# PROPOSED DALY UNIT NO. 16

# APPLICATION FOR ENHANCED OIL RECOVERY WATERFLOOD PROJECT

# LODGEPOLE FORMATION

# DALY, MANITOBA

December 6, 2017

Corex Resources Ltd.

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## INTRODUCTION

The Daly portion of the Daly Sinclair Field is situated in Townships 8 to 11 Ranges 27 to 29 W1M and was developed in the 1950's with vertical wells. Technological advances in drilling and completion operations, specifically with respect to horizontal wells, have revived field activity in this area. The proposed unit area surrounds Daly Unit No. 1 in which Corex is the licensed operator and sole working interest owner. In July 1953, three wells were drilled within the proposed unit and all produced oil, namely: 100/01-04-010-28W1, 100/07-04-010-28W1 and 100/08-04-010-28W1. Successful results through the use of hydraulically fractured horizontal wells surrounding the proposed unit resulted in Corex drilling two (2) horizontal wells within the proposed unit, that as of July 2017 were awaiting completion. Following up upon this success, Corex plans to have another two (2) wells drilled that are partially on the unit acreage to complete the full development plan.

Corex, as operator and sole working interest owner, is proposing a unit be created which will include the following lands: Lsd's 1, 7, and 8 of Section 4, all in Township 10 Range 28W1M and believes the potential exists for incremental production and reserves from an Enhanced Oil Recovery (EOR) waterflood project in the Lodgepole formation. As of July 2017, the proposed application area contained seven (7) wells which status can be broken down as follows: Four (4) horizontal Lodgepole wells, (2 fully within the unit waiting on completion, and 2 partially within the unit, to be drilled in September 2017) and three (3) vertical wells (all produced and are now abandoned). We anticipate converting some of the producing Lodgepole horizontal wells into injectors when implementing the EOR waterflood project, however, our plan would be to produce any newly drilled wells for at minimum one (1) year before such conversion. Corex hereby submits an application to establish Daly Unit No. 16 and implement an EOR Waterflood Project within the Lodgepole formation (Figure 1).

The proposed Daly Unit No. 16 falls within the Daly Sinclair Lodgepole Pool (Figure 2).

## SUMMARY

1. The proposed Daly Unit No. 16 will include the Lodgepole formation in three (3) legal subdivisions (Lsd's) and seven (7) wells which status can be broken down as follows: Four (4) horizontal Lodgepole wells, (2 fully within the unit waiting on completion, and 2 partially within the unit, to be drilled in September 2017) and three (3) vertical wells (all produced and are now abandoned) (Figure 1).

2. The original oil in place (OOIP) for the proposed Daly Unit No. 16 is calculated as 716 $10^3m^3$ (4,504 Mbbl), for an average of 238.7 $10^3m^3$ (1,501 Mbbl) per LSD.

3. Cumulative production in the proposed Daly Unit No. 16 to the end of July 2017 is 7.97 $10^3m^3$ (50.1 Mbbl) of oil. This represents a 1.11% recovery factor of the total OOIP.

4. Production from two vertical wells began in August 1953, with a third well adding more production in October 1953. These wells were the only producing wells within the application

area and were all shut in by February 1965. In August 1960, with a fracture treatment on the 100/07-04-010-28W1/00 well, the proposed Daly Unit No. 16 reached a peak of 7.3 $m^3/d$ (46 b/d), or an average of 2.4 $m^3/d$ (15 b/d) per well, with a 100% oil cut at the time, (Figure 3). Production from the horizontal wells drilled in winter 2017 is expected to result in high production volumes and much higher primary recovery than the vertical wells.

5. The Estimated Ultimate Recovery (EUR) of oil on primary production within the proposed Daly Unit No. 16 through the use of type curves and a section model is 58.8 $10^3m^3$ (370.1 Mbbl), with 50.8 $10^3m^3$ (320 Mbbl) remaining as of July 2017. The Estimated Ultimate Recovery Factor (EURF) on primary production would be 8.22% of the total OOIP within the Lodgepole section.

6. With the implementation of a waterflood within the Middle and Lower Daly members of the Lodgepole formation, incremental reserves of 50.8 $10^3m^3$ (320 Mbbl) are expected while the incremental recovery factor is expected to be 7.1% for a total recovery factor of 15.31% for the entire Lodgepole section.

7. The development plan will be to complete the existing horizontal wells that have been drilled and continue development with the drilling of two (2) additional horizontal wells, that will be partially within the unit. Horizontal wells will be converted into water injectors and the waterflood is expected to be initiated in early 2019 (Figure 4). This timing is contingent upon the approval of the unitization and EOR waterflood application. All recently drilled horizontal wells in the proposed Daly Unit No. 16 have been completed using multi-stage hydraulic fracturing.

## GEOLOGY

### Stratigraphy

The Lodgepole formation in the proposed Daly Unit No. 16 conformably overlies the hydrocarbon-bearing Bakken formation. It was deposited in a gently sloping carbonate ramp setting and has been subdivided by Corex into six laterally continuous, shallowing upwards cycles. In ascending order, the sequence consists of two non-reservoir cycles: the Basal Limestone and the Cromer Shale which are overlain by four reservoir cycles: the Cruikshank Crinoidal, Lower Daly, Middle Daly and Flossie Lake. The Lodgepole formation is unconformably overlain by the red silts and shales of the Lower Amaranth, and the anhydrites and shales of the Upper Amaranth which forms the top seal for the hydrocarbon system. The stratigraphy of the Lodgepole formation is shown on the type well (100/12-9-10-28W1/00) and structural section which runs through existing vertical well control in and around the proposed unit (see Appendix I). The majority of original 1950's era verticals were cored, so there is ample offsetting core and log data to assist in the ongoing development of the Lodgepole formation.

Fluid Contacts

Over sixty years of production combined with regional mapping done by Corex has indicated the Lodgepole system oil – water contact is at -290m SS, which is downdip from the proposed Daly Unit No. 16.

Sedimentology

Starting at the base of the Lodgepole section and working upwards, the first cycle immediately overlying the Bakken formation is the Basal Limestone (822-826.5m KB; in the following sections the depths will refer to 12-09-10-28W1 type log in Appendix I). The Basal Limestone is a basinal argillaceous limestone with traces of fossil hash and chert nodules. This unit is not prospective and is capped by an argillaceous marker bed.

The next cycle, the Cromer Shale (779.6-822m KB) is a basinal lime-mud consisting of tan to light brown to maroon-colored, occasionally dolomitic, limestone with minor anhydrite, grey-green shale and very fine quartz siltstone components. The Cromer Shale is non-reservoir and is capped by a light to medium grey shale.

The overlying Cruikshank Crinoidal (772-779.5m KB), is the first reservoir quality cycle deposited within the Lodgepole formation. The Crinoidal is characterized by bioclastic to biofragmental wackestones to grainstones. Abundant crinoid fragments and shallower-water shell debris has been transported downdip in submarine carbonate channels that have incised the underlying Cromer lime muds.

There are no wells that penetrate this cycle completely within the proposed unit area. The Crinoidal isopach ranges from 4 to 10m thick just outside the proposed unitized lands. Using a 6% porosity cutoff the average porosity ranges from 7-11% with a permeabilities from 3-34mD. Using the same cutoff for logs as for core, the net pays range from 1.4 to 8m through and around the proposed Daly Unit No. 16 acreage (Appendix III).

The Lower Daly (761-772m KB) is the next shallowing upwards reservoir cycle and grades from a tan to light brown lime mudstone into grainy bioclastic wackestones to packstones. It is occasionally argillaceous with traces of pyrite and has biofragment rich dolomite. Deposition is in an upslope higher-energy fairway where most of the matrix has been winnowed out, preserving better reservoir both vertically and laterally. The Lower Daly, using a 6% core/log cutoff, has 9-12% porosity and an isopach up to 13m with pays ranging from 4 - 9m and permeabilities from 1.8-15.3mD (Appendices VII and IX). Historical production has been obtained without fracture stimulation, but oil rates and recoveries have been positively impacted by stimulation.

The Middle Daly (752-761m KB) is a tan, partially recrystallized very fine to fine slightly dolomitic biofragmental wackestone that grades to a cryptocrystalline mudstone with minor anhydrite and shale. It has a very distinctive lower resistivity profile as result of higher bound water, yet there have been high oil cuts for decades out of this zone. Deposition of this shallowing

upward sequence occurred in a more restricted marine environment than the underlying Lower Daly. The Middle Daly isopach ranges from 10m to 12m in thickness over the proposed unit (Appendix X). Using a 6% cutoff the average porosities range from 8-13% and permeabilities from 0.8-5.3mD with net pays from 3.7-6.9m. (Appendices XI and XIII).

The final reservoir cycle within the Lodgepole is the Flossie Lake (738-752m KB). The base of which is a dolomitic limestone that then grades upward into a thinly interbedded dolomite and anhydrite. This is indicative of deposition in the uppermost shallow evaporitic ramp setting. This interval is a light to medium brown, horizontally laminated, microsucrosic dolomite interbedded with dense, white anhydrite beds. The uppermost 3 to 4m of the Flossie Lake is dominated by anhydrite and contains only minor oil stained dolomite. The Flossie isopach is 10 to 19m in thickness (Appendix XIV); using a 6% core/log cutoff the net pay is 4.2 to 7.8m, permeability of 3.6mD and porosities from 11-12% (Appendices XV and XVII). The juxtaposition of reservoir quality dolomites with ductile anhydrite laminae additionally complicates stimulation of this reservoir interval.

Structure

The structure within the proposed Daly Unit No. 16 area primarily reflects deposition on a carbonate ramp-margin with established regional trends dipping down to the southwest into the Williston basin. (see Appendices XVIII through XXI for structural maps of each reservoir cycle).

Localized salt dissolution has modified this regional trend in certain areas. For example, in section 16-10-28 there is a salt collapse which was infilled during Flossie deposition with ~25m of interlaminated oil stained dolomite and anhydrite. These dissolution events do not appear to represent continuous barriers to lateral fluid flow within the reservoir and they do not appear to interrupt the lateral continuity of the reservoir beds. In carbonate reservoirs, natural fractures will be present in varying degrees and can impact fluid movement within the reservoir cycles.

Reservoir

Maps for each of the four reservoir units were generated using available openhole logs as well as integration of core data. All maps have been derived and documented in the previous sections, with referenced appendices. Porosity and permeability cutoffs are consistent with previous studies and reflect Corex's detailed reservoir evaluation within the T10-R28W1 area.

## OIL IN PLACE, PRODUCTION HISTORY AND ESTIMATED RECOVERY

Original Oil in Place

The original-oil-in-place (OOIP) for the proposed Daly Unit No. 16 is 716 $10^3m^3$ (4,504 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 Daly Unit No. 16. There is a total of seven (7) wells which status can be broken down as follows: Four (4) horizontal Lodgepole wells, (2 fully within the unit waiting on completion, and 2 partially within the unit, to be drilled in September 2017) and three (3) vertical wells (all produced and are now abandoned). Within the proposed unit there is currently no water disposal. All the referenced wells are perforated in the Lodgepole formation.

To the end of July 2017, the proposed Daly Unit No. 16 has produced cumulative volumes of oil of 7.97 $10^3m^3$ (50.1 Mbbl) and water of 2.81 $10^3m^3$ (17.7 Mbbl). The current recovery factor is 1.11%.

Production began in August 1953 from two vertical wells with a third well adding production by October 1953. These wells were the only producing wells within the application area and were all shut in by February 1965. In August 1960 the 100/07-04-010-28W1/00 well was fracture stimulated and the proposed Daly Unit No. 16 reached a peak of 7.3 $m^3/d$ (46 b/d), or an average of 2.4 $m^3/d$ (15 b/d) per well, with a 100% oilcut (Figure 3). Production from the horizontal wells drilled in winter 2017, in addition to the ones drilled in the fall 2017, is expected to result in high production volumes and much higher primary recovery than the vertical wells.

Primary Recovery

Table 3 lists the wells within the proposed unit area, together with the cumulative oil production to the end of January 2017 and the EUR estimated using decline analysis. The total EUR for the proposed Daly Unit No. 16 with further development is 58.8 $10^3m^3$ (370.1 Mbbl) for a recovery factor of 8.22% of the total OOIP of the Lodgepole section.

Secondary Recovery

Within the Lodgepole formation, the proposed waterflood will target the Middle and Lower Daly members which contain over 51% of the total OOIP. A section model of the Middle and Lower Daly zones was built to estimate the expected recovery from waterflooding. This section model used average reservoir properties and was tuned to match the type production profile of Corex horizontal producers within the Middle Daly member. With decline analysis and model results Corex expects an EURF of 15.97% under primary depletion. With horizontal wells converted into injectors, the section model yields an ultimate EURF of 29.8%, or an incremental recovery factor of 13.8%. Note, these recovery factors are based on the OOIP of the Middle and Lower Daly zones only and not the entire Lodgepole formation. Additional information on the section model that was scaled to represent Daly Unit No. 16 is included in Appendix XXII.

## 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 Daly Unit No. 16.

Unit Operator

Corex will be the Operator for Daly Unit No. 16.

Unitized Zones

The unitized zone to be waterflooded in the Daly Unit No. 16 will be the Lodgepole formation.

Unit Wells

Four (4) horizontal Lodgepole wells, (2 fully within the unit waiting on completion, and 2 partially within the unit, to be drilled in September 2017) in the proposed Daly Unit No. 16 are outlined in Table 2.

Unit Lands

Daly Unit No. 16 will consist of three (3) Lsd's which will include Lsd's 1, 7 & 8 of 4, all in Township 10 Range 28W1M. The lands included in the 40-acre tracts are outlined in Appendix XXIII.

Tract Factors

The proposed Daly Unit No. 16 will consist of three (3) tracts based on remaining OOIP using maps created internally by Corex per Lsd, as of July 2017, with the production from the horizontal wells being divided according to the existing production allocation agreement. The calculation of the tract factors are outlined in Table 1.

Working Interest Owners

Appendix XXIII outlines the working interest for each recommended tract within the proposed Daly Unit No. 16. 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 gas-oil ratios. 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.

### 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 as well as existing oil analysis and PVT data.

Using Corex's internal database on fracture treatments and step rate tests, the fracture gradient for the Lodgepole formation is estimated to range between 19.0 kPa/m and 25.9 kPa/m, with an average of 23.3 kPa/m. The surface fracturing pressure is estimated to range between 6,348 kPa and 11,500 kPa with the average gradient the estimated surface fracturing pressure is 9,500 kPa.

### Estimated Recovery

Using the results from the Daly section model, incremental reserves of 50.8 $10^3m^3$ (320 Mbbl) are expected. Based on the total OOIP for the Lodgepole formation, the incremental recovery factor is expected to be 7.1% for an overall recovery factor of 15.31%.

### 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 $m^3/d$.

### Source of Injection Water

As the wells in the subject unit are all flowline tied in to the 12-04-10-28 Daly Unit No. 1 battery, source water will come from the newly installed waterflood facilities. The source will be Lodgepole produced water from the Daly Unit No. 1 and Daly Unit No. 16 producing wells. If required, a new Lodgepole source well will be drilled near the 12-04 Battery.

A simplified process flow diagram of the battery and injection system to the injectors can be found in Figure 7. The injector wells will be equipped with surface injection rate and pressure metering with choke valves to control wellhead pressure and injection rates (Figure 9). The wells will be evaluated for installation of a downhole nozzle system to ensure an even distribution of injection fluid across the horizontal wellbore (representation shown in Figure 6). These nozzles will also act as a choke to ensure the reservoir pressure remains below frac pressure. The water injection

pipeline system will be monitored for leak detection using pressure variance and volume balancing. The corrosion control program outlining the planned system design and operational practices to prevent corrosion is located in Figure 9.

Operating Strategy

Corex's plan is to have alternating producer-injector patterns within the proposed Daly Unit No. 16 and the proposed injection scheme can be seen in Figure 4.

Injection rates are expected to be in the range of 30 $m^3/d$ to 80 $m^3/d$, per well, subject to a maximum injection pressure of 8,500 kPa at the well head. This maximum pressure is based on a fracture pressure of 9,500 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 is attained, the injection rate will be scaled back to maintain the VRR at one, both monthly and a cumulative basis.

All producers will be kept at pump-off condition.

Pressure

The initial pressure is estimated to be between 7,800 kPa and 8,100 kPa. This is based on the depth of the Middle Daly zone and a static gradient ranging between 10.5 kPa/m and 10.8 kPa/m. To this date no pressure measurements have been taken within the proposed unit. However, due to pressure data from the adjacent Daly Unit No. 1, the pressure estimated to be is quite close to the estimated initial reservoir pressure. Minimal production to date would support this theory. With significant development plans in the near future it is projected that the pressure will decrease rapidly from primary depletion. With low solution-gas oil, another drive mechanism will need to be implemented in order to improve the recovery within the proposed unit.

Waterflooding will help to re-pressurize and add energy to the reservoir. During the initial over-injection period, the reservoir pressure is expected to increase from the current level. Once the cumulative VRR reaches one, a monthly VRR of one will be maintained. At the stage of the first conversion the reservoir pressure is expected to be below its initial value. Prior to injection Corex will endeavor to record reservoir pressures within the proposed unit and continue upon implementing a secondary recovery scheme.

Waterflood Facilities

Waterflood facilities are currently being installed at the 12-4-10-28 battery in the fall of 2017, and will be used for this waterflood. The system is designed to handle capacities both in and out of the Daly Unit No. 1. The equipment consists of a FWKO on the inlet stream, water tanks to filter out any large solids or emulsions from the produced water, 2 bag type filter banks to further filter out any solids down to 1 micron, and a new injection pump. No new equipment will be required for this application area, with exception to the injection wellhead tie-ins and flowlines.

Waterflood Surveillance

Waterflood response within the proposed Daly Unit No. 16 will be closely monitored with the following:

- Regular production well testing to monitor fluid rate and water cut to watch for waterflood response
- Comparison of daily injection rates and pressure monitoring to targets
- 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

With the success of the recently drilled horizontal wells within surrounding area, an active development plan will be implemented. Thus far in 2017, two (2) wells have been drilled within the proposed unit area and are waiting on completion. Another two (2) wells are currently planned to be drilled in the future that will be partially contained within the unit. After a period of primary recovery, Corex intends to convert several wells to injection in an alternating producer-injector waterflood scheme to support the other existing wells and implement a waterflood.

