MAWC – IUP Service Contract
Air Quality Monitoring at Beaver Run Reservoir
Quarterly Report #2

Covering the Period from 11/1/2018 – 1/31/2019

Submitted by

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OUTLINE OF REPORT

I. Scope of Contract

The third year of the contract between the Municipal Authority of Westmoreland County (MAWC) and the Indiana University of Pennsylvania (IUP) started on 1 August 2018 and runs until 31 July 2019. The scope of the contract calls for the contractor, IUP, to perform air quality measurement services at Beaver Run Reservoir (BRR) quarterly.

The air quality measurement services include field sampling, laboratory analyses and reporting as follows: (1) Field Sampling: air quality samples and hand-held sensor readings will be taken at the Mamont compressor station and at the Kuhns, DeArmitt, Hutchinson and Mamont (KDHM) pad sites. Background air quality samples will be taken near the Kuhns pad. (2) Laboratory Analyses: The air samples taken from the pad sites will be monitored for methane concentration and compared to the hand-held sensor readings taken at the pads. The air samples taken from the Mamont 1 compressor station will be monitored for the standard compressor gases of CO, NO_2, SO_2, Benzene, Ethylbenzene, Formaldehyde, n-Hexane, Toluene, Xlenes and 2,2,4 Trimethylpentane. (3) Reporting: A report on the results of the field sampling and analyses will be delivered to MAWC personnel when the data analysis is completed. After review and approval of the report results by MAWC, the results will then be posted on an IUP web site for public access.

II. Scope of Report

This report covers the second quarter of the contract. Field samples and hand-held sensor readings were taken directly off of the four BRR fracking pad sites on 10 November 2018. A background sample was taken about 200 meters from the edge of the Kuhns pad, as measured by Google Maps. Field samples and hand-held sensor readings were taken at the Mamont Compressor site on 11 November. Additionally, Carbon Monoxide (CO) data loggers were placed at the Mamont compressor site on 11 November 2018 and removed from the compressor site on 13 January in anticipation of frigid temperatures below the minimum operating temperature of the loggers (-10°C, 14°F). Field sampling notes and the results of logged data and laboratory analyses of the field samples are reported herein.

III. Field Report of Air Quality Sampling

Figure 1 (next page) shows the approximate locations where an air sample was taken or CO monitors were placed at the Mamont compressor station. One air sample was taken at position P7 and the CO data loggers were placed at the positions labeled P7, P1 and P3. Hand-held sensor readings for CO, SO_2, CH_4, NO_2 and CH_2O were taken at position P7. The hand-held sensor readings were taken for 10-minute durations for each gas.

All of the aerial views shown in this section of the report are taken from Google Maps and do not represent the vegetation or construction in the area on the date of the samples, but instead are intended to show the locations of the air and background samples relative to landmarks around the Mamont compressor and the Kuhns, DeArmitt, Hutchinson, and Mamont (KDHM) pad well sites.

Figure 1. Aerial image of the Mamont compressor station. An air sample was taken at position P7. Hand-held sensor readings for CO, SO_2, CH_4, NO_2 and CH_2O were recorded at P7. CO data loggers were placed at the positions P1, P2 and P7. The aerial image is from Google Maps.

Figure 2. Aerial image of the Kuhns pad and nearby vicinity. The red square marks the location of the air sample taken. The blue line shows the pathway for the walking survey for CH_4. The blue square labeled "bkg" at the upper right in the figure marks the location of the background air sample. The aerial image is from Google Maps.

Figure 3. Aerial image of the DeArmitt pad. The red square marks the location of the air sample taken. The blue line shows the pathway for the walking survey for CH_4. The aerial image is from Google Maps.

