
    - South half steam chamber growth still remains less than north half.
  - Steam injection continued to ramp up through 2012, leading to higher chamber pressures and larger steam chamber development
Pad 104 Performance – Medium Recovery

Firebag Pad 104 Production

- July 2012 Plant 93 Tripped

Graph showing production rate and SOR over time, with key indicators and dates.
Firebag Pad 104 North Production

- Oct 2008: First Steam
- Apr 2009: NL SAGD conversions commenced
- Sep-Dec 09: Reduced steam availability due to plant upsets
- Sep 2011 Plant Turnaround
- May 2012 Plant Turnaround
- July 2012 Plant Trip
Pad 104 South Performance – Medium Recovery

Firebag Pad 104 South Production

- Oct 2008: First Steam
- Sep-Dec 09: Reduced steam availability due to plant upsets
- Apr 2009: NL SAGD conversions commenced
- Sep 2011 Plant Turnaround
- July 2012 Plant Trip

Date

Rate, m³/d

 Sor, m³/m³

Oil Rate (m³/CD)  Steam Rate (m³/CD)  SOR (m³/m³)  CSOR (m³/m³)
Pad 105 Performance – Low Recovery

• Pad 105
  • 17 wells on production as of Feb 28, 2013
  • All Pad 105 wells converted to mechanical lift in 2012
  • Steam chamber pressures:
    • Average over period: 2543 kPag
    • Range over period: 2090 kPag - 3017 kPag
  • Performance as of Feb 28, 2013:
    • Cumulative steam injected is 3,055,207 m³
    • Cumulative oil produced is 701,357 m³
    • Recovery Factor of 3%
  • Production and steam injection ramping up as per expectations
Pad 105 Performance – Low Recovery

Firebag Pad 105 Production

- April 2012 - First Oil Production
- August 2012 - Final SAGD Conversion Completed (5WP6)

Date

Mar-12 Apr-12 May-12 Jun-12 Jul-12 Aug-12 Sep-12 Oct-12 Nov-12 Dec-12 Jan-13 Feb-13

Rate, m3/d

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000

SOR, m3/m3

0 2.00 4.00 6.00 8.00 10.00 12.00 14.00

- Oil Rate (m3/CD)
- Steam Rate (m3/CD)
- SOR (m3/m3)
- CSOR (m3/m3)
Pad 105 North Performance – Low Recovery

- Pad 105 North
  - All (7) well pairs in SAGD production as of Aug 2012
  - Oil rate and steam injection ramping up

**Firebag Pad 105 North Production**

- December 2011 - First Steam
- April 2012 - First Oil Production
- August 2012 - Final SAGD Conversion Completed (5WP6)
Pad 105 South Performance – Low Recovery

- Pad 105 South
  - All (7) well pairs in SAGD production as of July 2012
  - Oil rate and steam injection ramping up
Pad 105 East Performance – Low Recovery

- Pad 105 East
  - All (3) well pairs well pairs in SAGD production as of Aug 2012
  - Oil rate and steam injection ramping up
  - Drilled underneath Pad 104

![Firebag Pad 105 East Production Graph](image-url)

- December 2011 - First Steam
- April 2012 - First Oil Production
- August 2012 - Final SAGD Conversion Completed (SWP10)
• Do not anticipate abandonment of any SAGD pads within the next 5 years

• 3P3 and 3P4 downhole abandonments completed in Q3 of 2012

• Redrilled wells 3P3B and 3P4B are now producing
Steam Injection Properties

- Approved maximum operating pressures of
  - 4040 kPag (251 °C) during circulation
  - 3570 kPag (243 °C) during SAGD
- Average monthly casing injection pressure during Feb 2013 (as measured by blanket gas) was 2423 kPag (225 °C)
- Steam quality decreases between the central plant and the pads
  - Steam quality leaving the plant is 100% at approximately 11 MPag
  - Steam quality at the wellhead is not measured, but has been modelled and estimated to be 95%
- These conditions are in line with those in the original design
Steam Injection Properties

• The transportation distance from the central plant to the pads in which steam can be delivered at reasonable qualities will vary depending upon:
  • Line size
  • Insulation thickness
  • Initial pressure
  • Desired steam rate

• Steam transport distance remains economic at approximately 10 km from Firebag facility
  • Current longest steam transport distance to an operating pad is approximately 5.5 km
Summary of Key Learnings

• Startup Strategy
  • Startup time frame is two to three months
  • Startup wells converted directly to mechanical lift following steam circulation or bullheading
    • Natural lift phase is no longer employed, ESP operation allows for stable operation and strict subcool control
  • Startup steaming on Pads 105 and 108 completed in 2012
    • All 17 wells on Pad 105 are now in SAGD mode
    • All 12 wells on Pad 108 are now in SAGD mode
  • First steam on Pad 106 occurred in September 2012
    • All wells in Mechanical Lift SAGD as of March 2013
  • First steam on Pad 116 occurred in October 2012
    • Mechanical Lift SAGD conversions underway, first oil in Feb 2013
Summary of Key Learnings - Bullheading

- Bullheading Startup
  - Injecting steam into the reservoir without circulating a portion of the steam back to surface
  - Purpose is to heat the reservoir between injector and producer
  - Historically circulation startup wells at Firebag have leaked off a material portion of circulated steam
  - By not taking returns, bullheading:
    - Requires less cumulative steam
    - Achieves the same reservoir heating as circulation
    - Reduces CSOR and thus emissions / bbl produced
  - Operates within ERCB approved maximum operating pressure for startup (4040 kPag)
Summary of Key Learnings - Bullheading

- 4D Seismic interpretation of steam chamber thickness, 2012
  - Bullheading startup wells in red

- No systematic disparity discovered between circulation and bullheading startup methods:
  - Temperature falloff tests
  - 4D seismic interpretation
  - Production performance

- No indications that bullheading startup has in any way compromised steam chamber development to date
Summary of Key Learnings - Bullheading

- Difficulty establishing bullheading on 5WP10 and 5WP11
  - Leakoff not initially high enough for steam-to-toe. Intermittent circulation and bullheading employed
  - Drilled under Pad 104 and surrounded by more mature operating pads on three sides
  - Elevated reservoir pressure measured prior to startup (2386 kPa on 5P11)

- Difficulty establishing bullheading on 8WP10
  - Converted to circulation for startup
  - Drilled under Pad 107 and surrounded by more mature operating pads on three sides
Summary of Key Learnings – 5P6 Diluent Trial

- 5P6 diluent injection pilot
- 2 stage diluent injection program:
  - Diluent injected into two isolated sections of the injector well while producing using an ESP in the producer well
  - Stage 1: February 25-26 (200 m³ diluent)
  - Stage 2: March 3-4 (100 m³ diluent)
Pad 105 – 5P6 Diluent Trial Conclusions

- No diluent or tracer produced back during the test
- Significant fluid mobility in cold reservoir observed
  - Produced 250 m³/d water during test, with 80 kPa drawdown
  - Potential for solvent displacement between injector and producer in cold reservoir
- In the future a higher pressure drop in the producer utilizing a bigger pump might help recover the injected fluids
- No significant affect in ramp-up time or production rates attributed to trial
• Well Trajectories & Well Placement
  • Well trajectories planned to minimize doglegs throughout the length of the well
  • Tangent sections added in producers to allow pumps to lie straight
  • Producers placed as low as reasonably possible in the reservoir to allow for maximum recovery
Summary of Key Learnings

New well startups adjacent to operating pads:

- Pad 104 started before neighboring pads
- Correlation with increasing TFSR on Pad 104 as the neighboring pads brought online
- TFSR appears to normalize with time
Summary of Key Learnings

- **Subcool Management**
  - Operate SAGD well pairs with target of 20°C reservoir subcool
  - Temperature measured in all producers at the ESP intake
  - Low rate steam tests measure reservoir pressure monthly
  - Adjust pump speeds regularly to maintain subcool target
  - Producers less sensitive to steam injection rate changes
  - Improved pump reliability
  - Manage reservoir fluid levels below injectors to avoid flooding

- **Infill Start-ups**
  - Variation in initial mobility along wells
  - High degree of steam leak-off observed on most wells
  - Longer startups required on wells with lower mobility
  - Select wells required multiple steaming cycles
  - Generally stable in SAGD mode – no challenges from injector/producer interaction
Summary of Key Learnings

• Artificial Lift
  • Mechanical lift used in all Firebag production wells
  • Mechanical lift allows for quick adjustment to production rates in order to maintain subcool control
  • High temperature pumps now in operation which allow for operation at a range of steam chamber pressures
    • Enabled earlier use of mechanical lift
    • Higher pressure in early time promotes chamber growth and speeds ramp up
    • Lower pressure in later time may reduce water loss and decreases SOR
Future Plans - Steam Strategy

• Operating Pressure
  • Operating pressures ranged from 1900-3000 kPag chamber pressure in SAGD, depending on Pad
  • Plan to drop chamber pressures on mature wells over next few years

• Under normal operating conditions, steam is allocated to balance chamber pressures across patterns

• In periods of lower steam supply, priority generally given to younger wells
• Safety Moment – Alan Keller
• Introduction – Doug Castellino
• Geoscience – Tim Boyler
• Surface Heave and Cap Rock Integrity – Ken Powless
• Drilling and Completions – Micaela Streeter
• Artificial Lift – Micaela Streeter
• Instrumentation in Wells – Micaela Streeter
• 4-D Seismic – Tim Boyler
• Scheme Performance – Alan Keller
• Future Plans – Vicki Werner
Future Plans – Regulatory Applications

- Filed Applications

<table>
<thead>
<tr>
<th>D23 Applications</th>
<th>Description</th>
<th>Date Submitted</th>
<th>Date Approved</th>
<th>Approval</th>
</tr>
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<tbody>
<tr>
<td>Pad 117</td>
<td>Ten wellpairs (2 north, 8 west)</td>
<td>Jul-21-2011</td>
<td>Jun-27-2012</td>
<td>8870EE</td>
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<tr>
<td>Pad 114</td>
<td>Fifteen wellpairs</td>
<td>Jul-09-2012</td>
<td>Feb-11-2013</td>
<td>8870KK</td>
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<tr>
<td>Pads 111 &amp; 112</td>
<td>Thirty wellpairs</td>
<td>Dec-19-2012</td>
<td>In Progress</td>
<td></td>
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<tr>
<td>Pad 118</td>
<td>Sixteen wellpairs, three single producers</td>
<td>Dec-19-2012</td>
<td>In Progress</td>
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<table>
<thead>
<tr>
<th>Amendments</th>
<th>Description</th>
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<th>Date Approved</th>
<th>Approval</th>
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<tr>
<td>Pad 103</td>
<td>Eight infill wells</td>
<td>Jan-27-2012</td>
<td>Mar-02-2012</td>
<td>8870CC</td>
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<tr>
<td>Pad 103</td>
<td>Chemical co-injection in up to three injectors</td>
<td>Feb-03-2012</td>
<td>Apr-23-2012</td>
<td>8870DD</td>
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<tr>
<td>Pad 106 &amp; 116</td>
<td>Bullheading</td>
<td>Jun-01-2012</td>
<td>Oct-01-2012</td>
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<tr>
<td>Pad 101</td>
<td>NCG co-injection in three wellpairs</td>
<td>Aug-09-2012</td>
<td>Feb-20-2013</td>
<td>8870LL</td>
</tr>
<tr>
<td>Pad 108 North</td>
<td>Two wellpairs, one single producer</td>
<td>Oct-19-2012</td>
<td>Jan-23-2013</td>
<td>8870JJ</td>
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<tr>
<td>Vx Multiplexing</td>
<td>Multiple well measurement via single Vx™ multi-phase meter</td>
<td>Oct-19-2012</td>
<td>Jan-23-2013</td>
<td>8870JJ</td>
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<td>Pad 109</td>
<td>Trajectory adjustment</td>
<td>Oct-31-2012</td>
<td>Jan-16-2013</td>
<td>8870II</td>
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<tr>
<td>Pad 104 &amp; 105</td>
<td>Chemical co-injection in up to three injectors per pad</td>
<td>Dec-13-2012</td>
<td>Mar-15-2013</td>
<td>8870MM</td>
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<tr>
<td>Pad 117</td>
<td>Four east wellpairs &amp; west wellpair trajectory adjustments</td>
<td>Dec-19-2012</td>
<td>Jan-23-2013</td>
<td>8870JJ</td>
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<tr>
<td>Pad 104 South</td>
<td>Six infill wells (5 south, 1 north)</td>
<td>Mar-05-2013</td>
<td>In Progress</td>
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</tr>
</tbody>
</table>

