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## **Railroad Commission Update**

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# RAILROAD COMMISSION UPDATE

## I. Overview

In one way or another, the following topics addressed in this update relate to the continuing efforts by the Railroad Commission of Texas to regulate and accommodate unconventional resource development:

- The RRC concluded a rulemaking to update its Statewide Rules for horizontal wells, and as part of that rulemaking, it adopted new rules for unconventional fields developed with horizontal drilling and hydraulic fracture treatments (now to be designated as “UFT” Fields).
- The RRC continues to address issues relating to disposal wells for waste fluid from fracture treatments and production, including concerns about the potential for induced earthquakes and objections to disposal wells in residential areas.
- The RRC issued an order force pooling a State river tract that was not included in horizontal drilling and development on adjoining acreage.
- Downstream from the leases, as a result of the demand for pipeline transportation of natural gas liquids, the RRC is conducting a tariff rate case for a common carrier liquids pipeline.

## II. STATEWIDE RULE AMENDMENTS FOR HORIZONTAL WELLS AND UFT FIELDS

In a rulemaking completed in January 2016, the RRC amended its Statewide Rules for horizontal wells and adopted a new designation for unconventional fracture treated fields. The RRC adopted amendments to Statewide Rules 5, 31, 38, 40, 51, 52, and 86.<sup>1</sup> In part, these amendments update the RRC’s rules for horizontal wells drilled in any field. In addition, the amendments create a new designation for unconventional fracture treated fields (“UFT Fields”) with specific rules to facilitate development in unconventional plays. Most of the amendments are patterned after rules already adopted by the RRC as field rules for shale and unconventional fields across the state. The amendments bring forward the best and most widely accepted of those field rule provisions into generally applicable Statewide Rules.

### A. STATEWIDE RULE CHANGES FOR ALL HORIZONTAL WELLS

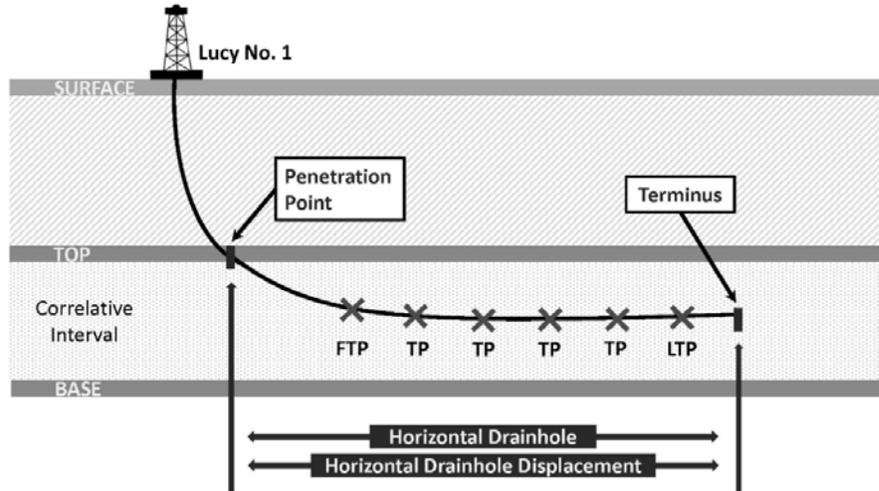
#### 1. Rule 86 Definition of Horizontal Drainhole Displacement

The Rule 86 definition of “horizontal drainhole displacement” has been amended. For some wells, this change might reduce the amount of additional acreage that can be assigned to the well for proration.

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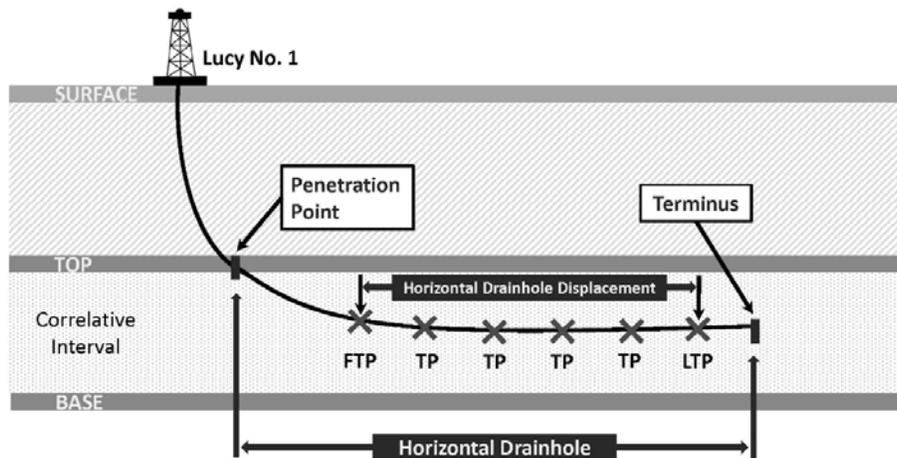
<sup>1</sup> 41 TexReg 785 (January 29, 2016)

Before the amendment, “horizontal drainhole displacement” was defined as the calculated horizontal displacement of the horizontal drainhole from the penetration point to the terminus. As depicted in the schematic diagram below, this prior definition focused on the entry of the lateral into the correlative interval, and on the end of the lateral, without regard to take points or perforations in the lateral.



**HORIZONTAL DRAINHOLE DISPLACEMENT “BEFORE” RULE 86 AMENDMENT**

With the amendment to Rule 86, the term “horizontal drainhole displacement” is now defined as the calculated horizontal displacement of the horizontal drainhole from the first take point to the last take point.”<sup>2</sup> This amendment would make no difference if the FTP and PP were to coincide and if the LTP and Terminus were to coincide. For most wells, however, the FTP and LTP will be inside the PP and Terminus as depicted in the schematic diagram below, so the horizontal drainhole displacement will be reduced under the amended rule.



**HORIZONTAL DRAINHOLE DISPLACEMENT “AFTER” RULE 86 AMENDMENT**

<sup>2</sup> Statewide Rule 86(a)(4), 16 TAC § 3.86.

Because the additional acreage table in Rule 86(d) adds acreage in increments of 20 or 40 acres,<sup>3</sup> the reduced displacement under the amended Rule 86 will not affect some wells, but for other wells the available additional acreage will be reduced.

**Additional Acreage Assignment**  
**For Fields with a Density Rule of 40 Acres or Less**

| Horizontal Drainhole Displacement, ft | Additional Acreage Allowed, acres |
|---------------------------------------|-----------------------------------|
| 100 to 585                            | 20                                |
| 586 to 1,170                          | 40                                |
| 1,171 to 1,755                        | 60                                |
| 1,756 to 2,340                        | 80                                |
| 2,341 to 2,925                        | 100                               |
| 2,926 to 3,510                        | 120                               |
| etc. - 585 ft increments              | etc. - 20 acre increments         |

**Additional Acreage Assignment**  
**For Fields with a Density Rule Greater Than 40 Acres**

| Horizontal Drainhole Displacement, ft | Additional Acreage Allowed, acres |
|---------------------------------------|-----------------------------------|
| 150 to 827                            | 40                                |
| 828 to 1,654                          | 80                                |
| 1,655 to 2,481                        | 120                               |
| 2,482 to 3,308                        | 160                               |
| 3,309 to 4,135                        | 200                               |
| 4,136 to 4,962                        | 240                               |
| etc. - 827 ft increments              | etc. - 40 acre increments         |

**RULE 86 ADDITIONAL ACREAGE ASSIGNMENT CHART**

This amendment will potentially reduce well allowables that rely on additional acreage, which in turn could reduce allowable production until a well declines in capability below its allowable limit. Additionally, this amendment will potentially impact pooling authority and retained acreage under leasehold documents that reference proration unit acreage or maximum allowable.

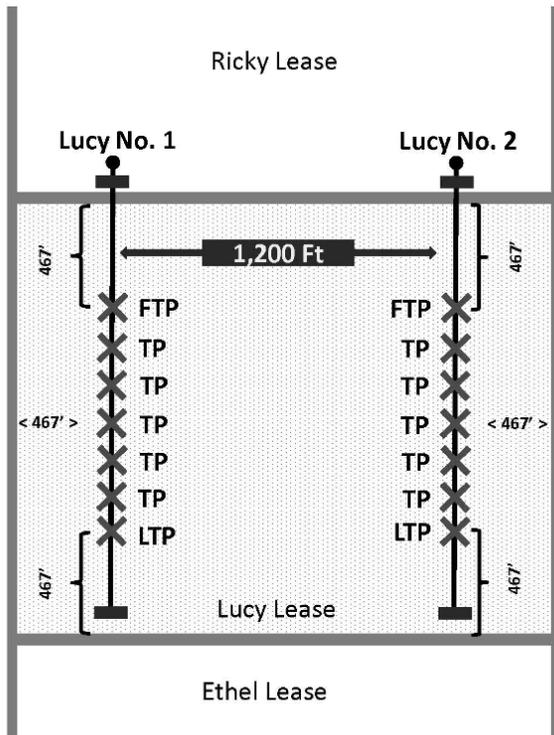
<sup>3</sup> Statewide Rule 86(d), 16 TAC § 3.86.

## 2. Rule 86 Take Point Spacing Rules

The new amendments to Rule 86 adopt “take point” rules for all horizontal wells, patterned after the take point rules developed in field rules for unconventional fields. A take point is defined as “any point along a horizontal drainhole where oil and/or gas can be produced from the correlative interval.”<sup>4</sup> In practice, this typically means a perforated interval. Under take point rules, the distances for spacing regulations are measured from the locations of the take points, and the portions of the lateral that are un-perforated and cased so that oil or gas cannot enter the well are not considered for spacing purposes.

### a. Minimum Spacing Distances from Take Points

Under the amendments to Rule 86, the minimum regular spacing distances for a horizontal well remain at the standard 467’ from boundary lines<sup>5</sup> and 1,200’ between wells on the same lease or pooled unit<sup>6</sup>. With the rule amendments, however, these standard distances to boundary lines and between wells are measured from take points for horizontal wells:



**REGULAR SPACING LOCATIONS UNDER RULE 86 TAKE POINT RULES**

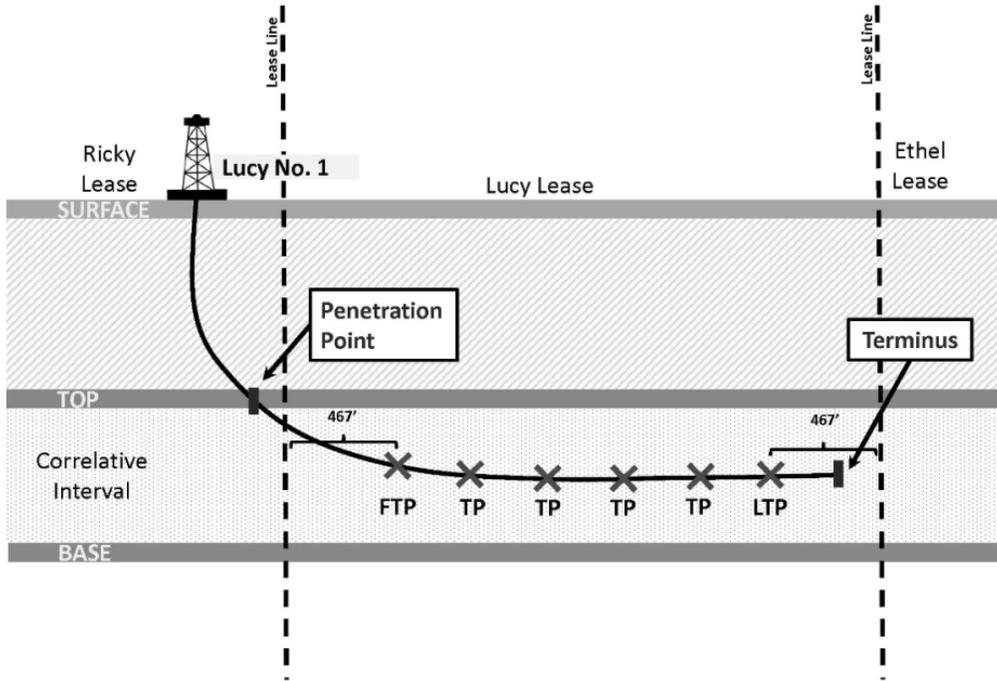
<sup>4</sup> Statewide Rule 86(a)(11), 16 TAC § 3.86.

<sup>5</sup> Statewide Rule 86(b)(2), 16 TAC § 3.86.

<sup>6</sup> Statewide Rule 86(b)(1), 16 TAC § 3.86.

**b. Offsite Penetration Points**

The Rule 86 amendments also provide for offsite penetration points for horizontal wells.<sup>7</sup> This allows the operator to build the heel of the horizontal well lateral from outside the lease so that the FTP can be closer to the lease line:

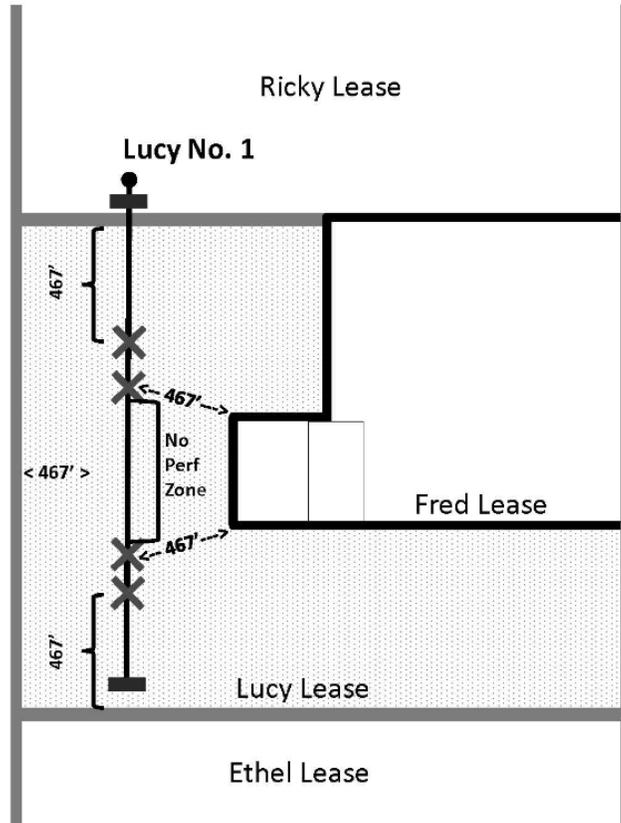


**OFFSITE PENETRATION POINT UNDER RULE 86 TAKE POINT RULES**

<sup>7</sup> Statewide Rule 86(g), 16 TAC § 3.86

**c. Nonperforation Zones**

The Rule 86 amendments include an NPZ or nonperforation zone rule to allow operators to avoid the need for a Rule 37 exception permit by not perforating the portion of a horizontal well that passes too close to a boundary line.



**NONPERFORATION ZONE UNDER RULE 86 TAKE POINT RULES**

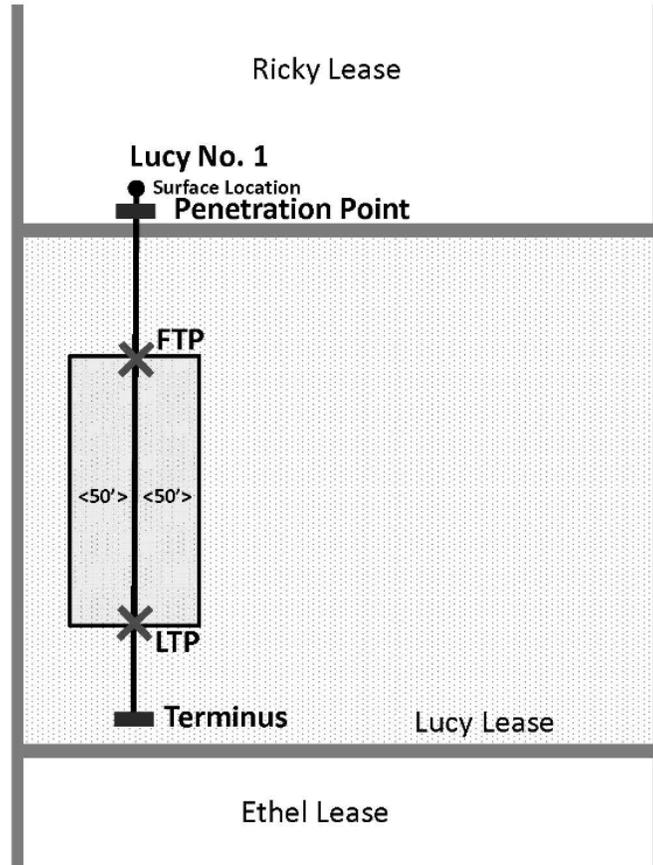
The term nonperforation zone is defined as “a portion of a horizontal drainhole well within the field between the first take point and the last take point that the operator has intentionally designated as containing no take points pursuant to the spacing requirements . . . .”<sup>8</sup> The operator must indicate the NPZs on the permit application and provide the locations of the NPZ on the as-drilled plat filed after completion.<sup>9</sup>

<sup>8</sup> Statewide Rule 86(a)(7), 16 TAC § 3.86.

<sup>9</sup> Statewide Rule 86(b)(4), 16 TAC § 3.86.

**d. Box Rule**

The Rule 86 amendments include a “Box Rule,” that provides operators with a safe harbor for compliance with permitted spacing distances.<sup>10</sup> Under this rule, the well complies with the spacing requirements if the as-drilled location of the lateral falls within a rectangle drawn through the FTP and the LTP that is 50’ from the lateral on either side (or 10% of the lease line spacing rule distance if that is greater than 50’).

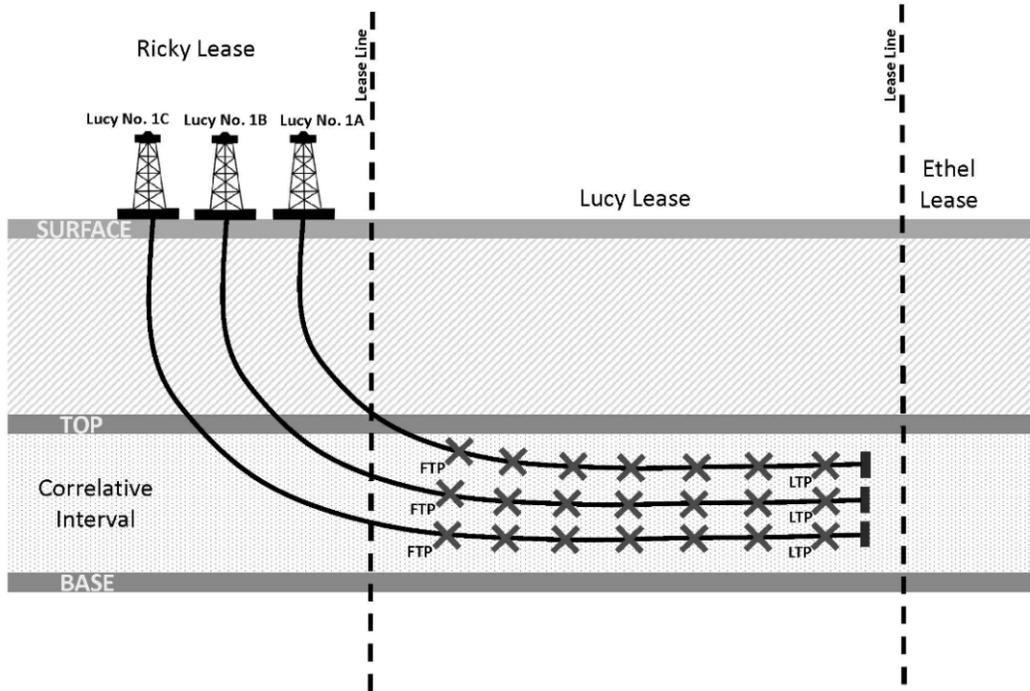


**BOX RULE UNDER RULE 86 TAKE POINT RULES**

<sup>10</sup> Statewide Rule 86(b)(5), 16 TAC § 3.86.

**e. Stacked Laterals**

The Rule 86 amendments include rules for stacked laterals, which allows an operator to drill and produce multiple horizontal wells that are treated as only a single well for density and allowable purposes.<sup>11</sup> This lets an operator develop and produce different depths with multiple horizontal laterals within the correlative interval without the need for obtaining density exceptions.



**STACKED LATERALS UNDER RULE 86 TAKE POINT RULES**

To qualify as stacked laterals under Rule 86, the operator’s horizontal drainholes must be from different surface locations to different depths within the field interval, and the take points for all the horizontal drainholes must be within a 660’-wide rectangle around one of the laterals that is designated as the “record” well.<sup>12</sup> In the vertical direction, however, there are no minimum or maximum distance limitations between the horizontal drainholes.<sup>13</sup>

<sup>11</sup> Statewide Rule 86(f)(1), 16 TAC § 3.86

<sup>12</sup> Statewide Rule 86(a)(10), 16 TAC § 3.86

<sup>13</sup> Statewide Rule 86(f)(4), 16 TAC § 3.86



For a horizontal well drilled across multiple tracts that are not pooled or unitized (for example, a well permitted as a PSA well or an Allocation Well), Sections V and VI of the Form P-16 require the operator to disclose each tract that contributes acreage to the well in the field and to identify the wells and assigned acreage on those tracts in that field.

| SECTION V. LISTING OF ALL TRACTS CONTRIBUTING ACREAGE TO AN RRC DESIGNATED DRILLSITE DEVELOPMENTAL UNIT THAT IS NOT A SINGLE LEASE, POOLED UNIT, OR GROUP OF TRACTS UNITIZED BY CONTRACT FOR PURPOSES OF SECONDARY RECOVERY |            |                         |                         |                       |  |
|---|------------|-------------------------|-------------------------|-----------------------|--|
| RRC ID No. or Lease No.   | Lease Name | Beginning Lease Acreage | Allocated Lease Acreage | Ending Lease Acreage  | Operator Name and Operator No. (if different from filing operator) |
|   |            |                         |                         |                       |  |
|   |            |                         |                         |                       |  |
|   |            |                         |                         |                       |  |
|   |            |                         |                         |                       |  |
|   |            |                         |                         |                       |  |
|   |            |                         |                         |                       |  |
|   |            |                         |                         |                       |  |
| Total Allocated Acreage >   |            |                         |                         | < Total Lease Acreage |  |

Filer is the owner or lessee, or has been authorized by the owner or lessee, of all or an undivided portion of the mineral estate under each tract for which filer is listed as operator below. For all leases operated by other entities, the number of assigned acres shown are reflected on current Commission records or the filer has been authorized by the current operator to change the assigned acreage of that operator as shown below.

| SECTION VI. LISTING OF ALL WELLS IN THE APPLIED FOR FIELD ON THE SAME ACREAGE AS THE LEASE OR POOLED UNIT DESIGNATED FOR THE TRACTS LISTED IN SECTION V BY FILER |          |                |                      |                          |                         |          |                |                      |                          |
|--|----------|----------------|----------------------|--------------------------|-------------------------|----------|----------------|----------------------|--------------------------|
| RRC ID No. or Lease No.  | Well No. | Acres Assigned | SWR 38 Except. (Y/N) |                          | RRC ID No. or Lease No. | Well No. | Acres Assigned | SWR 38 Except. (Y/N) |                          |
|  |          |                | H-Horizontal         | D-Directional V-Vertical |                         |          |                | H-Horizontal         | D-Directional V-Vertical |
|  |          |                |                      |                          |                         |          |                |                      |                          |
|  |          |                |                      |                          |                         |          |                |                      |                          |

The Form P-16 disclosures are certified by the operator under penalty of perjury and are relied on by the RRC in issuing drilling permits and assigning allowables.

