



## Earthquake Response Summary

- Researchers largely agree that wastewater injection into the Arbuckle formation, the state's deepest formation, poses the largest potential risk for induced earthquakes in Oklahoma. Most of the wastewater comes not from hydraulic fracturing operations, but rather from producing wells. The water exists in the producing formation and comes up with the oil and natural gas.
- The Oklahoma Corporation Commission's Oil and Gas Conservation Division (OGCD) took its first action on Arbuckle disposal wells regarding earthquakes concerns in September 2013, resulting in one well shutdown and the prevention of the startup of another.
- In early 2015, new research and data provided the basis for a switch from isolated actions on individual Arbuckle disposal wells to larger plans covering more square miles and wells, resulting in plans that have, when taken in conjunction with previous actions, reduced total disposed volume in earthquake areas by approximately 800,000 barrels a day over 2014 levels, with actions taken on about 700 Arbuckle disposal wells.
- The volume reduction area currently covers about 11 thousand square miles, and a 15 thousand square mile "Area of Interest" (AOI) has been established. All Arbuckle wells in the AOI must report disposal volumes at least weekly. New applications for Arbuckle disposal wells in the AOI are no longer eligible for administrative approval.
- More recently, earthquake events outside the main earthquake area have been linked to hydraulic fracturing. These events are rarer, accounting for less than 4 percent of the earthquake activity, and tend to be of lesser magnitudes. More information on the protocols developed to deal with this risk can be found below.

### Recent Actions

February 27, 2018 – New protocol issued to mitigate earthquake risk linked to hydraulic fracturing operations in the SCOOP and STACK plays.

<http://www.occeweb.com/News/2018/02-27-18PROTOCOL.pdf>

October 31, 2018 – Directive for 2 Arbuckle disposal wells in the Hennessey area directed to reduce volume 25 percent. (At OCC's recommendation, operators of the wells agree to work toward ending all disposal into the Arbuckle.) Wells in question are the Choate SWD1 (Choate Disposal Services) and the Dover Unit Hoover SWD1 (Chaparral Energy).

October 18, 2017 – Wilzetta #1, New Dominion, in Lincoln County directed to stop all disposal into the Arbuckle formation.

August 9, 2017 - Further Arbuckle disposal well volume reductions in the Edmond area.

<http://www.occeweb.com/News/2017/08-09-17ADVISORY.pdf>

June 27, 2017 – Report on progress of actions taken in relation to seismicity activity potentially related to well completion operations. <http://www.occeweb.com/News/2017/06-27b-17Seismicity-well%20completion.pdf>

March 1, 2017 – OGS/OCC joint statement regarding seismicity hazard map. <http://www.occeweb.com/News/2017/03-01-17OCC-%20OGS%20JOINT%20STATEMENT.pdf>

February 24, 2017 – Area of Interest (AOI) – Directive restricting future volume disposal rates. <http://www.occeweb.com/News/2017/02-24-17%20FUTURE%20DISPOSAL.pdf>

December 20, 2016 – Statewide: Directive regarding seismicity that may be linked to hydraulic fracturing operations. <http://www.occeweb.com/News/2016/12-20-16SCOOP-STACK.pdf>

November 8, 2016 – Cushing area: Directive modifying operations of 54 Arbuckle disposal wells. <http://www.occeweb.com/News/2016/11-08-16CUSHING%20PLAN.pdf>

November 3, 2016 – Pawnee area: Directive covering 38 Arbuckle disposal wells under OCC jurisdiction and 26 Arbuckle disposal wells under sole EPA jurisdiction. <http://www.occeweb.com/News/2016/11-03-16PAWNEE%20POSTING.pdf>

September 12, 2016 – Pawnee area: Directive modifying operations at 48 Arbuckle disposal wells under OCC jurisdiction in a 1,116 square mile area. 32 to shut in, remainder to reduce volume. EPA follows OCC lead in its area of jurisdiction (Osage County), shutting down 5 Arbuckle disposal wells, and reducing volumes at 14 others. <http://www.occeweb.com/News/2016/09-12-16Pawnee%20Advisory.pdf>

September 3, 2016 – Pawnee area: 37 wells directed to shut in (cease operations) under emergency directive as immediate response to Pawnee-area 5.8 magnitude earthquake. (Superseded by September 12, 2016 directive).

August 19, 2016 – Luther/Wellston area: 2 wells shut in, 19 wells to further reduce volume. Actions are in addition to the earlier 40 percent volume cutback that includes area. [http://www.occeweb.com/News/2016/08-19-16LUTHER-WELLSTON%20\(3\).pdf](http://www.occeweb.com/News/2016/08-19-16LUTHER-WELLSTON%20(3).pdf)

March 7, 2016 – Central Oklahoma Regional Volume Reduction Plan and Expansion of Area of Interest <http://www.occeweb.com/News/2016/03-07-16ADVISORY-AOI.%20VOLUME%20REDUCTION.pdf> (Note: On the advice of seismologists, plan is being phased in over a two month period. Completion is scheduled for the end of May).

