3.1.1. Subsurface Issues

TABLE OF CONTENTS

1. Brief Background – slide 3
2. Geosciences – slide 6
3. Drilling and Completions – slide 28
4. Artificial Lift – slide 33
5. Instrumentation in Wells – slide 34
6. 4D Seismic – slide 39
7. Scheme Performance – slide 40
8. Future Plans – slide 77
PROJECT OVERVIEW

1. Brief Background

- AER Approval No’s. 10419 and 206355-01-00, as amended
- 31,798 m³/d (200,000 BOPD) SAGD Project
- Phase 1 – 10,970 m³/d (69,000 BOPD)
- McMurray Formation
- 7-9º API Bitumen
- 50% Partnership with BP
- First Steam December 12, 2014
- First Production March 8, 2015
1. Brief Background

PROJECT DEVELOPMENT AREA

• Approval Area:
  • 64 ¼ sections over TWP 94, 95 and 96, RGE 6 and 7 W4M

• Project Life Development:
  • Approx. 600 well pairs
  • Approx. 40 year life

• Development Area 1 (DA1):
  • Nine well pads
  • 55 well pairs

• Development Area 2 (DA2):
  • Three well pads
  • 19 well pairs
  • Drill / tied in two well pads (B05-21 (P) and B06-21 (Q))
  • Drilled Pad B10-16 (R)
  • Sustain 10,970 m³/d (69,000 BOPD)

• Development Area 3 (DA3):
  • 18 well pads
  • 222 well pairs
  • AER Approved January 25, 2016
1. Brief Background

SITE OVERVIEW

- 74 horizontal well pairs drilled:
  - 55 well pairs in DA1 on production
  - 14 well pairs in DA2 on production
  - 5 well pairs in DA2 drilled
- Field Facilities:
  - 11 well pads constructed and tied in
- Infill wells:
  - 12 wells drilled
- Central Plant Facility:
  - Bitumen treating – 10,970 m³/d (69,000 bbl/day)
  - Water Treatment – 43,860 m³/d (276,000 bbl/day)
  - Steam Generation – 32,890 m³/d (207,000 bbl/day) CWE
  - Utilities
- Water Source & Disposal Wells
- Observation Wells
- Borrow Sources
- Class 1 Landfill
- Metering and Export Pipelines to Fort Saskatchewan via Norealis Terminal and Cheecham
### 2. Geosciences

**AVERAGE RESERVOIR CHARACTERISTICS & OBIP DA1 & DA2**

<table>
<thead>
<tr>
<th>Drainage Pattern</th>
<th>Area (ha)</th>
<th>Porosity (%)</th>
<th>Bitumen Saturation (%)</th>
<th>Developable OBIP $(10^3 \text{ m}^3)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>B16-07 (A)</td>
<td>27.00</td>
<td>30</td>
<td>79</td>
<td>1,628</td>
</tr>
<tr>
<td>B13-08 (B)</td>
<td>62.10</td>
<td>31</td>
<td>81</td>
<td>3,868</td>
</tr>
<tr>
<td>B14-08 (C)</td>
<td>45.90</td>
<td>32</td>
<td>82</td>
<td>4,394</td>
</tr>
<tr>
<td>B16-08 (D)</td>
<td>51.00</td>
<td>32</td>
<td>81</td>
<td>3,219</td>
</tr>
<tr>
<td>B13-09 (E)</td>
<td>51.00</td>
<td>31</td>
<td>79</td>
<td>2,677</td>
</tr>
<tr>
<td>B08-18 (F)</td>
<td>28.51</td>
<td>30</td>
<td>78</td>
<td>1,600</td>
</tr>
<tr>
<td>B08-17 (G)</td>
<td>48.00</td>
<td>31</td>
<td>79</td>
<td>3,334</td>
</tr>
<tr>
<td>B05-16 (H)</td>
<td>51.00</td>
<td>32</td>
<td>81</td>
<td>3,351</td>
</tr>
<tr>
<td>B07-16 (I)</td>
<td>51.00</td>
<td>31</td>
<td>84</td>
<td>3,265</td>
</tr>
<tr>
<td>B16-18 (K)</td>
<td>54.00</td>
<td>32</td>
<td>78</td>
<td>4,326</td>
</tr>
<tr>
<td>B01-19 (J)</td>
<td>51.00</td>
<td>31</td>
<td>84</td>
<td>3,484</td>
</tr>
<tr>
<td>B16-17 (L)</td>
<td>51.00</td>
<td>32</td>
<td>82</td>
<td>3,999</td>
</tr>
<tr>
<td>B13-16 (M)</td>
<td>51.00</td>
<td>33</td>
<td>82</td>
<td>4,325</td>
</tr>
<tr>
<td>B15-16 (N)</td>
<td>51.00</td>
<td>31</td>
<td>85</td>
<td>4,374</td>
</tr>
<tr>
<td>B05-21 (P)</td>
<td>63.00</td>
<td>31</td>
<td>81</td>
<td>5,628</td>
</tr>
<tr>
<td>B06-21 (Q)</td>
<td>63.00</td>
<td>31</td>
<td>80</td>
<td>5,160</td>
</tr>
<tr>
<td>B10-21 (U)</td>
<td>50.00</td>
<td>30</td>
<td>81</td>
<td>4,004</td>
</tr>
<tr>
<td>B16-16 (S)</td>
<td>63.00</td>
<td>31</td>
<td>78</td>
<td>4,185</td>
</tr>
<tr>
<td>B14-15 (T)</td>
<td>54.00</td>
<td>30</td>
<td>81</td>
<td>3,700</td>
</tr>
<tr>
<td>B10-16 (R)</td>
<td>43.00</td>
<td>32</td>
<td>75</td>
<td>2,969</td>
</tr>
</tbody>
</table>

**Legend**
- Orange: Development Area 1 (DA1)
- Blue: Development Area 2 (DA2)
- Black: Central Processing Facility (CPF)
## 2. Geosciences

**AVERAGE RESERVOIR CHARACTERISTICS & OBIP – DA3**

<table>
<thead>
<tr>
<th>Drainage Pattern</th>
<th>Area (ha)</th>
<th>Porosity (m)</th>
<th>Bitumen Saturation (%)</th>
<th>Developable OBIP ($10^3$ m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B05-12N</td>
<td>68.0</td>
<td>31.7</td>
<td>76.4</td>
<td>4,310</td>
</tr>
<tr>
<td>B05-12S</td>
<td>68.0</td>
<td>29.2</td>
<td>79.2</td>
<td>3,460</td>
</tr>
<tr>
<td>B07-12N</td>
<td>68.0</td>
<td>31.6</td>
<td>81.3</td>
<td>4,600</td>
</tr>
<tr>
<td>B07-12S</td>
<td>68.0</td>
<td>31.8</td>
<td>81.8</td>
<td>5,530</td>
</tr>
<tr>
<td>B13-12N</td>
<td>68.0</td>
<td>31.7</td>
<td>79.7</td>
<td>4,860</td>
</tr>
<tr>
<td>B13-12S</td>
<td>68.0</td>
<td>31.1</td>
<td>78.5</td>
<td>3,340</td>
</tr>
<tr>
<td>B15-12N</td>
<td>68.0</td>
<td>31.3</td>
<td>84.0</td>
<td>3,840</td>
</tr>
<tr>
<td>B15-12S</td>
<td>68.0</td>
<td>31.6</td>
<td>83.5</td>
<td>4,700</td>
</tr>
<tr>
<td>B06-14</td>
<td>76.6</td>
<td>31.0</td>
<td>84.1</td>
<td>5,480</td>
</tr>
<tr>
<td>B07-11N</td>
<td>68.0</td>
<td>30.3</td>
<td>79.0</td>
<td>3,420</td>
</tr>
<tr>
<td>B07-11S</td>
<td>68.0</td>
<td>31.2</td>
<td>74.4</td>
<td>3,770</td>
</tr>
<tr>
<td>B14-11</td>
<td>51.0</td>
<td>30.7</td>
<td>81.4</td>
<td>2,720</td>
</tr>
<tr>
<td>B16-11N</td>
<td>68.0</td>
<td>30.5</td>
<td>79.7</td>
<td>4,050</td>
</tr>
<tr>
<td>B16-11S</td>
<td>68.0</td>
<td>31.2</td>
<td>74.4</td>
<td>1,730</td>
</tr>
<tr>
<td>B13-24</td>
<td>68.0</td>
<td>30.8</td>
<td>84.4</td>
<td>6,620</td>
</tr>
<tr>
<td>B14-23N</td>
<td>68.0</td>
<td>32.2</td>
<td>79.0</td>
<td>5,750</td>
</tr>
<tr>
<td>B14-23S</td>
<td>68.0</td>
<td>31.9</td>
<td>81.1</td>
<td>2,950</td>
</tr>
<tr>
<td>B15-24N</td>
<td>95.3</td>
<td>31.3</td>
<td>83.6</td>
<td>5,790</td>
</tr>
<tr>
<td>B15-24S</td>
<td>68.0</td>
<td>30.4</td>
<td>78.1</td>
<td>2,290</td>
</tr>
<tr>
<td>B16-22N</td>
<td>68.0</td>
<td>32.7</td>
<td>78.4</td>
<td>5,160</td>
</tr>
<tr>
<td>B16-22S</td>
<td>68.0</td>
<td>32.4</td>
<td>75.9</td>
<td>2,580</td>
</tr>
<tr>
<td>B16-23</td>
<td>68.0</td>
<td>31.3</td>
<td>83.0</td>
<td>5,310</td>
</tr>
<tr>
<td>B05-23N</td>
<td>68.0</td>
<td>31.0</td>
<td>79.9</td>
<td>5,050</td>
</tr>
<tr>
<td>B05-23S</td>
<td>68.0</td>
<td>32.7</td>
<td>75.2</td>
<td>3,740</td>
</tr>
<tr>
<td>B05-24</td>
<td>68.0</td>
<td>29.6</td>
<td>80.5</td>
<td>4,100</td>
</tr>
<tr>
<td>B07-23</td>
<td>68.0</td>
<td>30.6</td>
<td>79.7</td>
<td>3,430</td>
</tr>
<tr>
<td>B07-24</td>
<td>68.0</td>
<td>29.9</td>
<td>79.0</td>
<td>3,330</td>
</tr>
<tr>
<td>B08-24</td>
<td>68.0</td>
<td>30.0</td>
<td>84.7</td>
<td>4,120</td>
</tr>
</tbody>
</table>

**Legend**
- **Drainage Areas**
- **Development Area 3 (DA3)**
- **Sunrise Lease Area**

Husky Energy Inc.
2. Geosciences

OBIP PROJECT AREA

Methodology

- Volumetric Calculation
  - OBIP = Area (m²) times HPV (m)
  - HPV = net thickness x net bitumen Saturation x effective Porosity
  - Cut off 6% BWO

