PROPOSED EBOR UNIT NO. 4

Application for Enhanced Oil Recovery Waterflood Project

Lodgepole Formation

Lodgepole A (01 59A)

Daly Sinclair Field, Manitoba

July 15, 2020
Tundra Oil and Gas Limited

INTRODUCTION

The Daly Sinclair oilfield is located in Townships 8, 9, 10 and 11, of Ranges 27, 28 & 29 WPM (Figure 1). Within the Daly Sinclair oilfield, most Lodgepole reservoirs have been developed with vertical producing wells on Primary Production and 40 acre spacing. Horizontal producing Lodgepole wells have recently been drilled by Tundra Oil and Gas (Tundra) in the southern part of the Daly Sinclair field.

Within the area, potential exists for incremental production and reserves from a Waterflood Enhanced Oil Recovery (EOR) project in the Lodgepole oil reservoir. The following represents an application by Tundra Oil and Gas Limited (Tundra) to establish Ebor Unit No. 4 (Sections 05 & 08-009-29W1) and implement a Secondary Waterflood EOR scheme within the Lodgepole formation as outlined on Figure 2.

The proposed project area falls within the existing designated Lodgepole A Pool of the Daly Sinclair Oilfield (Figure 3).

SUMMARY

1. The proposed Ebor Unit No. 4 consists of 17 producing horizontal Lodgepole wells and 1 abandoned vertical Lodgepole well. The area of the proposed Ebor Unit No. 4 comprises 32 Legal Sub Divisions (LSD), and is located northwest of Sinclair Unit No. 13 (Figure 2).

2. Total Original Oil in Place (OOIP) in the project area is estimated to be **3,391** e^3m^3 (21,329 Mbbl) for an average of **106.0** e^3m^3 (666.5 Mbbl) OOIP per 40 acre LSD. OOIP values were estimated by contouring phi*h values and applying volumetric methods.

3. Cumulative production to the end of April 2020 from the 17 producing Lodgepole wells within the proposed Ebor Unit No. 4 project area is **196.3** e^3m^3 (1235 Mbbl) of oil and **332.5** e^3m^3 (2092 Mbbl) of water, representing a **5.8%** Recovery Factor (RF) of the OOIP.

4. Figure 4 shows that the oil production rate in the Ebor Unit No. 4 area peaked during September 2015 at 121.1 m^3 of OPD when developed with horizontal wells at 400m inter-well spacing. Drilling 4 infill horizontal wells in 2016 at 200m inter-well spacing resulted in a new peak rate during May 2016 of 178.1 m^3 of OPD. As of April 2020, production was 44.5 m^3 (280.3 bbl) OPD, 129.0 m^3 (811.9 bbl) water per day (WPD) and a 74.3% water cut (WCUT).

5. In May 2016, production averaged 11.9 m^3 (74.7 bbl) OPD per well in the proposed Ebor Unit No. 4. As of April 2020, average per well production has declined to 2.96 m^3 (18.7 bbl) OPD. Production from this area is expected to decline by 15% under primary production.

6. Estimated Ultimate Recovery (EUR) of Primary producing oil reserves in the proposed Ebor Unit No. 4 project area is estimated to be **311.9** e^3m^3 (1,962.2 Mbbl), with **124.1** e^3m^3 (780.5 Mbbl) remaining as of year end 2019 from reserve reports.

7. Ultimate oil recovery of the proposed Ebor Unit No. 4 OOIP, under the current Primary production method, is forecasted to be **9.2%**

8. Estimated Ultimate Recovery (EUR) of oil under Secondary Waterflood EOR for the proposed Ebor Unit No. 4 is estimated to be **430.7** e^3m^3 (2,708.4 Mbbl). An incremental **118.7** e^3m^3 (746.5 Mbbl) of oil is forecasted to be recovered under the proposed Unitization and Secondary EOR production, versus the existing Primary production method.

9. Total RF under Secondary WF in the proposed Ebor Unit No. 4 is estimated to be **12.7%**.

10. There are no nearby Lodgepole Dolomite waterflood analogues with enough waterflood history at this time. However, based on simulation, results of Primary production and successful waterfloods in the Permian basin of carbonate reservoirs with similar reservoir characteristics, the proposed project area is thought to be suitable reservoir for successful EOR trial.

11. Horizontal producers with multi-stage hydraulic fractures, will be converted to injectors (Figure 5) within the proposed Ebor Unit No. 4, to complete waterflood patterns with 200m Horizontal to Horizontal spacing.

DISCUSSION

The proposed Ebor Unit No. 4 project area is located within Township 9, Range 29 W1 of the Daly Sinclair oilfield (Figure 1). The proposed Ebor Unit No. 4 currently consists of 17 producing horizontal wells and 1 abandoned vertical well within an area covering Sections 05 & 08-009-29W1M (Figure 2). A project area well list complete with recent production statistics is attached as Table 3.

Within the proposed Unit, potential exists for incremental production and reserves from a Waterflood EOR project in the Lodgepole oil reservoir.

Geology

Stratigraphy:

The proposed Ebor Unit 4 (Appendix 1) is located on the carbonate slope of the Mississippian Lodgepole Formation on the Eastern edge of the Williston Basin (Appendix 2). The Lodgepole lies conformably on top of the Bakken Formation, and it is unconformably overlain by the Jurassic Lower Amaranth. The Lower Amaranth consists of red argillaceous siltstones and anhydrites.

The Lodgepole section has been subdivided into 7 members. In descending order these are:

1. Unnamed
2. Upper Daly
3. Middle Daly
4. Cruickshank Shale
5. Cruickshank Crinoidal
6. Cromer Shale
7. Basal Limestone

Of the seven members, only the Unnamed is productive across the proposed unit area. The stratigraphy of the Lodgepole in Ebor Unit 4 is shown in the structural cross section (Appendix 3).

Sedimentology:

The whole of the Lodgepole Formation in the Daly Sinclair area consists of an overall shallowing upward cycle. It begins with the Upper Bakken transgressive cycle and continues to the Lodgepole Unnamed Dolomite facies, which represents the shallowest part of the cycle preserved.

Starting from the base of the Lodgepole section, working upwards, is the Basal Limestone. Where cored, the Basal Limestone consists of a nodular lime mudstone to wackestone. The Basal Limestone is thought to represent deeper water conditions following the Upper Bakken transgression. The Basal Lodgepole Limestone is considered non-reservoir.

Overlying the Basal Limestone, is the Cromer Shale which is the bottom seal for the productive Lodgepole units. It is an argillaceous carbonate that appears as a higher gamma ray unit on logs, and it is considered non-reservoir.

The Cruickshank Crinoidal overlies the Cromer Shale, and is the stratigraphically lowest producing unit within the Lodgepole. Within the area of this proposed unit, the Cruickshank Crinoidal is not productive.

Overlying the Cruickshank Crinoidal is the Cruickshank Shale. Though it is an argillaceous carbonate, it does have permeabilities & porosities that suggest it is a reservoir unit. However, in the area of this proposed unit, it is not productive.

The Middle Daly overlies the Cruickshank Shale, and the Upper Daly overlies the Middle Daly. Both the Upper Daly and Middle Daly are limestone in composition within this proposed unit. The depositional environment is suggested to be within a more distal and open marine part of the carbonate ramp. This is due to the lack of anhydrite beds and the presence of significantly more grainstones, especially when compared to the overlying Unnamed unit.

The Unnamed is the stratigraphically highest unit within the Lodgepole, and within this proposed unit, it is the producing member. In the area of this proposed Ebor Unit 4, the Unnamed appears to be entirely to partially dolomitized. The Unnamed consists of a series of "brining upward" cycles, comprised of 1-2 m sequences that begin at an erosional base with coarser grained carbonate grainstones which rapidly grade upward into fine-grained dolomitic mudstones that characterize the bulk of the cycle. The dolomite facies contain anhydrite bands of variable thickness and disseminated anhydrite. The coarser grained grainstones at the base of each cycle generally consist of fossil fragments which are often replaced by chert or are tightly cemented. The fine grained dolomitic mudstones bear rare fossils, generally fragmental, consisting of bryozoans, corals, brachiopods and crinoids.

Structure:

A structure contour map is provided for the top of the Lodgepole (Appendix 4). Structure on the top of the Lodgepole Formation reflects the erosional relief at the Mississippian Unconformity. Within the proposed unit area, the Lodgepole is on a slight structural high, with overall structure increasing to the NE.

Reservoir Quality:

Reservoir quality within the Unnamed is highly variable both laterally and vertically. Due to the heterolithic nature of the reservoir and the inherent challenges in determining reservoir properties from petrophysical logs in carbonates, high resolution pressure-decay profile permeameter (PDPK) core data was used to determine an average net to gross ratio. The net to gross ratio was calculated using a PDPK cutoff of 0.5mD (Appendix 5). To determine the net pay, an average net to gross ratio of 29.3% was applied to the gross isopach (Appendix 6). The top and base of the Unnamed Member were determined using open hole wireline logs.

Porosity was calculated from surrounding core data (Appendix 7) by taking the average core porosity over the Unnamed after applying the 0.5mD permeability cutoff. An average porosity of 10% was observed over the proposed unit area.

Fluid Contacts:

No oil-water contact is found within the Lodgepole formation in the area local to the proposed unit.

OOIP Estimates

Total volumetric OOIP for all the Lodgepole units within the proposed Ebor Unit 4 has been calculated to be **3,391** e^3m^3 (21,329 Mbbl).

Tabulated parameters for each LSD from the calculations can be found in Table 4.

OOIP values were calculated using the following volumetric equation:

$$OOIP = \frac{Area * Net\ Pay * \ Porosity * (1 - Water\ Saturation)}{Initial\ Formation\ Volume\ Factor\ of\ Oil}$$

or

$$OOIP(m3) = \frac{A * h * \emptyset * (1 - Sw)}{Bo} * \frac{10{,}000m2}{ha}$$

or

$$OOIP(Mbbl) = \frac{A * h * \emptyset * (1 - Sw)}{Bo} * 3.28084\frac{ft}{m} * 7{,}758.367\frac{bbl}{acre * ft} * \frac{1Mbbl}{1{,}000bbl}$$

where

OOIP	=Original Oil in Place by LSD
A	=Area
h * Ø	=Net Pay * Porosity, or Phi * h
Bo	=Formation Volume Factor of Oil
Sw	=Water Saturation

The initial oil formation volume factor (Bo) of 1.1 was adopted from historical PVT information taken from the Sinclair Daly area and is representative of the fluid characteristics in the reservoir.

Historical Production

A historical group production plot for the proposed Ebor Unit No. 4 is shown as Figure 4. Oil production commenced from the proposed unit area in March 1986. The oil production rate in the Ebor Unit No. 4 area peaked during September 2015 at 121.1 m^3 of OPD when developed with horizontal wells at 400m inter-well spacing. Drilling 4 infill horizontal wells in 2016 at 200m inter-well spacing resulted in a new peak rate during May 2016 of 178.1 m^3 of OPD. As of April 2020, production was 44.5 m^3 OPD, 129.0 m^3 WPD and a 74.3% WCUT.

Production from this area is expected to decline by 15% under the current primary production method.

The remainder of the field's production and decline rates indicate the need for pressure restoration and maintenance. Waterflooding is deemed to be the most efficient means of secondary recovery to introduce energy back into the system and provide areal sweep between wells.

UNITIZATION

Unitization and implementation of a Waterflood EOR project is forecasted to increase overall recovery of OOIP from the proposed project area by 3.5% (from a recovery factor of 9.2% to 12.7%). The basis for unitization is to develop the lands in an effective manner that will be conducive to waterflooding. Unitizing will enable the reservoir to have a higher recovery of oil by allowing the development of additional drilling and injector conversions over time. In addition, Unitizing will facilitate a pressure maintenance scheme, and overall will increase oil production over time.

Unit Name

Tundra proposes that the official name of the new Unit shall be Ebor Unit No. 4.

Unit Operator

Tundra Oil and Gas Limited (Tundra) will be the Operator of record for Ebor Unit No. 4.

Unitized Zone

The unitized zone(s) to be waterflooded in Ebor Unit No. 4 will be the Lodgepole formation.

Unit Wells

The 18 wells to be included in the proposed Ebor Unit No. 4 are outlined in Table 3.

Unit Lands

The Ebor Unit No. 4 will consist of 32 LSDs as follows:

Section 05, of Township 9, Range 29, W1M
Section 08, of Township 9, Range 29, W1M

The lands included in the 40 acre tracts are outlined in Table 1.

Tract Factors

The Tract Factor contribution for each of the LSD's within the proposed Ebor Unit No. 4 was calculated as follows:

- OOIP by LSD, minus cumulative production to date for the LSD as distributed by the LSD specific Production Allocation (PA) % in the applicable producing horizontal well (to yield Remaining OOIP)
- Tract Factor by LSD = The product of Remaining OOIP by LSD as a % of total proposed Unit Remaining OOIP

Tract Factor calculations for all individual LSD's based on the above methodology are outlined within Table 2.

Working Interest Owners

Table 1 outlines the working interest % (WI) for each recommended Tract within the proposed Ebor Unit No. 4.

Tundra Oil and Gas Limited will have a 100% working interest in the proposed Ebor Unit No. 4.

