Canadian Natural

PEACE RIVER IN SITU OIL SANDS PROJECT
DIRECTIVE 54 ANNUAL PERFORMANCE PRESENTATION

December 4, 2019

PREMIUM VALUE. DEFINED GROWTH. INDEPENDENT.

Outline – Subsurface

Outline – Surface

Directive 54 Section 3.1.2	Page
Facilities Overview	57-61
Facility Performance	62-71
Measurement & Reporting	72-76
Water Usage, Disposal & Waste Summary	77-81
Emission/Air Monitoring	82-84
Environmental Compliance	85
EPEA Approval Amendments	86
Environmental Monitoring Summary	87-90
Reclamation	91-92
Future Plans	93

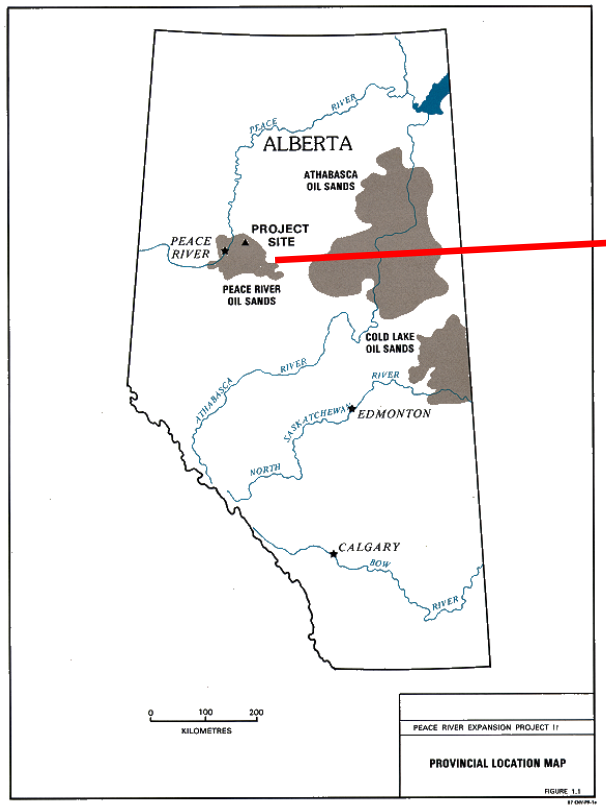
Acronyms

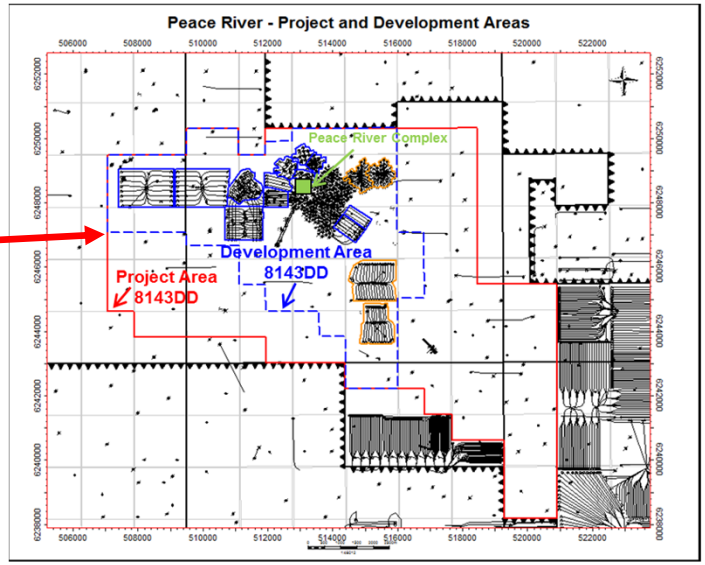
AER	Alberta Energy Regulator
Avg.	average
bbl	barrel, petroleum, (42 U.S. gallons)
BHA	bottom hole assembly
bitwt	bitumen weight
CD	cyclic drive
CDOR	calendar day oil rate
CDSR	calendar day steam rate
cP	centipoise
CSOR	cumulative steam to oil ratio
CSS	cyclic steam simulation
Cumm	cumulative
DFIT	diagnostic fracture injection testing
DI	depletion index
dP	pressure differential
e3m3	thousand cubic metres
ESP	electric submersible pumps
ESRD	Environment and Sustainable Resource Development
FUP	follow up process
HP	horse power
hz	horizontal
ICP	intermediate casing point
IHS	Inclined hetreolithic stratification
InSAR	interferometric synthetic aperture radar
J-Well	horizontal wellbore with toe-up lateral trajectory
KB	Kelly Bushing
kg/m	kilograms per metre
kPA	kiloPascal
kPa/day	kiloPascal per day
LIDAR	laser imaging, detection and ranging
LPCSS	low pressure cyclic steam stimulation
m	metre
m^3	cubic metres
m^3/d	cubic metres per day

Acronyms (...continued)

mD	milli-Darcy
mm	millimetre
MMbbl	million barrels
MPa	megapascal
mTVD	metres true vertical depth
OBIP	original bitumen in place
Obs	observation
ohm·m	ohm·metre
PV	pore volume
PVS, PVStm	pore volume steam
RF	recovery factor
SAGD	steam assisted gravity drainage
SF	steamflood
So	oil saturation
SOR	steam oil ratio
SPM	strokes per minute
SAR	synthetic aperture radar
Tbg.	tubing
TD	total depth
TVD	true vertical depth
VAF	volume over fill-up
WDI	water depletion index
WHT	wellhead temperature
YE	yearly

CNUL Peace River - Location

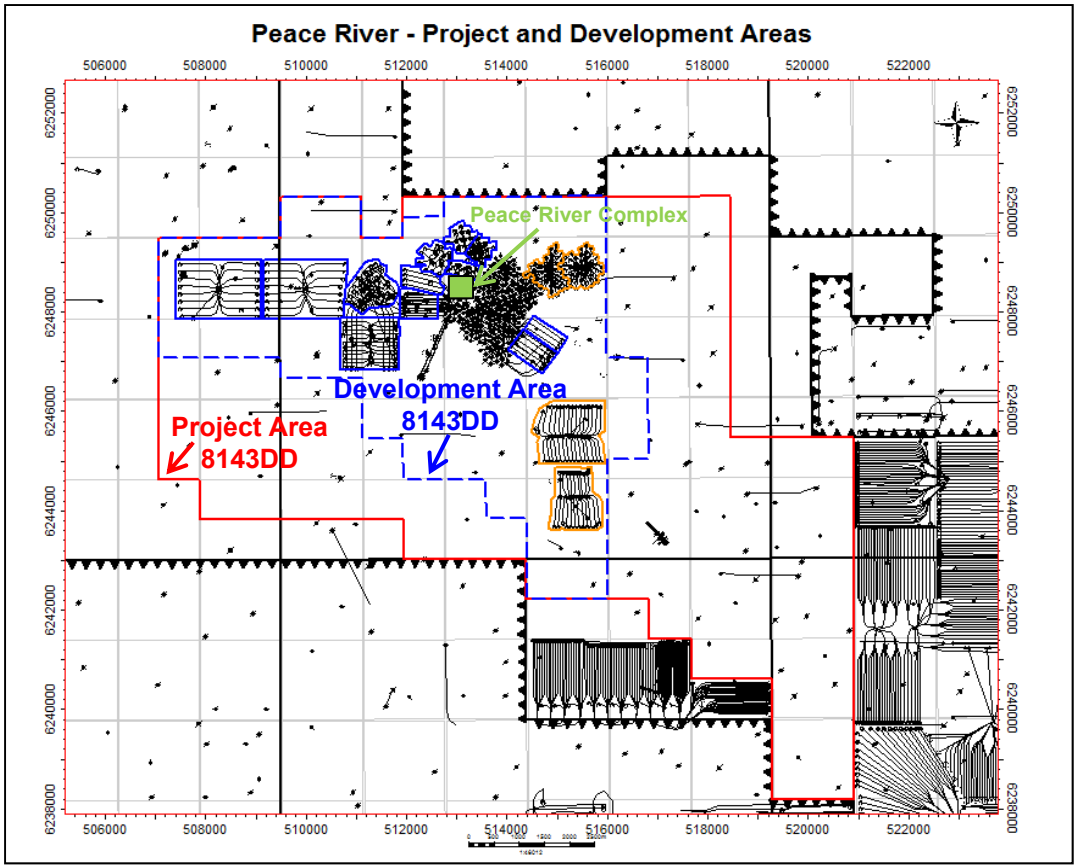




- Located in Northwestern Alberta
- OBIP 219 Million m³ for the area in Approval 8143DD Development Area

Canadian Natural

Peace River Approval Areas



Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area

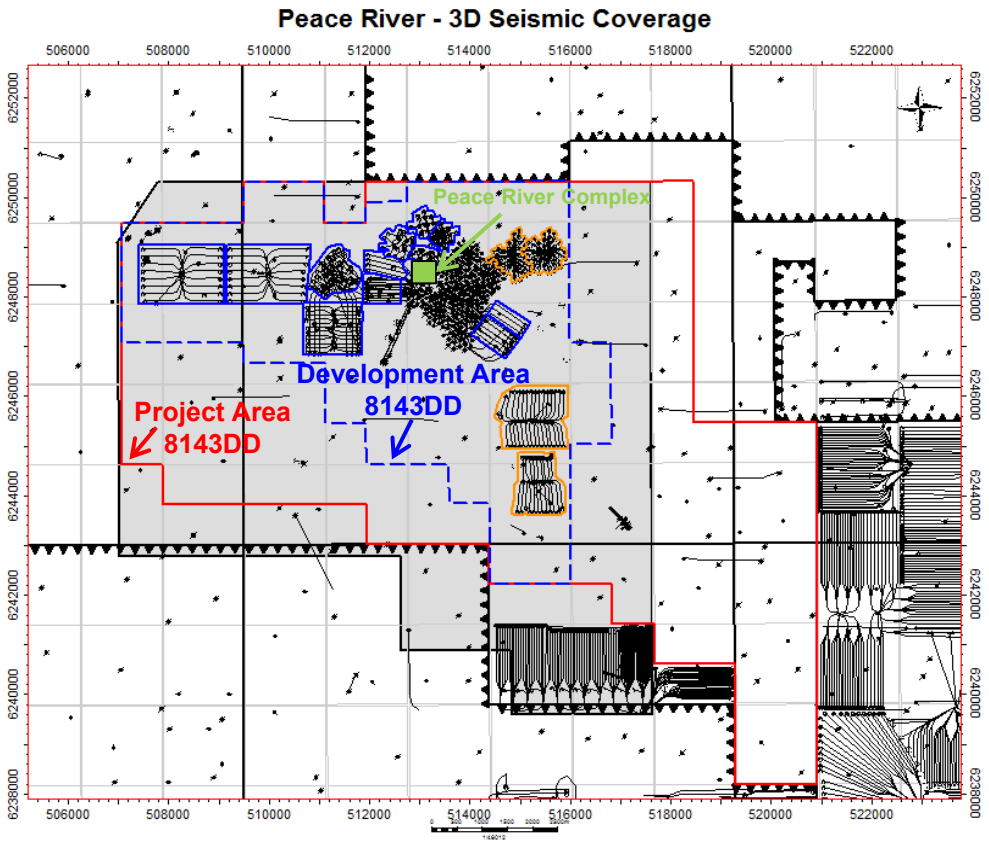
Canadian Natural


Canadian Natural
GEOSCIENCE

Peace River - Bluesky Reservoir Properties

General Properties	Approval Area
Target Formation	Bluesky
Pay Thickness	15 – 30m
Depth	550 - 600 m TVD
API Gravity	6-11^0
Porosity	0.25 – 0.30
Viscosity	10,000 – 1,000,000 cP (dead oil)
Initial pressure	3,800 kPa (sub-hydro static)
Initial temperature	18°C
Horizontal permeability	0.1 – 10 D (air)
Kv / Kh	0.3 – 0.9
Oil Saturation	0.70 – 0.85

Peace River Seismic Coverage

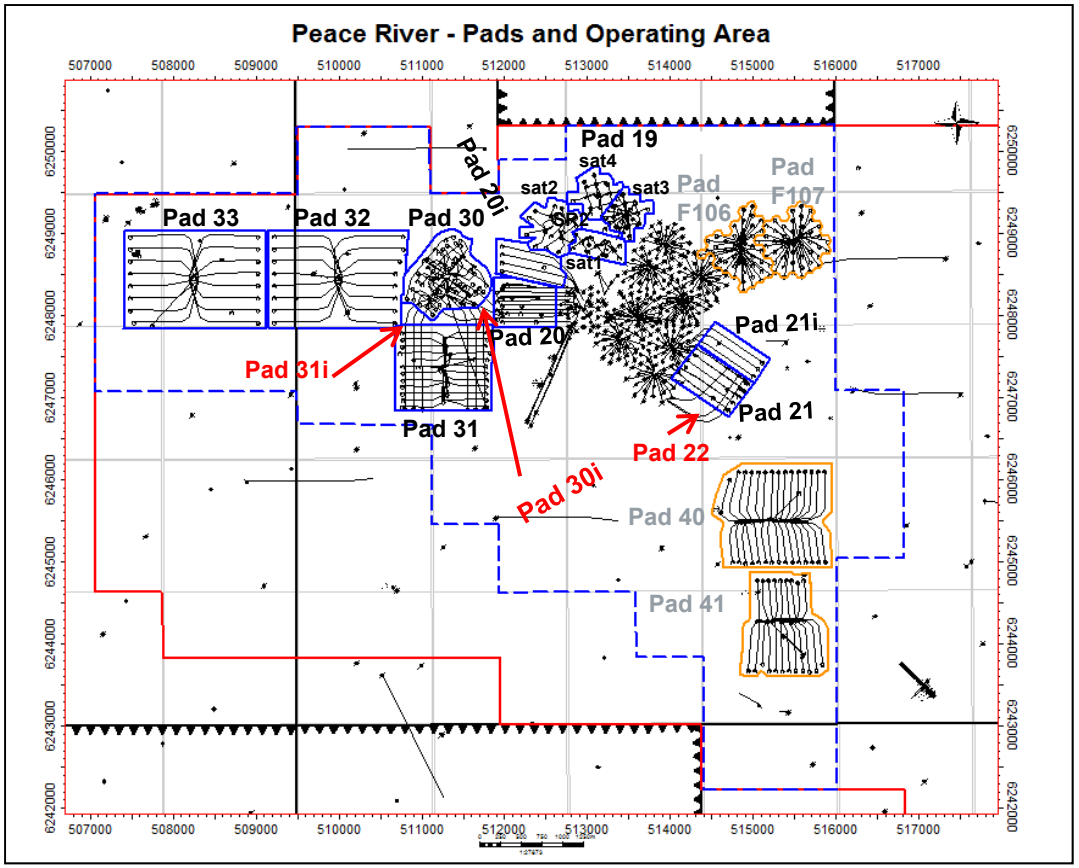


Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area
- 3D Seismic Area

Canadian Natural

Peace River - Zoom in on Operating Area Pads



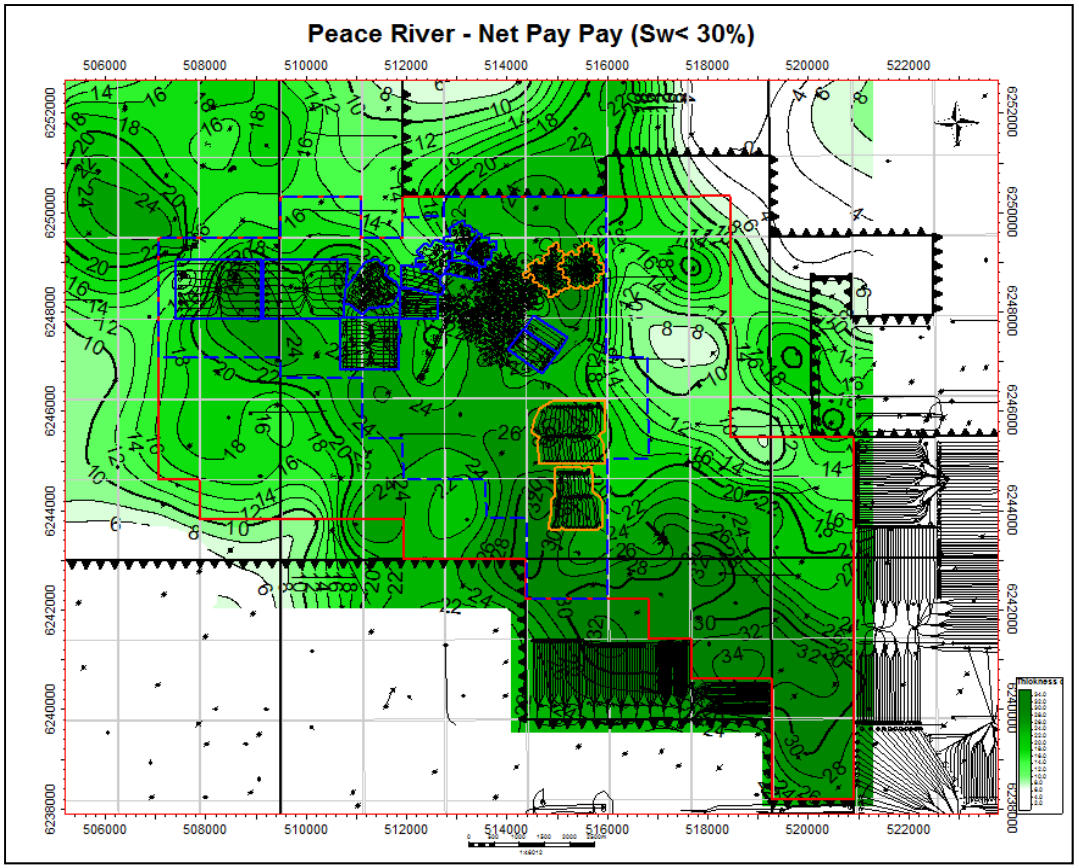
Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area

- Suspended Pads:
  - Pads 40 & 41
  - Pads F106 & F107
- Injector Pads:
  - Pads 30i, 31i and 22

Canadian Natural

Peace River Project Area - Net Pay Isopach



Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area

Canadian Natural

Project Area Volumetrics

	Average Pay Thickness (m)	Average Oil Saturation (%)	Average Porosity (%)	OBIP ($E6m^3$)
Project Area	**21.6**	**79.3**	**26.6**	**441**
Development Area	**22.7**	**81.1**	**27**	**220**

- Volumetric calculation:
  - Area × Pay Thickness × Oil Saturation × Porosity

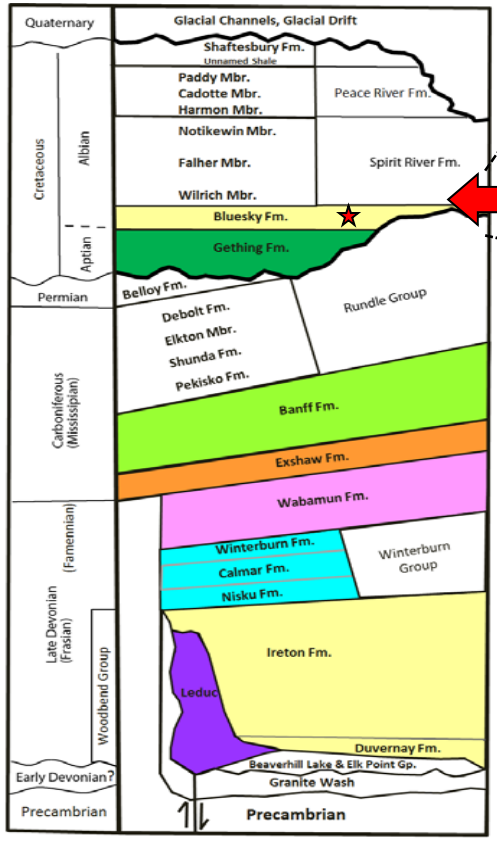
  - **OBIP: Project Area**

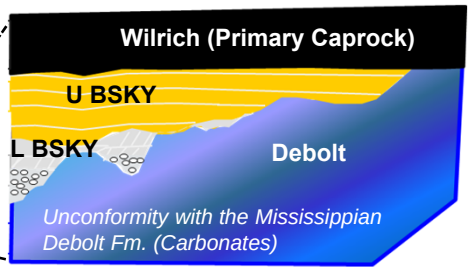
  $96{,}700{,}000\ m^2 \times 21.6\ m \times 0.793 \times 0.266 = 441\ E6m^3$