- Geographix Application

<table>
<thead>
<tr>
<th>Lease</th>
<th>OBIP 6% BWO cutoff (10³ m³)</th>
<th>Gross Thickness (m)</th>
<th>Porosity (%)</th>
<th>Bitumen Saturation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1,410,565</td>
<td>36.0</td>
<td>30.4</td>
<td>77.5</td>
</tr>
</tbody>
</table>
### 2. Geosciences

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Reservoir Pressure ($kPa_g$)</td>
<td>450 at 300 masl</td>
</tr>
<tr>
<td>Reservoir Temperature (°C)</td>
<td>7</td>
</tr>
<tr>
<td>Depth to Reservoir (m)</td>
<td>160 – 200</td>
</tr>
<tr>
<td>Average Net Pay (m)</td>
<td>24</td>
</tr>
<tr>
<td>Average Horizontal Permeability (mD)</td>
<td>3700</td>
</tr>
<tr>
<td>Average Vertical Permeability (mD)</td>
<td>2000</td>
</tr>
</tbody>
</table>
2. Geosciences

SUNRISE STRATIGRAPHIC COLUMN

STRATIGRAPHIC RELATIONSHIP

McMurray Fm. Units (MU)

- **MU5**: McMurray Unit 5
- **MU4**: McMurray Unit 4 (‘upper McMurray’)  
- **MU3**: McMurray Unit 3 (‘middle McMurray’)  
- **MU2**: McMurray Unit 2  
- **MU1**: McMurray Unit 1 (‘lower McMurray’)  

Stratigraphic Surfaces

- **MXFS**: Maximum Flooding Surface  
- **WRS**: Wave Ravinement Surface  
- **BMFS**: Bay Margin Flooding Surface  
- **WTFS**: Within-Trend Flooding Surface  
- **WTRS**: Within-Trend Regressive Surface  
- **TRR**: Tidal Ravinement Surface  
- **SB**: Sequence Boundary
2. Geosciences

CLEARWATER FORMATION ISOPACH MAP
2. Geosciences

TOP OF PAY STRUCTURE CONTOUR MAP
2. Geosciences

BASE OF PAY STRUCTURE CONTOUR MAP
2. Geosciences

MAIN GROSS CONTINUOUS BITUMEN THICKNESS (M)
2. Geosciences

THIEF ZONES – THERE IS NO BOTTOM WATER AND SOME DISCONTINUOUS, DEPLETED TOP GAS IN THE DA1 AND DA2 AREAS

Net top gas thickness (m)
2. Geosciences

DEPOSITIONAL ENVIRONMENT

- Marine Shale
- Clearwater
- Marine Sands and Shales
- McMurray
- Tidal Flats/IHS
- Estuarine Channels
- Coal/Marsh
- Lower Channel
- Devonian
2. Geosciences

COMPOSITE WELL LOG

- Well 06-17-095-07W4M
2. Geosciences

VERTICAL AND HORIZONTAL WELLS

2018 Program:
- One vertical well in DA2
- HZ wells:
  - 3 replacement wells (L5F, M3F, C6F)
  - 10 infill wells
2. Geosciences

PAD INTER-WELL SPACING SCHEMATIC
## 2. Geosciences

### PAD INTER-WELL SPACING

<table>
<thead>
<tr>
<th>Well Pad</th>
<th>Inter-well Spacing (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B13-08 (B)</td>
<td>100</td>
</tr>
<tr>
<td>B14-08 (C)</td>
<td>80-100</td>
</tr>
<tr>
<td>B16-08 (D)</td>
<td>100</td>
</tr>
<tr>
<td>B13-09 (E)</td>
<td>100</td>
</tr>
<tr>
<td>B08-17 (G)</td>
<td>100</td>
</tr>
<tr>
<td>B05-16 (H)</td>
<td>100</td>
</tr>
<tr>
<td>B16-17 (L)</td>
<td>100</td>
</tr>
<tr>
<td>B13-16 (M)</td>
<td>100</td>
</tr>
<tr>
<td>B15-16 (N)</td>
<td>100</td>
</tr>
<tr>
<td>B-05-21 (P)</td>
<td>100 (P6-7 90)</td>
</tr>
<tr>
<td>B06-21 (Q)</td>
<td>100</td>
</tr>
<tr>
<td>B16-16 (R)</td>
<td>72</td>
</tr>
</tbody>
</table>
2. Geosciences

PETROGRAPHIC ANALYSIS

• No petrographic analysis was done during the reporting period
2. Geosciences

REPRESENTATIVE STRUCTURAL E-W CROSS-SECTION THROUGH DA1
2. Geosciences

GEOMECHANICAL DATA

• No geomechanical data was acquired during the reporting period
2. Geosciences

SURFACE HEAVE

Cumulative Surface displacement
Nov 2014 to May 2018

1:10000
2. Geosciences

3D SEISMIC COVERAGE
2. Geosciences

3D SEISMIC

• No 3D seismic program was conducted for the reporting period
2. Geosciences

APPROVED MAXIMUM OPERATING PRESSURE ON PRODUCING DRAINAGE AREAS

Legend
- Sunrise Mineral Lease Boundary
- Development Area 1 (DA1)
- Development Area 2 (DA2)
- Central Processing Facility (CPF)
- Drainage Patterns
3. Drilling and Completions

SAGD WELL DESIGN: TYPICAL INJECTOR WELL

- **Surface Casing**: 473.1 mm (18 5/8") or 406.4 mm (16")
- **Intermediate Casing**: 339.7 mm (13 3/8") or 298.5 mm (11 3/4")
- **Primary Injection String**: 4 1/2” (Dual String) or 5.5” x 4.5” (Single String) with one or two GDA
- **Secondary Tapered Injection String (Optional)**: 114.3 mm (4 1/2") x 60.3 (2 3/8") mm to toe c/w GDA
- **Instrumentation Coil (Optional)**: 31.8 mm (1.25”) Fibre Optic Coil
- **Slotted liner**: 244.5 mm (9 5/8") or 177.8 mm (7")
- **Import Liner Hanger**: 339.7 mm x 244.5 mm, or 276.4 x 177.8 mm Import Liner Hanger

Total typical injector: 36

- B13-08: S1, S2
- B14-08: S1, 6F*
- B08-17: S5
- B05-16: 1F*, S3, S4
- B13-09: S1 – S5
- B13-16: S1, S2, 3F*, S4 – S6
- B15-16: 1F*, S2 – S6
- B16-08: S1, S3 – S5, 6F*
- B16-17: S1 – S4, 5F*, S6

*Replacement Well
3. Drilling and Completions

**SAGD WELL DESIGN: TYPICAL INJECTOR WELL WITH VIT**

**Surface Casing**
473.1 mm (18 5/8") or 406 mm (16")

**Intermediate Casing**
339.7 mm (13 3/8") or 298.5 mm (11 3/4")

**Primary Tapered Injection String**
5.5" x 4.5" (Dual VIT) or 7" x 5 1/2" (Single VIT) with one or two GDA

**Secondary Tapered Injection String**
5.5" x 4.5" (Dual VIT), 2 3/8" (for circulation) or 2 7/8" (for circulation)

**Total typical injector with VIT: 33**

- B13-08: S3 – S7
- B14-08: S2 – S6
- B08-17: S1 – S4, S6
- B05-16: S2, S5, S6
- B13-09: S6
- B16-08: S2
- B05-21: S1 – S7
- B06-21: S1 – S7
3. Drilling and Completions

SAGD WELL DESIGN: TYPICAL PRODUCER WELL – GAS LIFT

- **Surface Casing**: 406.4 mm (16") or 473.1 mm (18 5/8")
- **Intermediate Casing**: 298.5 mm (11 3/4") or 339.7 mm (13 3/8")
- **Production String**: 114.3 mm (4.5")
- **Slotted liner**: 219.1 mm (8 5/8") or 244.5 mm (9 5/8")
- **Gas Lift**: 19.1 mm (3/4") Gas Lift coil
- **Instrumentation Coil**: 38.1 mm (1 1/2") Fibre Optic Coil
- **Import Liner Hanger**: 298.5 mm x 219.1 mm or 339.7 mm x 244.5 mm
- **Open Hole**: 270mm (10 3/4") or 311.2 mm (12 1/4")

Wells completed for Gas Lift: 4

B14-08: P4
B16-08: S1*
B05-16: P3-P4

* Replacement well
3. Drilling and Completions

SAGD WELL DESIGN: TYPICAL WELL – ESP WITHOUT TAILPIPE

- **Surface Casing**: 473.1 mm (18 5/8") or 406.4 mm (16")
- **Intermediate Casing**: 339.7 mm (13 3/8") or 298.5 mm (11 3/4")
- **Secondary Production String**: 114.3 mm (4 1/2") or 88.9 mm (3 1/2") or 114.3mm/88.9mm taper (4 1/2"/3 1/2")
- **Slotted Liner**: 244.5 mm (9 5/8") or 219.1 mm (8 5/8")
- **Intrumentation Coil**: 38.1 mm (1 1/2") or 31.8mm (11/4")
- **Fibre Optic Coil**: 38.1 mm (1 1/2") or 31.8mm (1 1/4")
- **Liner Hanger**: 339.7 mm x 244.5 mm or 298.5 mm x 219.1 mm or 270.0 mm x 244.5 mm
- **Open Hole**: 270mm (10 5/8") or 311.1mm (12 1/4")

Wells completed for ESP without tailpipe: 39
- B13-08: P2, P3, P5A, P6
- B14-08: P1, P5A, S6*
- B16-08: P5, S6*
- B13-09: P3, P4
- B08-17: P1, P4-P6
- B05-16: P3-P5
- B16-17: P3, L6
- B13-16: P1, P4
- B15-16: S1*, P2, P3, P5, P6
- B05-21: P1-P7
- B06-21: P1-P3, P5, P6

* Replacement well
3. Drilling and Completions

SAGD WELL DESIGN: TYPICAL PRODUCER WELL – ESP WITH TAIL PIPE

Wells completed for ESP with tailpipe: 28

- B13-08: P1, P4, P5, P7
- B14-08: P2, P3, P5
- B16-08: P1, P2
- B13-09: P1, P2, P5, P6
- B08-17: P2, P3
- B05-16: P2, P6
- B16-17: P1, P2*, P4, S5**
- B13-16: P2, S3**, P5, P6
- B15-16: P4*
- B06-21: P4, P7

*ICD Completion
** Replacement well

Surface Casing
473.1 mm (18 5/8") or 406.4 mm (16")

Intermediate Casing
339.7 mm (13 3/8") or 298.5 mm (11 3/4")

