# Suncor MacKay River In Situ Project
# 2021 AER Scheme Performance Report
# Commercial Scheme Approval No. 8668

Reporting Period:
January 1, 2020 to December 31, 2020

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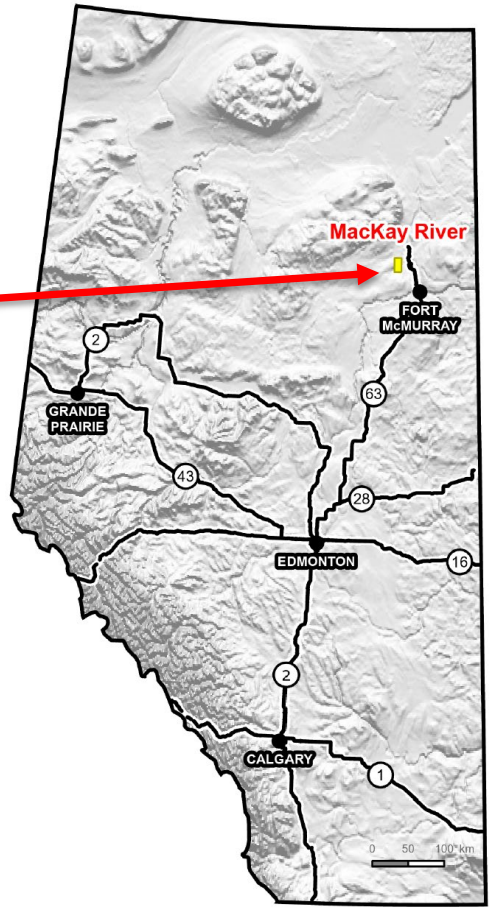
# Introduction

4.1

# MacKay River Project Overview




- The MacKay River Project is a commercial Steam Assisted Gravity Drainage (SAGD) scheme;
- It is the shallowest SAGD project currently in operation within Alberta;
- From January 2020 to December 2020 MacKay River averaged 2651 $m^3$/day (16,683 bpd) of bitumen production. The Design rate for MacKay River is 38,000 bpd @ 2.8 SOR.



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# MacKay River Project Overview

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

| | |
|---|---|
| Producing Well Pairs | 125 |
| Non-Producing Well Pairs | 10 |
| Abandoned or Planned for Abandonment – Well Pairs | 2 |
| Total Well Pairs | 137 |



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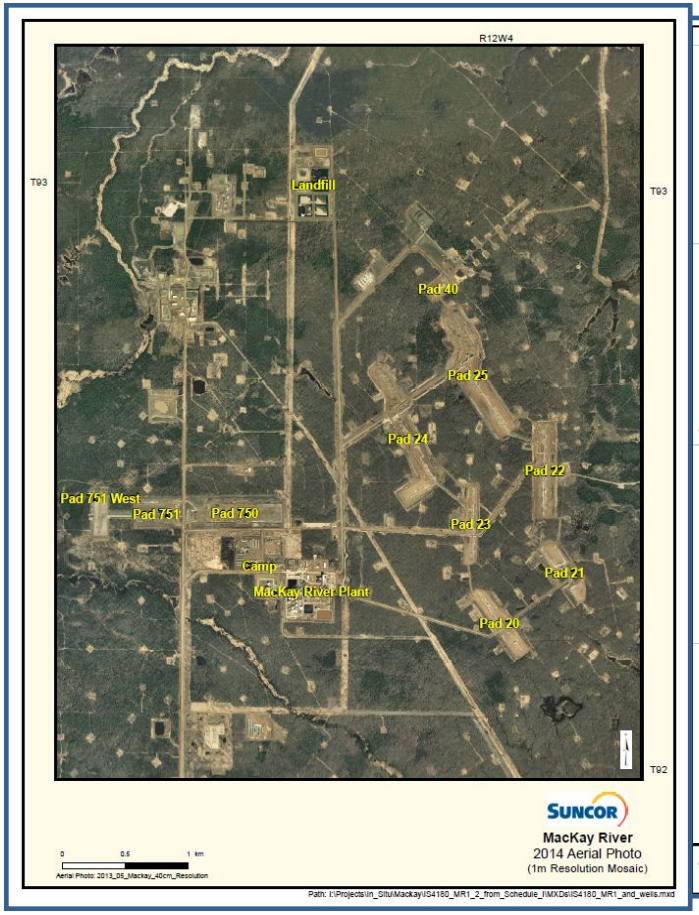
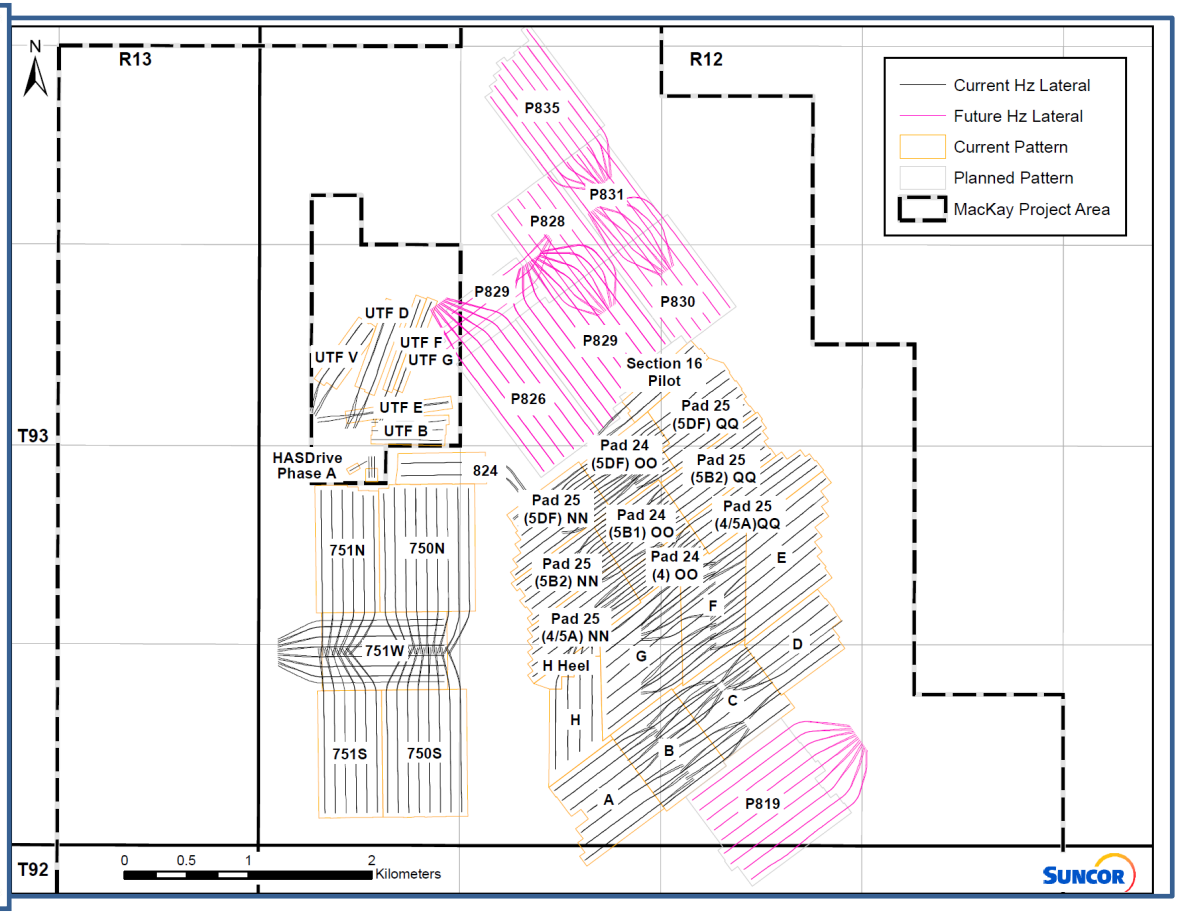
# Project Area and Project Site

- Current Project Area (PA) approximately 24 ½ sections.




Surface View




Subsurface View

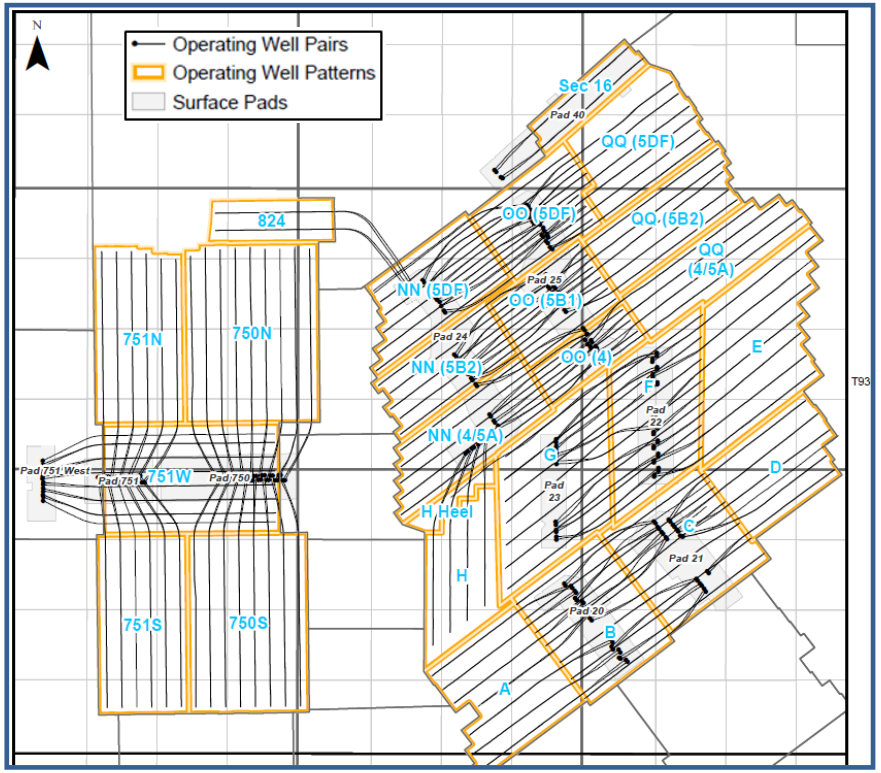
# Subsurface

4.2

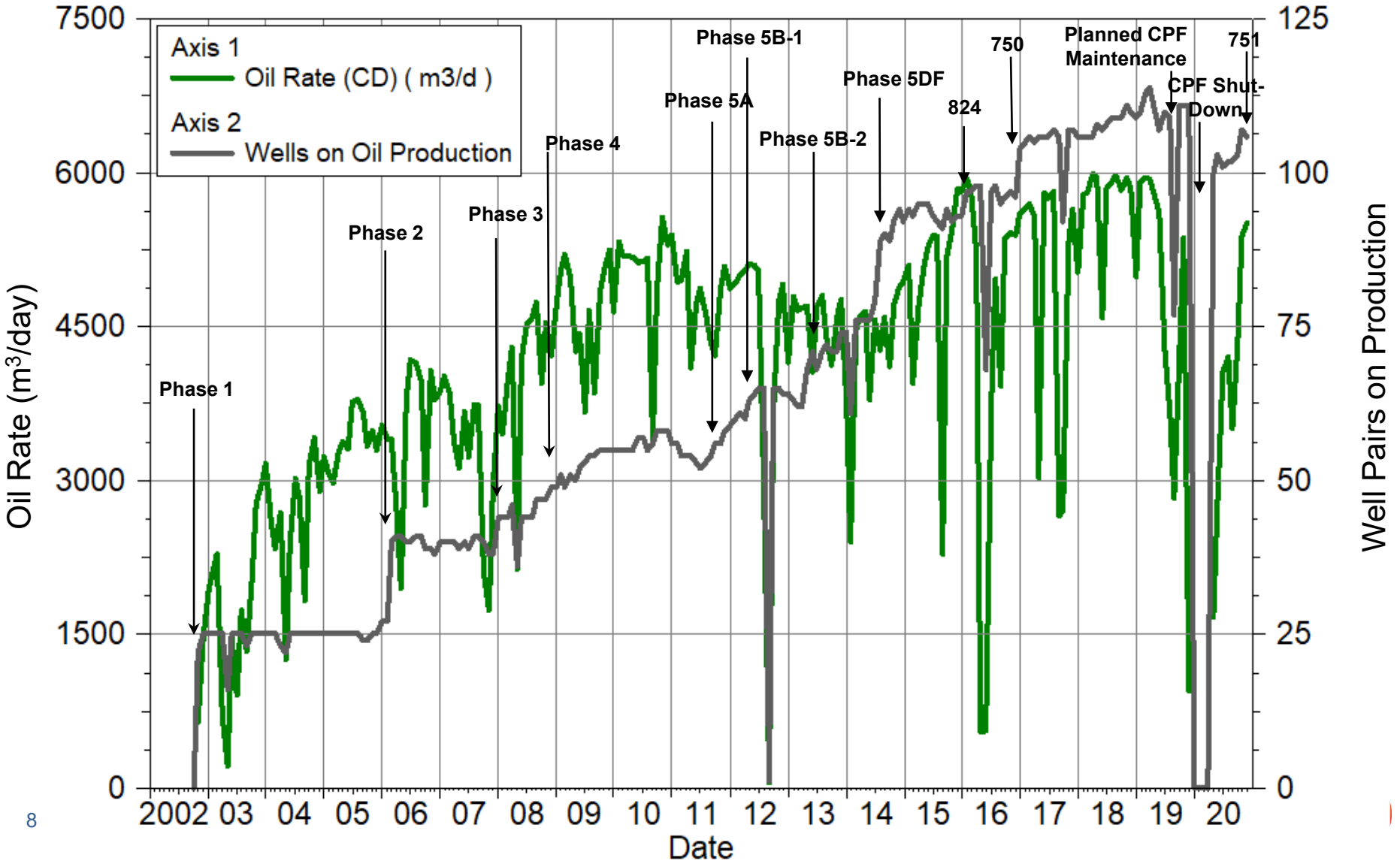
# Summary of Operating Wells

| Pad | Pattern | Phase | # Well Pairs | First Steam to Pad |
|---|---|---|---|---|
| 20 | A | 1 | 7 | 2002 |
| | C | | 6 | |
| 21 | B | | 7 | |
| | D | | 5 | |
| 22 | E | 2 | 7 | 2006 |
| | G | | 7 | |
| 23 | F | 3 | 7 | 2007 |
| 24 | OO | 4 | 3 | 2008 - 2009 |
| | | 5B-1 | 6 | 2012 |
| | | 5DF | 6 | 2014 |
| | H | 4 | 4 | 2009 - 2010 |
| 25 | QQ | 4 | 2 | 2008 |
| | | 5A | 2 | 2011 |
| | | 5B-2 | 5 | 2013 |
| | | 5DF | 6 | 2014 |
| | NN | 4 | 1 | 2008 |
| | | 5A | 4 | 2011 |
| | | 5B-2 | 5 | 2013 |
| | | 5DF | 6 | 2014 |

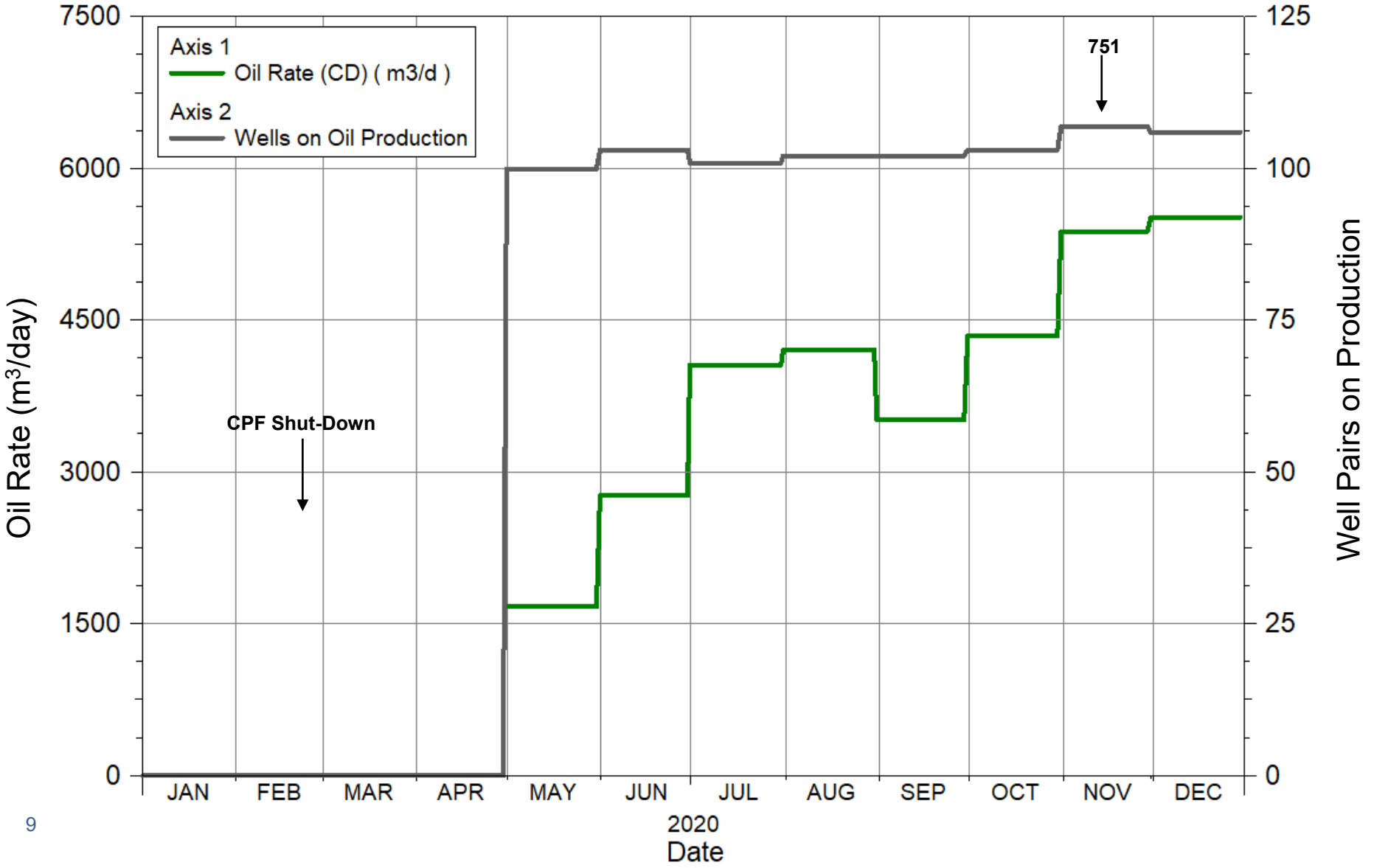
| Pad | Pattern | Phase | # Well Pairs | First Steam to Pad |
|---|---|---|---|---|
| 24 | 824 | 6 | 2 | 2015 |
| 750 | 750N | 7A/D | 8 | 2016 |
| | 750S | 7A/B/C | 8 | 2016 - 2019 |
| 751 | 751W | 8A/B | 6 | 2020 |
| | 751N | 8C | 1 | 2020 |
| | 751S | 8B/C | 5 | 2020 |



