Suncor MacKay River Project
2017 AER Performance Presentation

Reporting Period: September 1, 2017 to August 31, 2018

Table of Contents

Suncor MacKay River Project
2017 AER Performance Presentation: Subsurface
Commercial Scheme Approval No. 8668

October 24, 2018

Reporting Period September 1, 2017 – August 31, 2018

The Suncor Strategy

To provide greater reliability and flexibility to our feedstock supplies, we produce bitumen through mining and in-situ recovery technologies and supplement that supply through third party agreements.

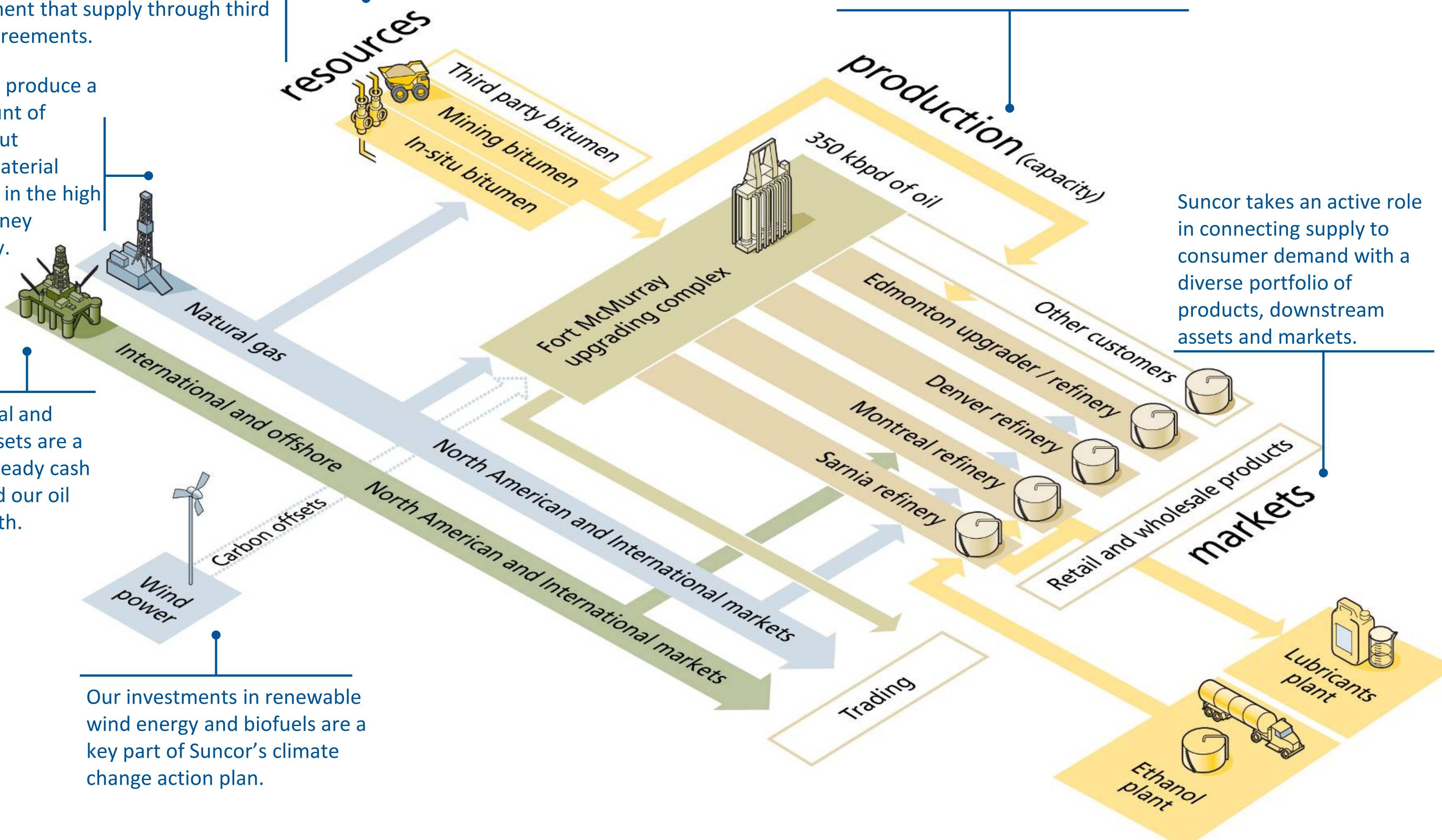
We currently produce a limited amount of natural gas but maintain a material land position in the high quality Montney resource play.

International and offshore assets are a source of steady cash flow to fund our oil sands growth.

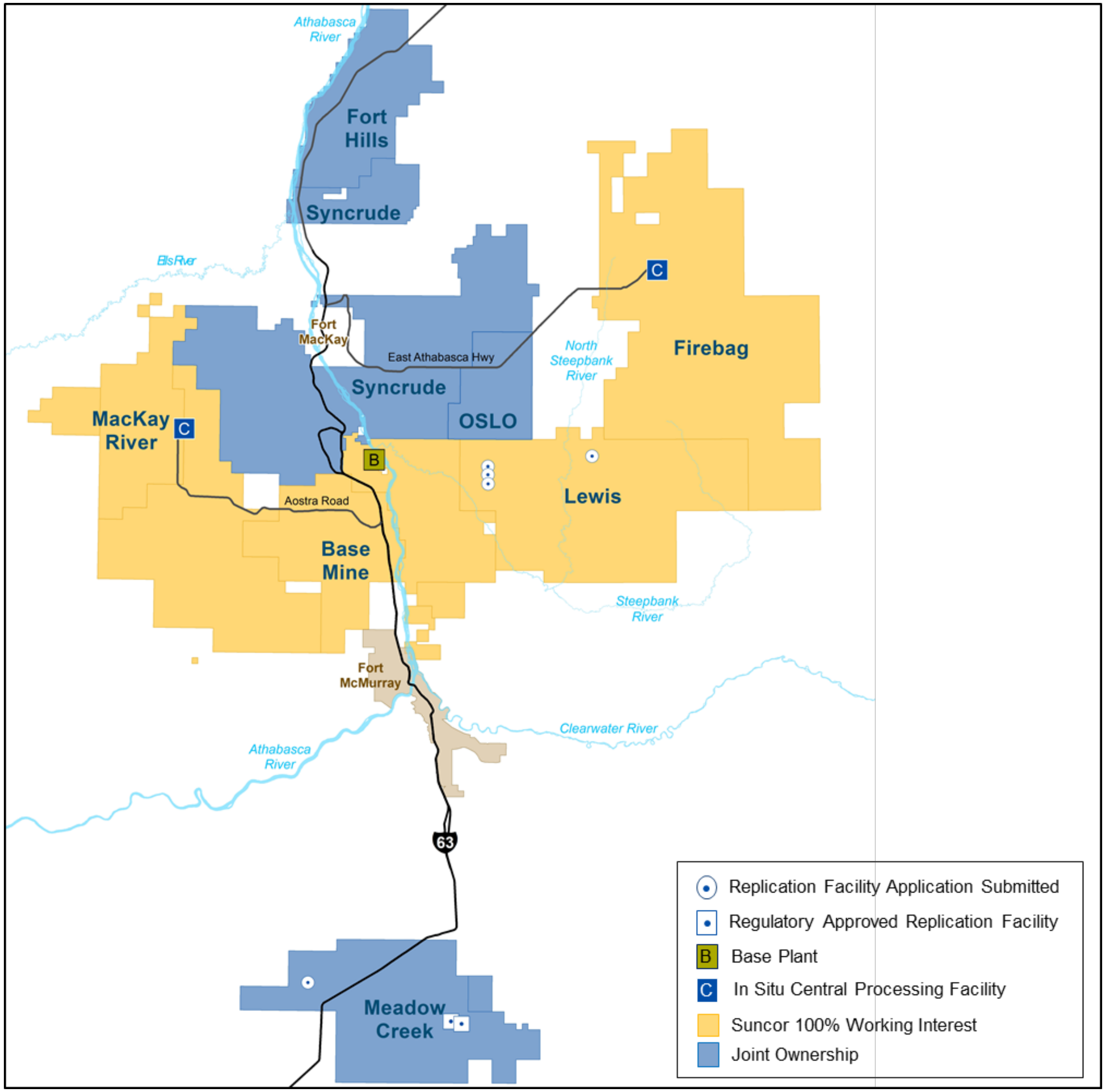
Our investments in renewable wind energy and biofuels are a key part of Suncor's climate change action plan.

A staged approach to increasing crude oil production capacity allows Suncor to better manage capital costs and incorporate new ideas and new technologies into our facilities.

Suncor takes an active role in connecting supply to consumer demand with a diverse portfolio of products, downstream assets and markets.



Suncor has High Quality Leases in Close Proximity



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AER Directive 054
2018 Performance Presentation

Section 3.1.1 – Subsurface Issues Related to Resource Evaluation and Recovery

Table of Contents

Background

3.1.1.1

MacKay River Project Overview

- Company's first operated steam-assisted gravity drainage (SAGD) facility - located 60 km NW of Fort McMurray
- Current Approved Bitumen Production Rate 11,600 m^3/d (73 kbpd)
- Adjacent to Suncor Dover (UTF / AOSTRA) Project
- Horizontal production wells are placed in the McMurray Formation at a depth of 98
  - 145m from surface
- No extensive underlying water or gas over bitumen issues in current development areas
- Initial development had 25 well pairs with first steam in September 2002 and first production in November 2002 (Phase 1)
- 112 well pairs have been subsequently added

Producing Well Pairs	**110**
Non-Producing Well Pairs	**25**
Abandoned/Planned for Abandonment Well Pairs	**2**
Total Well Pairs	**137**

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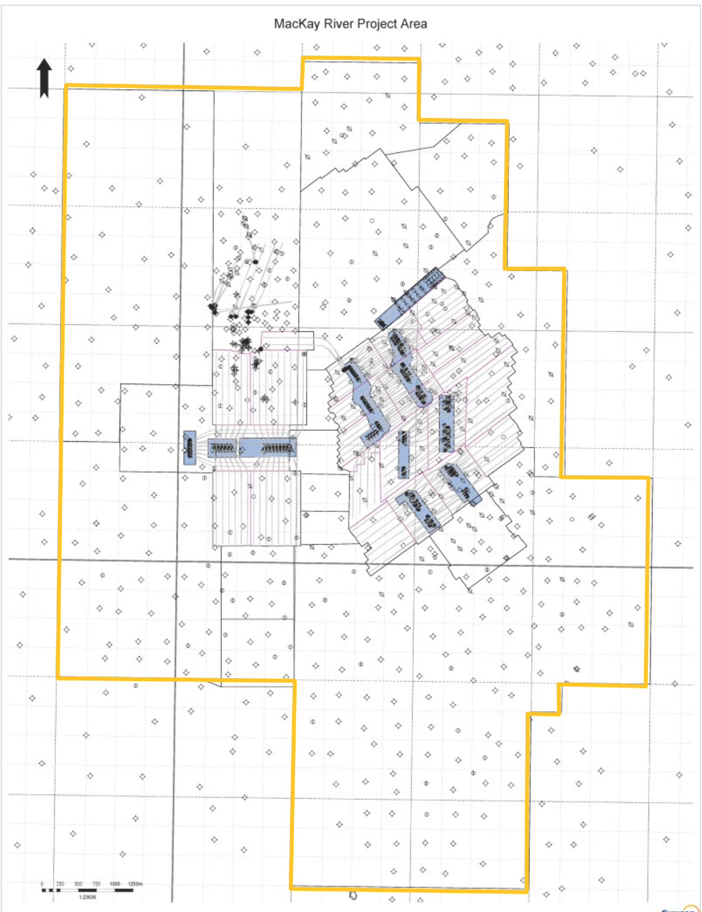
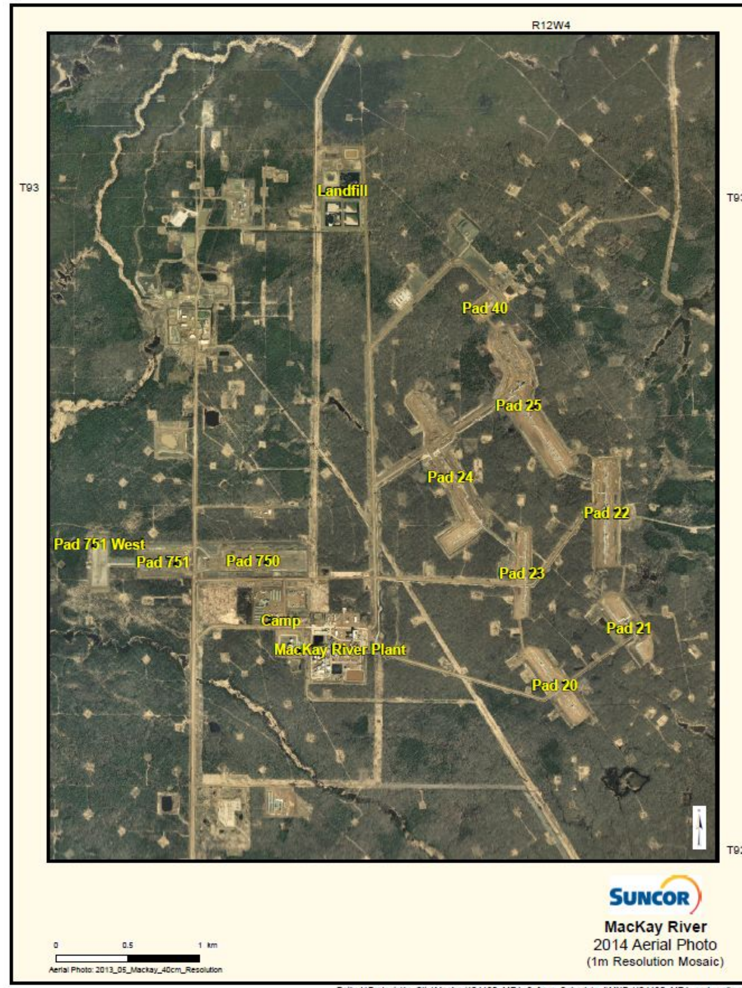
Project Area and Project Site

- Current Project Area (PA) approximately 24 ½ sections





Scheme Approval Amendments

- **Amendment 8668A**
  - Changed annual average volume to 33,000 bpd (5,250 m^3/d)
- **Amendment 8668B**
  - Increase to project area
- **Amendment 8668C**
  - Additional project area
  - Approval to inject non-condensable gas
- **Amendment 8668D**
  - Additions to project area
  - Increase to annual average volume to 72,964 bpd (11,600 m^3/d)
- **Amendment 8668E**
  - Approval to drill four well pairs
- **Amendment 8668F**
  - Approval to change approval holder from Petro-Canada to Suncor
- **Amendment 8668G**
  - Approval to undertake amendments & modifications to CPF systems
  - Approval tie-in 6 well pairs to well testing facilities
- **Amendment 8668H**
  - Approval to conduct non-condensable gas injection test on Pad 21 wells
- **Amendment 8668I**
  - Approval to conduct non-condensable gas injection at the Section 16 Test Project
- **Amendment 8668J**
  - Approval to transfer portions of the Dover project area into the MacKay River project area
- **Amendment 8668K**
  - Approval to tie-in 16 well pairs to well testing facilities
- **Amendment 8668L**
  - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21
- **Amendment 8668M**
  - Approval to inject chemical into Pad 22 wells
- **Amendment 8668N**
  - Approval to abandon 3 wells and suspend 1 well on Pad 20
- **Amendment 8668O**
  - Approval to change Phase 5F well trajectories
- **Amendment 8668P**
  - Approval to develop Pads 750/751/28 and add 2 sections to project area
- **Amendment 8668Q**
  - Approval to conduct a pilot of water treatment technologies
- **Amendment 8668R**
  - Approval to abandon well G1I
- **Amendment 8668S**
  - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)

Scheme Approval Amendments

- **Amendment 8668T**
  - Pad 819 Approval
- **Amendment 8668U**
  - Maximum Operating Pressure Approval
- **Amendment 8668V**
  - NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- **Amendment 8668W**
  - MR CPF Expansion Project and Directive 081 Waiver Approval
- **Amendment 8668X**
  - Administrative reissue approval
- **Amendment 8668Y**
  - WHIP for Phases 5B2, 5D and 5F Patterns approval
- **Amendment 8668Z:**
  - Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21 Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014.
- **Amendment 8668AA:**
  - Phase 1 NCG design amendment approval issued December 19, 2014.
- **Amendment 8668BB:**
  - Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015.
- **Amendment 8668CC:**
  - Approval for E1P Sidetrack well issued January 27, 2015.
- **Amendment 8668DD:**
  - Approval for NN6P Sidetrack well issued February 3, 2015.
- **Amendment 8668EE:**
  - Approval for VX™ multiphase meter on Pad 824 issued February 19, 2015.
- **Amendment 8668FF:**
  - Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015.
- **Amendment 8668GG:**
  - Approval to conduct CO2 Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015.
- **Amendment 8668HH:**
  - CO2 Co-Injection amendment to change to OO8 well pair on Pad 24 issued.
- **Amendment 8668II:**
  - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015.
- **Amendment 8668JJ:**
  - Approval for NCG Test at OO7I issued July 29, 2015.
- **Amendment 8668KK:**
  - Approval for an alternate MOP Strategy Trial.
- **Amendment 8668LL:**
  - Approval for C2IPB Sidetrack Well.
- **Amendment 8668MM:**
  - Approval for Pad 750 Thermal Compatibility Assessment.

Scheme Approval Amendments

- **Amendment 8668NN:**
  - Approval to increase MWHIP for all operating wells.
- **Amendment 8668OO:**
  - Approval to alter DA, DB, DC and DF Pattern MWHIPS;
- **Approval to adjust CO2 co-injection rate;**
  - Approval to extend chemical co-injection test at the D pattern wells on Pad 21.
- **Amendment 8668PP:**
  - Approval for abandonment of A3I.
- **Amendment 8668QQ:**
  - Approval to change Clause 32.
- **Amendment 8668RR**:
  - CO2 Extension
- **Amendment 8668SS:**
  - Phase 2 and 3 NCG Injection
- **Amendment 8668TT:**
  - Temporary Increase to BH MOP for Unloading
- **Amendment 8668UU:**
  - Subsurface Heating Pilot
- **Amendment 8668VV**:
  - MOP Increase QQ2 to QQ16
- **Amendment 8668WW:**
  - MWHIP Increase

Amendments Made in Reporting Year

- **Amendment 8668VV:**
  - MOP Increased QQ2 to QQ16
- **Amendment 8668WW:**
  - Increased MWHIP

Geoscience / Seismic

3.1.1.2, 3.1.1.6

Oil Sands Facies and Gross Bitumen Pay

Facies:
Defined by visual mud index (VMI)

Cutoffs:
F1 (Sandstone) = 0-5% VMI
F2 (Sandy IHS*) = 5-15% VMI
F3 (IHS*) = 15-30% VMI
F4 (Muddy IHS*) = 30-70% VMI
F5 (Mudstone) = 70-100% VMI
F10 (Breccia) = variable

* IHS = inclined, interbedded, sand and shale

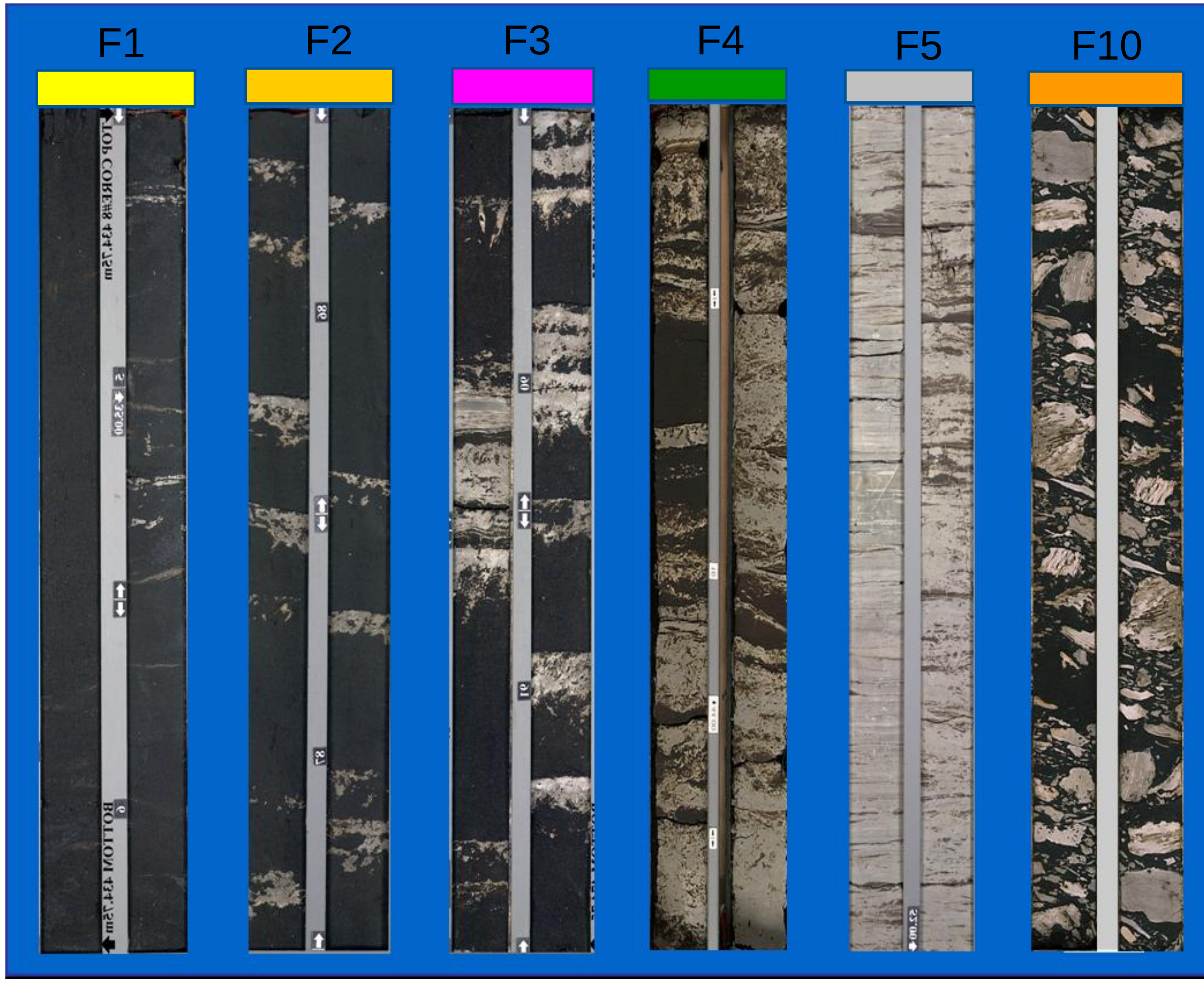
Pay:
Includes Facies F1, F2, and F10
Can include F3-F5, if < 2m thick

Weight percent bitumen > 6%

Generally > 30% Porosity
- PA averages 31.1% in clean sands

Permeability ~ 1 to 5 Darcy's

> 10m for OBIP volumetric



Pattern OBIP Calculation

Gross Rock Volume (GRV) = total rock volume derived from Continuous Reservoir map

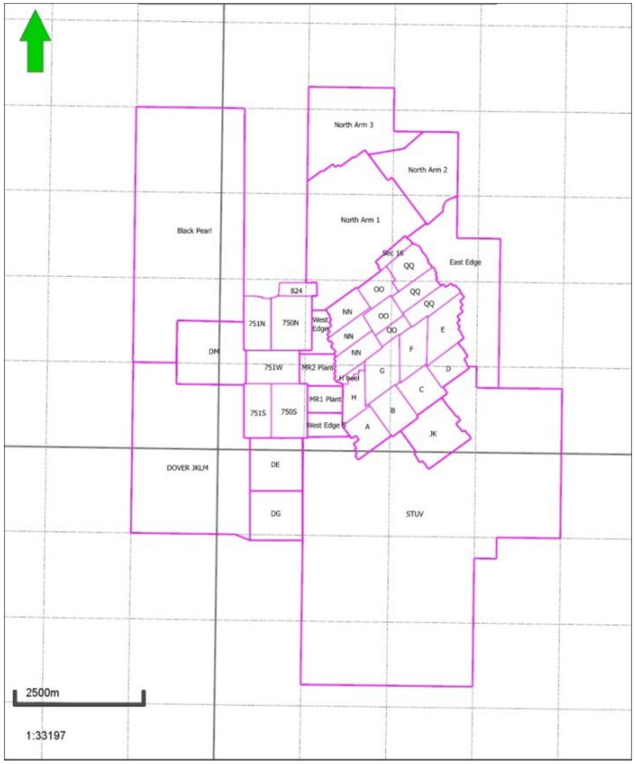
Original Bitumen in Place = product of the GRV multiplied by the average Porosity, and the average Oil Saturation over entire reservoir interval

OBIP=GRV * So * Por

New reservoir mapping includes non reservoir facies in calculation which are rectified via averaging of porosity and saturation values over the entire interval via petrophysics. Allows for consistency of calculation applied to all areas

Reservoir Properties and Base Case OBIP 2018

Average Reservoir Properties				Volumes	
Pattern	**So**	**Phi**	**h (m)**	**Area (m2)**	**OBIP(e^3m^3)**
A	71%	33.5%	21.7	466 561	2,443
B	82%	34.3%	27.0	476 917	3,616
C	82%	34.0%	33.0	475 673	4,398
D	82%	33.9%	27.1	362 305	2,742
E	77%	33.1%	27.1	572 621	4,410
F	83%	34.0%	29.6	475 138	3,961
G	78%	33.7%	28.0	584 365	4,328
H	79%	33.7%	21.9	336 301	1,940
NN (Phase 4/5)	79%	34.0%	26.0	1 061 057	7,347
OO (Phase 4/5)	76%	33.8%	27.0	791 409	5,453
QQ (Phase 4/5)	74%	33.8%	25.1	1 153 861	7,018
Pad 824	81%	32.8%	19.0	182 277	916
750N	79%	32.9%	22.8	795 880	4,716
750S	73%	33.7%	18.2	711 080	3,203
Subtotal				8 445 445	56,490
Approval Area Total	**72%**	**33%**	**20.2**	**43 759 598**	**220,390**



Average Reservoir Depth = 109 m TVD, Pi = 400 kPa, Ti = 6-7 ^{0}C , K_{max} = 1.7-8.5 D, K_{min} = 1.1-6.5 D

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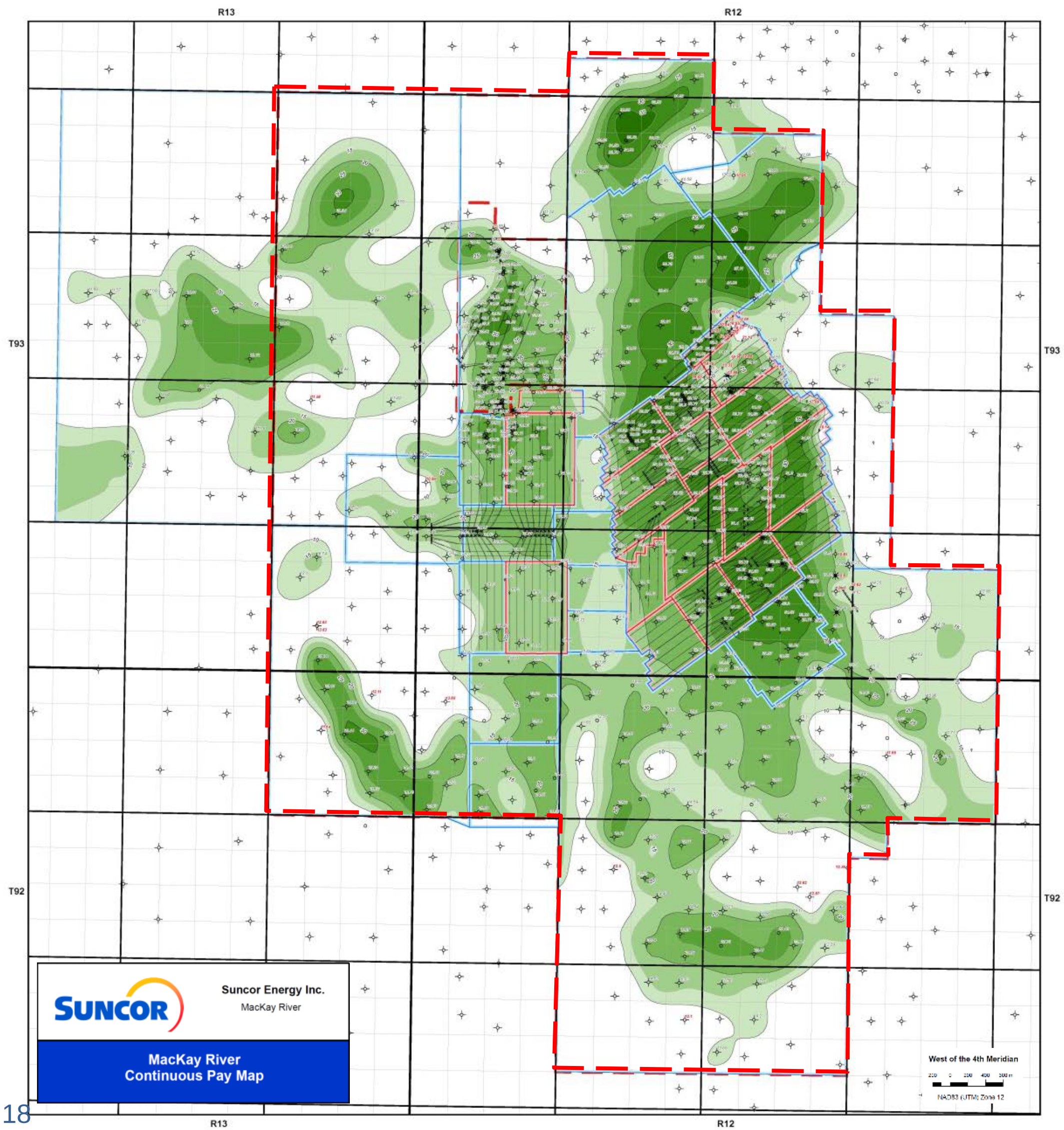
Bitumen Pay Isopach



2018 MacKay Bitumen Pay

Contour Interval = 5m

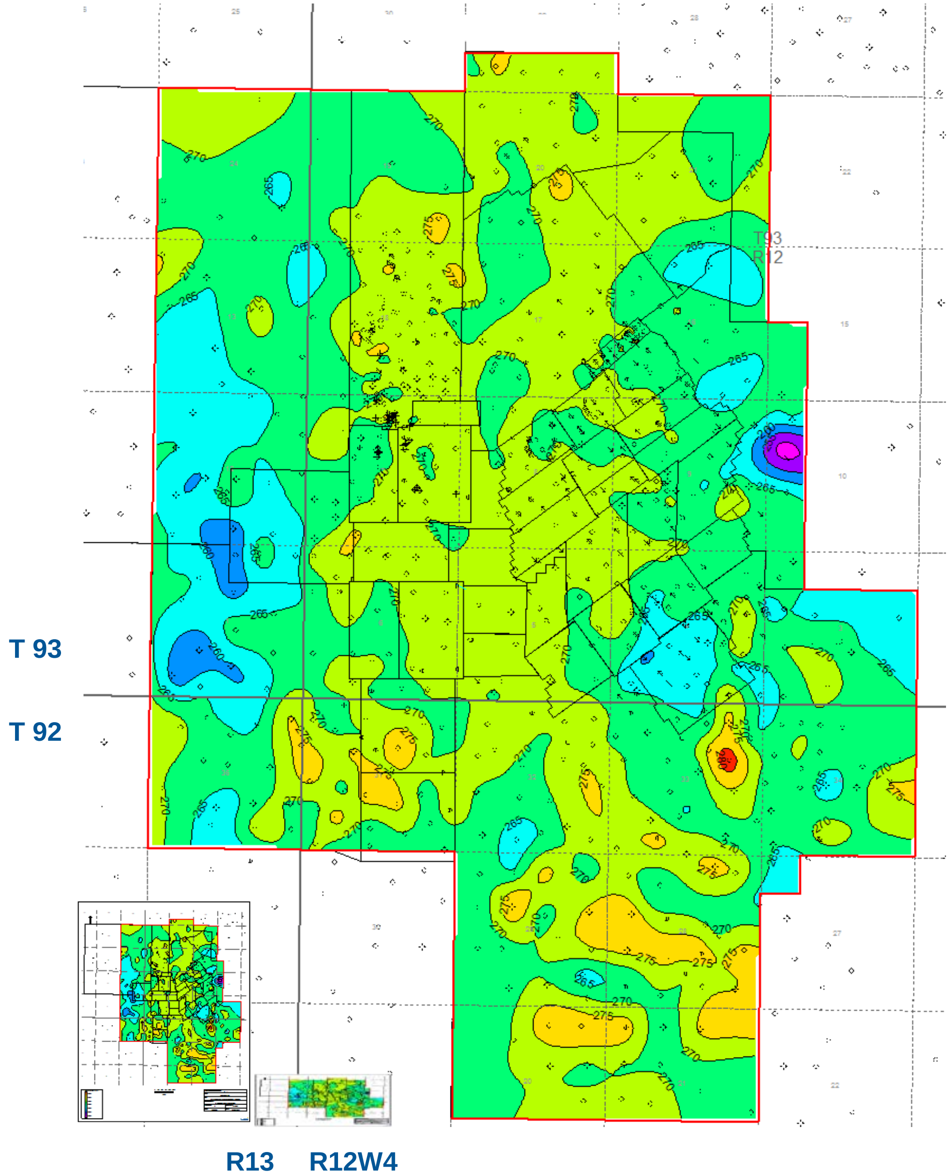
Legend

Continuous Pay Interval (5m)

- 10-15
- 15-20
- 20-25
- 25-30
- 30-35
- 35-40

- MacKay PA
- Reserves - Producing Area
- Reserve Area
- MacKay - Dover Hz Well Trajectories
- ***25.1*** Continuous Reservoir Thickness
- ***25.1*** Upper Stacked Continuous Reservoir Thickness

Base of Reservoir Structure Map



Legend

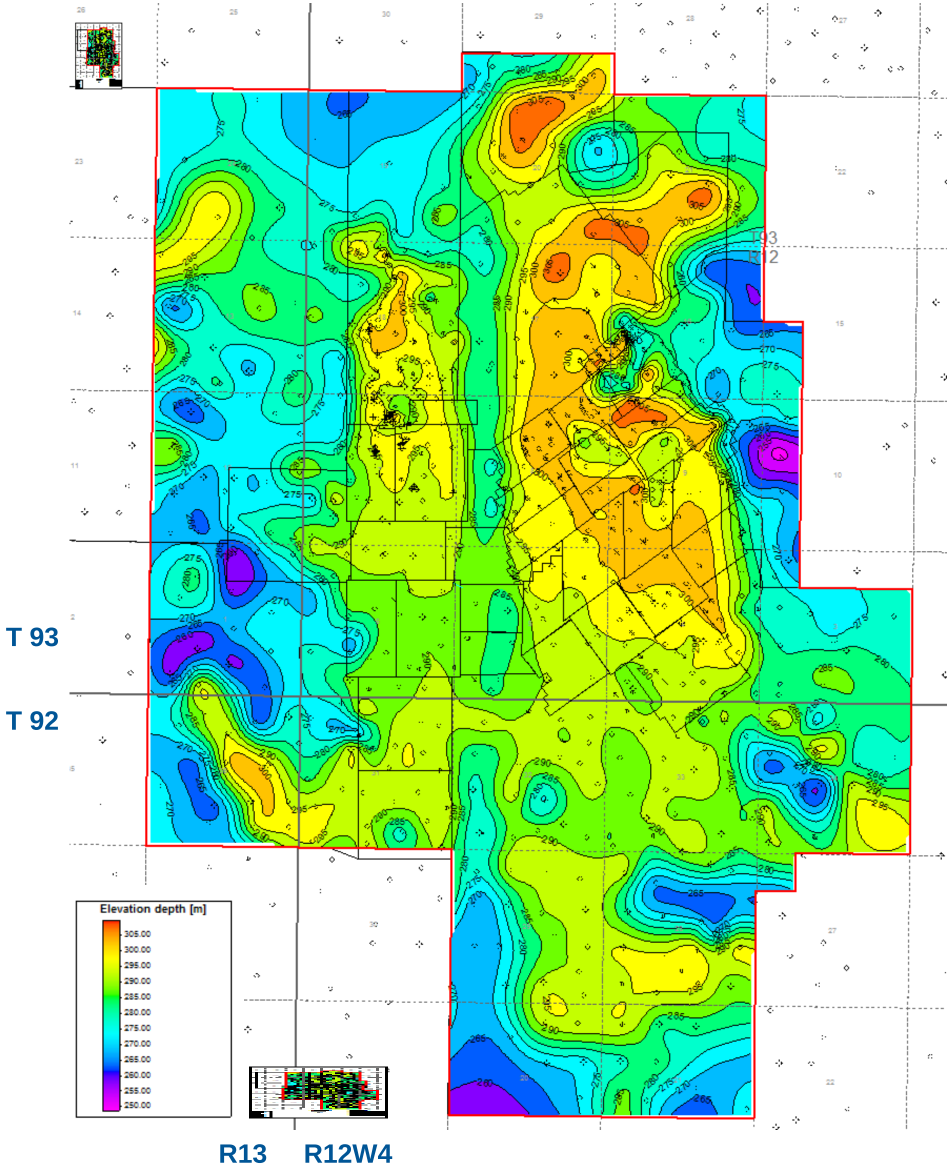
Approved PA Boundary

Contour Interval =5m

2018 MacKay Base of Reservoir

Contour Interval = 5m

Top of Reservoir Structure Map



Legend

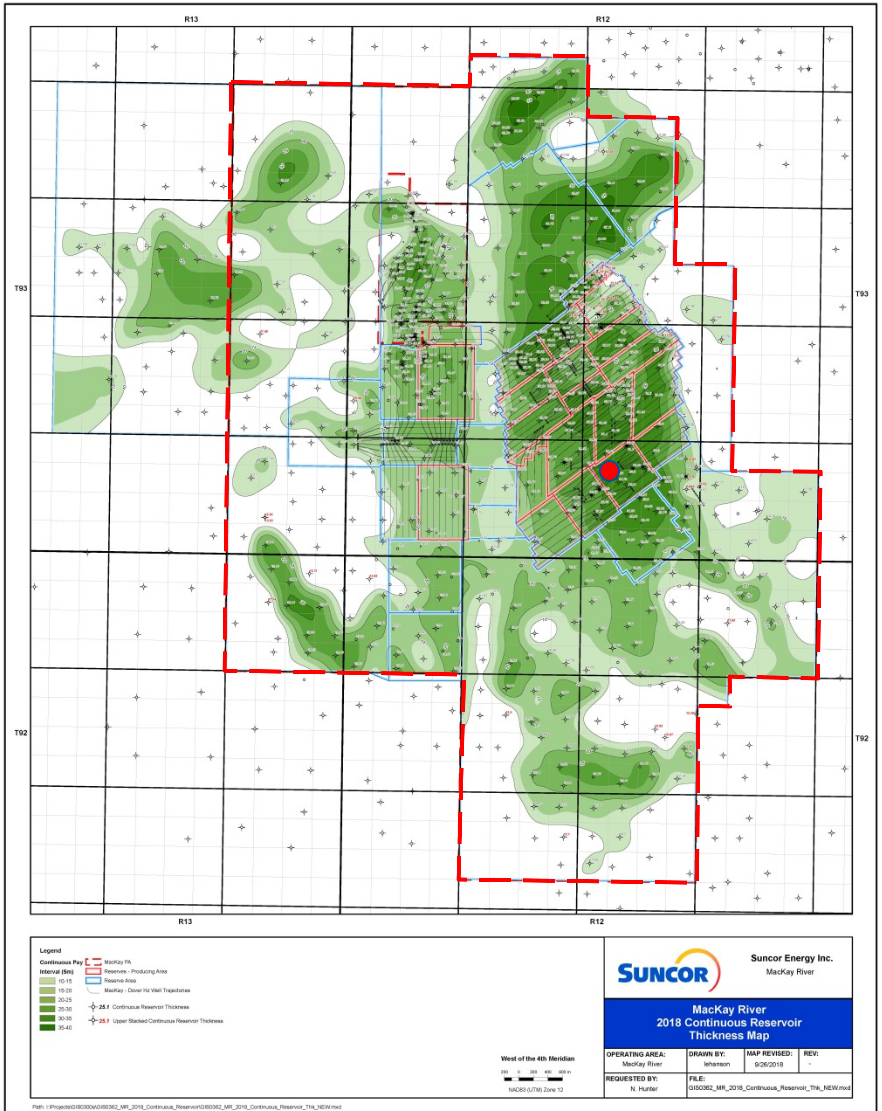
Approved PA Boundary

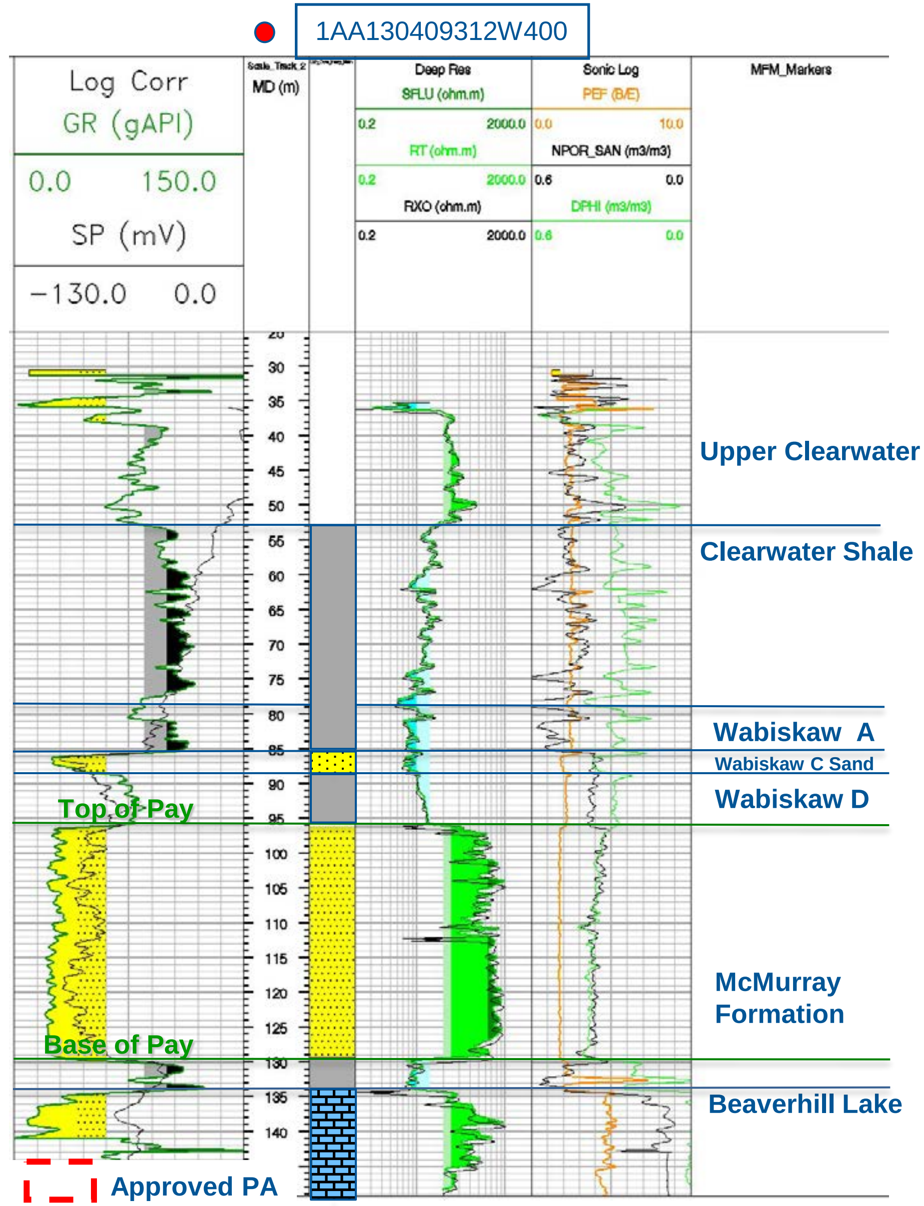
Contour Interval =5m

2018 MacKay Top of Reservoir

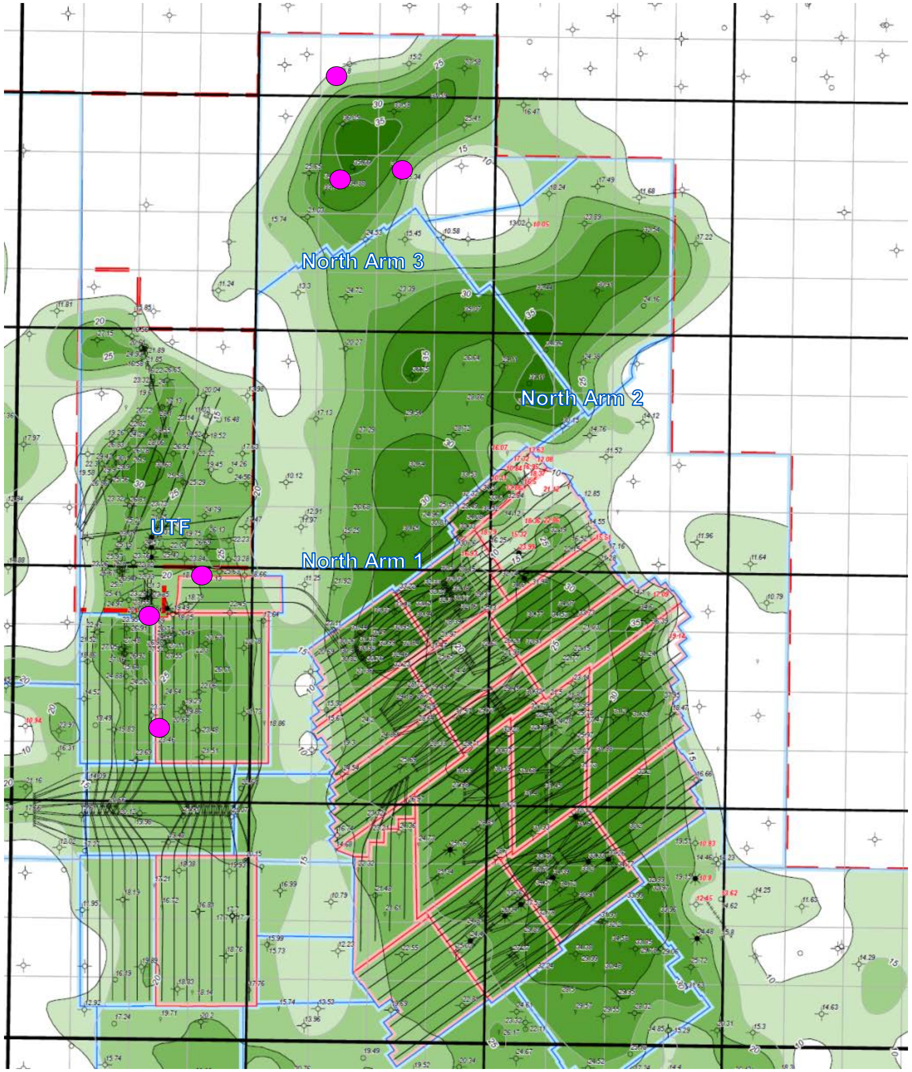
Contour Interval = 5m

MacKay River Stratigraphy





2017-18 Activities – Vertical Wells



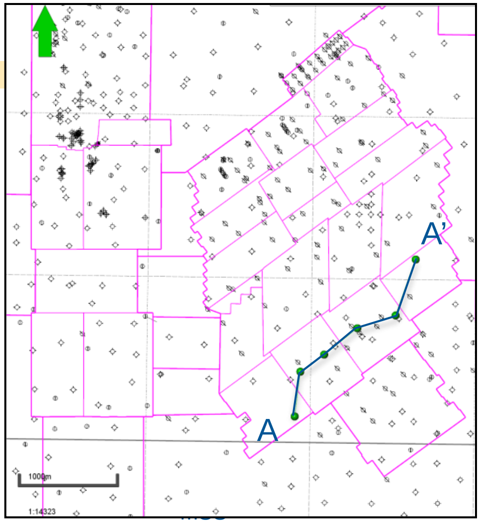
- 6 vertical observation wells drilled
- Core analyses / special testing
  - FMI

2018 MacKay Bitumen Pay
Contour Interval = 5m

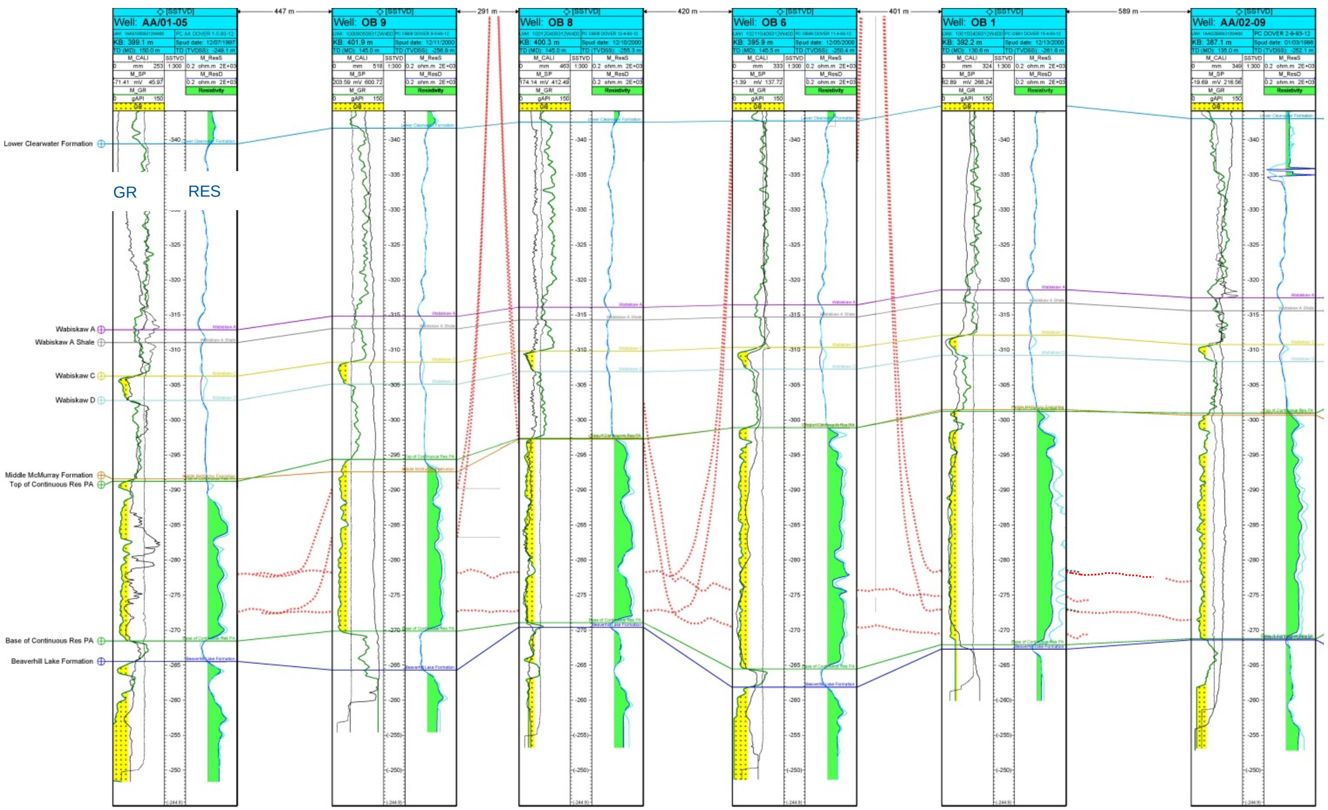
Legend

- **Vertical Delineation Wells**
- **Existing SAGD wells**

Phase 1

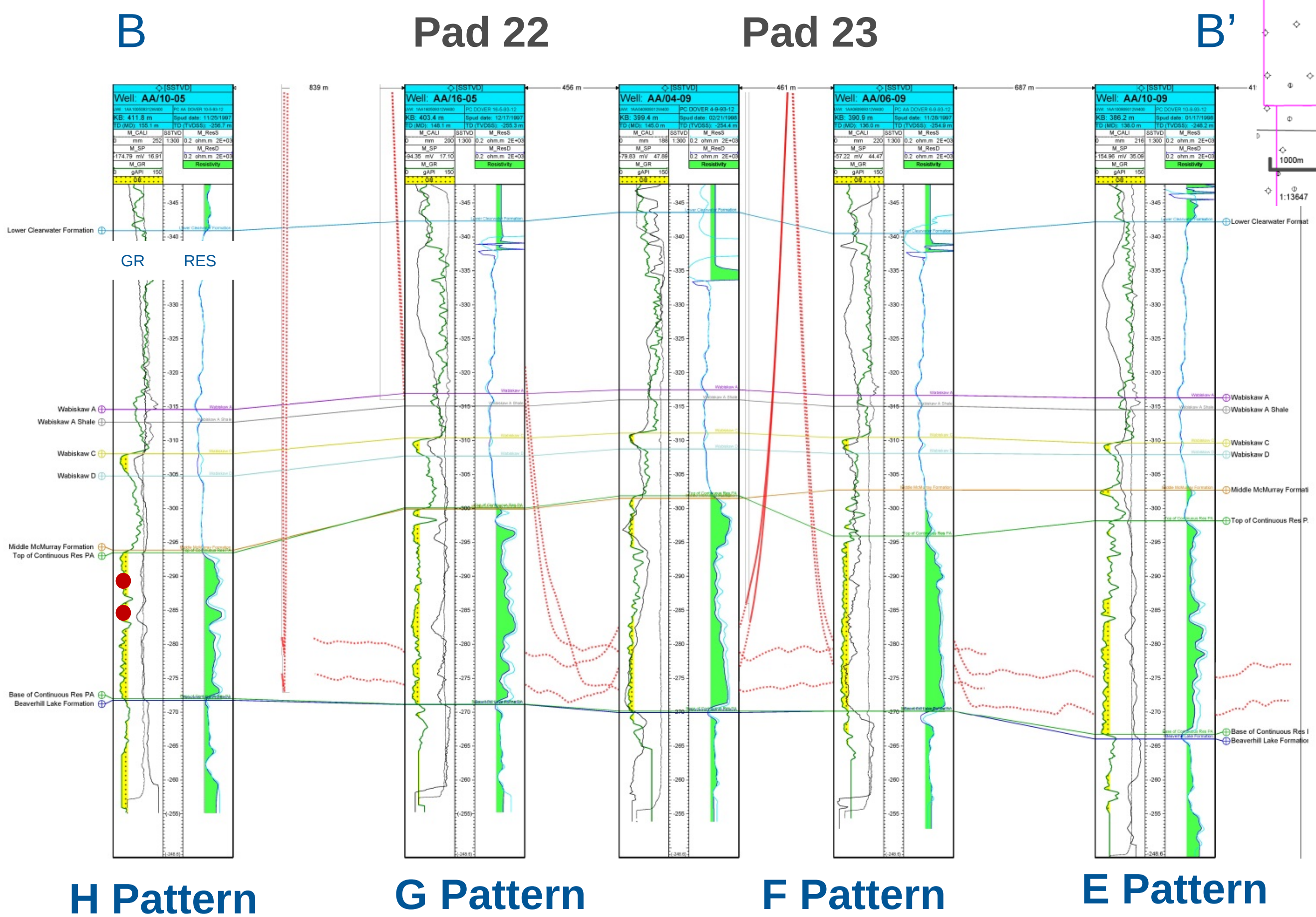


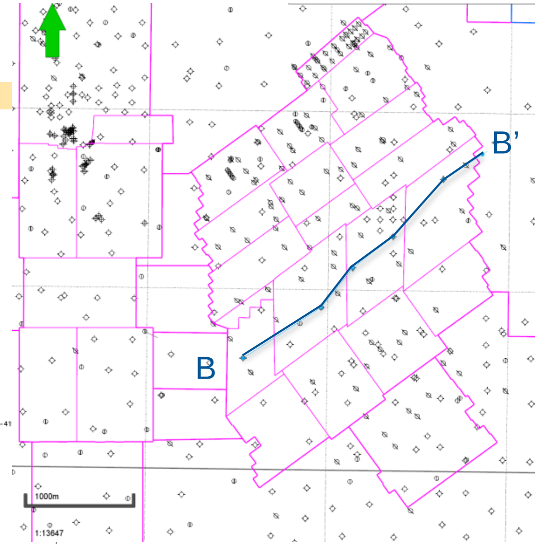
A Pad 20 Pad 21 A'



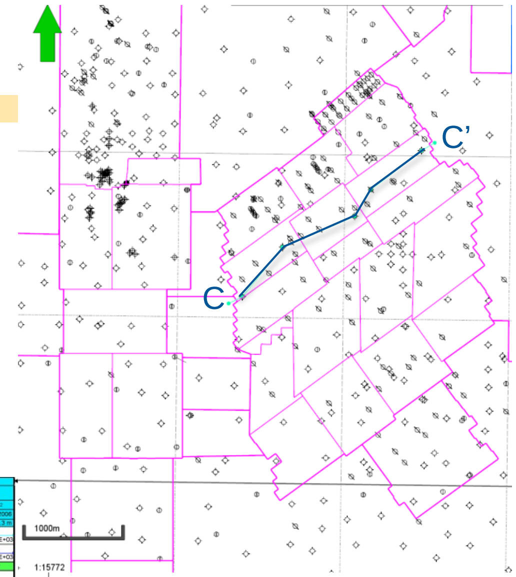
A Pattern B Pattern C Pattern D Pattern

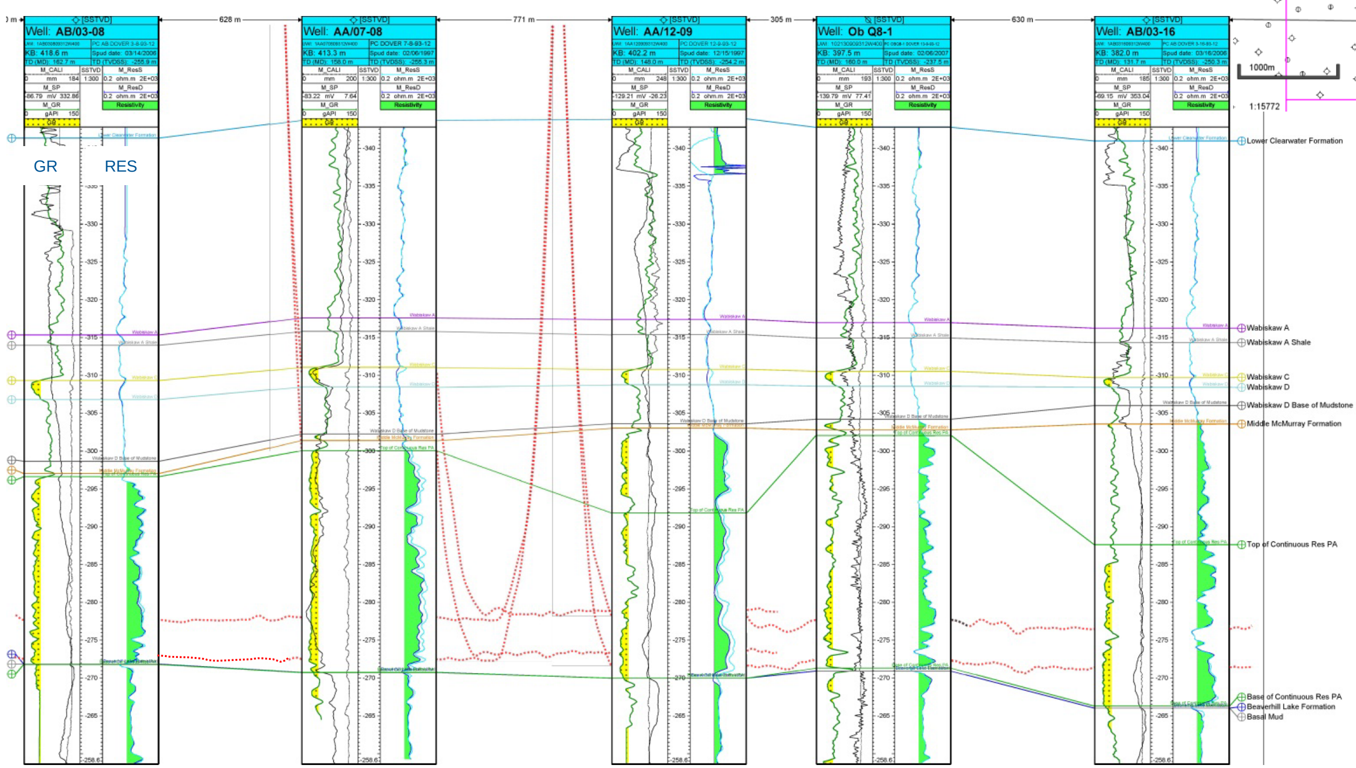
Phases 2, 3 and 4





Phase 5





NN Pattern OO Pattern QQ Pattern

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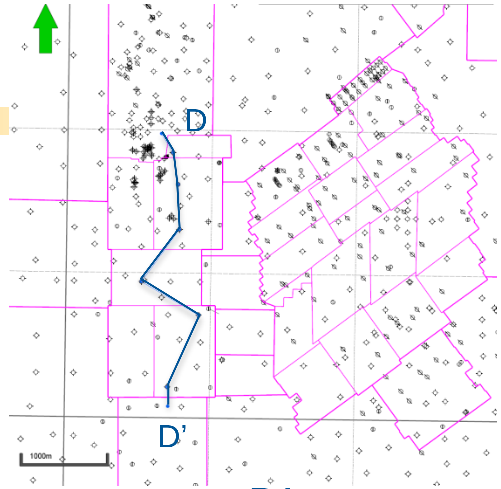
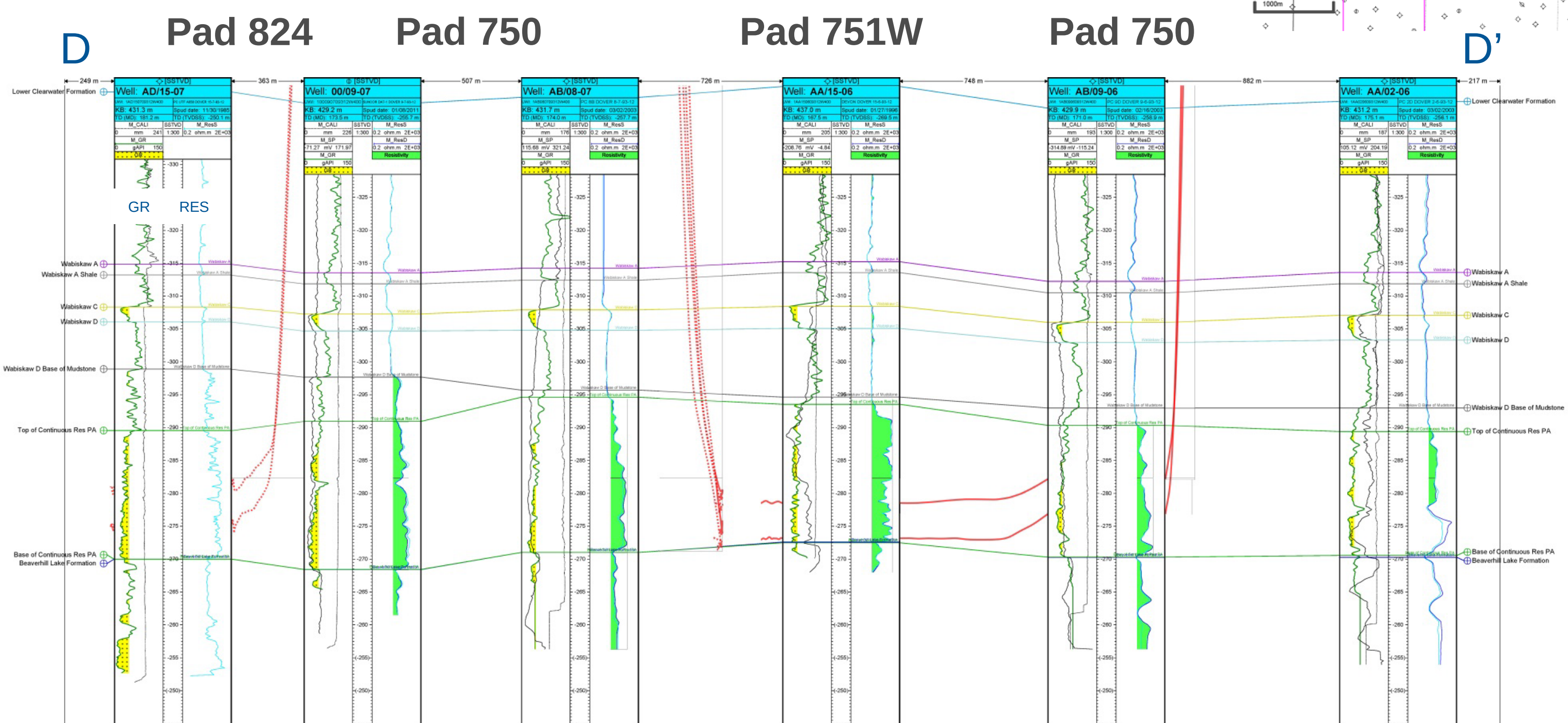
Pads 824 / 750 / 751





824 750N 751W 750S

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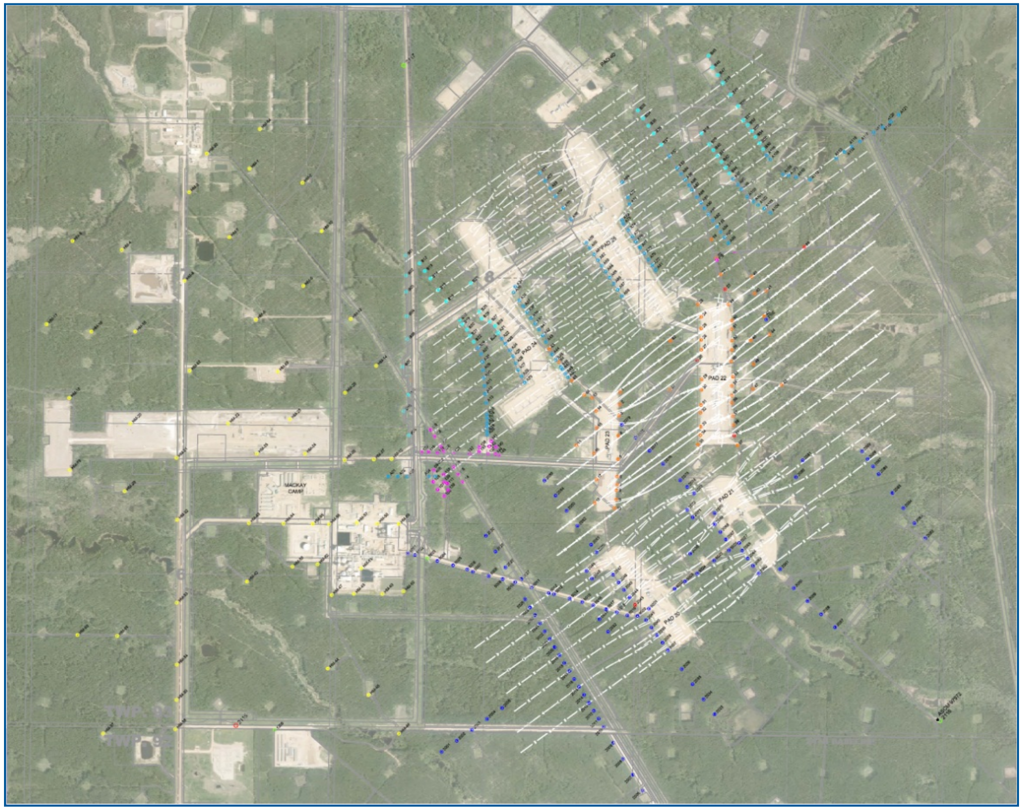
Steam Chamber Development: Surface Heave Monitoring

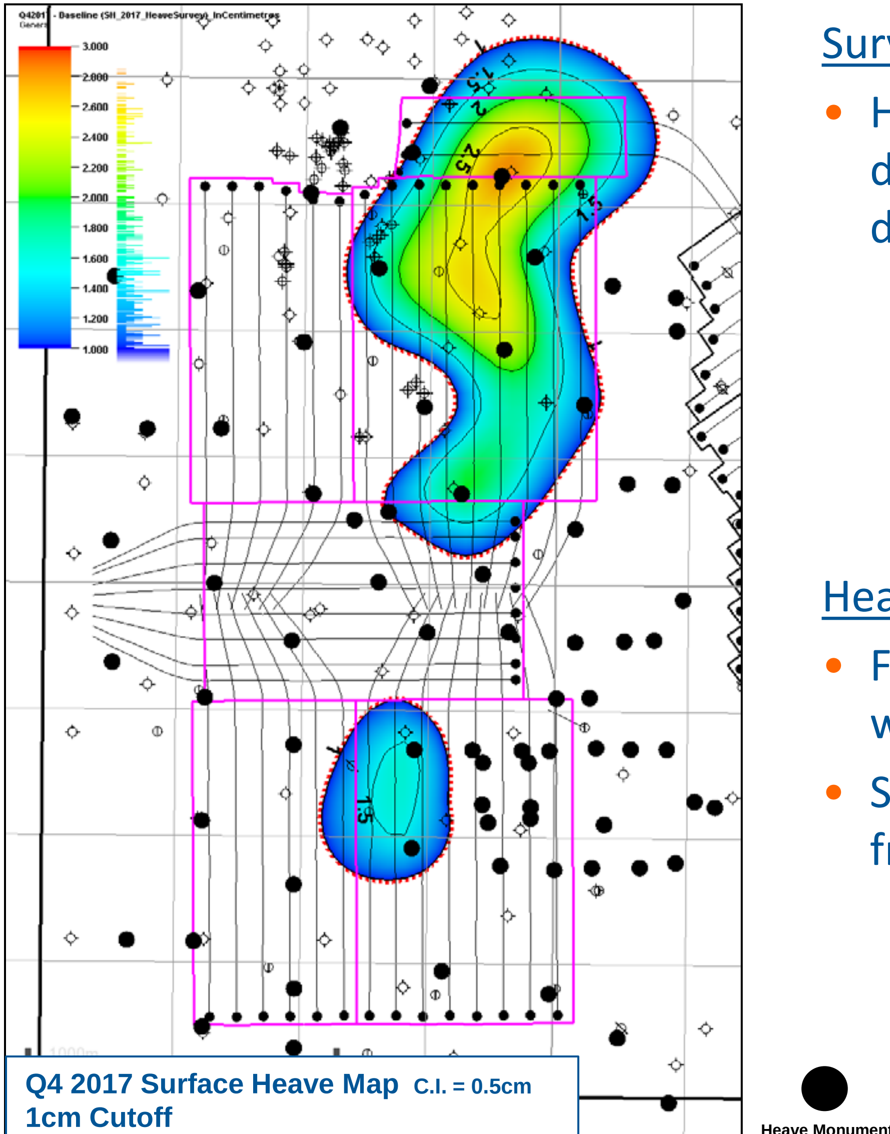


LEGEND

2013 HEAVE MONUMENT
2012 HEAVE MONUMENT
2011 HEAVE MONUMENT
2009 HEAVE MONUMENT
2007 HEAVE MONUMENT
2002 HEAVE MONUMENT
DESTROYED MONUMENT
CONTROL

- 418 active monuments exist over MacKay River for heave measurement and monitoring
- No new monuments installed since August 2016
- Survey History:
  - 1st: Fall 2002
  - 2nd: Dec 2006
  - 3rd: Fall/Winter 2007/08
  - 4th: Nov 2008
  - 5th: Jan/Feb 2010
  - 6th: Nov 2010
  - 7th: Dec 2011
  - 8th: Dec 2012
  - 9th: Oct 2013
  - 10th: Oct 2014
  - 11th: Oct 2015
  - 12th: Oct 2016
  - 13th: Oct 2017

2D Surface Heave: Change from Baseline to October 2017



Q4 2017 Surface Heave Map C.I. = 0.5cm
1cm Cutoff

Uncertainty with manual heave monuments +/- 5mm

Survey strategy:

- Heave surveys are performed at different frequencies to align with SAGD development:
  - Q1 2016 baseline survey of 750 / 751 / 824
  - Q4 2017 heave survey for 750 / 751 / 824

Heave monitoring application:

- Field performance monitoring coupled with seismic
- Surface heave maps made independent from 4D seismic

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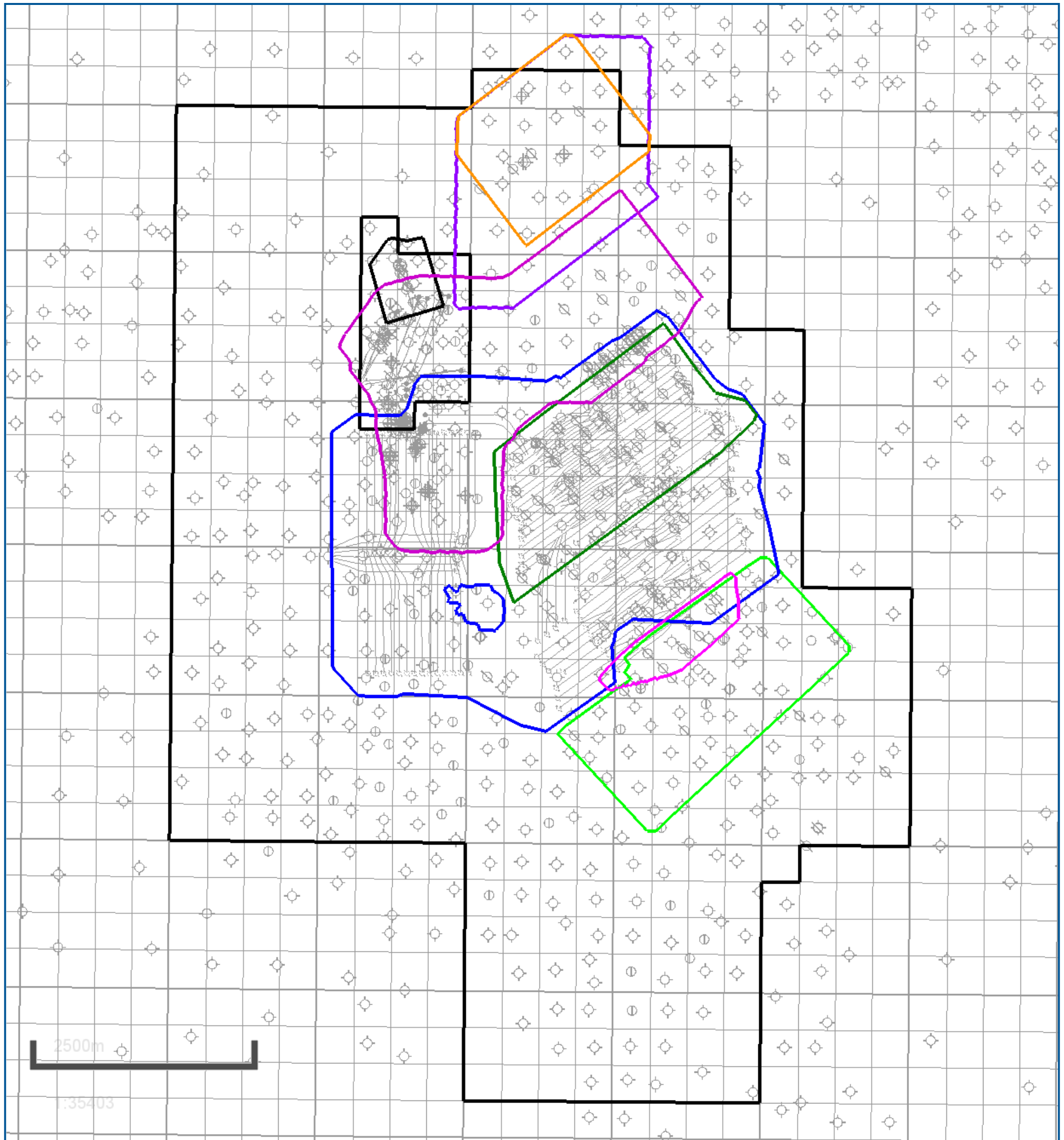
MacKay River – 3D / 4D Seismic Activity



2018 3D / 4D

2017 3D

2016 3D

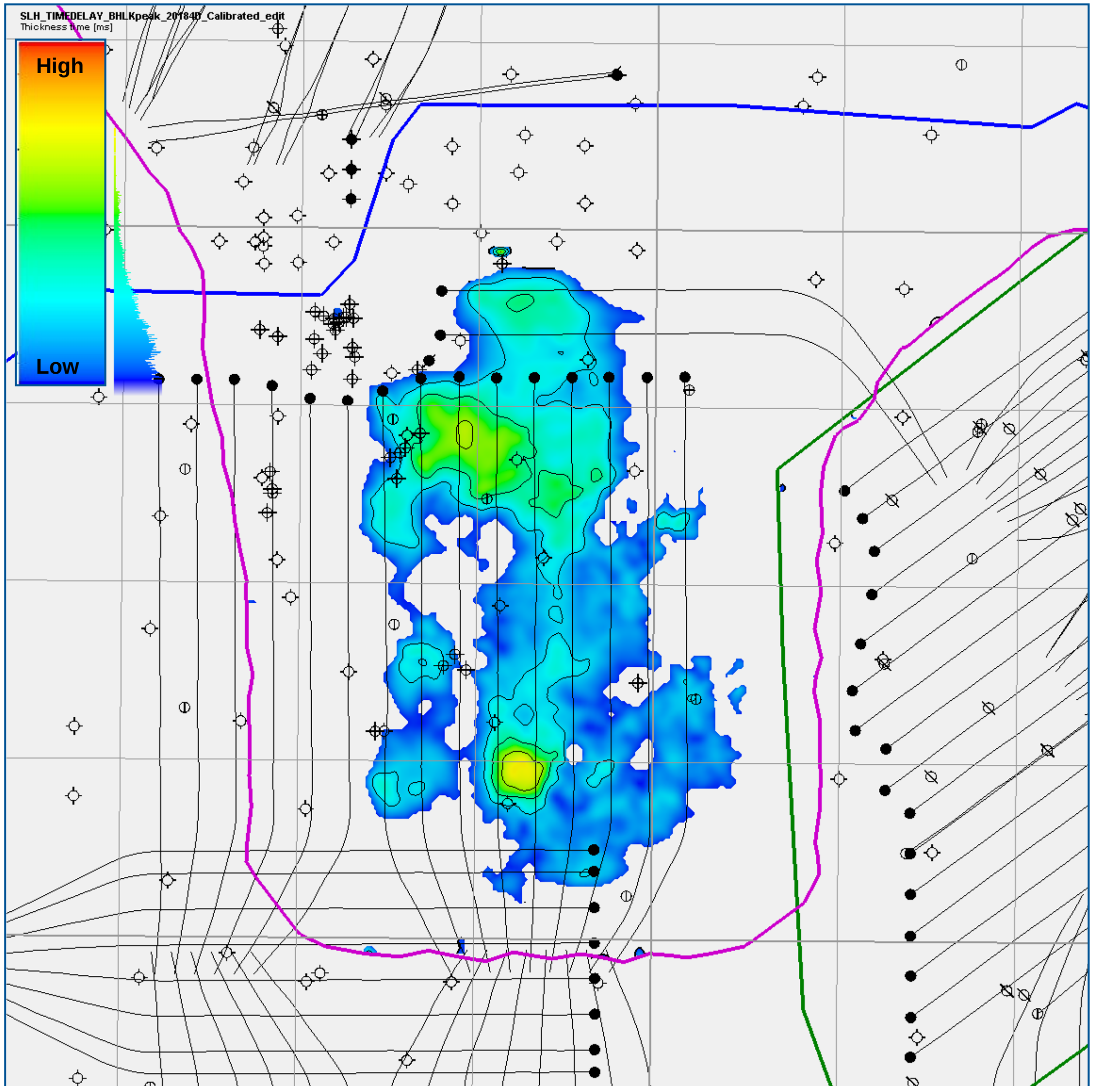
2016 4D

2014 4D

2013 3D / 4D

2011 3D / 4D

MacKay River – 2018 4D Time Delay



Time Delay on Beaverhill Lake Time Structure (ms)

Caprock Integrity

3.1.1.2 j,m

MacKay River Coupled Geomechanics/Reservoir Workflow

1 - Data Gathering
- SAGD well operations (Rate/Pressure)
- Ob well pressure (Piezometer)
- Ob well temperature (Thermocouple/Fiber)
- Surface heave (Monuments)
- Cores and borehole image log analysis
- Rock geo-mechanical properties (Lab tests)
- In situ stress (mini-frac tests)

2 – Data Interpretation

Reservoir Physics
- Well performance
- Pressure Leak-off
- Heat transfer

Geomechanics
- Stress state
- Rock behavior
  - Shear failure conditions
  - Tensile failure conditions
  - Permeability change
- Thermal expansion
- Reservoir level deformations

3 - Coupled Reservoir Geomechanics
- Update pressures and temperature
- Update stress state
- Recalibrate models using history match to field data
- Forecast/Design for safe development

4 - Learnings
- Sensitize key variables within uncertainty range
- Quantify geomechanical risks
- Verify and update MOP
- Recommend/Design further measurements / lab tests

Geomechanics analysis for safe optimal MacKay River operations

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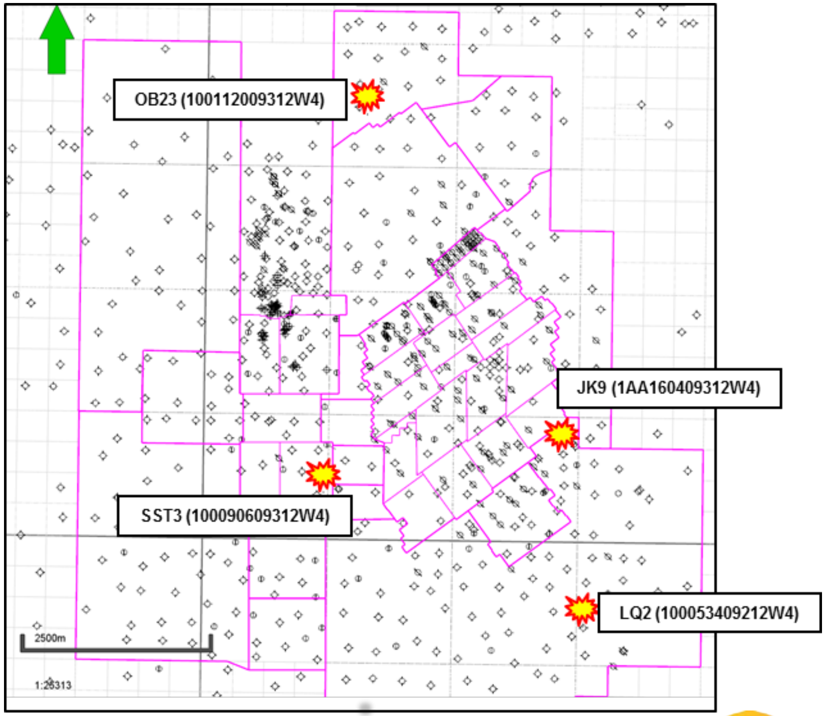
Geomechanics: Mini-frac Test

- No new mini-frac test in the reporting period
- Fracture gradient of the caprock within the operating area are at or above 21 kPag/m
- 2017 mini-frac data from OB23 well (in future development area) shows slightly lower fracture gradient, still consistent with the regional data set
- Subsequent geomechanical core test on OB23 by commercial lab indicate similar caprock strength to the existing MacKay River caprock SCAL data

Formation	OB23 (2017)	JK-9 (2014)	LQ2 (2011)	SST3 (2008)
CW	20.4	22.3	21.3	24.1
Wab A	19.5	21.1	21.2	
Wab D		22.1	22.6	24.3
McM	19.0		21.1	19.9

Unit of fracture gradients measured: kPag/m



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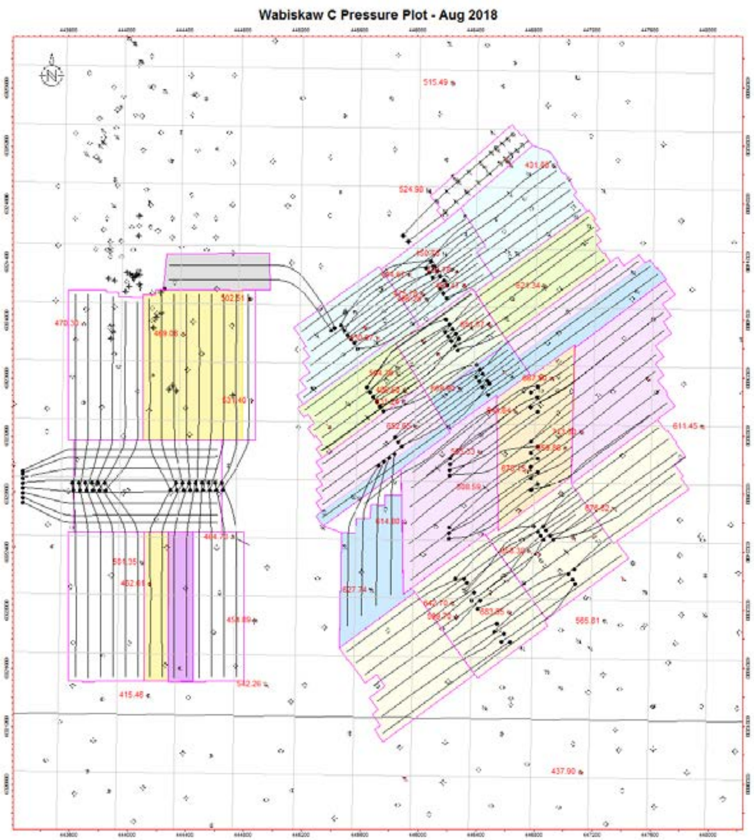
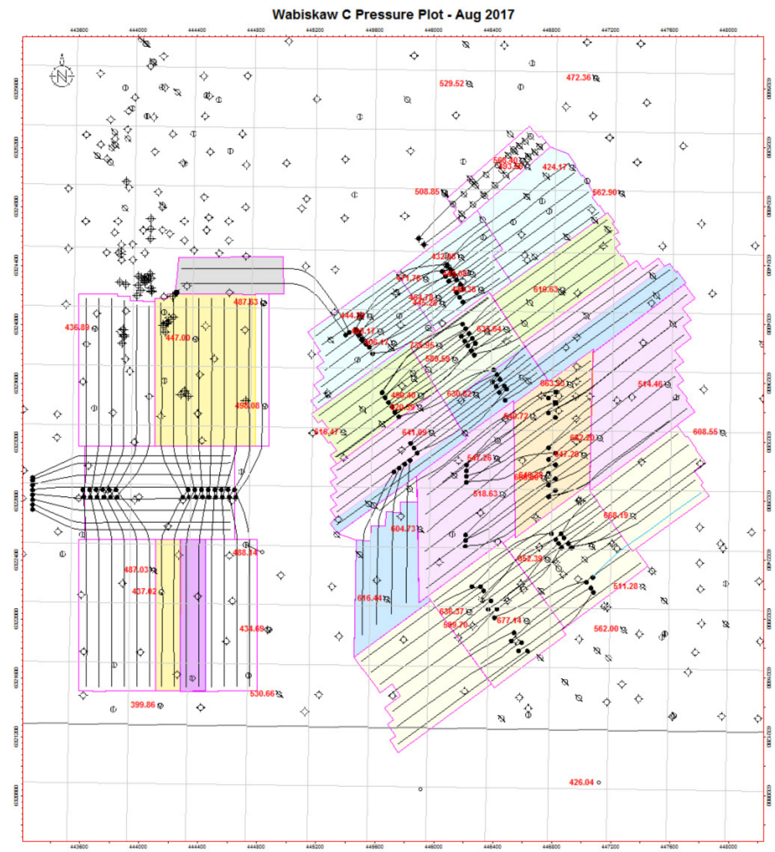
Monitoring: Wabiskaw C Pressure & Temperature



Datum = -313.6mSS



- Average pressure increase of ~10 kPa in original producing area; pressure increase of 23 kPa in Pad 750 area:
  - Pressures are below hydrostatic and well below fracture pressures
- 13 wells with elevated temperatures (>30°C) directly above mature SAGD operations:
  - 5 wells between 90°C and 143°C; 8 wells between 30°C and 90°C
  - Elevated temperatures are within the expected range

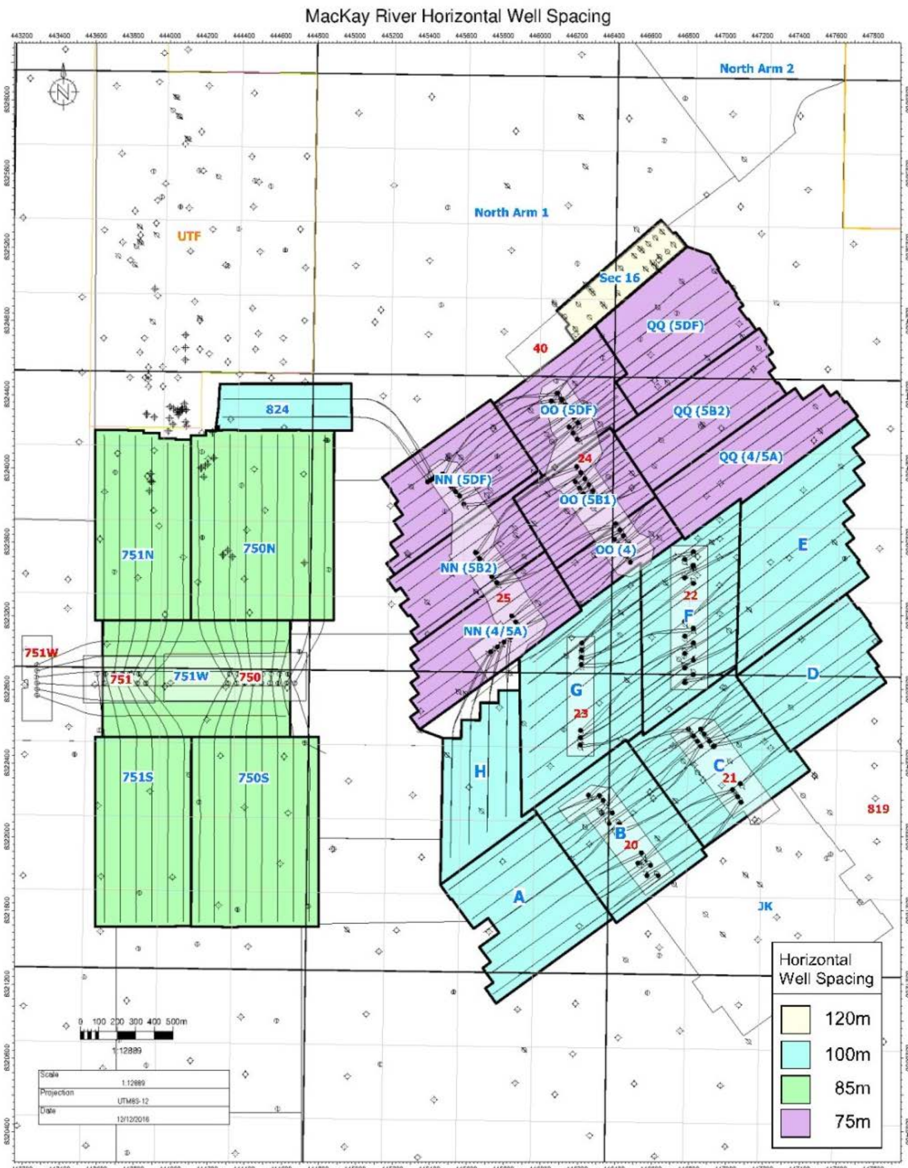
Geomechanics: Modeling

- Continued calibration of the model with an integrated dataset (SAGD performance data, pressure and temperature data acquired from the Wabisaw C and McMurray, and surface heave)
- Continued verification of the operation at the approved MOPs having no impact to MacKay River caprock integrity

Drilling and Completions

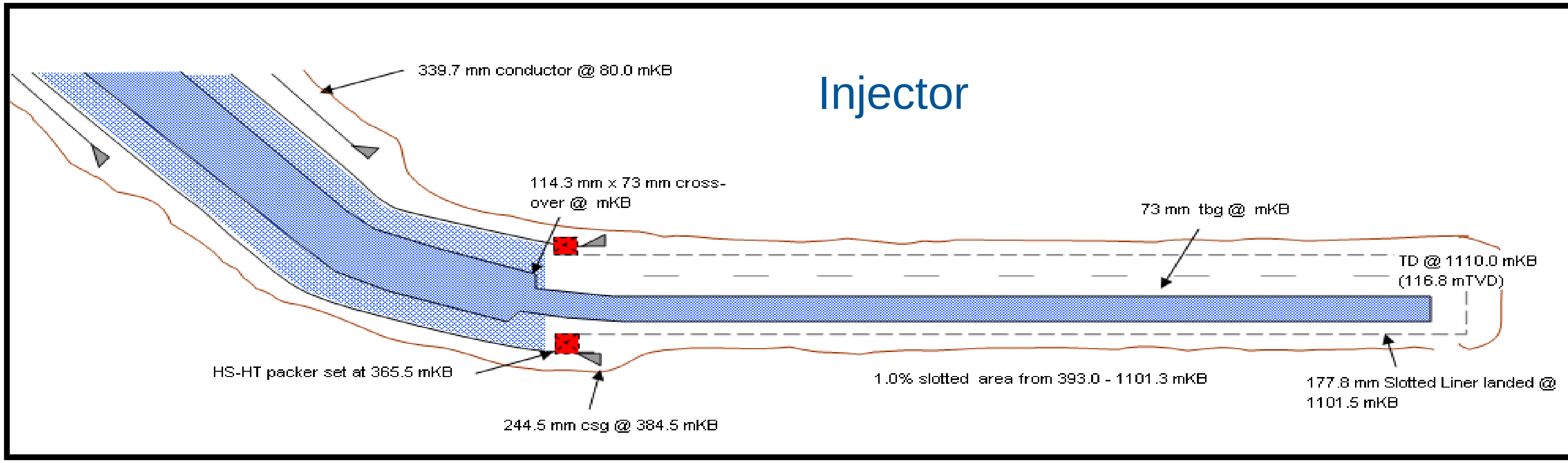
3.1.1.3

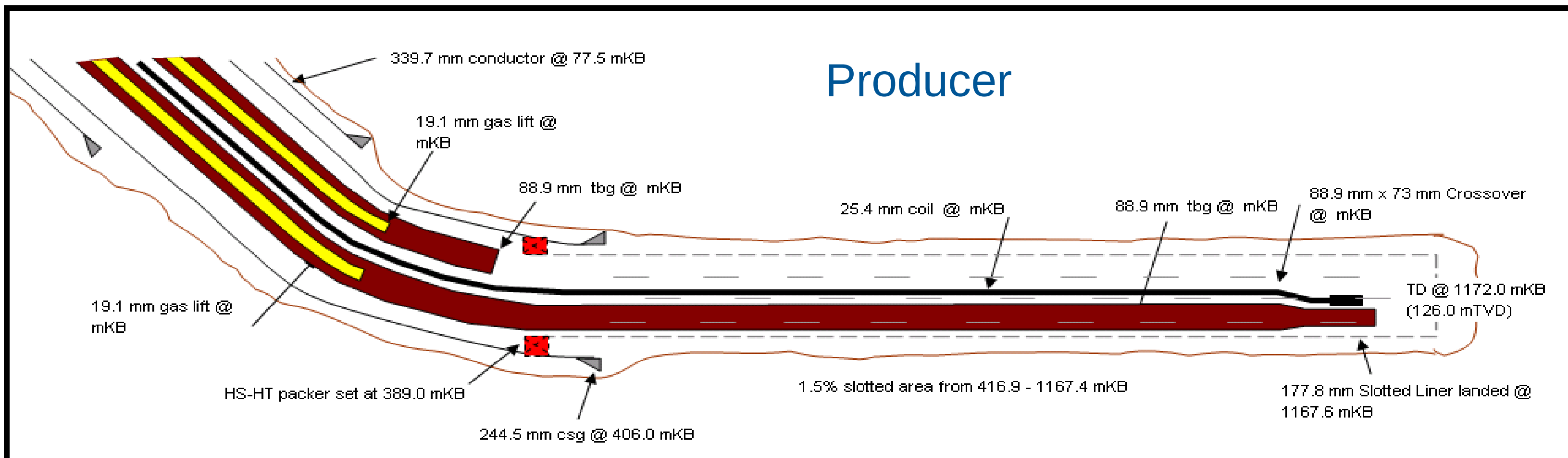
Mackay River Well Layout and Spacing Map



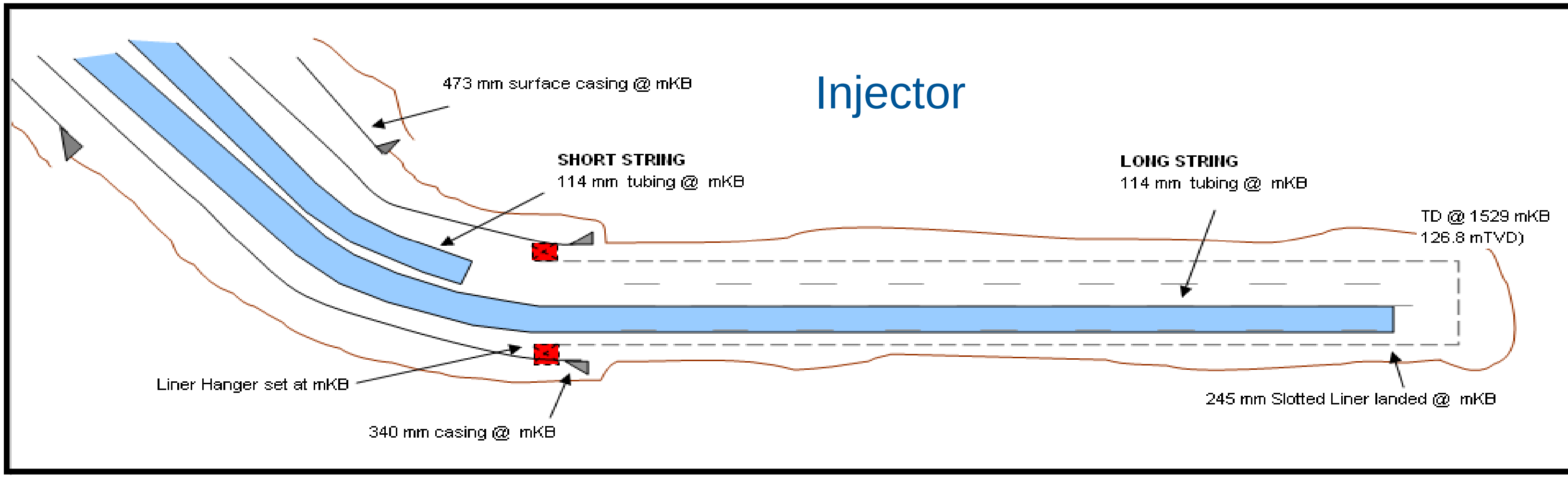
- 110 producing well pairs at MacKay River on 7 pads
- Optimal well spacing is evaluated for each new development

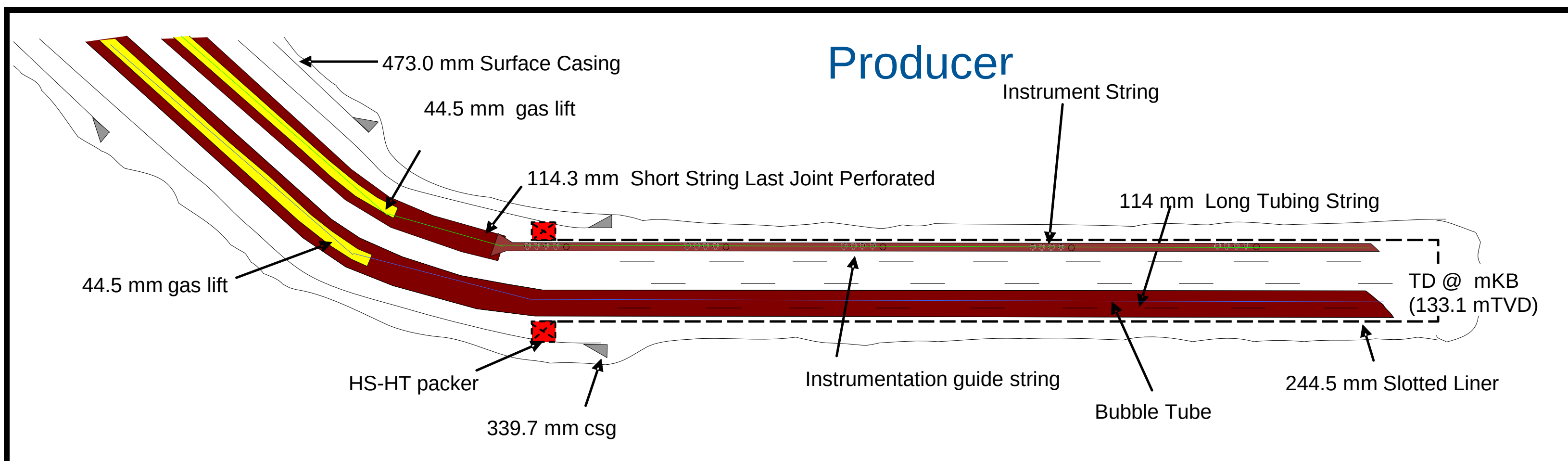
Typical Well Completions – Phase 1-4 Type



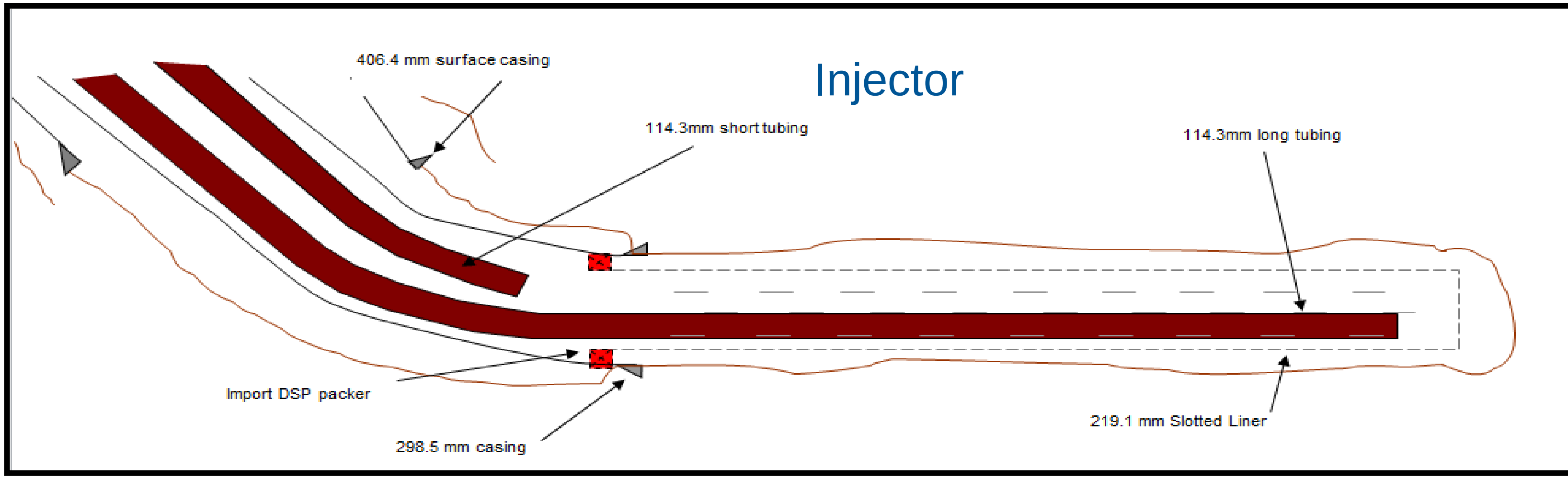


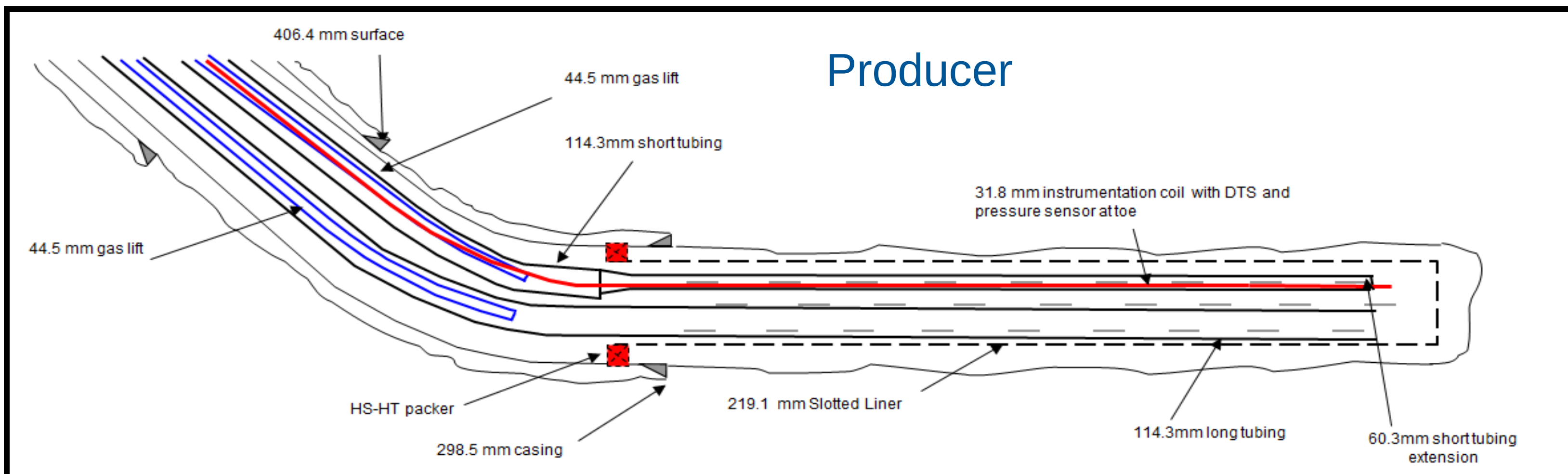
Typical Well Completions – Phase 5 Type



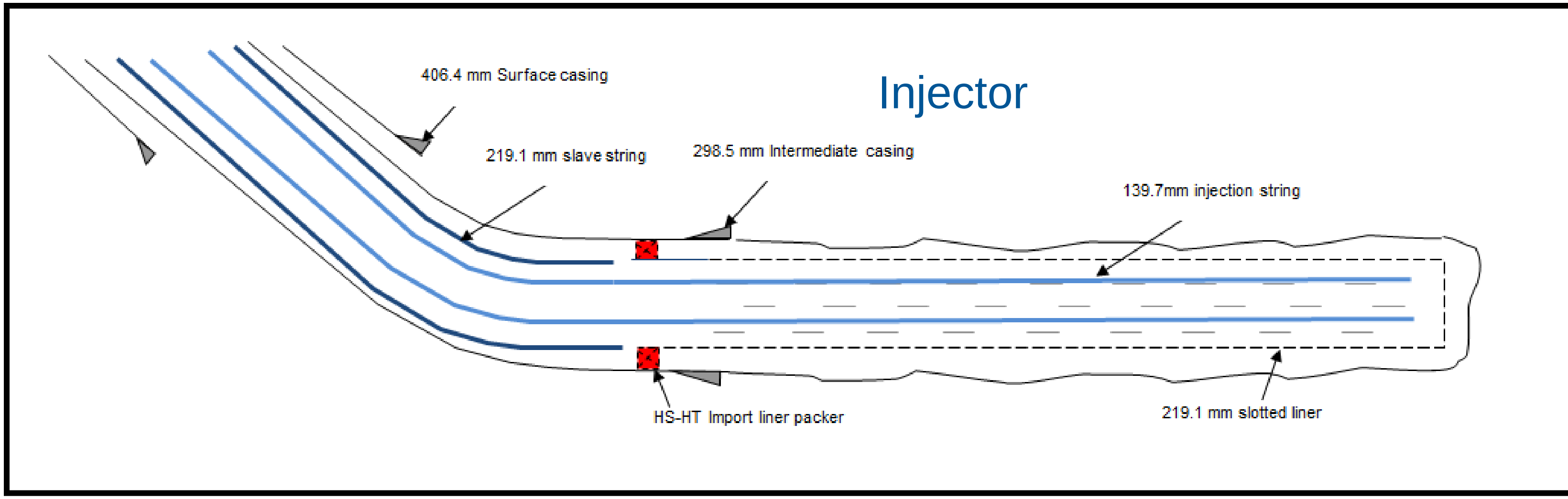


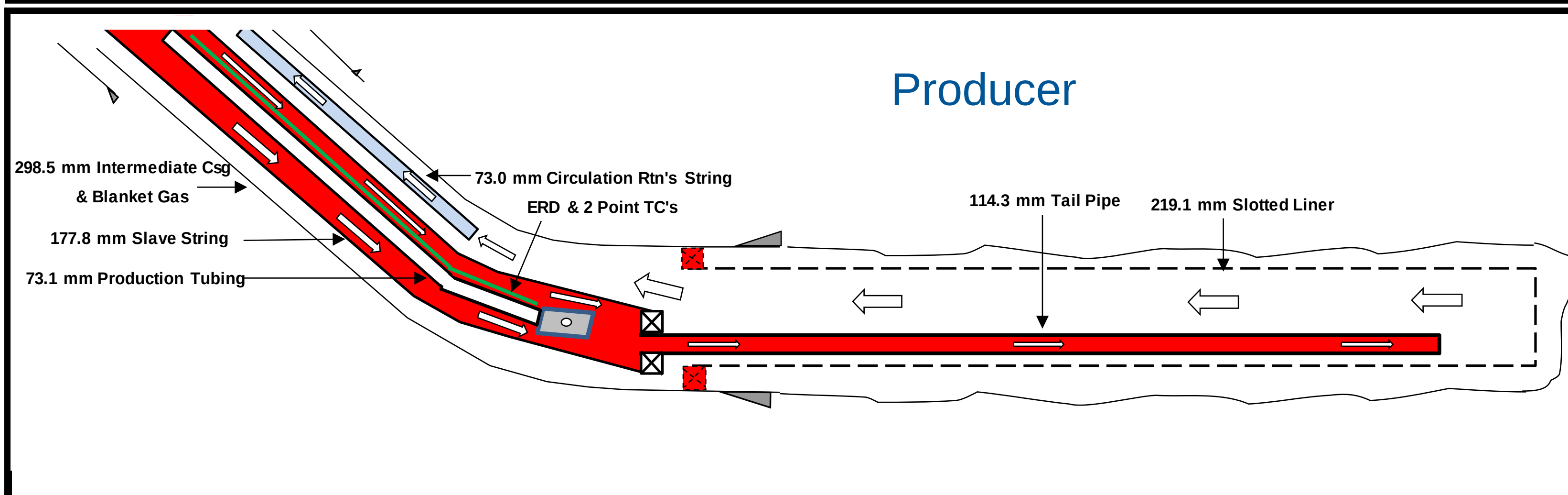
Typical Well Completions – Pad 750 Type



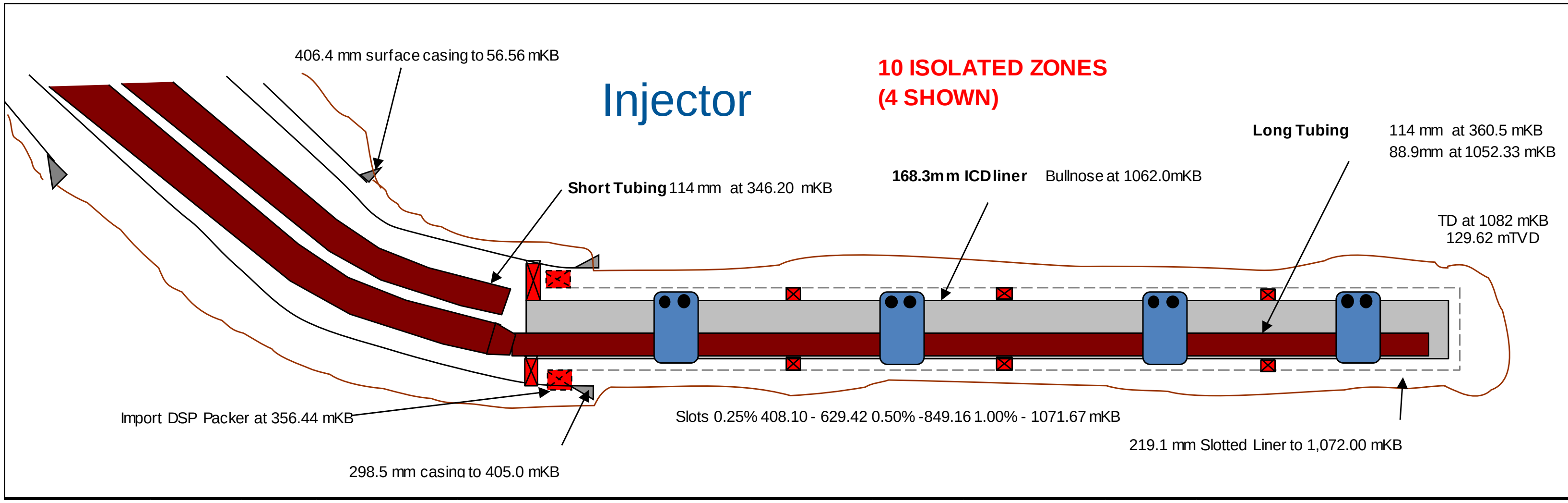


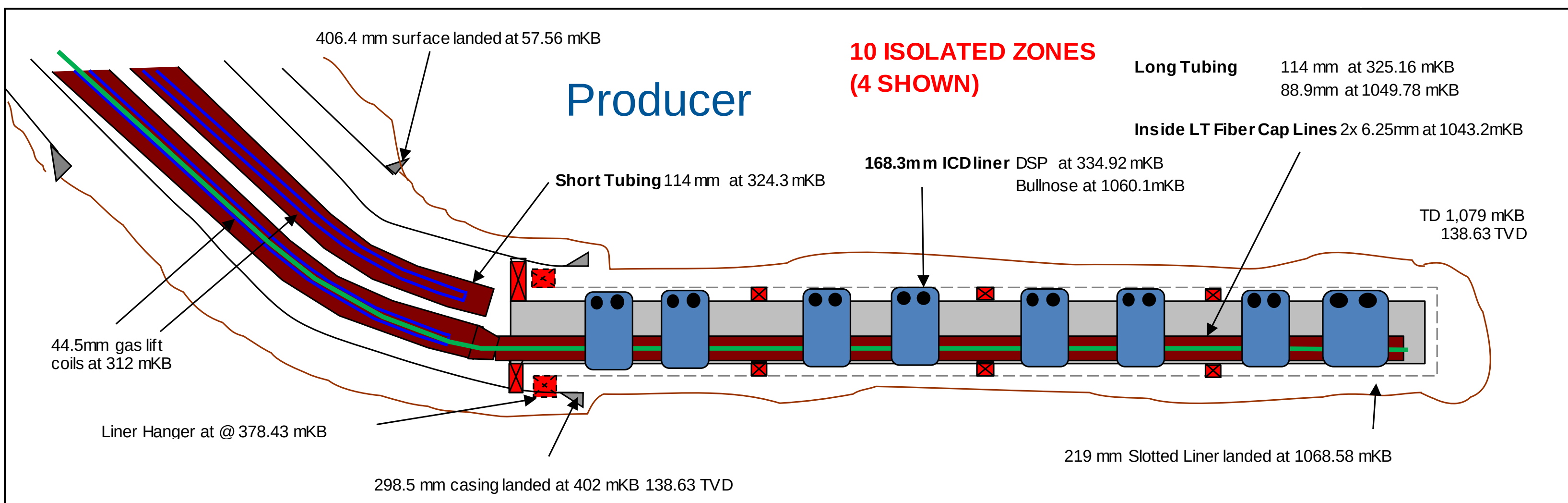
Typical Well Completions – Pad 824 (DSAGD)





Typical Well Completions – Flow Control Devices





Typical completion diagram for producer and injector in isolation

Key Learnings: Wellbore Integrity Management

- ***Wellbore integrity management*** continues to be a high priority focused on wellbore containment over a wells' full life cycle
  - **In Situ Well Integrity Standard** – comprehensive document developed to guide employees on well integrity considerations and practices through the life cycle of thermal wellbores (design, construction, operation and retirement)
    - **Monitoring and surveillance** for liner failures and intermediate casing failures**;**
    - **Wellbore thermal shock mitigation** for start-up after outages
    - **Erosion/corrosion monitoring program**
    - **Monitoring and repair of surface casing vent flows (SCVFs)**
      - Regular monitoring of pressure, rate and/or bubbles & H_2S concentration (annually for non-serious SCVFs, monthly – quarterly for serious SCVFs)
      - Gas venting rates continue to decline indicating remediation work may have been successful
      - Innovative repair techniques (i.e. SMART tool)

Key Learnings: Wellbore Integrity Management

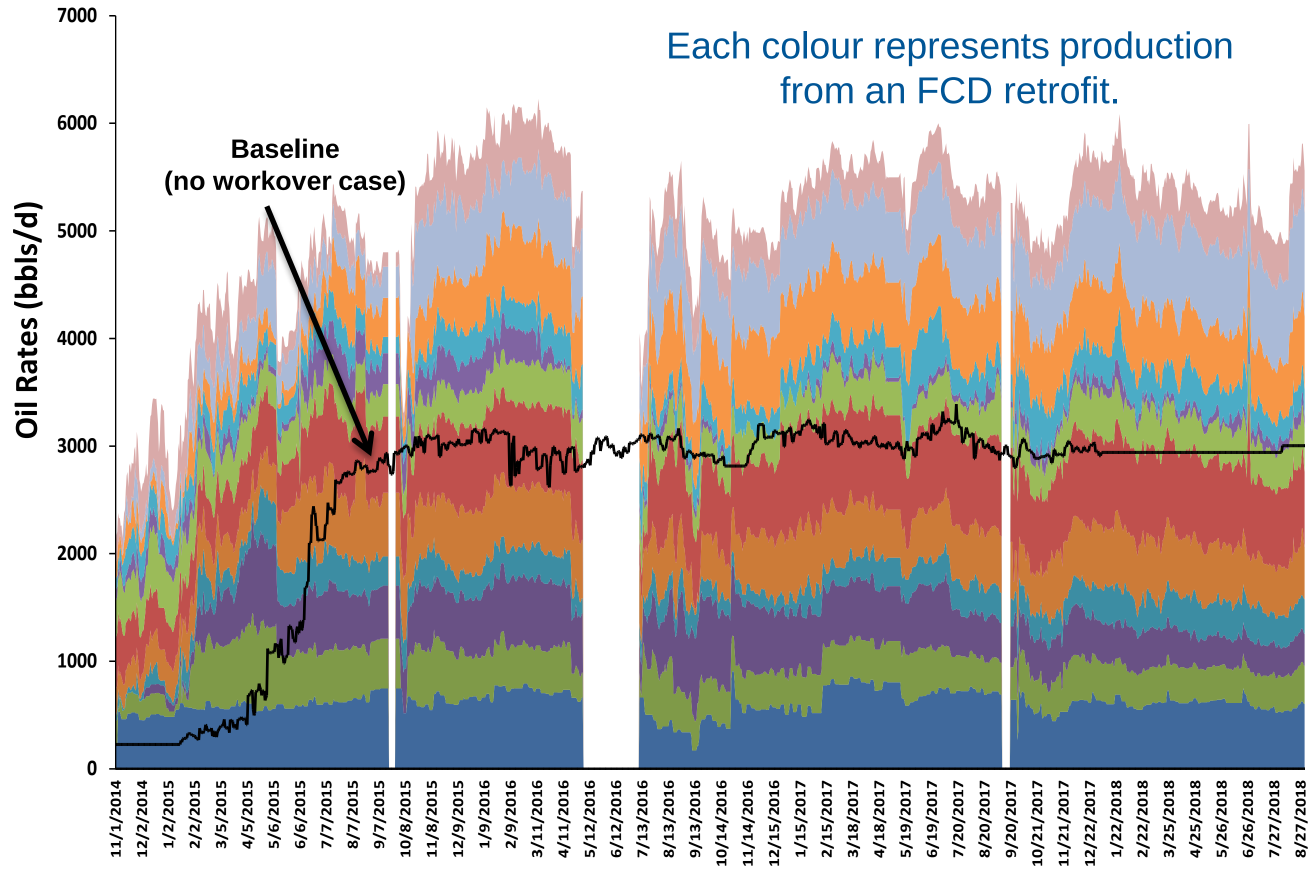
Summary of MacKay River Well Integrity Issues and Initiatives

- **Surface casing vent flows**
  - Three serious vent flows discovered with mitigations/monitoring in place
  - Annual testing program of non-serious vent flows
  - Evidence of vent flow cessation following periods of shut-in steam injection; heated overburden
- **Thermal Compatibility / Integrity**
  - Vintage well completions reviewed to ensure compatibility for thermal operations
  - Thermal abandonments conducted on incompatible wells prior to first steam in new development regions
    - Monitoring chamber growth and adjusting annual abandonment program
- **External Surface Corrosion**
  - Production casing exposure to oxygenated water below grade
  - Coating application; Thermal Arcing Spray on all new wells, old wells being reviewed
- **Intermediate Casing Integrity**
  - Intermediate casing issues in localized area, related to heave and connections placed at or near lithology changes
  - Future wells will use improved connections which provide a better radial seal and will avoid placing casing connections near lithological changes
  - QQ3P intermediate casing repaired in October 2017
    - DarkVision tool utilized post workover to confirm no issues elsewhere on intermediate casing

Flow Control Device Implementations

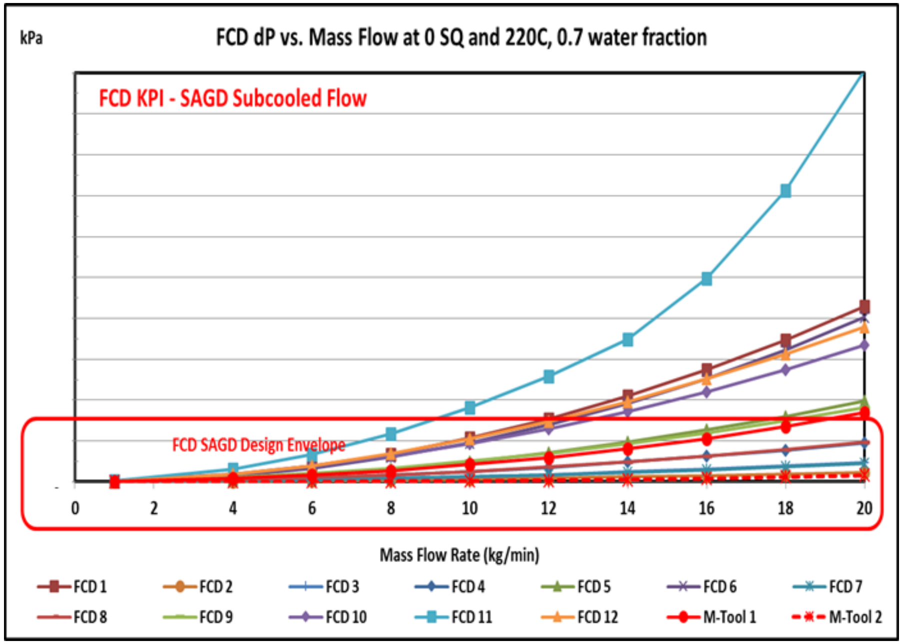
Wide use of flow control devices (FCDs)

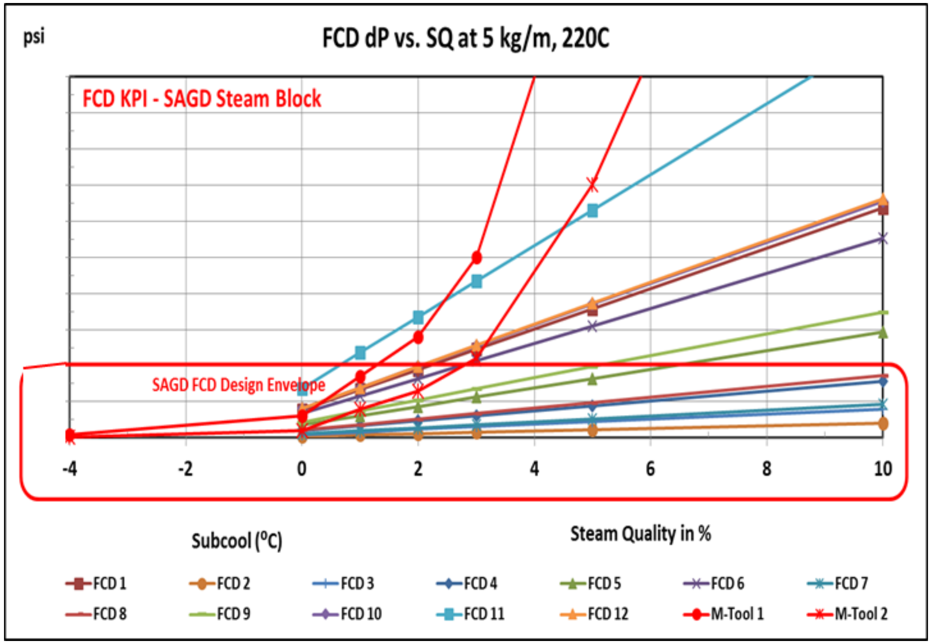
- ~15% of production at Mackay River is from wells with FCDs
- Used as a hot spot problem solver
- 1st M-tool device installed in August 2018; monitoring results



Flow Control Device (FCD) Technology Improvements

- M-tool deployment in 2018/2019 following lab testing in a flow loop
  - M-tool provides low resistance to liquid flow, high resistance to steam flow
  - Good erosion resistance relative to other devices tested
  - Evaluating performance of recent pilots against anticipated results from lab
    - August 2018 first installation



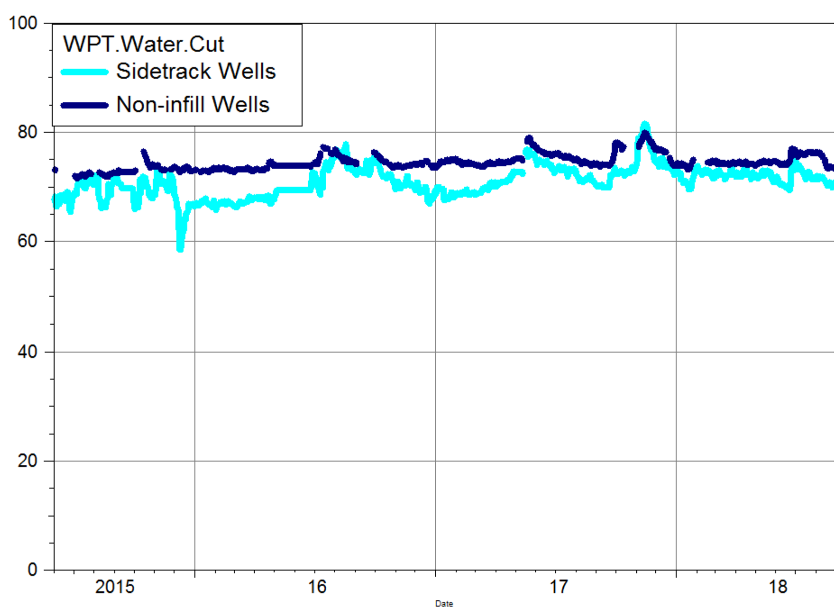


Key Learnings: Infill and Sidetracked wells

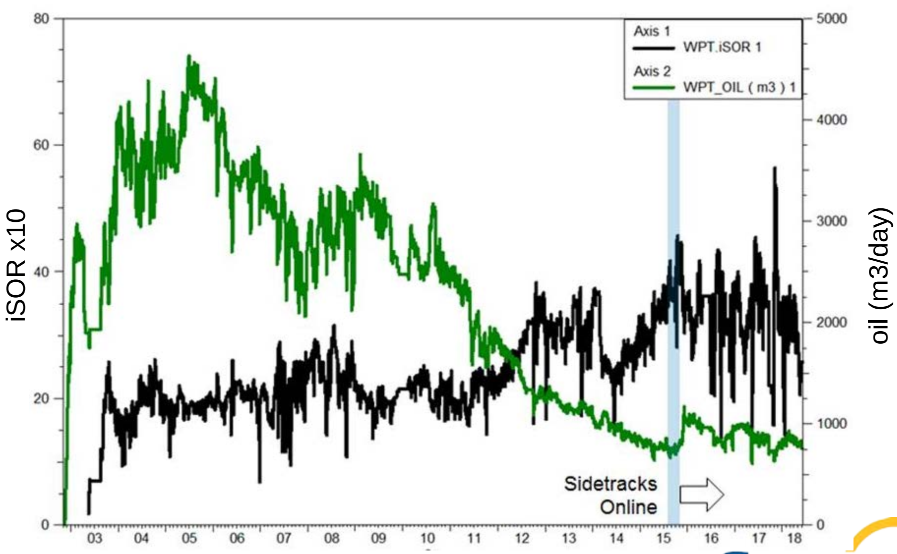
Infill and Sidetracked Wells

– Continued strong performance of infills vs. original/offset wells in terms of
  - Incremental oil rates
  - Lower water cuts
– New sand control (WWS, PPSS) performing up to expectations (lower ΔP relative to slotted liner designs)
– Increased oil rates and lower SOR since 2015 implementation

MR Sidetrack WC vs. Non-Infill WC



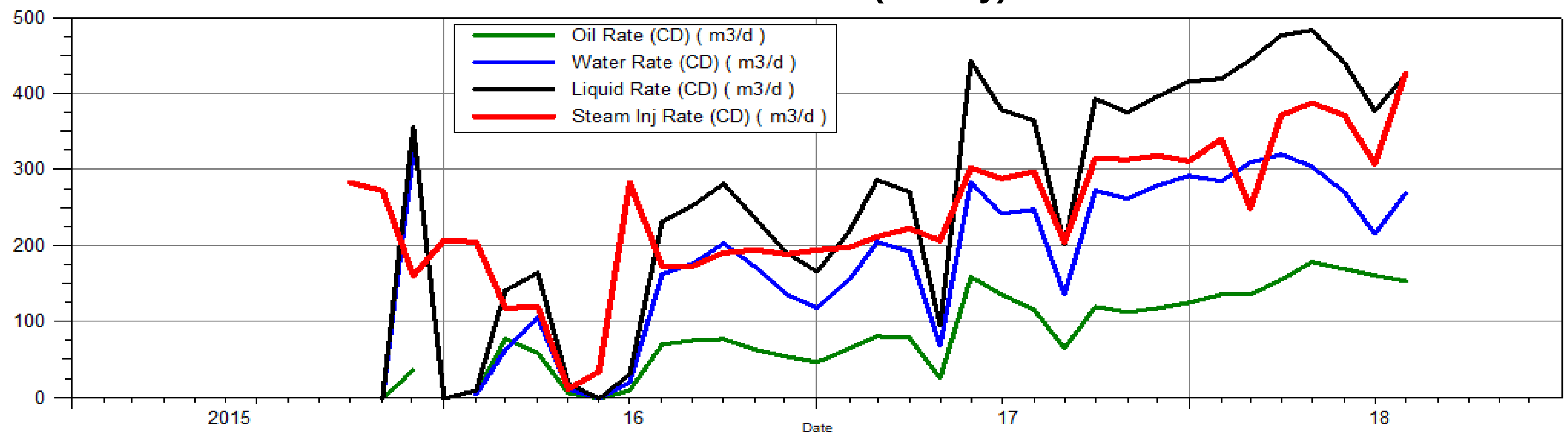
Phase 1 Performance following Sidetracks