WATERFLOOD EOR DEVELOPMENT

The waterflood performance predictions for the proposed Ebor Unit No. 4 Lodgepole project are based on internal engineering assessments. Project area specific reservoir and geological parameters were used to guide the overall Secondary Waterflood recovery factor.

Based on the geological descriptions, primary production decline rate, and positive waterflood response in the analog Clearfork formation in the Permian Basin of West Texas, the Lodgepole formation in the project area is deemed to be a suitable trial for waterflood EOR operations.

Reserves Recovery Profiles and Production Forecasts

The primary waterflood performance predictions for the proposed Ebor Unit No. 4 are based on oil production decline curve analysis, and the secondary predictions are based on internal engineering analysis performed by the Tundra reservoir engineering group using numerical simulation in combination with analogue studies of successful waterfloods in the Clearfork formation.

Primary Production Forecast

Cumulative production to the end of April 2020 from the 17 producing Lodgepole wells within the proposed Ebor Unit No. 4 project area is 196.3 e^3m^3 of oil and 332.5 e^3m^3 of water for a recovery factor of 5.8% of the total OOIP.

Based on decline curve analysis of the wells currently on production, the estimated ultimate recovery (EUR) for the proposed Unit with no further development is estimated to be 311.9 e^3m^3, representing a recovery factor of 9.2% of the total OOIP.

Production plots of the forecasted oil rate vs time and oil rate vs cumulative oil produced are shown in Figures 6 & 7, respectively.

Pre-Production Schedule/Timing for Conversion of Horizontal Wells to Water Injection

Tundra will plan an injection conversion schedule to allow for the most expeditious development of the waterflood within the proposed Ebor Unit No. 4, while maximizing reservoir knowledge.

Criteria for Conversion to Water Injection Well

Seven (7) water injection wells are required for this proposed unit as shown in Figure 5.

Tundra will monitor the following parameters to assess the best timing for each individual horizontal well to be converted from primary production to water injection service.

- Measured reservoir pressures at start of and/or through primary production
- Fluid production rates and any changes in decline rate
- Any observed production interference effects with adjacent wells
- Pattern mass balance and/or oil recovery factor estimates
- Reservoir pressure relative to bubble point pressure

The above schedule allows for the proposed Ebor Unit No. 4 project to be developed equitably, efficiently, and moves the project to the best condition for the start of waterflood as quickly as possible. It also provides the Unit Operator flexibility to manage the reservoir conditions and response to help ensure maximum ultimate recovery of OOIP.

Secondary EOR Production Forecast

The proposed Ebor Unit No. 4 Secondary Waterflood oil production forecast over time is plotted on Figure 8. Total EOR recoverable volumes in the proposed Ebor Unit No. 4 project under Secondary WF has been estimated at 430.7 e^3m^3, resulting in a 12.7% overall RF of calculated Net OOIP.

An incremental 118.7 e^3m^3 of oil is forecast to be recovered under the proposed Unitization and Secondary EOR production scheme vs. the existing Primary Production method. This relates to an incremental 3.5 % recovery factor as a result of secondary EOR implementation.

Estimated Fracture Pressure

The estimated fracture gradient for the Lodgepole is 21 kPa/m based on DFIT ISIP data in the area. The horizontal wells in this area are ~790mTVD. Therefore, the estimated frac pressure would be 16.6MPa.

WATERFLOOD OPERATING STRATEGY

Water Source

The injection water for the proposed Ebor Unit No. 4 will be supplied from the existing Sinclair 3-4-8-29W1 battery source and injection water system. All existing injection water is obtained from the Lodgepole formation in the 102/16-32-7-29W1 licensed water source well. Lodgepole water from the 102/16-32 source well is pumped to the main Sinclair Units Water Plant at 3-4-8-29W1, filtered, and pumped up to injection system pressure. A diagram of the Sinclair water injection system is shown as Figure 10.

Produced water is not currently used for any water injection in the Tundra-operated Daly Sinclair Units and there are no current plans to use produced water as a source supply for Ebor Unit No. 4.

Injection Wells

The water injection wells for the proposed Ebor Unit No. 4 have been drilled, are currently producing and plans are in progress to re-configure the wells for downhole injection after approval for waterflood has been received (Figure 11). The horizontal injection wells have been stimulated by multiple hydraulic fracture treatments to obtain suitable injection. Tundra has extensive experience with horizontal fracturing in the area, and all jobs are rigorously programmed and monitored during execution. This helps ensure optimum placement of each fracture stage to prevent, or minimize, the potential for out-of-zone fracture growth and thereby limit the potential for future out-of-zone injection.

The new water injection well will be placed on injection after the pre-production period and approval to inject. Wellhead injection pressures will be maintained below the least value of either:

1. the area specific known and calculated fracture gradient, or
2. the licensed surface injection Maximum Allowable Pressure (MOP).

Tundra has a thorough understanding of area fracture gradients. A management program will be implemented to set and routinely review injection target rates and pressures vs. surface MOP and the known area formation fracture pressures.

All new water injection wells will be surface equipped with injection volume metering and rate/pressure control. An operating procedure for monitoring water injection volumes and meter balancing will also be utilized to monitor the entire system measurement and integrity on a daily basis.

The proposed Ebor Unit No. 4 horizontal water injection well rate is estimated to average 10 – 25 m^3 WPD, based on expected reservoir permeability and pressure.

Reservoir Pressure

No representative initial pressure surveys are available for the proposed Ebor Unit No. 4 project area in the Lodgepole producing zone. The extremely long shut-in and build-up times required to obtain a

possible representative reservoir pressures are economically prohibitive. Tundra will make all attempts to capture a reservoir pressure survey in the proposed horizontal injection wells during the completion of the wells and prior to injection or production.

Reservoir Pressure Management during Waterflood

Tundra expects to inject water for a minimum 2 – 4 year period to re-pressurize the reservoir due to cumulative primary production voidage and pressure depletion. Initial Voidage Replacement Ratio (VRR) is expected to be approximately 1.25 to 1.75 within the pattern during the fill up period. As the cumulative VRR approaches 1, target reservoir operating pressure for waterflood operations will be 75 – 90 % of original reservoir pressure.

Waterflood Surveillance and Optimization

Ebor Unit No. 4 EOR response and waterflood surveillance will consist of the following:

- Regular production well rate and WCT testing
- Daily water injection rate and pressure monitoring vs target
- Water injection rate / pressure / time vs cumulative injection plot
- Reservoir pressure surveys as required to establish pressure trends
- Pattern VRR
- Potential use of chemical tracers to track water injector / producer responses
- Use of some or all of: Water Oil Ratio (WOR) trends, Log WOR vs Cum Oil, Hydrocarbon Pore Volumes Injected, Conformance Plots

The above surveillance methods will provide an ever-increasing understanding of reservoir performance and provide data to continually control and optimize the Ebor Unit No. 4 waterflood operation. Controlling the waterflood operation will significantly reduce or eliminate the potential for out-of-zone injection, undesired channeling or water breakthrough, or out-of-Unit migration. The monitoring and surveillance will also provide early indicators of any such issues so that waterflood operations may be altered to maximize ultimate secondary reserves recovery from the proposed Ebor Unit No. 4.

Economic Limits

Under the current Primary recovery method, existing wells within the proposed Ebor Unit No. 4 will be deemed uneconomic when the net oil rate and net oil price revenue stream becomes less than the current producing operating costs. With any positive oil production response under the proposed

Secondary recovery method, the economic limit will be significantly pushed out into the future. The actual economic cut off point will then again be a function of net oil price, the magnitude and duration of production rate response to the waterflood, and then current operating costs. Waterflood projects generally become uneconomic to operate when Water Oil Ratios (WOR's) exceed 100.

WATER INJECTION FACILITIES

The Ebor Unit No. 4 waterflood operation will utilize the existing Tundra operated source well supply and water plant (WP) facilities located at 3-4-8-29 W1M Battery. Injection wells will be connected to the existing high pressure water pipeline system supplying other Tundra-operated Waterflood Units.

A complete description of all planned system design and operational practices to prevent corrosion related failures is shown on Figure 12.

NOTIFICATION OF MINERAL AND SURFACE RIGHTS OWNERS

Tundra will notify all mineral rights and surface rights owners of the proposed EOR project and formation of Ebor Unit No. 4. Copies of the Notices, and proof of service, to all surface rights owners will be forwarded to the Petroleum Branch when available to complete the Ebor Unit No. 4 Application.

Ebor Unit No. 4 Unitization, and execution of the formal Ebor Unit No. 4 Agreement by affected Mineral Owners, is expected during Q3 2020. Copies of same will be forwarded to the Petroleum Branch, when available, to complete the Ebor Unit No. 4 Application.

Should the Petroleum Branch have further questions or require more information, please contact Krista [redacted] 587.747.5370 or by email at krista.town@tundraoilandgas.com.

