WYOMING OILFIELD WASTE DISPOSAL POND EMISSION STUDY

FINAL REPORT



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1.0 EXECUTIVE SUMMARY

The Wyoming Department of Environmental Quality (WDEQ)–Air Quality Division (AQD) has sought to more accurately characterize volatile organic compound (VOC) emissions to air from open waste disposal ponds or pits associated with oil and natural gas production, to better understand areas where these emissions could be reduced, and to fulfill tasks in their overall state ozone strategy. VOCs serve as key pre-cursors to ozone formation in air and, prior to the current study, their emissions of OWD ponds had not been thoroughly characterized. Beginning in 2015, WDEQ-AQD has led a series of field investigations at a variety of oilfield waste disposal (OWD) ponds across Wyoming and related computer modeling exercises. These efforts have supported the development and ongoing refinement of a spreadsheet-based calculation tool to estimate VOC emissions from OWD ponds, based on water concentrations and site-specific meteorological information.

This report summarizes the procedures and results of a fourth field investigation, conducted April 3-5, 2017, at the Anticline Disposal LLC facility, located in Sublette County, Wyoming, in the Upper Green River Basin (UGRB) and subsequent refinements to the predictive spreadsheet tool. The UGRB is an area of primary concern to the State of Wyoming, as Sublette County and portions of Lincoln and Sweetwater Counties have experienced exceedances of the 8-hour National Ambient Air Quality Standard (NAAQS) for ozone. Summer and winter sampling events were previously conducted at the Anticline Disposal LLC facility earlier in this study. The results described in this report provide additional characterization of cold-weather emissions from unfrozen ponds in the UGRB and have supported additional refinement of the predictive spreadsheet tool. Further background on the study, the results of previous field investigations, and details related to initial model development are presented in earlier reports referenced in this report.

Upon conclusion of this study, the tool's accuracy in predicting emissions remains as much as an order of magnitude in under- or over-predicting individual air emission measurements, depending on the specific species of VOC, season, and meteorological characteristics. This is due in part to a high degree of variability or heterogeneity in observed emissions on which the tool is based, which presents a challenge to accurately predicting emissions. Additional study is recommended to further evaluate the field data collected to date and the tool's prediction capability by way of detailed statistical uncertainty analyses with the ultimate goal of improving the tool prediction performance to a point where it can be confidently used for the WDEQ-AQD's New Source Review and Emission Inventory Programs.

2.0 PROJECT OVERVIEW

2.1 Background and Project Description

The WDEQ-AQD has sought improved ways to characterize VOC emissions to air from OWD facilities associated with oil and natural gas production. In 2015, AQD initiated a study of emissions from two OWD facilities in the Upper Green River Basin (UGRB), a region that has experienced exceedances of the 8-hour National Ambient Air Quality Standard (NAAQS) for ozone. Data collected during August 2015 and March 2016 at each of the two UGRB sites were used to develop a spreadsheet-based predictive tool for estimating average annual air emissions, based on source water concentrations, using a modified version of the USEPA regulatory model *Water9*. In August 2016, additional data were collected from two facilities in the eastern and southern parts of the state to expand on the UGRB study and in order to validate and refine the predictive tool.

For the current study, the project team returned to a previously studied facility in the UGRB, Anticline Disposal LLC, to collect a fourth round of data to provide for i) additional characterization of cold-weather emissions from unfrozen ponds in the UGRB, and ii) further validation and refinement of the predictive tool. The times and locations of all sampling events performed to date for this study are summarized below.

Sampling Event	Participating Facilities	Location
1. August 2015 2. March 2016	Anticline Disposal	UGRB – near Boulder
	Calpet/R360	UGRB – near La Barge
3. August 2016	Grasslands Environmental	East WY – near Douglas
	BP America Production	South WY – near Wamsutter
4. April 2017	Anticline Disposal	UGRB – near Boulder

2.2 Project Approach

To achieve overall project objectives, VOC emissions from a diverse selection of OWD ponds have been characterized under summer and winter conditions using multiple air monitoring technologies and a combination of mathematical emission models. The collection of concurrent surface water and meteorological data provides a basis for estimating VOC emissions from the ponds using theoretical and empirically-based mathematical emission models. The predictive tool developed for this project is calibrated to match predicted vs. observed emissions as closely as possible for all chemicals of concern.

