Oil & Natural Gas Technology

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Quarterly Research Performance Progress Report

(Period ending: 9/30/2015)

Marcellus Shale Energy and Environment Laboratory (MSEEL)

Project Period: October 1, 2014 – September 30, 2019

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Quarterly Progress Report

July 1 – September 30, 2015

Executive Summary

The objective of the Marcellus Shale Energy and Environment Laboratory (MSEEL) is to provide a long-term field site to develop and validate new knowledge and technology to improve recovery efficiency and minimize environmental implications of unconventional resource development.

The fourth quarter of activity on this project has concentrated on the drilling of wells, execution of sampling plans, setting up seismic monitoring, project planning and loading data into the online sharing infrastructure. Several meetings with the technical teams to establish data requirements have been held. Numerous tours of the drilling wells were undertaken with research University, DOE and other personnel. Sampling of air, water, drilling materials and noise monitoring continued through the period. In the current reporting quarter; a pilot well bore (3H) was cored, sidewall sampled and logged, two horizontal production wells were drilled (3H and 5H). The 3H lateral was logged with geomechanical and imaging tools. A science observation well was drilled, sidewall sampled, logged and instrumented for microseismic. The nearly complete core was microCT scanned and sent to a service company to be split and sampled. The project team is currently working to develop completion and fracture stimulation plans that will be executed in the coming quarter.

Project management updates include submission of continuation application for budget period/year 2, and updates to budget and scope to reflect current project status and progress. The continuation was accepted, and revisions to subcontracts and project management documents are in development at this time.

Quarterly Progress Report

July 1 – September 30, 2015

Project Performance

This report summarizes the activities of Cooperative Agreement DE-FE0024297 (Marcellus Shale Energy and Environment Laboratory – MSEEL) with the West Virginia University Research Corporation (WVURC) during the fourth quarter of the FY2015 (July 1 through September 30, 2015).

This report outlines the approach taken, including specific actions by subtopic. If there was no identified activity during the reporting period, the appropriate section is included but without additional information.

Topic 1 – Project Management and Planning

Subtopic 1.1. – Project Management

Approach

The project management team will work to generate timely and accurate reporting, and to maintain project operations, including contracting, reporting, meeting organization, and general oversight.

Results and Discussion

In this quarter, the team has worked to modify the drilling and completion plan, and sample collection plan, to reflect changes in the drilling schedule imposed by inclement weather. Heavy rains in June significantly impacted progress on the drilling of the science well and in production well activities. The project team worked with DOE and the operator to develop approaches and any required scope modification to respond to these issues. The result was that all planned data and samples were collected and in some aspects the quality was improved.

Project team also submitted and completed the budget period 2 continuation application, including budget and scope revisions that fully funded the first year effort, and extended the project into the second year. Budget and scope modifications were designed to capture the changes required from the drilling schedule and production well changes. A revised Project Management Plan (PMP) and revised subcontracts to project partners are in development now to reflect these changes and updates.

Subtopic 1.2. – Database Development

Approach

We will use CKAN, open source data portal software (www.ckan.org). This platform is used by NETL-EDX and Data.gov among other organizations and agencies. We will use this platform to store, manage, publish and find datasets.

Results and Discussion

CKAN is up and running and has been used to share data from the existing wells and presentations among research personnel. The MSEEL web site has been enhanced with MSEEL News articles, a time line and with images. We have generated static and dynamic 3D images of the surface and subsurface at the MSEEL site (Figure 1.2). In addition from surface environmental data, initial subsurface data from the two production wells and the vertical science well have been loaded into the portal. Data includes MicroCT scans of the core, drilling parameters (e.g., deviation surveys and drill rig monitoring) and electric logs.

Plan for Next Quarter

Continue to upload 3D static and dynamic images to online site and federate MSEEL portal with EDX. Also upload time-lapse video of drilling and fracture stimulation operations onto the web site.

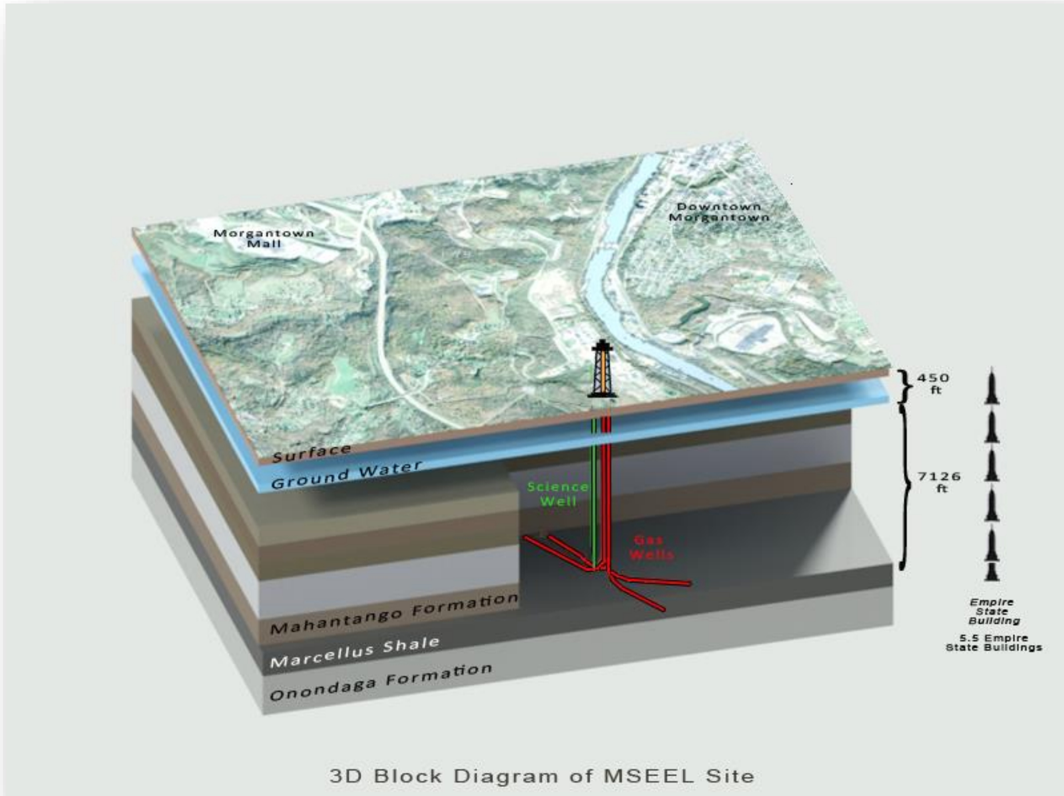


Figure 1.2.1 Static 3D image of the MSEEL sit showing the existing production wells and the two new production wells along with the science/observation well.

<u>Subtopic 1.3. – Drilling and sampling of pilot hole, science observation well and the two production wells.</u>

Approach

The MIP 3H and MIP 5H were located and spud in June and July (Figure 1.3.1 and Table 1.3.1). The top holes were drilled with an air rig (US Energy Explorer 9). A larger rig (Pat-UTI 254) was brought in to drill and core in the MIP-3H vertical pilot hole. A total of 111 feet of continuous core and 50 sidewall cores (1.5 inch diameter) were recovered across the Marcellus and adjacent formations. The vertical pilot hole was logged with an extensive suite of advanced geochemical, imaging and NMR tools (Figure 1.3.2). The logs show three organic-rich Marcellus tongues separated by thin limestones. After analysis it was decided to target the laterals just above (MIP-3H) and below (MIP-5H) the lower limestone (labelled Cherry Valley). The MIP-3H vertical pilot was plugged back to the kick off point (~6,500 feet). The Pat-UTI 254 walked to drill the curve and lateral of the MIP-5H commencing 10 September and reached total measured depth of 14,454 on 18 September (Figure 1.3.3). The Pat-UTI 254 walked back to the MIP 3H and began the curve and lateral on 19 September. The MIP-3H lateral reach 13, 879 feet (Figure 1.3.4), and was logged through pipe with an extensive suite of imaging and geomechanical tools. Fiber-optic cable was run the entire length of the MIP-3H.

The pad for the science well (MIP-SW) was located and built (Figure 1.3.1). The design of the vertical science well was modified to reflect the challenges presented by extensive precipitation in June and July. The rig used to drill the top holes for the production wells was used to drill the MIP-SW. The drilling sampling and logging plan occurred from 12 September to 28 September (Table 1.3.1). A total of 147 sidewall cores were recovered and the well was logged and cased for micro-seismic monitoring during planned fracture stimulation of the production wells.

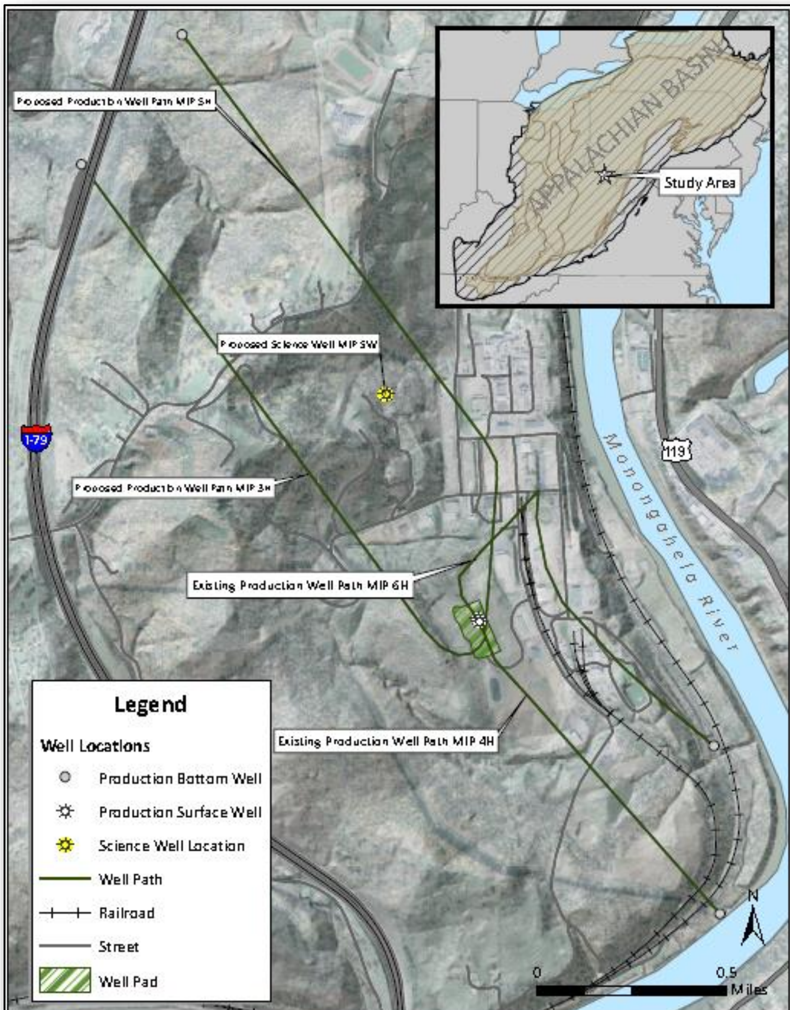
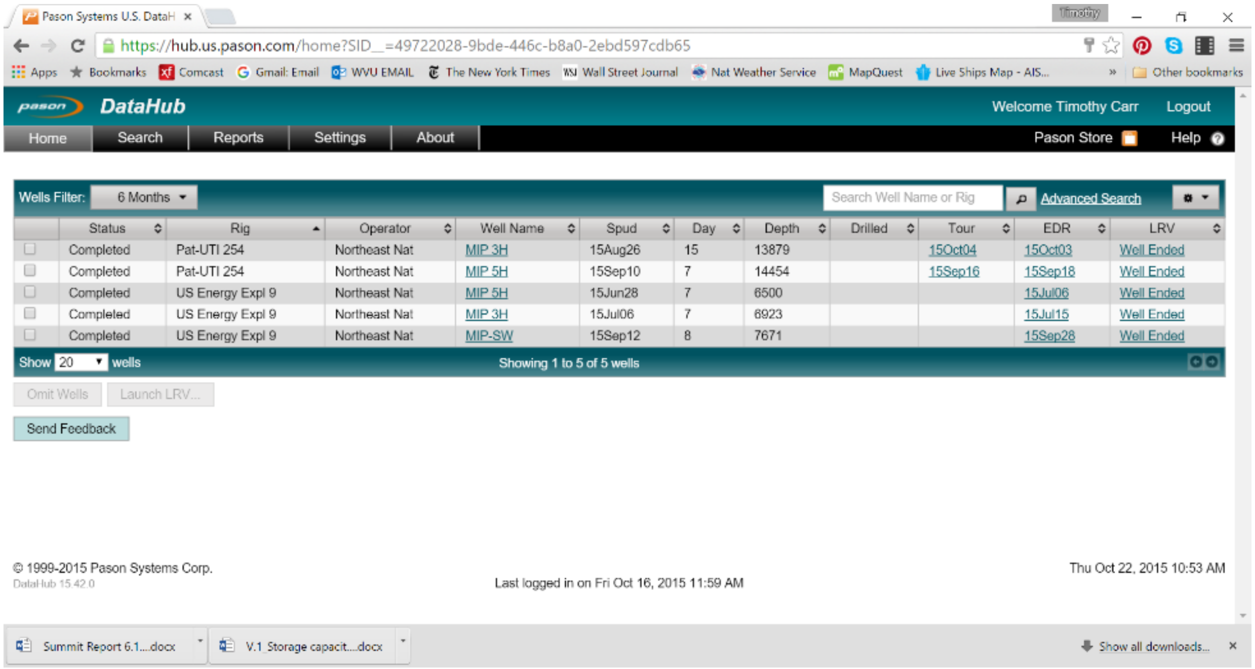


