ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Office of Oil and Gas Resource Management
One Natural Resources Way Springfield, Illinois 62702-1271

HIGH VOLUME HORIZONTAL HYDRAULIC FRACTURING PERMIT APPLICATION HVHHF-10

References to "1-xx" or "§1-xx" are to the Hydraulic Fracturing Regulatory Act., 225 ILCS 732/1-1 et seq. References to "240.xxx" and "245.xxx" are to 62 Ill. Admin. Code 240 and 245, respectively.

Attachment: HVHHFOperationsPlan

Please save attachment and use the file name above.

High Volume Horizontal Hydraulic Fracturing Operations Plan §1-35(b)(6), 245.210(a)(6).

Geological description.

Please list and describe in this attachment all formation(s) affected by the high volume horizontal hydraulic fracturing operation, including (but not limited to) the formation(s) to be stimulated and the formations constituting or contributing to the confining zone. For each such formation, please describe the lithology, extent, thickness, permeability, porosity, transmissive faults, fractures, water or water source content, and susceptibility to vertical propagation of fractures. For each formation, state if any of these features are unknown.

a) what is the anticipated surface treating pressure range?
b) what is the maximum anticipated injection treating pressure?
c) what is the estimated or calculated fracture pressure of the producing zone?
d) what is the estimated or calculated fracture pressure of the confining zones?
e) what is the planned depth of all proposed perforations?
f) what is the planned depth to the top of the open hole section?
g) what is the type, source and volume of base fluid anticipated to be used?

WOOLSEY OPERATING COMPANY, LLC
125 NORTH MARKET, SUITE 1000, WICHITA, KANSAS 67202-1775
(316) -267-4379 FAX (316) 267-4383

Woolsey Operating Company, LLC
Woodrow #1H-310408-193
White County, Illinois
High Volume Horizontal Hydraulic Fracturing Permit Application
HVHHF-10: Operations Plan

Geologic Formations Affected:
New Albany Gp. (Target)
Compton / Chouteau
Borden / Springville
Ft. Payne
Lingle

Herein are listed the geologic descriptions of all formations that may be affected by the HVHHFO of the proposed, permitted well. As requested, the lithology, extent, thickness, permeability/porosity, water or water source content and susceptibility to vertical propagation of fractures will be discussed for each of the formations referenced below. In regard to transmissive faults and large through-going fractures, it can be stated that according to a 3-D seismic survey collected over the proposed location / prospect area, there are none that exist anywhere near the proposed wellbore, and specifically that part of the well bore that will be in the reservoir zone, the New Albany Shale (herein referenced as 'NAS').

*The drilling objective is the NAS; this shale is of Group status and actually is composed of 3 Formations, in ascending order from the base to the top, is the Blocher Shale Formation, the Selmier Shale Formation and the Grassy Creek Shale Formation. They are described below.

Blocher Shale: olive black, organic-rich, massive appearing to faintly laminated, slightly calcareous silty shale with common thin gray, sharply bedded traction deposits composed of silty calcarenites and calcisiltites. Average core measured porosity is 3 to 4% and has permeability in the nanodarcy range, and thus, is extremely tight. Some fractures are recognized in this section but are not large or long and typically mineralized. With the exception of saturation measurements, no information was collected or tested in regard to water from this formation.

Selmier Shale: olive gray, organic rich, but lesser so than the Blocher below and Grassy Creek above, pyritic, burrowed and bioturbated silty shale that represents more oxic deposition. Average core measured porosity is 5 to 6% and has permeability in the nanodarcy range, and thus is extremely tight. Some fractures are recognized in this section but are not large or long and typically mineralized. With the exception of saturation measurements, no information was collected or tested in regard to water from this formation.

