

Using Natural Gas Liquids to Recover Unconventional Oil and Gas Resources

DE-FE-0031782

NETL HYDRAULIC FRACTURING TECHNOLOGIES
PROJECT REVIEW MEETING

Mark Moody
14 October 2020



MarkWest Sherwood Gas Processing Plant, New Milton, WV

Introduction

- The project objective is to unlock oil from the “oil window” of the Utica/Point Pleasant (UPP) shale in Ohio using Y-Grade (unrefined) Natural Gas Liquids (NGL)
- A large portion of the Appalachian shale play is composed of tight, oil-rich reservoirs which have proven to be uneconomical using current completion technologies
- The oil molecules are too large to move through the low permeability rock, rendering the oil inaccessible
- Oil and Gas Exploration Companies are looking for the key to unlock this huge oil resource

NGLs might be a big part of the solution

Using NGL in the “Oil Window” of the UPP

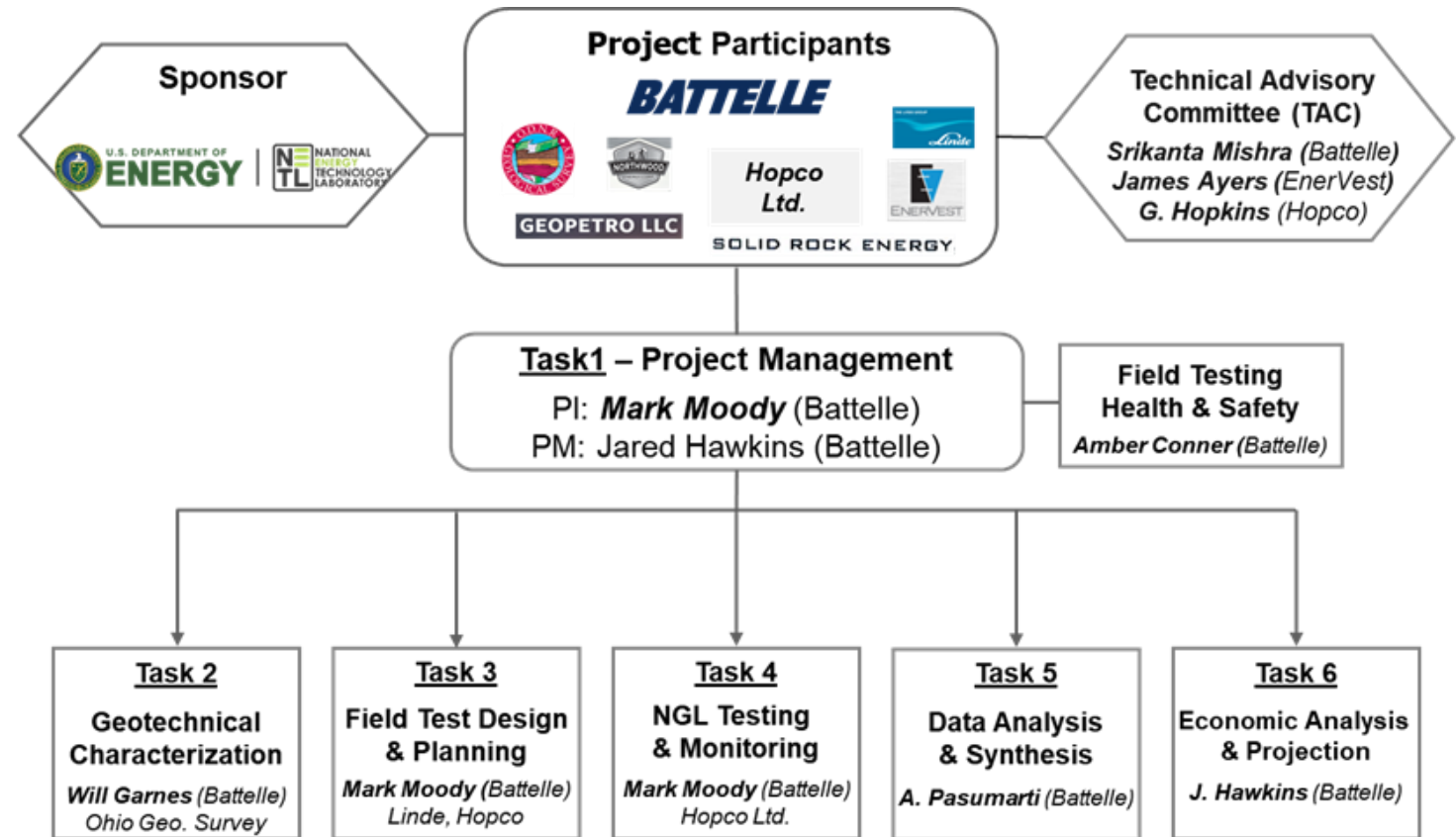
- Why use Y-Grade NGLs?
 - Liquid fuels production in the U.S. has increased by 5.5 million barrels per day between 2009 and 2016
 - Natural Gas Liquid (NGL) production from shale wells and tight oil formations has accounted for 29% of this growth
 - The Energy Information Administration (EIA) forecasts NGL production from Appalachian shale wells will increase 350% from 2013 to 2040
 - Battelle reservoir simulations indicate that NGLs recover greater volumes of oil than CO₂
 - The cost of using NGLs as a stimulation fluid can be partially recovered as the injected NGLs are produced back with the oil and gas
 - There is a surplus of locally produced NGLs
- ***NGLs are currently underutilized in the Appalachian Basin***

