Husky Oil Operations Limited

Tucker Thermal Project

Commercial Scheme Approval No. 9835

Annual Performance Presentation
Alberta Energy Regulator

September 5, 2018

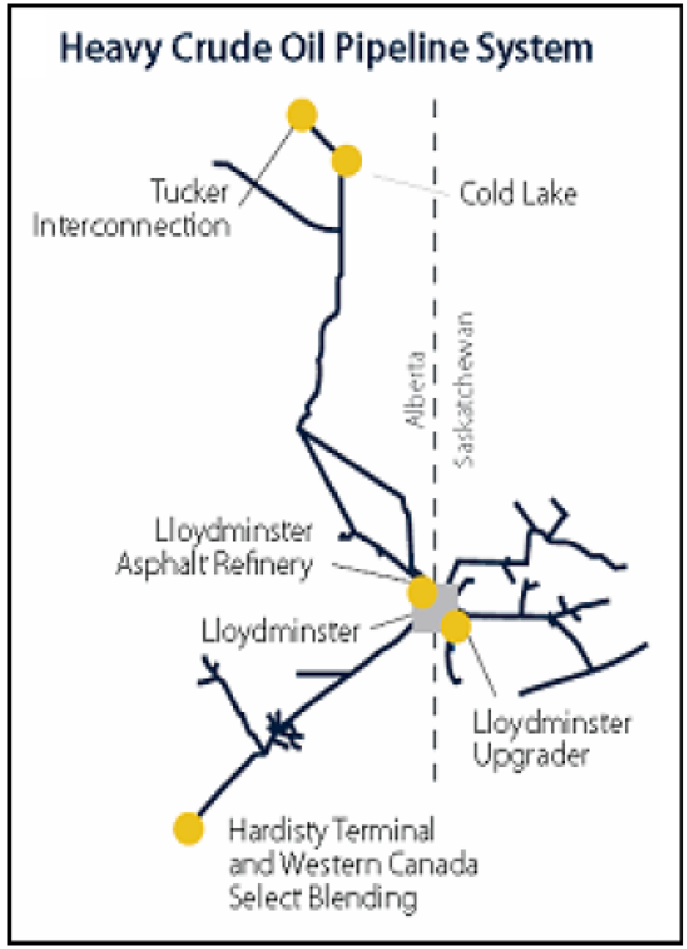
3.1.1. Subsurface

TABLE OF CONTENTS

1. Brief Background

PROJECT OVERVIEW

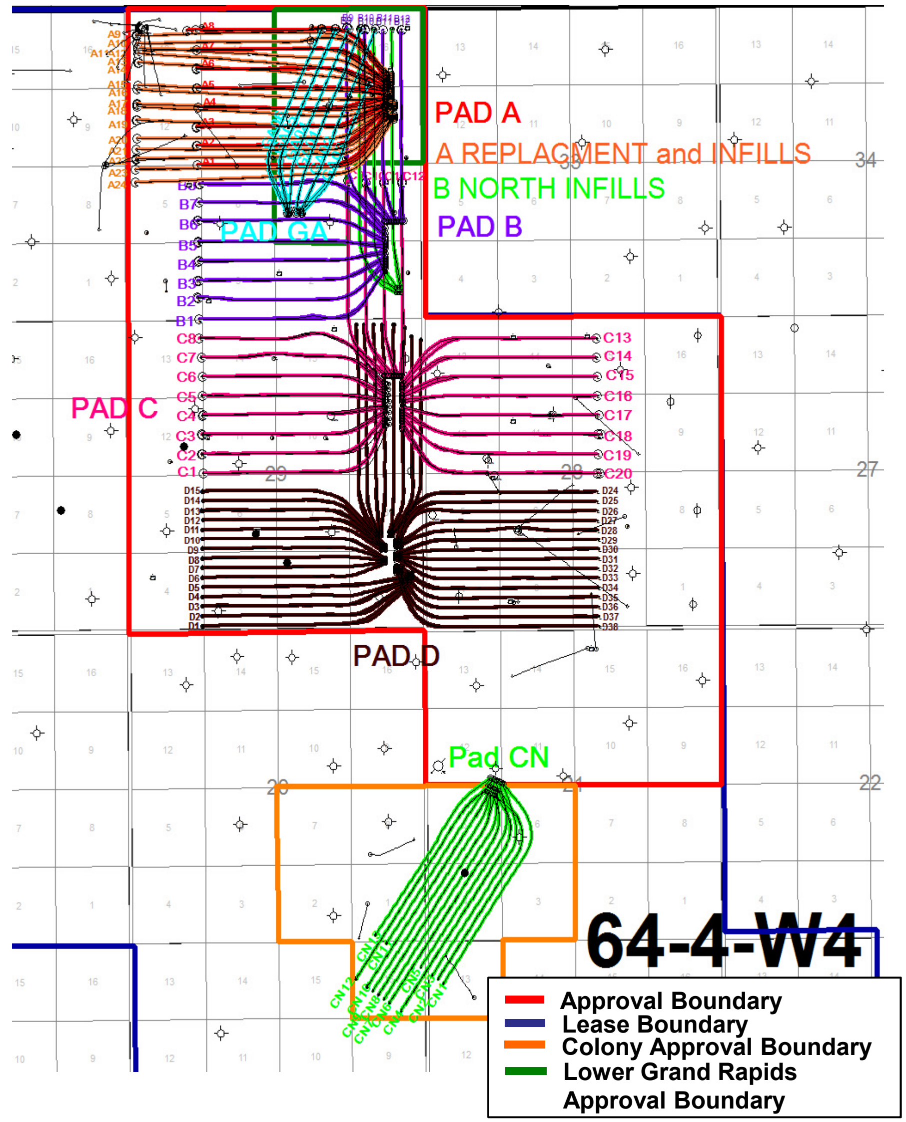
- AER Commercial Scheme Approval No. 9835
- 30,000 BOPD SAGD Project
- Clearwater and Grand Rapids Reservoirs
- 9-10º API Bitumen
- Integrated with Husky Pipeline & Upgrader
- First steam - August 20, 2006
- First production - November 29, 2006



1. Brief Background

PROJECT DEVELOPMENT AREA

- Approval Area:
  - Sections 28, 29, 32 & N/2 of 21 in 064-04 W4M
  - SE ¼ Section 23, SW ¼ Section 21, Section 17 LSD 16 & Section 16 LSD 13
- 35 Year Project Life
- 109 Horizontal Well Pairs & 7 Infill Producers
  - 32 original well pairs (Pads A, B, C)
  - Well pairs added:
    - Pad C East 2007 - 8 well pairs
    - Pad B Infill 2009-2010 - 3 well pairs
    - Pad A Infill & Replacements 2010/2011) - 16 well pairs
    - Pad Lower Grand Rapids (GA) 2011 - 1 well pair; 2012-2013 – 5 well pairs
    - Pad D East 2014 - 15 well pairs
    - Pad Colony (CN) 2015 - 6 well pairs & 7 infill producers
    - Pad D North 2016 - 8 well pairs
    - Pad C West Replacement 2016 – 8 injectors
    - Pad D West 2017 - 15 well pairs



1. Brief Background

SITE OVERVIEW

- Field Facilities – six well pads, infield pipelines and central pump station
- Central Plant:
    - Emulsion treating
    - Water Treatment – 120,000 bbl/day
    - Steam Generation – 99,000 bbl/day CWE
    - Utilities and Off -sites
- Water Source & Disposal Wells
- Metering and Export Pipelines to Cold Lake Terminal

2. Geology/Geosciences

AVERAGE RESERVOIR CHARACTERISTICS AND OBIP

CLEARWATER	OBIP ($X10^6$ m^3)	Thickness (m)	Φ	So	Viscosity (cP @ 20°C)	Original Pressure (kPa)	Original Temperature (°C)	Depth (m)	Vertical Permeability (mD)	Horizontal Permeability (mD)
Approval Area	72.0	45	0.31	0.57	50,000-1,000,000	3,200	16	440	1,800	3,000
Operating	40.9	46	0.32	0.57	50,000-1,000,000	3,200	16	440	1,800	3,000

LOWER GRAND RAPIDS	OBIP ($X10^6$ m^3)	Thickness (m)	Φ	So	Viscosity (cP @ 20°C)	Original Pressure (kPa)	Original Temperature (°C)	Depth (m)	Vertical Permeability (mD)	Horizontal Permeability (mD)
GA Approval Area	3.7	33	0.29	0.55	100,000-300,000	2,600	14	370	1,300	1,800

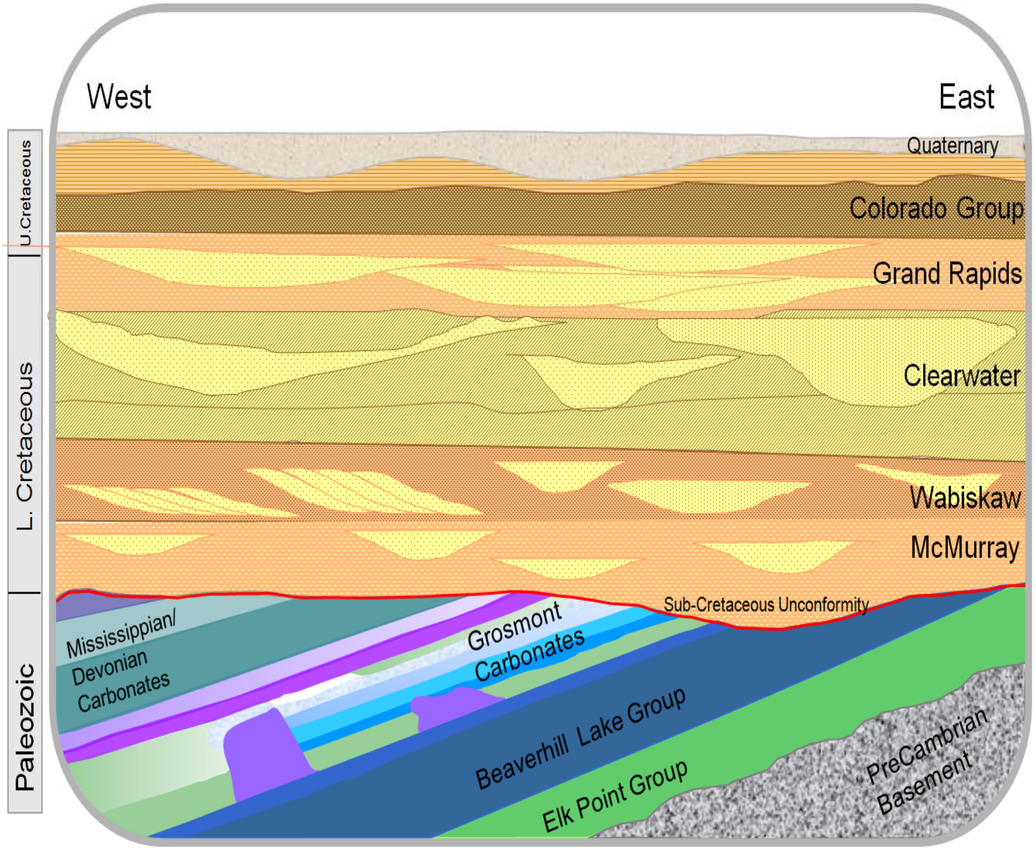
COLONY	OBIP ($X10^6$ m^3)	Thicknes s (m)	Φ	So	Viscosity (cP @ 20°C)	Original Pressure (kPa)	Original Temperature (°C)	Depth (m)	Vertical Permeability (mD)	Horizontal Permeability (mD)
CN Approval Area	2.8	10	0.30	0.79	25,000	2,500	12	305	2,400	4,000

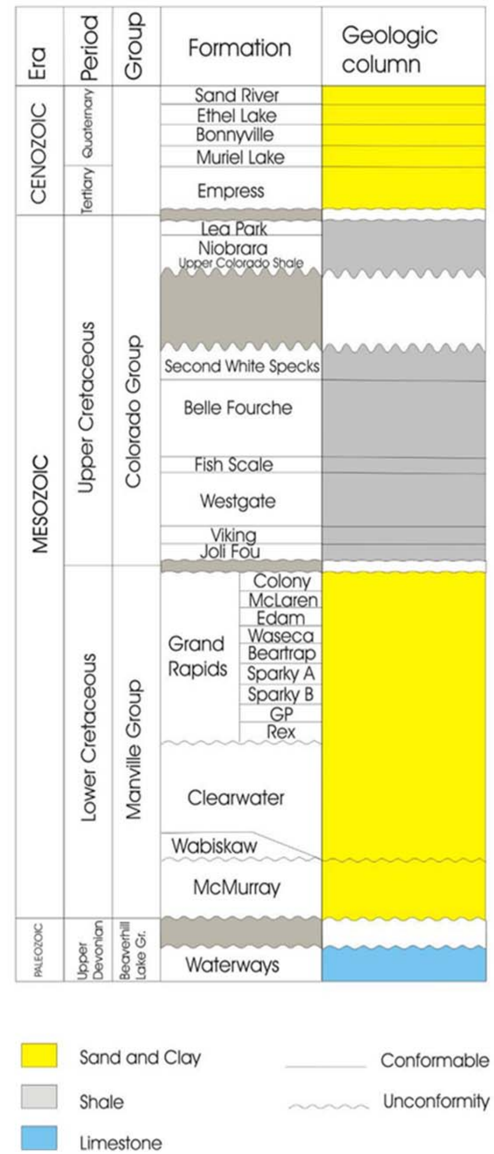
Notes:
Calculation: OBIP interval: Top of Formation → oil water contact
OBIP = Area x Thickness x Φ x S_o

2. Geology/Geosciences

REGIONAL STRATIGRAPHY

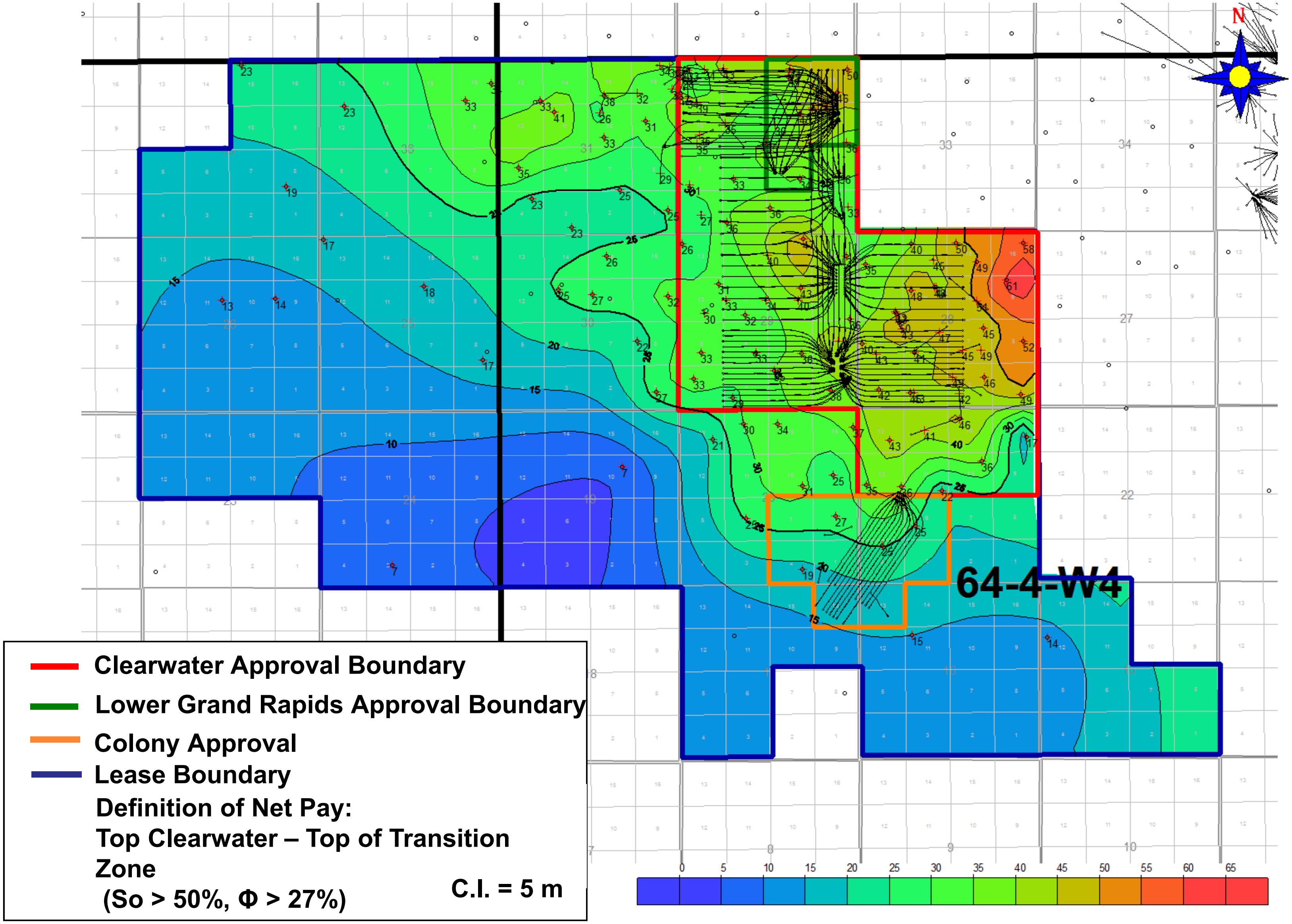
- Marginal marine deposits consisting of stacked incised valleys and shoreface deposits