Key Learnings: Pad 824 DSAGD Learnings

- Successful conversion of Pad 824 showed that it is possible to circulate a well with a DSAGD completion at MacKay River
  - Previous DSAGD completions in Firebag were bullheaded
  - The ESPs started up successfully after steaming past them
  - Subsequent circulation used following start-up to aid in ramp-up after unplanned outages
- ESP run life impacts being assessed; 1 pump change in August 2018
- The VX meter provides valuable real-time data regarding impact of changes in operating parameters

Pad 824 Rates (m^3/day)



Artificial Lift

3.1.1.4

Artificial Lift

- Most existing SAGD production wells designed for gas lift:
  - Low cost completion
  - Recover gas
  - No downhole moving parts
- Lift capacity sufficient for production rates and reservoir pressures
  - No instances of fluid inventories building due to lift issues
  - Lower pressure patterns generally require higher gas lift rates
- Producing wells with downhole pumps
  - F1P, ESP since February 2009, current pump installed July 2017
    - Previous pump ran for ~2300 days
  - OO3P, ESP since October 2009, current pump installed March 2012
    - ~2300 days
  - 824P1, DSAGD completion. On production since February 2016 with original pump
    - ~930 days
  - 824P2, DSAGD completion. Current pump installed August 2018
    - Original pump ran for ~850 days

Instrumentation

3.1.1.5

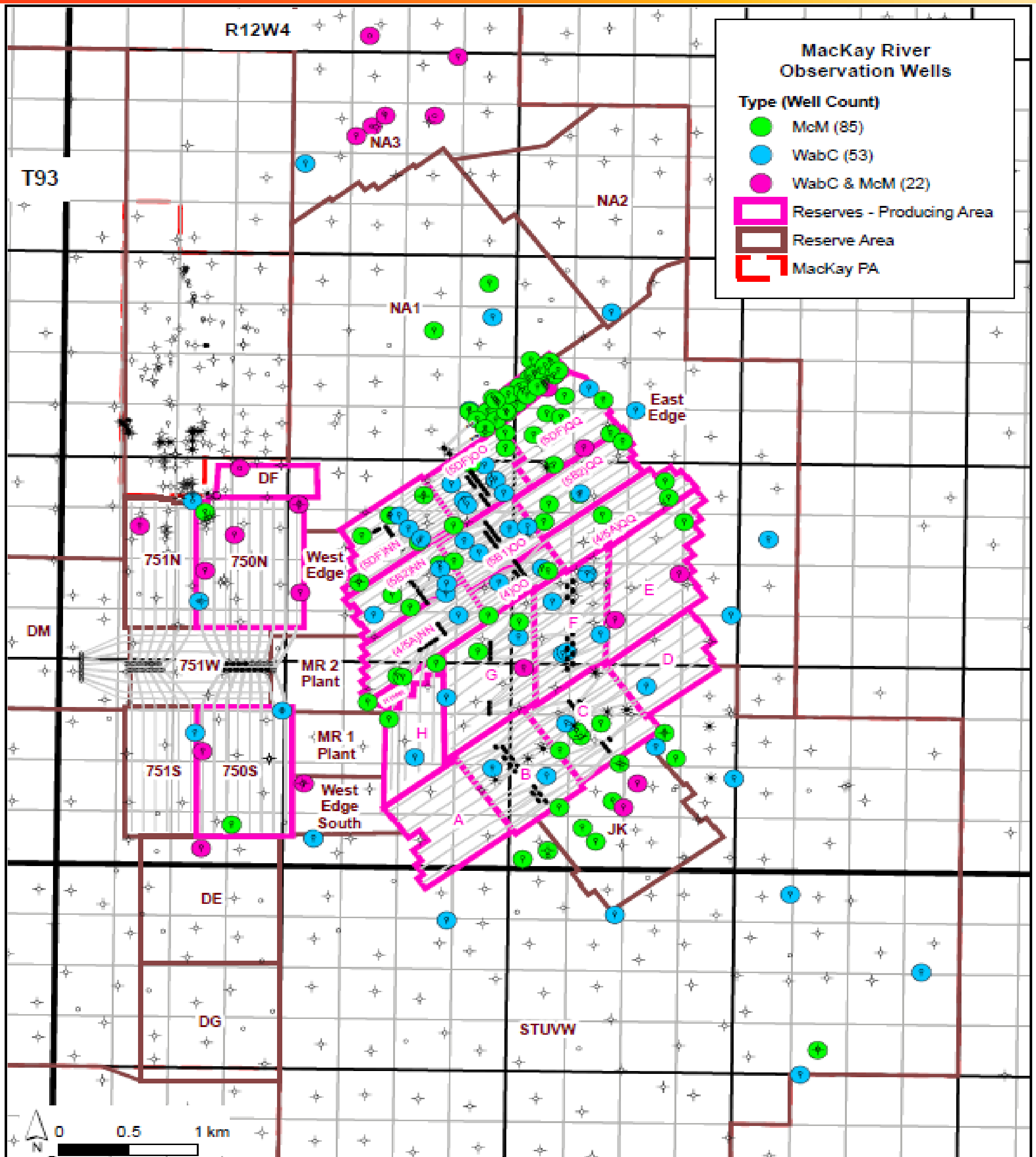
Well Downhole Instrumentation

- Phase 1 (25 well pairs)
  - Temperature optic fibre in 1 producer is functional today (C2)
- Phase 2 (14 well pairs)
  - Temperature fibre optic installed in G6P
  - P/T gauge installed in G6I
- Phase 3 (7 well pairs)
  - No instrumentation
- Phase 4 (10 well pairs)
  - No instrumentation except temperature fibre optics in OO3 I & P
  - Temperature fibre optic installed in NN1P
- Phase 5A (6 well pairs)
  - Pressure - bubble tube to the toe in every producer
  - QQ5P equipped with 6 point thermocouple bundle to the toe
  - NN5P equipped with 8 point thermocouple bundle to the toe

Well Downhole Instrumentation

- Phase 5B-1 (6 well pairs)
  - Pressure - bubble tube to the toe in every producer except OO5
  - All producers equipped with 6 point thermocouple bundle to the toe except OO5 and OO9 which have temperature fibre optic
- Phase 5B-2 (10 well pairs)
  - Pressure – bubble tube to the toe in every producer
  - All producers equipped with 6 point thermocouple bundle to the toe, except QQ9
- Phase 5D&F (18 well pairs)
  - Pressure – bubble tube to the toe in every producer except OO well pairs which have pressure gauges
  - All producers equipped with fibre optic to the toe, except OO10
- Pad 824 (2 well pairs)
  - All producers equipped with ERD (P/T) and 2 point thermocouple on pump
- Pad 750 (12 well pairs)
  - Pressure – ERD at the toe in every producer
  - All producers equipped with fibre optic to the toe

Observation Wells



Observation wells	
85	McM
53	Wab C
22	Wab C & McM
160	**Total**

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Observation Well Overview

- Total of 160 licensed observation wells at MacKay River.
  - 6 New Observation Wells drilled in 2018
- Observation wells at MacKay River serve three main purposes

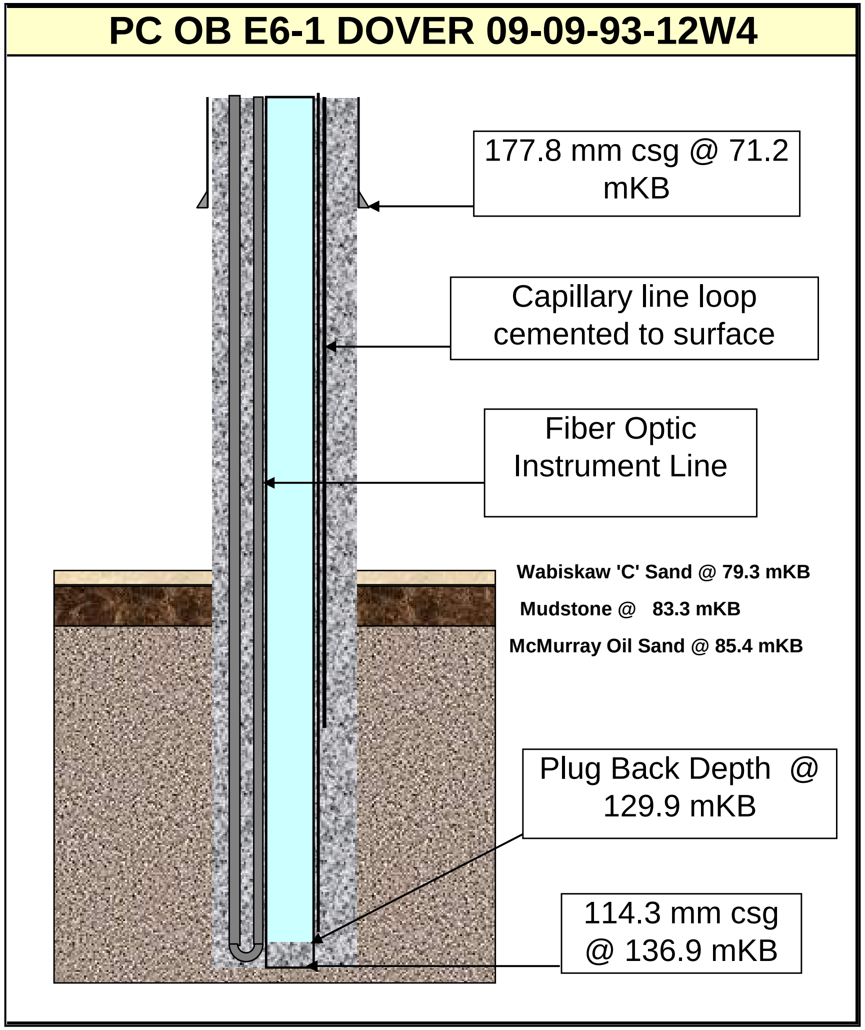
1. Reservoir optimization (steam chamber monitoring)
   - 42 wells with fibre optic cable from surface to TD
     - 7 wells with fibre optic cable and McM pressure sensors
   - 56 wells with thermocouple bundles
     - 47 wells with thermocouples and McM pressure sensors
2. Wabiskaw C pressure monitoring
   - 67 wells with a single pressure / temperature sensor dedicated to WabC.
     - 18 wells with WabC pressure / temperature combined with McM temperature
3. Subsurface Monitoring (outside of producing area)
   - 7 wells with thermocouple bundles and pressure sensors
   - 16 wells with a single pressure / temperature sensor (5 McM, 11 WabC)
   - 4 wells with pressure / temperature in both McM and WabC

- Current observation well design incorporates thermocouple measurement as this provides sufficient resolution for steam chamber monitoring and is preferred for remote well locations
- Reliability issues closely monitored and mitigated/repaired as required

Typical Observation Well Design

McMurray Observation Well (Type 1):

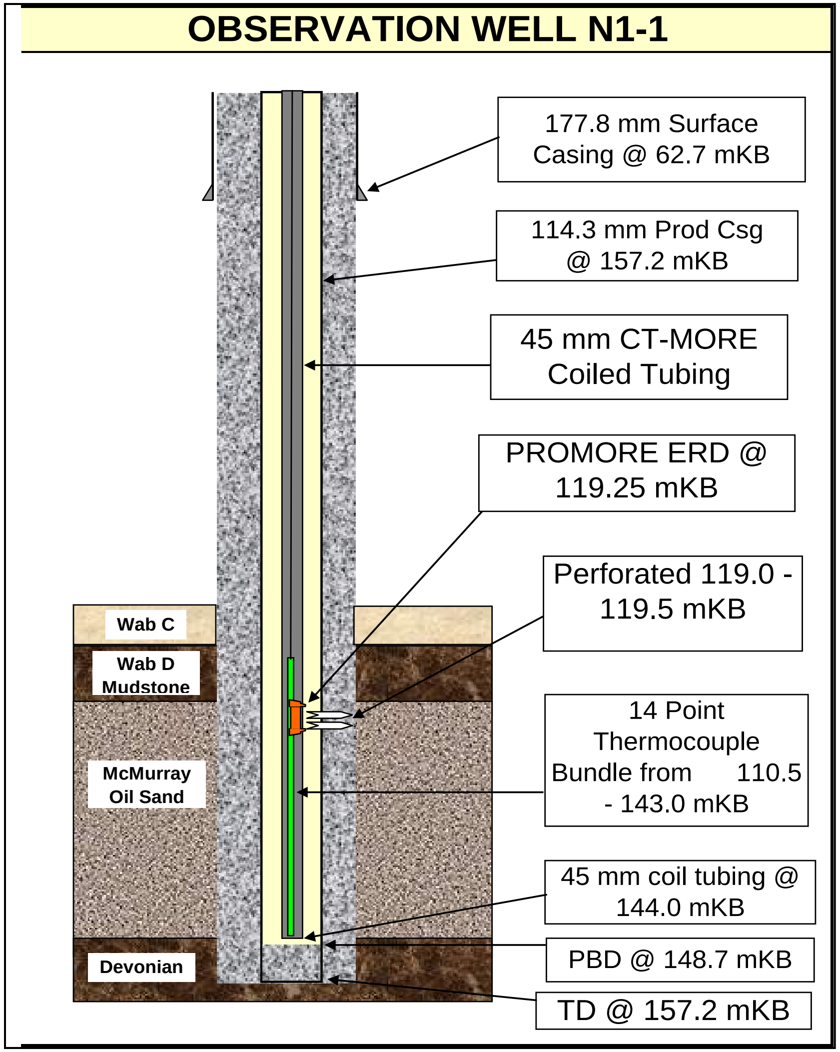
- Capillary line loop cemented outside casing
- Fibre optic cable pumped into capillary line loop to provide temperature profile along entire vertical well depth
- Allows for close monitoring of steam chamber development
- There are no reliability concerns with the Type 1 observation well temperature data



Typical Observation Well Design

McMurray Observation Well (Type 2):

- Coiled tubing instrument string containing 14 thermocouples and 1 P/T gauge run inside 114 mm intermediate casing
- Perforated near the top of the McMurray oil sands zone
- Pressure / temp gauge positioned at MPP
- 14 point thermocouple bundle collects temperature data across the McMurray
- 24 point thermocouple bundle go forward design

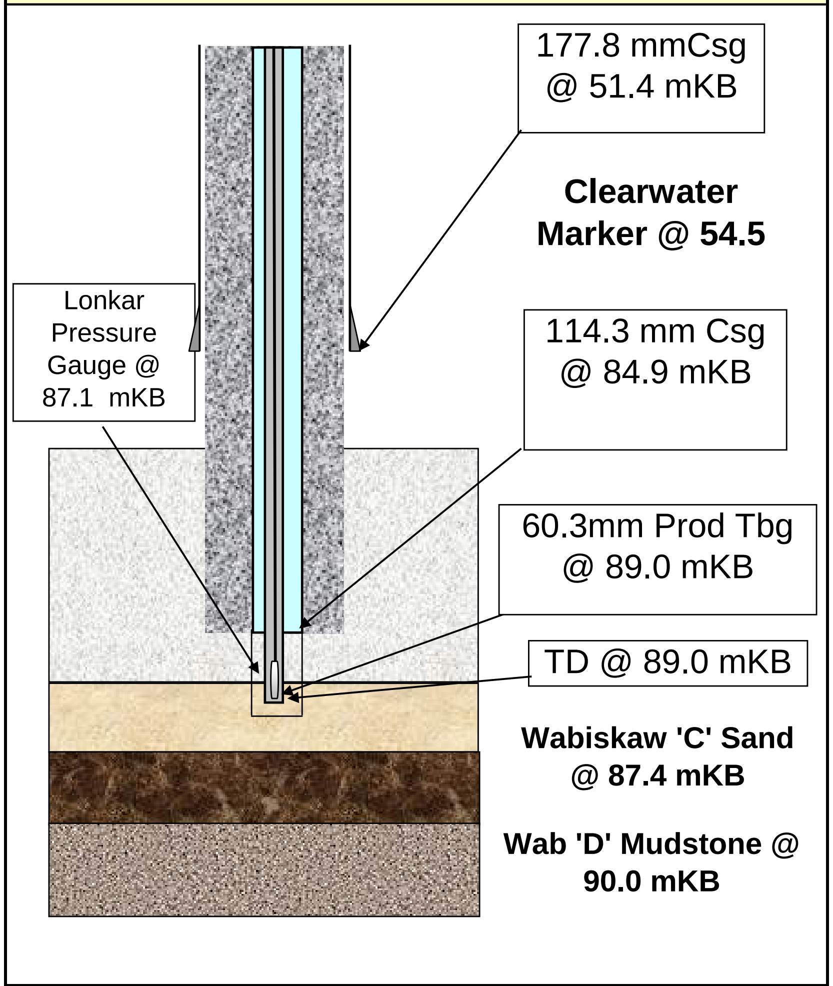


Typical Observation Well Design

Wabiskaw C Observation Well:

- Open hole into Wabiskaw C sand
- Wellbore does not penetrate Wabiskaw D mudstone or McMurray sand
- Pressure / temp gauge landed inside tubing

PC WB-C2 DOVER 102/04-09-93-12W4



Scheme Performance

3.1.1.7

Summary of Operating Wells

Pad	Pattern	Phase	# Well Pairs	First Steam to Pad
20	A	1	7	Sept 2002
	C		6	
21	B		7	
	D		5	
22	E	2	7	Jan 2006
	G		7	
23	F	3	7	Sept 2007
24	OO	4	3	Oct 2008 - Apr 2009
		5B-1	6	Feb 2012
		5DF	6	May 2014
	H	4	4	Feb 2009 - Jun 2010
25	QQ	4	2	Nov 2008
		5A	2	Jul 2011
		5B-2	5	Jan - May 2013
		5DF	6	June 2014
	NN	4	1	Dec 2008
		5A	4	Jun - Jul 2011
		5B-2	5	Jan - Feb 2013
		5DF	6	June 2014

Pad	Pattern	# Well Pairs	First Steam to Pad
24	824	2	Oct 2015
750	750N	8	Sept 2016
750	750S	4	Sept 2016 / July 2017

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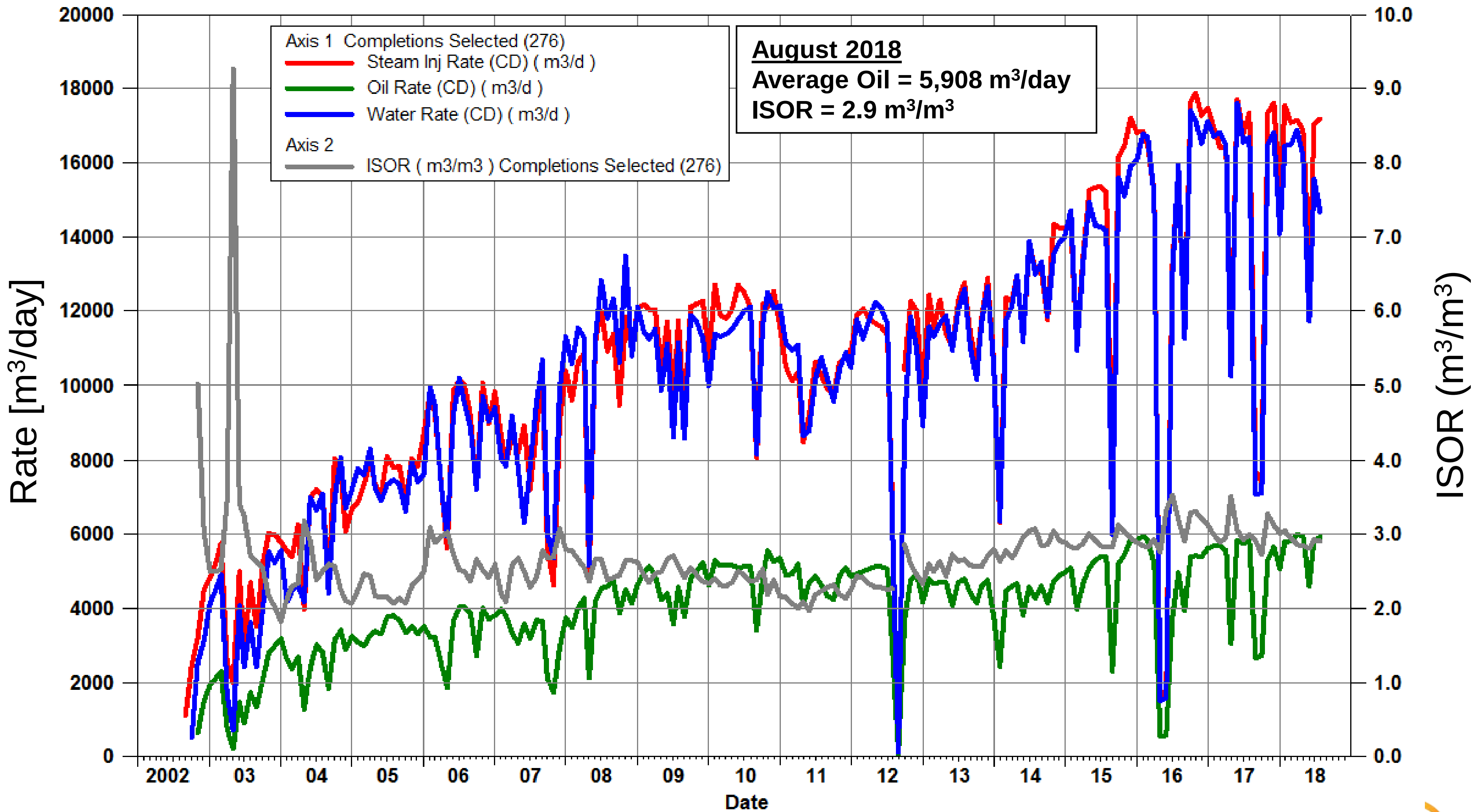
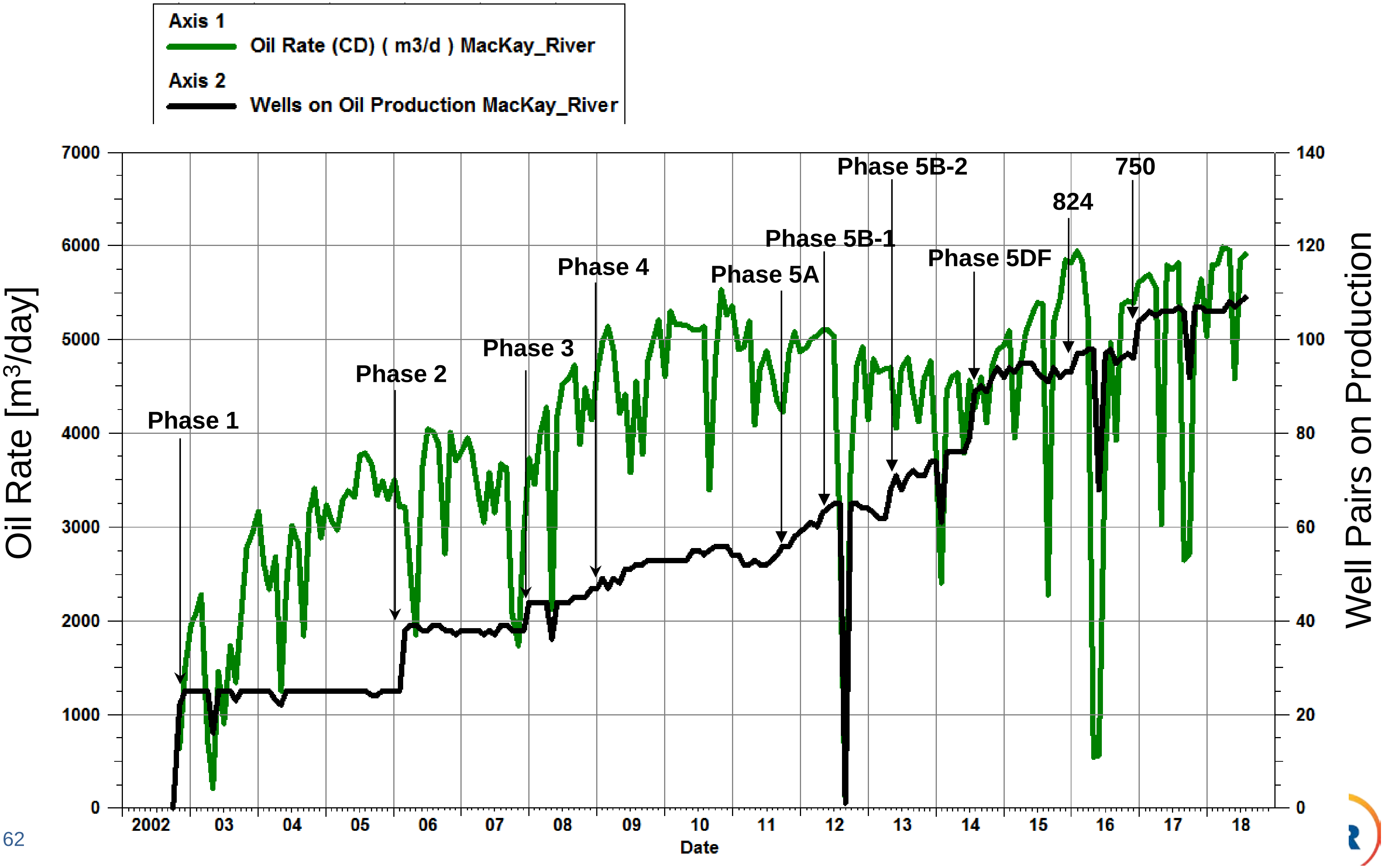
Fluid Rates

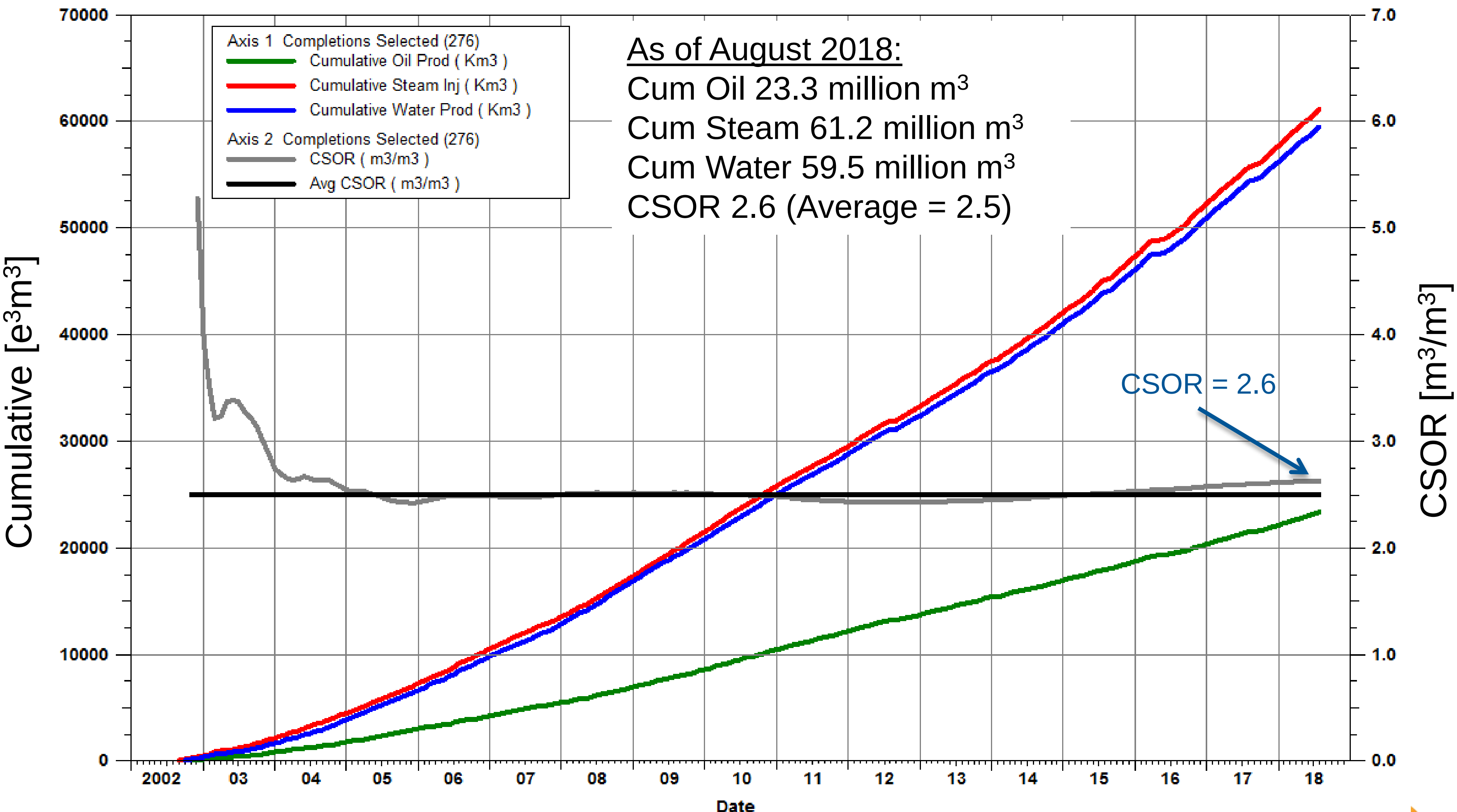


Axis 1 Completions Selected (276)
Steam Inj Rate (CD) (m3/d)
Oil Rate (CD) (m3/d)
Water Rate (CD) (m3/d)
Axis 2
ISOR (m3/m3) Completions Selected (276)
August 2018
Average Oil = 5,908 m³/day
ISOR = 2.9 m³/m³
Rate [m³/day]
ISOR (m³/m³)
Date
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2002
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18

Producing Well Count



Cumulative Fluid Volumes



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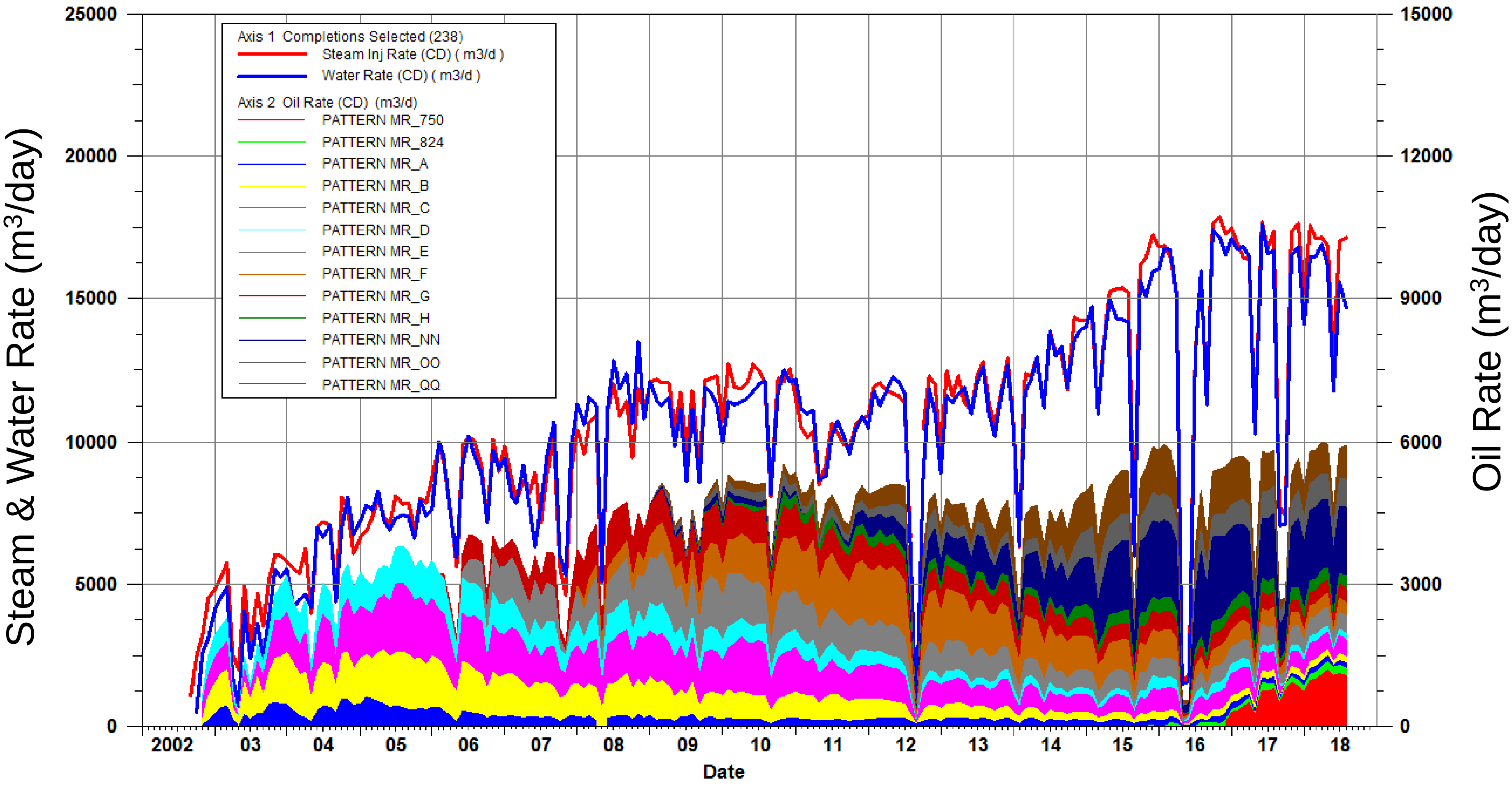
Average Oil Rate per Pattern



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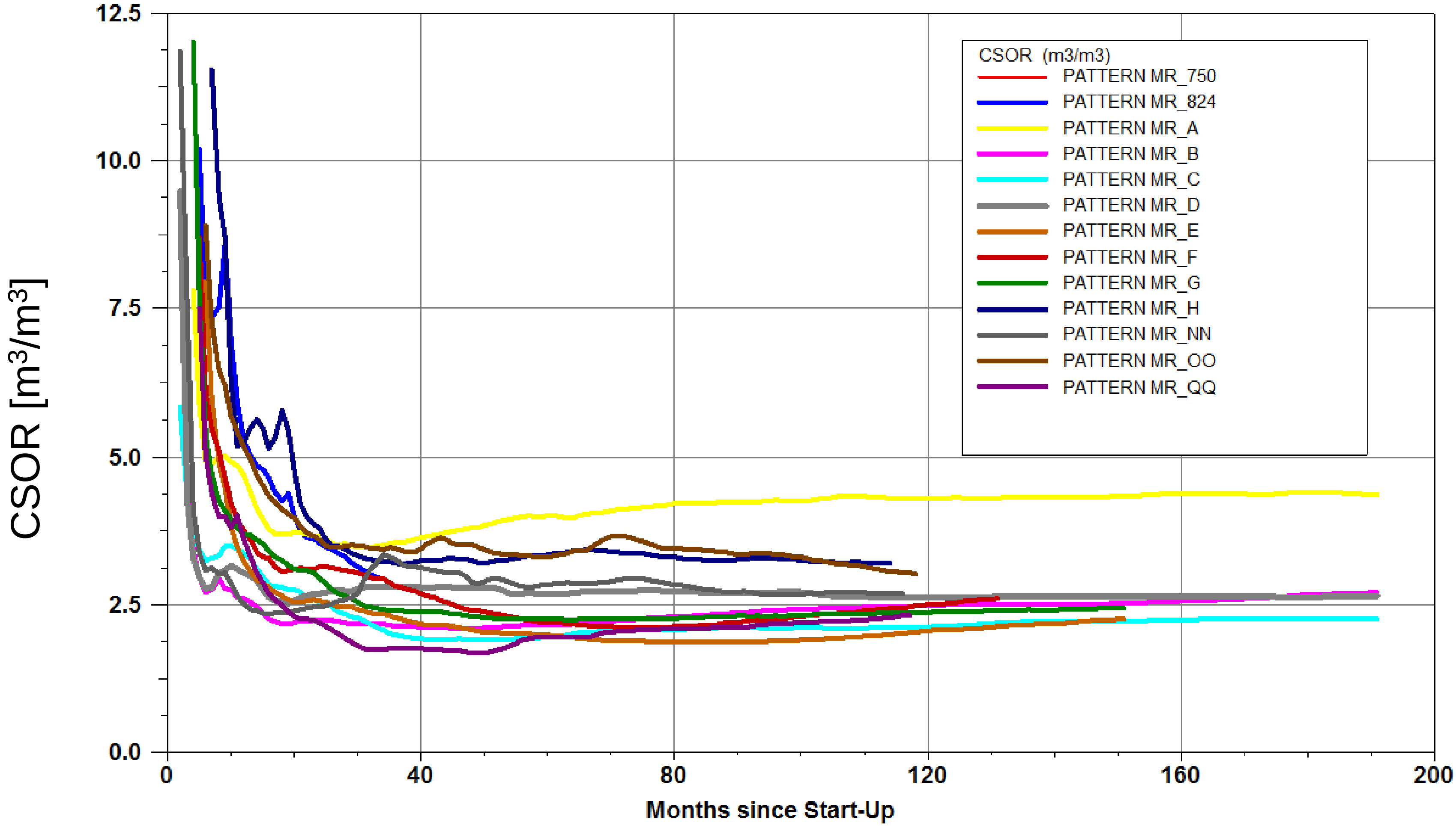
CSOR by Pattern (August 2018)



- C Pattern has the lowest CSOR
- NN wells have a mid range CSOR
- A Pattern has the highest CSOR

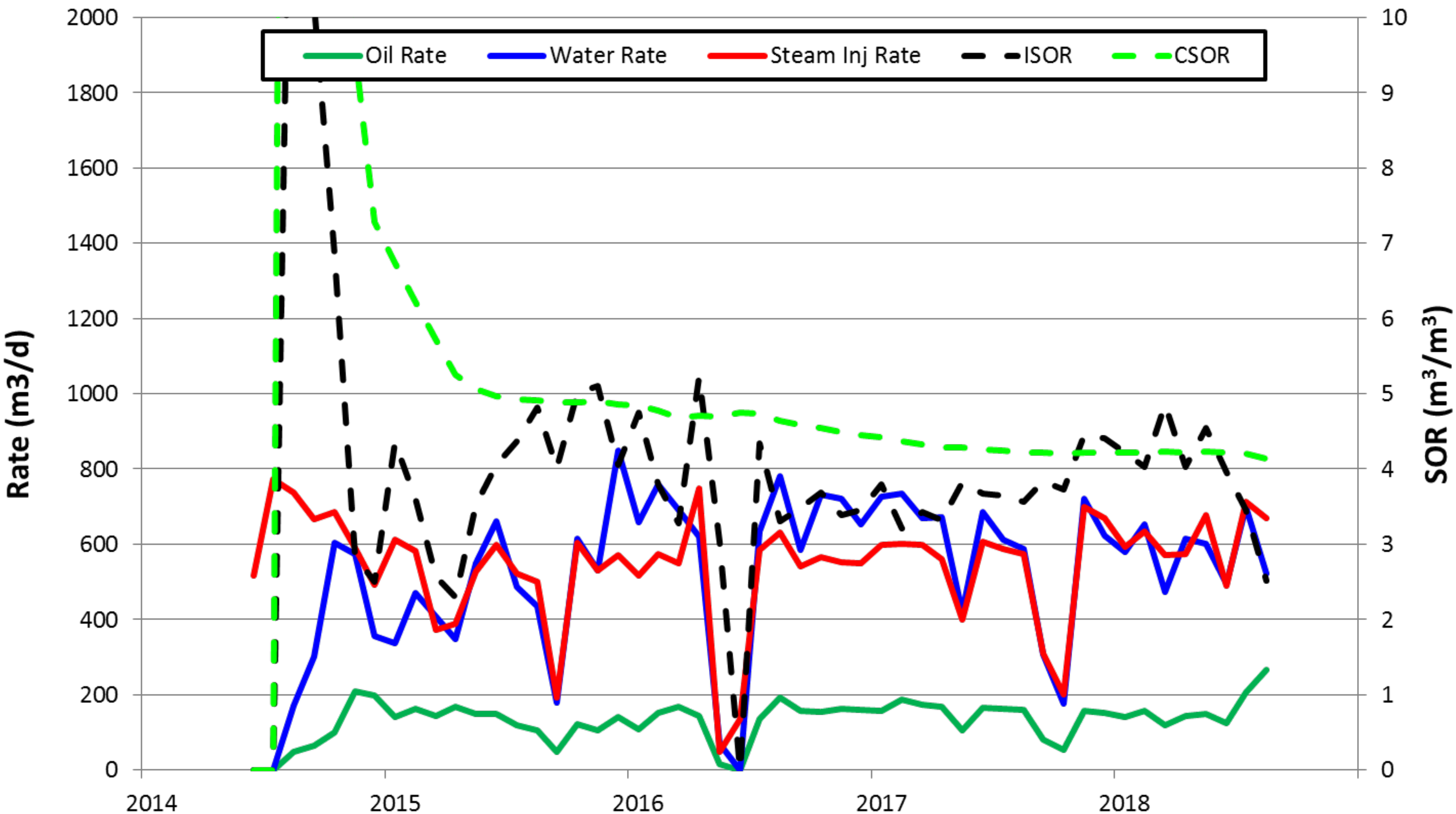
Performance Summary by Pattern

Pattern	OBIP [$e^3\ m^3$]	Cum. Oil (Aug. 2018) [$e^3\ m^3$]	Recovery up to August 2018 [%]	CSOR (Aug. 2018) [m^3/m^3]	ISOR (Aug. 2018) [m^3/m^3]	Ultimate Recovery [%]
Pattern A	2,443	1,109	45%	4.36	3.3	50%
Pattern B	3,616	2,772	77%	2.70	3.6	80%
Pattern C	4,398	3,743	85%	2.26	2.4	88%
Pattern D	2,742	2,023	74%	2.63	1.7	78%
Pattern E	4,410	2,544	58%	2.25	3.6	71%
Pattern F	3,961	2,557	65%	2.60	5.2	78%
Pattern G	4,328	2,082	48%	2.44	3.0	60%
Pattern H	1,940	607	31%	3.20	3.0	55%
Pattern NN	7,347	2,489	34%	2.67	2.6	57%
Pattern OO	5,453	1,140	21%	3.01	2.2	37%
Pattern QQ	7,018	1,695	24%	2.32	3.3	46%
Pad 824	916	88	10%	2.94	2.8	51%
Pad 750	7,919	470	6%	3.08	2.8	51%
Total	**56,490**	**23,319**	**41%**	**2.63**	**2.9**	**60%**

Phase 5DF – Examples Based on Recovery

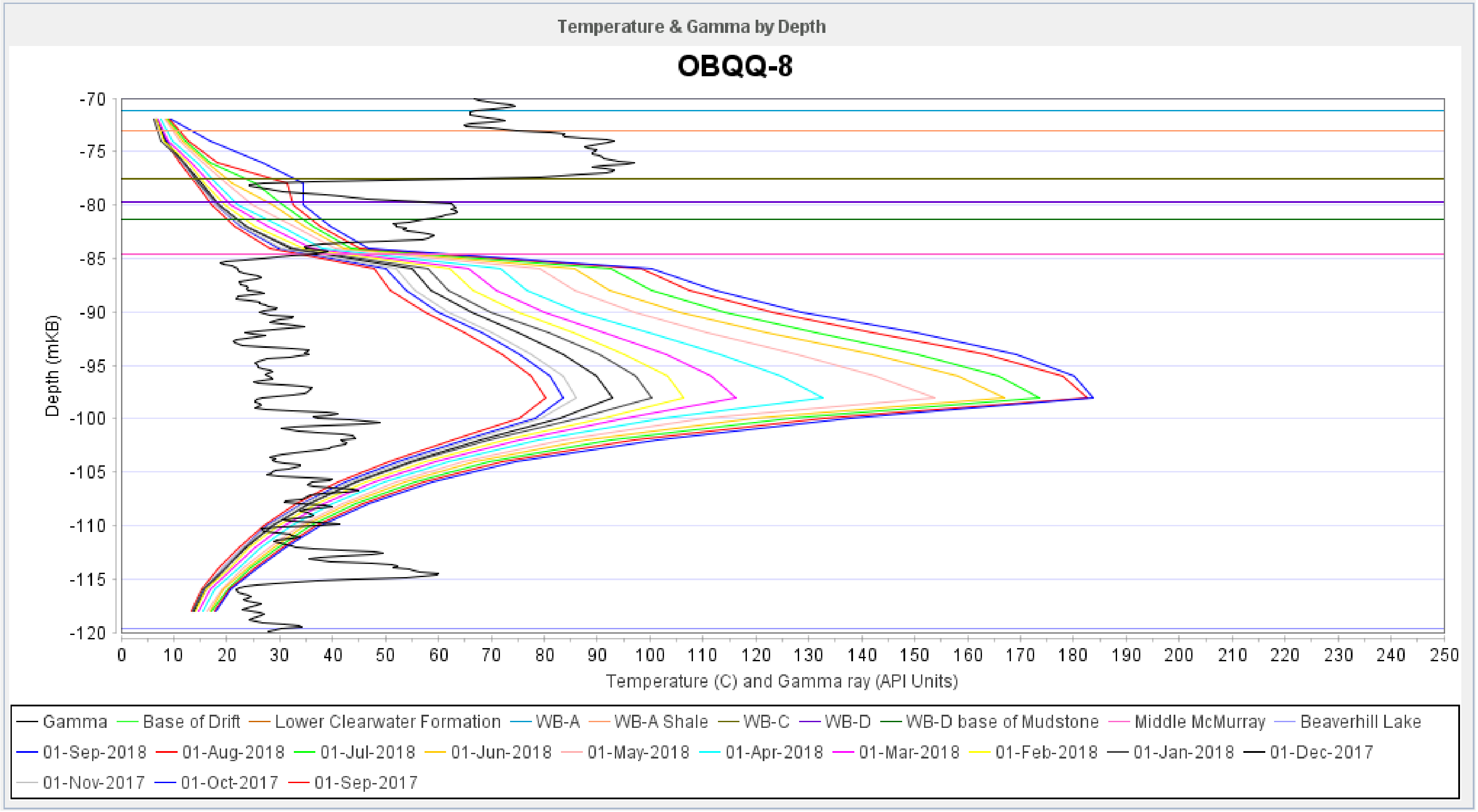
Well Pairs	ISOR [m^3/m^3]	CSOR [m^3/m^3]	Cum Oil [$10^3 m^3$]	Peak Oil Rate [m^3/d/well pair]	Current Oil Rate [m^3/d/well pair]	Comments
QQ11-16 **Low Recovery**	4.0	4.1	205	38 - 69	31 - 64	• Challenging geology • Shallow, lowest MOP in MacKay • 6 well pairs in pattern • 10% recovery to date (ultimate RF: 46%)
OO10-15 **Medium Recovery**	2.5	2.8	385	51 – 110	16 - 88	• Medium quality geology • 6 wells pairs in pattern • 17% recovery to date (ultimate RF: 37%)
NN11-16 **High Recovery**	2.3	2.2	626	112 - 146	45 - 138	• High quality geology • 6 well pairs in pattern • 24% recovery to date (ultimate RF: 57%)

QQ11-16 Well Pairs – Low Recovery

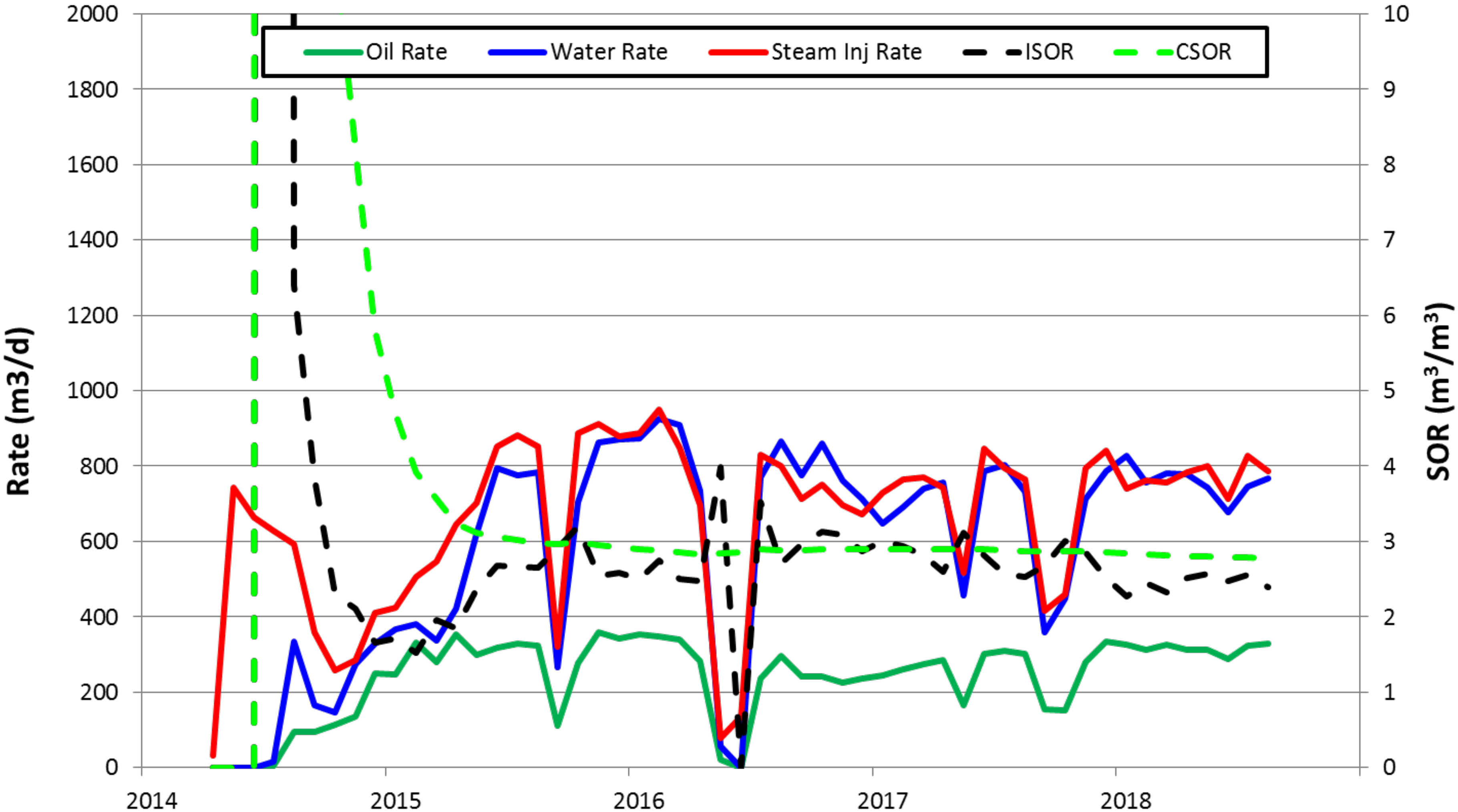


QQ11-16 Well Pairs– Observation Well Temperature

OBQQ-8: Mid well of QQ15 Well Pair (Low Recovery)



OO10-15 Well Pairs – Medium Recovery



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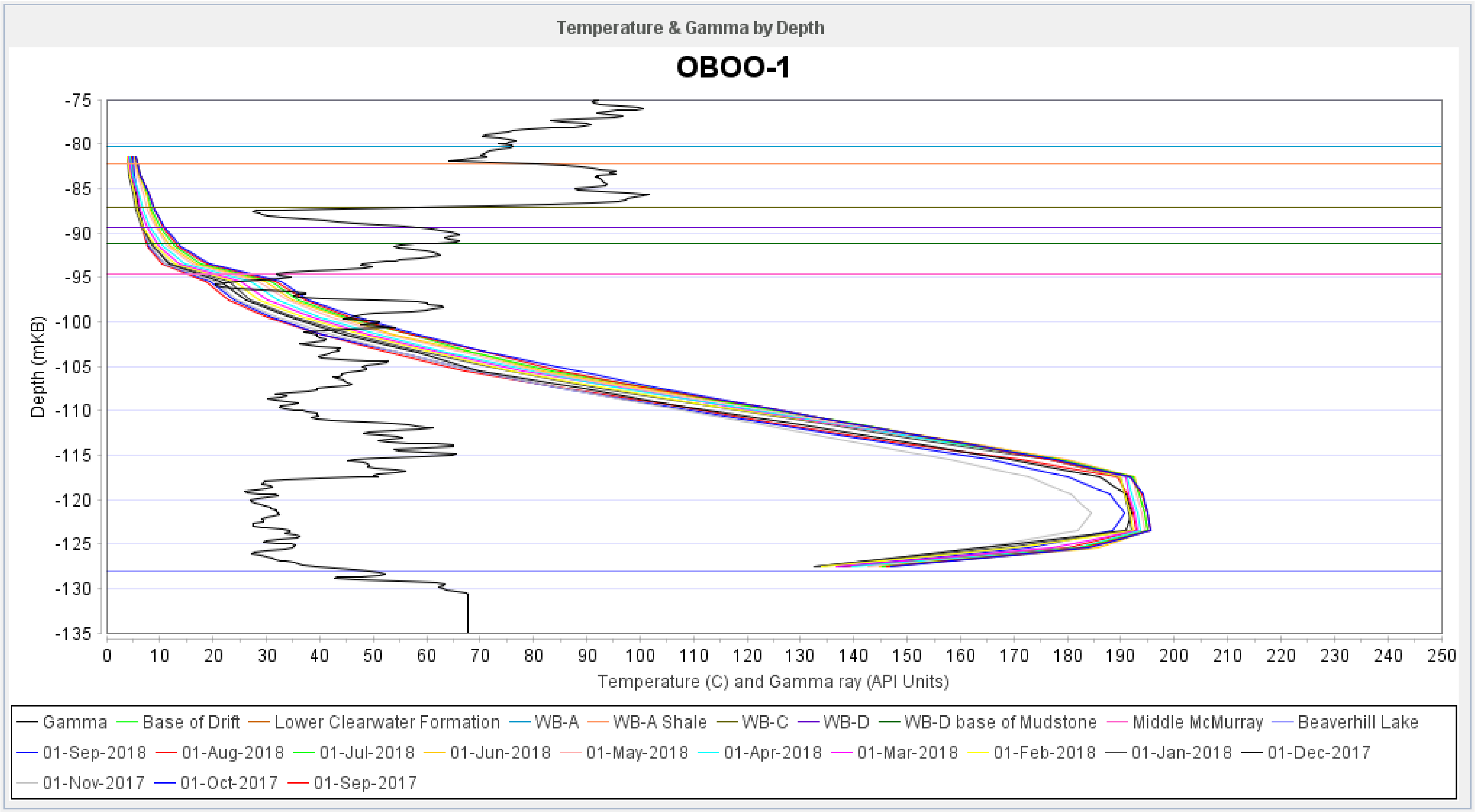
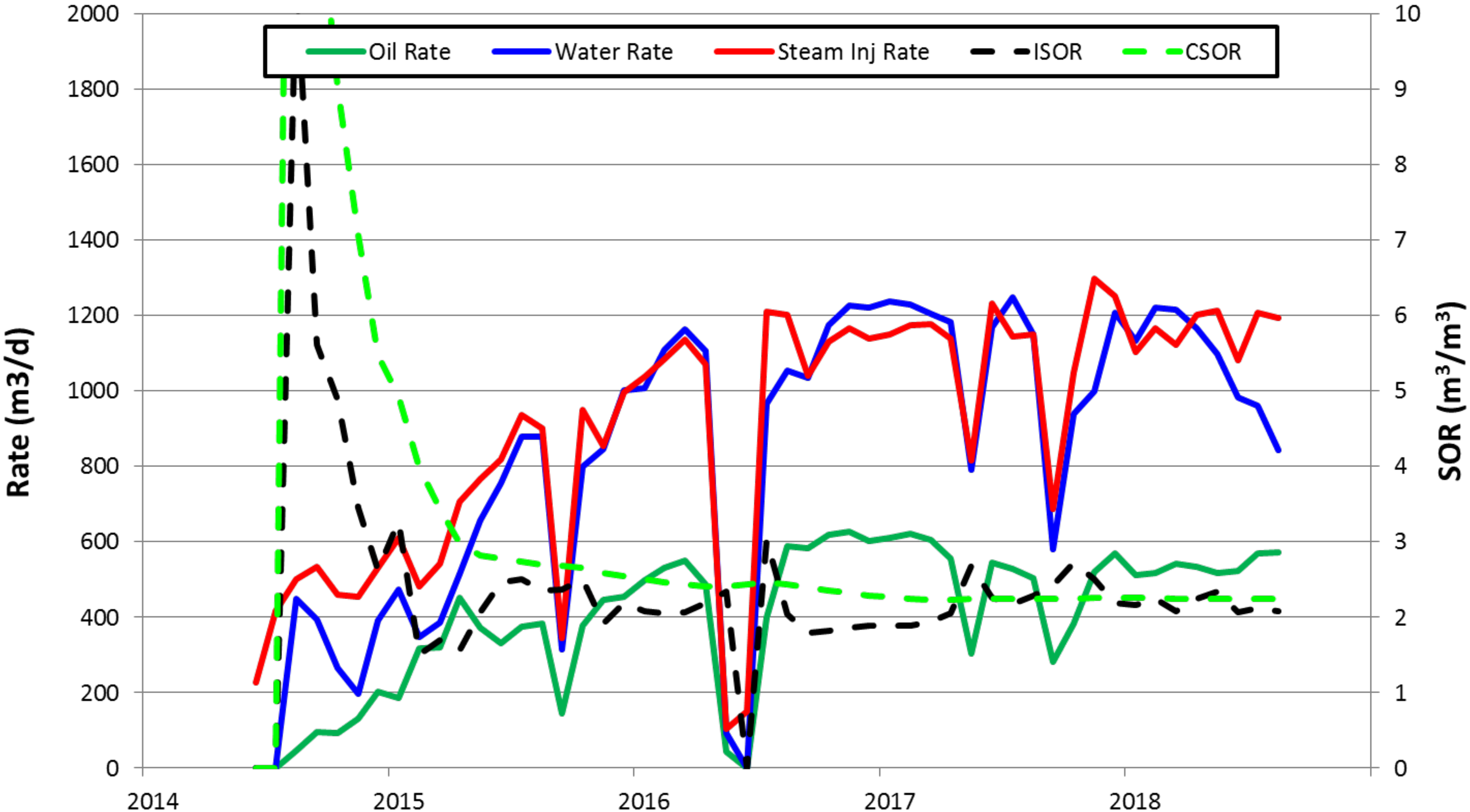
OO10-15 Well Pairs – Observation Well Temperature

OBOO-1: Toe of OO14 Well Pair (Medium Recovery)

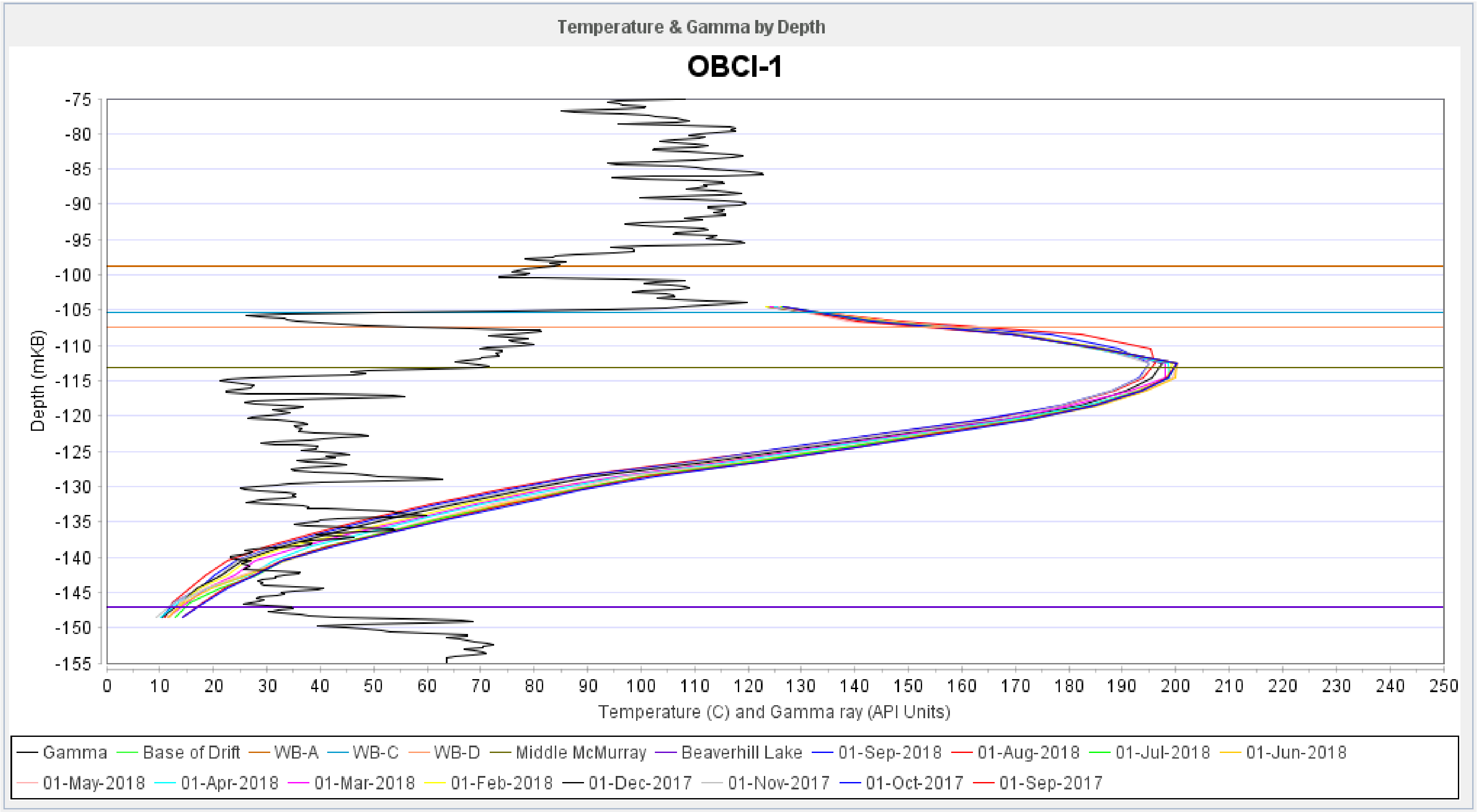


NN11-16 Well Pairs – High Recovery



NN11-16 Well Pairs – Observation Well Temperature

OBCI-1: Heel of NN15 Well Pair (High Recovery)



Pad Abandonment Outlook

- The strategy for future well and pad (including surface equipment) abandonments is under development
- Do not anticipate abandonment of operating Pads during the next 5 years
  - Pads 20 and 21 (A/C and B/D patterns) are the most mature and are expected to be under pressure maintenance
  - Individual wells may be suspended or abandoned as required
- Pad 40 expected to be abandoned within the next 5 years
  - Three of four wells on pad abandoned (NP, NI and SP)
  - Considerations for surface equipment are under review

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Steam Injection Conditions

Pattern	Wells	Maximum Operating Pressure Surface (kPag)	Maximum Operating Pressure Bottomhole (kPag)
A	A1-7	2120	1690
B	B1-7	2020	1600
C	C1-6	1745	1390
D	D1-5	1555	1240
E (S)	E1-4	1640	1310
E (N)	E5-7	1600	1270
F	F1-7	1680	1340
G	G1-7	1935	1530
H	H1-4	2225	1780
NN	NN1-5	2100	1680
NN	NN6-10	2185	1750
NN	NN11-16	2125	1700
OO	OO1-3	1870	1490
OO	OO4-9	1910	1520
OO	OO10-15	1880	1500
QQ	QQ2-5	1535	1210
QQ	QQ6-10	1500	1200
QQ	QQ11-16	1500	1200
824	824WP1-2	2320	2060
750 N	WP1-8	**2645**	2110
750 S	WP14-17	**2680**	2140

- Approved MOPs based on the methodology detailed in Application 1724610
- Approved Bottomhole MOP at 80% of the fracture closure pressure
- MOPs are set by shallowest point in each pattern to allow for intra-pattern communication
- Steam injection pressure limits are enforced at wellhead on tubing and annulus via pressure transmitters; Phase 1 wells are monitored via manual pressure measurement at the wellhead every second day
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below MOP for neighboring patterns in communication

Stewardship to Maximum Bottom-hole Operating Pressure

Pattern	Wells	Maximum Operating Pressure Bottomhole (kPag)	Average pressure Sep 17- Aug 18 Bottomhole (kPag)
A	A1-7	1690	1221
B	B1-7	1600	1175
C	C1-6	1390	1189
D	D1-5	1240	1154
E (S)	E1-4	1310	1136
E (N)	E5-7	1270	1169
F	F1-7	1340	1177
G	G1-7	1530	1189
H	H1-4	1780	1526
NN	NN1-5	1680	1522
NN	NN6-10	1750	1568
NN	NN11-16	1700	1490
OO	OO1-3	1490	1189
OO	OO4-9	1520	1340
OO	OO10-15	1500	1331
QQ	QQ2-5	1210	1150*
QQ	QQ6-10	1200	1146*
QQ	QQ11-16	1200	1126*
824	824WP1-2	2060	1909
750 N	WP1-8	2110	2016
750 S	WP14-17	2140	1941**

* Suncor had temporary approval to be above the 80% limit for QQ2-16
**750 WPs 14 & 15 LRT data available starting in March 2018

- All of the Mackay wells in SAGD are currently operating at pressures below the approved maximum bottomhole operating pressure
- Alarm systems are in place to ensure the approved maximum bottomhole operating pressures are not exceeded
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below maximum bottomhole operating pressure

Impact

- Lower production rates in low MOP areas
- Slower ramp-up post planned outage's
- Impacts new well conversions in low MOP areas
- Small impact to mature wells performance

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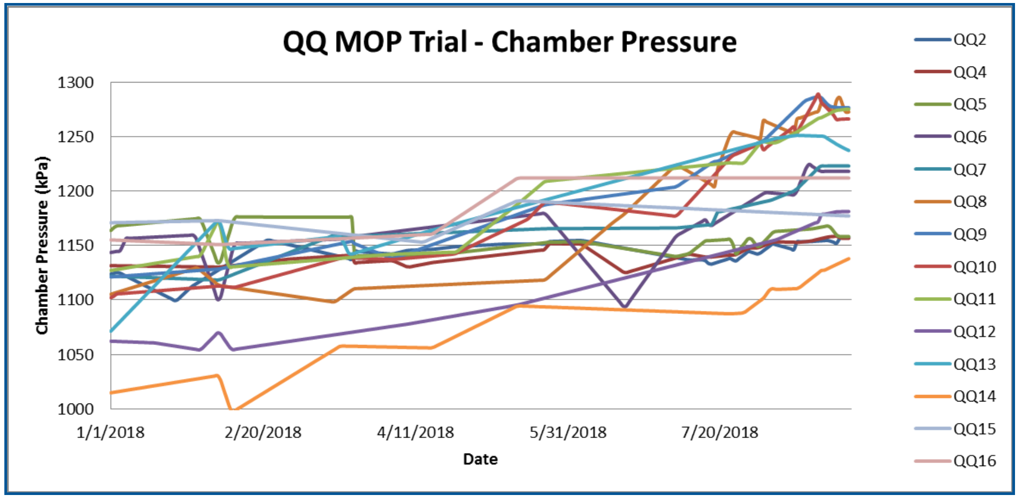
Pad QQ Temporary Bottom-hole Pressure Trial

- AER approval received: May 1, 2018
  - Approved to increase bottom-hole (BH) MOP from 1,210 to 1,370 kPag in QQ2-5 and from 1,200 to 1,350 kPag in QQ2-16 for four months (as per Approval No. 8668VV associated with Application No. 1905502)

- During the pilot the highest BHPs were in well pairs QQ8 to QQ11, ranging from 1,267 to 1,277 kPag
  - No wells reached target bottom-hole MOPs of 1,350 and 1,370 kPag during the trail

Well	Chamber Pressure (kPa) Pre-trial	Chamber Pressure (kPa) August 31, 2018	Difference (kPa)
QQ2	1145	1158	13
QQ4	1130	1157	27
QQ5	1140	1158	18
QQ6	1155	1218	63
QQ7	1160	1223	63
QQ8	1110	1273	163
QQ9	1145	1277	132
QQ10	1140	1267	127
QQ11	1145	1275	130
QQ12	1070	1181	111
QQ13	1160	1238	78
QQ14	1055	1138	83
QQ15	1150	1177	27
QQ16	1160	1212	52



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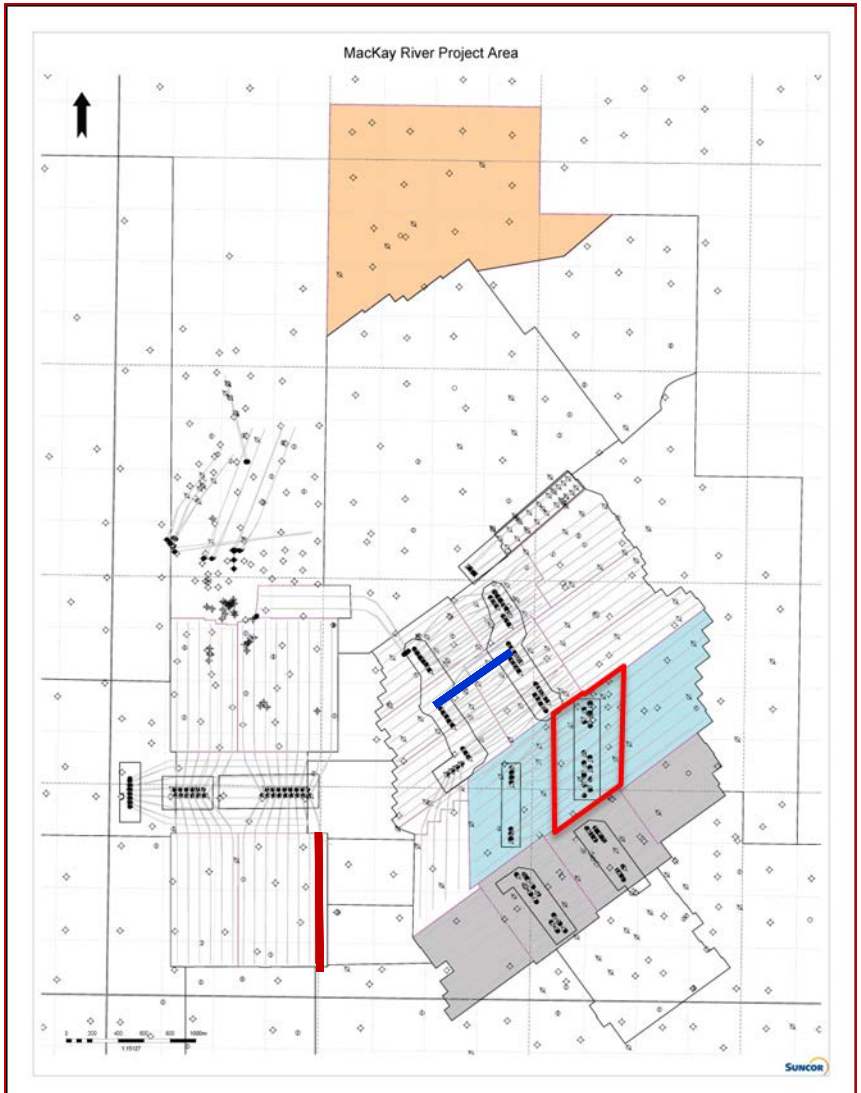
Stewardship to Maximum Bottom-hole Operating Pressure

- For SAGD wells with no downhole instrumentation **Step-down Tests (SDT)** and **Low Rate Tests (LRT)** are performed and used to calculate estimated chamber pressure to ensure that the Maximum Bottomhole Injection Pressure (MBHIP) is not exceeded

- **SDTs** are conducted by lowering the steam injection rate in steps and allowing pressures to stabilize between steps

- **LRTs** are conducted on wells that do not have reliable SDT correlations by reducing the steam injection rates low enough to estimate the chamber pressure

New Technology Projects – Near Term



NCG Co-Injection Expansion

- A/B/C/D first injection in October 2016
- E/F/G first injection planned for Q4 2018

Surfactant Co-Injection Pilot Expansion (F)

- First Injection commenced Q4 2016
- Surfactant returns to surface causing concerns with infrastructure
- Final injection March 2018, no plans to recommence

CO_2 Co-Injection Pilot Well (OO8)

- Injection completed in December 2017
- Final report submitted to AER in June 2018

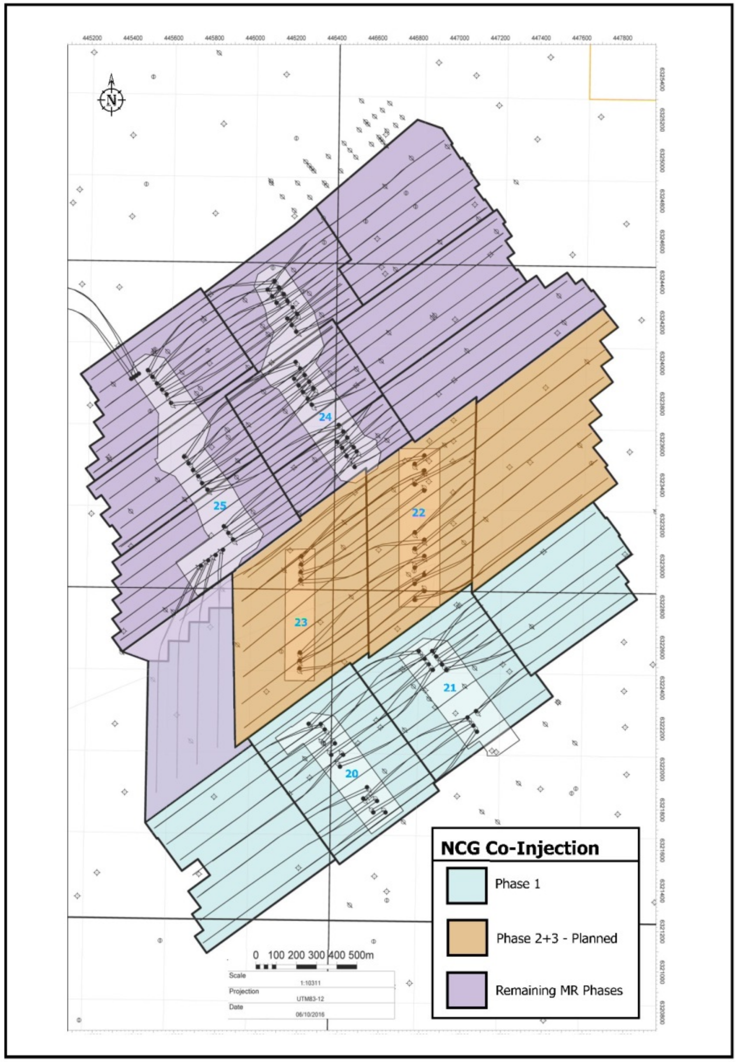
Closed Loop Hot Oil Circulation Pilot (750S10)

- Pilot Operations commenced May 2018

In Situ Demonstration Facility (ISDF)

- Demonstration facility currently at scoping stage
- Integrated Application submitted Q1 2018

SAGD NCG Co-Injection Strategy



Pilot

- NCG co-injection into B pattern commenced October 2011
- Injection was based on steam availability

Stage 1

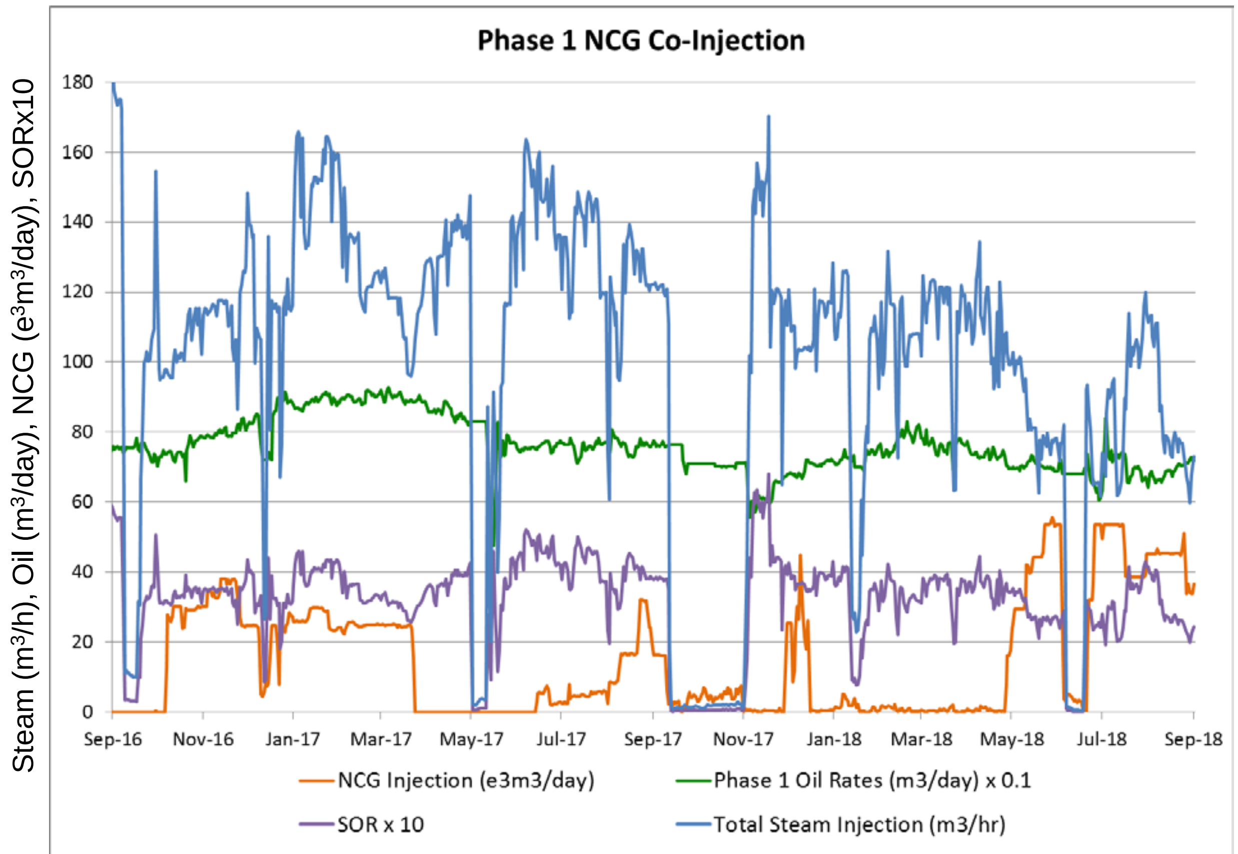
- NCG co-injection to A, B, C, D patterns began October 2016
- Reducing and reallocating steam to other pads to optimize field

Stage 2

- NCG co-injection into E, F, G, patterns work in progress
- Planning first NCG co-injection in Q4 2018

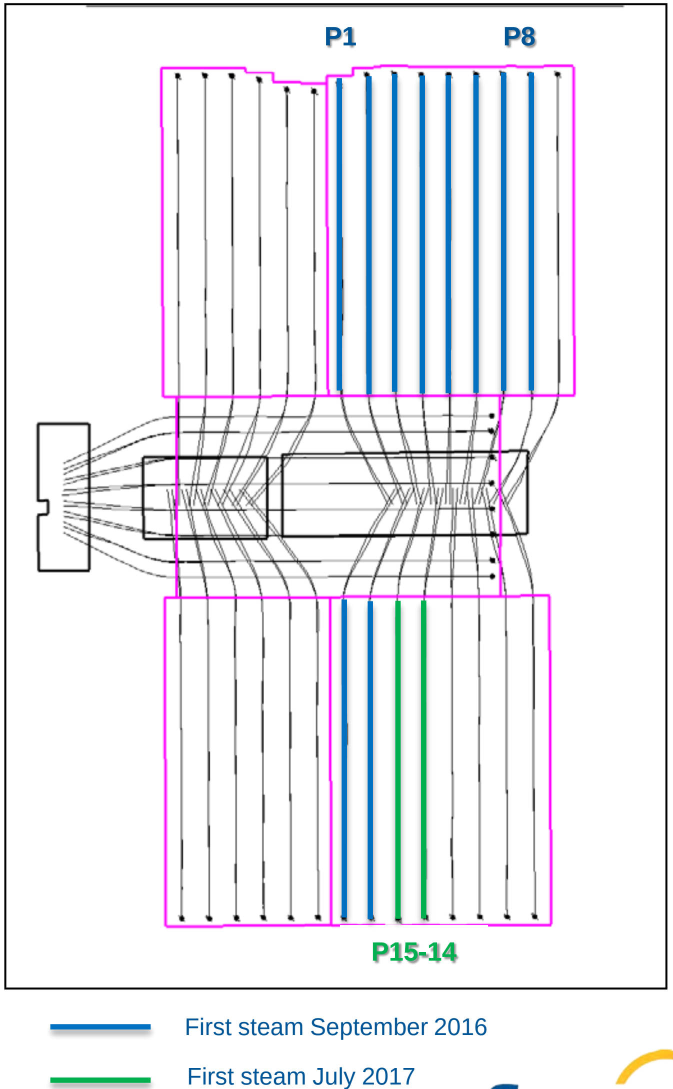
Key Learnings – Phase 1 NCG Co-Injection

- Plan to continue increasing steam cut and NCG injection pending steam demand of developing wells on Pad 750
- No significant impact to oil rates has been observed and partial pressure cooling effects have not been observed on OB wells within the patterns

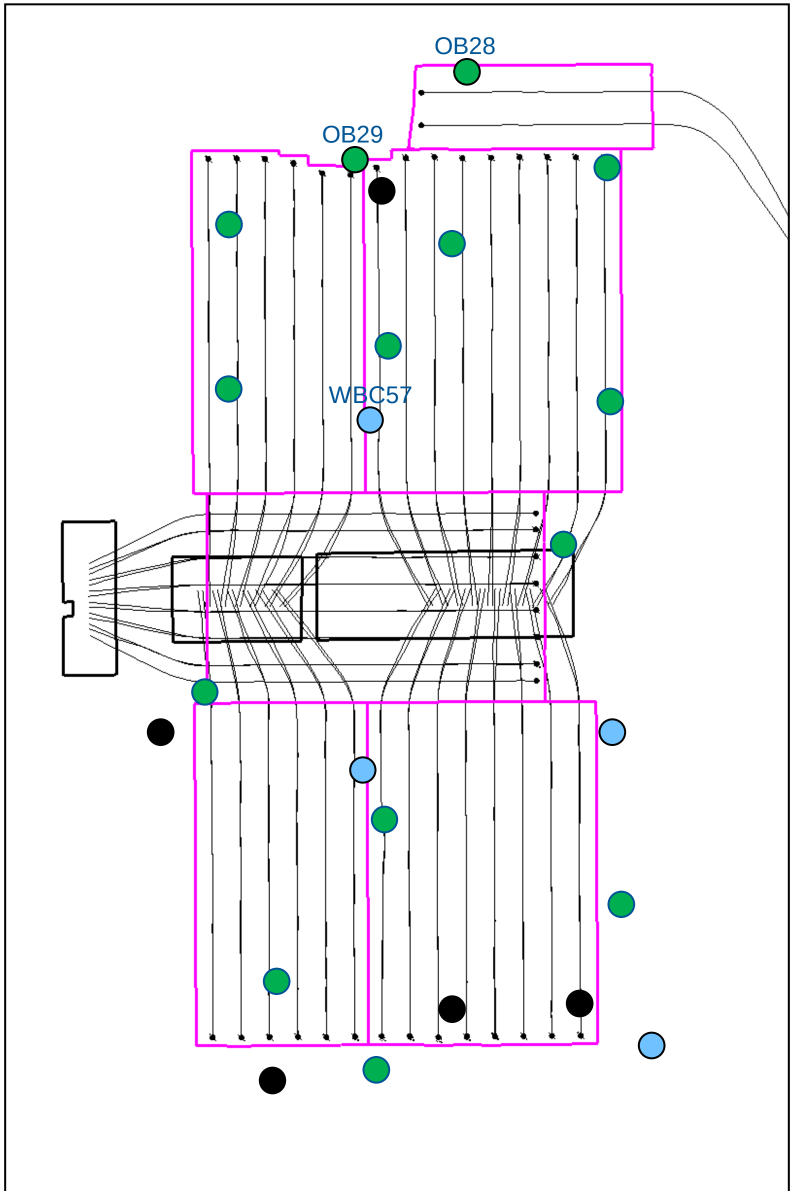


Pad 750 Well Pair Start-Up Update

- 10 wells pairs (WPs 1-8, 16 & 17) commenced circulation steam injection in Sept / Oct 2016 and converted to SAGD in Q1 2017
- 2 wells pairs (WPs 14 & 15) commenced circulation steam injection in July 2017
  - Steam circulation ~110 days prior to SAGD conversion in November 2017
- During the circulation phase, well pairs were operated below approved bottom-hole MOP

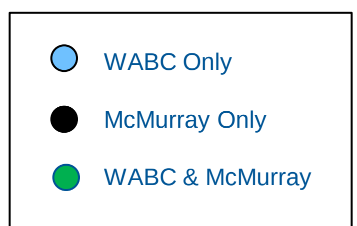


Updated Monitoring Plan for Pads 750, 751 and 824



The monitoring plan for Pads 750, 751 and 824 has been updated as shown

- OB28, north of Pad 824
  - Instrumented to obtain both pressure and temperature data in the cap-rock interval and temperature data in the reservoir interval
- OB29, north east corner of 751 N
  - Instrumented to obtain both pressure and temperature data in the cap-rock interval and temperature data in the reservoir interval
- WBC57, heels between 750 N & 751 N
  - Instrumented to obtain both pressure and temperature data in the cap-rock interval



Future Plans

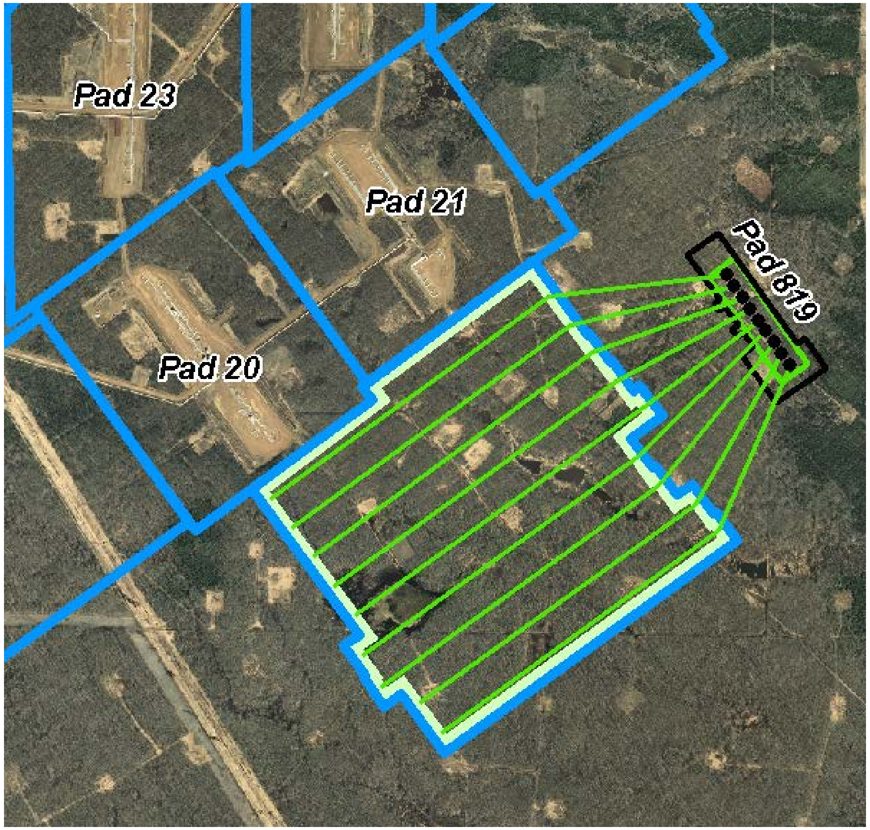
3.1.1.8

Future Development: Pads 750/751

- Pad 750/751 is a future area of development within the MacKay River PA
  - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Approval received August 7, 2012
  - 35 well pairs and 2 single producers in total
- Drilling completed June 2014
  - 12 well pairs on Pad 750 commenced operation in 2016/2017
- Remaining Pad 750 and Pad 751 completions will occur in 2018-2020
  - Start-up timing for 2 remaining well pairs (WP9 & 10) under evaluation
  - Pad 751 targeting first steam for 2020

Future Development: Pad 819

- Pad 819 is a future area of development within the MacKay River PA
  - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Directive 078 amendment approval received in January 2014
  - 9 well pairs located south of existing infrastructure
- Thermal compatibility plan under review
- Drilling planned to be completed in 2020
- Targeting first steam for 2021



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Suncor MacKay River Project: 2018 AER Performance Presentation: Surface Commercial Scheme Approval No. 8668

AER Directive 054
2018 Performance Presentation

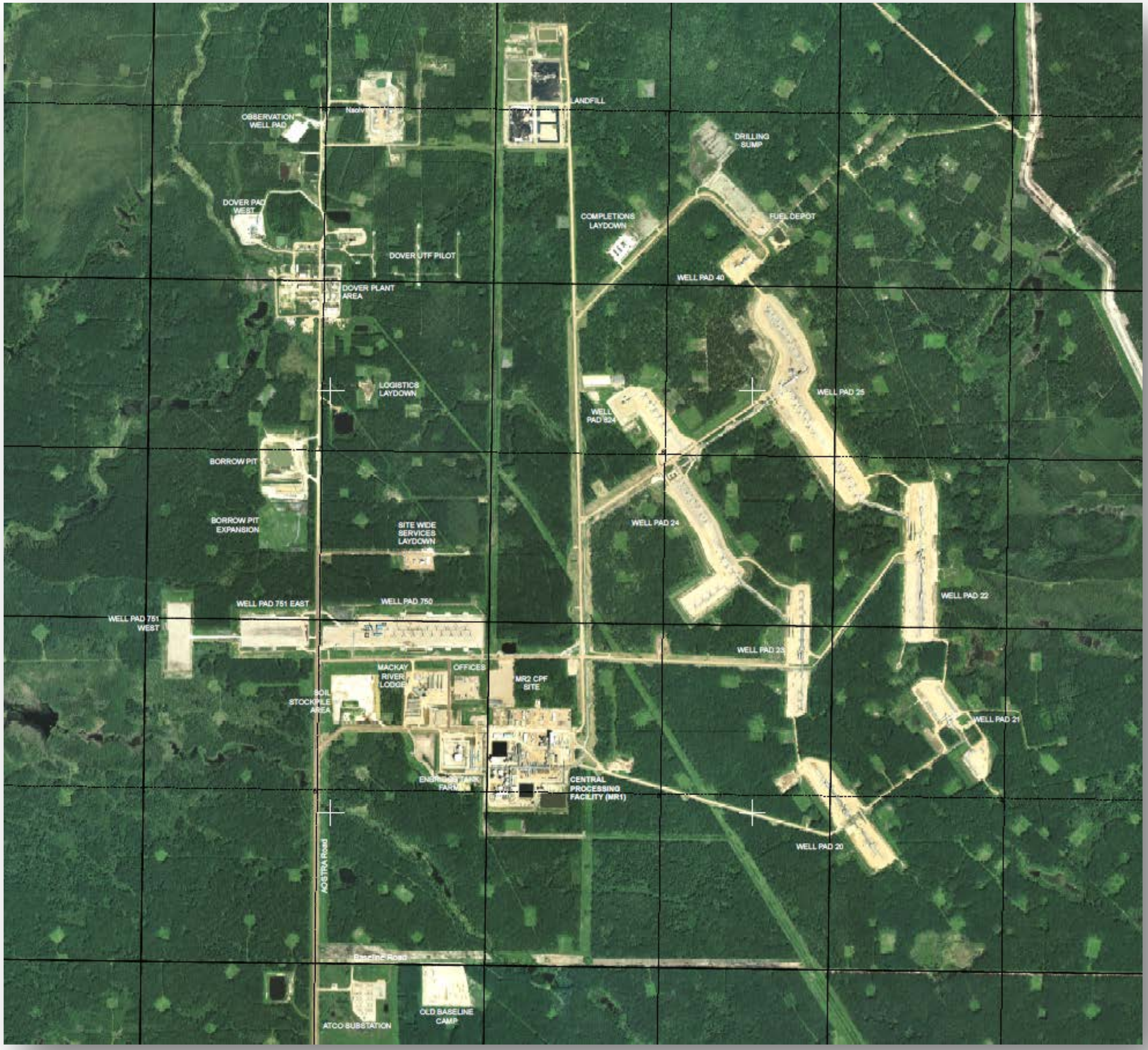
Section 3.1.2 – Surface Operations, Compliance, and Issues not related to Resource Evaluation and Recovery

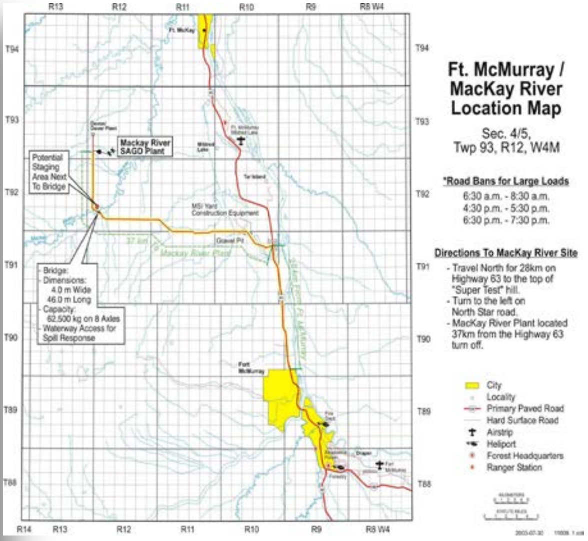
Table of Contents

MacKay River Performance Presentation

Facilities

MacKay River Project Site





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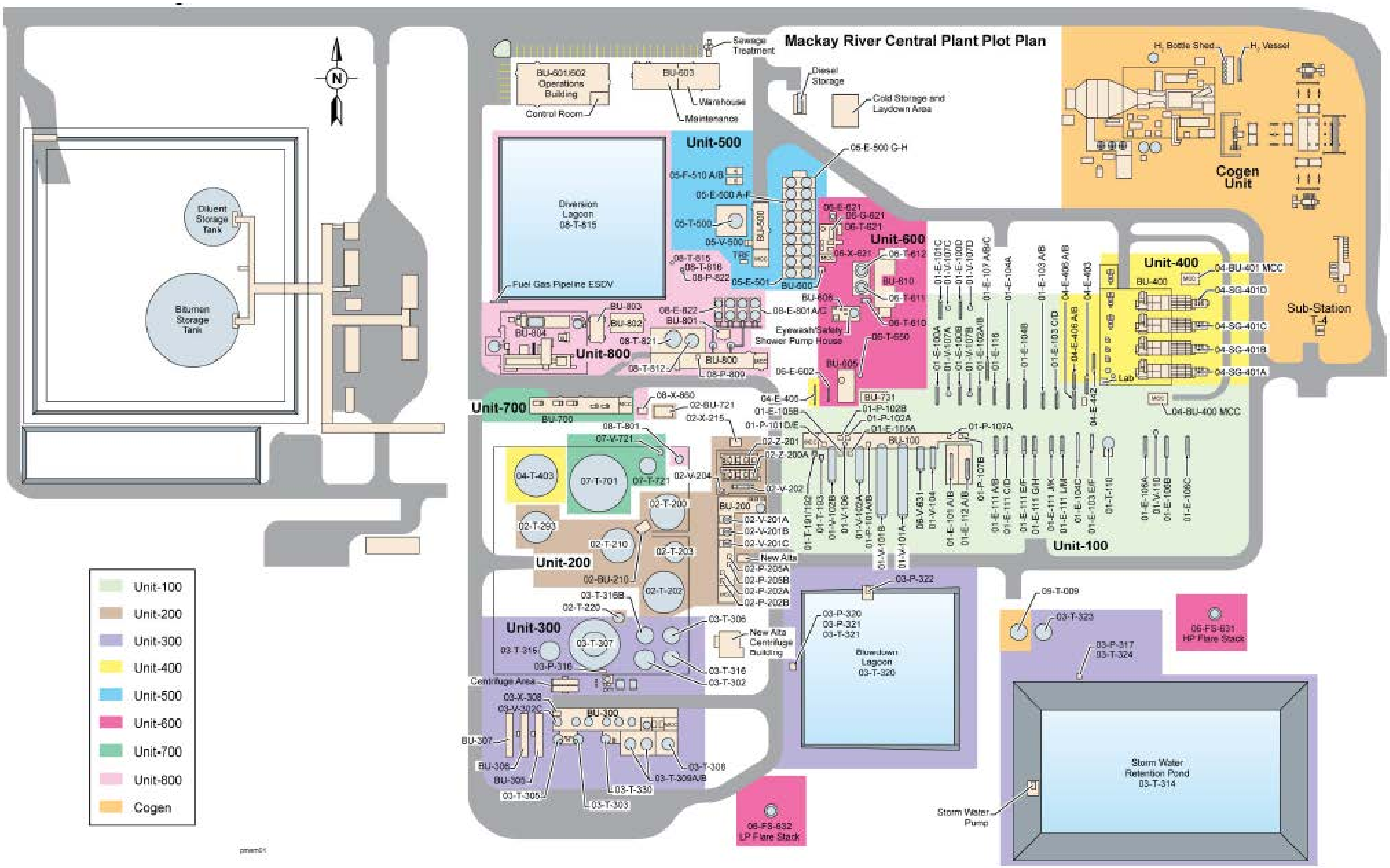
CPF Plot Plan



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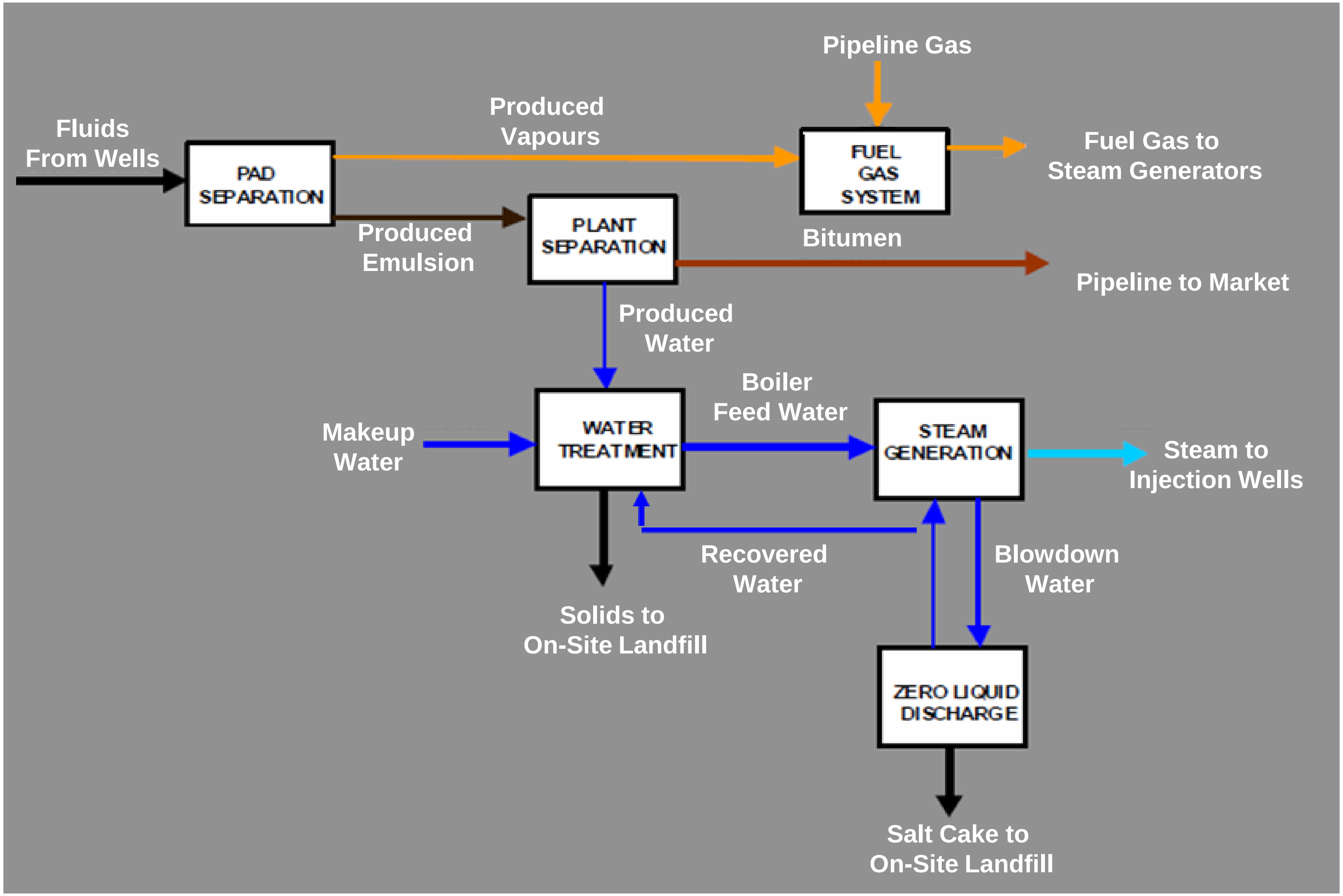
Simplified CPF Process Block Diagram



MacKay River Performance Presentation

Central Processing Facility Performance

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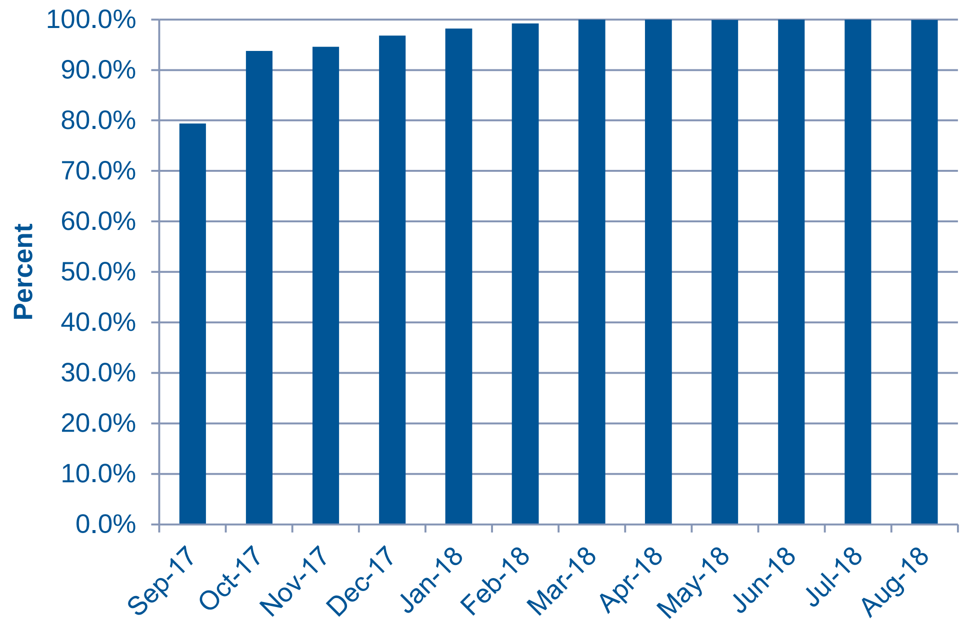
CPF Performance (September 2017 to August 2018)

The reliability of the facility has been steady:

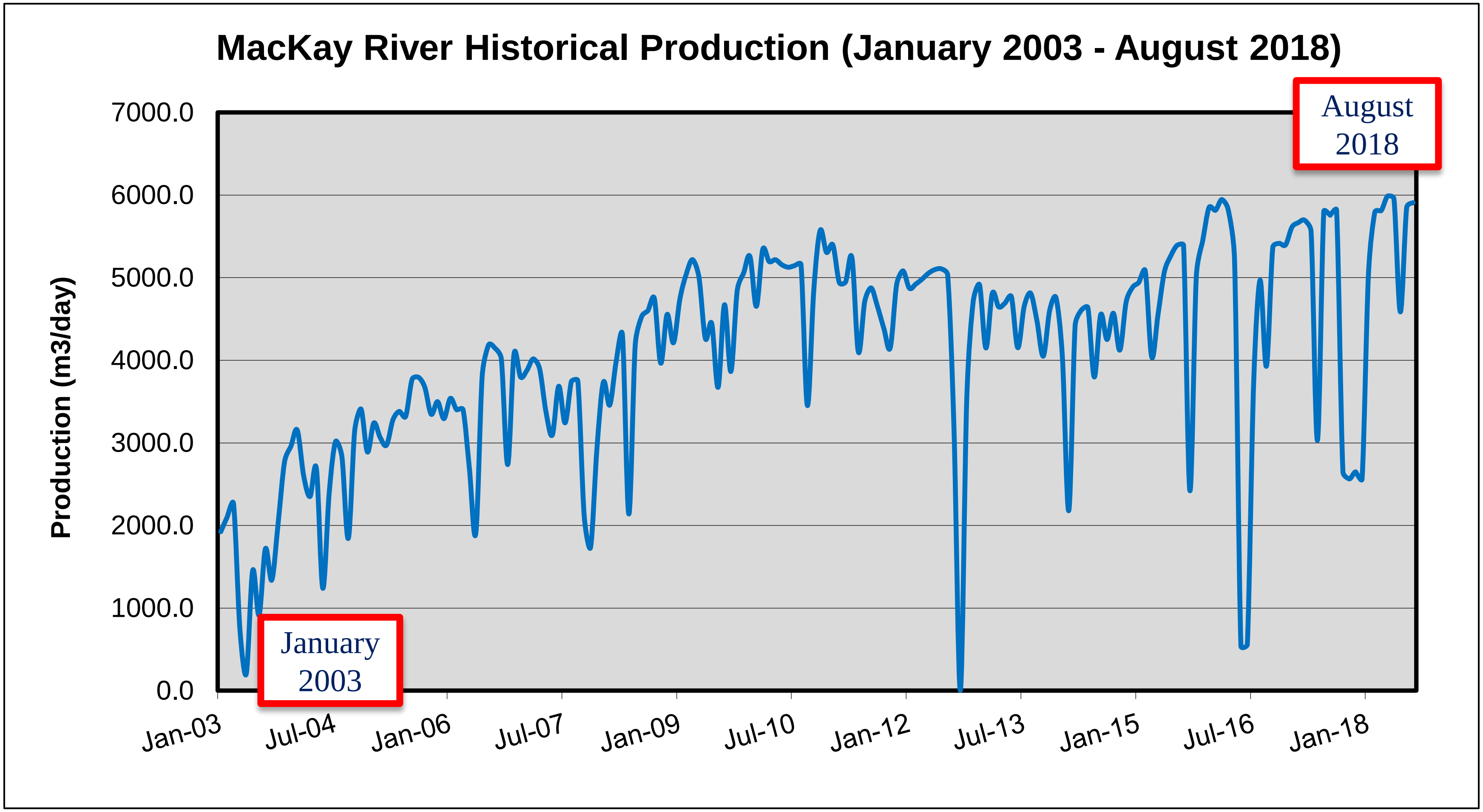
Average 96.8% (September 2017 to August 2018)



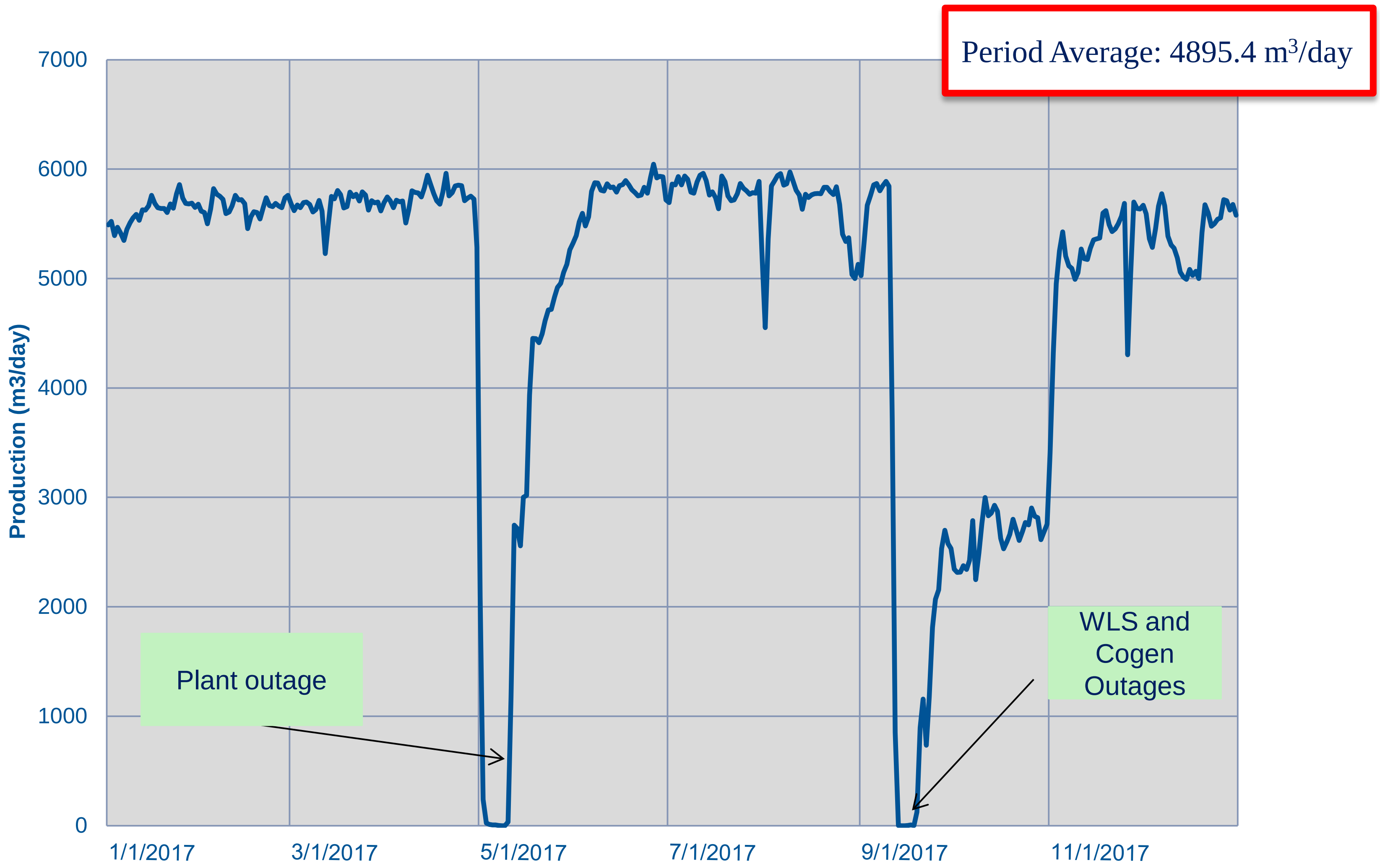
Major challenges:

September 2017 - Unplanned work on Cogen restricted produced steam and bitumen production.

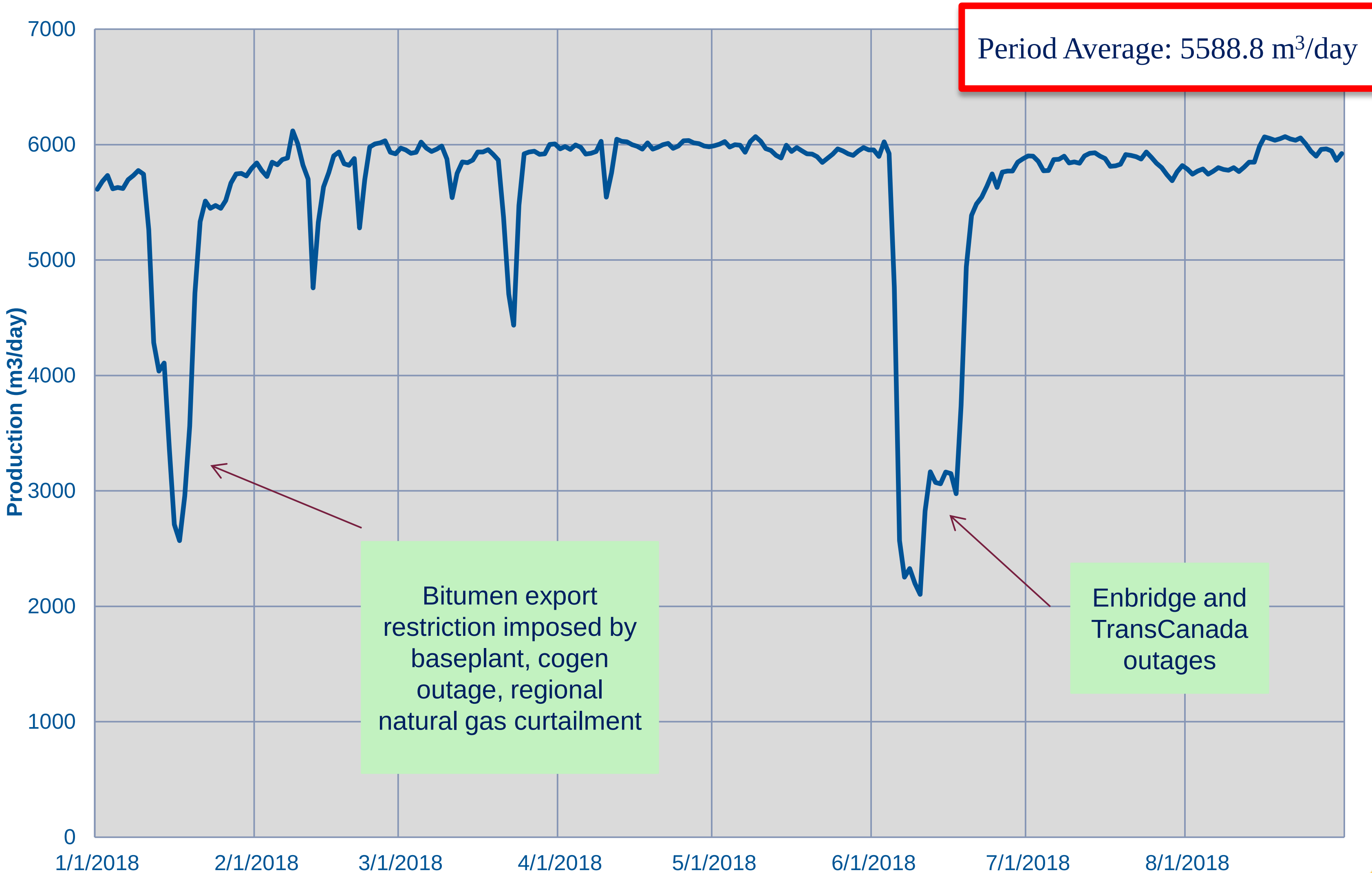
Historical Production (January 2003 – 2018 YTD)



Production (2017)



Production (January 2018 to August 2018)



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Water Treatment Technology

Warm Lime Softening (WLS) and Weak Acid Cation (WAC) softening for produced water;

Zero Liquid Discharge (ZLD) System on blowdown slip stream:

- Evaporators: one steam and one mechanical driven;
- Crystallizer: Steam driven;
- Dryer: gas fired;
- Filter press (2): back up for dryer.

Boiler Feed Water Quality

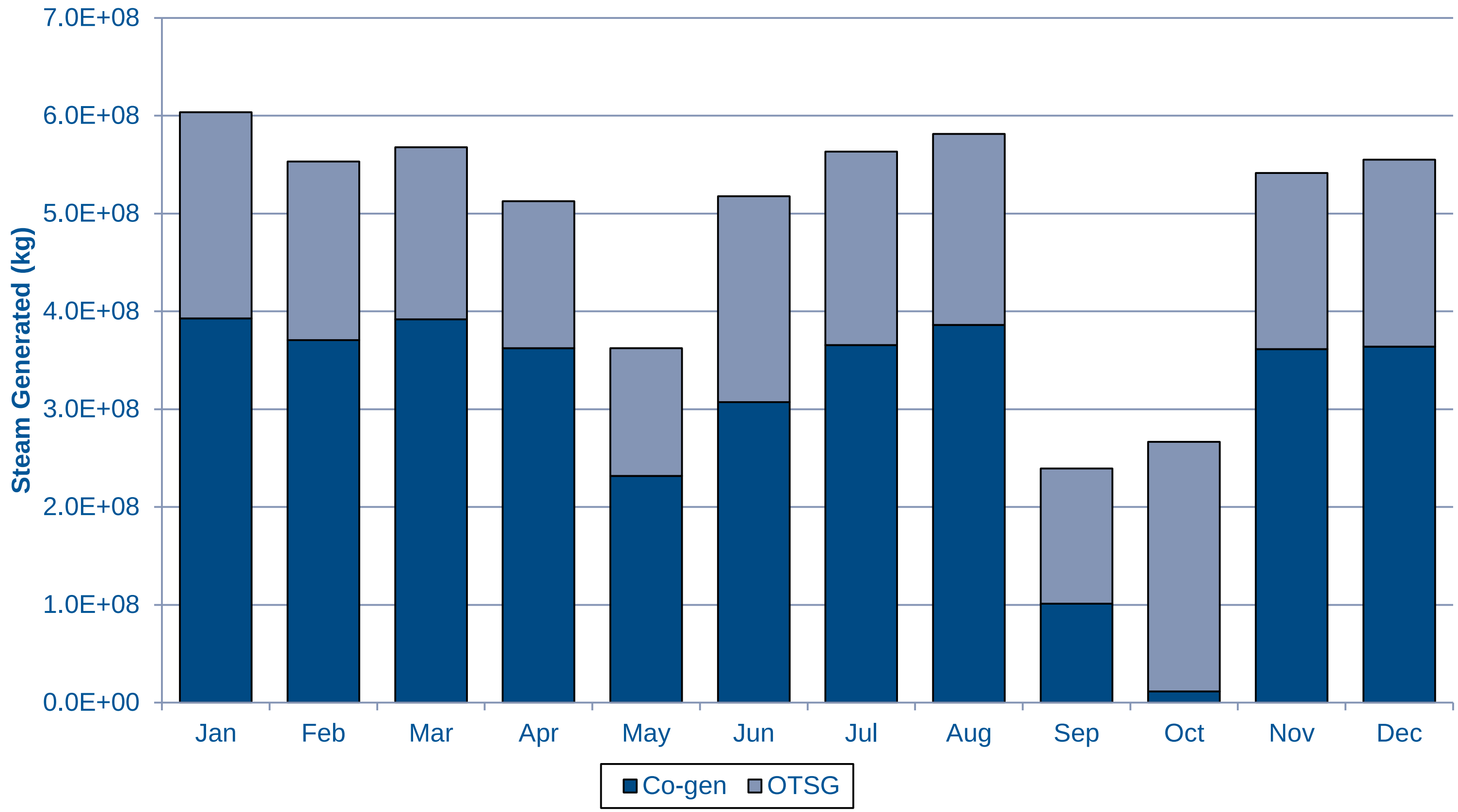
Parameter	Avg. Value (Sept 2017 – Aug 2018)	Max Value During Period	BFW Specifications
Temperature, ºC	151.6	160.6	140 - 170
Hardness (Dissolved), mg/L	0.2	1.4	<1.0
Total Dissolved Solids, mg/L	5967.7	8550.8	<8000
Silica, as SiO2, mg/L	20.1	52.6	<50.0

Water Treatment Successes and Challenges

WLS performance has been steady:

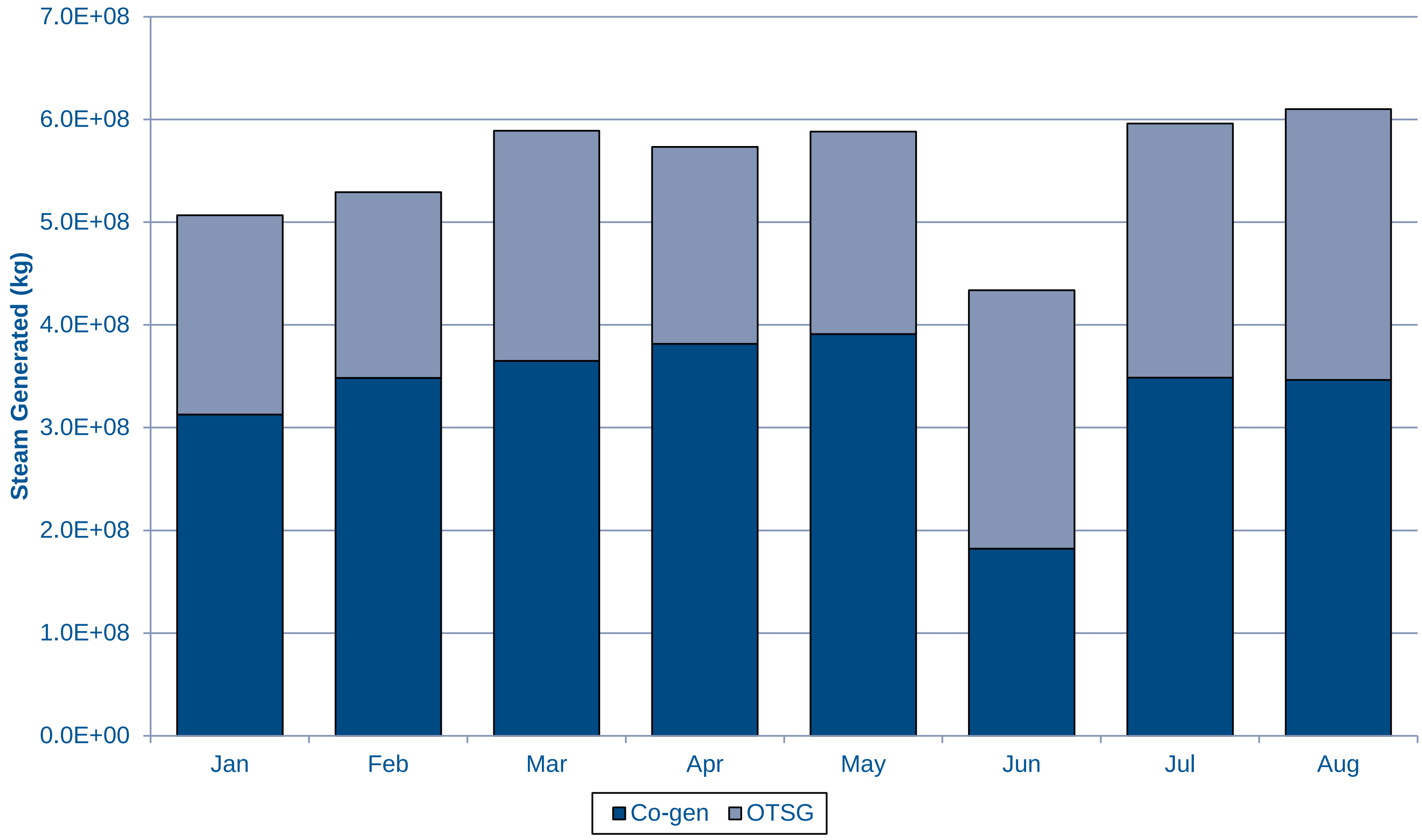
- Reliability is 95.5%:
  - Consecutive days within spec: 220 days Parameters: temperature, hardness, total dissolved solids, pH, silica, oil, free oxygen, total dissolved iron.

Steam Generation (2017)



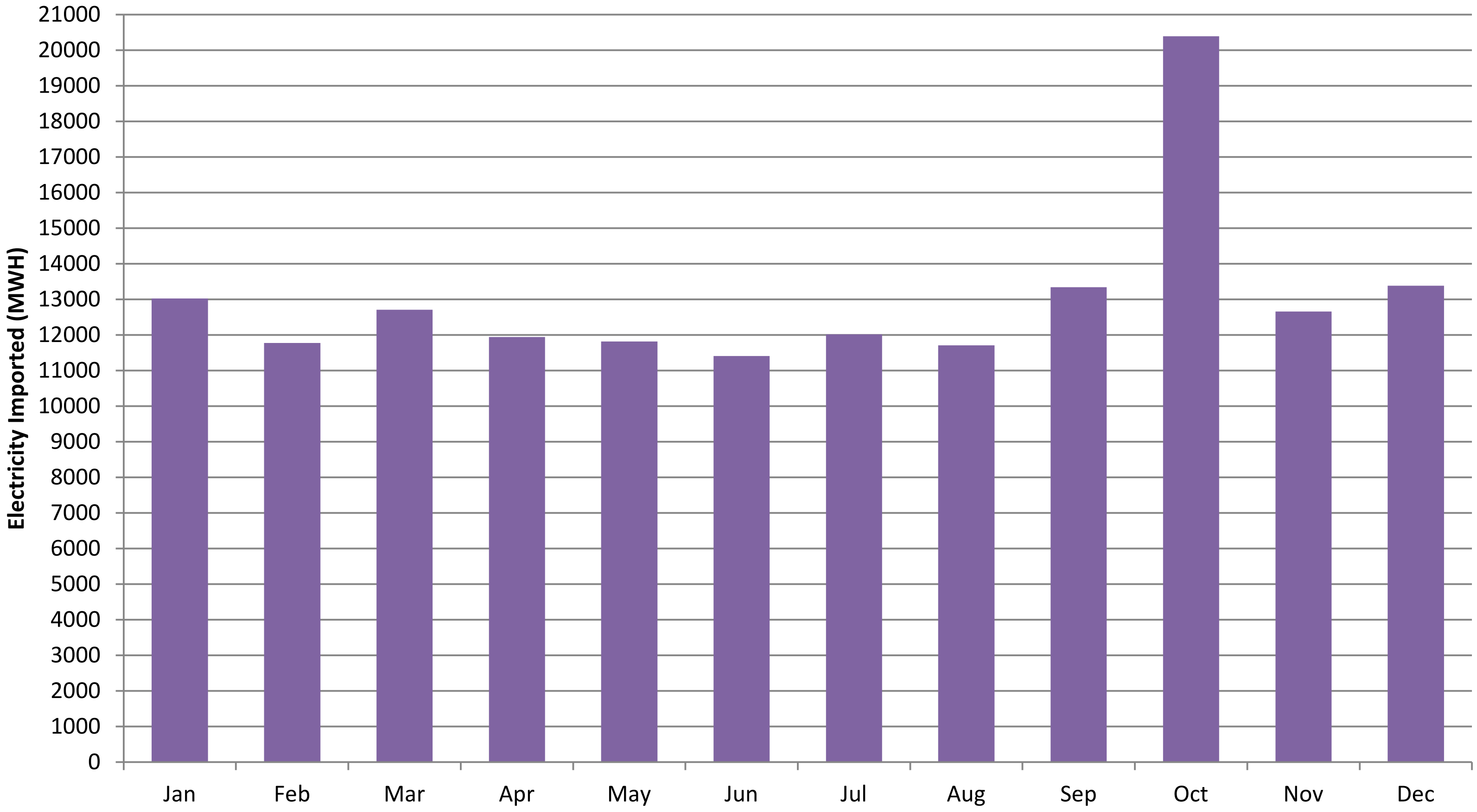
Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%

Steam Generation (2018 YTD)



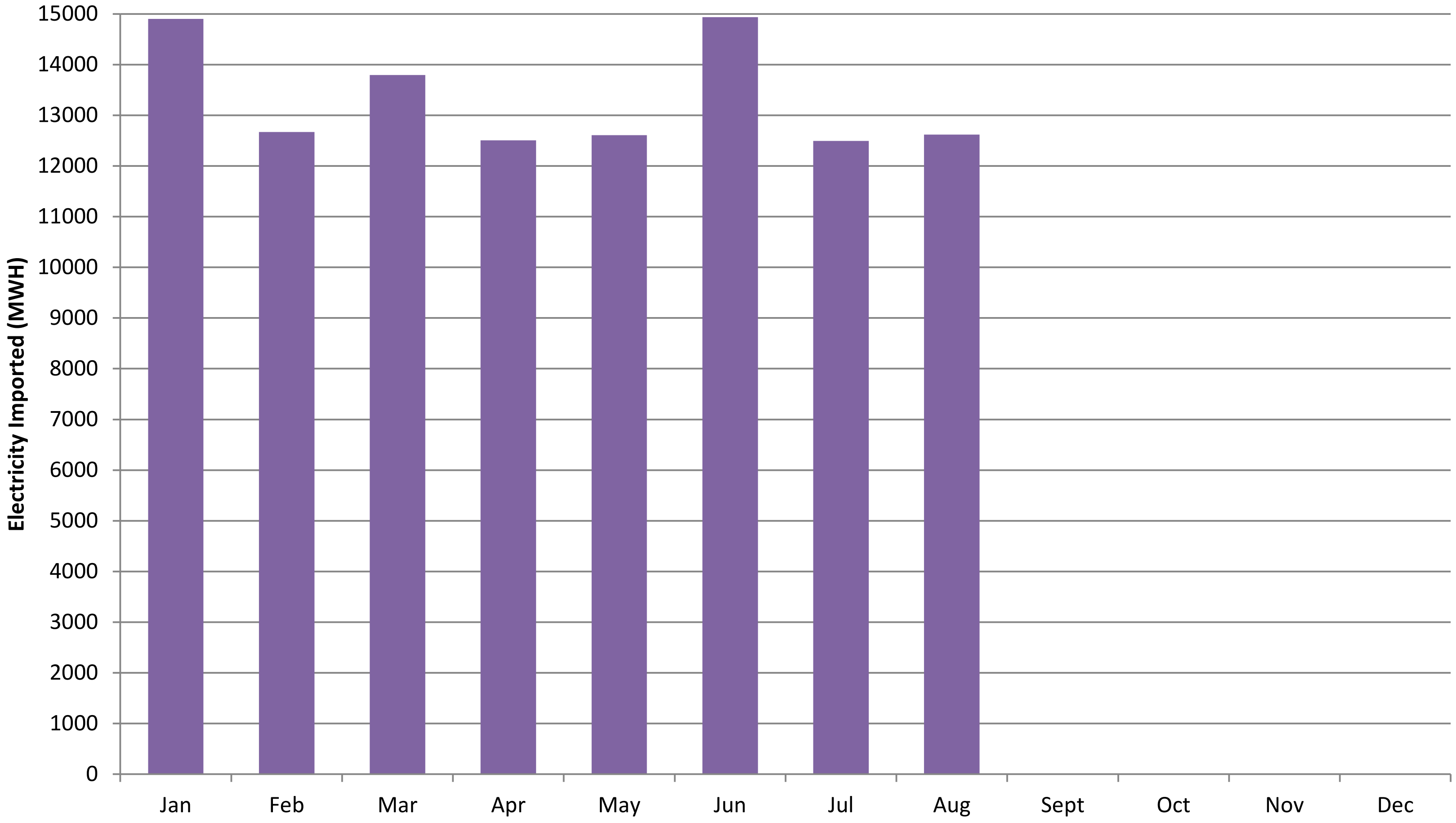
Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%

Power Imported (2017)



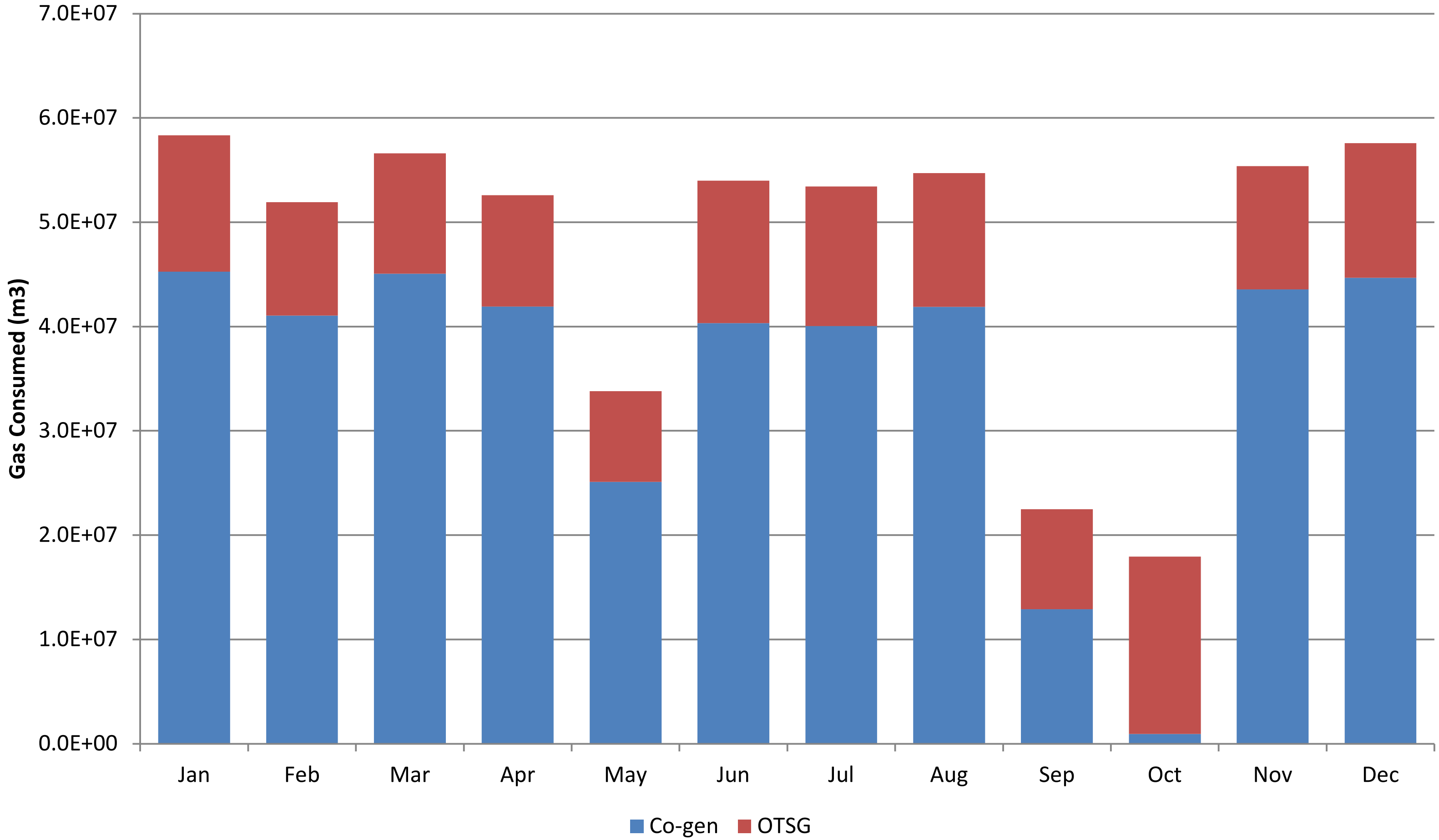
*Note: All power imported into Mackay River is consumed

Power Imported (2018 YTD)

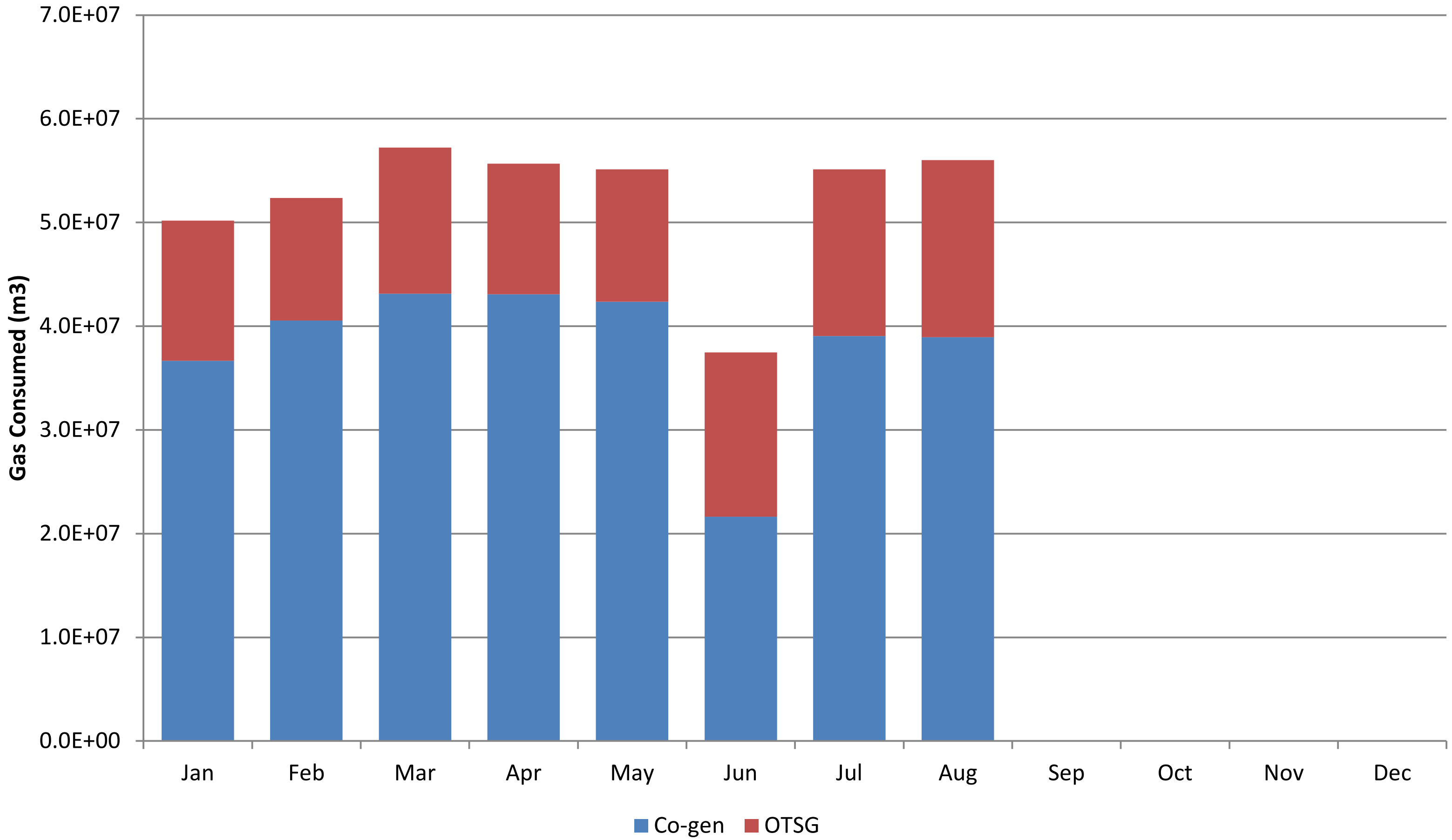


*Note: All power imported into Mackay River is consumed

Gas Consumption (2017)



Gas Consumption (2018 YTD)



Energy Intensity

Energy Intensity Formula

- Energy Intensity (GJ/m^3) = Total energy consumed by site / Sales bitumen volume;

- Total energy consumed by site (GJ) = Energy used to make steam and blowdown in Cogen + Natural Gas imported to site + Solution gas to Cogen + Electricity consumed by site – Mixed gas to Cogen duct firing:
  - Note that the term “site” does not include Cogeneration.