For leasehold pooling and retained acreage purposes, the Form P-16 can provide details about the acreage and interests assigned to wells.

In addition to the Form P-16, Rule 86 requires proration unit plats for horizontal wells in non-UFT fields.<sup>15</sup> For UFT fields, proration unit plats are not required, but an operator may file a proration unit plat along with the Form P-16.<sup>16</sup> Apart from the RRC’s requirements, an operator should determine whether a plat or proration unit plat must be filed with the RRC for pooling authority or retained acreage purposes under specific leasehold documents.

<sup>15</sup> Statewide Rule 86(g)(4), 16 TAC § 3.86.

<sup>16</sup> Statewide Rule 86(g)(4), 16 TAC § 3.86.

## **B. Designated UFT Fields**

### **1. Qualification and Designation as a UFT Field**

A UFT field is defined as a field designated by the RRC for which horizontal well development and hydraulic fracture treatment must be used to recover resources from all or part of the field.<sup>17</sup> To qualify for designation as a UFT field, there must be data or analysis indicating that part of the field has very limited permeability, and there must be a minimum number of horizontal wells completed with hydraulic fracture treatment.<sup>18</sup> The RRC may designate UFT fields on its own motion, or an operator may propose designation.<sup>19</sup>

The definition of unconventional fracture treated field focuses on the limited permeability of the formation and the need to develop the reserve with horizontal wells that are fracture treated. Rule 86(a)(13) provides the following definition:

Unconventional fracture treated (UFT) field--A field designated by the Commission under subsection (i) of this section for which horizontal well development and hydraulic fracture treatment (as defined in §3.29(a)(15) and (16) of this title (relating to Hydraulic Fracturing Chemical Disclosure Requirements)) must be used in order to recover resources from all or a part of the field and which may include the drilling of vertical wells along with the drilling of horizontal wells.<sup>20</sup>

Subsection (i)(1)(A) of Rule 86 specifies the criteria for administrative designation as UFT field, without a hearing:

Administrative UFT field designation. To be designated administratively as a UFT field, a field shall have the following characteristics:

- (i) the *in situ* permeability of at least one distinct producible interval within the field is 0.1 millidarcies or less prior to hydraulic fracture treatment, as determined by core data or other supporting data and analysis; and
- (ii) as to producing wells for which the Commission issued the initial drilling permit on or after February 1, 2012, that have been completed in the field, either:

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<sup>17</sup> Statewide Rule 86(a)(13), 16 TAC § 3.86.

<sup>18</sup> Statewide Rule 86(i)(1), 16 TAC § 3.86.

<sup>19</sup> Statewide Rule 86(i)(2), 16 TAC § 3.86.

<sup>20</sup> Statewide Rule 86(a)(13), 16 TAC § 3.86.

- (I) there are at least five such wells of which at least 65% were drilled horizontally and completed using hydraulic fracture treatment; or
- (II) there are at least twenty-five such wells drilled horizontally and completed using hydraulic fracture treatment.

If the field does not meet the criteria specified for administrative designation, the rule provides for designation through an evidentiary hearing, if the operator can prove that the field characteristics require horizontal wells and hydraulic fracture treatment to recover resources from all or part of the field:

(B) Alternative UFT field designation obtained through evidentiary hearing. If an applicant demonstrates in a hearing that reservoir characteristics exist other than the characteristics specified in subparagraph (A) of this paragraph such that horizontal drilling and hydraulic fracture treatment must be used in order to recover the resources from all or a part of the field and that UFT field designation will promote orderly development of the field, the hearings examiner may recommend to the Commission that the field be designated as a UFT field.

## **2. Consequences of UFT Field Designation**

### **a. Special Field Rules Prevail Over Conflicting Statewide UFT Rules**

If special field rules conflict with the Statewide UFT rules, the field rules prevail. Rule 86 (j)(1) states that “[s]pecial field rules for a UFT field shall prevail over all conflicting provisions of this chapter.”<sup>21</sup> The words “this chapter” refer to Chapter 3 of Title 16, Part 1 of the Texas Administrative Code, which contains all the RRC’s Oil and Gas Division Statewide rules.

### **b. Independent Acreage Assignments to Vertical and Horizontal Wells in UFT Fields**

The UFT amendments include changes to Statewide Rule 40 to regulate the assignment of acreage to vertical wells separately from the assignment of acreage to horizontal wells. For UFT fields, Rule 40 allows the same acreage to be double-assigned simultaneously to vertical and horizontal wells.<sup>22</sup> In a UFT field, it is as though the horizontal wells and the vertical wells

<sup>21</sup> Statewide Rule 86(j)(1), 16 TAC § 3.86.

<sup>22</sup> Statewide Rule 40(e)(1, (2), and (3), 16 TAC § 3.40

do not see each other. If applicable, this could increase the number of horizontal wells that can be drilled in UFT fields that have previously been developed with vertical wells.

**c. Increased Allowables for Horizontal Wells in UFT Fields**

Under Statewide Rule 86, all horizontal wells in any field can receive increased allowable by assigning additional acreage based on horizontal drainhole displacement.<sup>23</sup>

In general, horizontal wells in UFT fields can obtain more allowable than horizontal wells in non-UFT field. For a designated UFT field, the maximum daily allowable for a horizontal oil well is 100 barrels of oil for each acre assigned to the well, and the maximum daily allowable for a horizontal gas well is 600 Mcf of gas for each acre assigned to the well.<sup>24</sup>

**d. Rule 38 “Light” Density Exceptions for UFT Fields**

The UFT rules modify the notice and proof requirements for obtaining a Rule 38 exception to the density rule.<sup>25</sup>

The new rule requires notice of the proposed Rule 38 exception to only the affected parties within 600’ of a take point of a horizontal well or location of a vertical well.<sup>26</sup> This requirement is reduced from the normal Rule 38 requirement for notice to all operators and owners of the surrounding adjoining tracts.<sup>27</sup> Under the new rule, for a UFT well that is more than 600’ from the well, no notice would be required.

The Rule 38 “light” exception will be approved administratively, without submission of supporting data, if there is no objection to the application, if there are waivers from the affected parties, or if no notice is required to any affected party.<sup>28</sup> The no-supporting-evidence provision is relaxed from the standard requirement for supporting technical data required for a standard exception under Rule 38.<sup>29</sup>

If there is an objection, the applicant is required to show that the proposed density exception is “necessary to effectively drain an area of the UFT field that will not be effectively drained by existing wells or to prevent waste or confiscation.”<sup>30</sup> The option of proving that the proposed exception well will drain an area that is not effectively drained may in some instances provide a lesser standard of proof for the density exception than would be required for the normal waste or confiscation proof required for a normal density exception under Rule 38.

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<sup>23</sup> Statewide Rule 86(d)(1), 16 TAC § 3.86.

<sup>24</sup> Statewide Rule 86(d)(5), 16 TAC § 3.86.

<sup>25</sup> Statewide Rule 86(k), 16 TAC § 3.86.

<sup>26</sup> Statewide Rule 86(k)(2), 16 TAC § 3.86.

<sup>27</sup> Statewide Rule 38(h)(1)(A), 16 TAC § 3.38.

<sup>28</sup> Statewide Rule 86(k)(4), 16 TAC § 3.86.

<sup>29</sup> Statewide Rule 38(h)(1)(A)(i), 16 TAC § 3.38.

<sup>30</sup> Statewide Rule 86(k)(5), 16 TAC § 3.86.

**e. No-Hearing Field Rules Amendments for UFT Fields**

For a designated UFT field that already has special field rules, Rule 86 contains procedures for obtaining specified amendments to the spacing, density, or allowable rules without a hearing when there is no objection from any operator in the field after at 21-day notice period.<sup>31</sup> These no-hearing procedures apply to three specific field rules amendments:

- (1) reduction of the standard or option density rule to one-half of the existing standard or optional density rule,
- (2) deletion of the between-well spacing rule, or
- (3) adoption of the increased allowable rates specified by Statewide Rules.<sup>32</sup>

The applicant must submit supporting engineering or geological data and explanations showing that the amendment will result in protection of correlative rights or prevention of waste.<sup>33</sup> If there is no objection, the RRC staff can then present the application to the Commissioners, which presumably would be approved if warranted by the supporting data.<sup>34</sup>

**C. Acreage Assigned for Maximum Allowables for Horizontal Wells**

The amended rules identify the acreage assigned to a horizontal well for obtaining maximum allowables. Rule 86(d)(4) expressly ties the maximum daily allowable to both the additional acreage table in Rule 86(d)(1) and the barrels or mcf per acre rates in Rule 86(d)(5):

The maximum daily allowable assigned to a horizontal well shall comply with the table in subsection (d)(1) of this section and the maximum daily allowable specified by paragraph (5) of this subsection, unless special field rules specify different requirements for acreage or maximum daily allowable.<sup>35</sup>

Rule 86(d)(5) also ties the maximum daily rates to the acreage assigned to the well for allowable purposes:

The maximum daily allowable for a horizontal drainhole well in a designated UFT field shall be 100 barrels of oil for each acre that is assigned to an oil well for allowable purposes, or 600 Mcf of gas

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<sup>31</sup> Statewide Rule 86(j)(3), 16 TAC § 3.86.

<sup>32</sup> Statewide Rule 86(j)(3)(i) - (iii), 16 TAC § 3.86.

<sup>33</sup> Statewide Rule 86(j)(3)(B), 16 TAC § 3.86.

<sup>34</sup> Statewide Rule 86(j)(3)(C), 16 TAC § 3.86.

<sup>35</sup> Statewide Rule 86(d)(4), 16 TAC § 3.86

for each acre that is assigned to a gas well for allowable purposes. This paragraph does not affect suspension of the allocation formula under §3.31(j) of this title (relating to Gas Reservoirs and Gas Well Allowable). The maximum daily allowable for a horizontal drainhole well in a field that has not been designated as a UFT field shall be determined by multiplying the applicable allowable for a vertical well in the field with a proration unit containing the maximum acreage authorized by the applicable rules for the field, exclusive of tolerance acreage, by a fraction:

(A) the numerator of which is the acreage assigned to the horizontal drainhole well for proration purposes; and

(B) the denominator of which is the maximum acreage authorized by the applicable field rules for proration purposes, exclusive of tolerance acreage. The daily oil allowable shall be adjusted in accordance with §3.49(a) of this title (relating to Gas-Oil Ratio), when applicable.<sup>36</sup>

These rule provision may be useful for determining pooling authority and retained acreage amounts under leasehold documents.

### **III. DISPOSAL WELLS & INDUCED SEISMICITY**

#### **A. RRC Disposal Well Rules Require Applicants to Address Evidence of Recorded Seismicity in the Vicinity As Part of the Permit Application**

In 2014, the RRC amended its rules require that an applicant for a new disposal well permit submit information to show whether the proposed disposal well would be in an area of prior recorded earthquake activity. Rules 9 and 46 provide:

The applicant for a disposal well permit under this section shall include with the permit application a printed copy or screenshot showing the results of a survey of information from the United States Geological Survey (USGS) regarding the locations of any historical seismic events within a circular area of 100 square miles (a circle with a radius of 9.08 kilometers) centered around the proposed disposal well location.<sup>37</sup>

If there is no record of earthquake activity in the area of the proposed disposal well (which is the case in most of Texas), then nothing further would likely be required in connection with the application. On the other hand, if the disposal well would be in an area of seismic

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<sup>36</sup> Statewide Rule 86(d)(5), 16 TAC § 3.86

<sup>37</sup> Statewide Rules 9(3)(B) and 46(b)(1)(C); 16 TAC § 3.9 and § 3.46

activity, then the amended rules specify that the RRC may require additional information from the applicant:

The commission may require an applicant for a disposal well permit under this section to provide the commission with additional information such as logs, geologic cross-sections, pressure front boundary calculations, and/or structure maps, to demonstrate that fluids will be confined if the well is to be located in an area where conditions exist that may increase the risk that fluids will not be confined to the injection interval. Such conditions may include, but are not limited to, complex geology, proximity of the basement rock to the injection interval, transmissive faults, *and/or a history of seismic events in the area as demonstrated by information available from the USGS.*<sup>38</sup>

The RRC staff has been requesting additional information whenever there is a significant recorded earthquake activity in the vicinity of a proposed disposal well. In some instances, applicants have provided information to show that a recorded seismic event is incorrectly located in the USGS database and is not actually nearby the proposed disposal well. In other instances, applicants have demonstrated to the RRC Staff that the recorded seismic activity was related to fracture stimulation and is not indicative of fault movement associated with earthquake activity. For some applications, the RRC Staff has imposed seismic monitoring as a condition of the permit.

## **B. RRC Review of Permits for Seismic Activity**

### **1. Statewide Rules Provide for Permit Modification, Suspension, or Termination if Disposal Well is Contributing to Seismic Activity**

The RRC's 2014 amendments to Statewide Rules 9 and 46 included seismic activity in the list of events that can trigger RRC action to modify or cancel an existing permit:

A permit for saltwater or other oil and gas waste disposal may be modified, suspended, or terminated by the commission for just cause after notice and opportunity for hearing, if:

- (i) a material change of conditions occurs in the operation or completion of the disposal well, or there are material changes in the information originally furnished;
- (ii) freshwater is likely to be polluted as a result of continued operation of the well;
- (iii) there are substantial violations of the terms and provisions of the permit or of commission rules;

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<sup>38</sup> Statewide Rules 9(3)(C) and 46(b)(1)(D); 16 TAC § 3.9 and § 3.46, (*emphasis* added).

(iv) the applicant has misrepresented any material facts during the permit issuance process;

(v) injected fluids are escaping from the permitted disposal zone;

***(vi) injection is likely to be or determined to be contributing to seismic activity***; or

(vii) waste of oil, gas, or geothermal resources is occurring or is likely to occur as a result of the permitted operations.<sup>39</sup>

These rules changes make clear that the RRC can pursue earthquake issues for existing disposal permits, and sets a standard of “is likely or determined to be contributing” to earthquake activity.

## **2. Show-Cause Hearings on XTO and EnerVest Disposal Well Permits**

The RRC held two contested case hearings in 2015 to consider whether disposal well injection contributed to seismic activity near the cities of Reno and Azle, Texas.<sup>40</sup> Small earthquakes were felt near those cities for five months beginning in November 2013. A year later, authors from Southern Methodist University, the University of Texas, and the United States Geological Survey published a study concluding that:

“On the basis of modeling results and the absence of historical earthquakes near Azle, brine production combined with wastewater disposal represented the most likely cause of recent seismicity near Azle.”<sup>41</sup>

Specifically, the authors identified disposal wells operated by XTO and by EnerVest in the Ellenburger formation, and producing wells operated by EnerVest in the Newark, East Barnett Shale Field.

In response to the authors’ published conclusion, the RRC convened separate show-cause hearings for each disposal well permit. In those respective hearings, XTO and EnerVest responded with expert testimony and evidence asserting that the felt earthquakes originated two miles below the Ellenburger disposal formation in deep-seated Fort Worth Basin fault systems that are known to have moved over the past 600 million years. The operators presented evidence from the recorded seismic data showing that the earthquakes felt at Azle/Reno originated in the basement on these deep-seated basement faults. The operators also presented evidence that the

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<sup>39</sup> Statewide Rules 9(6) and 46(d); 16 TAC § 3.9 and § 3.46, (*emphasis* added).

<sup>40</sup> Oil and Gas Docket No. 09-0296411; Commission-Called Hearing, XTO Energy Inc., West Lake SWD Well No. 1, Newark, East (Barnett Shale) Field, Parker County, Texas; Oil and Gas Docket No. 09-0296410; Commission-Called Hearing, EnerVest Operating LLC, Briar Lease, Well No. 1, Coughlin (Strawn) Field, Parker County, Texas.

<sup>41</sup> “Causal Factors for Seismicity near Azle, Texas.” Hornback, Matthew J., *et al.* Nature Communications. Nature Publishing Group. April 21, 2015.

disposal injection has not increased the formation pressure in the Ellenburger two miles above the hypocenter of the earthquakes, calling into question whether that disposal injection could have induced a force sufficient to initiate fault movement two miles below. Finally, the operators pointed to felt earthquakes in the Irving area that resulted from similar seismic basement rocks activity, with no disposal injection activity in that vicinity, as confirmation that deep-seated basement faulting is naturally active in the Fort Worth Basin. Based on this evidence, in contrast to the conclusions of the Nature Communications paper, the operators argued that the evidence establishes that the earthquakes felt at Azle and Reno resulted from naturally occurring tectonic forces.

In each docket, the RRC determined that the evidence did not support a finding that the disposal injection well is likely to be or determined to be contributing to seismic activity. Interpreting that Statewide Rule 9 standard of review, the Examiners concluded that the term "likely" represents a preponderance of the evidence standard and that the inquiry under Statewide Rule 9 is whether it is more likely than not that the injection is causing the seismic activity. They interpreted the word "contributing" to mean that the injection must provide at least a part of the force necessary to cause or achieve the seismic activity. The Examiners concluded that to contribute at least part of that force, the injection and the seismic activity must occur in a mechanically connected system, and the actual operational parameters of the mechanical system must allow for stress caused by the force to be transferred to the location of the fault rupture. Applying that interpretation of the Statewide Rule 9 standard to the evidence, the Examiners recommended findings that the evidence did not show that force from the XTO and EnerVest disposal wells moved two miles down the mechanical fault system to the hypocenter of the initial felt seismic activity at Azle and Reno. The Commissioners adopted the Examiners' findings, and entered orders that the disposal permits remain active and unchanged.

#### **IV. DISPOSAL WELL PERMIT APPLICATIONS & PROOF OF "NEED" AS PART OF THE PUBLIC INTEREST**

Many of the hearings on the RRC's docket involve applications for disposal wells that are opposed by property owners and residents in the vicinity who object to the traffic, noise, dust, and potential for environmental harm from a proposed disposal well.<sup>42</sup> In a recent contested case hearing, the RRC denied an application by Select Energy Services for a commercial disposal well, concluding that it was not in the public interest under Texas Water Code Section 27.051(b)(1).<sup>43</sup> That conclusion was based, in part, on findings that already existing active disposal wells in the vicinity are operating at less than capacity. As described by the Examiners' proposal for decision:

CGODWIN persuasively demonstrated the available disposal capacity in the area is markedly underutilized. The community

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<sup>42</sup> The RRC has struggled with cases like this in the past, at times excluding issues like traffic, safety, and air pollution from the scope of its public interest review. See *Railroad Commission of Texas v. Texas Citizens for A Safe Future and Clean Water*, 336 S.W.3d 619 (Tex. 2001).

<sup>43</sup> Oil and Gas Docket No. 01-0285961, Application of select Energy Services, LLC Pursuant to Statewide Rule 9 for a Commercial Permit to Dispose of Oil and Gas Waste By Injection, Select Gonzales SWD Lease, Peach Creek (Austin Chalk) Field, Gonzales County, Texas

members of CGODWIN undertook a novel survey of the existing disposal wells near the proposed Select well. Making 77 visits to 14 wells over more than a one-year period, they documented numerous instances of complete availability of the existing disposal wells. On only four instances were trucks observed to be waiting to unload, and never for more than 20 minutes. CGODWIN made paper and photographic records of its survey visits, and several of its members directly testified to their observations.<sup>44</sup>

Other evidence showed that disposal wells that the RRC has already permitted in the vicinity have not yet been drilled or activated. Still other evidence showed that the proposed disposal well would be located in a partly residential area within the ETJ of the City of Gonzales.

Although the specifics of each disposal well application will vary, this case illustrates the extent to which property owners and residents in the vicinity of a proposed well can oppose a disposal well on what is literally a not-in-my-back-yard basis. It is worth noting that, apart from the public interest component, the Select Energy application otherwise met the requirements for approval under the RRC's rules.

## **V. FORCE POOLING STATE RIVER TRACTS**

Over the past several years, the Texas General Land Office, with assistance from Ammonite Oil and Gas, has engaged in an effort to include State river tracts in production by horizontal wells drilled on adjoining tracts in resource plays. This effort has often been successful in reaching voluntary settlements that allow river tracts to participate in adjacent wells. In some instances, however, Ammonite has made voluntary offers to pool as a predicate to force pooling under the Mineral Interest Pooling Act<sup>45</sup> and has filed applications for force pooling with the RRC. In two cases, Ammonite has pursued its applications through hearings -- one involving wells and acreage operated by Energen Resources Corp and the other involving wells and acreage operated by Chesapeake Operating, L.L.C. Last month, the RRC entered an order approving Ammonite's force pooling of State river tract acreage into the Energen wells.<sup>46</sup> The cases involving the Chesapeake wells remain pending.<sup>47</sup>

The RRC's decision in the Ammonite/Energen case is of interest because it involves river tract acreage, which exists in areas subject to drilling and development all across the State.

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<sup>44</sup> *Id.*, Examiners' Proposal for Decision, p. 15.

<sup>45</sup> TEX. NAT. RES. CODE §102.001 - §102.112.

<sup>46</sup> Oil and Gas Docket No. 08-0282996, Application of Ammonite Oil and Gas, Inc. Pursuant to the Mineral Interest Pooling Act for the Energen Elmer 33-67 Well, Two Georges (Bone Spring) Field, Ward County, Texas, and the Energen Kath "A" 3-11 Well, Two Georges (Bone Spring) Field, Reeves County, Texas

<sup>47</sup> Oil and Gas Docket Nos. 01-0290024, 01-0290026, 01-0299029, and 01-0290031, Application of Ammonite Oil and Gas Corporation Pursuant to the Mineral Interest Pooling Act for the Chesapeake Butterfly Dim Lease No. J 4H, Ivey Ranch A6H, Ivey Ranch Unit Well No. B5H, Gringita Dim Unit Well No. A3H, and Valley Wells Unit 22 Dim Well No. 1RH, Briscoe Ranch (Eagle Ford) Field, Dimmit County, Texas

Additionally, there are relatively few MIPA cases, especially cases involving wells and tracts in unconventional fields.