This report summarizes the procedures and results of a fourth field investigation, conducted April 3-5, 2017, and subsequent refinements to the predictive tool. Results of earlier project work performed in the UGRB and Southeast Wyoming, including initial development of the predictive tool, are detailed in two previous reports; i) *Upper Green River Basin Disposal Pit*

Emission Study, issued by GSI on 14 September 2016; and ii) *Southeast Wyoming Disposal Pit Emission Study*, issued by GSI on 10 March 2017.

2.3 Site Description

Located near Boulder, the Anticline Disposal, LLC, facility includes four major produced water storage ponds (Ponds A, B, C, and D), a water treatment plant, and a fresh water pond containing treated effluent (see **Figure 1**). Produced water and flow back water are transported by pipeline and trucks to a sump near the entrance of the facility and treated in an oil water separator (OWS) before being discharged into Pond C. In the event of an OWS upset, oil is skimmed from the southeast corner of Pond C. Water is pumped from Pond C to Pond A for biological treatment via aeration. Pond B receives concentrated brine with high solids content from the water treatment plant. Pond D is used for storage to maintain the receiving capacity of Ponds B and C and equalize the throughput of Pond C. Most of the Pond D contents are pumped in from and returned to Pond C, as needed. At the time of the April 2017 sampling, no ponds were frozen at the surface, and daytime temperatures ranged from -7.7 to 5.7 °C (18 to 42 °F).

2.4 Field Program Overview

For the April 2017 sampling event, air emissions measurements and water samples were collected from Ponds A, C, and D along with pond characteristics and other ancillary data on pond operations and background source activity. Data collection at each pond involved concurrent collection of water samples and air emissions monitoring. VOC emissions were measured at discrete locations on each pond's surface using flux chambers and from Ponds C and D using OP-FTIR spectrometry. Supplemental discrete-point air samples were collected at upwind and downwind locations around Ponds C and D. Meteorological conditions during all sampling activities were continuously recorded on the dike between Ponds C and D.

The field program was carried out in accordance with the Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) issued by GSI on 11 August 2016. Final sampling locations were selected in the field based on forecasted and actual weather conditions, as well as physical limitations at the ponds. All sampling locations, including OP-FTIR transects, flux chamber testing locations, and air and water sampling points are shown on **Figure 2**.

2.5 Target Chemical Parameters

In general, the field program aimed to quantify air emissions and water concentrations of volatile organic compounds (VOC), speciated hydrocarbons (C2-C10, in air only), alcohols, and specific carbonyl compounds considered to be key ozone precursors in air. Specific compounds evaluated in air and water are listed in Tables 2 and 3, respectively.

3.0 AIR EMISSIONS MONITORING

3.1 Flux Chamber Method

Flux chamber sampling was conducted by researchers from the Bingham Research Center at Utah State University, located in Vernal, Utah. This procedure yields chemical emission rates occurring directly at the pond surface (water-air interface) before they are diluted and dispersed into the overlying air.

3.1.1 Overview of Approach

Emission measurements at the pond surface were collected using a modified version of the EPA emission isolation dynamic flux chamber. The flux chamber measures chemical emissions based on the difference in concentrations inside and outside the chamber. This differential concentration is multiplied by the flow rate and divided by the surface area covered by the chamber to calculate the emission (or deposition) flux. Emissions were measured for approximately 60 minutes at each test location to allow emission rates to stabilize, and to characterize variability in emissions. Detailed field data collection and analysis procedures for the flux chamber air emissions measurement program are described in Appendix B of the SAP/QAPP, issued 11 August 2016.

3.1.2 Field Measurements

Methane (CH_4) and carbon dioxide (CO_2) concentrations and detailed meteorological data were collected at 20-second intervals during all emissions measurement periods. Meteorological data consisted of solar radiation, wind speed and direction, ambient temperature, pressure, and relative humidity. In addition, air and water temperatures inside and outside the chamber were measured for each 20-second interval.

