

April 15, 2019

# Cenovus EnCAID project

Approval #10440L  
Performance presentation

# Advisory

This document contains forward-looking information prepared and submitted pursuant to the Alberta Energy Regulator's requirements and is not intended to be relied upon for the purpose of making investment decisions, including without limitation, to purchase, hold or sell any securities of Cenovus Energy Inc. Additional information regarding Cenovus Energy Inc. is available at [cenovus.com](https://www.cenovus.com).

# Cenovus EnCAID\* introduction and overview

This presentation was prepared in accordance with AER Directive 054 - Performance presentations, auditing, and surveillance of in situ oil sands schemes

Subsurface issues related to resource evaluation and recovery

- Directive 054, Section 3.1.1

Surface operations, compliance, and issues not related to resource evaluation and recovery

- Directive 054, Section 3.1.2

# **AER Directive 054 Section 3.1.1**

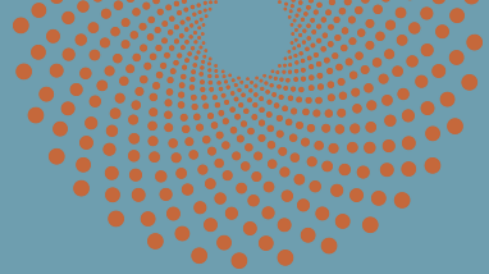
Subsurface issues related to resource evaluation and recovery

# Subsurface issues: table of contents

- Background
- Geology/geoscience
- Drilling and completions
- Instrumentation
- Scheme performance
- Future plans

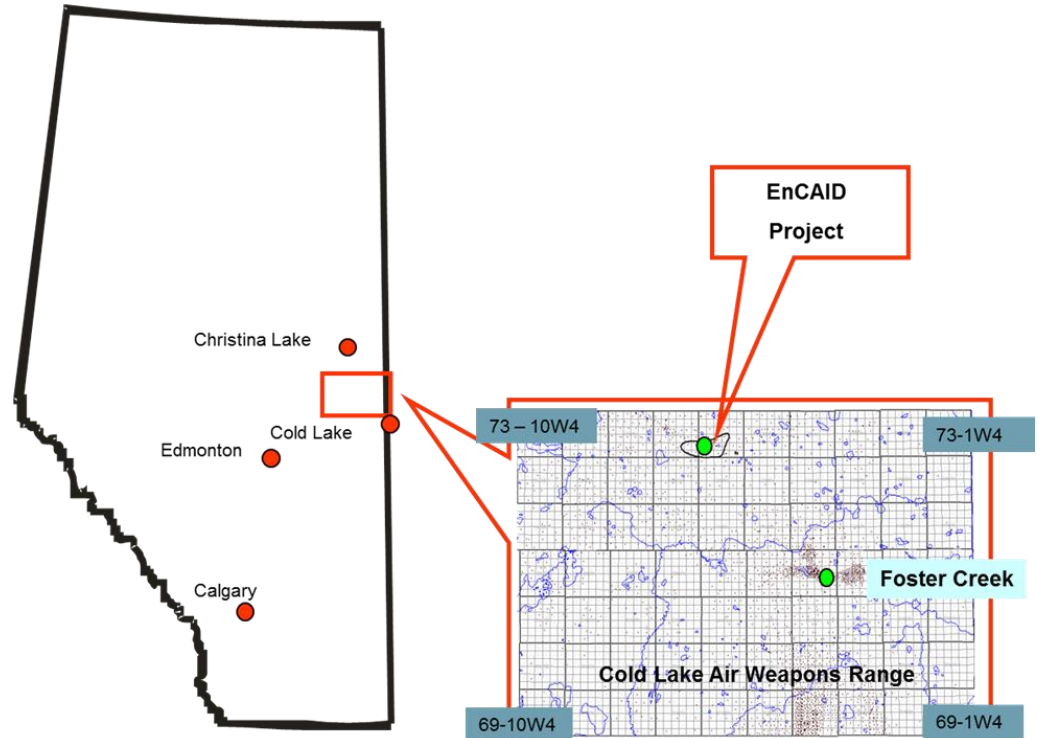
# Scheme background

Subsurface section 1



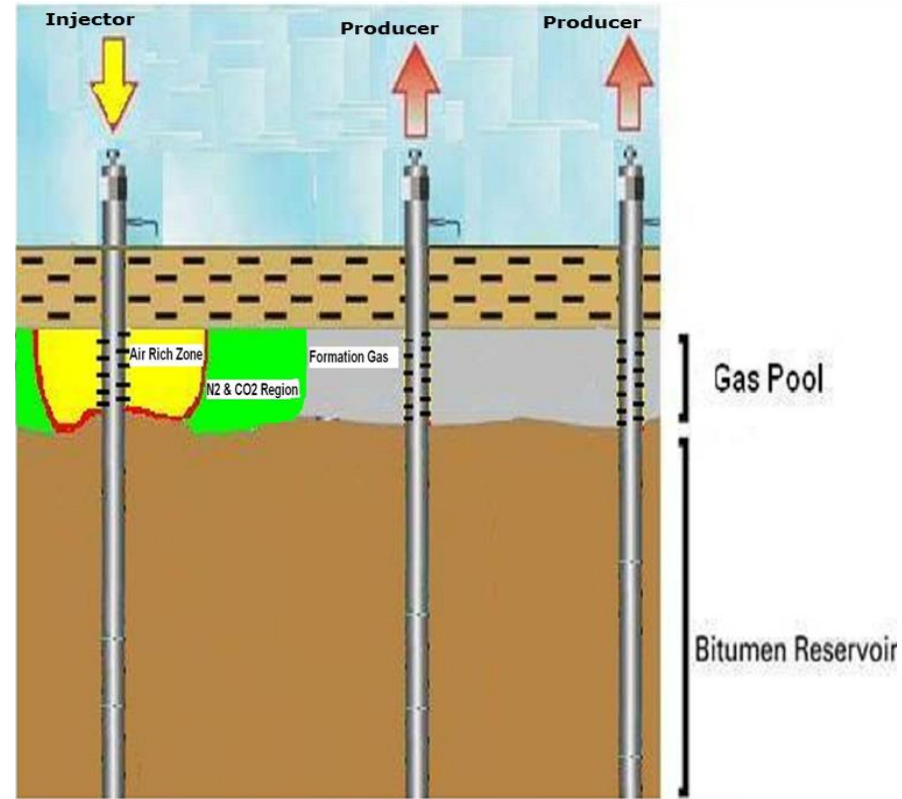
# Background

- The EnCAID project is an enhanced recovery scheme which displaces natural gas with combustion gases that are the result of combustion of residual bitumen in gas cap

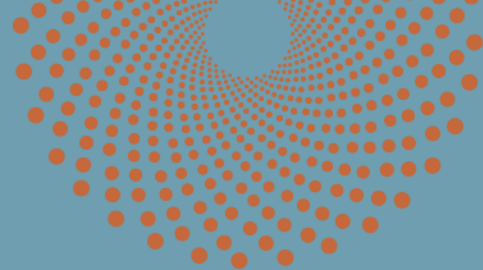


# Project overview

- Combustion of residual bitumen in gas cap
- Allows for displacement and re-pressurization of gas zone
- 100% Cenovus Energy Inc.







# Geological/geoscience

Subsurface section 2

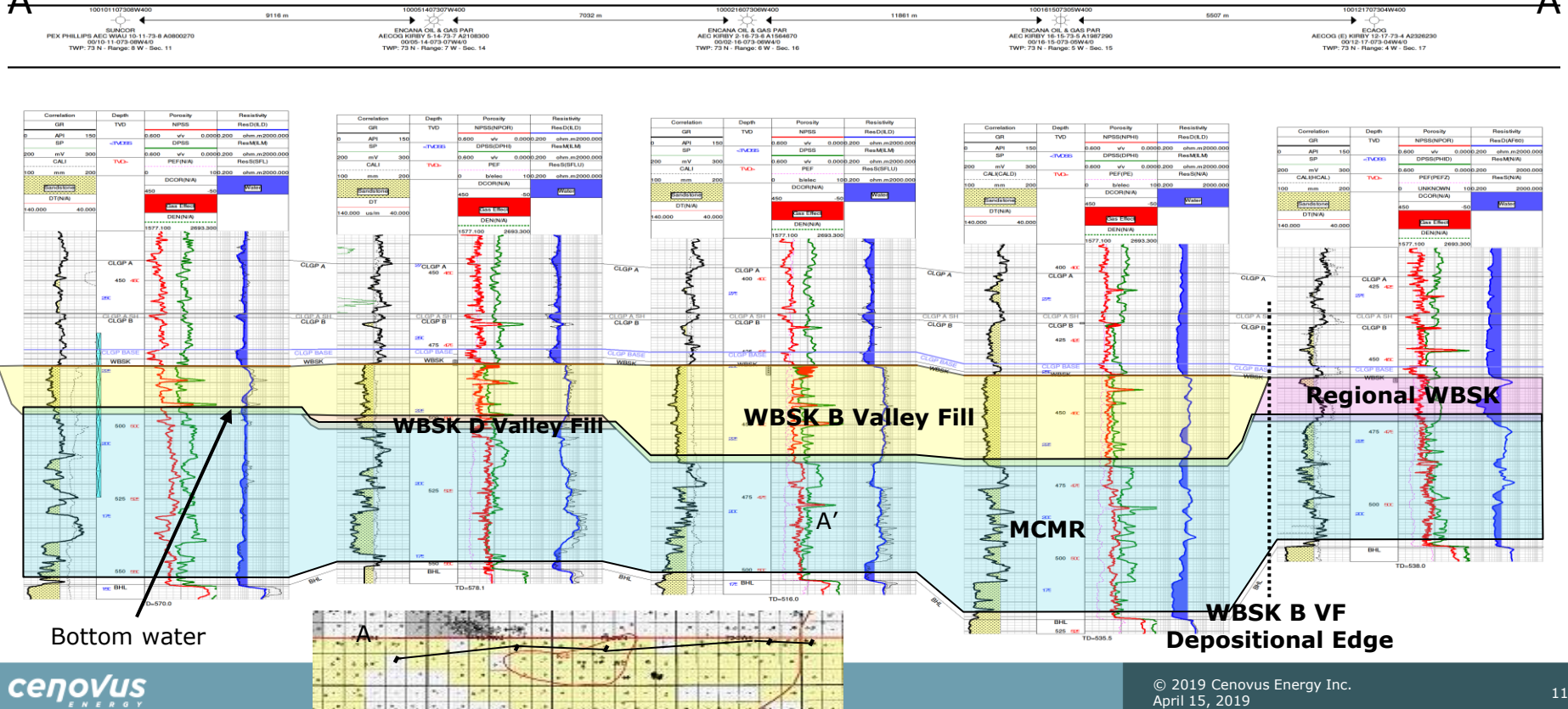
# Summary of Wabiskaw gas properties

<b>Depth</b>	<b>465 TVD</b>
<b>Thickness</b>	<b>5 m</b>
<b>Average porosity</b>	<b>~36%</b>
<b>Average gas saturation</b>	<b>~50%</b>
<b>Average water saturation</b>	<b>~30%</b>
<b>Average bitumen saturation</b>	<b>~20%</b>

# Wabiskaw stratigraphic cross-section

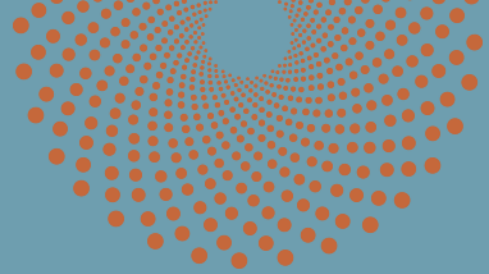
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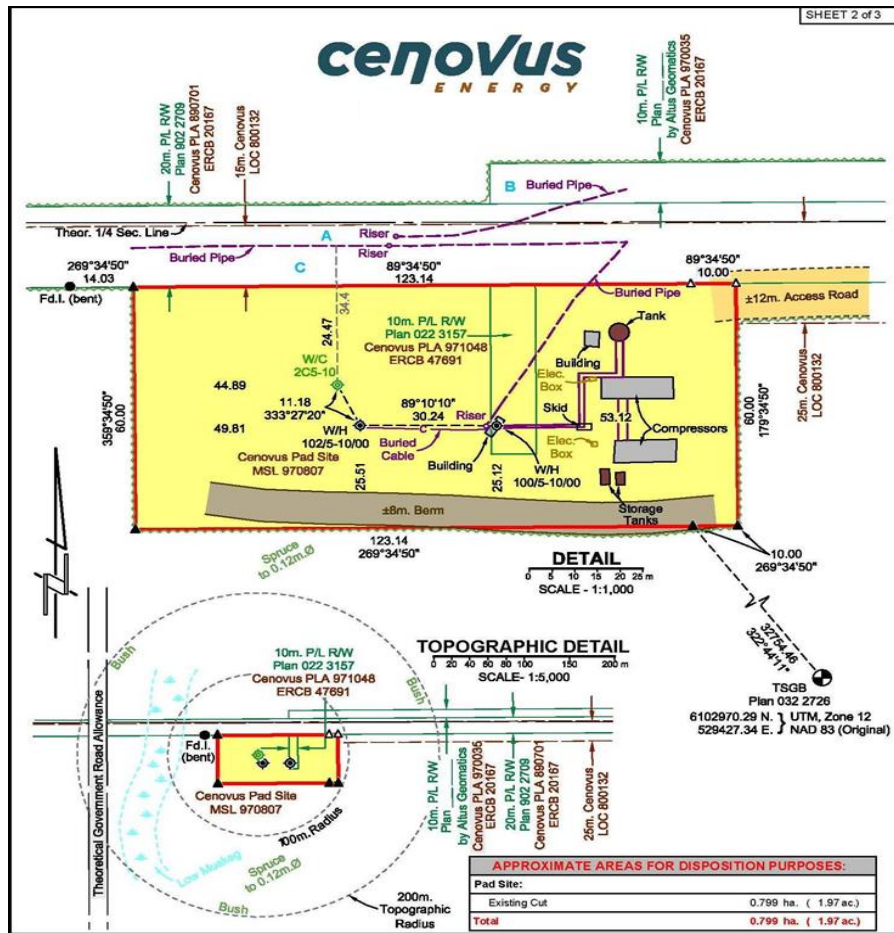