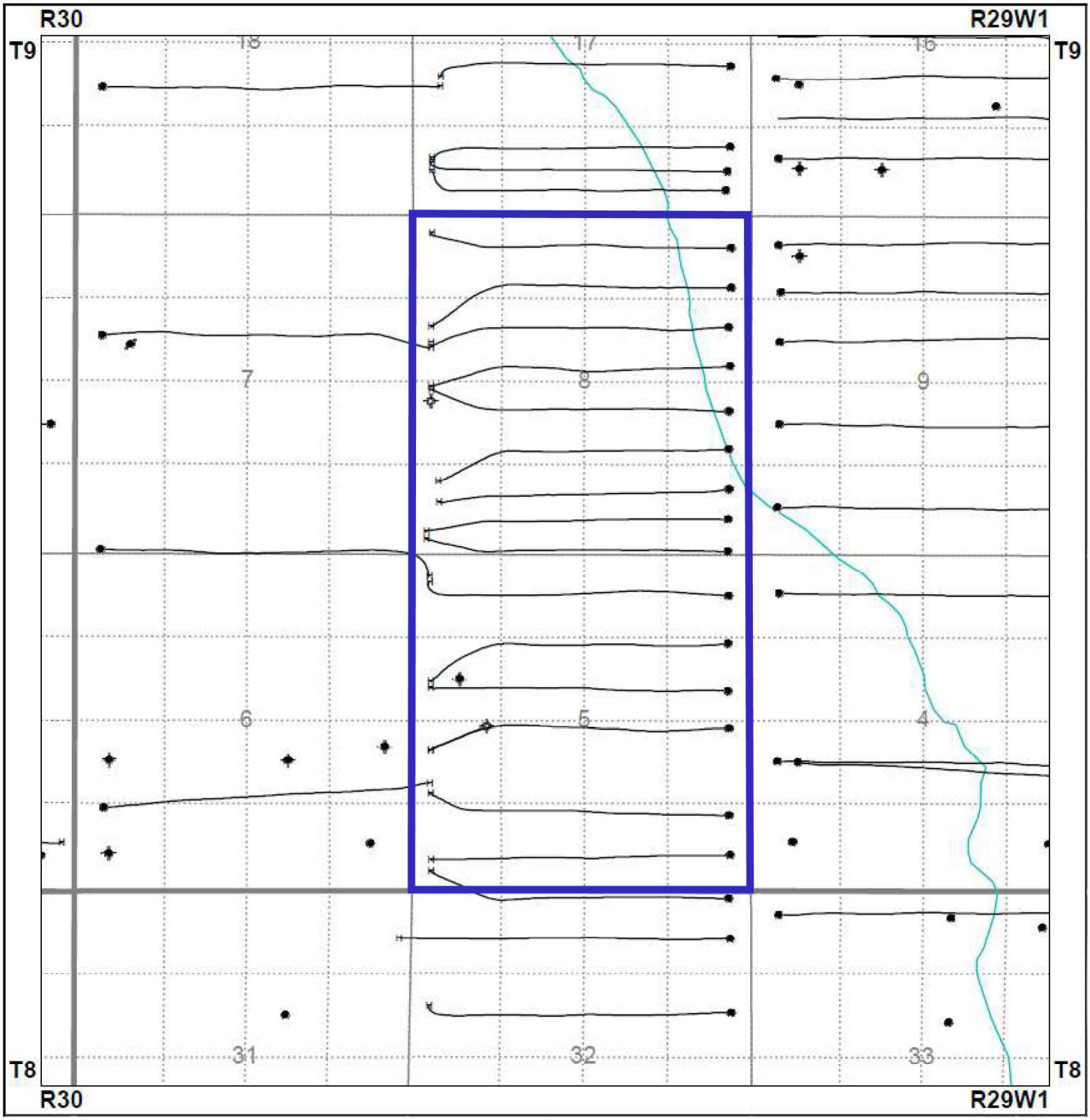
TUNDRA OIL & GAS LIMITED

Original Signed by Krista [redacted] July 15th, 2020, in Calgary, AB

Proposed Ebor Unit No. 4

Application for Enhanced Oil Recovery Waterflood Project

LIST OF APPENDICES



Appendix 1: Unit Outline

Center: 49.7240, -101.3859

Scale: 1:27,556

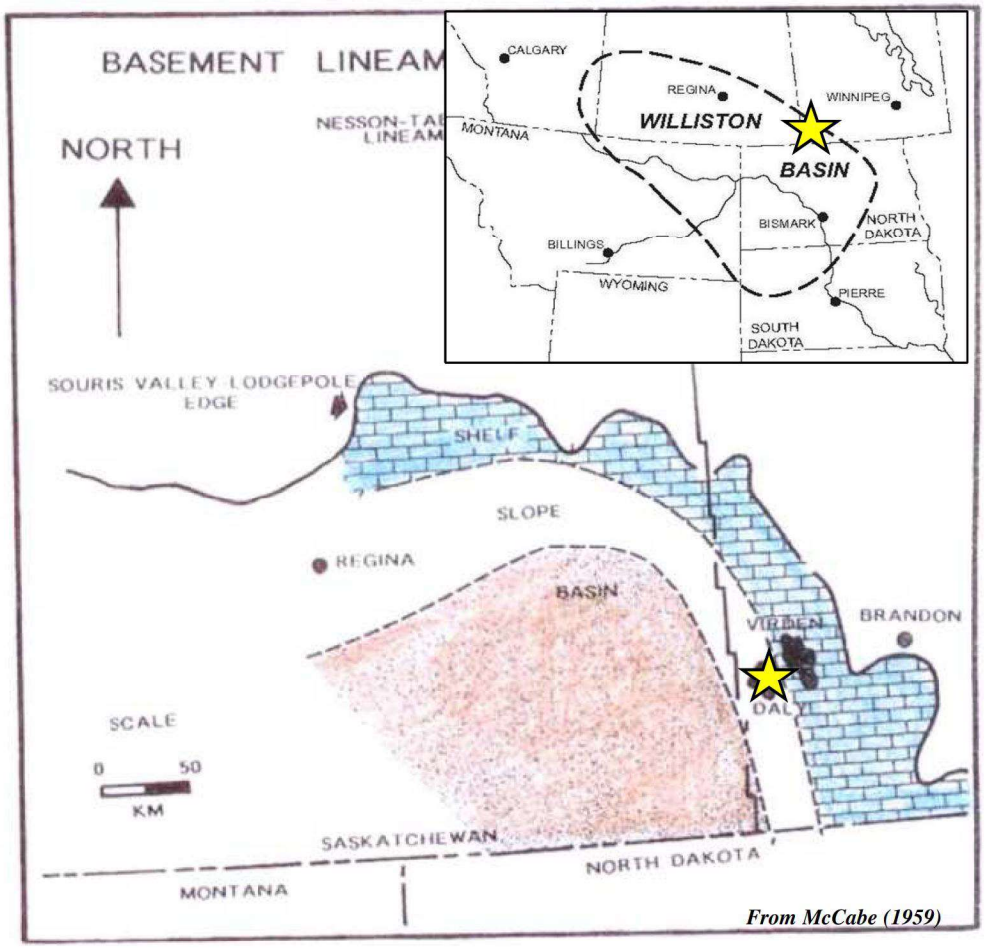
0 0.5 1 km

0 0.1 0.7 mi

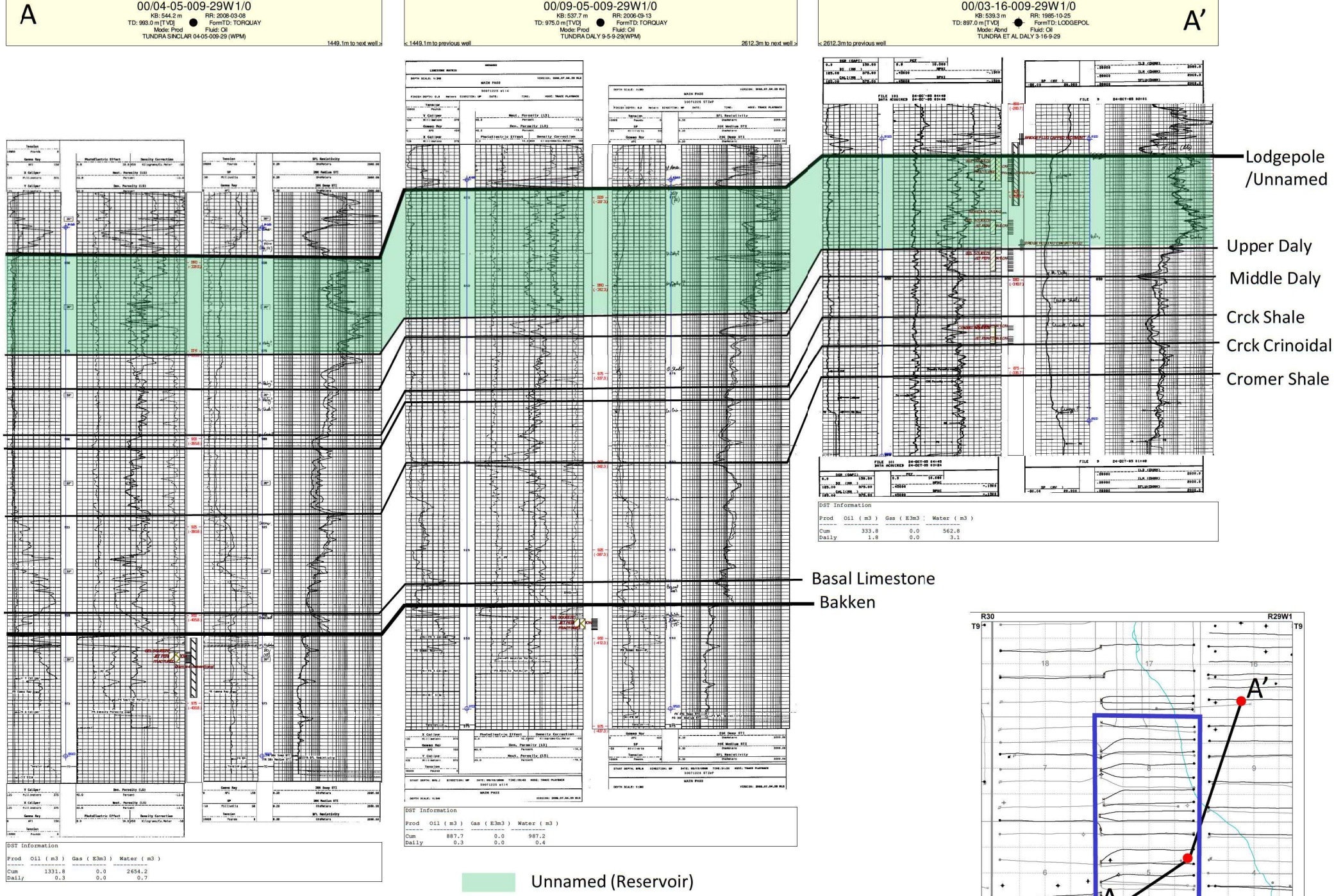
N NE E SE S SW W NW

Ebor Unit 4 Outline
Only Lodgepole wells are plotted.

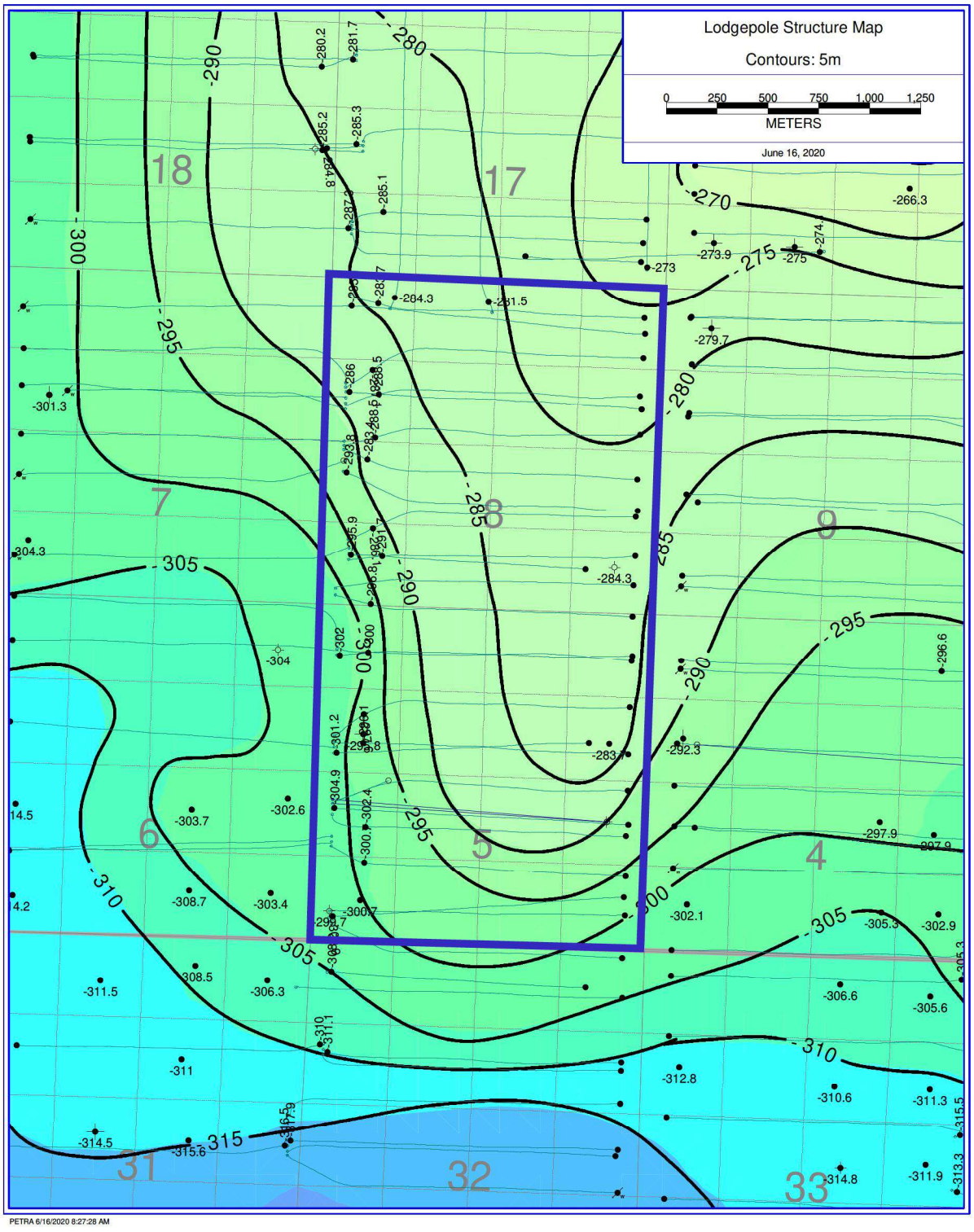
June 15, 2020



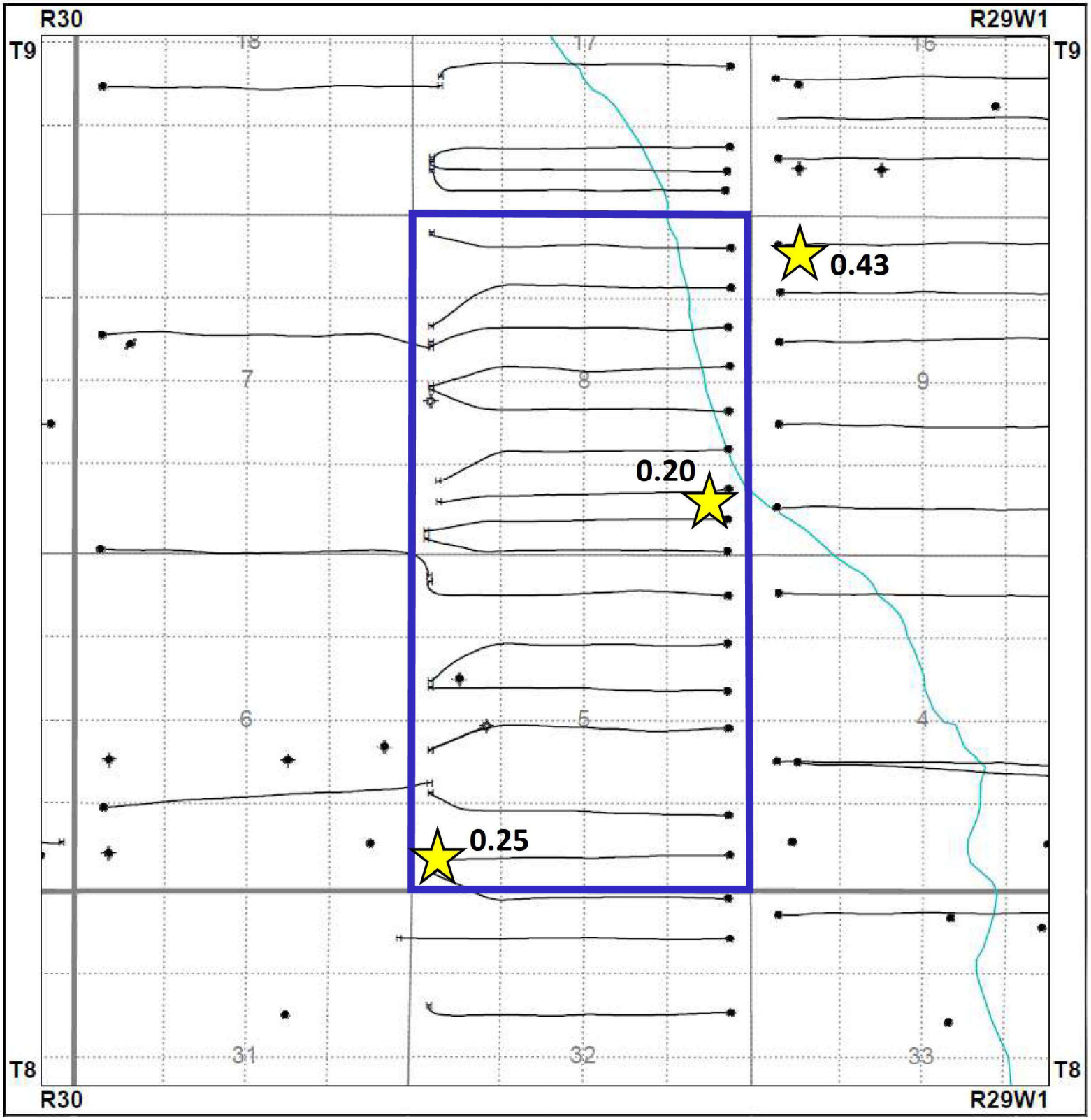
Appendix 2: Regional geological setting of the Lodgepole in the Daly area



Appendix 3: Structural Cross Section showing Lodgepole stratigraphy



Appendix 4: Lodgepole Structure Map (Contours: 5m)



Appendix 5: PDPK data points used for determining NGR value.
Value posted is the NGR using an average PDPK >0.5mD.
Average NGR ratio over the unit calculated to be 29.3%.

