PROPOSED VIRDEN ROSELEA UNIT NO. 5 APPLICATION FOR ENHANCED OIL RECOVERY WATERFLOOD PROJECT LODGEPOLE FORMATION VIRDEN, MANITOBA

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Corex Resources Ltd.

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INTRODUCTION

The Virden Lodgepole B Pool is located in Townships 9 to 11 Ranges 25 to 26 W1M. The field was originally developed with vertical wells but recent exploitation has shifted to horizontal development. The first horizontal well in the application area was drilled in March 2007 at 102/14-30-010-25W1M and the first horizontal well operated by Corex Resources Ltd. (Corex) within the subject area was the 102/14-32-010-25W1M well, drilled in November 2018. Since the winter of 2018 an additional eleven horizontal wells have been drilled within the proposed unit lands.

Corex believes the potential exists for incremental production and reserves from an Enhanced Oil Recovery ("EOR") waterflood project in the Lodgepole formation. Corex is the operator of the lands within the application area that contains thirteen (13) horizontal wells and nine (9) vertical wells (8 of which are currently abandoned). We anticipate converting seven (7) horizontal wells and one (1) vertical well into injectors when implementing the EOR waterflood project. Corex plans to drill four (4) new horizontal wells as injector wells later this year and pending approval of this application, resulting in no production loss within the proposed unit lands. Corex hereby submits an application to establish Virden Roselea Unit No. 5 and implement an EOR Waterflood Project within the Lodgepole formation (Figure 1).

The proposed Virden Roselea Unit No. 5 falls within the Virden Lodgepole B Pool (Figure 2).

SUMMARY

- 1. The proposed Virden Roselea Unit No. 5 is to include twenty-two (22) wells (6 vertical wells that were drilled and abandoned, 2 vertical wells that were previously producing and now abanoned, 1 currently producing vertical well, 12 producing horizontal wells, and 1 horizontal well (drilled for future injection) within the 23 legal subdivisions (LSD) that were completed in the Lodgepole formation (Figure 1).
- 2. The original oil in place (OOIP) for the proposed Virden Roselea Unit No. 5 is calculated as 1,876.8 10³m³ (11,805 Mbbl), for an average of 81.6 10³m³ (513 Mbbl) per LSD.
- 3. Cumulative production in the proposed Virden Roselea Unit No. 5 to the end of February 2022 is 56.8 10³m³ (357.4 Mbbl) of oil. This represents a 3.0% recovery factor of the total OOIP.
- 4. The last production from the original 8 vertical wells was in July 1968 and all are now abandoned. In March 2007, a dual leg horizontal well was drilled and is still currently producing. As of February 2022 the proposed Virden Roselea Unit No. 5 is producing 55.6 m³/d (349.7 b/d) of oil and 115.5 m³/d (726.6 b/d) of water, a water cut of 67.5%. Peak production for the proposed unit occurred in September 2021, with 114.5 m³/d (720.1 b/d) of oil and 123.6 m³/d (777.7 b/d) of water, giving a water cut of 51.9%.

- 5. The Estimated Ultimate Recovery (EUR) of oil on primary production within the proposed Virden Roselea Unit No. 5 using decline analysis and a reservoir model is 155 10³m³ (975.1 Mbbl), with 98.2 10³m³ (617.7 Mbbl) remaining as of February 2022. The Estimated Ultimate Recovery Factor (EURF) on primary would be 8.3% of the total OOIP in the Lodgepole section.
- 6. With the implementation of a waterflood within the Scallion member of the Lodgepole formation, incremental reserves of $199.6 \ 10^3 \text{m}^3$ (1,256 Mbbl) are expected. Based on the total OOIP for the Lodgepole formation, the incremental recovery factor is expected to be 10.6%, for an overall recovery factor of 18.9%.
- 7. The development plan will be to continue producing the existing horizontal wells and in late 2022 or early 2023 drill the additional injection wells (Figure 4), and commence waterflooding. This timing is contingent upon the approval of the unitization and EOR waterflood application. All horizontal wells in the proposed Virden Roselea Unit No. 5 are completed openhole.

GEOLOGY

Stratigraphy

The Lodgepole formation in the proposed unit area conformably overlies the Bakken formation and contains a number of hydrocarbon-bearing intervals. It was deposited in a gently sloping carbonate ramp setting and has been subdivided by Corex into a series of laterally continuous, shallowing upwards cycles. In ascending order, the sequence consists of a non-reservoir cycle, the Routledge Shale, which is overlain by two reservoir cycles, the Scallion and the Sandhill/Oolites, and is then capped by three non-reservoir cycles, the Virden, the Whitewater Lake and the Flossie Lake. The Flossie Lake member of the Lodgepole has been eroded over much of the proposed unit area. The Lodgepole formation is unconformably overlain by the red silts and shales of the Lower Amaranth, which are in turn overlain by the anhydrites and shales of the Upper Amaranth that form the top seal for the Lodgepole hydrocarbon system. The stratigraphy of the Lodgepole formation is shown on a structural cross section which runs west to east through the proposed unit (Appendix I).

Sedimentology

Starting at the base of the Lodgepole section and working upwards, the first cycle immediately overlying the Bakken formation is the Routledge Shale. The Routledge Shale is a black to dark grey to, occasionally, brown fissile calcareous shale. This shale cycle was deposited in a relatively deep, low energy, distal ramp environment. The Routledge Shale is non-reservoir and it is capped by the Scallion.

The overlying Scallion is the first reservoir quality cycle deposited within the Lodgepole Formation. It is comprised of cream to tan microcrystalline limestone with varying amounts of chert and anhydrite, and occasional vertical fracturing. This unit is typically biofragmental with minor argillaceous interbeds. Bioclastic components are dominated by crinoids and shell fragments. All of this indicates deposition in a relatively quiet shallow marine proximal ramp environment. Most of the wells in the proposed unit area do not go through the entire Scallion reservoir interval and therefore, reservoir parameters and fluid contacts have been interpreted from the available data in these wells along with data in offset vertical wells. The Scallion reservoir thickness varies across the area, as seen from the isopach (gross pay) map (Appendix II), but is generally quite thick in the proposed unit area and then thins as the structure drops off to the east. Net pay values, using a 9% porosity cutoff and 1mD permeability cutoff, have an interpreted range of 5 to 11m with gross reservoir thickness (above the oil/water contact) ranging from 6 to 13m (Appendices III and II, respectively). Porosity ranges from 9 to 18% and permeability ranges from 1 to over 100mD in the nearby wells with core analysis data. The Scallion is the primary target for horizontal wells drilled by Corex and for the proposed waterflood.

The Sandhill/Oolites is the next reservoir unit and consists of a package of five thin shallowing upwards cycles, indicating frequent sea level changes. Each cycle consists of an oil-bearing cream to tan oolitic wackestone that is capped by a barren pink to maroon argillaceous mudstone. Anhydrite is present in minor amounts, and in the proposed unit area the upper two cycles are more dolomitized. There is also occasional vertical fracturing. The oolitic wackestones are indicative of deposition in a relatively high energy but shallow water environment, while the argillaceous limestones are indicative of a relative sea level fall and the development of a lower energy, shallow, restricted environment. This is typical of a proximal to restricted ramp setting. The Sandhill/Oolites section thickens towards the southwest in the proposed unit area, with gross thickness values ranging from 8.5 to 12m (Appendix VI) and net pays from 0 to 5.7m (Appendix VII), using a 9% porosity cutoff and 1mD permeability cutoff. The nearby wells with core analysis data show that porosity ranges from 9 to 16% and permeability ranges from 1 to over 100mD in the reservoir zones. The Sandhill/Oolites are tight in most of the proposed unit area but are a secondary target for drilling and waterflood in the extreme southern area of the proposed unit (Appendix VII).

The Virden is a cream to tan cryptocrystalline dolomite with varying amounts of anhydrite and minor argillaceous components. Deposition of this shallowing upward sequence occurred in a more lagoonal, shallow marine, restricted ramp environment. Within the proposed unit area, the Virden is tight and is considered non-reservoir. The member varies in gross thickness from 7 to 9.5m.

The next cycle of the Lodgepole sequence is the Whitewater Lake. The Whitewater Lake is a cream to tan to grey micritic dolomudstone to cryptocrystalline dolomite. Anhydrite is common, as are minor argillaceous partings. There is a minor bioclastic component composed of skeletal fragments. Deposition of this cycle occurred in a very shallow water, nearshore lagoon,

restricted ramp environment. Within the proposed unit area, the Whitewater Lake is tight and is considered non-reservoir. The gross isopach ranges from 10 to 15m.

The final cycle of the Lodgepole sequence in the proposed unit area is the Flossie Lake. It is only present on the northwestern edge of the proposed unit and has been eroded everywhere else. The Flossie is a cream to off-white microcrystalline to cryptocrystalline dolomite with very common anhydrite partings and nodules. Deposition of this cycle occurred in very shallow, near shore restricted water to a partially exposed sabkha environment. Within the proposed unit area, the Flossie is tight and is considered non-reservoir. The gross isopach across the proposed unit ranges from 0 to 10m and is generally less than 4m.

Structure

The structure within the proposed unit area is generally relatively flat, but it dips down very quickly on the extreme east side of the proposed unit as the beds roll over into a structural low caused by dissolution of the underlying Prairie Evaporite. This dissolution event is mapped from proprietary 2D seismic and confirmed by both the 100/14-32-10-25W1 and 100/8-31-10-25W1 vertical wells. As well, many of the Horizontal development wells were drilled until the structure rolled over and dropped, and these also helped to map the dissolution event. There is no direct evidence from wells or seismic indicating significant faulting at the Lodgepole level in the vicinity of the proposed unit area. Structure maps for the two reservoir units are included in Appendices X and XI.