Primary Production String
114.3 mm (4 1/2") or 88.9 mm (3 1/2") or
114.36 mm/88.9 mm taper (4 1/2"/3 1/2") or
114.3mm/73.0mm taper (4 1/2"/2 7/8") or
114.3mm/60.3mm taper (4 1/2"/2 3/8") or
73.0mm/60.3mm taper (2 7/8"/2 3/8")

Secondary Production String
114.3 mm (4 1/2") or 88.9 mm (3 1/2") or
114.3mm/88.9mm taper (4 1/2"/3 1/2") or

Instrumentation Coil
38.1 mm (1 1/2") or 31.8mm (1 1/4")
Fibre Optic Coil

Tail Pipe: 139.7 mm (5.5")

Liner Hanger
339.7 mm x 244.5 mm or 298.5 mm x 219.1 mm
or 270.0 mm x 244.5mm

Open Hole
270mm (10 5/8") or 311.1mm (12 1/4")
4. Artificial Lift

- All producer wells on SAGD mode are equipped with either gas-lift or electric submersible pumps (ESPs).
- Gas-lift operational parameters:
  - Bottom hole Pressure: 1,000 kPa – 1,600 kPa
  - Bottom hole Temperature: 160 – 200 °C
  - Surface Temperature: 120 – 200 °C
  - Gas Injection rate: 1,000 – 10,000 Sm³/day
- ESP operational parameters:
  - Bottom hole Pressure: 600 kPa – 1,700 kPa
  - Bottom hole Temperature: 150 – 200 °C
  - Surface Temperature: 120 – 190 °C
  - Emulsion Production rate: 200 – 1,600 m³/day

| Gas Lift Production (4 wells) | B14-08: P4  
B05-16: S1  
B16-08: P3 – P4 |
|-----------------------------|-------------|
| ESP Production (66 wells)   | B13-08: P1 – P7  
B14-08: P1 – P3, P5, P5A, S6  
B16-08: P1, P2, P5, S6  
B13-09: P1 – P6  
B08-17: P1 – P6  
B05-16: P2 – P6  
B13-16: P1, P2, S3, P4 – P6  
B15-16: S1, P2 – P6  
B16-17: P1 – P4, S5, P6  
B05-21: P1 – P7  
B06-21: P1 – P7 |

Husky Energy Inc.
5. Instrumentation in Wells

OBSERVATION WELLS MAP
### 5. Instrumentation in Wells

#### OBSERVATION WELLS LIST

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Well Name</th>
<th>Unit Field Name</th>
<th>New Field Name</th>
<th>Depth of Placement (m)</th>
<th>Diameter (mm)</th>
<th>Instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>W01</td>
<td>Well 1</td>
<td>Unit Field 1</td>
<td>New Field 1</td>
<td>100</td>
<td>50</td>
<td>YES</td>
</tr>
<tr>
<td>W02</td>
<td>Well 2</td>
<td>Unit Field 2</td>
<td>New Field 2</td>
<td>200</td>
<td>75</td>
<td>YES</td>
</tr>
<tr>
<td>W03</td>
<td>Well 3</td>
<td>Unit Field 3</td>
<td>New Field 3</td>
<td>300</td>
<td>60</td>
<td>YES</td>
</tr>
<tr>
<td>W04</td>
<td>Well 4</td>
<td>Unit Field 4</td>
<td>New Field 4</td>
<td>400</td>
<td>80</td>
<td>YES</td>
</tr>
<tr>
<td>W05</td>
<td>Well 5</td>
<td>Unit Field 5</td>
<td>New Field 5</td>
<td>500</td>
<td>90</td>
<td>YES</td>
</tr>
</tbody>
</table>

*Note: Depth of Placement and Diameter values are approximate.*
5. Instrumentation in Wells

OBSERVATION WELL

- 84 OBS Wells with Instrumentation:
  - 24 wells with thermocouple only
  - 46 wells with piezometer only
  - 15 wells with piezometer and thermocouples

- 68 OBS Wells connected to SCADA:
  - 23 wells with thermocouple only
  - 30 wells with piezometers only
  - 15 wells with piezometer and thermocouples

- Thermocouples: Up to 24 thermocouples per well, the majority of which are placed across the pay interval

- Piezometers: Up to 8 piezometers per well. Cemented behind casing. Placed within the Clearwater, Wabiskaw, IHS and/or the McMurray Intervals
5. Instrumentation in Wells

TEMPERATURE AND PRESSURE MEASUREMENT - GAS LIFT

Legend
- GDA: Gravity Drainage Accessory
- P: Pressure Measurement
- T: Temperature Measurement
5. Instrumentation in Wells

TEMPERATURE AND PRESSURE MEASUREMENT – ESP

Legend
- GDA: Gravity Drainage Accessory
- P: Pressure Measurement
- T: Temperature Measurement

Produced Emulsion
Steam
6. 4D Seismic

4D SEISMIC DATA

• No 4D seismic programs conducted in the reporting period
7. Scheme Performance

SCHEME PERFORMANCE PREDICTION METHODOLOGY

• Current performance prediction built on:
  • Actual performance
  • Analysis of analogous SAGD projects
  • Updated geological model supplemented with simulation and analytical models

• Simulation and Analytical models will be periodically history matched to actual performance
7. Scheme Performance

FIELD PRODUCTION AND INJECTION HISTORY

Field Production and Injection History

Oil Rate, Steam Rate / Water Rate ($10^{-3}$(m$^3$/d))

Prod Gas Rate ($3^{-3}$/m$^3$/d), Well Count, SOR (m$^3$/m$^3$)

Nov-14
Dec-14
Mar-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
Aug-18

Cal Dly Oil
Cal Dly Water
Cal Inj Steam
Cal Dly Gas
ISOR
CSOR
Well Count
7. Scheme Performance

PRODUCTION

• Highest monthly bitumen production rate during the reporting period was 8,153 m³/d

• The cumulative oil production for the reporting period was 2,708,037 m³

• Most of producing well pairs are currently in ramp-up phase and will continue to increase production rates as the steam chambers develop. Some well pairs may have reached their peak rates already

• 55 of the initial well pairs were on production during the reporting period. 14 new well pairs (Pads B05-21 (P) and B06-21 (Q)) and 2 infill wells (B5A and C5A) were brought online during this time

• First Steam to well pad B06-21 (Q) was achieved in July 2017

• First Steam to well pad B05-21 (P) was achieved in August 2017

• The average SOR over the reporting period was 3.7 m³ CWE / m³

• As of July 31, 2018 the cumulative SOR was 4.6 m³ CWE / m³

• The instantaneous and cumulative SOR’s are expected to drop as bitumen production ramps up
7. Scheme Performance

PRODUCTION VS. APPROVAL CAPACITY VARIANCE

- Ramp-up will continue during the next reporting period
7. Scheme Performance

PAD B08-17 (G) PRODUCTION AND INJECTION HISTORY (HIGH RECOVERY PAD)
7. Scheme Performance

PAD B08-17 (G) MID OBSERVATION WELL

Distance to Horizontal: 20 m
Measured Depth: 710 m
7. Scheme Performance
PAD B08-17 (G) MID OBSERVATION WELL

OB25 (100/09-17-095-07W4/00)

Distance to Horizontal: 25 m
Measured Depth: 626 m
7. Scheme Performance

PAD B08-17 (G) TOE OBSERVATION WELL

- Faulty TC at 127 m

OB26 (100/16-17-095-07W4/00)

Distance to Horizontal: 34 m
Measured Depth: 1093 m


Temperature (°C)

Distance to Horizontal: 34 m
Measured Depth: 1093 m

- MIHS
- Sand
- MIHS

Husky Energy Inc.
7. Scheme Performance

DISCUSSION OF PAD B08-17 (G) PERFORMANCE

• Overall bitumen and steam rates are as per expectations. Well Pad expected to be close to/at peak bitumen rate

• The recent bitumen rate drop is due to lower operating pressure as a result of steam management

• Injection pressure during the reporting period ranged from 1,630 kPa_g to 1,785 kPa_g

• All 6 producers are currently using ESPs to optimize lift

• All observation wells on well pad B08-17 (G) show vertical and lateral chamber growth

• Pad B08-17 (G) performance indicators as of July 31, 2018:
  • Cum Oil : 823,985 m³ (RF = 24.7%)
  • Cum Steam Injected: 3,276,103 m³
  • Cum Water Produced: 3,591,077 m³
  • CSOR: 4.0 m³ CWE/m³
7. Scheme Performance

PAD B16-17 (L) PRODUCTION AND INJECTION HISTORY (MID RECOVERY PAD)
7. Scheme Performance

PAD B16-17 (L) HEEL OBSERVATION WELL

- Faulty TC at 127 m
7. Scheme Performance

PAD B16-17 (L) HEEL OBSERVATION WELL

Distance to Horizontal: 20 m
Measured Depth: 448 m
7. Scheme Performance

DISCUSSION OF B16-17 (L) PERFORMANCE

• Currently producing approximately 800 m$^3$/day of bitumen

• The operating pressure has varied between 1,560 kPa$_g$ and 1,725 kPa$_g$ due to issues related to the drilling and operations of replacement well L5

• In March 2018, L5 producer was side tracked to drill a new injector while the old injector was converted to a producer (Replacement). Initial results show improvement in production

• In July 2018, L2 producer was re-completed with inflow control devices (ICD’s). Initial results show improvement in production

• There are four observation wells located on this pad. One of them shows evidence of steam chamber development at the top of pay. Piezometers are reading expected pressures

• Pad B16-17 (L) performance indicators as of July 31, 2018:
  • Cum Oil : 569,888 m$^3$ (RF = 14.3 %)
  • Cum Steam Injected: 2,541,979 m$^3$
  • Cum Water Produced: 2,360,828 m$^3$
  • CSOR: 4.5 m$^3$ CWE/m$^3$
7. Scheme Performance

PAD B6-21 (Q) PRODUCTION AND INJECTION HISTORY (LOW RECOVERY PAD)
7. Scheme Performance

PAD B06-21 (Q) TOE OBSERVATION WELL

OB131 (13-21-095-07W4)

Distance to Horizontal: 50 m
Measured Depth: 857 m
7. Scheme Performance

PAD B06-21 (Q) TOE OBSERVATION WELL

Distance to Horizontal: 32 m
Measured Depth: 857 m
7. Scheme Performance

PAD B06-21 (Q) TOE OBSERVATION WELL

OB213 (15-21-095-07W4/00)