Conversion of the horizontal producers into injection wells is expected to start in early 2019. This schedule is contingent upon the approval of the Unitization and Waterflood application, as well as the various stake holders coming to agreement.

**NOTIFICATIONS**

In accordance with the regulations, Corex will deliver notification to all surface and mineral owners of the proposed EOR project of Daly Unit No. 16. Copies of the notices and proof of service to all affected owners will be forwarded to the Petroleum Branch, when available, to complete the Daly Unit No. 16 Application.

Should you have any comments and/or questions regarding this application, please contact Peter [redacted] or Chris [redacted] Engineering, at (403) 718-6371 or peterp@corexresources.ca or (403) 718-6357 or chrisd@corexresources.ca, respectively.

Regards,

**COREX RESOURCES LTD.**

[redacted]

Executive Vice [redacted]

# Table 1 – Summary of Original Oil In Place and Tract Factor Calculations

**Daly Unit No. 16**
**Lodgepole Unit**

| Tract<br>LSD | Tract<br>Weighting | Total | 1-4<br>01-04-010-28W1 | 7-4<br>07-04-010-28W1 | 8-4<br>08-04-010-28W1 |
|---|---|---|---|---|---|
| Tract Factor | | 100.000000000% | 31.487200282% | 30.402282998% | 38.110516720% |
| Flossie Lake | | | | | |
| Area (ac) | | 120 | 40 | 40 | 40 |
| h (m) | | | 6.3 | 5.4 | 5.7 |
| Vb (ac-ft) | | 2,283 | 827 | 709 | 748 |
| phi | | | 11.5% | 11.5% | 11.5% |
| Sw | | | 25% | 25% | 25% |
| HCPV | | | 0.543 | 0.466 | 0.492 |
| OOIP (Mbbls) | | 1,528 | 553 | 474 | 501 |
| OOIP (Mstb) | | 1,428 | 517 | 443 | 468 |
| OOIP ($10^3m^3$) | | 227 | 82 | 70 | 74 |
| Middle Daly (Green) | | | | | |
| Area (ac) | | 120 | 40.0 | 40.0 | 40.0 |
| h (m) | | | 4.7 | 5.5 | 5.4 |
| Vb (ac-ft) | | 2,047 | 617 | 722 | 709 |
| phi | | | 10.3% | 10.3% | 10.3% |
| Sw | | | 30% | 30% | 30% |
| HCPV | | 1 | 0.339 | 0.397 | 0.389 |
| OOIP (Mbbls) | | 1,145 | 345 | 404 | 396 |
| OOIP (Mstb) | | 1,070 | 322 | 377 | 370 |
| OOIP ($10^3m^3$) | | 170 | 51 | 60 | 59 |
| Lower Daly (Purple) | | | | | |
| Area (ac) | | 120 | 40.0 | 40.0 | 40.0 |
| h (m) | | | 6.3 | 4.5 | 8.9 |
| Vb (ac-ft) | | 2,585 | 827 | 591 | 1,168 |
| phi | | | 9.5% | 9.5% | 9.5% |
| Sw | | | 30% | 30% | 30% |
| HCPV | | 1 | 0.419 | 0.299 | 0.592 |
| OOIP (Mbbls) | | 1,334 | 427 | 305 | 603 |
| OOIP (Mstb) | | 1,247 | 399 | 285 | 563 |
| OOIP ($10^3m^3$) | | 198 | 63 | 45 | 90 |
| Crinoid | | | | | |
| Area (ac) | | 120 | 40.0 | 40.0 | 40.0 |
| h (m) | | | 3.0 | 4.9 | 5.3 |
| Vb (ac-ft) | | 1,732 | 394 | 643 | 696 |
| phi | | | 9.3% | 9.3% | 9.3% |
| Sw | | | 35% | 35% | 35% |
| HCPV | | 1 | 0.181 | 0.296 | 0.320 |
| OOIP (Mbbls) | | 812 | 185 | 302 | 326 |
| OOIP (Mstb) | | 759 | 173 | 282 | 305 |
| OOIP ($10^3m^3$) | | 121 | 27 | 45 | 48 |
| **Total Lodgepole** | | | | | |
| **Total OOIP (Mstb)** | | **4,504** | **1,411** | **1,387** | **1,706** |
| ***Total OOIP ($10^3m^3$)*** | | 716 | 224 | 221 | 271 |
| **Cumulative Oil (Mstb)** | | **50** | **8.2** | **33.0** | **8.8** |
| **OOIP-Cum Prd (Mstb)** | **100%** | **4,454** | **1,402** | **1,354** | **1,697** |

***Comments:*** **Cumulative production to July 2017**
**Bo** **1.07**

| | | | | | |
|---|---|---|---|---|---|
| Well 1 | | | 100/01-04-010-28W1/00 | 100/07-04-010-28W1/00 | 100/08-04-010-28W1/00 |
| Factor | | | 1 | 1 | 1 |
| Cumulative Oil (Mstb) | | | 8.2 | 33.0 | 8.8 |
| | | | | | |
| Well 2 | | | 103/04-04-010-28W1/00 | 102/08-04-010-28W1/00 | 102/08-04-010-28W1/00 |
| Factor | | | 0.25 | 0.5 | 0.5 |
| Cumulative Oil (Mstb) | | | 0.0 | 0.0 | 0.0 |
| | | | | | |
| Well 3 | | | 104/04-04-010-28W1/00 | 103/08-04-010-28W1/00 | 103/08-04-010-28W1/00 |
| Factor | | | 0.25 | 0.5 | 0.5 |
| Cumulative Oil (Mstb) | | | 0.0 | 0.0 | 0.0 |
| | | | | | |
| Well 4 | | | | | |
| Factor | | | | | |
| Cumulative Oil (Mstb) | | | | | |

**Table 2 – Well List – Status**

| UWI Well ID | Prod./Inject. Formation | First Prod. YYYY/MM | Last Prod. YYYY/MM | Type |
|---|---|---|---|---|
| 100/01-04-010-28W1/00 | Mlodgepl | 1953/08 | 1963/08 | Vertical |
| 103/04-04-010-28W1/00 | | | | Horizontal (STN) |
| 104/04-04-010-28W1/00 | | | | Horizontal (STN) |
| 100/07-04-010-28W1/00 | Mlodgepl | 1953/08 | 1965/02 | Vertical |
| 100/08-04-010-28W1/00 | Mldgpl_U | 1953/10 | 1963/08 | Vertical |
| 102/08-04-010-28W1/00 | | | | Horizontal (STN) |
| 103/08-04-010-28W1/00 | | | | Horizontal (STN) |

**Table 3 – Cumulative Oil Production and Estimated Ultimate Recovery**

| UWI Well ID | Type | Cumulative | Estimated |
|---|---|---|---|
| 100/01-04-010-28W1/00 | Vertical | 8.241 | 8.241 |
| 103/04-04-010-28W1/00 | Horizontal (STN) | 0.000 | - |
| 104/04-04-010-28W1/00 | Horizontal (STN) | 0.000 | - |
| 100/07-04-010-28W1/00 | Vertical | 32.974 | 32.974 |
| 100/08-04-010-28W1/00 | Vertical | 8.835 | 8.835 |
| 102/08-04-010-28W1/00 | Horizontal (STN) | 0.000 | - |
| 103/08-04-010-28W1/00 | Horizontal (STN) | 0.000 | - |

**Table 4 – Summary of Rock and Fluid Properties**

| Proposed Daly Unit No. 16 | | |
|---|---|---|
| Rock and Fluid Properties Lodgepole Formation | | |
| Formation Pressure | kPa | 7,800 |
| Oil Gravity | °API | 35.5 |
| Solution Gas-Oil Ratio | $m^3/m^3$ | 15 |
| Oil Formation Volume Factor | $Rm^3/Sm^3$ | 1.07 |
| Average Porosity | fraction | 0.09 |
| Average Air Permeability | mD | 1.2 |

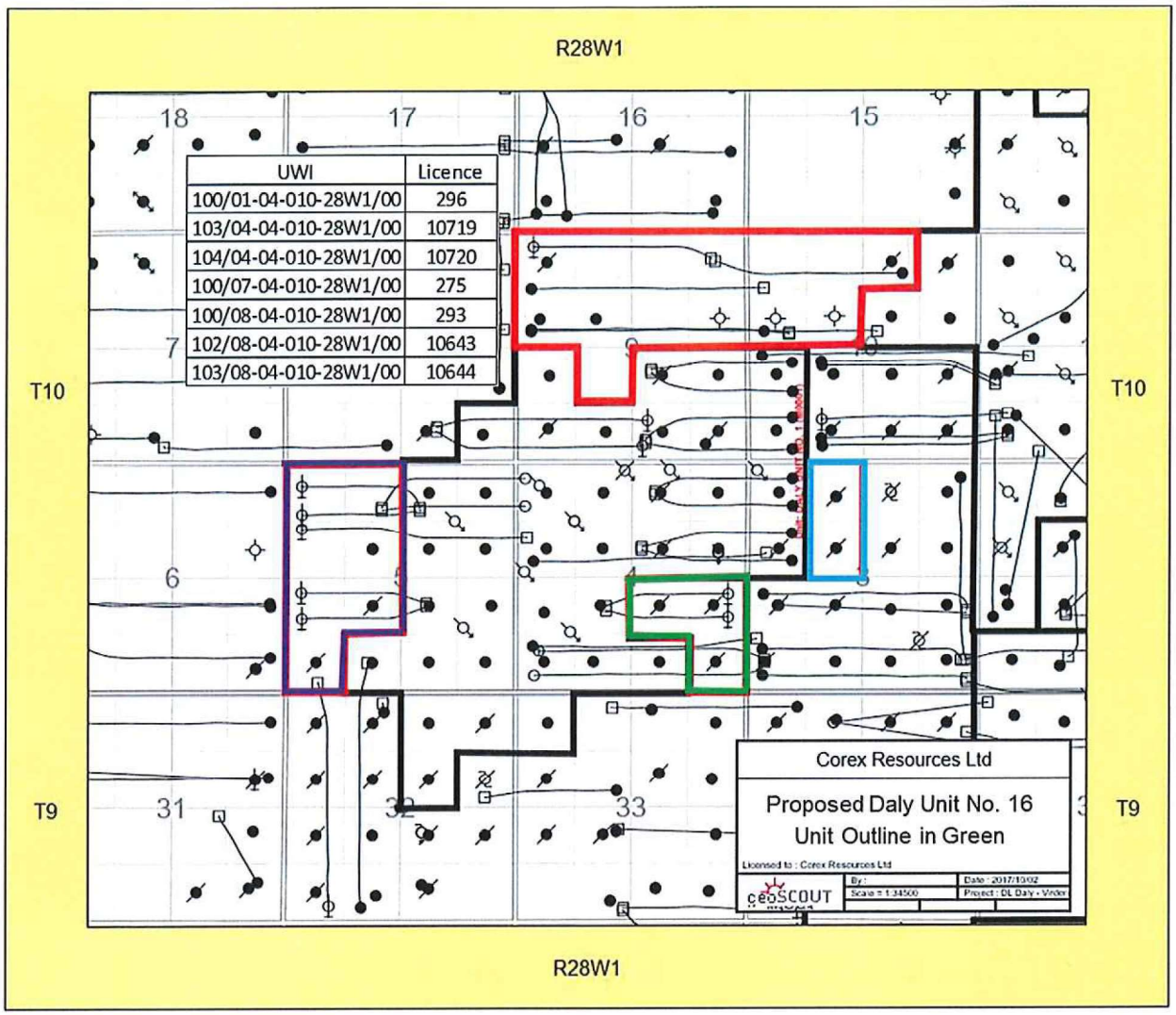



**Figure 1 – Location of Proposed Daly Unit No. 16, Green Outline**

- Proposed Daly Unit No. 15
- Proposed Daly Unit No. 16
- Proposed Daly Unit No. 17
- Proposed Daly Unit No. 18

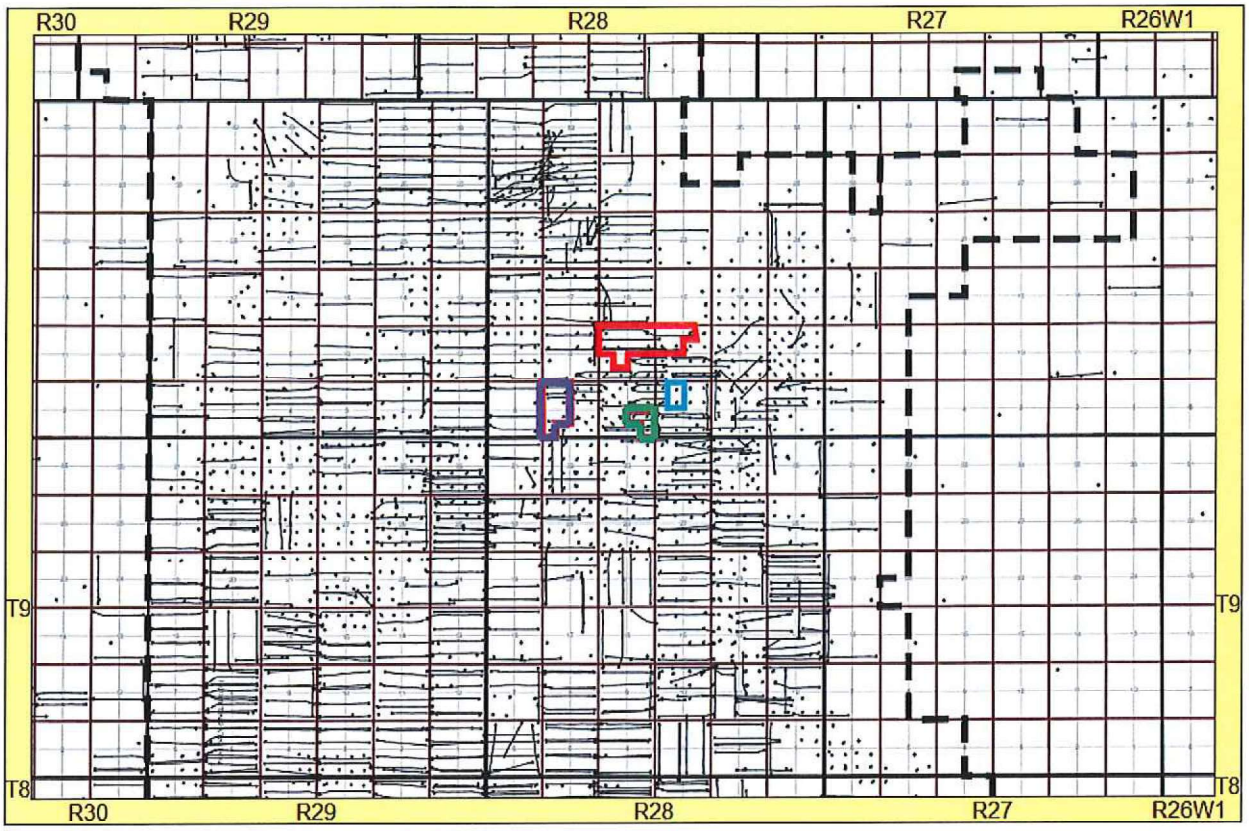



**Figure 2 – Location of Proposed Daly Unit No. 16 within the Daly Sinclair Field, Green Outline**


**Figure 3 – Production History of Wells within Proposed Daly Unit No. 16**

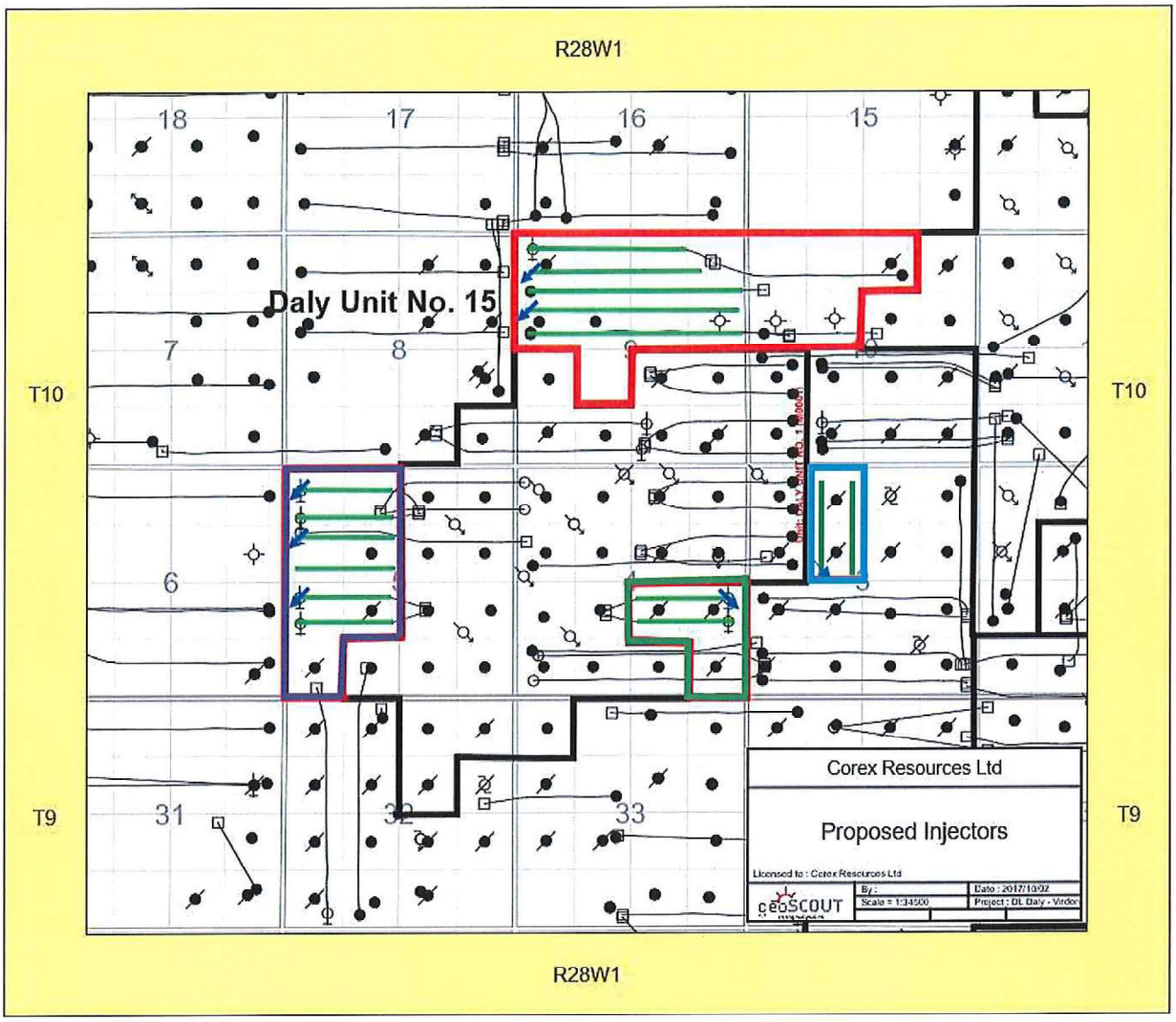



**Figure 4 – Proposed Injector Locations**

- Proposed Daly Unit No. 15
- Proposed Daly Unit No. 16
- Proposed Daly Unit No. 17
- Proposed Daly Unit No. 18

