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• Sub Surface Presentation

• Surface Presentation

• Appendix A: Piezometer Plots & Temperature vs Depth Plots
Suncor MacKay River Project
2017 AER Performance Presentation: Subsurface Commercial Scheme Approval No. 8668

October 24, 2018
Reporting Period September 1, 2017 – August 31, 2018
The Suncor Strategy

To provide greater reliability and flexibility to our feedstock supplies, we produce bitumen through mining and in-situ recovery technologies and supplement that supply through third party agreements.

We currently produce a limited amount of natural gas but maintain a material land position in the high quality Montney resource play.

A staged approach to increasing crude oil production capacity allows Suncor to better manage capital costs and incorporate new ideas and new technologies into our facilities.

International and offshore assets are a source of steady cash flow to fund our oil sands growth.

Our investments in renewable wind energy and biofuels are a key part of Suncor’s climate change action plan.

Suncor takes an active role in connecting supply to consumer demand with a diverse portfolio of products, downstream assets and markets.
Suncor has High Quality Leases in Close Proximity
AER Directive 054
2018 Performance Presentation

Section 3.1.1 – Subsurface Issues Related to Resource Evaluation and Recovery
Table of Contents

• Background
• Geoscience/Seismic
• Caprock Integrity
• Drilling and Completions
• Artificial Lift
• Instrumentation
• Scheme Performance
• Future Plans
Background

3.1.1.1
MacKay River Project Overview

- Company’s first operated steam-assisted gravity drainage (SAGD) facility - located 60 km NW of Fort McMurray
- Current Approved Bitumen Production Rate 11,600 m³/d (73 kbpd)
- Adjacent to Suncor Dover (UTF / AOSTRA) Project
- Horizontal production wells are placed in the McMurray Formation at a depth of 98 – 145m from surface
- No extensive underlying water or gas over bitumen issues in current development areas
- Initial development had 25 well pairs with first steam in September 2002 and first production in November 2002 (Phase 1)
- 112 well pairs have been subsequently added

<table>
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<tr>
<th>Producing Well Pairs</th>
<th>110</th>
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<tr>
<td>Non-Producing Well Pairs</td>
<td>25</td>
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<tr>
<td>Abandoned/Planned for Abandonment Well Pairs</td>
<td>2</td>
</tr>
<tr>
<td>Total Well Pairs</td>
<td>137</td>
</tr>
</tbody>
</table>
Project Area and Project Site

- Current Project Area (PA) approximately 24 ½ sections
Scheme Approval Amendments

- Amendment 8668A
  - Changed annual average volume to 33,000 bpd (5,250 m³/d)
- Amendment 8668B
  - Increase to project area
- Amendment 8668C
  - Additional project area
  - Approval to inject non-condensable gas
- Amendment 8668D
  - Additions to project area
  - Increase to annual average volume to 72,964 bpd (11,600 m³/d)
- Amendment 8668E
  - Approval to drill four well pairs
- Amendment 8668F
  - Approval to change approval holder from Petro-Canada to Suncor
- Amendment 8668G
  - Approval to undertake amendments & modifications to CPF systems
  - Approval tie-in 6 well pairs to well testing facilities
- Amendment 8668H
  - Approval to conduct non-condensable gas injection test on Pad 21 wells
- Amendment 8668I
  - Approval to conduct non-condensable gas injection at the Section 16 Test Project

- Amendment 8668J
  - Approval to transfer portions of the Dover project area into the MacKay River project area
- Amendment 8668K
  - Approval to tie-in 16 well pairs to well testing facilities
- Amendment 8668L
  - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21
- Amendment 8668M
  - Approval to inject chemical into Pad 22 wells
- Amendment 8668N
  - Approval to abandon 3 wells and suspend 1 well on Pad 20
- Amendment 8668O
  - Approval to change Phase 5F well trajectories
- Amendment 8668P
  - Approval to develop Pads 750/751/28 and add 2 sections to project area
- Amendment 8668Q
  - Approval to conduct a pilot of water treatment technologies
- Amendment 8668R
  - Approval to abandon well G11
- Amendment 8668S
  - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)
Scheme Approval Amendments

- Amendment 8668T
  - Pad 819 Approval
- Amendment 8668U
  - Maximum Operating Pressure Approval
- Amendment 8668V
  - NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- Amendment 8668W
  - MR CPF Expansion Project and Directive 081 Waiver Approval
- Amendment 8668X
  - Administrative reissue approval
- Amendment 8668Y
  - WHIP for Phases 5B2, 5D and 5F Patterns approval
- Amendment 8668Z:
  - Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21 Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014.
- Amendment 8668AA:
  - Phase 1 NCG design amendment approval issued December 19, 2014.
- Amendment 8668BB:
  - Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015.
- Amendment 8668CC:
- Amendment 8668DD:
  - Approval for NN6P Sidetrack well issued February 3, 2015.
- Amendment 8668EE:
  - Approval for VX™ multiphase meter on Pad 824 issued February 19, 2015.
- Amendment 8668FF:
  - Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015.
- Amendment 8668GG:
  - Approval to conduct CO2 Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015.
- Amendment 8668HH:
  - CO2 Co-Injection amendment to change to OO8 well pair on Pad 24 issued.
- Amendment 8668II:
  - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015.
- Amendment 8668JJ:
  - Approval for NCG Test at OO7I issued July 29, 2015.
- Amendment 8668KK:
  - Approval for an alternate MOP Strategy Trial.
- Amendment 8668LL:
  - Approval for C2IPB Sidetrack Well.
- Amendment 8668MM:
  - Approval for Pad 750 Thermal Compatibility Assessment.
Scheme Approval Amendments

- **Amendment 8668NN:**
  - Approval to increase MWHIP for all operating wells.

- **Amendment 8668OO:**
  - Approval to alter DA, DB, DC and DF Pattern MWHIPS;

- **Approval to adjust CO2 co-injection rate;**
  - Approval to extend chemical co-injection test at the D pattern wells on Pad 21.

- **Amendment 8668PP:**
  - Approval for abandonment of A3I.

- **Amendment 8668QQ:**
  - Approval to change Clause 32.

- **Amendment 8668RR:**
  - CO2 Extension

- **Amendment 8668SS:**
  - Phase 2 and 3 NCG Injection

- **Amendment 8668TT:**
  - Temporary Increase to BH MOP for Unloading

- **Amendment 8668UU:**
  - Subsurface Heating Pilot

- **Amendment 8668VV:**
  - MOP Increase QQ2 to QQ16

- **Amendment 8668WW:**
  - MWHIP Increase
Amendments Made in Reporting Year

- Amendment 8668VV:
  - MOP Increased QQ2 to QQ16
- Amendment 8668WW:
  - Increased MWHIP
Geoscience / Seismic

3.1.1.2, 3.1.1.6
Oil Sands Facies and Gross Bitumen Pay

**Facies:**
Defined by visual mud index (VMI)

**Cutoffs:**
- F1 (Sandstone) = 0-5% VMI
- F2 (Sandy IHS*) = 5-15% VMI
- F3 (IHS*) = 15-30% VMI
- F4 (Muddy IHS*) = 30-70% VMI
- F5 (Mudstone) = 70-100% VMI
- F10 (Breccia) = variable

* IHS = inclined, interbedded, sand and shale

**Pay:**
- Includes Facies F1, F2, and F10
- Can include F3-F5, if < 2m thick

- Weight percent bitumen > 6%
- Generally > 30% Porosity
  - PA averages 31.1% in clean sands
- Permeability ~ 1 to 5 Darcy's
- > 10m for OBIP volumetric
Pattern OBIP Calculation

**Gross Rock Volume (GRV)** = total rock volume derived from Continuous Reservoir map

**Original Bitumen in Place** = product of the GRV multiplied by the average Porosity, and the average Oil Saturation over entire reservoir interval

\[
\text{OBIP} = \text{GRV} \times \text{So} \times \text{Por}
\]

New reservoir mapping includes non reservoir facies in calculation which are rectified via averaging of porosity and saturation values over the entire interval via petrophysics. Allows for consistency of calculation applied to all areas.
Reservoir Properties and Base Case OBIP 2018

Average Reservoir Properties

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<tr>
<th>Pattern</th>
<th>So</th>
<th>Phi</th>
<th>h (m)</th>
<th>Area (m²)</th>
<th>OBIP(e³m³)</th>
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<tr>
<td>A</td>
<td>71%</td>
<td>33.5%</td>
<td>21.7</td>
<td>466 561</td>
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<td>B</td>
<td>82%</td>
<td>34.3%</td>
<td>27.0</td>
<td>476 917</td>
<td>3,616</td>
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<tr>
<td>C</td>
<td>82%</td>
<td>34.0%</td>
<td>33.0</td>
<td>475 673</td>
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<tr>
<td>D</td>
<td>82%</td>
<td>33.9%</td>
<td>27.1</td>
<td>362 305</td>
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<td>E</td>
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<td>572 621</td>
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<td>F</td>
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<td>H</td>
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<td>21.9</td>
<td>336 301</td>
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<td>NN (Phase 4/5)</td>
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<td>26.0</td>
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<td>OO (Phase 4/5)</td>
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<td>QQ (Phase 4/5)</td>
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<td>33.8%</td>
<td>25.1</td>
<td>1 153 861</td>
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<td>Pad 824</td>
<td>81%</td>
<td>32.8%</td>
<td>19.0</td>
<td>182 277</td>
<td>916</td>
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<td>750N</td>
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<td>32.9%</td>
<td>22.8</td>
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<td>750S</td>
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<td>33.7%</td>
<td>18.2</td>
<td>711 080</td>
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<td>Subtotal</td>
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<td></td>
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<td>Approval Area Total</td>
<td>72%</td>
<td>33%</td>
<td>20.2</td>
<td>43 759 598</td>
<td>220,390</td>
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Average Reservoir Depth = 109 m TVD, Pi = 400 kPa, Ti = 6-7 °C , K_{max} = 1.7-8.5 D, K_{min} = 1.1-6.5 D
Bitumen Pay Isopach

2018 MacKay Bitumen Pay
Contour Interval = 5m

Legend
Continuous Pay Interval (5m)
- 10-15
- 15-20
- 20-25
- 25-30
- 30-35
- 35-40

- Reserves - Producing Area
- Reserve Area
- MacKay - Dover Hz Well Trajectories
- Continuous Reservoir Thickness
- Upper Stacked Continuous Reservoir Thickness
Base of Reservoir Structure Map

Legend

- Approved PA Boundary
  Contour Interval = 5m

2018 MacKay Base of Reservoir
Contour Interval = 5m
Top of Reservoir Structure Map

Legend
- Approved PA Boundary
  Contour Interval = 5m

2018 MacKay Top of Reservoir
Contour Interval = 5m
MacKay River Stratigraphy
2017-18 Activities – Vertical Wells

- 6 vertical observation wells drilled
- Core analyses / special testing
  - FMI

Legend
- Vertical Delineation Wells
- Existing SAGD wells

2018 MacKay Bitumen Pay
Contour Interval = 5m
Phase 1

A Pattern         B Pattern                   C Pattern               D Pattern

A             Pad 20                    Pad 21

A'  

A Pattern  B Pattern  C Pattern  D Pattern
Phases 2, 3 and 4
Phase 5

GR

RES

Pad 24

Pad 25

NN Pattern

OO Pattern

QQ Pattern
Pads 824 / 750 / 751
418 active monuments exist over MacKay River for heave measurement and monitoring.

No new monuments installed since August 2016.

Survey History:
- 1st: Fall 2002
- 2nd: Dec 2006
- 3rd: Fall/Winter 2007/08
- 4th: Nov 2008
- 5th: Jan/Feb 2010
- 6th: Nov 2010
- 7th: Dec 2011
- 8th: Dec 2012
- 9th: Oct 2013
- 10th: Oct 2014
- 11th: Oct 2015
- 12th: Oct 2016
- 13th: Oct 2017
2D Surface Heave: Change from Baseline to October 2017

Survey strategy:

- Heave surveys are performed at different frequencies to align with SAGD development:
  - Q1 2016 baseline survey of 750 / 751 / 824
  - Q4 2017 heave survey for 750 / 751 / 824

Heave monitoring application:

- Field performance monitoring coupled with seismic
- Surface heave maps made independent from 4D seismic

Uncertainty with manual heave monuments +/- 5mm
MacKay River – 3D / 4D Seismic Activity
MacKay River – 2018 4D Time Delay

Time Delay on Beaverhill Lake Time Structure (ms)
Caprock Integrity

3.1.1.2 j,m
MacKay River Coupled Geomechanics/Reservoir Workflow

1 - Data Gathering
• SAGD well operations (Rate/Pressure)
• Ob well pressure (Piezometer)
• Ob well temperature (Thermocouple/Fiber)
• Surface heave (Monuments)
• Cores and borehole image log analysis
• Rock geo-mechanical properties (Lab tests)
• In situ stress (mini-frac tests)

2 – Data Interpretation
Reservoir Physics
• Well performance
• Pressure Leak-off
• Heat transfer
Geomechanics
• Stress state
• Rock behavior
  ➢ Shear failure conditions
  ➢ Tensile failure conditions
  ➢ Permeability change
• Thermal expansion
• Reservoir level deformations

3 - Coupled Reservoir Geomechanics
• Update pressures and temperature
• Update stress state
• Recalibrate models using history match to field data
• Forecast/Design for safe development

4 - Learnings
• Sensitize key variables within uncertainty range
• Quantify geomechanical risks
• Verify and update MOP
• Recommend/Design further measurements / lab tests

Geomechanics analysis for safe optimal MacKay River operations
Geomechanics: Mini-frac Test

• No new mini-frac test in the reporting period
• Fracture gradient of the caprock within the operating area are at or above 21 kPag/m
• 2017 mini-frac data from OB23 well (in future development area) shows slightly lower fracture gradient, still consistent with the regional data set
• Subsequent geomechanical core test on OB23 by commercial lab indicate similar caprock strength to the existing MacKay River caprock SCAL data