Project Schedule

- The period of performance of this project is 3 years, Oct. 2019 through Sept. 2022
 - The first year of the project will consist of research, lab work, modeling and computer simulations to determine the best treatment design
 - Treatment and monitoring will be performed during year two
 - Analysis and reporting will be performed during year three
- This is a proof-of-concept project
- Production results from the Y-Grade NGL treatment will be compared to production from the McCoy Unit #5 well and the COSH Mill Creek well to determine if Y-Grade NGLs are effective treatment fluid for the oil window of the UPP and other similar unconventional oil and gas reservoirs

Project Team

- Project Manager; Battelle Memorial Institute
- Operators; Hopco Ltd., Northwood Energy Corp., Geopetro LLC, Solid Rock Energy & EnerVest Operating Inc., Flat Rock Development Corp.
- Ohio Division of Geological Survey
- Linde Gas North America



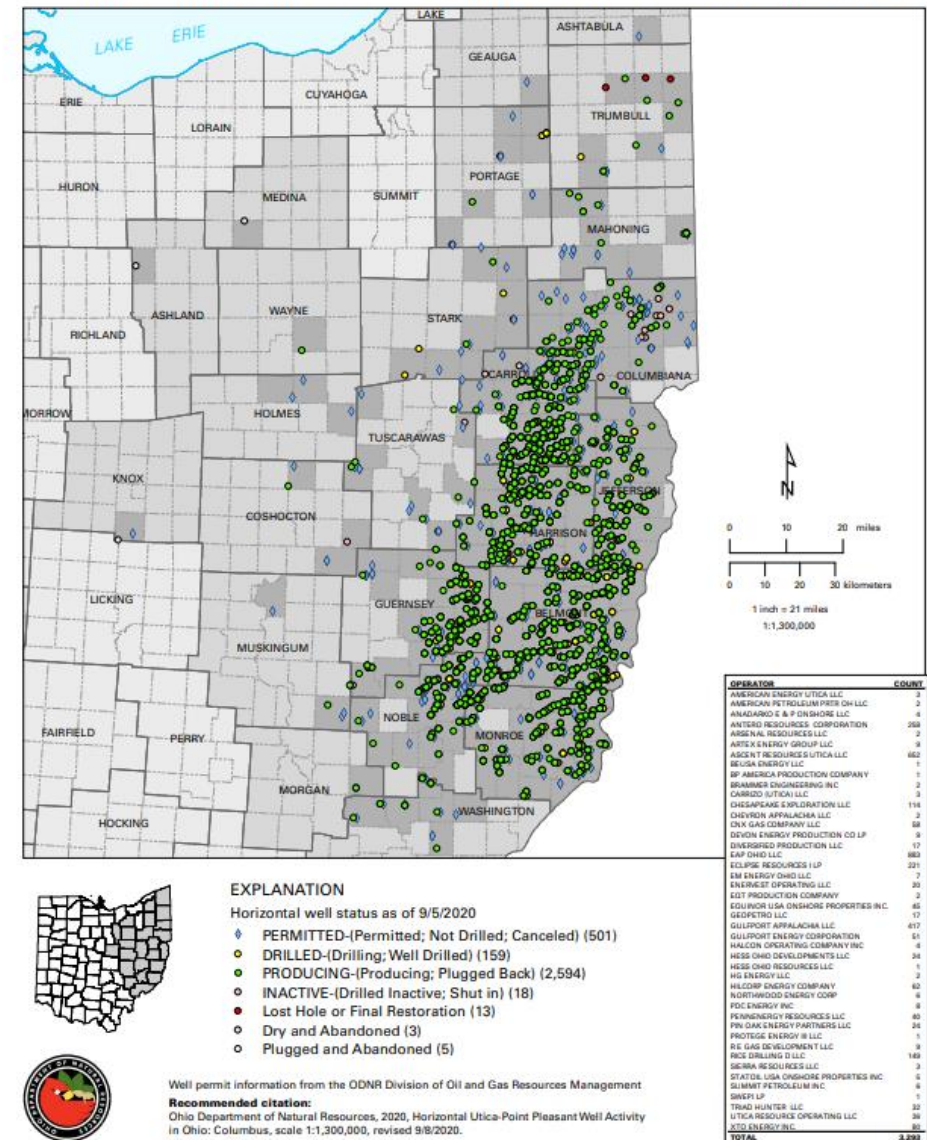
Utica/Point Pleasant Drilling Activity

As of September 5, 2020

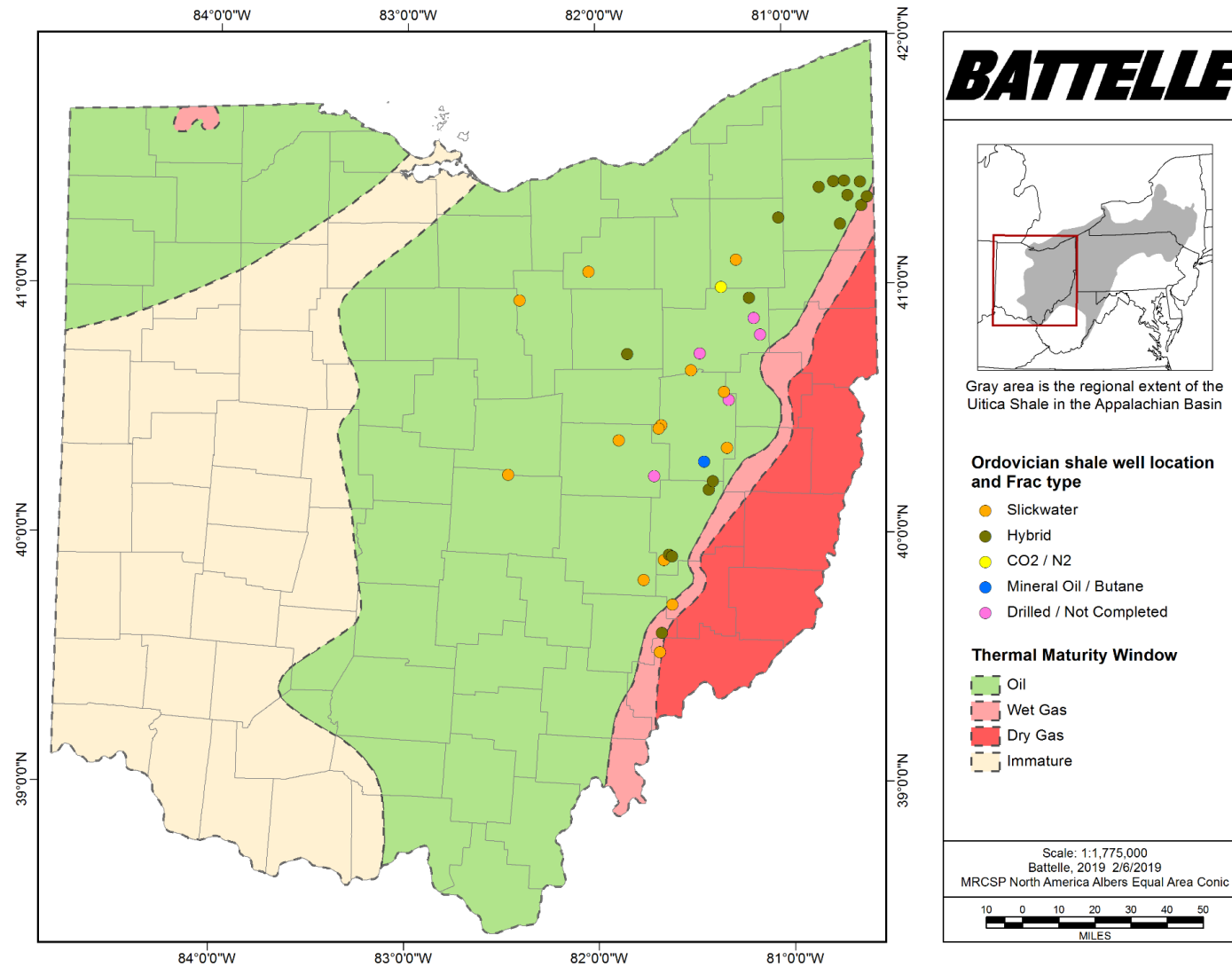
Total of 3,293 wells:

501	Permitted; (Not Drilled; Cancelled)
159	Drilled; (Drilling; Well Drilled)
2,594	Producing; (Producing; Plugged Back)
18	Inactive; (Drilled Inactive; Shut In)
13	Lost Hole or Final Restoration
3	Dry and Abandoned
5	Plugged and Abandoned