- Future Applications
  - Geoscience and Reservoir Development Team working to determine optimum depletion plans for next sustaining pads
  - Expect to submit D23 applications for approximately three additional pads in 2013
Future Plans – Testing

- **Pad 101 South Wind-down - NCG Co-injection**
  - Staged approach to develop a viable commercial wind-down process
  - NCG co-injection planned for Q2 2013, pending facilities completion

- **Pad 103 Chemical Co-Injection Test**
  - Laboratory chemical testing underway
  - Chemical co-injection to be determined

- **Pad 104 and 105 Chemical Co-Injection Test**
  - Chemical co-injection currently planned for Q4 2013
Future Plans - Drilling Activities

• Completed Drilling
  • Pad 115 drilling completed April 2012; first steam currently planned for Q1 2014
  • Pad 104 north infill well drilling completed October 2012; first steam currently planned for Q4 2013
  • Pad 103 infill well drilling completed April 2013; first steam currently planned for Q2 2014

• In Progress Drilling
  • Pad 110 drilling commenced May 2012 and anticipate rig release Q2 2013; first steam currently planned for Q4 2014
  • Pad 108 north drilling commenced April 2013 and anticipate rig release Q2 2013; first steam currently planned for Q2 2014
Future Plans – Drilling Activities

• Future Drilling

• Pad 117 drilling to commence Q2 2013
• Pad 109 drilling to commence Q2 2013
• Pad 114 drilling to commence Q3 2013
• Pad 104 south infill well drilling for Q2 2014, pending regulatory approval
• Coreholes/observation wells will be drilled as necessary to:
  • adequately delineate the resource
  • monitor SAGD operations
  • further cap rock integrity analysis
  • further hydrogeology and water disposal analysis
Appendix - Subsurface

2013 Reservoir ERCB Appendix to Presentation
<table>
<thead>
<tr>
<th>Well Name</th>
<th>UWI</th>
<th>Relative to</th>
<th>Lateral Position</th>
<th>Vertical Position</th>
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</thead>
<tbody>
<tr>
<td>ETS OB1</td>
<td>102/10-01-095-06 W4M</td>
<td>P8P1, P8P2</td>
<td>69.5 m S, 32.6 m N</td>
<td>311.5m MD, 315.9m MD</td>
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<tr>
<td>ETS OB3</td>
<td>100/01-11-095-06 W4M</td>
<td>P7P6, P7P7</td>
<td>24.4 m E, 79.8 m W</td>
<td>321.0m MD, 313.8m MD</td>
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<tr>
<td>ETS 1</td>
<td>100/12-06-095-05 W4M</td>
<td>P3P5</td>
<td>345 m N</td>
<td>N/A - diagonal distance to producer at toe depth = 446 m NE</td>
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<tr>
<td></td>
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<td>P1P6</td>
<td>276 m S</td>
<td>N/A - diagonal distance to producer at ICP depth = 428 m S</td>
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<tr>
<td>OB3</td>
<td>102/08-01-095-06 W4M</td>
<td>P1S6, P1P6</td>
<td>2.7 m E, 1 m E</td>
<td>310.06 m MD, 316.58 m MD</td>
</tr>
<tr>
<td>OB4</td>
<td>102/01-01-095-06 W4M</td>
<td>P1S6, P1P6</td>
<td>3.1 m E, 4 m E</td>
<td>310.33 m MD, 316.61 m MD</td>
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<tr>
<td>OB5</td>
<td>100/15-36-094-06 W4M</td>
<td>P1S6, P1P6</td>
<td>1.5 m E, 0.6 m W</td>
<td>310.21 m MD, 316.71 m MD</td>
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<tr>
<td>OB6</td>
<td>105/09-01-095-06 W4M</td>
<td>P1S2, P1P2, P8P1</td>
<td>165 m SE of heel, 165 m SE of heel, 16.5 m N</td>
<td>318.65 m MD, 324.2 m MD, 309.2mMD</td>
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<tr>
<td>OB7</td>
<td>102/09-01-095-06 W4M</td>
<td>P1S8, P1P8, P8P3</td>
<td>138.5 m NE of heel, 138.5 m NE of heel, 60.6 m N</td>
<td>313.49 m MD, 320.94 m MD, 320.0m MD</td>
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<tr>
<td>OB8</td>
<td>100/15-12-095-06 W4M</td>
<td>P3P9, P3P8</td>
<td>98.3 m S, 89 m N</td>
<td>N/A - between P3P8 and P3P9</td>
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<tr>
<td>OB9</td>
<td>102/16-12-095-06 W4M</td>
<td>P3S9, P3P9</td>
<td>18.7 m N, 20 m N</td>
<td>303.67 m MD, 311.52 m MD</td>
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<tr>
<td>OB10</td>
<td>100/13-01-095-06 W4M</td>
<td>P2S1, P2P1</td>
<td>91.5 m W, 91.5 m W</td>
<td>319.55 m MD, 326.59 m MD</td>
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<td>OB11</td>
<td>106/15-36-094-06 W4M</td>
<td>P1S7, P1P7</td>
<td>76 m S of toe, 76 m S of toe</td>
<td>312.83 m MD, 318.61 m MD</td>
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<tr>
<td>Well Name</td>
<td>UWI</td>
<td>Relative to</td>
<td>Lateral Position</td>
<td>Vertical Position</td>
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<tr>
<td>OB12</td>
<td>102/15-12-095-06 W4M</td>
<td>P3S9, P3P9</td>
<td>21.6 m N, 26 m N</td>
<td>302.05 m MD, 314.91 m MD</td>
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<tr>
<td>OB13</td>
<td>110/07-11-095-06 W4M</td>
<td>P7S2, P7P2</td>
<td>16.8 m W, 14.9 m W</td>
<td>322.66 m MD, 322.7 m MD</td>
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<tr>
<td>OB14</td>
<td>103/08-02-095-06 W4M</td>
<td>P8P6, P7P9</td>
<td>160.2 m W, 91.2 m E</td>
<td>312.4 m MD, 325.0 m MD</td>
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<tr>
<td>OB17</td>
<td>105/05-12-095-06 W4M</td>
<td>P2P1, P7P8</td>
<td>199.7 m W, 202.3 m E</td>
<td>326.5 m MD, 313.5 m MD</td>
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<tr>
<td>OB18</td>
<td>100/09-10-095-06 W4M</td>
<td>P5P6, P5P5</td>
<td>33.8 m W of horizontal, 100 m E of horizontal</td>
<td>319 m MD, 320 m MD</td>
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<tr>
<td>OB19</td>
<td>106/03-02-095-06 W4M</td>
<td>P4S7, P4P7</td>
<td>83.5 m E of toe, 49.9 m S of toe</td>
<td>319.31 m MD, 326.4 m MD</td>
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<tr>
<td>OB20</td>
<td>100/05-02-095-06 W4M</td>
<td>P4S9, P4P9</td>
<td>78.4 m E of horizontal, 74.9 m E of horizontal</td>
<td>317.28 m MD, 323.23 m MD</td>
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<tr>
<td>OB21</td>
<td>100/11-03-095-06 W4M</td>
<td>P5P18, P5P17</td>
<td>21.3 m E of horizontal, 116.8 m W of horizontal</td>
<td>325 m MD, 326.6 m MD</td>
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<tr>
<td>OB22</td>
<td>100/13-02-095-06 W4M</td>
<td>P4S10, P4P10</td>
<td>32.0 m W of heel, 3.25 m N of heel</td>
<td>310.17 m MD, 322.24 m MD</td>
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<tr>
<td>OB23</td>
<td>100/05-11-095-06 W4M</td>
<td>P4S3, P4P3</td>
<td>41.7 m W of horizontal, 42.7 m W of horizontal</td>
<td>311.87 m MD, 318.49 m MD</td>
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<tr>
<td>OB27</td>
<td>100/05-04-095-06 W4M</td>
<td>P116P12</td>
<td>559 m S of horizontal</td>
<td>296.2 m MD</td>
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<tr>
<td>OB28</td>
<td>100/07-04-095-06 W4M</td>
<td>P116P11</td>
<td>400m SW of ICP</td>
<td>315.75 m MD</td>
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<tr>
<td>OB29</td>
<td>100/07-05-095-06 W4M</td>
<td>P116P12</td>
<td>643.7 m SW of toe</td>
<td>293 m MD</td>
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<tr>
<td>OB30</td>
<td>100/15-05-095-06 W5M</td>
<td>P116P14, P116P13</td>
<td>63.4 m SW of toe, 87.6 m NW of toe</td>
<td>285.5 m MD, 288 m MD</td>
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<td>OB31</td>
<td>100/06-08-095-06 W4M</td>
<td>P116P19, P115P1</td>
<td>750 m NW of toe, 795 m SW of ICP_PLAN</td>
<td>275.75 m MD, 275.5 m MD</td>
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<td>OB32</td>
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<td>P115P1</td>
<td>476 m W of horizontal</td>
<td>277 m MD</td>
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<td>OB33</td>
<td>100/13-08-095-06 W4M</td>
<td>P115P1</td>
<td>868 m W of horizontal</td>
<td>270.5 m MD</td>
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**SAGD Observation Well Positioning**

