

BlackGold Project

Harvest Operations Corp.

Annual Performance – Commercial Scheme Approval No. 11387G

January 2020

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1.2	Geology / Geoscience
1.3	Drilling and Completions
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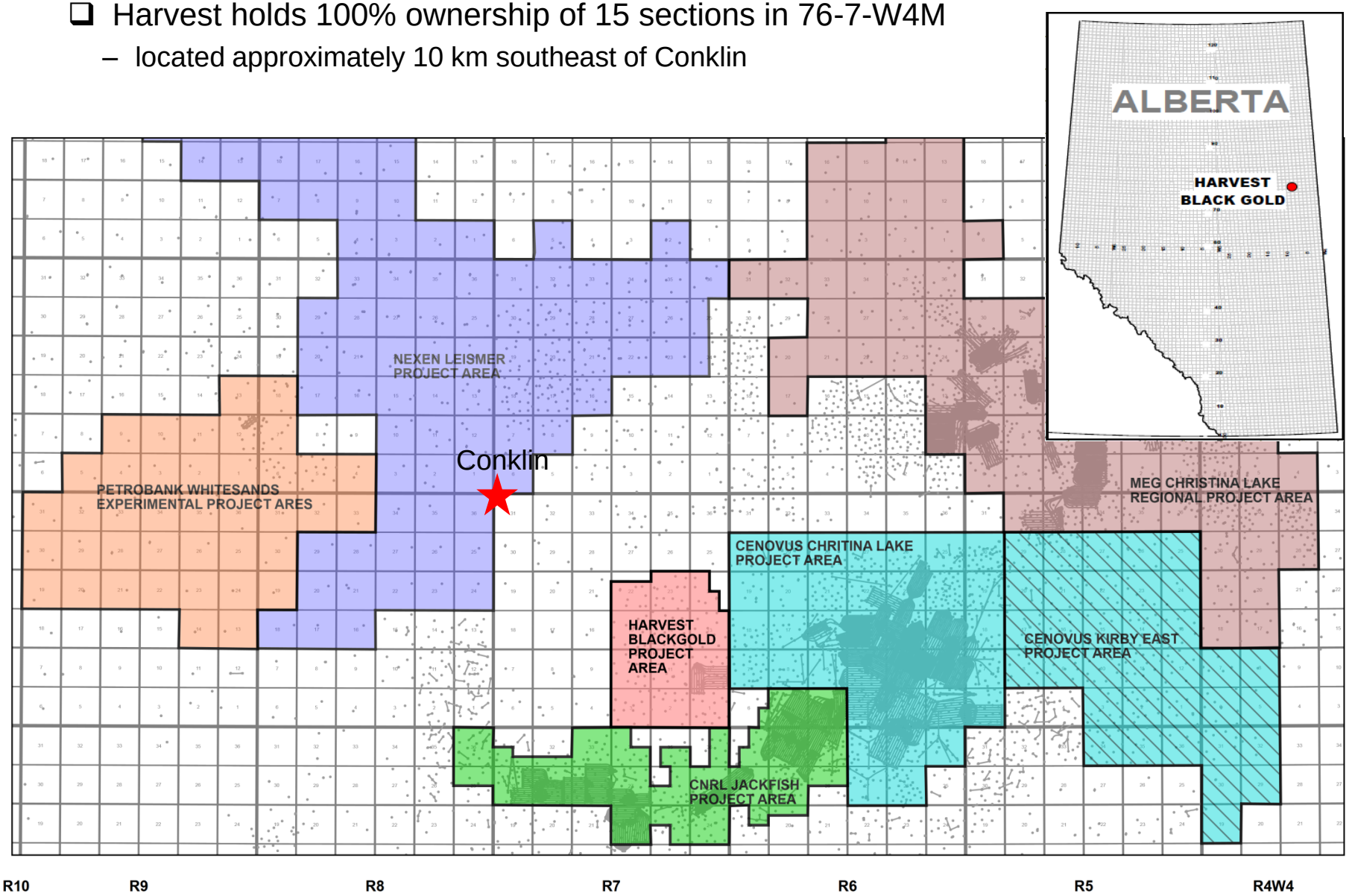
1.5	Instrumentation in Wells
1.6	Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1. Background

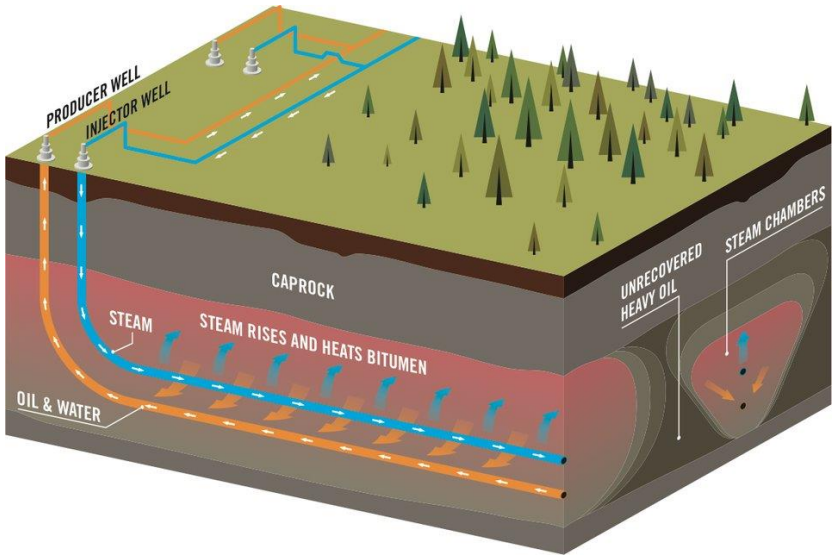
- Harvest holds 100% ownership of 15 sections in 76-7-W4M
  - located approximately 10 km southeast of Conklin



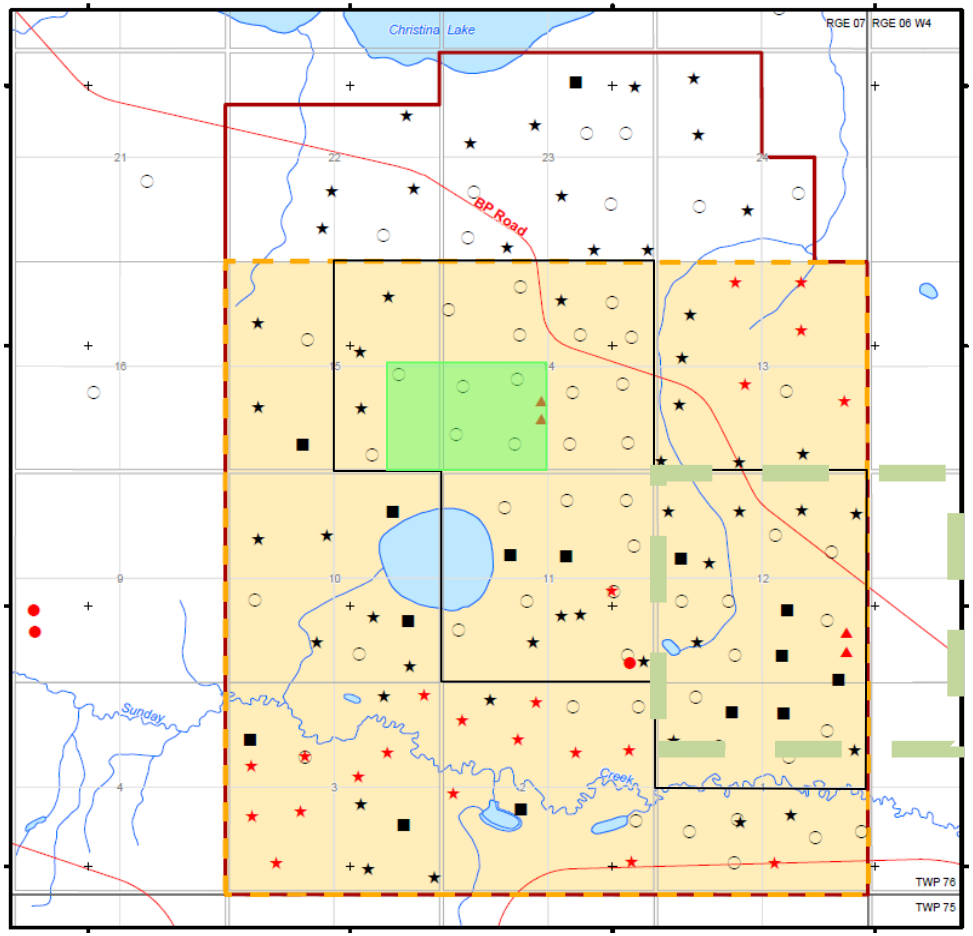
1. Background

- February 3, 2010 – Commercial Scheme Approval No. 11387 for BlackGold Phase 1 for 1,590 m^3/d bitumen recovered with the SAGD process.
- September 1, 2010 – Amendment Approval No. 11387A transfer of BlackGold Oil Sands Lease from KNOC Canada to Harvest Operations Corp.
- GEO 110308 4D Acquisition plan was Approved
- January 30, 2012 – Amendment Approval No. 11387B confirming minor modifications to the plot plan and modification of well trajectories.
- March 7, 2012 – Amendment Approval No. 11387C confirming a minor modifications to CPF.
- September 26, 2013 – Amendment Approval No. 11387D Phase 2 Application to produce an additional 3,180 m^3/d bitumen.
- April 22, 2014 – Amendment Approval No. 11387E – to reclassify well 1AA/06-12-077-06W4M
- September 26, 2014 – Amendment Approval No. 11387F – increasing the maximum bottom hole operating pressure of the pilot well pairs from 4,000 kPag to 5,500kPag during steam circulation.
- June 15, 2018 – Amendment Approval No. 11387G – increasing the maximum bottom hole operating pressure of the pilot well pairs from 4,000 kPag to 5,000kPag during SAGD operations.
- Dec 10, 2018 - GEO 180081 4D Acquisition plan was approved

SAGD Recovery



1. Background



- Project Area
  - Initial Project Area
  - Central Production Facility
  - Expansion Project Area
- Exploration Activity
  - Drilled before 2006 (52 wells)
  - Drilled 2007 (19 wells)
  - Drilled 2008 (32 wells)
  - Drilled 2009 (30 wells)
  - 3D Seismic (23 km^2) 2009
  - 4D Seismic (4.5 km^2) Under GEO180081 (approved area (35.9km^2))

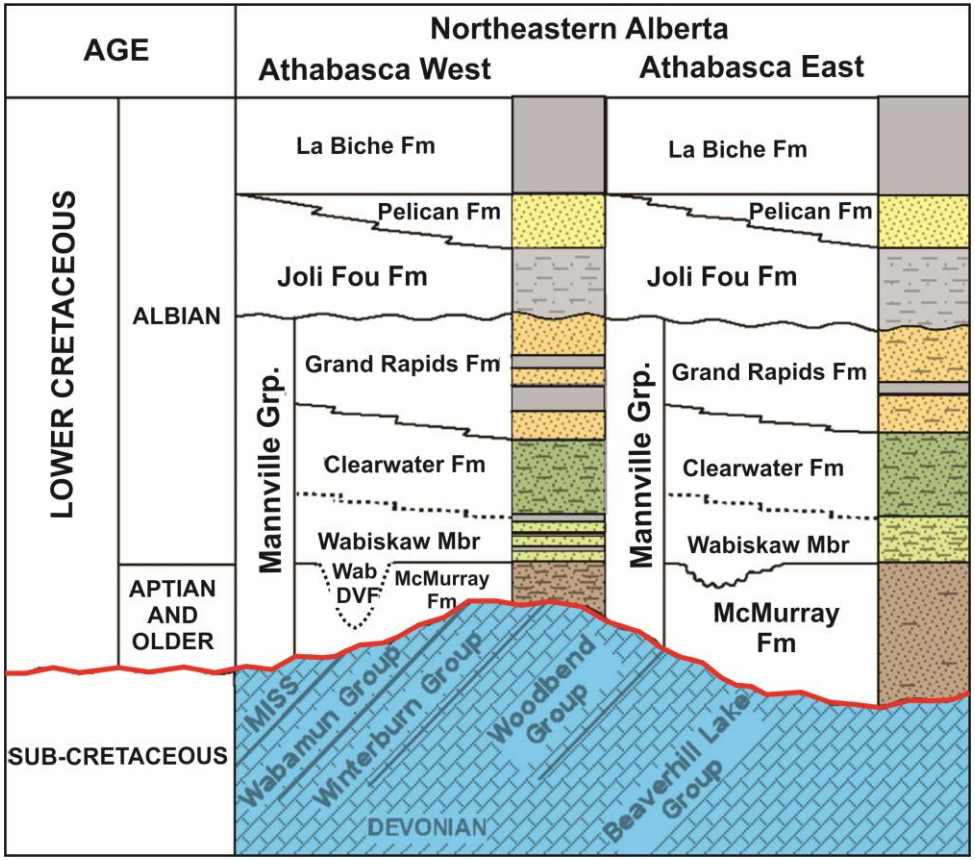
Agenda – 1.2 Subsurface

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	4-D Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1.2 Geology / Geoscience – Stratigraphy

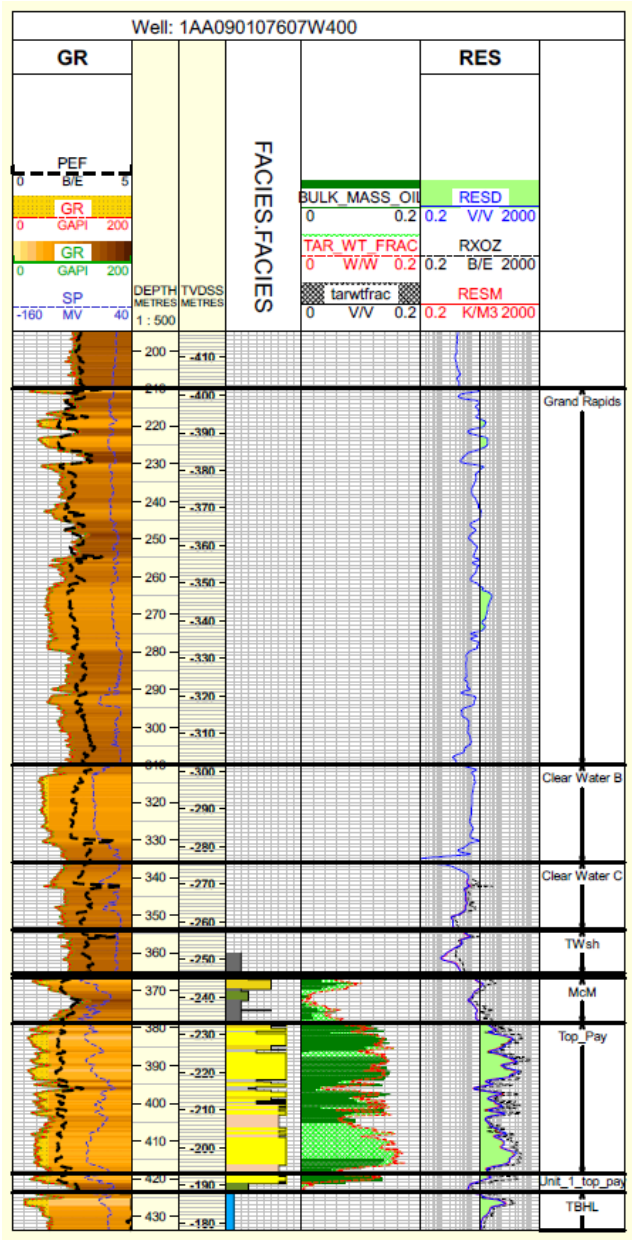
- General Stratigraphy

Stratigraphic Column



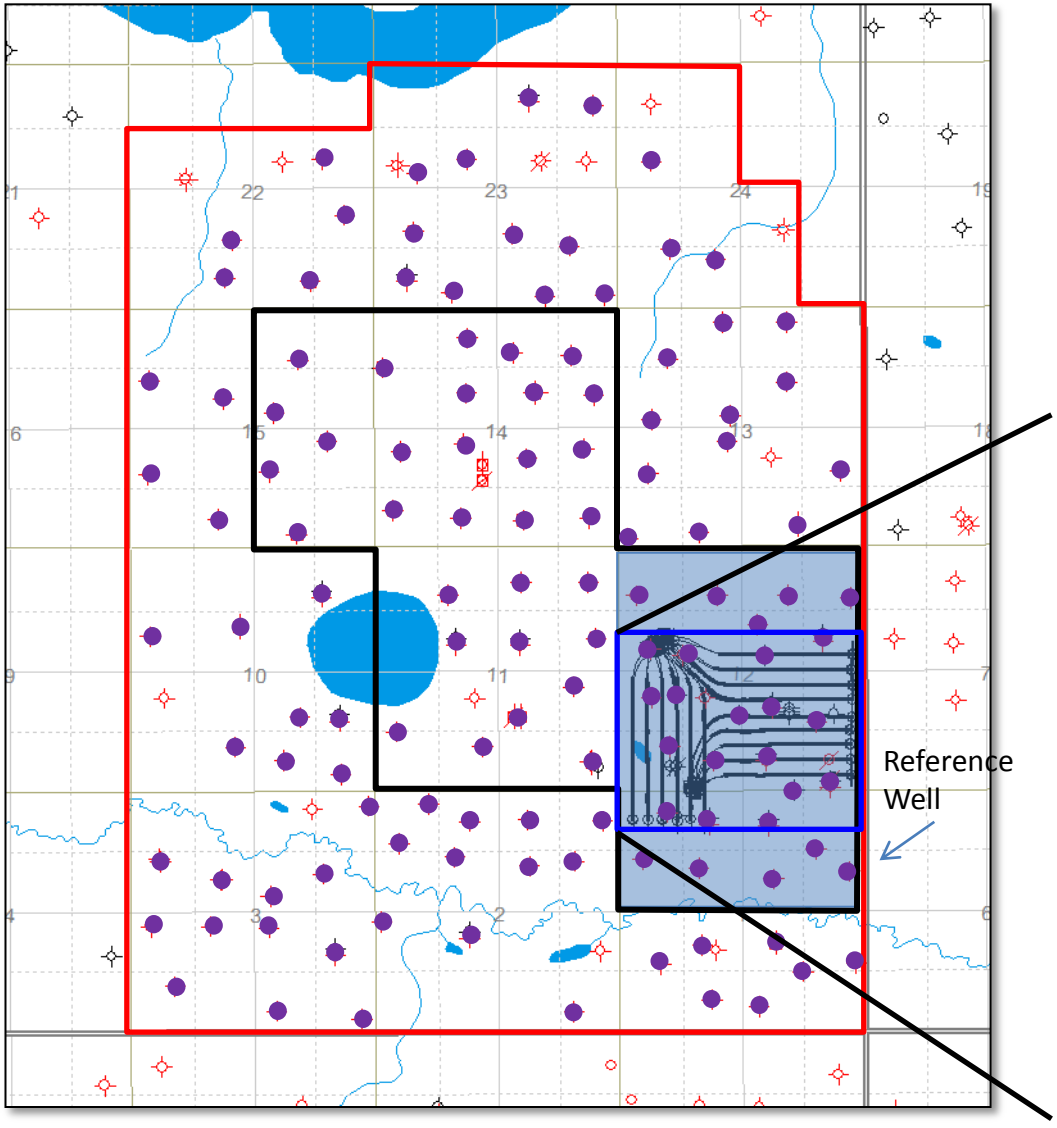
Source: Wightman & Pemberton, 1997

Reference Well 9-1-76-7W4M



1.2 Geology / Geoscience

❑ Location Map



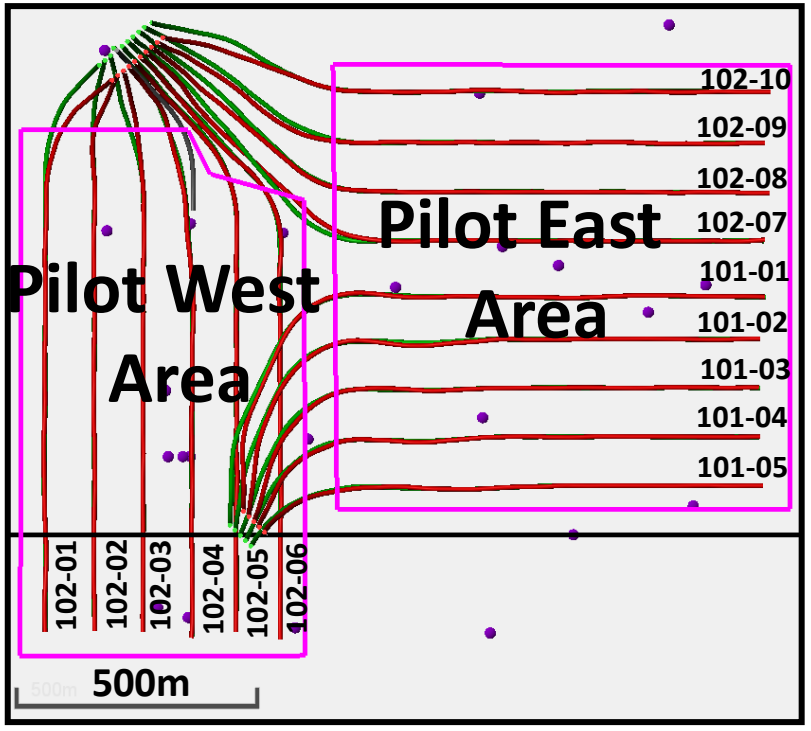
Legend

: Expansion area

: Initial area

: Initial Development Area

: Well with core (131 wells)

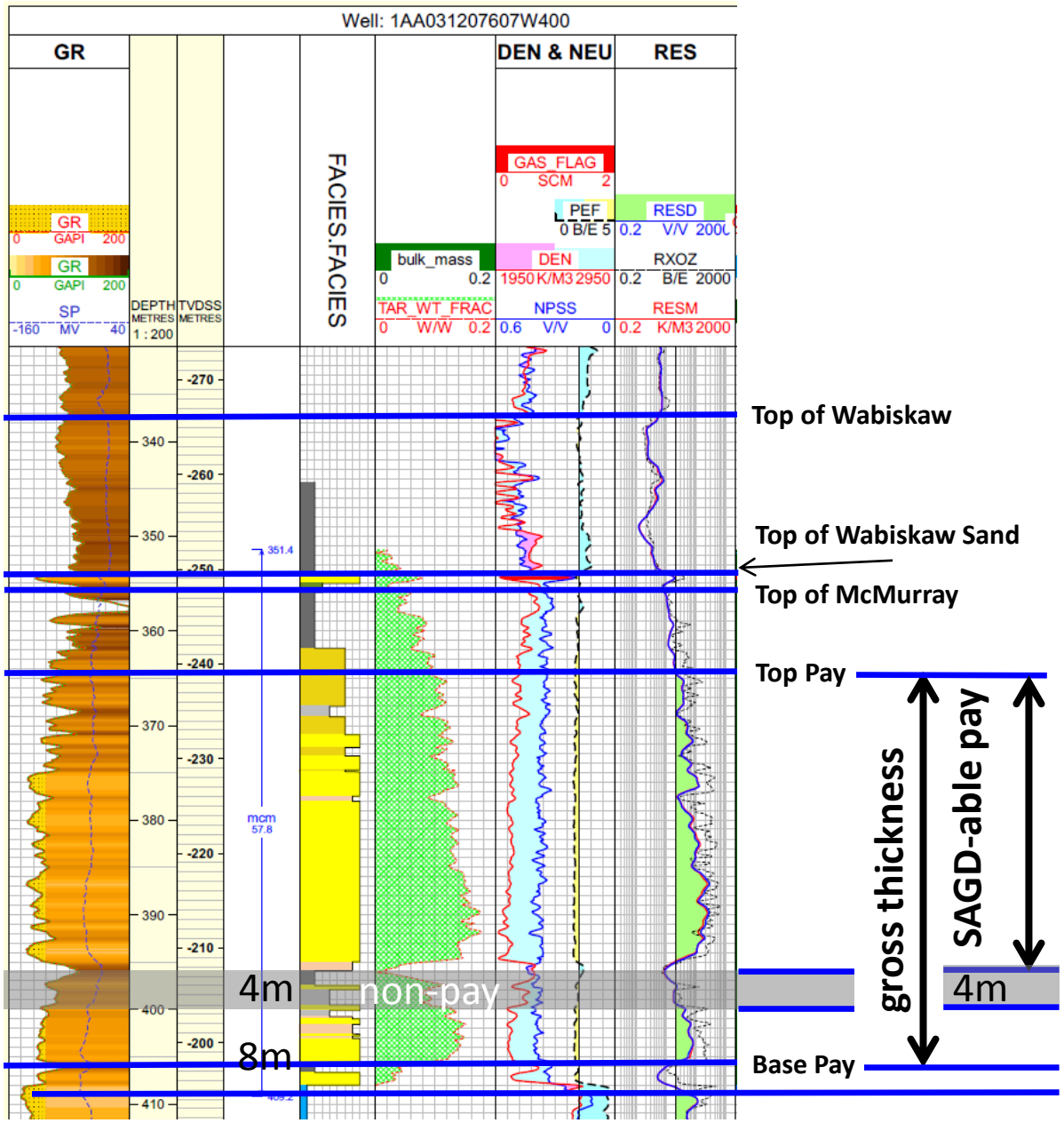


1.2 Geology / Geoscience

BlackGold McMurray Approved Area Average Reservoir Properties:

Property	McMurray Project Expansion Approved Area	Pilot East Area (Pad 101, Pad 102-7-10)	Pilot West Area (Pad 102-1-6)
Reservoir Top Depth, m TVD	350 - 370	350 - 370	350 - 370
Reservoir Bottom Depth, m TVD	400 - 410	400 - 410	400 - 410
Original Reservoir Pressure , kPa	2600	2600	2600
Original Reservoir Temperature, ^{o}C	12	12	12
Reservoir Thickness, m	25 - 30	33 - 43	22 - 37
Netpay Thickness, m	18 - 23	29 - 39	19 - 30
Porosity, %	31 - 32	31 - 33	31 - 33
Initial Bitumen Saturation, %	78 - 81	79 - 86	75 - 84
OBIP, MM m3	69 - 73	6.7	3.7

1.2 Geology / Geoscience – Pay Definition



GROSS BITUMEN IN PLACE (GBIP)

Petrophysical Criteria for bitumen pay:

- *Resistivity (RT) >= 20 ohm-m*
- *Porosity (DPSS) >= 27%*

SAGD-able BIP (SBIP)

SBIP = continuous (>10m thick) GBIP

Non-SAGD-able BIP (N-SBIP)

N-SBIP = continuous (<10m thick) GBIP

NOTE 1: 10m continuous pay is defined from cores, images and well logs.

NOTE 2: >1m thick shale commonly defines the top of the pay interval.

EXAMPLE 1

Pay Interval 1:

204m – 198m = 6m (*since <10m*) → **NSBIP**

Pay Interval 2:

239m – 208m = 21m (*since >10m*) → **SBIP**

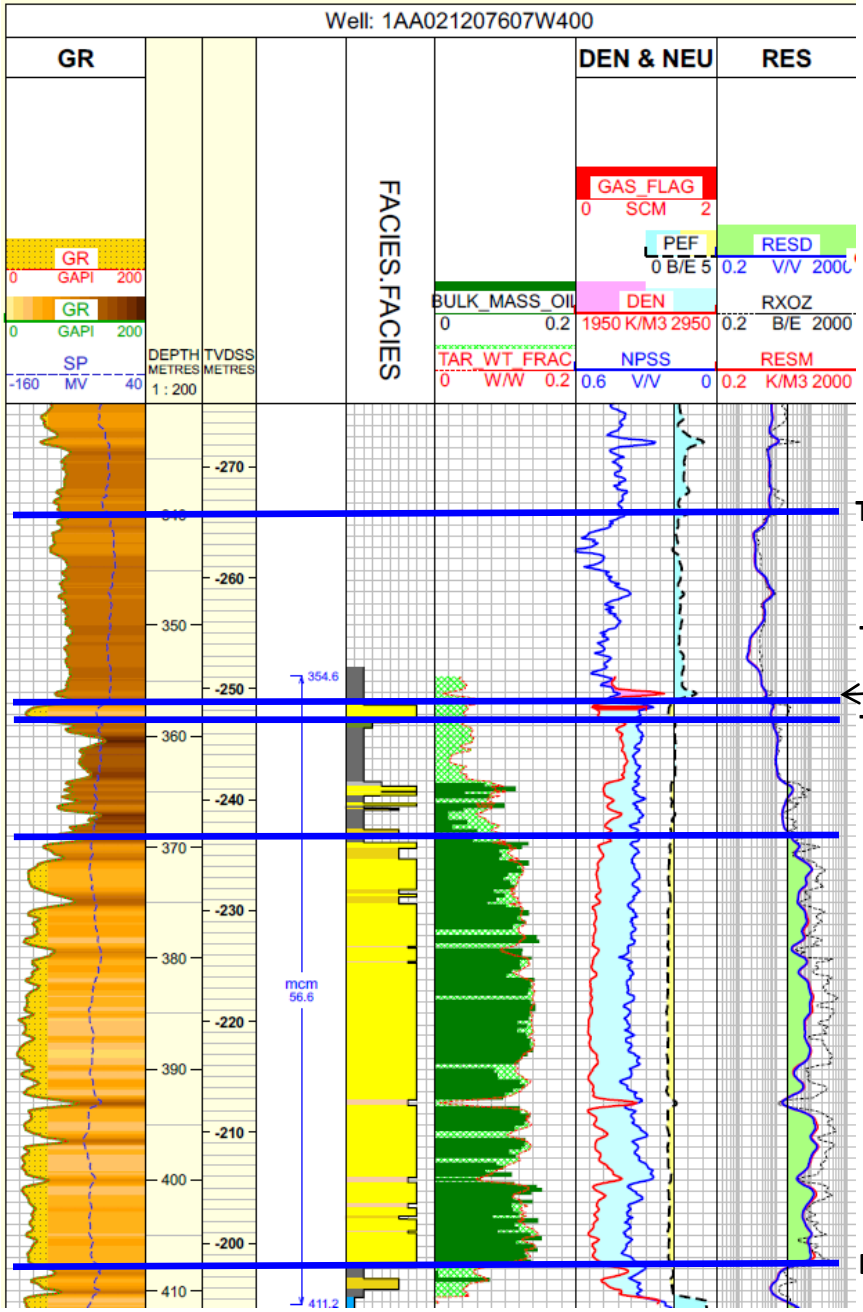
Non-pay interval:

208m-204m=4m (since >1m separates pay)

Gross Thickness: 239m – 198m = 41m

GBIP: 43m – 4m = 39m

1.2 Geology / Geoscience – Pay Definition



GROSS BITUMEN IN PLACE (GBIP)

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Non-SAGD-able BIP (N-SBIP)

N-SBIP = continuous (<10m thick) GBIP

NOTE 1: 10m continuous pay is defined from cores, images and well logs.

NOTE 2: >1m thick shale commonly defines the top of the pay interval.

EXAMPLE 2

Pay Interval 1:

237m–197m = 40m (*since <10m*) → **SBIP**

Pay Interval 2: **NA**

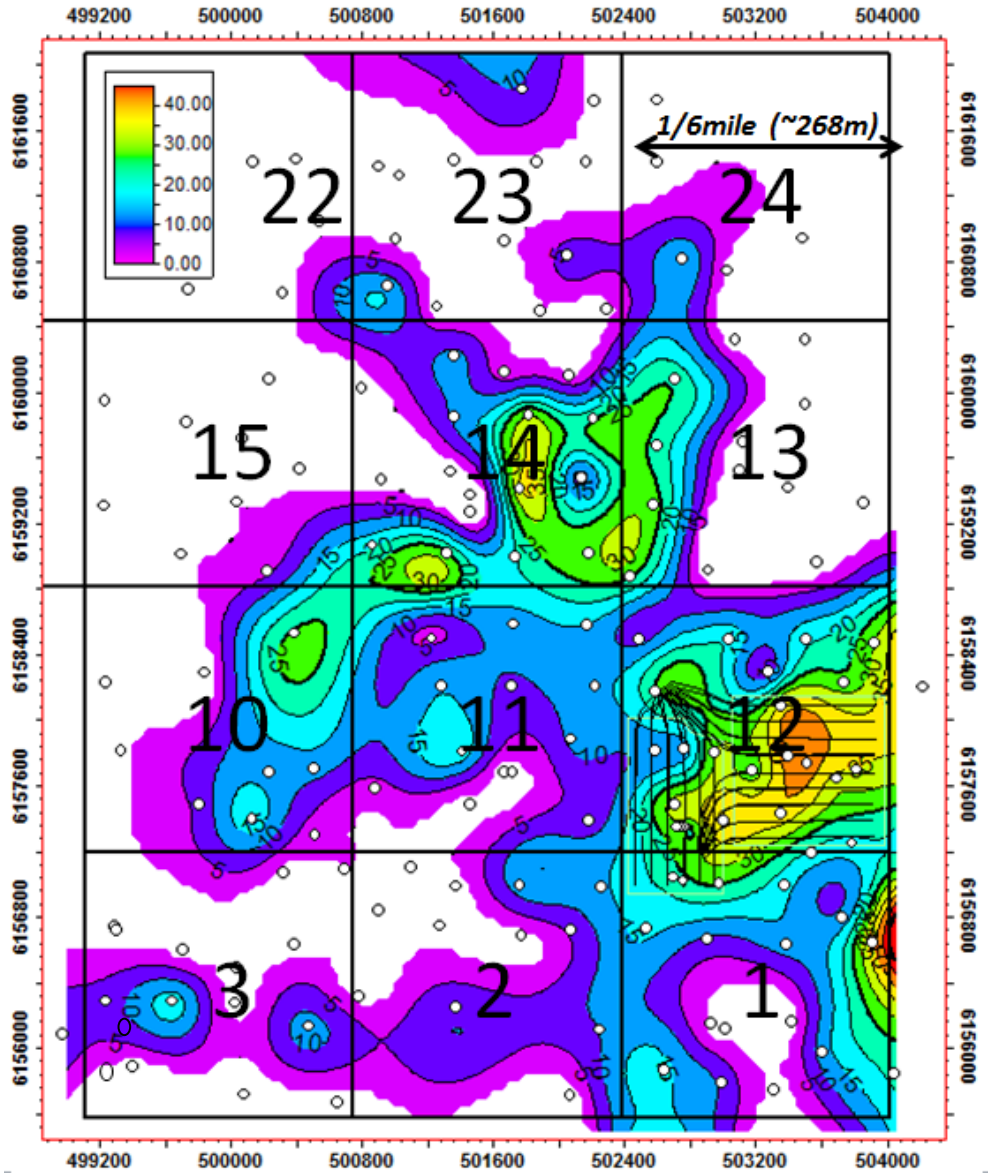
Non-pay interval: **NA**

Gross Thickness: 237m – 197m = 40m

GBIP: 40m – 0m = 40m

1.2 Geology / Geoscience (2c)

- Net pay – entire area with OBIP (GBIP_NET) – McM only



Legend

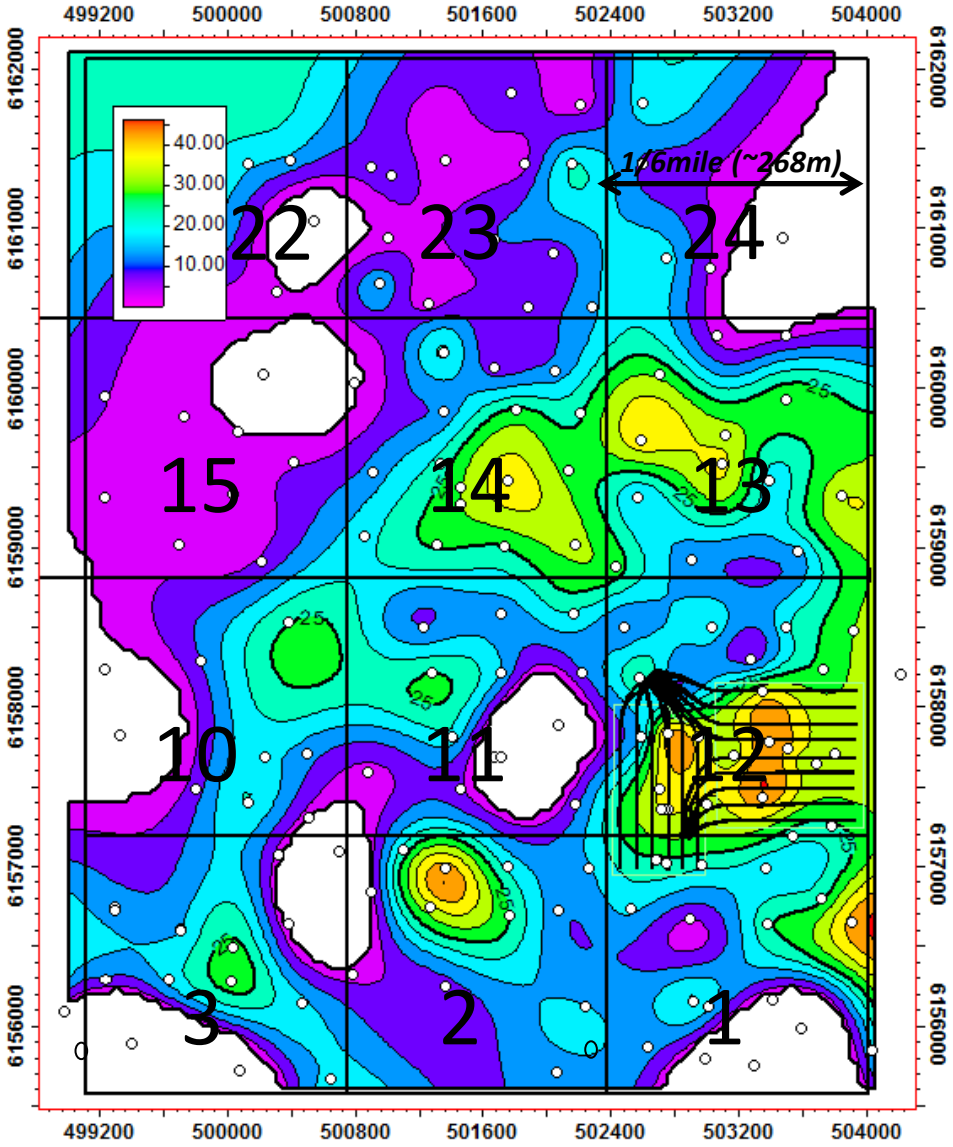
○ Vertical Well Locations

Contour Interval

5M

1.2 Geology / Geoscience

❑ Total Pay Thickness - GBIP_ISO



Legend

○ Vertical Well Locations

Contour Interval

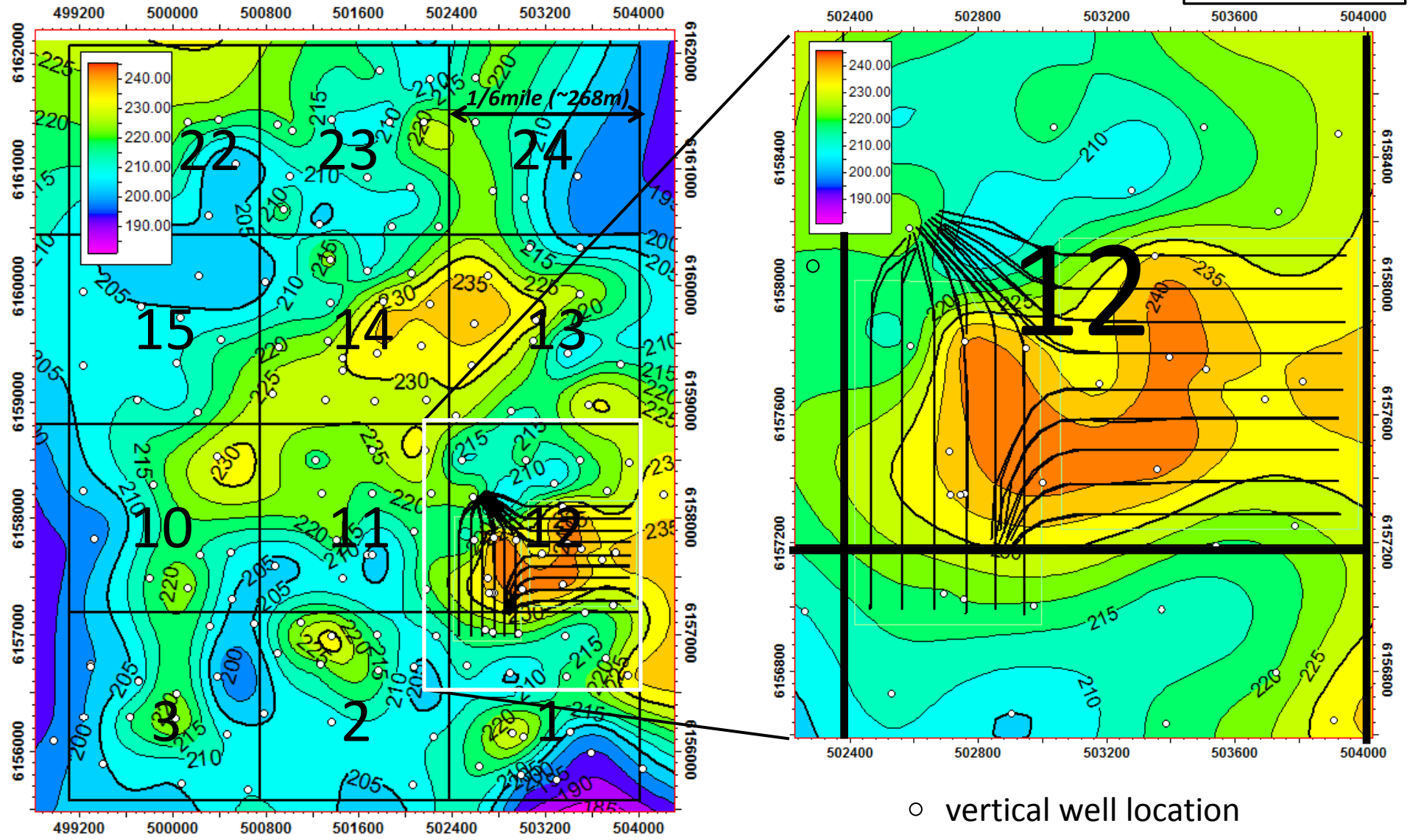
5 m

1.2 Geology / Geoscience (2d)

❑Structure map for top of bitumen pay

Contour Interval

5 m



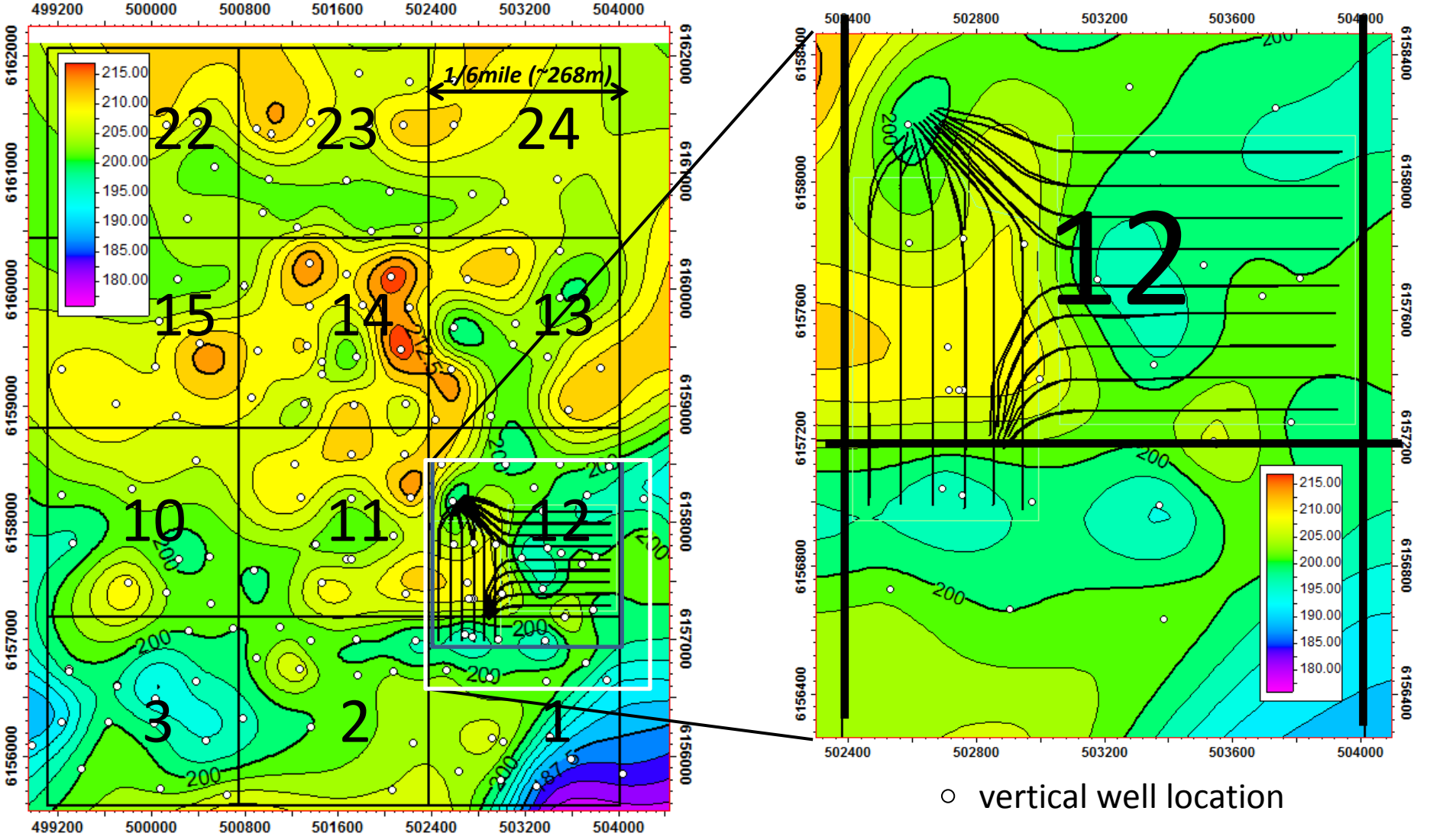
○ vertical well location

1.2 Geology / Geoscience

❑Structure map for base of bitumen pay

Contour Interval

2.5 m

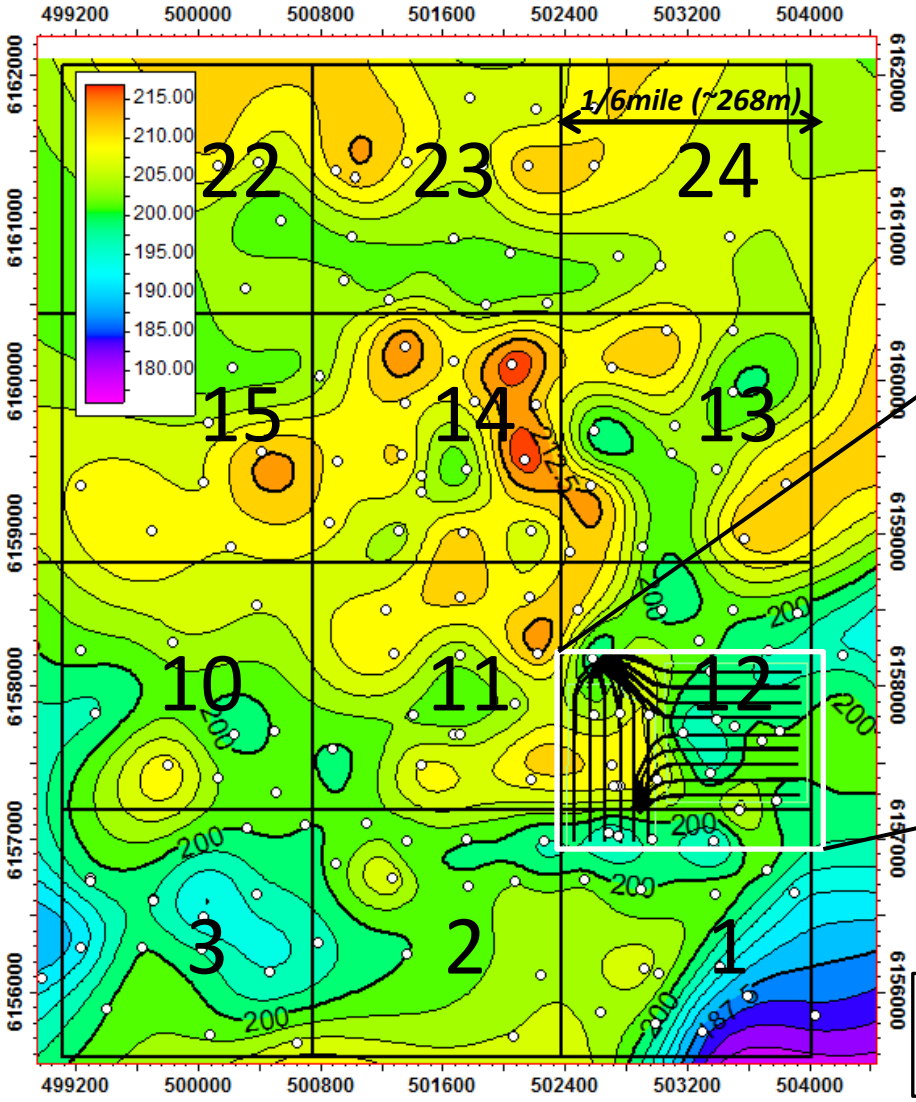


- vertical well location

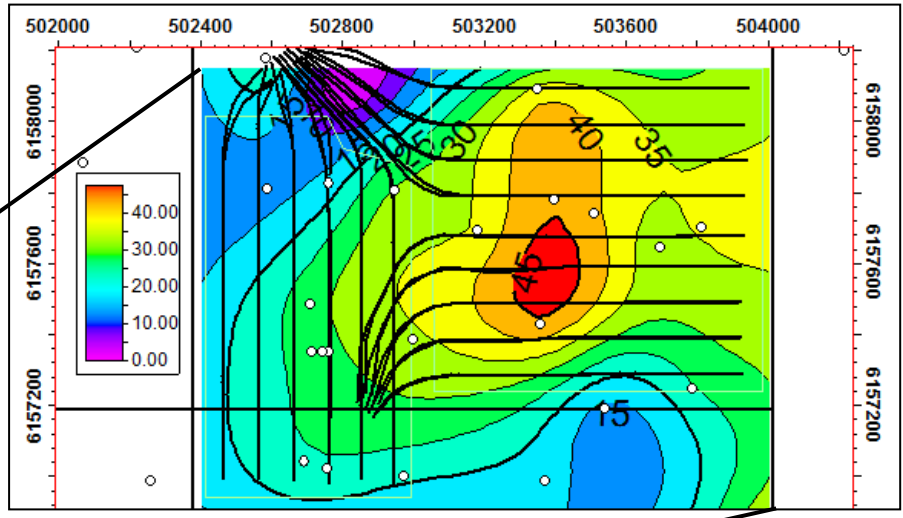
1.2 Geology / Geoscience

❑ Structure map for bottom of bitumen pay

Contour Interval
5 m



pay above producers

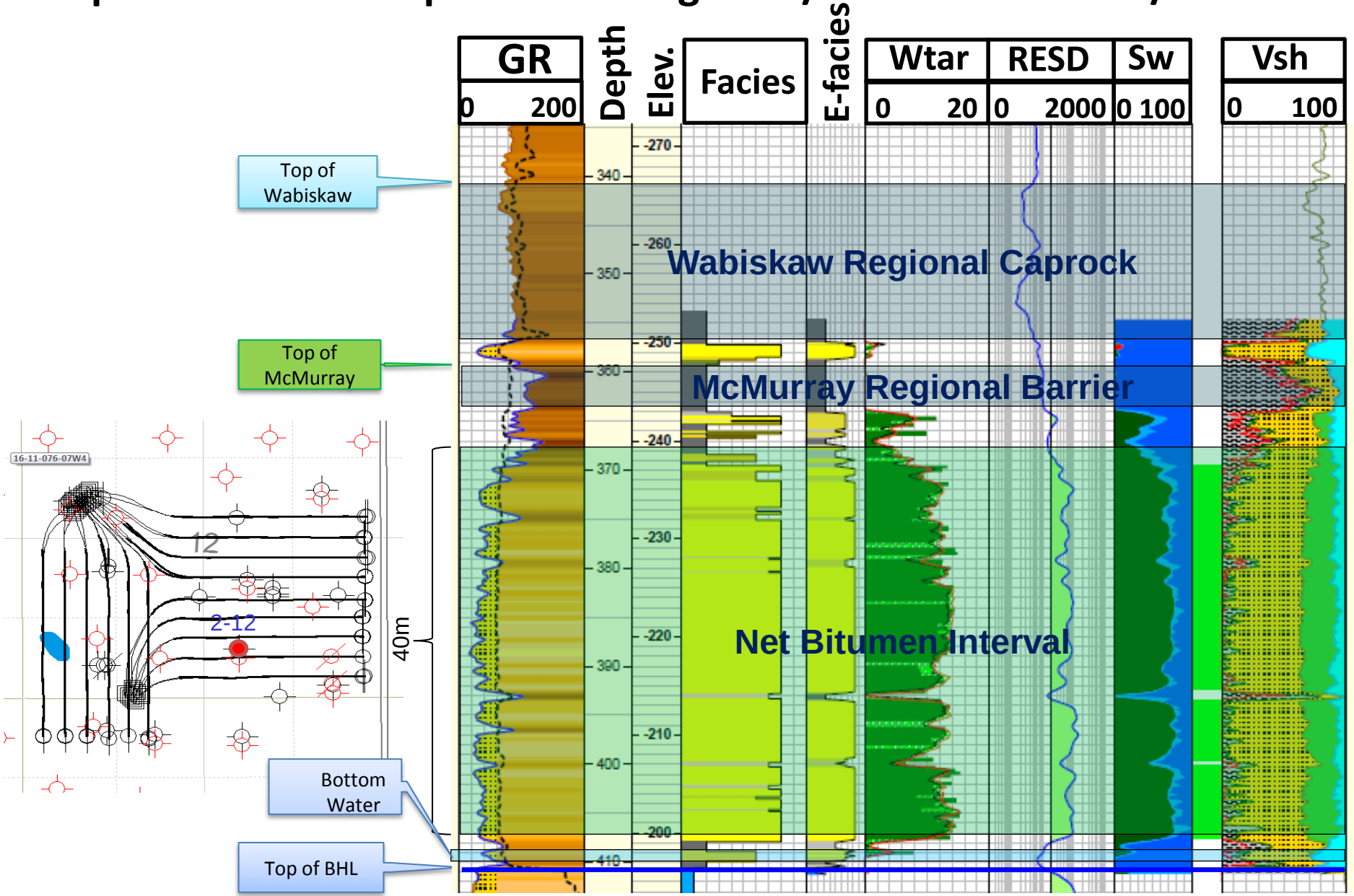


Contour Interval
2.5 m

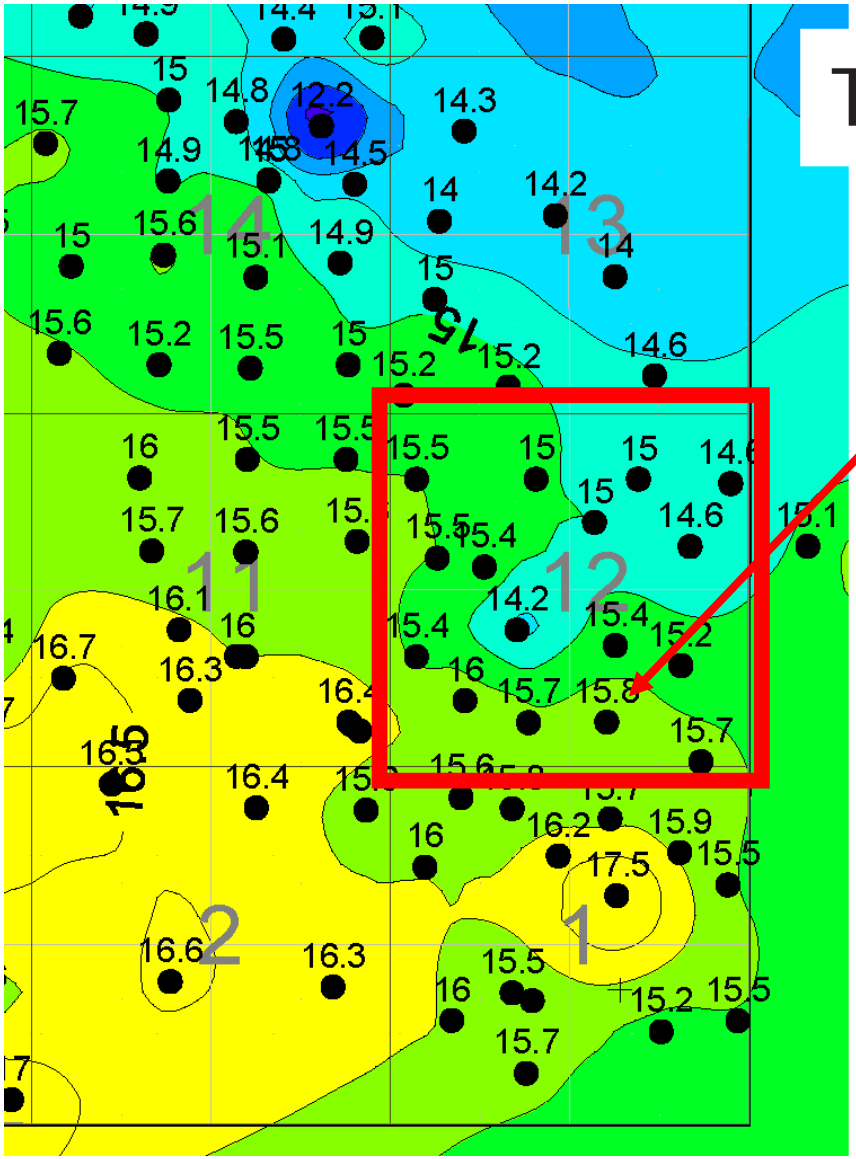
1.2 Geology / Geoscience (2e)

Harvest OPERATIONS CORP.

❑ Representative composite well log: 1AA/02-12-076-07 W4/0



BlackGold McMurray Reservoir Caprock-Wabiskaw Regional Marine Shale

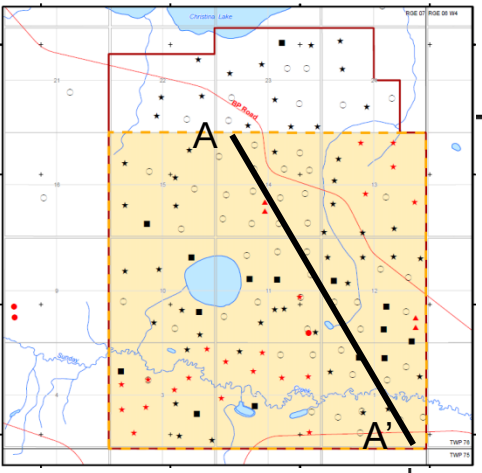


Reference Well 1AA/02-12
(previous slide)

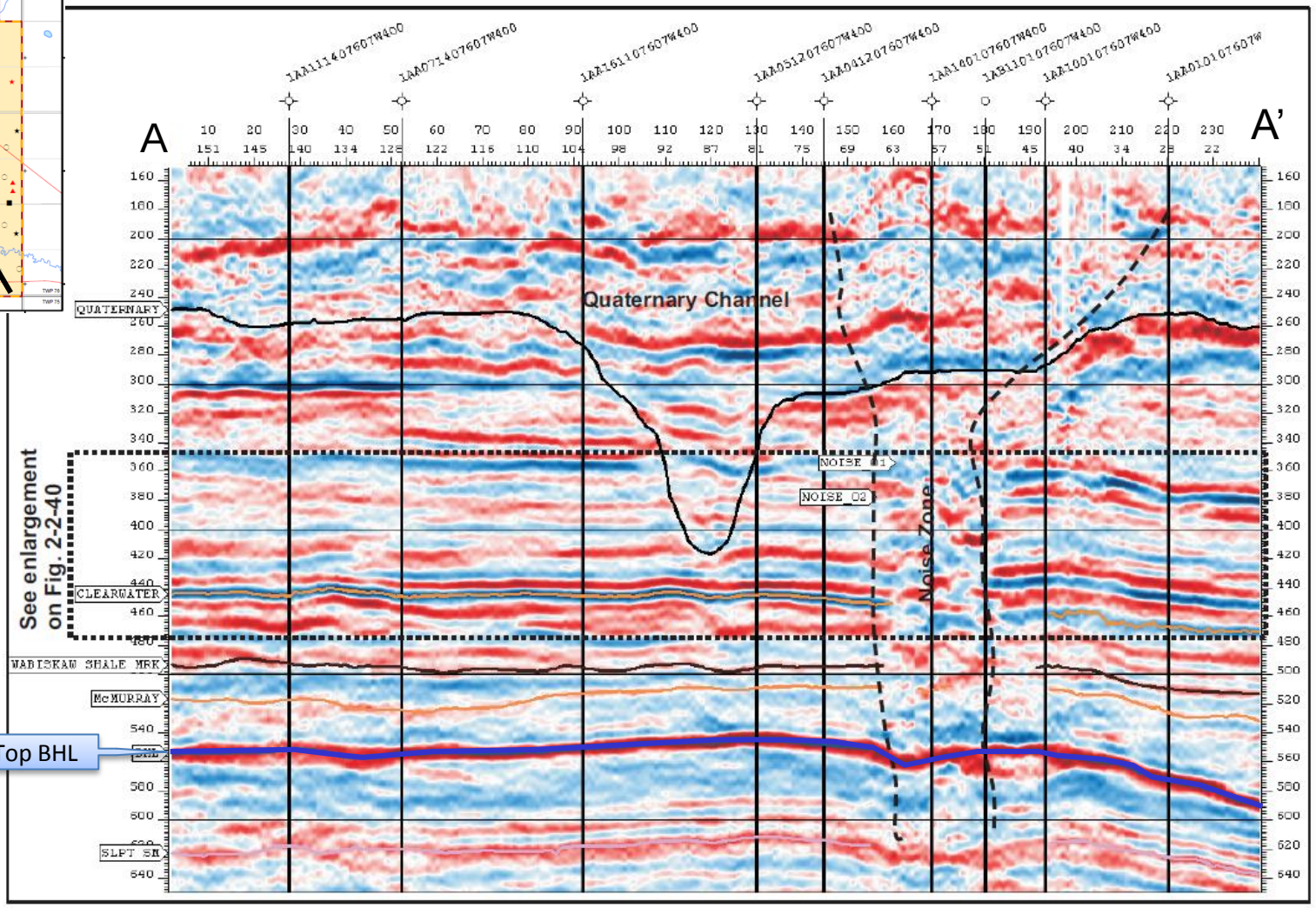
SAGD area,
Sec 12

Wabiskaw Marine Shale Isopach
Harvest Blackgold Project
Contour interval = 0.5 m
(modified from July 2008)

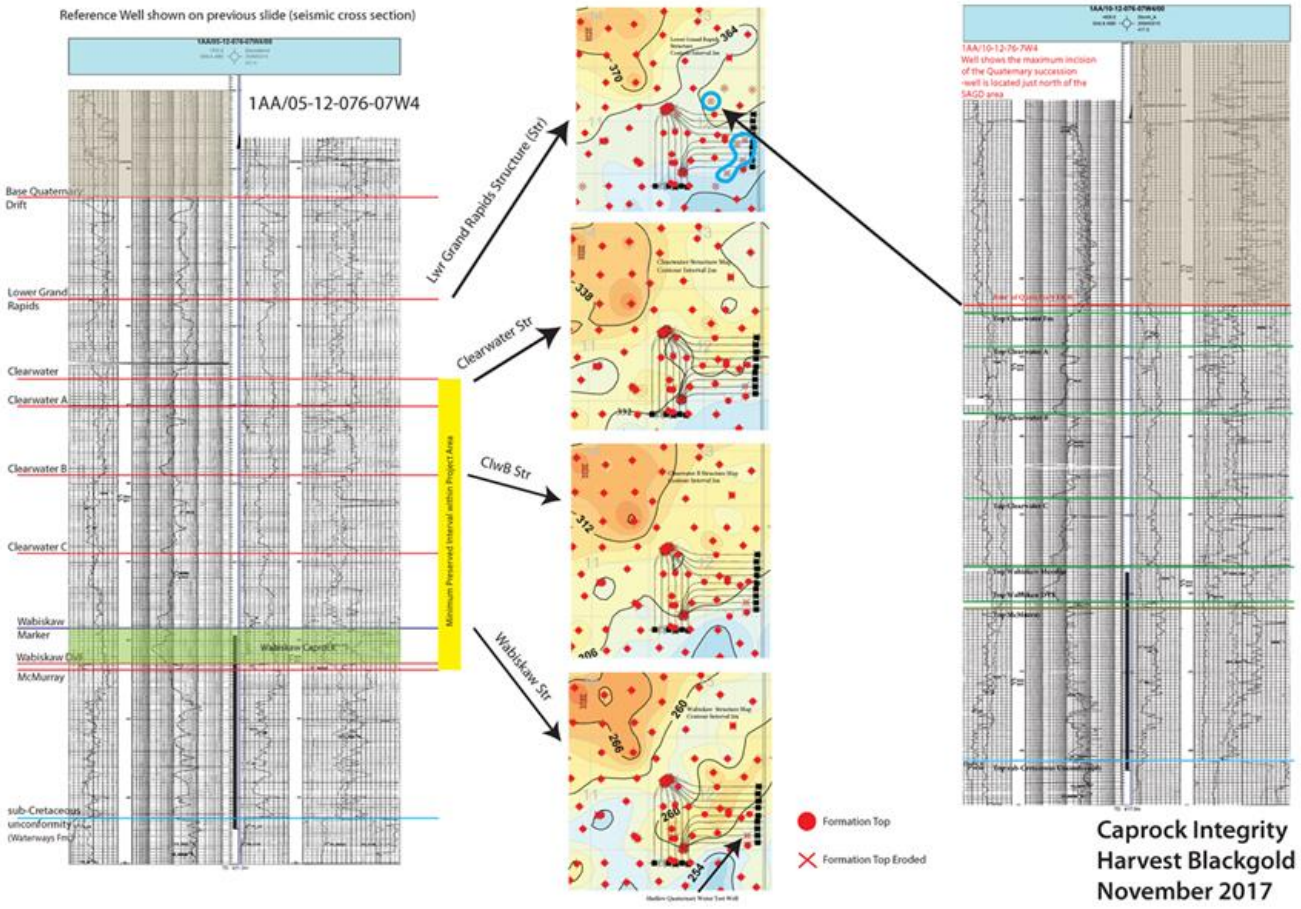
❑ BlackGold seismic cross section

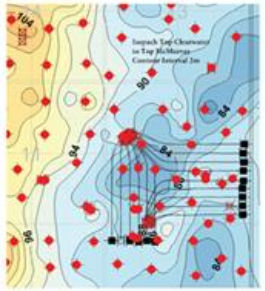


The Q-channel has been incised in Wabiskaw shale formation, BlackGold Oilsands Reservoir's main caprock.



Quaternary Channel Incision – BlackGold Project Area





Map showing the thickness from the top of the Clearwater Fm. to the top of the McMurray Fm. (interval highlighted in yellow, 5-12 ref well)

Summary

1) All wells within the Blackgold SAGD area display formation tops from the McMurray Formation to the top of the Clearwater Formation (no erosion). There is no evidence these formations have been comprimised by Quaternary incision.

2) The majority of wells within the SAGD area display a well-defined Lower Grand Rapids top.

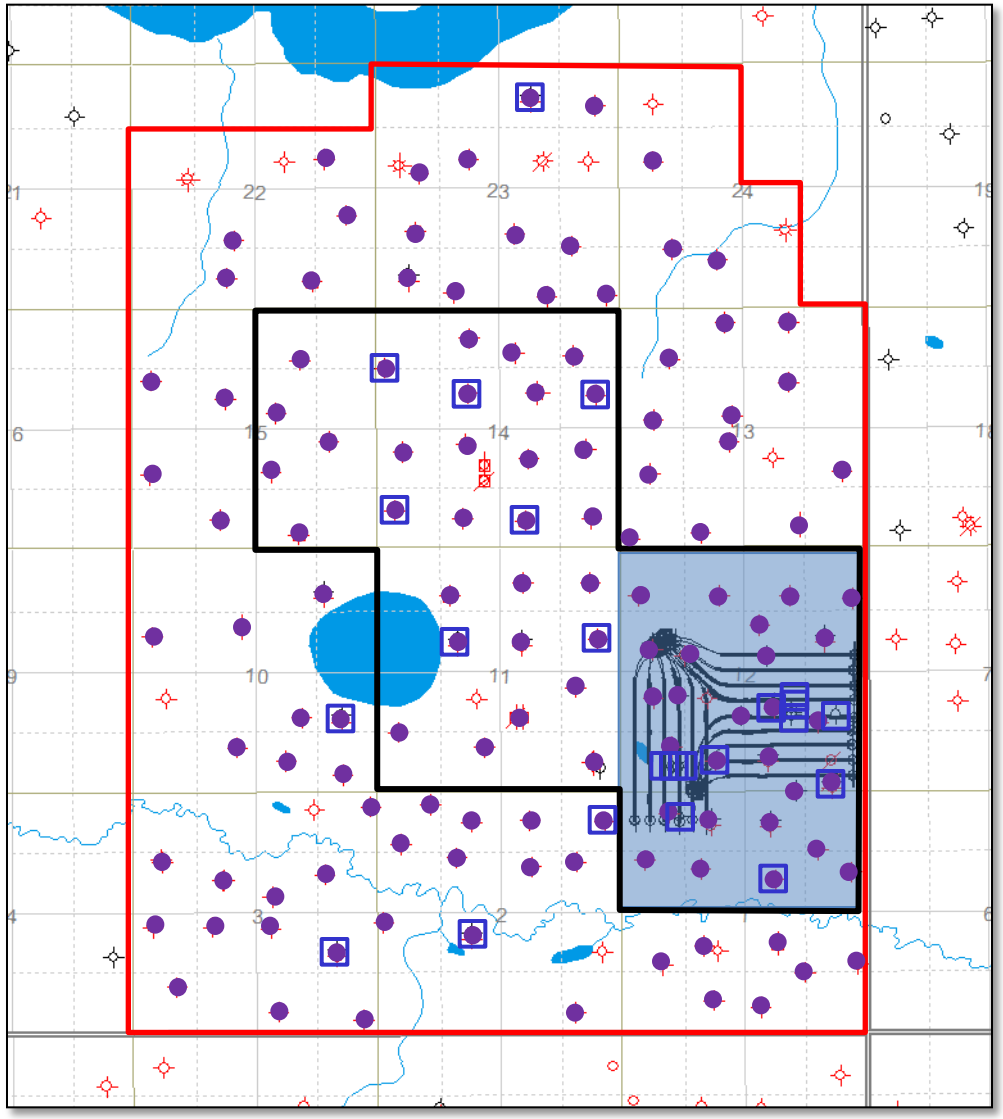
3) The Quaternary sucession does incise into the top of the Lower Grand Rapids in 4 wells within SAGD area.

4) The Quaternary does not incise into the top of the Clearwater shale (Clearwater Formation) within any of the Harvest's Blackgold oil sand leases.

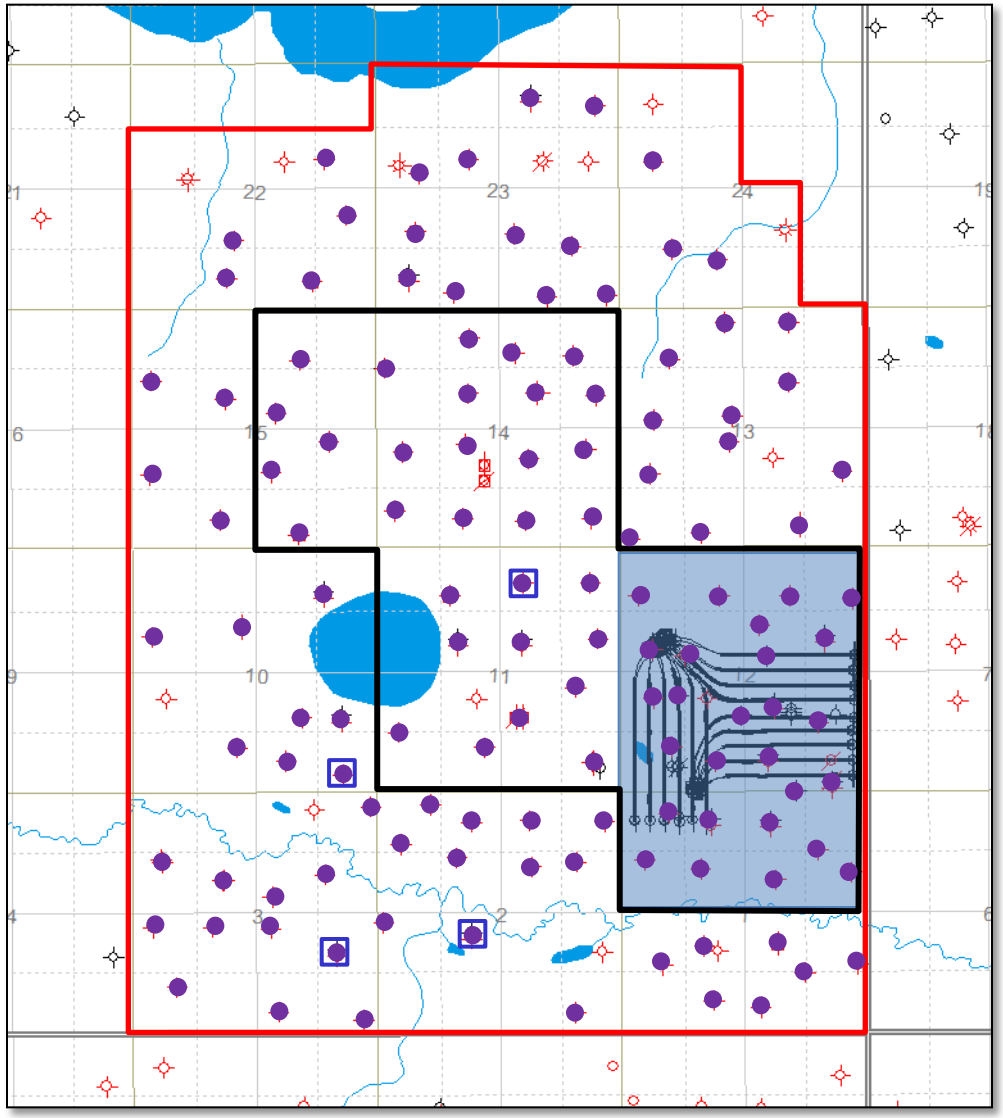
5) There is a minimum thickness of 84 m between the top of the McMurray Formation and the top of the Clearwater Formation.

1.2 Geology / Geoscience (2f,g)

❑ Existing cores and Formation Micro-Imager (FMI) logs



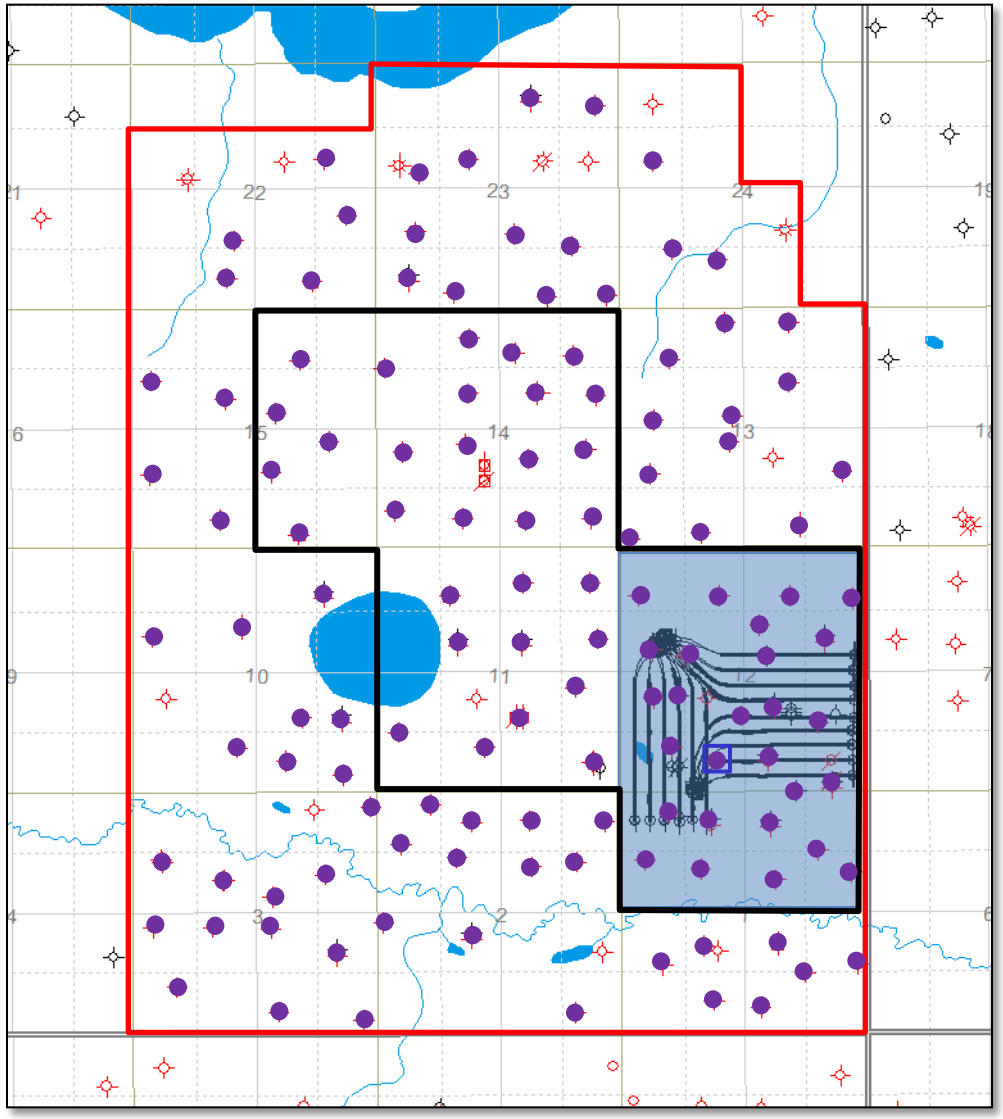
❑ Existing cores with bitumen viscosity measurements



Legend

- : Expansion area
- : Initial area
- : Initial Development Area
- : Well with core (131 wells)
- : Well with bitumen viscosity data (4 wells)

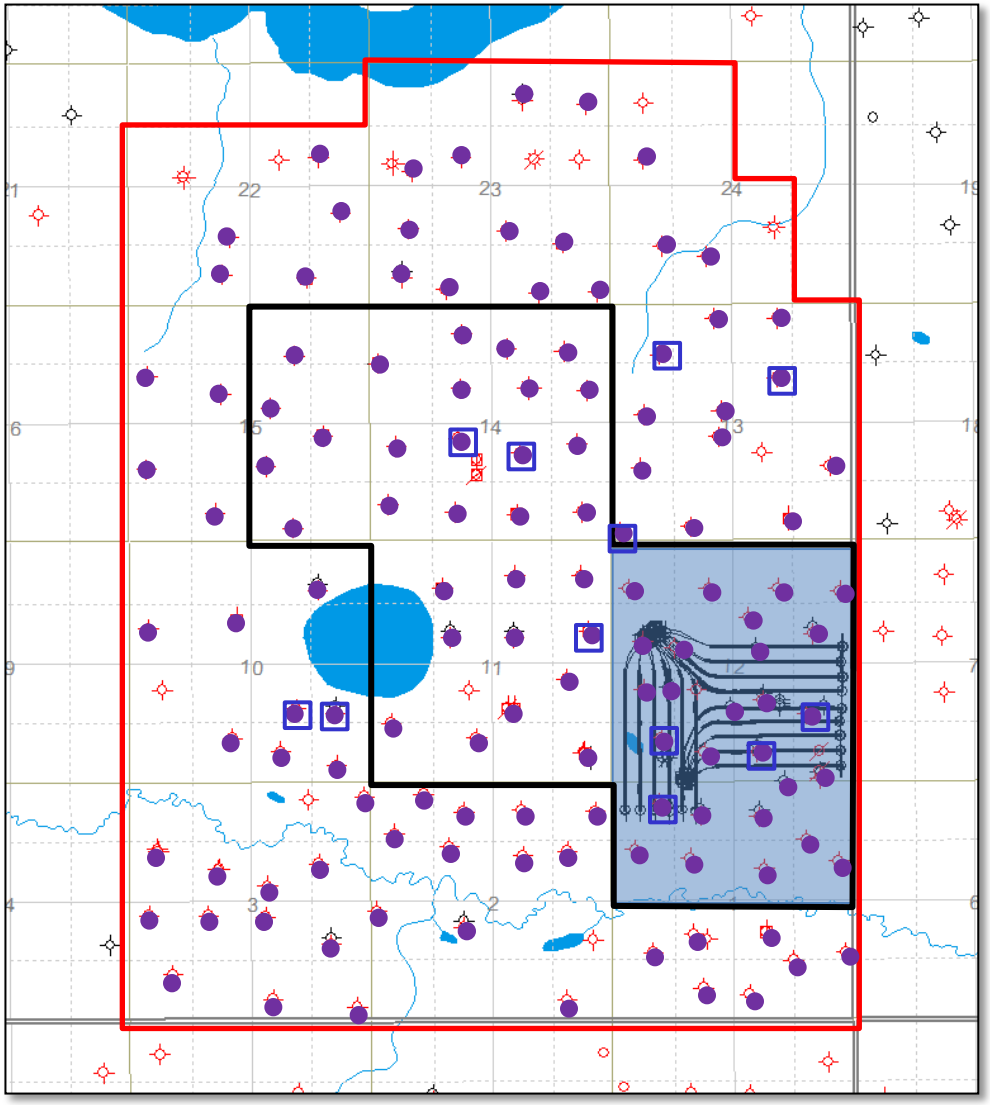
❑ Existing cores with Hyper-Spectra imaging and XRF



Legend

- : Expansion area
- : Initial area
- : Initial Development Area
- : Well with core (131 wells)
- : Well with hyper-spectra imaging and XRF (1 well) (1AA 03-12-076-07 W4)

❑ Existing cores with Gas Chromatography Mass Spectrometry



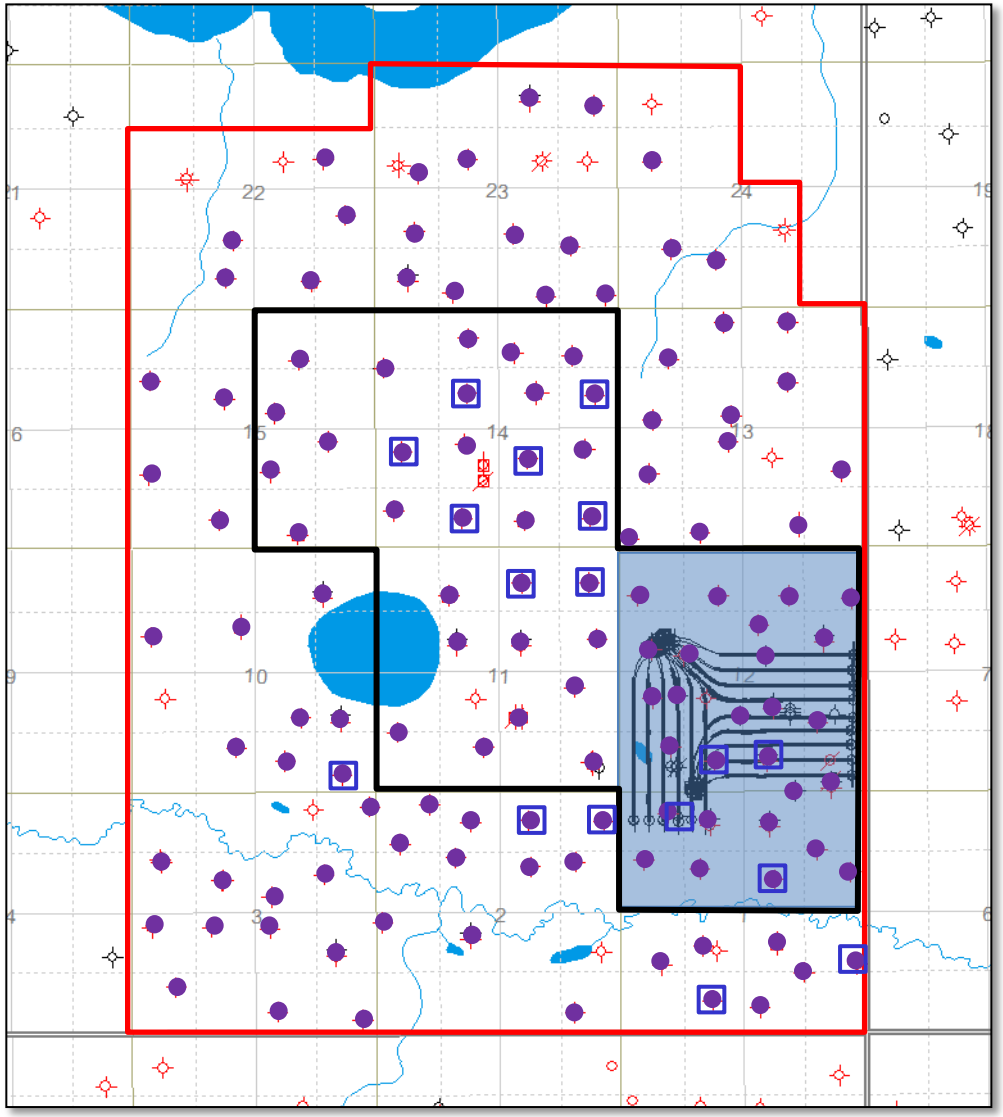
Legend

- : Expansion area
- : Initial area
- : Initial Development Area
- : Well with core (131 wells)
- : Wells with GCMS (12 wells)

1	1AA 13-01-076-07
2	1AA 08-12-076-07
3	1AA 10-13-076-07
4	1AA 09-11-076-07
5	1AA 04-13-076-07
6	1AA 13-13-076-07
7	1AA 06-14-076-07
8	1AA 07-10-076-07
9	1AA 04-12-076-07
10	1AA 02-12-076-07
11	1AA 07-14-076-07
12	1AA 08-10-076-07

1.2 Geology / Geoscience

❑ Existing cores with petrographic studies



Legend

: Expansion area

: Initial area

: Initial Development Area

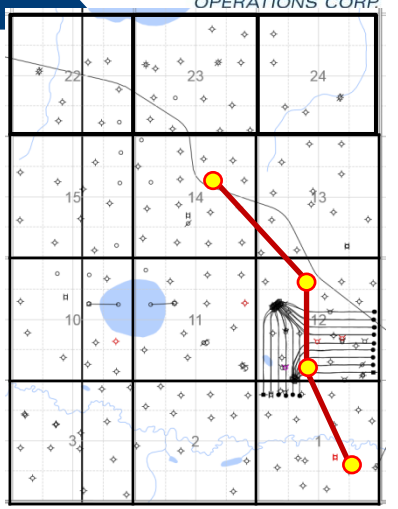
: Well with core (131 wells)

: Well with petrography (19 wells)

1	1AB 01-11-076-07
2	1AA 01-14-076-07
3	1AA 02-10-076-07
4	1AA 03-01-076-07
5	1AA 03-12-076-07
6	1AA 03-14-076-07
7	1AA 03-14-076-07
8	1AA 03-14-076-07
9	1AA 05-12-076-07
10	1AA 05-14-076-07
11	1AA 07-14-076-07
12	1AA 08-01-076-07
13	1AA 09-14-076-07
14	1AA 10-01-076-07
15	1AA 11-14-076-07
16	1AA 15-02-076-07
17	1AA 15-11-076-07
18	1AA 16-02-076-07
19	1AA 16-11-076-07

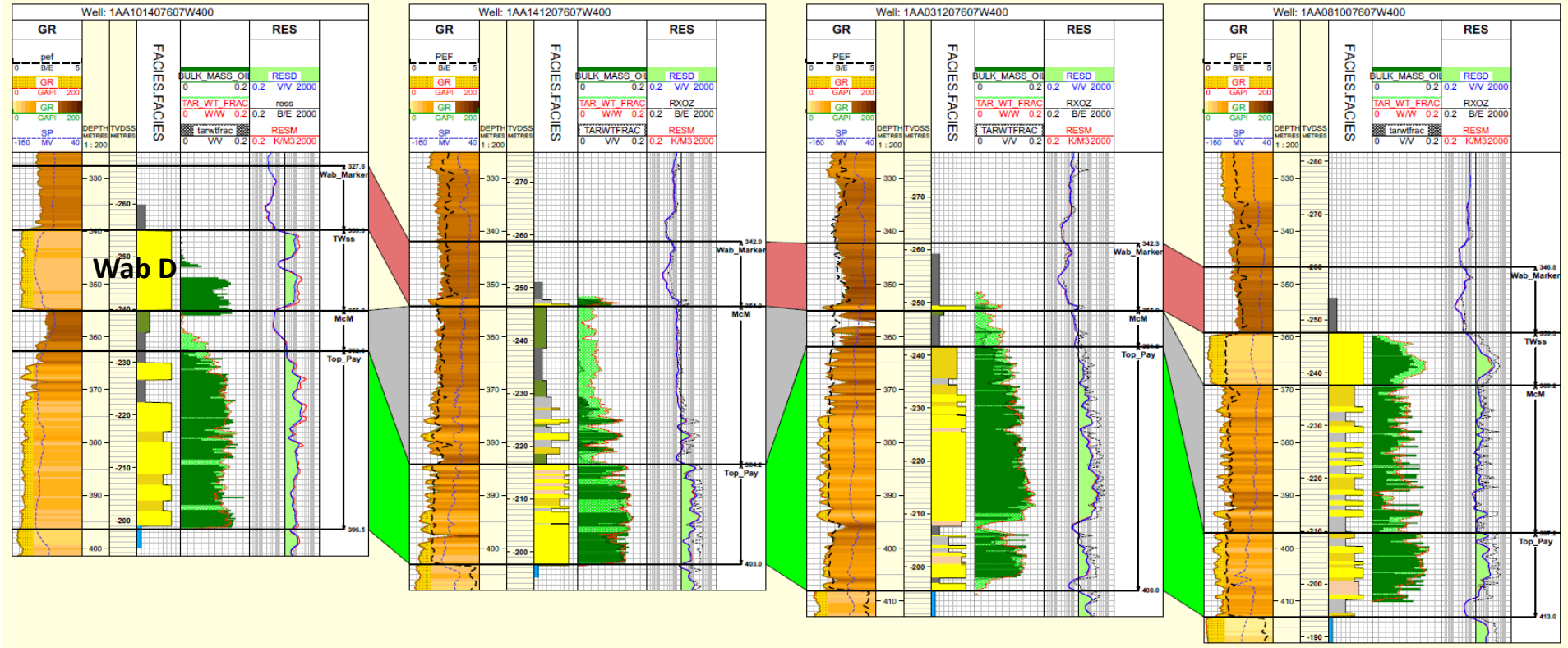
1.2 Geology / Geoscience

- BlackGold lease cross section – North to South



North **South**

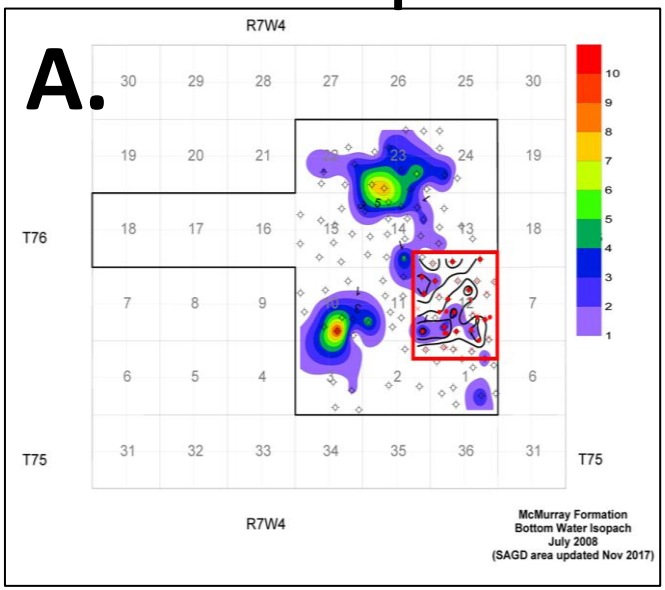
1AA/10-14-076-07W4 **1AA/14-12-076-07W4** **1AA/03-12-076-07W4** **1AA/08-01-076-07W4**

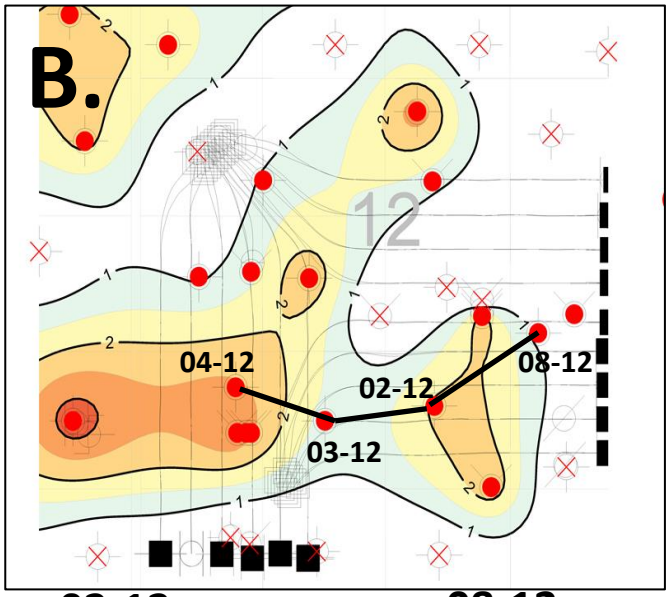


1.2 Geology / Geoscience

McMurray Bottom Water Sand Isopach

A - over the entire Area
B - over the SAGD Pilot



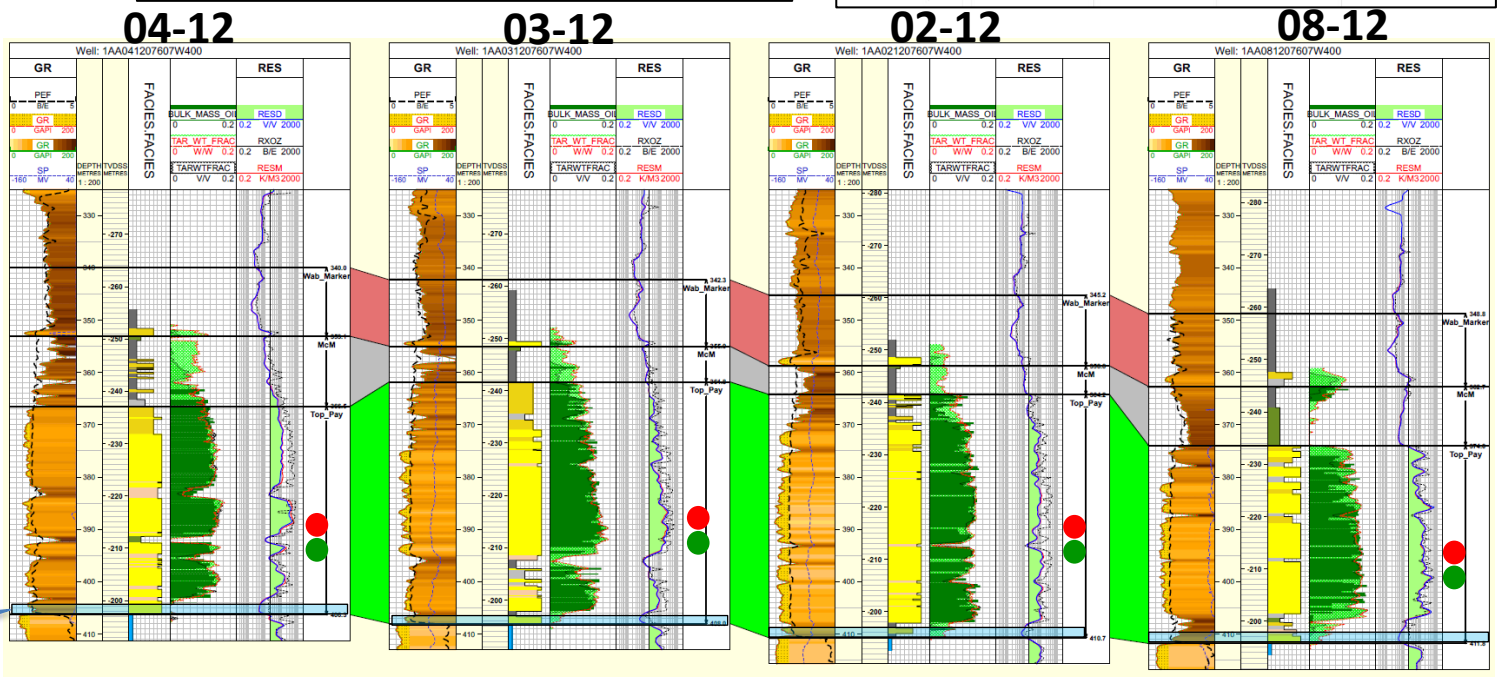


NOTE:

- none of bottom water intervals is in direct contact with identified SAGD-able pay.
- Stand off from well-pairs is >10m.