HORIZONTAL UTICA - PT PLEASANT WELL ACTIVITY IN OHIO



UPP “Oil Window” with Frac Type

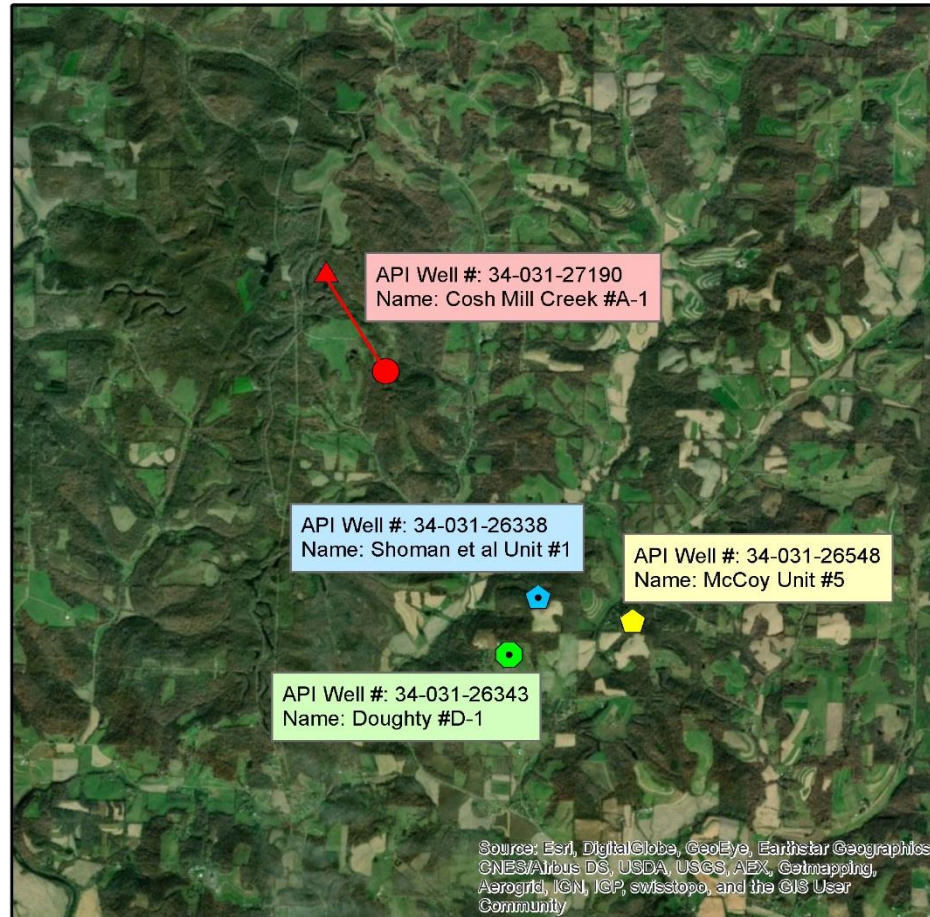


ODNR Division of Oil and Gas Resources Management (2018)

Proposed Field Test Sites

- Battelle plans to plug back two (2) Coshocton County Rose Run wells to the Utica/Point Pleasant formation
 - One well will be perforated and treated in the UPP
 - The other well will be a micro seismic monitoring well.
- The test site wells are approximately 2-1/4 miles SE of the COSH Mill Creek #A-1 well drilled by Anadarko in 2012
 - The Cosh Mill Creek well was completed with 16 stages utilizing large volume slickwater frac jobs.
- The test site wells are approximately 3/4 miles west of Northwood Energy's McCoy Unit #5, a Rose Run well which was plugged back and completed in the UPP in 2013 with a large volume slickwater frac job.

Project Map



Legend

- Injection test well
- Microseismic monitoring
- Completed horizontal well
- Horizontal well bottom hole location
- Plugged back/fraced in Utica in 2013