# Drilling and completion

Subsurface section 3



# Well layout



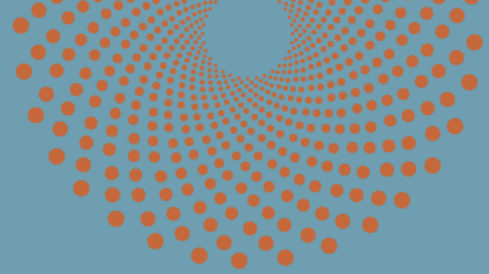
# Drilling and completion

- No new wells were drilled
- No recompletions
- No workovers

Requirements under subsection 3.1.1 3c – wellbore schematics are included in the appendix

# Instrumentation

Subsurface section 5



# Instrumentation in wells

## Observation Well: 102/05-10-73-6W4

- Equipped with three piezometers
- Equipped with 10 thermocouples

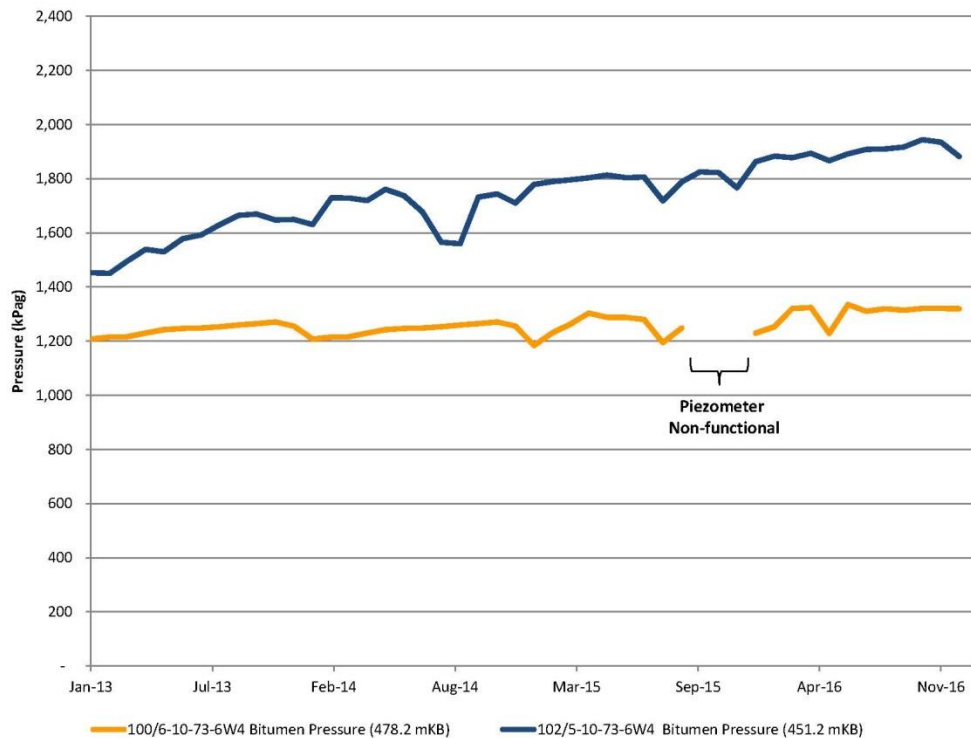
## Observation Well: 100/6-10-73-6W4

- Equipped with one piezometer
- Equipped with 10 thermocouples

Requirements under subsection 3.1.1 5a – wellbore schematics 5c and 5d are included in the appendix

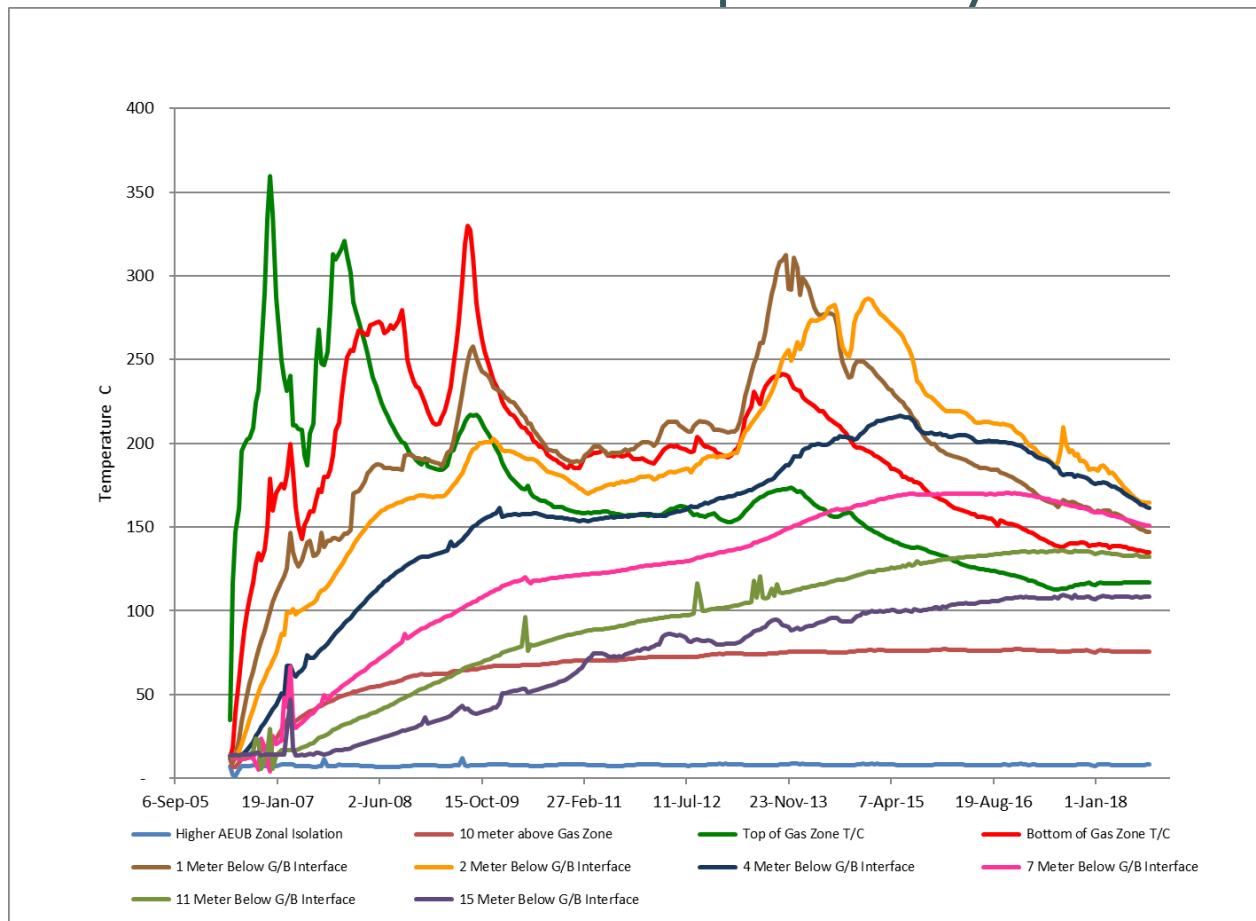


# Observation wells bitumen pressure



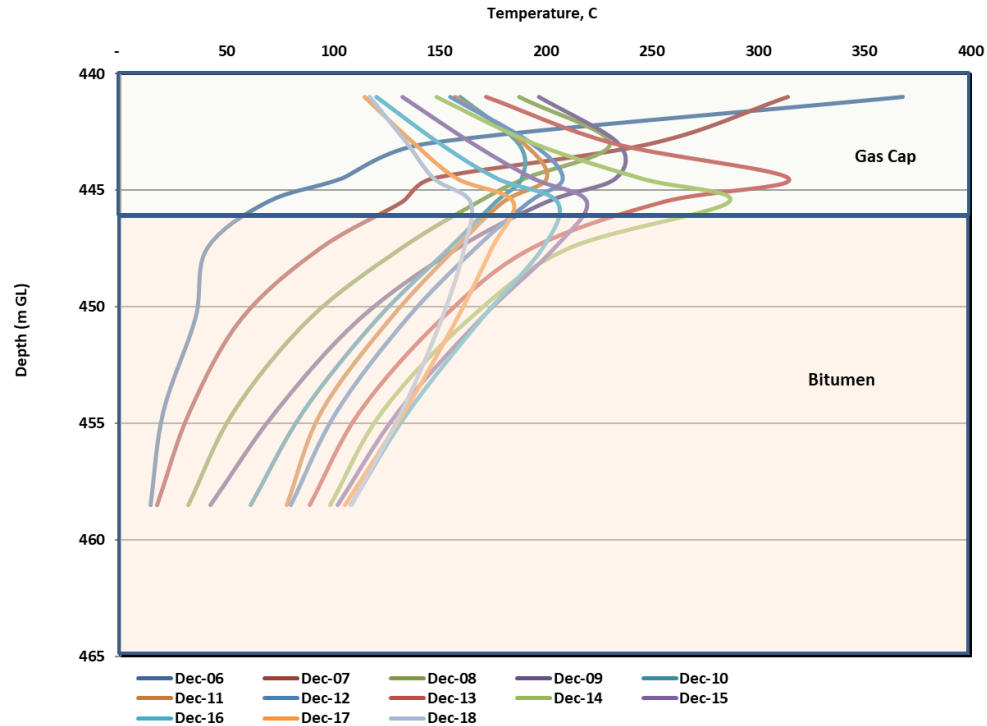
Recent data not available due to instrumentation issues

# 102/05-10-073-06W4 – Temp history



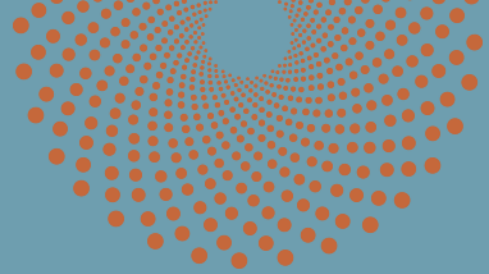
# 102/05-10-073-06W4/0

## Observation well temperature



# Scheme performance

Subsurface section 7



# Project performance history

Year	Activity		
2006	June: Ignition and start-up	2012	Jul: 00/6-7-76-6W4/00 startup Oct: Primrose sales volumes flowing to Caribou gas facility
2007	Q1: 00/14-9-73-6W4/00 nitrogen response a Q2: 00/2-16-73-6W4/00, 00/11-15-73-6W4/00 nitrogen response. 00/14-9-73-6W4/00 shut-in	2013	Feb: 00/6-6-73-6W4/00 startup of Mar: 00/7-8-73-6W4/00 shut-in
2008	May: Nitrogen response at 00/1-17-73-6W4/00	2014	Dec: 00/10-12-73-7W4/00 startup
2009	Jan: 00/6-18-73-6W4/00 gas production shut-in due to segregation repair Jun: 00/7-8-73-6W4/00 nitrogen response Oct: Injectivity decrease observed	2016	Feb: 00/11-15-73-6W4 abandoned Jul: S00/10-11-73-7W4/00 startup
2010	Q1: 00/5-10-73-6W4/00 injector stimulation treatment Q4: 00/1-17-73-6W4/00, 00/2-16-73-6W4/00, 00/11-15-73-6W4/00 shut-in. 00/5-10-73-6W4/00 removal of thermocouple string and perform pressure fall off tests	2017	Mar/Apr: Production shut-in due to non-compliance event Aug: 00/06-05-073-06/W4 shut-in Oct: 00/10-11-073-06W4 returned to production at restricted rate
2011	Q1: 00/5-10-73-6W4/00 injector stimulation treatment Mar/Apr: 00/11-15-73-6W4/00 flowed N <sub>2</sub> 85%	2018	Mar: 00/06-07-073-06W4/02 shut-in Sept: 00/06-06-073-06W4/02, 00/10-11-073-07W4/00, 00/10-12-073-07w4/00 shut-in Cenovus divested the EnCAID wells and facilities effective September 2018.