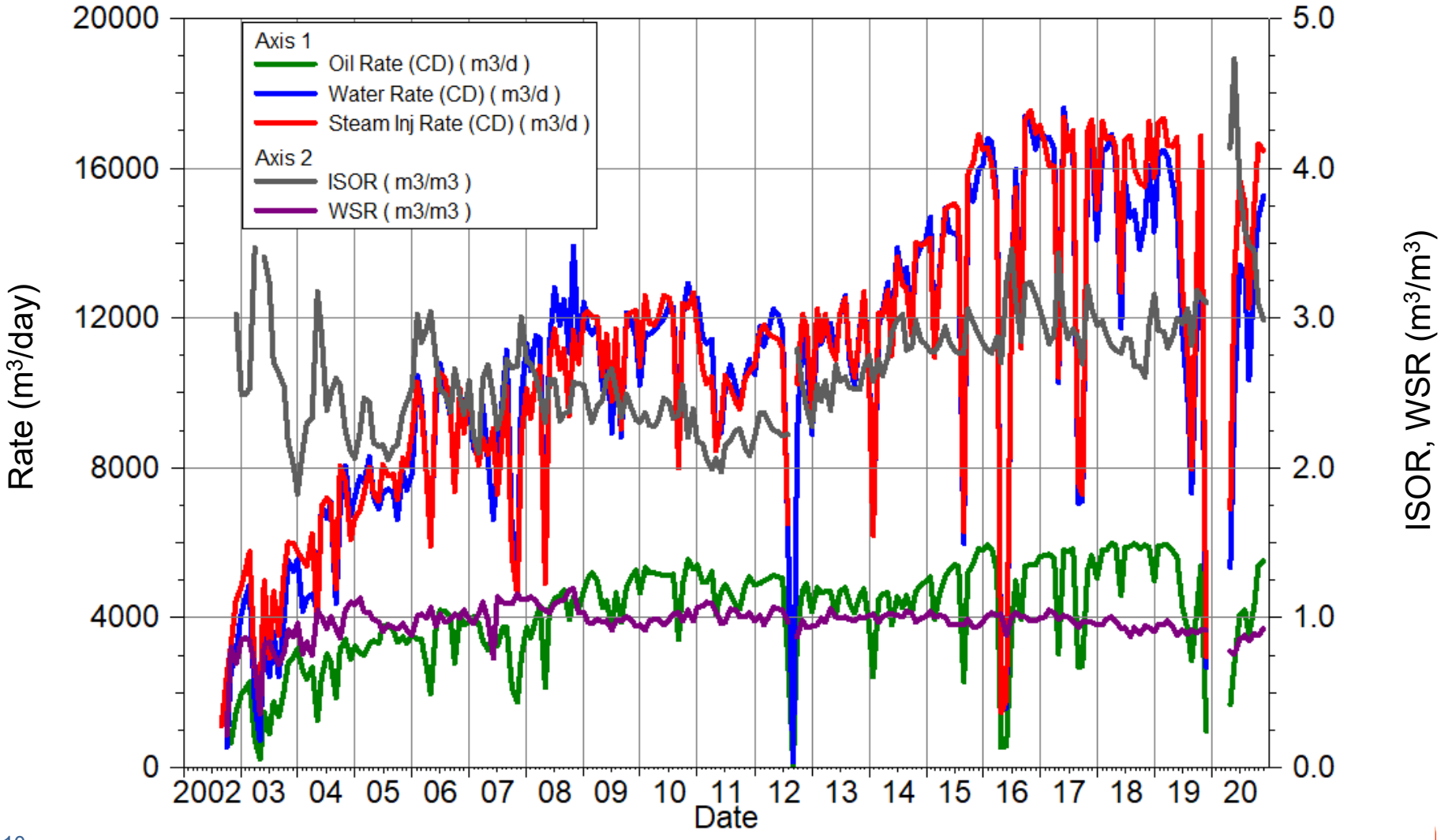
# Producing Well Count



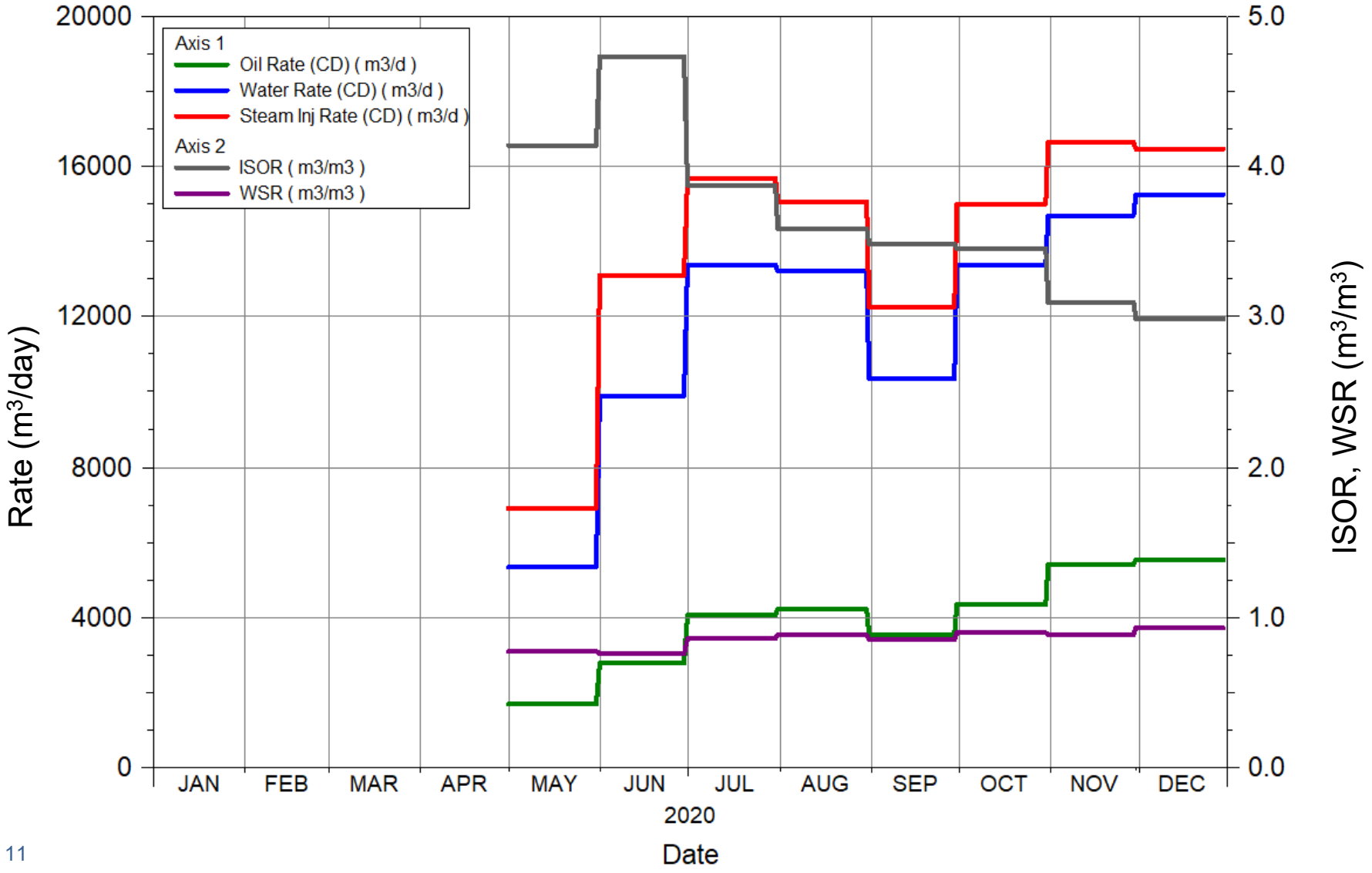
# Producing Well Count - 2020



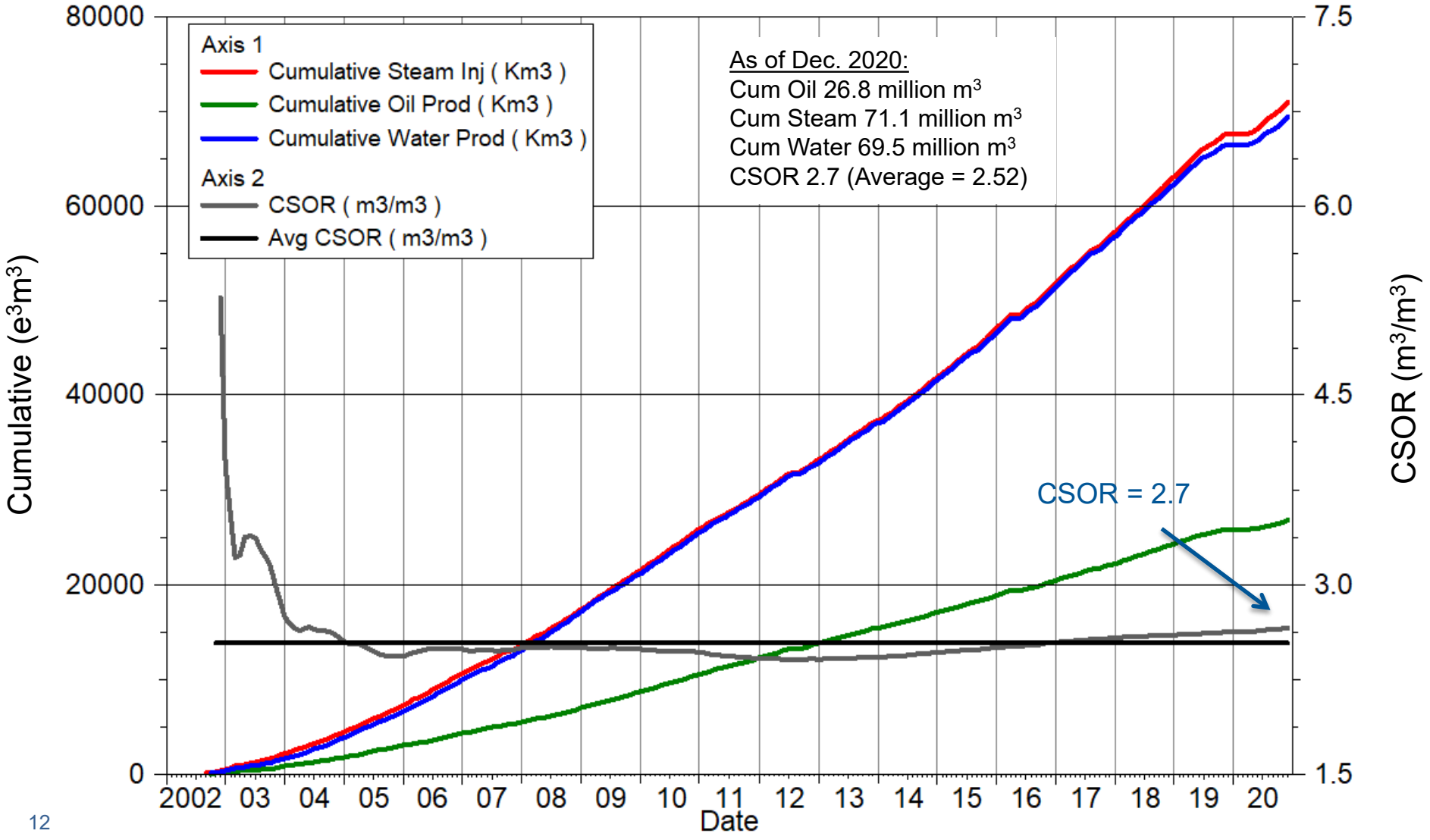
# Scheme Performance – Fluid Rates



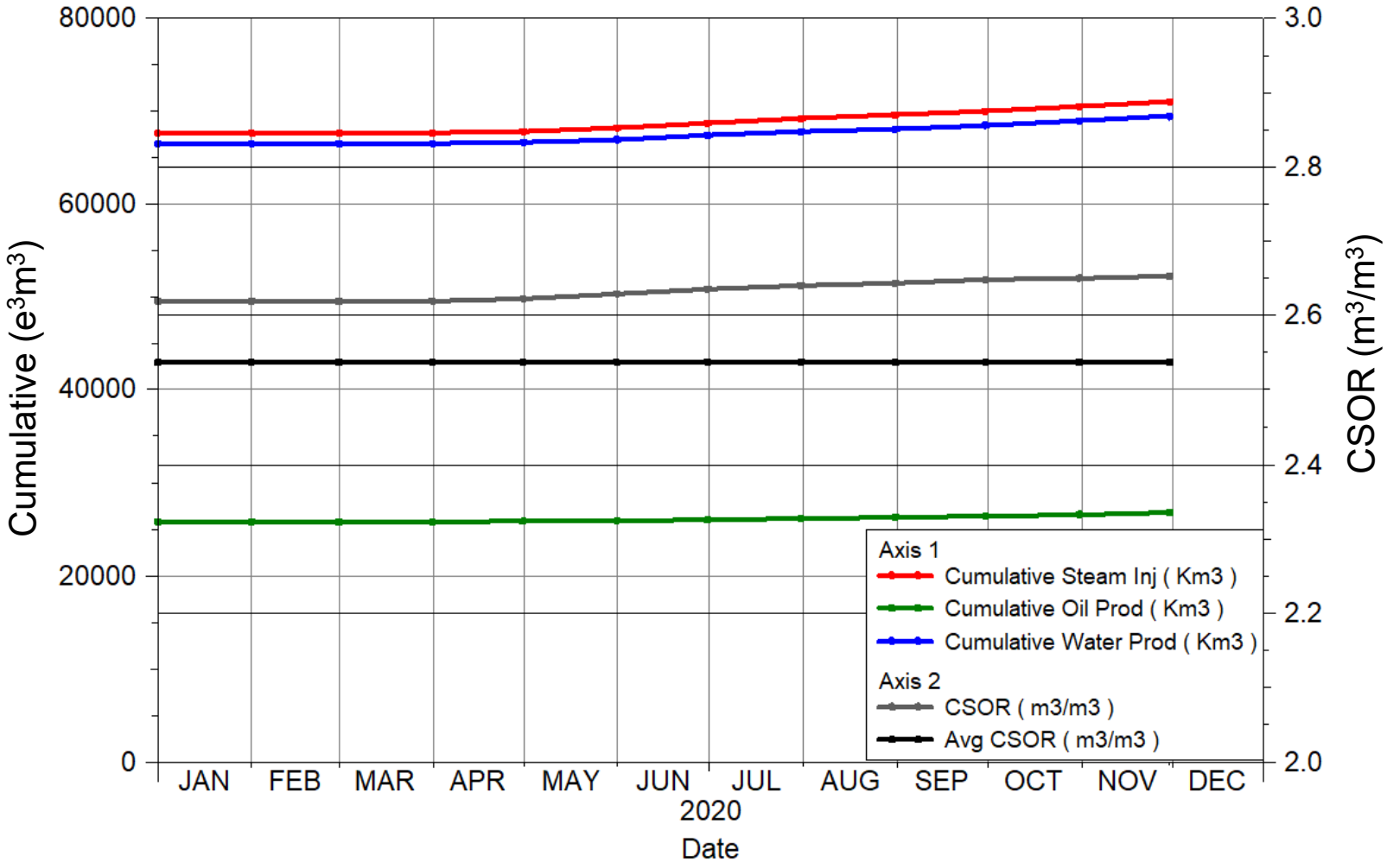
# Scheme Performance – Fluid Rates 2020



# Scheme Performance – Cumulative Fluid Volumes



# Scheme Performance – Cumulative Fluid Volumes (2020)



# Reservoir Facies

## Facies:

- Defined by Visual Mud Index (VMI).

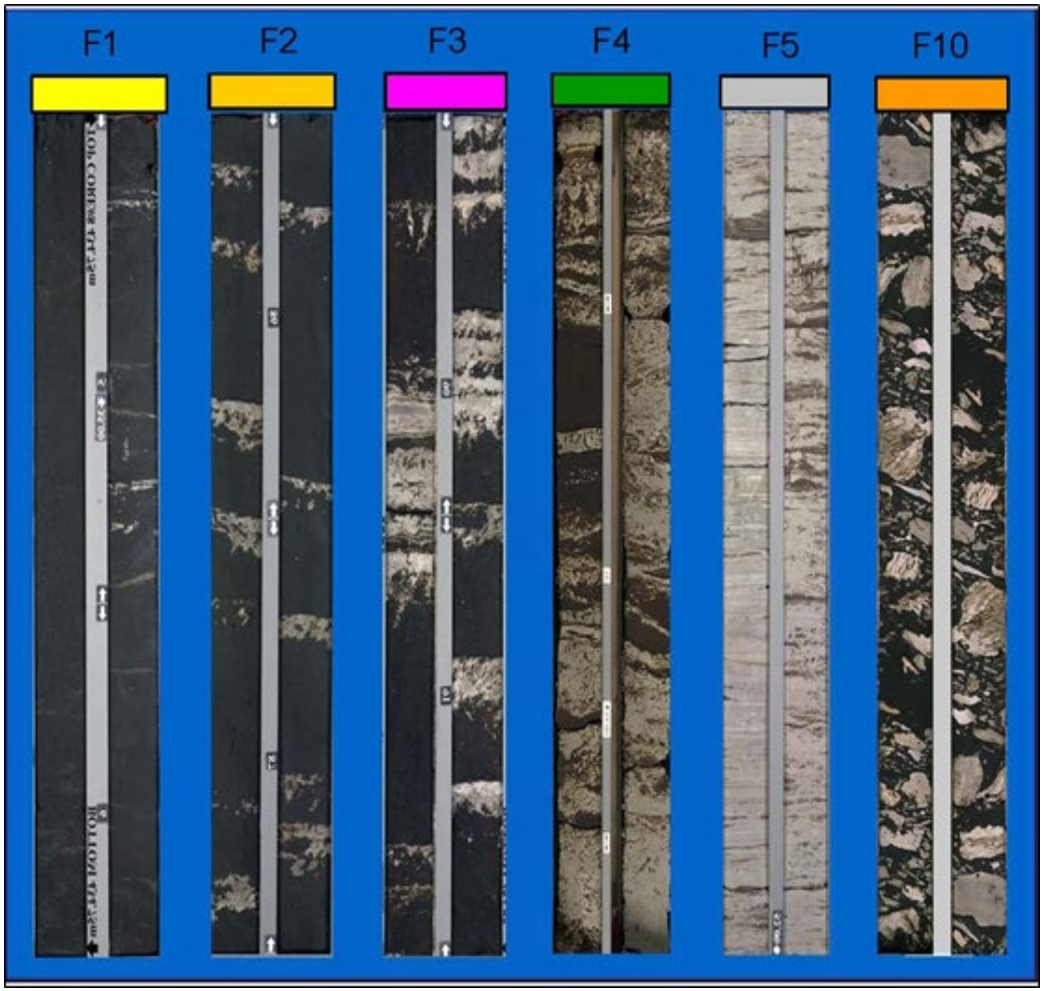
## Cutoffs:

- F1 (Sandstone) <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 Heterolithic Strata

- Reservoir includes Facies F1, F2, and F10, but can include F3-F5, if < 2m thick.

- Weight percent bitumen > 6%;
- Porosity (generally) > 30%;
- Continuous reservoir thickness> 10m for OBIP volumetric calculation.