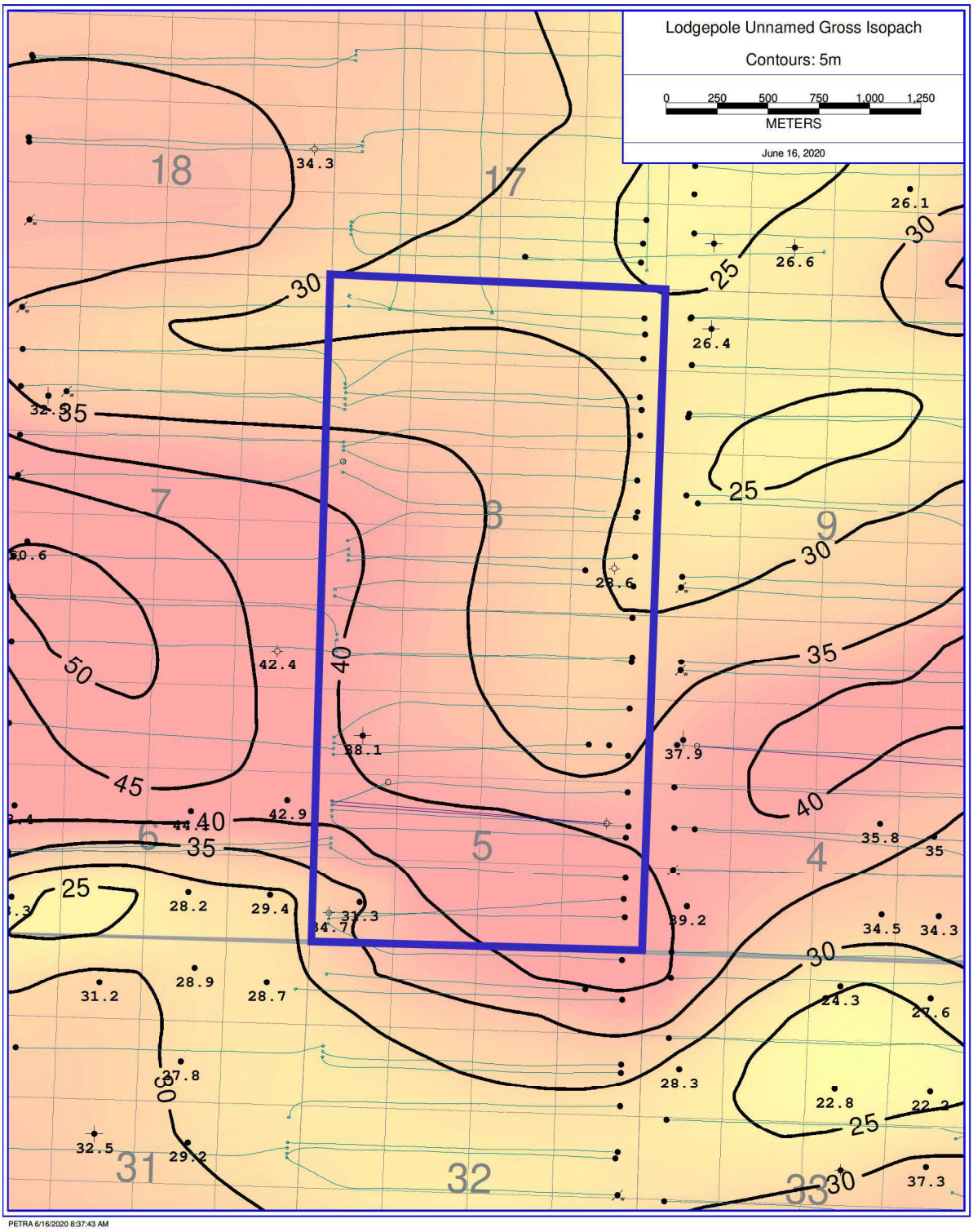
Center: 49.7240, -101.3859
Scale: 1:27,556
0 0.5 1 km
0 0.1 0.7 mi

N NE E SE S SW W NW

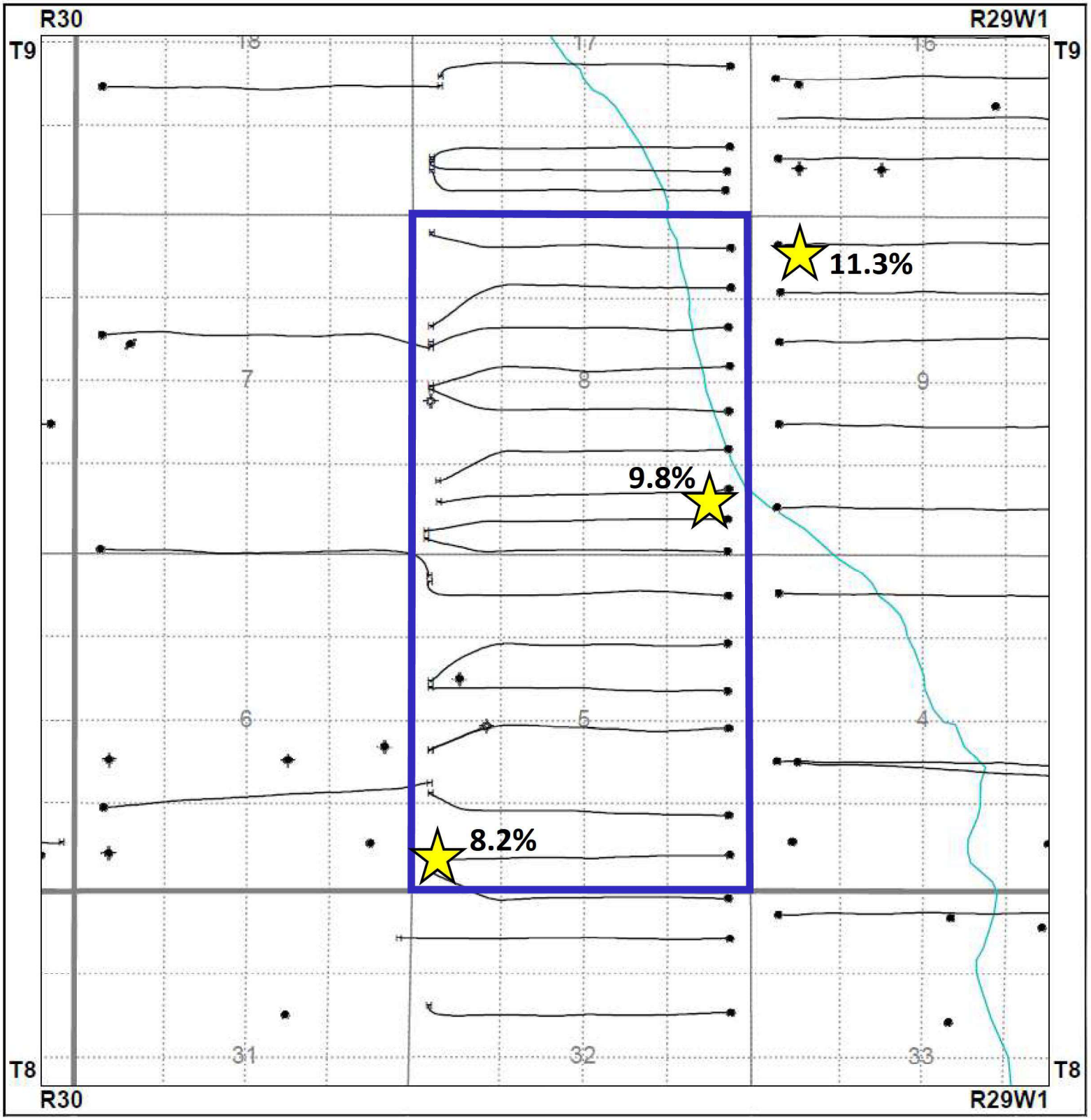
★ PDPK Data

Ebor Unit 4 Outline
Only Lodgepole wells are plotted.

June 15, 2020



Appendix 6: Lodgepole Unnamed Gross Isopach Map
(Contours: 5m)



Appendix 7: PDPK data points with average core porosity value posted using >0.5mD PDPK cutoff. Average core porosity over the unit calculated to be 10%.

Center: 49.7240, -101.3859
Scale: 1:27,556

0 0.5 1 km
0 0.1 0.7 mi

N
NE
E
SE
S
SW
W
NW

PDPK Data

Ebor Unit 4 Outline
Only Lodgepole wells are plotted.