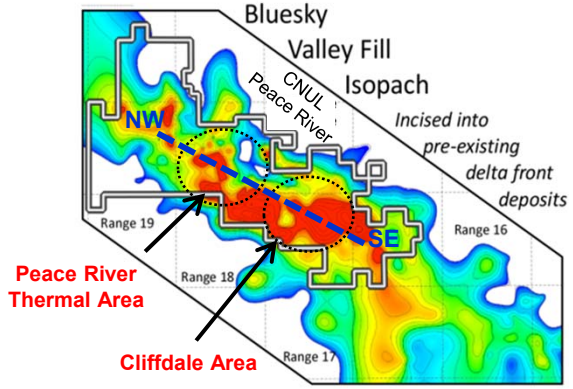
  - **OBIP: Development Area**

  $44{,}000{,}000\ m^2 \times 22.7\ m \times 0.811 \times 0.27 = 220\ E6m^3$

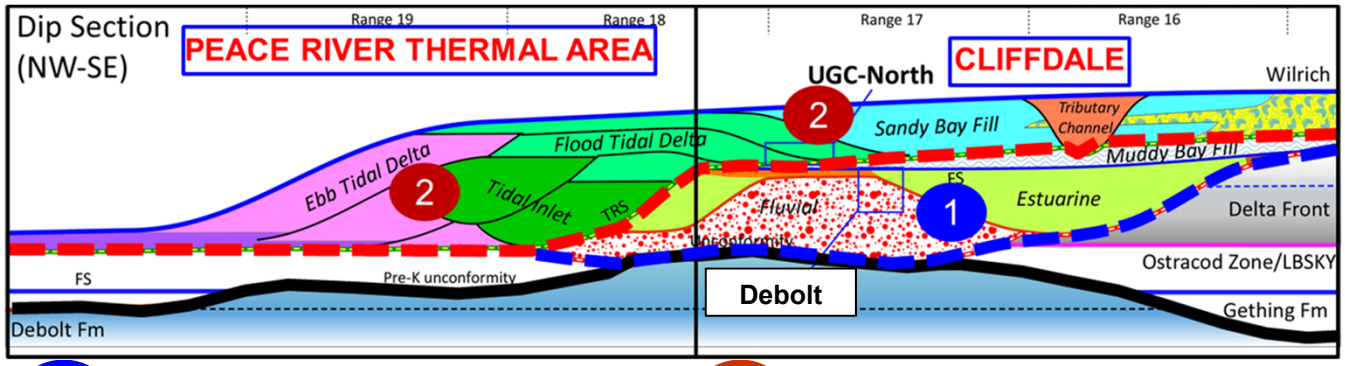
Geology - Stratigraphic Schematic







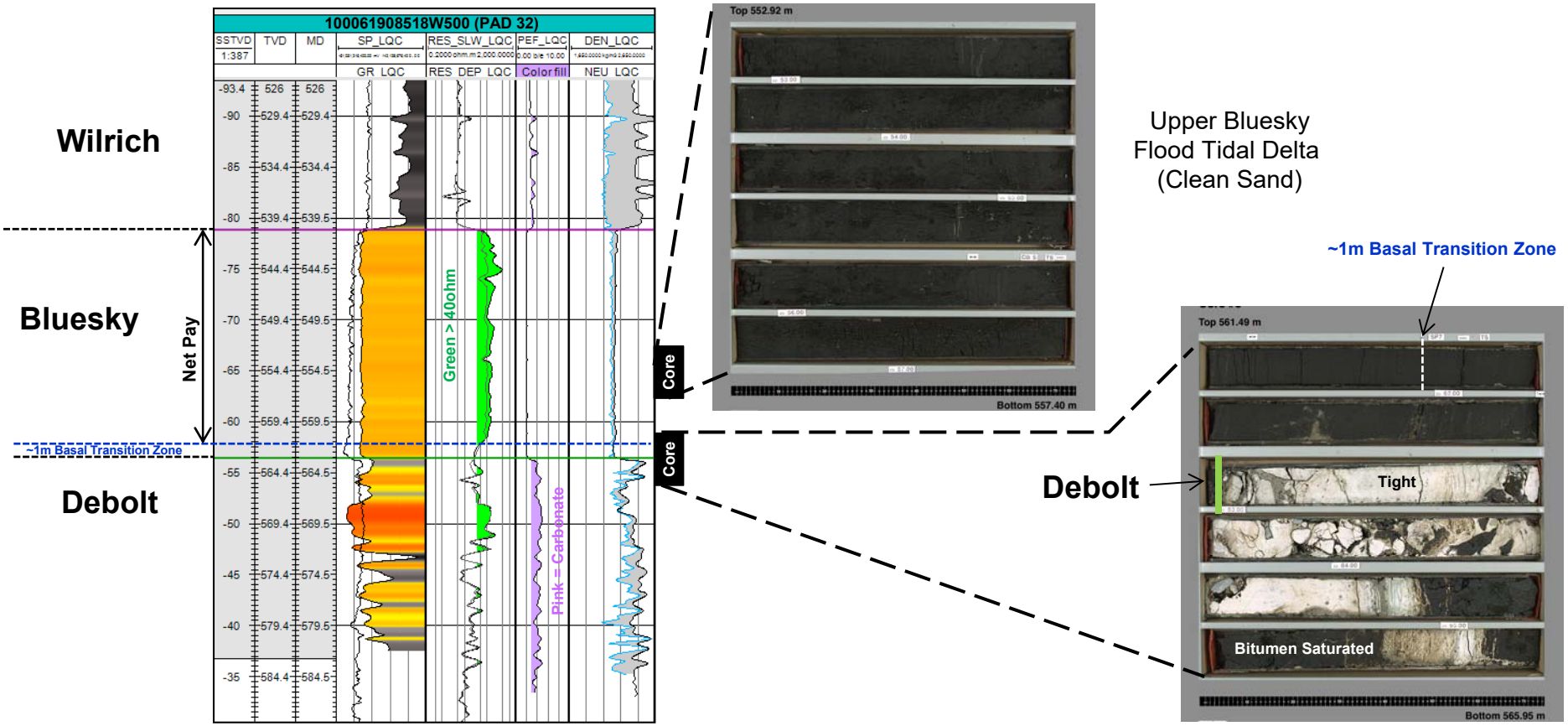
- The depositional environment of the Upper Bluesky (Sandstone) is a marginal marine estuarine complex.



1 **Tidally-influenced estuary with fluvial influx**
- Estuary channels and channel bars
- Fluvial bars

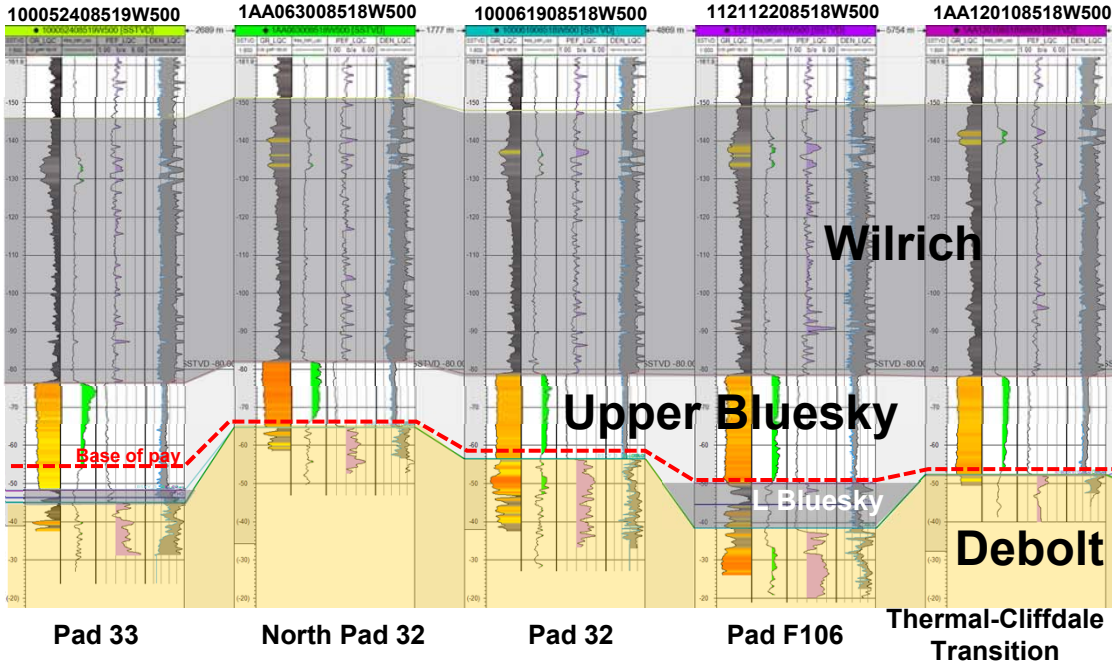
2 **Wave dominated estuary**
- Ebb tidal delta/ flood tidal delta/ Tidal Inlet/ Bay Fill

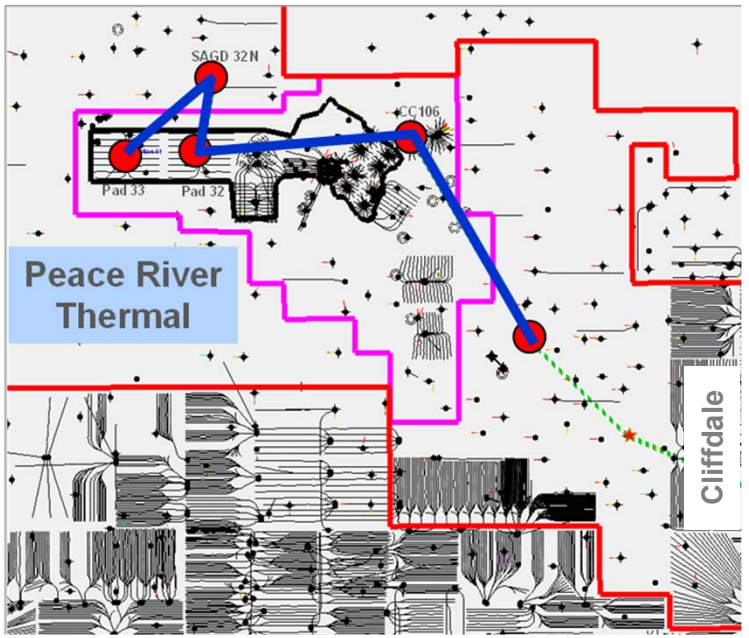
Peace River - Type Log



Peace River Structural Cross-Section

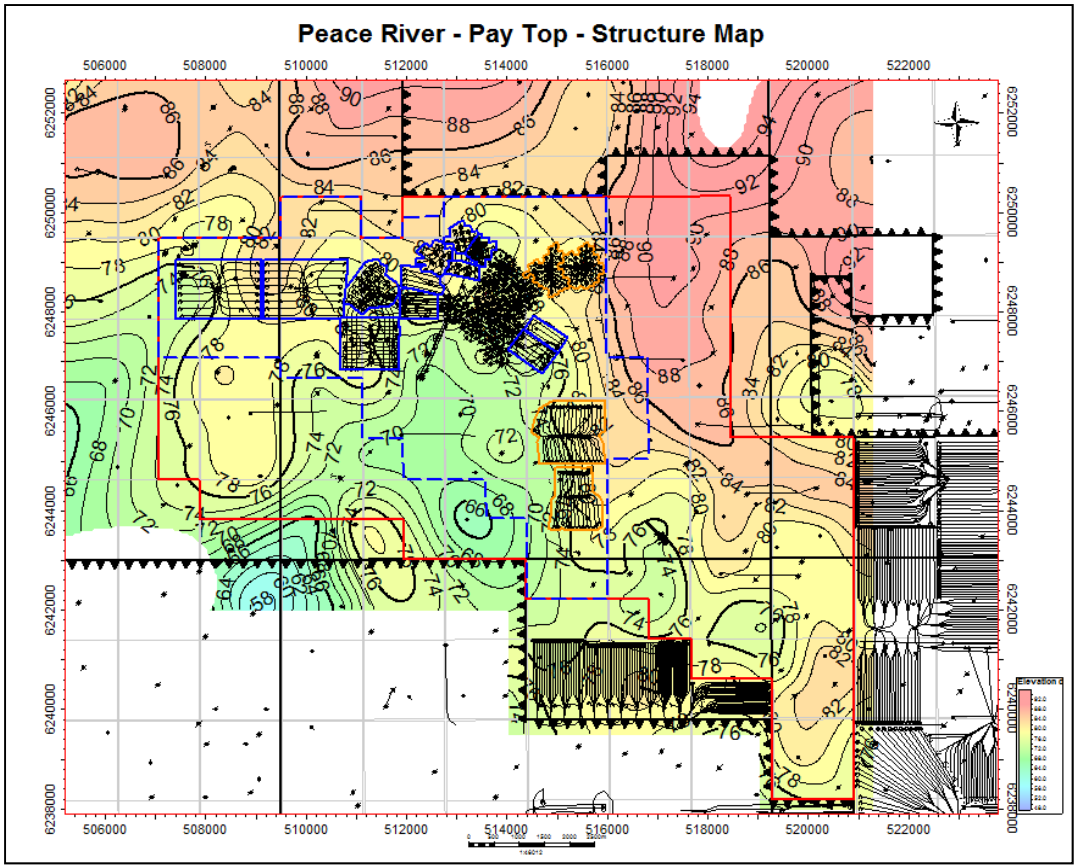
- Wilrich member of Spirit River Fm (Primary Caprock) ~ 80m
- Spirit River Formation minimum continuous Caprock Thickness ~ 240m
- Upper Bluesky Sand sitting on Debolt unconformity or Lower Bluesky filling lows in Debolt
- Reservoir Base Defined Sw = 30% cut-off (equivalent to Resistivity ~40ohms)





Top of Pay = Top of Bluesky (unless gas or lean zone present; not in project area)

Peace River Pay Top Structure



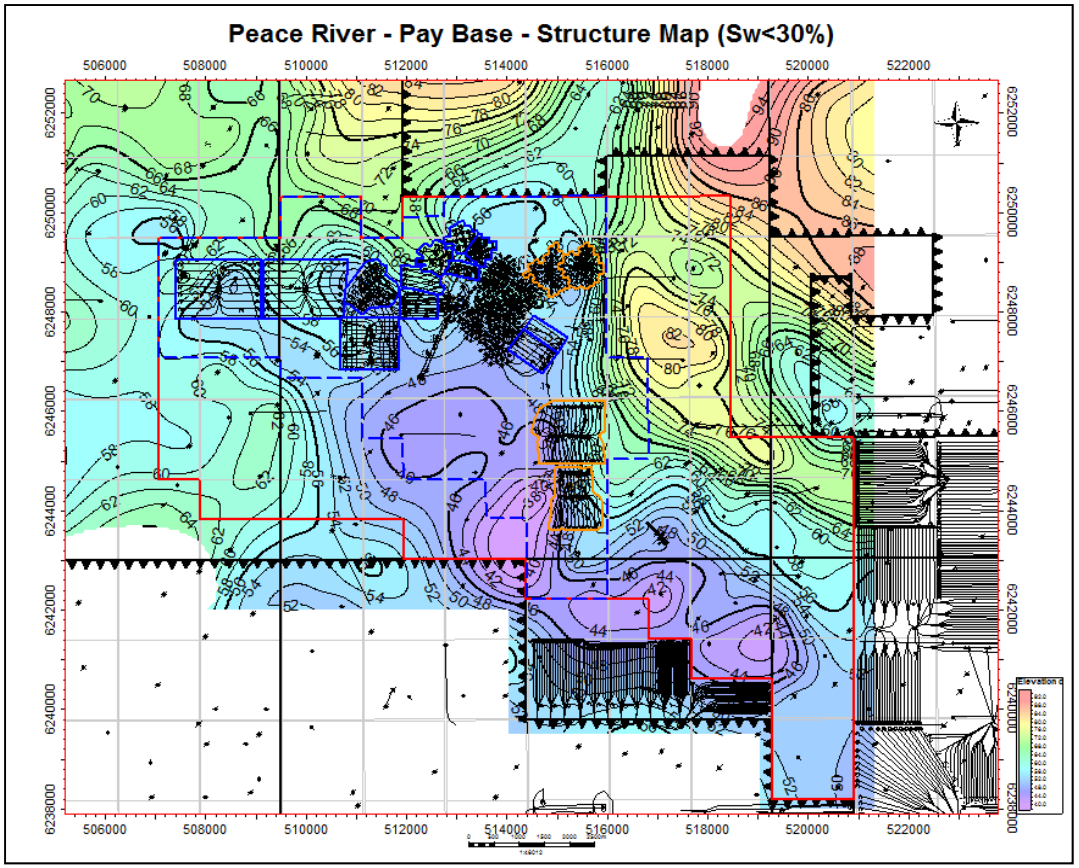
Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area

- This is typically the top of the Bluesky unless gas or lean zone with S_w> 30% exist
- Top Lean zones or gas do not exist within the approved Development Area

Canadian Natural

Peace River Pay Base Structure



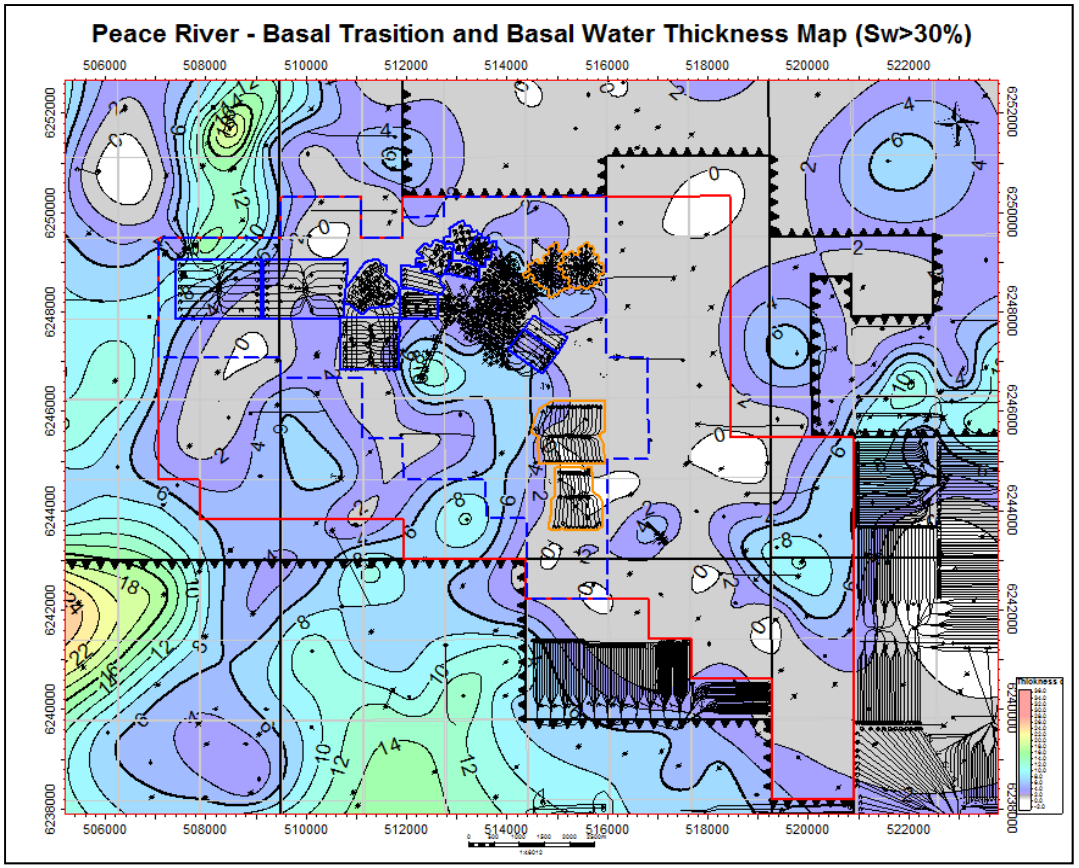
Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area

- Cut-off for base of pay: Base of continuous sand from Top of pay (normally top of Bluesky) to $S_w \leq 30\%$; equivalent to Res_D ~ 40ohm

Canadian Natural

Peace River - Net Water Sand Isopach



Peace River Thermal Area

- Operating Pad
- Suspended Pad
- Lease Boundary
- Approved Project Area
- Approved Development Area

- This thickness map includes a basal transition zone (BTZ) with S_w = 30-50%; and a basal water zone (BWZ) with S_w>50%

Canadian Natural

New Logs / Seismic Data Acquisition

- No new wells drilled in 2019
- No new seismic acquired in 2019

Caprock Integrity

- Caprock: consists of the highly continuous Spirit River Formation (Wilrich/Falher/ Notikewin) which has a minimum thickness of 240m over the approval area.