# Production/injection summary

## Production operations

**Operating for**

>12 years

**Air injected**

~ 305 e<sup>6</sup>m<sup>3</sup>

**Bulk gas recovered**

~ 217 e<sup>6</sup>m<sup>3</sup>

**Formation gas recovered**

~ 192 e<sup>6</sup>m<sup>3</sup>

## Approved producers

**UWI**

**Status**

00/06-05-073-06W4/0

Shut-in ~ 81% N<sub>2</sub>

00/06-06-073-06W4/2

Flowing \* ~2% N<sub>2</sub>

00/06-07-073-06W4/2

Shut-in ~79% N<sub>2</sub>

00/07-08-073-06W4/0

Shut-in ~ 87% N<sub>2</sub>

00/11-15-073-06W4/0

Abandoned

**UWI**

**Status**

00/02-16-073-06W4/0

Shut-in ~ 85% N<sub>2</sub>

00/01-17-073-06W4/0

Shut-in ~ 86% N<sub>2</sub>

00/10-11-073-07W4/0

Flowing \* <1% N<sub>2</sub>

00/10-12-073-07W4/0

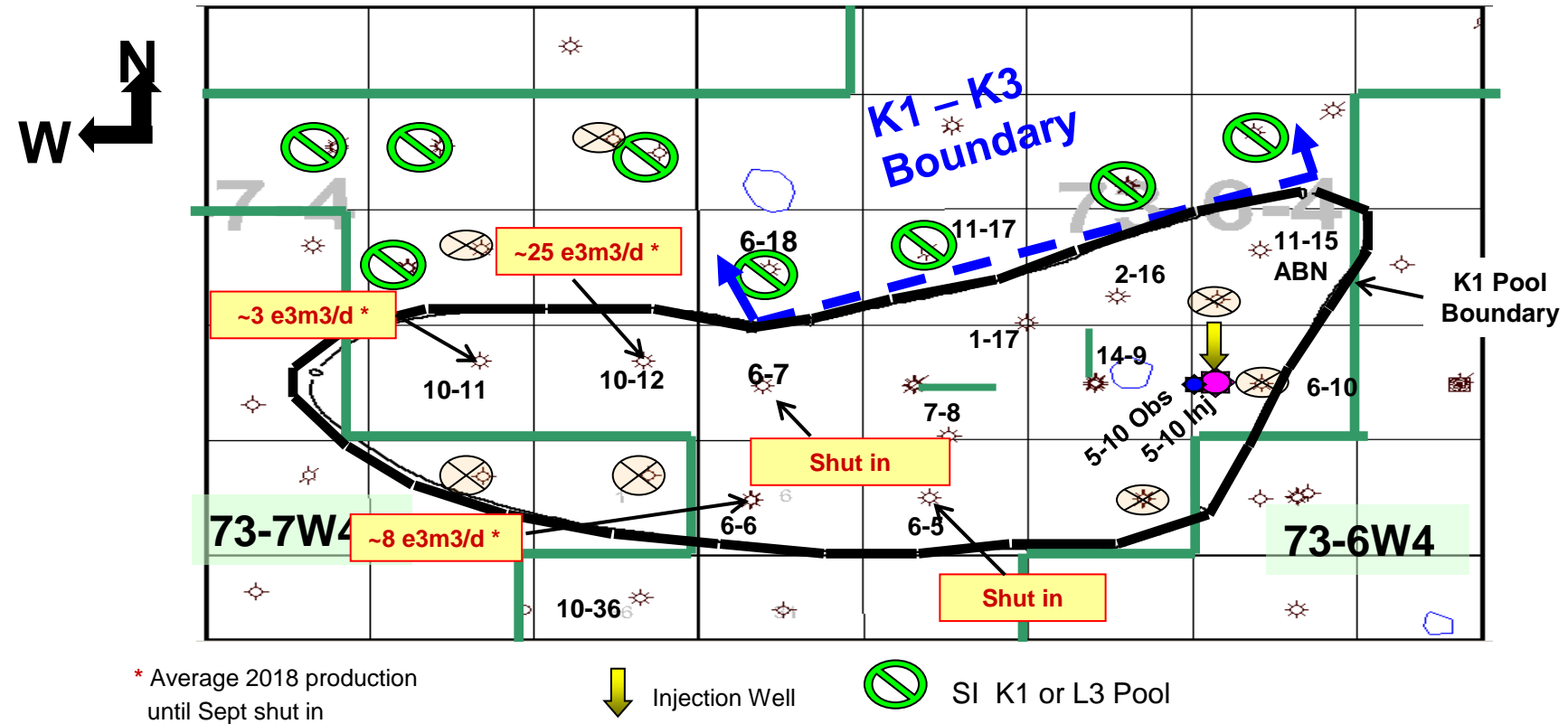
Flowing \* <1% N<sub>2</sub>

00/14-09-073-06W4/0

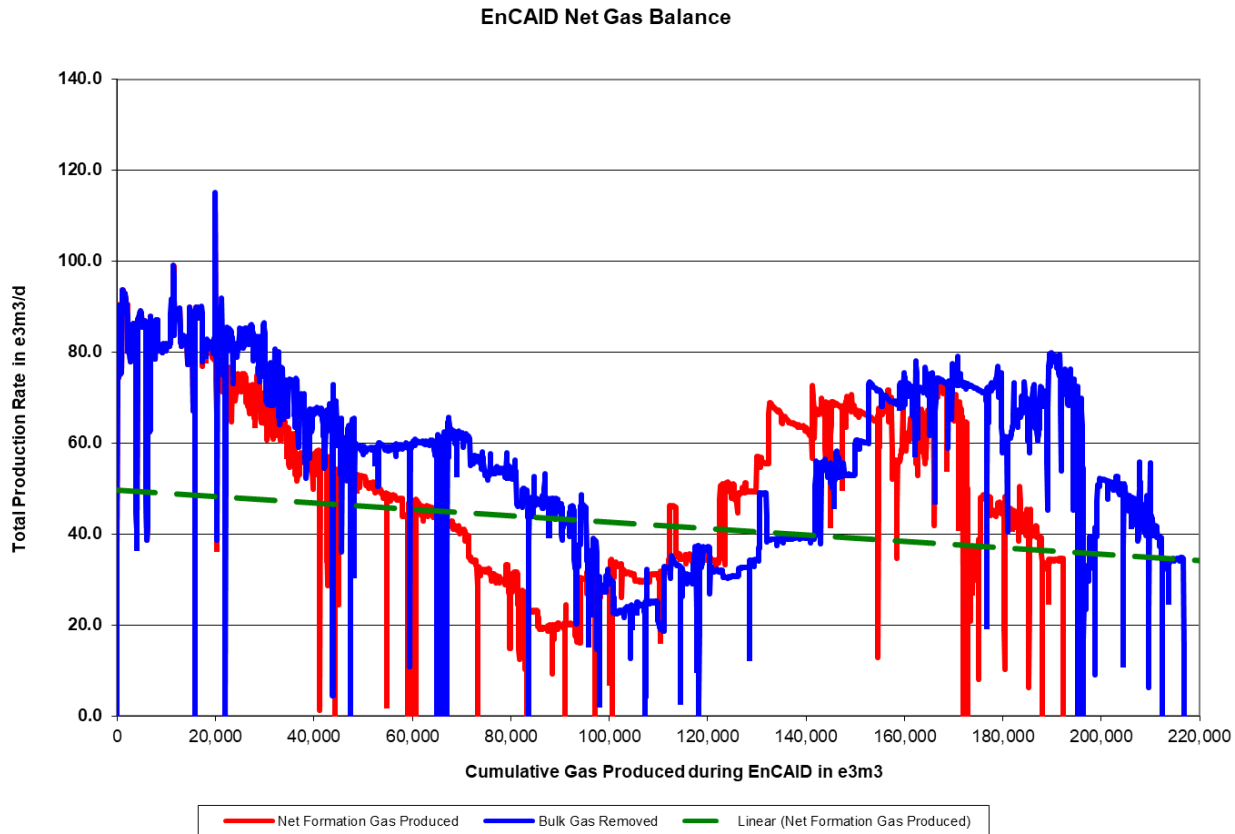
Shut-in ~ 85% N<sub>2</sub>

\* All wells shut-in Sept 2018

# K3 pool production



# History production





# Voidage replacement ratio (VRR) - 2018

## **January to September**

Managed air injection to minimize operating costs with intermittent high air injection rates to ensure that the minimum monthly VRR of 0.90 was met

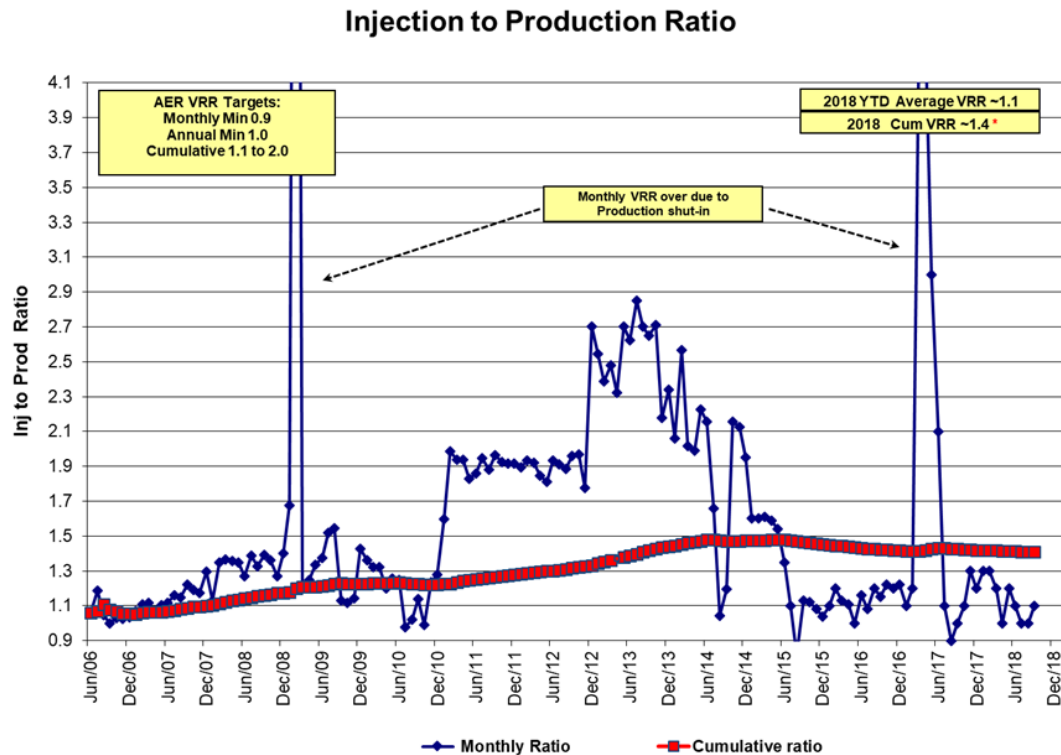
Cenovus divested the EnCAID wells and facilities effective September 2018.

# Voidage replacement ratio

	Monthly VRR	Cumulative VRR	VRR regulatory approved limit (Min monthly)
January	1.30	1.42	0.90
February	1.30	1.42	0.90
March	1.20	1.42	0.90
April	1.00	1.42	0.90
May	1.20	1.41	0.90
June	1.10	1.41	0.90
July	1.00	1.41	0.90
August	1.00	1.41	0.90
September *	1.10	1.41	0.90
October	-	-	-
November	-	-	-
December	-	-	-

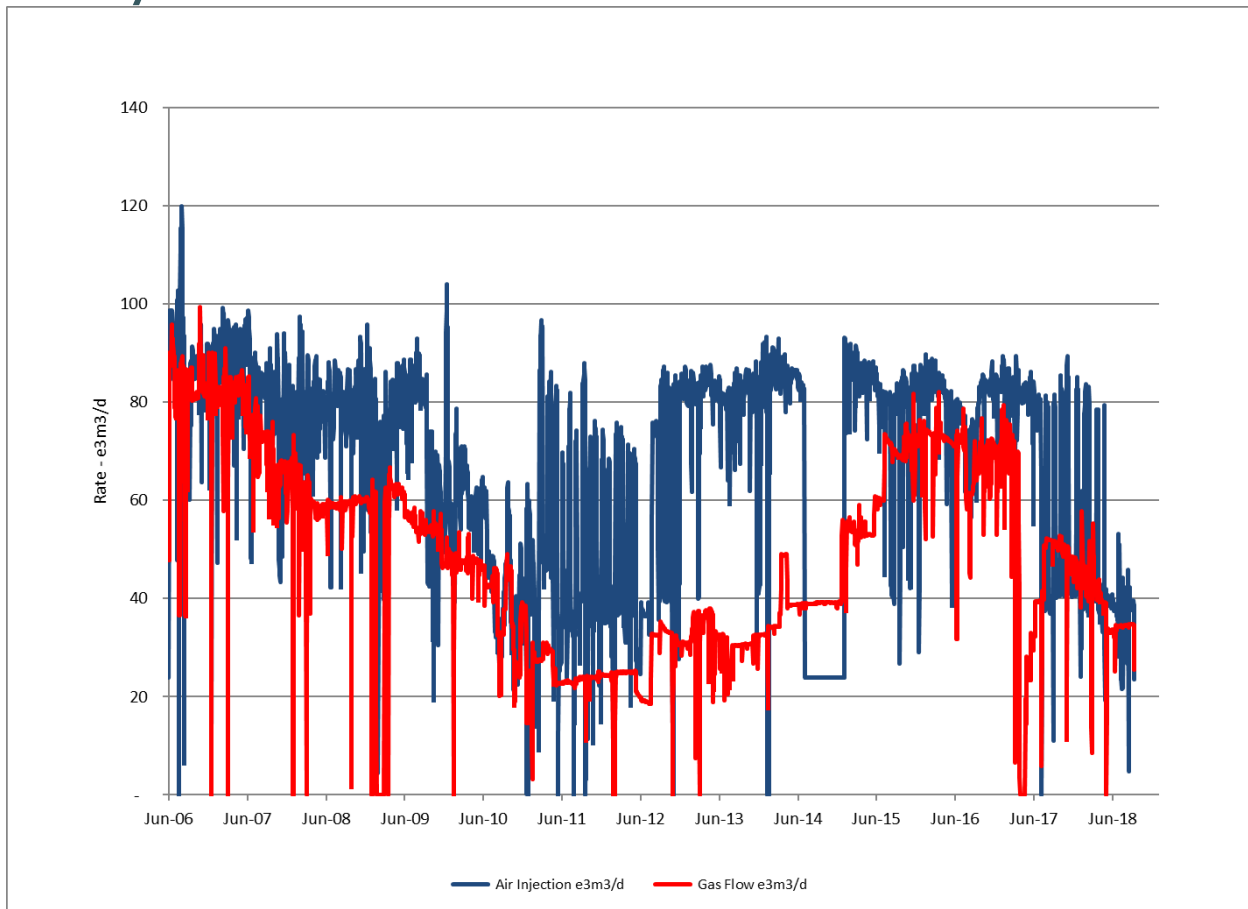
\* Cenovus divested the EnCAID wells and facilities effective September 2018.

