



ATHABASCA OIL CORPORATION

AER HANGINGSTONE PROJECT UPDATE

January 2020

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OIL CORPORATION

PROJECT DESCRIPTION AND STATUS

SUBSURFACE

- Geoscience
- Well Design and Instrumentation
- 4-D Seismic and Monitoring
- Scheme Performance
- Future Plans

SURFACE

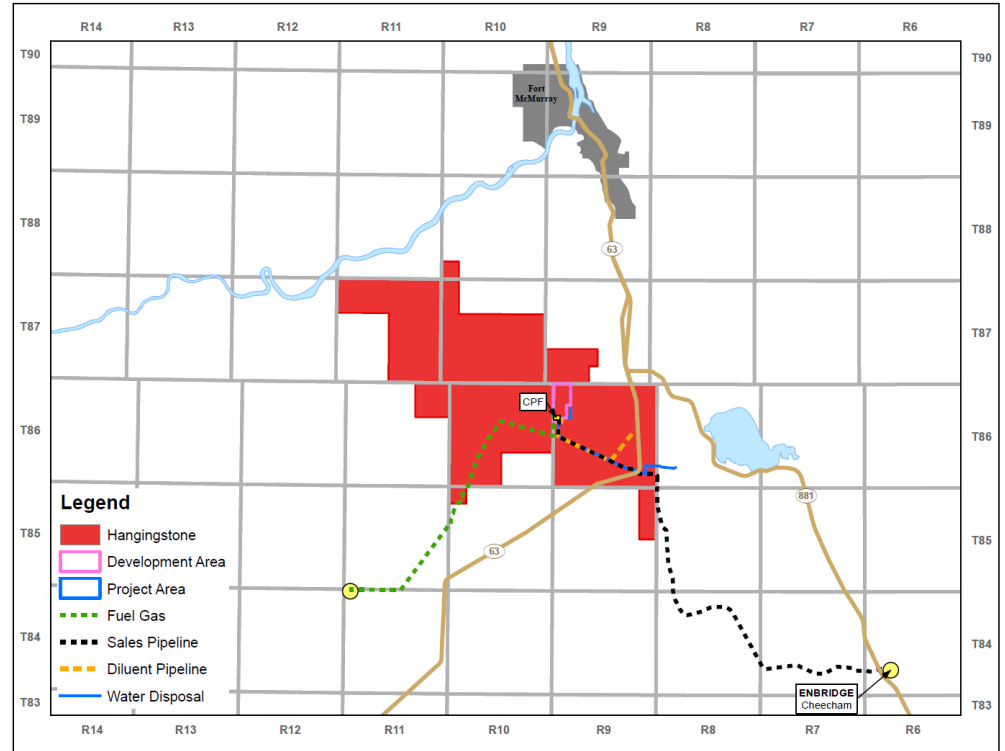
- Facilities
- Measurement and Reporting
- Facility Performance
- Water Production, Injection and Uses
- Sulphur Production
- Compliance
- Future Plans

PROJECT DETAILS

- Located 20 km south of Fort McMurray, AB
- 5 production pads
- 25 horizontal well pairs (5 well pairs per pad)
- Central Processing Facility (CPF)
- Offsite services and utilities

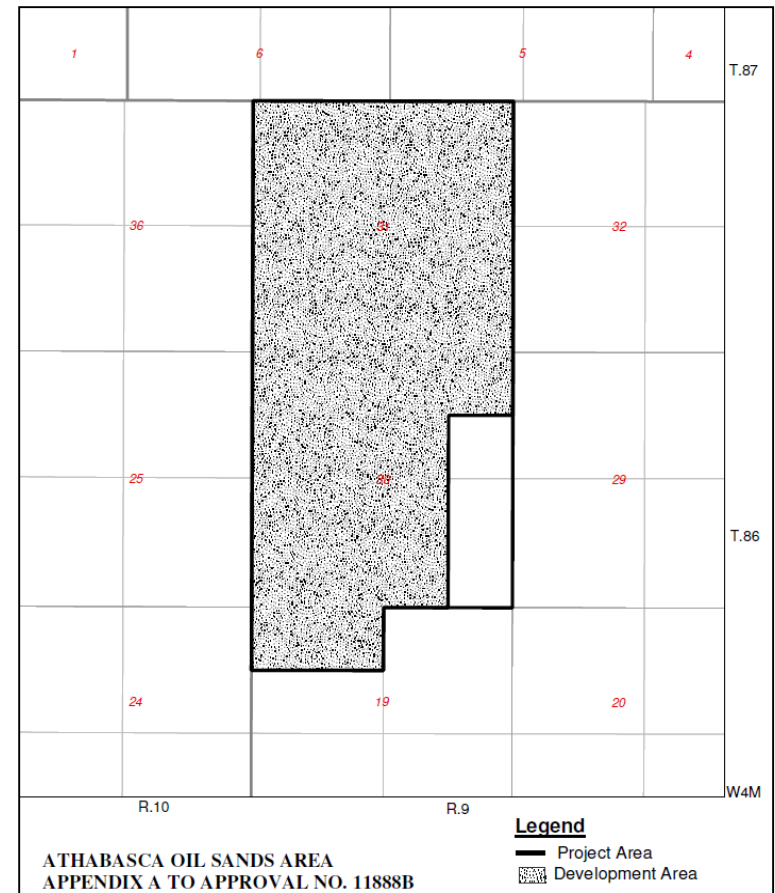
INFRASTRUCTURE

- Fuel gas from TransCanada Pipeline (TCPL)
- Dilbit export to Enbridge Cheecham Terminal
- Diluent from Inter Pipeline (IPL)



HANGINGSTONE PROJECT

- First steam (downhole) achieved March 2015
 - *First oil produced July 2015*
- 24 well pairs in SAGD mode and 1 standing well pair
 - *Last well pair (AA03) to be brought on-stream when steam is available*
- Expansion application submitted in 2013
 - *Environmental Impact Assessment report deemed complete by the AER pursuant to Section 53 of EPEA*
 - *Expands Project Area and Development Area*
 - *Application includes 3 phases (+70,000 bbl/d)*

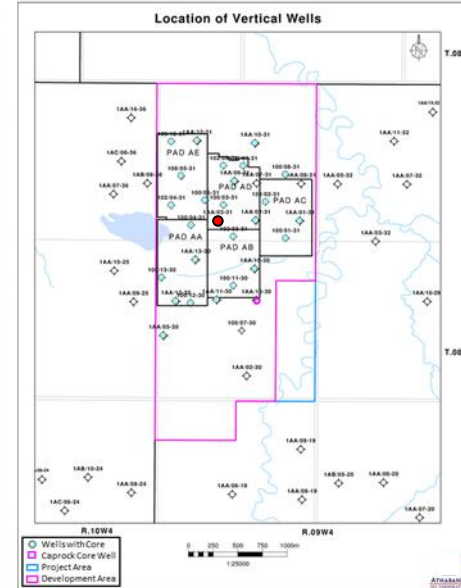
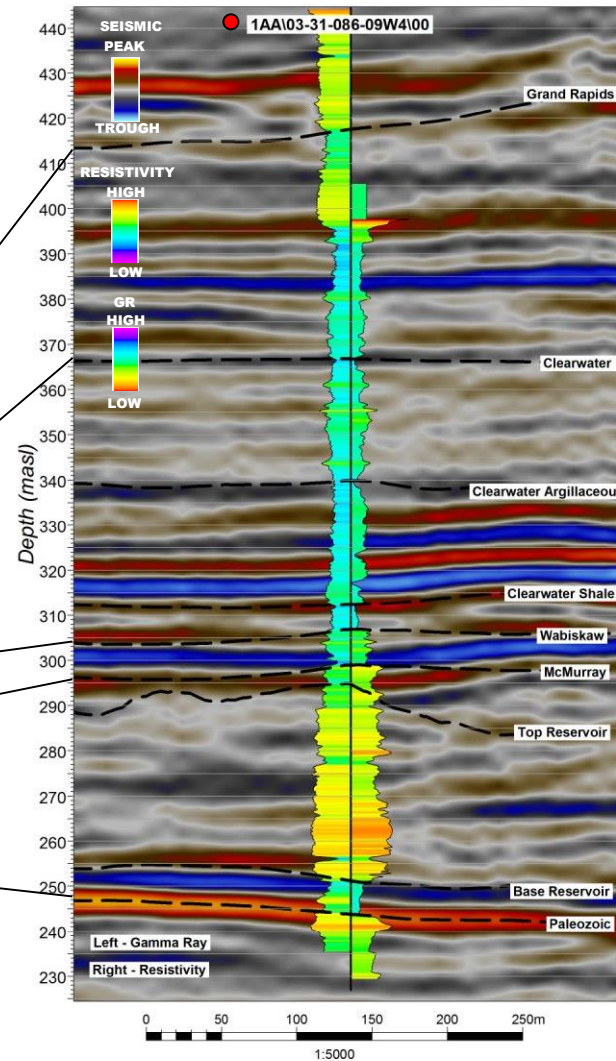
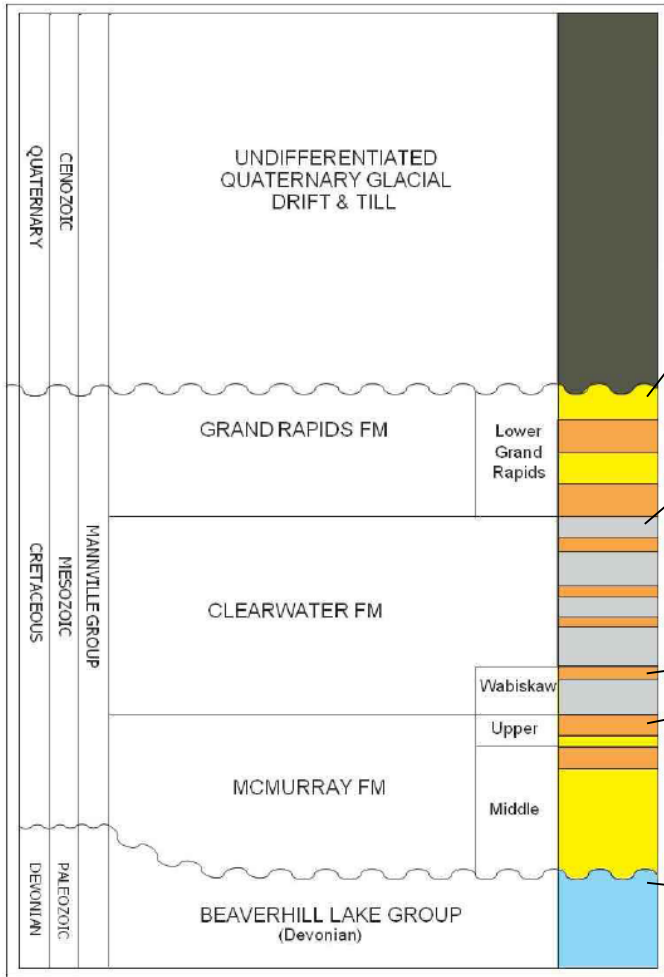




SUBSURFACE
GEOSCIENCES

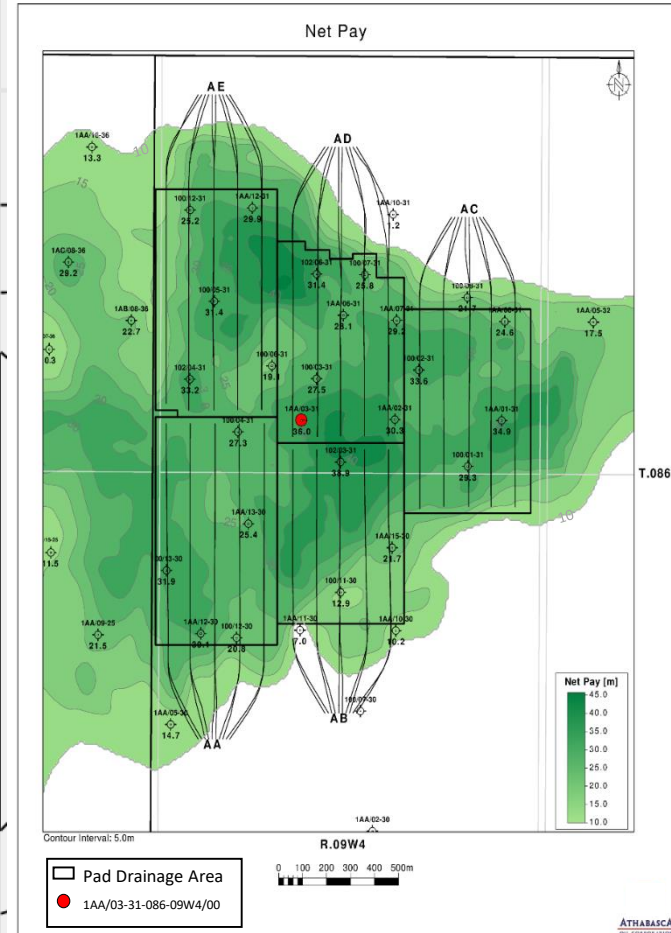
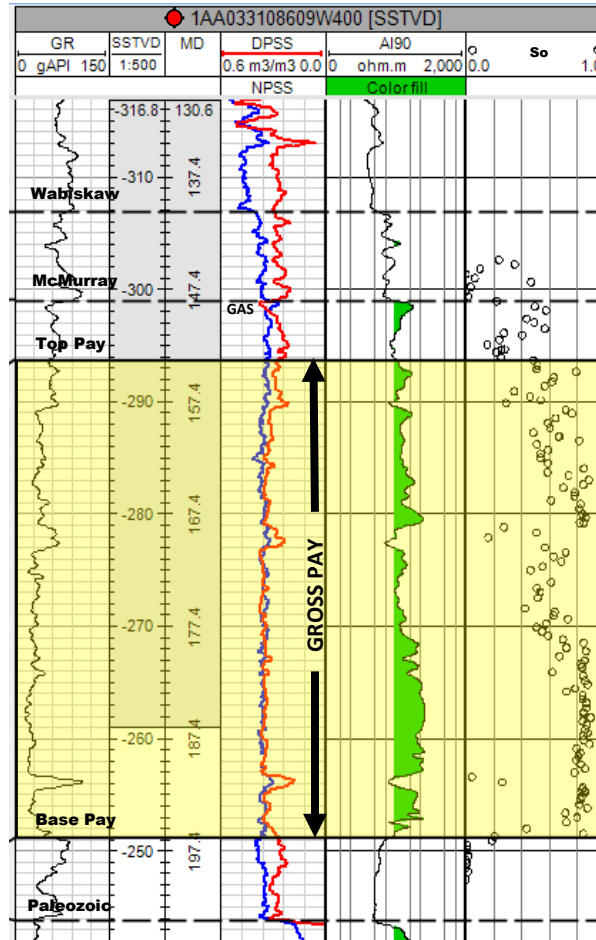
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MIDDLE MCMURRAY TARGET RESERVOIR

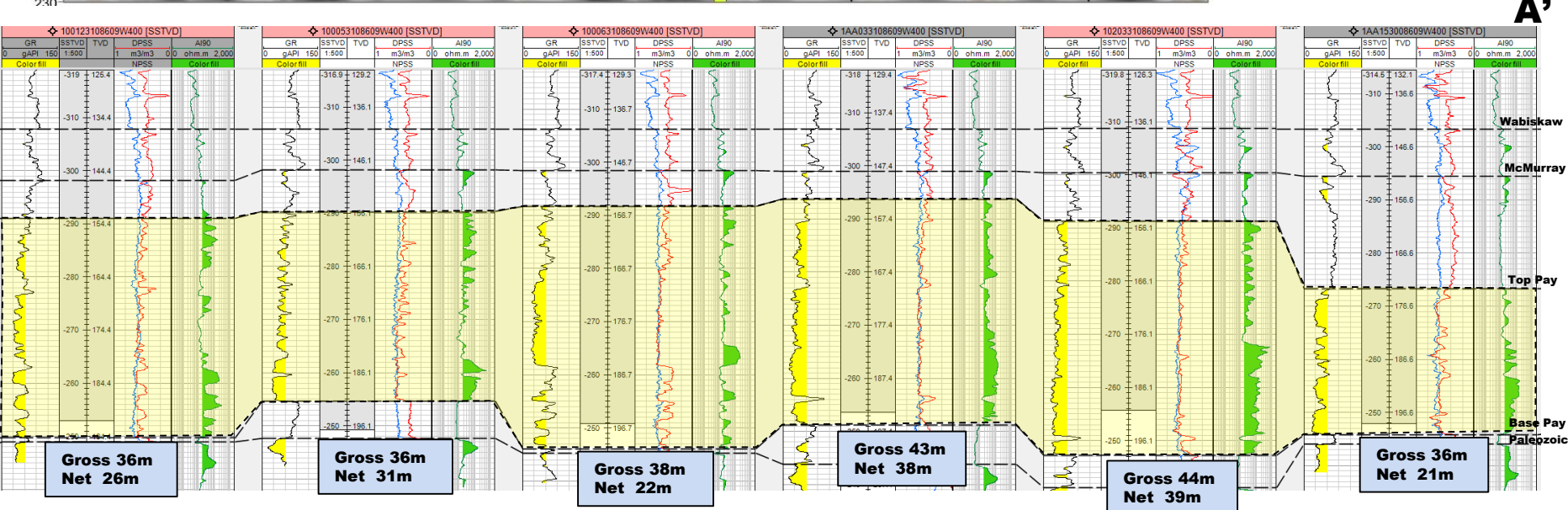
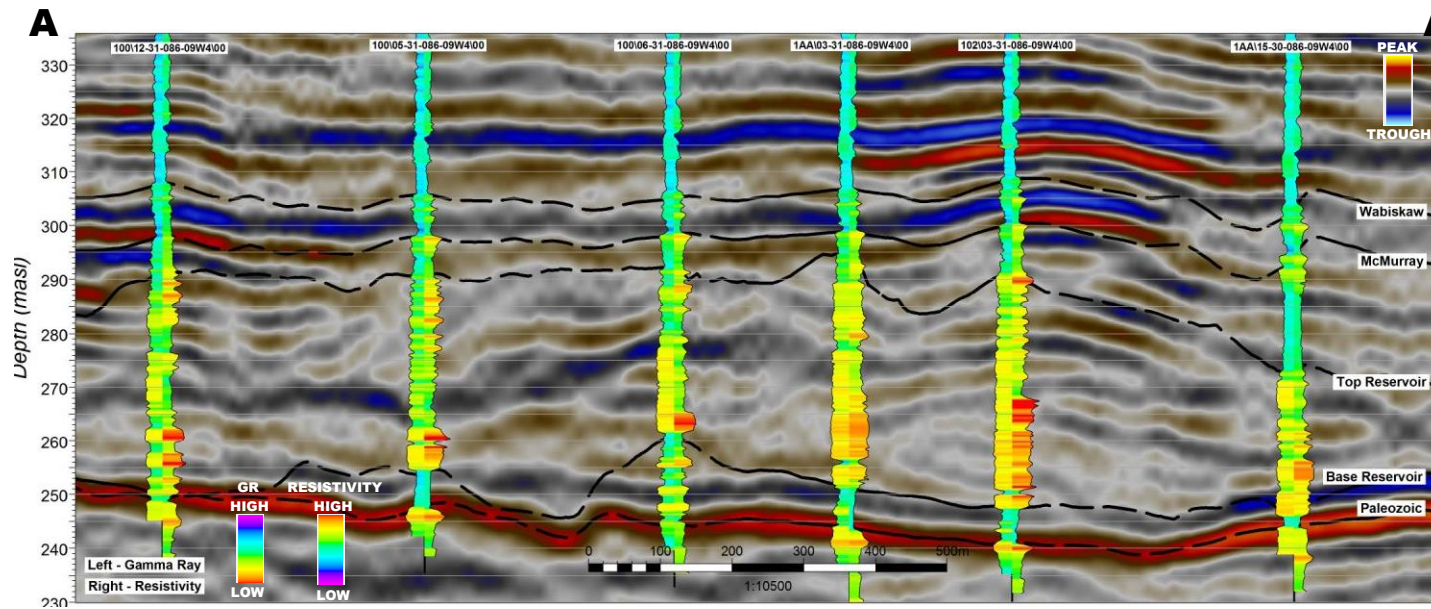