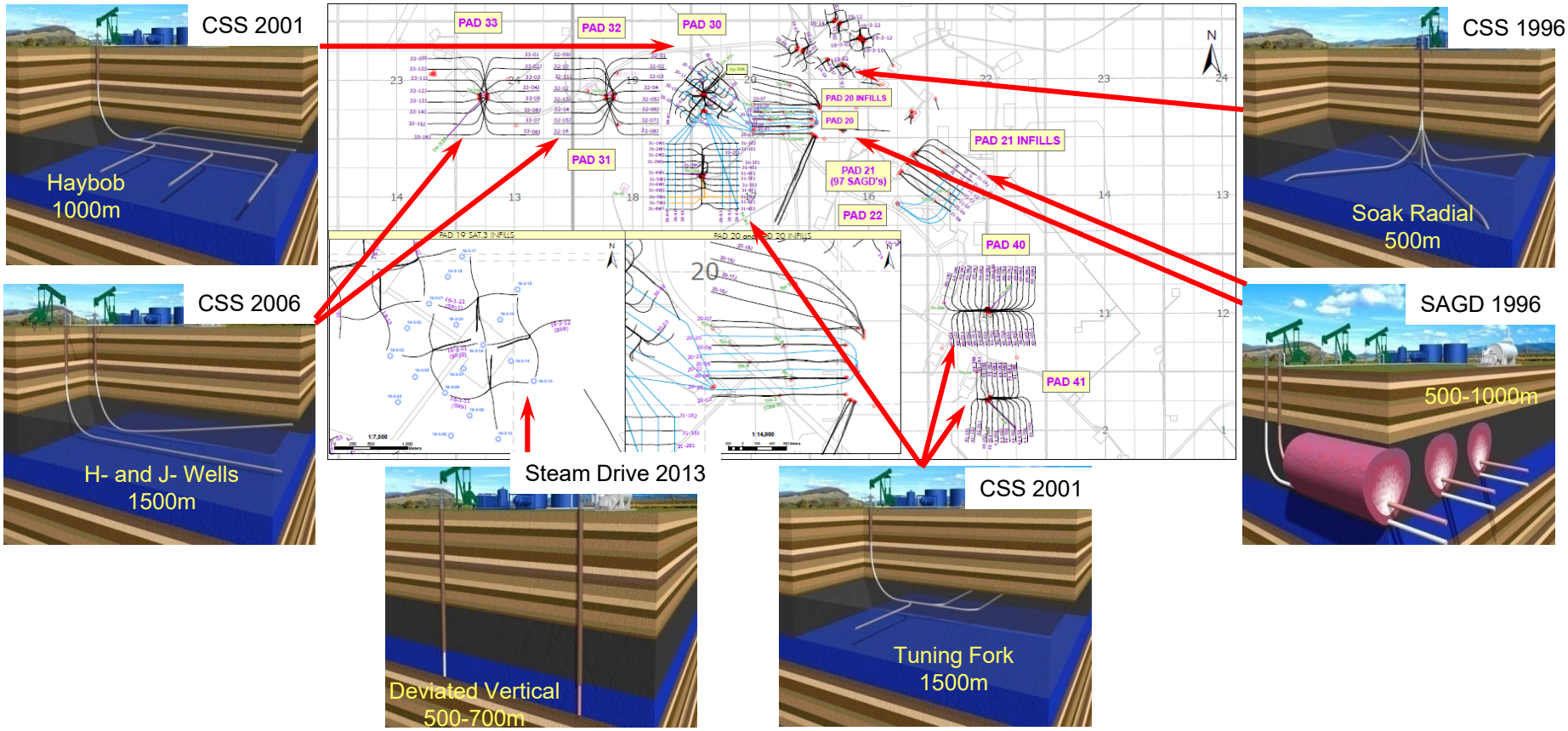
- Reviewing caprock integrity in regards to the following:
  - In-situ stresses
  - Passive seismic monitoring systems
  - Potential surveillance improvements
  - Injected steam volume above fill-up


Canadian Natural
DRILLING & COMPLETIONS

Drilling & Completion Overview

- PRISP & PREP (1979)
  - 31 wells and 212 wells, 7 spot pattern
- Disposal Wells (1978 & 2008)
  - 3 brine disposal, 2 water disposal
- Pad 19 (1996 and infills drilled in 2011)
  - 1 test hole and 15 producers, "soak radial" design
  - Pad 19 infill wells: 10 producers and 8 injectors (vertical wells)
- Pad 20/21 SAGD (1997 and phase 3 infills drilled in 2011)
  - 5 well pairs, 5 dual wellbores, 9 observation wells
  - Pad 20 phase 3 injectors (4 new horizontal wells)
- Pad 30/31/40/41 Multi Laterals (2000)
  - 8 "haybob", 25 "tuning fork", 6 observation wells
- Pad 20/21 Conversions, Infills, 19 SD (2004)
  - Converted SAGD well to CCS, drilled 7 single lateral infills, 2 steam wells on pad 19
- Pad 32/33 Horizontals (2005)
  - 16 wells per pad, 3 obs wells
- Pad 22 Steam Injectors (2006)
  - 2 steam injectors running over pad 21 conversions, acting as steam drive
- Pad 30 & 31 Steam Injectors (2014)
  - 10 steam injectors 4 over Pad 30 & 6 over Pad 31
- 2 Carmon Creek Wells (2014)
  - Brine disposal well (02/15-27-85-19W5)
  - Delineation well (AA/04-26-85-18W5, D&A)
- Pad 22 Steam Injector (2015)
  - Top down Steam Drive injector 22-04
- Carmon Creek Wells (2014/2015)
  - Pad F106
    - 43 wells, 3 surface holes, 1 Observation well
  - Pad F107
    - 46 wells, 1 Observation well
  - 2 Acid gas injection well & 1 monitoring well
  - 2 water back producers
- TH32C Future Observation Well - (2017)

Well Type Overview

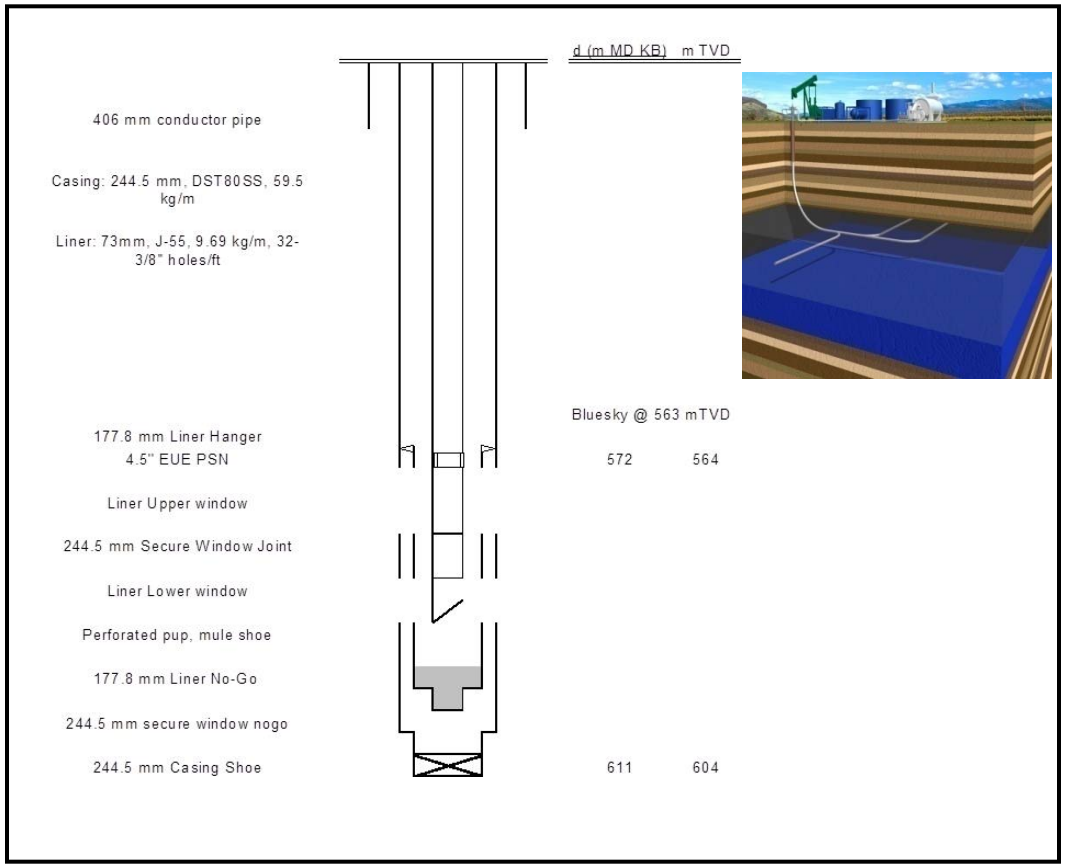


Well Spacing by Pad

- **Pad 19**
  - 100 m horizontal separation between injector and producer vertical wellbores
  - 150 m horizontal separation between producer vertical wellbores
  - Subsurface spacing variable due to soak radial geometry
- **Pad 20**
  - 5m vertical separation between SAGD injectors and producers
  - 100m horizontal separation between SAGD pairs and J-wells
  - 100m horizontal separation between new phase 3 infill injectors
  - 50m horizontal separation between a phase 3 injector and an original SAGD well pair
  - Vertical separation between a phase 3 injector and an original SAGD well pair is 3m to 15m
- **Pad 21/22**
  - 5m vertical separation between SAGD injectors and producers
  - 100m horizontal separation between SAGD pairs and J-wells
- **Pad 21/22**
  - 90m horizontal spacing between pad 22 injectors
  - Pad 22 injectors are 10m to 17m above original SAGD producers
- **Pad 30**
  - Highly variable due to Haybob geometry
  - 2014 injector spacing – 150 – 250m
- **Pad 31**
  - 80 m horizontal separation between laterals
  - 2014 injector spacing 100m
- **Pad 32**
  - 150 m horizontal separation between horizontal wells
- **Pad 33**
  - 150 m horizontal separation between horizontal wells
- **Pad 40**
  - 80 m horizontal separation between laterals
- **Pad 41**
  - 80 m horizontal separation between laterals

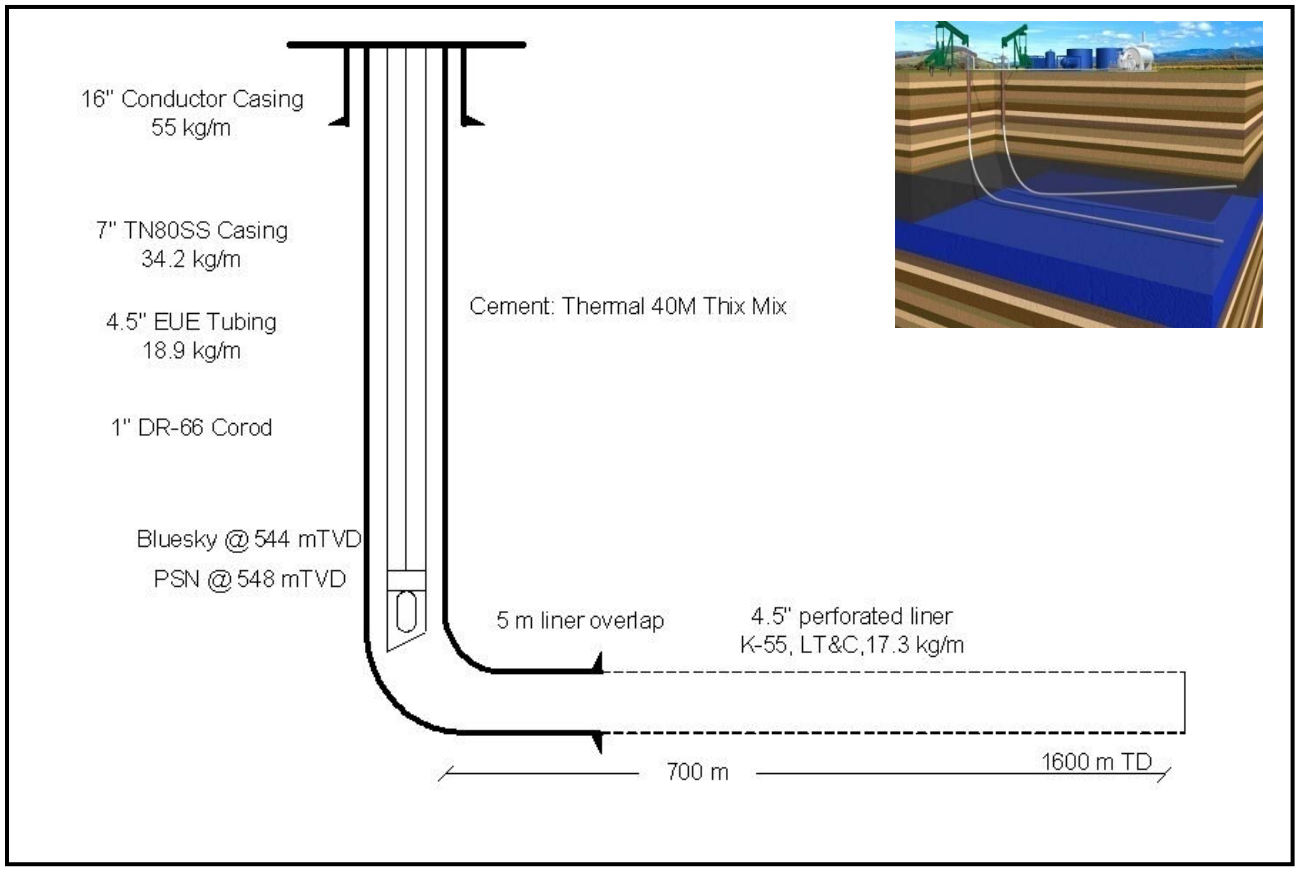
Multi Lateral Completion

- Pads 30, 31, 40, 41
- 244.5 mm L80 Production Casing
- 177.8 mm Window sleeve
- 73 mm Liner
- Thermal cement
- 114.3 mm tubing
- Insert pumps
- 550-700 m laterals



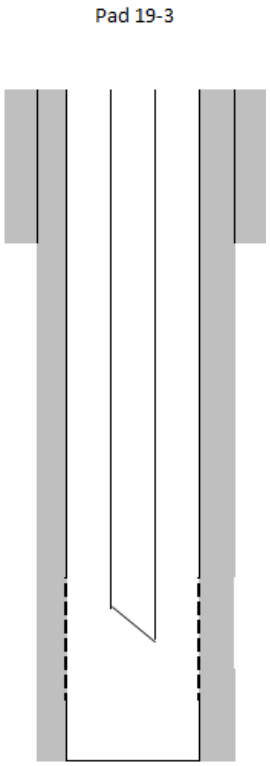
Single Lateral Completion

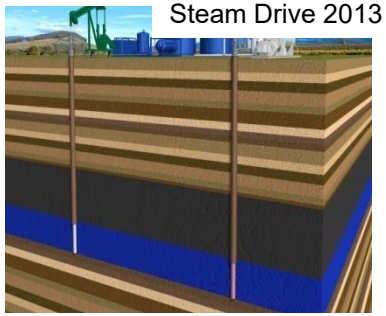
- Pads 32, 33
- 177.8 mm L80 Production Casing
- 114.3 mm Perforated Liner
- 114.3 mm Tubing
- Insert pumps
- Thermal cement
- 500-700 m lateral
- Pump is removed and steam injected down the tubing for high pressure CSS



Vertical Deviated Completion

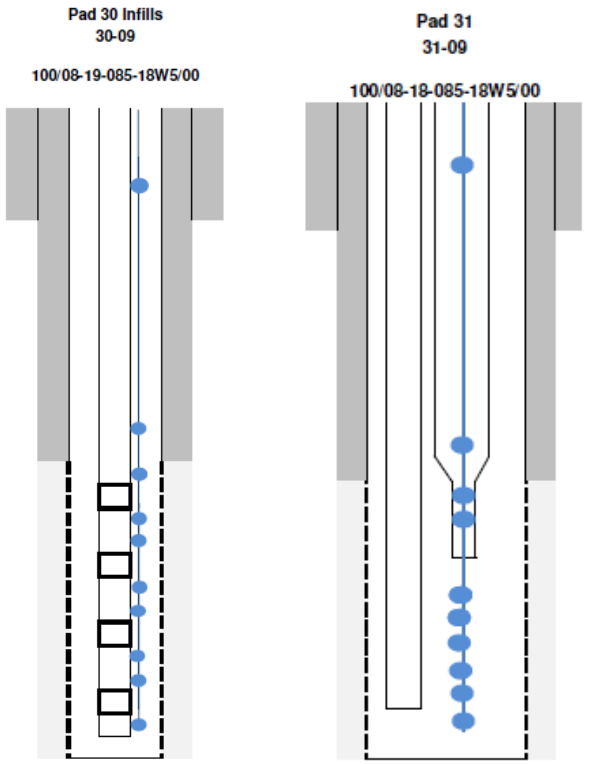
- Pad 19, Satellite 3
- 298 mm Surface Casing
- 219.1 mm L80IRP Production Casing
- 88.9 mm Tubing
- Insert pumps
- Thermal cement
- 19-24 m perforation interval



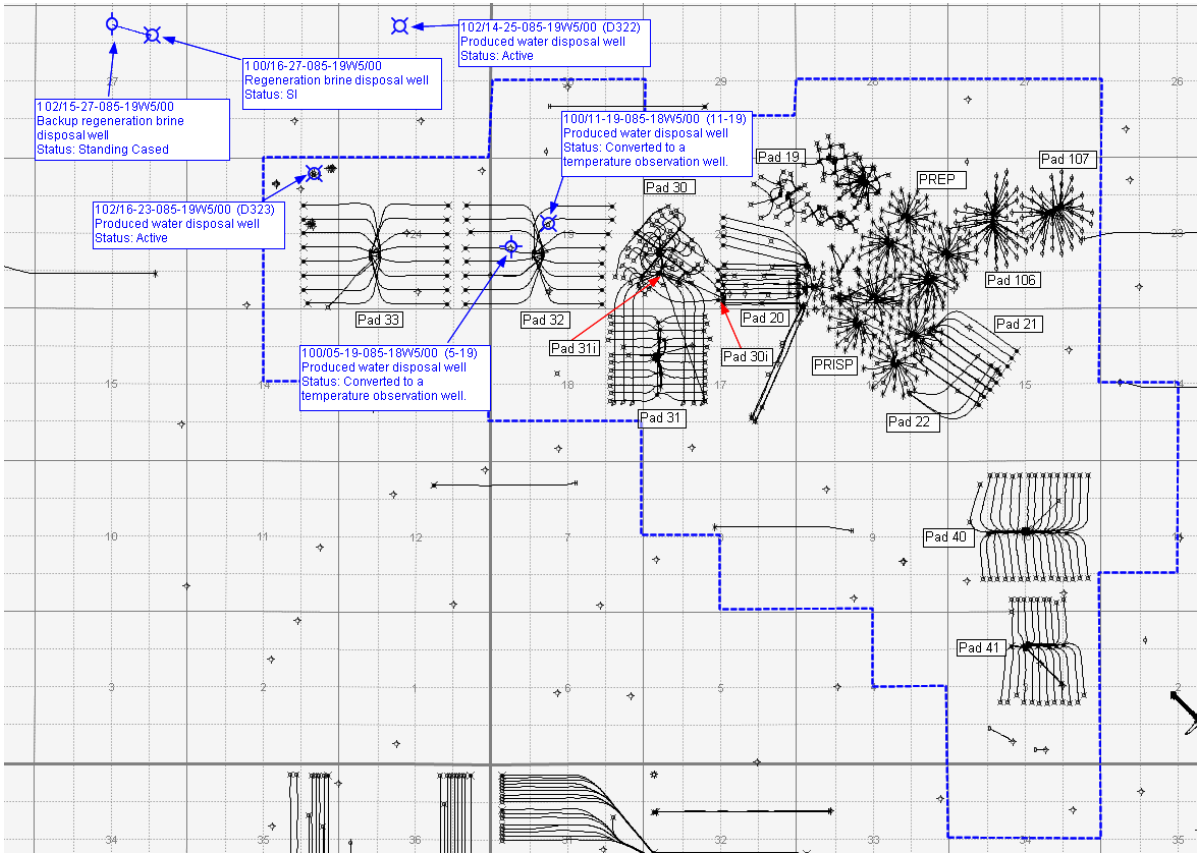


Horizontal Injector Completion

- Pad 20 Phase 3, Pad 30/31 Infills
- 339 or 298 mm Surface Casing
- 219.1 or 244.9 mm L80IRP Production Casing
- 177.8 or 139 mm wire wrap screen liner
- 88.9 and/or 73 mm Tubing
- Select wells completed with Flow Control Devices
- Thermal cement
- 500-1000 m lateral
- Select wells completed with thermocouples and/or DTS

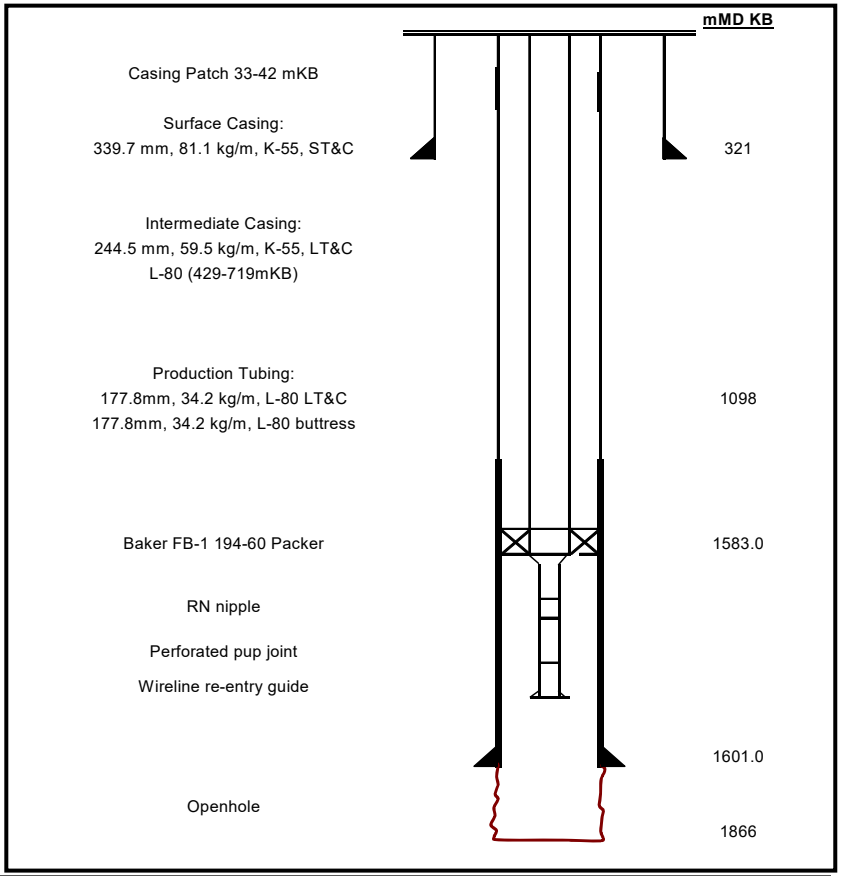


Active and Previous Source & Disposal Wells



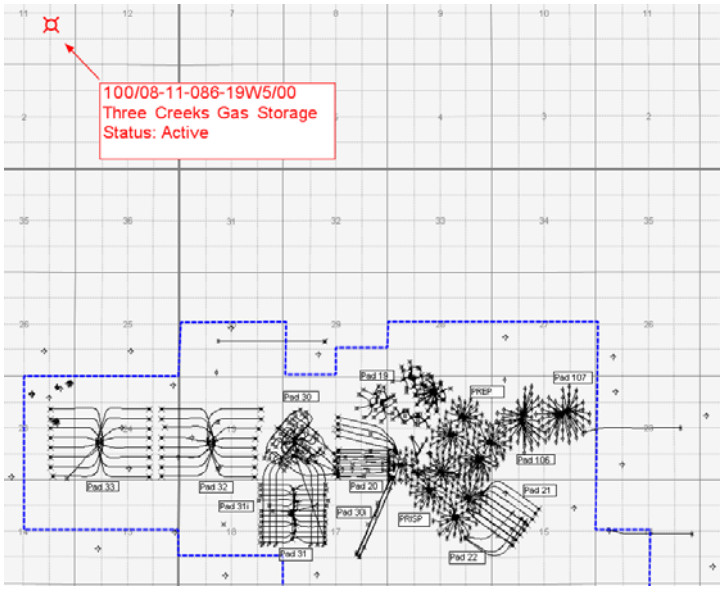
Produced & Brine Water Disposal Completion