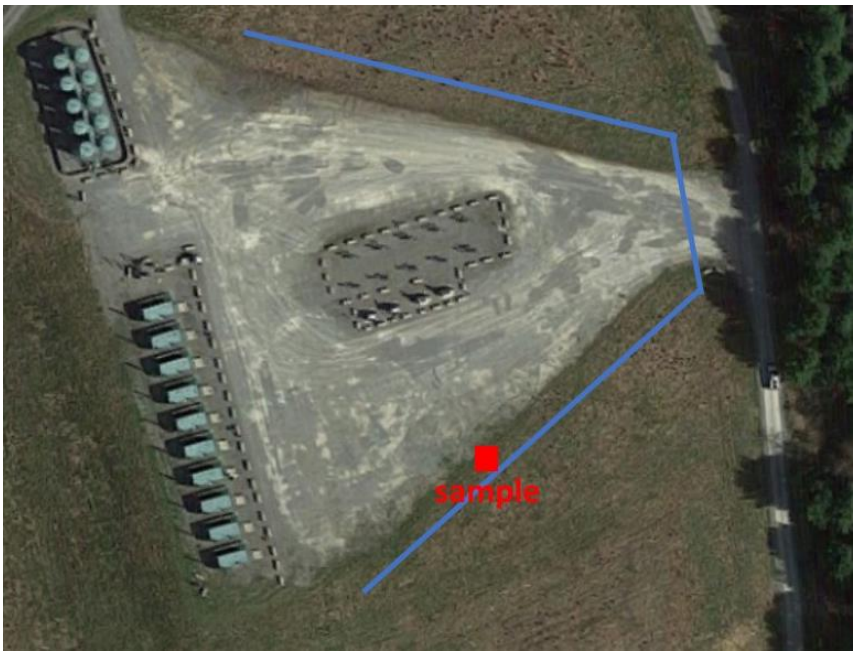

Figure 4. Aerial image of the Hutchinson pad. The red square marks the location of the air sample taken. The blue line shows the pathway for the walking survey for CH_4. The aerial image is from Google Maps.

Figure 5. Aerial image of the Mamont pad. The red square marks the location of the air sample taken. The blue line shows the pathway for the walking survey for CH_4. The aerial image is from Google Maps.

In figure 2, the location of the air sample taken at the Kuhns pad is marked with a red square (■). The location of the background sample (in the upper right of that figure) is marked with a blue square (■) and the notation "bkg". The walked pathway for the handheld monitor (Aeroqual) survey for CH_4 is shown as a blue line.

In figure 3, the location of the air sample taken at the DeArmitt pad is marked with a red square (■). The walked pathway for the handheld monitor survey for CH_4 is shown as a blue line. In figure 4, the location of the air sample taken at the Hutchinson pad is marked with a red square (■). The walked pathway for the handheld monitor survey for CH_4 is shown as a blue line. In figure 5, the location of the air sample taken at the Hutchinson pad is marked with a red square (■). The walked pathway for the handheld monitor survey for CH_4 is shown as a blue line.

The results of the field measurements are summarized in table and graphical forms and discussed in the next section.

IV. Results

A. Results of Methane content from air samples at Kuhns, DeArmitt, Hutchinson and Mamont-1 pads and background sampling

i. Air Sample Results

Table 1 below summarizes the results of the methane concentration measurements at the KDHM pads and the background sampling near the Kuhns pad. The sample locations at each pad are shown as the red squares in Figures 2 through 5. Each bag sample was analysed using Fourier-Transform Infrared Spectroscopy for methane presence. When the results are indistinguishable from the atmospheric background (which is approximately 1.8 ppmv), the results are shown as 1.5 ± 1.5 ppmv.

The methane content of all samples was determined to be indistinguishable from background.

Table 1. Summary of results of methane content analysis from air samples at the Kuhns, DeArmitt, Hutchinson and Mamont pads, including the background measurement taken near the Kuhns pad.

Date	sample	Methane concentration (ppmv)
11/10/2018	Kuhns-1	1.5 ± 1.5
11/10/2018	Dearmitt-1	1.5 ± 1.5
11/10/2018	Hutchinson-1	1.5 ± 1.5
11/10/2018	Mamont-1	1.5 ± 1.5
11/10/2018	bkg	1.5 ± 1.5

ii. Example walking survey results

The results for the walking survey for Methane at the Mamont pad is shown in Figure 6. The pathway walked at the Mamont pad is shown in Figure 5. The Aeroqual detector has a minimum detectable level of 10 ppm, which is approximately 5x background. As shown in the figure, the sensor reading was about 5ppm throughout the entire walked path.

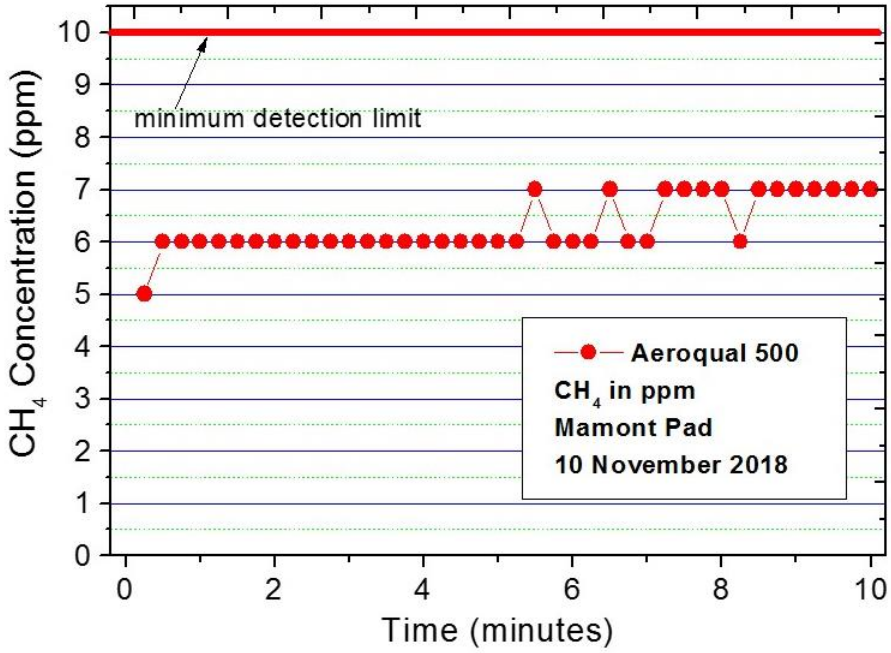

Figure 6. Aeroqual hand-held monitor readings for the walking survey about the Mamont pad on 10 November 2018. The readings show no detected methane concentration above the minimum detectable level of the sensor of 10 ppmv.