Additionally, the decision is interesting because there was little technical evidence in the hearing record. There was no evidence of the quantity of reserves in place beneath any of the tracts involved, and there was no evidence of drainage across tract boundaries. Instead, to demonstrate that the river tract is productive, Ammonite relied on general testimony from an expert witness about the field that the Energen wells are completed in and the fact that the boundaries of Energen's proration units in that field are adjacent to the river tract boundary. In effect, Ammonite argued that if Energen considers the proration unit acreage to be productive, it is reasonable for the RRC to infer that the adjoining State river tract is also productive. There was also no detailed evidence to quantify the amount of waste or harm to correlative rights that Ammonite alleges would occur without pooling. Instead, Ammonite relied on the fact that the State river tract has been stranded by surrounding horizontal well development, and that the stranding of those hydrocarbons constitutes waste and harm to the State's correlative rights. In response to arguments by the objecting owners that Ammonite must prove that the State river tract will be drained by the wells, Ammonite argued that drainage is not a required element of proof for force pooling under prior RRC decisions, and it points out that the MIPA has no requirement that the well must drain the State river tract.

The case touches on several other issues of interest. Ammonite was pursuing force pooling as a contract agent of the General Land Office and the State. The opposing owners argued that because Ammonite is not an interest owner in the acreage to be pooled, it cannot pursue force pooling, but the Commission rejected that argument. One of the units is larger than the 160-acre maximum that the RRC is authorized to force pool under MIPA Section 102.011, but Ammonite asserted that pooling of a larger unit is authorized under the "muscle-in" provision in Section 102.104, and the RRC ordered force pooling of the larger unit.

Ultimately, the RRC's decisions in this case and in the pending Chesapeake cases may be instructive to operators and owners in deciding whether to include State river tracts in development plans for river front acreage.

## **VI. COMMON CARRIER TARIFF RATE HEARING**

The RRC is in the process of conducting a hearing to review a tariff rate increase by West Texas LPG Pipeline for transportation of natural gas liquids on its pipeline from the Permian Basin to Mont Belvieu.<sup>48</sup> The tariff increase has been challenged by shippers on the line. The hearing on the merits is set for October 2016.

Over the objection of the pipeline, and against the recommendation of the Examiners, the RRC entered an interim order restoring the prior tariff rates for the duration of the docket.

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<sup>48</sup> GUD 10455: Consolidated Complaints of Targa Liquids Marketing and Trade, LLC, Pioneer Natural Resources USA, Inc., ConocoPhillips Company, ELTM, LP, f/k/a Enbridge Liquids Transportation Marketing, LP to Establish Common Carrier Rates for West Texas LPG Pipeline Limited Partnership.

Notice of the hearing is being sent to all shippers on the pipeline, who will have 30 days after notice to intervene as a party.

Pipeline rate cases are relatively rare, so this case will be interesting to watch.

# Railroad Commission Update

**Tim George**

42<sup>nd</sup> Annual Ernest E. Smith  
Oil, Gas and Mineral Law Institute  
UT Law CLE  
Houston, Texas

April 15, 2016

## Update Topics

- Statewide Rules Amendments
  - Horizontal Wells & UFT Fields
- Disposal Wells & Earthquakes
- Disposal Well Protests
- Force Pooling of State River Tracts
- Common Carrier Rate Increases

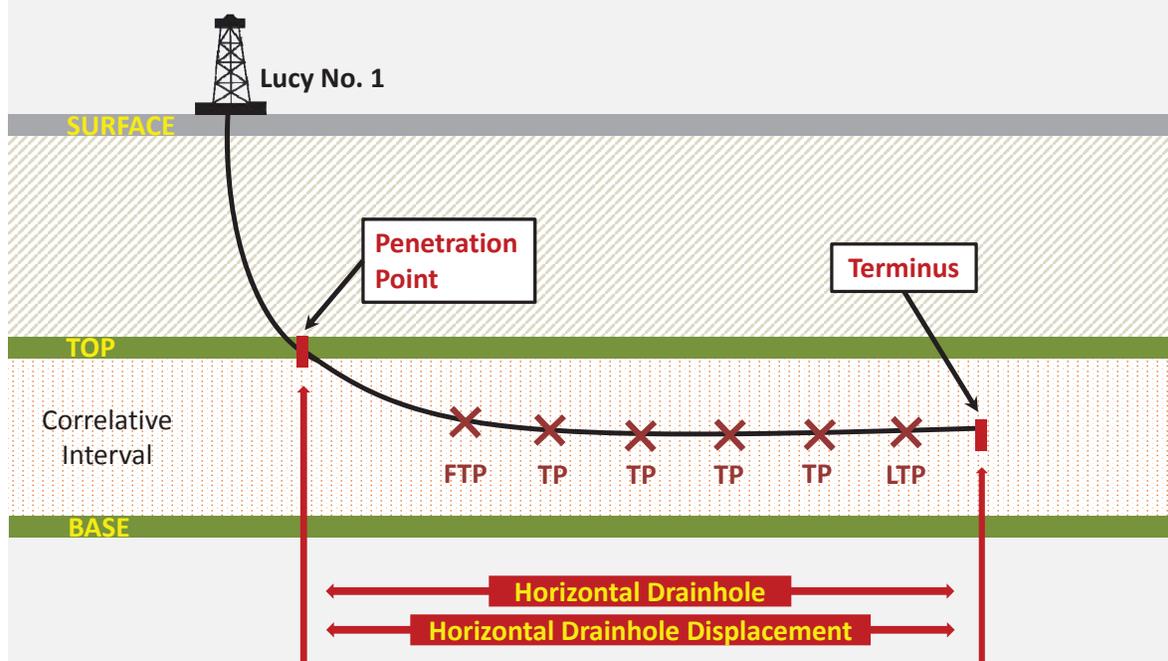
# Statewide Rule Changes

- Rule Changes for All Horizontal Wells
  - Horizontal Drainhole Displacement
  - Take Point Spacing
  - Offsite Penetration Point
  - Nonperforation Zone (NPZ)
  - Box Rule
  - Stacked Laterals
  - Mandatory Form P-16



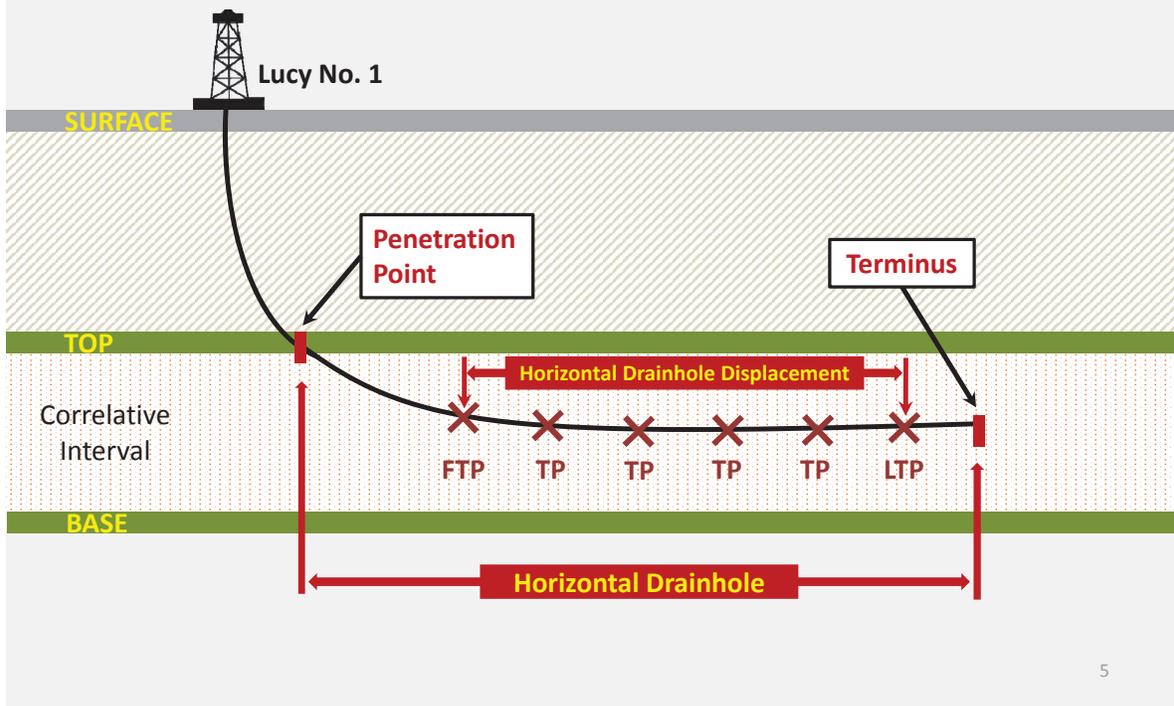
3

## Horizontal Drainhole Displacement – “Before”



4

## Horizontal Drainhole Displacement – “After”



## Horizontal Drainhole Displacement

- Assignment of Added Acreage For Lateral
  - “Horizontal Drainhole Displacement”
    - Distance from First Take Point to Last Take Point



# Horizontal Drainhole Displacement

## Rule 86 Table

**Additional Acreage Assignment**  
For Fields with a Density Rule of 40 Acres or Less

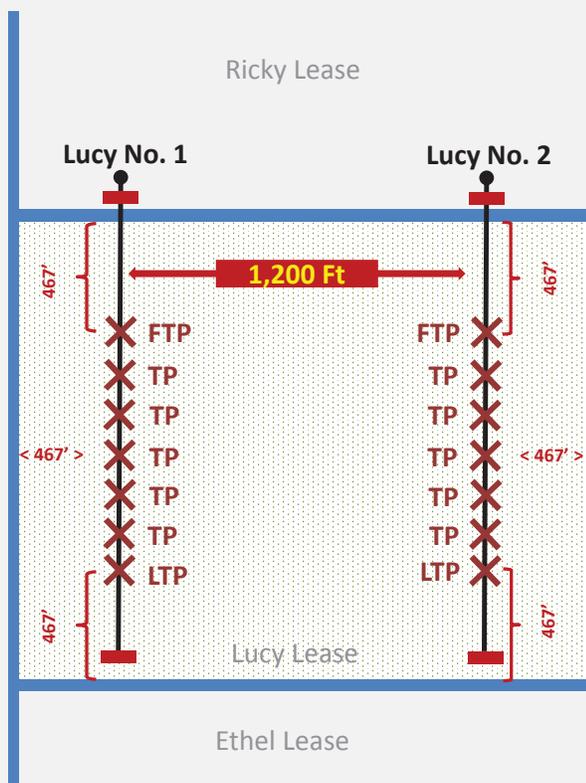
| Horizontal Drainhole Displacement, ft | Additional Acreage Allowed, acres |
|---------------------------------------|-----------------------------------|
| 100 to 585                            | 20                                |
| 586 to 1,170                          | 40                                |
| 1,171 to 1,755                        | 60                                |
| 1,756 to 2,340                        | 80                                |
| 2,341 to 2,925                        | 100                               |
| 2,926 to 3,510                        | 120                               |
| etc. - 585 ft increments              | etc. - 20 acre increments         |

**Additional Acreage Assignment**  
For Fields with a Density Rule Greater Than 40 Acres

| Horizontal Drainhole Displacement, ft | Additional Acreage Allowed, acres |
|---------------------------------------|-----------------------------------|
| 150 to 827                            | 40                                |
| 828 to 1,654                          | 80                                |
| 1,655 to 2,481                        | 120                               |
| 2,482 to 3,308                        | 160                               |
| 3,309 to 4,135                        | 200                               |
| 4,136 to 4,962                        | 240                               |
| etc. - 827 ft increments              | etc. - 40 acre increments         |

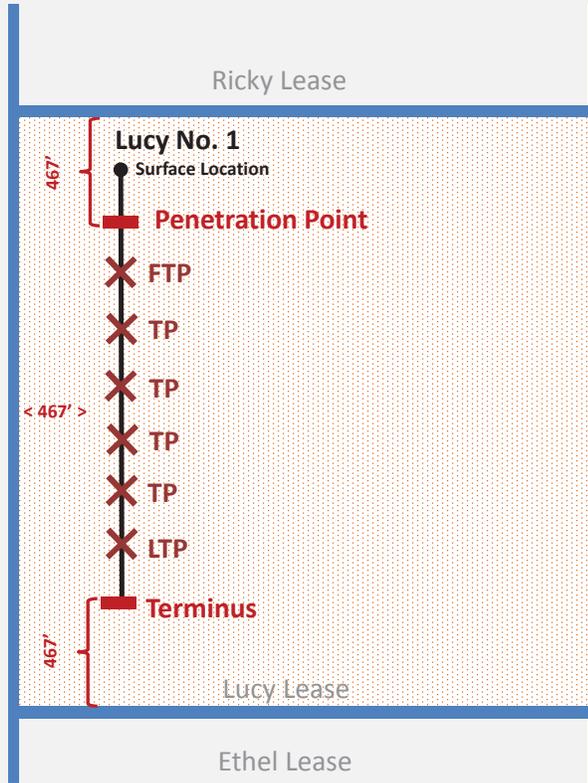
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# Take Point Spacing

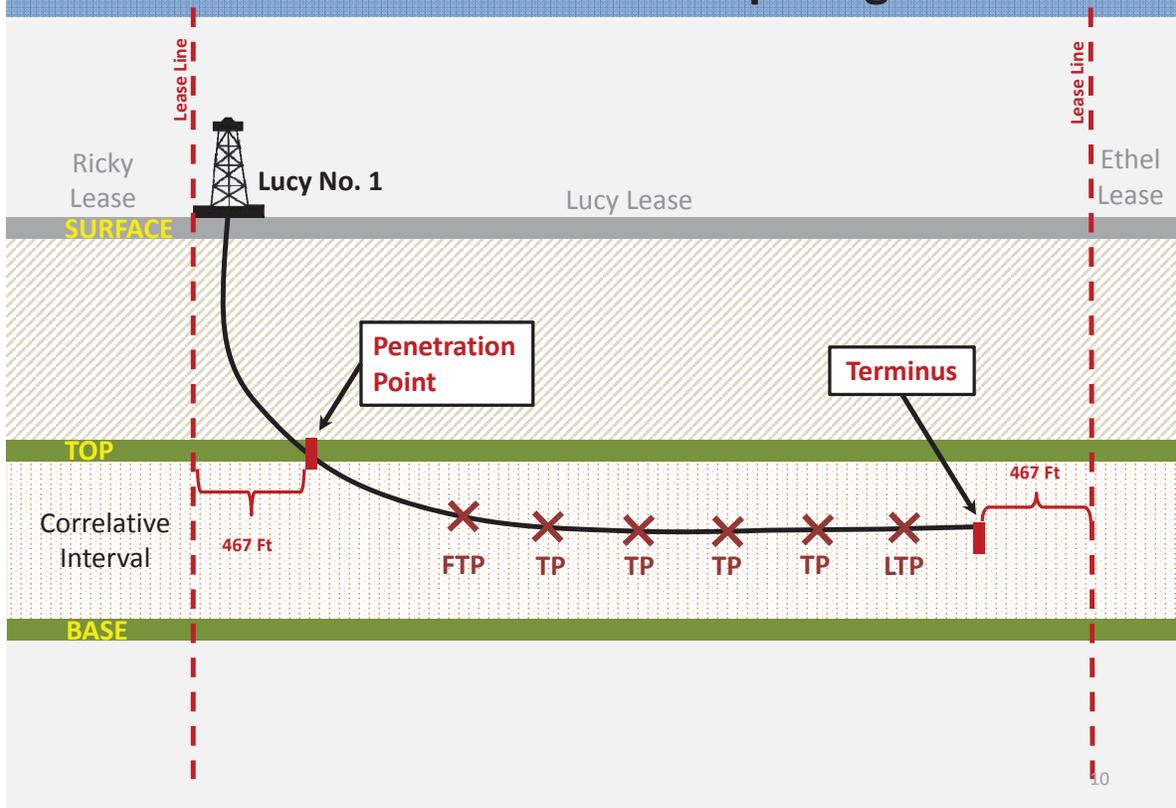


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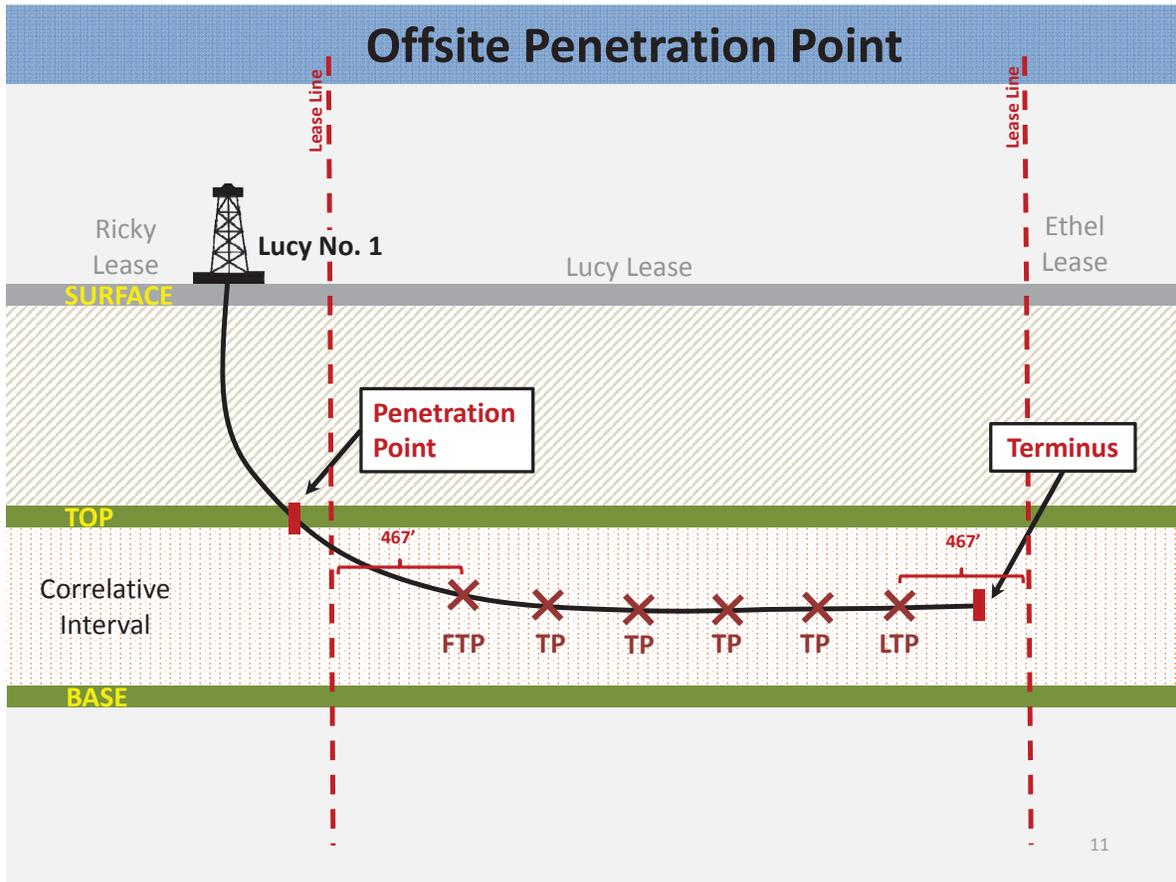
# Without Take Point Spacing