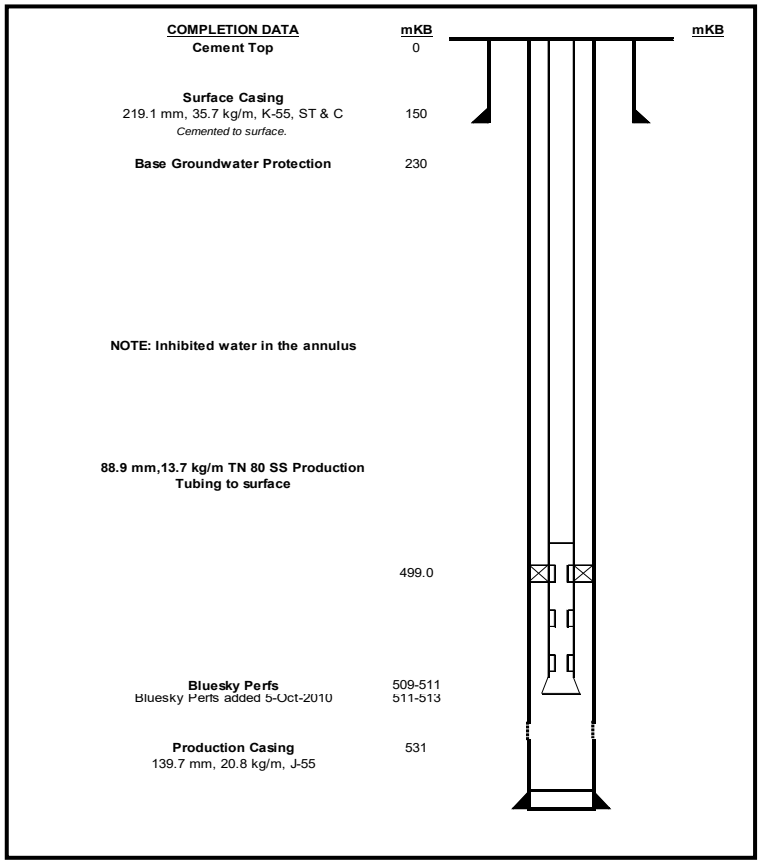
- 02/16-23-085-19W5/00
- 02/14-25-085-19W5/00
- Both dispose of produced water, boiler blowdown and brine into the Leduc formation.



Sour Gas Injector Completion

- The 8-11 sour gas injector was completed Nov 2009 as part of the Three Creeks Sour Gas Storage project.
- Injection started Aug 2010.
- Recently converted 12-35 (100/12-35-085-19W5/00) to a second storage well.



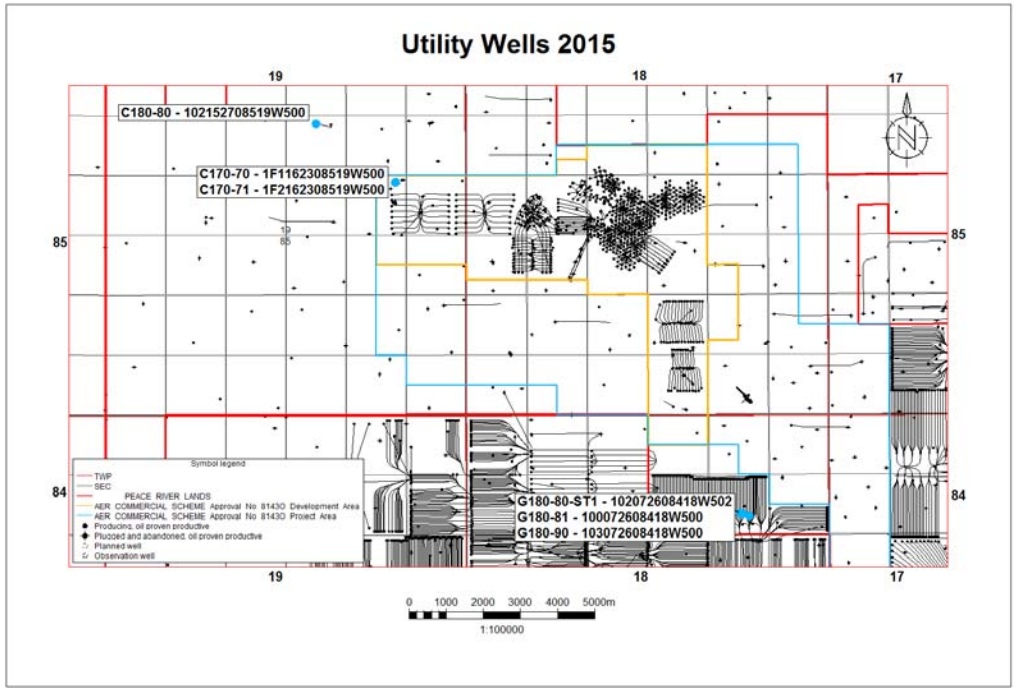


Canadian Natural

Utility Well Completion

Drilled 2014/2015 – All wells suspended

- **C180-80** Brine Injection Well Completion
  - Drilled Mar/Apr 2014
  - Completed
  - Suspended
- **G180-80 and G180-81**, Two injectors
  - Drilled Sept-Dec 2014
  - G180-80 required acid wash, step rate test OK
  - Perforated (50m) liner across Middle Leduc
  - No completion hardware installed, suspended
- **G180-90**, Observation well
  - Drilled Sept-Dec 2014
  - TD in Winterburn Formation
  - No completion, suspended
- **C170-70 and C170-71,** Water back producers
  - Drilled Dec 2014 – Jan 2015
  - Did not reach target depth on either well
    - C170-70 cemented intermediate casing @ 1603 mKB, called TD
    - C170-71 int casing @ 1610 mKB, drilled and open to TD @ 1776 mKB
  - No completion, suspended



ARTIFICIAL LIFT

Rod Pumping Specifications

Pumping Units: **Max. Capacity:**

- Pumpjacks:144” – 260” stroke
  - Pump Jacks 280 m^3/d
  - Rotoflex: 288’’ stroke 250 m^3/d

Automation:

- Pump Off Controllers (POC): load cells, motor sensor, crank sensor, VFD
- XSPOC: Real-time pump cards

Pumps:

- Insert rod pumps, 2.0 – 3.25’’ barrel, 1’’ continuous rod, rod string designs

INSTRUMENTATION SUMMARY

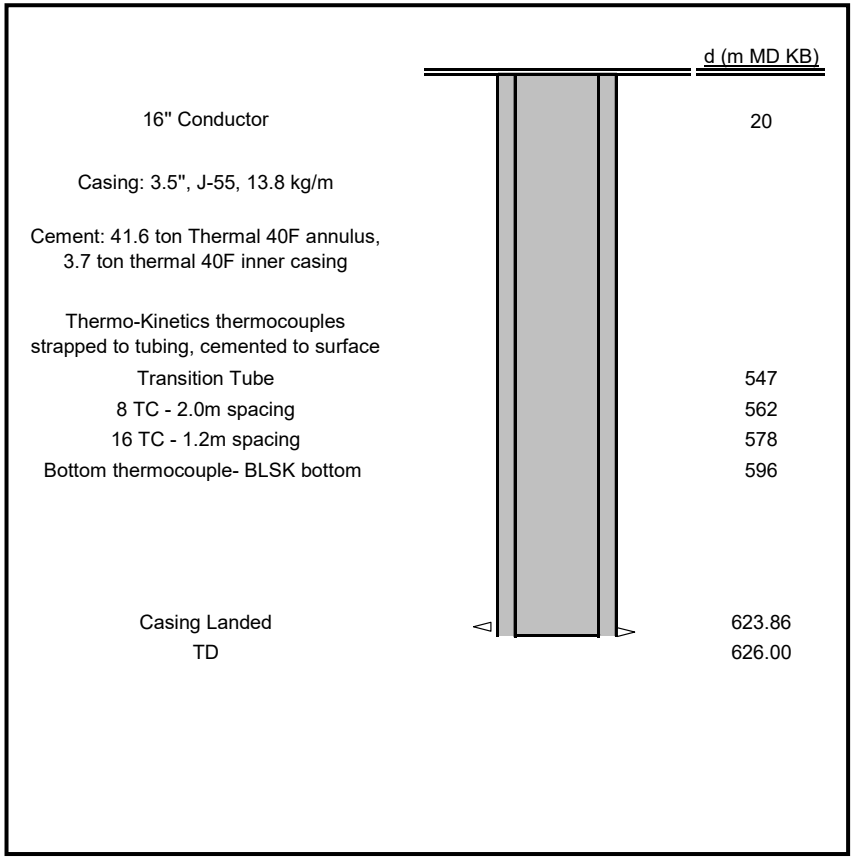
Observation Wells

Well Name	Type of observation well	Well Name	Type of observation well
TH6	Temperature	TH32A	Temperature and micro seismic
TH7	Temperature	TH33A	Temperature and micro seismic
TH8	Temperature	TH33B	Temperature
TH2 (Obs 9)	Temperature	TH40A	Disconnected
TH10	Temperature	TH40B	Temperature
TH11	Temperature	TH41A	Disconnected
TH12	Temperature	12-35	Pressure (Three Creeks) – *Converted to injection in 2019*
TH14	Temperature	D320 (5-19)	Temperature – DTS
TH30A	Temperature and micro seismic	D321 (11-19)	Temperature – DTS
TH30C	Temperature, pressure and DTS	R3-19	Temperature – DTS
TH31A	Temperature and micro seismic	TH33	Pressure
TH31C	Temperature, pressure and DTS		

Typical Temperature Observation Completion

- Thermocouples situated from the Wilrich to the Debolt formations to monitor steam chamber rise and temperature variations over cycle(s).

- 5 wells with DTS installed (Pads 30, 31 & 32)

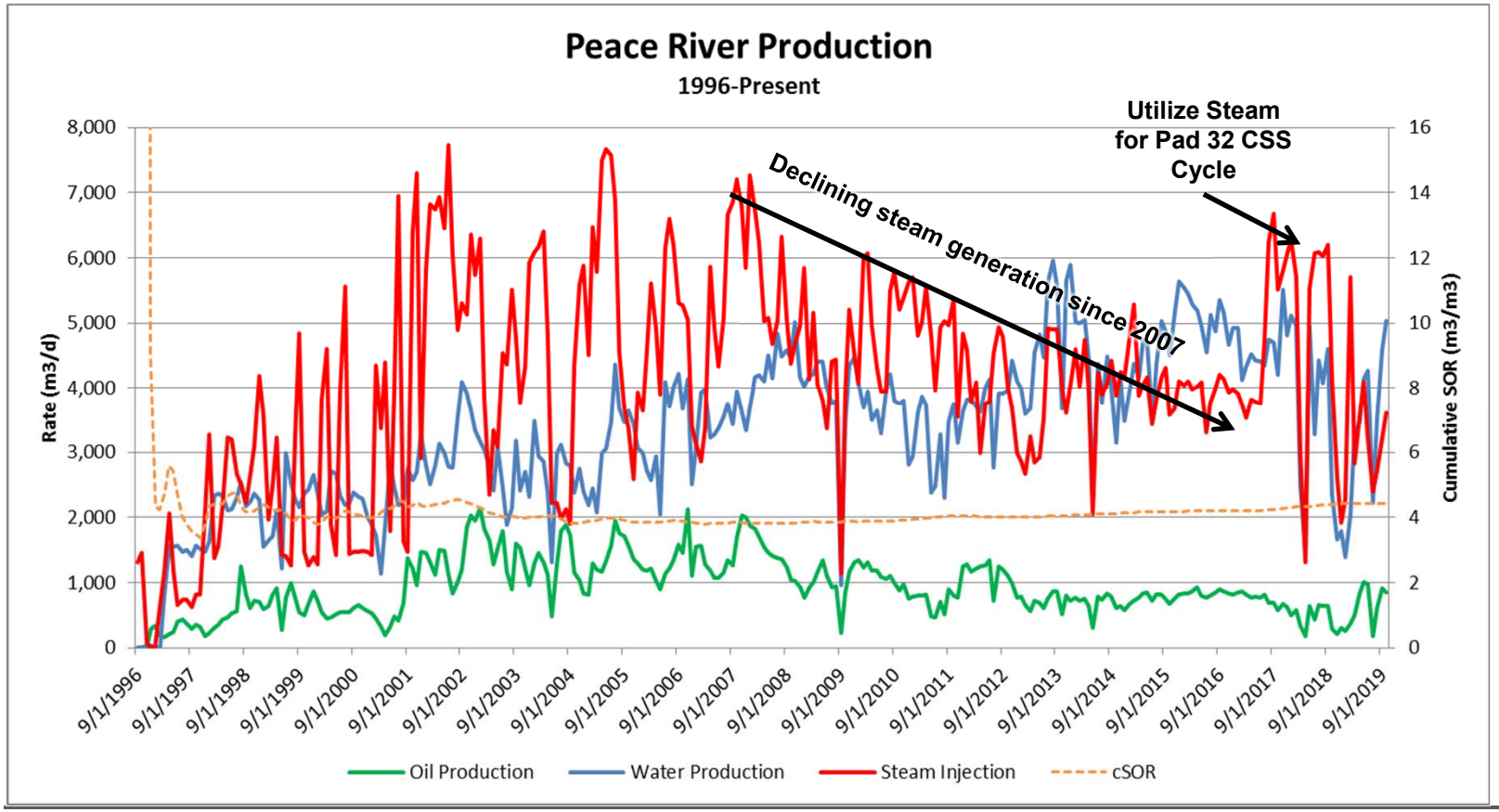


SCHEME PERFORMANCE

Scheme Recovery Processes

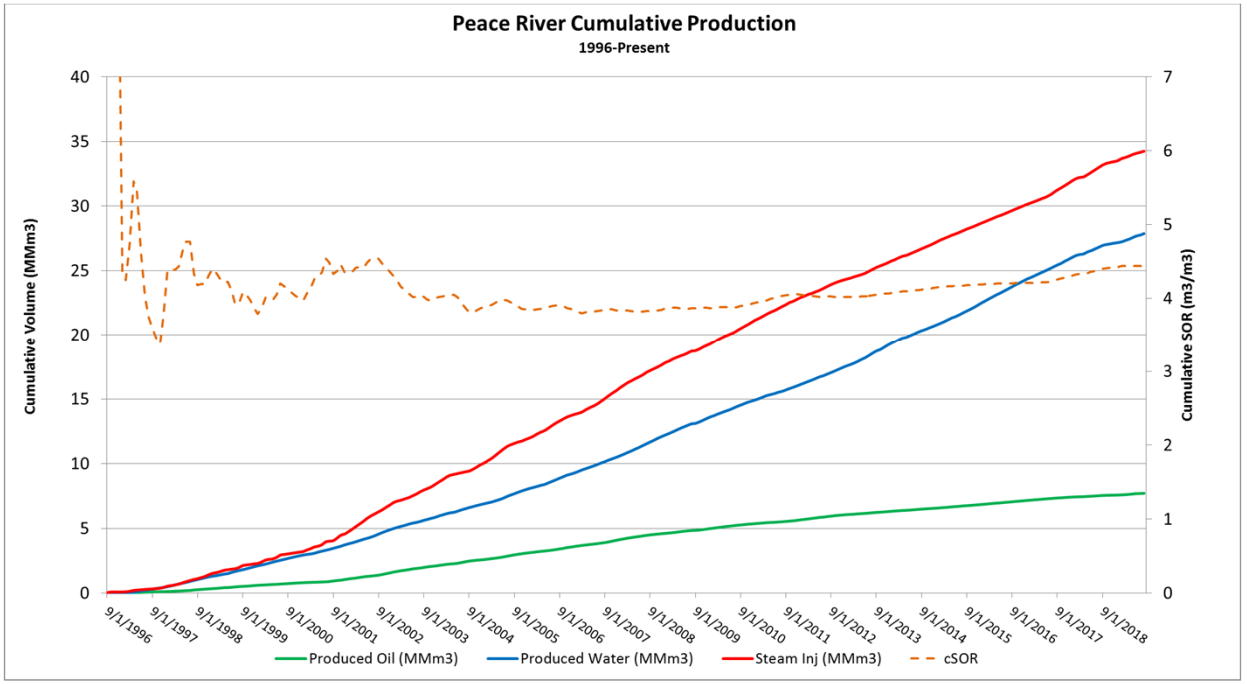
Pad	Recovery Process	Date of Conversion
19 Sat 1 and 2	Steamflood	Oct 2012
19 Infills	Steamflood	July 2013
20 Conv	Steamflood	July 2012
20 Infills	Steamflood	June 2012
21 Conv	Steamflood	Jan 2009
21 Infills	Steamflood	Nov 2011
30	Steamflood	Dec 2014
31	Steamflood	Nov 2014
32/33	32 - Cyclic Steam Stimulation (CSS) 33 - Steamflood	Steamflood Trial began December 2012 Pad 33 – Began conversion to steamflood Aug 2018
40	Suspended	Converted to steamflood June 2012 Blowdown June 2014 Suspended October 2015
41	Suspended	Converted to steamflood June 2012 Blowdown June 2014 Suspended October 2015

Peace River Production



Canadian Natural

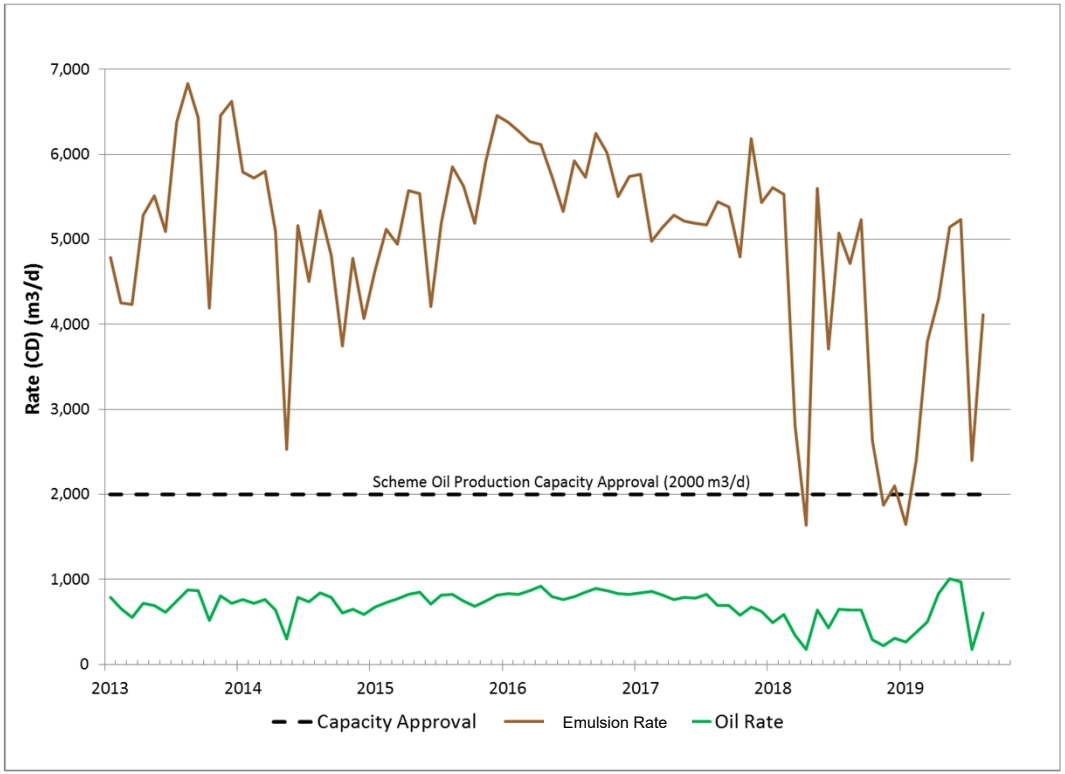
Peace River Production



- All data current as of Oct 2019
  - cOil = 7.7 Mm³
  - cWater = 27.9 Mm³
  - cSteam = 34.2 Mm³
  - Cumulative SOR = 4.4
  - Cumulative WSR = 0.8

Canadian Natural

Actual Production vs Approval Capacity

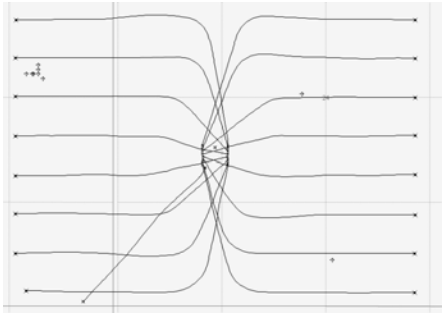


- Bitumen production steady until mid 2017 when Pad 32 was converted for a CSS cycle.