Grassy Creek Shale *(horizontal target Formation)*: dark gray to black, pyritic, organic-rich, faintly laminated and locally burrowed and bioturbated, slightly silty shale / mudrock that possesses thin light gray beds composed of quartz grains; algal cysts (*tasmanites*) express laminations. Average core measured porosity is 5 to 7% and, although the most permeably of the three NAS formations is also in the nanodarcy range, and is extremely tight. Natural fractures do exist in this section, especially in the lower 50', and are up to a foot or two long, vertically; most are mineralized but some open fractures do exist. Horizontal, healed, fractures associated with prior oil generation also exist. With the exception of saturation measurements, no information was collected or tested in regard to water from this formation.

*The potential formations that may be affected by the HVHHFO ***above*** the NAS, in *ascending* order are as follows: Compton Limestone, Borden Shale (a.k.a., Springville Shale), and the Fort Payne Limestone. All three formations are lower Mississippian in age. They are described below.

Compton Limestone: light grey to green mottled crinoid wackestone to sparse packstone with thin shale wisps, 8-10' thick throughout the prospect area. No measured porosity or permeability for this formation exists in or near the prospect area however, from cores in the basin these rocks visually are extremely tight and non-permeable (all logs in a 5 mile radius corroborate these visual observations). Fractures are at a minimum as small, healed (mineralized) microfractures. No information exists on water from the formation.

Borden Shale (a.k.a., Springville Shale): dark greenish gray, flaggy to slightly laminated, burrowed shale, 40-50'thick throughout the prospect area. No measured porosity or permeability for this formation exists in or near the prospect area however, from cores in the basin these rocks visually are extremely tight and non-permeable, and due to the layering specifically non-permeable vertically (all logs in a 5 mile radius corroborate these visual observations). Very few fractures exist in this formation and, when present, are small, healed (mineralized) microfractures. No information exists on water from this formation.

Fort Payne Limestone: very dark gray to black, extremely dense siliceous lime mudstone; the unit is slightly silty and spiculitic in the lower half and grades

upward into a lighter colored lime mudstone that becomes increasingly cherty upward; the chert is dark to light gray mottled and burrowed. This formation is ~500' thick in the prospect area. No measured porosity or permeability for this formation exists in or near the prospect area however, from cores in the basin these rocks visually are extremely tight and non-permeable (all logs in a 5 mile radius corroborate these visual observations). As stated previous, the limestone is extremely dense, particularly in the lower half and not fractured; fractures do occur upward in the section but are restricted to the small chert nodules and are mineralized. No information exists on water from this formation.

*The potential formations that may be affected by the HVHHFO ***below*** the NAS, in *descending* order are as follows: the Devonian, Lingle Limestone Formation. This formation is described below.

Lingle Limestone: light to medium and dark gray, crinoidal wackestone to packstone, with some rugose and button (*M. discus*) corals; this unit is argillaceous and in places, cherty. The chert occurs as 1 to 3" nodules and is medium to dark gray mottled with crinoid fragments. The formation in the prospect area is 75 to 85' thick. This unit in places throughout the Illinois Basin is porous near the top (typically 3 to 8%), near an intraformational unconformity, and does produce oil however, examination of all logs within a 5 mile radius of the proposed location show the Lingle to be extremely tight throughout. No measured porosity or permeability for this formation exists in or near the prospect area. Some fracturing was noted in collected cores, largely in the sections that contained chert but they were small fractures and most typically mineralized. No information exists on water from this formation.

Based on the lithology and gross petrophysics of the under and overlying units, it is not anticipated that the aforementioned units will be susceptible to vertical fracture propagation during completion of the NAS, Grassy Creek Shale Formation. Historically, from microseismic study in the basin, there appears to be two frac barriers to the objective Grassy Creek, the Fort Payne Limestone above, and the intraformational Selmier Shale, below.

a) 1,000 psi – 7,900 psi
b) 7,900 psi.
c) 2,875 psi
d) 4,000 psi
e) Between 5,275' TVD and 5,245' TVD
f) N/A
g) Slickwater (3% KCl), Local well(s), Approx. 7,000,000 gal.