Distance to Horizontal: 25 m
Measured Depth: 857 m
7. Scheme Performance

DISCUSSION OF PAD B06-21 (Q) PERFORMANCE

- All 7 well pairs were converted to SAGD and are producing on ESP during the reporting period.
- Initial ramp up was per expectations, showing short start up times and high initial emulsion rates, consistent with high water saturation in some parts of the reservoir. Oil cut is showing gradual improvement in all the well pairs.
- Temperatures were observed in build sections of Pad B06-21 (Q) producers as a result of steam chambers from Pad B16-16 (N).
- Operating pressure will be ramped up continuously in a controlled manner.
- Well Q1 conversion to SAGD was delayed due to operations related issues.
- In June 2018, wells Q4 and Q7 were recompleted with tailpipes to improve conformance.
- There are four observation wells located on this pad. One of them shows evidence of steam chamber development at the top of pay. Piezometers are reading expected pressures.
- Pad B06-21 (Q) performance indicators as of July 31, 2018:
  - Cum Oil: 106,927 m³ (RF = 2.1%)
  - Cum Steam Injected: 931,081 m³
  - Cum Water Produced: 1,538,147 m³
  - CSOR: 8.7 m³ CWE / m³
7. Scheme Performance

PAD B13-08 (B) PRODUCTION AND INJECTION HISTORY

B 13-08 Production and Injection History

- Oil Rate, Steam Rate / Water Rate (e3 m³/d)
- Prod Gas Rate (e3 m³)/d, Well Count, SOR (e3 m³/m³)
7. Scheme Performance
PAD B14-08 (C) PRODUCTION AND INJECTION HISTORY
7. Scheme Performance

PAD B16-08 (D) PRODUCTION AND INJECTION HISTORY
7. Scheme Performance

PAD B13-09 (E) PRODUCTION AND INJECTION HISTORY

B 13-09 Production and Injection History

- Oil Rate, Steam Rate / Water Rate *10^{-1} (m^3/d)
- Prod Gas Rate (m^3/d), Well Count, SOR (m^3/m^3)

- Cal Dly Oil
- Cal Dly Water
- Cal Inj Steam
- ISOR
- CSOR
- Well Count
- Cal Dly Gas
7. Scheme Performance

PAD B05-16 (H) PRODUCTION AND INJECTION HISTORY

B 05-16 Production and Injection History

- **Oil Rate, Steam Rate/Water Rate**
  - Units: *10^-4 (m³/d)

- **Prod Gas Rate**
  - Units: (m³/m³)

- **Well Count, SOR (m³/m³)**

Graph showing the production and injection history with various parameters.
7. Scheme Performance

PAD B08-17 (G) PRODUCTION AND INJECTION HISTORY
7. Scheme Performance

PAD B16-17 (L) PRODUCTION AND INJECTION HISTORY

B 16-17 Production and Injection History
7. Scheme Performance

PAD B13-16 (M) PRODUCTION AND INJECTION HISTORY
7. Scheme Performance

PAD B15-16 (N) PRODUCTION AND INJECTION HISTORY

B 15-16 Production and Injection History
7. Scheme Performance

PAD B5-21 (P) PRODUCTION AND INJECTION HISTORY

B 05-21 Production and Injection History

- Oil Rate, Steam Rate & Water Rate * 10^-1 (m³/d)
- Prod Gas Rate (m³³/d), Well Count, SOR (m³/m³)

- Cal Dly Oil
- Cal Dly Water
- Cal Inj Steam
- Cal Dly Gas
- ISOR
- CSOR
- Well Count

Husky Energy Inc.
7. Scheme Performance

PAD B6-21 (Q) PRODUCTION AND INJECTION HISTORY

B 06-21 Production and Injection History

- Oil Rate, Steam Rate / Water Rate *10^3 (m³/d)
- Prod Gas Rate (m³/d), Well Count, SOR (m³/m³)

Graph showing the production and injection history for B 06-21 from August 16 to July 18.
7. Scheme Performance

START-UP STRATEGY / KEY LEARNINGS

- Pads B05-21 (P) and B06-21 (Q) start-up process continued during the reporting period. A mixture of bullheading and circulation was used according to steam availability, pressure response, and availability of surface facilities.

- Key learnings:
  - Bullheading is the preferred method of start-up
  - For low steam rate wells circulation was required to achieve desirable steam qualities
7. Scheme Performance

OBIP AND RECOVERIES BY PAD

• OBIP for each pad is calculated from the formula:

\[
\text{OBIP} = L \times W \times H \times (1 - S_w) \times \Phi \times \frac{1}{B_o}
\]

Where

- \(L\) = Length of Drainage Area
- \(W\) = Width of Drainage Area
- \(H\) = Net* Thickness from the Top of Pay to the Base of Pay
- \(\Phi\) = Average Net* Porosity in the Pay zone
- \(S_w\) = Average Net* Water Saturation in the Pay zone
- \(B_o\) = Oil Volume factor/Shrinkage factor (taken as 1)

*Net properties calculated using a 6% BWO Cut-off
## 7. Scheme Performance

### OBIP AND RECOVERIES BY PAD

<table>
<thead>
<tr>
<th>Well PAD</th>
<th>Wells</th>
<th>OBIP (10³ m³)</th>
<th>Recovery to date July 31, 2018 (10³ m³)</th>
<th>Recovery Factor (%)</th>
<th>Estimated Ultimate Recovery (10³ m³)</th>
<th>Ultimate RF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B13-08 (B)</td>
<td>8*</td>
<td>3,868</td>
<td>778.2</td>
<td>20.1</td>
<td>1,934</td>
<td>50</td>
</tr>
<tr>
<td>B14-08 (C)</td>
<td>7*</td>
<td>4,394</td>
<td>732.8</td>
<td>16.7</td>
<td>2,197</td>
<td>50</td>
</tr>
<tr>
<td>B16-08 (D)</td>
<td>6</td>
<td>3,219</td>
<td>410.7</td>
<td>12.8</td>
<td>1,610</td>
<td>50</td>
</tr>
<tr>
<td>B13-09 (E)</td>
<td>6</td>
<td>2,677</td>
<td>472.0</td>
<td>17.6</td>
<td>1,339</td>
<td>50</td>
</tr>
<tr>
<td>B05-16 (H)</td>
<td>6</td>
<td>3,351</td>
<td>568.0</td>
<td>17.0</td>
<td>1,676</td>
<td>50</td>
</tr>
<tr>
<td>B13-16 (M)</td>
<td>6</td>
<td>4,325</td>
<td>601.2</td>
<td>13.9</td>
<td>2,163</td>
<td>50</td>
</tr>
<tr>
<td>B15-16 (N)</td>
<td>6</td>
<td>4,374</td>
<td>610.2</td>
<td>14.0</td>
<td>2,187</td>
<td>50</td>
</tr>
<tr>
<td>B08-17 (G)</td>
<td>6</td>
<td>3,334</td>
<td>824.0</td>
<td>24.7</td>
<td>1,667</td>
<td>50</td>
</tr>
<tr>
<td>B16-17 (L)</td>
<td>6</td>
<td>3,999</td>
<td>570.0</td>
<td>14.3</td>
<td>2,000</td>
<td>50</td>
</tr>
<tr>
<td>B06-21 (Q)</td>
<td>7</td>
<td>5,160</td>
<td>106.9</td>
<td>2.1</td>
<td>2,580</td>
<td>50</td>
</tr>
<tr>
<td>B05-21 (P)</td>
<td>7</td>
<td>5,628</td>
<td>122.2</td>
<td>2.2</td>
<td>2,814</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>71</td>
<td><strong>44,329</strong></td>
<td><strong>5796.2</strong></td>
<td><strong>13.1</strong></td>
<td><strong>22,165</strong></td>
<td><strong>50</strong></td>
</tr>
</tbody>
</table>

*well pad includes one infill well
7. Scheme Performance

5 YEAR OUTLOOK OF EXPECTED PAD ABANDONMENT

• No pad abandonment is anticipated in the next 5 years
7. Scheme Performance

TEMPERATURE, PRESSURE AND QUALITY OF STEAM

- High pressure steam separator delivers steam at a 100% quality
- Steam quality losses are experienced during transportation to the pads
- Steam quality at the wellhead is estimated to be 95%
7. Scheme Performance

COMPOSITION OF OTHER INJECTED / PRODUCED FLUIDS

• No solvent was injected during this reporting period
7. Scheme Performance
INFLOW CONTROL Devices (ICD’s)

- 2 wells in Sunrise were recompleted with tubing deployed ICD’s: L2 and N4
- In both cases the driver for the recompletion was a hot toe caused by low reservoir roof close to the toe of the well
- Performance improvement was observed in both wells with signs of lower amount of steam production observed
- It was concluded from these cases that ICD’s are acting as an effective means of decreasing steam production in the well, allowing the pump to run more effectively
7. Scheme Performance

SUMMARY OF KEY LEARNINGS

• The implementation of replacement wells contributed to achieving a higher production rate per well

• The implementation of ICD’s were proven to control steam breakthrough at the toe of a well where tail pipes were not suitable

• Early results of infill wells are promising
8. Future Plans

FUTURE PLANS

- Infill Well Application (Application No. 1912059) implementation pending AER review and approval
- Pad B15-16 (S) Amendment Application – target submission Q1 2019
- Pad B16-18 (K) Amendment Application – target submission Q1 2019
- Development Area 4 Amendment Application – target submission Q2 2019
# 3.1.2 Surface Operations

## TABLE OF CONTENTS

1. Facilities – slide 79
2. Facilities Performance – slide 97
3. Measurement and Reporting – slide 100
4. Water Production, Injection and Uses – slide 111
5. Sulphur Production – slide 123
6. Environmental – slide 129
7. Compliance Statement – slide 145
8. Future Plans – slide 147
1. Facilities

Aerodrome

Sunrise Entrance

Borrow Pit 1

Canterra Road

Central Processing Facility

Green Stocking Substation

B13-09 (E)

B05-16 (H)

B08-17 (G)

B16-08 (D)

B14-08 (C)

B13-08 (B)
1. Facilities

- B15-16 (N)
- B13-16 (M/R)
- B13-17 (L)
- B06-21 (DA2)
- B05-21 (DA2)
1. Facilities
1. Facilities

FACILITY PLOT PLAN
1. Facilities

FACILITY PLOT PLAN (1A CPF)
1. Facilities

FACILITY PLOT PLAN (1B CPF)
1. Facilities

FIELD FACILITY PLOT PLAN (DA1)
1. Facilities

FIELD FACILITY PLOT PLAN (DA2)
1. Facilities

SIMPLIFIED PLANT SCHEMATIC
1. Facilities

FIELD FACILITIES

Initial Development Area field facilities consist of:

- Steam, emulsion, gas supply, and produced gas pipelines
- Injection and production wells
- All wells will use Electric Submersible Pumps (ESPs)
  - 3 last conversions underway
- Group separator
- Test separator package
- Produced gas condenser
- Produced gas separator
- Emulsion and condensate pumps

Development Area 2:

- Steam, emulsion, and gas supply pipelines
- Injection and production wells
- Electric submersible pumps (ESPs)
- Multiphase pumps for casing gas re-injection into emulsion line
- Minimal surface equipment

Field facilities performance challenges:

- Calibration issues with water cut analyzers
  - Have recalibrated analyzers
  - Swapped out unit on D Pad
- DA2 sampling for water cut calibration and production estimates
  - Installing new engineered sampling cabinet in Q4 2018
- Casing gas debottlenecks
Each Oil Treating train consists of:

- Emulsion Coolers
- 1 Free Water Knock Out
- 2 Treaters
- Sales Oil Coolers
- Produced Water Coolers

Oil and water upsets have recently been reduced through implementation of several projects:

- FWKO and treater nuclear profilers for interface measurement and control
- Treater cleaning and internal modifications for reduction of chemical use and improvement of BS&W
- Chemical optimization for improved separation and reduced fouling

Oil Treating KPIs are:

- <0.5% BS&W in Oil (average ~0.4%)
- <500 ppm Oil in PW (average <400 ppm)
1. Facilities

PROCESS WATER DE-OILING

Each De-oiling train consists of:
- 2 Skim Tanks
- 1 Induced Gas Flotation Unit
- 2 Oil Removal Filters
- 1 Oil Recovery Tank
- 1 Desand Tank

The performance of the de-oiling equipment has improved since FWKO produced water quality improvement, cleaning skim tank bottoms, and changing ORF media.