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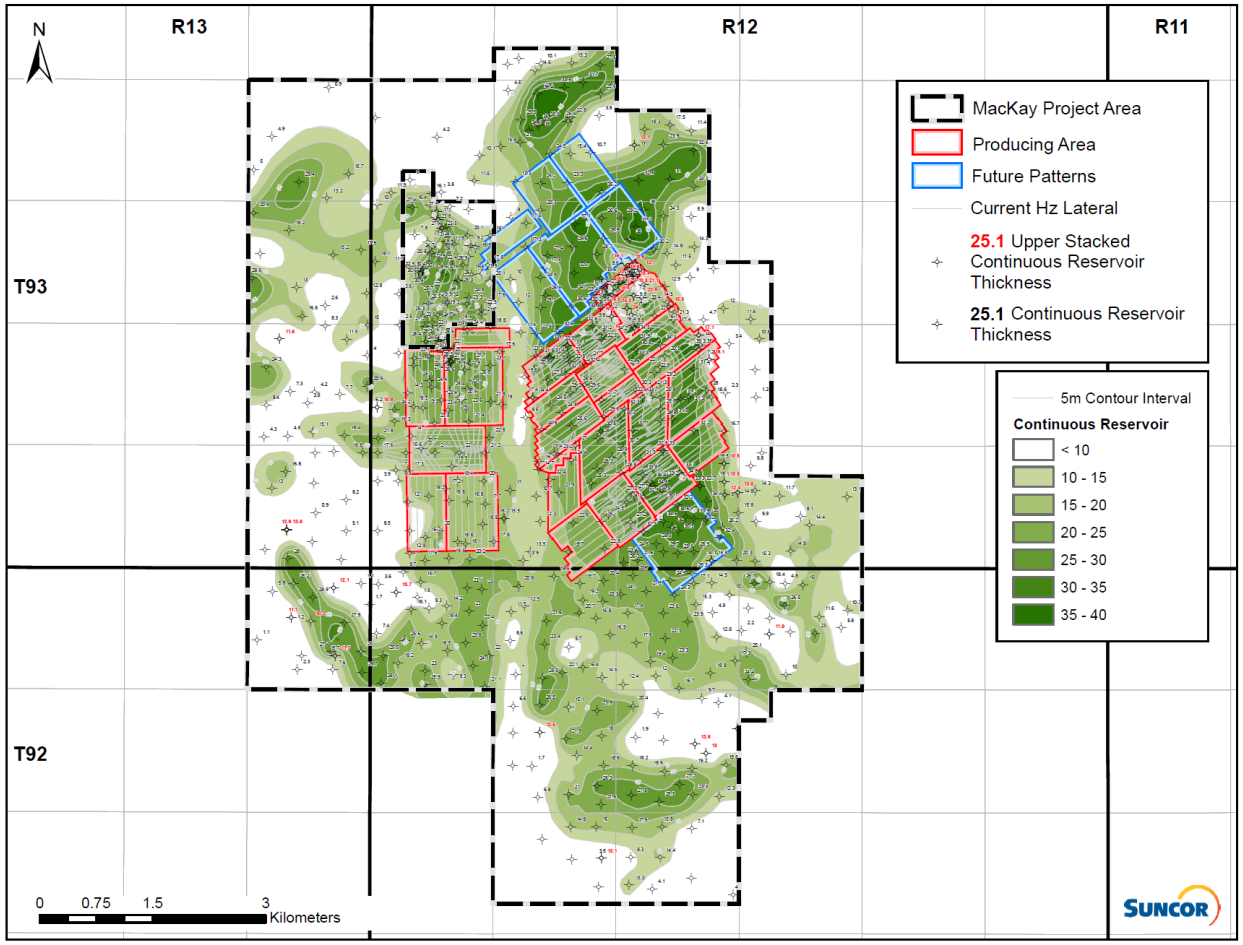
# Continuous Reservoir Isopach




2020 MacKay Continuous Reservoir Isopach

- Contour Interval = 5m



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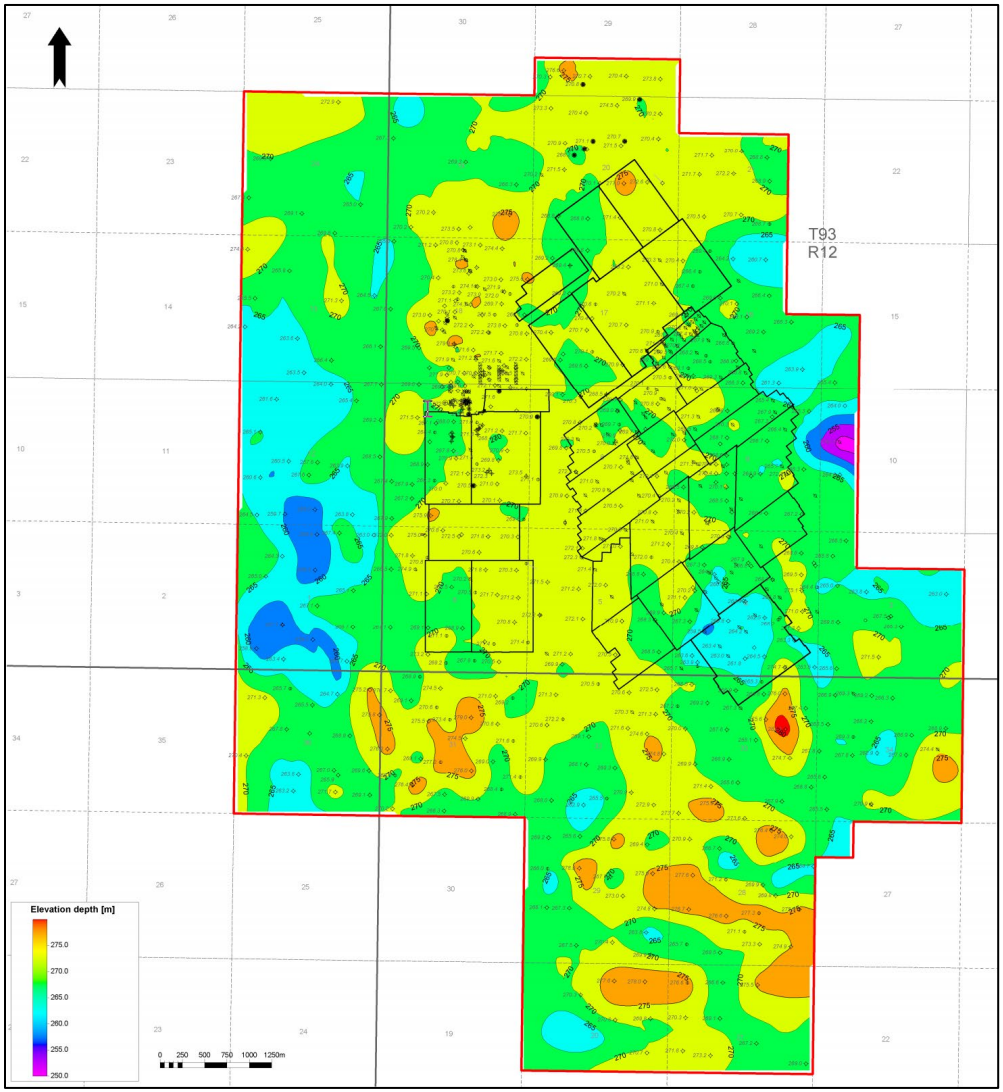
# Base of Reservoir Structure Map




**Legend**

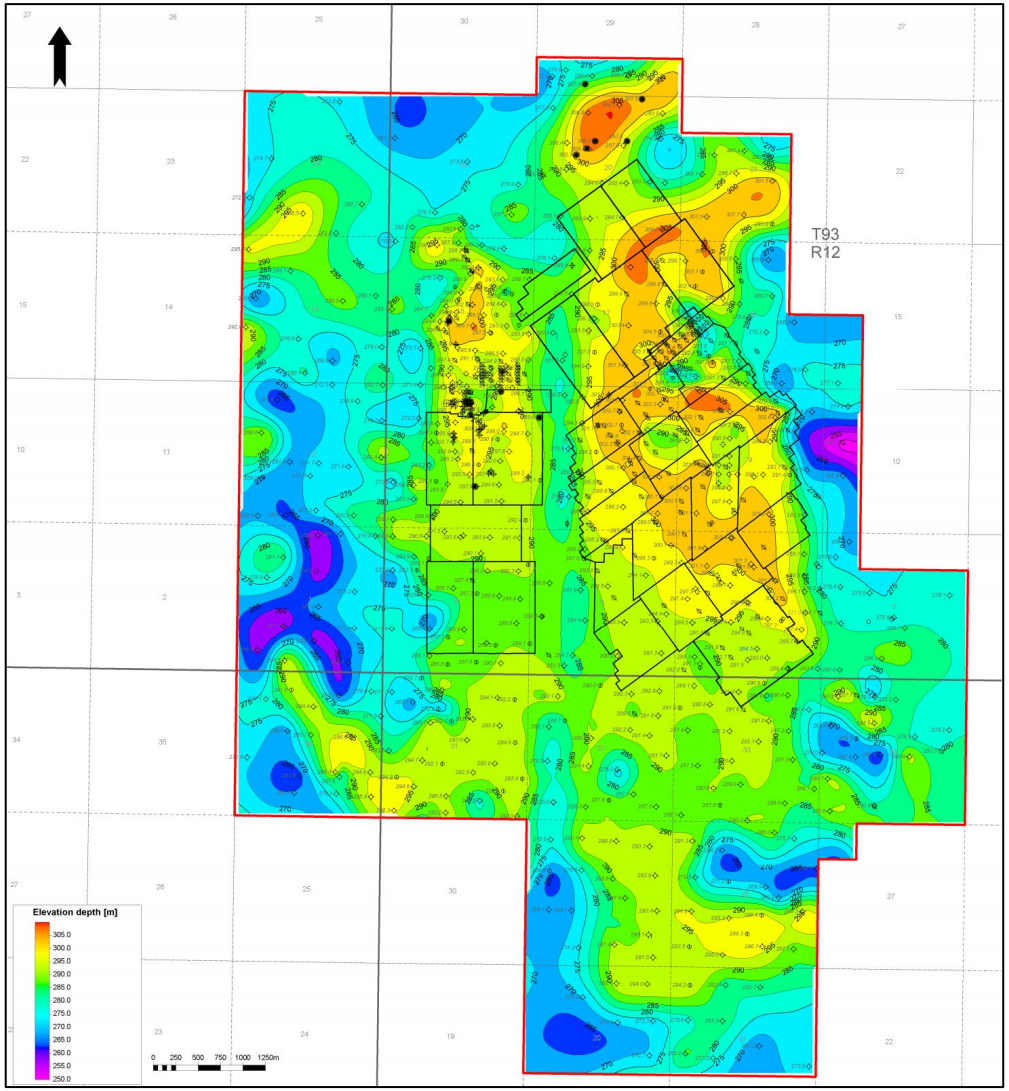
Approved PA Boundary

- Contour Interval =5m

2020 MacKay Base of Reservoir

- Contour Interval = 5m

# Top of Reservoir Structure Map




**Legend**

Approved **PA Boundary**

- **Contour** Interval **=5m**

2020 MacKay Top of Reservoir

- Contour Interval = 5m



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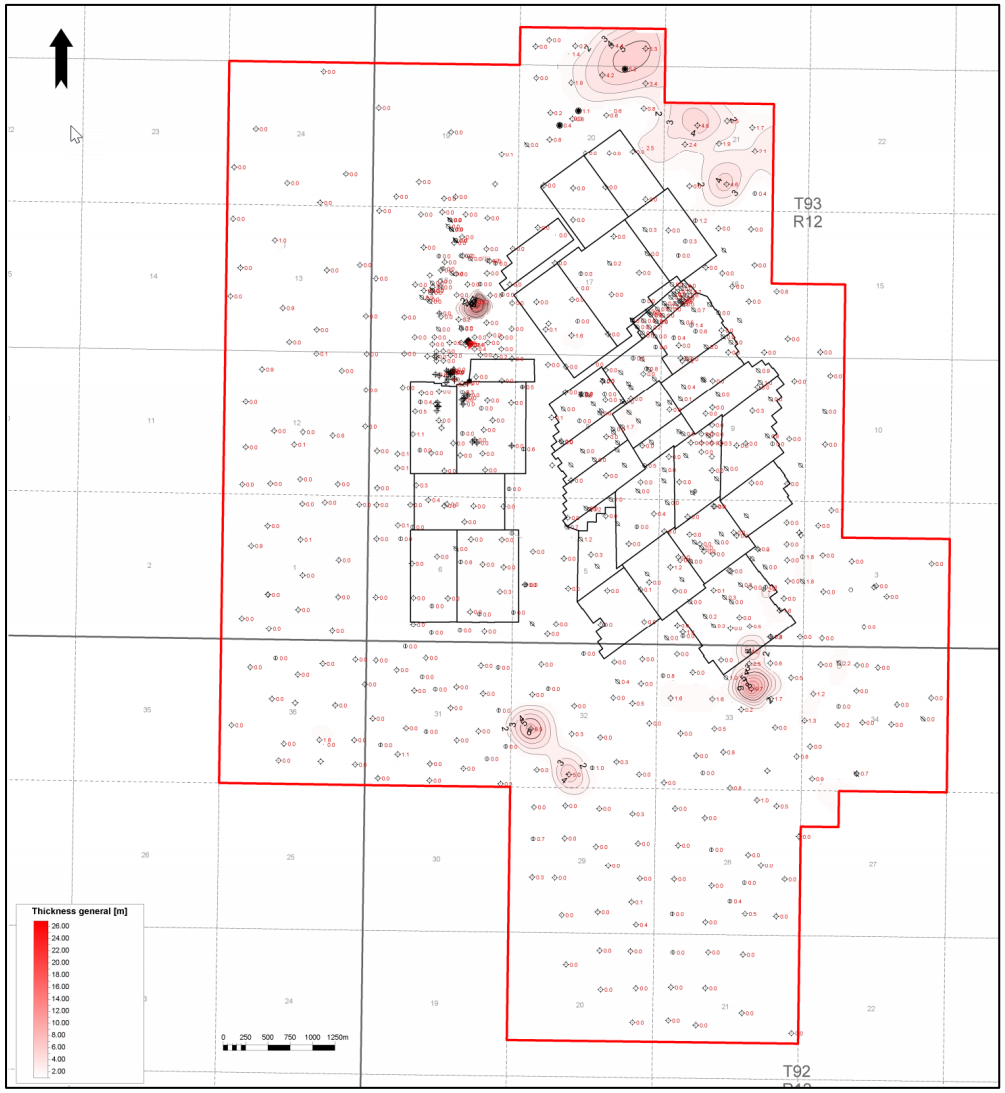
# Reservoir Gas Isopach




**Legend**

Approved PA Boundary

- Contour Interval =1m

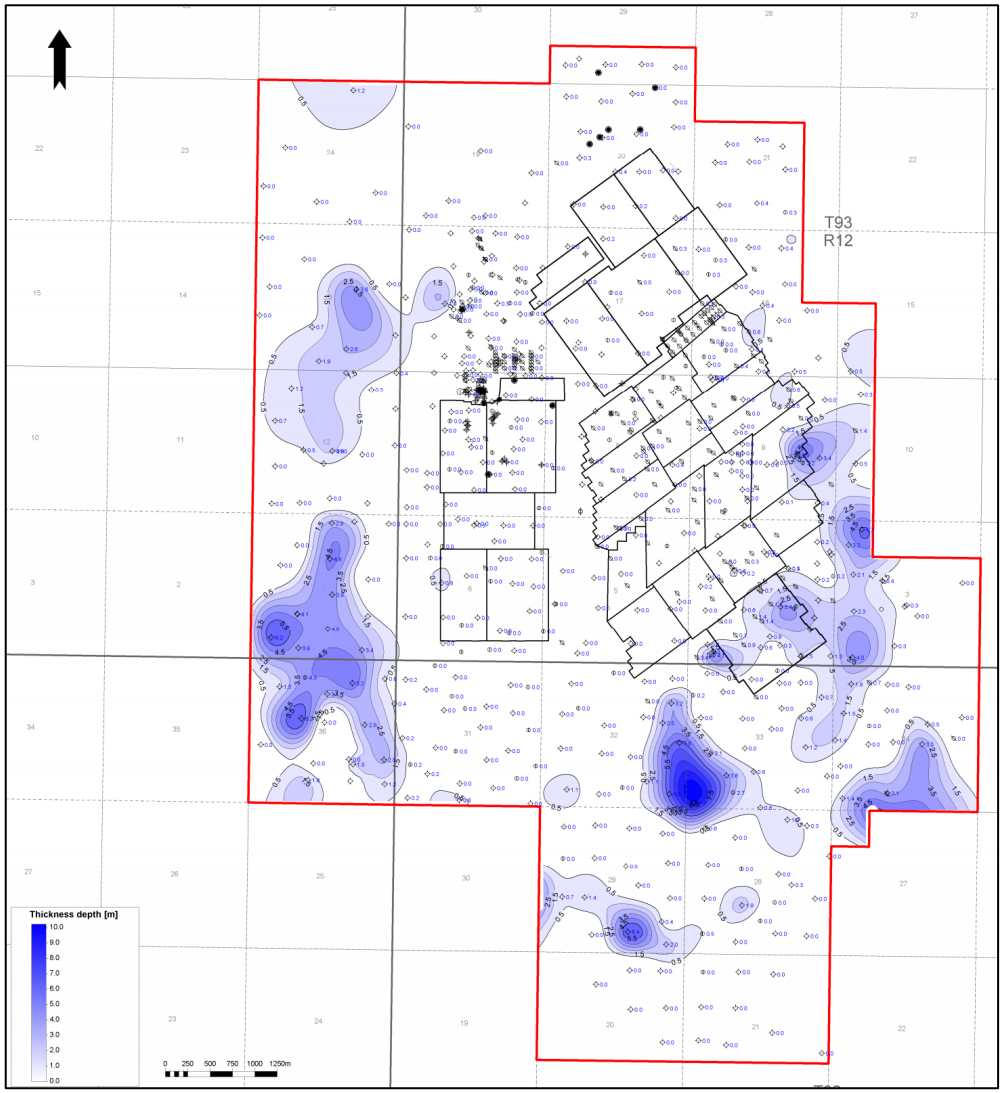
2020 Reservoir Cumulative Gas Isopach

Cutoff = Sg>0.03

Contour Interval = 1m

*Gas zones shown above are inconsequential to SAGD operations at Mackay River but are included for reference*

# Bottom Water Isopach




**Legend**

Approved PA Boundary

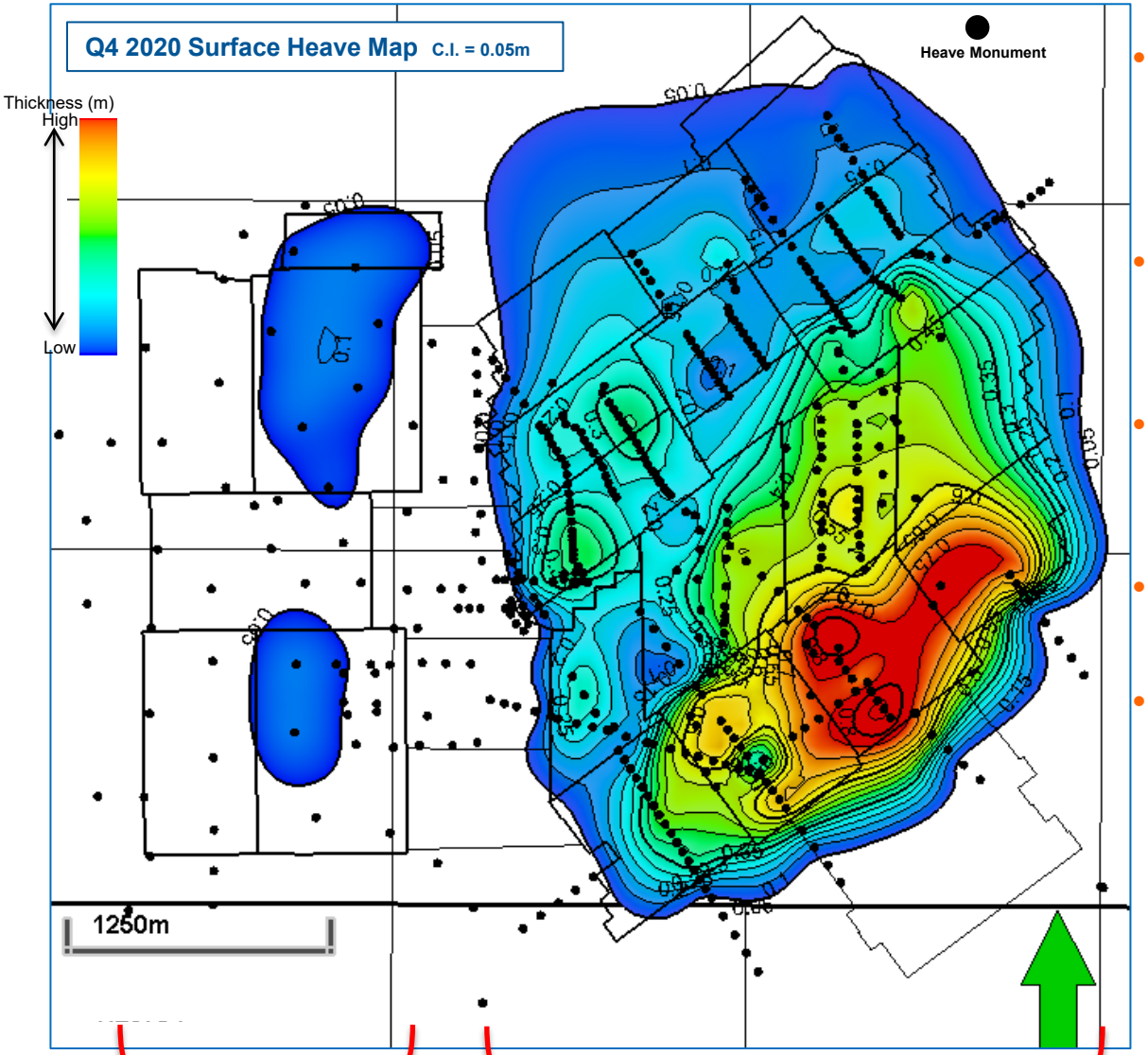
- Contour Interval =1m

2020 Mackay Bottom Water Isopach

Cutoffs: BMFO< 0.02 & GR < 60 API

Contour Interval = 1m

# Cumulative Heave: From 2002 - 2020




- Maximum heave of 80 cm observed over C Pattern / Pad 21:
  - Mature area of the field
- Monitor subsurface safety and investigate areas which appear anomalous;
- There are no geomechanical anomalies in the MacKay River development area;
- Heave data is used to calibrate geomechanical models;
- Note: 2020 heave mapping only covers the western area of Mackay River. The most recent heave survey for the eastern section of Mackay River was acquired in 2019.