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<thead>
<tr>
<th>Well Name</th>
<th>UWI</th>
<th>Relative to</th>
<th>Lateral Position</th>
<th>Vertical Position</th>
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<tr>
<td>OB34</td>
<td>100/03-09-095-06 W4M</td>
<td>P116P19, P116P18</td>
<td>90.4 m SE of ICP, 97.6 m NE of ICP</td>
<td>285.75m MD, 286.2m MD</td>
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<td>OB35</td>
<td>100/05-09-095-06 W4M</td>
<td>P115P12, P115P11</td>
<td>92.6 m NW of ICP, 119 m SW of ICP</td>
<td>285m MD, 285m MD</td>
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<td>OB36</td>
<td>100/11-09-095-06 W4M</td>
<td>P115P9</td>
<td>206.5 m N of horizontal</td>
<td>286.4m MD</td>
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<td>OB37</td>
<td>100/11-04-095-06 W4M</td>
<td>P116P12, P116P10</td>
<td>218 m SE of ICP, 585 m SW of ICP</td>
<td>294.3m MD, 306.2m MD</td>
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<td>OB38</td>
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<td>OB40</td>
<td>100/09-09-095-06 W4M</td>
<td>P6P1, P115P9</td>
<td>132.7 m W of horizontal, 229 m N of horizontal</td>
<td>291m MD, 288.4m MD</td>
</tr>
<tr>
<td>OB42</td>
<td>100/13-04-095-06 W4M</td>
<td>P116P15, P116P16</td>
<td>27.5 m N of horizontal, 60.5 m S of horizontal</td>
<td>288.7m MD, 288.3m MD</td>
</tr>
<tr>
<td>OB43</td>
<td>100/15-09-095-06 W4M</td>
<td>P6P1, P115P9</td>
<td>383 m NW of toe, 658 m N of horizontal</td>
<td>292.2m MD, 289.2m MD</td>
</tr>
<tr>
<td>OB44</td>
<td>100/01-05-095-06 W4M</td>
<td>P116P12</td>
<td>1065 m S of horizontal</td>
<td>296.4m MD</td>
</tr>
<tr>
<td>OB45</td>
<td>100/03-05-095-06 W4M</td>
<td>P116P12</td>
<td>1191 m SW of toe</td>
<td>285.6m MD</td>
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<tr>
<td>OB47</td>
<td>105/16-03-095-06 W4M</td>
<td>P5P13, P5P14</td>
<td>16.2m W of ICP, 121.5m E of ICP</td>
<td>329m TVD, 574m MD</td>
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<tr>
<td>OB48</td>
<td>102/11-06-095-06 W4M</td>
<td>P116P12</td>
<td>2229 m SW of toe</td>
<td>274.8m MD</td>
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<td>OB49</td>
<td>100/13-06-095-06 W4M</td>
<td>P116P14</td>
<td>2582 m W of toe</td>
<td>262.8m MD</td>
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<tr>
<td>OB51</td>
<td>100/03-18-095-05 W4M</td>
<td>P3P10</td>
<td>725 m NE of ICP</td>
<td>307.7m MD</td>
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<tr>
<td>OB54</td>
<td>100/13-07-095-05 W4M</td>
<td>P3S10, P3P10</td>
<td>1.82 m N of heel</td>
<td>299.67 m MD, 302.91 m MD</td>
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<td>OB56</td>
<td>100/15-06-095-05 W4M</td>
<td>P3S1, P3P1</td>
<td>108.64 m W of horizontal, 110.92 m W of horizontal</td>
<td>306.67 m MD, 314.85 m MD</td>
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<td>OB57</td>
<td>100/01-12-095-06 W4M</td>
<td>P1S4, P1P4</td>
<td>77.9 m W of horizontal, 78.6 m W of horizontal</td>
<td>316.76 m MD, 324.6 m MD</td>
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<td>Well Name</td>
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<td>Lateral Position</td>
<td>Vertical Position</td>
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<tr>
<td>OB59</td>
<td>100/03-07-095-05 W4M</td>
<td>P3S2, P3P2</td>
<td>85.46 m E of horizontal, 85.0 m E of horizontal</td>
<td>304.39 m MD, 311.11 m MD</td>
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<tr>
<td>OB60</td>
<td>100/04-01-095-06 W4M</td>
<td>P2S9, P2P9</td>
<td>25.1 m W of horizontal, 22.5 m W of horizontal</td>
<td>305.27 m MD, 312.29 m MD</td>
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<tr>
<td>OB61</td>
<td>100/04-11-095-06 W4M</td>
<td>P4S4, P4P4</td>
<td>27.13 m E of heel, 3.32 m E of heel</td>
<td>211.76 m MD, 157.52 m MD</td>
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<tr>
<td>OB62</td>
<td>100/06-02-095-06 W4M</td>
<td>P4P6, ST1N, P7P14</td>
<td>51 m E of horizontal, 73 m W of horizontal</td>
<td>325 m MD, 331.1 m MD</td>
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<tr>
<td>OB63</td>
<td>107/08-11-095-06 W4M</td>
<td>P7P6, P7P7</td>
<td>34 m E of horizontal, 55 m W of horizontal</td>
<td>323.6 m MD, 316.6 m MD</td>
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<tr>
<td>OB66</td>
<td>1AA/15-35-094-6 W4M</td>
<td>P8S5, P8S4</td>
<td>31.2 m E of horizontal, 75.3 m W of horizontal</td>
<td>307.2 m MD, 307.3 m MD</td>
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<tr>
<td>OB67</td>
<td>1AB/03-06-095-5 W4M</td>
<td>P1S6</td>
<td>645.3 m E of Horizontal</td>
<td>308 m MD</td>
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<tr>
<td>OB68</td>
<td>1AB/07-36-094-6 W4M</td>
<td>P1S7</td>
<td>747.3 m SE of toe</td>
<td>316.5 m MD</td>
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<td>OB69</td>
<td>1AA/11-35-094-6 W4M</td>
<td>P7S9</td>
<td>365.5 m SW of toe</td>
<td>320.1 m MD</td>
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<tr>
<td>OB70</td>
<td>1AB/13-35-094-6 W4M</td>
<td>P7P14</td>
<td>38.7 m W of horizontal</td>
<td>326.4 m MD</td>
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<td>OB71</td>
<td>1AC/03-02-095-6 W4M</td>
<td>P7P14</td>
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<td>326.2 m MD</td>
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<tr>
<td>OB72</td>
<td>1AC/16-02-095-6 W4M</td>
<td>P7S6, P7S7</td>
<td>68.5 m E of horizontal, 19.6 m W of horizontal</td>
<td>316.5 m MD, 310.5 m MD</td>
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<tr>
<td>OB73</td>
<td>1AB/05-31-094-5 W4M</td>
<td>P1S6</td>
<td>1041.5 m SE of toe</td>
<td>307.5 m MD</td>
</tr>
<tr>
<td>OB74</td>
<td>1AB/13-31-094-5 W4M</td>
<td>P1S6</td>
<td>738.1 m E of horizontal</td>
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<tr>
<td>OB75</td>
<td>1AB/11-31-094-5 W4M</td>
<td>P1S6</td>
<td>1141 m SE of toe</td>
<td>below TD of OB well</td>
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<td>OB76</td>
<td>1AA/11-02-095-6 W4M</td>
<td>P8S8, P8S9</td>
<td>25 m N of horizontal, 73.5 m S of horizontal</td>
<td>309.6 m MD, 311.9 m MD</td>
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<tr>
<td>OB77</td>
<td>1AA/13-12-095-6 W4M</td>
<td>P3P9, P3P10</td>
<td>353.4 m NW of toe, 350.8 m SW of toe</td>
<td>317 m MD, 313 m MD</td>
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<tr>
<td>OB78</td>
<td>1AA/06-11-095-6 W4M</td>
<td>P4P4, P4P5</td>
<td>94.7 m E of build, 61.2 m W of build</td>
<td>319.1 m MD, 326.2 m MD</td>
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<tr>
<td>OB79</td>
<td>1AB/14-35-094-6 W4M</td>
<td>P7S12, P7S11</td>
<td>40.8 m E of horizontal, 48.2 m W of horizontal</td>
<td>320 m MD, 321.2 m MD</td>
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### SAGD Observation Well Positioning

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<tr>
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<td>P4P3, P4S2</td>
<td>71.4 m W of horizontal</td>
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<td>92.7 m E of horizontal</td>
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<td>OB81</td>
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<td>P4S3, P4S4</td>
<td>40.8m E of horizontal</td>
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<td>113.7m E of horizontal</td>
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<td>OB82</td>
<td>1AA/14-11-095-6 W4M</td>
<td>P4S4, P4P5</td>
<td>29.9 m E of horizontal</td>
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<td>94.8 m W of horizontal</td>
<td>326.5m MD</td>
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<td>OB83</td>
<td>1AB/04-07-095-5 W4M</td>
<td>P3P4B, P3P3B</td>
<td>81.6 m E of horizontal</td>
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<td>59.4 m W of horizontal</td>
<td>301m MD</td>
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<td>OB84</td>
<td>1AA/13-06-095-5 W4M</td>
<td>P3S5, P3S4</td>
<td>70.45 m SE of horizontal</td>
<td>297m MD</td>
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<td>87.6 m W of horizontal</td>
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<td>OB85</td>
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<td>P5P12, P4P10</td>
<td>73.8 m E of horizontal</td>
<td>322.1m MD</td>
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<td>78.8 m W of horizontal</td>
<td>321.9m MD</td>
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<td>OB86</td>
<td>1AB/12-11-095-6 W4M</td>
<td>P4S1, P4S2</td>
<td>24.4 m E of horizontal</td>
<td>305.4m MD</td>
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<td>131.9 m W of horizontal</td>
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<td>OB87</td>
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<td>P4S6, P7S1</td>
<td>105 m NE of horizontal</td>
<td>311.3m MD</td>
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<td>OB88</td>
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<td>P7P3, P7S4</td>
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<td>25.1 m W of horizontal</td>
<td>322.8m MD</td>
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<td>OB89</td>
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<td>P7S10, P7S9</td>
<td>59.9 m E of horizontal</td>
<td>319.6m MD</td>
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<td>29.3 m W of horizontal</td>
<td>319.2m MD</td>
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<td>OB90</td>
<td>1AC/15-07-095-5 W4M</td>
<td>P3S1</td>
<td>790 m NE of horizontal</td>
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<td>OB91</td>
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<td>P3S1</td>
<td>862.2 m NE of horizontal</td>
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<td>OB92</td>
<td>1AB/12-02-095-6 W4M</td>
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<td>323.5m MD</td>
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<td>91.5 m W of horizontal</td>
<td>321.8m MD</td>
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<td>OB93</td>
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<td>P4P10, P4S9</td>
<td>129.8 m E of horizontal</td>
<td>321.5m MD</td>
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<td>29.3 m W of horizontal</td>
<td>312.9m MD</td>
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<td>OB94</td>
<td>1AB/13-02-095-6 W4M</td>
<td>P4S8, P4S7</td>
<td>44.4 m E of horizontal</td>
<td>313m MD</td>
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<td>114.9 m W of horizontal</td>
<td>313.6m MD</td>
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## SAGD Observation Well Positioning

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<td>OB95</td>
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<td>P5P6, P5P7</td>
<td>59.2 m E of horizontal, 61.25 m W of horizontal</td>
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<tr>
<td>OB96</td>
<td>1AA/05-10-095-6 W4M</td>
<td>P6S6, P6P7</td>
<td>65.1 m E of horizontal, 24.3 m W of horizontal</td>
<td>285.8m MD, 294.7m MD</td>
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<td>OB97</td>
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<td>487.5 m N of horizontal</td>
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<td>OB98</td>
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<td>1023.8 m NW of horizontal</td>
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<td>P116S3, P116P4</td>
<td>41 m S of horizontal, 21.6 m N of horizontal</td>
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<td>P116P9, P116P10</td>
<td>24.3 m S of horizontal, 65.2 m N of horizontal</td>
<td>304m MD, 309.7m MD</td>
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<td>OB103</td>
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<td>965 m NW of horizontal</td>
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<td>OB104</td>
<td>1AB/16-06-095-6 W4M</td>
<td>P116S16</td>
<td>1541 m W of toe</td>
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<td>OB105</td>
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<td>OB106</td>
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<td>P5P2B, P5P3</td>
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<td>OB107</td>
<td>1AA/10-32-094-6 W4M</td>
<td>P116P11</td>
<td>2025 m SW of build</td>
<td>307.5m MD</td>
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<td>OB109</td>
<td>1AC/11-34-094-6 W4M</td>
<td>P5P15</td>
<td>1031.8 m SE of build</td>
<td>328.3m MD</td>
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<td>OB110</td>
<td>1AB/15-33-094-6 W4M</td>
<td>P6P16</td>
<td>835.5 m SW of toe</td>
<td>308.5m MD</td>
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<td>P2N8, P2P8</td>
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<td>OB113</td>
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<td>P2P10, P2P9</td>
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<td>P5S2 OB</td>
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<td>P5P2</td>
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<td>P5P3</td>
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<td>P5P4</td>
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<td>13.45m MD</td>
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Firebag Pad 103 Monthly Production

- Monthly Oil, m3
- Monthly Steam, m3
- Monthly Water, m3
- Monthly SOR, m3/m3

Date:
- Jul 05
- Oct 05
- Jan 06
- Apr 06
- Jul 06
- Oct 06
- Jan 07
- Apr 07
- Jul 07
- Oct 07
- Jan 08
- Apr 08
- Jul 08
- Oct 08
- Jan 09
- Apr 09
- Jul 09
- Oct 09
- Jan 10
- Apr 10
- Jul 10
- Oct 10
- Jan 11
- Apr 11
- Jul 11
- Oct 11
- Jan 12
- Apr 12
- Jul 12
- Oct 12
- Jan 13
Firebag Pad 105 Monthly Production

Date: Oct-11, Nov-11, Dec-11, Jan-12, Feb-12, Mar-12, Apr-12, May-12, Jun-12, Jul-12, Aug-12, Sep-12, Oct-12, Nov-12, Dec-12, Jan-13, Feb-13

- **Monthly Cum, m³**: 0 to 500,000
- **SOR, m³/m³**: 0 to 8.00

- **Monthly Oil, m³**
- **Monthly Steam, m³**
- **Monthly Water, m³**
- **Monthly SOR, m³/m³**
Firebag Pad 108 Monthly Production

- **Monthly Cum, m³**
- **SOR, m³/m³**

**Legend:**
- Monthly Oil, m³
- Monthly Steam, m³
- Monthly Water, m³
- Monthly SOR, m³/m³

**Dates:**
- Aug-11 to Feb-13
Pad Produced & Injected Fluids Plots

Firebag Pad 106 Monthly Production

- Monthly Oil, m³
- Monthly Steam, m³
- Monthly Water, m³
- Monthly SOR, m³/m³
Pad Produced & Injected Fluids Plots