INSET MAP

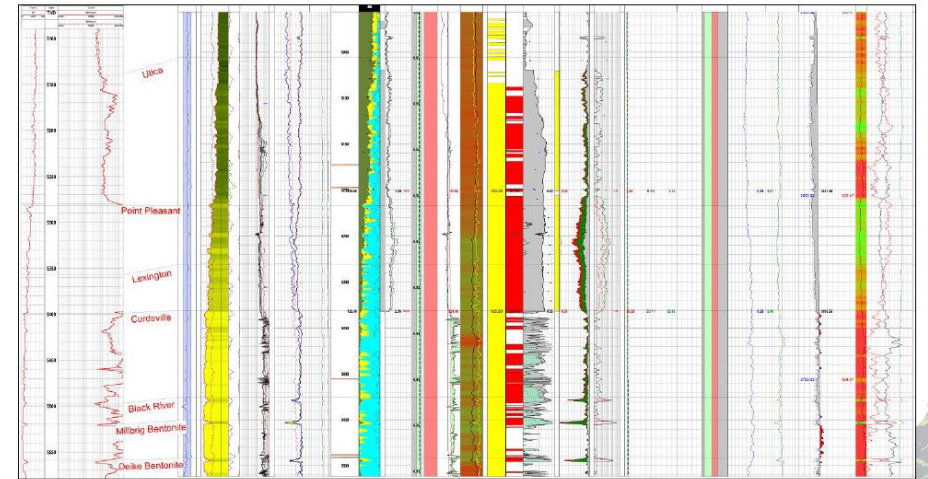


Jared Hawkins 2/6/2019
NAD83 2011 StatePlane Ohio South FIPS 3401 Ft US

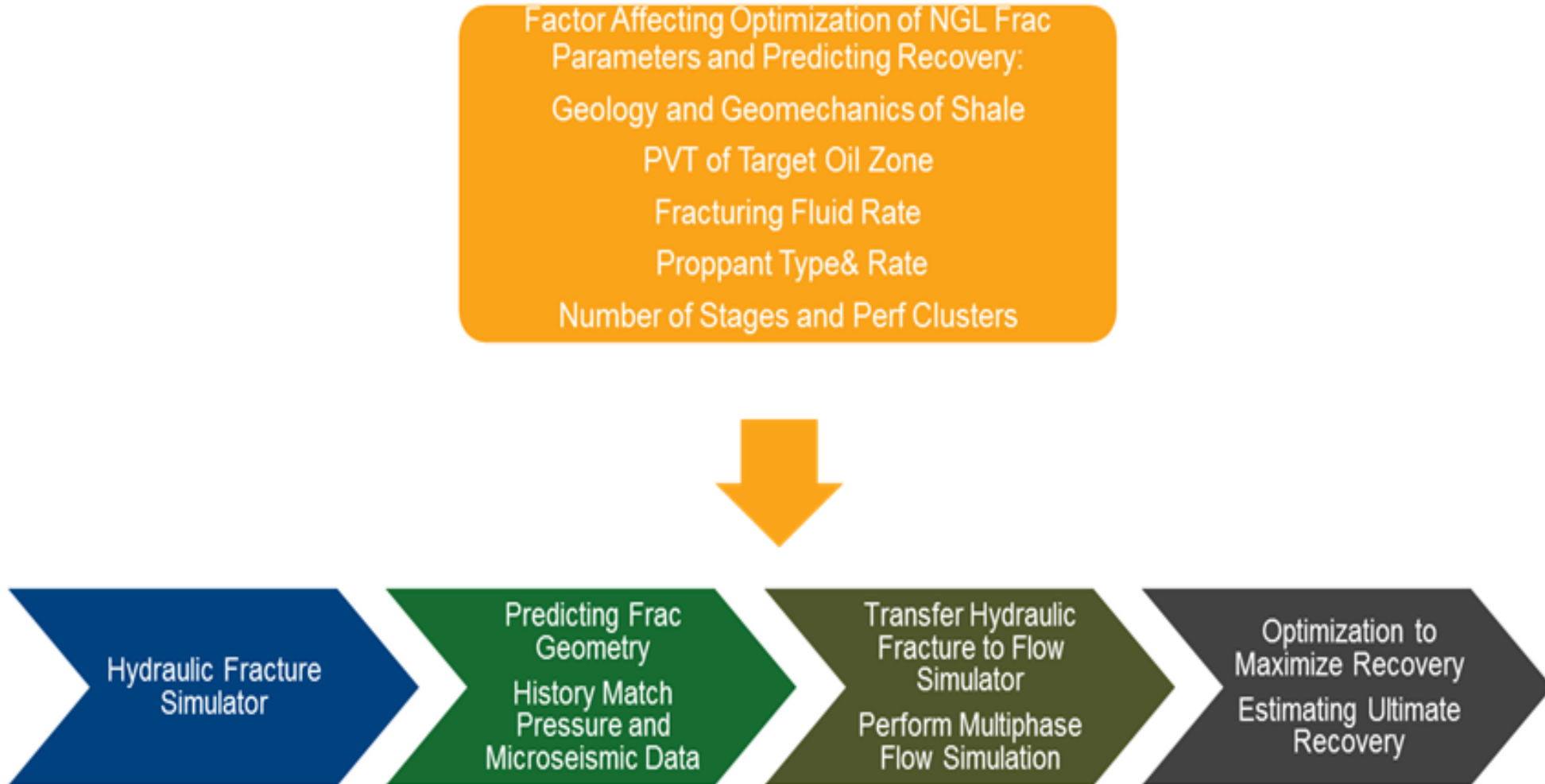
NGL Treatment Design

- In their natural state, Y-Grade NGLs have poor proppant transport capacity
- The project will research ways to increase the viscosity of the Y-Grade fluid by gelling or foaming
- As an alternative, a small-volume frac job consisting of a viscous, sand-laden fluid can be pumped ahead of the Y-Grade NGL
 - N2 foam or cross-link gelled water
 - The Y-Grade NGL can be pumped as a formation treatment following the frac job