OBIP & Recovery Factors by Pad

Pad	OBIP (e3m3)	Area (m2)	Pay Thickness (m)	Porosity (%)	Cum Oil (e3m3)	Current Recovery	Ultimate Recovery
Pad 19 S1	1,060	199,000	23	28	273	26%	26%
Pad 19 S2	1,370	361,000	16	28.5	245	18%	29%
Pad 19 S3	1,110	238,000	21	28	342	31%	30%
Pad 19 S4	1,200	249,000	20	29	227	19%	29%
Pad 20	2,040	423,000	22	27	679	33%	34%
Pad 20i	1,500	339,000	20	27	217	14%	22%
Pad 21	2,350	431,000	25	27	647	28%	29%
Pad 21i	1,520	287,000	25	26	247	16%	31%
Pad 30	4,250	765,000	24	28	848	20%	34%
Pad 31	6,520	1,232,000	23	28	785	12%	34%
Pad 40	8,790	1,676,000	25	26.5	847	10%	26%
Pad 41	5,990	1,134,000	26	26	483	8%	23%
Pad 32	9,650	1,953,000	22	27.5	1005	10%	17%
Pad 33	9,800	2,044,000	22	27.5	919	9%	14%
Total	**57,150**				**7,764**	**18%**	

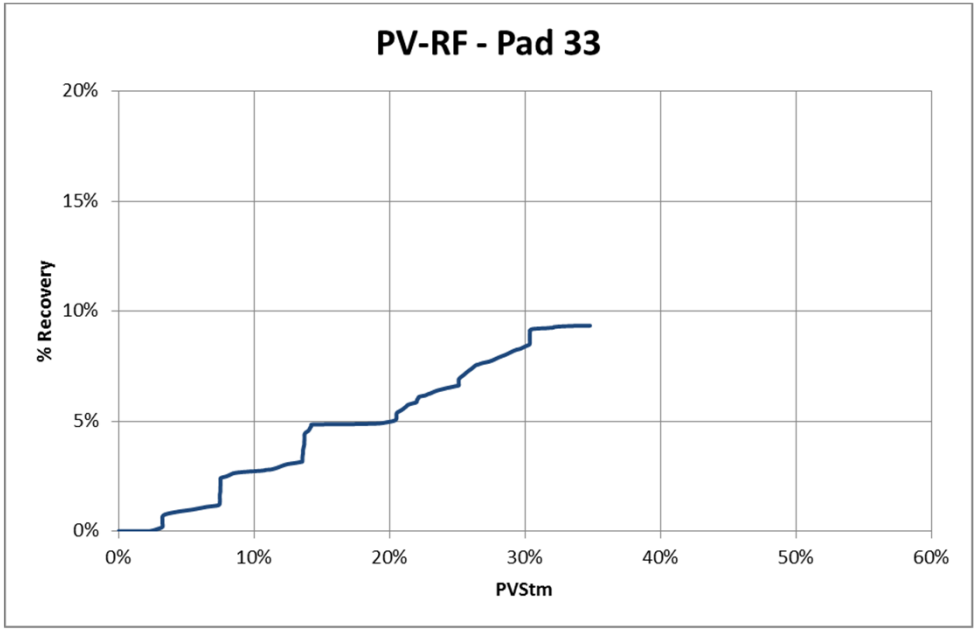
Pad 33 - Low Recovery



16 Wells – Previously CSS.
Converted to steamflood in late 2018.

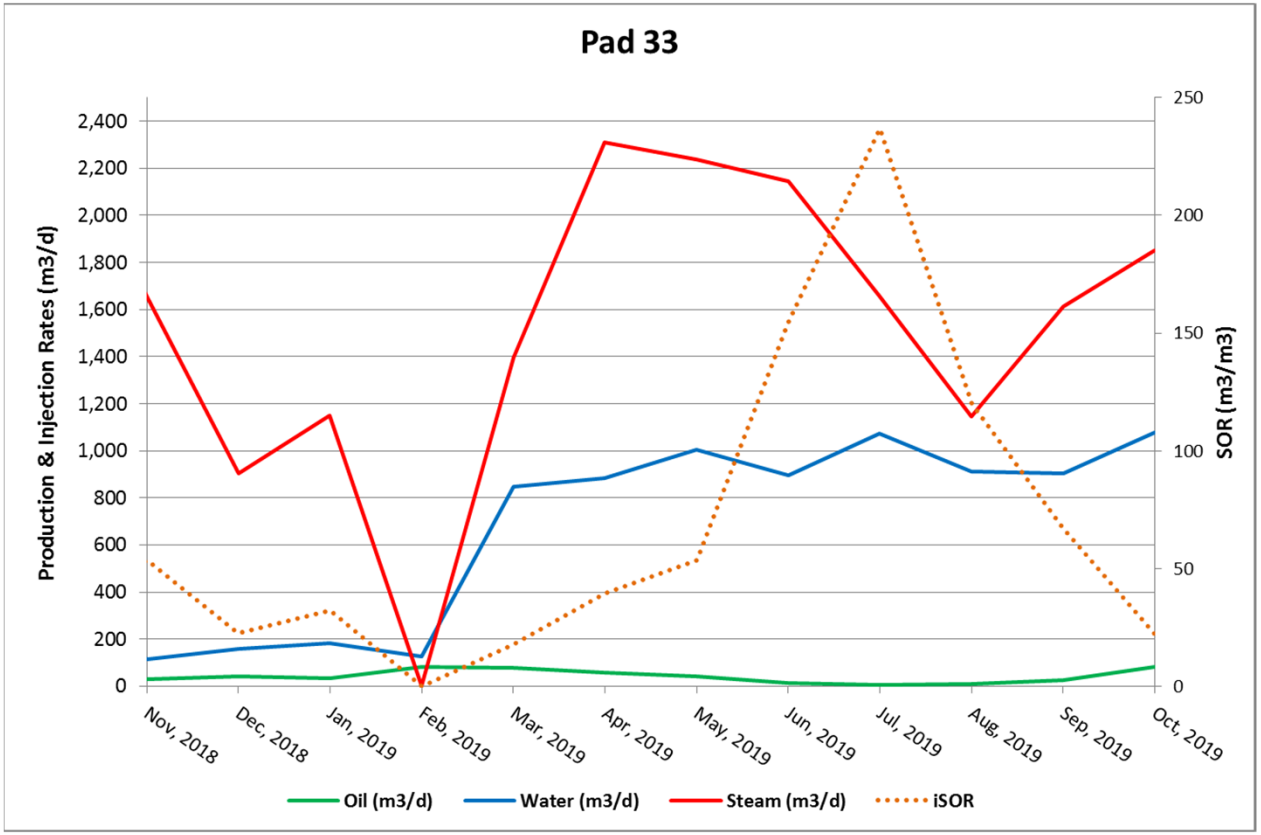
Current RF: 9%

- Spacing: 150m
- Avg. Net Pay: 22m
- Avg. So: 80%
- Avg. Porosity: 27.5%



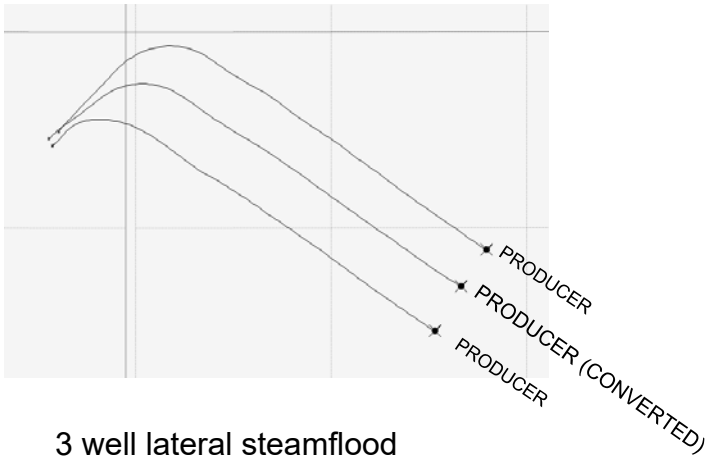
Canadian Natural

Pad 33 - Low Recovery



- Steaming in previous years has been single well CSS (2016/2017)
- Converted to steamflood in Aug 2018, continuing to pressurize throughout 2019
- 2020 plans:
  - Continue steamflood and pressurize to BHP target of 4 MPa.
  - Convert to full-pad low-pressure CSS if steamflood performance continues to be poor due to limited producer/injector connectivity

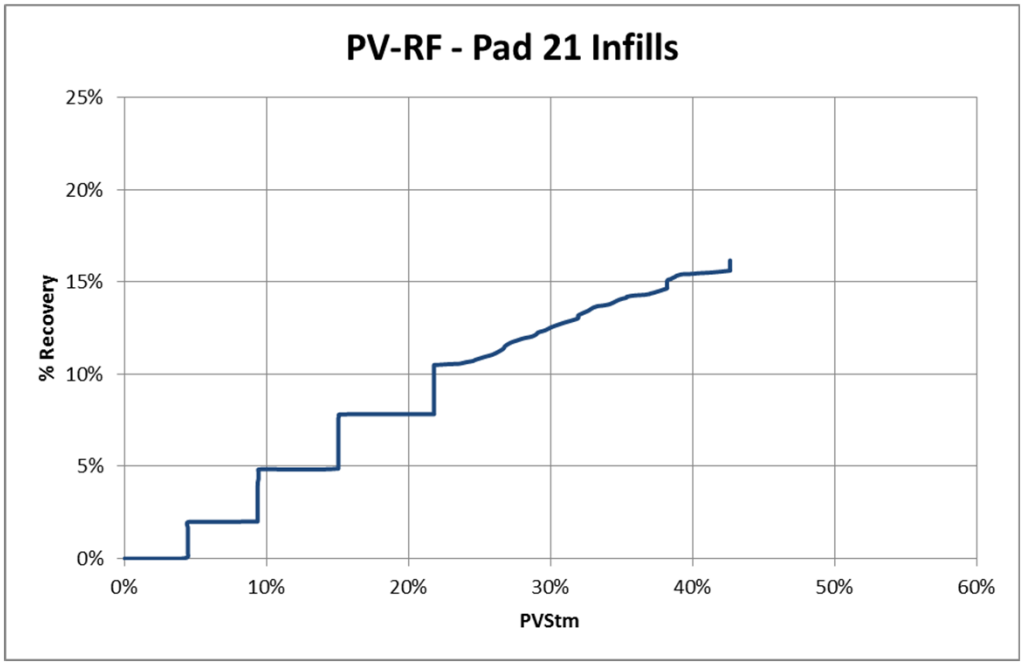
Pad 21 Infills - Medium Recovery



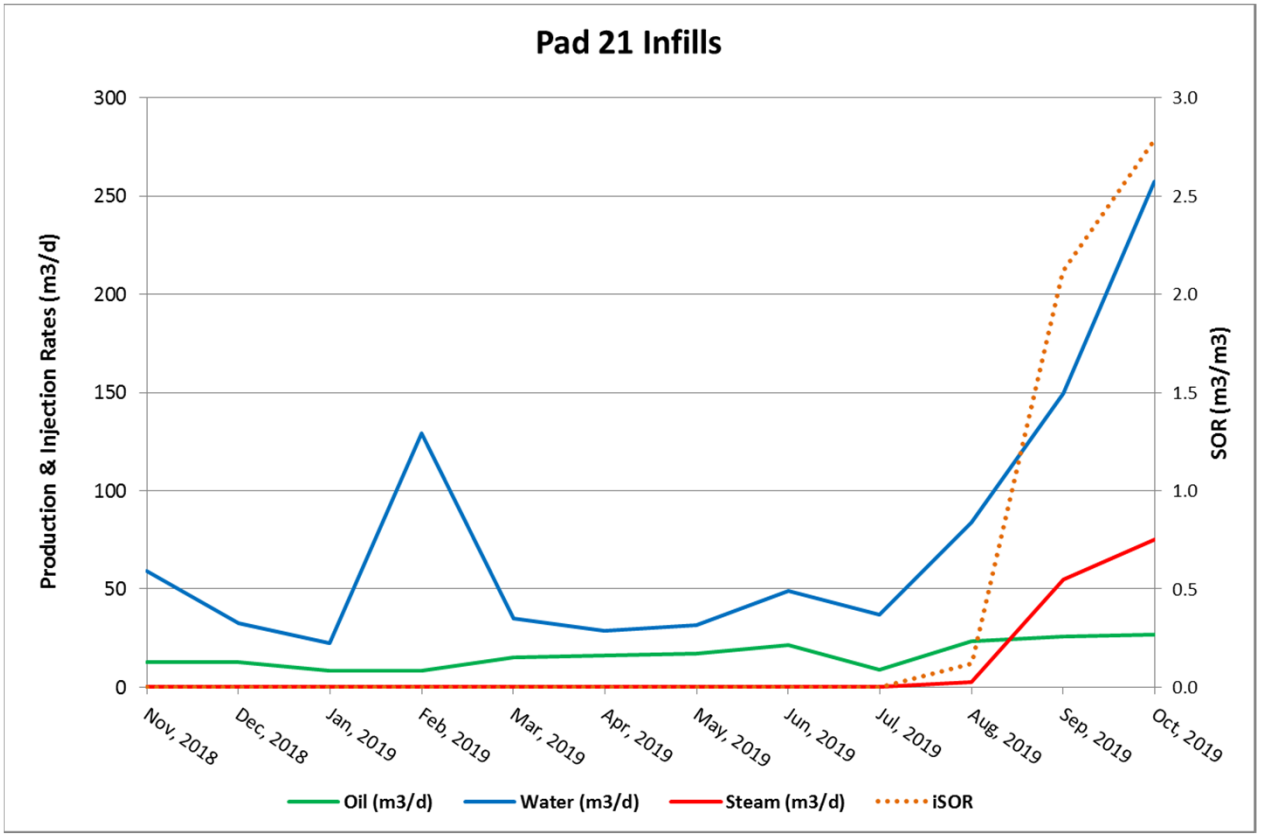
3 well lateral steamflood

Current RF: 16%

- Spacing: 100m
- Avg. Net Pay: 25m
- Avg. So: 83%
- Avg. Porosity: 26%



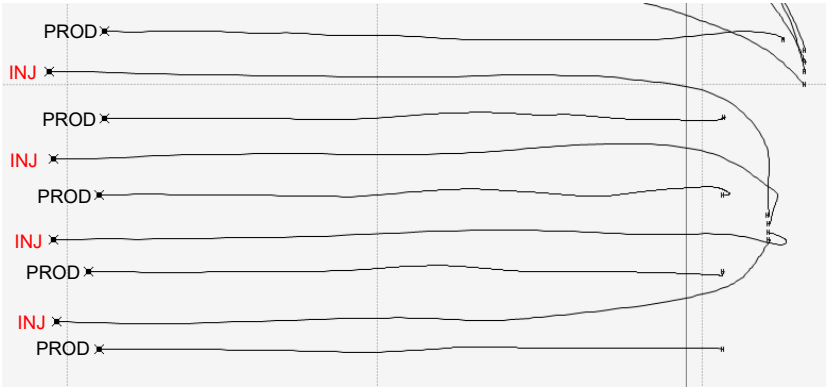
Pad 21 Infills - Medium Recovery



- Tested pad with higher steam rates in late 2017 and then cut steam to 0 for Pad 32 CSS cycle.
- Converted 21-14 injector to producer when steam to pad was off.
- 2020 plans:
  - Pad was frequently curtailed to minimum rates in 2019, and likely to extend this into 2020.

Canadian Natural

Pad 20 - High Recovery

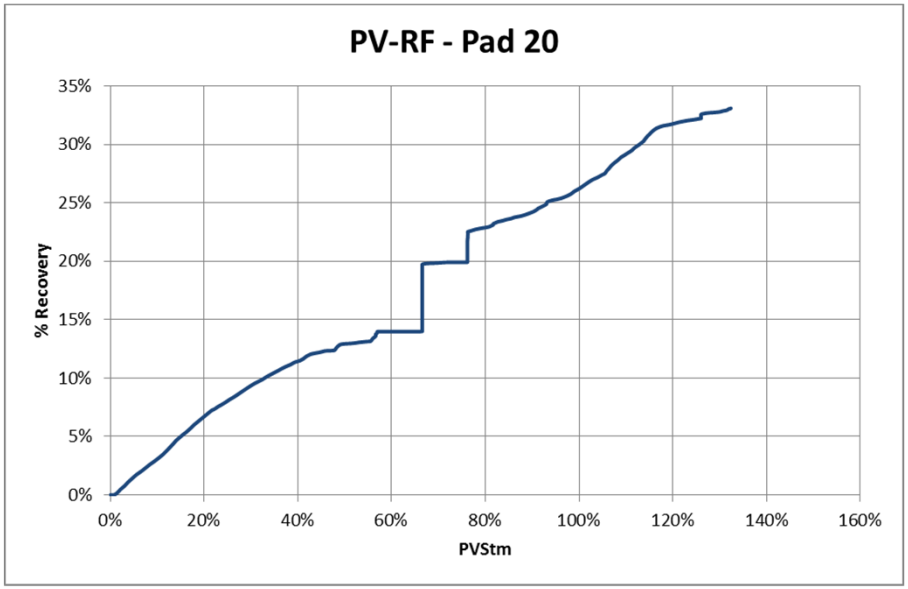


Top Down Steam Drive (prev. SAGD)

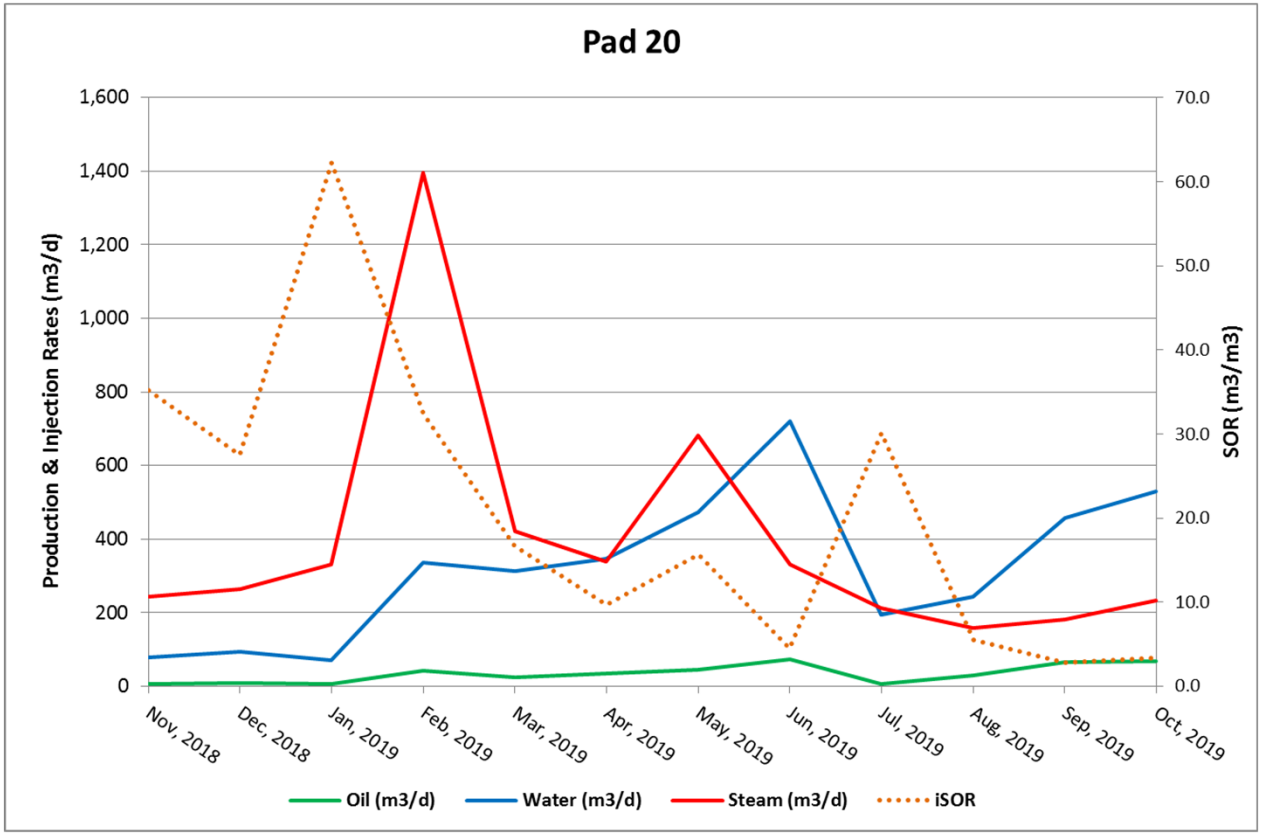
4 Injectors, 5 producers

Current RF: 33%

- Spacing: 100m
- Avg. Net Pay: 22m
- Avg. So: 82%
- Avg. Porosity: 27%



Pad 20 - High Recovery



- Tested pad with higher steam rates from 2017-2019 and then cut steam to 0 for Pad 32 CSS cycle.
- Injectors and producers frequently curtailed in 2019, will likely continue in 2020.
- 2020 Plans
  - Potential to cleanout horizontal liners for improved performance.