Figure 1.3.1. Location of the science well (MIP-SW) and the two production wells (MIP-3H and MIP-5H) drilled during June to September 2015.A vertical pilot hole was drilled at the surface location of the MIP-3H. The pilot hole was cored, sidewall sampled and logged, then cemented to kick-off point for drilling the MIP-3H lateral. The MIP-4H and MIP-6H were existing wells that were drilled and completed in 2011.

Table 1.3.1. Activity at the MSEEL site with the total depth, and spud and end dates of the top holes for the MIP 3H and MIP 5H production wells and the laterals. Also included is the spud and start dates, and total depth of the science observation well (MIP-SW).



Status	Rig	Operator	Well Name	Spud	Day	Depth	Drilled	Tour	EDR	LRV
Completed	Pat-UTI 254	Northeast Nat	MIP 3H	15Aug26	15	13879		15Oct04	15Oct03	Well Ended
Completed	Pat-UTI 254	Northeast Nat	MIP 5H	15Sep10	7	14454		15Sep16	15Sep18	Well Ended
Completed	US Energy Expl 9	Northeast Nat	MIP 5H	15Jun28	7	6500			15Jul06	Well Ended
Completed	US Energy Expl 9	Northeast Nat	MIP 3H	15Jul06	7	6923			15Jul15	Well Ended
Completed	US Energy Expl 9	Northeast Nat	MIP-SW	15Sep12	8	7671			15Sep28	Well Ended

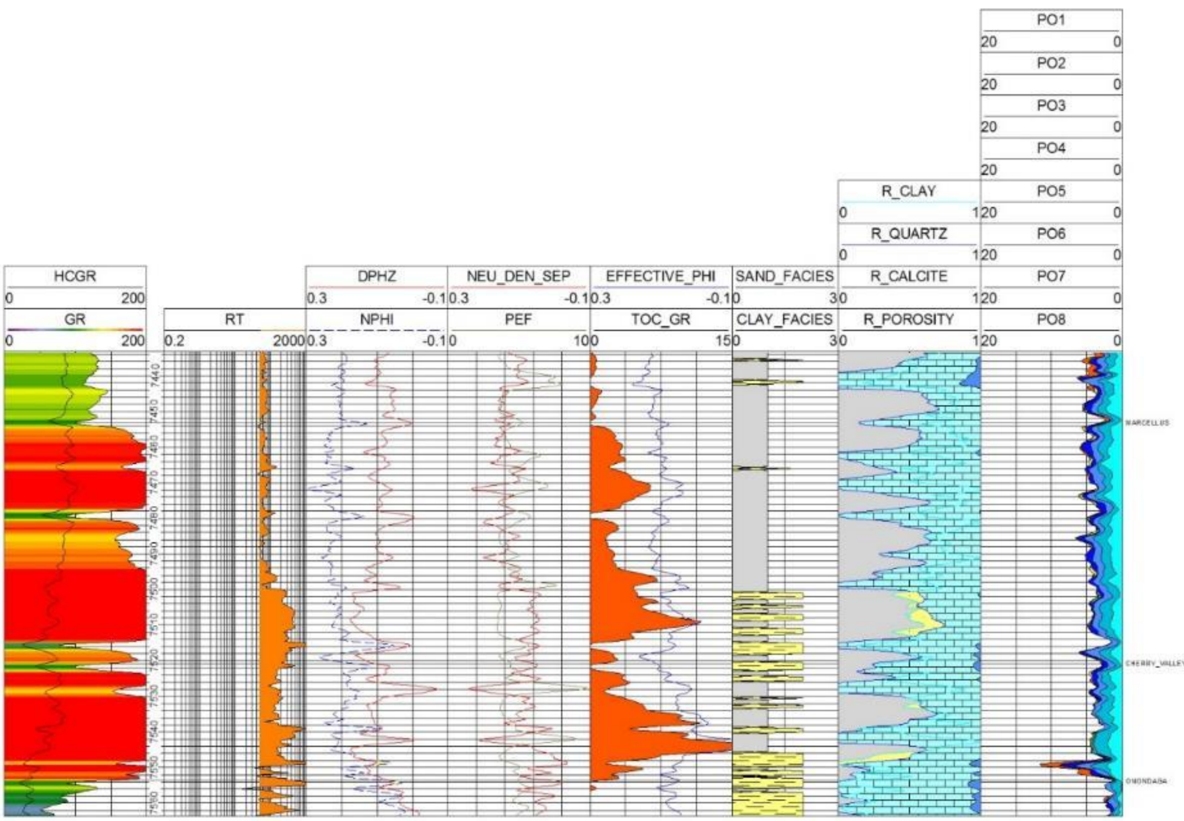


Figure 1.3.2. Preliminary log interpretation of the MIP-3H vertical pilot hole showing the three organic-rich Marcellus Shale tongues separated by thin limestones. Based on the analysis it was decided to target the laterals just above (MIP-3H) and below (MIP-5H) the lower limestone (labelled Cherry Valley).

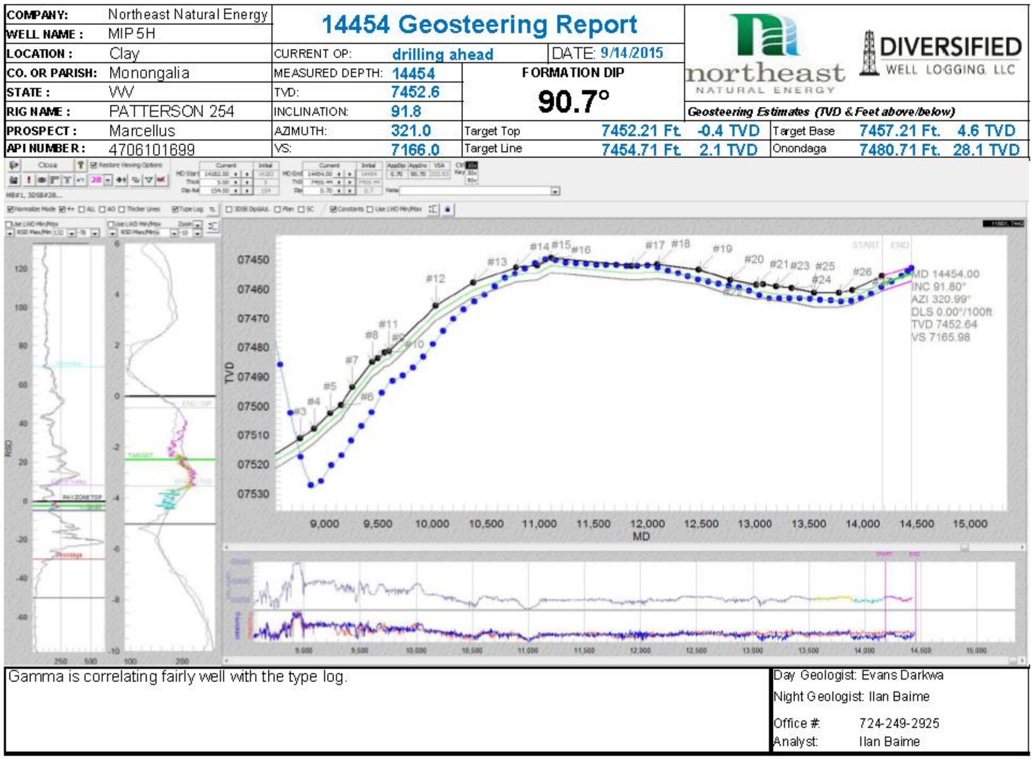


Figure 1.3.3. Geosteering report for the MIP-5H showing the well path of the lateral. The well path target was the top of the lower Marcellus organic-rich tongue and immediately below the lower limestone bed (Figure 1.3.2). The well path stayed within the organic-rich tongue.

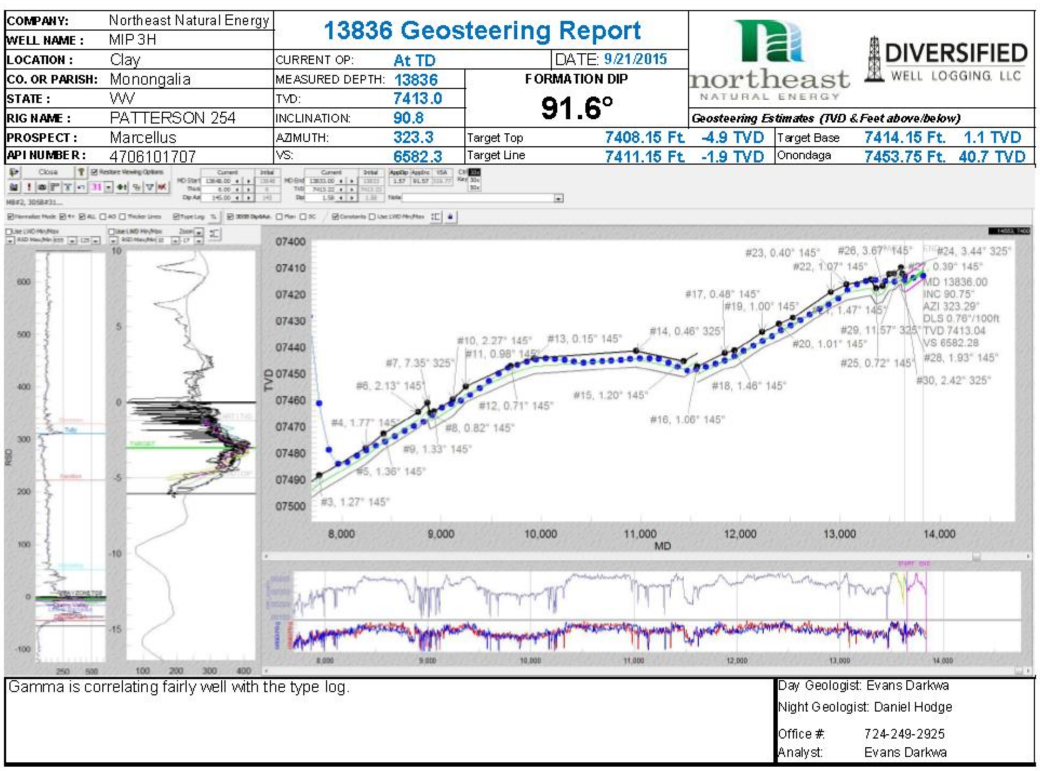


Figure 1.3.4. Geosteering report for the MIP-3H showing the well path of the lateral. The well path target was the base of the middle Marcellus organic-rich tongue and immediately above the lower limestone bed (Figure 1.3.2). The well path stayed within the target organic-rich tongue.