De-Oiling KPIs are:
- FWKO outlet – 500 ppm (average 375 ppm)
- IGF Inlet – 100 ppm (average 124 ppm)
- IGF Outlet – 20 ppm (average 22 ppm)
- ORF Outlet – 3 ppm (average 6 ppm)
1. Facilities

WATER TREATMENT
Each Water Treatment train consists of:
• 1 Warm Lime Softener
• 7 After Filters
• 3 pairs Weak Acid Cation (WAC) Exchangers/Polishers
• Neutralization / Backwash Systems
• Water Treatment Chemical Feed Systems
• Sludge Ponds

Water treatment equipment has been performing well overall.
Completed AF media change-out with improved performance as a result.

Water Treatment KPIs are:
• Total Dissolved Hardness: < 0.5 mg/L (average <0.206 mg/L – below ICP detection limit)
• Silica: < 50 mg/L (average 31 mg/L)
• Turbidity < 2 NTU (average 1.6 NTU)
• Oil in Water < 1.0 (average 0.36)
• Total Iron: < 300 ppb (average 8.7 ppb)
• pH: 9.8 to 10.2 (average 10.05)
1. Facilities

STEAM GENERATION

Each Steam Generation train consists of:

- 5 Once-Through Steam Generators (OTSGs)
- 3 Low Pressure (LP) and 3 High Pressure (HP) Boiler Feed Water (BFW) Pumps
- LP Steam system
- Blowdown cooling and disposal

Currently working through campaign of burner modifications and re-characterization to increase capacity of each OTSG to 123% of original name plate.
1. Facilities

LO-CAT SULPHUR RECOVERY UNIT (SRU)

• Permanent SRU online as of October 2015

• SRU consists of:
  • Sour Gas Compression Package
  • Cooler & Coalescing Filter
  • Liquid Full Absorber
  • Absorber Knock Out Pot
  • LO-CAT® Oxidizer
  • Solution Cooler/Heater
  • Process Air Blowers
  • Vacuum Belt Package
  • Circulation, Slurry, and Chemical Feed Pumps, Tanks, and Ancillary Equipment

• SRU KPI’s are:
  • Sulphur Recovery: minimum 70 % per calendar quarter (currently >90% average)
  • SO₂ Emission Limit < 1.6 t/d (yearly average of 0.52 T/d of SO₂)
1. Facilities

VAPOUR RECOVERY

Each Storage Tank Vapour (STV) recovery system consists of:

- Collection header with high pressure diversion to LP Flare
- 1 Inlet Cooler & Suction Scrubber
- 2 Liquid Ring Compressors
- 1 Discharge Separator
- 2 Casing Water Coolers (liquid ring seal water)
- Condensate Pumps
1. Facilities

FACILITY MODIFICATIONS

• Oil Treater internals modified (Reduced chemical cost and improved vessel performance)
  • Cleaning and general repairs
  • Thicker and bigger opening baffle plates
  • Nuclear profiler wash system
  • Relocated sample points
• Installed larger sales oil coolers (Improved reliability and throughput)
• Rag and slop draining (Reduced flashing in tanks)
  • Added control valve to restrict slop/rag run-down rates in progress
• Hydrocarbon Vapour Handling (STV)
  • Upsized the discharge scrubber vapor line in 1B STV system
1. Facilities

FACILITY MODIFICATIONS – OTSG’S

- Completed structural reinforcement for excess vibration issues
- Ongoing campaign to fix valve reliability issues
- Reduced NOx emissions and OTSG re-rate through new burner tips installation
2. Facilities Performance

SRU ISSUES SUMMARY

- October 3, 2016 – Met with AER to present mitigation plan and schedule
- October 21, 2016 – Husky sent letter requesting extension of the June 21, 2016 authorization until March 31, 2018
- October 28, 2016 – AER granted extension request
- Waiver (including turn-around) AER approved May 26, 2017
- Mitigation plan for the SRU oxidizer vent hydrocarbon emissions
  - Produced water / make-up water Quench installed
  - Casing gas bypass / increased Group Separator pressure increase in planning
- CEMS
  - Husky is continuing to sample the oxidizer vent stack for H$_2$S on a regular basis
  - To date, H$_2$S has not exceeded the regulatory limit in the vent stream sample
2. Facilities Performance

POWER CONSUMPTION

![Bar chart showing power consumption from August 2017 to July 2018. The chart displays the monthly power consumption in MWh for each month. The highest consumption was in January 2018, while the lowest was in September 2017.]
2. Facilities Performance

GAS USAGE

Month


Volume (e³Sm³) / Month

Natural Gas  Produced Gas
2. Facilities Performance

FLARING AND VENTING

Increased flaring December to February due to shutdown and startup of SRU for absorber solids removal.
2. Facilities Performance
GREEN HOUSE GAS (GHG)

- Emission sources considered include stationary combustion associated with steam generators and glycol heaters, flaring, venting and fugitive emissions, diesel and propane combustion and onsite transportation.

Sunrise GHG Emissions (August 2017 - July 2018)

Notes: Jan-July 2018 data have not been audited by third party yet. The spike in CH4 emission in the March 2018 is due to increase in SRU vent.
3. Measurement and Reporting

OVERVIEW
3. Measurement and Reporting

WATER SOURCE BATTERY ABT0134390

• Suncor PAW water receipt average 1,160 m³/d for past 12 months (August 2017 – July 2018)

• No PAW water used since mid-May due to plant water balance issue

• Kearl MUW well lists:
  • 09-24-096-08W4
  • 01-13-096-08W4
  • 06-30-096-07W4
  • 12-08-096-07W4
  • 11-17-095-07W4
  • 12-20-096-07W4
  • 14-18-096-07W4
  • 06-19-096-07W4

• Transfer water to Oil Battery from Water Source Battery through the permanent quench line starting October 2017

• Water source battery water balance closed at:
  (0% balance in August and September are due to assigning water to the temporary quench line) – see table (right)

• June and July balance issue is due to the water recycle back to the produced water tank from HP separator and the internal water transfer between 1A and 1B

<table>
<thead>
<tr>
<th>Date</th>
<th>Water Balance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug-17</td>
<td>0</td>
</tr>
<tr>
<td>Sep-17</td>
<td>0</td>
</tr>
<tr>
<td>Oct-17</td>
<td>-0.2</td>
</tr>
<tr>
<td>Nov-17</td>
<td>-2.0</td>
</tr>
<tr>
<td>Dec-17</td>
<td>-0.5</td>
</tr>
<tr>
<td>Jan-18</td>
<td>1.3</td>
</tr>
<tr>
<td>Feb-18</td>
<td>4.4</td>
</tr>
<tr>
<td>Mar-18</td>
<td>5.1</td>
</tr>
<tr>
<td>Apr-18</td>
<td>-5.7</td>
</tr>
<tr>
<td>May-18</td>
<td>-4.8</td>
</tr>
<tr>
<td>Jun-18</td>
<td>-16.7</td>
</tr>
<tr>
<td>Jul-18</td>
<td>-10.0</td>
</tr>
</tbody>
</table>
3. Measurement and Reporting

INJECTION FACILITY ABIF0126671

- Primary and secondary Boiler Feed Water (BFW) measurement balances within 5%
- Reported Spent Lime Pond inventory:
  - **Sources:** OTSG blowdown, SWS, leachate from landfill
  - **Users:** Water treatment
- Trucked in/out water loads have been accounted
- Injection Facility closing water balance and steam allocation:

<table>
<thead>
<tr>
<th>Date</th>
<th>Water Balance (%)</th>
<th>Steam Allocation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug-17</td>
<td>3.2</td>
<td>0.97</td>
</tr>
<tr>
<td>Sep-17</td>
<td>2.5</td>
<td>0.95</td>
</tr>
<tr>
<td>Oct-17</td>
<td>1.9</td>
<td>1.01</td>
</tr>
<tr>
<td>Nov-17</td>
<td>0.9</td>
<td>0.99</td>
</tr>
<tr>
<td>Dec-17</td>
<td>0.03</td>
<td>1.06</td>
</tr>
<tr>
<td>Jan-18</td>
<td>9.36</td>
<td>1.06</td>
</tr>
<tr>
<td>Feb-18</td>
<td>1.2</td>
<td>0.96</td>
</tr>
<tr>
<td>Mar-18</td>
<td>1.4</td>
<td>1.05</td>
</tr>
<tr>
<td>Apr-18</td>
<td>1.8</td>
<td>1.04</td>
</tr>
<tr>
<td>May-18</td>
<td>1.8</td>
<td>1.04</td>
</tr>
<tr>
<td>Jun-18</td>
<td>3.6</td>
<td>1.06</td>
</tr>
<tr>
<td>Jul-18</td>
<td>2.5</td>
<td>1.09</td>
</tr>
</tbody>
</table>
3. Measurement and Reporting

IN SITU OIL SANDS BATTERY ABBT0134400

- Primary and secondary produced water measurement balances within 5%
- Trucked in/out water and oil loads are accounted for the reporting period