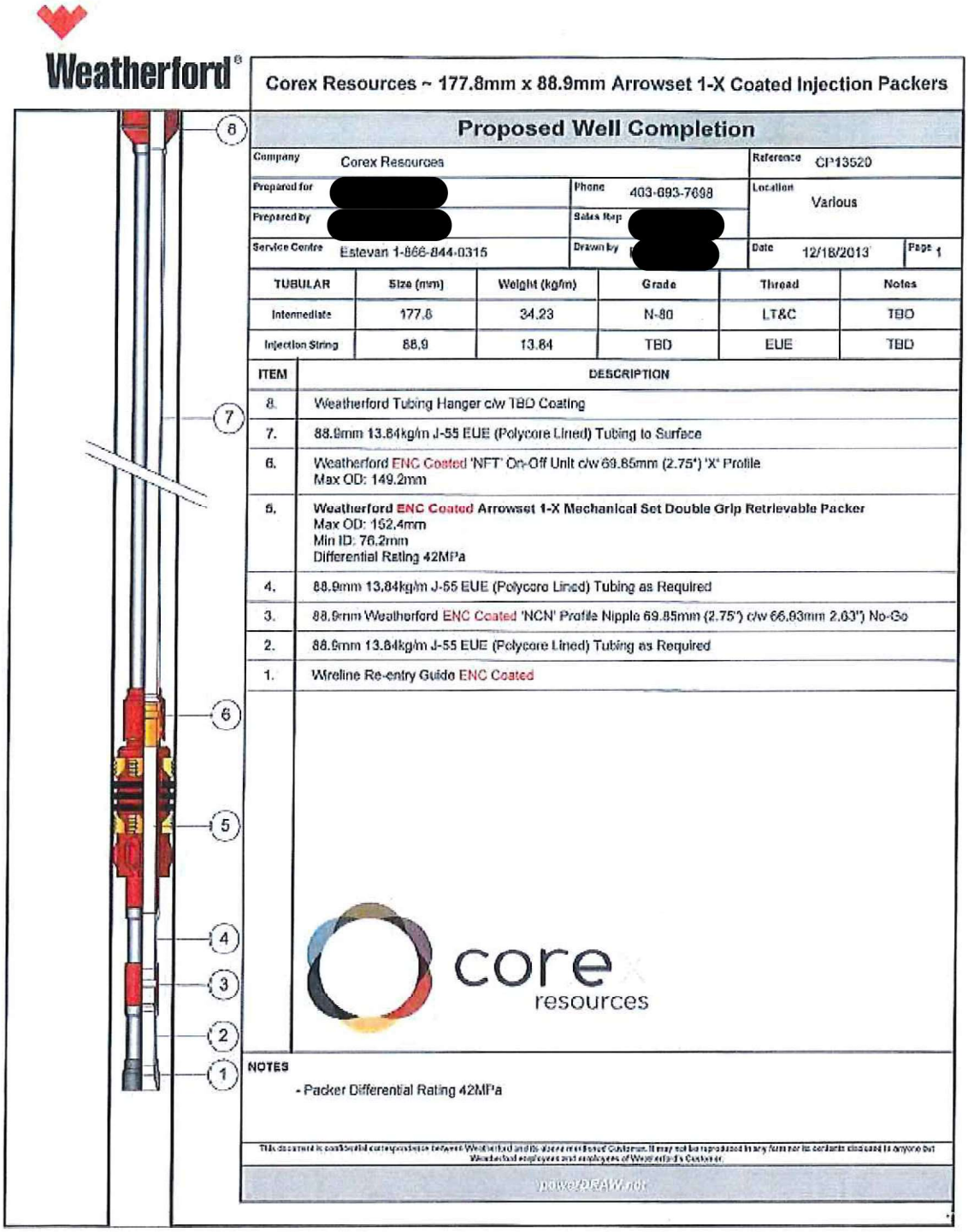



**Figure 5 – Wellbore Schematic for Typical Injector**

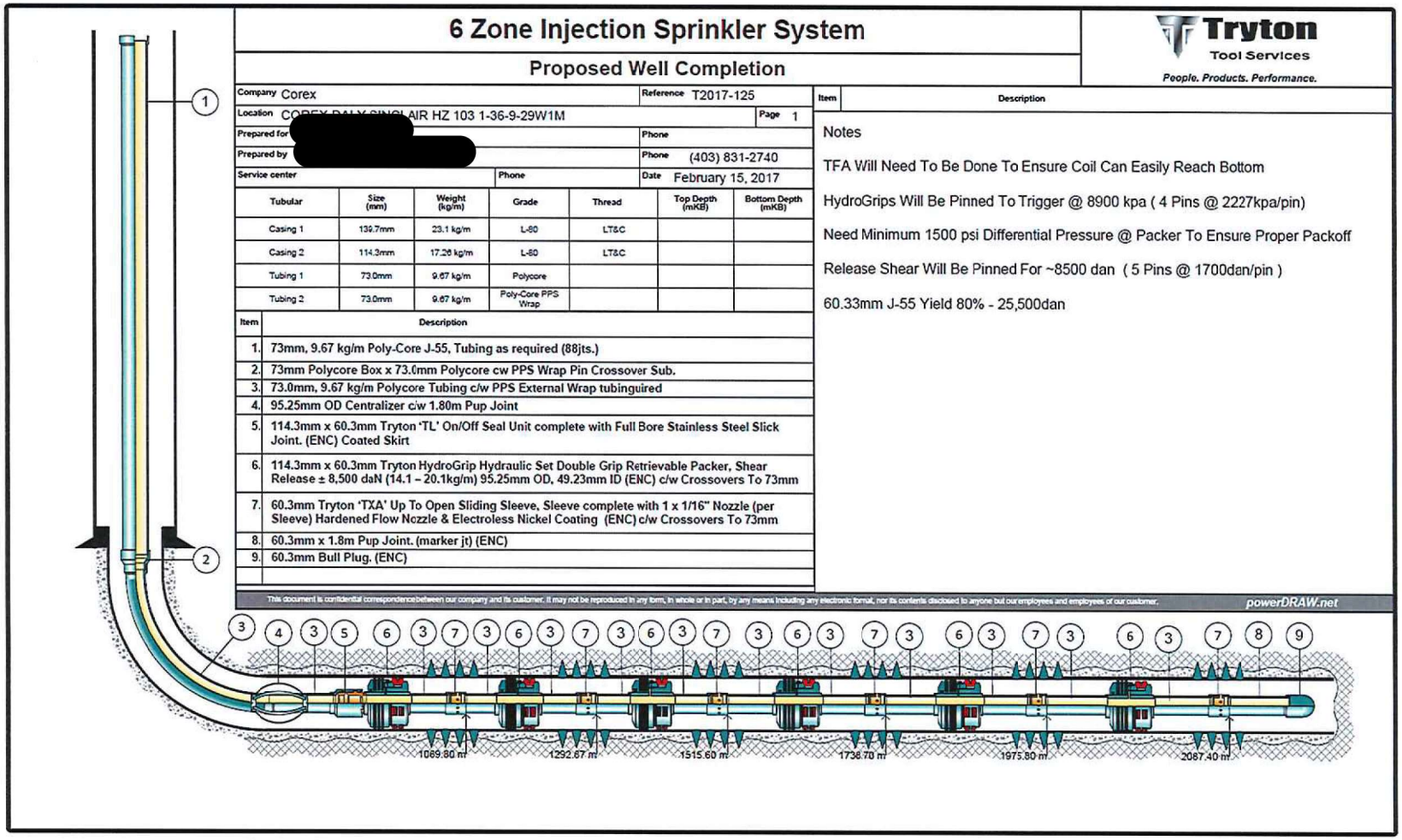



Figure 6 – Wellbore Schematic for Injector Nozzle System

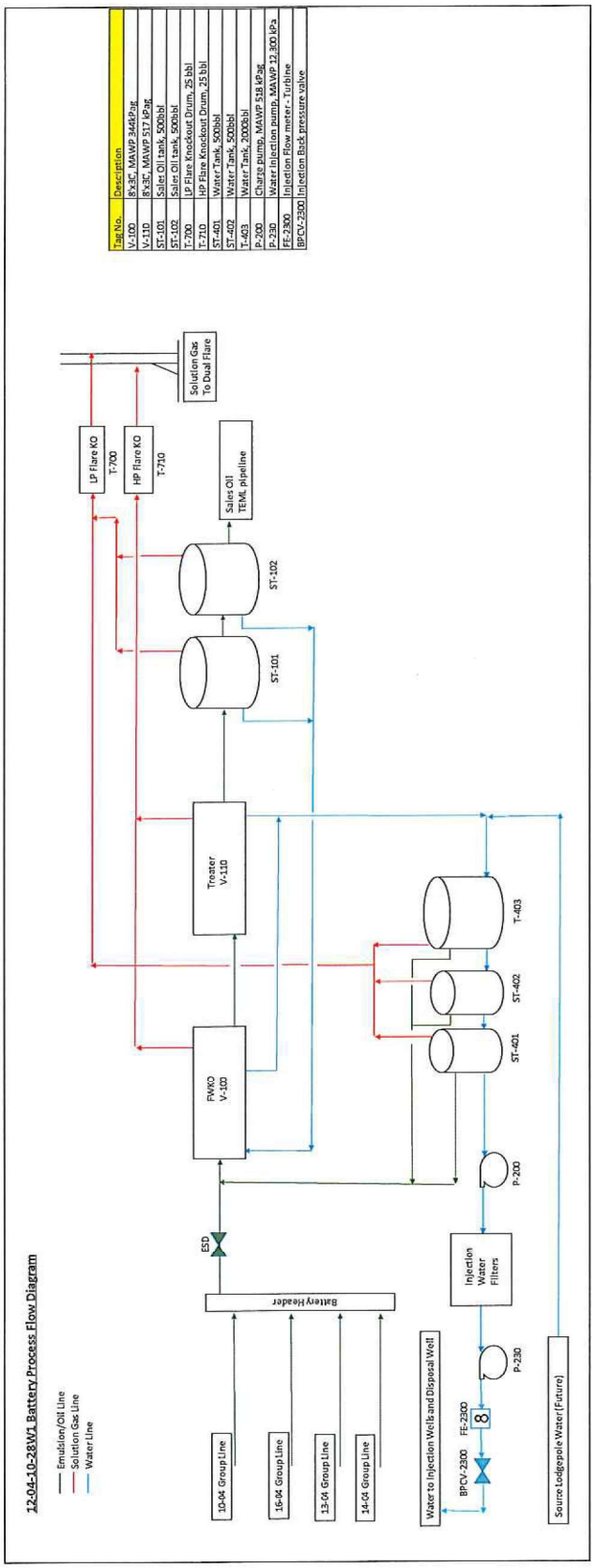



**Figure 7 – Simplified Flow Diagram from Battery**

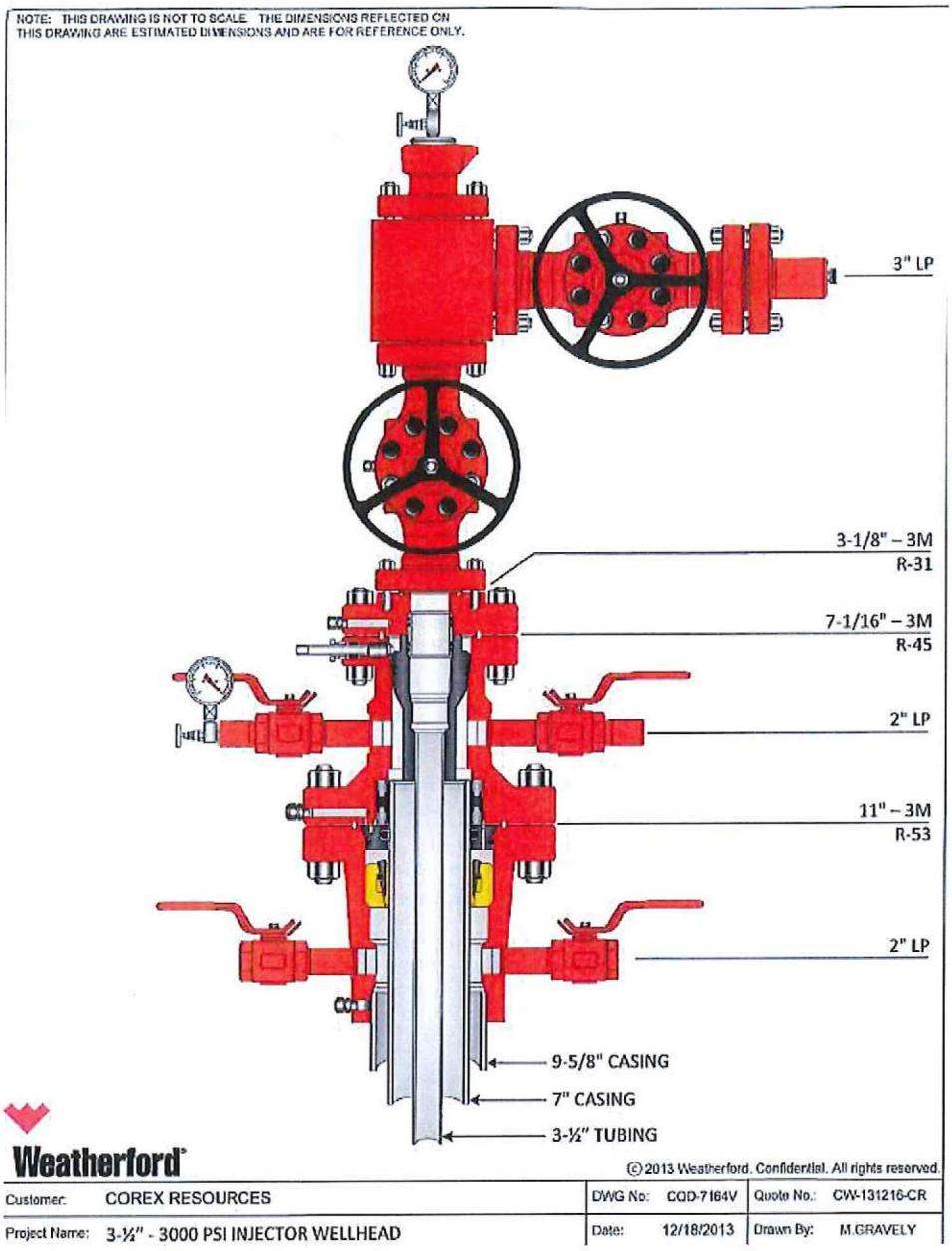
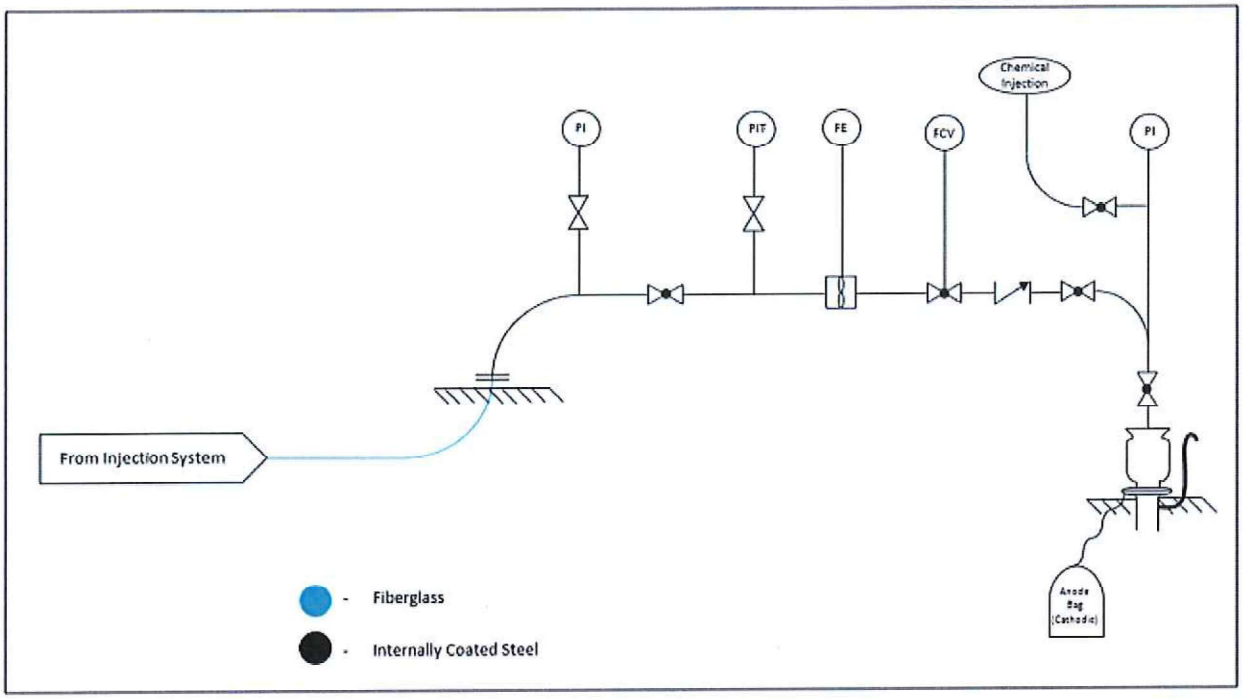