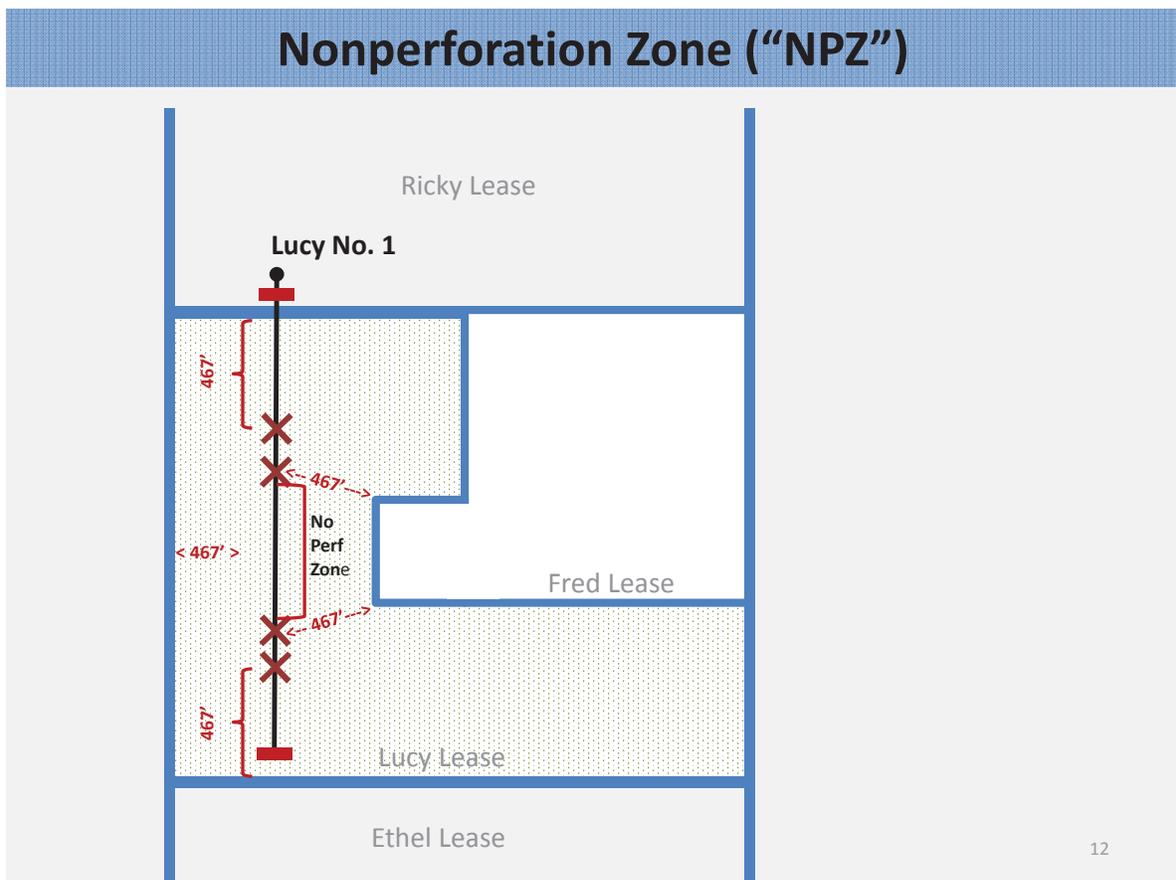
# Without Take Point Spacing



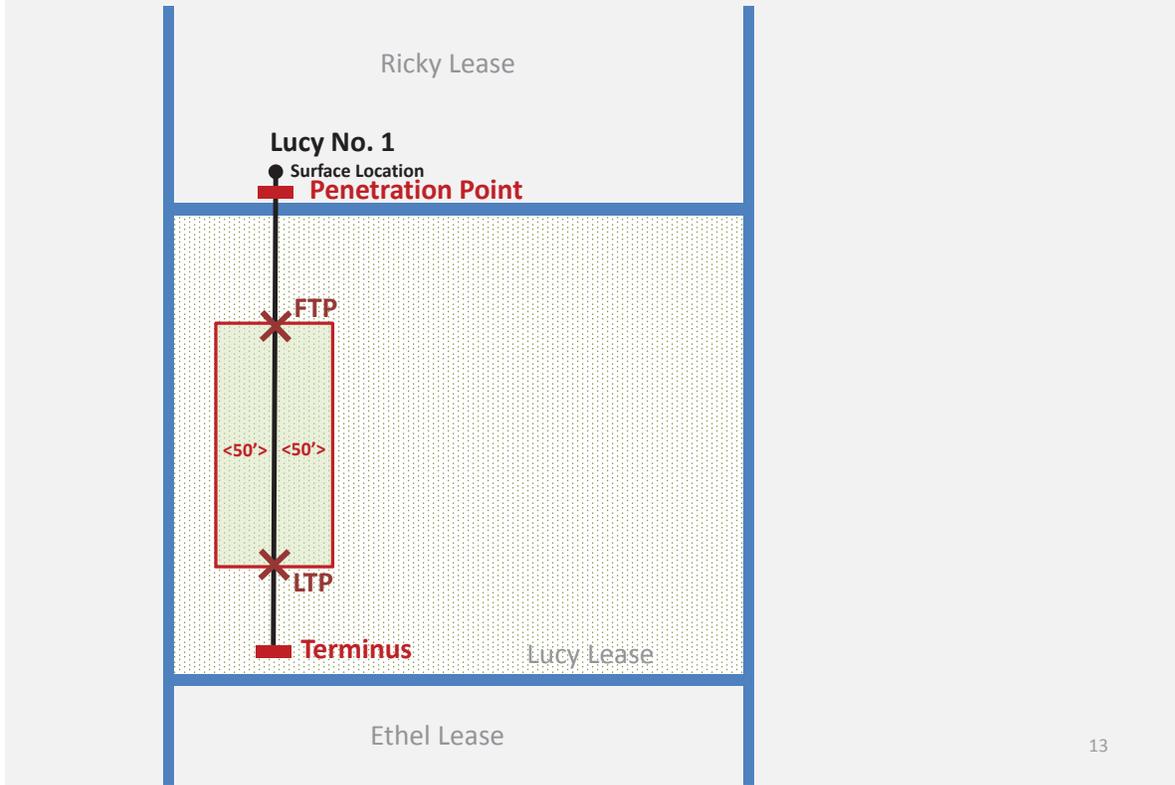
## Offsite Penetration Point



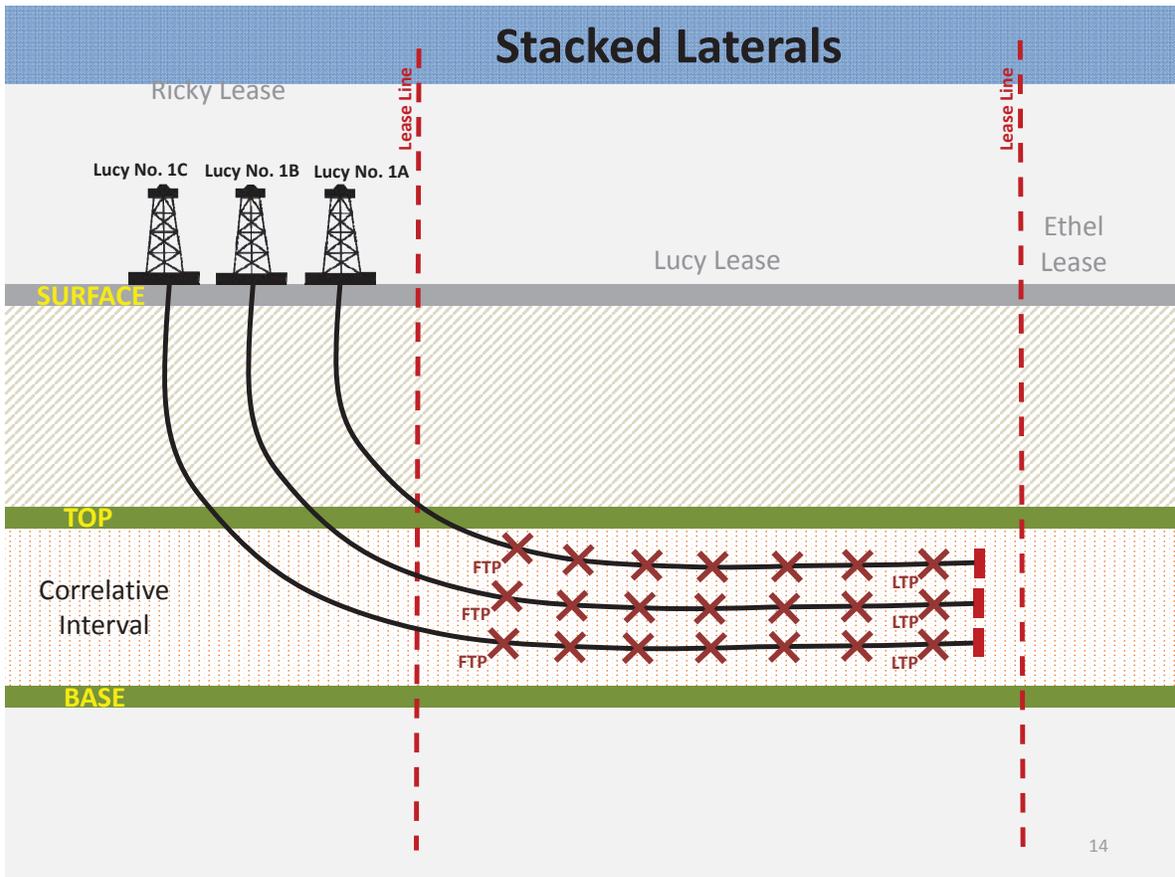
## Nonperforation Zone ("NPZ")



# Box Rule

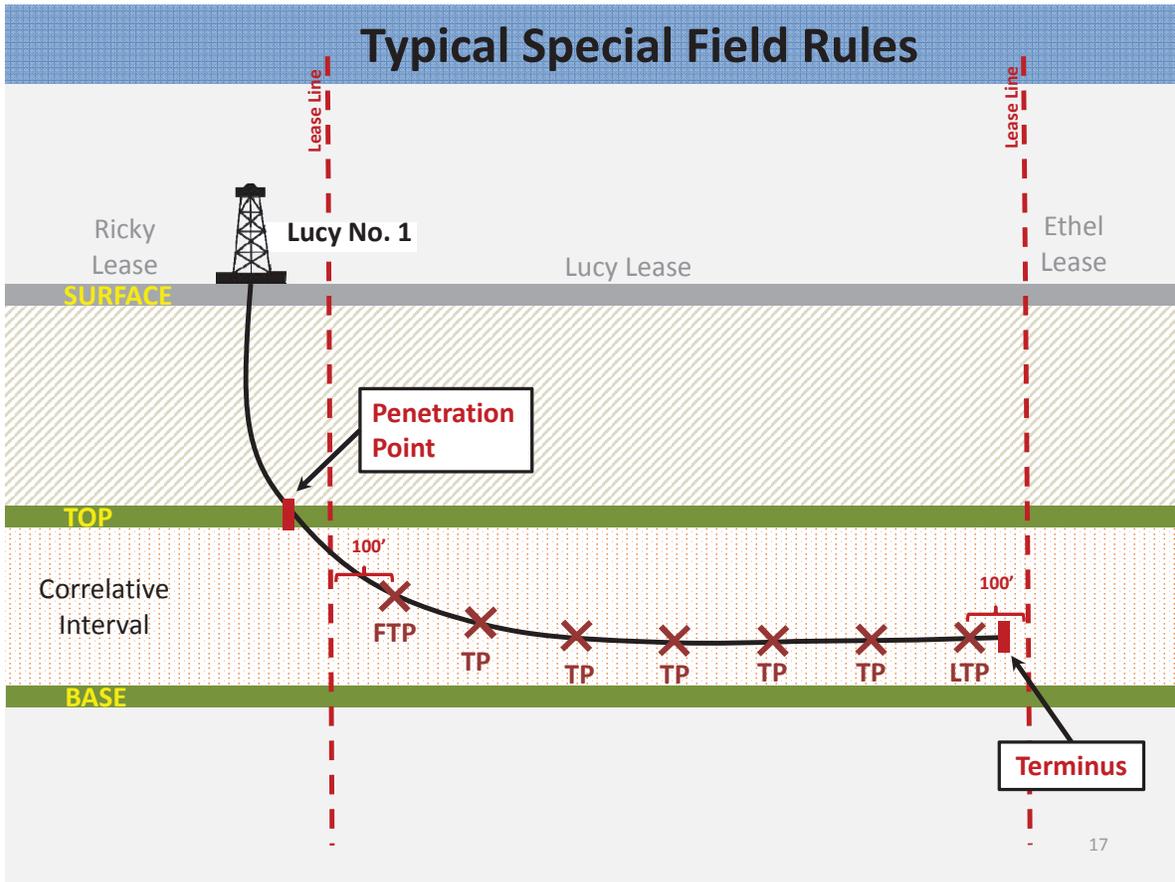


# Stacked Laterals



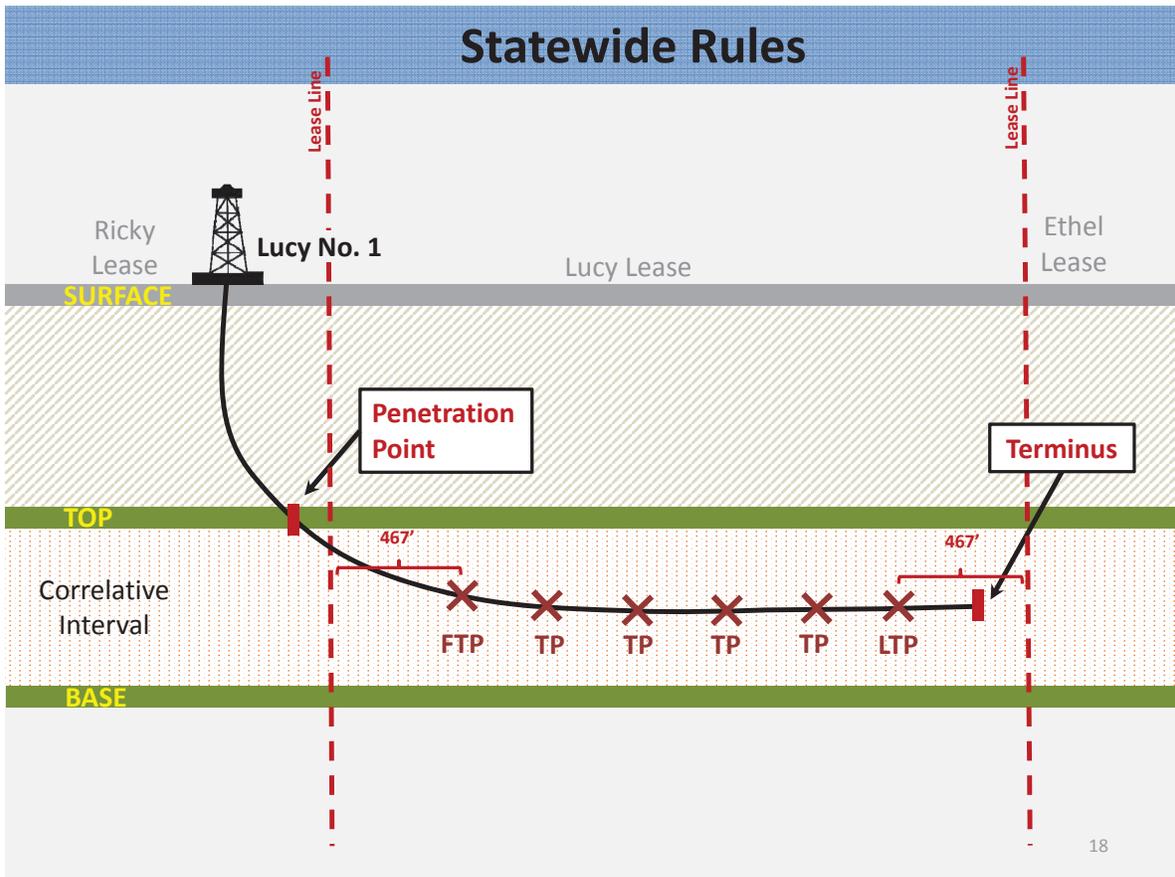


## Typical Special Field Rules



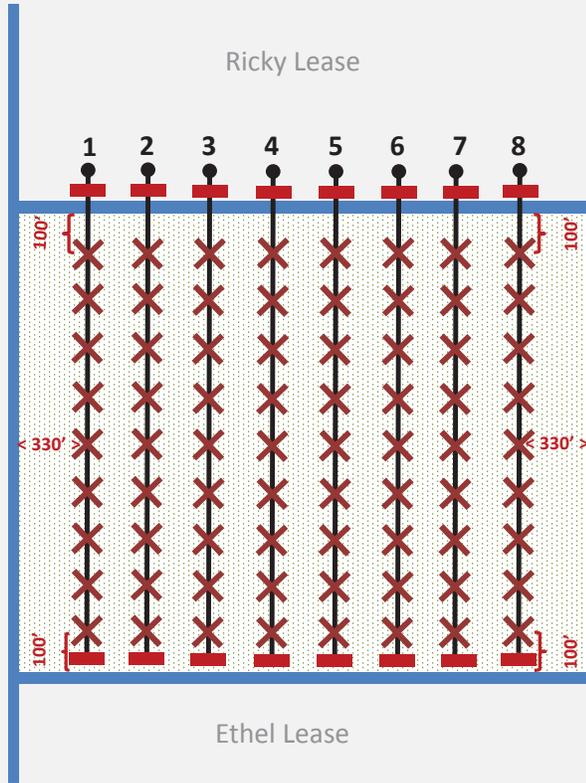
17

## Statewide Rules



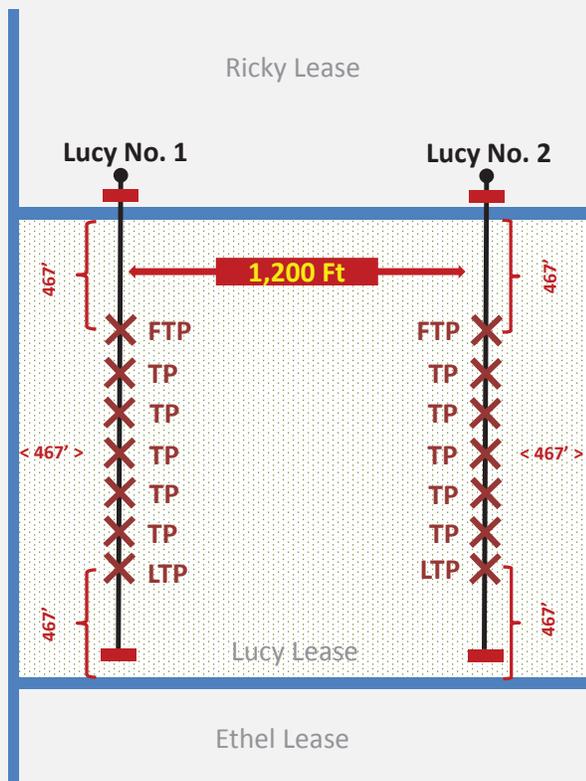
18

## Typical Special Field Rules



**No Between-Well Spacing Rule**

## Statewide Rules



## UFT Fields

- Unconventional Fracture Treated Field
  - Designated by RRC
  - Requires:
    - Horizontal well development
    - Hydraulic fracture treatment
    - *All or part* of the field



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## UFT Fields

- *Criteria for Administrative Designation*
  - *in situ* permeability
  - at least one distinct producible interval
  - 0.1 millidarcies or less prior to hydraulic fracture treatment
  - determined by
    - core data or
    - other supporting data and analysis



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## UFT Fields

- *Criteria for Administrative Designation*
- At least 5 Wells with initial drilling permits on or after February 1, 2012:
  - At least 65% drilled horizontally and completed using hydraulic fracture treatment, or
- At least 25 wells with initial drilling permits on or after February 1, 2012:
  - Drilled horizontally and completed using hydraulic fracture treatment



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## UFT Fields

- *Designation by Hearing*
- Standard of proof:
  - Horizontal drilling and hydraulic fracture treatment must be used in order to recover the resources from all or a part of the field
  - UFT field designation will promote orderly development of the field



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## UFT Fields

- *Consequences of UFT Designation*
  - Special Field Rules prevail if there is conflict between SWRs and Field Rules
  - “Conflict” will be important to determine



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## UFT Fields

- *Consequences of UFT Designation*
- Double-assignment of acreage to vertical and horizontal wells is allowed
  - Vertical and Horizontal Wells “do not see” each other
  - Increases number of wells
  - Avoids need for Rule 38 exceptions



26

## UFT Fields

- *Consequences of UFT Designation*
- Increased Allowables
  - Oil: 100 barrels for each assigned acre
  - Gas: 600 Mcf of gas for each assigned acre



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## UFT Fields

- *Consequences of UFT Designation*
- Rule 38 “Light” Density Exception
  - Reduced notice requirement
    - Notice only to affected parties 600’ from take points
      - Instead of all surrounding tracts
    - If no objection, administrative approval without supporting data
    - If protested, reduced standard of proof
      - “necessary to effectively drain an area of the UFT field that will not be effectively drained by existing wells”



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## UFT Fields

- *Consequences of UFT Designation*
- No-Hearing Special Field Rules Amendment
  - Field must already have Special Field Rules
  - Three Available Amendments
    - Reduction of standard or optional density by half
    - Deletion of between-well spacing rule
    - Increased allowable rates
  - Requires notice, no objection, supporting data, and RRC approval by order



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## Statewide Rule Changes

- “Maximum Allowables” for Horizontal Wells
- Rule 86(d)(4) expressly ties allowables to
  - Acreage Assignment table in Rule 86(d)(1)
  - Rates per acre specified by Rule 86(d)(5)
- Useful for leasehold pooling and retained acreage



30

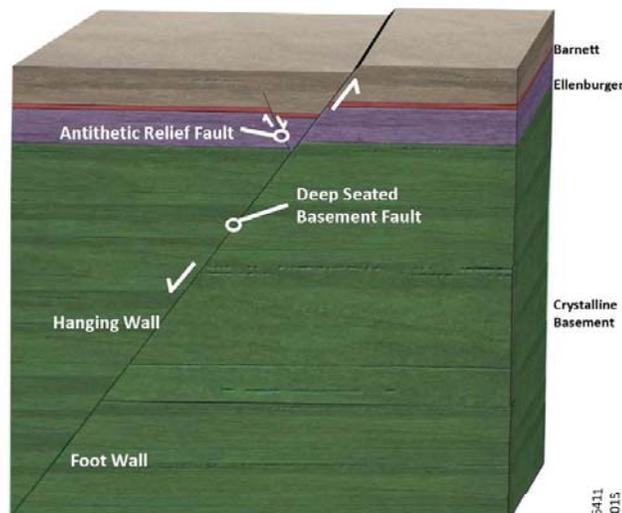
# Earthquakes

- Basic Elements
  - Underground Fault
  - Critical Stress: Shear Stress vs. Shear Strength
  - Rupture: Fault Movement at Hypocenter



31

Schematic of Azle Area Subsurface



**Fault** A brittle rupture of a rock body occurring as a result of a stress that exceeds the cohesive strength of the rock. (Billings 1972)

**Normal Fault** A type of fault in which the hanging wall moves down relative to the footwall, and the fault surface dips steeply, commonly from 50° to 90°. In response to vertical or tensile stresses.

**Antithetic Faults** are minor, secondary faults, that form to compensate stress on the major fault, whose sense of displacement is opposite to its associated major and synthetic faults. Antithetic-synthetic fault sets are typical in areas of normal faulting.