# VRR performance



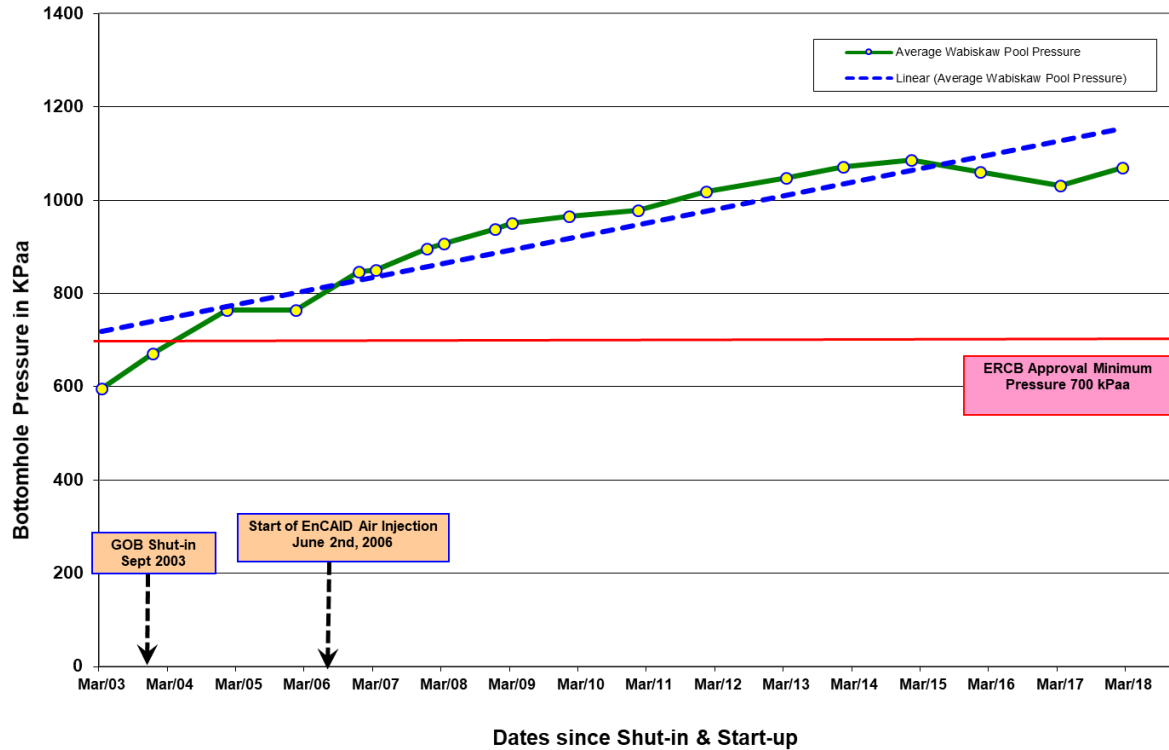
\* Note: The Cumulative VRR since 2015 has been updated.  
 Due to an error in the calculation, the previously reported values were higher than actuals.

# VRR history

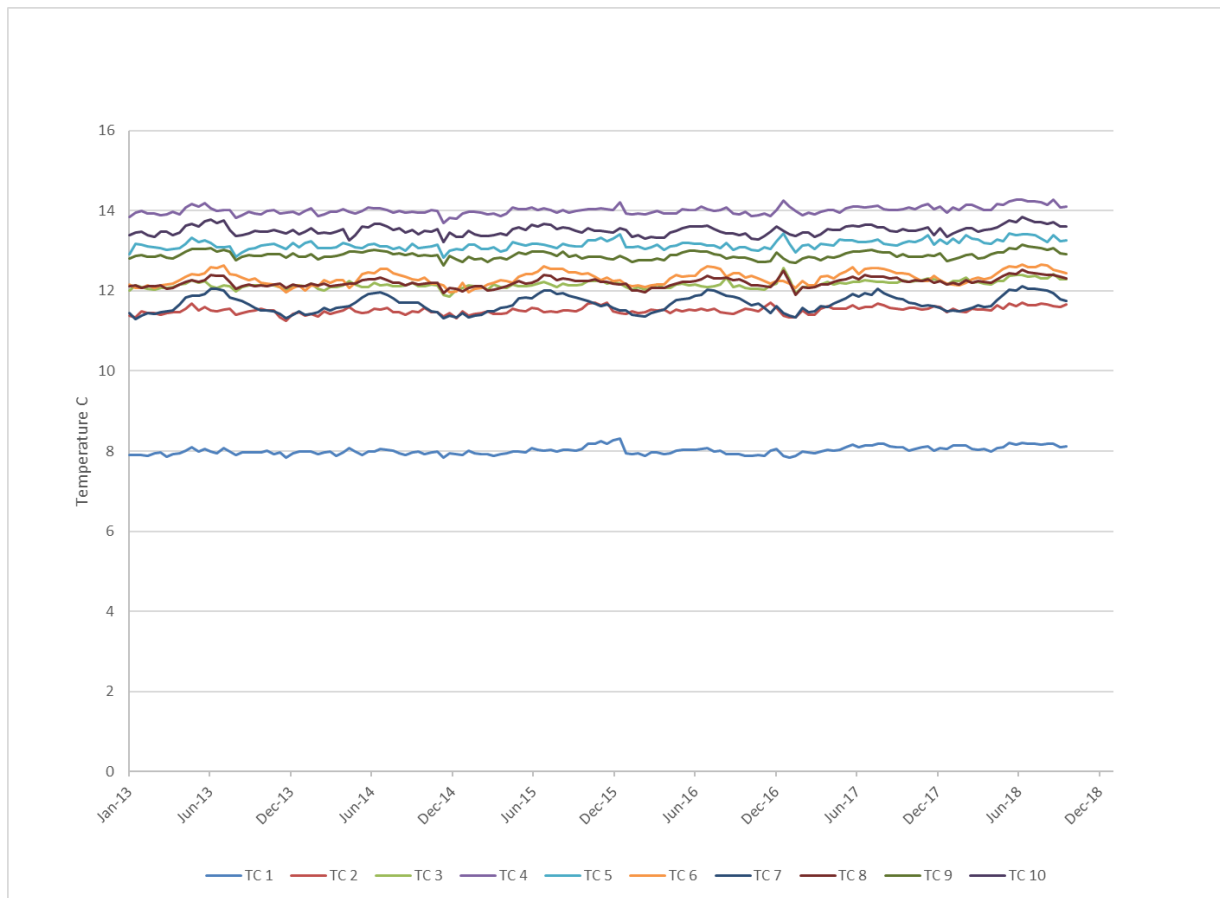


# K3 pool pressure

Average Pool Pressure History for EnCAID Wabiskaw K-3



# Observation 6-10 well temperature

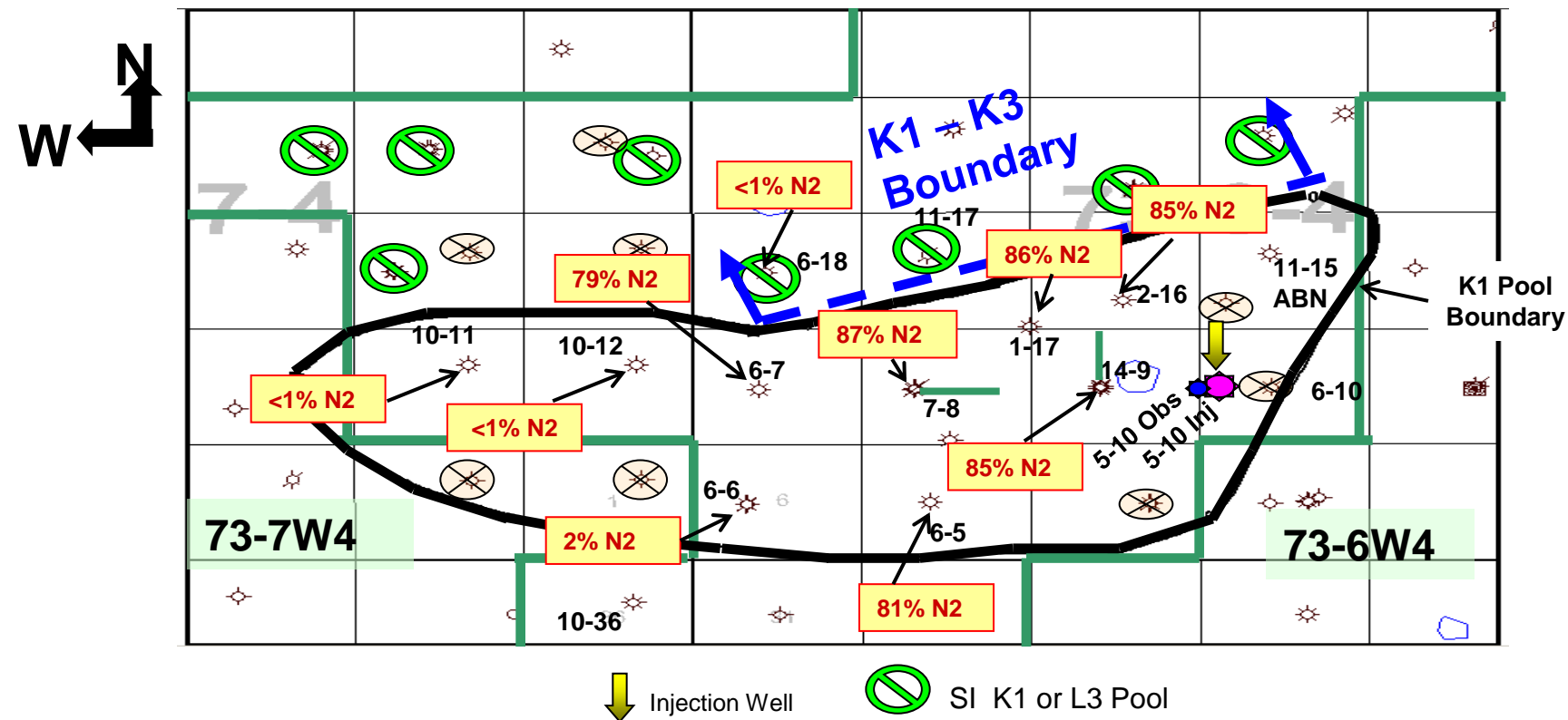


# Composition of injected/produced fluids

- EnCAID does not currently sample air injected
- EnCAID captures gas samples for analysis on the schedule located to the right and monitors compositional changes for each well
- Cenovus samples selective wells on more frequent basis than required under Approval 10440L

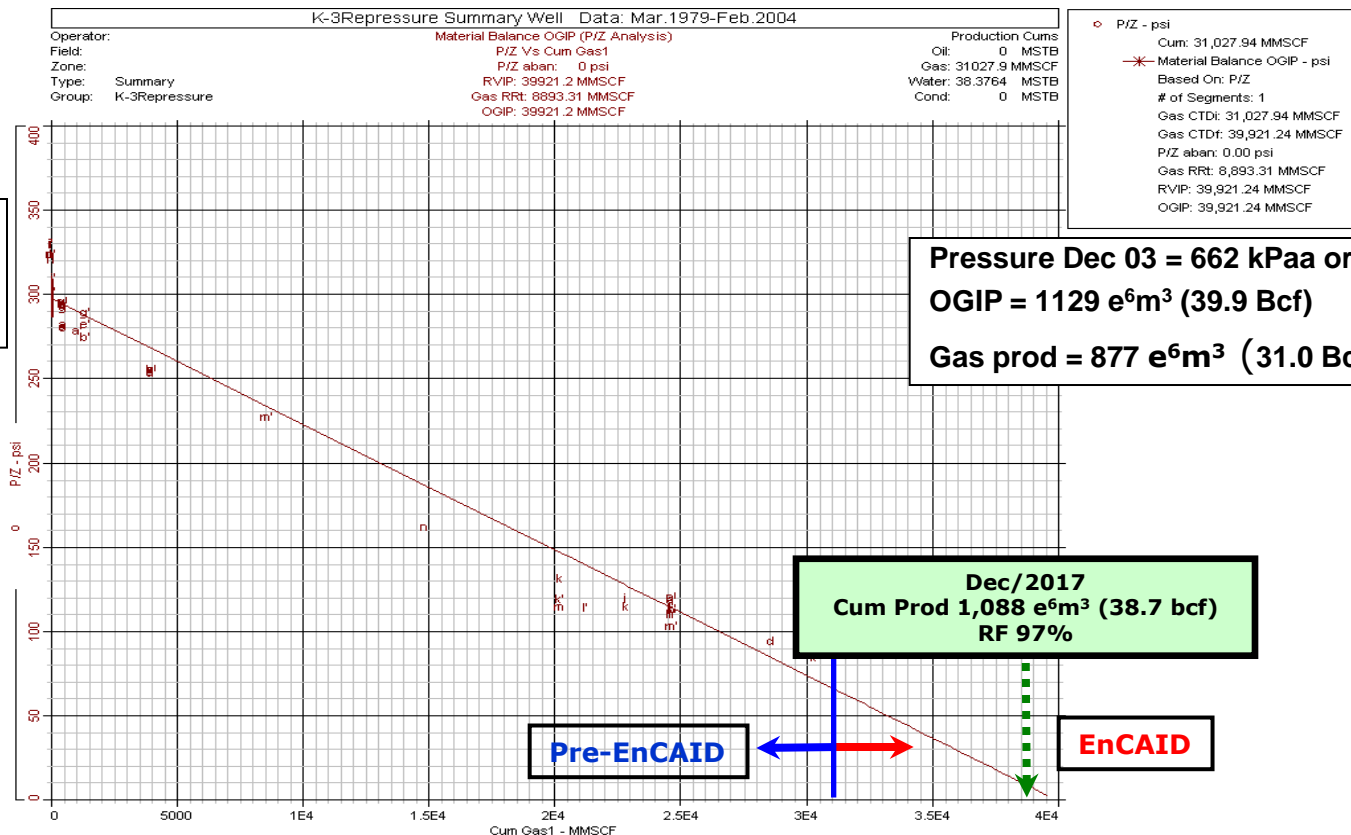
	Sampling Frequency
00/01-17-073-06W4/0	Annual
00/02-16-073-06W4/0	Annual
00/06-05-073-06W4/0	Semi-annual
00/06-06-073-06W4/2	Semi-annual
00/06-07-073-06W4/2	Semi-annual
00/06-10-073-06W4/2	Annual
00/06-18-073-06W4/0	Annual
00/07-08-073-06W4/0	Annual
00/10-11-073-07W4/0	Semi-annual
00/10-12-073-07W4/0	Semi-annual
00/10-36-072-07W4/2	Annual
00/11-17-073-06W4/0	Annual
00/14-09-073-06W4/0	Annual