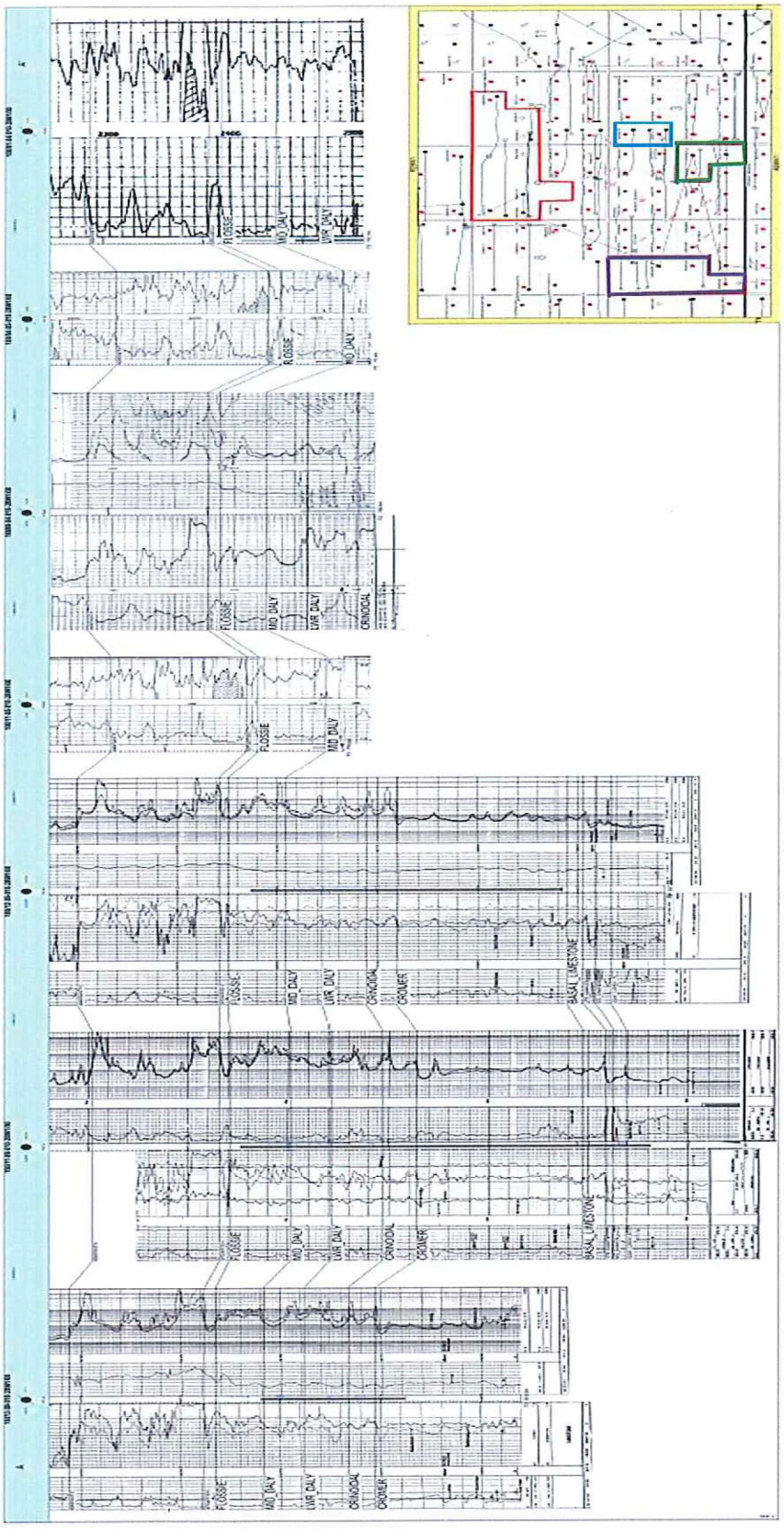

**Figure 8 – Wellhead Design**



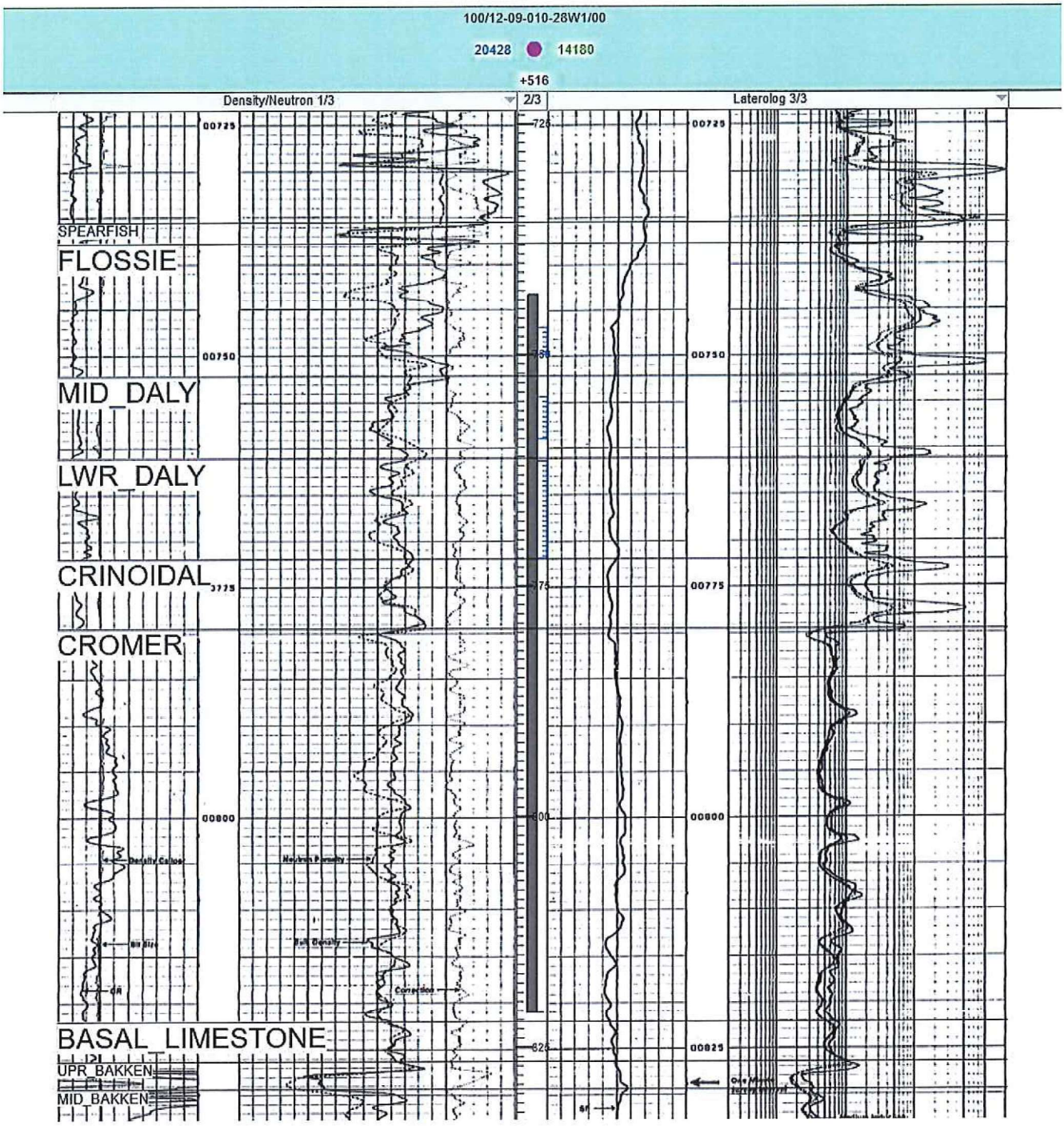

All injection pipelines will have corrosion inhibitor injected at the 12-04 facility, which will carry through to the wellhead for downhole corrosion control (wellhead injection points will be available as needed). Scale inhibitor will be injected in as well at the wellhead through continuous pumps as necessary. Both of these chemicals are also injected upstream at the producing source wells to protect the pipelines and the injection facilities at the battery. Wellbore casing will have cathodic protection installed for corrosion control. The PIT and FE on the diagram will be setup through a monitoring system in addition to one at the injection plant to monitor pipelines for any leaks through pressure and flow balance. Alarm points will be setup with callouts.