Topic 2 – Geologic Engineering

Approach

The geologic engineering team will work to generate to improve the effectiveness of fracture stage design. Evaluating innovative stage spacing and cluster density practices to optimize recovery efficiency. The team will use a data driven approach to integrate geophysical, fluid flow and mechanical properties logs, microseismic and core data to better to characterize subsurface rock properties, faults and fracture systems to model and identify the best practices for field implementation, and assess potential methods that could enhance shale gas recovery through experimental and numerical studies integrated with the results of the production wells at the MSEEL site.

Results and Discussion

The data requirements and the protocols for sample collection and analysis have been established. The analysis of the production and stimulation data from the existing horizontal wells at the MIP site as well as other horizontal Marcellus shale wells in the region has continued.

In addition, data generated during drilling was collected from wells drilled at NNE site. Initial data consists of the operational parameters used in the drilling of wells MIP-3H and MIP-5H. The work is in progress to retrieve data from wireline logging and thermal logs for the purpose of determining formation characteristics.

Microseismic monitoring well was drilled and cased in preparation for microsesimic monitoring during the hydraulic fracturing job to be done in the next month. The seismic velocity model is being created from the open hole dipole sonic log that was run after the drilling of the MIP 3H pilot hole.

Products

Plan for Next Quarter

The results of the production data analysis will be used to establish subsurface baseline information and to develop a base model for the site. Furthermore, the combined drilling and wireline data will be used to study drilling parameters and their impact on the performance of bits. Additional data will be collected from cement bond logs to verify the integrity of the cement.

Topic 3 – Deep Subsurface Rock, Fluids, and Gas

Approach

The “Deep Subsurface Rock, Fluids & Gas” team will be responsible for high resolution temporal and/or spatial characterization of the core, produced fluids, and produced gases. The team will use whole and sidewall core and geophysical logs from the science well to conduct various petrophysical analyses to analyze physical rock properties. Data generated by all team members will be integrated to answer following key research questions: 1) geological controls on microbial distribution, diversity and function and how it can effect gas productivity, potential for fracture and pore clogging, well infrastructure and souring 2) major controls on distribution/source/type of organic matter that has implications for oil vs gas production, frackability, restimulation and porosity/permeability effects 3) what are spatiotemporal variations in elemental, isotopic, mineralogical and petrological properties that control presence, geological migration, and modern flow of fluids, water, gases and microorganisms and also effect long-term production behavior of reservoir 4) what are possible water-rock-microbial interactions as a result of injection of fracturing fluids, and 5) does hydraulic fracturing create new pathways for fluid/gas migration

Plan is to develop specific methodology for testing during the next quarter, so that all scientific objectives can be achieved.

Results and Discussion

Whole core, sidewall cores, open hole logs, and cased hole logs have all been acquired and analysis is currently underway on cores and core plugs.

Subsurface Biogeochemistry task lead Sharma drafted a final core/fluid/gas sampling and sample distribution plan in collaboration with PI's at WVU, OSU and NETL. Sharma also outlined the major research questions to be addressed by the Subsurface Biogeochemistry group and their implications. Different sub-tasks and analyses to be conducted by individual PI's were also defined. Several talks and presentations were given at local and regional conferences /universities. Two proposals are currently underworks to support MSEEL research.

1. Major goals – progress towards

Goal 1: Develop a sampling protocol to incorporate into the field plan:

Sidewall and Vertical Core

Task lead Sharma finalized a detailed sampling and sample distribution plan for sidewall cores and core plugs to be collected from vertical core and is depicted in Figure 3-1.

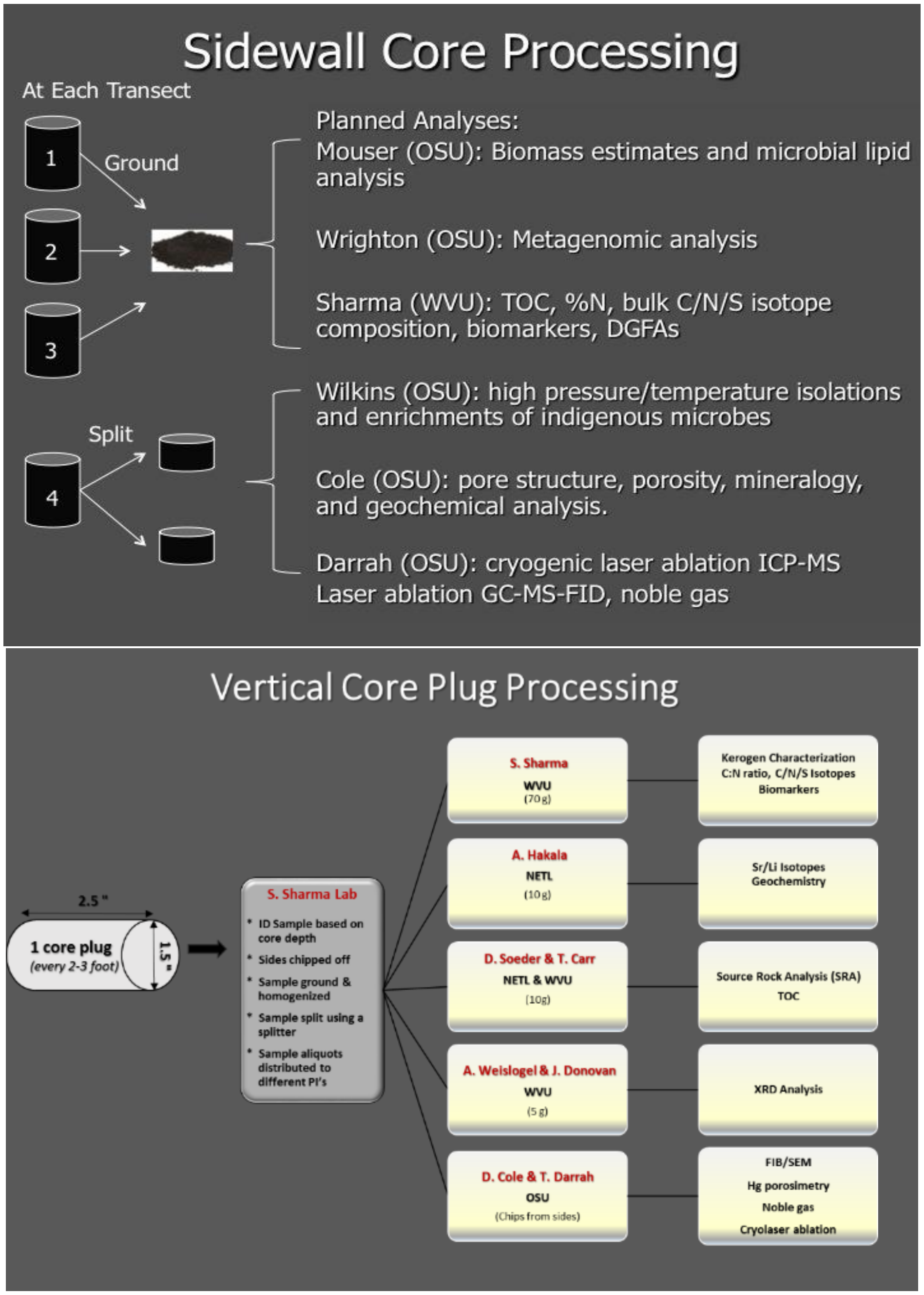


Figure 3-1: Proposed sample distribution plan for a) set of 4 side wall cores collected from each depth at well MIP# 3H and Science well, and b) core plugs to be collected from every 2-3 feet from the vertical core

To identify sections of sidewall cores which have come in contact with coring fluids fluorescent microspheres (0.5 mm diam) were added to drilling fluids at target concentration. The side wall cores were received by our group as soon as they hit ground. The cores were photographed, inventoried, labeled and transported to the laboratory in cold and sterile environment. The cores were examined microscopically and sections of the core contaminated by the fluorescent microspheres were scraped off by fine steel wool by Daly. One core at each depth was ground in sterile laminar flow hood and the powder split among Sharma, Mouser and Wrighton group for different analysis listed in Figure 3-1 a. The other 1-2 cores from near that depth were stored in freezer at OSU and WVU for future analysis. One sidewall core was kept intact and passed on to

Darrah, Cole and Wilkins for incubations and high resolution petrographic, mineralogical, geochemical and noble gas analysis.

From the vertical core our team has requested subcores from every 2-3 feet (depending on core availability). Each core plug we get from the vertical core will be processed in Sharma Laboratory at WVU and distributed for further analysis as per the protocol defined in Fig 3-1 b.

Produced Fluid and Gas

Task lead Sharma finalized a detailed sampling and sample distribution plan for produced gas and water samples. Produced water samples will be collected in 3-5 gallon carboys just after the seperartor. The samples will be tranported, filtered and processed in Sharma Laboratory at WVU. All water samples will be collected in different containers using different methods/ preservatives etc. specified for different kinds of analysis. All PI's have handed their detailed sampling instructions to Sharma. Dr. Warrier, Wilson and Daly will be responsible for sample collection and distribution among different PI's listed in the plan below (Figure 3-2 a).

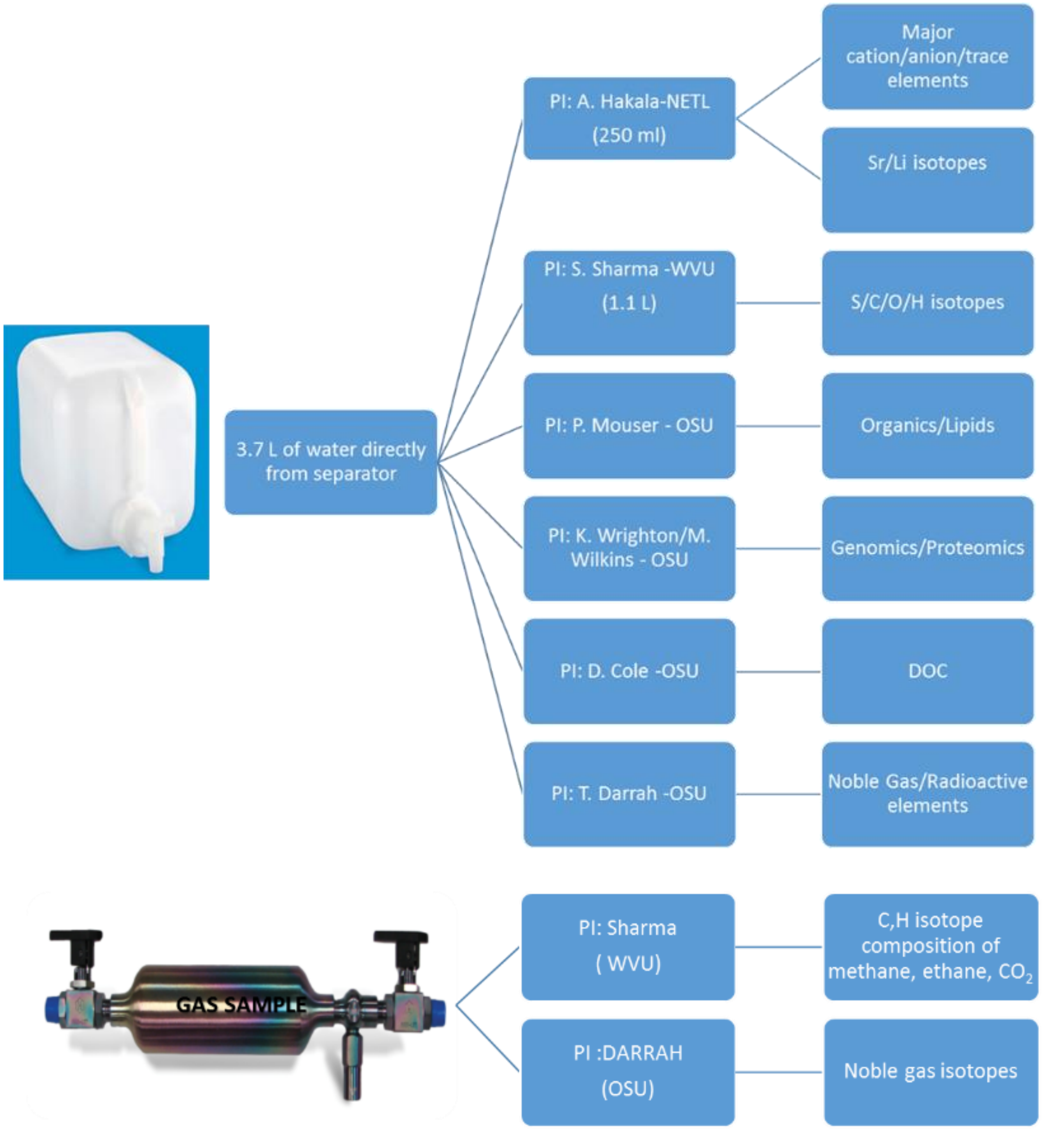


Figure 3-2: Proposed sample distribution plan for a) produced water sample collected from separator of each well, and b) produced gas collected from each well