*Uncertainty with manual heave monuments +/- 5mm*

# 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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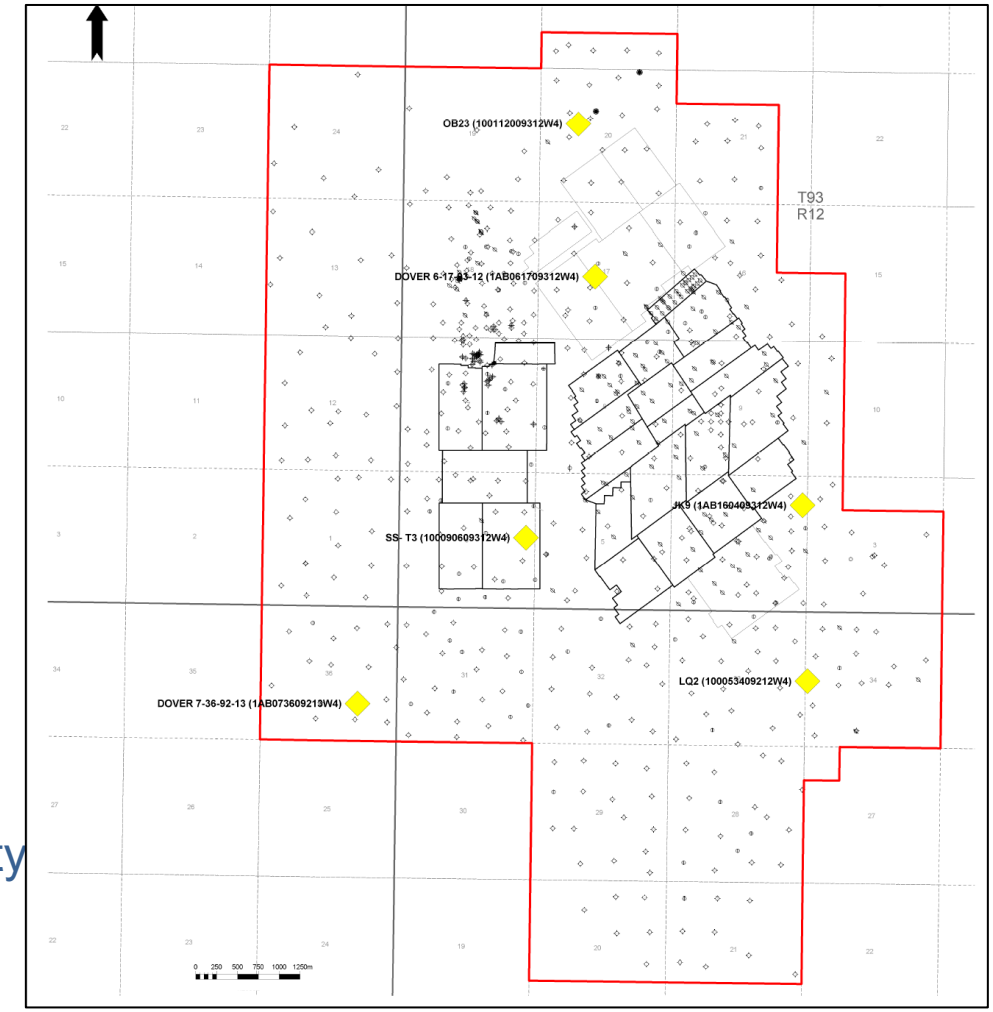
# Reservoir Fracture Closure Gradients

- Two new Mini-Frac wells in 2020; 6-17 and 7-36;
- No changes recommended to the MacKay River bottomhole MOPs currently approved; using the following methodology:
  - Fracture gradient of 21 kPa/m X based of the caprock (Wab D) in pattern X 80% (20% safety factor).

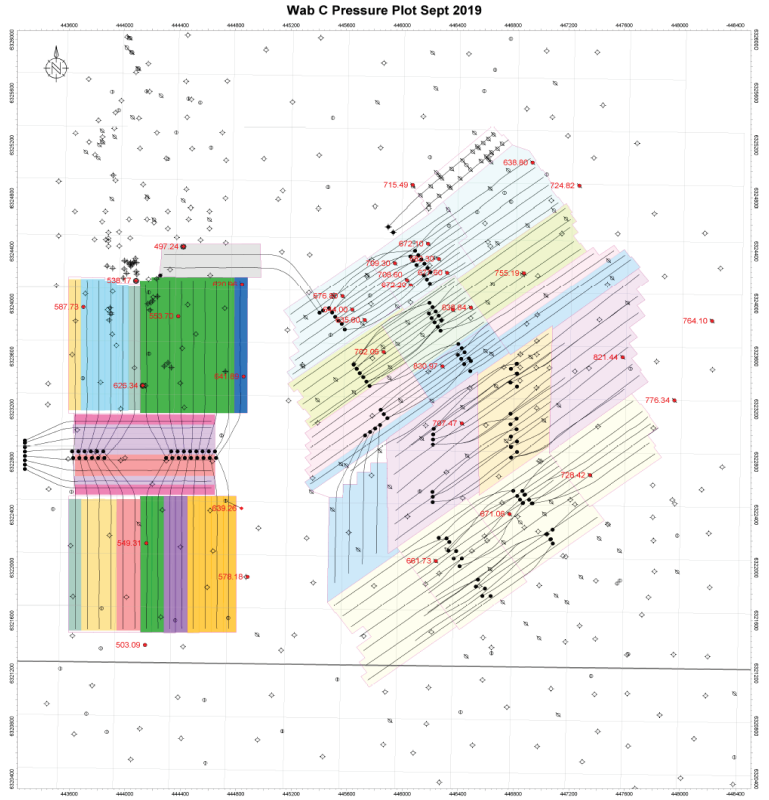
| Well<br>Date Collected | Formation<br>Clearwater | Wabiskaw D | Wabiskaw C | McMurray |
|---|---|---|---|---|
| Dover 7-36<br>AB/07-36-092-13W4<br>2020 | 22.8 | 23.1 | 23.7 | 19.8 |
| Dover 6-17<br>AB/06-17-093-12W4<br>2020 | 22.2 | 22.8 | 24.2 | 21.5 |
| OB23<br>100/11-20-093-12W4<br>2017 | 20.4 | 19.5 | - | 19.0 |
| JK-9<br>1AA/16-04-093-12W4<br>2014 | 22.3 | 21.1 | 22.1 | - |
| LQ2<br>100/05-34-092-12W4<br>2011 | 21.3 | 21.2 | 22.6 | 21.1 |
| SST3<br>100/09-06-093-12W4<br>2008 | 24.1 | - | 24.3 | 19.9 |
| kPa/m: unit of fracture gradient | | | | |

# Caprock Integrity Assurance

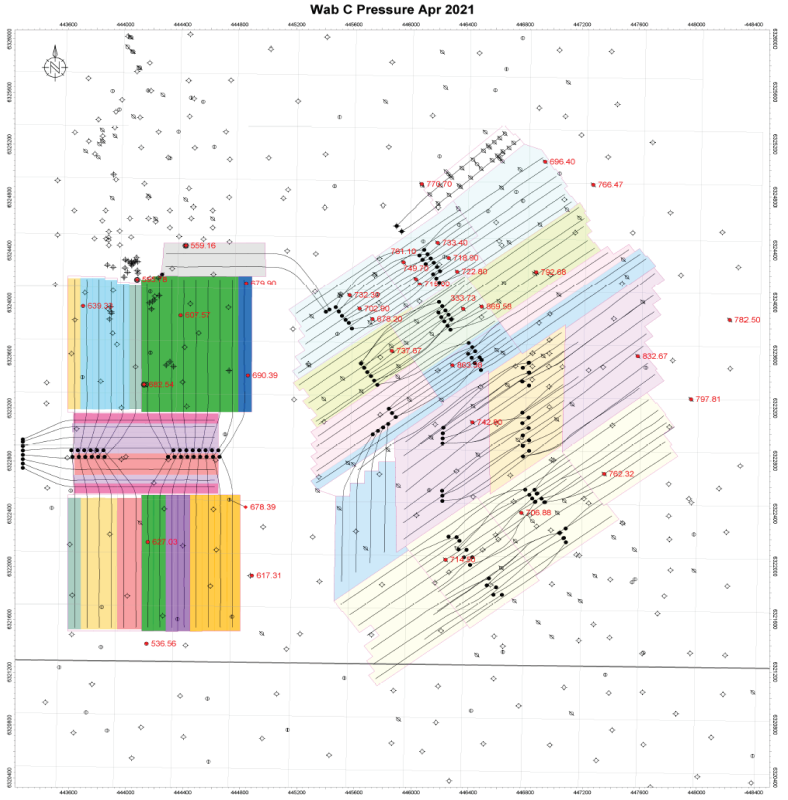
- Two new Mini-Frac wells in 2020; 6-17 and 7-36;
- Fracture gradient of the caprock within the operating area is at or above 21 kPa/m;
- Geomechanical simulations are developed to assess all new pad startups;
- These activities confirm that operating at the approved MOPs does not impact the caprock integrity at MacKay River.



# Monitoring: Wabiskaw C Pressure & Temperature



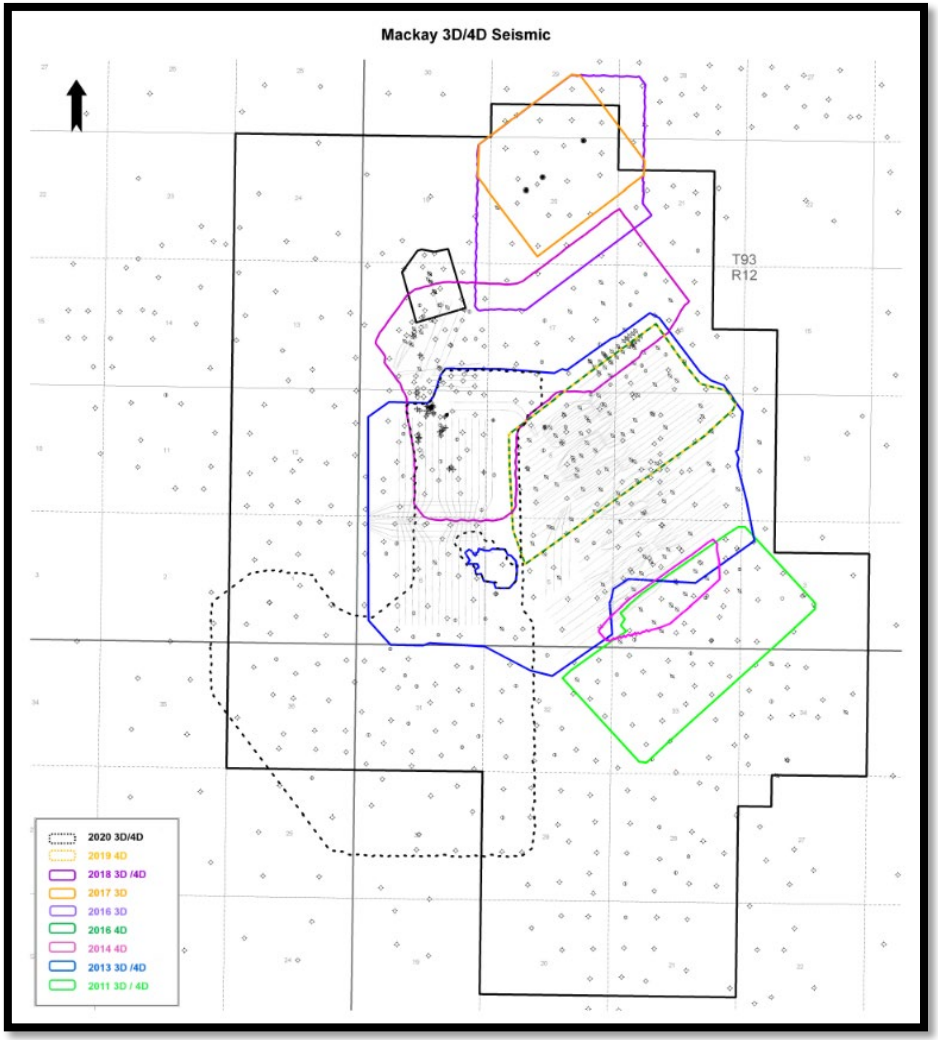

Datum = -313.6mSS



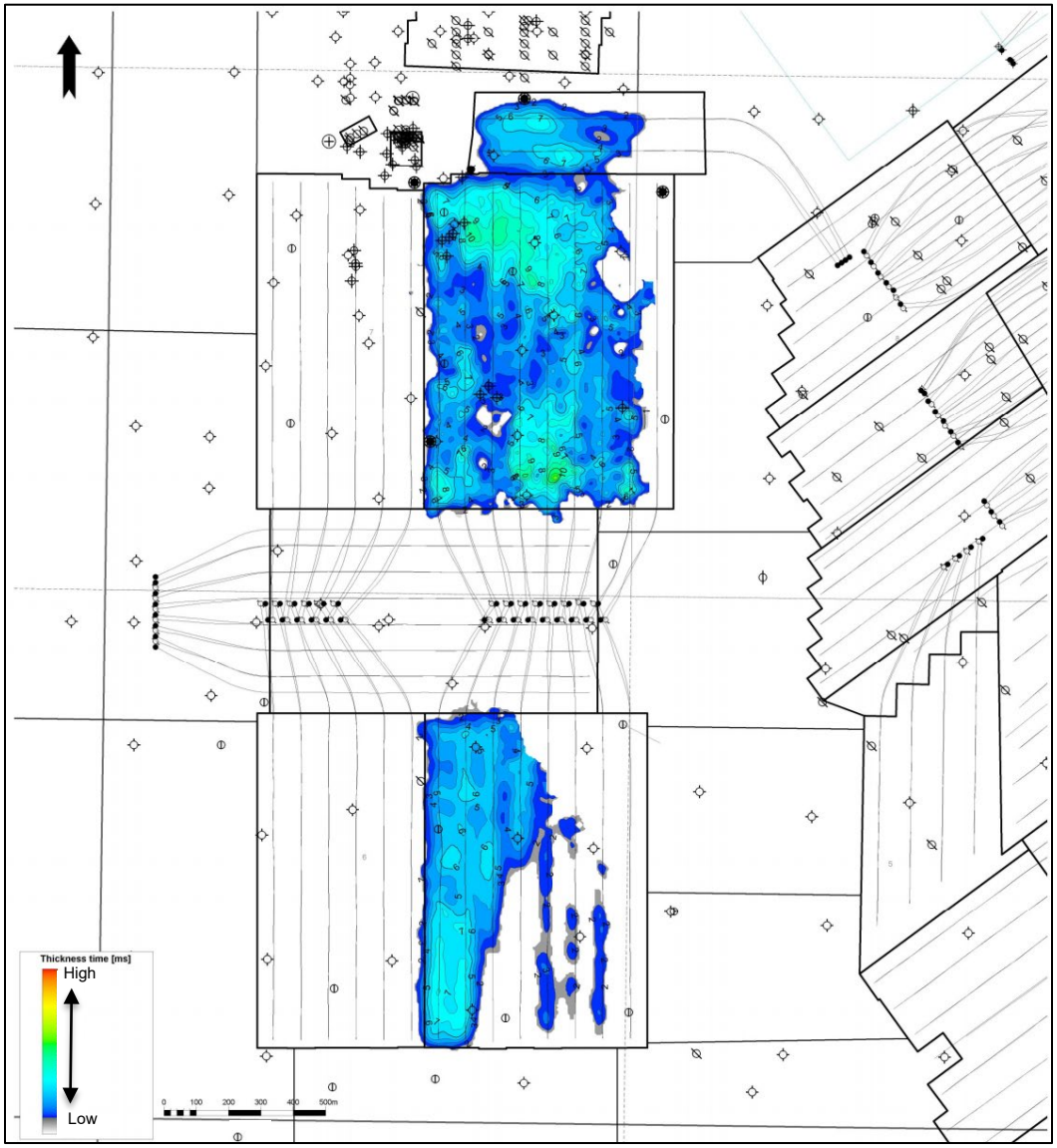

- Average pressure increase of ~22 kPa in original producing area; pressure increase of ~19 kPa in Pad 750 area:
  - Pressures are below fracture pressures
- 14 wells with elevated temperatures (>30°C) directly above mature SAGD operations:
  - 5 wells between 90°C and 145°C; 9 wells between 30°C and 90°C
  - Elevated temperatures are within the expected range

# MacKay River – 3D / 4D Seismic Activity

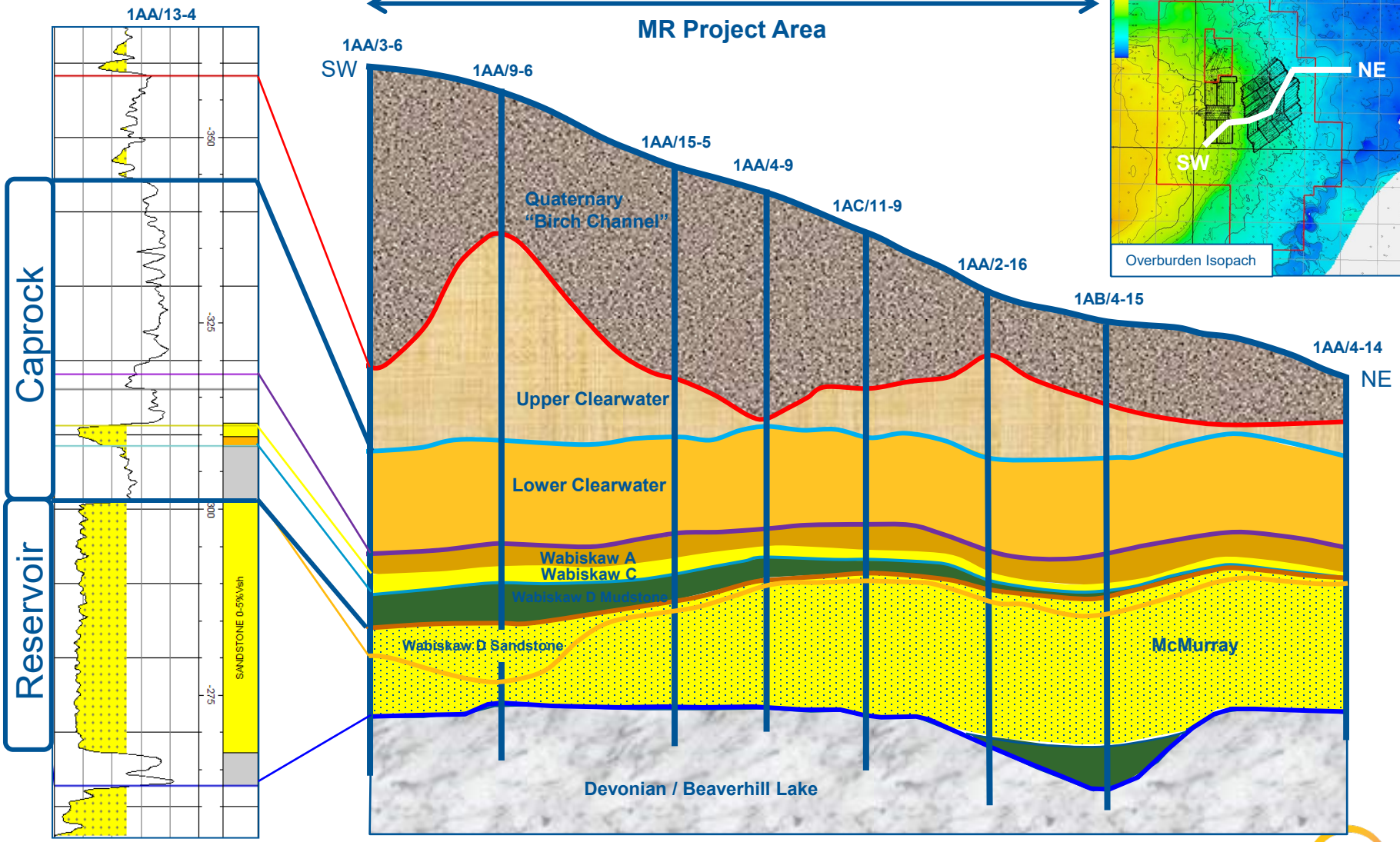
- In 2020, 3D and 4D seismic data were collected in the west region of the field;