- Energy used to make steam and blowdown in Cogen (GJ) = BFW Mass Flow Rate to Cogen x Hourly average difference in enthalpy between steam/blowdown and BFW.

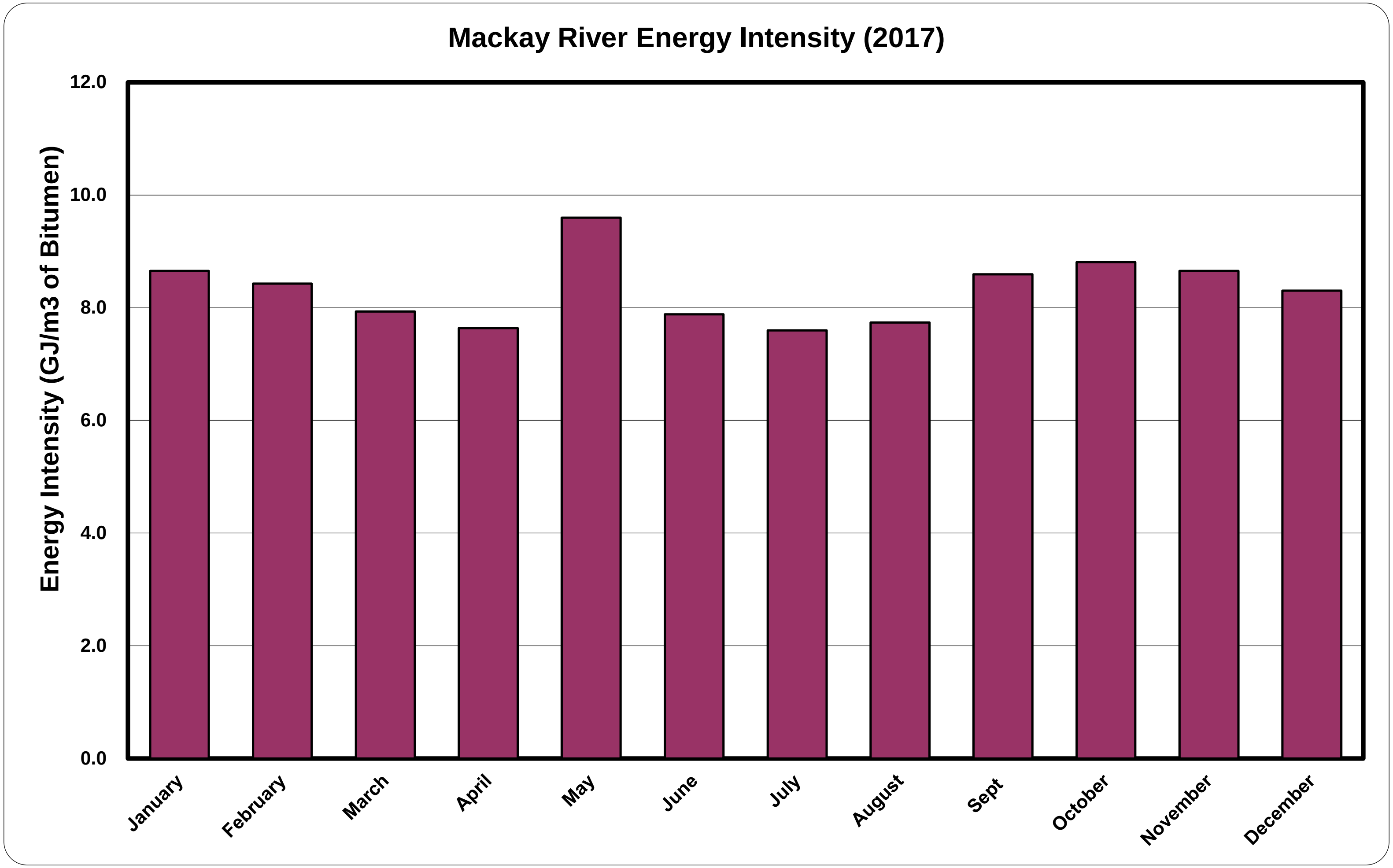
Cogeneration with TransCanada Energy

- Energy exchange: TransCanada Energy (TCE) provides steam and electricity to Suncor in exchange for BFW and a fee;

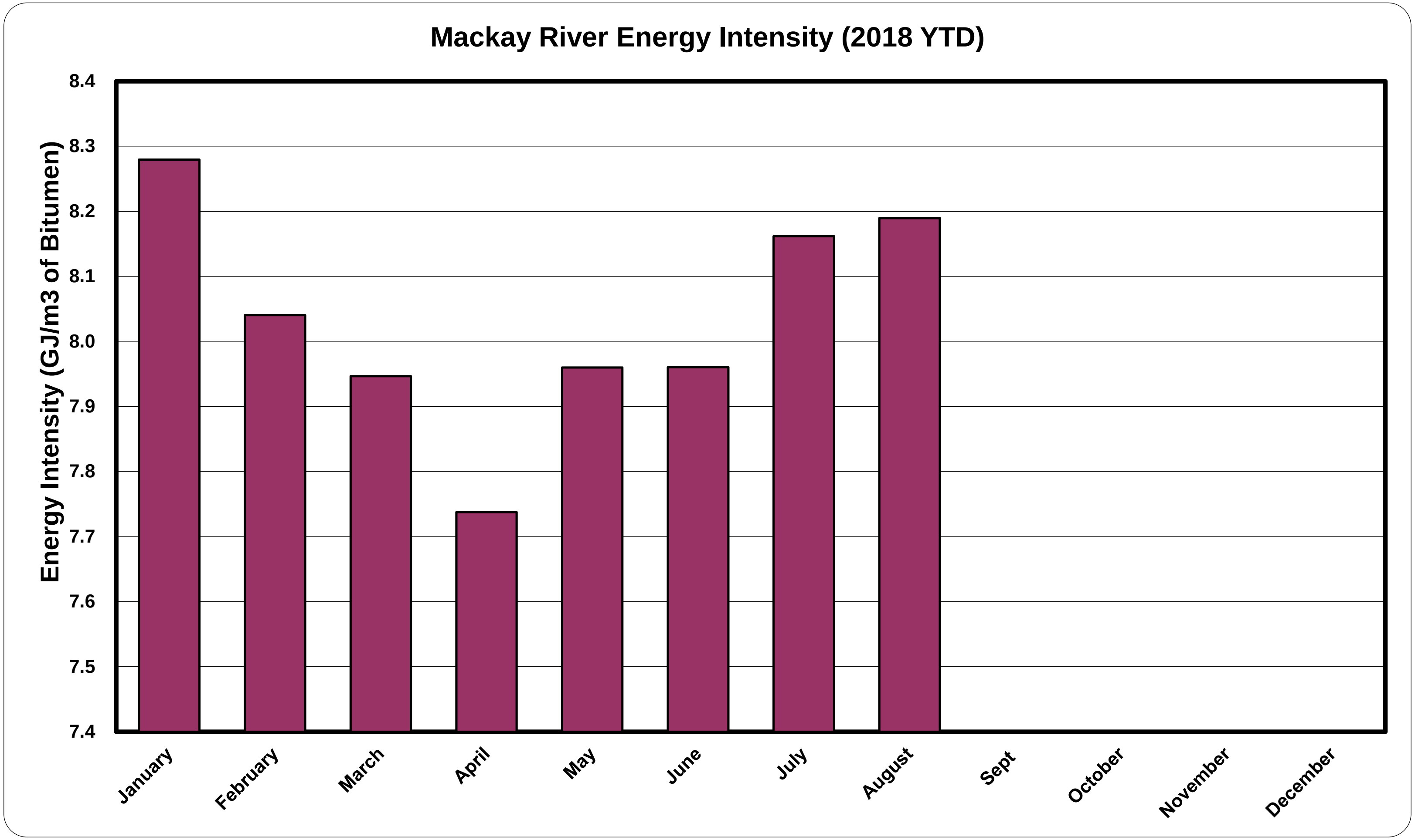
- A large portion of the steam used in the injection wells is recovered by Suncor as produced water. This produced water supplies most of the feedwater required for the HRSG.;

- A portion of the electrical power generated by the cogeneration plant is sold to Suncor for use onsite as well as at other offsite locations. In addition to the power contracted to Suncor, up to 150 MW of power is made available to Alberta consumers

Energy Intensity (2017)



Energy Intensity (2018 YTD)



MacKay River Performance Presentation

Measurement and Reporting

Measurement Accounting & Reporting Plan (MARP)

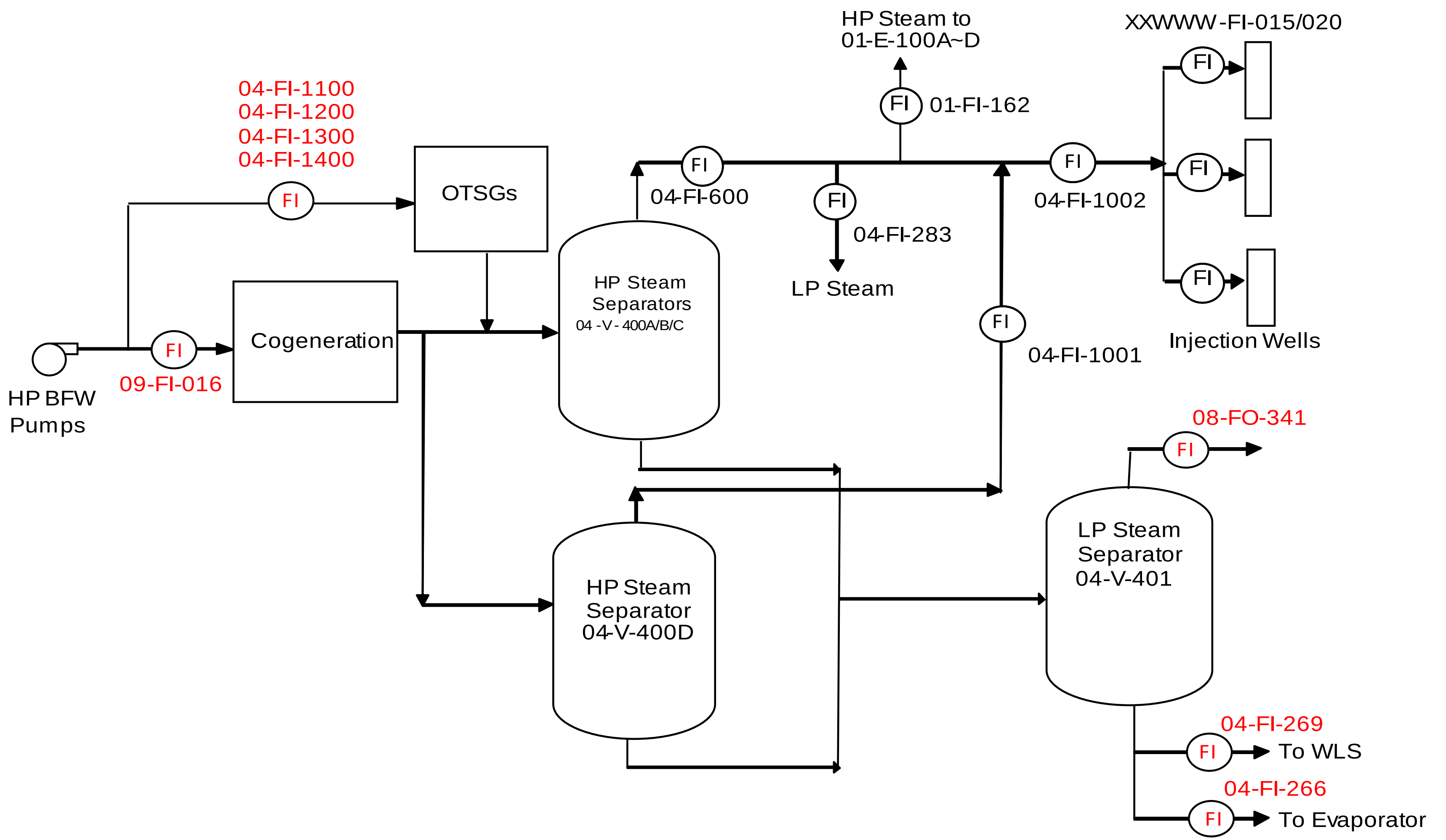
- Annual internal update to be finalized by November 30, 2018

- MacKay River Report Codes:
  - Battery – AB BT 0067097;
  - Injection Facility – AB IF 0009498;
  - Meter Station – AB MS 0084090.

Water Balance

- **Steam**:
  - Primary produced steam:
    - Steam Injection to Wells = BFW to Steam Generators – Boiler Blowdown – Utility Steam – LP Steam – Condensate from Pads
  - Secondary produced steam:
    - Sum of steam meters from steam separators (04-FI-600, 04-FI-1001) minus steam sent to production heaters (01-FI-162) and any steam vented (04-FI-283).

Water Balance Continued



Water Balance Continued

- **Raw Water** = Σ Water Source wells (3 water source wells);

- **Accumulation** = Closing Inventory – Opening Inventory;

- **Produced Water**

  Primary Method:

  Produced water to WLS + Accumulation – Others.

  Where:

  – Produced Water to WLS = 02-FI-500 + bypass + 02-FI-306;

  – Others include: Raw water, BLD Recycle, BFW to VRU.

  Secondary Method:

  Produced water to Deoiled Tank – ORF Backwash Flow + Accumulation – Others.

  Where,

  – Produced water to Deoiled Tank - ORF Backwash Flow = (02-FI-220 + 02-FI-240+ 02-FI-260 + 02-FI-520) – (02-FI-300 + 03-FI-612 + 03-FI-610 + 07-FI-228)

  – Others include: Water Condensate from Pads, Raw water, BLD Recycle, BFW to VRU

- **Water from the crystallizer is metered at the crystallizer outlet before it goes to the dryer:**

  – Truck tickets capture the volume of water trucked

  – Volumes reported in Petrinex.

Well Testing Strategy

Test Separators are used to test all wells for production allocation

- **Fully compliant with Directive 017**

Pad 20 Well Testing Strategy

- 13 active SAGD producers, 4 hour tests (+ purge time)

Pad 21 Well Testing Strategy

- 12 active SAGD producers, 4 hour tests (+ purge time)

Pads 22 Well Testing Strategy

- 22 active SAGD producers, 5.5 hour tests (+ purge time)
- Phase 4 (NN1 and QQ2-3) are tested via Pad 22 Test Separator
- Phase 5A (NN2-5, QQ4-5) are tested via Pad 22 Test Separator

Pads 23/24 Well Testing Strategy

- 14 active SAGD producers, 7-7.5 hour tests (+ purge time)
- Pad 24 Phase 4 (OO1-3) are tested via Pad 23 Test Separator
- Pad 24 (H1-4) are tested via Pad 23 Test Separator

Pad 25 Well Testing Strategy

- V-100 Test Separator
  - 10 active SAGD producers, 5 hour tests (+ purge time)
- V-1100 Test Separator
  - *12 active SAGD producers,* 4 hour tests (+ purge time)
- V-1150 Test Separator
  - *12 active SAGD producers*, 4-5 hours test (+ purge time)
  - Pad 24 Phase 5B1 (OO4-9) are tested via V-1150
  - Pad 24 Phase 5DF (OO10-15) are tested via V-1150

Pad 824 Well Testing Strategy

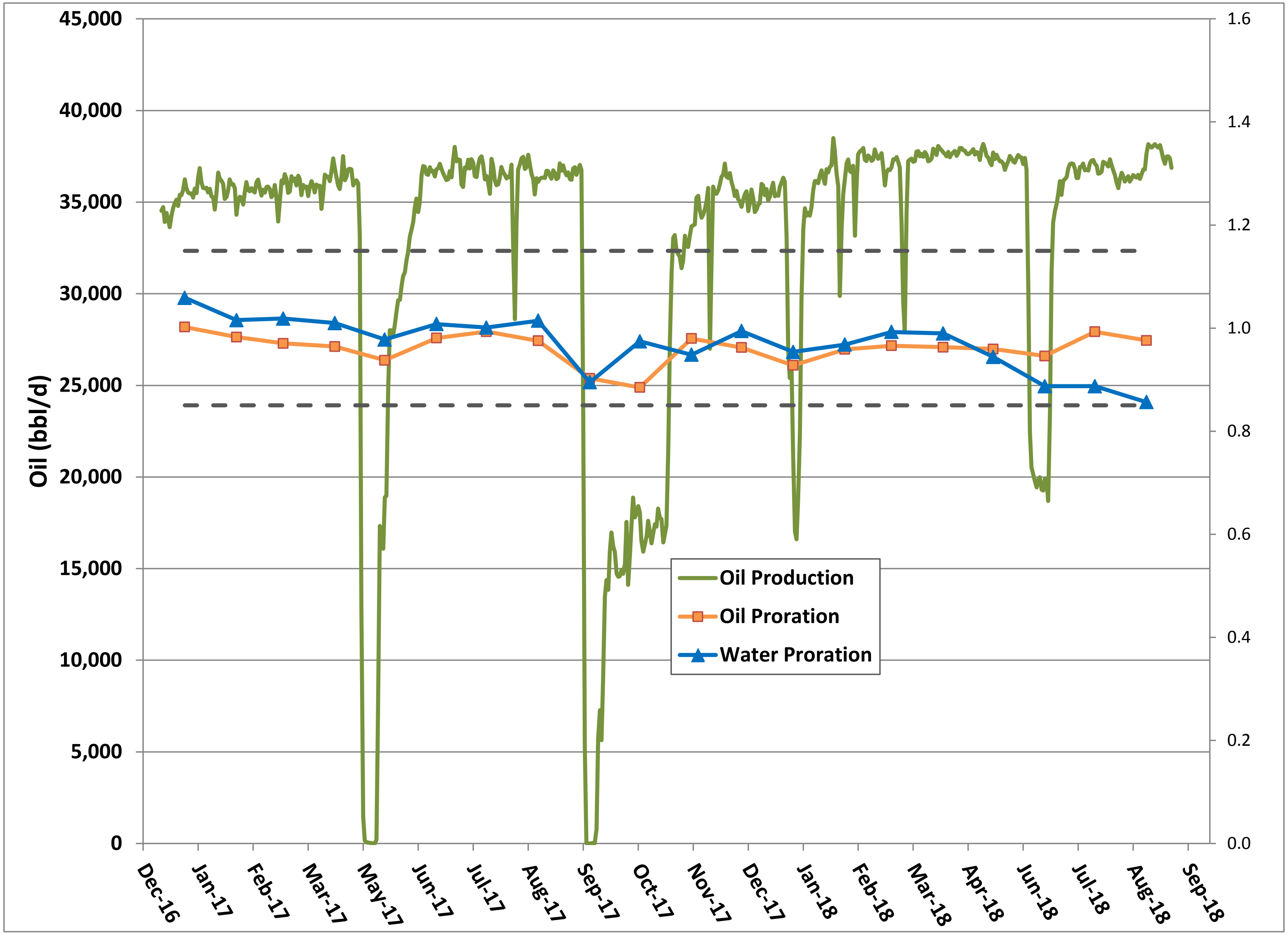
- 2 active SAGD producers, 7 hour tests (+ purge time)
- Wells are tested via Vx Meter

Pad 750 Well Testing Strategy

- Pad 750 Test Separator V-8350
- 12 active SAGD producers, 5 hour tests (+ purge time)

Proration of Oil and Water

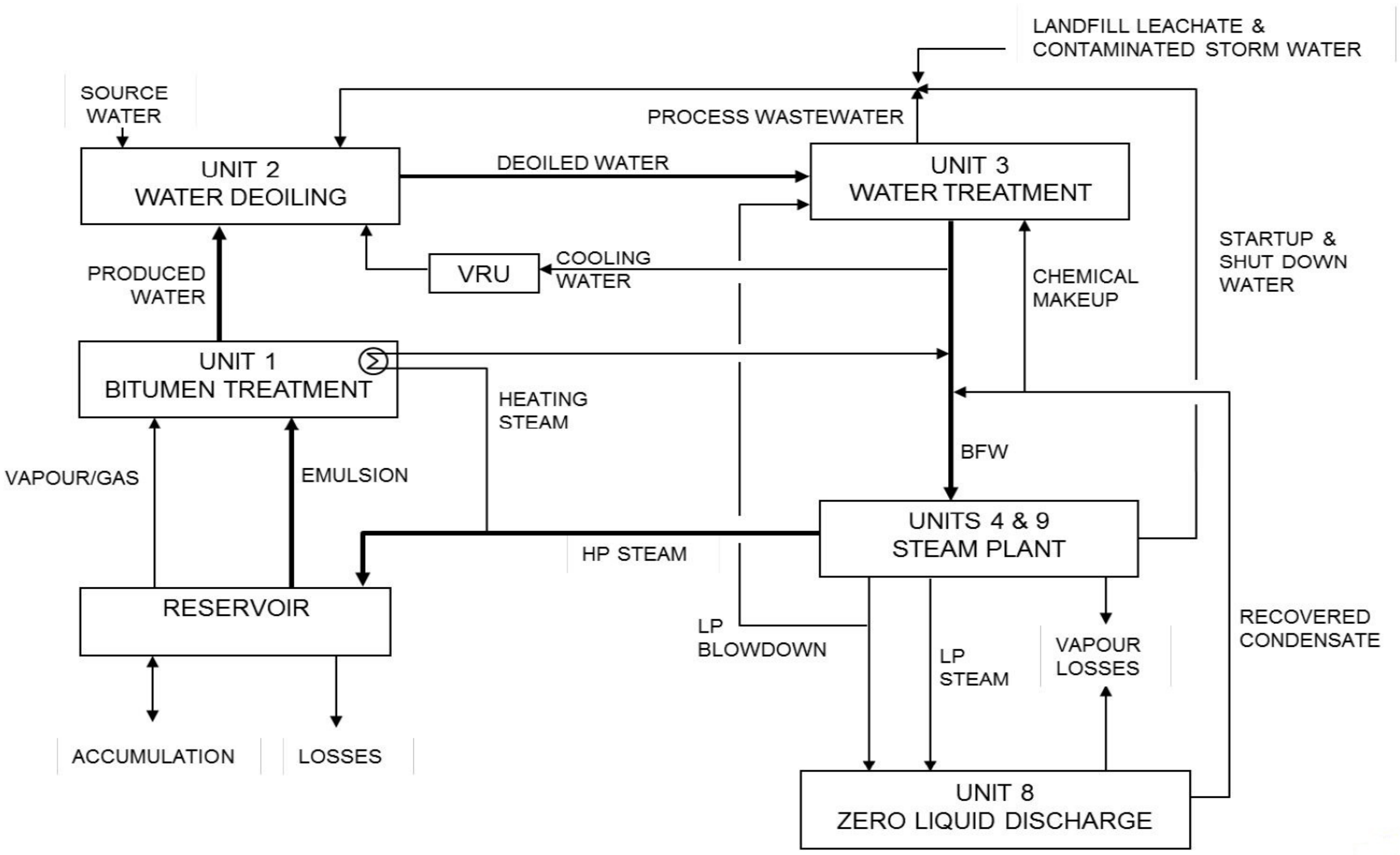
- Average for 2017: Oil Factor = 0.96 Water Factor = 0.99
- Average for 2018 YTD: Oil Factor = 0.96 Water Factor = 0.93



MacKay River Performance Presentation

Water Production, Injection and Use

CPF Water Traffic



Fresh Water

Source Water Wells

- *Water Act* Licence No. 00188229-03-00 (511,000 m^3/year) Birch Channel Aquifer (Renewal issued August 2017):

1. 13-05-093-12W4 (GD-SW-212-53; formerly WSW-1), max. rate 450 m^3/day;
2. 04-08-093-12W4 (GD-SW-213-86; formerly WSW-2), max. rate 1368 m^3/day;
3. 04-08-093-12W4 (GD-SW-215-91; formerly WSW-3), max. rate 1411 m^3/day.

Domestic Water Well:

- *Water Act* Licence No. 00249470-01-00 (25,550 m3/y) Birch Channel Aquifer (Issued in July 2013) :

4. 12-05-093-12W4 (CWSW-SW-218-55), max. rate 123 m3/day.

Monthly reporting for Source Water Wells and Domestic Water Well is done through Water Use Reporting System (WURS).

Raw Water Source Wells

Source Well - SW-212-53					
Test	**Parameter**	**Water Analysis Result (5-Oct-15)**	**Water Analysis Result (29-Sep-2016)**	**Water Analysis Result (23-Oct-2017)**	**Water Analysis Result (30-May-2018)**
Physical	EC (uS/cm)	855	842	805	858
	pH (units)	8.32	7.8	8.35	8.08
	Tot Hard as $CaCo_3$ (mg/L)	398	434	381	398
	Tot Alk as $CaCO_3$ (mg/L)	363	376	369	371
Indicators	Chloride:D (mg/L)	<0.5	0.53	0.52	0.54
	Sulphate:D (mg/L)	111	113	111	111
	Iron:D (mg/L)	<0.03	5.6	<0.03	<0.01
	Manganese:D (mg/L)	0.258	0.272	0.183	0.256
	TDS-calculated (mg/L)	504	526	525	525
cations, anions, and ion balance	Calcium:D (mg/L)	105	115	95.7	104
	Magnesium:D (mg/L)	33	35.7	34.4	33.6
	Potassium:D (mg/L)	5.36	5.5	5.11	5.31
	Sodium:D (mg/L)	31.8	30.9	33.4	31.6
	Bicarbonate:D (mg/L)	363	376	438	453
	Carbonate:D (mg/L)	<5	<5	6.2	<5
	Hydroxide:D (mg/L)	<5	<5	<5	<5
	Fluoride:D (mg/L)	0.205	0.25	0.237	0.259
	Ion balance % (%)	99.7	103	88.9	96.9
nitrogen parameters	NO2 as N (mg/L)	<0.01	<0.01	<0.01	<0.01
	NO3 and N (mg/L)	<0.02	<0.02	<0.02	0.029
	NO2 + NO3 as N (mg/L)	<0.022	<0.022	<0.022	<0.029
	DKN (mg/L)	-	-	-	-
	TKN (mg/L)	-	-	-	-
	Tot Amm N (mg/L)	-	-	-	-
phenols	phenols (mg/L)	-	-	-	-
PAH	Naphthenic Acids (mg/L)	-	-	-	-

Typical water quality assessment parameters;

Monitoring station GD-SW-212-53 (formerly WSW-1);

Results shown are from 2015 - 2018.

There is no change in the water quality.

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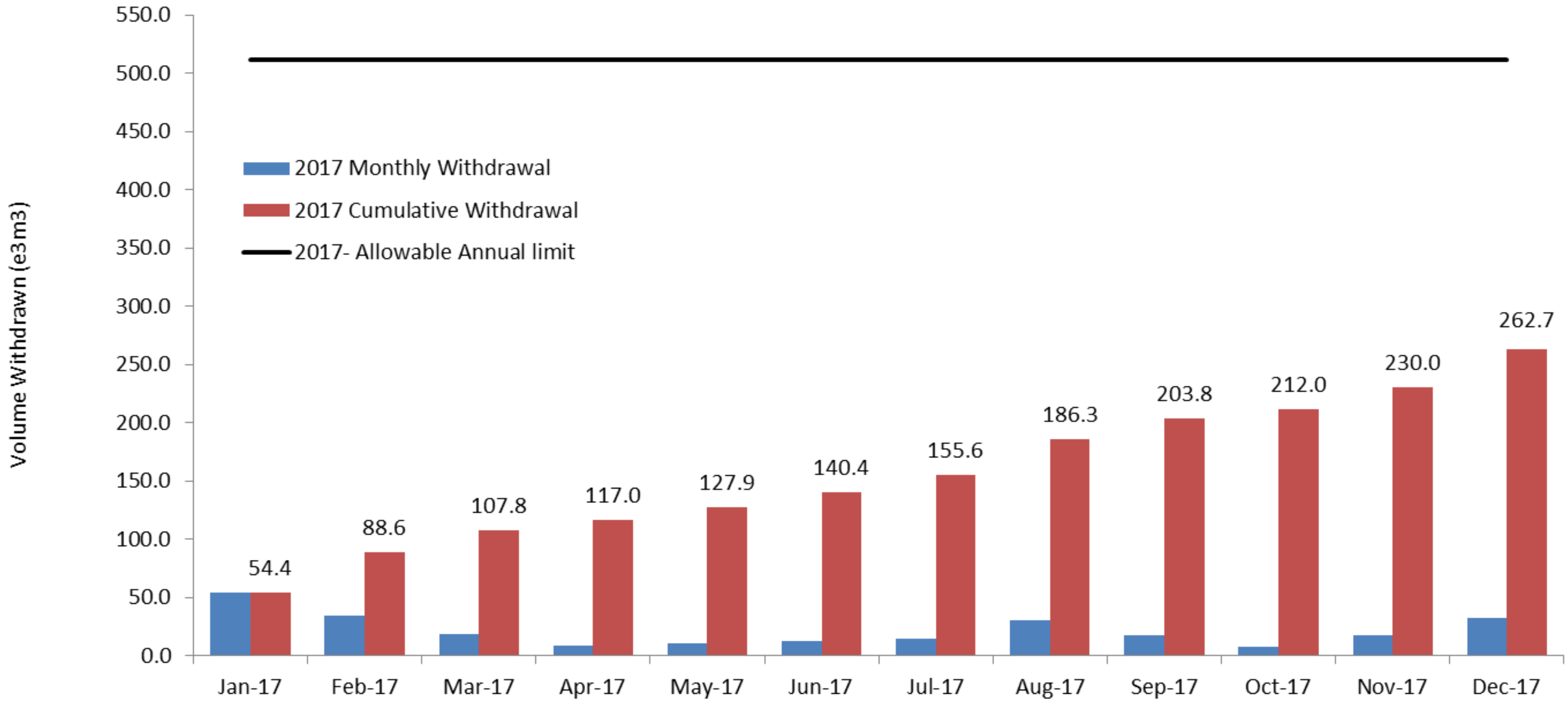
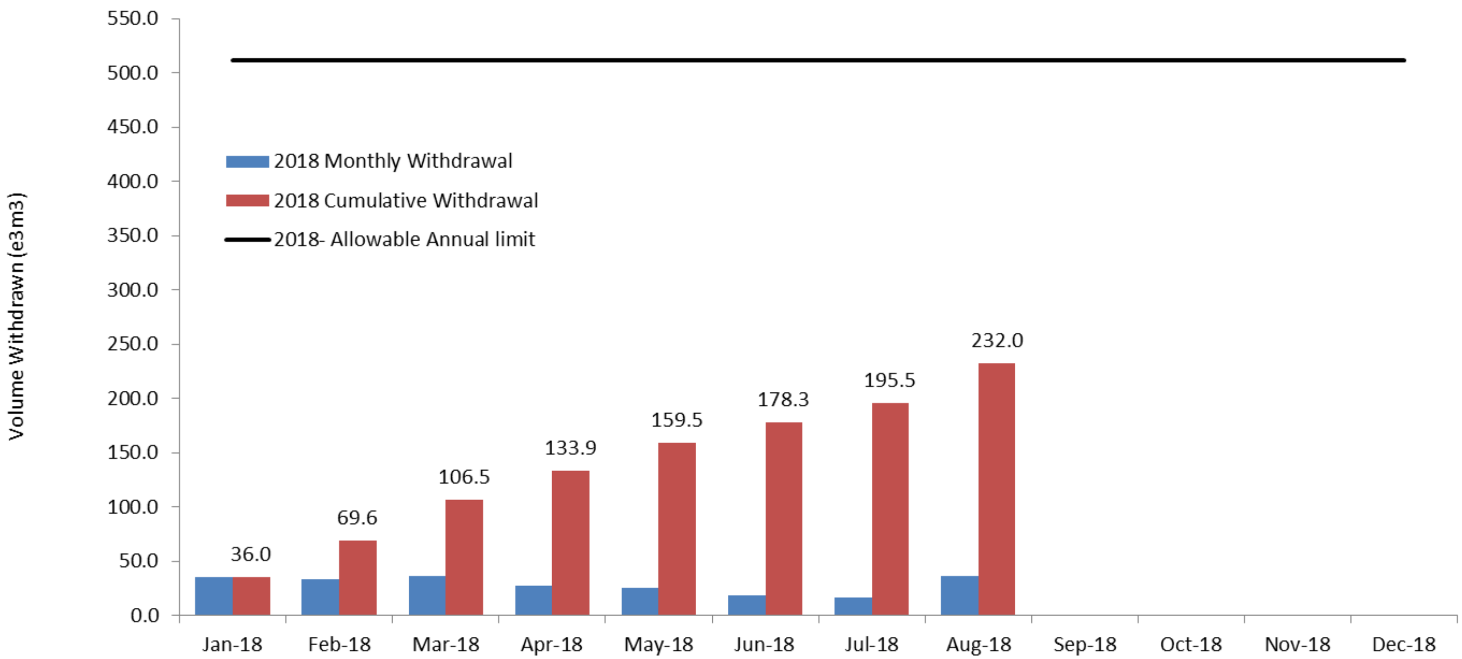
Raw Water Withdrawal – Source Wells (2017)



- Regulatory allowable limit from *Water Act* Licence No. 188229 is 511e^3m^3 per year;
- In 2017 MacKay River withdrawal water was from the Water Licence No. 00188229-03-00 – Total 262.7 e3m3.

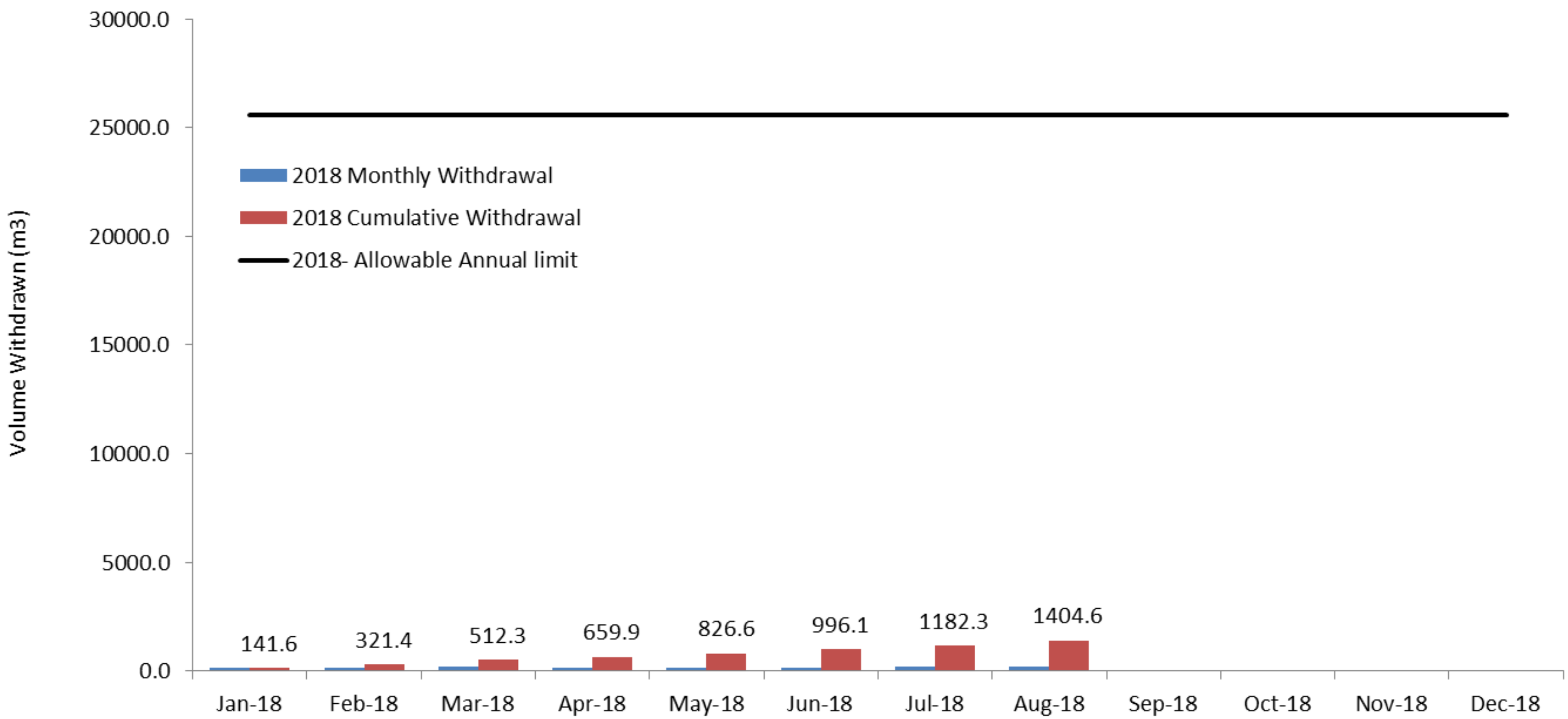
Raw Water Withdrawal – Source Wells (2018 YTD)



- Regulatory allowable limit from *Water Act* Licence No. 188229 is $511e^3m^3$ per year

Domestic Well (2018)

- The project to produce Potable water from the well under License 249470 started in December 2017 – The total water withdrawn in December/17 was 90.3 m3
- The Total withdrawal in 2018 YTD is 1404.6 m^3



Regulatory allowable limit from *Water Act* Licence No. 249470 is 25,550m^3 per year

Overall Facility Water Balance

	Overall Facility Water Balance									
	Inlet Streams				Outlet Streams					Water Balance
	Produced Water	Fresh Water		Produced Water	Steam	Disposal	Produced Water		Fresh Water	
	PW1 (m3)	FW1 (m3)	FW4 (m3)	PW4 (m3)	INT (m3)	DIT(m3)	PW5 (m3)	PW7 (m3)	FW5 (m3)	%
Sep-17	228773.1	17470.4	34	24168.6	231061.1	3040.9	30529.9	913.4	29.8	-4.42%
Oct-17	220291.3	8189	29.8	30529.9	229497	2296.6	26958.1	3573.9	34.4	-6.19%
Nov-17	494435.4	18040.6	34.4	26958.1	520182.7	445.5	29080.5	1514.3	28.4	-2.00%
Dec-17	521646.6	32726.7	28.4	29080.5	546631.8	2984.4	25345.4	1515.4	33.9	1.09%
Jan-18	437266.2	36002.5	33.9	25345.4	470014.2	0	28777.6	2565.9	30.7	-0.48%
Feb-18	461256.1	33615.5	30.7	28777.6	491651.3	0	26340.4	765.1	34.3	0.83%
Mar-18	511672.2	36800.7	34.3	26340.4	530095.1	136.2	23788.5	714.9	33.4	3.11%
Apr-18	507215.6	27390.7	33.4	23788.5	514561.8	3411.2	24042.5	2339.7	33.9	2.20%
May-18	501680.1	25609.1	33.9	24042.5	523252.2	0	23561.8	878.3	27.8	0.56%
Jun-18	352559.3	18797.7	27.8	23561.8	385890	1265.4	25895.2	603.7	36.3	-4.21%
Jul-18	483008.5	17204.2	36.3	25895.2	528623.1	2118.2	25672.1	11548.3	27.4	-4.29%
Aug-18	455269.6	36489.8	27.4	25672.1	532420.9	964.7	24181.7	6042.6	33	-5.83%

Overall Facility Water Balance

Below are a set of definitions of the terms used in the water balance table provided in this presentation

Freshwater

- REC (FW1): The sum of all freshwater streams received. MacKay River receives fresh water from three source water wells.
- INVOP (FW4): Fresh water tank opening inventory. This volume is carried forward from last month's closing inventory.
- INVCL (FW5): Fresh water tank closing inventory. This volume takes into consideration levels in Fresh water tanks.

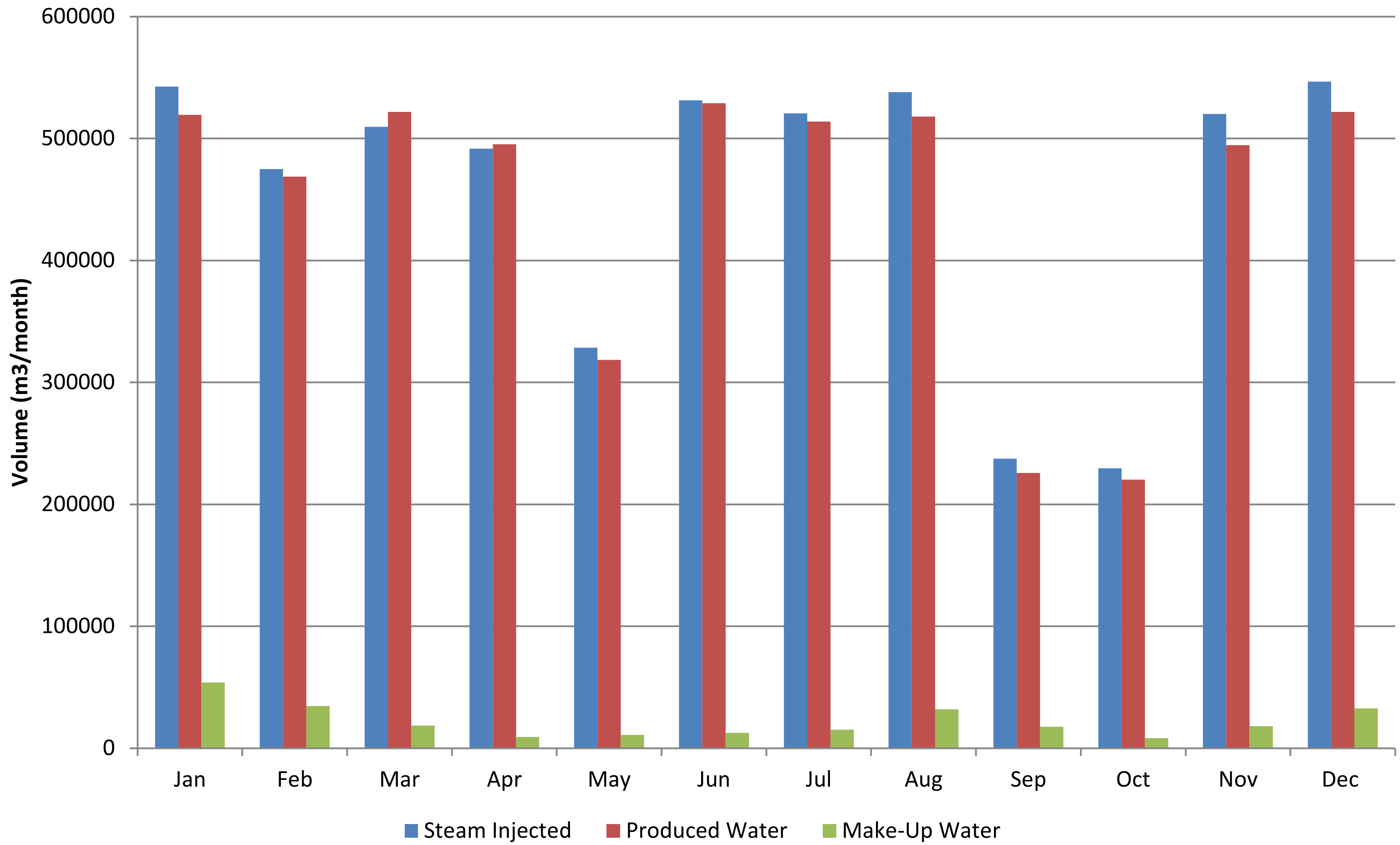
Steam

- INJ (INT): The total steam injected at the wells. Steam is metered by subtracting total BFW feed to all OTSG and Cogen at MR minus the total blowdown.

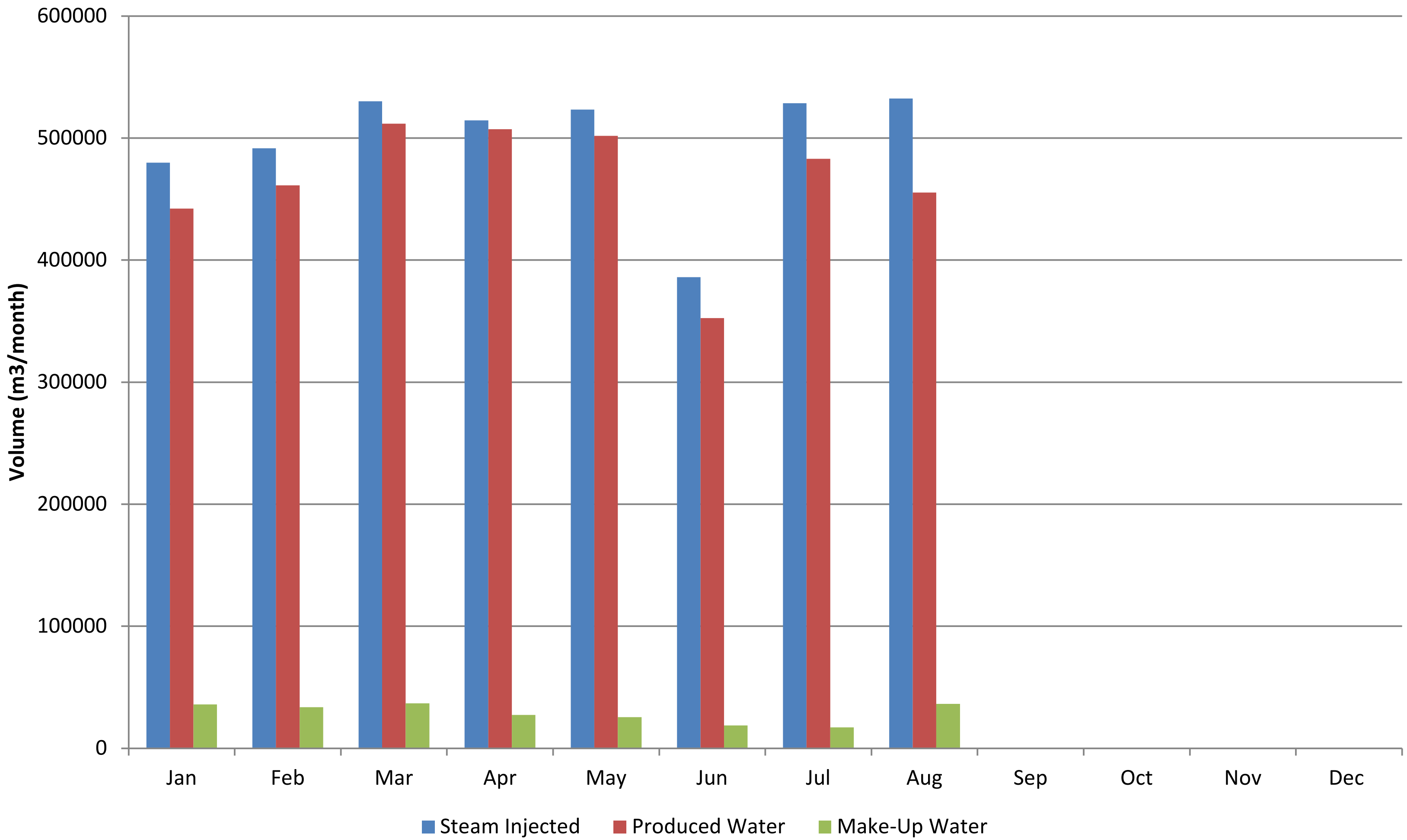
Water

- REC (PW1): The water received from the wells..
- INVCL (PW5): Water tank closing inventory. This volume takes into consideration levels in water tanks.
- INVOP (PW4): Water tank opening inventory. This volume is carried forward from last months closing inventory.
- INJ (DIT): Water disposed from the facility.
- UTIL (PW7): Water Stream used at the injection facility for utility and waste steam and not recovered due to venting.

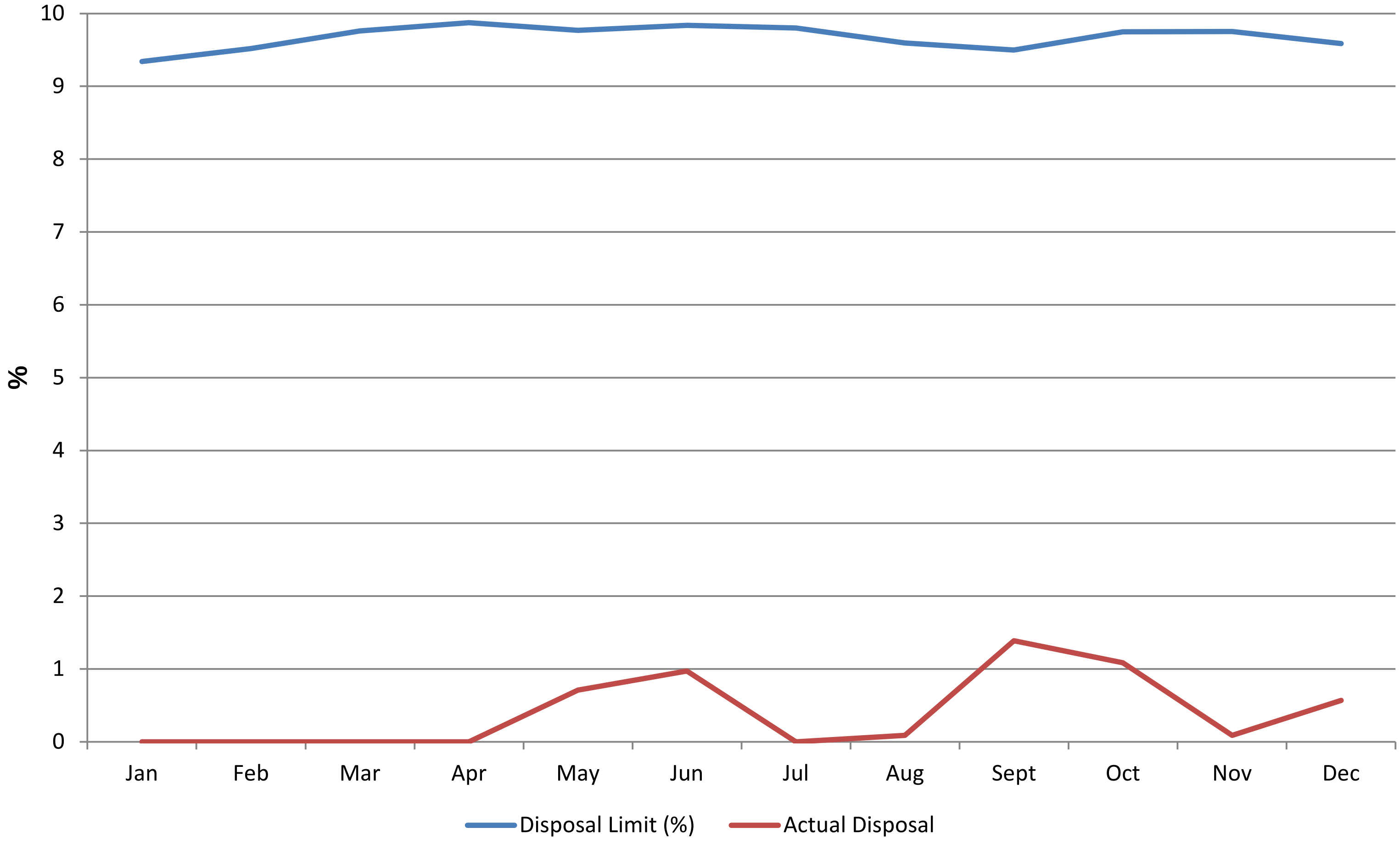
Water Balance (2017)



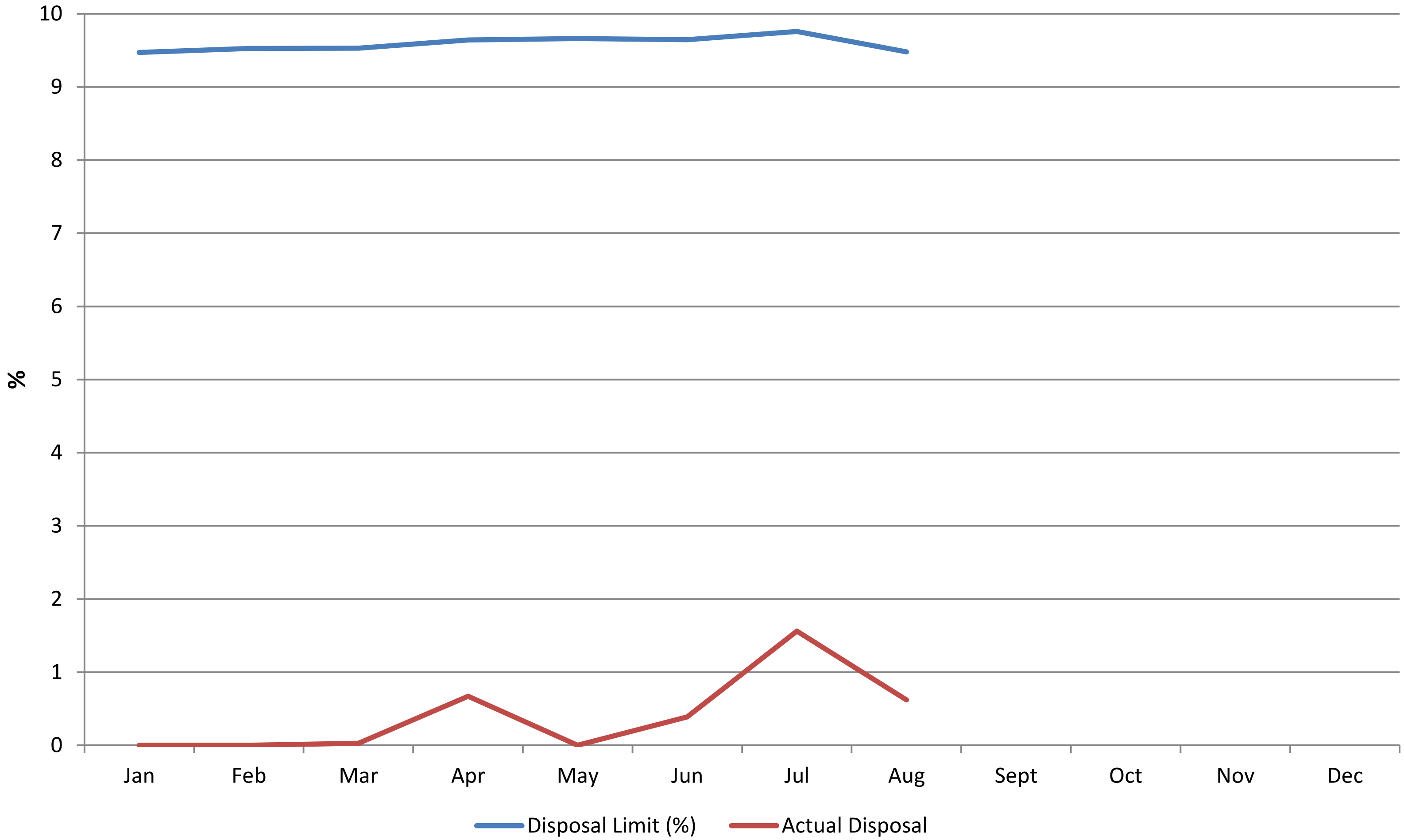
Water Balance (2018 YTD)



Water Disposal % (2017)



Water Disposal % (2018 YTD)



Low Pressure Blowdown Recycle (2017 & 2018 YTD)

Blowdown Recycle = 100%:

- Blowdown treated in the Water Plant:
  - YTD: 51,750.1 m^3/month
  - 2017: 47,865.95 m^3/month
- Blowdown treated in the Zero Liquid Discharge (ZLD) Plant:
  - YTD: 40,317.04 m^3/month
  - 2017: 36,597.73 m^3/month

Trucked volumes from Diversion Lagoon:

- 2018: 14,642.5 m^3 (January 1,2018 – August 31, 2018);
- 2017: 16,631.4 m^3 (January 1,2017 – December 31, 2017).

Note: The diversion lagoon is filled by crystallizer concentrate during purges *and* by landfill leachate after periods of rain.

MacKay River Landfill / Waste Management

AER Approval WM-072E Class II Oilfield Landfill – Waste Streams :

- Warm lime Softener Sludge – residual from the water treatment plant (Unit 200) = solids , lime and polymers
- Salt Waste – Residual from the evaporator - Unit 800 waste = salt brine dust.

Volumes of solids (salt/lime) to landfill	
Year	Volume (m^3)
2015	28,019
2016	20,685
2017	22,651
2018	17,767

Source: Annual Landfill Report

Total of Leachate removed from landfill	
Year	Volume (m^3)
2015	14,465
2016	25,988
2017	26,943
2018	26,420

Source: Annual Landfill Report

*Volumes estimated in August 2018

- Waste services contract in place:
  - Addresses hazardous, scrap metal, domestic waste.

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MacKay River Landfill / Volume of fill Survey

Status: Closed, repairs in progress

Status: Pilot project closure

Approved Volume: **86,000 m3**
Current Volume: **72,000m3**

Status: Active operations

Approved Volume: **92,000 m3**
Current Volume: **60,000 m3**
Full by: **Sep 2019**

Status: Active operations

Approved Volume: **93,870 m3**
Current Volume: **25,000 m3**
Full by: **Dec 2021**

Volumes / forecasts current as of June, 2018
(Source: photogrammetric data captured by drones)

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Off-Site Brine Water Disposal

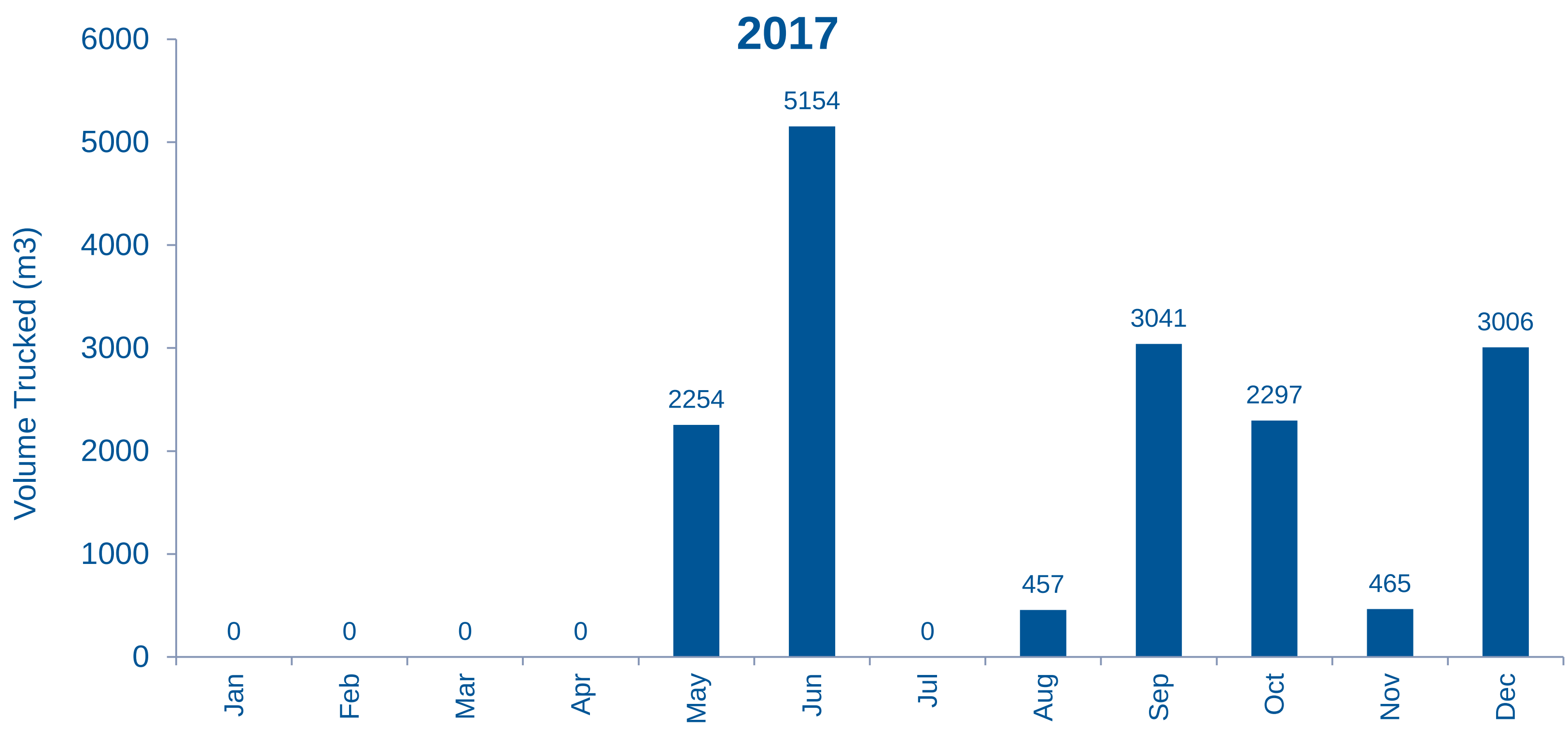
Location of disposal site:

- Eco Industrial Waste Plant;
- 11-17-53-23-W4M.

- Brine water is disposed of off-site when the diversion tank and diversion lagoon reach capacity and the ZLD system cannot process the boiler blowdown from Unit 400.

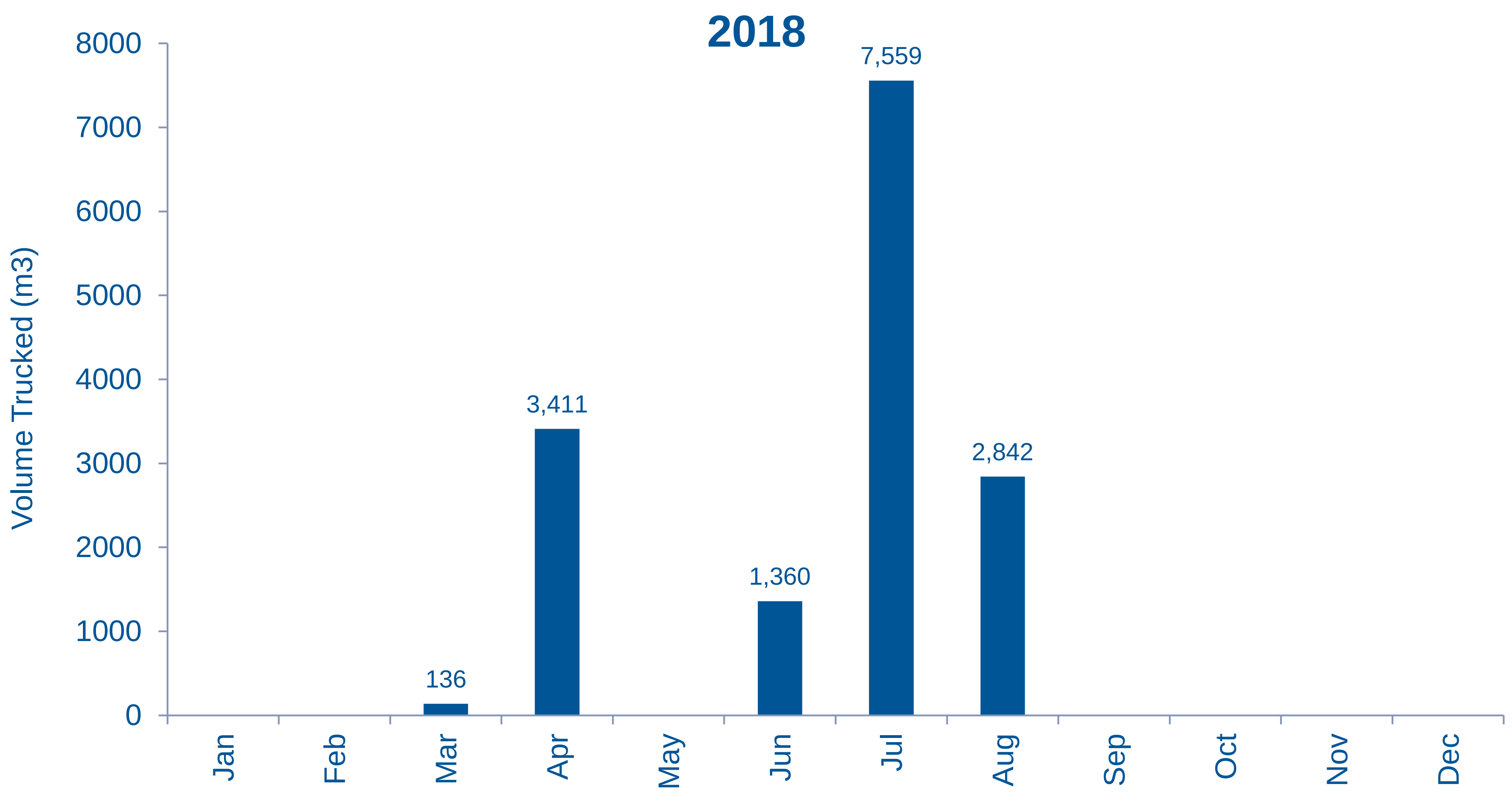
- Water sources in the diversion lagoon include: precipitation, leachate from the MacKay River Landfill and excess boiler blowdown water during upset conditions.

Off-Site Brine Water Disposal (2017)



* Volumes reported via Petrinex

Off-Site Brine Water Disposal (2018 YTD)



* Volumes reported via Petrinex

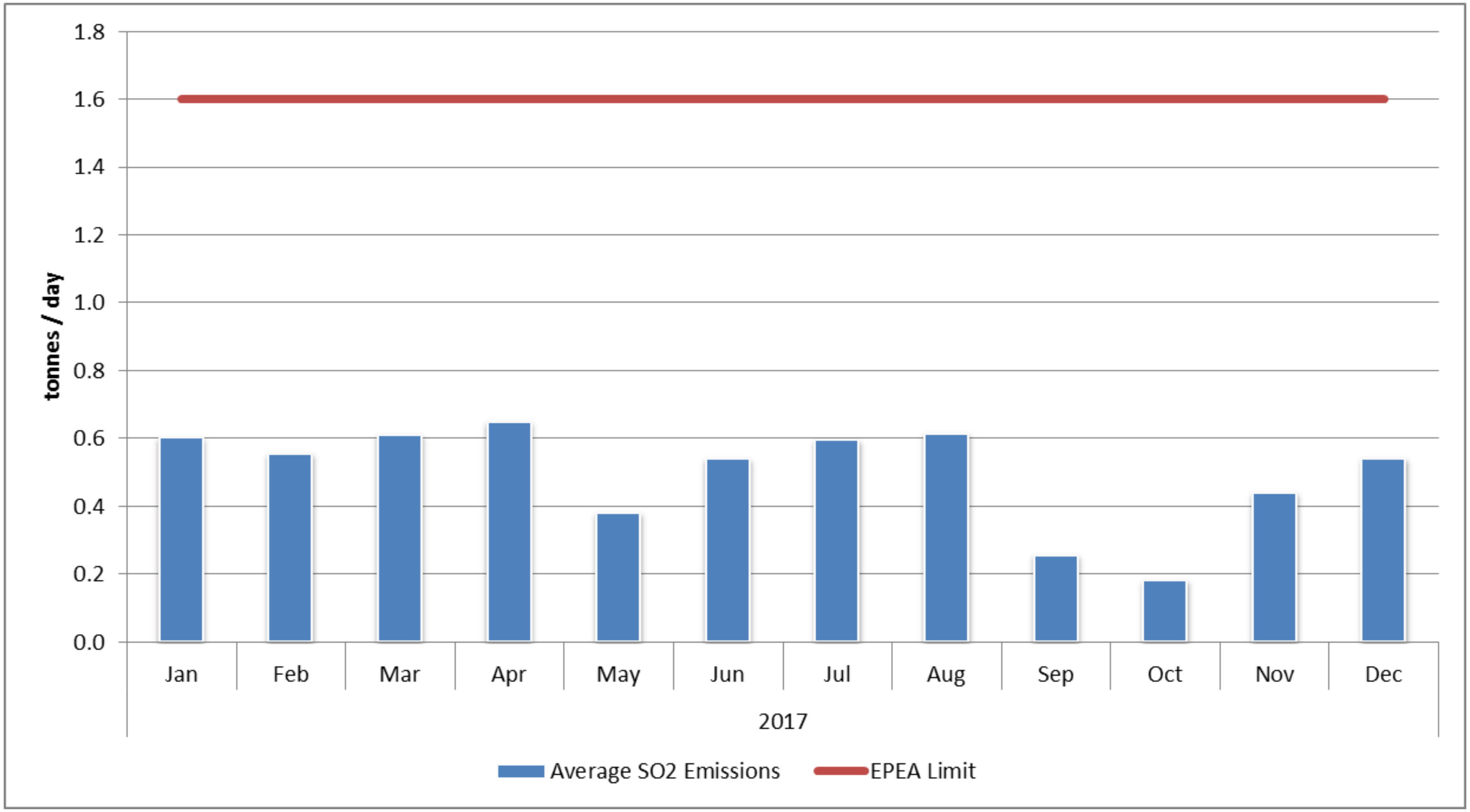
MacKay River Performance Presentation

Sulphur Production

Sulphur Production

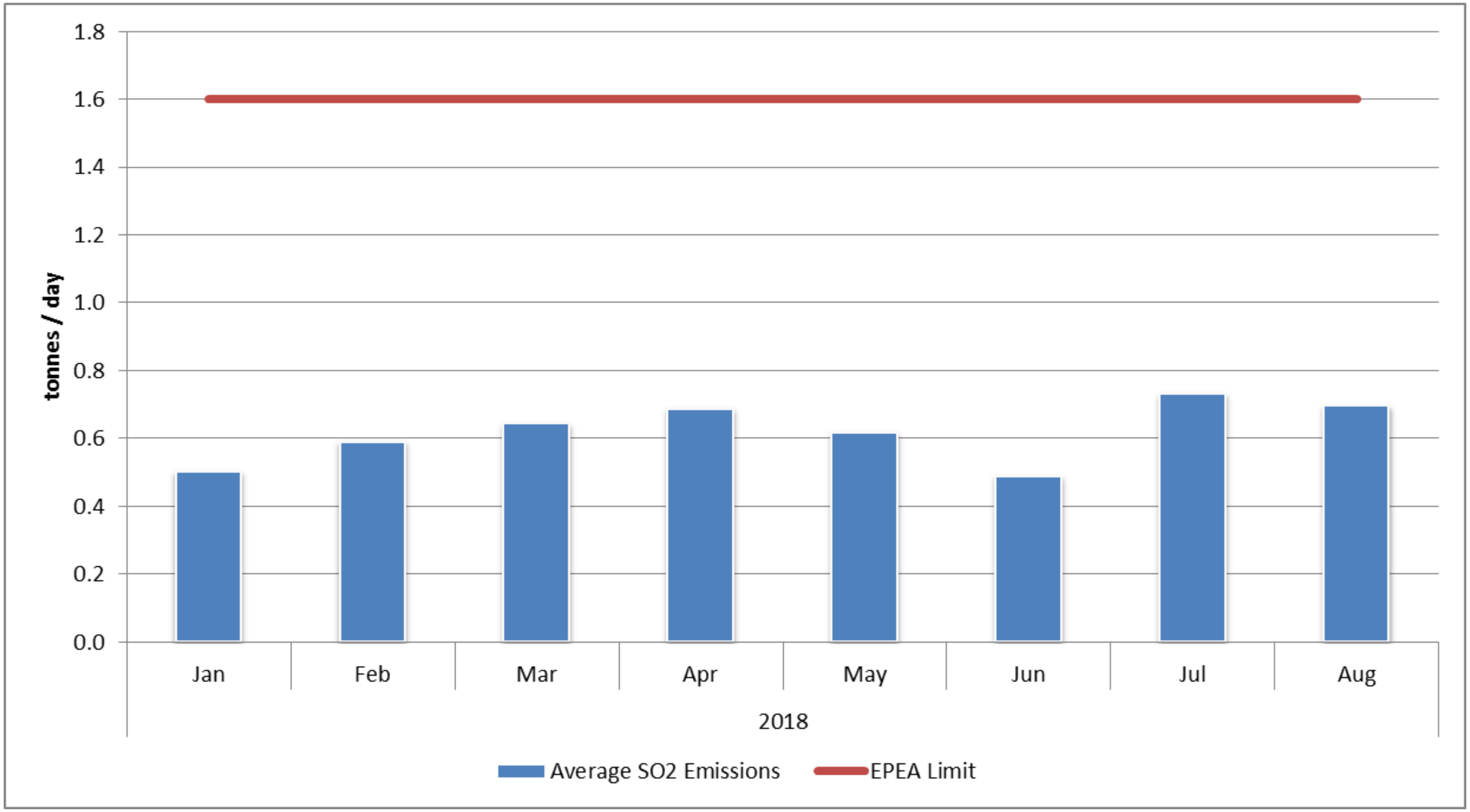
- Currently there are no sulphur recovery facilities at the MacKay River Project;
- All produced Sulphur is burnt off in the overall process;
- Present trends indicate an SRU will not be required for the Project;
- Suncor will continue to monitor the sulphur trends.

Sulphur Dioxide Emissions (2017)



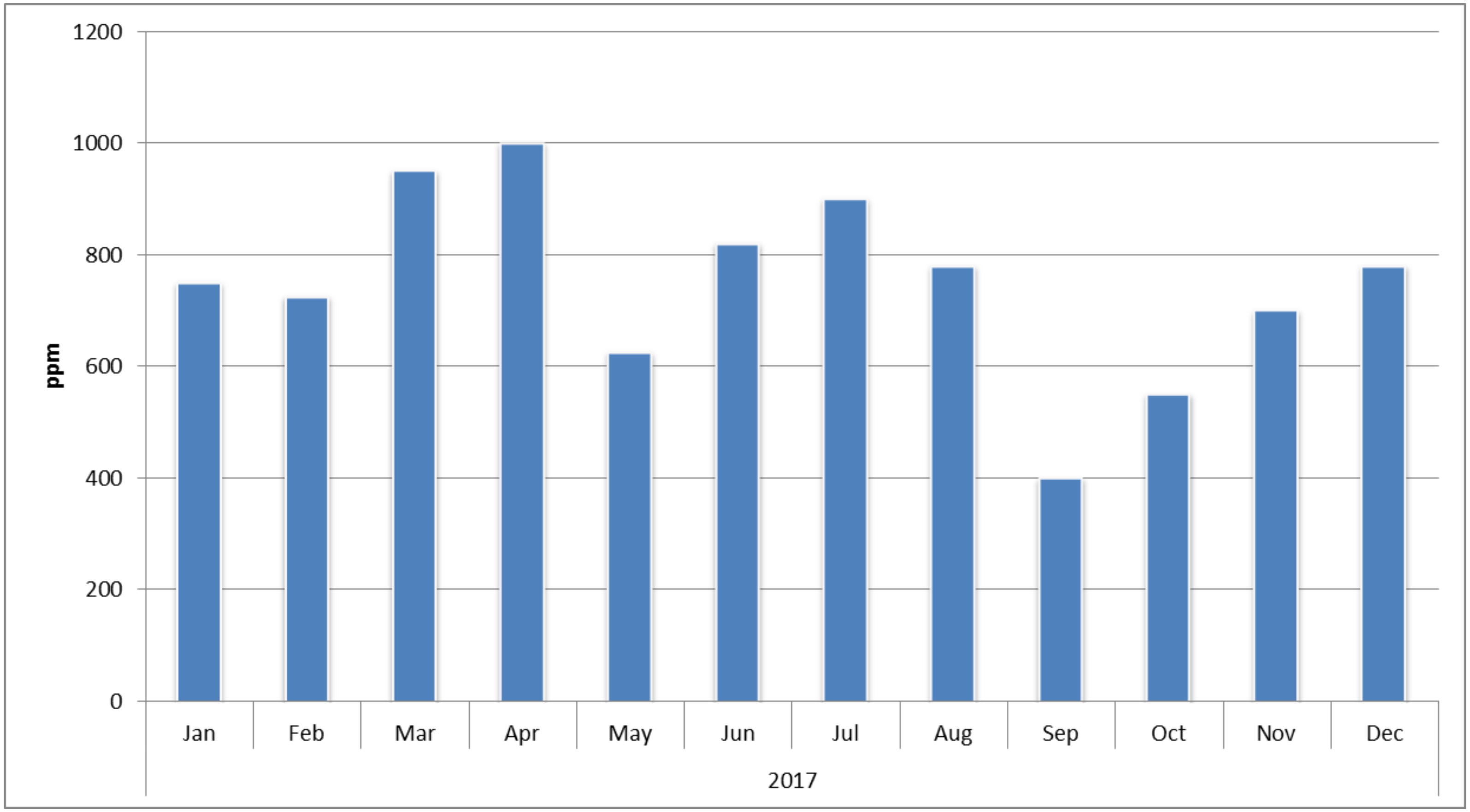
* SO_2 emissions are based engineering estimations that use H2S results from monthly produced gas samples

Sulphur Dioxide Emissions (2018 YTD)



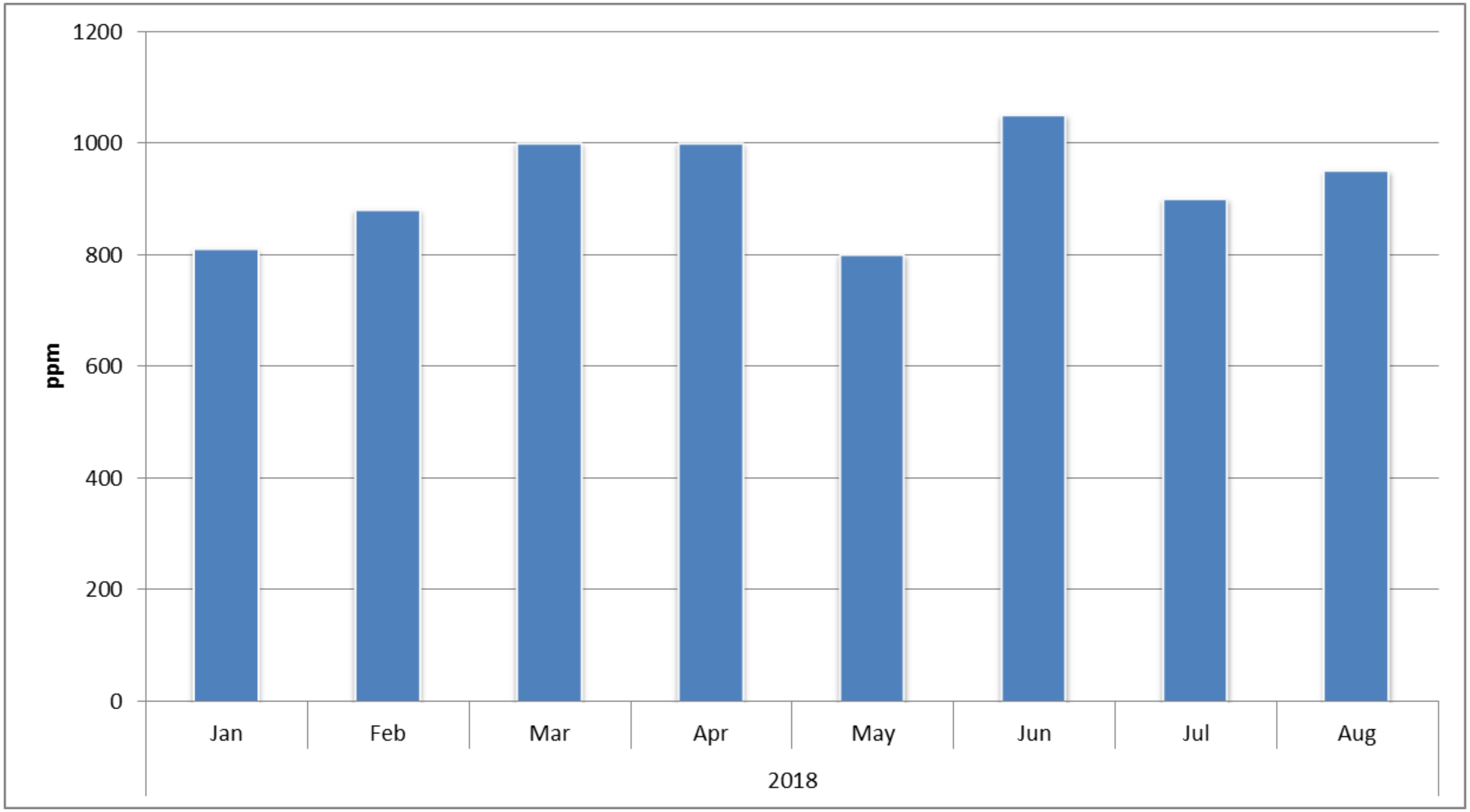
* SO_2 emissions are based engineering estimations that use H2S results from monthly produced gas samples

H_2S Concentration (2017)



* H_2S concentrations are measured in monthly produced gas samples.

H_2S Concentration (2018 YTD)



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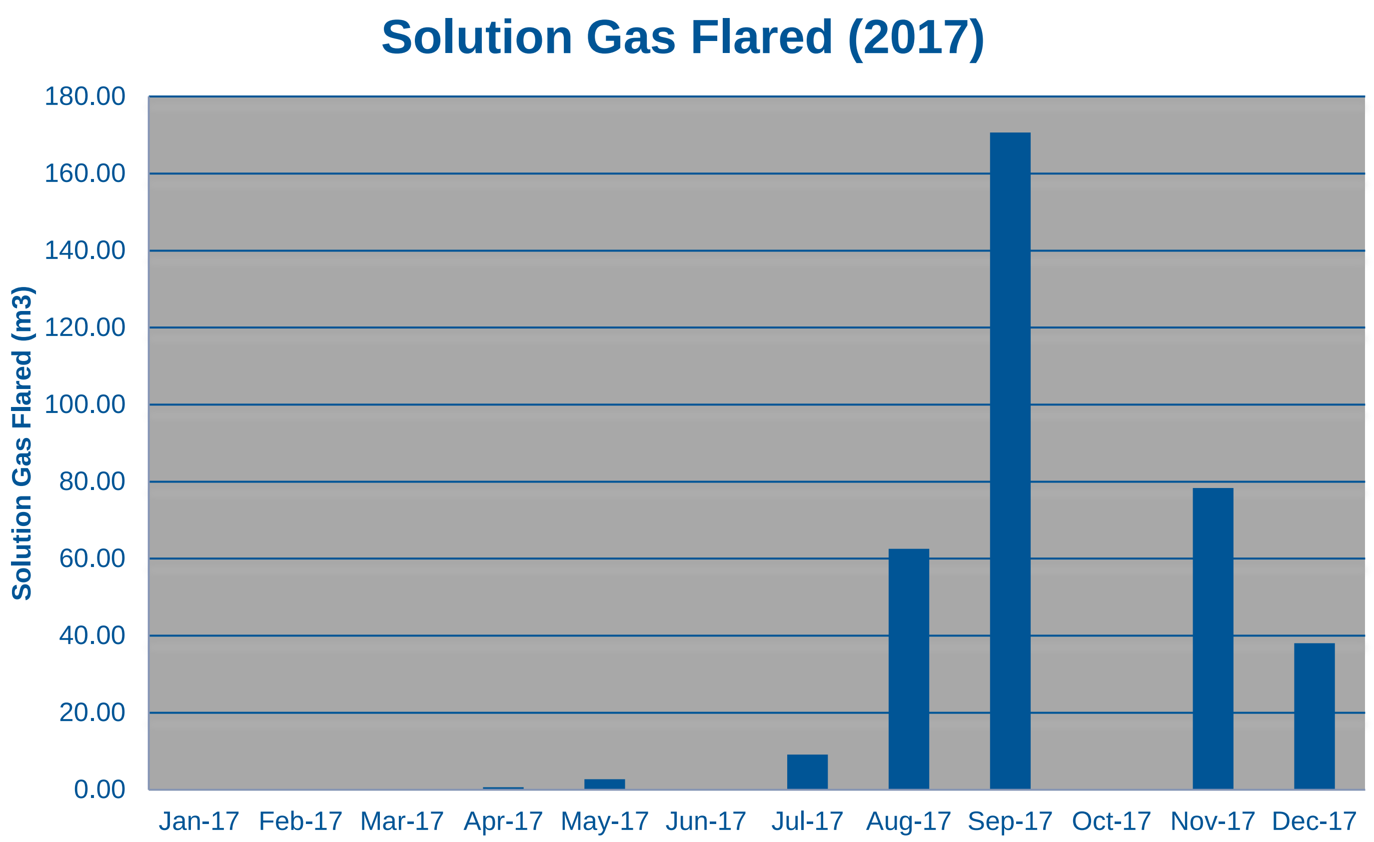
Solution Gas Flared (2017)



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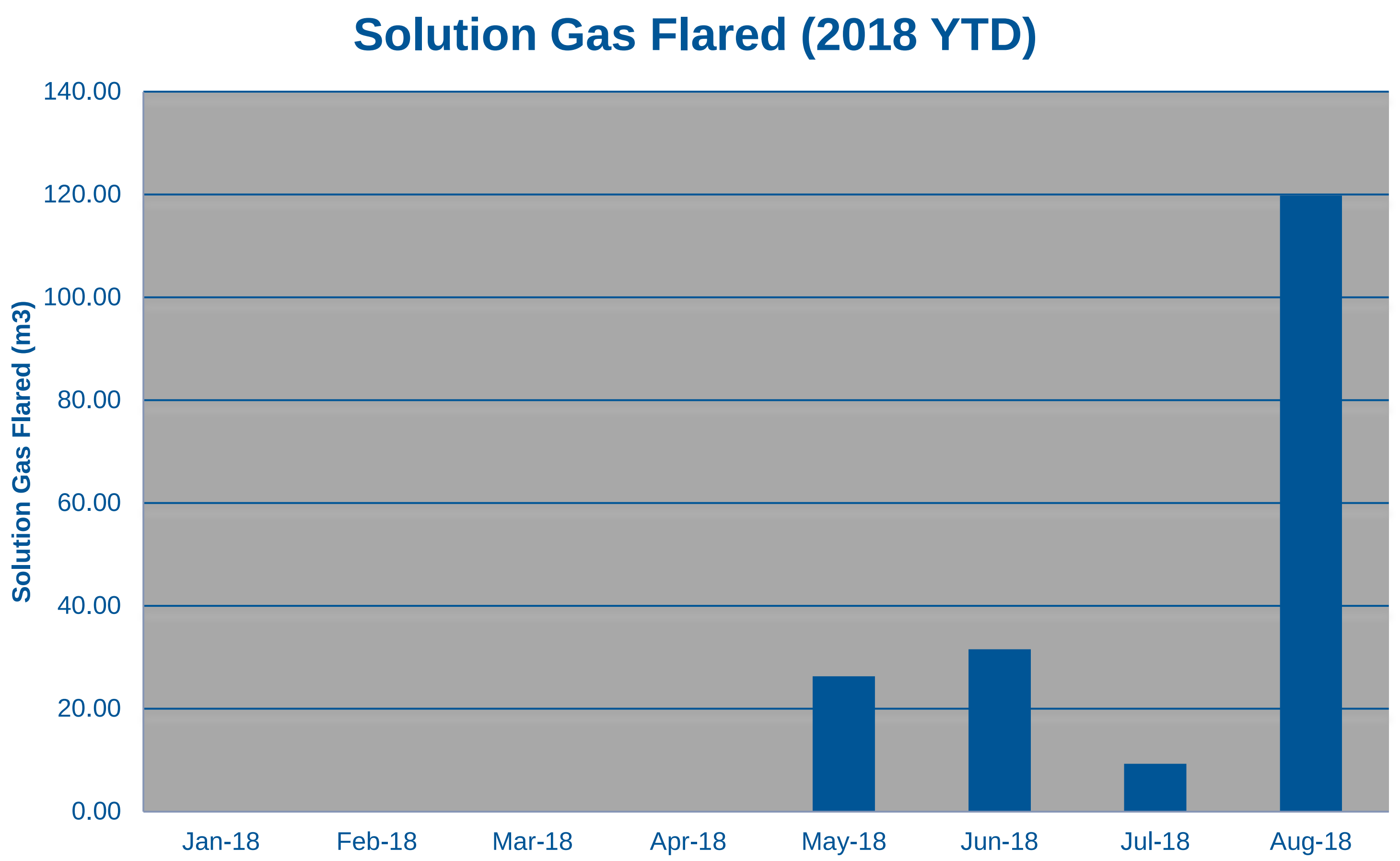
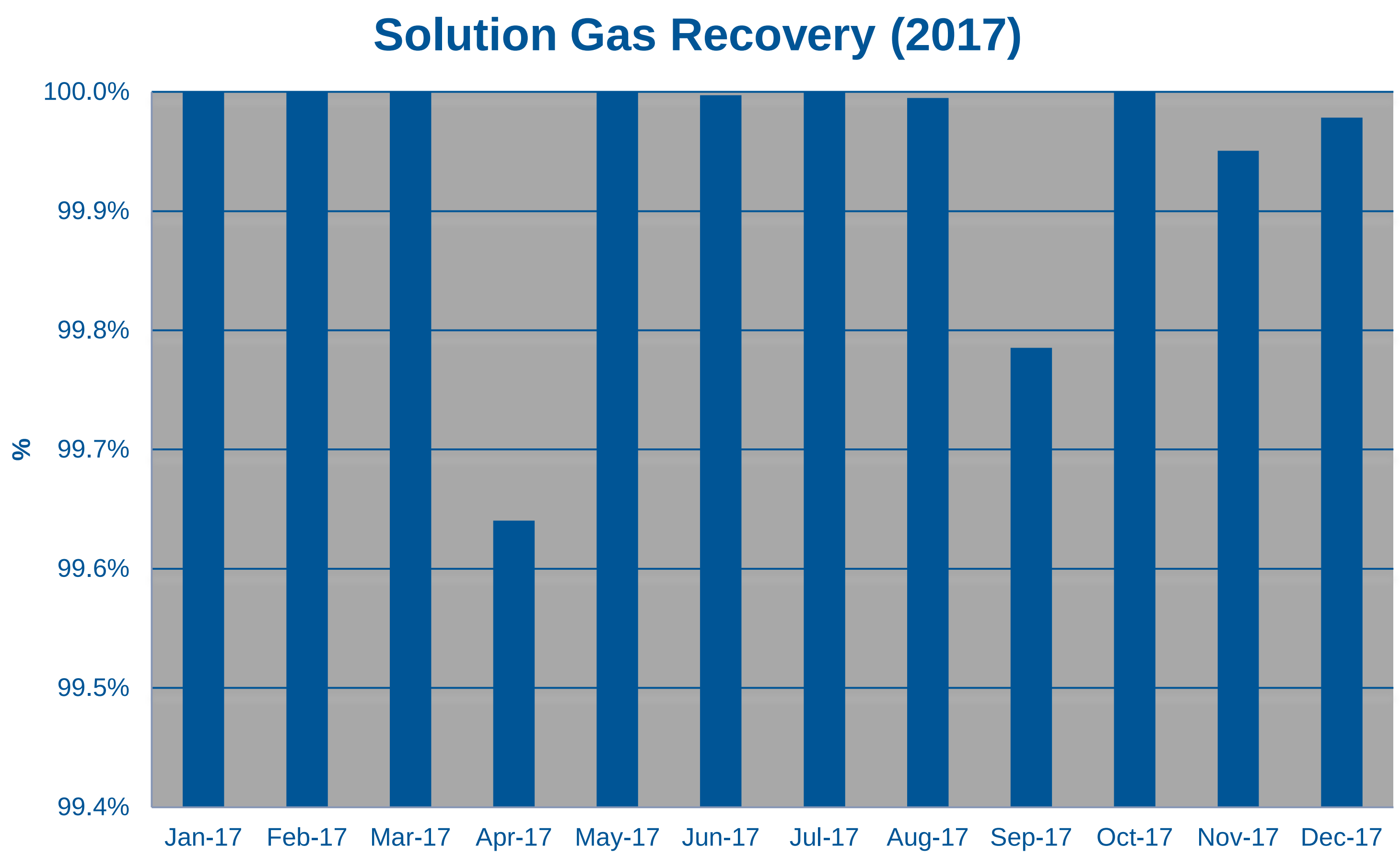
Solution Gas Flared (2018 YTD)



Solution Gas Recovery (2017)



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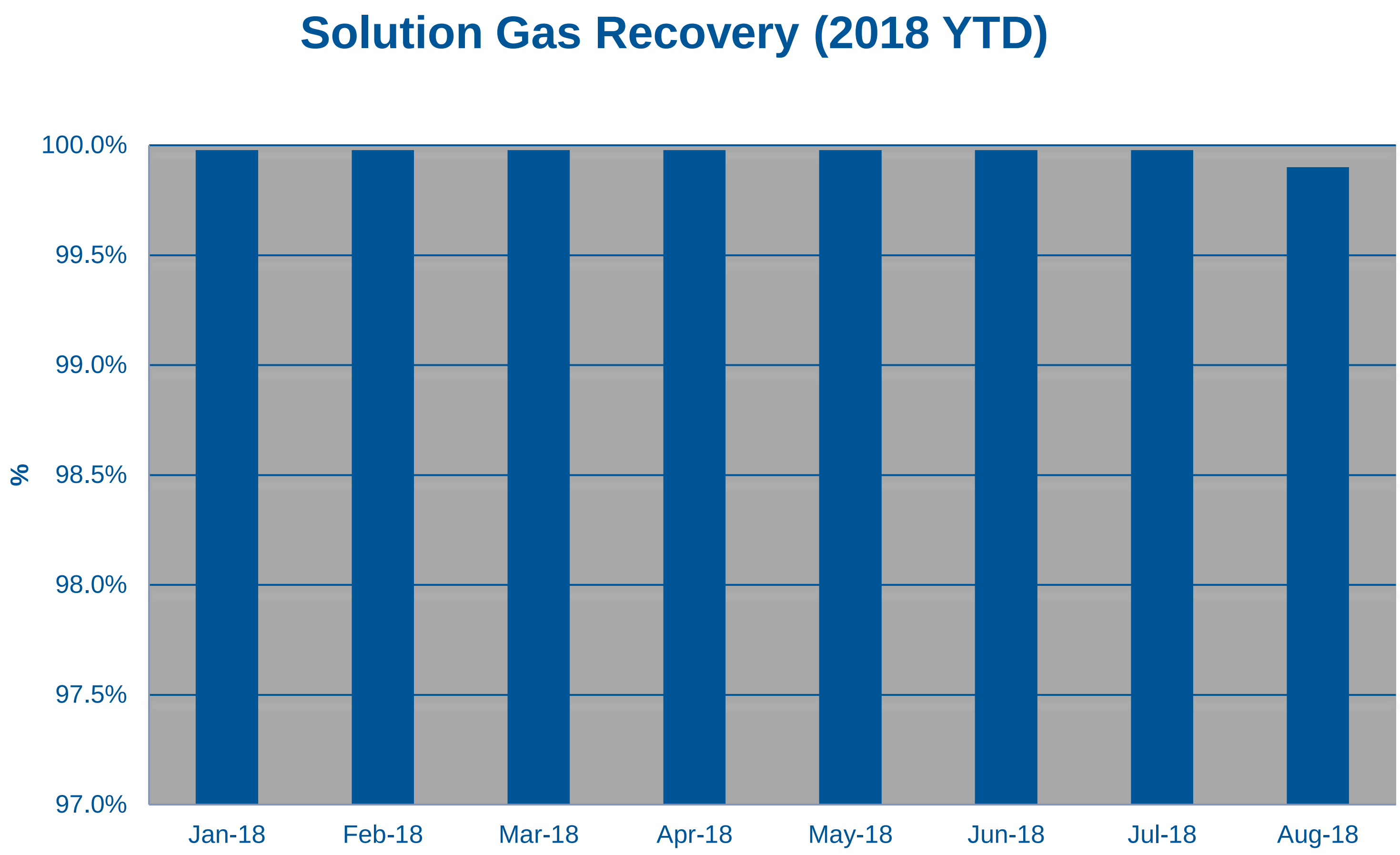
Solution Gas Recovery (2018 YTD)



MacKay River Performance Presentation

Environmental Performance

Greenhouse Gas Emissions (GHG)

Submitted the annual SGER report to Alberta Climate Change Office and NPRI GHG report to Environment Canada:

- GHG calculation methodology developed to improve transparency.

Total direct emissions for 2017:

- 318,971 tonnes of CO_2equiv;
- Total emissions have been reported to ACCO.

Total regulated emissions for 2018 (Budget):

- 857,656 tonnes of CO_2equiv*;
- Total emissions will be reported to ACCO under new CCIR policy

Approved baseline emissions intensity:

- 0.1174 tCO_2e/m^3 (Global Warming Potential Updated).

* 2018 MR is under new Alberta CCIR policy and 2018 actual data to be verified in 2019

Ambient Air Monitoring

- WBEA Air Monitoring Stations:
  - Ambient air quality data available for viewing on WBEA website.

- Passive Air Monitoring:
  - Four passive air monitoring stations at MacKay River;
  - Monthly passive air monitoring performed by a site representative and sample analysis reports submitted to AER by Suncor for H_2S and SO_2 ;
  - In 2017 passive sampling results showed: average H2S concentration was 0.06 ppb and average SO2 was 0.49 ppb;
  - In 2018 (YTD) passive sampling results showed: average H_2S concentration was 0.06 and average SO2 was 0.35 ppb.

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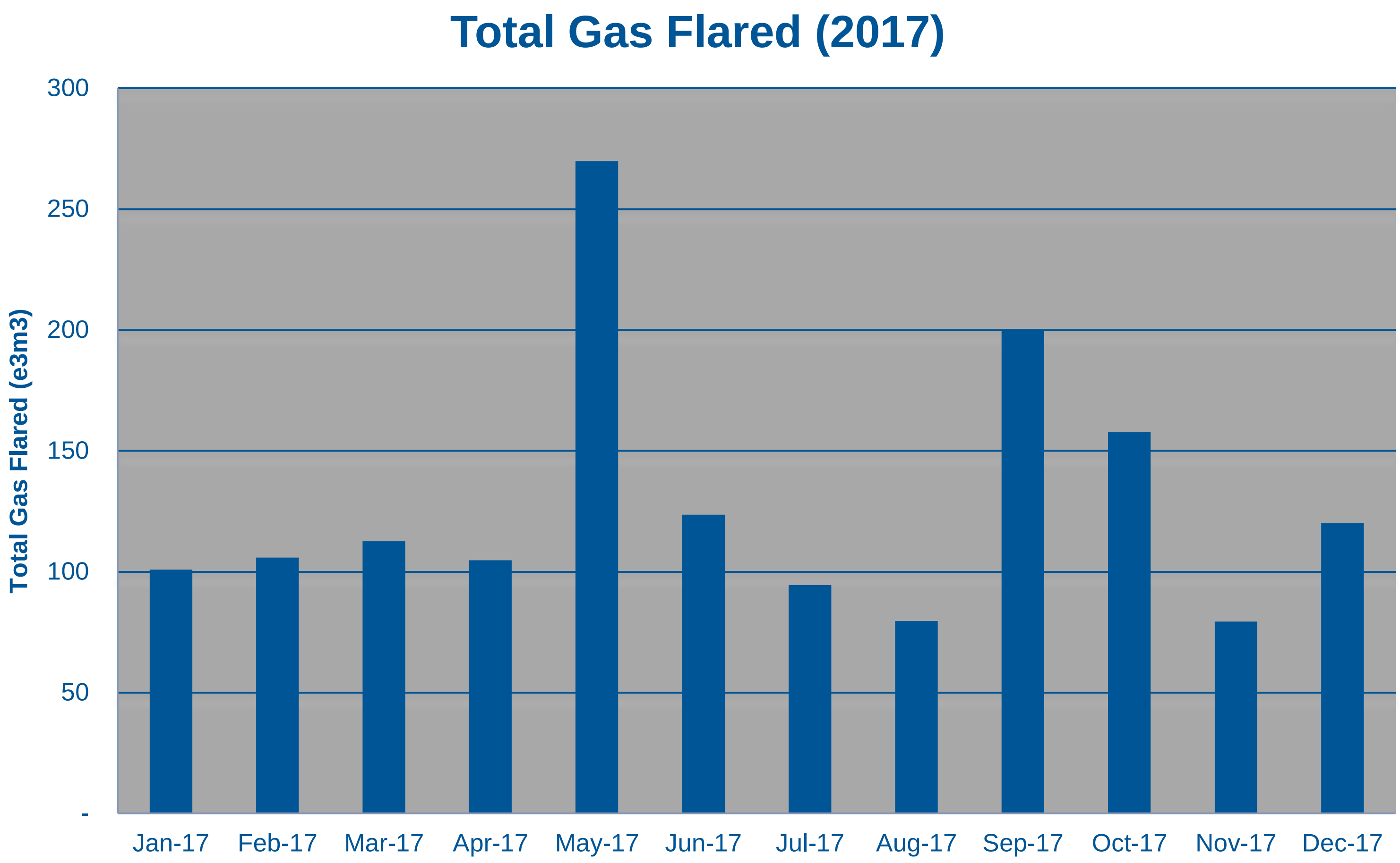
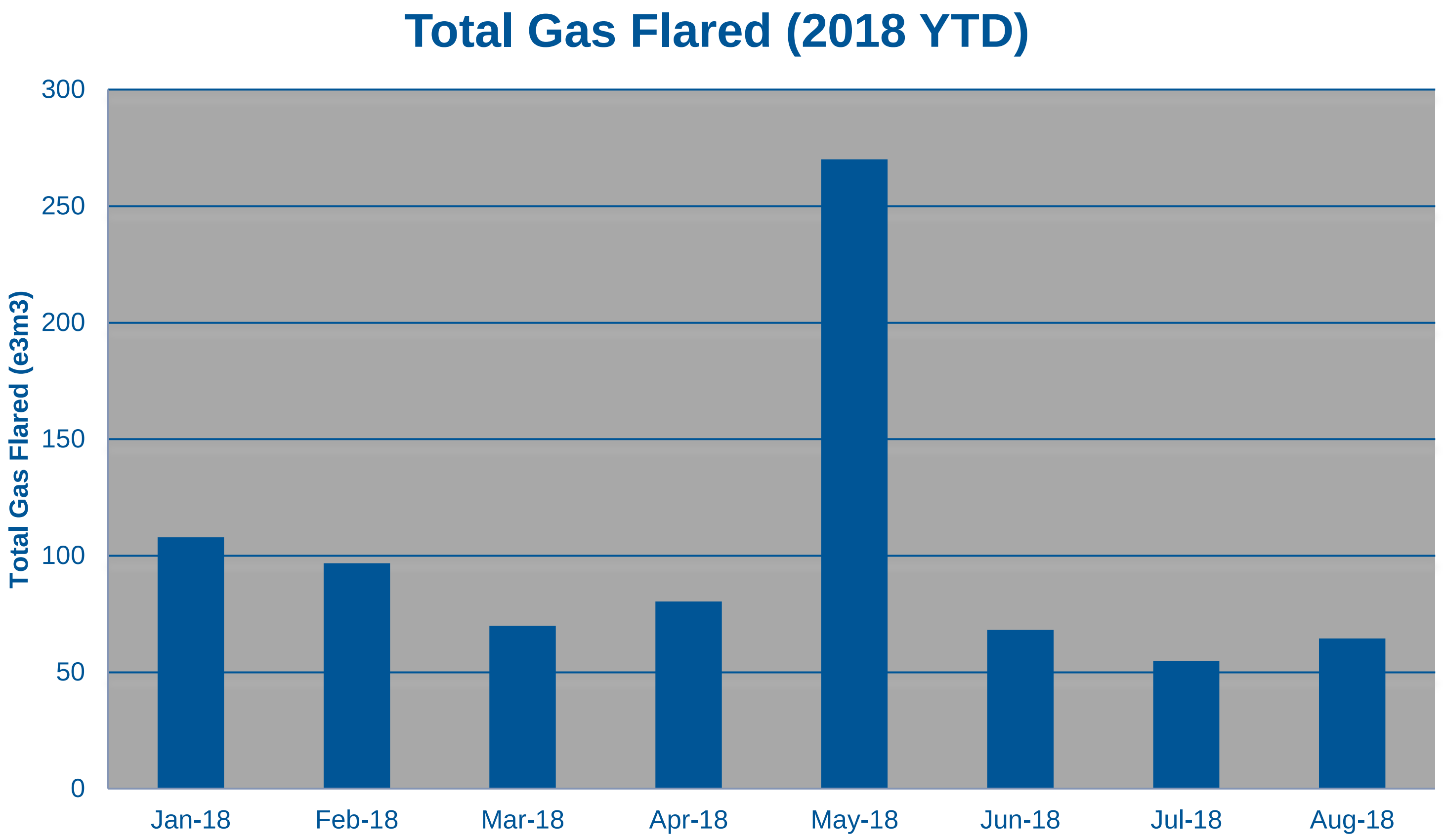
Total Flared Gas (2017)



Total Flared Gas (2018 YTD)



Regulatory Compliance (2017 and 2018 YTD)

- **2017:**
  - May 30, 2017: Landfill Inspection (Phoebe Thompson);
  - May 30, 2017: Hydrochloric Acid Release (Phoebe Thompson)
  - May 31, 2017 AER conducted Watercourse Crossing Inspection along the Aostra road.(Virginia Hudges)
  - December 06, 2017: Landfill Follow up Presentation in regards to the scope of work for Phase I, II and III.

- **2018:**
  - February 01, 2018: Pipeline detail operation Inspection(Colon Sheppard);

Incident Summary (2017– 2018 YTD)

2017

AER Reportable Releases :

- 7 reportable spills;
- 7 reportable flaring events.
- 5 contravention reports

Voluntary Self Disclosures :

- Injection of NCG without AER authorization (BEST Site)
- MARP – missed internal inspection to fulfill D17;
- Landfill – underdrain issues .
- Landfill – Phase II cell issues
- Missing to submit D56 notification in regards to abandoned pipeline
- Failure of the primary measurement as per D17.

2018

AER Reportable Releases for 2018 (YTD – Sept 30):

- 3 reportable spills;
- 7 reportable flaring events.

Voluntary Self Disclosures 2018 (YTD – Sept 30):

- Tear in the liner of Landfill Phase III W cell A
- Tear in the liner of Landfill Phase III E cell B
- Leachate head over the limit of 300 mm

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Scheme Approval Amendments

- **Amendment 8668A**
  - Changed annual average volume to 33,000 bpd (5,250 m^3/d)
- **Amendment 8668B**
  - Increase to project area
- **Amendment 8668C**
  - Additional project area
  - Approval to inject non-condensable gas
- **Amendment 8668D**
  - Additions to project area
  - Increase to annual average volume to 72,964 bpd (11,600 m^3/d)
- **Amendment 8668E**
  - Approval to drill four well pairs
- **Amendment 8668F**
  - Approval to change approval holder from Petro-Canada to Suncor
- **Amendment 8668G**
  - Approval to undertake amendments & modifications to CPF systems
  - Approval tie-in 6 well pairs to well testing facilities
- **Amendment 8668H**
  - Approval to conduct non-condensable gas injection test on Pad 21 wells
- **Amendment 8668I**
  - Approval to conduct non-condensable gas injection at the Section 16 Test Project
- **Amendment 8668J**
  - Approval to transfer portions of the Dover project area into the MacKay River project area
- **Amendment 8668K**
  - Approval to tie-in 16 well pairs to well testing facilities
- **Amendment 8668L**
  - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21
- **Amendment 8668M**
  - Approval to inject chemical into Pad 22 wells
- **Amendment 8668N**
  - Approval to abandon 3 wells and suspend 1 well on Pad 20
- **Amendment 8668O**
  - Approval to change Phase 5F well trajectories
- **Amendment 8668P**
  - Approval to develop Pads 750/751/28 and add 2 sections to project area
- **Amendment 8668Q**
  - Approval to conduct a pilot of water treatment technologies
- **Amendment 8668R**
  - Approval to abandon well G1I
- **Amendment 8668S**
  - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)

Scheme Approval Amendments

- **Amendment 8668T**
  - Pad 819 Approval
- **Amendment 8668U**
  - Maximum Operating Pressure Approval
- **Amendment 8668V**
  - NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- **Amendment 8668W**
  - MR CPF Expansion Project and Directive 081 Waiver Approval
- **Amendment 8668X**
  - Administrative reissue approval
- **Amendment 8668Y**
  - WHIP for Phases 5B2, 5D and 5F Patterns approval
- **Amendment 8668Z:**
  - Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21 Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014.
- **Amendment 8668AA:**
  - Phase 1 NCG design amendment approval issued December 19, 2014.
- **Amendment 8668BB:**
  - Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015.
- **Amendment 8668CC:**
  - Approval for E1P Sidetrack well issued January 27, 2015.
- **Amendment 8668DD:**
  - Approval for NN6P Sidetrack well issued February 3, 2015.
- **Amendment 8668EE:**
  - Approval for VX™ multiphase meter on Pad 824 issued February 19, 2015.
- **Amendment 8668FF:**
  - Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015.
- **Amendment 8668GG:**
  - Approval to conduct CO2 Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015.
- **Amendment 8668HH:**
  - CO2 Co-Injection amendment to change to OO8 well pair on Pad 24 issued.
- **Amendment 8668II:**
  - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015.
- **Amendment 8668JJ:**
  - Approval for NCG Test at OO7I issued July 29, 2015.
- **Amendment 8668KK:**
  - Approval for an alternate MOP Strategy Trial.
- **Amendment 8668LL:**
  - Approval for C2IPB Sidetrack Well.
- **Amendment 8668MM:**
  - Approval for Pad 750 Thermal Compatibility Assessment.

Scheme Approval Amendments

- **Amendment 8668NN:**
  - Approval to increase MWHIP for all operating wells.
- **Amendment 8668OO:**
  - Approval to alter DA, DB, DC and DF Pattern MWHIPS;
- **Approval to adjust CO2 co-injection rate;**
  - Approval to extend chemical co-injection test at the D pattern wells on Pad 21.
- **Amendment 8668PP:**
  - Approval for abandonment of A3I.
- **Amendment 8668QQ:**
  - Approval to change Clause 32.
- **Amendment 8668RR**:
  - CO2 Extension
- **Amendment 8668SS:**
  - Phase 2 and 3 NCG Injection
- **Amendment 8668TT:**
  - Temporary Increase to BH MOP for Unloading
- **Amendment 8668UU:**
  - Subsurface Heating Pilot
- **Amendment 8668VV**:
  - MOP Increase QQ2 to QQ16
- **Amendment 8668WW:**
  - MWHIP Increase

Amendments Made in Reporting Year

- **Amendment 8668VV:**
  - **MOP Increase QQ2 to QQ16**
- **Amendment 8668WW:**
  - **MWHIP Increase**

Current Amendments / Applications

- As of August 31, 2018, there were no applications under review that are related to MacKay River;

Environmental Initiatives

Suncor supports the Joint Oil Sands Monitoring Program and is also an active member of:

- The Wood Buffalo Environmental Association (WBEA) and its continued work through JOSM;
- The Alberta Biodiversity Monitoring Institute (ABMI);
- The Athabasca Watershed Planning and Advisory Council (AWC-WPAC);
- The Canadian Oil Sands Innovation Alliance (COSIA);
- Mining Association of Canada Toward Sustainable Mining initiative;
- Oil Sands Spill Coop Area Y;
- Alberta Association of Conservation Offsets (AACO).

Suncor is in ongoing consultation with:

- Regional stakeholders;
- Aboriginal Communities and the local Municipality.

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Land Disturbance and Reclamation

- A Project-Level Conservation, Reclamation & Closure Plan (PLCRCP) is due to the AER October 31, 2018. The PLCRCP will follow AER's SED-001 and will be aligned in approach to Suncor's Firebag PLCRCP authorized July 3, 2018.
  - The PLCRCP will present a project-level reclamation material balance and a realistic schedule for reclamation and closure

- Activities in 2017:
  - 4.66 ha of land cleared of vegetation for observation well installation
  - 0 ha of land reclaimed
  - The boundaries of all disturbances and clearings were re-assessed in GIS and updated for the Annual C&R Report and PLCRCP
  - All stockpile volumes were updated for the PLCRCP & signage was assessed

- Planned for 2018:
  - No clearing, disturbance or reclamation activities are planned
  - Installation of soil stockpile signs where they were missing or where names changed

Note: EPEA approved facilities only - oil sands exploration (OSE) programs are not included

Regulatory Compliance

- As noted earlier Suncor has communicated with the AER regarding:
  - Landfill:
    - Berm Expansion, Waste Pilot project, temporary placement of tanks

- Suncor Energy Inc. is in compliance with all regulatory approvals, decisions, regulations and conditions as described in Decision Report 2000-50; specifically pertaining to:
  - Plant and waste management facility location,
  - Ground level ozone and VOC monitoring,
  - Groundwater monitoring wells,
  - Surface water quality monitoring, and
  - Participation in Regional Initiatives.

Summary of Key Learnings (Operations)

- Continued focus on Suncor's Safety Task force initiatives driving and reinforcing correct behaviours:
  - Primary focus on operational discipline and leadership;
  - Dedication to improving onsite process and personal safety.
- Continual focus on process indicators continues high performance of reliability:
  - Record consecutive days without unplanned steam outages;
  - Record consecutive days of on-spec boiler feed water.
- Many learnings from a safety and onsite performance perspective post fire at Mackay River- well performance, pipeline availability, etc.;
- Focus on brine dryer operation has significantly reduced offsite disposal. Further improvements and efficiencies to be realized.