Produced gas samples will be collected from well heads of the two production wells and transported to Sharma Lab at WVU and analyzed for molecular composition and C/H isotope composition of methane, ethane and CO_2 . The gas samples will then be sent to Darrah's lab at OSU for noble gas analysis. Two sets of produced gas and water samples were collected from the two existing wells at MIP site to get background signatures before hydraulic fracturing starts and also test the sample processing and workflow in Sharma's lab. The samples were collected for all PI's following their required protocols and currently analysis is underway.

Goal 2: Identify and order any specialized equipment and materials:

All required supplies and materials were ordered for sampling side wall cores, produced fluids and gas samples.

Goal 3: Test out methods for extracting lipid biomarkers from core and fluids:

Sharma supplied shale core samples (~1.5 kg) for methods extraction of lipids. Graduate students Ryan Texler from Mouser lab and Rawlings Akondi from Sharma Lab traveled to Univ. Tennessee, Knoxville (UTK) to work through a detailed experiment testing the efficiency of lipid extractions from shale core. Results from both experiments have been analyzed and interpreted. The initial findings will be presented in 2 poster presentations at the Annual GSA meeting in Baltimore.

Goal 4: Develop methods and protocols for sampling fluids and gases for isotopic, molecular and microbiological analysis:

R. Akondi , V. Agrawal two PhD. students with help of A. Warrier in Sharma Lab have developed method for extracting polar and non-polar biomarkers and kerogen from shales of different maturity. R. Daly, a senior researcher in the Wrighton lab, has developed a new method of DNA extraction from shale that accounts for chemistry and mineral properties of this matrix. This method obtained higher yields than previously reported for this system and results are being synthesized.

Goal 5: Develop liaison between different PI's interested in sub-surface samples:

Task lead Sharma has had several conversations and meetings with PI's at OSU (Mouser, Wrighton, Wilkins, Cole & Darrah) , NETL (Hakala, Crandall, Lopano & Soeder) and WVU (Weislogel & Donovan) to understand their sampling needs, research questions and finalize a sample distribution plan. The sampling and sample distribution plan has now been finalized.

Goal 6: High resolution characterization of vertical core in collaboration with NETL:

The vertical core from #3H well was transported to Dustin Crandall's lab in NETL Morgantown and was scanned using CT scanner within the Aluminum sleeves. After scanning was complete the core was shipped to Core lab for further processing

Training/Professional Development

- Rawlings Akondi, PhD student with Sharma and Ryan Trexler, MS student with Mouser were trained with Susan Pfiffner at UTK to interpret and analyzed lipid biomarker peak data from GC-MS analysis
- Sharma, Warrier, Wilson from Sharma Lab and Rebecca Daly from Wrighton Lab, trained in sidewall core sample collection

Data Dissemination

Sharma, Mouser, Wrighton & Wilkins gave several presentations highlighting the importance of MSEEL research in future discoveries.

Plan for Next Quarter

Finish core, fluid and gas sampling at MSEEL site and start initial analysis of samples. Identify and procure funding to support PhD. students and technicians involved in sampling, analysis and interpretation of data to be collected from MSEEL site.

Topic 4 – Geophysical and Geomechanical

Approach

Team will conduct microseismic analyses during the frac jobs of the production wells and tie that data back to the geophysical logs obtained from the science well, providing a clearer picture of proppant placement through the establishment of a detailed rock velocity model. Some inferences toward fracture quantity and patterns will also be vetted.

Plan is to identify specific methodology to obtain the data that will provide most understanding of subsurface rock model

Results and Discussion

Task 4a - Geophysics:

This past quarter: 1) fracture data from the MERC#1 well, including natural fracture and slickenline data were compiled from old DOE reports and analyzed; 2) fracture data obtained from the MIP3H well were interpreted; 3) potential microseismic event trends were interpreted and 4) Shmin was plotted for reference from the log data. Seismic velocity model is being constructed from acquired dipole sonic data for use during microseismic monitoring.

Fracture data from the MERC#1 well provided some historical perspectives along with a nearby control point for comparison to results obtained from present day logging operations conducted in the MIP3H well. Two separate natural fracture interpretations of the MERC#1 core were obtained and revealed some differences. Natural fractures noted in these two reports were obtained from core observations. One set of observations (Cliff Minerals, 1982) is based on only 33 natural fracture picks (Figure 4a-1A), while the other (Evans, 1980) has 103 picks. The Cliff Minerals' picks reveal a prominent N91E set with two smaller strike and dip parallel sets (N33E and N57W). Evans (1980) interpretation reveals two prominent sets: N82E and N73W. The N73W set would be roughly dip parallel and nearly coincides with the average slickenline orientations of N73W. The N82E fracture trend observed is anomalous and was apparently excluded from the interpretations made by Cliff Minerals.

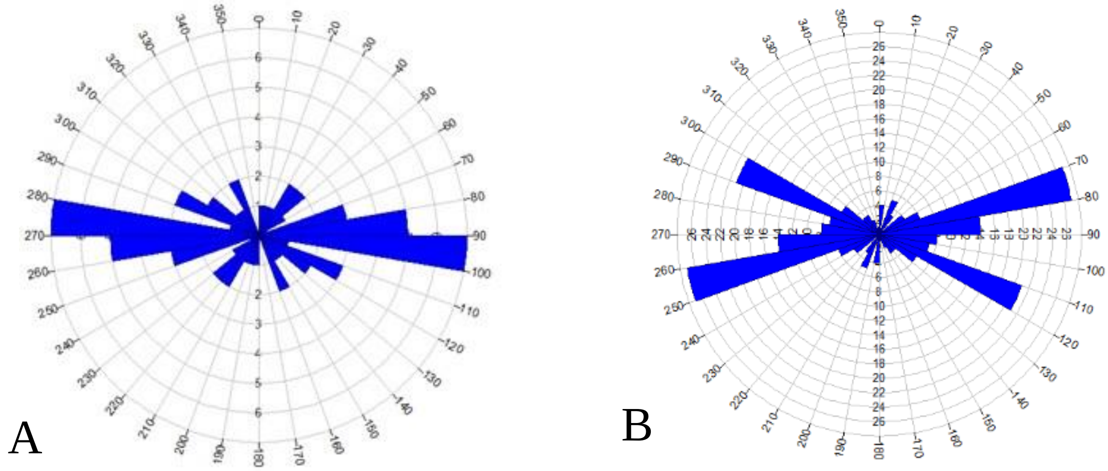


Figure 4a-1: A) Cliff minerals (1982) interpreted natural fractures trends (n=33); B) Evans (1980). Plotted data are reproduced to approximate rose diagrams presented by Cliff Minerals and Evans for the MERC#1 well.

Slickenline trends (Figure 4a-2) reported by Evans (1980) have a tightly clustered N67W trend normal to the local fold trend. The direction of movement is associated with Alleghenian orogenic event.

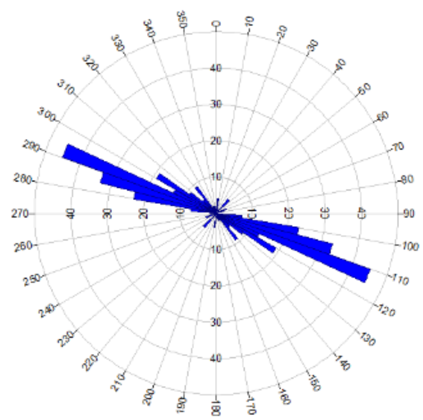


Figure 4a-2: Slickenline trends measured in the Merc #1 well (reproduced from Evans' (1980) rose diagram.

Data from the MIP3H well reveal induced and breakout fracture sets. The induced breakout trend is about N55E and the breakouts trend about N25W. The induced fracture trends imply an S_{Hmax} orientation of ~N55E, while the breakout trends imply an S_{Hmax} orientation of about N65E. Open fracture trends in the MIP3H are oriented about N57E while partially healed fractures trend about N80E (Figure 4a-3).

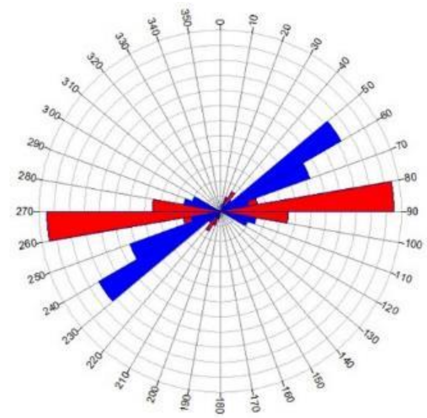


Figure 4a-3: Open fracture trends are shown predominantly in blue. Partially healed fractures likely to fail in response to HFT are highlighted in red. Orientations highlighted in red represent fracture trends interpreted to fail under shear.

The open fractures are positioned nicely to facilitate hydraulic fracture growth along the trend of S_{Hmax}. Rupture of pre-existing fractures appears likely in the N12-38E and N72-98E orientations.

A plot of S_{hmin} from the MIP 3H logs suggests majority of induced fracturing may be confined to the lower Marcellus (Figure 4a-4).