June 15, 2020

Proposed Ebor Unit No. 4

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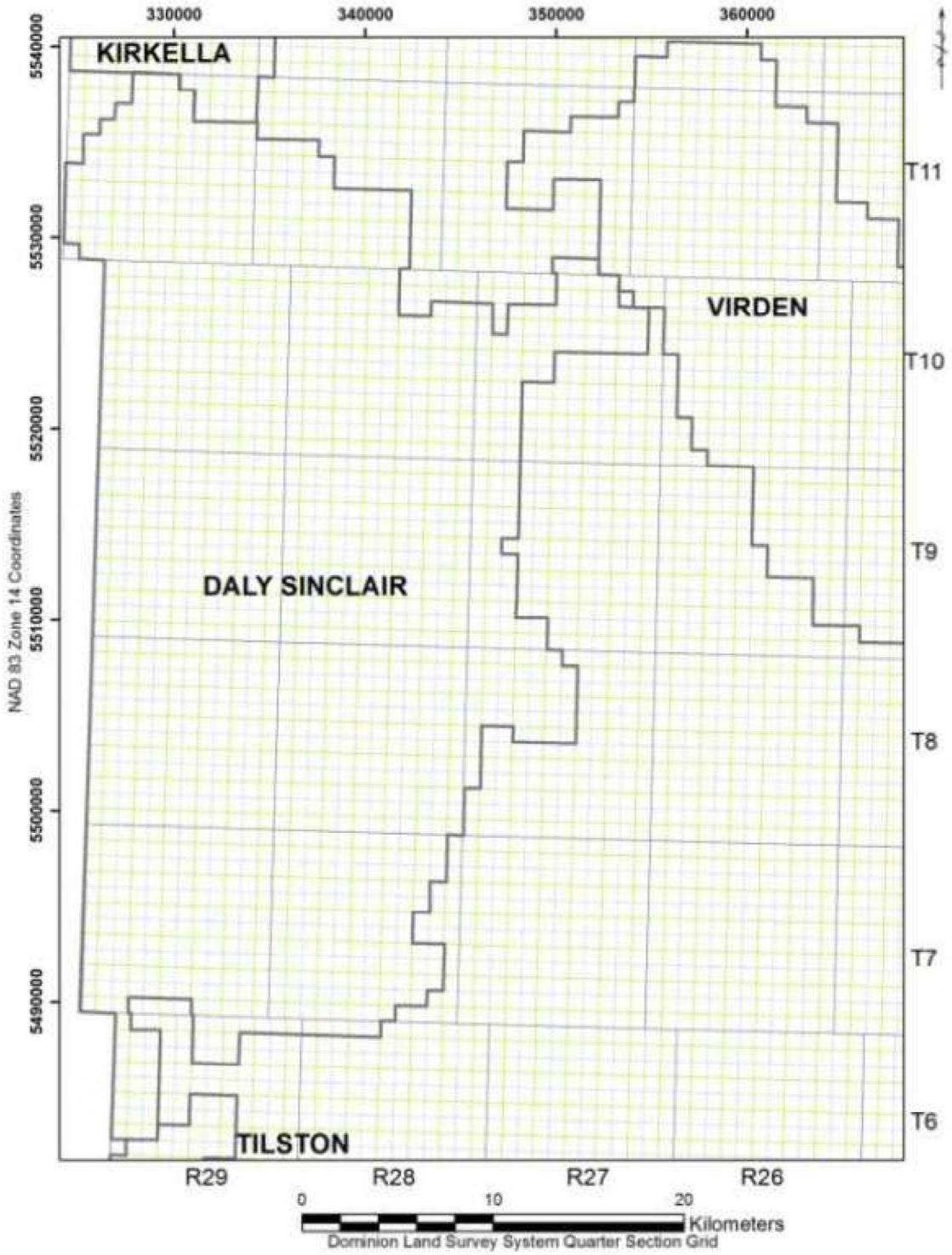
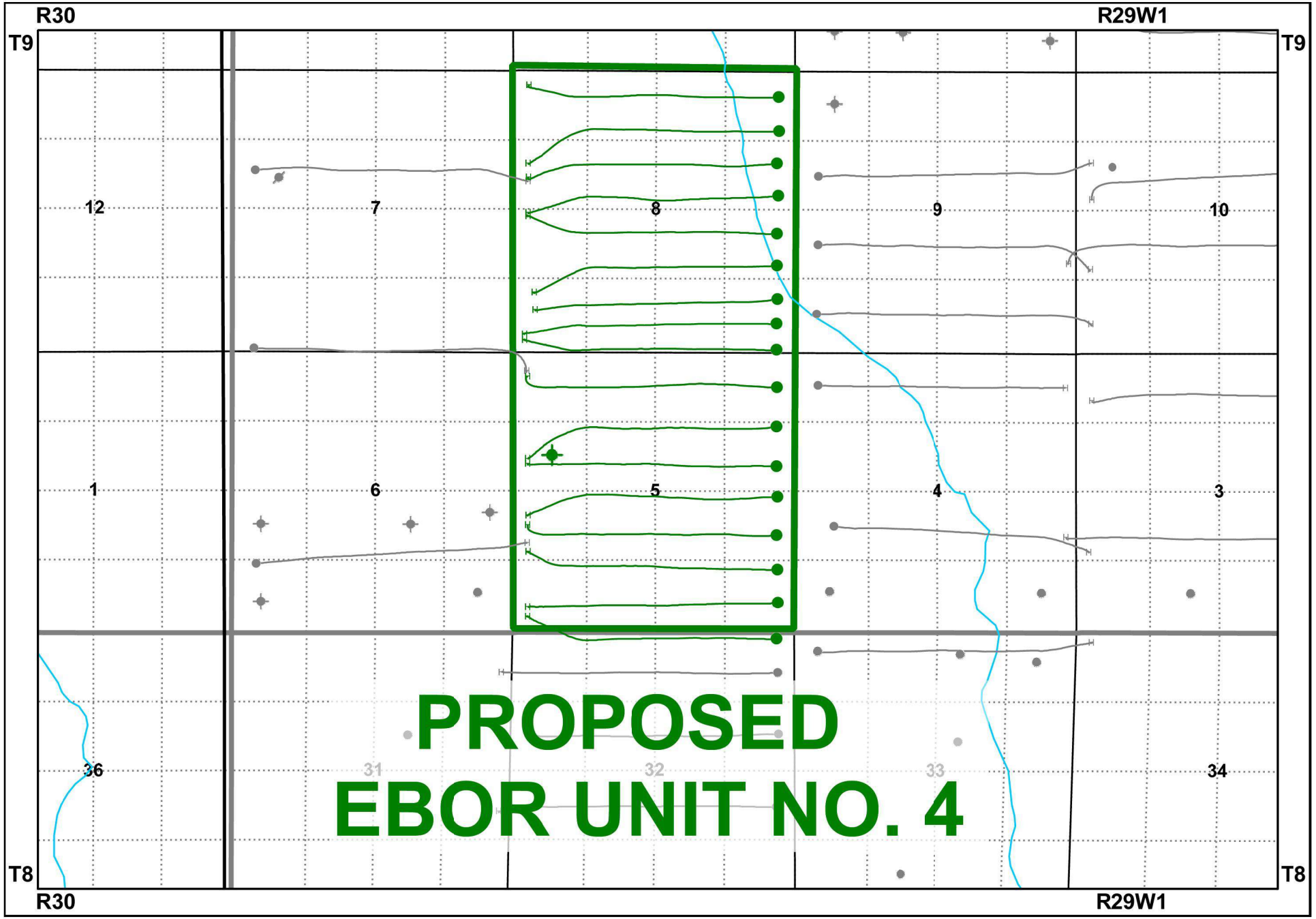


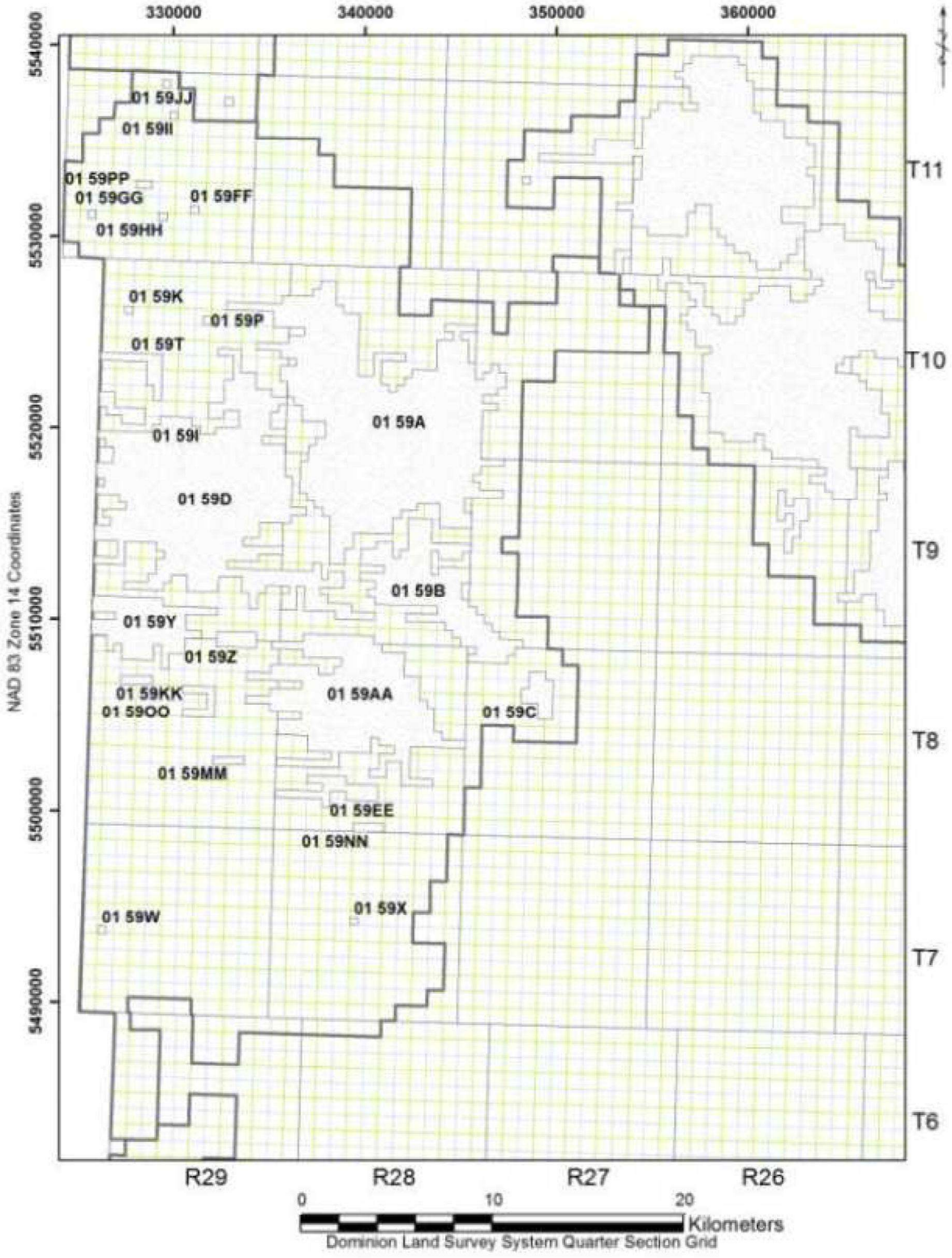
Figure 1 - Daly Sinclair (01)

Figure No. 2



PROPOSED UNIT AREA

Figure No. 3



Daly Sinclair Lodgepole Pools (01 59A, B, C, D, I, K, P, T, W, X, Y, Z, AA, EE, FF, GG, HH, II, JJ, KK, MM, NN, OO & PP)

Well Information as of 6/23/2020 - Group Well Report

Production Graph

Group:	ebor unit no. 4 well list.lwell	On Prod:	1986-03 to 2020-04	Cum Oil:	196278.6 m3
# of Wells:	18	Prod Form:	LODGEPOL; BAKKENM	Cum Gas:	0.0 E3m3
Fluid:	Oil	Field:	DALY (MB1)	Cum Wtr:	332515.9 m3
Mode:	Producing; Abandoned	Pool Code:	MB000159A	Cum Inj Oil:	0.0 m3
		Unit Code:		Cum Inj Gas:	0.0 E3m3
				Cum Inj Wtr:	0.0 m3

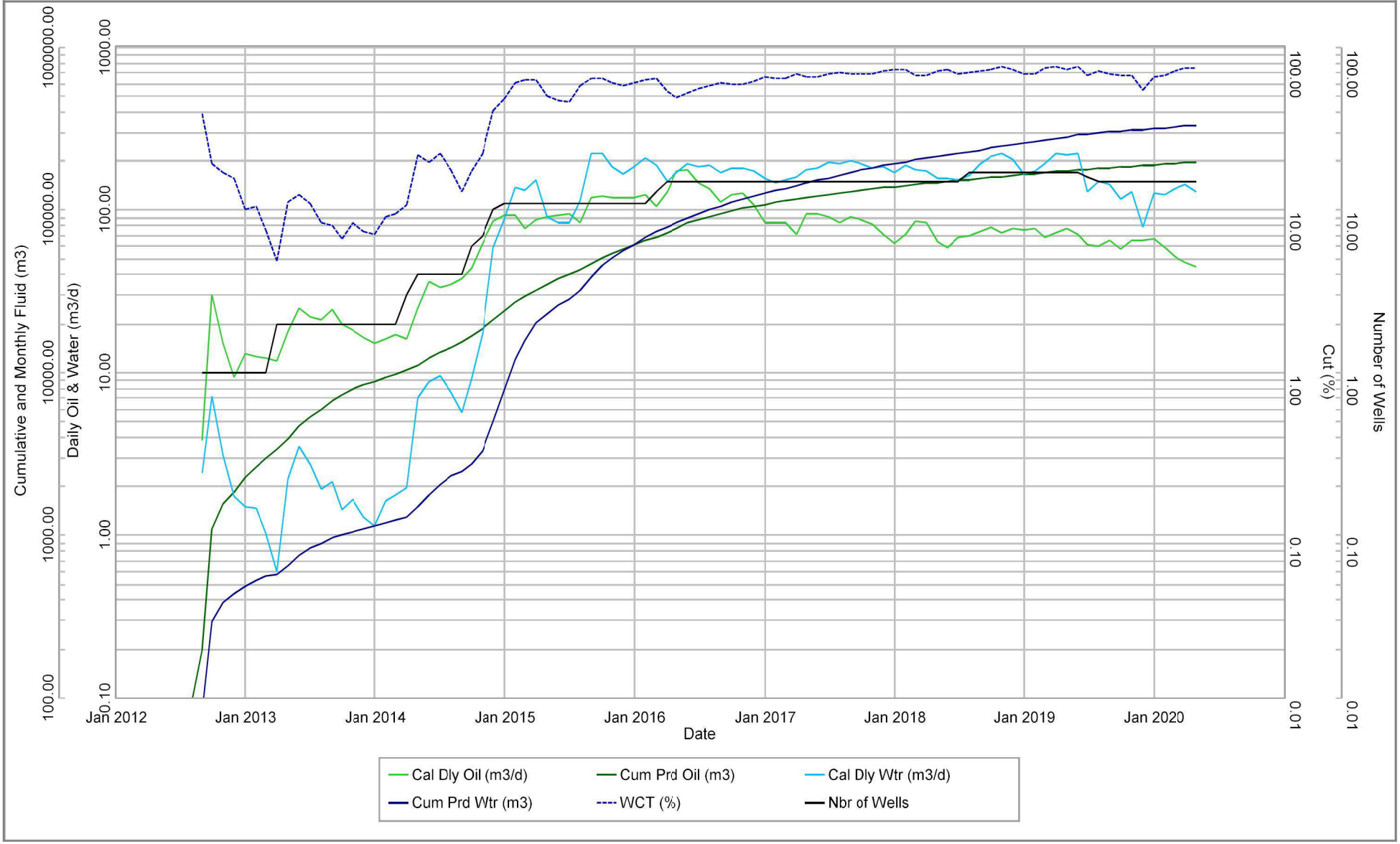


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Figure 5. Ebor Unit 4 Proposed Development Plan