Reservoir

Maps for each of the two reservoir units were generated using available open-hole logs and core data, and include net pay, porosity-thickness, and permeability-thickness. These maps are in Appendices III to V for the Scallion and VII to IX for the Sandhill/Oolites. Pore volume and permeability-thickness values could only be calculated for wells with core analysis data, which is a very small number of the wells in and around the proposed unit area. Net pay for the Scallion and Sandhill/Oolites was calculated using a 9% porosity cutoff and a 1mD permeability cutoff. Both of these reservoir units are considered conventional reservoirs and are produced from openhole completions. Weighted average permeability and porosity were calculated using the same cutoffs as used for net pay.

Fluid Contacts

The oil-water contact in the proposed unit area is interpreted at -177m SS from log and core data in offsetting wells that drilled through the contact, along with gas data and drill cuttings from several of the horizontal wells that also penetrated the contact. In the proposed unit area this contact lies mainly within the Scallion reservoir unit, although in those areas where the structure has dropped off it lies within the Sandhill/Oolites.

OIL IN PLACE, PRODUCTION HISTORY AND ESTIMATED RECOVERY

Original Oil in Place

The original-oil-in-place (OOIP) for the proposed Virden Roselea Unit No. 5 is 1,876.8 10^3 m³ (11,805 Mbbl), for the Lodgepole formation. The OOIP was calculated in-house. Values of thickness, porosity and water saturation of each LSD for the various reservoir zones are used to calculate the OOIP on an individual LSD basis. Details of the calculations are summarized in Table 1.

Historical Production

Figure 3 shows the production history of the wells within the proposed Virden Roselea Unit No. 5. The unit consists of twenty-two (22) wells, two (2) vertical wells that did produce and are abandoned, and six (6) dry and abandoned wells. In addition, there are twelve (12) horizontal wells on production, one (1) producing vertical well, and one (1) drilled horizontal well that was drilled as a future injection well, which will not produce. Historically, there has been no injection or disposal into the Lodgepole formation within the proposed Virden Roselea Unit No. 5. Production from the producing wells is from the Lodgepole formation.

Up to and including the month of February 2022, the proposed Virden Roselea Unit No. 5 has produced cumulative volumes of oil of 56.8 10^3 m³ (357.4 Mbbl) and water of 338.2 10^3 m³ (2,127 Mbbl). The current recovery factor is 3.0%.

Development began in March 1954, with one (1) vertical well, which produced until September 1957. A second vertical well was drilled in June 1968 and produced for two (2) months with the last production from the original vertical wells was July 1968. In March 2007, a dual leg horizontal well was drilled and continues to produce. In November 2018, Corex drilled a horizontal well within the proposed unit area and further horizontal development quickly followed.

At the end of February 2022, the proposed Virden Roselea Unit No. 5 was producing 55.6 m³/d (349.7 b/d) of oil and 115.5 m³/d (726.6 b/d) of water, a water cut of 67.5%. Peak production for the proposed unit occurred in September 2021, with 114.5 m³/d (720.1 b/d) of oil and 123.6 m³/d (777.7 b/d) of water, giving a water cut of 51.9%. Presently, there is no water injection or disposal; all fluids are taken to either the Virden Roselea Unit No. 1 or Virden Roselea Unit No. 2 battery.

Primary Recovery

Table 3 lists the wells within the proposed unit area; together with the cumulative oil production to the end of February 2022 and the EUR estimated using decline analysis. The total EUR for

the proposed Virden Roselea Unit No. 5 is $155 \ 10^3 \text{m}^3$ (975.1 Mbbl), for a recovery factor of 8.3% of the total OOIP in the Lodgepole section.

Secondary Recovery

Within the Lodgepole formation, the proposed waterflood will target the Scallion member, which contains over 87% of the total OOIP. A reservoir model of the proposed unit was built to estimate the expected recovery from waterflooding the Scallion member. This reservoir model used average reservoir properties and was tuned to match the historical production and a type well production profile of a representative horizontal producer within the Scallion member, for any future wells. The model results suggest an EURF of 7.3% under primary depletion, similar to the numbers using decline analysis. By drilling infill injection wells the reservoir model predicts an incremental recovery factor on waterflood of 10.6%. Additional information on the reservoir model is included in Appendix XII.

UNITIZATION

The basis for unitization is to implement a waterflood to increase the ultimate recovery of the OOIP from the proposed project area.

Unit Name

Corex proposes the name of the new unit shall be Virden Roselea Unit No. 5.

Unit Operator

Corex will be the Operator for Virden Roselea Unit No. 5.

Unitized Zones

The unitized zone to be waterflooded in the Virden Roselea Unit No. 5 will be the Lodgepole Formation.

Unit Wells

The unit will include twenty-two (22) wells (6 vertical wells that were drilled and abandoned, 2 vertical wells that were previously producing and now abanoned, 1 currently producing vertical well, 12 producing horizontal wells and 1 horizontal well drilled as a future injection well, that will not produce) in the proposed Virden Roselea Unit No. 5 are outlined in Table 2 with their current status.

Unit Lands

The Virden Roselea Unit No. 5 will consist of all 23 LSDs as follows:

- LSDs 13 & 14 of Section 30 of Township 010, Range 25, W1M
- SE ¹/₄ & NE ¹/₄ & LSDs 3, 4, 6, 11, & 14 of Section 31 of Township 010, Range 25, W1M
- LSDs 12, 13, & 14 of Section 32 of Township 010, Range 25, W1M
- LSD 4 of Section 4 of Township 011, Range 25, W1M
- LSDs 1, 2, 3, & 6 of Section 5 of Township 011, Range 25, W1M

The lands included in the 40 acre tracts are outlined in Appendix XIII.

Tract Factors

The proposed Virden Roselea Unit No. 5 will consist of twenty-three (23) tracts based on remaining OOIP using maps created internally by Corex per LSD, as of February 2022, with the production from the horizontal wells being divided according to the existing production allocation agreements. The calculation of the tract factors are outlined in Table 1.

Working Interest Owners

Appendix XIII outlines the working interest for each recommended tract within the proposed Virden Roselea Unit No. 5. Corex will have a 100% WI across all tracts.

WATERFLOOD DEVELOPMENT

The objective of implementing a waterflood is to provide pressure support and improve recovery. The Lodgepole formation is relatively shallow, with undersaturated oil having low solution gasoil ratios and as such, there is not much drive energy within the system. Corex believes additional energy is required to improve the recovery. Waterflooding will enhance the recovery by providing pressure support as well as displacing the oil from the injectors towards the producers.

With the success of the recently drilled producing horizontal wells and one (1) standing horizontal injector well, Corex intends to drill an additional six (6) horizontal injection wells and convert a vertical producer to injection in 2023. Waterflood is expected to commence in late 2023 although will be dependent upon the approval of the Unitization and Waterflood application, as well as the various stake holders coming to agreement.

Rock and Fluid Properties

Rock and fluid properties for the Lodgepole formation are summarized in Table 4. These properties were estimated using standard correlations in the literature and using existing oil analysis and PVT data.

Using Corex's internal database on step rate tests in the Lodgepole, the fracture gradient for the Lodgepole formation in the Virden area is estimated to be 22 kPa/m. Based on the average fracture gradient a surface fracturing pressure of 7,400 kPa is anticipated. The surrounding units have maximum allowable injection pressures (MAP) ranging from 7,000 kPa to 8,000 kPa, which Corex feels is appropriate for the proposed Virden Roselea Unit No. 5.

Estimated Recovery

Using the results from a reservoir model and analogs within the area, the incremental reserves of $199.6 \ 10^3 \text{m}^3$ (1,256 Mbbl) are expected. Based on the total OOIP for the Lodgepole formation, the incremental recovery factor is expected to be 10.6% for an overall recovery factor of 18.9%.

Economic Limit

The economic limit will be when the net oil rate and net oil price revenue stream becomes less than the current producing operating costs. Based on current price forecasts, the economic limit for the project would be $1 \text{ m}^3/\text{d}$.

Source of Injection Water and Waterflood Facilities

The source of the injection water will be from the Lodgepole formation and water supply will come from the offsetting units, Virden Roselea Unit No. 1 (VRU #1) and Virden Roselea Unit No. 2 (VRU #2). These units are also operated by Corex Resources. VRU #1 and VRU #2 produce from the Lodgepole formation and already have facilities in place for water injection. A flowline will be ran from the VRU #2 high pressure injection system to the northern injectors in VRU #5. The southern-most injector in VRU #5 will be fed by the injection system in VRU #1. There will be no additional waterflood facilities required for Virden Roselea Unit No. 5.

A simplified process flow diagram of the system is located in Figure 6. All producing wells will flow to test separators before entering gathering systems in Roselea Units #1 and #2. All injection wells will have turbine meters (totalizers) at the wellhead to record water injection volumes.

Water injection volumes and balancing will be utilized to monitor the entire system measurement and integrity on a daily basis. The corrosion control program outlining the planned system design and operational practices to prevent corrosion is located in Figure 7.

Operating Strategy

The proposed injection scheme within the proposed Virden Roselea Unit No. 5 can be seen in Figure 4. All of the horizontal wells that will be converted to injection will be drilled as injection wells, resulting in no production loss within the proposed unit. One vertical producer will be converted to injection.

Injection rates are expected to be in the range of 45 m³/d to 100 m³/d, subject to a maximum injection pressure of 6,600 kPa at the well head. This maximum pressure is based on a fracture pressure of 7,400 kPa and a safety factor of 90%. Initially, injection will target a monthly voidage replacement ratio (VRR) between 1.25 and 1.75. This over-injection will serve to replace the existing voidage within the proposed unit area. Once a cumulative VRR of one (1.00) is attained, the injection rate will be scaled back to maintain the VRR at one (1.00), both on a monthly basis and a cumulative basis.