**Figure 9 – Corrosion Control System & Monitoring**

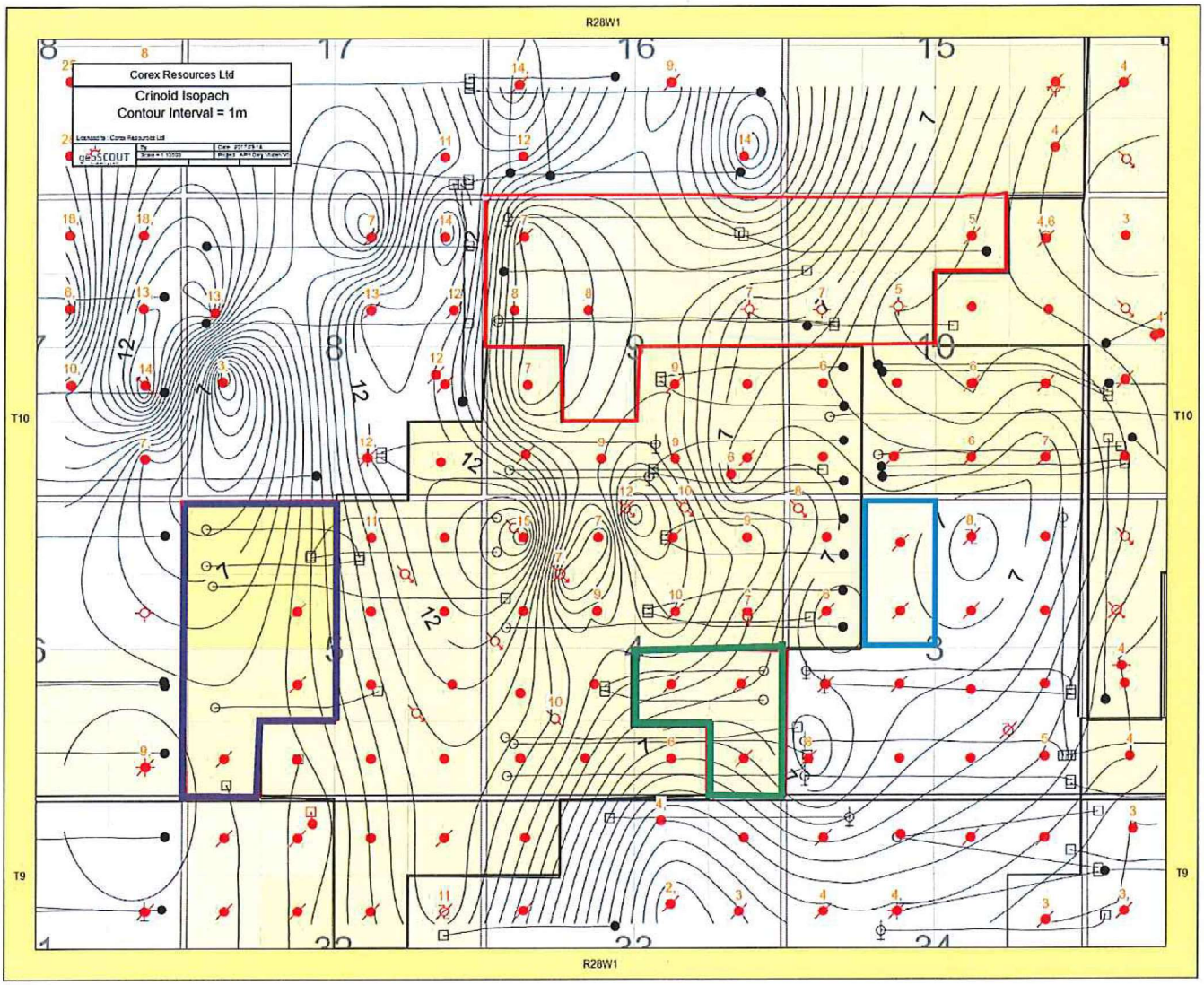
# Appendix I – Cross Section



## Stratigraphy of the Lodgepole Formation: Type Log

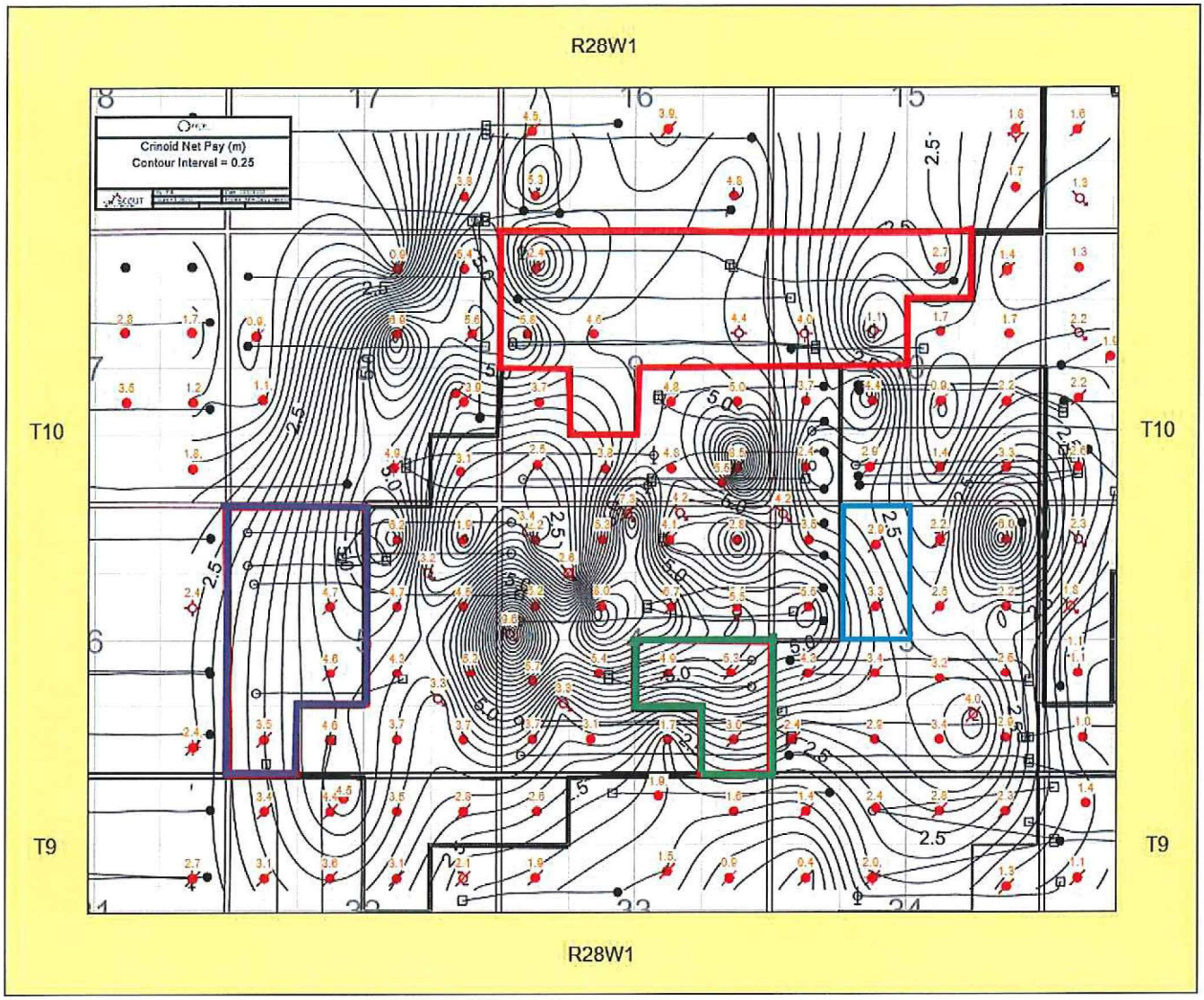


## Appendix II – Crinoidal– Isopach



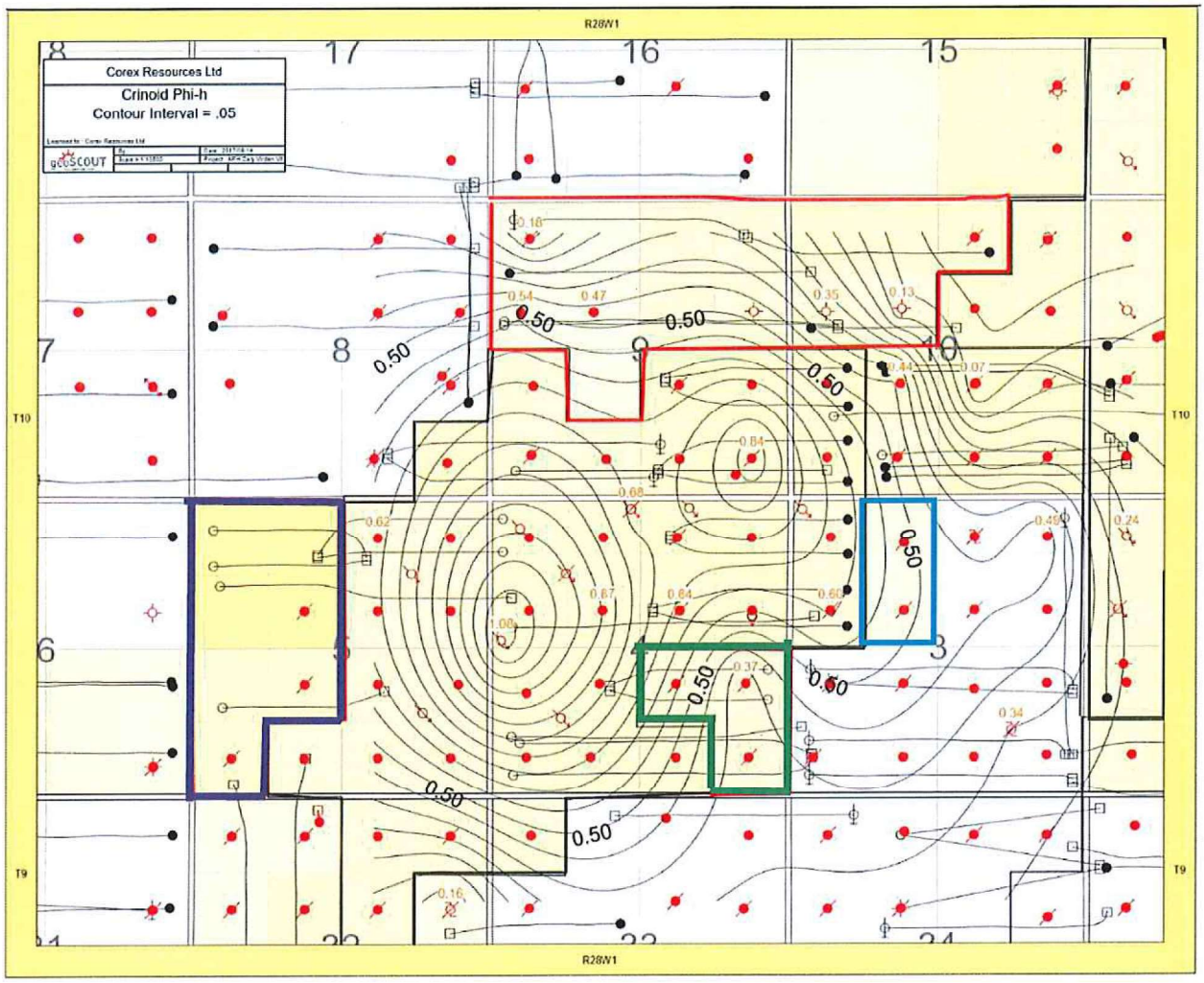

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix III – Crinoidal– Net Pay



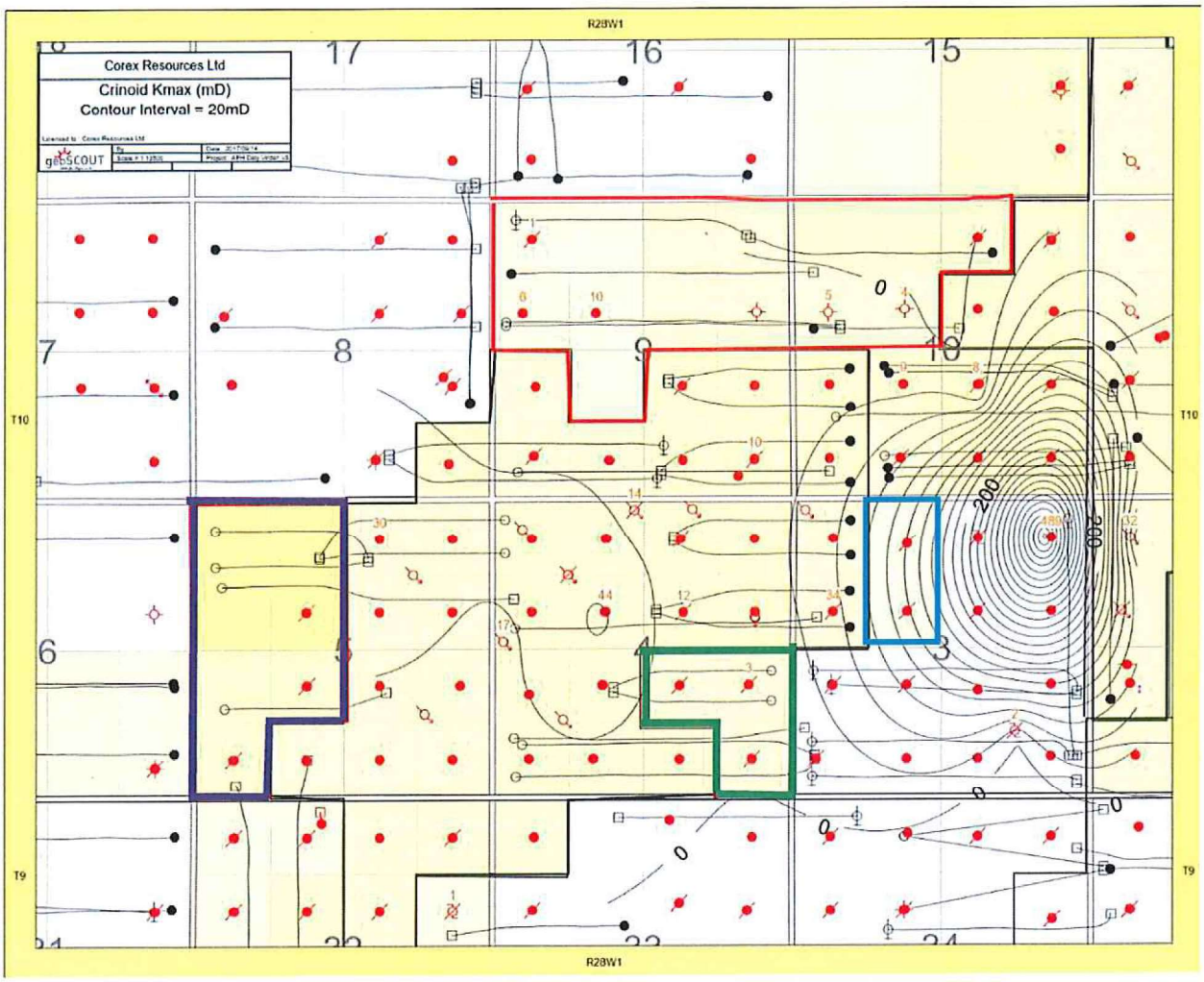

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix IV – Crinoidal – Porosity-Thickness



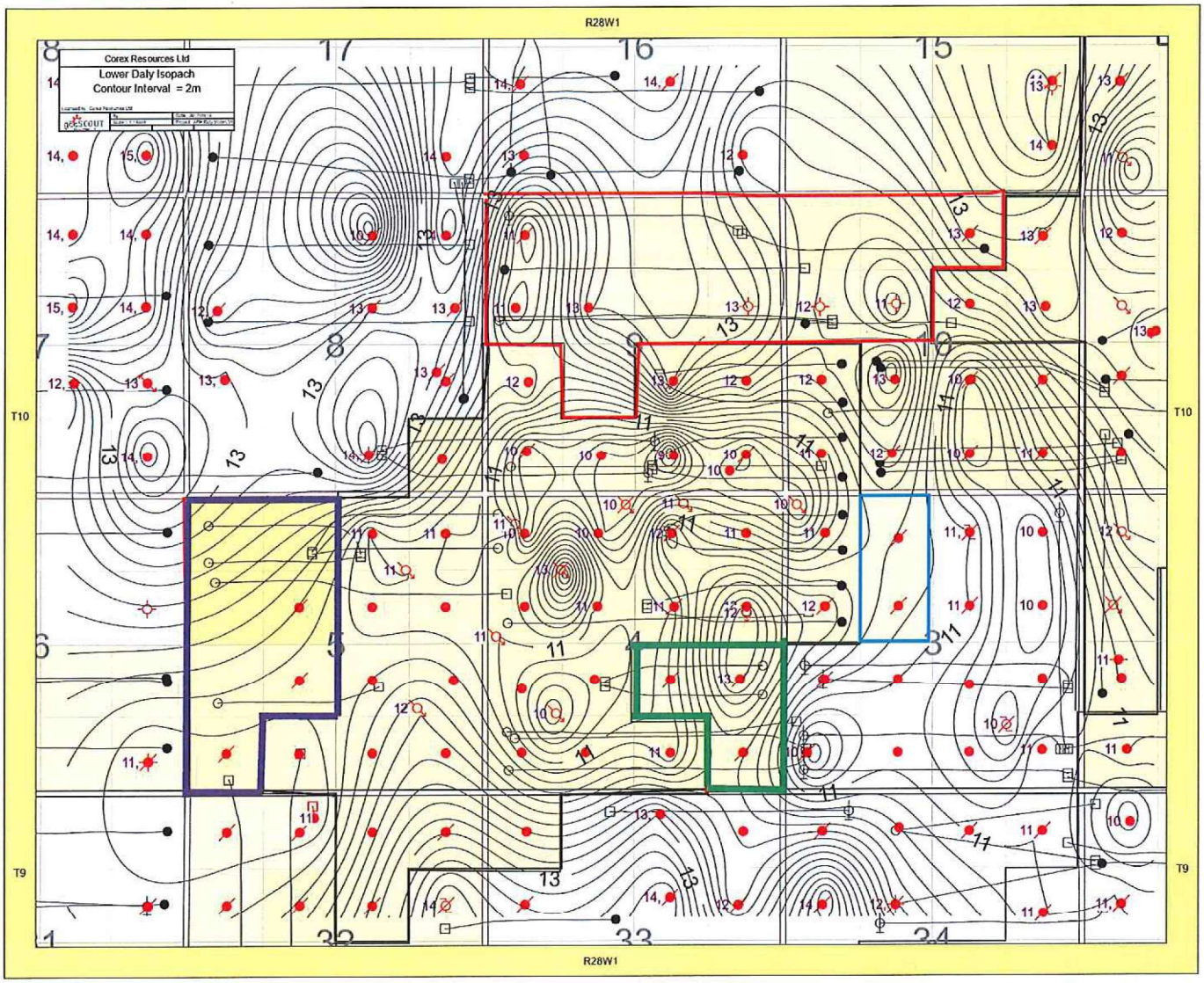

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix V – Crinoidal – Permeability