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<td>20.4</td>
<td>22.3</td>
<td>21.3</td>
<td>24.1</td>
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<td>Wab A</td>
<td>19.5</td>
<td>21.1</td>
<td>21.2</td>
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<td>Wab D</td>
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<td>22.6</td>
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<td></td>
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<tr>
<td>McM</td>
<td>19.0</td>
<td>21.1</td>
<td>19.9</td>
<td></td>
</tr>
</tbody>
</table>

Unit of fracture gradients measured: kPag/m
Monitoring: Wabiskaw C Pressure & Temperature

- Average pressure increase of ~10 kPa in original producing area; pressure increase of 23 kPa in Pad 750 area:
  - Pressures are below hydrostatic and well below fracture pressures
- 13 wells with elevated temperatures (>30°C) directly above mature SAGD operations:
  - 5 wells between 90°C and 143°C; 8 wells between 30°C and 90°C
  - Elevated temperatures are within the expected range
Geomechanics: Modeling

- Continued calibration of the model with an integrated dataset (SAGD performance data, pressure and temperature data acquired from the Wabisaw C and McMurray, and surface heave)

- Continued verification of the operation at the approved MOPs having no impact to MacKay River caprock integrity
• 110 producing well pairs at MacKay River on 7 pads

• Optimal well spacing is evaluated for each new development
Typical Well Completions – Phase 1-4 Type
Typical Well Completions – Phase 5 Type

Injector

- 473 mm surface casing @ mKB
- SHORT STRING
  - 114 mm tubing @ mKB
- Liner Hanger set at mKB
- 340 mm casing @ mKB
- LONG STRING
  - 114 mm tubing @ mKB
- TD @ 1529 mKB
  - 1268 mTVD
- 245 mm Slotted Liner landed @ mKB

Producer

- 473.0 mm Surface Casing
- 44.5 mm gas lift
- 114.3 mm Short String Last Joint Perforated
- Instrument String
- Instrumentation guide string
- Bubble Tube
- 244.5 mm Slotted Liner
- TD @ mKB
  - 133.1 mTVD

- 44.5 mm gas lift
- HS-HT packer
- 339.7 mm csg
Typical Well Completions – Pad 750 Type

**Injector**

- 406.4 mm surface casing
- 114.3 mm short tubing
- Import DSP packer
- 298.5 mm casing
- 114.3 mm long tubing
- "219.1 mm Slotted Liner"

**Producer**

- 406.4 mm surface
- 44.5 mm gas lift
- 114.3 mm short tubing
- HS-HT packer
- 298.5 mm casing
- "219.1 mm Slotted Liner"
- 114.3 mm long tubing
- 60.3 mm short tubing extension
- 31.8 mm instrumentation coil with DTS and pressure sensor at toe
Typical Well Completions – Pad 824 (DSAGD)

Injector
- 406.4 mm Surface casing
- 219.1 mm Slave string
- 206.5 mm Intermediate casing
- 139.7 mm Injection string
- HS-HT Import liner packer
- 219.1 mm Slotted liner

Producer
- 298.5 mm Intermediate Casing & Blanket Gas
- 177.8 mm Slave String
- 73.1 mm Production Tubing
- 73.0 mm Circulation Return String
- ERD & 2 Point TC's
- 114.3 mm Tail Pipe
- 219.1 mm Slotted Liner
Typical Well Completions – Flow Control Devices

Typical completion diagram for producer and injector in isolation
Key Learnings: Wellbore Integrity Management

- **Wellbore integrity management** continues to be a high priority focused on wellbore containment over a well’s full life cycle

- **In Situ Well Integrity Standard** – comprehensive document developed to guide employees on well integrity considerations and practices through the life cycle of thermal wellbores (design, construction, operation and retirement)
  - Monitoring and surveillance for liner failures and intermediate casing failures;
  - Wellbore thermal shock mitigation for start-up after outages
  - Erosion/corrosion monitoring program
  - Monitoring and repair of surface casing vent flows (SCVF)
    - Regular monitoring of pressure, rate and/or bubbles & H$_2$S concentration (annually for non-serious SCVF, monthly – quarterly for serious SCVF)
    - Gas venting rates continue to decline indicating remediation work may have been successful
    - Innovative repair techniques (i.e. SMART tool)
Key Learnings: Wellbore Integrity Management

Summary of MacKay River Well Integrity Issues and Initiatives

- **Surface casing vent flows**
  - Three serious vent flows discovered with mitigations/monitoring in place
  - Annual testing program of non-serious vent flows
  - Evidence of vent flow cessation following periods of shut-in steam injection; heated overburden

- **Thermal Compatibility / Integrity**
  - Vintage well completions reviewed to ensure compatibility for thermal operations
  - Thermal abandonments conducted on incompatible wells prior to first steam in new development regions
    - Monitoring chamber growth and adjusting annual abandonment program

- **External Surface Corrosion**
  - Production casing exposure to oxygenated water below grade
  - Coating application; Thermal Arcing Spray on all new wells, old wells being reviewed

- **Intermediate Casing Integrity**
  - Intermediate casing issues in localized area, related to heave and connections placed at or near lithology changes
  - Future wells will use improved connections which provide a better radial seal and will avoid placing casing connections near lithological changes
  - QQ3P intermediate casing repaired in October 2017
    - DarkVision tool utilized post workover to confirm no issues elsewhere on intermediate casing
Flow Control Device Implementations

Wide use of flow control devices (FCDs)

- ~15% of production at Mackay River is from wells with FCDs
- Used as a hot spot problem solver
- 1st M-tool device installed in August 2018; monitoring results

Each colour represents production from an FCD retrofit.
Flow Control Device (FCD) Technology Improvements

- M-tool deployment in 2018/2019 following lab testing in a flow loop
  - M-tool provides low resistance to liquid flow, high resistance to steam flow
  - Good erosion resistance relative to other devices tested
  - Evaluating performance of recent pilots against anticipated results from lab
    - August 2018 first installation
Key Learnings: Infill and Sidetracked wells

Infill and Sidetracked Wells

- Continued strong performance of infills vs. original/offset wells in terms of
  - Incremental oil rates
  - Lower water cuts
- New sand control (WWS, PPSS) performing up to expectations (lower $\Delta P$ relative to slotted liner designs)
- Increased oil rates and lower SOR since 2015 implementation
Successful conversion of Pad 824 showed that it is possible to circulate a well with a DSAGD completion at MacKay River

- Previous DSAGD completions in Firebag were bullheaded
- The ESPs started up successfully after steaming past them
- Subsequent circulation used following start-up to aid in ramp-up after unplanned outages
- ESP run life impacts being assessed; 1 pump change in August 2018
- The VX meter provides valuable real-time data regarding impact of changes in operating parameters

**Pad 824 Rates (m³/day)**

- Oil Rate (CD) (m³/d)
- Water Rate (CD) (m³/d)
- Liquid Rate (CD) (m³/d)
- Steam Inj Rate (CD) (m³/d)
Artificial Lift

3.1.1.4
Artificial Lift

• Most existing SAGD production wells designed for gas lift:
  – Low cost completion
  – Recover gas
  – No downhole moving parts
• Lift capacity sufficient for production rates and reservoir pressures
  – No instances of fluid inventories building due to lift issues
  – Lower pressure patterns generally require higher gas lift rates

• Producing wells with downhole pumps
  – F1P, ESP since February 2009, current pump installed July 2017
    • Previous pump ran for ~2300 days
  – OO3P, ESP since October 2009, current pump installed March 2012
    • ~2300 days
  – 824P1, DSAGD completion. On production since February 2016 with original pump
    • ~930 days
  – 824P2, DSAGD completion. Current pump installed August 2018
    • Original pump ran for ~850 days
Instrumentation

3.1.1.5
Well Downhole Instrumentation

- Phase 1 (25 well pairs)
  - Temperature optic fibre in 1 producer is functional today (C2)
- Phase 2 (14 well pairs)
  - Temperature fibre optic installed in G6P
  - P/T gauge installed in G6I
- Phase 3 (7 well pairs)
  - No instrumentation
- Phase 4 (10 well pairs)
  - No instrumentation except temperature fibre optics in OO3 I & P
  - Temperature fibre optic installed in NN1P
- Phase 5A (6 well pairs)
  - Pressure - bubble tube to the toe in every producer
  - QQ5P equipped with 6 point thermocouple bundle to the toe
  - NN5P equipped with 8 point thermocouple bundle to the toe
Well Downhole Instrumentation

- Phase 5B-1 (6 well pairs)
  - Pressure - bubble tube to the toe in every producer except OO5
  - All producers equipped with 6 point thermocouple bundle to the toe except OO5 and OO9 which have temperature fibre optic
- Phase 5B-2 (10 well pairs)
  - Pressure – bubble tube to the toe in every producer
  - All producers equipped with 6 point thermocouple bundle to the toe, except QQ9
- Phase 5D&F (18 well pairs)
  - Pressure – bubble tube to the toe in every producer except OO well pairs which have pressure gauges
  - All producers equipped with fibre optic to the toe, except OO10
- Pad 824 (2 well pairs)
  - All producers equipped with ERD (P/T) and 2 point thermocouple on pump
- Pad 750 (12 well pairs)
  - Pressure – ERD at the toe in every producer
  - All producers equipped with fibre optic to the toe
Observation Wells

Observation wells:
- 85 McM
- 53 Wab C
- 22 Wab C & McM
- 160 Total
Observation Well Overview

• Total of 160 licensed observation wells at MacKay River.
  – 6 New Observation Wells drilled in 2018

• Observation wells at MacKay River serve three main purposes
  1. Reservoir optimization (steam chamber monitoring)
     • 42 wells with fibre optic cable from surface to TD
       – 7 wells with fibre optic cable and McM pressure sensors
     • 56 wells with thermocouple bundles
       – 47 wells with thermocouples and McM pressure sensors
  2. Wabiskaw C pressure monitoring
     • 67 wells with a single pressure / temperature sensor dedicated to WabC.
       – 18 wells with WabC pressure / temperature combined with McM temperature
  3. Subsurface Monitoring (outside of producing area)
     • 7 wells with thermocouple bundles and pressure sensors
     • 16 wells with a single pressure / temperature sensor (5 McM, 11 WabC)
     • 4 wells with pressure / temperature in both McM and WabC

• Current observation well design incorporates thermocouple measurement as this provides sufficient resolution for steam chamber monitoring and is preferred for remote well locations

• Reliability issues closely monitored and mitigated/repaired as required
Typical Observation Well Design

McMurray Observation Well (Type 1):

• Capillary line loop cemented outside casing
• Fibre optic cable pumped into capillary line loop to provide temperature profile along entire vertical well depth
• Allows for close monitoring of steam chamber development
• There are no reliability concerns with the Type 1 observation well temperature data
Typical Observation Well Design

McMurray Observation Well (Type 2):

- Coiled tubing instrument string containing 14 thermocouples and 1 P/T gauge run inside 114 mm intermediate casing
- Perforated near the top of the McMurray oil sands zone
- Pressure / temp gauge positioned at MPP
- 14 point thermocouple bundle collects temperature data across the McMurray
- 24 point thermocouple bundle go forward design
Typical Observation Well Design

**Wabiskaw C Observation Well:**

- Open hole into Wabiskaw C sand
- Wellbore does not penetrate Wabiskaw D mudstone or McMurray sand
- Pressure / temp gauge landed inside tubing
### Summary of Operating Wells

<table>
<thead>
<tr>
<th>Pad</th>
<th>Pattern</th>
<th>Phase</th>
<th># Well Pairs</th>
<th>First Steam to Pad</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>A</td>
<td>1</td>
<td>7</td>
<td>Sept 2002</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>B</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>E</td>
<td>2</td>
<td>7</td>
<td>Jan 2006</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>F</td>
<td>3</td>
<td>7</td>
<td>Sept 2007</td>
</tr>
<tr>
<td>24</td>
<td>OO</td>
<td>4</td>
<td>3</td>
<td>Oct 2008 - Apr 2009</td>
</tr>
<tr>
<td></td>
<td>5B-1</td>
<td>6</td>
<td></td>
<td>Feb 2012</td>
</tr>
<tr>
<td></td>
<td>5DF</td>
<td>6</td>
<td></td>
<td>May 2014</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>4</td>
<td>4</td>
<td>Feb 2009 - Jun 2010</td>
</tr>
<tr>
<td>25</td>
<td>QQ</td>
<td>4</td>
<td>2</td>
<td>Nov 2008</td>
</tr>
<tr>
<td></td>
<td>5A</td>
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<td></td>
<td>Jul 2011</td>
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<td>5B-2</td>
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<td>Jan - May 2013</td>
</tr>
<tr>
<td></td>
<td>5DF</td>
<td>6</td>
<td></td>
<td>June 2014</td>
</tr>
<tr>
<td></td>
<td>NN</td>
<td>4</td>
<td>1</td>
<td>Dec 2008</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Jun - Jul 2011</td>
</tr>
<tr>
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<td></td>
<td>5</td>
<td>Jan - Feb 2013</td>
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<tr>
<td></td>
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<td></td>
<td>6</td>
<td>June 2014</td>
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<table>
<thead>
<tr>
<th>Pad</th>
<th>Pattern</th>
<th># Well Pairs</th>
<th>First Steam to Pad</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>824</td>
<td>2</td>
<td>Oct 2015</td>
</tr>
<tr>
<td>750</td>
<td>750N</td>
<td>8</td>
<td>Sept 2016</td>
</tr>
<tr>
<td>750</td>
<td>750S</td>
<td>4</td>
<td>Sept 2016 / July 2017</td>
</tr>
</tbody>
</table>
Fluid Rates

