# AER Directive 054 – Scheme Performance Report

## Hangingstone DEMONSTRATION SAGD Project

**Scheme Approval No. 8788, as amended**
**EPEA Approval No. 1604, as amended**

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This presentation contains forward-looking statements and forward-looking information (collectively "forward-looking information") within the meaning of applicable securities laws relating to the Company's plans and other aspects of the Company's anticipated future operations, strategies and production results. Forward-looking information typically uses words such as " anticipate", “believe" “project", "expect", "goal", “plan", "intend", "may", "would", “could” or “will” or similar words suggesting future outcomes, events or performance. Specifically, this presentation contains forward-looking statements relating to our continued strategy of implementing industry production practices at the Hangingstone Demonstration Project and the Company’s future optimization performance and plans.

Forward-looking statements regarding the Company are based on certain key expectations and assumptions of the Company concerning regulatory developments, current and future commodity prices and exchange rates, applicable royalty rates, tax laws, industry conditions, future production rates, future operating costs, the timing and success of its optimization initiatives, the impact of competition and general economic and market conditions.

These forward-looking statements are also subject to numerous risks and uncertainties, certain of which are beyond the Company's control. Such risks and uncertainties include, without limitation volatility in oil prices; industry conditions; liabilities inherent in bitumen operations; environmental risks; the lack of availability of qualified personnel; and changes in income tax laws or changes in royalty rates and incentive programs relating to the oil and gas industry. Management has included the forward-looking statements above and a summary of assumptions and risks related to forward-looking statements provided in this presentation in order to provide readers with a more complete perspective on the Company’s performance and such information may not be appropriate for other purposes. The Company's actual results, performance or achievement could differ materially from those expressed in, or implied by, these forward-looking statements and, accordingly, no assurance can be given that any of the events anticipated by the forward-looking statements will transpire or occur, or if any of them do so, what benefits that the Company will derive therefrom. Readers are cautioned that the foregoing lists of factors are not exhaustive These forward-looking statements are made as of the date of presentation and the Company disclaims any intent or obligation to update publicly any forward-looking statements, whether as a result of new information, future events or results or otherwise, other than as required by applicable securities laws.

# Table of Contents

# Section 1.0 – Background

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# 1.1 Background

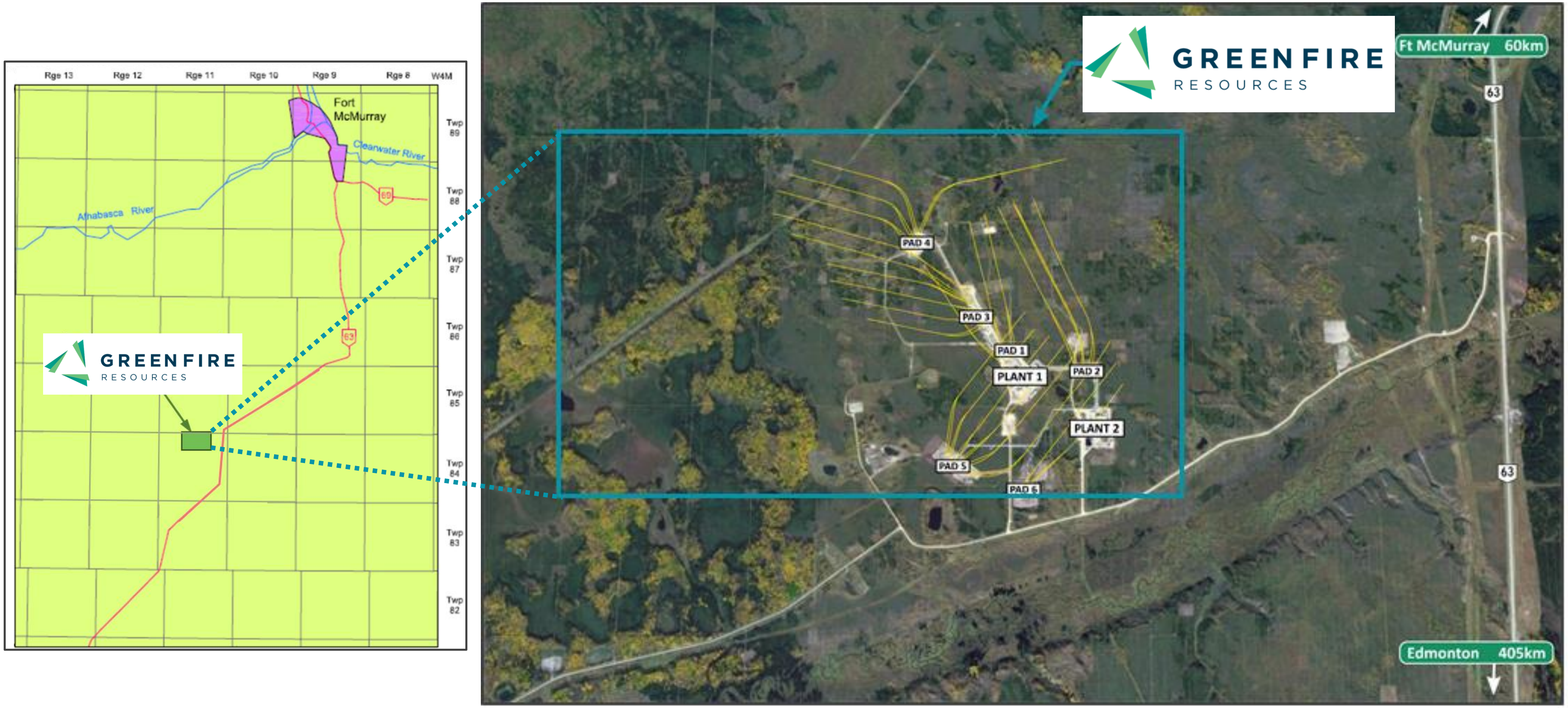
- Hangingstone Demonstration Project (the "**Project**") has been in operation since 1999, with an approved production capacity of 1,760 $m^3$/day (~11,000 bbl/day)
- Alberta Energy Regulator Approvals:
  - EPEA Approval No. 1604, as amended
  - Scheme Approval No. 8788, as amended
- Project Operational History
  - Operated from 1999 to May 2016
  - Suspension from May 2016 to September 2018
  - Operated from September 2018 to April 2020
  - Suspension from May 2020 to December 2020
  - Re-start activities commenced in December 2020
  - Production recommenced March 2021

