(1)

NC Oil and Gas Commission Meeting February 12,2019

Hello, my name is Jim Lister and I am a Certified Petroleum Geologist. I am also a licensed Professional Geologist in ~~Colorado~~ WYOMING and Utah.

I have been studying the Oil and Gas Commission's Rules and Regulations in what is referred to as Subchapter 05H and I wish to make comments regarding the definitions of "Conventional Reservoir", found in paragraph (30) and "Unconventional Reservoir", found in paragraph (106).

These are two commonly used terms, but they have very different physical properties; and I believe the current definition of each in the Commission's section entitled "Terms of Reference and Definitions" is incomplete and perhaps ambiguous.

The reason it matters is because if and when there is ever a well drilled that is productive, the size and shape of the drilling and spacing units will be dictated by the reservoir drainage area of the well.

Unless there is a clear distinction between the definition of Conventional and Unconventional, misinterpretations might result, and improper conclusions may be reached.

I have researched the definition and use of these terms by other science and business organizations. I have prepared documents for the Commission containing examples of each from the US Geological Survey, the US Energy Information Administration, the Geological Society of America, ConocoPhillips and the Petroleum Resources Management System.

The Petroleum Resources Management System is a 2018 publication by Netherland and Sewell, an international company engaged in regulatory reporting of petroleum reserves. This publication was sponsored in part by the International Society of Petroleum Engineers and the World Petroleum Council.

I have combined the essence of each definition used by those cited sources and submit for your consideration two proposed new definitions of Conventional and Unconventional Reservoir.

Since this is only a public comment opportunity and not a discussion session with the Commission, I will conclude by saying that the information I have prepared for your review consist of several PDFs and Word Documents, a Power Point presentation and a flash drive containing all the digital files.

Thank you for your time.

Jim Lister

(1) Page 1 of 1

(2)

15A NCAC 05H.0102 Terms of Reference and Definitions

(30) "Conventional reservoir" means an accumulation of hydrocarbons that are localized in structural or stratigraphic traps.

(106) "Unconventional reservoir" means a resource whose porosity, permeability, fluid trapping mechanism, or other characteristics differ from conventional reservoirs.

(2) Page 1 OF 7

Suggested definitions:

- **Conventional Reservoir**
  - A reservoir that is porous and permeable rock with buoyancy pressure equilibrium, trapped in discrete accumulations related to a localized geological structural and/or stratigraphic condition. Typically, each accumulation is bounded by a downdip contact with an aquifer and is significantly affected by hydrodynamic influences such as buoyancy of petroleum in water.
- **Unconventional Reservoir**
  - A reservoir that is pervasive or continuous throughout a large area and lacks a well-defined oil-water contact or gas-water contact. Resources in such reservoirs cannot be recovered using traditional recovery methods owing to fluid viscosity (e.g., oil sands) and/or reservoir permeability (e.g., tight gas/oil/CBM) that impede natural mobility. Unconventional shale reservoirs typically have low permeability (generally less than 0.1 millidarcy).

USGS Energy Resources

- **Conventional oil & gas accumulations** - Are discrete accumulations with well-defined hydrocarbon-water contacts, where the hydrocarbons are buoyant on a column of water. Conventional accumulations commonly have relatively high matrix permeabilities, have obvious seals and traps, and have relatively high recovery factors.
- **Unconventional oil accumulation** - A "continuous" or "unconventional" oil accumulation means that the oil resource is dispersed throughout a geologic formation(s) rather than existing as discrete, localized occurrences, such as those in conventional accumulations. Unconventional resources often require special technical drilling and recovery methods.
- https://energy.usgs.gov/GeneralInfo/HelpfulResources/EnergyGlossary.aspx#c

(2) Page 3 of 7

Petroleum Resources Management System 2018 Netherland and Sewell

- **Conventional resources:** Resources that exist in porous and permeable rock with buoyancy pressure equilibrium. The petroleum initially in place (PIIP) is trapped in discrete accumulations related to a localized geological structural and/or stratigraphic condition, typically with each accumulation bounded by a downdip contact with an aquifer and is significantly affected by hydrodynamic influences such as buoyancy of petroleum in water.
- **Unconventional resources:** Unconventional resources exist in petroleum accumulations that are pervasive throughout a large area and lack a well defined OWC or GWC (also called continuous-type deposits). Such resources cannot be recovered using traditional recovery projects owing to fluid viscosity (e.g., oil sands) and/or reservoir permeability (e.g., tight gas/oil/CBM) that impede natural mobility.
- **Reservoir:** A subsurface rock formation that contains and individual and separate natural accumulation of petroleum that is confined by impermeable barriers, pressure systems or fluid regimes (conventional reservoir) or is contained by hydraulic fracture barriers or fluid regimes (unconventional reservoirs).
- https://netherlandsewell.com/wp-content/uploads/2018/09/SPE_Petroleum_Resources_Management_System_2018.pdf