MIDDLE MCMURRAY GROSS PAY DEFINITION

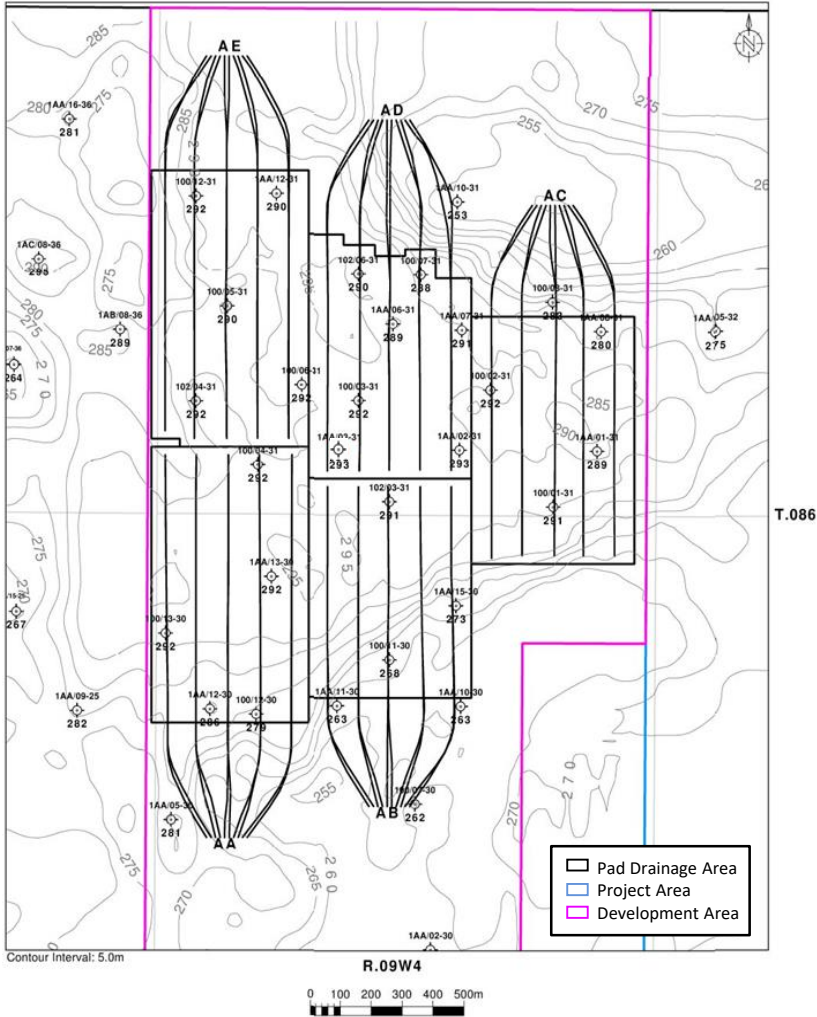
- Thickness ≥ 10 m
- GR < 70 API
- Density $> 27\%$
- Resistivity > 18 ohm-m
- Water Saturation $< 50\%$
- Includes < 1 m thick mud
- Net pay thickness uses gross pay criteria but excludes mud



STRUCTURAL CROSS SECTION NW-SE ACROSS HS1 AREA



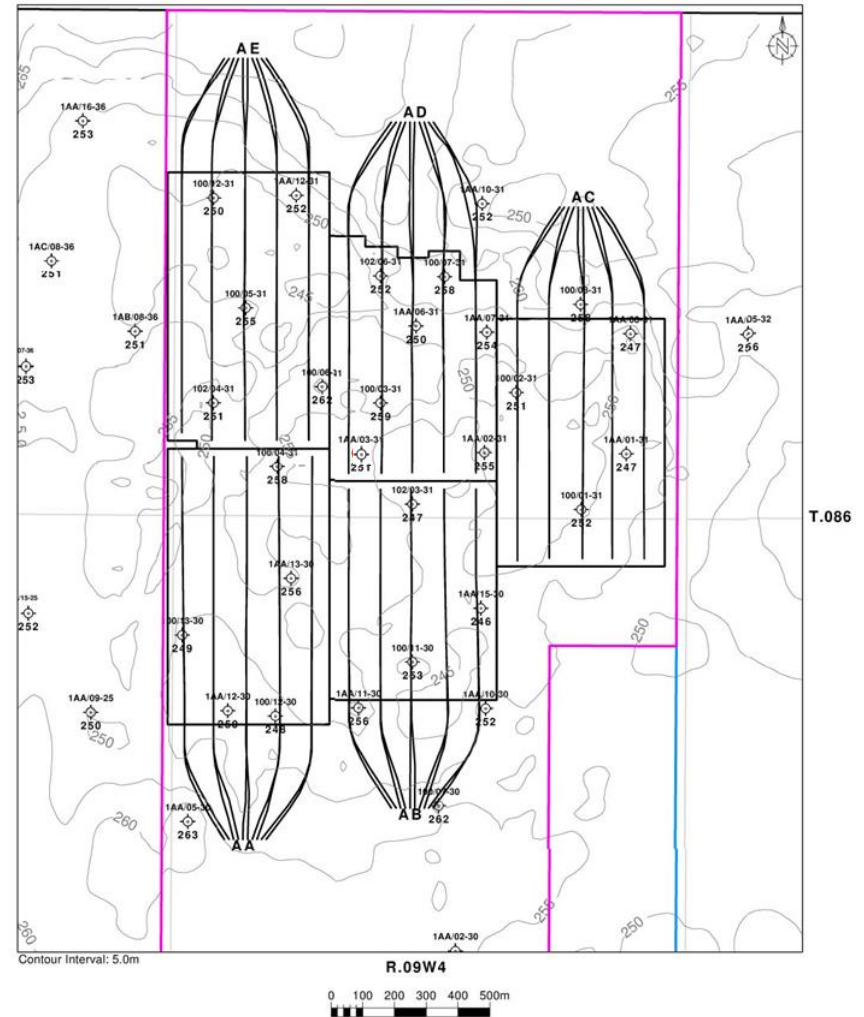
Top Reservoir Structure, m asl



ELEVATION RANGE

- 262 to 301 m asl

Base Reservoir Structure , m asl



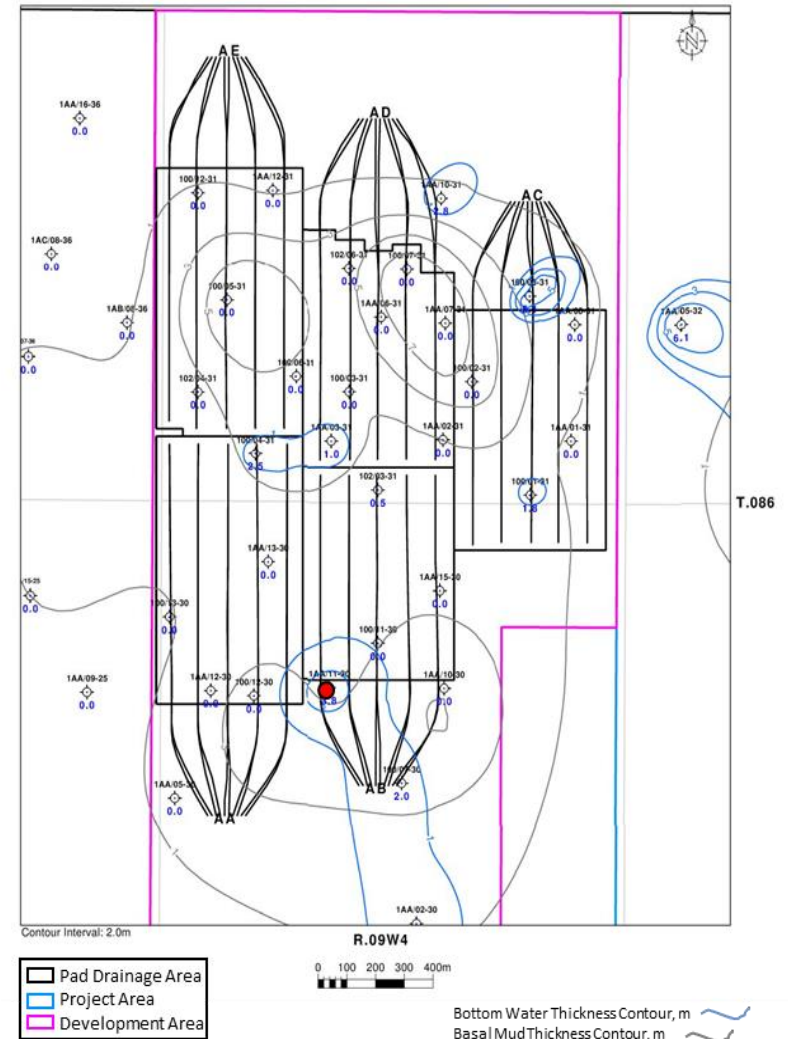
ELEVATION RANGE

- 241 to 262 m asl

BOTTOM WATER

- Localized and not in direct contact with bitumen; separated by MIHS or mud
- Bottom water interval consists of interbedded mud and sand (resistivity < 10 ohm-m)

Thickness of Bottom Water and Basal Mud, m

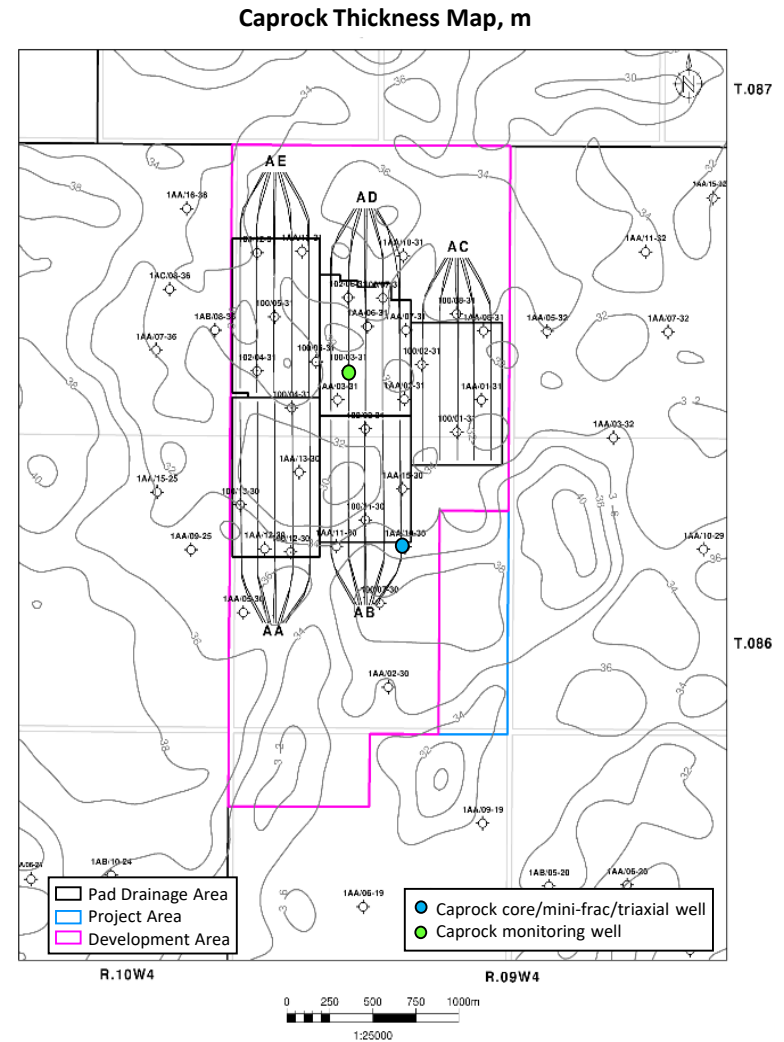


2019

- No pressure or temperature change has been observed in the caprock during the reporting period
- No new caprock core, mini-frac or tri-axial testing completed during the reporting period

HISTORICAL

- Caprock is defined as the unit between the top of the Clearwater and Wabiskaw
- One observation well has one piezometer and two thermocouples in the caprock

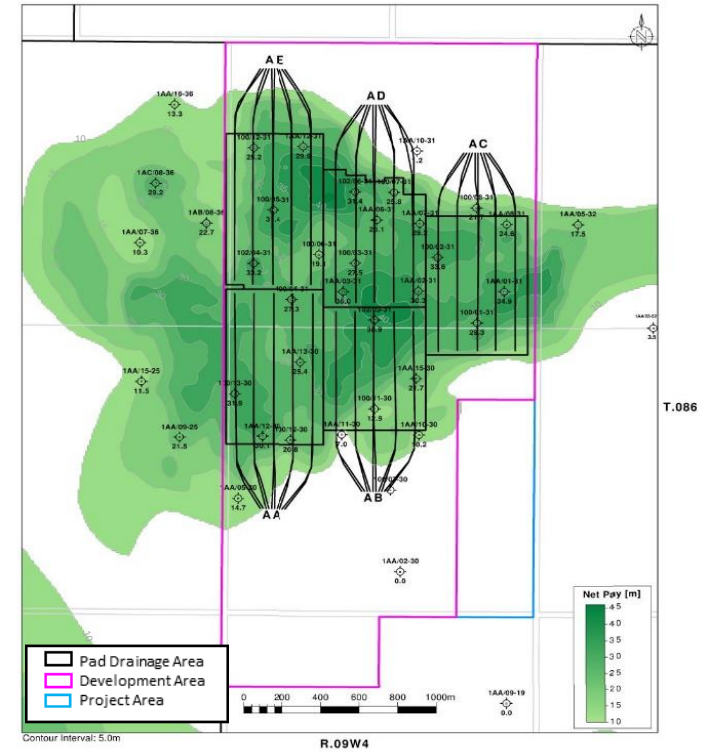


RESERVOIR PROPERTIES

- Typical Producer Depth: 191 TVD (258 masl)
- Initial Reservoir Pressure @ 190 m TVD: 600 kPaa
- Initial Reservoir Temperature: 8°C
- Horizontal Permeability: 3,500-4,300 mD
- Vertical Permeability: 2,800-3,600 mD
- Bitumen Viscosity @ initial reservoir temperature: >1 mln cP

Gross OBIP = Thickness from Top to Base Pay x Area x Porosity x So

Net Pay Thickness (m) from Top to Base Pay



	Avg Por (frac)	Avg So (frac)	OBIP (mln m ³)
Drainage Areas	0.36	0.72	15.6
Development Area	0.36	0.72	18.6
Project Area	0.36	0.72	18.6



SUBSURFACE

WELL DESIGN AND INSTRUMENTATION

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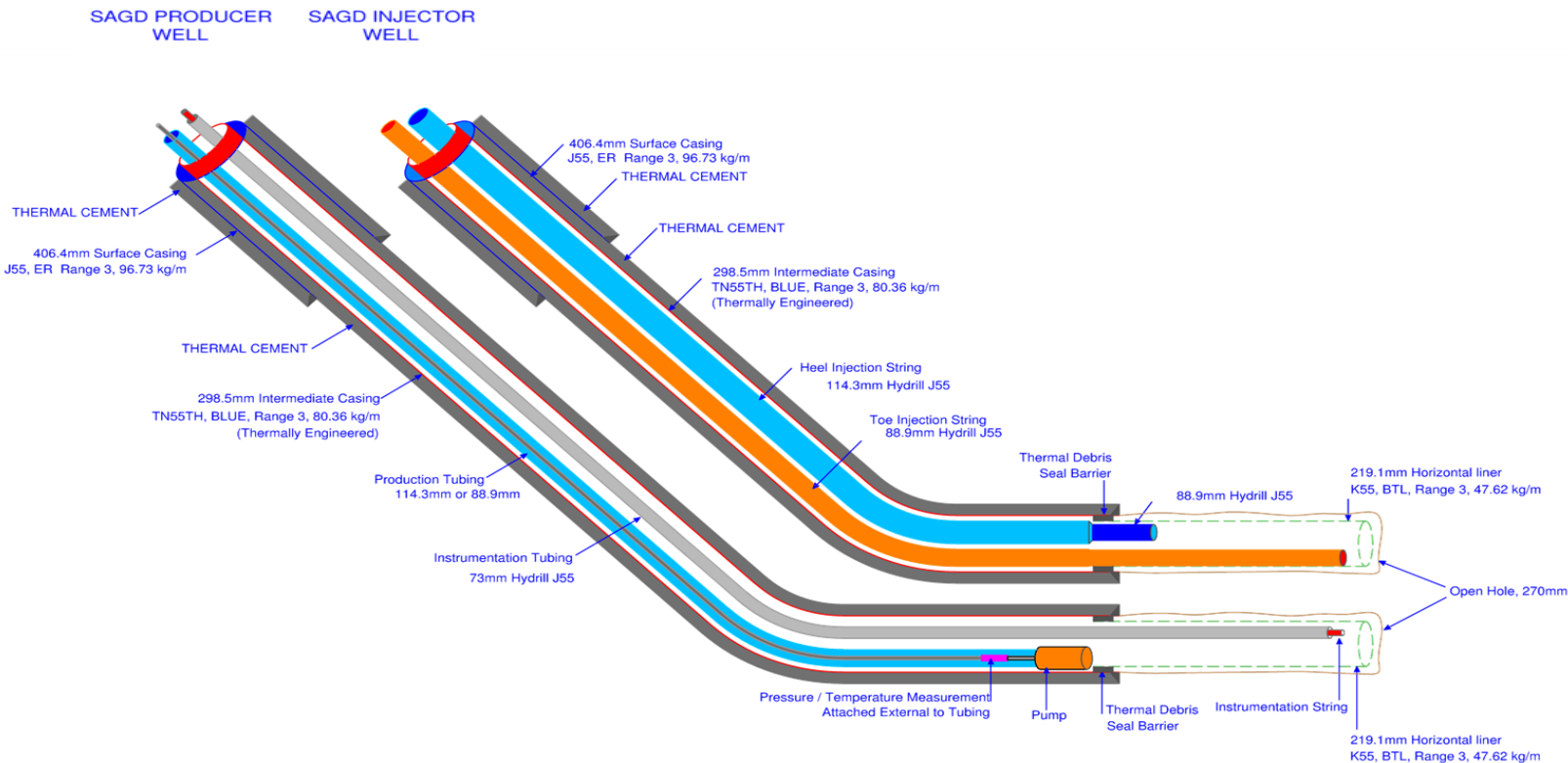
TYPICAL COMPLETION & ARTIFICIAL LIFT