February 16, 2016 – Western Oklahoma Regional Volume Reduction Plan: <http://www.occeweb.com/News/2016/02-16-16WesternRegionalPlan.pdf> (Completed on April 30)

January, 20, 2016 – Medford, Byron-Cherokee areas\*\*: Sandridge Energy - 8 wells to stop disposal, 9 wells to be used by researchers. 36 wells to reduce volume. Total volume reduction: 191,327 barrels/day, (40 percent). A barrel is 42 gallons.

\*\*Supersedes Sandridge Energy portion of plans issued 12/3/15.

<http://www.occeweb.com/News/01-20-16SANDRIDGE%20PROJECT.pdf>

January 13, 2016 - Fairview area: 27 disposal wells to reduce volume. Total volume reduction for the area in question: 54,859 barrels a day or (18 percent). <http://www.occeweb.com/News/01-13-16ADVISORY.pdf>

January 4, 2016 - Edmond area: 5 disposal wells to reduce volumes by 25 to 50 percent. Wells 15 miles from epicenter to conduct reservoir pressure testing. (Two disposal wells ceased operation as part of the action). <http://www.occeweb.com/News/01-04-16EO%20ADVISORY.pdf>

December 3, 2015 – Byron/Cherokee area: 4 disposal wells shut-in, volume cuts of 25 to 50 percent for 47 other disposal wells. [http://www.occeweb.com/News/12-03-15BYRON-CHEROKEE\\_MEDFORD%20EARTHOUAKE%20RESPONSE.pdf](http://www.occeweb.com/News/12-03-15BYRON-CHEROKEE_MEDFORD%20EARTHOUAKE%20RESPONSE.pdf)

December 3, 2015 – Medford area: 3 disposal wells shut-in and f cuts of 25 to 50 percent in disposed volumes for 19 other wells. The total net volume reduction for the area in question is 42 percent.  
[http://www.occeweb.com/News/12-03-15BYRON-CHEROKEE\\_MEDFORD%20EARTHOUAKE%20RESPONSE.pdf](http://www.occeweb.com/News/12-03-15BYRON-CHEROKEE_MEDFORD%20EARTHOUAKE%20RESPONSE.pdf)

November 20, 2015 – Crescent: 4 disposal wells shut-in, 7 others reduce volume 50 percent.  
<http://www.occeweb.com/News/11-20-15CRESCENT%20ADVISORY.pdf>

November 19, 2015 – Cherokee: 2 disposal wells shut-in, 23 others reduce volume 25 to 50 percent.  
<http://www.occeweb.com/News/CHEROKEE%20ADVISORY-VOLUME,%20OPERATOR.PDF>

November 16, 2015 – Fairview: 2 wells reduce volume 25 percent, 1 well stop operations and reduce depth.  
<http://www.occeweb.com/News/11-16-15FAIRVIEW%20and%20MAP.pdf>

November 10, 2015 – Medford: 10 wells reducing volume disposed 25 to 50 percent.  
<http://www.occeweb.com/News/11-10-15MEDFORD02.pdf>

October 19, 2015 – Cushing: 13 wells either ceasing operations or cutting volume disposed 25 percent.  
<http://www.occeweb.com/News/10-19-15CUSHING%202.pdf>

August 3, 2015 – Volume cutback plan for area that includes portions of northern Oklahoma, Logan, Lincoln, and Payne counties. Goal is to bring total disposed volume in area to 30 percent below 2012 total (pre seismicity). Plan covers 23 wells.  
<http://www.occeweb.com/News/08-03-15VOLUME%20ADVISORY%20RELEASE.pdf>

July 28, 2015 – Crescent: 2 wells shut in, 1 reducing volume 50 percent.  
<http://www.occeweb.com/News/Crescent%20wells.pdf>

\*\* July 17, 2015 – Directive for 211 disposal wells in the Arbuckle to check depth. Must prove that that depth is not in communication with basement rock, or a plug back operation is completed to bring the bottom of the well at least 100 feet up into the Arbuckle.  
<http://www.occeweb.com/News/DIRECTIVE-2.pdf>

\*\* March 25, 2015 – Directive for 347 wells in the Arbuckle to check depth, etc.  
<http://www.occeweb.com/News/2015/03-25-15%20Media%20Advisory%20-%20TL%20and%20related%20documents.pdf>

\*\* To date, the July 17 and March 25 directives have resulted in 227 wells plugging back (i.e., reducing depth).