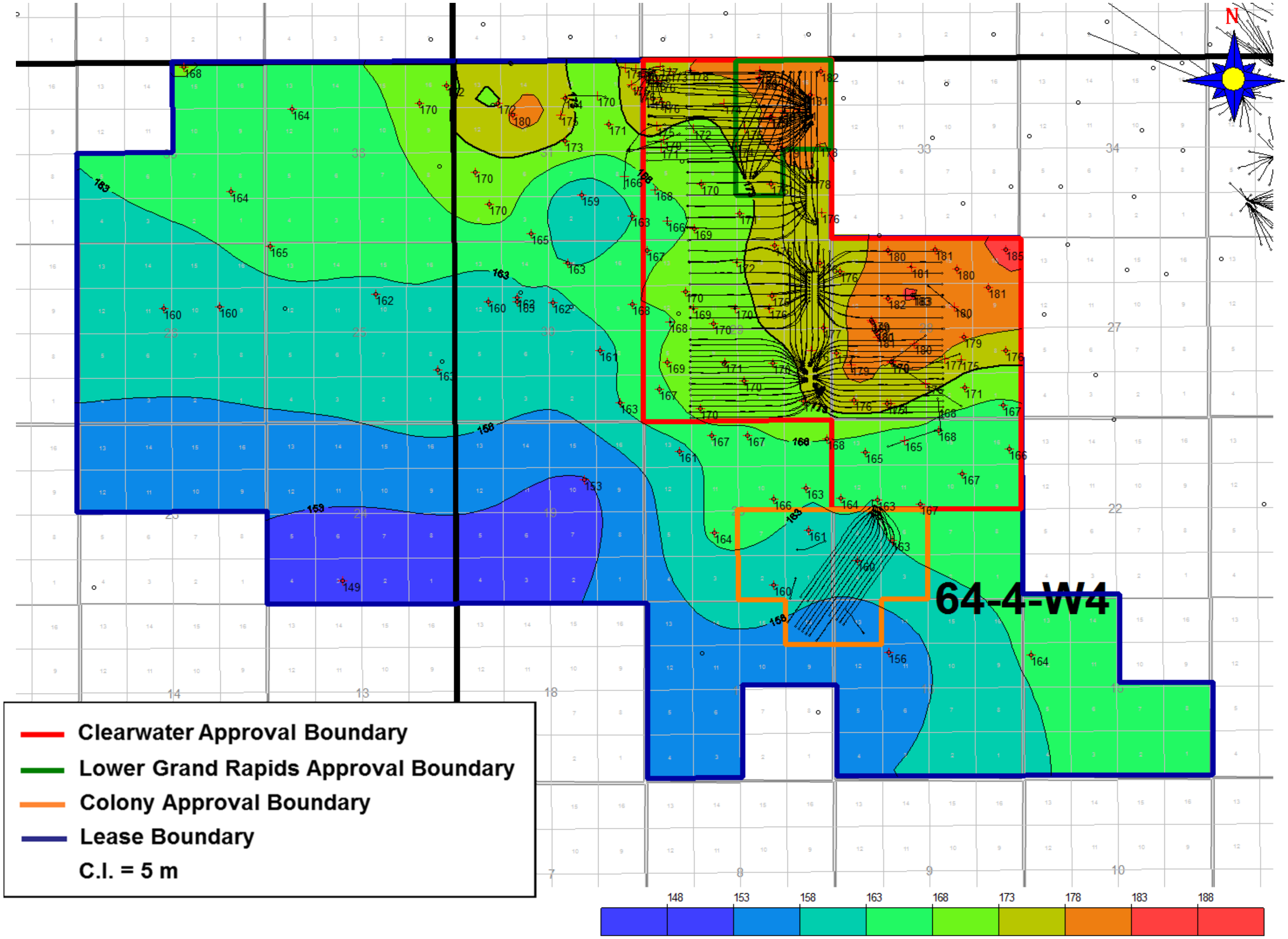
2. Geology/Geosciences

ISOPACH MAP OF CLEARWATER SAGD NET PAY



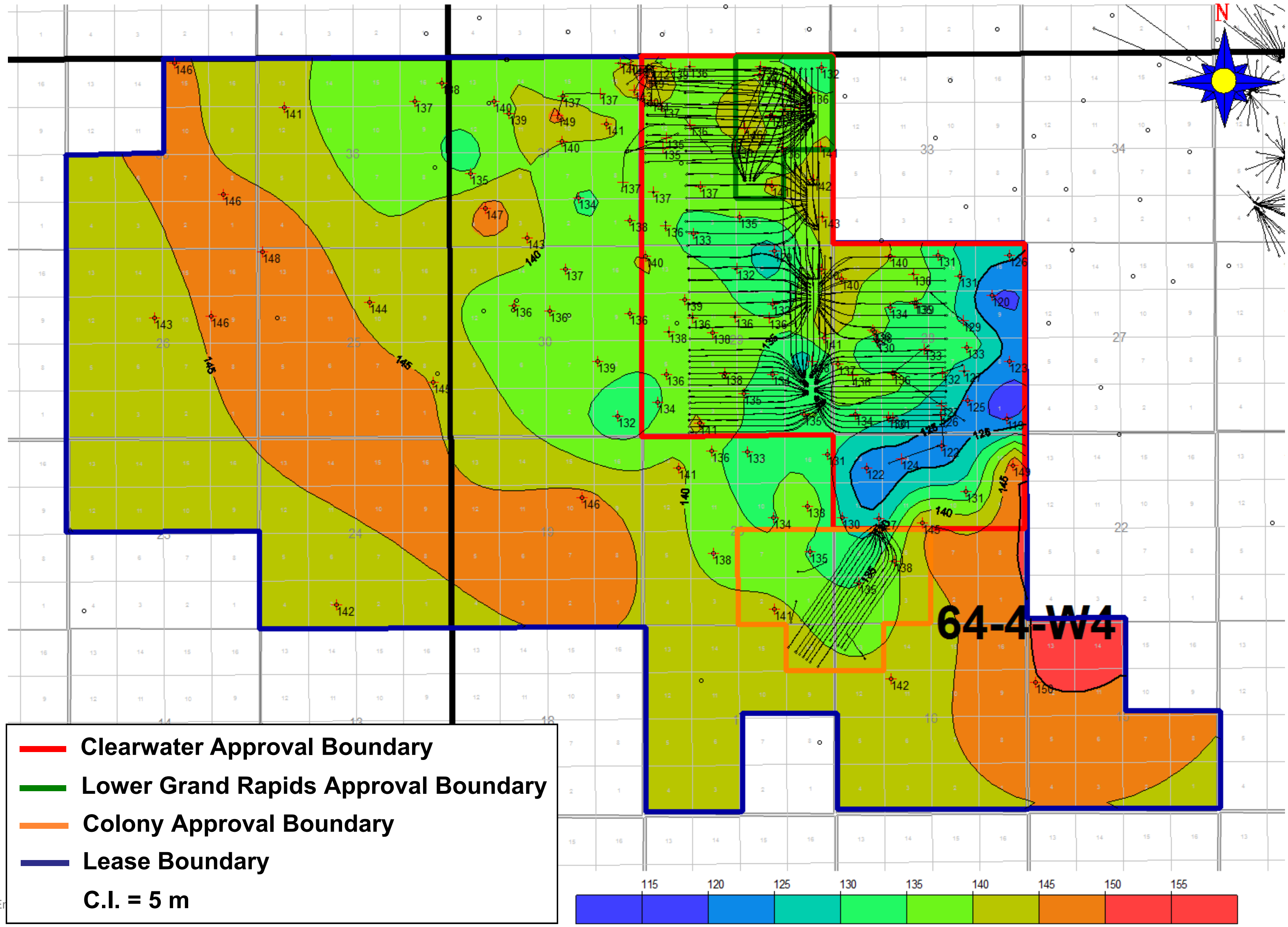
2. Geology/Geosciences

STRUCTURE MAP OF THE CLEARWATER TOP OF NET PAY



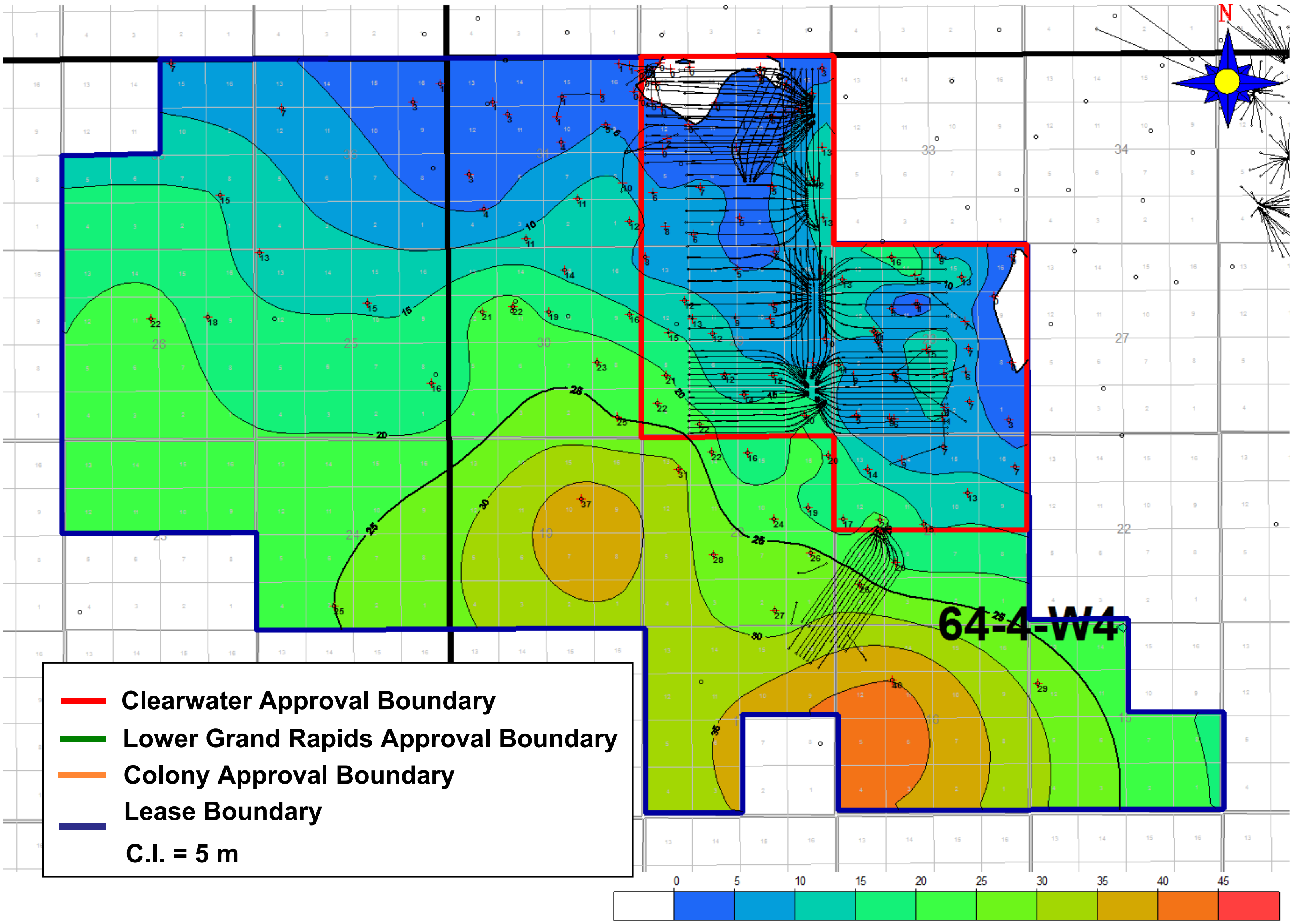
2. Geology/Geosciences

STRUCTURE MAP OF THE CLEARWATER BASE OF NET PAY



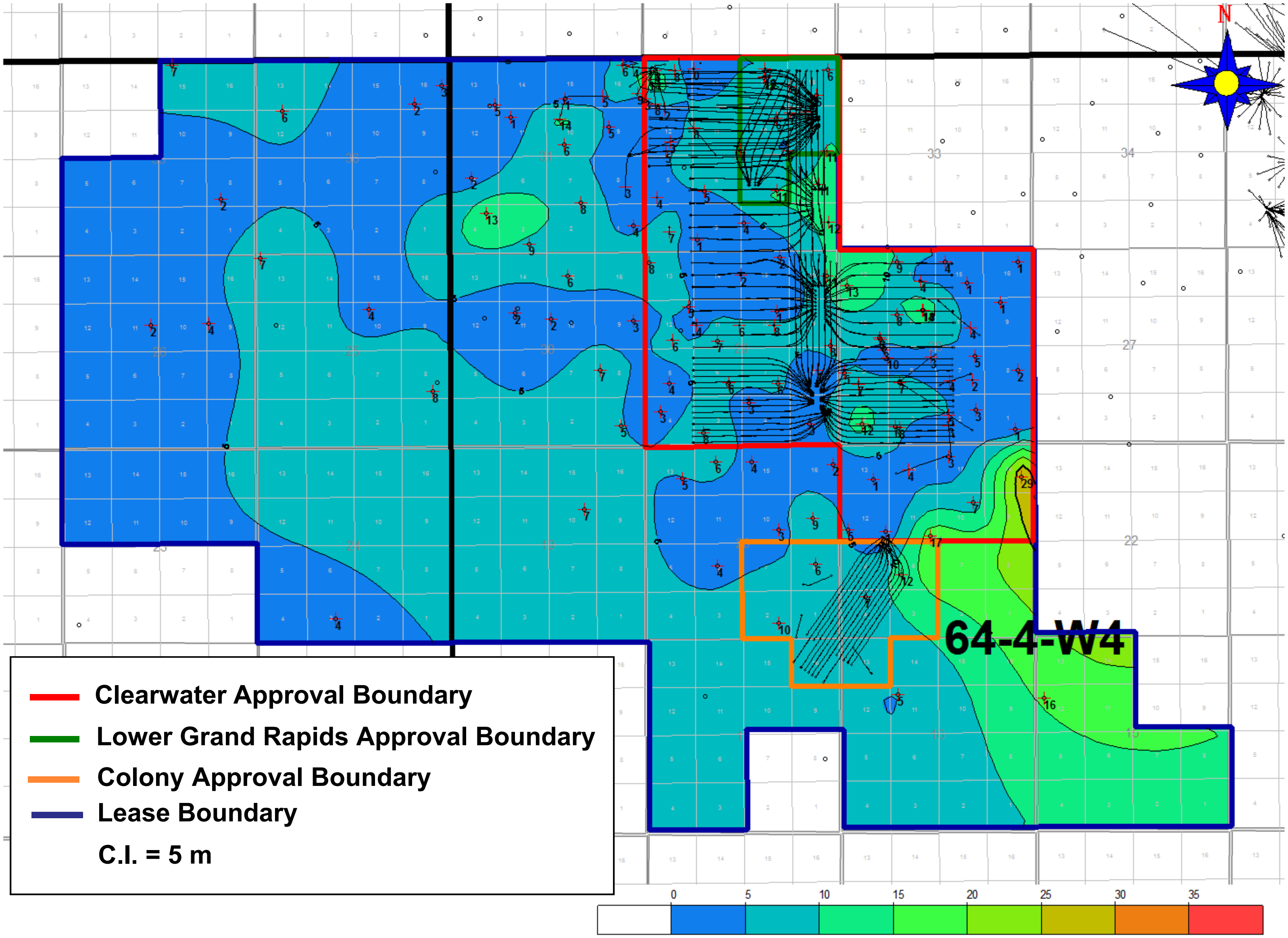
2. Geology/Geosciences

ISOPACH OF CLEARWATER BOTTOM WATER



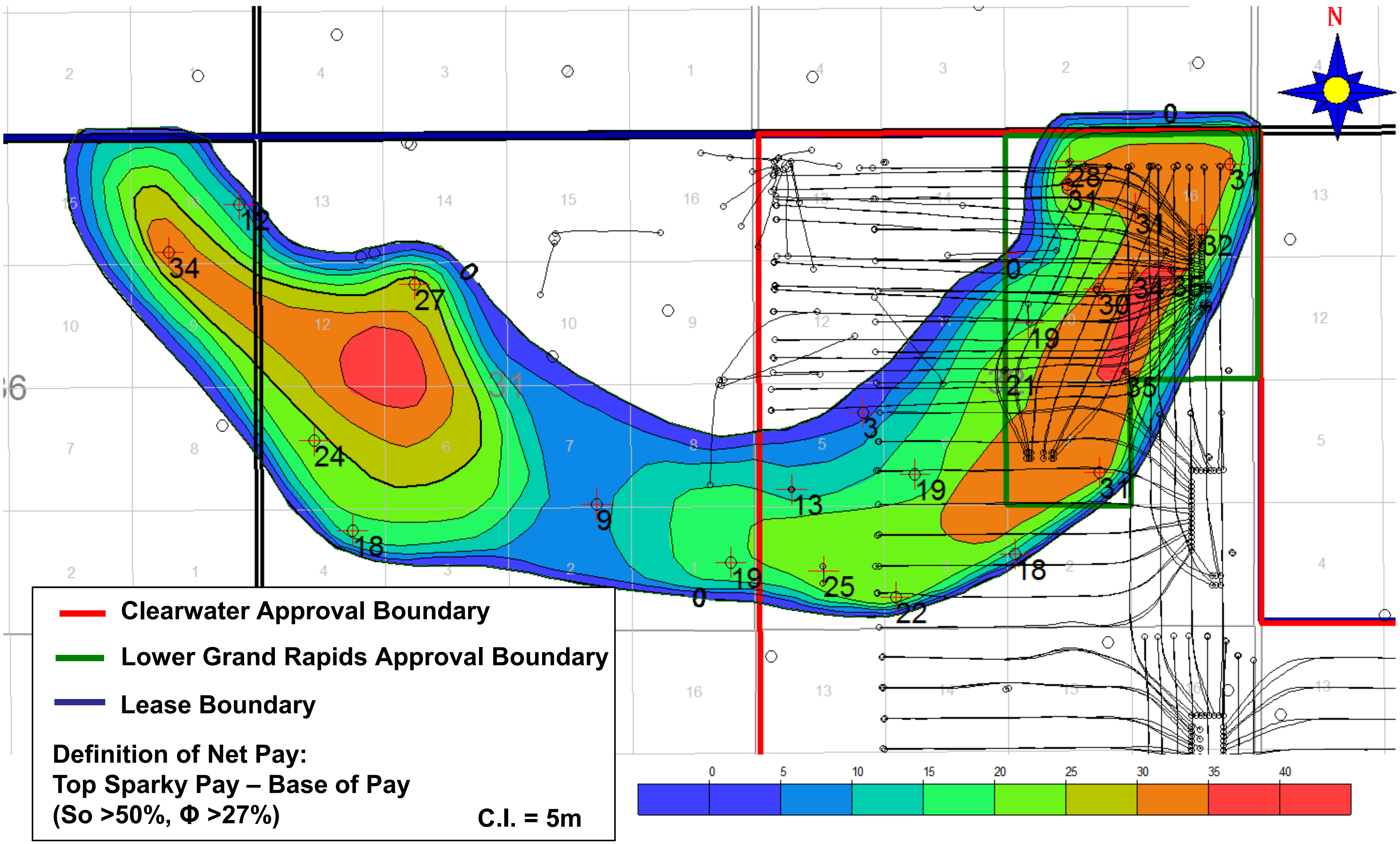
2. Geology/Geosciences

ISOPACH OF CLEARWATER TRANSITION ZONE



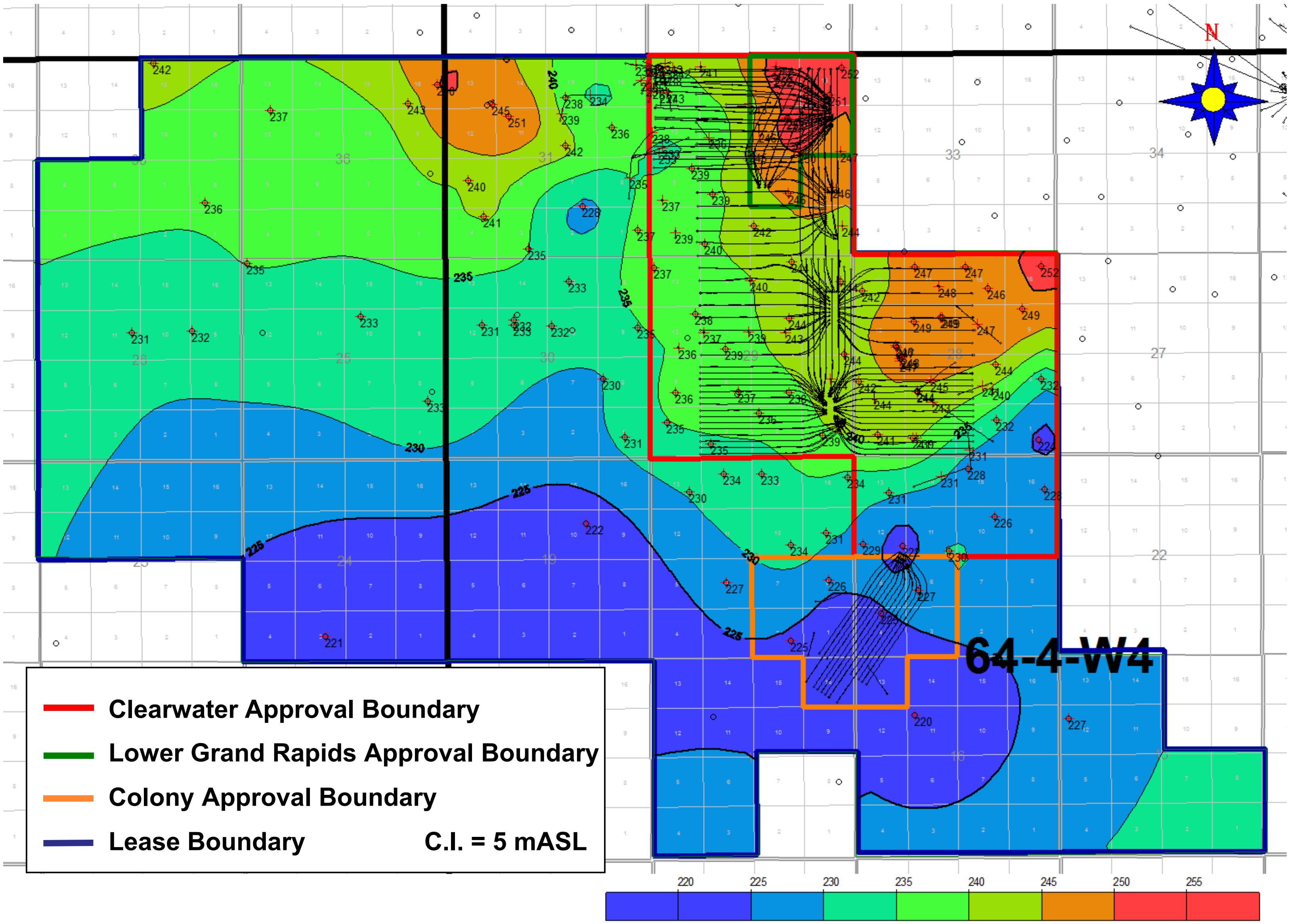
2. Geology/Geosciences

ISOPACH MAP OF LOWER GRAND RAPIDS SAGD NET PAY



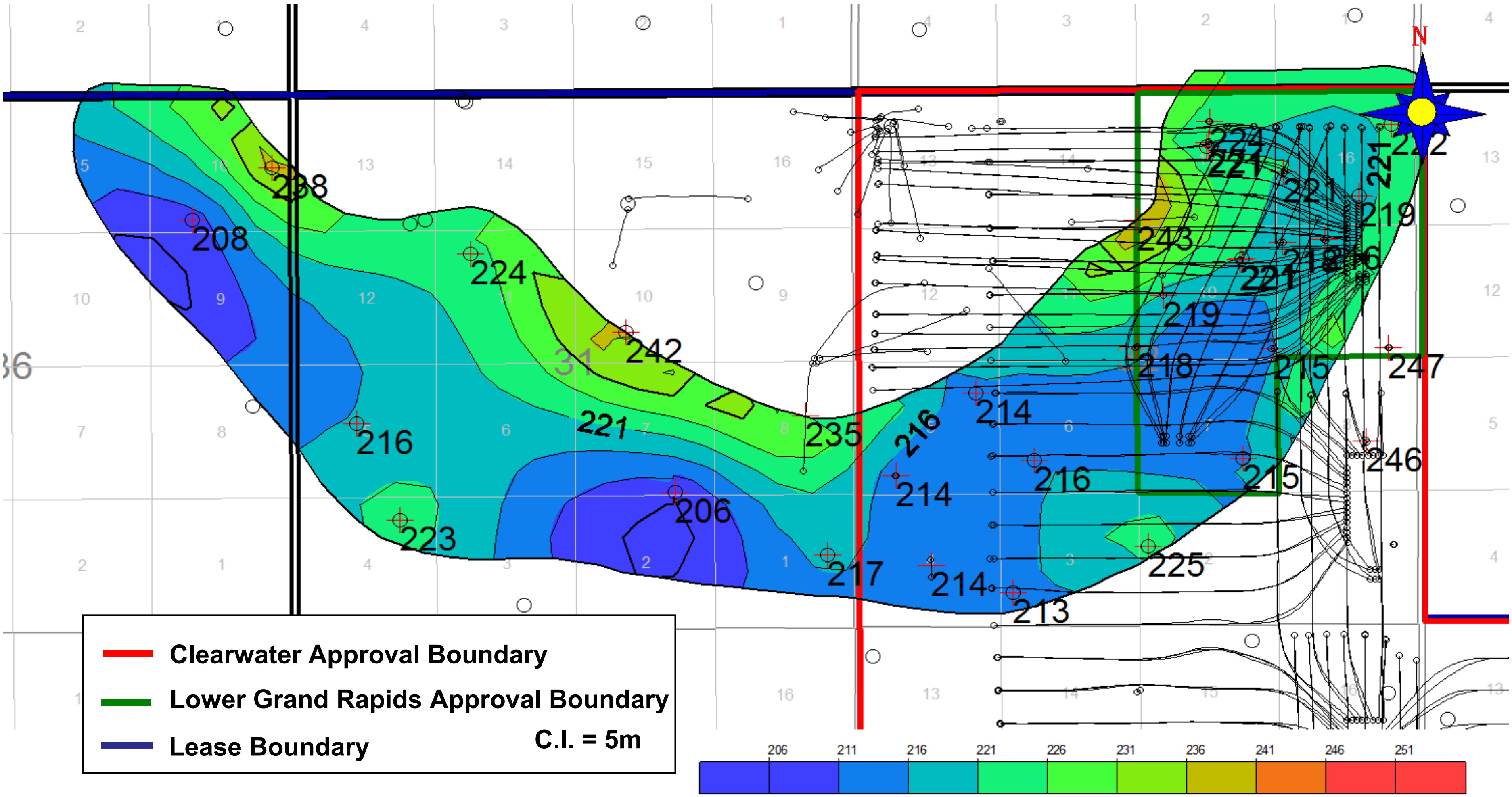
2. Geology/Geosciences

STRUCTURE MAP OF THE LOWER GRAND RAPIDS



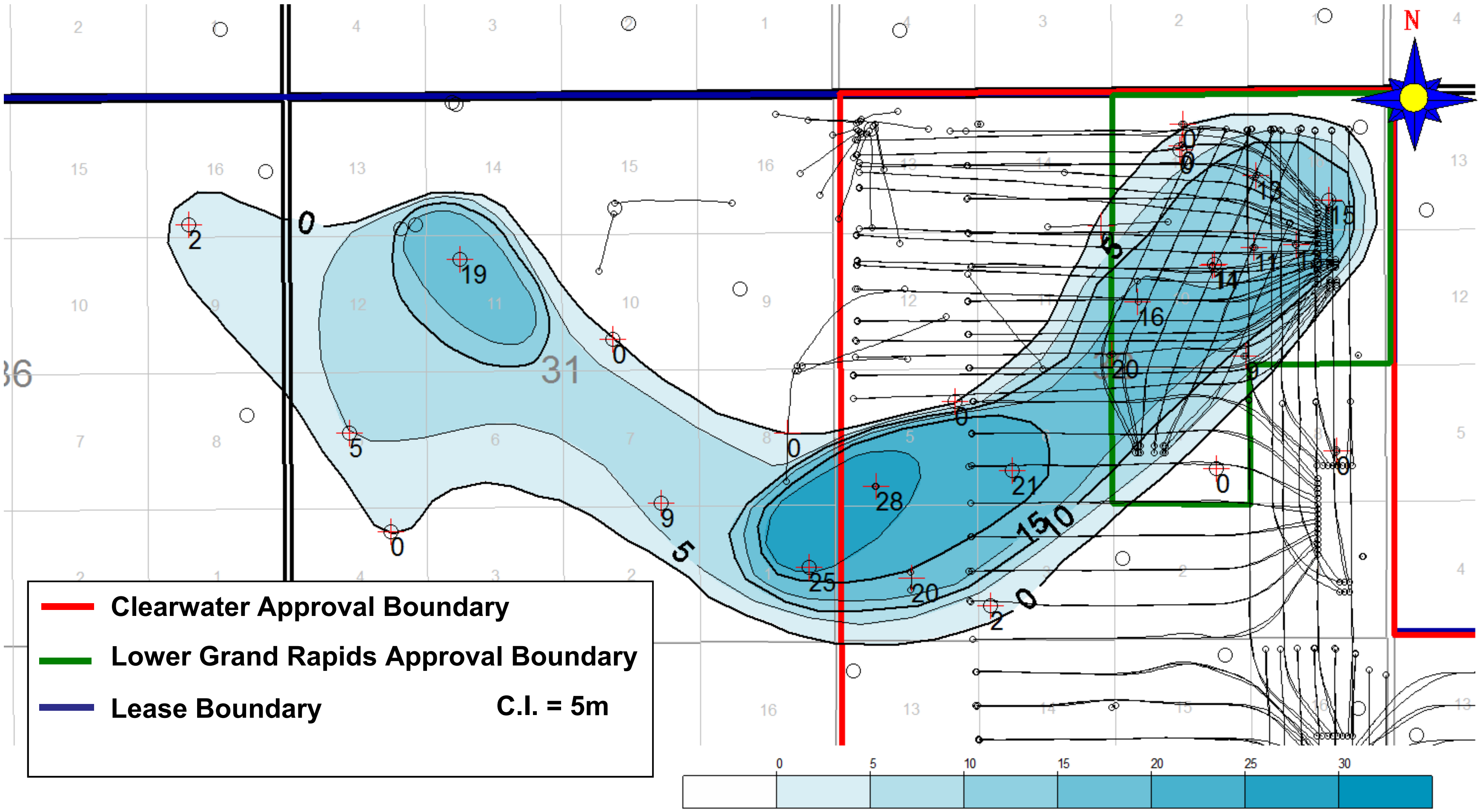
2. Geology/Geosciences

STRUCTURE MAP OF THE LOWER GRAND RAPIDS BASE OF NET PAY



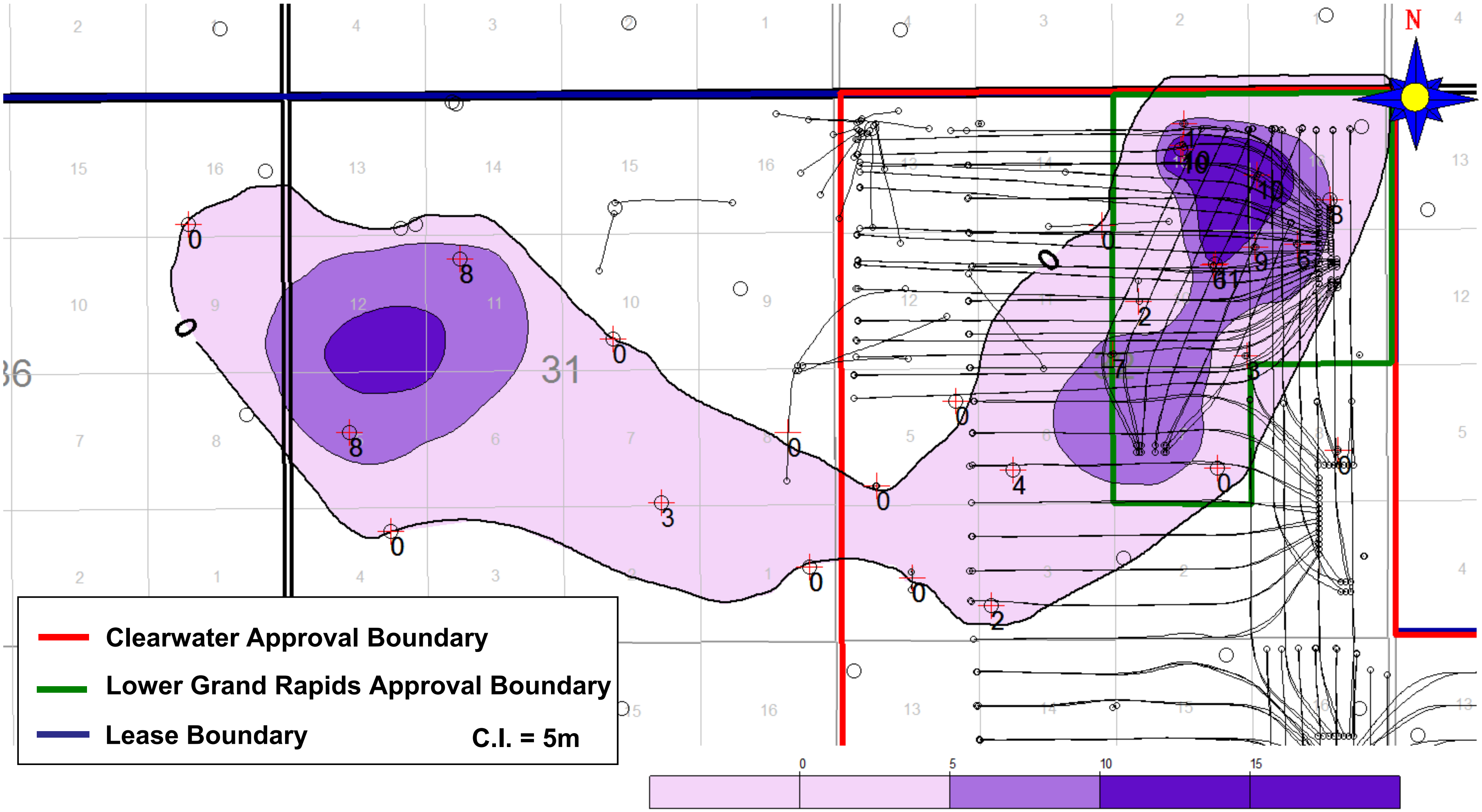
2. Geology/Geosciences

ISOPACH MAP OF LOWER GRAND RAPIDS BOTTOM WATER



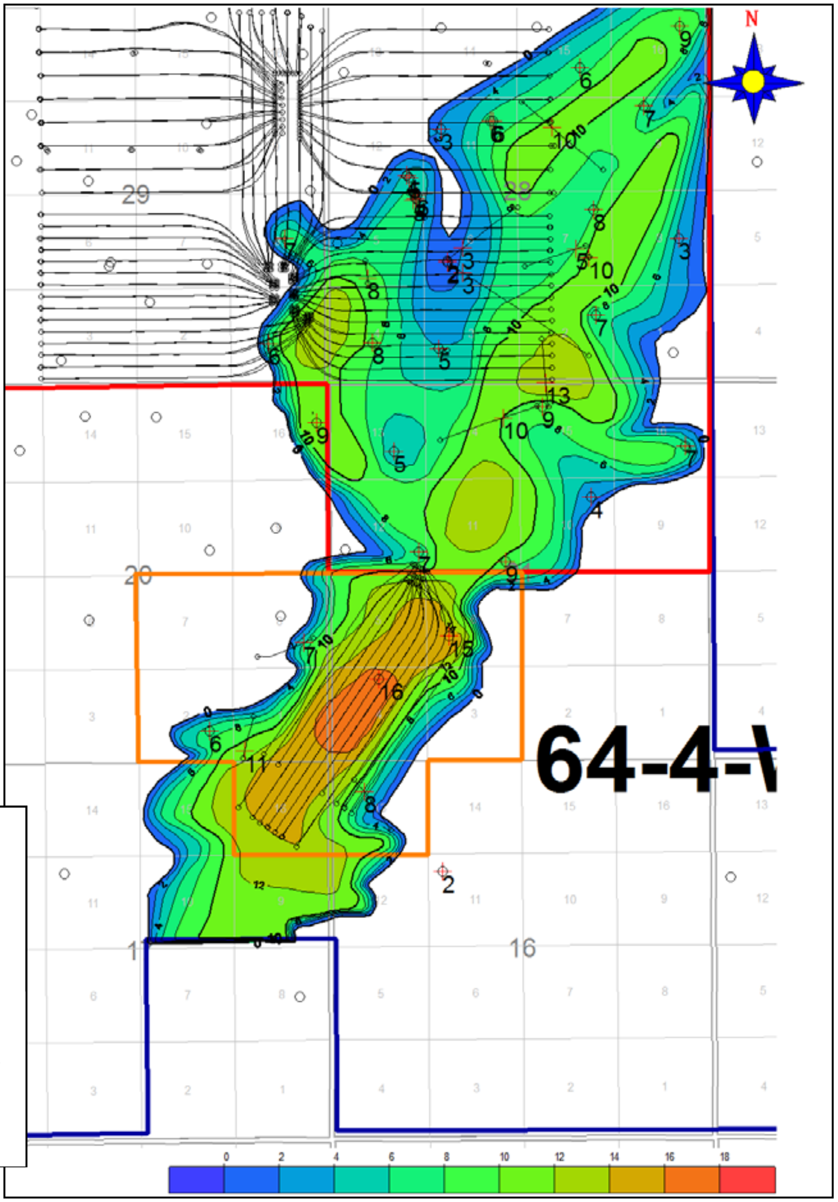
2. Geology/Geosciences

ISOPACH MAP OF LOWER GRAND RAPIDS TRANSITION ZONE



2. Geology/Geosciences

ISOPACH MAP OF COLONY SAGD NET PAY



Clearwater Approval Boundary

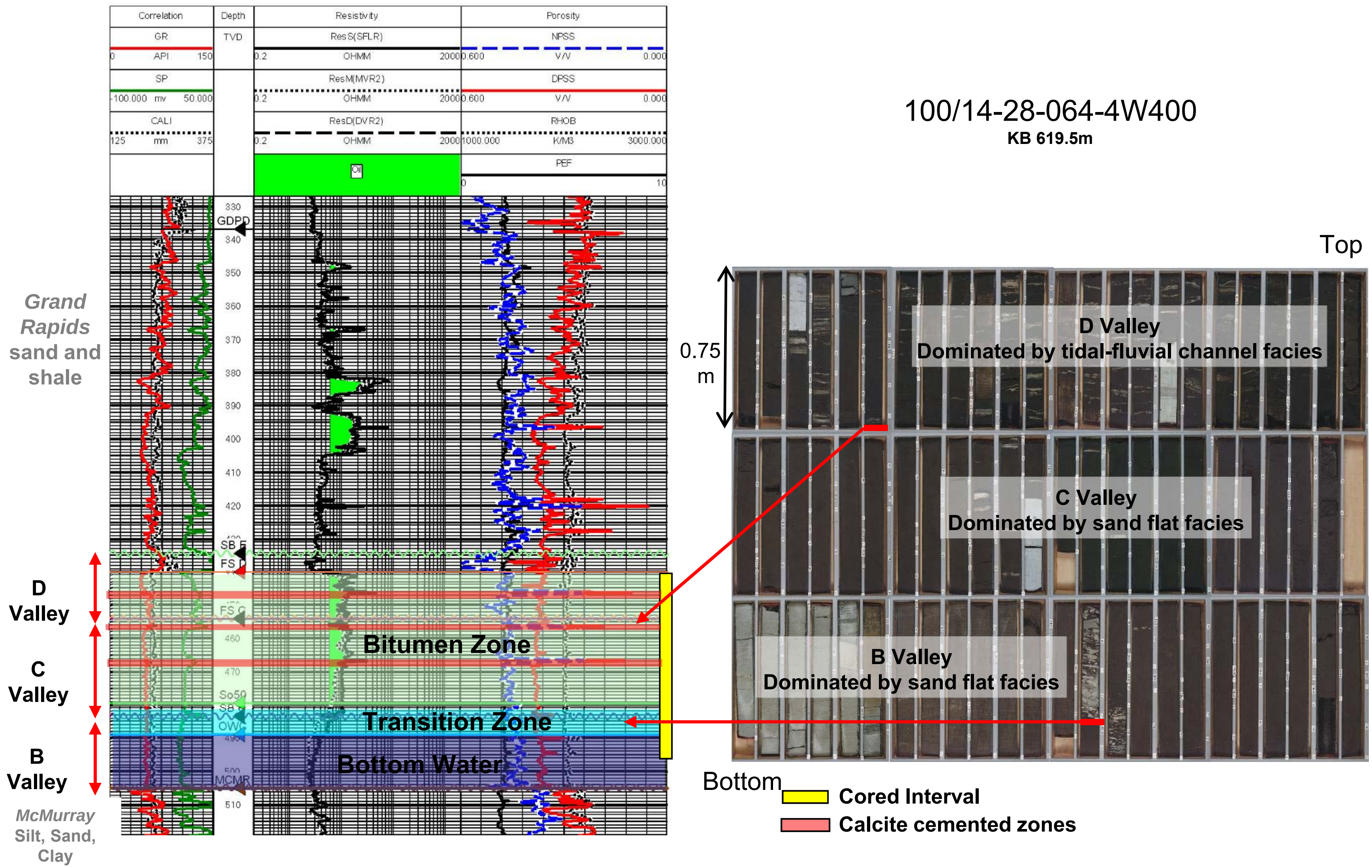
Colony Approval Boundary

Lease Boundary

Definition of Net Pay:
Colony Top Pay– Colony Channel Base Pay (So >50%, Φ>27%)
C.I. = 2 m

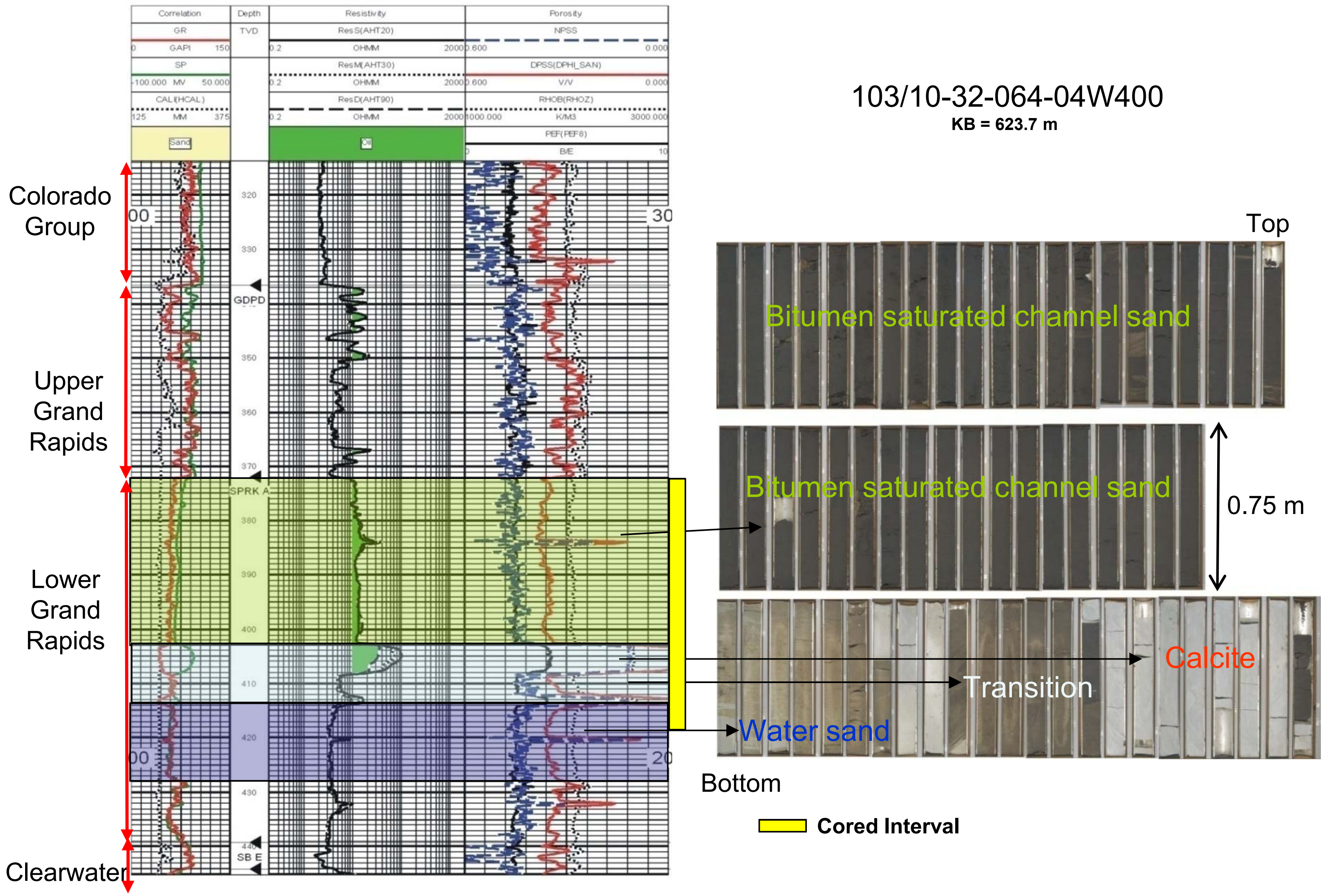
2. Geology/Geosciences

CLEARWATER FORMATION TYPE LOG



2. Geology/Geosciences

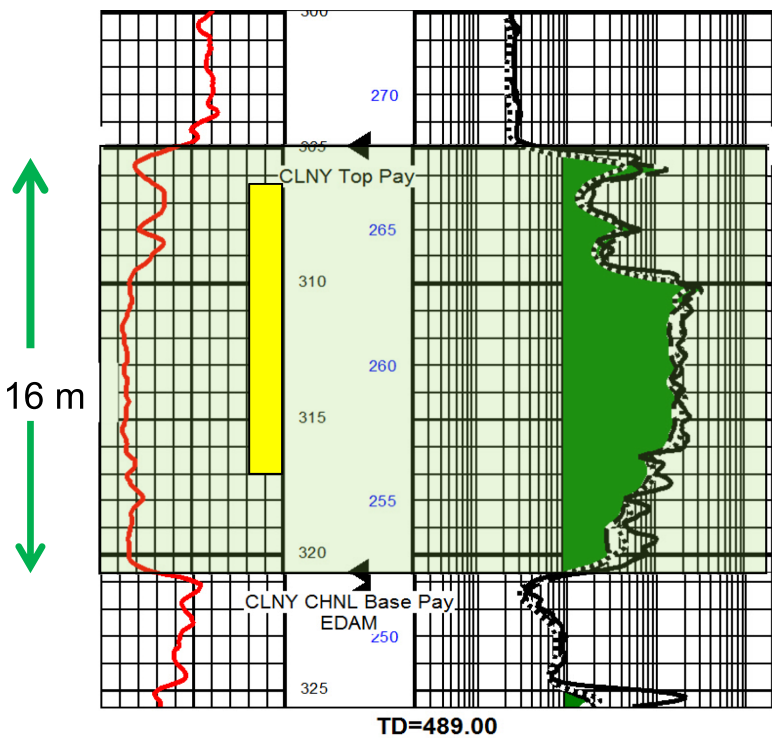
SPARKY FORMATION TYPE LOG



2. Geology/Geosciences

COLONY FORMATION TYPE LOG

100/04-21-064-04W00



Cored Interval

Top

Bottom

0.75 m

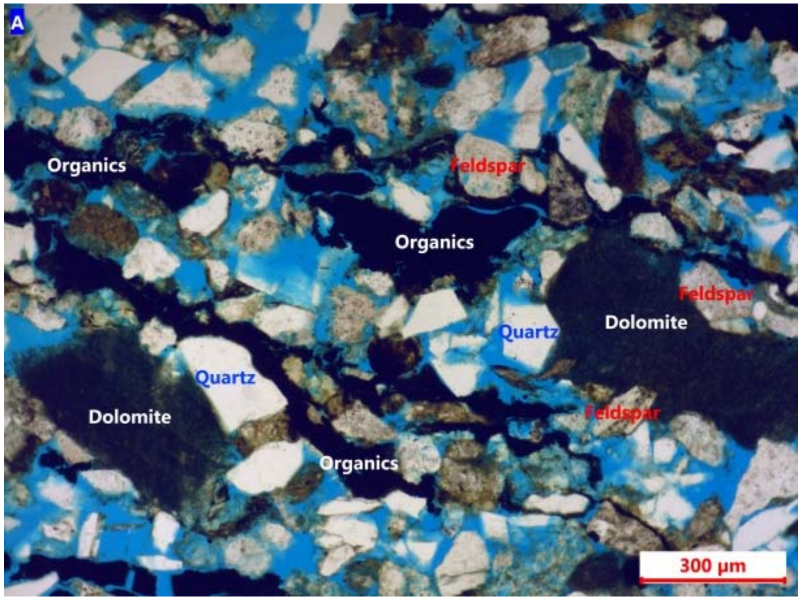
2. Geology/Geosciences

CORED WELLS AND SPECIAL CORE ANALYSIS

- Sparky Petrography

- Moderately well sorted sand, dominantly upper very fine grained
- Feldspar-rich (up to 28 wt % XRD) and lithic unconsolidated sandstone
- Monocrystalline quartz grains make up the majority of the detrital clasts (up to 60 wt% XRD)
- Lithic clasts: include chert, volcanics, organics, minor dolomite, and detrital clay (up to 23 wt. % XRD)

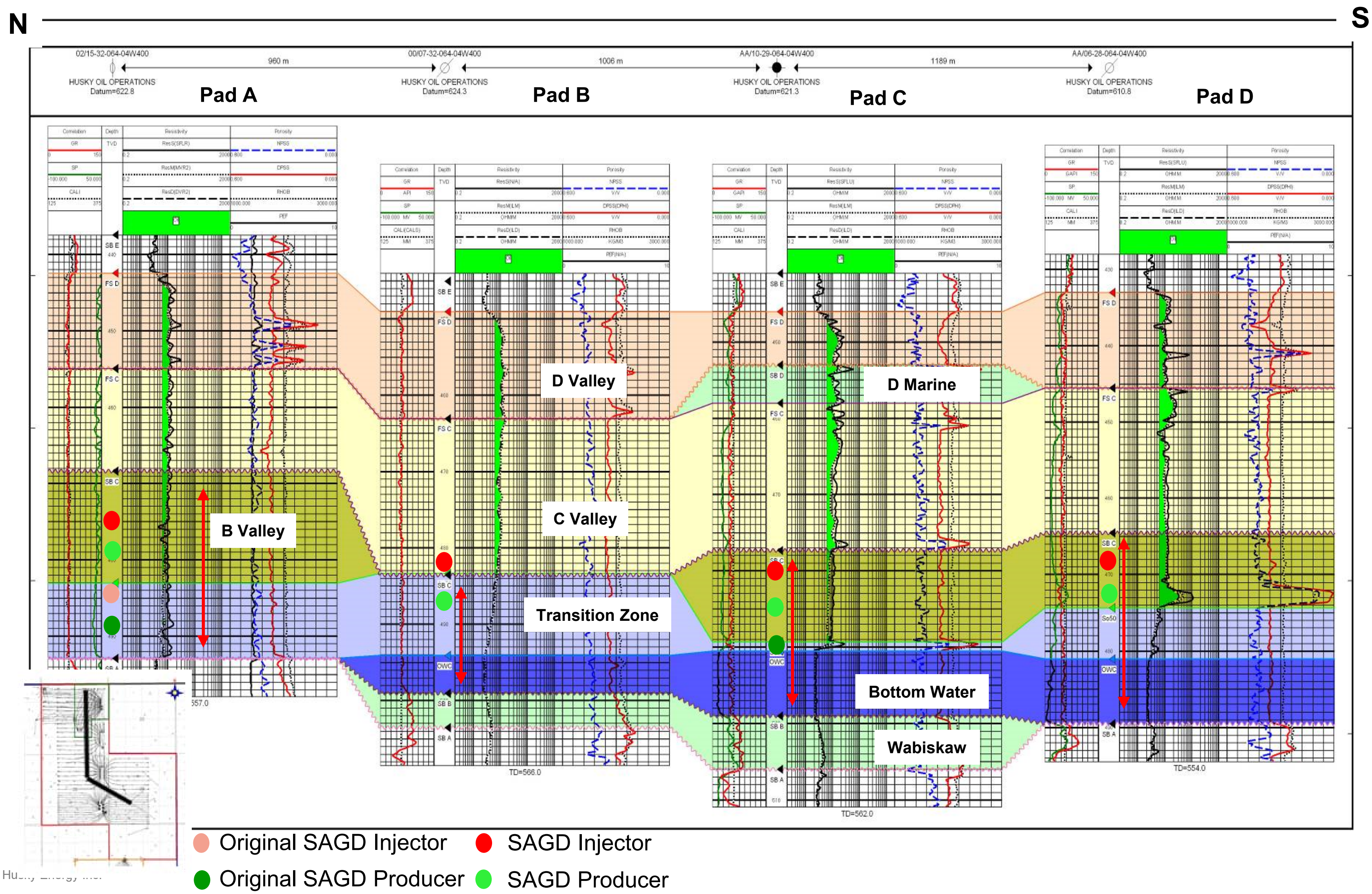
well 116/05-32-064-04W400



- Viscosity @ 20°C varies between 313,000 cp to more than 1,000,000 cp

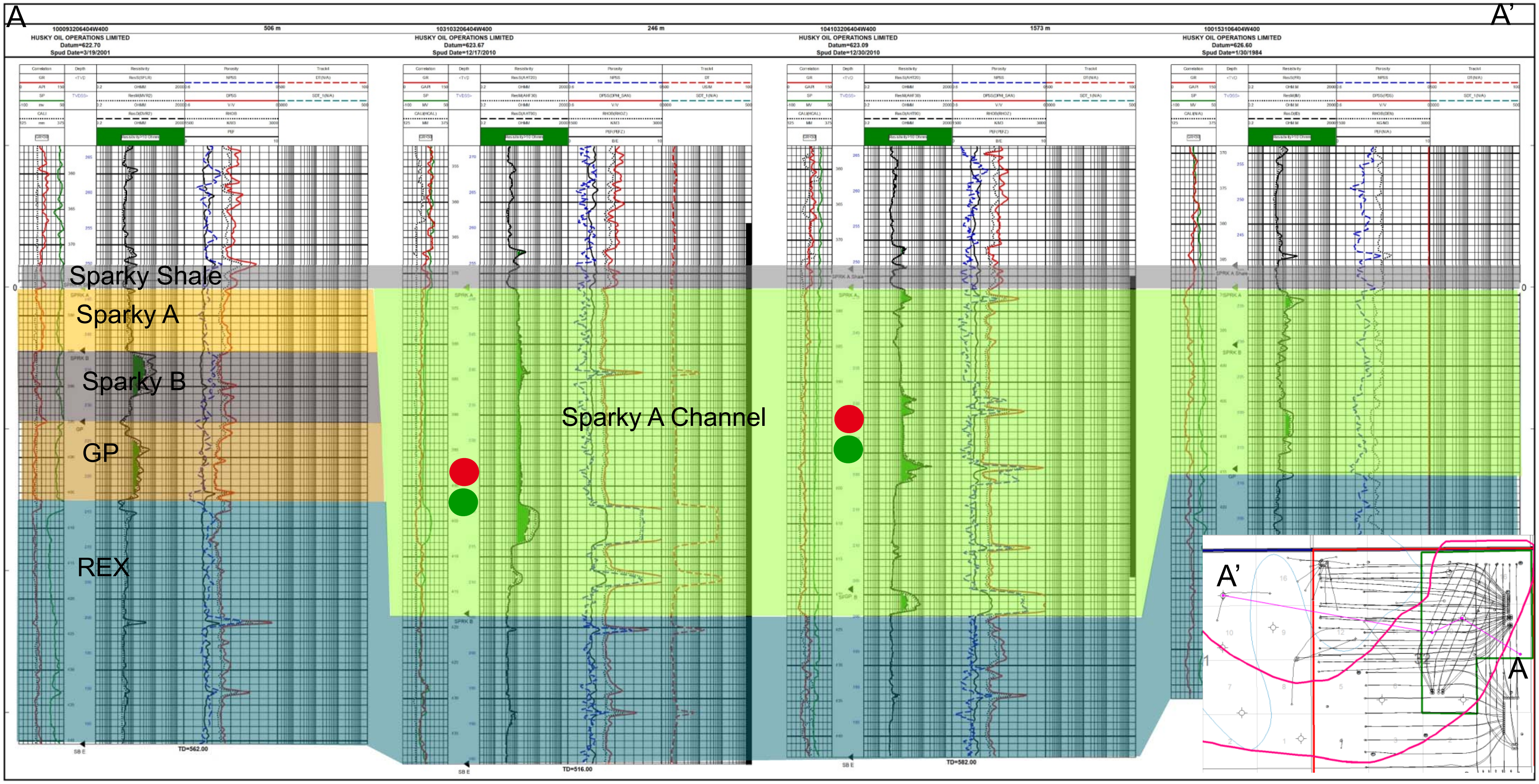
2. Geology/Geosciences

REPRESENTATIVE STRUCTURAL N-S CROSS-SECTION THROUGH THE APPROVAL AREA



2. Geology/Geosciences

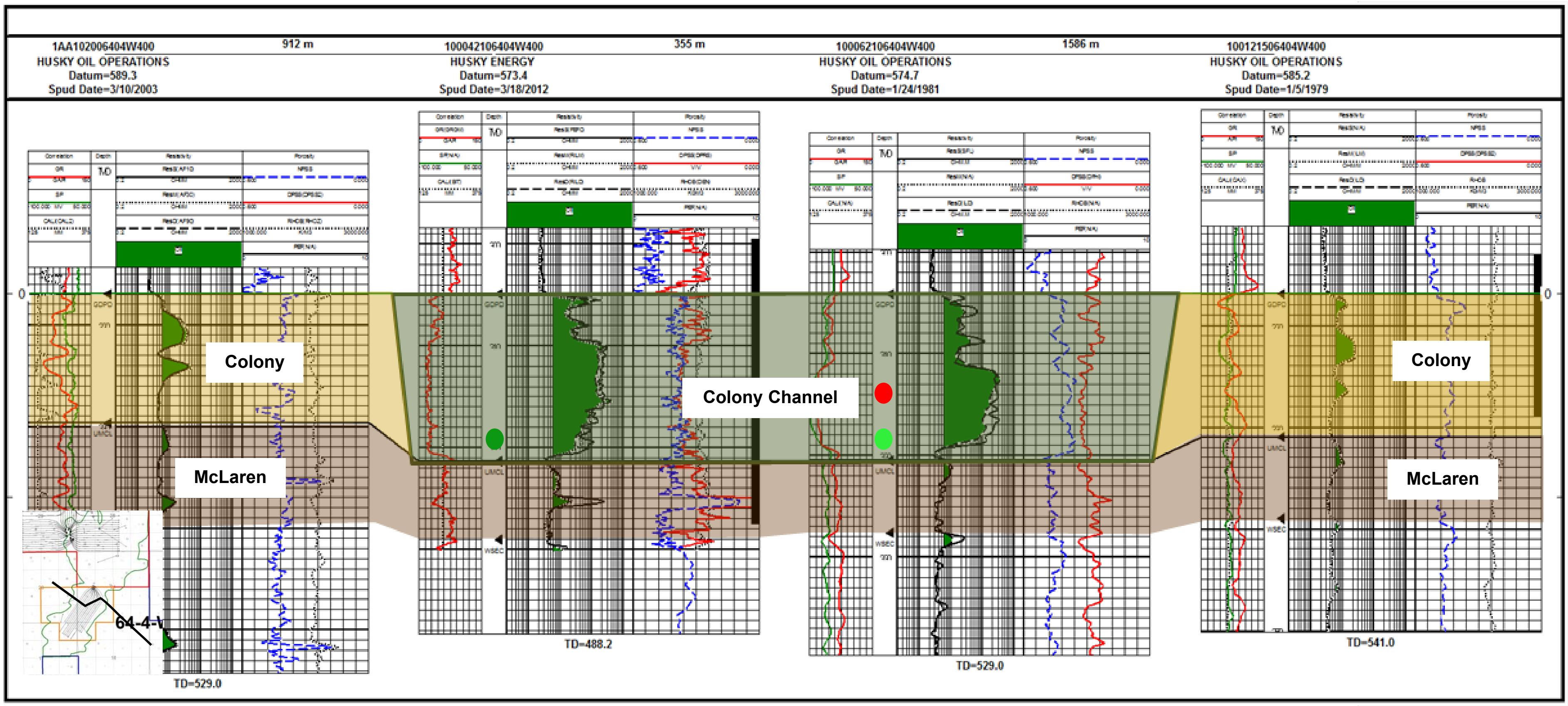
REPRESENTATIVE STRIKE CROSS-SECTION THROUGH THE SPARKY CHANNEL



- SAGD Injector
- SAGD Producer

2. Geology/Geosciences

REPRESENTATIVE STRIKE CROSS-SECTION THROUGH THE COLONY CHANNEL



SAGD Injector

SAGD Producer

Infill Producer

2. Geology/Geosciences

SURFACE/SUBSURFACE GEOMECHANICAL DATA/ANALYSIS

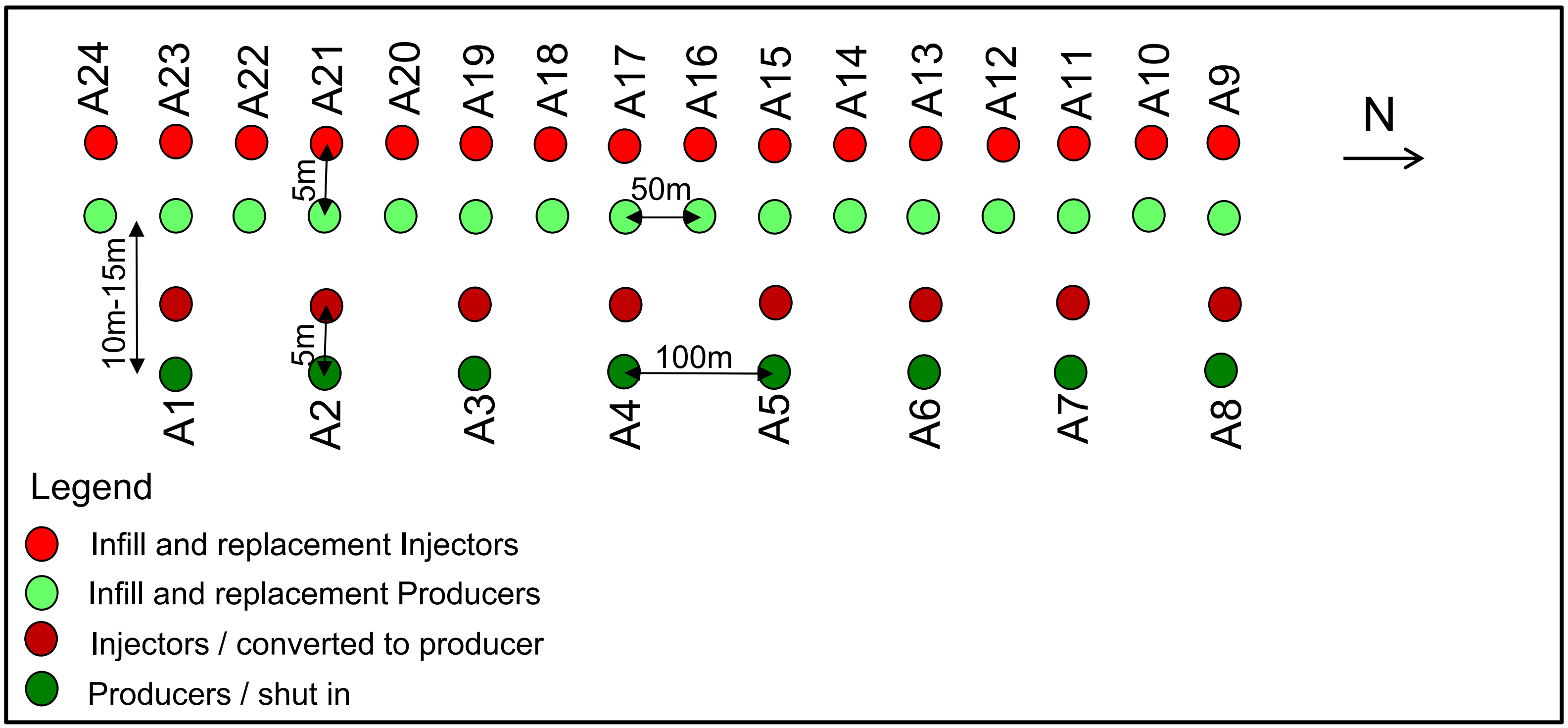
Capping Shale Properties						
Well Pad	Capping Shale Issues to date	Capping shale Fracture Pressure Exceeded	Shale Depth (m)	Measured Fracture Gradient (kPa/m)	Measured Fracture Pressure (kPa)	Fracture Regime
CN	No	No	305	20.0	6,100	Horizontal
GA	No	No	357	19.9	7,120	Horizontal
Clearwater	No	No	426	21.8	9,280	Horizontal

Sand Properties				
Well Pad	Sand Depth (m)	Measured Fracture Gradient (kPa/m)	Measured Fracture Pressure (kPa)	Fracture Regime
GA	375	17.0	6,360	Vertical
Clearwater	446	16.0	7,140	Vertical