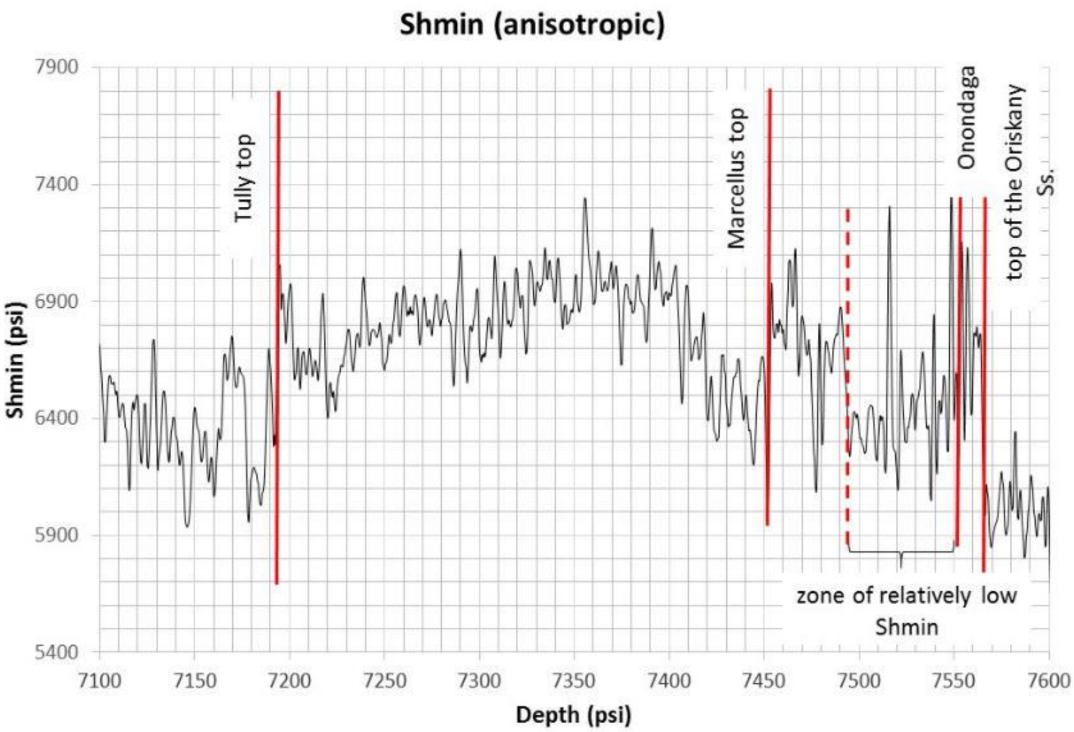


Figure 4a-4: Shmin is plotted as a function of depth for the MIP3H well.

Task 4b - Geomechanical:

Review of data was continued in order to identify modeling parameters for the anticipated hydraulic fracturing operation. Following specific items were performed.

(a) Participated in a visit to the field site.
(b) Review of geologic information was continued to establish geometric details of the strata above and below the reservoir layer.
(c) Preliminary modeling work was performed to determine potential fracture geometry based on assumed treatment schedule (fluid volume, proppant mass, and injection rate) and geomechanical properties. The following treatment parameters were assumed:

(1) Injection fluid volume = 300,000 US Gallons
(2) Proppant mass = 400,000 lbm
(3) Proppant type: 40/70 sand
(4) Maximum injection rate = 80 bpm

The assumed slurry and proppant injection schedules are shown in Figure 4b-1 and Figure 4b-2. The computed hydraulic fracture geometry is shown in Figure 4b-3. The modeling work is being continued. Well log and microseismic data will be used to develop a rock mechanics and fracture model to better describe and predict well performance, based on criteria used during hydraulic fracturing.

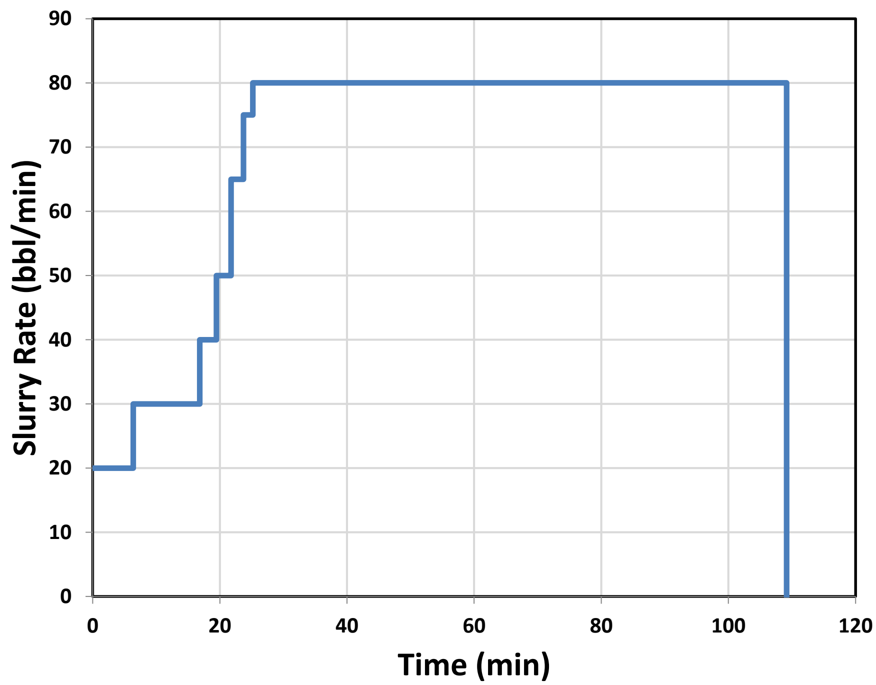


Figure 4b-1: Assumed Slurry Injection Schedule

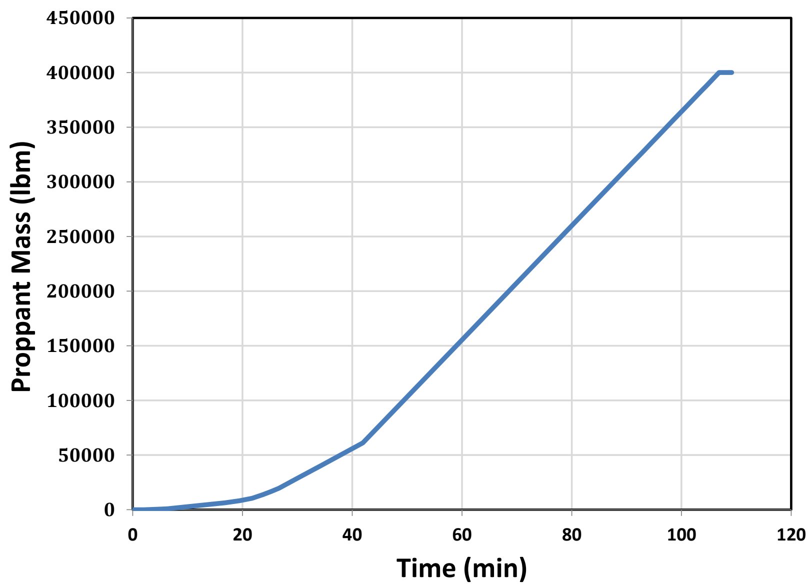


Figure 4b-2: Assumed Proppant Injection Schedule

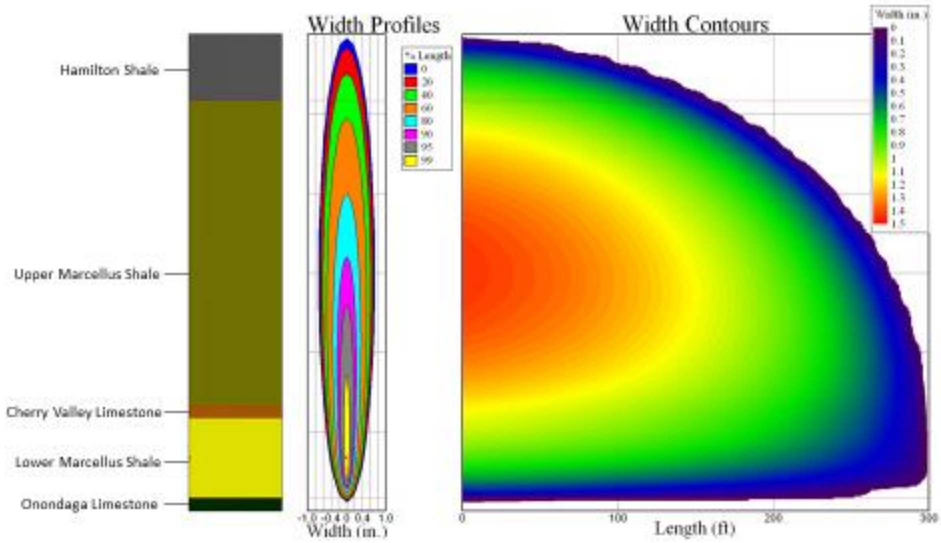


Figure 4b-3: Preliminary Computed Fracture Geometry

Plan for Next Quarter

Task 4a – Geophysical:

Analysis of data from the science well and laterals will continue as logs become available. Of particular interest will be additional information regarding orientations of the natural fractures, faults, induced tensile fractures and compressive breakouts observed in the Quanta Geo log along with orientations and magnitudes of S_{Hmax} and S_{hmin} based on sidewall core and sonic scanner analysis.

Acquire and analyze microseismic data during the hydraulic fracturing of the MIP 3H and 5H wells.

2D seismic data will be evaluated if made available.

Task 4b - Geomechanical:

Information on the hydraulic fracturing field parameters (fluid volumes, pumping rate, and proppant schedule) will be sought from NNE for the planned field operations. The modeling work will be performed on the basis of available data.

Topic 5 – Surface Environmental

Approach

Surface water sampling stations have been established as locations MR-1, MR-2, and MR-3 along the Monongahela River. GPS coordinates were obtained for each of the three surface water sampling stations and recorded in a field book. Based on the timeline for gas well development being shortened and activities moved up, two separate sampling events were conducted. Figure 5.1 shows the locations of sampling points MR-1, MR-2, and MR-3 in red with the Northeast Energy site indicated in purple. Permitted well locations, as per WVDEP Oil & Gas data, are shown in **Figure 5.2**. The two wells currently under development at the Northeast Energy site are MIP 3H (API 061-01707) and MIP 5H (API 061-01699).