Proposed Injector Conversion
103/16-08-009-29W1
103/09-08-009-29W1
103/08-08-009-29W1
103/16-05-009-29W1
104/09-05-009-29W1
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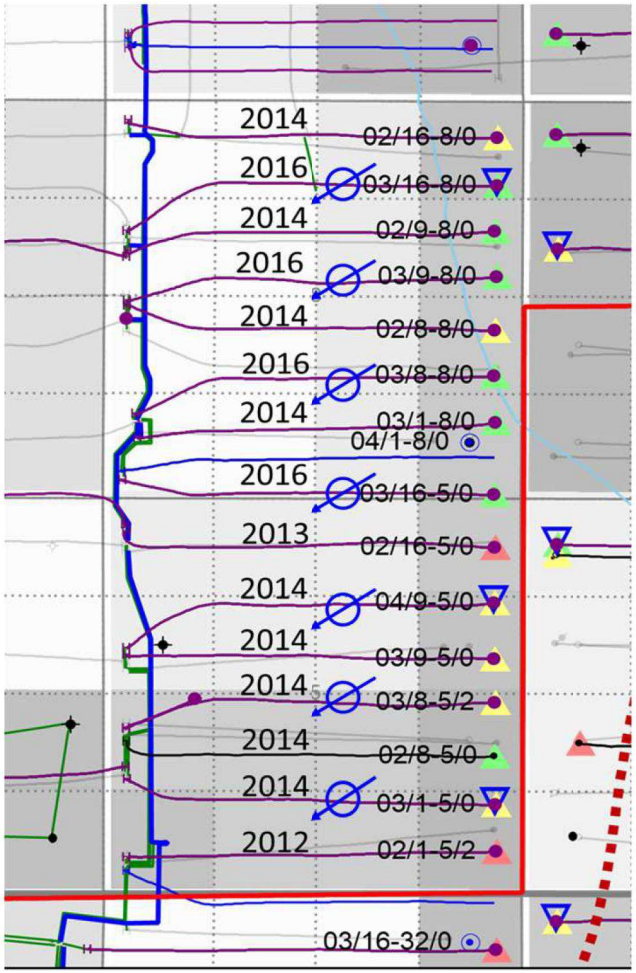
103/01-05-009-29W1