MacKay River Performance Presentation

Future Plans

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Future Plans

Project Description	Comments	Status
Mackay River optimization .	Unlocking throughput availability with improvements and testing to design	Currently being evaluated.
Pad 750 ramp up	Continue with ramping up production from Pad 750	Ongoing
Pad 751 development and construction	Sustaining production	Currently in development
Pad 819 development and construction	Sustaining production	Currently in development
Considering installations of flow control devices (FCD)	Improve SOR and reduce emission	Currently under evaluation

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Suncor MacKay River Project;
Appendix A: Piezometer Plots & Temperature vs Depth Plots

October 24, 2018
Reporting Period September 1, 2017 – August 31, 2018

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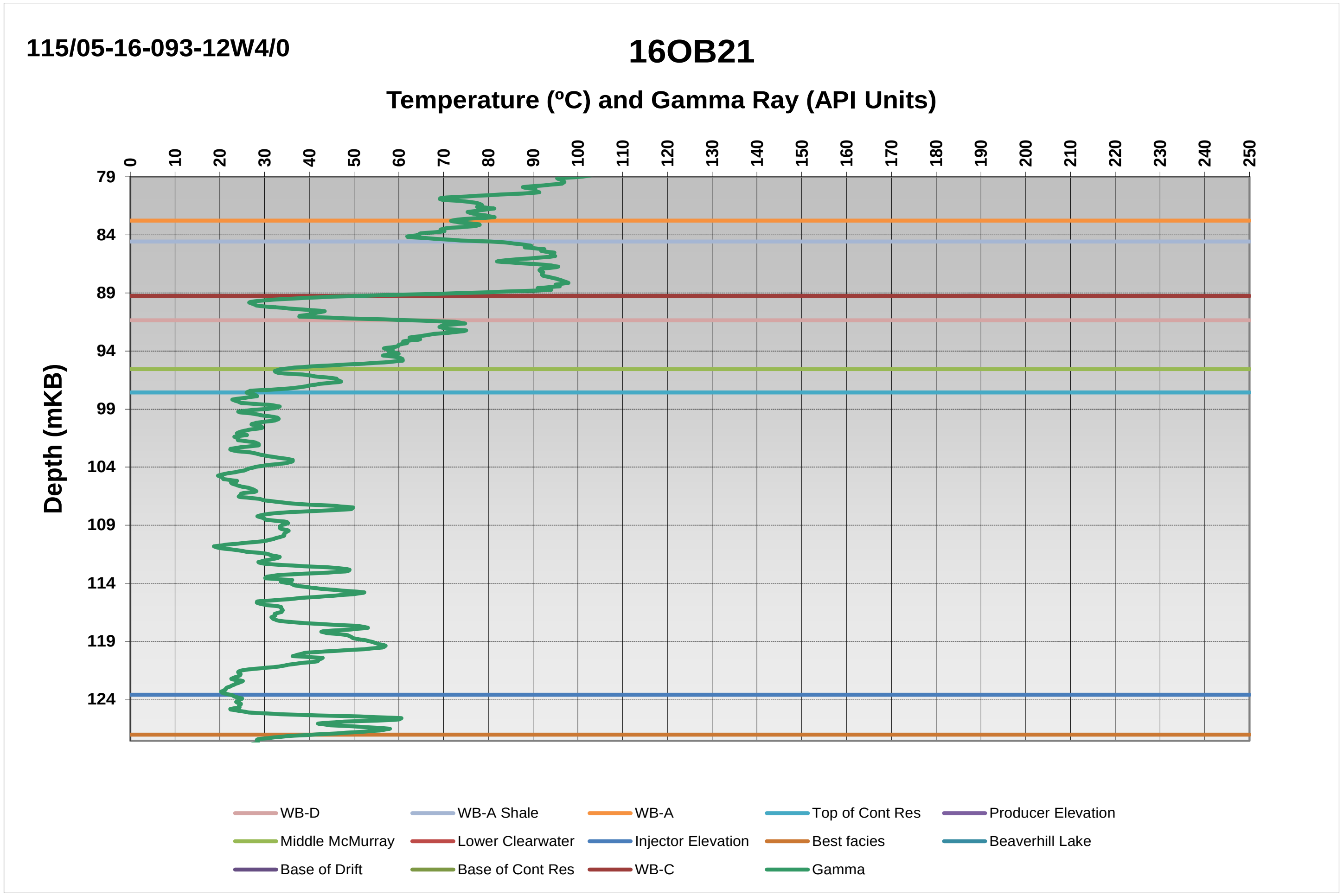
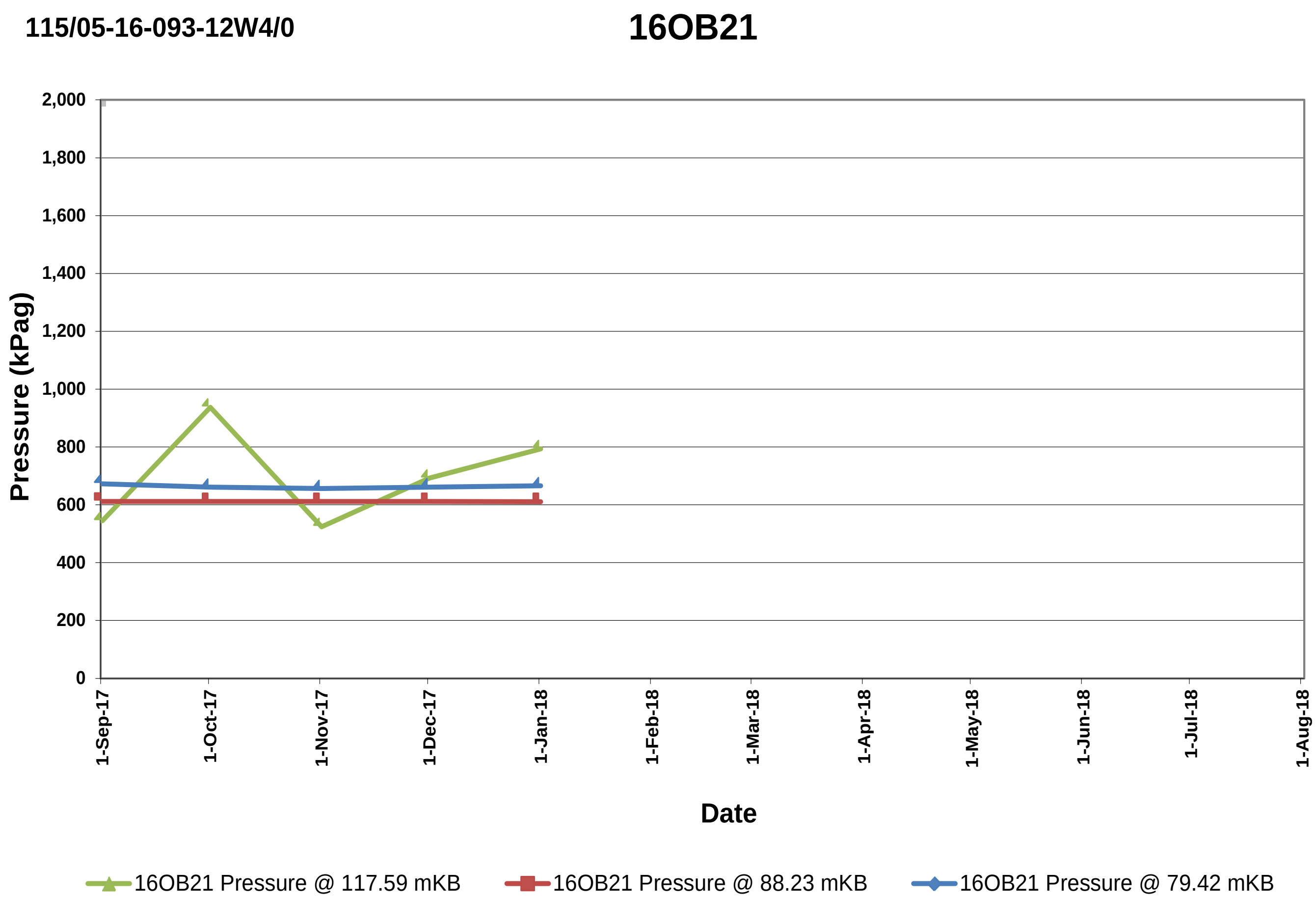
Piezometer Plots & Temperature vs Depth Plots



Piezometer Plots & Temperature vs Depth Plots



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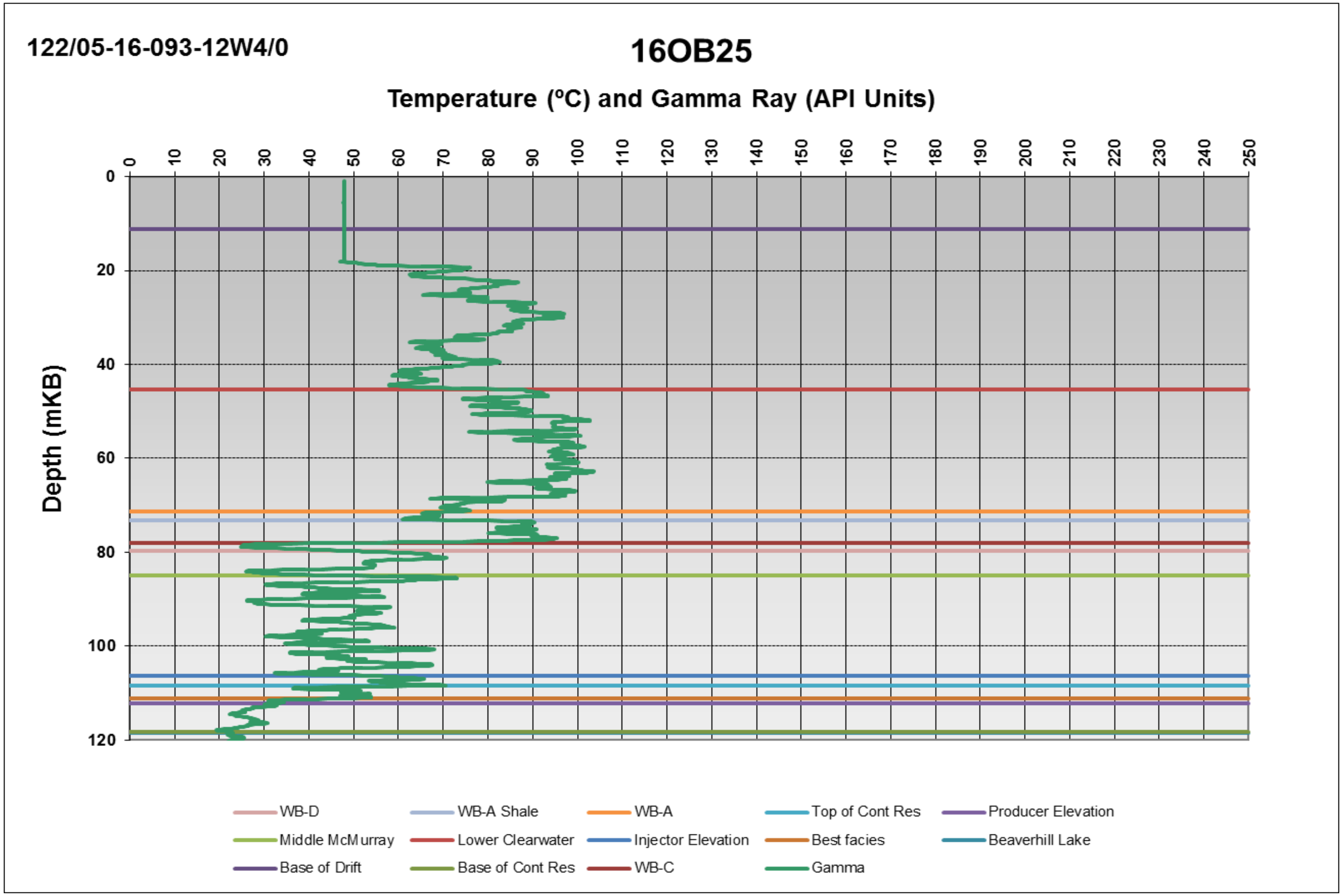

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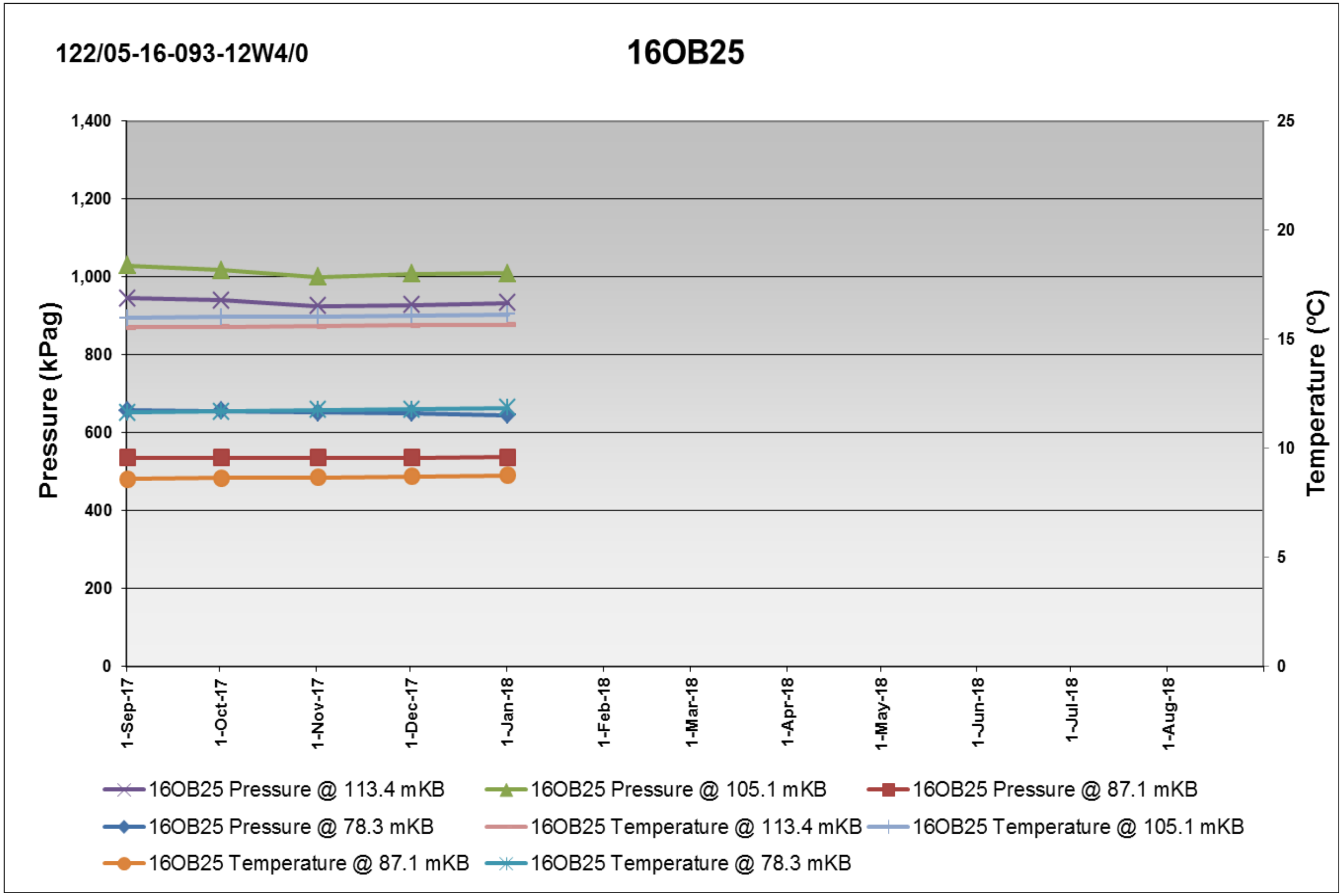

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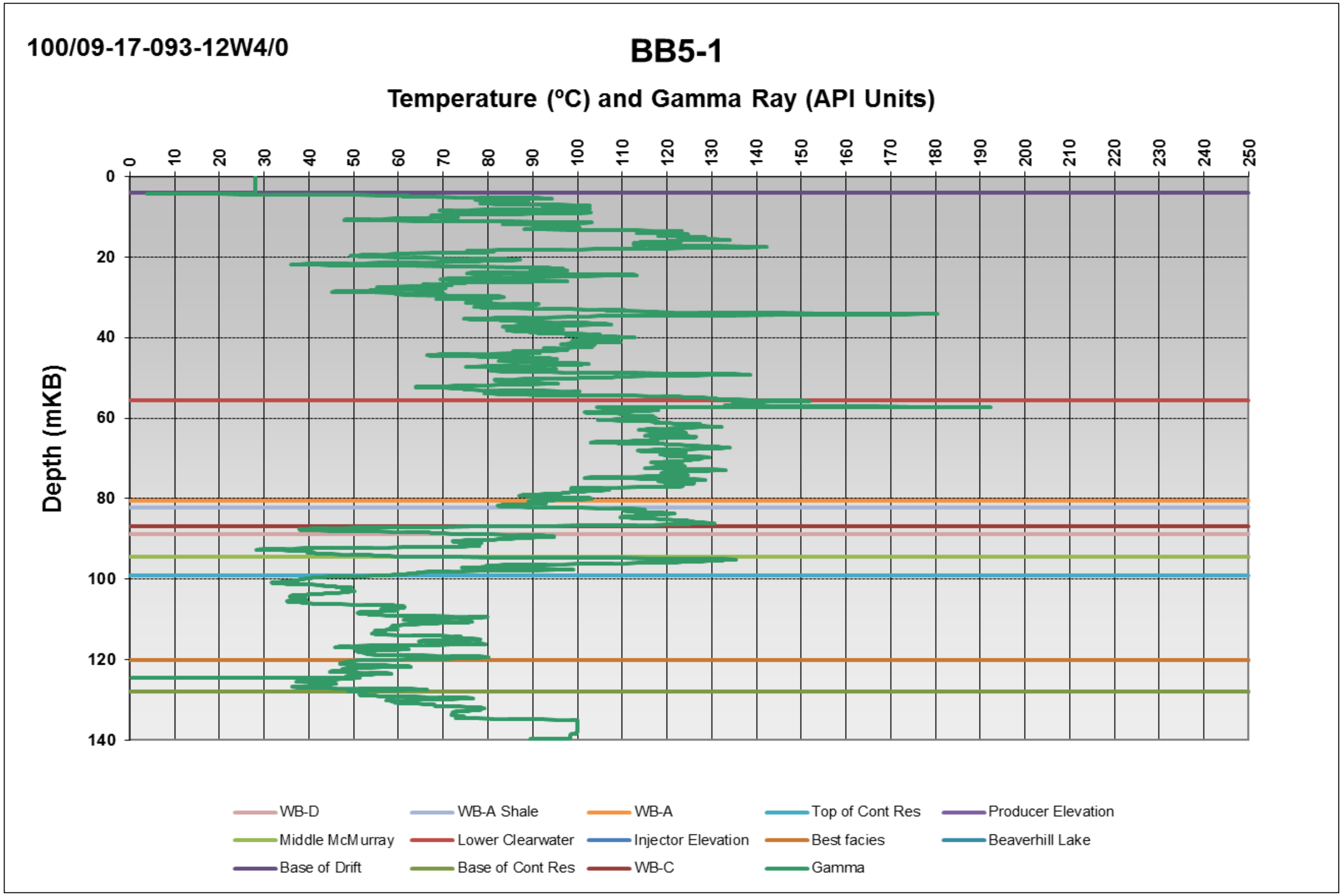

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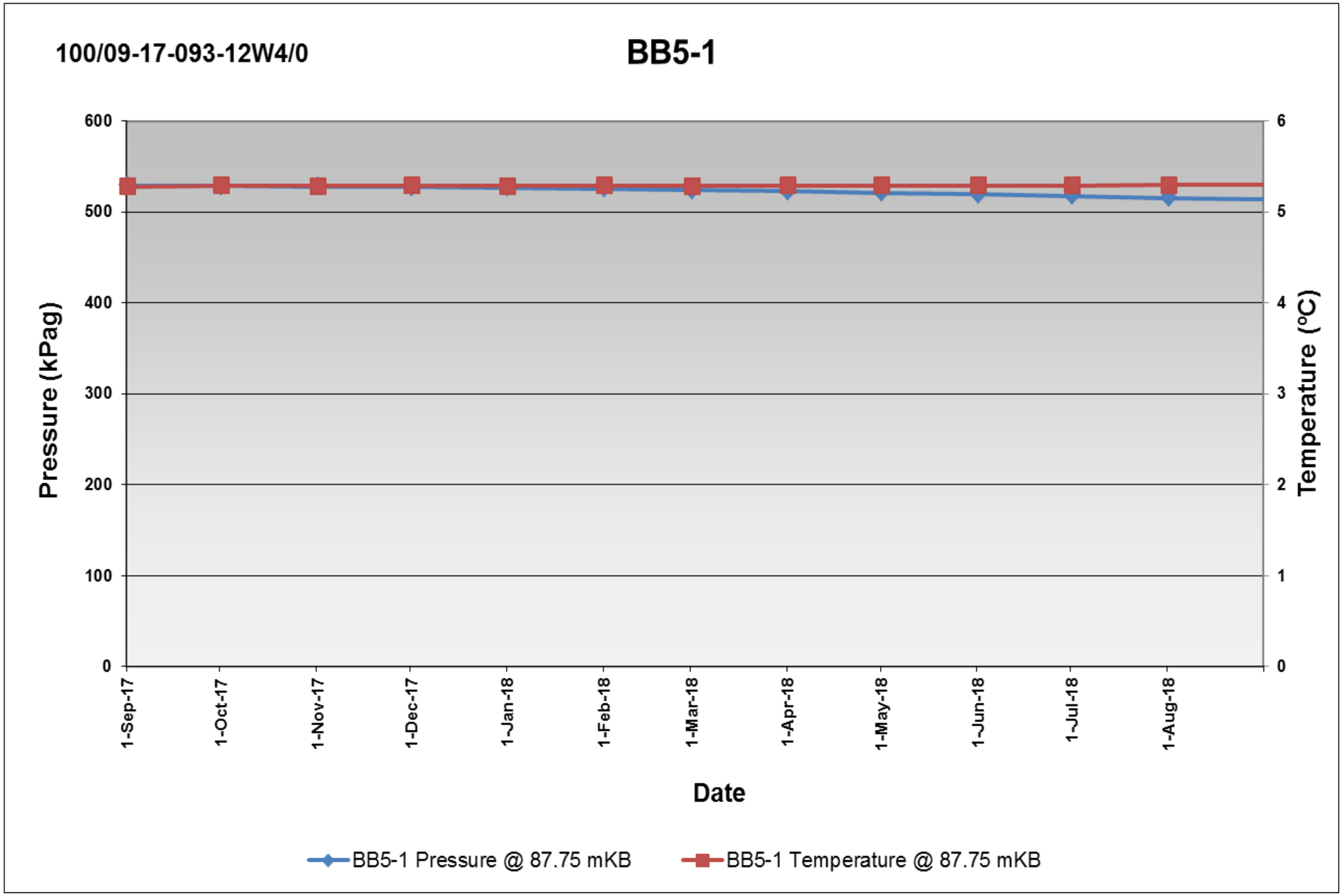

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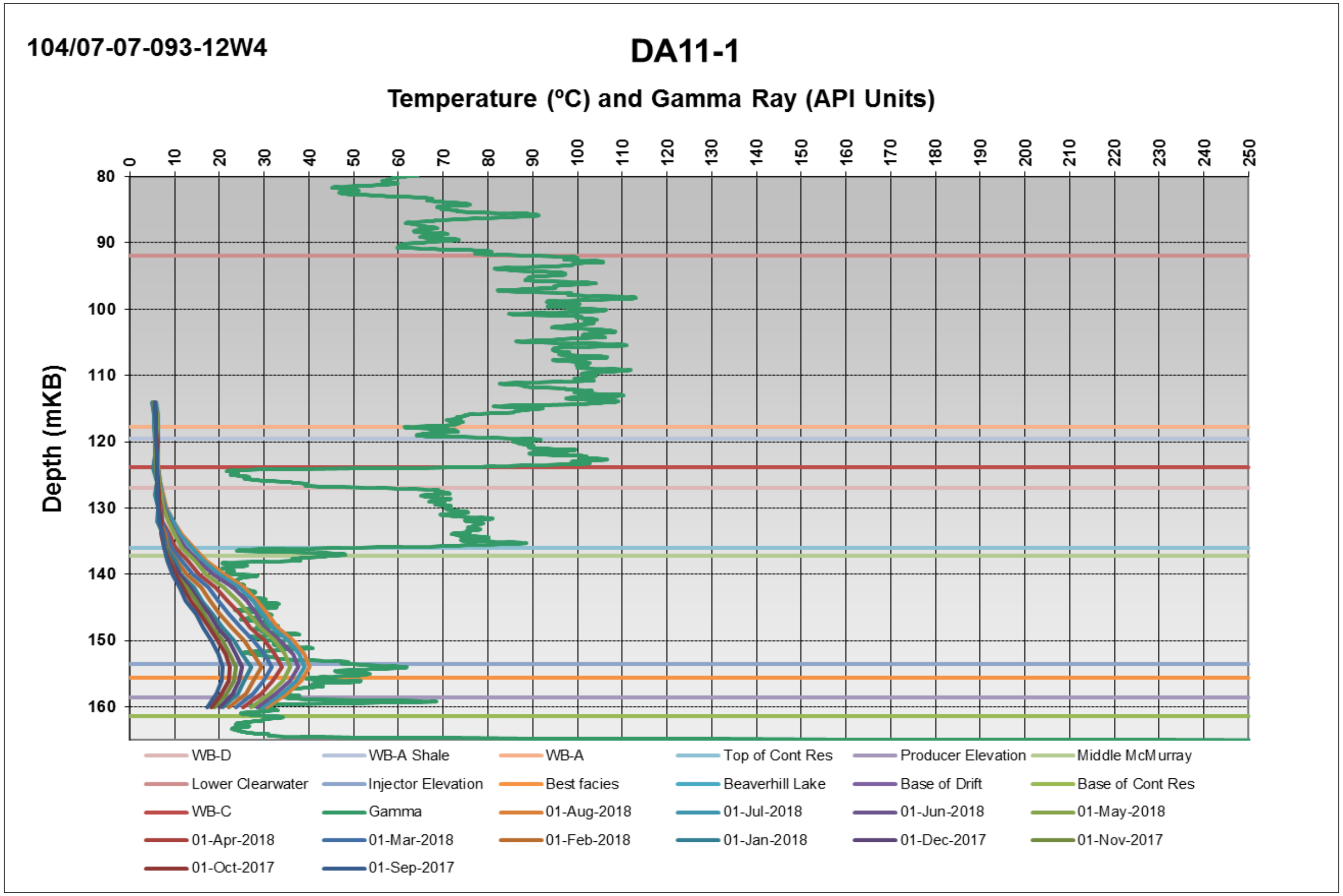

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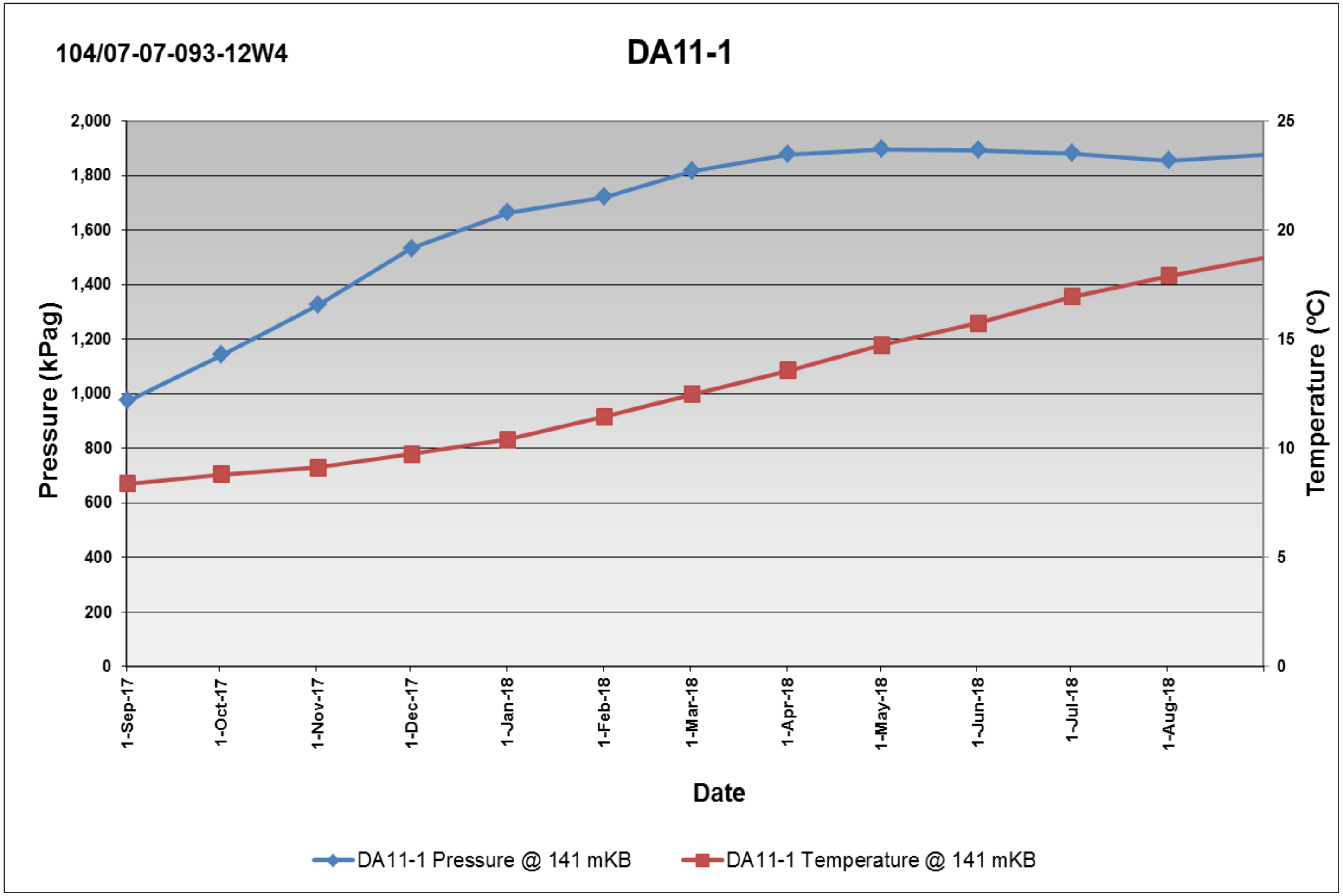

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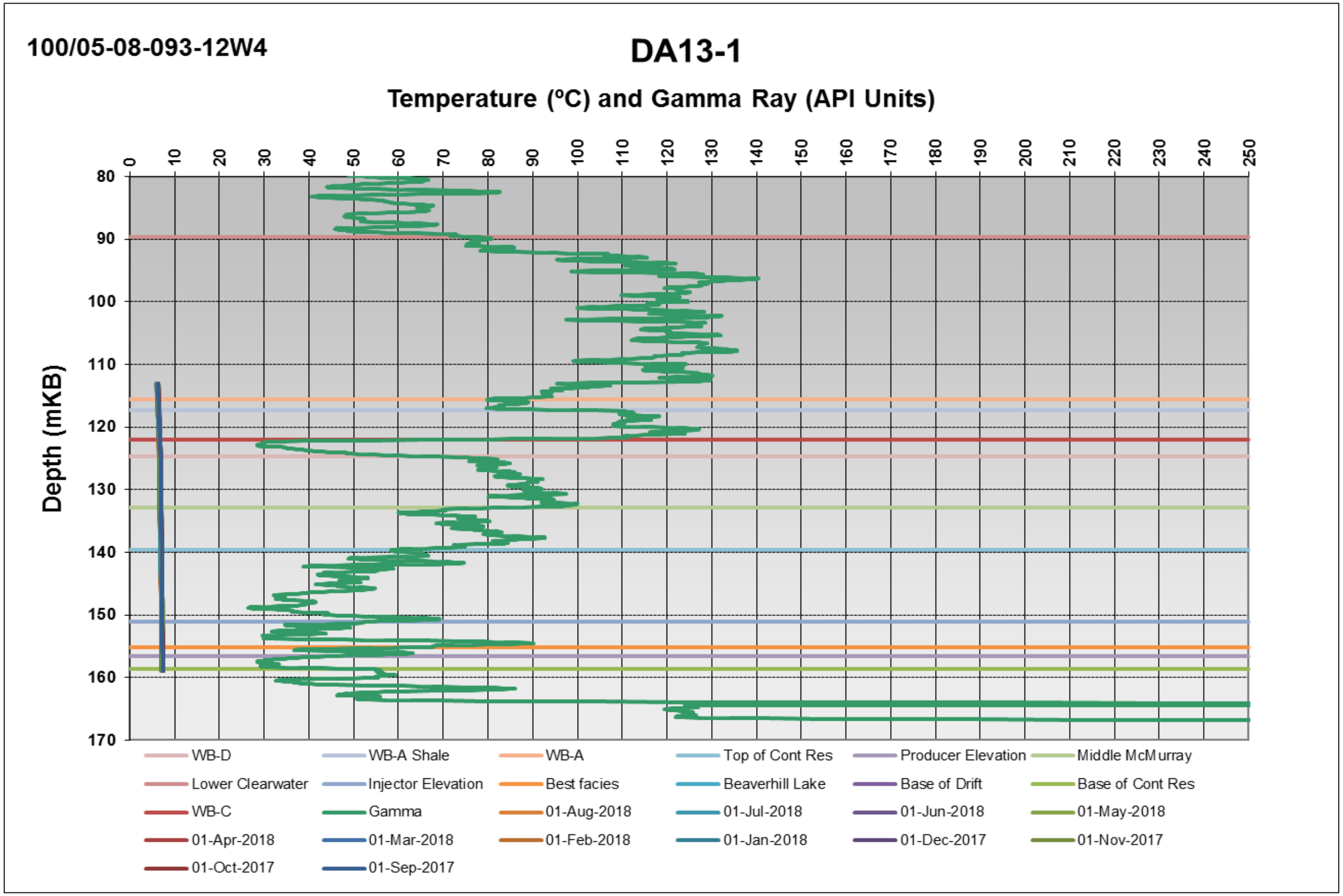

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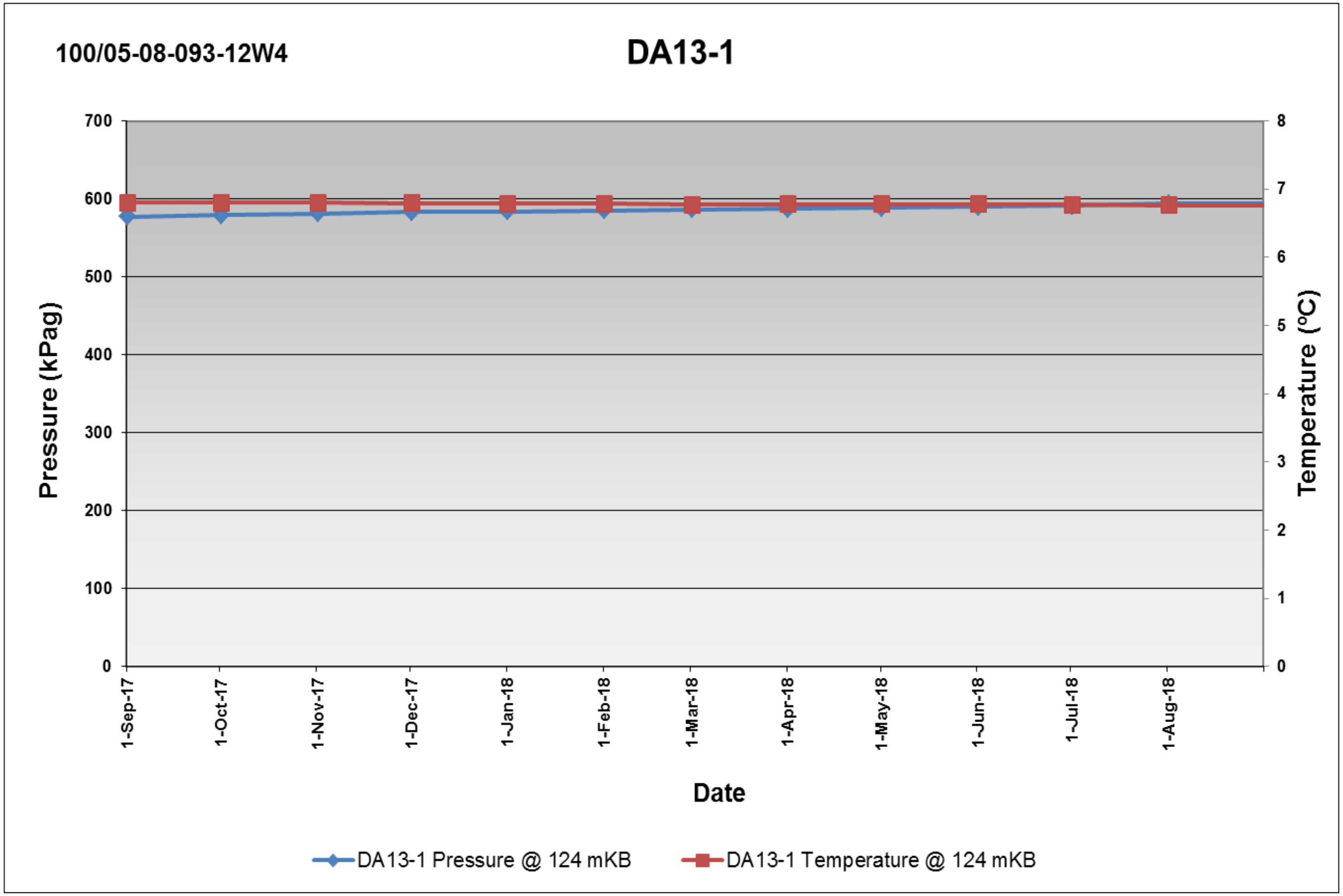

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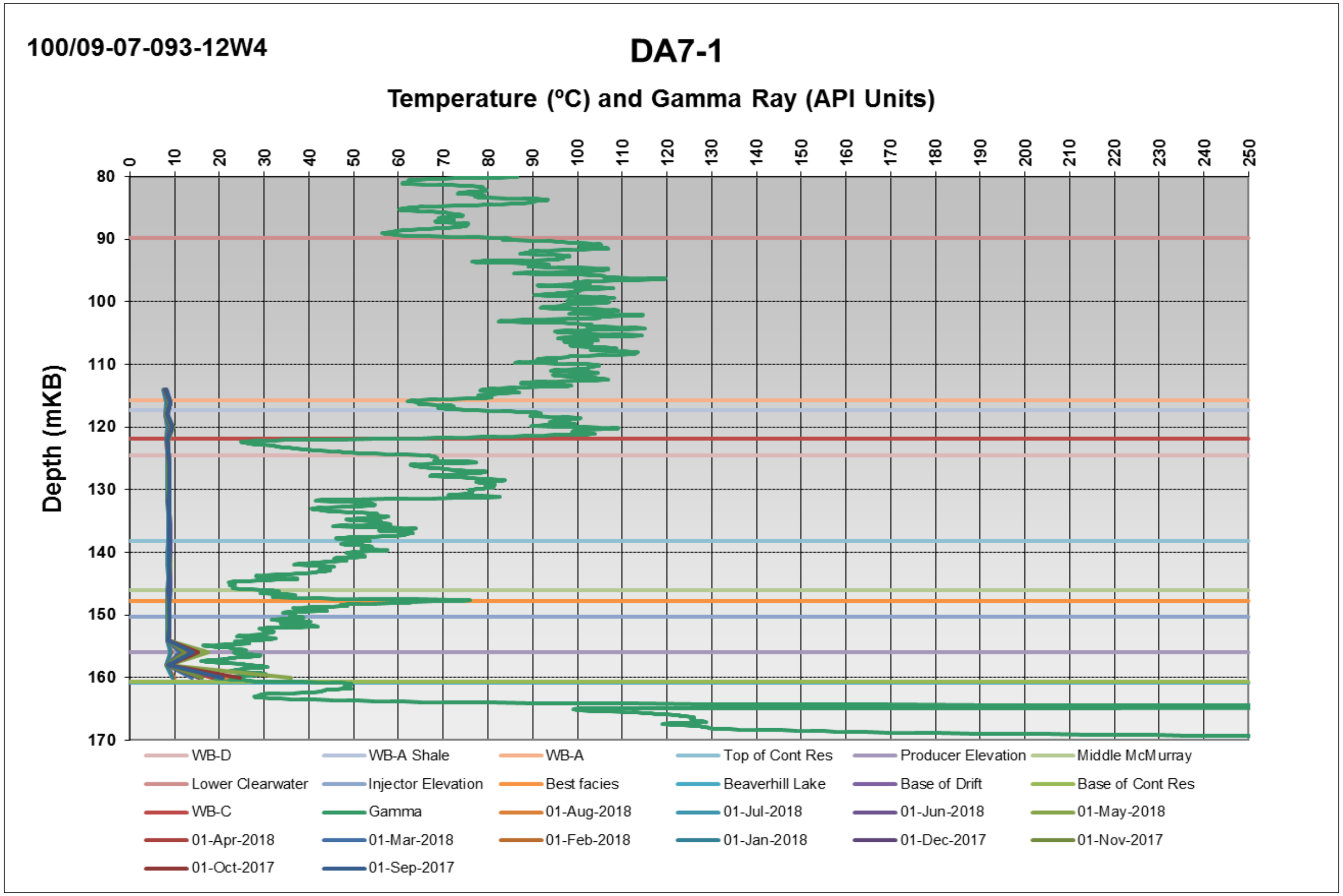

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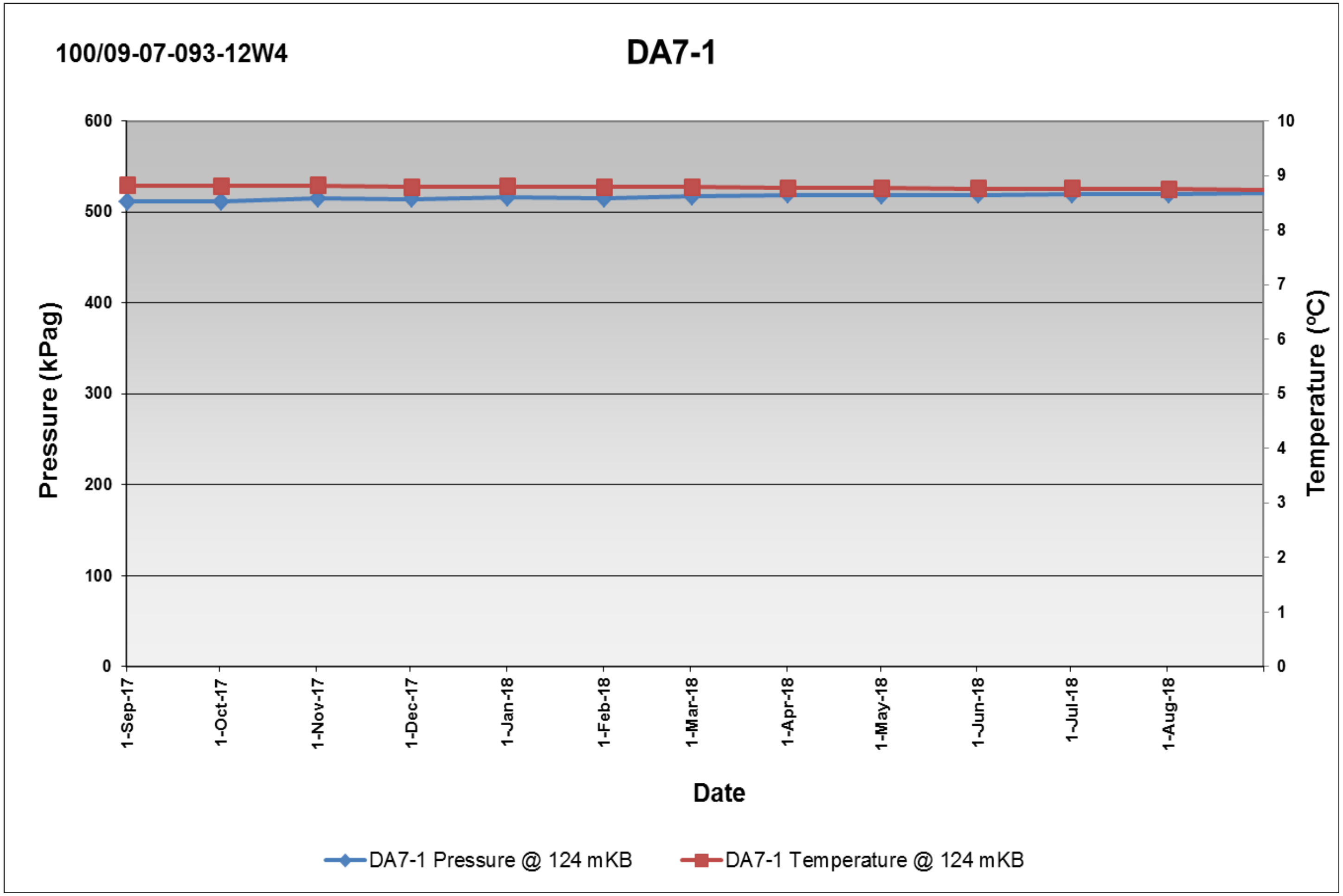

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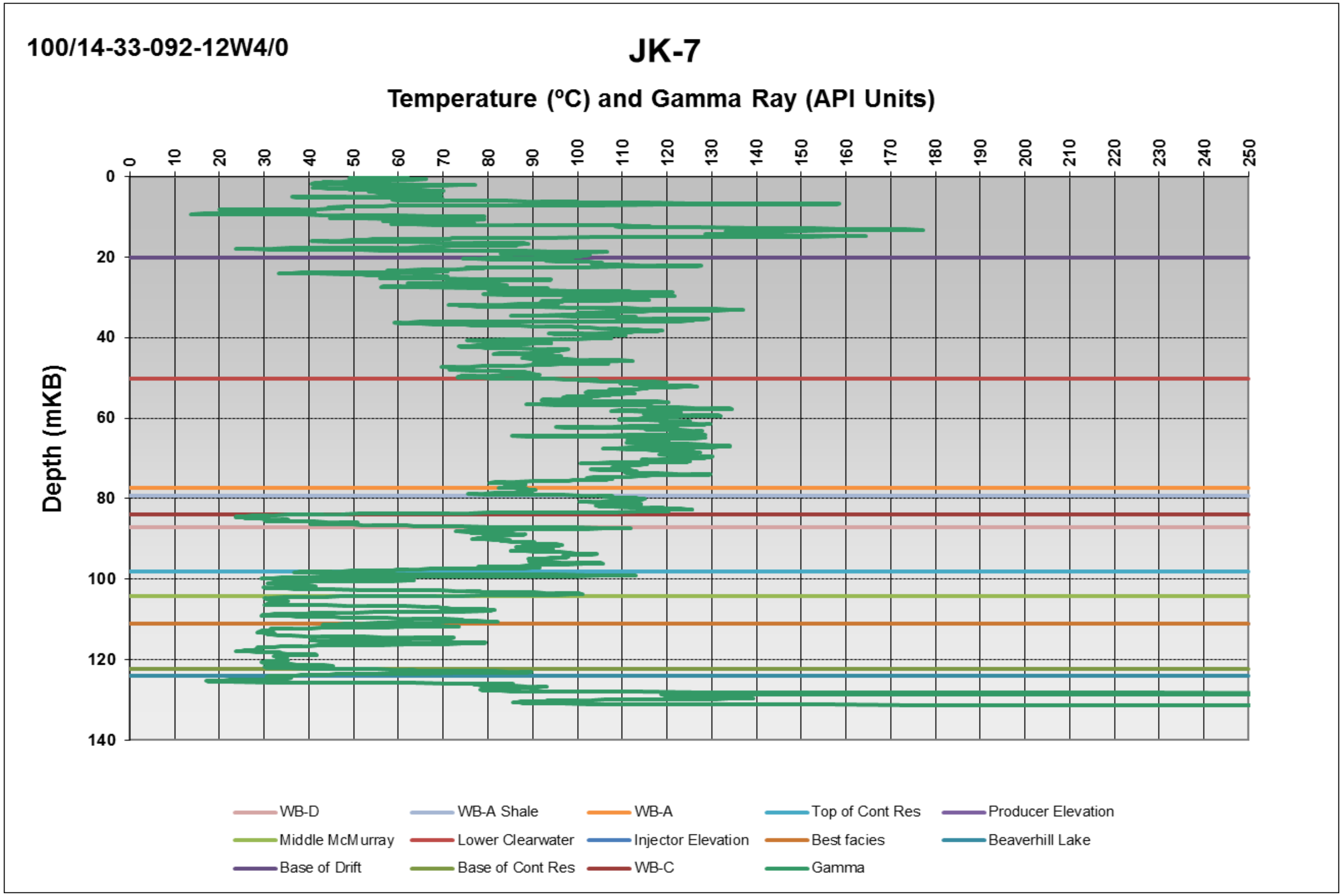

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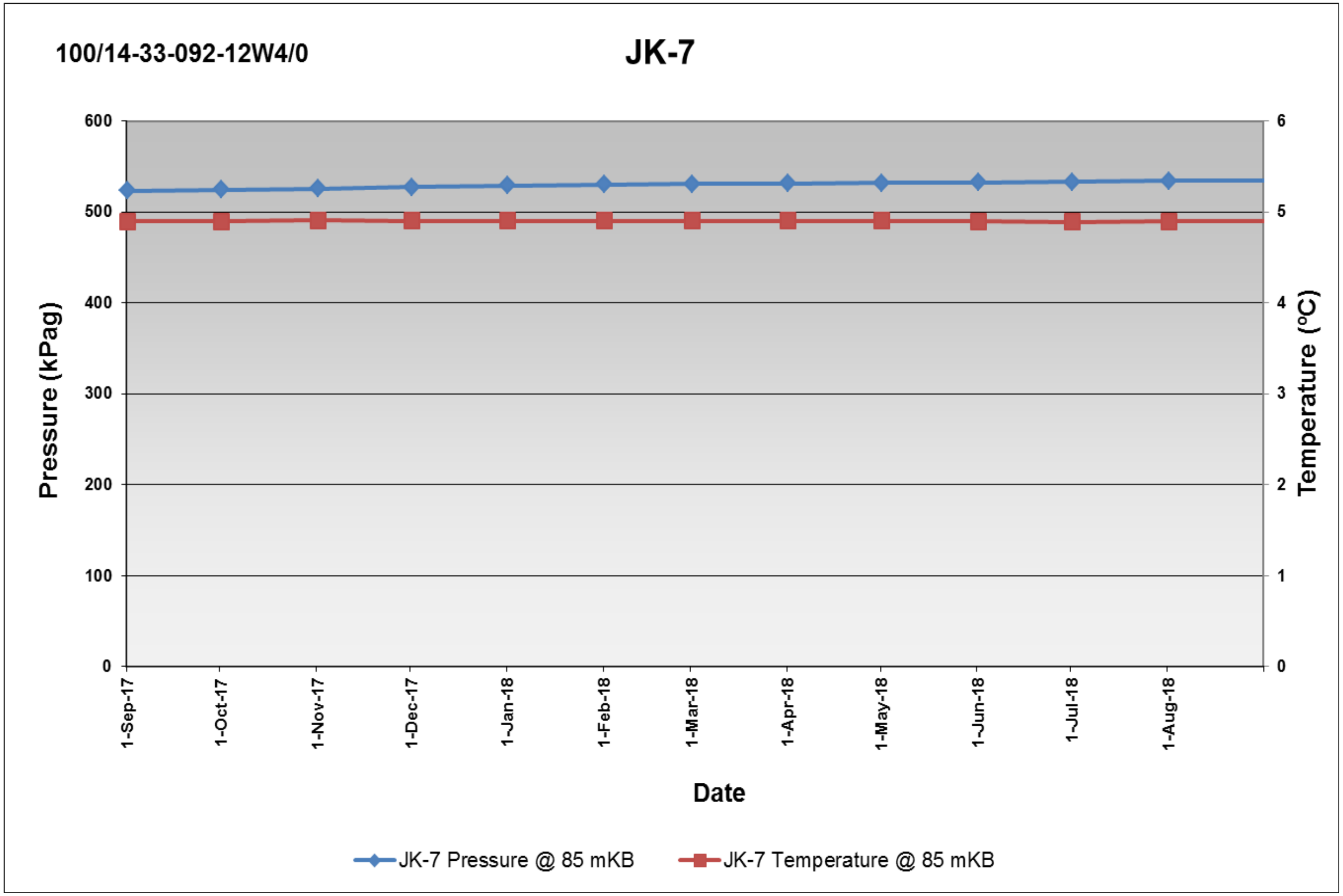

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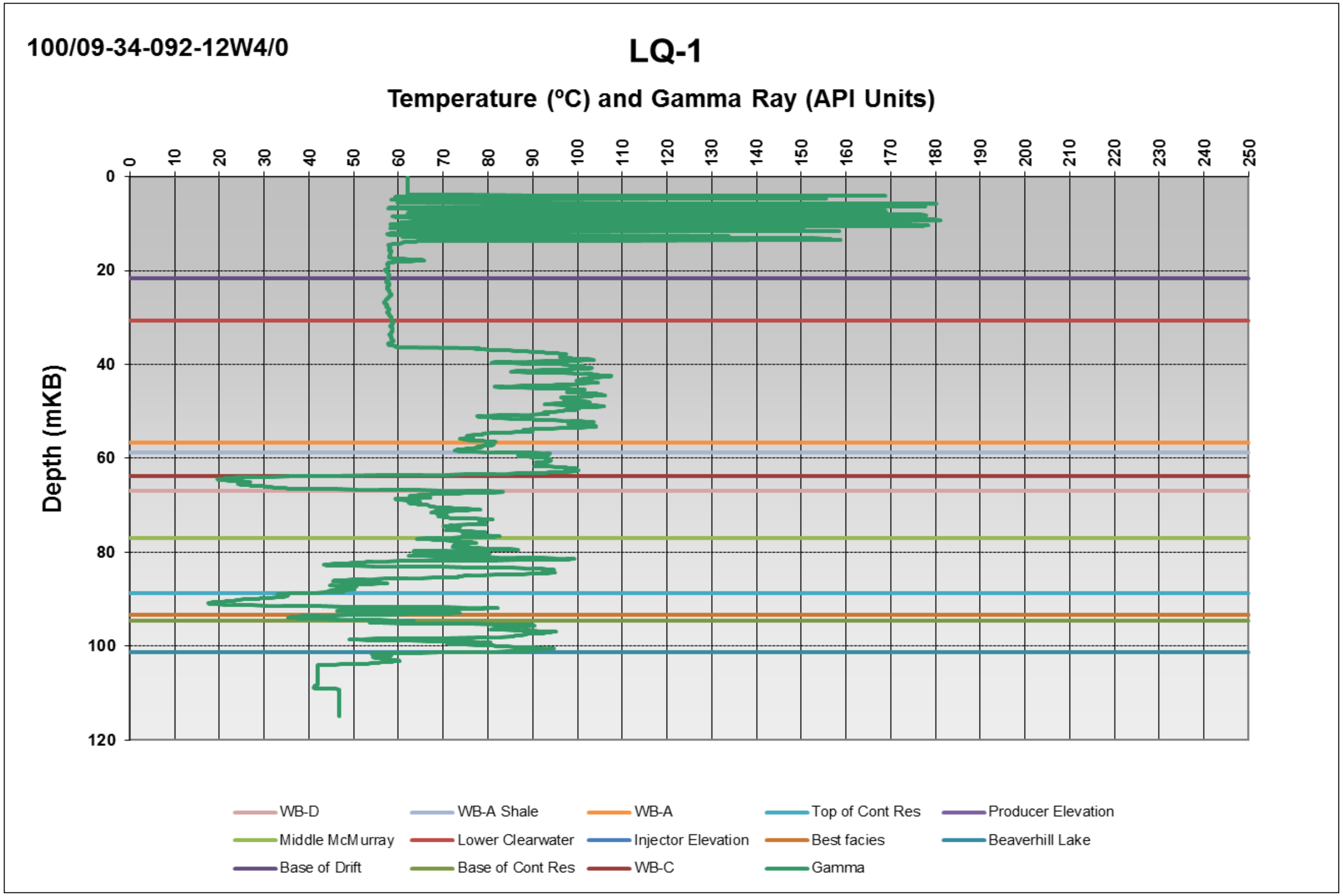

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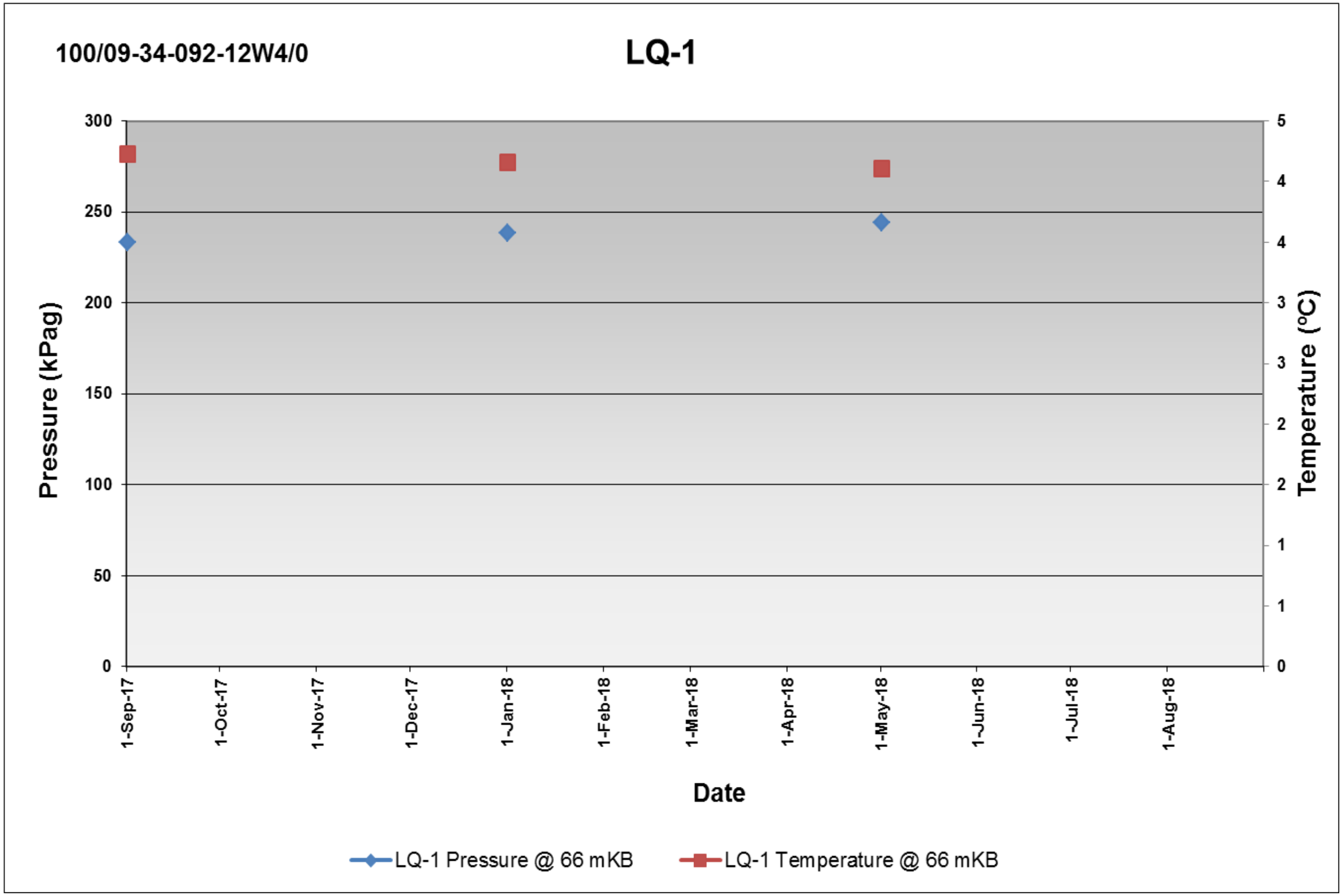

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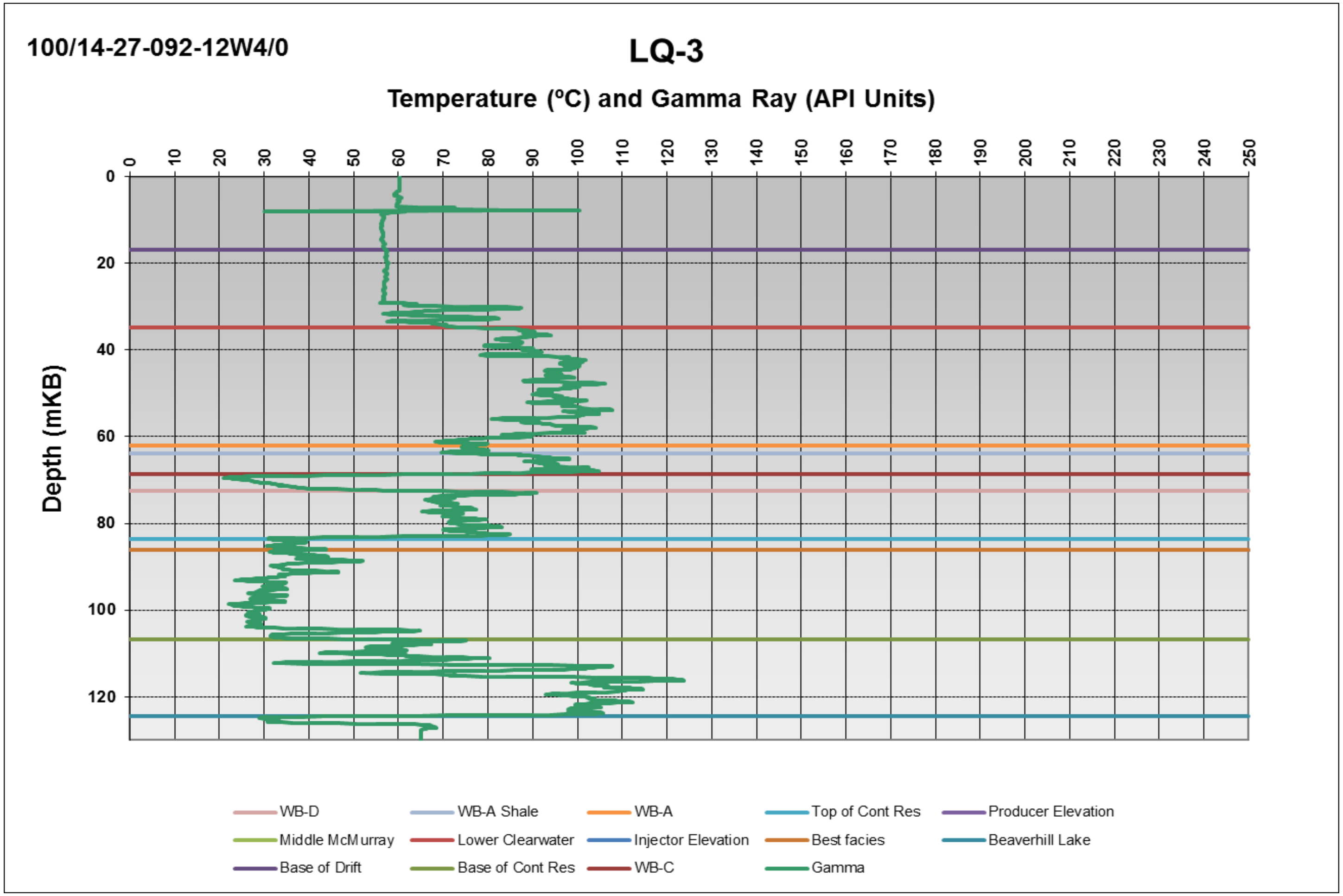
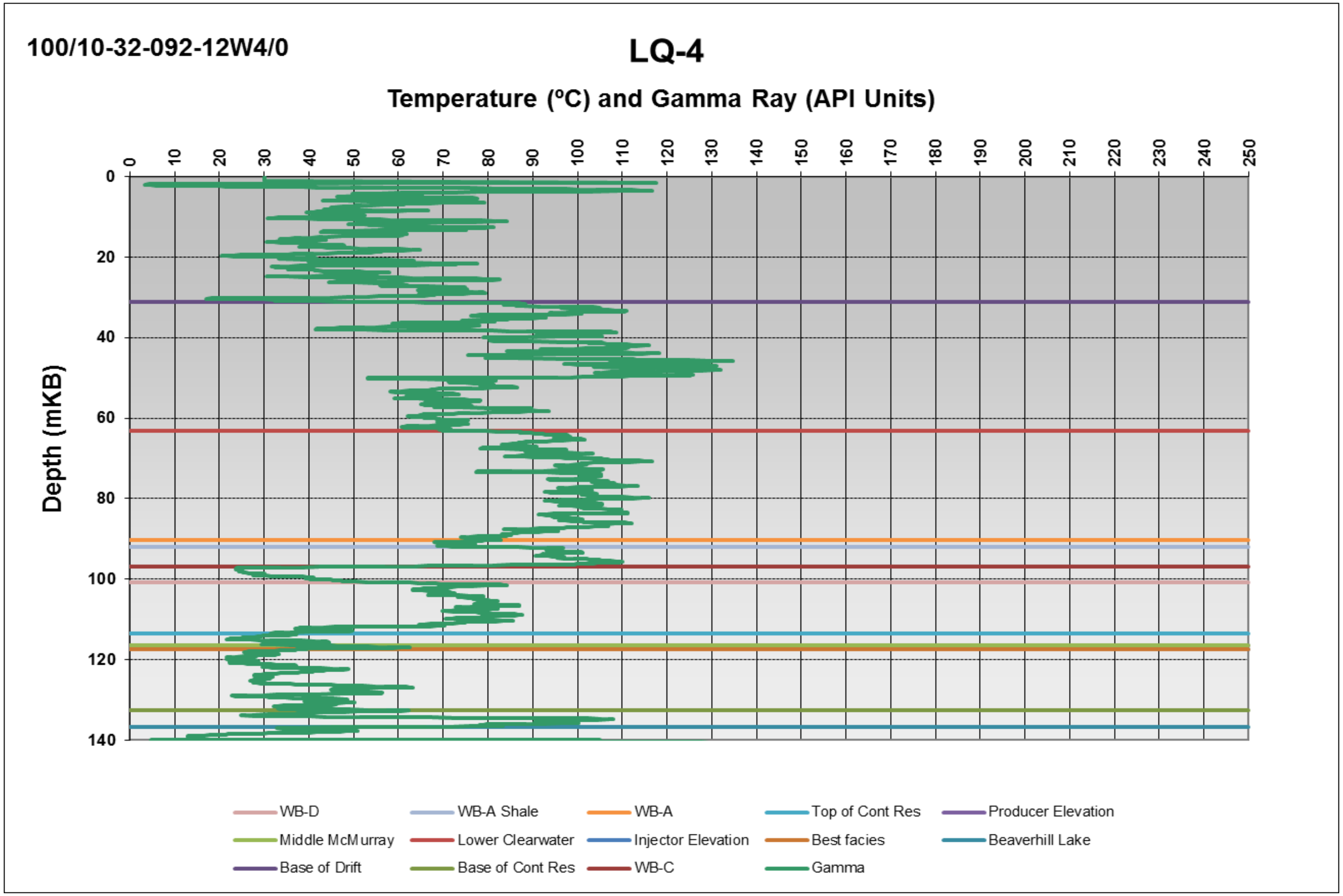


Piezometer Plots & Temperature vs Depth Plots



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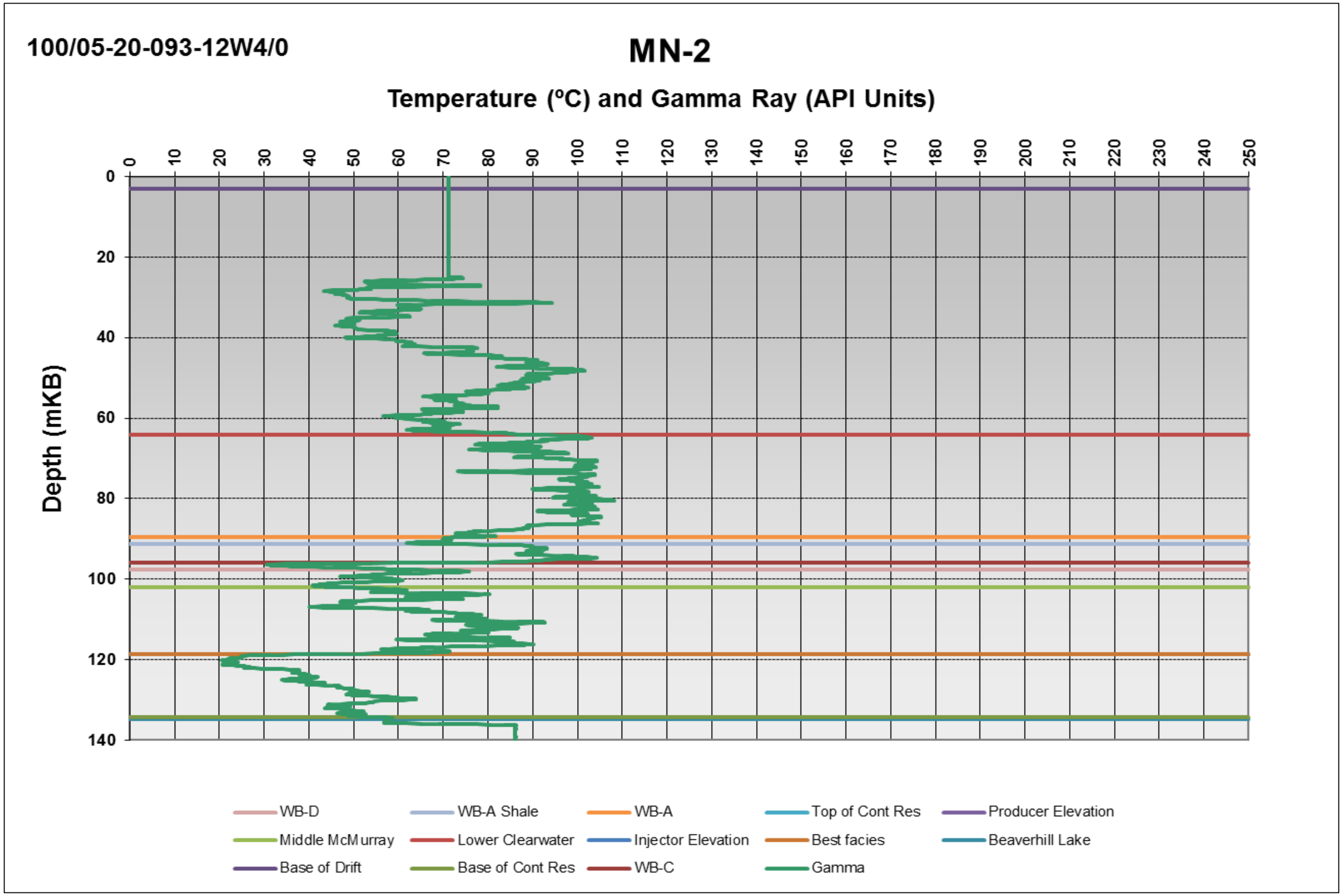

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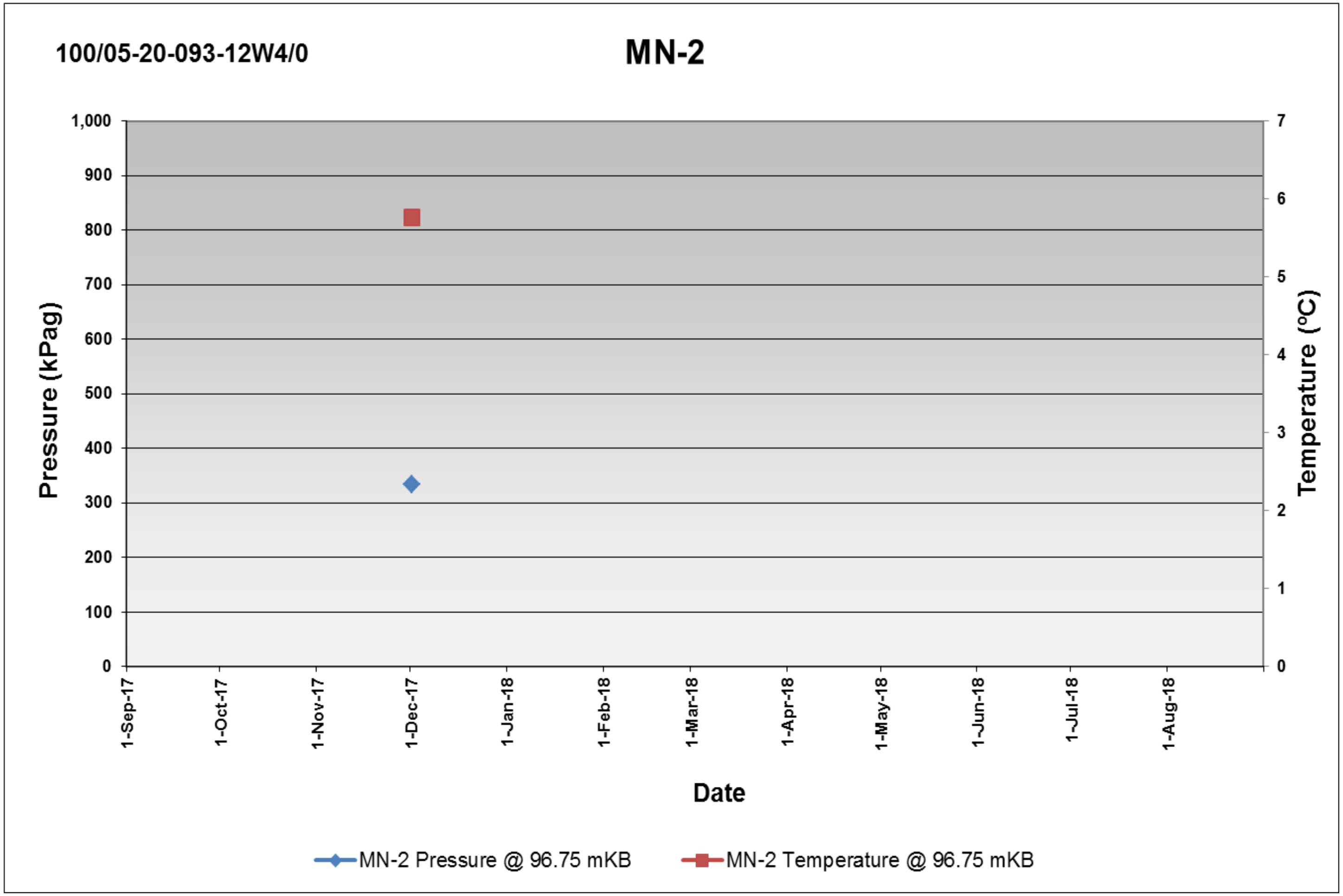

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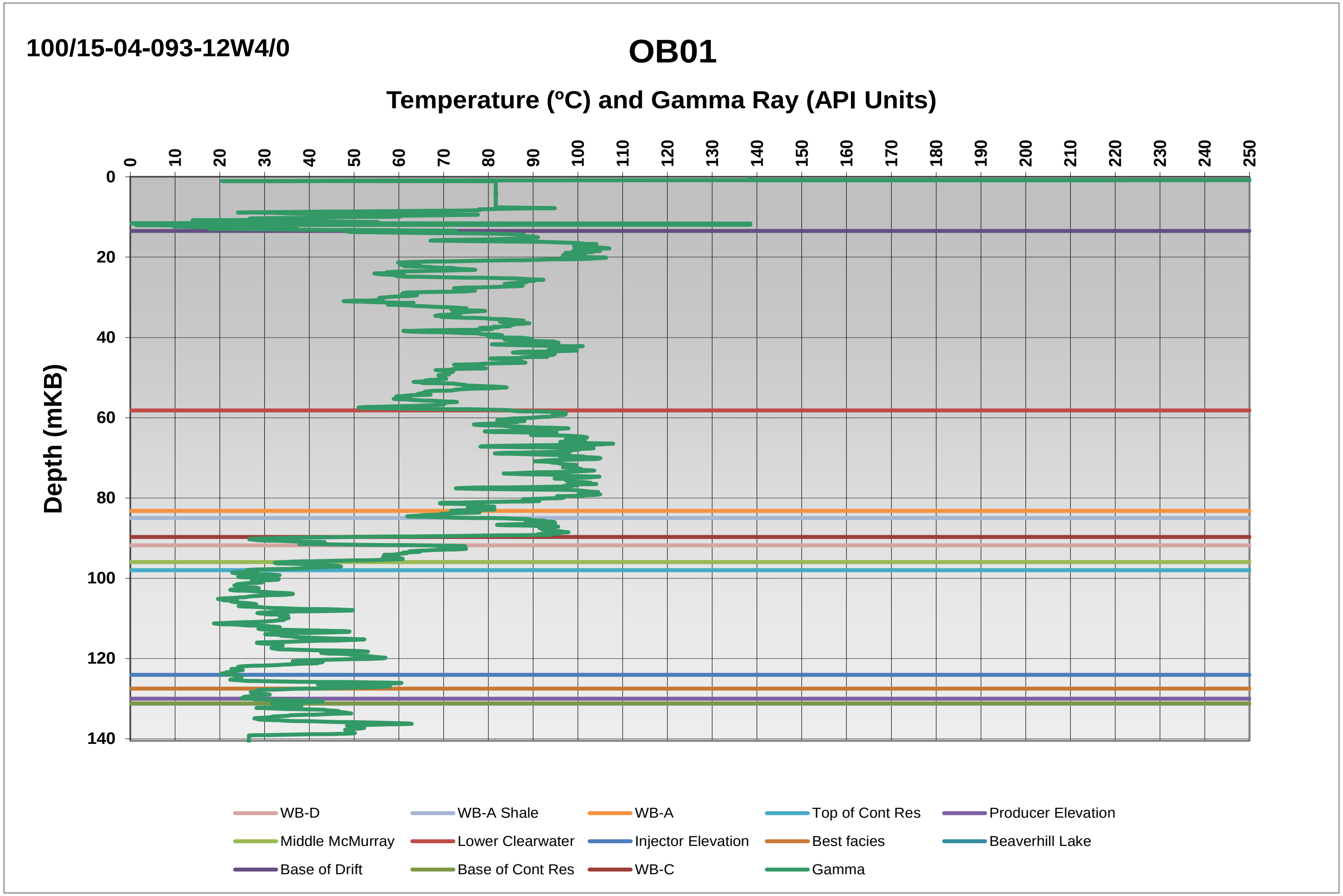

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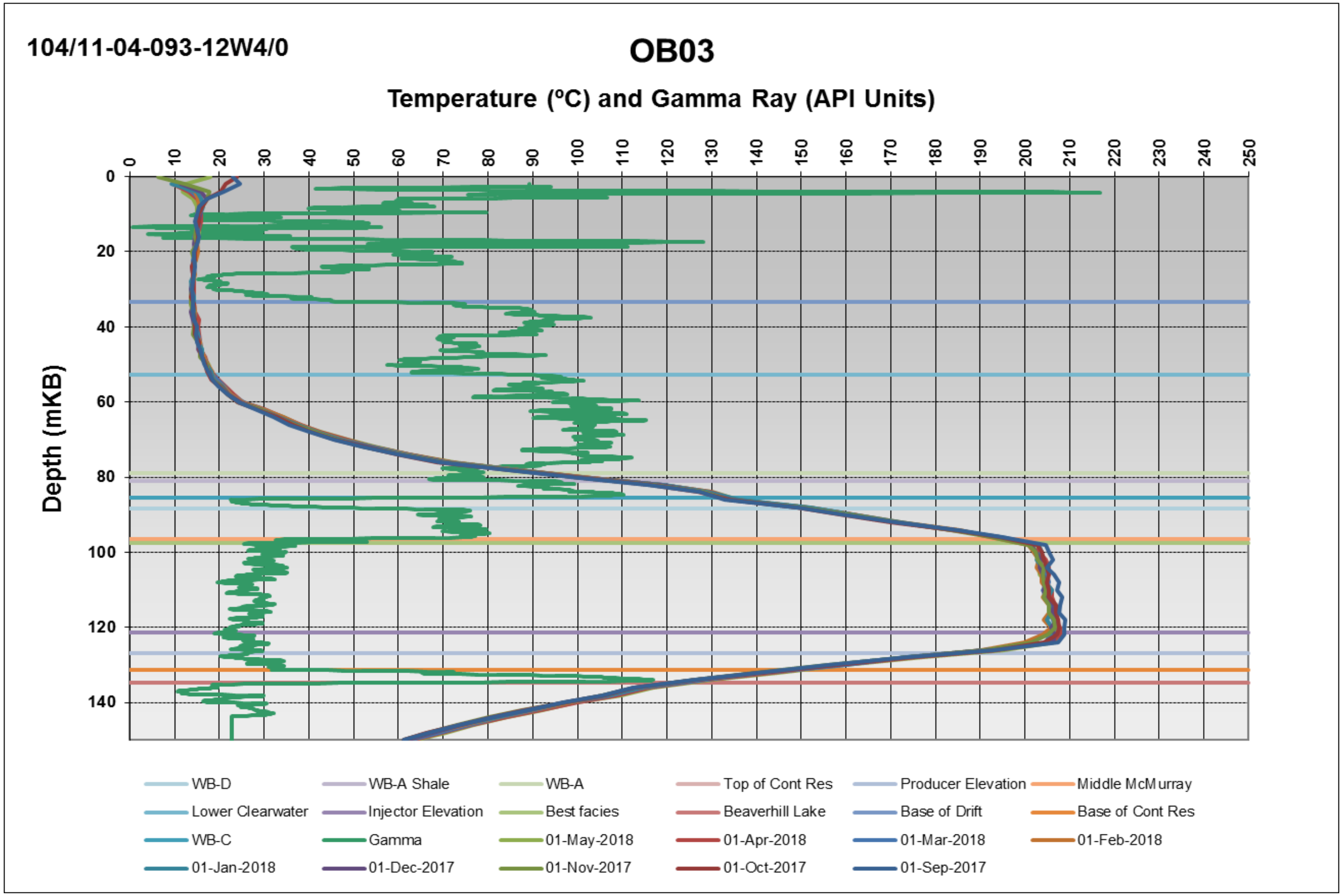

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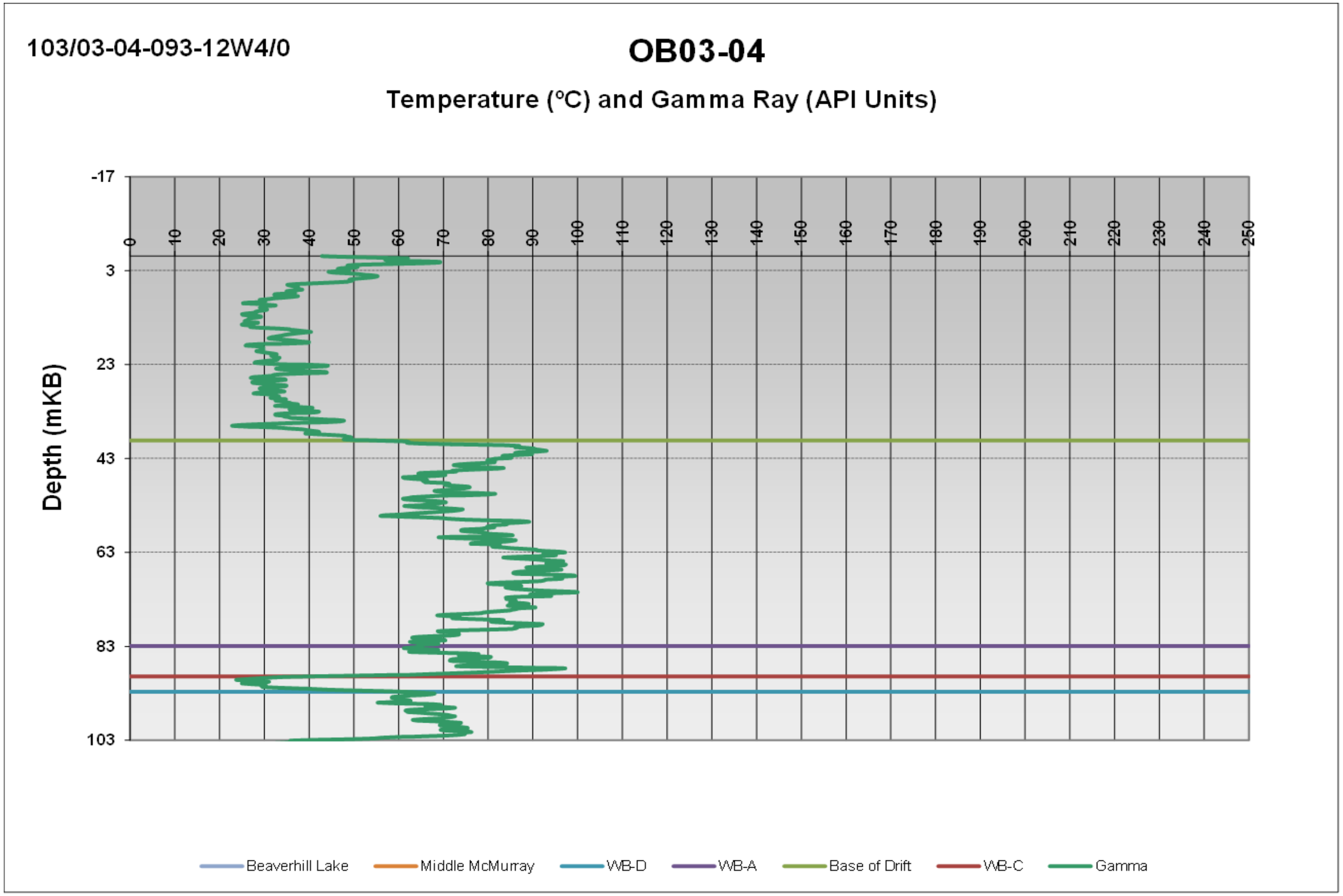

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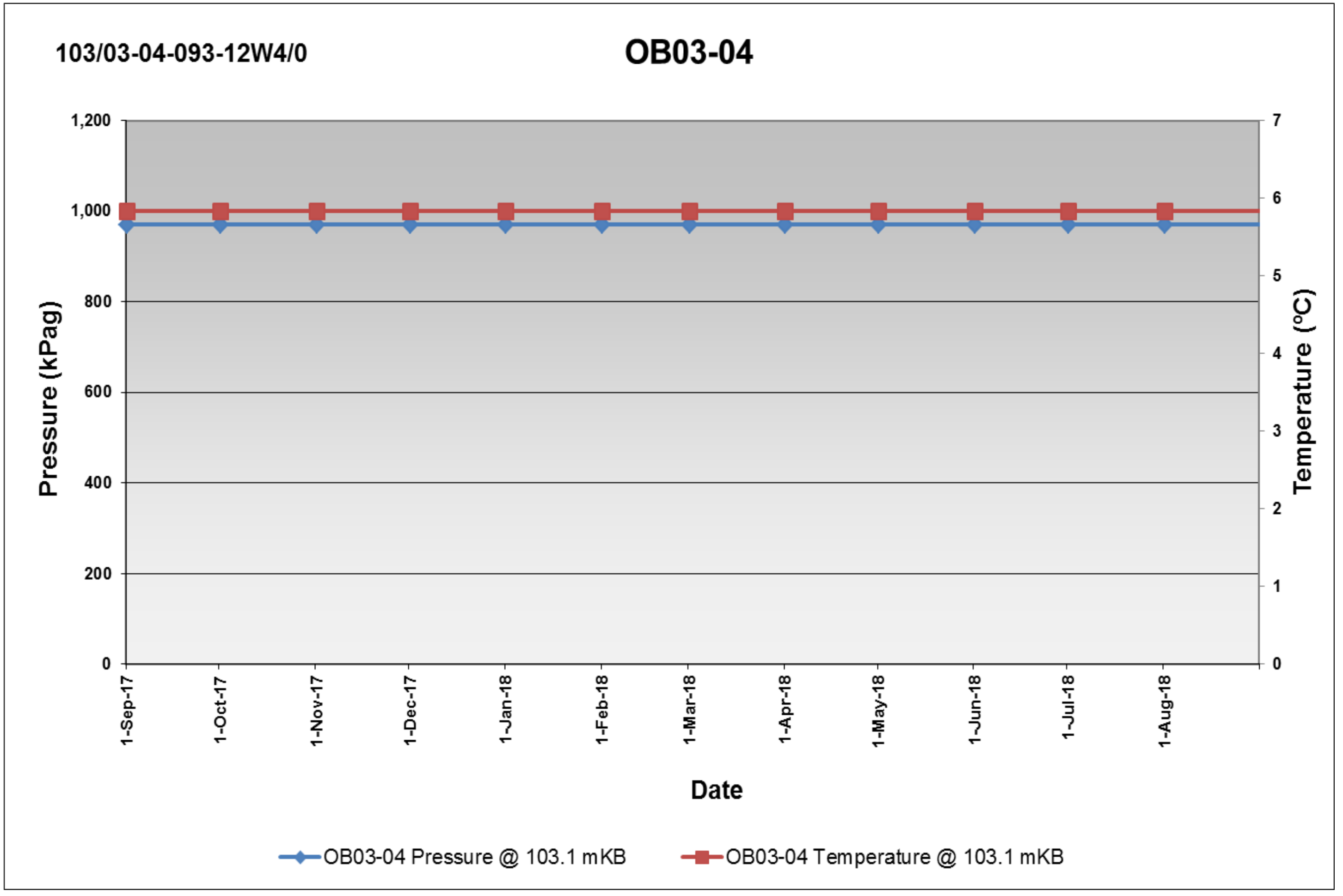

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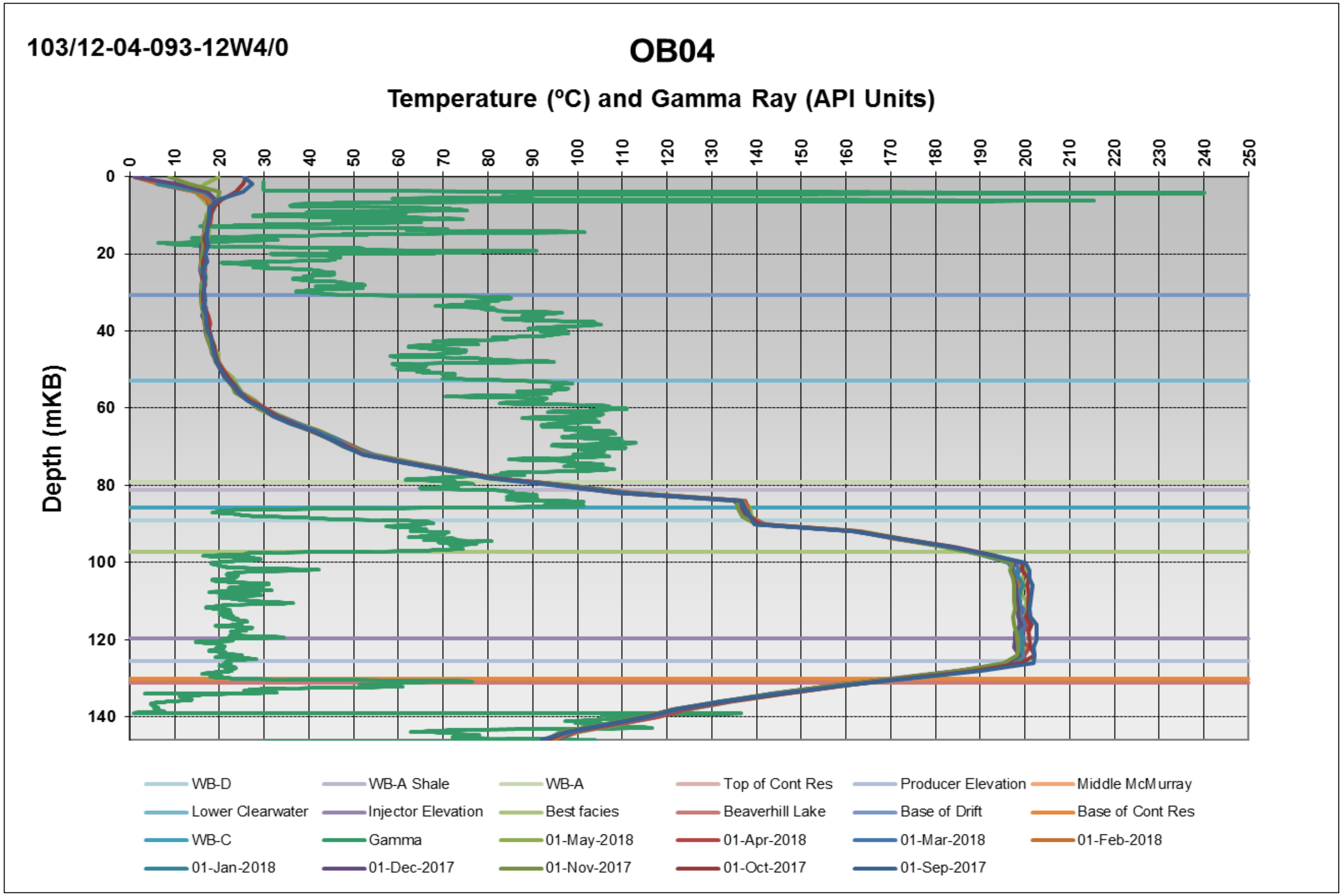

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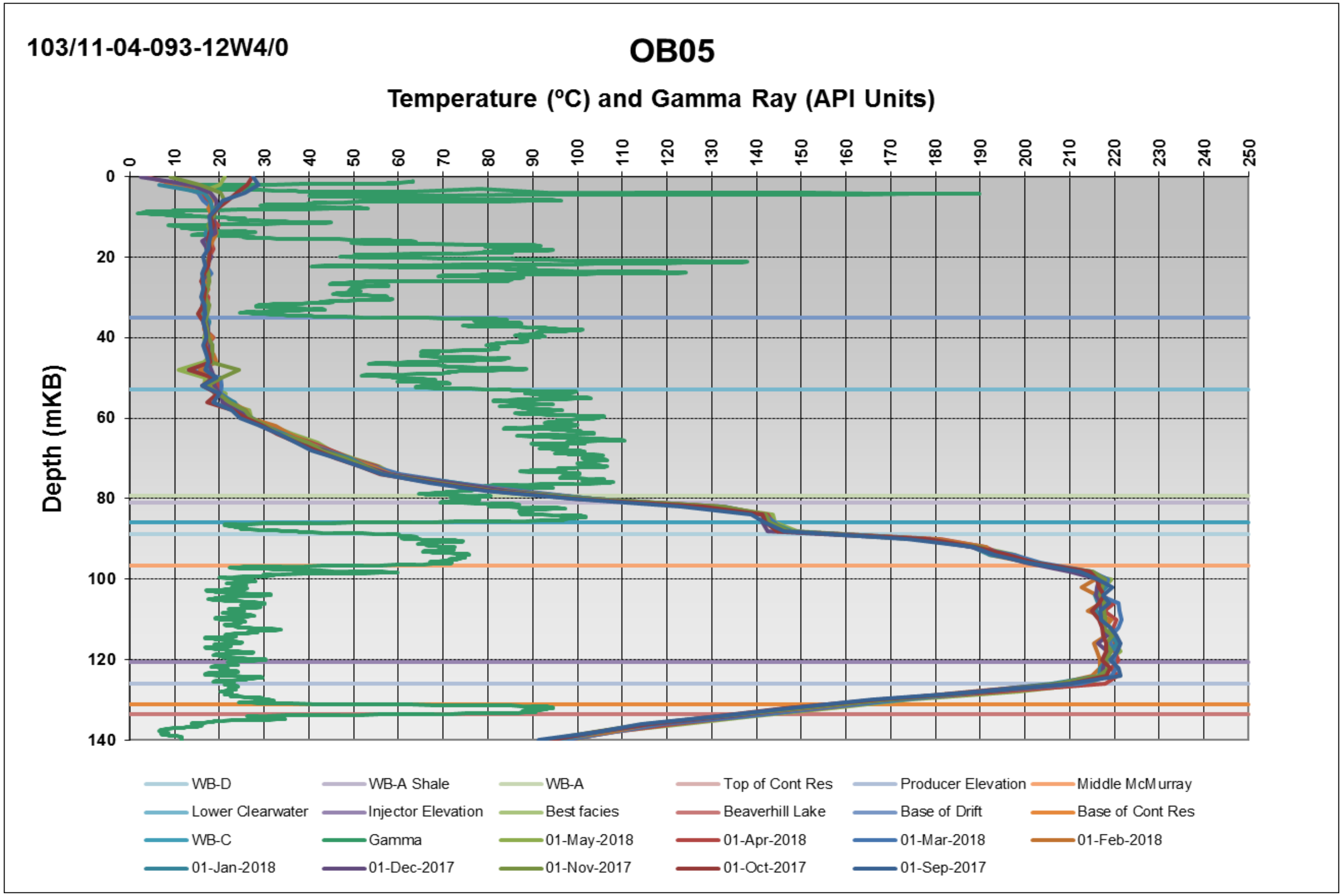

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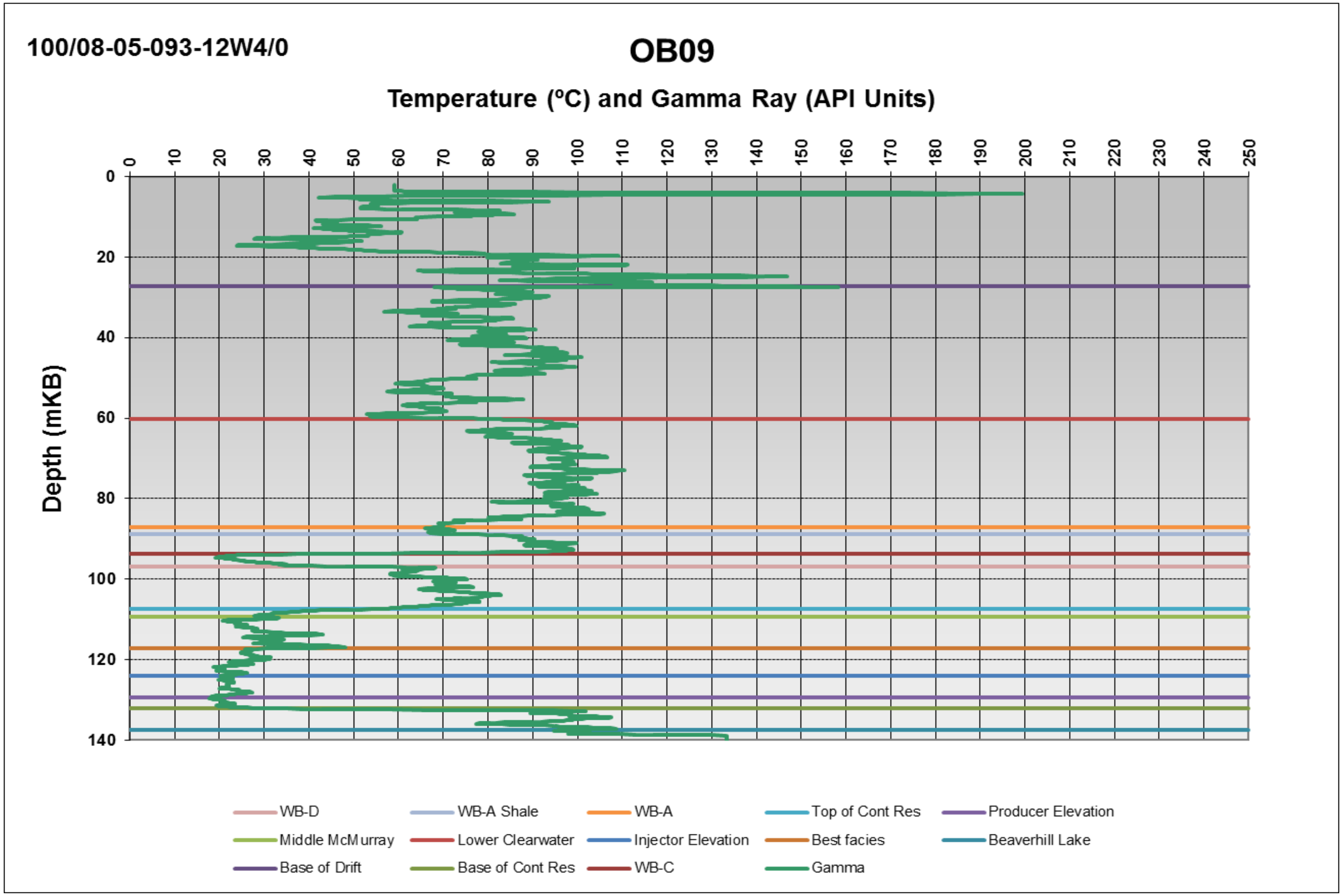

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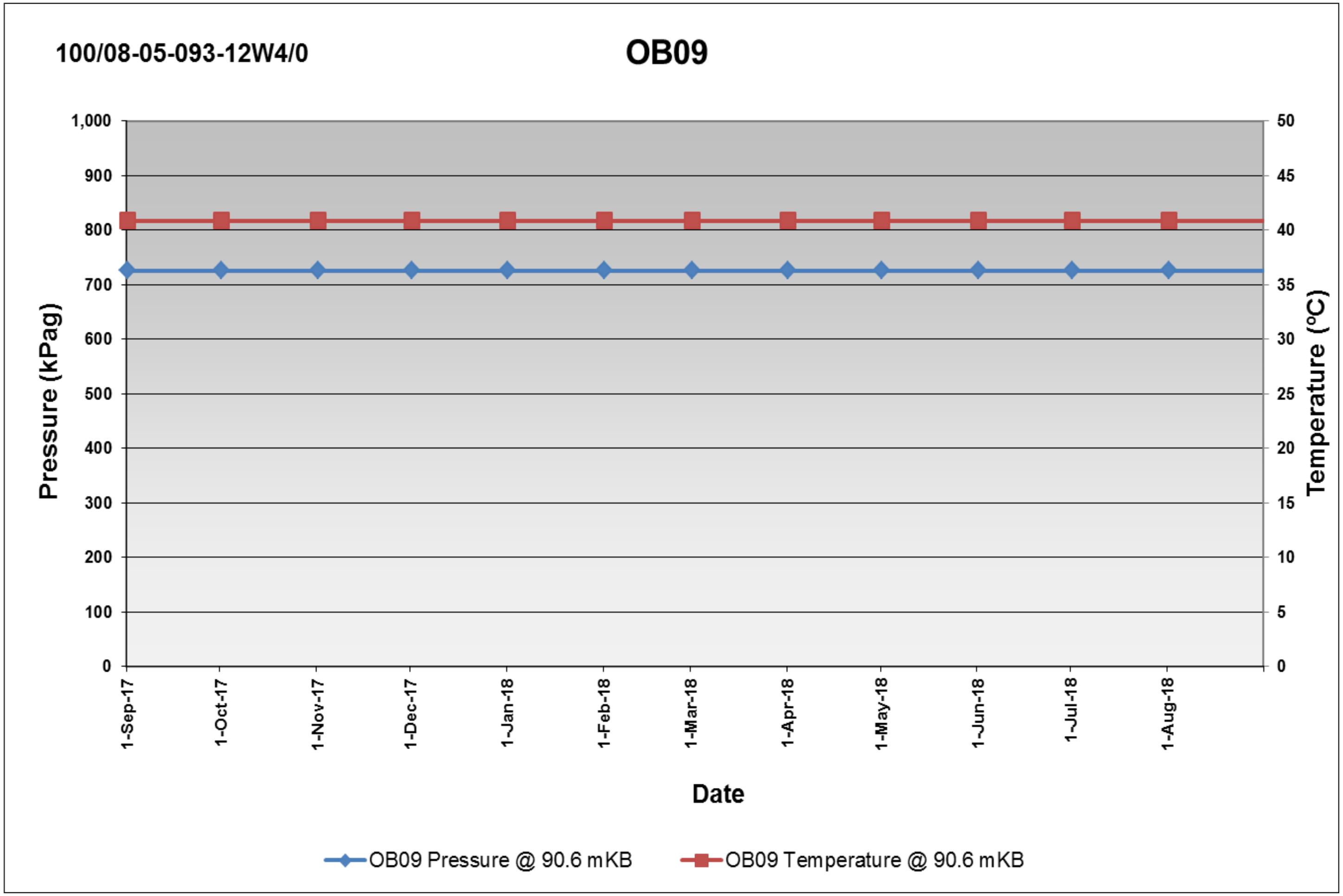

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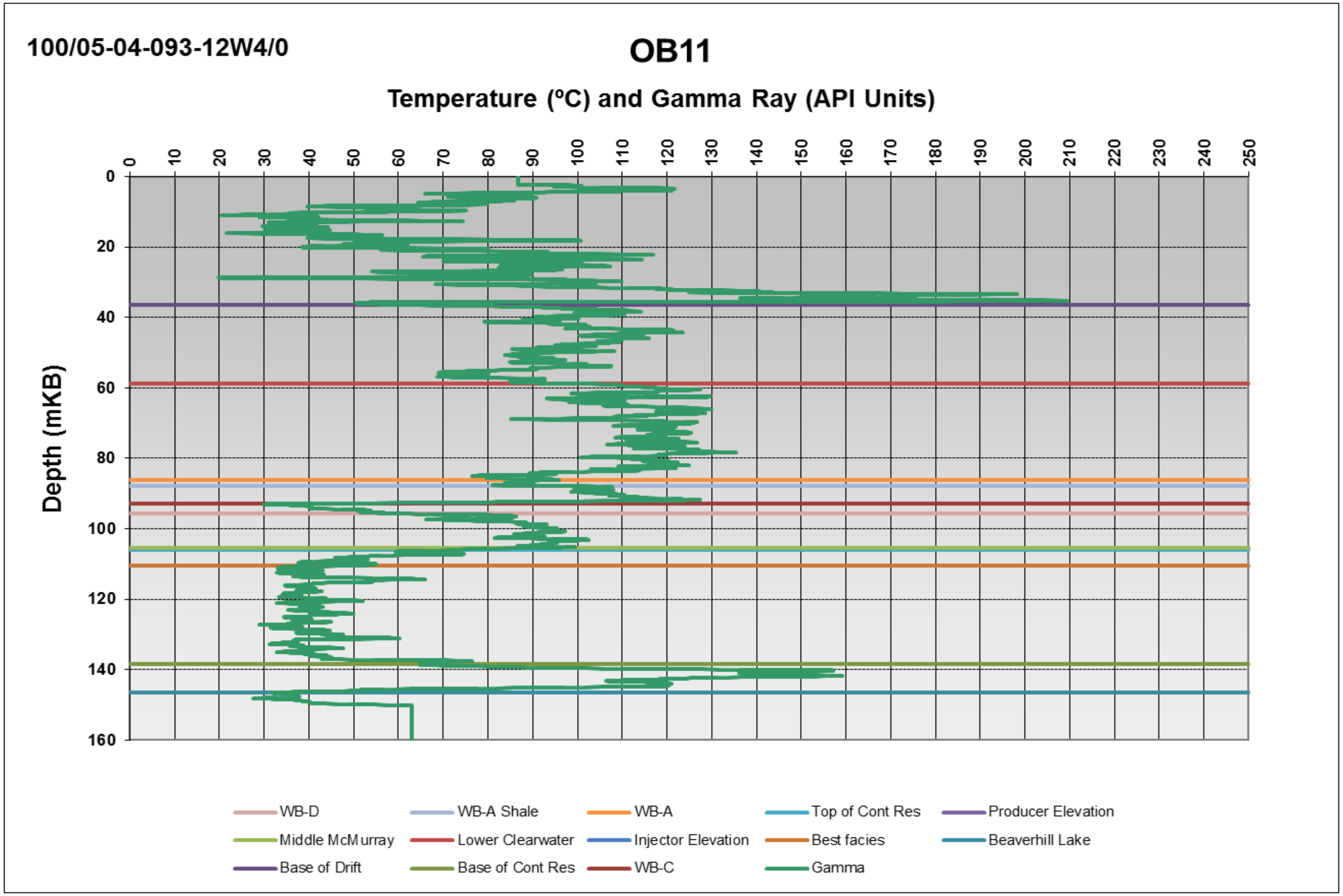

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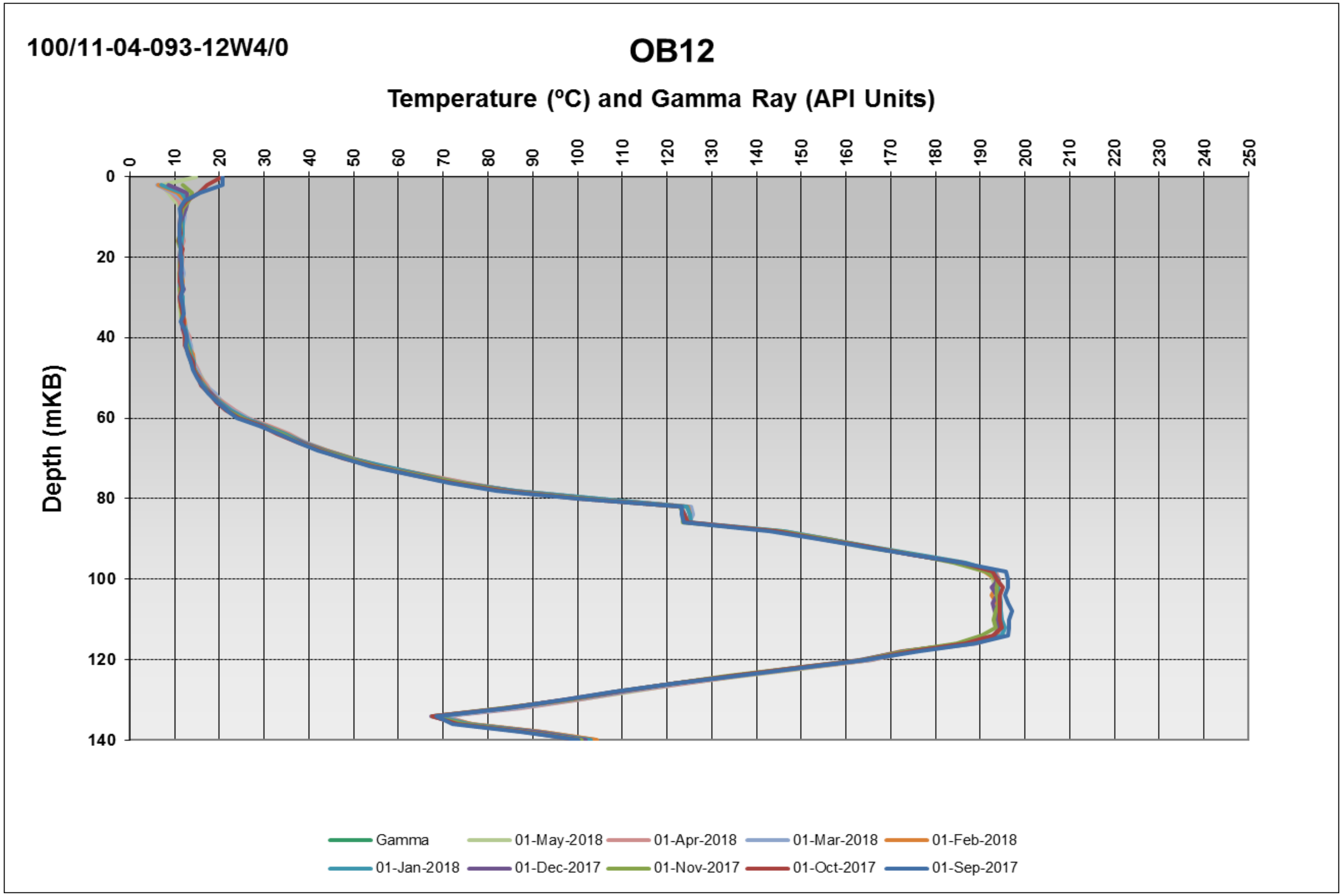

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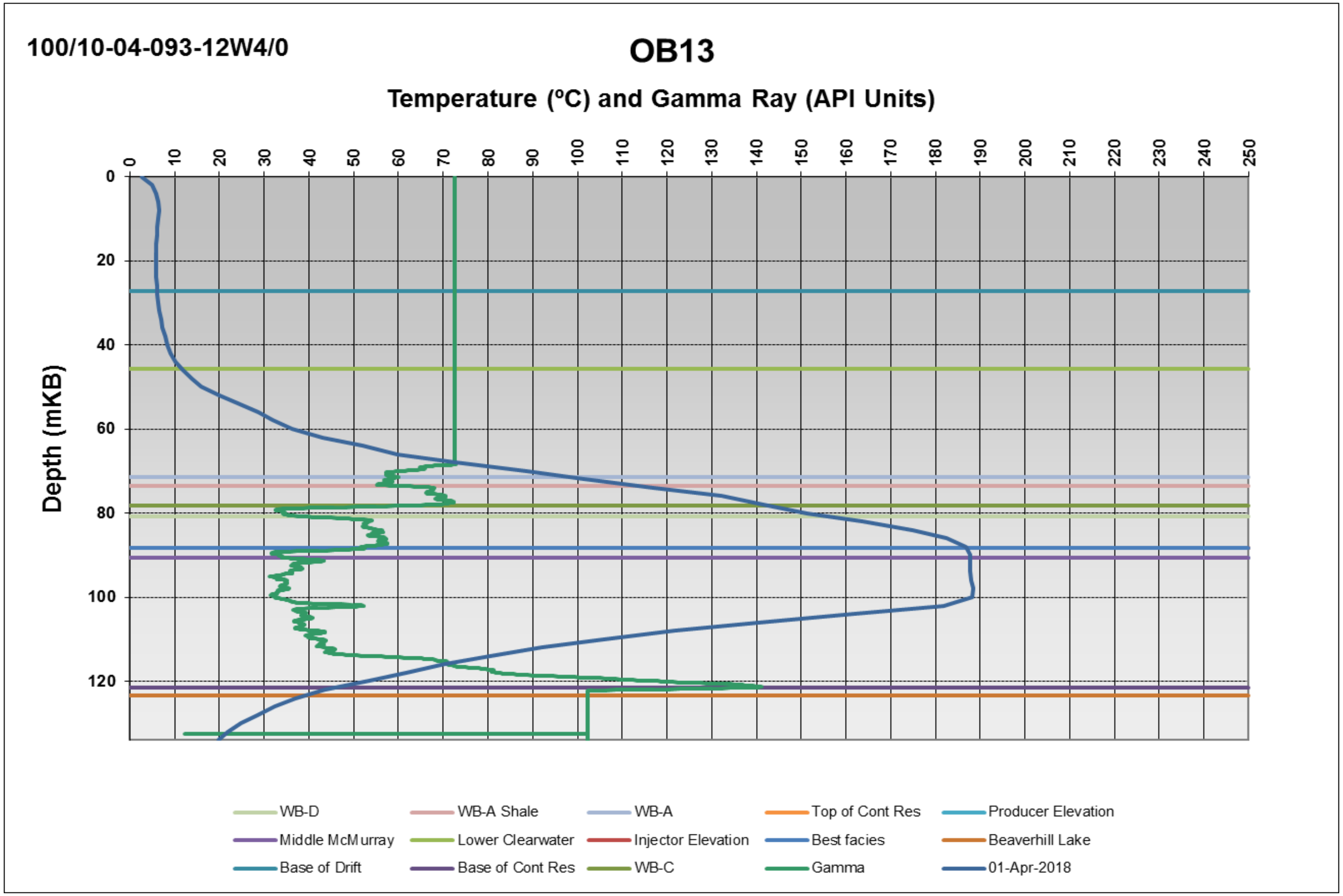

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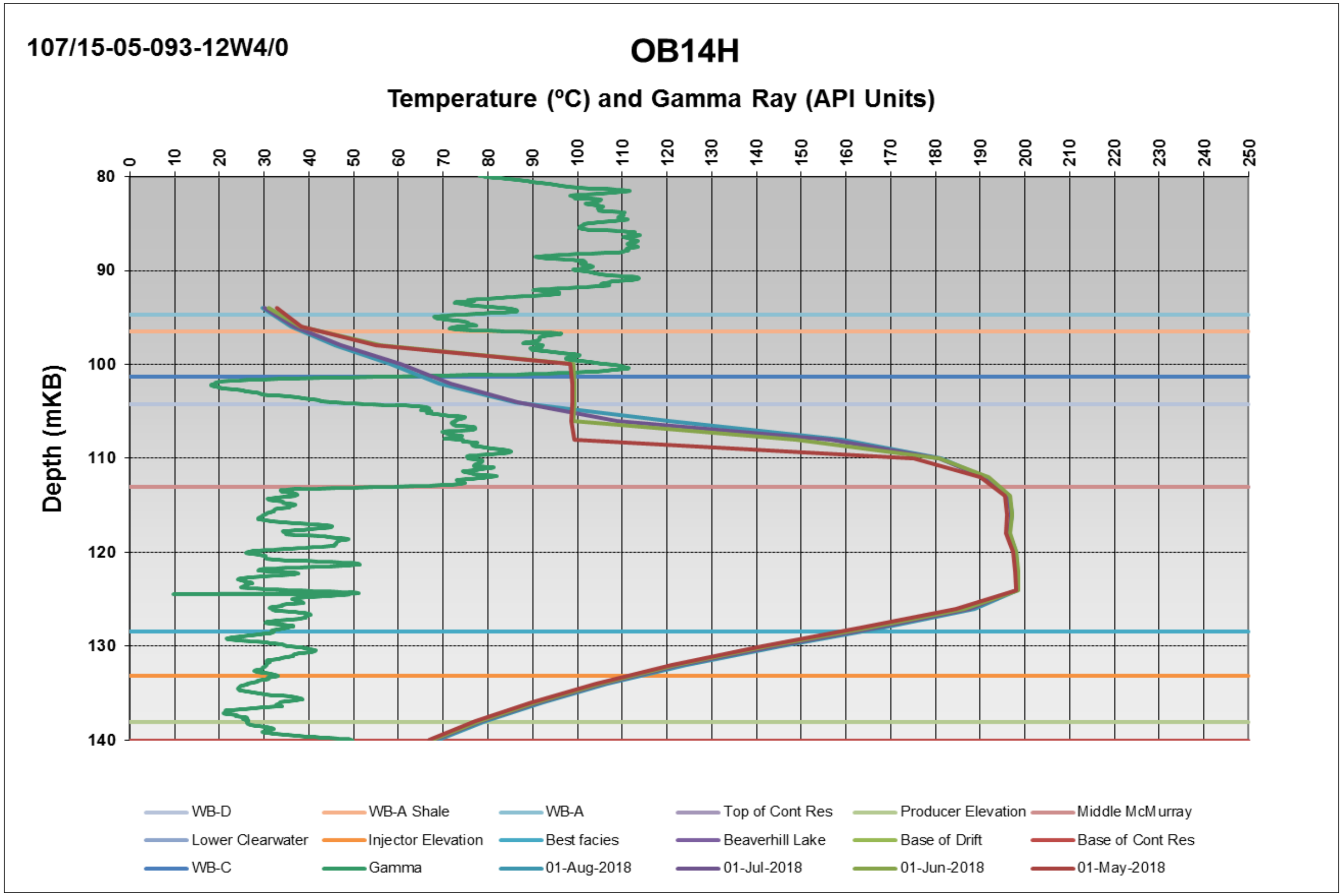

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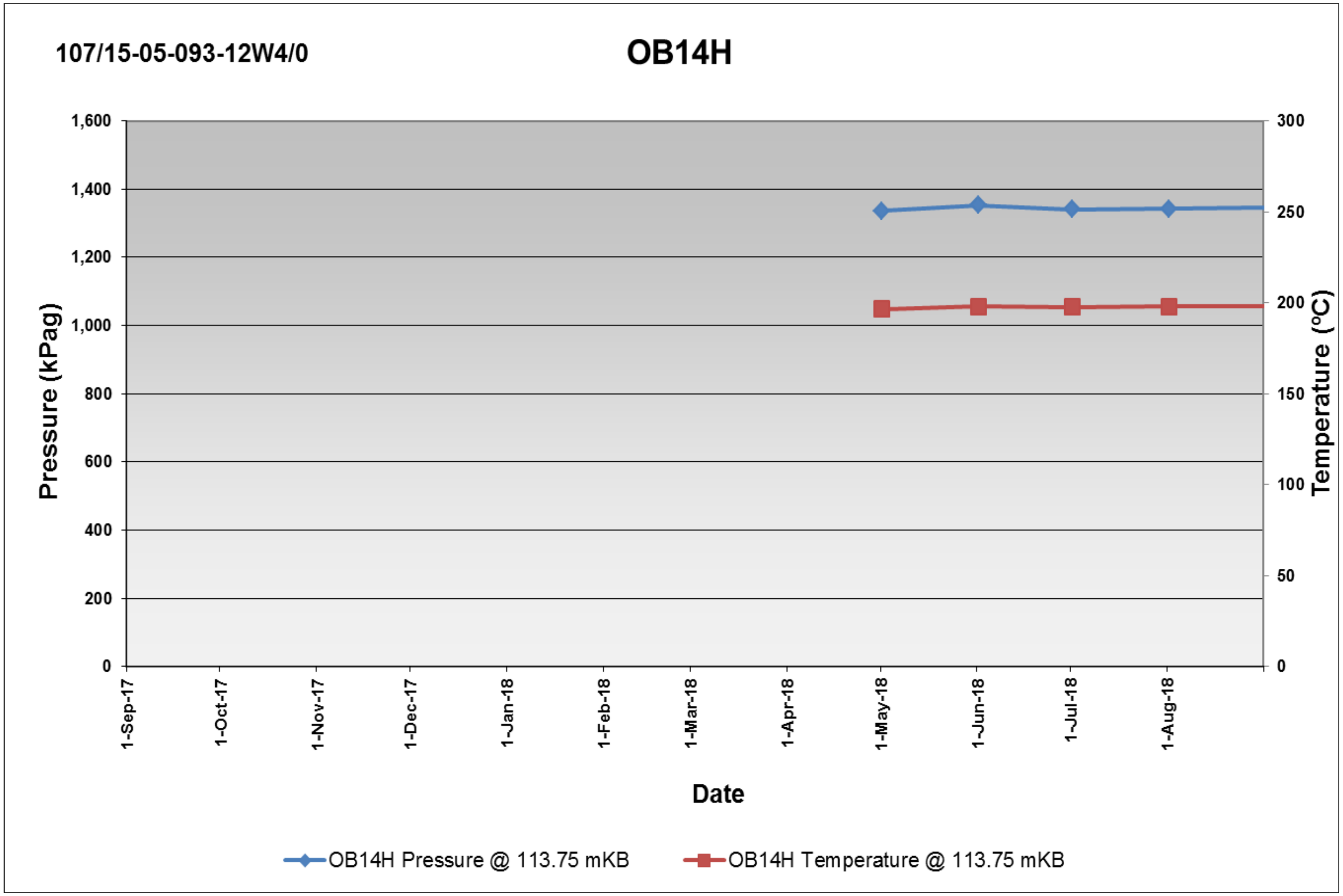

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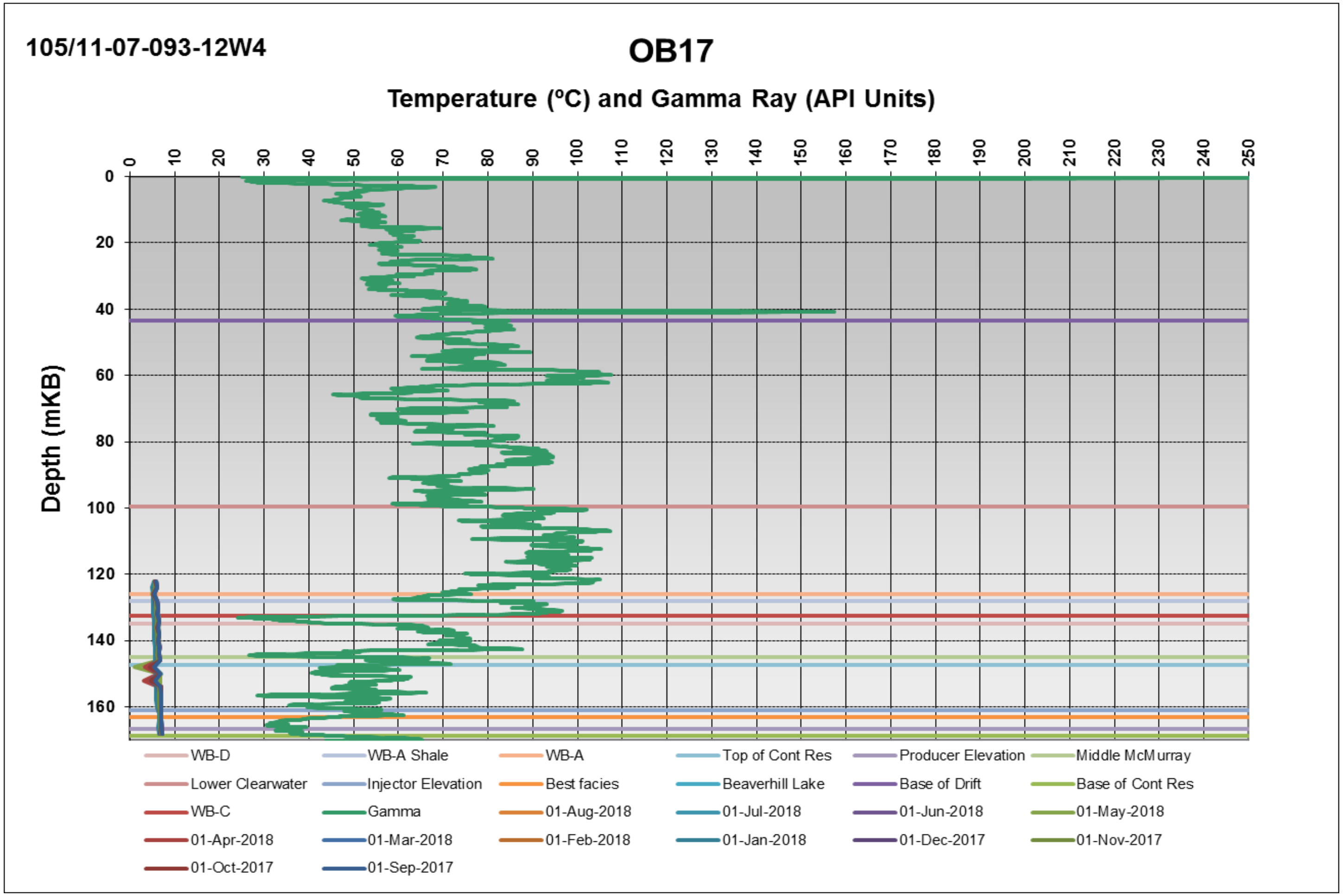
Piezometer Plots & Temperature vs Depth Plots



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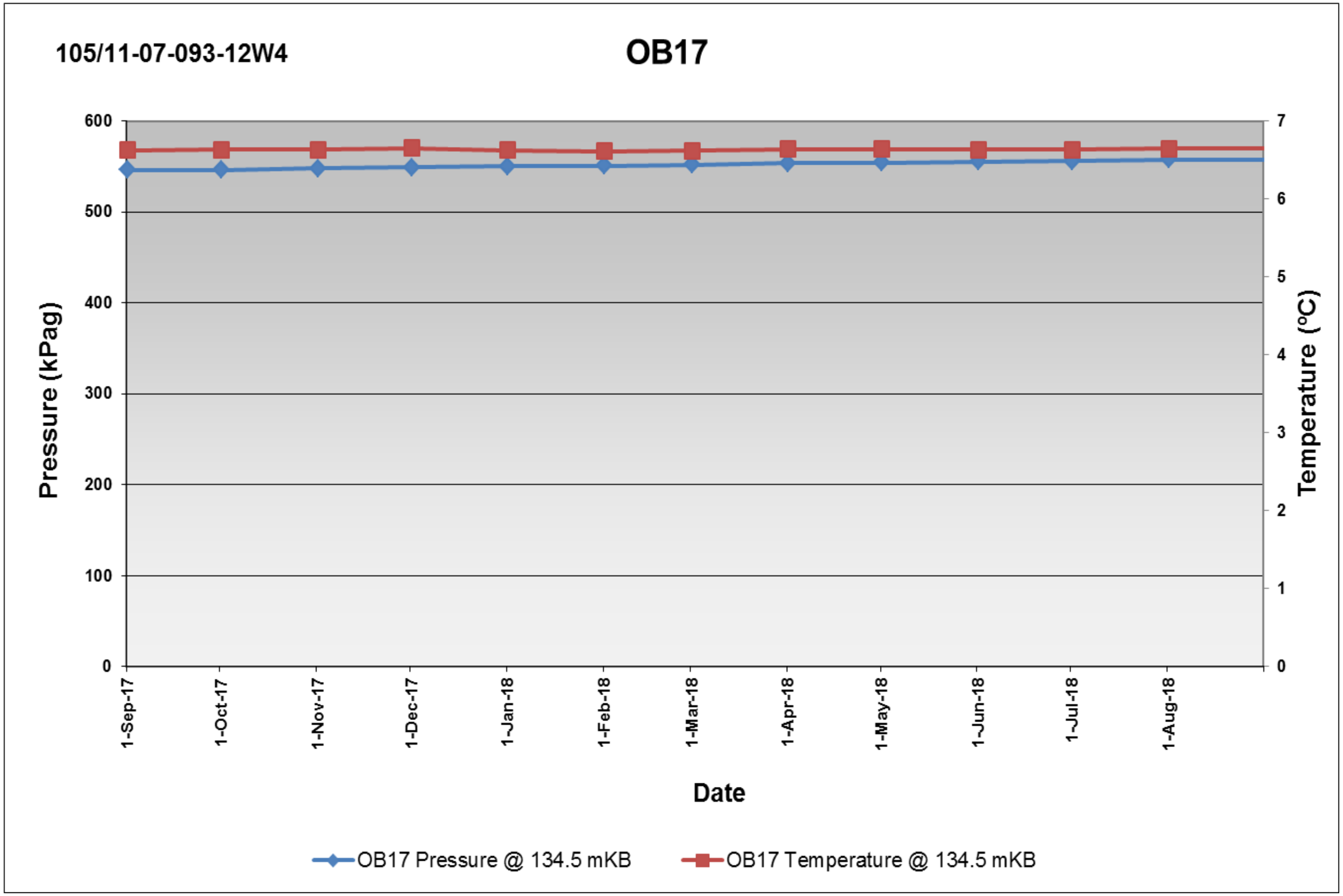

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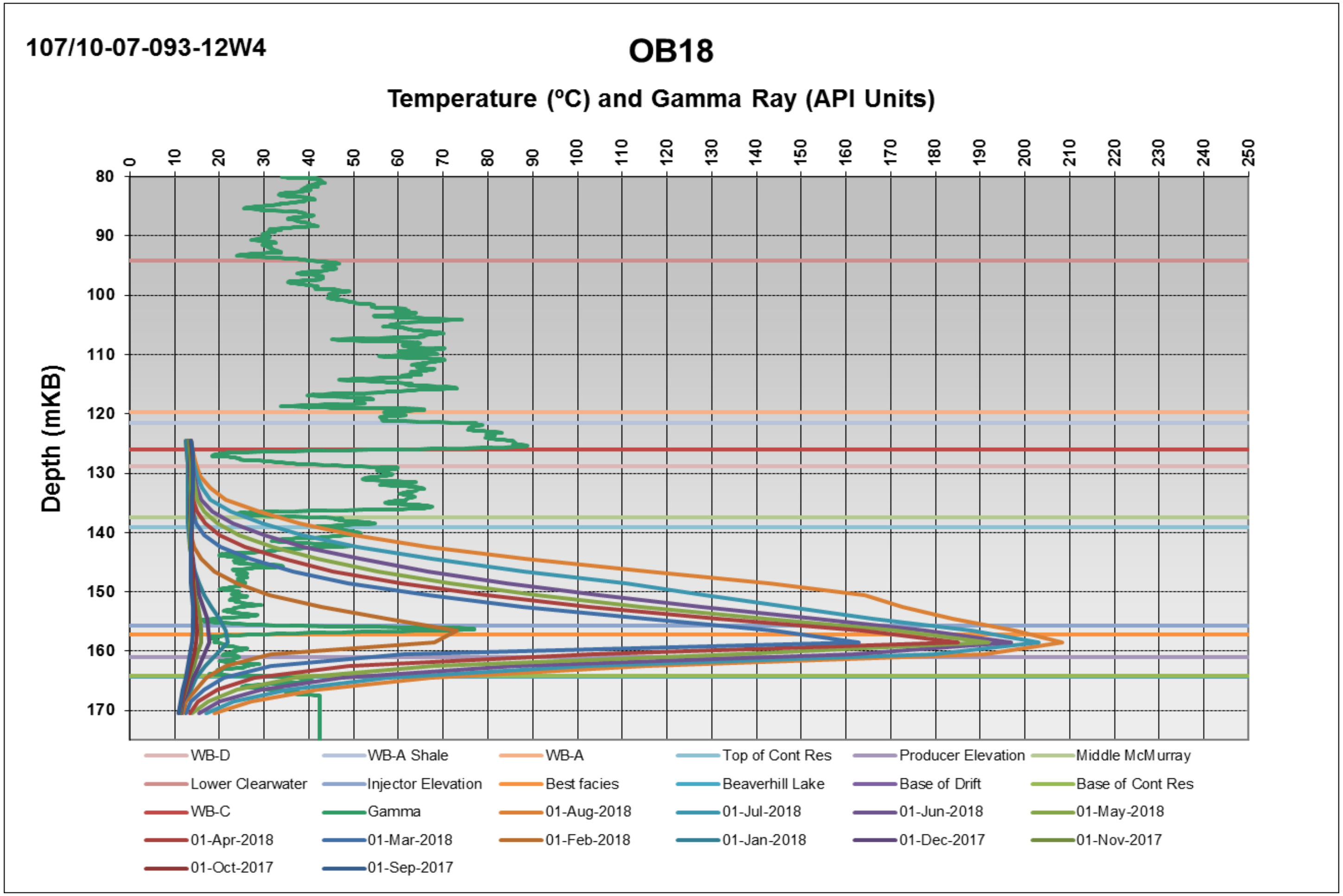

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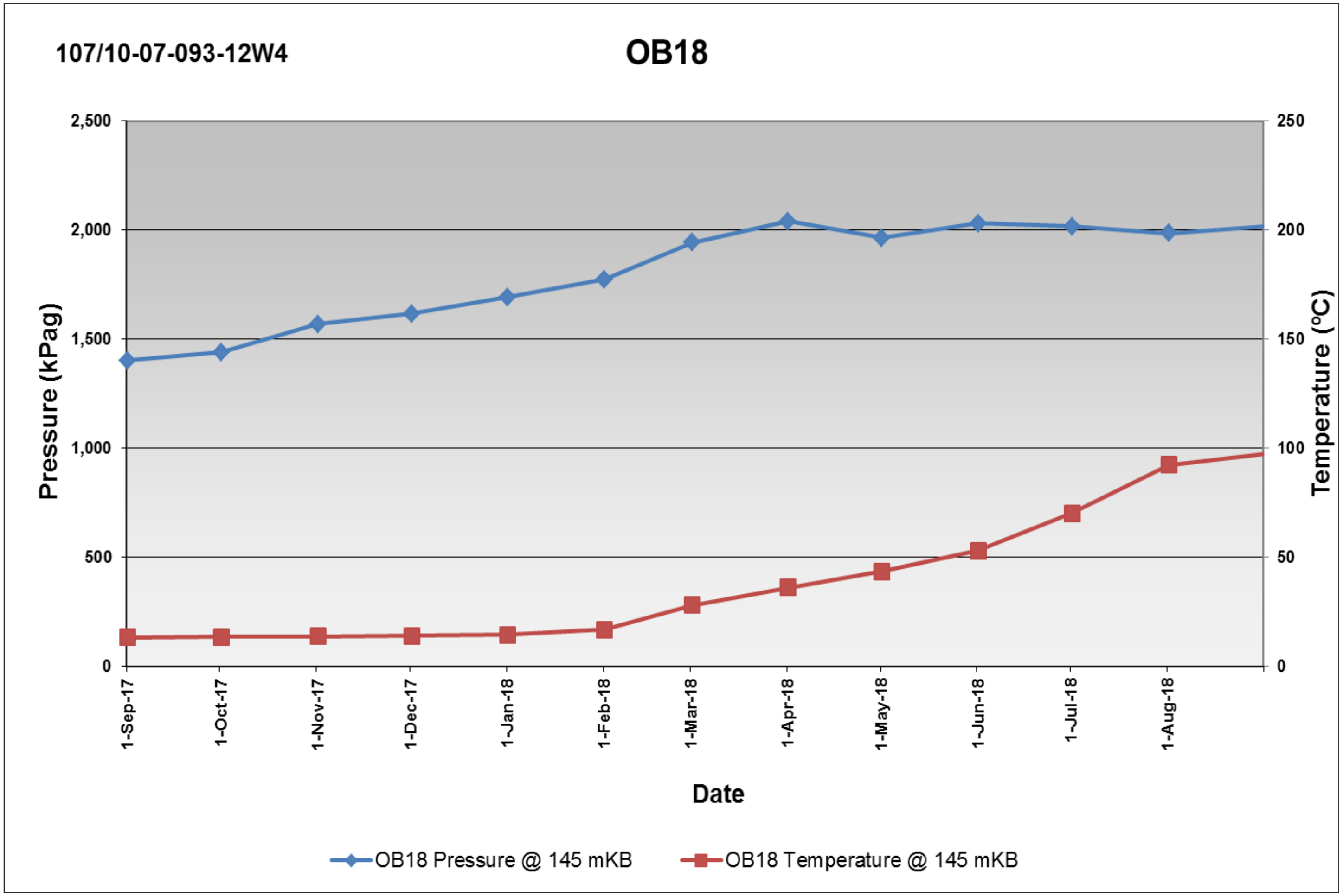

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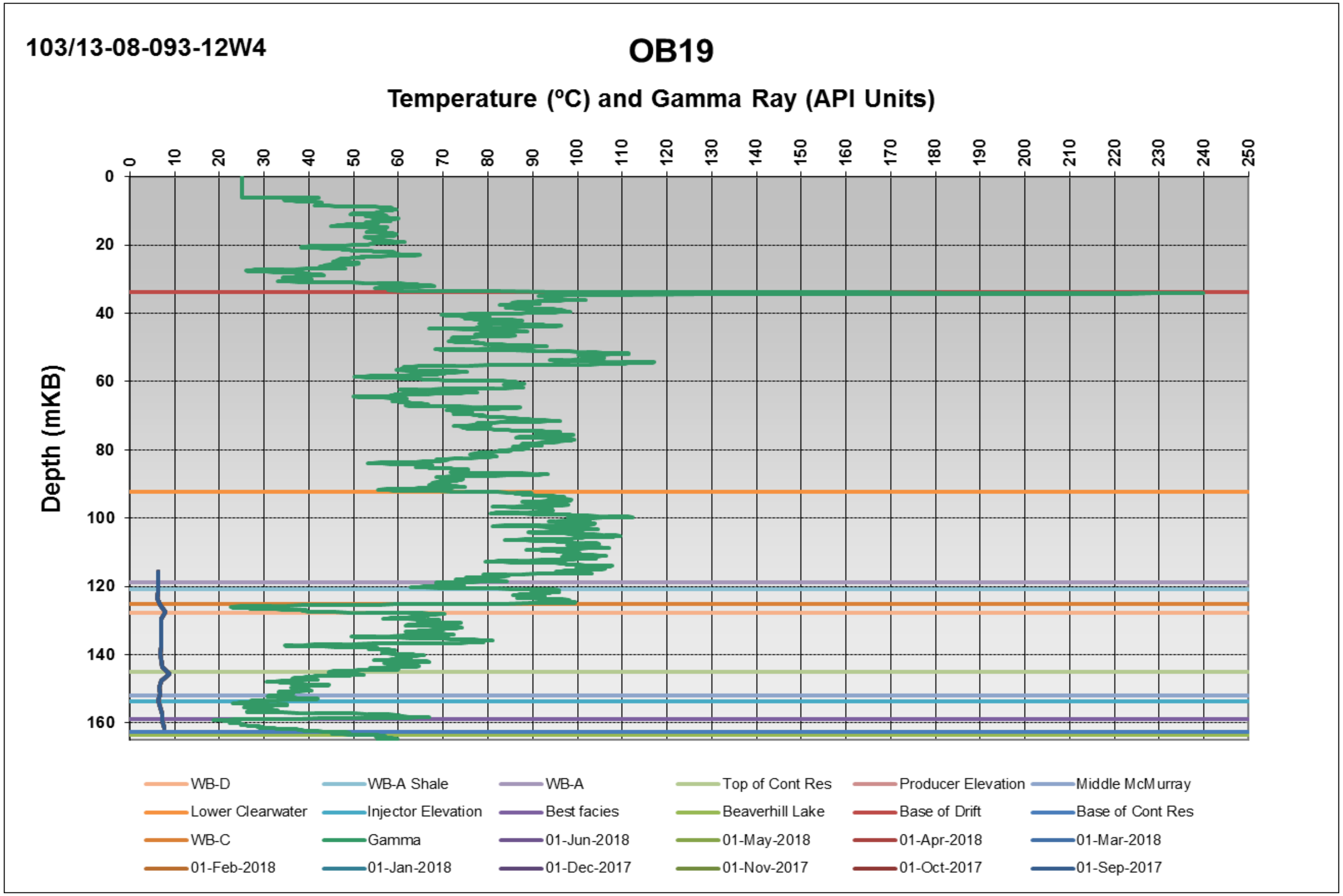