2. Geology/Geosciences

PAD A WELL SPACING SCHEMATIC

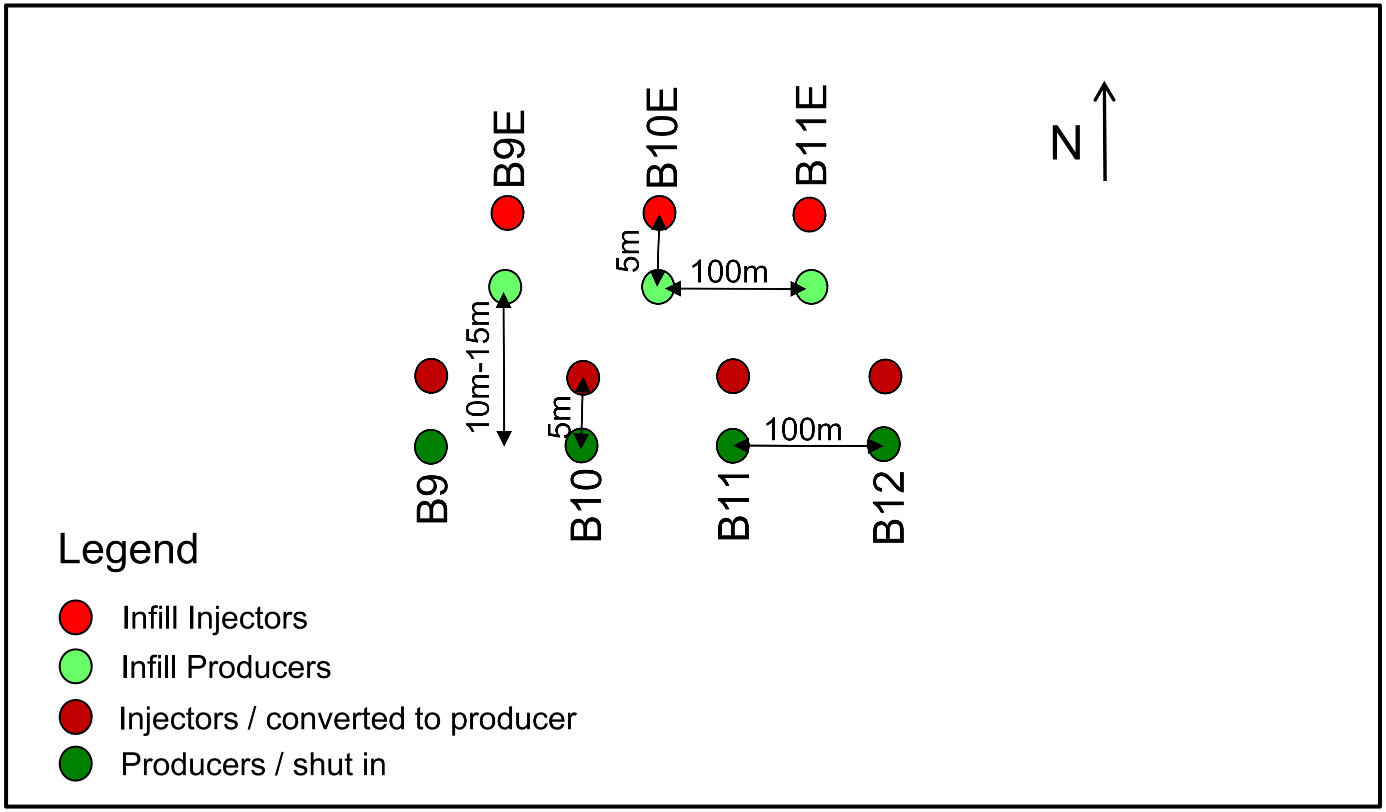
- Pad A original (A1 – A8 drilled 2005) injectors were converted into producers in 2015
- Pad A replacement producers (A9 – A24 drilled 2010/2011) are 10m - 15m directly above Pad A original producers
- Pad A infill producers are 10m - 15m above and mid distance from Pad A original producers



2. Geology/Geosciences

PAD B NORTH WELL SPACING SCHEMATIC

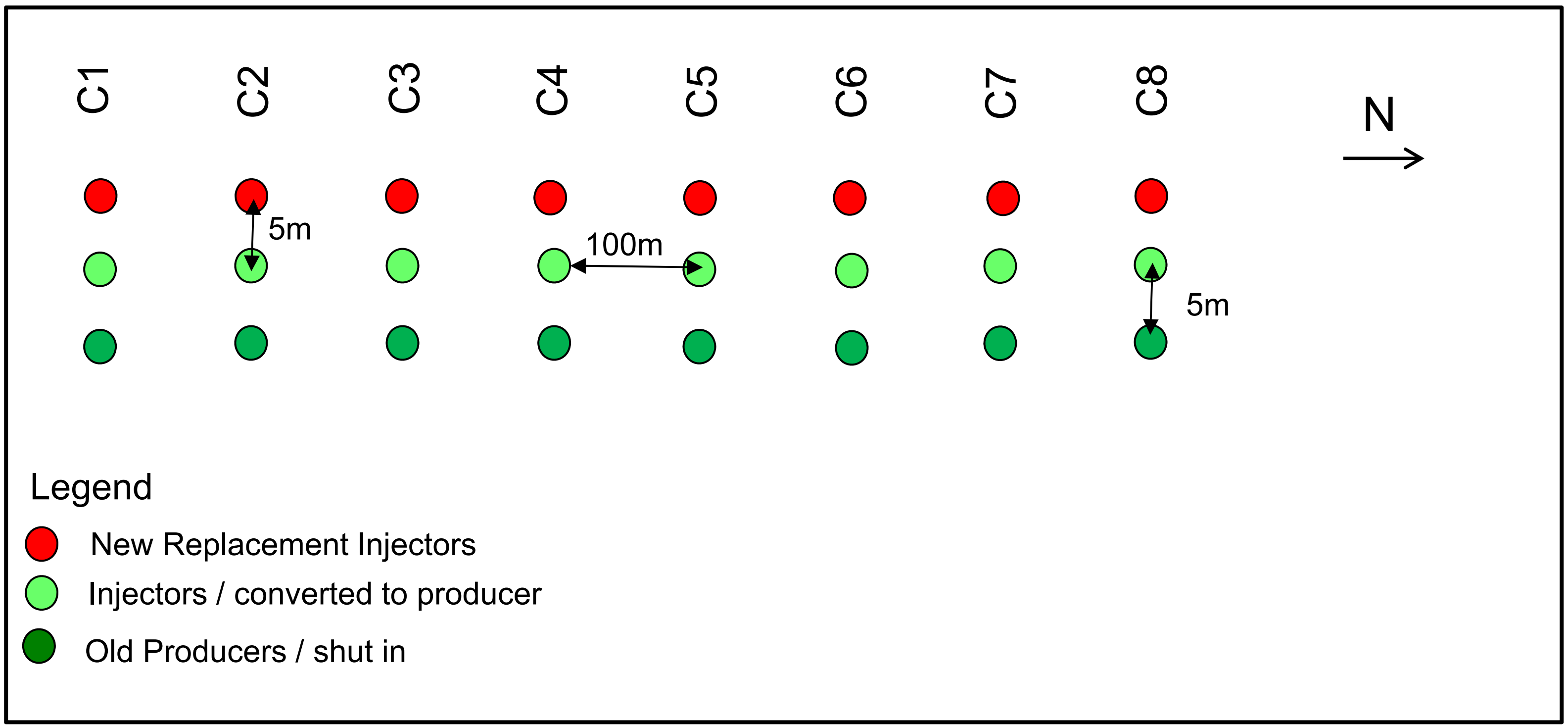
- Pad B North injectors (B9 – B12 drilled 2005/2006) converted into producers in 2014
- Pad B North infill producers (B9 – B11 drilled 2009/2010) are 10m - 15m above and mid distance from Pad B North



2. Geology/Geosciences

PAD C WEST WELL SPACING SCHEMATIC

- Pad C West (C1 – C8 drilled 2005)
- Pad C West replacement injectors (C1R – C8R drilled 2016) are 5m directly above injectors



2. Geology/Geosciences

PAD INTER-WELL SPACING

Well Pad	Inter-well Spacing (m)
A Original	100
A Infill and Replacements	50
B West	100
B North	100
B North Infill	100
C North	100
C West	100
C East	100
D East	50
D North	50
D West	50
GA (LGR)	75
CN (SAGD)	75
CN Infill	37.5*

* Spacing to SAGD producer

2. Geology/Geosciences

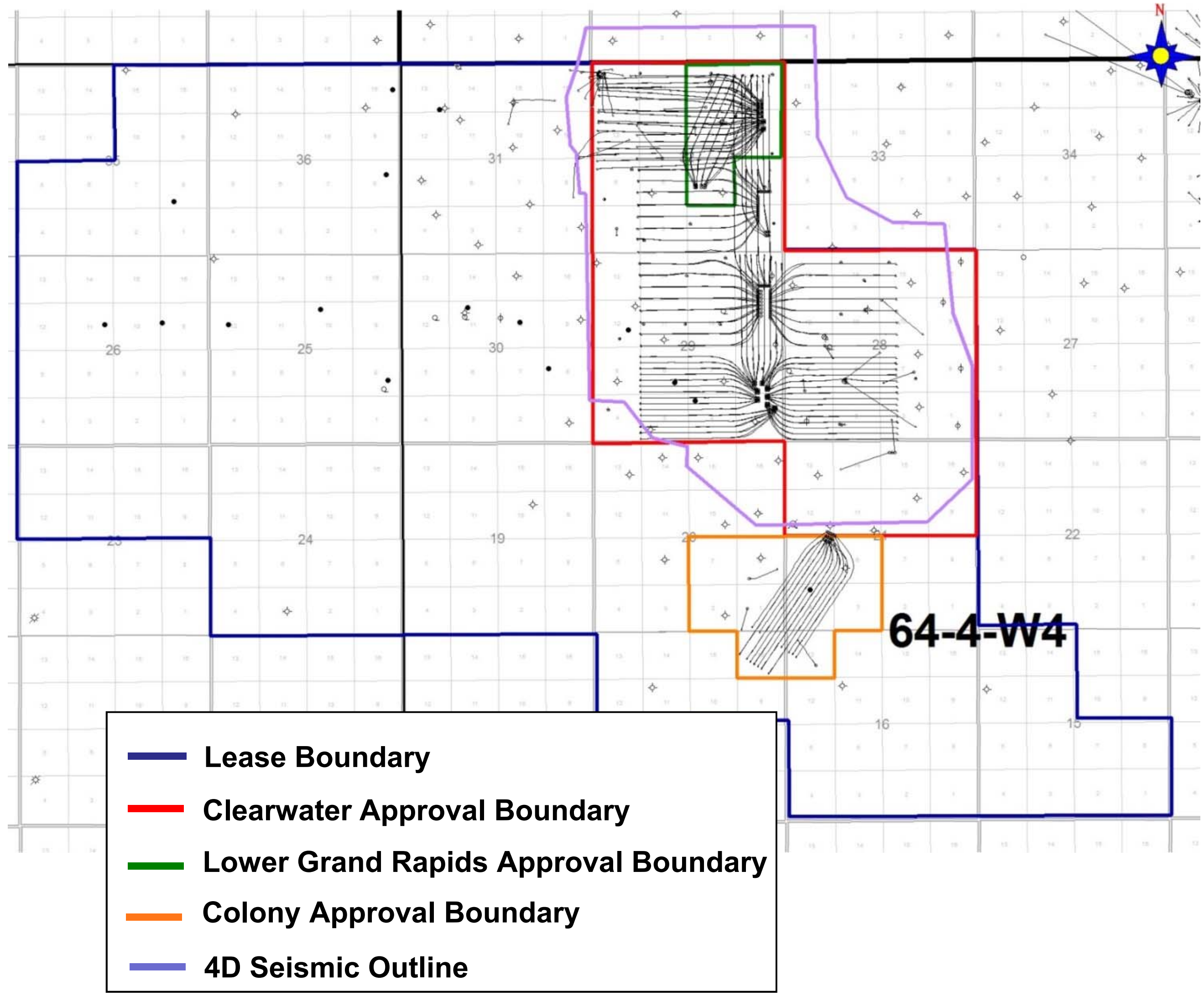
SURFACE HEAVE MONITORING PROGRAMS

- No surface heave monitoring programs have been conducted
- Operating near reservoir pressure, therefore unlikely to be any surface heave
- Husky is committed to further investigate the possible extent of surface heave if a change in operating conditions

2. Geology/Geosciences

3D SEISMIC DATA

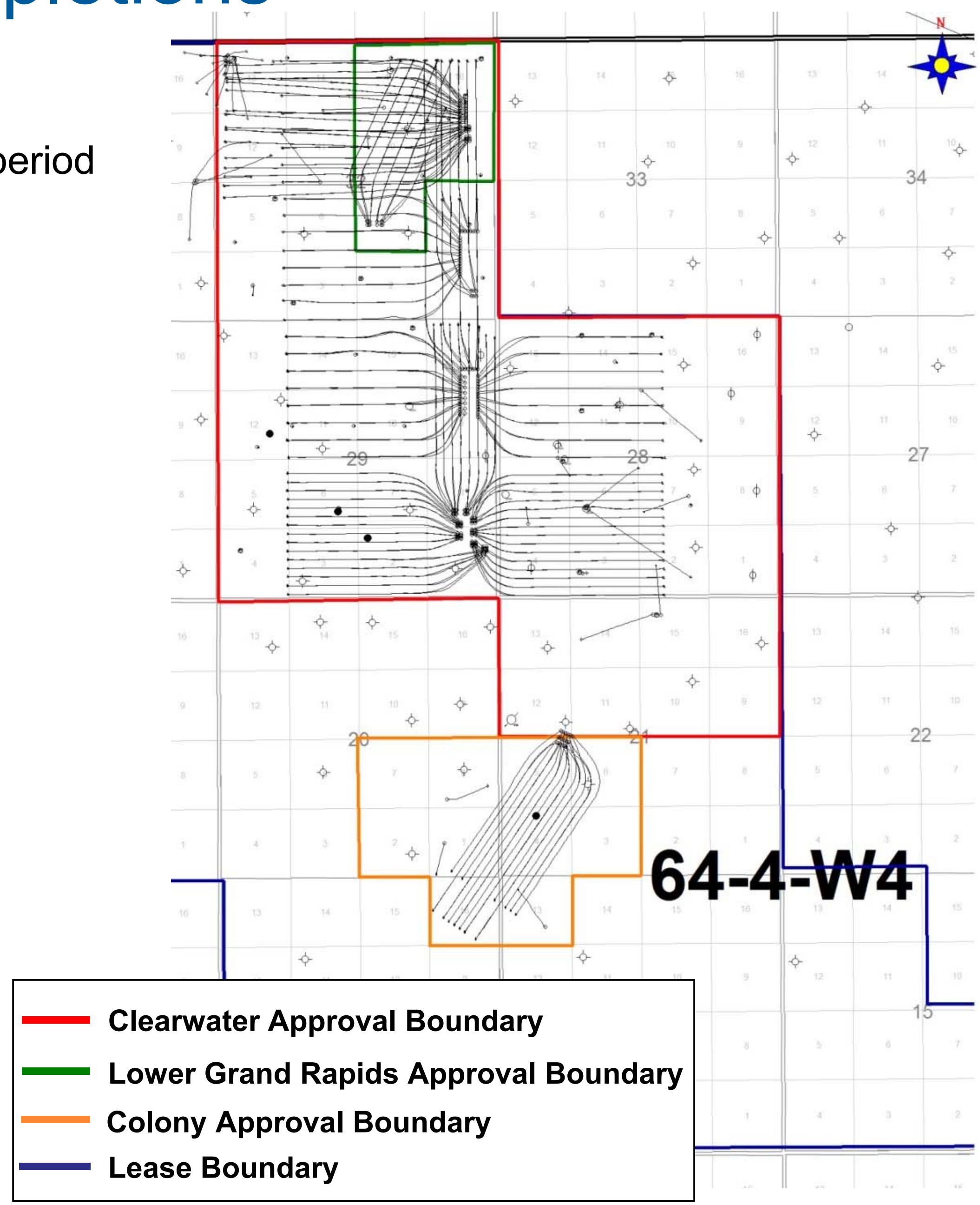
- 2018 - 3D Seismic acquisition extended to cover Pad D East
- 10.4 km^2 of seismic data was acquired



3. Drilling and Completions

DRILLING RESULTS

- No wells drilled during the reporting period
- Pad D West: 15 well pairs completed (Q4 2017 to Q1 2018)



3. Drilling and Completions

SUMMARY OF WELL COMPLETIONS

Injectors (109 SAGD Injectors):

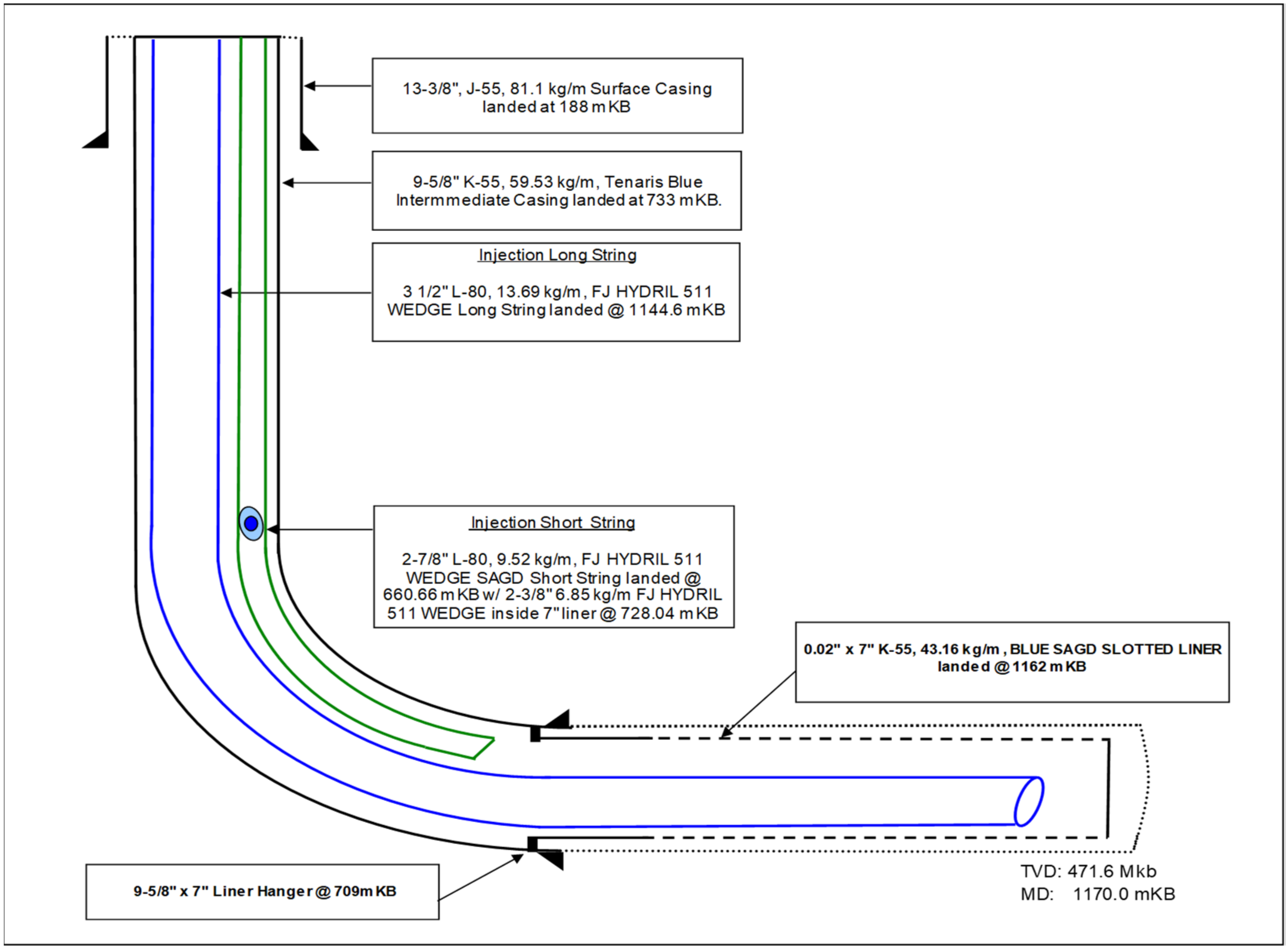
- All injectors completed with Slotted Liner: 109 (includes Pad D West)
- Injectors completed with Vacuum Insulated Tubing (VIT): 45
  - Pad C: 2
  - Pad D: 37
  - Pad CN: 6
- Injectors completed with Steam Splitters: 51
  - Pad B: 7
  - Pad D: 38
  - Pad CN: 6

Producers (116 Producers: 109 SAGD Producers and 7 Infill Producers):

- Producers completed with Slotted Liner: 38
  - Pad A: 8
  - Pad B: 12
  - Pad C: 18
- Producers completed with Wire Wrap Screen (WWS) : 78
  - Pad A: 16
  - Pad B: 3
  - Pad C: 2
  - Pad D: 38
  - Pad GA: 6
  - Pad CN: 13

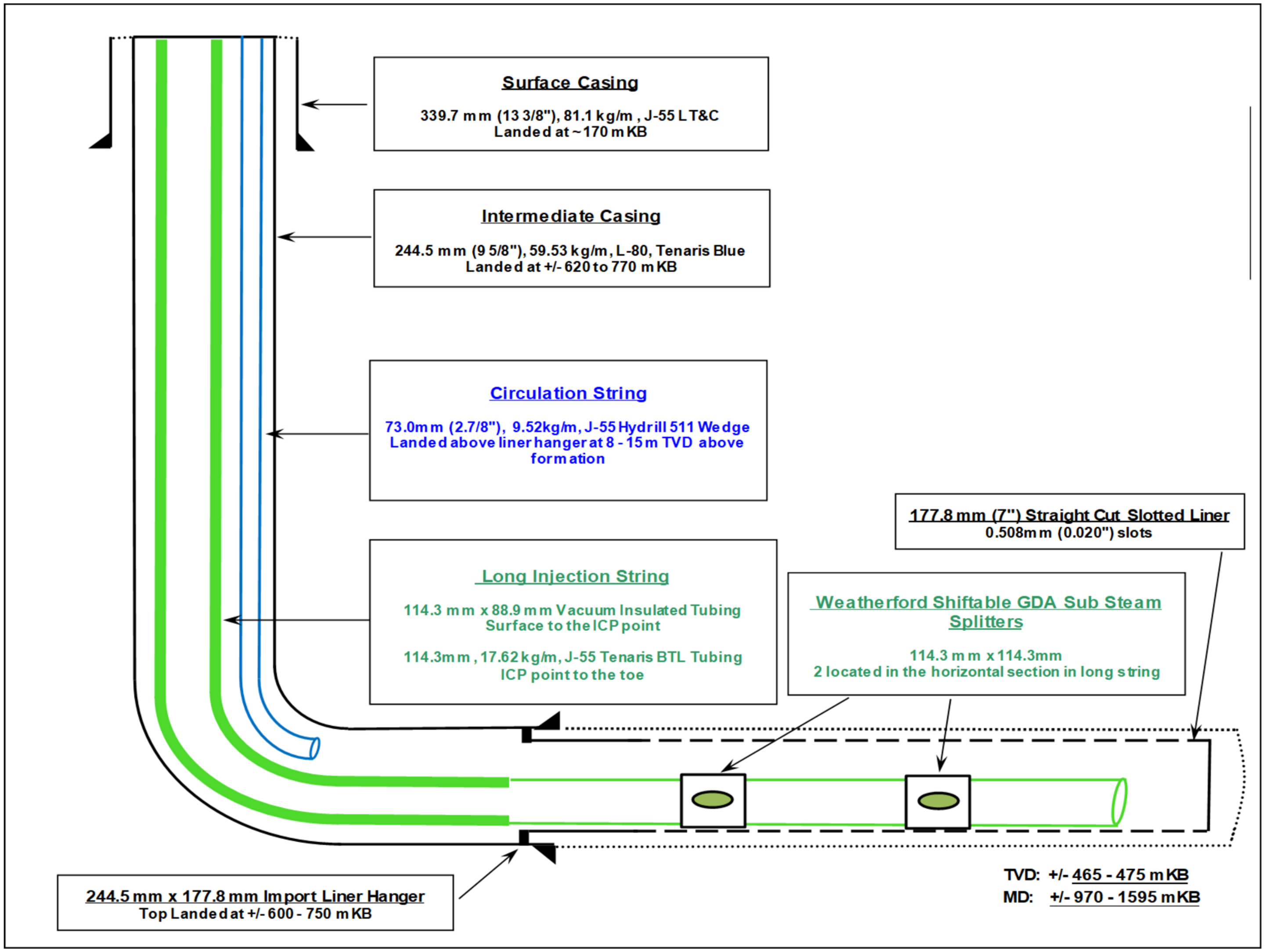
3. Drilling and Completions

SAGD WELL – INJECTOR WITHOUT VACUUM INSULATED TUBING (VIT)



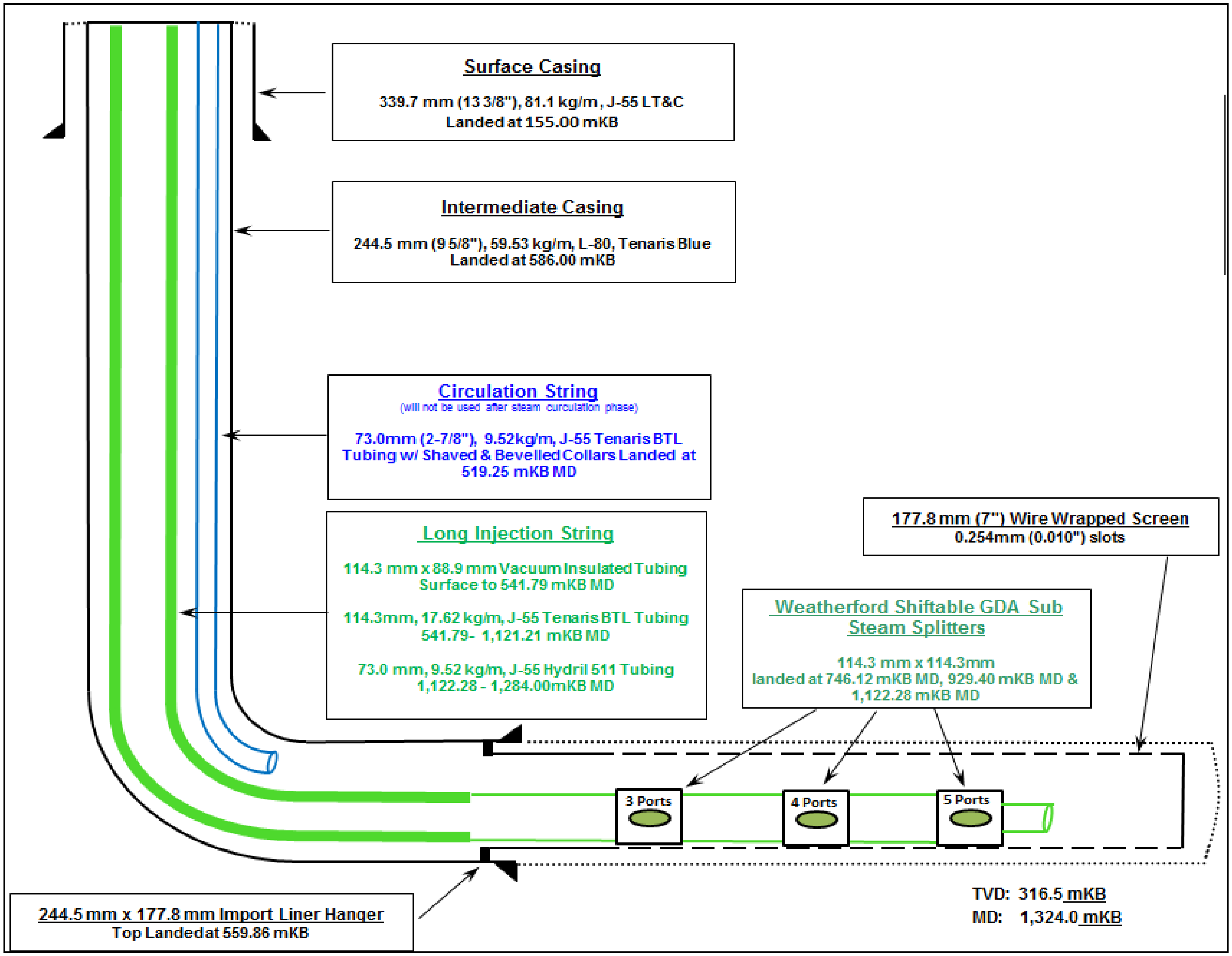
3. Drilling and Completions

SAGD WELL – INJECTOR WITH VIT



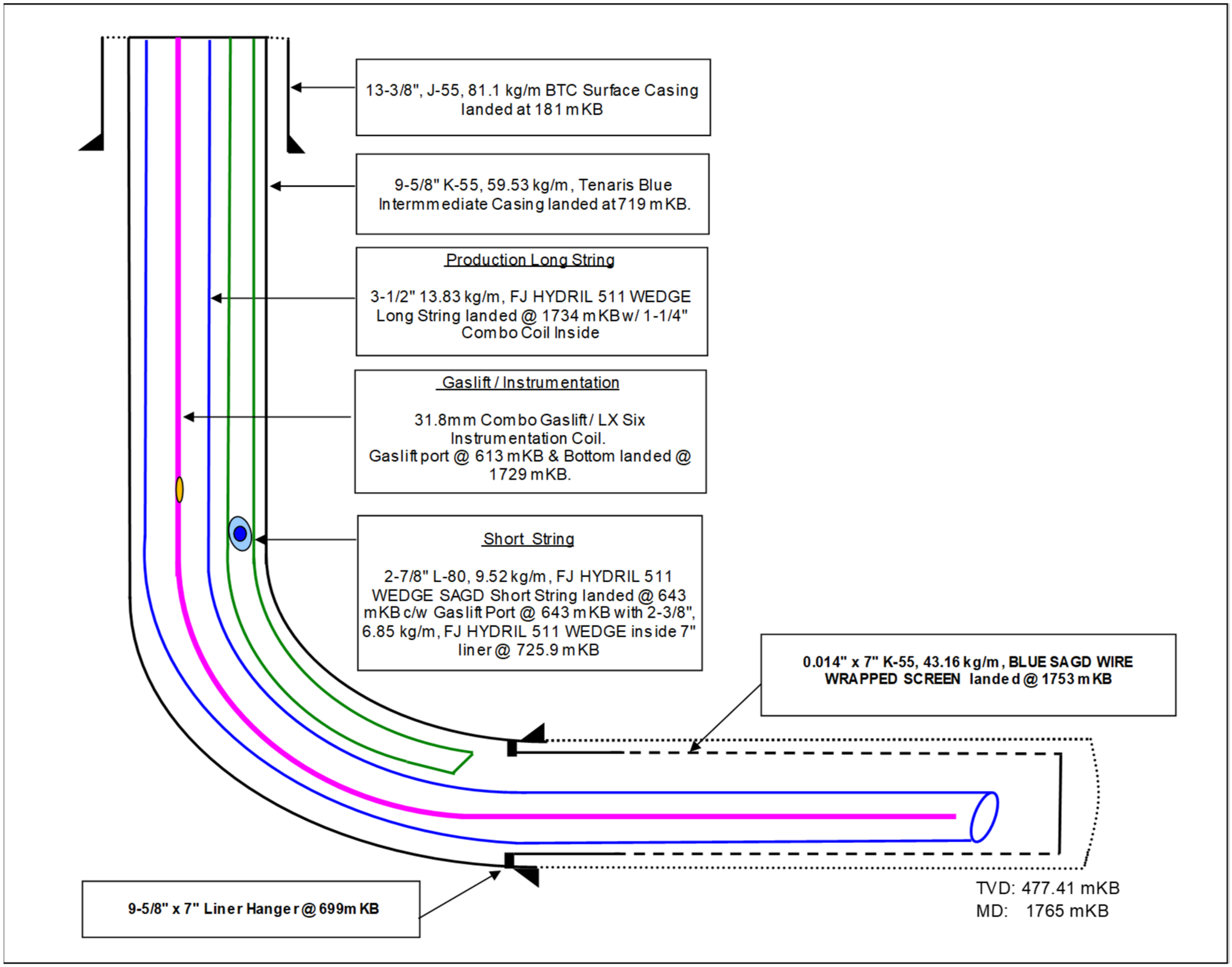
3. Drilling and Completions

SAGD WELL PAD CN – INJECTOR WITH VIT



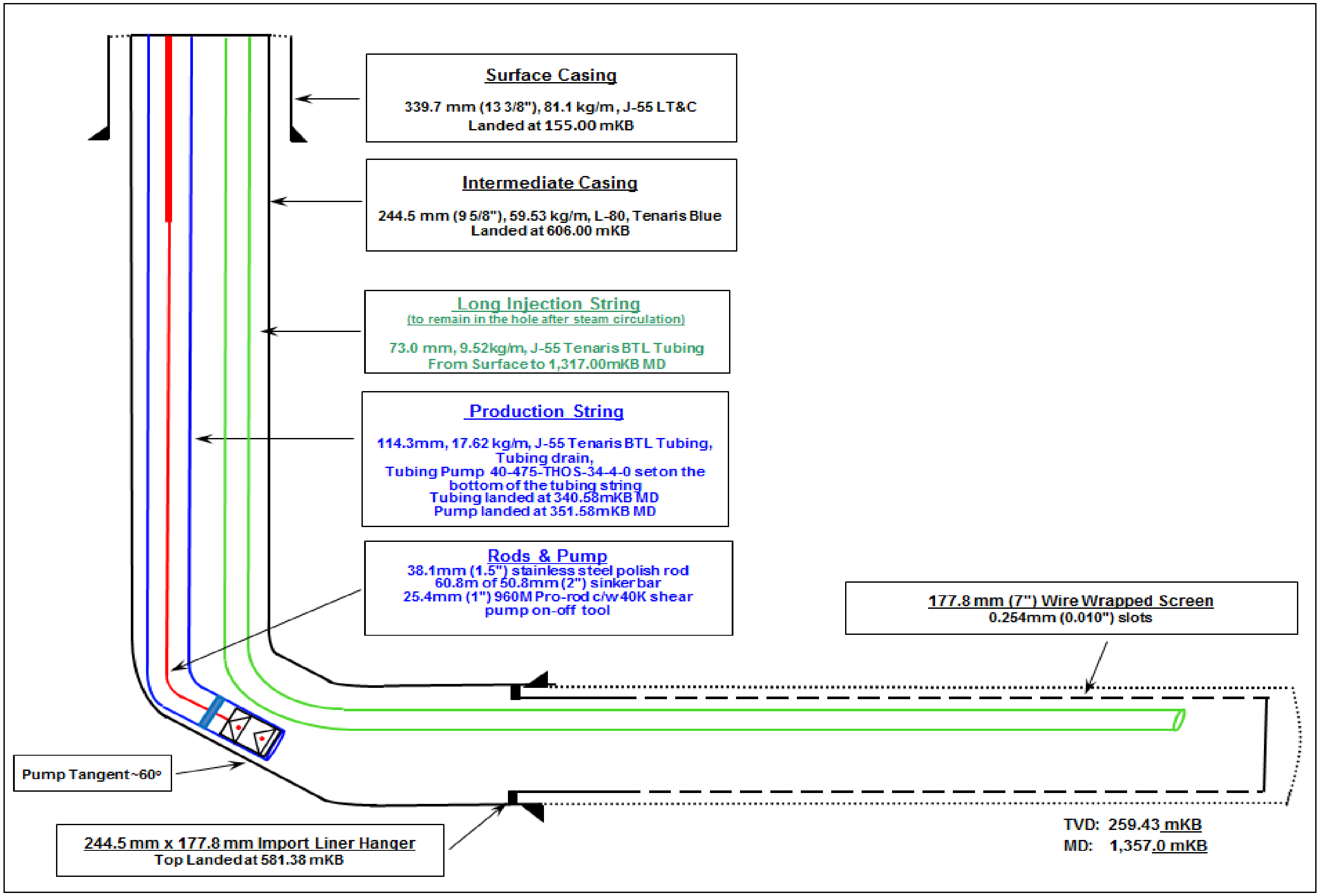
3. Drilling and Completions

SAGD WELL – PRODUCER WITH GAS-LIFT



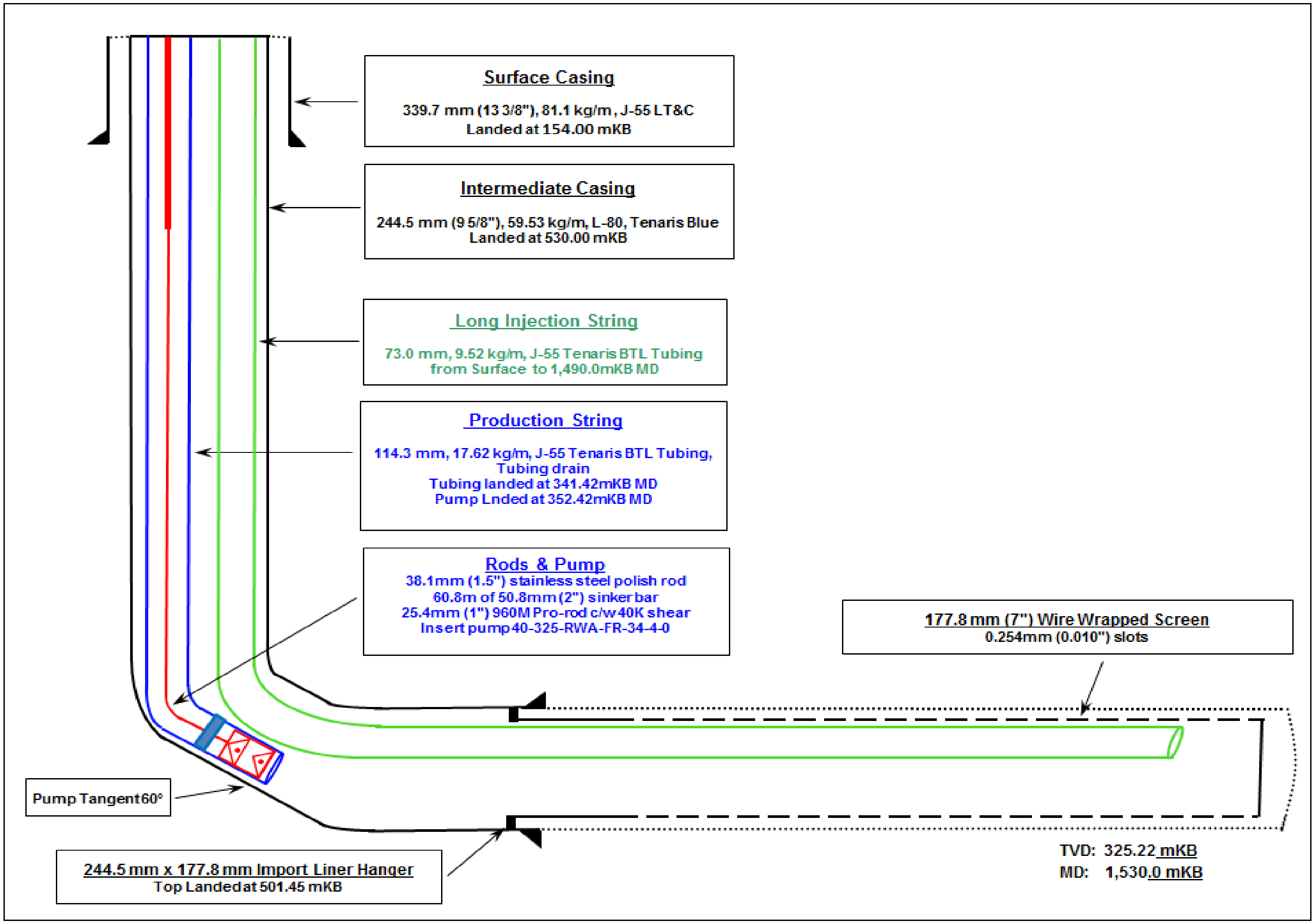
3. Drilling and Completions

SAGD WELL PAD CN – PRODUCER WITH ROD-PUMP



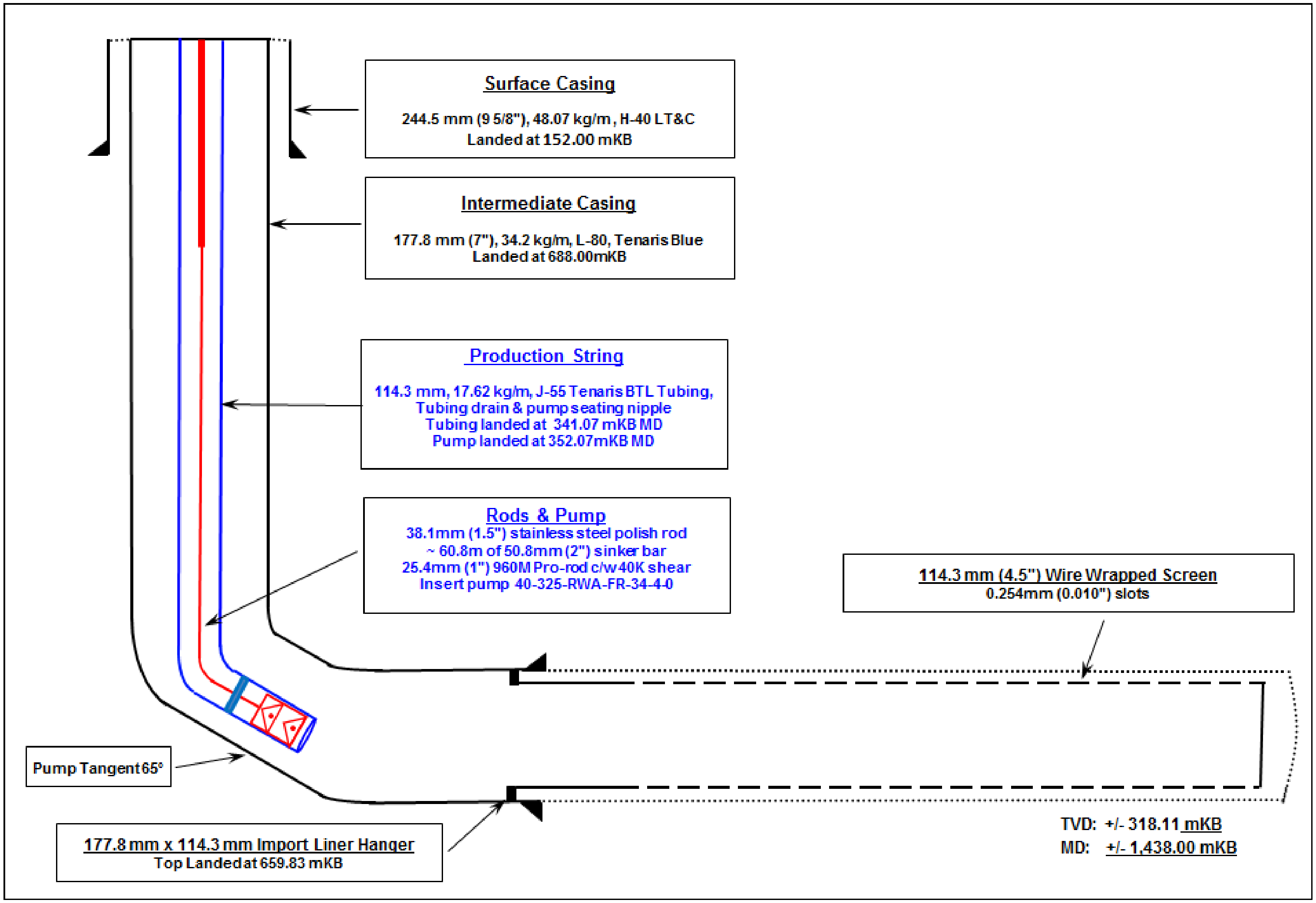
3. Drilling and Completions

INTERMITTENT STEAM STIMULATION WELL PAD CN – PRODUCER WITH ROD-PUMP



3. Drilling and Completions

INFILL WELL PAD CN – PRODUCER WITH ROD-PUMP



3. Drilling and Completions

COMPLETIONS – KEY LEARNINGS

Production - Slotted Liners vs Wire Wrap Screens (WWS):