(Schlumberger Oilfield Glossary  
<http://www.glossary.oilfield.slb.com/en/Terms.aspx?LookInItem%2Dname&filter=antithetic%2Dfault>)

Exhibit No. 23  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
Hearing Date: June 10, 2013

32

# Earthquakes

- Magnitude
  - Felt vs. Not-Felt
  - Dividing Line  $M \sim 2.5$  on the Richter Scale

(“Not-Felt” earthquakes can be recorded)



33

# Earthquakes

- Oil & Gas Activities Can Induce Seismicity
  - Production of Fluid (withdrawal of oil, gas, water)
  - Injection of Fluid
  - Fracing



34

## Earthquakes in Texas Producing Areas

- Production Activities
  - Goose Creek Field (Houston-Galveston - 1925)
  - Imogene Field (Pleasanton - 1973)
  - Fashing Field (Fashing - 1973 and 1993)



35

## Earthquakes in Texas Disposal Injection Areas

- Northeast Texas - Fort Worth Basin
  - DFW Airport (2008 – 2009)
    - Chesapeake SWD Well P&A'd
  - Azle-Reno (2013 – 2014)
    - XTO and EnerVest SWD Wells subject of show cause hearings
  - Johnson County (2015)
    - Bosque, EOG, MetroSaltwater, and Pinnergy SWD Wells asked to conduct bottom hole pressure surveys



36

## Railroad Commission Regulatory Actions

- Staff Seismologist (2014)
- Statewide Rule 9 and 46 Amendments (2014)
- Show Cause Hearings On Azle-Reno Earthquake Allegations (2015)



37

## Amendments to Statewide Rules 9 and 46:

- Applicants for disposal/injection well permit must submit recorded earthquake activity
  - USGS Web Page
  - Search of 100 square miles around proposed disposal well location



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## Amendments to Statewide Rules 9 and 46:

- If earthquake activity, RRC may require additional information:
  - geologic info (logs, structure maps, cross sections)
  - pressure front calculations
  - focus is on confinement of disposal fluid



39

## Amendments to Statewide Rule 9 and 46

- Administrative Processing
  - No recorded earthquakes in most of Texas:
    - Most USGS screenshots show no earthquakes
    - No RRC Staff review of faulting or seismic activity for most disposal/injection applications



40

## Amendments to Statewide Rule 9 and 46

- Administrative Processing
  - If recorded seismic activity is shown by USGS:
    - Staff typically requests structure and isopach maps to consider the presence/absence of faulting
    - If faulting nearby, Staff may request pressure front calculations
    - Staff meets to review applications with recorded earthquakes



41

## Amendments to Statewide Rule 9 and 46

- Administrative Processing
  - Some applicants have shown that recorded seismic event is incorrectly located in the USGS database
  - Some applicants have shown that recorded seismic activity was related to fracture stimulation and is not indicative of fault movement associated with earthquake activity



42

## Amendments to Statewide Rule 9 and 46

- Administrative Processing:
  - For some applications, the RRC Staff has imposed seismic monitoring as a condition of the permit



43

## Amendments to Statewide Rule 9 and 46

- RRC action to modify or cancel an existing permit:
  - *A permit for saltwater or other oil and gas waste disposal may be modified, suspended, or terminated by the commission for just cause after notice and opportunity for hearing, if:*

\*\*\*

*(vi) injection is likely to be or determined to be contributing to seismic activity;*



44

## Azle-Reno Earthquakes

- Events
  - Felt Earthquakes (11/11/13 through 4/12/14)
  - SMU seismologists initiate seismic monitoring network
    - Seismic monitoring/recording equipment installed
    - Cooperative exchange of information between industry, academics, USGS, and RRC



45

## Azle-Reno Earthquakes

- Events
  - Bureau of Economic Geology proposes state-wide seismic monitoring program to be called Tex-Net
  - Legislature's 2015 supplemental spending bill, HB 2, includes a \$2.4 million dollar budget item to fund Tex-Net



46

## Azle-Reno Earthquakes

- Events
  - Publication of “Causal Factors for Seismicity Near Azle, Texas”
    - Published April 15, 2015
    - Authors from SMU, USGS, and UT
    - Published online by Nature Communications



47

## Azle-Reno Earthquakes

- Events
  - Causal Factors Publication concludes:
    - "On the basis of modeling results and the absence of historical earthquakes near Azle, brine production combined with wastewater disposal represented the most likely cause of recent seismicity near Azle."*
  - Identifies 2 disposal wells, one operated by XTO and one operated by EnerVest
  - Identifies 2 producing wells operated by EnerVest



48

# Azle-Reno Earthquakes

- Events
  - RRC issues show cause hearing notices
    - Notices Issued April 24, 2015
    - Two separate hearings:
      - XTO Hearing Set on June 10<sup>th</sup>
      - EnerVest Hearing Set on June 15<sup>th</sup>



49

# Azle-Reno Earthquakes

- Events
  - House Energy Resources Committee Holds Hearing
    - May 4, 2015
    - Three Authors Testify about Causal Factors Publication
  - HB2 is later amended to add \$1 million/year for analysis of Tex-Net data
    - As amended, Tex-Net is authorized and funded with passage of HB2



50

# Azle-Reno Earthquakes

- Events
  - Commissioner Sitton convenes “Round Table”
    - June 5<sup>th</sup>
    - Attendees:
      - Authors of Causal Factors Publication
      - RRC Staff
      - EnerVest
    - Webcast Live



51

# Azle-Reno Earthquakes

- Events
  - XTO Hearing Held June 10<sup>th</sup>
  - EnerVest Hearing Held June 15<sup>th</sup>
  - One-day hearings
  - Parties:
    - XTO and EnerVest
    - RRC Attorney for the Oil and Gas Division  
(Authors of Causal Factors Publication do not attend)



52

# Azle-Reno Earthquakes Operators' Evidence

- *Disposal injection not likely to be or determined to be contributing to seismic activity:*
  - seismic activity in the vicinity of Azle and Reno results from naturally occurring underground movements that originate in basement rocks in response to tectonic forces in the fault system within the Fort Worth Basin.
  - episodic movements of the Fort Worth Basin fault systems have been occurring for 600 million years.
  - hydrocarbon generation and migration patterns prove that episodic fault movements occurred in recent geologic time, allowing gas to migrate from Barnett Shale source rock into overlying sediments
  - basement movements of the Fort Worth Basin fault systems continue today



53

# Azle-Reno Earthquakes Operators' Evidence

- *Disposal injection is not likely to be or determined to be contributing to seismic activity:*
  - at both Azle/Reno and Irving, there are deep-seated basement faults that are part of the Fort Worth Basin fault systems
  - earthquakes at both Azle/Reno and Irving originated in the basement rocks in deep-seated basement faults
  - seismic movements at Azle/Reno and at Irving are the result of naturally occurring tectonic forces in the Fort Worth Basin fault system
  - there is no injection in the vicinity of the Irving earthquakes
  - injection into the Ellenburger has not increased the formation pressure in the Ellenburger



54

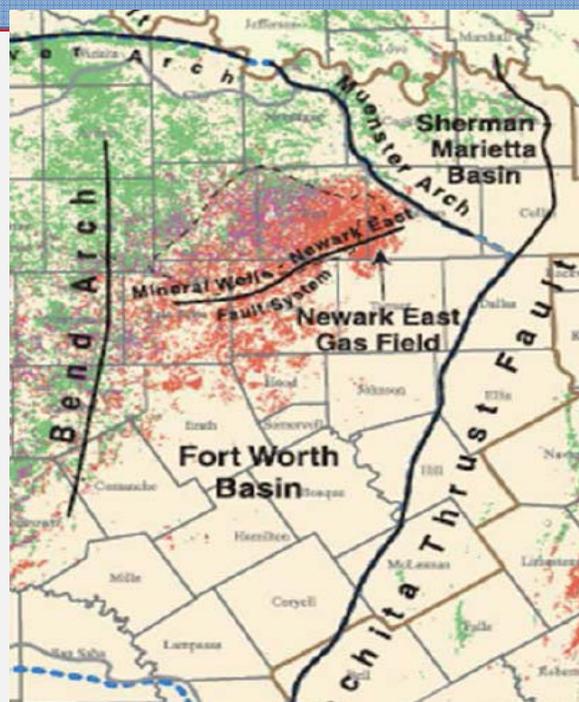
# Azle-Reno Earthquakes Operators' Evidence

- *Flaws in the Causal Factors Publication:*
  - Fails to consider the geologic history of the Fort Worth Basin
  - Incorrect reservoir model of only the Ellenburger
  - Incorrect data (assumes that all produced brine identified in the modeling originated from the Ellenburger formation)
  - Fails to acknowledge hypocenter in the deep crystalline basement



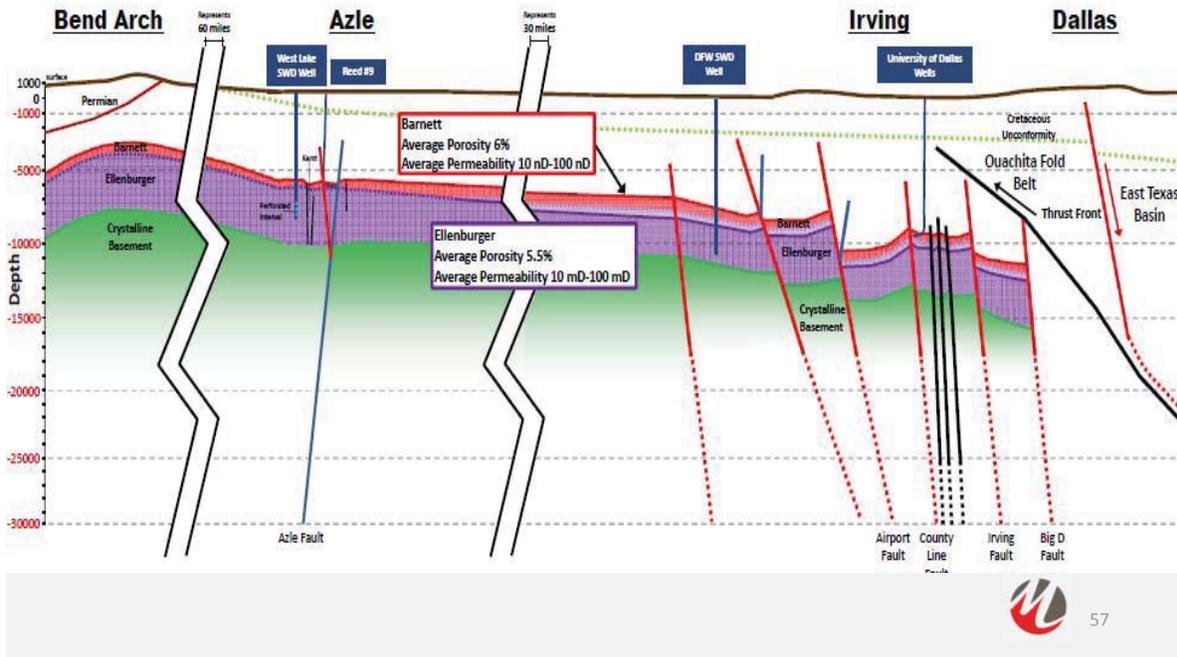
55

## Fort Worth Basin

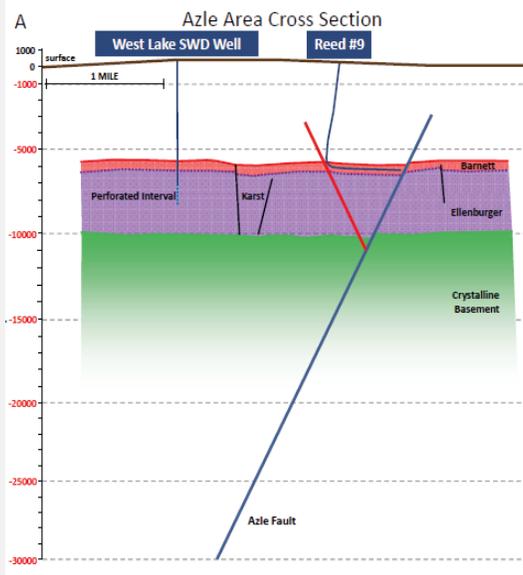


56

# Cross Section Azle-Reno and Irving Faults



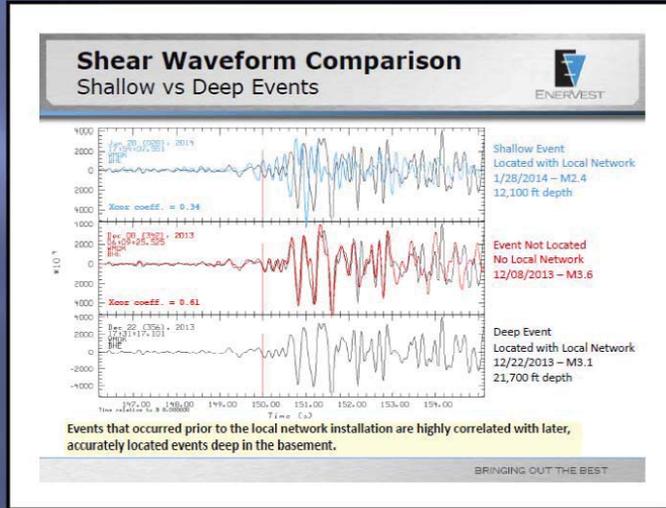
# Azle-Reno Fault Extends to Deep Basement



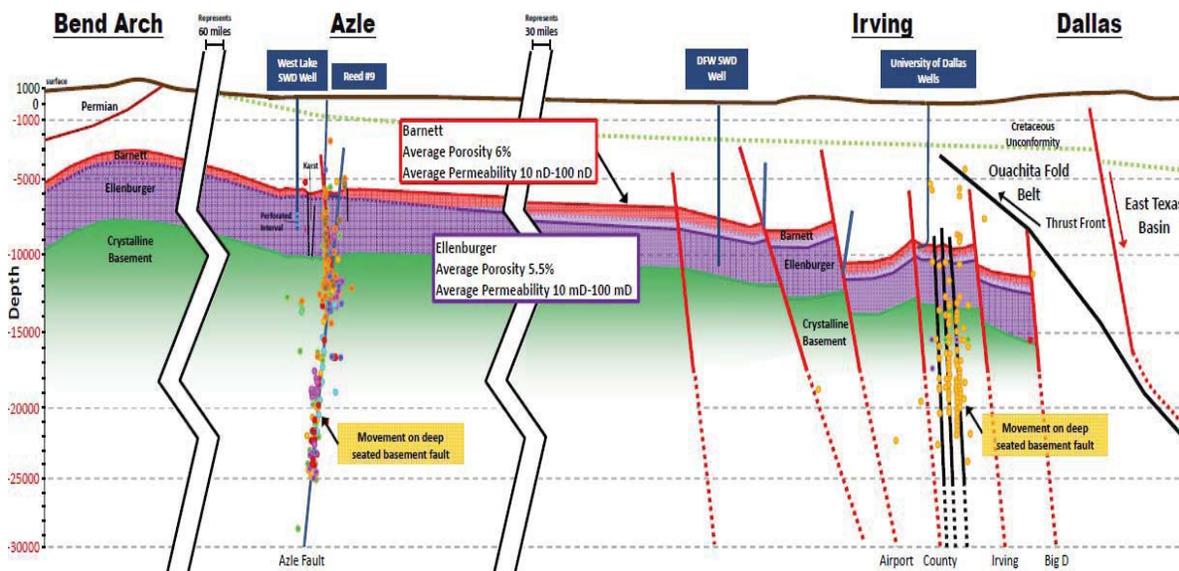
# Azle-Reno Seismic Activity Originated in the Basement

Dr. Keller:

If you go to the next slide. I repeat basically set up the slide where I repeated the black event, the well recorded deep event in each of the displays where you can really see the wave form shape overlaid for the shallow event and for the magnitude 3.6 that was recorded prior to the local network. And so to us this means that because the wave form shapes are very similar this is pretty strong evidence that the larger events and the events that were recorded prior to the local network were also deep.



# Seismic Events on Azle and Irving Faults

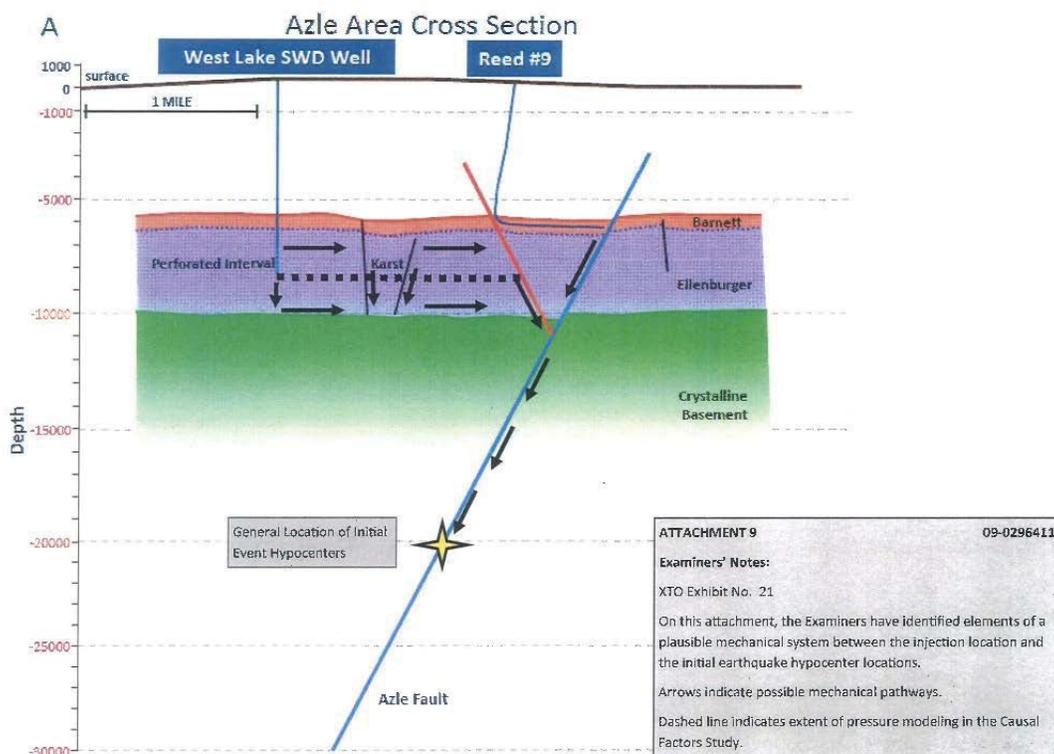


# Azle-Reno Earthquakes Standard of Review

- The term "contributing" indicates that the subject action (injection) must provide *at least a part of the force* necessary to cause or achieve an outcome (seismic activity).
- The injection stimulus and the consequent seismic activity must occur in a mechanically connected system, and the actual operational parameters of the mechanical system must allow stress to be transferred to the location of rupture to "contribute" to an event.



61



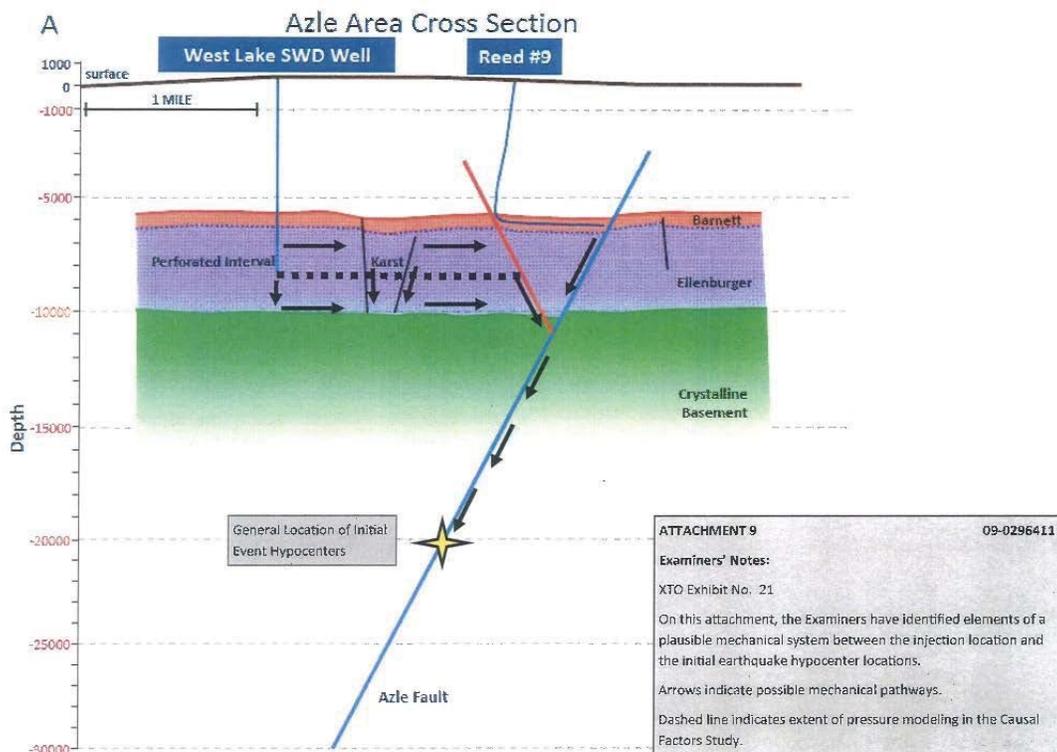
62

# Azle-Reno Earthquakes

- RRC concludes:
  - the preponderance of the evidence does not support a finding that fluids injected into the Ellenburger Formation are “likely to be or determined to be contributing to seismic activity.”