# Nitrogen response





# Wabiskaw K-3 Pool material balance



# Subsurface key learnings

Presence of more than one oxidation front indicates

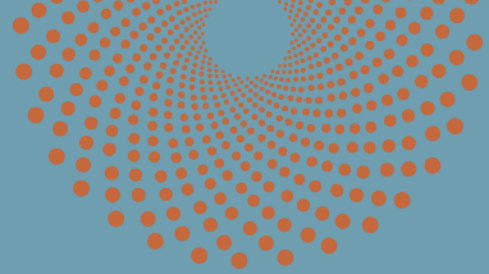
- fuel remaining in the region swept by the combustion front
- could be either residual oil left behind first oxidation front, or re-saturation with oil from adjacent rock or, possibly from flammable vapor produced from the oxidation and cracking reactions

Continues to be strong correlations between air-injection rate and temperature changes

- first oxidation zone at the bottom of the gas cap was truncated by a reduction in injection rate
- increase in injection rate performed in early 2013 resulted in ignition and combustion of the top of the bitumen

# Future plans

Subsurface section 8



# Future plans

- Cenovus divested the EnCAID well and facilities effective September 2018 and plans to transfer the scheme approval to the new owner.

# **AER Directive 054 Section 3.1.2**

Surface operations, compliance and issues not related to  
resource evaluation and recovery

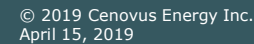
# Surface operations: table of contents

- Facility overview/modifications
- Measurement and reporting
- Environmental issues
- Compliance statement
- Future plans

# Facilities Overview

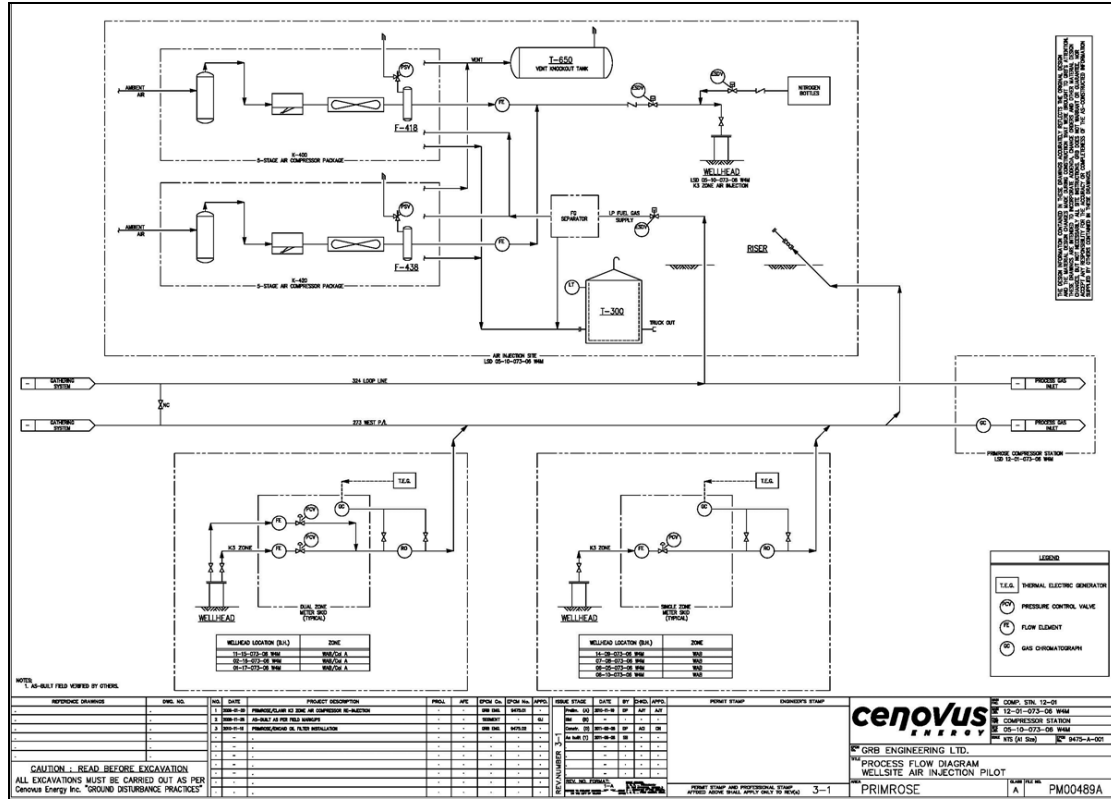
Surface section 1

**ceponus**  
ENERGY





## Process flow schematic



# Plant performance - 2018

Facility is operating as expected

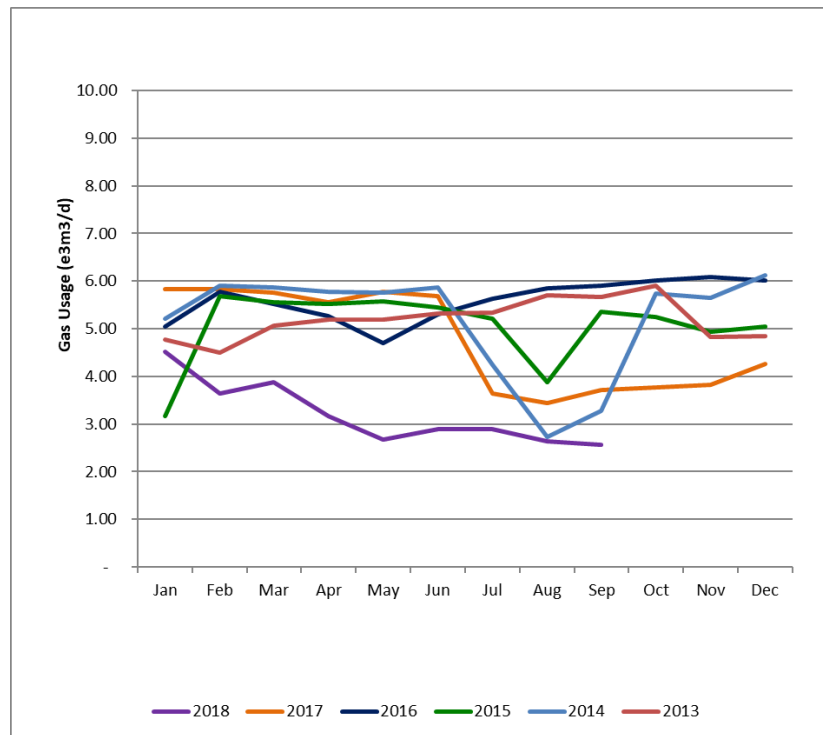
- Steady air injections
- Operated to optimize operating costs

# Gas usage

Usage is as fuel gas for air compressor operations

- Gas source Primrose plant fuel gas
- Total 2018 usage 824 e<sup>3</sup>m<sup>3</sup> \*

\* All wells & air injection shut-in Sept 2018



# Greenhouse gas emissions

	2018 (tonnes CO2e)
January	368.67
February	287.56
March	331.13
April	243.76
May	231.82
June	238.62
July	244.90
August	221.46
September *	70.82
October	0.00
November	0.00
December	0.00

\* All wells & air injection shut-in Sept 2018

# 2018 Annual Venting and Flaring Volumes

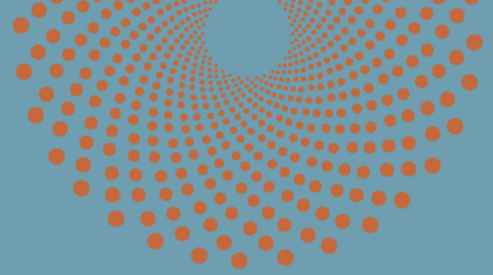
<b>SO<sub>2</sub> (tonnes)</b>	<b>NOx (tonnes)</b>	<b>Venting (e<sup>3</sup>m<sup>3</sup>)</b>	<b>Flaring (e<sup>3</sup>m<sup>3</sup>)</b>
0	10.577	24.86	0

# Surface facility key learnings

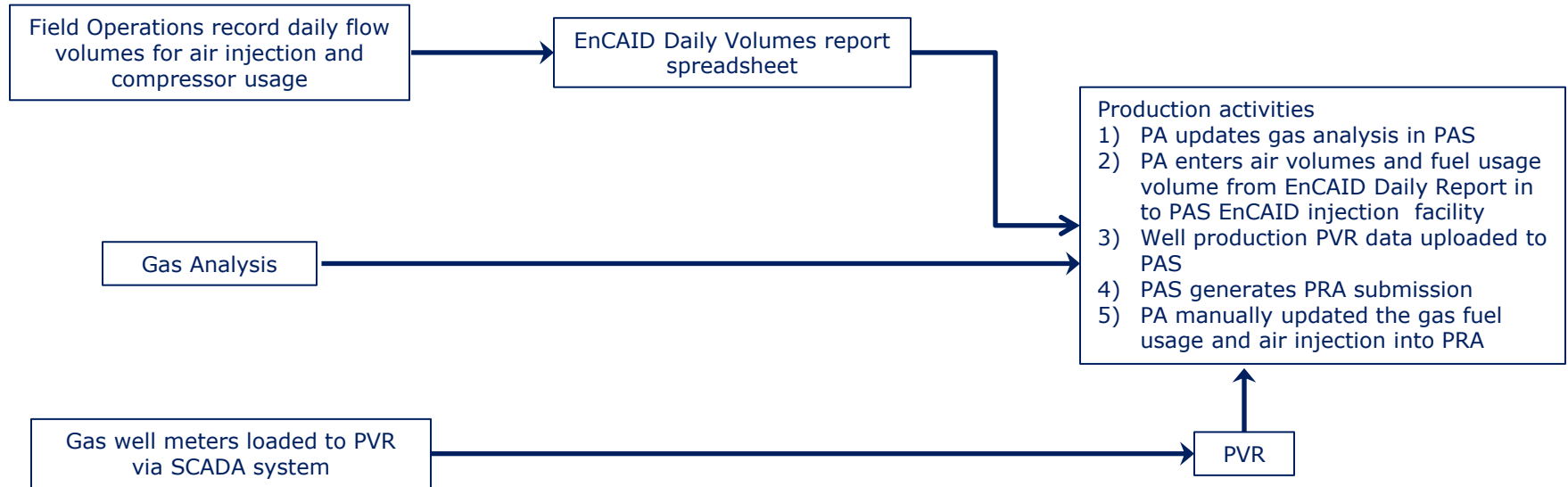
- Safe operation of production and injection wells
- Geographical location provides challenges for instrumentation operations utilizing solar panels during the winter season
- Purity of injection gases plays key role in maintaining injectivity
- Marginal economics to operate in today's pricing environment