Average Oil = 5,908 m³/day
ISOR = 2.9 m³/m³

August 2018
Cumulative Fluid Volumes

As of August 2018:
Cum Oil 23.3 million m³
Cum Steam 61.2 million m³
Cum Water 59.5 million m³
CSOR 2.6 (Average = 2.5)
Average Oil Rate per Pattern

- **Steam & Water Rate (m³/day)**
- **Oil Rate (m³/day)**

**Graph Details:**
- Axis 1: Completions Selected (238)
  - Steam Inj Rate (CD) (m³/d)
  - Water Rate (CD) (m³/d)
- Axis 2: Oil Rate (CD) (m³/d)
  - PATTERN MR_750
  - PATTERN MR_824
  - PATTERN MR_A
  - PATTERN MR_B
  - PATTERN MR_C
  - PATTERN MR_D
  - PATTERN MR_E
  - PATTERN MR_F
  - PATTERN MR_G
  - PATTERN MR_H
  - PATTERN MR_NIN
  - PATTERN MR_QQ
  - PATTERN MR_QQ

**Axes:**
- **Stein & Water Rate:** Y-axis on the left.
- **Oil Rate:** Y-axis on the right.

**Dates:**
- **Date:** X-axis ranges from 2002 to 2018.
C Pattern has the lowest CSOR
NN wells have a mid range CSOR
A Pattern has the highest CSOR
## Performance Summary by Pattern

<table>
<thead>
<tr>
<th>Pattern</th>
<th>OBIP [e³ m³]</th>
<th>Cum. Oil (Aug. 2018) [e³ m³]</th>
<th>Recovery up to August 2018 [%]</th>
<th>CSOR (Aug. 2018) [m³/m³]</th>
<th>ISOR (Aug. 2018) [m³/m³]</th>
<th>Ultimate Recovery [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern A</td>
<td>2,443</td>
<td>1,109</td>
<td>45%</td>
<td>4.36</td>
<td>3.3</td>
<td>50%</td>
</tr>
<tr>
<td>Pattern B</td>
<td>3,616</td>
<td>2,772</td>
<td>77%</td>
<td>2.70</td>
<td>3.6</td>
<td>80%</td>
</tr>
<tr>
<td>Pattern C</td>
<td>4,398</td>
<td>3,743</td>
<td>85%</td>
<td>2.26</td>
<td>2.4</td>
<td>88%</td>
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<tr>
<td>Pattern D</td>
<td>2,742</td>
<td>2,023</td>
<td>74%</td>
<td>2.63</td>
<td>1.7</td>
<td>78%</td>
</tr>
<tr>
<td>Pattern E</td>
<td>4,410</td>
<td>2,544</td>
<td>58%</td>
<td>2.25</td>
<td>3.6</td>
<td>71%</td>
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<tr>
<td>Pattern F</td>
<td>3,961</td>
<td>2,557</td>
<td>65%</td>
<td>2.60</td>
<td>5.2</td>
<td>78%</td>
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<tr>
<td>Pattern G</td>
<td>4,328</td>
<td>2,082</td>
<td>48%</td>
<td>2.44</td>
<td>3.0</td>
<td>60%</td>
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<tr>
<td>Pattern H</td>
<td>1,940</td>
<td>607</td>
<td>31%</td>
<td>3.20</td>
<td>3.0</td>
<td>55%</td>
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<tr>
<td>Pattern NN</td>
<td>7,347</td>
<td>2,489</td>
<td>34%</td>
<td>2.67</td>
<td>2.6</td>
<td>57%</td>
</tr>
<tr>
<td>Pattern OO</td>
<td>5,453</td>
<td>1,140</td>
<td>21%</td>
<td>3.01</td>
<td>2.2</td>
<td>37%</td>
</tr>
<tr>
<td>Pattern QQ</td>
<td>7,018</td>
<td>1,695</td>
<td>24%</td>
<td>2.32</td>
<td>3.3</td>
<td>46%</td>
</tr>
<tr>
<td>Pad 824</td>
<td>916</td>
<td>88</td>
<td>10%</td>
<td>2.94</td>
<td>2.8</td>
<td>51%</td>
</tr>
<tr>
<td>Pad 750</td>
<td>7,919</td>
<td>470</td>
<td>6%</td>
<td>3.08</td>
<td>2.8</td>
<td>51%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56,490</strong></td>
<td><strong>23,319</strong></td>
<td><strong>41%</strong></td>
<td><strong>2.63</strong></td>
<td><strong>2.9</strong></td>
<td><strong>60%</strong></td>
</tr>
</tbody>
</table>
## Phase 5DF – Examples Based on Recovery

<table>
<thead>
<tr>
<th>Well Pairs</th>
<th>ISOR [m³/m³]</th>
<th>CSOR [m³/m³]</th>
<th>Cum Oil [10³m³]</th>
<th>Peak Oil Rate [m³/d/well pair]</th>
<th>Current Oil Rate [m³/d/well pair]</th>
<th>Comments</th>
</tr>
</thead>
</table>
| QQ11-16    | 4.0          | 4.1          | 205             | 38 - 69                       | 31 - 64                          | • Challenging geology  
• Shallow, lowest MOP in MacKay  
• 6 well pairs in pattern  
• 10% recovery to date (ultimate RF: 46%) |
| OO10-15    | 2.5          | 2.8          | 385             | 51 – 110                      | 16 - 88                          | • Medium quality geology  
• 6 wells pairs in pattern  
• 17% recovery to date (ultimate RF: 37%) |
| NN11-16    | 2.3          | 2.2          | 626             | 112 - 146                     | 45 - 138                         | • High quality geology  
• 6 well pairs in pattern  
• 24% recovery to date (ultimate RF: 57%) |
QQ11-16 Well Pairs – Low Recovery

The graph shows the oil rate, water rate, steam injection rate, ISOR, and CSOR over the years 2014 to 2018. The oil rate appears to decrease significantly after 2015, while the water rate remains relatively stable. The steam injection rate and ISOR show fluctuations, with ISOR values generally higher than those of the steam injection rate. The CSOR values fluctuate around the line, indicating a steady ratio throughout the period.
QQ11-16 Well Pairs– Observation Well Temperature

OBQQ-8: Mid well of QQ15 Well Pair (Low Recovery)
OO10-15 Well Pairs – Observation Well Temperature

OBOO-1: Toe of OO14 Well Pair (Medium Recovery)
NN11-16 Well Pairs – High Recovery

- Oil Rate
- Water Rate
- Steam Inj Rate
- ISOR
- CSOR

Rate (m³/d)
SOR (m³/m³)

2014 2015 2016 2017 2018
NN11-16 Well Pairs – Observation Well Temperature

OBCI-1: Heel of NN15 Well Pair (High Recovery)
Pad Abandonment Outlook

• The strategy for future well and pad (including surface equipment) abandonments is under development

• Do not anticipate abandonment of operating Pads during the next 5 years
  • Pads 20 and 21 (A/C and B/D patterns) are the most mature and are expected to be under pressure maintenance
  • Individual wells may be suspended or abandoned as required

• Pad 40 expected to be abandoned within the next 5 years
  • Three of four wells on pad abandoned (NP, NI and SP)
  • Considerations for surface equipment are under review
Steam Injection Conditions

- Approved MOPs based on the methodology detailed in Application 1724610
- Approved Bottomhole MOP at 80% of the fracture closure pressure
- MOPs are set by shallowest point in each pattern to allow for intra-pattern communication
- Steam injection pressure limits are enforced at wellhead on tubing and annulus via pressure transmitters; Phase 1 wells are monitored via manual pressure measurement at the wellhead every second day
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below MOP for neighboring patterns in communication

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Wells</th>
<th>Maximum Operating Pressure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Surface (kPag)</td>
<td>Bottomhole (kPag)</td>
</tr>
<tr>
<td>A</td>
<td>A1-7</td>
<td>2120</td>
<td>1690</td>
</tr>
<tr>
<td>B</td>
<td>B1-7</td>
<td>2020</td>
<td>1600</td>
</tr>
<tr>
<td>C</td>
<td>C1-6</td>
<td>1745</td>
<td>1390</td>
</tr>
<tr>
<td>D</td>
<td>D1-5</td>
<td>1555</td>
<td>1240</td>
</tr>
<tr>
<td>E (S)</td>
<td>E1-4</td>
<td>1640</td>
<td>1310</td>
</tr>
<tr>
<td>E (N)</td>
<td>E5-7</td>
<td>1600</td>
<td>1270</td>
</tr>
<tr>
<td>F</td>
<td>F1-7</td>
<td>1680</td>
<td>1340</td>
</tr>
<tr>
<td>G</td>
<td>G1-7</td>
<td>1935</td>
<td>1530</td>
</tr>
<tr>
<td>H</td>
<td>H1-4</td>
<td>2225</td>
<td>1780</td>
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<tr>
<td>NN</td>
<td>NN1-5</td>
<td>2100</td>
<td>1680</td>
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<td>NN</td>
<td>NN6-10</td>
<td>2185</td>
<td>1750</td>
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<td>NN11-16</td>
<td>2125</td>
<td>1700</td>
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<td>1870</td>
<td>1490</td>
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<tr>
<td>OO</td>
<td>OO4-9</td>
<td>1910</td>
<td>1520</td>
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<tr>
<td>OO</td>
<td>OO10-15</td>
<td>1880</td>
<td>1500</td>
</tr>
<tr>
<td>QQ</td>
<td>QQ2-5</td>
<td>1535</td>
<td>1210</td>
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<tr>
<td>QQ</td>
<td>QQ6-10</td>
<td>1500</td>
<td>1200</td>
</tr>
<tr>
<td>QQ</td>
<td>QQ11-16</td>
<td>1500</td>
<td>1200</td>
</tr>
<tr>
<td>824</td>
<td>824WP1-2</td>
<td>2320</td>
<td>2060</td>
</tr>
<tr>
<td>750 N</td>
<td>WP1-8</td>
<td>2645</td>
<td>2110</td>
</tr>
<tr>
<td>750 S</td>
<td>WP14-17</td>
<td>2680</td>
<td>2140</td>
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</tbody>
</table>
Stewardship to Maximum Bottom-hole Operating Pressure

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Wells</th>
<th>Maximum Operating Pressure</th>
<th>Average pressure Sep 17- Aug 18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bottomhole (kPag)</td>
<td>Bottomhole (kPag)</td>
</tr>
<tr>
<td>A</td>
<td>A1-7</td>
<td>1690</td>
<td>1221</td>
</tr>
<tr>
<td>B</td>
<td>B1-7</td>
<td>1600</td>
<td>1175</td>
</tr>
<tr>
<td>C</td>
<td>C1-6</td>
<td>1390</td>
<td>1189</td>
</tr>
<tr>
<td>D</td>
<td>D1-5</td>
<td>1240</td>
<td>1154</td>
</tr>
<tr>
<td>E (S)</td>
<td>E1-4</td>
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<td>1136</td>
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<tr>
<td>E (N)</td>
<td>E5-7</td>
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<td>1169</td>
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<tr>
<td>F</td>
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<td>1177</td>
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<td>G</td>
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<tr>
<td>H</td>
<td>H1-4</td>
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<tr>
<td>NN</td>
<td>NN6-10</td>
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<td>1568</td>
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<tr>
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<td>1490</td>
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<tr>
<td>OO</td>
<td>OO10-15</td>
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</tr>
<tr>
<td>QQ</td>
<td>QQ2-5</td>
<td>1210</td>
<td>1150*</td>
</tr>
<tr>
<td>QQ</td>
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</tr>
<tr>
<td>QQ</td>
<td>QQ11-16</td>
<td>1200</td>
<td>1126*</td>
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<tr>
<td>824</td>
<td>824WP1-2</td>
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<td>1909</td>
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<tr>
<td>750 N</td>
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<td>2110</td>
<td>2016</td>
</tr>
<tr>
<td>750 S</td>
<td>WP14-17</td>
<td>2140</td>
<td>1941**</td>
</tr>
</tbody>
</table>

- All of the Mackay wells in SAGD are currently operating at pressures below the approved maximum bottomhole operating pressure.
- Alarm systems are in place to ensure the approved maximum bottomhole operating pressures are not exceeded.
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below maximum bottomhole operating pressure.

**Impact**

- Lower production rates in low MOP areas.
- Slower ramp-up post planned outage's.
- Impacts new well conversions in low MOP areas.
- Small impact to mature wells performance.

*Suncor had temporary approval to be above the 80% limit for QQ2-16
**750 WPs 14 & 15 LRT data available starting in March 2018*
Pad QQ Temporary Bottom-hole Pressure Trial

- **AER approval received: May 1, 2018**
  - Approved to increase bottom-hole (BH) MOP from 1,210 to 1,370 kPag in QQ2-5 and from 1,200 to 1,350 kPag in QQ2-16 for four months (as per Approval No. 8668VV associated with Application No. 1905502)

- During the pilot the highest BHPs were in well pairs QQ8 to QQ11, ranging from 1,267 to 1,277 kPag
  - No wells reached target bottom-hole MOPs of 1,350 and 1,370 kPag during the trail

<table>
<thead>
<tr>
<th>Well</th>
<th>Chamber Pressure (kPa)</th>
<th>Chamber Pressure (kPa)</th>
<th>Difference (kPa)</th>
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<tr>
<td></td>
<td>Pre-trial</td>
<td>August 31, 2018</td>
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</tr>
<tr>
<td>QQ2</td>
<td>1145</td>
<td>1158</td>
<td>13</td>
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<td>QQ4</td>
<td>1130</td>
<td>1157</td>
<td>27</td>
</tr>
<tr>
<td>QQ5</td>
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<td>QQ6</td>
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<td>27</td>
</tr>
<tr>
<td>QQ16</td>
<td>1160</td>
<td>1212</td>
<td>52</td>
</tr>
</tbody>
</table>
Stewardship to Maximum Bottom-hole Operating Pressure

- For SAGD wells with no downhole instrumentation **Step-down Tests (SDT)** and **Low Rate Tests (LRT)** are performed and used to calculate estimated chamber pressure to ensure that the Maximum Bottomhole Injection Pressure (MBHIP) is not exceeded.