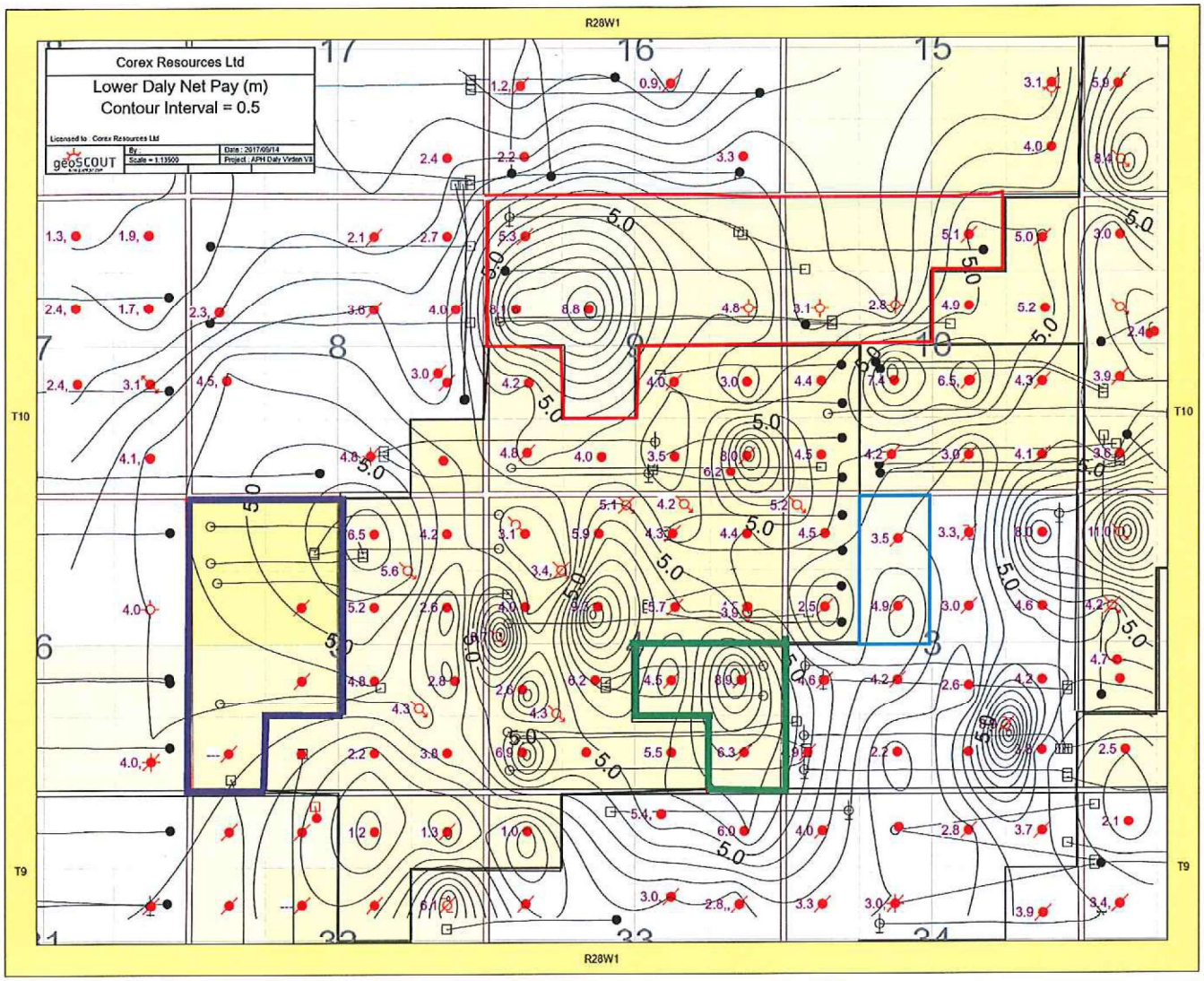

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

# Appendix VI – Lower Daly – Isopach



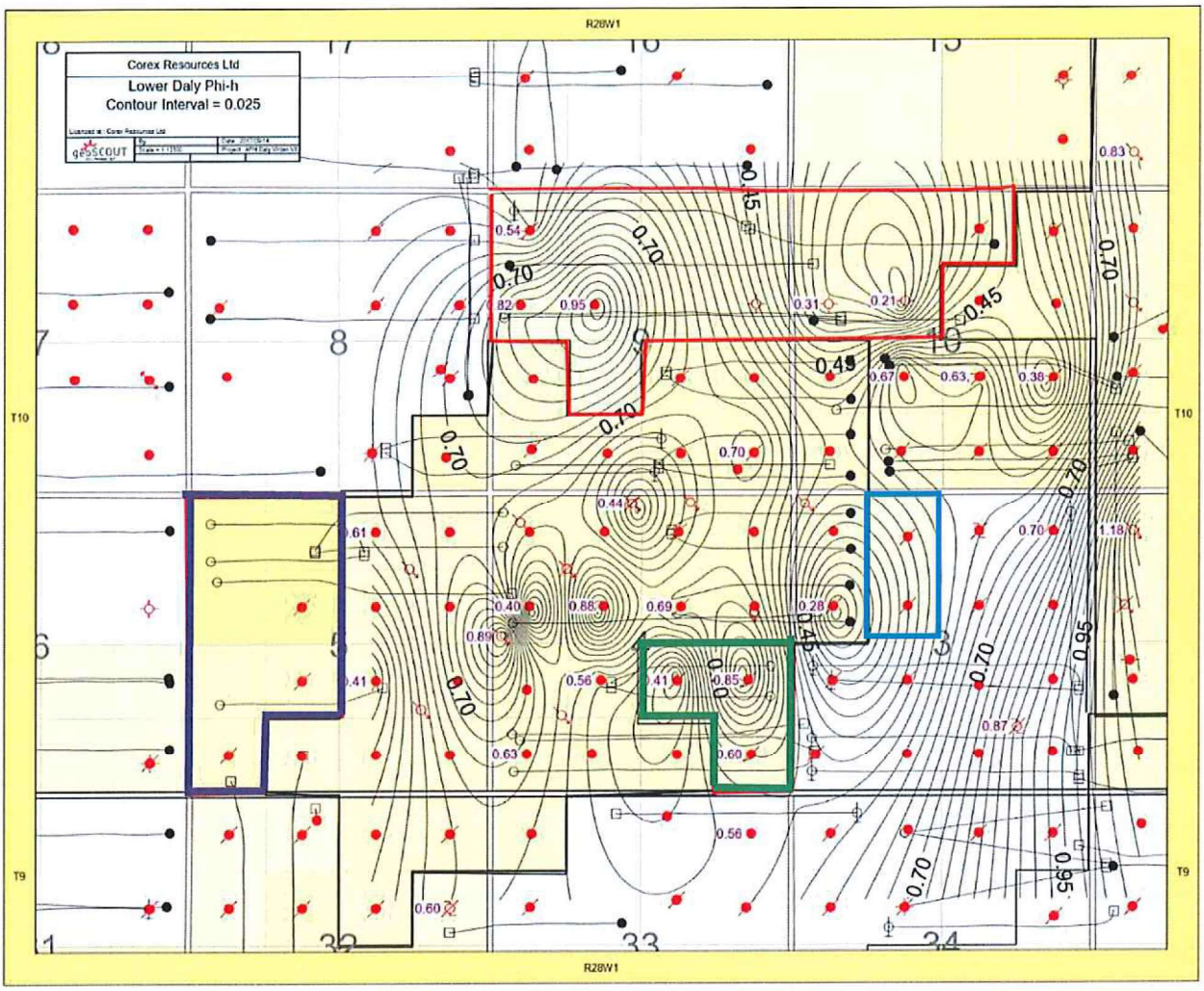

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

# Appendix VII – Lower Daly – Net Pay



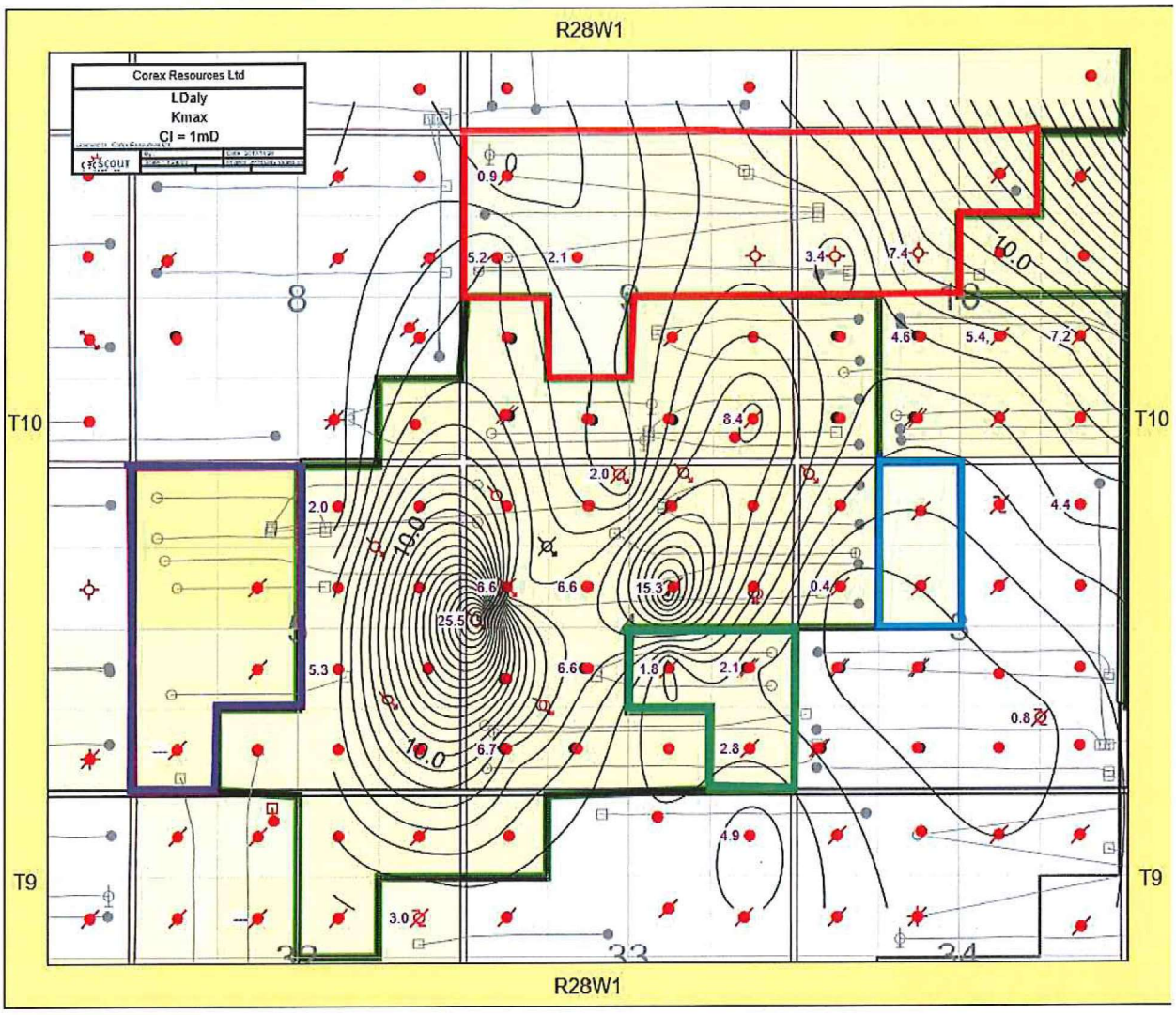

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix VIII – Lower Daly – Porosity-Thickness



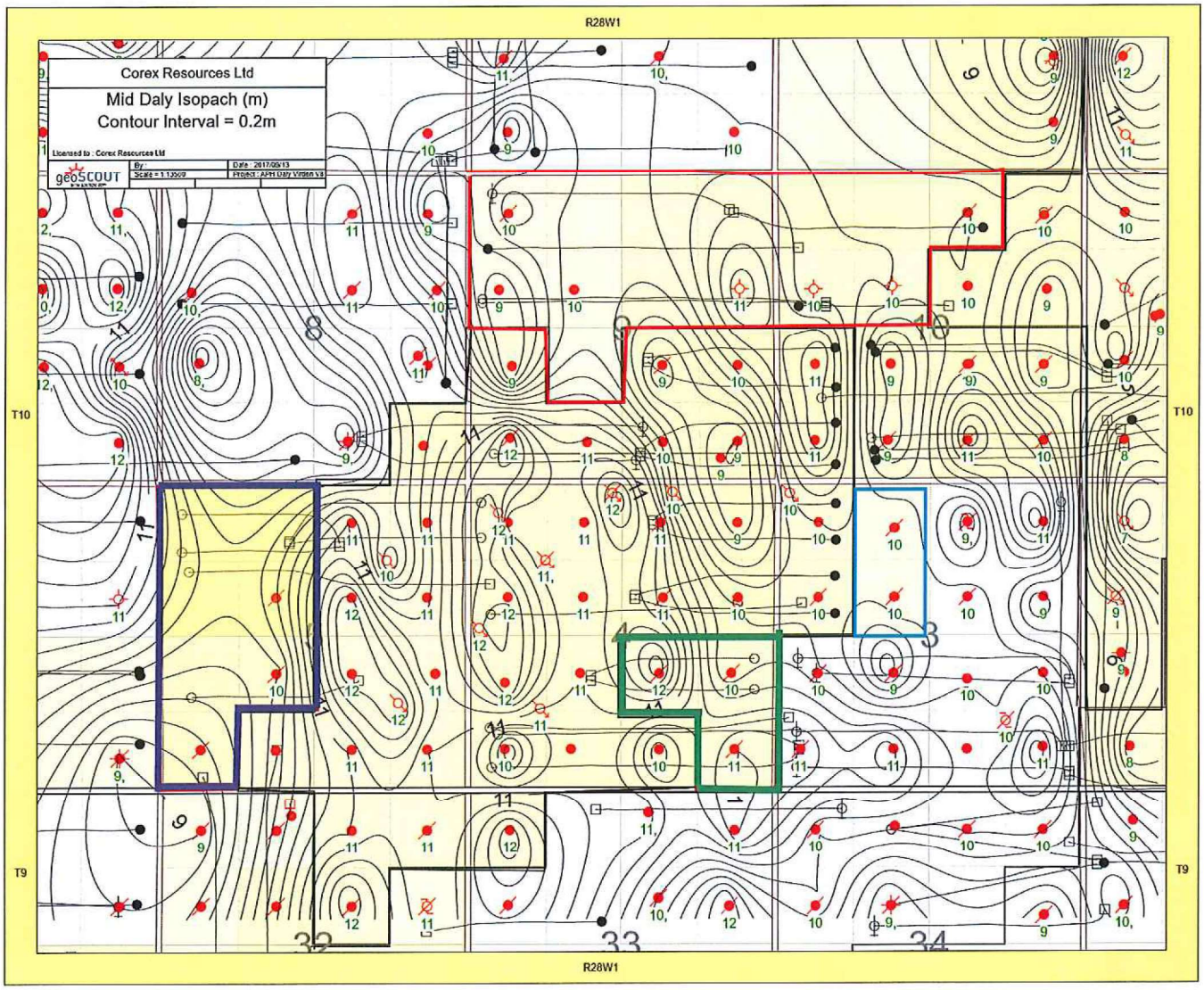

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix IX – Lower Daly – Permeability



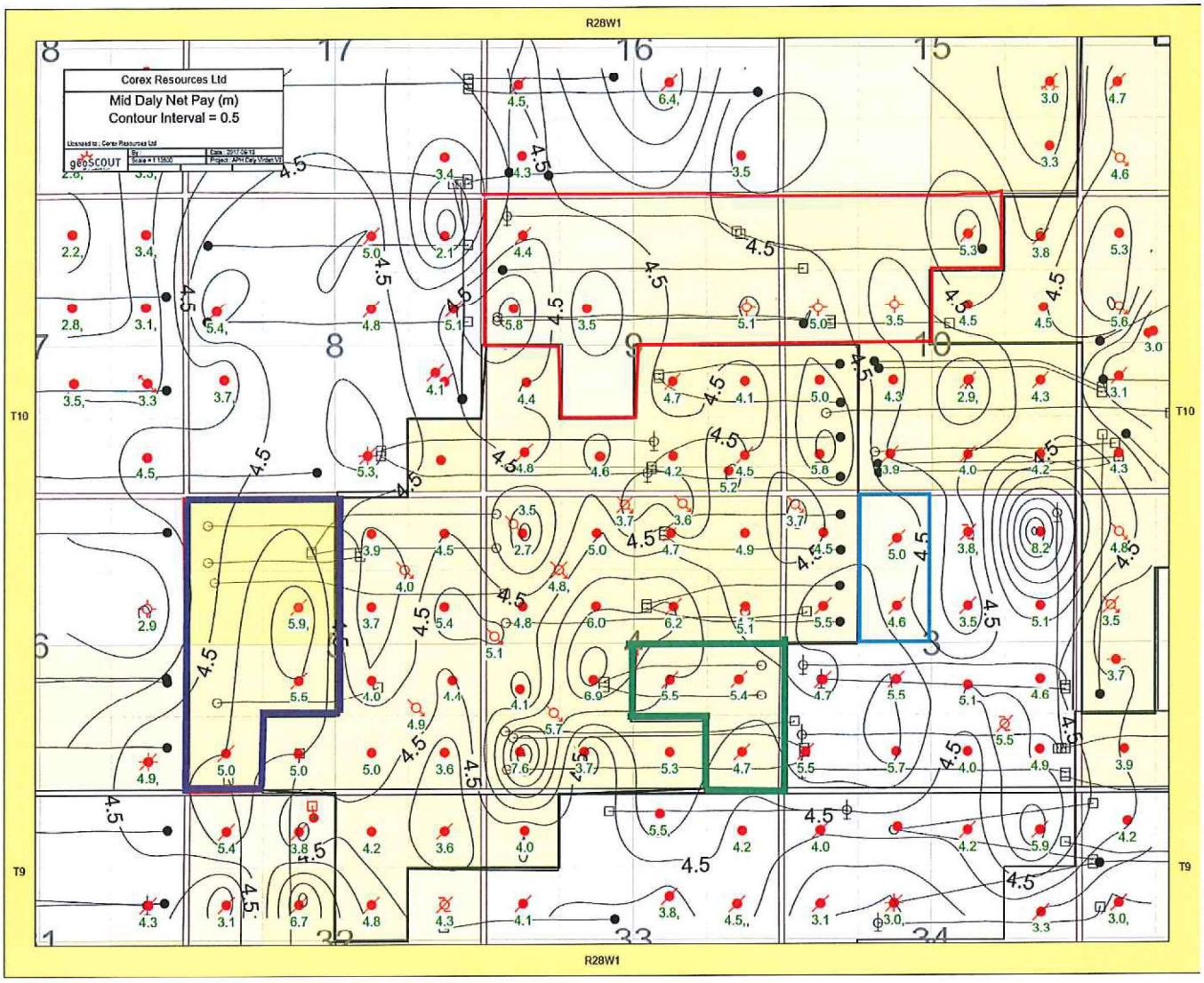

- Proposed Daly Unit No. 15
- Proposed Daly Unit No. 16
- Proposed Daly Unit No. 17
- Proposed Daly Unit No. 18

## Appendix X – Middle Daly – Isopach



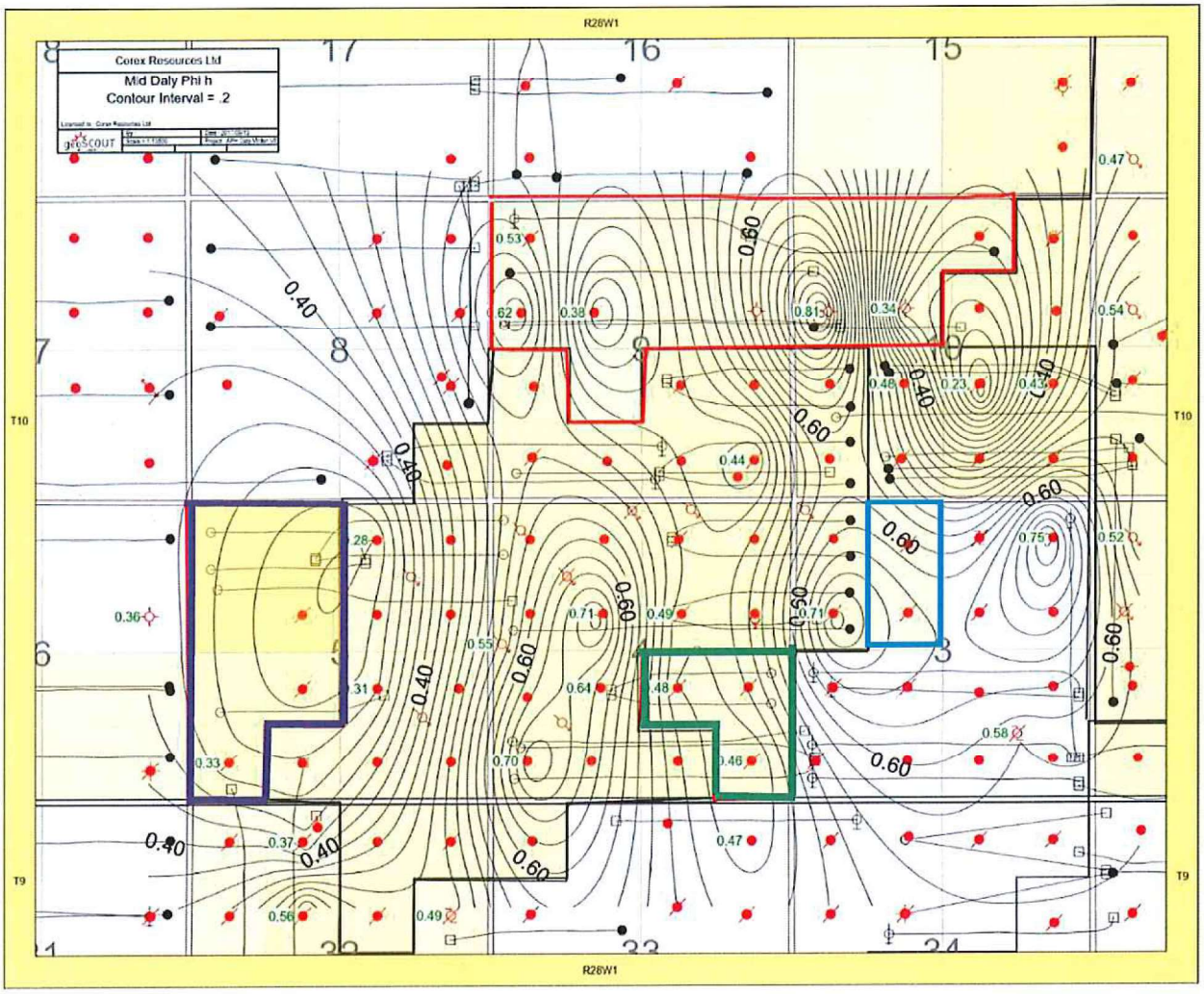

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

# Appendix XI – Middle Daly – Net Pay



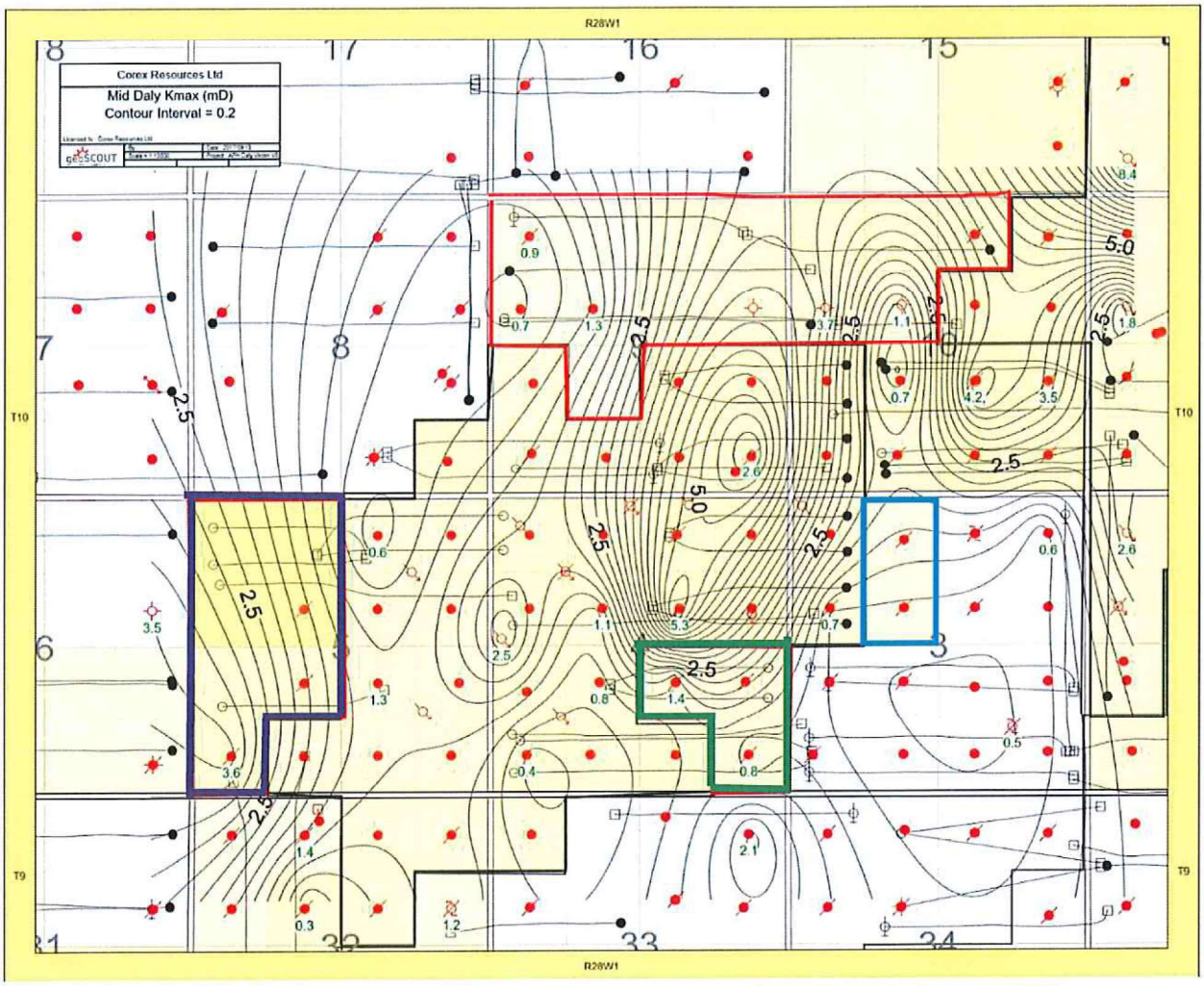

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XII – Middle Daly – Porosity-Thickness