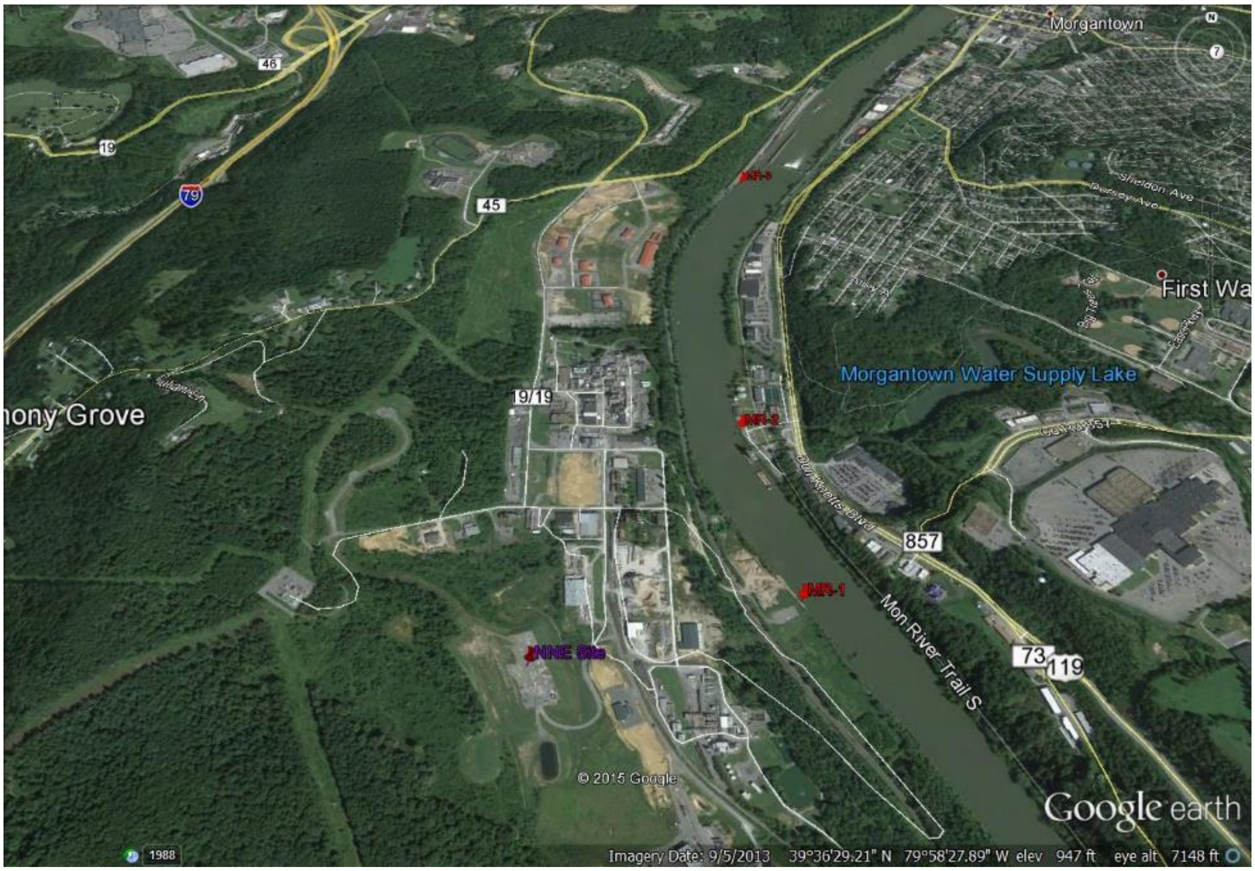


Figure 5.1: MSEEL surface water sampling locations

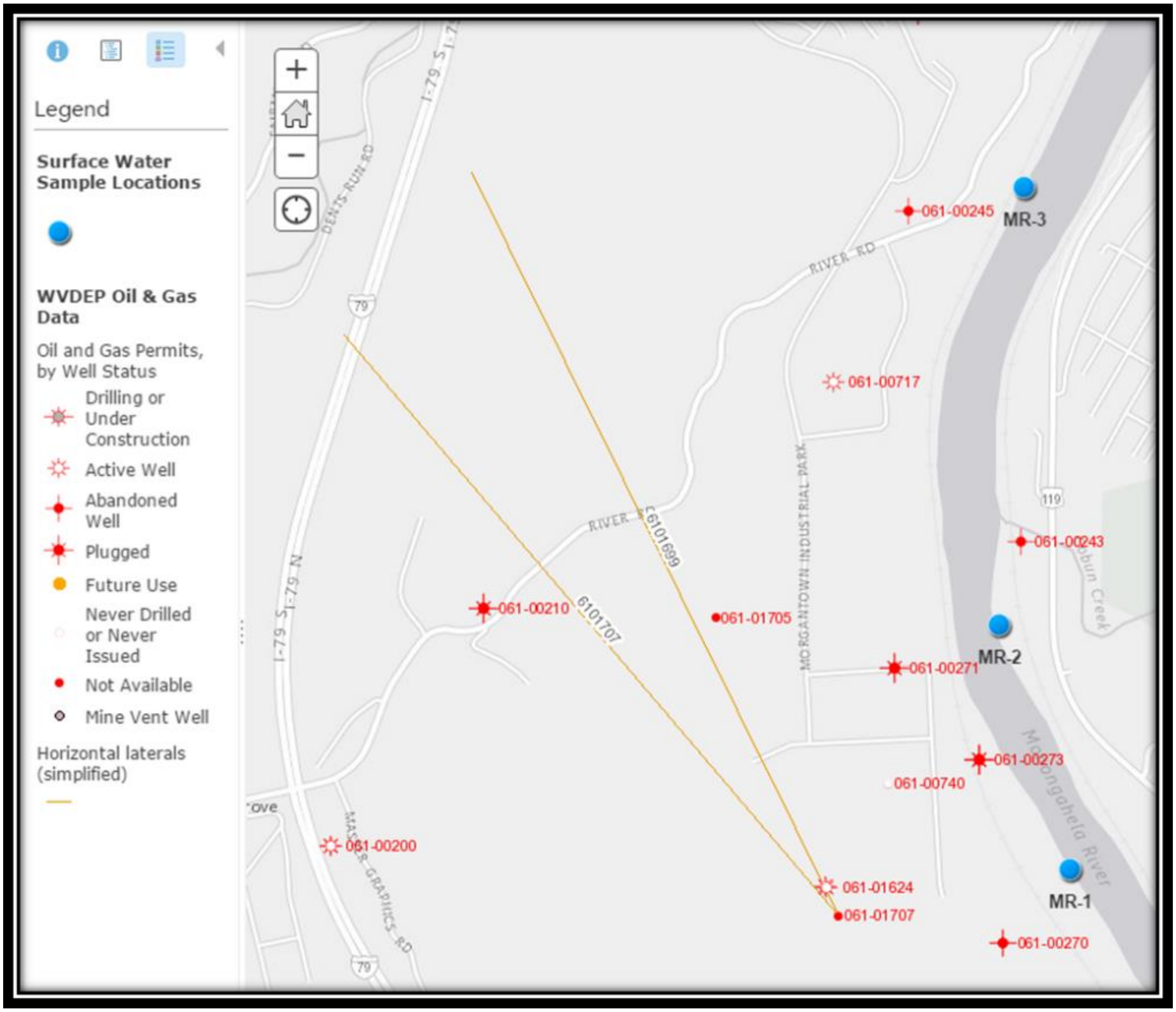


Figure 5.2: Locations of WVDEP oil and gas well sites relative to surface water sampling sites

Surface water samples were collected on 06/12/2015 and 06/25/2015 to establish a water quality baseline for the Monongahela River prior to gas well drilling. Field parameters (temperature, electric conductance, total dissolved solids, dissolved oxygen, and pH) were measured using an YSI-556 multi-probe meter with readings recorded in a field notebook. Grab samples were collected for measurements of parameters listed in **Table 5.1**. All field equipment is decontaminated prior to use at each sampling station. Disposable syringes and 0.45 µm filters are used for sample collection for dissolved metals analysis, see **Figure 5.3**. All sample bottles are prepared and provided by the commercial laboratory, ALS Analytical, for each sampling event. Chain-of-custody forms are completed and provided to the commercial laboratory with the samples.

Spud dates for MIP 5H and MIP 3H were 06/28/2015 and 07/06/2015 respectively with surface water samples collected on 07/08/2015. Please see the **Results and Discussion** section below.

Table 5.1: Parameters, analytical methods, and reporting limits for surface water samples

Parameter	MDL	Method	Units	Parameter	MDL	Method	Units
Al	0.0011	SW6020A	mg/L	*Alkalinity (as CaCO3)*	4.3	A4500-CO2D	mg/L
As	0.0007			*Br*	0.19	E300.0	
Ba	0.0002			*Cl*	0.29		
Ca	0.4			*SO4*	3		
Cr	0.0001			*Anionic Surfactants as MBAS*	0.005	A5540C	mg MBAS/L
Fe	0.01			*Specific Conductance*	2.4	A2510 B-97	µmhos/cm @25°C
Pb	0.0001			*Total Dissolved Solids*	7.6	A2540 C-97	mg/L
Mg	0.02			*Total Suspended Solids*	1.8	A2540 D-97	
Mn	0.0002			*Temp.*		Field Readings	°C
Ni	0.0004			*Conductivity*			µS/cm
K	0.03			*TDS*			(mg/L)
Se	0.001			*pH*			pH
Ag	0.0001			*DO*			(mg/L)
Na	0.1			*Gross Alpha*		GFPC	pCi/L
Sr	0.000			*Gross Beta*			
Zn	0.02			*Radium-226*		903.10	
Al d	0.001			*Radium-228*		Analysis by GFPC	
As d	0.001			*Potassium-40*		Gamma Spec	
Ba d	0.0002			*Benzene*	0.25	SW8260	µg/L
Ca d	0.4			*Ethylbenze*	0.22		
Cr d	0.000			*m,p-Xylene*	0.4		
Fe d	0.01			*o-Xylene*	0.21		
Pb d	0.0001			*Toluene*	0.2		
Mg d	0.2			*Total-Xylene*	0.62		
Mn d	0.0002			*Surr: 1,2 - Dichlorethan*	75-120		%REC
Ni d	0.0004			*Surr: 4-Bromoflurobe*	80-110		
K d	0.03			*Surr: Dibromofluor*	85-115		
Se d	0.001			*Surr: Toluene -d8*	85-110		
Ag d	0.000						
Na d	0.1						
Sr d	0.000						
Zn d	0.002						

Figure 5.3: Dissolved metals sample collection

Vertical cuttings from the MIP 3H well were collected on 07/13/2015 at depths of 4,400 feet and 5,026 feet. Due to safety concerns for research staff, Northeast Energy contractors collected samples within view of WV Water Research Institute (WVWRI) researchers, see **Figure 5.4**. Grab samples were collected for measurements of parameters listed in **Table 5.2**. The same field parameters as mentioned above were measured using the YSI-556 multi-probe meter and recorded in the fieldbook. In addition, a radiation alert detector and a 6-gas photo ionizer detector (methane, oxygen, hydrogen sulfide, carbon monoxide, and carbon dioxide) are used to scan the work environment and collected samples with results of background and samples recorded in the fieldbook.

Samples of horizontal cuttings and muds from MIP 5H were collected on 09/11/2015 on site at a measured depth of 8,555 feet. Samples of horizontal cuttings and muds from MIP 3H were collected on 09/25/2015 on site at a measured depth of 13,480 feet. As during the vertical drilling stage, Northeast Energy contractors collected samples within view of WVWRI researchers. Grab samples were collected for measurements of the parameters listed in **Table 5.2**. All sample bottles are prepared and provided by the commercial laboratory, ALS Analytical, for each sampling event. Chain-of-custody forms are completed and provided to the commercial laboratory with the samples. The same field parameters were measured using the YSI-556 multi-probe meter, radiation alert detector, and the 6-gas PID and recorded in the fieldbook. All field equipment is decontaminated after each sample.

Additional large volume samples of cuttings and muds from MIP 5H were collected approximately every 250 feet by Northeast Energy and provided to WVU's principle investigator. WVWRI researchers obtained grab samples for analytical purposes from these collections at measured depths of 6,798 feet, 9,998 feet, 11,918 feet, and 14,454 feet.

Figure 5.4: Collection of MIP 3H vertical cuttings

Table 5.2: Parameters, analytical methods, and reporting limits for cuttings and muds (as appropriate)

Analysis	Method	Units	Parameter	MDL	TCLP Limit
TCLP Herbicides	SW8151	ug/L	*2,4,5-TP (Silvex)*	0.062	1
			2,4D	0.051	10
		% Rec	*Surr: DCAA*		
TCLP Pesticides	SW8081	ug/L	*Chlordane technical*	0.42	0.03
			Endrin	0.009	0.02
			gamma-BHC (Lindane)	0.0075	-
			Heptachlor	0.0085	-
			Heptachlor epoxide	0.006	0.008
			Methoxychlor	0.006	10
			Toxaphene	0.14	0.5
		% Rec	*Surr: Decachlorobiphenyl*		
			Surr: Tetrachloro-m-xylene		
TCLP Mercury by CVAA	SW7470A	mg/L	*Hg*	0.00018	0.2
TCLP Metals Analysis By ICP-MS	SW6020A	mg/L	*As*	0.007	5
			Ba	0.002	100
			Cd	0.001	1
			Cr	0.001	5
			Pb	0.001	5
			Se	0.01	1
			Ag	0.001	5
TCLP Semi-Volatile Organics	SW8270	ug/L	*1,4- Dichlorobenzene*	8.2	7.5
			2,4,5- Trichlorophenol	5.8	400
			2,4,6- Trichlorophenol	5	2
			2,4- Dinitrotoluene	2.8	*0.13
			Hexachloro-1,3- butadiene	7.4	0.5
			Hexachlorobenzene	4.6	*0.13
		ug/L	*Hexachloroethane*	9.4	3
			m-Cresol	4.8	200
			Nitrobenzene	4.6	2
			o-Cresol	2.8	**200
			p-Cresol	4.8	**200
			Pentachlorophenol	10	100
	SW8270		*Pyridine*	61	*5
		% Rec	*Surr: 2,4,6- tribromophenol*		
			Surr: 2- Fluorobiphenyl		
			Surr: 2- Fluorophenol		
			Surr: 4- Terphenyl-d14		
			Surr: Nitrobenzene-d5		
			Surr: Phenol-d6		
TCLP Volatile Organics	SW8260B	ug/L	*1,1- Dichloroethene*	4.7	0.7
			1,2- Dichloroethane	5.3	0.5
			2- Butanone	17	-
			Benzene	5	0.5
			Carbon Tetrachloride	2.8	0.5
			Chlorobenzene	3.7	100
			Chloroform	4.9	6
			Tetrachloroethene	4.9	0.7
			Trichloroethene	6.9	0.5
			Vinyl Chloride	3.8	0.2
	SW8260B	% Rec	*Surr: 1,2- Dichloroethane-d4*		
			Surr: 4-bromofluorobenzene		
			Surr: Dibromofluoromethane		
			Surr: Toluene-d8		