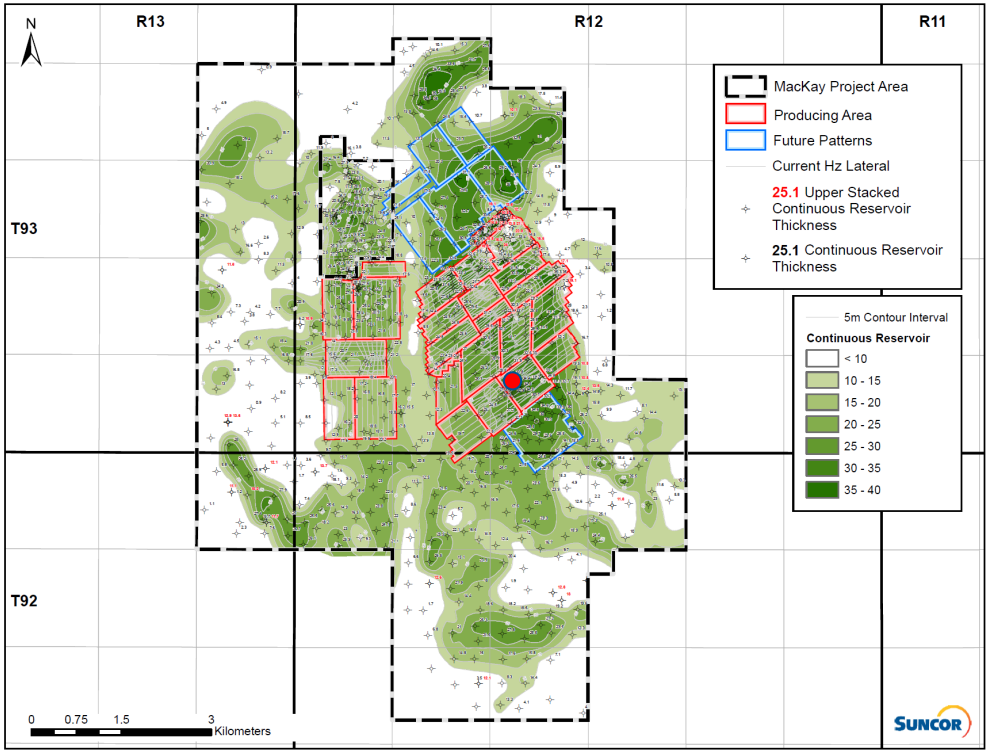
# 2020 4D Seismic – Time Delay (ms)

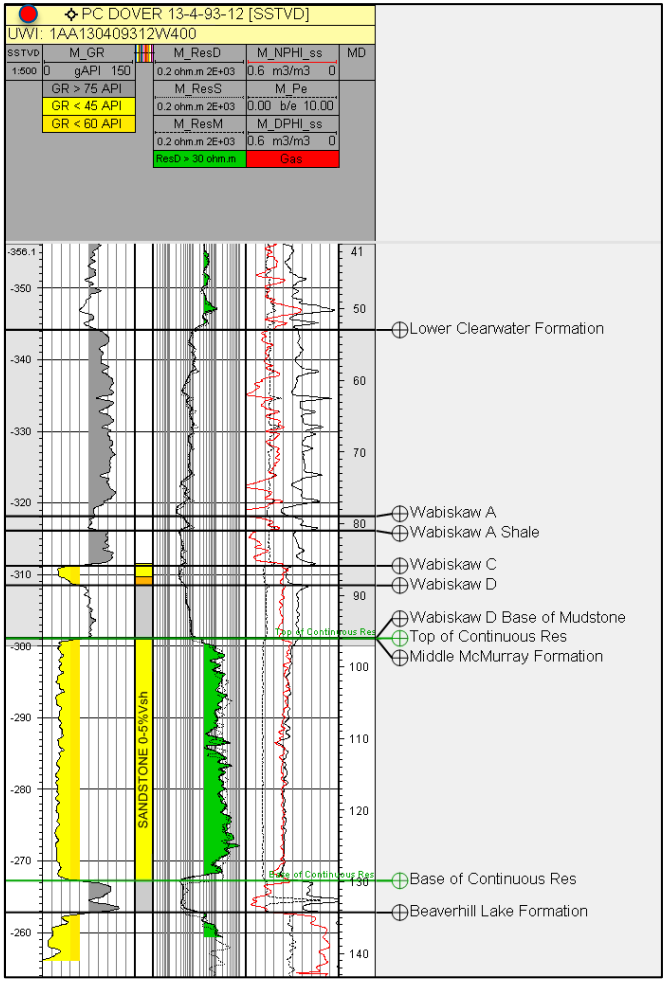


# MacKay River Regional Structure



# MacKay River Stratigraphy



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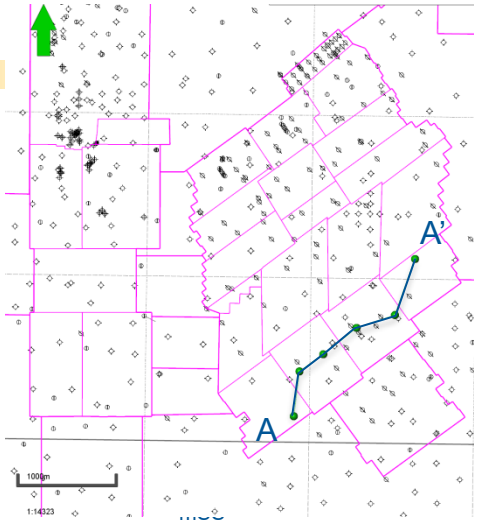
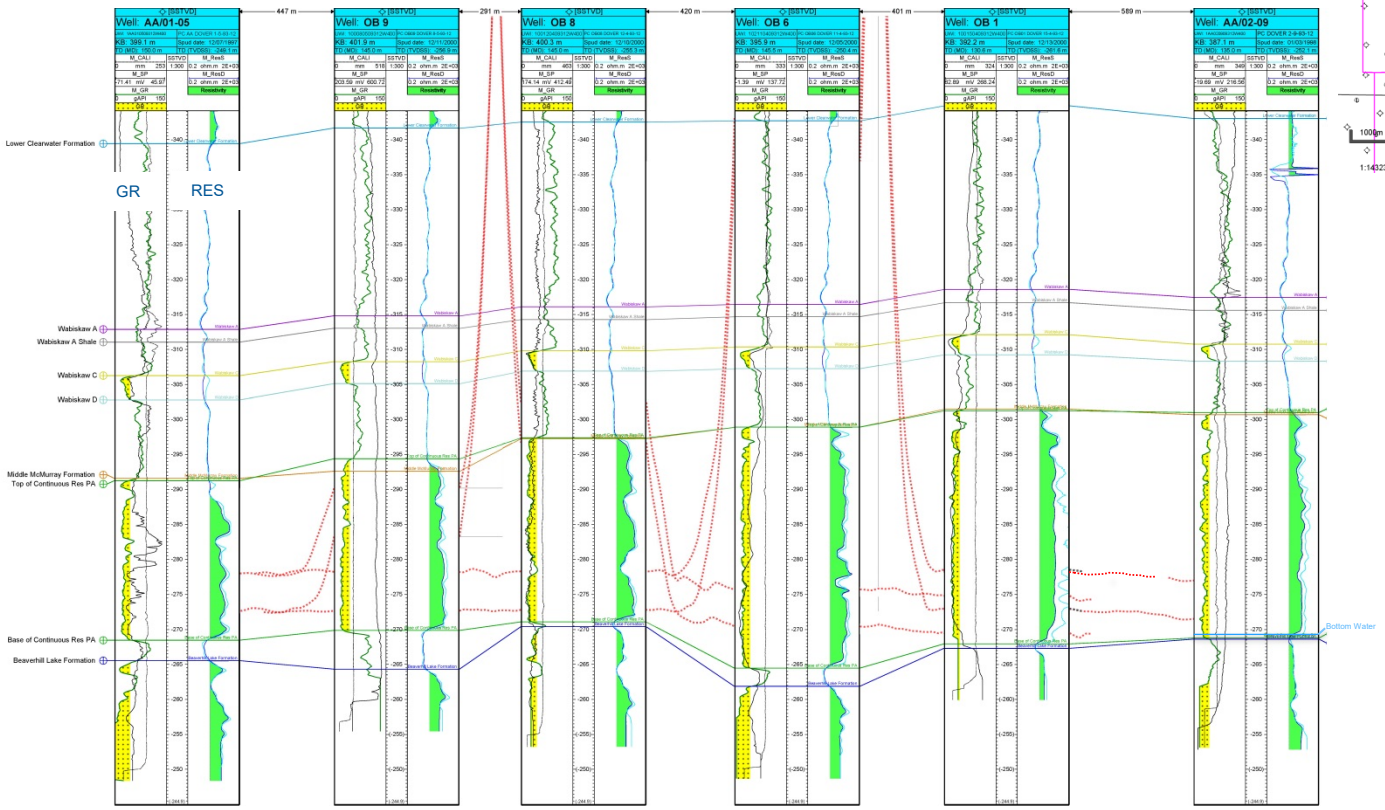
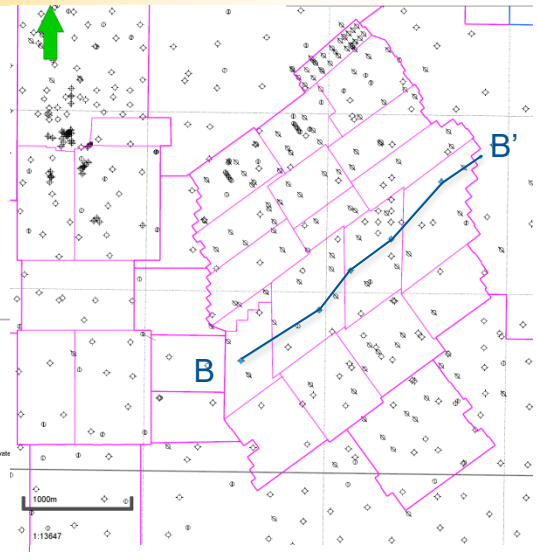
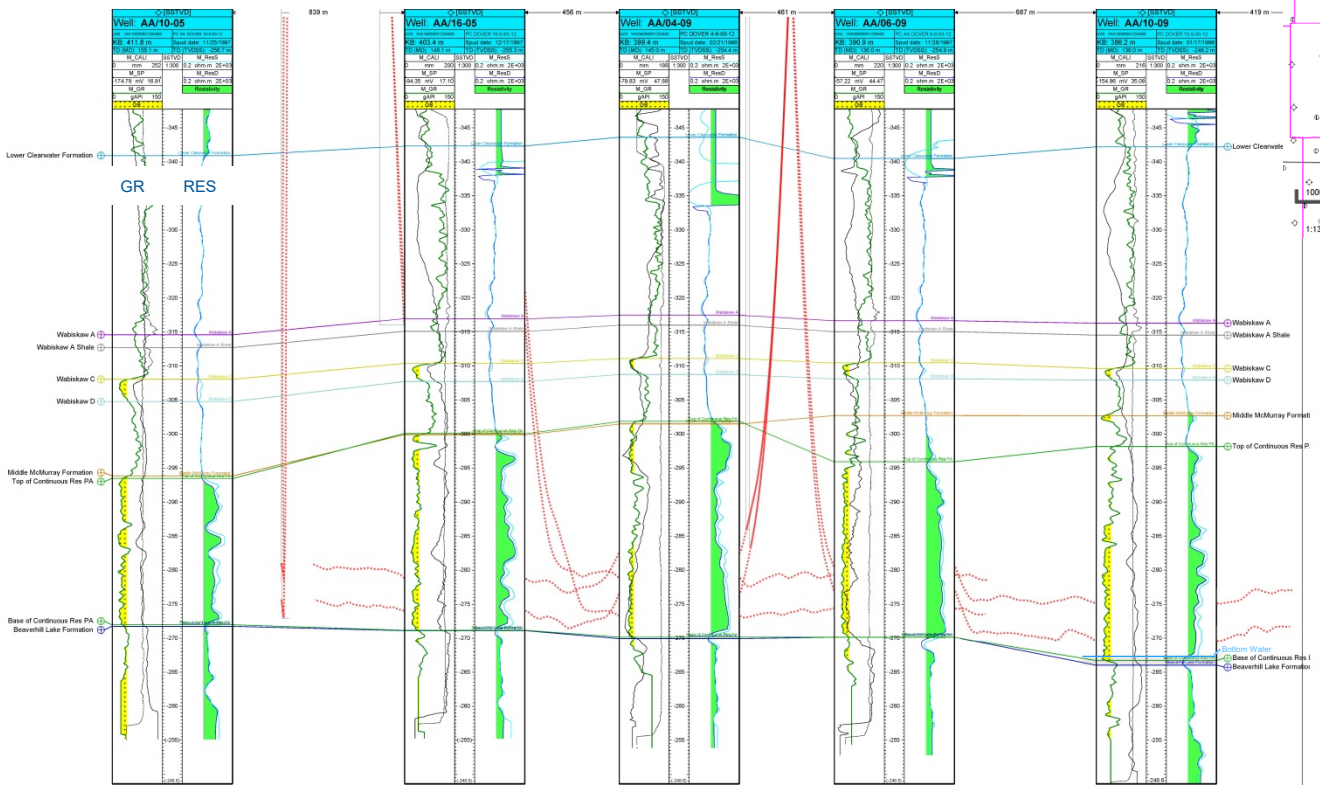
# Representative well cross-section: Phase 1



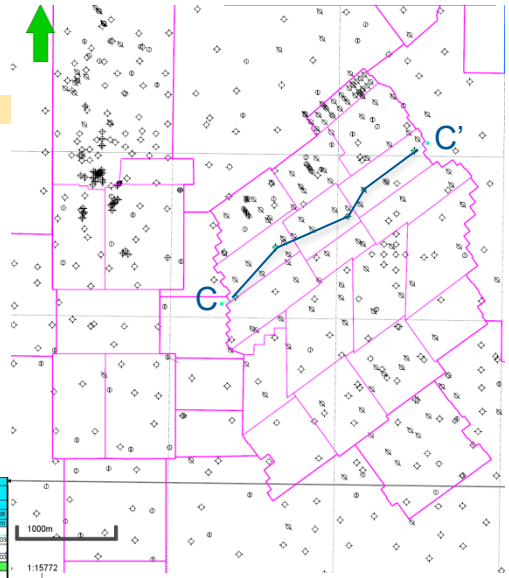



# Representative well cross-section: Phases 2, 3 and 4

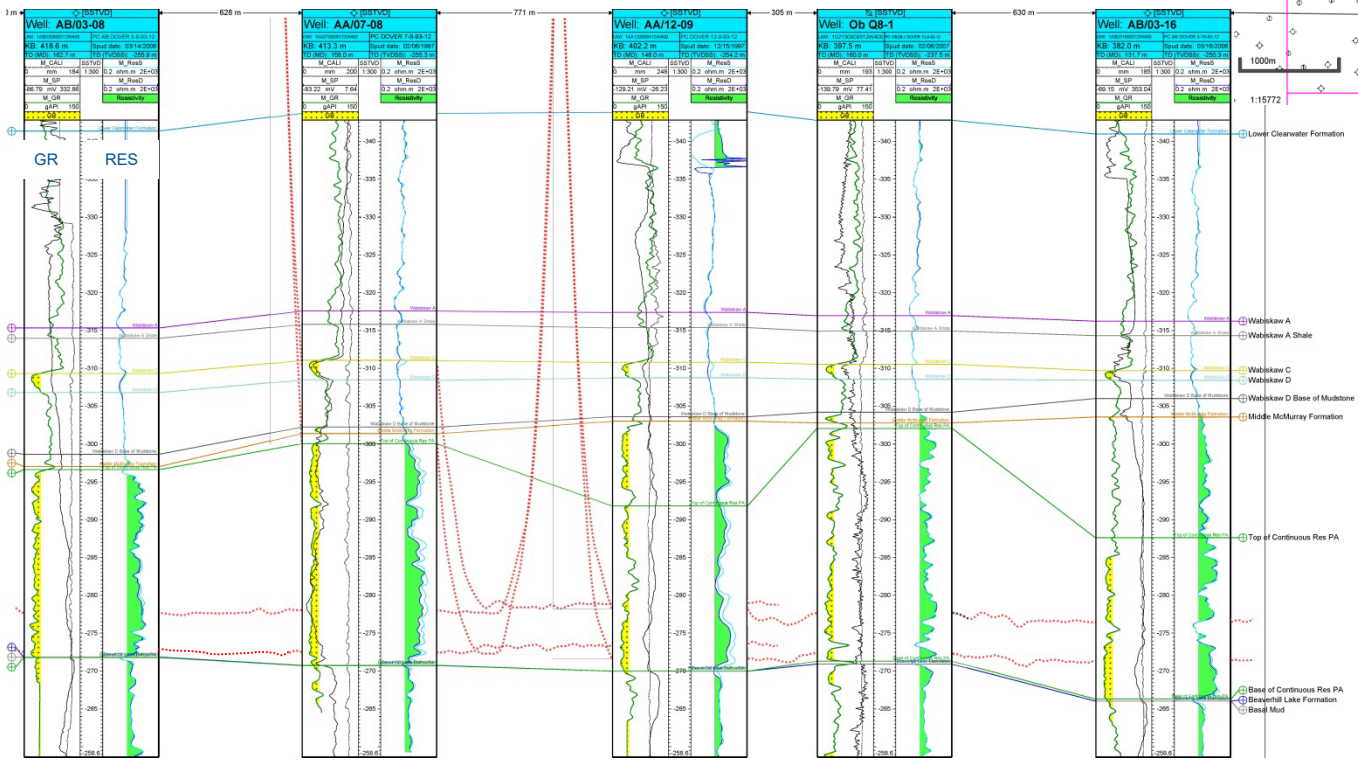


# Representative well cross-section: Phase 5




C Pad 24 Pad 25 C'




NN Pattern OO Pattern QQ Pattern



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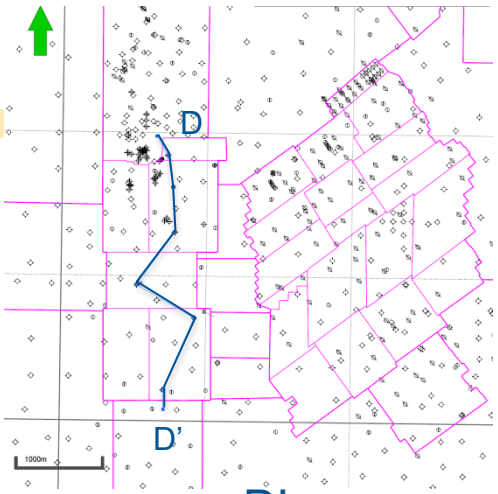
# Representative well cross-section: Pads 824 / 750 / 751