Firebag Pad 116 Monthly Production

- Monthly Oil, m³
- Monthly Steam, m³
- Monthly Water, m³
- Monthly SOR, m³/m³
Piezometer Plots & Temperature vs Depth Plots

ETS OB1

Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

Dates:
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012

102/10-01-095-06 W4/0

3.1.1 5d) i) & ii)
Piezometer Plots & Temperature vs Depth Plots

ETS OB3

Temperature (°C)

Depth (mKB)

Gamma

01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012

01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Apr-2012
01-Mar-2012

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top

100/01-11-095-06 W4/0
Piezometer Plots & Temperature vs Depth Plots

ETS OB4

Temperature (°C)

Depth (mKB)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top

Clearwater Top
Gamma

01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012

01-Aug-2012
01-Jul-2012
01-Jun-2012
Piezometer Plots & Temperature vs Depth Plots

ETS 1

Temperature (°C)

Depth (mKB)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

105/09-01-095-06 W4/0

OB6

Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

102/09-01-095-06 W4/0

OB7

Temperature (°C)

Depth (mKB)

Devonian Top, Continental Top, Channel Base, Channel Top, Tidal Flat Top, Shoreface Top, Clearwater Top, Gamma, 01-Feb-2013, 01-Jan-2013, 01-Dec-2012, 01-Nov-2012, 01-Oct-2012, 01-Sep-2012, 01-Aug-2012, 01-Jul-2012, 01-Jun-2012, 01-May-2012, 01-Apr-2012, 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/15-12-095-06 W4/0

OB8

Date

Pressure (kPag)

Temperature (ºC)

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB8 Pressure @ 309.97 mKB
OB8 Temperature @ 271.38 mKB
OB8 Temperature @ 309.97 mKB
Ob9

Temperature (ºC)

Depth (mKB)

102/16-12-095-06 W4/0

Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

106/15-36-094-06 W4/0

OB11

Date

Pressure (kPag)

Temperature (ºC)

1-Mar-12
1-Apr-12
1-May-12
1-Jun-12
1-Jul-12
1-Aug-12
1-Sep-12
1-Oct-12
1-Nov-12
1-Dec-12
1-Jan-13
1-Feb-13

OB11 Pressure @ 316.89 mKB
OB11 Pressure @ 294.65 mKB
OB11 Temperature @ 294.65 mKB
OB11 Temperature @ 316.89 mKB
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

Dates:
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012

110/07-11-095-06 W4/0
3.1.1 5d) i) & ii) Piezometer Plots & Temperature vs Depth Plots

OB17
Temperature (ºC)

105/05-12-095-06 W4/0

Depth (mKB)

Devonian Top  Continental Top  Channel Base  Channel Top  Tidal Flat Top  Shoreface Top  Clearwater Top
Gamma  01-Feb-2013  01-Jan-2013  01-Dec-2012  01-Nov-2012  01-Oct-2012  01-Sep-2012  01-Aug-2012  01-Jul-2012  01-Jun-2012  01-May-2012  01-Apr-2012  01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB21
Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/05-04-095-06 W4/0

Temperature (ºC)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

Dates:
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/03-09-095-06 W4/0

Temperature (°C)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

Temperature (ºC)

100/11-04-095-06 W4/0

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Mar-2012
OB37 Pressure @ 278.8 mKB
OB37 Pressure @ 310.47 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/11-05-095-06 W4/0

OB38

1,400
1,200
1,000
800
600
400
200
0

Pressure (kPag)

Date

1-Mar-12
1-Apr-12
1-May-12
1-Jun-12
1-Jul-12
1-Aug-12
1-Sep-12
1-Oct-12
1-Nov-12
1-Dec-12
1-Jan-13
1-Feb-13

OB38 Pressure @ 300.2 mKB  OB38 Pressure @ 326.4 mKB
3.1.1 5d) i) & ii)

Piezometer Plots & Temperature vs Depth Plots

100/07-08-095-06 W4/0

OB39

Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/07-08-095-06 W4/0

OB39

- OB39 Pressure @ 283.5 mKB
- OB39 Pressure @ 312.5 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

Graph showing temperature vs depth for OB42, with depth ranging from 232 to 292 m(KB) and temperature ranging from 0 to 150 °C.
Piezometer Plots & Temperature vs Depth Plots

OB43

Temperature (°C)

Depth (m KB)

100/15-09-095-06 W4/0

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

102/11-06-095-06 W4/0

OB48

Pressure (kPag)

Date

1-Mar-12  1-Apr-12  1-May-12  1-Jun-12  1-Jul-12  1-Aug-12  1-Sep-12  1-Oct-12  1-Nov-12  1-Dec-12  1-Jan-13  1-Feb-13

OB48 Pressure @ 298 mKB  OB48 Pressure @ 327 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/03-18-095-05 W4/0

OB51

OB51 Pressure @ 285 mKB

Date

Pressure (kPag)

1-Mar-12, 1-Apr-12, 1-May-12, 1-Jun-12, 1-Jul-12, 1-Aug-12, 1-Sep-12, 1-Oct-12, 1-Nov-12, 1-Dec-12, 1-Jan-13, 1-Feb-13

OB51 Pressure @ 285 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB54 Pressure @ 298.81 mKB

Date

Pressure (kPag)

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

100/13-07-095-05 W4/0
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
3.1.1 5d) i) & ii)

Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB57

Pressure (kPag)

Date

1-Mar-12     1-Apr-12     1-Jul-12     31-Aug-12     31-Oct-12     31-Dec-12

OB57 Pressure @ 248.78 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB59

Pressure (kPa)

Date

1-Mar-12, 1-Apr-12, 1-May-12, 1-Jun-12, 1-Jul-12, 1-Aug-12, 1-Sep-12, 1-Oct-12, 1-Nov-12, 1-Dec-12, 1-Jan-13, 1-Feb-13

OB59 Pressure @ 237.8 mKB
Piezometer Plots & Temperature vs Depth Plots

![Graph showing temperature vs depth and depth vs time for OB60 well.](image)
Piezometer Plots & Temperature vs Depth Plots

Graph showing pressure data over time for OB60.
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/04-11-095-06 W4/0

OB61

Pressure (kPag)

Date

OB61 Pressure @ 252.25 mKB
3.1.1 5d) i) & ii)

Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/06-02-095-06 W4/0

OB62

Date

Pressure (kPag)

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB62 Pressure @ 320 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

111/15-35-094-6 W4/0

OB66

Temperature (°C)

Depth (mKB)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Apr-2012
01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

111/15-35-094-6 W4/0

Pressure (kPag)

Date

OB66 Pressure @ 256.3 mKB

OB66 Pressure @ 301.3 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/11-35-094-6 W4/0

OB69

- Pressure (kPag)
- Temperature (ºC)

- OB69 Pressure @ 263.6 mKB
- OB69 Pressure @ 308.6 mKB
- OB69 Temperature @ 263.6 mKB
- OB69 Temperature @ 308.6 mKB
Piezometer Plots & Temperature vs Depth Plots

105/13-35-094-6 W4/0

OB70

Temperature (°C)

Temperature vs Depth Plots

01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma
Piezometer Plots & Temperature vs Depth Plots

OB70 Pressure @ 262.6 mKB
OB70 Pressure @ 307.6 mKB
Piezometer Plots & Temperature vs Depth Plots

107/03-02-095-6 W4/0

OB71

Temperature (ºC)

Depth (mKB)

3.1.1 5d) i) & ii)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top

- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/16-02-095-6 W4/0

OB72

Temperature (°C)

Depth (mKB)

Legend:
- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top

- Gamma
  - 01-Feb-2013
  - 01-Jan-2013
  - 01-Dec-2012
  - 01-Nov-2012
  - 01-Oct-2012
  - 01-Sep-2012

- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/16-02-095-6 W4/0

OB72

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB72 Pressure @ 263 mKB   OB72 Pressure @ 308 mKB

3.1.1 5d) i) & ii)
Piezometer Plots & Temperature vs Depth Plots

100/05-31-094-5 W4/0
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure vs. date with two lines representing OB73 Pressure @ 252 mKB and OB73 Pressure @ 297 mKB.](chart.png)
Piezometer Plots & Temperature vs Depth Plots

100/13-31-094-5 W4/0

OB74

Date

Pressure (kPag)

Temperature (ºC)

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB74 Pressure @ 249 mKB  OB74 Pressure @ 294 mKB
OB74 Temperature @ 249 mKB  OB74 Temperature @ 294 mKB
Piezometer Plots & Temperature vs Depth Plots

100/11-31-094-5 W4/0

OB75

Pressure (kPag) vs Date

Temperature (°C) vs Date

- OB75 Pressure @ 236.65 mKB
- OB75 Pressure @ 281.65 mKB
- OB75 Temperature @ 236.65 mKB
- OB75 Temperature @ 281.65 mKB
Piezometer Plots & Temperature vs Depth Plots

109/11-02-095-6 W4/0

OB76
Temperature (ºC)

Depth (mKB)

Devonian Top  Continental Top  Channel Base  Channel Top  Tidal Flat Top  Shoreface Top  Clearwater Top
Gamma  01-Feb-2013  01-Jan-2013  01-Dec-2012  01-Nov-2012  01-Oct-2012  01-Sep-2012
01-Aug-2012  01-Jul-2012  01-Jun-2012  01-May-2012  01-Apr-2012  01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

109/11-02-095-6 W4/0

OB76

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB76 Pressure @ 258 mKB

OB76 Pressure @ 303 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/13-12-095-6 W4/0

OB77

Date
1-Mar-12
1-Apr-12
1-May-12
1-Jun-12
1-Jul-12
1-Aug-12
1-Sep-12
1-Oct-12
1-Nov-12
1-Dec-12
1-Jan-13
1-Feb-13

Pressure (kPag)
0
500
1,000
1,500
2,000
2,500

OB77 Pressure @ 272 mKB
OB77 Pressure @ 317 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

107/03-11-095-6 W4/0

OB78

<table>
<thead>
<tr>
<th>Date</th>
<th>OB78 Pressure @ 259.7 mKB</th>
<th>OB78 Pressure @ 304.7 mKB</th>
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<tbody>
<tr>
<td>1-Mar-12</td>
<td>2,500</td>
<td>2,200</td>
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<td>1-Apr-12</td>
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<td>2,100</td>
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<td>2,300</td>
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<td>1-Jun-12</td>
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<td>1,200</td>
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<tr>
<td>1-Feb-13</td>
<td>1,400</td>
<td>1,100</td>
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</tbody>
</table>
Ob79
Temperature (ºC)

110/14-35-094-6 W4/0

Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

110/14-35-094-6 W4/0

OB79

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB79 Pressure @ 263 mKBB OB79 Pressure @ 308 mKBB
Piezometer Plots & Temperature vs Depth Plots

102/05-11-095-6 W4/0

OB80
Temperature (ºC)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

102/05-11-095-6 W4/0

OB80

Date
1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

Pressure (kPag)
0 500 1,000 1,500 2,000 2,500 3,000

OB80 Pressure @ 259.5 mKB  OB80 Pressure @ 304.5 mKB
Piezometer Plots & Temperature vs Depth Plots

102/12-11-095-6 W4/0

OB81

Pressure (kPag)

Date

1-Mar-12, 1-Apr-12, 1-May-12, 1-Jun-12, 1-Jul-12, 1-Aug-12, 1-Sep-12, 1-Oct-12, 1-Nov-12, 1-Dec-12, 1-Jan-13, 1-Feb-13

OB81 Pressure @ 263.5 mkB, OB81 Pressure @ 308.5 mkB
Piezometer Plots & Temperature vs Depth Plots

Temperature (ºC) vs Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top

Date Range:
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012

105/14-11-095-6 W4/0

3.1.1 5d) i) & ii)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

103/04-07-095-5 W4/0

OB83

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-Jul-12 31-Aug-12 31-Oct-12 31-Dec-12

OB83 Pressure @ 245.2 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

104/14-02-095-6 W4/0

OB87

Temperature (°C)