- All wells initially completed with all-metal PCP
 - *Converted from PCPs to ESPs as rates improved and the wells matured*
- Typical pump operating conditions:
 - *Average bottomhole pressure = 1,800 kPag*
 - *Average bottomhole temperature = 180 °C*
- ESP run life greater than 2 years on 14 wells
 - *7 ESPs with greater than 1,000 day run life*

Artificial Lift Performance	PCP	ESP
Typical Minimum Rate (m ³ /d)	100	125
Typical Maximum Rate (m ³ /d)	600	825

Well	Type
AA1	ESP
AA2	ESP
AA3	PCP*
AA4	ESP
AA5	PCP
AB1	ESP
AB2	ESP
AB3	ESP
AB4	ESP
AB5	ESP
AC1	ESP
AC2	PCP
AC3	ESP
AC4	ESP
AC5	ESP
AD1	ESP
AD2	ESP
AD3	ESP
AD4	PCP
AD5	ESP
AE1	ESP
AE2	ESP
AE3	ESP
AE4	ESP
AE5	ESP

*Production assurance well



Instrumentation and Completions

TEMPERATURE

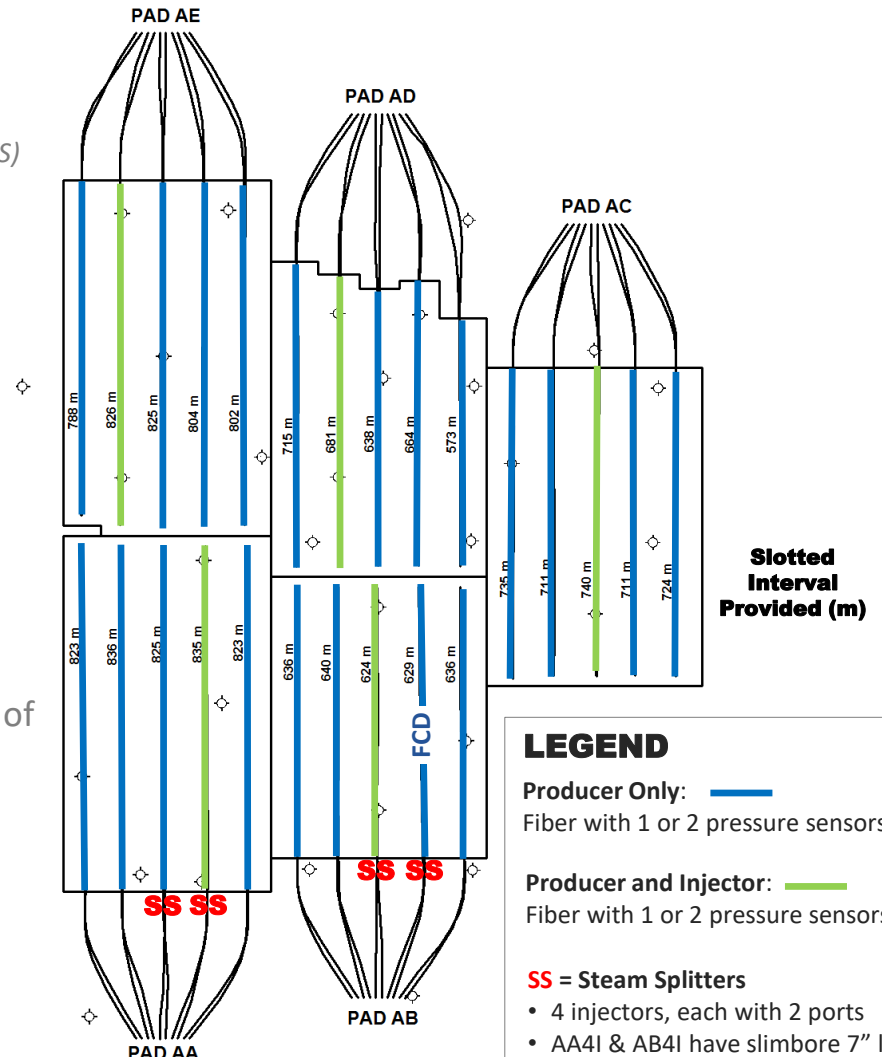
- Two types of fiber for temperature measurements
 - *Fiber Bragg Grating (FBG) and Distributed Temperature Sensing (DTS)*

BOTTOMHOLE PRESSURE (BHP)

- Injector BHP is measured with blanket gas
- Producer BHP is measured using optical gauges and/or bubble tubes

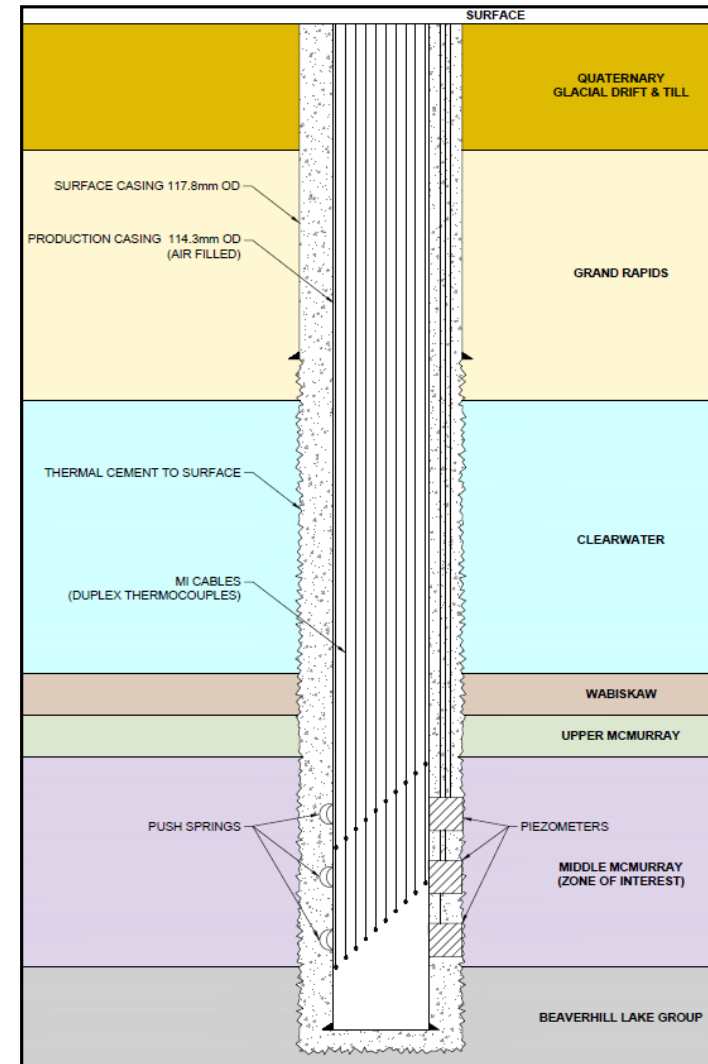
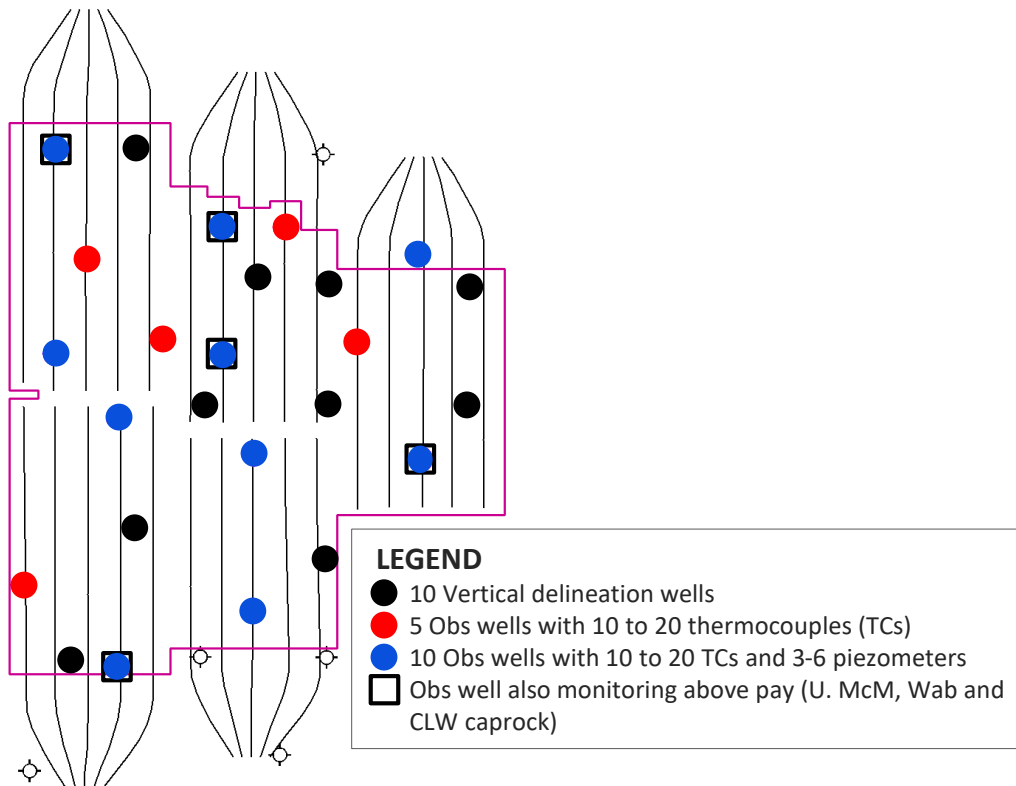
FLOW CONTROL DEVICES (FCDs)

- FCD installed in well AB04, March 2018
- Evaluation of performance is inconclusive due to impact of voluntary curtailment after install



OBSERVATION WELLS

- Instrumentation used to monitor reservoir pressure and temperature
 - *Some pressure sensors have failed (typically after steam conditions observed)*





SUBSURFACE

4D SEISMIC AND MONITORING

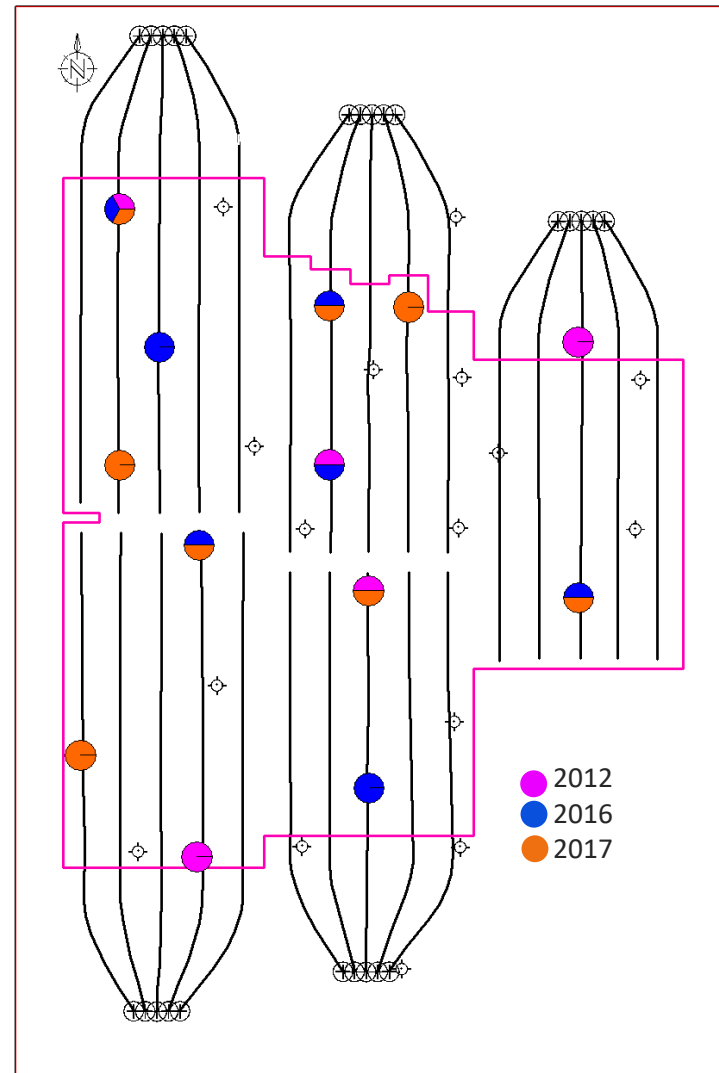
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2019

- No new data acquired in reporting period

HISTORICAL

- Baseline acquired in 2012
- 2016 acquired 7 saturation logs; 2017 acquired 8 saturation logs
- Results show steam chamber thickness correlates with observation well temperature profiles

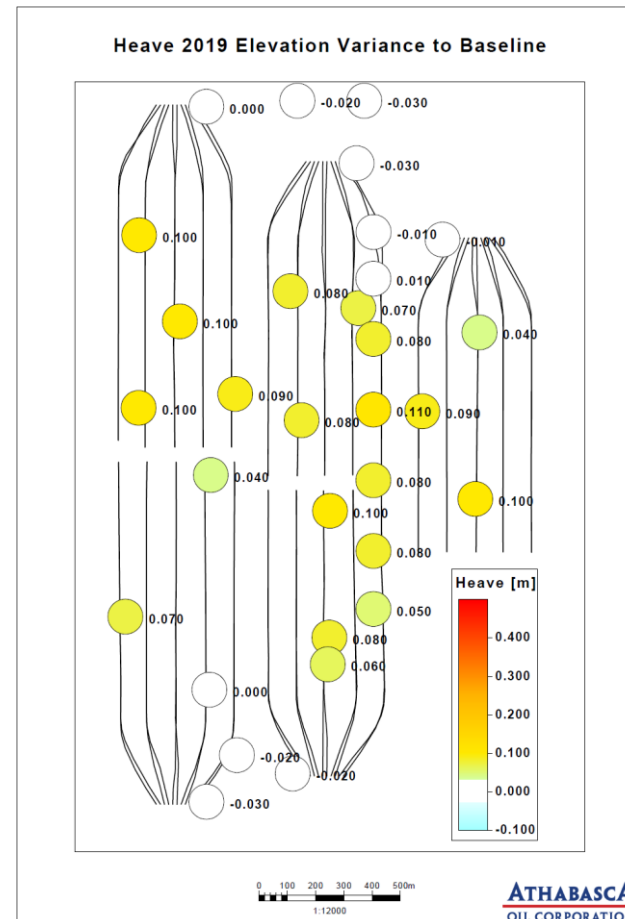
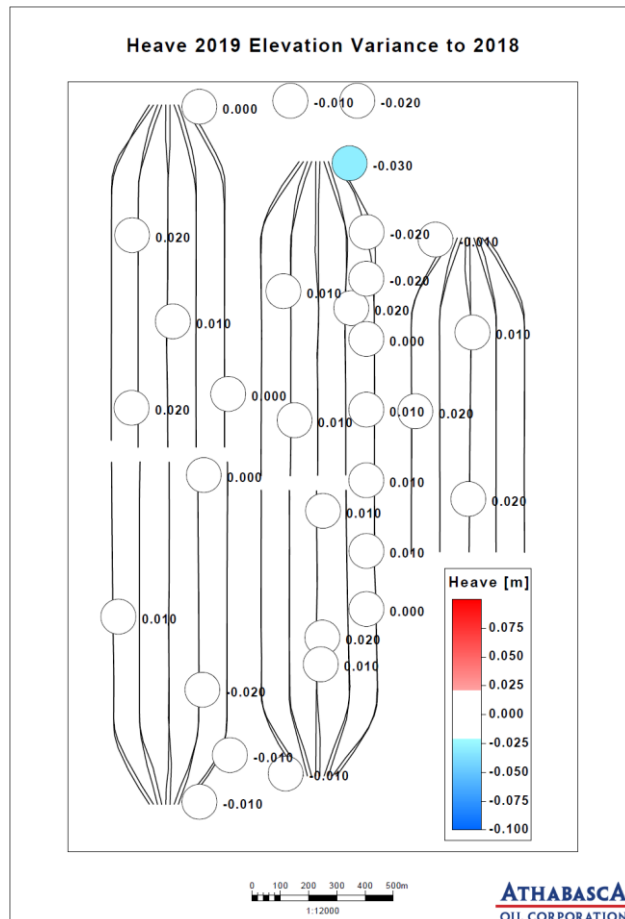


PROGRAM DESIGN

- 31 permanent surface heave monuments (0.30 x 0.30 m plate)
- Survey tolerance range is +/- 3 cm

SURVEY/RESULTS

- During 2019 the maximum change observed was within the +/- 3 cm survey tolerance
- The maximum change observed between 2015 and 2019 is 11 cm