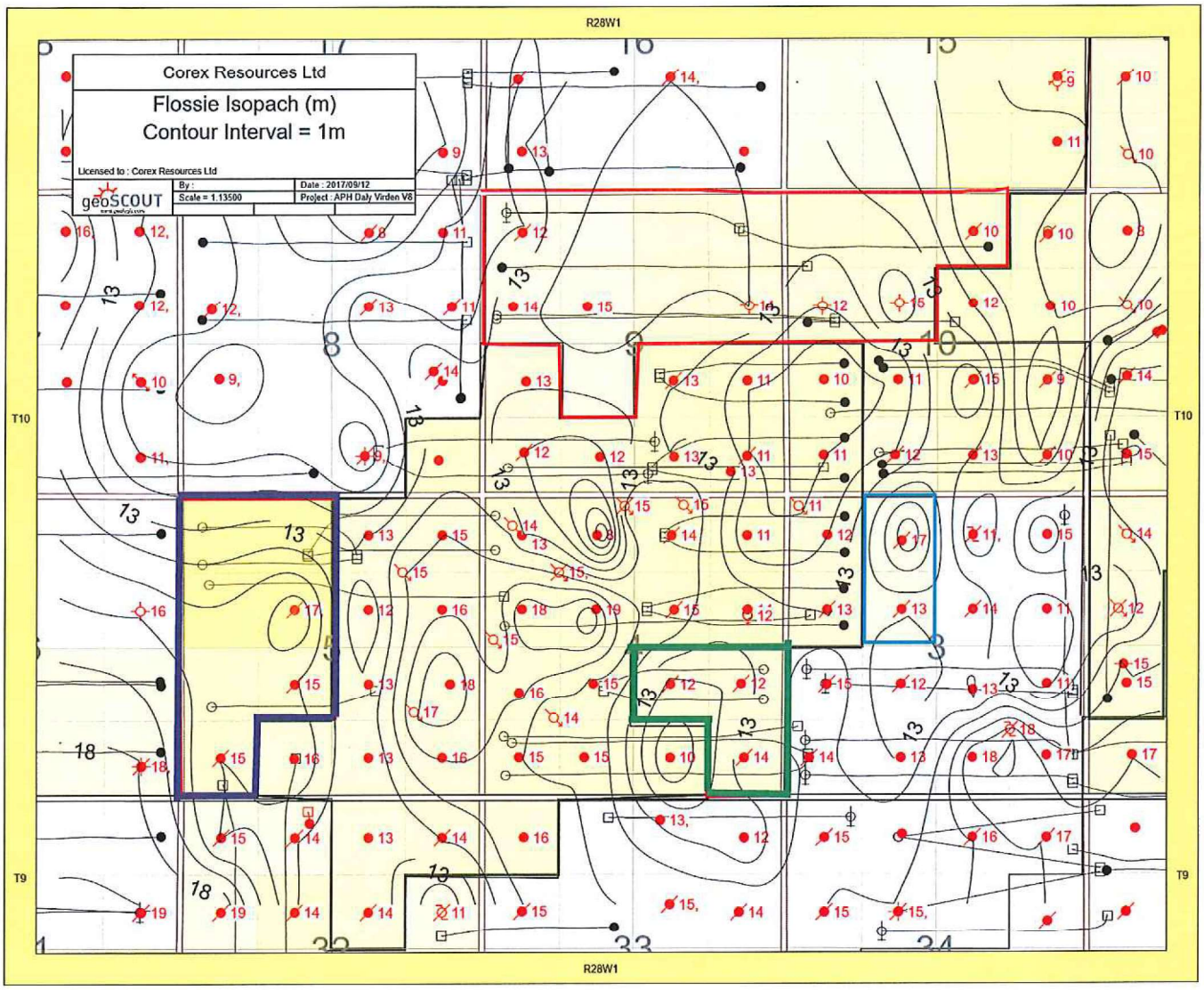

- Proposed Daly Unit No. 15
- Proposed Daly Unit No. 16
- Proposed Daly Unit No. 17
- Proposed Daly Unit No. 18

## Appendix XIII – Middle Daly – Permeability



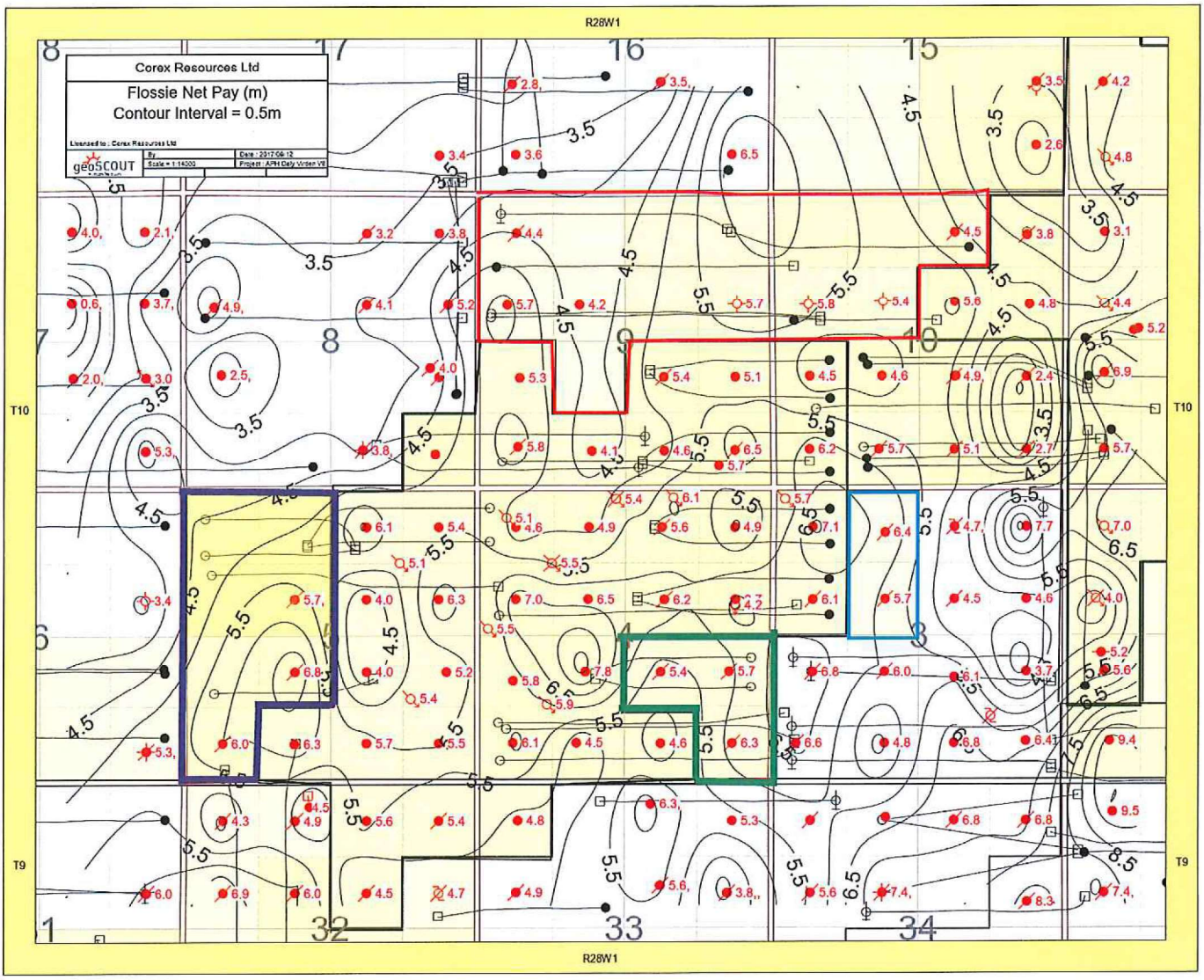

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

# Appendix XIV – Flossie Lake – Isopach



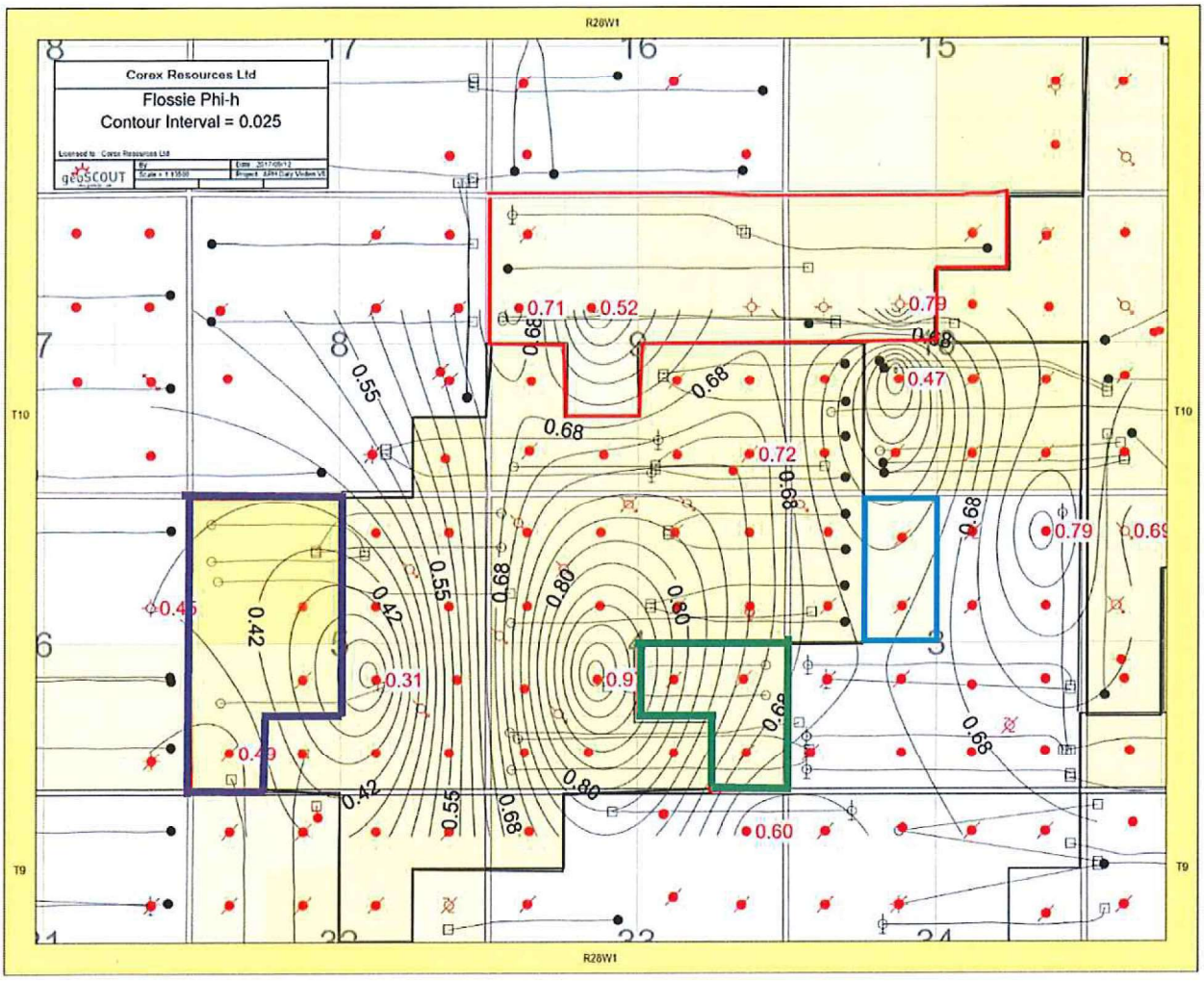

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

# Appendix XV – Flossie Lake – Net Pay



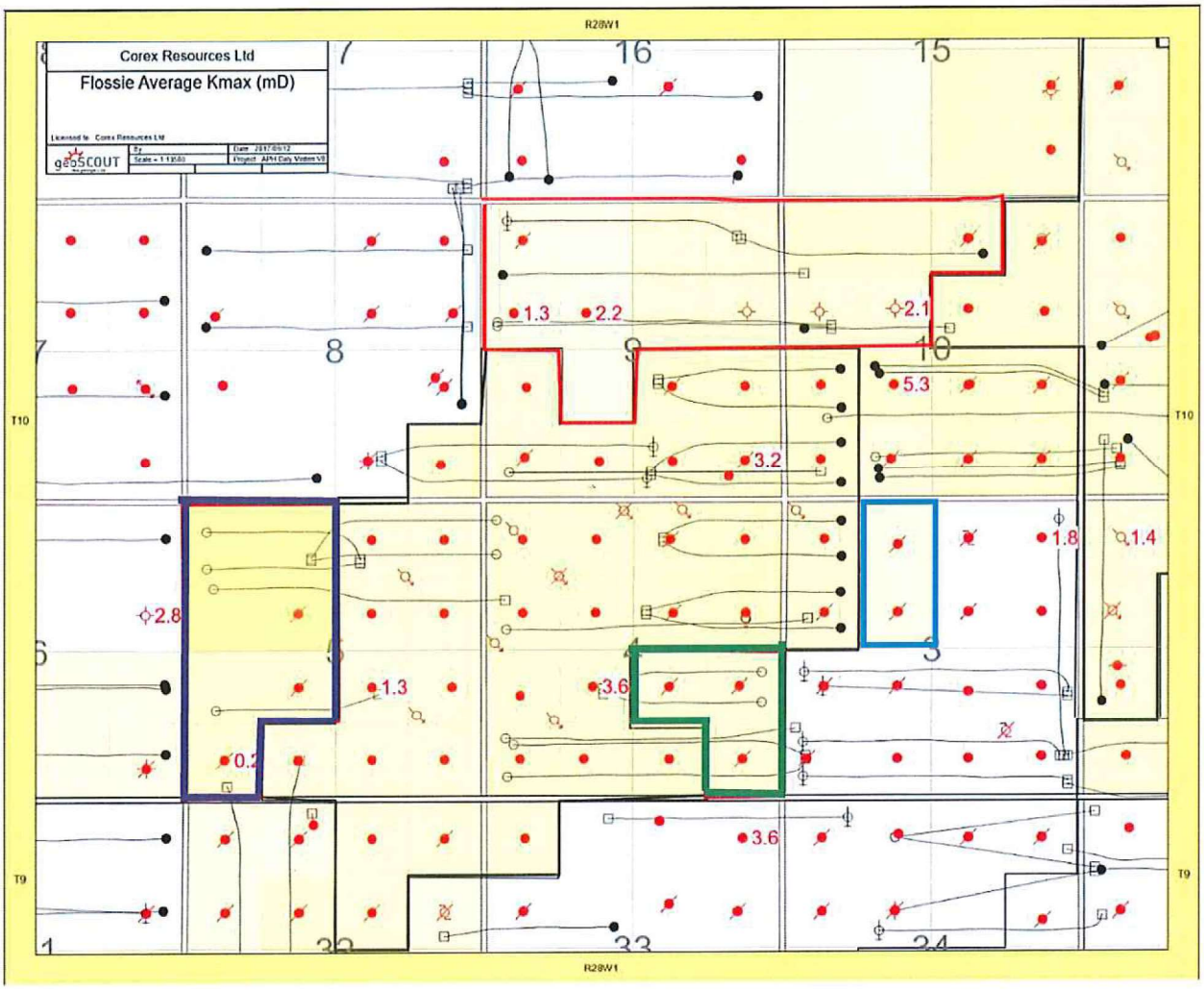

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XVI – Flossie Lake – Porosity-Thickness



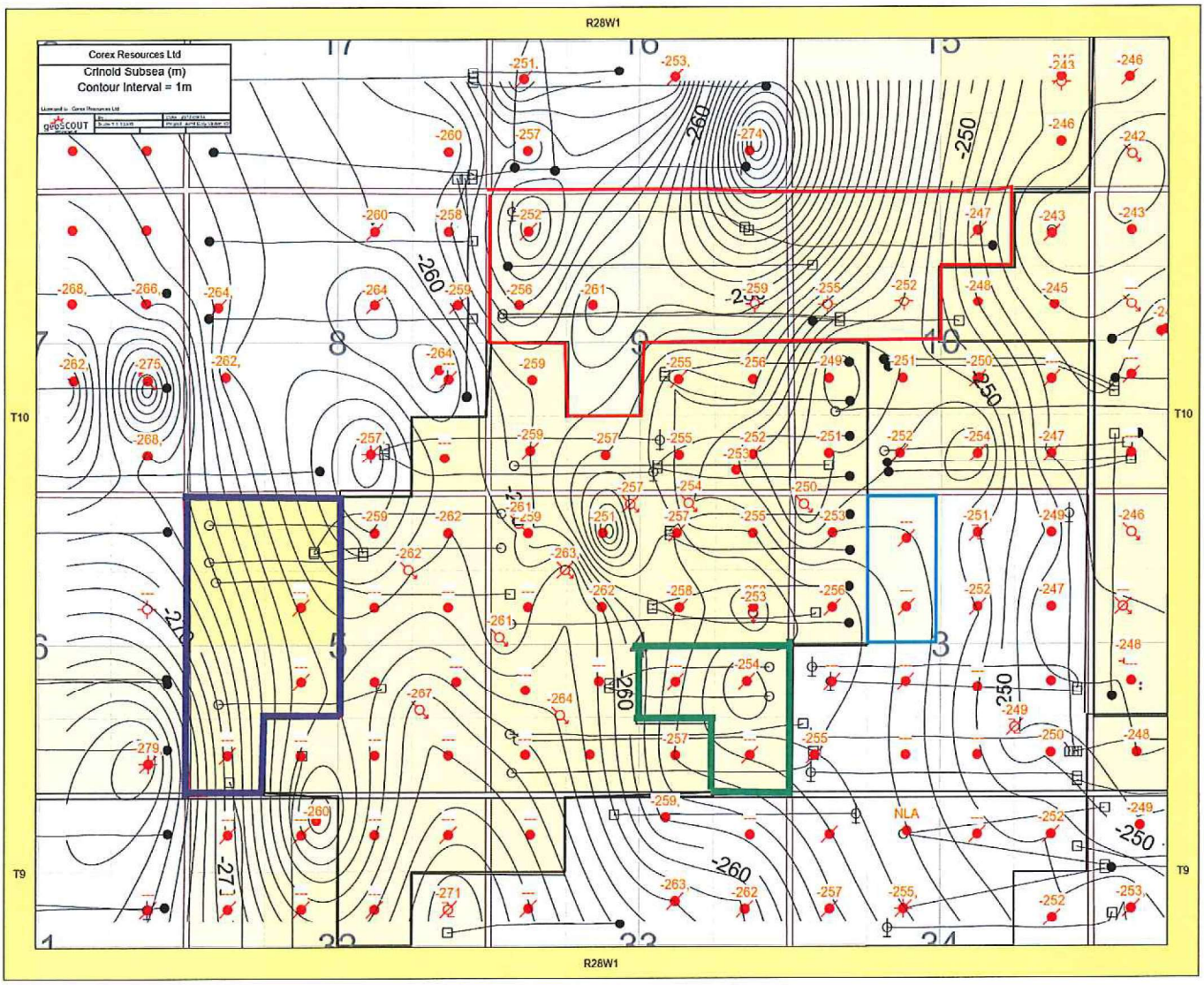

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XVII – Flossie Lake – Permeability