Depth (mKB)
Piezometer Plots & Temperature vs Depth Plots

104/14-02-095-6 W4/0

OB87

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<thead>
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<th>1-Oct-12</th>
<th>1-Nov-12</th>
<th>1-Dec-12</th>
<th>1-Jan-13</th>
<th>1-Feb-13</th>
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<tbody>
<tr>
<td>Pressure (kPag)</td>
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</tr>
<tr>
<td>OB87 Pressure @ 259.3 mKB</td>
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<td></td>
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</tr>
<tr>
<td>OB87 Pressure @ 304.3 mKB</td>
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</tbody>
</table>
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/15-07-095-5 W4/0

OB90

Temperature (°C)

Depth (mKB)

Devonian Top  Continental Top  Channel Base  Channel Top  Tidal Flat Top  Shoreface Top  Clearwater Top
Gamma
01-Feb-2013  01-Jan-2013  01-Dec-2012  01-Nov-2012  01-Oct-2012  01-Sept-2012
01-Aug-2012  01-Jul-2012  01-Jun-2012  01-May-2012  01-Apr-2012  01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

OB90 Pressure @ 234 mKB
OB90 Pressure @ 279 mKB
Piezometer Plots & Temperature vs Depth Plots

100/09-07-095-5 W4/0

OB91

Temperature (ºC)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/09-07-095-5 W4/0 OB91

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB91 Pressure @ 238 mKB  OB91 Pressure @ 283 mKB
Piezometer Plots & Temperature vs Depth Plots

100/12-02-095-6 W4/0

OB92
Temperature (°C)

Depth (mKB)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Apr-2012
01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/12-02-095-6 W4/0

OB92

Pressure (kPag)

Date

1-Mar-12
1-Apr-12
1-May-12
1-Jun-12
1-Jul-12
1-Aug-12
1-Sep-12
1-Oct-12
1-Nov-12
1-Dec-12
1-Jan-13
1-Feb-13

OB92 Pressure @ 270.15 mKB
OB92 Pressure @ 315.15 mKB
Piezometer Plots & Temperature vs Depth Plots

102/05-02-095-6 W4/0

OB93
Temperature (°C)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Apr-2012
01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

102/05-02-095-6 W4/0

OB93

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB93 Pressure @ 266.5 mKB
OB93 Pressure @ 311.5 mKB
Piezometer Plots & Temperature vs Depth Plots

102/13-02-095-6 W4/0

OB94
Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012

- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

102/13-02-095-6 W4/0

OB94

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB94 Pressure @ 259.3 mKB   OB94 Pressure @ 304.3 mKB
Piezometer Plots & Temperature vs Depth Plots

Temperature (ºC) vs Depth (mKB)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top

Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Apr-2012
01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

109/01-10-095-6 W4/0

OB95

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB95 Pressure @ 266 mKB
OB95 Pressure @ 311 mKB
Piezometer Plots & Temperature vs Depth Plots

100/05-10-095-6 W4/0

OB96
Temperature (°C)

Depth (mKB)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
01-Jul-2012
01-Jun-2012
01-May-2012
01-Apr-2012
01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots

100/05-10-095-6 W4/0

OB96 Pressure @ 247 mKB
OB96 Pressure @ 244.55 mKB
OB96 Pressure @ 289.55 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/13-09-095-6 W4/0

OB97 Pressure @ 244.5 mKB

OB97 Pressure @ 289.5 mKB

Date

Pressure (kPag)

1-Mar-12, 1-Apr-12, 1-May-12, 1-Jun-12, 1-Jul-12, 1-Aug-12, 1-Sep-12, 1-Oct-12, 1-Nov-12, 1-Dec-12, 1-Jan-13, 1-Feb-13

OB97 Pressure @ 244.5 mKB OB97 Pressure @ 289.5 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/01-17-095-6 W4/0

OB98

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB98 Pressure @ 246.25 mKB
OB98 Pressure @ 291.25 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/02-09-095-6 W4/0

OB101

Date
1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

Pressure (kPag)
0 500 1,000 1,500 2,000 2,500

OB101 Pressure @ 241.5 mKB OB101 Pressure @ 286.5 mKB
Piezometer Plots & Temperature vs Depth Plots

102/09-04-095-6 W4/0

OB102
Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Gamma

Dates:
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
- 01-Jul-2012
- 01-Jun-2012
- 01-May-2012
- 01-Apr-2012
- 01-Mar-2012
- Series 14
Piezometer Plots & Temperature vs Depth Plots

OB102 Pressure @ 256 mKB
OB102 Pressure @ 301 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure over time for OB103 with data points indicating pressure at different dates and depths.](image-url)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

102/07-10-095-6 W4M/0

OB105

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB105 Pressure @ 267.1 mKB
OB105 Pressure @ 312.1 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/15-33-094-6 W4/0

OB110

Pressure (kPag) vs Date

Temperature (°C) vs Date

OB110 Pressure @ 267.6 mKB
OB110 Pressure @ 312.6 mKB
OB110 Temperature @ 267.6 mKB
OB110 Temperature @ 312.6 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/12-36-094-6W4/0

OB113

Pressure (kPag) vs Date

Temperature (ºC) vs Date

OB113 Pressure @ 314.6 mKB  OB113 Temperature @ 314.6 mKB
Piezometer Plots & Temperature vs Depth Plots

100/09-35-094-6W4/0

OB114

Pressure (kPag) vs Date

Temperature (ºC) vs Date

OB114 Pressure @ 310.2 mKB

OB114 Temperature @ 310.2 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

107/07-03-095-06W4/0

OB118

Pressure (kPag)

Date

1-Mar-12
1-Apr-12
1-May-12
1-Jun-12
1-Jul-12
1-Aug-12
1-Sep-12
1-Oct-12
1-Nov-12
1-Dec-12
1-Jan-13
1-Feb-13

OB118 Pressure @ 266 mKB
OB118 Pressure @ 309 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB122

Temperature (°C)

Depth (mKB)

100/09-02-095-06W4/0

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma

01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Aug-2012

100/09-02-095-06W4/0
Piezometer Plots & Temperature vs Depth Plots

102/15-02-095-06W4/0

Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots

100/02-02-095-06W4/0

OB125
Temperature (°C)

Depth (mKB)

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Clearwater Top
Gamma

01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots

100/07-02-095-06W4/0

OB126
Temperature (°C)

Depth (mKB)

Devonian Top  Continental Top  Channel Base  Channel Top  Tidal Flat Top  Shoreface Top
Clearwater Top  Gamma  01-Feb-2013  01-Jan-2013  01-Dec-2012  01-Nov-2012
01-Oct-2012  01-Sep-2012  01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB128
Temperature (°C)

Depth (mKB)

105/08-02-095-06W4/0

Devonian Top
Continental Top
Channel Base
Channel Top
Tidal Flat Top
Shoreface Top
Gamma
01-Feb-2013
01-Jan-2013
01-Dec-2012
01-Nov-2012
01-Oct-2012
01-Sep-2012
01-Aug-2012
Series9
Piezometer Plots & Temperature vs Depth Plots

OB128 Pressure @ 264 mKB

Date
1-Mar-12, 1-Apr-12, 1-May-12, 1-Jun-12, 1-Jul-12, 1-Aug-12, 1-Sep-12, 1-Oct-12, 1-Nov-12, 1-Dec-12, 1-Jan-13, 1-Feb-13

Pressure (kPag)
0, 200, 400, 600, 800, 1,000, 1,200
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

102/09-03-095-06W4/0

OB130
Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots

Temperature (ºC)
Depth (mKB)
110/01-10-095-06W4/0

Ob131

Pressure (kPag)

Date

110/01-10-095-06W4/0

OB131 Pressure @ 257 mKB
OB131 Pressure @ 300 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/01-16-095-06W4/0

OB134

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB134 Pressure @ 264 mKB OB134 Pressure @ 307 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB135 Pressure @ 236 mKB

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

Pressure (kPag)

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800

106/09-09-095-06W4/0
Piezometer Plots & Temperature vs Depth Plots

100/11-10-095-06W4/0
Piezometer Plots & Temperature vs Depth Plots

100/11-10-095-06W4/0

OB136

Pressure (kPag)

Date

1-Mar-12 1-Apr-12 1-May-12 1-Jun-12 1-Jul-12 1-Aug-12 1-Sep-12 1-Oct-12 1-Nov-12 1-Dec-12 1-Jan-13 1-Feb-13

OB136 Pressure @ 249.5 mKB
Piezometer Plots & Temperature vs Depth Plots

100/09-08-095-05W4/0

OB137

Date

Pressure (kPag)

Temperature (ºC)

OB137 Pressure @ 278.5 mKB

OB137 Temperature @ 278.5 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

The graph shows temperature (ºC) plotted against depth (mKB) for various geological features and dates.

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma

Dates represented include:
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure and temperature data over time for OB147 at 263.3 mKB.]
Piezometer Plots & Temperature vs Depth Plots

111/13-10-095-06W4/0

QW1

<table>
<thead>
<tr>
<th>Date</th>
<th>Pressure (kPa)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Mar-12</td>
<td>1,400</td>
<td>5</td>
</tr>
<tr>
<td>1-May-12</td>
<td>1,300</td>
<td>4.5</td>
</tr>
<tr>
<td>1-Jul-12</td>
<td>1,200</td>
<td>4</td>
</tr>
<tr>
<td>31-Aug-12</td>
<td>1,100</td>
<td>3.5</td>
</tr>
<tr>
<td>31-Oct-12</td>
<td>1,000</td>
<td>3</td>
</tr>
<tr>
<td>31-Dec-12</td>
<td>900</td>
<td>2.5</td>
</tr>
</tbody>
</table>

QW1 Pressure @ 145.8 mKB, QW1 Temperature @ 145.8 mKB
Piezometer Plots & Temperature vs Depth Plots

100/12-10-095-06W4/0

QW2

Pressure (kPa)

Temperature (°C)

Date

QW2 Pressure @ 130.7 mKB
QW2 Temperature @ 130.7 mKB
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure and temperature data over time for QW4.](image-url)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB DS2

Pressure (kPag)

Date

1-Mar-12 1-May-12 1-Jul-12 31-Aug-12 31-Oct-12 31-Dec-12

Temperature (°C)

OB DS2 Pressure @ 286 mKB
OB DS2 Pressure @ 289 mKB
OB DS2 Temperature @ 286 mKB
OB DS2 Temperature @ 289 mKB
Piezometer Plots & Temperature vs Depth Plots

OB DS4
Temperature (°C)

Depth (mKB)

- Devonian Top
- Continental Top
- Channel Base
- Channel Top
- Tidal Flat Top
- Shoreface Top
- Clearwater Top
- Gamma
- 01-Mar-2013
- 01-Feb-2013
- 01-Jan-2013
- 01-Dec-2012
- 01-Nov-2012
- 01-Oct-2012
- 01-Sep-2012
- 01-Aug-2012
Piezometer Plots & Temperature vs Depth Plots

100/13-34-094-06W4/0

OB DS4

Pressure (KPa)

Date

- OB DS4 Pressure @ 367.5 mKB
- OB DS4 Pressure @ 341 mKB
- OB DS4 Pressure @ 212 mKB
- OB DS4 Pressure @ 341 mKB
Piezometer Plots & Temperature vs Depth Plots

100/02-15-095-06W4/0

OB DS5

Pressure (kPag)

1,200
1,400
1,600
1,800
2,000

Temperature (°C)

0
2
4
6
8
10
12

1-Mar-12
1-May-12
1-Jul-12
31-Aug-12
31-Oct-12
31-Dec-12

- OB DS5 Pressure @ 187 mKB
- OB DS5 Pressure @ 332.5 mKB
- OB DS5 Pressure @ 354 mKB
- OB DS5 Temperature @ 187 mKB
- OB DS5 Temperature @ 332.5 mKB
- OB DS5 Temperature @ 354 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

105/15-10-095-06W4/0

P5S3 OB

Temperature (°C)

Depth (mKB)

01-Dec-2012  01-Nov-2012  01-Oct-2012  01-Sep-2012  01-Aug-2012
01-Jul-2012  01-Jun-2012  01-May-2012  01-Mar-2012
Piezometer Plots & Temperature vs Depth Plots
Section 3.1.2 – Surface Operations, Compliance and Issues Not Related to Resource Evaluation and Recovery
Table of Contents