Petrophysical Analysis of COSH Mill Creek A-1 and Doughty D-1 Well Logs



Treatment Design Workflow

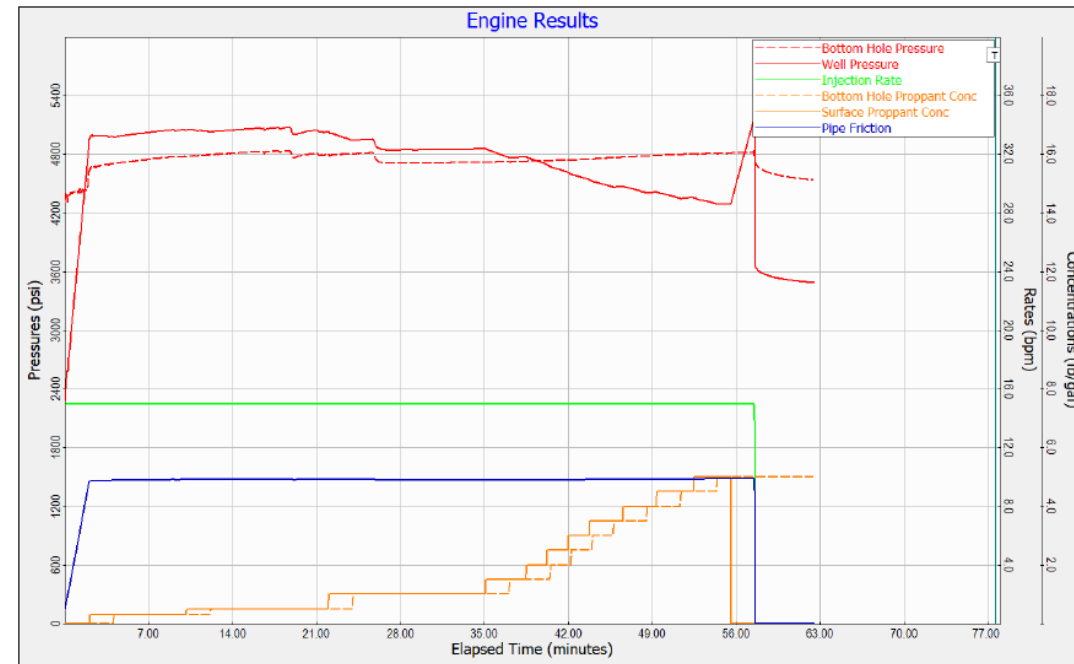


Fracture Modeling – Predicted Rates and Pressures

Mill Creek A-1

Bottomhole Rate, Conc., and Pressures

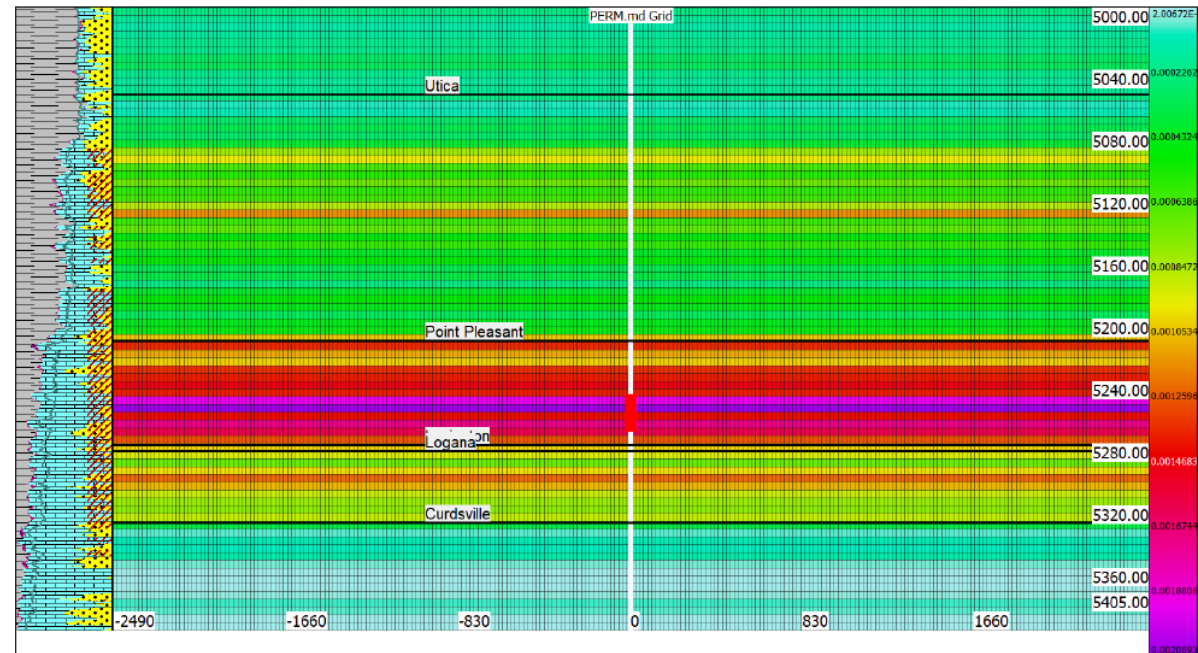
Predicted Surface and Bottom Hole Rates, Pressures and Proppant Concentrations