- **SDTs** are conducted by lowering the steam injection rate in steps and allowing pressures to stabilize between steps.

- **LRTs** are conducted on wells that do not have reliable SDT correlations by reducing the steam injection rates low enough to estimate the chamber pressure.
New Technology Projects – Near Term

NCG Co-Injection Expansion
- A/B/C/D first injection in October 2016
- E/F/G first injection planned for Q4 2018

Surfactant Co-Injection Pilot Expansion (F)
- First Injection commenced Q4 2016
- Surfactant returns to surface causing concerns with infrastructure
- Final injection March 2018, no plans to recommence

CO₂ Co-Injection Pilot Well (OO8)
- Injection completed in December 2017
- Final report submitted to AER in June 2018

Closed Loop Hot Oil Circulation Pilot (750S10)
- Pilot Operations commenced May 2018

In Situ Demonstration Facility (ISDF)
- Demonstration facility currently at scoping stage
- Integrated Application submitted Q1 2018
SAGD NCG Co-Injection Strategy

**Pilot**
- NCG co-injection into B pattern commenced October 2011
- Injection was based on steam availability

**Stage 1**
- NCG co-injection to A, B, C, D patterns began October 2016
- Reducing and reallocating steam to other pads to optimize field

**Stage 2**
- NCG co-injection into E, F, G, patterns work in progress
- Planning first NCG co-injection in Q4 2018
Key Learnings – Phase 1 NCG Co-Injection

- Plan to continue increasing steam cut and NCG injection pending steam demand of developing wells on Pad 750
- No significant impact to oil rates has been observed and partial pressure cooling effects have not been observed on OB wells within the patterns
Pad 750 Well Pair Start-Up Update

- 10 wells pairs (WPs 1-8, 16 & 17) commenced circulation steam injection in Sept / Oct 2016 and converted to SAGD in Q1 2017

- 2 wells pairs (WPs 14 & 15) commenced circulation steam injection in July 2017
  - Steam circulation ~110 days prior to SAGD conversion in November 2017

- During the circulation phase, well pairs were operated below approved bottom-hole MOP
Updated Monitoring Plan for Pads 750, 751 and 824

The monitoring plan for Pads 750, 751 and 824 has been updated as shown:

- **OB28**, north of Pad 824
  - Instrumented to obtain both pressure and temperature data in the cap-rock interval and temperature data in the reservoir interval

- **OB29**, north east corner of 751 N
  - Instrumented to obtain both pressure and temperature data in the cap-rock interval and temperature data in the reservoir interval

- **WBC57**, heels between 750 N & 751 N
  - Instrumented to obtain both pressure and temperature data in the cap-rock interval
Future Plans

3.1.1.8
Future Development: Pads 750/751

- Pad 750/751 is a future area of development within the MacKay River PA
  - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Approval received August 7, 2012
  - 35 well pairs and 2 single producers in total
- Drilling completed June 2014
  - 12 well pairs on Pad 750 commenced operation in 2016/2017
- Remaining Pad 750 and Pad 751 completions will occur in 2018-2020
  - Start-up timing for 2 remaining well pairs (WP9 & 10) under evaluation
  - Pad 751 targeting first steam for 2020
Future Development: Pad 819

- Pad 819 is a future area of development within the MacKay River PA
  - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Directive 078 amendment approval received in January 2014
  - 9 well pairs located south of existing infrastructure
- Thermal compatibility plan under review
- Drilling planned to be completed in 2020
- Targeting first steam for 2021
AER Directive 054
2018 Performance Presentation

Section 3.1.2 – Surface Operations, Compliance, and Issues not related to Resource Evaluation and Recovery
Table of Contents

- Introduction
- Facilities
- Central Processing Facilities (CPF) Performance
- Measurement and Reporting
- Water Production, Injection and Use
- Sulphur Production
- Environmental Performance
- Future Plans
Simplified CPF Process Block Diagram

- Fluids From Wells
- Produced Vapours
- Produced Emulsion
- Pipeline Gas
- Fuel Gas to Steam Generators
- Bitumen
- Pipeline to Market
- Makeup Water
- Boiler Feed Water
- Recovered Water
- Blowdown Water
- Solids to On-Site Landfill
- Salt Cake to On-Site Landfill
CPF Performance (September 2017 to August 2018)

The reliability of the facility has been steady:

Average 96.8%
(September 2017 to August 2018)

Major challenges:
September 2017 - Unplanned work on Cogen restricted produced steam and bitumen production.
Historical Production (January 2003 – 2018 YTD)

MacKay River Historical Production (January 2003 - August 2018)

- Production (m3/day)
- January 2003
- August 2018
Production (2017)

Period Average: 4895.4 m³/day
Production (January 2018 to August 2018)

Period Average: 5588.8 m³/day

- Bitumen export restriction imposed by base plant, cogen outage, regional natural gas curtailment
- Enbridge and TransCanada outages
Water Treatment Technology

Warm Lime Softening (WLS) and Weak Acid Cation (WAC) softening for produced water;

Zero Liquid Discharge (ZLD) System on blowdown slip stream:
- Evaporators: one steam and one mechanical driven;
- Crystallizer: Steam driven;
- Dryer: gas fired;
- Filter press (2): back up for dryer.
### Boiler Feed Water Quality

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Temperature, ºC</td>
<td>151.6</td>
<td>160.6</td>
<td>140 - 170</td>
</tr>
<tr>
<td>Hardness (Dissolved), mg/L</td>
<td>0.2</td>
<td>1.4</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Total Dissolved Solids, mg/L</td>
<td>5967.7</td>
<td>8550.8</td>
<td>&lt;8000</td>
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<tr>
<td>Silica, as SiO2, mg/L</td>
<td>20.1</td>
<td>52.6</td>
<td>&lt;50.0</td>
</tr>
</tbody>
</table>
Water Treatment Successes and Challenges

WLS performance has been steady:

- Reliability is 95.5%:
  - Consecutive days within spec: 220 days
  - Parameters: temperature, hardness, total dissolved solids, pH, silica, oil, free oxygen, total dissolved iron.
Steam Generation (2017)

Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%
Steam Generation (2018 YTD)

Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%
Power Imported (2017)

*Note: All power imported into Mackay River is consumed*
Power Imported (2018 YTD)

*Note: All power imported into Mackay River is consumed
Gas Consumption (2017)
Gas Consumption (2018 YTD)
Energy Intensity

**Energy Intensity Formula**

- Energy Intensity (GJ/m³) = Total energy consumed by site / Sales bitumen volume;

- Total energy consumed by site (GJ) = Energy used to make steam and blowdown in Cogen + Natural Gas imported to site + Solution gas to Cogen + Electricity consumed by site – Mixed gas to Cogen duct firing:
  - Note that the term “site” does not include Cogeneration.

- Energy used to make steam and blowdown in Cogen (GJ) = BFW Mass Flow Rate to Cogen x Hourly average difference in enthalpy between steam/blowdown and BFW.
Cogeneration with TransCanada Energy

- Energy exchange: TransCanada Energy (TCE) provides steam and electricity to Suncor in exchange for BFW and a fee;

- A large portion of the steam used in the injection wells is recovered by Suncor as produced water. This produced water supplies most of the feedwater required for the HRSG.

- A portion of the electrical power generated by the cogeneration plant is sold to Suncor for use onsite as well as at other offsite locations. In addition to the power contracted to Suncor, up to 150 MW of power is made available to Alberta consumers.
Energy Intensity (2017)

Mackay River Energy Intensity (2017)
Energy Intensity (2018 YTD)

Mackay River Energy Intensity (2018 YTD)

<table>
<thead>
<tr>
<th>Month</th>
<th>Energy Intensity (GJ/m³ of Bitumen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>8.3</td>
</tr>
<tr>
<td>February</td>
<td>8.2</td>
</tr>
<tr>
<td>March</td>
<td>8.0</td>
</tr>
<tr>
<td>April</td>
<td>8.1</td>
</tr>
<tr>
<td>May</td>
<td>8.1</td>
</tr>
<tr>
<td>June</td>
<td>8.1</td>
</tr>
<tr>
<td>July</td>
<td>8.3</td>
</tr>
<tr>
<td>August</td>
<td>8.3</td>
</tr>
<tr>
<td>Sept</td>
<td>8.1</td>
</tr>
<tr>
<td>Oct</td>
<td>8.0</td>
</tr>
<tr>
<td>Nov</td>
<td>8.0</td>
</tr>
<tr>
<td>Dec</td>
<td>8.0</td>
</tr>
</tbody>
</table>
MacKay River Performance Presentation
Measurement and Reporting
Measurement Accounting & Reporting Plan (MARP)

• Annual internal update to be finalized by November 30, 2018

• MacKay River Report Codes:
  • Battery – AB BT 0067097;
  • Injection Facility – AB IF 0009498;
  • Meter Station – AB MS 0084090.
Water Balance

• Steam:
  • Primary produced steam:
    - Steam Injection to Wells = BFW to Steam Generators – Boiler Blowdown – Utility Steam – LP Steam – Condensate from Pads
  • Secondary produced steam:
    - Sum of steam meters from steam separators (04-FI-600, 04-FI-1001) minus steam sent to production heaters (01-FI-162) and any steam vented (04-FI-283).
Water Balance Continued

HP BFW Pumps

Cogeneration

TO SGs

HP Steam Separators
04-V-400A/B/C

LP Steam

HP Steam to 01-E-100A-D

XXWWW-FI-015/020

Injection Wells

08-FO-341

To WLS

04-FI-269

04-FI-266

To Evaporator

04-FI-1100
04-FI-1200
04-FI-1300
04-FI-1400

04-FI-016
Water Balance Continued

• **Raw Water** = \( \Sigma \) Water Source wells (3 water source wells);

• **Accumulation** = Closing Inventory – Opening Inventory;

• **Produced Water**
  - **Primary Method:**
    - Produced water to WLS + Accumulation – Others.
  - Where:
    - Produced Water to WLS = 02-FI-500 + bypass + 02-FI-306;
    - Others include: Raw water, BLD Recycle, BFW to VRU.
  - **Secondary Method:**
    - Produced water to Deoiled Tank – ORF Backwash Flow + Accumulation – Others.
  - Where,
    - Produced water to Deoiled Tank - ORF Backwash Flow = (02-FI-220 + 02-FI-240 + 02-FI-260 + 02-FI-520) – (02-FI-300 + 03-FI-612 + 03-FI-610 + 07-FI-228)
    - Others include: Water Condensate from Pads, Raw water, BLD Recycle, BFW to VRU

• **Water from the crystallizer is metered at the crystallizer outlet before it goes to the dryer:**
  - Truck tickets capture the volume of water trucked
  - Volumes reported in Petrinex.
Well Testing Strategy

Test Separators are used to test all wells for production allocation
- Fully compliant with Directive 017

Pad 20 Well Testing Strategy
- 13 active SAGD producers, 4 hour tests (+ purge time)

Pad 21 Well Testing Strategy
- 12 active SAGD producers, 4 hour tests (+ purge time)

Pads 22 Well Testing Strategy
- 22 active SAGD producers, 5.5 hour tests (+ purge time)
- Phase 4 (NN1 and QQ2-3) are tested via Pad 22 Test Separator
- Phase 5A (NN2-5, QQ4-5) are tested via Pad 22 Test Separator

Pads 23/24 Well Testing Strategy
- 14 active SAGD producers, 7-7.5 hour tests (+ purge time)
- Pad 24 Phase 4 (OO1-3) are tested via Pad 23 Test Separator
- Pad 24 (H1-4) are tested via Pad 23 Test Separator

Pad 25 Well Testing Strategy
- V-100 Test Separator
  - 10 active SAGD producers, 5 hour tests (+ purge time)
- V-1100 Test Separator
  - 12 active SAGD producers, 4 hour tests (+ purge time)
- V-1150 Test Separator
  - 12 active SAGD producers, 4-5 hours test (+ purge time)
  - Pad 24 Phase 5B1 (OO4-9) are tested via V-1150
  - Pad 24 Phase 5DF (OO10-15) are tested via V-1150

Pad 824 Well Testing Strategy
- 2 active SAGD producers, 7 hour tests (+ purge time)
- Wells are tested via Vx Meter

Pad 750 Well Testing Strategy
- Pad 750 Test Separator V-8350
- 12 active SAGD producers, 5 hour tests (+ purge time)
Proration of Oil and Water

- Average for 2017: Oil Factor = 0.96  Water Factor = 0.99
- Average for 2018 YTD: Oil Factor = 0.96  Water Factor = 0.93
Fresh Water

Source Water Wells

- Water Act Licence No. 00188229-03-00 (511,000 m³/year) Birch Channel Aquifer (Renewal issued August 2017):
  1. 13-05-093-12W4 (GD-SW-212-53; formerly WSW-1), max. rate 450 m³/day;
  2. 04-08-093-12W4 (GD-SW-213-86; formerly WSW-2), max. rate 1368 m³/day;
  3. 04-08-093-12W4 (GD-SW-215-91; formerly WSW-3), max. rate 1411 m³/day.

Domestic Water Well:

- Water Act Licence No. 00249470-01-00 (25,550 m³/y) Birch Channel Aquifer (Issued in July 2013):
  4. 12-05-093-12W4 (CWSW-SW-218-55), max. rate 123 m³/day.