**NOTE:**

*The subject report includes information from January 1, 2021, to December 31, 2021. This period covers the period from the last Directive 054 report to the end of the 2021 calendar year and is noted as the "**reporting period**" throughout.*

# 1.2 Location

The Project is located approximately 60km south of Fort McMurray, Alberta



# Section 2.0 – Subsurface

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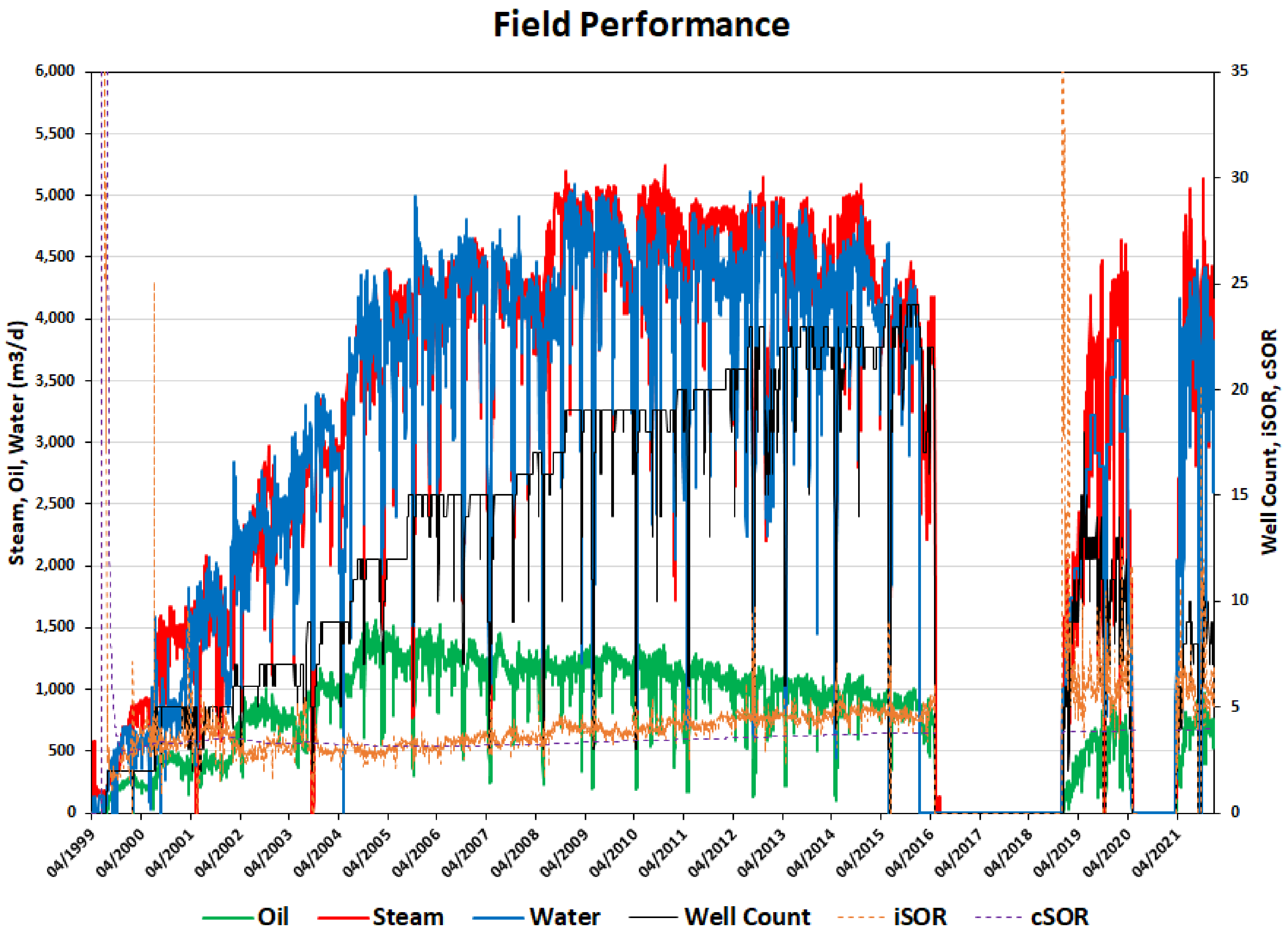
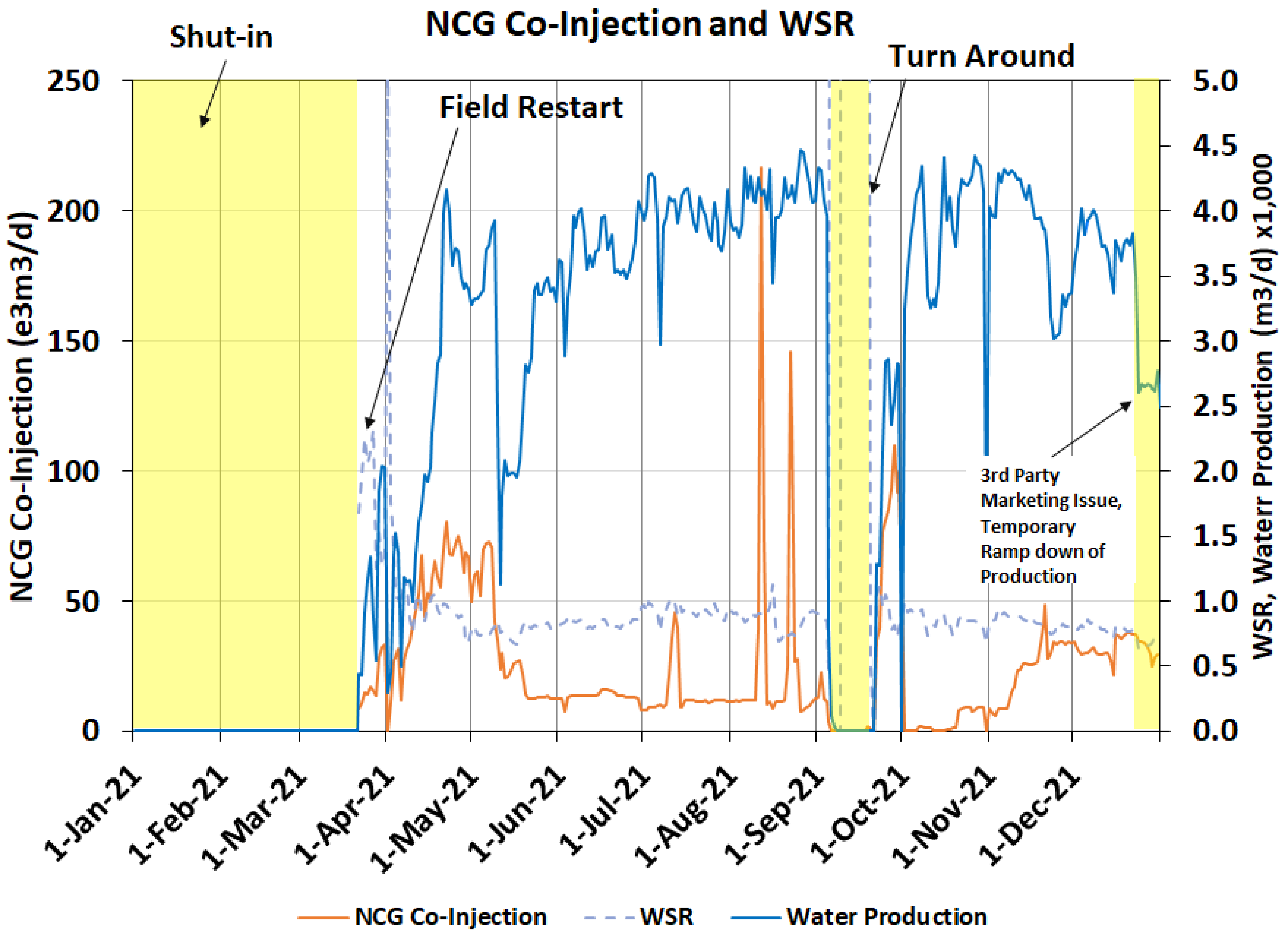
# 2.1 Lifespan Production: Field Performance