D

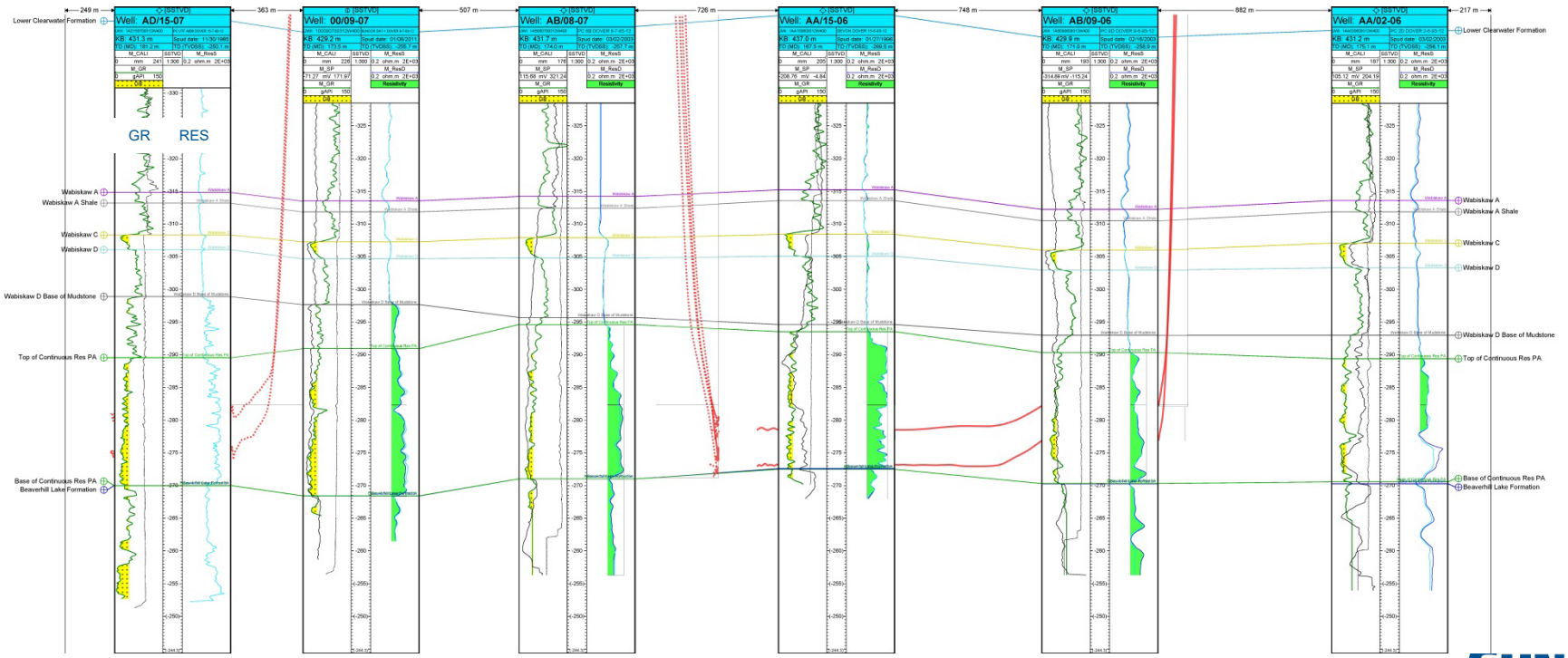
Pad 824

Pad 750

Pad 751W

Pad 750

D'




824

750N

751W

750S



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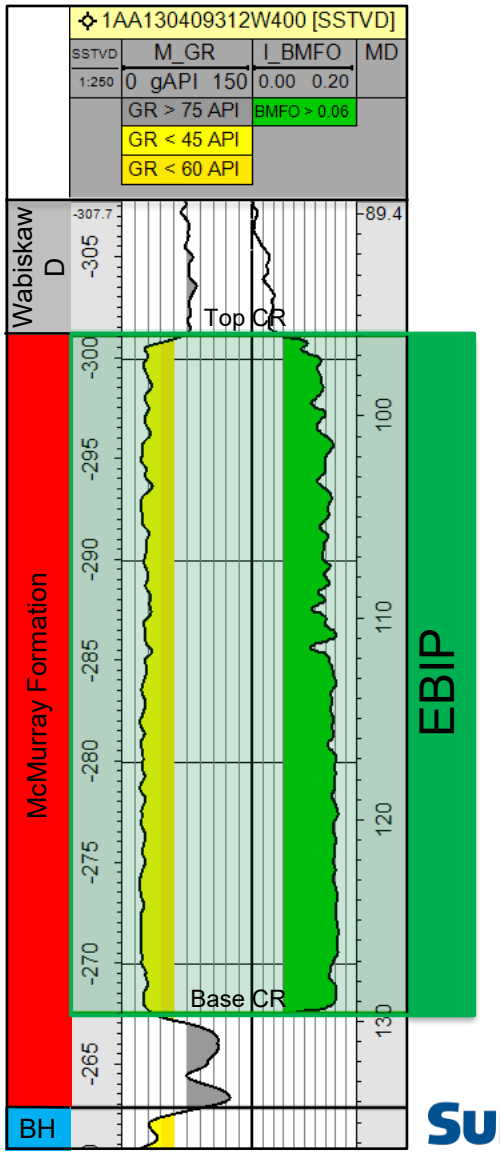
# Exploitable Bitumen in Place (EBIP)

- Exploitable Bitumen in Place (EBIP) is defined in each well by the top and base of Continuous Reservoir. It is selected at the base of a continuous sand unit either developed or most likely to be developed.
  - Continuous Reservoir base: lowest portion of the continuous reservoir sandstone with BMFO cut off of 6%, <3m of >50% mud/breccia in the lower portion.
  - Continuous Reservoir top: 2m of mudstone, no BMFO or porosity cut offs.
- Upper Lean, Middle Lean, and Gas Zones that are in pressure communication with the continuous reservoir are included with no thickness cutoffs.
- Observation wells and 4D seismic will take precedence over pre-operations core and log based picks.




BH: Beaverhill Lake Group

# Exploitable Bitumen in Place & Average Reservoir Properties

| Pattern | HC area ($m^2$) | Continuous Reservoir Thickness (m) | Porosity | Permeability (mD) | Oil Saturation | EBIP ($e^3m^3$) | EBIP (MMbbls) |
|---|---|---|---|---|---|---|---|
| **A** | 466,561 | 21.7 | 0.34 | 1000-6000 | 0.72 | 2,449 | 15.40 |
| **B** | 476,917 | 26.8 | 0.34 | 1000-7000 | 0.82 | 3,596 | 22.62 |
| **C** | 475,673 | 33.1 | 0.34 | 1000-7000 | 0.82 | 4,399 | 27.67 |
| **D** | 362,305 | 28.1 | 0.34 | 1000-6000 | 0.82 | 2,806 | 17.65 |
| **E** | 523,590 | 28.7 | 0.34 | 1000-6000 | 0.82 | 4,180 | 26.29 |
| **F** | 475,138 | 29.4 | 0.34 | 1000-7000 | 0.83 | 3,913 | 24.61 |
| **G** | 584,365 | 28.3 | 0.34 | 1000-6000 | 0.78 | 4,341 | 27.30 |
| **H** | 405,338 | 21.9 | 0.34 | 1000-6000 | 0.79 | 2,367 | 14.89 |
| **NN** | 1,059,073 | 26.2 | 0.34 | 1000-6000 | 0.78 | 7,351 | 46.24 |
| **OO** | 769,362 | 27.7 | 0.34 | 1000-6000 | 0.76 | 5,482 | 34.48 |
| **QQ** | 1,014,944 | 26.3 | 0.34 | 1000-6000 | 0.76 | 6,833 | 42.98 |
| **824** | 181,530 | 19.6 | 0.33 | 1000-6000 | 0.81 | 946 | 5.95 |
| **750N** | 795,880 | 22.9 | 0.33 | 1000-6000 | 0.79 | 4,446 | 27.96 |
| **750S** | 711,080 | 18.1 | 0.34 | 1000-6000 | 0.74 | 3,197 | 20.11 |
| **751W** | 639,111 | 20.2 | 0.34 | 1000-6000 | 0.78 | 3,359 | 21.13 |
| **751N** | 522,977 | 22 | 0.33 | 1000-5000 | 0.77 | 2,930 | 18.43 |
| **751S** | 410,219 | 17.3 | 0.34 | 1000-6000 | 0.76 | 1,846 | 11.61 |
| **Combined Active Well Pattern Area** | 9,874,062 | 24.6 | 0.34 | N/A | 0.78 | 64,441 | 405.32 |
| *** Project Development Area** | 41,230,470 | 20.78 | 0.33 | N/A | 0.73 | 208,798 | 1,313 |

**EBIP:** Exploitable Bitumen In Place. Without modification this generally stands for SAGD EBIP or producible bitumen in place.
**HC:** Hydrocarbon
*** Project area and Development area are the same.**



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# Performance Summary by Pattern

| Pattern | EBIP ($e^3m^3$) | Cum. Oil ($e^3m^3$) | Recovery (%) | CSOR ($m^3/m^3$) | iSOR ($m^3/m^3$) | Ultimate Recovery (%) |
|---|---|---|---|---|---|---|
| A | 2,449 | 1,178 | 48% | 4.30 | 3.84 | 56% |
| B | 3,596 | 2,863 | 80% | 2.71 | 4.61 | 88% |
| C | 4,399 | 3,900 | 89% | 2.28 | 1.97 | 95% |
| D | 2,806 | 2,108 | 75% | 2.61 | 1.95 | 84% |
| E | 4,180 | 2,715 | 65% | 1.83 | 2.66 | 74% |
| F | 3,913 | 2,739 | 70% | 2.67 | 3.20 | 80% |
| G | 4,341 | 2,219 | 51% | 2.45 | 2.78 | 63% |
| H | 2,367 | 747 | 32% | 3.24 | 2.52 | 43% |
| NN | 7,351 | 3,204 | 44% | 2.77 | 2.36 | 70% |
| OO | 5,482 | 1,487 | 27% | 2.87 | 4.09 | 47% |
| QQ | 6,833 | 2,059 | 30% | 2.54 | 2.47 | 52% |
| 824 | 946 | 178 | 19% | 3.10 | 3.37 | 40% |
| 750 | 7,643 | 1,284 | 17% | 3.14 | 2.72 | 69% |
| 751 | 8,135 | 3 | 0% | 50.40 | 19.03 | 67% |
| Combined Active Well Pattern Area | 64,441 | 26,684 | 41% | 2.65 | 2.99 | 67% |



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# Average Reservoir Properties

- Average reservoir properties for the operating portion of the scheme:
  - Initial reservoir pressure: 400kPa
  - Initial reservoir temperature: 6°C
  - Average reservoir thickness= 21.0 m
  - Average porosity = 0.337
  - Average oil saturation = 0.78
  - Horizontal permeability: 2 to 8 D
  - Vertical permeability: 1 to 4 D
  - Viscosity: ~ 1,000,000 cp @ 15°C



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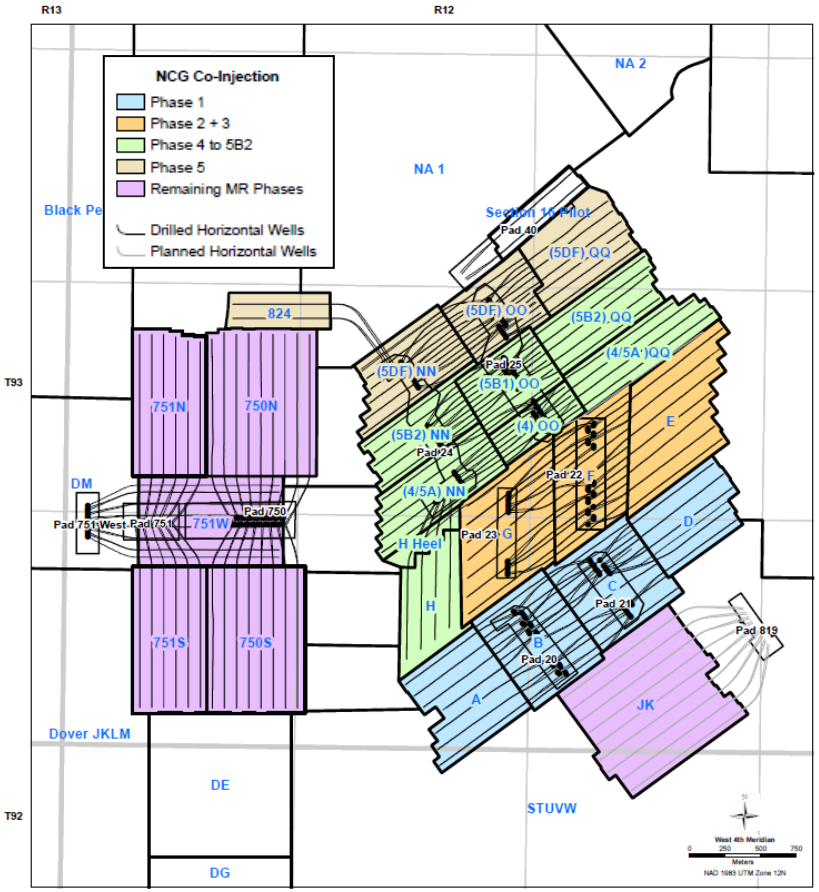
# SAGD NCG Co-Injection Strategy




## Pilot

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

## Phase 1

- NCG co-injection to A, B, C and D patterns – 2016

## Phase 2 + 3

- NCG co-injection to E, F and G patterns – 2018

## Phase 4

- NCG co-injection to H Pattern, NN1 to NN10, OO1 to OO9 and QQ2 to QQ10 – Mar 2021 **(Recently started)**

## Phase 5

- NCG co-injection to Pad 824, NN11 to NN16, OO10 to OO15 and QQ11 to QQ16 – 2022 / 2023

## Received Regulatory Approval:

# Co-Injection Strategy

- At MacKay, NCG (i.e. methane fuel gas) is co-injected with steam:
  - The primary purpose is to maintain production and chamber pressures while reducing steam usage.
- NCG injection targets are determined by:
  - Desired operating pressures;
  - Field wide strategies for steam reallocation;
  - Steam chamber maturity and current oil recovery;
  - NCG retention within the reservoir.
- Typical NCG to gas replacement ratios range between 15 – 40 $Sm^3/m^3$ CWE;
- Injected NCG does not exceed a maximum of 18 $e^3m^3/d$ per well on a quarter year average basis;
- NCG returns have been challenging to measure precisely due to produced gas from gas lift usage.



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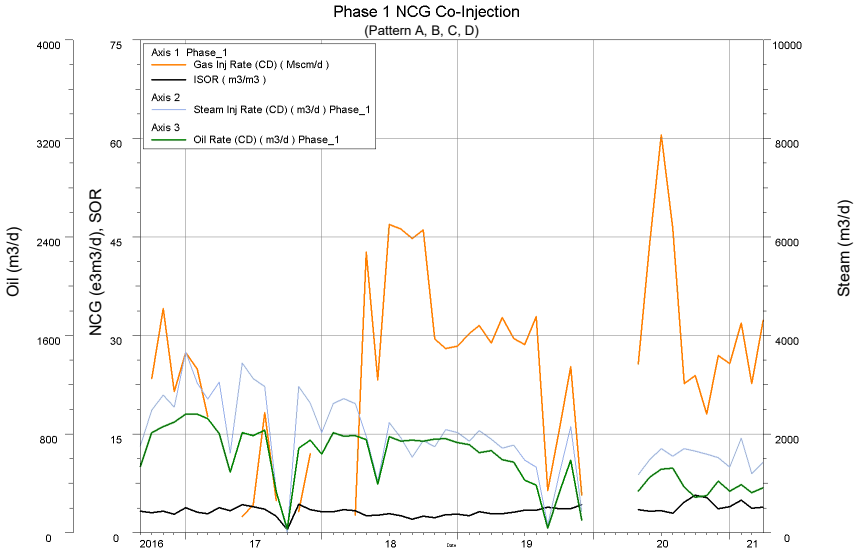
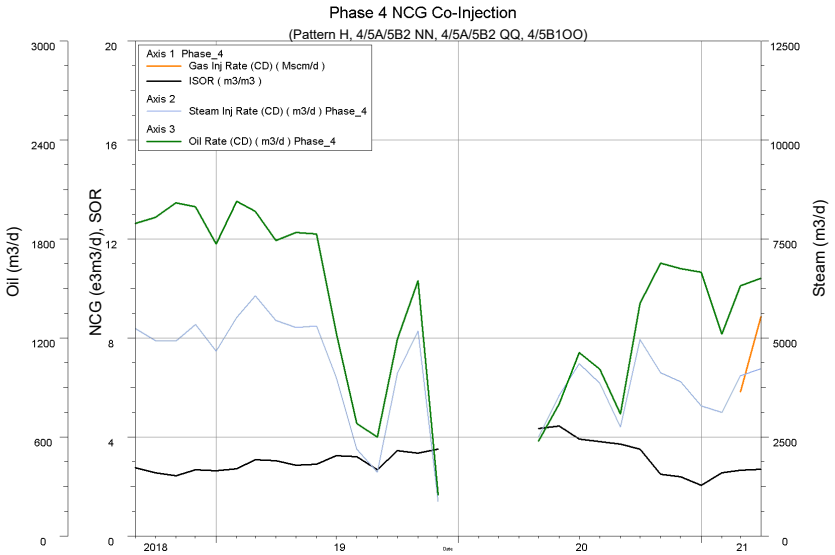
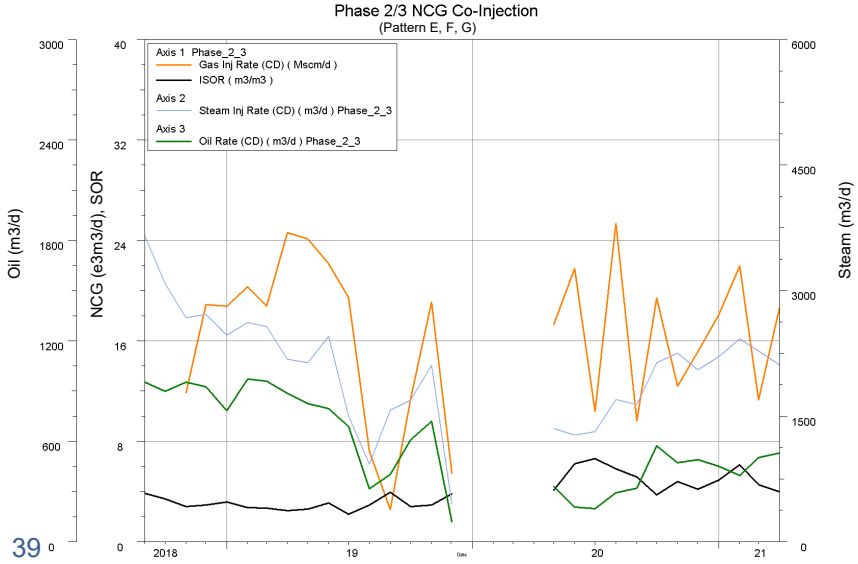
# Key Learnings




- NCG was used successfully after the extended 2019 outage to help rebuild pressures and optimize steam allocation to younger, more impacted patterns
- Phase 4 NCG co-injection was started as of March 2021
- Steam cuts were made while co-injecting less NCG than anticipated to sustain target chamber pressures
- Overall, NCG has helped reduce SOR where it has been applied
- No negative impacts to oil rates, wellbore integrity, or ultimate recovery have been observed

# Lessons Learned from 2019-2020 Outage

# Start-Up- Potential for High Consequence Events

- Plant startups and shutdowns are significantly more hazardous than normal facility operations;

- The Center for Chemical Process Safety (CCPS):
  - Process safety incidents occur five times more often during startup than during normal operations;
  - 50 percent of process safety incidents occur during startups, shutdowns, and other events that infrequently occur (specific to the refining industry).

- Why?
  - Startup and shutdown periods involve many non-routine procedures, and these periods can result in unexpected and unusual situations.