63



64

# Azle-Reno Earthquakes

RRC Orders that disposal permits  
“remain active and unchanged”

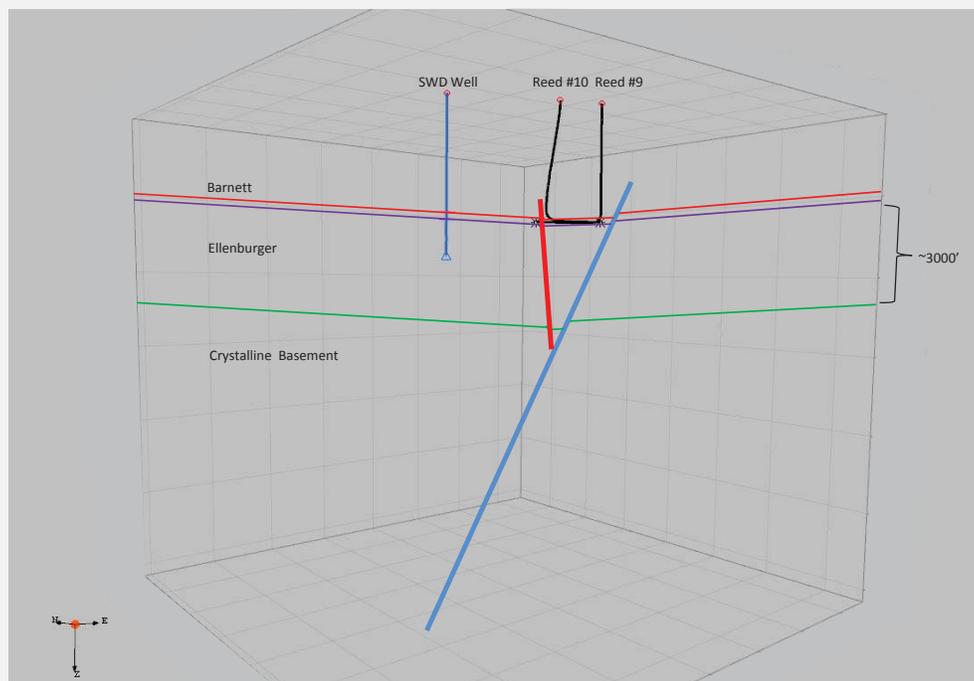


65

C

## Sequence of Events

C'



66

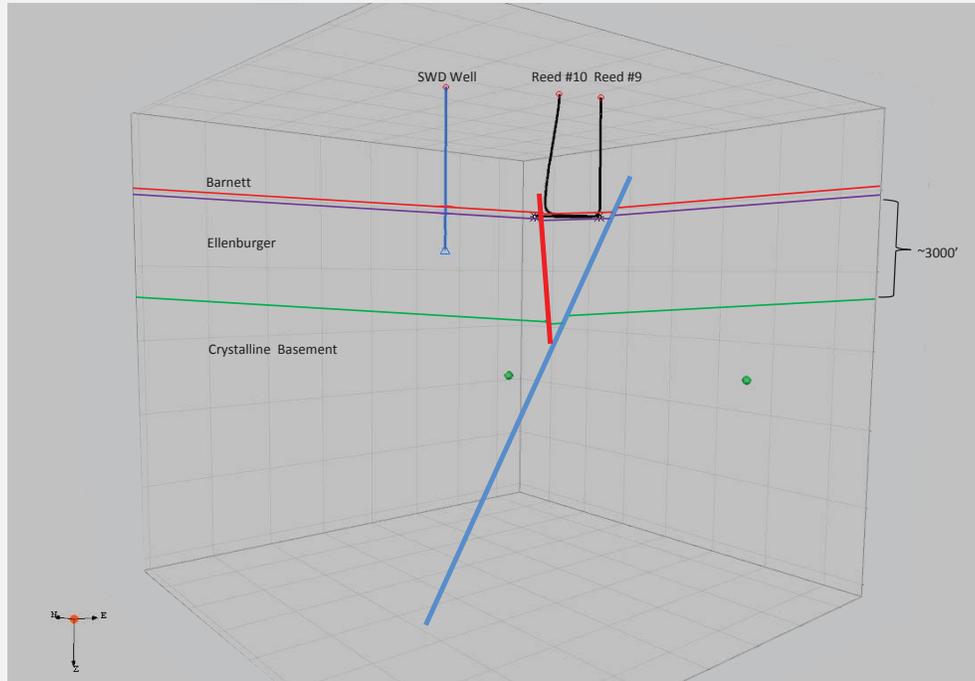
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. 33  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 1 (11/11/13-11/15/13)



67

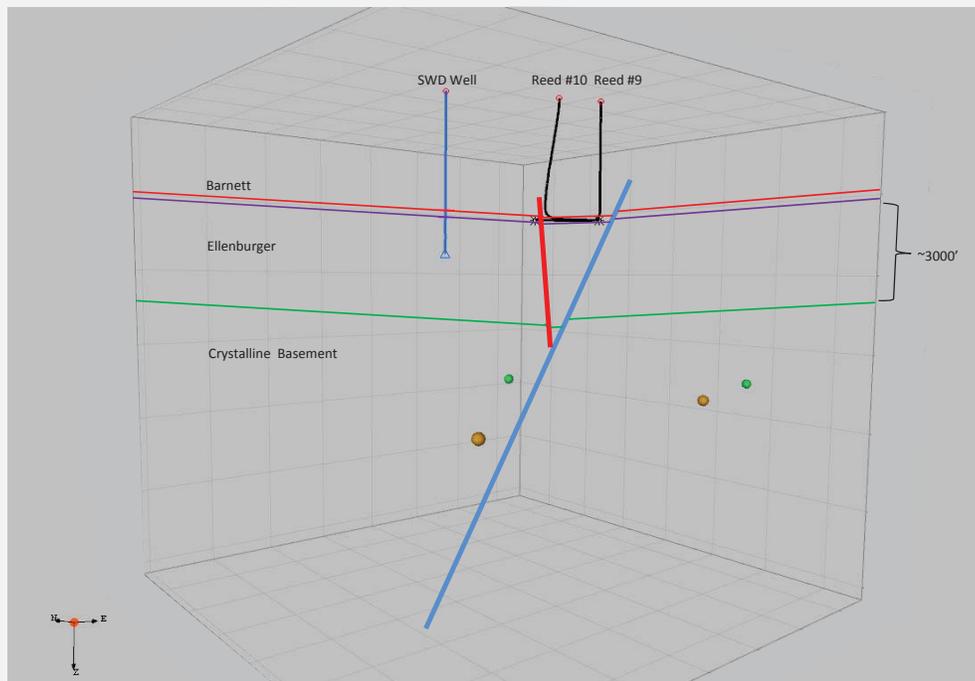
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 2 (11/11/13-11/30/13)



68

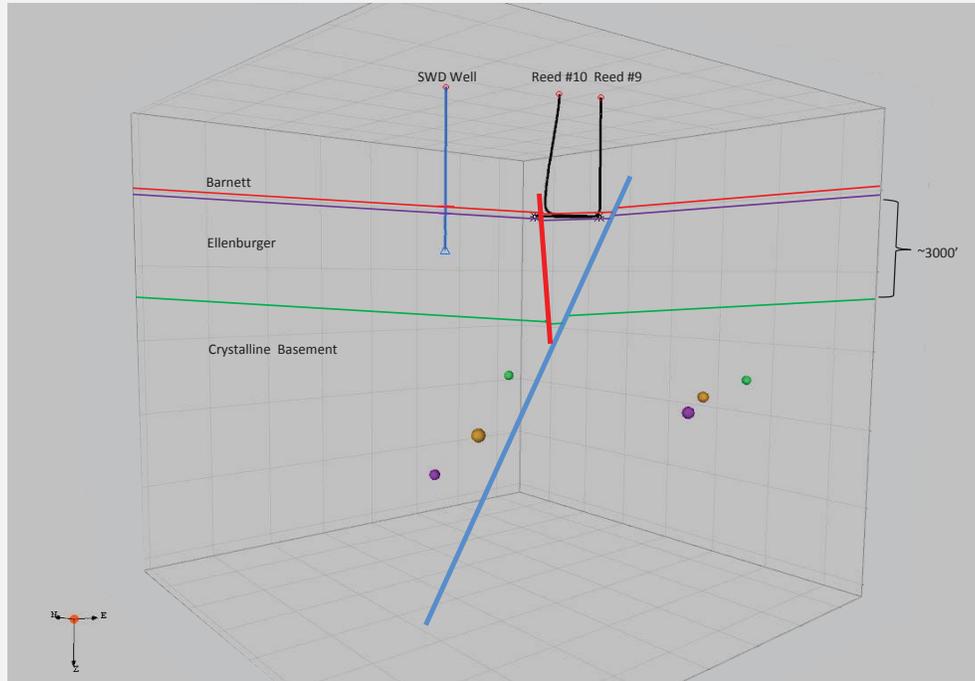
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 3 (11/11/13-12/15/13)



69

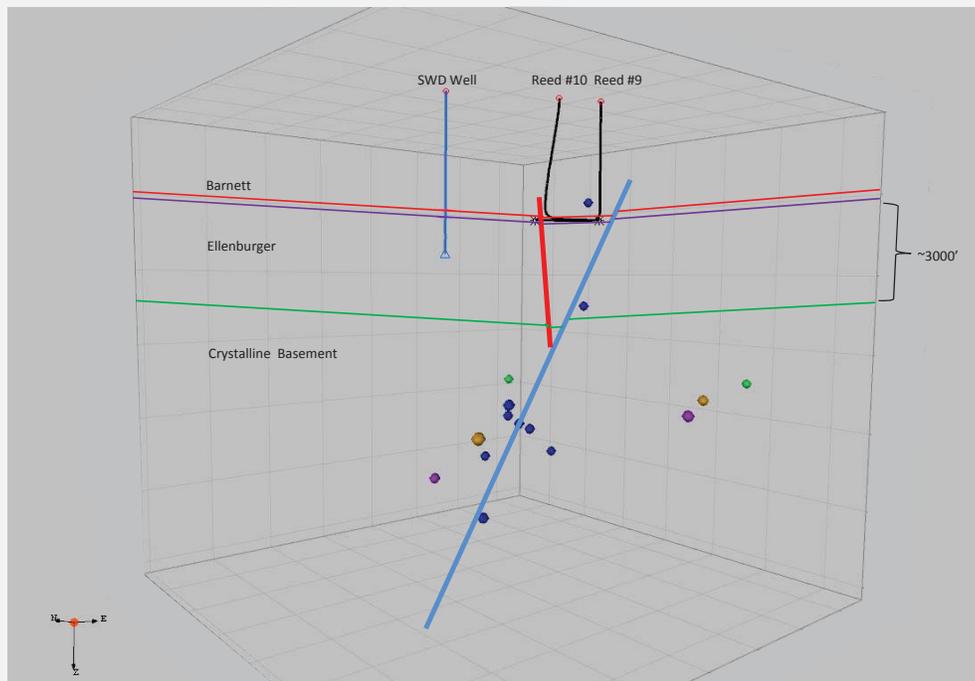
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 4 (11/11/13-12/31/13)



70

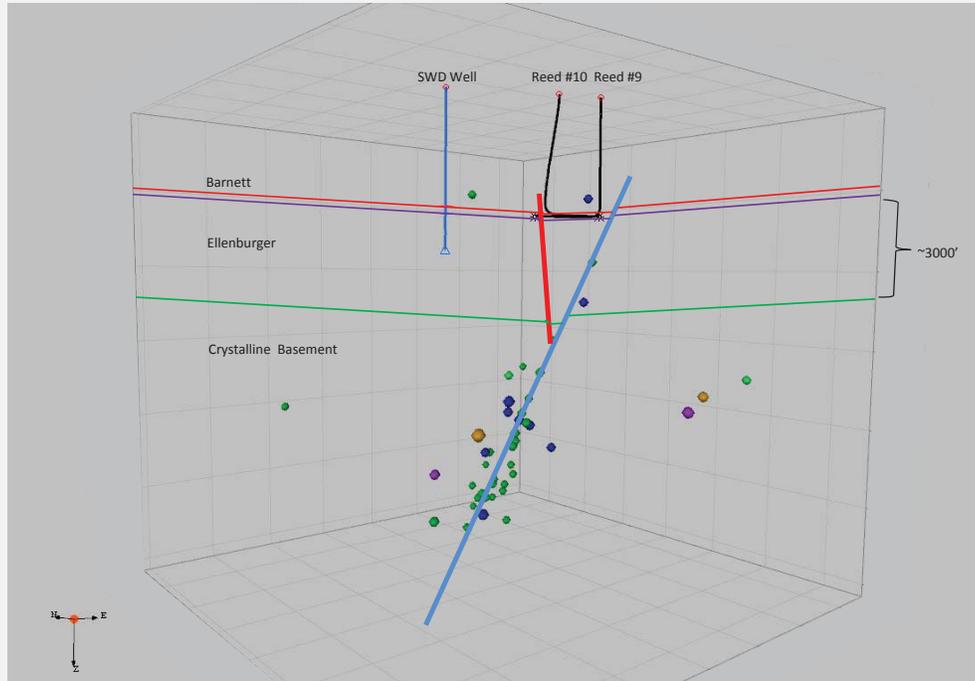
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 5 (11/11/13-01/15/14)



71

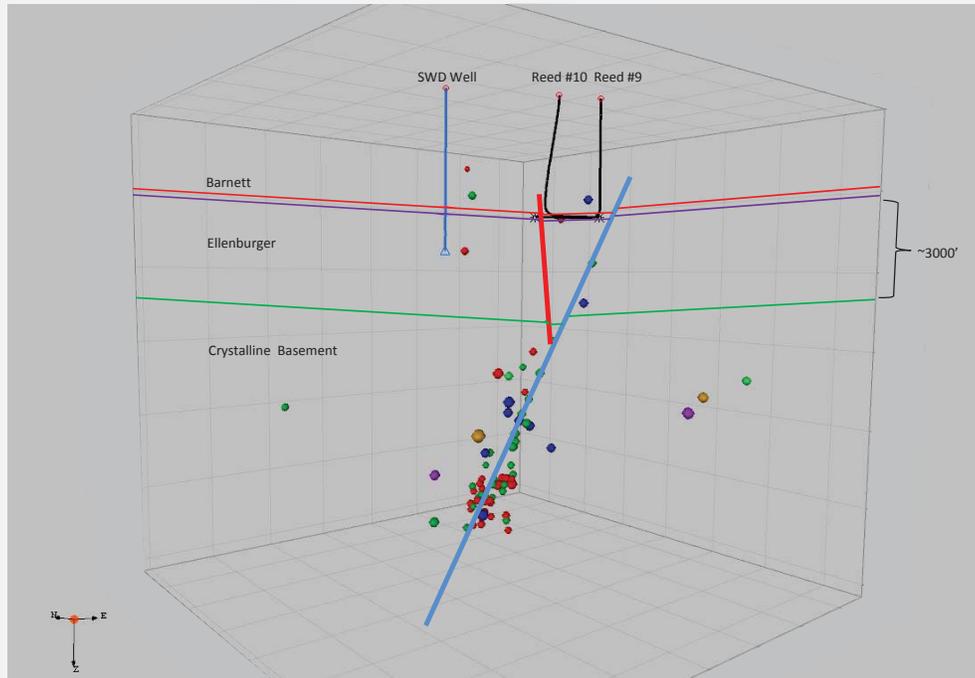
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 6 (11/11/13-01/27/14)



72

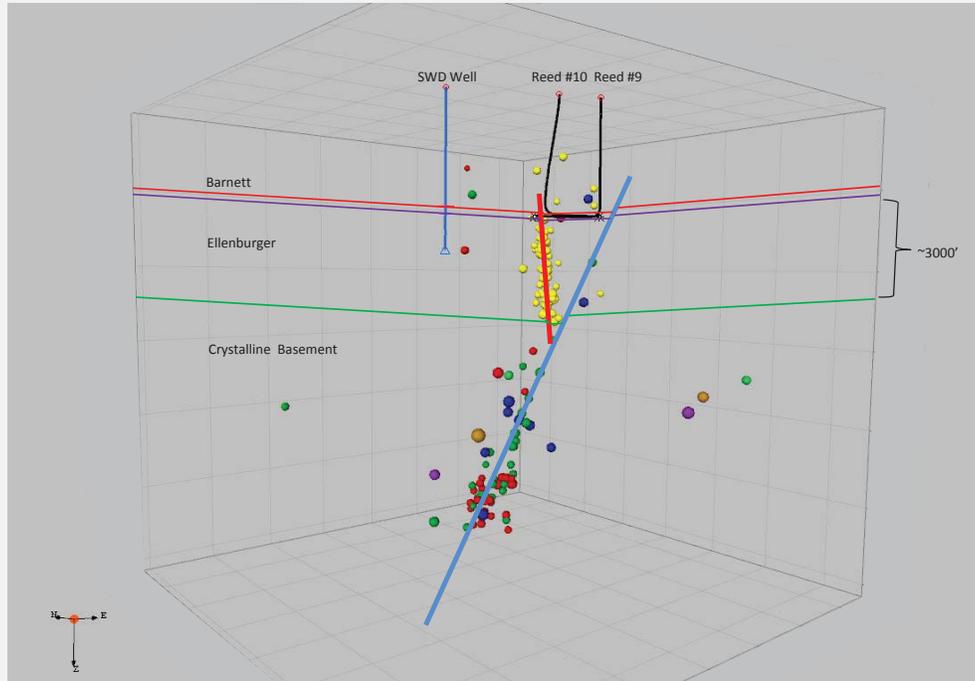
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
Hearing Date: June 10, 2015

C

C'

### Sequence of Events – Time Step 7 (11/11/13-1/28/14)



73

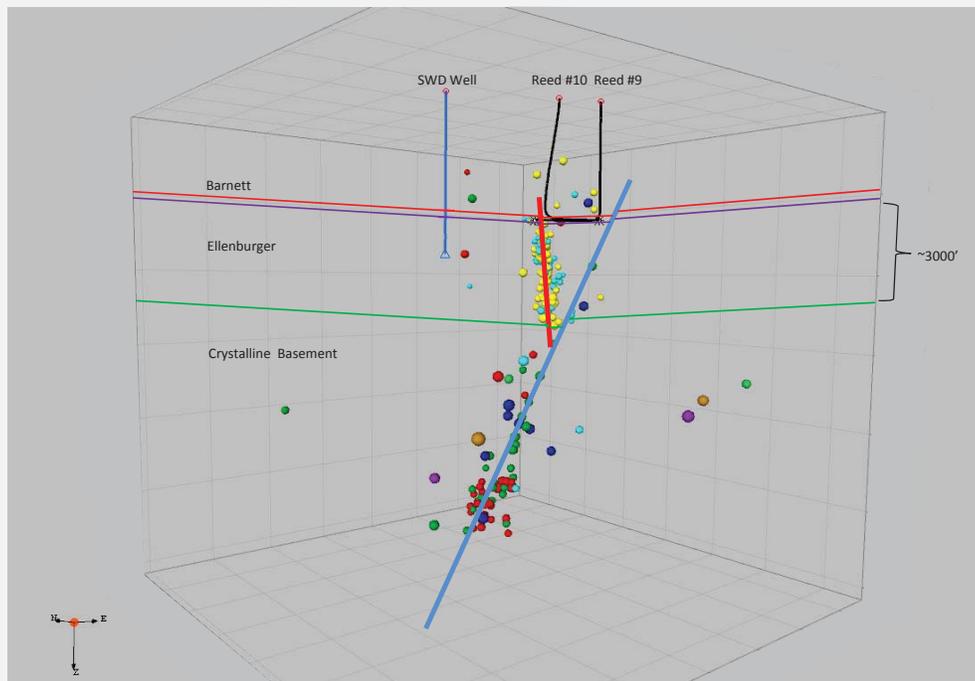
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
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C

C'

### Sequence of Events – Time Step 8 (11/11/13-01/31/14)



74

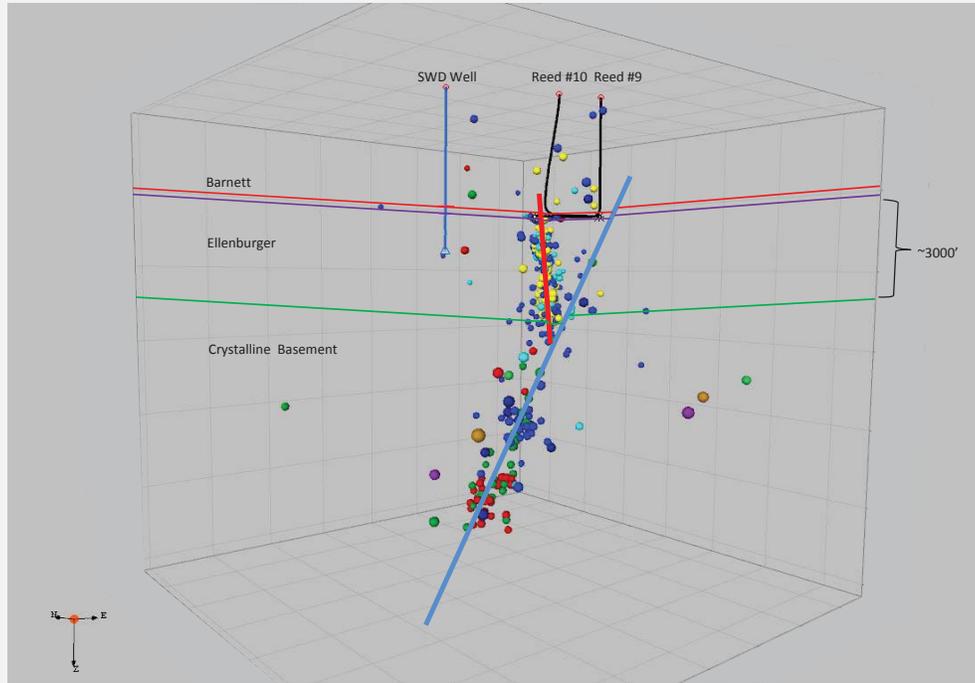
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 9 (11/11/13-02/15/14)



75

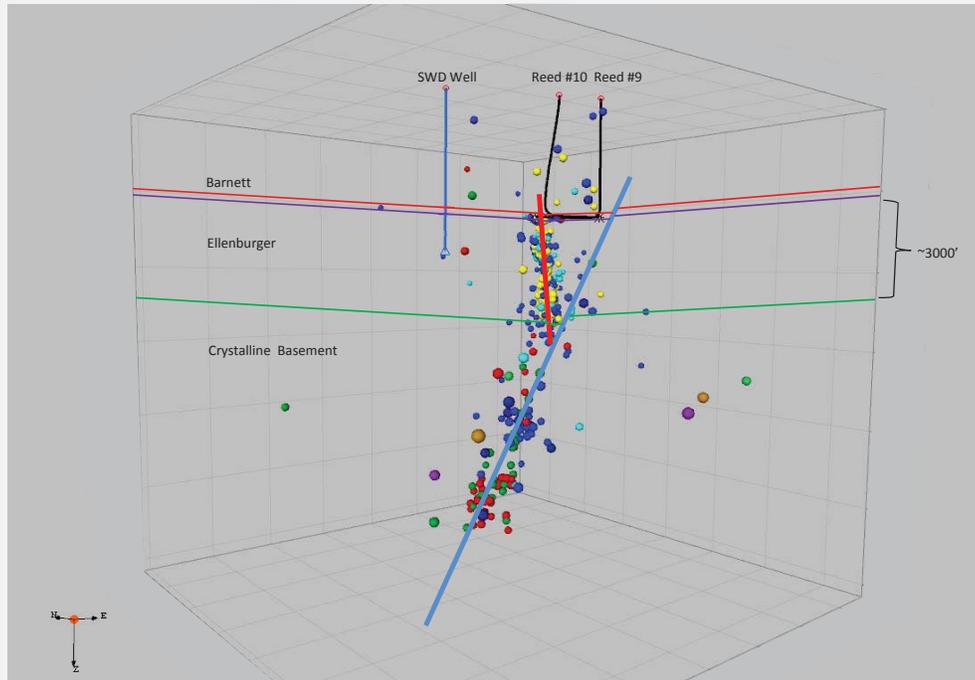
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
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C

C'

### Sequence of Events – Time Step 10 (11/11/13-02/28/14)



76

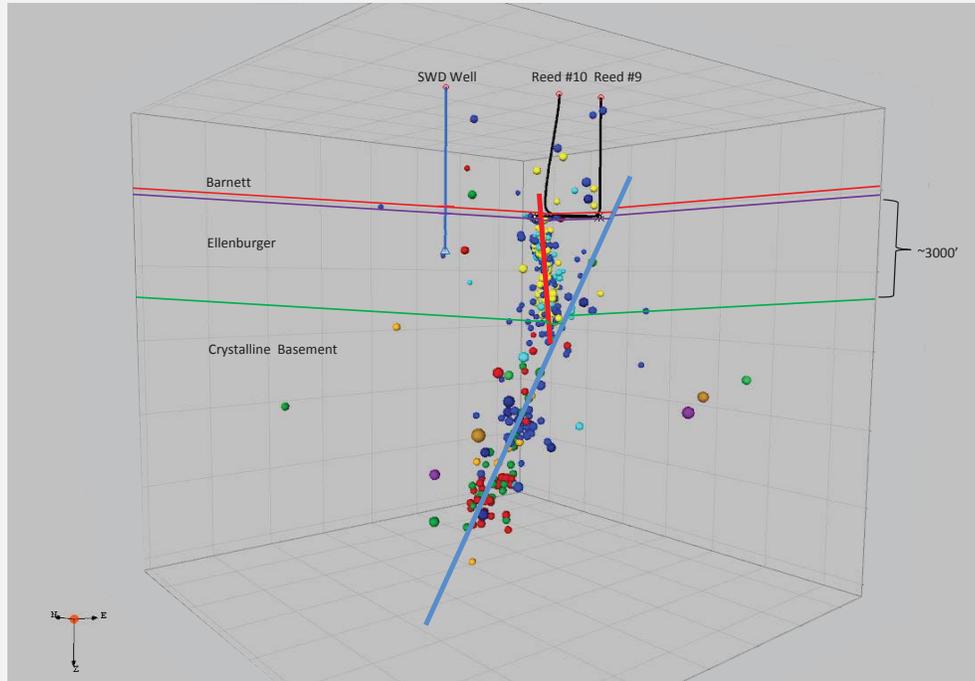
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 11 (11/11/13-03/15/14)