Analysis	Method	Units	Parameter	MDL	TCLP Limit
Diesel Range Organics by GC-FID	SW8015M	mg/Kg	*DRO (C10-C28)*	1.4	
			ORO (C28-C40)	1.4	
		% Rec	*Surr: 4-terphenyl-d14*		
Gasoline Range Organics by GC-FID	SW8015D	ug/Kg	*GRO C6-C10)*	1200	
		% Rec	*Surr: Toluene-d8*		
Volatile Organic Compounds	SW8260B	ug/Kg	*Benzene*	12	
			Ethylbenzene	11	
			m,p- Xylene	23	
			o- Xylene	13	
			Styrene	11	
			Tetrachloroethene	13	
			Toluene	11	
			Xylenes total	35	
	SW8260B	% Rec	*Surr: 1,2- Dichloroethane-d4*		
			Surr: 4-Bromofluorobenzene		
			Surr: Dibromofluoromethane		
			Surr: Tolouene-d8		
Radionuclides	EPA 901.1	pCi/g	*Potassium-40*		
			Radium-226		
			Radium-228		
	EPA 9310		*Gross Alpha*		
			Gross Beta		
Inorganics	SW9056A	mg/Kg	*Br*		
			Cl		
			SO4		
	SW9034		*sulfide*		
	E353.2		*nitrate*		
	E354.1		*nitrite*		
	A4500-CO2 D		*alkalinity*		
	A2510M	µmhos/cm	*conductance*		
	SW9045D		*pH*		
	A4500-CO2 D	mg/Kg	*bicarbonate*		
			carbonate		
	E365.1 R2.0		*TP*		
	SW6020A		*Ag*		
			Al		
			As		
			Ba		
			Ca		
			Cr		
			Fe		
			K		
			Mg		
			Mn		
			Na		
			Ni		
			Pb		
			Se		
			Sr		
			Zn		

* Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

** If o- , m- , and p- Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

Results and Discussion

During this quarter, WVWRI researchers received two requests from external parties interested in the project. Each were directed to the MSEEL website and to complete data collection forms. The two parties were:

1. representatives of the WVU School of Journalism seeking to field test a probe to measure water quality parameters similar to the YSI-556 unit, and
2. Professors from Cornell University's Civil and Environmental Engineering Department seeking surface water samples and flowback/produced water samples to study the fate and transport of polar and semi-polar organic chemicals in the aquatic environment.

Results of surface water samples received during this quarter are presented in **Table 5.3**. Please note, values less than minimum detection limit (MDL) were reported as ½ the MDL and are highlighted in the table. Results from the vertical cuttings samples are presented in **Table 5.4**.

Minimum Detection Limit	Drinking Water Limit	units	Parameter	Sampling Station / Date								
				1st Baseline			*2nd Baseline*			*During Drilling*		
				MR-1	MR-2	MR-3	MR-1	MR-2	MR-3	MR-1	MR-2	MR-3
				6/12/2015	6/12/2015	6/12/2015	6/25/2015	6/25/2015	6/25/2015	7/8/2015	7/8/2015	7/8/2015
Anions												
4.3		mg/L	Alk	84	85	85	34	51	52	61	62	47
0.19		mg/L	Br	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095
0	250	mg/L	Cl	12.0	12.0	13.0	4.6	4.9	4.8	6.9	6.6	6.8
3		mg/L	SO4	220	210	220	40	45	45	66	64	64
Other laboratory parameters												
2.4		µS/cm	EC	620	610	610	170	170	170	260	250	260
7.6		mg/L	TDS	410	390	400	94	96	96	150	150	150
1.8		mg/L	TSS	20	6	6	21	28	16	12	12	14
Organics												
0.25		µg/L	Benzene	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
0.22		µg/L	Ethylbenze	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.4		µg/L	m,p-Xylene	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
0.21		µg/L	o-Xylene	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105
0.2		µg/L	Toluene	0.1	0.48	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.62		µg/L	Total-Xylene	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
0.025		mg/L	MBAS	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125			
Field determinations												
		°C	Temp.	24.44	24.21	25.85	20.39	20.46	20.37	22.52	22.52	22.66
		mg/L	EC	643	635	657	181	180	181	256	254	256
		mg/L	TDS	419	419	420	131	128	129	175	173	174
		pH	pH	8.05	8.23	8.49	7.80	7.71	7.77	7.88	7.97	7.99
		mg/L	DO	6.47	6.02	9.73	8.11	7.60	8.37	6.40	6.49	6.40
Radioactivity												
		pCi/L	Alpha	ND	ND	ND	2.75	2.78	2.64	2.24	1.62	2.09
		pCi/L	Beta	5.20	3.20	ND	2.16	2.59	2.63	1.89	2	2.4
		pCi/L	^{226}Ra	ND	0.23	0.15	0.58	0.63	0.751	0.479	0.772	0.804
		pCi/L	^{228}Ra	ND	0.75	ND	0.884	0.842	0.794	0.891	0.957	0.831
		pCi/L	^{40}K	ND	ND	ND	110.8	100.9	100.9	116.3	96.53	106.9

Table 5.3: Surface water sampling results

Analysis	Method	Units	Parameter	MDL	TCLP Limit	3H 5026'	3H 4400'
TCLP Herbicides	SW8151	ug/L	*2,4,5-TP (Silvex)*	0.062	1	ND	ND
			2,4D	0.051	10	ND	ND
		% Rec	*Surr: DCAA*			97.4	90.2
TCLP Pesticides	SW8081	ug/L	*Chlordane technical*	0.42	0.03	ND	ND
			Endrin	0.009	0.02	ND	ND
			gamma-BHC (Lindane)	0.0075	-	ND	ND
			Heptachlor	0.0085	-	ND	ND
			Heptachlor epoxide	0.006	0.008	ND	ND
			Methoxychlor	0.006	10	ND	ND
			Toxaphene	0.14	0.5	ND	ND
		% Rec	*Surr: Decachlorobiphenyl*			91	90
			Surr: Tetrachloro-m-xylene			68	64
TCLP Mercury by CVAA	SW7470A	mg/L	*Hg*	0.00018	0.2	0.00022	0.00021
TCLP Metals Analysis By ICP-MS	SW6020A	mg/L	*As*	0.007	5	ND	ND
			Ba	0.002	100	0.99	0.82
			Cd	0.001	1	ND	ND
			Cr	0.001	5	0.0028	0.0022
			Pb	0.001	5	0.012	0.04
			Se	0.01	1	ND	ND
			Ag	0.001	5	ND	ND
TCLP Semi-Volatile Organics	SW8270	ug/L	*1,4- Dichlorobenzene*	8.2	7.5	ND	ND
			2,4,5- Trichlorophenol	5.8	400	ND	ND
			2,4,6- Trichlorophenol	5	2	ND	ND
			2,4- Dinitrotoluene	2.8	*0.13	ND	ND
			Hexachloro-1,3- butadiene	7.4	0.5	ND	ND
			Hexachlorobenzene	4.6	*0.13	ND	ND
		ug/L	*Hexachloroethane*	9.4	3	ND	ND
			m-Cresol	4.8	200	ND	ND
			Nitrobenzene	4.6	2	ND	ND
			o-Cresol	2.8	**200	ND	ND
			p-Cresol	4.8	**200	ND	ND
			Pentachlorophenol	10	100	ND	ND
			Pyridine	61	*5	ND	ND
	SW8270	% Rec	*Surr: 2,4,6- tribromophenol*			80.2	70.2
			Surr: 2- Fluorobiphenyl			52.1	57.4
			Surr: 2- Fluorophenol			38.1	40.5
			Surr: 4- Terphenyl-d14			51.5	64.7
			Surr: Nitrobenzene-d5			50.8	55.6
			Surr: Phenol-d6			26	23.6
TCLP Volatile Organics	SW8260B	ug/L	*1,1- Dichloroethene*	4.7	0.7	ND	ND
			1,2- Dichloroethane	5.3	0.5	ND	ND
			2- Butanone	17	-	ND	ND
			Benzene	5	0.5	ND	ND
			Carbon Tetrachloride	2.8	0.5	ND	ND
			Chlorobenzene	3.7	100	ND	ND
			Chloroform	4.9	6	ND	ND
			Tetrachloroethene	4.9	0.7	ND	ND
			Trichloroethene	6.9	0.5	ND	ND
			Vinyl Chloride	3.8	0.2	ND	ND
	SW8260B	% Rec	*Surr: 1,2- Dichloroethane-d4*			98.4	96.2
			Surr: 4-bromofluorobenzene			98	94.6
			Surr: Dibromofluoromethane			98	98.3
			Surr: Toluene-d8			97.8	96.4

Analysis	Method	Units	Parameter	MDL	TCLP Limit	3H 5026'	3H 4400'
Diesel Range Organics by GC-FID	SW8015M	mg/Kg	*DRO (C10-C28)*	1.4		85	250
			ORO (C28-C40)	1.4		34	65
		% Rec	*Surr: 4-terphenyl-d14*			63.5	89.8
Gasoline Range Organics by GC-FID	SW8015D	ug/Kg	*GRO C6-C10)*	1200		ND	60000
		% Rec	*Surr: Toluene-d8*			95.2	96.3
Volatile Organic Compounds	SW8260B	ug/Kg	*Benzene*	12		ND	ND
			Ethylbenzene	11		29	58
			m,p- Xylene	23		240	430
			o- Xylene	13		60	130
			Styrene	11		ND	ND
			Tetrachloroethene	13		ND	ND
			Toluene	11		200	370
			Xylenes total	35		300	560
	SW8260B	% Rec	*Surr: 1,2- Dichloroethane-d4*			108	102
			Surr: 4-Bromofluorobenzene			93.2	97.4
			Surr: Dibromofluoromethane			108	103
			Surr: Tolouene-d8			92.9	94
Radionuclides	EPA 901.1	pCi/g	*Potassium-40*			24.28	28.324
			Radium-226			1.352	1.221
			Radium-228			1.895	1.82
	EPA 9310		*Gross Alpha*			10.5	15
			Gross Beta			19.4	24.5
Inorganics	SW9056A	mg/Kg	*Br*			7.3	2.8
			Cl			750	260
			SO4			46	36
	SW9034		*sulfide*			37	37
	E353.2		*nitrate*			1.4	0.098
	E354.1		*nitrite*			0.006	0.04
	A4500-CO2 D		*alkalinity*			410	280
	A2510M	µmhos/cm	*conductance*			1900	1200
	SW9045D		*pH*			9.2	8.8
	A4500-CO2 D	mg/Kg	*bicarbonate*			140	150
			carbonate			270	130
	E365.1 R2.0		*TP*			240	220
	SW6020A		*Ag*			0.025	0.025
			Al			11000	7500
			As			13	12
			Ba			42	40
			Ca			9700	9400
			Cr			22	11
			Fe			40000	23000
			K			1200	710
			Mg			5400	4100
			Mn			660	570
			Na			850	420
			Ni			24	20
			Pb			7.8	11
			Se			0.35	0.45
			Sr			24	13
			Zn			43	36

ND = non detect

results above MDL

* Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

** If o- , m- , and p- Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

Table 5.4: Vertical cuttings sampling results

Plan for Next Quarter

Activities moving forward will follow the schedule provided in **Table 5.5** below.