• Introduction – Mike Morden
• Safety Moment – Mike Morden
• Operations and Facility Performance – Pat De Haas
• Measurement and Reporting – John Graham
• Water Production, Injection and Usage – Leah Butler, John Graham/Brett Fairbairn
• Sulphur Production – Brett Fairbairn
• Environmental Performance – Brett Fairbairn, Mike Morden
• Future Plans – Pat De Haas
Firebag Performance Presentation
Operations and Facility Performance
May 1st and May 2nd, 2013
Firebag Project Site
Site Survey Plan
Firebag Site Layout
• Plant 91 and 92 utilize freewater knockout drums and treaters as primary methods of bitumen separation
• Both plants inject diluent upstream of the free water knockout drum
• Plant 93/94 primary differences:
  • Produced gas separators at the pads
  • Addition of a Diluent Recovery Unit (DRU) to recover diluent
  • Electrostatic treaters (new to Firebag)
  • Spiral Produced Water Coolers (new to Firebag)
  • Oil Removal Filters (ORF’s)
• Sulphur Recovery Unit (SRU) includes a three stage Claus process. The unit sweetens the produced gas for steam generation
Plant 91/92/93/94

- Ongoing Chemical Usage Optimization
- Handling solids accumulation in the vessels which is coming in with the emulsion
- Automated interface control implementation in Oil Treating vessels
- Produced water cooler fouling issues as well as Produced Water cooling capacity issues in Plant 93/94
- Dilbit Cooling Capacity Issues during summer time
- Cooling issues from Glycol System which is operating close to capacity
- DSU Start-up, operation in both Hotbit and Dilbit mode
- Ongoing operation improvement to reduce venting incidents
Water treatment technology used at Firebag:

- Plant 91 - Warm Lime Softening (WLS)
- Plant 92 - Evaporators and Disposal Water Treatment (DWT) Technology
- Plant 93 – WLS
- Plant 94 – WLS
Water Treatment Risks and Opportunities

- **91 – WLS Performance**
  - Chemical Optimization
- Integration with Oil Sands
  - Using Pond Effluent Water as makeup water
- Oil Sands Leadership Initiatives (OSLI) – pilot plant proposal
- **92 – Increasing use of Evaporators to concentrate disposal**
  - Improved cleaning methods
  - Improved monitoring program
  - Testing internal mechanical changes
- **93/94 – WLS Performance**
  - Chemical Optimization
  - Optimize sludge handling
  - Bottleneck identification and removal
Steam Generation Risks and Opportunities

- Continued optimization of control systems and safety interlocks

- Optimization of steam generation capacity during steam long situations

- Stage 3/4 cogenerator troubleshooting control systems and quality control optimizations

- Trialing new tube temperature monitoring equipment to help understand impact of water quality excursions
# Produced Water (PW) Quality

<table>
<thead>
<tr>
<th></th>
<th>Plant 91</th>
<th>Plant 92</th>
<th>Plant 93 &amp; 94</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (pH units)</td>
<td>9.7</td>
<td>11.0</td>
<td>7.1</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>60.6</td>
<td>92.7</td>
<td>208.4</td>
</tr>
<tr>
<td>Reactive Silica (mg/L)</td>
<td>214.0</td>
<td>232.4</td>
<td>240.5</td>
</tr>
<tr>
<td>Bitumen in Water (ppm)</td>
<td>0.4</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Dissolved Ca (mg/L)</td>
<td>6.7</td>
<td>1.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Dissolved Mg (mg/L)</td>
<td>1.7</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Dissolved Hardness CaCO3 (mg/L)</td>
<td>25.0</td>
<td>6.5</td>
<td>12.2</td>
</tr>
</tbody>
</table>
## Boiler Feed Water (BFW) Quality

<table>
<thead>
<tr>
<th></th>
<th>Plant 91</th>
<th>Plant 92</th>
<th>Cogen (HRSG)</th>
<th>Plant 93/94</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Dissolved Solids (mg/L)</strong></td>
<td>1150</td>
<td>284</td>
<td>640</td>
<td>2400</td>
</tr>
<tr>
<td><strong>Reactive Silica (mg/L)</strong></td>
<td>22.4</td>
<td>6.2</td>
<td>12.2</td>
<td>41.9</td>
</tr>
<tr>
<td><strong>Dissolved Chloride (mg/L)</strong></td>
<td>211.4</td>
<td>38.4</td>
<td>89.6</td>
<td>583</td>
</tr>
<tr>
<td><strong>Dissolved Sodium (mg/L)</strong></td>
<td>473.7</td>
<td>101.9</td>
<td>267.6</td>
<td>893</td>
</tr>
<tr>
<td><strong>Dissolved Potassium (mg/L)</strong></td>
<td>18.4</td>
<td>3.6</td>
<td>6.6</td>
<td>80</td>
</tr>
<tr>
<td><strong>Alkalinity (mg/L)</strong></td>
<td>457</td>
<td>135</td>
<td>302</td>
<td>742</td>
</tr>
<tr>
<td><strong>pH (pH units)</strong></td>
<td>10.1</td>
<td>9.9</td>
<td>9.6</td>
<td>10.2</td>
</tr>
</tbody>
</table>
Plant Improvements

- Optimized operation on the FWKO and Deoiling area ensuring onspec BS&W in Dilbit and Oil in Water

- MBF Skimmed oil permanent line to DSU

- Cleaning connections to PWC’s to decrease cleaning time

- Constructed line to treat 93/94 disposal water in evaporators

- Optimized steam generation capacity during steam long situations to maximize energy efficiency

- Upgraded peroxide dosing system to meet increasing H2S removal demand
Stage 3/4 Update

- All Oil, Deoiling, Water Treatment and Steam Generation assets are turned over and operating

- Diluent Stripping Unit to be started up in May

- Second Sulphur Recovery Unit train to be started up in Spring/Summer

- Pad 106 and Pad 116 startup. Total of 5 pads now online feeding Stage 3 and 4
Stage 3/4 Technical Highlights

• Four Oil treating trains each consisting of FWKO and Electrostatic treater

• Deoiling via a Microbubble Flotation tank common for Stage 3 and 4

• Diluent Stripping Unit

• Water treatment includes WLS, Afterfilters, Primary Weak Acid Cation’s (WACs) and polishing WACs

• Four OTSG’s (largest in the industry) that were designed for 383 m$^3$/h of Cold Water Equivalent (CWE); 75 % steam quality

• Four Cogens 85 MW power generation 440 m$^3$/hr of CWE and 75% steam quality

• Additional Two Pads for Stage 3/4: Pad 106, Pad 116 in addition to Pad 105, 107, 108
Steam Injected

From March 2012 to February 2013, Firebag injected on average 61,149 m³/day of steam into the wells.
### Steam Qualities

<table>
<thead>
<tr>
<th>Month</th>
<th>Plant 91 OTSGs</th>
<th>Plant 92 OTSGs</th>
<th>Plant 91 Cogen</th>
<th>Plant 93 OTSGs</th>
<th>Plant 93 Cogens</th>
<th>Plant 94 OTSGs</th>
<th>Plant 94 Cogens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar-12</td>
<td>77.1%</td>
<td>77.9%</td>
<td>77.7%</td>
<td>74.1%</td>
<td>68.5%</td>
<td>Not started</td>
<td>Not started</td>
</tr>
<tr>
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<td>77.2%</td>
<td>80.4%</td>
<td>72.6%</td>
<td>74.7%</td>
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<td>Not started</td>
</tr>
<tr>
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<td>76.8%</td>
<td>77.4%</td>
<td>81.5%</td>
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<td>71.7%</td>
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<tr>
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<td>81.1%</td>
<td>73.7%</td>
<td>74.5%</td>
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</tr>
<tr>
<td>Jul-12</td>
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<td>78.8%</td>
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<td>73.5%</td>
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<td>Not started</td>
</tr>
<tr>
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<td>77.6%</td>
<td>79.4%</td>
<td>74.2%</td>
<td>74.9%</td>
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</tr>
<tr>
<td>Sep-12</td>
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<td>78.6%</td>
<td>73.2%</td>
<td>72.1%</td>
<td>73.5%</td>
<td>Not started</td>
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<tr>
<td>Oct-12</td>
<td>77.0%</td>
<td>77.7%</td>
<td>78.4%</td>
<td>73.9%</td>
<td>72.1%</td>
<td>73.6%</td>
<td>74.0%</td>
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<td>Nov-12</td>
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<td>72.6%</td>
<td>73.9%</td>
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</tr>
<tr>
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<td>78.9%</td>
<td>74.8%</td>
<td>73.0%</td>
<td>74.9%</td>
<td>75.3%</td>
</tr>
<tr>
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<td>77.9%</td>
<td>73.8%</td>
<td>74.1%</td>
<td>73.7%</td>
<td>75.1%</td>
</tr>
<tr>
<td>Feb-13</td>
<td>75.1%</td>
<td>77.4%</td>
<td>77.2%</td>
<td>74.7%</td>
<td>74.0%</td>
<td>75.0%</td>
<td>75.5%</td>
</tr>
<tr>
<td><strong>Average:</strong></td>
<td><strong>76.3%</strong></td>
<td><strong>77.3%</strong></td>
<td><strong>79.1%</strong></td>
<td><strong>73.9%</strong></td>
<td><strong>73.0%</strong></td>
<td><strong>74.1%</strong></td>
<td><strong>75.0%</strong></td>
</tr>
</tbody>
</table>
From March 2012 to February 2013, Firebag more than doubled the amount of electricity generated (and exported)
Firebag’s average energy intensity was 9.20 GJ per m3 of production, from March 2012 to February 2013.

Note: Energy Intensity includes all facility gas consumption and both electricity imported and exported.
Firebag averaged 17,981 m³/day (113,099 BPD) of production from March 2012 to February 2013.
Firebag used on average 5,060 $\text{e}^3\text{m}^3$ of natural gas per day, from March 2012 to February 2013.
### Facility Environmental Performance

#### Emissions Parameter

<table>
<thead>
<tr>
<th>Emissions Parameter</th>
<th>Mar 2012 - Feb 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution Gas Consumed (e³m³)</td>
<td>4,037.9</td>
</tr>
<tr>
<td>Solution Gas Flared (e³m³)</td>
<td>35.0</td>
</tr>
<tr>
<td>Solution Gas Vented¹ (e³m³)</td>
<td>3.9</td>
</tr>
<tr>
<td>Solution Gas Recovery</td>
<td>99.0%</td>
</tr>
<tr>
<td>Total Gas Flared (e³m³)</td>
<td>365.7</td>
</tr>
<tr>
<td>Total Gas Vented (e³m³)</td>
<td>123.5</td>
</tr>
<tr>
<td>H₂S Emissions² (kg)</td>
<td>1,163.8</td>
</tr>
</tbody>
</table>

¹ Solution gas vented = gas vented from tanks upstream of produced gas separators (i.e. production tanks)

² H₂S emissions = gas vented from tanks containing greater than 10 ppm H₂S (i.e. skim/skimmed oil tanks, production tanks, and produced water tanks)

#### GHG Emission Parameter

<table>
<thead>
<tr>
<th>GHG Emission Parameter</th>
<th>Jan 2012 – Dec 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>*2012 GHG Emissions (tonnes CO₂e) Calendar Year</td>
<td>2,661,181.1</td>
</tr>
<tr>
<td>*2012 GHG Emission Intensity (tonnes CO₂e/m³) Calendar Year</td>
<td>0.43960</td>
</tr>
</tbody>
</table>

*CO₂e is based on AENV SGER Reporting for the 2012 calendar year
• Introduction – Mike Morden
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• Future Plans – Pat De Haas
Firebag Performance Presentation
Measurement and Reporting
May 1st and May 2nd, 2013
• Firebag MARP approved June 2010

• Third MARP update submitted to the ERCB in February 2013

• MARP details all the requirements in Directive 42
• Fluid tests are performed as per Directive 17 requirements

• BS&W metering and manual cuts are applied to emulsion to determine water and oil production

• Plant bitumen number is pro-rated to the bitumen well tests

• Water production is pro-rated to total water produced from each plant

• Firebag is working with MacKay River to incorporate the well test stability program to meet ID 91-03

• Steam volumes are metered at the wellheads and prorated against the plant steam
Testing Improvements

• Implemented multiphase flow meter (MPFM) measurement on 5 wells in Sep. 2011 on Pad 102, additional 4 came on in Jan. 2012

• Completed 1 month of direct MPFM testing in comparison with the test separator on Pad 102