# 2.1 2021 Field NCG Co-Injection & WSR



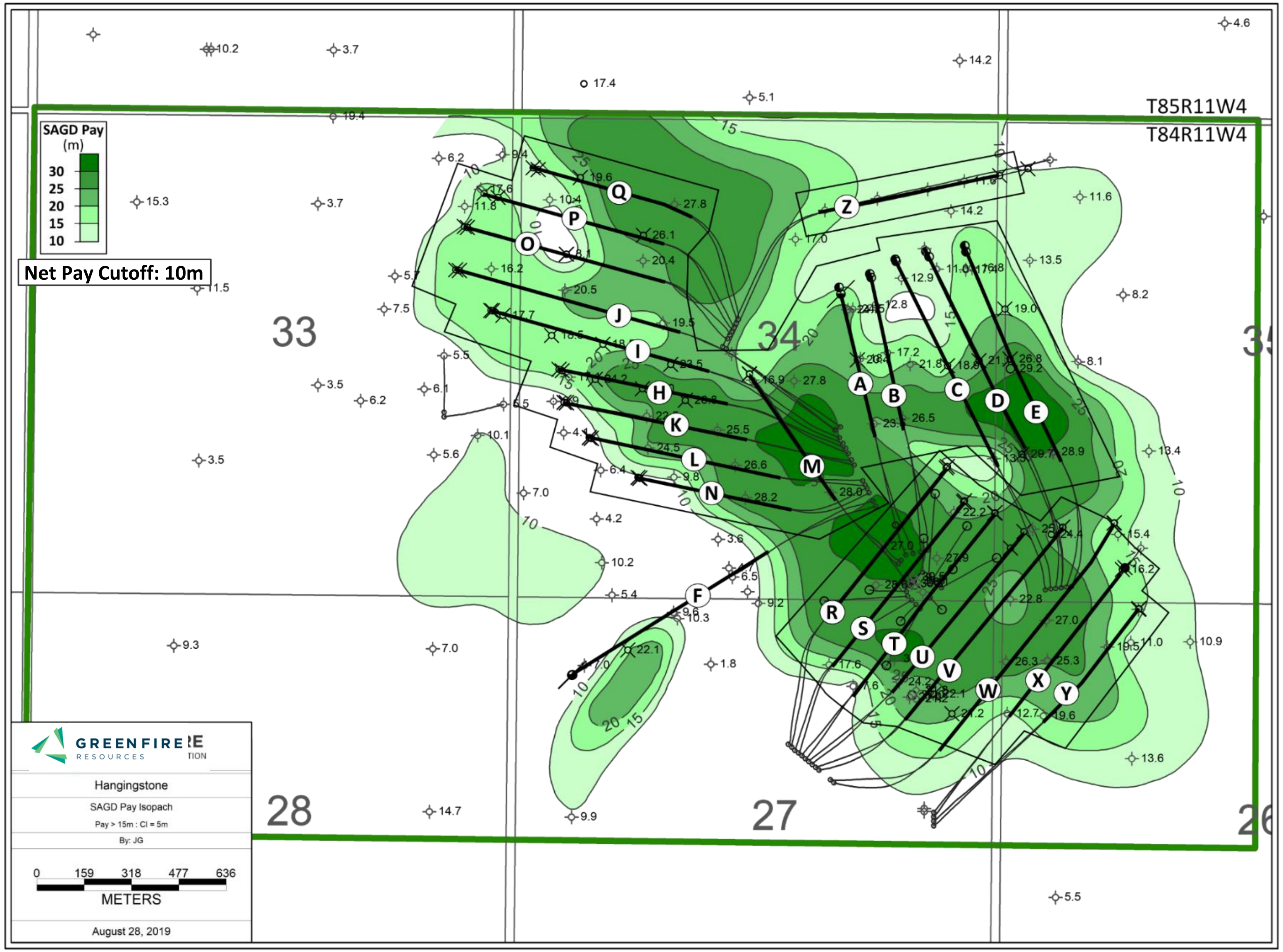

Note: NCG Co-injection is an operational tool that initializes and ceases depending on operational and economic requirements

# 2.2 Net Pay Isopach and Drainage Areas

<u>McMurray Net Pay Criteria:</u>
<60API Gamma Ray
>27% Porosity
>20 Ω·m Rt (>50% So)
< 30% Vshale
Muds <1m thick

