

Blackrod SAGD Pilot Project Athabasca Oil Sands Area Scheme Approval No. 11522E

2014 Annual Performance Presentation Alberta Energy Regulator



Blackrod Subsurface

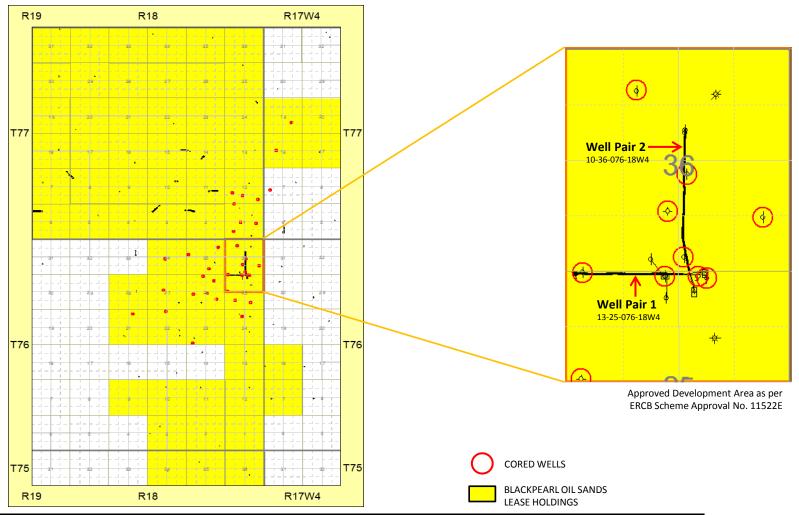
Subsurface Agenda

- 1. Background
- 2. Geology / Geoscience
- 3. Drilling & Completions
- 4. Artificial Lift
- 5. Well Instrumentation
- 6. Scheme Performance

Blackrod Subsurface

1. Background

Project Overview



Project Summary

- AER Scheme Approval No. 11522E
- Two(2) SAGD Pilot Well Pairs
- Portage area on Oil Sands Lease 7407060158
- Pilot site located in 02-36-076-18W4
- Target formation is the Lower Grand Rapids Unit 1 (L.GR1)
- Traditional SAGD recovery process
- BlackPearl is the 100% W.I. Owner

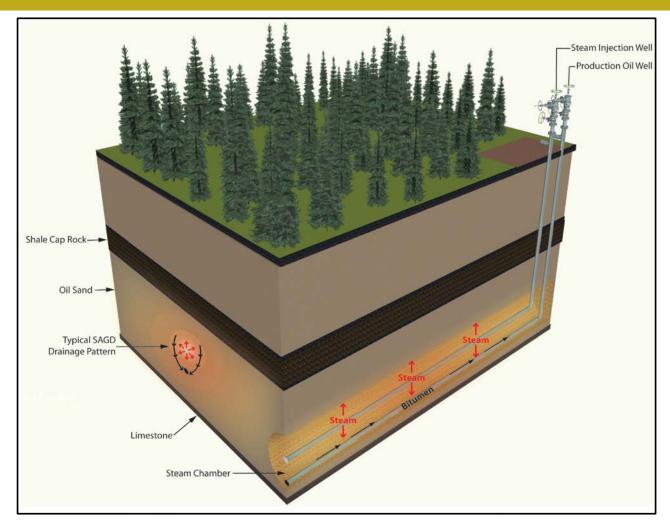
Blackrod Pilot Site



Blackrod Pilot Site (cont.)



Traditional SAGD Process



Project Milestones – 13-25 WP1

• <u>Oct 2010</u> AER Scheme Approval No. 11522

<u>Dec 2010</u> Drill 13-25 WP1

• *May 2011* Commission Pilot Facility

• Jun 2011 Commence Circulation Phase

• <u>Sep 2011</u> Convert to SAGD Production Phase

• <u>Apr 2012</u> Achieve commercial production monthly rate of 400 bbl/d

• Oct 2014 Produce 260,000 cumulative barrels

• **Q1 2015** "Ultra-Temp" ESP surpasses 500 days of continuous run-time

Project Milestones – 10-36 WP2

 Feb 2012 	AER Approval No. 11522C for 10-36 WP2 and facility expansion
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• <i>Feb 2013</i> Dril	l 10-36 WP2
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Oct 2013 Commission Phase 2 Pilot Facility Expansion

Commence Circulation Phase • Nov 2013

Mar 2014 Convert to SAGD Production Phase

Production ramp-up approaching commercial rate of 400 bbl/d Oct 2014

Produce 125,000 cumulative barrels <u>Q1 2015</u>

Blackrod Subsurface

2. Geology / Geoscience

Original Bitumen in Place

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• OBIP<sub>WP1</sub> = A_1 * h_1 * So_1 * Ø_1 * Bo
= (100 \text{ m} * 800 \text{ m}) * 22 \text{ m} * 0.63 * 0.35 * 1.0
= 388,080 \text{ m}^3
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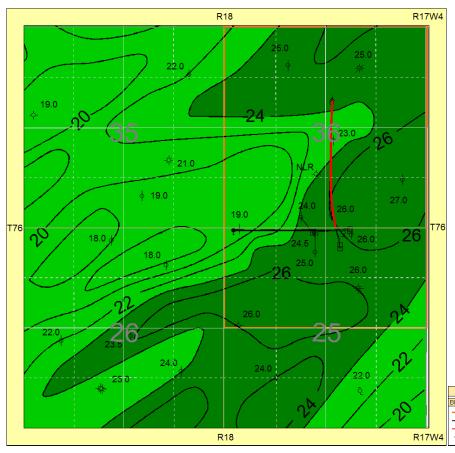
• OBIP_{WP2} =
$$A_2 * h_2 * So_2 * Ø_2 * Bo$$

= (100 m * 1050 m) * 25 m * 0.63 * 0.34 * 1.0
= 562,275 m³

Where:

OBIP = Original Bitumen In Place **Drainage Area** A = h = Thickness So = Oil Saturation Ø= **Average Porosity** Bo = **Expansion Factor** WP1= 1st Pilot Well Pair drilled at 13-25-076-18W4 WP2= 2nd Pilot Well Pair drilled at 10-36-076-18W4

Net Pay Map



- Existing lease and access selected for Pilot surface location
- Bottom hole locations for both Pilot Well Pairs selected based on offsetting well control

Legend Blackrod SAGD Pilot Project — PILOT PROJECT STUDY AREA — ORIGINAL SAGD PILOT WELL PAIR — SECOND BLACKROD SAGD WELL PAIR CJ. 2m