All producers will be kept at pump-off condition.

Pressure

The initial pressure for the proposed unit area was somewhat over pressure, with the first recorded pressure from the 102/14-32-010-25W1/00 well being 8,500 kPa. A normally pressured reservoir for this formation would expect to have pressures in the range of 6,000 kPa to 6,500 kPa. The over pressure seen in this formation is due to the offsetting injection in Virden Roselea Unit No. 2, where there was pressure support, however no depletion within the proposed unit boundary. Subsequent pressure surveys have varied considerably, depending on the location of the pressure survey. With some undrained areas still showing over pressure readings, but more depleted areas having pressures as low as 3,600 kPa. In general, we have seen pressure continue to decline with production. Current average reservoir pressure is around 5,000 kPa.

The pressure is lower than the initial pressure due to offsetting production depleting the reservoir pressure. Waterflooding will help to re-pressurize and add energy to the reservoir. As seen by the pressure surveys on new drills, the reservoir pressure is below its initial value and with further drilling and production within the unit the pressure will drop further. Therefore, a waterflood scheme is deemed to be beneficial. Upon conversion, during the initial over-injection period, the reservoir pressure is expected to increase from the current level. Once the cumulative VRR reaches one (1.00), a monthly VRR of one (1.00) will be maintained.

Wellbore and Surface Piping Specifications and Corrosion Control

All injection flowlines will have a maximum operating pressure of at least 8,825 kPa (consistent with injection systems in VRU #1 and VRU #2). Typical operating pressure is expected to be around 6,000 kPa.

Maximum pump discharge from the VRU #1 & VRU #2 injection pumps is less 7,500 kPa, limiting maximum wellhead pressure to 7,500 kPa. All wellheads are rated to 21,000 KPa.

All emulsion flowlines will have a maximum operating pressure of greater than 3,415 kPa (consistent with VRU #1 and VRU #2 gathering systems). Typical operating pressure is around 800 kPa.

Corex's planned corrosion control program is as follows:

Pipelines

• All pipelines are fiberglass. No corrosion inhibitor is required

Surface piping

• All above ground piping and wellheads are be internally coated for producing wells. Injection well piping will be either internally coated or stainless steel. No corrosion inhibitor is required.

Producing Wells (Downhole)

- Continuous corrosion inhibition down annulus as required.
- Cathodic protection on casing

Injection Wells (Downhole)

- Inhibited fluid in annulus
- Internally coated packer and tubing
- Cathodic protection on casing

Waterflood Surveillance

Waterflood response within the proposed Virden Roselea Unit No. 5 will be closely monitored with the following:

- Regular production well testing to monitor fluid rate and water cut to watch for waterflood response
- Real time monitoring of injection rates and pressures
- Monitor monthly and cumulative voidage replacement ratio by pattern and overall unit
- Evaluation of Hall plots
- New injection targets will be sent to the field on a regular basis

Project Schedule

Horizontal drilling in the area has been very successful. After a period of primary recovery, Corex intends to drill injection wells to support the existing producer wells and implement a waterflood.

The drilling of the horizontal injecton wells is expected to start in Q4 2022 and/or the first half of 2023. This schedule is contingent upon the approval of the Unitization and Waterflood application, as well as the various stake holders consenting to same.

NOTIFICATIONS

Corex will notify all surface and mineral owners of the proposed EOR project and formation of the Virden Roselea Unit No. 5. Copies of the Notices, and proof of service, to all surface and mineral owners within the application area and mineral owners offsetting the application area will be forwarded to the Petroleum Branch, when available, to complete the Virden Roselea Unit No. 5 Application.

Unitization and execution of the formal Virden Roselea Unit No. 5 agreement by affected mineral owners will occur once the Petroleum Branch has reviewed the tract factors. Copies of the agreement will be forwarded to the Petroleum Branch to complete the Virden Roselea Unit No. 5 application.

Should you have any comments and/or questions regarding this application, please contact Peter Parkinson or Myles Simonar, Engineering, at (403) 718-6371 or <u>peterp@corexresources.ca</u> or (587) 390-0290 or <u>myless@corexresources.ca</u>, respectively.

Yours truly,

Corex Resources Ltd.

David McGuinness Executive VP Land

Proposed Virden Roselea Unit No. 5 Lodgepole Unit

Tract	Tract	Total	13-30	14-30	01-31'	02-31
LSD	Weighting		13-30-010-25W1	14-30-010-25W1	01-31-010-25W1	02-31-010-25W1
Fract Factor		100.00000000%	3.246868693%	2.662461103%	0.322109147%	3.404935982%
/irden						
Area (ac)		920	40	40	40	40
ı (m)			0.0	0.0	0.0	0.0
/b (ac-ft)		0	0	0	0	0
bhi						
Sw						
ICPV			0.000	0.000	0.000	0.000
OOIP (Mbbls)		0	0	0	0	0
OOIP (Mstb)		0	0	0	0	0
DOIP (10 ³ m ³)		0	0	0	0	0
andhill/Oolites						
Area (ac)		920	40.0	40.0	40.0	40.0
(m)			1.7	0.0	0.4	2.0
/b (ac-ft)		2,297	223	0	52	262
hi			11.0%	12.0%	16.0%	16.0%
Sw			40%	100%	40%	20%
HCPV		2	0.112	0.000	0.038	0.256
OOIP (Mbbls)		1,589	114	0	39	261
DOIP (Mstb)		1,499	108	ŏ	37	246
OOIP (10 ³ m ³)		238	17	ŏ	6	39
		200		0	0	
callion						
rea (ac)		920	40.0	40.0	40.0	40.0
(m)			4.5	5.0	0.0	2.5
/b (ac-ft)		15,748	591	656	0	328
hi			10.0%	15.0%	12.0%	12.0%
Św			30%	50%	100%	50%
ICPV		11	0.315	0.375	0.000	0.150
OOIP (Mbbls)		10,924	321	382	0	153
OOIP (Mstb)		10,306	303	360	0	144
DOIP (10 ³ m ³)		1,638	48	57	0	23
Total Lodgepole						
Total OOIP (Mstb)		11,805	410	360	37	390
Total OOIP (10 ³ m ³)		1,877	65	57	6	62
Cumulative Oil (Mstb)		357	38.6	55.4	0.0	0.2
OOIP-Cum Prd (Mstb)	100%	11,447	372	305	37	390
		.,				
<u>Comments:</u> Bo			Cumulative production 1.06	to February 2022		
/ell 1			100/13-30-010-25W1/00	102/14-30-010-25W1/00	100/02-31-010-25W1/00	100/02-31-010-25W1/00
actor			100.00%	58.91%	2.57%	33.89%
umulative Oil (Mstb)			0.0	94.0	0.3	0.3
amalative on (mstu)			0.0	54.0	0.0	0.0
/ell 2			102/14-30-010-25W1/00			102/02-31-010-25W1/00
actor			41.09%			21.15%
umulative Oil (Mstb)			94.0			0.3
Vell 3						
actor						
umulative Oil (Mstb)						
Vell 4						
actor						

Cumulative Oil (Mstb)

Tract	Tract Total	03-31'	04-31	06-31	07-31'
LSD	Weighting	03-31-010-25W1	04-31-010-25W1	06-31-010-25W1	07-31-010-25W1
Tract Factor	100.00000000	% 4.872772634%	7.570449476%	9.944140403%	5.847615459%
Virden					
Area (ac)	920	40	40	40	40
h (m)		0.0	0.0	0.0	0.0
Vb (ac-ft)	0	0	0	0	0
phi					
Sw					
HCPV		0.000	0.000	0.000	0.000
DOIP (Mbbls)	0	0	0	0	0
OOIP (Mstb)	0	0	0	0	0
DOIP (10 ³ m ³)	0	0	0	0	0
Sandhill/Oolites					
Area (ac)	920	40.0	40.0	40.0	40.0
h (m)		4.0	5.0	1.0	0.0
Vb (ac-ft)	2,297	525	656	131	0
phi		14.0%	14.0%	12.0%	
Św		30%	30%	40%	100%
HCPV	2	0.392	0.490	0.072	0.000
OOIP (Mbbls)	1,589	399	499	73	0
DOIP (Mstb)	1,499	377	471	69	0
00IP (10 ³ m ³)	238	60	75	11	0
Scallion					
Area (ac)	920	40.0	40.0	40.0	40.0
h (m)		3.0	5.5	10.0	8.5
Vb (ac-ft)	15,748	394	722	1,312	1,115
phi		12.0%	12.0%	15.0%	13.0%
Sw		48%	38%	25%	35%
HCPV	11	0.189	0.413	1.125	0.718
DOIP (Mbbls)	10,924	192	420	1,145	731
OOIP (Mstb)	10,306	182	396	1,081	690
OOIP (10 ³ m ³)	1,638	29	63	172	110
Total Lodgepole					
Total OOIP (Mstb)	11,805	558	867	1,150	690
Total OOIP (10 ³ m ³)	1,877	89	138	183	110
Cumulative Oil (Mstb)	357	0.2	0.2	11.3	20.5
OOIP-Cum Prd (Mstb)	100% 11,447	558	867	1,138	669