- Slotted liner scaling has been a chronic problem:
    - Short term solution - Acidization
    - Long term solution - perforated liners
- WWS, which increase the open area, used in producers drilled since 2009:
    - No scaling issues observed in these wells
- Current plan to complete future producers with WWS

Injection - Vacuum Insulated Tubing (VIT) and Steam Splitters:

- VIT:
    - Improve the wellbore integrity by slowing heat transfer through tubing
    - Deliver high quality steam downhole and improve production
- Steam Splitters:
    - Shift-able steam splitters enable proper circulation and allow steam distribution adjustments
- VIT combined with Steam Splitters:
    - Improve steam quality and distribution into the reservoir

4. Artificial Lift

WELL PADS

Rod-pump: 13 (Pad CN only)

- 6 SAGD producers (Tubing liner pump)
- 2 ISS producers (Insert pump)
- 5 Infill producers (Insert pump)
- Rod-pump operational parameters:
  - Pressure: 1,500 – 2,500 kPa
  - Bottom hole temperature: 130 – 180 ºC
  - Fluid production range: 65 – 420 m^3/day

Gas-lift: 103, all producers except Pad CN

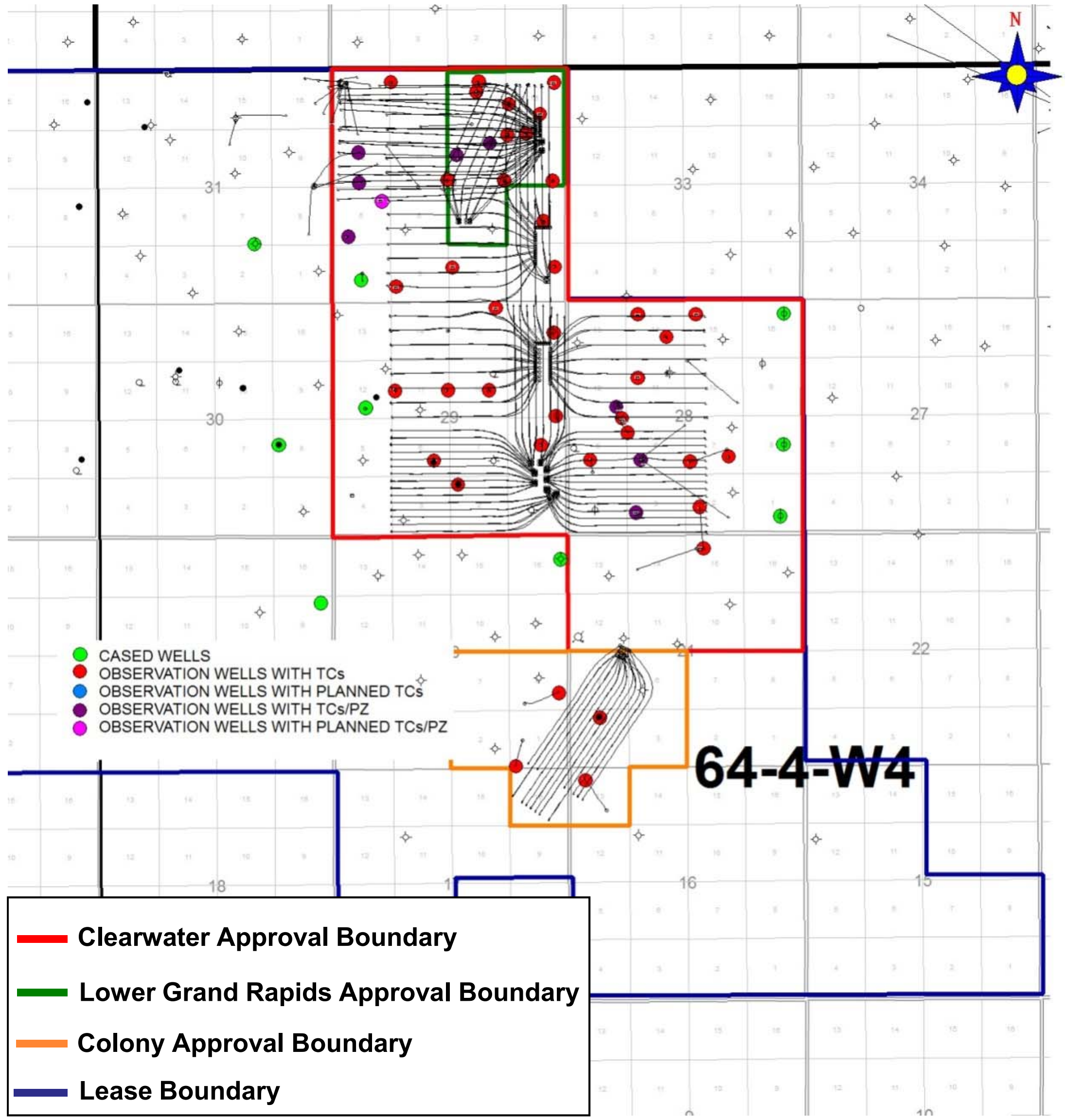
- 103 SAGD producers
- Gas-lift operational parameters:
  - Pressure: 2,400 kPa – 4,000 kPa
  - Bottom hole temperature: 200 – 240 ºC
  - Gas injection rate: 1,200 – 10,800 m^3/day

5. Instrumentation in Wells

OBSERVATION WELL MAP

2017/2018:

- Pad D West – 3 OBS wells

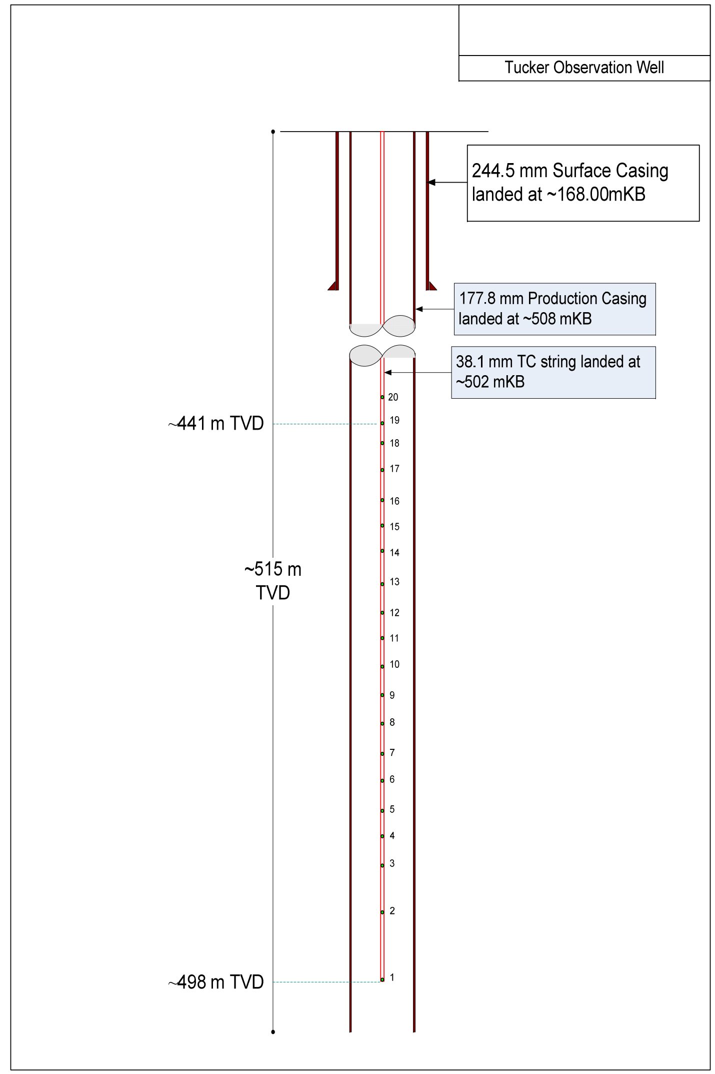


5. Instrumentation in Wells

OBSERVATION AND SAGD WELLS

- 47 OBS Wells with Instrumentation:
  - 39 wells: thermocouple only
  - 8 wells: both thermocouple & piezometer
- Planned: OBS Wells (convert existing well):
  - 1 well (Pad GB thermocouple and piezometers)
- SAGD Injectors – wells use blanket gas to measure pressure and for insulation
- SAGD Producers – equipped with combo instrumentation coil (gas lift & thermocouple or fiber)
  - Combo coil installed in the long production string delivers lift-gas for the long string and provides temperature measurement in the horizontal section
  - Pressure at the heel of producers is estimated from the gas pressure of the lift-gas injected into the annulus (annulus injection provides lift-gas for the short production string)

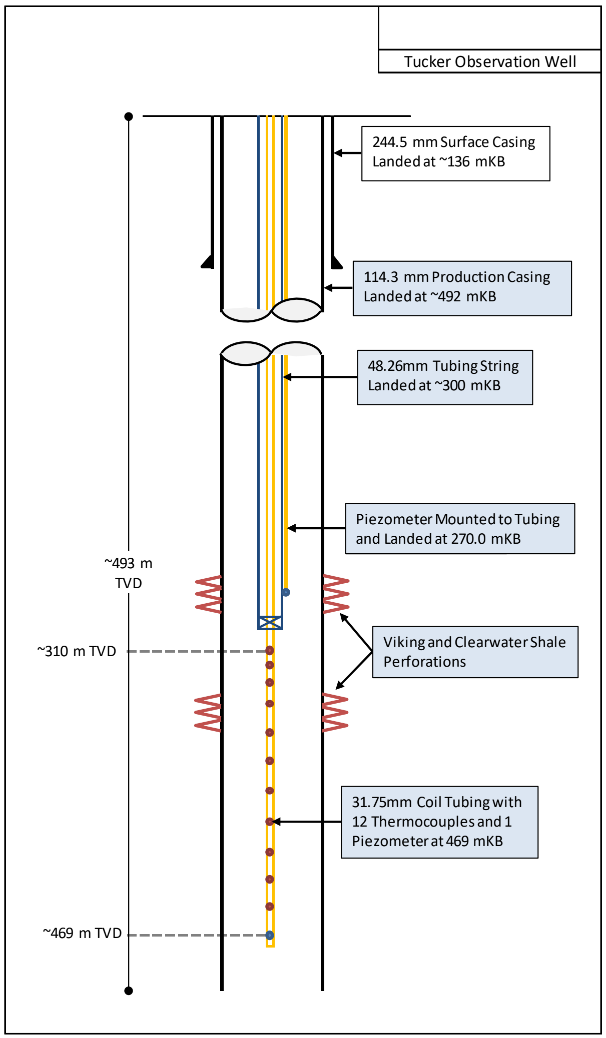
Thermocouple only OBS well



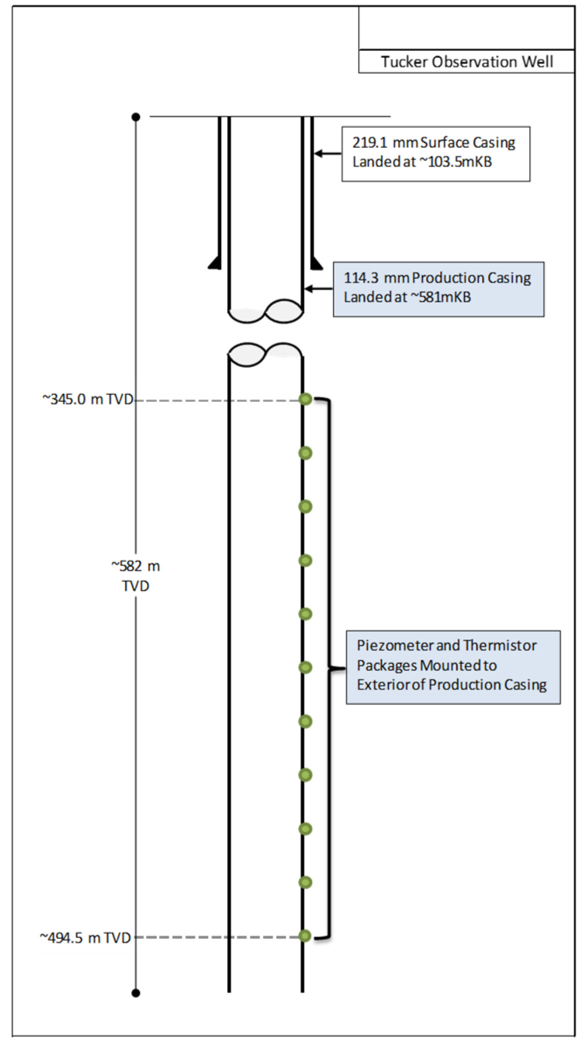
5. Instrumentation in Wells

THERMOCOUPLES AND PIEZOMETER OBSERVATION WELLS

Type 1 – Instrumentation Inside Tubing



Type 2 – Instrumentation Outside of Casing

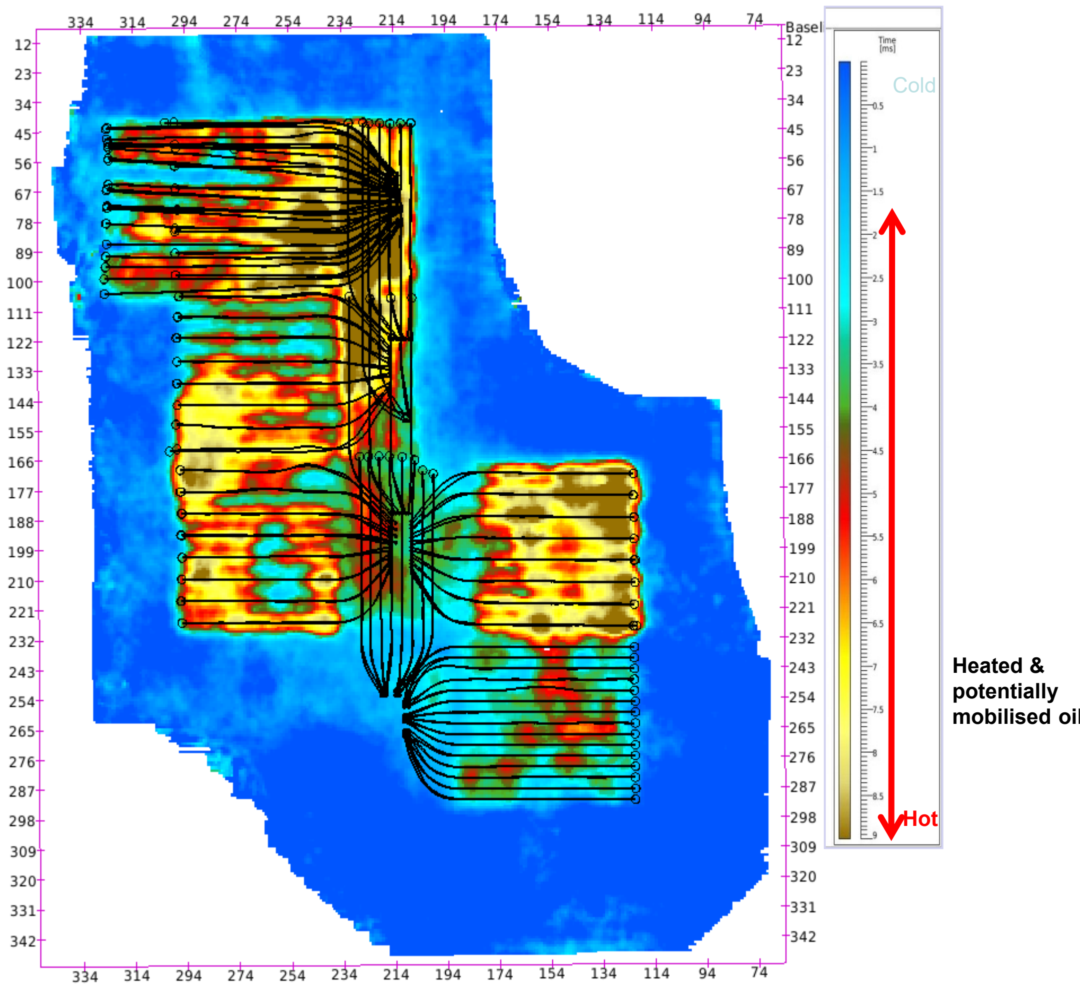


6. 4D Seismic

4D SEISMIC DATA: TIME LAPSE MAP 2018 MONITOR

- 2018 time delay map shows the “heated zones” after ~ 11 years of steam injection
- Steam conformance varies across the field
- 2018 Monitor - analysis is ongoing
- Maximum delay of ~12 milliseconds on the Paleo horizon

Clearwater Reservoir

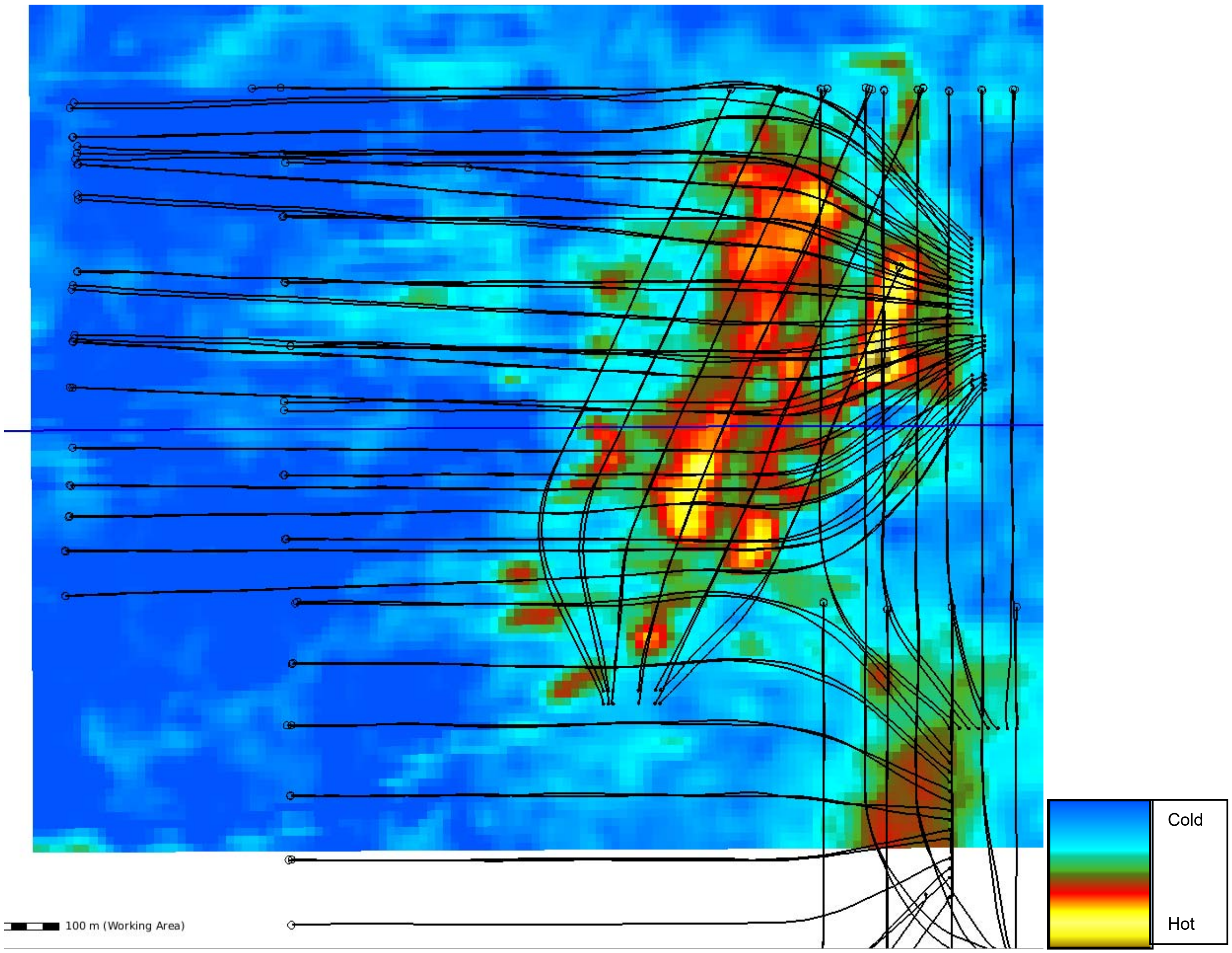


6. 4D Seismic

4D SEISMIC DATA: TIME LAPSE MAP 2018 MONITOR

- 2018 Time delay map shows the “heated zones” after ~ 4.5 years of steam injection
- Steam conformance varies across the drainage pattern
- 2018 Monitor - analysis is ongoing
- Maximum delay of ~9 milliseconds on the Clearwater shale horizon

Lower Grand Rapids Reservoir



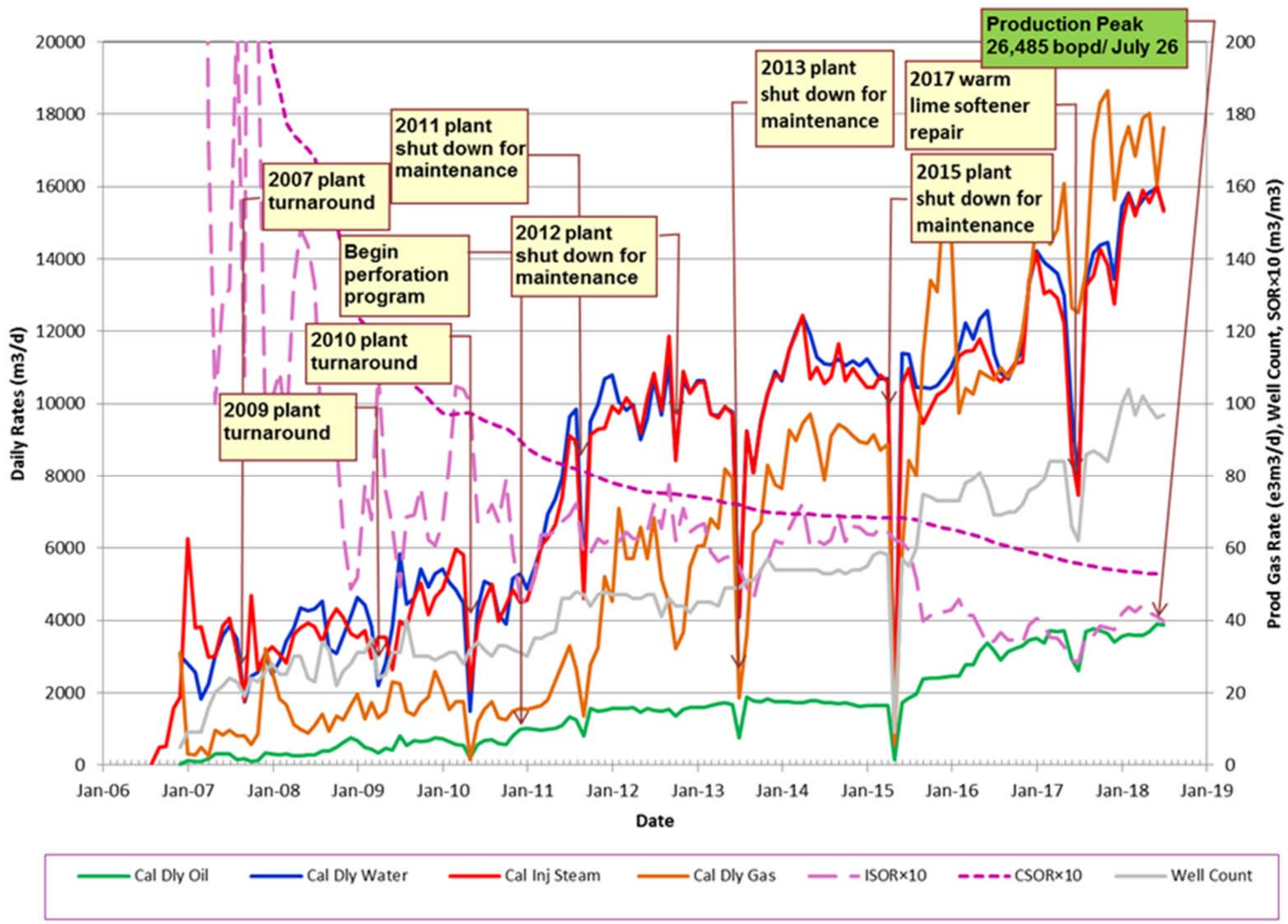
7. Scheme Performance

SCHEME PERFORMANCE PREDICTIONS METHODOLOGY

- Current performance prediction based on:
  - Updated geological model supplemented with simulation and analytical models
  - Observation of actual performance
  - Analysis of analogous SAGD projects

7. Scheme Performance

PRODUCTION AND INJECTION HISTORY



7. Scheme Performance

PRODUCTION VS. APPROVAL CAPACITY VARIANCE

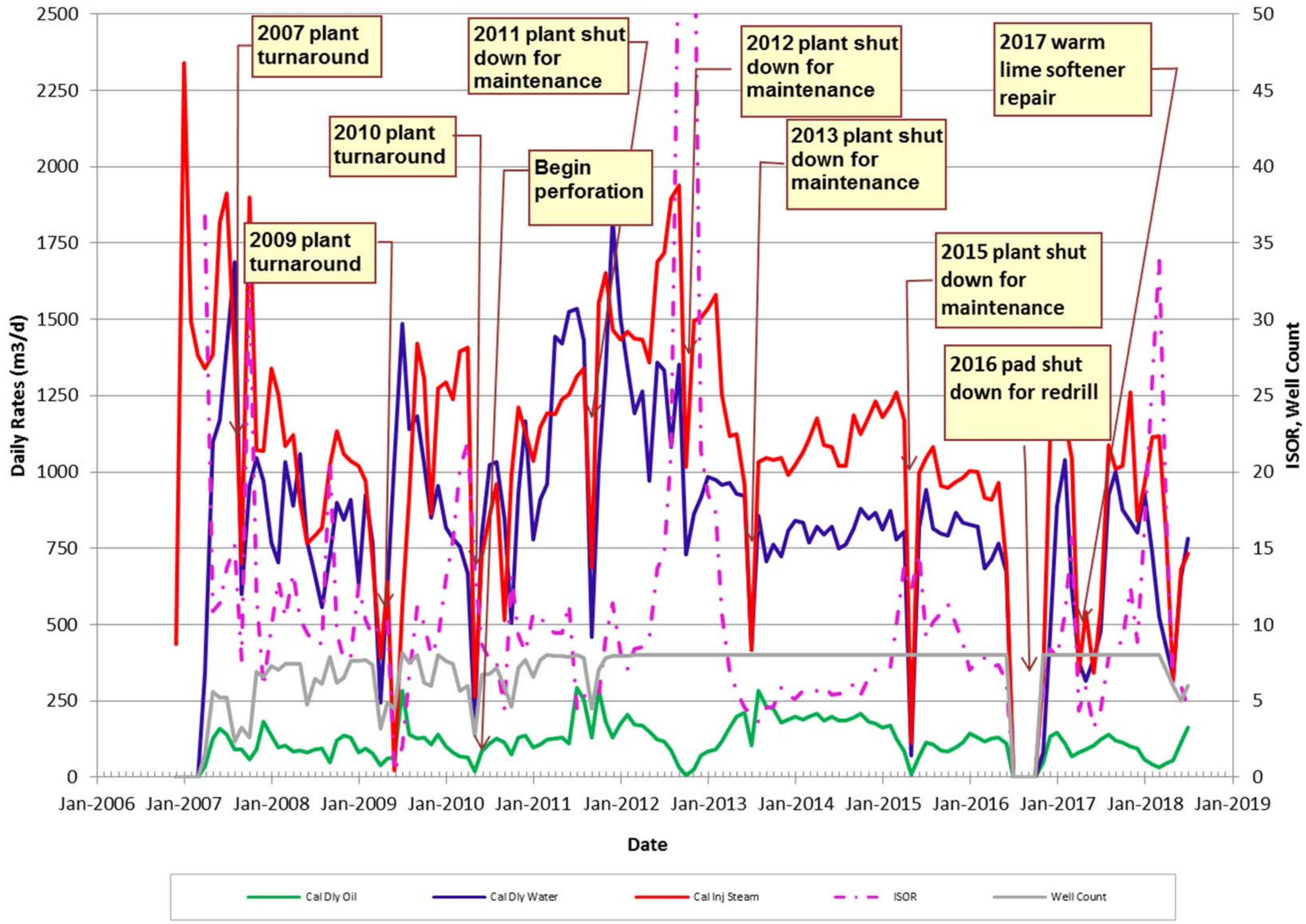
- 32 original well pairs had poor performance due to:
  - Placement in the transition zone where oil saturation is low
  - Poor start-up strategy (bull-heading); currently use circulation

- Since 2008 all well pairs drilled to the base of SAGD net pay

- Revised completion of new wells
  - Dual string completions in both injector and producer
  - Injectors completed with VITs and steam splitters for Pads D and CN
  - Wire Wrapped Screens for all new producers to increase open area
  - Blanket gas installed on all wells to provide
    - Insulation
    - Casing protection
    - Down hole pressure measurement