	Freshwater		Aqueous/Solids: drilling/completion/production								
	Mon River	Ground water	HF fluid makeup	HF fluids	flowback/ produced	drilling fluids	drilling cuttings/ muds	total aqueous	total solids	Sampling Dates	Sampling Notes
Sampling Stations	3	0	2	2	2	2	2				
Subtask 1.4.1 Test surface sampling plan											
ID and review existing GW/SW data	**Completed-flow path identification, otherwise no other value**										
Finalize project surface sampling plan	**Completed-see below**										
Subtask 1.4.3 Develop water quality baseline											
Groundwater baseline prior to drilling	**Access denied-groundwater will not be sampled**										
Surface water baseline prior to drilling along the Monongalia River	3							3		6/12/2015	point upstream near NEE water withdrawal, two points downstream are lock and dam and MUB property (opposidte side of river)
Surface water baseline prior to drilling along the Monongalia River	4							4		6/25/2015	Surface water samples + field duplicate included
Subtask 2.1.1 Environmental monitoring-Drilling											
Vertical Drilling of MIP 3H and 5H											
Surface water sampling during vertical drilling	3							3		7/8/2015	Surface water samples only from along the Monongalia River
Cuttings sample from MIP 3H during vertical drilling							1		1	7/13/2015	MIP 3H well @ 4400'
Cuttings sample from MIP 3H during vertical drilling							1		1	7/13/2015	MIP 3H well @ 5026'
Horizontal drilling of MIP 5H											liquids & solids fraction of muds from 5H: curve + 2 horizontal
Cuttings and muds samples from MIP 5H during horizontal drilling							3		3	9/11/2015	Curve - 8555', true vertical depth - 7469', 1 - cuttings, 1 - muds, plus cuttings duplicate
Cuttings sample from MIP 3H during horizontal drilling							1		1	9/25/2015	Obtained 1 cuttings samples from Carr. Sample was collected by NEE reps on 9/13/15 at approximately 12000'
Horizontal drilling of MIP 3H						1	3	1	3		liquids & solids fraction of muds from 3H: curve + 2 horizontal
Cuttings and muds samples from MIP 3H during horizontal drilling							3		3	9/21/2015	Horizontal - 13480', 1 - cuttings, 1 - muds, plus cuttings duplicate
Surface water sampling after horizontal drilling of MIP 5H and 3H	3							3		9/25/2015	surface water only, 1 round after both production wells drilled
Subtask 2.2.1 Environmental monitoring-Completion											
Hydraulic fracturing - 3H	3		1	1				5			one sample for 3H + surface water
Hydraulic fracturing - 5H	3		1	1				5			one sample for 5H + surface water
Flowback initial - 3H	3				1			4			one sample from 3H
Flowback initial - 5H	3				1			4			one sample from 5H
Flowback @ 1 week - 3H	3				1			4			one sample from 3H
Flowback @ 1 week - 5H	3				1			4			one sample from 5H
Flowback @ 2 weeks - 3H	3				1			4			one sample from 3H
Flowback @ 2 weeks - 5H	3				1			4			one sample from 5H
Flowback @ 4 weeks - 3H	3				1			4			one sample from 3H
Flowback @ 4 weeks - 5H	3				1			4			one sample from 5H
Flowback @ 8 weeks - 3H	3				1			4			one sample from 3H
Flowback @ 8 weeks - 5H	3				1			4			one sample from 5H
Subtask 2.3.1 Environmental monitoring-Production											
Production 3 stations x 3/yr x 4 yrs	36				24			60			one sample from each - 3H and 5H, per sampling event

Table 5.5: Sampling Schedule

Topic – Air Quality Monitoring (Environmental Impacts)

University of Pittsburgh – Emily Elliott, Justin Coughlin, Lucy Rose

Dept. of Energy (National Energy Technology Laboratory) – Natalie Pekney

Approach

The University of Pittsburgh air quality monitoring team has been monitoring ambient reactive nitrogen concentrations and deposition flux measurements since May 8, 2015. We utilize passive sampling techniques that have been previously validated by both federal agencies (e.g. United States Forest Service, UK Centre for Ecology and Hydrology) and previous academic studies. These passive samplers use chemically impregnated filters to capture ambient NO_2, NH_3, HNO_3, and O_3 and are currently deployed at the MSEEL site. There are 16 sites transecting upwind and downwind of the MSEEL site, equaling a total length of ~1 km (Figure 1). Each site consists of 3 posts (48 total posts) which hold 2-4 samplers. NO_2 and NH_3 are located on each post (48 total samplers) and HNO_3 and O_3 samplers are located at every other site (24 total samplers). Filters are exchanged on a biweekly basis and are frozen until subsequent elution and concentration analysis on an ion chromatograph. Additionally, NO_2, NH_3, and HNO_3 sample eluents are being analyzed respectively for the stable isotopic composition of $\delta^{15}N$ and $\delta^{18}O$ on a continuous flow – isotope ratio mass spectrometer. Spatial and temporal differences in isotopic composition are expected to indicate the relative proportion of NO_x and NH_3 emission sources to ambient concentrations and deposition fluxes, as well as variations in atmospheric oxidation processes.

Our team has also deployed a HOBOware meteorological station on the northeast corner of the well pad site (Figure 5.5). Data from this station has been retrieved during every biweekly filter exchange. Thus far, we have completed 11 filter exchanges (5/8/2015-10/13/2015).

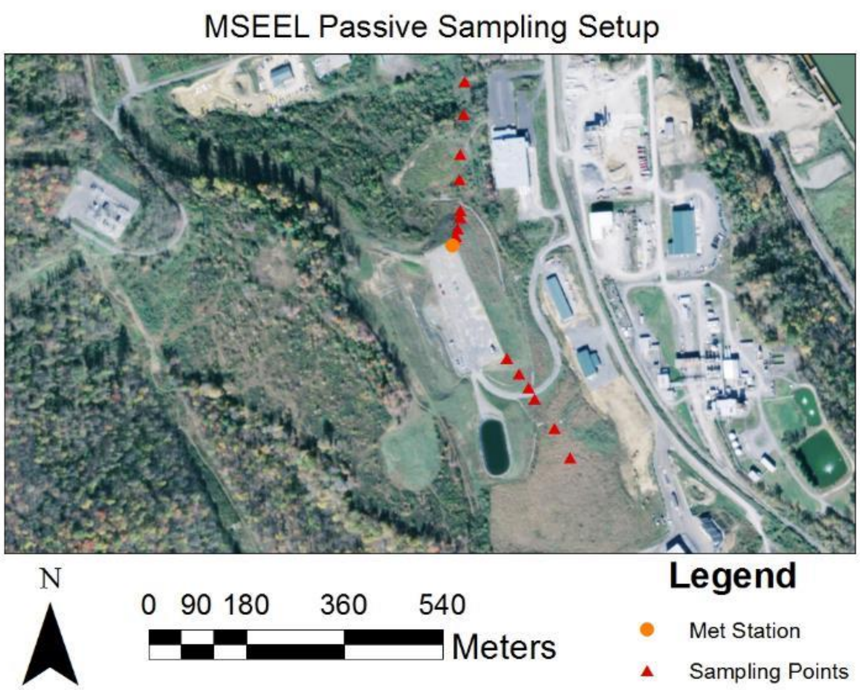


Figure 5.5. A map displaying the layout of the University of Pittsburgh air quality monitoring network established at the MSEEL site. An additional site has been added on the eastern side of the well pad directly next to the berm (not shown). The northern (downwind) transect spans ~300 m from the NE corner of the pad while the southern (upwind) transect spans ~225 m from the SE corner of the pad.

Results and Discussion

To date, we have collected 572 NO_2 and NH_3 samples, respectively, and 296 HNO_3 and O_3 samples, respectively, including field and laboratory blanks for each analyte (See Table 5.6). We have been continually making progress on both concentration and isotope analyses throughout the course of sampling. Currently, we have analyzed a total of 653 samples for concentration (all analytes) and 128 samples for isotope measurements. Table 5.6 displays the breakdown of completion percentages for each analyte. Ammonia (NH_3) measurements have been inhibited due to instrumentation issues but analyses will begin by mid-November.

Analyte	Samples collected	Samples analyzed for concentration (#)	Samples analyzed for isotopes (#)	Concentration completion (%)	Isotope completion (%)
NO_2	572	354	10	61.9	1.7
HNO_3	296	219	118	74.0	39.9
NH_3	572	0	0	0.0	0.0
O3	296	80	N/A	27.0	N/A

Table 5.6: The table shows the different analytes being observed, the number of samples collected, the number analyzed for concentration, and the number analyzed for isotopes. The completion percentage of each analyte is also shown. The column highlighted in yellow represents an approximate number as final sample counts are pending adjustment for QA/QC.

Eluant concentrations will be converted to ambient air concentration (ppb) and deposition measurements (kg N ha^{-1} yr^{-1}) using published methods. Meteorological data has not been fully processed but is currently undergoing quality assurance and completion.

Plans for Next Quarter

Continue to exchange filters through the production phase. We will stop sampling after two filter exchanges post-hydraulic fracturing. Additionally, we will continue to process retrieved samples for both concentration and isotope measurements during this time and following final retrieval. Once all samples are analyzed and interpreted, this work will culminate into a manuscript that we plan to submit in March 2015, as well as into a chapter into J. Coughlin's M.S. thesis which will be submitted to the *University of Pittsburgh* in April 2015.

Topic 6 – Economic and Societal

Approach

The lead on the political and societal project will work to identify and evaluate the factors shaping the policymaking response of local political actors. Included in this assessment will be an accounting, past and present, of the actions of public and private individuals and groups acting in favor of or opposed to shale gas drilling at the MSEEL site.

First year activity includes developing, distributing, collecting and compiling the responses from a worker survey and a vendor survey. The worker survey will address job characteristics and offsite expenditures. The vendor survey will help to identify per-well cost structures.

Results and Discussion

Project team continued to distribute and collect surveys from on-site workers. Approximately 70 surveys have been completed to date. This data will be used to develop an estimate of worker consumption expenditures by type, which will be used to estimate the local economic impacts. Other data collected will be drilling expenditures by type. Data collection is expected to continue into 2QCY2016, with analysis to being shortly after.

Plan for Next Quarter

Continue collection of worker and well cost data. Develop methodology for data reduction and begin development of model.

Cost Status

Project Title:	Marcellus Shale Energy and Environment Laboratory at West Virginia University
DOE Award Number:	DE-FE0024297

Year 1

Start: 10/01/2014 End: 09/30/2015

Baseline Reporting Quarter	Q1 (12/31/14)	Q2 (3/30/15)	Q3 (6/30/15)	Q4 (9/30/15)
Baseline Cost Plan	(From 424A, Sec. D)			
(from SF-424A)				
Federal Share	$549,000		$3,549,000	
Non-Federal Share	$0.00		$2,814,930	
Total Planned (Federal and Non-Federal)	$549,000		$6,363,930	
Cumulative Baseline Costs				
Actual Incurred Costs				
Federal Share	$0.00	$14,760.39	$237,451.36	$300,925.66
Non-Federal Share	$0.00	$0.00	$0.00	$0.00
Total Incurred Costs - Quarterly (Federal and Non-Federal)	$0.00	$14,760.39	$237,451.36	$300,925.66
Cumulative Incurred Costs	$0.00	$14,760.39	$252,211.75	$533,137.41
Uncosted				
Federal Share	$549,000	$534,239.61	$3,296,788.25	$2,995,862.59
Non-Federal Share	$0.00	$0.00	$2,814,930.00	$2,814,930.00
Total Uncosted - Quarterly (Federal and Non-Federal)	$549,000	$534,239.61	$6,111,718.25	$5,810,792.59

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