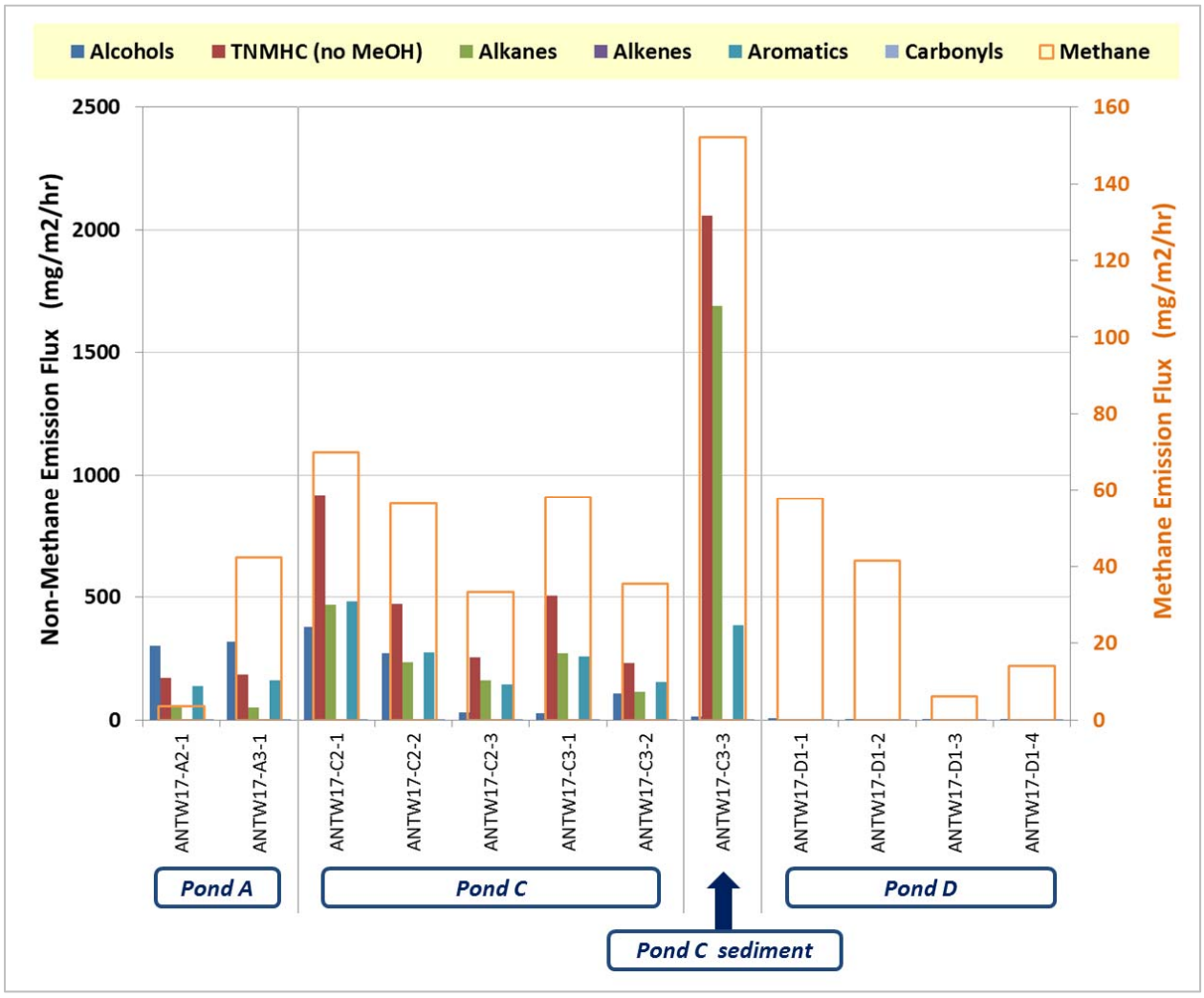
3.1.3 Air Sample Collection and Analysis