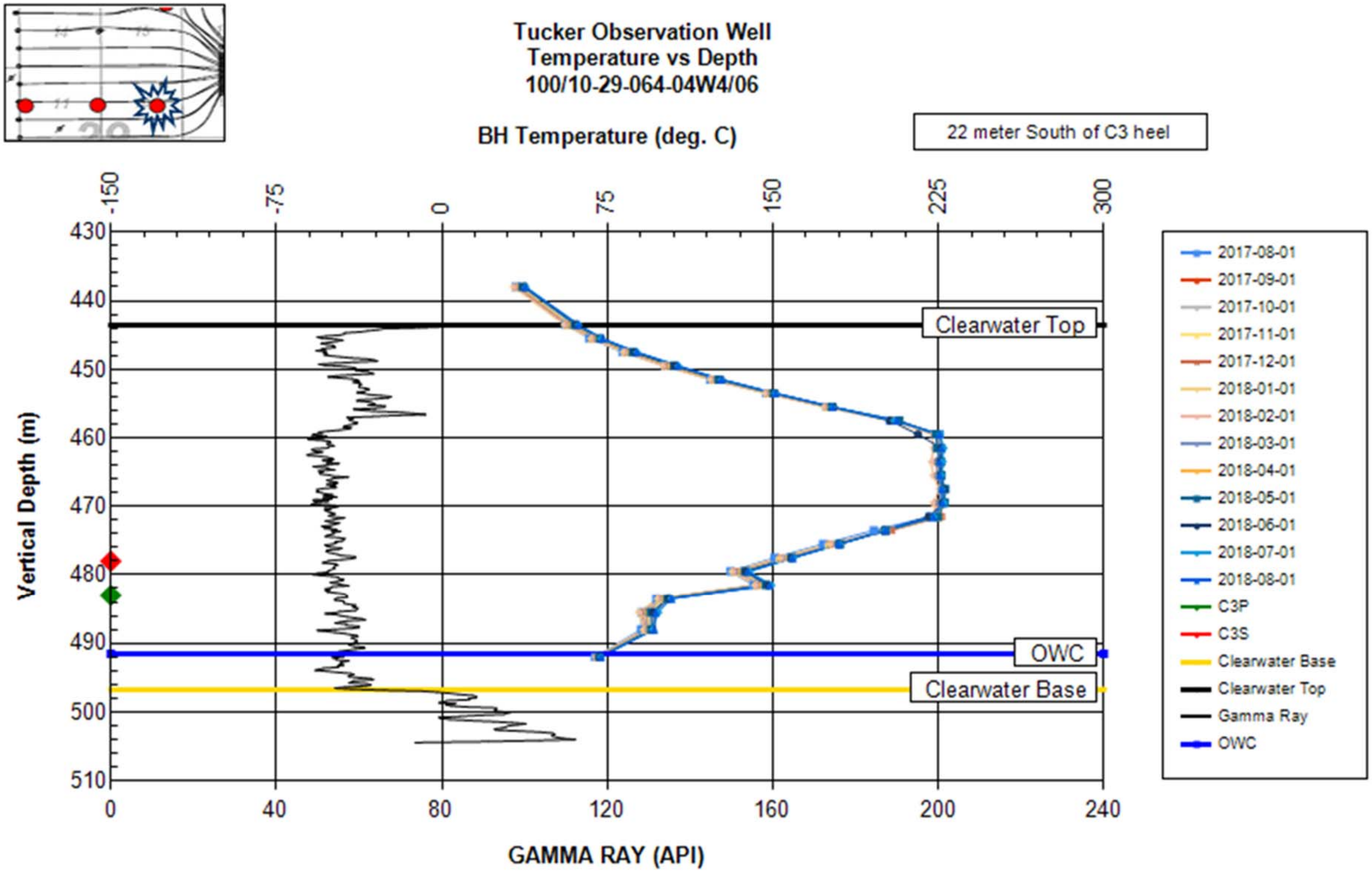
7. Scheme Performance

PAD C WEST PERFORMANCE – LOW RECOVERY EXAMPLE



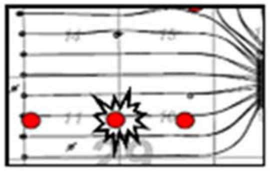
7. Scheme Performance

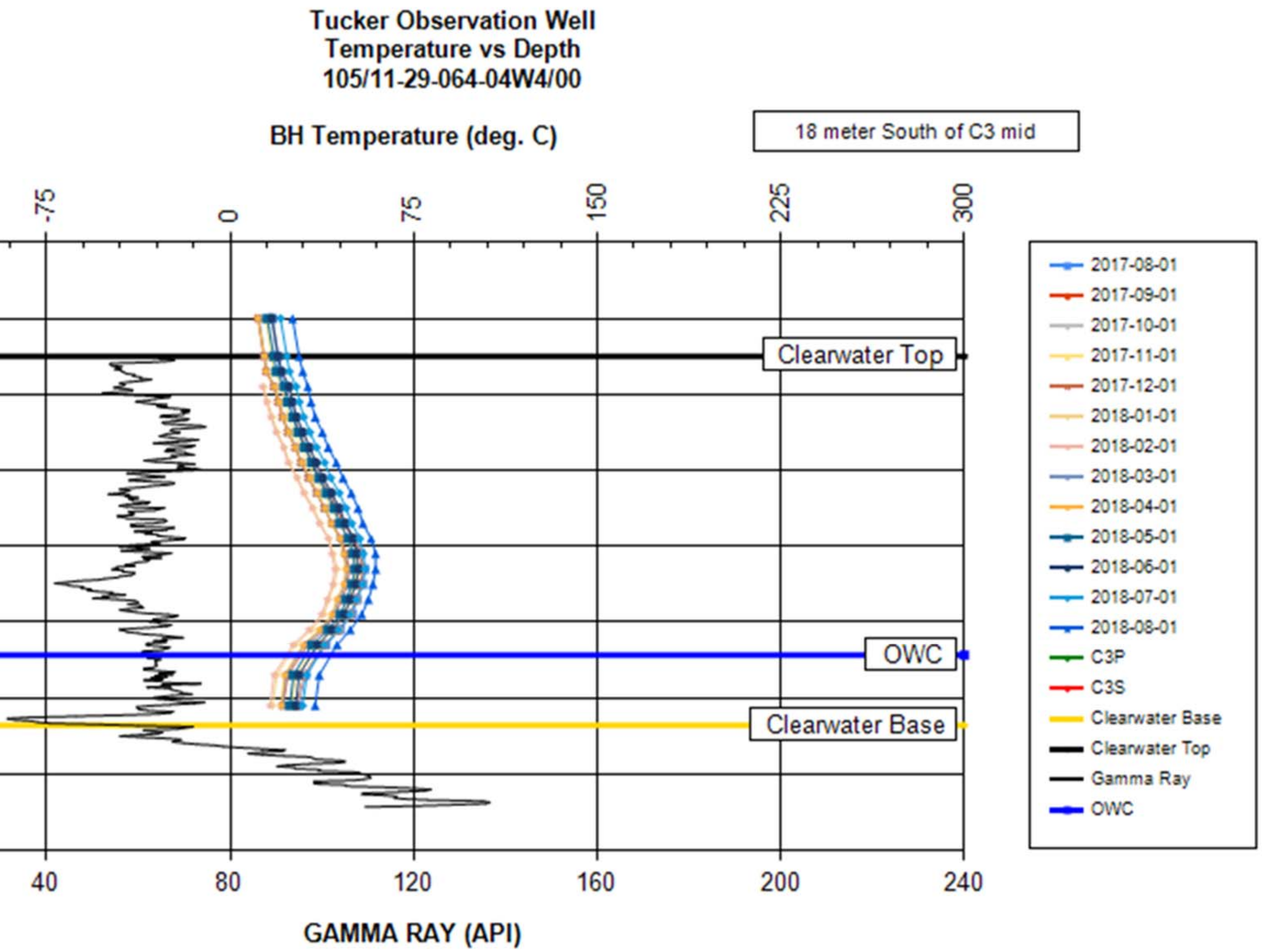
PAD C WEST HEEL OBSERVATION WELL



7. Scheme Performance

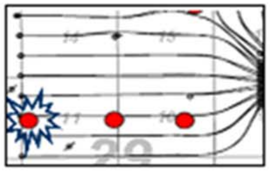
PAD C WEST MID OBSERVATION WELL

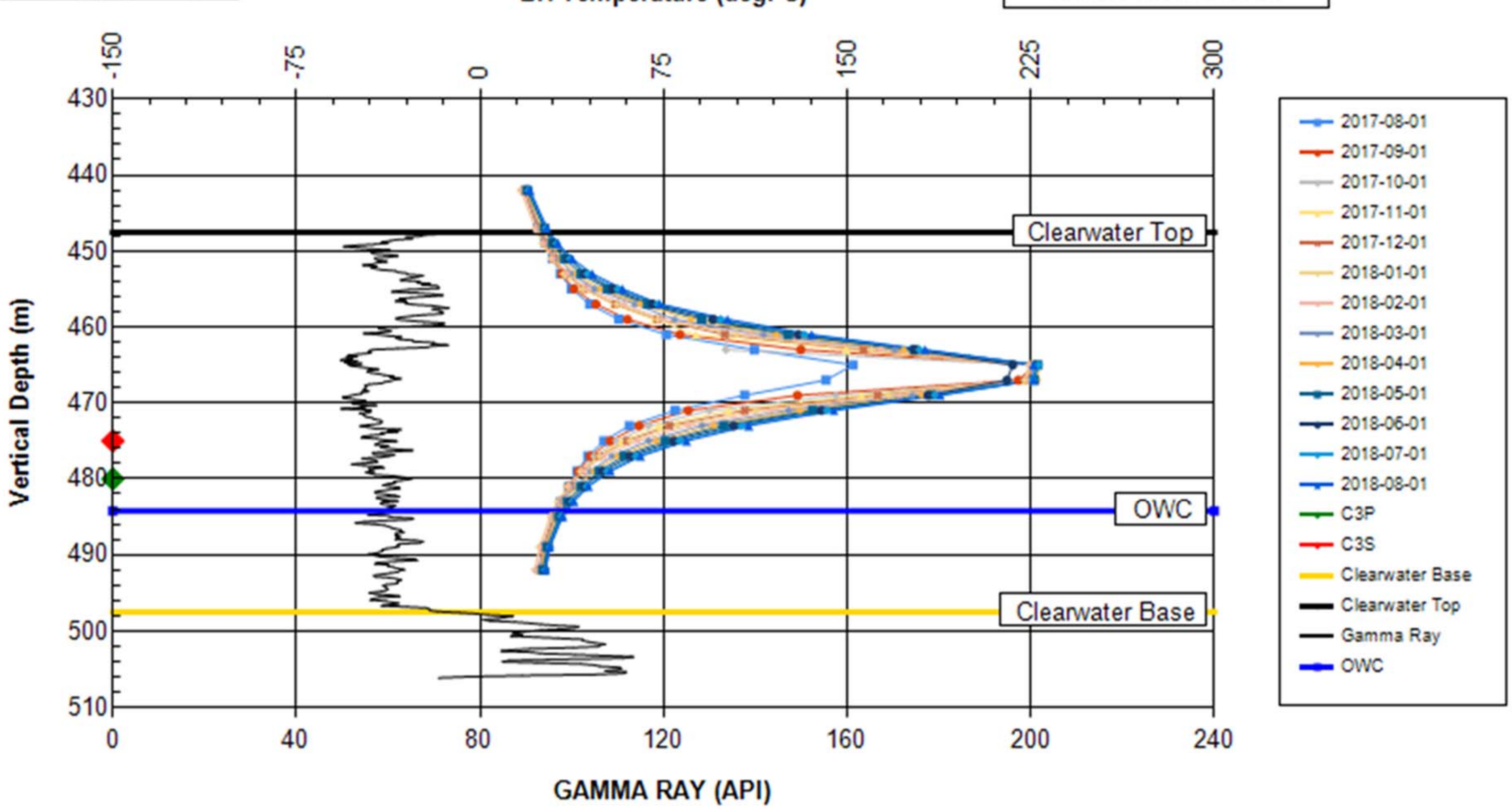




7. Scheme Performance

PAD C WEST TOE OBSERVATION WELL





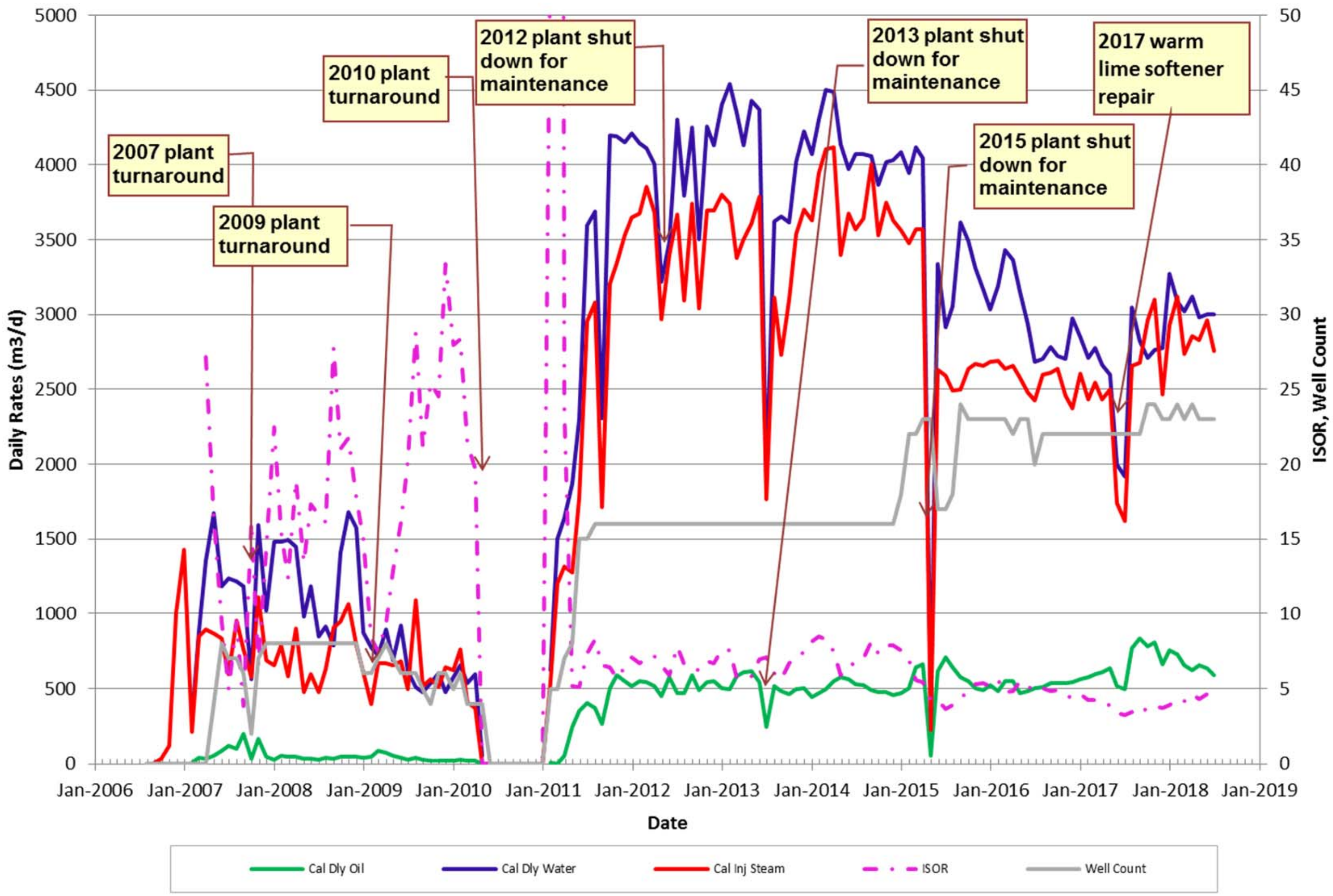
7. Scheme Performance

DISCUSSION OF PAD C WEST WELL PERFORMANCE

- The OBS wells along well pair C3 shows non-uniform steam chamber development
- To improve production, new injector wells were drilled 5m above existing injectors and existing injector wells were converted to producers
- Pad C West performance indicators as of July 31, 2018:
  - Cum Oil: 495,542 m^3
  - Cum Steam Injected: 4,487,796 m^3
  - Cum Water Produced: 3,499,813 m^3
  - CSOR: 9.1
- Pad C West performance for the reporting period:
  - Cum Oil: 32,827 m^3
  - Oil Rate per well: 12.3 m^3/day
  - SOR: 10.1

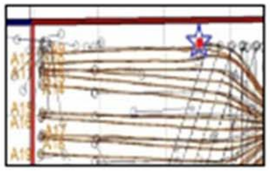
7. Scheme Performance

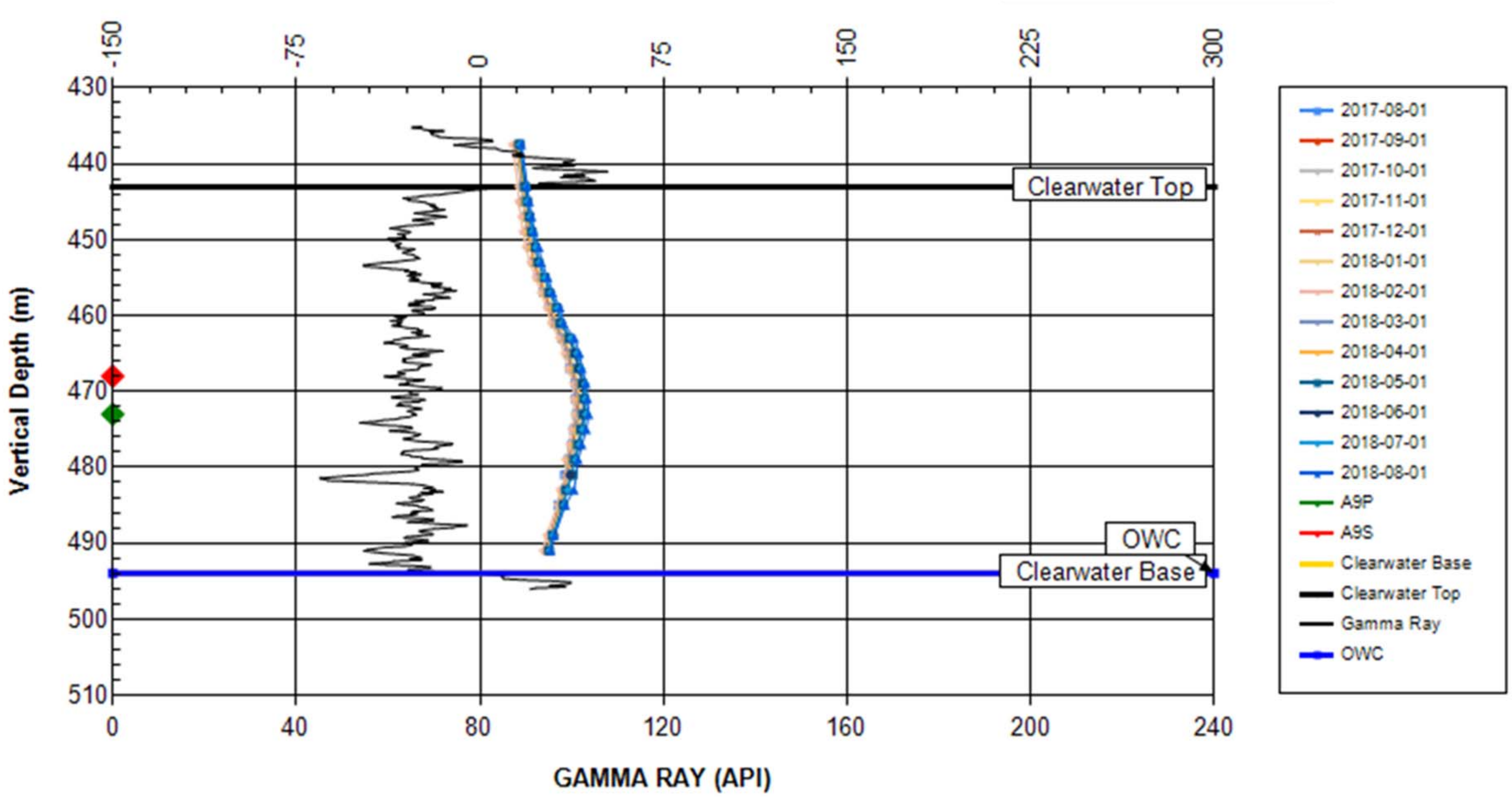
PAD A PERFORMANCE – MEDIUM RECOVERY EXAMPLE



7. Scheme Performance

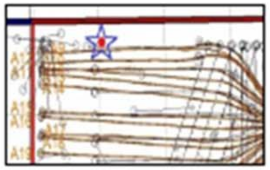
PAD A WELLS HEEL OBSERVATION WELL

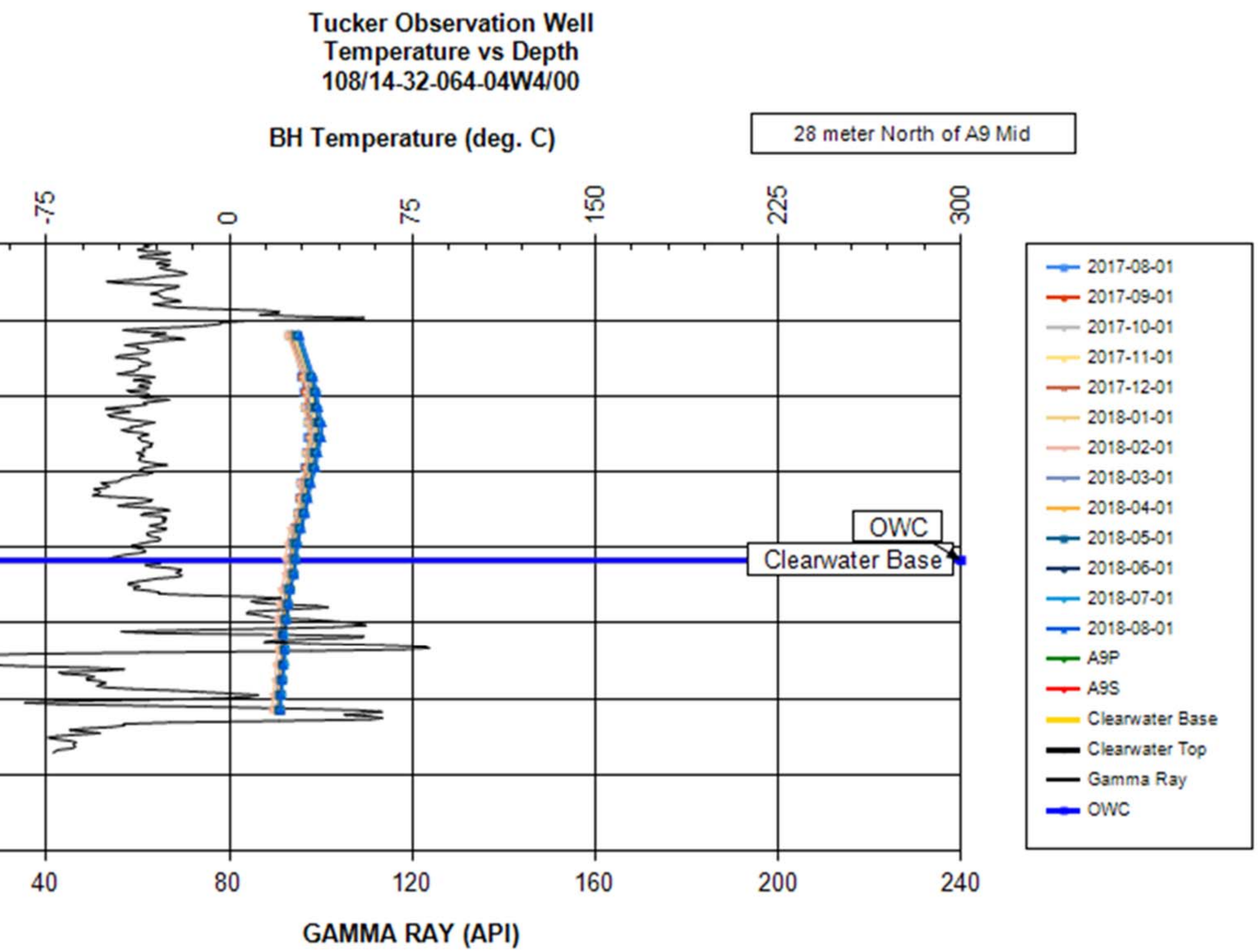




7. Scheme Performance

PAD A WELLS MID OBSERVATION WELL





7. Scheme Performance

DISCUSSION OF PAD A WELL PERFORMANCE

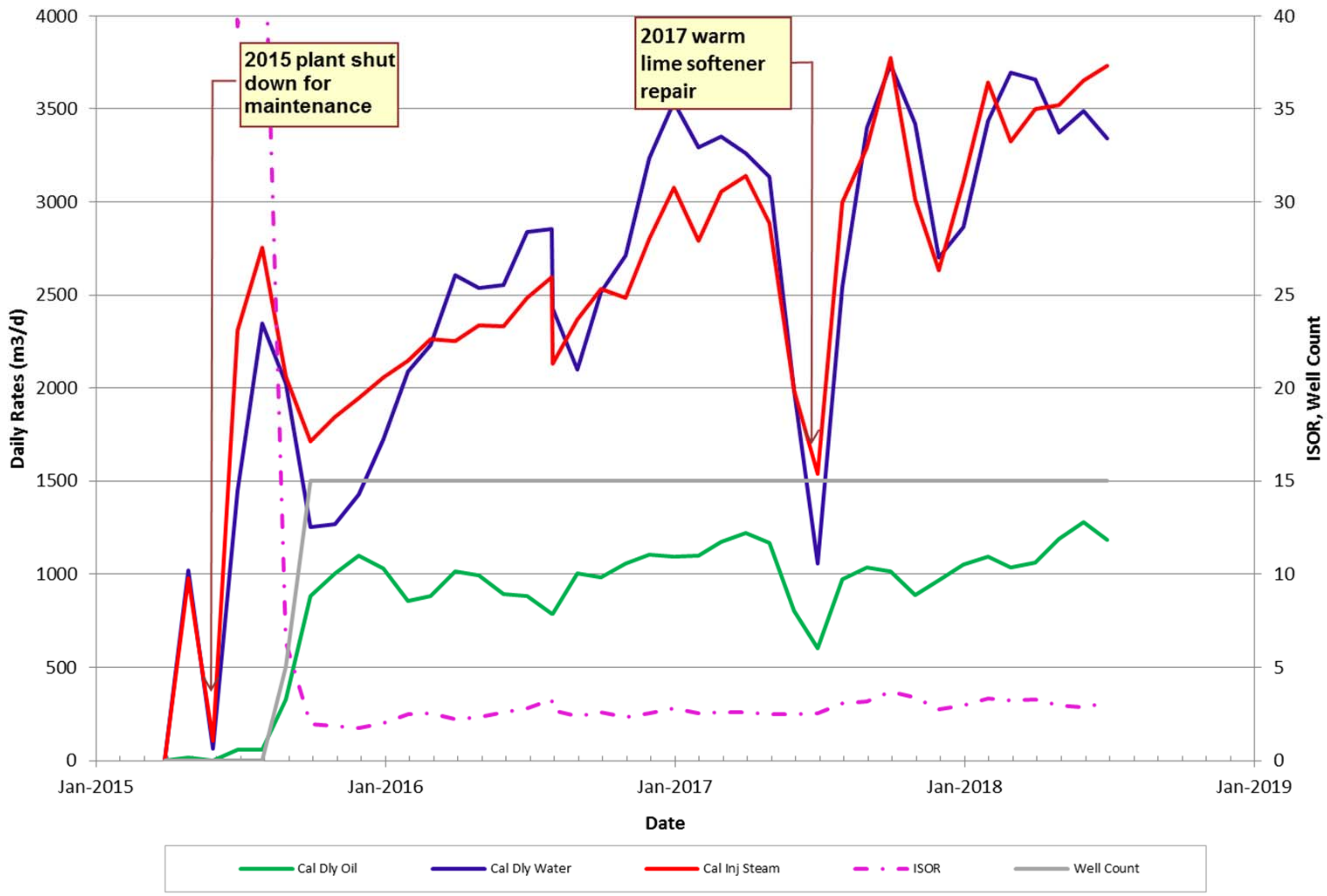
- The OBS wells near well pair A9 shows minimal steam chamber development

- Pad A performance indicators as of July 31, 2018:
  - Cum Oil: 1,485,886 m^3
  - Cum Steam Injected: 8,938,273 m^3
  - Cum Water Produced: 10,365,774 m^3
  - CSOR: 6.0

- Pad A performance for the reporting period:
  - Cum Oil: 258,238 m^3
  - Oil Rate per well: 30.5 m^3/day
  - SOR: 4.0

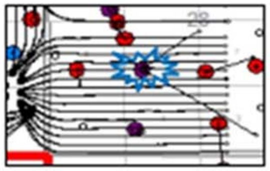
7. Scheme Performance

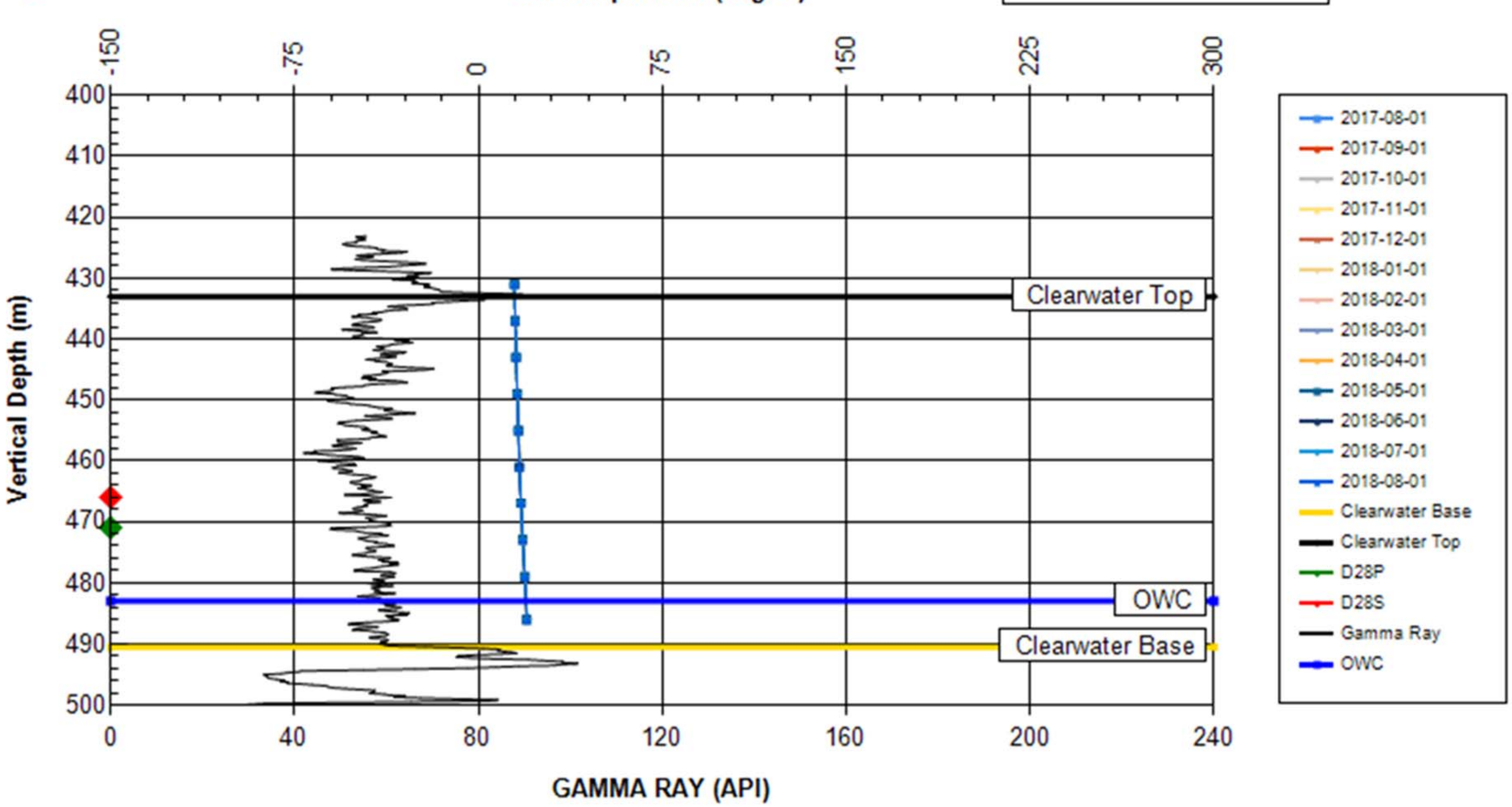
PAD D EAST PERFORMANCE – HIGH RECOVERY EXAMPLE



7. Scheme Performance

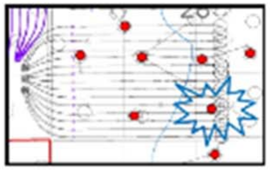
PAD D EAST MID OBSERVATION WELL

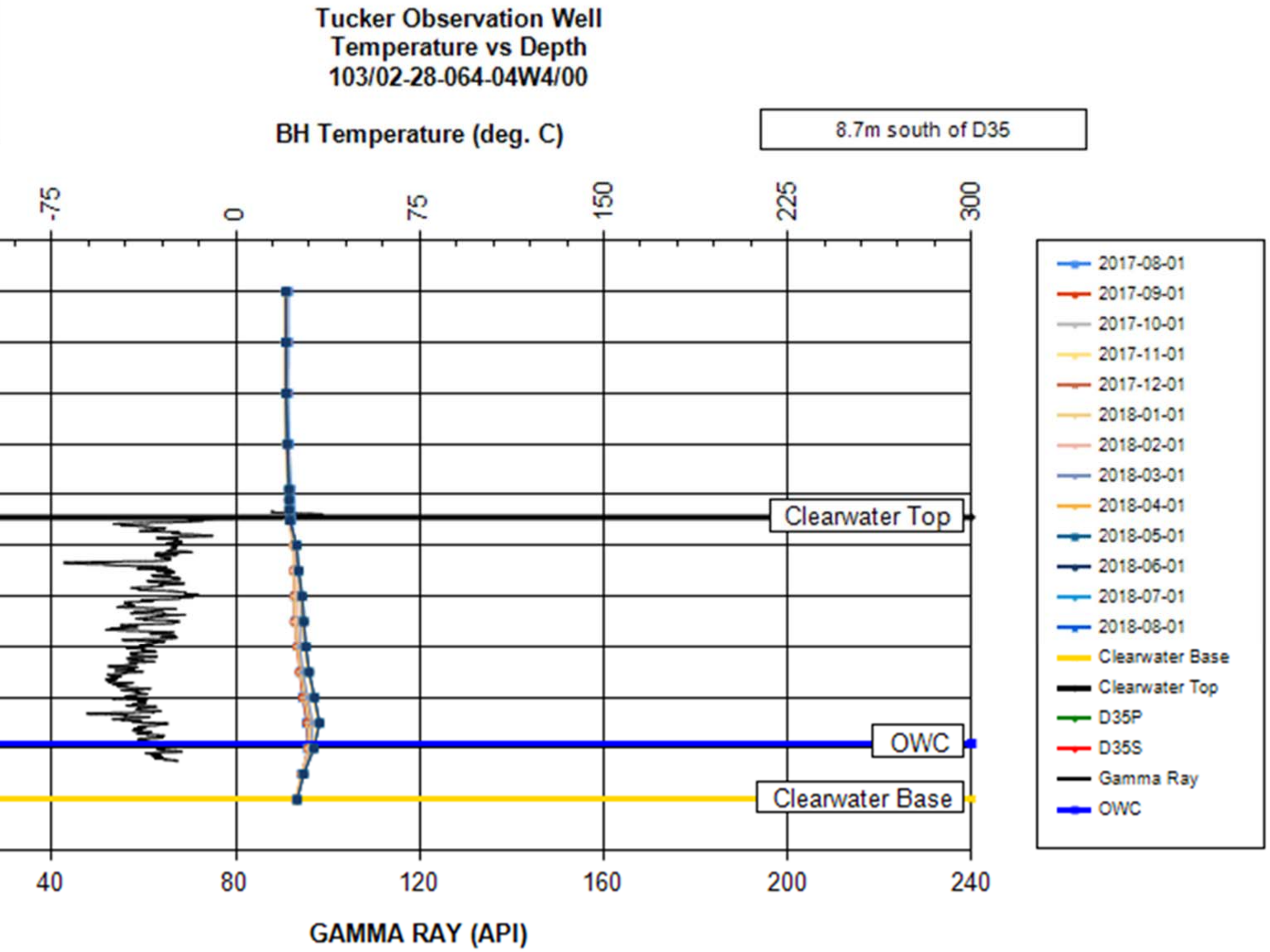




7. Scheme Performance

PAD D EAST TOE OBSERVATION WELL





7. Scheme Performance

DISCUSSION OF PAD D EAST PERFORMANCE

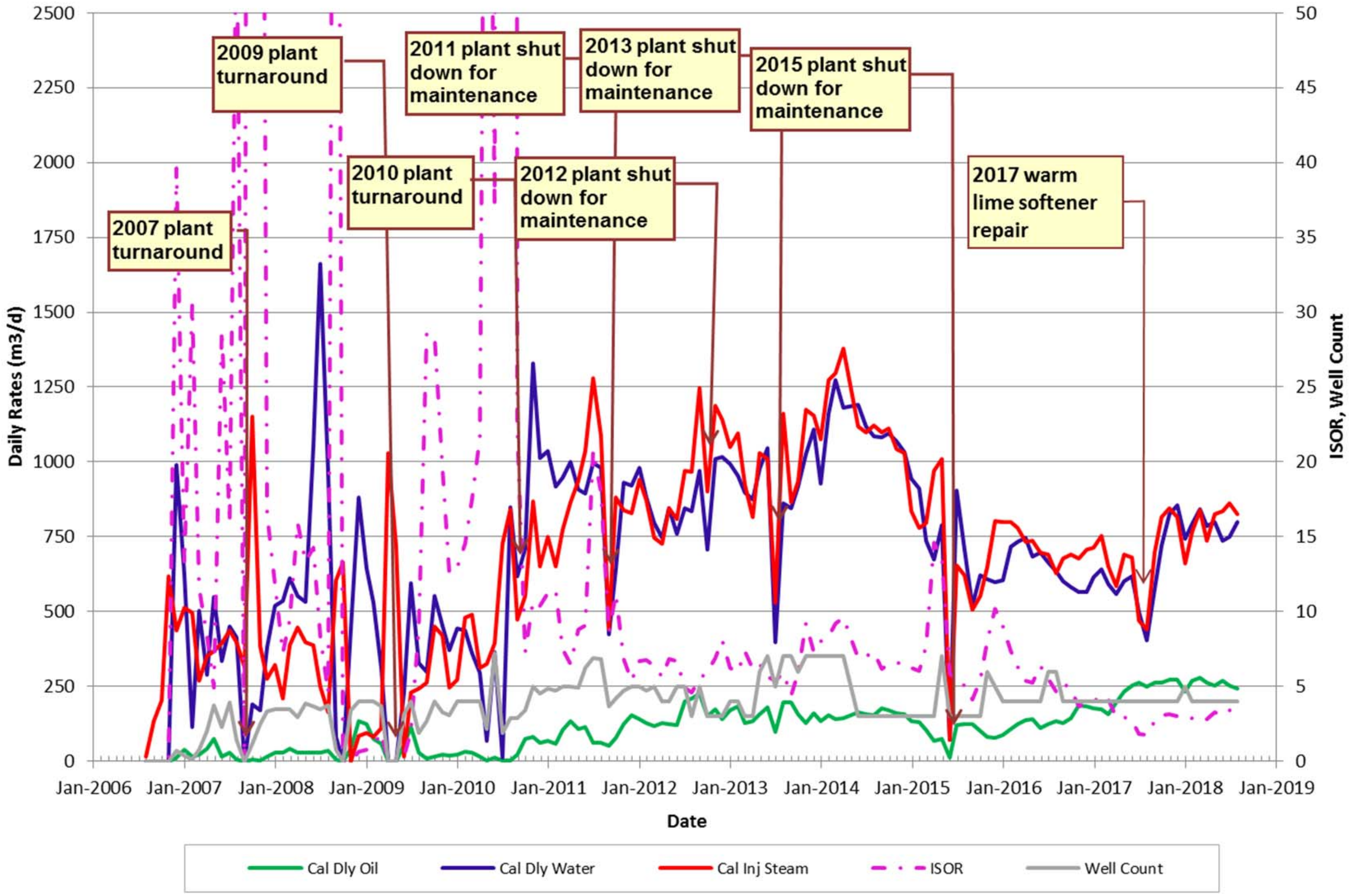
- Since steam commenced in Q2 2015, high temperature has not been observed at the OBS wells

- Pad D East performance indicators as of July 31, 2017:
  - Cum Oil: 1,085,733 m^3
  - Cum Steam Injected: 3,140,687 m^3
  - Cum Water Produced: 3,121,871 m^3
  - CSOR: 2.9

- Pad D East performance for the reporting period:
  - Cum Oil: 389,003 m^3
  - Oil Rate per well: 71.0 m^3/day
  - SOR: 3.1