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# For a Success Start Up

- Communication is key!
  - Regular communication during planning and execution is crucial to start up and adapt safely;
  - Providing the right amount of detail to the right people (a detailed plan can still be flexible).
- Take a proactive approach to safety and risk:
  - Considerations for well integrity, surface facilities, reservoir/caprock integrity;
  - Slow and steady wins the race.
- Cross-discipline integration is necessary for constraint planning:
  - Balance between produced water, make-up source water, and steam generation;
  - Gas lift setpoints and handling limits tied to steam generation.
- Expect the unexpected and be flexible:
  - COVID-19, Fort McMurray floods, third party facilities;
  - Have the right tools beforehand, so swift changes to the plan can be made.
- Find the silver lining:
  - Take advantage of downtime and lower pressures to do otherwise expensive/difficult work (valve replacements, wellhead inspections, fluid sampling).



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# Planning for Start-up

- Comprehensive production & plant start-up plan including:
  - Risk assessment;
  - Operations start-up plan including applicable procedures;
  - Communication plan and daily meetings;
  - What If? Scenarios;
  - Well by well ramp-up forecast;
  - Training sessions on the start-up plan with Operations;
  - Reviews with the Cross Function Team (CFT), “Cold Eyes Review”, peer review;
  - Tools to adapt the plan and address changes;
  - Dashboards to track deviations from the plan and monitor ramp-up.



*Start-up Plan Dashboard in Subsurface Platform*

# Start Up Learnings

- Pad sequencing is important for a successful startup:
  - Target the guaranteed volumes first to get the fluid flowing to the plant and the water required for steam generation;
  - Mature wells were reliable volumes for MacKay River.
- Bottomhole pressure is the most important factor for artificial lift to work well:
  - Very low bottomhole pressures is challenging for a gas lift system.
- Plugged gas lift coils; 6% of coils were plugged, check ahead if gas is available to minimize production losses
- Well testing was not functional during the initial start up:
  - Therefore, it is difficult to understand how much volume is coming for part of the field;
  - Challenging to set production expectations, understand if the well were flowing.
- Lower water cuts and less emulsion led to challenges with steam production:
  - Higher gas lift required;
  - Less water to produce steam led to issues with produced gas system & steam generation.



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# Reservoir Pressure Learnings

- Pressure losses due to extended shut-in without injection:
  - Average pressure loss of ~250 kPa across the field; ranging from ~100-850 kPa/pattern;
  - Greater pressure loss in less mature areas, edge patterns, and wells with no NCG co-injection.
- Areas with higher pressure loss, bullheading was more efficient to rebuild pressure, than circulation
- Able to regain 400-500 kPa over 2 months (~50% of pressure loss) by bullheading
- Rapid re-pressurization also due to smaller size of steam chamber
- NCG co-injection useful to support re-pressurization and flexibility to divert steam where needed



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# Well Integrity during Outage and Restart

- Incorporating well integrity into the operations startup discussions and plan:
  - Completed field wide checks for bonnet gaps & leaking valves.
- Regular communication throughout shut down and ramp up period on well integrity observations
- Shut in was an opportune time to perform preventative maintenance work on wellheads & subsurface:
  - No kill fluid required due to decline in bottomhole pressures, allowing for cost savings.
- Steam Warm-up plan:
  - Similar warm-up plan to new wells in circulation;
  - 3-5 day warm up;
  - Completions support on start-up to address any additional wellhead issues, plugged gas lift coils.
- SCVF monitoring
  - Completed baseline testing on all wells with SCVA's with AGAT;
  - Follow up testing scheduled.



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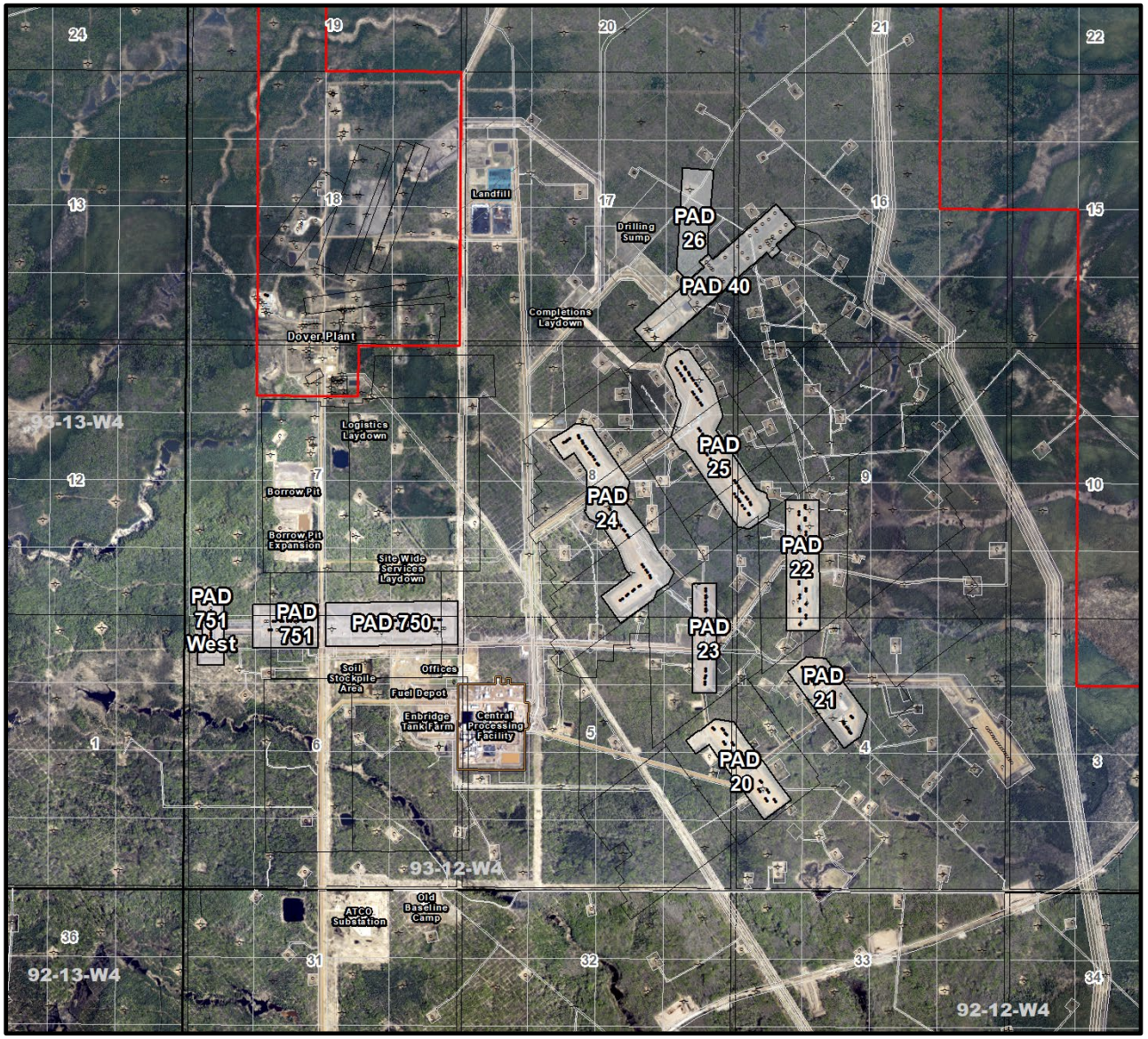
# Surface

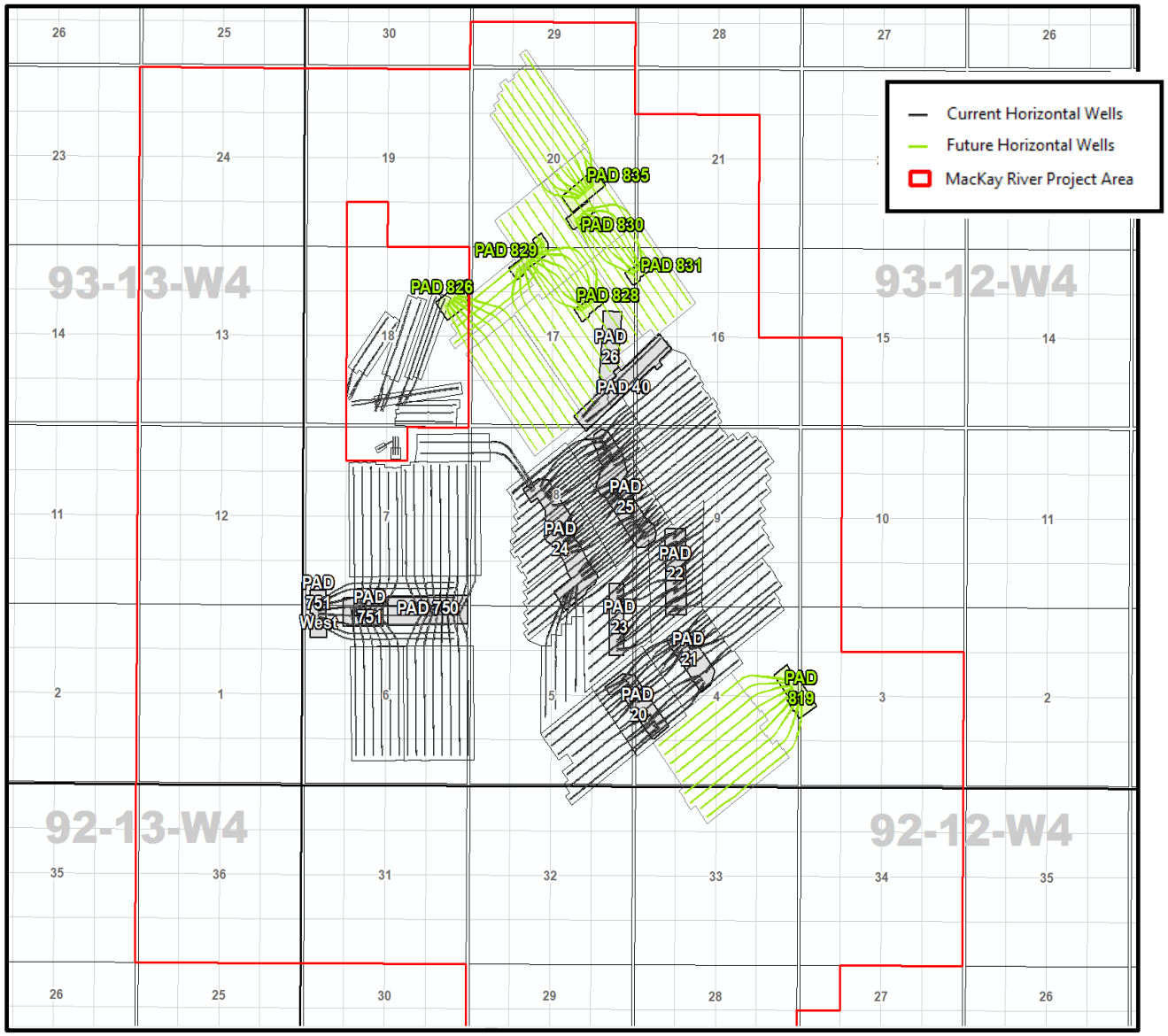
4.3

# Overview of Surface Infrastructure



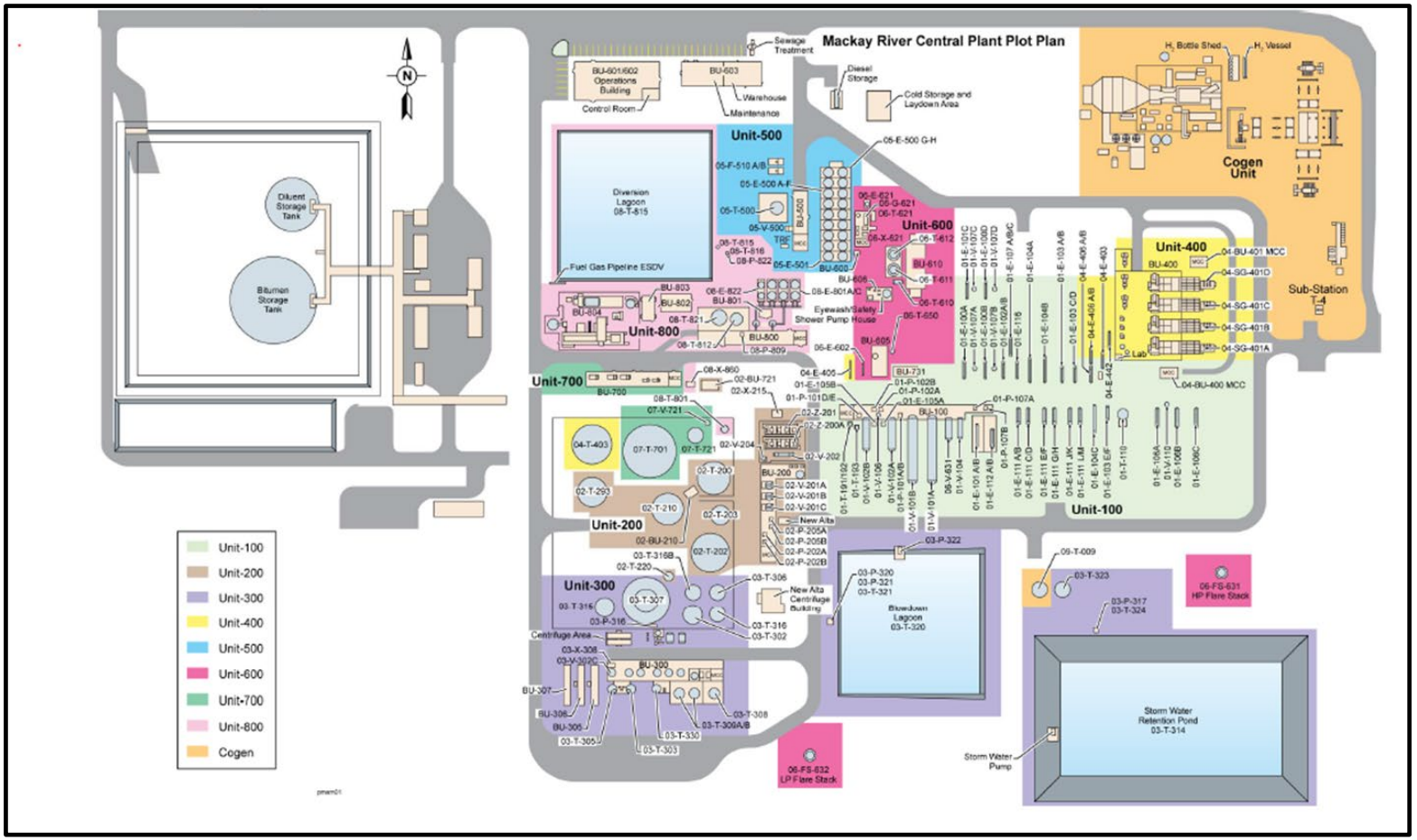
# Aerial Photo of MacKay River

# AER Project & Approved Development Areas

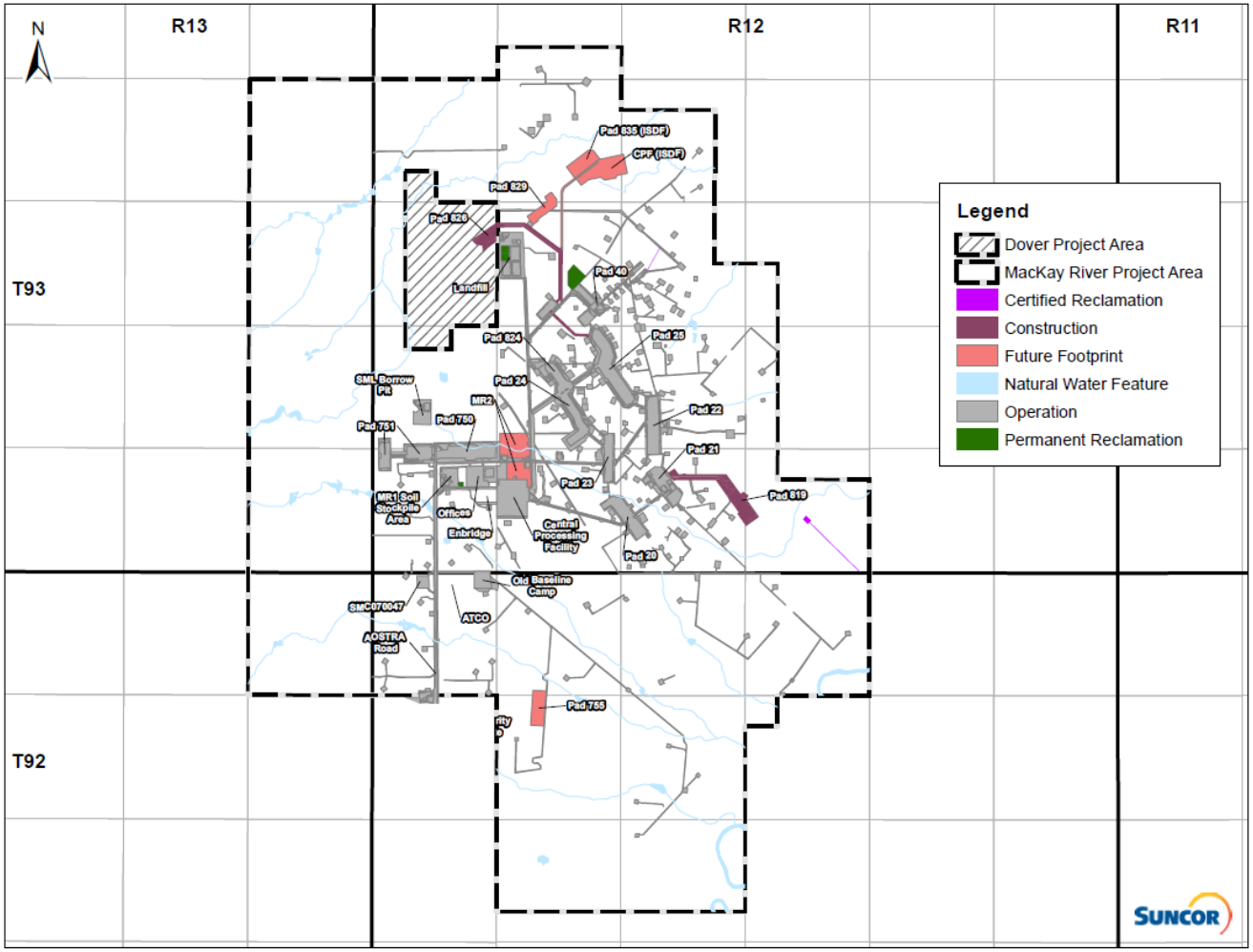


# MacKay River Central Processing Plant Modifications

- There were no modifications to the CPF over the last reporting period that required AER approval



# MacKay River; Built and Planned Surface Infrastructure



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# Updates to the AER

On January 29, 2020 (File No. 4101-00254465-02-0202), the AER approved a water transfer from the PetroChina Canada Ltd MacKay River project to the Suncor MacKay River project:

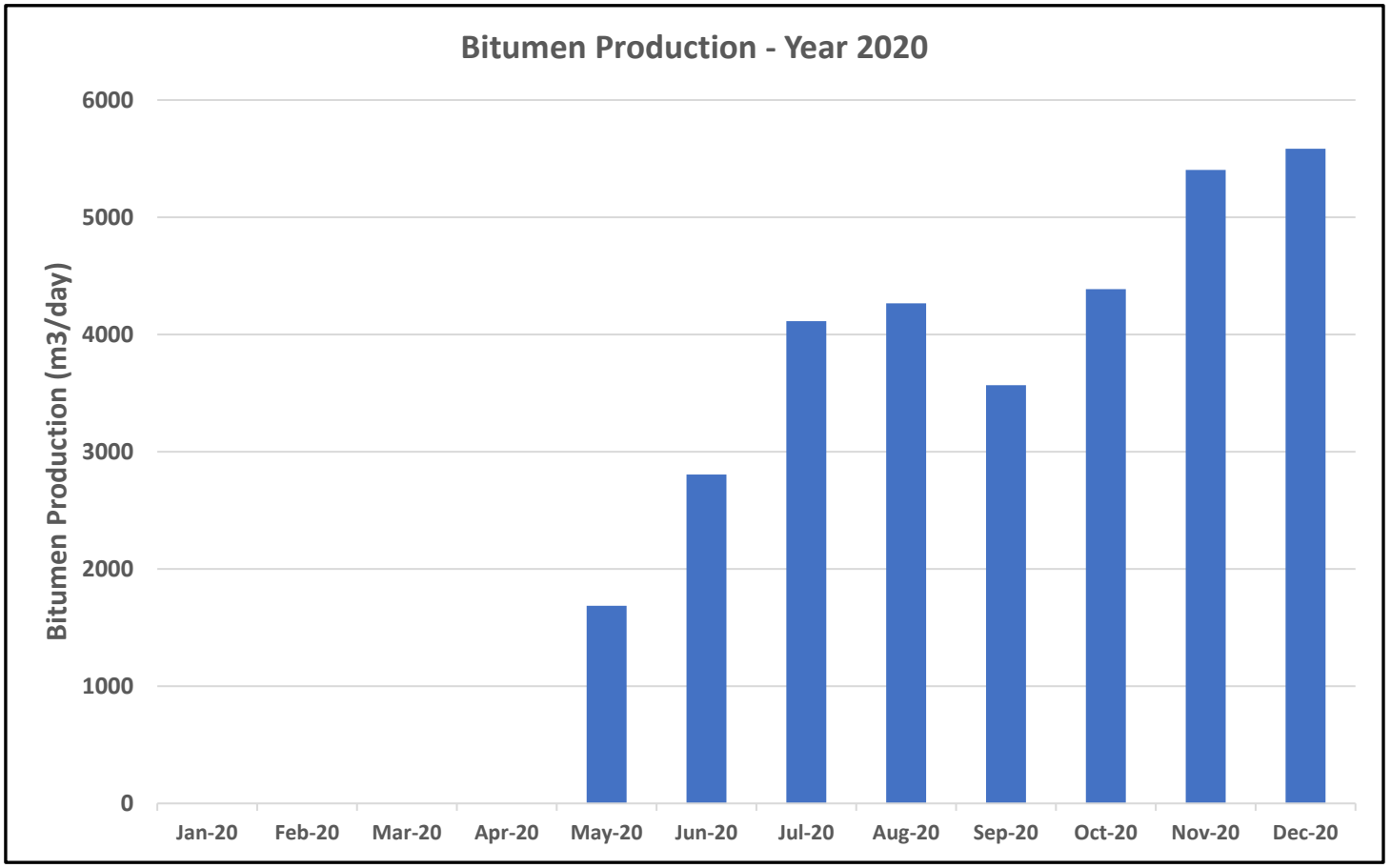
- Water from the PetroChina MacKay River project used to support start-up activities at the Suncor MacKay River project.