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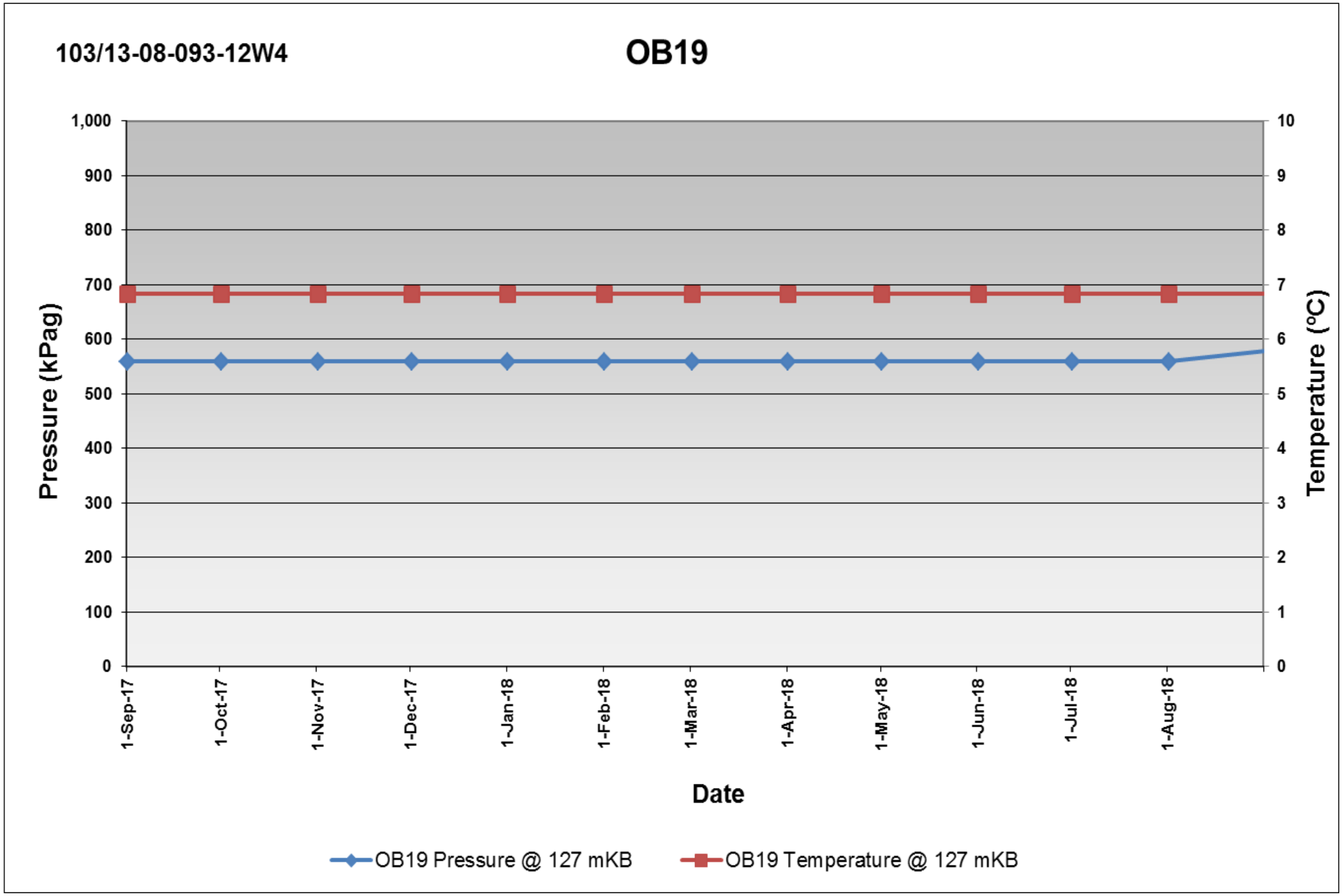

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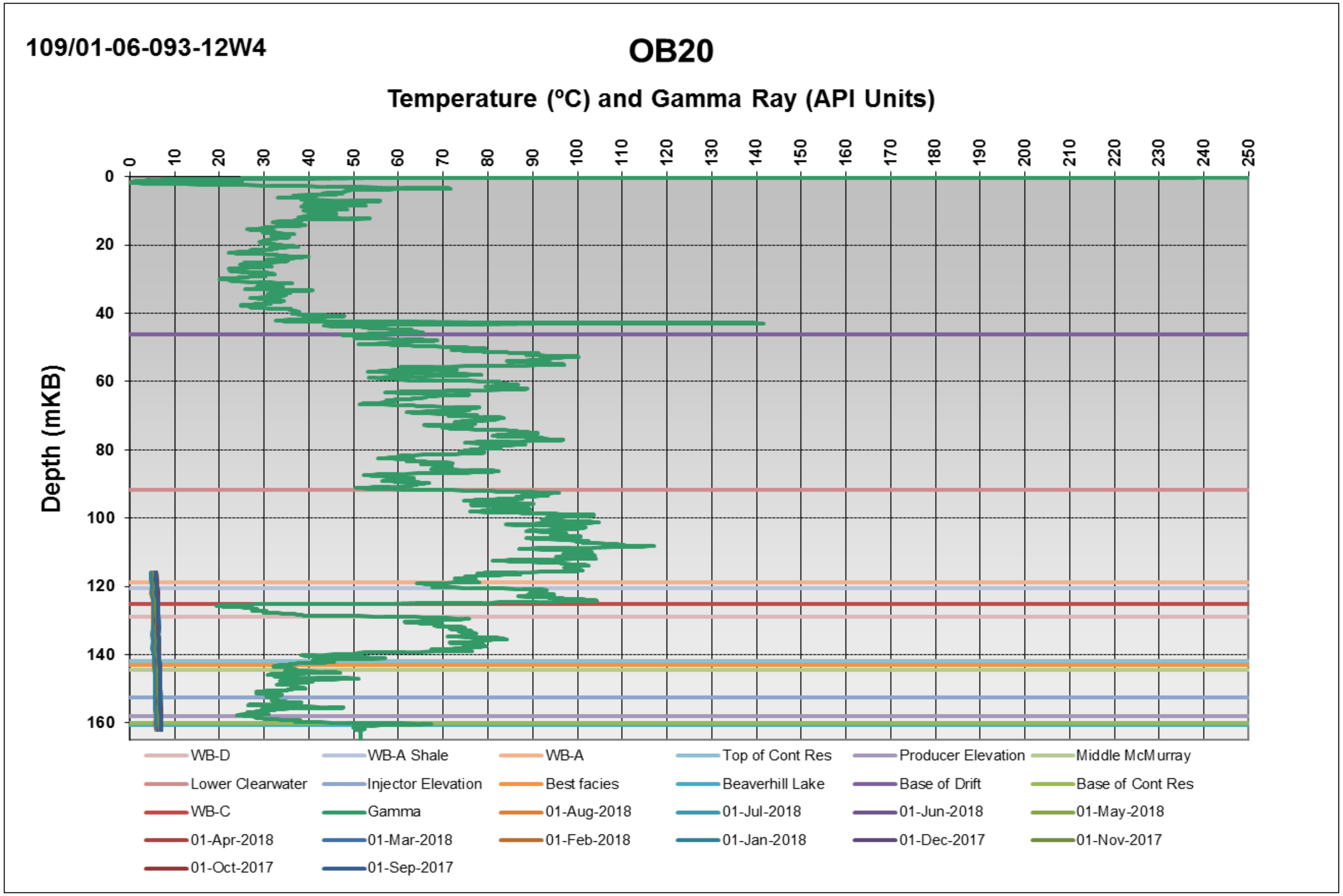

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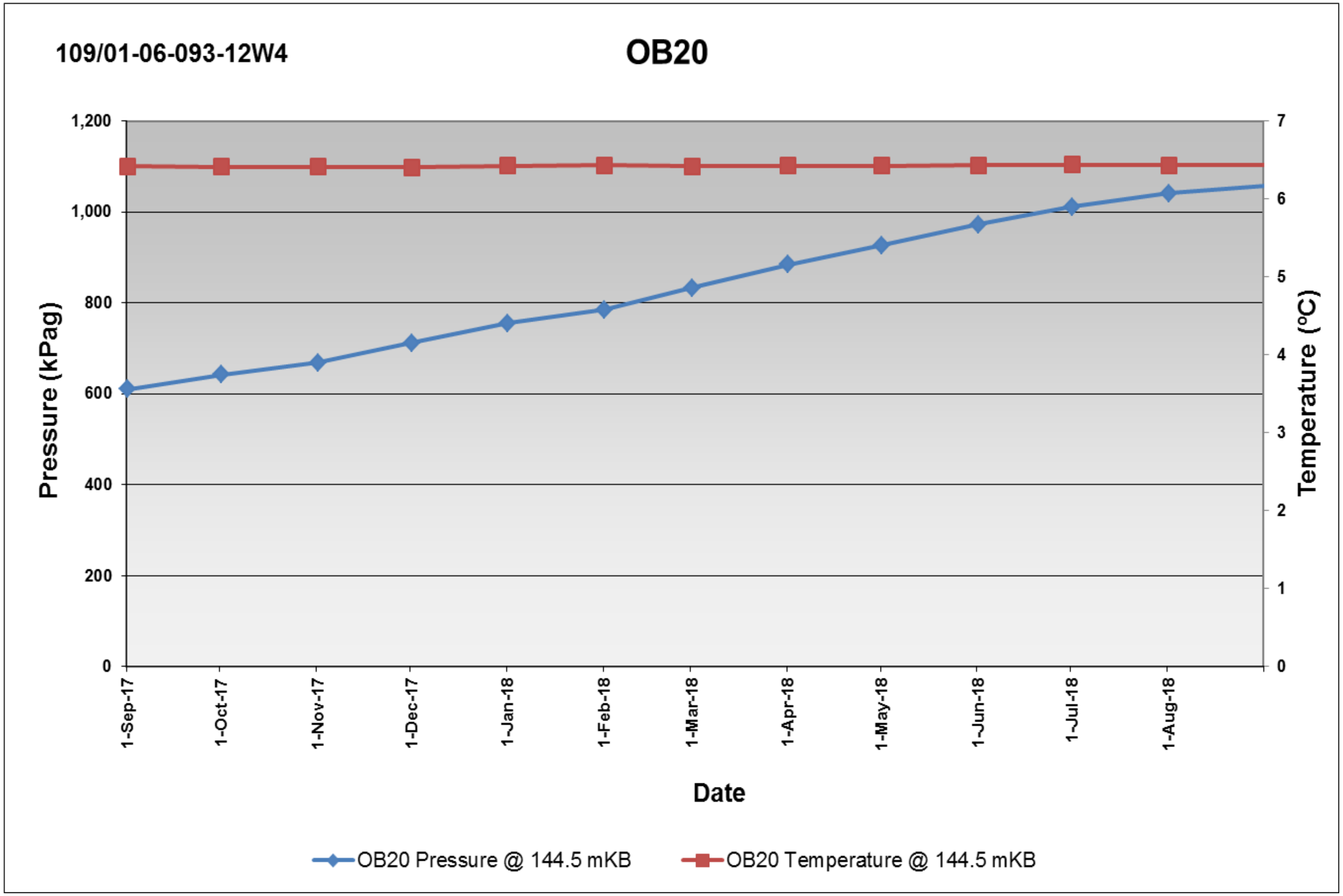

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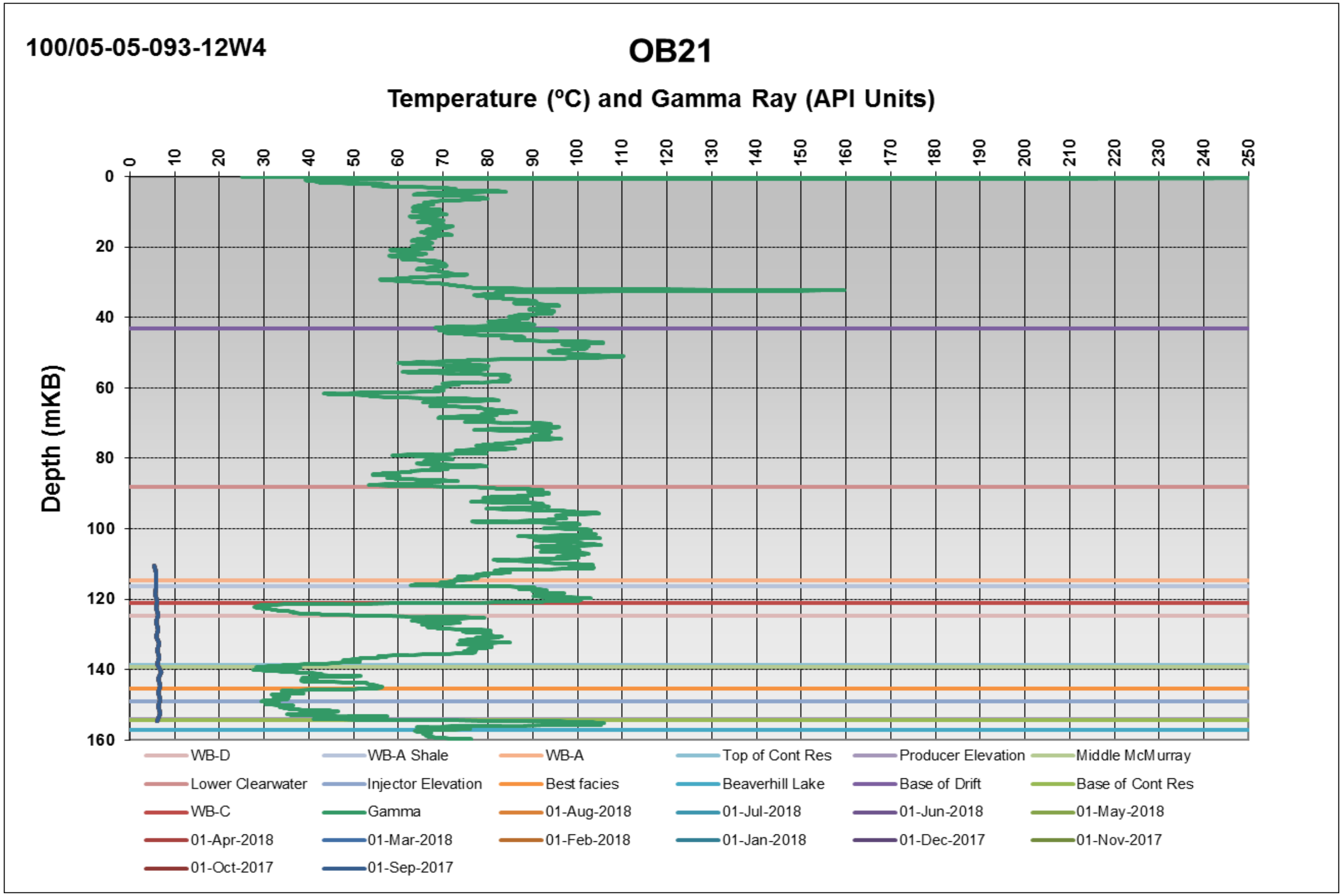

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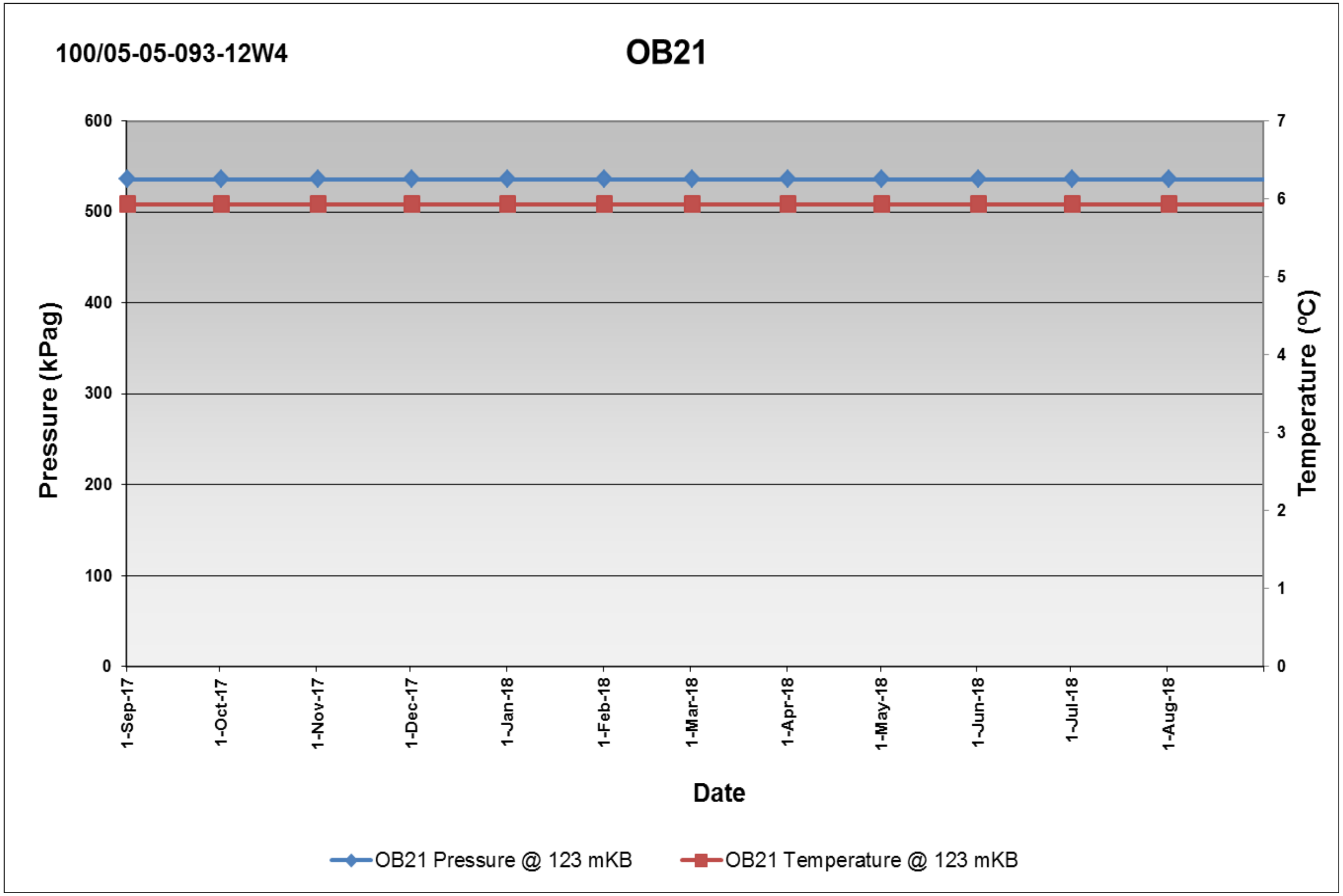

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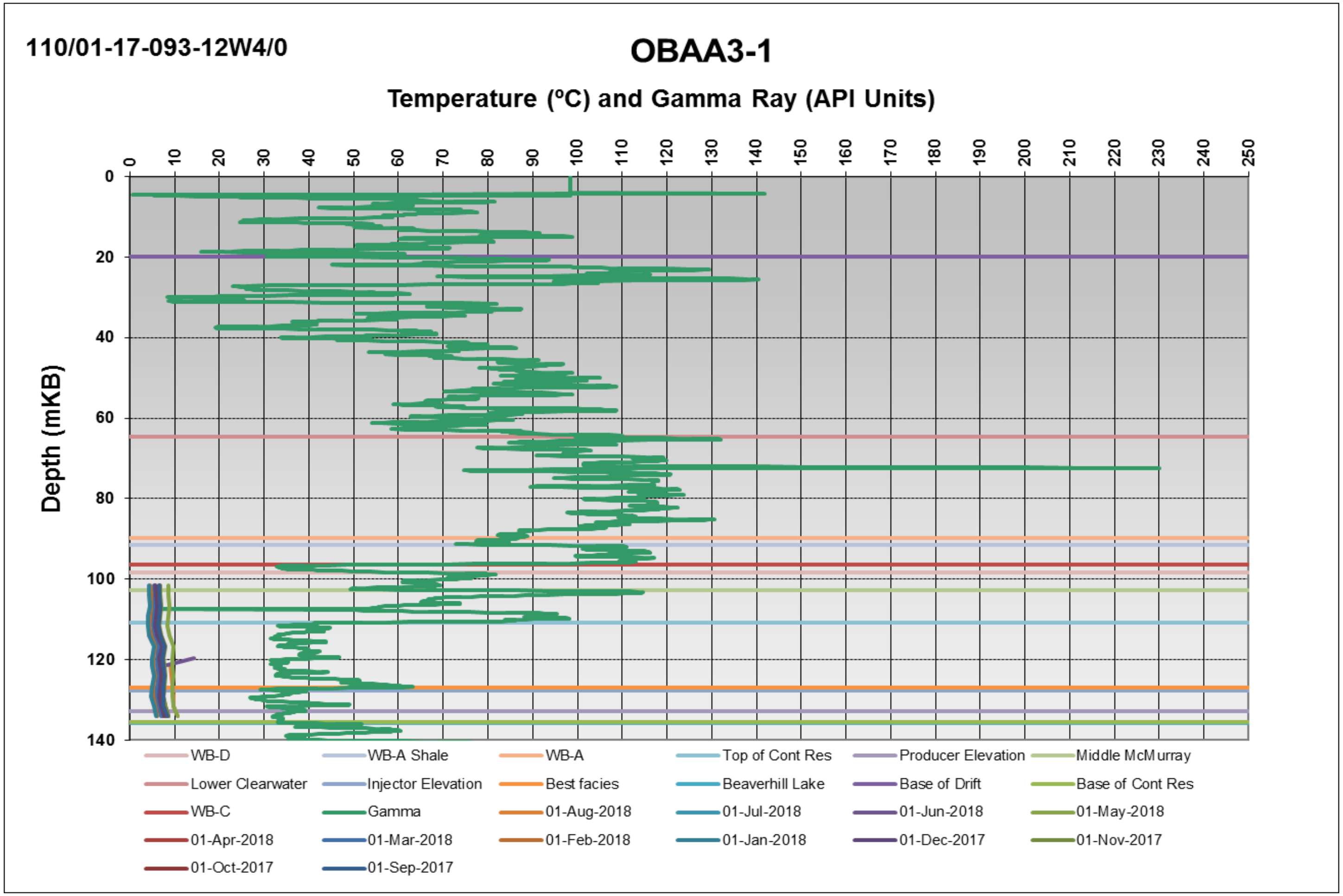

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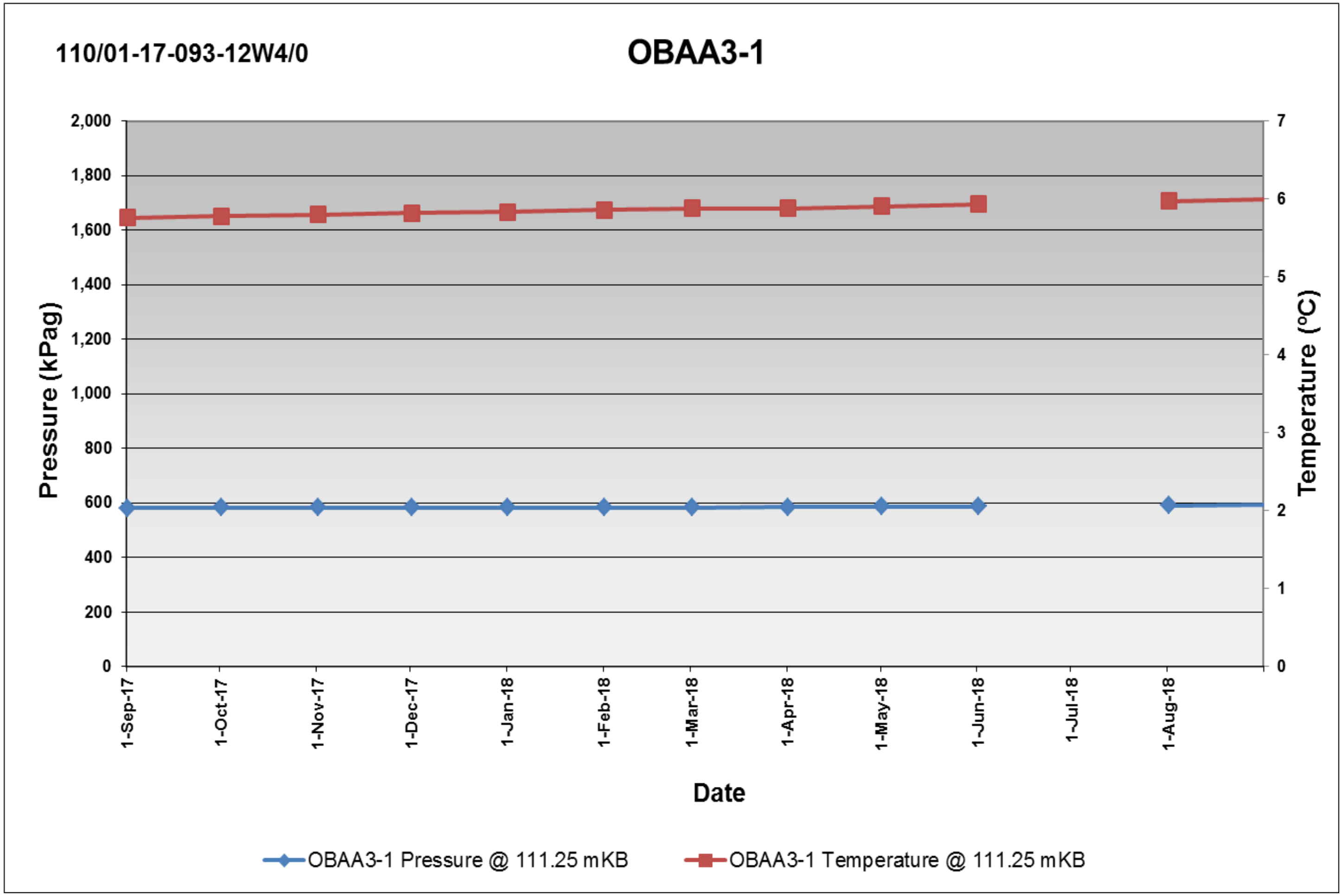

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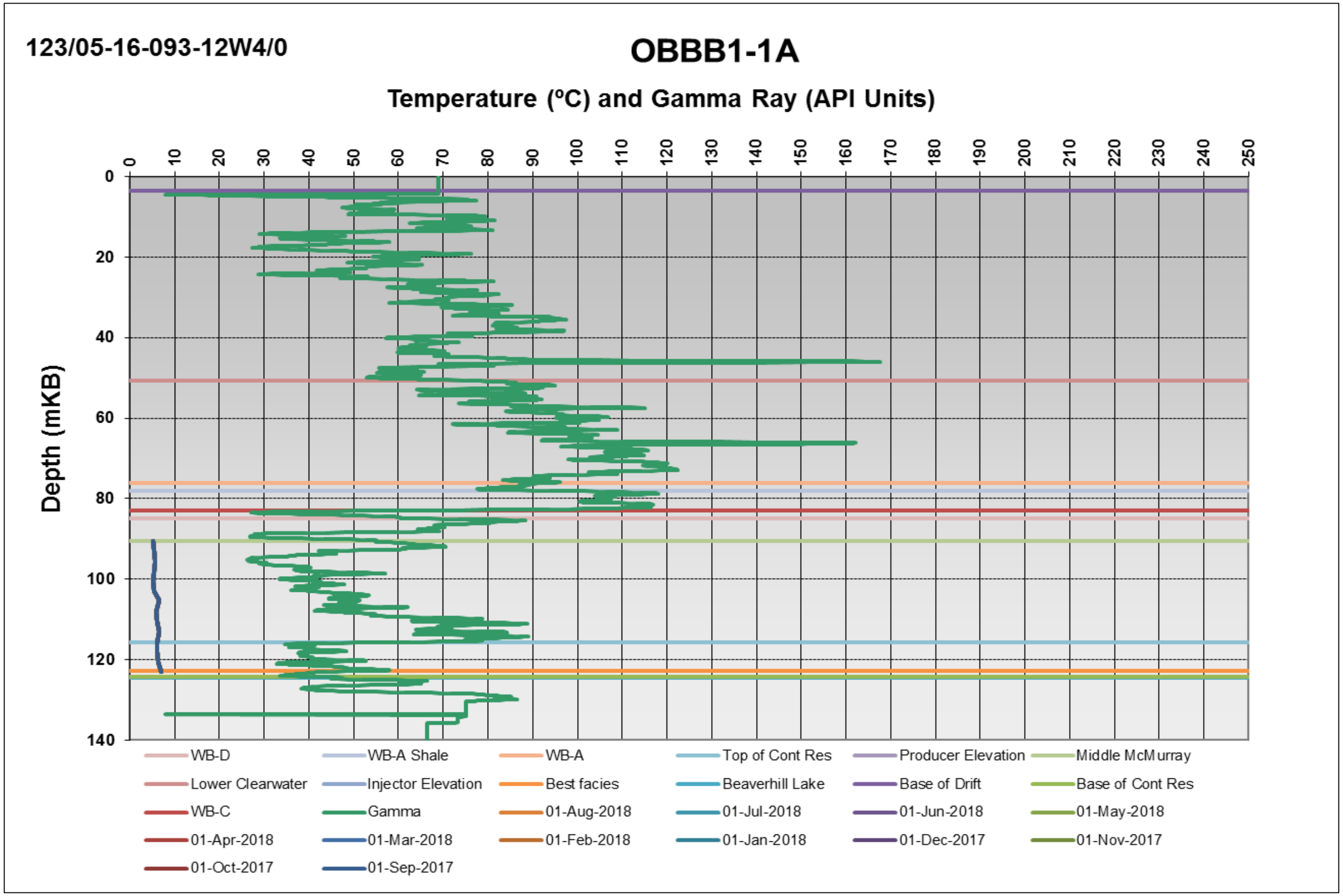

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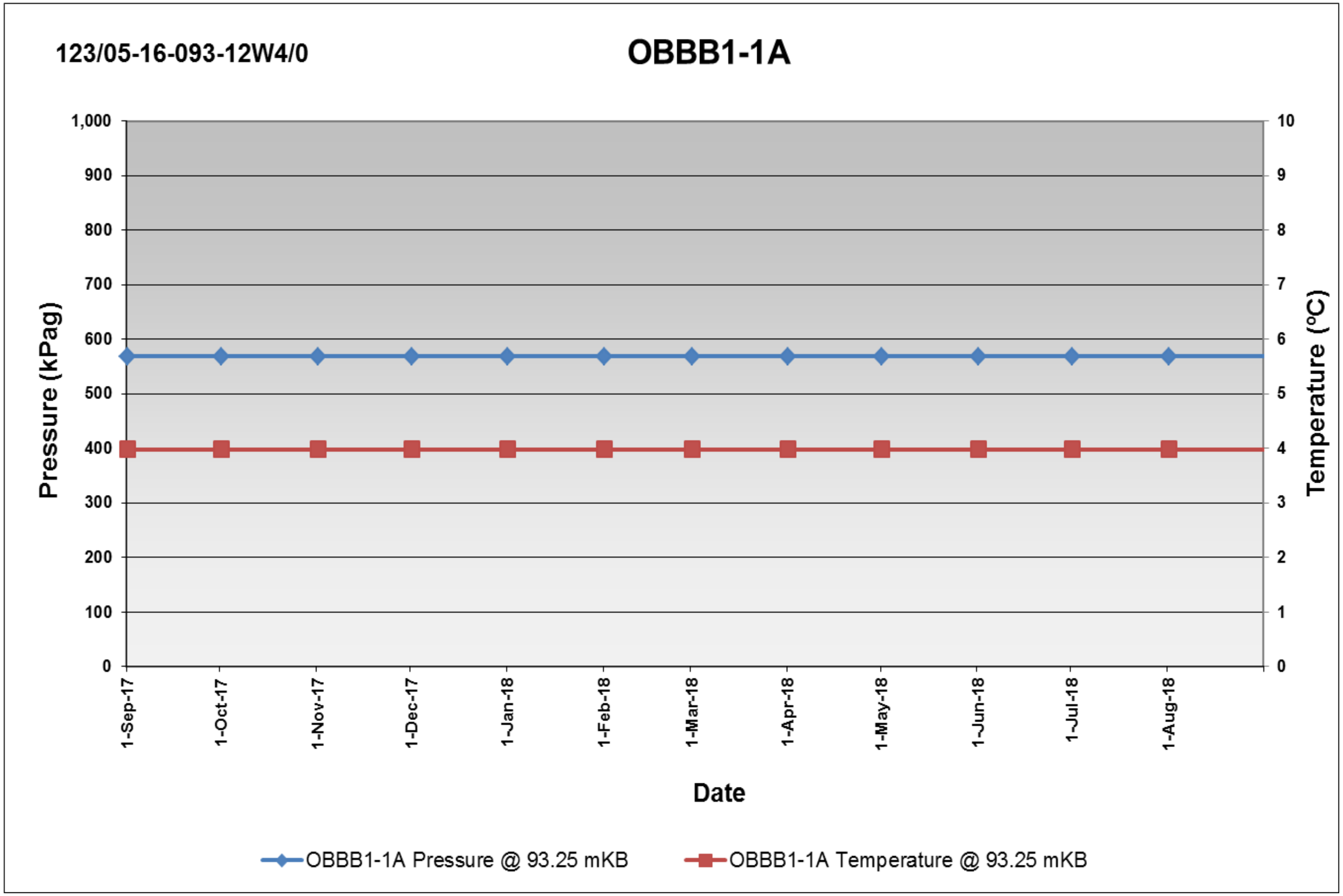

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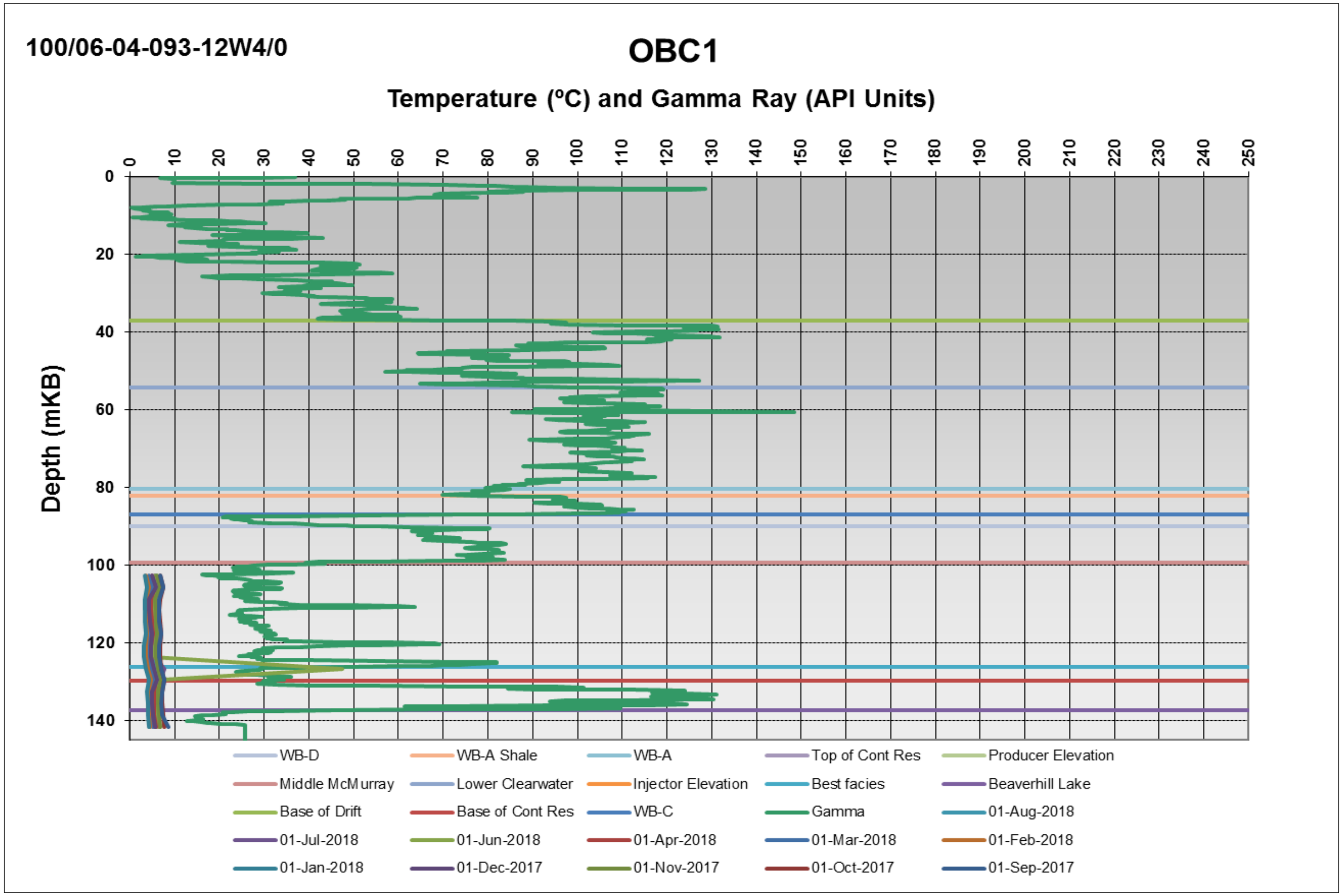

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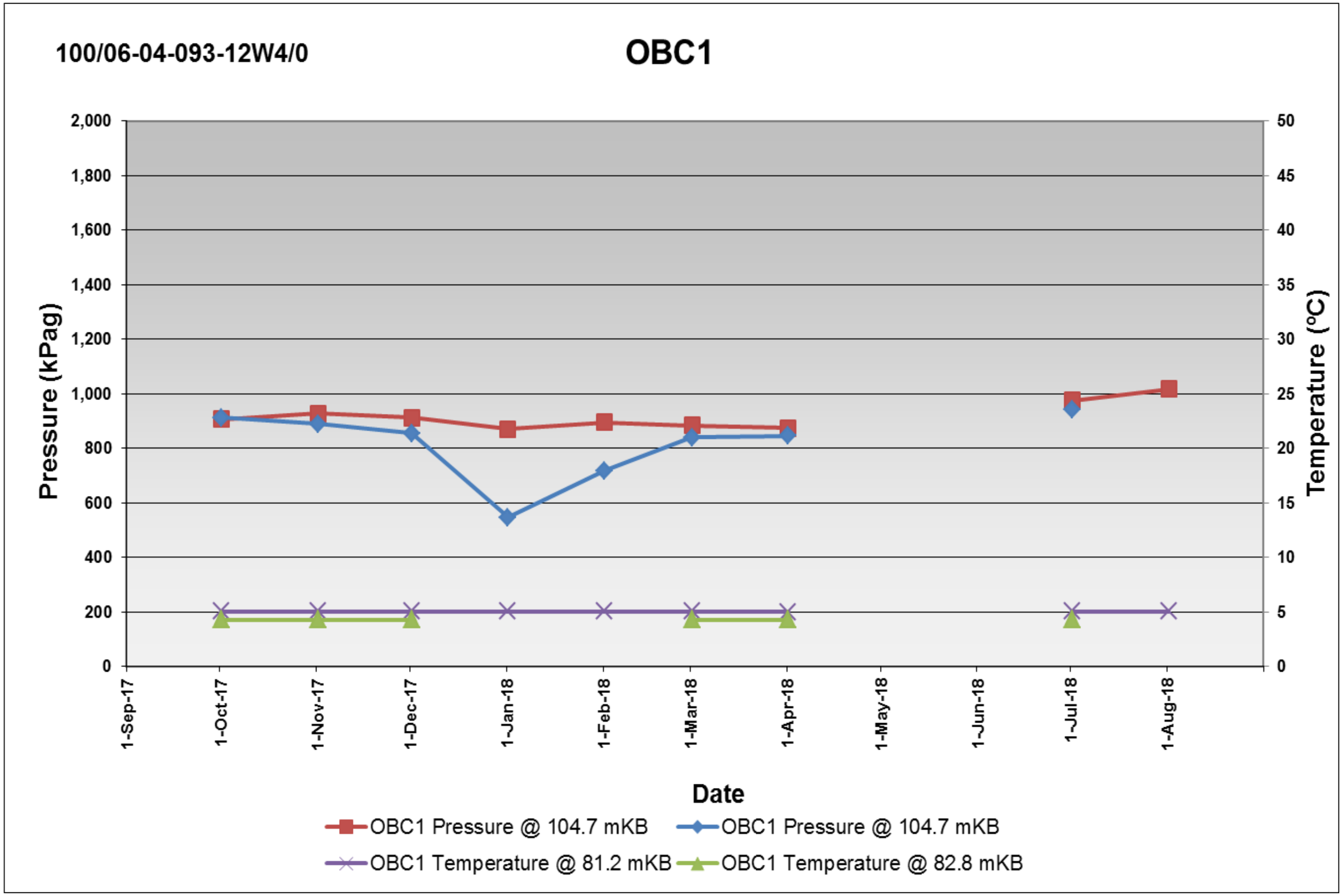

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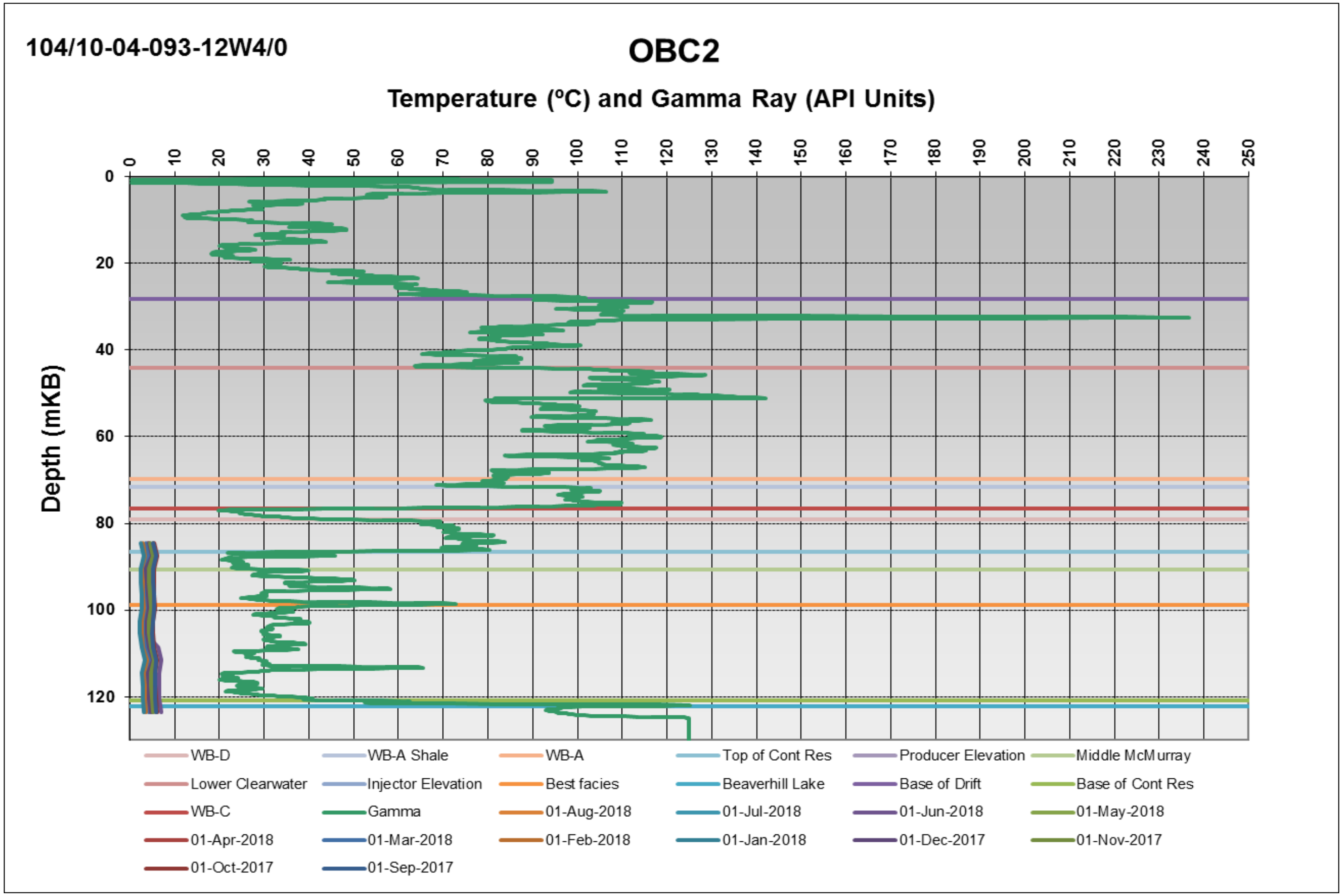

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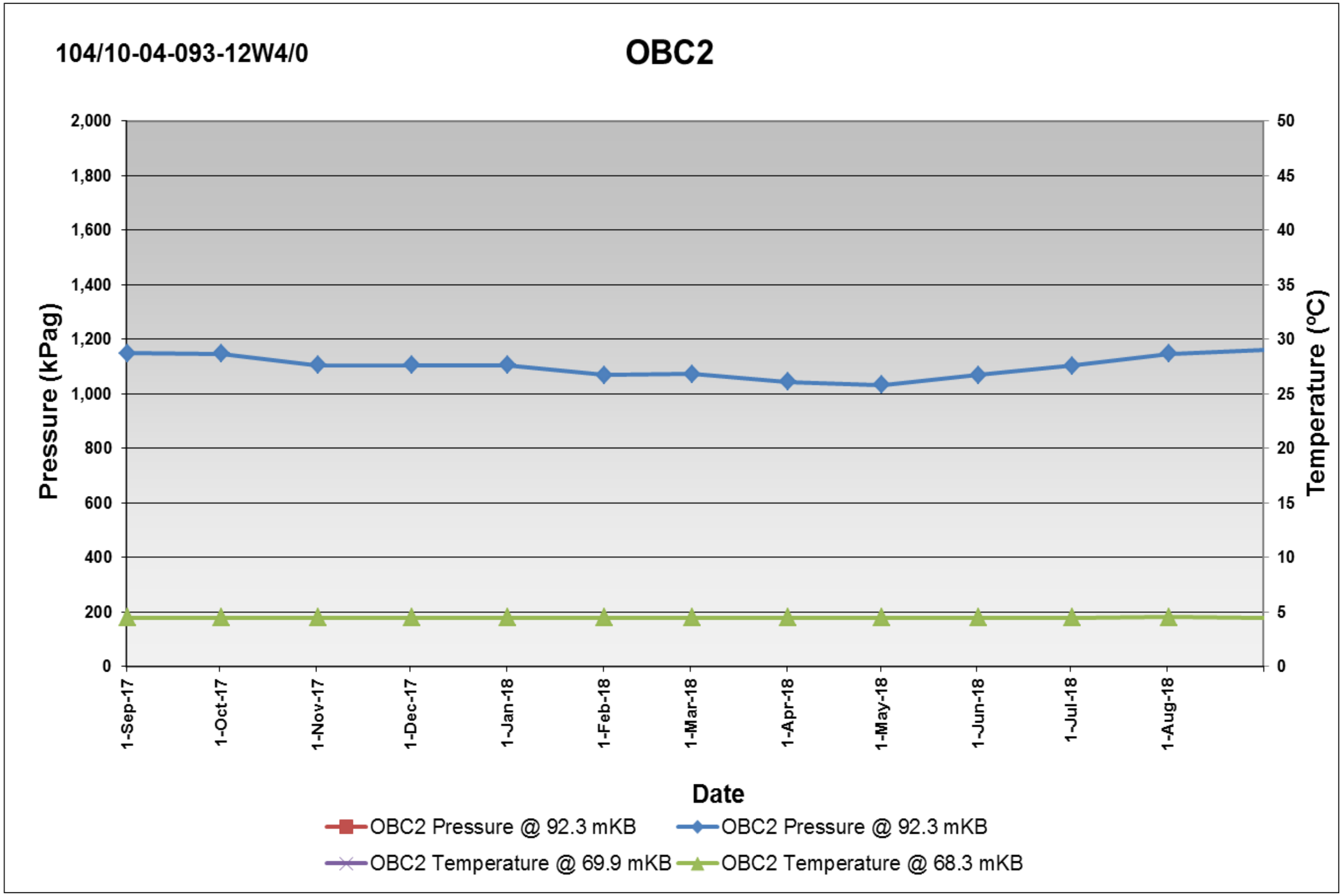

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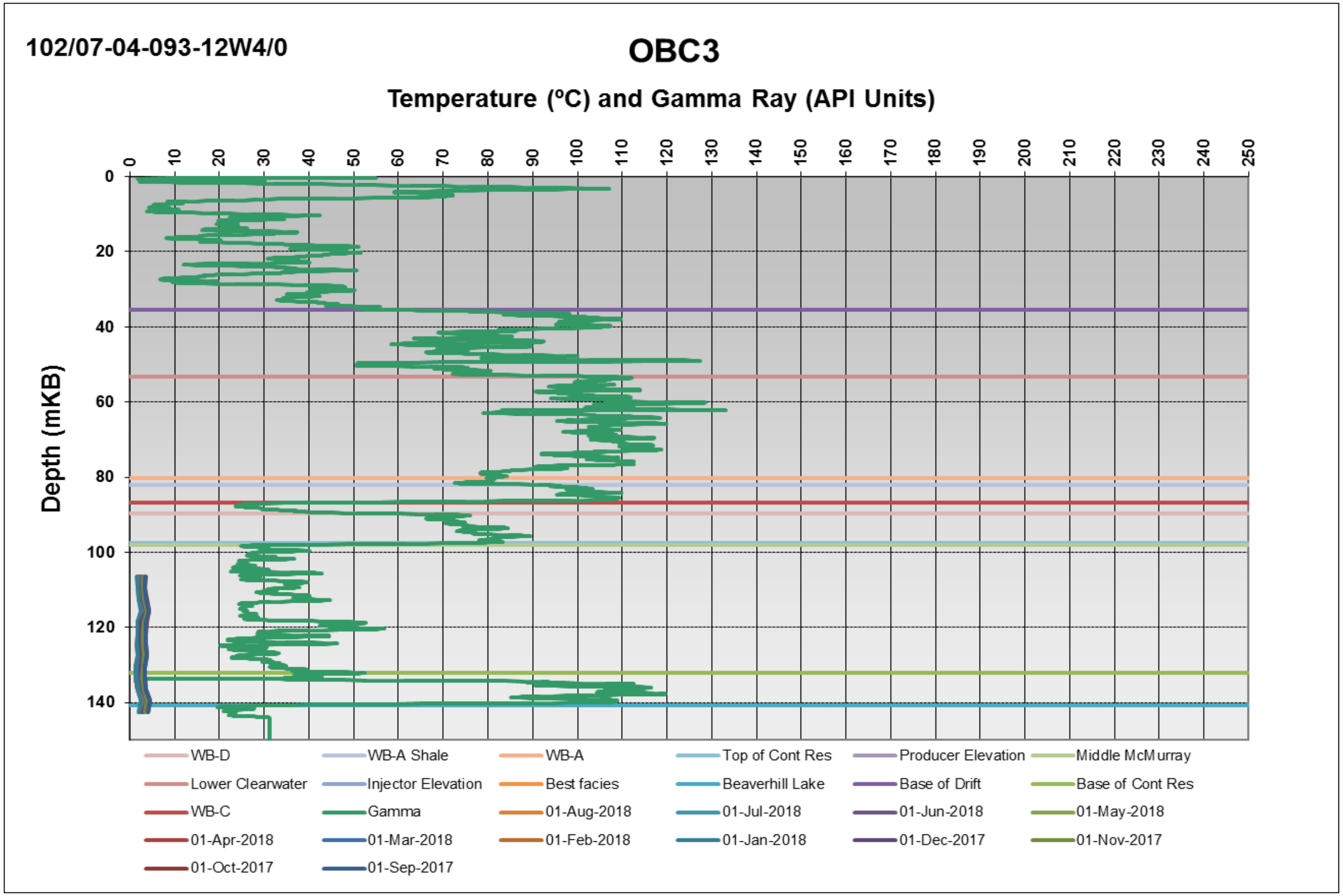

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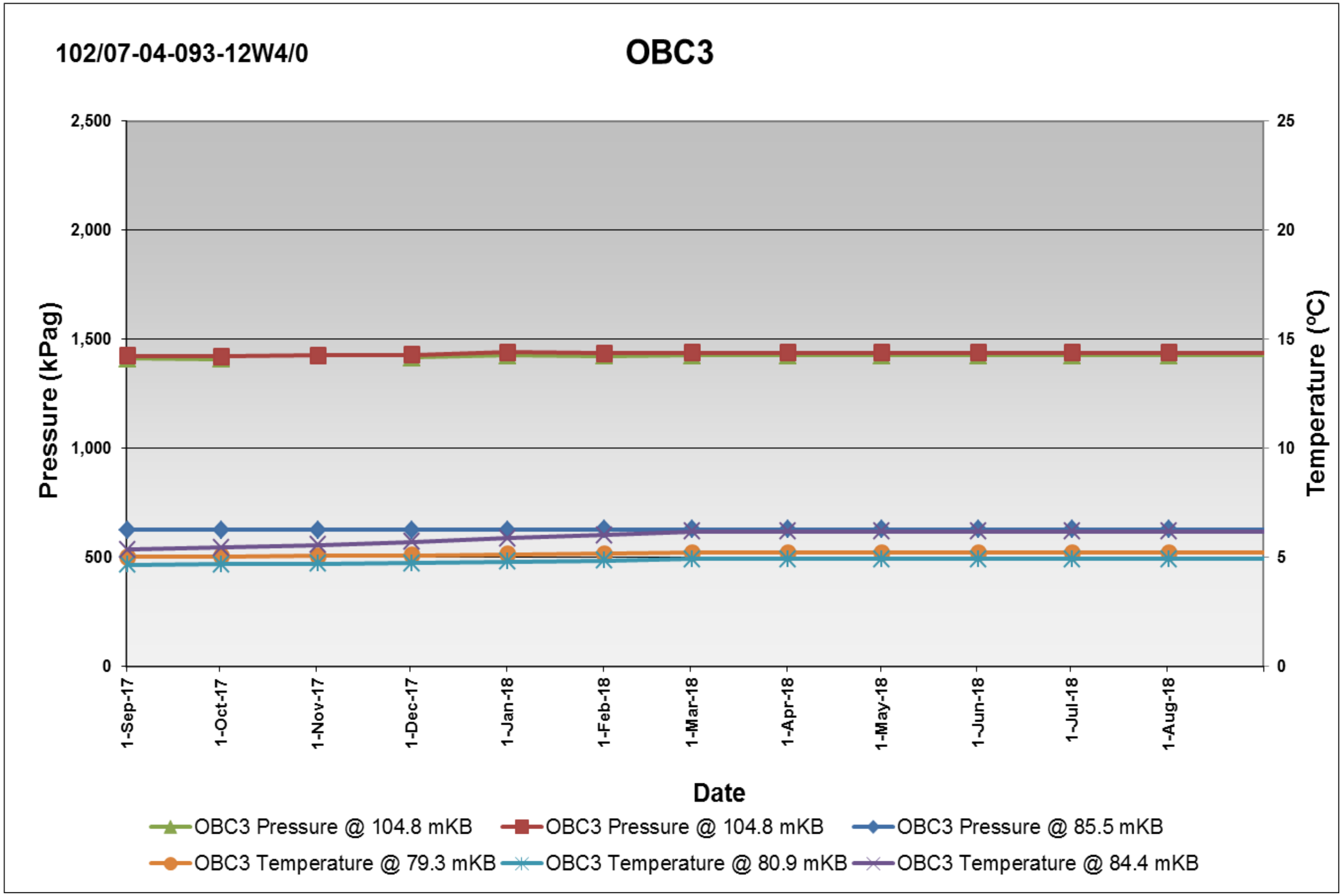

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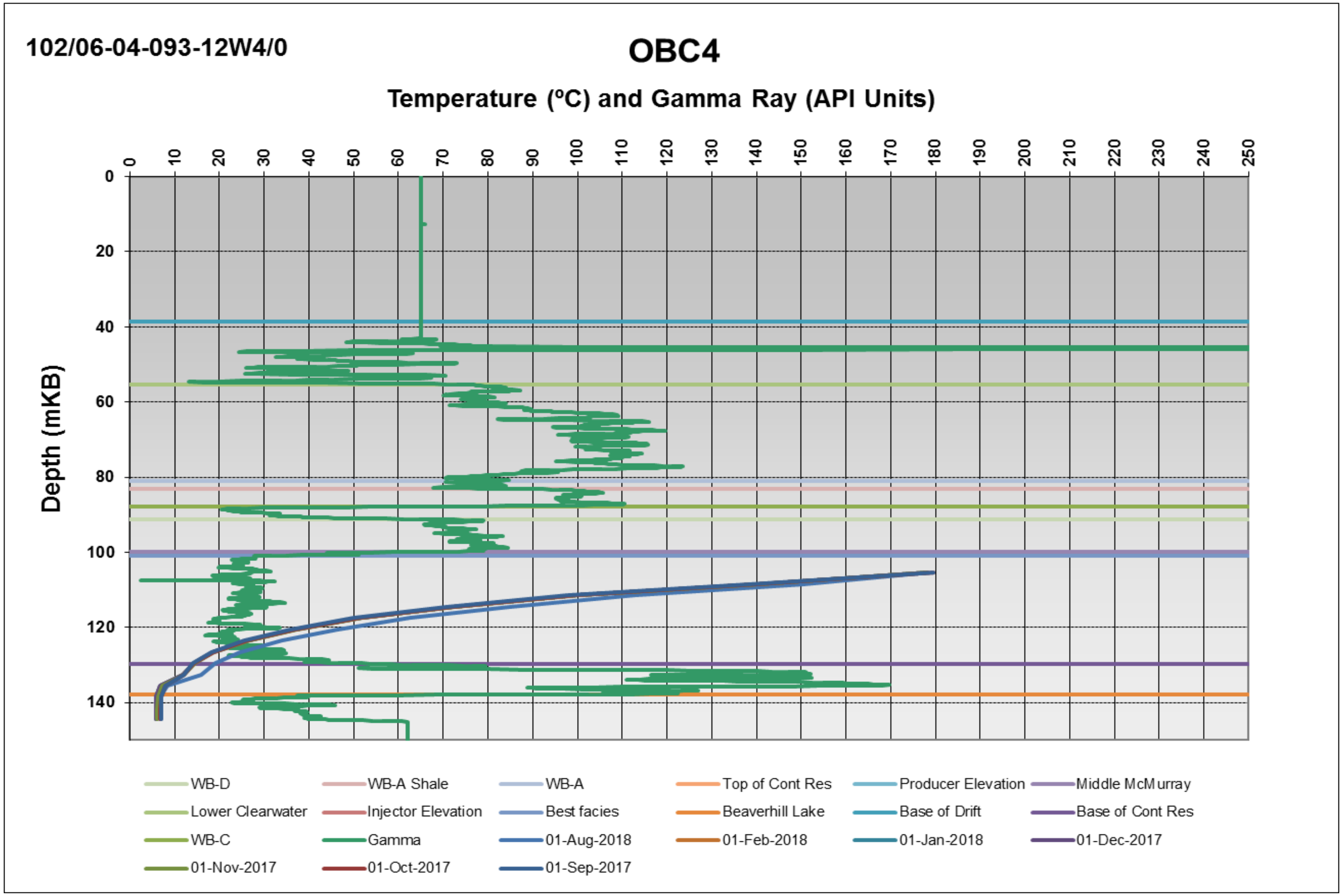

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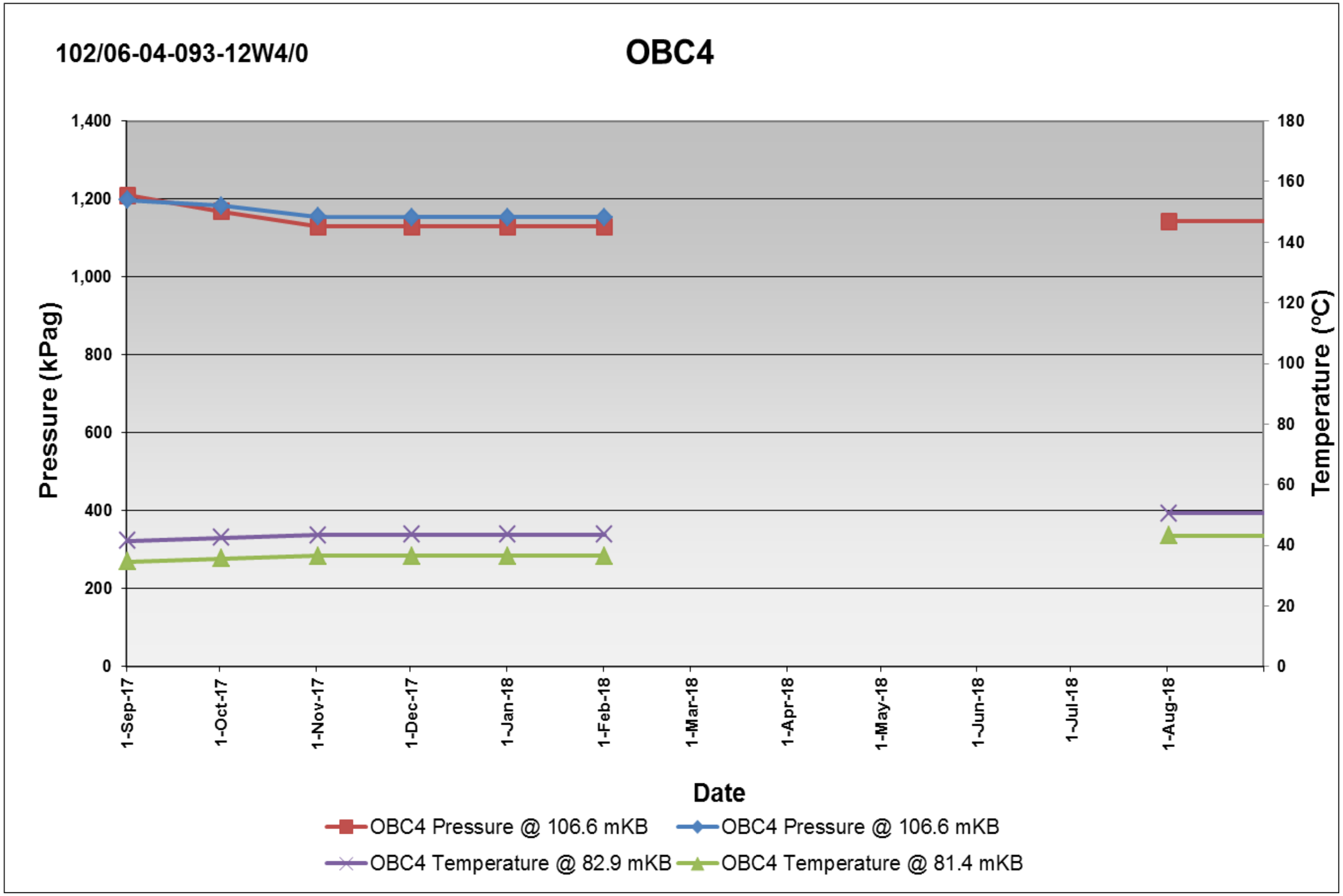

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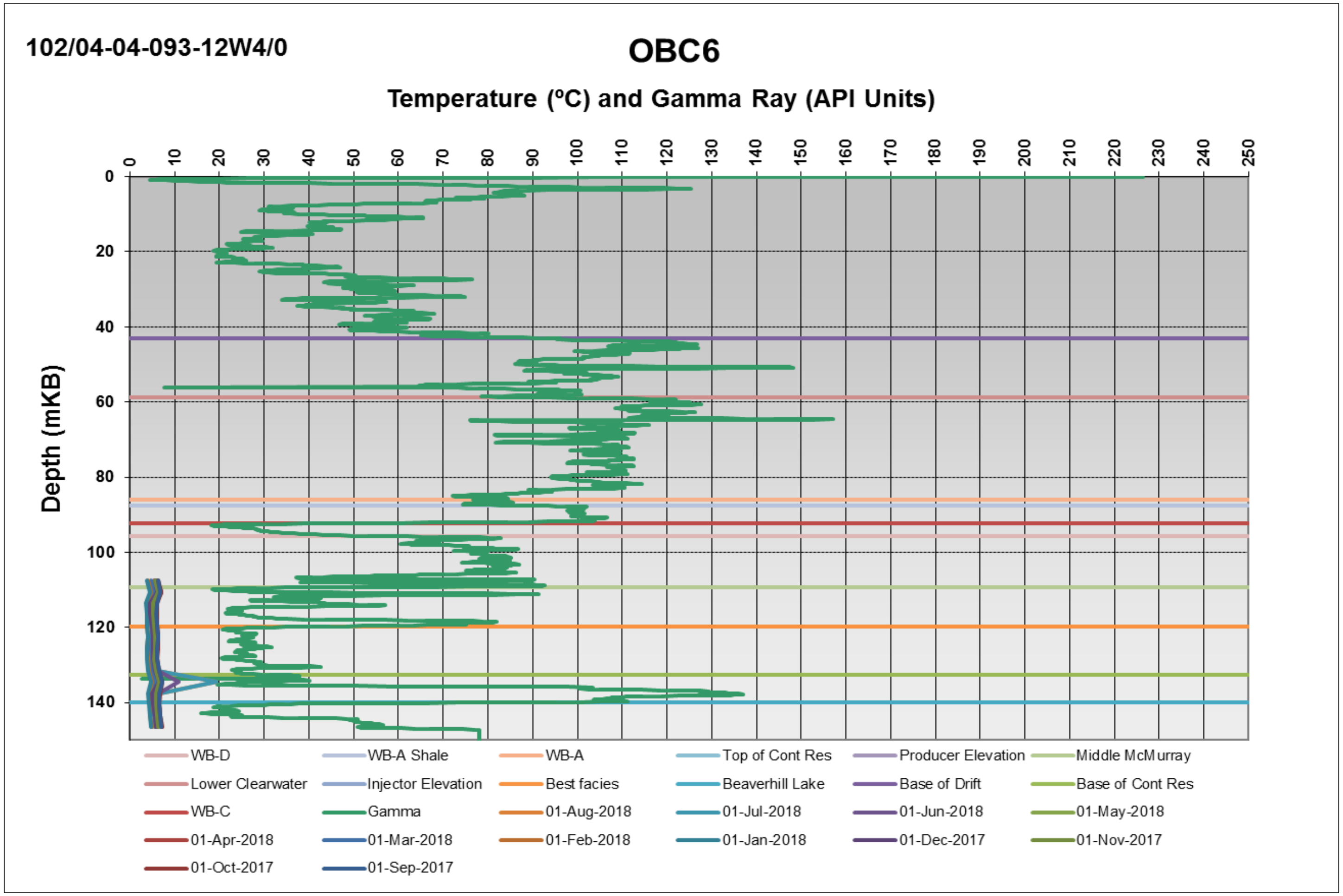

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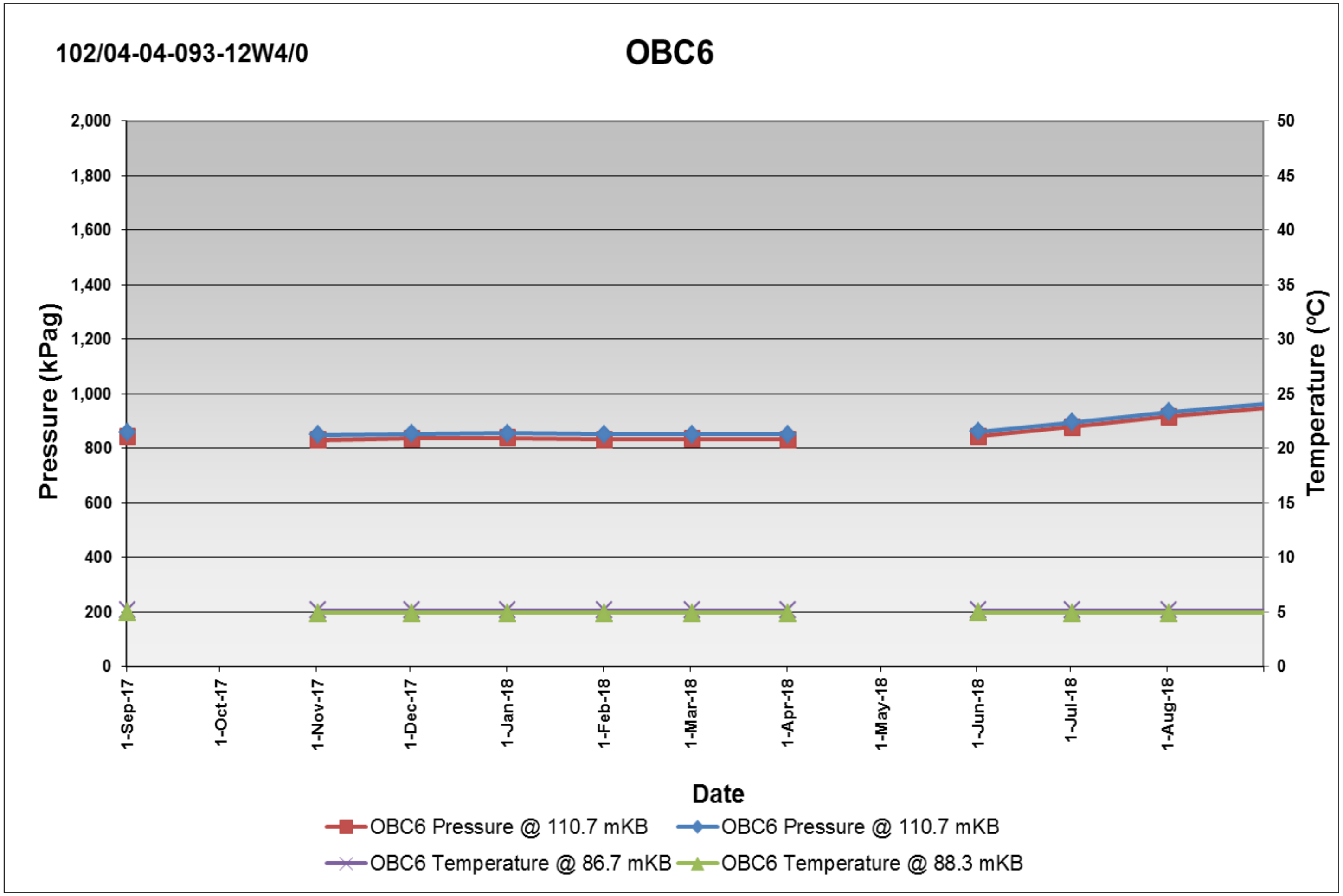

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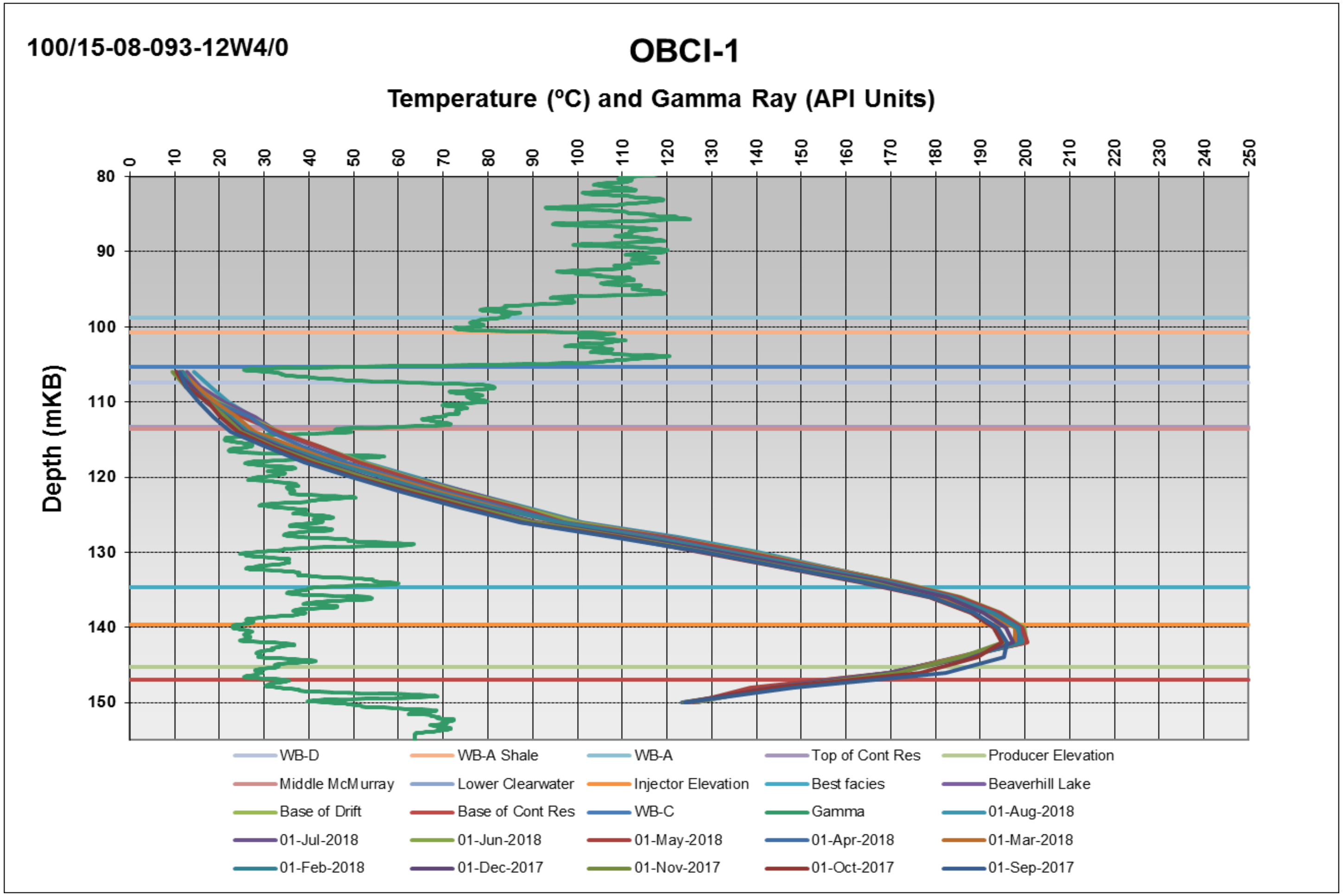

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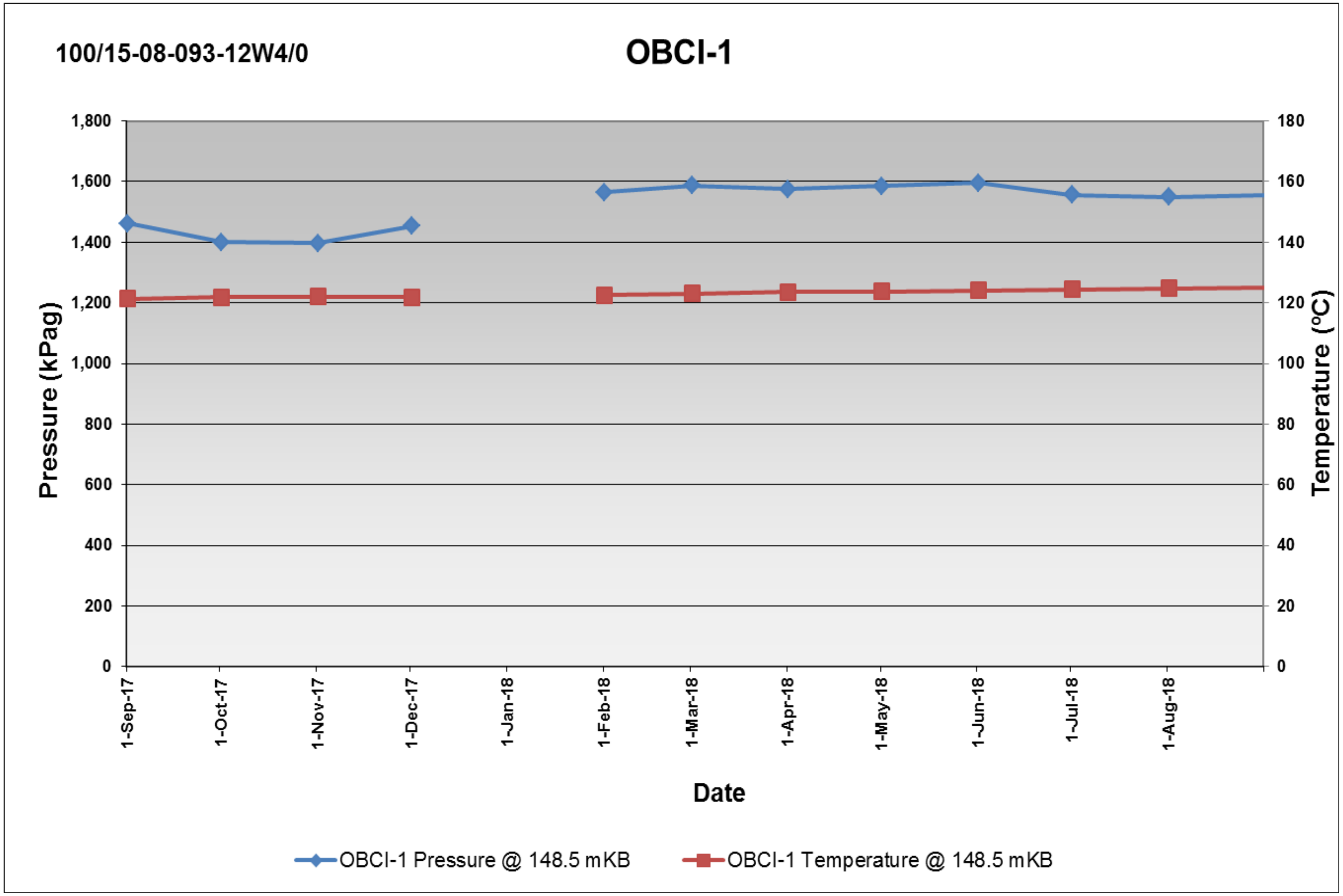

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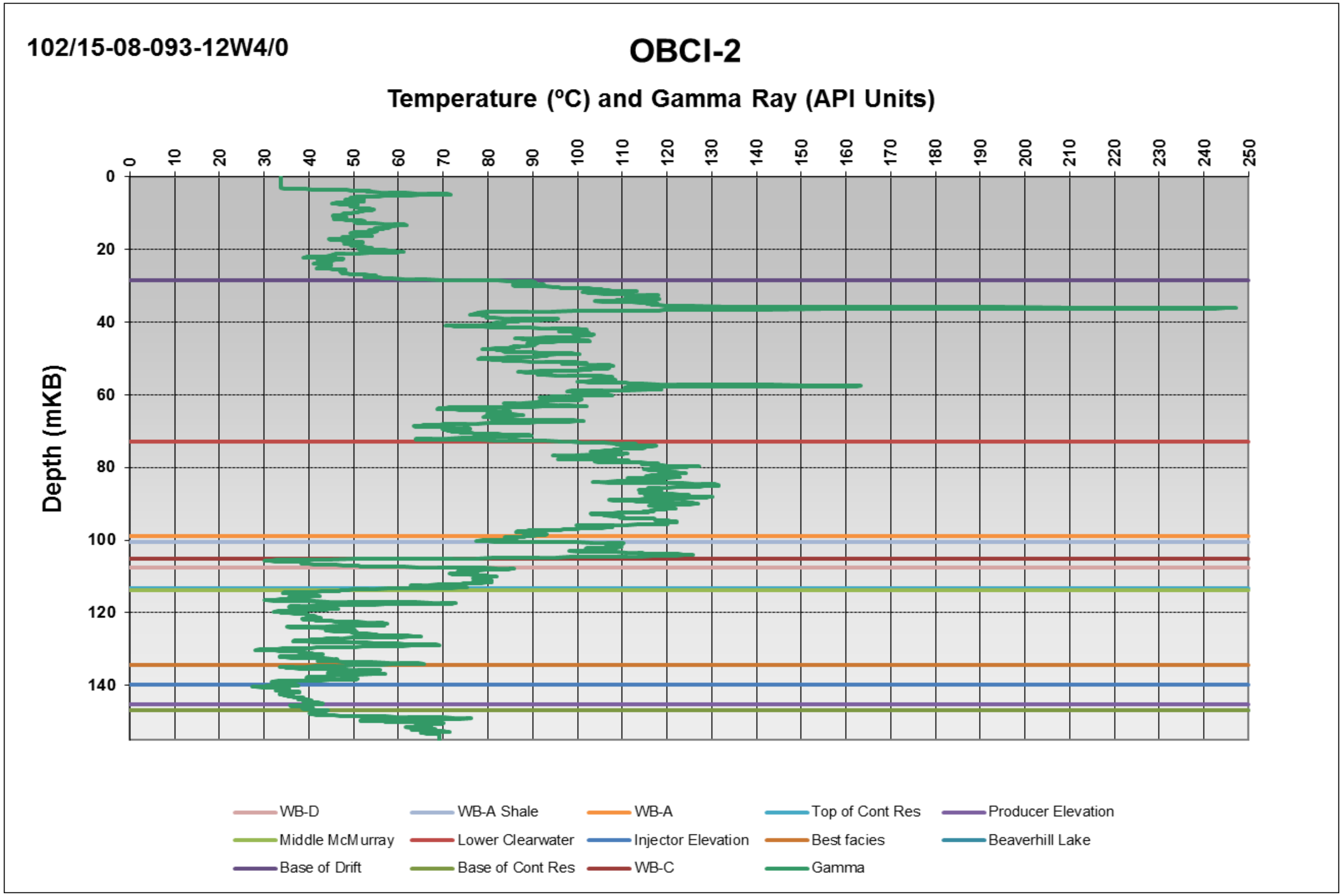

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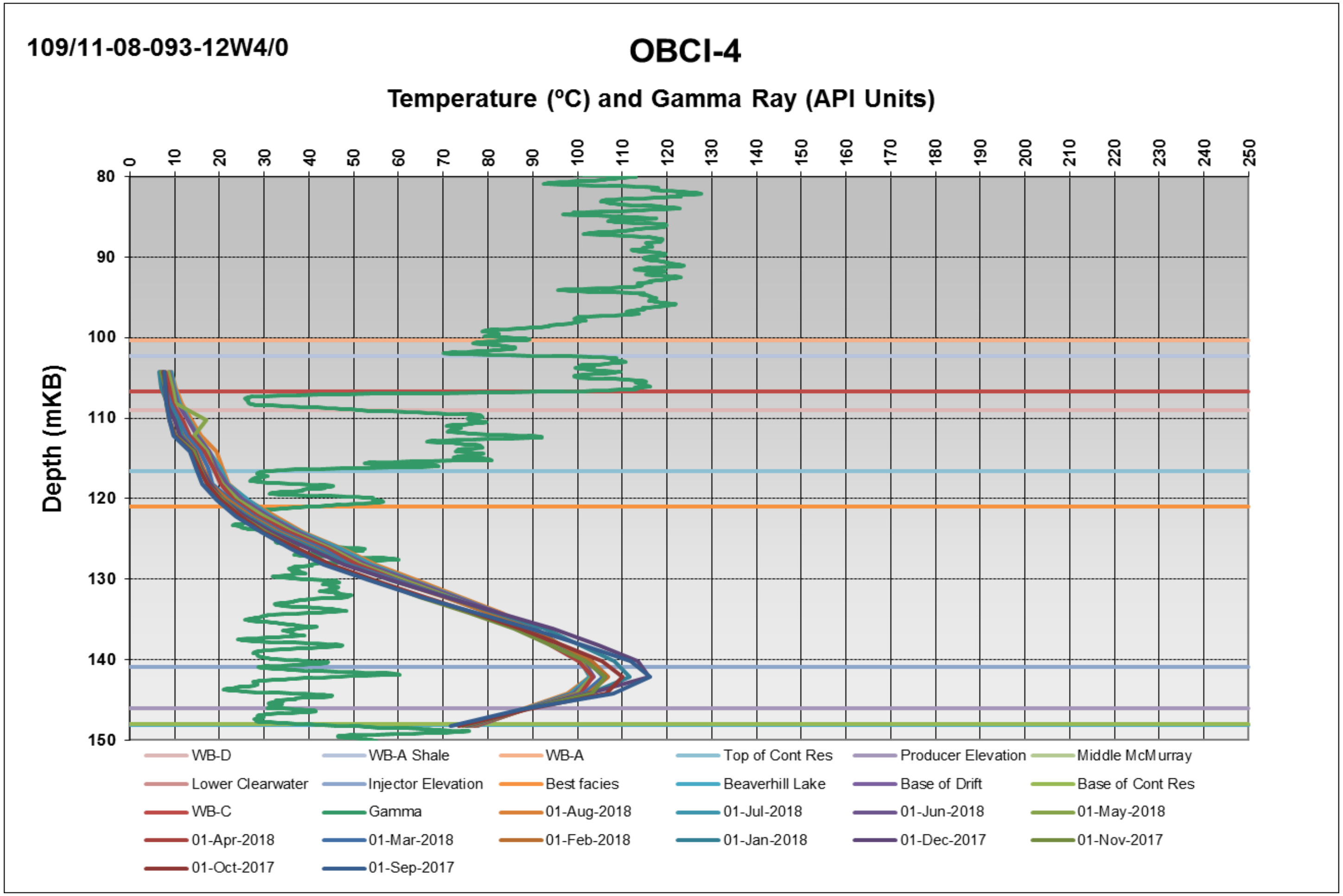

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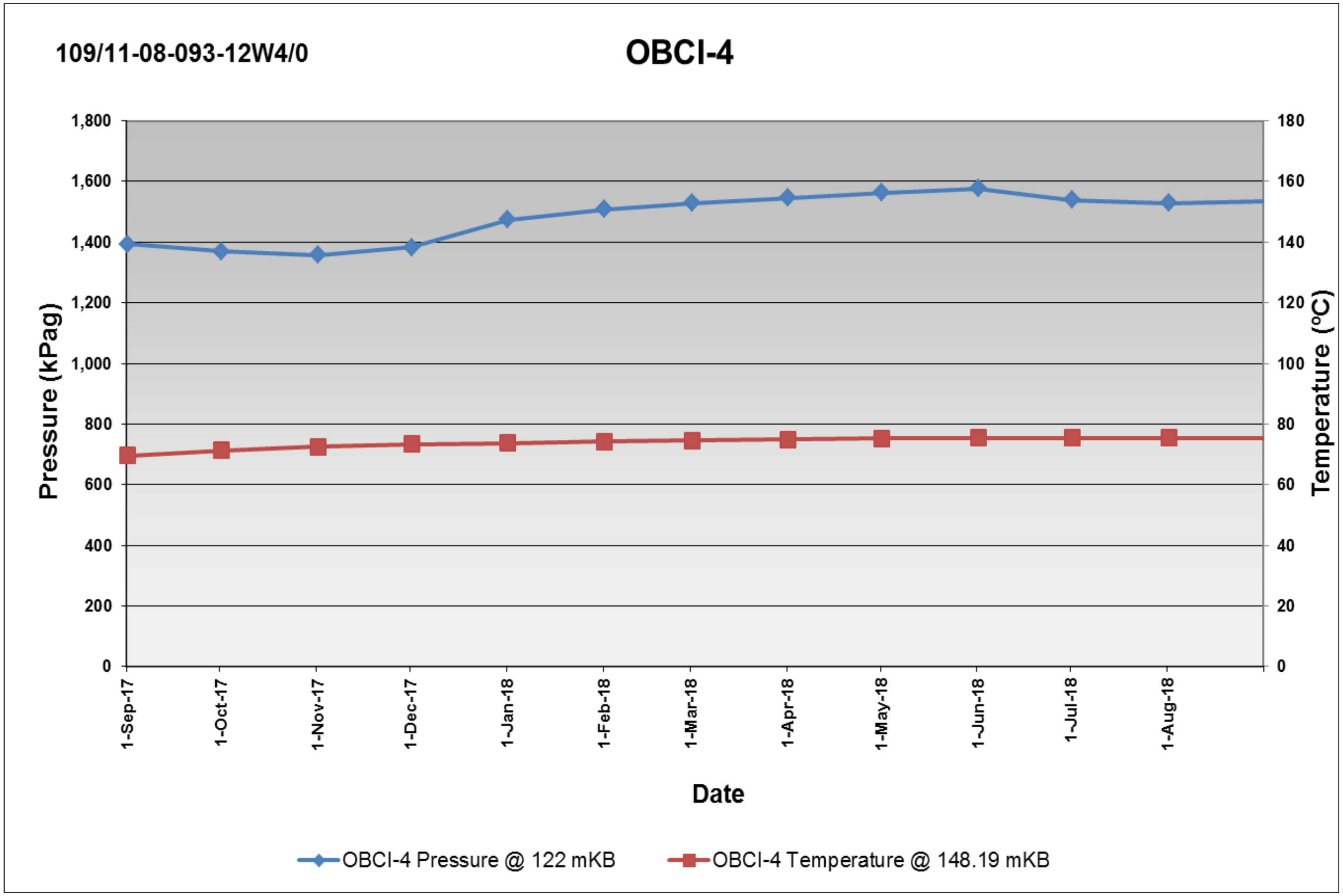

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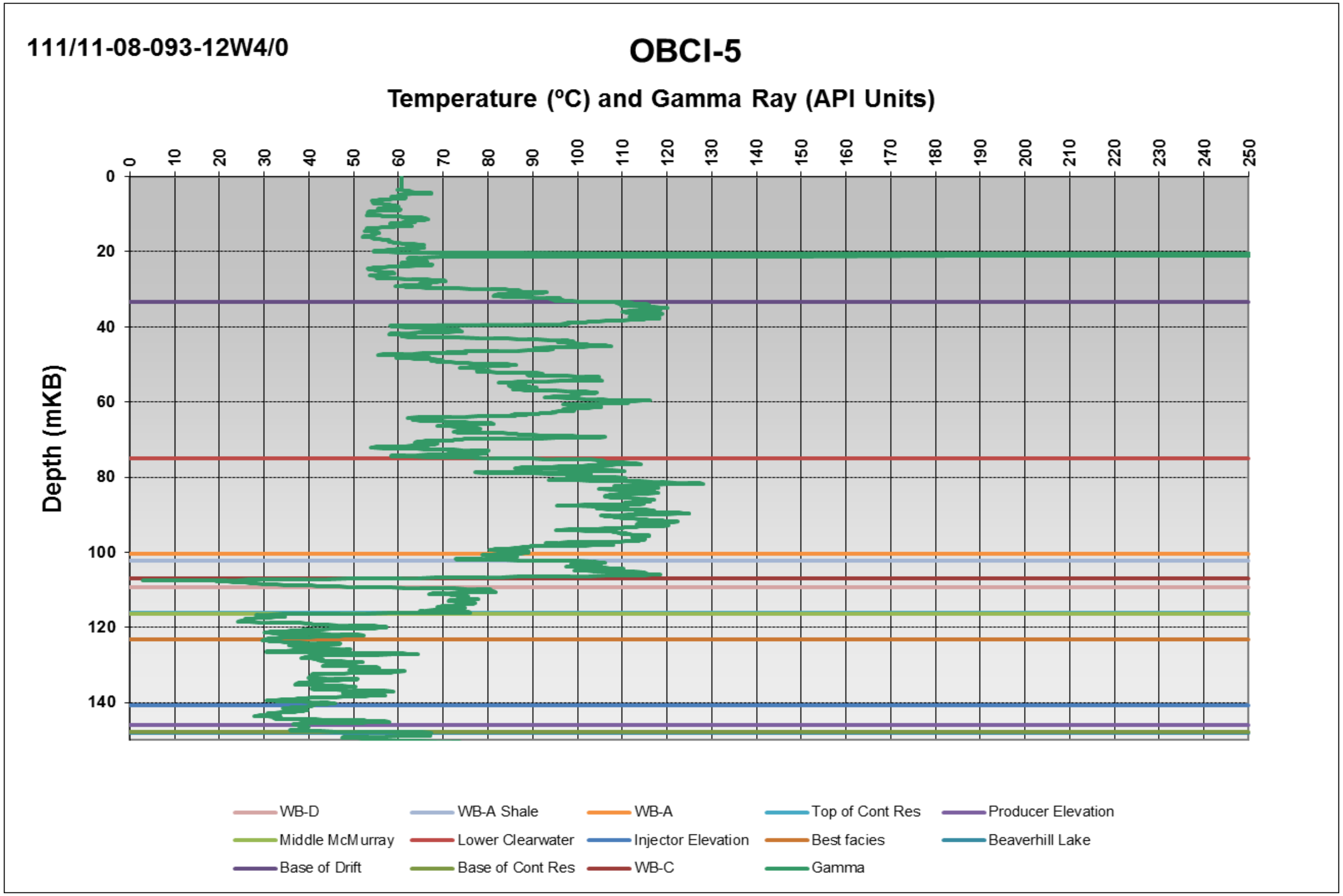

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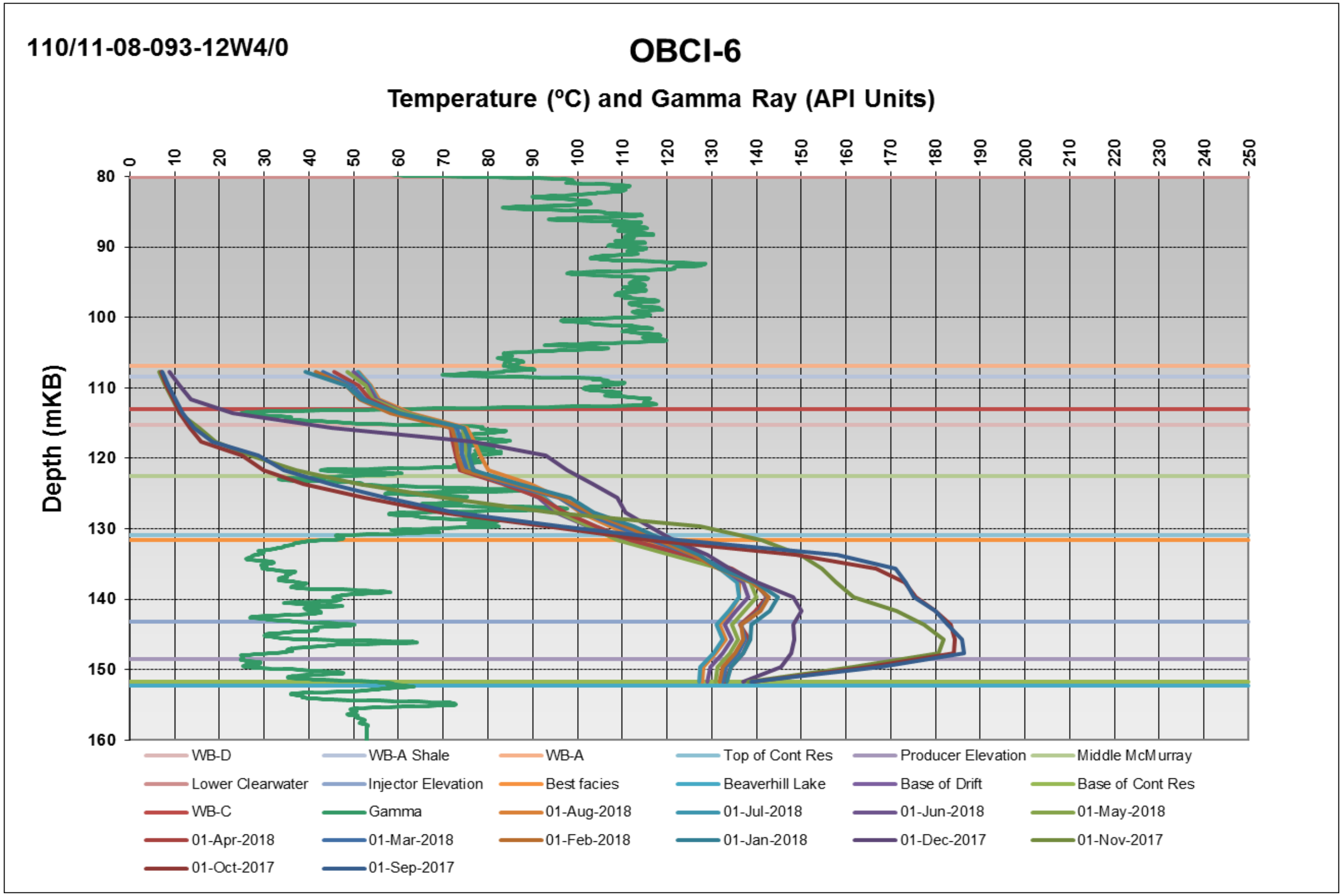

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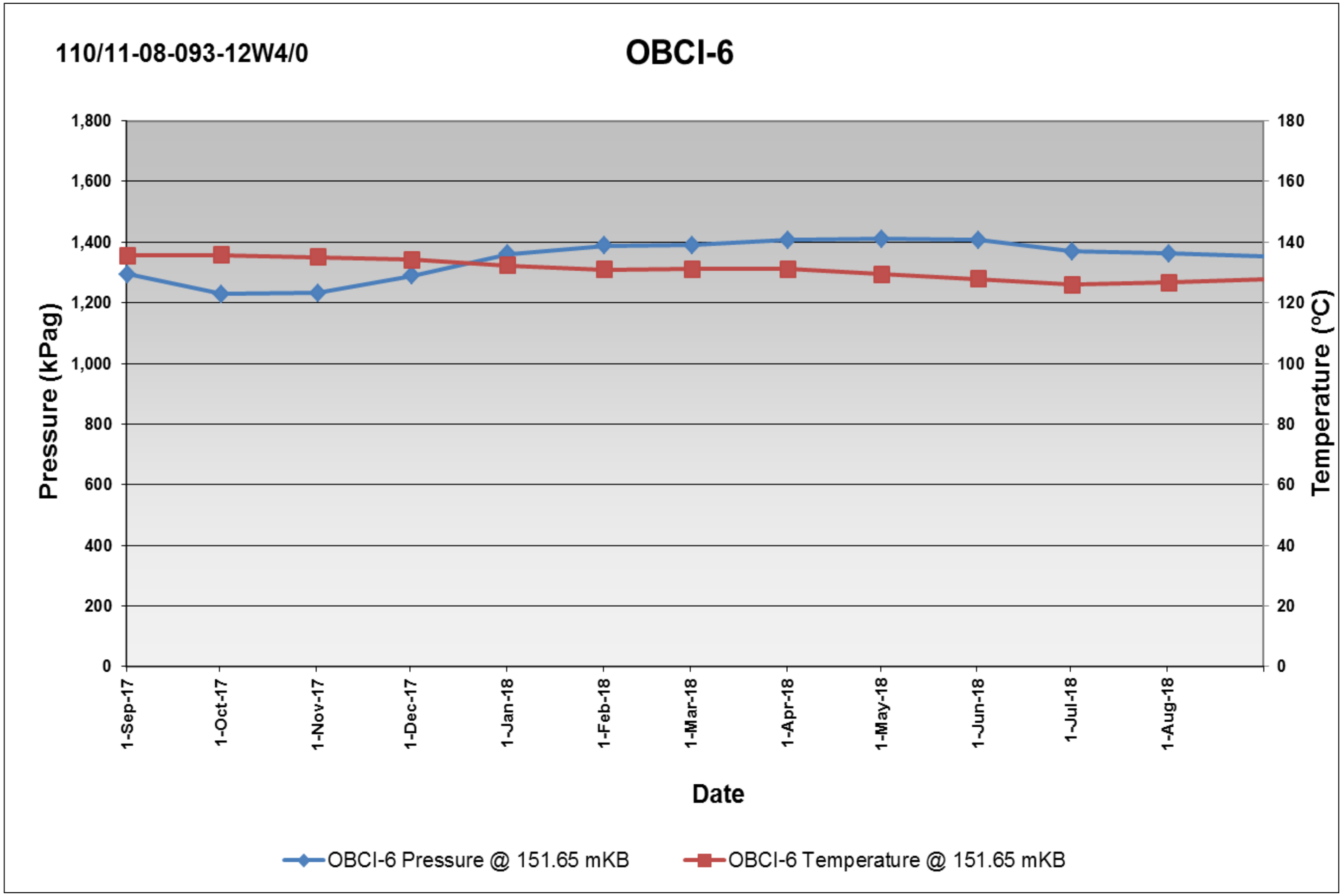

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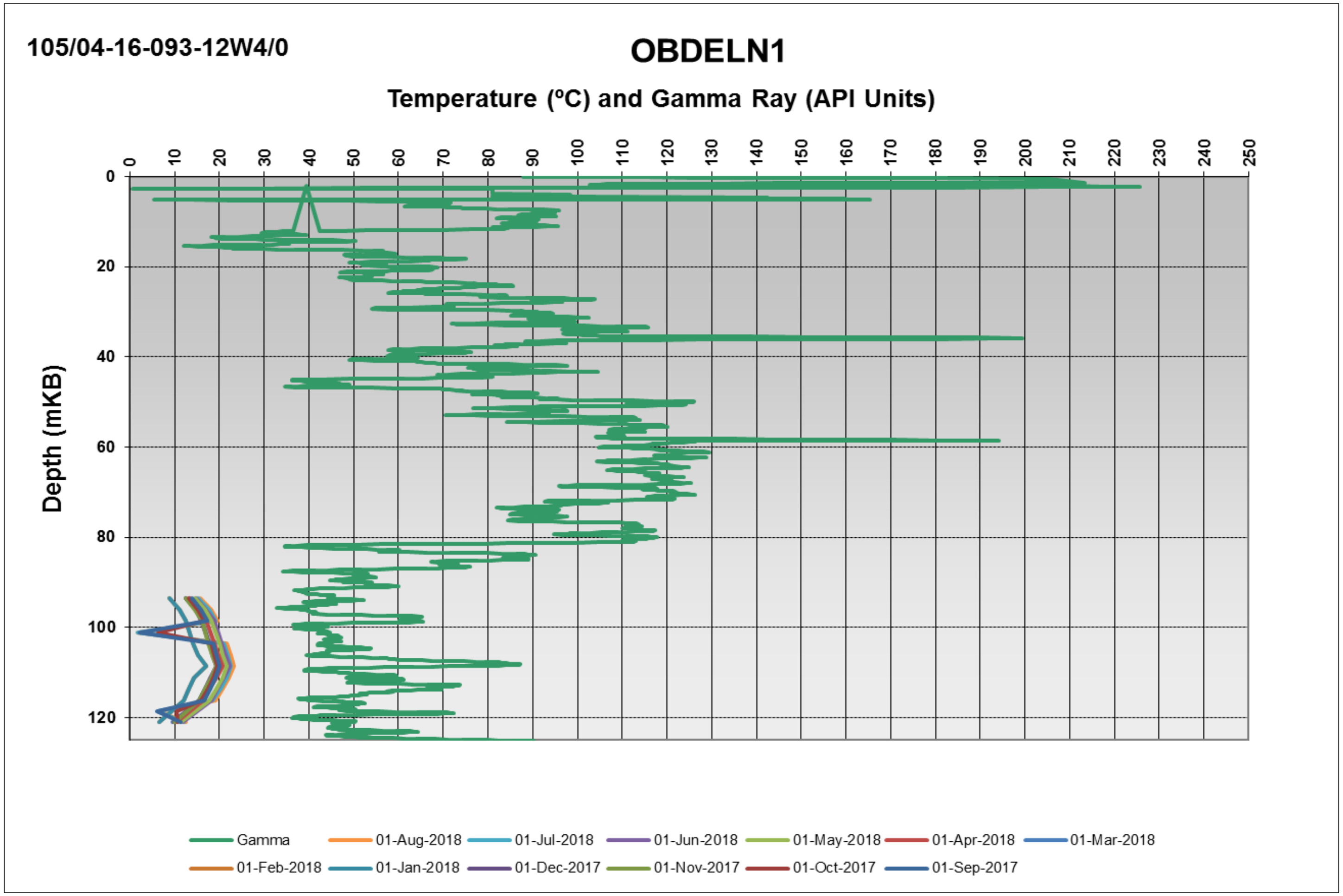

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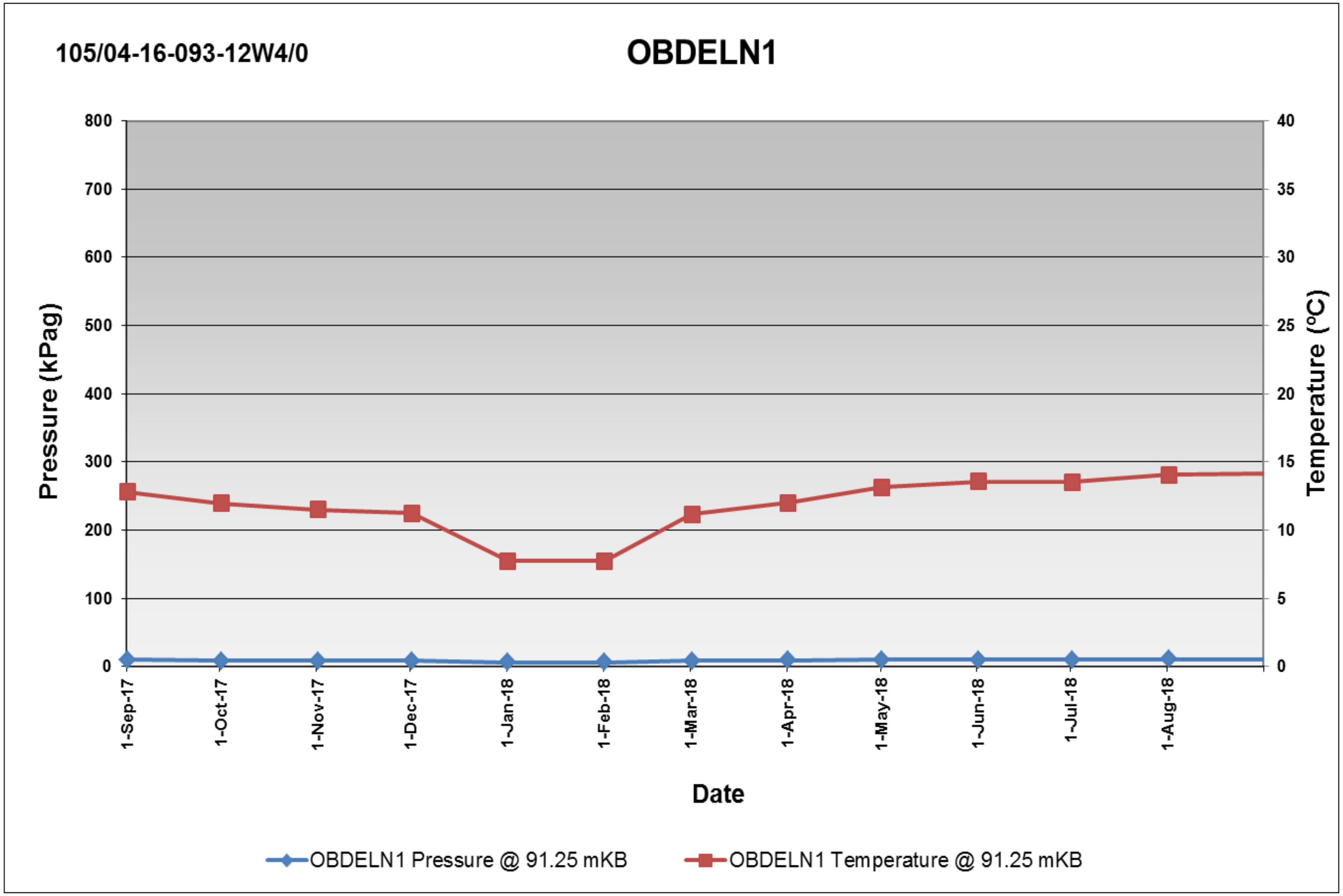

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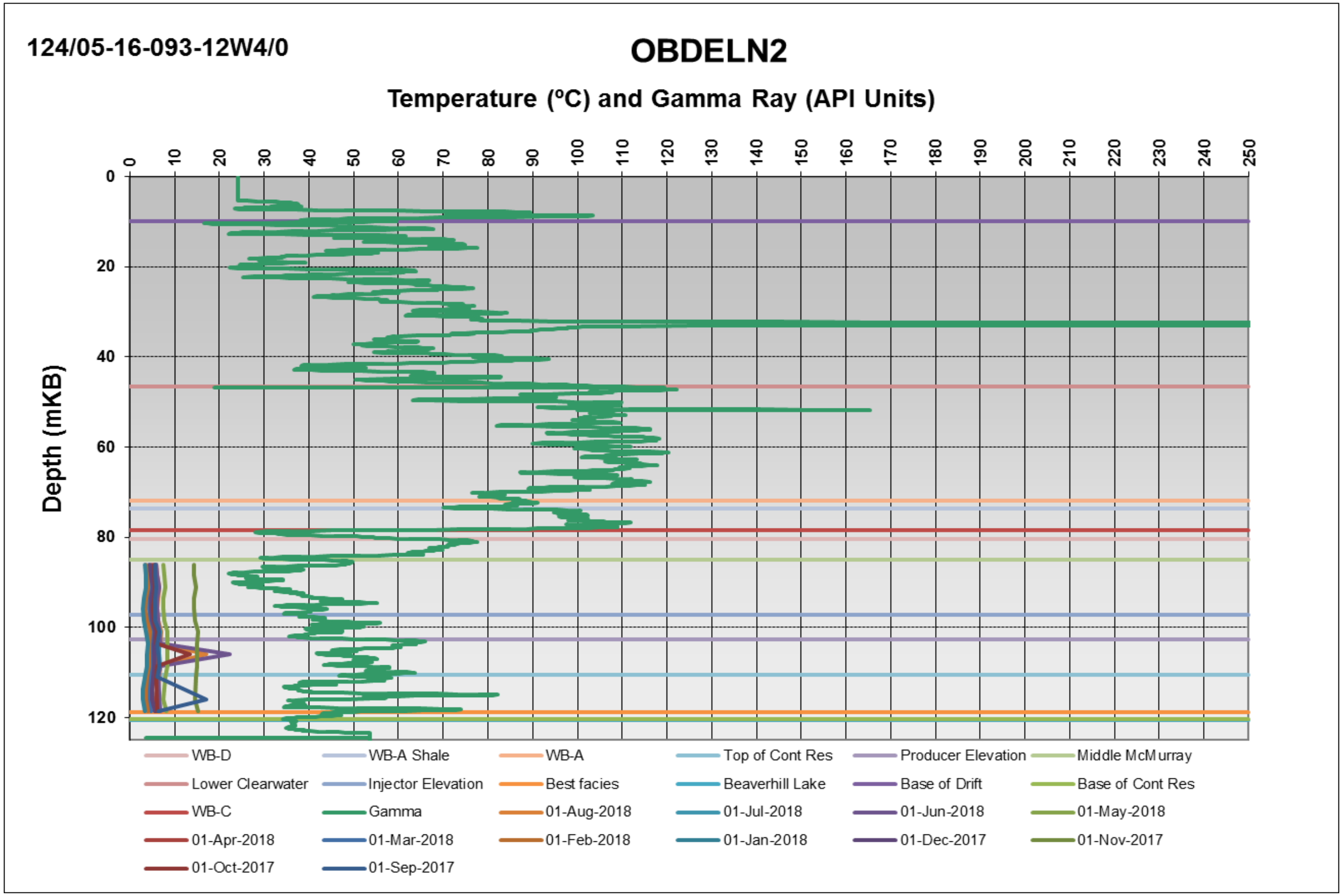

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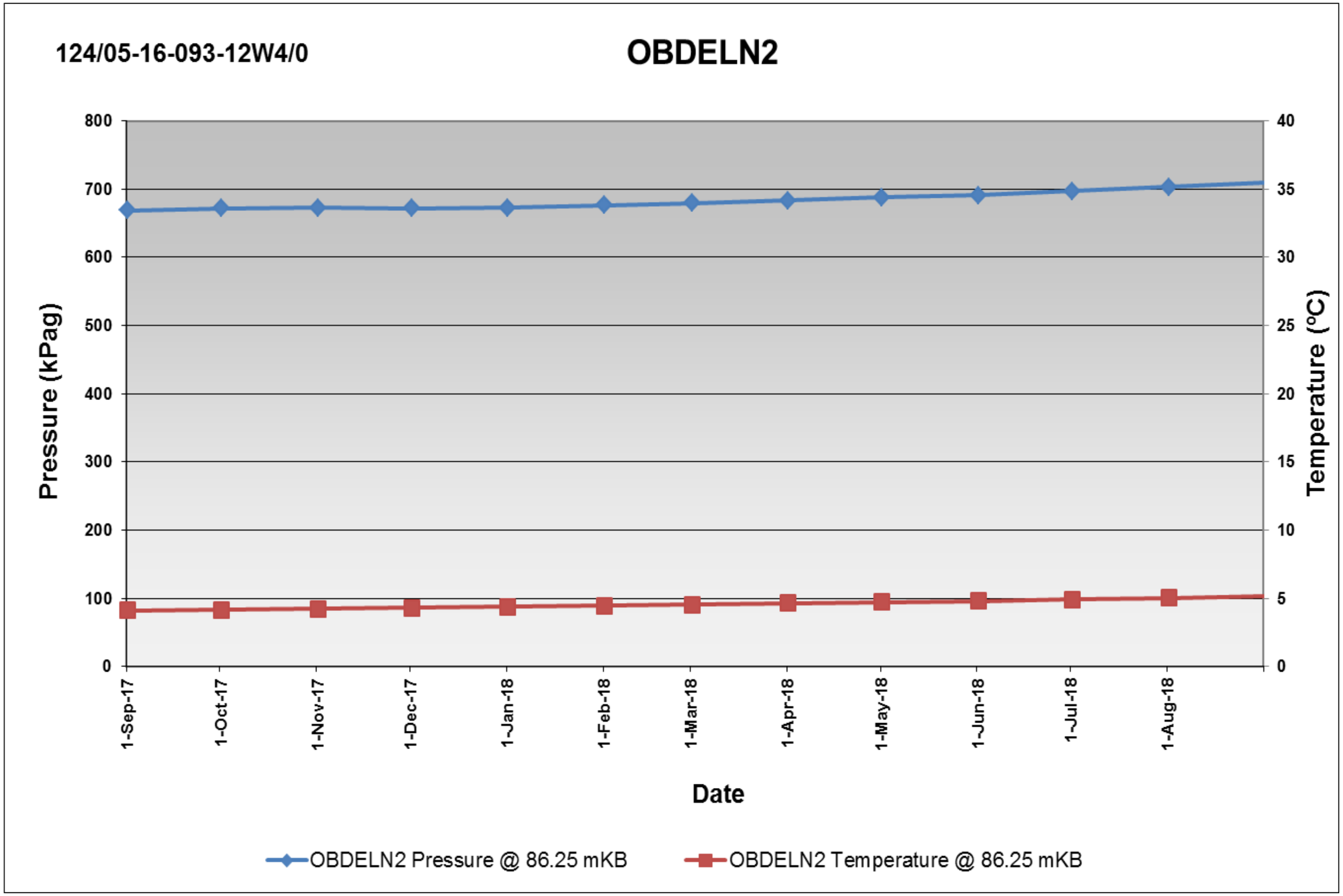

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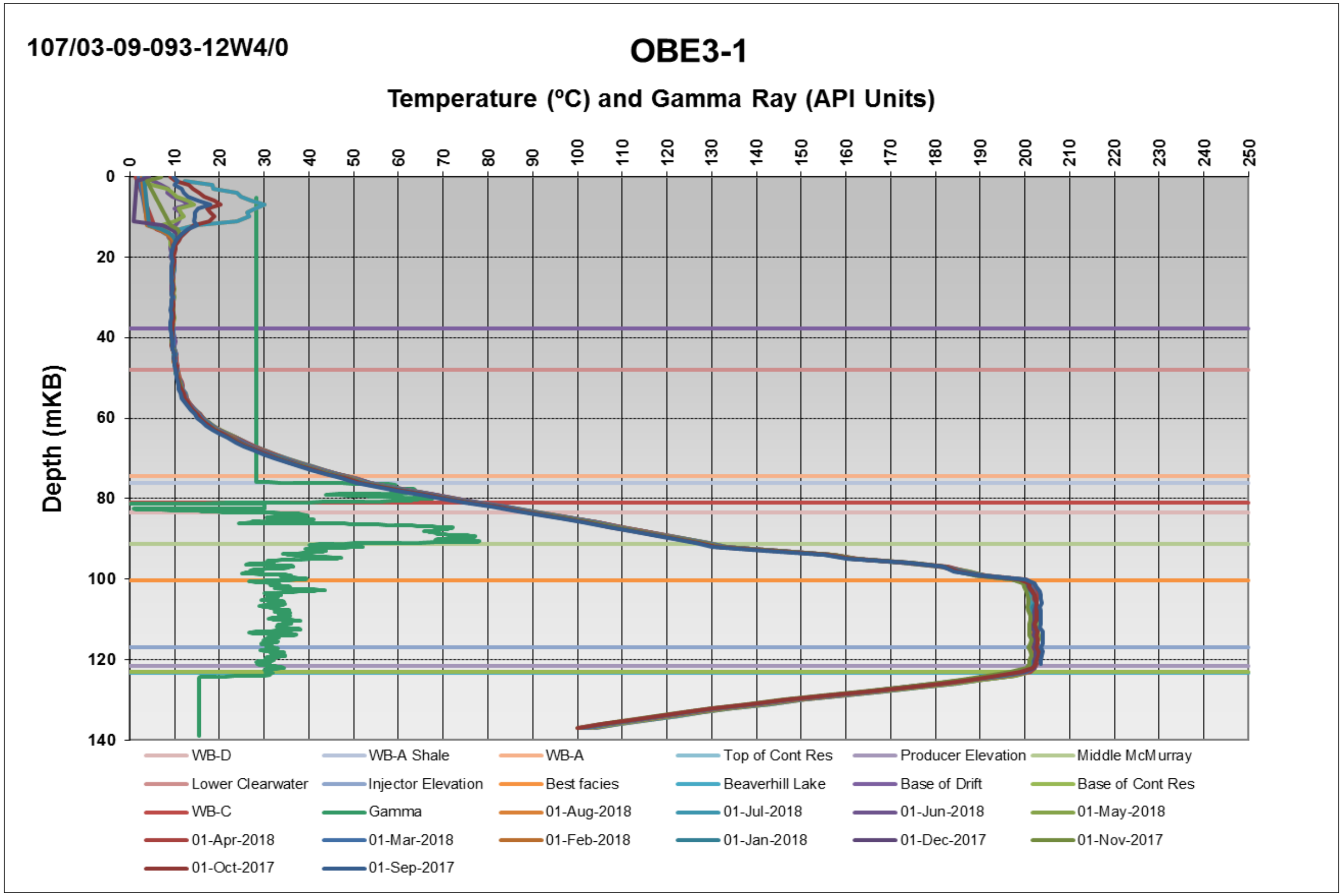

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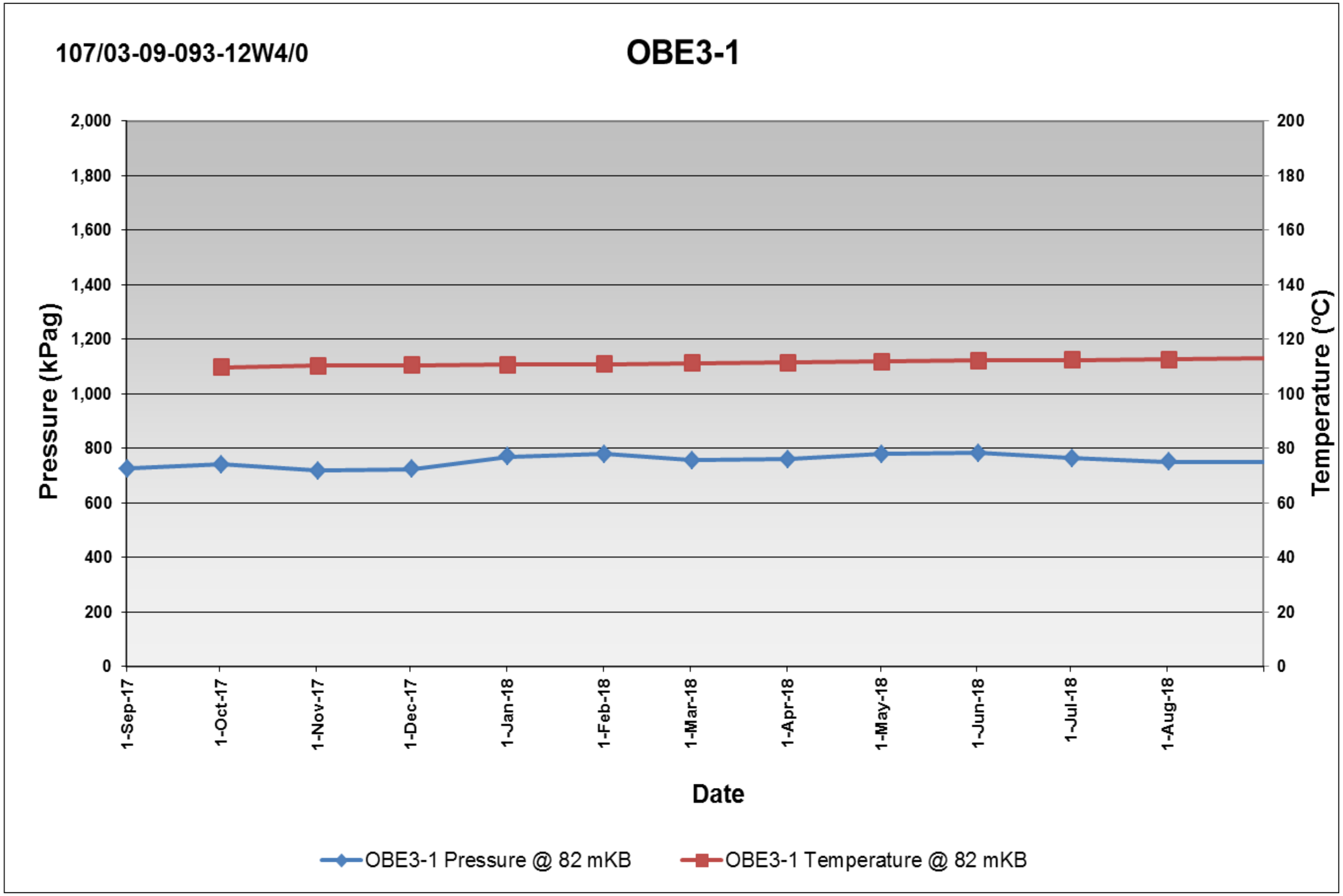

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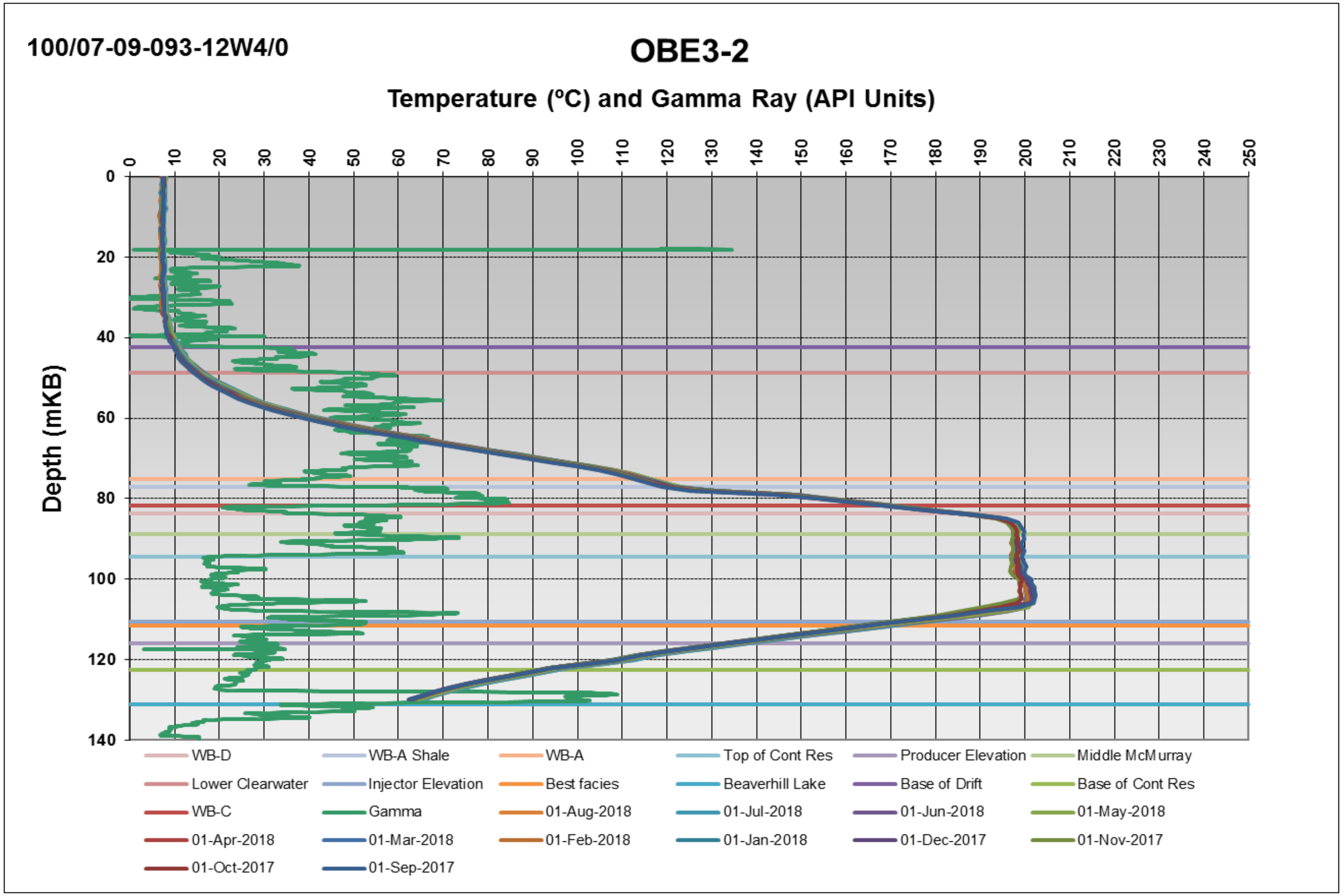

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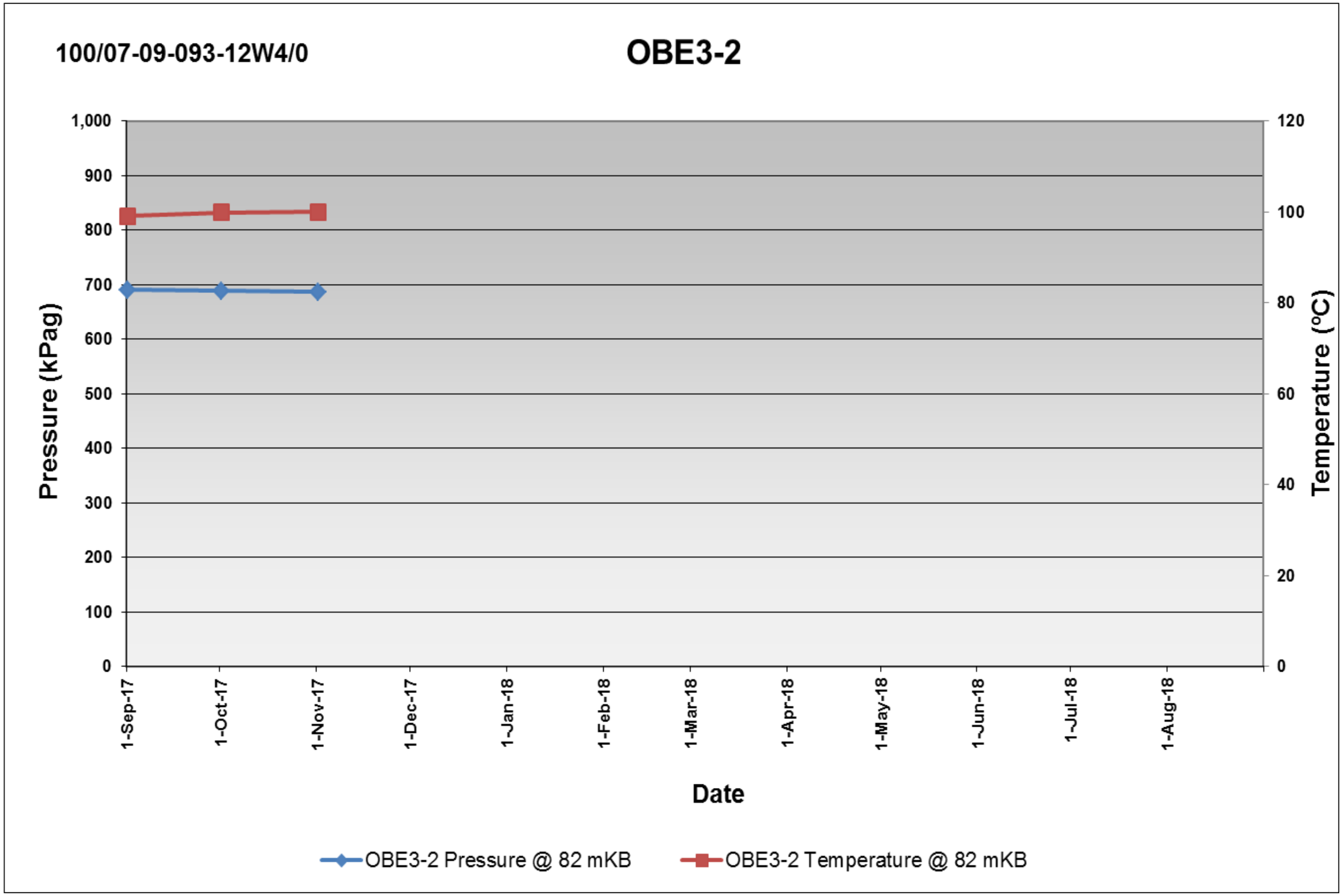

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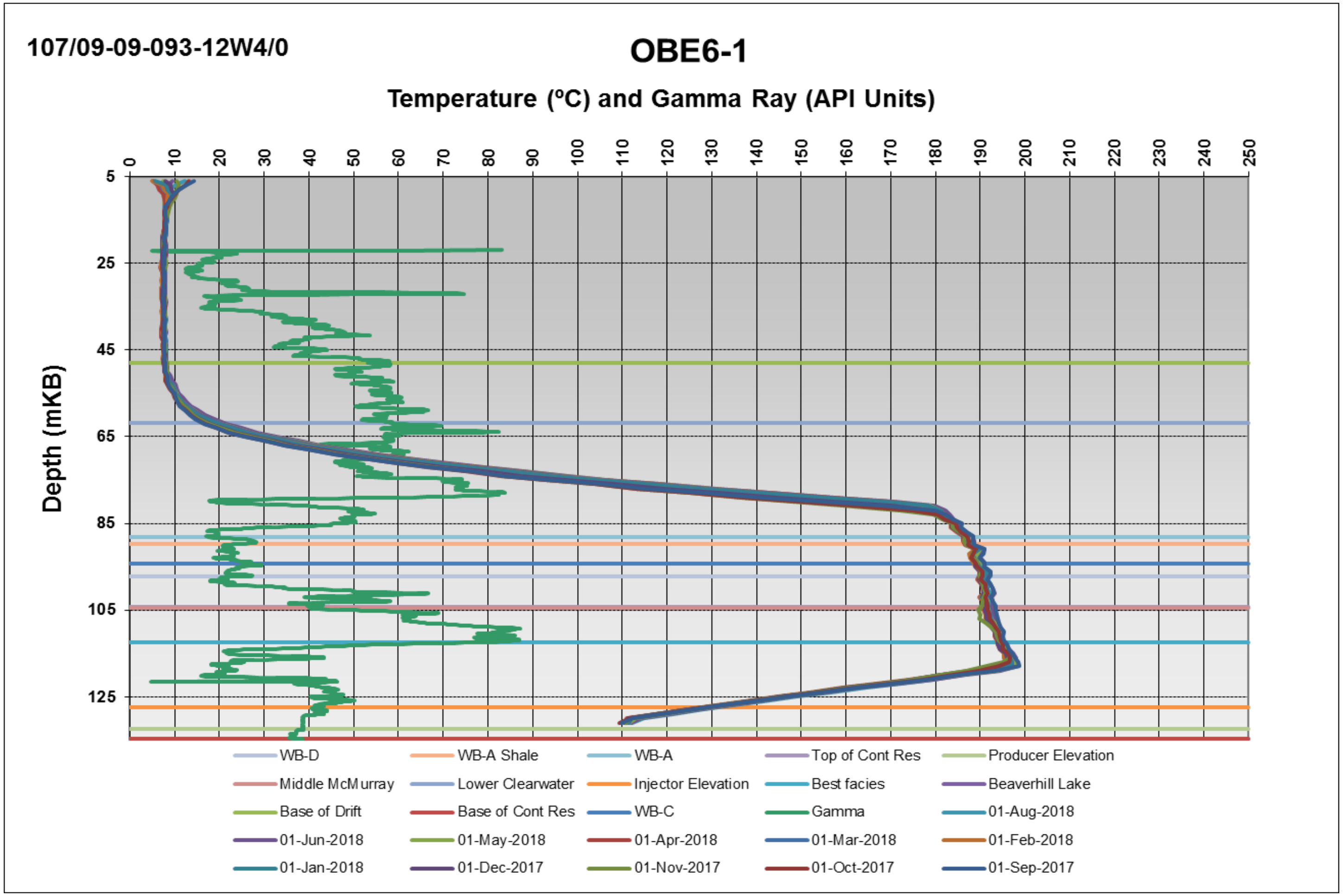