<u>Fluid Interactions:</u>
No Top Gas
No Bottom Water
No Lean Zones

Greenfire Hangingstone Demo Project Boundary



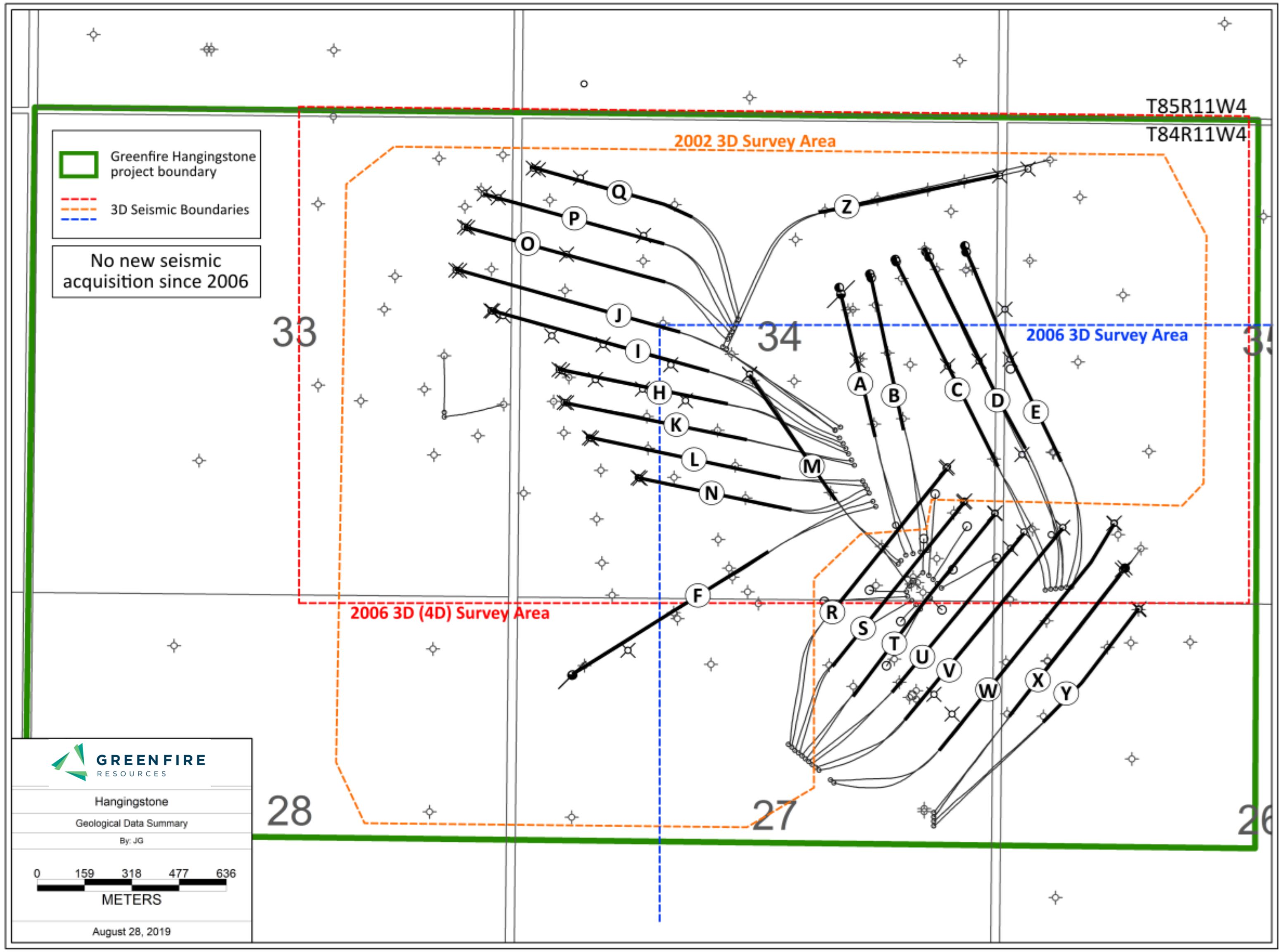
# 2.3 Geomechanical Summary

- No change in caprock integrity analysis since August 2018
- Original injection pressures determined by mini-frac tests in the 1980's
- Greenfire's Hangingstone Expansion (~3km from the Project) conducted mini-frac testing in 2010 and exhibited consistent results to original data
- 5 MPa determined to be maximum wellhead injection pressure (80% of fracture pressure)
- Reservoir pressure is monitored through blanket gas pressure readings in the casing annulus

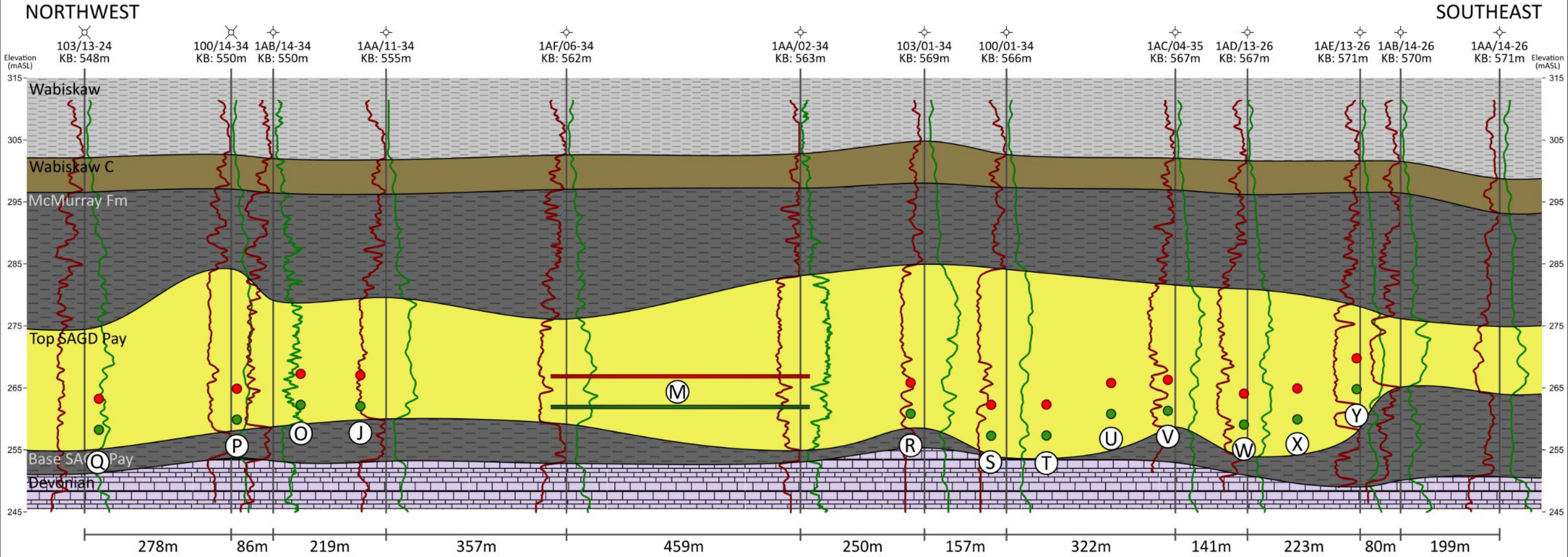