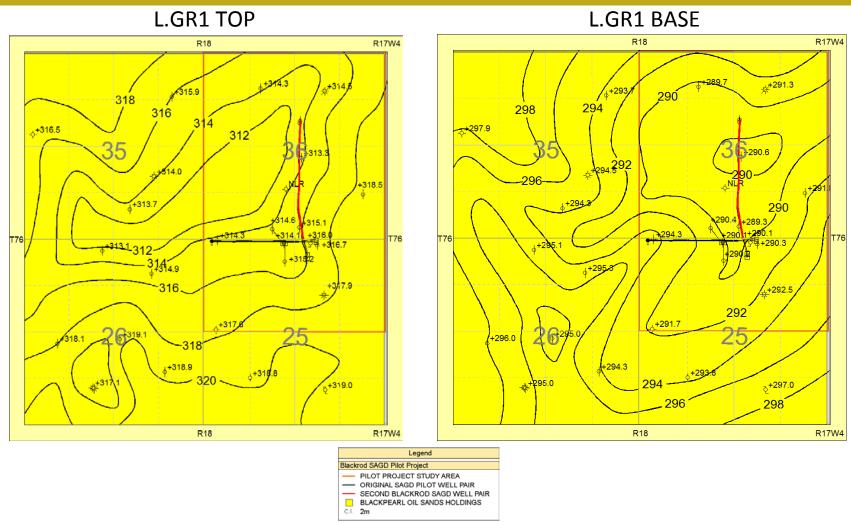
LOG CUTOFFS

- Gamma Ray < 75 API
- Resistivity > 20 Ohm.m
- Porosity > 33%

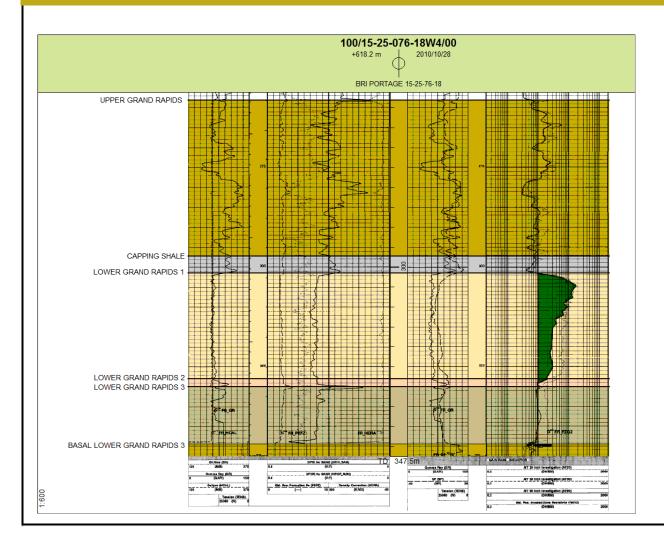
Total L.GR1 SAGD Net Oil Pay



Structure Map



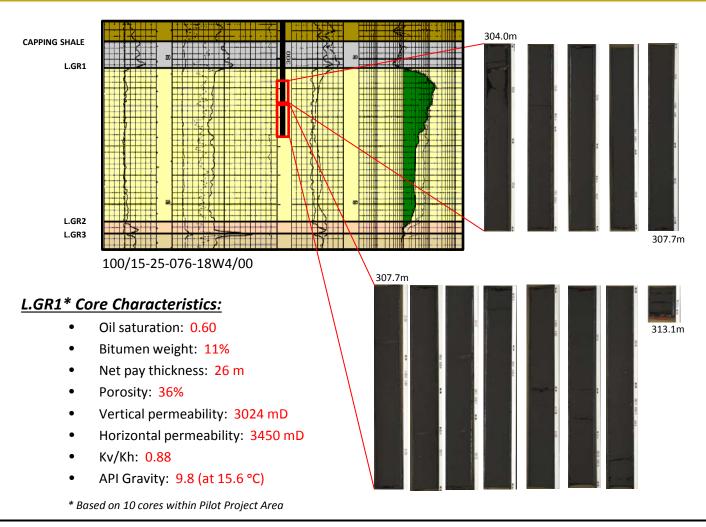
Type Log



LOG CUTOFFS

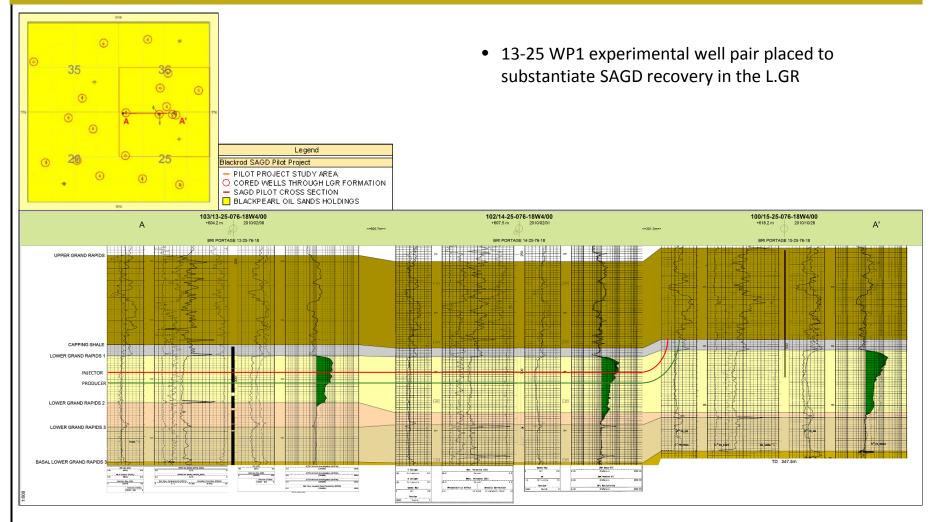
- Gamma Ray < 75 API
- Resistivity > 20 Ohm.m
- Porosity > 33%