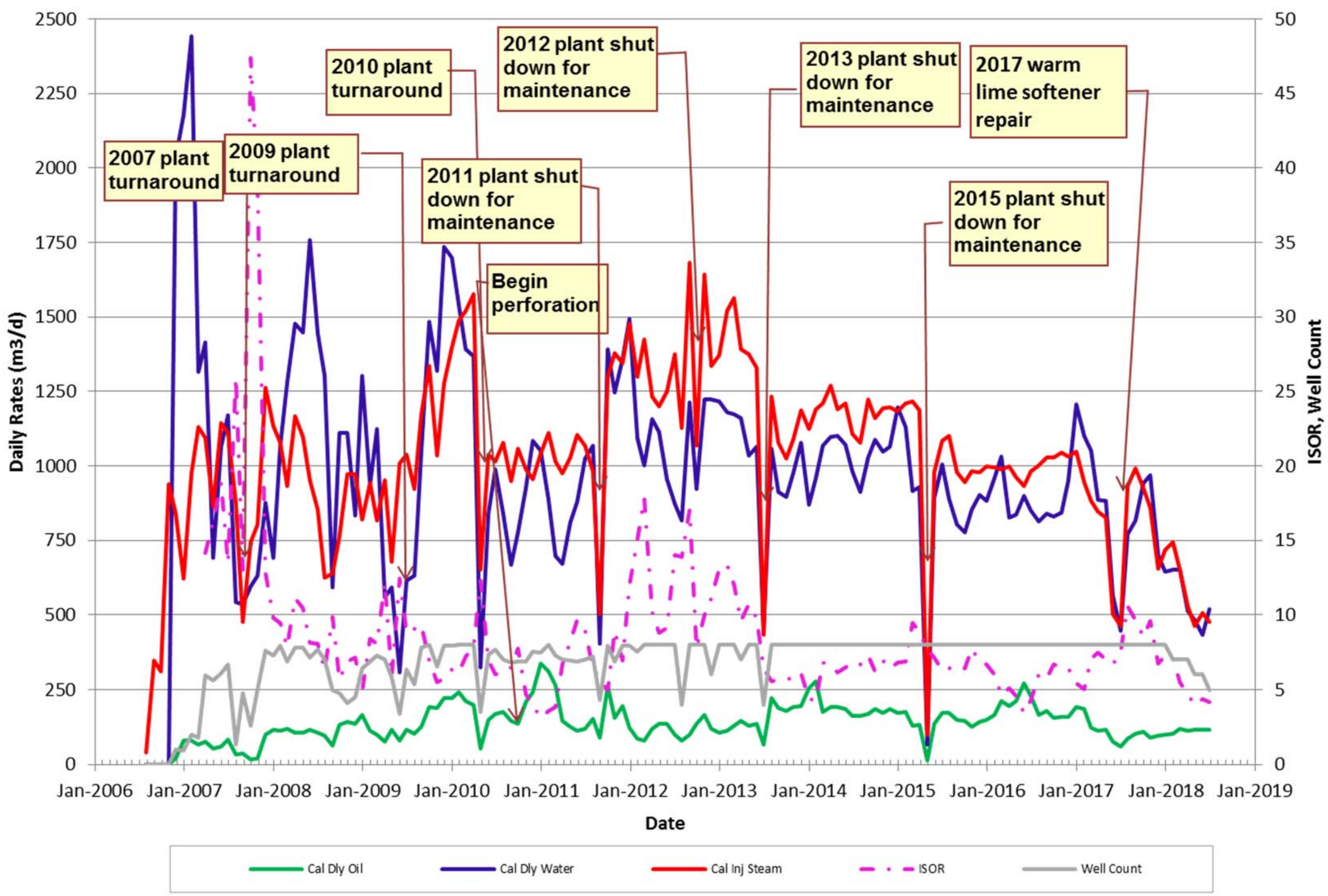
7. Scheme Performance

PAD B NORTH PERFORMANCE



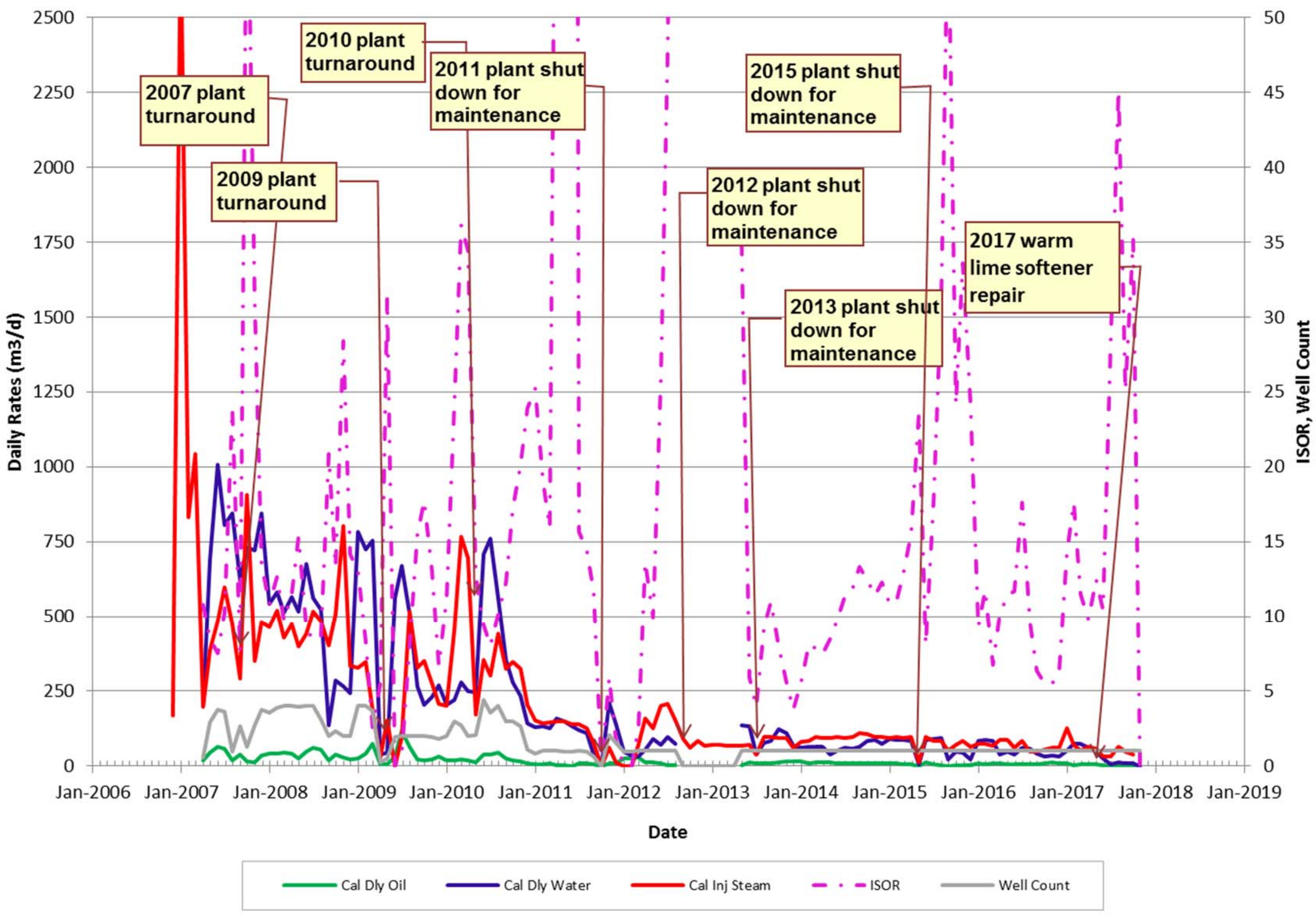
7. Scheme Performance

PAD B WEST PERFORMANCE



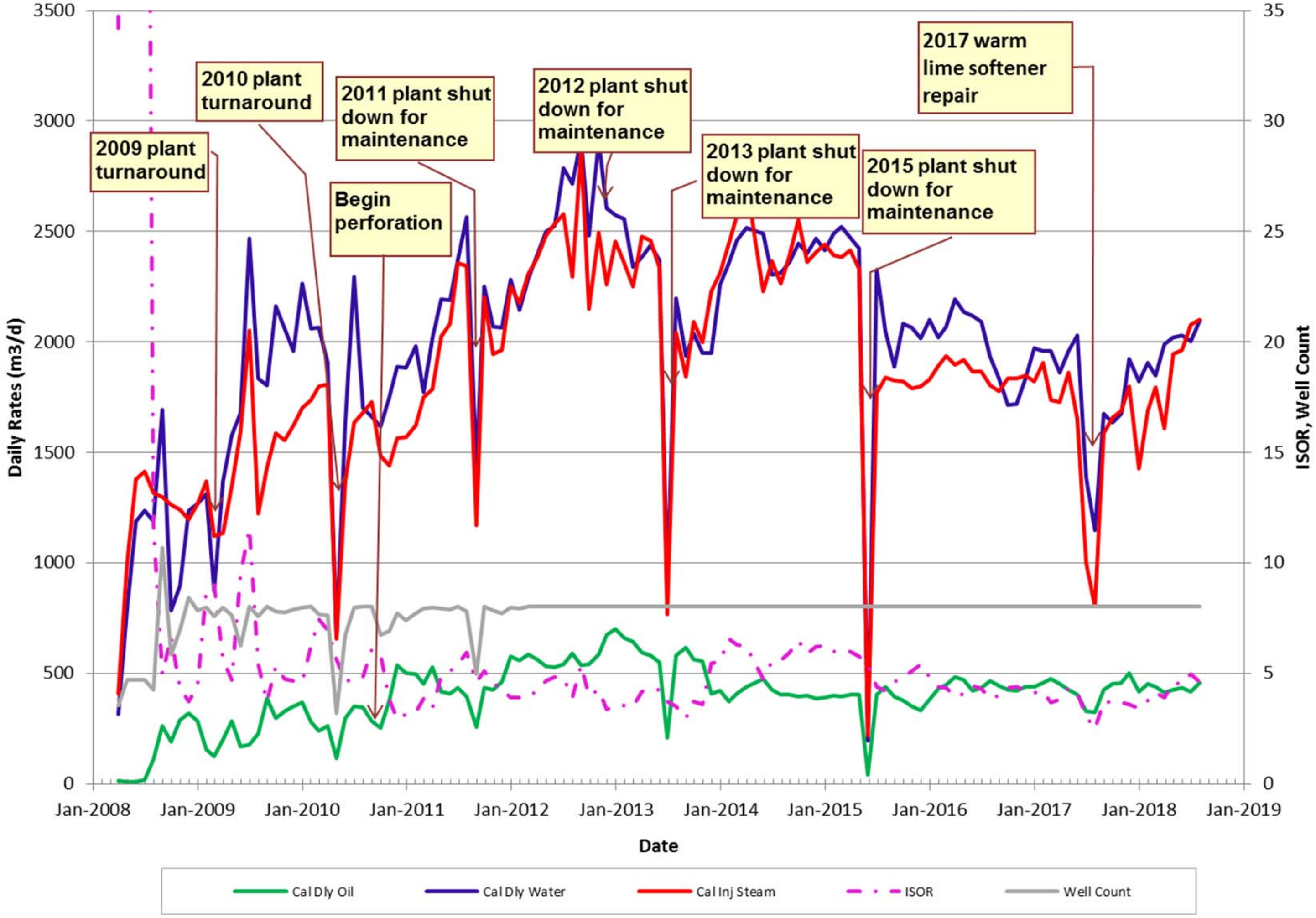
7. Scheme Performance

PAD C NORTH PERFORMANCE



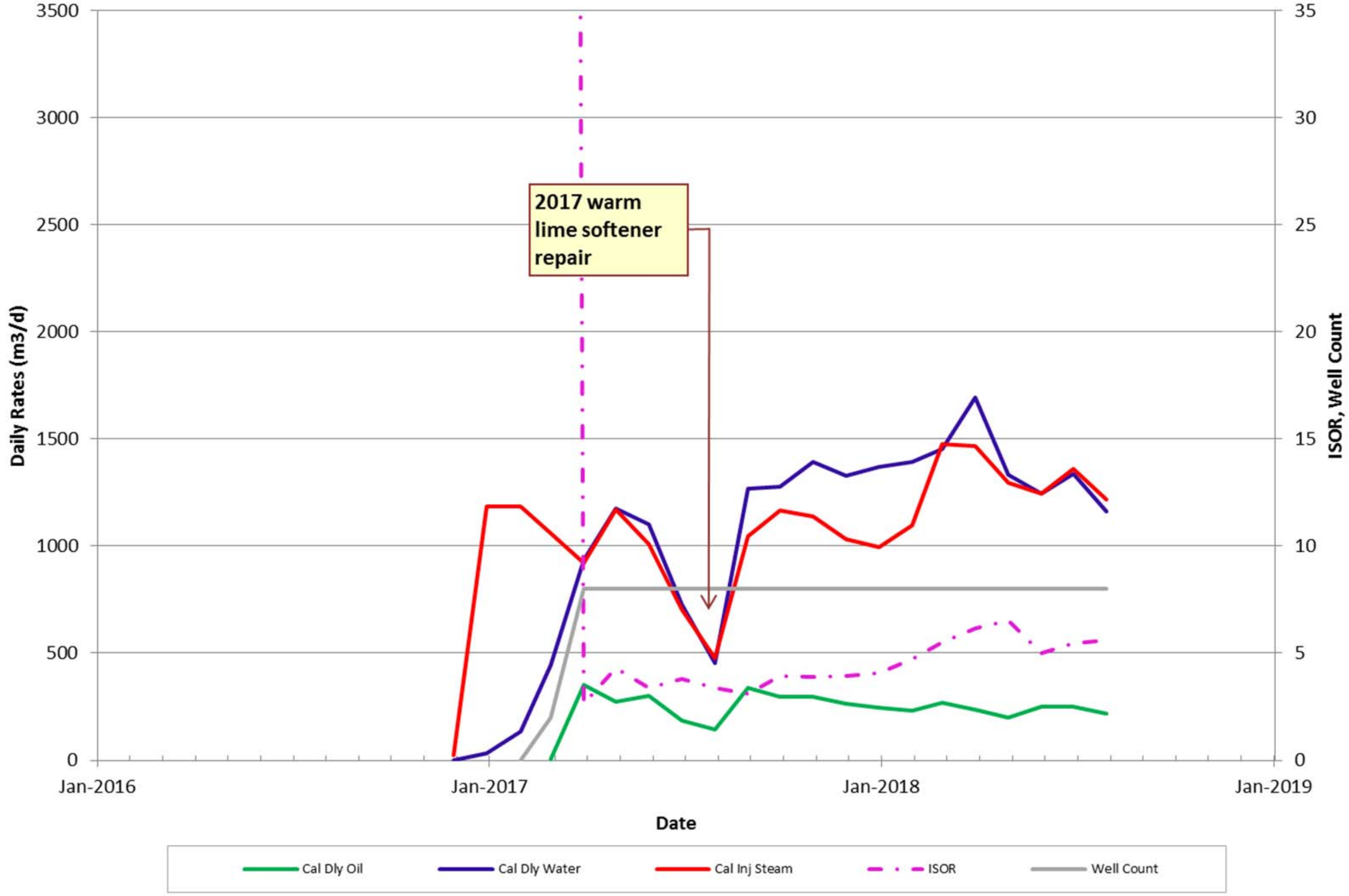
7. Scheme Performance

PAD C EAST PERFORMANCE



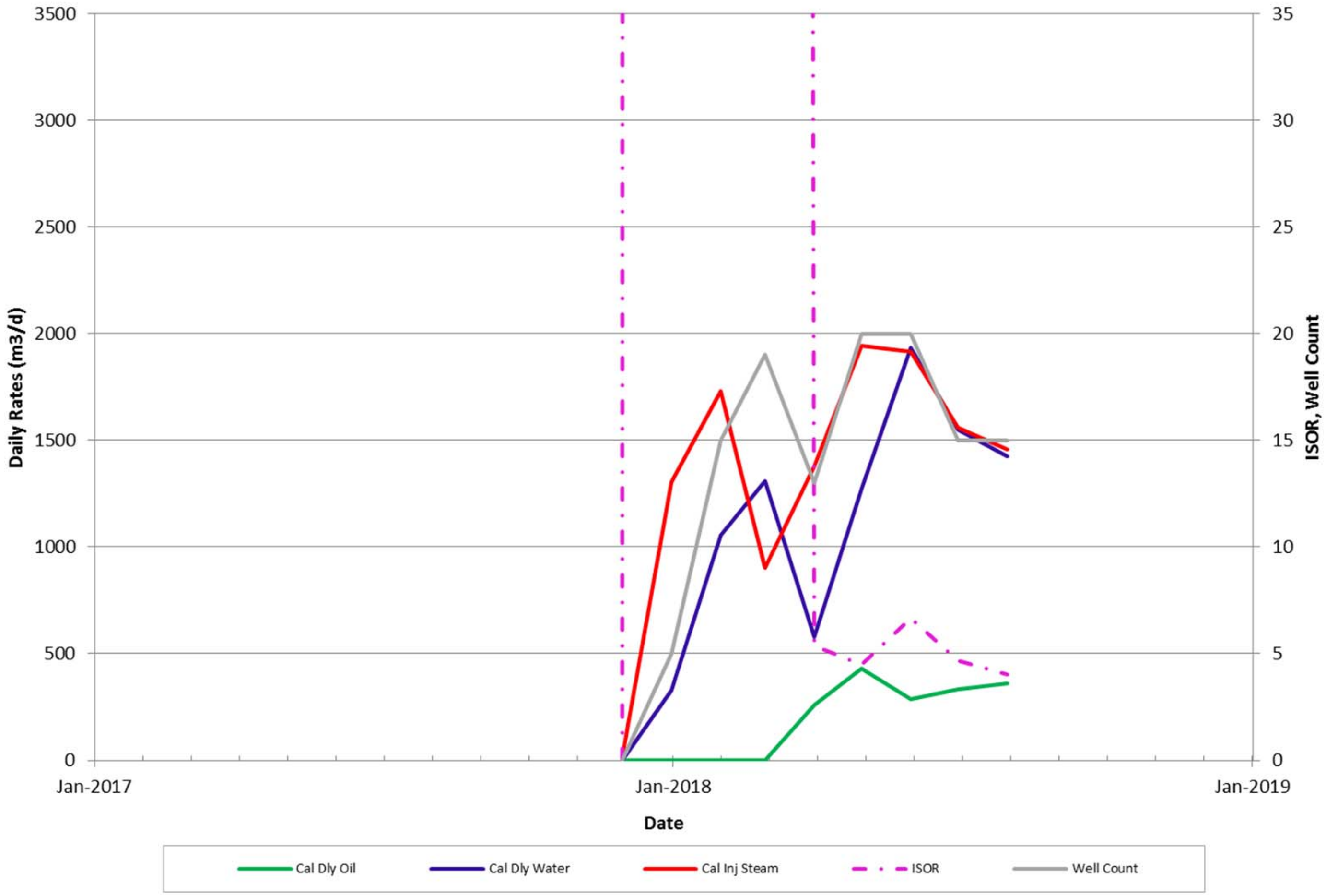
7. Scheme Performance

PAD D NORTH PERFORMANCE



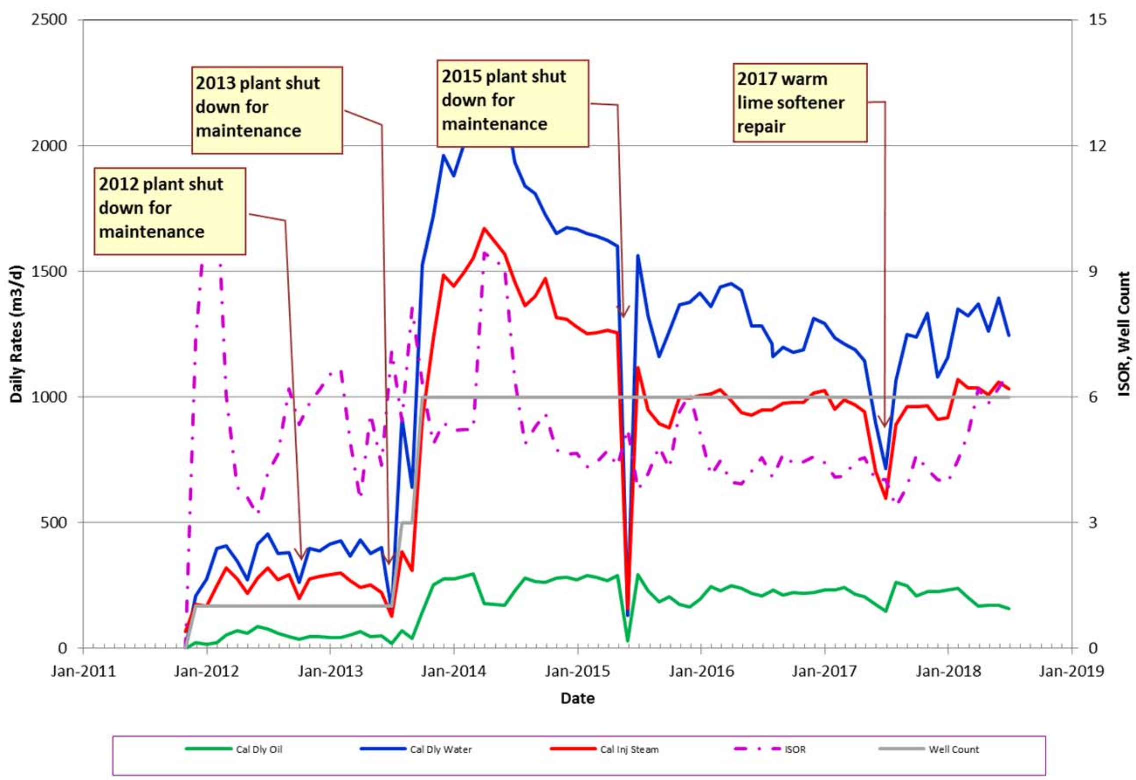
7. Scheme Performance

PAD D WEST PERFORMANCE



7. Scheme Performance

PAD LOWER GRAND RAPIDS (GA) PERFORMANCE



- Water-steam-ratio is due to high water mobility and bottom water
- Operating strategy at or slightly below the bottom water pressure to maintain the reservoir pressure and optimize steam efficiency
- Steam injection rates are optimized on a weekly basis based on well performance and total water produced from each well pair

7. Scheme Performance

DISCUSSION OF PAD GA PERFORMANCE

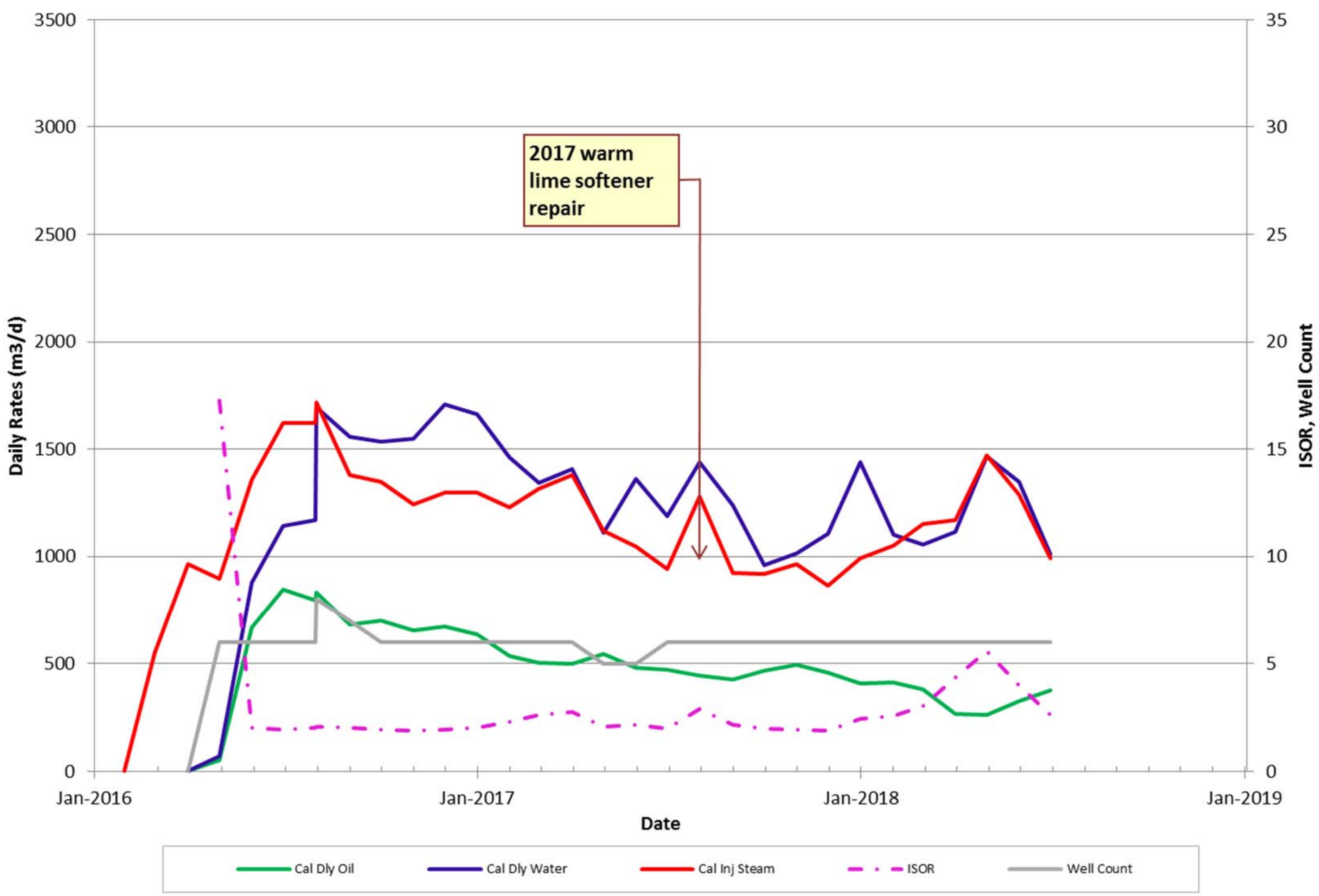
- Pilot well started in September 2011
- Remaining 5 well pairs started up September 2013

- Pad GA performance indicators as of July 31, 2018:
  - Cum Oil: 430,258 m^3
  - Cum Steam Injected: 2,084,678 m^3
  - Cum Water Produced: 2,767,327 m^3
  - CSOR: 4.8

- Pad GA performance for the reporting period:
  - Cum Oil: 76,486 m^3
  - Oil Rate per well: 34.9 m^3/day
  - SOR: 4.7

7. Scheme Performance

PAD COLONY (CN) PERFORMANCE



7. Scheme Performance

DISCUSSION OF PAD CN PERFORMANCE

- First steam in February 2016
- 6 SAGD well pairs and 7 infill wells

- Pad CN performance indicators as of July 31, 2018:
  - Cum Oil: 435,022 m^3
  - Cum Steam Injected: 1,077,448 m^3
  - Cum Water Produced: 1,069,794 m^3
  - CSOR: 2.5

- Pad CN performance for the reporting period:
  - Cum Oil: 143,650 m^3
  - Oil Rate per well: 65.5 m^3/day
  - SOR: 2.8

7. Scheme Performance

NEW DEVELOPMENT

- Pad C East Infill Well Application (No. 1908154) was approved March 26, 2018

7. Scheme Performance

OBIP AND RECOVERIES BY WELL PAD

- OBIP for each pad is calculated from the formula:

$$OBIP = L \times W \times H \times (1-S_w) \times \Phi \times 1/B_o$$

Where

L = Effective Average Length of wells

W = Lateral Width covered by the wells

H = Thickness from the top of pay to the producer elevation

Φ = Average Porosity in the Pay zone

S_w = Average Water Saturation in the Pay zone

B_o = Oil Volume factor/Shrinkage factor (taken as 1)

7. Scheme Performance

OBIP AND RECOVERIES BY WELL PAD

Well PAD		Thickness (m)	Area (10^3 m^2)	Pad Volume[1] (10^3 m^3)	So	PhiE	OBIP (10^6 m^3)	Recovery to Date 7/31/2017 (10^3 m^3)	Recovery Factor to Date (%)	Estimated Ultimate Recovery (10^6 m^3)	Ultimate Recovery Factor (%)
Pad A	A Infills and Replacement (16 well pairs)	30	880	30.6	0.56	0.32	5.5	1486	27	2.7	50
	A original (8 well pairs)	7	640								
Pad B	B West (8 well pairs)	37	640	39.8	0.57	0.32	7.3	1076	15	3.6	50
	B North (4 well pairs)	8	320								
	B North Infills (3 well pairs)	40	345								
Pad C	C West (8 well pairs)	36	640	53.8	0.60	0.32	10.3	2058	20	5.2	50
	C North Original[2] (4 well pairs)	10	320								
	C East (8 well pairs)	43	640								
Pad D	D East (15 well pairs)	43	660	28.1	0.61	0.32	5.5	1085	20	2.7	50
	D North (8 well pairs)	36	330	11.8	0.61	0.33	2.4	132	6	1.2	50
	D west (15 well pairs)	31	578	17.9	0.63	0.32	3.6	51	1	1.8	50
Pad GA (6 well pairs)		30	355	10.6	0.62	0.30	2.0	430	22	1.0	50
Pad CN (6 well pairs + 7 infill)		13	502	6.5	0.82	0.29	1.6	436	28	0.8	50

Note:
OBIP – volume x So x Phi-E
[1] Due to rounding of values, the calculated values may not equal the individual values presented in the table
[2] Pad C North future development not included in the table. The OBIP is equal to 1.1×10^6 m^3

7. Scheme Performance

5-YEAR OUTLOOK OF EXPECTED PAD ABANDONMENT

- No pad abandonment anticipated in the next 5 years

7. Scheme Performance

TEMPERATURE, PRESSURE AND QUALITY OF STEAM

- High pressure steam separator delivers steam at a 100% quality
- Steam quality losses are experienced during transportation to the pads
- Steam quality at the wellhead is estimated to be 95%

7. Scheme Performance

COMPOSITION OF OTHER INJECTED/PRODUCED FLUIDS

- Not applicable for the reporting period

7. Scheme Performance

SUMMARY OF KEY LEARNINGS

- Well placement is key for well performance
- Circulation is the optimal start-up strategy for establishing thermal communication
- Wire-wrapped screens are used to avoid scaling problem of the production liner
- Steady operating conditions are key to obtaining good steam chamber conformance
- To maintain steady operations and prevent water inflow a constant operating pressure is needed and retain bottom water pressure

8. Future Plans

FUTURE PLANS 2019/2020

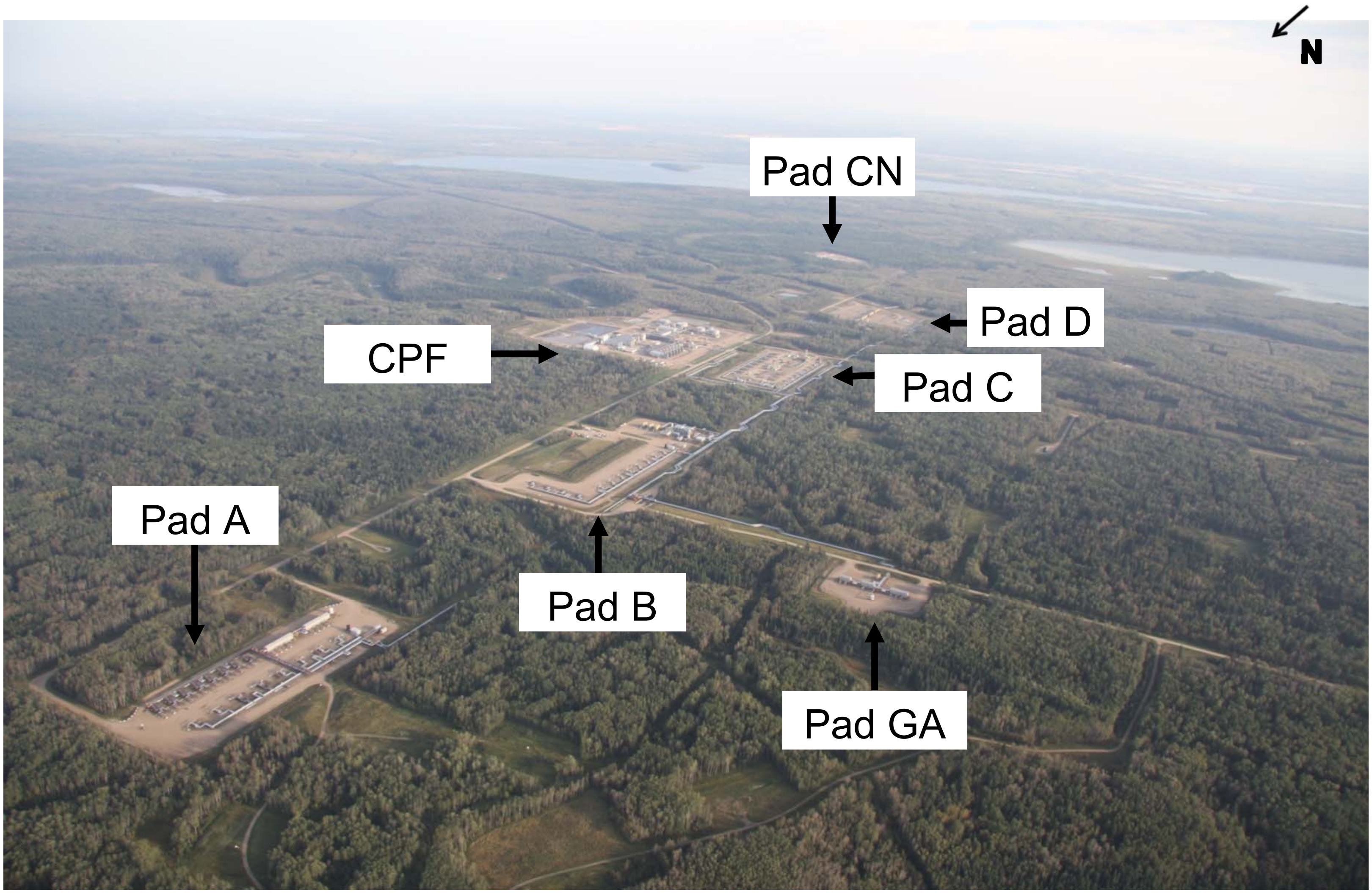
- Pad Colony Infill Wells:
  - Evaluate options to enable these wells to produce as soon as possible
- Pad B West Replacement Wells:
  - Future development based upon the performance of Pad C West Replacement wells
- Pad C East Infill Wells:
  - Application approved in March 2018
  - Plan to commence drilling in 2019
- Pad Lower Grand Rapids B Development:
  - Target Application submission Q4 2018
- Pad C North Future Development:
  - On-going evaluation of strategies for optimizing the resource recovery

3.1.2 Surface

TABLE OF CONTENTS

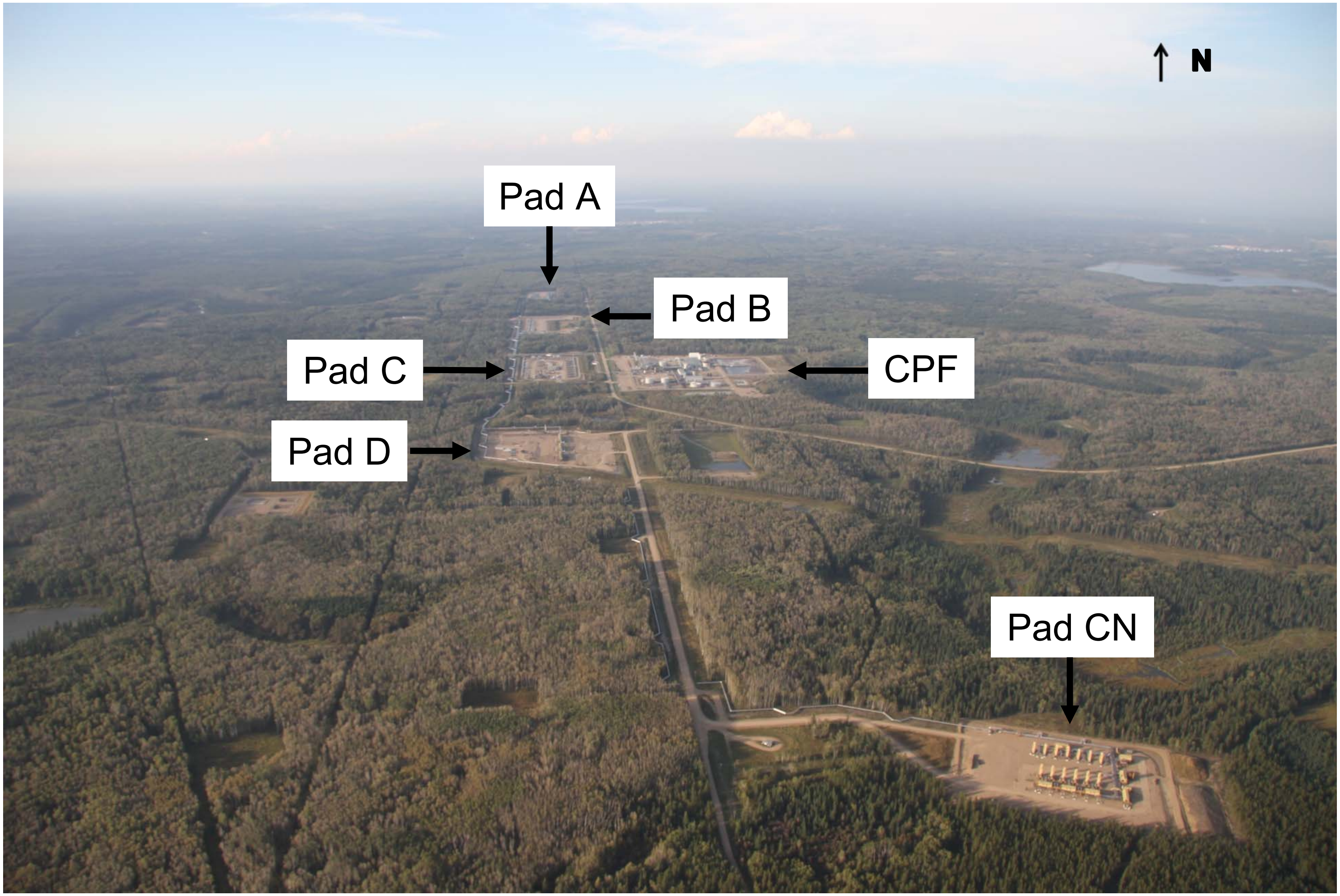
1. Facilities

LAYOUT – SOUTHEAST



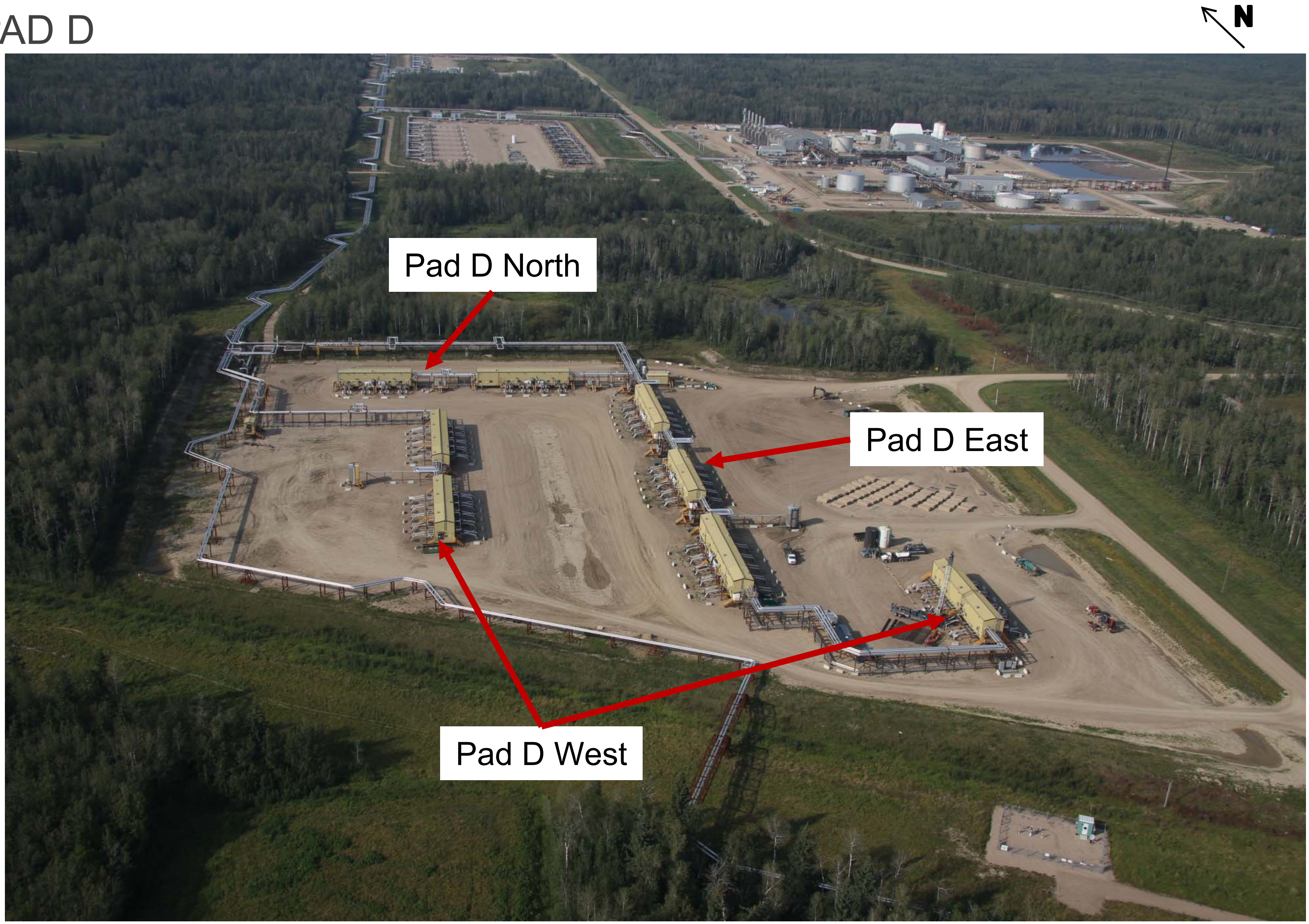
1. Facilities

LAYOUT - NORTH



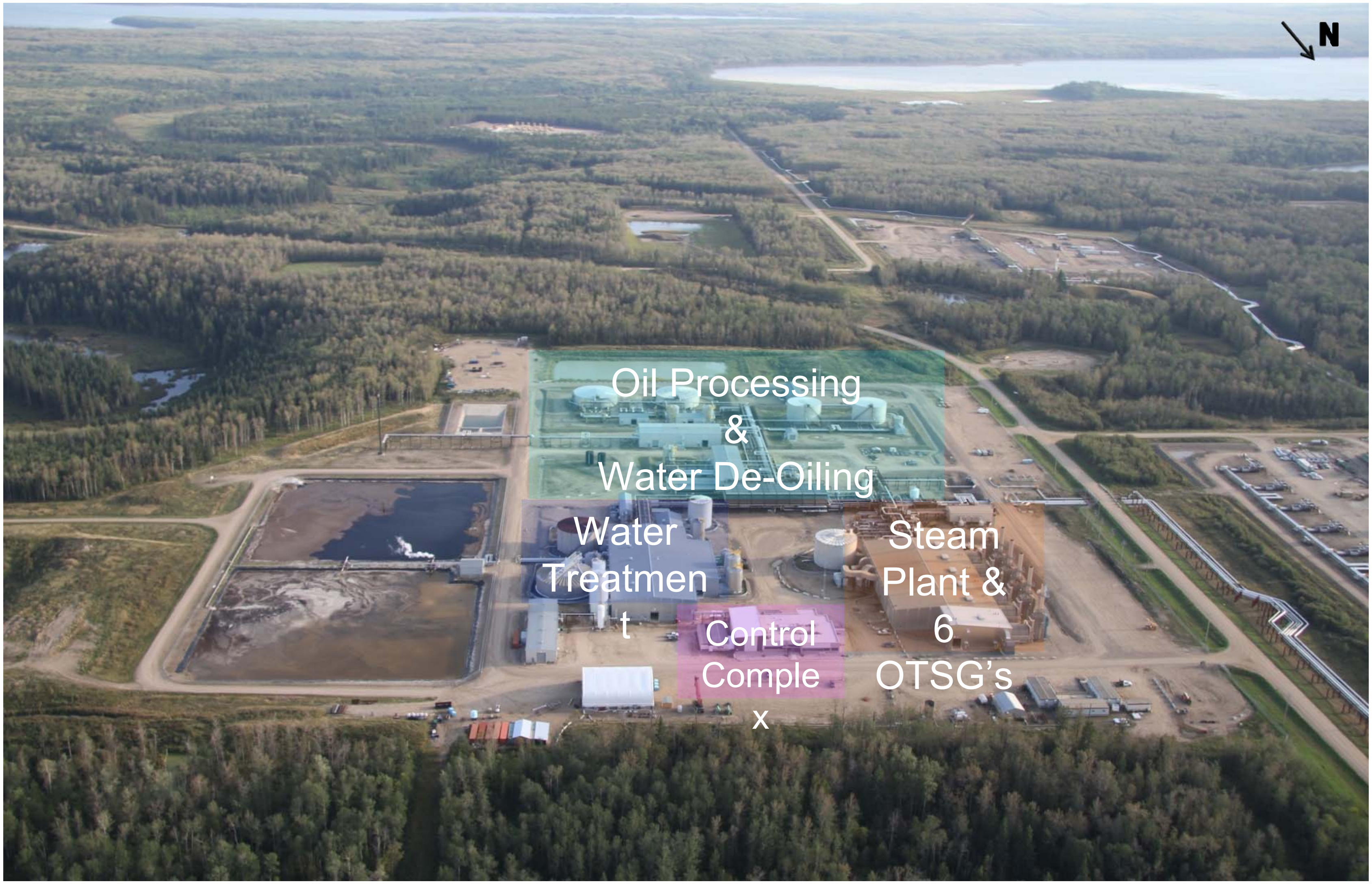
1. Facilities

PAD D



1. Facilities

CENTRAL PROCESSING FACILITY (CPF)



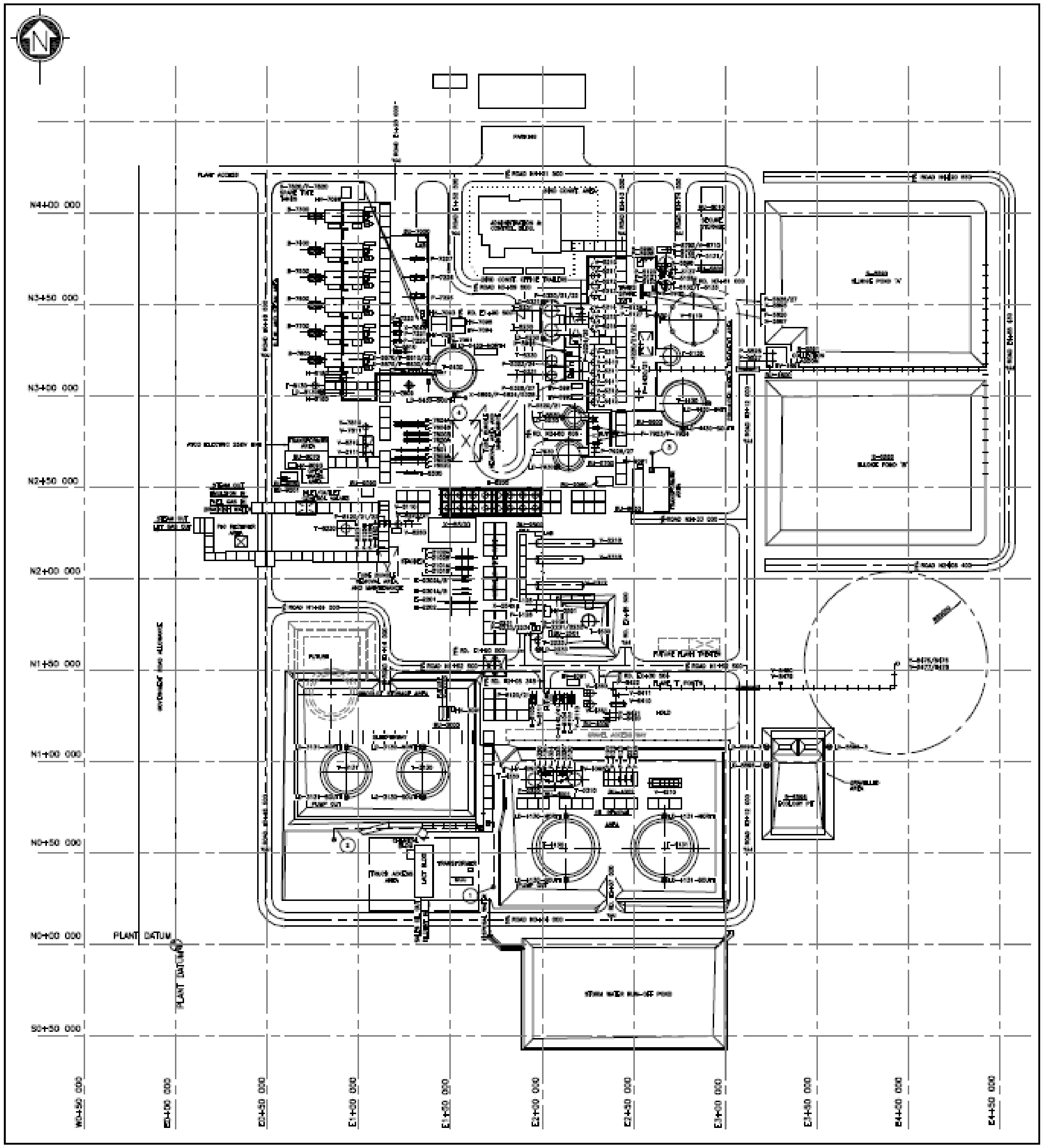
1. Facilities

CENTRAL FIELD FACILITIES (CFF)