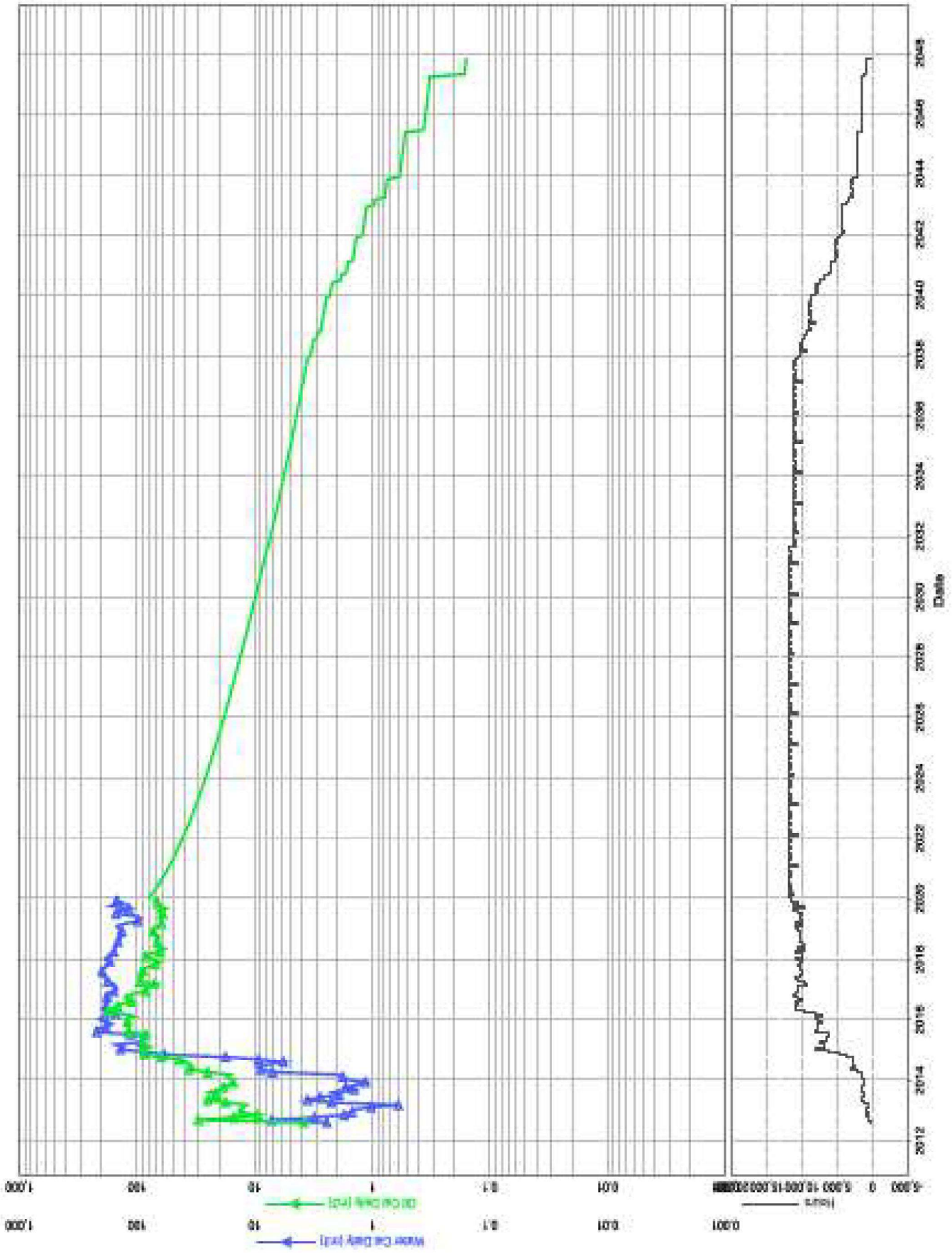


Figure No. 6 Primary Recovery - Rate vs Time

Figure No. 7 Primary Recovery - Rate vs Cum

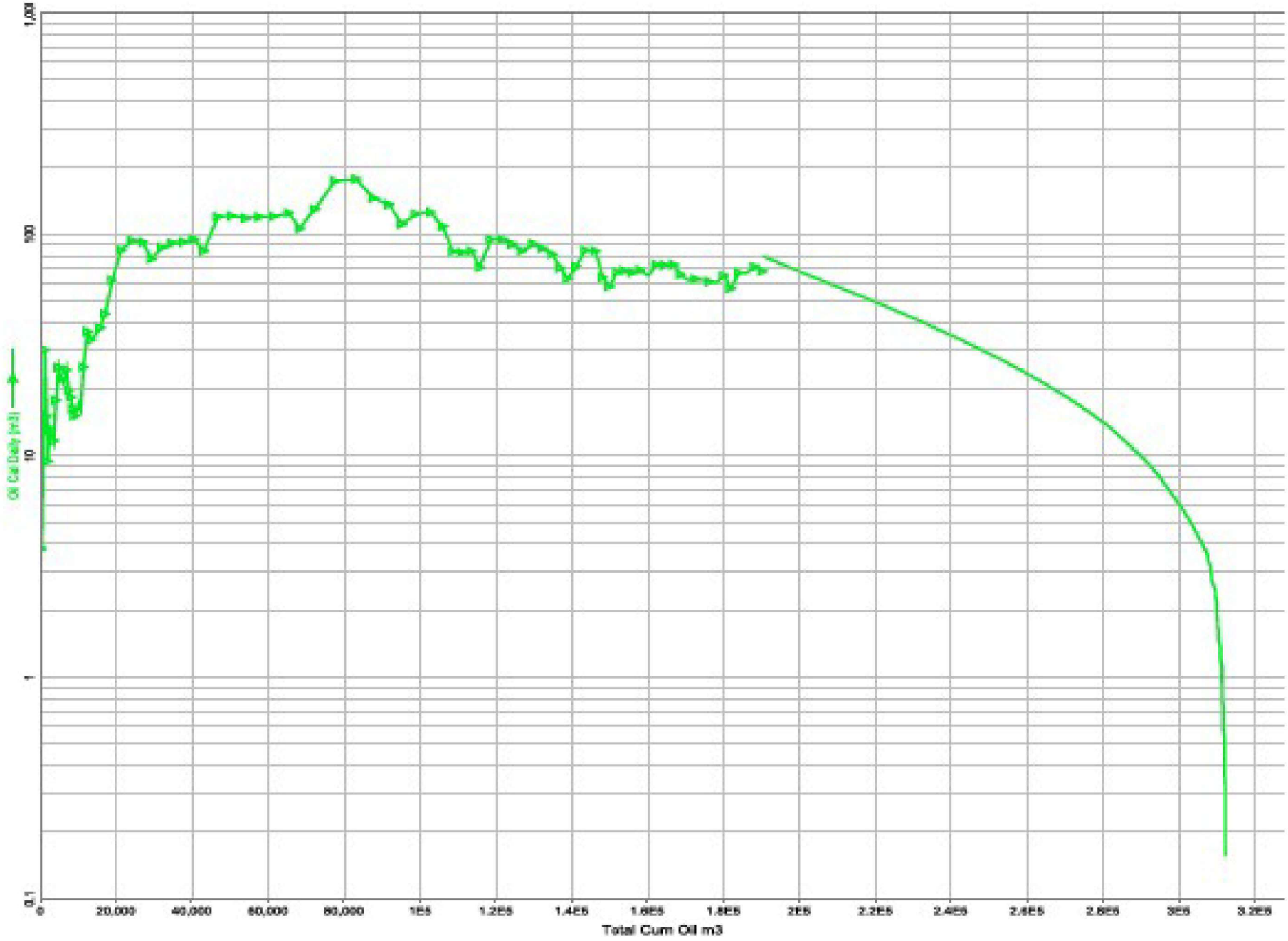


Figure No. 8 Primary + Secondary Recovery - Rate vs Time

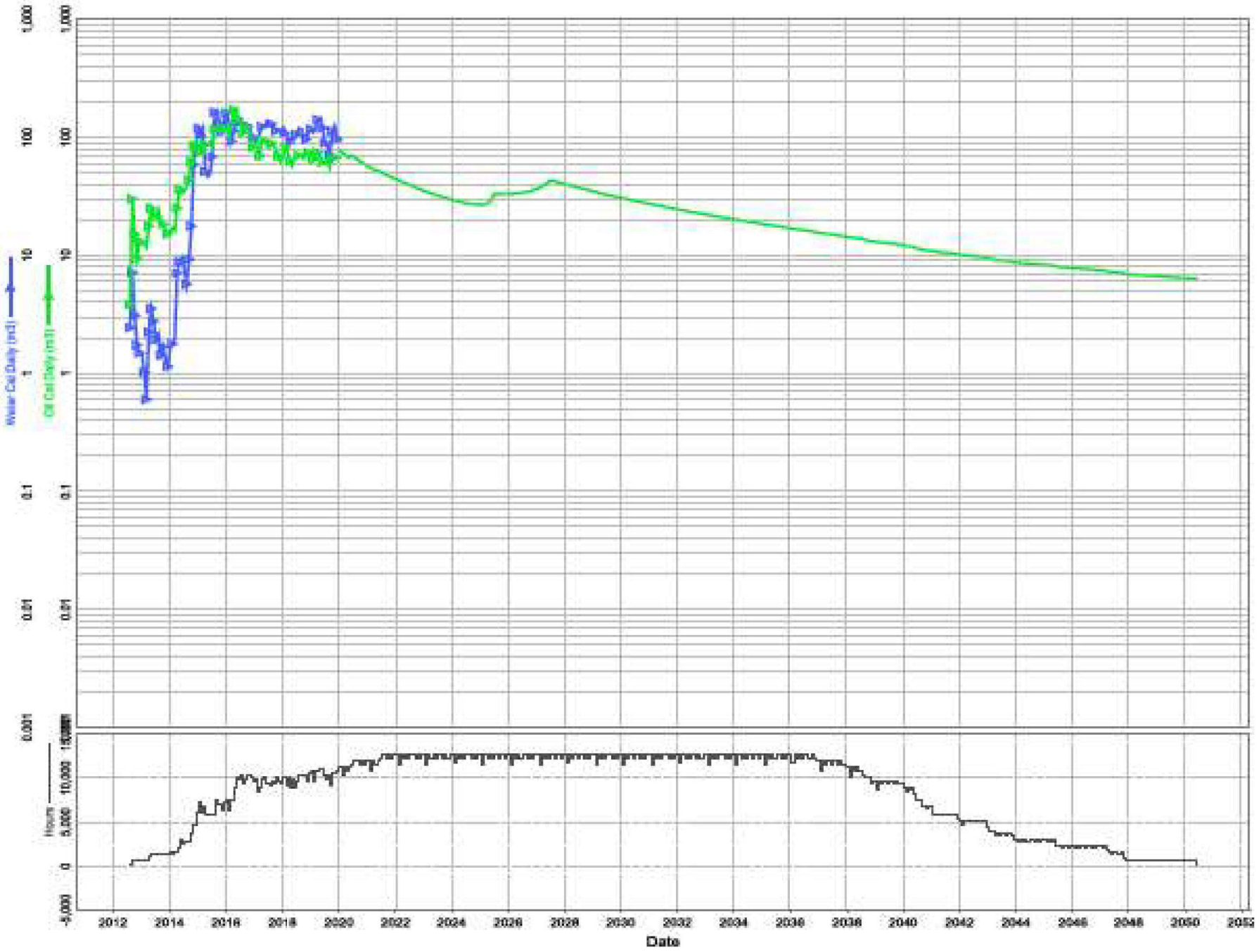


Figure No. 9 Primary + Secondary Recovery - Rate vs Cum

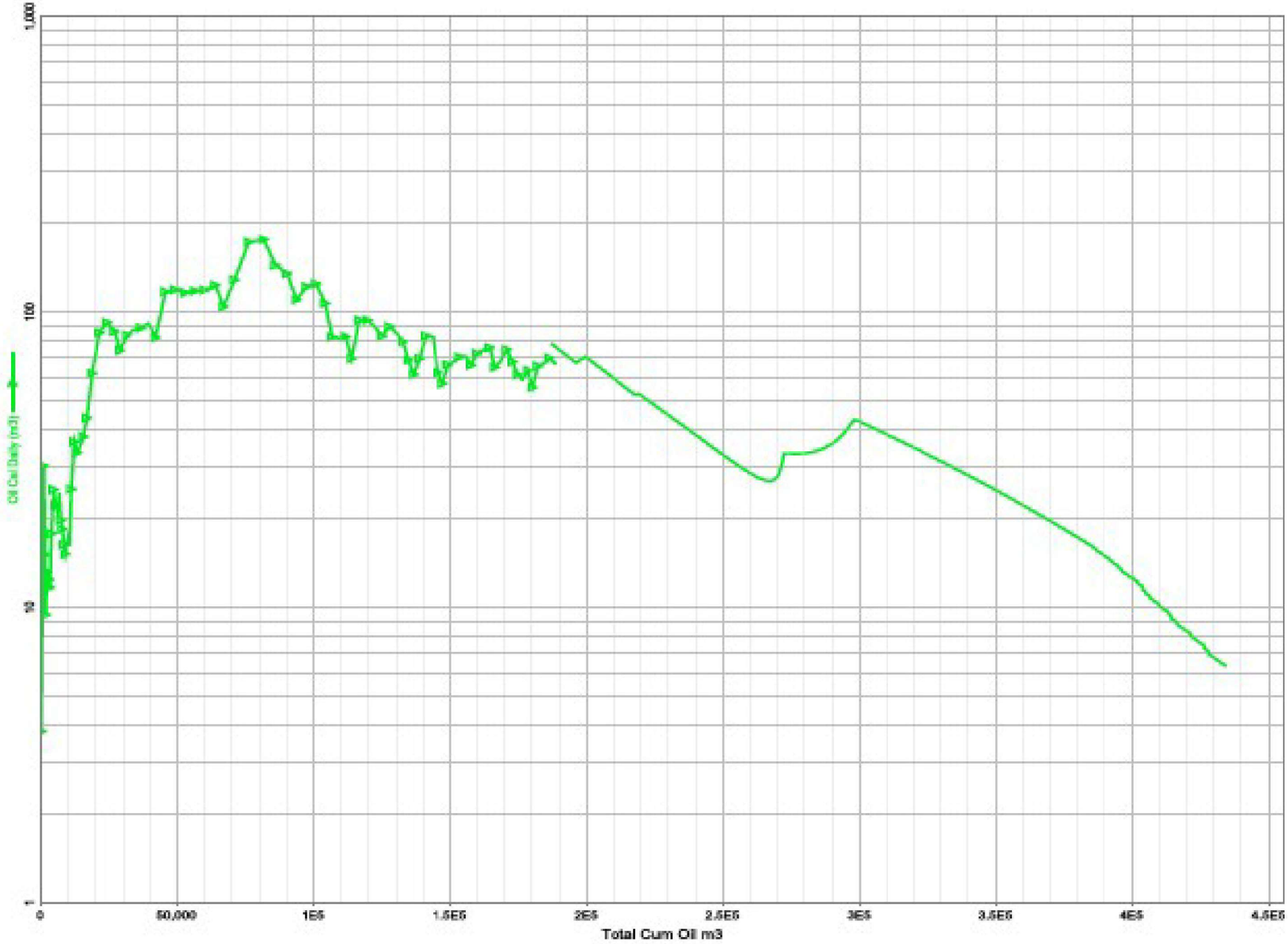
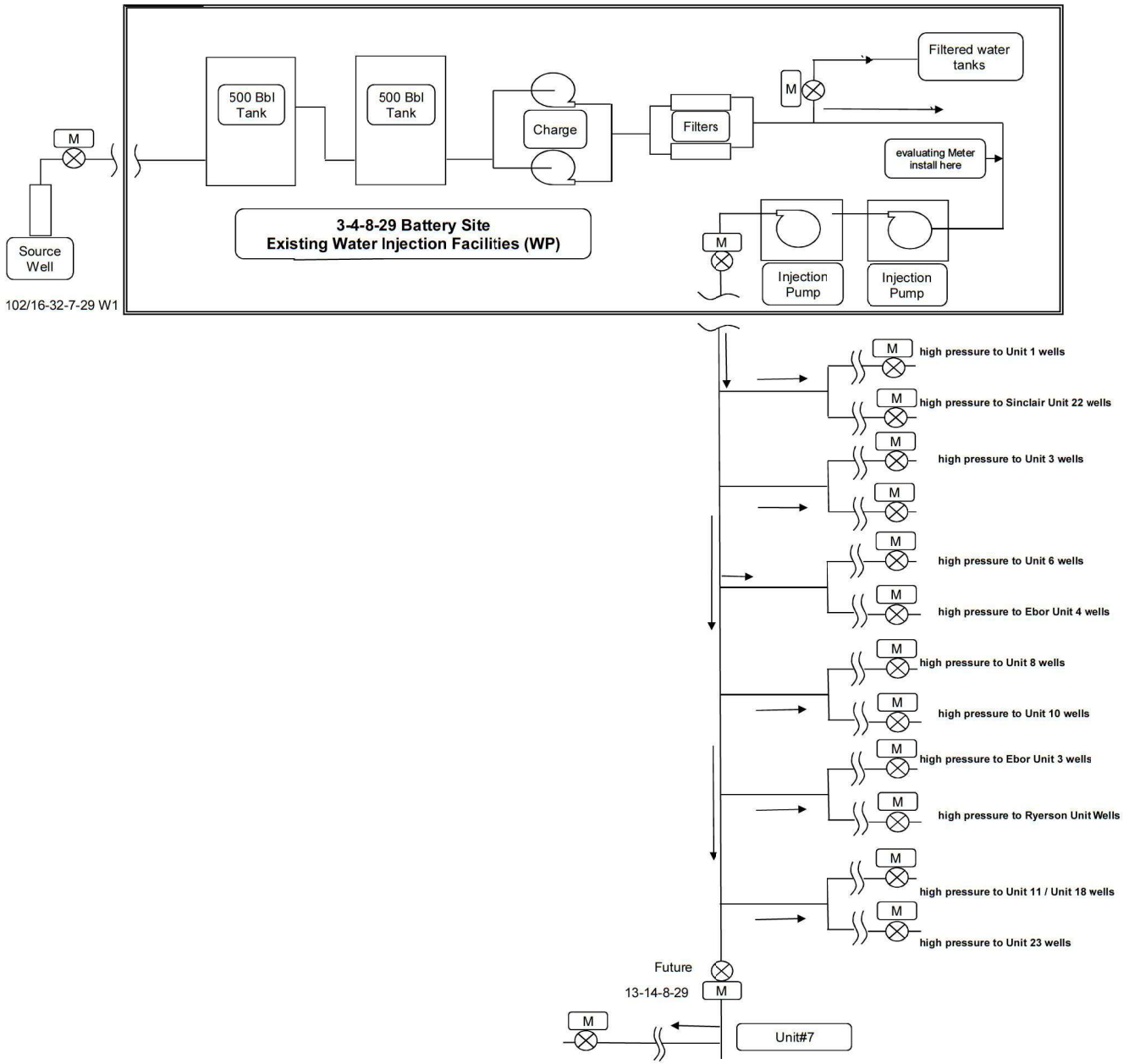


FIGURE 10

Sinclair Water Injection System



Tundra Oil And Gas Partnership

TYPICAL OPEN HOLE WATER INJECTION WELL (WIW) DOWNHOLE DIAGRAM

WELL NAME:	Tundra Ebor Unit No. 4 HZNTL Open Hole WIW				**WELL LICENCE:**	
Prepared by	WRJ	(average depths)		Date:	2012	
Elevations :						
KB [m]		KB to THF [m]			TD [m]	2400.0
GL [m]		CF (m)			PBTD [m]	
Current Perfs:	**Open Hole**			950.0	to	2400.0
Current Perfs:					to	
KOP:	700 m MD		Total Interval		to	

Tubulars	**Size [mm]**	**Wt - Kg/m**	**Grade**	**Landing Depth [mKB]**		
Surface Casing	244.5	48.06	H-40 - ST&C	Surface	to	140.0
Intermed Csg (if run)	177.8	34.23 & 29.76	J-55 - LT&C	Surface	to	950.0
Open Hole Latera	none	none	none	950.0	to	2400.0
Tubing	60.3 or 73.0 - TK-99	6.99 or 9.67	J-55	Surface	to	940.0

Date of Tubing Installation:

Item	Description	K.B.--Tbg. Flg.	Length 0.00	Top @ m KB
	Corrosion Protected ENC Coated Packer (set within 15 m of Intermed Csg shoe)			
	60.3 mm or 73 mm TK-99 Internally Coated Tubing			
	TK-99 Internally Coated Tubing Pup Jt			
	Coated Split Dognut			
	Annular space above injection packer filled with inhibited fresh water			
	Bottom of Tubing mKB			

Rod String :

Date of Rod Installation:

Bottomhole Pump:

Directions:

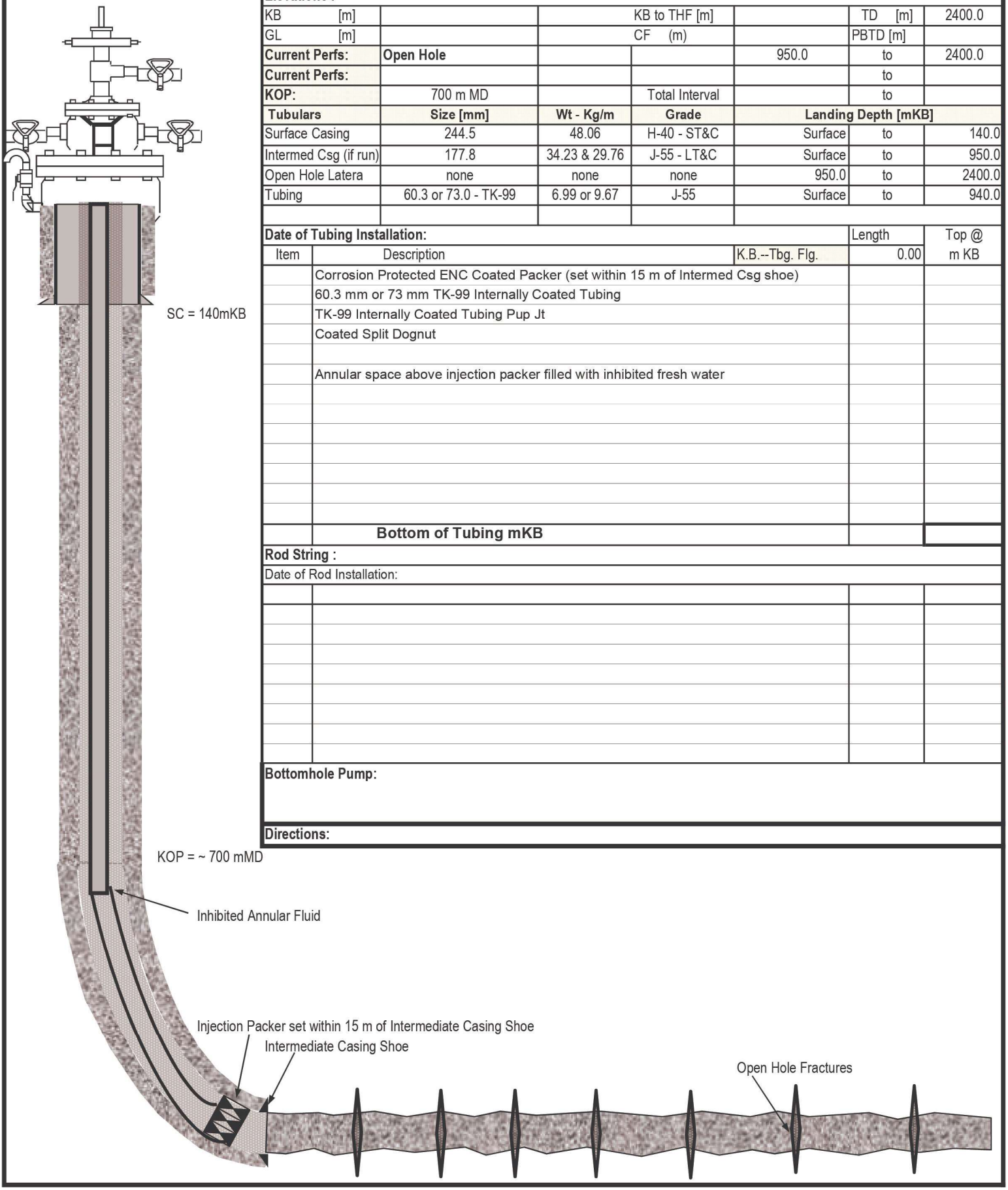


Figure 12 – Corrosion Controls

Source Well

- Located at 02-25-010-29
- Continuous downhole corrosion inhibition
- Downhole scale inhibitor injection
- Corrosion resistant valves and internally coated surface piping
- Biocide injected at source well for entire system

Pipelines

- The water source line will be composite from source well to 12-24-10-29 water plant.
- Injection lines will be a mix of 2000psi high pressure fiberglass and composite pipe.
- Producing lines existing as per original flowline licenses.