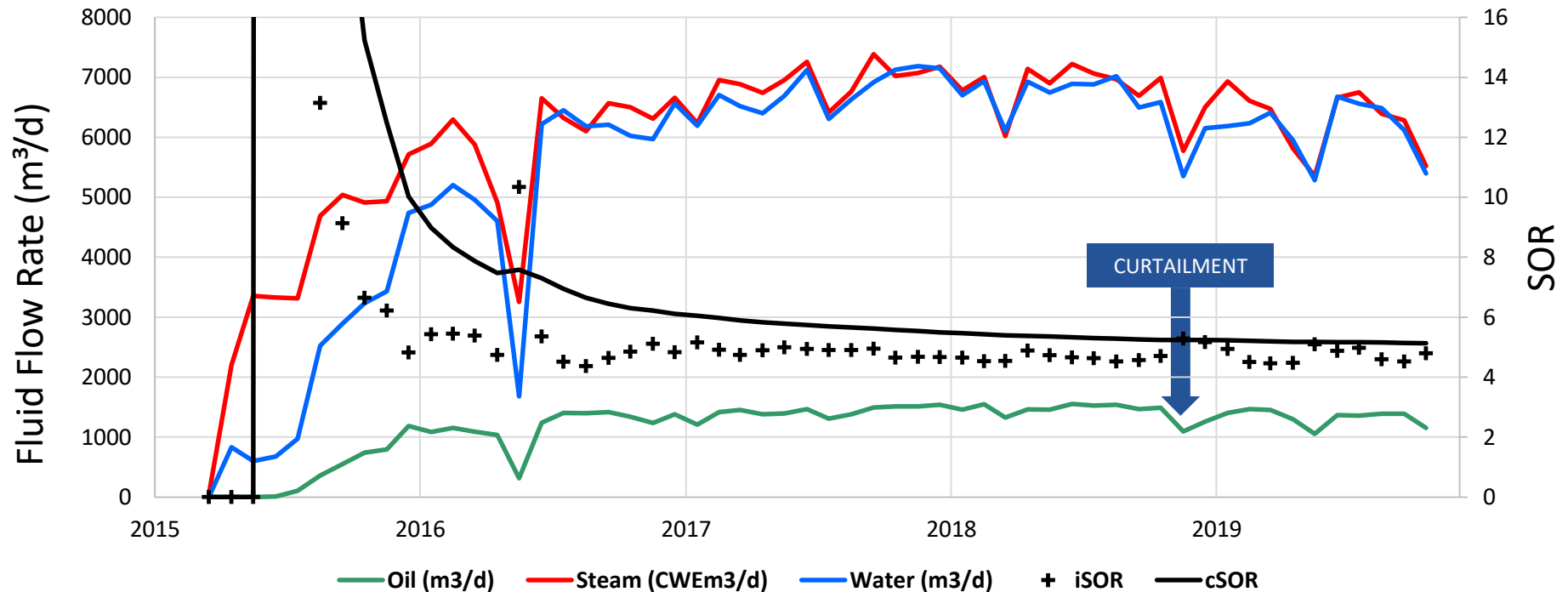
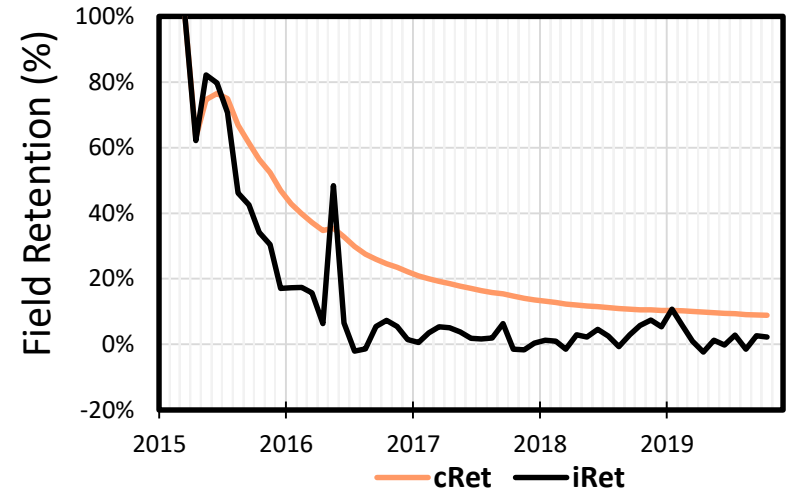




SUBSURFACE
SCHEME PERFORMANCE

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- 24 of the 25 SAGD well pairs on production
- Injectors at target operating pressure
- SOR declining as upper portions of the reservoir drain
- Maximum monthly bitumen rate 1,466 m³/d (9,223 bbl/d) with SOR of 4.5 (Feb 2019)
- Curtailed production in Q4 2018 in response to extreme pricing differentials



Pad	Well Pairs	Average Lateral Length (m)	Average Net Pay (m)	Oil Saturation (frac)	Total Net Pay Porosity (frac)	OBIP (10 ⁶ m ³)	Current Recovered ¹ (10 ⁶ m ³)	Current Recovery Factor (%)	Predicted Recovery Factor (%)
AA	4/5	850	28.0	0.71	0.35	3.3	0.31	9.4	50-70
AB	5/5	640	29.3	0.73	0.37	2.9	0.68	23.5	50-70
AC	5/5	750	28.7	0.70	0.36	3.0	0.25	8.5	50-70
AD	5/5	670	32.1	0.71	0.35	3.2	0.35	11.0	50-70
AE	5/5	830	28.2	0.70	0.35	3.2	0.39	12.3	50-70
TOTAL	24/25					15.6	1.99	12.8	50-70

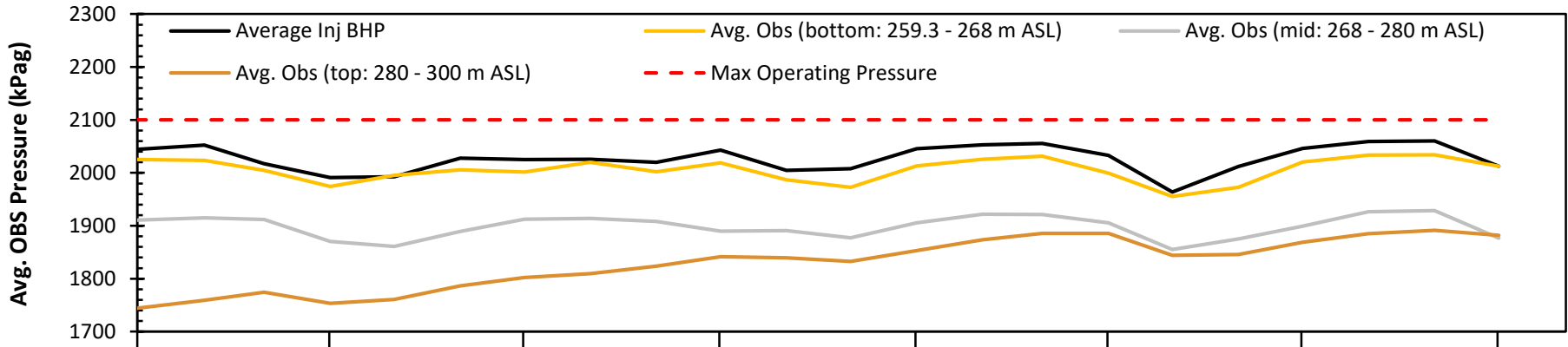
¹ Recovery Factor based on cumulative oil production in Oct 2019

Notes:

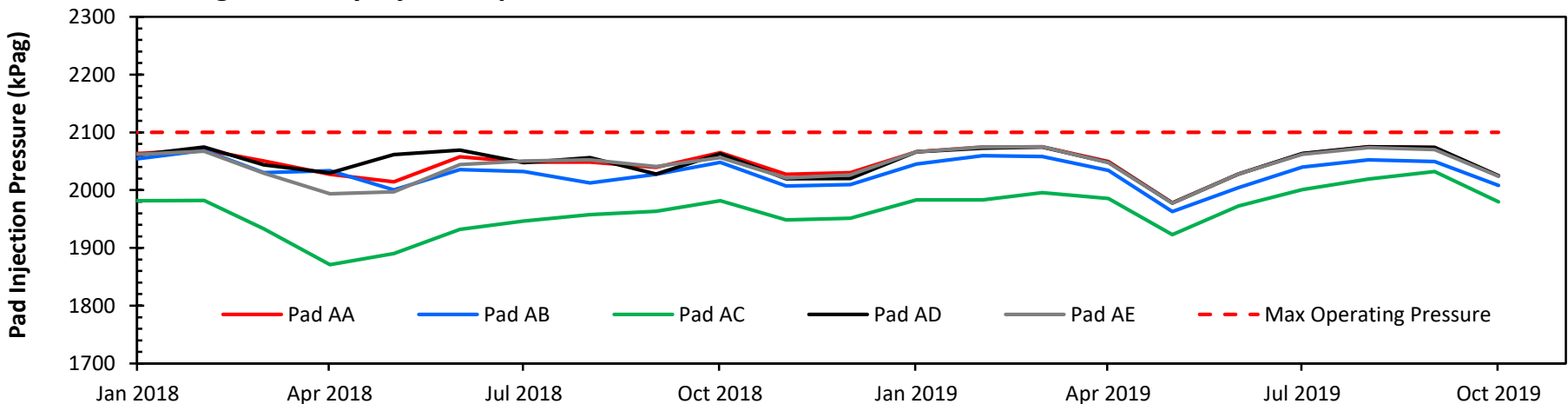
- Well Spacing: 100 m, Spacing between pads: 130 m
- Volumetrics include 25 m at heel and toe of the well pair
- OBIP is gross oil volume between base and top of pay

- Approved Maximum Operating Pressure is 2,100 kPag
- Throughout the reporting period, the reservoir continues pressuring up
 - *Pressure drops due voluntary curtailment in Nov/Dec 2018 and facility maintenance*
- No pressure change in caprock

Average monthly field pressure at base, middle and top of reservoir



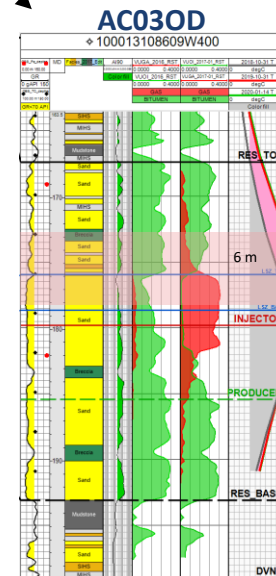
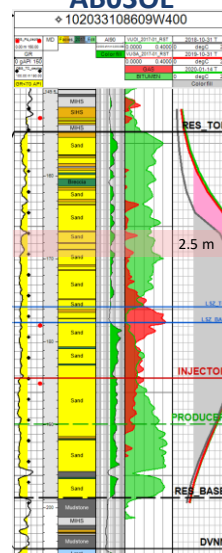
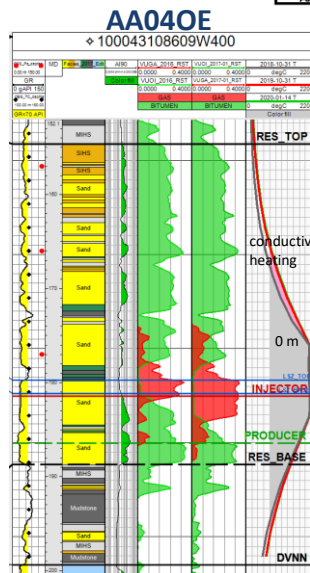
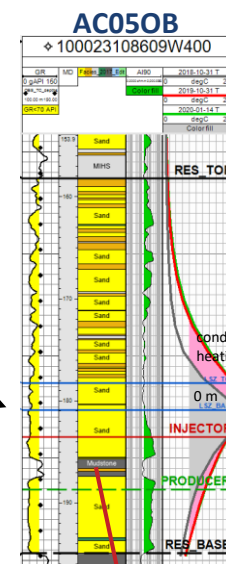
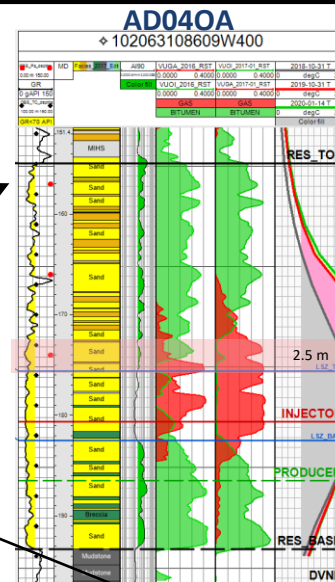
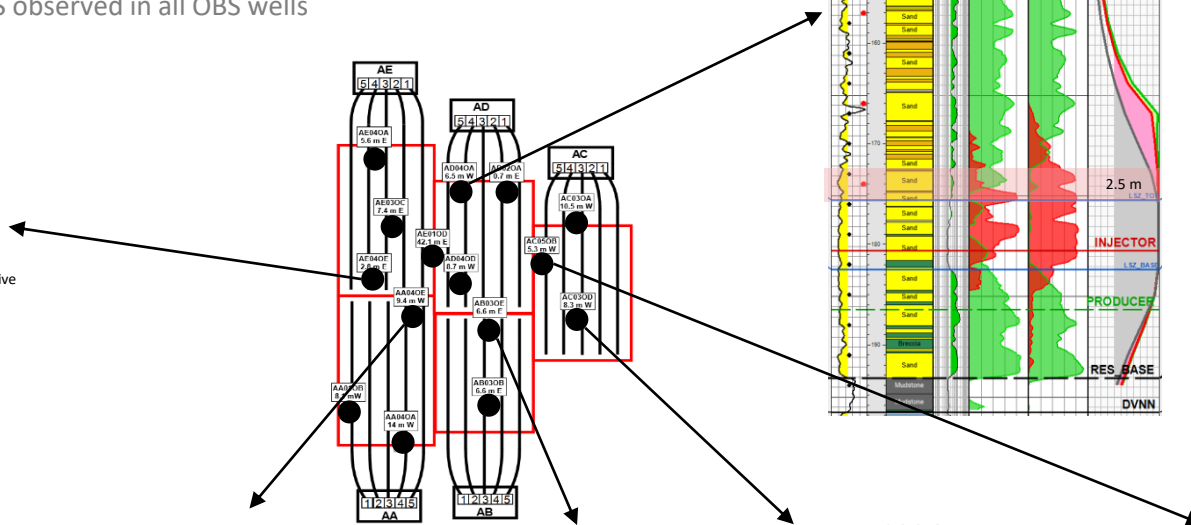
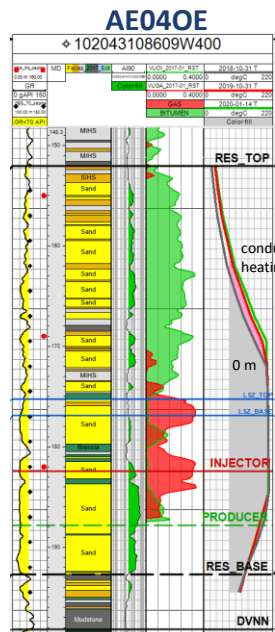
Average monthly injection pressure in each Pad



STEAM CHAMBER PROGRESSION IN OBSERVATION WELLS

PROGRESSING THROUGH IHS

- Height of steam chamber top was maintained during voluntary curtailment; some pads showed increased steam chamber development over the year
- Conductive heating into IHS observed in all OBS wells



AC05OB: 1 to 2 m mudstone acted as a baffle, not a barrier, to flow

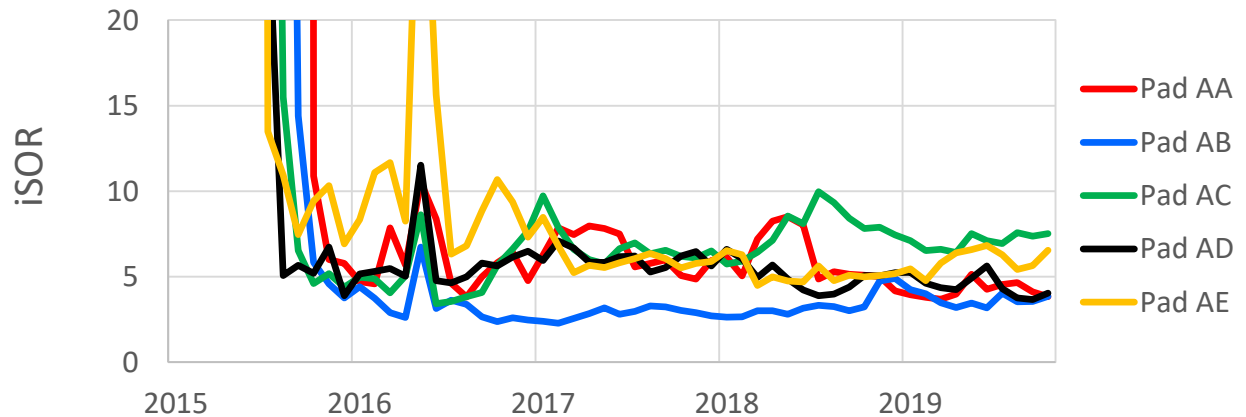
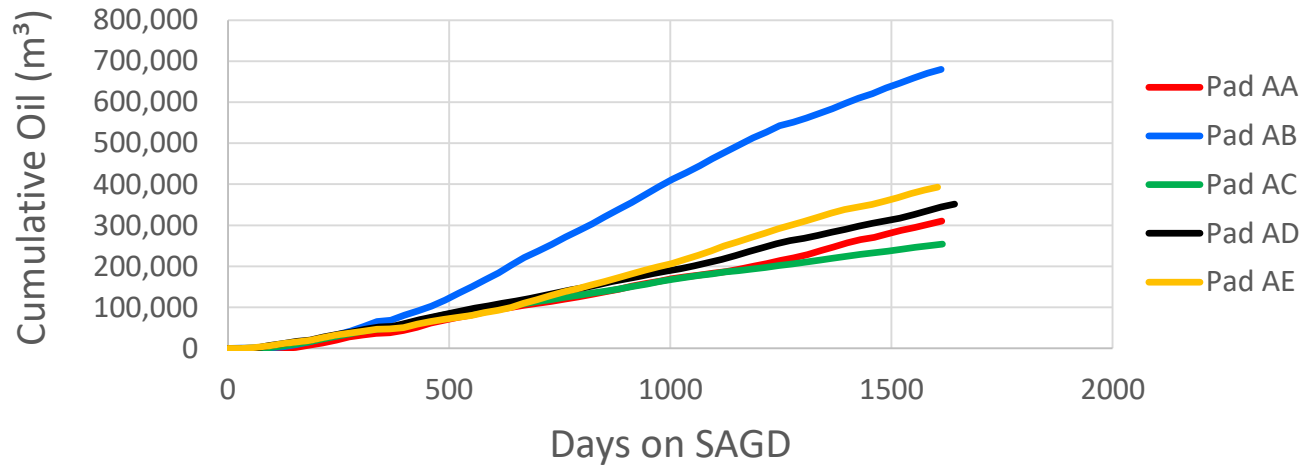
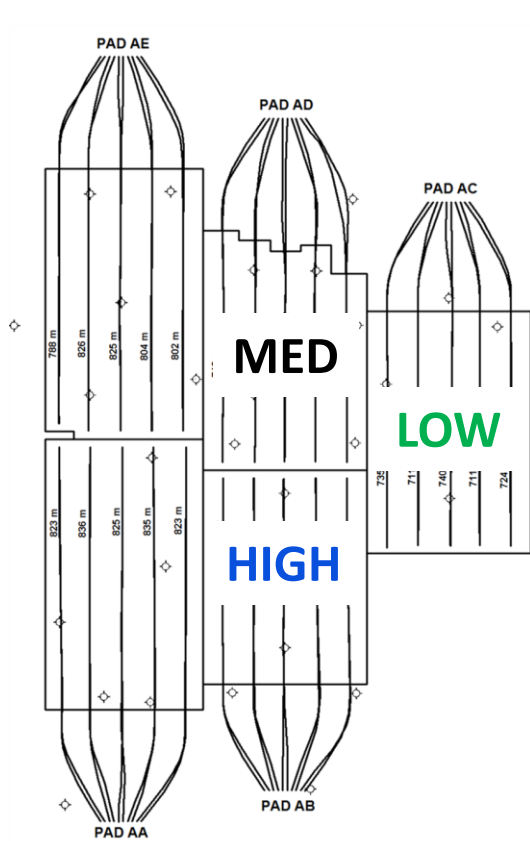
Temperature Plots