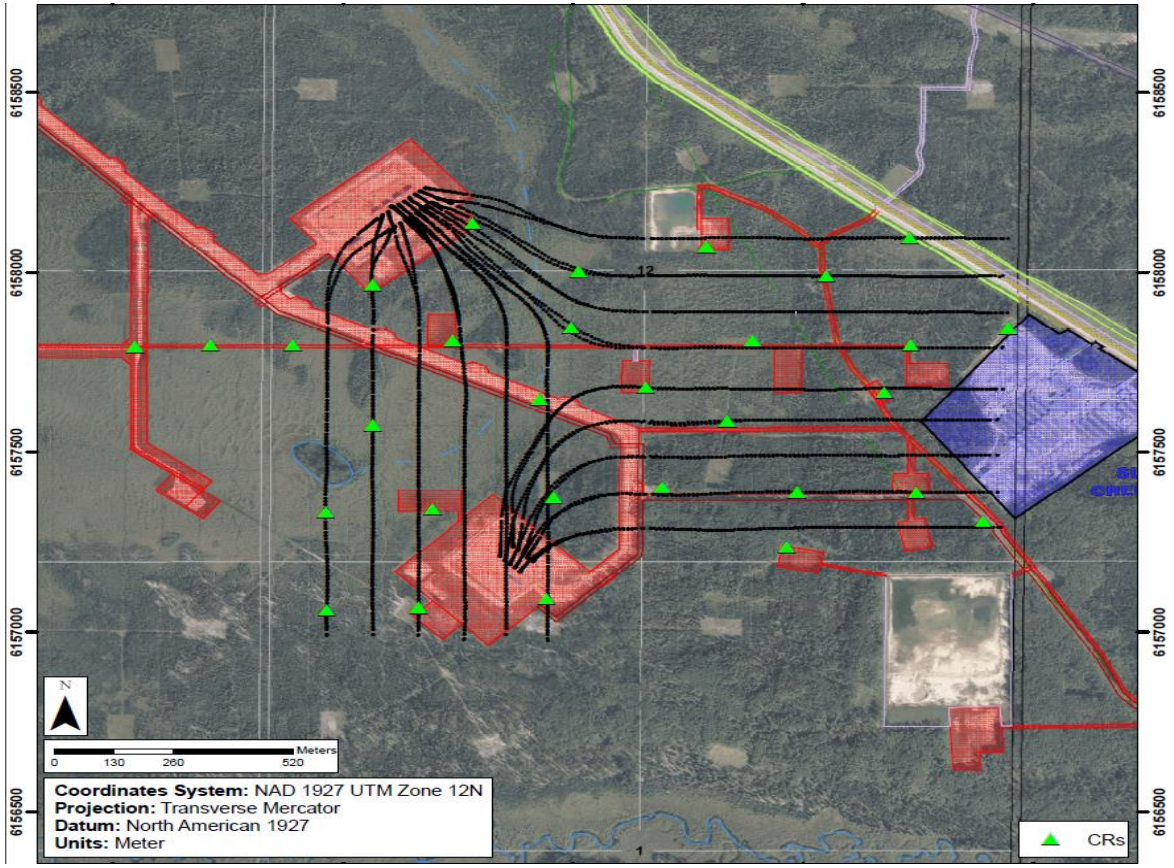
SAGD well-pair

Localized Bottom Water



1.2 Geology / Geoscience (2K)

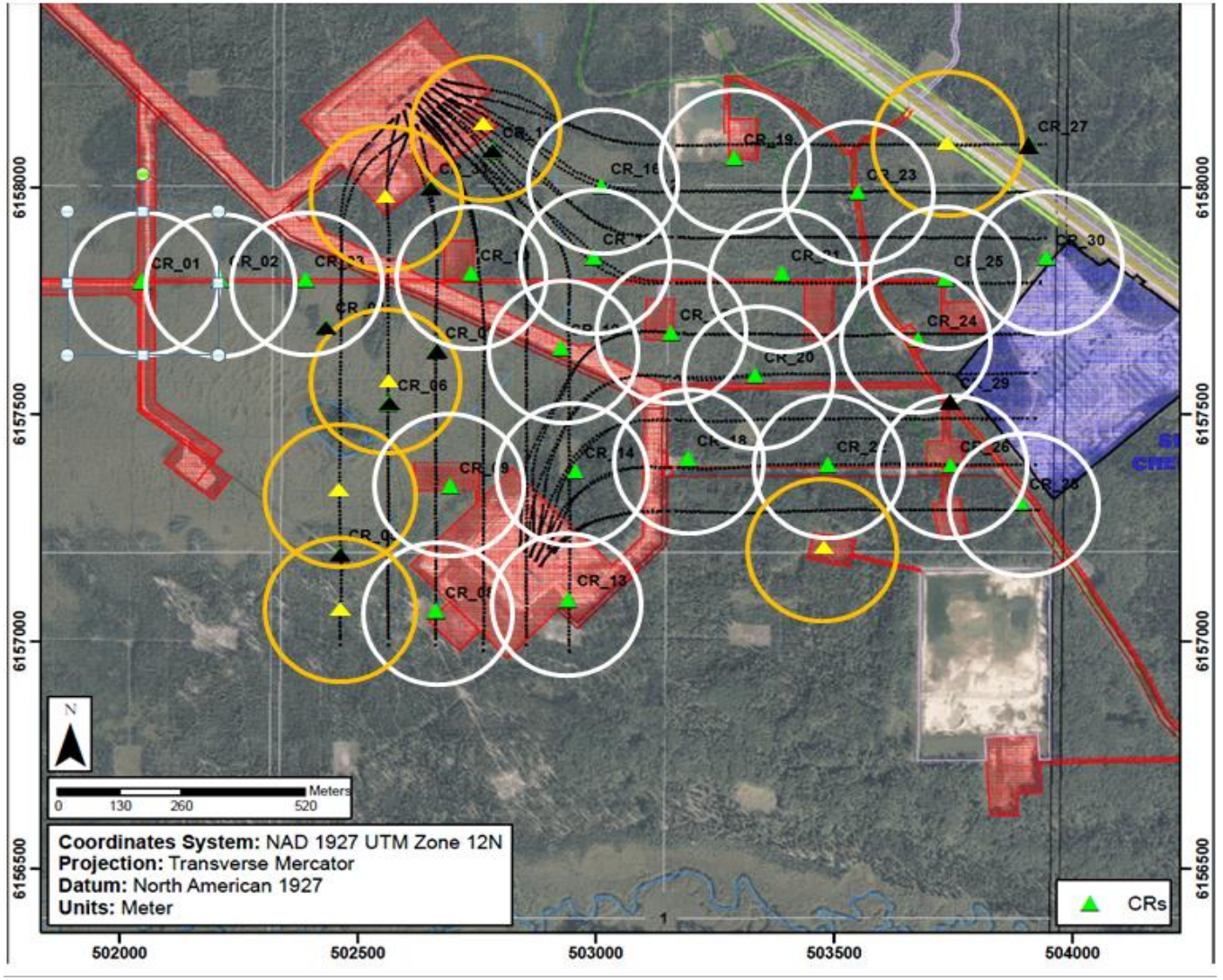
- 2016 January, 30 corner reflectors were installed.



Corner Reflectors

1.2 Geology / Geoscience

- Reflector sites have been placed.
- Satellite data was collected and analyzed as a baseline prior to first steam.
  - Each reflector allows monitoring of approximately a 150 m radius

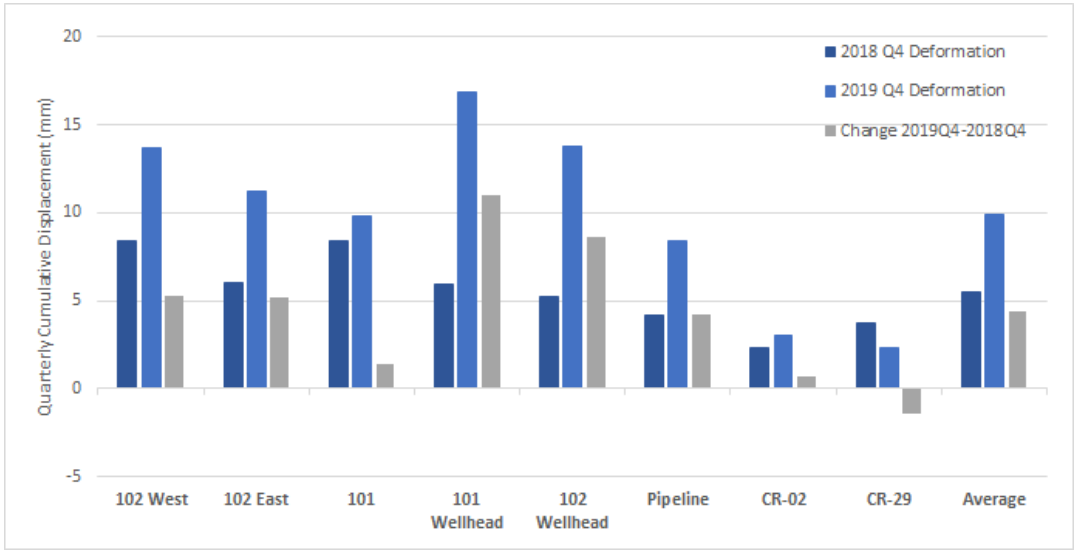


1.2 Geology / Geoscience

2019 Q2 & Q3 Surface Heave Monitoring Results

	2018 Q4 Cumulative Displacement	2019 Q4 Cumulative Displacement	Change in Average Deformation
	15/12/17-16/11/18	15/12/17-11/11/19	(16/11/18 – 11/11/19)
	[mm]	[mm]	[mm]
102 West	+8.4	+13.7	+5.3
102 East	+6.0	+11.2	+5.2
101	+8.4	+9.8	+1.4
101 Wellhead	+5.9	+16.9	+11.0
102 Wellhead	+5.2	+13.8	+8.6
Pipeline	+4.2	+8.4	+4.2
CR-02	+2.3	+3.0	+0.7
CR-29	+3.7	+2.3	-1.4
Average	+5.5	+9.9	+4.4

Deformation changes recorded over BlackGold Pilot SAGD drainage pads are within typical values for SAGD projects.



1.2 Geology / Geoscience (2m)

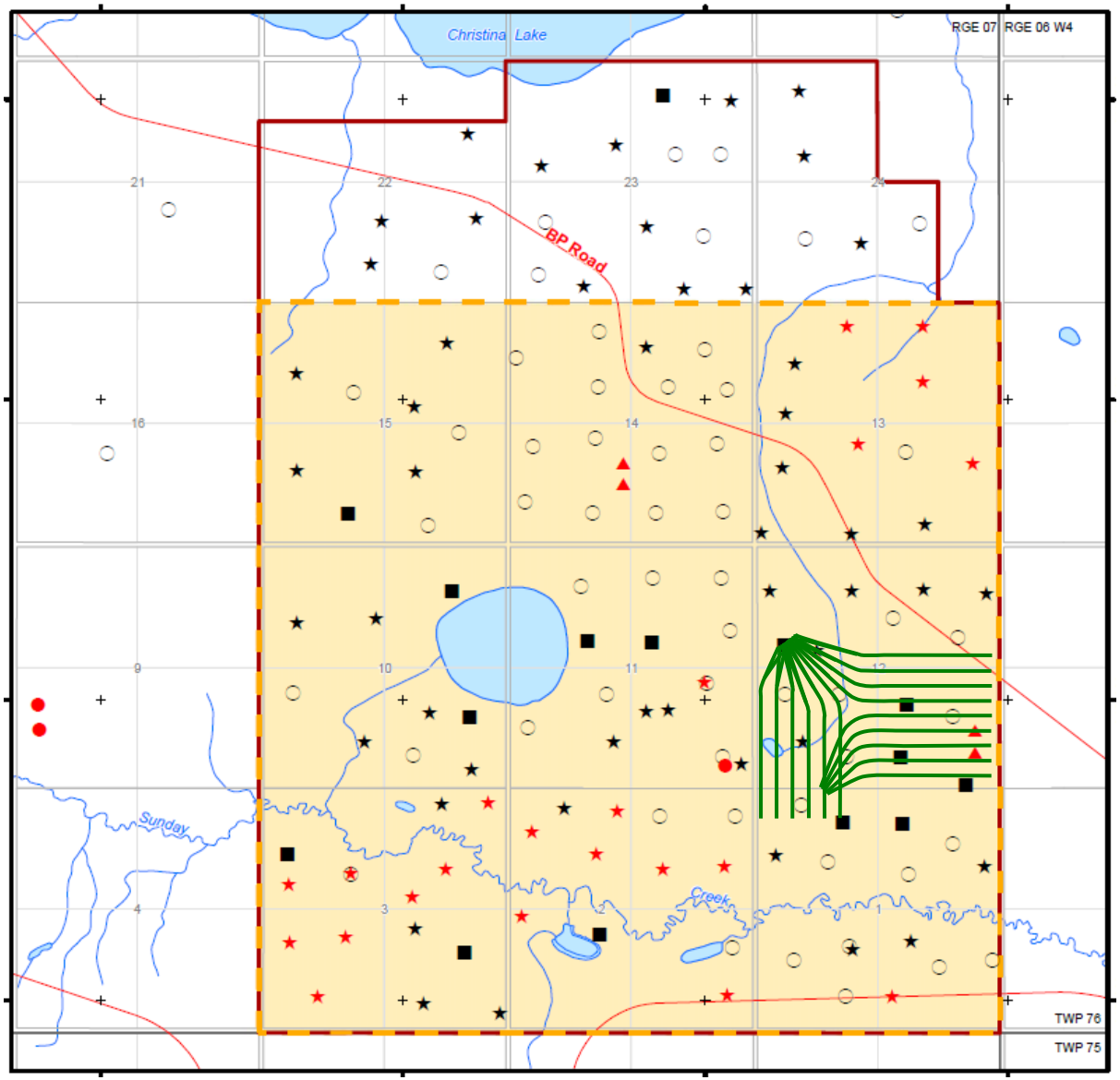
- BlackGold geomechanical data and analyses
  - Mini-fracture physical testing results obtained in 2008.
  - The in-situ minimum stress in the McMurray shale is between 6.01 MPa and 6.9 MPa (16.7 to 19.2 kPa/m).
  - BlackGold geomechanical modeling confirmed that the McMurray cap rock integrity has a maximum down hole pressure of 6 MPa.
  - Approved maximum operating pressure is 5.5 MPa during steam circulation and 5 MPa during SAGD operations.

Agenda – 1.3 Subsurface

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1.3 Drilling and Completions

- Well pair trajectories.



- Legend

Well Pair Trajectory

3D Seismic (23 km^2)

Drilled before 2006 (52 wells)

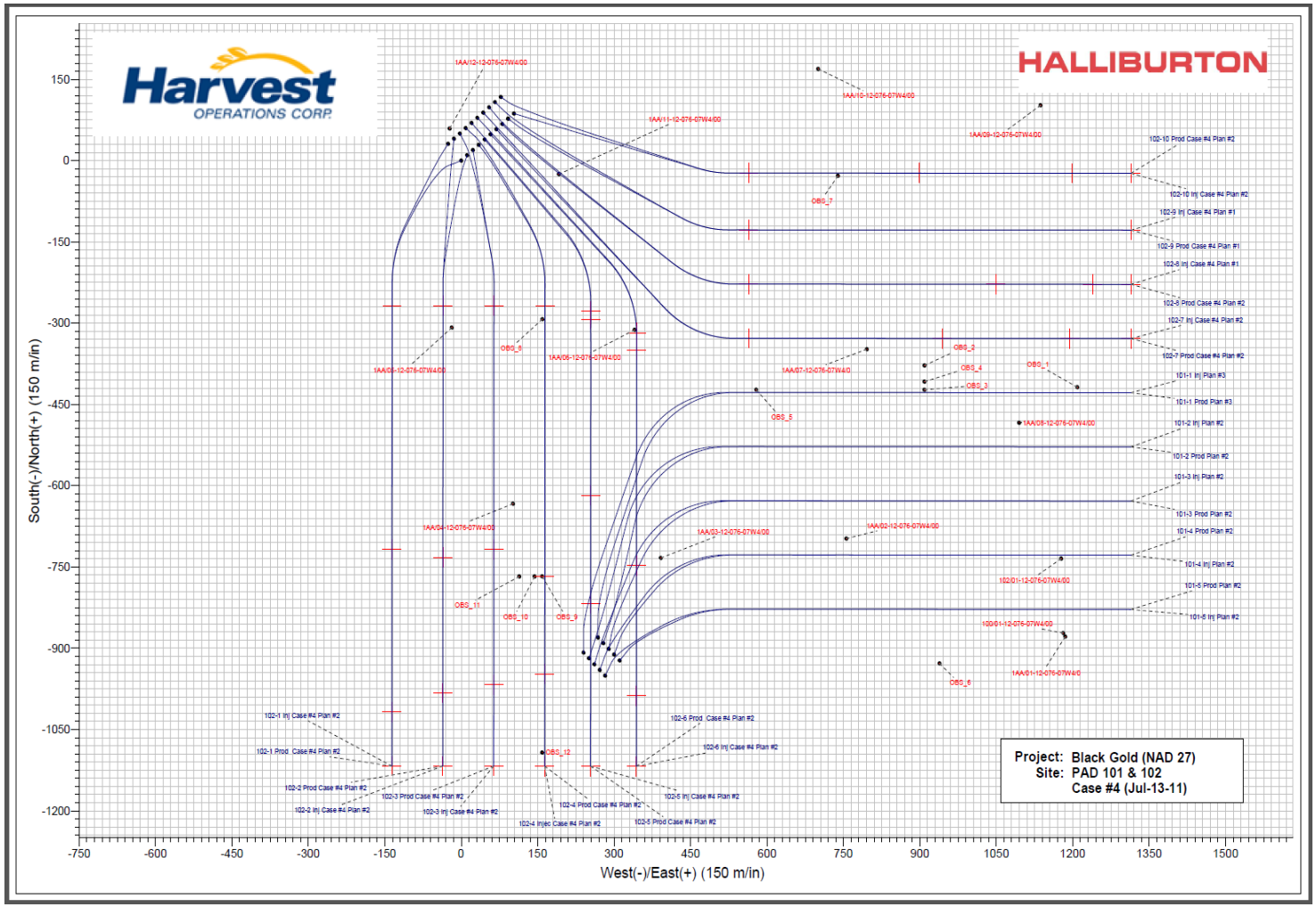
Drilled 2007 (19 wells)

Drilled 2008 (32 wells)

Drilled 2009 (30 wells)

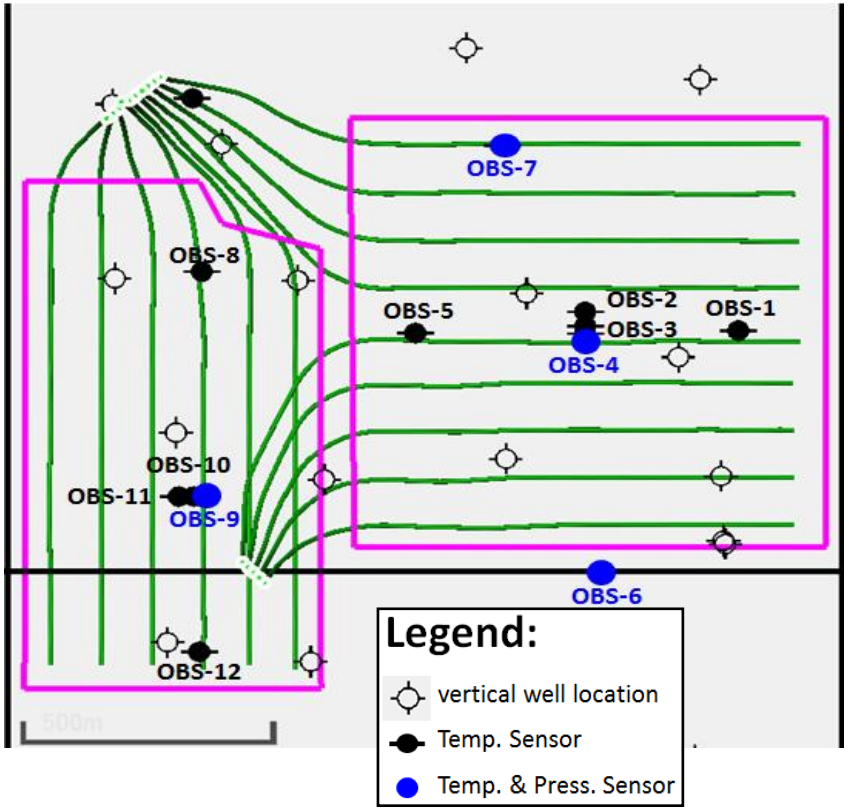
1.3 Drilling and Completions

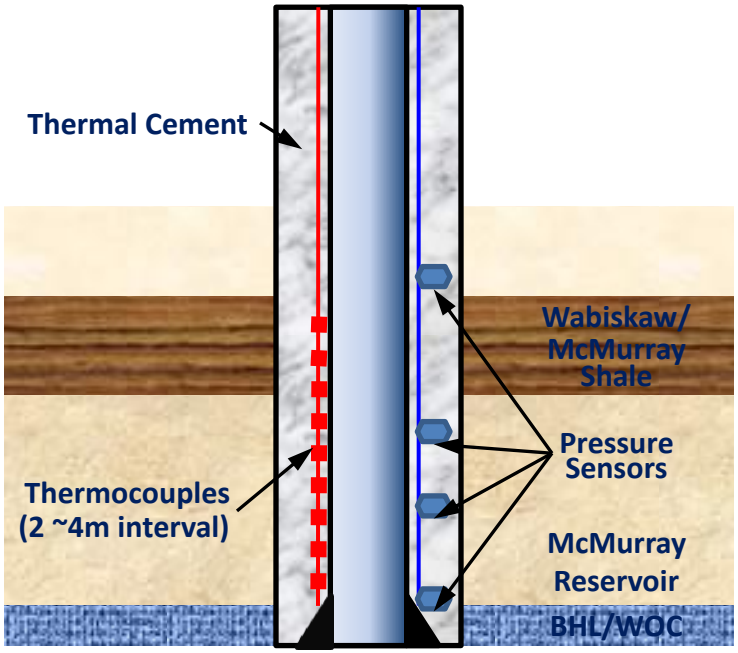
All BlackGold SAGD well pairs are spaced about 95 - 100 meters except for 102-4, 102-5 and 102-6 which are spaced about 85 - 90 meters.



Overview of OBS Wells

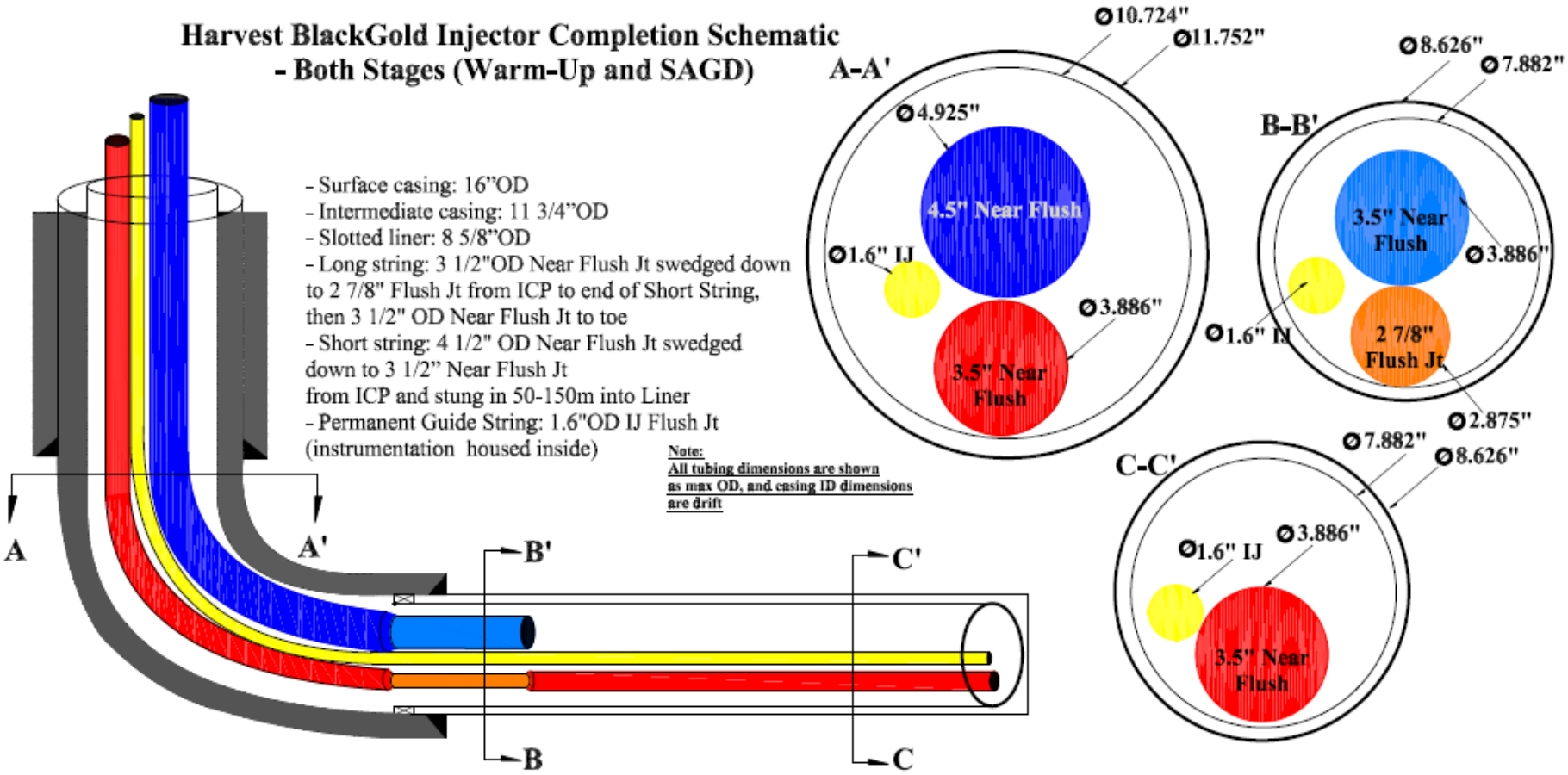
- Harvest drilled 12 observation wells in 2011 to monitor performance
  - 4 clamp type wells installed thermocouples and pressure gauge
  - 8 spool in type wells installed thermocouples



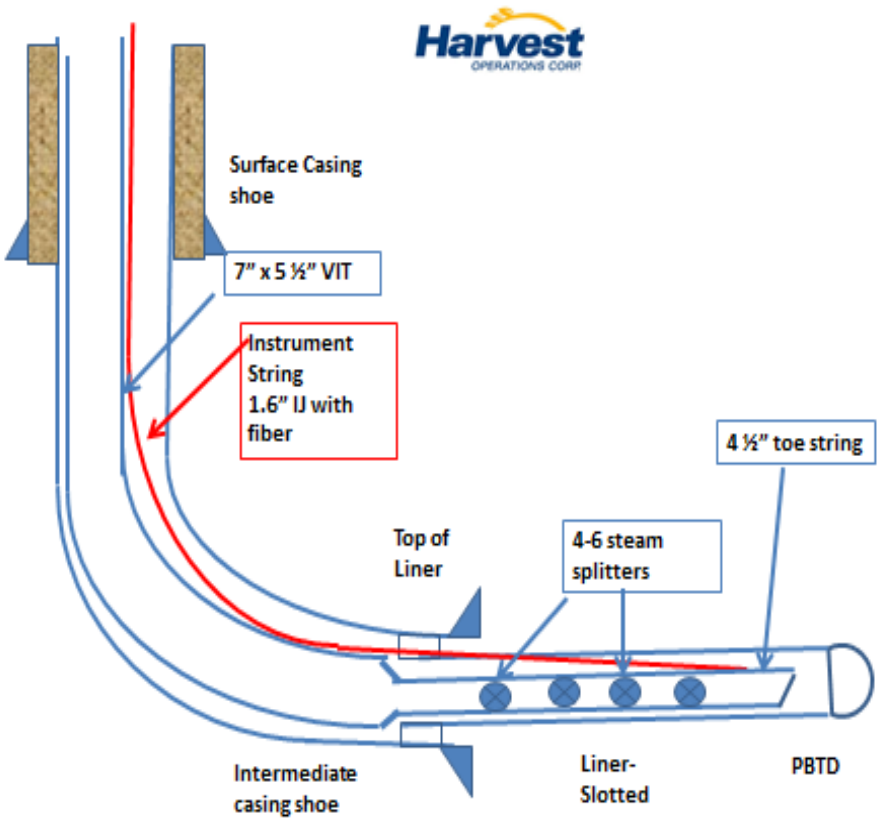


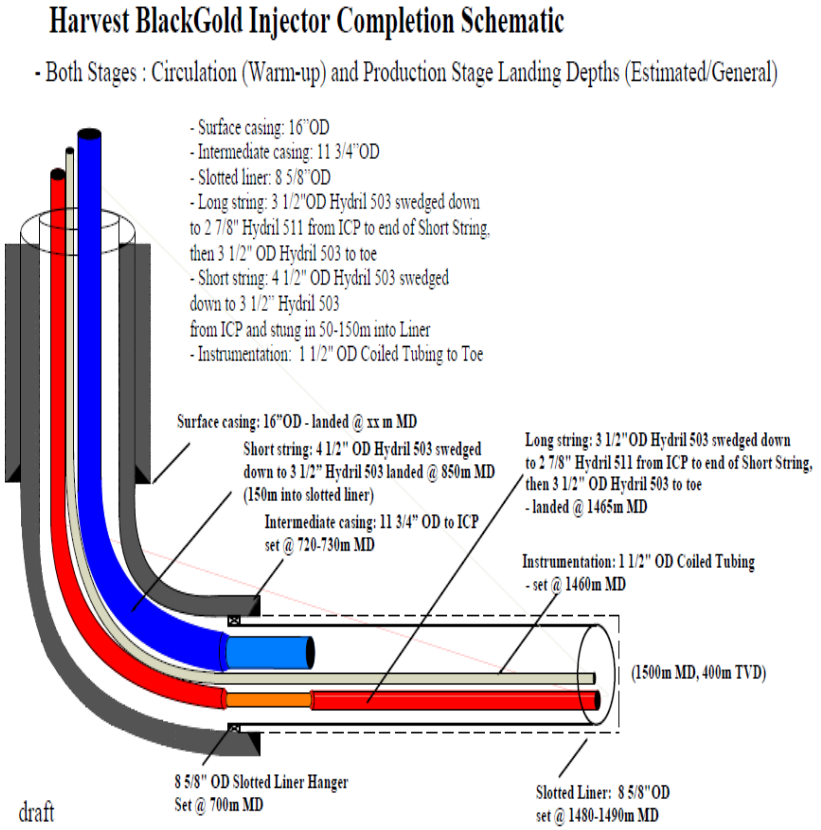
1.3 Drilling and Completions

- Typical well bore schematic – Injector



Design comparison – injector retrofit





- 2 injectors have been reconfigured with a single injection string with multiple steam splitters.

101 Pair 1 (VIT) and 101 Pair 3 wellheads

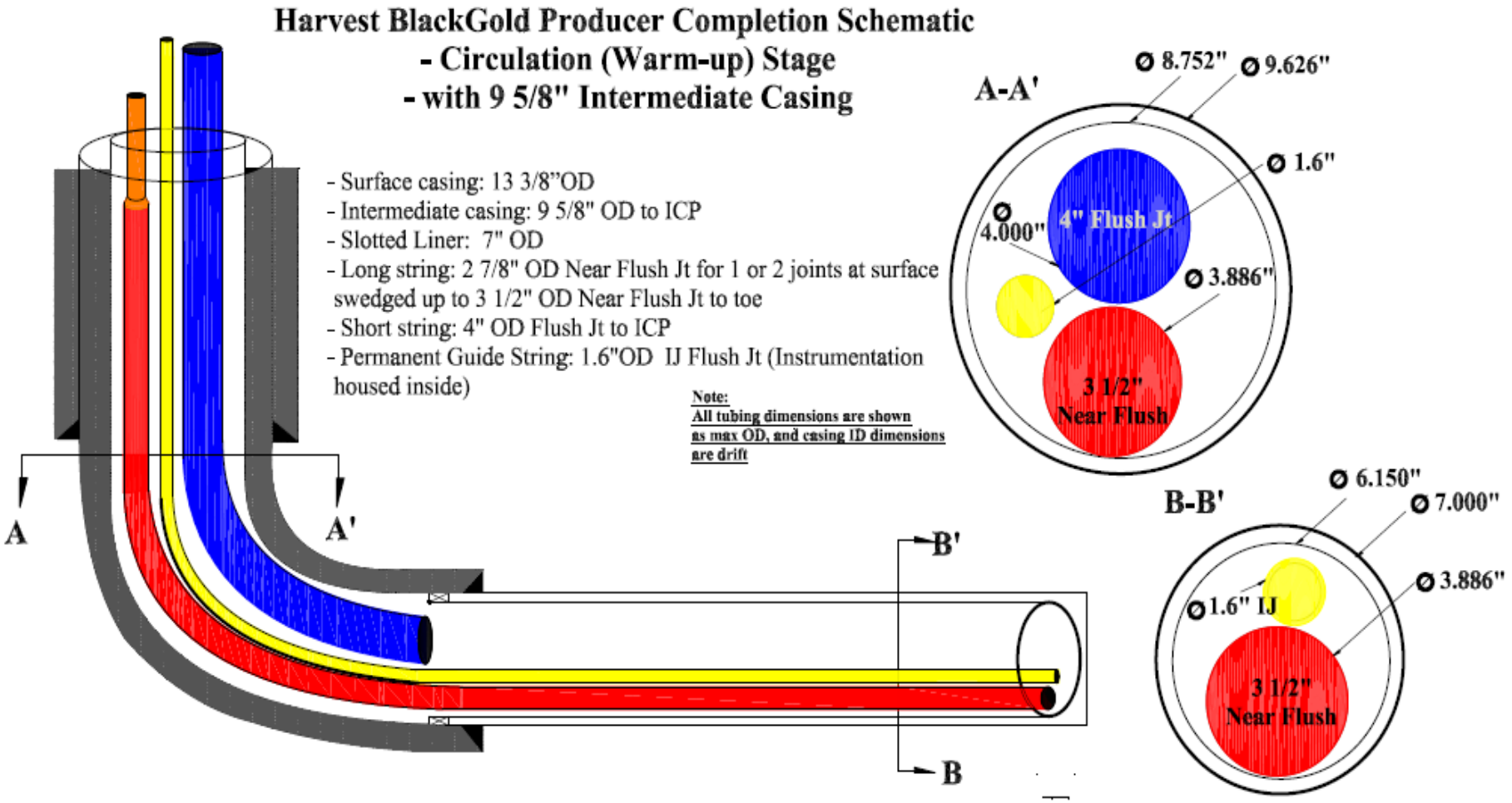
101 Pair 3 injector - bare dual string completion

101 Pair 1 injector - VIT

note the smaller brown circle of melted snow around the wellhead indicating cooler ground temperatures

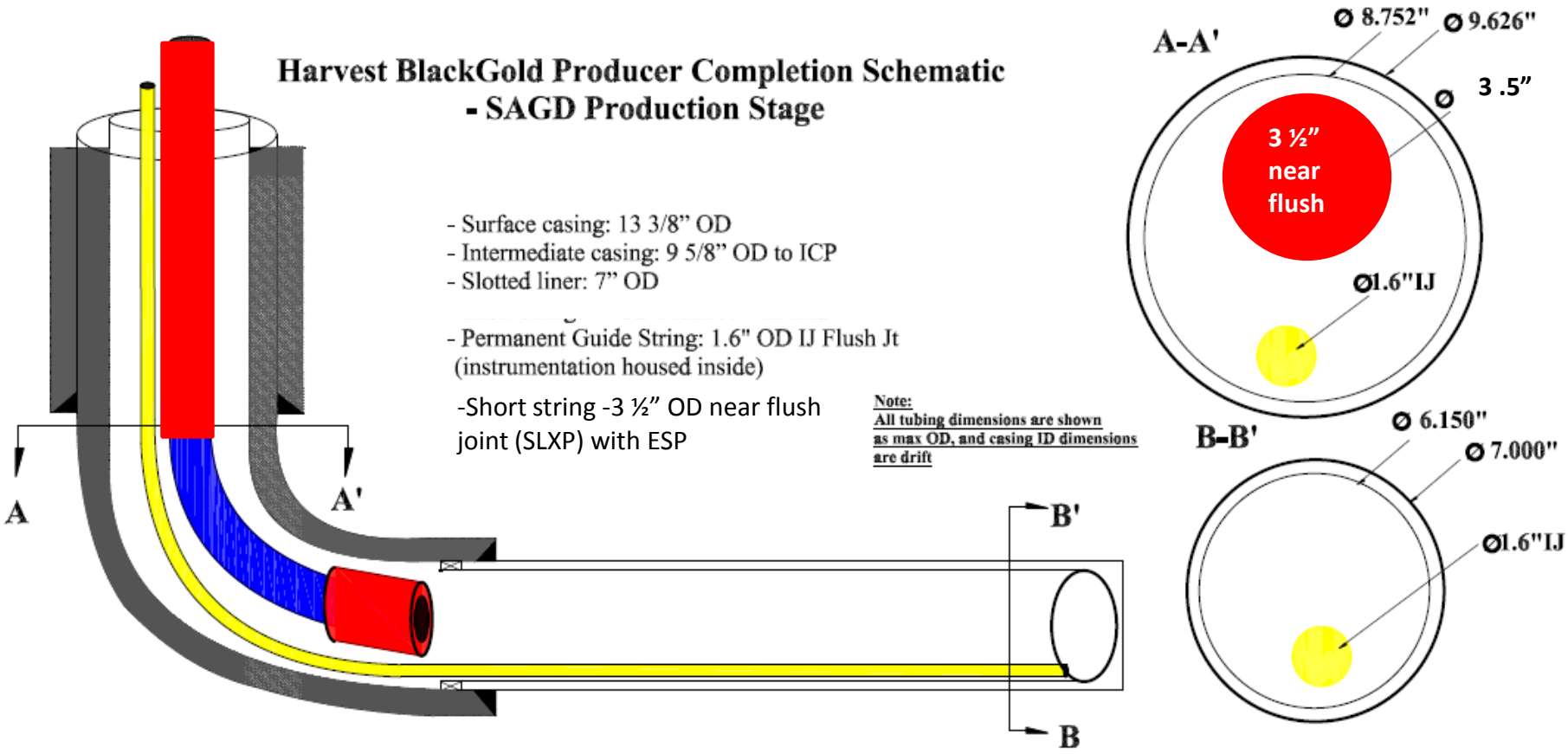
1.3 Drilling and Completions

- Typical well bore schematic – Producer during circulation



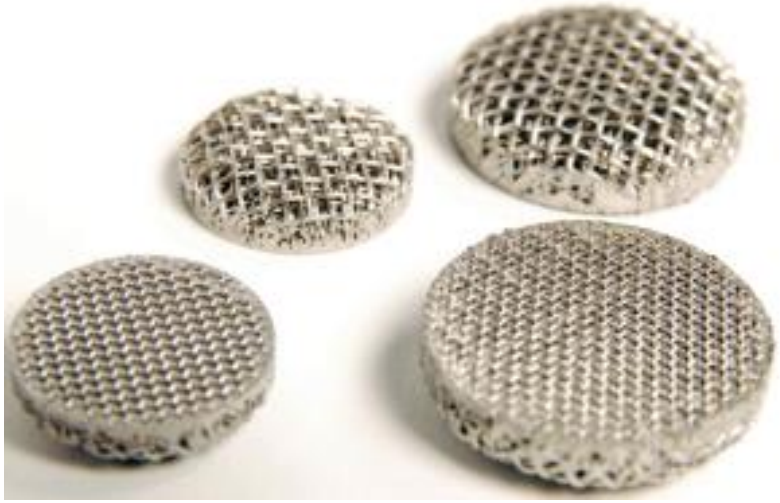
1.3 Drilling and Completions

- Typical well bore schematic – Producer on SAGD production with ESP (Electric Submersible Pump)



1.3 Drilling and Completions

- Harvest installed a Flush Absolute Cartridge System (FacsRite) for sand control in 15 producers:
  - Sand retention and retained permeability properties.
  - Tolerates wider variation in Particle Size Distribution (PSD).
  - Higher Open Flow Area (OFA) than gap-based media.
  - Premium media discs flush mounted and tightly secured into the base material.
  - 316 SS, 25.4mm disc with OFA of 3.61% at 22 discs/ft.



Agenda – 1.4 Subsurface (5ab)

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1.4 Artificial Lift

- 3 additional producer wells were converted to ESP production in 2019
  - 101-04 Jun 08th
  - 102-02 Aug 29th
  - 101-02 Oct 09th

- All 13 active well pairs are now operating on ESP production
  - ESPs remain the artificial lift of choice at BlackGold and are currently planned for all future wells

- Average emulsion flow rate ~ 125 to 890 m^3/d

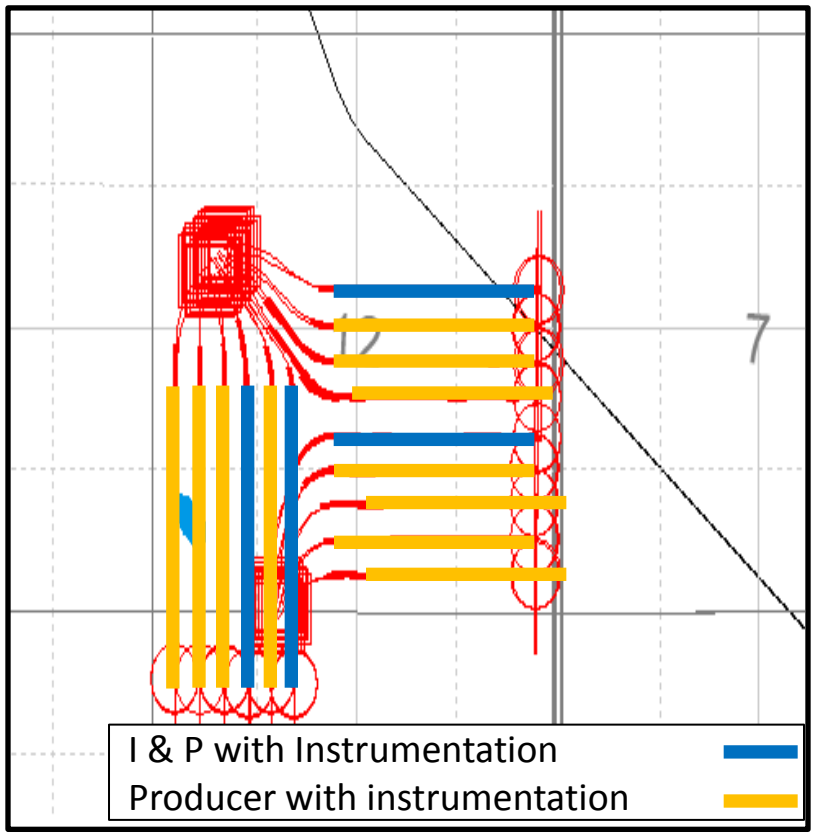
- Operational challenges:
  - Initial ESP sizing to handle both early ramp up and peak production
  - ESP placement in high dog leg severity well trajectories (up to 6 °/30m)

Agenda – 1.5 Subsurface

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	4-D Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

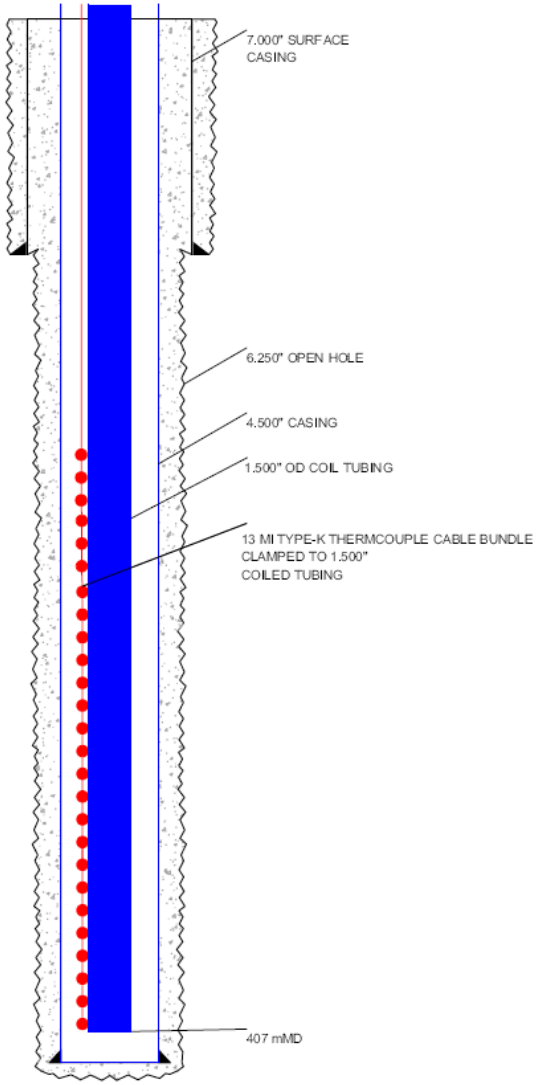
1.5 Instrumentation in Wells

- Producers:
  - 15 DTS fiber system during circulation and SAGD phase.
  - 15 bubble tube to toe during circulation phase and 15 bubble tube to both toe and heel after ESP conversion. Many of the toe bubble tubes have plugged and are no longer reading accurately.
- Injectors:
  - 4 DTS fiber system during circulation and SAGD phase.
  - 4 bubble tube to toe during circulation and SAGD phase.