Canadian Natural

Peace River Performance Summary

Pad 32 CSS

- Injection completed on Pad 32 and wells on flow back as of mid-Sept 2018. Will likely carry out full-pad CSS steaming within the next 12-18 months.

- Pad 33 has been converted over to steamflood.

- All wells were frequently curtailed to minimum rates due to marketing conditions and government-mandated curtailment throughout 2019. Steam injection was also curtailed during these periods.

Factors Impacting Recovery

- Well design
  - Multi-well designs have no clear performance advantage
  - Lack of sand control has resulted in significantly plugged portions of liners
  - Unable to re-enter some wells for cleanouts due to complexity of well design and/or small liner diameters
  - No control of steam placement in laterals

- Inter-well and Inter-pad Communication
  - Reduces thermal efficiency by suboptimal placement of injected steam, and/or quenching of heated reservoir with cooler fluids
  - Examples include: Pad 40-41, Pad 32-33, Pad 32 to Pad 30,31
  - Recent block steam cycle on Pad 32 saw less inter-well communication than previous cycles.

Key Learnings

- Oil rates remained fairly steady on steam flood pads when steam was cut completely, although cooling of emulsion led to some treating issues.
  - Steam was cut for ~5 months
  - Pads 19,20,21,30,31
- Peak oil and gross rates and well productivity generally unaffected by prolonged curtailment
  - Full field was subject to frequent shut-ins and reduction to minimum pumping rates, etc. during 2019
- Issue with external casing corrosion near surface on Pads 32 and 33.
  - Casing was inspected and replaced where necessary.
  - Casing integrity has been proven with a 21 MPa pressure test, rather than a 10 MPa test.
  - Top 1.5m of casing was coated externally on all wells to prevent future corrosion.
  - Annual inspection being carried out

2020 Depletion Strategy

- Continue to produce back Pad 32 and monitor performance. Cycle SOR and oil rates will provide direction for future cycles.

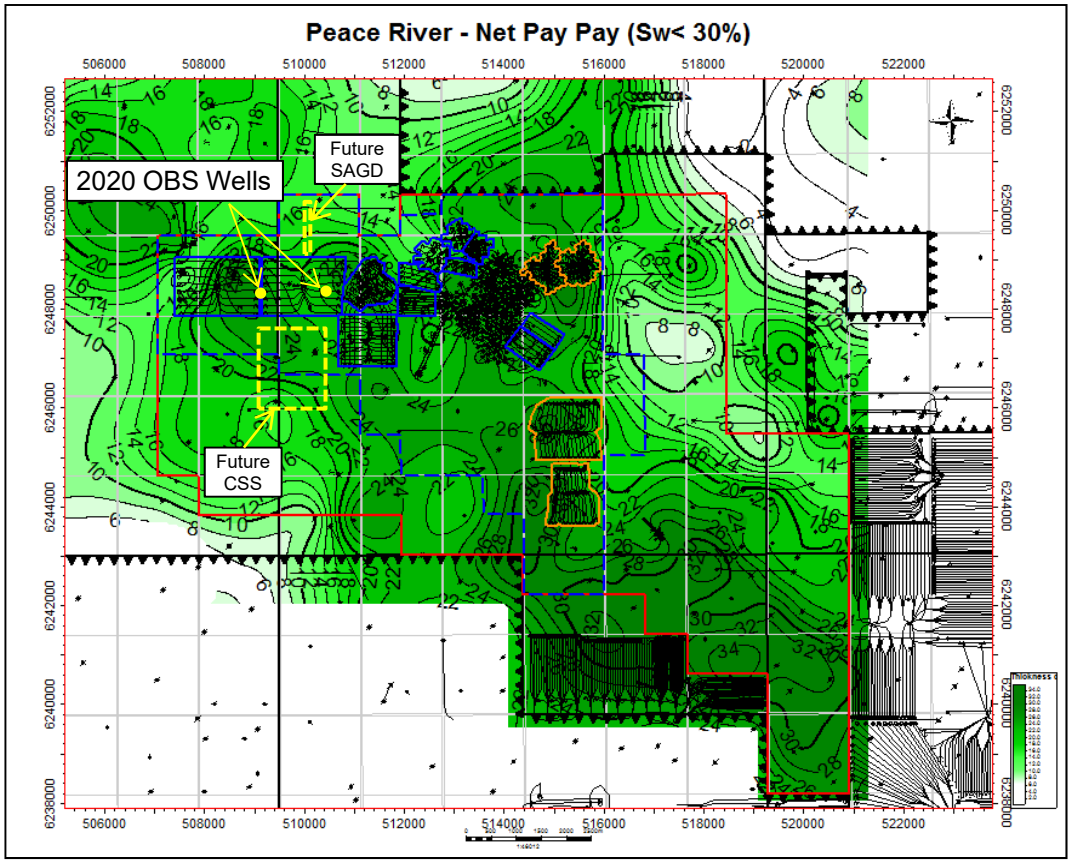
- Pad 33 – Continue steamflood and evaluate performance going forward, option to convert to CSS in the future

- Optimize other steamflood areas (i.e. Pads 19, 20, 21, 30, 31)

5 Year Outlook of Pad Abandonments

- No pads are scheduled for abandonment from 2019 to 2023

Future Development Plans



- 2020 Drilling
  - 2 observation wells planned for passive seismic monitoring of CSS operations on Pad 32 and Pad 33
- Future plans
  - 3 SAGD well pairs north of Pad 32
  - 15 CSS wells south of Pad 32

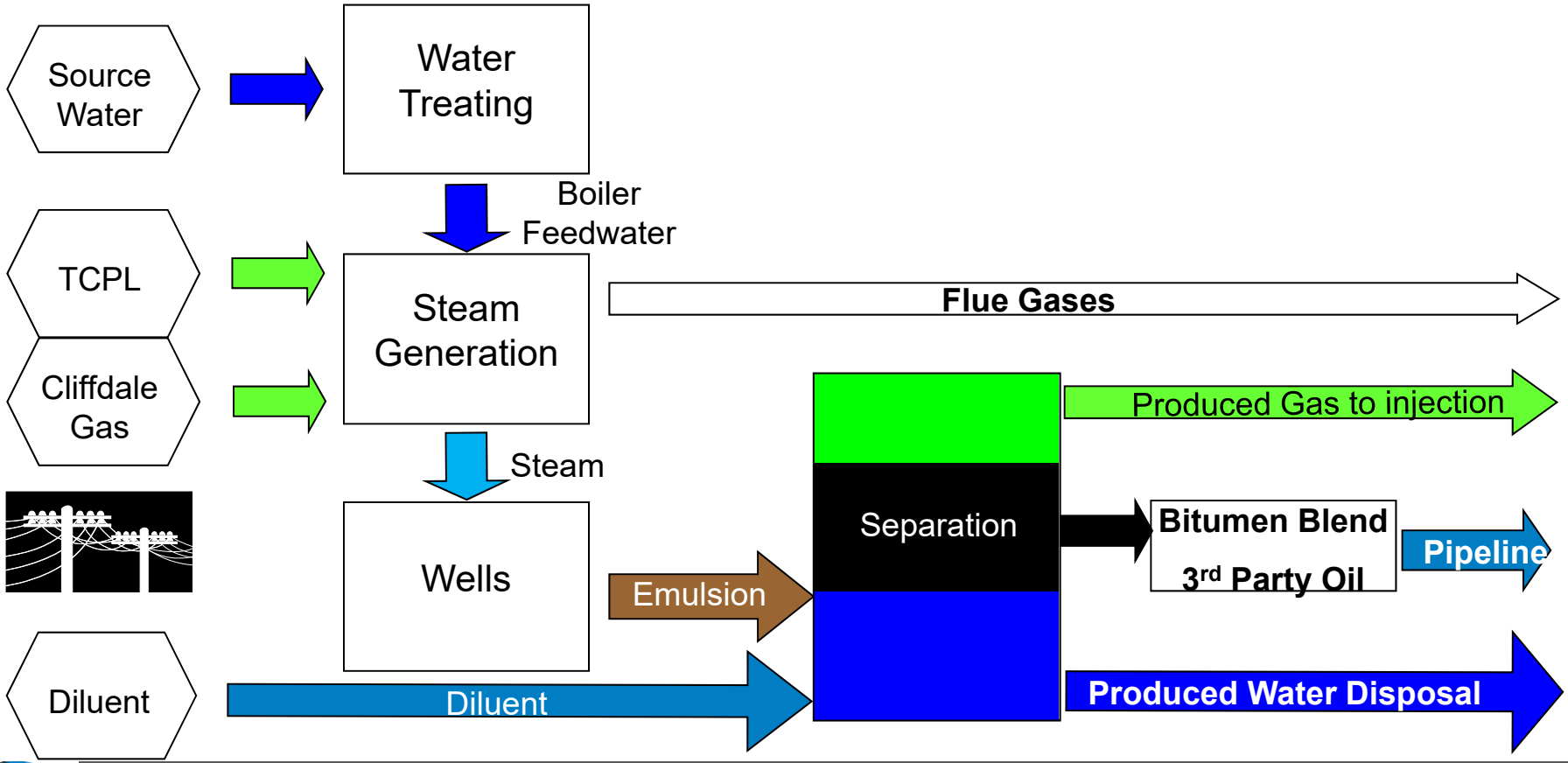
Canadian Natural

Canadian Natural

DIRECTIVE 54 SECTION 3.1.2
SURFACE OPERATIONS, COMPLIANCE, AND ISSUES NOT RELATED TO RESOURCE EVALUATION AND RECOVERY

Peace River Plant

Thermal Production Treating: Process Flow Diagram

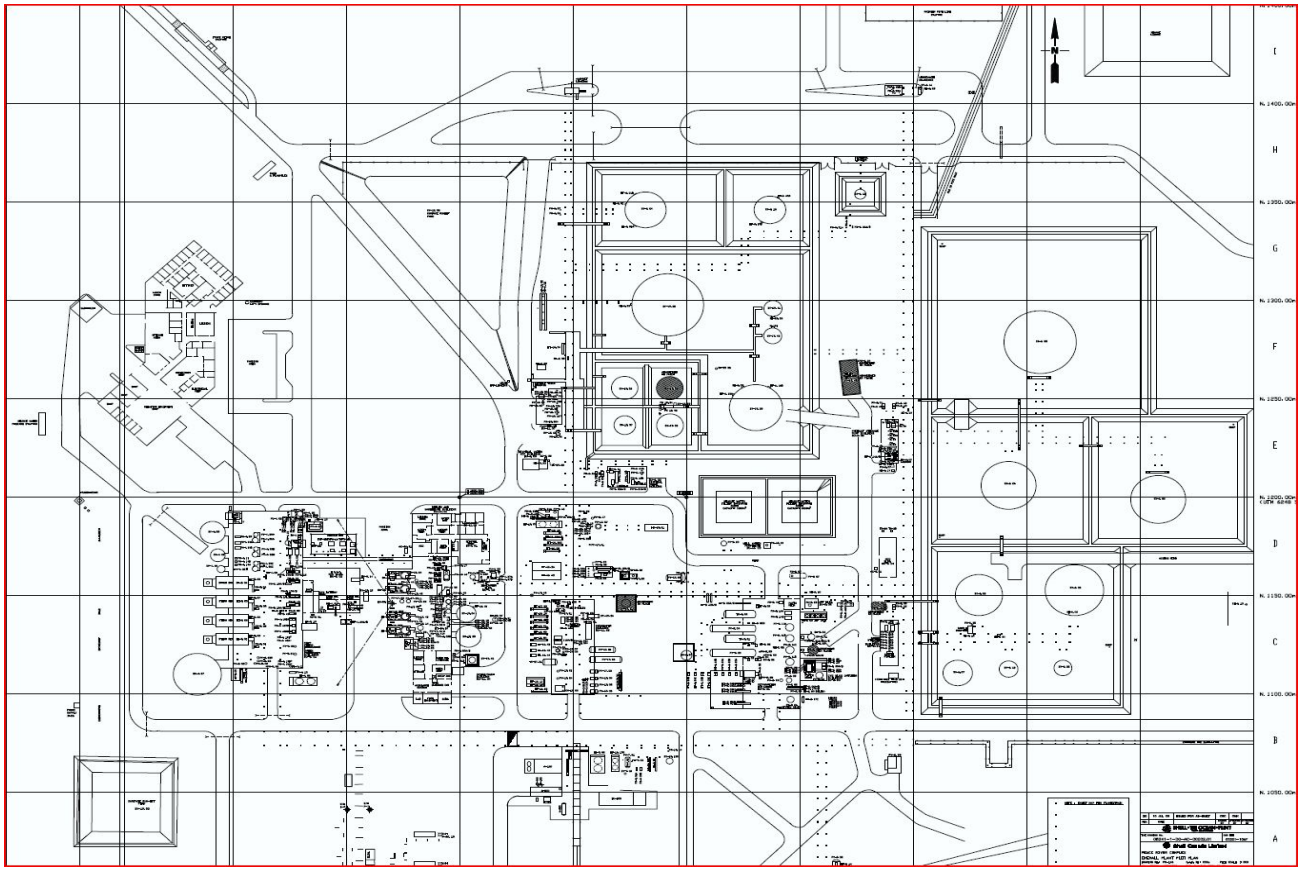


Canadian Natural

2019 Facility Modifications

- Modified the PLC logic on the Three Creeks gas storage compressor to enable different cylinder unloaders on the compressor for reduced current draw and power consumption.
- Modified the route for the liquids off the third stage discharge scrubber on the Three Creeks compressor from the flare to the Diltar rundown. This change resulted in reduced flaring volumes for the facility and recovery of C5 plus liquids into the Diluted Bitumen stream to sales.

Peace River Complex Plot Plan



Facility Performance: Production & Oil Treating

- Production averaged between 10-50% of 2,000 m^3/day licensed capacity in 2019
- Oil treatment has largely not been an issue due to low oil volumes
- Degasser pressures fluctuate significantly due to slugging in emulsion lines

Facility Performance: Source Water

- PRC pulls water from the Peace River on a continuous basis. Source water treatment facility located on the east bank of the Peace River
- PRC is licensed to withdraw 4.3 e^6m^3 of water from the Peace River per year (11,813 m^3/day)
- Historical water usage range is 5,000 m^3/day to 11,000 m^3/day
  - YTD fresh water withdrawal (Jan 1 to Sep 30) is 875 e^3m^3 or an average of 3,601 m^3/day
  - Before being sent to the main complex, source water is treated to:
    - less than 5 ntu, and less than 0 ppm oxygen
- A small volume of water is also withdrawn from the PRC intake and pumped to New Water Limited for use as potable water for public consumption
  - Northern Sunrise County has it's own withdrawal license and reporting requirements
- Waste brine previously disposed down disposal well (16-27) in the Leduc Formation but now co-mingled with produced water before disposal down wells at 14-25 and 16-23

Facility Performance: Produced Water

- Typical produced water quality:
  - Produced water TDS 10372 mg/L, pH 7.85, Total Alkalinity 3286 mg/L, Chlorides 4110 mg/L
- Solids are periodically disposed of through approved waste stream treating companies
- Design produced water handling and injection capacity is 7,977 m^3/day
  - Disposal pump capacity currently limited to 7,400 m3/d as a result of VFD being undersized

Produced Water Treatment & D81 Compliance

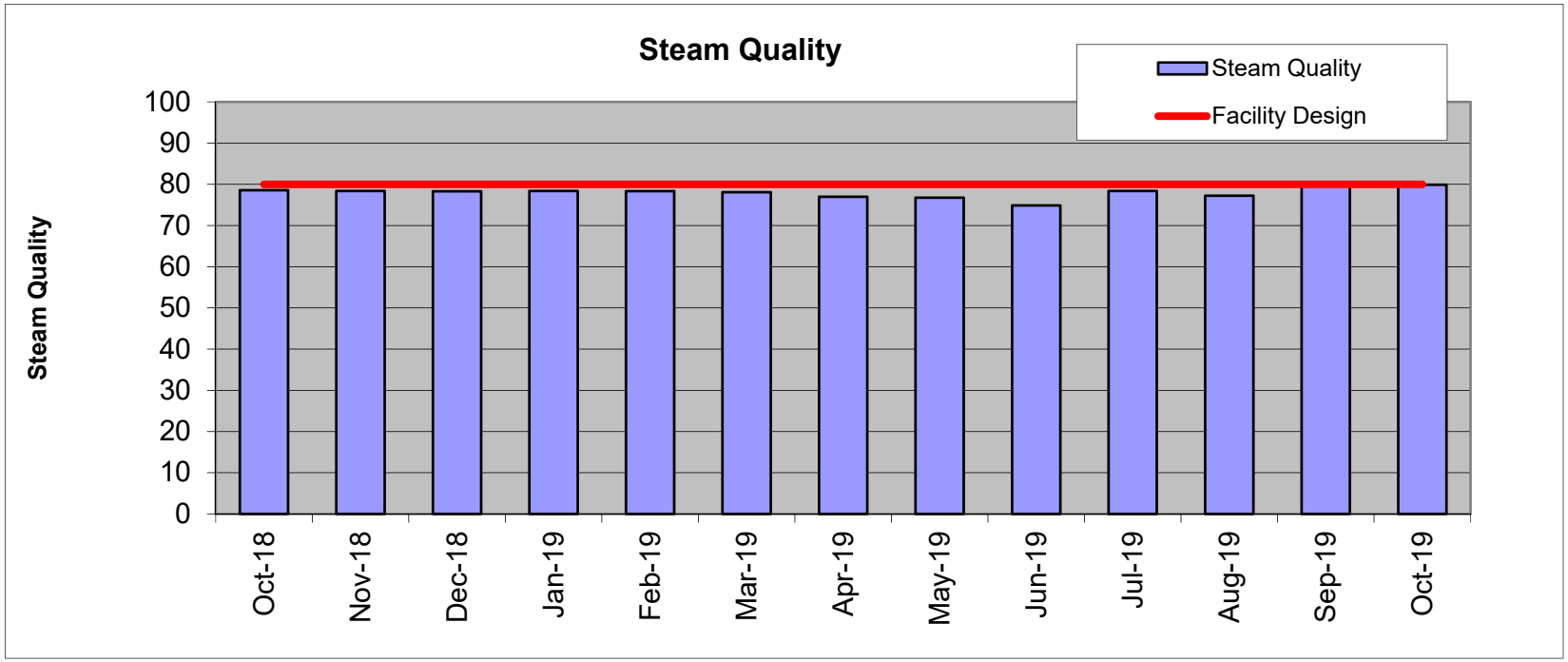
- Current Directive 081 waiver to the end of December 31, 2030
  - Application 1914499 extension approval received March 18, 2019

- Water Treatment Plans
  - Seeking to match the produced water treatment solution to the reservoir strategy and corresponding steam water specification
  - Conventional water treatment technologies such as evaporation and warm lime softening continue to be investigated but are very costly
  - Looking to the COSIA WTDC to develop new technologies for water treatment

Facility Performance: Steam Generation

- PRC generates 80% steam quality from four once through steam generators.
- The four steam generators have a total capacity of approximately 8,000 t/d.
- Steam pressures of 14 MPa and 335^{o}C.
- PRC has a100% utility steam system blowdown recycle back in to the plant steam condensate recovery system.
- All Steam Generators use a mixture of up to 75% Cliffdale and 25% Natural Gas by volume as their fuel source.