- Oct 31, 2018
- Oct 31, 2019
- Jan 14, 2020
- >80C Temp log cutoff for mobile oil (shaded)
- m Growth of Top of Steam Chamber from Oct 31, 2018 to Oct 31, 2019

FACIES

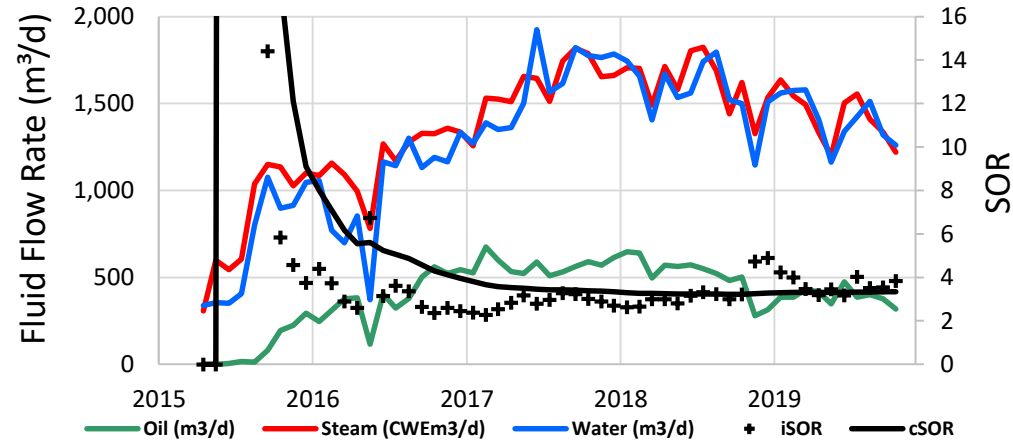
Sand	Yellow
SIHS	Orange
MHIS	Grey
Breccia	Green
Mudstone	Dark Grey
Lmst	Blue

- Variation of pad performance depends on geology, pad boundary, well pair trajectories, pump performance and subcool conformance
 - Pads AB, AD and AC selected as examples of high/medium/low performing pads
 - Selection based on cumulative oil recovery and cSOR
 - Differences in the productivity of the wells primarily due to geological variability



PAD AB

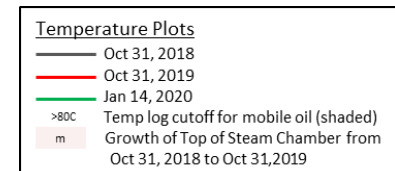
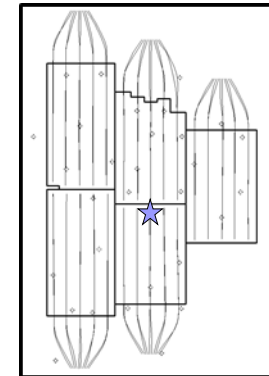
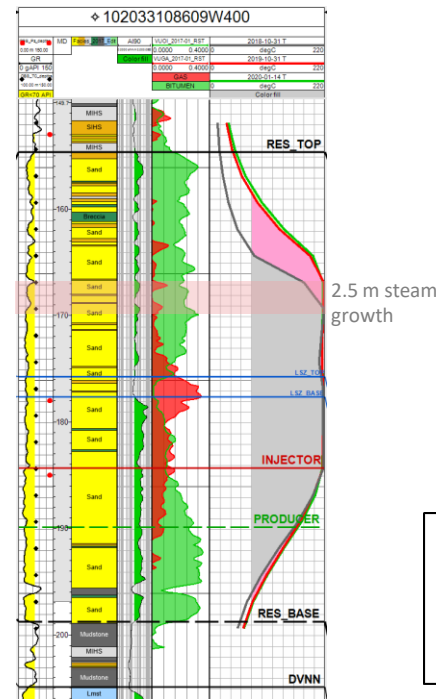
- Highest reservoir quality
 - Mostly sandy reservoir
 - High oil saturation around well pairs
 - Thin low bitumen saturation zone
- Highest average effective wellbore (97%)
- Peak well pair monthly rates >1,000 bbl/d



★ AB03OE - TOE (6.6m OFFSET)

STEAM CHAMBER DEVELOPMENT

- Well AB03OE shows 2.5 m steam chamber rise near toe
- Pressure continues to increase at top of reservoir (through IHS)

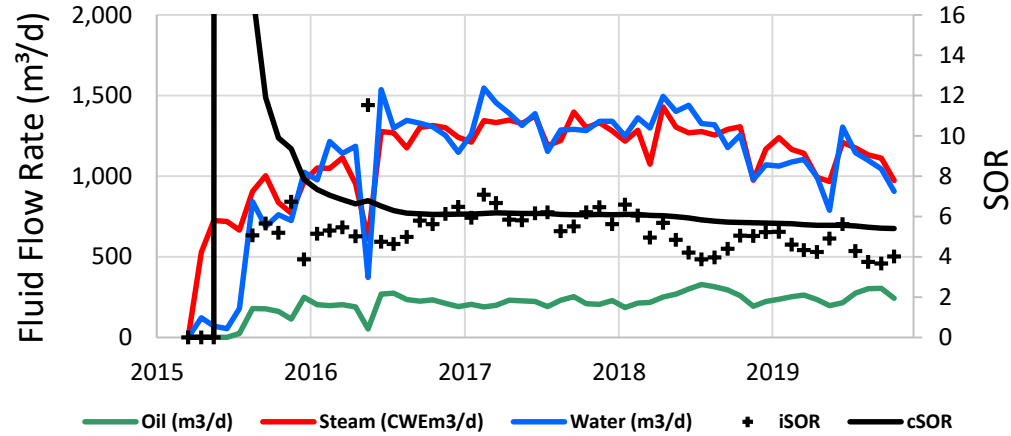


FACIES	
Sand	Yellow
SIHS	Orange
MIHS	Light Green
Breccia	Dark Green
Mudstone	Grey
Lmst	Light Blue

◆ Thermocouple ● Piezometer

PAD AD

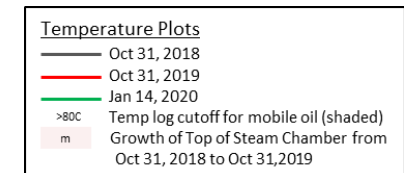
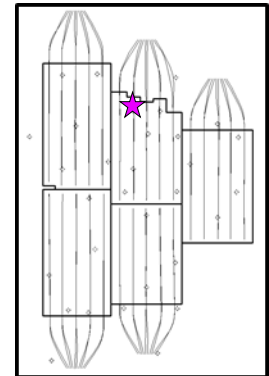
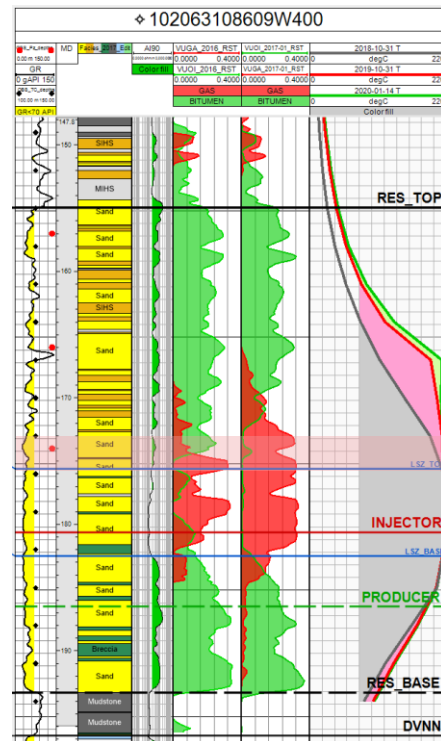
- Average reservoir quality
 - *Thickest net pay above producer (26.2 m)*
 - *IHS with high oil saturation in upper reservoir*
 - *Thick low bitumen saturation zone above injection well*
- Shortest wells
- High average effective wellbore (96%)



STEAM CHAMBER DEVELOPMENT

- Well AD04OA shows 2.5 m steam chamber rise near heel of AD04 in 12 months, 9 m in 14 months
- Steam chamber advanced through LSZ

★ AD04OA – HEEL (6.5 m OFFSET)



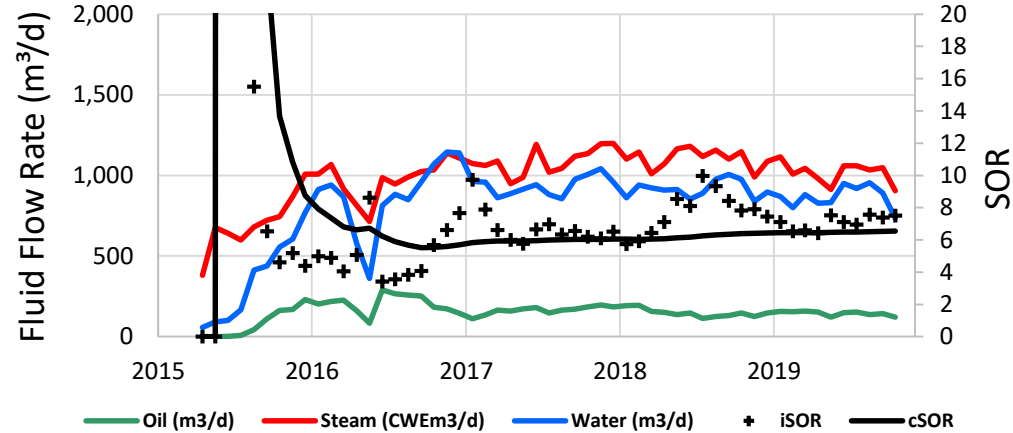
◆ Thermocouple

PAD AC

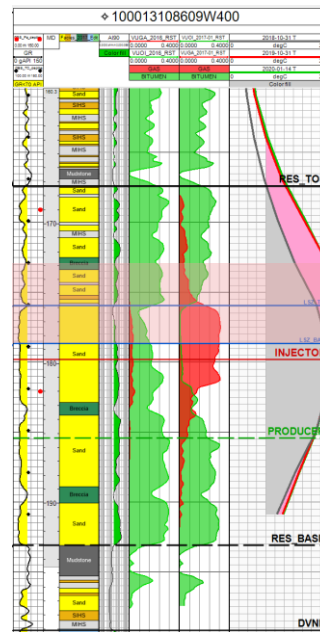
- Heterogeneous reservoir
 - *IHS dominated*
 - *Thin low bitumen saturation zone above injection well*
- Bounded at east of pad
- Sharing west boundary with pads AB and AD

STEAM CHAMBER DEVELOPMENT

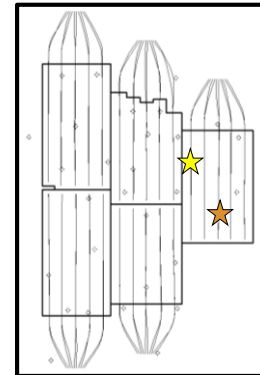
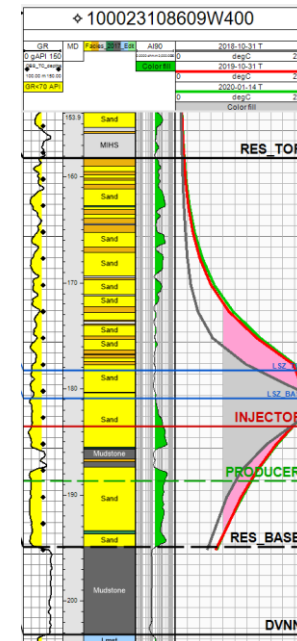
- AC030D steam chamber developed beyond the LSZ and is now advancing through SIHS and Breccia



★ AC030D - TOE (8.3 m OFFSET)



★ AC050B - MID (5.3 m OFFSET)



FACIES

Sand	Yellow
SIHS	Orange
MHS	Light Green
Breccia	Dark Green
Mudstone	Grey
Lmst	Blue

◆ Thermocouple ● Piezometer

Temperature Plots

Black line	Oct 31, 2018
Red line	Oct 31, 2019
Green line	Jan 14, 2020
Shaded area	>80C Temp log cutoff for mobile oil (shaded)
Shaded area	Temp log cutoff for mobile oil (shaded)
Shaded area	Growth of Top of Steam Chamber from Oct 31, 2018 to Oct 31, 2019

STEAM QUALITY

- Steam quality leaving the plant is approximately 98% (includes Continuous Blow Down at typically 6,000 kPag)
- Steam quality decreases to wellheads and is not measured but is modeled to be ~95%
- These conditions align with the original design

WELL INTEGRITY

- Well integrity is addressed by using thermally engineered casing, thermal cement and completing cement bond logs in accordance with Directive 051
 - No wellbore integrity failures during the reporting period
 - No non-compliances of reporting and repairing wellbore integrity issues during the reporting period
- AOC has a wellhead valve maintenance program in place to prevent wellhead valve failures
 - No wellhead failures during the reporting period

ABANDONMENTS

- No wells have been abandoned or suspended within the project area to date

- No plans for the drilling of any new SAGD well pairs for next reporting period
- No abandonments planned in the next 5 years
- Well AA03 to be brought online pending steam availability (Q3 2020)
- Expect to convert remaining active PCP wells to ESPs as required
- Evaluating opportunities for Flow Control Devices (FCDs) into producer wells

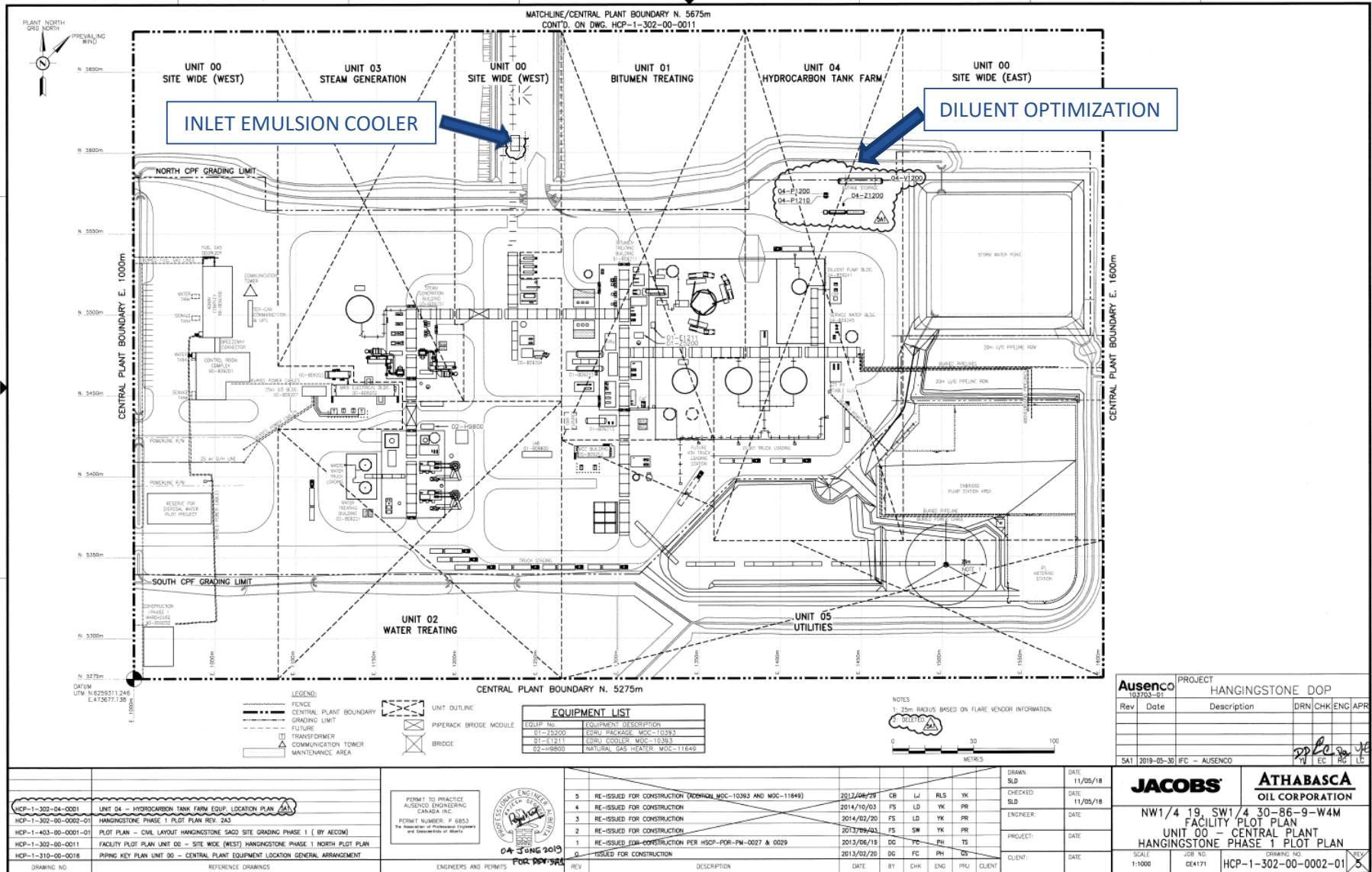


SURFACE OPERATIONS

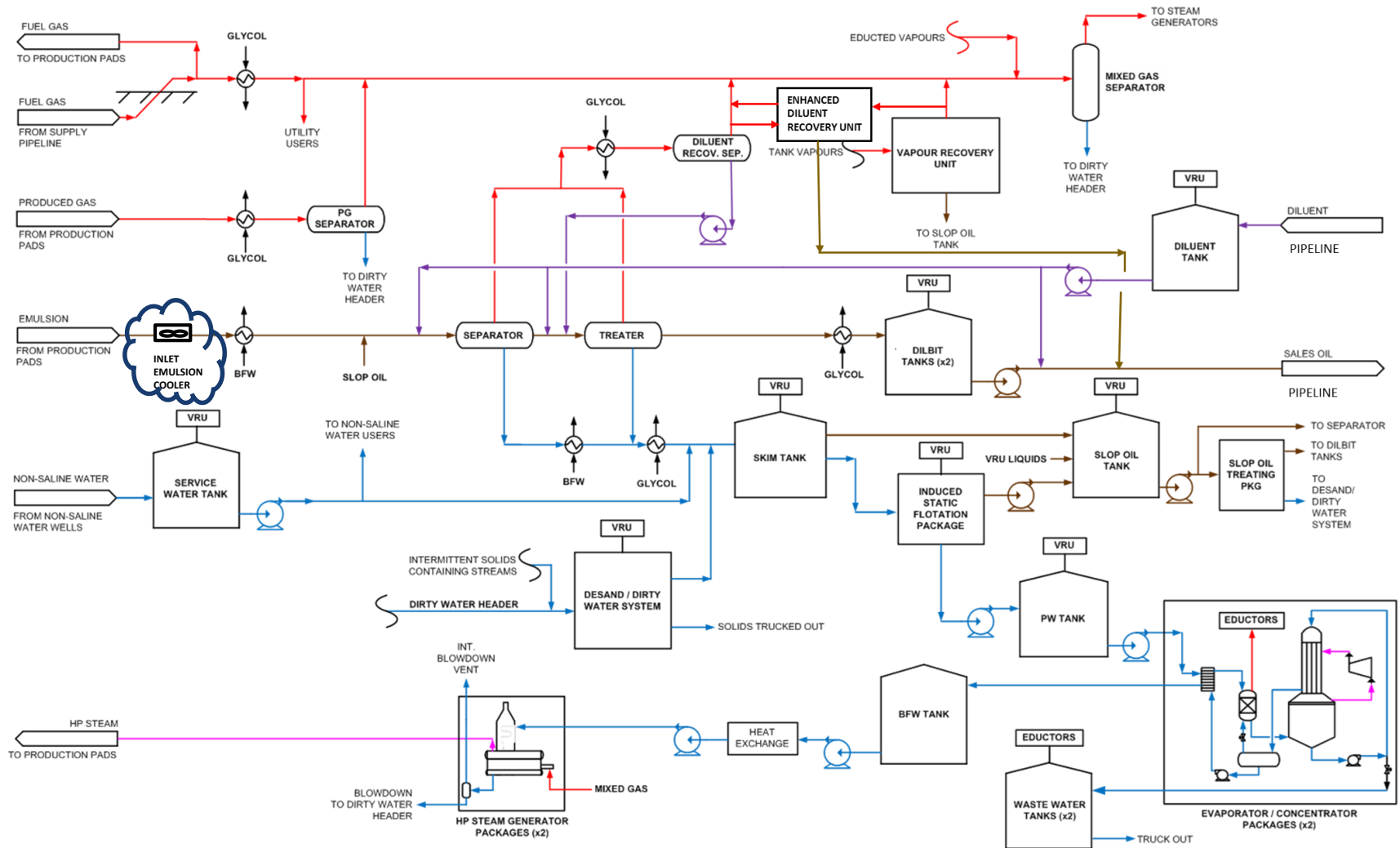
FACILITIES

CENTRAL PROCESSING FACILITY PLOT PLAN

- Diluent Optimization and Inlet Emulsion Cooler projects completed during reporting period