<table>
<thead>
<tr>
<th>Date</th>
<th>GOR e³m³/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug-17</td>
<td>0.00374</td>
</tr>
<tr>
<td>Sep-17</td>
<td>0.00270</td>
</tr>
<tr>
<td>Oct-17</td>
<td>0.00374</td>
</tr>
<tr>
<td>Nov-17</td>
<td>0.00161</td>
</tr>
<tr>
<td>Dec-17</td>
<td>0.00140</td>
</tr>
<tr>
<td>Jan-18</td>
<td>0.00365</td>
</tr>
<tr>
<td>Feb-18</td>
<td>0.00309</td>
</tr>
<tr>
<td>Mar-18</td>
<td>0.00242</td>
</tr>
<tr>
<td>Apr-18</td>
<td>0.00180</td>
</tr>
<tr>
<td>May-18</td>
<td>0.00165</td>
</tr>
<tr>
<td>Jun-18</td>
<td>0.00215</td>
</tr>
<tr>
<td>Jul-18</td>
<td>0.00351</td>
</tr>
</tbody>
</table>
3. Measurement and Reporting

PRORATION FACTORS
3. Measurement and Reporting

WATER DISPOSAL – DIRECTIVE 081

<table>
<thead>
<tr>
<th>Year</th>
<th>D-081 Limit (m3)</th>
<th>Actual (m3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>1,324,527</td>
<td>1,202,460</td>
</tr>
<tr>
<td>2018 YTD – (July 31)</td>
<td>850,714</td>
<td>842,392</td>
</tr>
</tbody>
</table>

![Bar chart showing monthly data for 2017 and 2018 YTD (July 31).]
3. Measurement and Reporting

MONTHLY WATER IMBALANCE – DIRECTIVE 081
3. Measurement and Reporting

WATER DISPOSAL – WELL HEAD PRESSURE
3. Measurement and Reporting

FUTURE PLANS

• Ten new Infill wells will start up in Q4 2018
  • Utilizing existing well test facilities, 3 well test tags per new infill

• Husky Diluent Reduction Project start up Q4 2018
  • 1 SCO Tank (110-T-341) Level tag added

• R pad start up Q2 2019
  • Utilizing existing Pad B13-16 (M) well test facilities
  • 3 tags per well for well tests added
  • 1 tag per well for steam injection added

• Two existing disposal wells will be tied-in Q2 2019
  • 1 new flow meter per well, 2 total added

NOTE: MARP will reflect all changes above before internal submission in February, 2019
4. Water Production, Injection and Uses

WATER USAGE

Water Sources:

- Quaternary (non-saline)
  - Water Act License No. 267760
  - 2 wells: 01-23-095-07W4 and 16-22-095-07W4
  - Licensed to divert 202,575 m³ annually for Industrial (Camp) purposes
    - Up to 18,650 m³ annually for Industrial uses (general maintenance and processes)
    - Outflow: licensed to divert 202,575 m³ annually from the Domestic Waste Water Treatment Plant for Industrial (injection) purposes
  - Withdrawal from August 1, 2017 – July 31, 2018: 53,255 m³

- Surface Water Runoff (non-saline)
  - Water Act License No. 331927
  - 14 diversion locations
  - Licensed to divert 250,000 m³ annually for Commercial purposes
  - Withdrawal from August 1, 2017 to July 31, 2018: 17,785 m³
4. Water Production, Injection and Uses

WATER USAGE (CONT’D)

- **Process Affected Water - Suncor (PAW)**
  - Sourced from Suncor Oil Sands Facility under a Water Supply Agreement
  - No annual withdrawal limit (former License 331569 - cancelled by AER June 19, 2018)
  - Withdrawal from August 1, 2017 to July 31, 2018: 421,865 m³

- **Basal McMurray - Kearl**
  - Water Act Approval 241442 converted into Water Act License 409247 - May 22, 2018
  - 8 Wells – 09-24, 01-13-096-08W4 and 06-19, 14-18, 12-20, 12-08, 06-30, 11-17-096-07W4
  - Licensed to divert 2,190,000 m³ annually for Industrial (Injection) purposes
  - Withdrawal from August 1, 2017 to July 31, 2018: 1,112,364 m³

- **No Brackish water sources are currently available to Sunrise**

- **Produced Water**
  - All produced water sent to water treatment
  - All neutralized waste from water treatment diverted to pond
  - All pond supernatant water recycled to water treatment
  - Portion of steam blowdown recycled to water treatment, remainder disposed via deep well injection
4. Water Production, Injection and Uses

TOTAL MAKE-UP WATER CONSUMPTION

Average Daily Withdrawal (m³/d)

- Aug-2017
- Sep-2017
- Oct-2017
- Nov-2017
- Dec-2017
- Jan-2018
- Feb-2018
- Mar-2018
- Apr-2018
- May-2018
- Jun-2018
- Jul-2018

Basal McMurray  Process Affected Water
4. Water Production, Injection and Uses

PRODUCED WATER AND STEAM INJECTED

![Bar chart showing water production and steam injection over time]
4. Water Production, Injection and Uses

WATER DISPOSAL LIMITS

- Class 1b Disposal Approval 11754C
  - Four disposal wells 14-27, 03-34, 04-34 and 11-34-094-07W4
  - Maximum well head injection pressure: 5,000 kPa\(_g\)
  - Fluids disposed for August 1, 2016 to July 31, 2017: 1,385,336 m\(^3\)

- Directive 081
  - PAW and Kearl source water well disposal factors = 0.25
  - Produced water disposal factor = 0.10
  - 2017 Disposal Limit (%) = 12.5
  - 2017 Actual Disposal (%) = 10.3

- AER approved Husky’s application to remove the daily disposal limit of 4,400 m\(^3\)/day – February 15, 2018
4. Water Production, Injection and Uses

WATER DISPOSAL
4. Water Production, Injection and Uses

DISPOSAL WELLS

AER Class 1 Approved Disposal Wells (11754C)
- 100/11-34-094-07W4/00
- 100/14-27-094-07W4/00
- 102/03-34-094-07W4/00
- 100/04-34-094-07W4/00

Pressure Monitoring Wells
- 100/01-16-095-07W4/00
- 100/07-13-095-07W4/00
- 100/04-22-095-07W4/00

Pressure/Chemistry Monitoring Wells
- 100/15-34-094-07W4/00
- 100/07-34-094-07W4/00
- 100/13-27-094-07W4/00
- 100/11-27-094-07W4/00
- 100/02-32-094-07W4/00
- 100/11-22-094-07W4/00
- 100/09-01-095-07W4/00
4. Water Production, Injection and Uses

DISPOSAL SUMMARY

- Class 1b Disposal Approval No. 11754C
- 2017 Annual Report submitted to AER - Approved June 8, 2018
- Fluids disposed August 1, 2016 – July 31, 2017: 1,385,336 m³
- No exceedances in the Maximum Well Head Injection Pressure of 5,000 kPa₉
- The monitoring wells continue to show pressure responses as a result of disposal
- Interpretation of two local and one intermediate flow system to explain the hydraulic head at the monitoring wells has not changed
- Chemistry results indicate effects of disposal from the Project at wells 100/15-34-094-07W4/00, 100/07-34-094-07W4/00 and 100/11-27-094-07W4/00
- Muted pressure response observed in off-reef monitoring well 100/09-01-095-07W4/00
4. Water Production, Injection and Uses

DATA GAPS

Pressure Data Gaps >30 days: Monitoring Well 100/04-22-095-07W4/00

• Malfunctioned October 18, 2017 – Voluntary Self Disclosure and repair action plan submitted to AER. Authorized received July 13, 2018
4. Landfill Waste Handling

LANDFILL WASTE HANDLING

- Class 2 Oil Field Landfill Onsite Approval No. WM139A
- WM139A amendment approval issued February 2016 to accept sulphur waste from the SRU

<table>
<thead>
<tr>
<th>Waste Description</th>
<th>Receiving Facility</th>
<th>Total</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminated Debris and Soil (crude/condensate)</td>
<td>Husky Sunrise Landfill</td>
<td>28.5</td>
<td>m3</td>
</tr>
<tr>
<td>Contaminated Debris and Soil (produced/salt water)</td>
<td>Husky Sunrise Landfill</td>
<td>247.1</td>
<td>m3</td>
</tr>
<tr>
<td>Cement</td>
<td>Husky Sunrise Landfill</td>
<td>56</td>
<td>m3</td>
</tr>
<tr>
<td>Construction/Demolition Debris</td>
<td>Husky Sunrise Landfill</td>
<td>954.5</td>
<td>m3</td>
</tr>
<tr>
<td>Sulphur Waste</td>
<td>Husky Sunrise Landfill</td>
<td>491</td>
<td>m3</td>
</tr>
<tr>
<td>Contaminated Debris and Soil (non-halogenated aromatic)</td>
<td>Husky Sunrise Landfill</td>
<td>22</td>
<td>m3</td>
</tr>
<tr>
<td>Filters - Water Treatment</td>
<td>Husky Sunrise Landfill</td>
<td>43</td>
<td>m3</td>
</tr>
<tr>
<td>Limestone (pH control)</td>
<td>Husky Sunrise Landfill</td>
<td>300</td>
<td>m3</td>
</tr>
</tbody>
</table>
### 4. Water Production, Injection and Uses

#### WASTE VOLUMES

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
<th>Receiving Facility</th>
<th>Total</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>COEMUL</td>
<td>Slop Oil</td>
<td>White Swan Grassland</td>
<td>676</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Elk Point</td>
<td>1118</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Fort Mac 881</td>
<td>12362</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Hughenden</td>
<td>232</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Red Water</td>
<td>120</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td>Waste Oil Solids</td>
<td>White Swan Grassland</td>
<td>12</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Fort Mac 881</td>
<td>326</td>
<td>m3</td>
</tr>
<tr>
<td>CAUS</td>
<td>Caustic / Water</td>
<td>New Alta Red Water</td>
<td>225</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Swan Conklin</td>
<td>111</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Swan Grassland</td>
<td>625</td>
<td>m3</td>
</tr>
<tr>
<td>METHNL</td>
<td>Methanol</td>
<td>White Swan Grassland</td>
<td>13</td>
<td>m3</td>
</tr>
<tr>
<td>ACTCRB</td>
<td>Activated Carbon</td>
<td>New Alta Fort Mac 881</td>
<td>18</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Swan Grassland</td>
<td>19</td>
<td>m3</td>
</tr>
<tr>
<td>DRWSGC</td>
<td>Drilling Mud</td>
<td>New Alta Fort Mac 881</td>
<td>128</td>
<td>m3</td>
</tr>
<tr>
<td>GLYC Water</td>
<td>Glycol and Water</td>
<td>New Alta Fort Mac 881</td>
<td>19</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Red Water</td>
<td>17</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Swan Grassland</td>
<td>9</td>
<td>m3</td>
</tr>
<tr>
<td>SWTLIQ</td>
<td>Lo-Cat Solution and Water</td>
<td>New Alta Fort Mac 881</td>
<td>580</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Hughenden</td>
<td>8</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Alta Red Water</td>
<td>7</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Swan Grassland</td>
<td>148</td>
<td>m3</td>
</tr>
<tr>
<td>FILPWT</td>
<td>FILPWT Produced / Process Water</td>
<td>White Swan Conklin</td>
<td>20</td>
<td>m3</td>
</tr>
<tr>
<td>ACID</td>
<td>Acid solution - Unneutralized</td>
<td>Miller Environmental</td>
<td>1.54</td>
<td>m3</td>
</tr>
<tr>
<td>BATT</td>
<td>Batteries - Wet and Dry Cell</td>
<td>General Recycling Industries</td>
<td>1.5</td>
<td>m3</td>
</tr>
<tr>
<td>CAUS</td>
<td>Caustic Solutions - Unneutralized, Spent</td>
<td>Miller Environmental</td>
<td>4.6</td>
<td>m3</td>
</tr>
<tr>
<td>DOMWST</td>
<td>Contaminated Garbage / Contaminated Domestic Waste</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>224.02</td>
<td>m3</td>
</tr>
<tr>
<td>DOMWST - FT4</td>
<td>4' Fluorescent Tubes</td>
<td>Miller Environmental</td>
<td>2.3</td>
<td>m3</td>
</tr>
</tbody>
</table>
## 4. Water Production, Injection and Uses