(2) Page 4 of 7

US Energy Information Administration

- **Conventional oil and natural gas production:** Crude oil and natural gas that is produced by a well drilled into a geologic formation in which the reservoir and fluid characteristics permit the oil and natural gas to readily flow to the wellbore.
- https://www.eia.gov/tools/glossary/index.php?id=C

Geological Society of America

- **Unconventional reservoir**: Tight deposits such as shale and other rocks with low porosity and permeability. The gas or oil remains in the layer in which it was created or migrates short distances and requires stimulated production to extract.
- https://www.geosociety.org/GSA/Science_Policy/Critical_Issues/Induced_Seismicity/GSA/Policy/issues/is/glossary.aspx

ConocoPhillips

- **Unconventional reservoirs** • Reservoirs with permeability so low (generally less than 0.1 millidarcy) that horizontal hydraulically fractured stimulated wells or other advanced completion techniques must be utilized to extract hydrocarbons at commercial rates
- **Conventional resources** • Discrete accumulations of hydrocarbons contained in rocks with relatively high matrix permeability, which normally have relatively high recovery factors.
- https://static.conocophillips.com/files/resources/conocophillips-glossary-of-terms-external-final-6-.pdf

(2) Page 7 OF 7

15A NCAC 05H.0102 Terms of Reference and Definitions

(30) "Conventional reservoir" means an accumulation of hydrocarbons that are localized in structural or stratigraphic traps.

(106) "Unconventional reservoir" means a resource whose porosity, permeability, fluid trapping mechanism, or other characteristics differ from conventional reservoirs.

Suggested definitions:

Conventional Reservoir

A reservoir that is porous and permeable rock with buoyancy pressure equilibrium, trapped in discrete accumulations related to a localized geological structural and/or stratigraphic condition. Typically, each accumulation is bounded by a downdip contact with an aquifer and is significantly affected by hydrodynamic influences such as buoyancy of petroleum in water.

Unconventional Reservoir

A reservoir that is pervasive or continuous throughout a large area and lacks a well-defined oil-water contact or gas-water contact. Resources in such reservoirs cannot be recovered using traditional recovery methods owing to fluid viscosity (e.g., oil sands) and/or reservoir permeability (e.g., tight gas/oil/CBM) that impede natural mobility. Unconventional shale reservoirs typically have low permeability (generally less than 0.1 millidarcy).

For reference, conventional and unconventional reservoirs are defined by these governmental, science, industry and regulatory organizations:

USGS Energy Resources

Conventional oil & gas accumulations - Are discrete accumulations with well-defined hydrocarbon-water contacts, where the hydrocarbons are buoyant on a column of water. Conventional accumulations commonly have relatively high matrix permeabilities, have obvious seals and traps, and have relatively high recovery factors.

https://energy.usgs.gov/GeneralInfo/HelpfulResources/EnergyGlossary.aspx#c

Unconventional oil accumulation - A "continuous" or "unconventional" oil accumulation means that the oil resource is dispersed throughout a geologic formation(s) rather than existing as discrete, localized occurrences, such as those in conventional accumulations. Unconventional resources often require special technical drilling and recovery methods.

https://energy.usgs.gov/GeneralInfo/HelpfulResources/EnergyGlossary.aspx#c

US Energy Information Administration

Conventional oil and natural gas production: Crude oil and natural gas that is produced by a well drilled into a geologic formation in which the reservoir and fluid characteristics permit the oil and natural gas to readily flow to the wellbore.
https://www.eia.gov/tools/glossary/index.php?id=C

Jim Lister Comments

Geological Society of America

Unconventional reservoir: Tight deposits such as shale and other rocks with low porosity and permeability. The gas or oil remains in the layer in which it was created or migrates short distances and requires stimulated production to extract.

https://www.geosociety.org/GSA/Science_Policy/Critical_Issues/Induced_Seismicity/GSA/Policy/issues/is/glossary.aspx

ConocoPhillips

Unconventional reservoirs • Reservoirs with permeability so low (generally less than 0.1 millidarcy) that horizontal hydraulically fractured stimulated wells or other advanced completion techniques must be utilized to extract hydrocarbons at commercial rates

https://static.conocophillips.com/files/resources/conocophillips-glossary-of-terms-external-final-6-.pdf

Conventional resources • Discrete accumulations of hydrocarbons contained in rocks with relatively high matrix permeability, which normally have relatively high recovery factors.

https://static.conocophillips.com/files/resources/conocophillips-glossary-of-terms-external-final-6-.pdf

Petroleum Resources Management System – Netherland and Sewell

Conventional resources: Resources that exist in porous and permeable rock with buoyancy pressure equilibrium. The petroleum initially in place (PIIP) is trapped in discrete accumulations related to a localized geological structural and/or stratigraphic condition, typically with each accumulation bounded by a downdip contact with an aquifer and is significantly affected by hydrodynamic influences such as buoyancy of petroleum in water.