Monthly reporting for Source Water Wells and Domestic Water Well is done through Water Use Reporting System (WURS).
## Raw Water Source Wells

**Source Well - SW-212-53**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>EC (uS/cm)</td>
<td>855</td>
<td>842</td>
<td>805</td>
<td>858</td>
</tr>
<tr>
<td></td>
<td>pH (units)</td>
<td>8.32</td>
<td>7.8</td>
<td>8.35</td>
<td>8.08</td>
</tr>
<tr>
<td></td>
<td>Tot Hard as CaCO₃ (mg/L)</td>
<td>398</td>
<td>434</td>
<td>381</td>
<td>398</td>
</tr>
<tr>
<td></td>
<td>Tot Alk as CaCO₃ (mg/L)</td>
<td>363</td>
<td>376</td>
<td>369</td>
<td>371</td>
</tr>
<tr>
<td>Indicators</td>
<td>Chloride:D (mg/L)</td>
<td>&lt;0.5</td>
<td>0.53</td>
<td>0.52</td>
<td>0.54</td>
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<tr>
<td></td>
<td>Sulphate:D (mg/L)</td>
<td>111</td>
<td>113</td>
<td>111</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Iron:D (mg/L)</td>
<td>&lt;0.03</td>
<td>5.6</td>
<td>&lt;0.03</td>
<td>&lt;0.01</td>
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<tr>
<td></td>
<td>Manganese:D (mg/L)</td>
<td>0.258</td>
<td>0.272</td>
<td>0.183</td>
<td>0.256</td>
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<tr>
<td></td>
<td>TDS-calculated (mg/L)</td>
<td>504</td>
<td>526</td>
<td>525</td>
<td>525</td>
</tr>
<tr>
<td>Cations, anions, and</td>
<td>Calcium:D (mg/L)</td>
<td>105</td>
<td>115</td>
<td>95.7</td>
<td>104</td>
</tr>
<tr>
<td>ion balance</td>
<td>Magnesium:D (mg/L)</td>
<td>33</td>
<td>35.7</td>
<td>34.4</td>
<td>33.6</td>
</tr>
<tr>
<td></td>
<td>Potassium:D (mg/L)</td>
<td>5.36</td>
<td>5.5</td>
<td>5.11</td>
<td>5.31</td>
</tr>
<tr>
<td></td>
<td>Sodium:D (mg/L)</td>
<td>31.8</td>
<td>30.9</td>
<td>33.4</td>
<td>31.6</td>
</tr>
<tr>
<td></td>
<td>Bicarbonate:D (mg/L)</td>
<td>363</td>
<td>376</td>
<td>438</td>
<td>453</td>
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<tr>
<td></td>
<td>Carbonate:D (mg/L)</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>6.2</td>
<td>&lt;5</td>
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<tr>
<td></td>
<td>Hydroxide:D (mg/L)</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
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<tr>
<td></td>
<td>Fluoride:D (mg/L)</td>
<td>0.205</td>
<td>0.25</td>
<td>0.237</td>
<td>0.259</td>
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<td></td>
<td>Ion balance % (%)</td>
<td>99.7</td>
<td>103</td>
<td>88.9</td>
<td>96.9</td>
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<tr>
<td>Nitrogen parameters</td>
<td>NO₂ as N (mg/L)</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>NO₃ and N (mg/L)</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>NO₂ + NO₃ as N (mg/L)</td>
<td>&lt;0.022</td>
<td>&lt;0.022</td>
<td>&lt;0.022</td>
<td>&lt;0.029</td>
</tr>
<tr>
<td></td>
<td>DKN (mg/L)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>TKN (mg/L)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Tot Amm N (mg/L)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Phenols</td>
<td>phenols (mg/L)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PAH</td>
<td>Naphthenic Acids (mg/L)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Typical water quality assessment parameters;

Monitoring station GD-SW-212-53 (formerly WSW-1);

Results shown are from 2015 - 2018.

There is no change in the water quality.
Raw Water Withdrawal – Source Wells (2017)

- Regulatory allowable limit from *Water Act* Licence No. 188229 is $511e^3m^3$ per year;
- In 2017 MacKay River withdrawal water was from the Water Licence No. 00188229-03-00 – Total 262.7 e3m3.
Raw Water Withdrawal – Source Wells (2018 YTD)

- Regulatory allowable limit from Water Act Licence No. 188229 is $511e^3m^3$ per year
Domestic Well (2018)

- The project to produce Potable water from the well under License 249470 started in December 2017 – The total water withdrawn in December/17 was 90.3 m³
- The Total withdrawal in 2018 YTD is 1404.6 m³

Regulatory allowable limit from Water Act Licence No. 249470 is 25,550m³ per year
## Overall Facility Water Balance

<table>
<thead>
<tr>
<th></th>
<th>Inlet Streams</th>
<th>Outlet Streams</th>
<th>Water Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Produced Water</td>
<td>Fresh Water</td>
<td>Produced Water</td>
</tr>
<tr>
<td></td>
<td>PW1 (m³)</td>
<td>FW1 (m³)</td>
<td>PW4 (m³)</td>
</tr>
<tr>
<td>Sep-17</td>
<td>228773.1</td>
<td>17470.4</td>
<td>34</td>
</tr>
<tr>
<td>Oct-17</td>
<td>220291.3</td>
<td>8189</td>
<td>29.8</td>
</tr>
<tr>
<td>Nov-17</td>
<td>494435.4</td>
<td>18040.6</td>
<td>34.4</td>
</tr>
<tr>
<td>Dec-17</td>
<td>521646.6</td>
<td>32726.7</td>
<td>28.4</td>
</tr>
<tr>
<td>Jan-18</td>
<td>437266.2</td>
<td>36002.5</td>
<td>33.9</td>
</tr>
<tr>
<td>Feb-18</td>
<td>461256.1</td>
<td>33615.5</td>
<td>30.7</td>
</tr>
<tr>
<td>Mar-18</td>
<td>511672.2</td>
<td>36800.7</td>
<td>34.3</td>
</tr>
<tr>
<td>Apr-18</td>
<td>507215.6</td>
<td>27390.7</td>
<td>33.4</td>
</tr>
<tr>
<td>May-18</td>
<td>501680.1</td>
<td>25609.1</td>
<td>33.9</td>
</tr>
<tr>
<td>Jun-18</td>
<td>352559.3</td>
<td>18797.7</td>
<td>27.8</td>
</tr>
<tr>
<td>Jul-18</td>
<td>483008.5</td>
<td>17204.2</td>
<td>36.3</td>
</tr>
<tr>
<td>Aug-18</td>
<td>455269.6</td>
<td>36489.8</td>
<td>27.4</td>
</tr>
</tbody>
</table>
Overall Facility Water Balance

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

**Freshwater**
- **REC (FW1):** The sum of all freshwater streams received. MacKay River receives fresh water from three source water wells.
- **INVOP (FW4):** Fresh water tank opening inventory. This volume is carried forward from last month’s closing inventory.
- **INVCL (FW5):** Fresh water tank closing inventory. This volume takes into consideration levels in fresh water tanks.

**Steam**
- **INJ (INT):** The total steam injected at the wells. Steam is metered by subtracting total BFW feed to all OTSG and Cogen at MR minus the total blowdown.

**Water**
- **REC (PW1):** The water received from the wells.
- **INVCL (PW5):** Water tank closing inventory. This volume takes into consideration levels in water tanks.
- **INVOP (PW4):** Water tank opening inventory. This volume is carried forward from last month’s closing inventory.
- **INJ (DIT):** Water disposed from the facility.
- **UTIL (PW7):** Water Stream used at the injection facility for utility and waste steam and not recovered due to venting.
Water Balance (2017)

![Water Balance Graph]

- **Steam Injected**
- **Produced Water**
- **Make-Up Water**

Volume (m³/month)
Water Balance (2018 YTD)
Water Disposal % (2017)
Water Disposal % (2018 YTD)
Low Pressure Blowdown Recycle (2017 & 2018 YTD)

**Blowdown Recycle = 100%:**

- **Blowdown treated in the Water Plant:**
  - YTD: 51,750.1 m³/month
  - 2017: 47,865.95 m³/month

- **Blowdown treated in the Zero Liquid Discharge (ZLD) Plant:**
  - YTD: 40,317.04 m³/month
  - 2017: 36,597.73 m³/month

**Trucked volumes from Diversion Lagoon:**

- 2018: 14,642.5 m³ (January 1, 2018 – August 31, 2018);

**Note:** The diversion lagoon is filled by crystallizer concentrate during purges and by landfill leachate after periods of rain.
### MacKay River Landfill / Waste Management

#### AER Approval WM-072E Class II Oilfield Landfill – Waste Streams:
- Warm lime Softener Sludge – residual from the water treatment plant (Unit 200) = solids, lime and polymers
- Salt Waste – Residual from the evaporator - Unit 800 waste = salt brine dust.

#### Volumes of solids (salt/lime) to landfill

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>28,019</td>
</tr>
<tr>
<td>2016</td>
<td>20,685</td>
</tr>
<tr>
<td>2017</td>
<td>22,651</td>
</tr>
<tr>
<td>2018</td>
<td>17,767</td>
</tr>
</tbody>
</table>

#### Total of Leachate removed from landfill

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>14,465</td>
</tr>
<tr>
<td>2016</td>
<td>25,988</td>
</tr>
<tr>
<td>2017</td>
<td>26,943</td>
</tr>
<tr>
<td>2018</td>
<td>26,420</td>
</tr>
</tbody>
</table>

*Volumes estimated in August 2018

#### Waste services contract in place:
- Addresses hazardous, scrap metal, domestic waste.
MacKay River Landfill / Volume of fill Survey

Status: Closed, repairs in progress
Approved Volume: 92,000 m³
Current Volume: 60,000 m³
Full by: Sep 2019

Status: Pilot project closure
Approved Volume: 86,000 m³
Current Volume: 72,000 m³

Status: Active operations
Approved Volume: 93,870 m³
Current Volume: 25,000 m³
Full by: Dec 2021

Status: Active operations
Approved Volume: 93,870 m³
Current Volume: 25,000 m³
Full by: Dec 2021

Volumes / forecasts current as of June, 2018
(Source: photogrammetric data captured by drones)
Off-Site Brine Water Disposal

**Location of disposal site:**
- Eco Industrial Waste Plant;
- 11-17-53-23-W4M.

- Brine water is disposed of off-site when the diversion tank and diversion lagoon reach capacity and the ZLD system cannot process the boiler blowdown from Unit 400.

- Water sources in the diversion lagoon include: precipitation, leachate from the MacKay River Landfill and excess boiler blowdown water during upset conditions.
Off-Site Brine Water Disposal (2017)

* Volumes reported via Petrinex
Off-Site Brine Water Disposal (2018 YTD)

* Volumes reported via Petrinex

*Jan* | *Feb* | *Mar* | *Apr* | *May* | *Jun* | *Jul* | *Aug* | *Sep* | *Oct* | *Nov* | *Dec*
---|---|---|---|---|---|---|---|---|---|---|---
*Volume Trucked (m3)* | 136 | 3,411 | 1,360 | 7,559 | 2,842 | 0 | 0 | 0 | 0 | 0 | 0
MacKay River Performance Presentation
Sulphur Production
Sulphur Production

- Currently there are no sulphur recovery facilities at the MacKay River Project;
- All produced Sulphur is burnt off in the overall process;
- Present trends indicate an SRU will not be required for the Project;
- Suncor will continue to monitor the sulphur trends.
Sulphur Dioxide Emissions (2017)

* SO$_2$ emissions are based engineering estimations that use H2S results from monthly produced gas samples
Sulphur Dioxide Emissions (2018 YTD)

* SO₂ emissions are based engineering estimations that use H2S results from monthly produced gas samples
H₂S Concentration (2017)

* H₂S concentrations are measured in monthly produced gas samples.
H₂S Concentration (2018 YTD)

* H₂S concentrations are measured in monthly produced gas samples.
Solution Gas Flared (2017)

Solution Gas Flared (2017)

Solution Gas Flared (m3)

Jan-17  Feb-17  Mar-17  Apr-17  May-17  Jun-17  Jul-17  Aug-17  Sep-17  Oct-17  Nov-17  Dec-17
Solution Gas Flared (2018 YTD)
Solution Gas Recovery (2017)

<table>
<thead>
<tr>
<th>Month</th>
<th>Recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-17</td>
<td>99.4%</td>
</tr>
<tr>
<td>Feb-17</td>
<td>99.4%</td>
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<tr>
<td>Mar-17</td>
<td>99.4%</td>
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<tr>
<td>Apr-17</td>
<td>99.4%</td>
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<tr>
<td>May-17</td>
<td>99.4%</td>
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<td>Jun-17</td>
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<td>Jul-17</td>
<td>99.4%</td>
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<tr>
<td>Aug-17</td>
<td>99.4%</td>
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<tr>
<td>Sep-17</td>
<td>99.4%</td>
</tr>
<tr>
<td>Oct-17</td>
<td>99.4%</td>
</tr>
<tr>
<td>Nov-17</td>
<td>99.4%</td>
</tr>
<tr>
<td>Dec-17</td>
<td>99.4%</td>
</tr>
</tbody>
</table>
Solution Gas Recovery (2018 YTD)

<table>
<thead>
<tr>
<th>Month</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-18</td>
<td>100</td>
</tr>
<tr>
<td>Feb-18</td>
<td>100</td>
</tr>
<tr>
<td>Mar-18</td>
<td>100</td>
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<tr>
<td>Apr-18</td>
<td>100</td>
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<td>May-18</td>
<td>100</td>
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<tr>
<td>Jun-18</td>
<td>100</td>
</tr>
<tr>
<td>Jul-18</td>
<td>100</td>
</tr>
<tr>
<td>Aug-18</td>
<td>100</td>
</tr>
</tbody>
</table>
MacKay River Performance Presentation

Environmental Performance
Submitted the annual SGER report to Alberta Climate Change Office and NPRI GHG report to Environment Canada:

- GHG calculation methodology developed to improve transparency.