Representative Core

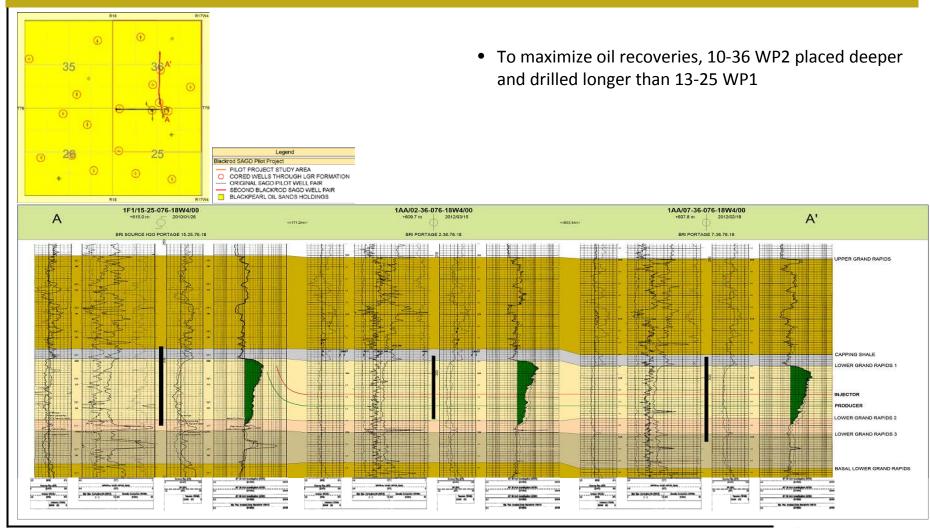




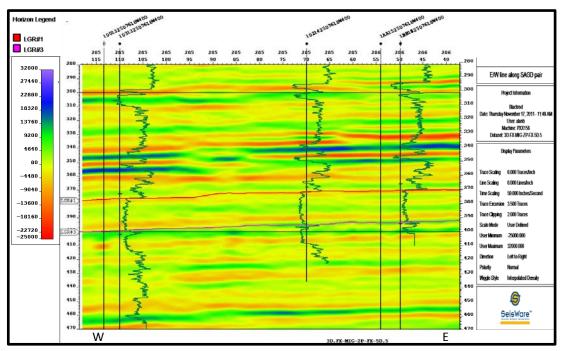
Cross Section Through 13-25 WP1



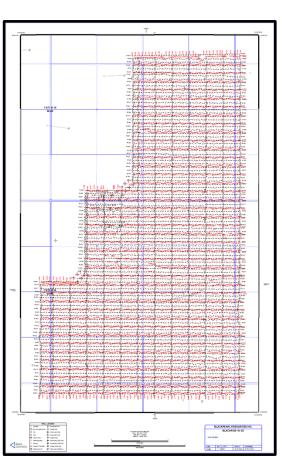
Cross Section Through 10-36 WP2



Seismic



3D X-Line along 13-25 WP1

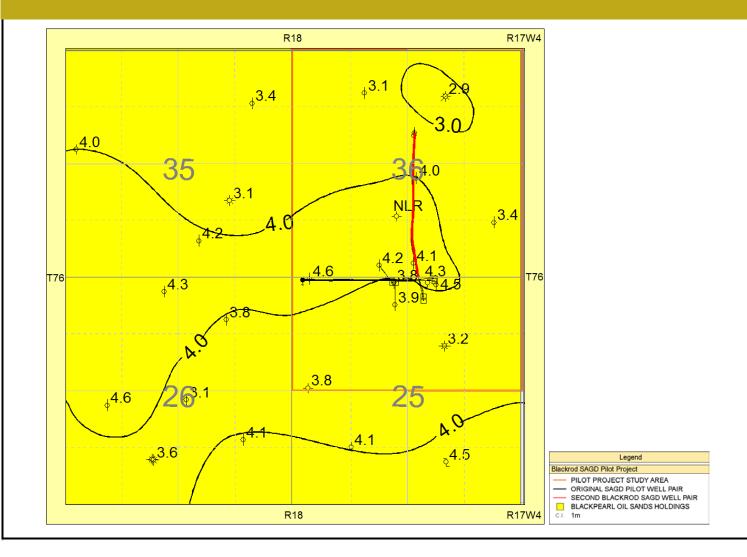


3D Seismic Area Coverage

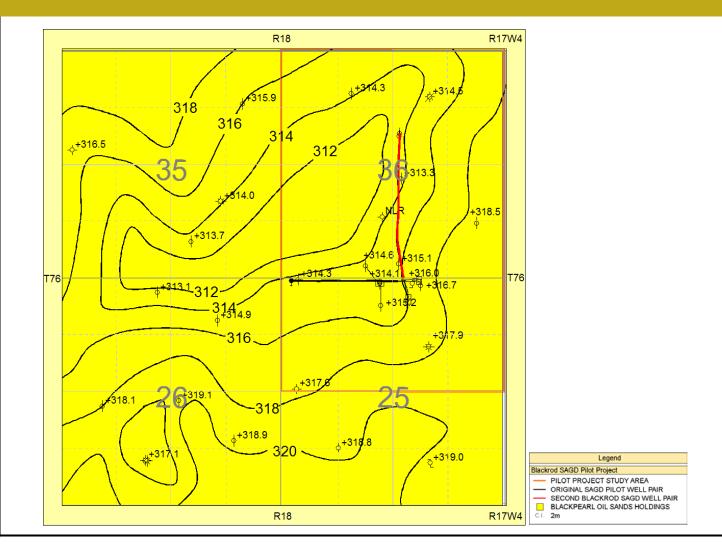
Primary Cap Rock

- MFS (Maximum Flooding Shale)
- Directly overlays Lower Grand Rapids formation
- Regionally extensive
- 3 m average thickness
- Mini Frac Analysis:
 - Performed on the 13-25-076-18W4 OSE Core Hole
 - -Initial Breakdown Pressure = 8500 kPa
 - -Closure Pressure Gradient = 13.7 kPa/m