77

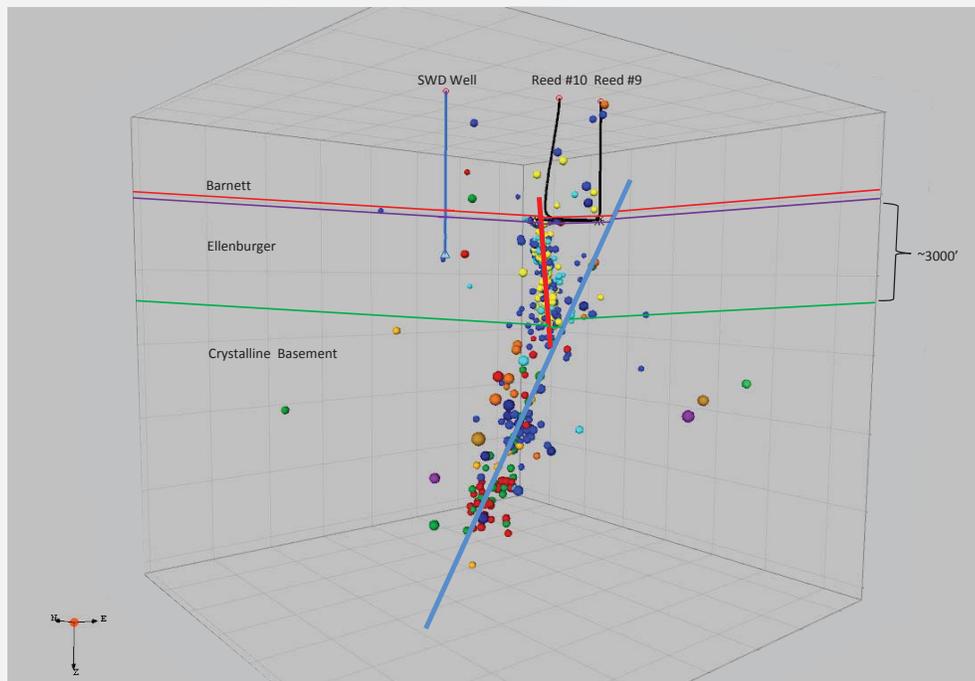
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 12 (11/11/13-03/31/14)



78

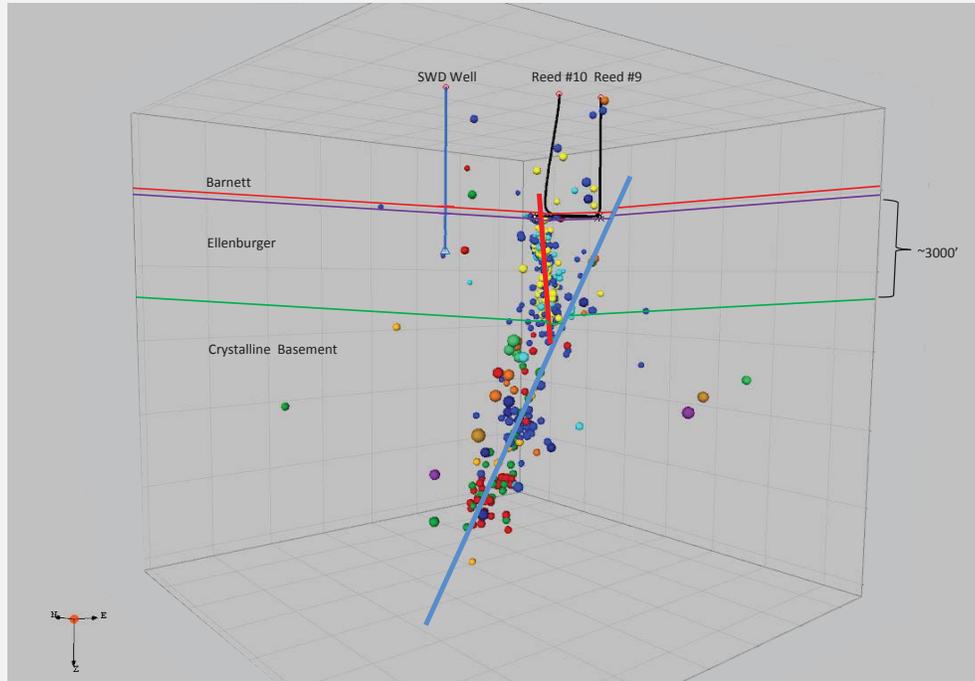
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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Hearing Date: June 10, 2015

C

### Sequence of Events – Time Step 13 (11/11/13-04/15/14)

C'



79

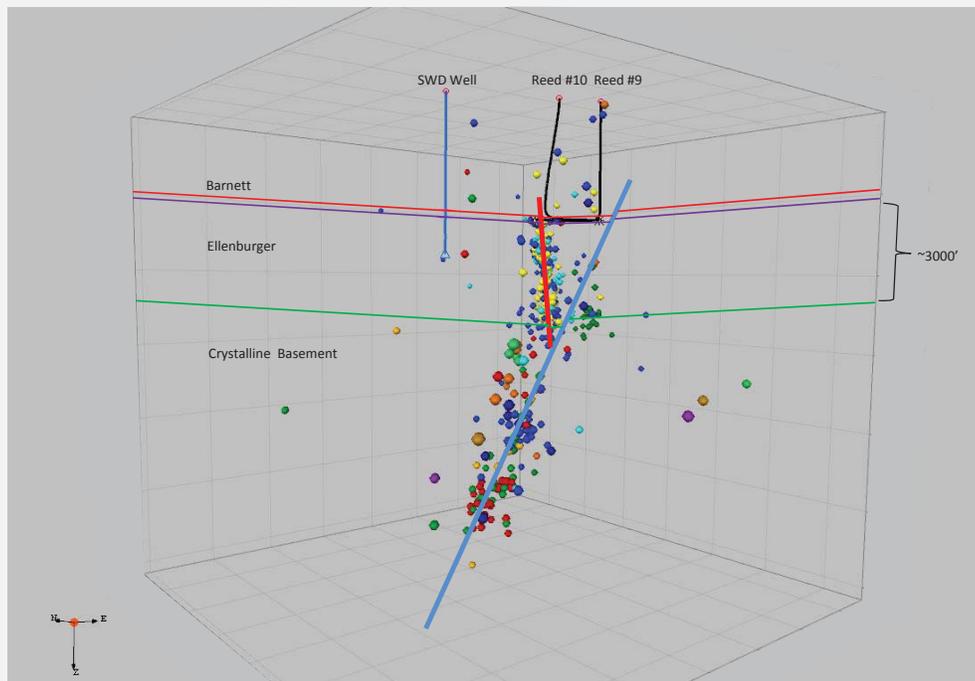
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
Hearing Date: June 10, 2015

C

### Sequence of Events – Time Step 14 (11/11/14-04/30/14)

C'



80

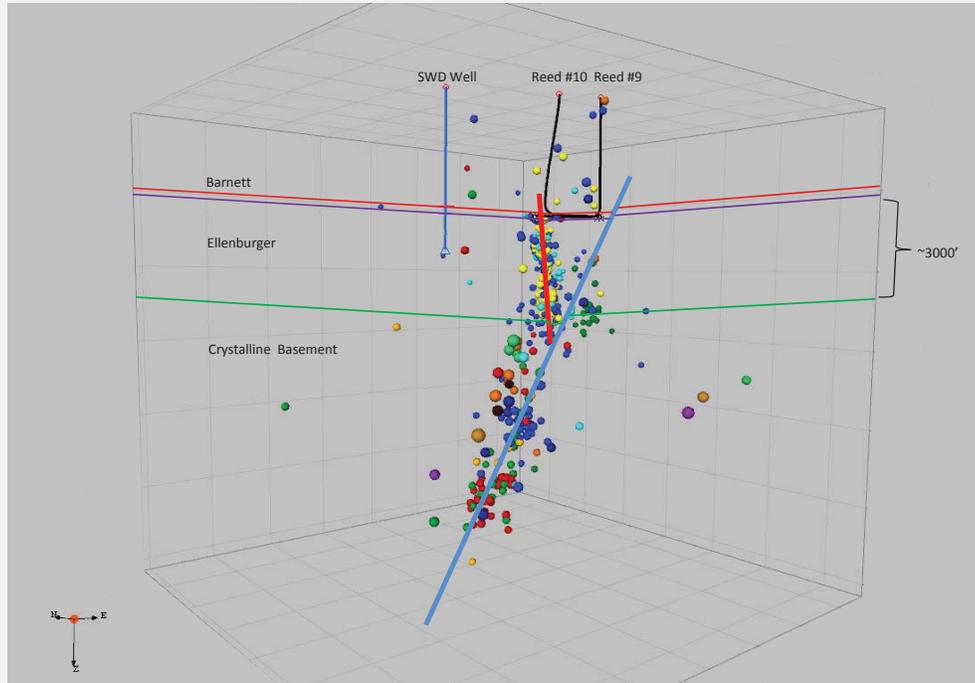
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 15 (11/11/13-05/15/14)



81

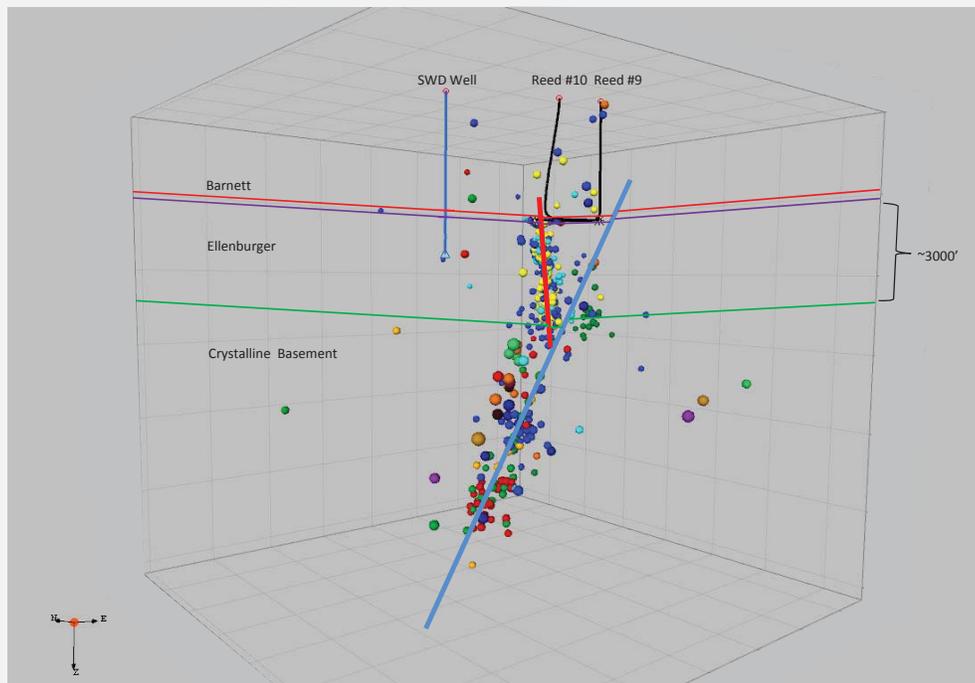
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 16 (11/11/13-05/31/14)



82

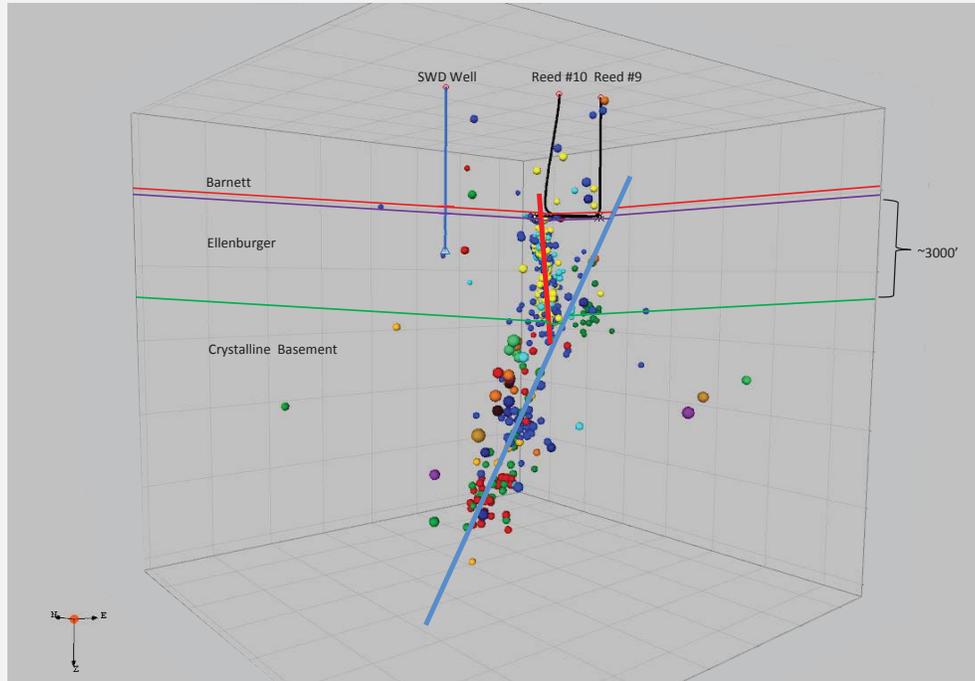
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

### Sequence of Events – Time Step 17 (11/11/13-06/15/14)

C'



83

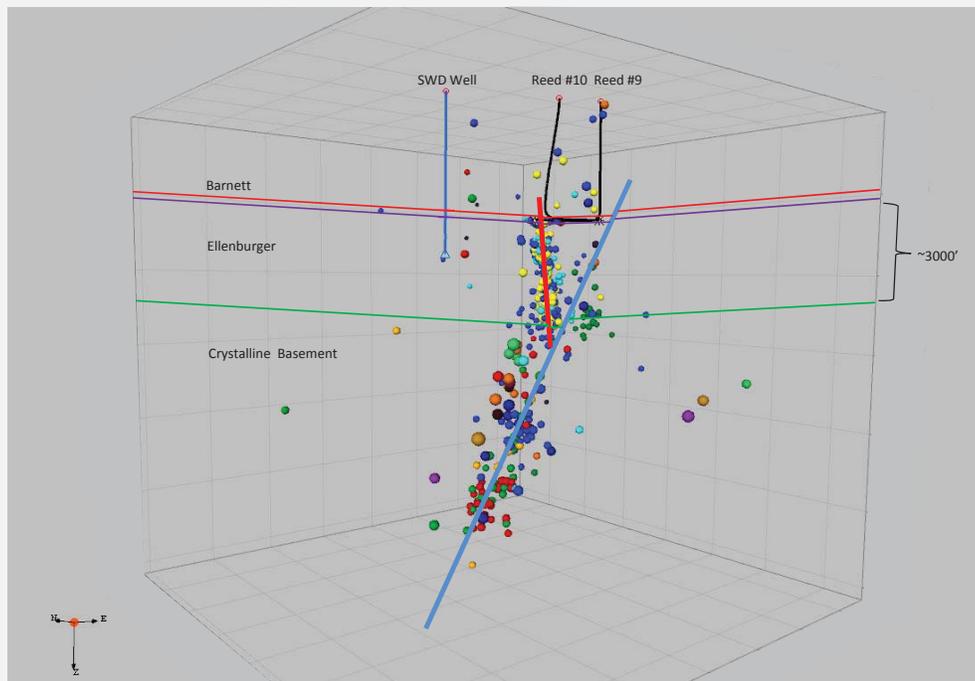
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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Hearing Date: June 10, 2015

C

### Sequence of Events – Time Step 18 (11/11/13-06/30/14)

C'



84

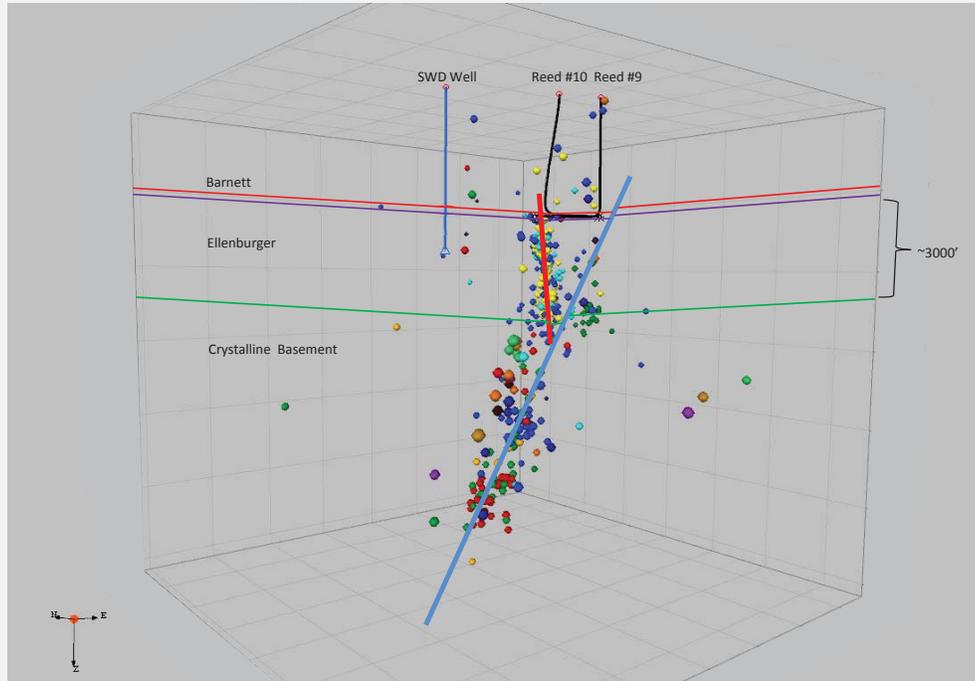
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

### Sequence of Events – Time Step 19 (11/11/13-07/15/14)

C'



85

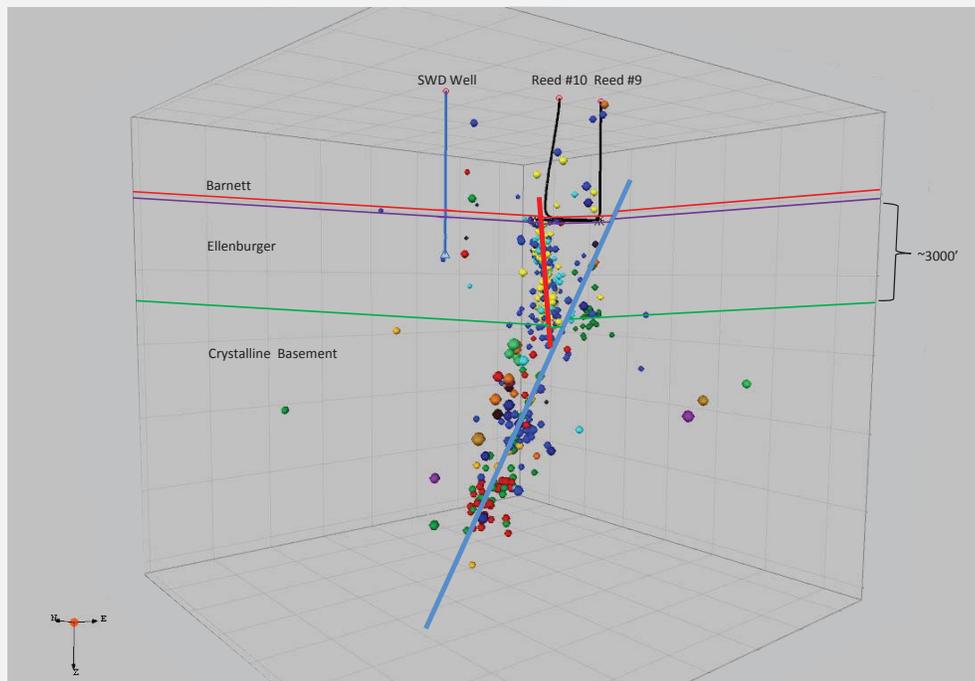
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

### Sequence of Events – Time Step 20 (11/11/13-07/30/14)

C'



86

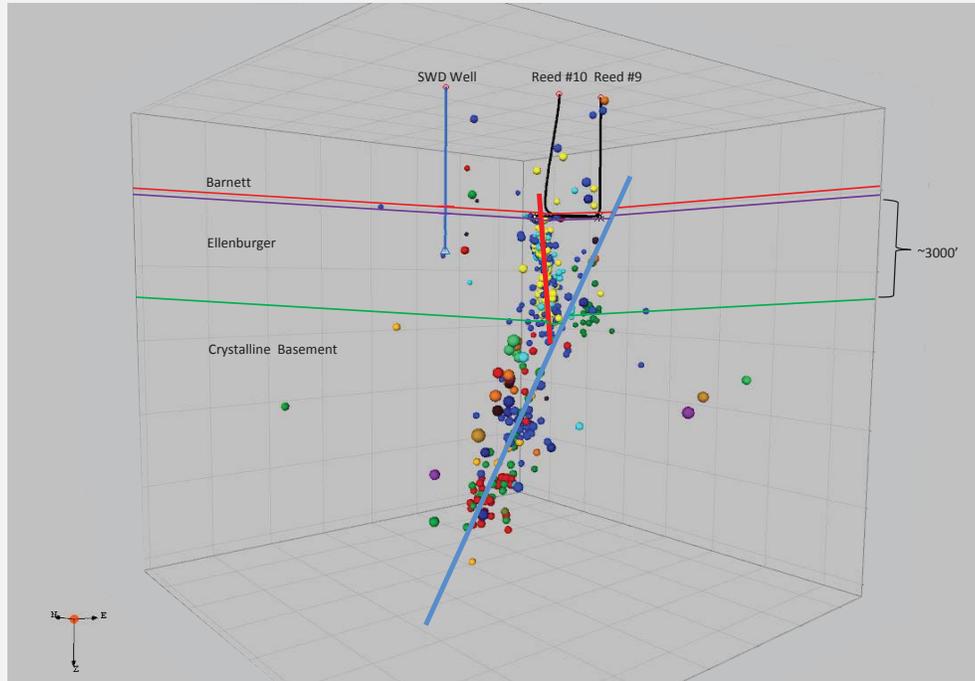
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 21 (11/11/13-08/15/14)