**Total direct emissions for 2017:**

- 318,971 tonnes of CO$_2$equiv;
- Total emissions have been reported to ACCO.

**Total regulated emissions for 2018 (Budget):**

- 857,656 tonnes of CO$_2$equiv*;
- Total emissions will be reported to ACCO under new CCIR policy

**Approved baseline emissions intensity:**

- 0.1174 tCO$_2$e/m$^3$ (Global Warming Potential Updated).

*2018 MR is under new Alberta CCIR policy and 2018 actual data to be verified in 2019*
Ambient Air Monitoring

- **WBEA Air Monitoring Stations:**
  - Ambient air quality data available for viewing on WBEA website.

- **Passive Air Monitoring:**
  - Four passive air monitoring stations at MacKay River;
  - Monthly passive air monitoring performed by a site representative and sample analysis reports submitted to AER by Suncor for H$_2$S and SO$_2$;
  - In 2017 passive sampling results showed: average H$_2$S concentration was 0.06 ppb and average SO$_2$ was 0.49 ppb;
  - In 2018 (YTD) passive sampling results showed: average H$_2$S concentration was 0.06 and average SO$_2$ was 0.35 ppb.
Total Flared Gas (2017)

Total Gas Flared (2017)

Jan-17  Feb-17  Mar-17  Apr-17  May-17  Jun-17  Jul-17  Aug-17  Sep-17  Oct-17  Nov-17  Dec-17

Total Gas Flared (in e3m3)
Total Flared Gas (2018 YTD)

Total Gas Flared (2018 YTD)
Regulatory Compliance (2017 and 2018 YTD)

- **2017:**
  - May 30, 2017: Landfill Inspection (Phoebe Thompson);
  - May 30, 2017: Hydrochloric Acid Release (Phoebe Thompson)
  - May 31, 2017 AER conducted Watercourse Crossing Inspection along the Aostra road (Virginia Hudges)
  - December 06, 2017: Landfill Follow up Presentation in regards to the scope of work for Phase I, II and III.

- **2018:**
  - February 01, 2018: Pipeline detail operation Inspection (Colon Sheppard);
Incident Summary (2017– 2018 YTD)

2017

AER Reportable Releases:
- 7 reportable spills;
- 7 reportable flaring events.
- 5 contravention reports

Voluntary Self Disclosures:
- Injection of NCG without AER authorization (BEST Site)
- MARP – missed internal inspection to fulfill D17;
- Landfill – underdrain issues .
- Landfill – Phase II cell issues
- Missing to submit D56 notification in regards to abandoned pipeline
- Failure of the primary measurement as per D17.

2018

AER Reportable Releases for 2018 (YTD – Sept 30):
- 3 reportable spills;
- 7 reportable flaring events.

Voluntary Self Disclosures 2018 (YTD – Sept 30):
- Tear in the liner of Landfill Phase III W cell A
- Tear in the liner of Landfill Phase III E cell B
- Leachate head over the limit of 300 mm
**Scheme Approval Amendments**

- **Amendment 8668A**
  - Changed annual average volume to 33,000 bpd (5,250 m³/d)

- **Amendment 8668B**
  - Increase to project area

- **Amendment 8668C**
  - Additional project area
  - Approval to inject non-condensable gas

- **Amendment 8668D**
  - Additions to project area
  - Increase to annual average volume to 72,964 bpd (11,600 m³/d)

- **Amendment 8668E**
  - Approval to drill four well pairs

- **Amendment 8668F**
  - Approval to change approval holder from Petro-Canada to Suncor

- **Amendment 8668G**
  - Approval to undertake amendments & modifications to CPF systems
  - Approval tie-in 6 well pairs to well testing facilities

- **Amendment 8668H**
  - Approval to conduct non-condensable gas injection test on Pad 21 wells

- **Amendment 8668I**
  - Approval to conduct non-condensable gas injection at the Section 16 Test Project

- **Amendment 8668J**
  - Approval to transfer portions of the Dover project area into the MacKay River project area

- **Amendment 8668K**
  - Approval to tie-in 16 well pairs to well testing facilities

- **Amendment 8668L**
  - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21

- **Amendment 8668M**
  - Approval to inject chemical into Pad 22 wells

- **Amendment 8668N**
  - Approval to abandon 3 wells and suspend 1 well on Pad 20

- **Amendment 8668O**
  - Approval to change Phase 5F well trajectories

- **Amendment 8668P**
  - Approval to develop Pads 750/751/28 and add 2 sections to project area

- **Amendment 8668Q**
  - Approval to conduct a pilot of water treatment technologies

- **Amendment 8668R**
  - Approval to abandon well G1I

- **Amendment 8668S**
  - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)
Scheme Approval Amendments

- **Amendment 8668T**: Pad 819 Approval
- **Amendment 8668U**: Maximum Operating Pressure Approval
- **Amendment 8668V**: NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- **Amendment 8668W**: MR CPF Expansion Project and Directive 081 Waiver Approval
- **Amendment 8668X**: Administrative reissue approval
- **Amendment 8668Y**: WHIP for Phases 5B2, 5D and 5F Patterns approval
- **Amendment 8668Z**: Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21 Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014.
- **Amendment 8668AA**: Phase 1 NCG design amendment approval issued December 19, 2014.
- **Amendment 8668BB**: Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015.
- **Amendment 8668CC**: Approval for E1P Sidetrack well issued January 27, 2015.
- **Amendment 8668DD**: Approval for NN6P Sidetrack well issued February 3, 2015.
- **Amendment 8668EE**: Approval for VX™ multiphase meter on Pad 824 issued February 19, 2015.
- **Amendment 8668FF**: Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015.
- **Amendment 8668GG**: Approval to conduct CO2 Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015.
- **Amendment 8668HH**: CO2 Co-Injection amendment to change to OO8 well pair on Pad 24 issued.
- **Amendment 8668II**: Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015.
- **Amendment 8668JJ**: Approval for NCG Test at OO7I issued July 29, 2015.
- **Amendment 8668KK**: Approval for an alternate MOP Strategy Trial.
- **Amendment 8668LL**: Approval for C2IPB Sidetrack Well.
- **Amendment 8668MM**: Approval for Pad 750 Thermal Compatibility Assessment.
Scheme Approval Amendments

- **Amendment 8668NN:**
  - Approval to increase MWHIP for all operating wells.
- **Amendment 8668OO:**
  - Approval to alter DA, DB, DC and DF Pattern MWHIPS;
- **Approval to adjust CO2 co-injection rate:**
  - Approval to extend chemical co-injection test at the D pattern wells on Pad 21.
- **Amendment 8668PP:**
  - Approval for abandonment of A3I.
- **Amendment 8668QQ:**
  - Approval to change Clause 32.
- **Amendment 8668RR:**
  - CO2 Extension
- **Amendment 8668SS:**
  - Phase 2 and 3 NCG Injection
- **Amendment 8668TT:**
  - Temporary Increase to BH MOP for Unloading
- **Amendment 8668UU:**
  - Subsurface Heating Pilot
- **Amendment 8668VV:**
  - MOP Increase QQ2 to QQ16
- **Amendment 8668WW:**
  - MWHIP Increase
Amendments Made in Reporting Year

- Amendment 8668VV:
  - MOP Increase QQ2 to QQ16
- Amendment 8668WW:
  - MWHIP Increase
Current Amendments / Applications

- As of August 31, 2018, there were no applications under review that are related to MacKay River;
Environmental Initiatives

Suncor supports the Joint Oil Sands Monitoring Program and is also an active member of:

- The Wood Buffalo Environmental Association (WBEA) and its continued work through JOSM;
- The Alberta Biodiversity Monitoring Institute (ABMI);
- The Athabasca Watershed Planning and Advisory Council (AWC-WPAC);
- The Canadian Oil Sands Innovation Alliance (COSIA);
- Mining Association of Canada Toward Sustainable Mining initiative;
- Oil Sands Spill Coop Area Y;
- Alberta Association of Conservation Offsets (AACO).

Suncor is in ongoing consultation with:

- Regional stakeholders;
- Aboriginal Communities and the local Municipality.
Land Disturbance and Reclamation

- A Project-Level Conservation, Reclamation & Closure Plan (PLCRCP) is due to the AER October 31, 2018. The PLCRCP will follow AER’s SED-001 and will be aligned in approach to Suncor’s Firebag PLCRCP authorized July 3, 2018.
  - The PLCRCP will present a project-level reclamation material balance and a realistic schedule for reclamation and closure

- Activities in 2017:
  - 4.66 ha of land cleared of vegetation for observation well installation
  - 0 ha of land reclaimed
  - The boundaries of all disturbances and clearings were re-assessed in GIS and updated for the Annual C&R Report and PLCRCP
    - All stockpile volumes were updated for the PLCRCP & signage was assessed

- Planned for 2018:
  - No clearing, disturbance or reclamation activities are planned
  - Installation of soil stockpile signs where they were missing or where names changed

Note: EPEA approved facilities only - oil sands exploration (OSE) programs are not included
Regulatory Compliance

- As noted earlier Suncor has communicated with the AER regarding:
  - Landfill:
    - Berm Expansion, Waste Pilot project, temporary placement of tanks

- Suncor Energy Inc. is in compliance with all regulatory approvals, decisions, regulations and conditions as described in Decision Report 2000-50; specifically pertaining to:
  - Plant and waste management facility location,
  - Ground level ozone and VOC monitoring,
  - Groundwater monitoring wells,
  - Surface water quality monitoring, and
  - Participation in Regional Initiatives.
Summary of Key Learnings (Operations)

- Continued focus on Suncor’s Safety Task force initiatives driving and reinforcing correct behaviours:
  - Primary focus on operational discipline and leadership;
  - Dedication to improving onsite process and personal safety.

- Continual focus on process indicators continues high performance of reliability:
  - Record consecutive days without unplanned steam outages;
  - Record consecutive days of on-spec boiler feed water.

- Many learnings from a safety and onsite performance perspective post fire at Mackay River- well performance, pipeline availability, etc.;

- Focus on brine dryer operation has significantly reduced offsite disposal. Further improvements and efficiencies to be realized.
### Future Plans

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Comments</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mackay River optimization</td>
<td>Unlocking throughput availability with improvements and testing to design</td>
<td>Currently being evaluated.</td>
</tr>
<tr>
<td>Pad 750 ramp up</td>
<td>Continue with ramping up production from Pad 750</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Pad 751 development and construction</td>
<td>Sustaining production</td>
<td>Currently in development</td>
</tr>
<tr>
<td>Pad 819 development and construction</td>
<td>Sustaining production</td>
<td>Currently in development</td>
</tr>
<tr>
<td>Considering installations of flow control devices (FCD)</td>
<td>Improve SOR and reduce emission</td>
<td>Currently under evaluation</td>
</tr>
</tbody>
</table>
Suncor MacKay River Project;
Appendix A: Piezometer Plots & Temperature vs Depth Plots

October 24, 2018
Reporting Period September 1, 2017 – August 31, 2018
Piezometer Plots & Temperature vs Depth Plots

115/05-16-093-12W4/0

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

16OB21

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
Piezometer Plots & Temperature vs Depth Plots

**Graph Details**

- **115/05-16-093-12W4/0**
- **16OB21**

**Pressure (kPag) vs Date**

- **Date Range**: 1-Sep-17 to 1-Aug-18
- **Pressure Values**:
  - 16OB21 Pressure @ 117.59 mKB
  - 16OB21 Pressure @ 88.23 mKB
  - 16OB21 Pressure @ 79.42 mKB

**Legend**

- 16OB21 Pressure @ 117.59 mKB
- 16OB21 Pressure @ 88.23 mKB
- 16OB21 Pressure @ 79.42 mKB
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

122/05-16-093-12W4/0

16OB25

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

122/05-16-093-12W4/0

Pressure (kPag)

<table>
<thead>
<tr>
<th>Date</th>
<th>16OB25 Pressure @ 113.4 mKB</th>
<th>16OB25 Pressure @ 105.1 mKB</th>
<th>16OB25 Pressure @ 87.1 mKB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Sep-17</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>1-Oct-17</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>1-Nov-17</td>
<td>1000</td>
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<tr>
<td>1-Dec-17</td>
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<td>1-May-18</td>
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<td>1-Jun-18</td>
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<td>1-Jul-18</td>
<td>1000</td>
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<td>1000</td>
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<tr>
<td>1-Aug-18</td>
<td>1000</td>
<td>1000</td>
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</tr>
</tbody>
</table>

Temperature (°C)

16OB25 Temperature @ 113.4 mKB
16OB25 Temperature @ 105.1 mKB
16OB25 Temperature @ 87.1 mKB
16OB25 Temperature @ 78.3 mKB
Piezometer Plots & Temperature vs Depth Plots

100/09-17-093-12W4/0

BB5-1

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

Legend:
- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
Piezometer Plots & Temperature vs Depth Plots

100/09-17-093-12W4/0

BB5-1

Pressure (kPag)

Temperature (°C)

Date

BB5-1 Pressure @ 87.75 mKB
BB5-1 Temperature @ 87.75 mKB
Piezometer Plots & Temperature vs Depth Plots

![Piezometer Plots & Temperature vs Depth Plots](image-url)
Piezometer Plots & Temperature vs Depth Plots

104/07-07-093-12W4

DA11-1

Pressure (kPag)

Date

1-Sep-17 1-Oct-17 1-Nov-17 1-Dec-17 1-Jan-18 1-Feb-18 1-Mar-18 1-Apr-18 1-May-18 1-Jun-18 1-Jul-18 1-Aug-18

Temperature (°C)

DA11-1 Pressure @ 141 mKB

DA11-1 Temperature @ 141 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure and temperature data over time]

- **100/05-08-093-12W4**
- **DA13-1**

- Pressure (kPag) vs Date
- Temperature (°C)