# Measurement and reporting

Surface section 2



# Measurement reporting





# Environmental issues

Surface section 7

# Environmental compliance

No environmental non-compliance events related to EnCAID occurred in 2018

# Compliance statement

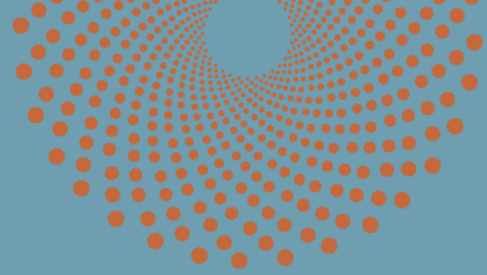
Surface section 8

# Compliance confirmation

There were no non-compliance events related to EnCAID Approval 10440L in 2018

# Non-compliance discussion

Surface section 9



# Non-compliance discussion

There were no non-compliance events related to EnCAID Approval 10440L in 2018

# Future plans

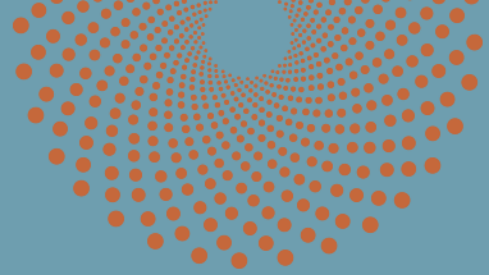
Surface section 10

# Future plans

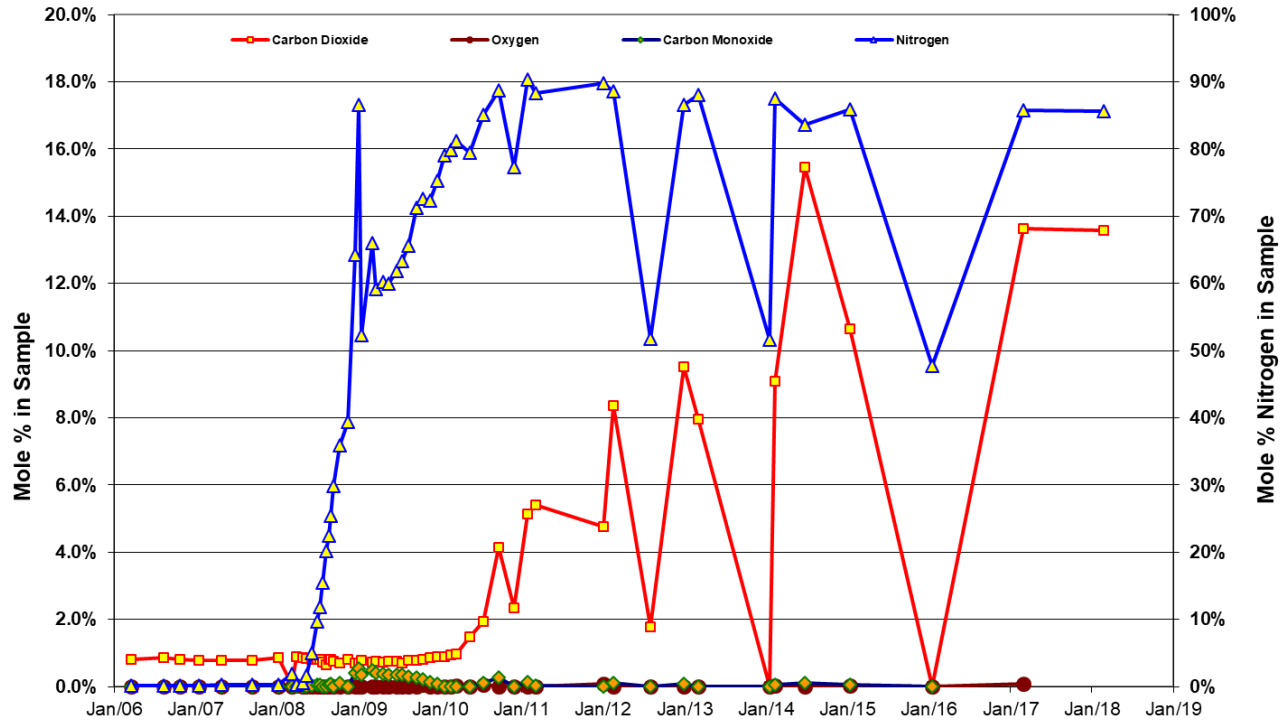
- Cenovus divested the EnCAID well and facilities effective September 2018 and plans to transfer the scheme approval to the new owner.