Proposed Virden Roselea Unit No. 5 Lodgepole Unit

<u>Comments:</u> Bo

Well 1	100/02-31-010-25W1/00	100/02-31-010-25W1/00	102/08-31-010-25W1/00	100/02-31-010-25W1/00
Factor	33.41%	30.09%	26.27%	0.03%
Cumulative Oil (Mstb)	0.3	0.3	12.8	0.3
Well 2	102/02-31-010-25W1/00	102/02-31-010-25W1/00	103/08-31-010-25W1/00	102/08-31-010-25W1/00
Factor	41.56%	37.29%	26.73%	49.10%
Cumulative Oil (Mstb)	0.3	0.3	29.8	12.8
Well 3				103/08-31-010-25W1/00
Factor				47.51%
Cumulative Oil (Mstb)				29.8
Well 4				
Factor				
Cumulative Oil (Mstb)				

Proposed Virden Roselea Unit No. 5 Lodgepole Unit

Tract	Tract	Total	08-31'	09-31	10-31'	11-31
LSD	Weighting		08-31-010-25W1	09-31-010-25W1	10-31-010-25W1	11-31-010-25W1
Tract Factor		100.00000000%	2.166483964%	3.003562182%	6.286450539%	5.770751328%
Sw			100%	100%	100%	100%
HCPV		2	0.000	0.000	0.000	0.000
OOIP (Mbbls)		1,589	0	0	0	0
OOIP (Mstb)		1,499	0	0	0	0
00IP (10 ³ m ³)		238	0	0	0	0
Scallion						
Area (ac)		920	40.0	40.0	40.0	40.0
h (m)			3.5	4.5	8.0	8.5
Vb (ac-ft)		15,748	459	591	1,050	1,115
phi			14.0%	14.0%	14.0%	12.0%
Sw			45%	40%	30%	30%
HCPV		11	0.270	0.378	0.784	0.714
OOIP (Mbbls)		10,924	274	385	798	727
OOIP (Mstb)		10,306	259	363	753	686
OOIP (10 ³ m ³)		1,638	41	58	120	109
Total Lodgepole						
Total OOIP (Mstb)		11,805	259	363	753	686
Total OOIP (10 ³ m ³)		1,877	41	58	120	109
Cumulative Oil (Mstb)		357	10.8	19.2	33.4	25.2
OOIP-Cum Prd (Mstb)	100%	11,447	248	344	720	661

<u>Comments:</u> Bo

Well 1	102/08-31-010-25W1/00	100/09-31-010-25W1/00	100/09-31-010-25W1/00	100/09-31-010-25W1/00
Factor	24.63%	16.62%	47.85%	35.52%
Cumulative Oil (Mstb)	12.8	31.6	31.6	31.6
Well 2	103/08-31-010-25W1/00	102/09-31-010-25W1/00	102/09-31-010-25W1/00	102/09-31-010-25W1/00
Factor	25.77%	19.52%	46.62%	33.86%
Cumulative Oil (Mstb)	29.8	13.4	13.4	13.4
Well 3	100/08-31-010-25W1/00	100/16-31-010-25W1/00	100/16-31-010-25W1/00	100/16-31-010-25W1/00
Factor	100.00%	16.68%	17.63%	13.82%
Cumulative Oil (Mstb)	0.0	68.1	68.1	68.1
Well 4				
Factor				
Cumulative Oil (Mstb)				

Proposed Virden R	oselea Unit No. 5
Lodgepole Unit	

Lodgepole	Unit
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Tract LSD	Tract Weighting	Total	14-31 14-31-010-25W1	15-31 15-31-010-25W1	16-31 16-31-010-25W1	12-32 12-32-010-25W1
Tract Factor	weighting	100.00000000%	8.323221431%	5.515652201%	2.600900068%	0.080428245%
		100.00000000	0.32322143176	3.31303220176	2.000300000 %	0.00042024376
lirden						
rea (ac)		920	40	40	40	40
(m)			0.0	0.0	0.0	0.0
/b (ac-ft)		0	0	0	0	0
hi						
Sw						
ICPV			0.000	0.000	0.000	0.000
OIP (Mbbls)		0	0	0	0	0
OOIP (Mstb)		0	0	0	0	0
OOIP (10 ³ m ³)		0	0	0	0	0
andhill/Oolites						
Area (ac)		920	40.0	40.0	40.0	40.0
(m)		020	0.3	0.0	0.0	0.0
/b (ac-ft)		2,297	39	0	0	0
bhi		2,201	8.0%	•	0	°
Św			40%	100%	100%	100%
ICPV		2	0.014	0.000	0.000	0.000
OIP (Mbbls)		1,589	15	0.000	0.000	0.000
OIP (Mobis)		1,499	14	0	0	0
DOIP (10 ³ m ³)		238	2	0	0	0
Scallion						
Area (ac)		920	40.0	40.0	40.0	40.0
ı (m)			9.5	7.5	4.0	0.2
/b (ac-ft)		15,748	1,247	984	525	26
bhi			15.0%	14.0%	14.0%	12.0%
Sw			30%	35%	40%	60%
ICPV		11	0.998	0.683	0.336	0.010
OOIP (Mbbls)		10,924	1,016	695	342	10
OOIP (Mstb)		10,306	958	656	323	9
DOIP (10 ³ m ³)		1.638	152	104	51	1
Total Lodgepole		1,000	102			
Total OOIP (Mstb)		11,805	972	656	323	9
Total OOIP (10 ³ m ³)		1,877	155	104	51	1
		357	19.1	24.1		0.0
Cumulative Oil (Mstb)	40004				25.0	
OIP-Cum Prd (Mstb)	100%	11,447	953	631	298	9
Comments:						
30						
Vell 1			100/16-31-010-25W1/00	100/16-31-010-25W1/00	100/16-31-010-25W1/00	100/16-31-010-25W1/
Factor			14.04%	18.57%	19.20%	0.02%
			00.4	00.4	00.4	00.4

VVCII I	100/10-31-010-23001/00	100/10-31-010-23771/00	100/10-31-010-23001/00	100/10-31-010-23/01/00
Factor	14.04%	18.57%	19.20%	0.02%
Cumulative Oil (Mstb)	68.1	68.1	68.1	68.1
Well 2	102/13-32-010-25W1/00	102/13-32-010-25W1/00	102/13-32-010-25W1/00	
Factor	21.07%	29.04%	30.12%	
Cumulative Oil (Mstb)	10.0	10.0	10.0	
Well 3	102/14-32-010-25W1/00	102/14-32-010-25W1/00	102/14-32-010-25W1/00	
Factor	19.77%	23.06%	23.94%	
Cumulative Oil (Mstb)	37.1	37.1	37.1	
Well 4	100/14-31-010-25W1/00			
Factor	100.00%			
Cumulative Oil (Mstb)	0.1			

Proposed	Virden	Roselea	Unit No.	5
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Lodgepole Unit

Tract LSD	Tract Weighting	Total	13-32 13-32-010-25W1	14-32 14-32-010-25W1	04-04' 04-04-011-25W1	01-05' 01-05-011-25W1
Tract Factor		100.00000000%	2.418016411%	0.060358311%	0.229117966%	4.416542468%
Virden						
Area (ac)		920	40	40	40	40
h (m)			0.0	0.0	0.0	0.0
Vb (ac-ft)		0	0	0	0	0
phi			_			
Sw						
HCPV			0.000	0.000	0.000	0.000
OOIP (Mbbls)		0	0	0	0	0
OOIP (Mstb)		0	0	0	0	0
OOIP (10 ³ m ³)		0	0	0	0	0
Sandhill/Oolites						
Area (ac)		920	40.0	40.0	40.0	40.0
h (m)		320	1.6	0.0	0.0	0.0
Vb (ac-ft)		2,297	210	0	0.0	0.0
phi		2,231	10.0%	0	0	v
Sw			40%	100%	100%	100%
HCPV		2	0.096	0.000	0.000	0.000
OOIP (Mbbls)		1,589	98	0	0	0
OOIP (Mstb)		1,499	92	ŏ	ő	ő
00IP (10 ³ m ³)		238	15	ő	ő	ő
		230	15	0	•	v
Scallion				40.0		
Area (ac)		920	40.0	40.0	40.0	40.0
h (m)		15 7 10	3.0	0.2	0.5	7.5
Vb (ac-ft)		15,748	394	26	66	984
phi			12.0%	12.0%	12.0%	12.0%
Sw			40%	55%	40%	40%
HCPV		11	0.216	0.011	0.036	0.540
OOIP (Mbbls)		10,924	220 207	11	37	550
OOIP (Mstb)		10,306		10	35	519
00IP (10 ³ m ³)		1,638	33	2	5	82
Total Lodgepole						
Total OOIP (Mstb)		11,805	300	10	35	519
Total OOIP (10 ³ m ³)		1,877	48	2	5	82
Cumulative Oil (Mstb)		357	22.9	3.5	8.3	13.1
OOIP-Cum Prd (Mstb)	100%	11,447	277	7	26	506
<u>Comments:</u>						
Bo Woll 1			400/40 04 040 050/44/00	102/14/22 010 2510/1/00	400/04 04 044 051//4/00	400/04 04 044 05144

	(
Well 1	100/16-31-010-25W1/00	102/14-32-010-25W1/00	102/04-04-011-25W1/00	102/04-04-011-25W1/00
Factor	0.04%	9.33%	19.81%	28.04%
Cumulative Oil (Mstb)	68.1	37.1	42.2	42.2
Well 2	102/13-32-010-25W1/00			100/01-05-011-25W1/00
Factor	19.78%			32.51%
Cumulative Oil (Mstb)	10.0			3.9
Well 3	102/14-32-010-25W1/00			
Factor	23.90%			
Cumulative Oil (Mstb)	37.1			
Well 4	100/13-32-010-25W1/00			
Factor	100.00%			
Cumulative Oil (Mstb)	12.0			