Facilities

12-24-10-29 Water Plant

- Plant piping – 600 ANSI stainless steel schedule 80 pipe, fiberglass or internally coated
- Filtration – Stainless steel bodies, PVC piping or stainless steel piping
- Pumping – Ceramic plungers, stainless disc valves
- Tanks – Fiberglass shell, corrosion resistant valves

Injection Wellhead / Surface Piping

- Corrosion resistant valves and stainless steel and/or internally coated steel surface piping

Injection Wells

- Casing cathodic protection where required
- Wetted surfaces coated downhole packer
- Corrosion inhibited water in the annulus between tubing / casing
- Internally coated tubing surface to packer
- Surface freeze protection of annular fluid
- Corrosion resistant master valve
- Corrosion resistant pipeline valve
- Scale inhibition (pellets & injected post pump at battery)

Producing Wells

- Downhole corrosion inhibitor, either batch or daily injection, as needed.
- Scale inhibitor treatment daily injection as required for horizontal wells.
- Casing cathodic protection where required.

Proposed Ebor Unit No. 4

Application for Enhanced Oil Recovery Waterflood Project

List of Tables

TABLE NO. 2: TRACT FACTOR CALCULATIONS FOR PROPOSED EBOR LODGEPOLE UNIT NO. 4

TRACT FACTORS BASED ON OIL-IN-PLACE (OOIP) - CUMULATIVE PRODUCTION TO APRIL 2020

LSD-SEC	*TWP-RGE*	*UWI*	*OOIP (m3)*	*Hz Allocated Cum Prodn Feb 2020 (m3)*	*Vertical Cum Prodn Feb 2020 (m3)*	*OOIP - Cum Oil Prodn (m3)*	*Tract Factor (%)*	*UWI*
01-05	009-29W1M	01-05-009-29W1M	126,181	4,748.0	0.0	121,433	3.798909415	01-05-009-29W1M
02-05	009-29W1M	02-05-009-29W1M	127,092	4,946.0	0.0	122,146	3.821206306	02-05-009-29W1M
03-05	009-29W1M	03-05-009-29W1M	120,956	4,896.9	0.0	116,059	3.630787742	03-05-009-29W1M
04-05	009-29W1M	04-05-009-29W1M	107,748	2,855.4	0.0	104,893	3.281456345	04-05-009-29W1M
05-05	009-29W1M	05-05-009-29W1M	121,207	6,540.9	0.0	114,666	3.587206160	05-05-009-29W1M
06-05	009-29W1M	06-05-009-29W1M	121,778	10,287.1	0.0	111,491	3.487881568	06-05-009-29W1M
07-05	009-29W1M	07-05-009-29W1M	120,554	10,805.0	0.0	109,749	3.433376942	07-05-009-29W1M
08-05	009-29W1M	08-05-009-29W1M	117,393	10,042.8	0.0	107,350	3.358326464	08-05-009-29W1M
09-05	009-29W1M	09-05-009-29W1M	102,234	8,982.7	0.0	93,251	2.917256890	09-05-009-29W1M
10-05	009-29W1M	10-05-009-29W1M	104,538	9,546.3	0.0	94,992	2.971728451	10-05-009-29W1M
11-05	009-29W1M	11-05-009-29W1M	111,518	10,290.5	0.0	101,227	3.166781668	11-05-009-29W1M
12-05	009-29W1M	12-05-009-29W1M	117,926	6,164.0	80.9	111,681	3.493813961	12-05-009-29W1M
13-05	009-29W1M	13-05-009-29W1M	117,350	3,570.1	0.0	113,780	3.559488126	13-05-009-29W1M
14-05	009-29W1M	14-05-009-29W1M	107,876	6,500.5	0.0	101,375	3.171409968	14-05-009-29W1M
15-05	009-29W1M	15-05-009-29W1M	99,234	6,491.5	0.0	92,743	2.901355842	15-05-009-29W1M
16-05	009-29W1M	16-05-009-29W1M	95,127	6,212.1	0.0	88,915	2.781611995	16-05-009-29W1M
01-08	009-29W1M	01-08-009-29W1M	90,236	6,160.7	0.0	84,075	2.630193659	01-08-009-29W1M
02-08	009-29W1M	02-08-009-29W1M	99,015	6,694.8	0.0	92,320	2.888123445	02-08-009-29W1M
03-08	009-29W1M	03-08-009-29W1M	109,051	6,723.0	0.0	102,328	3.201210648	03-08-009-29W1M
04-08	009-29W1M	04-08-009-29W1M	119,956	3,827.7	0.0	116,128	3.632937560	04-08-009-29W1M
05-08	009-29W1M	05-08-009-29W1M	114,423	3,974.9	0.0	110,448	3.455239266	05-08-009-29W1M
06-08	009-29W1M	06-08-009-29W1M	107,893	6,339.8	0.0	101,553	3.176982583	06-08-009-29W1M
07-08	009-29W1M	07-08-009-29W1M	100,467	6,477.0	0.0	93,990	2.940364406	07-08-009-29W1M
08-08	009-29W1M	08-08-009-29W1M	90,567	5,916.7	0.0	84,650	2.648186210	08-08-009-29W1M
09-08	009-29W1M	09-08-009-29W1M	90,401	5,675.4	0.0	84,726	2.650551488	09-08-009-29W1M
10-08	009-29W1M	10-08-009-29W1M	97,530	5,857.7	0.0	91,672	2.867858327	10-08-009-29W1M
11-08	009-29W1M	11-08-009-29W1M	99,933	5,863.3	0.0	94,069	2.942857768	11-08-009-29W1M
12-08	009-29W1M	12-08-009-29W1M	100,463	3,970.4	0.0	96,493	3.018678172	12-08-009-29W1M
13-08	009-29W1M	13-08-009-29W1M	90,301	2,333.0	0.0	87,968	2.751997623	13-08-009-29W1M
14-08	009-29W1M	14-08-009-29W1M	90,696	4,168.8	0.0	86,528	2.706921577	14-08-009-29W1M
15-08	009-29W1M	15-08-009-29W1M	89,134	4,073.3	0.0	85,060	2.661018549	15-08-009-29W1M
16-08	009-29W1M	16-08-009-29W1M	82,635	3,863.8	0.0	78,771	2.464280876	16-08-009-29W1M
			3,391,411	**194,800.1**	**80.9**	**3,196,530**	**100.000000000**	

TABLE NO. 3: WELL LIST AND STATUS

UWI	License Number	Type	Pool Name	Producing Zone	Mode	On Production Date	Prod Date	Cal Dly Oil (m3/d)	Monthly Oil (m3)	Cum Prd Oil (m3)	Cal Dly Water (m3/d)	Monthly Water (m3)	Cum Prd Water (m3)	WCT (%)
103/16-32-008-29W1/0	010936	Horizontal	LODGEPOLE A	LODGEPOL	Producing	7/31/2018	May-2019	2.31	71.70	810.30	76.83	2381.60	14557.20	97.08
102/01-05-009-29W1/2	008761	Horizontal	LODGEPOLE A	LODGEPOL	Producing	8/29/2012	Apr-2020	1.90	57.00	14962.10	0.46	13.90	1683.20	19.61
103/01-05-009-29W1/0	010102	Horizontal	LODGEPOLE A	LODGEPOL	Producing	12/29/2014	Apr-2020	1.63	49.00	3335.80	55.63	1668.80	97761.20	97.15
102/08-05-009-29W1/0	009765	Horizontal	LODGEPOLE A	BAKKENM	Producing	9/30/2014	Apr-2020	4.44	133.30	17101.60	8.06	241.80	10243.80	64.46
103/08-05-009-29W1/2	010072	Horizontal	LODGEPOLE A	LODGEPOL	Producing	11/30/2014	Apr-2020	8.24	247.20	28626.90	27.19	815.60	53116.80	76.74
103/09-05-009-29W1/0	009793	Horizontal	LODGEPOLE A	LODGEPOL	Producing	11/30/2014	Apr-2020	0.77	23.10	19084.50	7.93	237.90	32474.20	91.15
104/09-05-009-29W1/0	010073	Horizontal	LODGEPOLE A	LODGEPOL	Producing	11/30/2014	Apr-2020	3.59	107.70	9861.50	8.23	246.80	30433.80	69.62
100/12-05-009-29W1/0	003858	Vertical	LODGEPOLE A	LODGEPOL	Abandoned	3/31/1986	Sep-1987	0.11	3.20	80.90	0.02	0.60	3.30	15.79
102/16-05-009-29W1/0	009209	Horizontal	LODGEPOLE A	LODGEPOL	Producing	3/31/2013	Apr-2020	1.03	30.80	13155.90	0.19	5.80	1821.70	15.85
103/16-05-009-29W1/0	010508	Horizontal	LODGEPOLE A	LODGEPOL	Producing	2/29/2016	Apr-2020	4.48	134.30	13789.00	0.42	12.50	2063.50	8.51
103/01-08-009-29W1/0	009763	Horizontal	LODGEPOLE A	LODGEPOL	Producing	4/17/2014	Apr-2020	2.51	75.20	14289.90	0.20	6.10	2618.20	7.50
104/01-08-009-29W1/0	010935	Horizontal	LODGEPOLE A	LODGEPOL	Producing	7/19/2018	Jun-2019	0.38	11.30	1309.30	30.35	910.40	8580.20	98.77
102/08-08-009-29W1/0	010002	Horizontal	LODGEPOLE A	LODGEPOL	Producing	9/30/2014	Apr-2020	4.15	124.60	16003.20	0.38	11.40	1910.50	8.38
103/08-08-009-29W1/0	010509	Horizontal	LODGEPOLE A	LODGEPOL	Producing	2/29/2016	Apr-2020	1.92	57.70	6544.90	0.18	5.30	656.80	8.41
102/09-08-009-29W1/0	009764	Horizontal	LODGEPOLE A	LODGEPOL	Producing	3/31/2014	Apr-2020	1.68	50.30	11810.30	0.10	2.90	2245.20	5.45
103/09-08-009-29W1/0	010510	Horizontal	LODGEPOLE A	LODGEPOL	Producing	3/31/2016	Apr-2020	3.13	93.80	8916.40	0.25	7.60	1028.60	7.50
102/16-08-009-29W1/0	010000	Horizontal	LODGEPOLE A	LODGEPOL	Producing	10/31/2014	Apr-2020	1.82	54.70	8518.30	19.60	587.90	70176.30	91.49
103/16-08-009-29W1/0	010511	Horizontal	LODGEPOLE A	LODGEPOL	Producing	3/31/2016	Apr-2020	3.25	97.50	8077.80	0.21	6.30	1141.40	6.07
										196278.60			**332515.90**	

TABLE NO. 4 - OOIP Calculation

LSD	Area (m2)	Avg Gross Isopach (m)	Net Isopach (m)	OOIP (m3)	OOIP (bbls)
1-5-9-29W1	161236	42.0	12.3	126,181	793,680
2-5-9-29W1	161301	42.3	12.4	127,092	799,409
3-5-9-29W1	161393	40.2	11.8	120,956	760,814
4-5-9-29W1	161453	35.8	10.5	107,748	677,736
5-5-9-29W1	161499	40.3	11.8	121,207	762,392
6-5-9-29W1	161439	40.5	11.9	121,778	765,986
7-5-9-29W1	161347	40.1	11.7	120,554	758,284
8-5-9-29W1	161282	39.0	11.4	117,393	738,400
9-5-9-29W1	161325	34.0	10.0	102,234	643,050
10-5-9-29W1	161388	34.7	10.2	104,538	657,547
11-5-9-29W1	161482	37.0	10.9	111,518	701,446
12-5-9-29W1	161544	39.2	11.5	117,926	741,753
13-5-9-29W1	161590	38.9	11.4	117,350	738,133
14-5-9-29W1	161527	35.8	10.5	107,876	678,538
15-5-9-29W1	161434	33.0	9.7	99,234	624,183
16-5-9-29W1	161371	31.6	9.3	95,127	598,350
1-8-9-29W1	161993	29.9	8.8	90,236	567,582
2-8-9-29W1	162122	32.8	9.6	99,015	622,801
3-8-9-29W1	162279	36.0	10.6	109,051	685,928
4-8-9-29W1	162409	39.6	11.6	119,956	754,521
5-8-9-29W1	162334	37.8	11.1	114,423	719,718
6-8-9-29W1	162203	35.7	10.5	107,893	678,647
7-8-9-29W1	162052	33.3	9.7	100,467	631,935
8-8-9-29W1	161922	30.0	8.8	90,567	569,665
9-8-9-29W1	161855	30.0	8.8	90,401	568,623
10-8-9-29W1	161990	32.3	9.5	97,530	613,461
11-8-9-29W1	162137	33.1	9.7	99,933	628,576
12-8-9-29W1	162263	33.2	9.7	100,463	631,915
13-8-9-29W1	162186	29.9	8.7	90,301	567,996
14-8-9-29W1	162061	30.0	8.8	90,696	570,480
15-8-9-29W1	161918	29.5	8.7	89,134	560,650
16-8-9-29W1	161783	27.4	8.0	82,635	519,776
Totals:				**3,391,411**	**21,331,974**

NGR:	**0.293**
Porosity:	**0.1**
Sw:	**0.3**
So:	**0.7**
Bo:	**1.1**