• Dec. 16, 2011 received approval for MPFM on Pad 105 and future developments

• Automated sampler currently running and being evaluated, taking multiple samples during well test achieving a more proportional sample on Pads 103 and 104

• Continue to make improvements to Well Production Test software (WPT)
Measurement During Circulation

<table>
<thead>
<tr>
<th></th>
<th>Pad 107</th>
<th>Pad 108</th>
<th>Pad 105</th>
<th>Pad 106</th>
<th>Pad 116</th>
</tr>
</thead>
</table>

- Production metering
  - Pads 107 & 108: AGAR & Coriolis meters (Test separator)
  - Pad 105, 106 & 116: Vx Meters (No test separator)

- Production accounting
  - All steam injection is metered on each well and reported to the PRA
  - Pads 107 & 108:
    - Assumed 100% water cut during circulation and a 90% water cut during Semi-SAGD/Steam Assist
    - As wells were converted to production, returns were metered using the AGAR meter for water cuts (referenced against manual samples, if >5% difference, manual sample values were used for that test) and the Coriolis meter for mass flow rate
    - AGAR meters are recalibrated quarterly
  - Pad 105, 106 &116:
    - Assumed 100% water cut during circulation
    - During circulation, the pad outflow meters were used to measure total flow from the pad, which was distributed evenly among the circulating wells to provide an estimate of returns
    - As wells are converted to production, Vx meters are used to measure flow rates and water cuts for each producing well (calibration currently ongoing)
Pad 105 Metered Water Cut vs Manual Water Cut
Post-Initial Calibration

40 additional water cuts after first sample
- 9 (23%) out more than 5%
- 5 (13%) out more than 10%
• Schlumberger noted strange nuclear counts
• Opened up Meter after steam circulation phase and discovered scale that was up to \( \frac{1}{2} \)” thick in the lower part of the venturi
• Discovered scale in only 1 out of 17 wells
Sample is amorphous (non-crystalline)
  - Primarily
  - Silicone
  - Oxygen
Some carbon
<25% soluble (non-crushed) in HF & Xylene
Removed by hydro-jetting
Sensor lines Freezing

- Lines are filled with silicone oil
- When lines freeze, the MVT can lose zero and require another zero trim
- Detected by very high negative or positive dP readings
- Lines freeze when we take wells down to convert them to mechanical lift and heat trace is shut off
  Some issues on Pad 106 and 116 with this happening during cold weather
- Reviewing heat trace and insulation
• ESP software provides a means to check Vx
• Works well at rates in excess of 300 m³/d, but the pump curves are too sensitive at lesser rates to small changes in head
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• Future Plans – Pat De Haas
Firebag Performance Presentation

Water Production, Injection and Usage

May 1st and May 2nd, 2013
Primary makeup water source for process operations is two wastewater streams from Oil Sands Base Plant:

- **Reverse Osmosis (RO) Water**
  - The total volume of RO water used from March 2012 to February 2013 was 1,097,383 m³ (2012 calendar year usage was 1,198,525 m³)

- **Pond B Water**
  - The total volume of Pond B water used from March 2012 to February 2013 was 253,521 m³ (2012 calendar year usage was 312,332 m³)
Water Usage

- Site runoff water (rainfall and snow melt) is routed to the site process ponds and reused in the process

- A total of 222,592 m$^3$ of storm water runoff water was diverted for process use from March 2012 to February 2013 (for the 2012 calendar year, usage was 216,770 m$^3$; 18,780 m$^3$ for the Stages 1/2 area and 197,990 m$^3$ for the Stages 3/4 area)

  - Water Act Approval 00159019 for ponds in NE 11-095-06-04-W4 (Stages 1/2 Area) for diversion of up to 95,000 m$^3$ annually

  - Water Act Approval 00253054 for ponds in SW 13-095-06-W4 and NE 14-095-06-W4 (Stages 3/4 Area) for diversion of up to 250,000 m$^3$ annually

- Water Act License 00233808 for Production Well 03-05 as back-up supply for up to 620,500 m$^3$ annually. The well was not used in 2012 or 2013 year-to-date
### Overall Water Balance

<table>
<thead>
<tr>
<th>Month</th>
<th>Fresh Water (m³)</th>
<th>Steam (m³)</th>
<th>Water (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PLTUSE</td>
<td>REC</td>
<td>INJ</td>
</tr>
<tr>
<td>Jan-12</td>
<td>200,916.0</td>
<td>1,448,838.3</td>
<td>38,010.0</td>
</tr>
<tr>
<td>Feb-12</td>
<td>150,074.6</td>
<td>1,414,826.6</td>
<td>51,189.6</td>
</tr>
<tr>
<td>Mar-12</td>
<td>155,964.9</td>
<td>1,578,279.6</td>
<td>45,538.9</td>
</tr>
<tr>
<td>Apr-12</td>
<td>1.3</td>
<td>127,854.1</td>
<td>1,585,029.5</td>
</tr>
<tr>
<td>May-12</td>
<td>142,926.2</td>
<td>1,530,031.7</td>
<td>56,622.6</td>
</tr>
<tr>
<td>Jun-12</td>
<td>141,339.5</td>
<td>1,572,529.0</td>
<td>45,902.3</td>
</tr>
<tr>
<td>Jul-12</td>
<td>5.2</td>
<td>145,071.7</td>
<td>1,690,876.1</td>
</tr>
<tr>
<td>Aug-12</td>
<td>738.6</td>
<td>144,211.8</td>
<td>1,808,681.0</td>
</tr>
<tr>
<td>Sep-12</td>
<td>1,067.6</td>
<td>183,500.2</td>
<td>1,812,004.0</td>
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<tr>
<td>Oct-12</td>
<td>111,984.0</td>
<td>2,006,437.8</td>
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<td>Nov-12</td>
<td>75.1</td>
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<td>Dec-12</td>
<td>101,012.1</td>
<td>2,254,793.5</td>
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<td>Jan-13</td>
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<td>91,987.0</td>
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<td>Feb-13</td>
<td>17.2</td>
<td>104,873.0</td>
<td>2,118,871.1</td>
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</table>
For the 2012 calendar year, Firebag’s water recycle rate was 90.3%*

* Calculated using formula of (Steam Injected – Fresh Water)/(Produced Water), as defined in Bulletin 2006-11.
Through investigation, it has been determined that Oil Sands Tailings Pond Effluent Water (PEW) is the best source of water based on the premises of beneficial reuse, good water management practices, availability, and reasonable quality.

Suncor has secured the permanent use of Pond B water as a backup to Tailings Industrial Wastewater (PEW).

PEW started supplying Firebag with MUW for operations in early 2013. The volume of PEW transferred will be relatively small initially, but will grow over time with commissioning of future Firebag stages.

Using PEW as MUW will ensure that Firebag has a reliable water supply that will allow them to meet their production forecast for future Stages.

This use of PEW is expected to reduce fresh water consumption at Firebag and to contribute to the permanent disposal of PEW water.
Disposal Well Locations

- Current Disposal Wells:
  - 100/10-03-095-06W4/00
  - 100/06-03-095-06W4/00

- New Disposal Well – Approved March 27, 2013:
  - 100/02-10-095-06W4/00
  - Drilled in 2007/2008
### Disposal Information – 10-3-95-6W4
(data shown is averaged across the month)

<table>
<thead>
<tr>
<th>Month</th>
<th>Injection Rate (m3/day)</th>
<th>Wellhead Pressure (kPa-g)</th>
<th>Downhole Pressure (kPa-g)</th>
<th>Injection Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March-2012</td>
<td>1466</td>
<td>1155</td>
<td>3469</td>
<td>42</td>
</tr>
<tr>
<td>April-2012</td>
<td>1140</td>
<td>410</td>
<td>3607</td>
<td>42</td>
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<tr>
<td>May-2012</td>
<td>1200</td>
<td>535</td>
<td>3766</td>
<td>45</td>
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<tr>
<td>June-2012</td>
<td>668</td>
<td>297</td>
<td>741</td>
<td>51</td>
</tr>
<tr>
<td>July-2012</td>
<td>1336</td>
<td>757</td>
<td>3443</td>
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<tr>
<td>August-2012</td>
<td>1325</td>
<td>819</td>
<td>3795</td>
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<tr>
<td>September-2012</td>
<td>1340</td>
<td>872</td>
<td>3869</td>
<td>43</td>
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<tr>
<td>October-2012</td>
<td>1245</td>
<td>613</td>
<td>3743</td>
<td>43</td>
</tr>
<tr>
<td>November-2012</td>
<td>1402</td>
<td>996</td>
<td>3889</td>
<td>46</td>
</tr>
<tr>
<td>December-2012</td>
<td>949</td>
<td>77</td>
<td>3389</td>
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<tr>
<td>January-2013</td>
<td>1095</td>
<td>338</td>
<td>3677</td>
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<td>February-2013</td>
<td>1383</td>
<td>1050</td>
<td>3893</td>
<td>46</td>
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</table>
## Disposal Information – 6-3-95-6W4
(data shown is averaged across the month)

<table>
<thead>
<tr>
<th>Month</th>
<th>Injection Rate (m³/day)</th>
<th>Wellhead Pressure (kPa-g)</th>
<th>Downhole Pressure (kPa-g)</th>
<th>Injection Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March-2012</td>
<td>189</td>
<td>906</td>
<td>2763</td>
<td>41</td>
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<tr>
<td>April-2012</td>
<td>878</td>
<td>261</td>
<td>3796</td>
<td>41</td>
</tr>
<tr>
<td>May-2012</td>
<td>626</td>
<td>281</td>
<td>4247</td>
<td>44</td>
</tr>
<tr>
<td>June-2012</td>
<td>944</td>
<td>197</td>
<td>4140</td>
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<td>July-2012</td>
<td>1009</td>
<td>456</td>
<td>4145</td>
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<td>August-2012</td>
<td>969</td>
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<td>4262</td>
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<td>September-2012</td>
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<td>749</td>
<td>4406</td>
<td>45</td>
</tr>
</tbody>
</table>
Waste Management – Disposal

Disposal Information – 10-3-95-6 W4M (daily data)
Issues with downhole pressure gauge freezing intermittently (March 9, 2012 – July 23, 2012)
Disposal Observation Well Locations

- Current Observation Wells:
  - 100/12-06-095-06W4/00 (DS1)
  - 102/12-06-095-06W4/00 (DS2)
  - 103/12-06-095-06W4/00 (DS3)
  - 100/13-34-094-06W4/00 (DS4)
  - 100/02-15-095-06W4/00 (DS5)
  - 109/13-03-095-06W4/00 (PP7/DW22)
  - 100/08-02-095-06W4/00 (DW OB1)
  - 100/16-03-095-06W4/00 (DW12)
  - 1AA/12-30-095-05W4/00 (DW4)
- Data (chemistry, pressure and temperature) from these wells is reported as part of the annual disposal well submission, due October 31 of each year
Goals of Suncor’s Hydrogeological Work

• **Delineation** – refine understanding of the geological setting and assess current distribution of disposal water

• **Estimate Future Disposal Water Distribution** – assess future distribution of disposal water

• **Monitoring** – establish a monitoring well network to directly measure and evaluate plume movement

Chemistry at Locations:
- Downgradient: DS1, DS2, DS3, PP7
- Cross-gradient: DS4, DS5
- Potentially Within Plume: DS6

Pressures, Permeabilities, Chemistry:
- DS1, DS2, DS3; PP7; DS4, DS5, DS6

Trends for Pressure and Chemistry:
- DS1, DS2, DS3; PP7; DS4, DS5, DS6

Existing Wells

Conceptual Plume
As per long-term surveillance plan, completed, tested and sampled chemistry at PP7, DS1, DS2, DS3, DS4 and DS5

- Monitoring of downhole pressure at temperature continued at DW OB1, DW12 and DW4
- All results (chemistry, pressure and temperature) will be reported as part of the annual disposal well monitoring report, to be submitted October 31 of each year
- Additional drilling and testing will be based on results of testing and modeling
Fracture gradients were measured in the Devonian at two locations:

- OB178 (100/07-20-059-06W4/00): measured gradients of 16.6 kPa/m and 18.5 kPa/m in the Waterways.
- DS1 (100/12-06-095-06W4/00): measured gradient of 17.3 kPa/m in the Elk Point.
- Currently, 17 kPa/m is used to estimate maximum injection pressures at Firebag.
Numerical modeling of the disposal wells is currently in progress, working on the following:

- Incorporating up to date geological interpretations in the vicinity of the disposal zone
- Refining the grid blocks within the model to be able to capture geological heterogeneities
- Modifying boundary conditions on surface (i.e. river boundary conditions)
- Steady state calibration of the model
Landfill

- Two Landfill Waste Disposal Sites:
  W1/2 - 3 - 95 - 6 - W4M and E1/2 - 4 - 95 - 6 - W4M
- 2012 Landfill Volumes:
  Domestic Cell - No waste was sent to the Domestic Cell in 2012.
  Oilfield Cell - 15,066 ktonnes - Warm Lime Sludge
  - 6,586 ktonnes - Disposal Water Treatment Solids
  Offsite Disposal - 39,558 ktonnes - filters, contaminated soil, ecopit waste, Lime Sludge
  Offsite Disposal (Oilsands) - 1948 tonnes - contaminated soil, ecopit waste, Lime Sludge, tank bottoms
  Domestic Wastewater Offsite Disposal - 15,665 ktonnes - Sewage
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Firebag Performance Presentation
Sulphur Production
May 1st and May 2nd, 2013
From March 2012 to February 2013, inlet sulphur rates were between 5 and 9 tonnes/day.