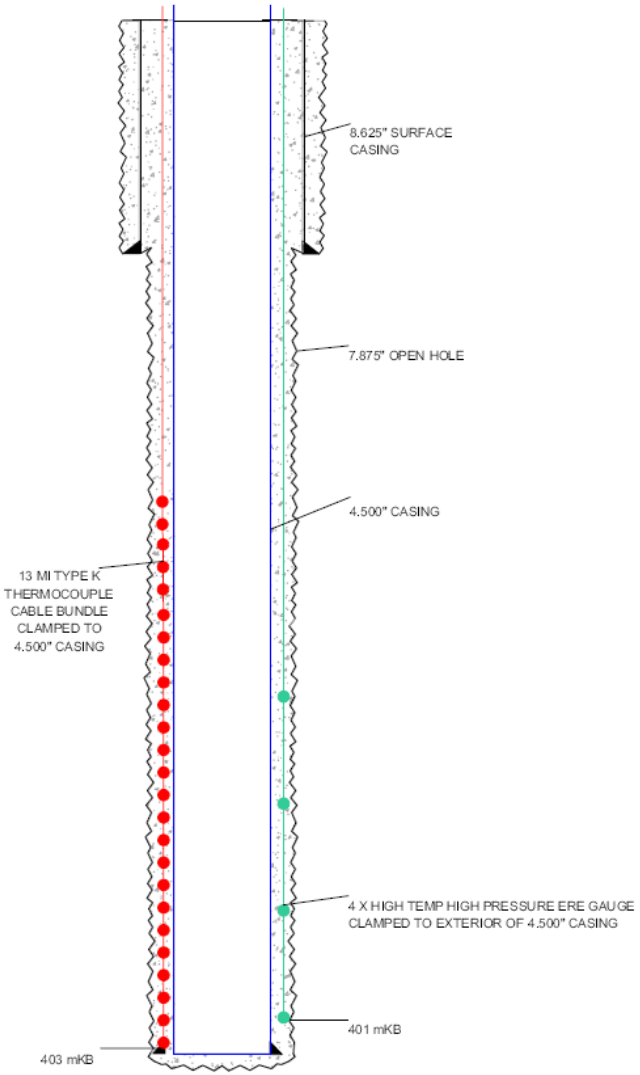


Instrumentation in Observation Wells (typical completions)

Thermocouples Inside Casing



Piezometers & Thermocouples Outside Casing

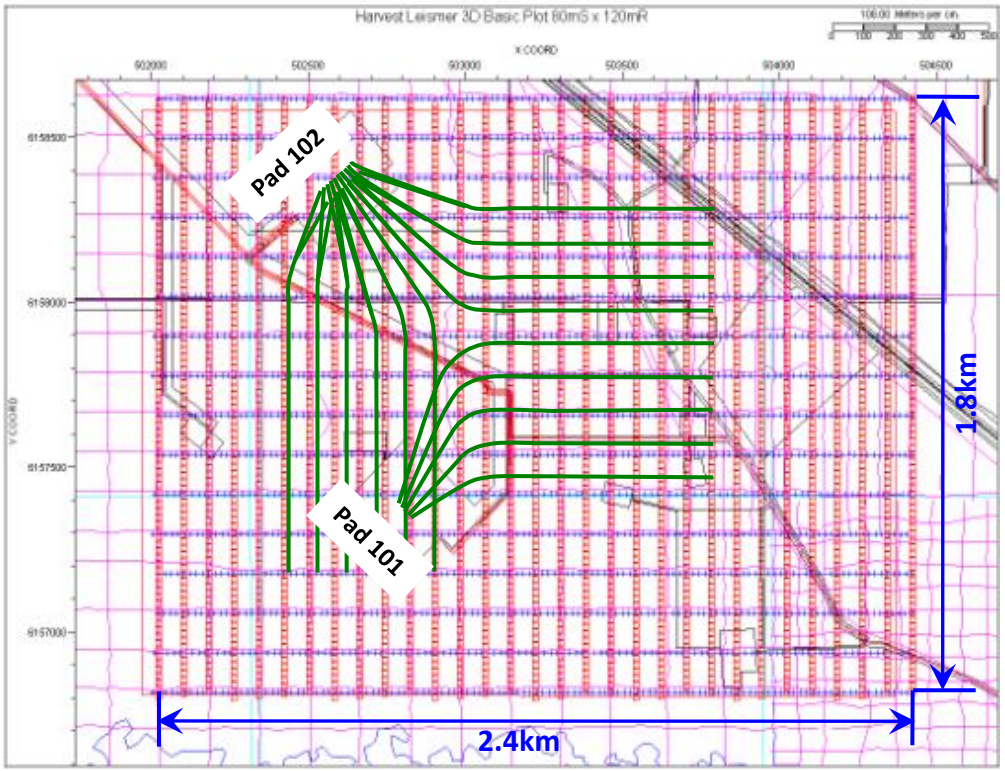


Agenda – 1.6 Subsurface

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1.6 Seismic

- Harvest acquired the 4D base line seismic survey over the Initial Development Area February 2012
  - GEO 110308 Nov 3D Acquisition 4.3km^2



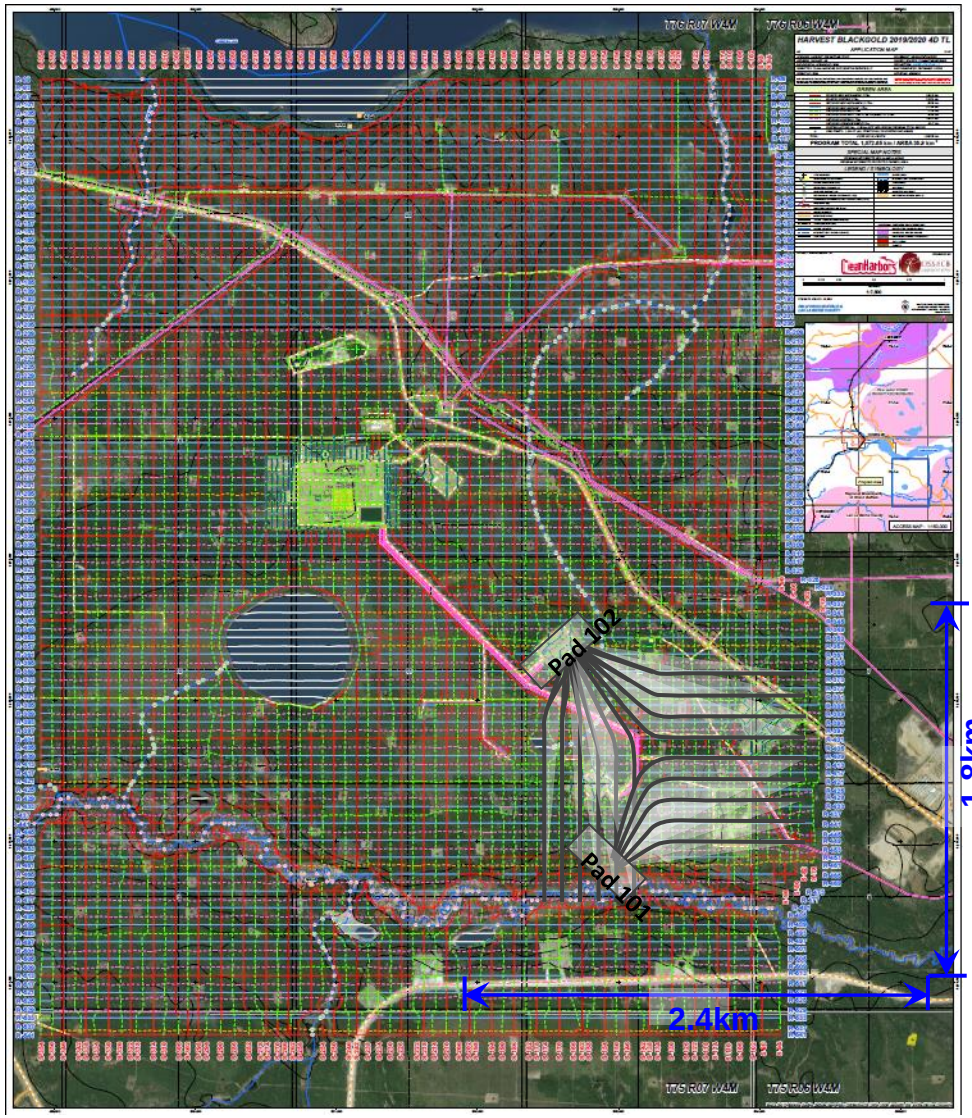
4D Seismic Parameters	
Area	4.26 km^2
Bin size	10m x 10m
Source	Mini VibroSeis
Source line interval	80m
Receiving line interval	120m

Note: Red lines are shot lines; blue lines are receiving lines

1.6 Seismic

- Harvest Approval GEO180081 (Dec 2018) 4D seismic– Replaces GEO 110308

SOURCE NEW MECHANICAL 2.75m		246.16 km
SOURCE EXISTING 2.75m		210.51 km
RECEIVER NEW MECHANICAL 2.75m		50.00 km
RECEIVER NEW MECH/HC 1.75m		277.64 km
RECEIVER EXISTING 2.75m		71.52 km
RECEIVER EXISTING 1.75m TO BE WIDENED TO 2.75m		34.50 km
RECEIVER EXISTING 1.75m		166.15 km
RECEIVER OPEN/WATERBODY 0m		16.17 km
EXISTING ACCESS 3m - 11.66 km (NOT INCLUDED IN PROGRAM TOTAL BELOW)		
VIBE POINTS - 1,104 VP (ALL POINTS FALL ON EXISTING PAD AREAS)		
TOTAL:	43,378 SP / 61,435 STN	1,063.35 km
PROGRAM TOTAL 1,072.65 km / AREA 35.9 km ^{2}		

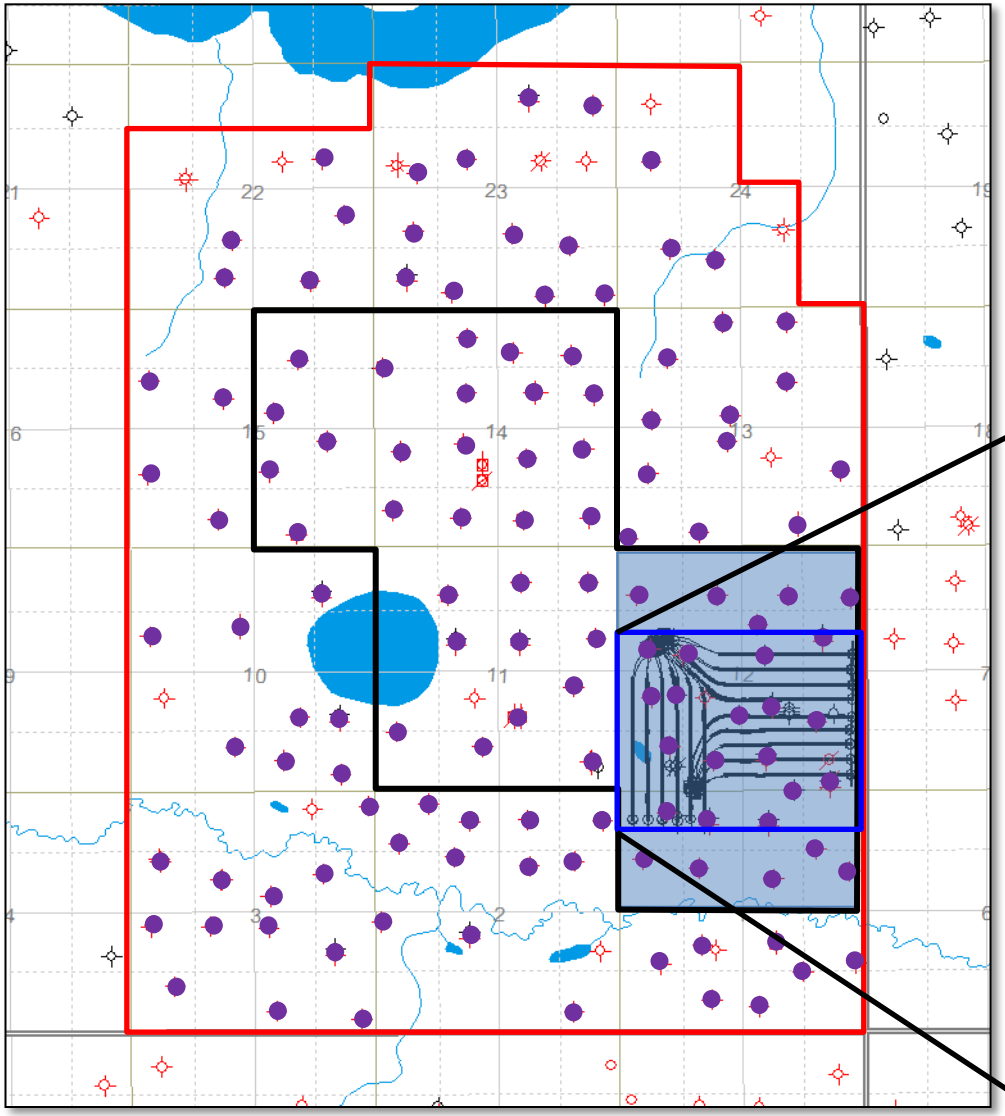


Agenda – 1.7 Subsurface

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	4-D Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1.7 Scheme Performance

Pilot Area Reserve Volumes:

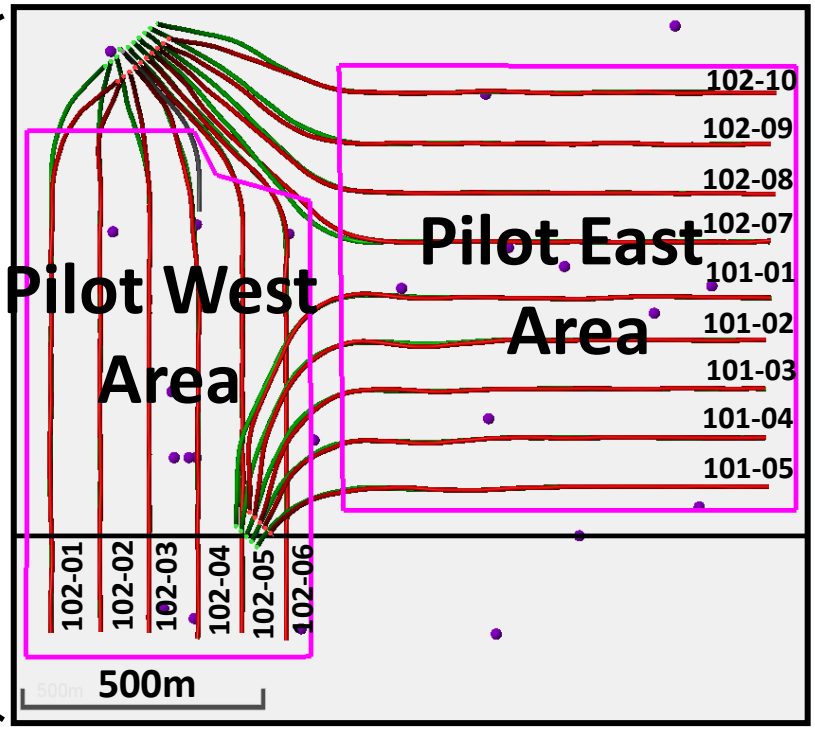


***Total Proved and Probable:**

Pilot Eastside-Pad 101, Pad 102-7-10):
4.3 MM m^3

Pilot Westside Pad 102-1-6):
1.5 MM m^3

Pilot Area:



*GLJ Petroleum Consultants Evaluation (December 31, 2019)

1.7 Scheme Performance

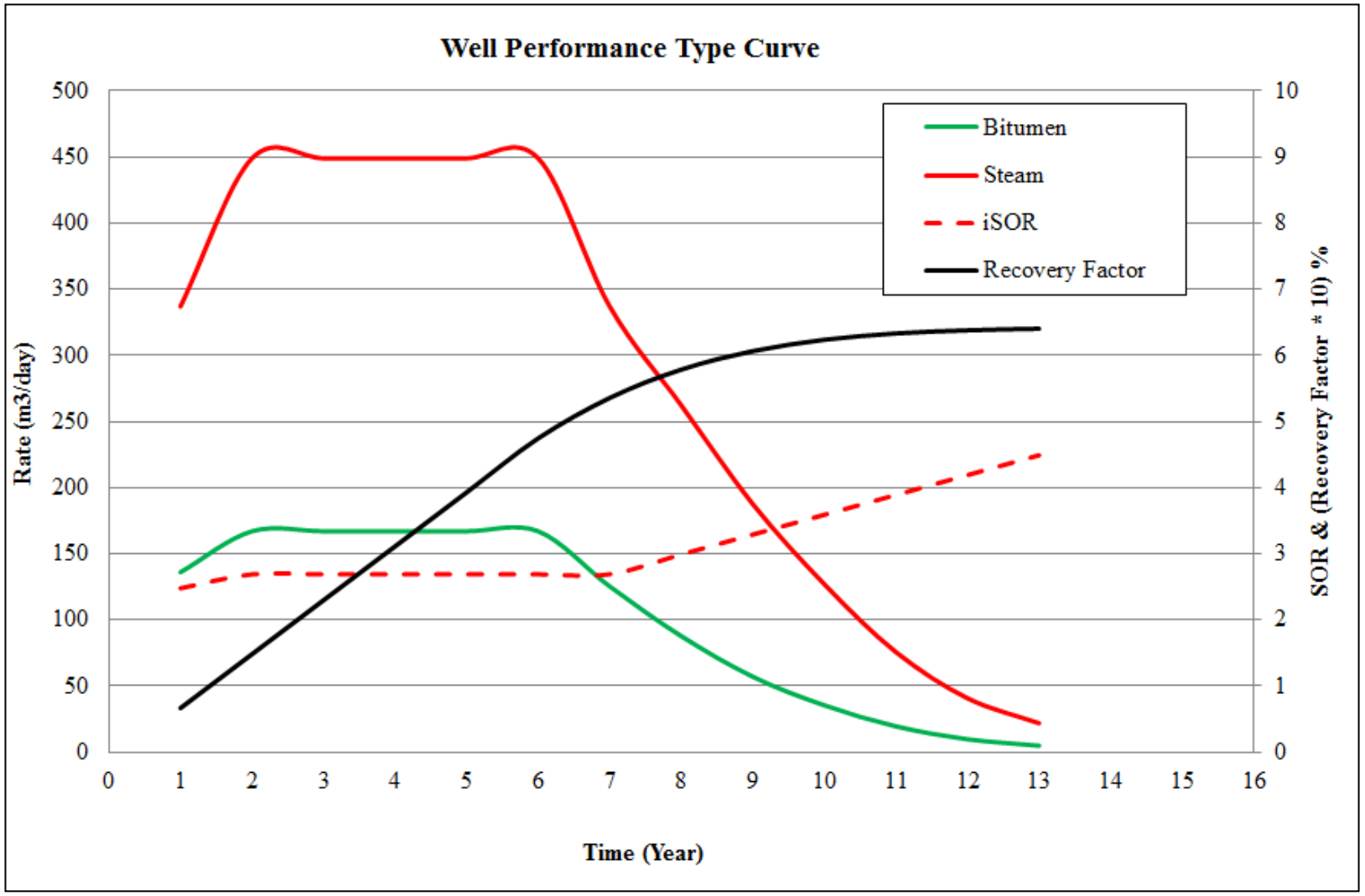
Scheme Performance Highlights:

- First steam in Jun 2018.
- First Oil Production Sep 2018.
- BlackGold successfully achieved 10k bpd oil production milestones:
  - Single day: May 2019
  - Full Month: Oct 2019
- Converted 3 additional wells to ESP production in 2019:
  - 101-02
  - 101-04
  - 102-02
- Successfully recompleted 2 injector wells with tubing deployed flow control devices in Sep 2019
  - One injector was also equipped with VIT in the intermediate section

1.7 Scheme Performance

Performance Prediction Methodology

- Simulation and Butler analytical models used to predict SAGD performance.
- SAGD analogues used to tune peak rates, ramp-up time, and SOR.

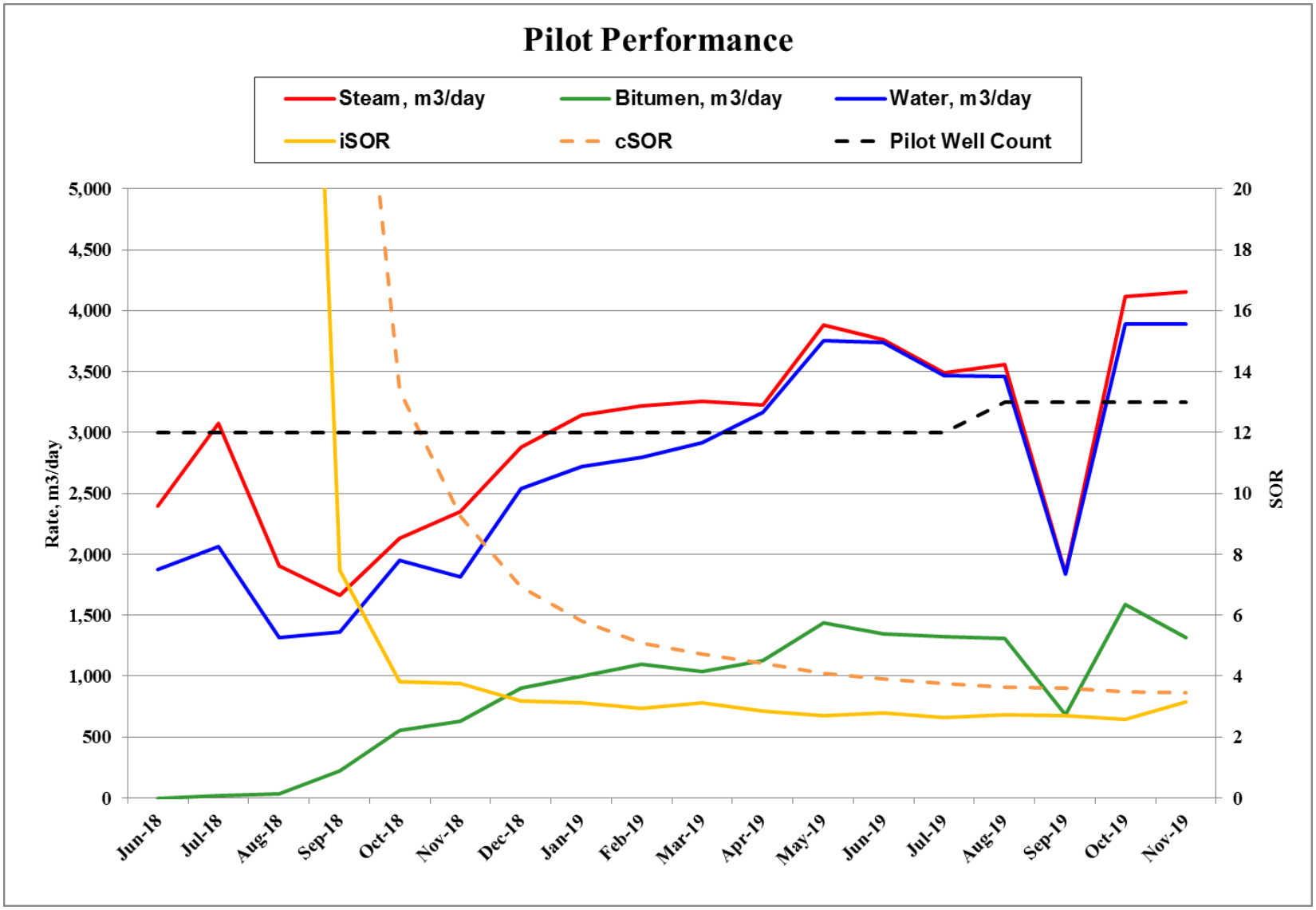


1.7 Scheme Performance

Pad Area	Area (m^2)	Net Pay (m)	Porosity (%)	Initial Oil Saturation (%)	OOIP (Mm^3)	Cum Oil (Mm^3) (as of Nov 30, 2019)	Recovery, % OOIP	Expected Ultimate Recovery, (Mm^3)	Ultimate Recovery as % of OOIP
Pilot West (102P01 - 06) (6 Well Pairs)	530,138	27	31%	85%	3,721	128.5	3.5%	1,526	41%
Pilot East (102P07 - 10, 101P01 - 05) (9 Well Pairs)	861,980	30	31%	85%	6,719	346.6	5.2%	4,300	64%
Total	1,392,120				10,440			5,826	

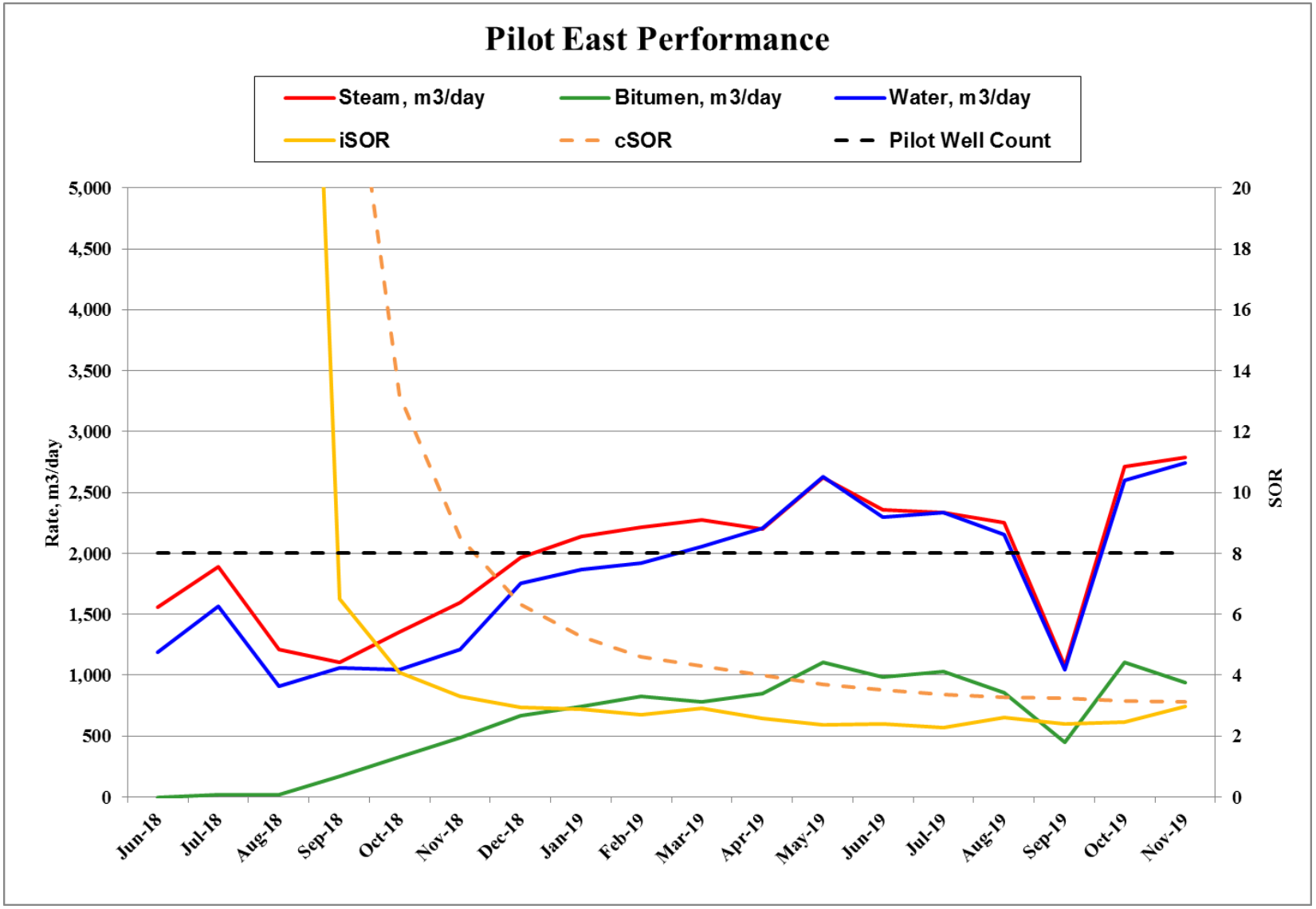
1.7 Scheme Performance

Pilot SAGD Performance



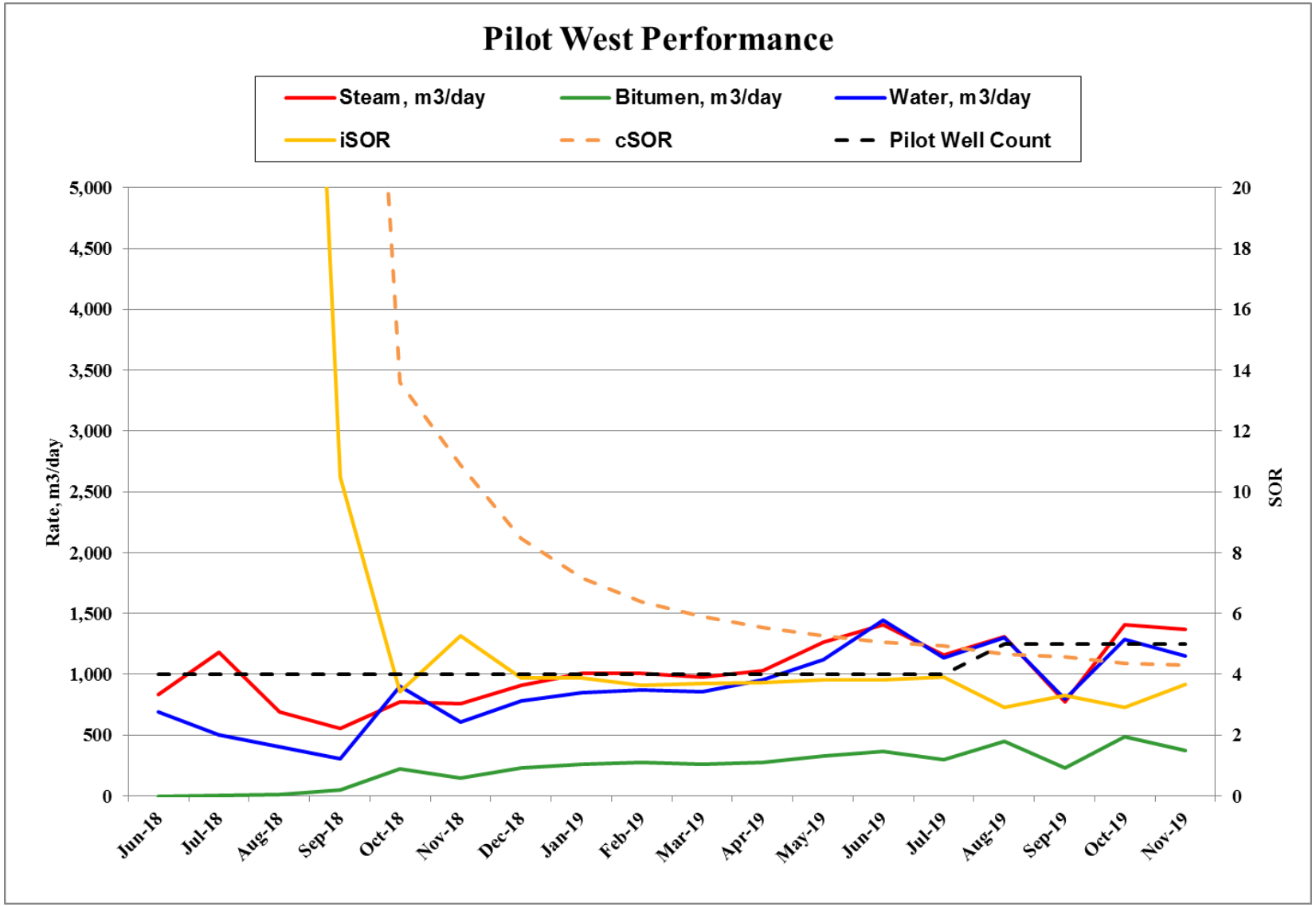
1.7 Scheme Performance

Pilot East SAGD Performance



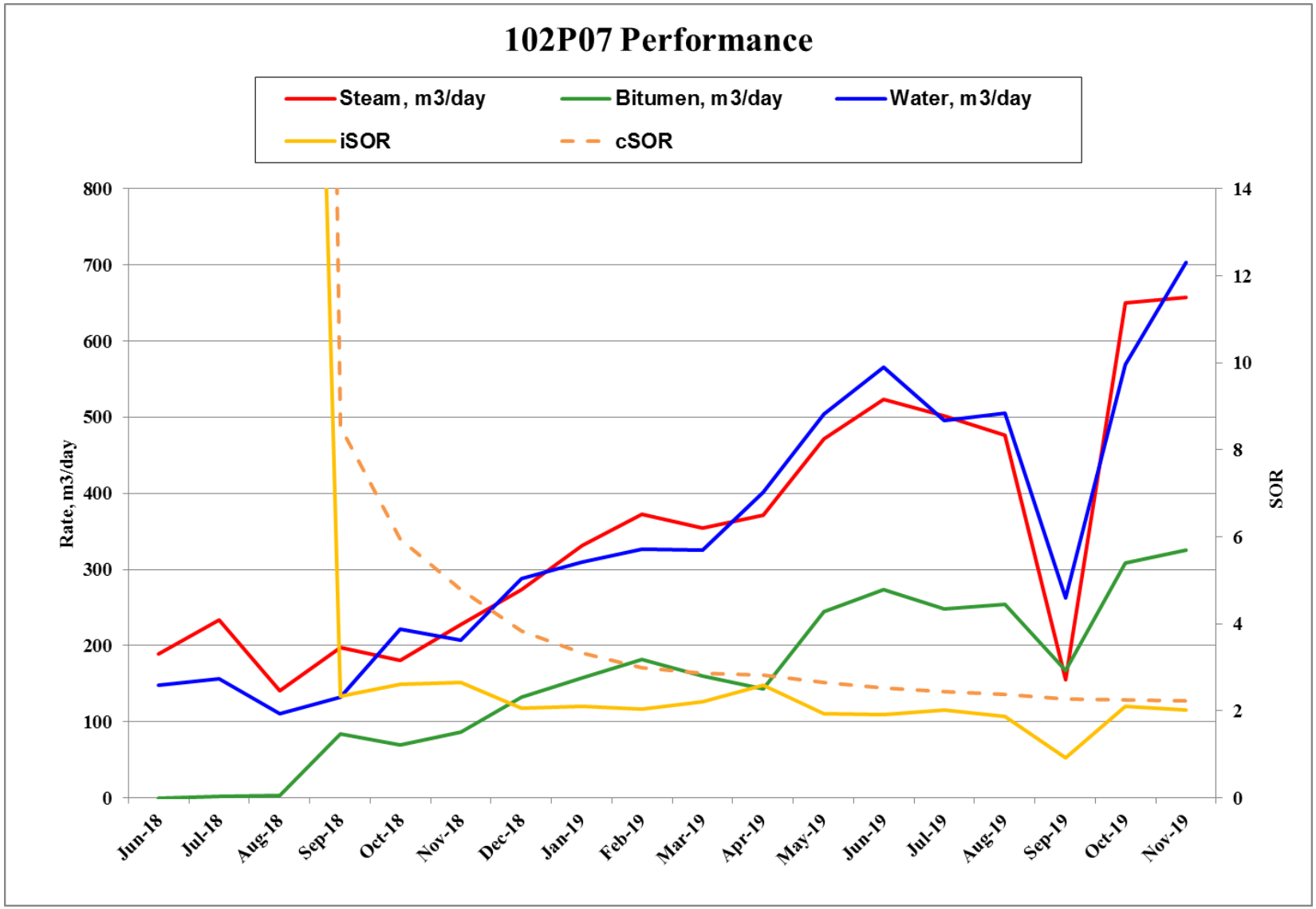
1.7 Scheme Performance

Pilot West SAGD Performance



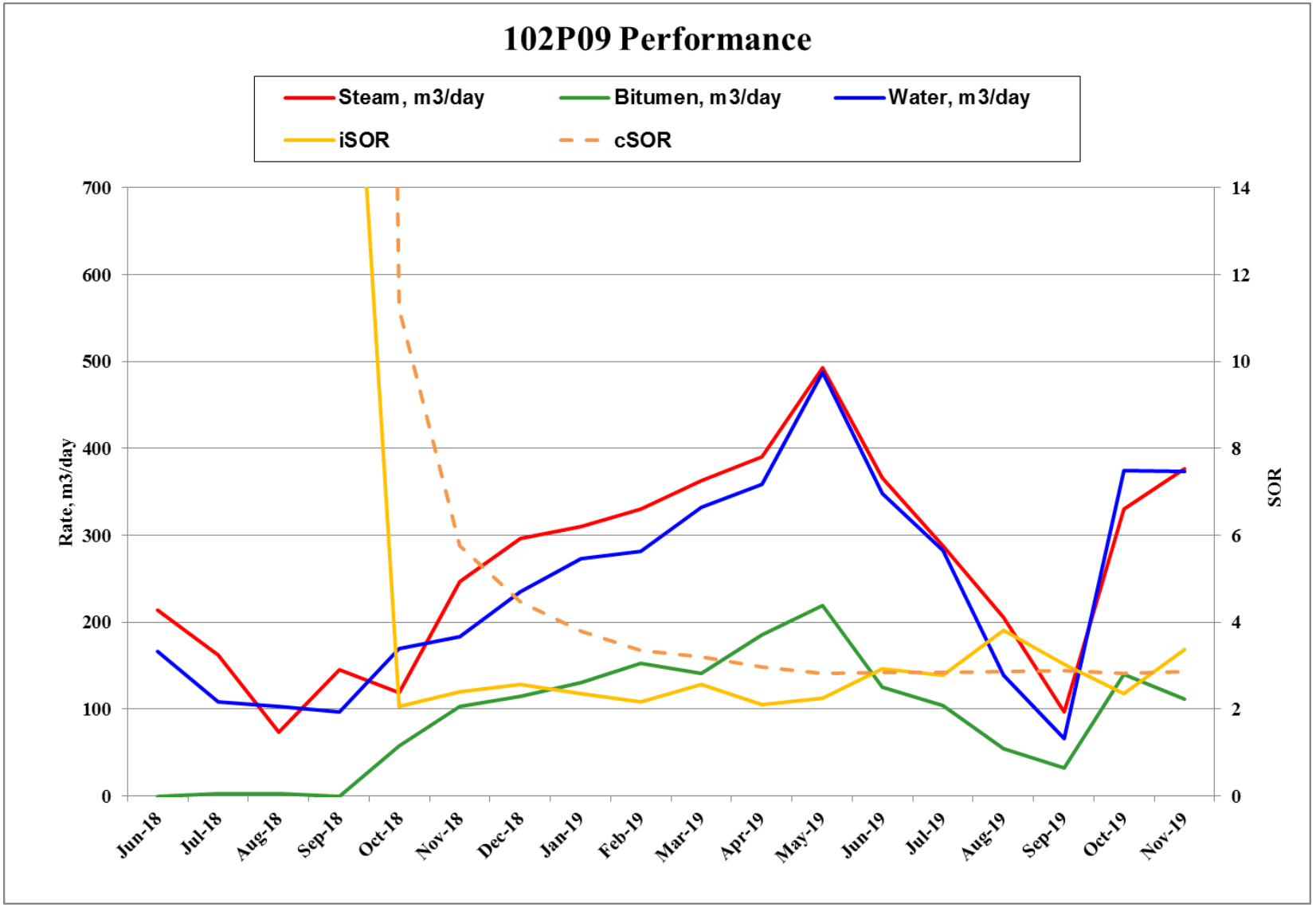
1.7 Scheme Performance

High Performing Well Pair Example: (102P07: Pilot East Area)



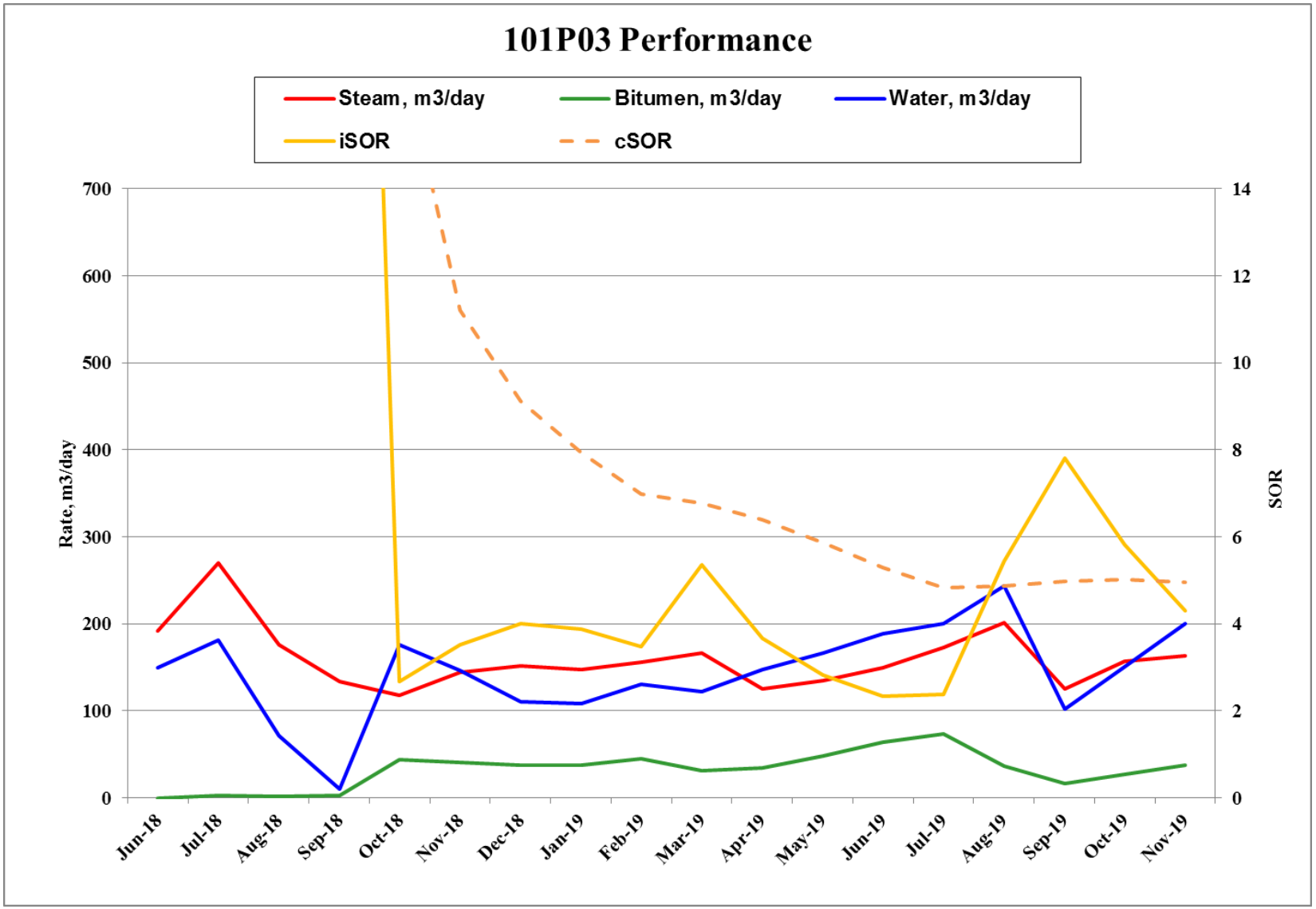
1.7 Scheme Performance

Medium Performing Well Pair Example: (102P09: Pilot East Area)



1.7 Scheme Performance

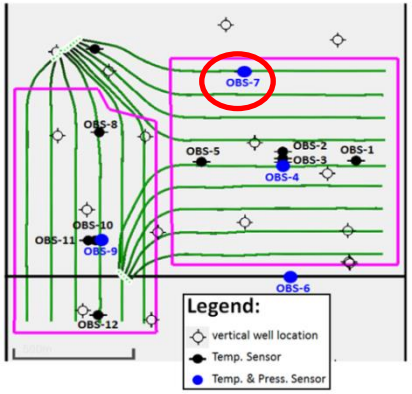
Low Performing Well Pair Example: (101P03: Pilot East Area)

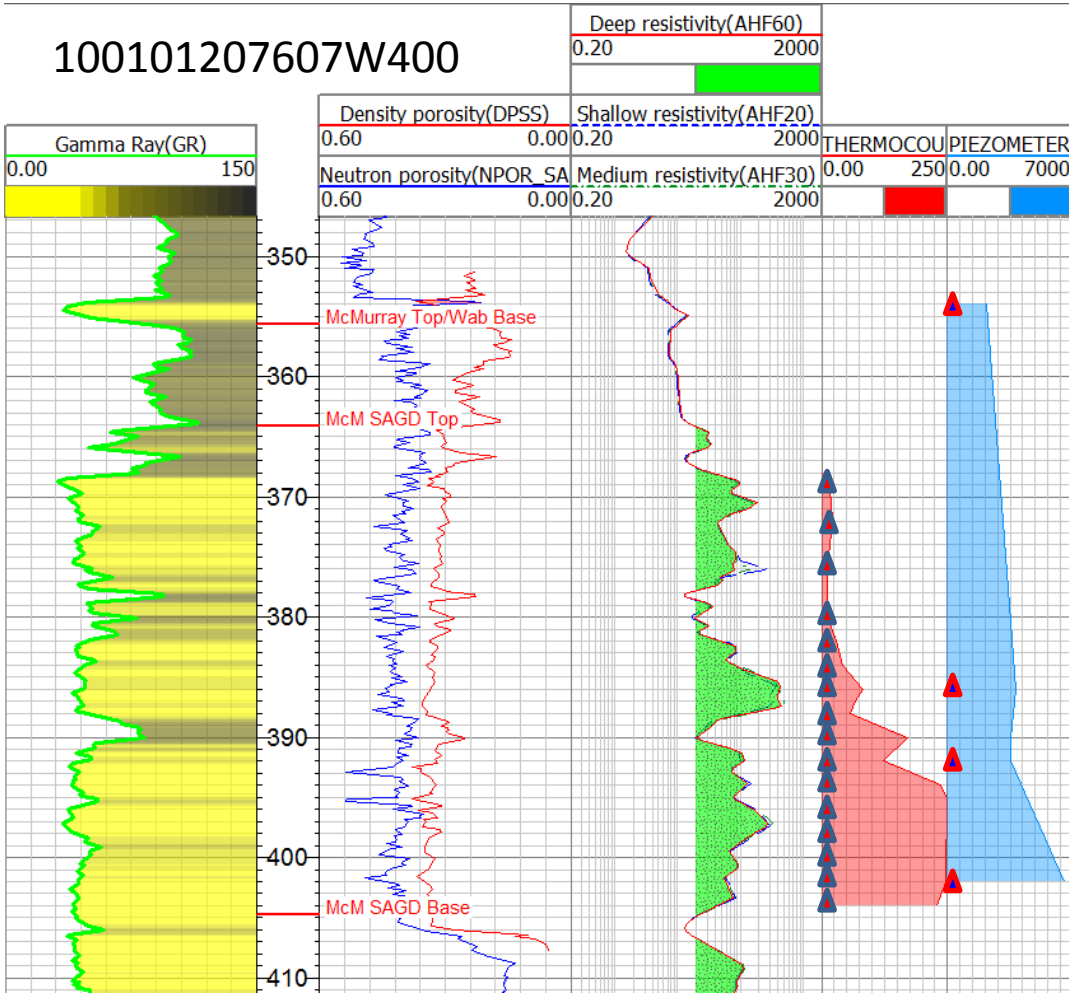


1.7 Scheme Performance

Observation Well Monitoring:

- Observation Well 7, 1.2m South from 102P10 between heel & middle
- Steam chamber development, 8m height 17 months after first steam (including circulation)
- Temp and Press from Nov 30, 2019
- Pressures recorded at 201.8mSS, showing 6554 kPa are erroneous, piezometer failed.
  - Max injection pressure did not exceed 5000kPa, as alarm system and shutdown in place to ensure pressure does not exceed 5000kPa
  - Temperatures of 247°C recorded at same depth, reflect saturation pressure of ~3800kPa





**NOTE: Observation well temperature versus depth & pressure versus depth plots included in Appendices

Subsurface Key Learnings

- 6m heel down to 4m toe separation improves circulation duration and early conformance. Provides some mitigation for steam breakthrough towards the ESPs.
- Reservoir pressure confinement allowing higher operating pressure and temperature for longer than predicted.
- Reduced diameter production tubing directly above the ESP having some success in managing early mechanical failures related to high DLS.
- Tighter clustering of obs wells for higher resolution would not be repeated. Broader distribution along the wellbore would provide more information on conformance and overall chamber growth.