N

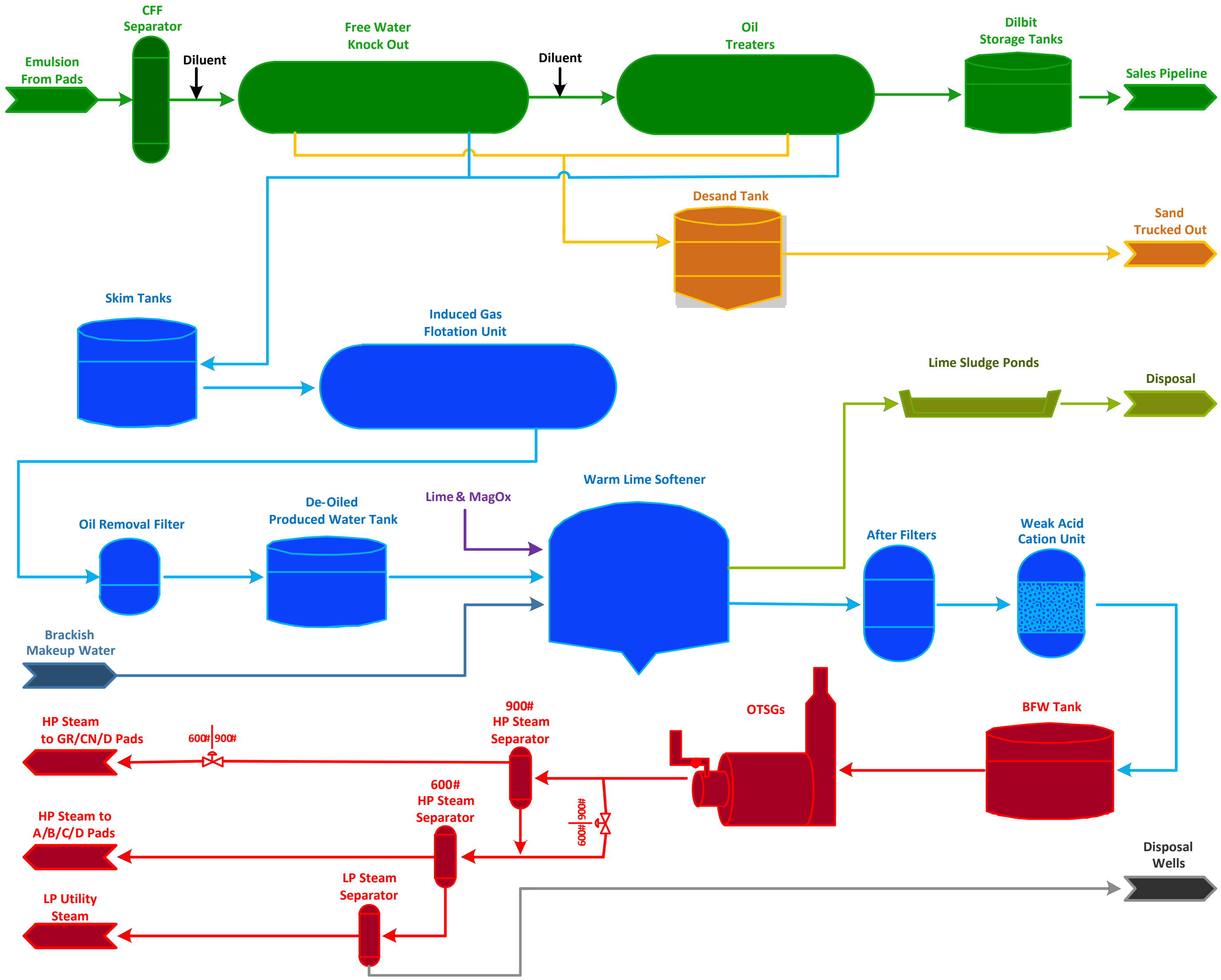
1. Facilities

CENTRAL PROCESSING FACILITY - PLOT PLAN



1. Facilities

FACILITY SCHEMATIC



1. Facilities

FACILITY MODIFICATIONS

- Pad D West well pairs D1–D15 Commissioning:
  - Surface facility commissioning and circulation Q4 2017 to Q1 2018
  - First oil in Q1 2018

- Colony Intermittent Steam Stimulation (ISS) wells CN7 and CN9 start-up:
  - Wells on production July 2018

2. Facility Performance

OPERATING LIMITATIONS

- Brackish water wells producing excessive amounts of sand
  - Replaced gravel pack, downhole screen, tubing and wellheads on wells 1F1/08-25-064-04 W4M and 1F1/11-30-064-04 W4M
  - Work-over on remaining well 1F1/12-30-064-04 W4M planned for Q4 2018

- De-oiled water quality KPIs exceeded:
  - Several Total Suspended Oil (TSO) targets exceedences caused when commissioning Pad D West, diluent outages and treating resulted in thick, heavy sludge in Warm Lime Softener (WLS) and off-spec boiler feed water (BFW)
  - WLS rake stalled in thick sludge - December 2017
  - De-scaled (Pigged) OTSG B-7400 - Q3 2017 (as a precaution)

2. Facility Performance

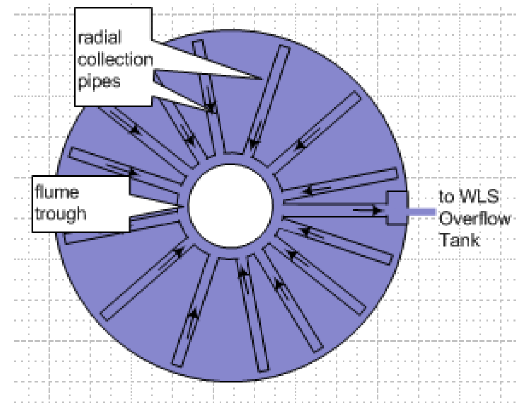
PROCESS WATER DE-OILING

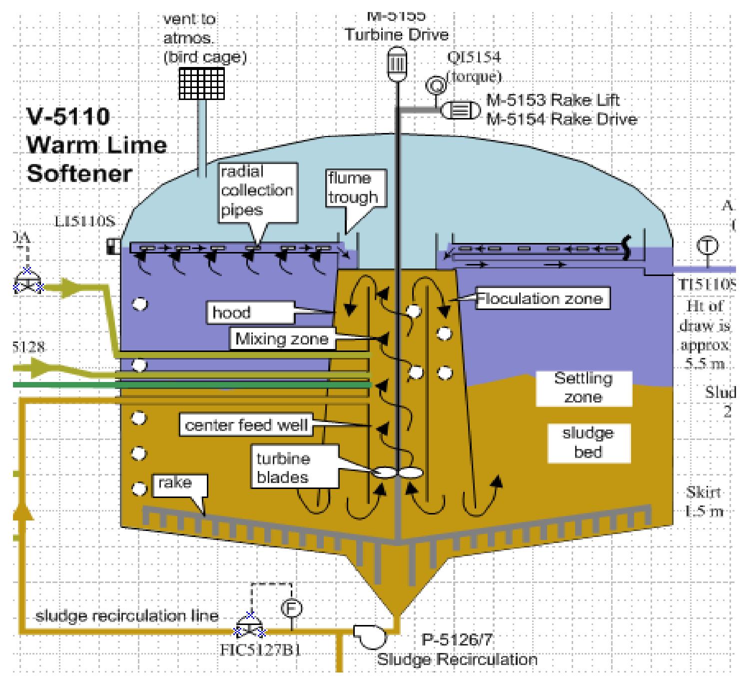
- The de-oiling process consists of 2 skim-tanks (in series), IGF and 2 oil-removal-filters
- Treating challenges were experienced early in the year. Recent moves have brought water chemistry well within specifications
- De-Oiling TSO KPI's:
  - FWKO – 1,000 ppm (average 240 ppm)
  - IGF Inlet – 100 ppm (average 69 ppm)
  - IGF Out – 40 ppm (average 52 ppm)
  - ORF Outlet – 20 ppm (average 32 ppm)

2. Facility Performance

WARM LIME SOFTENER (WLS)

- Primary water treatment to produce boiler feed water
- Feed sources:
  1. De-oiled produced water
  2. Brackish water make-up
  3. Sludge pond water
- Reduces water contaminants:
  1. Hardness - primarily Calcium and Magnesium
  2. Silica - main contaminant due to thermal recovery process
  3. Turbidity - suspended solids
- Produces sludge as waste product - stored in ponds
- Mechanical turbine, rake drives
- Main zones: Mixing, Reaction, Settling
- Produces water effluent with hardness ~20 ppm and silica ~50 ppm





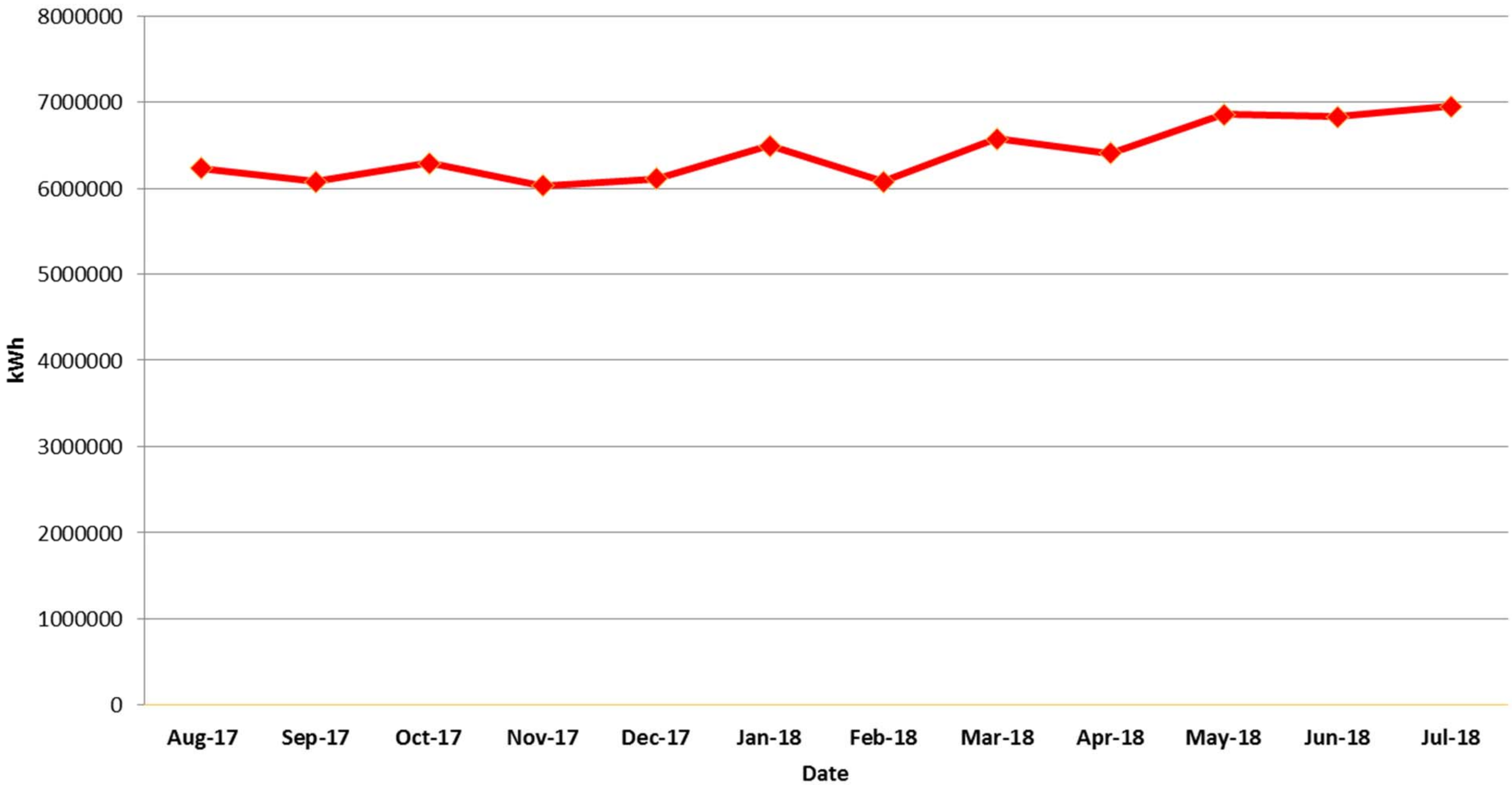
2. Facility Performance

WLS CHEMISTRY / PERFORMANCE

- Chemistry:
  - Lime – primary hardness control
  - Magnesium Oxide (MagOx) – primary silica reduction
  - Caustic – water pH control, aids softening
  - Sodium Carbonate (soda ash) – permanent hardness removal
  - Polymer – coagulants and flocculants establish sludge bed control
- Performance:
  - The WLS has performed well to date
- Key KPIs:
  - Soluble Hardness – 25 ppm (average 11 ppm)
  - Silica – 50 ppm (average 44 ppm)
  - Turbidity – 20 NTU (average 20 NTU)

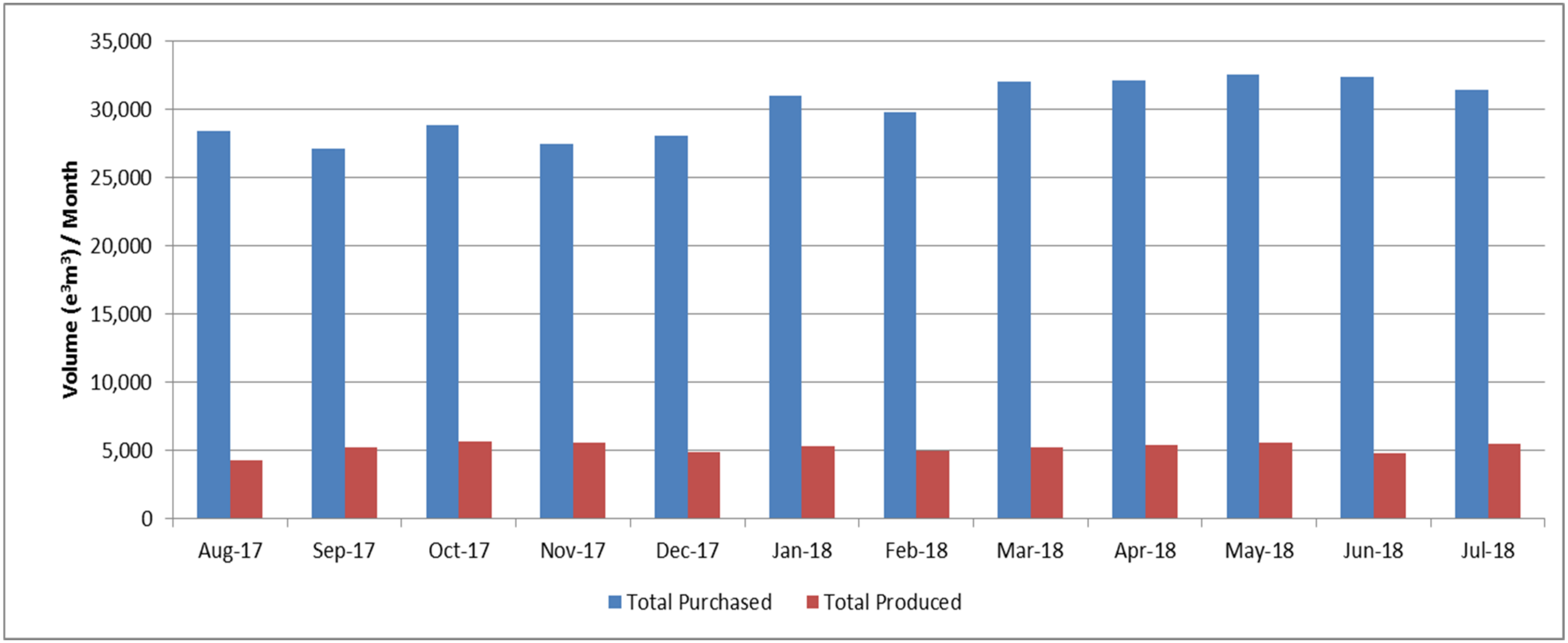
2. Facility Performance

POWER CONSUMPTION



2. Facility Performance

GAS USAGE

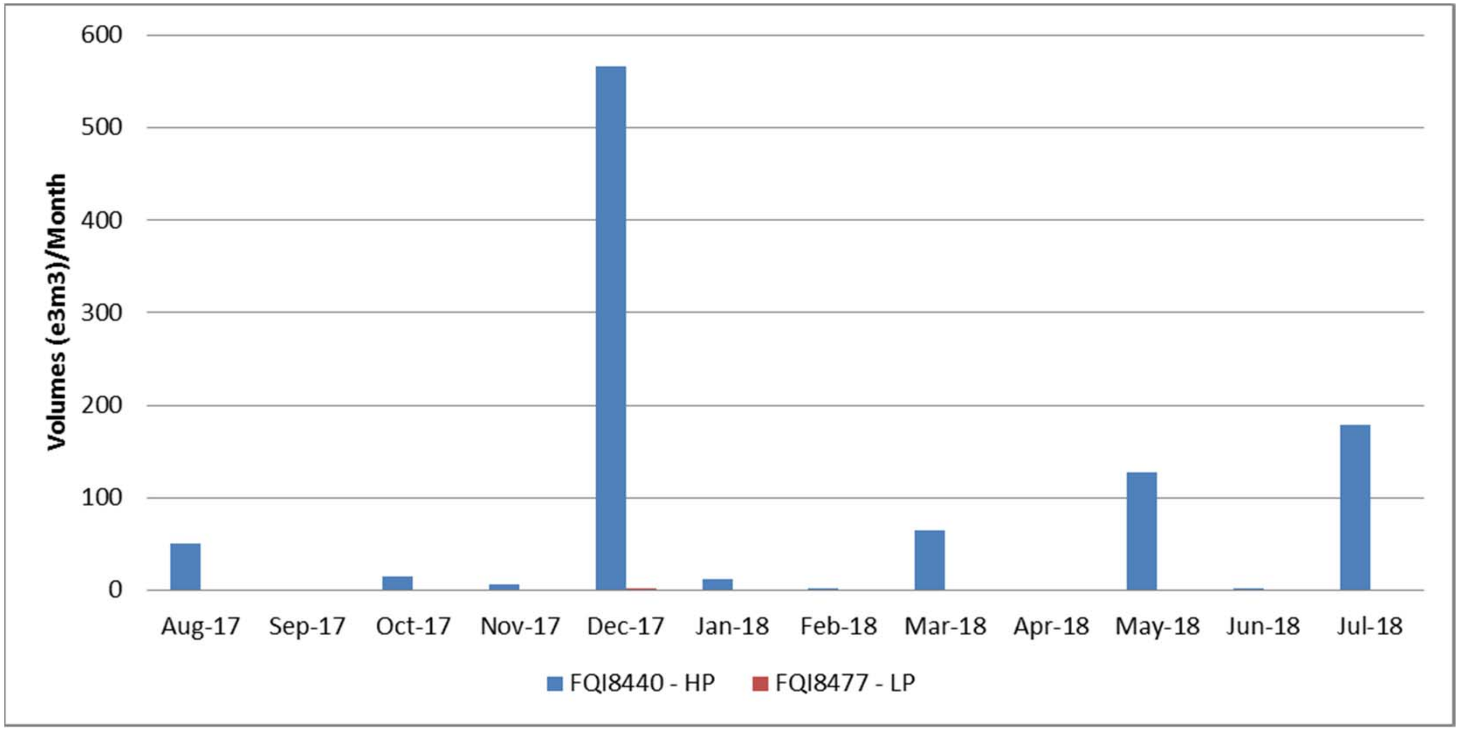


2. Facility Performance

FLARING AND VENTING

- 7 flaring events that were either over 4 hours in duration or over a volume of 30,000 m^3:
  - December 7, 2017- WLS rake stuck
  - March 15, 2018 - CPF & field trip
  - May 2, 2018 – Emergency Shut Down (ESD) system upgrades tripped CPF & field
  - May 28, 2018 - High temperatures caused CPF trip
  - June 9, 2018 - Power outage due to storm
  - July 6, 2018 - Maintenance activities tripped CPF and field
  - July 18, 2018 - Maintenance activities tripped CPF and field

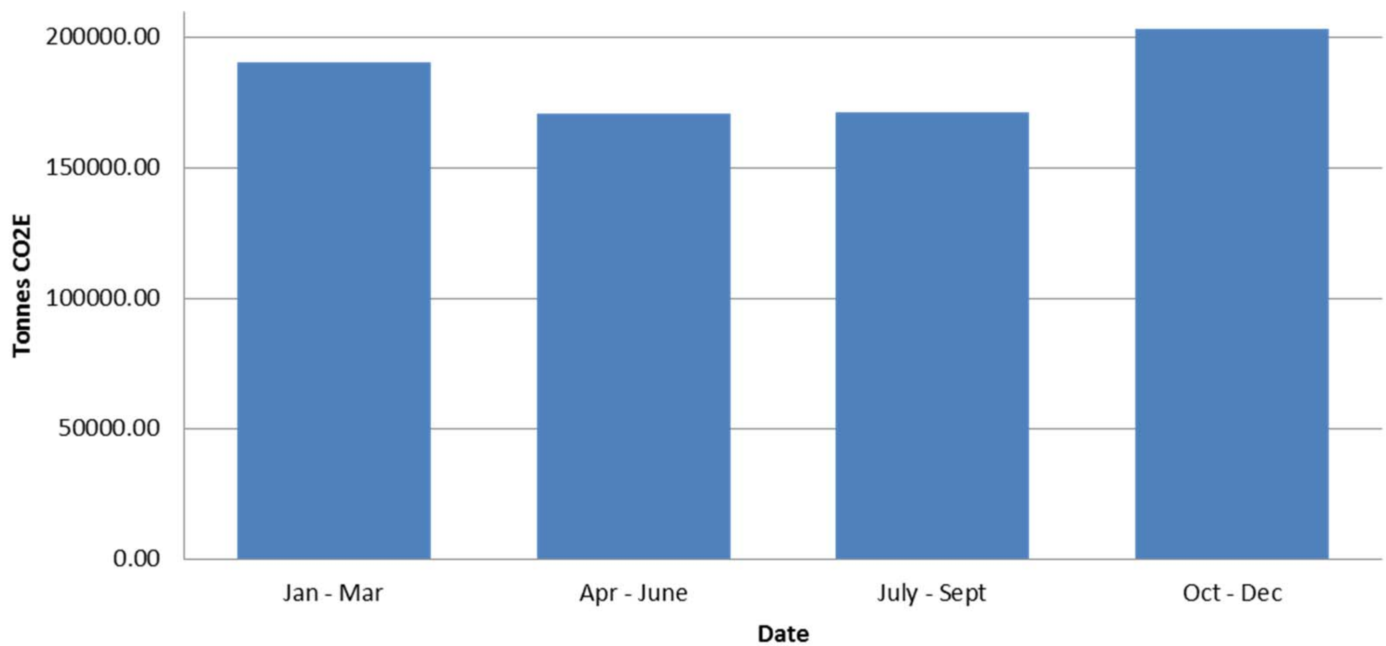
Flare Volumes (e3m3)		
Month	FQI8440 - HP	FQI8477 - LP
Aug-17	50.3	1.2
Sep-17	0.8	0.1
Oct-17	14.8	0.7
Nov-17	6.3	0.1
Dec-17	566.5	2.0
Jan-18	12.1	0.0
Feb-18	2.7	0.2
Mar-18	64.9	0.3
Apr-18	0.2	0.1
May-18	126.9	0.8
Jun-18	2.0	1.0
Jul-18	178.7	1.0



2. Facility Performance

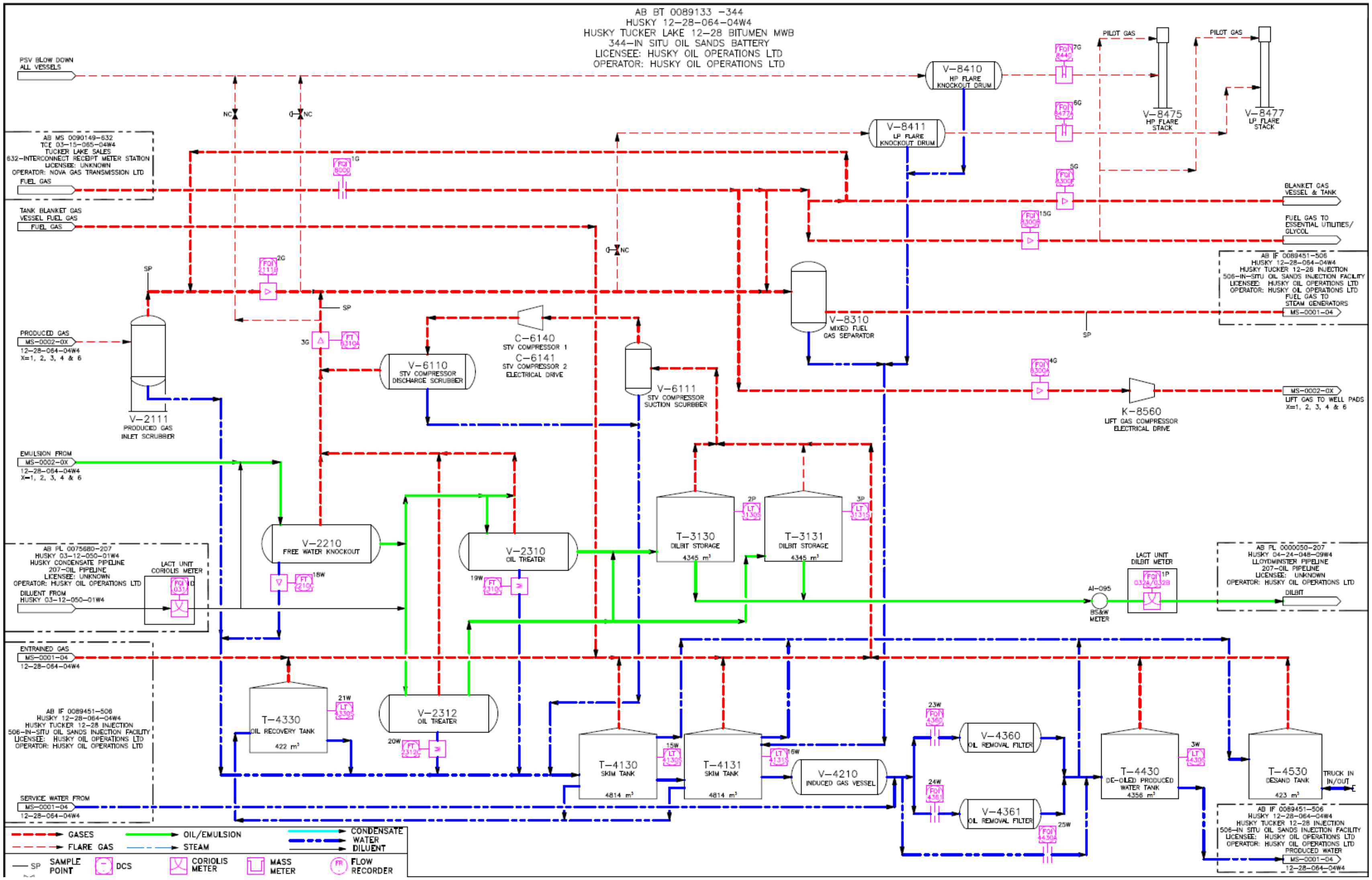
GREEN HOUSE GAS (GHG)

- Emission sources considered include stationary combustion associated with steam generators and glycol heaters, flaring, venting and fugitive emissions
- 739,409.19 tonnes of Carbon Dioxide Equivalent were emitted in 2017 (information taken from the Tucker Thermal 2017 Compliance report submitted under the Specified Gas Emitters Regulation)
- 243,884 emission performance credits generated (currently being audited by Alberta Environmental and Parks)



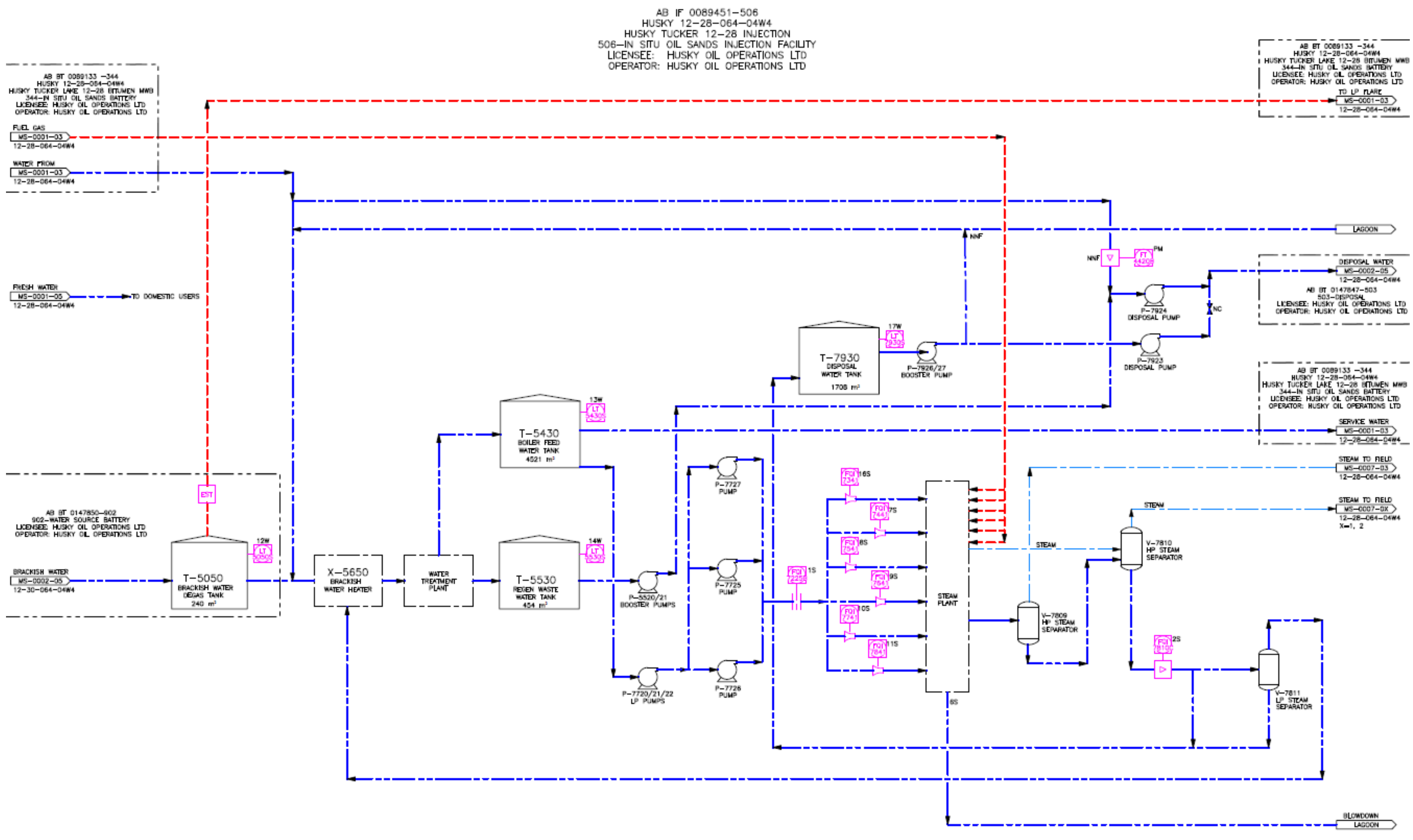
3. Measurement, Accounting and Reporting

BATTERY SCHEMATICS – AB BT 0089133-344



3. Measurement, Accounting and Reporting

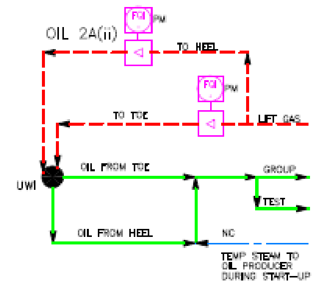
INJECTION FACILITY SCHEMATIC – AB IF 0089451-506

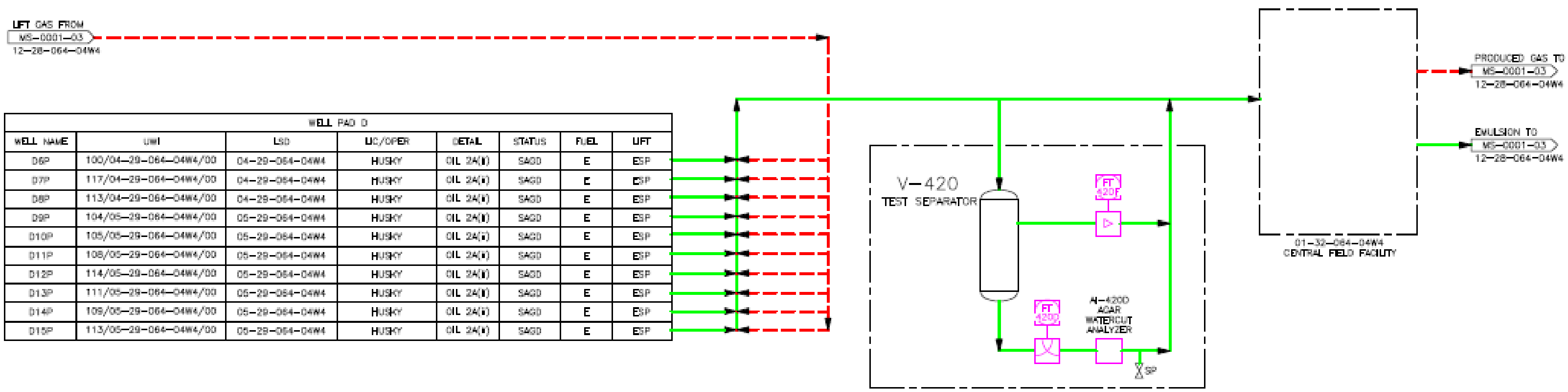


3. Measurement, Accounting and Reporting

MEASUREMENT AND REPORTING – PAD D WEST TESTING

AB BT 0089133 –344
HUSKY 12–28–064–04W4
HUSKY TUCKER LAKE 12–28 BITUMEN MWB
344–IN SITU OIL SANDS BATTERY
LICENSEE: HUSKY OIL OPERATIONS LTD
OPERATOR: HUSKY OIL OPERATIONS LTD

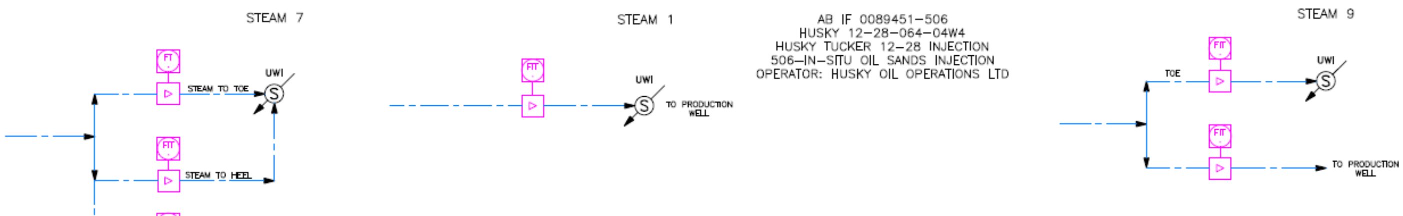


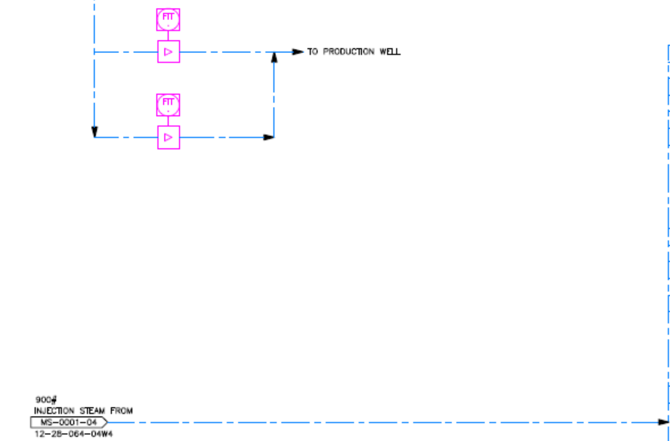


WELL PAD D							
WELL NAME	UWI	LSD	LIC/OPER	DETAIL	STATUS	FUEL	LIFT
D6P	100/04–29–064–04W4/00	04–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D7P	117/04–29–064–04W4/00	04–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D8P	113/04–29–064–04W4/00	04–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D9P	104/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D10P	105/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D11P	108/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D12P	114/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D13P	111/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D14P	109/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP
D15P	113/05–29–064–04W4/00	05–29–064–04W4	HUSKY	OIL 2A(ii)	SAGD	E	ESP

3. Measurement, Accounting and Reporting

MEASUREMENT AND REPORTING – STEAM INJECTION





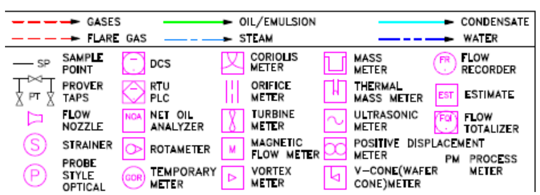
WELL PAD GRAND RAPIDS							
WELL NAME	UWI	LSD	LIC/OPER	DETAIL	STATUS	TOE TAG	HEEL TAG
GA05S	107/15–32–064–04W4/00	07–32–064–04W4	HUSKY	STEAM 7	SAGD	FIC–505H	FIC–505J
GA06S	108/15–32–064–04W4/00	07–32–064–04W4	HUSKY	STEAM 7	SAGD	FIC–506H	FIC–506J
GA01S	118/16–32–064–04W4/00	07–32–064–04W4	HUSKY	STEAM 7	SAGD	FIC–501H	FIC–501J
GA02S	123/16–32–064–04W4/00	07–32–064–04W4	HUSKY	STEAM 7	SAGD	FIC–502H	FIC–502J
GA03S	124/16–32–064–04W4/00	07–32–064–04W4	HUSKY	STEAM 7	SAGD	FIC–503H	FIC–503J
GA04S	125/16–32–064–04W4/00	07–32–064–04W4	HUSKY	STEAM 7	SAGD	FIC–504H	FIC–504J

WELL PAD COLONY							
WELL NAME	UWI	LSD	LIC/OPER	DETAIL	STATUS	TOE TAG	HEEL TAG
CN2	102/13–16–064–04W4/00	05–21–064–04W4	HUSKY	STEAM 9	SAGD	FIC–602H	–
CN4	114/16–17–064–04W4/00	05–21–064–04W4	HUSKY	STEAM 9	SAGD	FIC–604H	–
CN6	100/16–17–064–04W4/00	05–21–064–04W4	HUSKY	STEAM 9	SAGD	FIC–606H	–
CN8	102/16–17–064–04W4/00	05–21–064–04W4	HUSKY	STEAM 9	SAGD	FIC–608H	–
CN10	103/16–17–064–04W4/00	05–21–064–04W4	HUSKY	STEAM 9	SAGD	FIC–610H	–
CN12	113/16–17–064–04W4/00	05–21–064–04W4	HUSKY	STEAM 9	SAGD	FIC–612H	–

WELL PAD COLONY							
WELL NAME	UWI	LSD	LIC/OPER	DETAIL	STATUS	TOE TAG	HEEL TAG
CN7	108/16–17–064–04W4/00	12–21–064–04W4	HUSKY	STEAM 1	SAGD	FIC–607G	–
CN9	109/16–17–064–04W4/00	12–21–064–04W4	HUSKY	STEAM 1	SAGD	FIC–609G	–

WELL PAD D							
WELL NAME	UWI	LSD	LIC/OPER	DETAIL	STATUS	TOE TAG	HEEL TAG
D16S	103/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–416H	–
D17S	106/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–417H	–
D18S	108/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–418H	–
D19S	110/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–419H	–
D20S	112/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–420H	–
D21S	114/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–421H	–
D22S	116/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–422H	–
D23S	102/16–29–064–04W4/00	08–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–423H	–

WELL PAD D							
WELL NAME	UWI	LSD	LIC/OPER	DETAIL	STATUS	TOE TAG	HEEL TAG
D6S	111/04–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–406H	–
D7S	116/04–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–407H	–
D8S	112/04–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–408H	–
D9S	103/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–409H	–
D10S	106/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–410H	–
D11S	107/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–411H	–
D12S	110/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–412H	–
D13S	116/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–413H	–
D14S	115/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–414H	–
D15S	112/05–29–064–04W4/00	04–29–064–04W4	HUSKY	STEAM 9	SAGD	FIC–415H	–



3. Measurement, Accounting and Reporting

ESTIMATING WELL PRODUCTION

- Oil and Water Estimated by well test:
  - Battery level measurement prorated to wells based on the estimates
  - Correction factor applied to calculated well steam fraction volume

- Three Test Separator Designs (well tests):
  1. Blow-Case (Pads A Original, B, C East, C West):
     - Load-cell or level
     - Vortex for steam + natural gas
     - AGAR water-cut analyzer
  2. Conventional (Pad B North, A Infill & Replacement Wells, Pad GA, Pad D):
     - Coriolis meter for liquid
     - Vortex for steam + natural gas
     - AGAR water-cut analyzer
  3. Horizontal (Pad CN)
     - Coriolis meter for liquid
     - Orifice plate for steam + natural gas
     - Phase Dynamics water-cut analyzer

- Steam fraction calculated (from P_{sat} / P_{meas}) for all three designs

- Gas Measured at the Battery (proration = 1):
  - GOR for August 1, 2017 to July 31, 2018 = 46.4 m^3/m^3

3. Measurement, Accounting and Reporting

WATER BALANCE

- Steam Injection:
  - Vortex meters on each well toe and heel
  - Total steam to field measured at the battery
  - Steam Proration = 1.007 m^3/m^3