Fracture Modeling – Permeability

Mill Creek A-1
Permeability

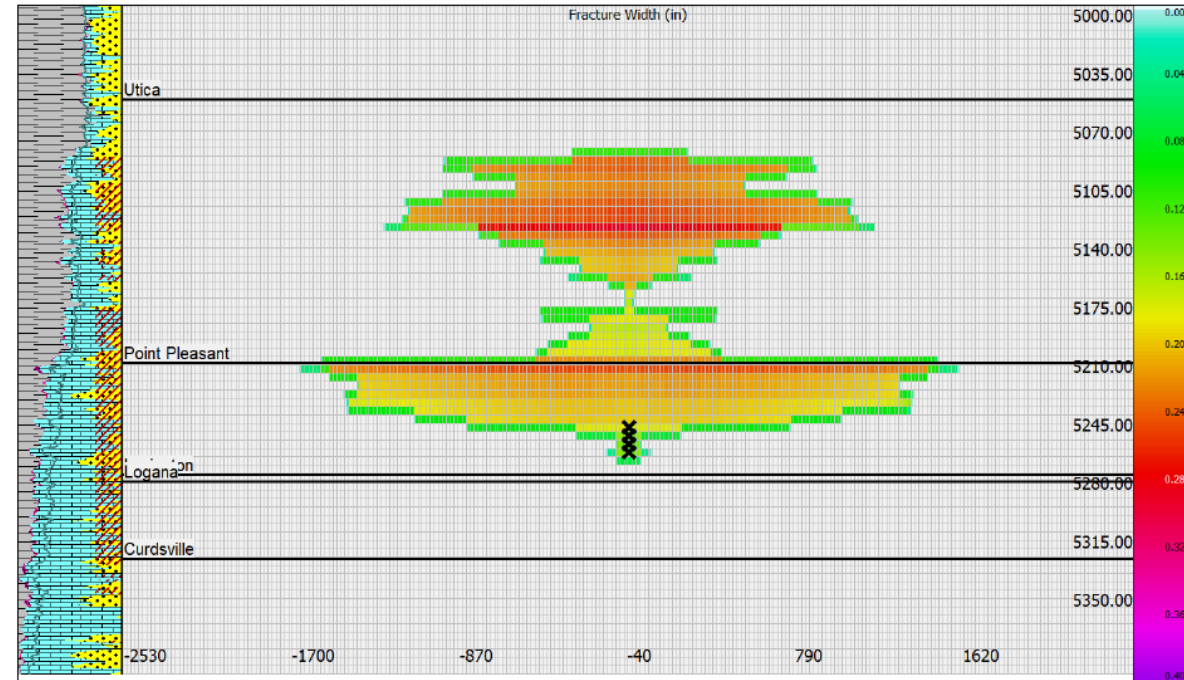
Simulated Permeability from log
and core analysis.



Fracture Modeling – Fracture Width

Mill Creek A-1 Fracture Width

Model Based on:
1,000 Bbl 75 Quality N2 Foam Frac
100 Sacks 100 mesh and
400 sacks 40/70 mesh sand