Agenda – 1.8 Subsurface – Future Plans

1.1	Background
1.2	Geology / Geoscience
1.3	Drilling and Completions
1.4	Artificial Lift
1.5	Instrumentation in Wells
1.6	4-D Seismic
1.7	Scheme Performance
1.8	Subsurface – Future Plans

1.8 Subsurface – Future Plans (8a-c)

- 101P05 and 102P01 First Steam in 2020 subject to facility capacity and field performance
- 2-4 additional injector wells recompleted with tubing deployed FCDs in 2020
- 4D seismic acquisition in 2020
- Observation well temperature data will be analyzed and compared to 4D seismic, when 4D seismic results are available
- Continue evaluating optimal timing to pursue NCG co-injection
- The BlackGold project is entering its second full year of operations and has no plans for material changes in steam injection strategy
- Steam generation capacity is expected to fully service the existing field and up to 2 additional well start-ups. Steam will be prioritized to individual wells to achieve optimum performance for the overall project.

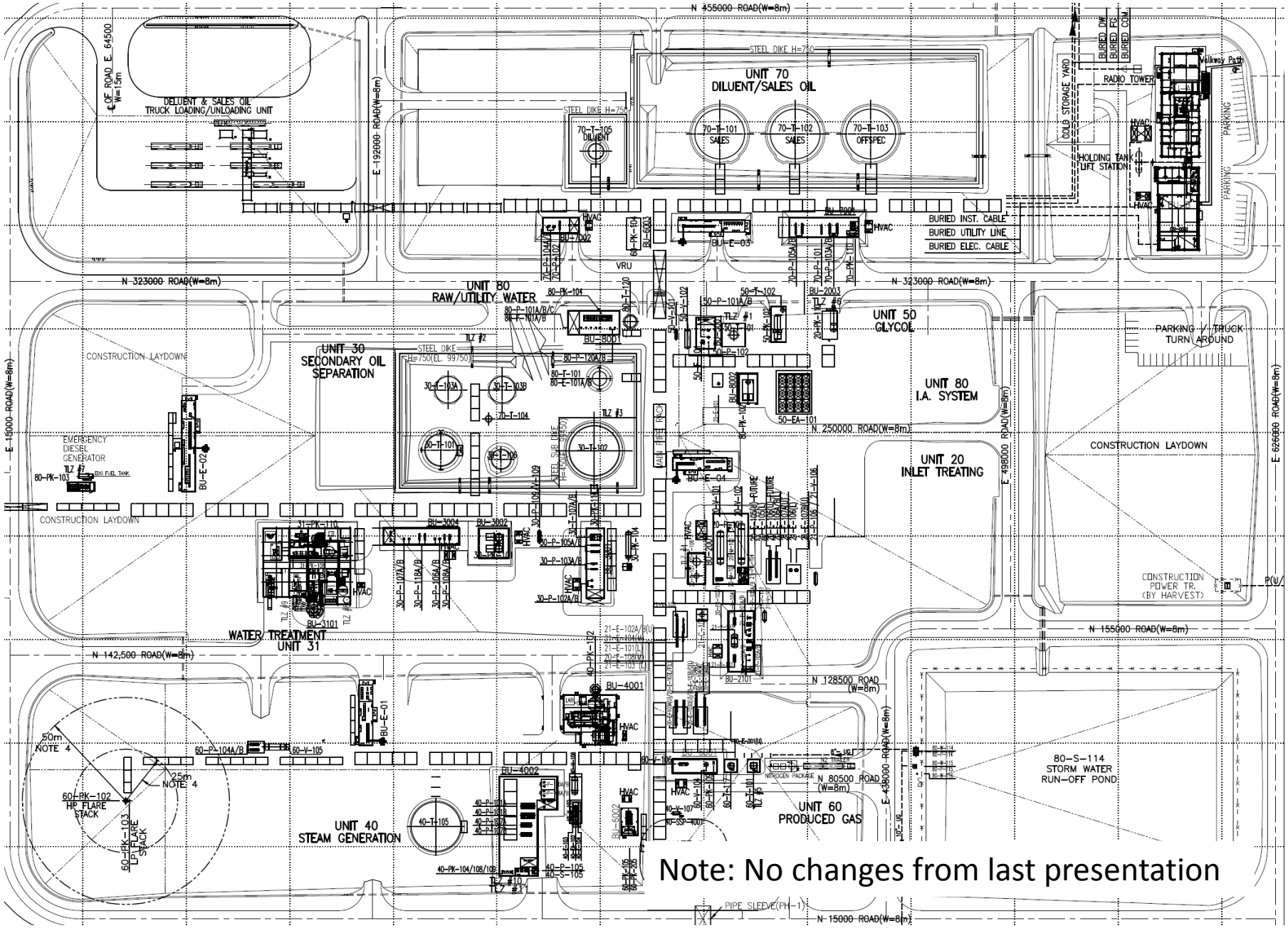
Subsurface Key Learnings

- 6-5-4m heel to toe separation improves circulation duration and early conformance. Provides some mitigation for steam breakthrough towards the ESPs
- Reservoir pressure confinement allowing higher operating pressure and temperature for longer than predicted
- Reduced diameter production tubing directly above the ESP having some success in managing early mechanical failures related to high DLS
- Tighter clustering of obs wells for higher resolution would not be repeated. Broader distribution along the wellbore would provide more information on conformance and overall chamber growth

Agenda – 2. Surface Operations

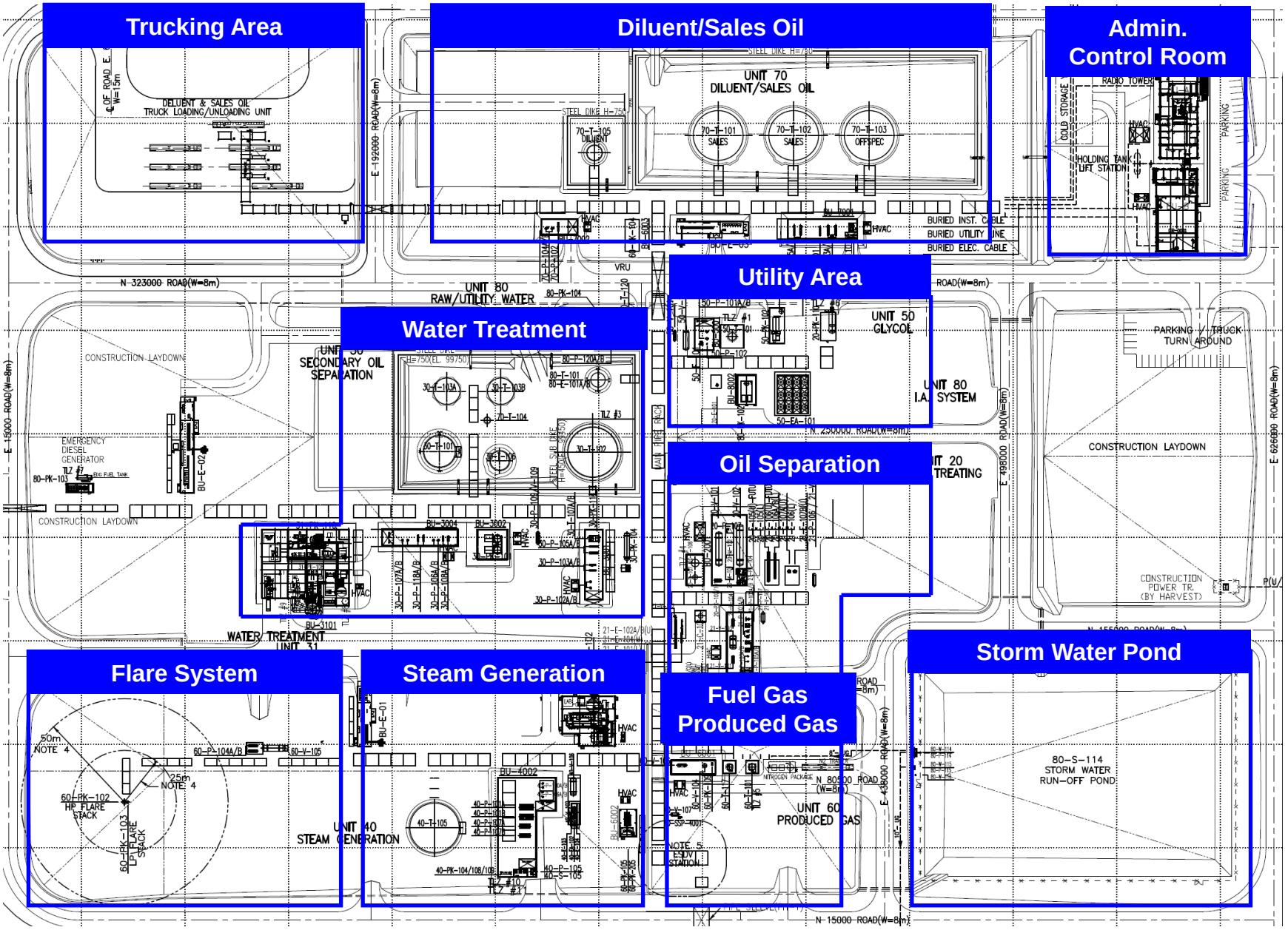
2.1	Facilities
2.2	MARP
2.3	Water Sources and Uses
2.4	Water Treatment Technology
2.5	Water and Waste Disposal
2.6	Sulphur Production
2.7	Environmental Issues & Compliance
2.8	Surface – Future Plans

2.1 Facilities – Plot Plan

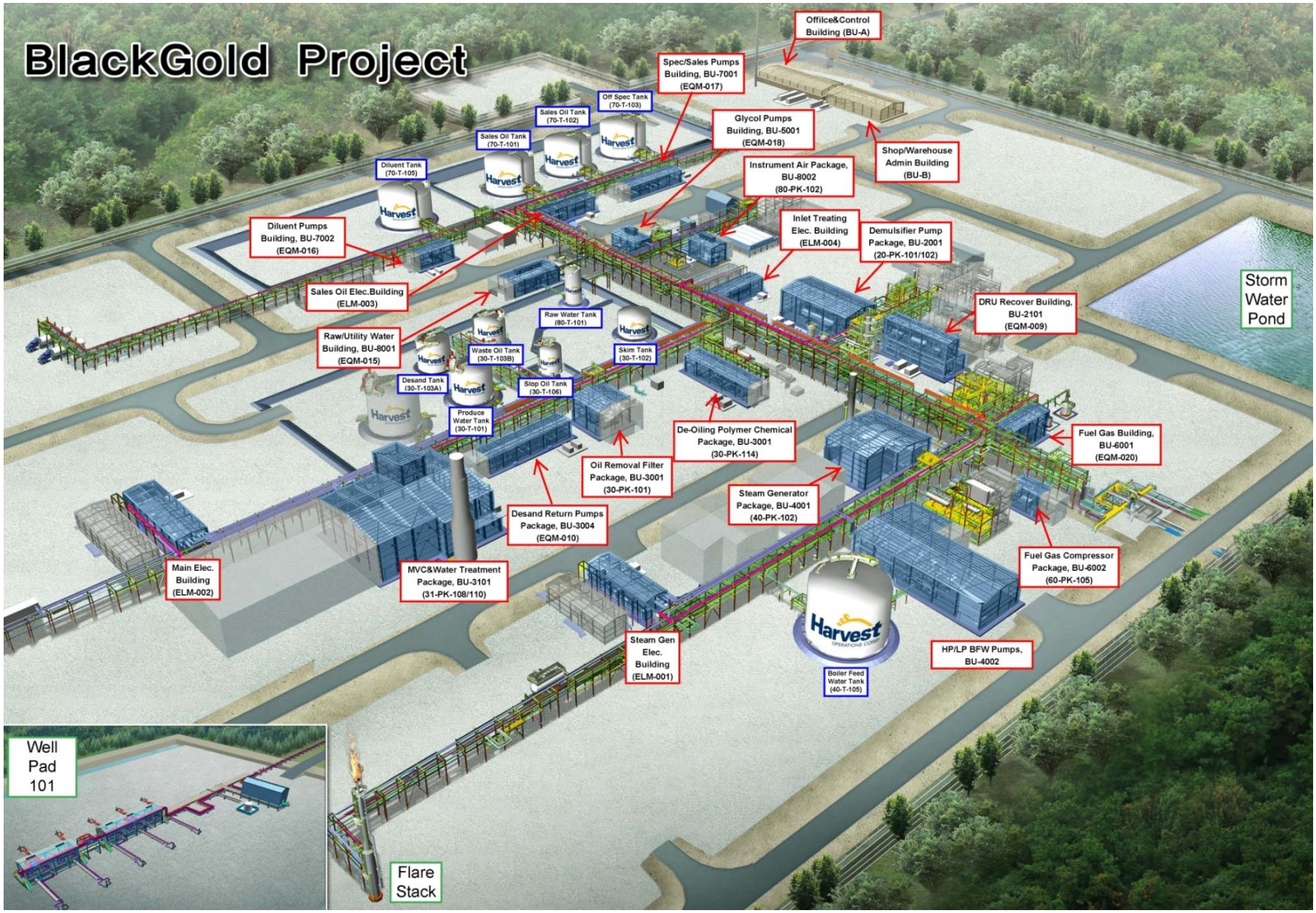


Note: No changes from last presentation

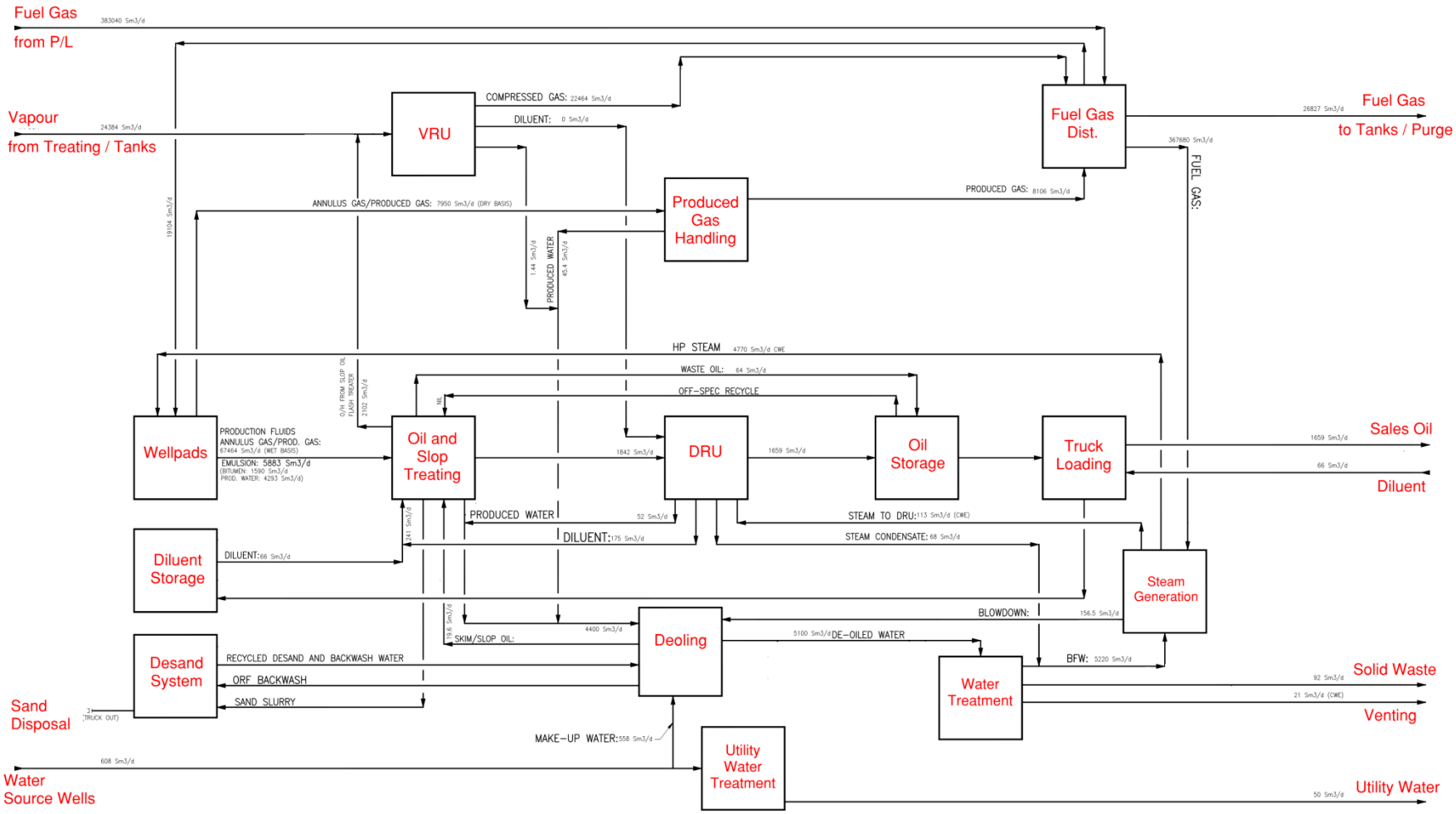
2.1 Facilities – Plot Plan



2.1 Facilities – 3D View



2.1 Facilities – Block Flow Diagram



2.1 Facilities

2019 Facilities Overview

- BlackGold focused on ramping facility operations throughout 2019.
- A number of capacity tests were completed to benchmark performance versus design.
  - diluent recovery and oil treating capacities were proven to 11,500bpd of bitumen
- Based on performance test results several smaller scale debottlenecking activities have been initiated in select areas of the facility.
- The first facility Turnaround was successfully completed in September 2019.
- As of Q4 2019, BlackGold's highest producing month achieved 1,589 m^3/day of bitumen.

2.1 Facilities

Plant and Well pad Operational Issues and Activities

- 3rd Sales Tank remaining construction scope underway to improve optionality on market pricing and normalize trucking levels
  - substantially constructed as part of the original project but never tied in to the facility
  - Anticipate tank in service Q1 2020

- The project has experienced several production choke failures and the majority of the field has been replaced with an upgraded valve better suited to erosional service

- Efforts are ongoing to reduce Produced Water Exchanger and Evaporator fouling and cleaning

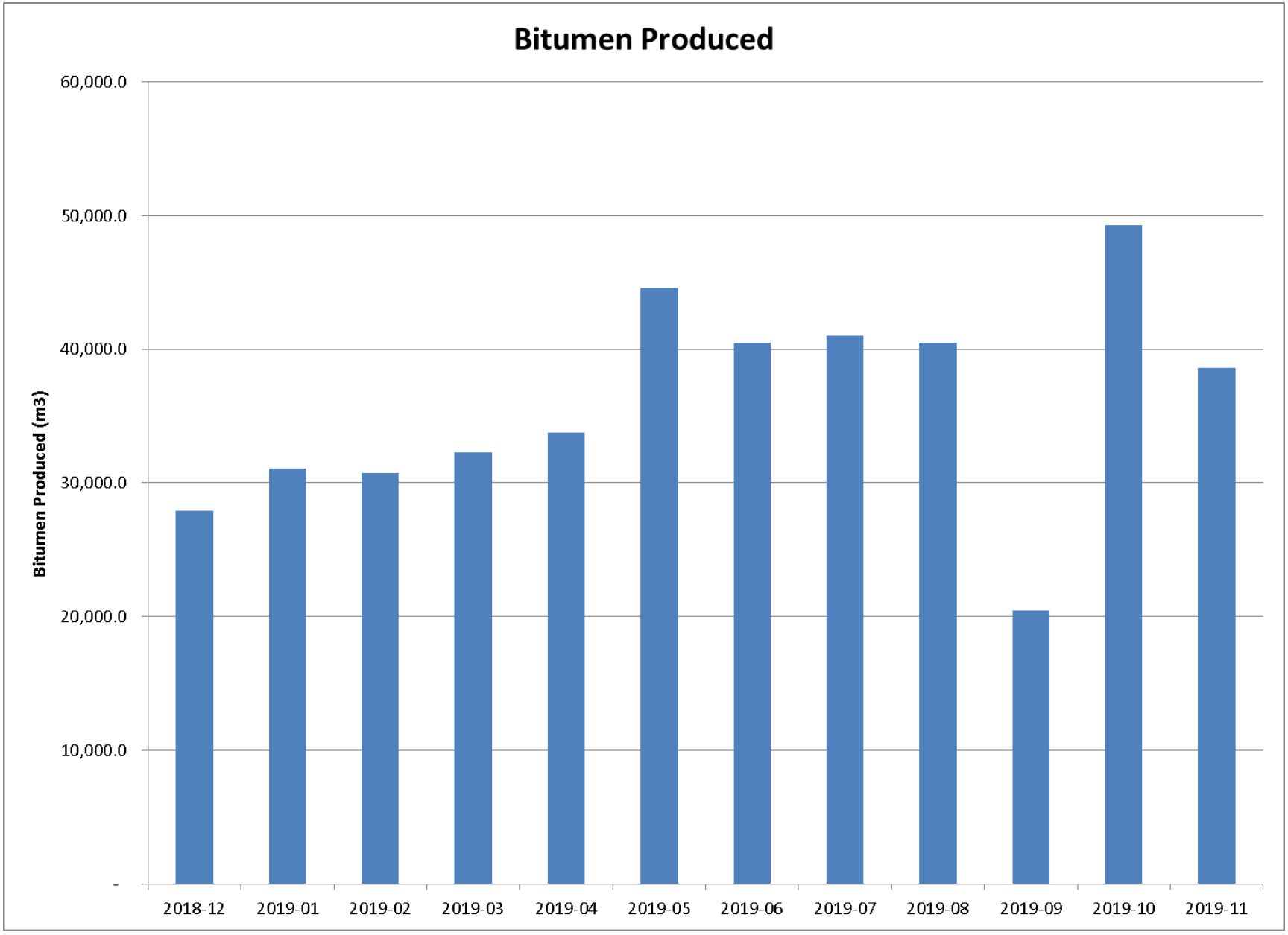
Turnaround Highlights

- In Sept of 2019 Harvest completed its first maintenance turnaround at BlackGold

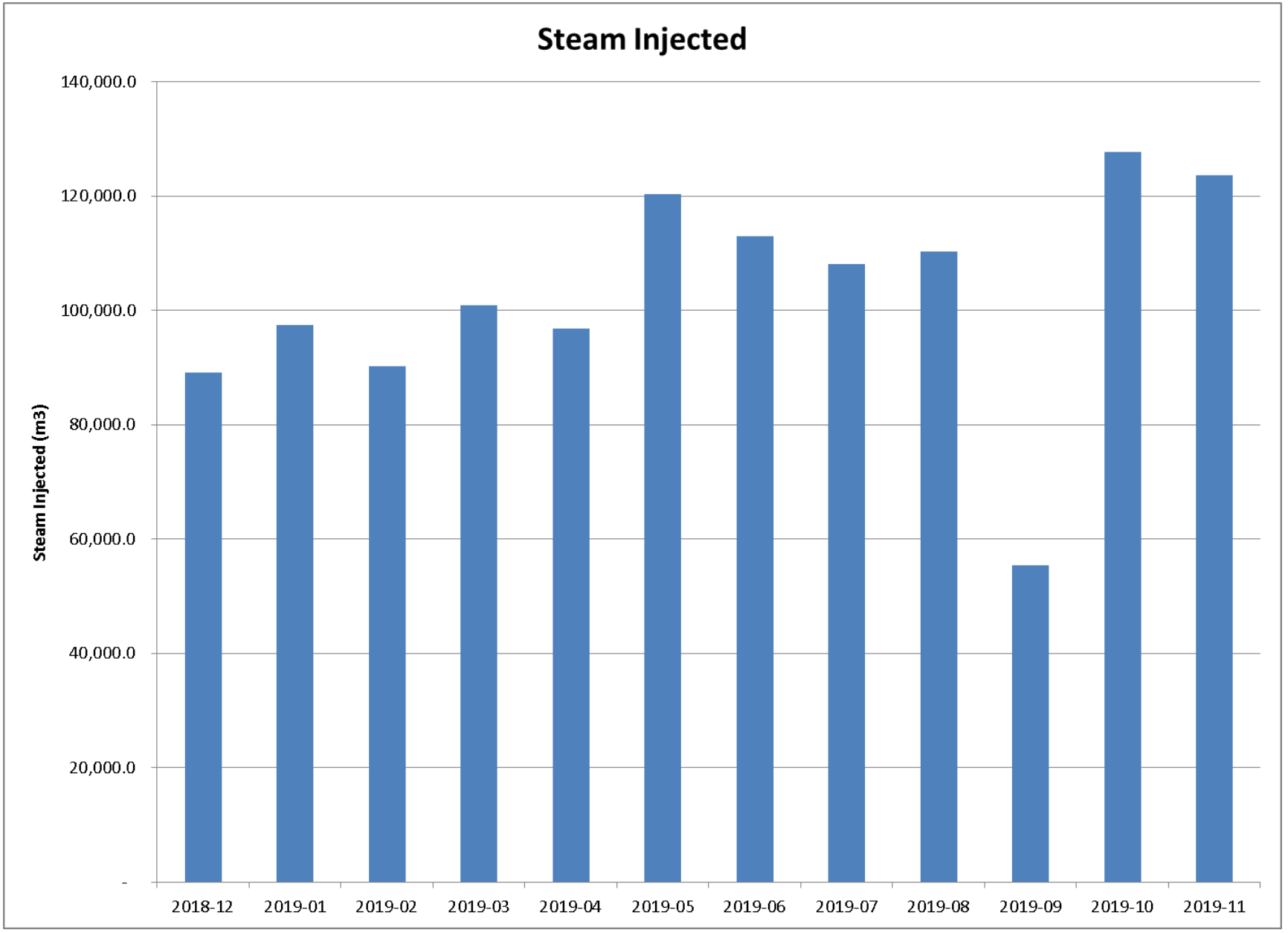
- Turnaround highlights included:
  - No recordable injuries or spills
  - No high potential near miss incidents
  - ~21,000 hours of work completed on schedule
  - 126 Work Orders and 21 MOC Projects completed

- Major Work Completed:
  - Regulatory inspections throughout the facility
  - Skim Tank Service inspection
  - Operational cleaning of 3 vessels and 3 heat exchangers
  - One heat exchanger repair
  - 21 MOC Projects of varying types completed

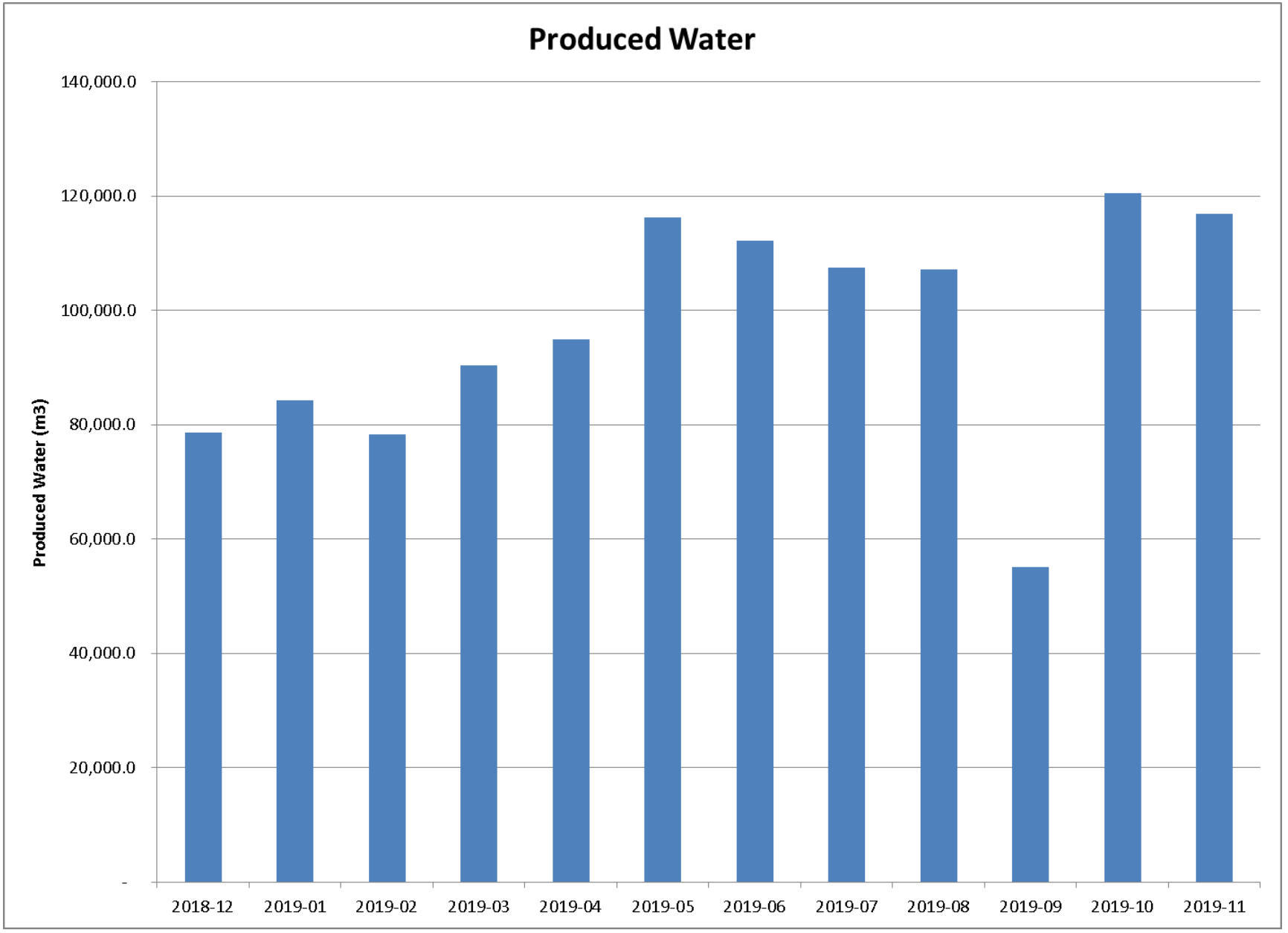
Bitumen Produced



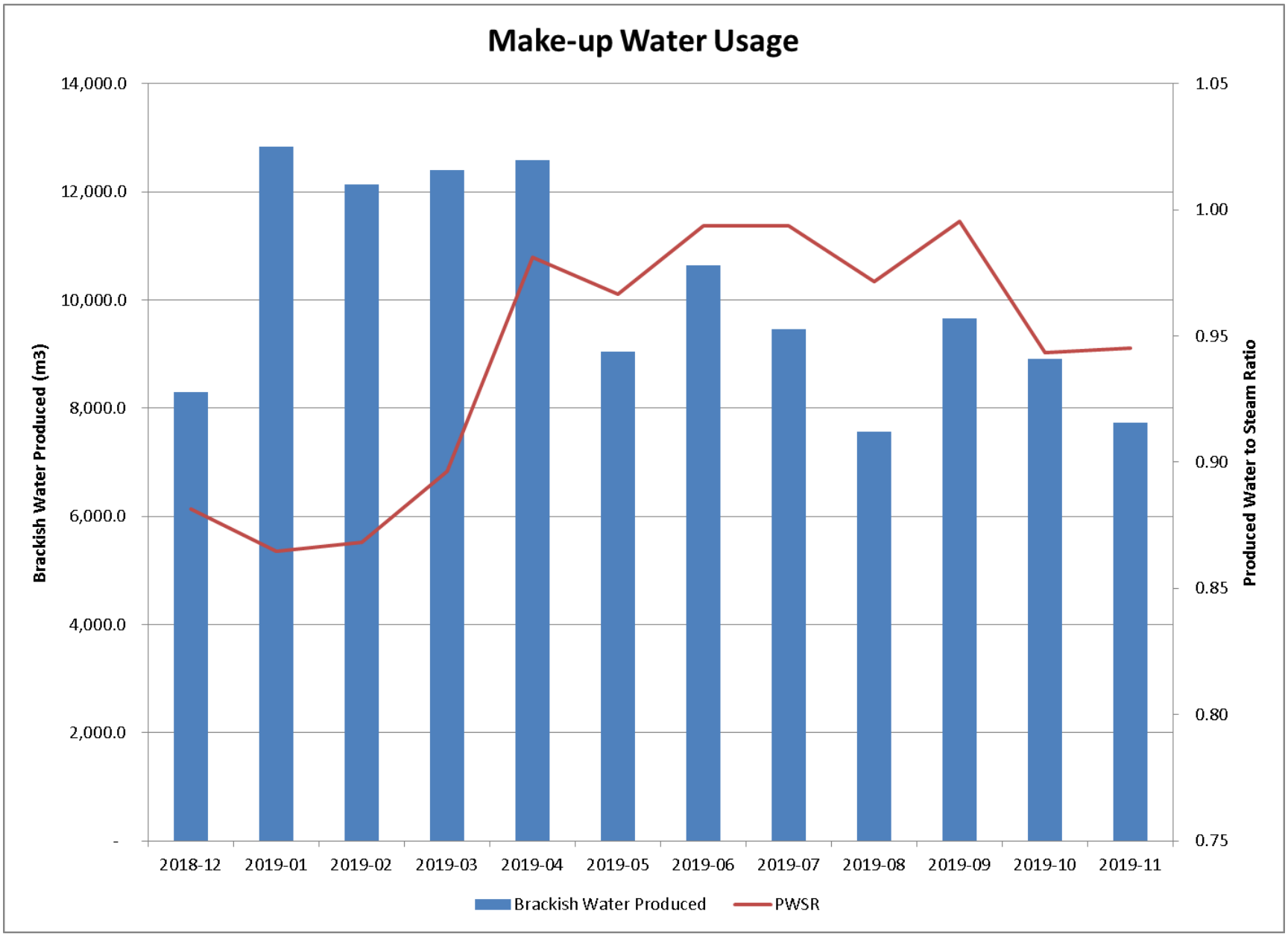
Steam Injected



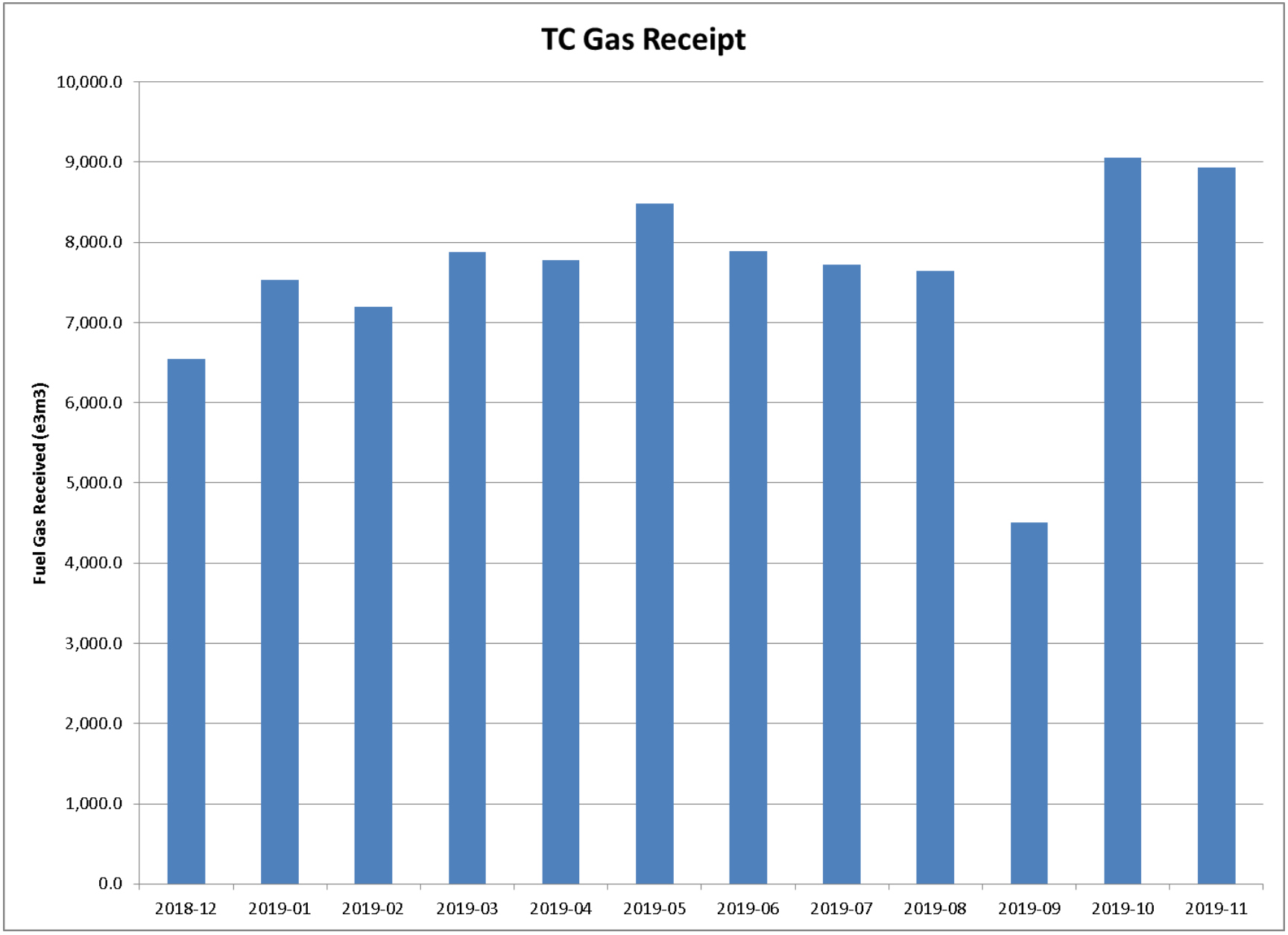
Produced Water



Make-Up Water Production



Fuel Gas Consumption



Agenda – 2. Surface Operations

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2.2 MARP

2019 MARP Overview

- The updated MARP was submitted and approved in 2017 in accordance with AER Directive 042 requirements.
- MARP has been continually reviewed during the start-up process to ensure that the meters are performing as expected.
- MARP meter temperature and pressure compensation has also been continuously improved for regulatory volume totalizing including the water balance.

Compliance with regulations

- Meters will be calibrated as per the requirements within Directive 017.

Solvent and gas injection

- No immediate plans to use solvent or gas injection.

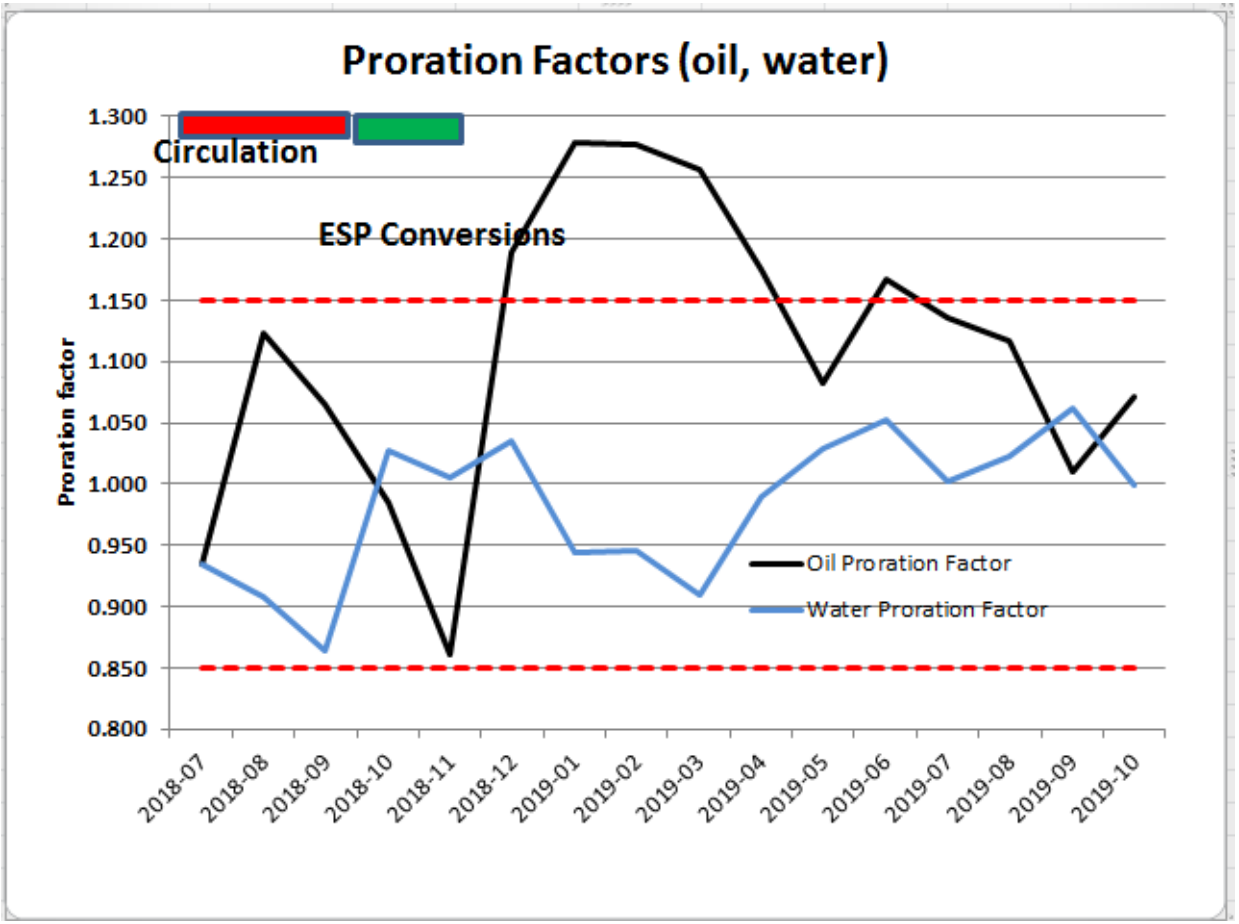
2.2 MARP

2019 MARP Overview

- Well production and injection volumes are estimated by the use of Coriolis meters (emulsion) within the test seperator and vortex meters (injection) for each well as the raw data check for the well tests.
- BlackGold utilizes one test separator per pad that automatically cycles through each well on the pad. Well test duration can be altered and the time between test is dictated by the number of wells linked to the separator.
- Typically each well will be in test for 70 hours per month. Test separators are used continuously.
- Well testing validations are completed once per week per pad within the Energy Components software by the engineering team.
- This data is rolled up and balanced with the facility production and injection volumes to determine month end pro-rations prior to submission to Petrinex.

Proration Factors

- Well Tests reflect actual emulsion production within AER tolerances.
- Wells are tested for 23 hours per test.
- Although inlet emulsion rate have increased substantially, the BG proration factors on oil and water are within range, supporting an accurate allocation.



Production Sampling

- AGAR's with sampling stations are in place.
- Significant bitumen volumes (oil cuts >10%) were not anticipated until after circulation, allowing time to calibrate meters. Meters have been calibrated three times. Calibration is supported by grab sample cuts.
- Single meter for multiple well pairs will help meter calibration. Only 2 AGARs make oil cut measurement consistency easier.
- Chlorides are being used to monitor performance/optimize steam/validate cuts.