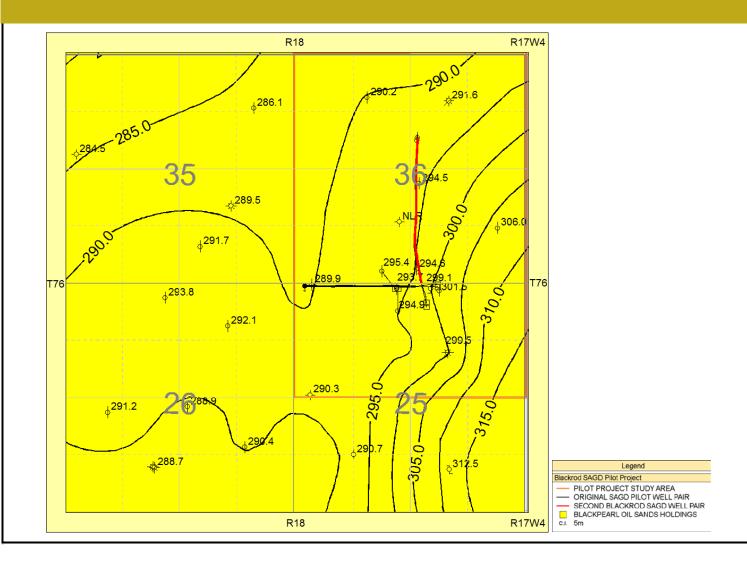
MFS Cap Rock Isopash Map



MFS Cap Rock Structure Map



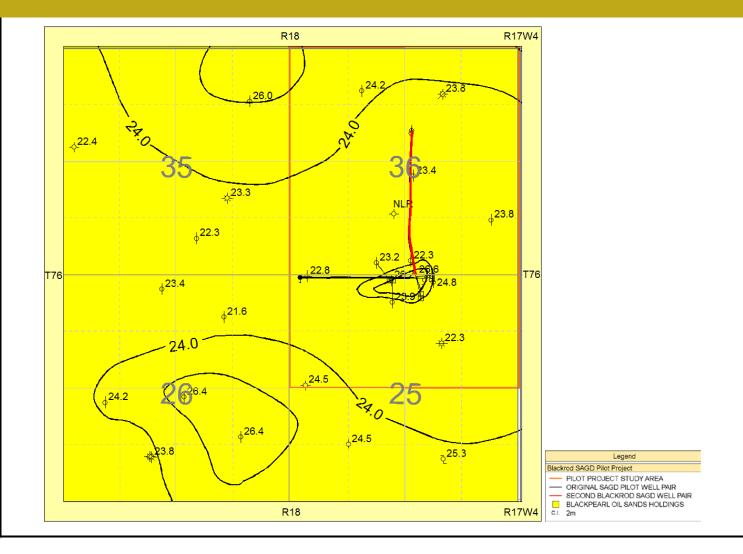
MFS Cap Rock Base Depth Map



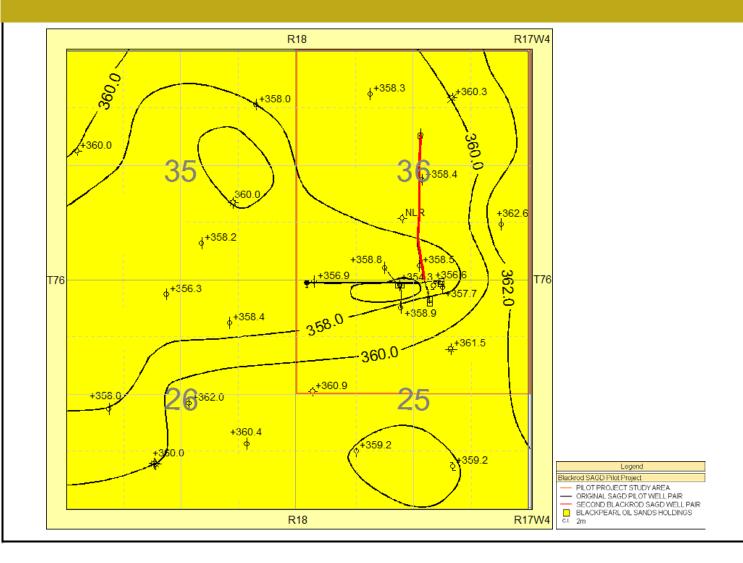
Secondary Cap Rock

- Joli Fou formation
- 45 m above Lower Grand Rapids formation
- Regionally extensive
- 20 m average thickness
- Mini Frac Analysis:
 - Performed on the 01-36-076-18W4 OSE Core Hole
 - Initial Breakdown Pressure = 12,750 kPa
 - -Closure Pressure Gradient Range = 19.4 kPa/m