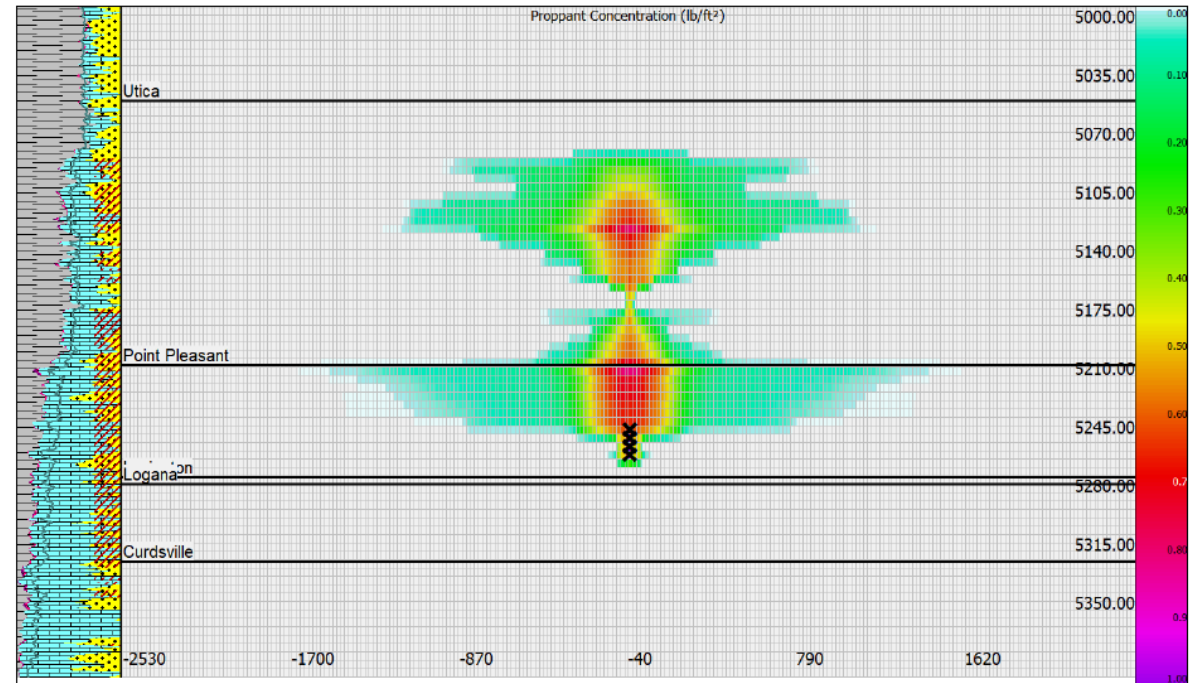


Fracture Modeling – Proppant Concentration

Mill Creek A-1

Proppant Concentration

Proppant Concentration in
pounds per square foot.



Field Test Well Preparation - Shoman Etal Unit #1

Hopco Shoman Etal Unit #1
pad and well head

September 5, 2020



Field Test Well Preparation - Shoman Etal Unit #1

Hopco Shoman Etal Unit #1

Rigging up to plug back and
cement the well across the
Utica/Point Pleasant formation

September 11, 2020



Field Test Well Preparation – Doughty #D-1

Hopco Doughty #D-1 Well Head
Field Site Visit

July 13, 2020

Moved workover rig on location
October 1, 2020



Project Status

- Geotechnical Characterization of the Utica/Point Pleasant has been completed
- Stimulation and NGL Treatment Design is in progress
 - Nitrogen DFIT
 - 1,000 Bbl 75 Quality N2 Foam Frac
 - 1,000 Bbl Y-Grade NGL Injection Treatment
- Field test wells were prepared
 - Both field test wells have been plugged back and cemented across the UPP formation for stimulation, treatment and micro seismic monitoring
- Procurement of contractors and vendors is in progress
- Y-Grade NGL injection test scheduled for summer of 2021

Questions???



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BATTELLE

It can be done

Back Up Slides

Project Schedule

Task Name	FY2020				FY2021				FY2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1: Project Management & Planning												
1.1 Project Management	PMP			CA				CA				
1.2 Workforce Readiness Plan				◆				◆				
1.3 Technology Maturation Plan				◆							◆	
1.4 Data Management Plan	◆											
1.4 Progress Reporting	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	F
Task 2: Geotechnical Characterization												
2.1 Geologic Characterization			◆									
2.2 Exploration, Drilling & Prod. Activity Rev.												
Task 3: NGL Test Design & Planning												
3.1 NGL Test Design				◆								
3.2 Site Prep, Procurement & Scheduling												
Task 4: Field NGL Testing & Monitoring												
4.1 Field Test Preparations												
4.2 Treatment Monitoring												
4.3 NGL Testing & Monitoring												
Task 5: Data Synthesis & Analysis												
5.1 Numerical Simulations												
5.2 Well Testing Data Proc. & Interp.												
5.3 Monitoring Well Microseismic Data												
5.4 Production Data Analysis												
Task 6: Economic Analysis & Projection												
6.1 Oil Recovery Projection to UPP Oil Wind.												
6.2 Economic Analysis												
6.3 NGL Recovery Potential In UOG Fields												
(Project Month)	3	6	9	12	15	18	21	24	27	30	33	36

Project Milestones

- Field activity-based project with key milestones related to the NGL treatment testing.

Task/ Subtask	Milestone	Planned Completion Date	Verification method
1	Update PMP, Data Mgmt. Plan	9/30/2019	Submit updated PMP to DOE
1	Workforce Readiness, Tech. Mat. Plan	Sept 2020, 2021	Plans submitted w/ Cont. Appl.
2	Utica Characterization Task	6/30/2020	Submit Task Report
3	Site Access Agreement	3/30/2020	Access agreement in place
3	Testing Health & Safety Plan	8/30/2020	Health & Safety Plan
3	Complete Field-Testing Design & Plan	10/31/2020	Submit field testing plan to DOE
4	NGL Injection Field Testing	3/30/2021	Submit field test report to DOE
5	Complete NGL Injection Monitoring	9/30/2021	Submit field monitoring report to DOE
6	Complete data analysis and integration	3/30/2022	Task Summary Report
7	Complete Economic Analysis Task	8/15/2022	Task Summary Report
1	Submit field testing data to EDX	02/2022	EDX upload confirmation
1	Final Technical Report	9/30/2022	Submit Final Technical Report