Agenda – 2. Surface Operations

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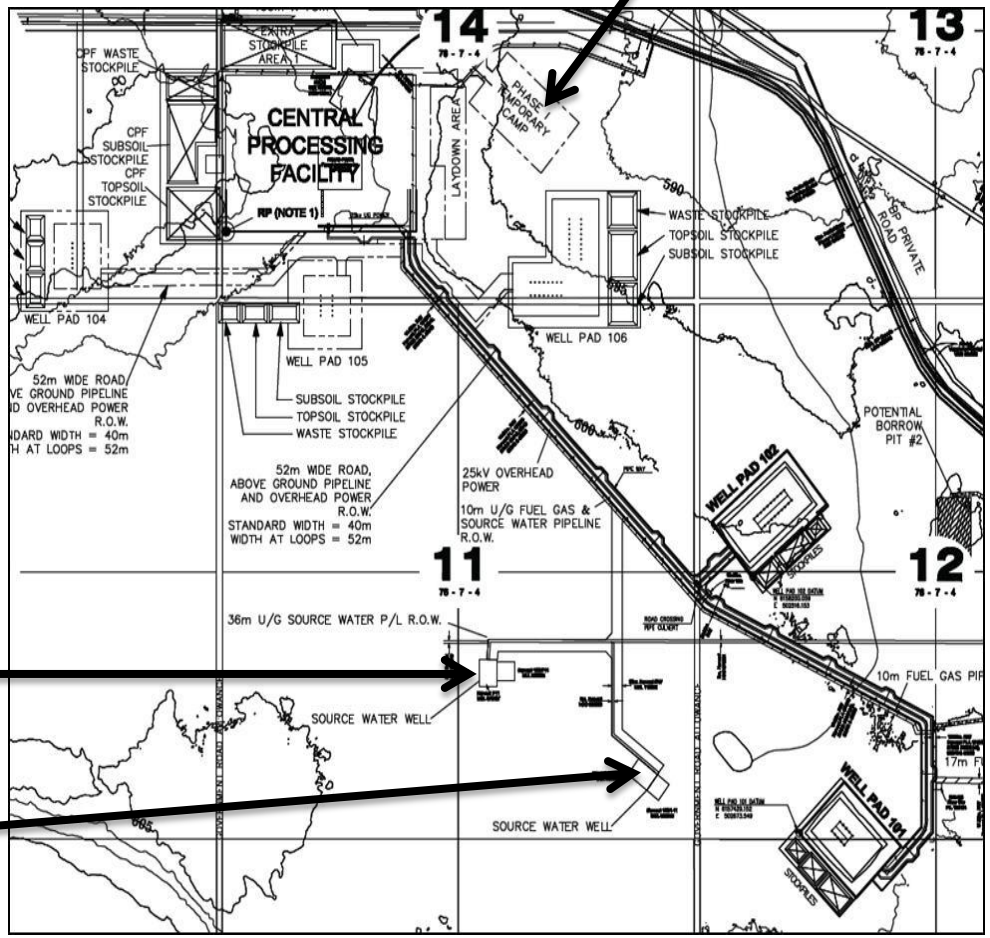
2.8	Surface – Future Plans

2.3 Water Sources and Uses

- 1-11-76-7W4M & 7-11-76-7W4M
  - Depth: 350 m to 353 m Total Vertical Depth (TVD)
  - Primary wells for source water

- 07- 14-76-7W4M – Surface Location
  - Depth: 109.7-115.8 TVD
  - Back-up for source water
  - ABWS 0149324

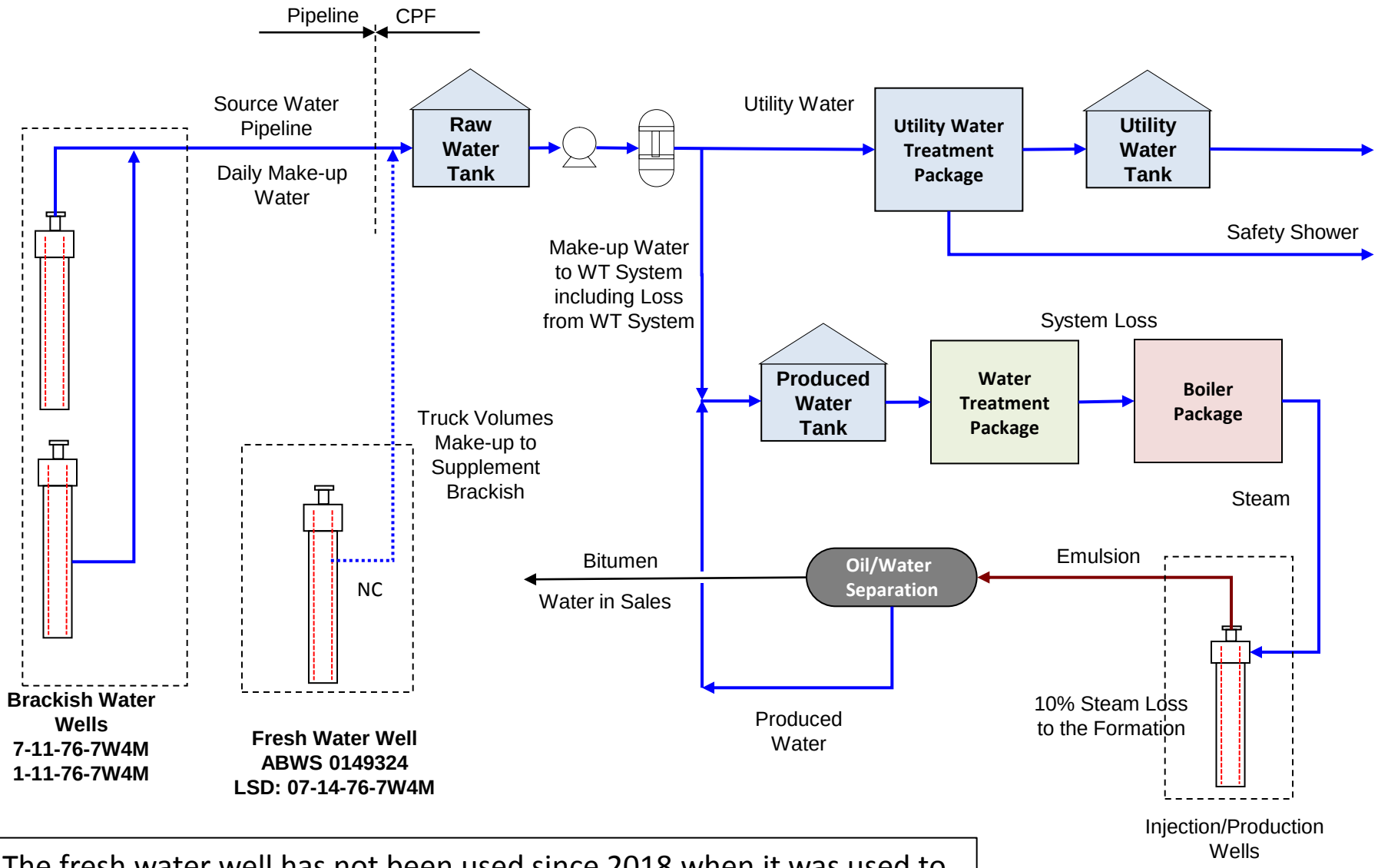
Well ID No. 1421226
07-14-76-7W4M
Formation:
Undifferentiated Q Sediments
TDS: <4,000 ppm



7-11-76-7W4M
Formation: Clearwater B
TDS: 4,330 ppm

1-11-76-7W4M
Formation: Clearwater B
TDS: 4,550 ppm

2.3 Water Sources and Uses



*The fresh water well has not been used since 2018 when it was used to supplement water volumes for project startup.

2.3 Water Sources and Uses

Fresh Water Well-not used

- Well test was previously completed and estimated to generate approximately 600 m^3/d.
- LSD: 07-14-076-07W4/ ABWS 0149324: TDL: 00413718
- Has not been used since startup, 2018.

List of Brackish Water Wells Completed in the Clearwater B Formation

- 1F1/01-11-076-07W4/0 (Main Source well 802A)
- 1F1/07-11-076-07W4/0 (Main Source well 801A)
- 100/01-11-076-07W4/0 (Backup Well 802B)
- 100/07-11-076-07W4/0 (Backup Well 801B)

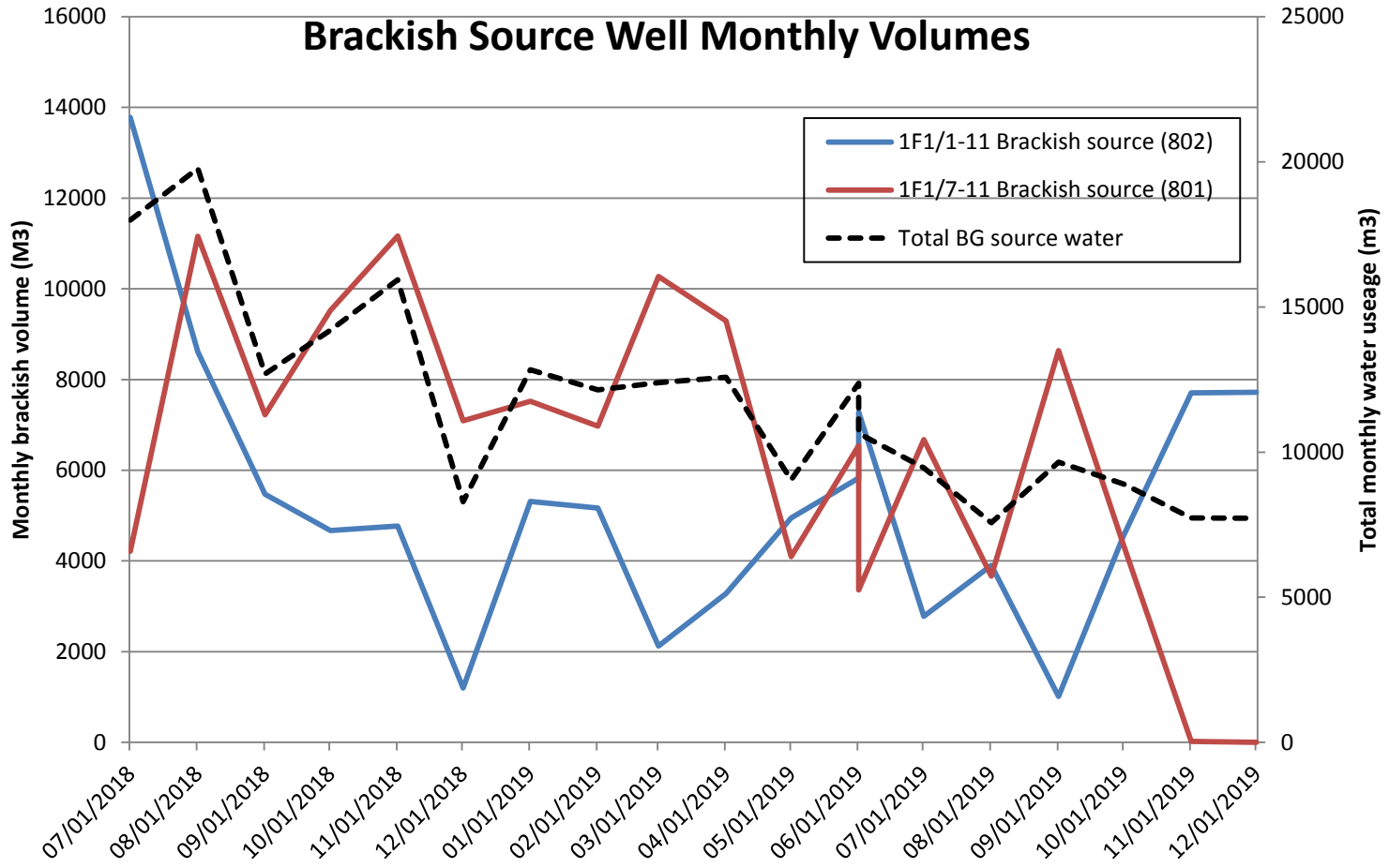
Volume of Saline Water

- The volume of brackish/saline water required for steaming operations is reduced to 300-400 m^3/d for normal operation.

Saline Source Water Well Production Test commenced (Oct 2016)

- The total volume of water produced was measured by flow meter installed in the well common header (801-FIT-0104 and 802-FIT-0104) and in CPF (80-FIT-0163) including flow totalizers.
- Separate casing gas measurements were executed between June, 2018 and October, 2018 to establish brackish source well gas rates. Casing gas measurements were repeated in October 2019 to confirm current gas rates at the lower water demand.(GLR)
- A failure of the internal liner in the 801 (1F1/7-11) pipeline to the junction is being repaired (January, 2020).

2.3 Water Sources and Uses - Steam Injection



- Brackish source well water only was used during 2019. Volumes are declining as water/steam ratios approach 1.0, and as reservoir operating pressures are reduced.

Agenda – 2. Surface Operations

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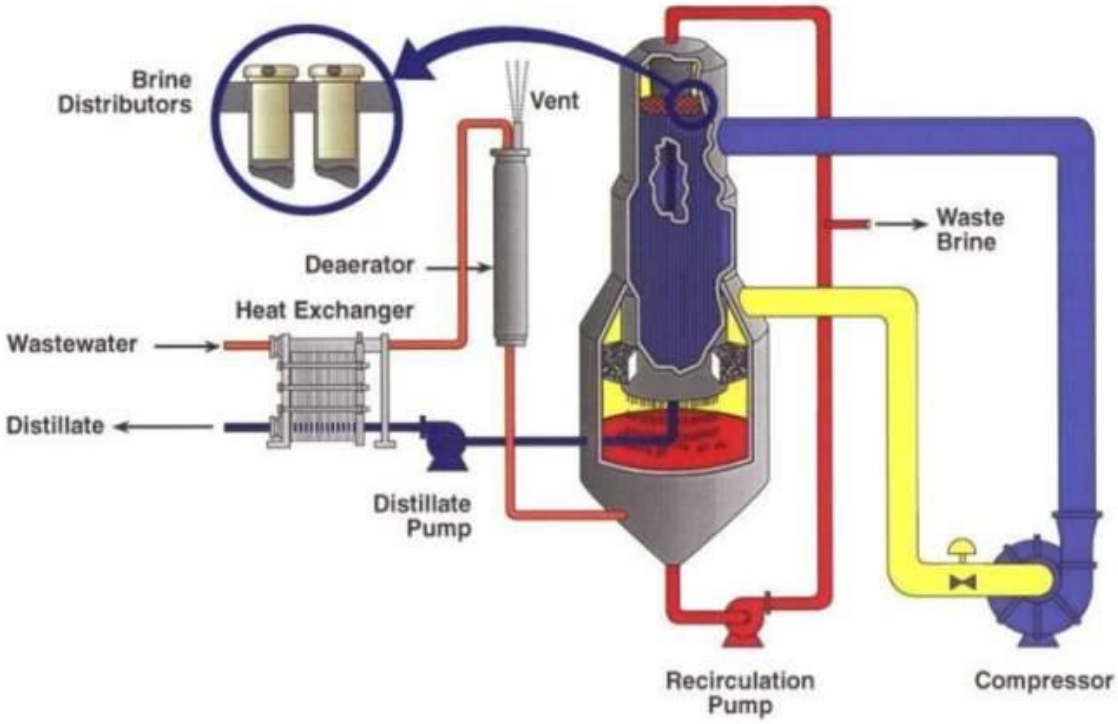
2.4 Water Treatment Technology

- The water treatment technology is a high pH Mechanical Vapour Compression (MVC) evaporator with a crystallizer and solid forming equipment.

Evaporator Process

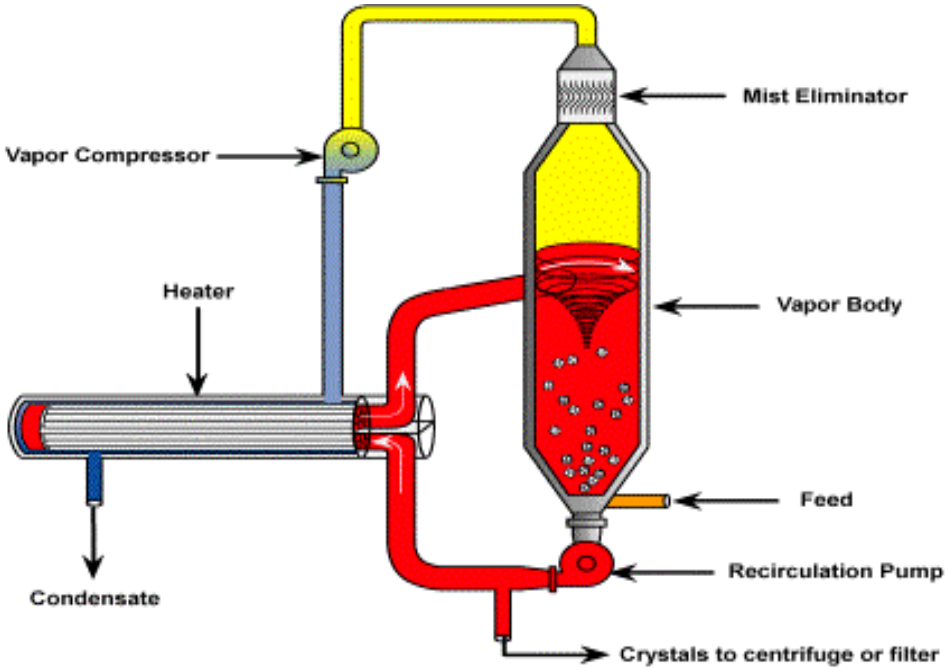
- The feed water enters the steam stripping de-aerator, which has five stages of separation that lowers the dissolved oxygen level to less than 7 parts per billion.
- The split-sump design minimizes energy consumption by evaporating roughly 70% of the total distillate flow in the first stage, or split.
- The remaining 30% of the total distillate flow is produced in the second split under slightly more rigorous operating conditions. Combined distillate from two splits flows through a common distillate collection line.



2.4 Water Treatment Technology

Crystallizer Process

- The liquid waste, or blow-down, from the Evaporator unit is collected in an agitated Crystallizer feed tank.
- The brine is heated a few degrees as it passes through the heater and flashes when it re-enters the vapour body.
- The vapour produced is collected in the vapour body, passes upward through an entrainment separator, and enters the suction side of the rotary lobe type vapour compressor. The vapour is transferred to the shell side of the heater where the vapour condenses, providing the thermal driving force for evaporation. The condensed vapour is collected in the condensate tank and transferred to the evaporator feed tank.
- To control the recirculation brine solids level, a slipstream is removed from the crystallizer recirculating brine and sent to the Crystallizer Waste Tank where it is continually mixed and recirculated to maintain suspension of the solids.



2.4 Water Treatment Technology - Performance

- Performance of the industrial waste water treatment plant has been as expected.
- The Directive 081 Disposal Limit calculated for the facility is 14.25% with the facility Actual Disposal of 1.12%.
- Brackish Water is the only make-up source for steam generation.
- Fresh Water was not utilized within the facility during the operational year.

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2.5 Water and Waste Disposal

- There are no disposal wells or land fills associated with the BlackGold Project.
- All waste streams are transported offsite within Alberta to AER approved third party waste management facilities.
- Waste water streams include crystallizer waste, evaporator waste, produced water in slop oil, and any wash water collected in the facility.
- Slop oil was transported to AER approved waste management facilities for recovery.
- Third party waste receivers include but are not limited to Tervita, White Swan Environmental Ltd., Secure Energy Services and CNRL.
- The BlackGold Project is designed to utilize a proprietary cement plant process as part of its industrial waste water management system.
  - To date commissioning of the cement plant has not been successful and Harvest will re-evaluate the need for commissioning the cement plant in the later half of 2020.
- Solid waste and waste fluids (i.e. sewage, sludge, etc.) produced at the facility trucked out to third party disposal facilities.

Agenda – 2.6 Surface Operations

2.1	Facilities
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2.6 Sulphur Production – Emissions

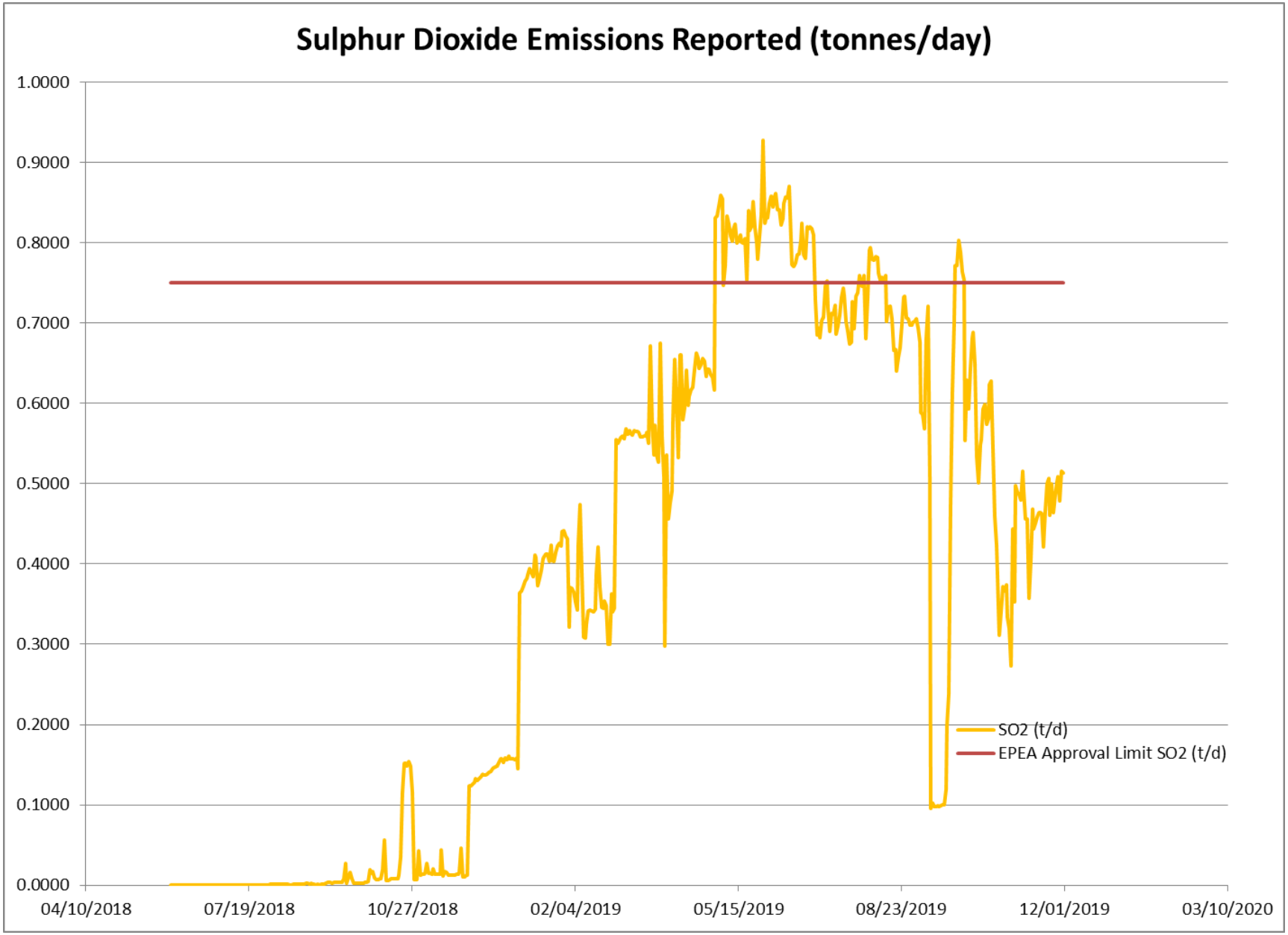
- Peak SO_2 Emissions were 0.93 tonnes on May 30.
- Average SO_2 Emissions During Q3 were 0.32 tonnes/day.
- Plant Total SO_2 = Flared SO_2 + SO_2 Steam Generator.
- The Glycol Heater is supplied by purchased sweet fuel gas.
- SO_2 emissions have increased as production ramped up to nameplate.
- SO_2 emissions reported monthly in industrial air emissions monitoring report.
- Issues identified in sampling locations and water vapour content in process streams are the major contributing factors to estimated SO_2 emissions exceeding the daily limit.
- Sulphur production is well below the 1 tonne/day limit.
- A sulphur emissions material balance approach has recently been implemented as it is more accurate and representative of process conditions.
- SO_2 emissions were calculated based on analytical results of process sampling, and volumetric flow rates.
- Harvest will be revising several months of industrial air emissions data to reflect more accurate emissions.

2.6 Sulphur Production – Emissions

- Calendar Quarterly Sulphur Emissions.

Year	Quarter	Quarterly Average Sulphur (t/d)
2018	Q4	0.03
2019	Q1	0.20
2019	Q2	0.38
2019	Q3	0.32
2019	Q4	0.24
Note: 2019 Q4 data does not include December		

Sulphur Production – SO2



Emissions Summary – Air Monitoring Results

- Four passive monitoring stations for H2S and SO2.
- Monthly monitoring results indicate compliance with the AAQOs.

	Peak Monthly	
	SO2 (ppb)	H2S (ppb)
Jan-19	1.9	0.19
Feb-19	1.4	0.18
Mar-19	1.5	0.11
Apr-19	0.8	0.11
May-19	1.1	0.13
Jun-19	1.8	0.15
Jul-19	0.9	0.19
Aug-19	1	0.35
Sep-19	0.6	0.16
Oct-19	1.2	0.22
Nov-19	1.9	0.2

- Continuous Emissions monitoring Oct – Dec 2019.
- Monitoring results indicate compliance with the AAQOs.
- AMD contravention associated with less than 90% uptime of wind system equipment during October.

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2.7 Applications

- Authorization for extension of EPEA Approval Expiry to Dec 31, 2020.
- Applications for extension to the deadline for certification of the CEMS unit to the end of May.
- Temporary Diversion Licence from various borrow pit locations was utilized for dust control on roads during non-winter months.
- Application for CEMS data methodology variance authorized in August following equipment failure.
- Oil Sands Exploration Program OSE190031 – Applied for Authorized by the AER then cancelled due to an AER error in procedure.
- Variance Application for D55 Alternative Storage Authorized November, 2019.

2.7 Environmental Monitoring

- Wetland and Waterbody Monitoring Program
  - Second year of monitoring complete extreme wildfire hazard limited access during June.
  - Monitoring of plots and wells .
  - Completed culvert monitoring within the project area.

- Wildlife and Caribou Mitigation and Monitoring Programs
  - Wildlife track surveys limited due to lack of snow conditions.
  - Camera monitoring program on above ground pipeline crossings.
  - Employee wildlife card program.
  - CPP (Caribou Protection Plan).
  - Confirmation of pipeline heights and caribou underpass locations.
  - Amphibian auditory surveys cancelled due to extreme wildfire risk.

- Ground Water Monitoring Program
  - Program includes near surface and thermal effects monitoring wells.
  - Semi-annual groundwater monitoring events occurred.
  - No indication of any negative effects.

2.7 Environmental Monitoring continued

- Air Emissions Monitoring
  - Monthly passive air monitoring around the facility for SO_2 and H_2S indicated compliance with the AAAQO's.
  - Continuous emissions Trailer Monitoring was completed in the last three months of 2019.
    - Continuous emissions trailer monitoring during operations results indicate compliance with the AAAQG's.
    - One contravention in October relating to <90% up time for wind monitoring equipment.
  - Manual stack testing was completed and results indicate compliance with the NO_x requirements of Table 3.1 of the EPEA Approval.
  - Contravention regarding exceedance of the daily plant SO2 limit.

- Continuous Emissions Monitoring Program (CEMS)
  - CEMS certification was completed May 25, all prior data was reported as pre-certification data.
  - CEMS component reliability and uptime issues in August.
  - Method 4 variance authorization received in August regarding CEMS data replacement.
  - Contraventions regarding exceedance of hourly NOx EPEA limit.
  - Contravention regarding <90% up time for CEMS equipment.
  - Contravention regarding error in the CEMS mass conversion formula.

- Surface Water Monitoring
  - Industrial runoff monitored and tested prior to release and reported annually.
  - Industrial runoff parameters meet the limits established in Table 1 of the EPEA Approval.
  - Water use reporting for dust control.

2.7 Environmental Issues & Compliance

- Annual AEIR submitted for the facility.
- No soil management or monitoring events were required in the reporting period.
- Compliance with building and trench design and operation with Directive 55 requirements plan being implemented in 2020.
- Compliance with truck out vent facility design and reporting achieved.

Reclamation and Initiatives

- Since the BlackGold Project commenced operations reclamation of project development areas is not planned for the next 5 years.
- Completed Phase 1 assessments of 5 historical OSE programs.
- Harvest is compliant with the Alberta Oil Sands Monitoring Program.
- Harvest is a member of the Explorers and Producers Association of Canada.
- Harvest is an active funding member of iFROG focused on Wetland Reclamation Research.

Releases

- Harvest tracks all non-reportable spill events within the corporate incident tracking system.
- All incidents are reviewed internally to identify casual factors and to ensure that corrective actions are taken.

Substance	Number of incidents	Total Volume (m3)	AER Notification	Release Location
Emulsion	1	3.0	Release and Remediation Reports Submitted	CPF
Diluent	1	0.10	Release and Remediation Report Submitted	11-06-070-11-W4M
Crude Oil	1	2.5	Release and Remediation Report Submitted	12-06-076-07-W4M

2019 Compliance Issues

- Contravention (Edge Reference # 0354524) – NOx emissions exceeded the 22.8 kg/h limit. Root cause was operations error during complex operations.
  - Additional alarms installed and training regarding not exceeding the NOx emissions limits.
- Contravention (Edge Reference # 0354526) – NOx emissions exceeded the 22.8 kg/h limit. Root cause was systemic error in the mass calculation formula in the CEMS DAHS.
  - This was an issue related to installation of the incorrect mass conversion formula as per the Alberta CEMS code by the CEMS supplier.
  - This error was correct.
- Contravention (Edge Reference # 0354529) – SO2x emissions exceeded the 0.75t/d limit.
  - Root cause appears to be a combination of water vapour in process samples, sample points needing to be modified, and using a volumetric balance to determine sulfur mass content
  - Issues appear to have been rectified through using produced gas analysis in a mass balance.

- Contravention Edge Reference # 0358665 – CEMS NOx analyzer was online for less than 90% for August
  - Root cause was a combination of plugged orifices and electronic component issues.
  - The critical component list has been updated and spares have been acquired.

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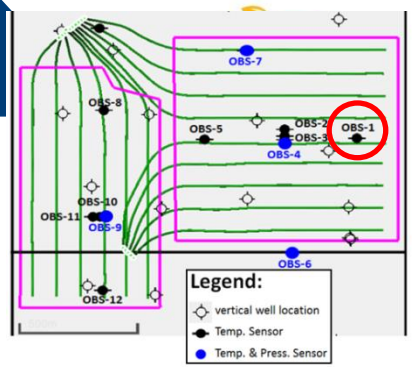
2.8 Surface – Future Plans

- Debottleneck the existing facility in 2020 including:
  - Tie-in of additional sales oil tank.
  - Upsizing of selected pumps.
  - Minor piping modifications as needed to support facility reliability.
  - Improvements in automation and control.

Appendices

- Observation Well 1 Thermocouple Placement



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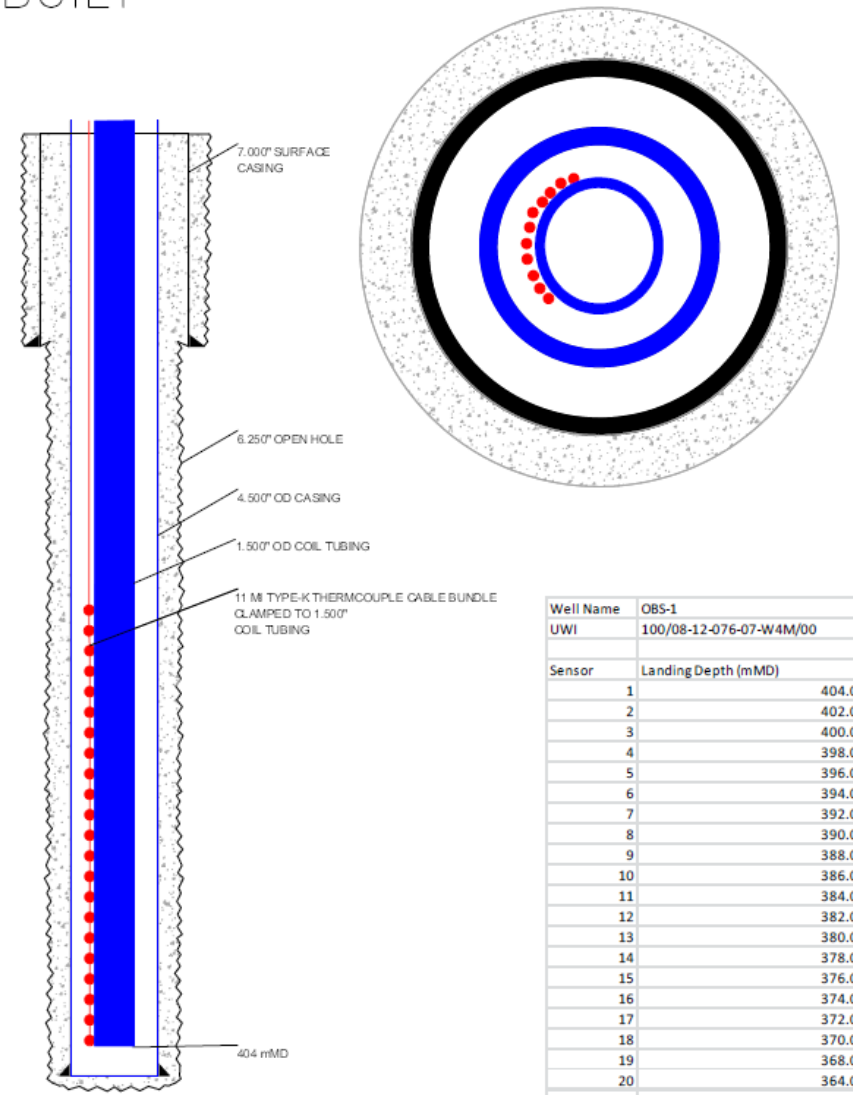
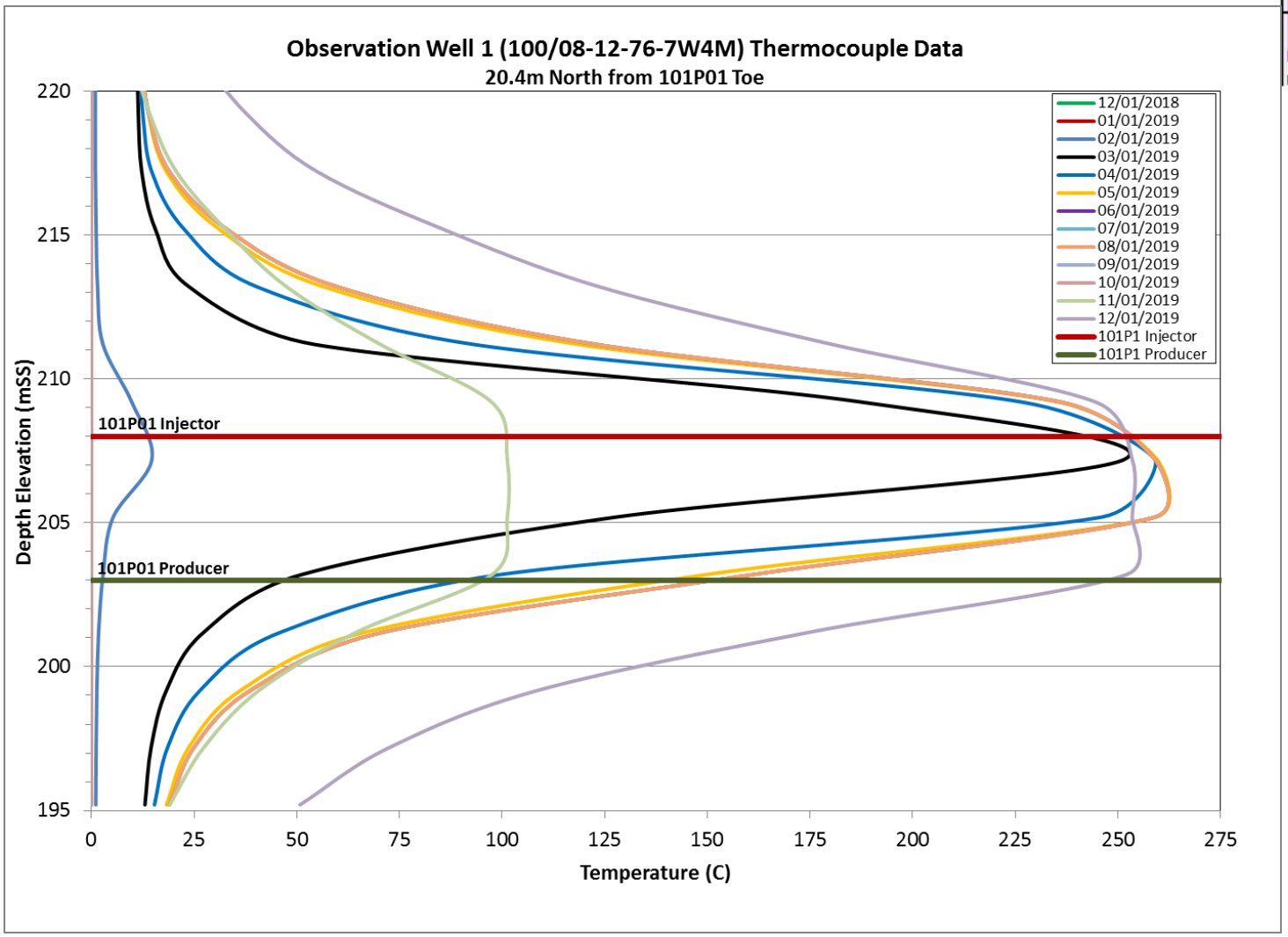
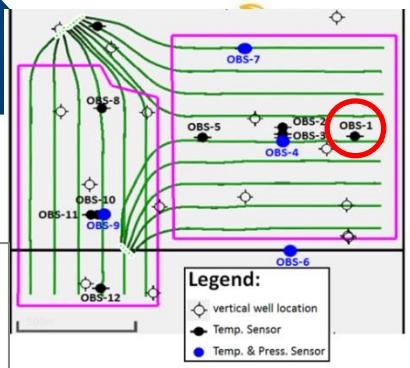


Well Name	OBS-1
UWI	100/08-12-076-07-W4M/00
Sensor	Landing Depth (mMD)
1	404.0
2	402.0
3	400.0
4	398.0
5	396.0
6	394.0
7	392.0
8	390.0
9	388.0
10	386.0
11	384.0
12	382.0
13	380.0
14	378.0
15	376.0
16	374.0
17	372.0
18	370.0
19	368.0
20	364.0
21	313.0
22	308.0

Appendices

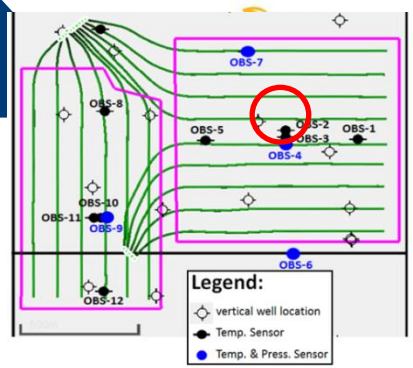
- Observation Well 1 Temperature Data





Appendices

- Observation Well 2 Thermocouple Placement



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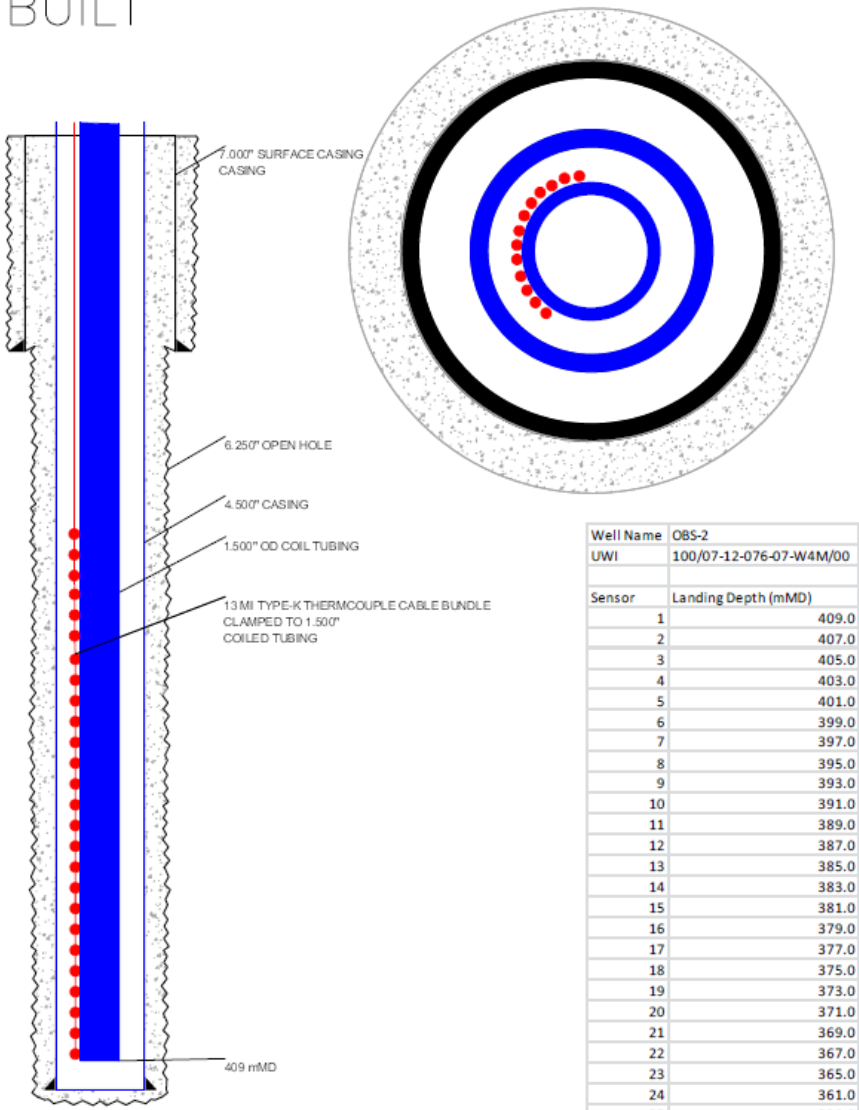
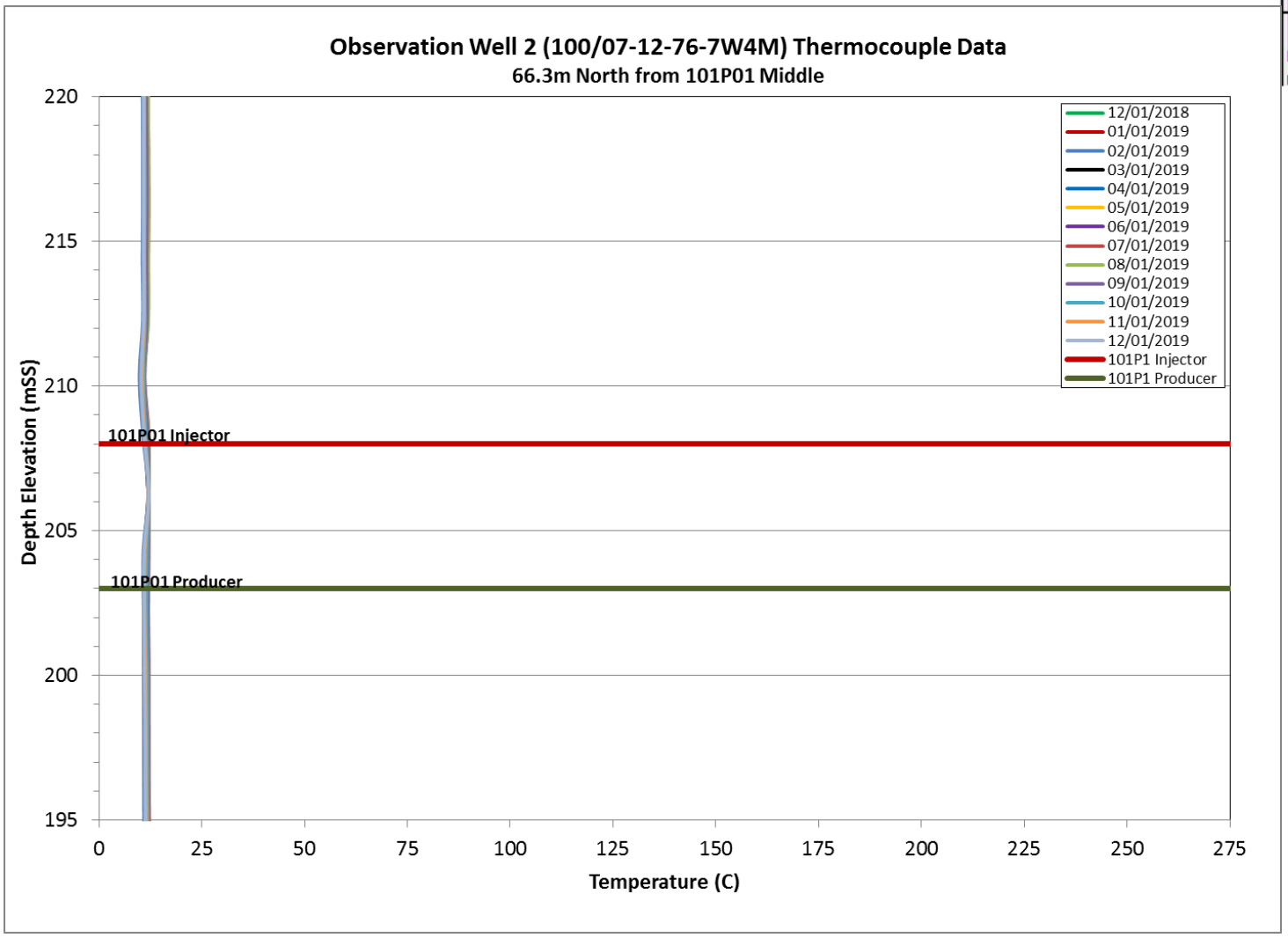
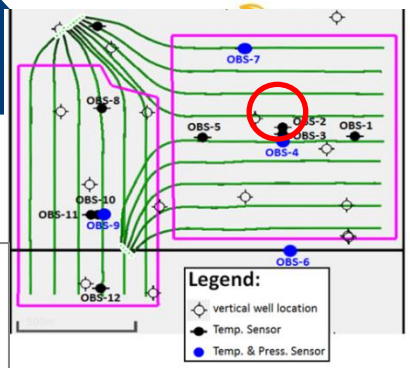


Well Name	OBS-2
UWI	100/07-12-076-07-W4M/00
Sensor	Landing Depth (mMD)
1	409.0
2	407.0
3	405.0
4	403.0
5	401.0
6	399.0
7	397.0
8	395.0
9	393.0
10	391.0
11	389.0
12	387.0
13	385.0
14	383.0
15	381.0
16	379.0
17	377.0
18	375.0
19	373.0
20	371.0
21	369.0
22	367.0
23	365.0
24	361.0
25	320.0
26	315.0

Appendices

- Observation Well 2 Temperature Data





Appendices

- Observation Well 3 Thermocouple Placement

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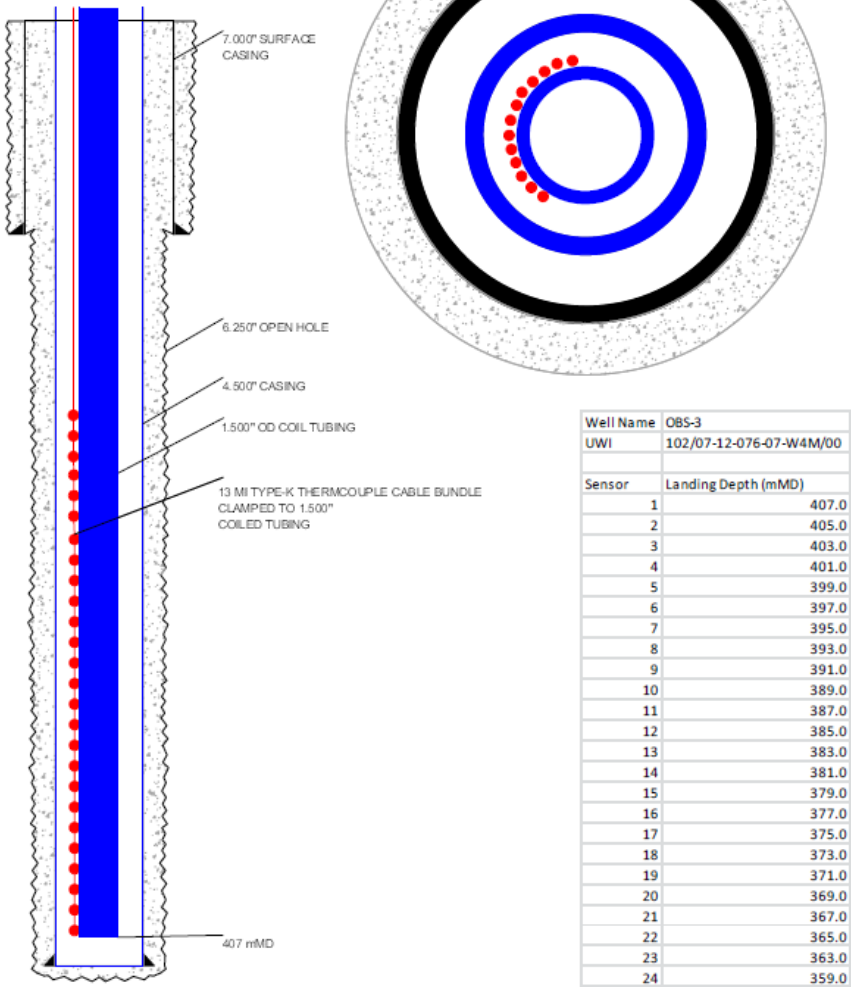
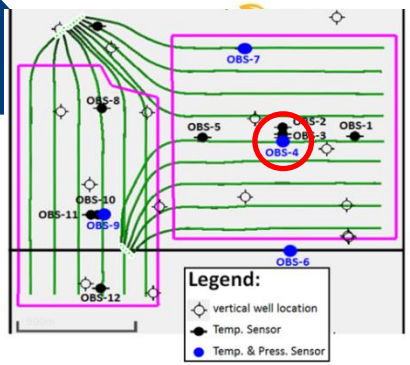
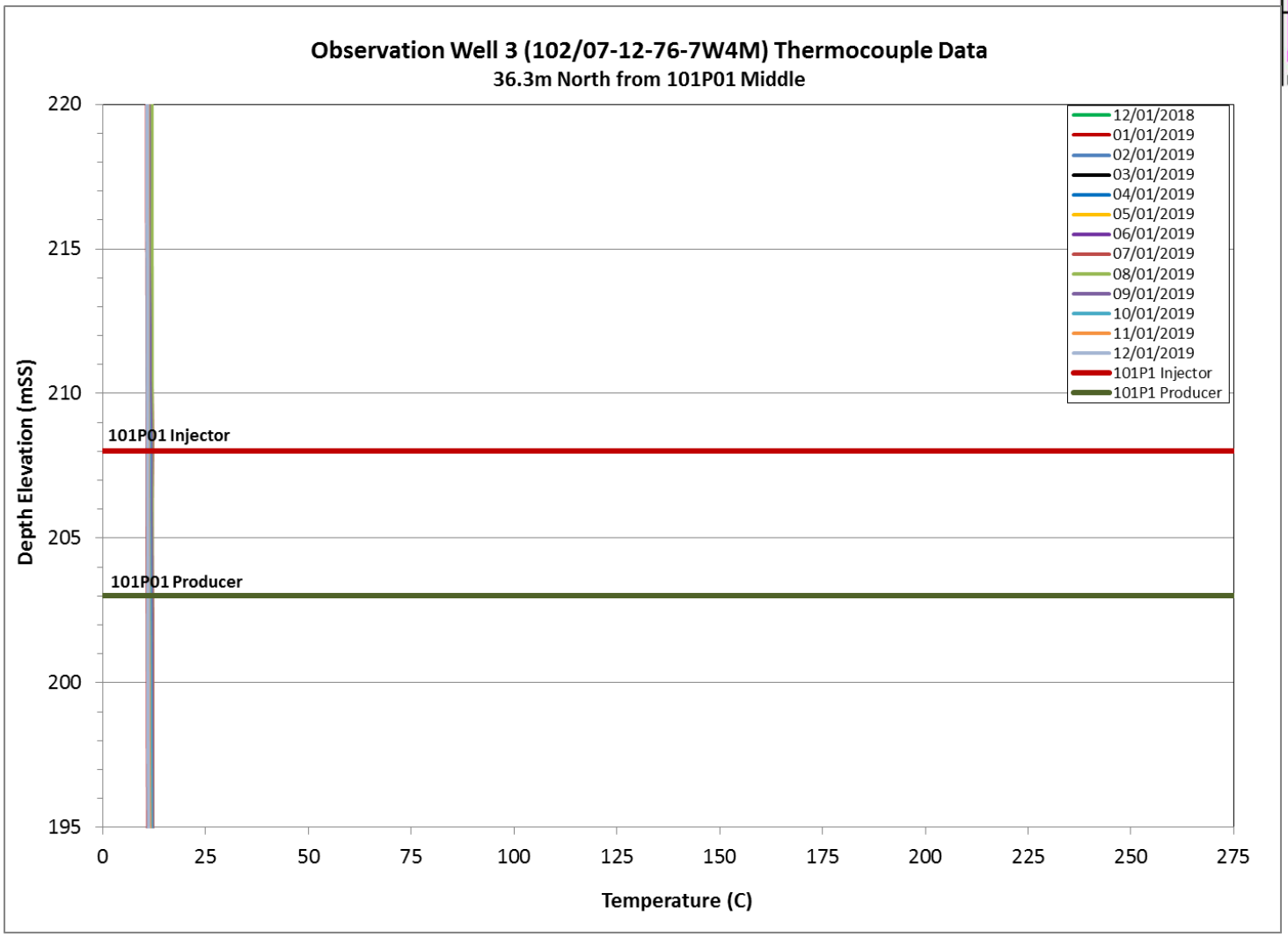