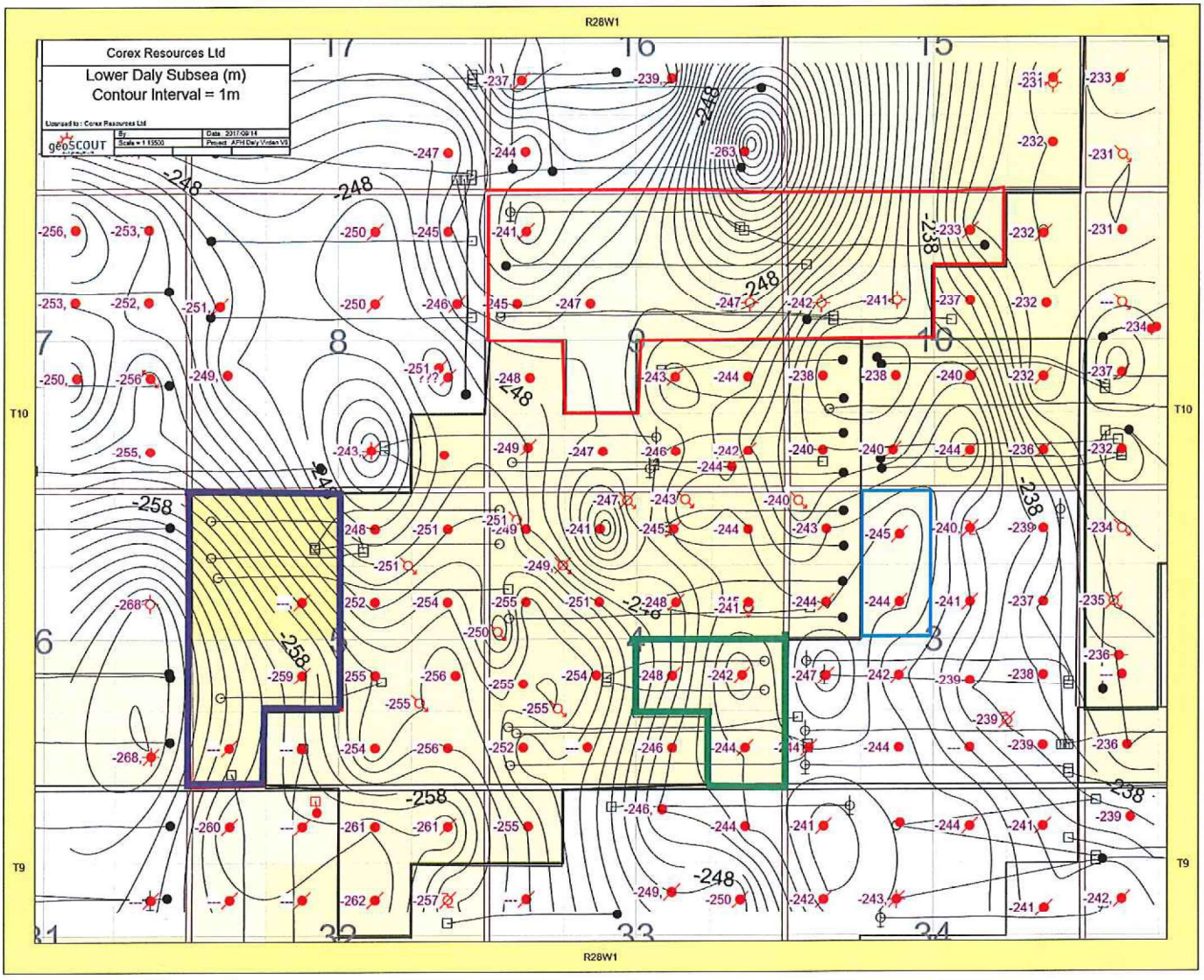

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XVIII – Crinoidal – Top of Structure



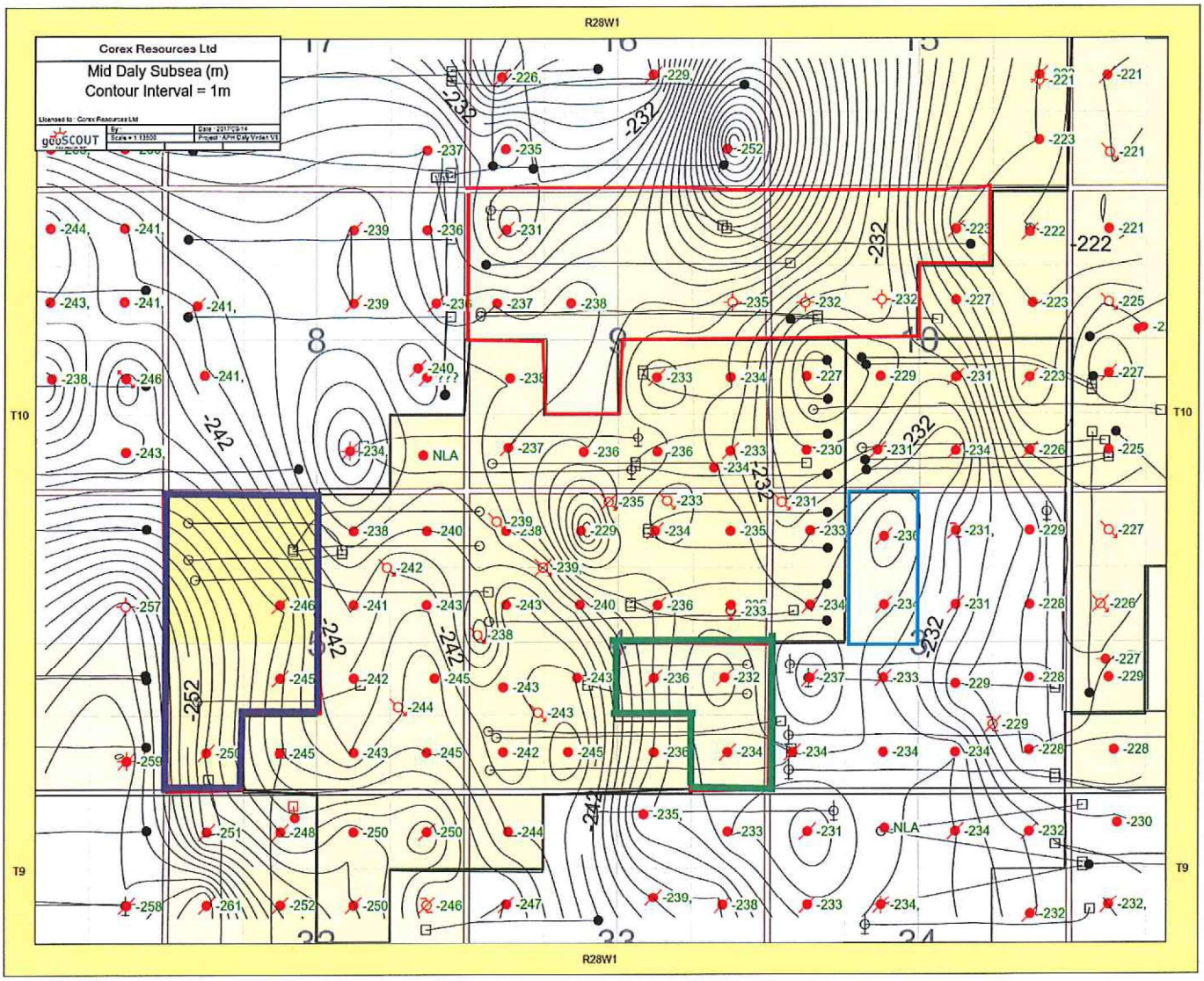

- Proposed Daly Unit No. 15
- Proposed Daly Unit No. 16
- Proposed Daly Unit No. 17
- Proposed Daly Unit No. 18

## Appendix XIX – Lower Daly – Top of Structure



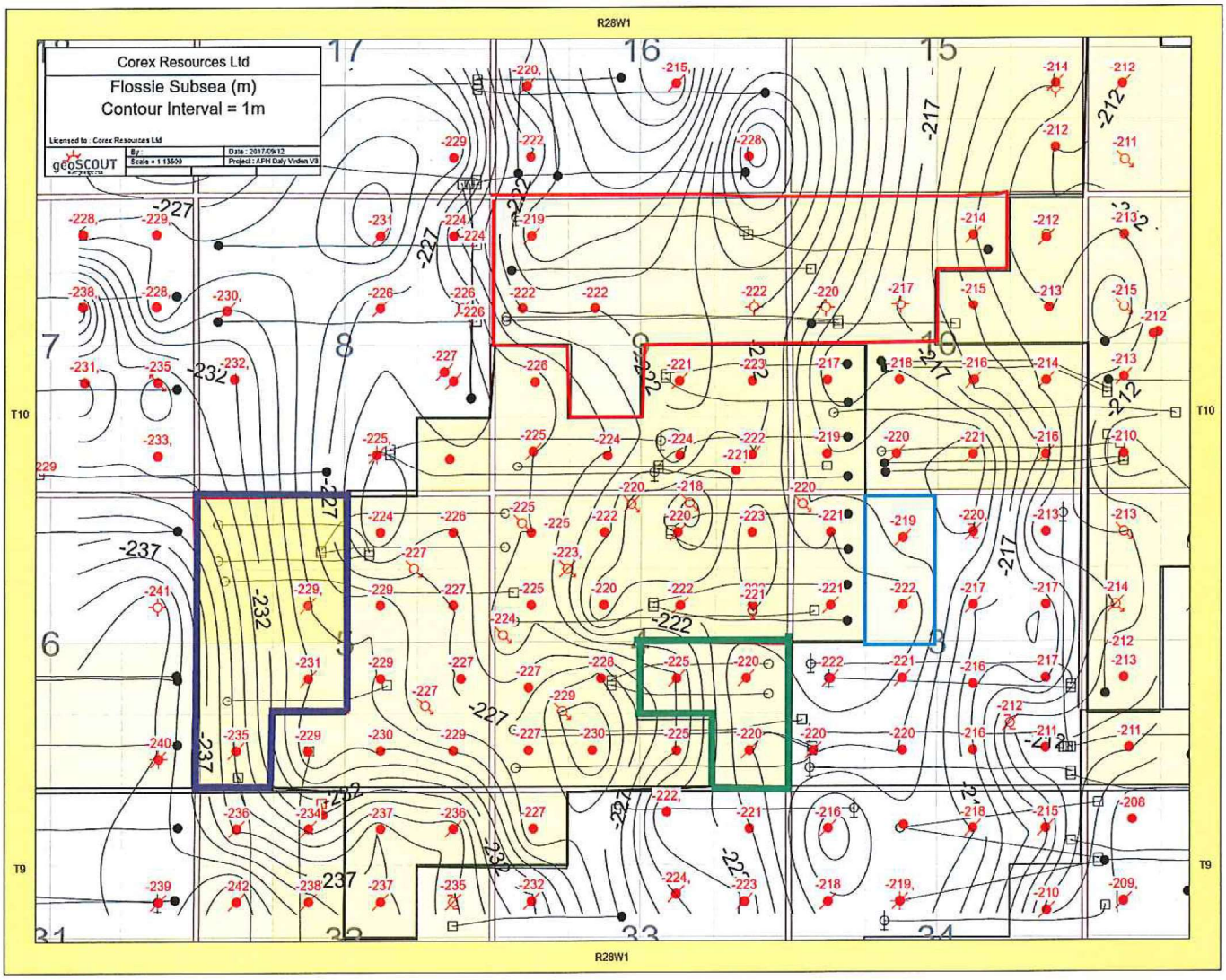

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XX – Middle Daly – Top of Structure



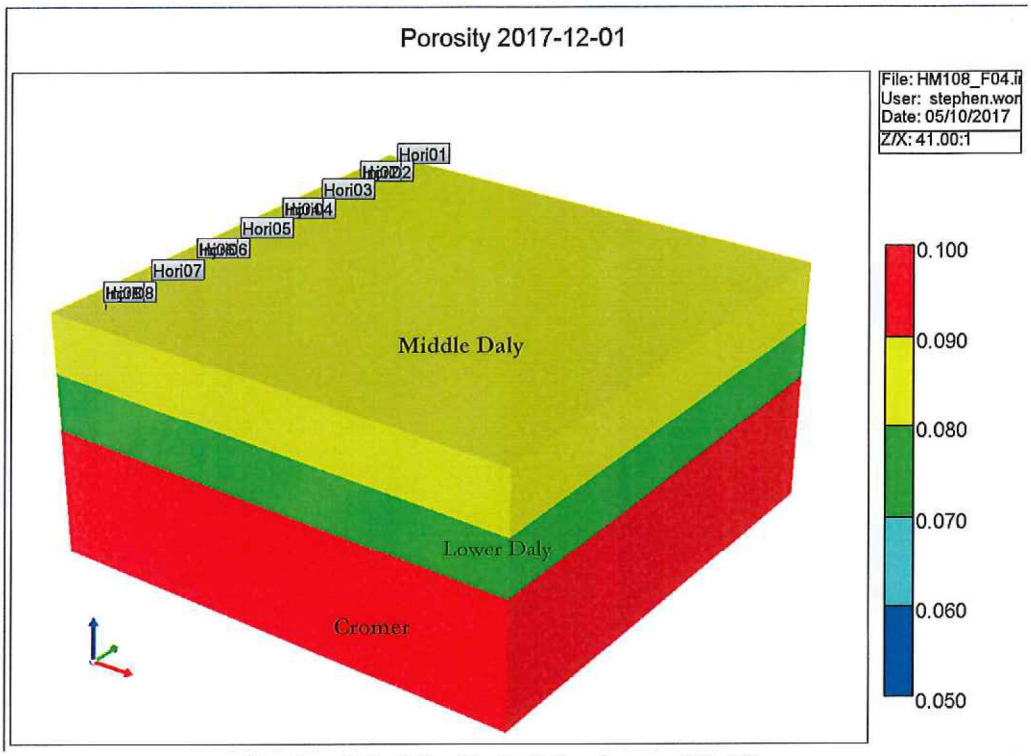

Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XXI – Flossie Lake – Top of Structure

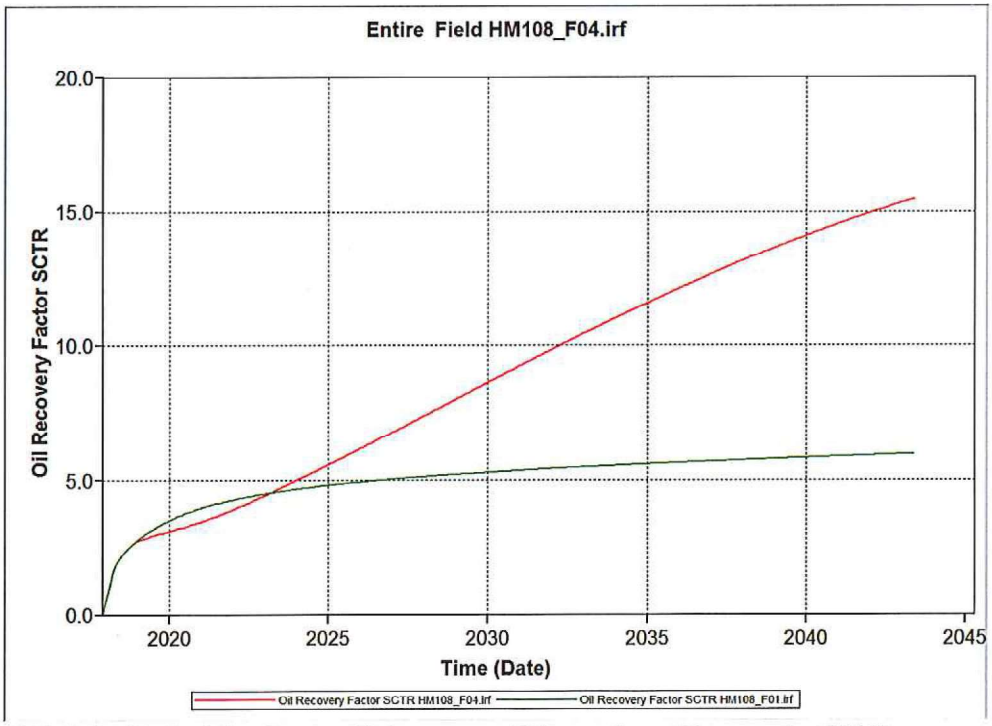



Proposed Daly Unit No. 15
Proposed Daly Unit No. 16
Proposed Daly Unit No. 17
Proposed Daly Unit No. 18

## Appendix XXII – Daly Members – Section Model




*Section Model – Daly Members– 3D View*




*Section Model – Daly Members – Primary and Secondary Forecast – Oil Recovery Factor versus Time -This Model Was Used to Scale Results for the Daly Unit No. 16 Area*