Facility Performance: Steam Generated



- Four PREP boilers at 2,000 t/d capacity each

Facility Performance: Three Creeks Compressor

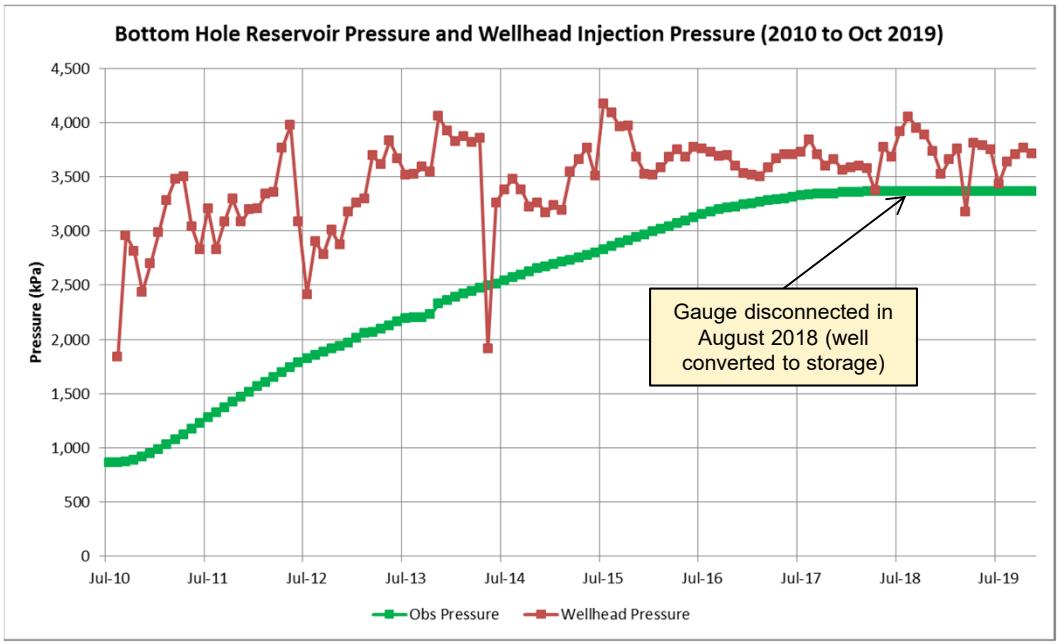
- Three Creeks Gas injection facility has been operational for nine years.
  - Sour produced gas from PRC currently going to Three Creeks storage well at 8-11-085-18W5
  - Second Three Creeks gas storage well and pipeline commission to well location at 12-35-085-19W5.

- Gas is currently analyzed once per month at the Three Creeks dehydration outlet to the Three Creeks gas injection pipeline. Analysis done by third party.

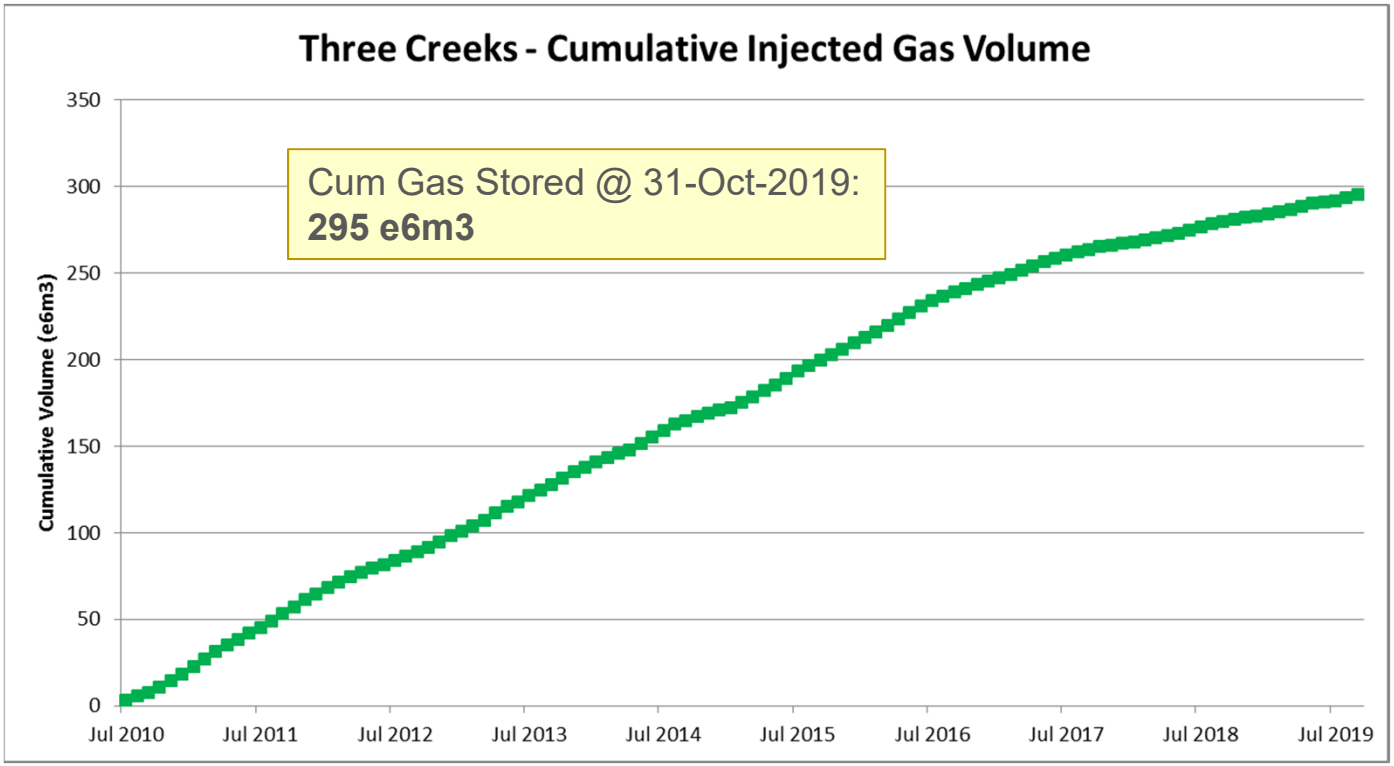
- 2019 Injection facility reliability is currently 97%. This includes planned maintenance shutdowns.

Three Creeks Subsurface Information

- Data as per Three Creeks annual progress report, submitting in December 2019
  - Approved pressure is 5,000 kPa(a) static reservoir pressure
  - 12-35 obs well pressure disconnected in August 2018, as 12-35 has been converted to a second storage well for the Three Creeks pool

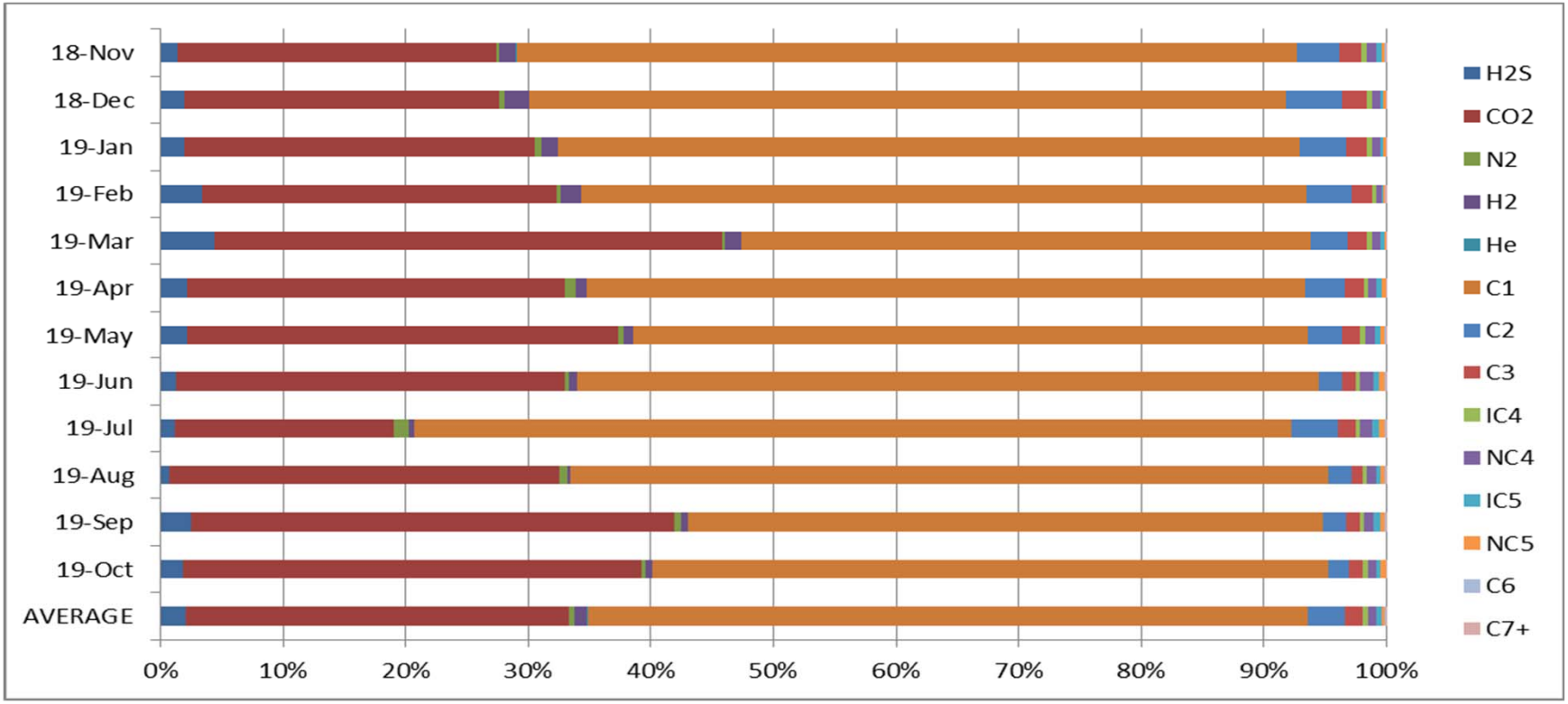


Three Creeks Subsurface Information



Three Creeks Subsurface Information

- Injected gas stream is analyzed once each month. The graph below presents the gas analysis from Nov 2018 to Oct 2019.



Measurement, Accounting & Reporting Plan (MARP)

- The following changes to the Measurement, Accounting and Reporting Plan were included in the last submission:
  - No changes to the MARP were made in 2019

Production Well Testing

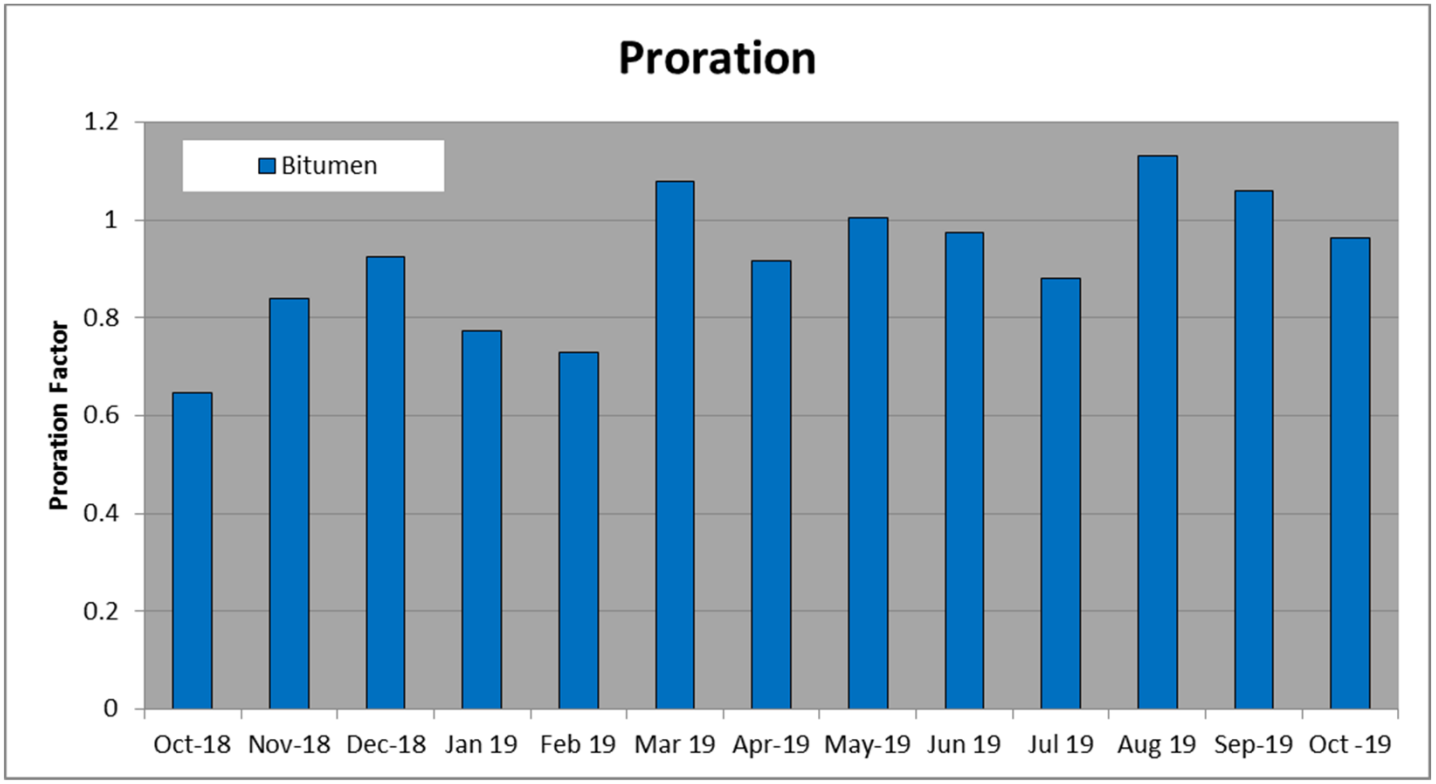
- Wells are directed to a test vessel to separate liquids and gas.
- Liquid flow rates are measured by a Coriolis meter
- Watercuts are determined by inline BS&W analyser (except for 19 sat 1-2-4 & Pad 20, which use a 3 phase separator)
- Reported volumes are prorated based on measured total volumes at the plant

Pad	Separator	Purge time*	Duration	Frequency
21	2 phase	~3-8 hrs	12 hours	2x/week
19 sat 1-2-4 & 20	3 phase	~ 1 to 8 hrs	12 hours	1-2x/week
19 sat 3	2 phase	~0.5 hrs	6 hours	3x/week
30, 31	2 phase	~ 0.5 hrs	3 hours	7x/week
32, 33	2 phase	~ 0.5 hr	3 hours	3x/week

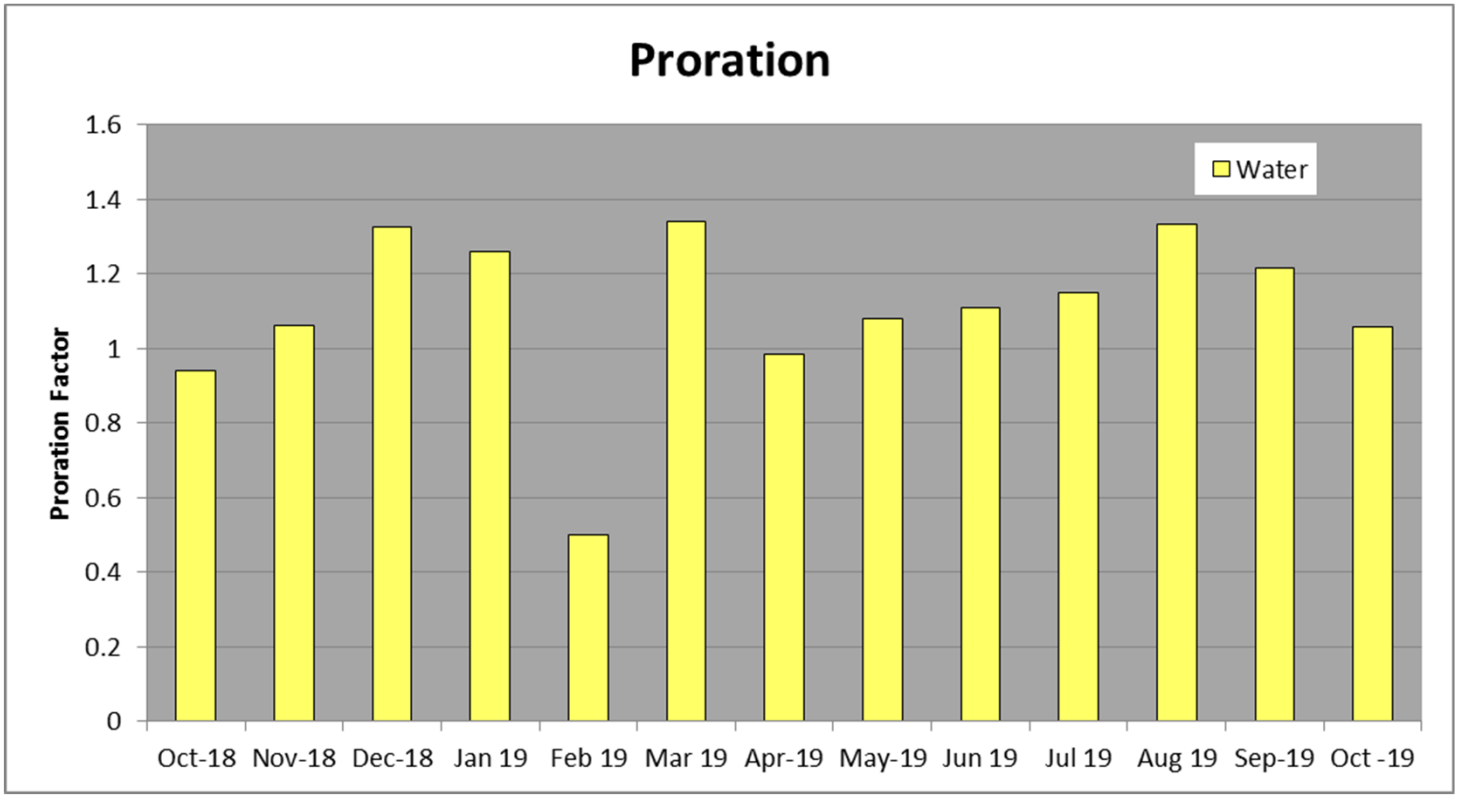
- Well test duration/frequency largely dependent on purge time & number of wells tied into each test separator:

* Purge time varies for each test, as it is dependent on the production rate of the well. A pre-determined purge volume is applied to each vessel