- **DA13-1 Pressure @ 124 mKB**
- **DA13-1 Temperature @ 124 mKB**
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/09-07-093-12W4

DA7-1

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

Pressure (kPag)

Temperature (°C)

DA7-1 Pressure @ 124 mKB  DA7-1 Temperature @ 124 mKB
Piezometer Plots & Temperature vs Depth Plots

100/14-33-092-12W4/0

JK-7

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best Facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

100/14-33-092-12W4/0
JK-7

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

JK-7 Pressure @ 85 mKB  JK-7 Temperature @ 85 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

![Piezometer Plots & Temperature vs Depth Plots](image)
Piezometer Plots & Temperature vs Depth Plots

100/14-27-092-12W4/0

LQ-3

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

Graph showing temperature and gamma ray measurements at different depths.
Piezometer Plots & Temperature vs Depth Plots

LQ-4

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

Legend:
- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
Piezometer Plots & Temperature vs Depth Plots

100/05-20-093-12W4/0

MN-2

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

100/05-20-093-12W4/0

MN-2

Pressure (kPag)

Date

1-Sep-17 1-Oct-17 1-Nov-17 1-Dec-17 1-Jan-18 1-Feb-18 1-Mar-18 1-Apr-18 1-May-18 1-Jun-18 1-Jul-18 1-Aug-18

Temperature (°C)

0 1 2 3 4 5 6 7

MN-2 Pressure @ 96.75 mKB

MN-2 Temperature @ 96.75 mKB

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

**OB01**

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB) vs Temperature (°C) and Gamma Ray (API Units) for OB01.
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Upper Clearwater
- Injector Elevation
- Base facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

103/03-04-093-12W4/0

OB03-04

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

-17
-3
3
23
43
63
83
103
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260

Beaverhill Lake  Middle McMurray  WB-D  WB-A  Base of Drift  WB-C  Gamma

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

103/03-04-093-12W4/0

OB03-04

Pressure (kPag)

Temperature (°C)

Date

OB03-04 Pressure @ 103.1 mKB
OB03-04 Temperature @ 103.1 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB05
Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Temperature & Gamma Ray Data for OB05

Legend:
- WS-D
- WS-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Cleaswater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- 01-May-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2019
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/05-04-093-12W4/0

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

OB11

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/10-04-093-12W4/0

OB13

Temperature (°C) and Gamma Ray (API Units)

Depth (mKb)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- 01-Apr-2018
Piezometer Plots & Temperature vs Depth Plots

107/15-05-093-12W4/0

OB14H

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- 01-Aug-2018
- 01-Jul-2018
- 01-Jun-2018
- 01-May-2018

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

107/15-05-093-12W4/0

OB14H

Pressure (kPag) vs Date

- OB14H Pressure @ 113.75 mKB
- OB14H Temperature @ 113.75 mKB
Piezometer Plots & Temperature vs Depth Plots

105/11-07-093-12W4

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

OB17

WBD  WB-A Shale  WB-A  Top of Cont Res  Producer Elevation  Middle McMurray
Lower Clearwater  Injector Elevation  Best facies  Beaverhill Lake  Base of Drift  Base of Cont Res
WB-C  Gamma  01-Aug-2018  01-Jul-2018  01-Jun-2018  01-May-2018

01-Oct-2017  01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

105/11-07-093-12W4

OB17

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

OB17 Pressure @ 134.5 mKB  OB17 Temperature @ 134.5 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

107/10-07-093-12W4

OB18

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

OB18 Pressure @ 145 mKB
OB18 Temperature @ 145 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OB20

Temperature (°C) and Gamma Ray (API Units)

Depth (mKb)

109/01-06-093-12W4

Legend:
- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- 01-Aug-2018
- 01-Jul-2016
- 01-Jun-2018
- 01-May-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017

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

OB21
Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- 01-Aug-2018
- 01-Jul-2018
- 01-Jun-2018
- 01-May-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

100/05-05-093-12W4

OB21

Pressure (kPag)

Temperature (°C)

Date

OB21 Pressure @ 123 mKB
OB21 Temperature @ 123 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

110/01-17-093-12W4/0

OBAA3-1

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

OBAA3-1 Pressure @ 111.25 mKB
OBAA3-1 Temperature @ 111.25 mKB

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

123/05-16-093-12W4/0

OBBB1-1A

Pressure (kPag) vs Date

- OBBB1-1A Pressure @ 93.25 mKB
- OBBB1-1A Temperature @ 93.25 mKB

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

OBC1

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

0 20 40 60 80 100 120 140

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

WB-D  WB-A Shale  WB-A  Top of Cont Res  Producer Elevation
Middle McMurray  Lower Clearwater  Injector Elevation  Best facies  Beaverhill Lake
Base of Drift  Base of Cont Res  WB-C  Gamma  01-Aug-2018
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OBC2

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

104/10-04-093-12W4/0

WB-D
WB-A Shale
WB-A
Top of Cont Res
Producer Elevation
Middle McMurray
Lower Clearwater
Injector Elevation
Best facies
Beaverhill Lake
Base of Drift
Base of Cont Res
01-Aug-2018
01-Jul-2016
01-Jun-2018
01-May-2018
01-Apr-2016
01-Mar-2016
01-Feb-2016
01-Jan-2016
01-Dec-2017
01-Nov-2017
01-Oct-2017
01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

102/07-04-093-12W4/0

OBC3

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

WB-D
WB-A Shale
WB-A
Top of Cont Res
Producer Elevation
Middle McMurray
Lower Clearwater
Injector Elevation
Best facies
Beaverhill Lake
Base of Drift
Base of Cont Res
WB-C
Gamma
01-Aug-2018
01-Jul-2018
01-Jun-2018
01-May-2018
01-Apr-2018
01-Mar-2018
01-Feb-2018
01-Jan-2018
01-Dec-2017
01-Nov-2017
01-Oct-2017
01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

102/07-04-093-12W4/0

OBC3

Pressure (kPag)

Temperature (°C)

Date

OBC3 Pressure @ 104.8 mKB  OBC3 Pressure @ 104.8 mKB  OBC3 Pressure @ 85.5 mKB
OBC3 Temperature @ 79.3 mKB  OBC3 Temperature @ 80.9 mKB  OBC3 Temperature @ 84.4 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

![Piezometer Plots & Temperature vs Depth Plots](image-url)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OBCI-1

Pressure (kPag) vs Temperature (°C) for OBCI-1 from 1-Sep-17 to 1-Aug-18.

- Blue line: OBCI-1 Pressure @ 148.5 mKB
- Red line: OBCI-1 Temperature @ 148.5 mKB
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

Legend:
- WB-C
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

109/11-08-093-12W4/0

OBCI-4

Temperature (°C) and Gamma Ray (API Units)
Piezometer Plots & Temperature vs Depth Plots

OBCI-4

Pressure (kPag)

Temperature (°C)

Date

109/11-08-093-12W4/0

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

OBCI-4 Pressure @ 122 mKB
OBCI-4 Temperature @ 148.19 mKB
Piezometer Plots & Temperature vs Depth Plots

![Graph showing temperature vs depth plots for OBCI-5 well. The graph includes various depth markers and temperature readings.]
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)
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

107/03-09-093-12W4/0

OBE3-1

Pressure (kPag) vs Date

- OBE3-1 Pressure @ 82 mKB
- OBE3-1 Temperature @ 82 mKB

Temperature (°C)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

107/09-09-093-12W4/0

OBE6-1

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- W6/C
- Gamma
- 01-Jun-2018
- 01-May-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

Graph showing pressure and temperature trends over time for OBG3-1 from September to August.
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/01-08-093-12W4/0

Temperature (°C) and Gamma Ray (API Units)

Depth (mKfB)

- WB-O
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- W6/C
- Gamma
- 01-Aug-2018
- 01-May-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/14-05-093-12W4/0

OBN1-1

Temperature (°C) and Gamma Ray (API Units)

Depth (mKb)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Base of Drift
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- WB-C
- Gamma
- 01-Jul-2016
- 01-Jan-2018
- 01-Dec-2017
- 01-May-2018
- 01-Nov-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Oct-2017
- 01-Sep-2018

Beaverhill Lake
Piezometer Plots & Temperature vs Depth Plots

100/14-05-093-12W4/0

OBN1-1

Pressure (kPag) vs Date

Temperature (°C)

Date

1-Sep-17 1-Oct-17 1-Nov-17 1-Dec-17 1-Jan-18 1-Feb-18 1-Mar-18 1-Apr-18 1-May-18 1-Jun-18 1-Jul-18 1-Aug-18

OBN1-1 Pressure @ 119.25 mKB  OBN1-1 Temperature @ 119.25 mKB

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

100/07-08-093-12W4/0

OBN6-1

Pressure (kPag)

Temperature (°C)

Date


OBN6-1 Pressure @ 120.25 mKB

OBN6-1 Temperature @ 120.25 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

OBNN-1 Pressure @ 114.75 mKB

OBNN-1 Temperature @ 114.75 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

104/10-08-093-12W4/0

OBNN-2

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

OBNN-2 Pressure @ 111.8 mKB  OBNN-2 Temperature @ 111.8 mKB
Piezometer Plots & Temperature vs Depth Plots

[Graph showing temperature (°C) and gamma ray (API Units) data over depth (mKB).]

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

OBNN-4

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

112/06-08-093-12W4/0
Piezometer Plots & Temperature vs Depth Plots

OBNN-4

112/06-08-093-12W4/0

Pressure (kPag)

Date

Temperature (°C)

OBNN-4 Pressure @ 120 mKB  OBNN-4 Temperature @ 120 mKB
Piezometer Plots & Temperature vs Depth Plots

105/07-08-093-12W4/0

OBNN-5

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Lower Clearwater
- Injector Elevation
- Best facies
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- 01-Dec-2017
- 01-Nov-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

OBNN-5

Pressure (kPag) vs Date (1-Sep-17 to 1-Aug-18)

- OBNN-5 Pressure @ 117.5 mKB
- OBNN-5 Temperature @ 117.5 mKB
Piezometer Plots & Temperature vs Depth Plots

100/05-09-093-12W4/0

OBO1-1

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res

- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017

01-Oct-2017
01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

![Piezometer Plots & Temperature vs Depth Plots](image_url)

- **OBO7-1**
- **Pressure (kPag)**
- **Temperature (°C)**
- **Date**
- **OBO7-1 Pressure @ 109.79 mKB**
- **OBO7-1 Temperature @ 109.75 mKB**
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

114/01-17-093-12W4

OBOO-1

Pressure vs Date

- OBOO-1 Pressure @ 97 mKB
- OBOO-1 Temperature @ 97 mKB
Piezometer Plots & Temperature vs Depth Plots

111/01-17-093-12W4/0

OBOO15-1

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Cleanwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017

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

**111/01-17-093-12W4/0**

**OBOO15-1**

- **Pressure (kPag)**
  - 1,000
  - 900
  - 800
  - 700
  - 600
  - 500
  - 400
  - 300
  - 200
  - 100
  - 0

- **Temperature (°C)**
  - 20
  - 18
  - 16
  - 14
  - 12
  - 10
  - 8
  - 6
  - 4
  - 2
  - 0

**Date**
- 1-Sep-17
- 1-Oct-17
- 1-Nov-17
- 1-Dec-17
- 1-Jan-18
- 1-Feb-18
- 1-Mar-18
- 1-Apr-18
- 1-May-18
- 1-Jun-18
- 1-Jul-18
- 1-Aug-18

**Graph Legend**
- **OBOO15-1 Pressure @ 95.75 mKB**
- **OBOO15-1 Temperature @ 95.75 mKB**
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

OBQ11-1

100/03-16-093-12W4/0

SUNCOR
Piezometer Plots & Temperature vs Depth Plots

100/03-16-093-12W4/0

OBQ11-1

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OBQ11-1 Pressure @ 83.2 mKB
OBQ11-1 Temperature @ 83.2 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

102/15-09-093-12W4/0

OBQ3-1

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

WS-D  WS-A Shale  WB-A  Top of Cont Res  Producer Elevation  Middle McMurray
Lower Cleanwater  Injector Elevation  Best facies  Beaverhill Lake  Base of Drift  Base of Cont Res
WB-C  Gamma  01-Aug-2018  01-Jul-2018  01-Jun-2018  01-May-2018
Piezometer Plots & Temperature vs Depth Plots

OBQ4-1
Temperature (°C) and Gamma Ray (API Units)

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

![Graph showing pressure and temperature over time for OBQ8-1.](image-url)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/06-16-093-12W4

OBQQ-1

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

OBQQ-1 Pressure @ 103 mKB
OBQQ-1 Temperature @ 103 mKB

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

115/03-16-093-12W4/0

OBQQ-3

Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- 01-May-2018
- 01-Sept-2017
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Nov-2017
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)

102/14-09-093-12W4/0

OBQQ-5

Depth (m/kB)

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Temperature

Depth (m/kB)

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

Legend:
- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- Beaverhill Lake
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

111/04-16-093-12W4

OBQQ-8

Pressure (kPag) vs Date

Temperature (°C)

- OBQQ-8 Pressure @ 87.5 mKB
- OBQQ-8 Temperature @ 87.5 mKB
125/04-16-093-12W4

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

OBQQ-9

112/04-16-093-12W4

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

112/04-16-093-12W4

OBQQ-9

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</thead>
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<td>1-Jun-18</td>
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<td>1-Aug-18</td>
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OBQQ-9 Pressure @ 94 mKB
OBQQ-9 Temperature @ 94 mKB

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

109/15-05-093-12W4/0

OBSS-T1
Piezometer Plots & Temperature vs Depth Plots

110/14-05-093-12W4/0

OBSS-T2

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- 01-Aug-2018
- 01-Jul-2018
- 01-Jun-2018
- 01-May-2018
- 01-Apr-2018
- 01-Mar-2018
- 01-Feb-2018
- 01-Jan-2018
- 01-Dec-2017
- 01-Oct-2017
- 01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