Unconventional resources: Unconventional resources exist in petroleum accumulations that are pervasive throughout a large area and lack a well defined OWC or GWC (also called continuous-type deposits). Such resources cannot be recovered using traditional recovery projects owing to fluid viscosity (e.g., oil sands) and/or reservoir permeability (e.g., tight gas/oil/CBM) that impede natural mobility.

https://netherlandsewell.com/wp-content/uploads/2018/09/SPE_Petroleum_Resources_Management_System_2018.pdf

Reservoir: A subsurface rock formation that contains and individual and separate natural accumulation of petroleum that is confined by impermeable barriers, pressure systems or fluid regimes (conventional reservoir) or is contained by hydraulic fracture barriers or fluid regimes (unconventional reservoirs).

https://netherlandsewell.com/wp-content/uploads/2018/09/SPE_Petroleum_Resources_Management_System_2018.pdf

- **(30) "Conventional reservoir" means an accumulation of hydrocarbons that are localized in structural or stratigraphic traps.**
- My comments:
    - The definition above refers to the reservoir as an "accumulation of hydrocarbons"
    - Technically, the Rift Basins are structural features which have faults defining its sides
    - Tar sand fields are stratigraphic traps, but are considered to be an unconventional reservoir
    - Coal bed methane is a stratigraphic trap, but is considered to be an unconventional reservoir
- **(106) "Unconventional reservoir" means a resource whose porosity, permeability, fluid trapping mechanism, or other characteristics differ from conventional reservoirs.**
- My comments:
    - The definition above refers to the reservoir as a "resource"
    - The current definition simply says everything else that's not conventional
    - Fractured carbonates (Monterey Fm) are unconventional reservoirs which produce commercially on conventional structures

EMAIL

Taylor, Kenneth

From: Chapman, James
Sent: Monday, February 11, 2019 1:21 PM
To: Taylor, Kenneth
Subject: FW: [External] Fwd: NC O&G Commission Mtg February 12, 2019 - Jim Lister Reference Materials
Attachments: 15A NCAC 05H Definition Conventional and Unconventional.pdf; Comments February 12 2019.pdf; Conventional and Unconventional Reservoir.pdf; Definition Inconsistencies.pdf

(2) (1) (3) (4)

I spoke to Bridget on the phone. This gentleman would like to present to the commission tomorrow.

- Jim

From: Munger, Bridget
Sent: Monday, February 11, 2019 1:09 PM
To: Chapman, James <james.chapman@ncdenr.gov>
Cc: Munger, Bridget <bridget.munger@ncdenr.gov>
Subject: FW: [External] Fwd: NC O&G Commission Mtg February 12, 2019 - Jim Lister Reference Materials

Hi Jim,
Please see the attached files for materials that Mr. James Lister would like to share with commission members at tomorrow's meeting. I will see you at 10 a.m. tomorrow.
Thanks,
Bridget

Bridget Munger
Deputy Communications Director
N.C. Department of Environmental Quality

919-707-3644 office
919-207-7786 mobile
bridget.munger@ncdenr.gov

1612 Mail Service Center
Raleigh, NC 27699-1612

Email correspondence to and from this address is subject to the North Carolina Public Records Law and may be disclosed to third parties.

From: Jim Lister <gullpt.jl@gmail.com>
Sent: Monday, February 11, 2019 12:45 PM
To: Munger, Bridget <bridget.munger@ncdenr.gov>
Subject: [External] Fwd: NC O&G Commission Mtg February 12, 2019 - Jim Lister Reference Materials

CAUTION: External email. Do not click links or open attachments unless you verify. Send all suspicious email as an attachment to report.spam@nc.gov

Hi Bridget,

Here are my handouts for tomorrow's meeting.

Thank you
Jim Lister

EMAIL Page 1 of 2

---------- Forwarded message ---------
From: **JimLister** <JimLister@ec.rr.com>
Date: Mon, Feb 11, 2019 at 11:43 AM
Subject: NC O&G Commission Mtg February 12, 2019 - Jim Lister Reference Materials
To: <gullpt.jl@gmail.com>

For submission to the NC O&G Commission

EMAIL Page 2 OF 2