| | Depth | Min. Stress | | Vertical Stress | | Stress Regime |
|---|---|---|---|---|---|---|
| **Formation/Lithology** | **TVD (m)** | **Mpa** | **kPa/m** | **Mpa** | **kPa/m** | |
| Clearwater Shale | 272.0 | 5.39 | 19.82 | 5.73 | 21.07 | Horizontal Fracture |
| Wabiskaw Shale | 297.0 | 6.17 | 20.77 | 6.26 | 21.08 | Horizontal Fracture |
| McMurray Shale | 314.5 | 5.55 | 17.65 | 6.64 | 21.11 | Vertical Fracture |
| McMurray Sand | 327.0 | 5.59 | 17.09 | 6.91 | 21.13 | Vertical Fracture |

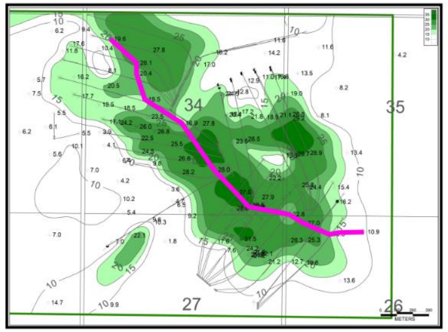
*From Greenfire Hangingstone Expansion 2018 AER Insitu Performance Review*

# 2.4 Seismic Summary



# 2.5 Well Cross Section




Hangingstone is a Tier 1 Reservoir:

- No top gas
- No top water
- No lean/transition zones
- No bottom water

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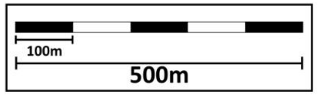
Hangingstone Cross Section



# 2.6 Original Bitumen in Place (OBIP)

| Reservoir Parameters | Value |
|---|---|
| Initial oil saturation (%) | 85 |
| Porosity (%) | 30 |
| Average SAGD Pay Thickness (m) | 24.4 |
| Vertical Permeability, Kv (mD) | 5,132 |
| Horizontal Permeability, Kh (mD) | 5,774 |

**OBIP Calculation Method**

$$\text{OBIP} = \text{Rv} \times \phi \times (1-\text{Sw}) \times \text{FVF}$$

Where:

OBIP: Original bitumen in place
Rv: Rock Volume
ϕ : Porosity
Sw: Initial water saturation
FVF: Formation volume factor (1.001)

| | Original Bitumen in Place ($e^6m^3$) | Cumulative Production ($e^6m^3$) | Recovery Factor (%) |
|---|---|---|---|
| Operating Area | 27.0 | 6.0 | 22.2 |
| Development Area | 27.0 | | 22.2 |
| Project Area | 14.9 | | 40.3 |

*Note: Project Area and Development Area are not defined in the Scheme Approval and a therefore deemed to be the same*

# 2.7 Well Patterns

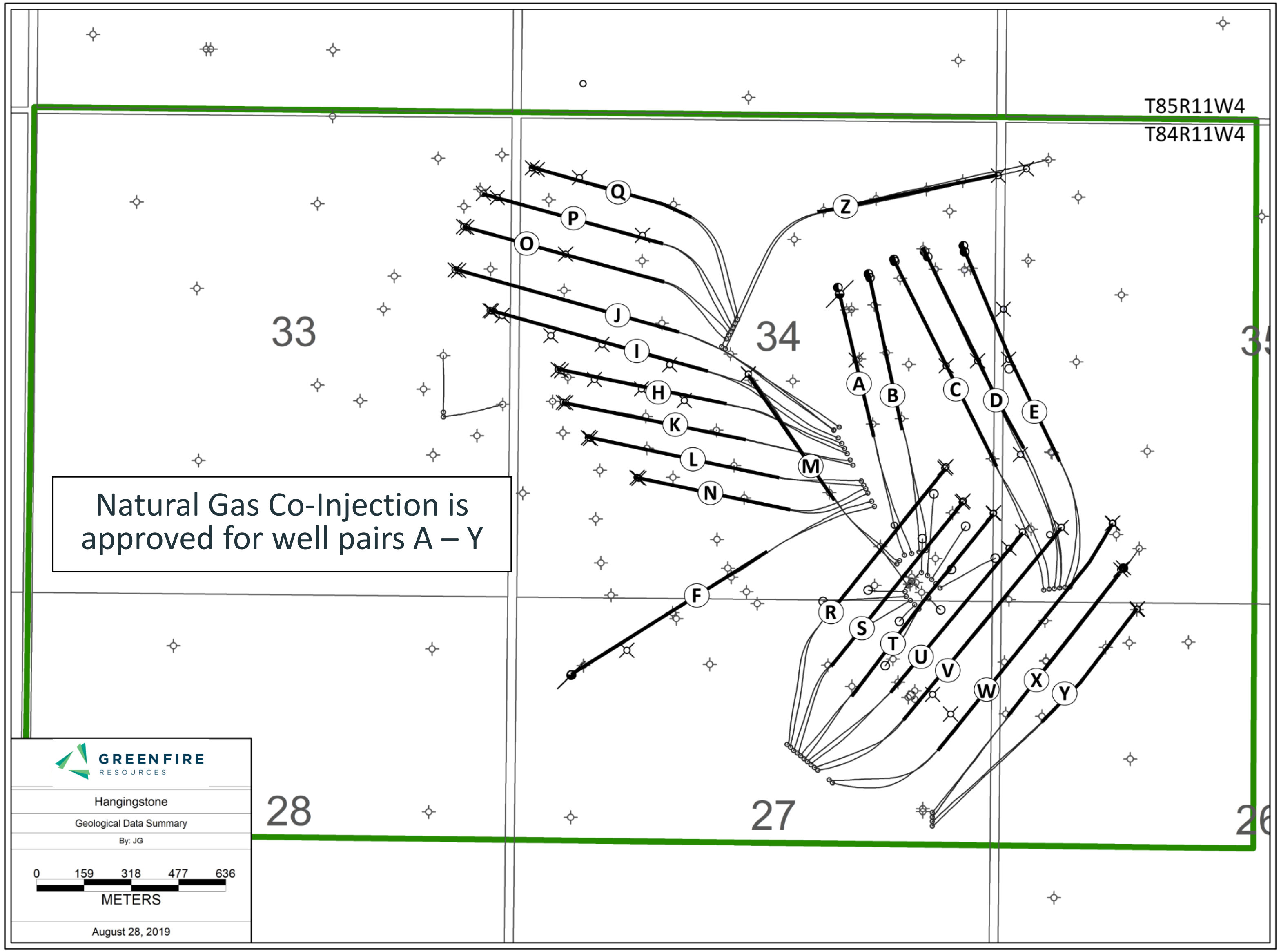
| Pad | Wellpairs | Area ($m^2$) | Average Net Pay (m) | Porosity (%) | Oil Saturation (%) | Vertical Permeability (mD) | Horizontal Permeability (mD) | OBIP ($e^3m^3$) | PBIP ($e^3m^3$) | Cumulative Production ($e^3m^3$) | Current OBIP RF (%) | Current PBIP RF (%) | Estimated Ultimate RF (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ABM | 338,560 | 27.0 | 30 | 85 | 5,132 | 5,774 | 2,342 | 2,032 | 1,383 | 59 | 68 | 75-85 |
| 2 | CDE | 395,550 | 23.4 | 30 | 85 | 5,132 | 5,774 | 2,368 | 2,053 | 1,026 | 43 | 50 | 70-80 |
| 3 | HIJKLN | 525,613 | 23.8 | 30 | 85 | 5,132 | 5,774 | 3,133 | 2,766 | 1,950 | 62 | 70 | 75-85 |
| 4 | OPQZ | 364,067 | 21.6 | 30 | 85 | 5,132 | 5,774 | 1,983 | 1,807 | 741 | 37 | 41 | 65-75 |
| 5 | RSTUVW | 627,926 | 25.9 | 30 | 85 | 5,132 | 5,774 | 4,123 | 3,795 | 823 | 20 | 22 | 65-75 |
| 6 | XY | 148,378 | 24.7 | 30 | 85 | 5,132 | 5,774 | 934 | 774 | 113 | 13 | 16 | 60-70 |
| Operating Area | | 2,400,094 | 24.4 | 30 | 85 | 5,132 | 5,774 | 14,882 | 13,227 | 6,036 | 41 | 46 | 70-80 |