![Graph showing piezometer plots and temperature vs depth plots for OBSS-T2 with data from 1-Sep-17 to 1-Aug-18. The graph indicates a steady pressure and temperature throughout the period.](image-url)
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/02-06-093-12W4

SD10

Pressure (kPag)

1,000
900
800
700
600
500
400
300
200
100
0

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

SD10 Pressure @ 128.5 mKB
SD10 Temperature @ 128.5 mKB
Piezometer Plots & Temperature vs Depth Plots

SD-6

Temperature (°C) and Gamma Ray (API Units)

Depth (m/kB)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
Piezometer Plots & Temperature vs Depth Plots

100/10-06-093-12W4/0

SD-6

Pressure (kPag)

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

Temperature (°C)

SD-6 Pressure @ 125.5 mKB  SD-6 Temperature @ 125.5 mKB
Piezometer Plots & Temperature vs Depth Plots

Temperature (°C) and Gamma Ray (API Units)
Piezometer Plots & Temperature vs Depth Plots

SD8

102/10-06-093-12W4

Pressure (kPag)

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

Temperature (°C)

SD8 Pressure @ 129.5 mKB
SD8 Temperature @ 129.5 mKB
Piezometer Plots & Temperature vs Depth Plots

STUV10
Temperature (°C) and Gamma Ray (API Units)

Depth (mKB)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

102/03-04-093-12W4/0

WB-D  WB-A Shale  WB-A  Top of Cont Res  Producer Elevation  Middle McMurray
Lower Clearwater  Injector Elevation  Best facies  Beaverhill Lake  Base of Drift  Base of Cont Res
WB-C  Gamma  01-Aug-2018  01-Jul-2018  01-Jun-2018  01-May-2018
01-Oct-2017  01-Sep-2017
Piezometer Plots & Temperature vs Depth Plots

102/03-04-093-12W4/0

STUV10

Pressure (kPag)

1,600
1,400
1,200
1,000
900
800
700
600
500
400
300
200
100
0

Temperature (°C)

80
70
60
50
40
30
20
10
0

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

STUV10 Pressure @ 107.25 mKB
STUV10 Temperature @ 107.25 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure and temperature data over time for WBC01 well, with dates ranging from 1-Sep-17 to 1-Aug-18. The graph includes data points for pressure and temperature at different depths, with the x-axis representing dates and the y-axis representing pressure and temperature. The legend indicates that the blue line represents WBC01 Pressure @ 88.8 mKB and the red line represents WBC01 Temperature @ 88.8 mKB.]
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

112/06-09-093-12W4/0

WBC03

<table>
<thead>
<tr>
<th>Date</th>
<th>Pressure (kPa)</th>
<th>Temperature (°C)</th>
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<td>750</td>
<td>65</td>
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<tr>
<td>1-Oct-17</td>
<td>750</td>
<td>65</td>
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<tr>
<td>1-Nov-17</td>
<td>750</td>
<td>65</td>
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<td>1-Apr-18</td>
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<td>750</td>
<td>65</td>
</tr>
<tr>
<td>1-Aug-18</td>
<td>750</td>
<td>65</td>
</tr>
</tbody>
</table>

- **WBC03 Pressure @ 84.9 mKB**
- **WBC03 Temperature @ 84.9 mKB**
Piezometer Plots & Temperature vs Depth Plots

113/12-09-093-12W4/0

WBC04

Pressure (kPag) vs Date

Temperature (°C)

Date:
- 1-Sep-17
- 1-Oct-17
- 1-Nov-17
- 1-Dec-17
- 1-Jan-18
- 1-Feb-18
- 1-Mar-18
- 1-Apr-18
- 1-May-18
- 1-Jun-18
- 1-Jul-18
- 1-Aug-18

WBC04 Pressure @ 94.2 mKB
WBC04 Temperature @ 94.2 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/11-16-093-12W4/0

WBC14

Pressure (kPag)

Temperature (°C)

Date

1-Sep-17 1-Oct-17 1-Nov-17 1-Dec-17 1-Jan-18 1-Feb-18 1-Mar-18 1-Apr-18 1-May-18 1-Jun-18 1-Jul-18 1-Aug-18

WBC14 Pressure @ 72.3 mKB
WBC14 Temperature @ 72.3 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

103/04-09-093-12W4/0

WBC17

Pressure (KPag)

Temperature (°C)

Date

1-Sep-17 1-Oct-17 1-Nov-17 1-Dec-17 1-Jan-18 1-Feb-18 1-Mar-18 1-Apr-18 1-May-18 1-Jun-18 1-Jul-18 1-Aug-18

WBC17 Pressure @ 90.3 mKB WBC17 Temperature @ 90.3 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

**WBC19**

<table>
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<th>Pressure (kPag)</th>
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<td>1-Oct-17</td>
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<td>600</td>
<td>6</td>
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<tr>
<td>1-Dec-17</td>
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<td>6</td>
</tr>
<tr>
<td>1-Jan-18</td>
<td>600</td>
<td>6</td>
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<tr>
<td>1-Feb-18</td>
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<td>1-May-18</td>
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<td>600</td>
<td>6</td>
</tr>
<tr>
<td>1-Aug-18</td>
<td>600</td>
<td>6</td>
</tr>
</tbody>
</table>

- **WBC19 Pressure @ 120.3 mKB**
- **WBC19 Temperature @ 120.3 mKB**
Piezometer Plots & Temperature vs Depth Plots

WBC25

Temperature (°C) and Gamma Ray (API Units)

- WB-D
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma

108/15-05-093-12W4/0
Piezometer Plots & Temperature vs Depth Plots

![Piezometer Plots & Temperature vs Depth Plots](image)

- WBC25 Pressure @ 99.4 mKB
- WBC25 Temperature @ 99.4 mKB
Piezometer Plots & Temperature vs Depth Plots

103/07-08-093-12W4/0

WBC27

Pressure (kPag)

Temperature (°C)

Date

WBC27 Pressure @ 94.8 mKB
WBC27 Temperature @ 94.8 mKB
Piezometer Plots & Temperature vs Depth Plots

112/08-05-093-12W4/0

WBC29

<table>
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<tr>
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<th>Temperature (°C)</th>
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<td>70</td>
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<td>1-Oct-17</td>
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<td>1-Nov-17</td>
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<td>1-Mar-18</td>
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<td>1-Apr-18</td>
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<td>1-Aug-18</td>
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WBC29 Pressure @ 88.3 mKB  WBC29 Temperature @ 88.3 mKB
Piezometer Plots & Temperature vs Depth Plots

104/05-04-093-12W4/0

WBC30

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<td>1-Nov-17</td>
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<td>55</td>
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<tr>
<td>1-Jun-18</td>
<td>640</td>
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<td>1-Jul-18</td>
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<tr>
<td>1-Aug-18</td>
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</table>

WBC30 Pressure @ 85.7 mKB
WBC30 Temperature @ 85.7 mKB
Piezometer Plots & Temperature vs Depth Plots

100/14-09-093-12W4/0

WBC31

Pressure (kPag)

1,000
900
800
700
600
500
400
300
200
100
0

Temperature (°C)

20
18
16
14
12
10
8
6
4
2
0

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

WBC31 Pressure @ 78.3 mKB
WBC31 Temperature @ 78.3 mKB
Piezometer Plots & Temperature vs Depth Plots

![Graph showing pressure and temperature over time for WBC32 at 97.3 mKB]

- Pressure (kPag) is plotted on the y-axis, ranging from 0 to 1,000 kPag.
- Temperature (°C) is plotted on the right y-axis, ranging from 0 to 50 °C.
- Dates from 1-Sep-17 to 1-Aug-18 are shown on the x-axis.

Legend:
- Blue line: WBC32 Pressure @ 97.3 mKB
- Red line: WBC32 Temperature @ 97.3 mKB
Piezometer Plots & Temperature vs Depth Plots

102/09-08-093-12W4/0

WBC33

Pressure (kPag) vs Date

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

Temperature (°C)

WBC33 Pressure @ 102.4 mKB
WBC33 Temperature @ 102.4 mKB
Piezometer Plots & Temperature vs Depth Plots

![Piezometer Plots & Temperature vs Depth Plots](image)

- **WBC34 Pressure @ 100 mKB**
- **WBC34 Temperature @ 100 mKB**

- **Date**: 1-Sep-17, 1-Oct-17, 1-Nov-17, 1-Dec-17, 1-Jan-18, 1-Feb-18, 1-Mar-18, 1-Apr-18, 1-May-18, 1-Jun-18, 1-Jul-18, 1-Aug-18

- **Pressure (kPag)**: 0 to 1,000
- **Temperature (°C)**: 0 to 50

---

**SUNCOR**
Piezometer Plots & Temperature vs Depth Plots

[SUNCOR logo]
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

112/03-08-093-12W4/0

WBC37

Pressure (kPag)

1,000
900
800
700
600
500
400
300
200
100
0

Temperature (°C)

20
18
16
14
12
10
8
6
4
2
0

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

WBC37 Pressure @ 110.5 mKB
WBC37 Temperature @ 110.5 mKB
Piezometer Plots & Temperature vs Depth Plots

![Graph showing piezometer plots and temperature vs depth plots for WBC56]

- **104/04-09-093-12W4**
- **WBC56**

**Axes:**
- **Y-axis:** Pressure (kPag)
- **X-axis:** Date

**Lines:**
- **Blue line:** WBC56 Pressure @ 88.41 mKB
- **Red line:** WBC56 Temperature @ 88.41 mKB

**Dates shown:**
- 1-Sep-17
- 1-Oct-17
- 1-Nov-17
- 1-Dec-17
- 1-Jan-18
- 1-Feb-18
- 1-Mar-18
- 1-Apr-18
- 1-May-18
- 1-Jun-18
- 1-Jul-18
- 1-Aug-18

**Graph Values:**
- Pressure values range from 700 to 1000
- Temperature values range from 60 to 100

*Source: SUNCOR*
Piezometer Plots & Temperature vs Depth Plots

![Graph showing piezometer plots and temperature vs depth plots for WOB1, with dates from 1-Sep-17 to 1-Aug-18, pressure in kPag on the y-axis, and temperature in °C on the x-axis. The graph shows trends in pressure and temperature over time.]
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

100/15-20-093-12W4/0

Pressure (kPag)

Temperature (°C)

Date

OB22 Pressure @ 82.5 mKB
OB22 Pressure @ 75.2 mKB
OB22 Temperature @ 82.5 mKB
OB22 Temperature @ 75.2 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

102/11-20-093-12W4/0

OB24

Pressure (kPag)

1,000
900
800
700
600
500
400
300
200
100
0

Date

1-Sep-17
1-Oct-17
1-Nov-17
1-Dec-17
1-Jan-18
1-Feb-18
1-Mar-18
1-Apr-18
1-May-18
1-Jun-18
1-Jul-18
1-Aug-18

Temperature (°C)

10
9
8
7
6
5
4
3
2
1
0

OB24 Pressure @ 85.2 mKB
OB24 Temperature @ 85.2 mKB
Piezometer Plots & Temperature vs Depth Plots

100/10-20-093-12W4/0

OB25

Temperature (°C) and Gamma Ray (API Units)

Depth (mKb)

- WB-O
- WB-A Shale
- WB-A
- Top of Cont Res
- Producer Elevation
- Middle McMurray
- Lower Clearwater
- Injector Elevation
- Best facies
- Beaverhill Lake
- Base of Drift
- Base of Cont Res
- WB-C
- Gamma
- 01-Jul-2018
- 01-Jun-2018
- 01-May-2018
- 01-Apr-2018
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

104/11-20-093-12W4/0

Pressure (kPag)

Temperature (°C)

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

OB27 Pressure @ 119 mKb
OB27 Pressure @ 113.6 mKb
OB27 Pressure @ 95.5 mKb
OB27 Pressure @ 90.2 mKb
OB27 Temperature @ 119 mKb
OB27 Temperature @ 113.6 mKb
OB27 Temperature @ 95.5 mKb
OB27 Temperature @ 90.2 mKb
Piezometer Plots & Temperature vs Depth Plots

OB28
Temperature (°C) and Gamma Ray (API Units)

111/16-07-093-12W4/0

Depth (m/kB)

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170

80 90 100 110 120 130 140 150 160 170

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Piezometer Plots & Temperature vs Depth Plots

111/16-07-093-12W4/0

OB28

Pressure (kPag)

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<thead>
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<th>Date</th>
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<td>1-Jul-18</td>
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<td>14°C</td>
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<tr>
<td>1-Aug-18</td>
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OB28 Pressure @ 123 mKB
OB28 Temperature @ 123 mKB
Piezometer Plots & Temperature vs Depth Plots
Piezometer Plots & Temperature vs Depth Plots

132/15-07-093-12W4/0

OB29

Date

1-Sep-17  1-Oct-17  1-Nov-17  1-Dec-17  1-Jan-18  1-Feb-18  1-Mar-18  1-Apr-18  1-May-18  1-Jun-18  1-Jul-18  1-Aug-18

Pressure (kPag)  Temperature (°C)

0  5  10  15  20  25  30  35  40  45  50

0  100  200  300  400  500  600  700  800  900  1000

OB29 Pressure @ 126 mKB  OB29 Temperature @ 126 mKB
Piezometer Plots & Temperature vs Depth Plots

106/07-07-093-12W4/0

WBC57

<table>
<thead>
<tr>
<th>Date</th>
<th>Pressure (kPag)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
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<tr>
<td>1-Sep-17</td>
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<td>1-Aug-18</td>
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WBC57 Pressure @ 128.7 mKB  WBC57 Temperature @ 128.7 mKB
Piezometer Plots & Temperature vs Depth Plots