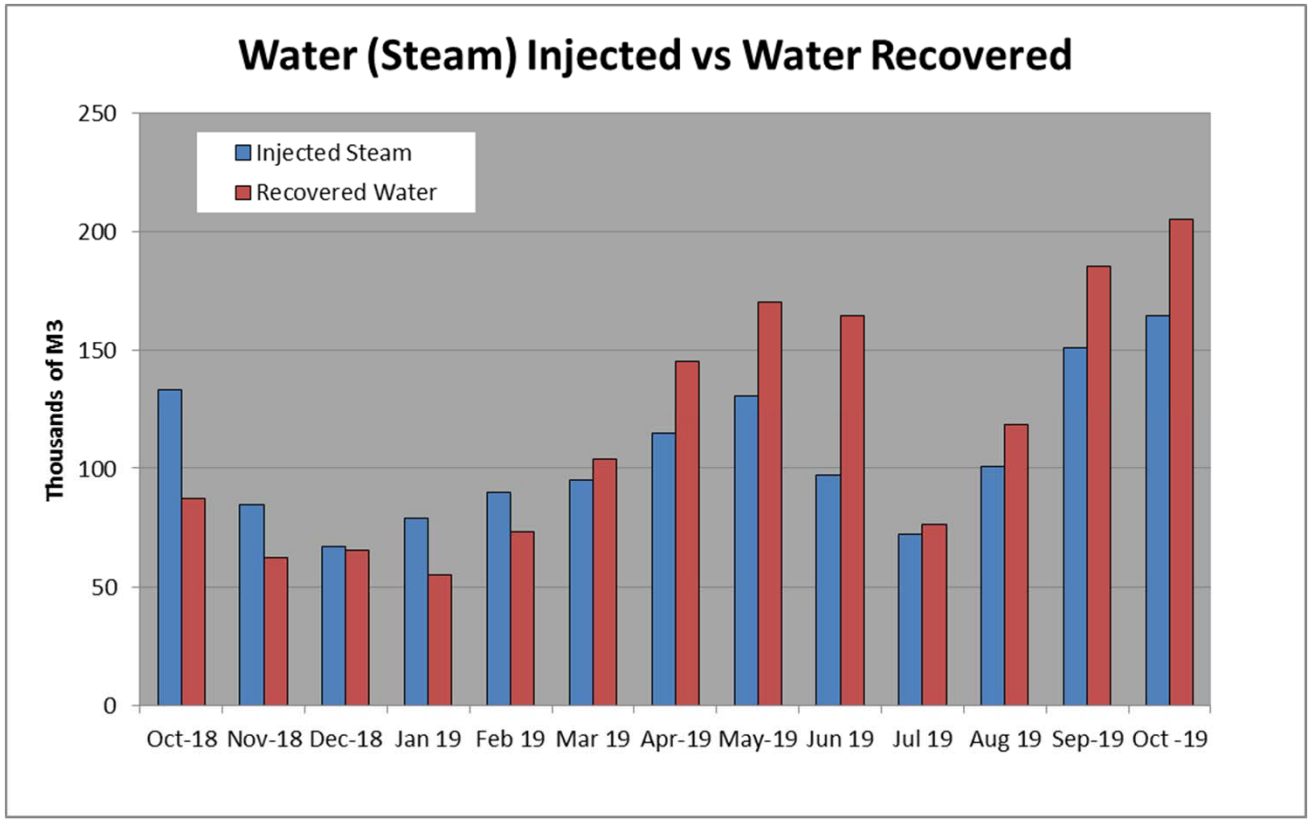
Bitumen Proration



Water Proration



Steam Injected & Produced Water



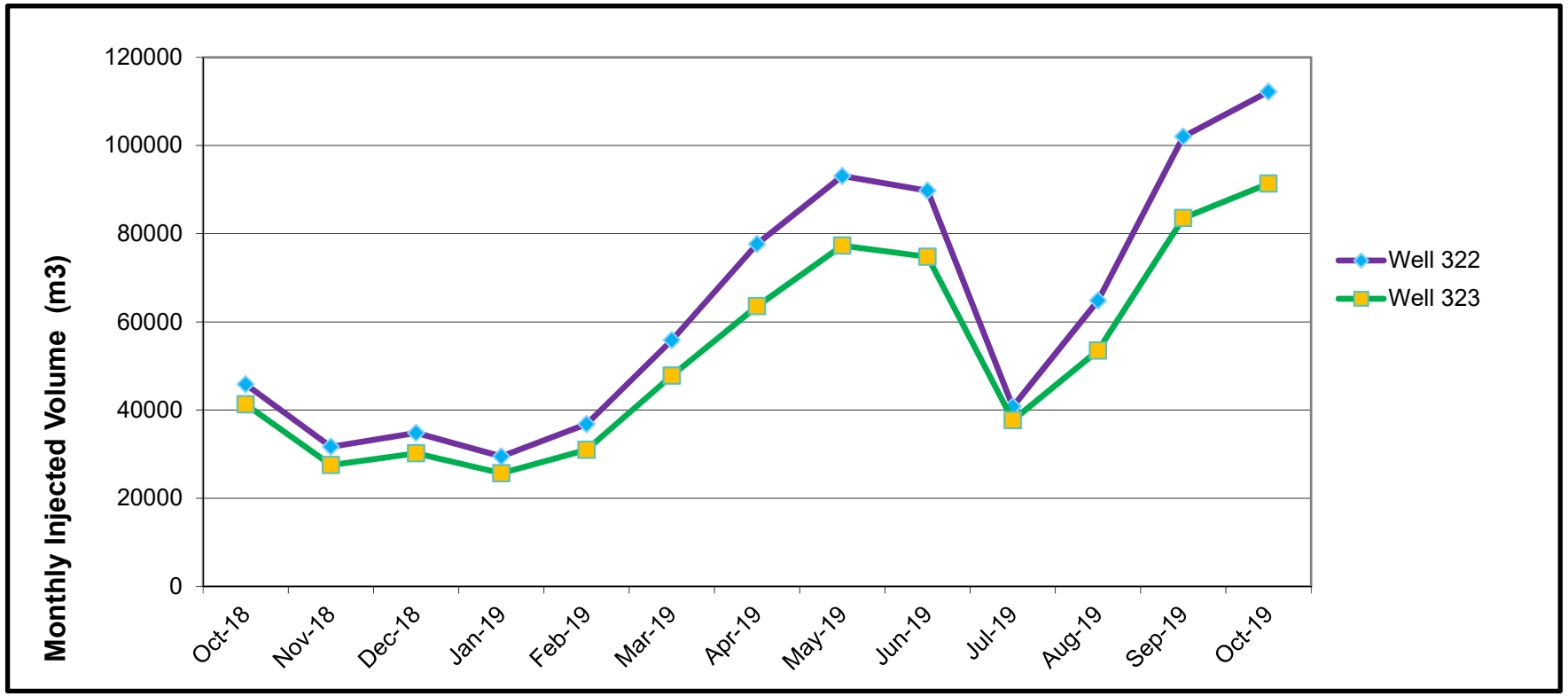
Brine Water Disposal

- Brine Water Disposal Well (100/16-27-85-19W5)
  - Disposed into the Leduc Formation until July 2017
    - Well currently suspended
- Ion Exchange Brine Disposal
  - Brine pipeline shut down due to integrity concerns Q2 2017
  - Brine from Ion Exchange regens now being co-disposed with produced water

Water Disposal

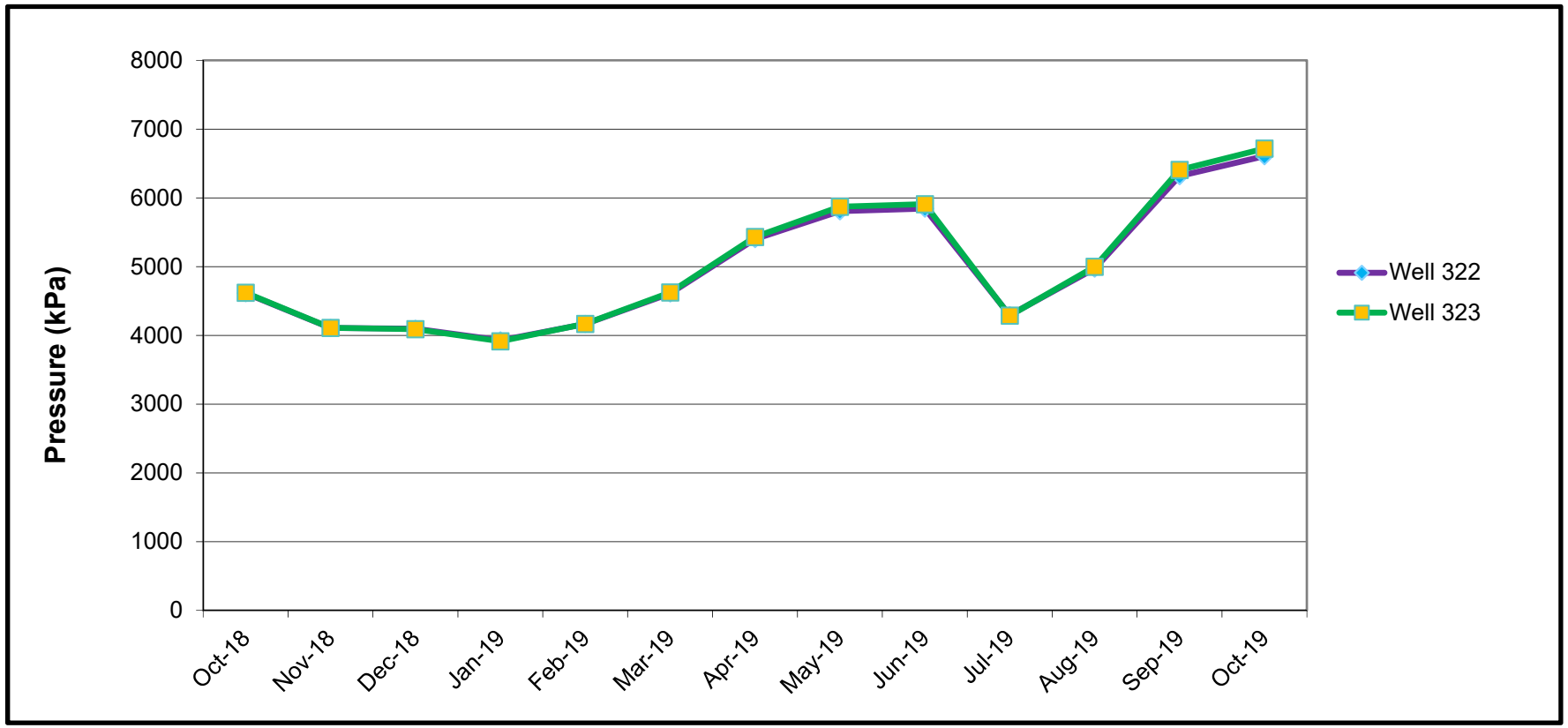
- Produced Water Disposal Well 322 (102/14-25-85-19W5)
  - Disposing into the Leduc Formation
  - Used as produced water disposal well
  - Average Disposal Volume/Day = 2011.2 m^3/d
  - Average Pressure = 4881 kPa
  - Max Pressure = 6815 kPa
  - Average Temperature = 58 ^oC
  - Typical Total Dissolved Solids (TDS) is 5300 g/m3
  - Approval up to 18,000 kPag (as per approval no. 6308)
- Produced Water Disposal Well 323 (102/16-23-85-19W5)
  - Disposing into the Leduc Formation
  - Used as produced water disposal well
  - Average Disposal Volume/Day = 1694.0 m^3/d
  - Average Pressure = 4904 kPa
  - Max Pressure = 6974 kPa
  - Average Temperature = 60 ^oC
  - Typical Total Dissolved Solids (TDS) is 5300 g/m3
  - Approval up to 18,000 kPag (as per approval no. 6308)

Water Disposal Monthly Volumes



Canadian Natural

Water Disposal Max Monthly Injection Pressures

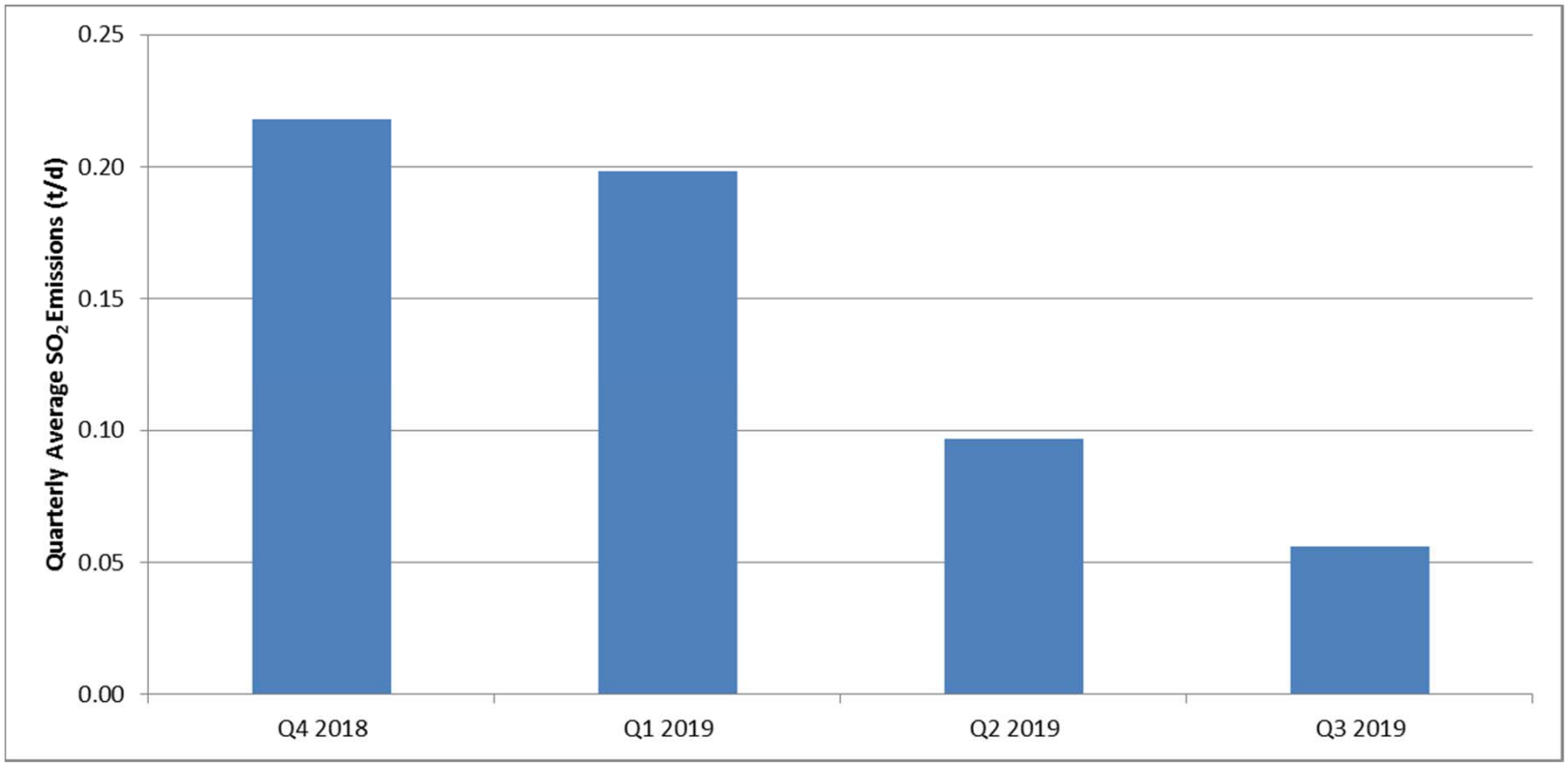


Canadian Natural

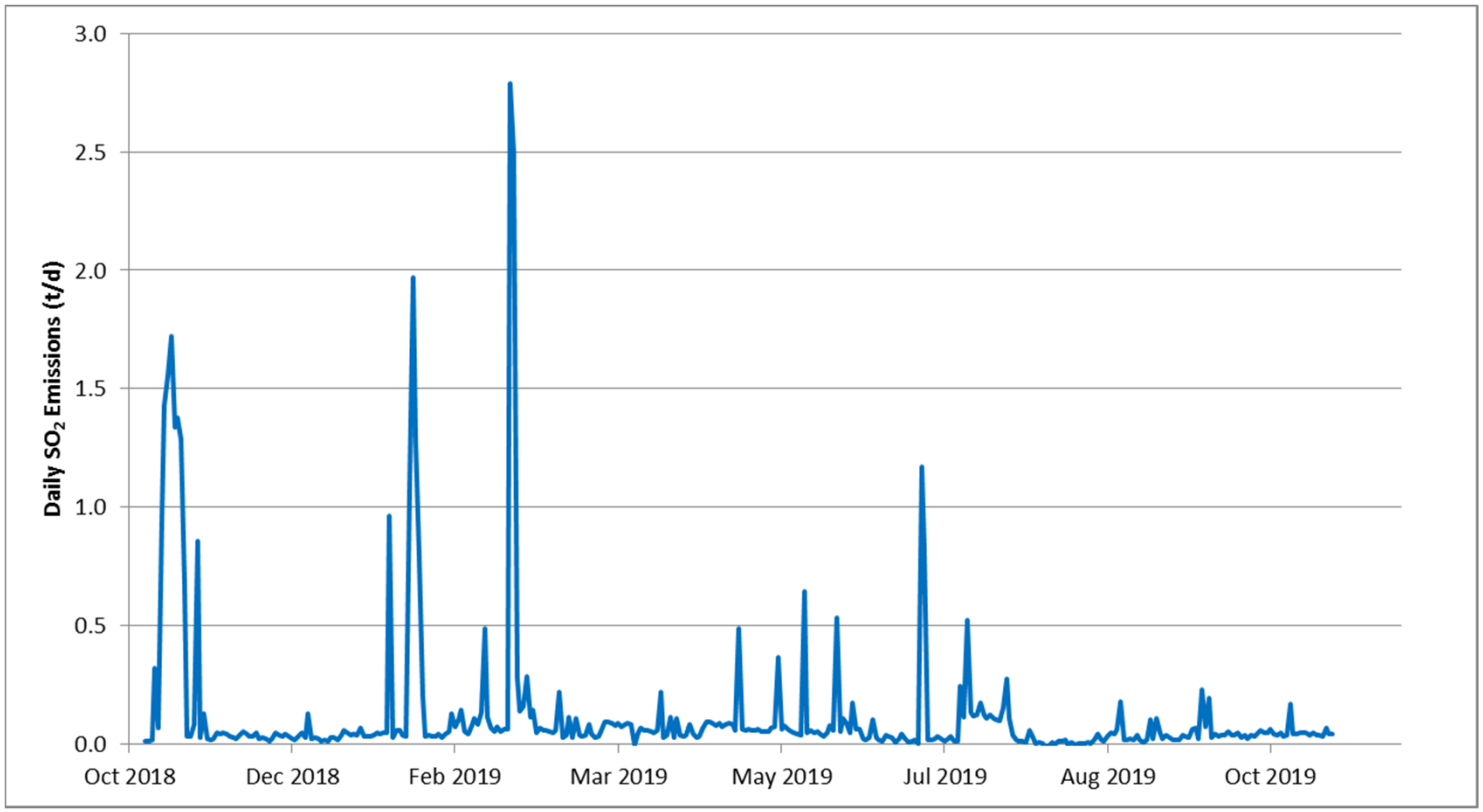
Waste Disposal

- Tervita Corporation– Peace River (12-24-85-19-W5)
  - Treatment, Recovery & Disposal (TRD) Facility
  - Total tank bottom, hydrocarbon sludge, and bitumen waste = 758 m^3 to October 2019
  - Total contaminated waster, spill material, pad solids etc. = 178 m^3 to October 2019
  - Grand total = 936 m^3 to October 2019

Sulphur Emissions



Sulphur Emissions



Canadian Natural

Ambient Air Monitoring

- Static/Passive Air Monitoring
  - Twelve passive stations
  - Gathers sulphur dioxide and hydrogen sulphide data
  - 2019 monitoring and reporting satisfactory

- Continuous Ambient Monitoring data
  - Parameters include: sulphur dioxide, hydrogen sulphide, methane, non-methane hydrocarbons, total hydrocarbons, total reduced sulphur, ambient temperature, wind speed and direction
  - Audit conducted January 17th, 2019 of ambient air monitoring station
  - Taller tower being installed December 2019 in response to audit findings

Environmental Compliance

- Several H_2S Exceedances noted at the Ambient Air Monitoring Trailer in 2019, none as a result of Operations
  - Determined the exceedances were the result of naturally occurring sulphur reducing bacteria (SRB) in surrounding standing water
  - Monthly calibrations completed, air trailer maintained uptime requirement

- Summary of spills and releases
  - 10 spills comprising 5.2 m^3

EPEA Approval 1642-02-00 Amendments

- EPEA Operating Approval Amendments between October 2018 - October 2019:
  - 1642-02-12 Approved December 13, 2018
    - Minor adjustments made to short term produced gas flaring and burning conditions

EPEA Approval 1642-02-03
Monitoring Program Summary

- Groundwater Program
  - PRC has requirements for groundwater and deep well water testing
    - Testing and reporting required on an annual basis
    - Testing completed September 2019, results to be reported in 2019 annual report
- Soil Monitoring Program
  - Soil testing will be completed December 2019
    - Results to be reported in 2019 annual report
- Wetland Monitoring Program
  - Testing completed August 2019
    - Results to be reported in 2021 comprehensive report

EPEA Approval 1642-02-03
Monitoring Program Summary

- Shallow groundwater monitoring program:
  - Groundwater testing occurred on plant piezometers
  - Results to be submitted March 2020

- Shallow groundwater wells around reclaimed PSDS (Produced Solids Disposal Site):
  - PSDS has been reclaimed and well Pad 32 built on the location
  - Piezometers remain around perimeter of well pad
  - No impacts observed in these wells with little variation at a majority of the monitoring locations
  - Results to be submitted March 2020

- Deep groundwater monitoring program at regional wells:
  - Groundwater sampling program included thermal profiles, samples collected, packer integrity assessment
  - Results to be submitted March 2020

EPEA Approval 1642-02-03
Monitoring Program Summary

- Wildlife Monitoring Program updated to include the use of Autonomous Recording Units (ARU) to replace amphibian, breeding birds, and bat surveys and an expanded remote camera program to replace winter tracking:

  -Authorization was received from the AER on June 29, 2019.

- All wildlife data for these surveys is uploaded into the Fish & Wildlife Management Information System (FWMIS) and incorporated into the Comprehensive Wildlife Reports

- Wrap up of peatland reclamation research with NAIT Boreal Research Institute. Report being compiled

Peatland Research Sites Overview

- Peatland indicator framework for monitoring reclamation success using UAV and proven methods (COSIA-JIP supported by CNRL)
- Project team: NAIT CBR, C-CORE
- Sites: IPAD, Airstrip, SKEG 12 and 16, ASPEN, Chip Road
- Methods: 60 vegetation plots per 1 km^2 area, 40 water wells/area, 2 topography transects; 2 UAV flights
- Summer sampling and field data being compiled, developing algorithms to match ground data with UAV imagery

From dirt to peat: development of peat accumulating communities on reclaimed in-situ features

- Sites: IPAD, Airstrip, SKEG 12 and 16, Aspen, and Pad 8-22
- Methods: vegetation survey (25 cm quadrats), biomass harvest, litter bags (decomposition), ingrowth bags (belowground productivity)
- Status: litter bags buried by end of October 2019. Ingrowth bags placed. Processing biomass samples for nutrient analysis.

Reclamation Summary

24 EPEA sites in R&R status in Siteview

- 2019 Reclamation activities:
  - 8 reclamation certificates received totaling 25.1 hectares
  - Completed DSA reporting and submitted 6 reclamation certificates total 11.73 hectares
  - Continuing weed control and vegetation assessments on 5 locations
- Proposed 2020 Activities:
  - Complete outstanding reclamation certificate applications as per sites evaluated in 2019
  - Continue weed control and vegetation assessments on 5 locations.
  - Complete one Phase 2 Assessment
  - Continue research on 2 sites

Research Trials - 2019

- Peatland Restoration
  - NAIT has been compiling results from multiple peatland restoration projects near Peace River Facility since 2015
- Field Trials Include
  - Complete pad removal and moss layer transfer technique (IPAD, 8-22)
  - Partial pad removal and moss layer transfer technique (ASPEN)
  - Burial of woodchips under peat (Chip Road)
  - Recovery of donor areas
  - Mineral wetland reclamation (Airstrip)
  - Linear footprint impact on peatland functions (Carmon creek bypass road)
  - Field trail technical notes and videos being developed
- Final 5-year report to be provided by early 2020

Future Plans

- D081 waiver extension to 2030 to permit small incremental development opportunities to progress
  - Due to current unfavorable market conditions, the future potential of PRC is being evaluated, including the possibility of shutting in the facility
  - Without a D081 waiver extension, the likelihood of PRC being shut-in would increase
- Steam water specification to be developed to coincide with reservoir strategy
- Facility modifications to accomplish revised reservoir and steam water specification strategy (if required)
  - Future water treatment options being considered that will align with both the asset development strategy and steam water specification


Canadian Natural
PROVEN • EFFECTIVE • STRATEGY