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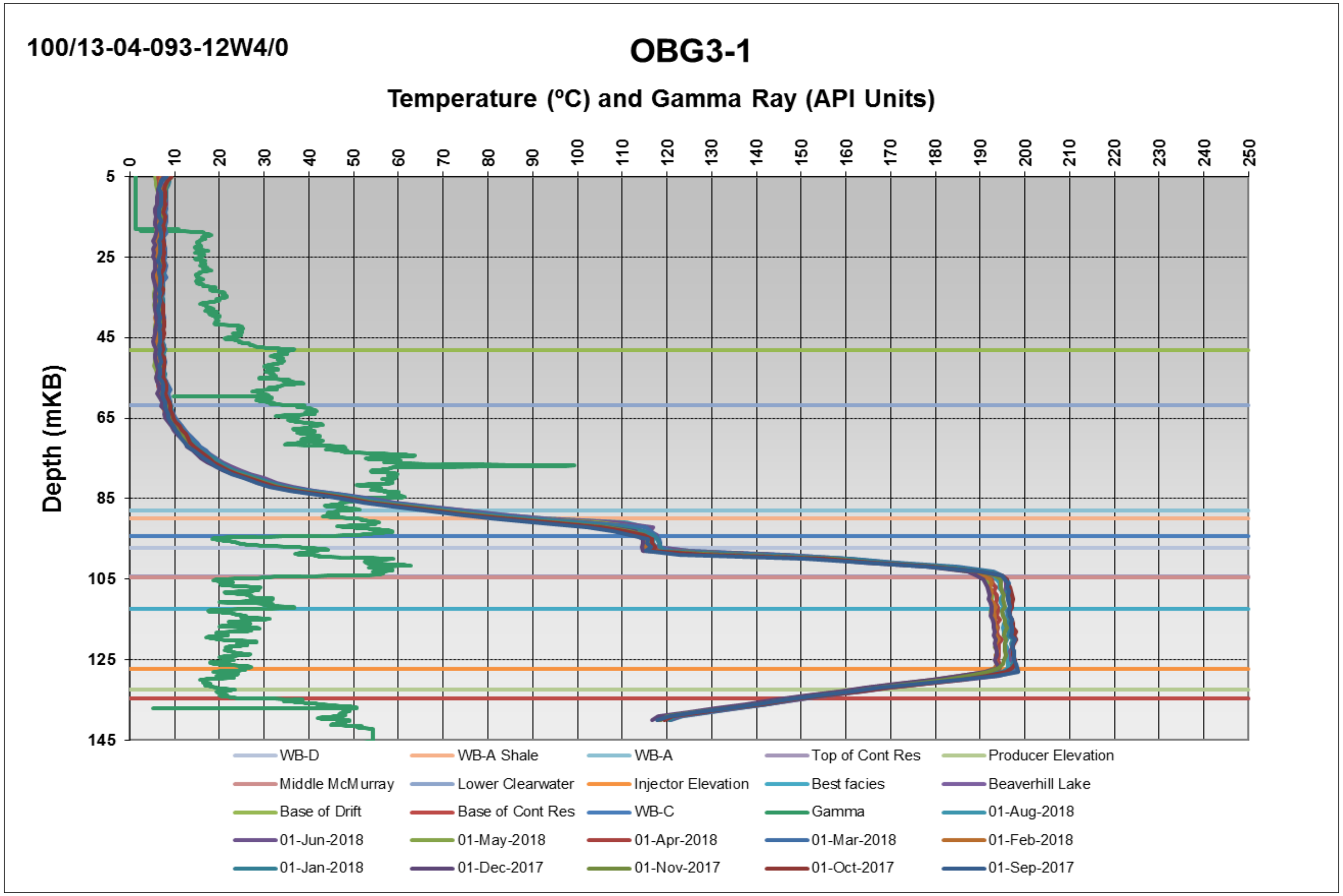

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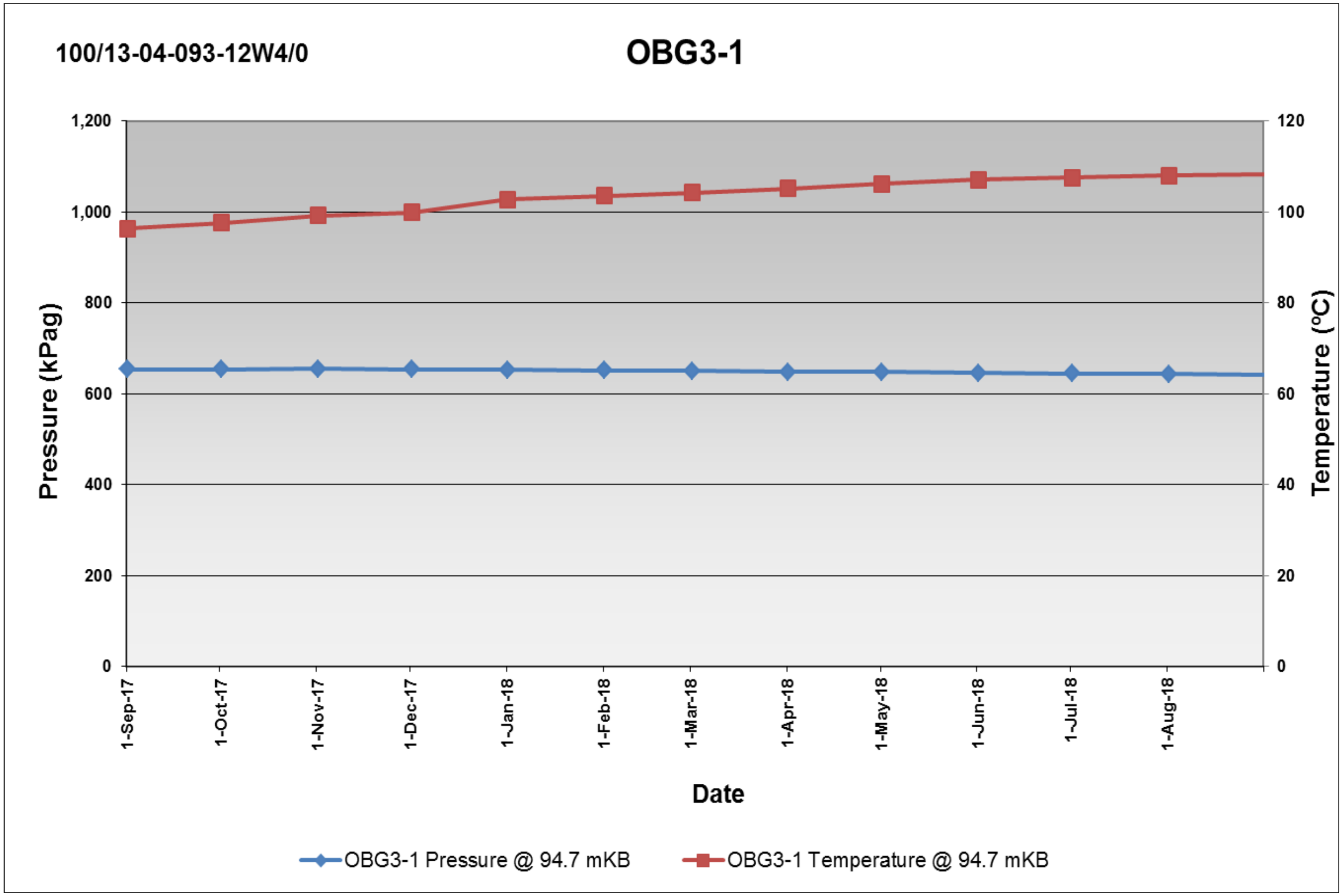

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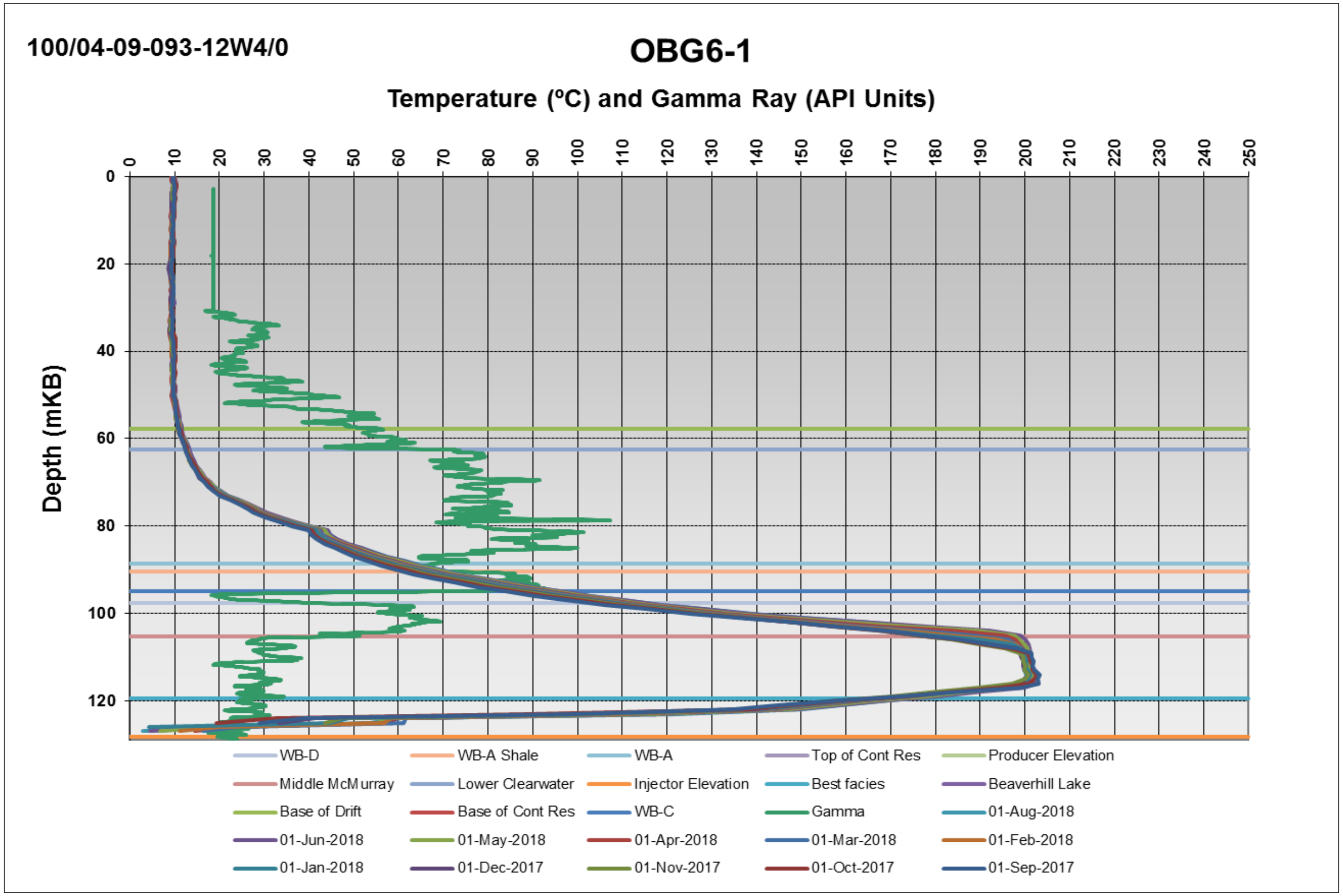

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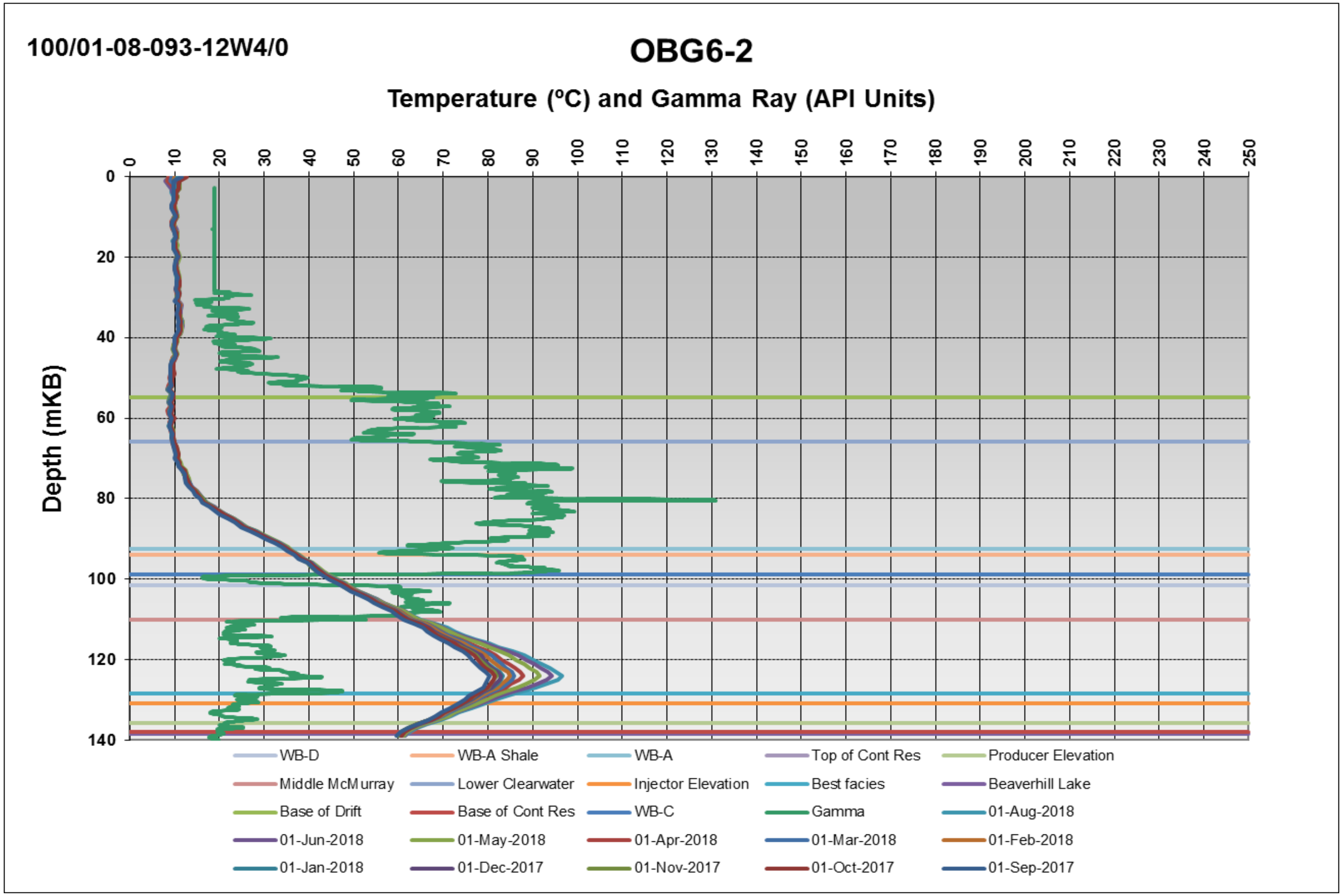

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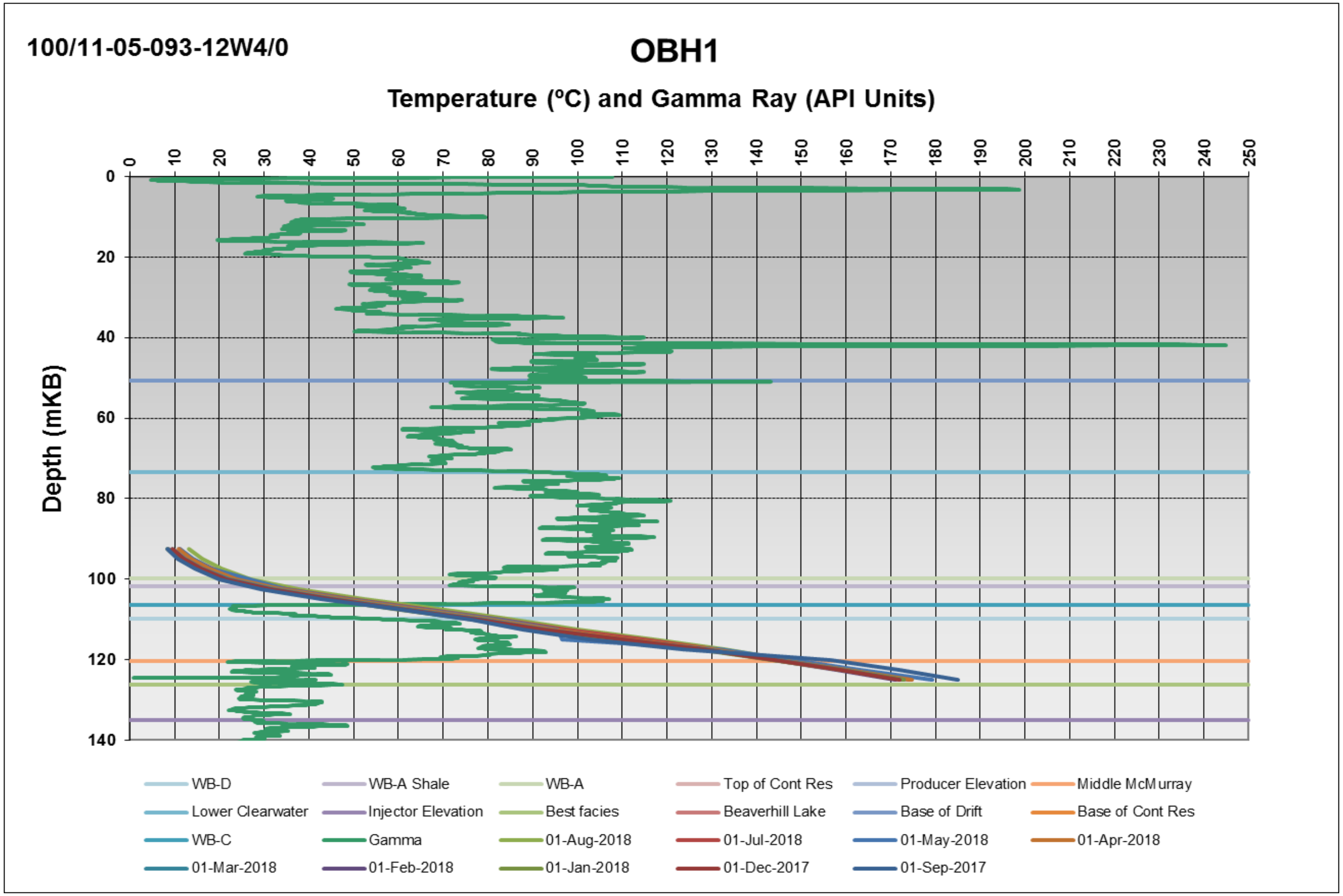

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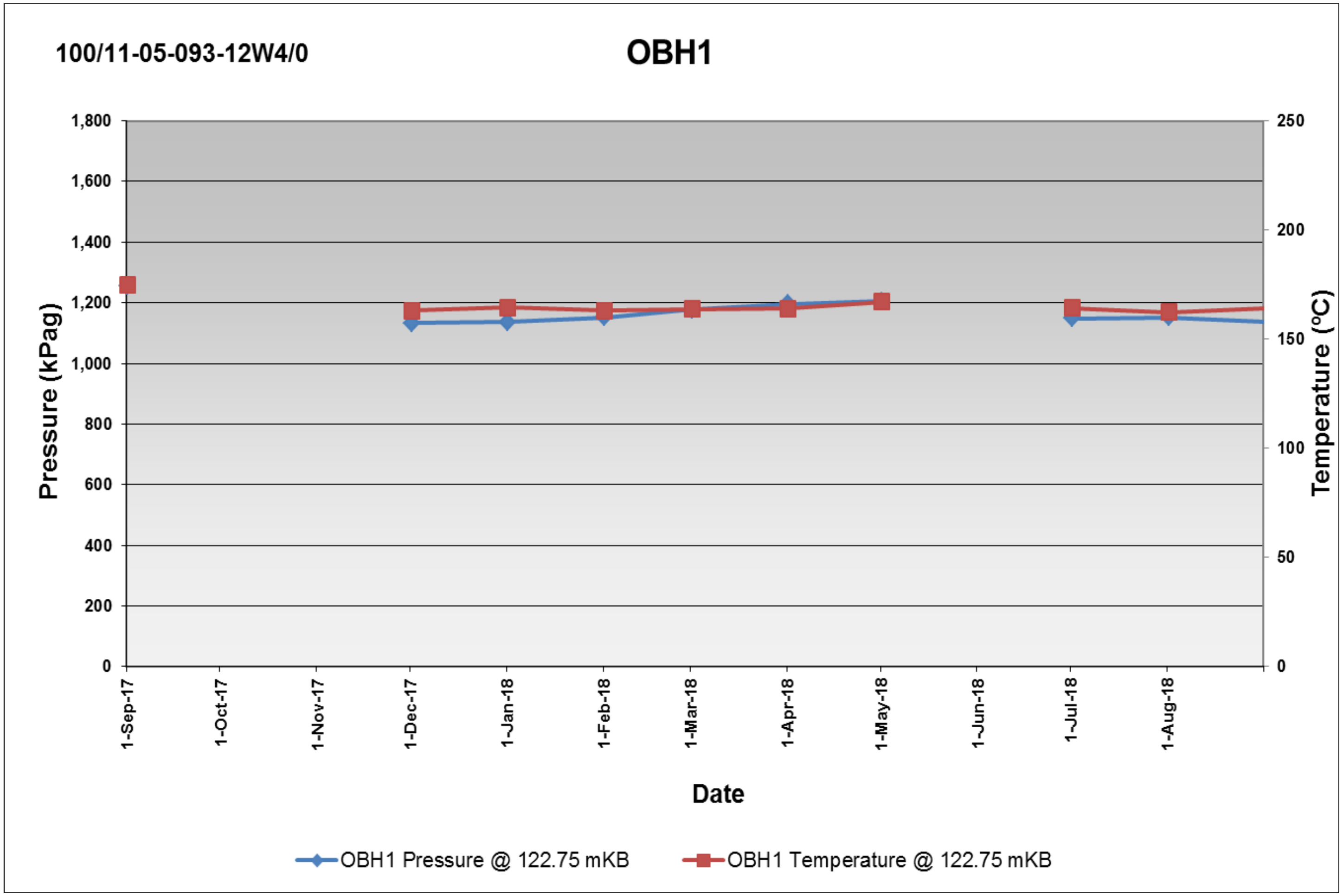

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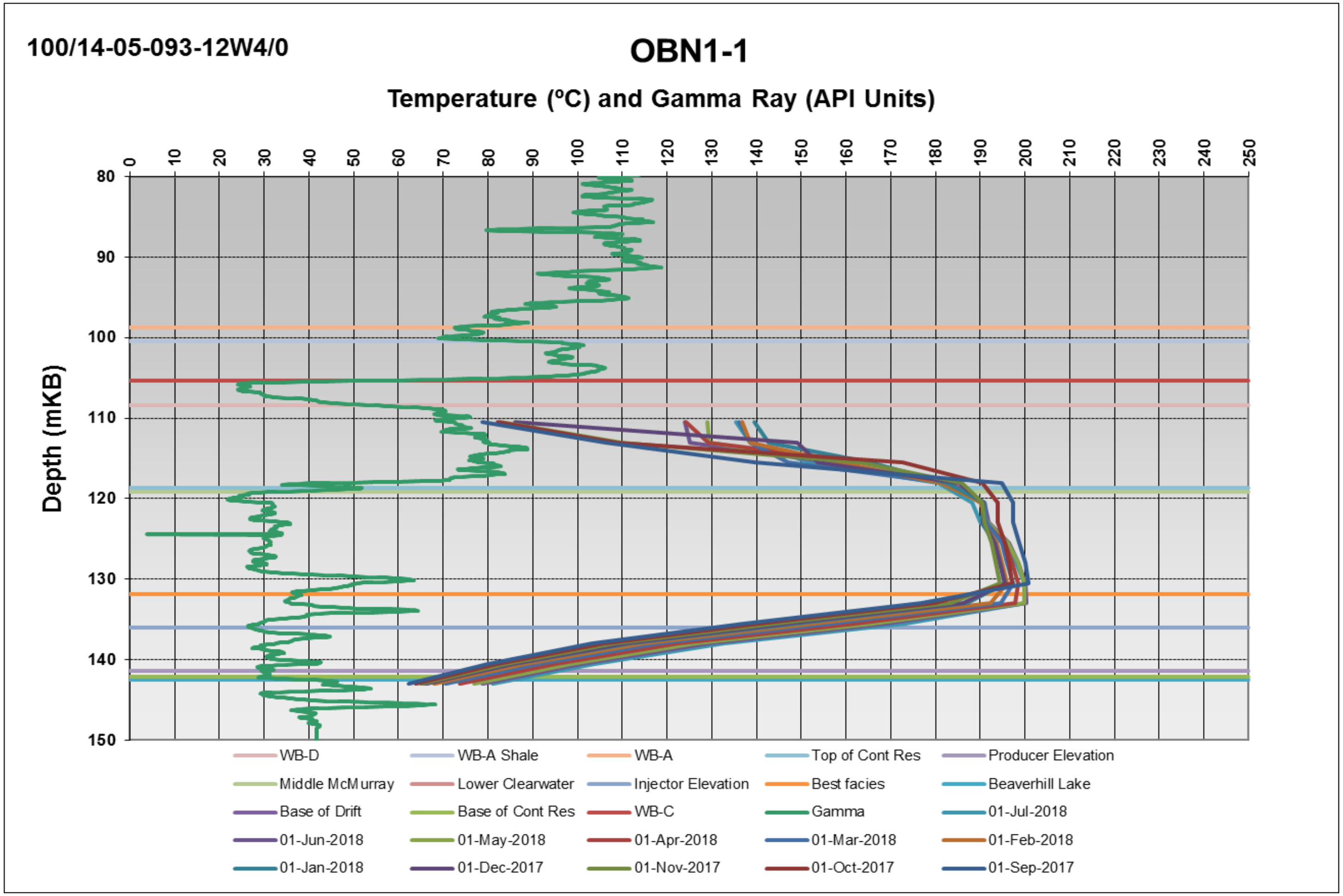

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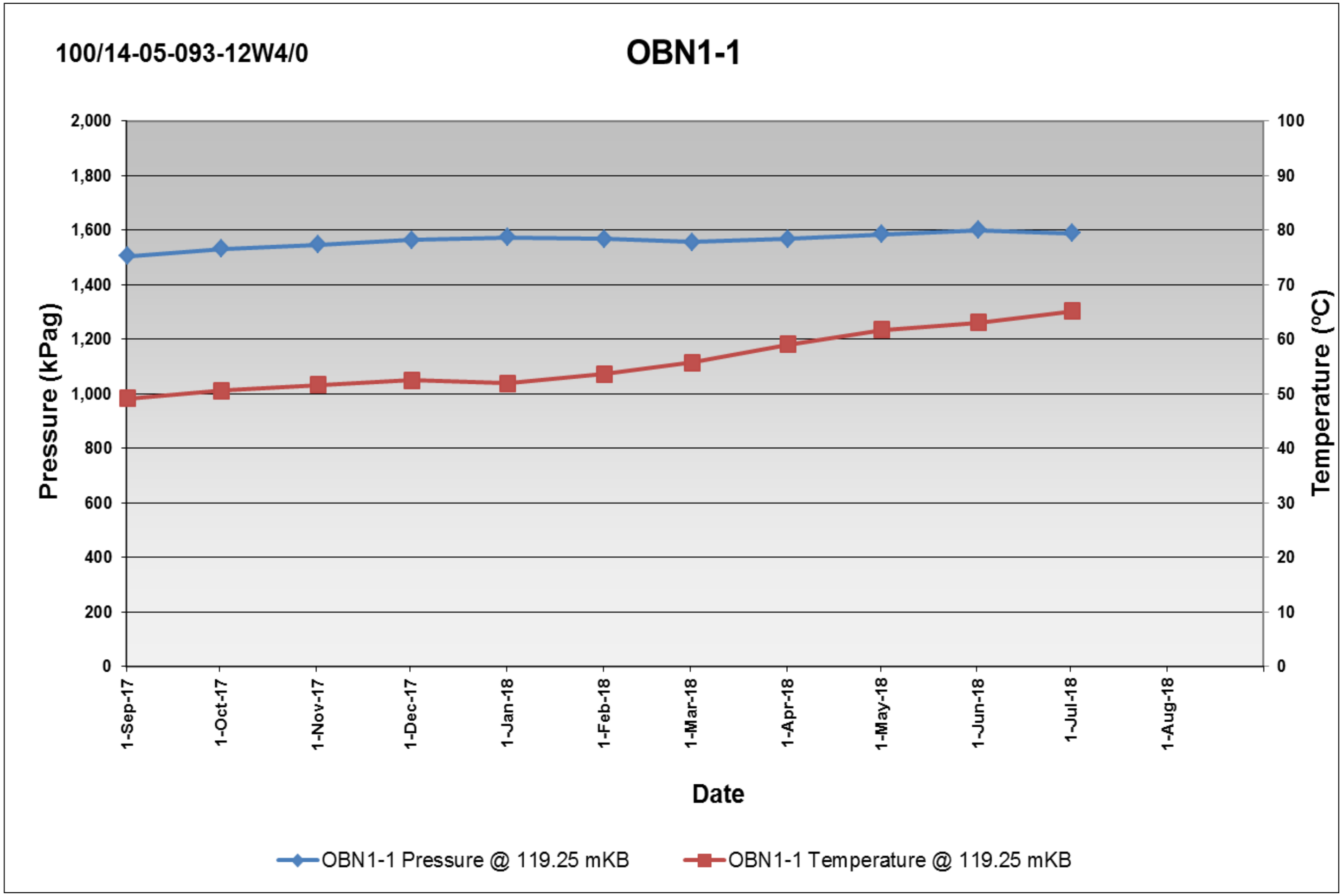

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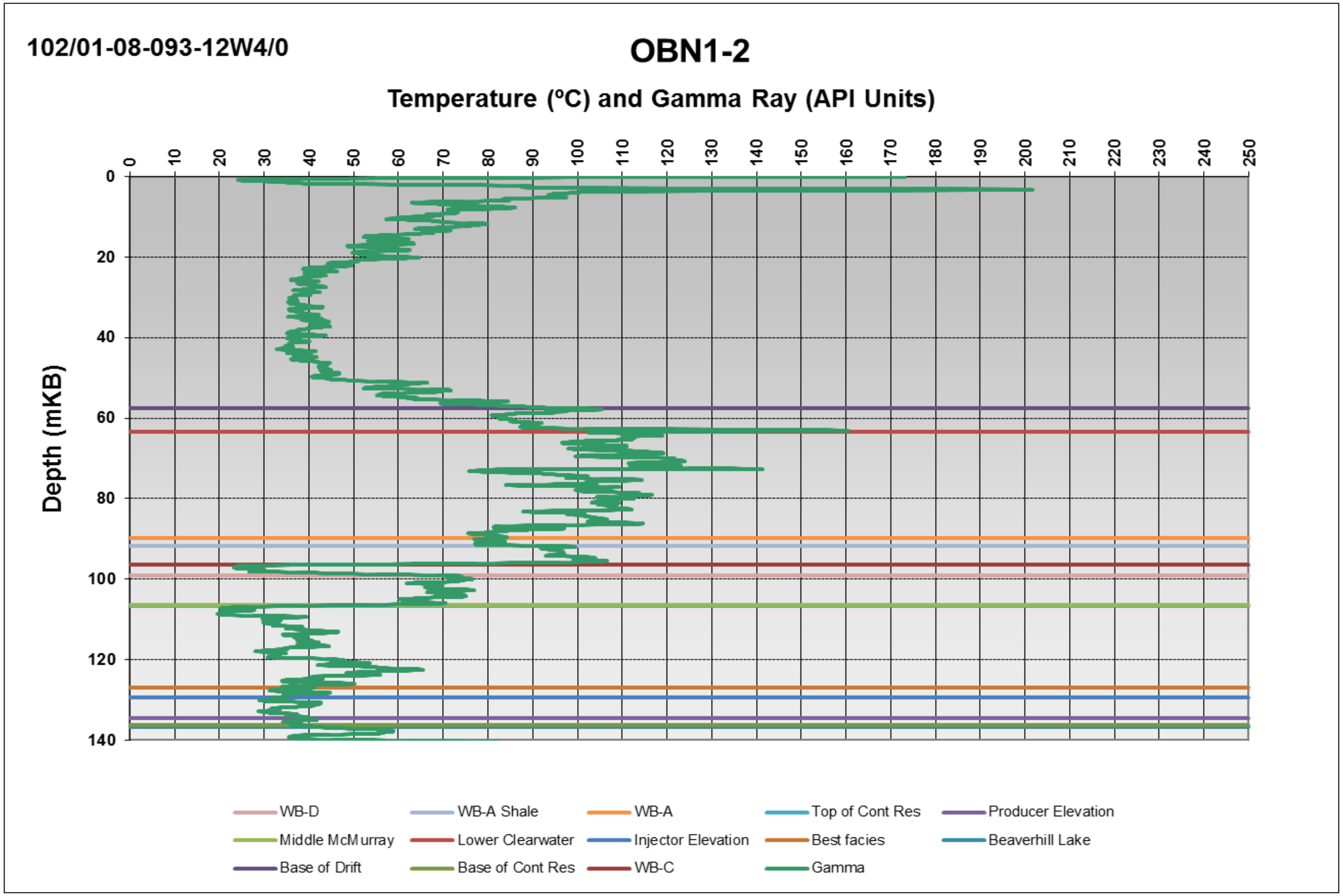

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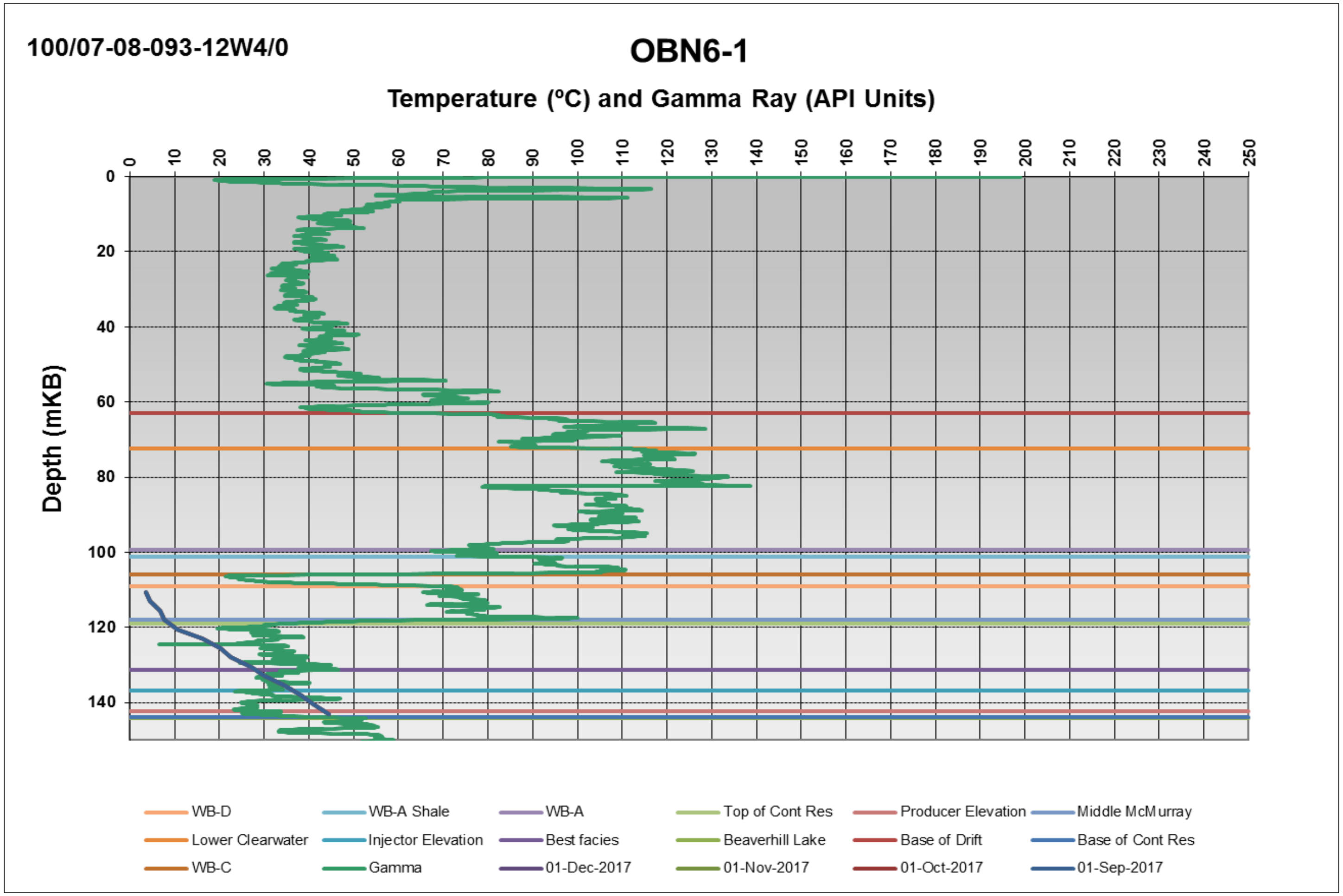
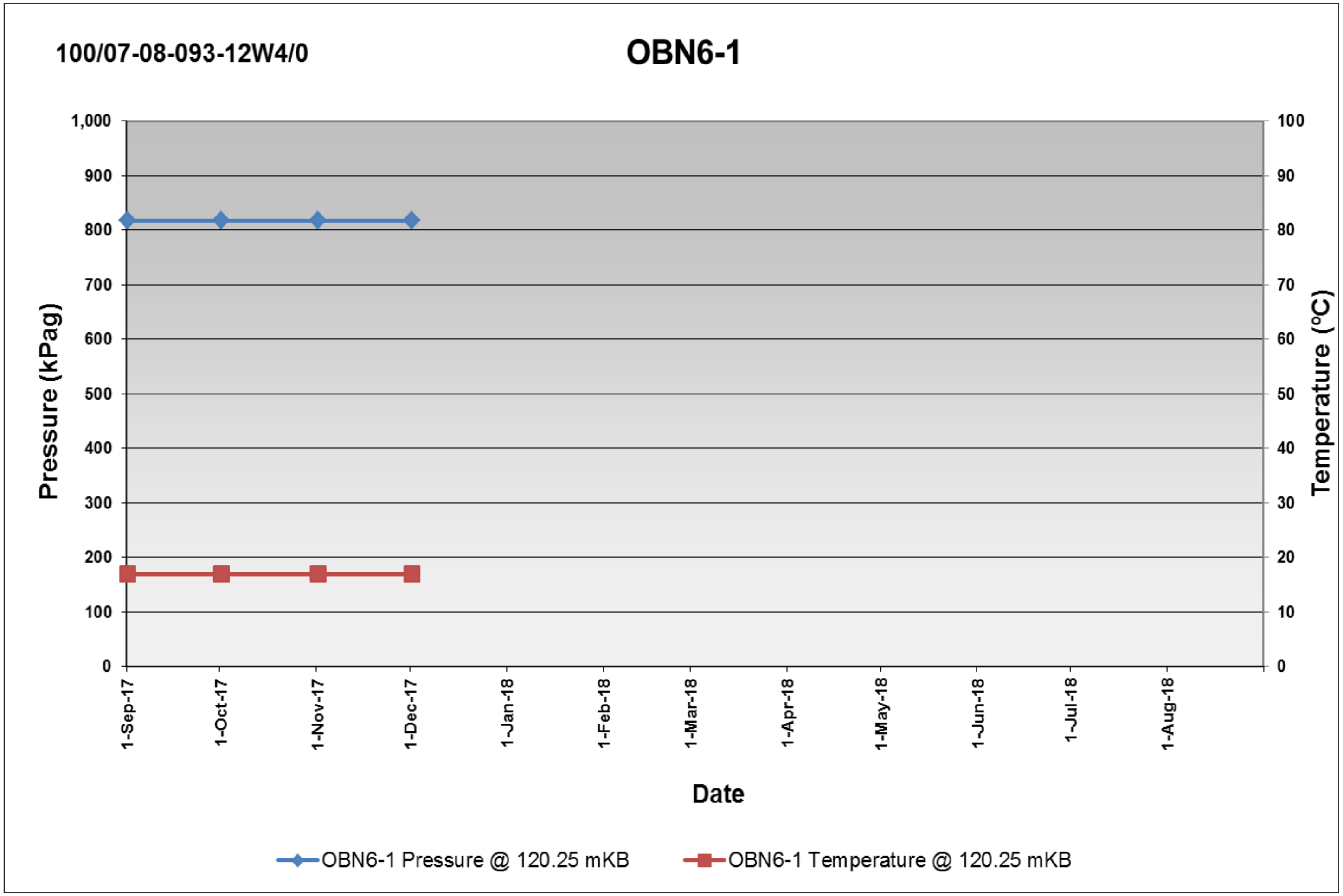


Piezometer Plots & Temperature vs Depth Plots



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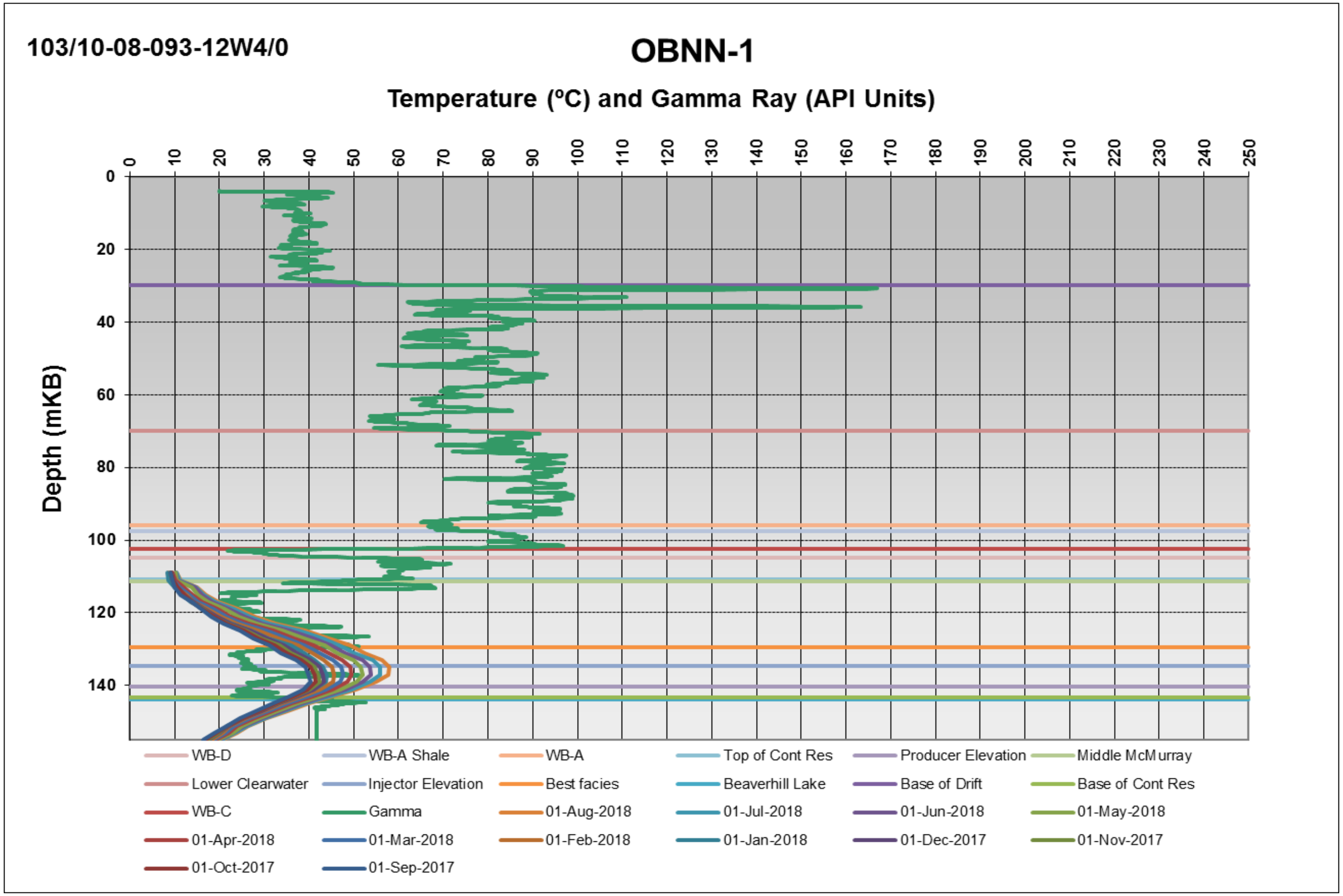

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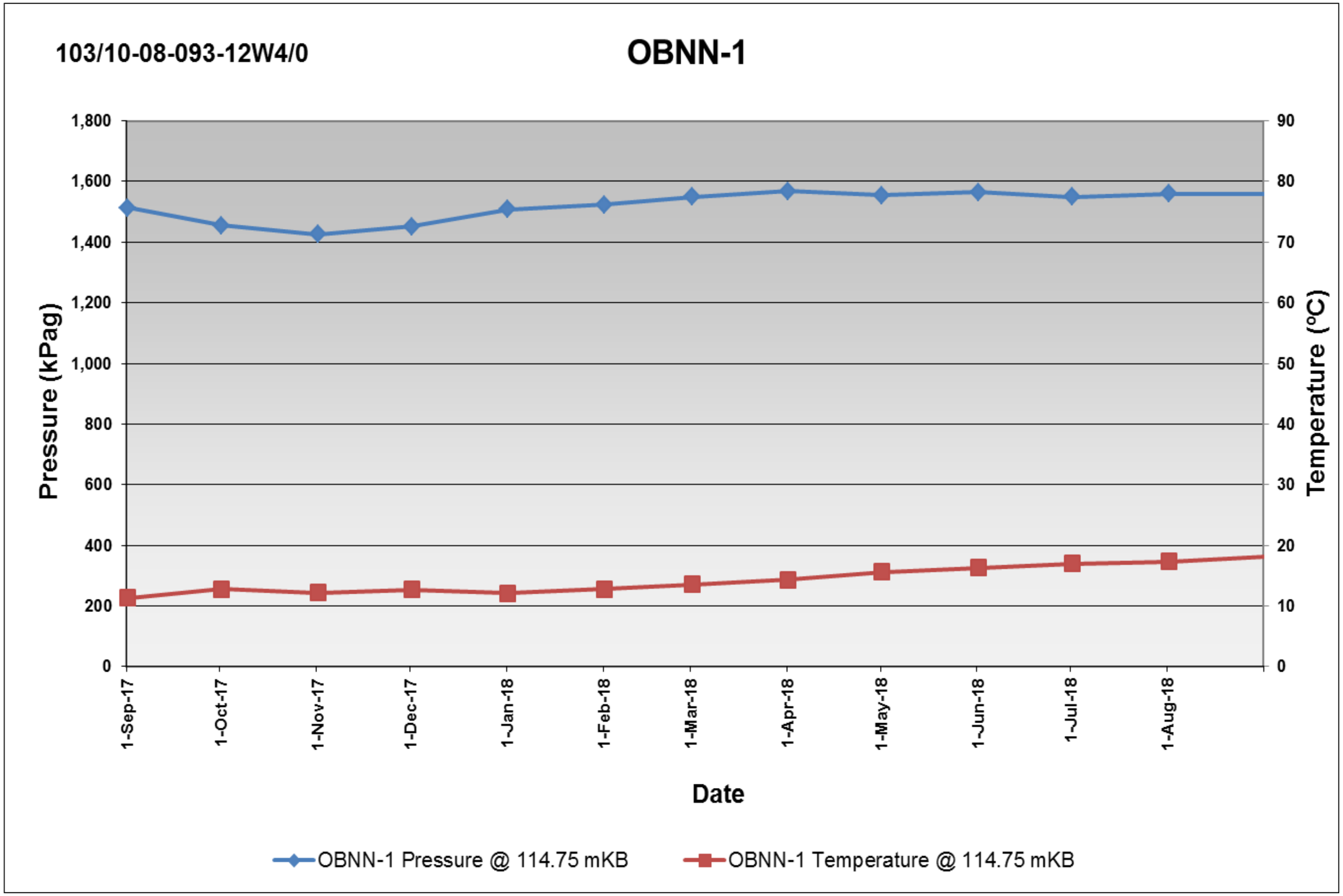

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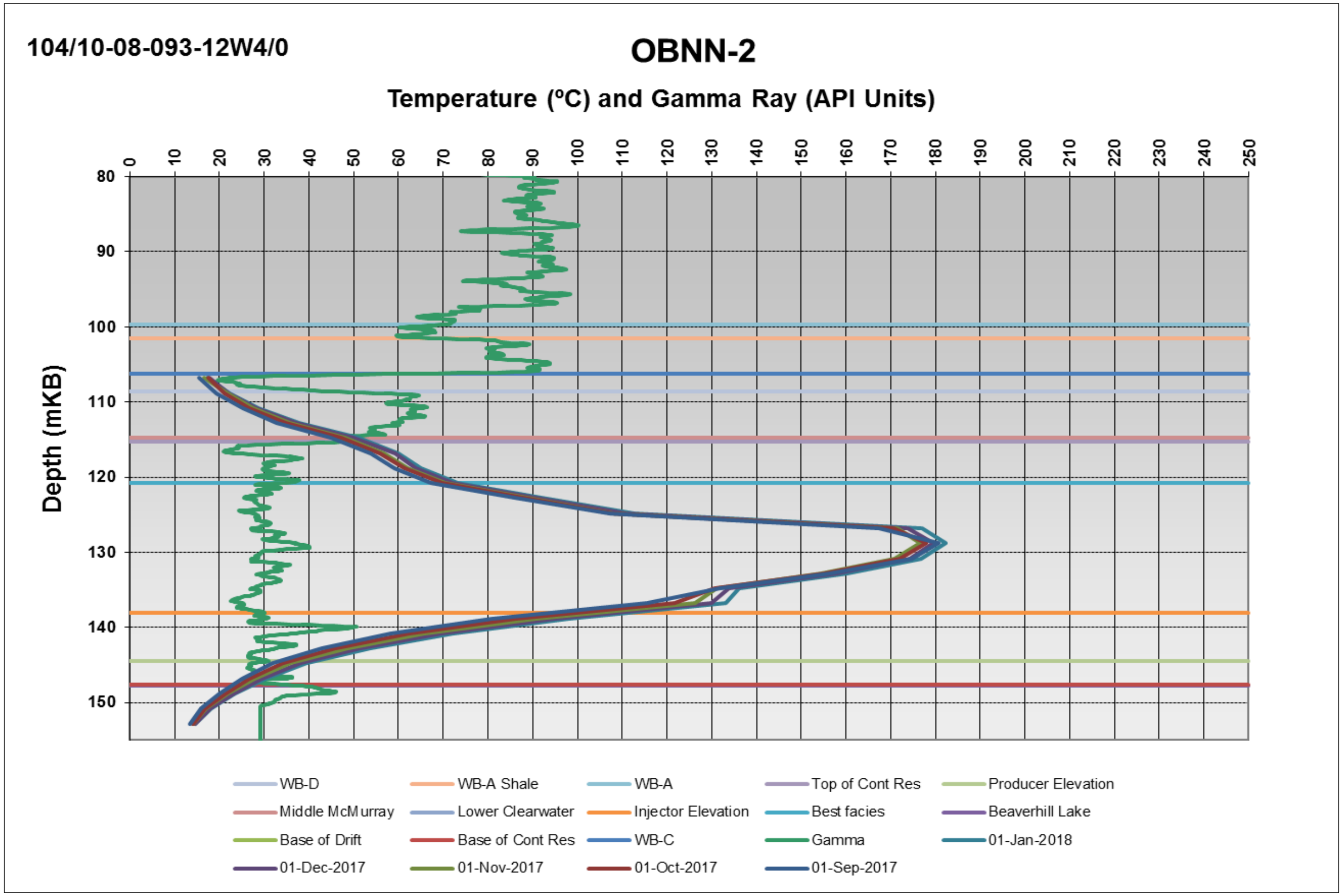

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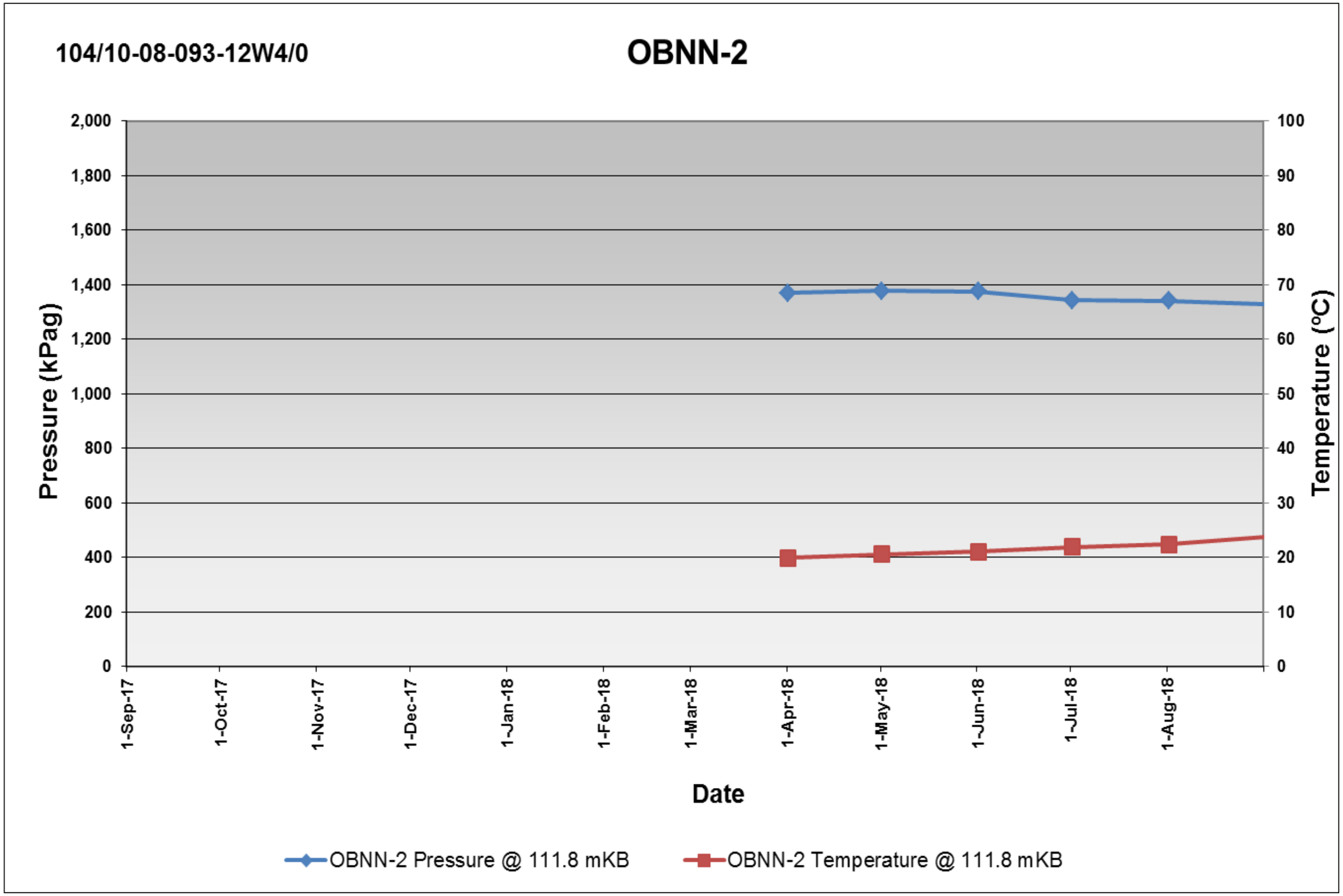

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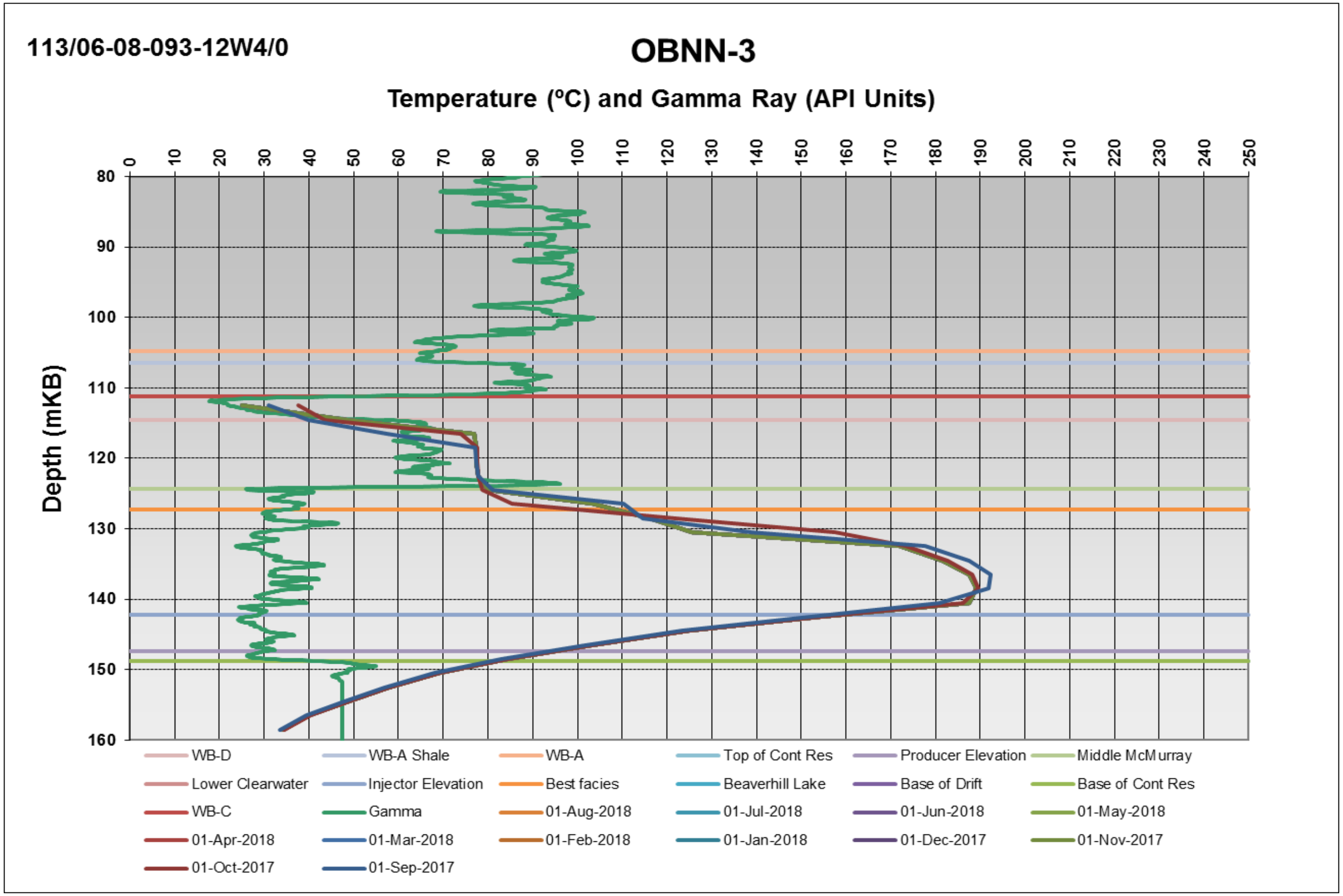

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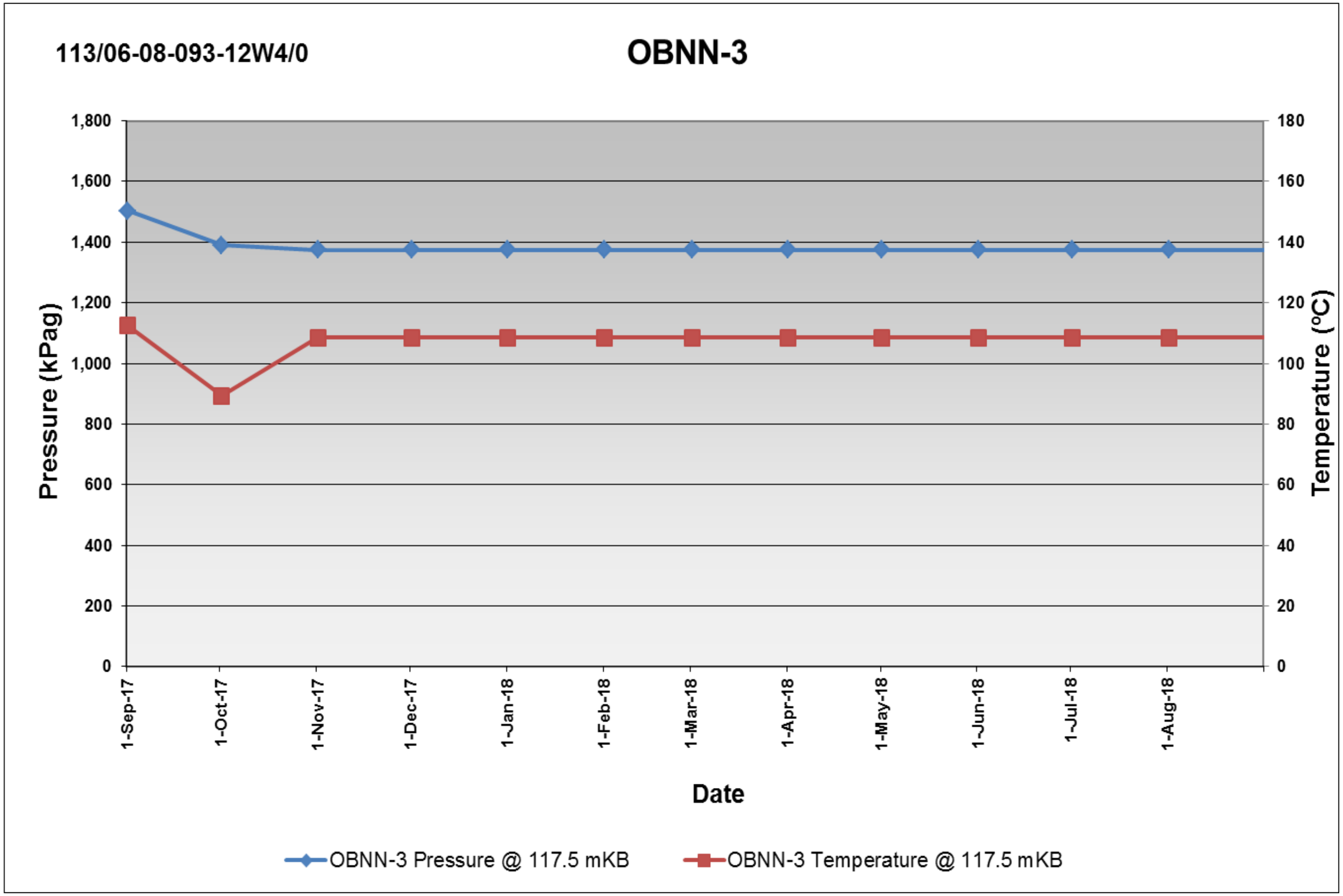

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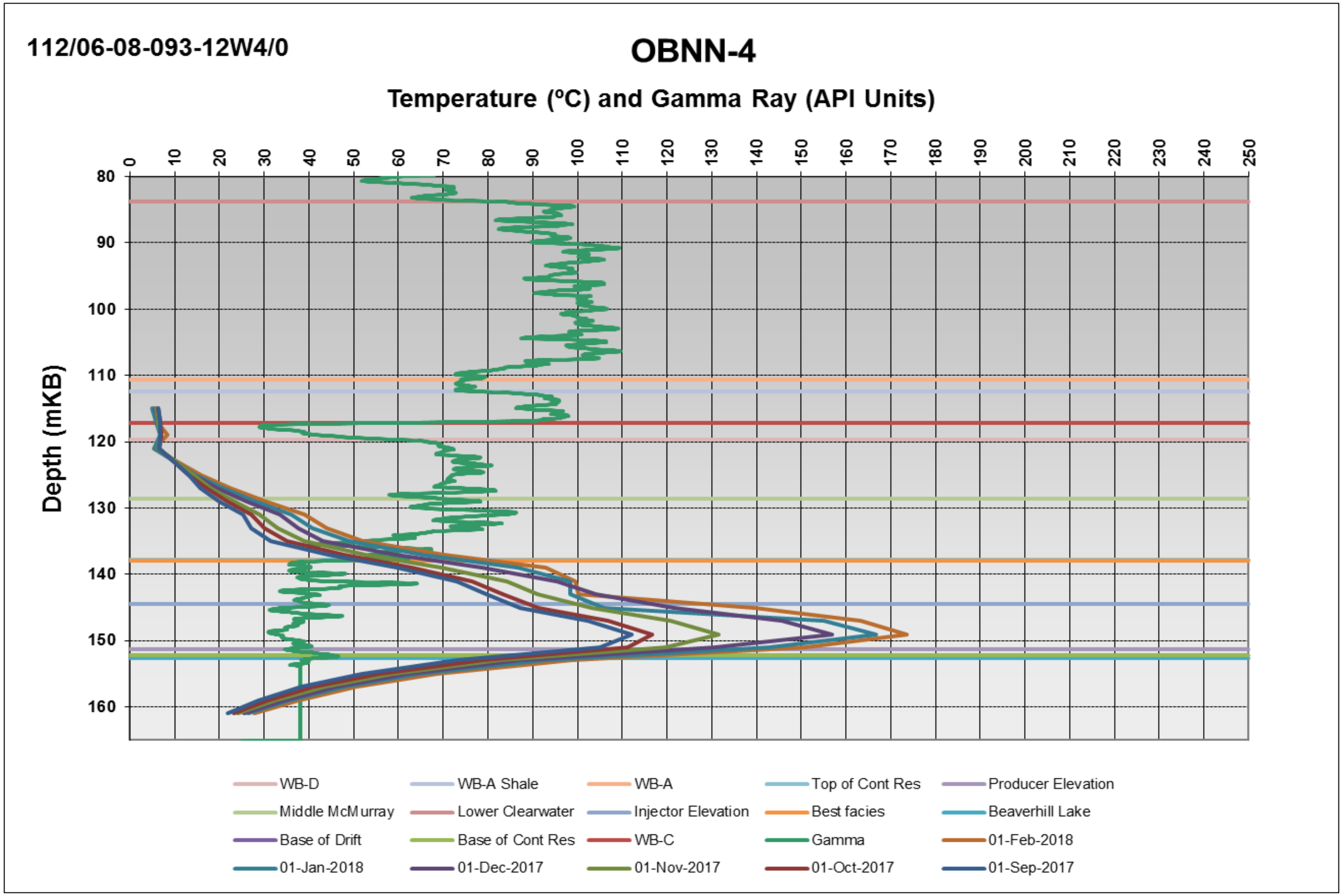

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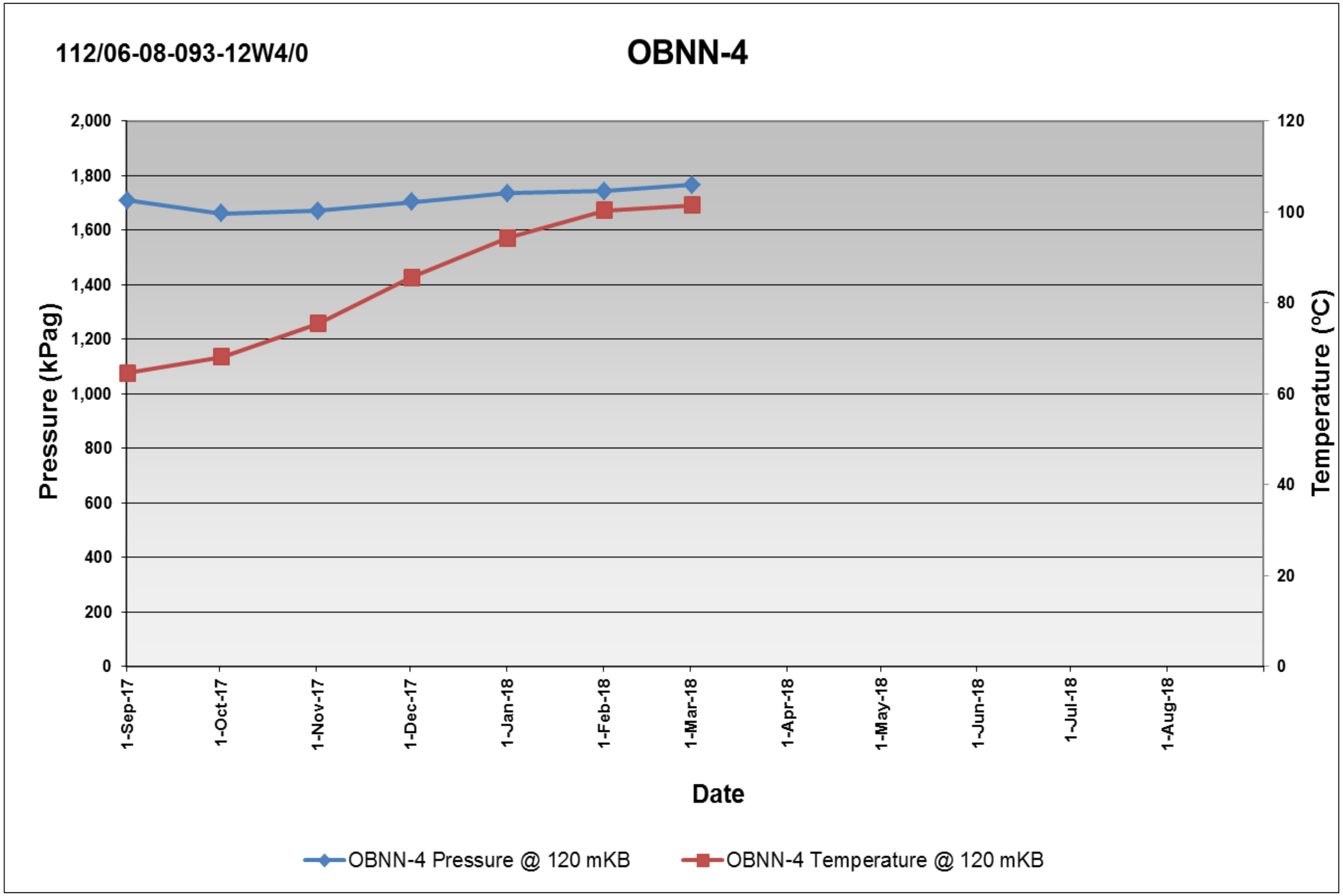

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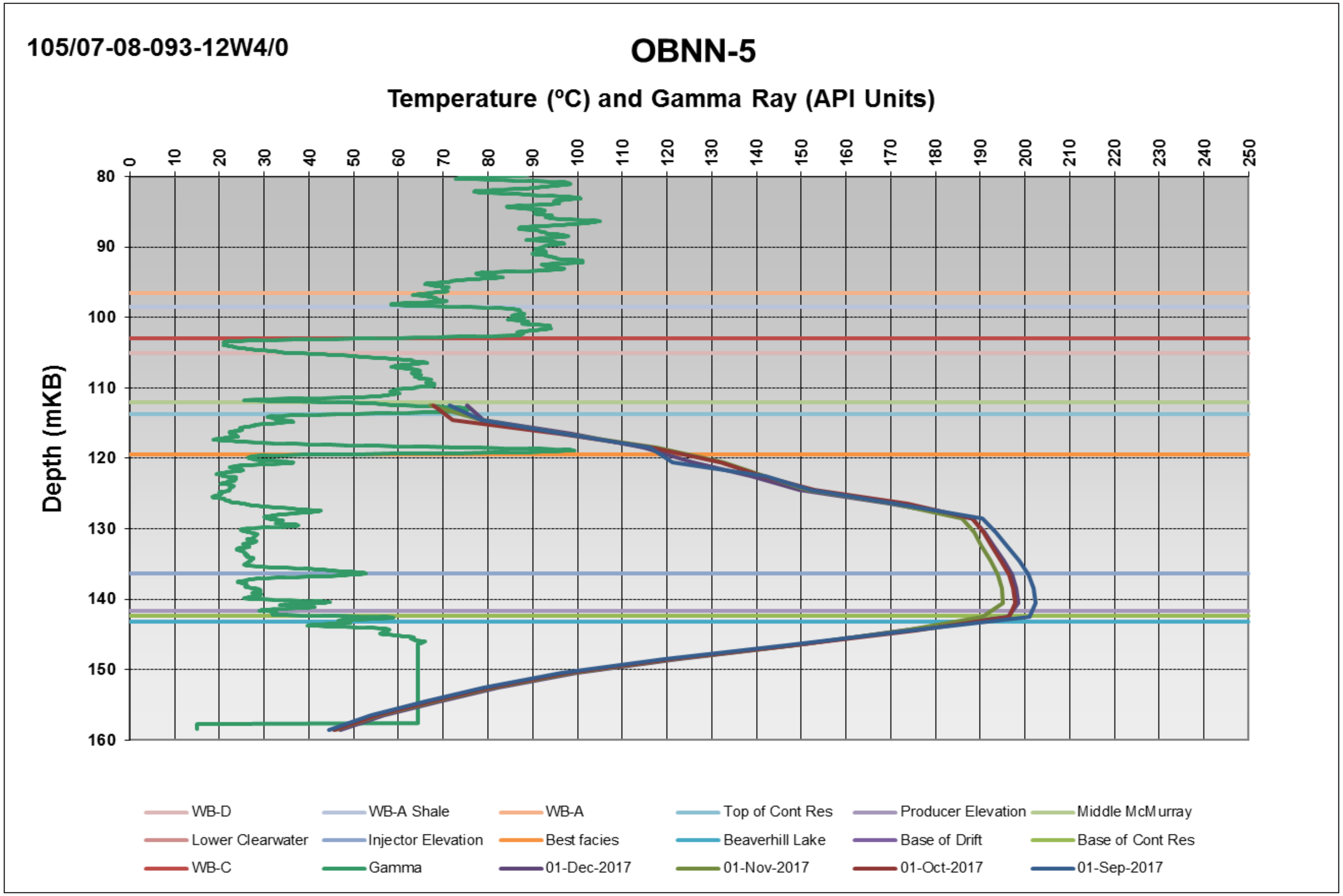

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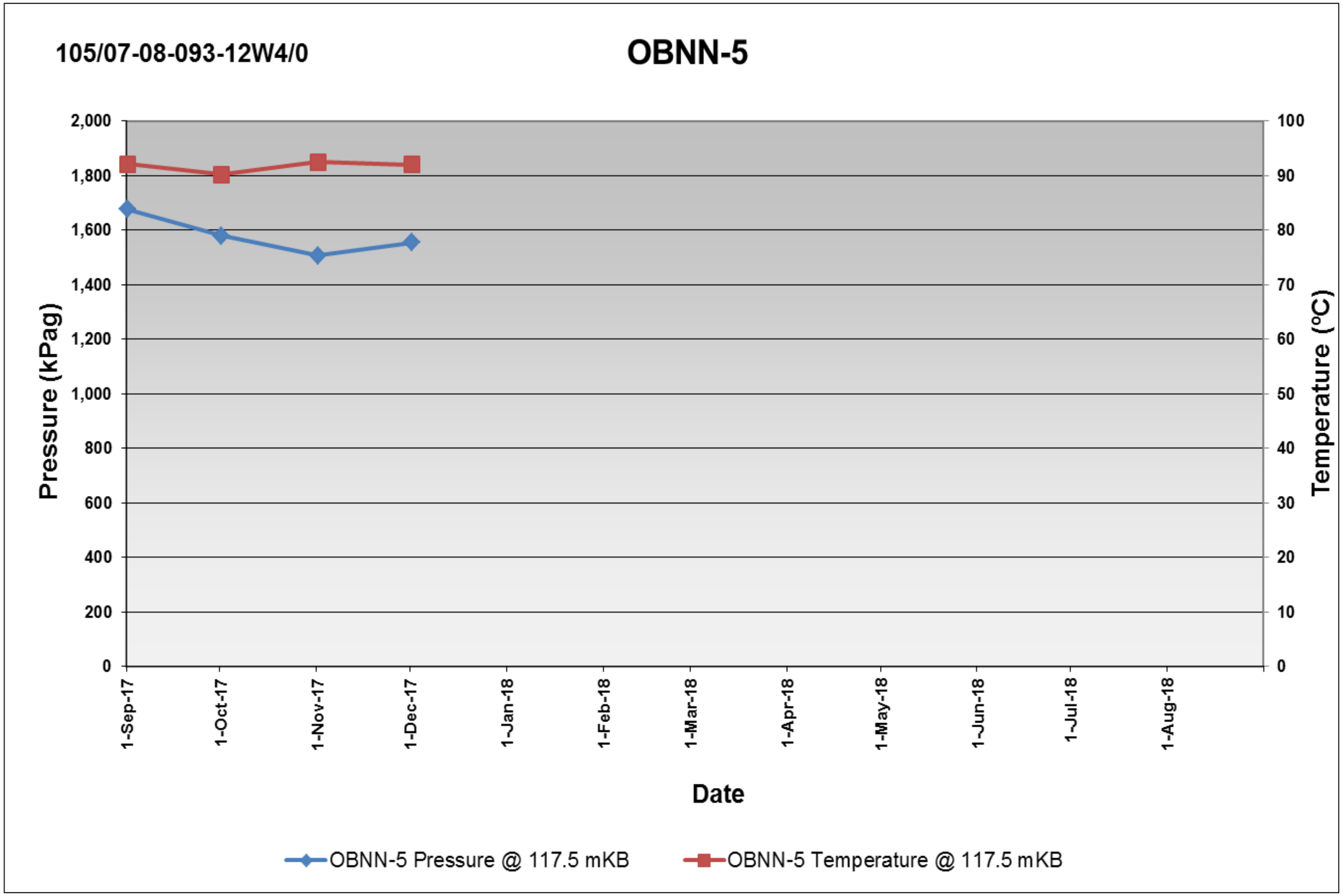

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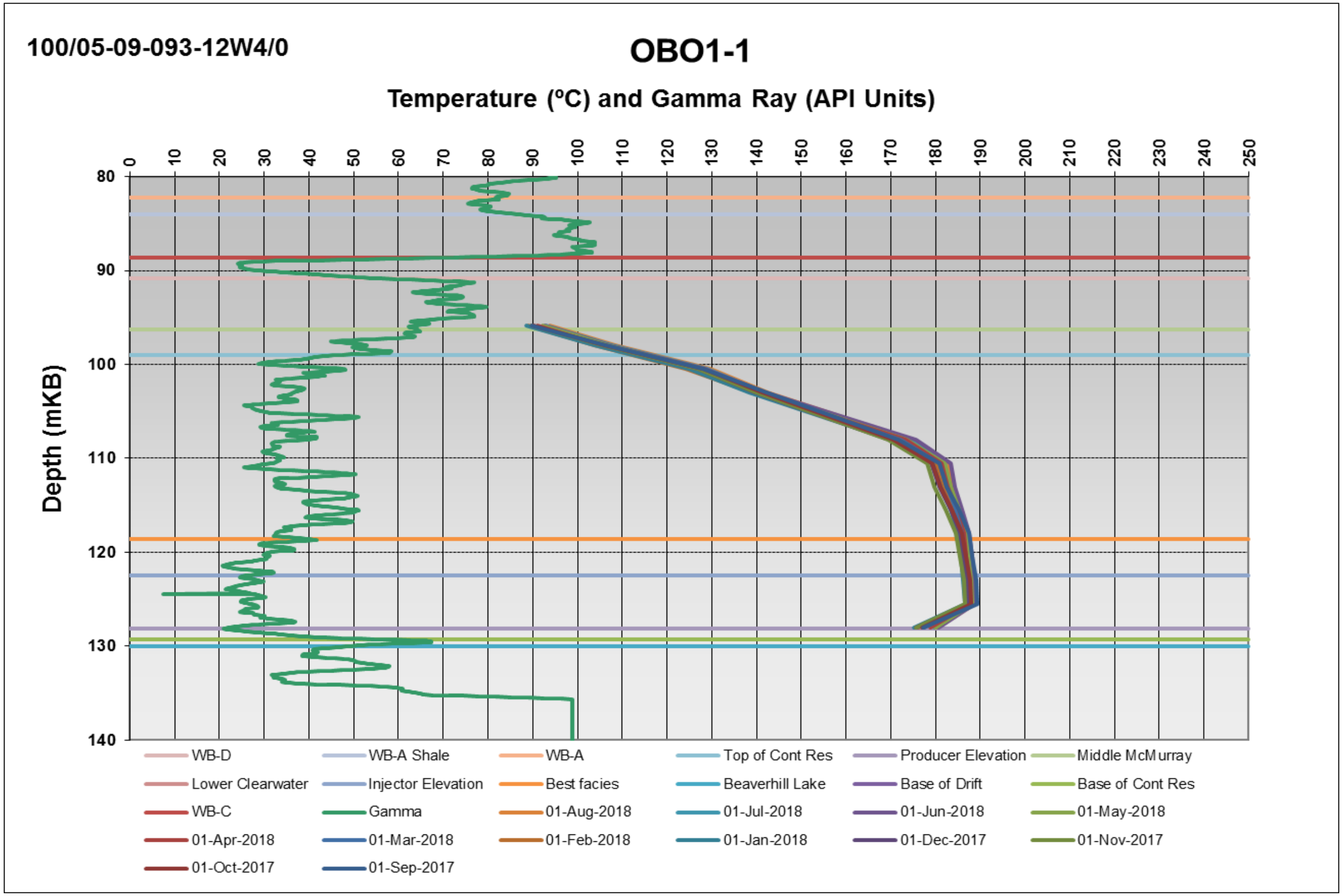

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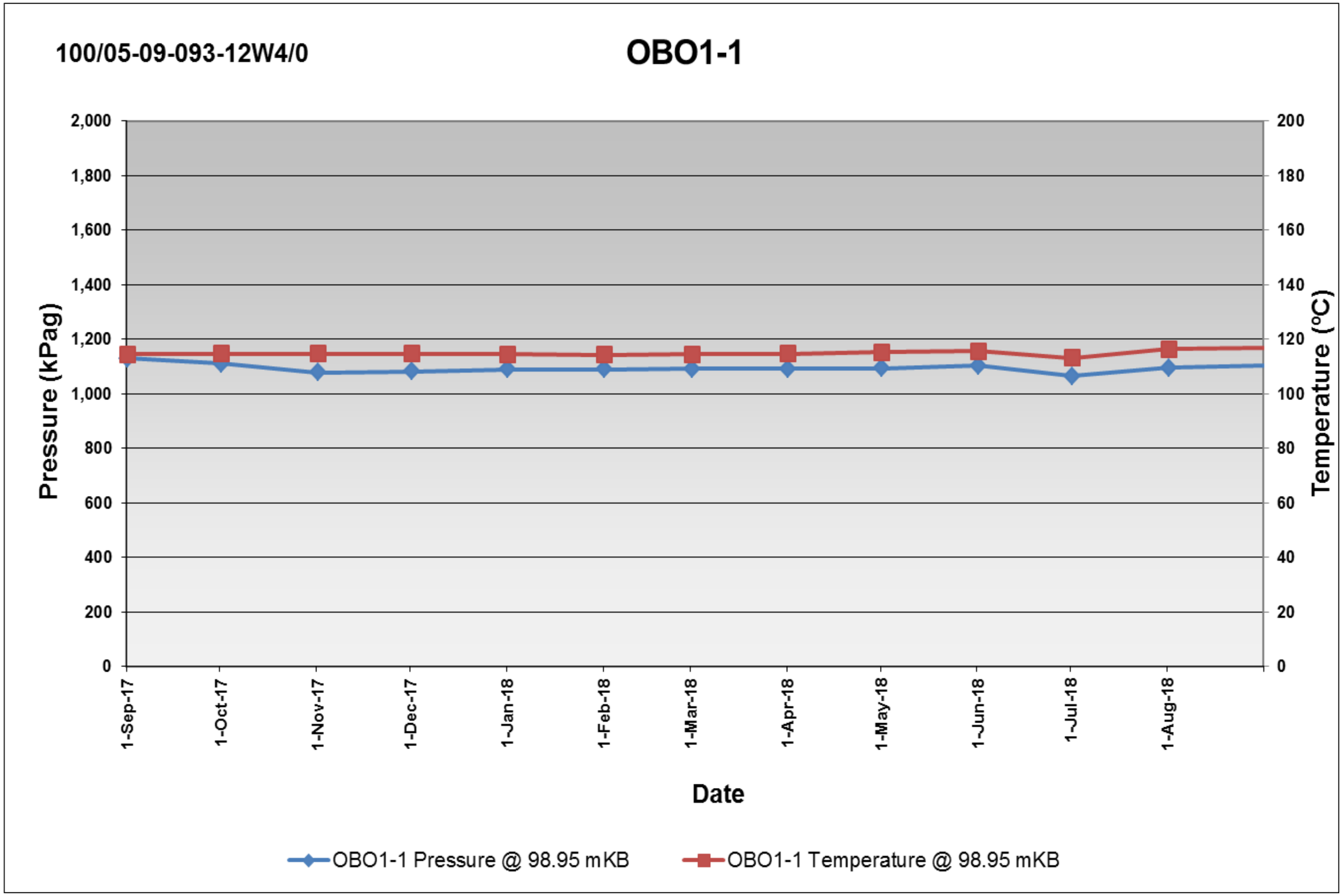

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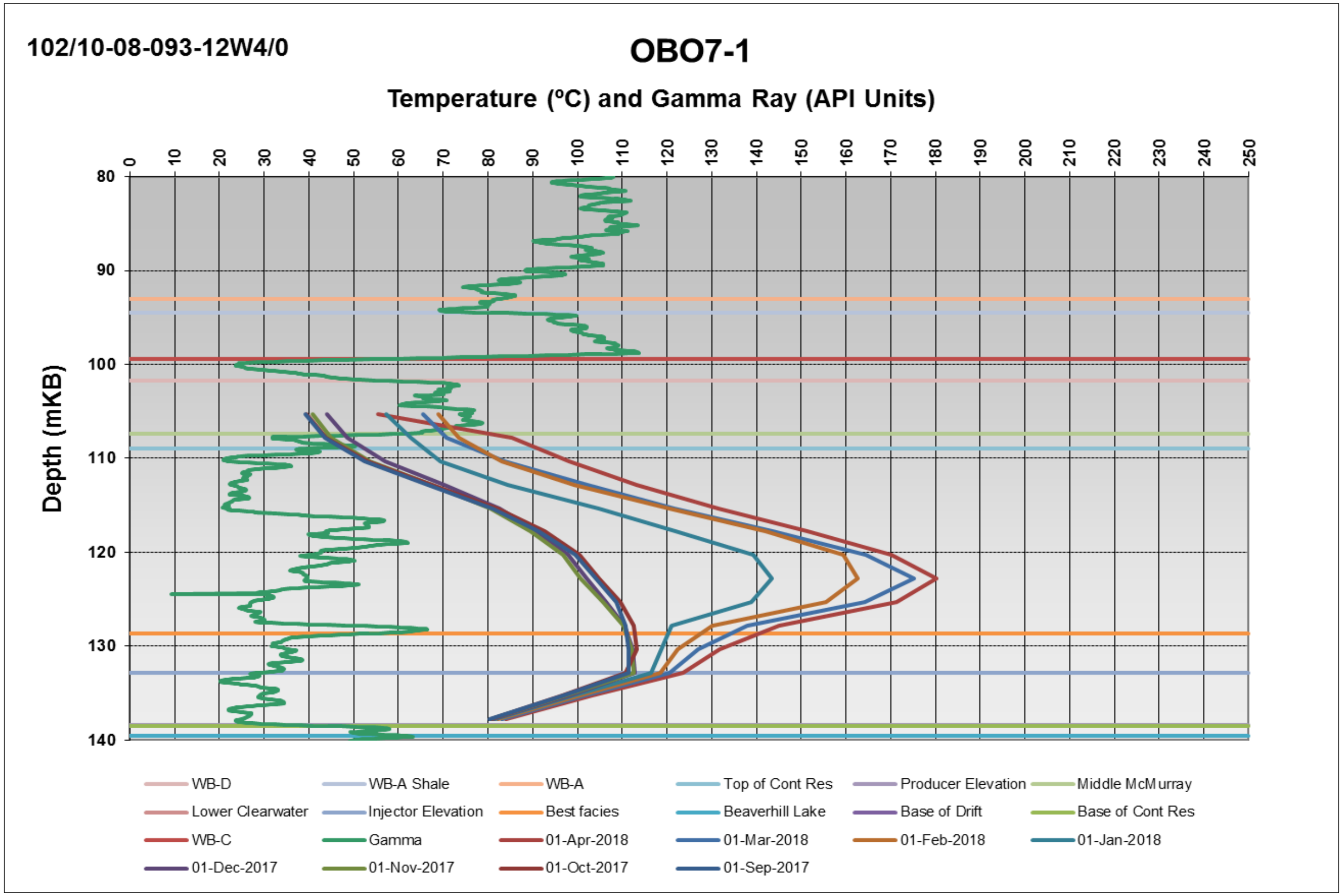

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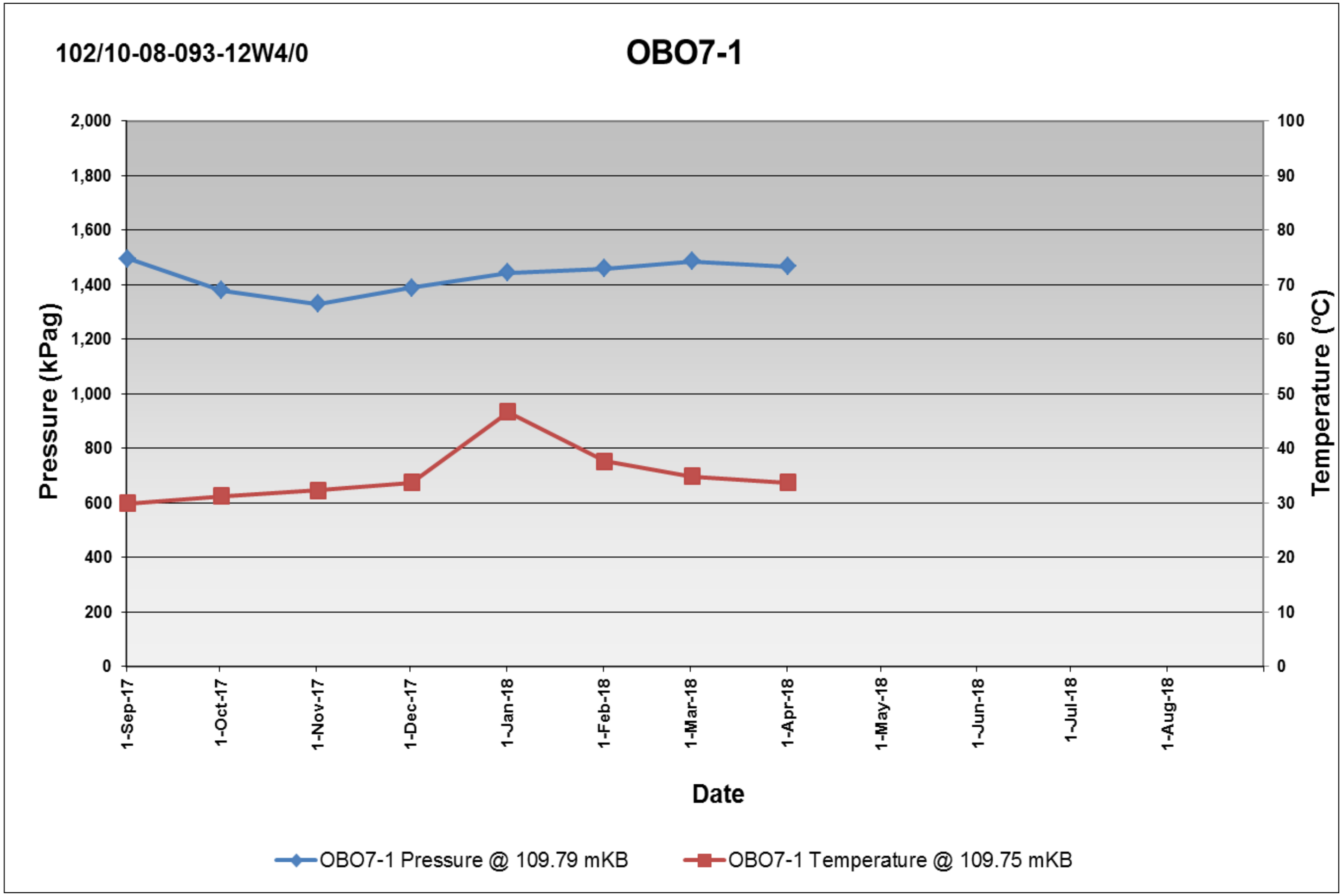

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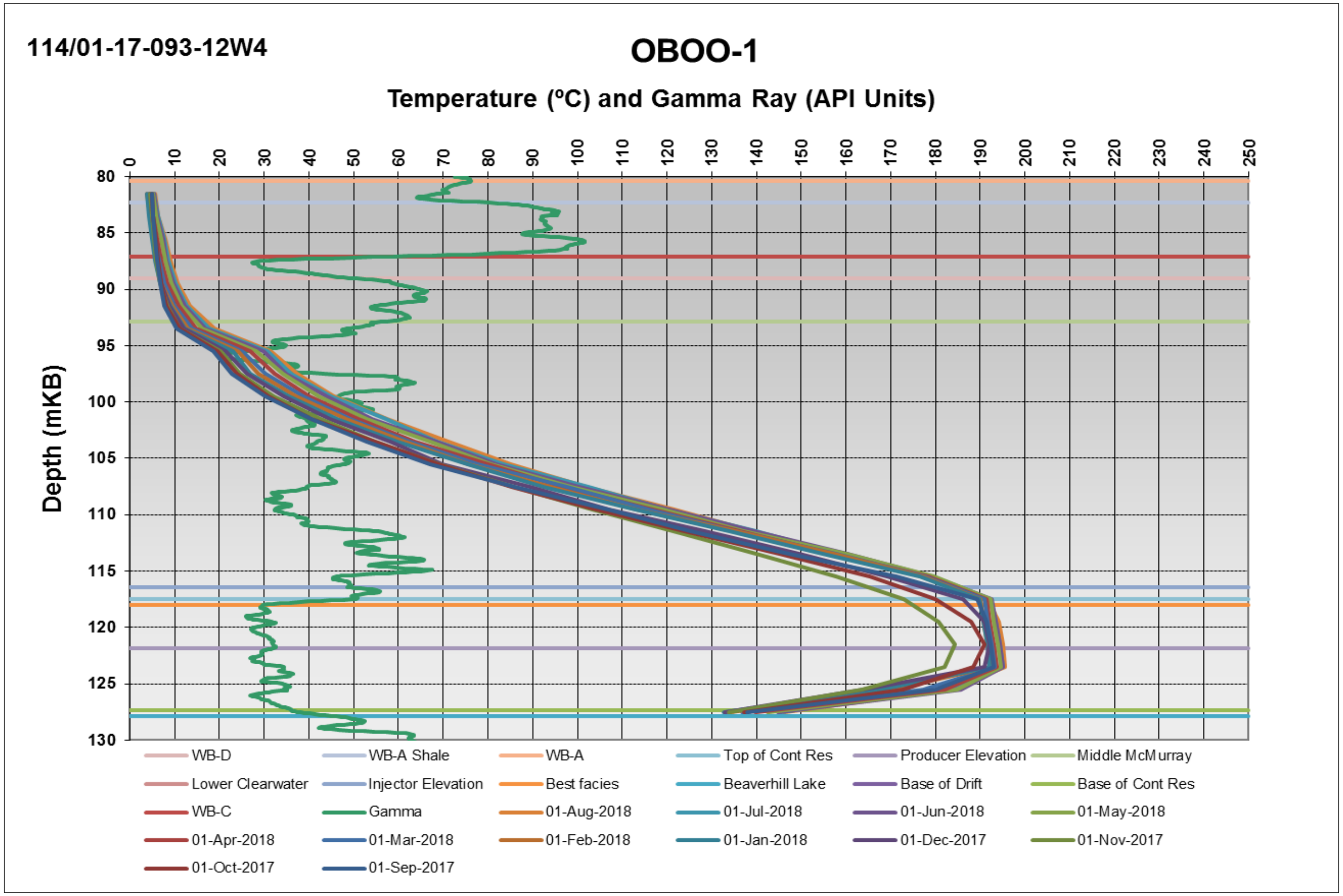

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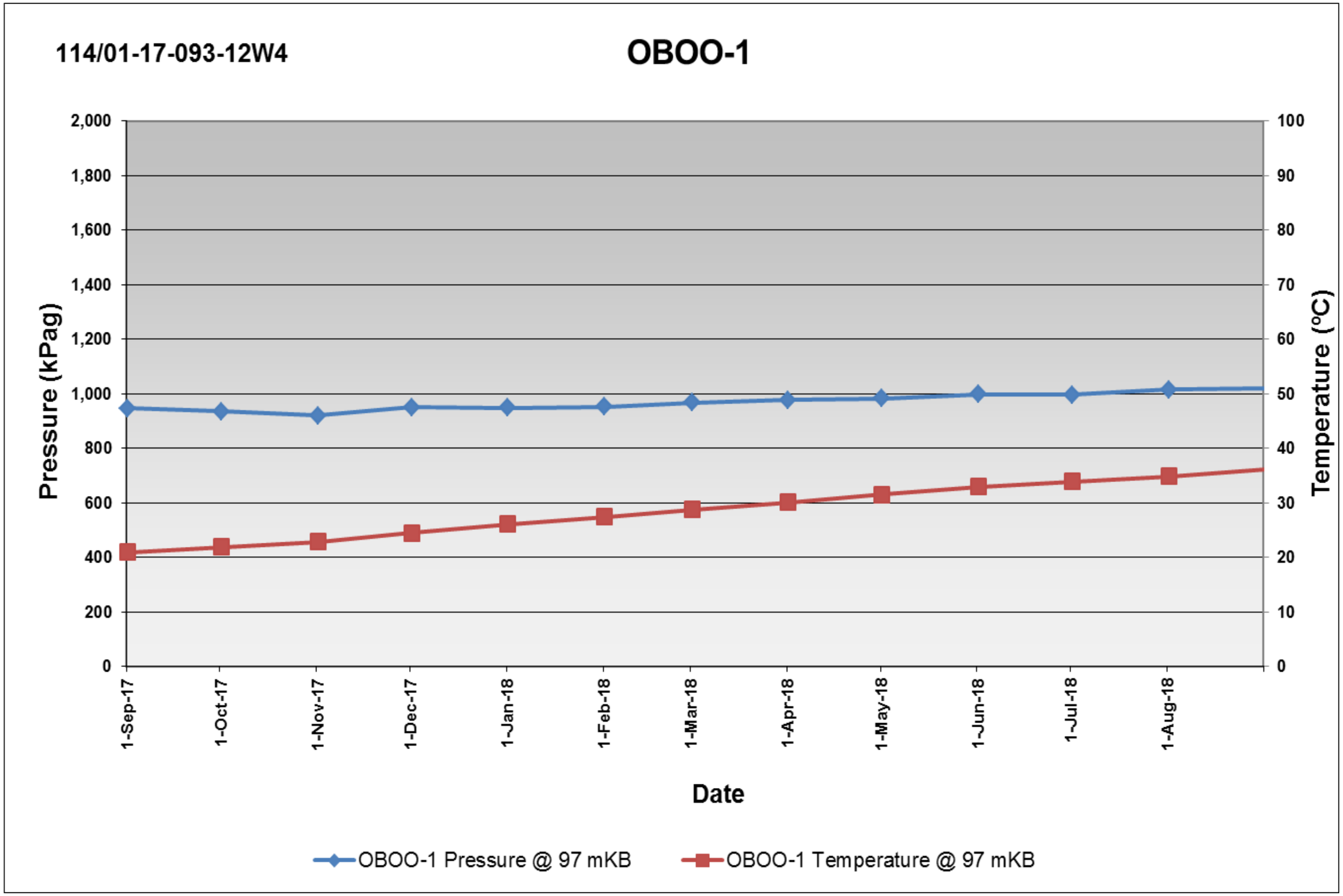
Piezometer Plots & Temperature vs Depth Plots



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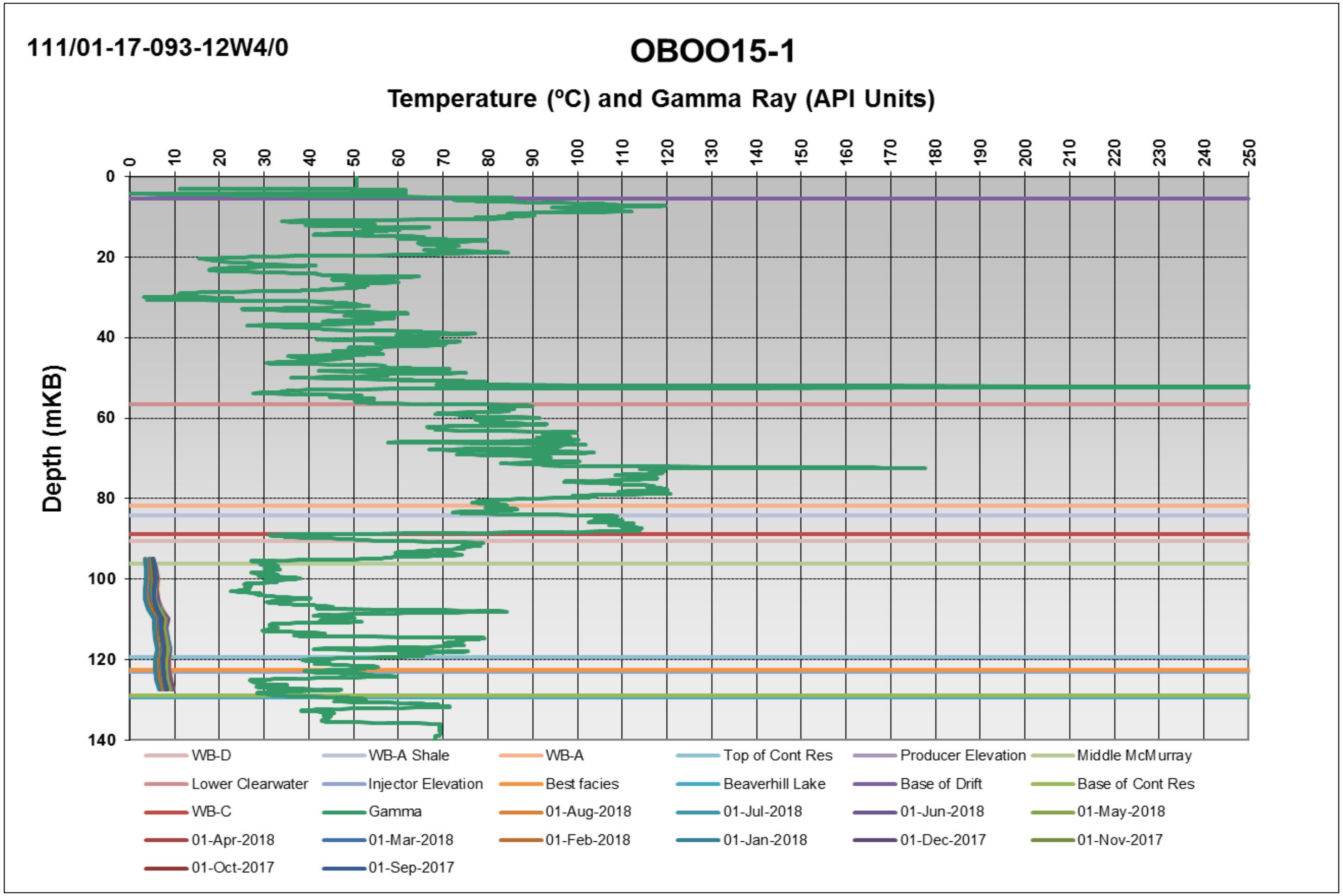

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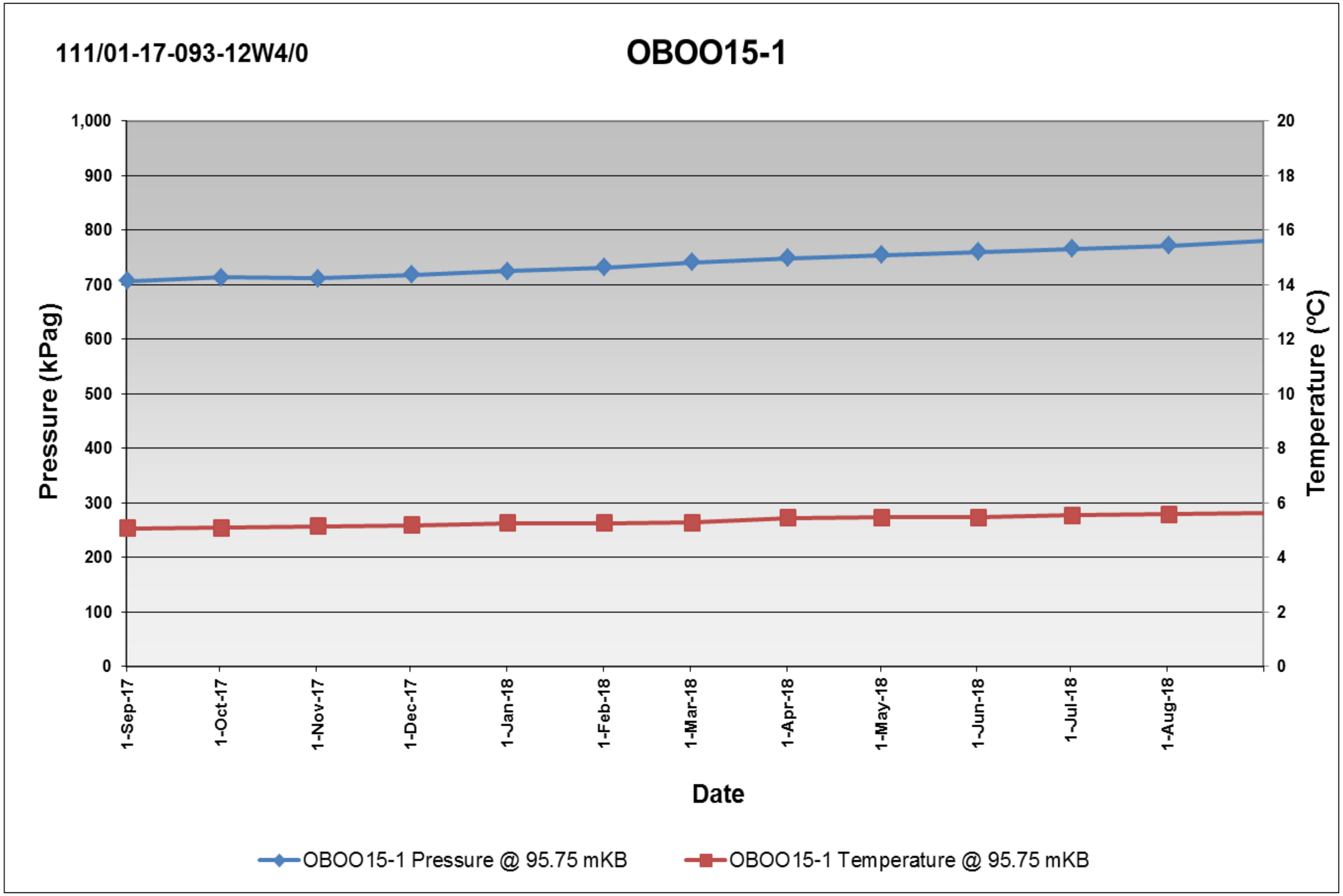

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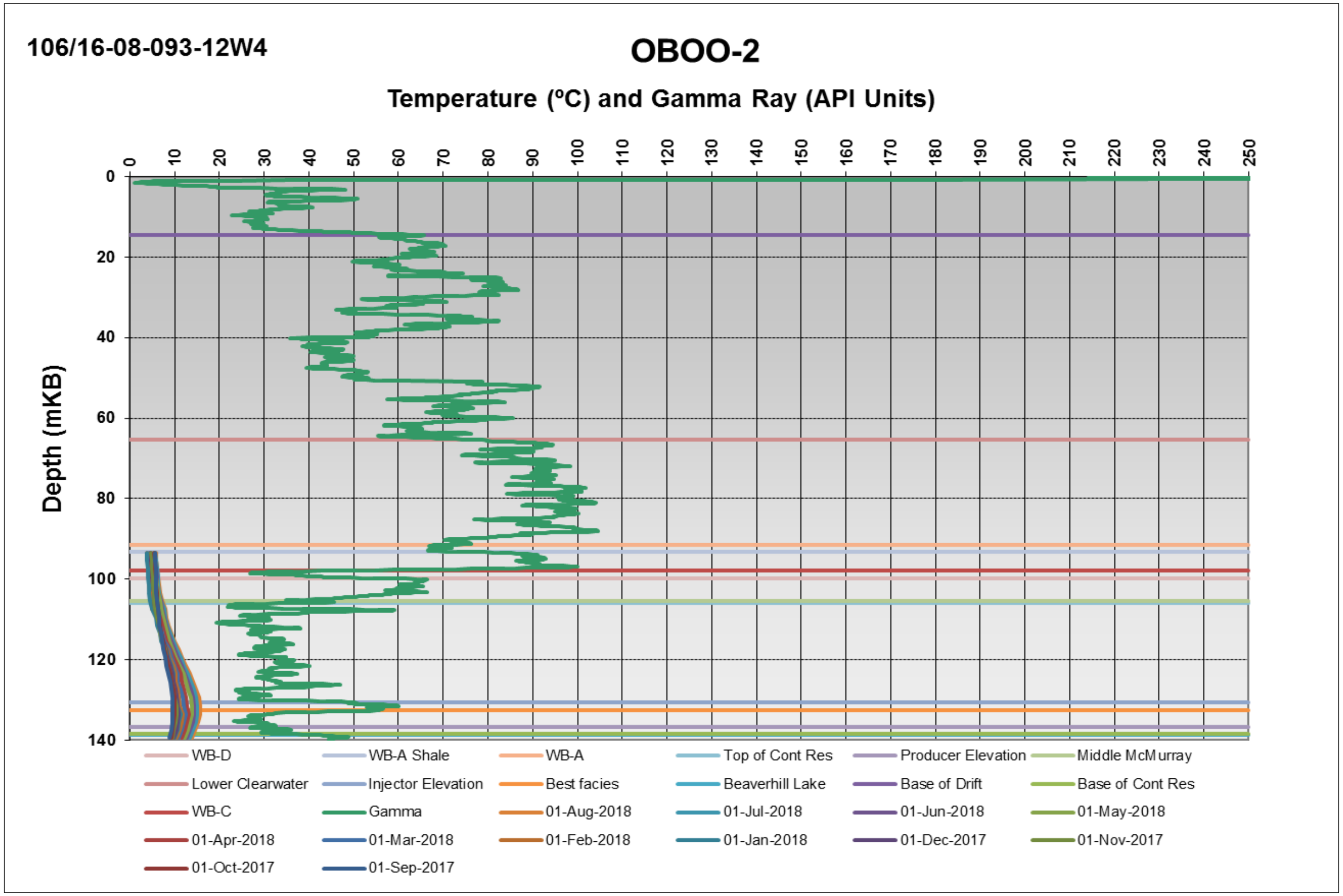

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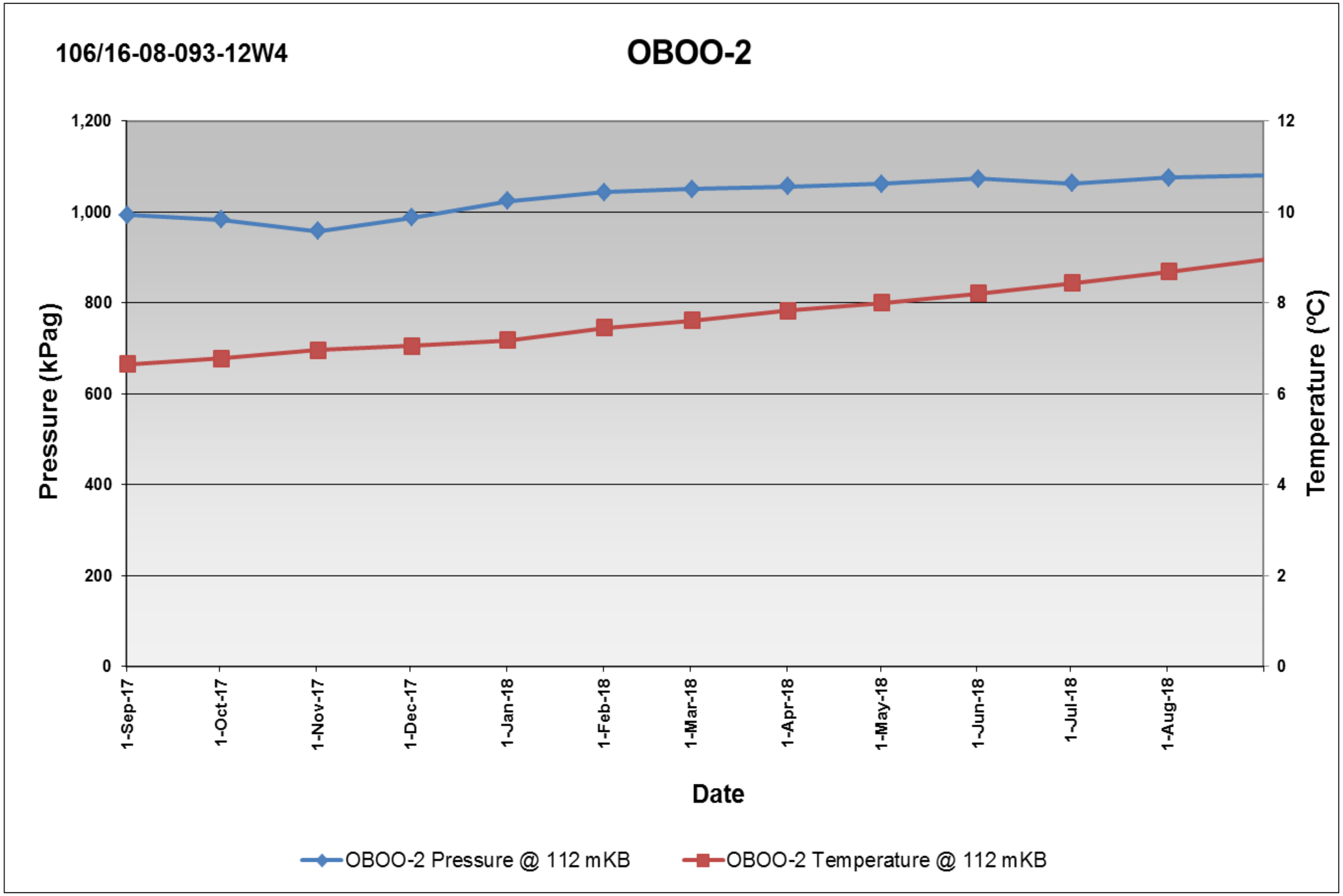

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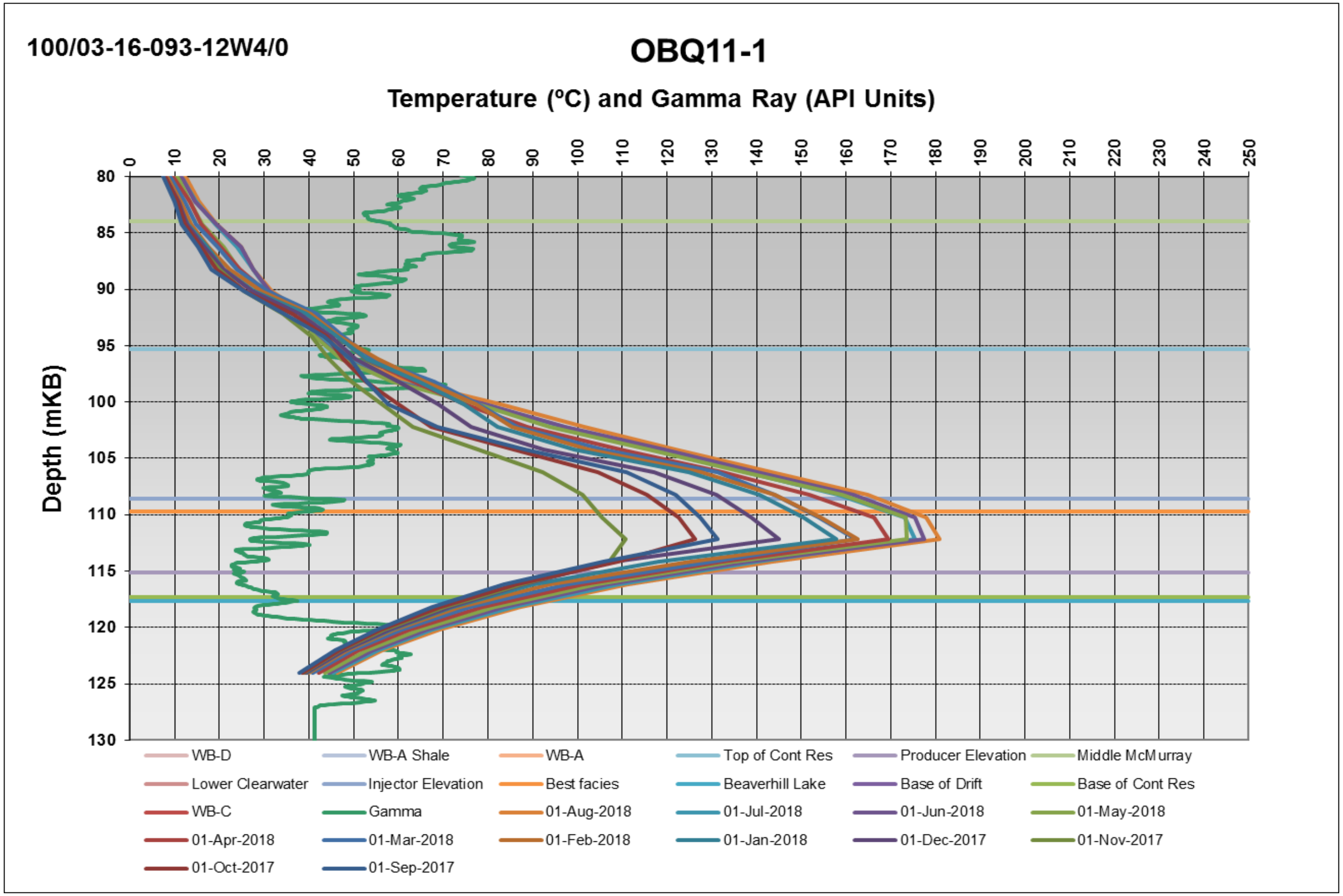

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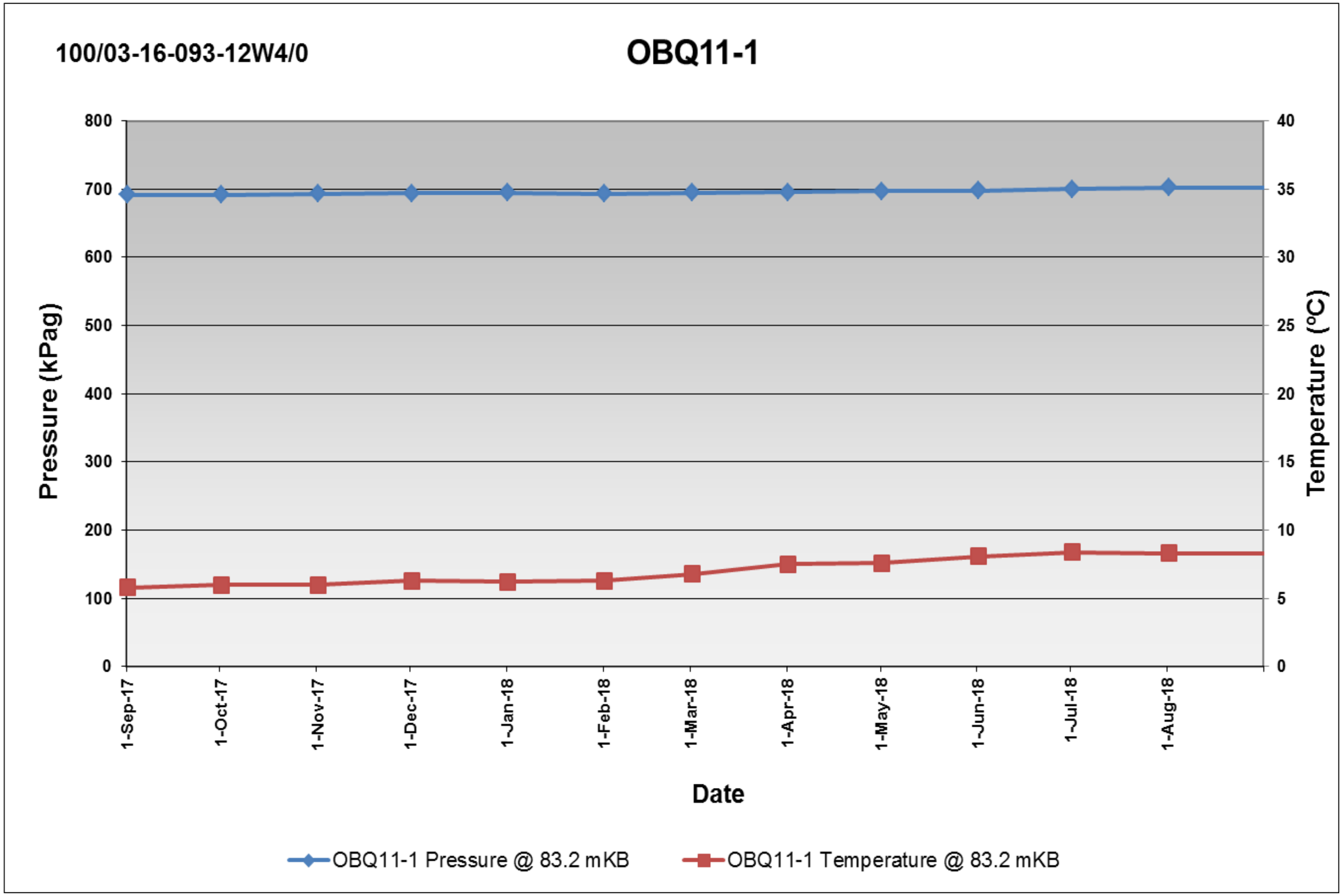

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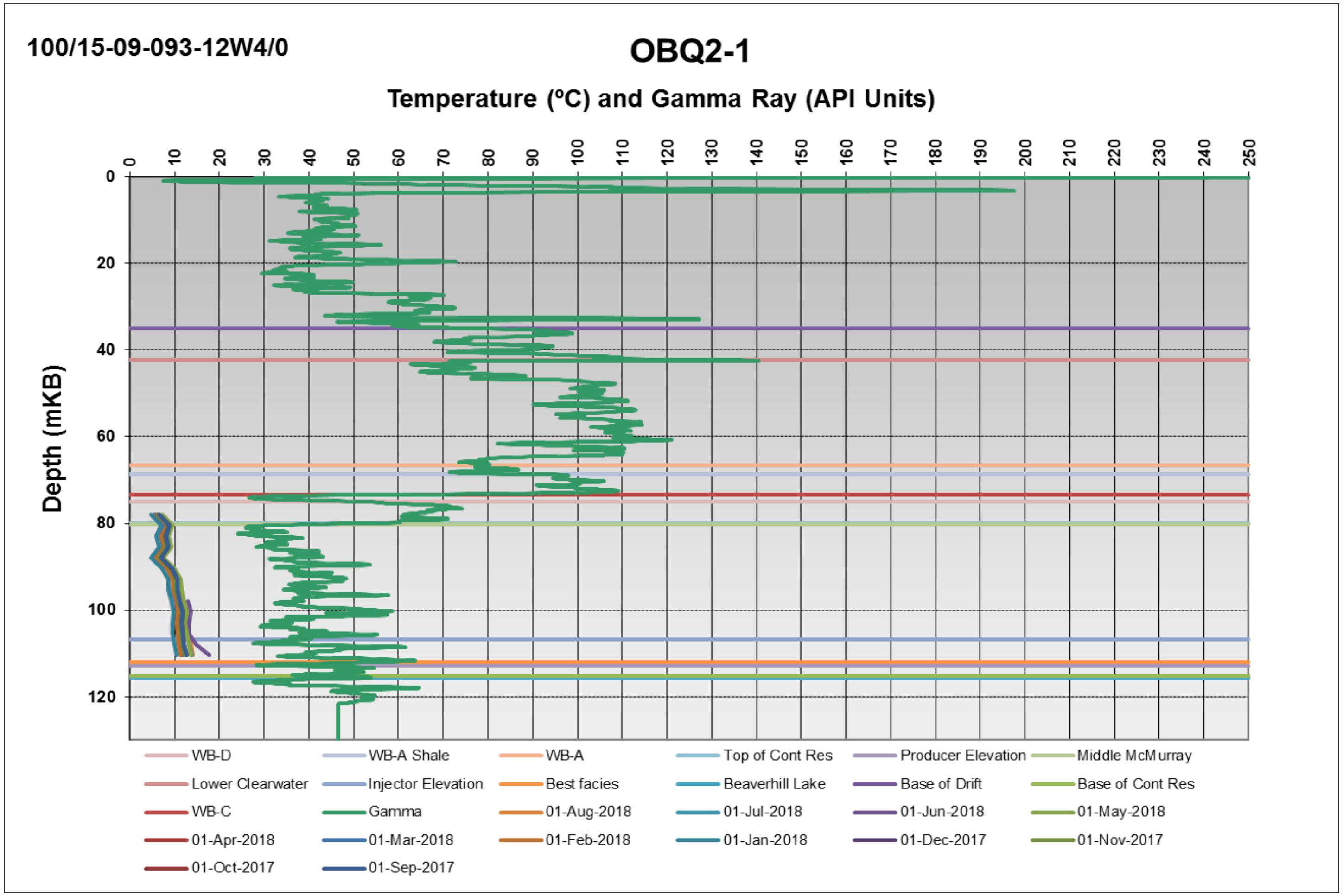

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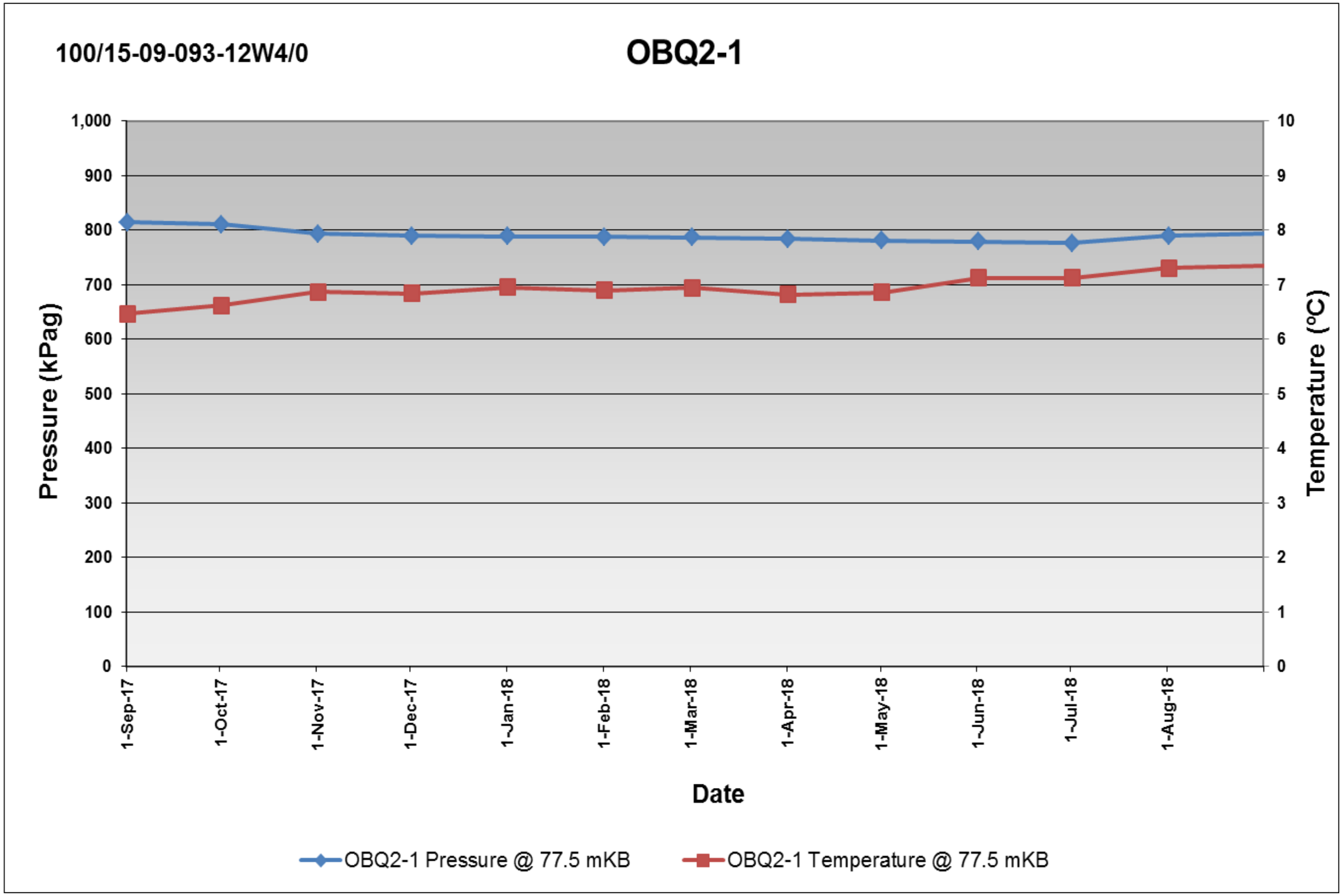