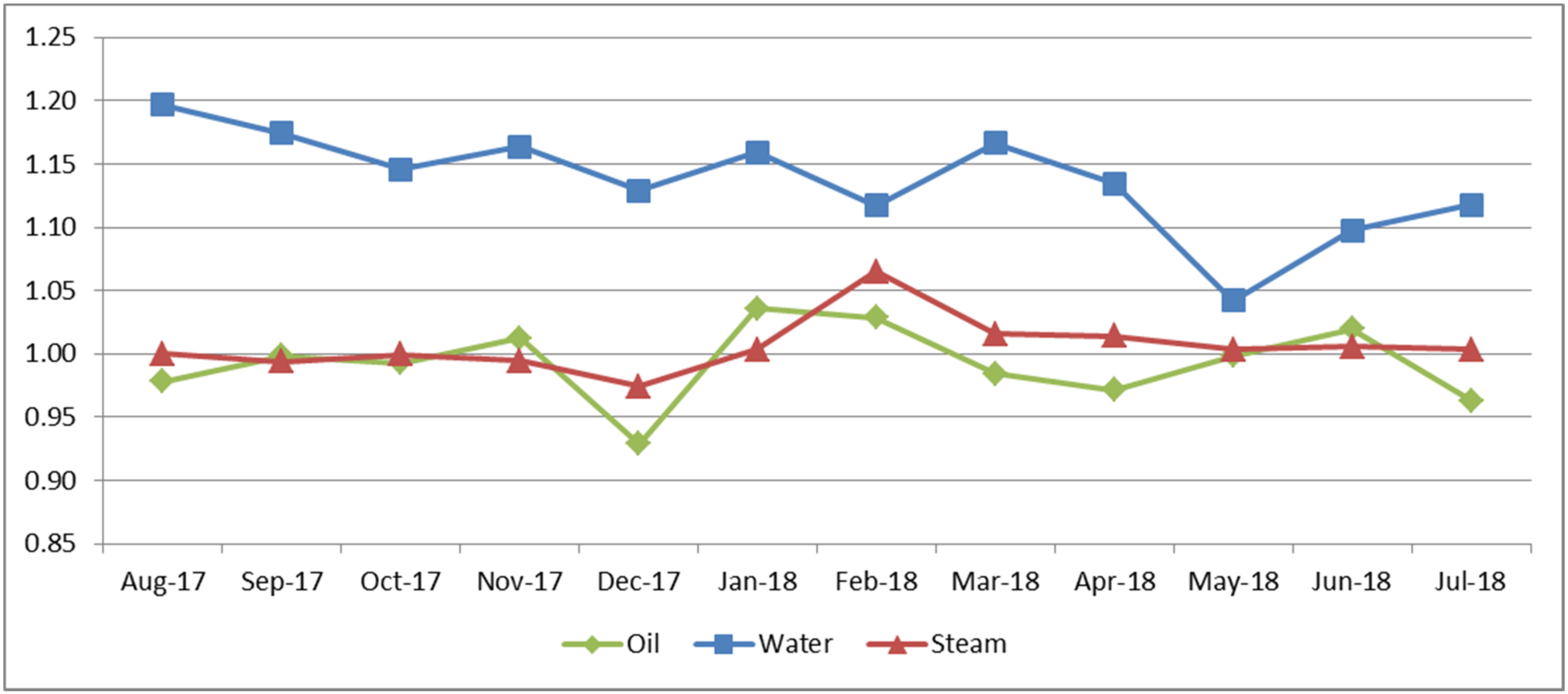
- Water Proration Factors (see next slide):
  - Average 12-Month Rolling Proration Factors
    - Water = 1.137
    - Oil = 0.993

- Water / Steam Meter Calibrations:
  - Metering equipment inspected / calibrated annually
  - Annual well steam injection meters inspection as per Directive 017
  - AGAR water cut analyzer calibration program as per Directive 017
  - MARP updated to include all new measurement meters and changes

- Metering Accuracy:
  - Accounting meters meets requirements as per Directive 017 single point measurement accuracy

3. Measurement, Accounting and Reporting

ESTIMATING WELL PRODUCTION – PRORATION FACTORS



3. Measurement, Accounting and Reporting

WELL TEST AVERAGES

Test Separator	Wells	Average Test Duration (hours)	Average # of Tests for each Well Per Month
V-151/152	A1 - A8	5.4	8.6
V-170	A9 - A20	5.8	7.8
V-171	A21 - A24	7.8	18.9
V-213A	B9E	23.4	27.5
V-214A	B10E	23.7	26.2
V-215A	B11E	23.4	27.8
V-251/252	B1 - B12	4.8	7.3
V-351/352	C1 - C9	11.2	3.7
V-391/392	C13 - C20	4.1	14.5
V-420	D6 - D15	6.0	5.5
V-430	D16-D23	6.4	8.6
V-440	D24 - D33	6.4	8.6
V-450	D1 - D5, D34 - D38	6.2	9.0
V-540	GA1 - GA6	5.4	17.5
V-630	CN2/4/6/8/10/12	10.9	8.2
V-640	CN7/9	19.2	4.5

3. Measurement, Accounting and Reporting

SOLVENTS AND CONDENSABLE GAS

- Bitumen production accounts for diluent flash and volumetric shrinkage
- No solvent injection to reservoir
- No non-condensable gas injection

3. Measurement, Accounting and Reporting

MEASUREMENT INITIATIVES – CONTINUOUS IMPROVEMENT

- MARP updated February 28, 2018

- Implemented improvements:
  - Added Pad D West wells (D6-D15) and test separator V-420
  - Added water source battery and disposal facilities to MARP
  - 2 LACT Dilbit meters were added

- Future opportunities:
  - Review findings from AER MARP and internal Enhanced Protection Audit Program (EPAP) audit
  - LP and HP flare meters upgraded to ultrasonic meters in September 2018

4. Water Production, Injection and Uses

BRACKISH WATER

- Make-up water for steam generation
- McMurray Formation
- 3 Source Wells:
  - 1F1/11-30-064-04 W4M
  - 1F1/12-30-064-04 W4M
  - 1F1/08-25-064-04 W4M

4. Water Production, Injection and Uses

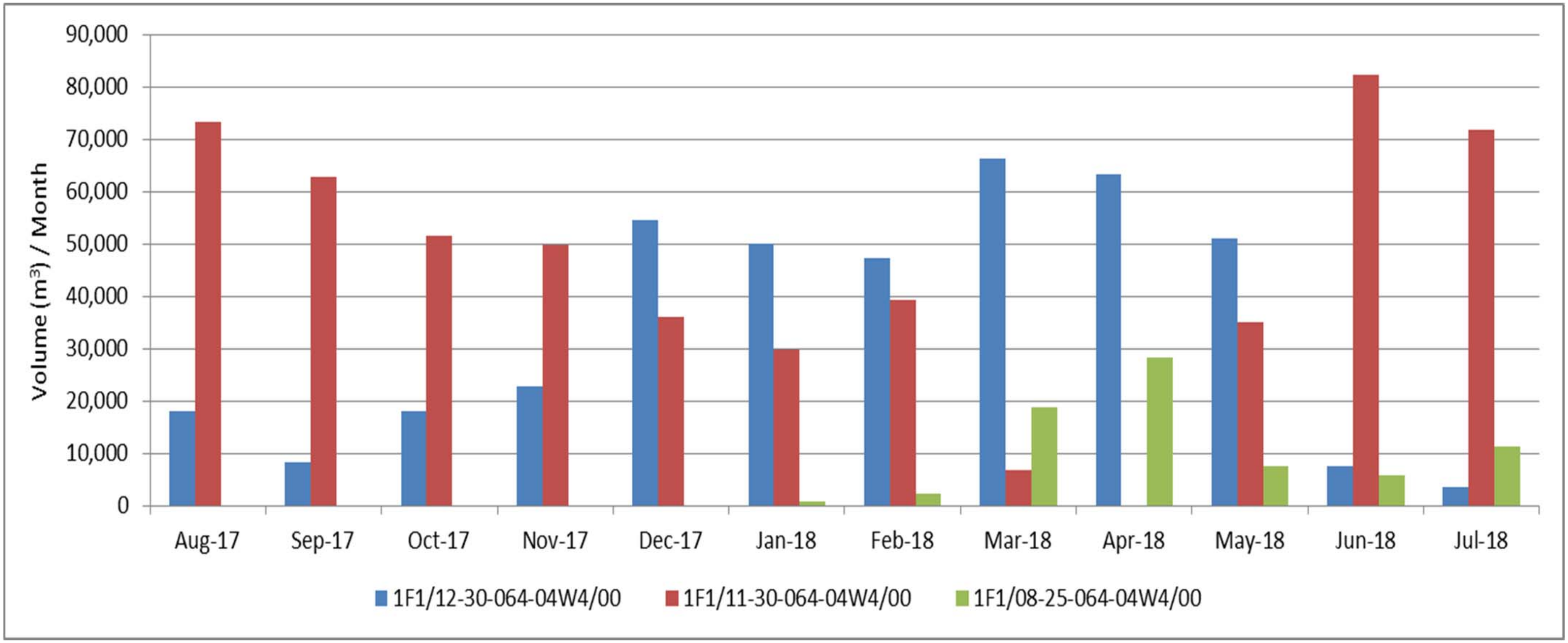
WATER USAGE

- Brackish water ~20,000 ppm Total Dissolved Solids (TDS) for steam generation (when required)

- No fresh water is used in process

4. Water Production, Injection and Uses

BRACKISH WATER CONSUMPTION



4. Water Production, Injection and Uses

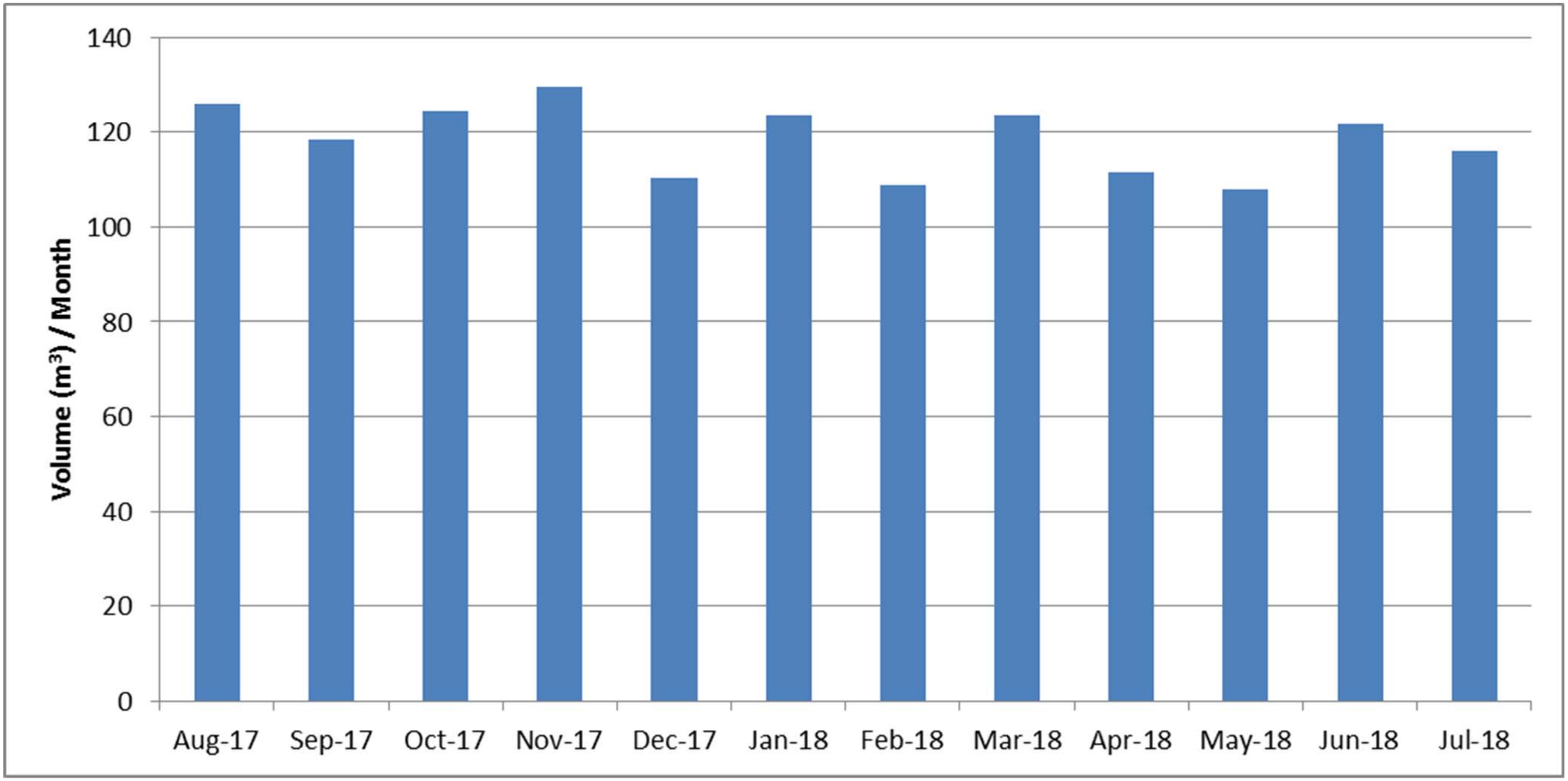
FRESH WATER

- Water Diversion License No. 00194427-00-01
  - Location well: 12-28-064-04-W4 (CPF)
  - Bonnyville Aquifer
  - Domestic use only:
    - Safety showers/eye-wash stations
    - Cleaning water
    - Washroom/kitchen use

- No Temporary Diversion License (TDL) required during the reporting period

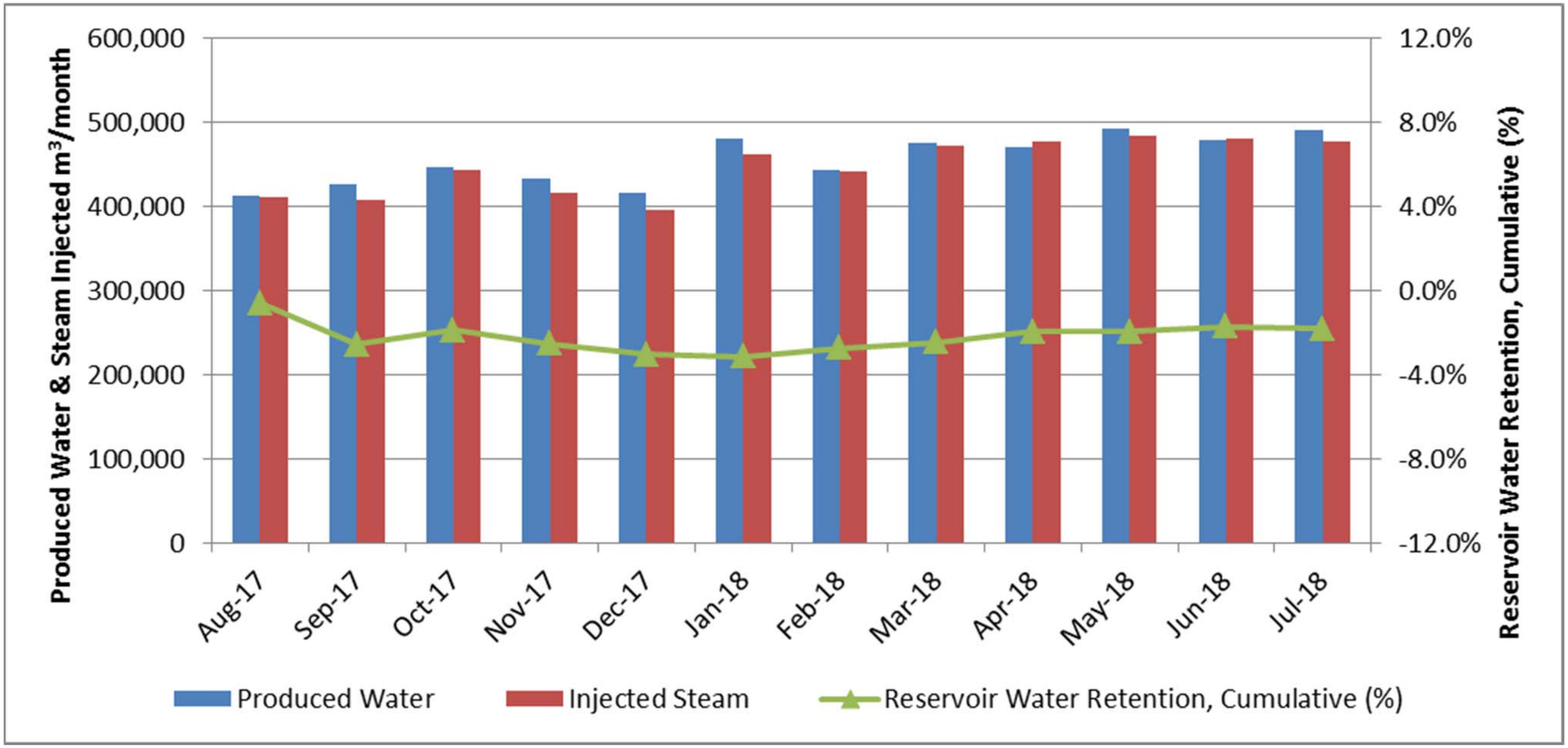
4. Water Production, Injection and Uses

FRESH WATER CONSUMPTION



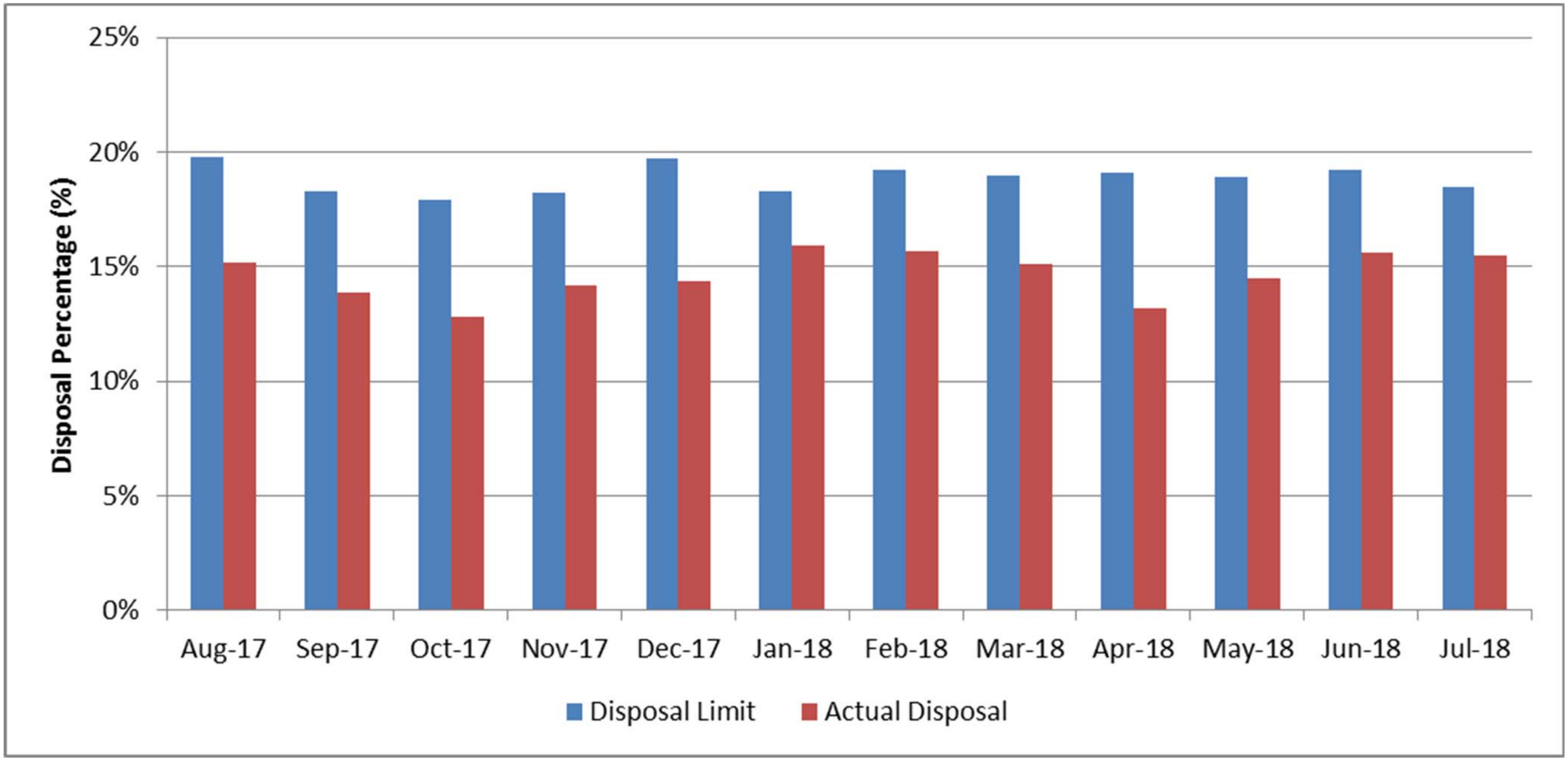
4. Water Production, Injection and Uses

PRODUCED WATER & STEAM INJECTED



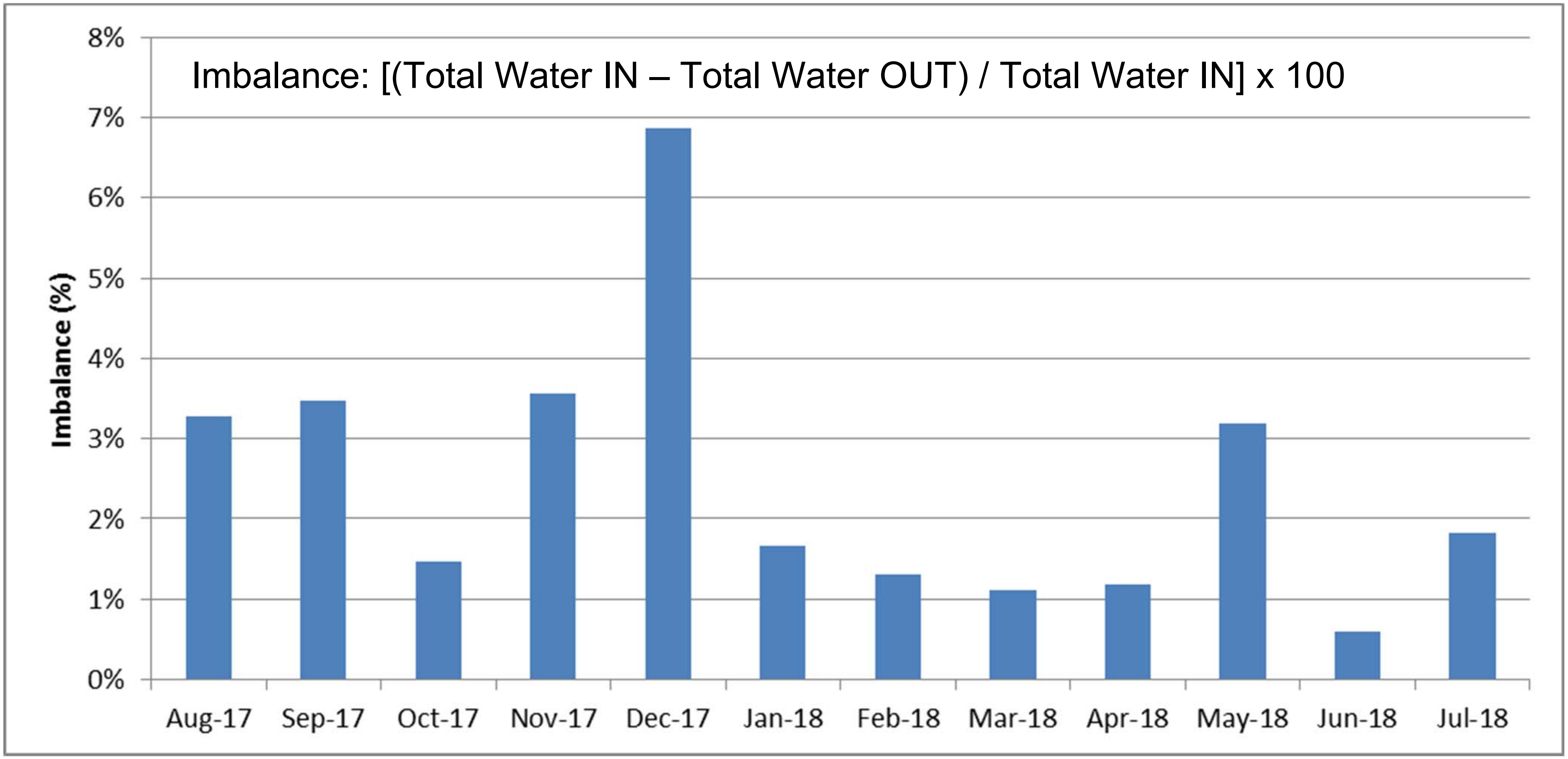
4. Water Production, Injection and Uses

WATER DISPOSAL LIMITS



4. Water Production, Injection and Uses

MONTHLY INJECTION WATER BALANCE



4. Water Production, Injection and Uses

OTSG BLOW-DOWN RECYCLE

- OTSG blow-down is recycled to the WLS at a percentage that allows the total dissolved solids, out of the OTSG, to remain below 50,000 uS/cm
- Brackish water make-up has a very high TDS and affects OTSG blow-down recycle
- Recycle approximately 36% of blow-down back to the WLS

4. Water Production, Injection and Uses

DISPOSAL WELLS

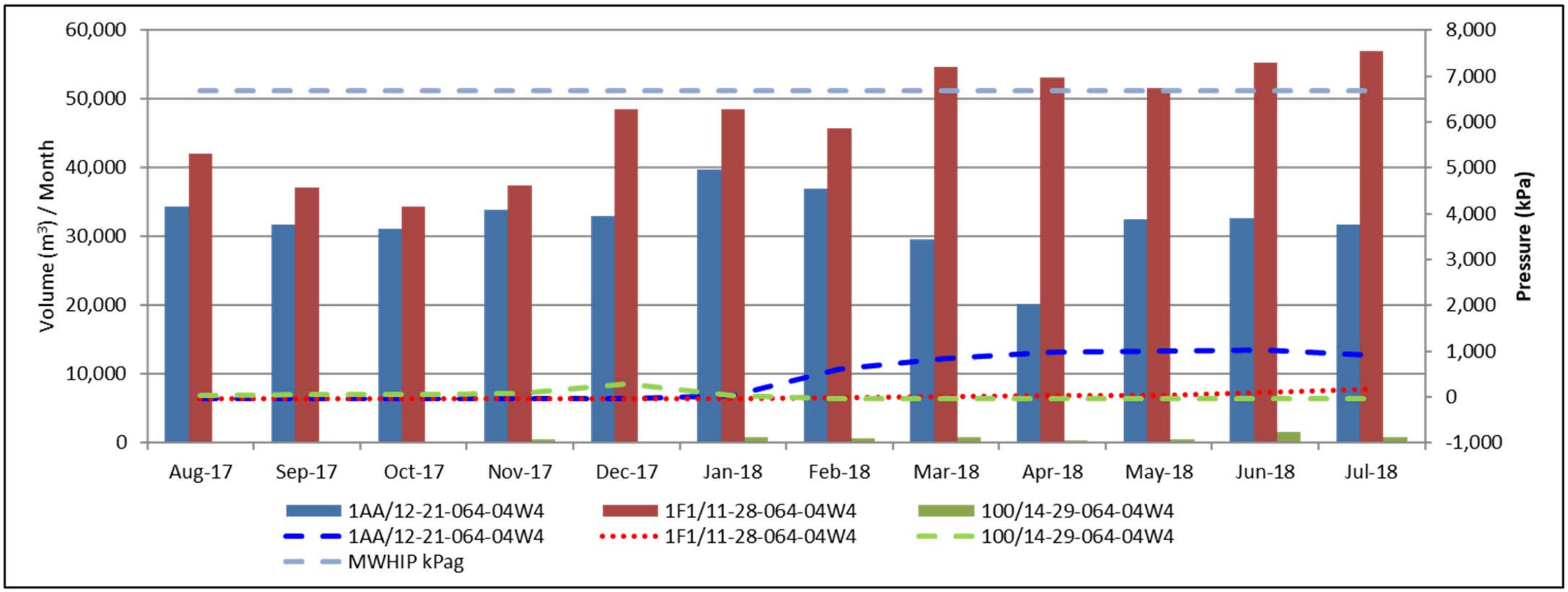
- AER Class 1 Wastewater Disposal Wells

- Boiler blow-down disposal:
  - 1AA/12-21-064-04 W4M (AER Approval 10591)
  - 1F1/11-28-064-04 W4M (AER Approval 10591)
  - 00/04-28-064-04W4/0 (AER Approval 10591A) – licensed

- Water treatment process disposal:
  - 00/14-29-064-04 W4M (AER Approval 10591)

4. Water Production, Injection and Uses

DISPOSAL WELLHEAD INJECTION PRESSURE & VOLUMES



4. Water Production, Injection and Uses

LANDFILL WASTE HANDLING

- No landfill within facility
- All landfill waste streams disposed off-site at licensed facilities

4. Water Production, Injection and Uses

WASTE VOLUMES

- Waste summary for 12-28-064-04-W4 (CPF)
- Summary does not include RBW waste for June and July 2018 or Tervita waste for April to July 2018

Waste Code	Waste Description	Location Sent To	Final Handling Method	Quantity	Unit
BLBDWT	Water EBD <12.5 PH	Tervita - Lindbergh	Cavern	49.94	m3
COEMUL	High Solids: Solids >40%	Elk Point Service Centre	Oilfield Waste Processing Facility	190.5	m3
	Interphase > 20%, Oil <= 30%	Elk Point Service Centre	Oilfield Waste Processing Facility	1805.5	m3
	Interphase 0 - 10%, Oil <= 30%	Elk Point Service Centre	Oilfield Waste Processing Facility	9440.5	m3
	Interphase 0 - 10%, Oil > 30%	Elk Point Service Centre	Oilfield Waste Processing Facility	61	m3
	Interphase 10.1 - 20.0%, Oil <= 30%	Elk Point Service Centre	Oilfield Waste Processing Facility	1314.5	m3
	Waste Oil - Solids	Tervita - Lindbergh	Cavern	43.79	m3
CWATER	Specific, Ice And Snow	Elk Point Service Centre	Oilfield Waste Processing Facility	55.5	m3
DOMWST	Garbage Domestic Waste	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	36.68	m3
DOMWST-HZ	Contaminated Waste Non Recyclable	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	29.26	m3
EMTCON	Plastics	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	2.725	m3
EMTCON-A	Aerosol Cans Empty	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	0.41	m3
EMTCON-SB	Empty Container Sample Bottles	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	1.68	m3
FILAPC	Filters Air Pollution Control Cardboard	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	0.28	m3
FILOTH	Filters	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	2.1	m3
INOCHM	Chemicals Inorganic	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	9.8	m3
N/A	Industrial Waste	Tervita - Marshall Landfill	Class II Landfill	30.2	Tonnes
OILABS	Absorbents	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	6.3	m3
OILRAG	Rags Oily	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	1.37	m3
SAND	Shake-off Sand, NON - DOW	Elk Point Service Centre	Oilfield Waste Processing Facility	2.5	m3
SLGHYD	Interphase 0 - 10%, Oil <= 30%	Elk Point Service Centre	Oilfield Waste Processing Facility	30	m3
	Interphase 10.1 - 20.0%, Oil <= 30%	Elk Point Service Centre	Oilfield Waste Processing Facility	12	m3
SLGSWT	Gas Sweetening Sludge	Tervita - Lindbergh	Cavern	0.5	m3
SMETAL	Metal Scrap	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	3.04	m3
SOILCO	Contaminated Debris and Soil Crude Oil Condensate	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	12	m3
SOILCO-DW	Contaminated Debris and Soil Non Processable Waste	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	1.12	m3
WSTMIS-R	Waste Hydraulic Hoses	Rbw Waste Management Ltd	Recycling Facility (excluding used oil)	1.12	m3

5. Sulphur Production

SULPHUR DIOXIDE (SO_2) SOURCES

- Six Once-Through Steam Generators (OTSG)
- One High Pressure Flare Stack
- One Low Pressure Flare Stack

5. Sulphur Production

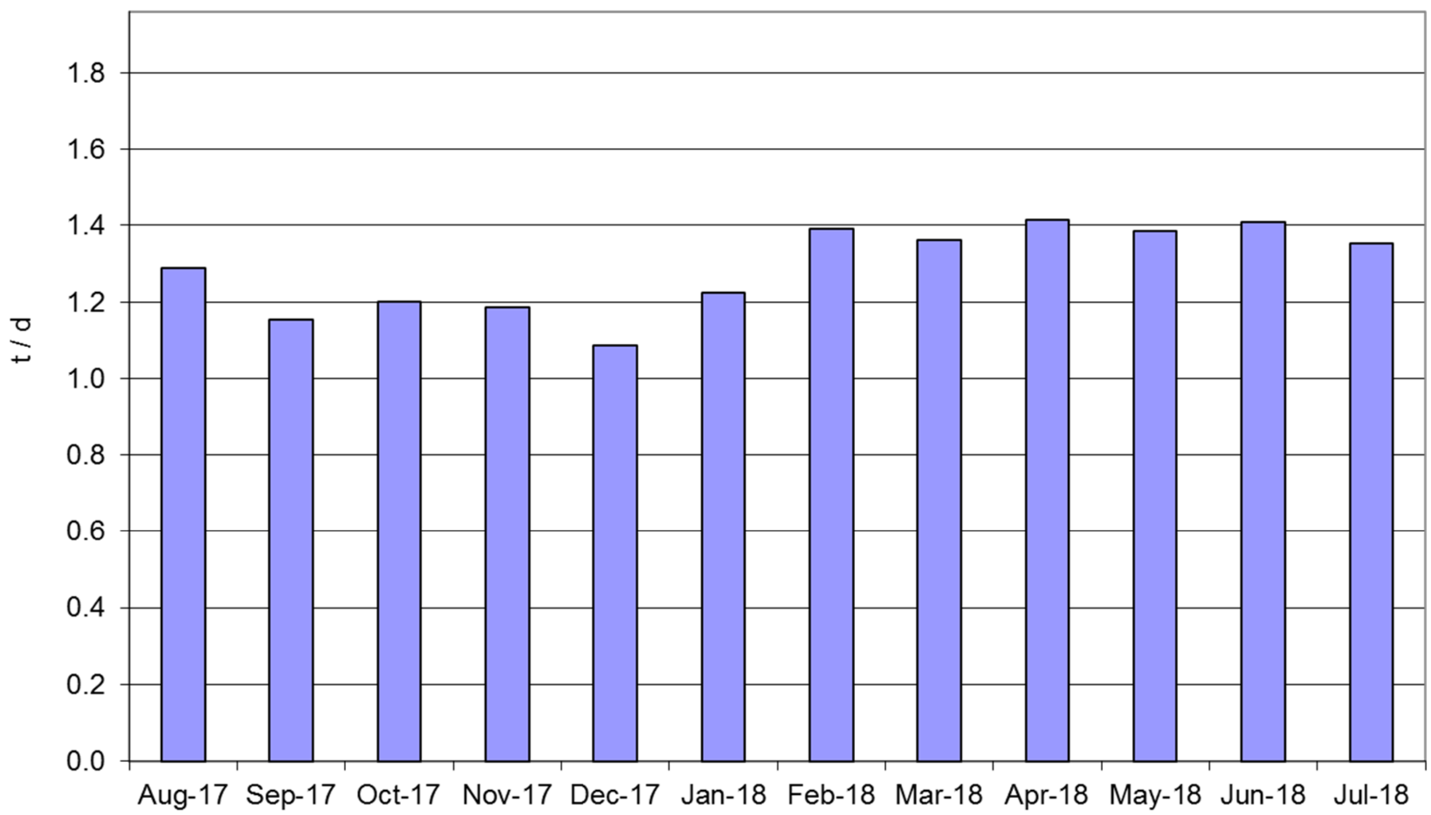
QUARTERLY SO_2 EMISSIONS

Q3 2017 (August 2017 – October 2017)	111.74 tonnes
Q4 2017 (November 2017 – January 2018)	107.20 tonnes
Q1 2018 (February 2018 – April 2018)	123.60 tonnes
Q2 2018 (May 2018 – July 2018)	127.11 tonnes

5. Sulphur Production

SO_2 EMISSION TRENDS

- SO_2 emission limit = 1.96 tonnes/day



5. Sulphur Production

PEAK AND AVERAGE SO_2 EMISSIONS

- August 1, 2017 to July 31, 2018:

SO_2 Emissions	
Average Daily (highest)	1.29 tonnes
Maximum Daily (highest)	1.48 tonnes

- Limit under EPEA Approval is 1.96 tonnes/day

- No exceedances

5. Sulphur Production

AMBIENT AIR MONITORING

- Ambient air quality is currently monitored by the Lakeland Industry and Community Association (LICA) - Air Shed committee. LICA is under contract from Alberta Environmental Monitoring and Science Division (EMSD) of Alberta Environment and Parks (AEP) to provide these services

- No exceedances were recorded during the reporting period

- Airshed quality results available on LICA website or Clean Air Strategic Alliance (CASA) Data Warehouse

- http://www.lica.ca/

- http://www.casadata.org/

6. Environmental Issues

ENVIRONMENTAL – COMPLIANCE TO APPROVALS

- EPEA Approval:
  - No compliance issues during this reporting period
- AER:
  - No compliance issues during this reporting period
- AEP:
  - No compliance issues during this reporting period
- DFO:
  - No compliance issues during this reporting period

6. Environmental Issues

ENVIRONMENTAL – AMENDMENT TO EPEA APPROVAL

- Produced Gas Handling System amendment application (No. 1906604)
    - EPEA Approval No. 147753-01-01

6. Environmental Issues

ENVIRONMENTAL - WILDLIFE

- As part of the regulatory approval, Husky has developed and implemented a Wildlife Monitoring Program (WMP) for:
  - Canadian toad distribution, abundance and population status
  - Above Ground Pipeline (AGP) monitoring to ensure wildlife can cross under the lines
  - Wildlife Habitat Enhancement Program (WHEP)

- Annual WMP report describes the observations and results collected during the previous year

- Worked with Cold Lake High school to construct replacement bat houses

6. Environmental Issues

ENVIRONMENTAL – INDUSTRIAL WASTEWATER

- Disposal Locations:
  - Boiler blow-down disposal wells 12-21-064-04W4M and 11-28-064-04W4M
  - Water treatment process disposal well 14-29-064-04W4M
  - 958,857 m^3 water disposed

- Domestic Wastewater:
  - Domestic waste sludge is disposed of at the Cold Lake Municipal Treatment Facility or the Bonnyville Municipal Treatment Facility

- Industrial Run-off (from 2017 Annual Waste Water Report):
  - Total of six discharge locations (Well Pads: A, B, C, D, GA, CN and the run-off retention pond located on CPF)
  - A total of 70,722 m^3 surface water was discharged due to a very wet year
  - All discharges were in compliance with EPEA approval

6. Environmental Issues

ENVIRONMENTAL - SOILS

- Soil sampling program was completed in Q4 2017 and the report was submitted to AER on March 27, 2018. A total of 32 locations within the CPF and well pads were sampled.

6. Environmental Issues

ENVIRONMENTAL - AIR

- Air related monitoring, reporting and studies are conducted by Lakeland Industry and Community Association (LICA) under contract from Alberta Environmental Monitoring and Science Division (EMSD)

- The LICA airshed monitoring network consists of:
  - 4 continuous monitoring stations
  - 26 passive monitoring stations
  - 2 volatile organic compound and polycyclic aromatic hydrocarbon samplers, and
  - 2 soil acidification monitoring plots

6. Environmental Issues

ENVIRONMENTAL – GROUND WATER

- Groundwater monitoring program includes:
  - CPF Groundwater: monitors shallow groundwater quality beneath the CPF
  - Pad-specific Groundwater: monitors possible impacts to groundwater quality
  - Regional Groundwater: monitors possible effects on regional groundwater quality between the project areas and the local lakes and streams

- Expansion to Groundwater Monitoring Program:
  - No additional expansion to the monitoring network occurred during the reporting period

6. Environmental Issues

ENVIRONMENTAL - INITIATIVES

- Alberta Environmental Monitoring and Science Division (EMSD)

- Participation in the Lakeland Industry and Community Association (LICA)
  - Board of Directors
  - Beaver River Watershed Alliance
  - Airshed

- Participation in Alberta Biodiversity Monitoring Institute (ABMI)

6. Environmental Issues

ENVIRONMENTAL - RECLAMATION

- Objectives of the Annual Report (demonstrate and document):
  - Compliance with the development and reclamation approval
  - Site conditions and successful reclamation
  - General project development (surface disturbances) and reclamation activities
  - Problem areas and resolution

- Site Clearing and Timber Salvage:
  - No site clearing or timber salvage occurred during the reporting period

- Vegetation Monitoring:
  - Annual weed monitoring and control as per Husky's best practices

- Reclamation Activities:
  - No permanent reclamation activities were completed during the reporting period

7. Compliance Statement

COMPLIANCE

AER:

- All conditions of AER License F-32143 as well as all scheme approvals for the Project were met during the reporting period

- All conditions of the EPEA approval 147753-01-01 were met during the reporting period

7. Compliance Statement

SELF DECLARATIONS

- No self declaration during the reporting period

8. Non-Compliance Events

AER REPORTABLE

- AER Contravention report - CIC # 334732:
  - February 15, 2018 - Water Act temporary diversion licence violation. Unable to download data from the transducer because it was stuck in the well, this is now repaired
- AER Contravention report - CIC # 334731:
  - February 15, 2018 - Water Act temporary diversion licence violation. Unable to take a water level measurement daily because the transducer was stuck in the well, this is now repaired
- AER Contravention report - CIC # 335878:
  - March 19, 2018 - Emulsion pump seal failure causing release of emulsion. Clean-up is complete
- AER Contravention report - CIC # 337475:
  - April 30, 2018 - CEMS Code 90% uptime requirement
- AER Inspection 476494:
  - June 18, 2018 - Low Risk for secondary containment not designed, constructed, sized and maintained as required

8. Non-Compliance Events

SCFV/GM UPDATE SUMMARY – WELL C13S

- C13S SCVF Update:
  - No SCVF; continue to trickle-in steam
  - Multiple temperature deviations along tubing
  - Maximum temperature of approximately 194 ºC at depth of 388 m
  - Increased temperature due to loss-of-insulating properties in the Vacuum Insulated Tubing (VIT)
  - Temperature log trend deviation commenced in June 2015
  - Currently, quarterly monitoring of H2S, SCVF and temperature

- Yearly monitoring of existing non-serious vent flows in accordance with AER ID 2003-01; on-going

- Plan:
  - To evaluate and engage AER on path forward

9. Future Plans

FUTURE PLANS 2018/2019

- Complete Phase 1 debottleneck of the Produced Gas Handling System (September 2018)
- Phase 2 debottleneck of the Produced Gas Handling System (Q4 2019)
  - Submit application to AER for review and approval Q4 2018
- Facility turn-around in 2020