# 2.8 Co-Injection Summary

- The Project is approved for full field NCG co-injection (pipeline fuel gas) and to increase injection up to 50 mole percent with steam on a monthly basis.
- Recovery is estimated at ~10 – 15% of injected volumes
- The table provides NCG co-injection carried rates for January to December 2021
  - Average project injection for 2021 was 18.2 e3m3/d
  - Cumulative co-injection for 2021 was 6,651 e3m3
- Greenfire intends to continue with NCG co-injection to assist with reservoir pressure maintenance, pending market conditions as it helps to keep pressure in the reservoir while allocation steam around the field
- Greenfire has observed no negative impacts from the use of NCG.

| Pad | Well | Max Month, Daily Avg NCG Rate (sm3/d) | Avg NCG Rate (sm3/d) |
|---|---|---|---|
| 1 | B | 25 | 3 |
| | M | 5,598 | 1,359 |
| 2 | C | 7 | 2 |
| | D | 8,892 | 1,551 |
| | E | 10,415 | 2,049 |
| 3 | H | 4,180 | 849 |
| | I | 4,763 | 635 |
| | J | 1,079 | 232 |
| | K | 20 | 12 |
| | L | 1,181 | 101 |
| | N | - | - |
| 4 | O | 1,829 | 341 |
| | P | 1,829 | 341 |
| | Q | 698 | 136 |
| 5 | R | 6,214 | 1,793 |
| | S | 11,510 | 3,620 |
| | T | 10,415 | 3,535 |
| | U | 6,421 | 1,173 |
| | V | 2,405 | 419 |
| | W | 672 | 75 |
| 6 | X | - | - |
| | Y | - | - |