Tract LSD	Tract Weighting	Total	02-05' 02-05-011-25W1	03-05' 03-05-011-25W1	06-05' 06-05-011-25W1
Tract Factor	weighting	100.00000000%	6.877749074%	8.706323030%	5.673089885%
		100.0000000078	0.01114301476	0.10032303076	3.07 3003003 78
Virden		000	40	40	40
Area (ac)		920		40	40
h (m)			0.0	0.0	0.0
Vb (ac-ft)		0	0	0	0
ohi Sw					
HCPV			0.000	0.000	0.000
DOIP (Mbbls)		0	0	0.000	0.000
OOIP (Mobis)		0	0	0	0
		0	0	0	0
00IP (10 ³ m ³)		v	U	0	U
Sandhill/Oolites					
Area (ac)		920	40.0	40.0	40.0
h (m)			0.0	0.0	1.5
Vb (ac-ft)		2,297	0	0	197
phi					10.0%
Sw		-	100%	100%	40%
HCPV		2	0.000	0.000	0.090
OOIP (Mbbls)		1,589	0	0	92
OOIP (Mstb)		1,499	0	0	86
00IP (10 ³ m ³)		238	0	0	14
Scallion					
Area (ac)		920	40.0	40.0	40.0
h (m)			8.5	10.0	5.6
Vb (ac-ft)		15,748	1,115	1,312	735
phi			14.0%	14.0%	15.0%
Sw			30%	25%	30%
HCPV		11	0.833	1.050	0.588
OOIP (Mbbls)		10,924	848	1,069	599
OOIP (Mstb)		10,306	800	1,008	565
00IP (10 ³ m ³)		1,638	127	160	90
Total Lodgepole					
Total OOIP (Mstb)	_	11,805	800	1,008	651
Total OOIP (10 ³ m ³)		1,877	127	160	104
Cumulative Oil (Mstb)		357	12.7	11.8	1.8
OOIP-Cum Prd (Mstb)	100%	11,447	787	997	649

Proposed Virden Roselea Unit No. 5 Lodgepole Unit

<u>Comments:</u> Bo

Во			
Well 1	102/04-04-011-25W1/00	102/04-04-011-25W1/00	100/06-05-011-25W1/00
Factor	27.01%	25.14%	100.00%
Cumulative Oil (Mstb)	42.2	42.2	1.8
Well 2	100/01-05-011-25W1/00	100/01-05-011-25W1/00	
Factor	35.23%	32.27%	
Cumulative Oil (Mstb)	3.9	3.9	
Well 3			
Factor			
Cumulative Oil (Mstb)			
Well 4			
Factor			
Cumulative Oil (Mstb)			

	D L /L L ·			
Well ID	Prod./Inject.	First Prod.	Last Prod.	Well Type
	Formation	YYYY/MM	YYYY/MM	Wen type
100/13-30-010-25W1/00	N/A			Vertical
100/14-30-010-25W1/00	N/A			Vertical
102/14-30-010-25W1/00	Mlodgepl	2007-03-01	2022-02-28	Horizontal
100/02-31-010-25W1/00	Mlodgepl	2022-02-28	2022-02-28	Horizontal
102/02-31-010-25W1/00	Mlodgepl	2022-02-28	2022-02-28	Horizontal
103/02-31-010-25W1/00	N/A			Horizontal
100/08-31-010-25W1/00	N/A			Vertical
102/08-31-010-25W1/00	Mlodgepl	2021-09-01	2022-02-28	Horizontal
103/08-31-010-25W1/00	Mlodgepl	2021-09-01	2022-02-28	Horizontal
100/09-31-010-25W1/00	Mlodgepl	2020-12-01	2022-02-28	Horizontal
102/09-31-010-25W1/00	Mlodgepl	2021-09-01	2022-02-28	Horizontal
100/14-31-010-25W1/00	Mlodgepl	1968-06-01	1968-07-31	Vertical
100/15-31-010-25W1/00	N/A			Vertical
100/16-31-010-25W1/00	Mlodgepl	2020-02-01	2022-02-28	Horizontal
100/13-32-010-25W1/00	Mlodgepl	1954-03-01	1957-09-30	Vertical
102/13-32-010-25W1/00	Mlodgepl	2021-09-01	2022-02-28	Horizontal
100/14-32-010-25W1/00	N/A			Vertical
102/14-32-010-25W1/00	Mlodgepl	2018-12-01	2022-02-28	Horizontal
100/04-04-011-25W1/00	N/A			Vertical
102/04-04-011-25W1/00	Mlodgepl	2020-12-01	2022-02-28	Horizontal
100/01-05-011-25W1/00	Mlodgepl	2021-10-01	2022-02-28	Horizontal
100/06-05-011-25W1/00	Mlodgepl	2021-10-01	2022-02-28	Vertical

Table 2 – Well List – Status

	-		
Well	Well Type	Cumulative Oil	Expected Ultimate
		(Mbbl)	Recovery (Mbbl)
100/13-30-010-25W1/00	Vertical	0.00	0.00
100/14-30-010-25W1/00	Vertical	0.00	0.00
102/14-30-010-25W1/00	Horizontal	94.02	116.89
100/02-31-010-25W1/00	Horizontal	0.35	105.62
102/02-31-010-25W1/00	Horizontal	0.27	60.56
103/02-31-010-25W1/00	Horizontal	0.00	0.00
100/08-31-010-25W1/00	Vertical	0.00	0.00
102/08-31-010-25W1/00	Horizontal	12.81	61.30
103/08-31-010-25W1/00	Horizontal	29.82	104.46
100/09-31-010-25W1/00	Horizontal	31.64	86.37
102/09-31-010-25W1/00	Horizontal	13.37	50.06
100/14-31-010-25W1/00	Vertical	0.10	0.10
100/15-31-010-25W1/00	Vertical	0.00	0.00
100/16-31-010-25W1/00	Horizontal	68.08	121.91
100/13-32-010-25W1/00	Vertical	11.98	11.98
102/13-32-010-25W1/00	Horizontal	10.03	47.75
100/14-32-010-25W1/00	Vertical	0.00	0.00
102/14-32-010-25W1/00	Horizontal	37.13	65.36
100/04-04-011-25W1/00	Vertical	0.00	0.00
102/04-04-011-25W1/00	Horizontal	42.15	107.32
100/01-05-011-25W1/00	Horizontal	3.87	25.06
100/06-05-011-25W1/00	Vertical	1.78	10.36

 Table 3 – Cumulative Oil Production and Estimated Ultimate Recovery

Table 4 – Summary of Rock and Fluid Properties

Proposed Virden Roselea Unit No. 5			
Rock and Fluid Properties			
Formation Pressure	kPa	6,500	
Oil Gravity	°API	34.3	
Solution Gas-Oil Ratio	m^3/m^3	22	
Oil Formation Volume Factor	Rm ³ /Sm ³	1.06	
Average Porosity	fraction	0.131	
Average Air Permeability	mD	15	

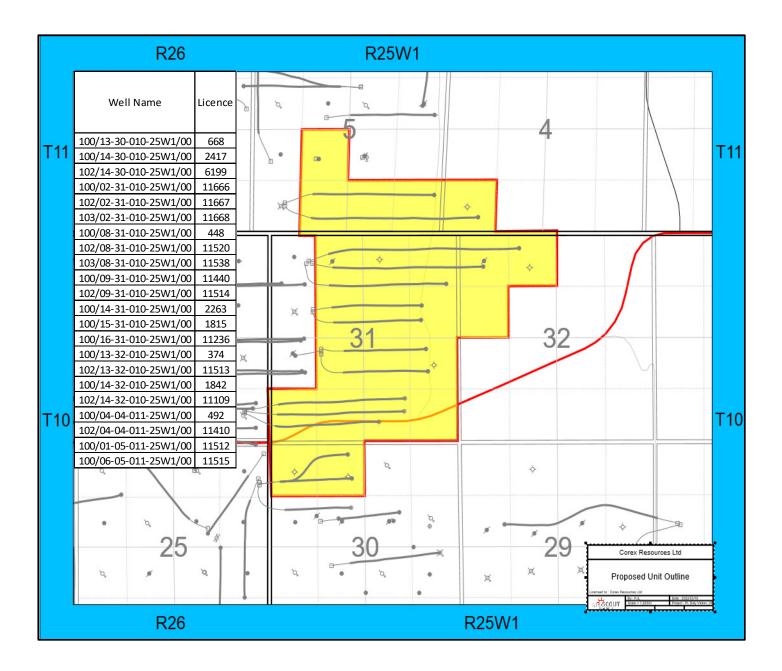


Figure 1 – Location of Proposed Virden Roselea Unit No. 5

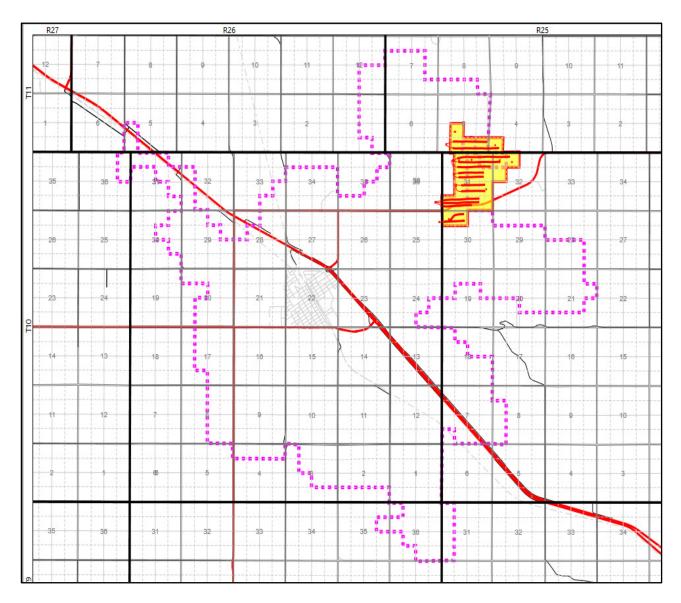


Figure 2 – Location of Proposed Virden Roselea Unit No. 5 within the Virden Lodgepole B Pool