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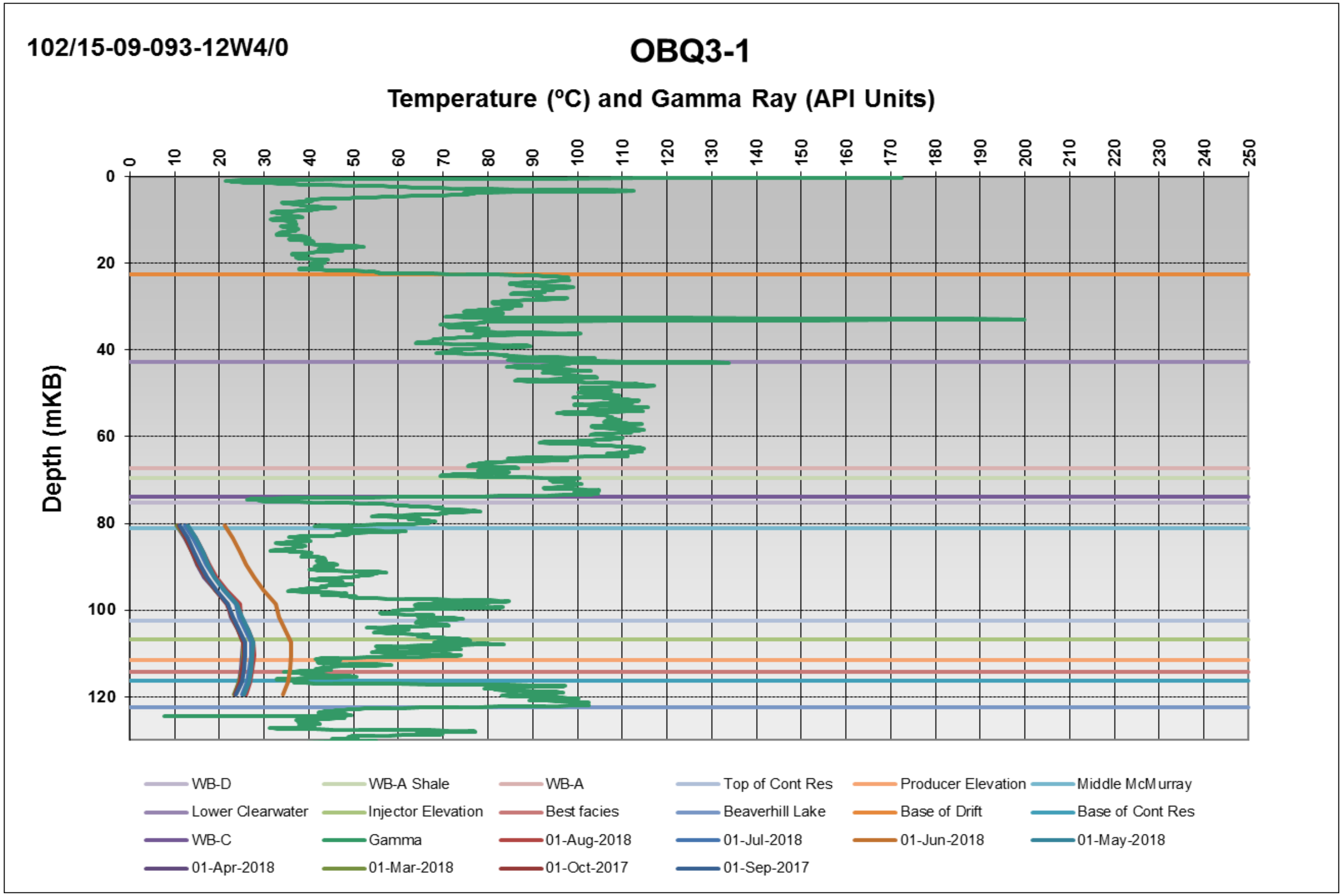

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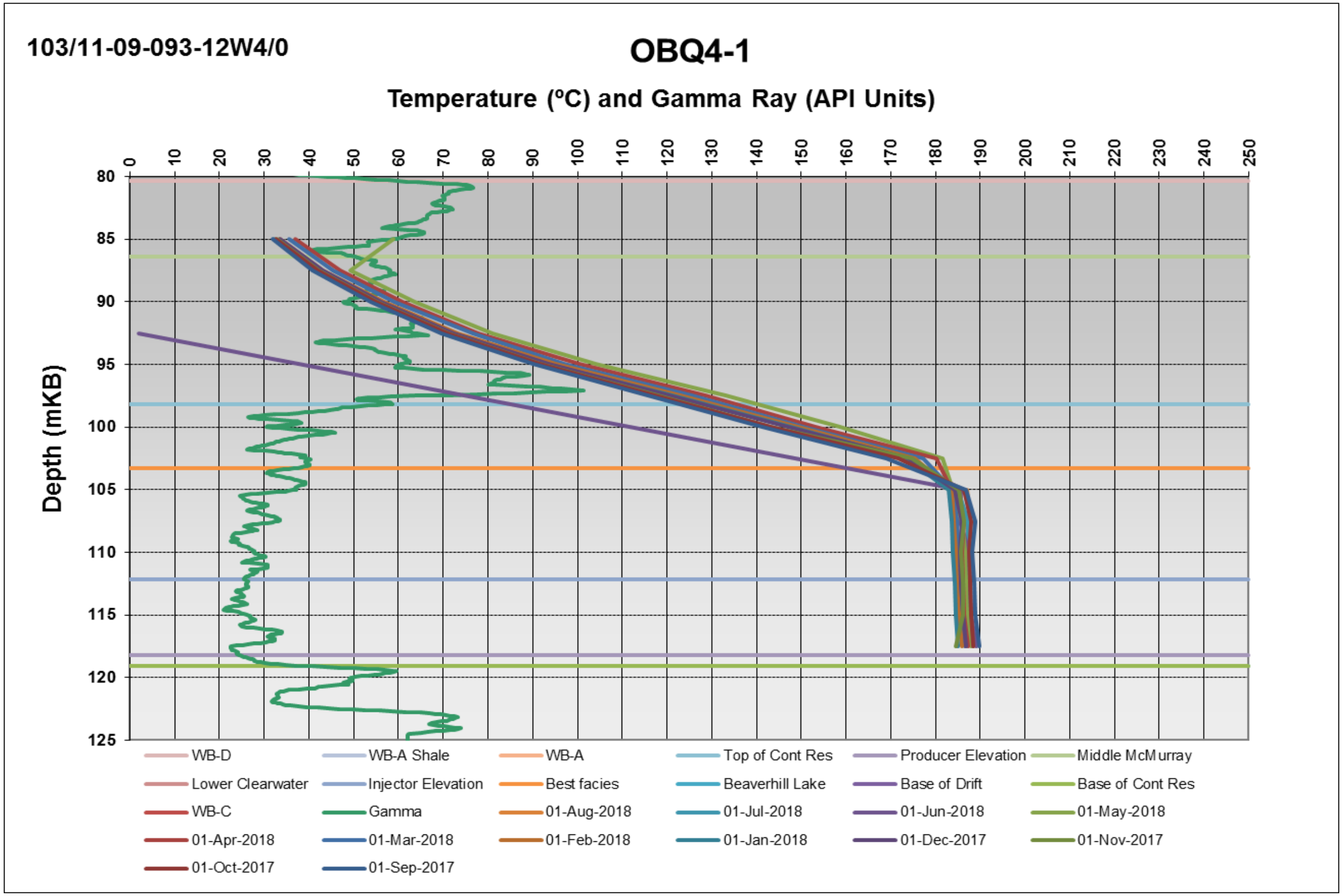

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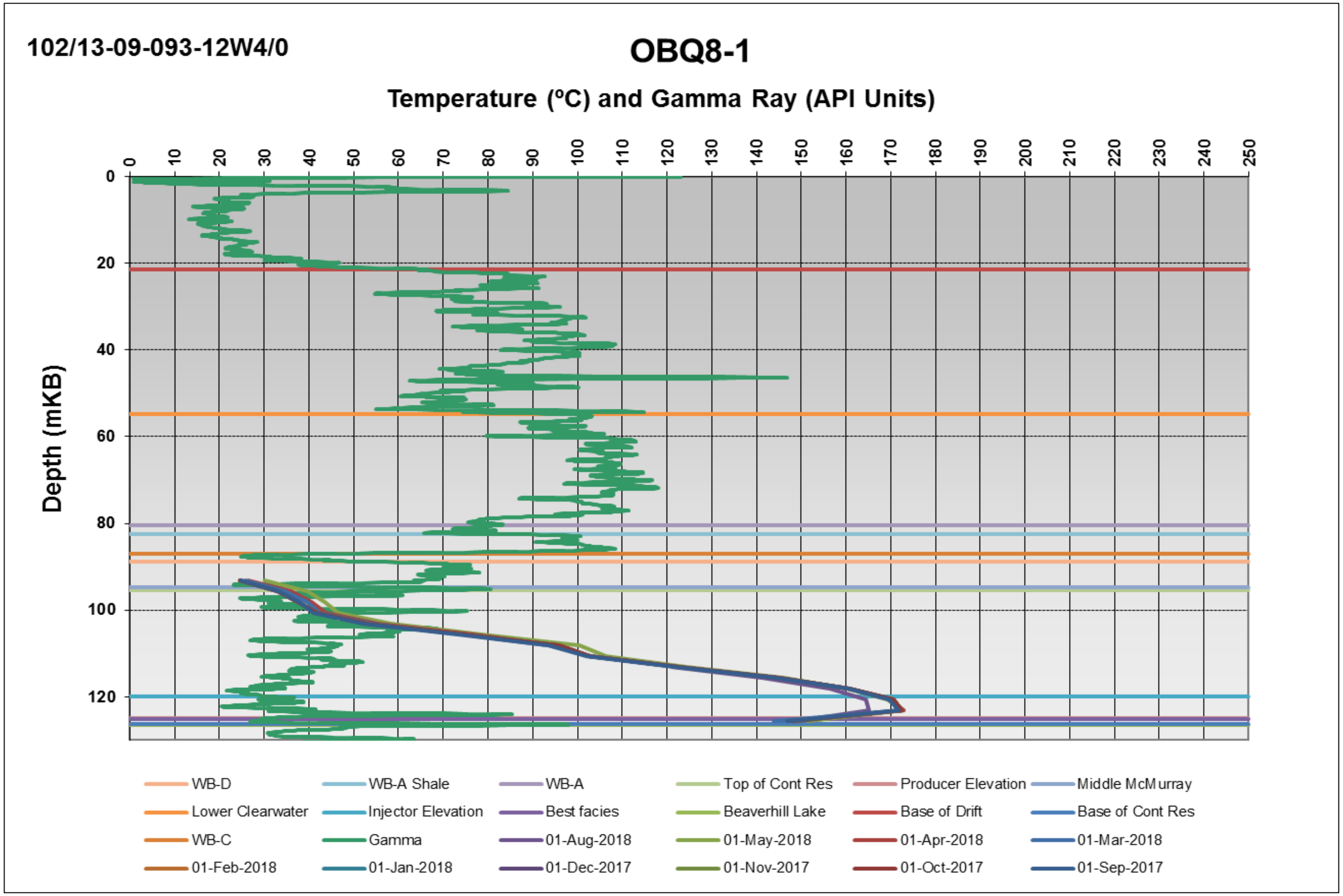

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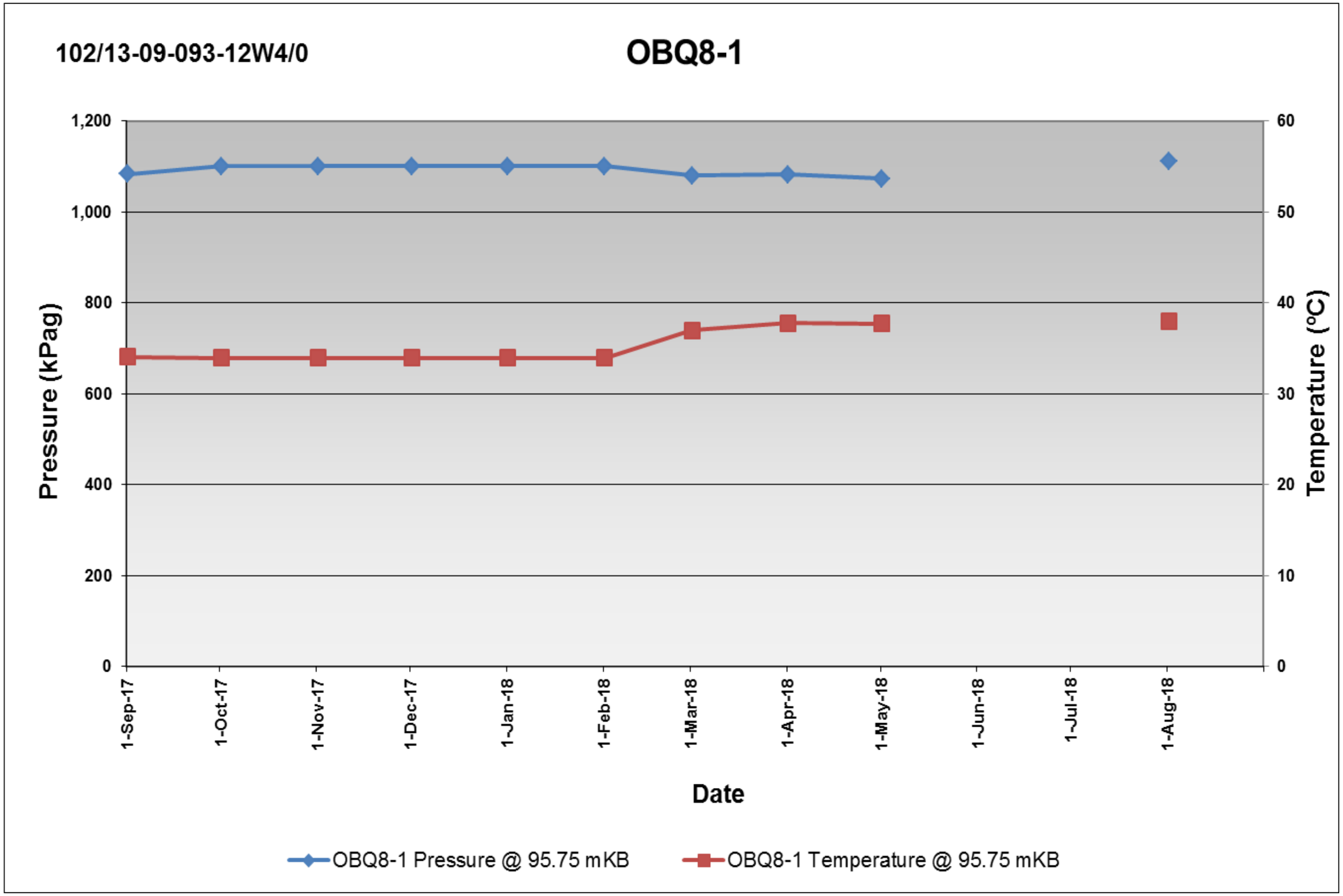

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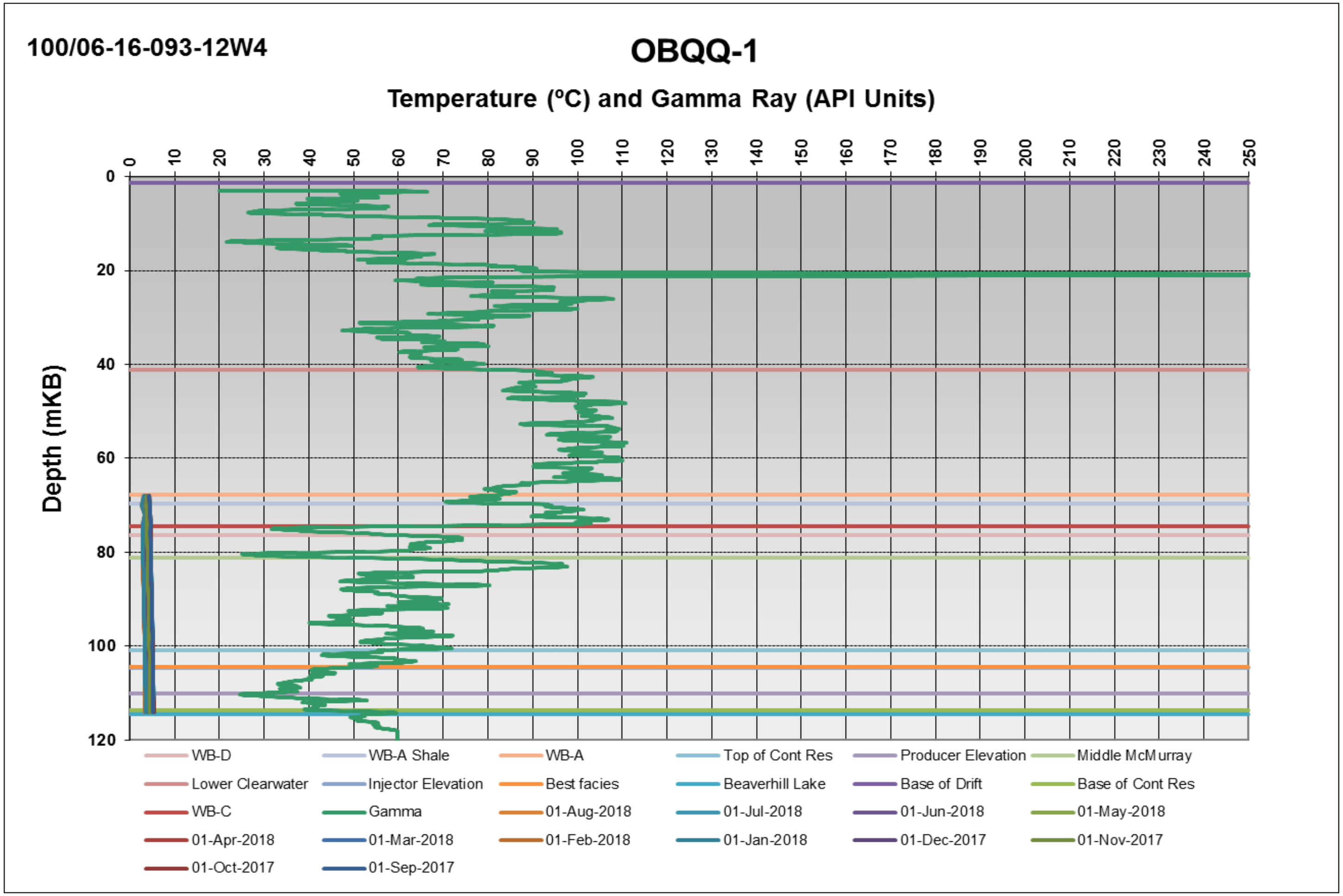

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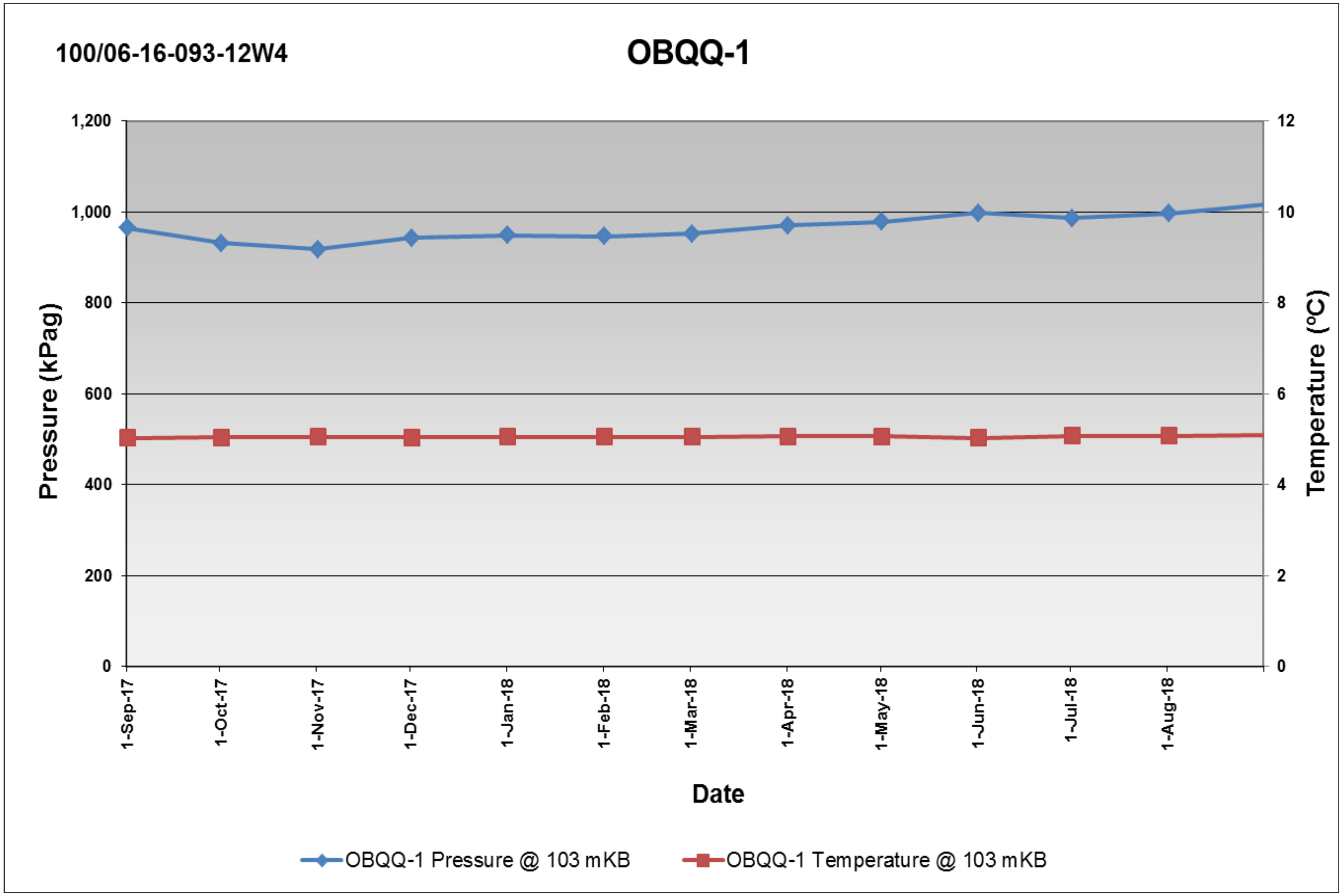

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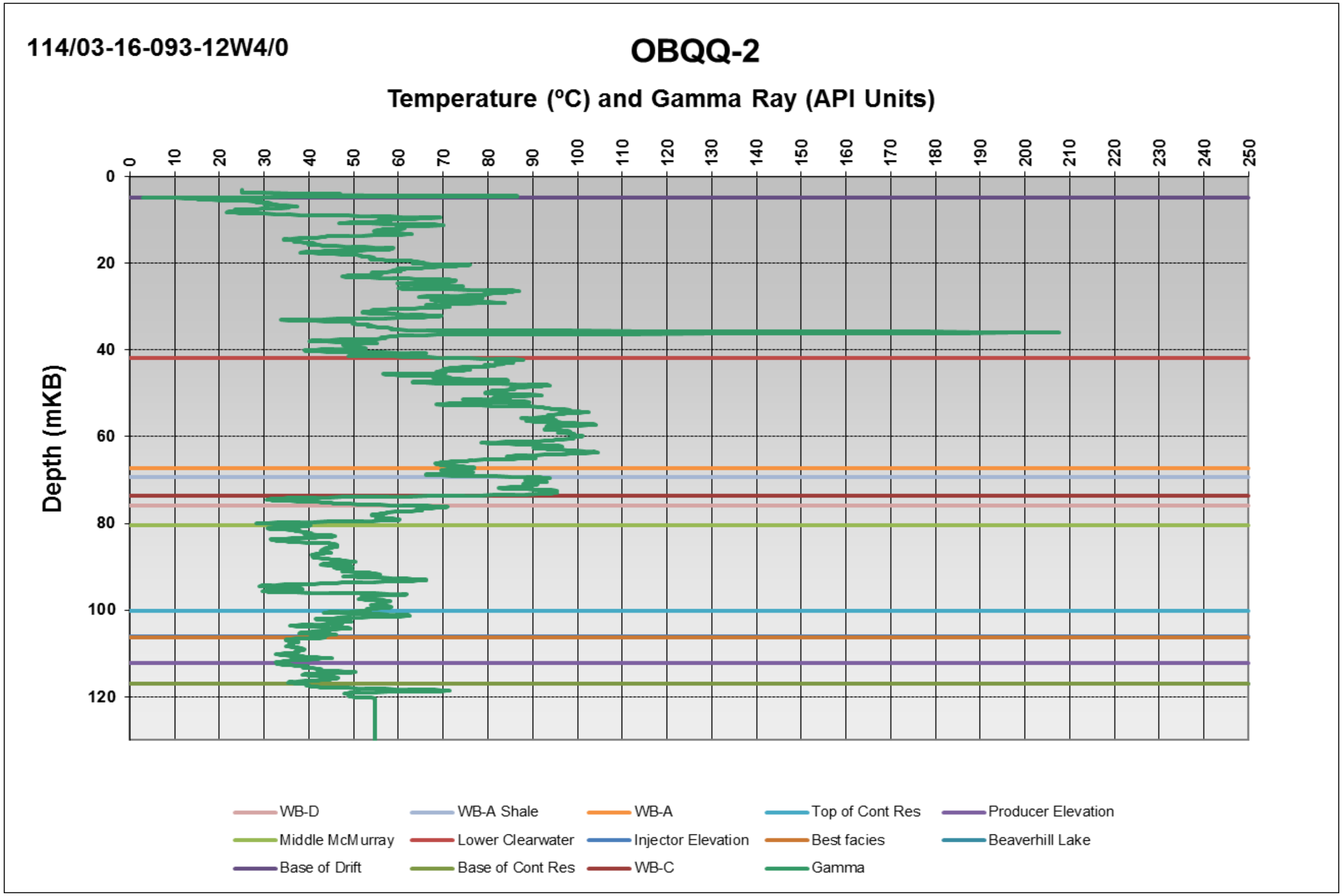

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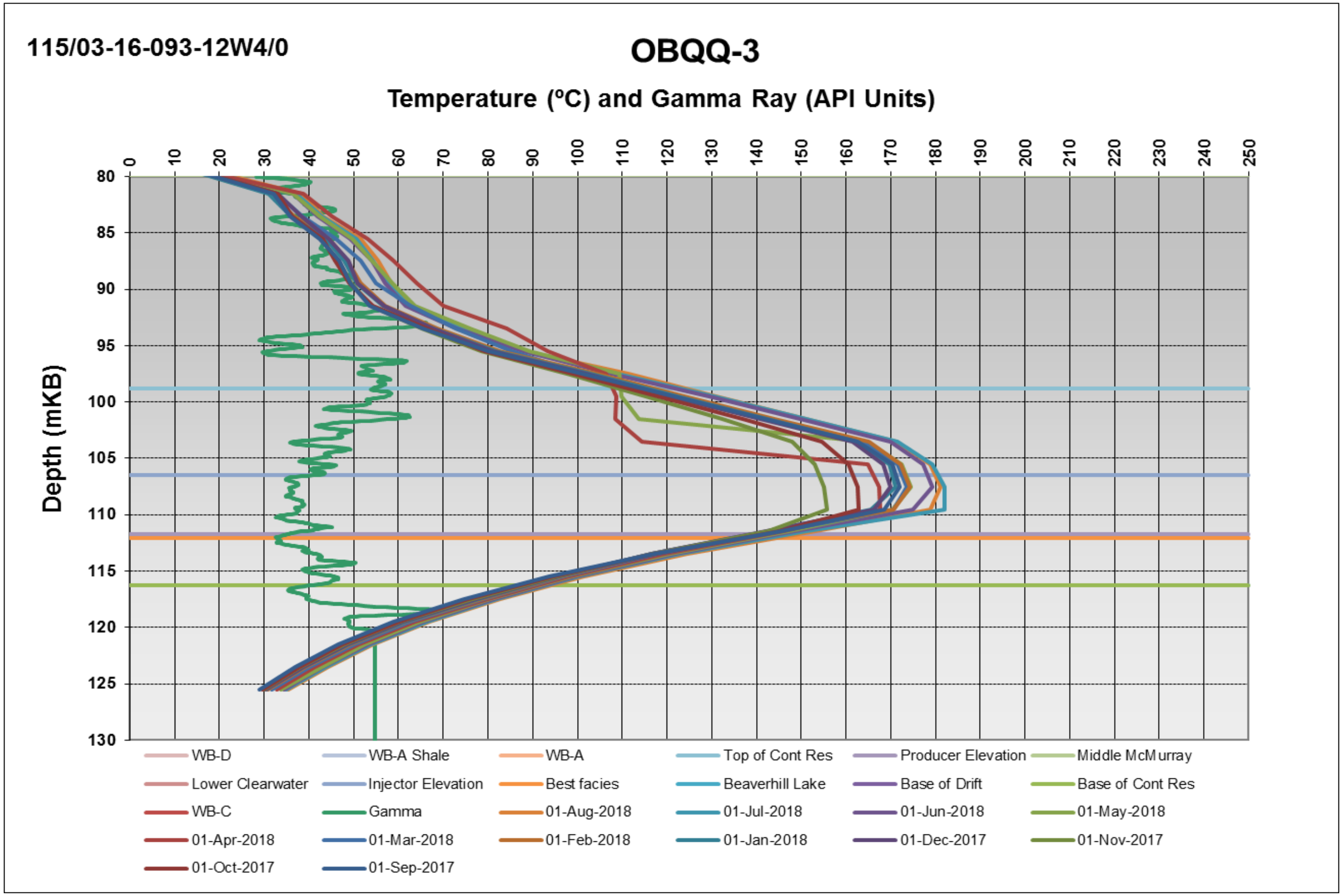

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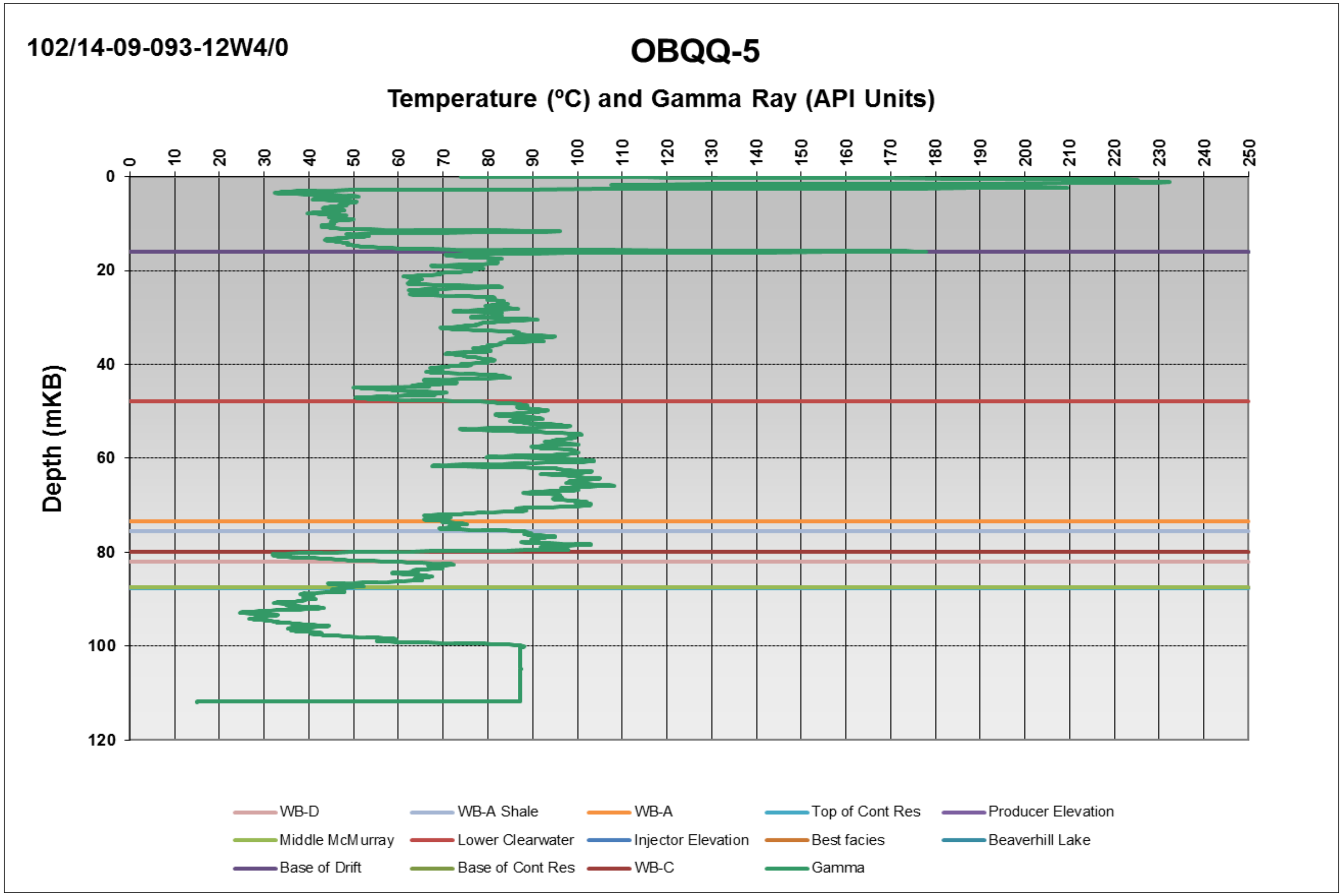

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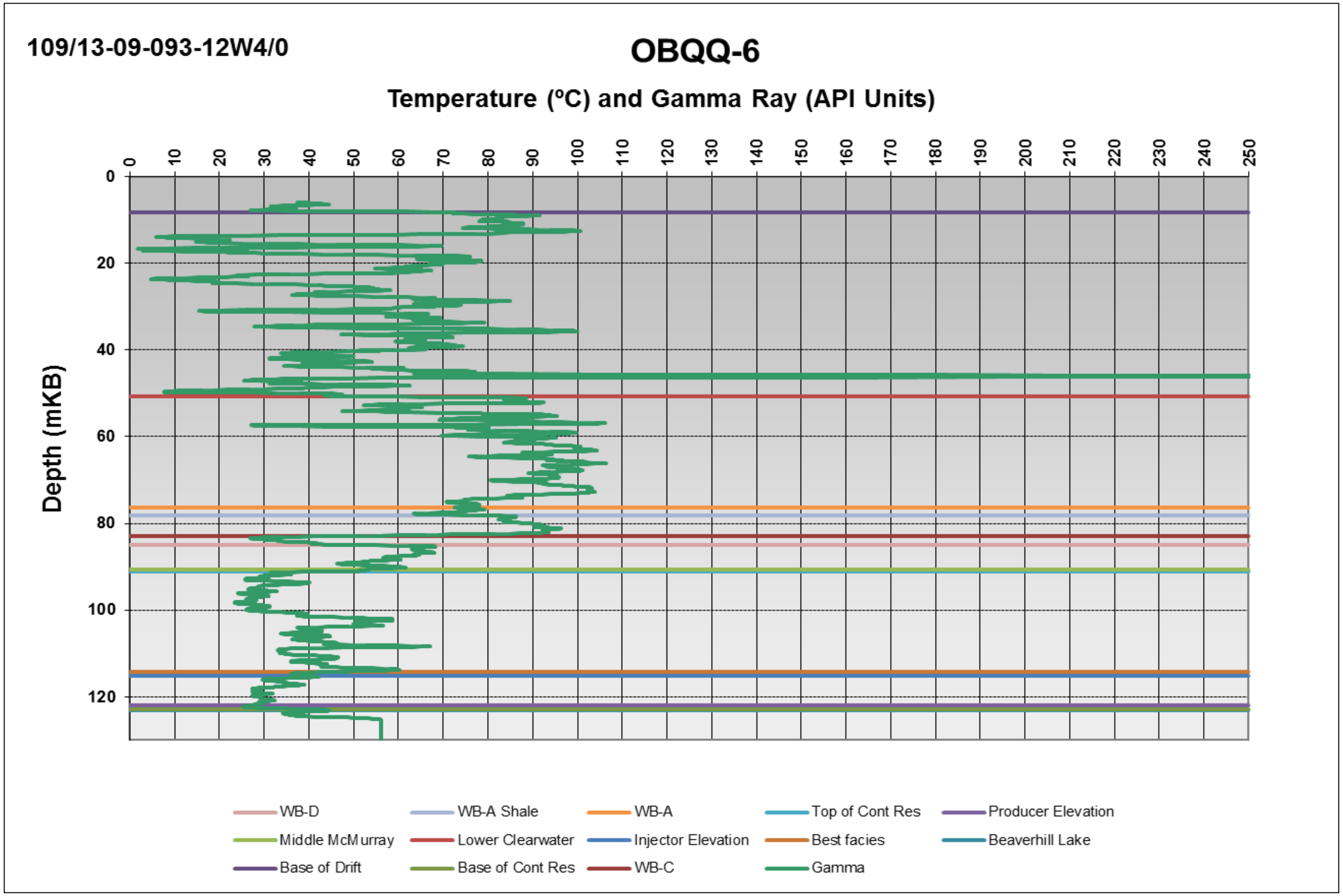

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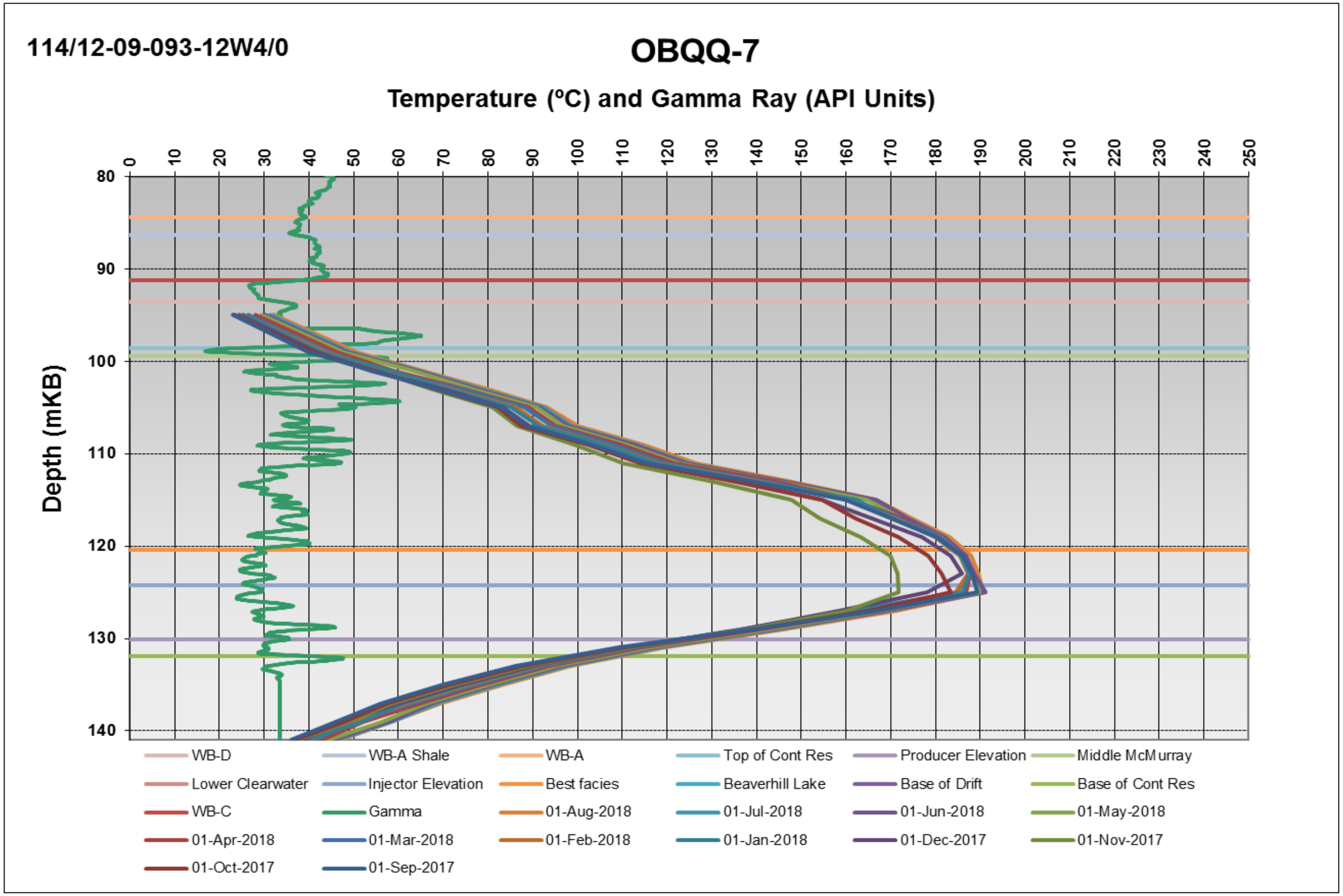

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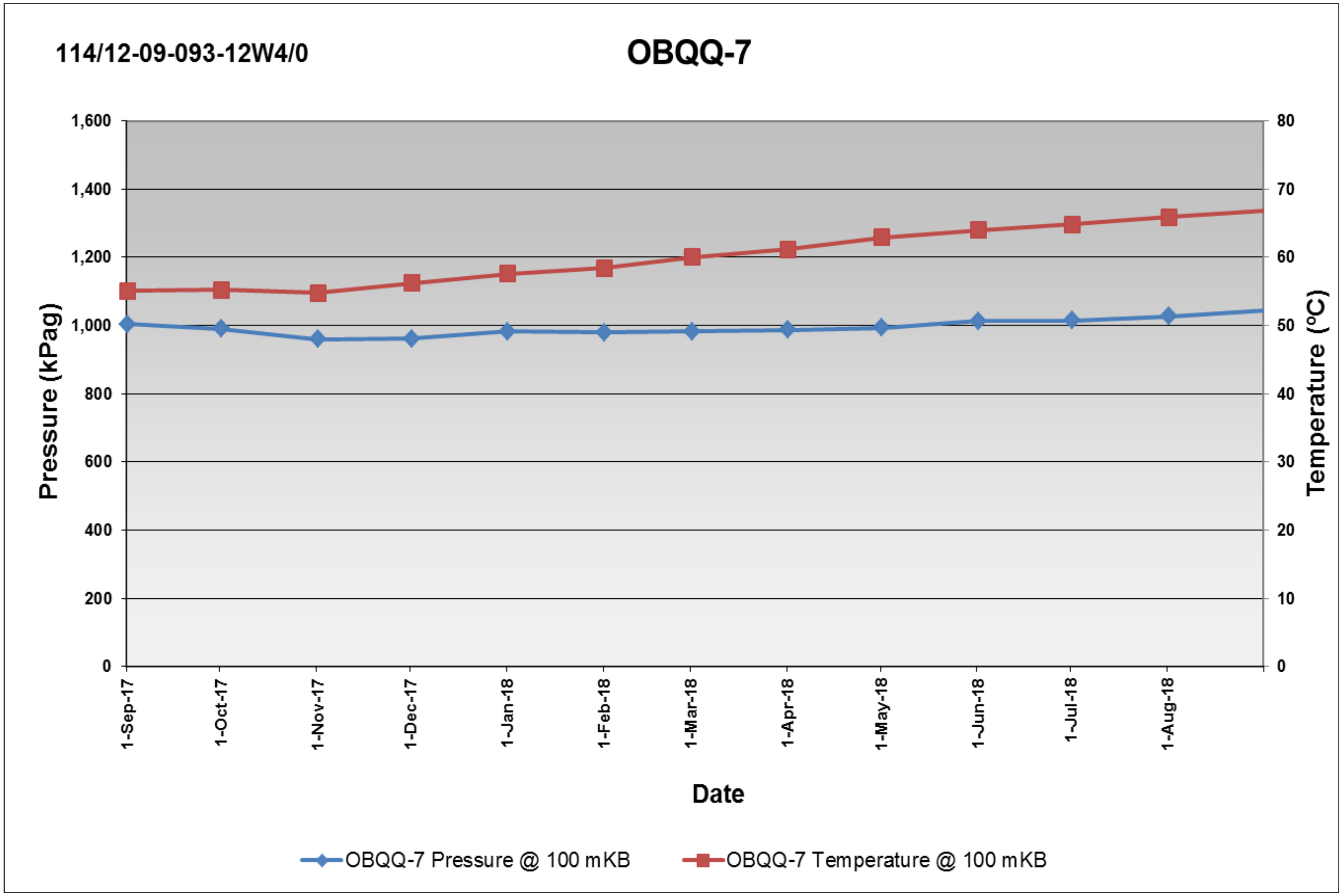

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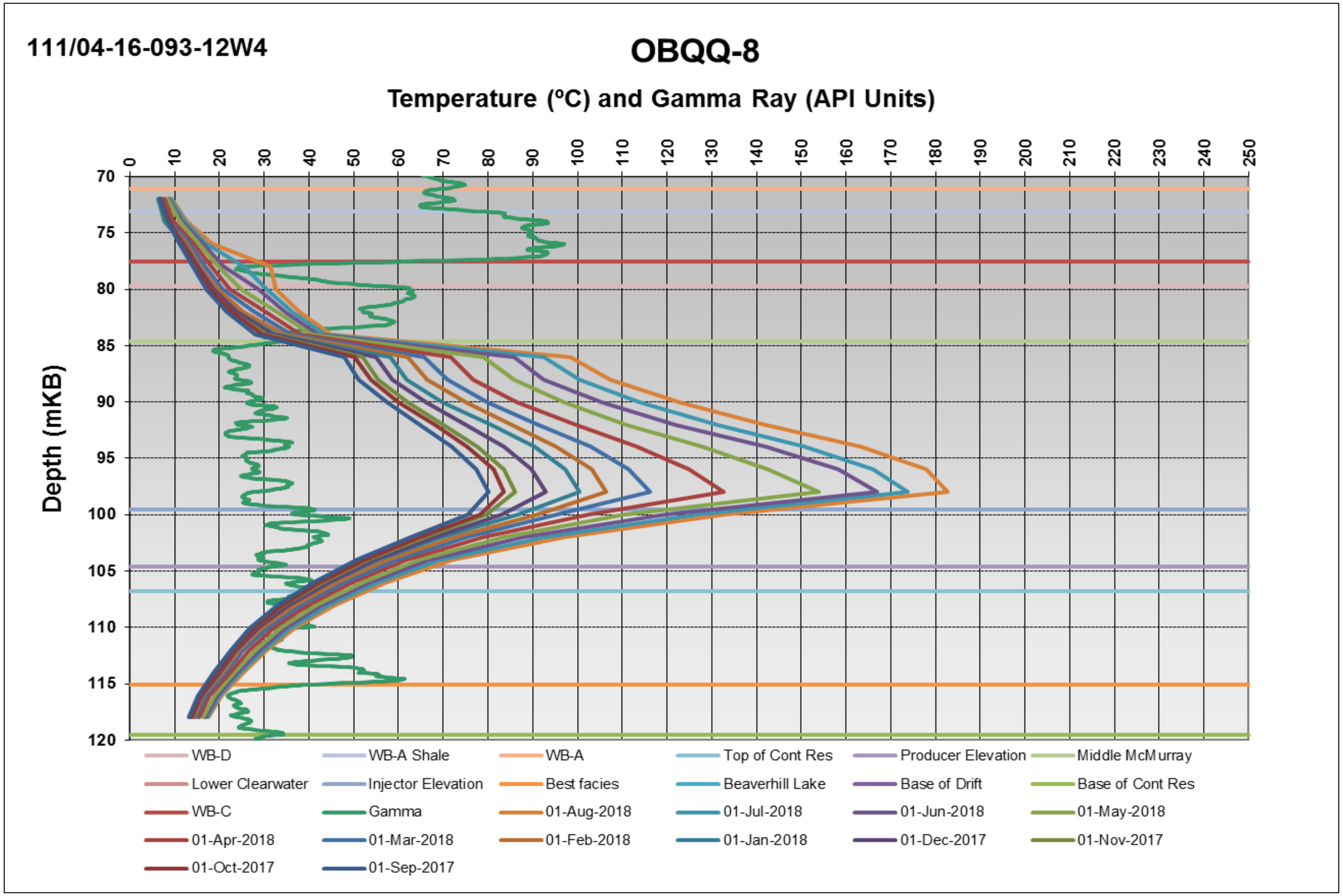

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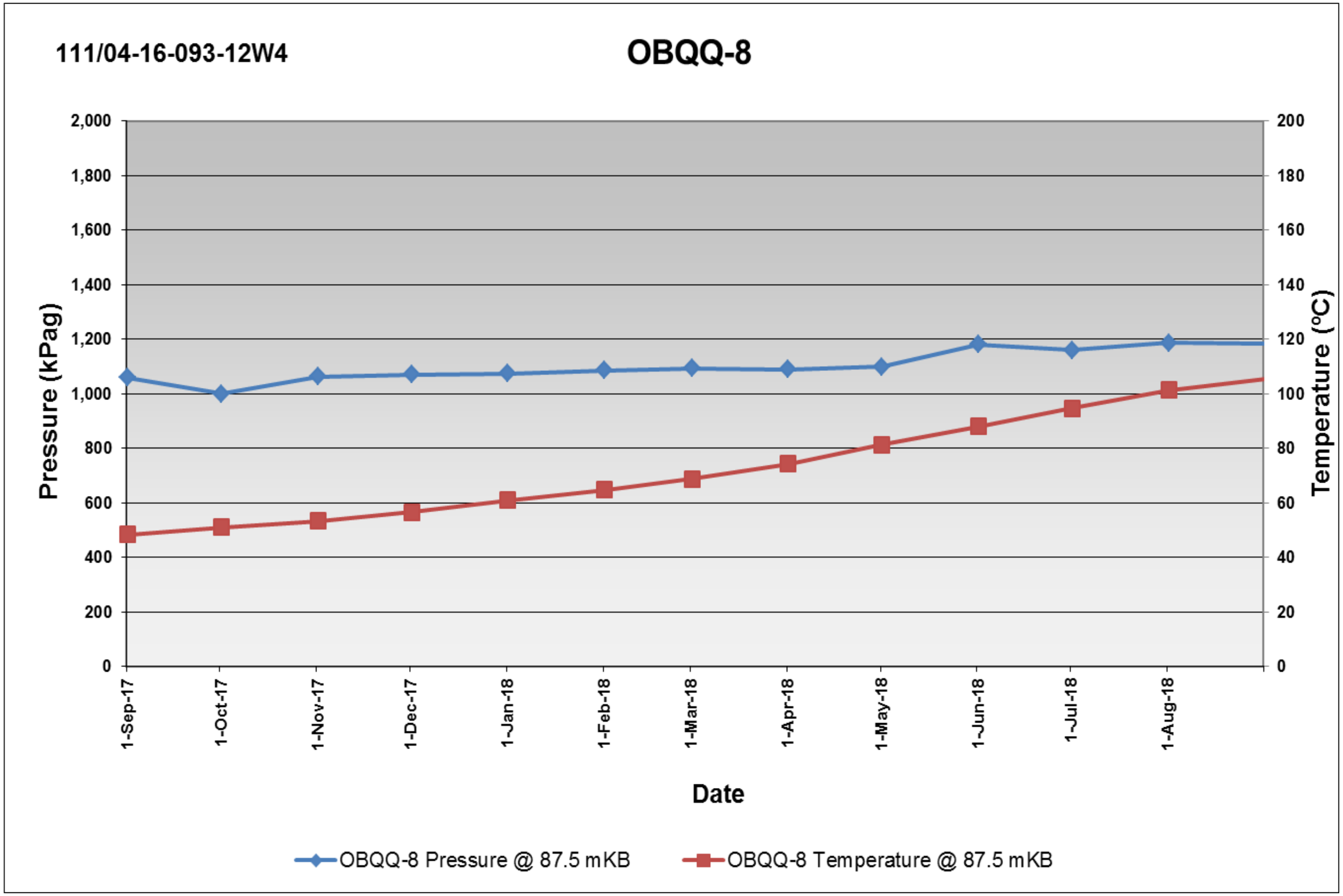

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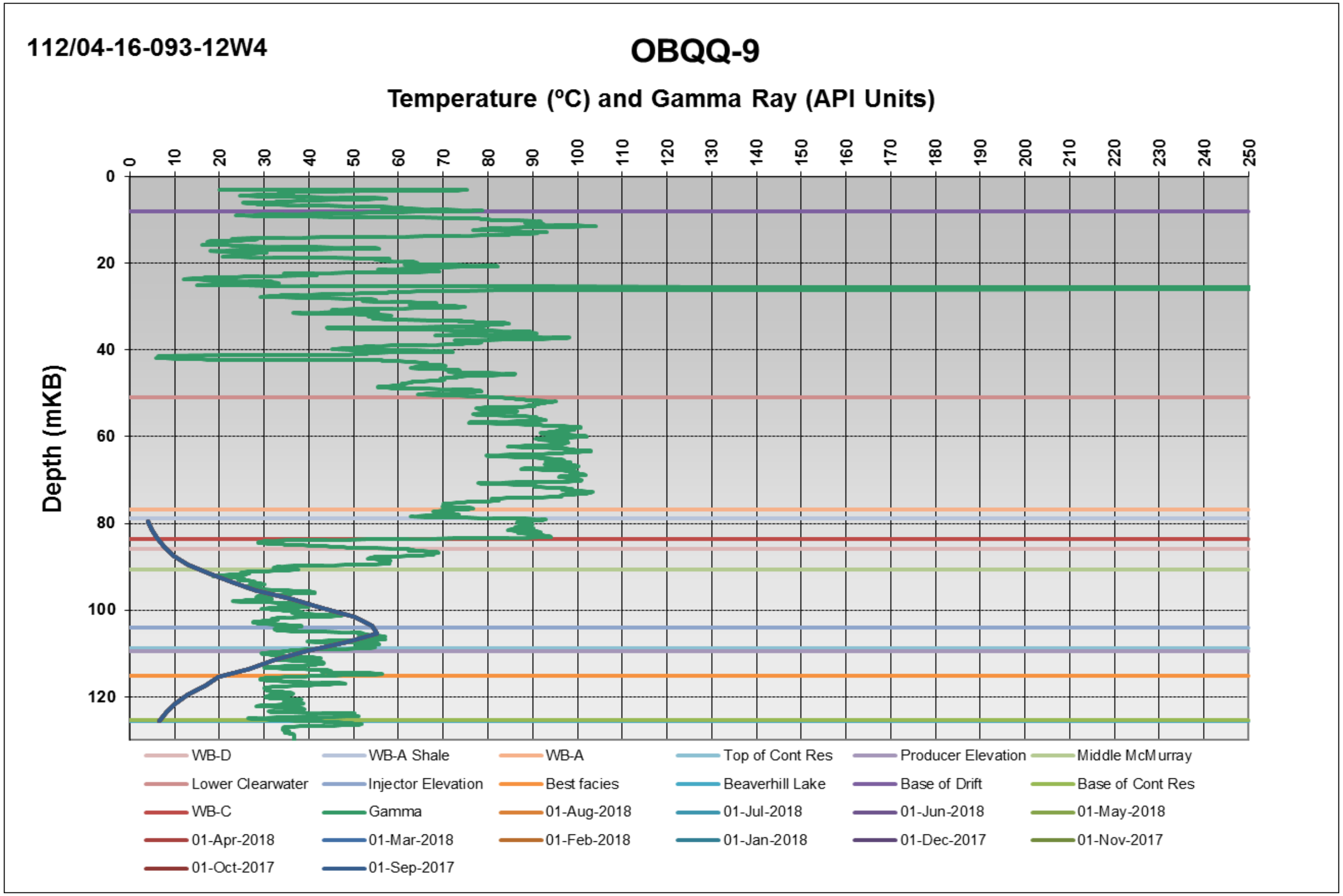

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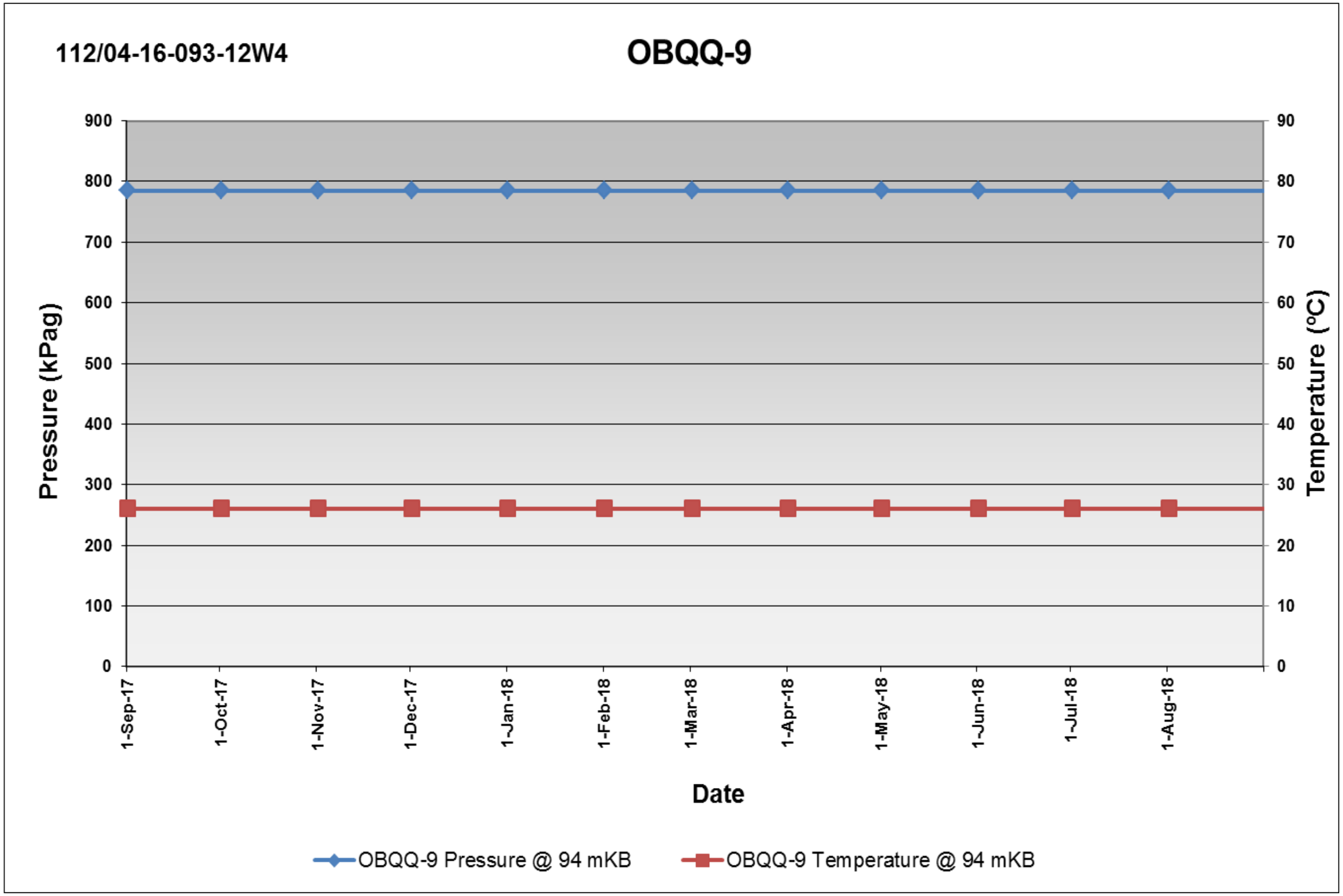

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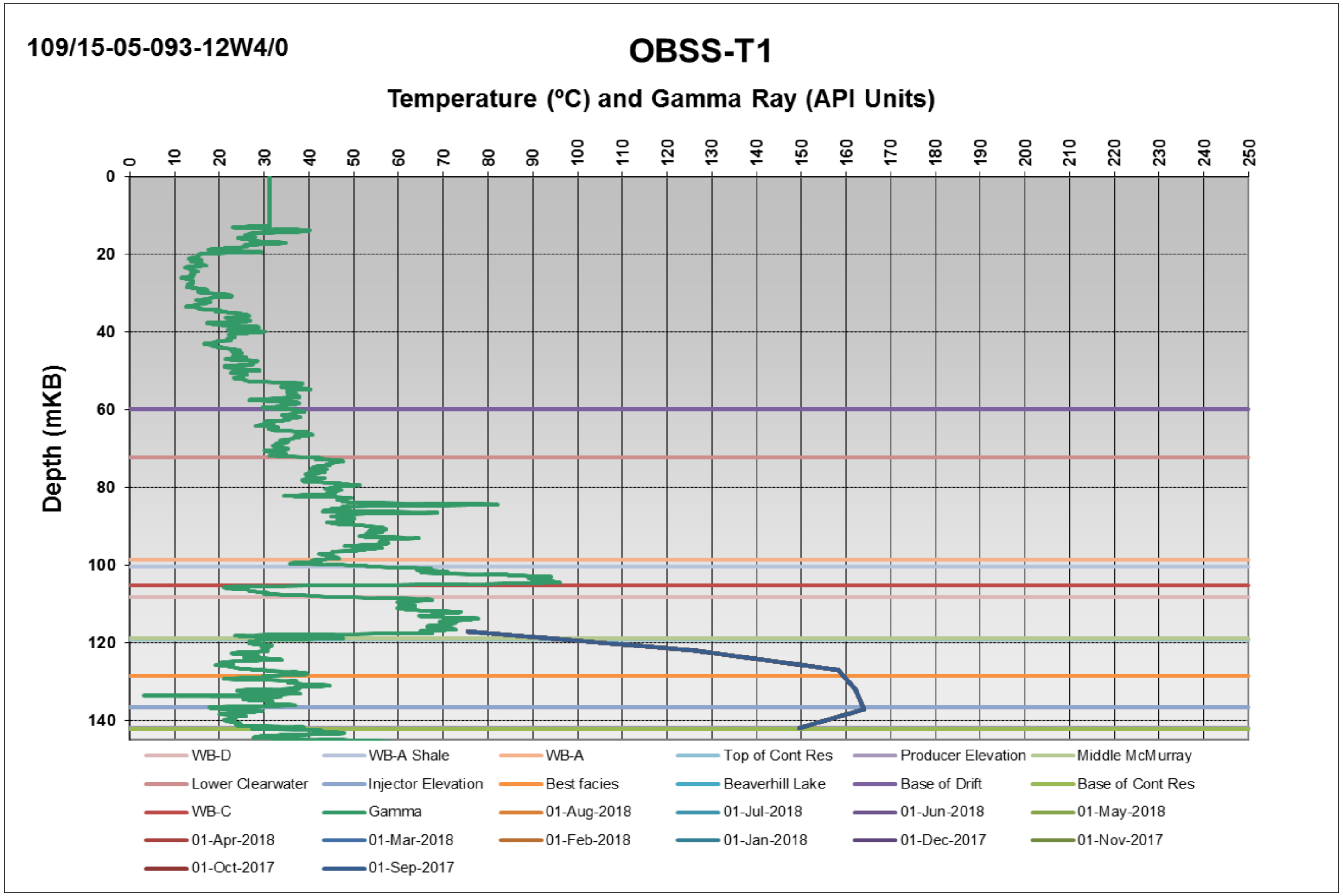

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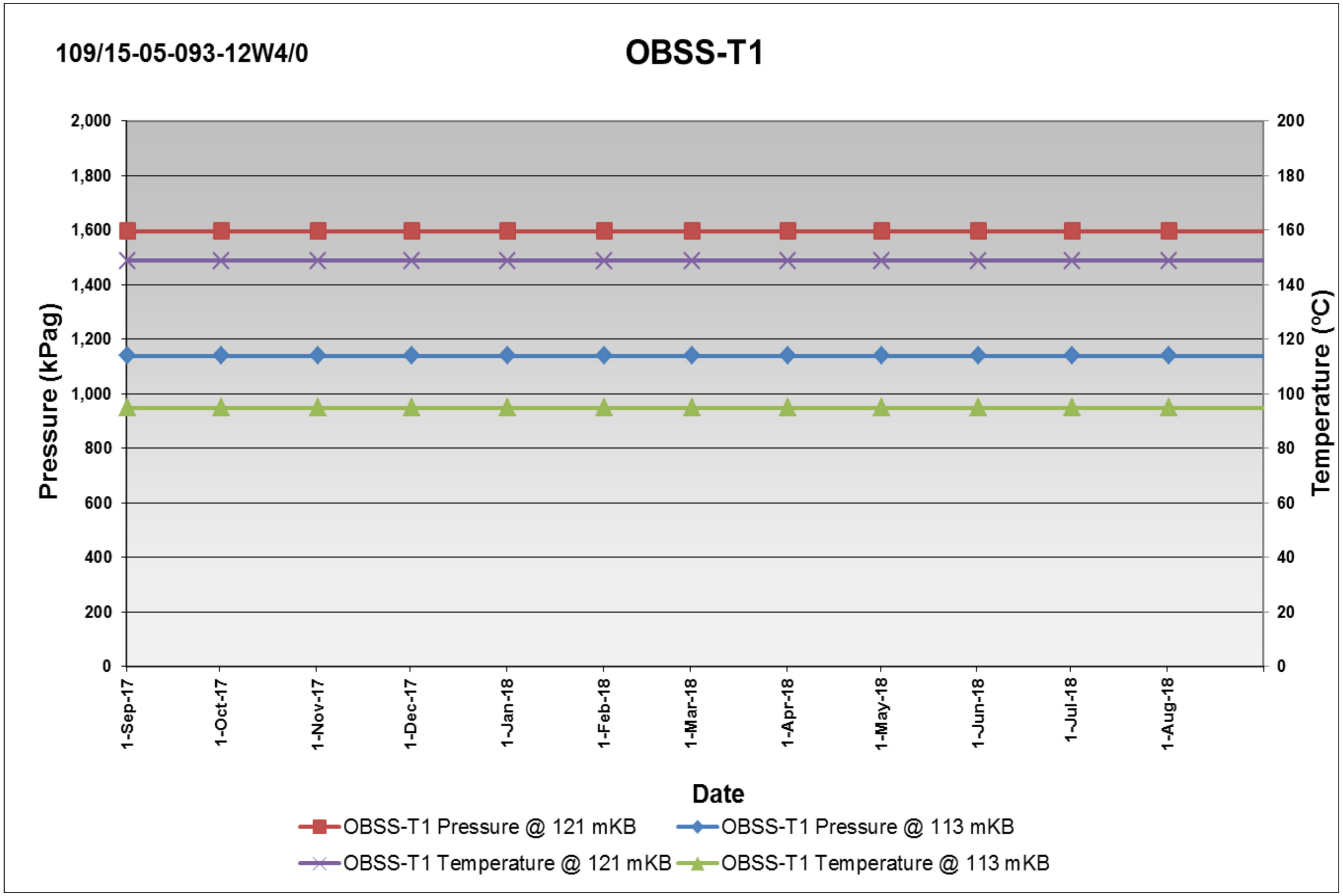

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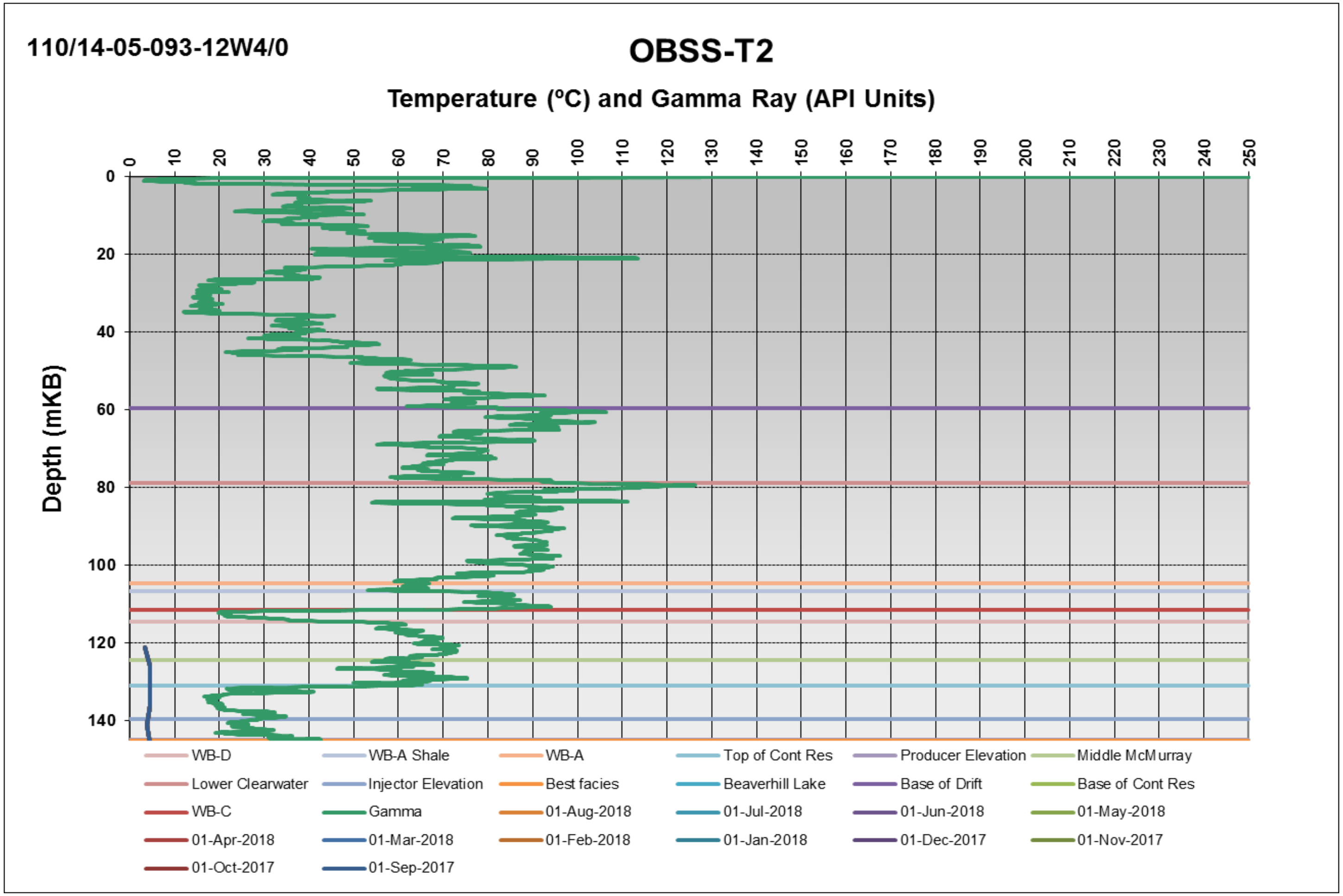

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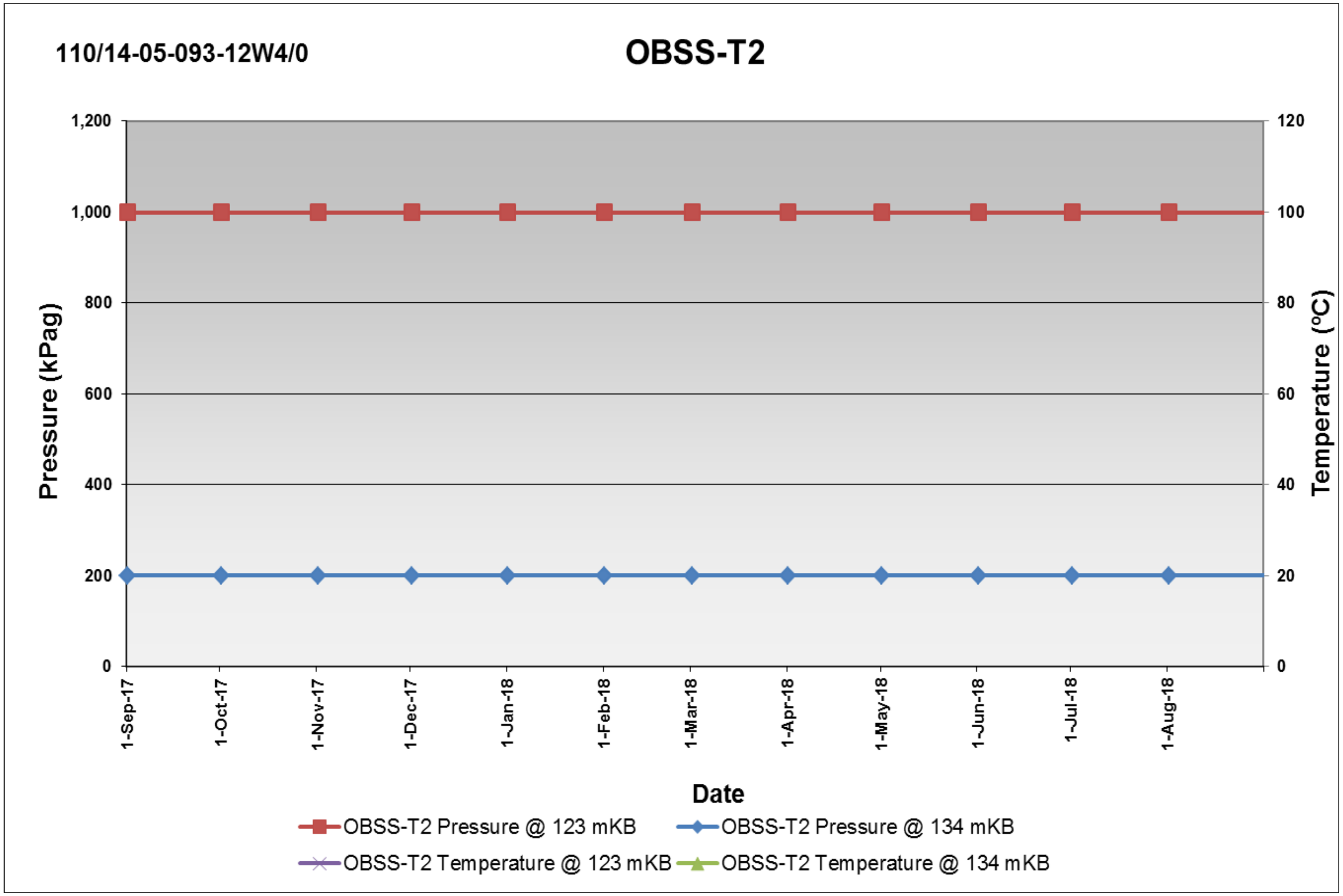

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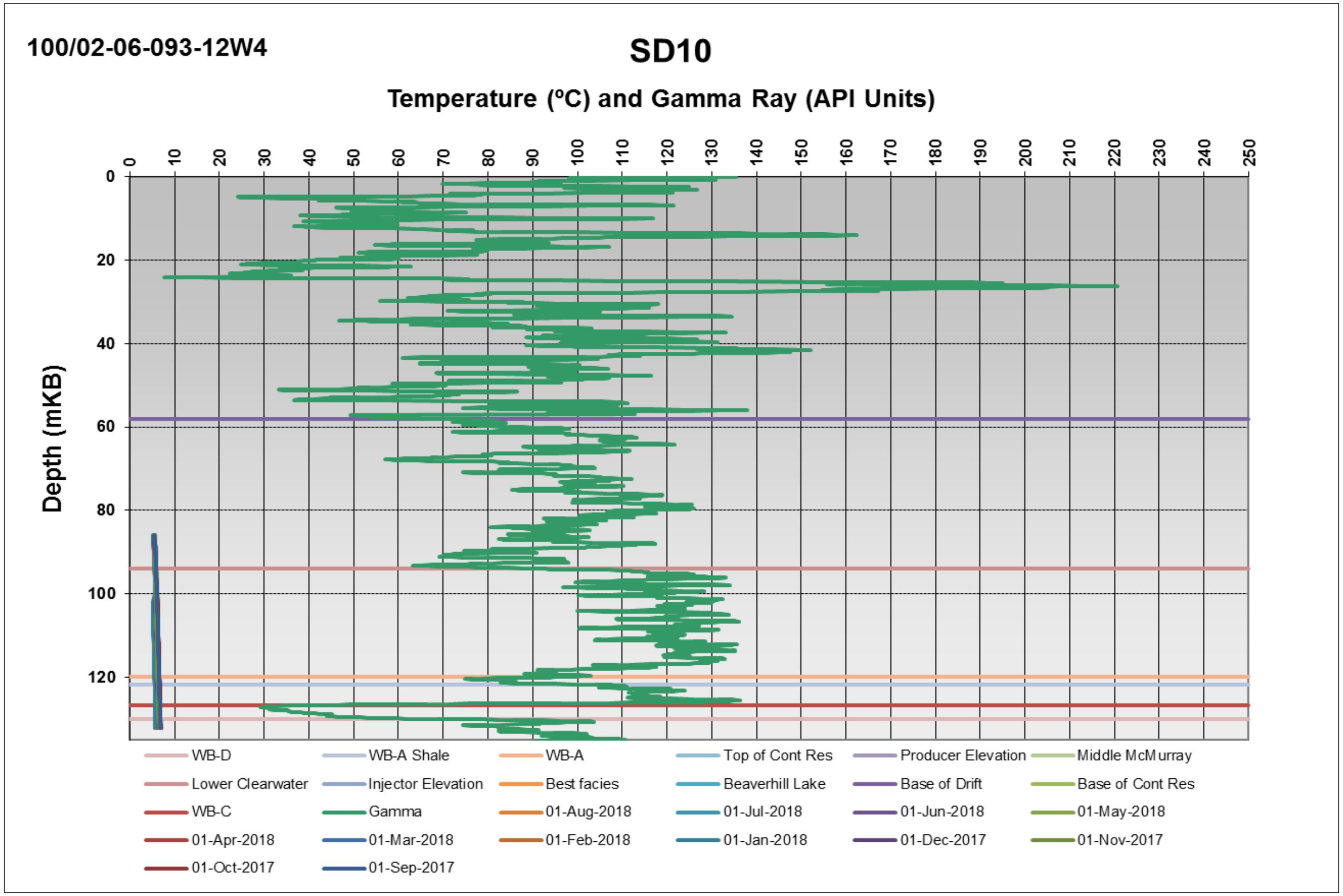

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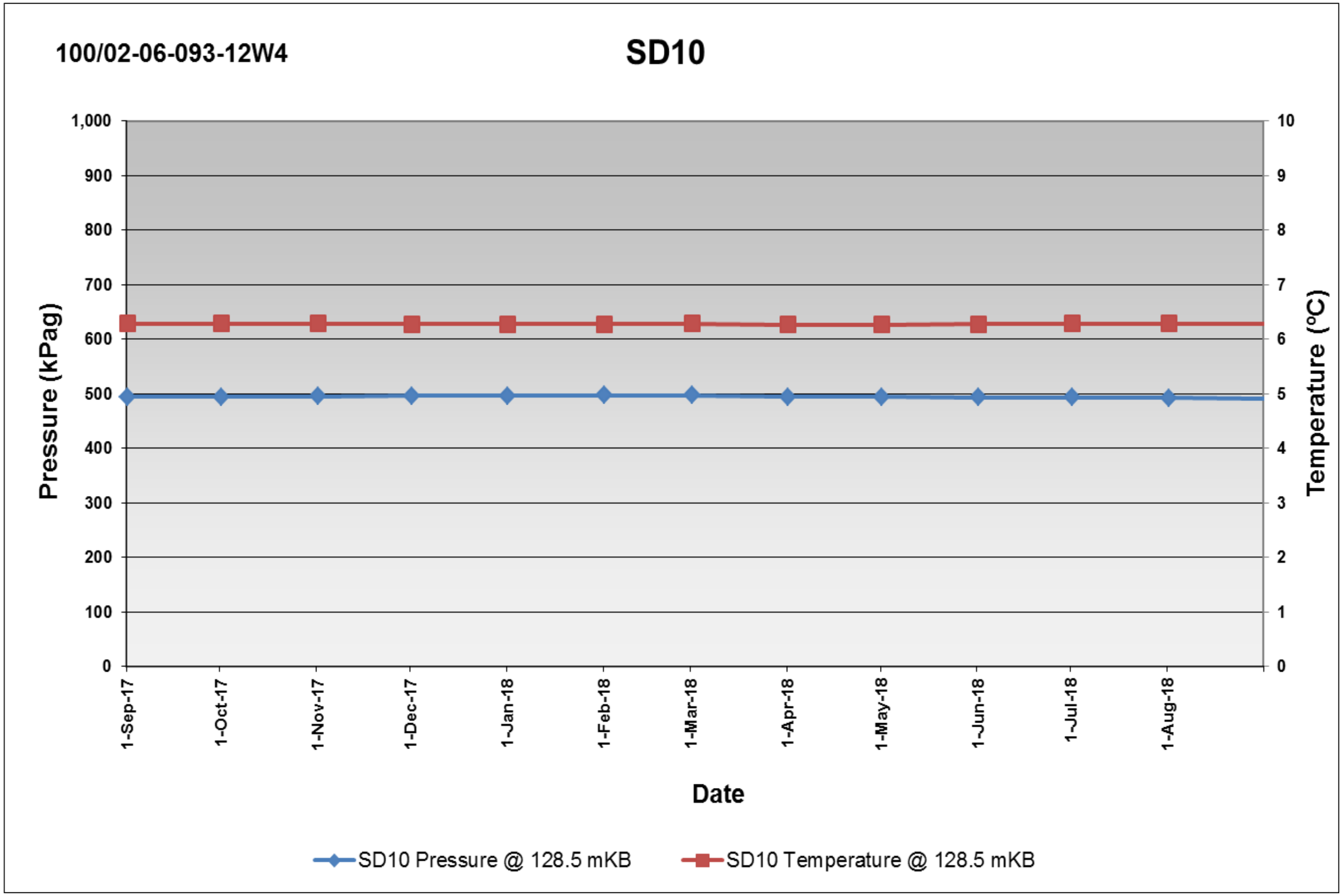

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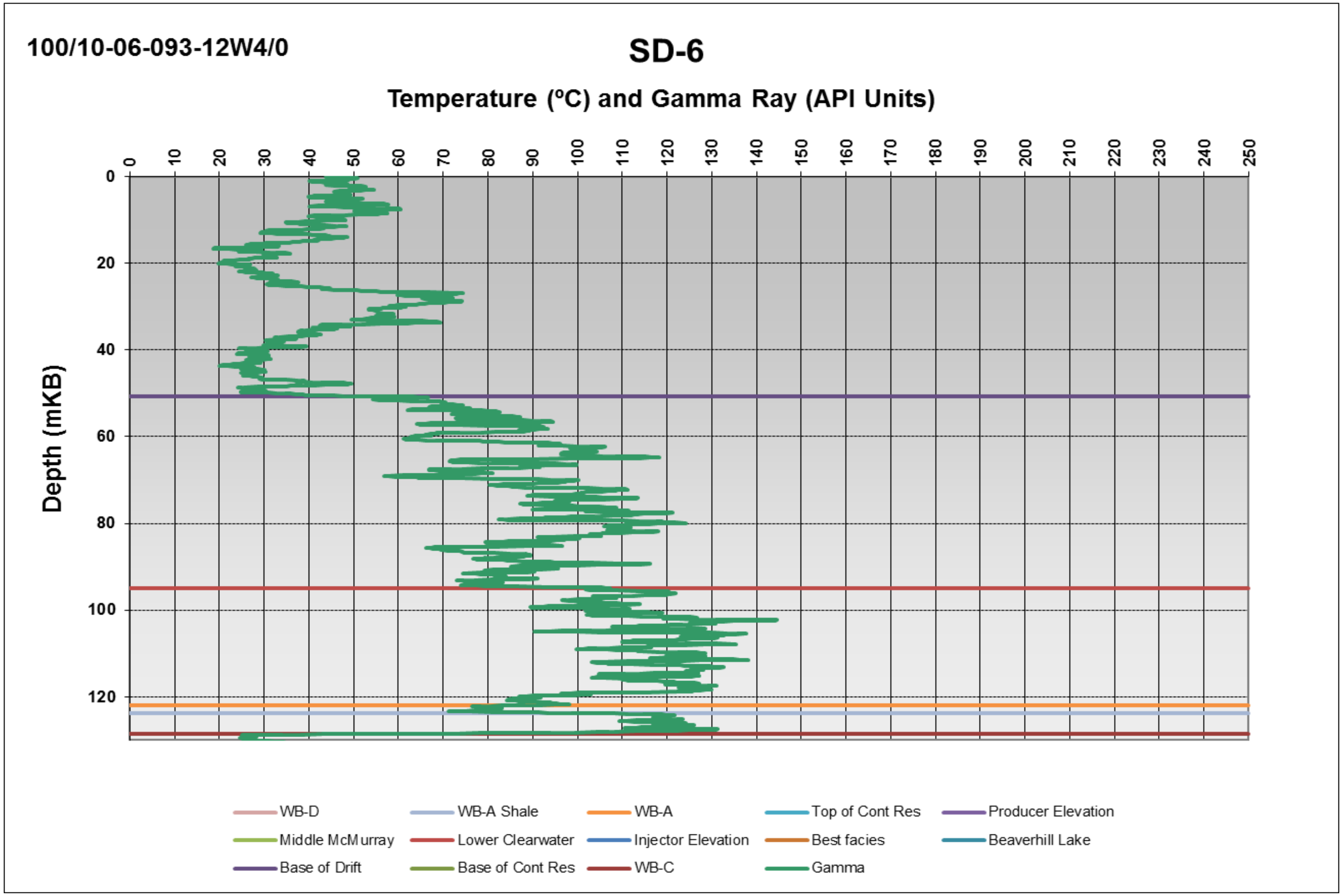

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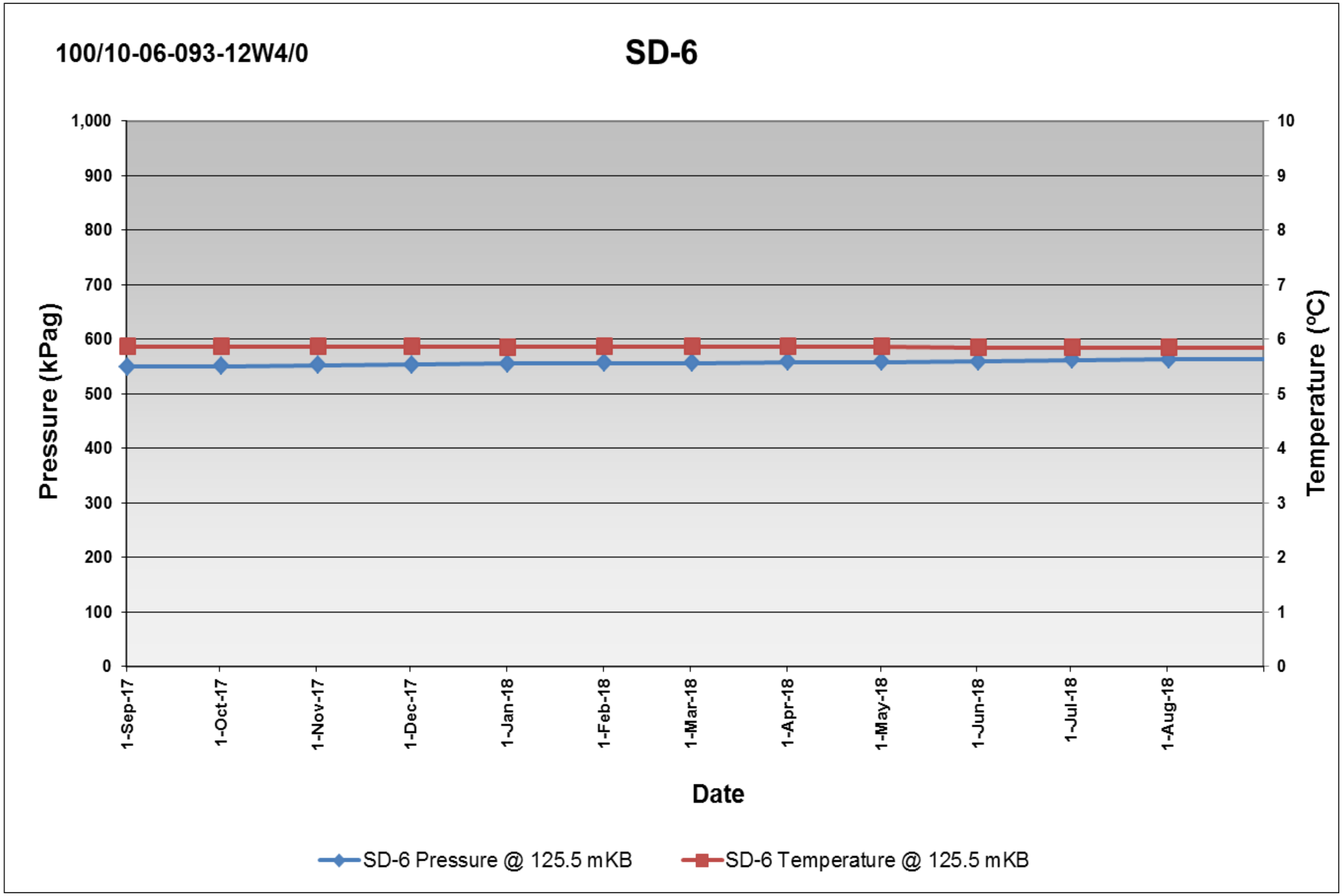

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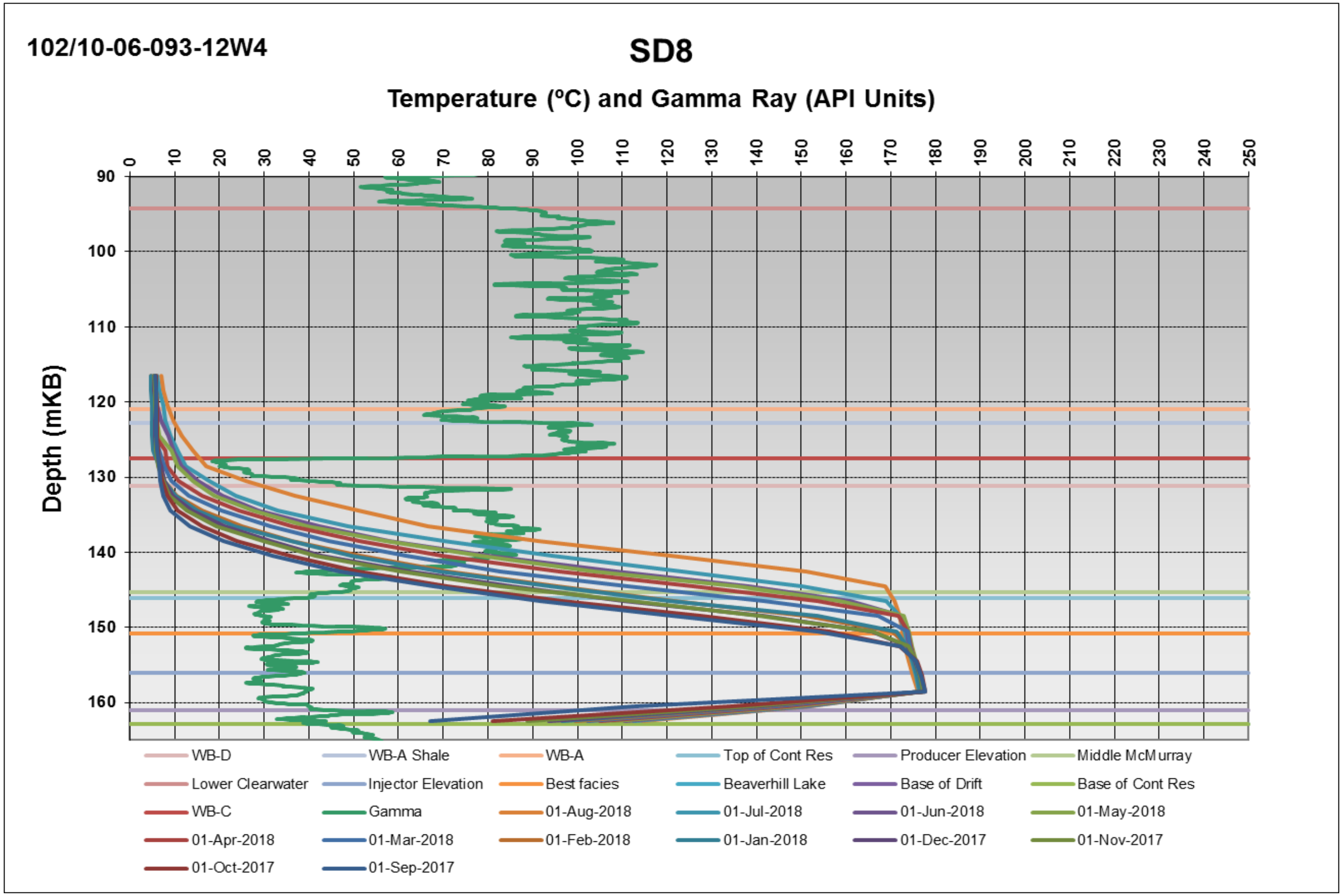

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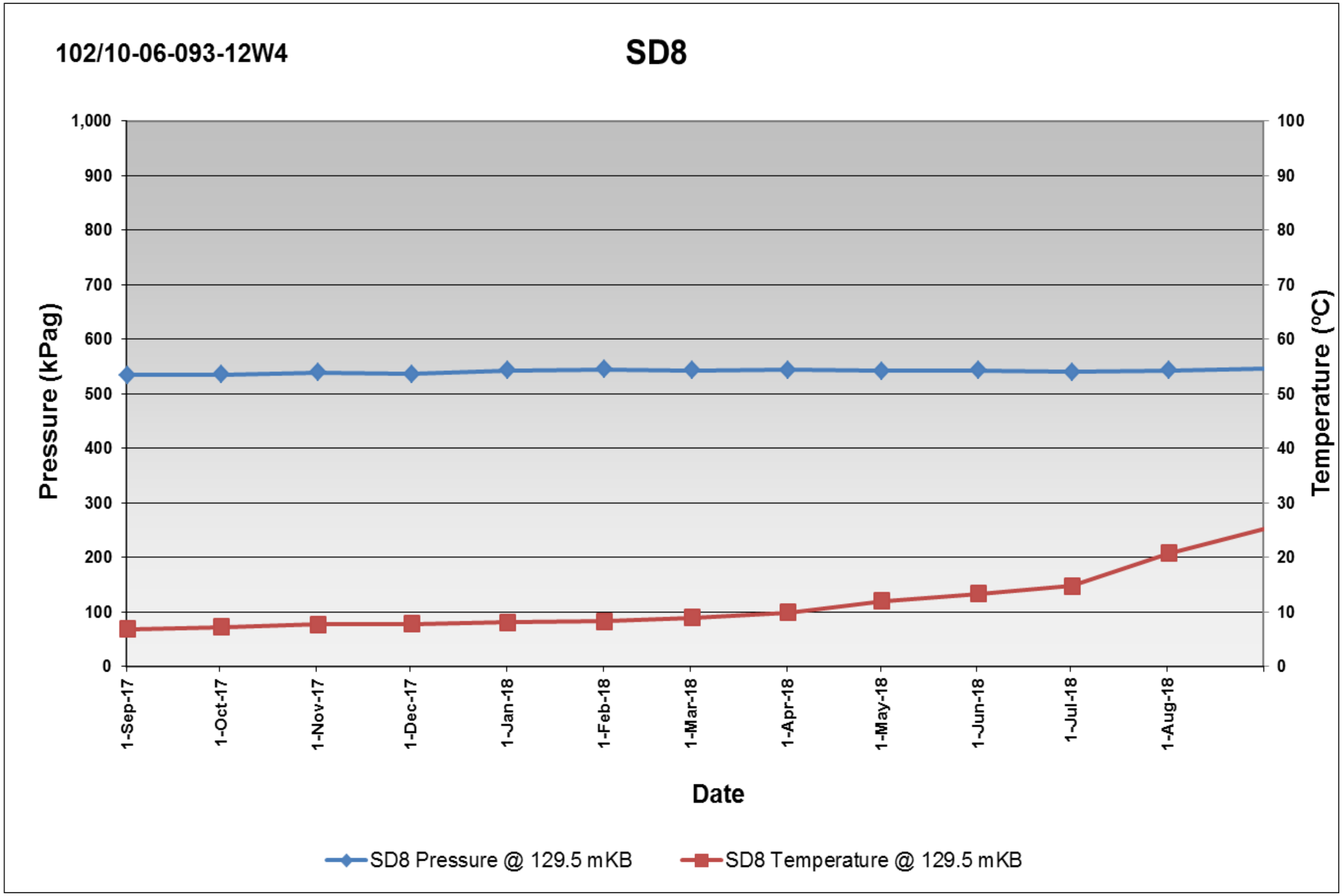

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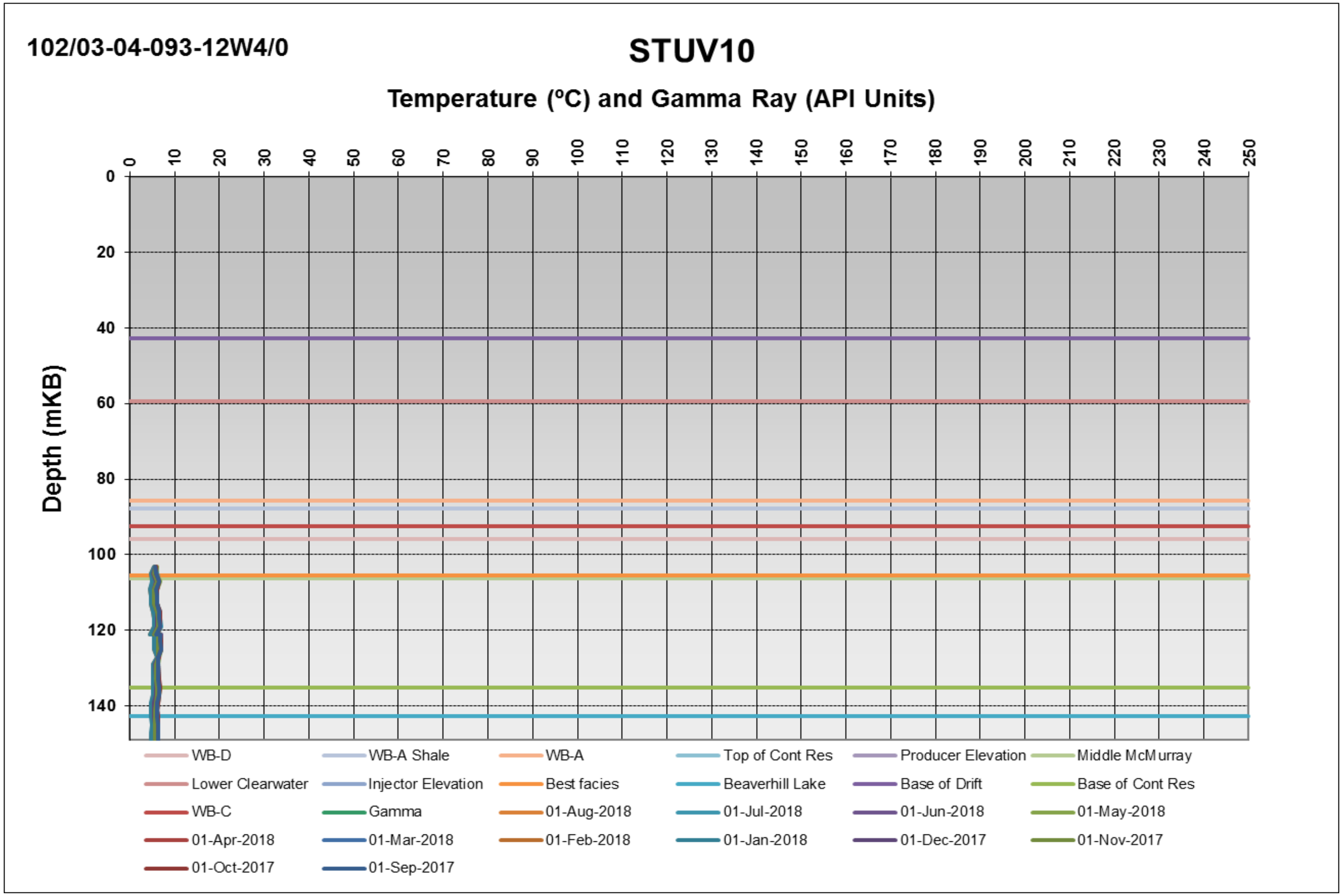

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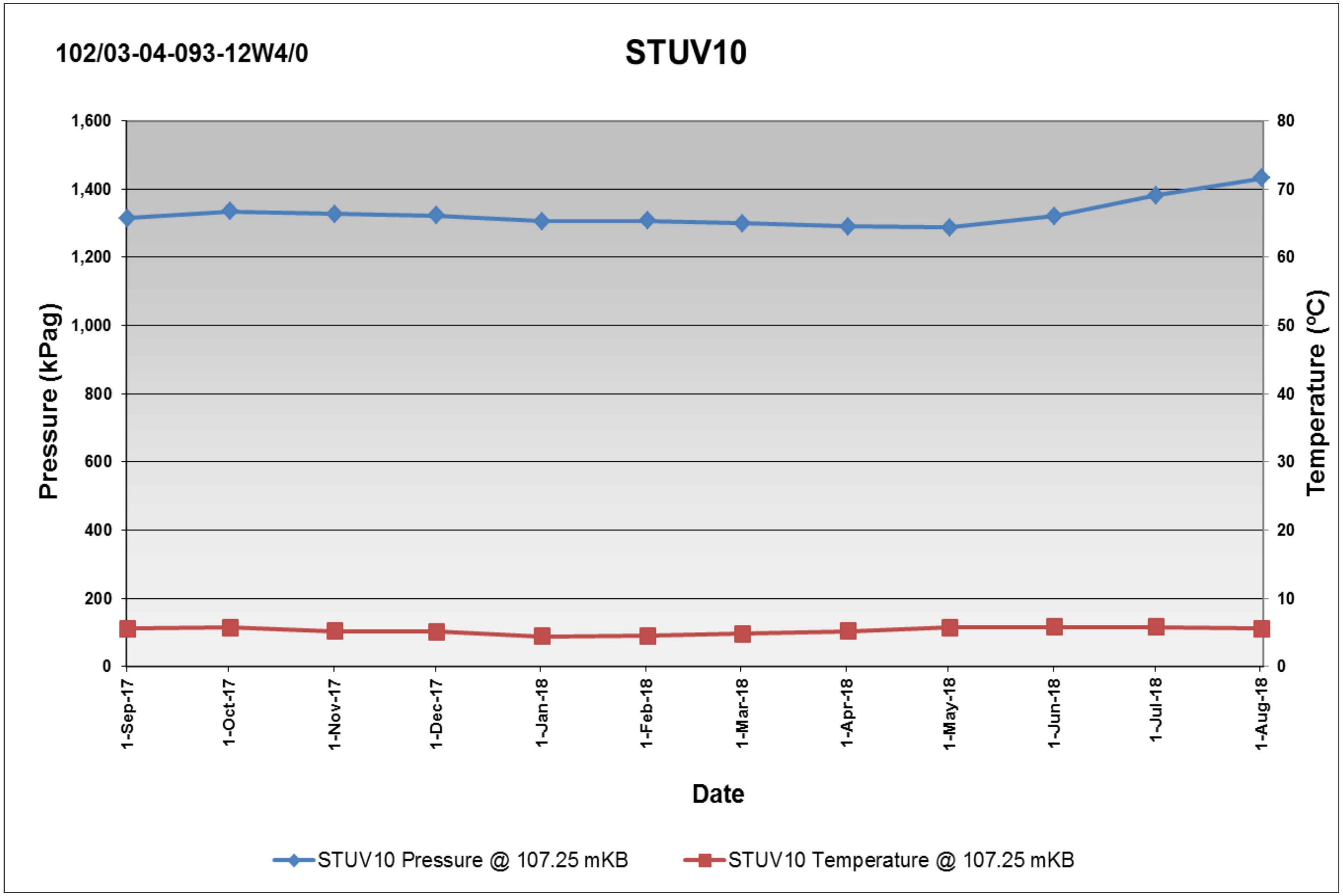

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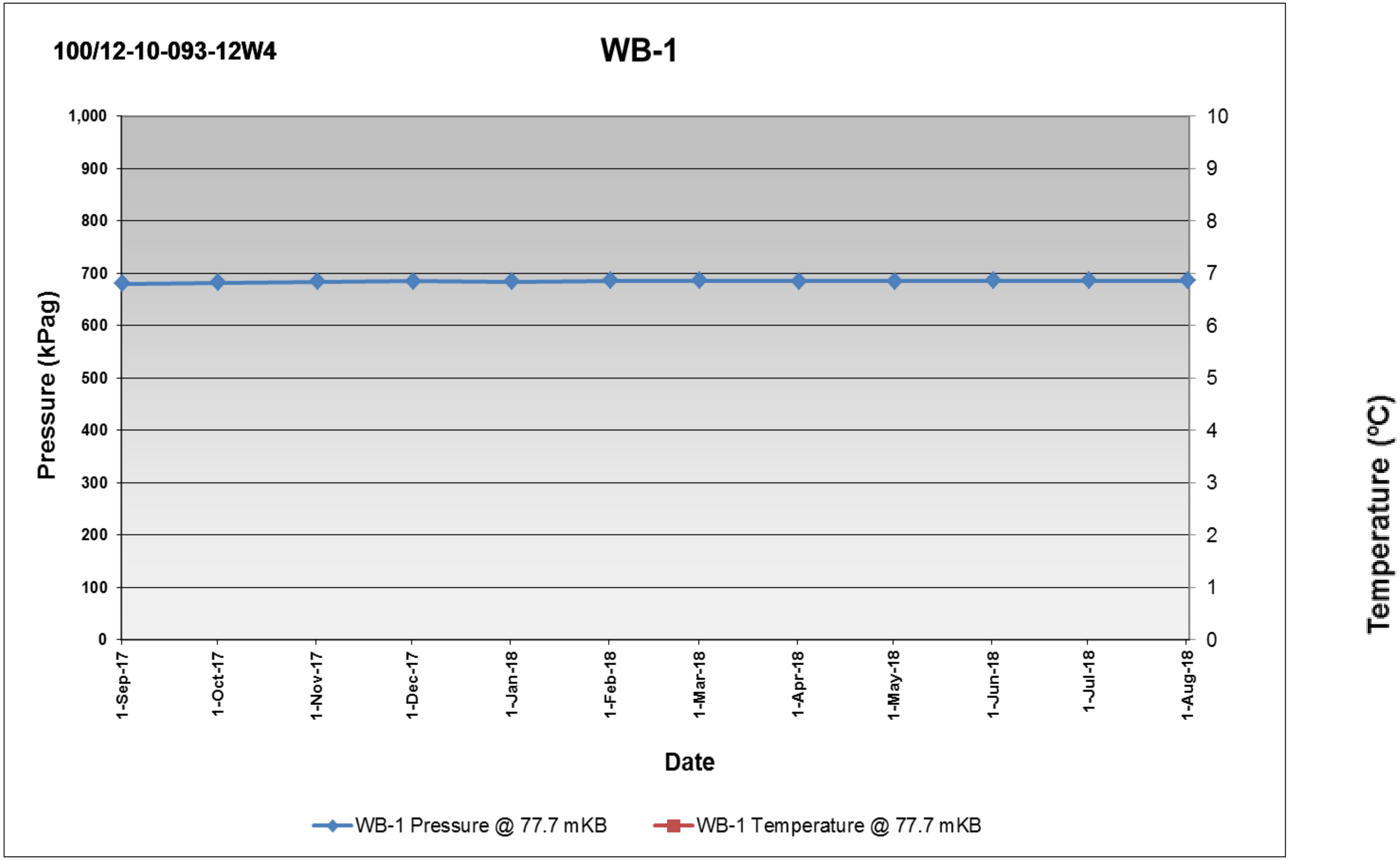

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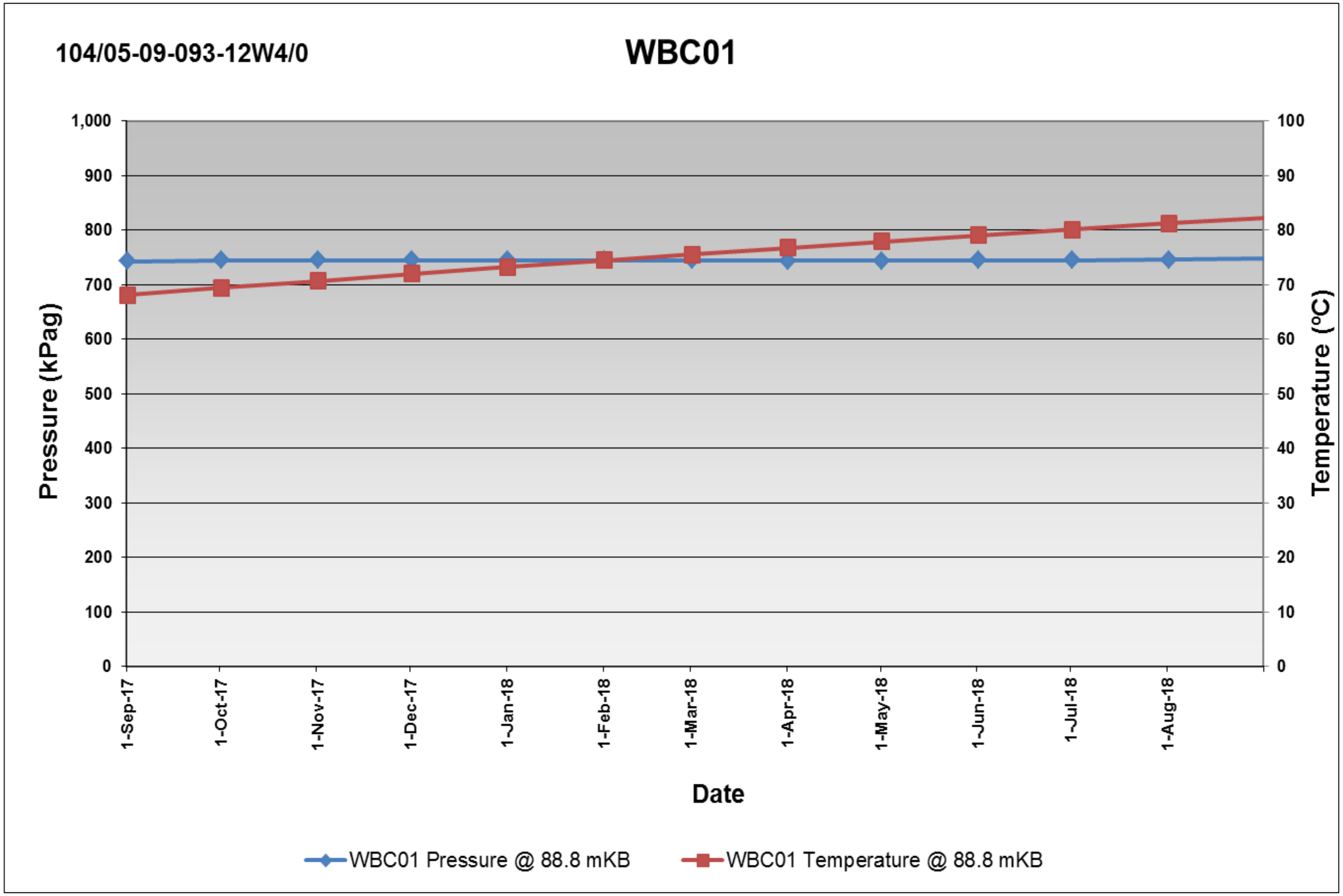

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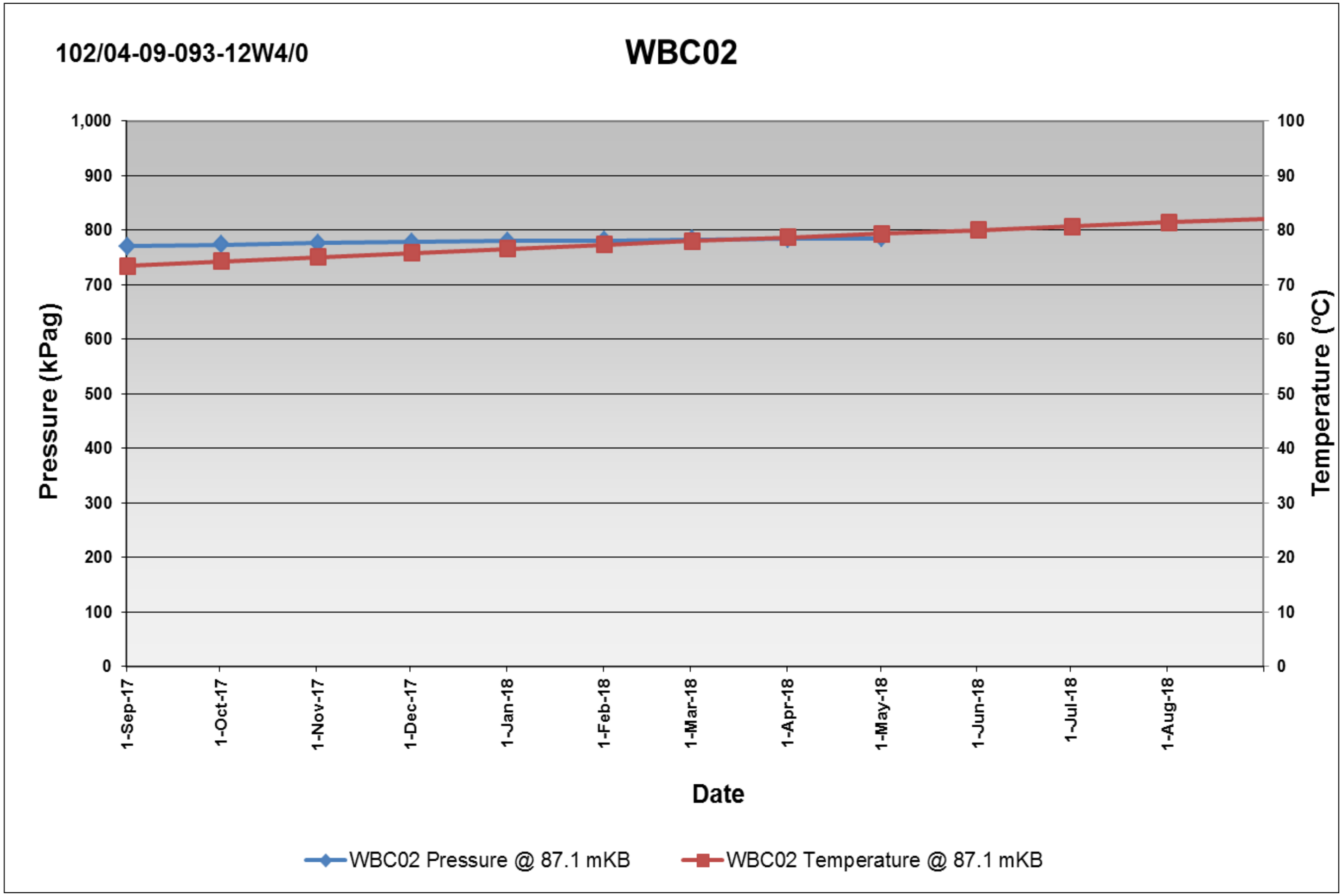

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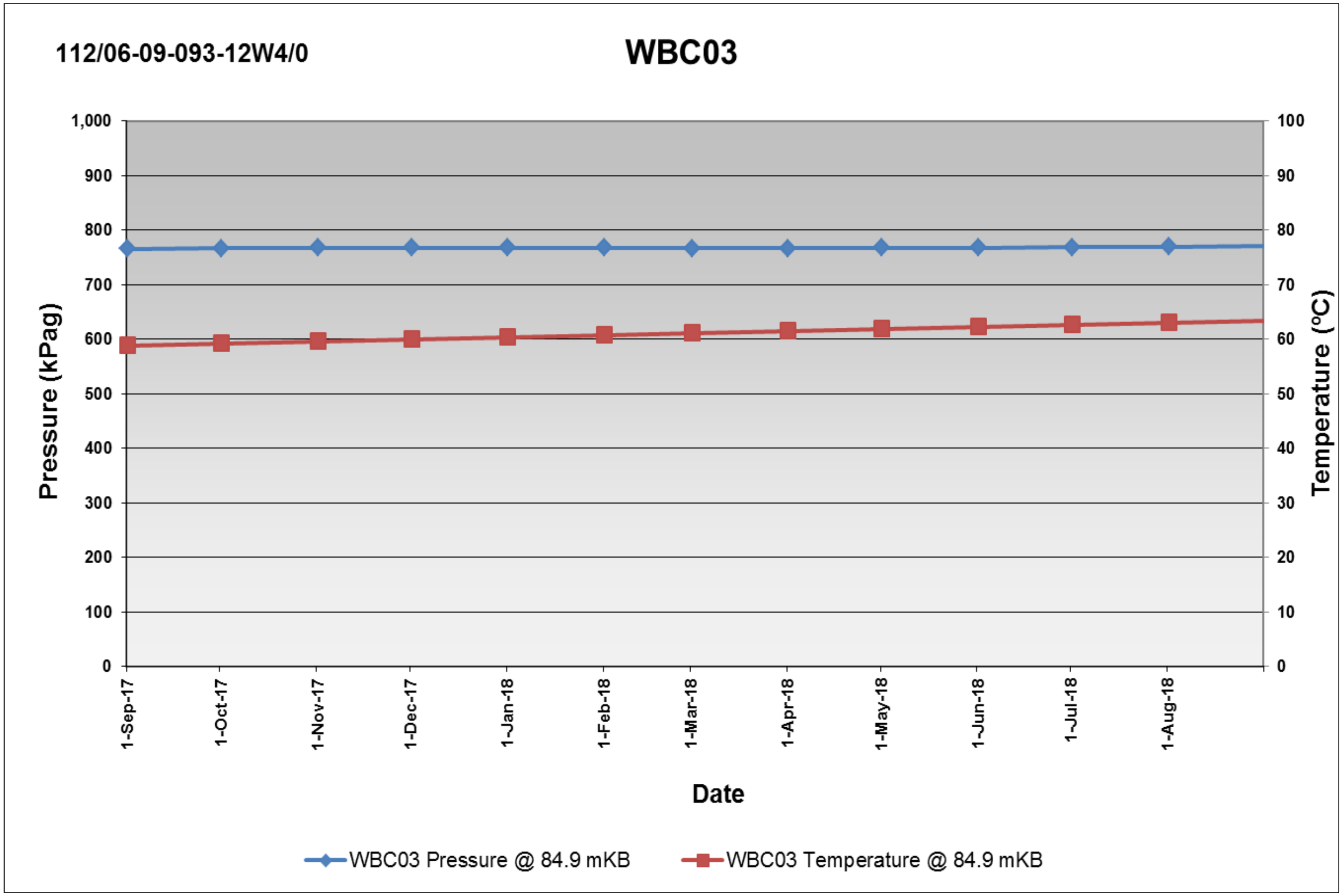

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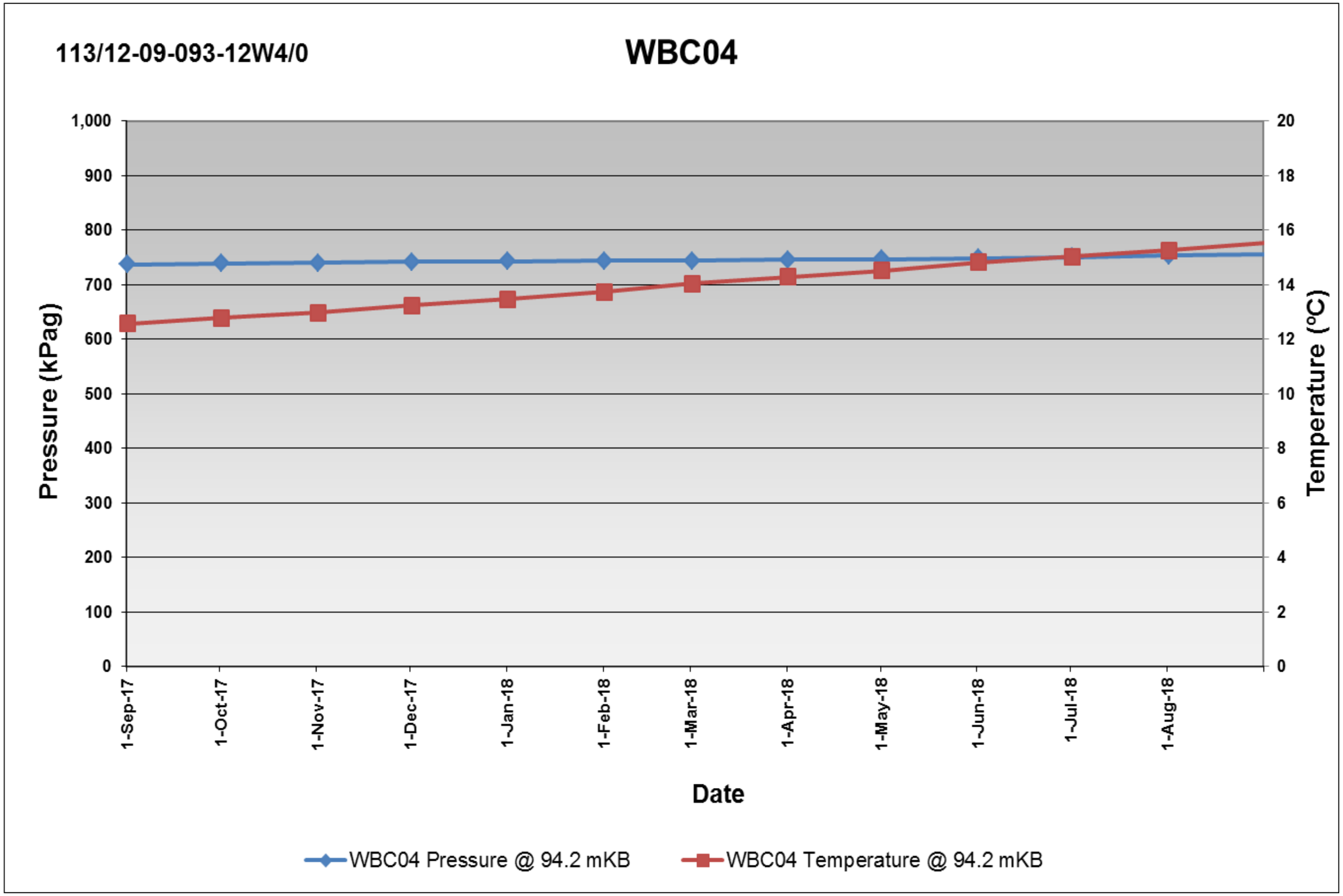

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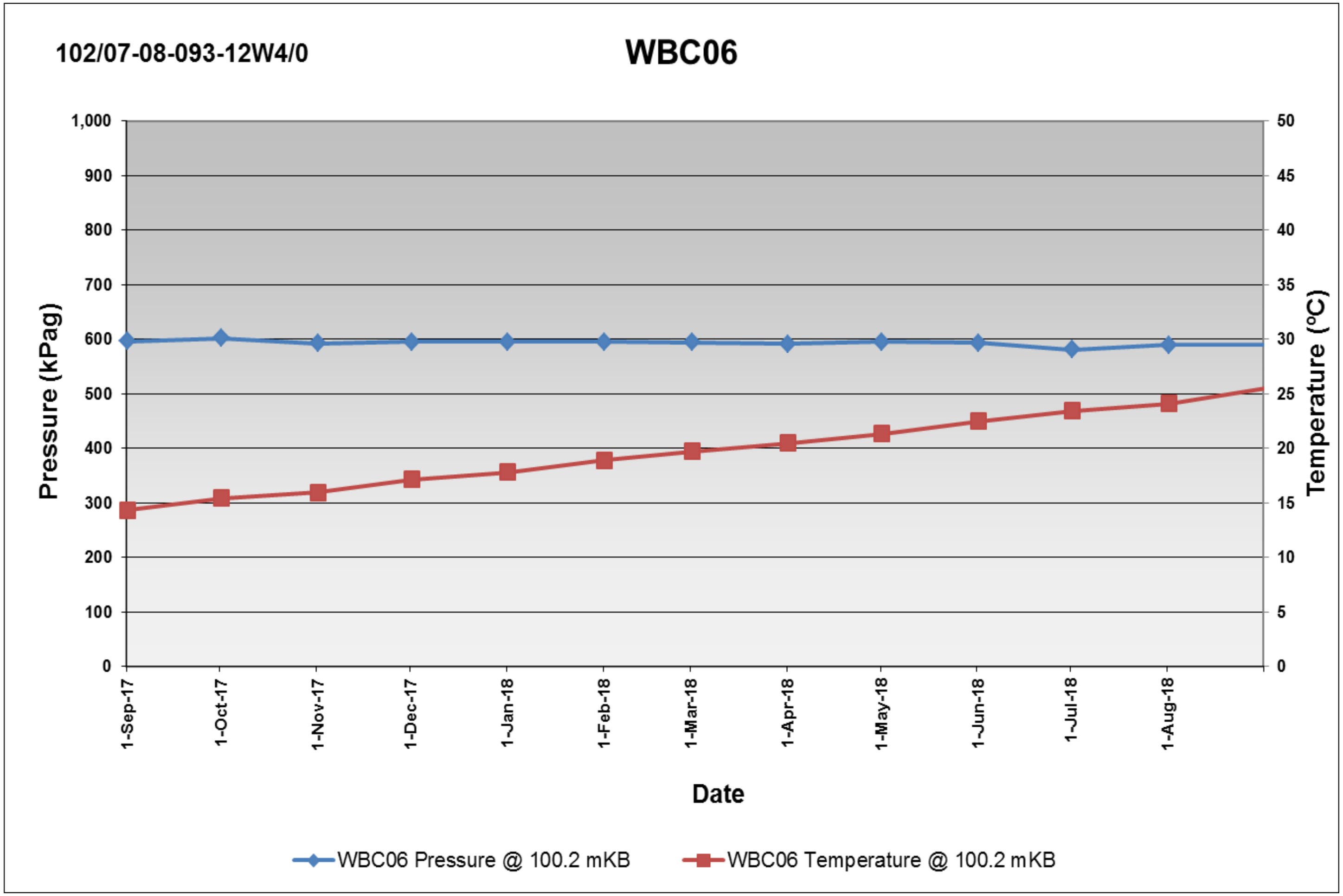

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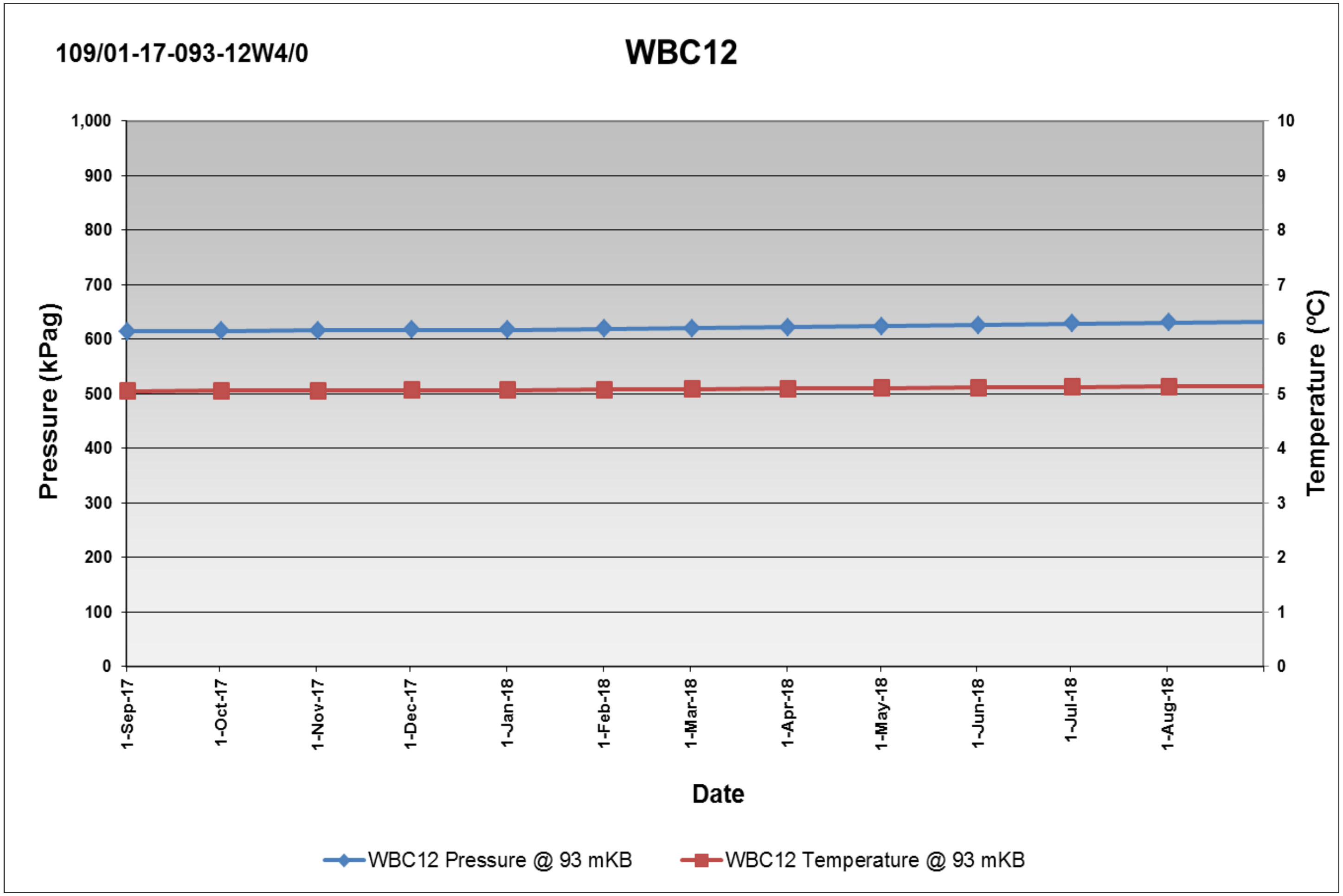

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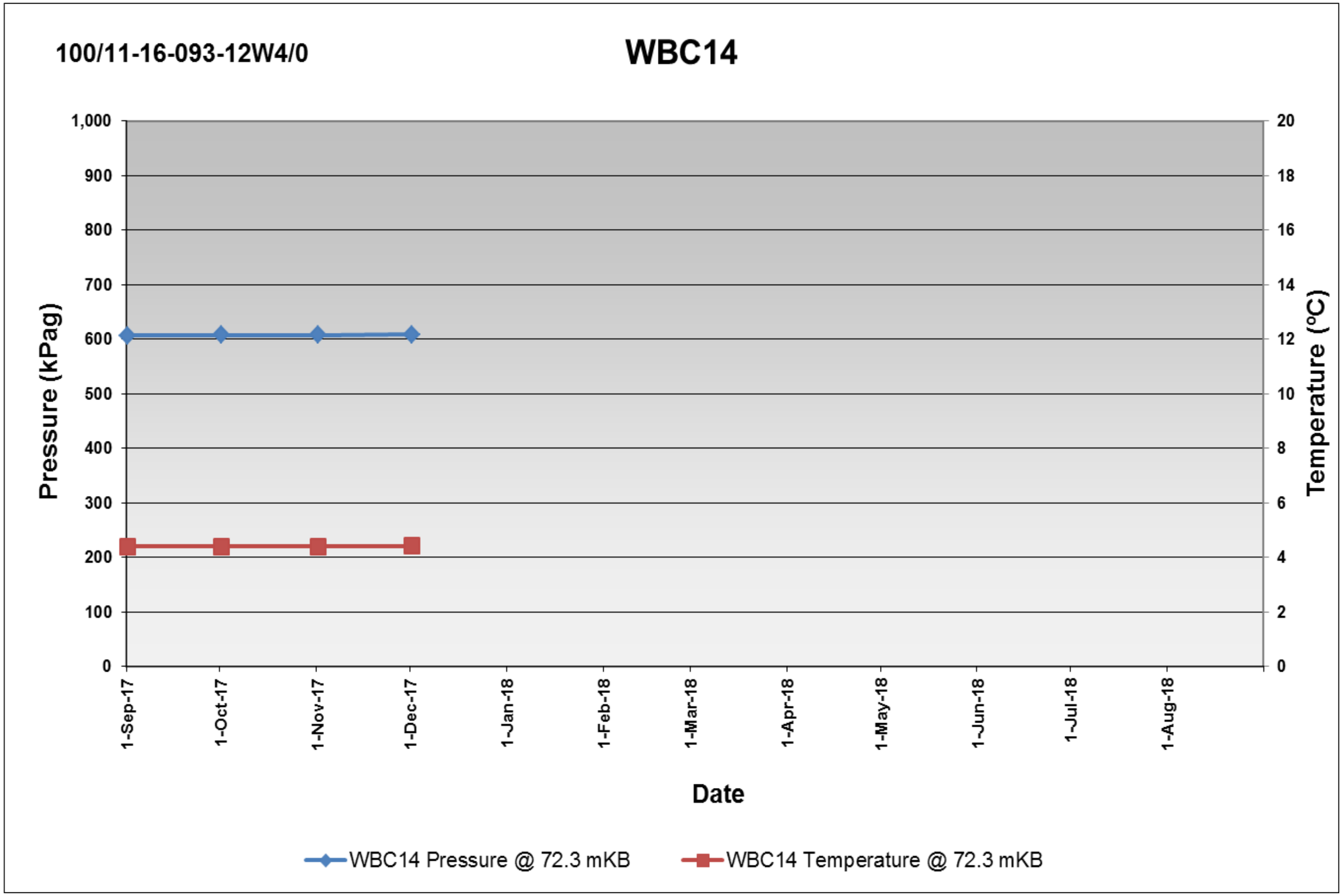