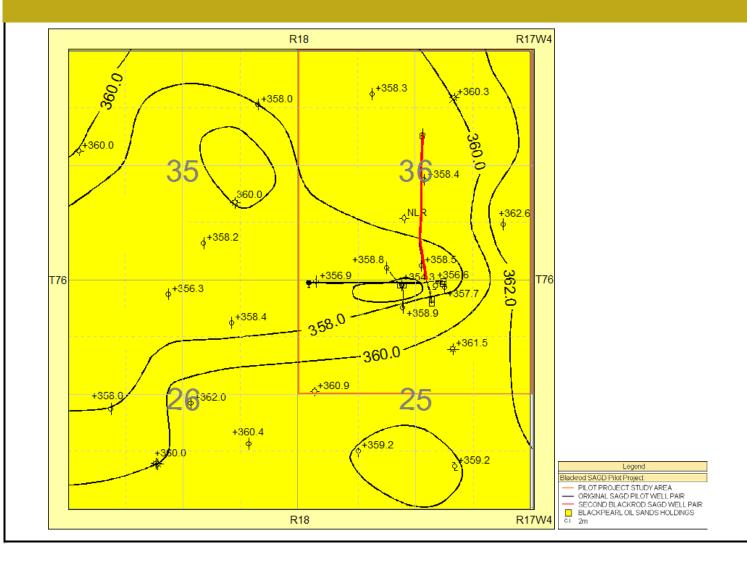
Joli Fou Cap Rock Isopash Map



Joli Fou Cap Rock Structure Map



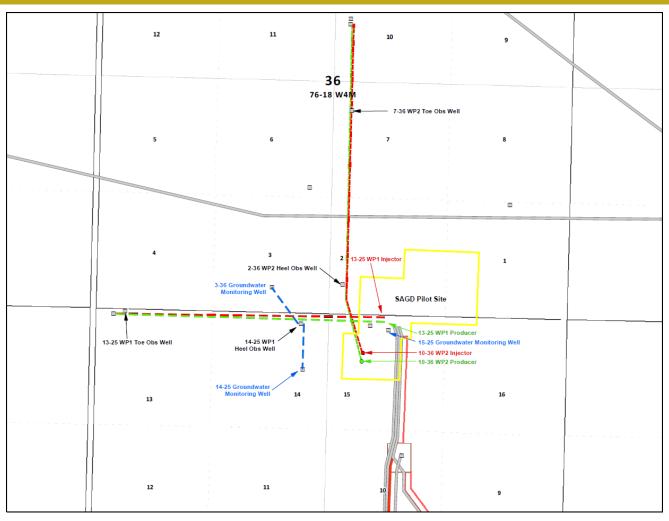
Joli Fou Cap Rock Base Depth Map



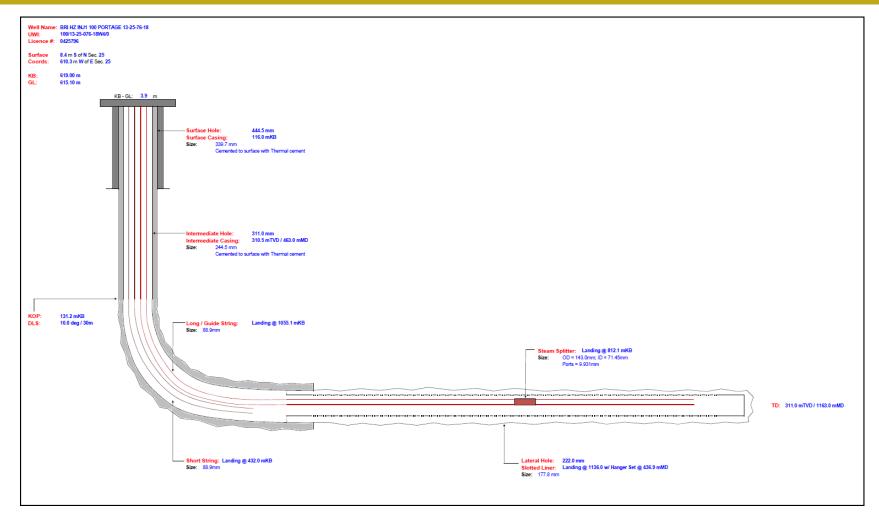
Blackrod Subsurface

3. Drilling and Completions

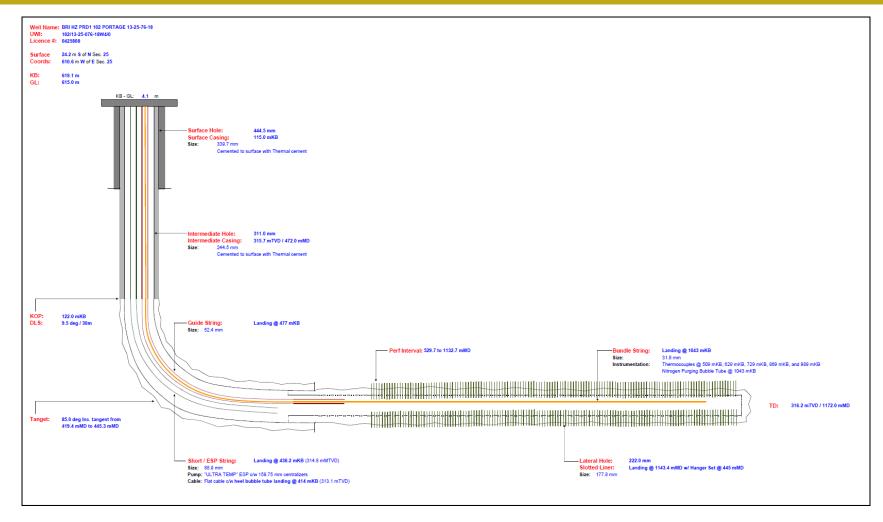
Blackrod Pilot Well Network



13-25 WP1 - Injector



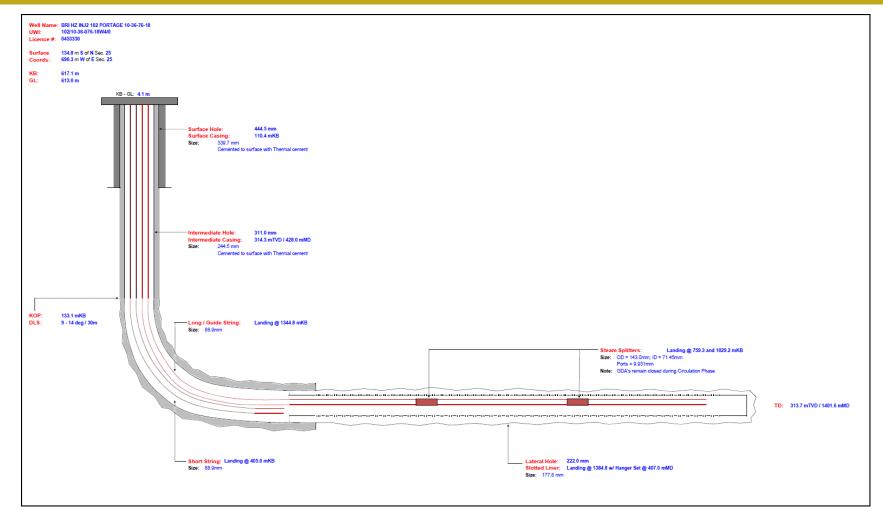
13-25 WP1 - Producer (Prod. Phase)



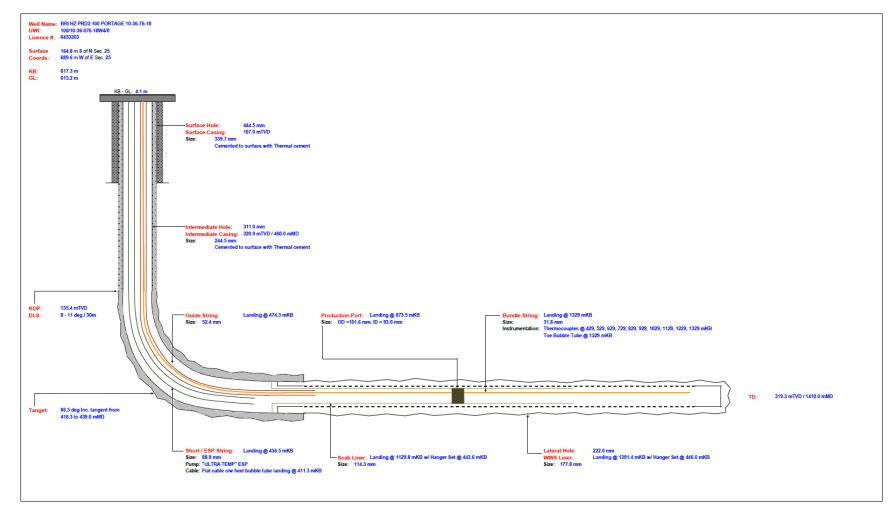
13-25 WP1 – Downhole Modifications

- Injector Well:
 - No modifications
- Producer Well:
 - No modifications

10-36 WP2 - Injector



10-36 WP2 – Producer (Prod. Phase)



10-36 WP2 – Downhole Modifications

• Injector Well:

- Open Steam Splitters in Mar 2014 as part of SAGD Production Phase conversion
- Close Steam Splitters in May 2014 to accelerate thermal development at the toe

Producer Well:

 Install "Ultra Temp" ESP and scab liner c/w production port in Mar 2014 as part of SAGD Production Phase conversion

Blackrod Subsurface

4. Artificial Lift

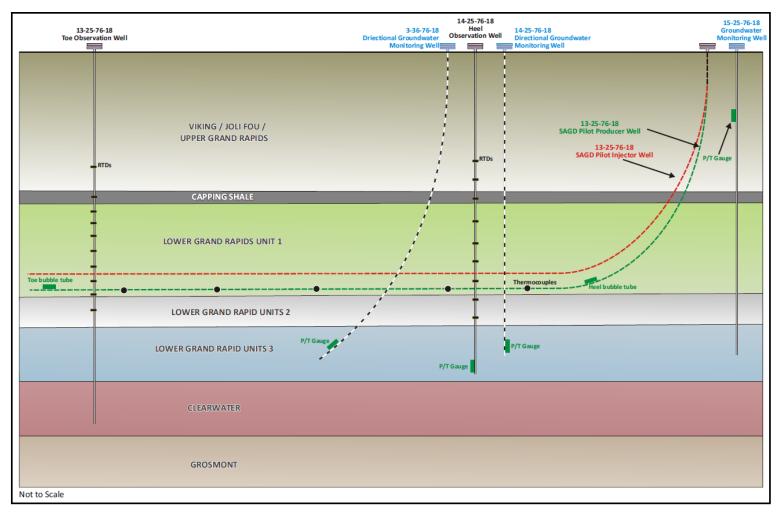
Electrical Submersible Pump

- Fluid production via "Ultra Temp" Electrical Submersible Pumps (ESP) on both 13-25 WP1 and 10-36 WP2
- ESP advantages:
 - Operate and lift fluids at controlled downhole pressures
 - Maintain continuous fluid production
- Variable Flow Drive (VFD) utilized to control pump speed and production rates
- Current ESPs meeting expectations