- Updated facility schematic showing inlet emulsion cooler





SURFACE

MEASUREMENT, ACCOUNTING AND REPORTING PLAN (MARP)

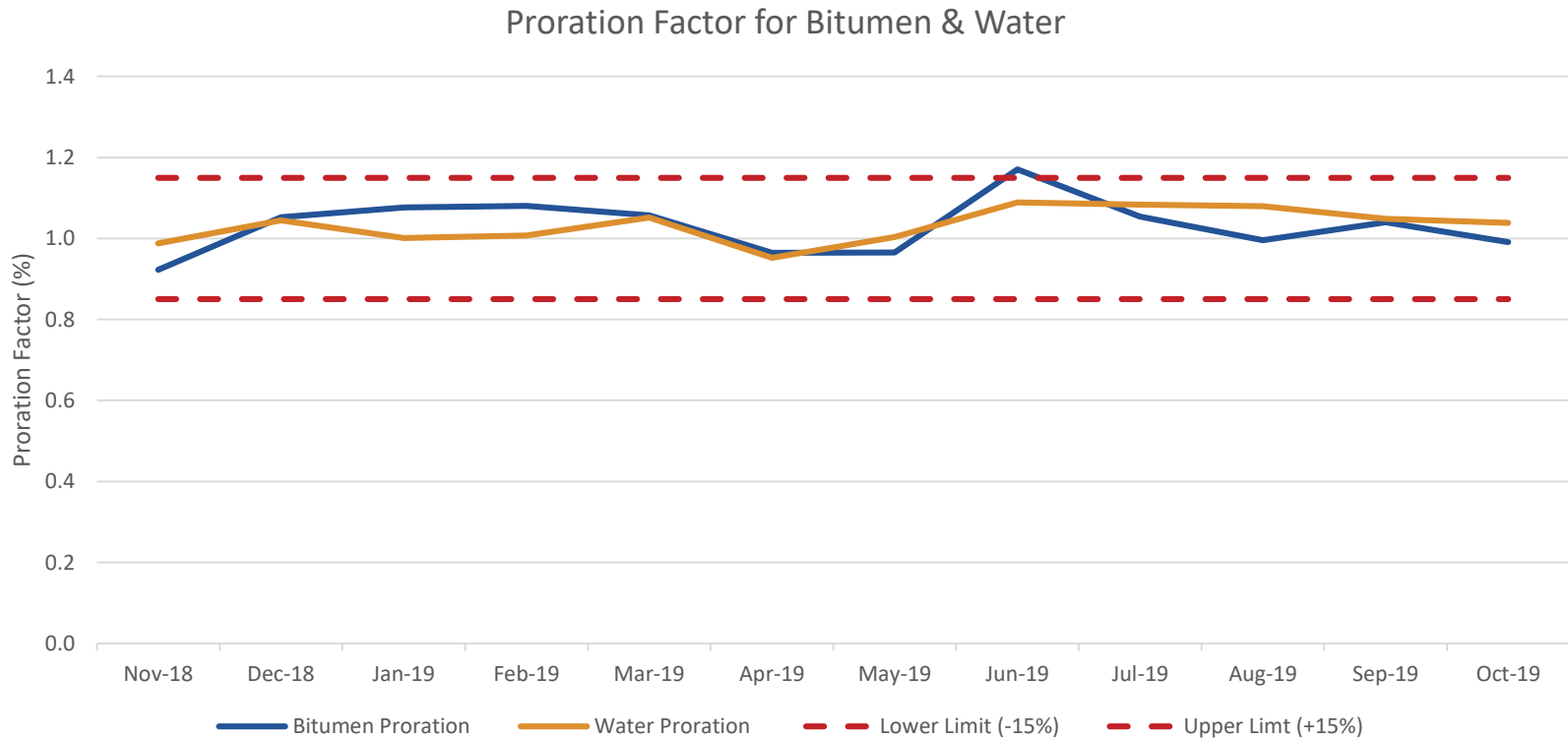
MEASUREMENT, ACCOUNTING AND REPORTING PLAN (MARP)

- MARP approved 2012
- 2019 - Voluntary disclosure of failed MARP meter (June 4) meter replacement (June 9)

MEASUREMENT METHODOLOGY

- No changes or alterations made to measurement methodology in reporting period
- WELL PRODUCTION AND INJECTION VOLUMES
 - *Each well pad has a dedicated test separator with liquid flow meter and water cut analyzer to determine well bitumen and water production*
 - *Wells are individually put on test for one valid testing hour for every 20 hours of operation*
 - *Valid well test criteria per approved MARP*
 - *Well gas production prorated from Battery Level GOR using a proration factor of 1*
 - *Battery Level GOR is updated monthly*
 - *Steam injection is metered at each individual wellhead. Primary and secondary steam production metering available at the central steam plant*
- BATTERY SALES OIL
 - *Sales oil is shipped via pipeline from the Hangingstone Battery. Custody transfer metering is done at receiving facility*
- MEASUREMENT TECHNOLOGY
 - *Well testing uses standard method of test separators with microwave water cut analyzers*
- STEAM VOLUMES
 - *Steam quality leaving the plant is approximately 98%*
 - *A continuous blowdown (CBD) of approximately 2% is added to the steam of each boiler and is injected into the wells*
 - *Intermittent blow down (IBD) flow is estimated at 0.02% of total water out of the facility using sound engineering practices*
- PRODUCED WATER VOLUMES
 - *Calculated using the measured Water Disposition to the Injection Facility plus the Water Dispositions from the Plant plus changes in Water Inventory less any Water Receipts*

PRORATION OF BITUMEN AND WATER





SURFACE OPERATIONS

FACILITY PERFORMANCE

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SITE RELIABILITY > 95%

- Based on steam performance
- Integrity management program and predictive maintenance programs have been implemented to maintain higher site reliability