Regulatory requirement of > 89.7% sulphur recovery per calendar quarter for these inlet rates:
- Current sulphur recovery rates consistently above this requirement.

It is expected mid-2013 inlet sulphur rates will be >10 tonnes/day;
- regulatory requirements will increase to 95.9% minimum sulphur recovery.
- 2013 sulphur recovery rates to-date have proven this rate is achievable.
# Sulphur Recovery

<table>
<thead>
<tr>
<th></th>
<th>Sulphur Recovery (%)</th>
<th>Sulphur Balance (%)</th>
<th>Acid Gas Flared (m3)</th>
<th>Sulphur Flared (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-12</td>
<td>92.1%</td>
<td>2.4%</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Feb-12</td>
<td>92.2%</td>
<td>5.7%</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mar-12</td>
<td>91.5%</td>
<td>2.2%</td>
<td>2243.9</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Quarter</strong></td>
<td><strong>91.9%</strong></td>
<td><strong>1.9%</strong></td>
<td><strong>2243.9</strong></td>
<td><strong>1.6</strong></td>
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<td>Apr-12</td>
<td>94.2%</td>
<td>1.4%</td>
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<td>May-12</td>
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<td>10.5%</td>
<td>1436.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Jun-12</td>
<td>91.7%</td>
<td>6.0%</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Quarter</strong></td>
<td><strong>93.7%</strong></td>
<td><strong>5.8%</strong></td>
<td><strong>1436.1</strong></td>
<td><strong>0.1</strong></td>
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<tr>
<td>Jul-12</td>
<td>93.9%</td>
<td>4.7%</td>
<td>1397.6</td>
<td>0.9</td>
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<tr>
<td>Aug-12</td>
<td>94.0%</td>
<td>2.9%</td>
<td>1208.1</td>
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</tr>
<tr>
<td>Sep-12</td>
<td>94.5%</td>
<td>0.7%</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td><strong>Quarter</strong></td>
<td><strong>94.2%</strong></td>
<td><strong>2.7%</strong></td>
<td><strong>2605.7</strong></td>
<td><strong>1.8</strong></td>
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<tr>
<td>Oct-12</td>
<td>96.7%</td>
<td>1.1%</td>
<td>0.0</td>
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<tr>
<td>Nov-12</td>
<td>95.3%</td>
<td>0.4%</td>
<td>555.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Dec-12</td>
<td>82.4%</td>
<td>0.6%</td>
<td>47724.8</td>
<td>34.6</td>
</tr>
<tr>
<td><strong>Quarter</strong></td>
<td><strong>91.0%</strong></td>
<td><strong>0.3%</strong></td>
<td><strong>48279.8</strong></td>
<td><strong>35.1</strong></td>
</tr>
<tr>
<td>Jan-13</td>
<td>95.0%</td>
<td>4.5%</td>
<td>1198.6</td>
<td>0.9</td>
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<tr>
<td>Feb-13</td>
<td>95.9%</td>
<td>3.4%</td>
<td>1101.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Mar-13</td>
<td>95.9%</td>
<td>4.3%</td>
<td>247.1</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Quarter</strong></td>
<td><strong>95.6%</strong></td>
<td><strong>4.1%</strong></td>
<td><strong>2547.1</strong></td>
<td><strong>1.9</strong></td>
</tr>
</tbody>
</table>
SO₂ Emissions (March 2012 – February 2013)

- EPEA SO₂ Limit for Firebag Stages 1 to 4 =< 6.9 tonnes/day rolling 365-day average

- SO₂ Daily Average = 0.91 tonnes/day

- SO₂ Total = 330.8 tonnes

- Average Inlet H₂S Concentration = 7.45%
SO₂ Emissions

SRU Upset
December 9th – 13th

3.69 t/day 365 rolling day average limit
Regulatory Compliance (2012 and 2013 YTD)

- Short duration venting incidents during plant upsets. The duration of these venting incidents continues to show a significant reduction as a result of optimization of the control strategies on the skimmed oil tanks.

- Minor Spills and releases (on lease)

- No AAAQQ exceedences were experienced during 2012 after the relocation of the Air Monitoring Station to a location that meets regional air monitoring objectives.

- Increases in reportable incidents are attributable to the continued startup of Stage 3 and 4.
Breakdown of Firebag Contraventions

- **Tank Ventings**
- **Spill/Release (Sewage, BFW, PW)**
- **Other**
- **Ambient Air Quality Exceedences**
### SUMMARY OF FIREBAG CONTRAVENTIONS

<table>
<thead>
<tr>
<th>Contraventions</th>
<th>2013 YTD(^1)</th>
<th>2012</th>
<th>2011 (^4)</th>
<th>2010</th>
<th>2009</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank Ventings(^2)</td>
<td>6</td>
<td>24</td>
<td>25</td>
<td>18</td>
<td>27</td>
<td>94</td>
</tr>
<tr>
<td>Flaring &gt; 4 hours</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Ambient Air Quality Exceedences</td>
<td>0</td>
<td>18</td>
<td>16</td>
<td>4</td>
<td>7</td>
<td>45</td>
</tr>
<tr>
<td>SO(_2) Exceedence (SRU)(^3)</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>n/a</td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>Low Stack Temperature Event (SRU)(^3)</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>n/a</td>
<td>n/a</td>
<td>5</td>
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<tr>
<td>NO(_x) Exceedence (OTSG/COGEN)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Waste Water Treatment Plant (WWTP) Exceedence</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Spill/Release (Sewage, BFW, PW)</td>
<td>9</td>
<td>33</td>
<td>20</td>
<td>10</td>
<td>14</td>
<td>77</td>
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<tr>
<td>Administrative (Missing Sample, etc.)</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>11</td>
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<tr>
<td>Other (Self-Disclosure, etc.)</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>20</strong></td>
<td><strong>102</strong></td>
<td><strong>77</strong></td>
<td><strong>43</strong></td>
<td><strong>62</strong></td>
<td></td>
</tr>
</tbody>
</table>

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1. 2013 YTD Data for January & February
2. Only includes Tank Ventings > 10 minutes
3. SRU start-up occurred in February 2011
The Alberta ESRD approved compliance air monitoring trailer and was relocated west of the operating plant May 30th, 2012.

There have been no recorded exceedences to the Ambient Air Quality Objectives (AAQO) from the compliance station since relocation.

Currently in consultation with WBEA regarding the relocation and installation of a permanent Suncor Firebag compliance Air Monitoring Station.

The permanent Suncor Firebag compliance station is expected to be in operation 4th quarter 2013.

Alberta ESRD and Environment Canada recommended a separate Regional Air Monitoring station to be located east of the Husky Sunrise Project.

The Regional monitoring station will be operated by the WBEA and is to be in operation summer 2013.
• July 3, 2012 – MARP Meter Inspection disclosure

• July 17, 2012 – ECOPIT not approved disclosure

• November 4, 2012 – 5P10 Surface piping MOP disclosure
• 8870DD Caustic Injection at Pad 103 April 23, 2012
• 8870EE Pad 117 June 27, 2012
• 8870FF OSLI Water Treatment Development Center July 10, 2012
• 8870GG Pad 107 Dropped wells, Pad 106/116 Bullheading October 1, 2012
• 8870HH Pad 109 October 24, 2012
• 8870II Pad 109 elevation changes January 16, 2013
• 8870JJ Pad 108N wells, Pad 117 revisions and Vx Multiplexing January 23, 2013
• 8870KK Pad 114 February 11, 2013
• 8870LL Pad 101 Co-injection February 20, 2013
• 8870MM Caustic injection Pad 104 &105 March 15, 2013
• 9487D Re-completion Disposal well 6-3-95-6W4 March 19, 2012
• 9487E Re-completion Disposal well 10-3-95-6W4 June 13, 2012
Other Environmental Initiatives

• Suncor is an active member of:
  • Cumulative Environmental Management Association (CEMA)
  • Regional Aquatics Monitoring Program (RAMP)
  • Wood Buffalo Environmental Association (WBEA)
  • Oil Sands Leadership Initiative (OSLI)
  • Alberta Biodiversity Monitoring Institute (ABMI)
  • Alberta Water Council (Watershed Planning Advisory Council)
  • Oil Sands Developers Group (OSDG)

• Suncor is in ongoing consultation with:
  • Regional stakeholders
    • Aboriginal Communities and the local Municipality
• Suncor Energy is in compliance with all regulatory approvals, decisions, regulations and conditions; specifically pertaining to:

  • Plant and waste management facility location
  • Fugitive Emissions and VOC monitoring
  • Participation in Regional Initiatives
• Introduction – Mike Morden
• Safety Moment – Mike Morden
• Operations Performance – Pat De Haas
• Facility Performance – Pat De Haas
• Measurement and Reporting – John Graham
• Water Production, Injection and Usage – Leah Butler, John Graham/Brett Fairbairn
• Sulphur Production – Brett Fairbairn
• Environmental Performance – Brett Fairbairn, Mike Morden
• Future Plans – Pat De Haas
Firebag Performance Presentation

Future Plans

May 1st and May 2nd, 2013
Plant 94 Overview

- Started up Plant 94 in September/October 2012
- Start up of Line 24 Hotbit Line initially on Dilbit mode
- Start up of Diluent Stripping Unit which will allow Plant 93/94 to operate on Hotbit mode. Future operation of Plant 93/94 will likely be a combination of Dilbit and Hotbit mode
- Ongoing effort to ramp rates up to meet design capacity. Evaluate bottlenecks in the plant; Produced Water Cooling, operating Warm Lime Softener at a warmer temperature
- Successful start up SRU B Train. Both sulfur plant in Firebag are now commissioned
- Pad 106, Pad 116 in addition to Pad 105, 107, 108 are now feeding Stage 3/4
- Ongoing start up of approximately one pad every six months
- Planning for initial Plant 93/94 Turnaround
Appendix - Surface
Overall Water Balance

Below are a set of definitions of the terms used in the water balance table provided in this presentation

Freshwater

- PLTUSE: This is the volume of fresh water vented from the evaporators. It is determined by multiplying the ratio of freshwater to total feed water by the total evaporator vent. As of March 2010, an evaporator vent collection was in operation that now ceases venting.
- REC: Total fresh water received as plant makeup water from Oilsands facility plus surface water runoff diverted to the retention ponds.

Steam

- INJ: Total steam injected to the Pads. Steam is metered at each of the steam generators in Plants 91 – 94 and the Cogeneration units.

Water

- INJ: Water that is sent down the disposal well.
- INVCL: Closing water inventory. This volume takes into consideration levels in water tanks.
- INVOP: Opening water inventory. This value is carried forward from last months closing inventory.
- PLTUSE: The remaining volume of water vented from the evaporators. This is the total vent minus the fresh vent volume.
- REC: Produced water from the Firebag battery. This is determined from the flow of deoiled water to water treatment, adjusted for the make-up water and utility water added upstream of the de-oiling system.