Blackrod Subsurface

5. Well Instrumentation

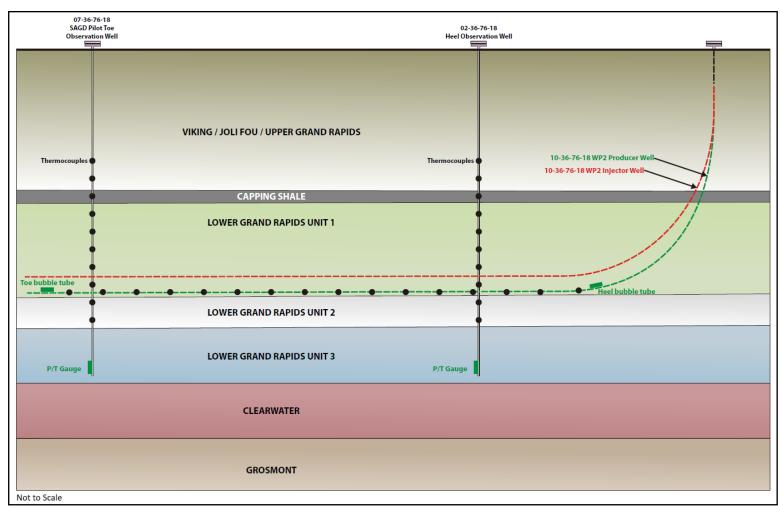
13-25 WP1 – Instrumentation Overview



13-25 WP1 – Obs Wells

- Toe Obs Well:
 - 103/13-25-076-18W4
 - 8.5 m North of WP1
 - RTD gauges to monitor temperature above, below, and within L.GR1
 - RTD temperature profile indicating maturing steam chamber
- Heel Obs Well:
 - 102/14-25-076-18W4
 - 17.7 m South WP1
 - RTD gauges to monitor temperature above, below, and within L.GR1
 - RTD temperature profile indicating maturing steam chamber
 - P/T gauge to monitor pressure & temperature within L.GR3 aquifer

10-36 WP2 – Instrumentation Overview



10-36 WP2 – Obs Wells

Toe Obs Well:

- 100/07-36-076-18W4
- 17.5 m West of WP2
- Thermocouples to monitor temperature above, below, and within L.GR1
- Thermocouple profile indicating early stages of steam chamber development
- P/T gauge to monitor pressure & temperature within L.GR3 aquifer

• Heel Obs Well:

- 100/02-36-076-18W4
- 16.1 m East of WP2
- Thermocouples to monitor temperature above, below, and within L.GR1
- Thermocouple profile indicating early stages of steam chamber development
- P/T gauge to monitor pressure & temperature within L.GR3 aquifer



Groundwater Monitoring Wells

- 100/03-36-076-18W4 GWM:
 - Directionally drilled from 14-25 lease
 - PCP to sample/analyze non-saline L.GR3 H₂O
 - P/T gauge to monitor pressure & temperature within L.GR3 aquifer
- 100/14-25-076-18W4 GWM:
 - Directionally drilled from 14-25 lease
 - PCP to sample/analyze non-saline L.GR3 H₂O
 - P/T gauge to monitor pressure & temperature within L.GR3 aquifer
- 100/15-25-076-18W4 GWM:
 - PCP to sample/analyze non-saline Viking H₂O
 - P/T gauge to monitor pressure & temperature within Viking aquifer

Blackrod Subsurface

6. Scheme Performance

13-25 WP1 Performance as of Oct 31, 2014

- Three (3) years of SAGD Production Phase
- Maturing steam chamber / flat-lined oil production
- Current performance in line with internal simulated SAGD models
- Oil production currently averaging 26 m³/d

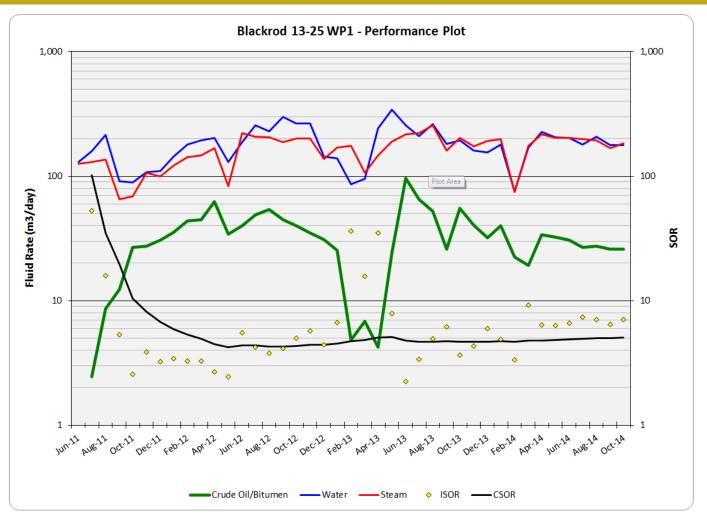
13-25 WP1 Oil Production as of Oct 31, 2014

- Cumulative Production = 41,500 m³
- Recovery to Date = 10.7%
- Ultimate Recovery = 20 25% (lower due to 13-25 WP1 well placement)
- CSOR including Circ. Phase = 5.0
- CSOR during Prod. Phase only = 4.7
- Average Rate during Prod. Phase = 36 m³/day
- Max Rate during Prod. Phase = 96 m³/day

13-25 WP1 Steam Injection as of Oct 31, 2014

- Average Steam Chamber Pressure = 2505 kPa
- Average Surface Steam Temperature = 240 °C
- Wellhead Steam Quality = 95 − 100%

13-25 WP1 Performance Plot



10-36 WP2 Performance as of Oct 31, 2014

- 8 months of SAGD Production Phase
- Early stages of steam chamber development
- Preliminary results are favourable and in line with internal simulated SAGD models
- Oil production currently averaging 60 m³/d and continuing to ramp-up

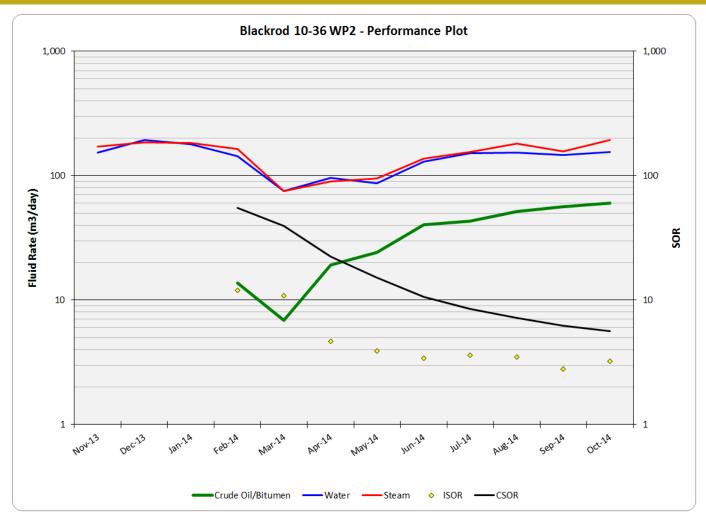
10-36 WP2 Oil Production as of Oct 31, 2014

- Cumulative Production = 9700 m³
- Recovery = 1.7%
- Ultimate Recovery = 55 60%
- CSOR including Circ. Phase = 5.6
- CSOR during Prod. Phase only = 3.4
- Average Rate during Prod. Phase = 40 m³/day
- Current Ramp-up Rate = 60 m³/day (and climbing)

13-25 WP1 Steam Injection as of Oct 31, 2014

- Average Steam Chamber Pressure = 2355 kPa
- Average Surface Steam Temperature = 240 °C
- Wellhead Steam Quality = 95 − 100%