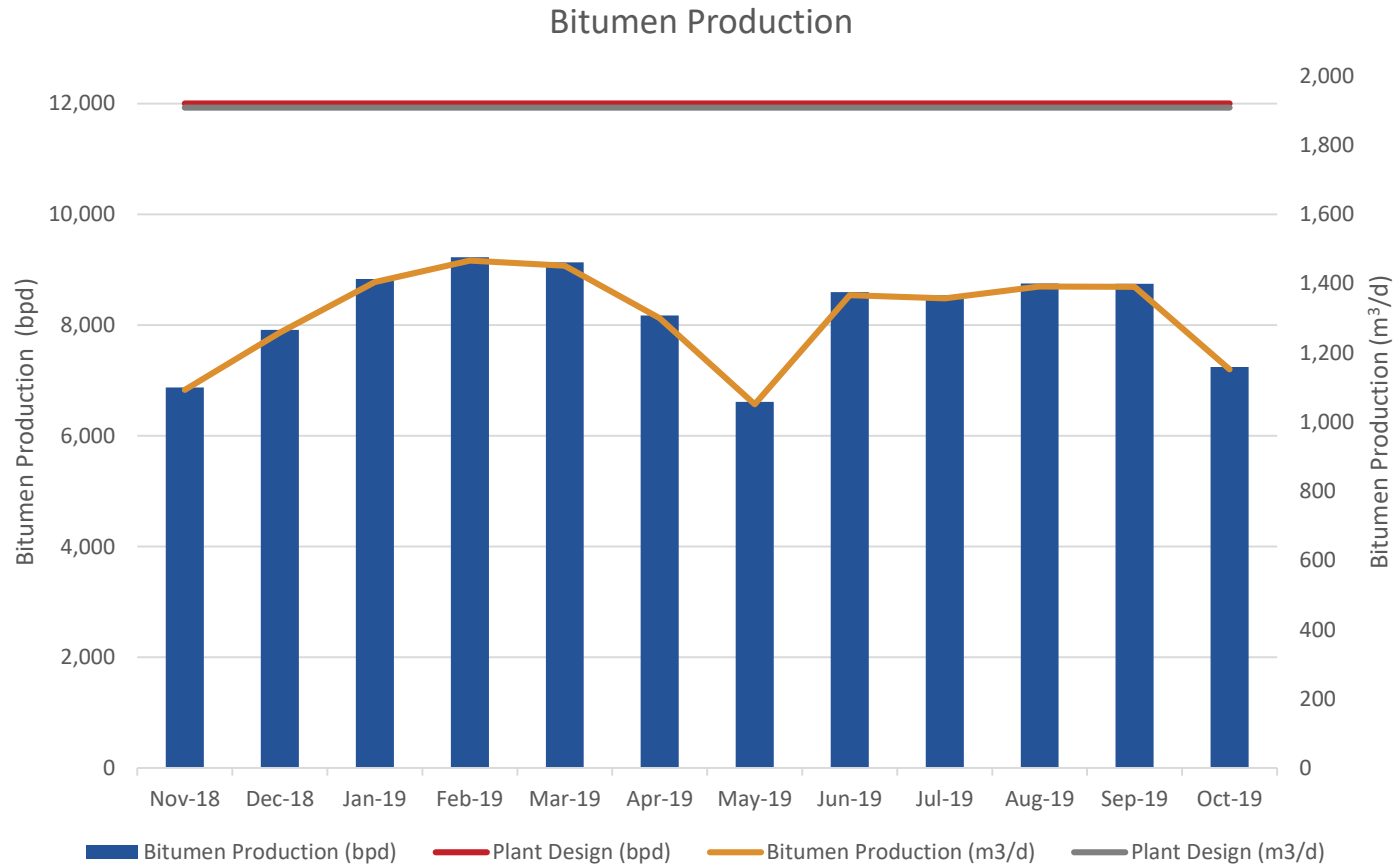
MAJOR ACTIVITIES

- Boiler Mechanical Cleaning
- Evaporator Chemical Cleaning

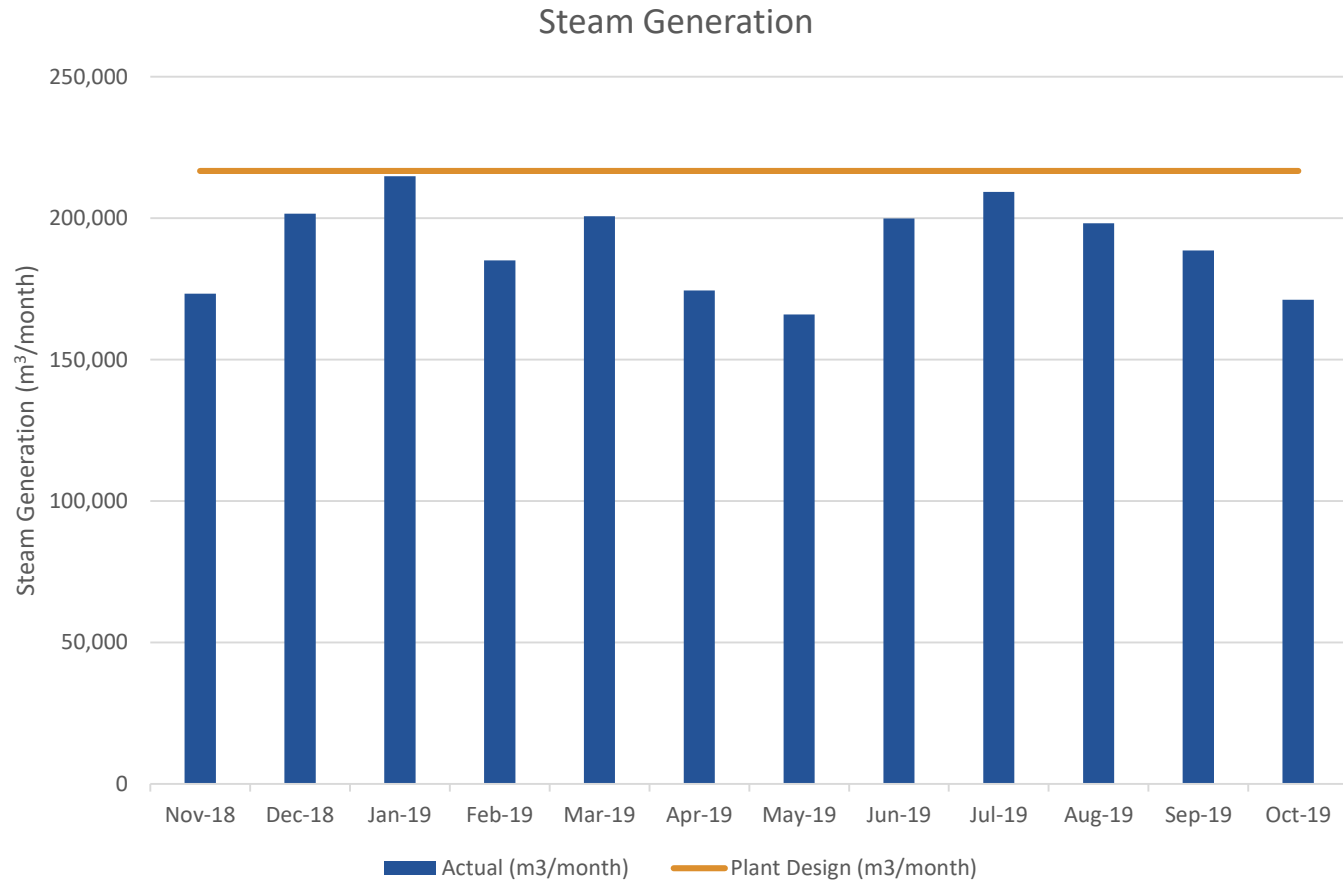
MAJOR CHALLENGES

- De-oiling optimization

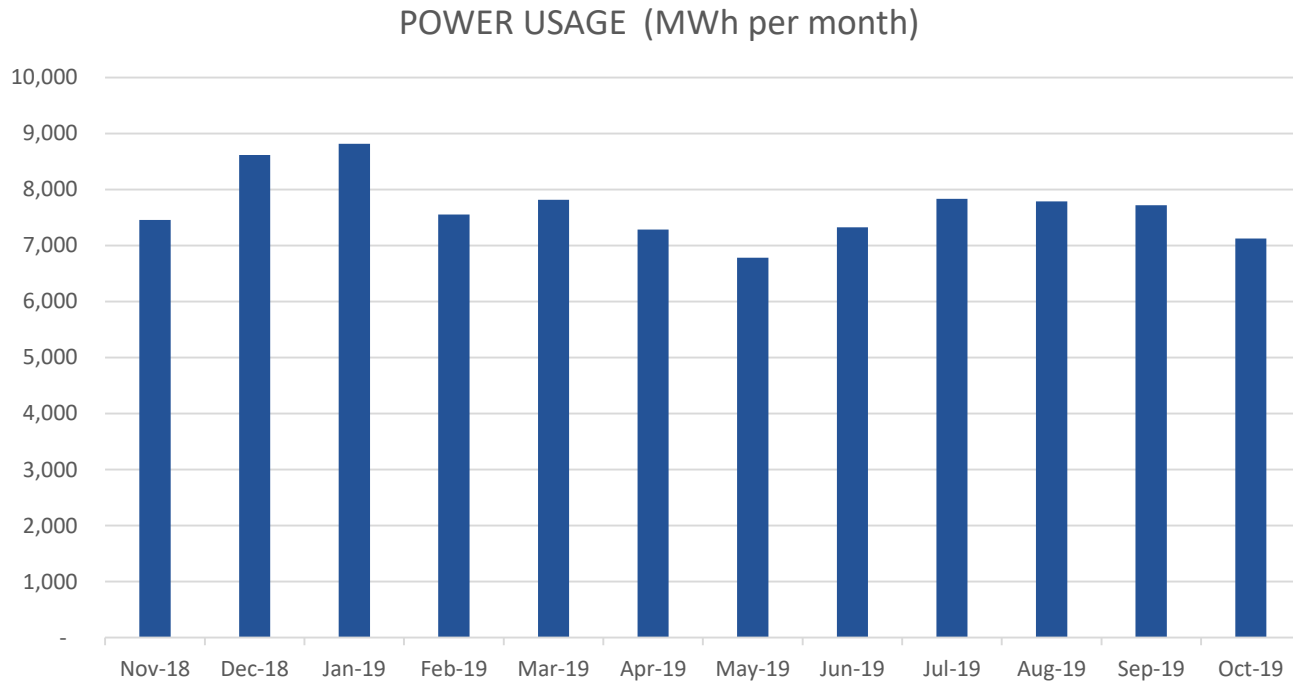
BITUMEN PRODUCTION



STEAM GENERATION

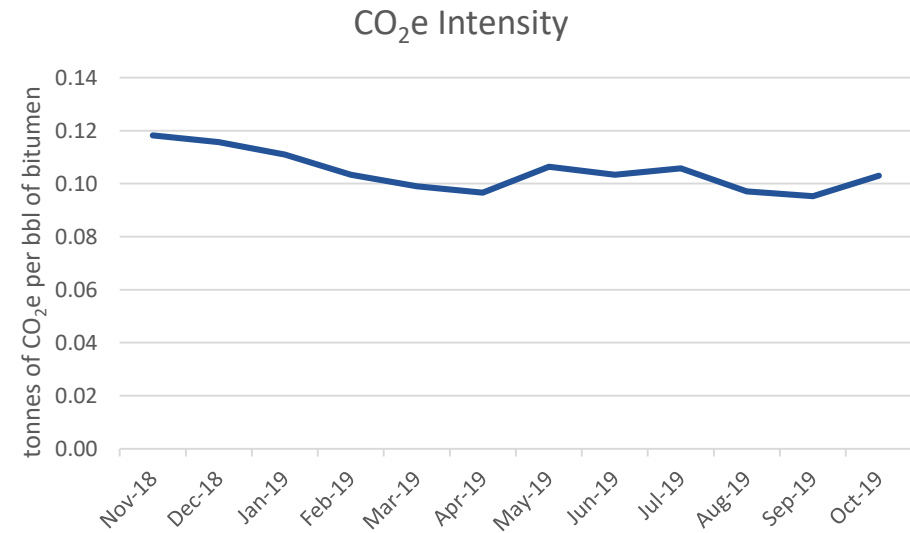
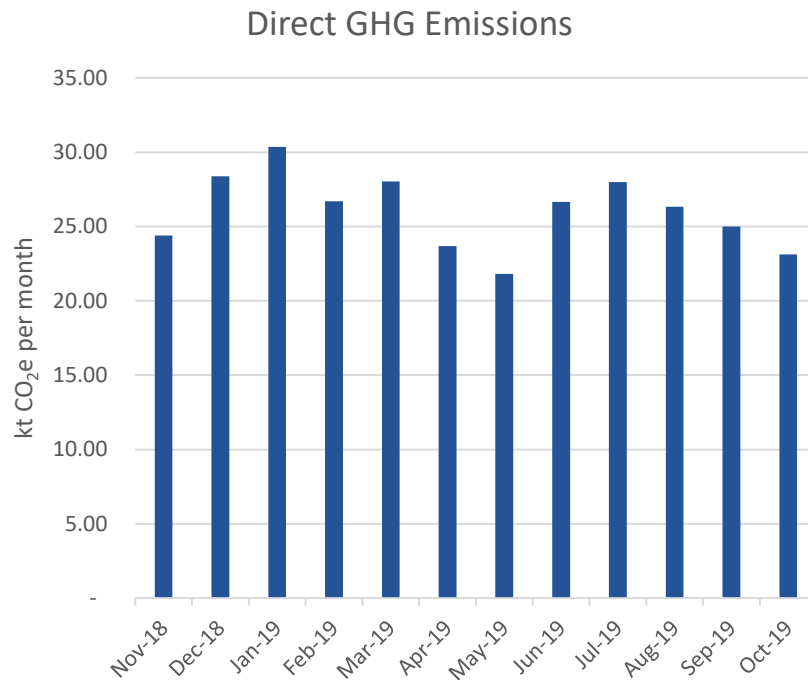


POWER USAGE YTD 92,096 MWH



DIRECT GHG EMISSIONS FROM NOVEMBER 2018 – OCTOBER 2019 : 312 KT CO₂e

- Sources: stationary combustion, flaring, venting and fugitives
- Calculated using 2019 CCIR

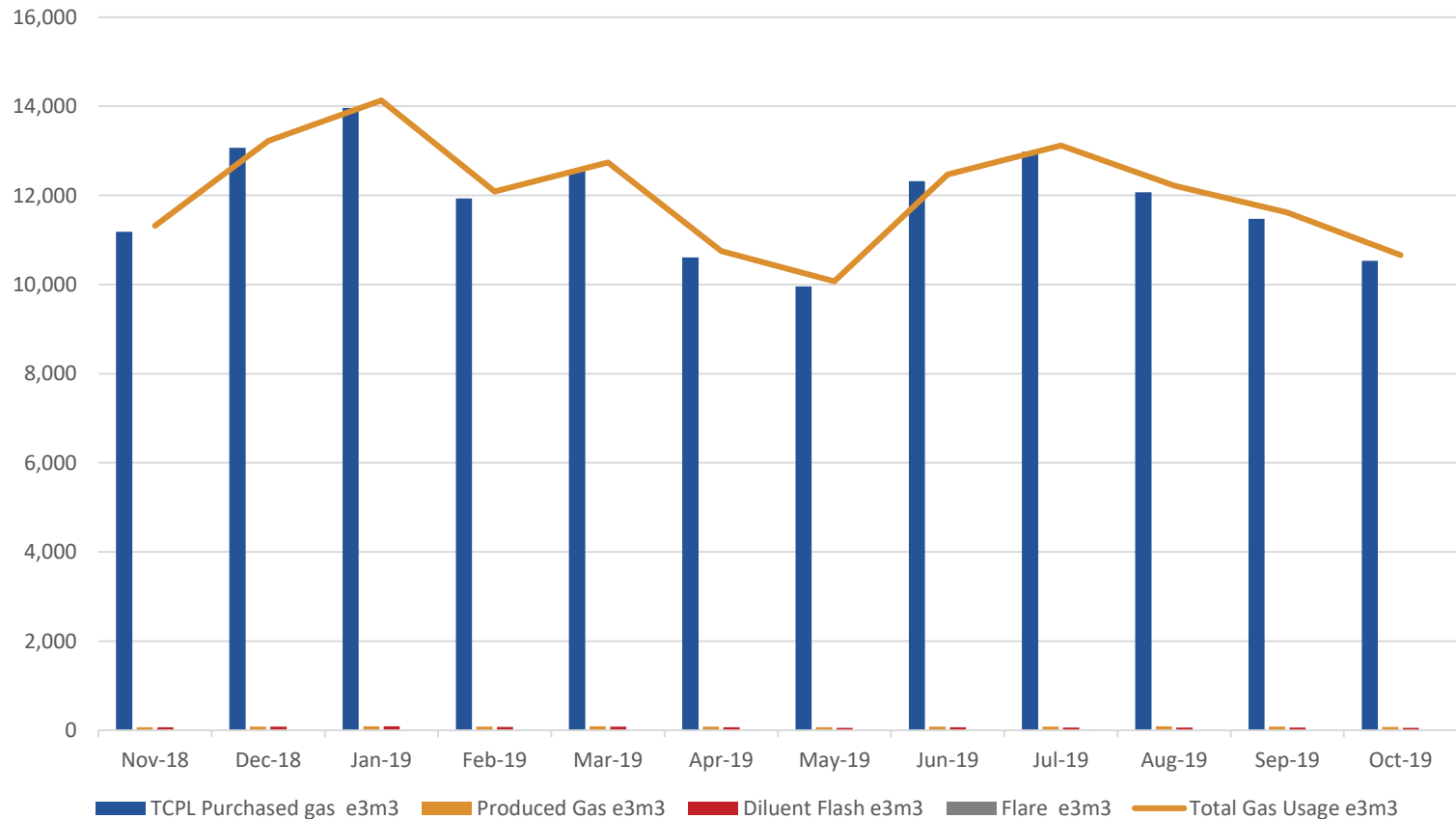


FACILITY PERFORMANCE

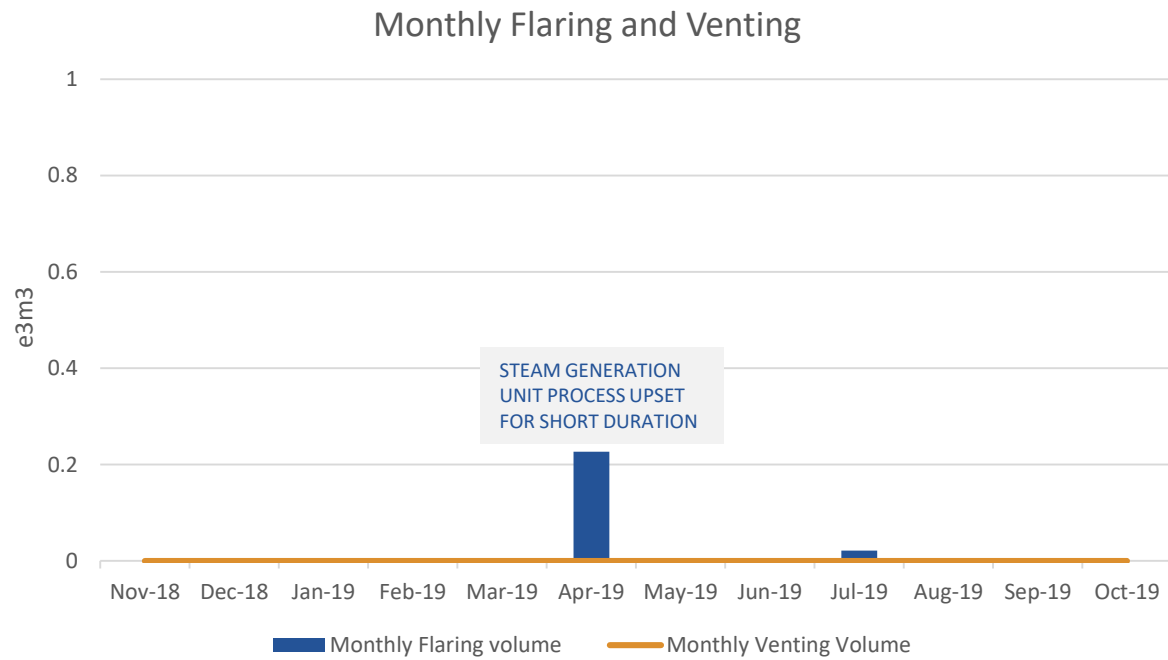
TOTAL GAS USAGE YTD 144,421 e³m³

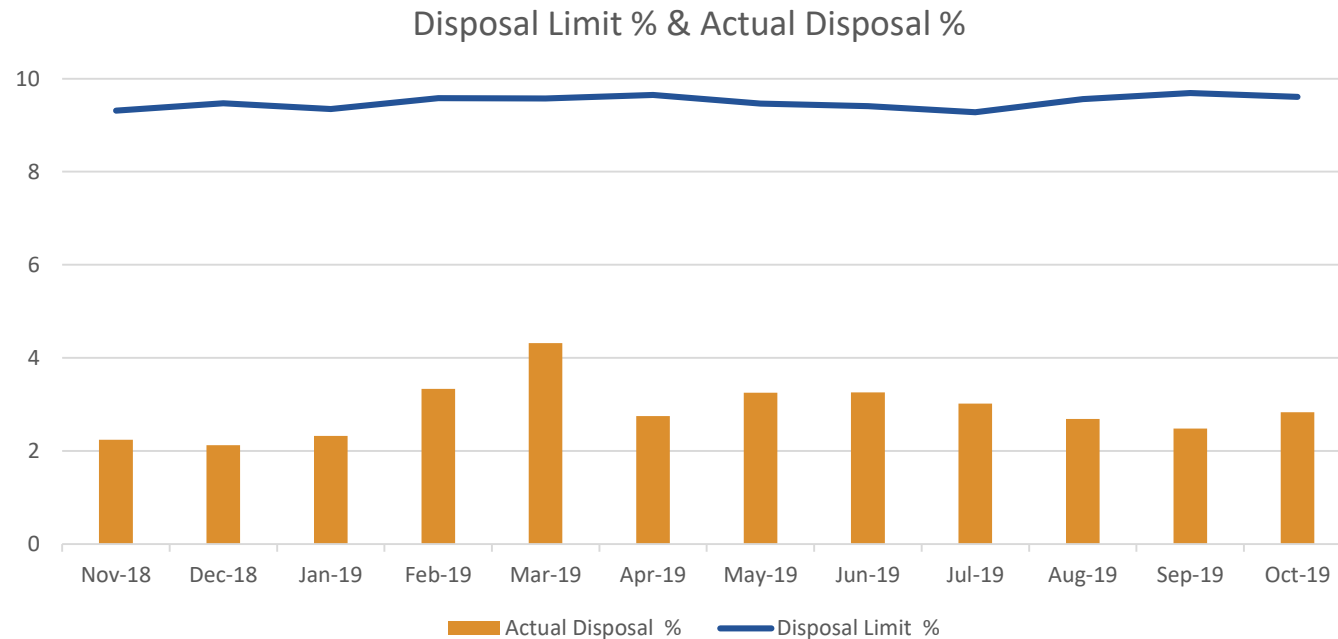
SOLUTION GAS RECOVERY 100%

GAS USAGE (e³m³ per month)



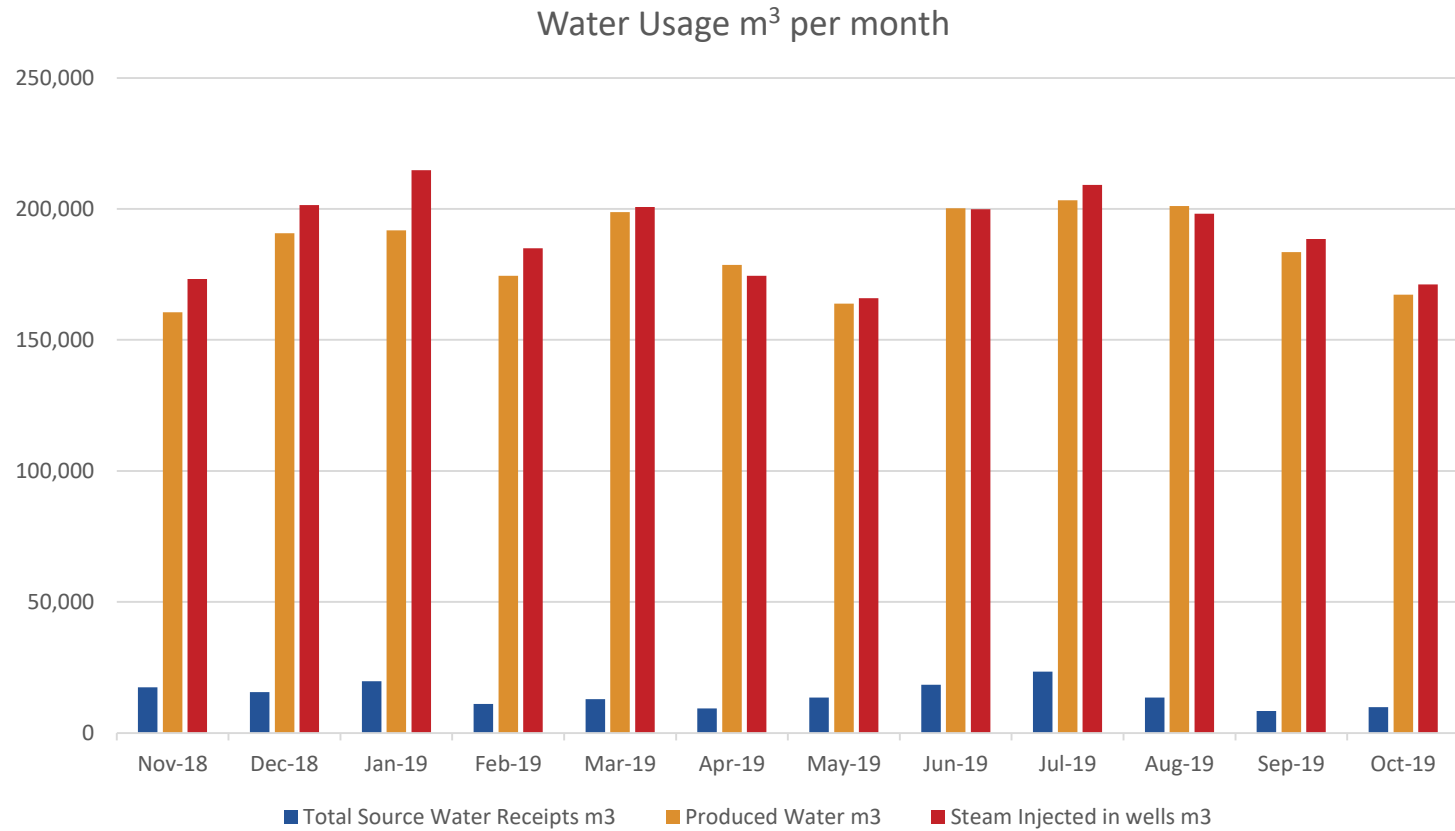
MONTHLY FLARING AND VENTING





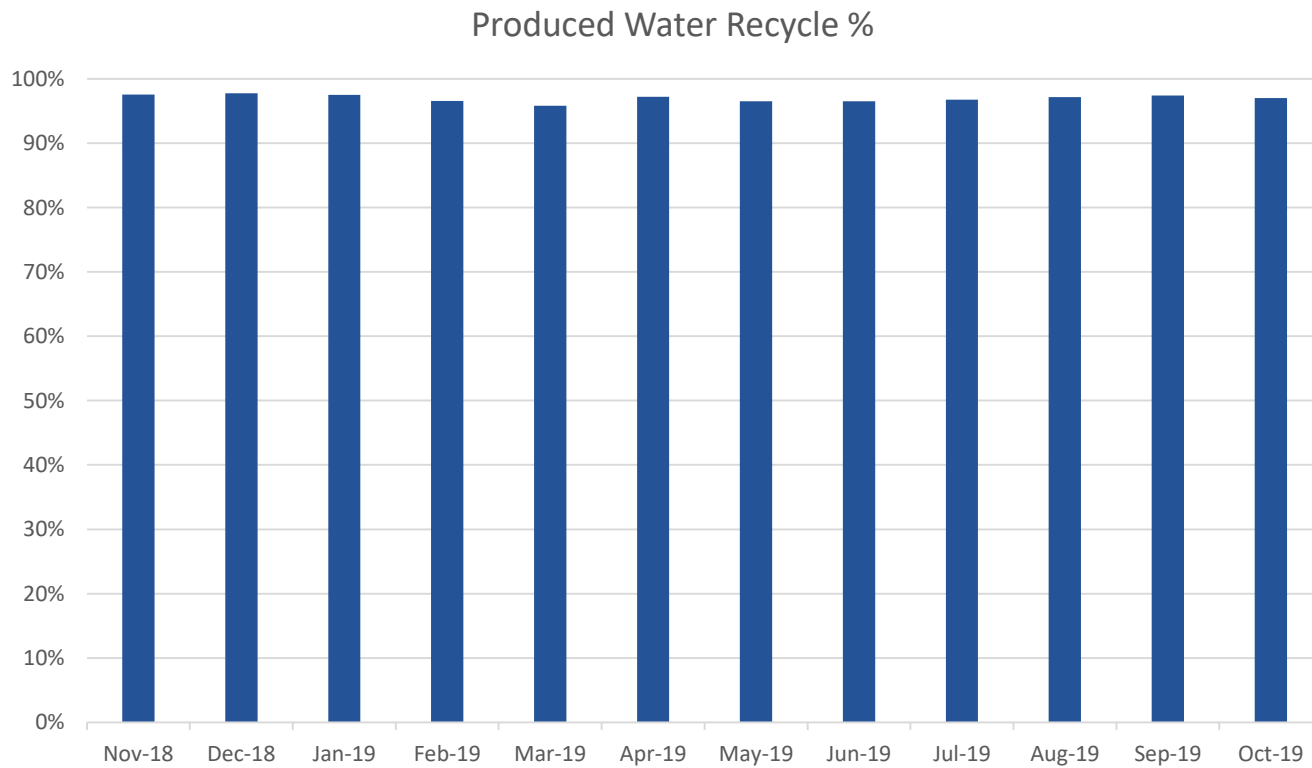
- Calculations completed in accordance Directive 081 (2012)
- Revised Directive 081 released November 5, 2019, and is not applicable to the current reporting period (Nov. 1, 2018 – Oct. 31, 2019)
- AOC will incorporate new disposal factors in the 2020 Performance Report