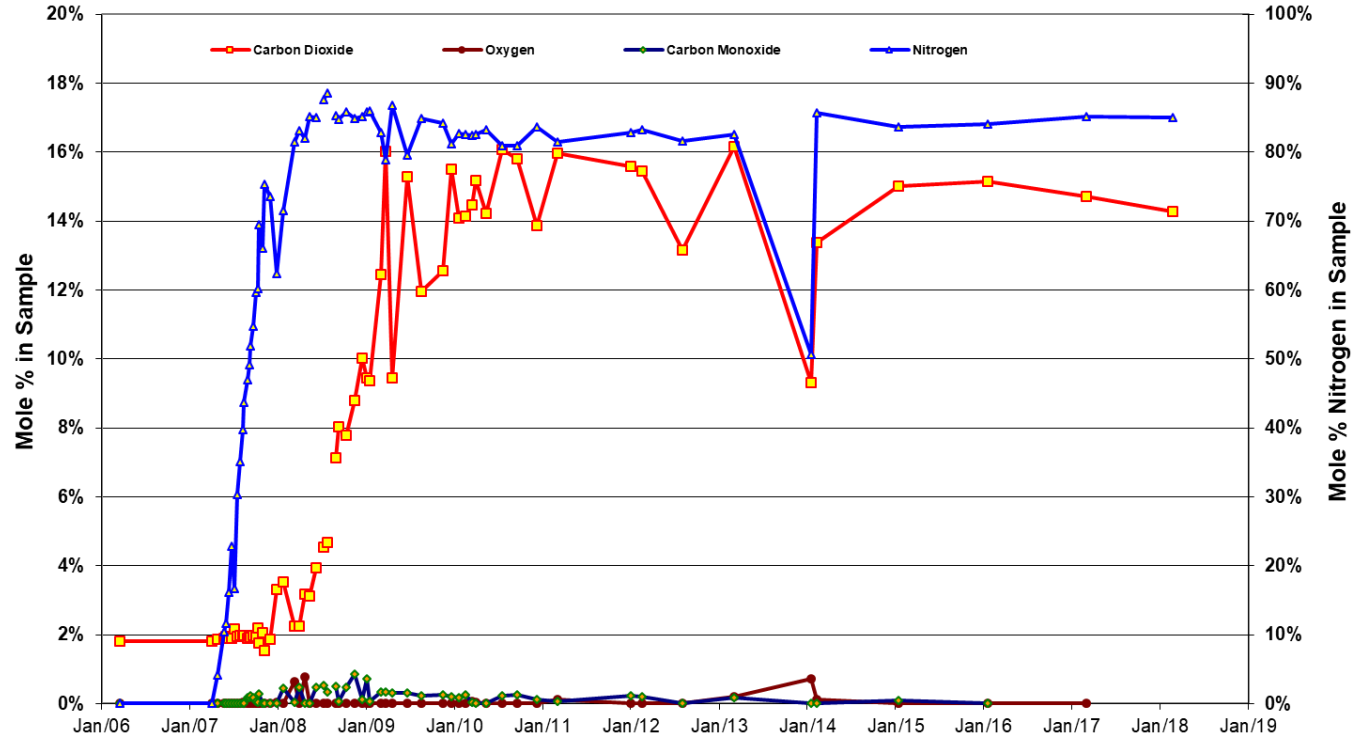
# Appendix



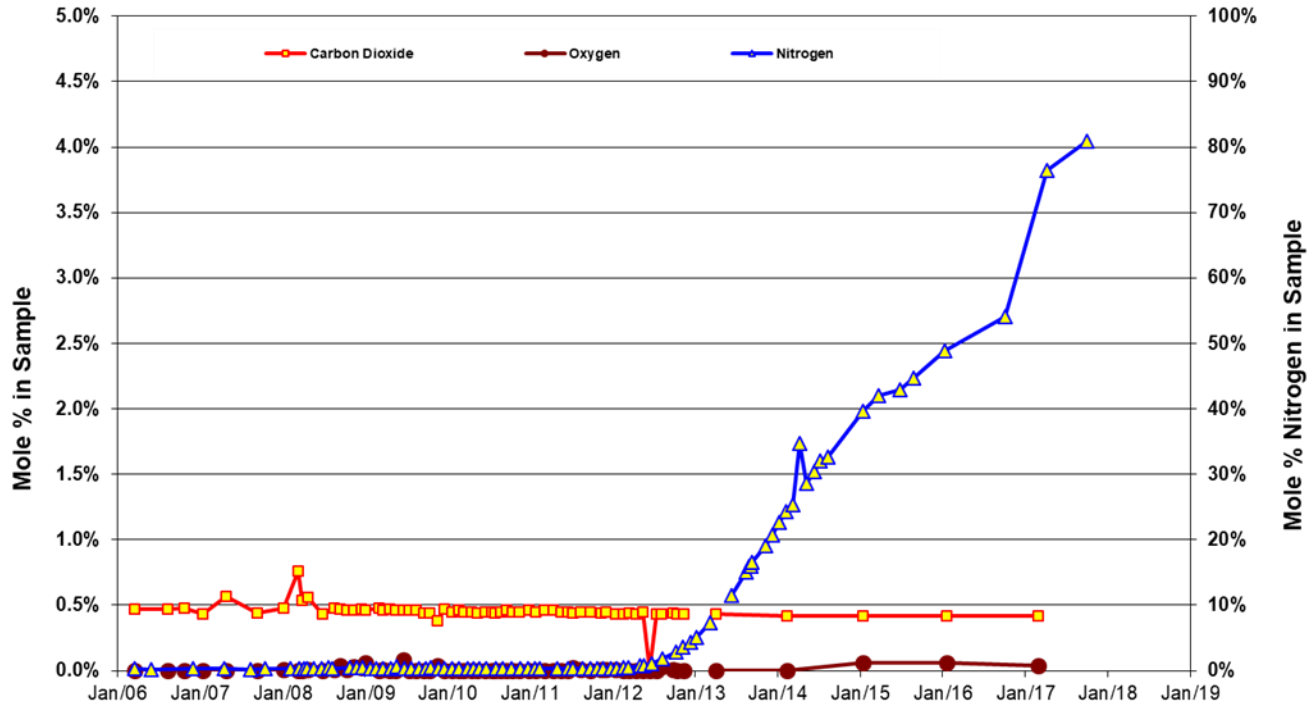
# Gas composition 00/1-17-73-6W4/0



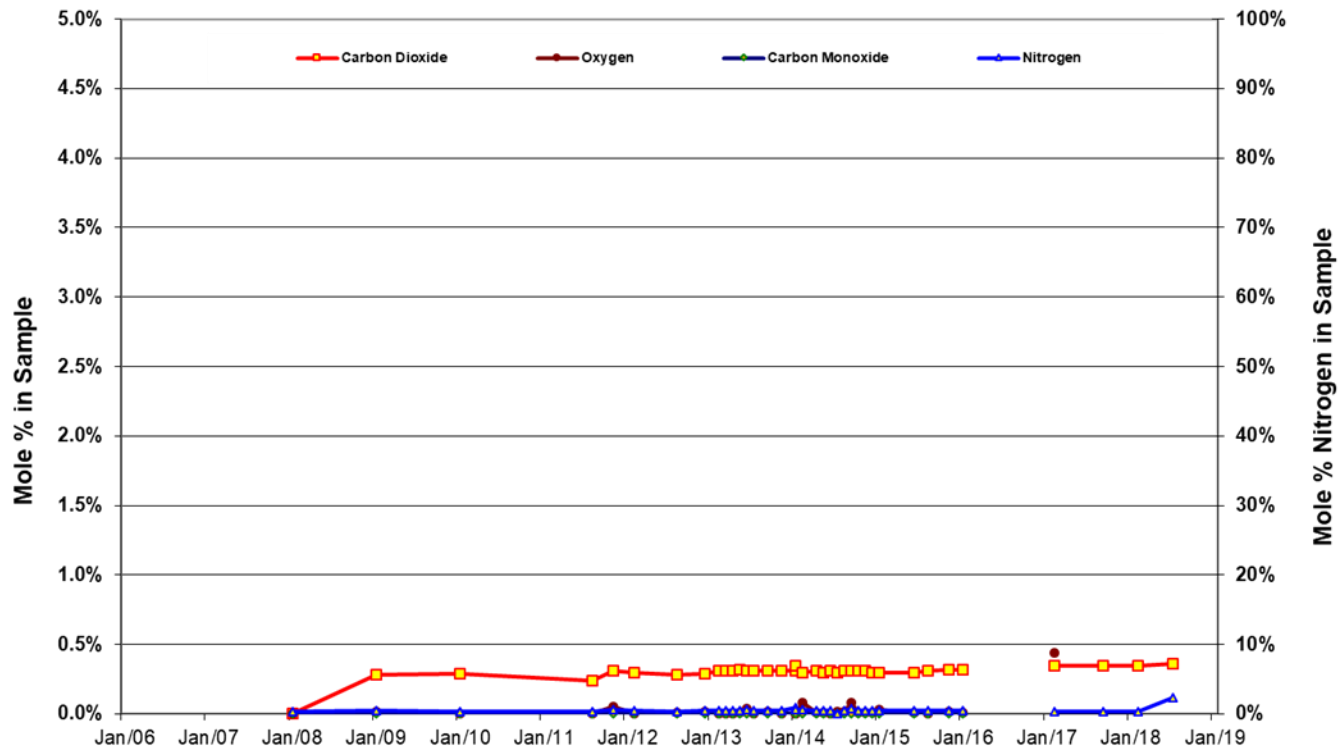
# Gas composition 00/2-16-73-6W4/0



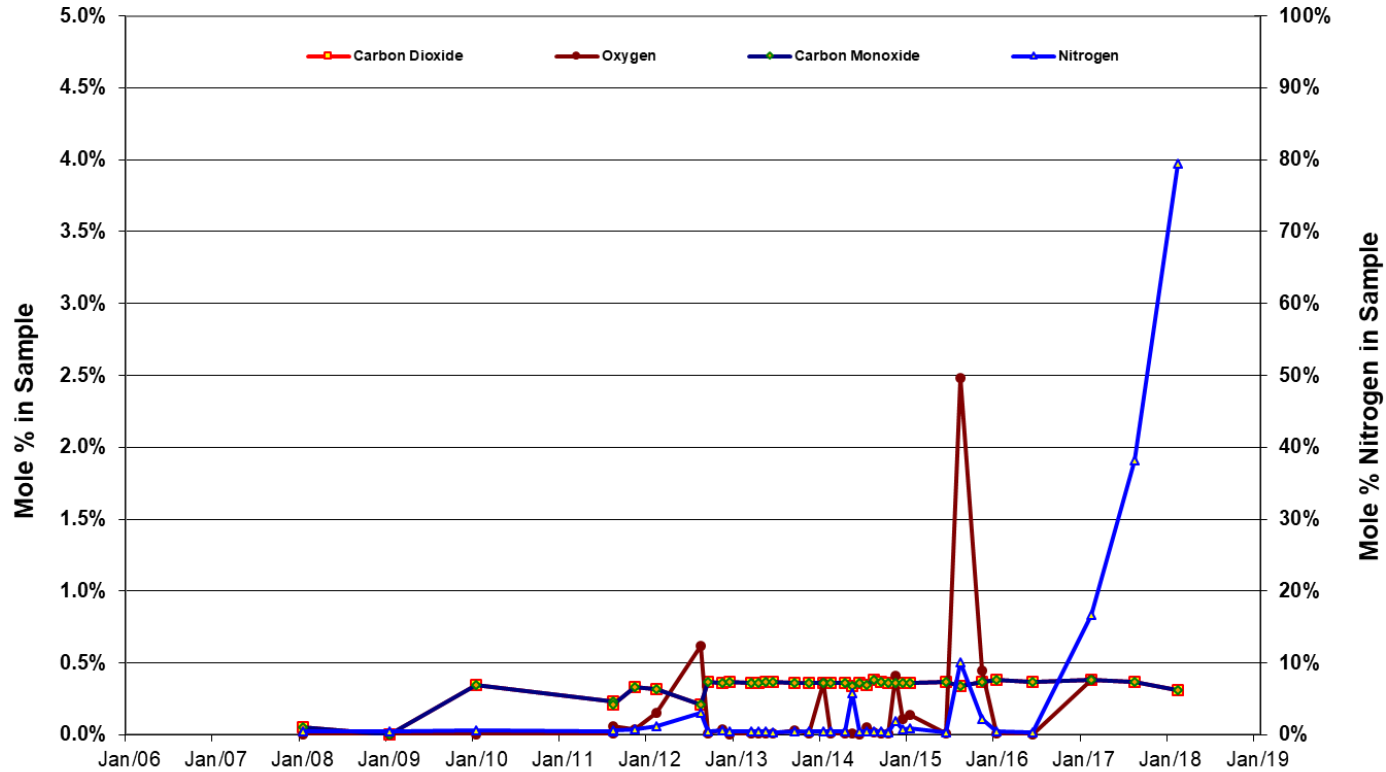
# Gas composition 00/6-5-73-6W4/0



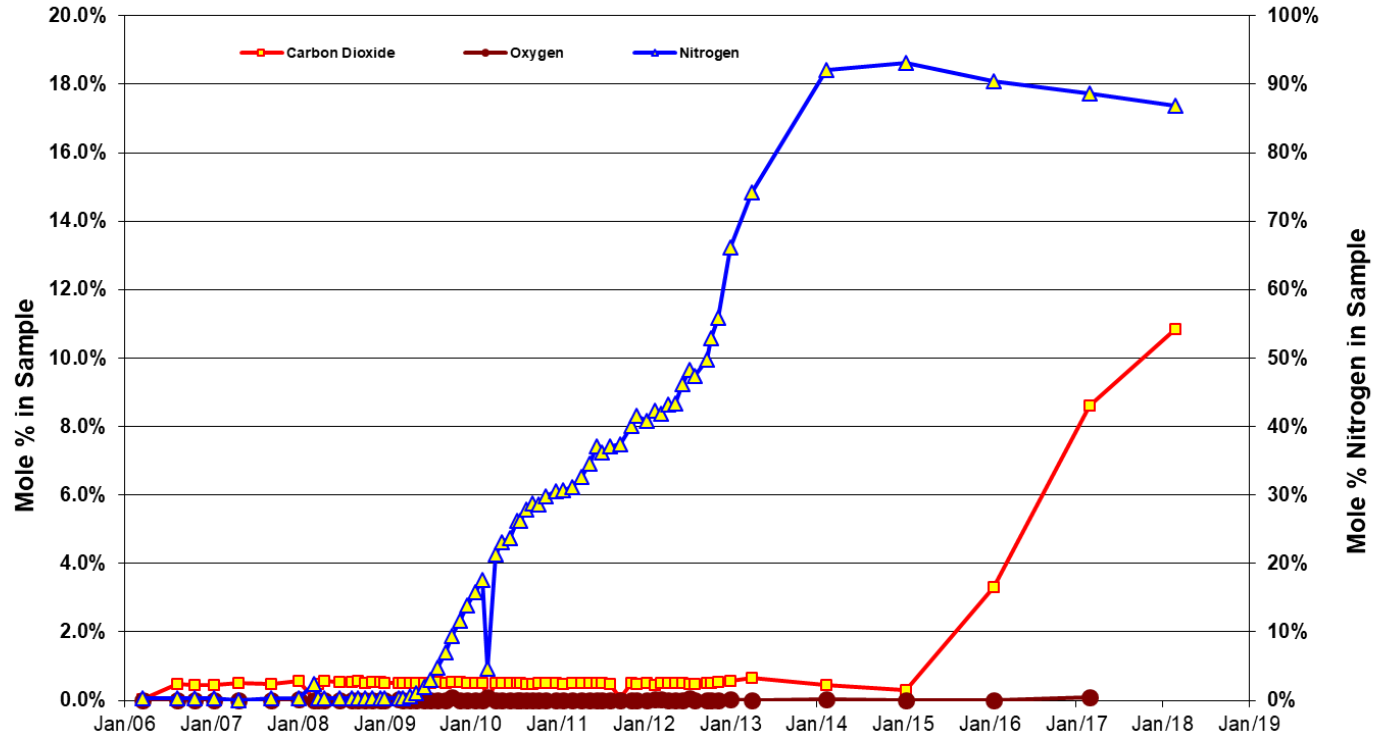
# Gas composition 00/6-6-73-6W4/0



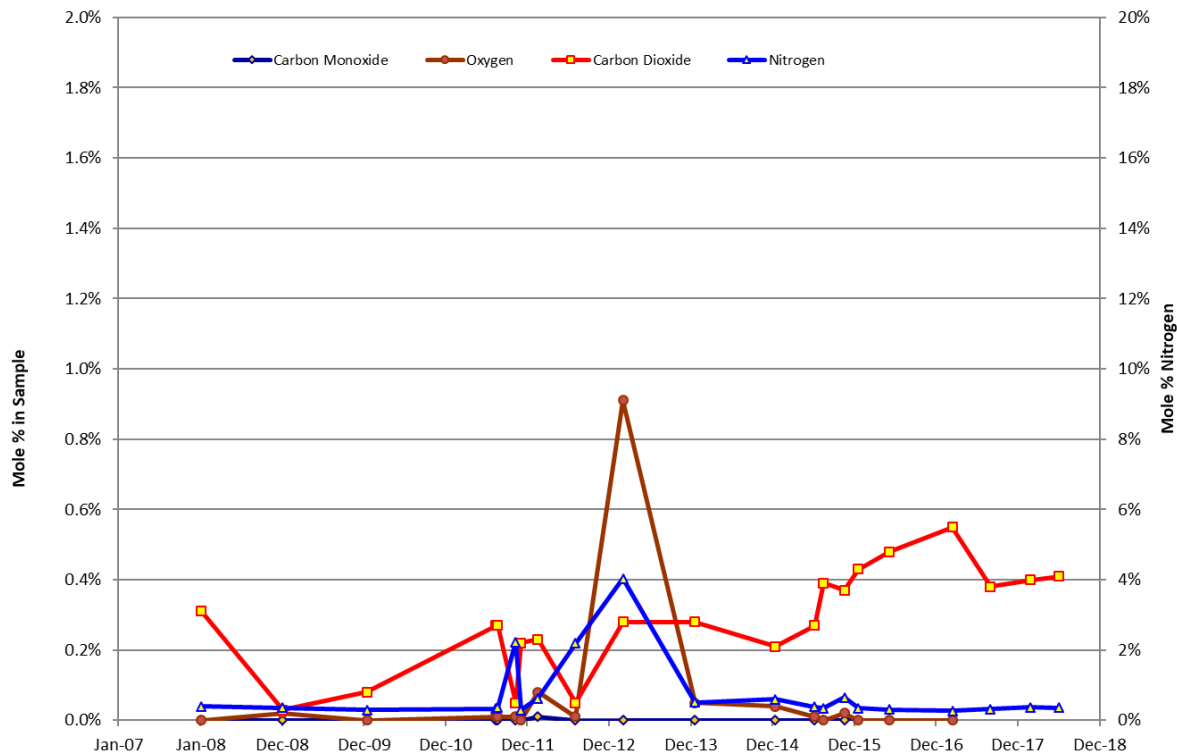
# Gas composition 00/6-7-73-6W4/0



# Gas composition 00/7-8-73-6W4/0

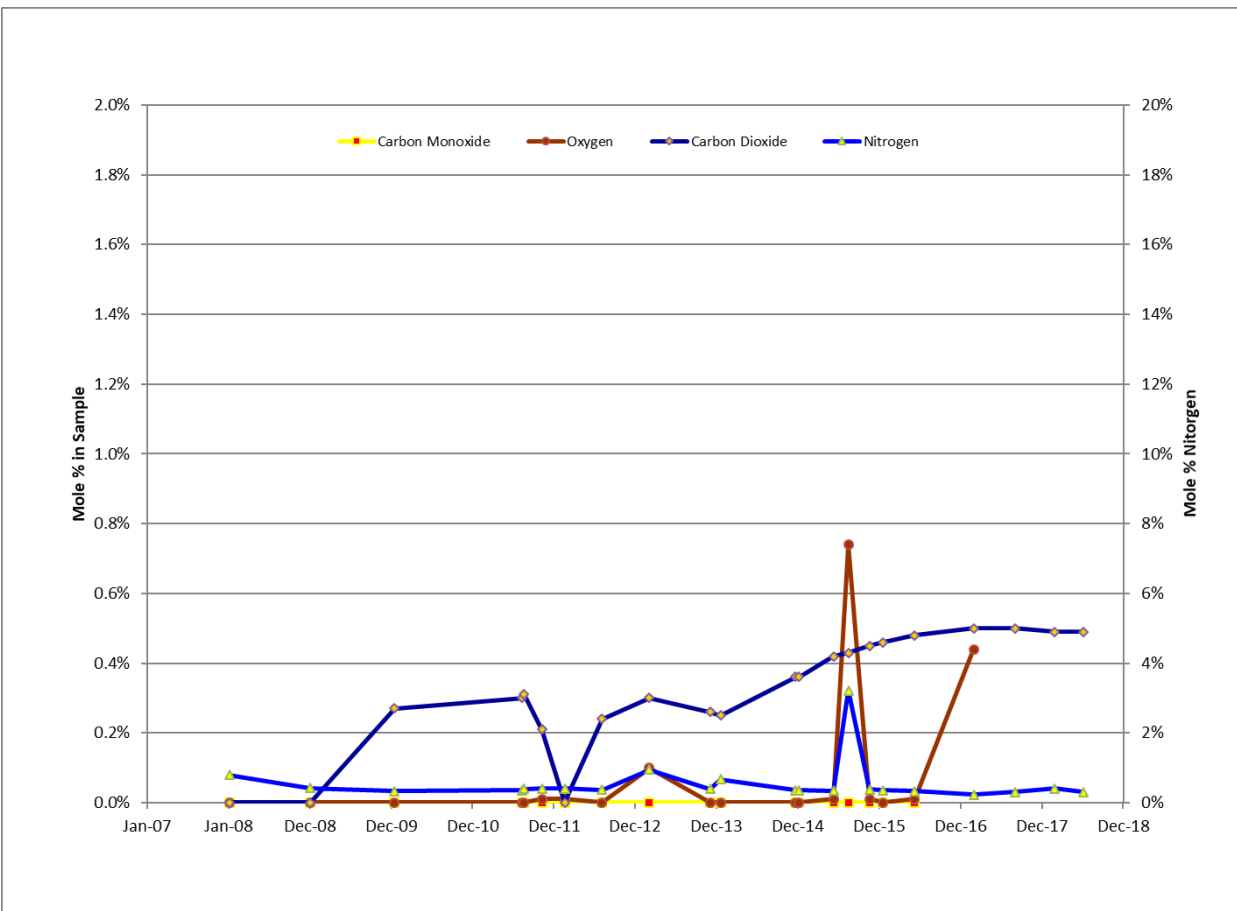