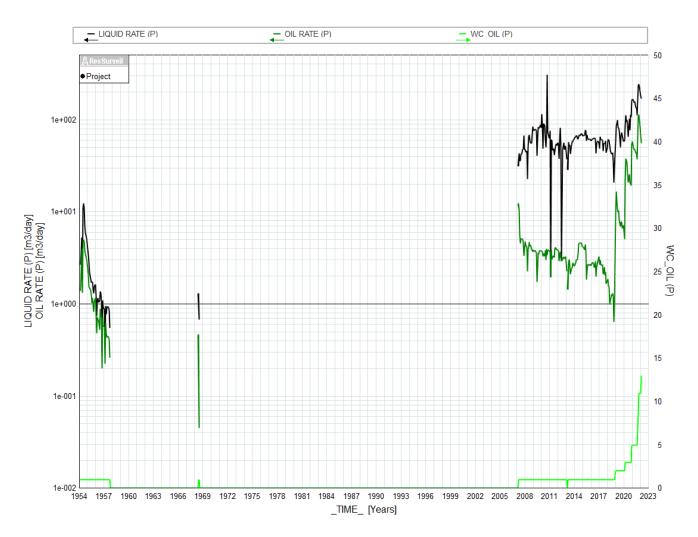


Figure 3 – Production History of Wells within Proposed Virden Roselea Unit No. 5

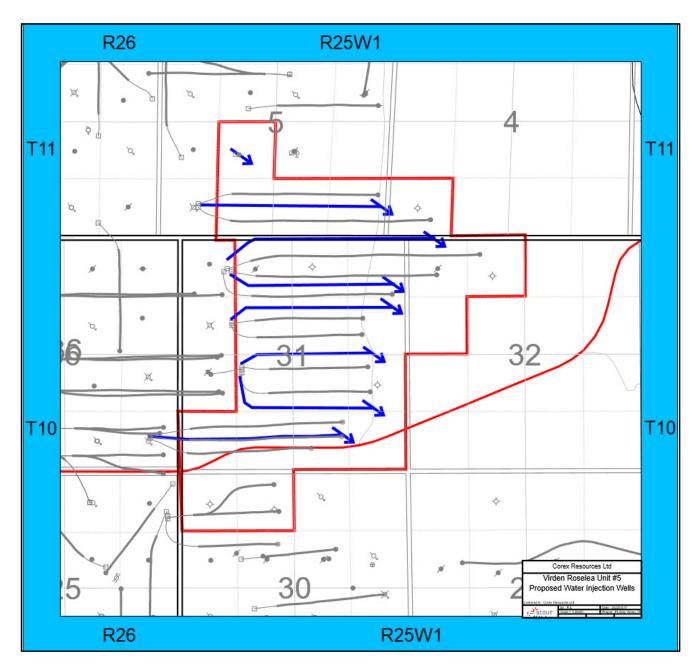
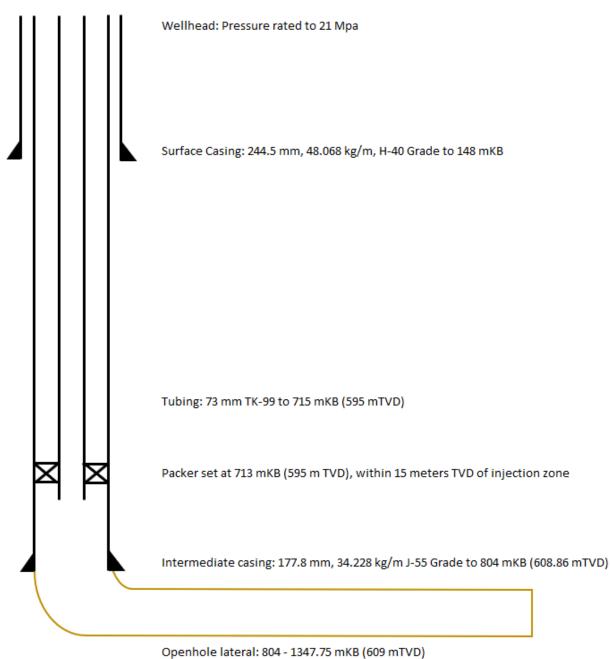
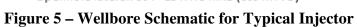
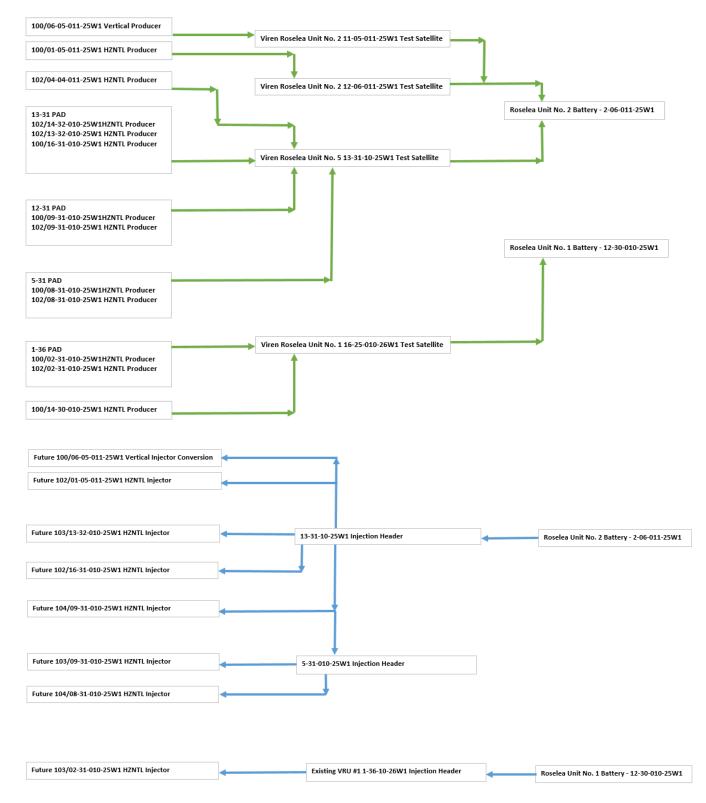


Figure 4 – Proposed Injector Locations







Injection pumps are located at the 12-30-010-25W1 and 2-06-011-25W1 Batteries. Oil rates for all wells are measured at the test satellites shown above. Injection rates are measured through turbine meters at the wellhead **Figure 6a – Simplified Flow Diagram and Metering**

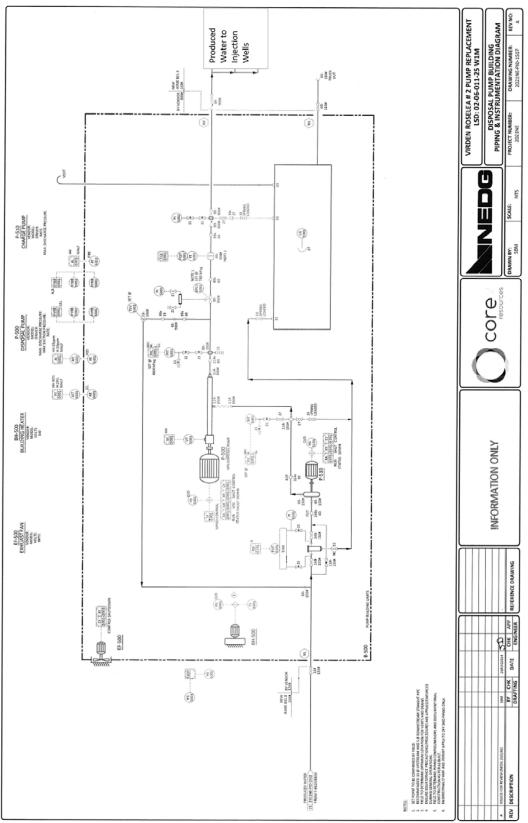


Figure 6b – Injection Pump at 2-06-011-25W1 Battery (12-30 similar design)

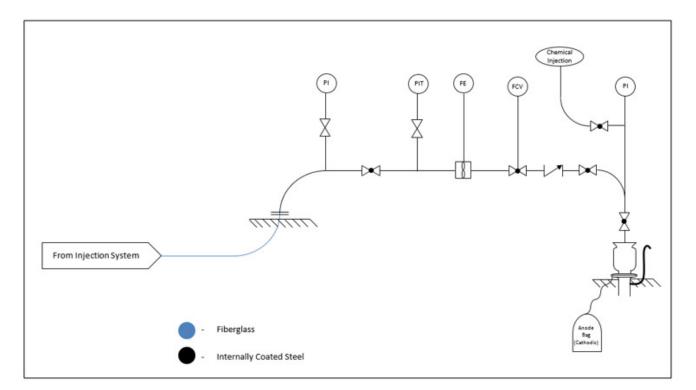
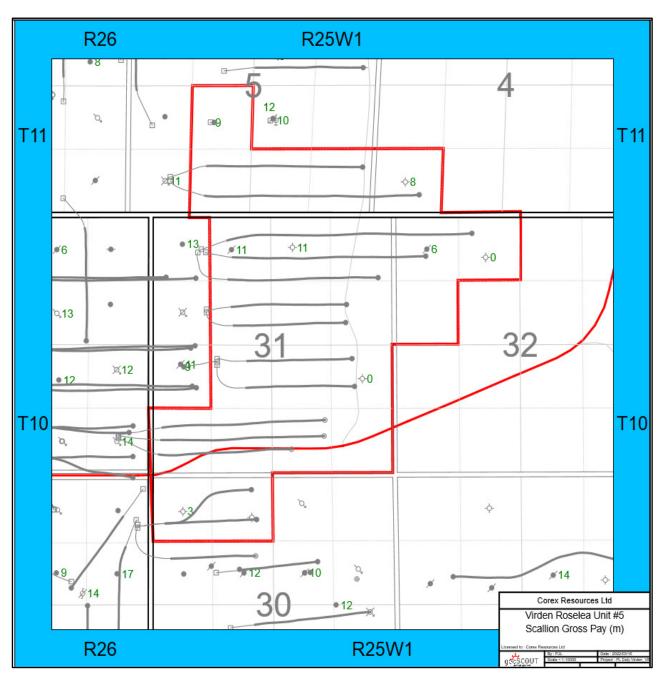