WATER USAGE



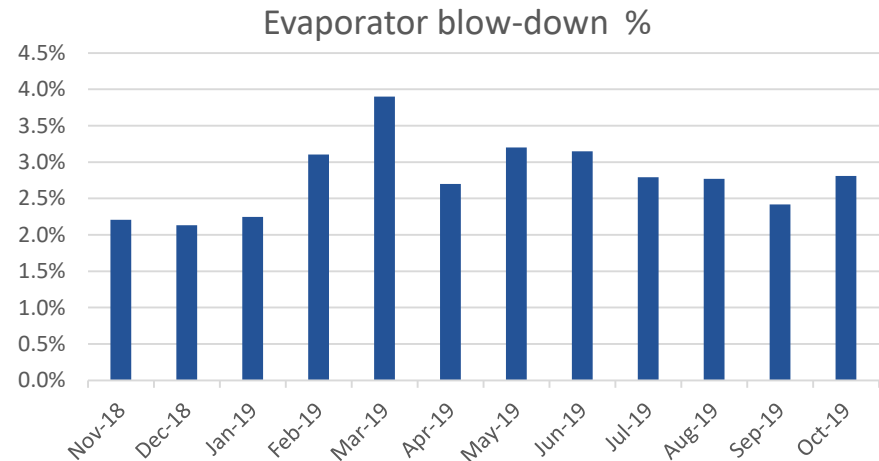
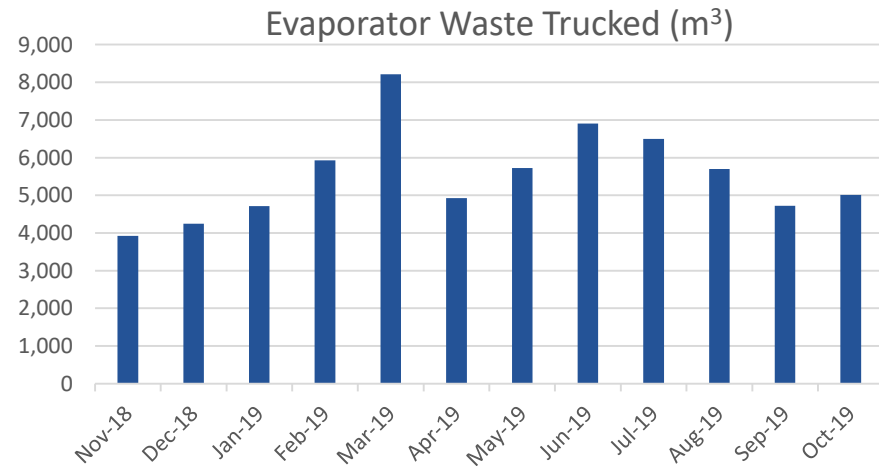
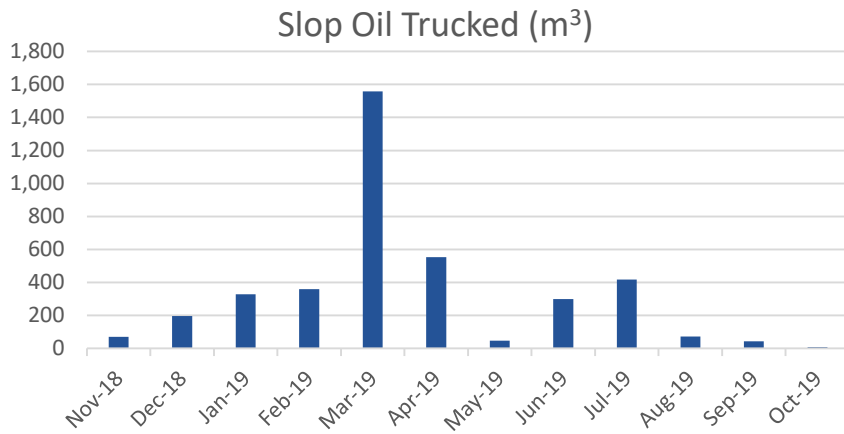
PRODUCED WATER RECYCLE (AVG. 97%)

Directive 081 (2012), Appendix H, Equation 6

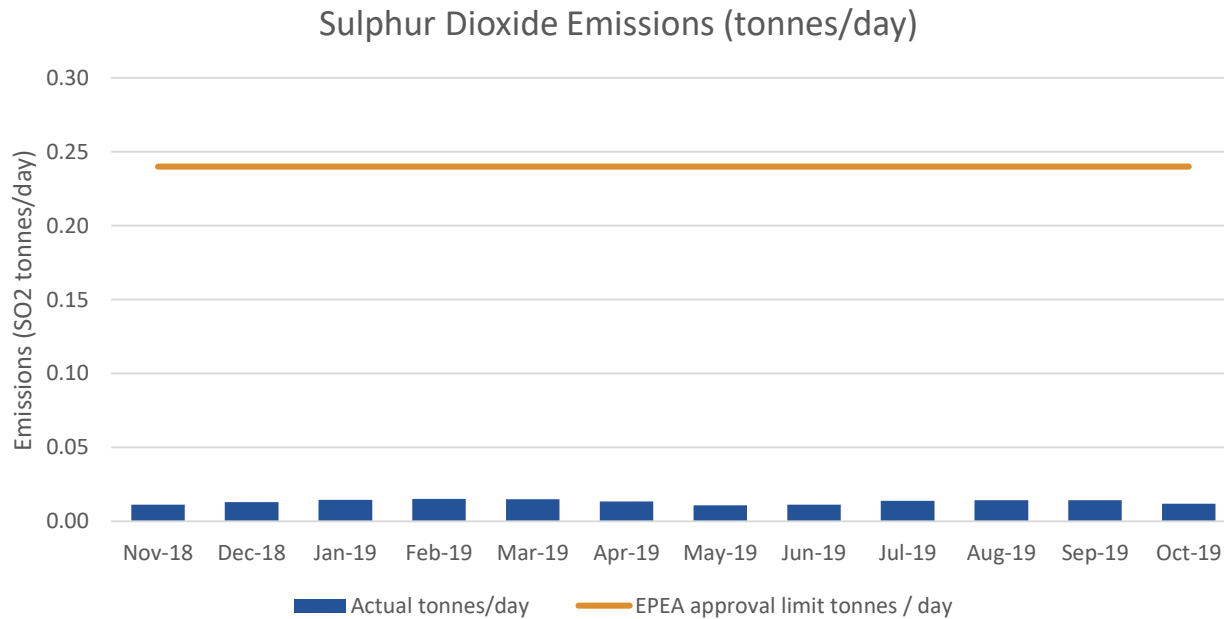


WASTE DISPOSAL

- Waste streams are slop oil and evaporator blowdown
- Evaporator waste disposal volume reduced by 13,364 m³
- No excess produced water trucked out in reporting period



- Currently there is no sulphur recovery



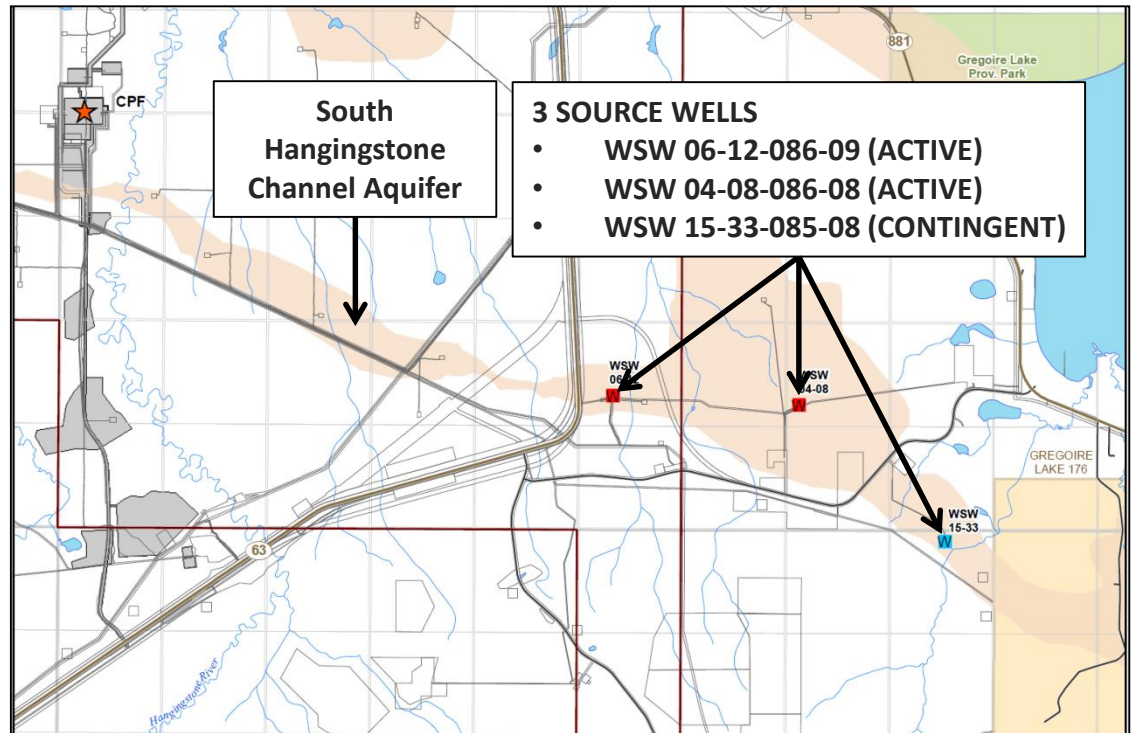
- SO₂ emissions are calculated based on analytical results of produced gas samples



SURFACE
SOURCE WATER AND WATER CHEMISTRY

NON-SALINE WATER WELLS

- Hangingstone Water Act License 00316166-01-00 annual allocation is 479,975 m³
- During Nov. 1, 2018 to Oct. 31, 2019 AOC diverted 159,286 m³
- Aquifer drawdown is stable and within the allowable as specified in the *Water Conservation and Allocation Guideline for Oilfield Injection (AENV 2006)*



Well ID	Location	Formation	TDS (mg/L)	Maximum Rate of Diversion (m ³ /d)
WSW153308508W400	15-33-085-08-W4	Quaternary	286	3,000
WSW061208609W400	06-12-086-09-W4	Quaternary	310*	3,000
WSW040808608W400	04-08-086-08-W4	Quaternary	310*	3,000

Wells are less than 150 m in depth and not licenced with the AER

Well IDs are AOC internal identifiers, not UWIs

* 2019 Analysis

TYPICAL WATER ANALYSIS

Parameter	Non-Saline Make-up Water (mg/L)	Produced Water (mg/L)	Disposal Water (Evap blow-down) (mg/L)
pH	7.97	7.36	11.8
Total Dissolved Solids (TDS)	310	2,300	130,000
Chlorides	7.4	1,200	49,000
Hardness as CaCO ₃	220	14.5	550
Alkalinity as CaCO ₃	270	320	25,000
Silica	5	150	7,000
Total Organic Carbon	<1	180	6,000
Oil Content	<1	20	500



COMPLIANCE
ENVIRONMENTAL

ATHABASCA
OIL CORPORATION

APPROVALS AND AMENDMENTS

- No applications were made or approvals received during the reporting period

AUDITS

- The AER completed an audit of the Emergency Response Plan and found it satisfactory

INSPECTIONS

- The AER completed 6 facility inspections, all results satisfactory

COMPLIANCE – SUMMARY OF NON-COMPLIANCE ⁶¹

Notices of Non-Compliance and Voluntary Self Disclosures

Event	Corrective Action
April 24, 2019 – CEMS code violation 90% uptime	Investigation identified a defective communication card. Method 4 calculation approved for missing data and the defective card was replaced.
June 4, 2019 - Voluntary Self-Disclosure for failed MARP meter	Meter was repaired and put back into service June 9, 2019

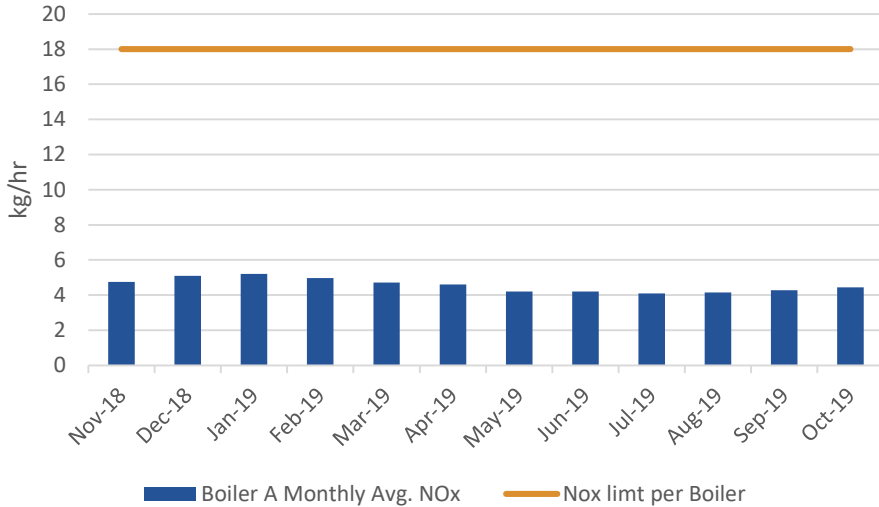
From November 1, 2018 to October 31, 2019 there were

- 2 reportable releases

MONTHLY AND ANNUAL MONITORING PROGRAMS

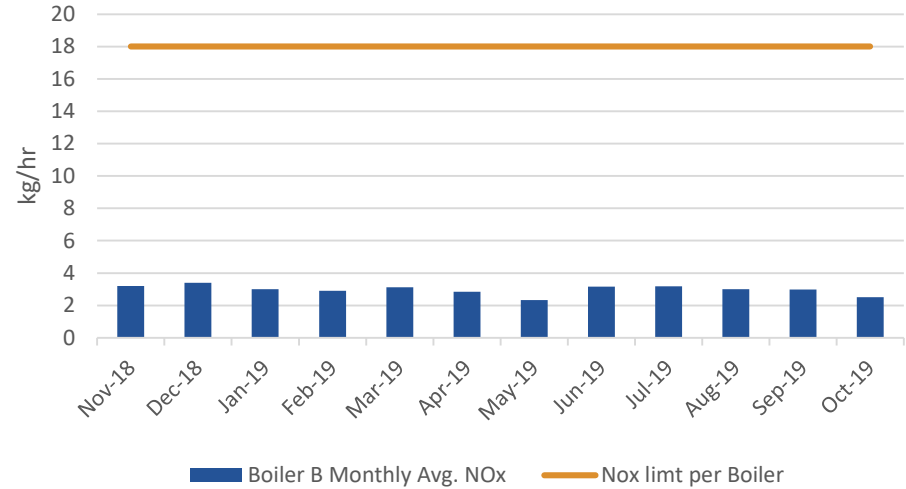
- Passive air monitoring stations– no exceedances (SO₂, NO₂, H₂S) of the Alberta Ambient Air Quality Objectives
- A continuous air monitoring station **is not** an EPEA approval requirement
- Continuous NO₂ emissions monitored using a Continuous Emissions Monitoring System (CEMS) as required under the EPEA approval (Boiler A)
- SO₂ and NO₂ emissions were summarized in monthly and annual EPEA Air Emissions Reports
- Air Emissions Inventory Report submitted in September 2019
- Industrial wastewater and runoff – all releases monitored with no exceedances
- Groundwater water monitoring completed (2 events)
- A soil monitoring program proposal was approved by the AER and the monitoring program completed
- A Woodland Caribou Report (2015 – 2018) was submitted and approved by the AER
- Water Act Licenses (term & surface) all conditions met and reporting completed

Boiler "A" NOx Monthly Average



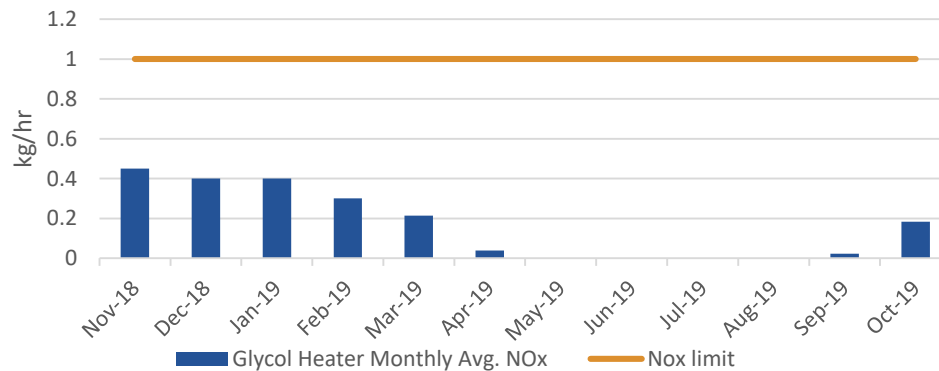
○ Boiler "A" NOx based on online CEMS unit

Boiler "B" NOx Monthly Average



○ Boiler "B" NOx based on manual calculation

Glycol Heater NOx Monthly Average



○ Glycol Heater NOx based on manual calculation and is operated only in winter months

- Reclamation certificates have been obtained for all Hangingstone OSE programs with the exception of 3 programs that were applied for in Q4 2019



AOC IS A FUNDING MEMBER OF:

- Oil Sands Environmental Monitoring Program
- Wood Buffalo Environmental Association (WBEA) – air shed monitoring
- Regional Industry Caribou Collaboration (RICC)
- Industrial Footprint Reduction Options Group (iFROG) – wetland reclamation research industry collaboration

AOC PARTICIPATES IN:

- Various regional CAPP Committees
 - *Oil Sands Environmental Policy and Regulatory Committee*
 - *NE Alberta Caribou Working Group*
 - *Indigenous Affairs Committee*
 - *Air Issues Committee*
- Oil Sands Community Alliance



ATHABASCA OIL CORPORATION HANGINGSTONE PROJECT IS IN COMPLIANCE WITH AER APPROVALS AND REGULATORY REQUIREMENTS

- For the period of November 1, 2018 to October 31, 2019, AOC has no unaddressed non-compliant events

- No new initiatives planned

ATHABASCA

OIL CORPORATION

ATHABASCA OIL CORPORATION

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