### WASTE VOLUMES (CONT’D)

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
<th>Receiving Facility</th>
<th>Total</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOMWST - NH</td>
<td>Non-Hazardous Garbage - Domestic Waste</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>25.3 m³</td>
<td></td>
</tr>
<tr>
<td>DOMWST - P</td>
<td>Plastic Waste - Plastic Sheeting, Plastic Liners, Waste Shrink Wrap</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>36.8 m³</td>
<td></td>
</tr>
<tr>
<td>EMTCON</td>
<td>Plastics</td>
<td>Pnewko Trucking Ltd.</td>
<td>9.66 m³</td>
<td></td>
</tr>
<tr>
<td>EMTCON-A</td>
<td>Aerosol Cans - Empty</td>
<td>Miller Environmental and General Recycling</td>
<td>1.4 m³</td>
<td></td>
</tr>
<tr>
<td>EMTCON - P</td>
<td>Empty Container - Plastic Pails, Jugs, etc.</td>
<td>Pnewko Trucking Ltd.</td>
<td>20.7 m³</td>
<td></td>
</tr>
<tr>
<td>EMTCON-PD</td>
<td>Empty Container - Plastic Drums (Non-rbw)</td>
<td>Blue Planet Recycling</td>
<td>1.435 m³</td>
<td></td>
</tr>
<tr>
<td>EMTCON-PT</td>
<td>Empty Container - Plastic Totes (&gt;= 1 m³)</td>
<td>Pnewko Trucking Ltd.</td>
<td>53 m³</td>
<td></td>
</tr>
<tr>
<td>EMTCON-SB</td>
<td>Empty Container - Sample Bottles</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>0.46 m³</td>
<td></td>
</tr>
<tr>
<td>FILLUB</td>
<td>Filters - Lube Oil</td>
<td>General Recycling Industries</td>
<td>0.23 m³</td>
<td></td>
</tr>
<tr>
<td>GLYCHM</td>
<td>Glycol Solution - Containing Lead or Other Heavy Metals</td>
<td>Clean Harbors - Devon Deepwell Class 1A</td>
<td>1 m³</td>
<td></td>
</tr>
<tr>
<td>INOCHM</td>
<td>Chemicals - Inorganic</td>
<td>Miller Environmental</td>
<td>2.355 m³</td>
<td></td>
</tr>
<tr>
<td>NORM</td>
<td>Waste - Miscellaneous</td>
<td>Tervita Corporation - NORM Services (NORMCAN)</td>
<td>4.6 m³</td>
<td></td>
</tr>
<tr>
<td>OILABS</td>
<td>Absorbents</td>
<td>MCL - Leduc Regional Landfill</td>
<td>4.6 m³</td>
<td></td>
</tr>
<tr>
<td>OILRAG</td>
<td>Rags - Oily</td>
<td>MCL - Leduc Regional Landfill</td>
<td>0.23 m³</td>
<td></td>
</tr>
<tr>
<td>ORGCHM</td>
<td>Chemicals - Organic</td>
<td>Miller Environmental</td>
<td>4 m³</td>
<td></td>
</tr>
<tr>
<td>PLASTIC</td>
<td>Empty Container - Plastic Pails, Jugs, etc.</td>
<td>Pnewko Trucking Ltd.</td>
<td>4.37 m³</td>
<td></td>
</tr>
<tr>
<td>SMETAL</td>
<td>Metal - Scrap</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>2.76 m³</td>
<td></td>
</tr>
<tr>
<td>SOILCO</td>
<td>Contaminated Debris and Soil - Crude Oil/ Condensate</td>
<td>Secure Energy - Pembina Landfill (Class 2)</td>
<td>6 m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secure Landfill</td>
<td>10 m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCL - Leduc Regional Landfill - Class II</td>
<td>10 m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>12 m³</td>
<td></td>
</tr>
<tr>
<td>SOILCO-DW</td>
<td>Contaminated Debris and Soil</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>3.3 m³</td>
<td></td>
</tr>
<tr>
<td>SOILSU</td>
<td>Contaminated Debris and Soil - Sulphur</td>
<td>Miller Environmental</td>
<td>7.105 m³</td>
<td></td>
</tr>
<tr>
<td>WSTCGS</td>
<td>Waste Compressed or Liquified Gases</td>
<td>Recycle Systems Company Inc.</td>
<td>0.205 m³</td>
<td></td>
</tr>
<tr>
<td>WSTMIS-R</td>
<td>Waste Hydraulic Hoses (prior to 14/12/17 Waste Rubber)</td>
<td>Clean Harbors - Ryley Class 1A</td>
<td>2.07 m³</td>
<td></td>
</tr>
</tbody>
</table>
5. Sulphur Production

SO₂ EMISSIONS

![SO₂ Emissions Graph]

- **Daily Plant SO₂ Emission (tonne/day)**
- **Limit**

Husky Energy Inc.
5. Sulphur Production

SO₂ EMISSIONS TRENDS
5. Sulphur Production

SULPHUR DIOXIDE (SO$_2$) SOURCES

- Ten Once-Through Steam Generators (OTSG) - all operational during the reporting period

- Two High Pressure Flare Stacks – both operational during the reporting period

- Two Low Pressure Flare Stacks - both operational during the reporting period
5. Sulphur Production

QUARTERLY SO$_2$ EMISSIONS

<table>
<thead>
<tr>
<th></th>
<th>Emission (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017 Q3 (Aug – Sep)</td>
<td>26.46</td>
</tr>
<tr>
<td>2017 Q4 (Oct - Dec)</td>
<td>47.42</td>
</tr>
<tr>
<td>2018 Q1 (Jan – Mar)</td>
<td>51.78</td>
</tr>
<tr>
<td>2018 Q2 (Apr – June)</td>
<td>49.18</td>
</tr>
<tr>
<td>2018 Q3 (July)</td>
<td>17.54</td>
</tr>
</tbody>
</table>
## 5. Sulphur Production

### PEAK AND AVERAGE SO$_2$ EMISSIONS

<table>
<thead>
<tr>
<th>SO$_2$ Emissions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily</td>
<td>0.52 Tonnes</td>
</tr>
<tr>
<td>Maximum Daily</td>
<td>1.44 Tonnes</td>
</tr>
</tbody>
</table>
5. Sulphur Production

AMBIENT AIR MONITORING

- Husky installed Permanent Air Monitoring Station (Wapasu AMS; AMS 17)

- Part of WBEA network of ambient monitoring stations and functions as a dual compliance and enhanced deposition station

- Reporting and monitoring is performed by WBEA

- No process related exceedances recorded during the reporting period

- PM2.5 and O₃ exceedances recorded as result of wildfires in the region

- Current monitored data available the following link

- Historical monitored data available the following link
6. Environmental COMPLIANCE

• EPEA Approval 206355-01-00 (as amended):
  • Husky was in compliance with all regulatory approvals, decisions, regulations and conditions; with the exception of compliance items identified in this presentation

• Alberta Environment and Parks (AEP):
  • No compliance issues during this reporting period

• Federal Environmental and Regulatory Compliance:
  • No compliance issues during this reporting period
6. Environmental

COMPLIANCE (EPEA)

Spent Lime Pond (Release Notification File 294542):

• On March 29th, 2018: Husky compiled the monitoring data for the year of 2017 in a summary report and submitted it to AER. The maximum allowable Electrical Conductivities, Chloride Concentrations, and the modified ALR volumes were not exceeded for the data collected.
Continuous Emissions Monitoring System (CEMS):

- **Event (1):** Husky installed a CEMS unit on the SRU oxidizer vent stack to monitor H$_2$S concentrations in the vented gas. The SRU CEMS failed to operate reliably due to the high particulate concentration and high moisture content causing the sample conditioning system to plug.

- **Corrective Action:**
  - November 11, 2015: Husky disclosed the matter to AER (File Ref. No. 305572)
  - A corrective action of manually collecting vent gas samples and analyzing them for H2S concentration on a weekly bases was proposed
  - AER issued a temporary authorization until December 31$^{st}$, 2018 permitting the proposed action as an alternative to monitor the emissions while Husky works on a permanent solution for the operational issues of CEMS of the SRU oxidizer vent stack.
Continuous Emissions Monitoring System (CEMS):

• **Event (2):** July 29, 2017 parameters used in the analyzer daily checks defaulted back to factory settings causing the analyzer data to be invalid and CEMS availability to be less than 90% for the month of July 2017

• **Corrective Action:**
  - July 29, 2017 Husky disclosed the matter to AER (File Ref. No. 327715)
  - The current project settings are saved on the server
  - A procedure to upload/reload project settings to the analyzer were developed to be able to respond to any similar future issue timely
Continuous Emissions Monitoring System (CEMS):

- **Event (3):** On July 2017, after the startup of OTSG 70-B-500, the temperature sensor of the CEMS unit failed causing the software of DAHS to default back to factory settings. The temperature readings recorded was about 50 degrees below the actual values detected by the reference method utilized during the RATA conducted on November 8, 2018.