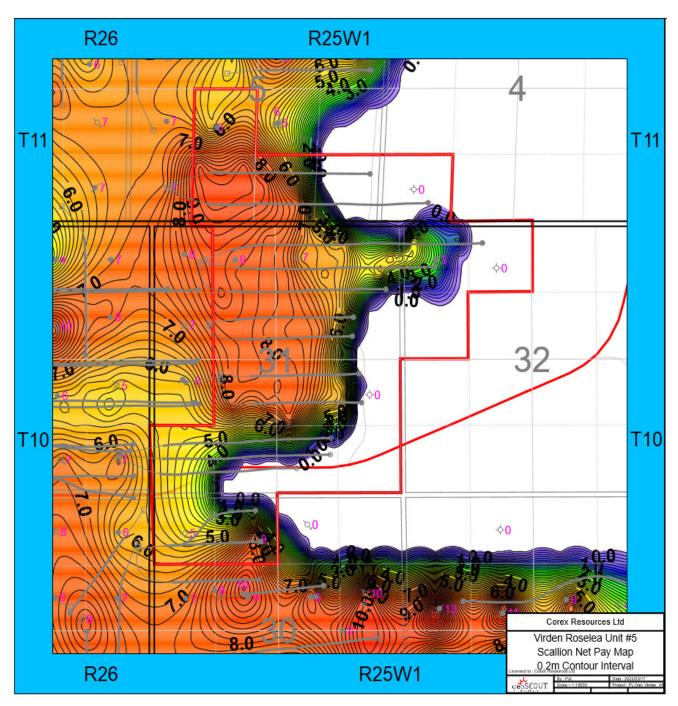
Figure 7 – Corrosion Control System

100/13-31-010-25W1/00 1960/08/25 +429.2 +431.9 100/15-31-010-25W1/00 1961/01/24 +428.5 -------+432.2 100/14-32-010-25W1/00 1962/04/06 ---------+371.2 +374.6 100/14-31-010-25W1/0 100/13-32-010-25W1/00 <=881.3m=> <=388.9m=> <=323.9m= <=399 7m= 1967/10/15 1954/02/28 +368.8 A' Elogs 2/2 geoGRAM 1/2 Gamma Ray Neutron 2/2 geoGRAM 1/2 Gamma Ray Neutron 2/2 geoGRAM 1/2 geoGRAM 1/2 Eloos 2/2 geoGRAM 1/2 Elogs 2/2 MM SPEAREISH CON 550 SPEARFISH 2 MRAA. WHERE Alexander WHITEWA 5 MARANA E SPEARFISH **100GEPOLE** SPEARFISH LODGEPOLE ſ VIRDEN UPR VIRDE WWW/ 5 Sandhill/Oolites - Top of Reservoir VIRDEN SANDHILL SANDHILL SANDHILL OOLITES 21-2-4 3 7 1 OOLITES OOLITES WHITEWATE 2 SANDHILL OOLITES ===== -2 SCALLION SCALLION SCALLION Scallion SCALLION VIRDEN H,C, TICKE MAITON IN KOSKAL IF IF WITH TD 536 1m Scallion_OW Scallion_{FL}OW597.4m Scallion_OW Scallion_O **__**600 600 SANDHILL TD 600.5m - |¹⁵| • **Oil-Water Contact** IS' NORME OOLITES AT HOLE CONTENENT (2007): Micino (2007): Micino (2007): Micino NICRO-ADDITIONS/MEA Base of Reservoir TD 605.0m 40° INDECTION 550 SCALLION RESISTIVITY - ebms m'/m 5 NUCTOR TD 560.8m IN' NOTING - ++ + 32

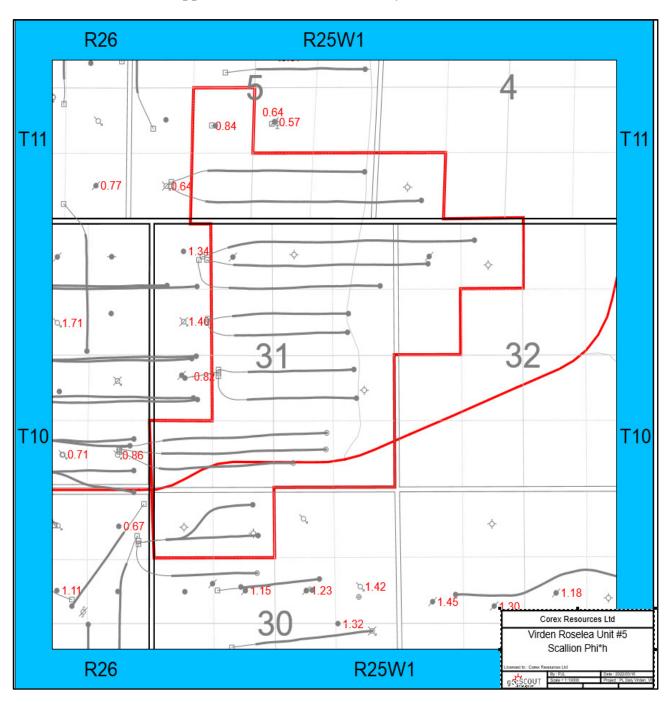
Appendix I - Stratigraphy of Lodgepole Formation



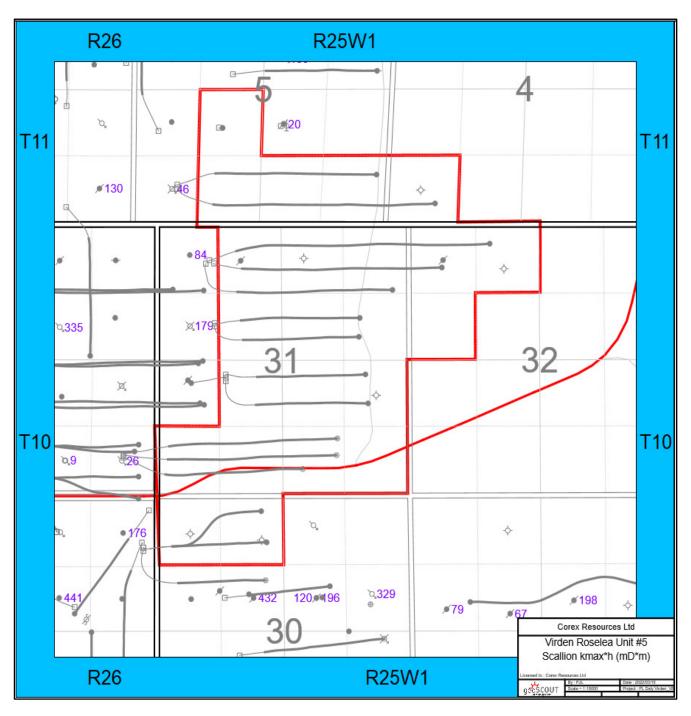
Appendix II – Scallion – Gross Pay



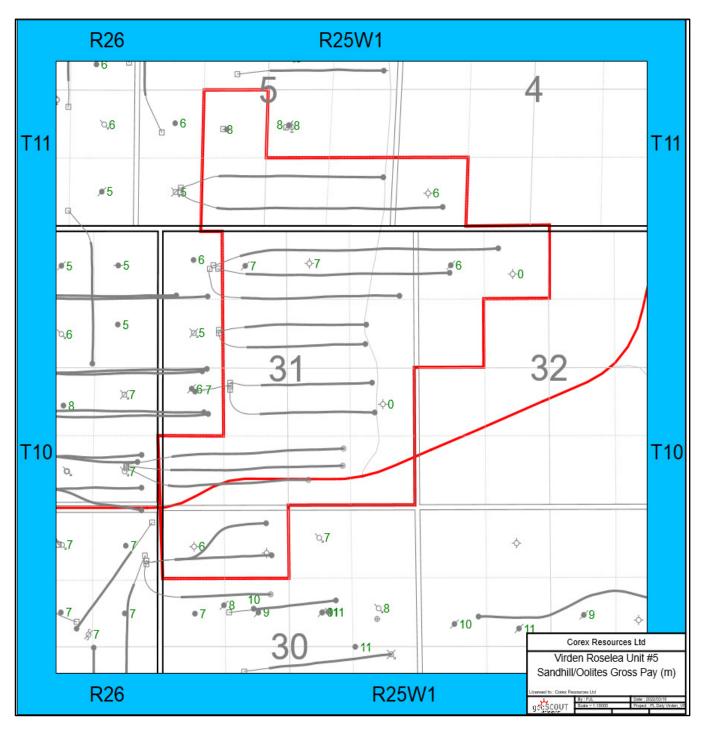
Appendix III – Scallion – Net Pay



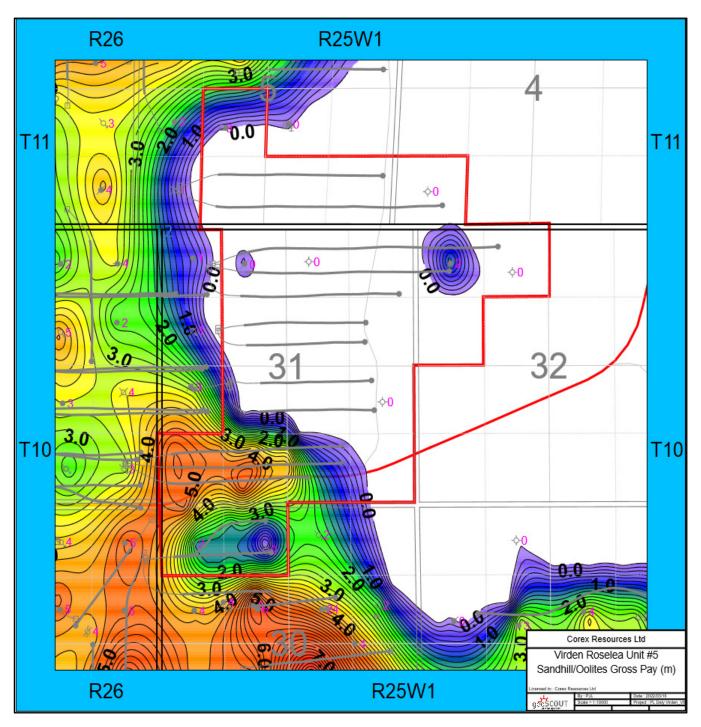
Appendix IV – Scallion – Porosity-Thickness