- Pad 826:
  - Project is at site clearing stage;
  - Injector and Producer well head positioning were swapped in relation to the inlet modules;
  - No subsurface change.

- Four 400 bbl (64 $m^3$) tanks added to the MacKay River tank farm
  - Tanks will store leachate from the MacKay River landfill:
    - Allows Suncor to fill tanker trucks for transport to third-party disposal site.
  - Landfill approval allows for transfer of leachate out of the landfill;
  - Directive 055 conditions will be met for placement of the four tanks.

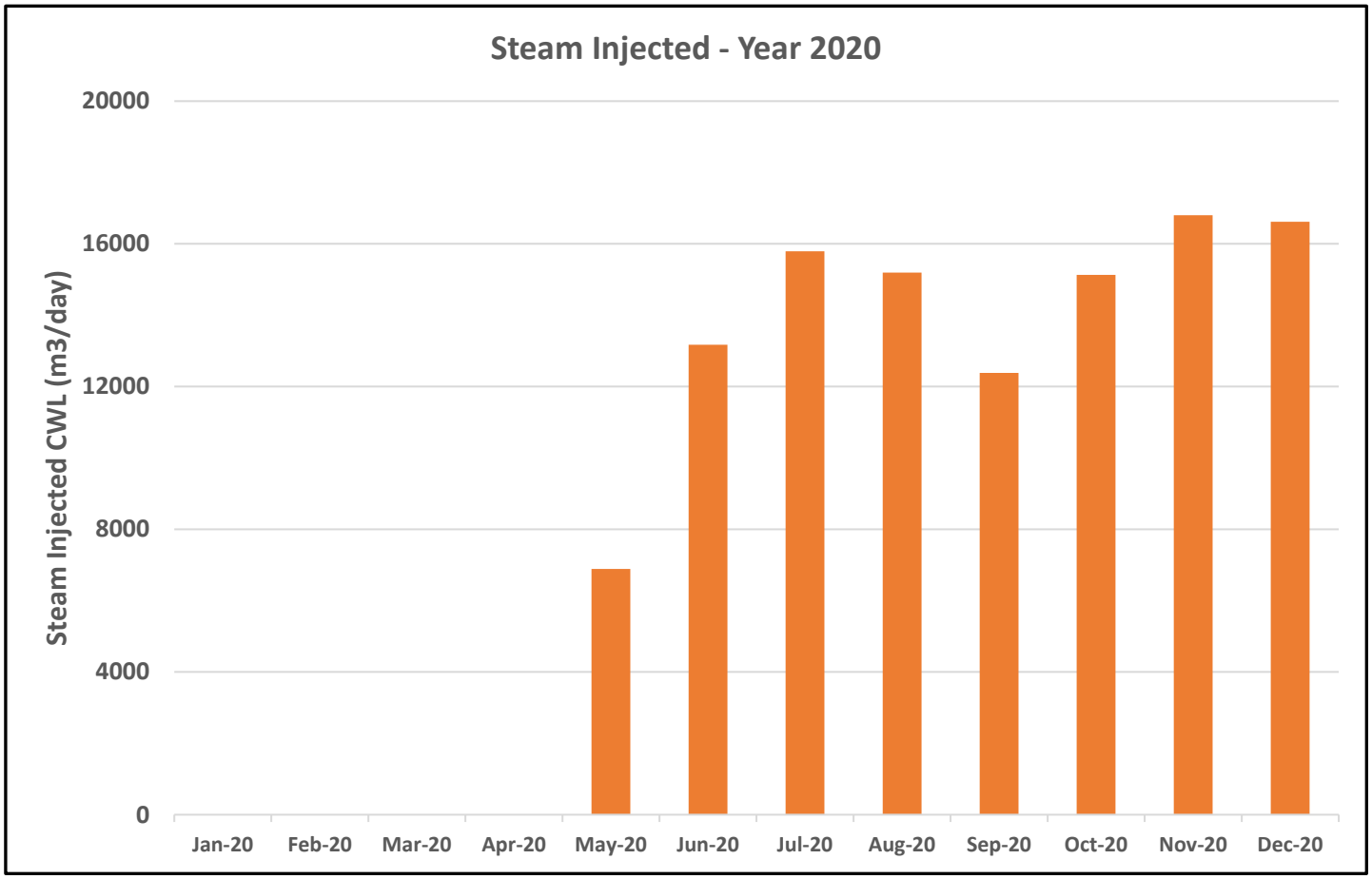
# Annual Rates-Bitumen; January 1, 2020 to December 31, 2020

- From January 2020 to December 2020 MacKay River averaged 2,651 $m^3$/day (16,683 bpd) of bitumen production. The Design rate for the MacKay River CPF is 6,041 $m^3$/day (38,000 bpd) @ 2.8 SOR.



# Annual Rates- Steam; January 1, 2020 to December 31, 2020

- From January 2020 to December 2020 MacKay River injected on average 9,331 $m^3$/day of steam into the wells.
- The steam injection design rate for the MacKay River CPF is 18,432 standard $m^3$/d.



# Historical and Upcoming Activity

4.4

# Suspension and Abandonment Activity

- Well Abandonment:
  - For the reporting period from January 1, 2020 to December 31, 2020,  no wells were abandoned in the MacKay River project.

- Pad Abandonment:
  - For the reporting period from January 1, 2020 to December 31, 2020, no pads were abandoned in the MacKay River project.

# Regulatory Applications; January 1, 2020, to December 31, 2020

## Approved Applications:

| Application Number | Application Files | Approval Date |
|---|---|---|
| 1931951 | MacKay River In Situ Project; Approval 8668 FFF, Condition 31 | 2021/03/10 |
| 1928158 | Amendment application by Suncor Energy to add sustaining pads 828, 829, 830 and 831 | 2020/08/07 |
| 1926052 | Suncor Energy Inc. MacKay River Steam Assisted Gravity Drainage (SAGD) Application to Modify Producer and Injector Well Designs at Pad 819 AER Commercial Scheme Approval No. 8668 | 2020/01/13 |
| 1923682 | Suncor Mackay River In Situ Project AER Approval No 8668BBB (as amended) Request for Approval Pad 751 Thermal Compatibility Assessment | 2019/09/06 |

## Future Applications:

- For the reporting period of January 1, 2021, to December 31. 2022:
  - Suncor to submit Water Act Licence application for use of surface water for industrial uses including dust suppression;
  - Suncor to amend Water Act Licence 188229 to delete WSW3 and add WSW3B.

# Summary of Events

## MR Ramp-Up

- First steam achieved late April with introduction of steam to Pads 20 & 21. Produced fluids flowed back to CPF early May and first oil sent to Enbridge mid May;
- Mature wells saw minimal pressure loss over the extended shut-in while wells in plateau or ramp-up phase required warm-up period;
- NCG supported re-pressurization and allowed for re-direct steam to pads in plateau and/or early life phase.

## Produced Fluids Pipeline Failure

- In June 2020, a pressure surge from a plant trip led to a release from the Pad 22 emulsion pipeline on pad grounds.

## Pad 751 Start-Up

- Start up schedule has been staggered to meet CPF capacity demand. Circulation started on eight Pad 751 wells with the first four starting in July 2020. Of the eight wells in circulation, four were converted to SAGD in December 2020 and four converted to SAGD in January 2021. Another four wells started circulation in January 2021 and were converted to SAGD in April 2021.

# Summary of Key Learnings

## MR Ramp-Up

- Regular communication during planning and execution of start-up was crucial to ramping up safely and being able to adapt to changes in the plan;
- NCG supported re-pressurization and allowed for flexibility to divert steam when needed to other areas of the field without any negative reservoir impacts.

## Produced Fluids Pipeline Failure (June 2020)

- Metallurgical lab analysis determined the damage mechanism to the pipeline to be external. The damage mechanism appears to be a result of wet mineral wool insulation releasing leachate compounds that caused damage to carbon steel;
- Key learnings from this failure has led to implementation of effective inspection programs to detect cracks as well as improved insulation system design.

## Pad 751 Start-Up

- Start up order driven by reservoir quality and applied learnings from recent start up of Pad 750.

# Pilots / Technical Innovations - New Technology Update

- Electric Resistive Heater Pilot (750S9)
  - Project canceled; well location targeted for pilot will be made available for operation.

- In Situ Demonstration Facility (ISDF)
  - Project is temporarily on hold;
  - No updates for this reporting period.



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# Compliance History

| | Date Incident | AER - Edge# OneStop # | Type of Incident | Title & Description | Remediation or compliance efforts |
|---|---|---|---|---|---|
| January 2020 to December 2020 | Feb-4-2020 | 363212 | Contravention | MR - Passive Samples Over exposure | AMD Assurance Plan procedures were reviewed and incorporated. |
| | Apr-21-2020 | 30725872 30792059 | Flaring > 4hrs | HP and LP Flaring event during the Plant Start up - Notification to AER by email | Flaring occurred during the start up mode of the plant. Once operations were able to stabilized the process, the flaring ceased. |
| | Jun-14-2020 | 367663 | Reportable | Pad 22 - Process fluids spill | Spill clean up completed on July 11-2020. After further investigation it was confirmed the failure mechanism as externally - initiated stress corrosion cracking . A more detailed response was provided to AER on August 06, 2020 File 4009. |
| | Jun-14-2020 | 30725884 30725879 | Flaring > 4hrs | HP and LP Flaring event Plant at low rates due to P22/23 outage 9 Pipeline rupture | This was an emergency flaring event due to excess produced gas. Operations reduced loads to stabilized the process. |
| | Jun-17-2020 | 367810 | Contravention | MR- Landfill - Leachate head Exceedance | Due to increased rain precipitation, Suncor increased efforts to bring down the leachate head and added more vacuum trucks for leachate removal. |
| | Jun-17-2020 | 367835 | Contravention | WL-289164- Monthly water levels has not been reported in Annual basis not in monthly basis as required. ( Section 4.7) | The Water Act license has been amended for reporting on a quarterly cycle rather than a monthly cycle. |
| | Jul-29-2020 | 369605 | Contravention | MR- Landfill - Leachate head Exceedance | Suncor continues to work diligently to manage the leachate in the landfill to avoid a similar contravention and, most importantly, to avoid any overflow. |
| | Aug-27-2020 | 370888 | Reportable | Pad 25 to CPF - Pipeline spill - Pipeline 36367-010 | The root cause of this event was similar to the Pad 22 spill. Suncor has implemented a full inspection/repair on all pipelines that are susceptible to have the same damage mechanism. |
| | Aug-28-2020 | 370911 | Reportable | Blowdown lagoon overflow - August 28-2020 | An alarm for high level was set up for the Blowdown Lagoon. Alarm to indicate if the valve is open in order to alert the control room operator that this valve is still open. |
| | Aug-12-2020 | 30794515 | Flaring > 4hrs | Flaring event due to 02-PCV-501 failed causing excess sweep gas to enter T-293 | Emergency flaring ceased when PCV -501 was repaired. |
| | Aug-31-2020 | 30792133 | Flaring > 4hrs | HP Flaring event Cogen online, less demand for produced gas - Pad 25 pipeline header down. | Emergency Flaring due to low demand for produced gas. |
| | Sep-02-2020 | 371118 | Reportable | DVL seepage - Southeast corner | An assessment was conducted to identify the leak. The initial smoke test did not indicate any problem. Operations decide to operate the DVL 20" until the next opportunity to perform further investigation of the liner. |
| | Sep-08-2020 | 371299 | Contravention | MR- Landfill - Leachate head Exceedance | Suncor continues to work diligently to manage the leachate in the landfill to avoid a similar contravention and, most importantly, to avoid any overflow. |
| | Sep-16-2020 | n/a | VSD | Liner Tear MR Phase III East SW corner | Temporary repair was put in place until the permanent repair was completed on October 22, 2020 |
| | Oct-16-2020 | 30838077 | Flaring > 4hrs | HP Flaring due Pad 750-751 shutdown | Flaring due to excess produced gas. Flaring continued until Pad 750/751 came back online. |
| | Nov-16-2020 | 373741 | Reportable | Drain valve leak in the Pad 21 pipeline - 36366-001 | Maintenance torqued the bolts of the bonnet, which halted the leak . The bonnet was injected with sealant to avoid any further failures. |
| | Nov-30-2020 | 374100 | Contravention | Duplicate H2S passive sample from October destroyed | The hood that holds the samples, was replaced to ensure that the sample cartridges are secured in place. |
| | Nov-24-2020 | 30993220 | Flaring > 4hrs | Duct burners off line causing HP flaring | Flaring ceased after duct burners were replaced |
| | Dec 09-2020 | 31016443 - 31016454 - 31055848 | Flaring > 4hrs | Plant Trip - Loss of Power | Flaring stopped after plant came back online. |
| | Dec 31-2020 | 31055893 | Flaring > 4hrs | HPBFW Offspecs - Silica Excursion, Duct Burners taken offline | BFW was brought to specs and duct burners were put back in operation. |

# Future Plans

- The following horizontal drilling activities are expected to commence within the next five years:
  - Brownfield Program – potentially 6 wells – 2022;
  - Pad 819 – 9 well pairs – 2022;
  - Pad 826 – 6 well pairs – 2022 – 2023;
  - Pad 829 – 9 well pairs – 2023 – 2024.

- The following first steam dates are planned to occur within the next five years:
  - Pad 819 – Q1-2 2023;
  - Pad 826 – Q1 2024;
  - Pad 829 – Q4 2025.

- Coreholes and observation wells will be drilled as necessary to:
  - Adequately delineate the resource;
  - Monitor SAGD operations;
  - Further caprock integrity analysis;
  - Allow land retention.

- Development plans are evaluated annually and are subject to change.



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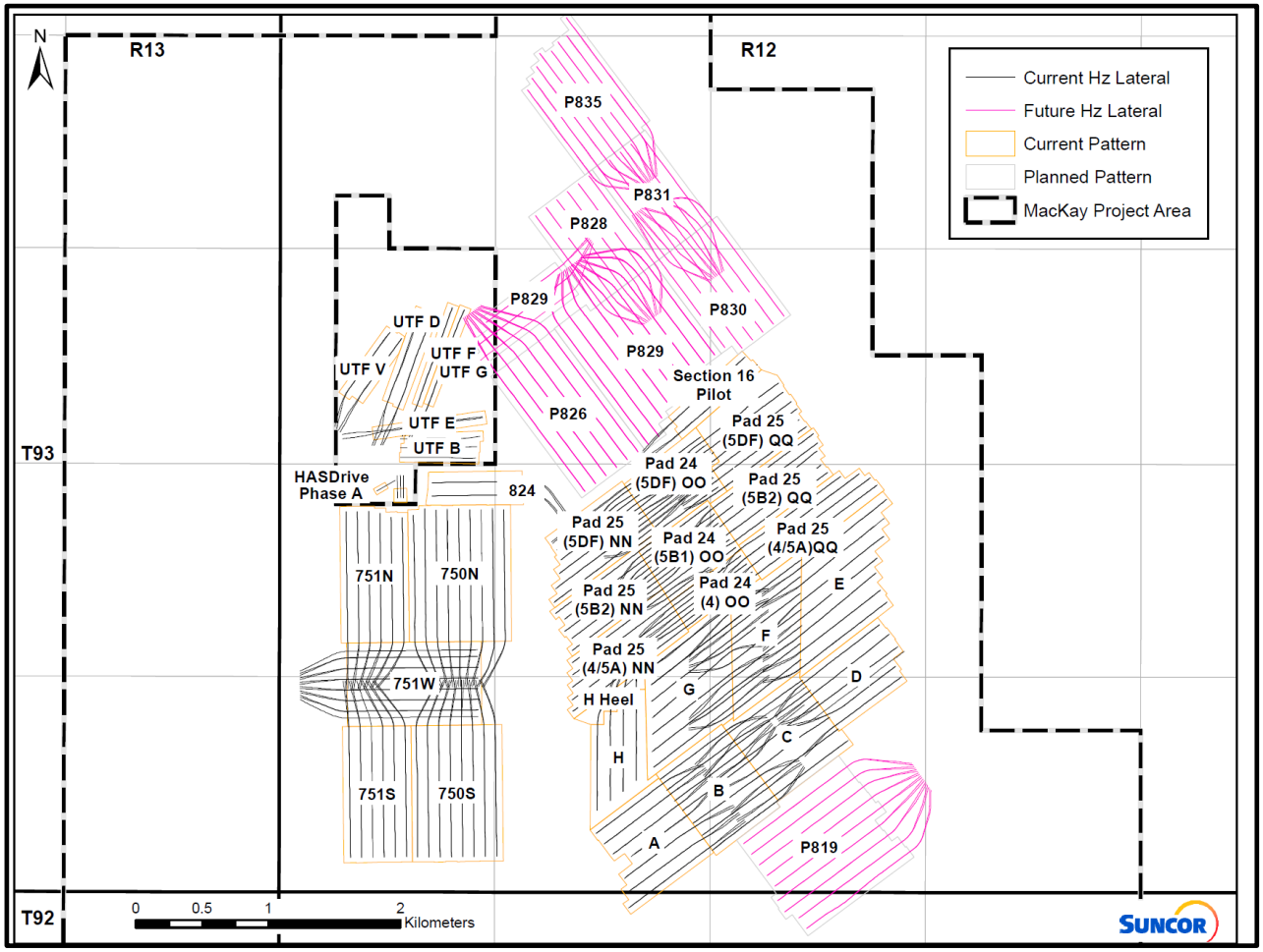
# Future Plans

- First steam dates planned to occur within the next five years:
  - Pad 819 – Q1-2 2023;
  - Pad 826 – Q1 2024;
  - Pad 829 – Q4 2025.

  (Regulatory approval in place for these pads)

- Development plans evaluated annually and are subject to change.

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