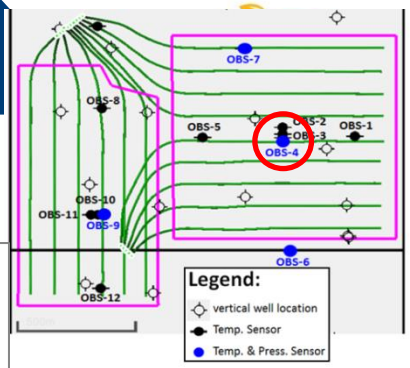
Well Name	OBS-3
UWI	102/07-12-076-07-W4M/00
Sensor	Landing Depth (mMD)
1	407.0
2	405.0
3	403.0
4	401.0
5	399.0
6	397.0
7	395.0
8	393.0
9	391.0
10	389.0
11	387.0
12	385.0
13	383.0
14	381.0
15	379.0
16	377.0
17	375.0
18	373.0
19	371.0
20	369.0
21	367.0
22	365.0
23	363.0
24	359.0
25	318.0
26	313.0



Appendices

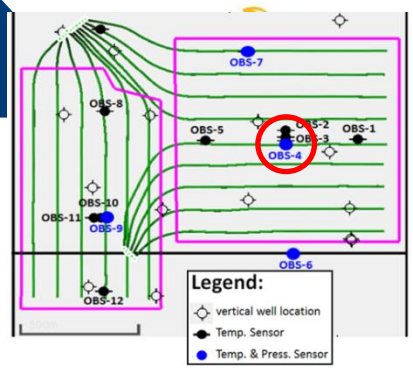
- Observation Well 3 Temperature Data





Appendices

- Observation Well 4 Thermocouple & Piezometer Placement



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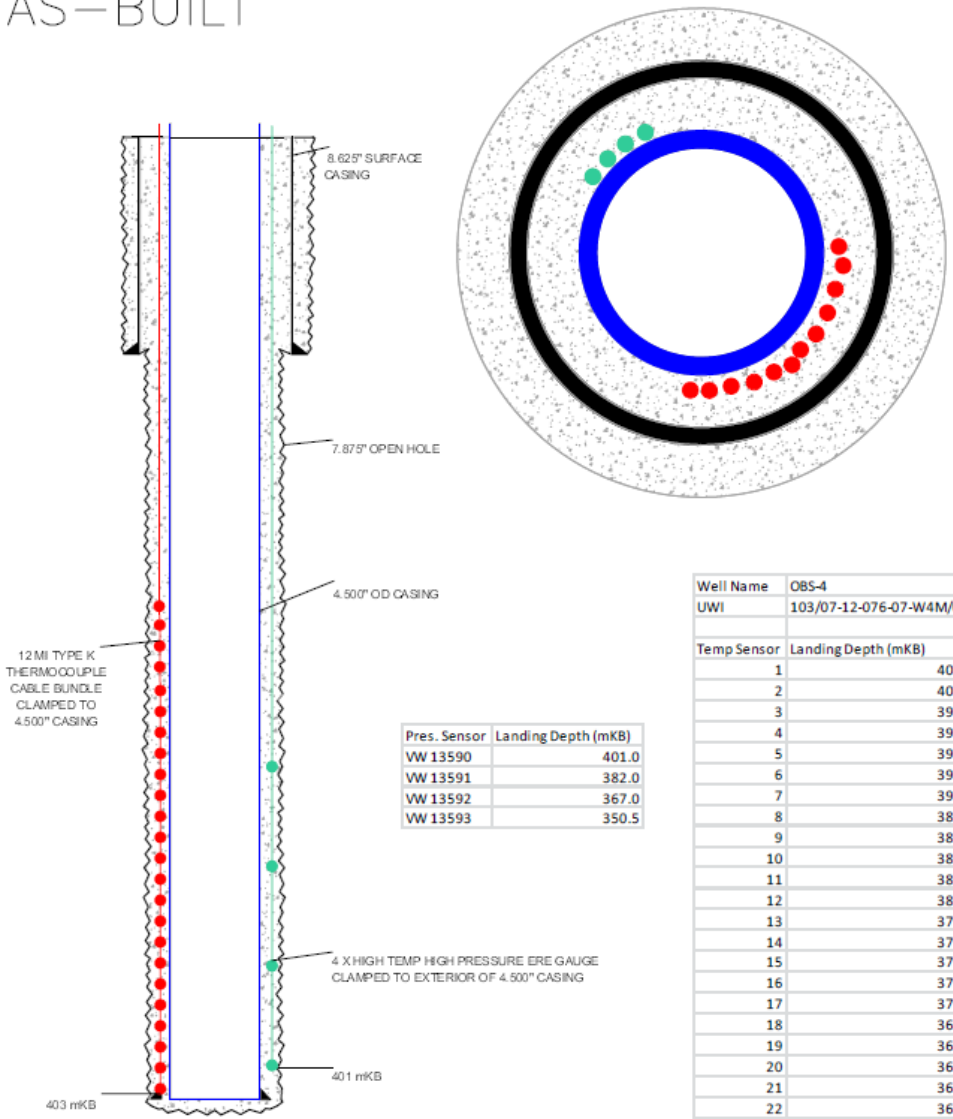
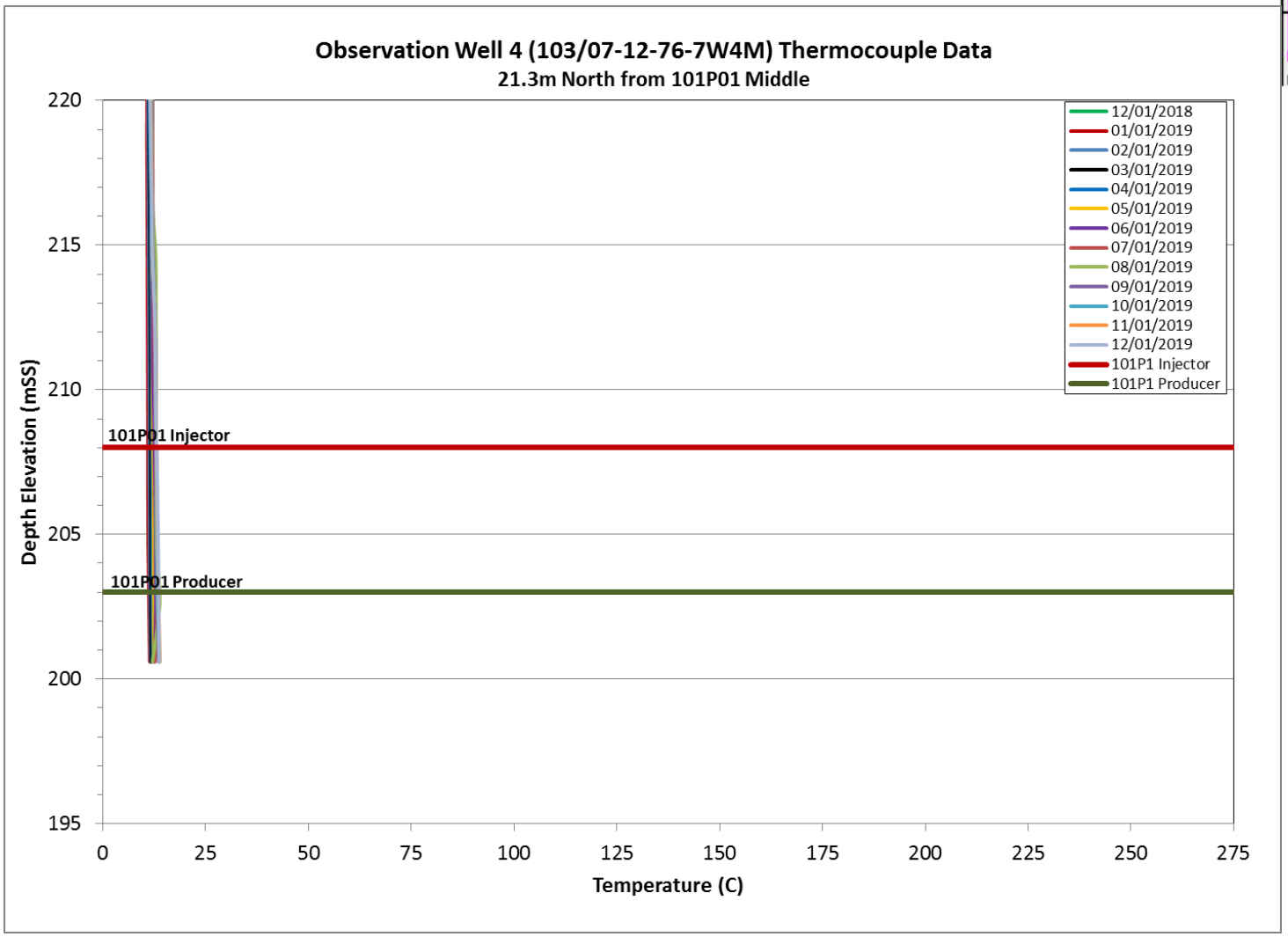


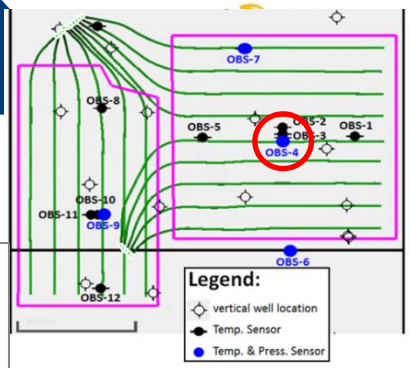
Pres. Sensor	Landing Depth (mKB)
VW 13590	401.0
VW 13591	382.0
VW 13592	367.0
VW 13593	350.5

Well Name	OBS-4
UWI	103/07-12-076-07-W4M/00
Temp Sensor	Landing Depth (mKB)
1	403.0
2	401.0
3	399.0
4	397.0
5	395.0
6	393.0
7	391.0
8	389.0
9	387.0
10	385.0
11	383.0
12	381.0
13	379.0
14	377.0
15	375.0
16	373.0
17	371.0
18	369.0
19	367.0
20	365.0
21	363.0
22	361.0
23	359.0
24	357.0

Appendices

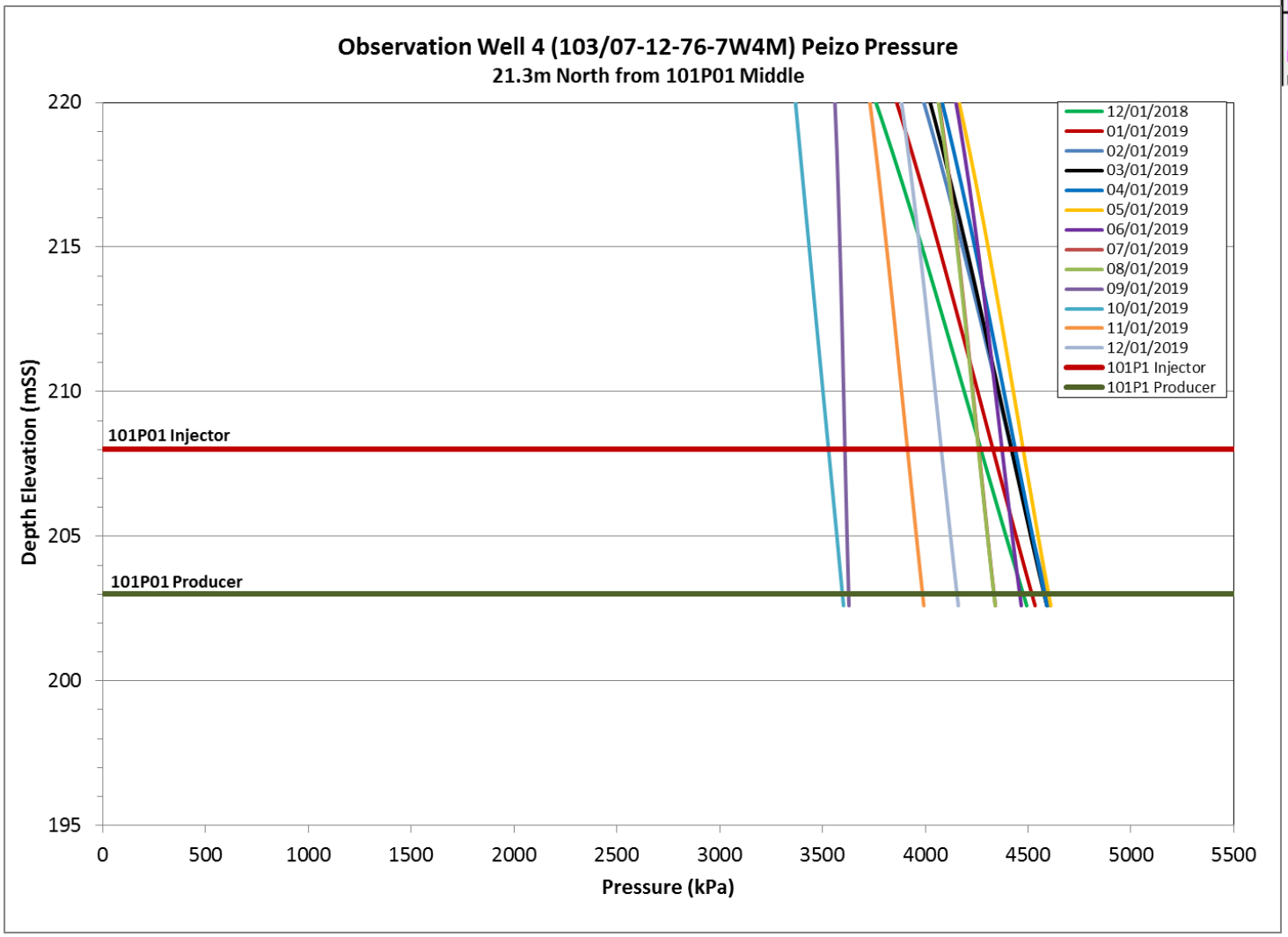
- Observation Well 4 Temperature Data

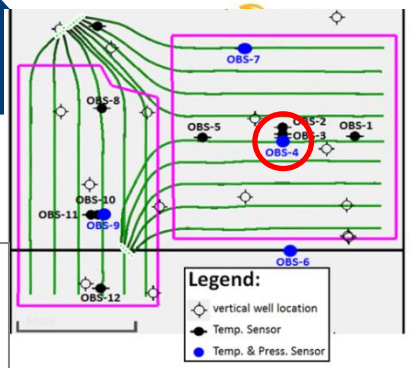




Appendices

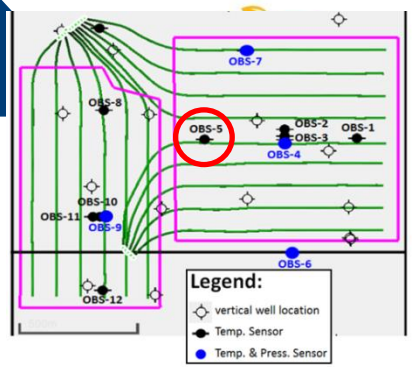
- Observation Well 4 Pressure Data



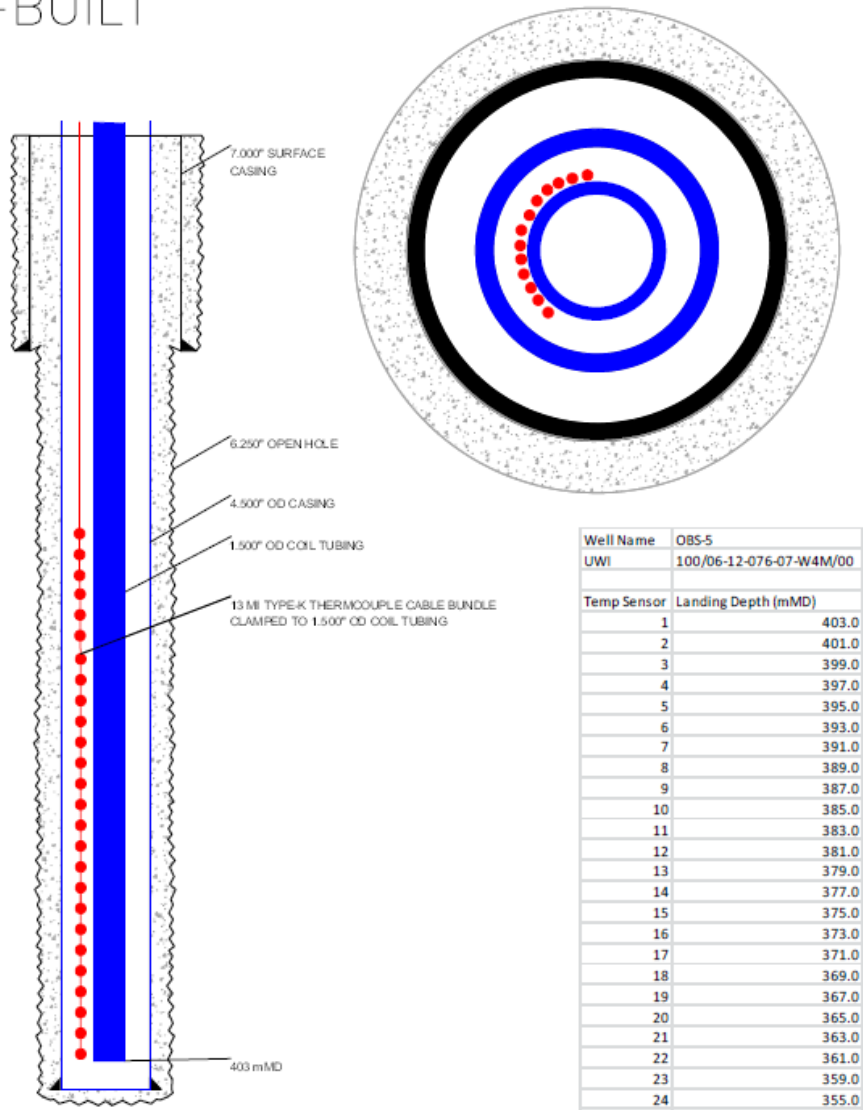


Appendices

- Observation Well 5 Thermocouple Placement



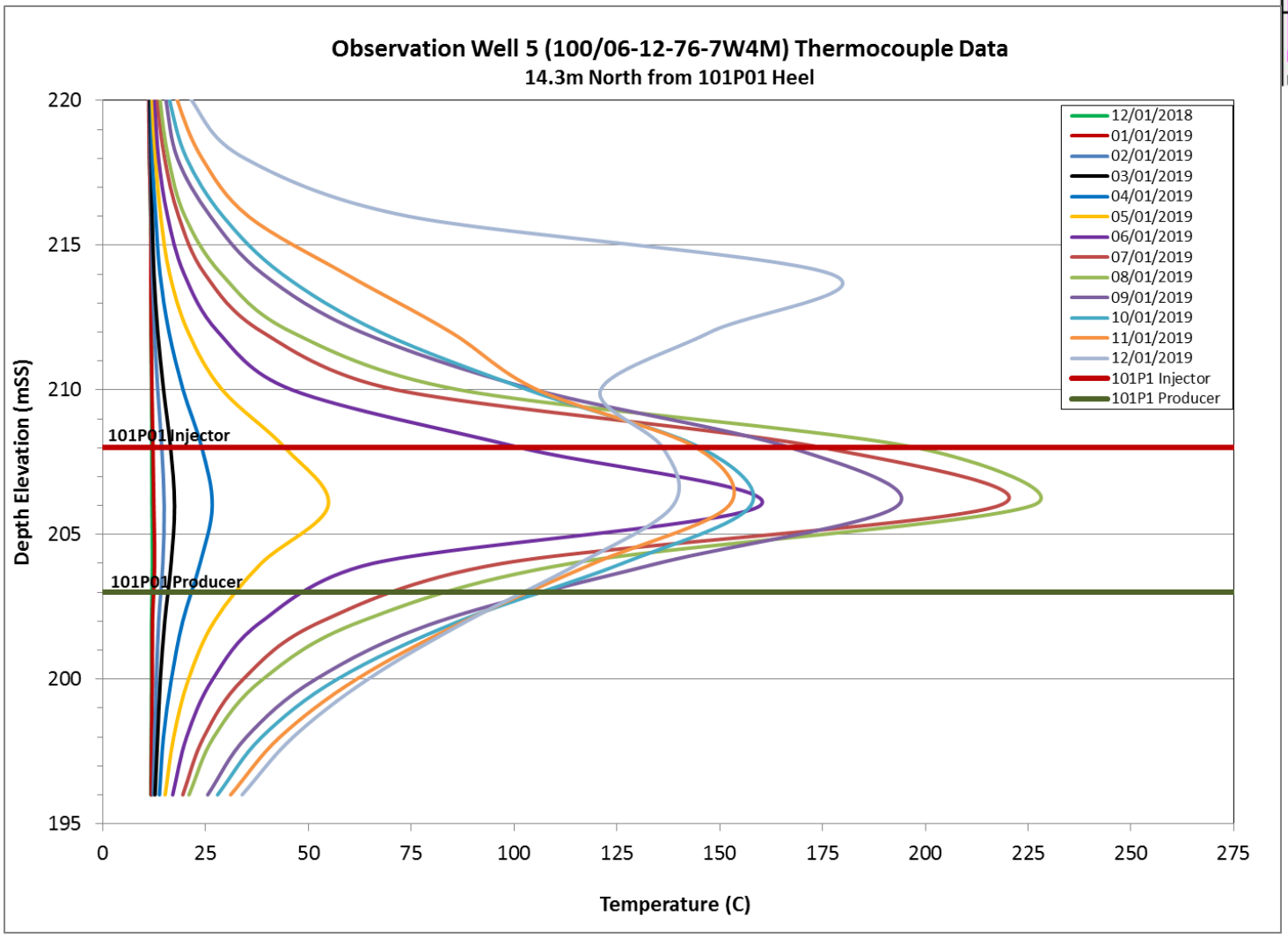
AS–BUILT

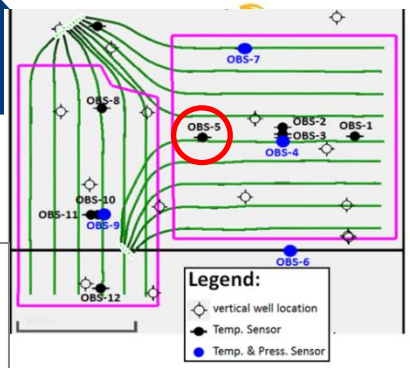


Well Name	OBS-5
UWI	100/06-12-076-07-W4M/00
Temp Sensor	Landing Depth (mMD)
1	403.0
2	401.0
3	399.0
4	397.0
5	395.0
6	393.0
7	391.0
8	389.0
9	387.0
10	385.0
11	383.0
12	381.0
13	379.0
14	377.0
15	375.0
16	373.0
17	371.0
18	369.0
19	367.0
20	365.0
21	363.0
22	361.0
23	359.0
24	355.0
25	313.0
26	308.0

Appendices

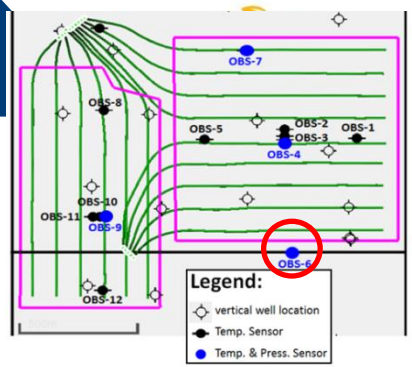
- Observation Well 5 Temperature Data



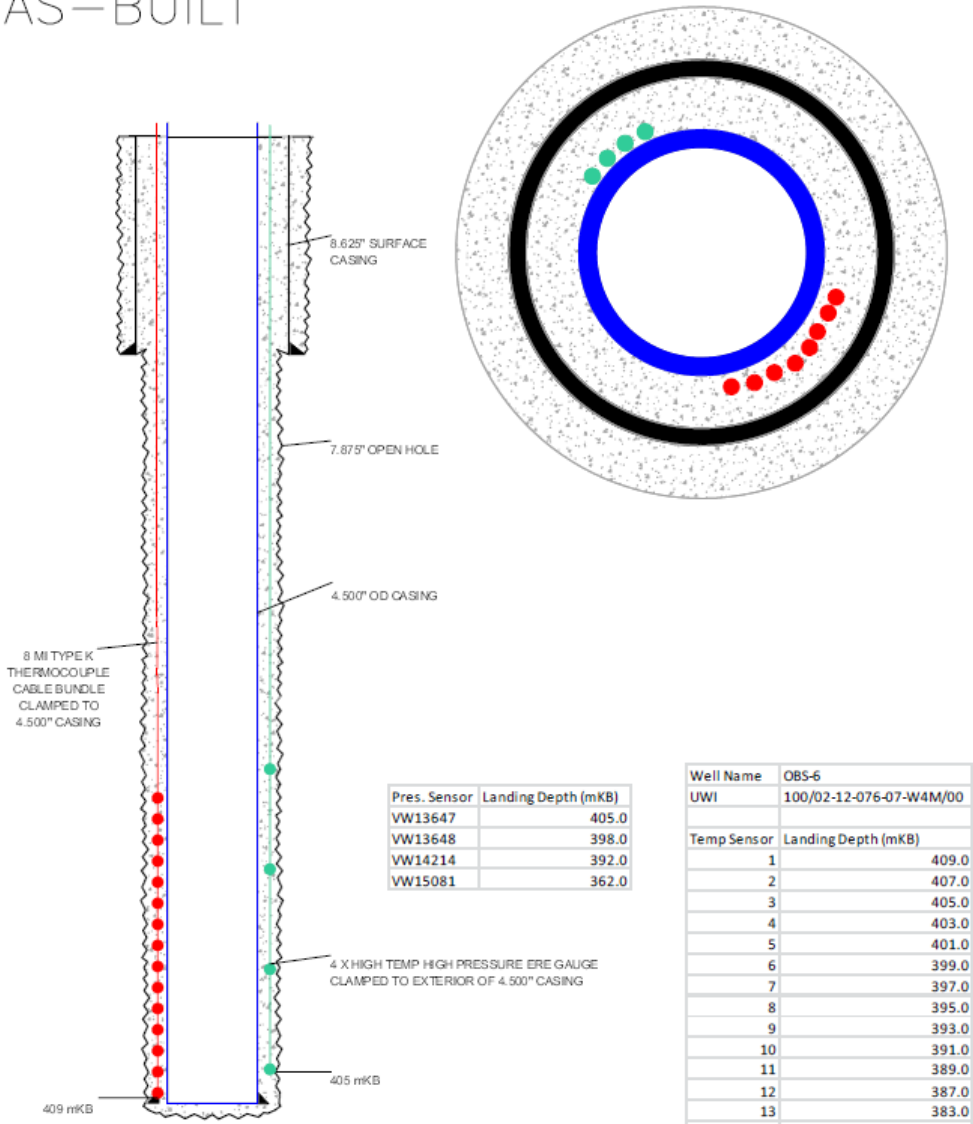


Appendices

- Observation Well 6 Thermocouple & Piezometer Placement



AS–BUILT

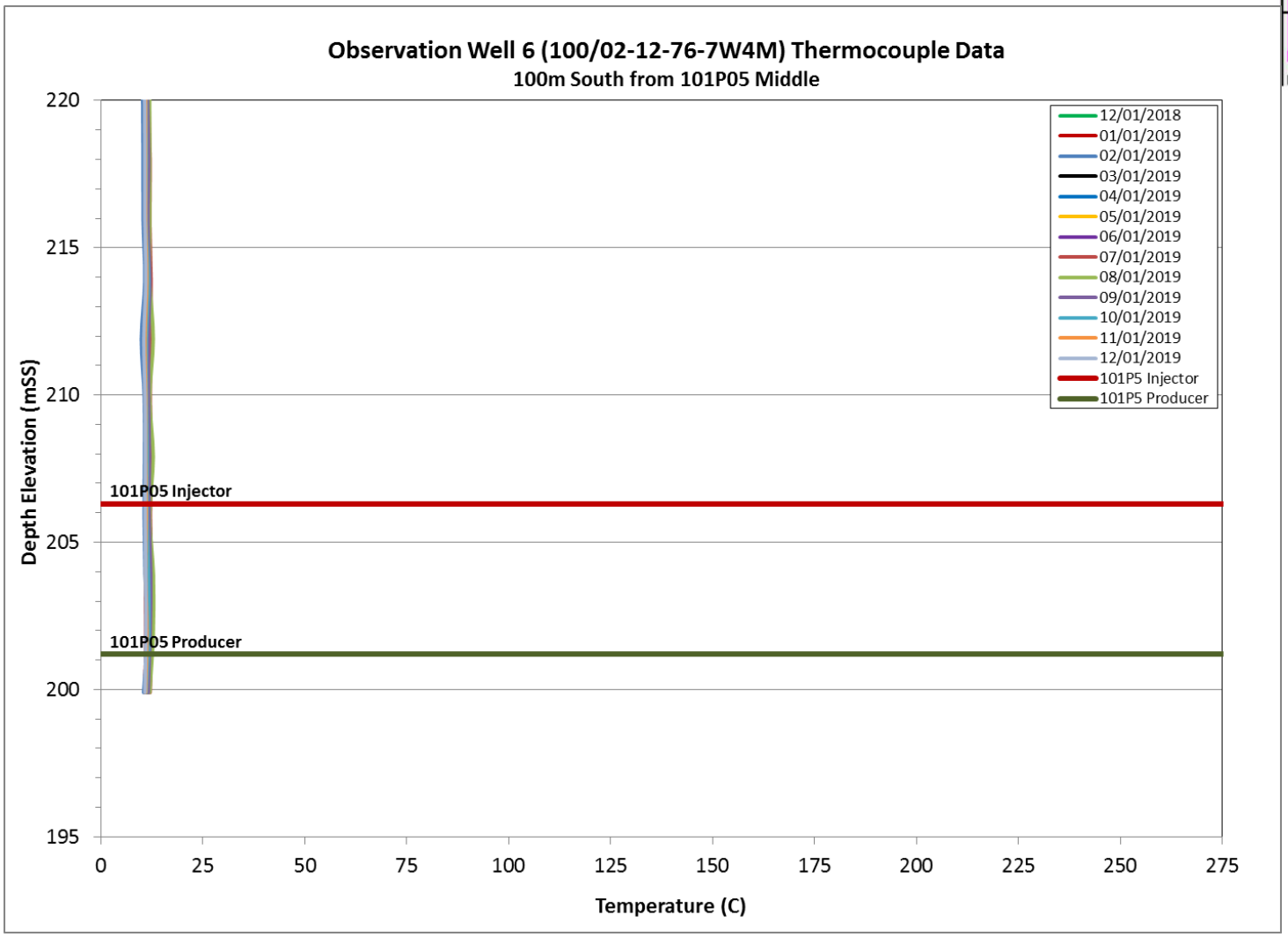


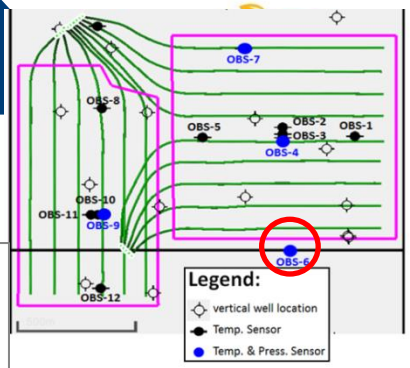
Pres. Sensor	Landing Depth (mKB)
VW13647	405.0
VW13648	398.0
VW14214	392.0
VW15081	362.0

Well Name	OBS-6
UWI	100/02-12-076-07-W4M/00
Temp Sensor	Landing Depth (mKB)
1	409.0
2	407.0
3	405.0
4	403.0
5	401.0
6	399.0
7	397.0
8	395.0
9	393.0
10	391.0
11	389.0
12	387.0
13	383.0
14	379.0
15	375.0

Appendices

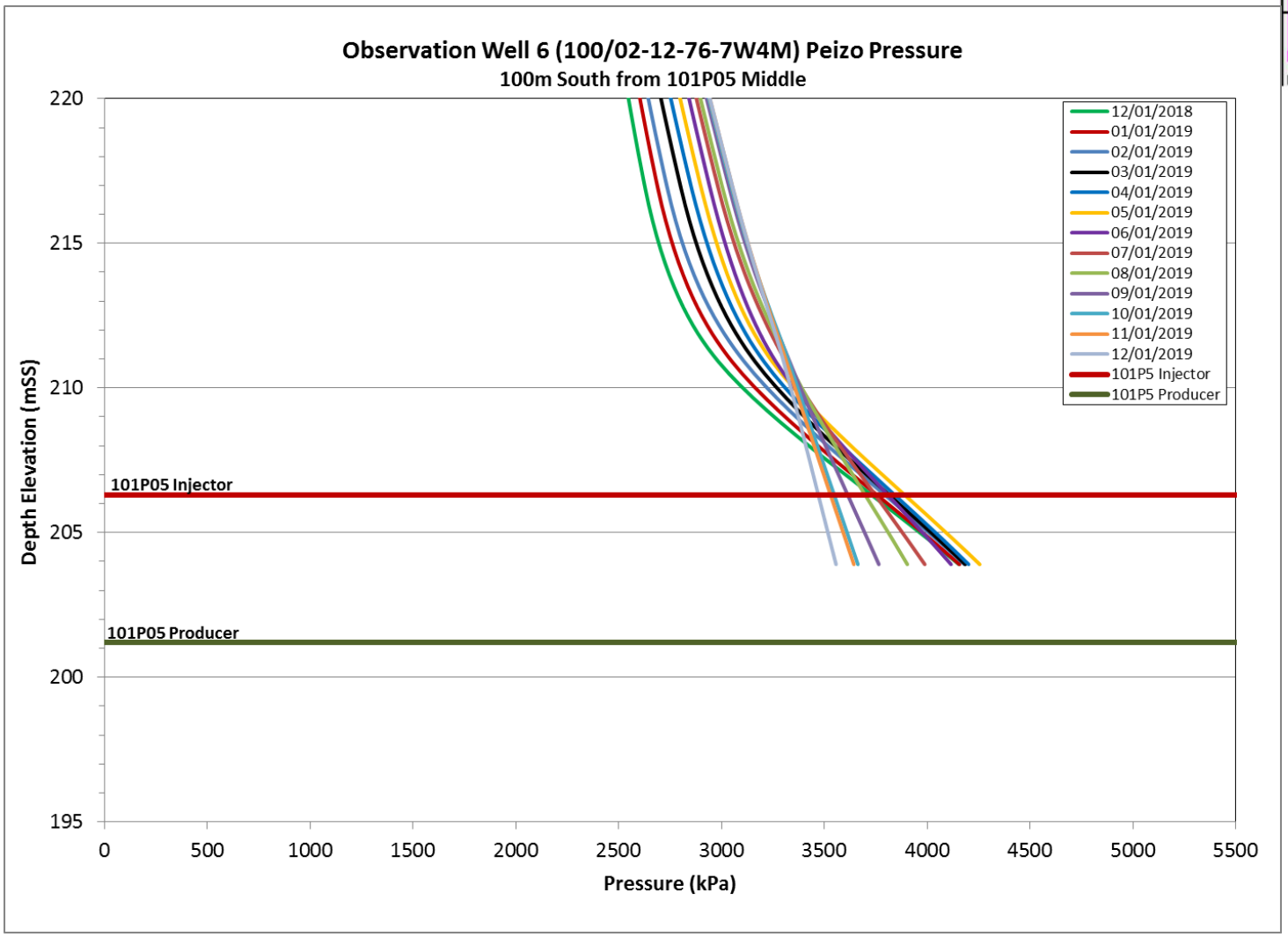
- Observation Well 6 Temperature Data

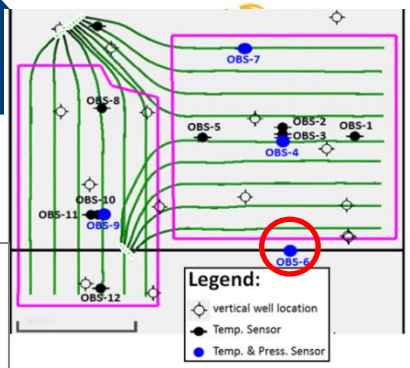




Appendices

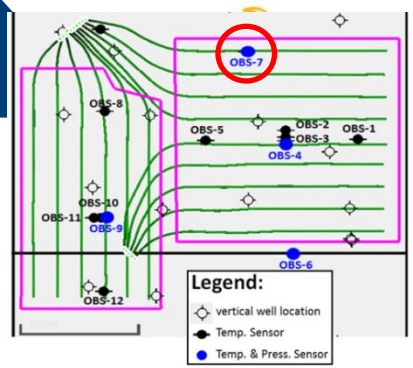
- Observation Well 6 Pressure Data



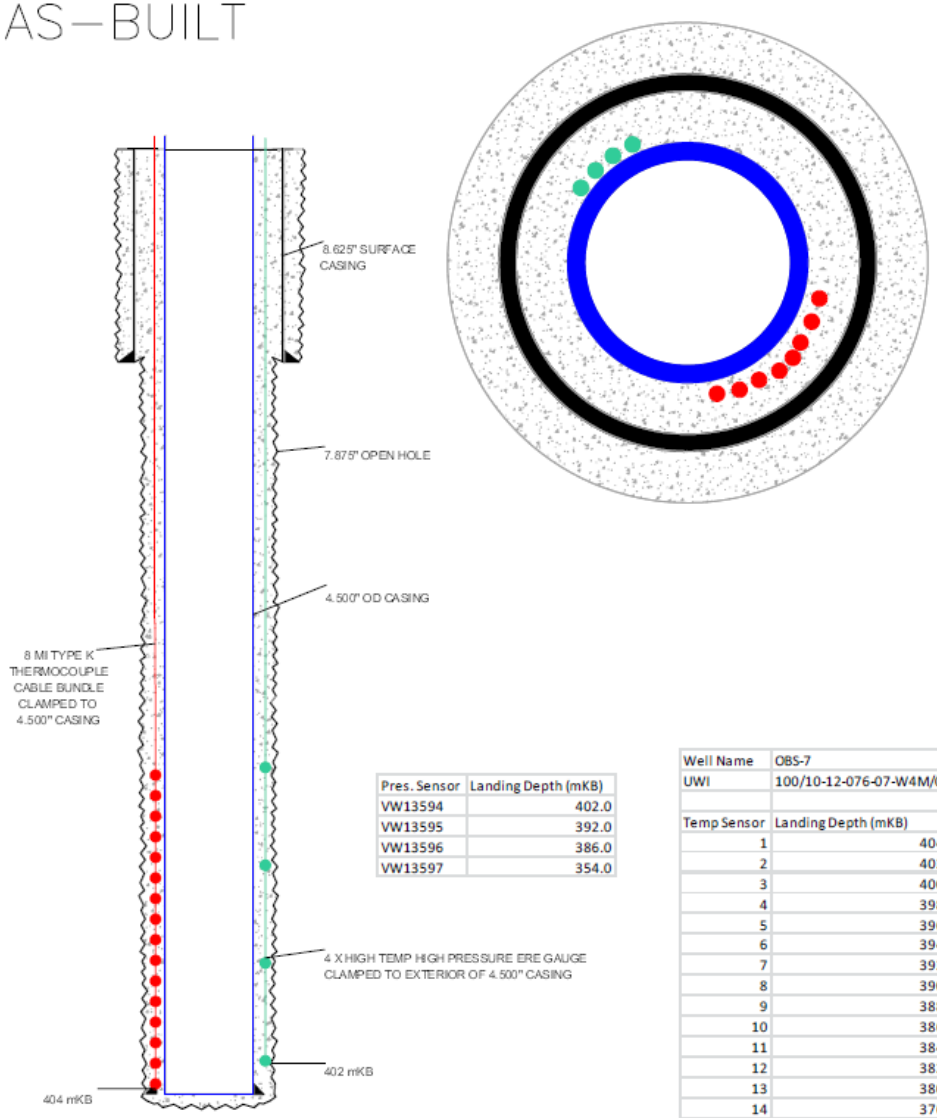


Appendices

- Observation Well 7 Thermocouple & Piezometer Placement



AS–BUILT

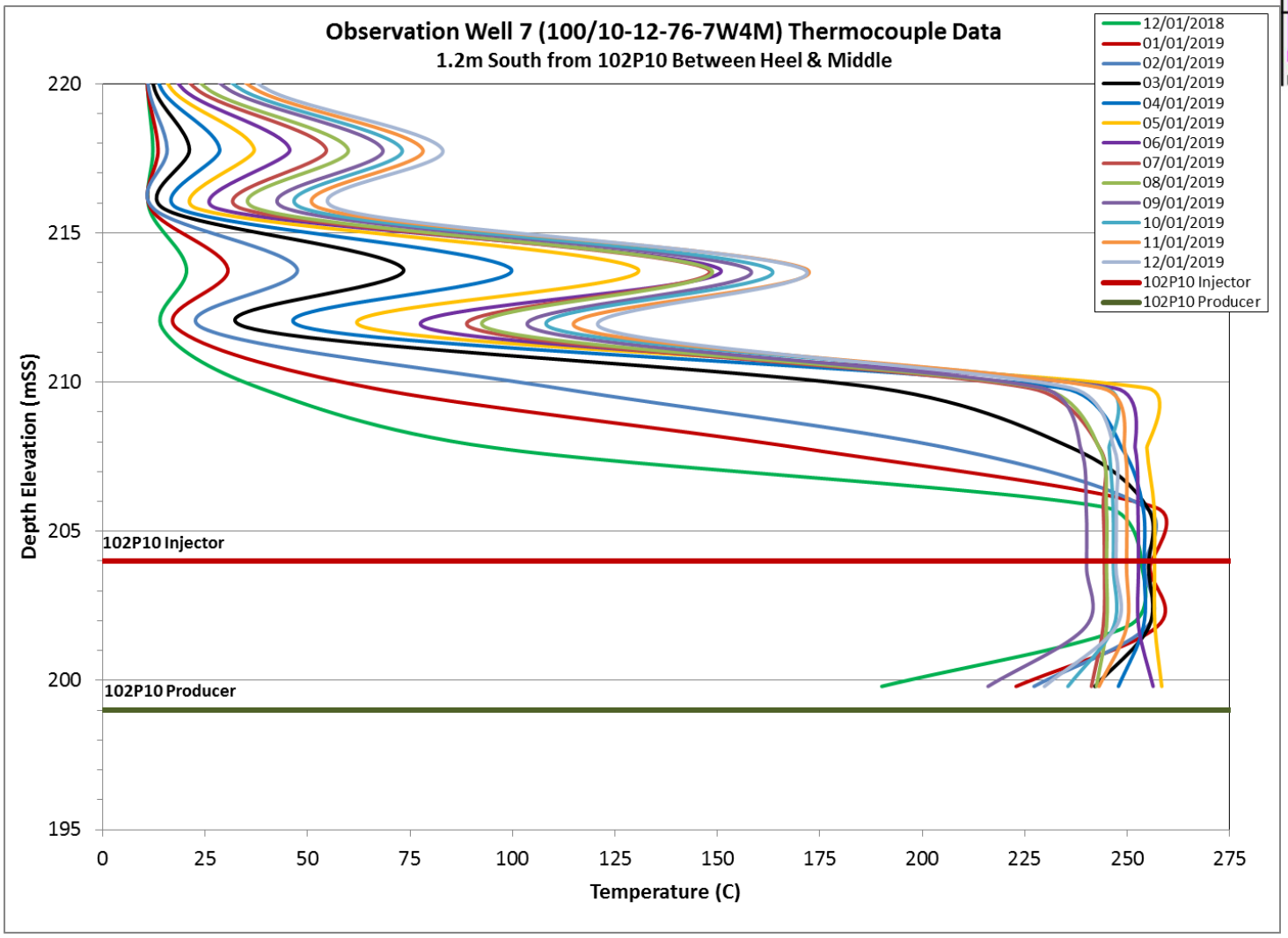


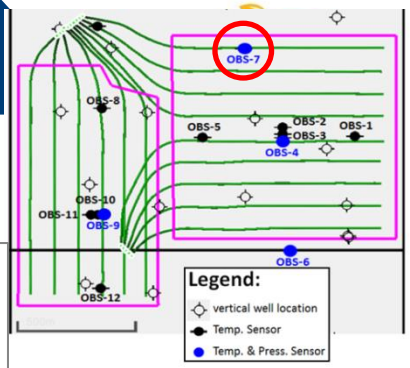
Pres. Sensor	Landing Depth (mKB)
VW13594	402.0
VW13595	392.0
VW13596	386.0
VW13597	354.0