10-36 WP2 Performance Plot





Blackrod Surface Operations

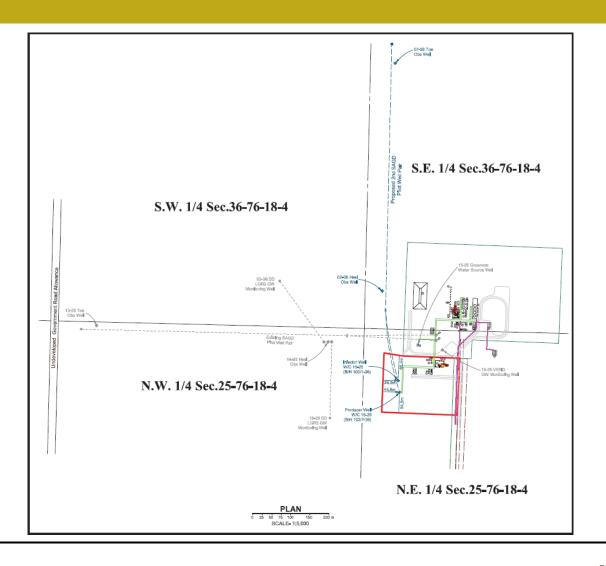
Surface Operations Agenda

- 1. Facilities
- 2. Measurement & Reporting
- 3. Water Source
- 4. Disposal
- 5. Environmental
- 6. Compliance Statement

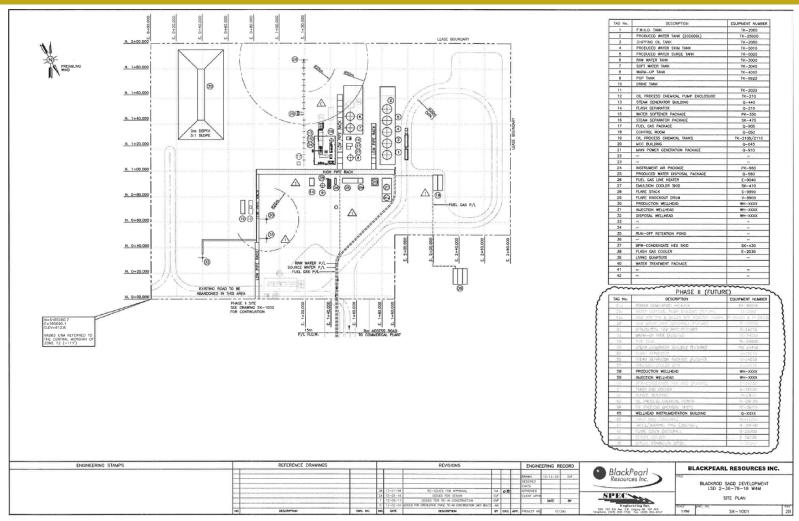
Blackrod Surface Operations

1. Facilities

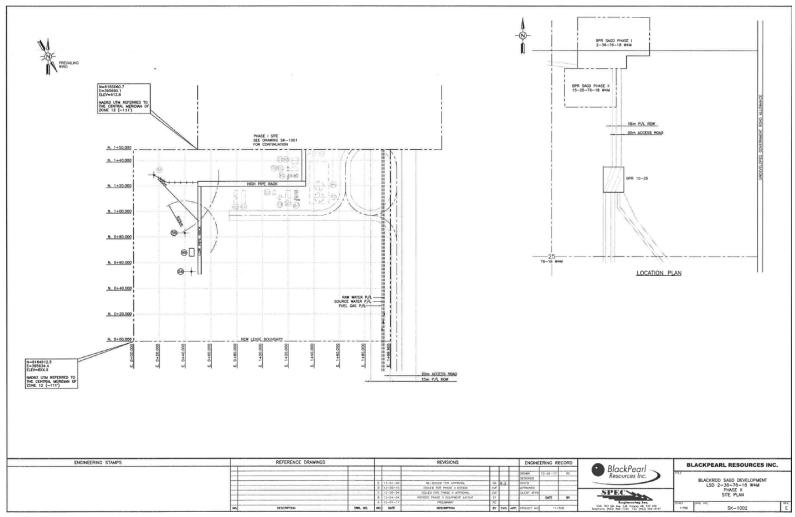
Pilot Facility Overview



Pilot Facility Plot Plan



Pilot Facility Plot Plan (cont.)



Pilot Facility Performance

- No issues with bitumen treatment, water treatment, or steam generation
- Pilot Facility downtime associated with scheduled shut-downs as well as the odd critical valve failure
- Generated steam, produced bitumen, produced water, and produced gas volumes reported to Petrinex
- Purchased gas volumes reported to Petrinex
- Flared gas volumes reported to AER and Petrinex
- SO₂ & No_x emissions and ambient air quality data submitted to AER both monthly and annually as per terms of EPEA Approval 00264736-00-00
- GHG emissions reporting not required for Blackrod Pilot Facility as per terms of EPEA Approval 00264736-00-00