87

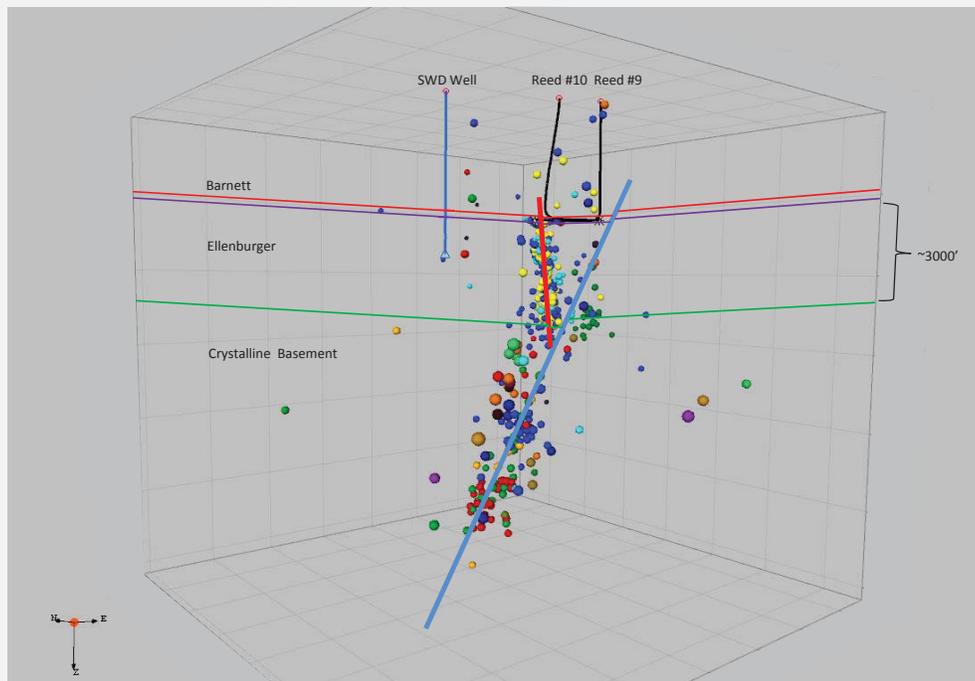
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 22 (11/11/13-08/30/14)



88

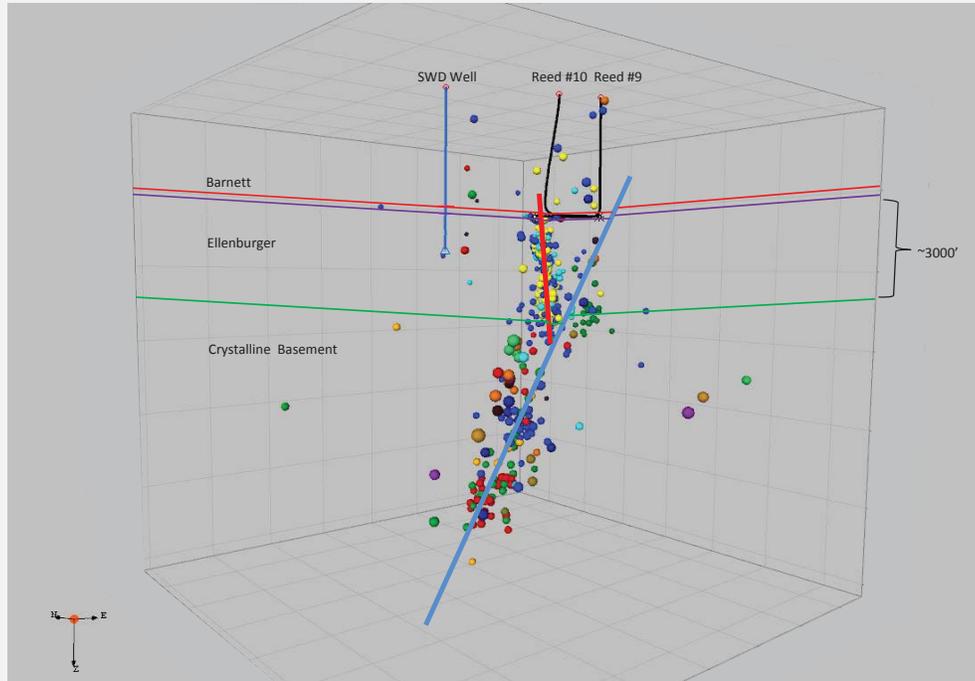
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

### Sequence of Events – Time Step 23 (11/11/13-09/15/14)

C'



89

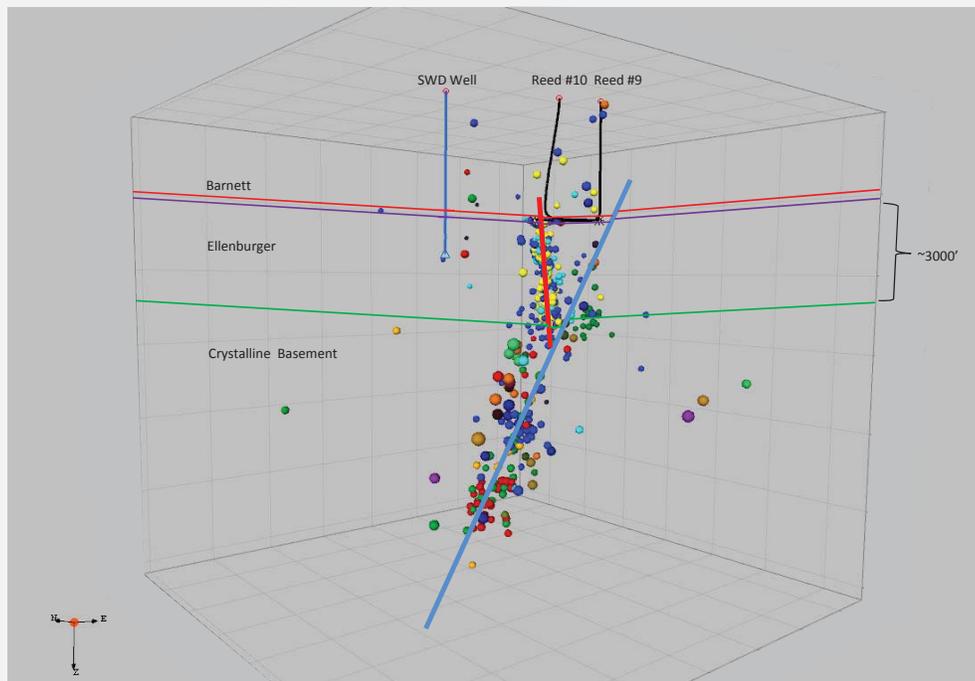
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

### Sequence of Events – Time Step 24 (11/11/13-09/30/14)

C'



90

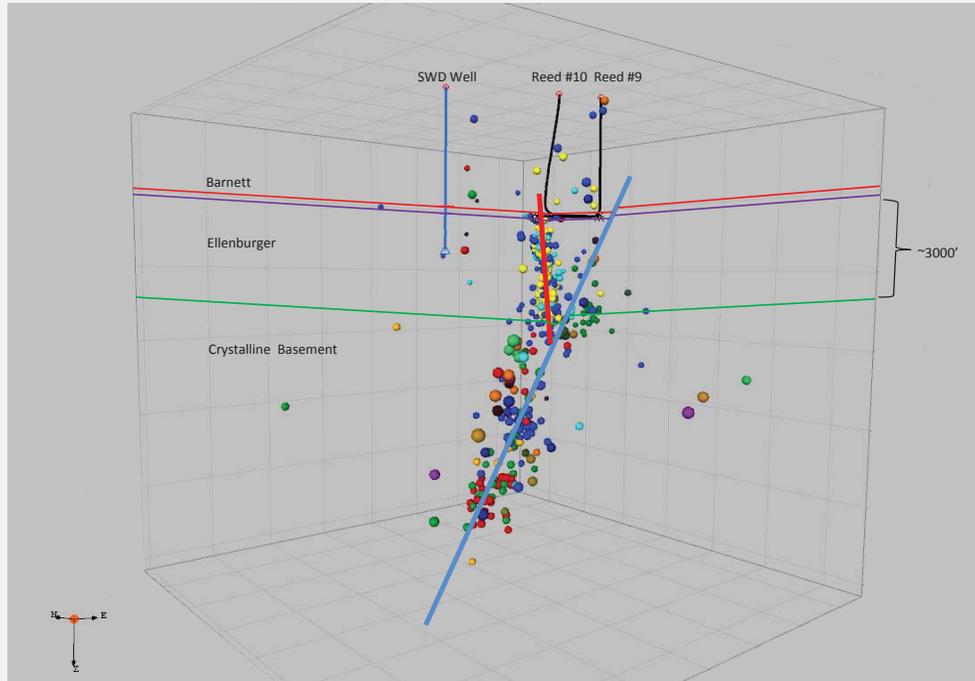
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 25 (11/11/13-10/15/14)



91

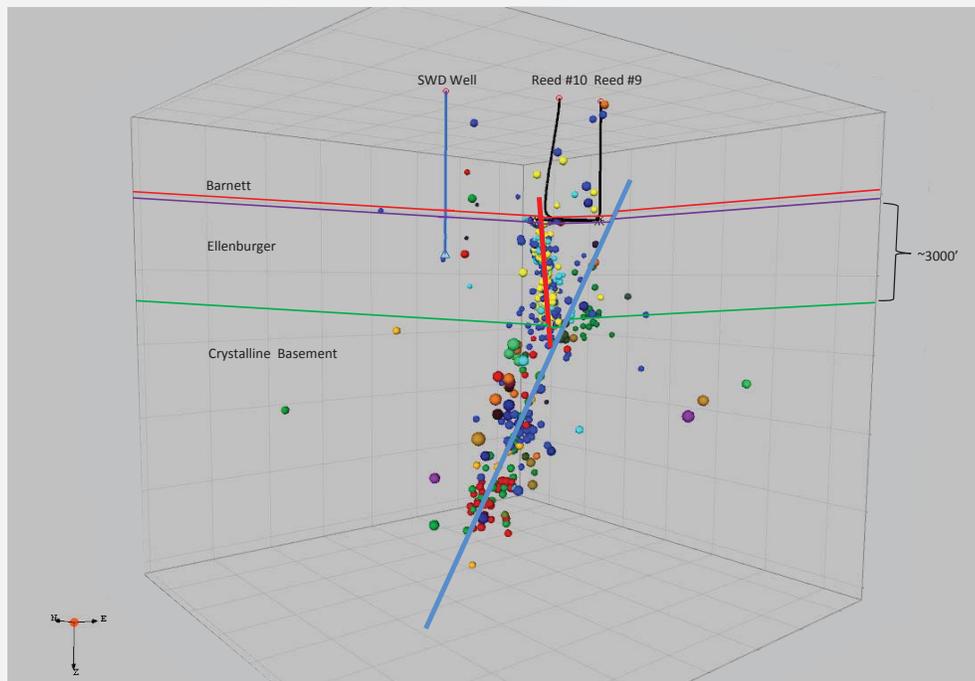
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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O&G Docket No. 09-0296411  
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C

C'

### Sequence of Events – Time Step 26 (11/11/13-10/31/14)



92

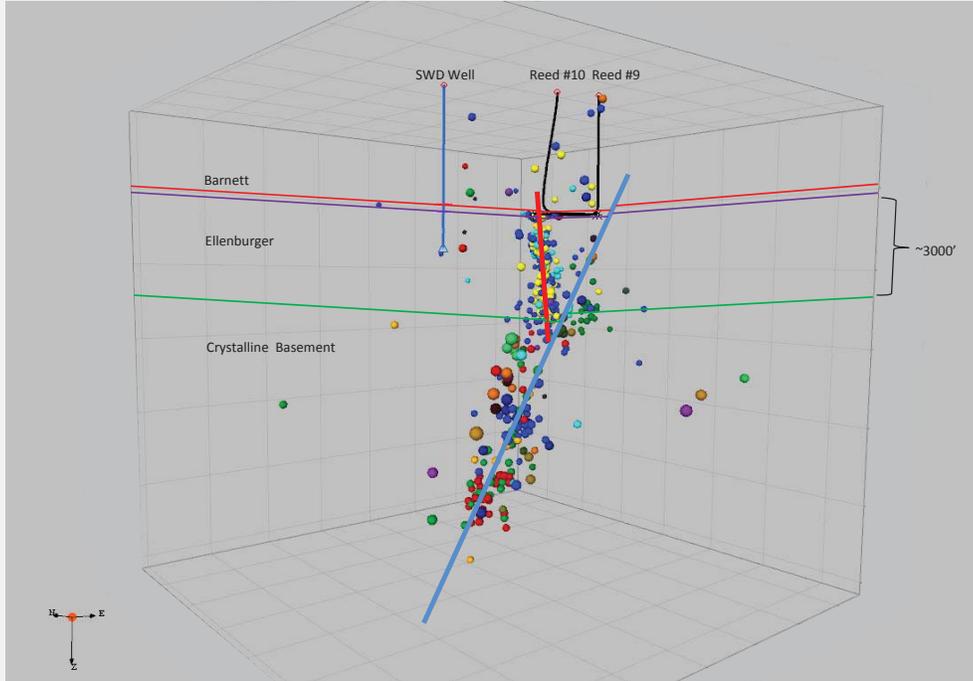
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

### Sequence of Events – Time Step 27 (11/11/13-11/15/14)

C'



93

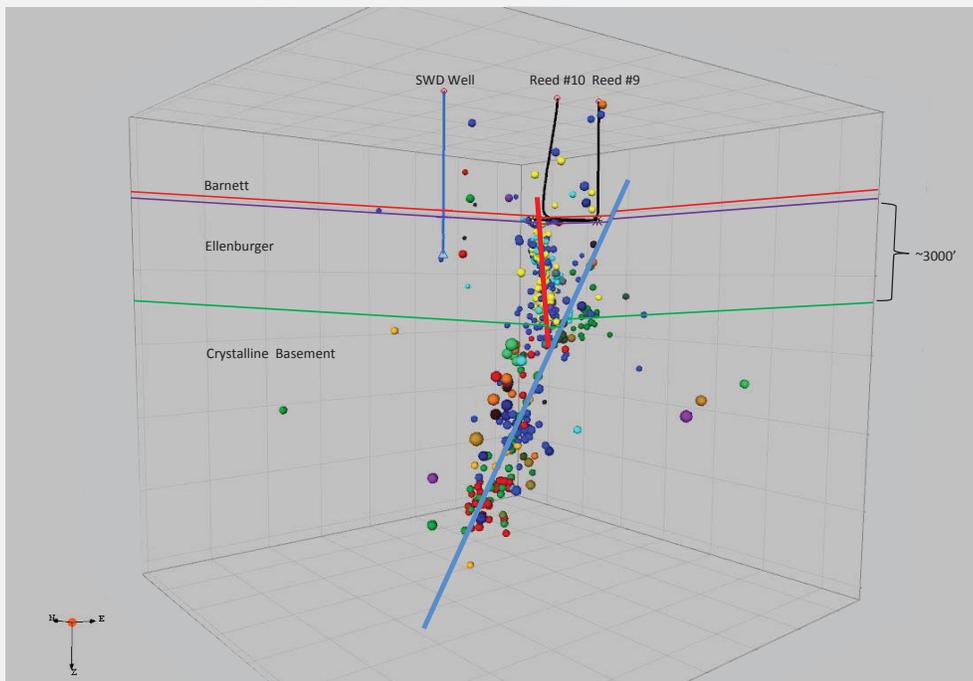
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
XTO Energy Inc.  
O&G Docket No. 09-0296411  
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C

### Sequence of Events – Time Step 28 (11/11/13-11/30/14)

C'



94

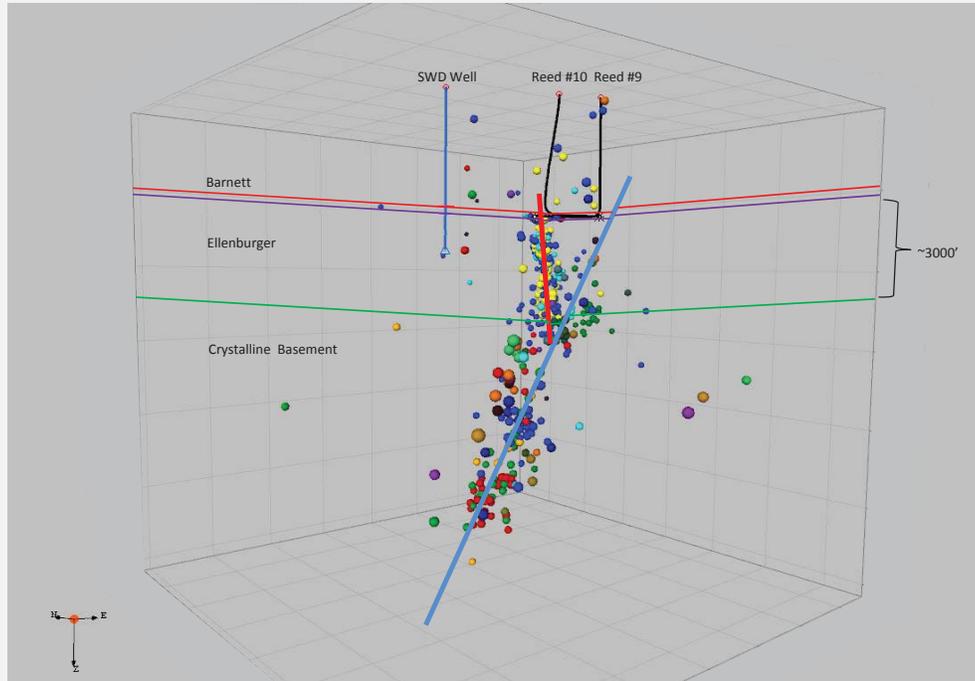
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 29 (11/11/13-12/15/14)



95

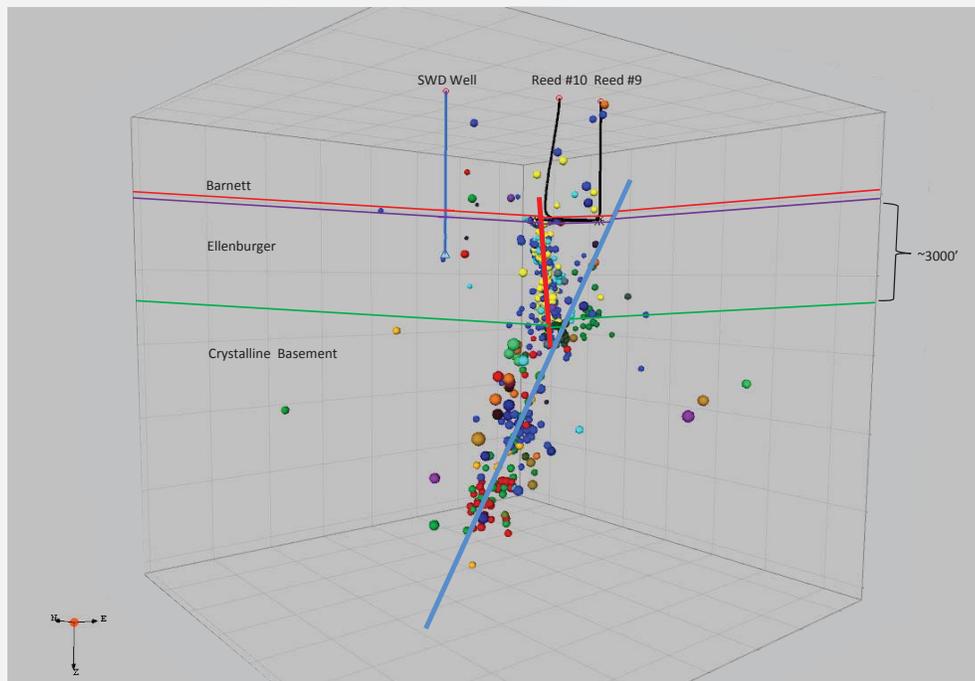
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 30 (11/11/13-12/31/14)



96

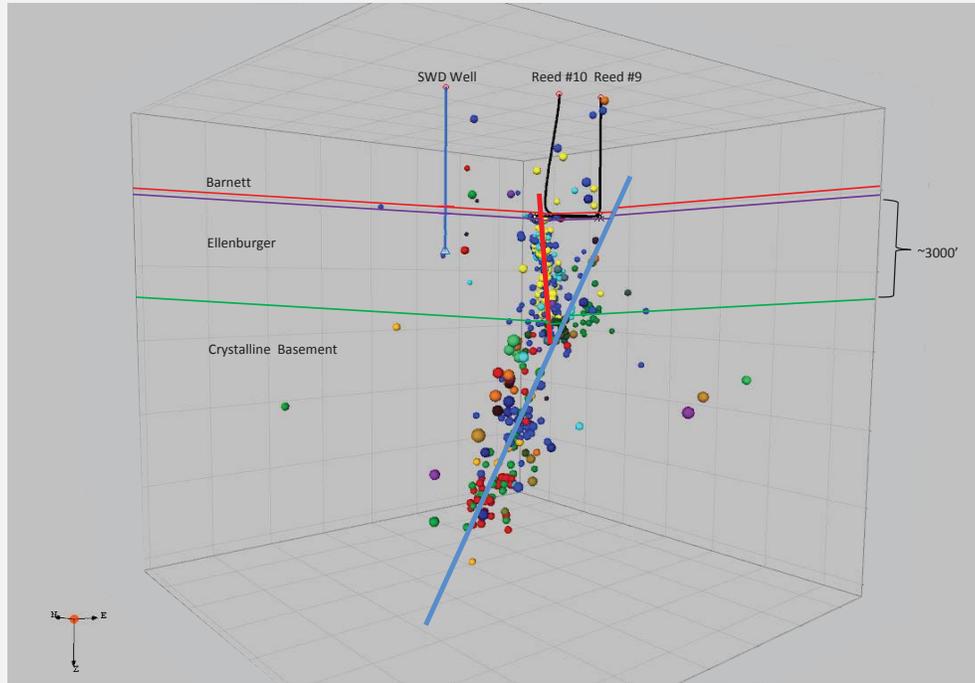
Diagrammatic Cross-section – Cumulative Sequences

Exhibit No. \_\_\_\_  
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C

C'

### Sequence of Events – Time Step 31 (11/11/13-01/15/15)



97

Diagrammatic Cross-section – Cumulative Sequences

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