Well Name	OBS-7
UWI	100/10-12-076-07-W4M/00
Temp Sensor	Landing Depth (mKB)
1	404.0
2	402.0
3	400.0
4	398.0
5	396.0
6	394.0
7	392.0
8	390.0
9	388.0
10	386.0
11	384.0
12	382.0
13	380.0
14	376.0
15	372.0
16	368.0

Appendices

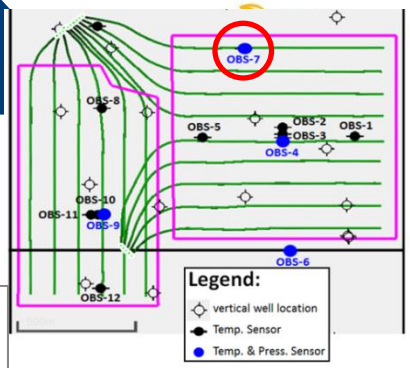
- Observation Well 7 Temperature Data

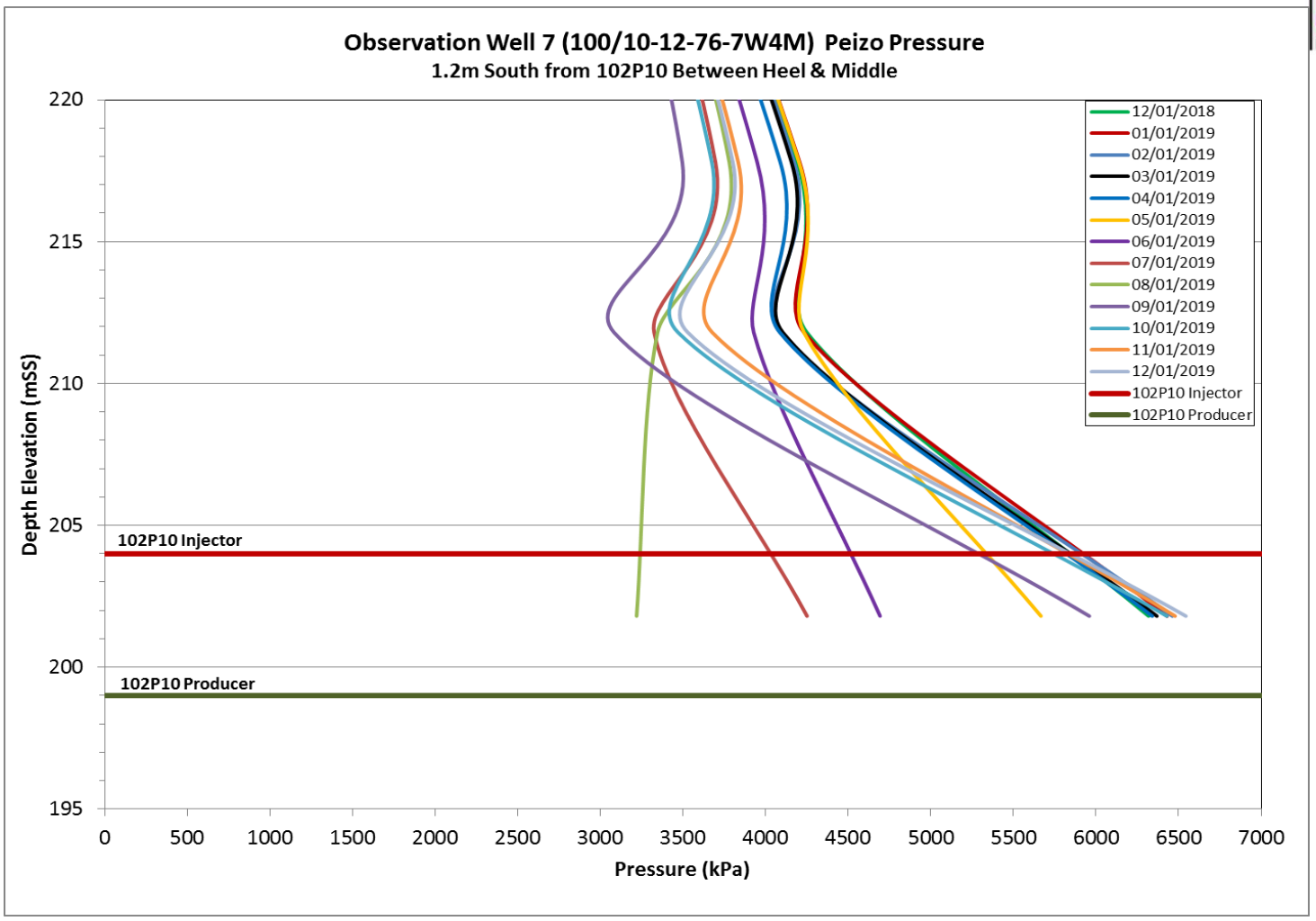




Appendices

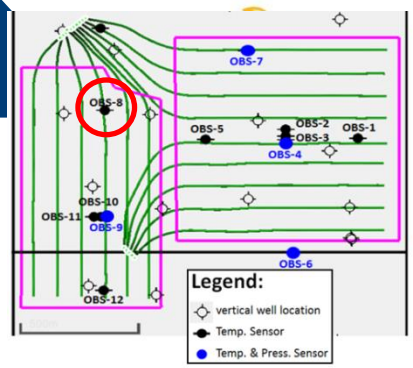
- Observation Well 7 Pressure Data – Piezometers have failed, not a real pressure



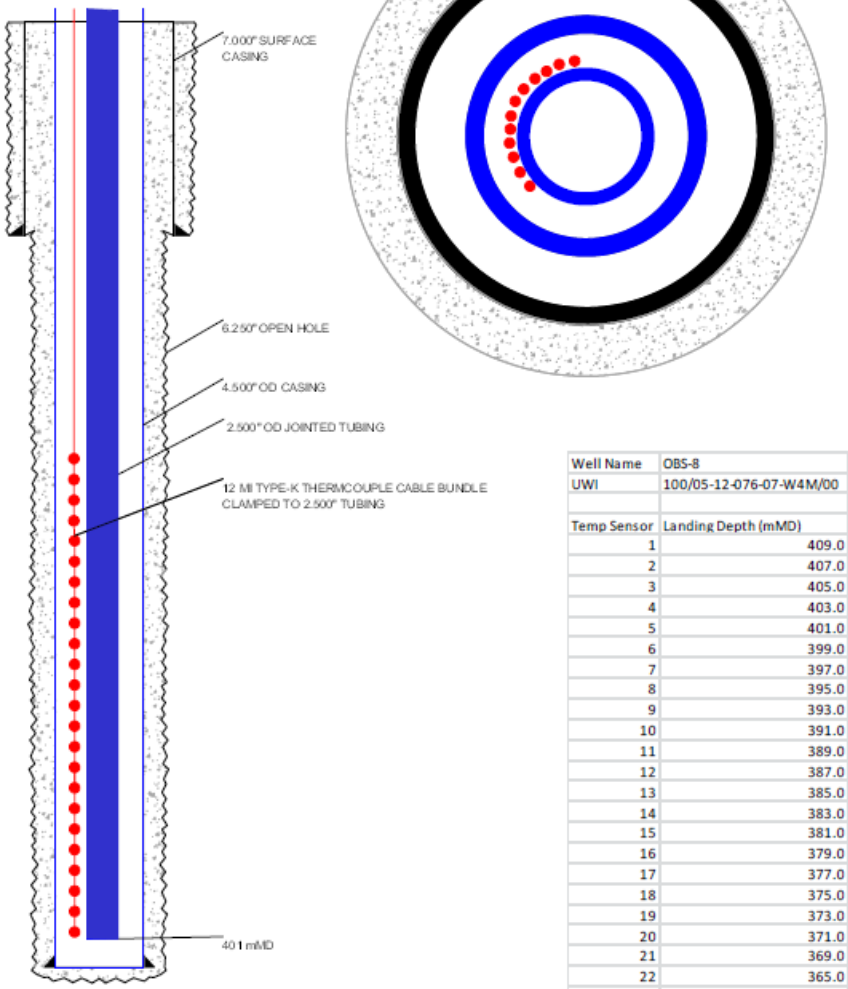


Appendices

- Observation Well 8 Thermocouple Placement



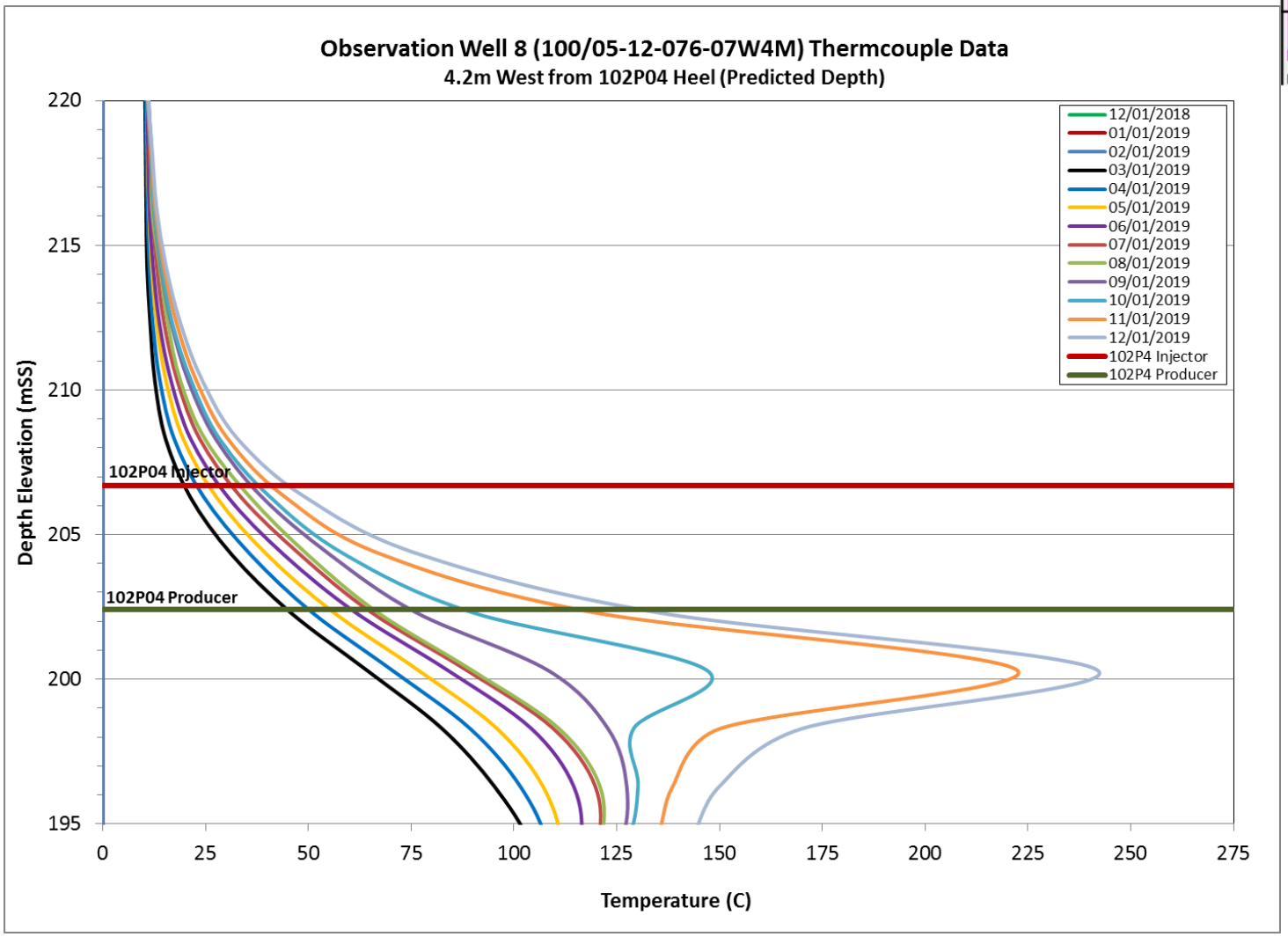
AS–BUILT

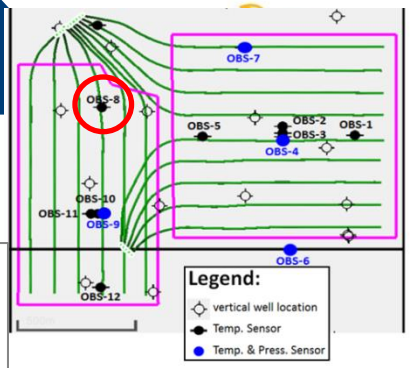


Well Name	OBS-8
UWI	100/05-12-076-07-W4M/00
Temp Sensor	Landing Depth (mMD)
1	409.0
2	407.0
3	405.0
4	403.0
5	401.0
6	399.0
7	397.0
8	395.0
9	393.0
10	391.0
11	389.0
12	387.0
13	385.0
14	383.0
15	381.0
16	379.0
17	377.0
18	375.0
19	373.0
20	371.0
21	369.0
22	365.0
23	321.0
24	316.0

Appendices

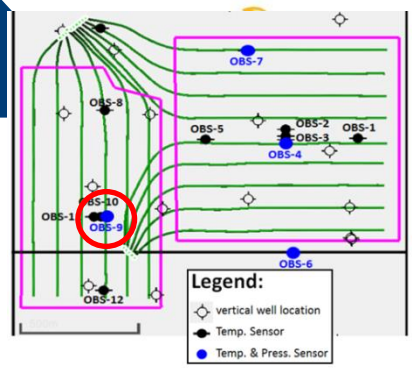
- Observation Well 8 Temperature Data



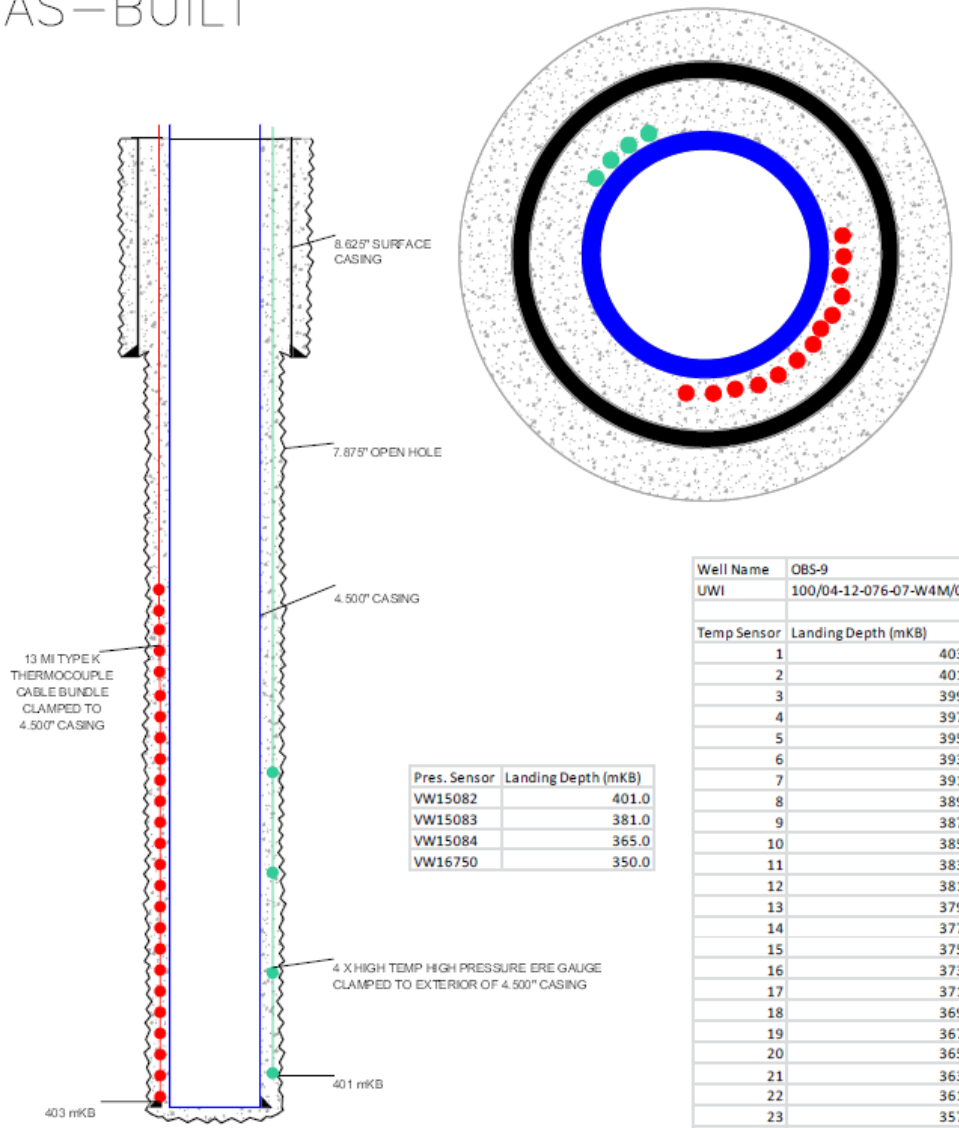


Appendices

- Observation Well 9 Thermocouple & Piezometer Placement



AS–BUILT

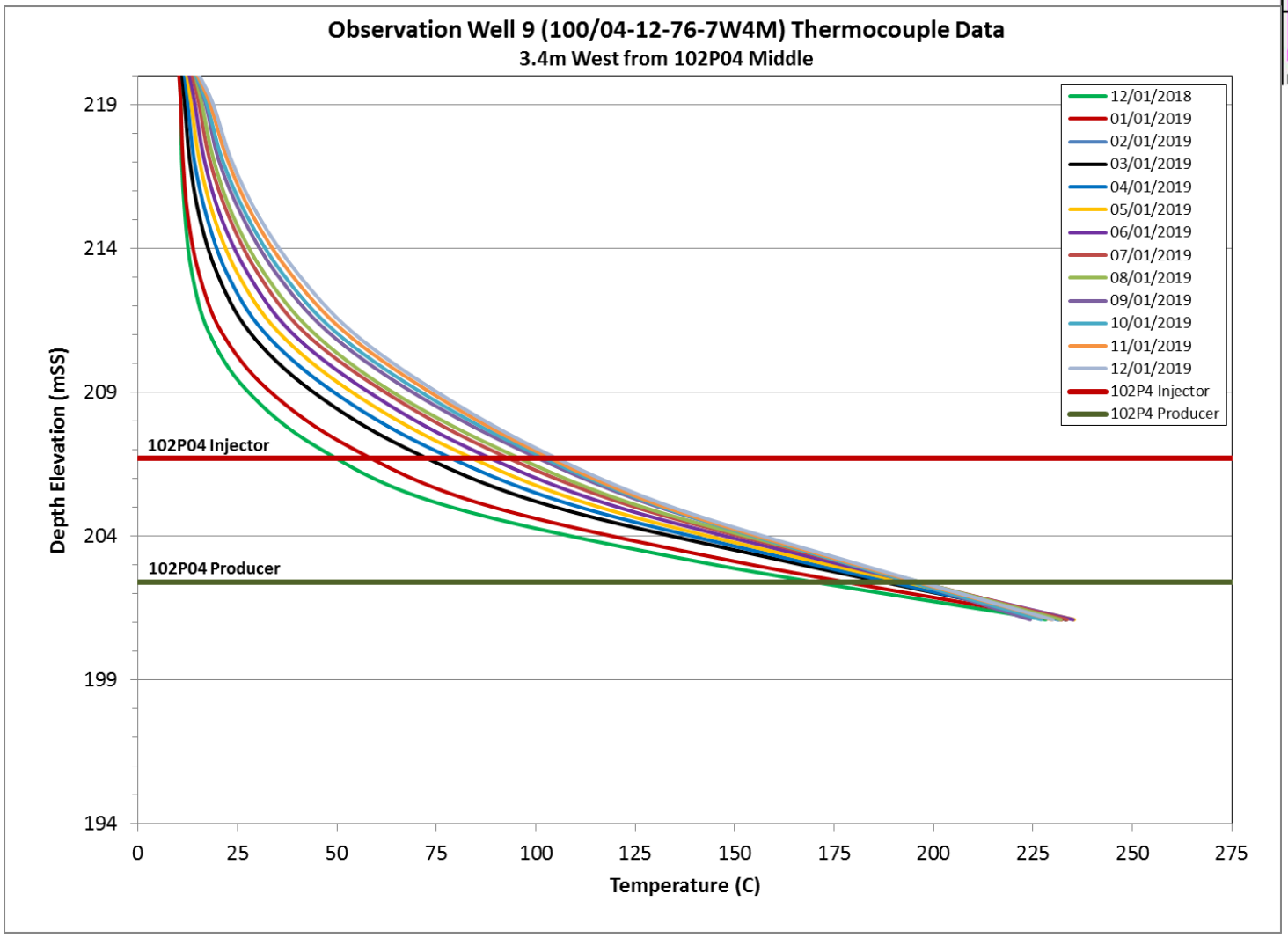


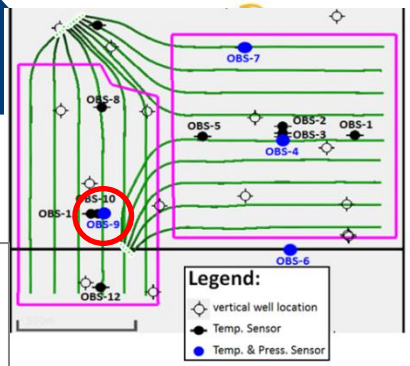
Pres. Sensor	Landing Depth (mKB)
VW15082	401.0
VW15083	381.0
VW15084	365.0
VW16750	350.0

Well Name	OBS-9
UWI	100/04-12-076-07-W4M/00
Temp Sensor	Landing Depth (mKB)
1	403.0
2	401.0
3	399.0
4	397.0
5	395.0
6	393.0
7	391.0
8	389.0
9	387.0
10	385.0
11	383.0
12	381.0
13	379.0
14	377.0
15	375.0
16	373.0
17	371.0
18	369.0
19	367.0
20	365.0
21	363.0
22	361.0
23	357.0
24	353.0
25	349.0

Appendices

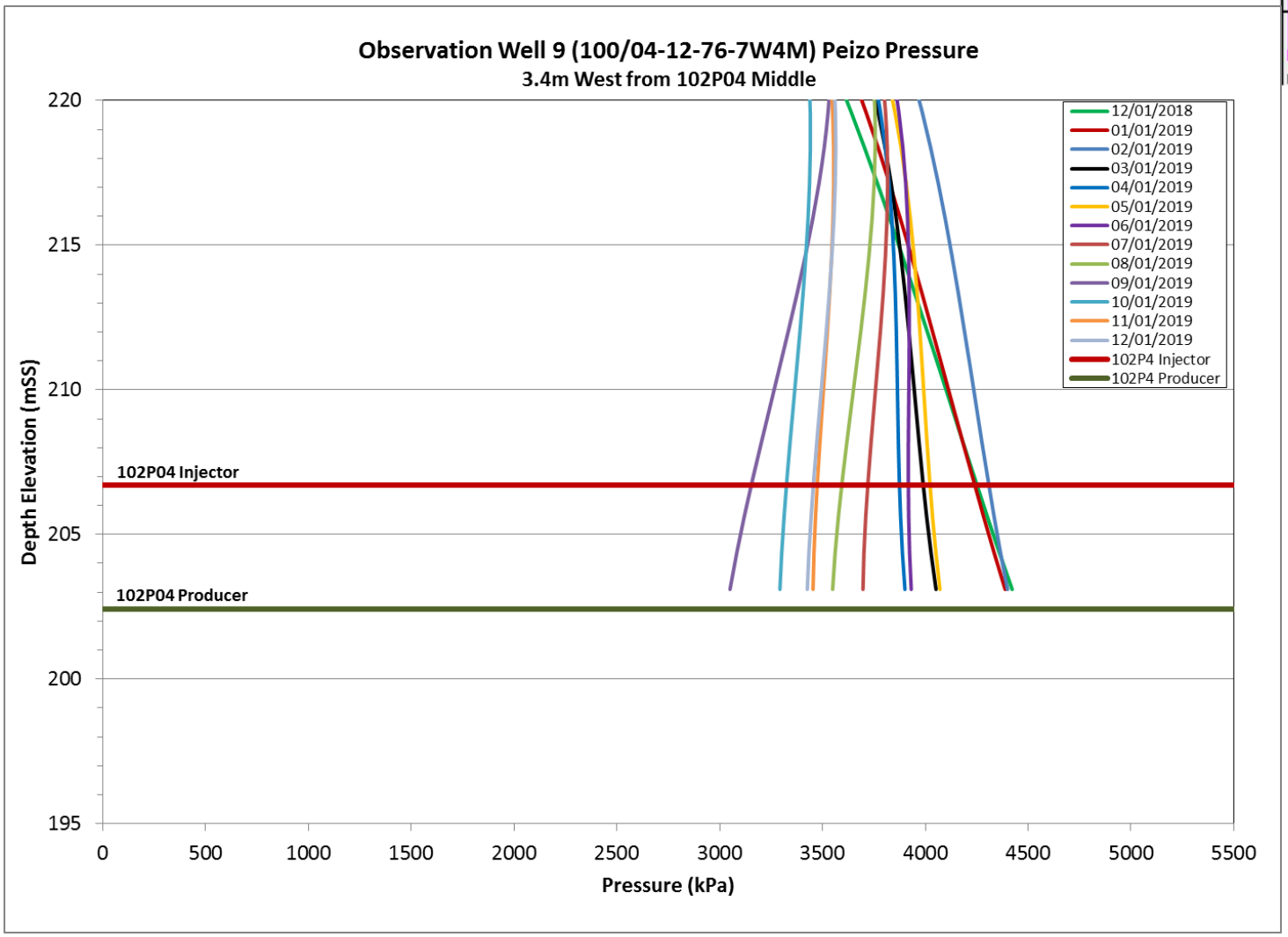
- Observation Well 9 Temperature Data

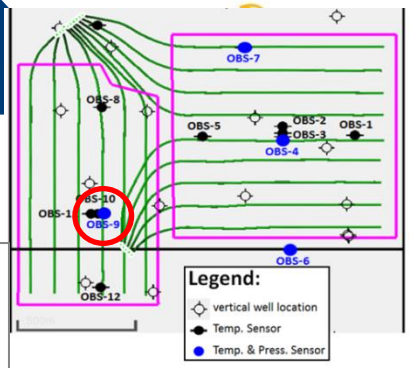




Appendices

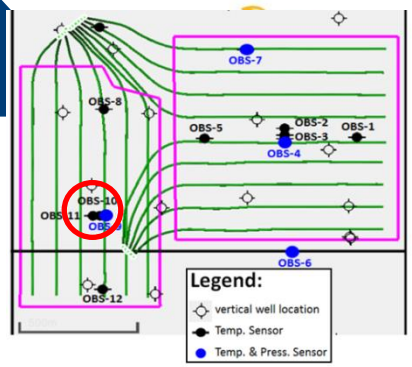
- Observation Well 9 Pressure Data



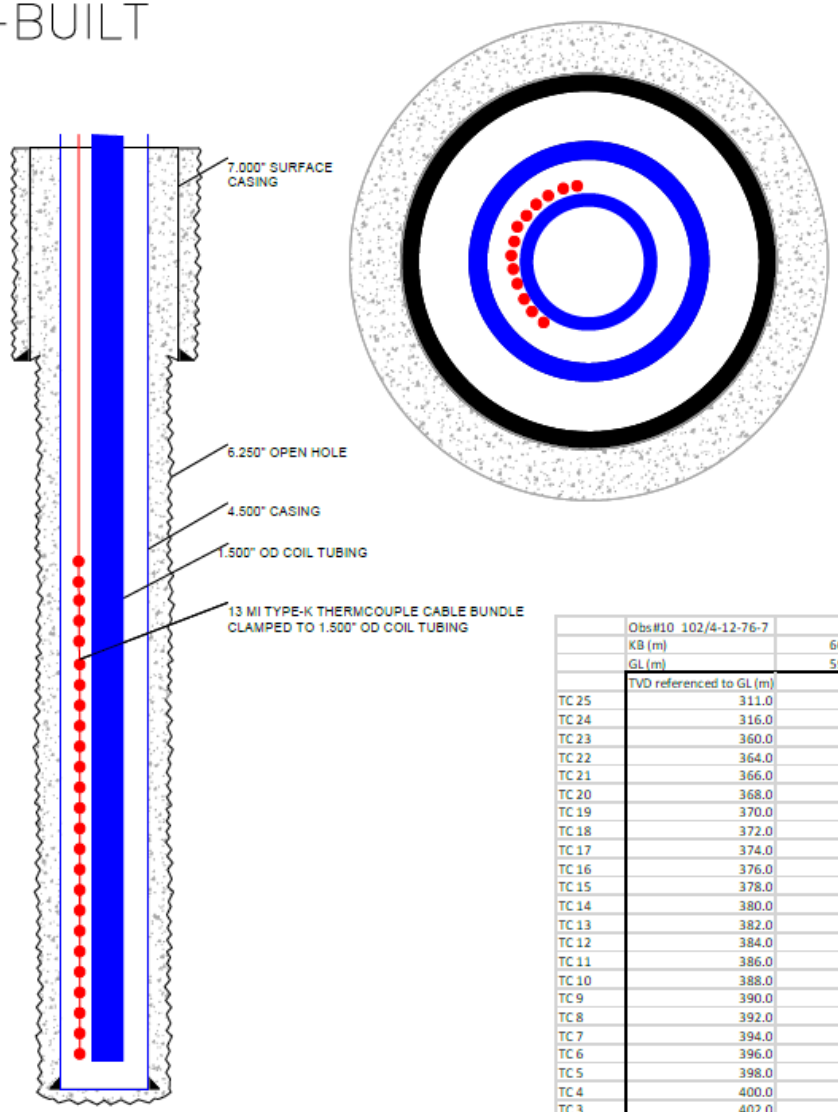


Appendices

- Observation Well 10 Thermocouple Placement



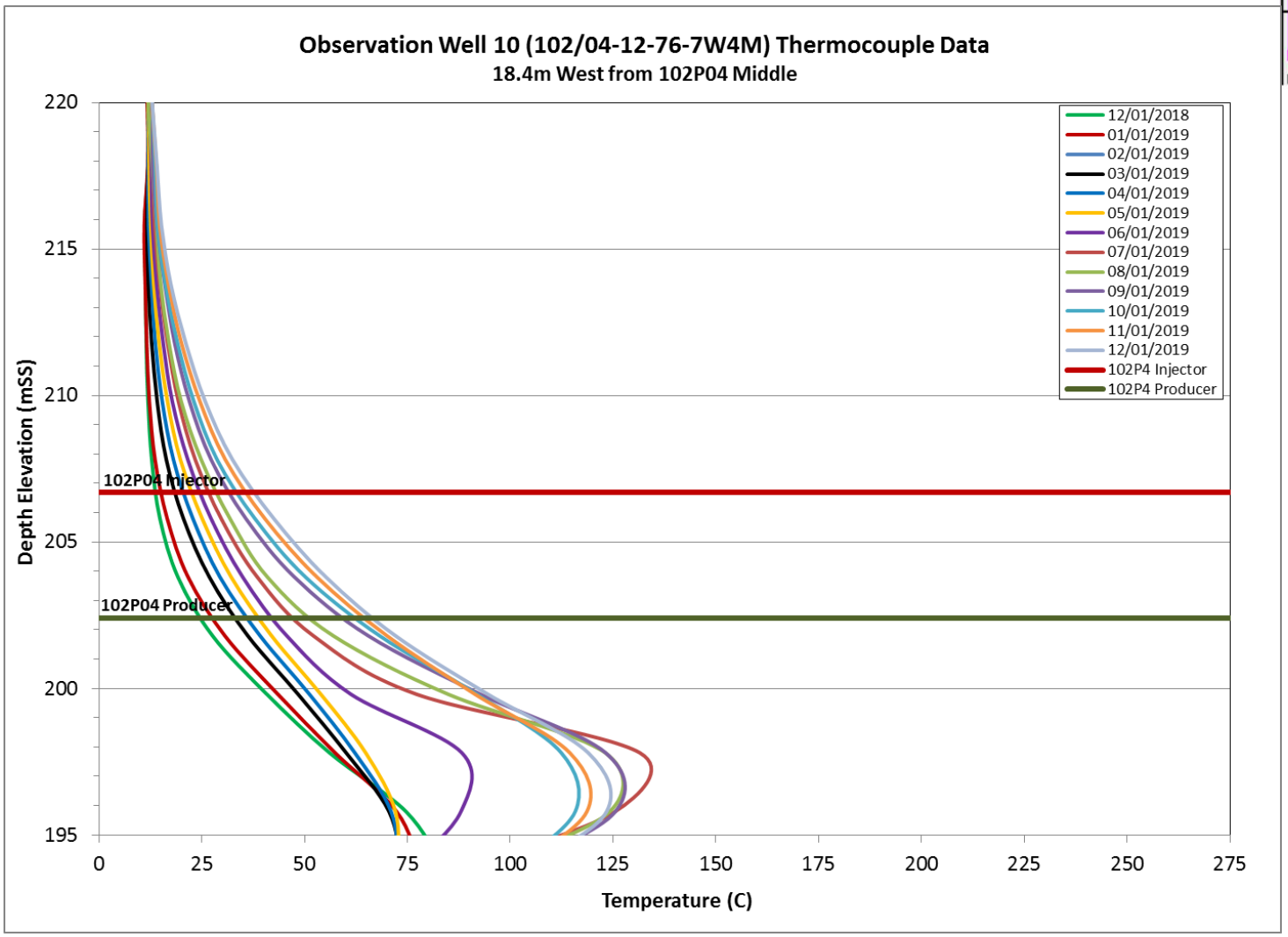
AS–BUILT

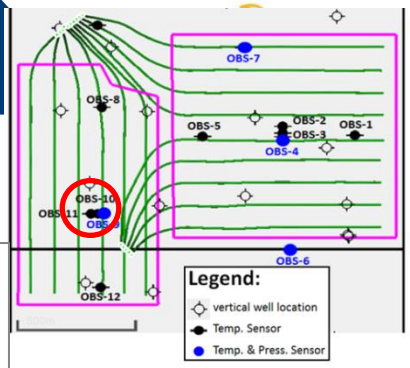


	Obs#10 102/4-12-76-7	
	KB (m)	604.1
	GL (m)	599.8
	TVD referenced to GL (m)	
TC 25	311.0	
TC 24	316.0	
TC 23	360.0	
TC 22	364.0	
TC 21	366.0	
TC 20	368.0	
TC 19	370.0	
TC 18	372.0	
TC 17	374.0	
TC 16	376.0	
TC 15	378.0	
TC 14	380.0	
TC 13	382.0	
TC 12	384.0	
TC 11	386.0	
TC 10	388.0	
TC 9	390.0	
TC 8	392.0	
TC 7	394.0	
TC 6	396.0	
TC 5	398.0	
TC 4	400.0	
TC 3	402.0	
TC 2	404.0	
TC 1	406.0	

Appendices

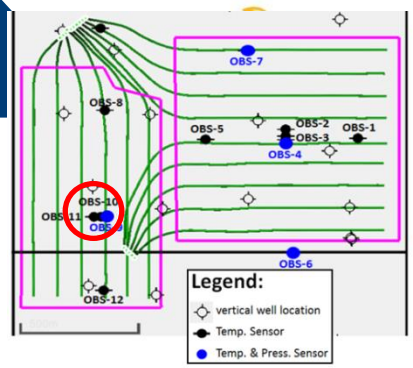
- Observation Well 10 Temperature Data



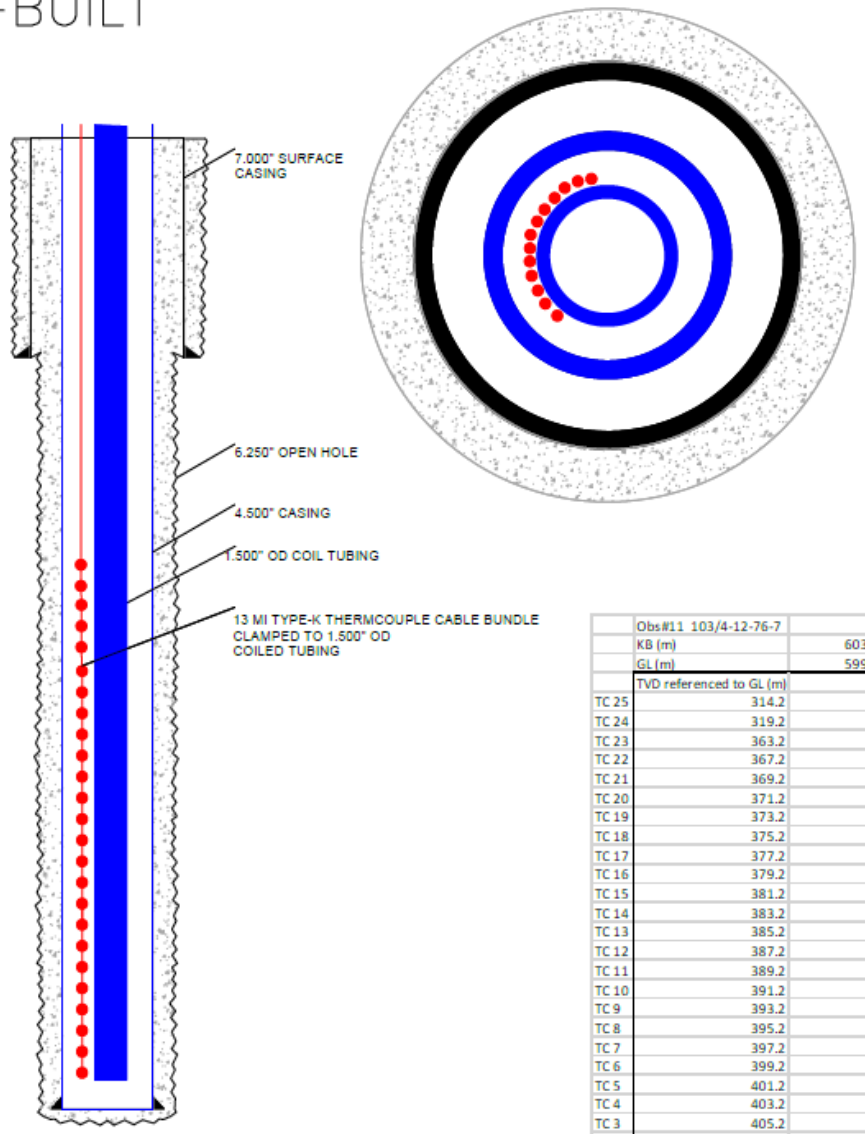


Appendices

- Observation Well 11 Thermocouple Placement



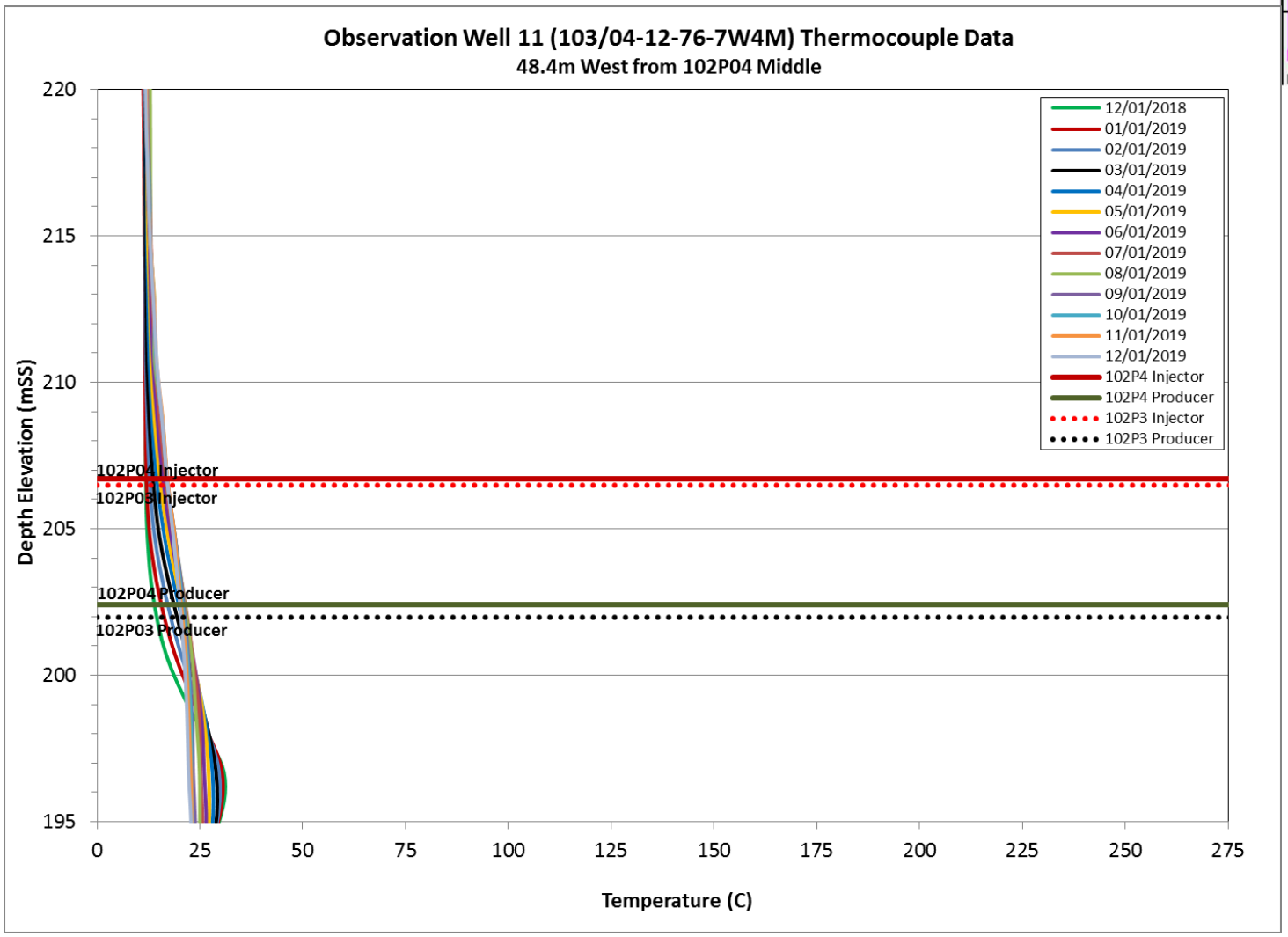
AS–BUILT

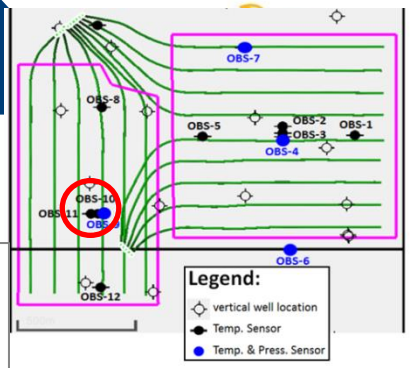


	Obs.#11 103/4-12-76-7	
	KB (m)	603.9
	GL (m)	599.9
	TVD referenced to GL (m)	
TC 25	314.2	
TC 24	319.2	
TC 23	363.2	
TC 22	367.2	
TC 21	369.2	
TC 20	371.2	
TC 19	373.2	
TC 18	375.2	
TC 17	377.2	
TC 16	379.2	
TC 15	381.2	
TC 14	383.2	
TC 13	385.2	
TC 12	387.2	
TC 11	389.2	
TC 10	391.2	
TC 9	393.2	
TC 8	395.2	
TC 7	397.2	
TC 6	399.2	
TC 5	401.2	
TC 4	403.2	
TC 3	405.2	
TC 2	407.2	
TC 1	409.2	

Appendices

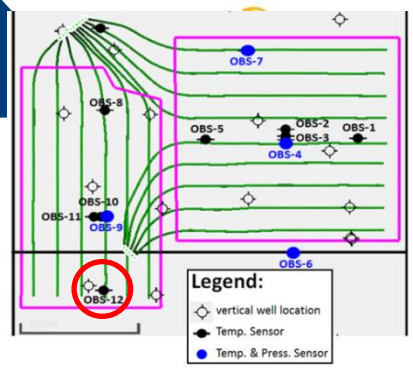
- Observation Well 11 Temperature Data



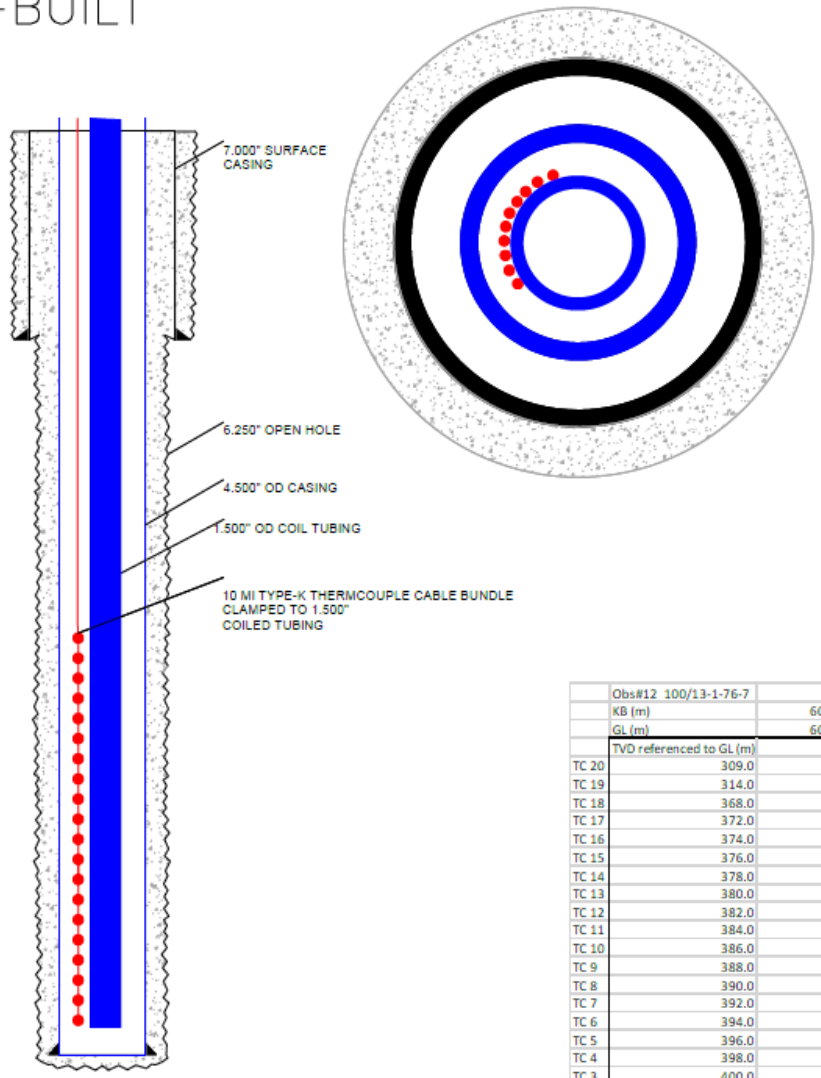


Appendices

- Observation Well 12 Thermocouple Placement



AS–BUILT



	Obs#12 100/13-1-76-7	
	KB (m)	606.1
	GL (m)	601.7
	TVD referenced to GL (m)	
TC 20	309.0	
TC 19	314.0	
TC 18	368.0	
TC 17	372.0	
TC 16	374.0	
TC 15	376.0	
TC 14	378.0	
TC 13	380.0	
TC 12	382.0	
TC 11	384.0	
TC 10	386.0	
TC 9	388.0	
TC 8	390.0	
TC 7	392.0	
TC 6	394.0	
TC 5	396.0	
TC 4	398.0	
TC 3	400.0	
TC 2	402.0	
TC 1	404.0	

Appendices

- Observation Well 12 Temperature Data