Very similar results, meaning readings between 5 and 7 ppm CH_4, all reading being below the minimum detectable level of the Aeroqual detector, were obtained for the walked paths at the Kuhns, DeArmitt and Hutchinson pads.

B. Results of Air Quality Measurements at the Mamont compressor

i. CO logger data results

Three data loggers were at the Mamont compressor site between 1 November and 13 January 2018. Data download from these CO loggers failed. Subsequent trials to get the loggers to function with new batteries or resetting programming parameters also failed. All computer communication with the loggers failed. A tentative explanation for the failure is a combination of rain, moisture and freezing temperature cycling during the time that these loggers were in the field. Several remediation actions to reduce the possibility of similar failures in the future are discussed in section VI.

ii. Aeroqual handheld data

The Aeroqual handheld is a multi-sensor platform. By switching sensor heads, gaseous concentrations of CO, SO_2, NO_2, CH_4, NH_3 and CH_20 at 0.005 to 1.0 ppm sensitivities are recorded. The handheld sensor has the additional advantage of real-time and mobile measurements. It is useful for gauging the concentration of the other compressor gases in proportion to the CO concentration. Ten-minute surveys for each of the compressor gases were taken on 11 November 2018. The compressor was not in operation at the time of the surveys and no concentration above the minimum detectable levels of the instrument(s) were observed. The results are summarized in Table 2 below.

Table 2. Summary of results of compressor gas surveys at the Mamont compressor taken on 11 November using the Aeroqual handheld detector and different sensor heads.

Gas	Measured concentration (ppm)	minimum detectable level (ppm)
CO	0.00	0.05
SO_2	0.00	0.04
NO_2	0.000	0.005
CH_4	5	10
NH_3	0.0	0.2
CH_2O	0.00	0.01

V. Summary of Results

The methane content measurements summarized in table 1 indicate methane levels that vary from 0.0 to 3.0 ppmv at the KDHM pads. These levels are totally consistent with the background atmospheric methane level of approximately 1.8-1.9 ppmv. The estimated uncertainty of the concentrations of ±1.5 ppmv in table 1 are due to normal fluctuations in background and the accuracy of the FTIR method used.

The Aeroqual handheld sensor data shown in Figure 6 also indicates no methane was detected above the minimum detectable concentration for that sensor along the walked pathway show in Figure 5.

The compressor gas concentration results summarized in Table 2 indicate that no compressor gases were detected. The compressor was not operating in a compression-exhaust cycle at the time of the measurements.

VI. Contract Status and Notes

The Lascar Electronics CO data logger results reported here were downloaded on 13 January and the failed data download was attempted that day.

The CO data logger failure is tentatively presumed to be due to a combination of moisture, rain and temperature experienced by these loggers during their time in the field. The reason for this initial explanation is that when the loggers were opened to download the data, there was a significant amount of water found in all three loggers. To remediate against the possibility that this will happen again, three steps are undertaken effective for the third quarter of the contract.

First, the loggers will be sealed with internal O-rings. O-rings are available on other data loggers shipped by Lascar Electronics, but they were not shipped with the CO loggers. Secondly, the loggers will be placed on vertical posts underneath plastic domes at the top of the posts that will shield the loggers from direct exposure to the elements, but still allow unimpeded access to the atmosphere directly in front of the sensitive sensor element. Finally, an additional temperature-relative humidity (T-RH) sensor will also be placed at the P7 site at the Mamont compressor station. If there are future failures, then the temperature and moisture history prior to the failure should be recorded by the T-RH sensor.

The T-RH sensors have a more robust operating range than the CO data loggers between -35°C and +80°C (-31°F to 176°F) and 0% to 100% relative humidity. Additionally, these loggers are always shipped with internal O-rings to protect the internal electronics from moisture.

It should be noted that the Google maps pictures of the compressor and fracking pad areas are now somewhat dated. The aerial images appear to have been taken in the very early spring, and therefore never were a good representation of the vegetation about the compressor and pads in the spring and summer months. Also since the beginning of the air quality service contracts, there has been additional construction around the Aikens, Shaw, and Mamont South fracking pads, as well as the Mamont compressor station. In particular, the Mamont South fracking pad is considerably larger toward the south and east of the aerial images shown in Figure 5.