# 2.8 Co-Injection Well Locations



# Section 3.0 – Surface

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# 3.1 Infrastructure

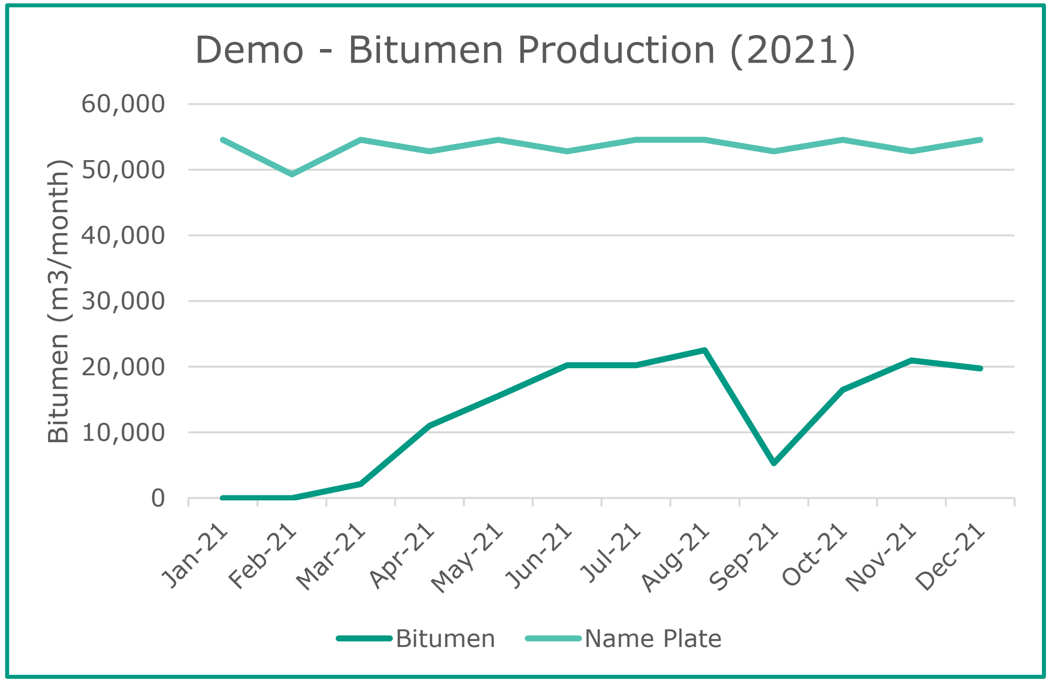

There are no immediate infrastructure projects planned for the Project

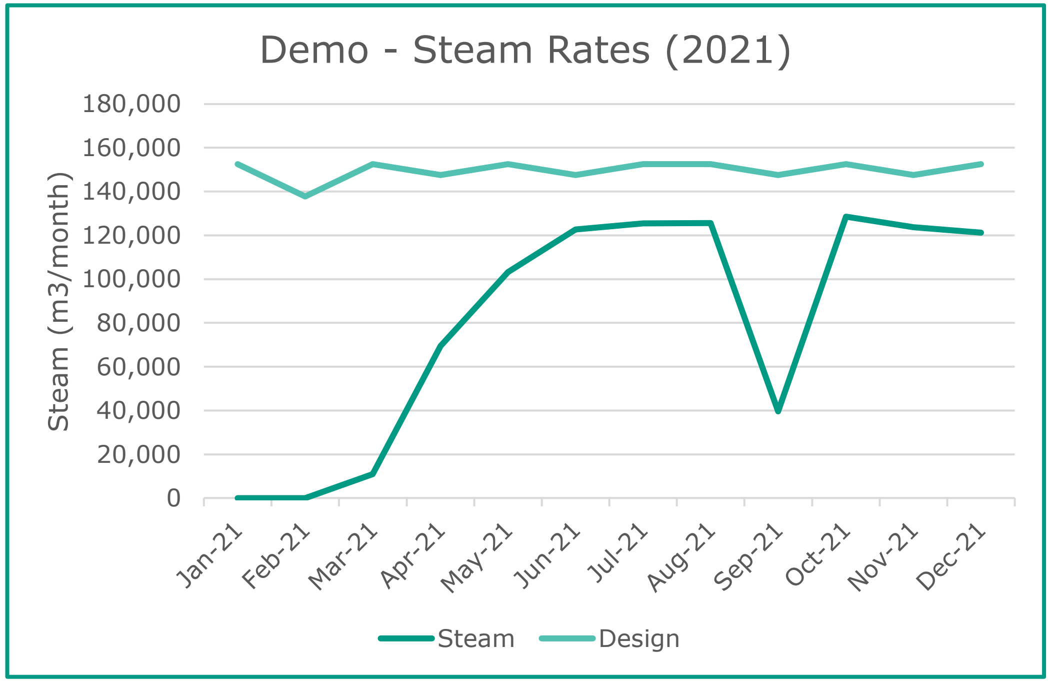
# 3.2 CPF Modifications

There have been no modifications to the Projects central processing facility for the reporting period that have required an AER approval.

# 3.3 Bitumen & Steam Rates

The following are the steam and bitumen rates for the Project for the Reporting Period. The rates matched the forecasted profiles.




***Plant Turnaround in September 2021*

Licensed Nameplate = 1,760 $m^3$/day

Steam Rate Design = 4,919 tonnes/day (80% quality)

# Section 4.0 – Historical & Upcoming Activity

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# 4.1 Suspension & Abandonments

- The Project was in a recommissioning and restart phase in January and February 2021.
    - Steam injection and oil production operations recommenced in March 2021.
- The Project conducted annual turnaround activities in September 2021.
- There are no well patterns with active blow-down or ramp down.

# 4.2 Operational & Regulatory Changes

- Regulatory Approvals for the Reporting Period

| Application No. | Description | Approval Date |
|---|---|---|
| Scheme Approval 8788Q | Transfer of Approval to Greenfire from Previous Operator | March 17, 2021 |
| EPEA Amendment 1604-03-01 | Transfer of Approval to Greenfire from Previous Operator | March 17, 2021 |

- Successes
  - Successful restart of the Project after suspension
  - High recycle rate of produced water
  - Water treatment water quality exceeded expectations due to a rigorous chemical program
  - Oil treatment has high uptime with limited creation of off-spec oil
- Issues
  - Freezing issues were experienced during recommissioning and start-up. All damaged piping was replaced
  - Accumulation of solids at the bottom of the WAC's which had to be cleaned
- There were no events for the reporting period that could materially affect scheme performance or energy or material balances (e.g., no phase expansions, no material changes in injection strategy, and no major infrastructure changes)
- There were no pilots or major technical innovations conducted at the Project during the reporting period

# 4.3 Compliance History

- AER Reportable Incidents and Contraventions – 2021
  - March: EPEA Contravention
    - Missing EPEA reports from 2020 that were not submitted by the previous operator due to the suspension of the Project
    - Matter has been resolved
  - August: EPEA Contravention
    - Missed monthly gas analysis

- Greenfire continues to ameliorate outstanding remediation activities associated with historic incidents

# 4.4 Future Plans

- Greenfire remains focused on obtaining full regulatory approval and the subsequent commissioning and start-up of its Clearwater disposal scheme that the AER conditionally approved on April 18, 2022 (Approval No. 13122)
    - As required by the approval, Greenfire has submitted an amendment application to provide additional subsurface information in support of its disposal scheme
    - The disposal scheme will benefit the overall performance and energy/material balance of the scheme
- Greenfire is installing a truck loading facility at its Hangingstone Expansion Project to accept bitumen deliveries from the Demonstration Project. This will reduce total trucking kilometres.
- Greenfire continues to evaluate numerous central processing facility and well pad debottlenecking opportunities that could alter the overall performance of the scheme
- At this time, Greenfire has not conclusively evaluated the following development types over the next five years: delineation, seismic, well patterns, etc.
- Greenfire does not anticipate or expect to submit any *major* applications for the Project in 2022