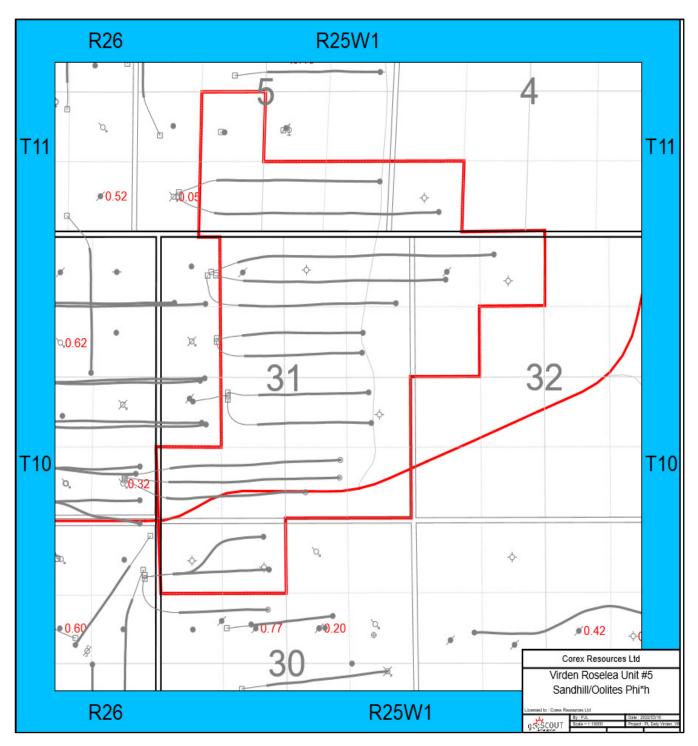
Appendix V – Scallion – Permeability-Thickness



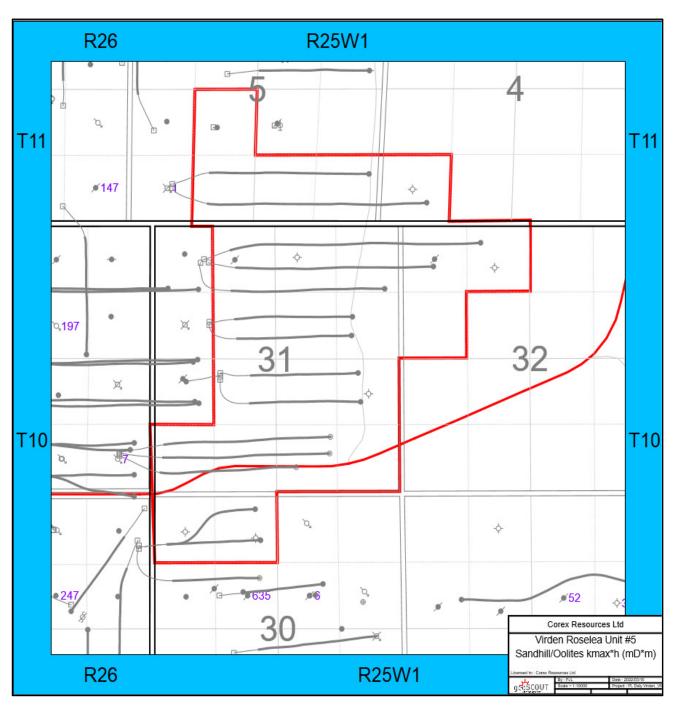
Appendix VI – Sandhill/Oolites – Gross Pay



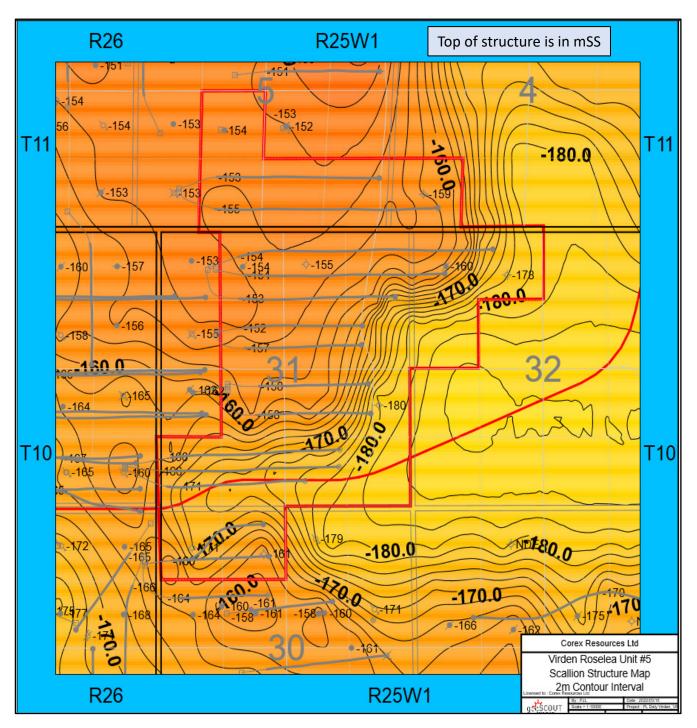
Appendix VII – Sandhill/Oolites – Net Pay



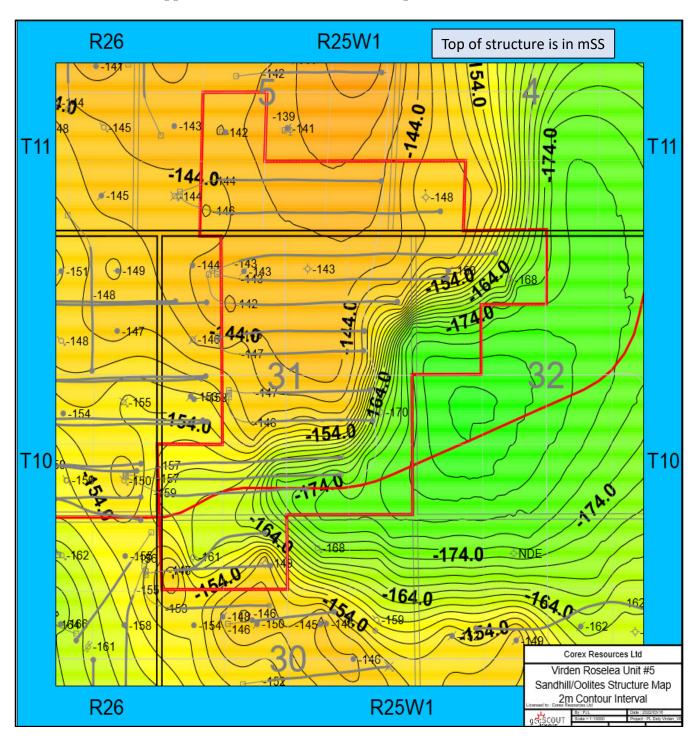
Appendix VIII – Sandhill/Oolite – Porosity-Thickness



Appendix IX – Sandhill/Oolites – Permeability-Thickness

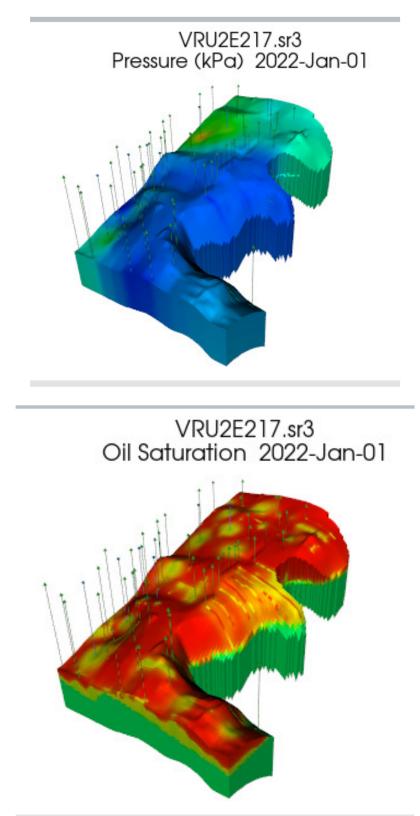


Appendix X – Scallion – Top of Structure



Appendix X1 – Sandhill/Oolites – Top of Structure

Appendix XII – Reservoir Model



Reservoir Model – Scallion – 3D View – Pressure & Oil Saturation