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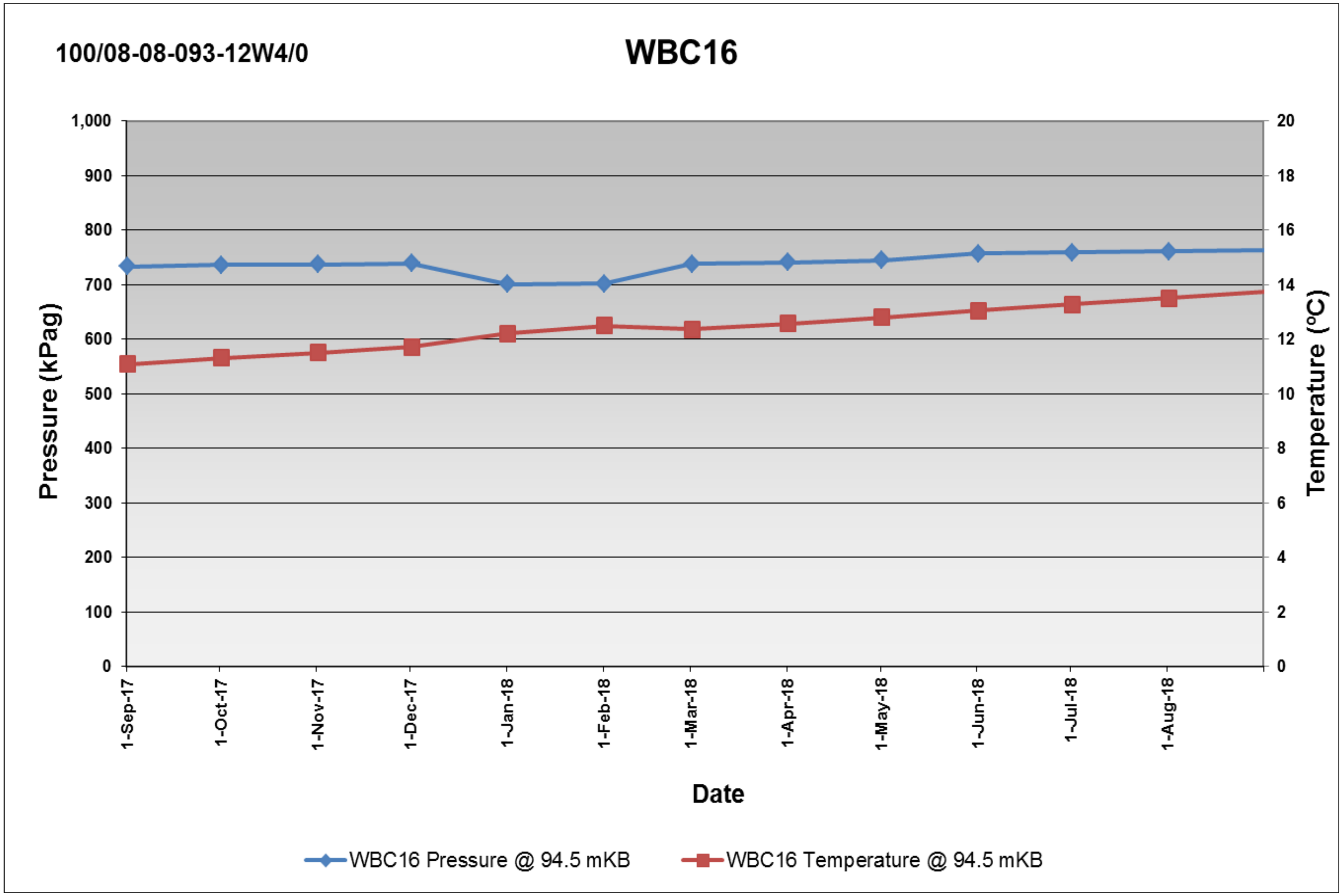

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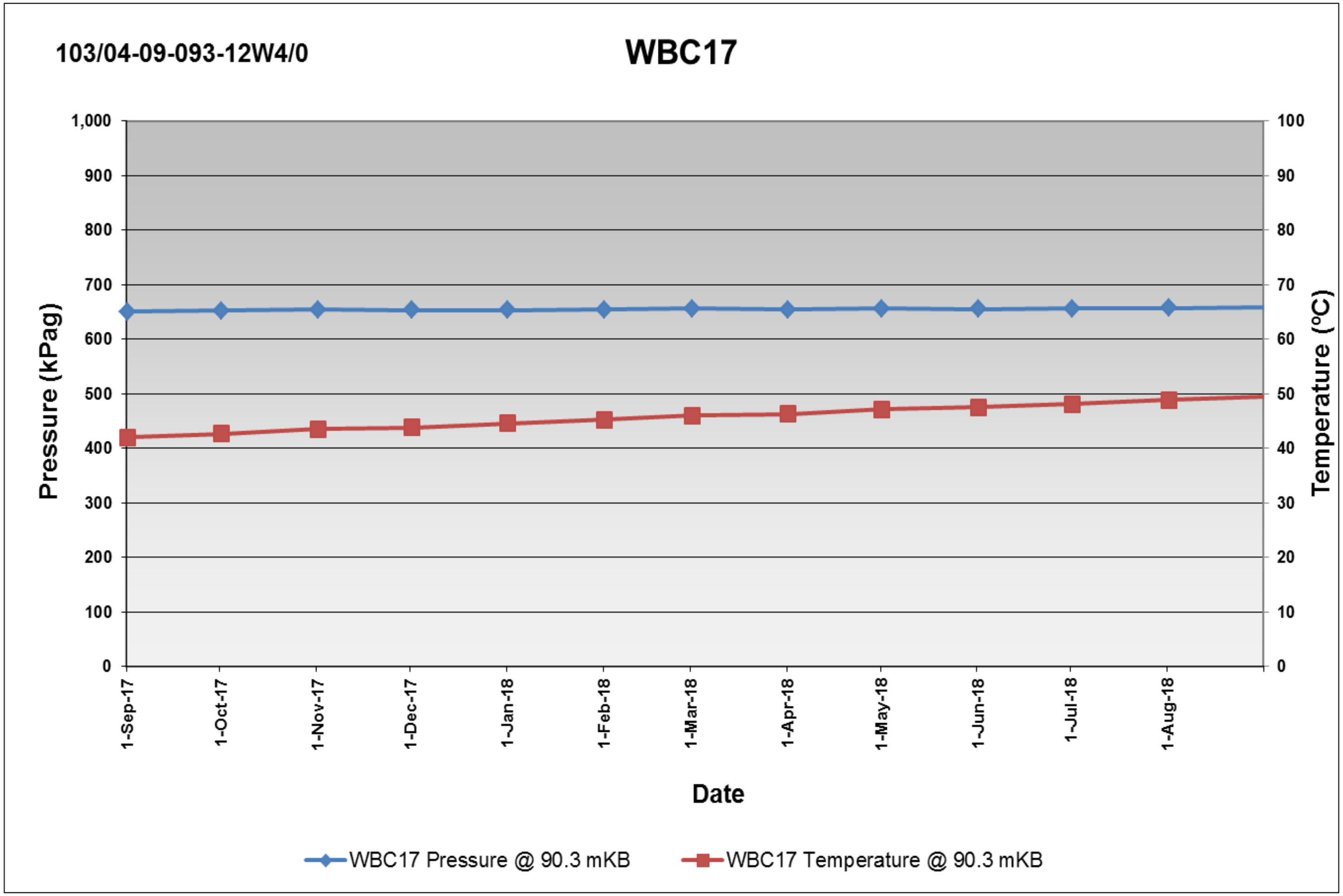

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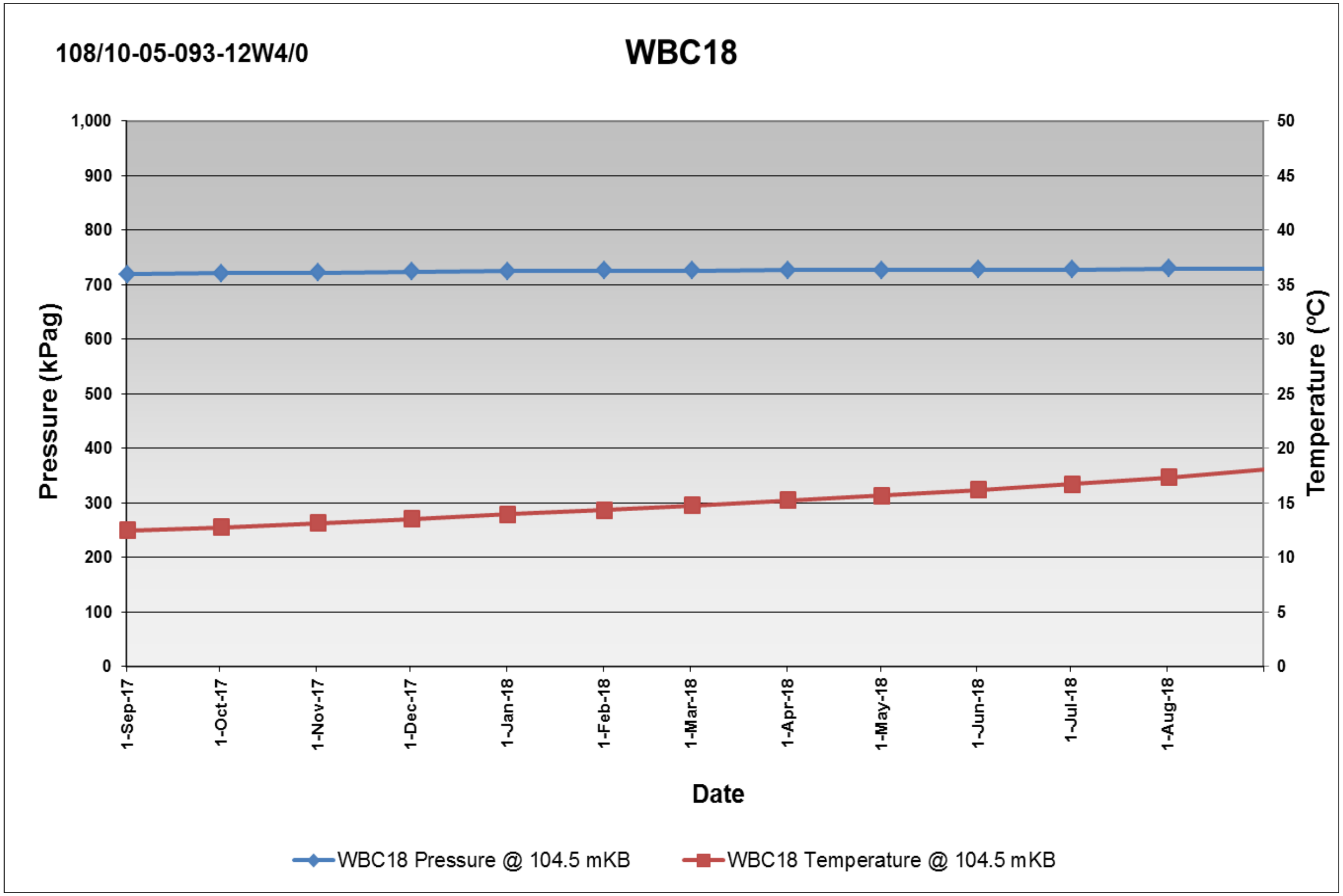

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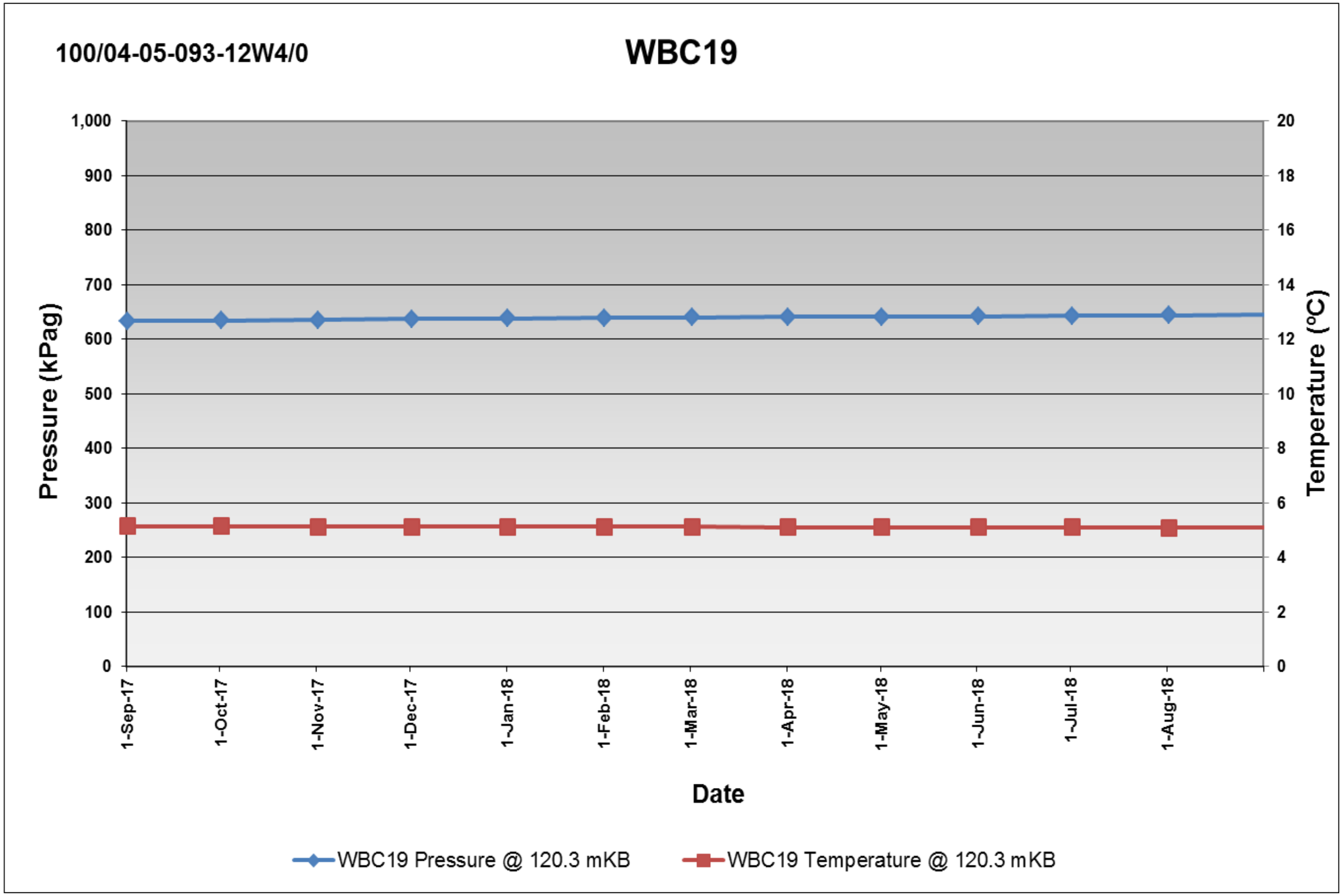

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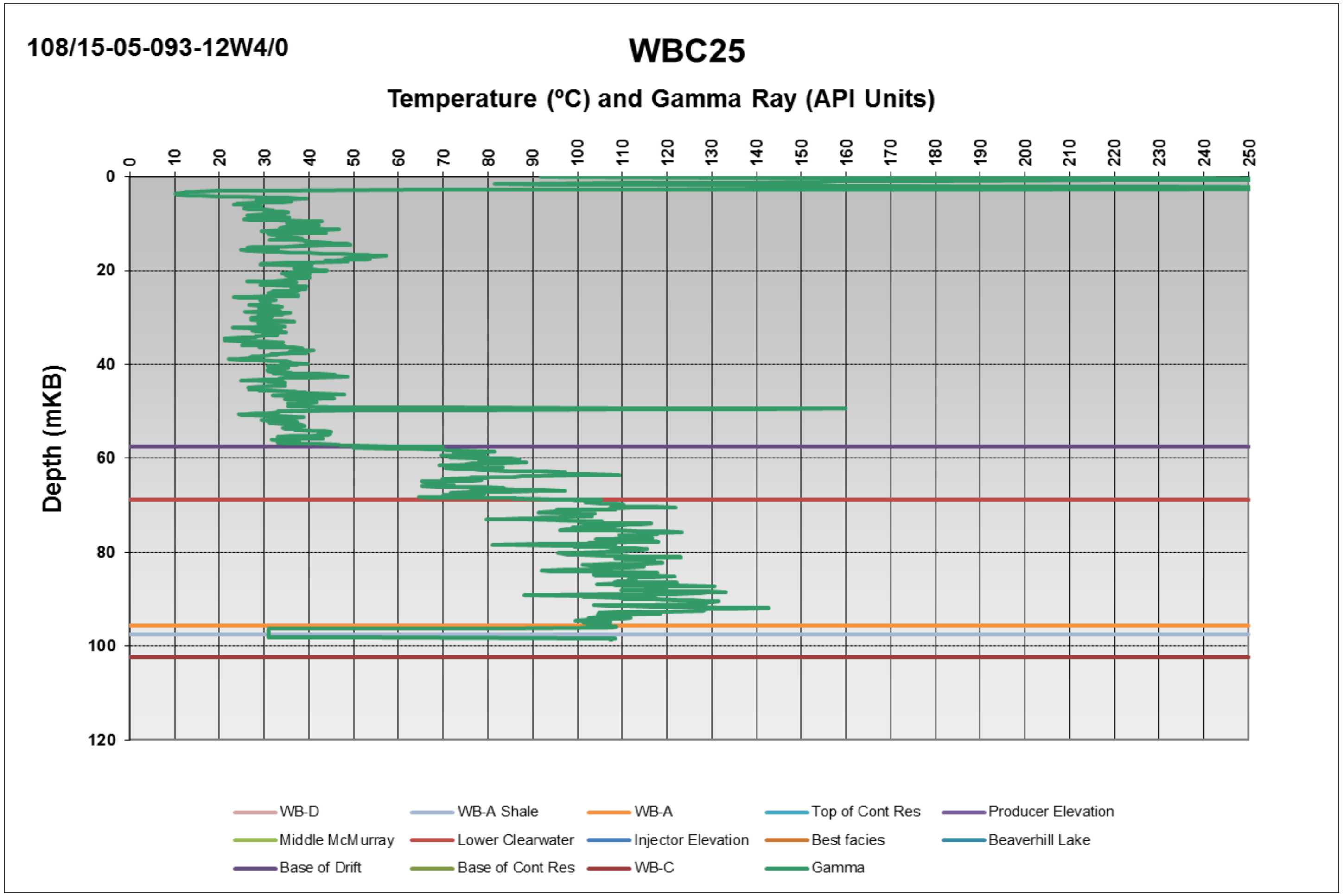

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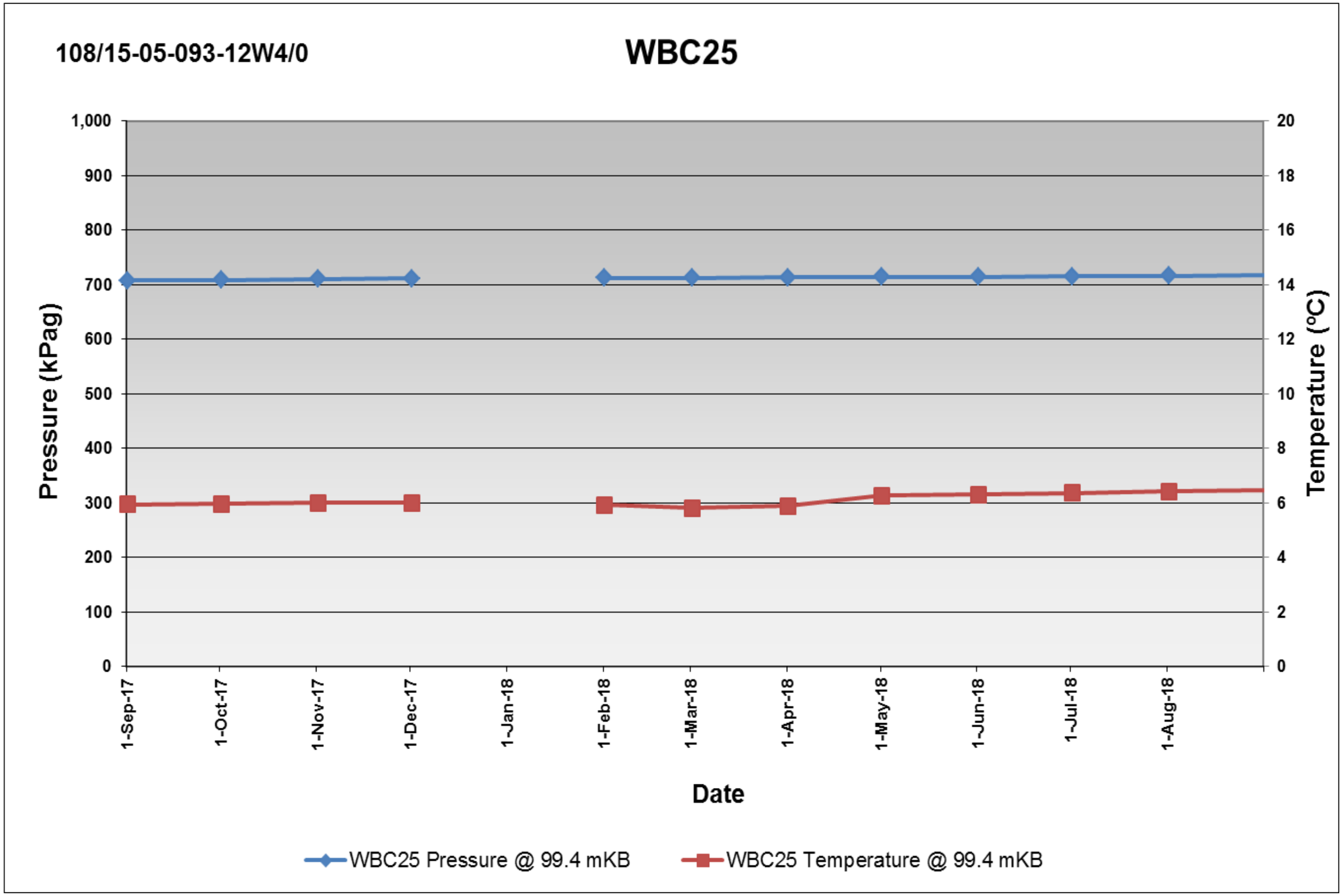

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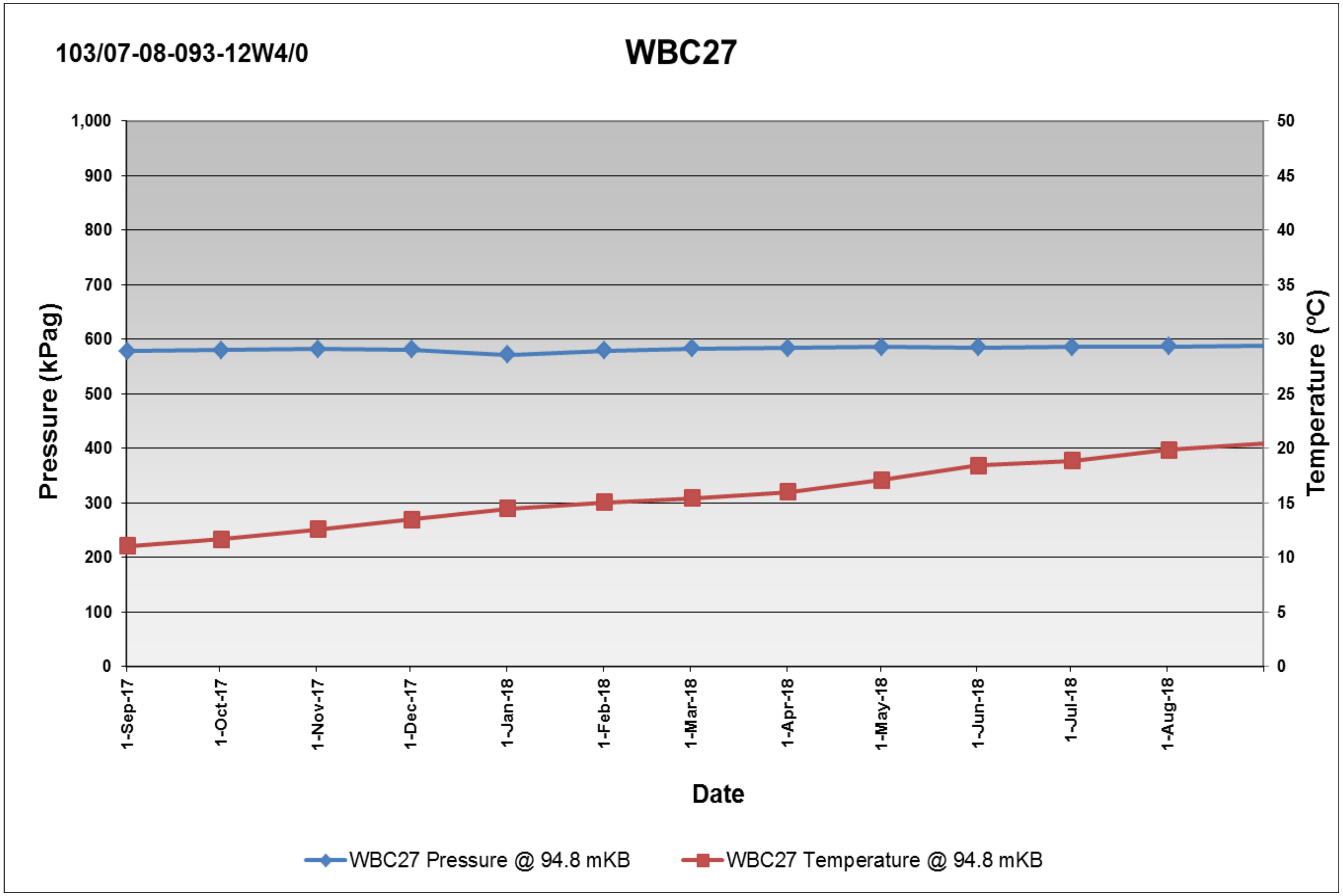

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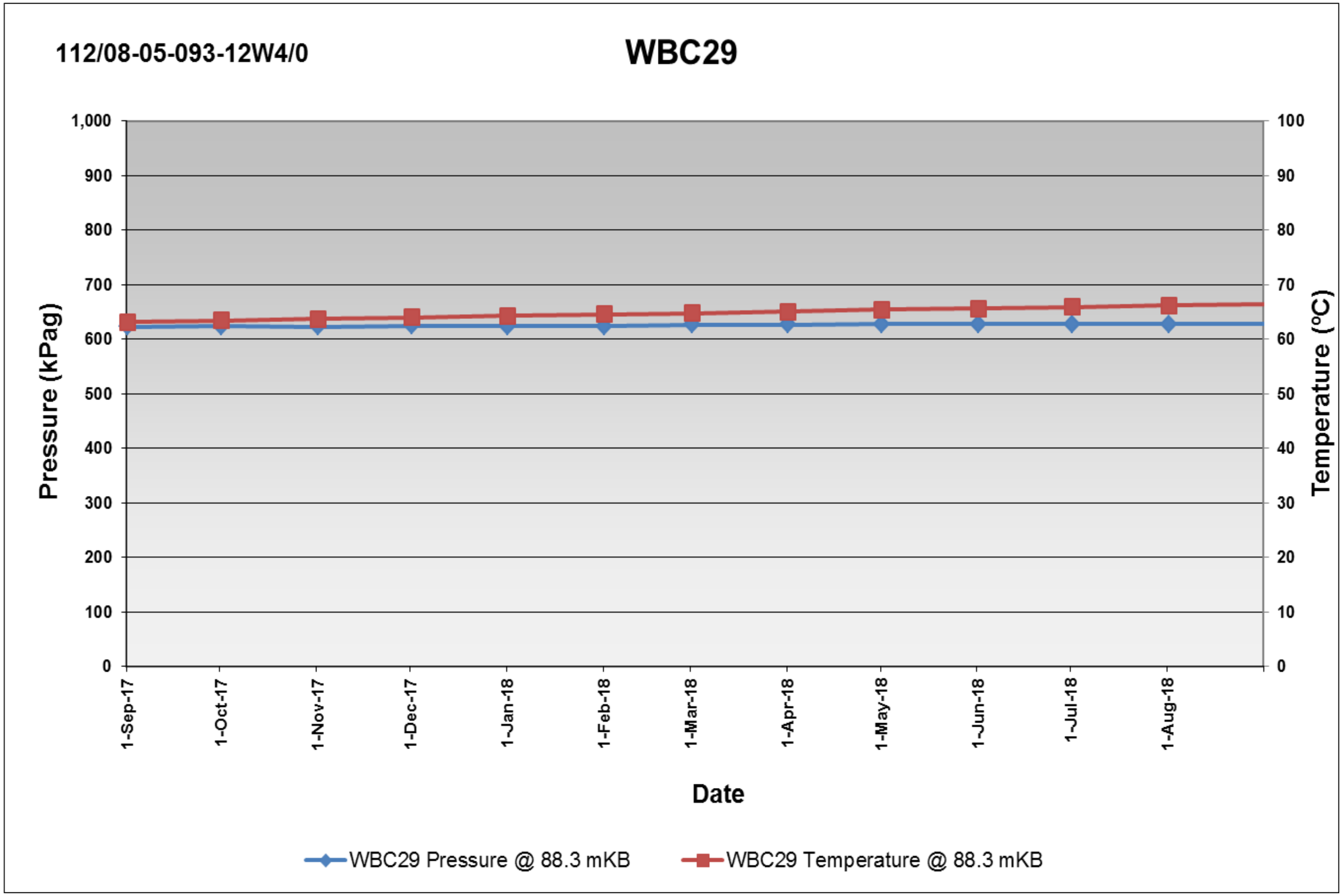

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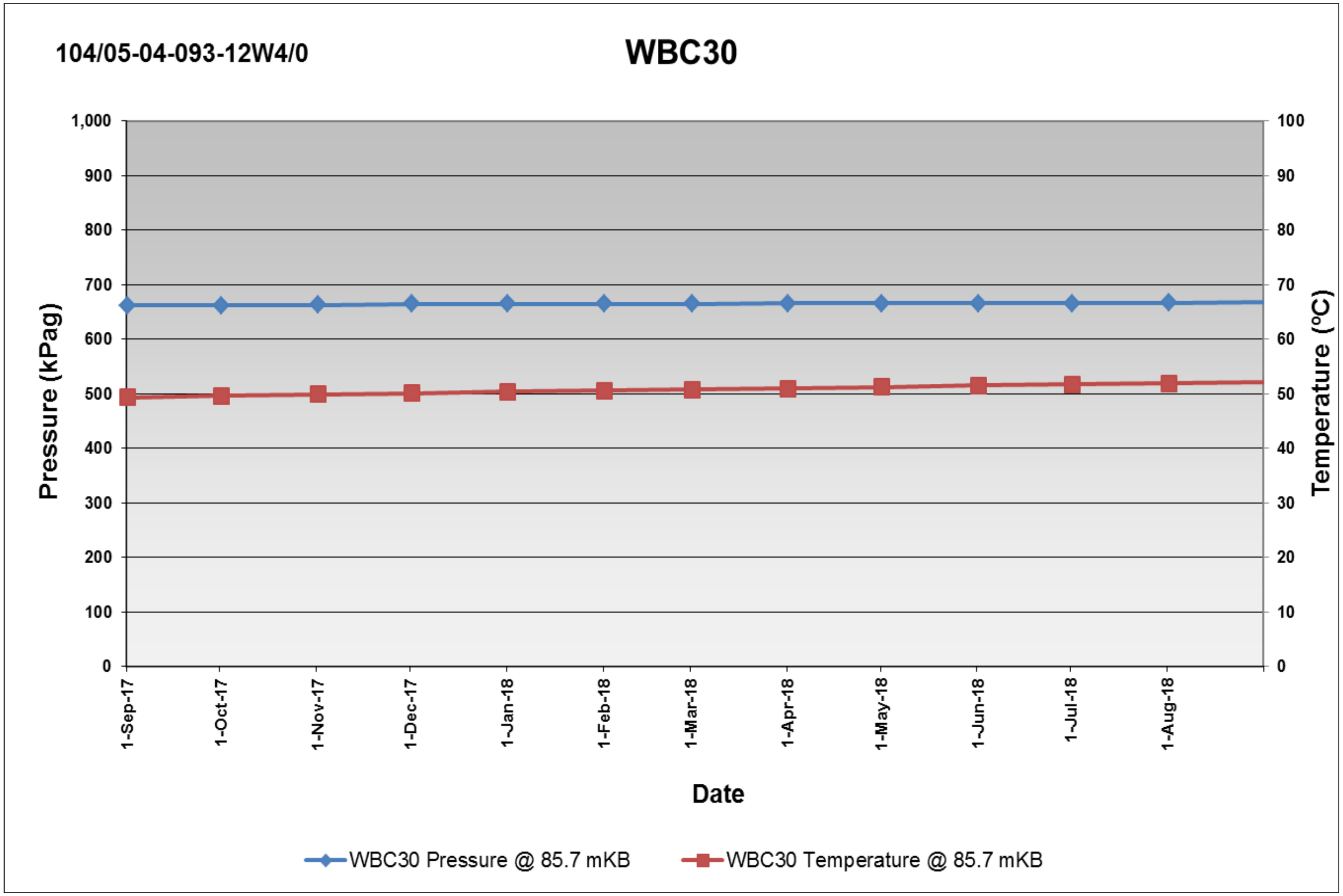

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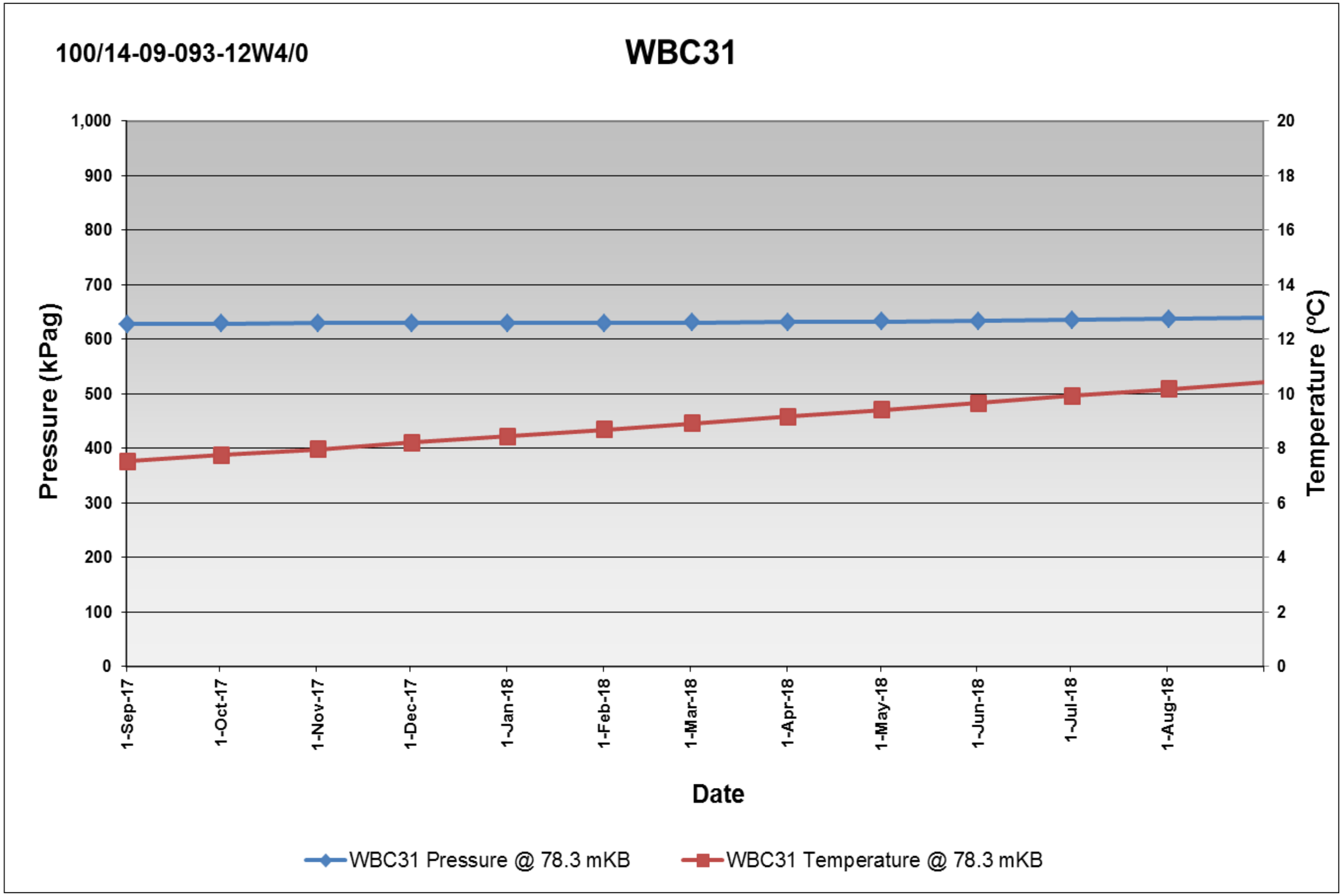

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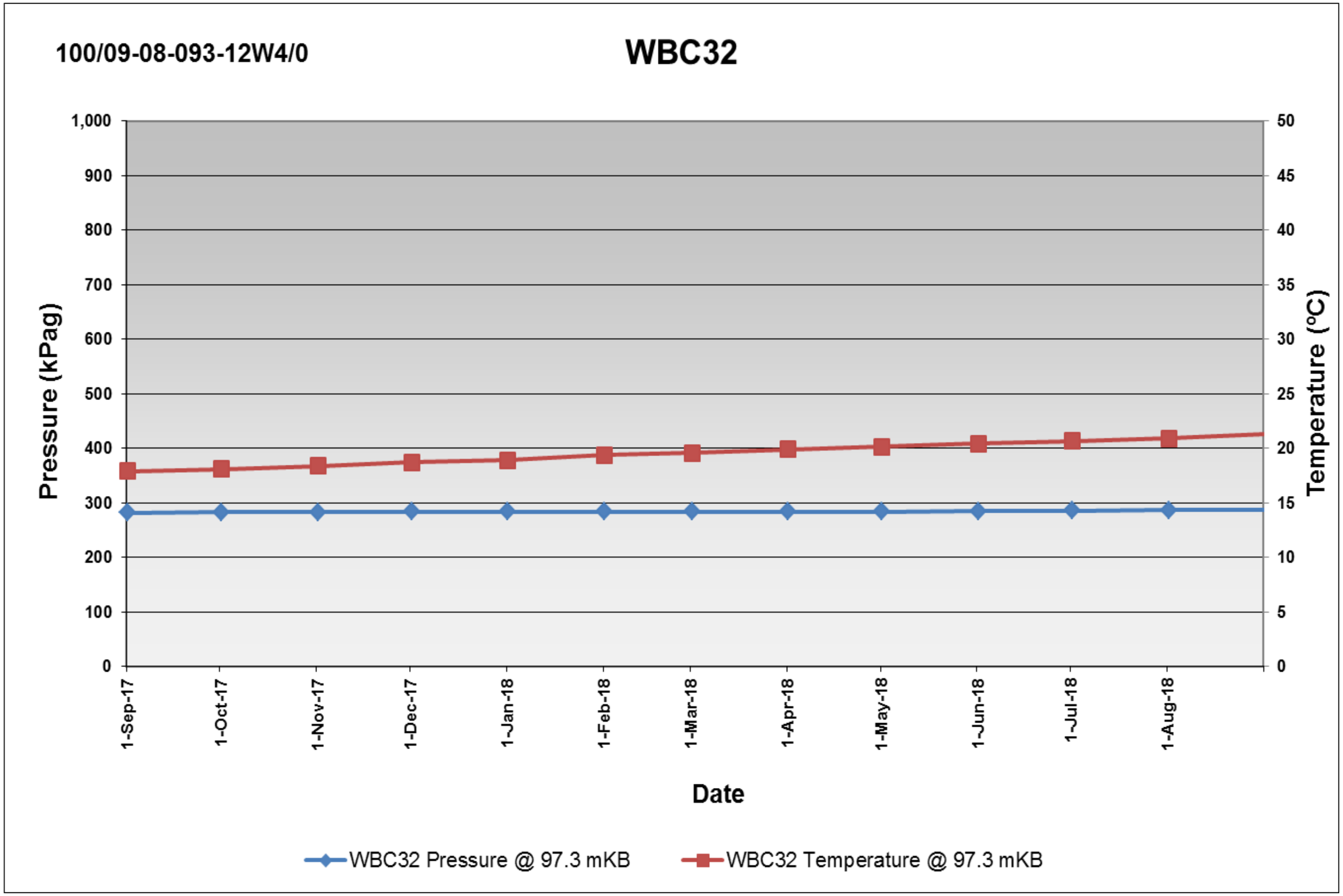

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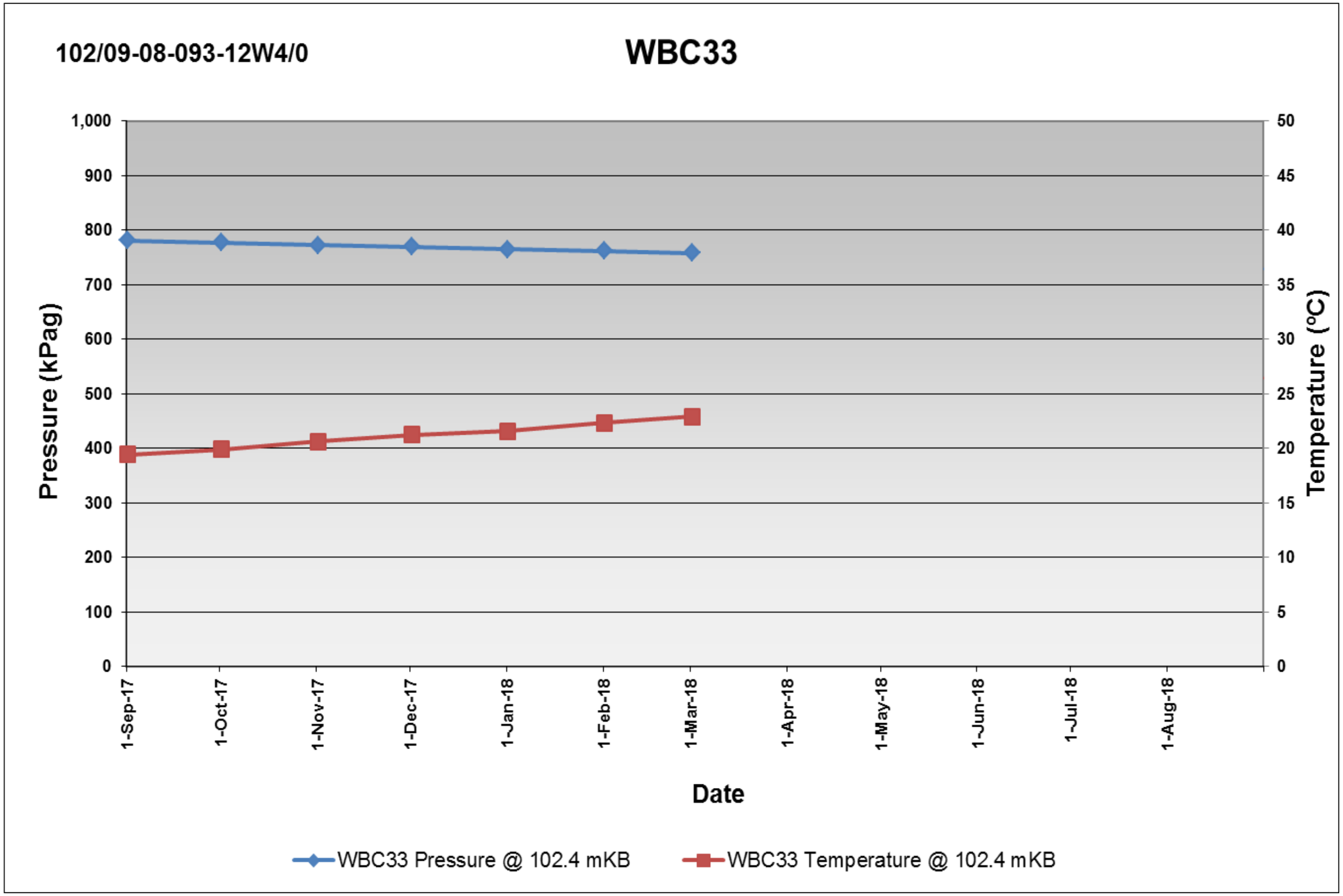

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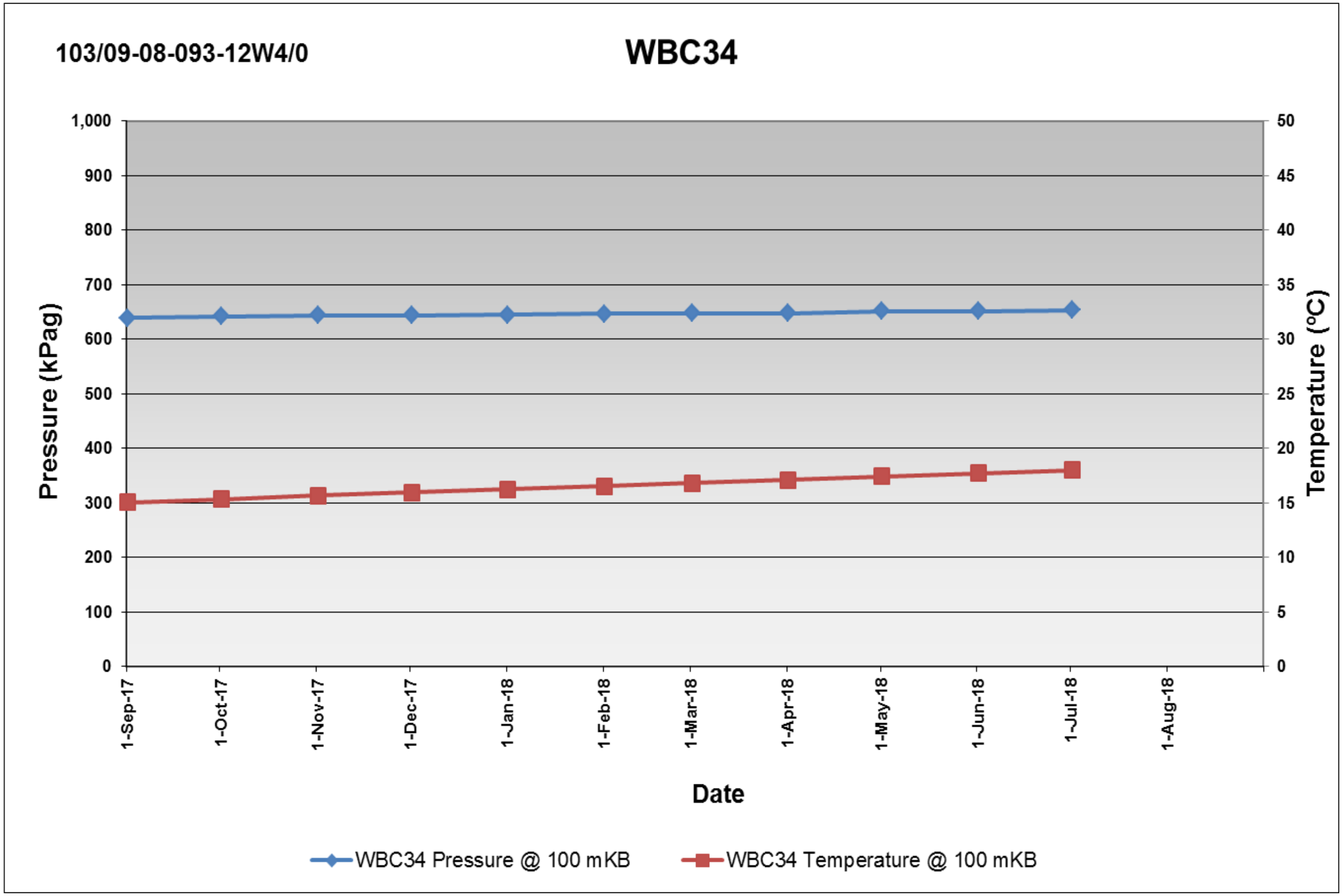

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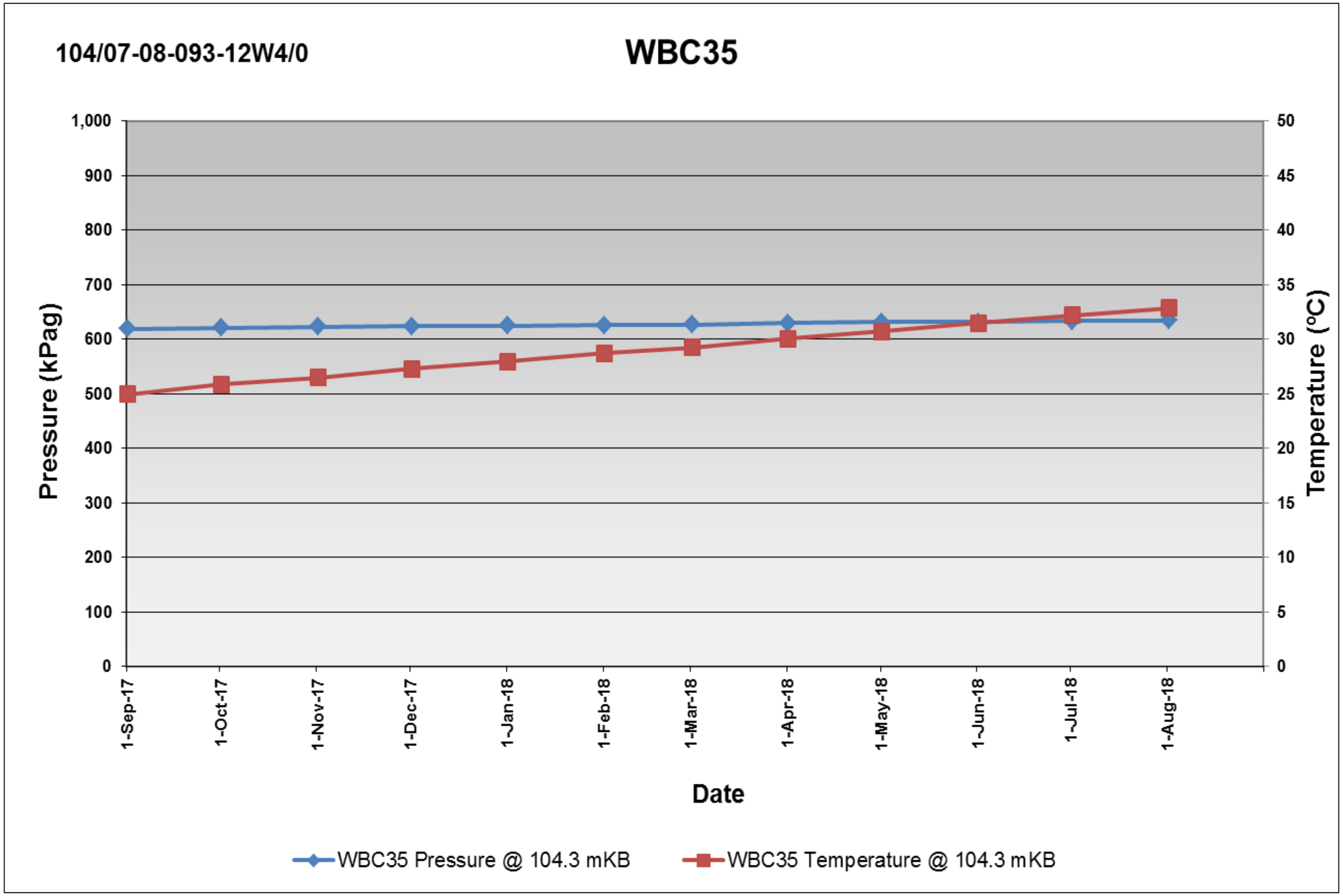

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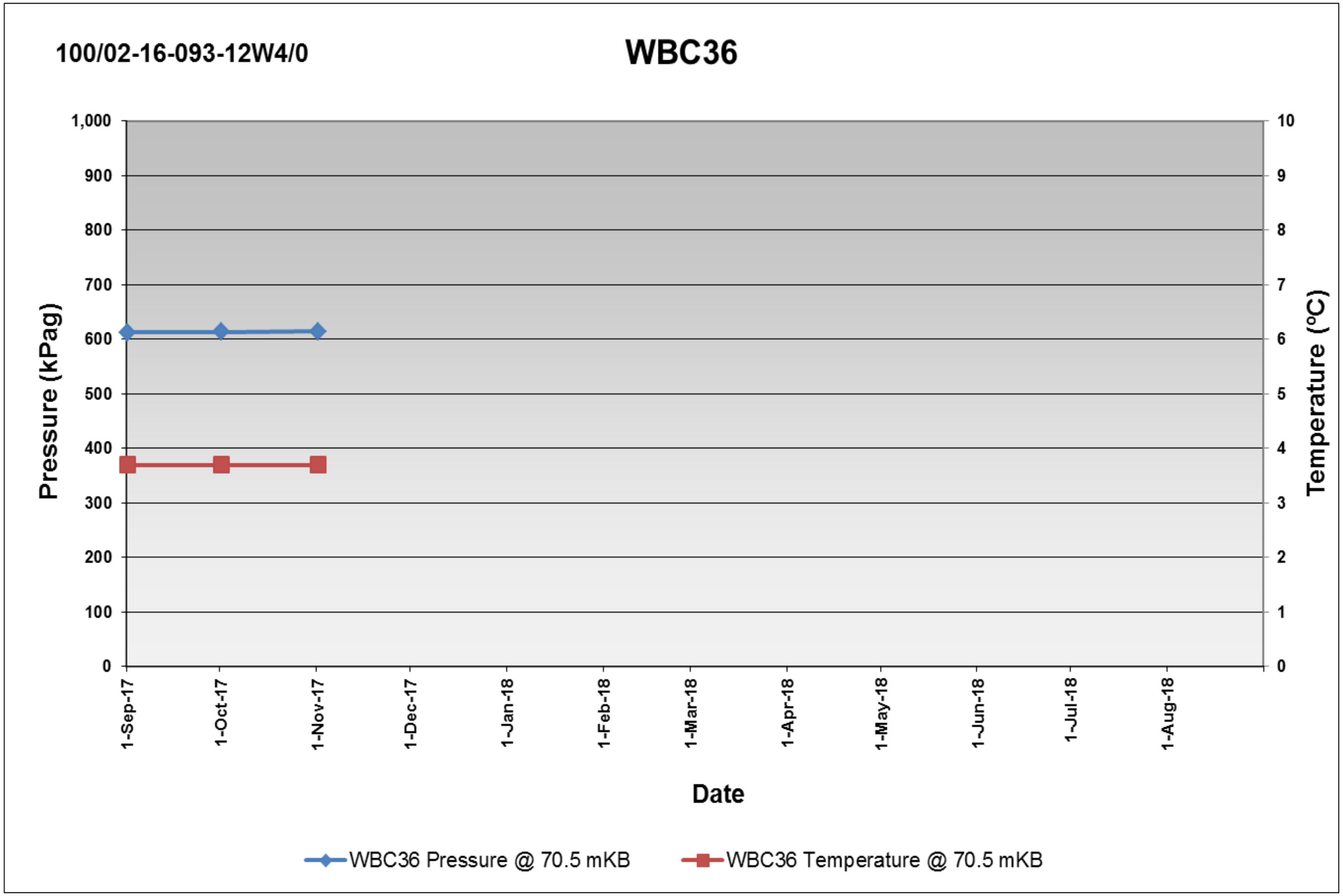

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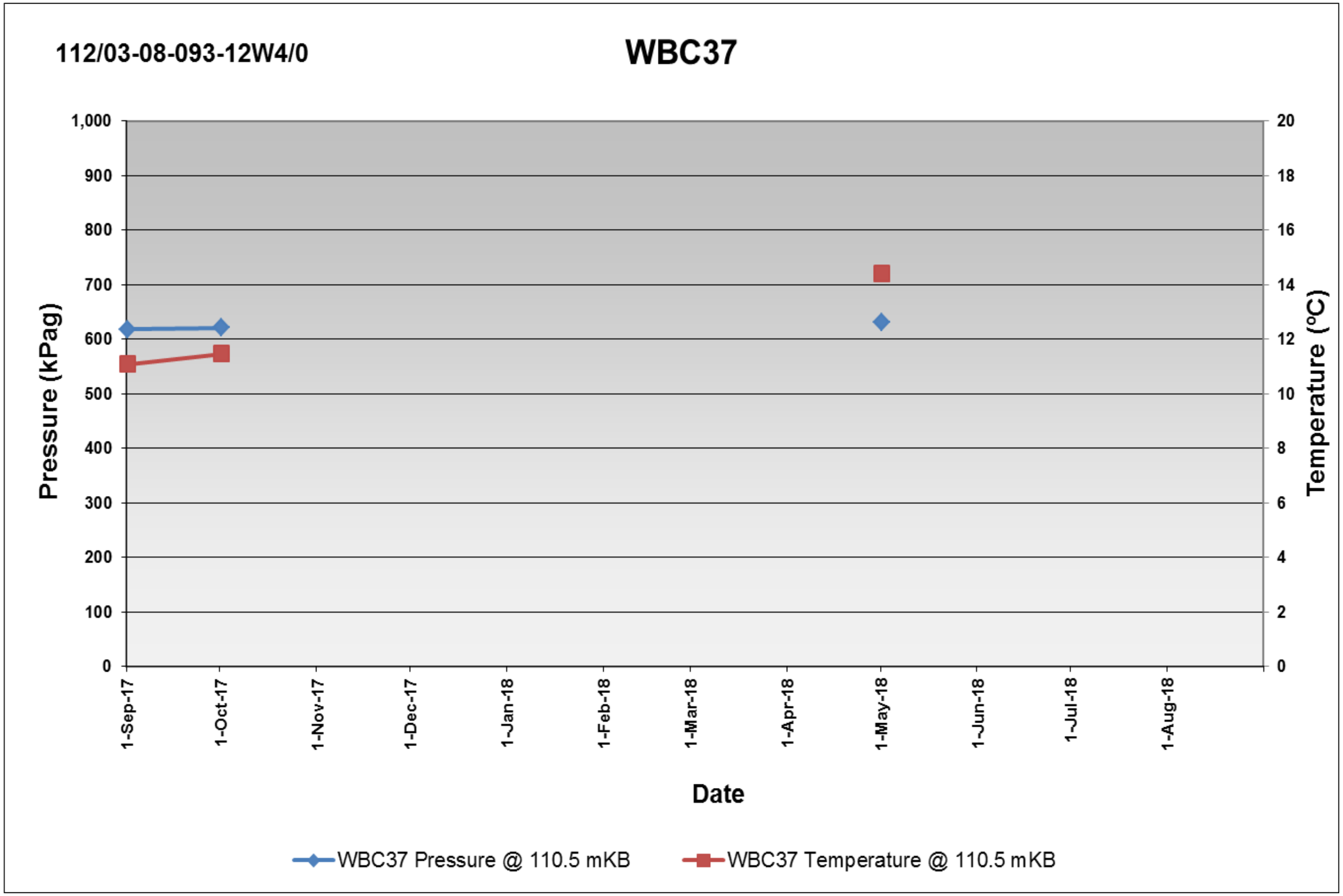

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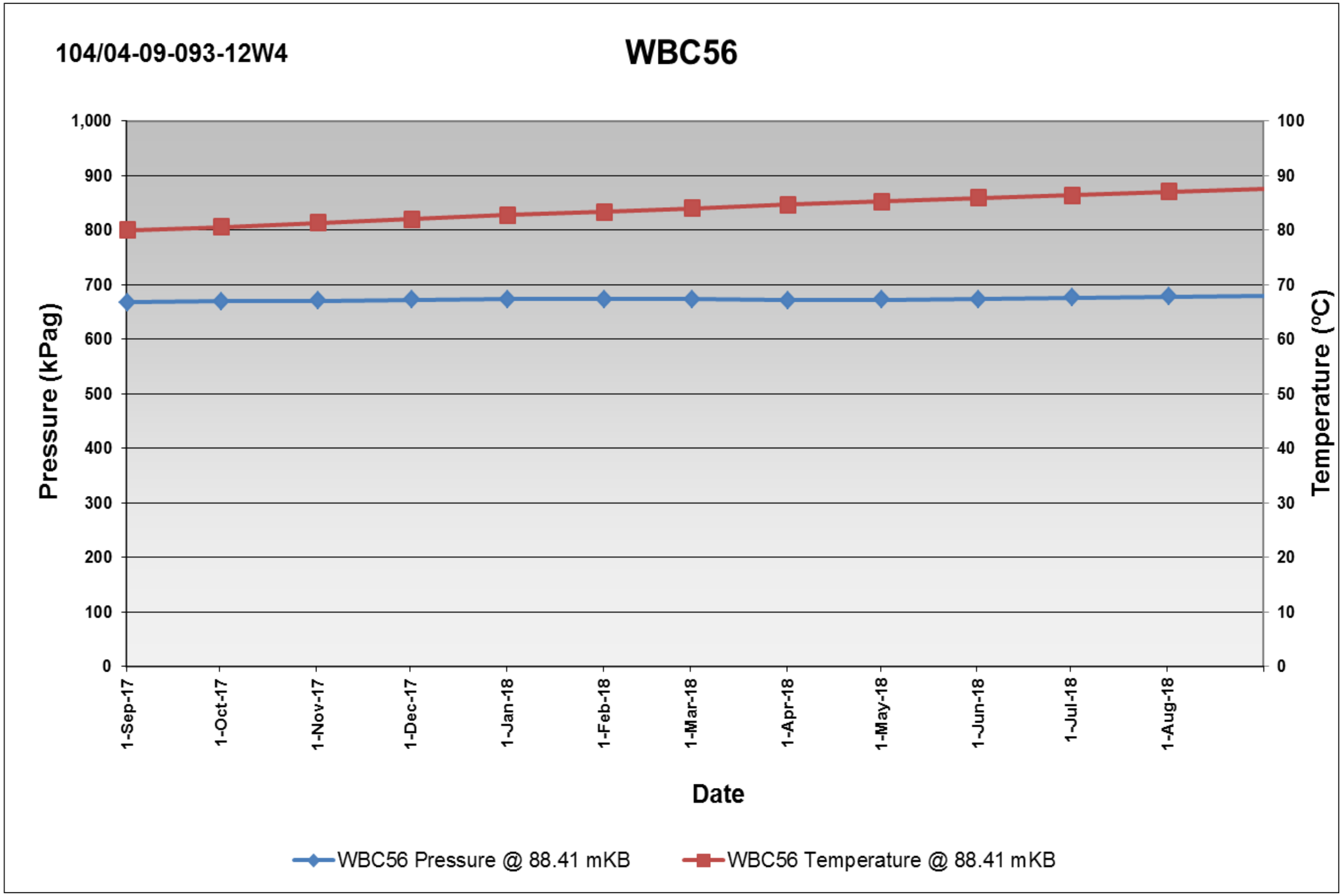

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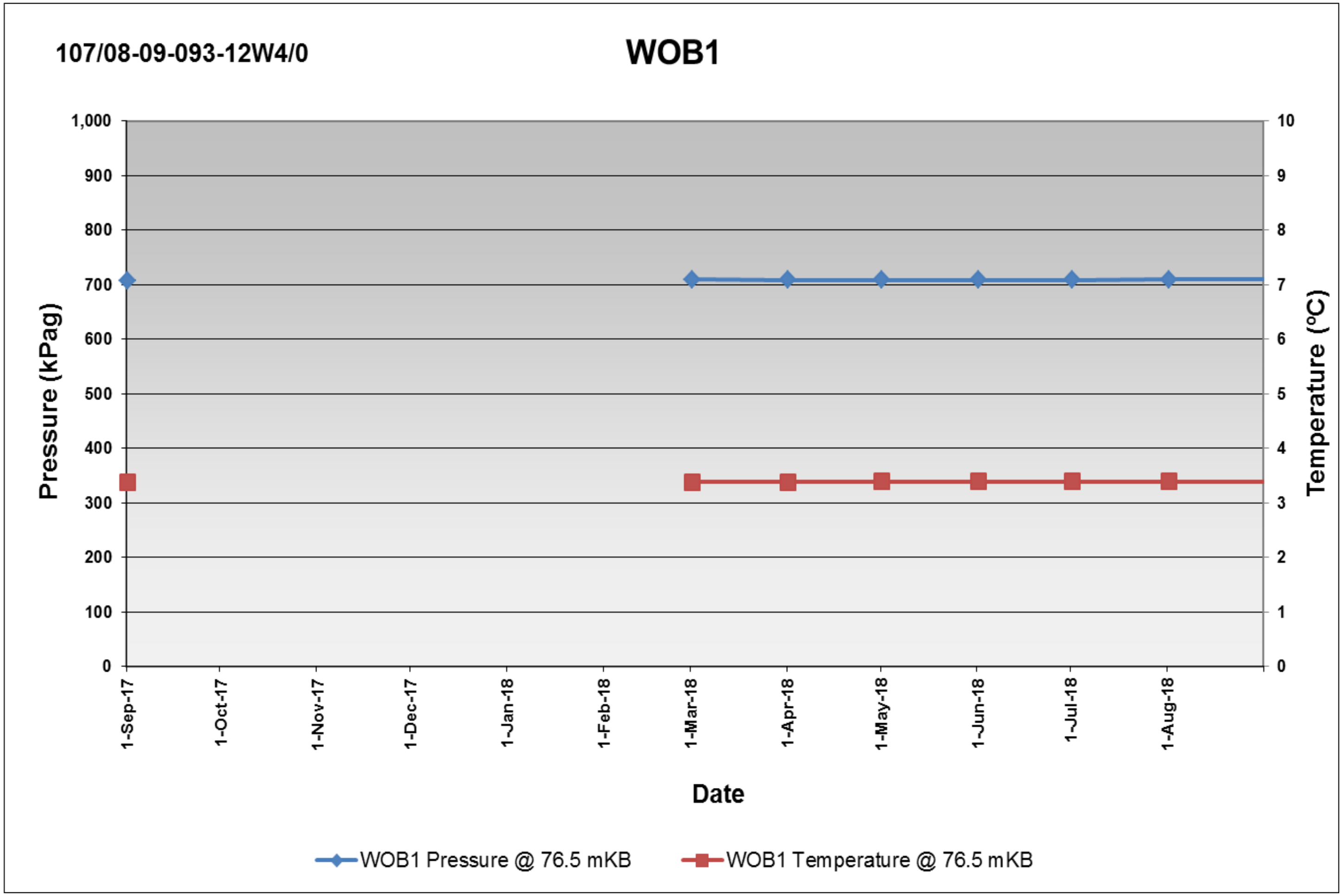

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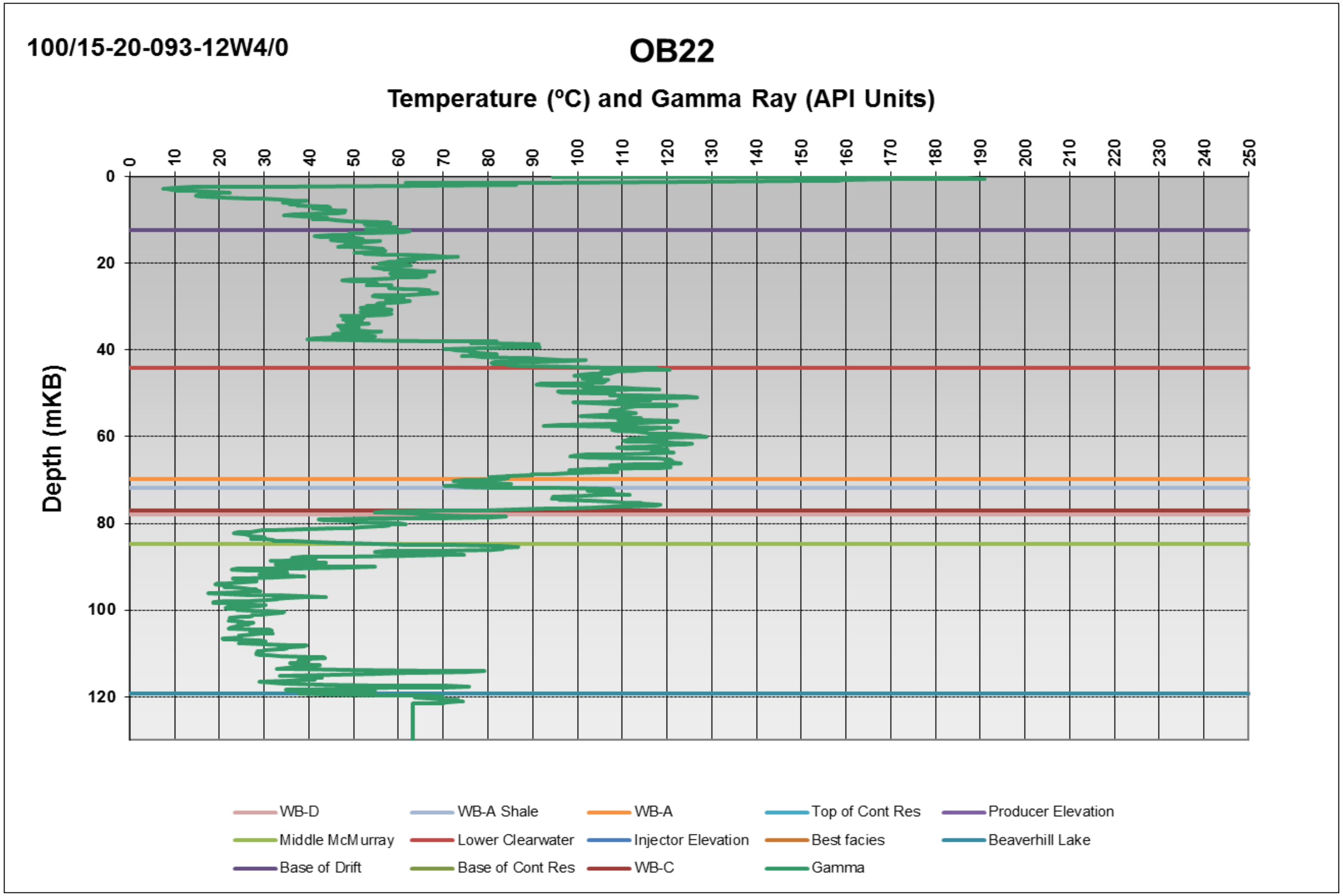

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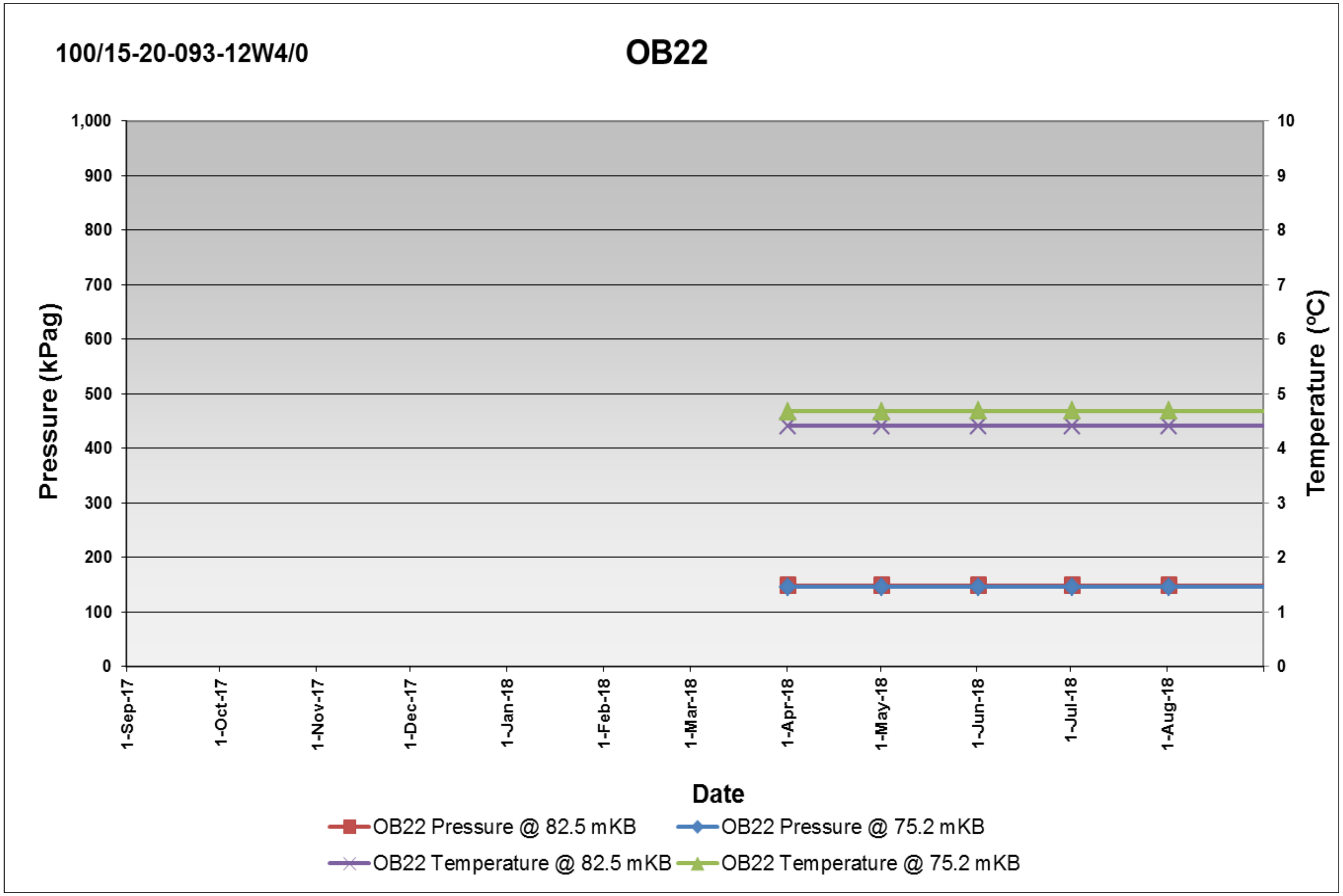

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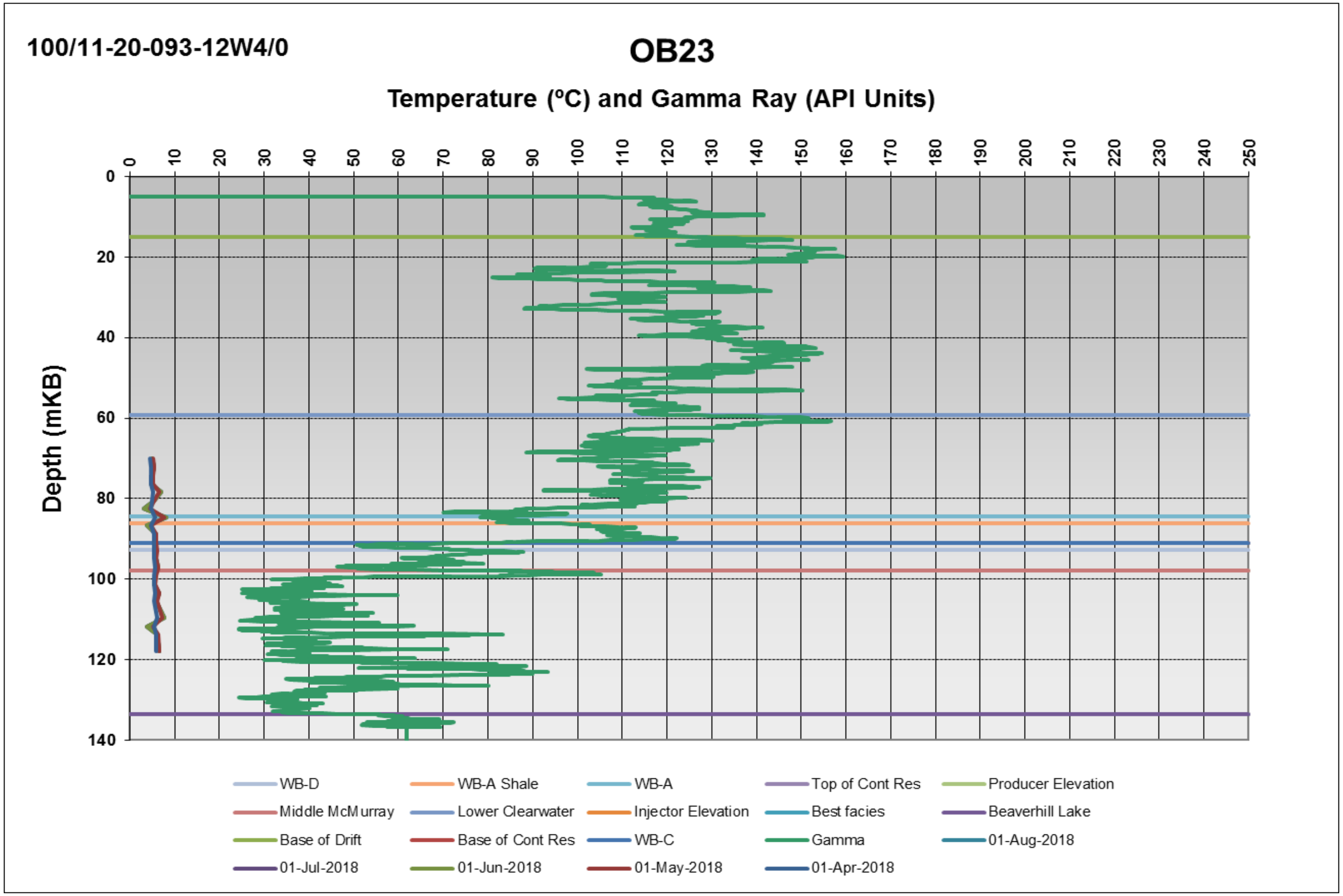

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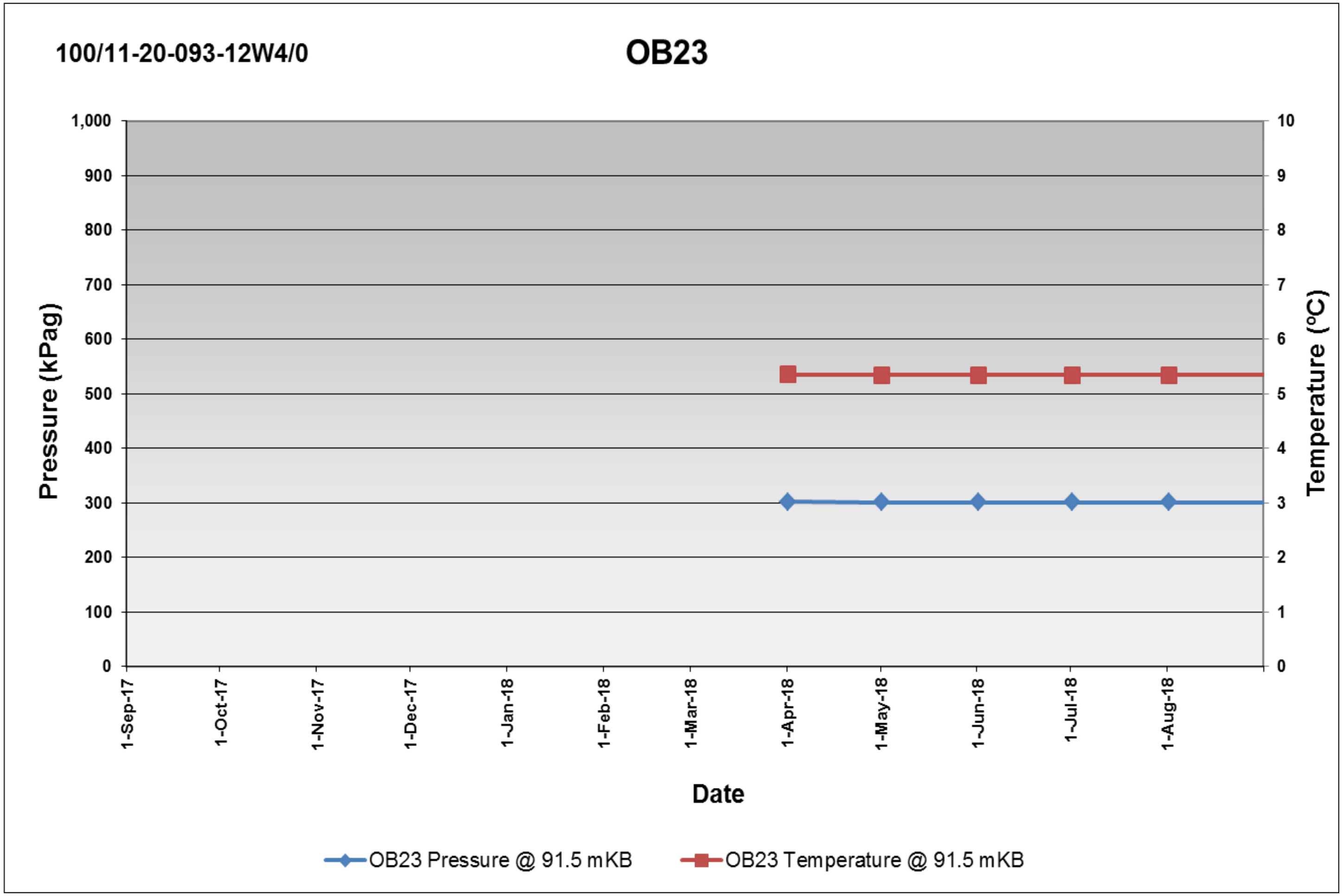

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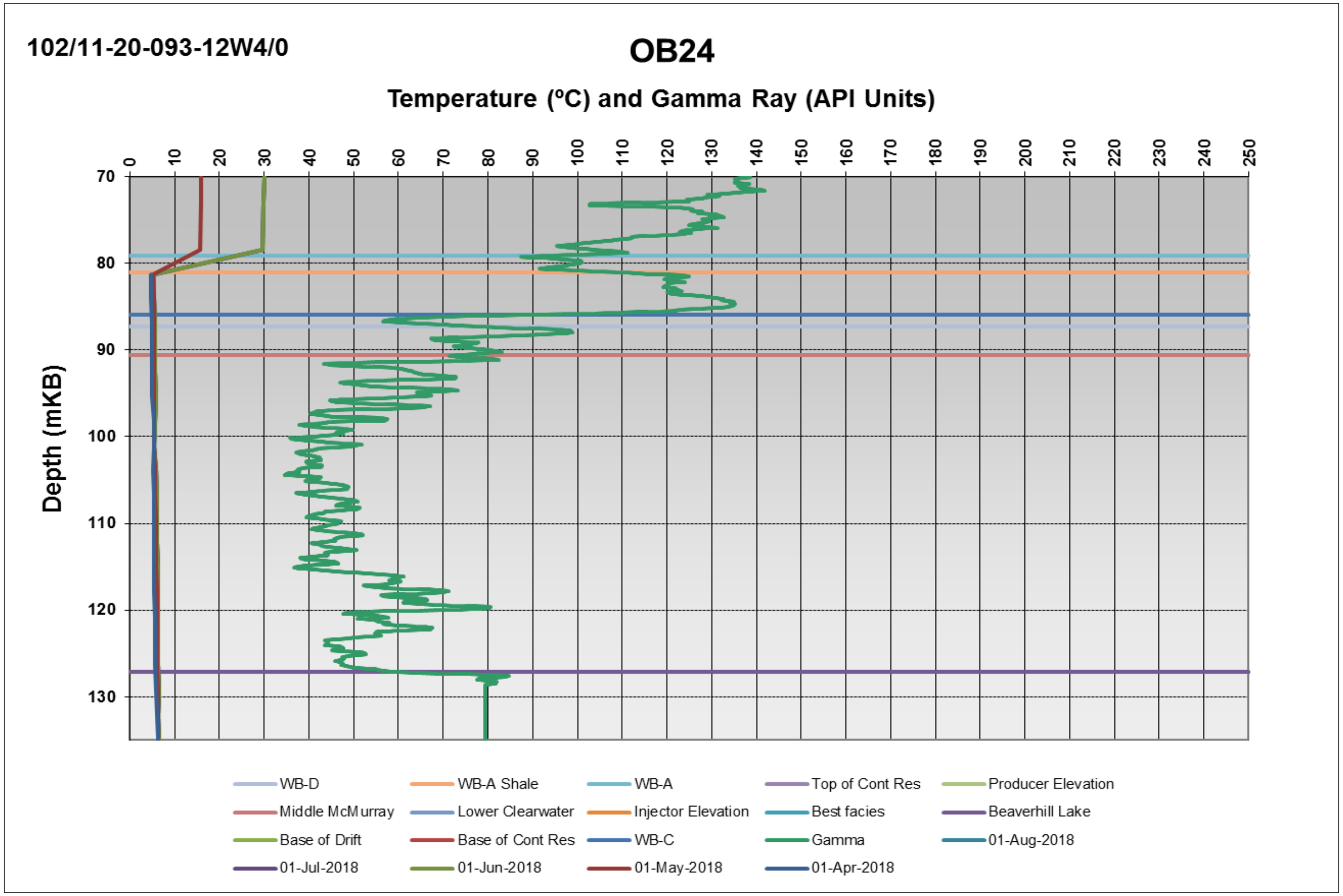

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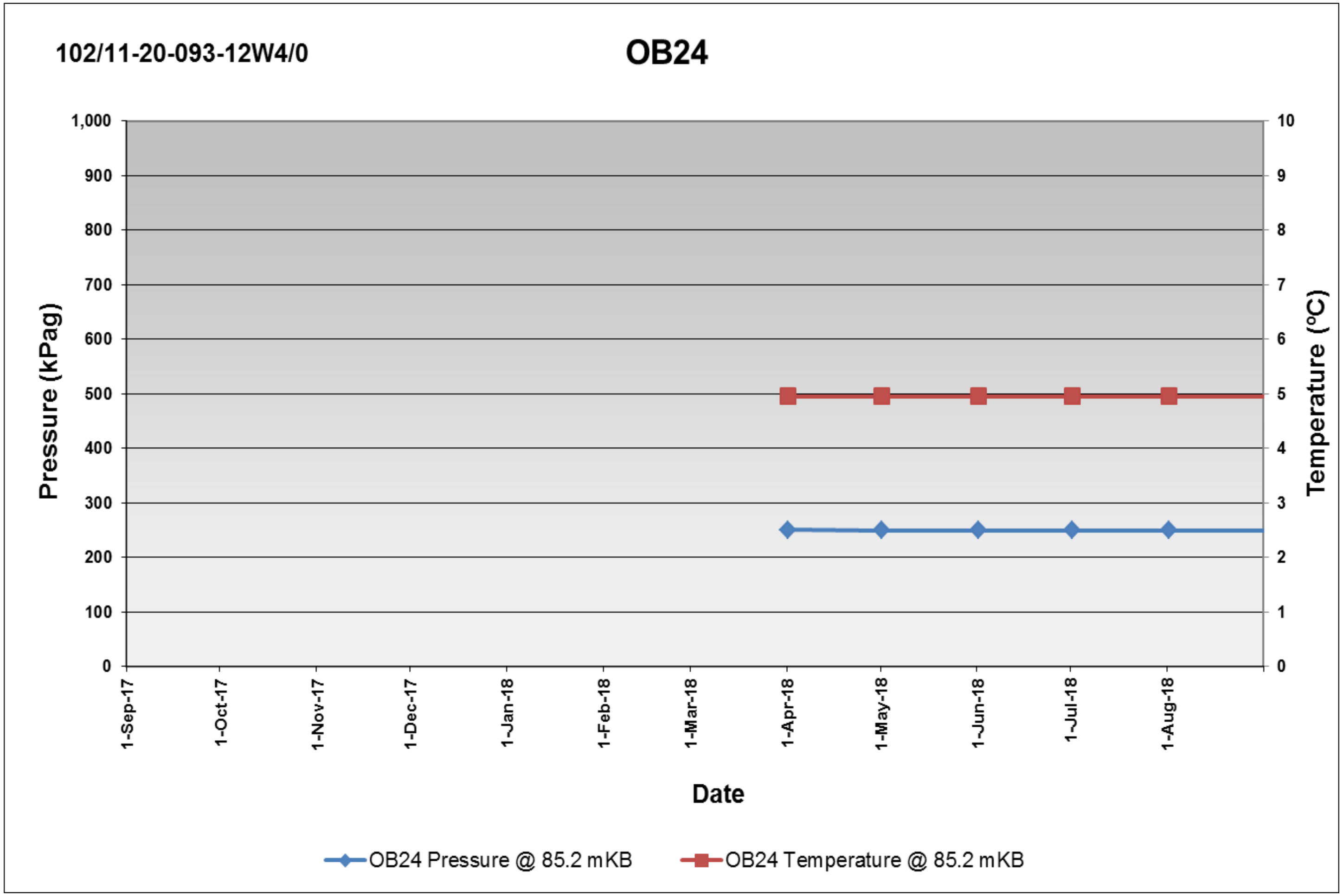

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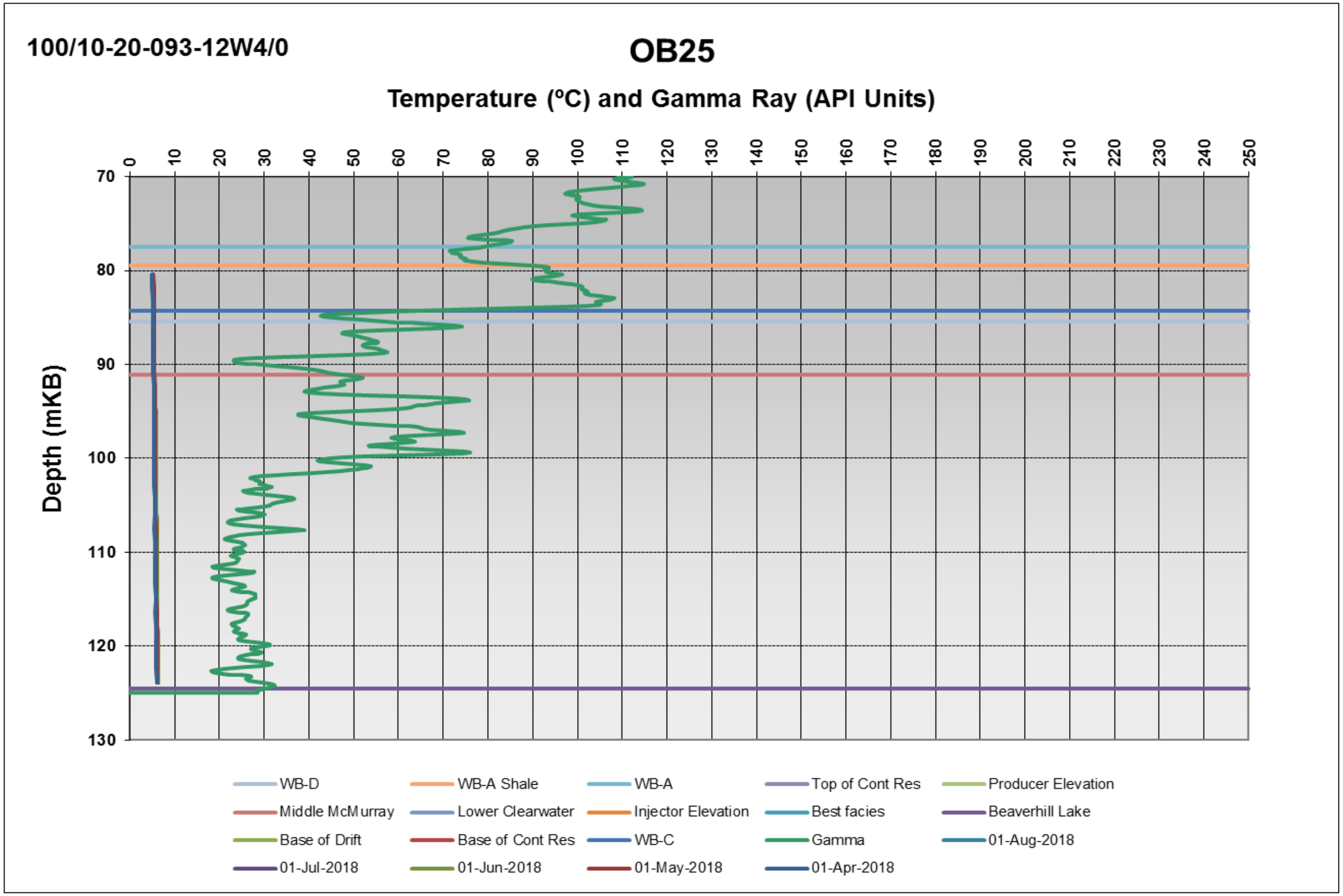

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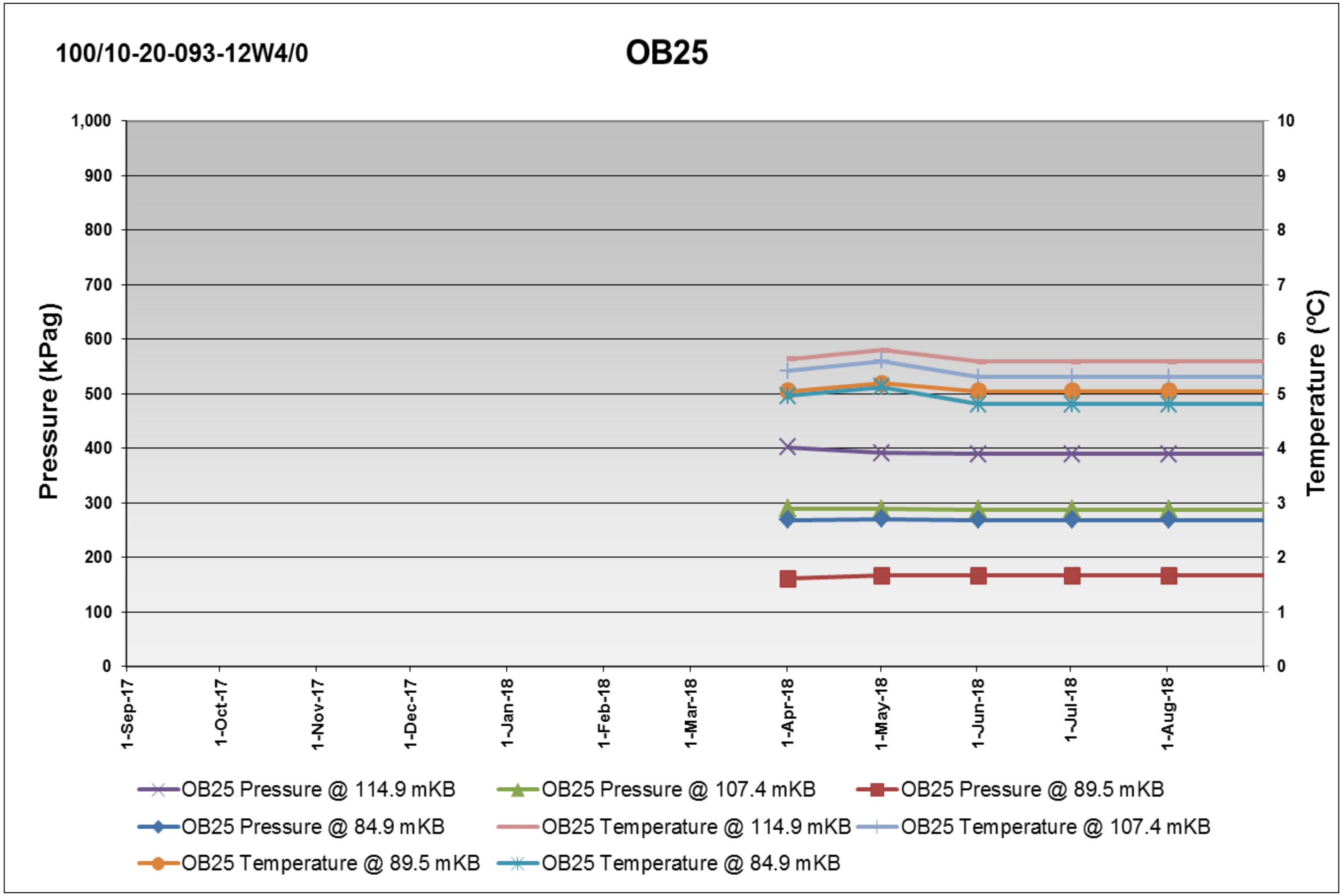

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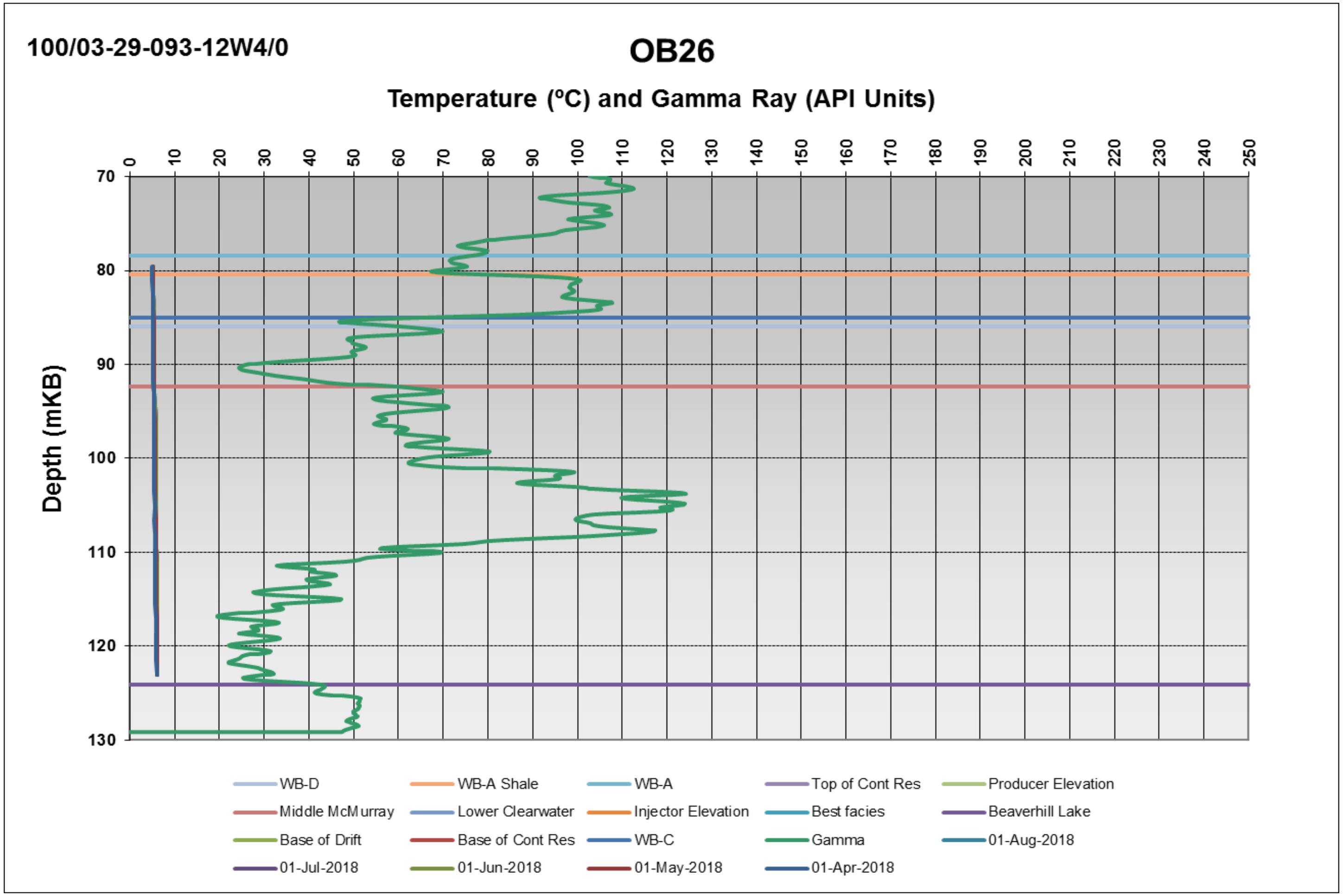

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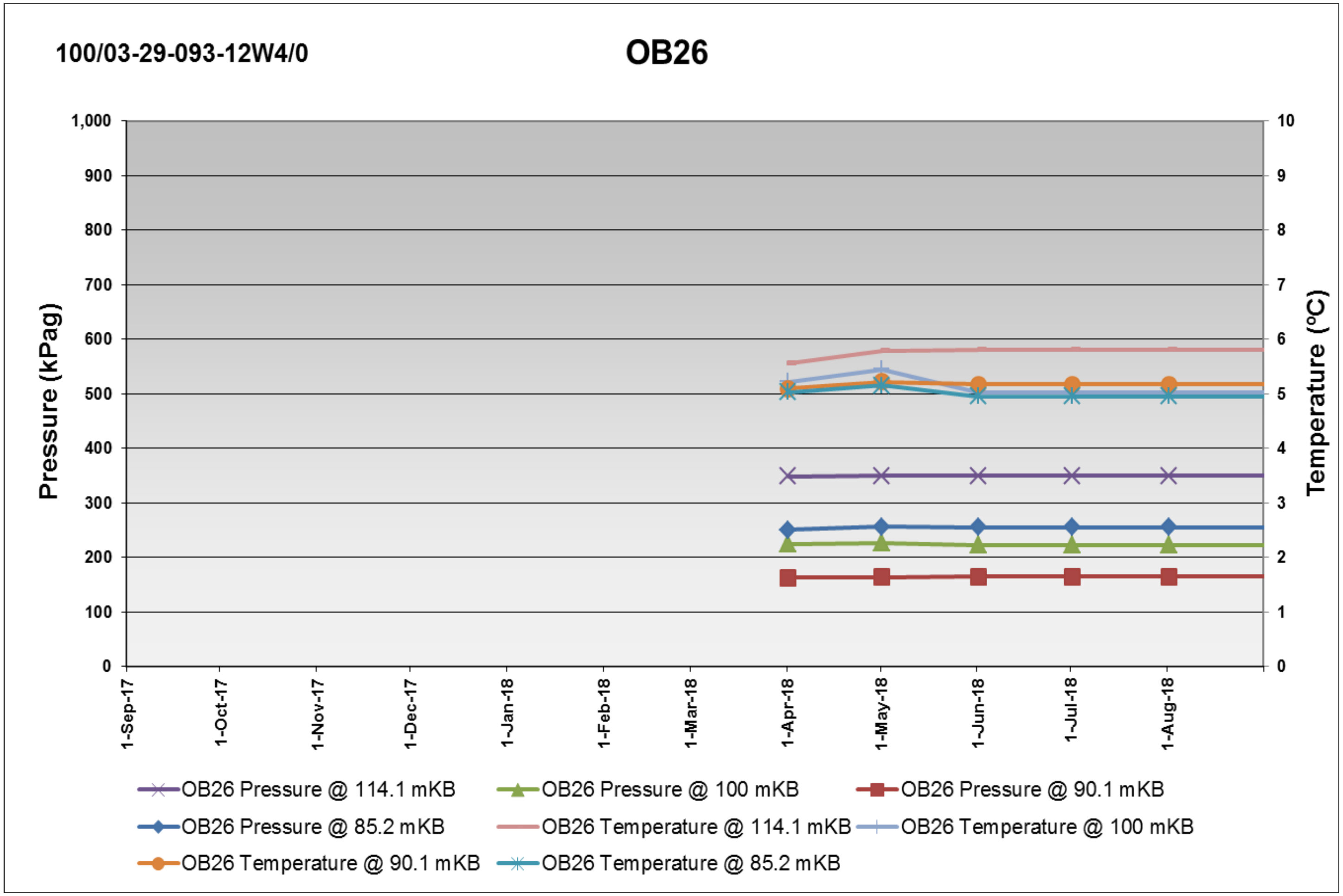

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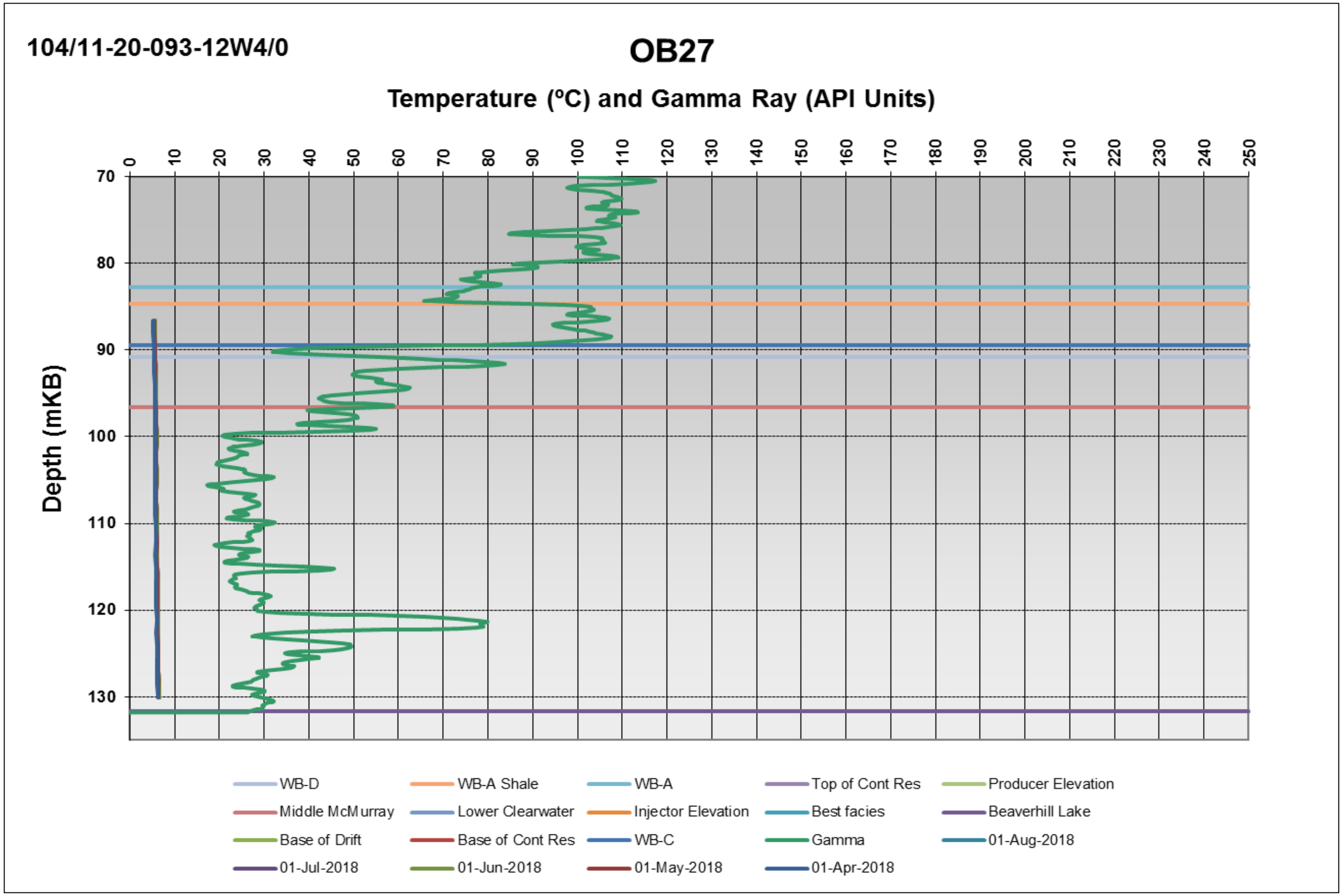

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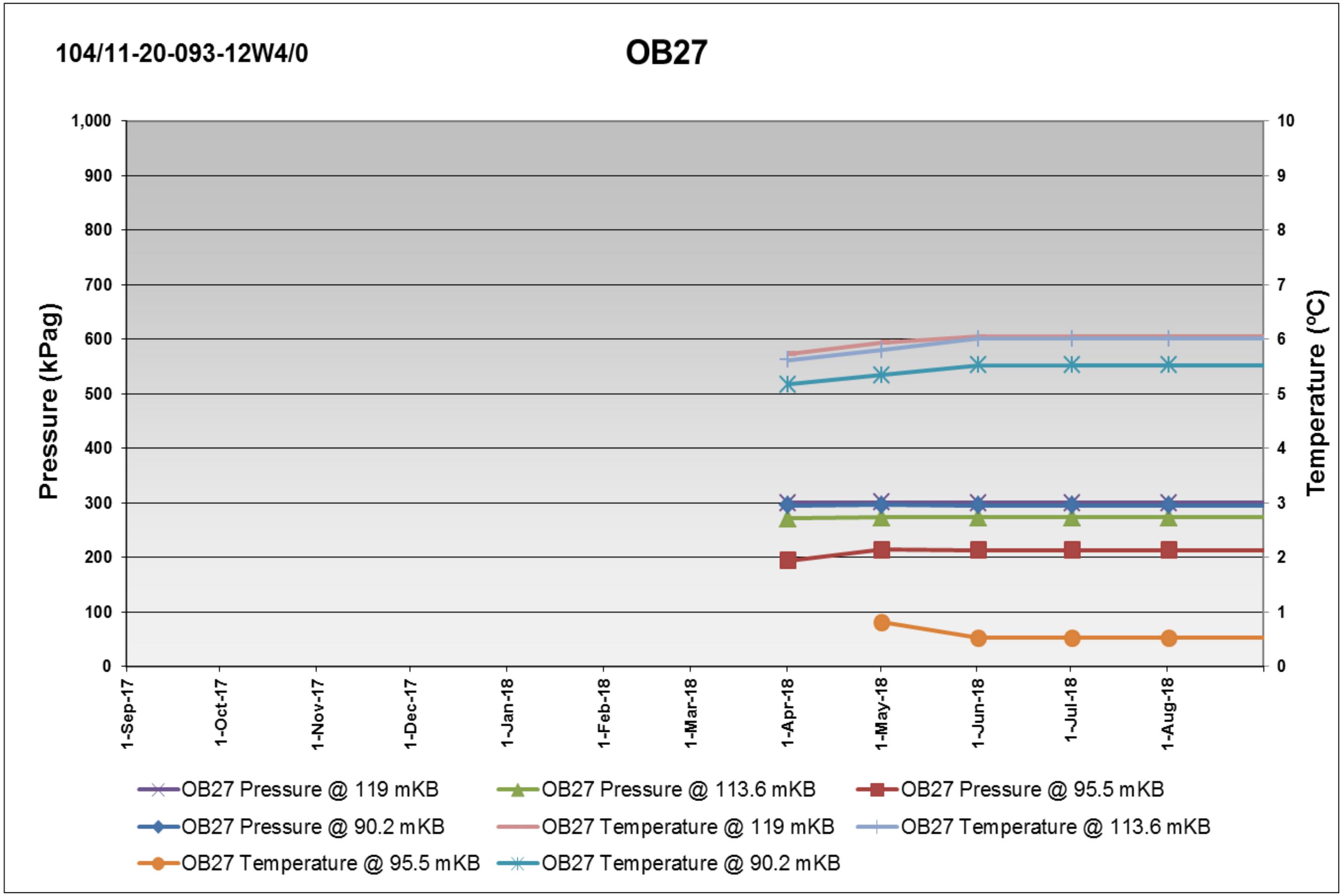

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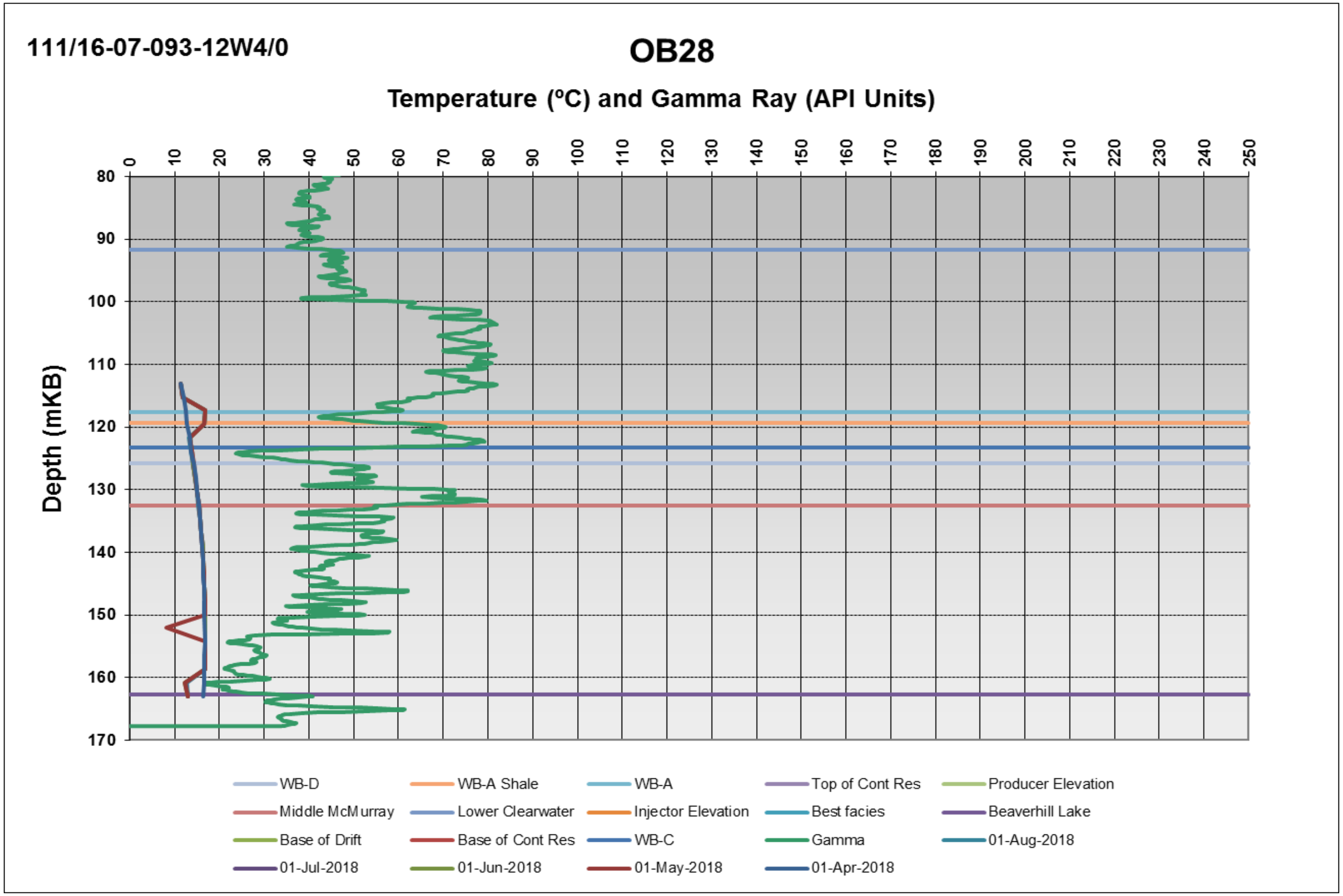

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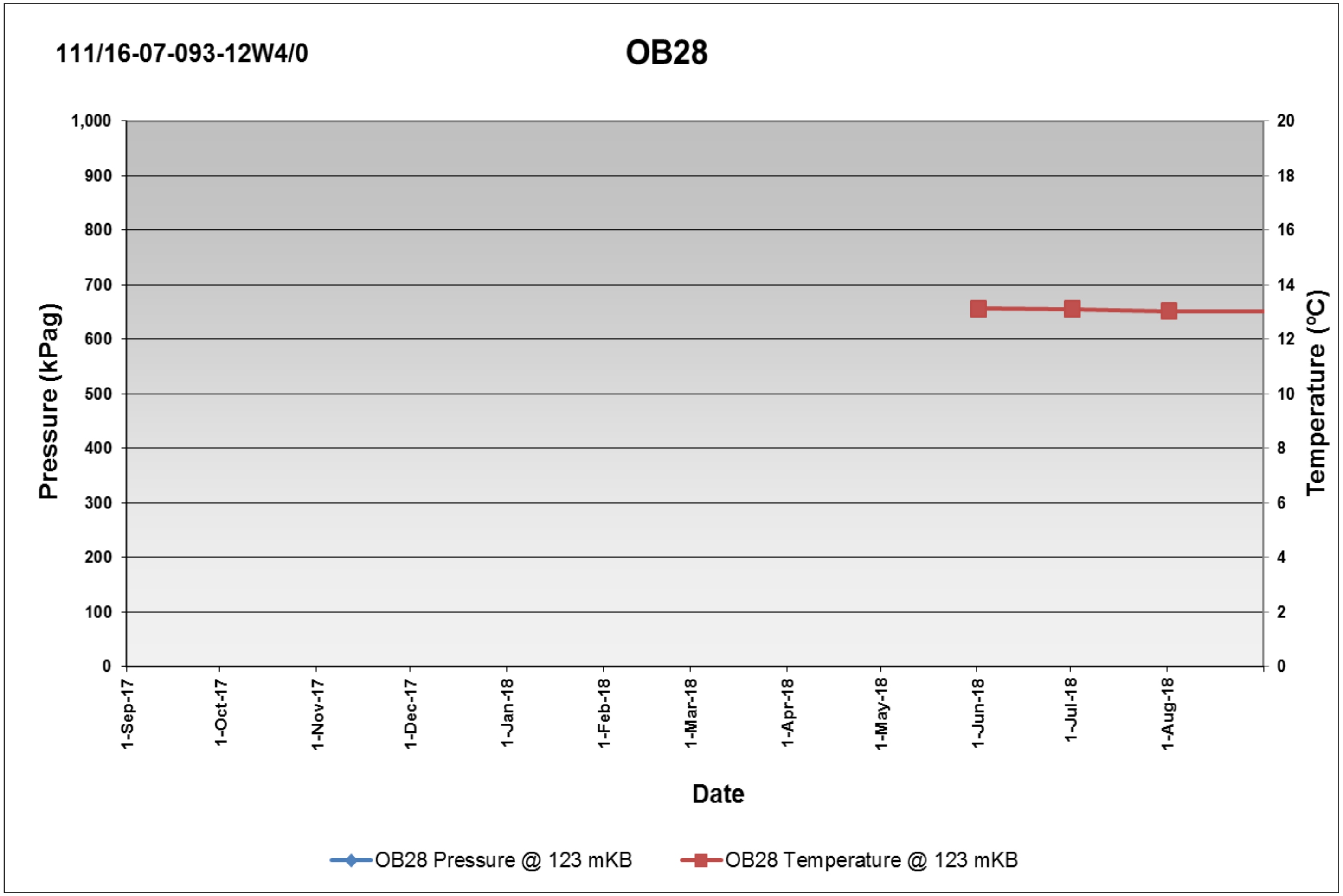

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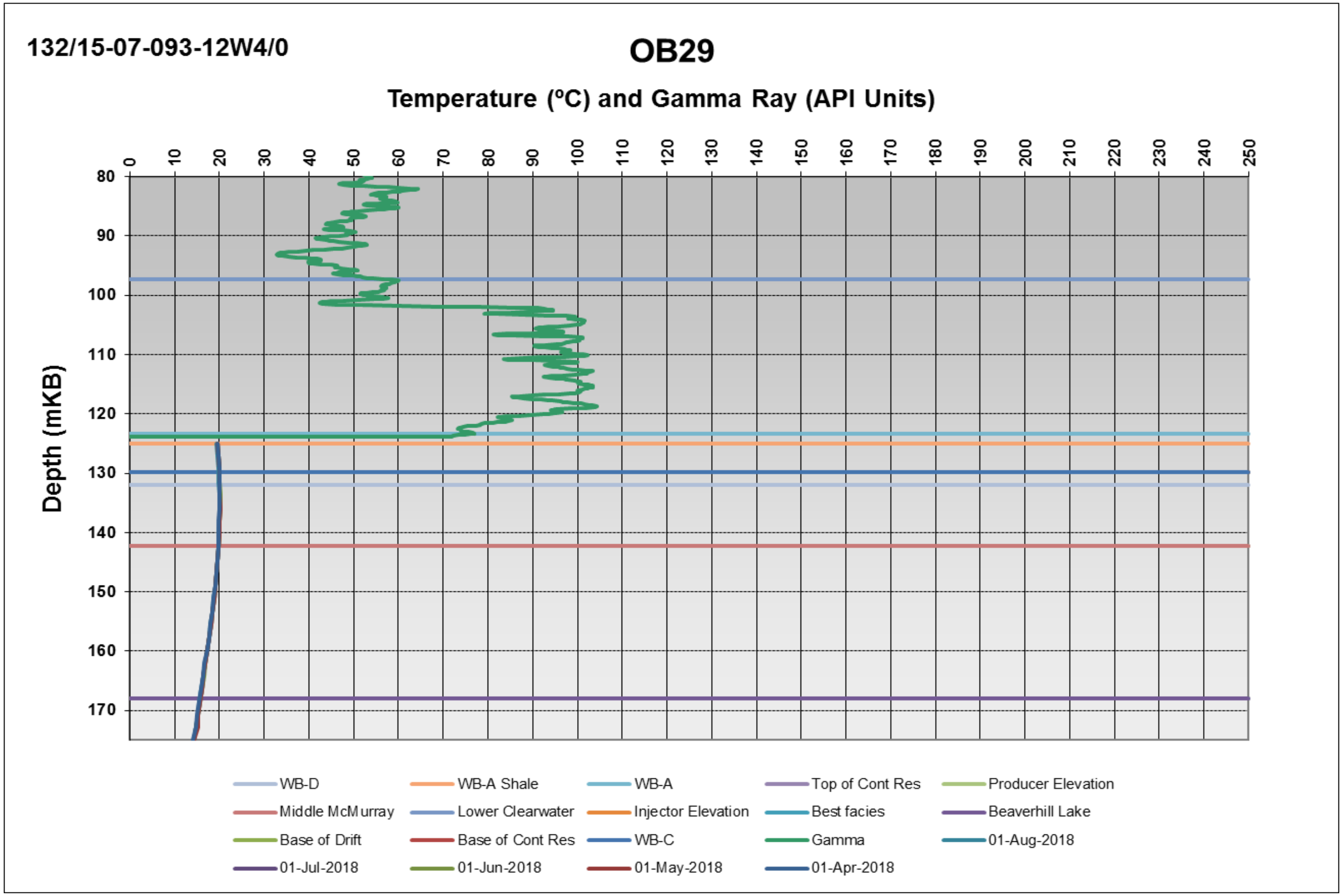

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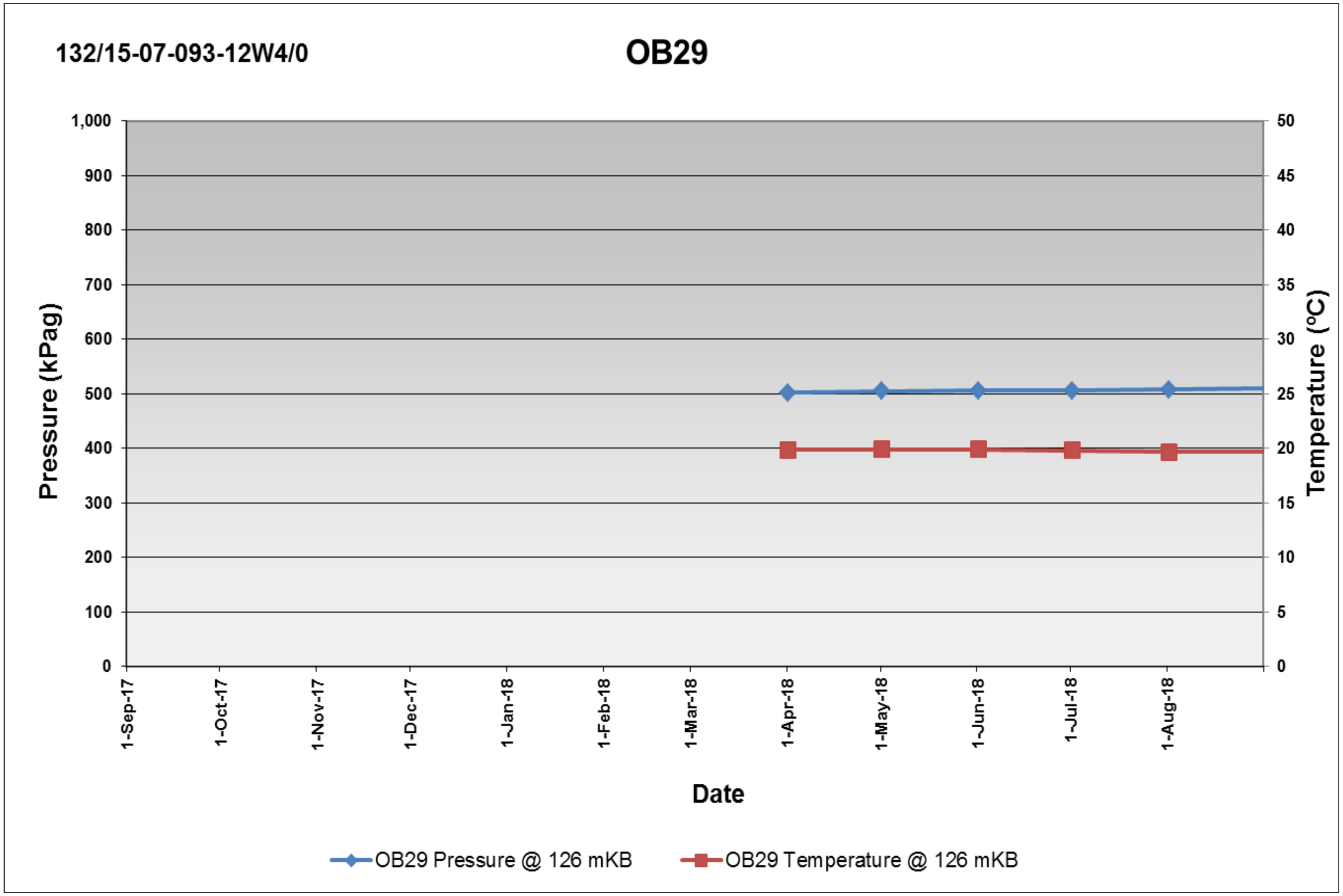

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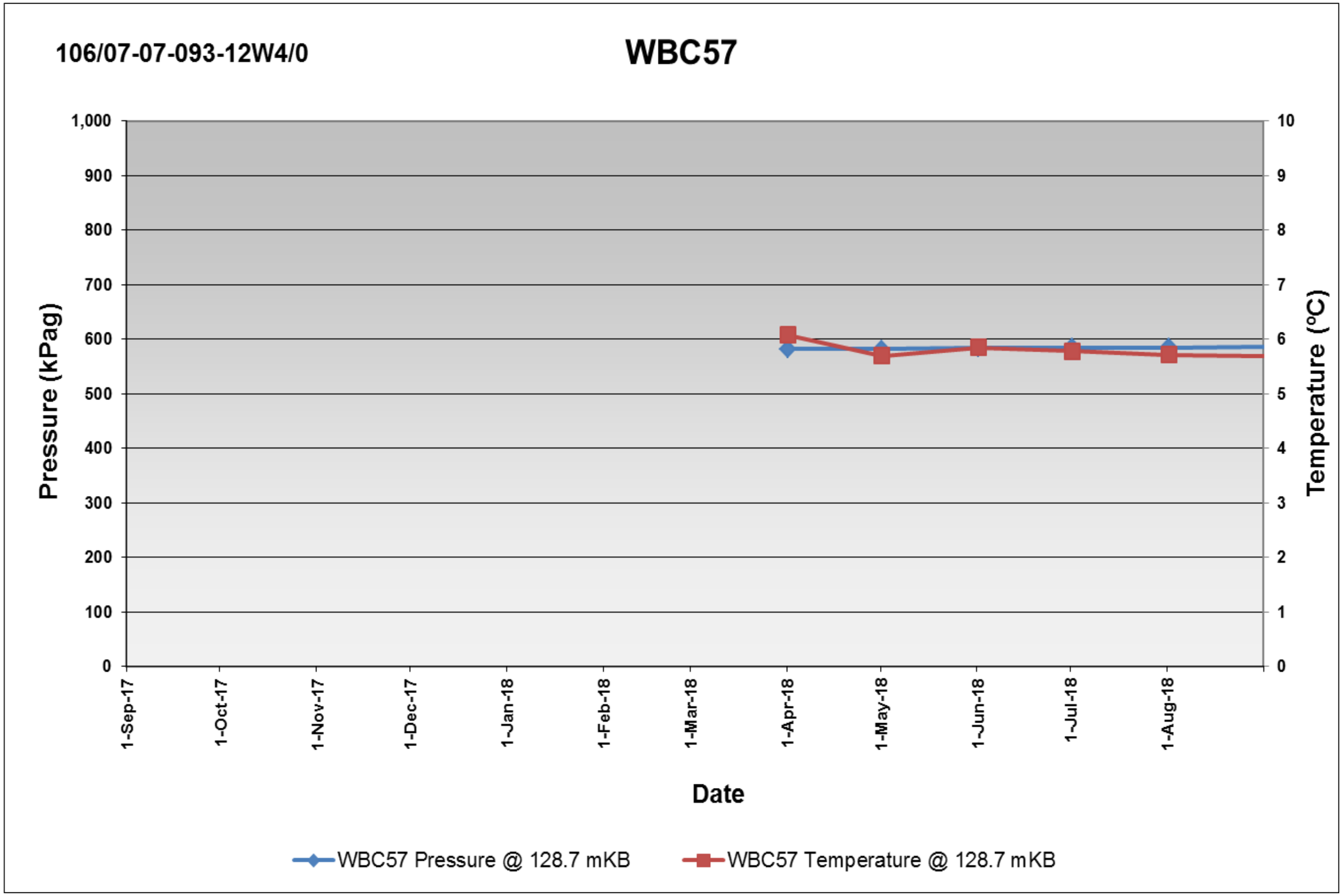

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