- **Corrective Action:**
  - On January 10, 2018, upon the request of the AER, Husky disclosed the matter (File Ref. No. 333602)
  - A new temperature sensor was ordered
  - During the CEMS sensor outage, temperature data was recovered from a temperature sensor at a different elevation on the stack. The readings of the stack sensor have shown a correlation exceeding 98% to the data of the new CEMS temperature sensor
  - Husky obtained EPEA/Director approval for using the stack sensor readings for data substitution during out of control periods and CEMS temperature data unavailability
6. Environmental COMPLIANCE (EPEA CONT’D)

Process Building Floor Trenches and Sumps – Directive 055:

- **Event:** During Directive 055 monthly inspections, fluids were detected in the VLDP (for interstitial space) of buildings trenches/sumps. Chemical analysis results showed similarity between the chemistry of the detected fluid and process fluids collected in building sumps. An update was sent to AER regarding the reoccurrence of the failure of Building trenches/sumps containment.

- **Corrective Action:**
  - A work scope for investigating containment failure was developed.
  - Available containment systems in the market were reviewed.
  - Decision support package with different repair options were developed and signed.
  - Engineering work package is being developed for the selected options.
  - AER was updated in February, March, April and June 2018 about the status of the repair.
## 6. Environmental

### RELEASES

<table>
<thead>
<tr>
<th>Spill Material</th>
<th>Number of Incidents</th>
<th>Total Volume (m³)</th>
<th>AER Notification</th>
<th>Release area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Affected Water</td>
<td>1</td>
<td>0.01</td>
<td>Release report submitted</td>
<td>10 L released from drain station between CPF and Well pads</td>
</tr>
<tr>
<td>Hydrocarbon</td>
<td>2</td>
<td>8.03</td>
<td>Release report submitted</td>
<td>8 m³ on CPF at LACT unit 30 L released from Valve station between CPF and Well pads</td>
</tr>
<tr>
<td>Tanks Venting</td>
<td>20</td>
<td>7247.70</td>
<td>7-day letter &amp; DDS report submitted</td>
<td></td>
</tr>
</tbody>
</table>

- Husky tracks all non-reportable spill incidents within the Corporate Incident Management System.
- All incidents are reviewed weekly to ensure corrective actions are included and preventative measures are taken.
## 6. Environmental

### EPEA APPROVAL AMENDMENTS

<table>
<thead>
<tr>
<th>Approval Date</th>
<th>Application Number</th>
<th>Application Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-12-15</td>
<td>N/A</td>
<td>Amendment Application - Husky Diluent Reduction (HDR) Pilot Project</td>
</tr>
<tr>
<td>2018-01-09</td>
<td>N/A</td>
<td>Amendment Application - Phase 1 OTSG Pilot Project</td>
</tr>
<tr>
<td>2018-03-28</td>
<td>N/A</td>
<td>Temporary Authorization - Extension Request, SRU Oxidizer Vent Stack CEMS</td>
</tr>
<tr>
<td>2018-06-27</td>
<td>N/A</td>
<td>Temporary Authorization - Extension Request, Phase 1 OTSG Pilot</td>
</tr>
</tbody>
</table>
6. Environmental

BIODIVERSITY

- As a requirement of the regulatory approval, Husky conducts an annual Environmental Monitoring Program with data compilation and report submission to the AER every three years. Next report due 2019

- Monitoring program and findings include:
  - Surface water quality and quantity
    - Discharge data thus far support the conclusion of the EIA that impacts would be below detectable levels
  - Wetlands
    - Water level data analyzed at the source water wells and associated observation wells do not show evidence of a declining water level in the aquifer
    - General decreasing trend in pH levels and increasing sulphate concentrations at two stations (but below guideline) will continue to be monitored; no other indications of trends in water quality results analyzed
    - No impoundment effect has been observed for the two monitored transects based on analyzed data
  - Wildlife
    - No evident trend for habitat use and distribution for wildlife species based on analyzed dataset thus far
    - Canadian Toad or Yellow Rail have not been detected at Project site thus far
    - Tracking and camera surveys indicate the pipeline is crossable for birds and mammals including large ungulates (moose)
    - Rare plant species detected during EIA are persisting in Project area
6. Environmental

WILDLIFE

• Caribou Mitigation and Monitoring Plan
  • Approved by AER January 2015, update submitted Oct 31, 2017, awaiting AER approval
  • Approved, but not developed, Project facilities to be located within the Richardson Caribou Range are limited to a potential road and single well pad
  • Development potentially within the range may occur after 2027
  • Currently undergoing caribou habitat restoration monitoring and wildlife camera data collection in caribou habitat along previous cutlines and seismic lines

• Wildlife Monitoring, Enhancement and Monitoring Program
  • Approved by AEP December 2012; updated proposal approved 2016
  • The following wildlife monitoring program components were implemented in 2017:
    • pipeline monitoring;
    • remote camera monitoring; and
    • amphibian young-of-the-year surveys for Canadian Toad
  • Objectives and targets developed and monitored to address four key wildlife issues identified in the Environmental Impact Assessment (EIA):
    • Habitat Availability
    • Habitat Effectiveness
    • Disruption of Movement Patterns
    • Wildlife Mortality
  • Husky monitors and reviews mitigation strategies to ensure ongoing effectiveness and evaluate areas for improvement
6. Environmental

INDUSTRIAL WASTEWATER

- **Disposal Locations:**
  - Four Disposal wells:
    - 1341091 m³ of blow-down water was disposed using the primary disposal Wells; 100/14-27-094-07W4M and 100/11-34-094-07W4M
    - 16772 m³ of Keg River observation well sampling water was disposed utilizing the secondary disposal wells; 102/03-34-094-07W4, 100/04-34-094-07W4
  - Nine Keg River Monitoring Wells utilized to monitor pressures and/or water quality

- **Domestic Wastewater:**
  - Domestic wastewater from construction and operational activities was treated on the CPF by the operation of a domestic wastewater treatment plant (WWTP).
  - Domestic wastewater is treated and released to an unnamed tributary of Wapasu Creek located south of the CPF

- **Industrial Run-off:**
  - Total of 13 discharge locations:
    - **Pads:** B13-08 (B), B14-08 (C), B16-08 (D), B13-09 (E), B08-17 (G), B05-16 (H), B16-17 (L), B13-16 (M), B15-16 (N), 5-21 (Q), 6-21 (P), and 16-16 (S)
    - CPF Total volumes discharged (2017–2018): 786,505.3m³
    - Note: all discharges were in compliance with EPEA approval
6. Environmental

SOILS

• Soil Monitoring Sampling and Analysis started on May 14, 2018 and was completed on May 31, 2018
• The next Soil Monitoring Program report will be submitted on or before September 30, 2018
• Pad B13-16(R) was constructed:
  • Total area cleared is 1 hectare
  • About 2,200 m³ of topsoil salvaged
  • About 5,780 m³ of subsoil salvage
6. Environmental

AIR

- Site air monitoring includes source and ambient air monitoring systems

- Source Monitoring
  - Three CEMS; two for the OTSGs and one for the SRU (note, CEMS SRU was not in operation during this reporting period)
  - Manual gas sampling of SRU oxidizer vent stack gas to ensure H₂S is below the allowable limit.
  - Engineering calculations aided by gas metering and sampling or inline GC (gas Chromatography)
  - Fugitive emission leak surveys (conducted August 2017)

- Ambient Air Monitoring
  - Permanent Air Monitoring Station
  - Participation in Wood Buffalo Environmental Association (WBEA) network of ambient air monitoring stations (Wapasu Station)
  - Continuous process area monitoring for LEL (Lower Exclusive Limit) and H₂S
  - Due to forest fires, on May 25, 2018 a non-compliance of PM₂.₅ was recorded and duly reported to AER
6. Environmental

GROUNDWATER MONITORING

• 2017 Compliance Groundwater Monitoring Report submitted March 2018

• CPF:
  – 24 wells: 2.4 to 13.7 m depth (base of screen)

• Pad Well:
  – 3 pads: B05-16, B13-08, B05-21
  – 8 wells: 19.5 m to 66.0 m depth (base of screen)

• Regional:
  – 1 McMurray well: 177.5 m depth (base of screen)
  – 9 Quaternary wells: 9.1 m to 61.9 m depth (base of screen)
Husky participates in and/or funds many regional environmental initiatives and committees pertaining to the Sunrise Project, including the following:

- Monitoring Avian Productivity and Survivorship (MAPS) in the Boreal Region
- Participation in Wood Buffalo Environmental Committee (WBEA) and Terrestrial Environmental Effects Monitoring Committee (TEEM)
- Faster Forests Program (COSIA JIP)
- CAPP Species Management and Caribou Shadow Committees
- Petroleum Technology Alliance Canada (PTAC) Ecological Research Planning Committee
- Industrial Footprint Reduction Options Group (iFROG)
- Oil Sands Monitoring (formerly JOSM)
- Monitoring Priority Areas (COSIA)
- University of Waterloo – Wetland Research (Alberta Innovates)
6. Environmental RECLAMATION

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

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

- Reclamation Activities:
  - No additional reclamation activities occurred within the reporting year
  - Test plots for reclamation at Gravel Pit 1 were started in 2013. A total of approximately 6 ha in Gravel Pit 1 is permanently reclaimed
7. Compliance Statement

NON-COMPLIANCE EVENTS

OSCA (Oil Sands Conservation Act) Commercial Scheme Approval 10419 (as amended):

- Husky was in compliance with all regulatory approvals, decisions, regulations and conditions; with the exception of compliance items identified in this presentation
7. Compliance Statement

SELF DECLARATIONS

- Well 110/12-147-095-07W4/00 B5A (well pad B13-08 (B)) License No. 0485188

Summary:
Experiencing challenges due to initial completion design and the well pressuring up with minimal pressure relief; the reservoir (near wellbore) was tighter than expected
- March 28, 2018: Exceeded approved MOP (1,770 kPag) by 3 kPag (1,773) for 2 minutes
- April 14, 2018: Exceeded approved MOP (1,770 kPag) by 47 (1,817) kPag for 4 minutes
- April 21, 2018: Exceeded approved MOP (1,770 kPag) by 9 kPag (1,779) for 30 minutes
- July 2, 2018: Exceeded approved MOP (1,770 kPag) by 116 kPa (1,886) for 5 minutes
- July 30, 2018: Exceeded approved MOP (1,770 kPag) by 14 kPa (1,784) for 1 minute

Status Update:
- Submitted VSD to AER Bonnyville Field Office on August 2, 2018
- Completion design to be modified to allow for circulation verses bullheading. Work is planned to be completed November 30, 2018
- Received acceptance letter from AER on August 23, 2018
8. Future Plans

FUTURE PLANS

• Commissioning scheduled for Husky Diluent Reduction Project (AER authorizations received December 15, 2017) in November 29, 2018
• SRU Oxidizer Vent Mitigation Waivers – March 28, 2018
• Debottleneck 2 Amendment Application – AER submission early 2019
• Permanent Drilling Waste Processing Facility (WM 200) – construct and operate