Pilot Facility Modifications

• No facility modifications in 2014

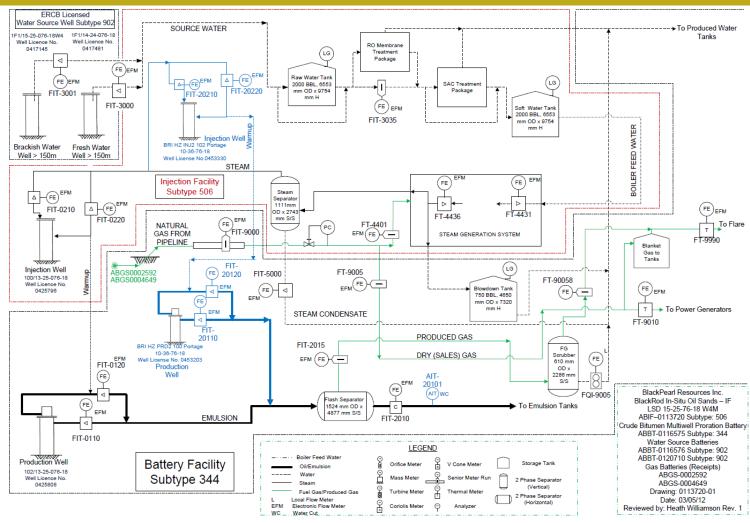
Blackrod Surface Operations

2. Measurement & Reporting

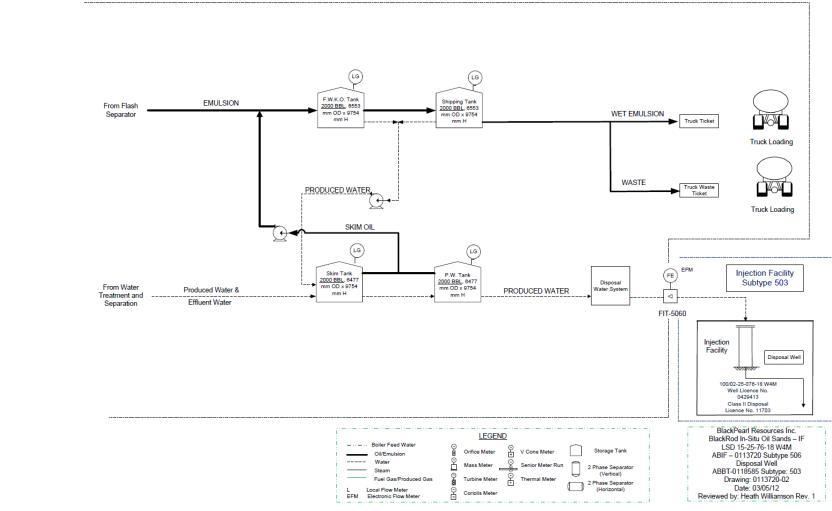
Blackrod MARP

- BlackPearl remains compliant with AER Directive 017 as well as Directive 042 as per the terms of our approved MARP (Measurement, Accounting, and Reporting Plan)
- To validate compliance with Directive 017 and Directive 042, BlackPearl performs a detailed EPAP (Enhanced Production Audit Program) review annually as per Directive 076 with an independent consulting group
- Annual MARP update to be submitted on Feb 28, 2015

Process Flow Diagram



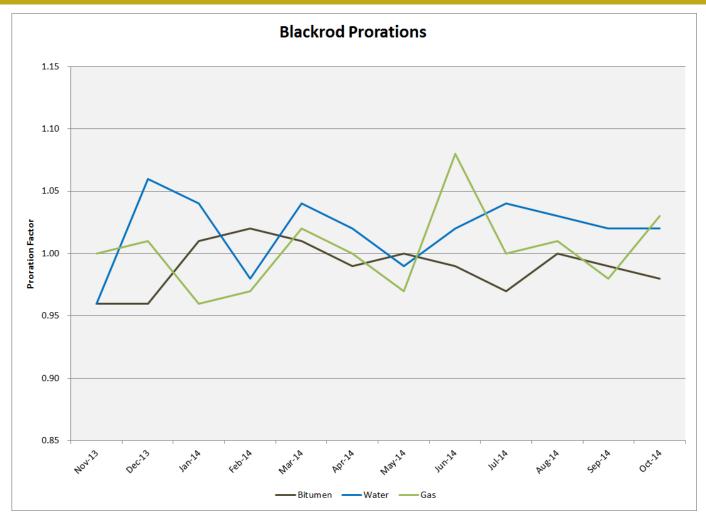
Process Flow Diagram (cont.)



Individual Well Testing

- The Blackrod Pilot Facility became a Crude Bitumen Multiwell Proration Battery in Nov-2013 when 10-36 WP2 was brought on-line
- Production volumes from both pilot well pairs are determined using the test-to-test method as per the terms of our approved MARP:
 - Both the 13-25 and 10-36 Producer wells are tested individually through the flash separator for 36 hours cumulative every month
 - Bitumen and water production rates are measured through a mass flow (coriolis) meter downstream the flash separator with BS&W cuts determined through a proportional fluid sampler
 - Total battery gas production is measured through the flare gas meter and is prorated to the 13-25 and 10-36 Producer wells based on the production volumes determined using the testto-test method

Proration Factors



Blackrod Surface Operations

3. Water Source

Blackrod Water Source(s)

- 1F1/14-24-076-18W4 L.GR3 WSW:
 - Non-saline (~3700 TDS)
 - AER Water Act Licence No. 00308617-01-00 valid until Jun 2019
 - Approved for 109,500 m³ annually
 - Production volumes reported to AER and Petrinex
 - 100/14-24-076-18W4 monitoring well 20 m North of 1F1/14-24 WSW
 - No issues with water treatment process
- 1F1/15-25-076-18W4 Grosmont Member D WSW
 - Saline (~12,800 TDS)
 - No issues with saline water softening process



Blackrod Surface Operations

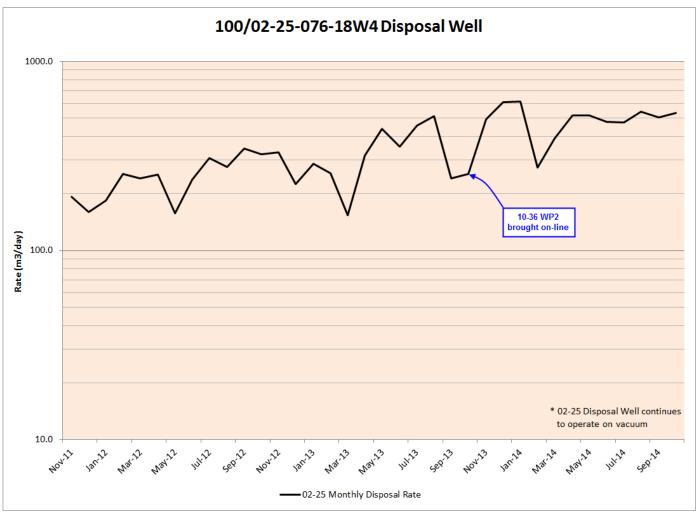
4. Disposal

Blackrod Disposal

- Produced Water:
 - -100/02-25-076-18W4 Class 1b Disposal Well
 - AER Scheme Approval No. 11703A
 - Disposal into Grosmont Members B, A
 - Maximum wellhead injection pressure of 6300 kPa
 - This well continues to operate on vacuum with no pressure at the wellhead
 - Disposal volumes reported to Petrinex
- Waste:
- Waste fluids (i.e. sewage, sludge, etc.) trucked out to third party disposal facilities



Blackrod Disposal



Blackrod Surface Operations

5. Environmental Issues

Blackrod Environmental

- No environmental issues to date
- BlackPearl remains compliant with the terms of AER Approval No. 264736-00-00:
 - -CPP (Caribou Protection Plan)
 - -Air Monitoring
 - -Groundwater Monitoring
 - -Soil Monitoring
 - -Etc.

Blackrod Surface Operations

6. Compliance

Blackrod Environmental

• To the best of BlackPearl's knowledge, the Blackrod SAGD Pilot Project is currently in full compliance with all conditions and regulatory requirements related to AER Scheme Approval No. 11522E



Blackrod Future Plans

Blackrod Future Plans

1. Ongoing Pilot Objectives

Ongoing Pilot Objectives

- Continue to ramp-up and optimize 10-36 WP2
- Plan and apply for a 3rd Pilot Well Pair incorporating flow control devices and a longer horizontal profile
- Plan and apply for NCG co-injection

Blackrod Future Plans

2. SAGD Commercial Development

SAGD Commercial Development

- 80,000 bbl/d (12,720 m3/d) to be developed in phases, with the first phase planned for 20,000 bbl/d; two additional phases of 30,000 bbl/d each to follow
- Commercial SAGD Application No. 1728831 submitted in Q2 2012 currently under AER review
- BlackPearl is awaiting AER approval





Appendices

Appendices

- 1. Pressure & Temperature Data
 - 13-25 WP1
 - 10-36 WP2
 - **Heel & Toe Observation Wells**