# Gas composition 00/10-11-73-7W4/0

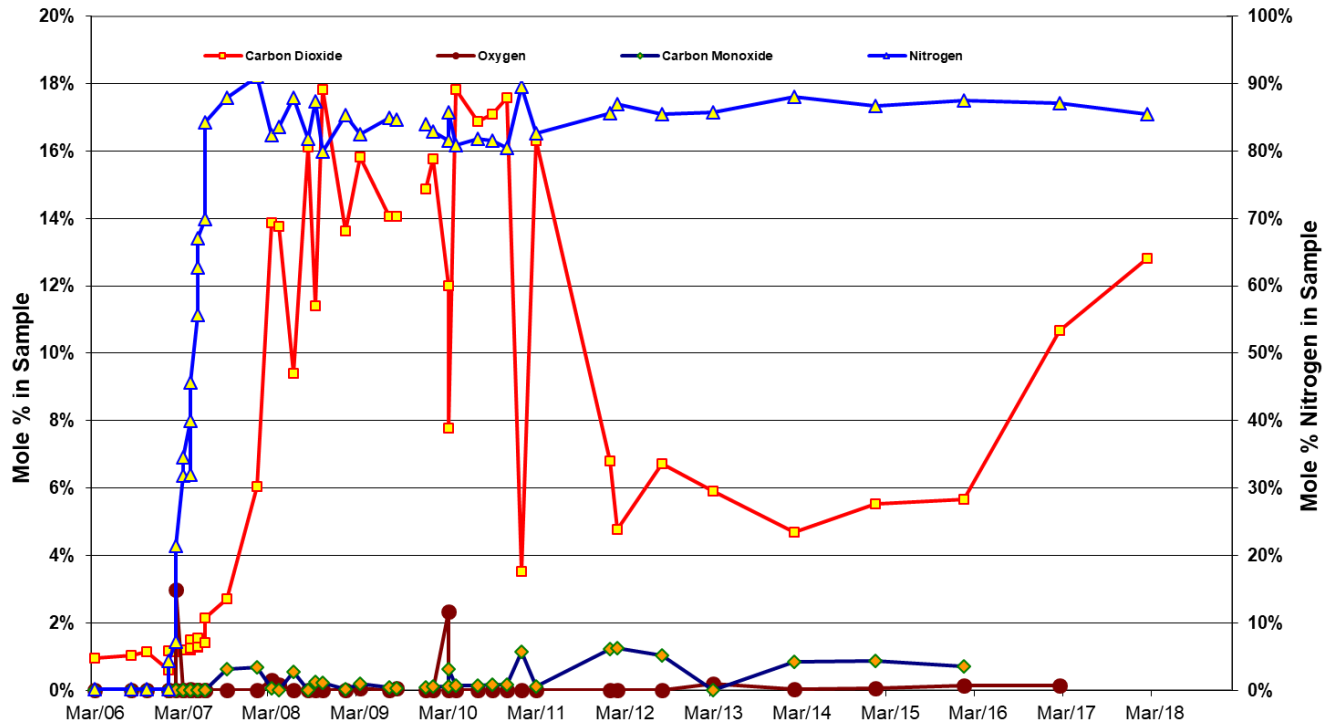




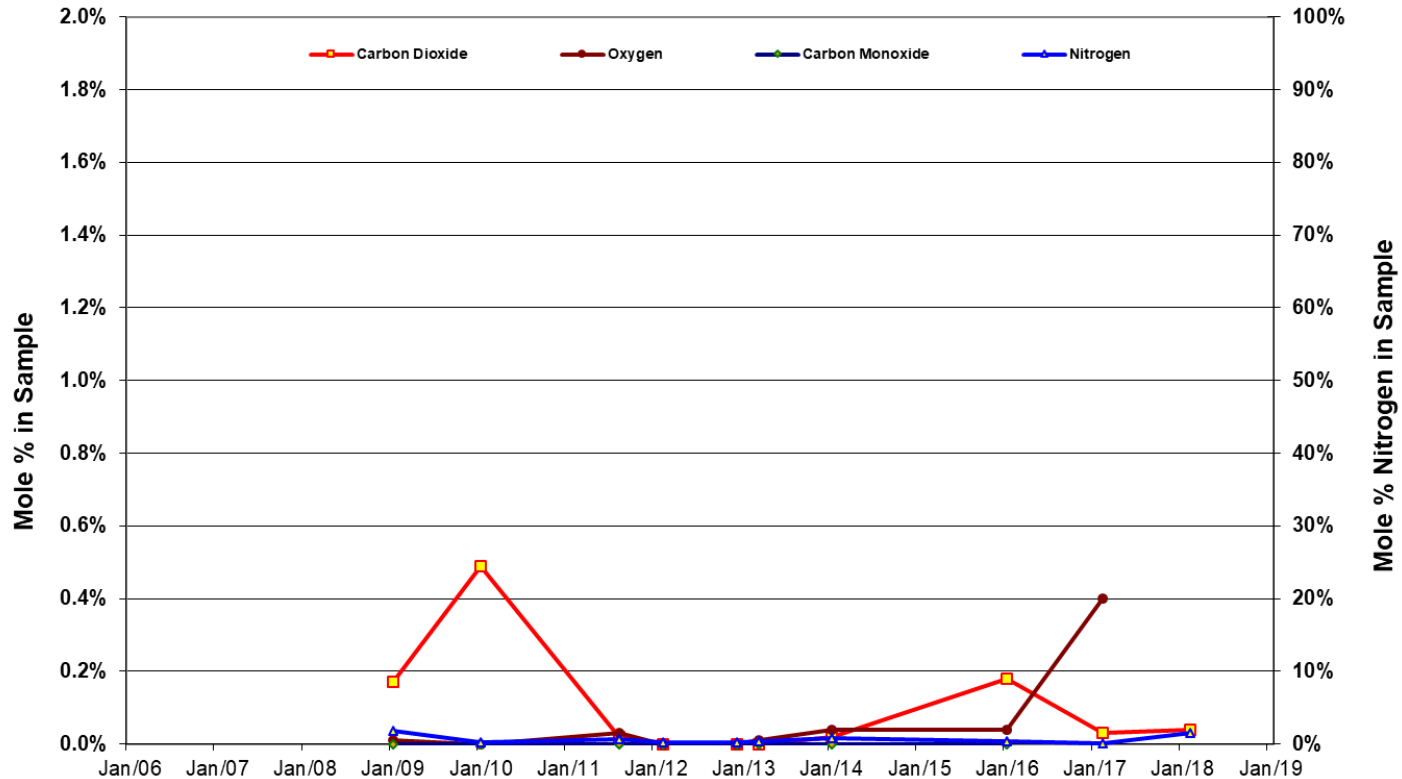
# Gas composition 00/10-12-73-7W4/0



# Gas composition 00/14-9-73-6W4/0



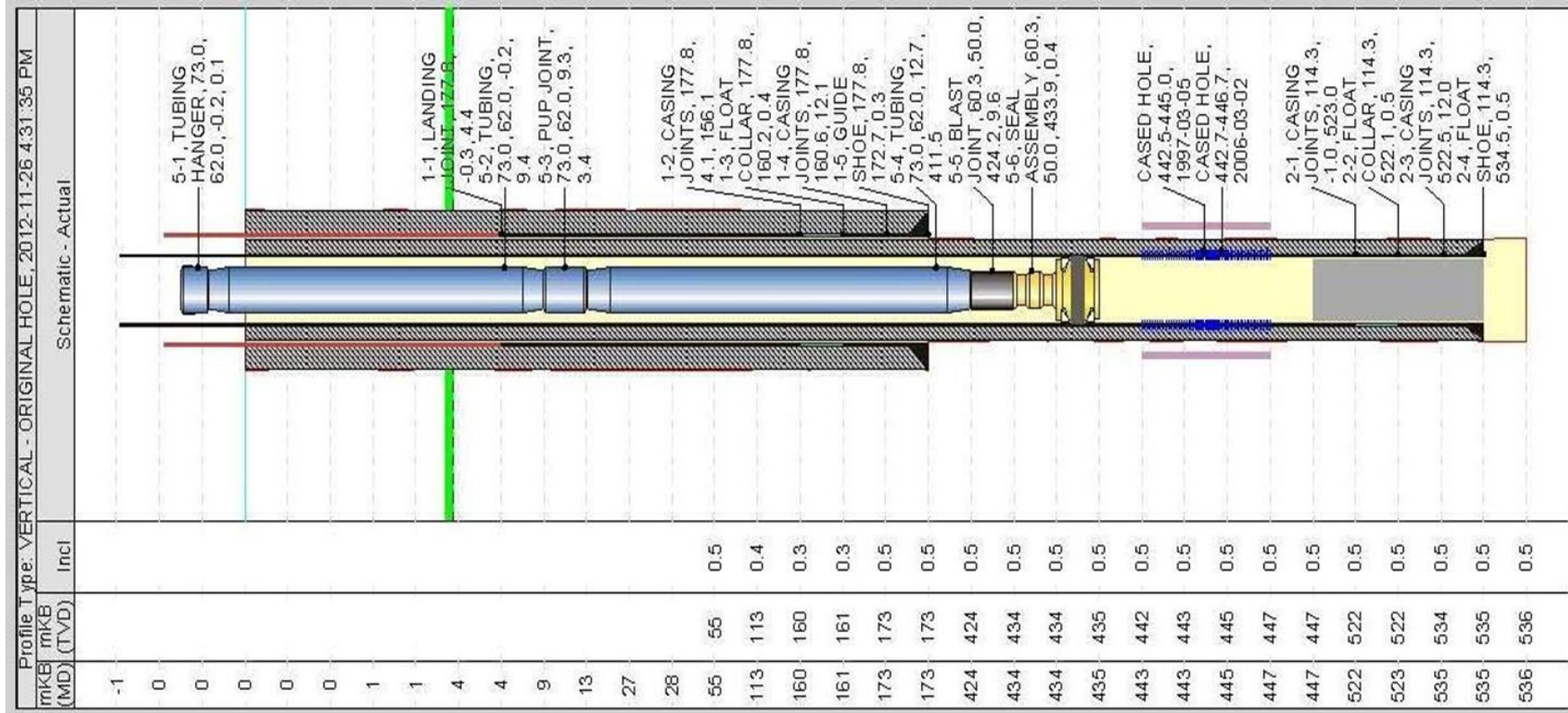
# Gas composition 00/6-18-73-6W4/0



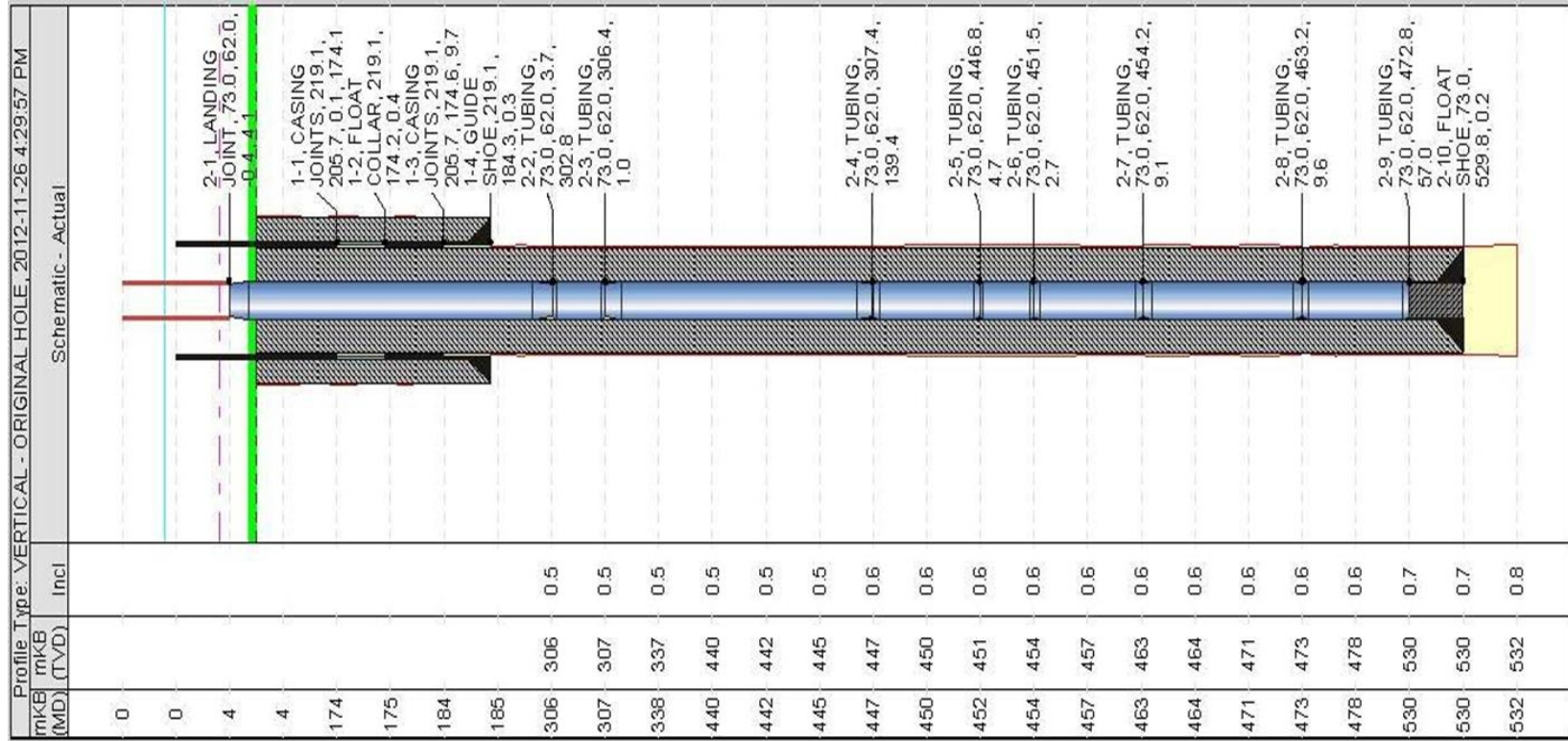
# Downhole instrumentation layout



# 100/05-10-073-06W4 wellbore schematic



# 102/05-10-073-06W4 wellbore schematic



# 103/05-10-073-06W4 wellbore schematic