At each sampling location, air samples were collected from inside and outside the chamber, and analyzed for VOCs, speciated hydrocarbons, and carbonyl compounds. Chemical analyses of all air samples related to flux chamber measurements were performed in laboratories at Utah State University. Methane was measured in real time using a greenhouse gas analyzer located in the flux chamber equipment trailer. Samples for C2-C10 non-methane hydrocarbons and alcohols were collected in 6 L stainless steel Summa or Silonite-coated canisters and analyzed by EPA Method TO-15 (GC/MS) and PAMS (GC/FID/MS). Samples for carbonyls were collected on DNPH cartridges using sampling pumps and analyzed by EPA method TO-11A.

3.1.4 Air Emissions Estimation Results

The flux chamber emission rate measurements for each sampling location (see **Figure 2**) are presented on **Table 1** and summarized below on **Chart 1**.

Chart 1. Flux Chamber-Measured Emission Rates



3.2 OP-FTIR Spectrometry Method

Open path FTIR sampling was conducted by Kassay Field Services, located in Mohrsville, Pennsylvania. Site specific meteorological data was collected with instrumentation provided by MSI Trinity Consultants of Salt Lake City, Utah.

3.2.1 Overview of Approach

Path-integrated gas concentrations were obtained using a RAM2000™ OP-FTIR spectrometer and retroreflector, oriented to measure air concentrations along the downwind side of each pond. The OP-FTIR operates by shooting a beam of mid-infrared light across a path to a retroreflector. Contaminants present in the beam path absorb energy transmitted by the beam source, and the signal from the returning beam is processed, generating interferograms, and ultimately path-integrated contaminant concentrations. Interferograms collected by the OP-FTIR spectrometer were analyzed by EPA Method TO-16 and interpreted by Kassay Field Services to estimate path-integrated concentrations of target compounds and Total Hydrocarbons, based

on reference absorbance spectra for those analytes. Field data collection and analysis procedures for the OP-FTIR were performed in accordance with Appendix C of the SAP/QAPP, issued 11 August 2016.

Weather conditions were forecasted daily by a WDEQ-AQD meteorologist, and wind conditions were continuously monitored in order to direct the path of the OP-FTIR beam perpendicular to the wind, to the extent practicable. An on-site weather station installed between Ponds C and D was used to collect synchronous meteorological data, including 3D wind speeds (20 Hz data), wind direction, standard deviation of wind direction ("sigma theta"), and ambient temperature, at 5-minute intervals during OP-FTIR sampling at all transect locations.

3.2.2 Air Sample Collection and Analysis

Arrays of multiple discrete-point air samples aligned with each open path transect and at appropriate background locations were collected to facilitate a greater understanding of spatial variations that may affect the calculation of pond-wide emission rates using inverse modeling approaches. Air samples were collected over durations of approximately 15 minutes using 6 L stainless steel Summa canisters and dinitrophenylhydrazine (DNPH) cartridges. Sample locations were distributed both vertically and laterally downwind along each open path transect, as well as at upwind locations. Canisters and cartridges were analyzed by EAS laboratories in San Louis Obispo, California, by EPA method TO-15 for alcohols and aromatics, TO-15 with GC/FID for PAMS hydrocarbons, EPA method TO-11 for carbonyls.

Results of the air samples are summarized on **Table 2.** All air sampling locations are shown on **Figure 2**.

3.2.3 Path-Integrated Air Concentration Results

Charts 2 and **3** below summarize the quantifiable methanol and total hydrocarbons concentrations around Pond C together with wind direction and average wind speed. All open path beam transects are shown on **Figure 2**. No target analytes were detectable with the OP-FTIR during sampling downwind of Pond D. The yellow shaded bands on Charts 2 and 3 represent periods with relatively stable wind conditions and downwind emissions concentrations, which were selected for inverse modeling to calculate emission rates.

Chart 2. OP-FTIR Measured Concentration vs. Time: Pond C, 4 April 2017.

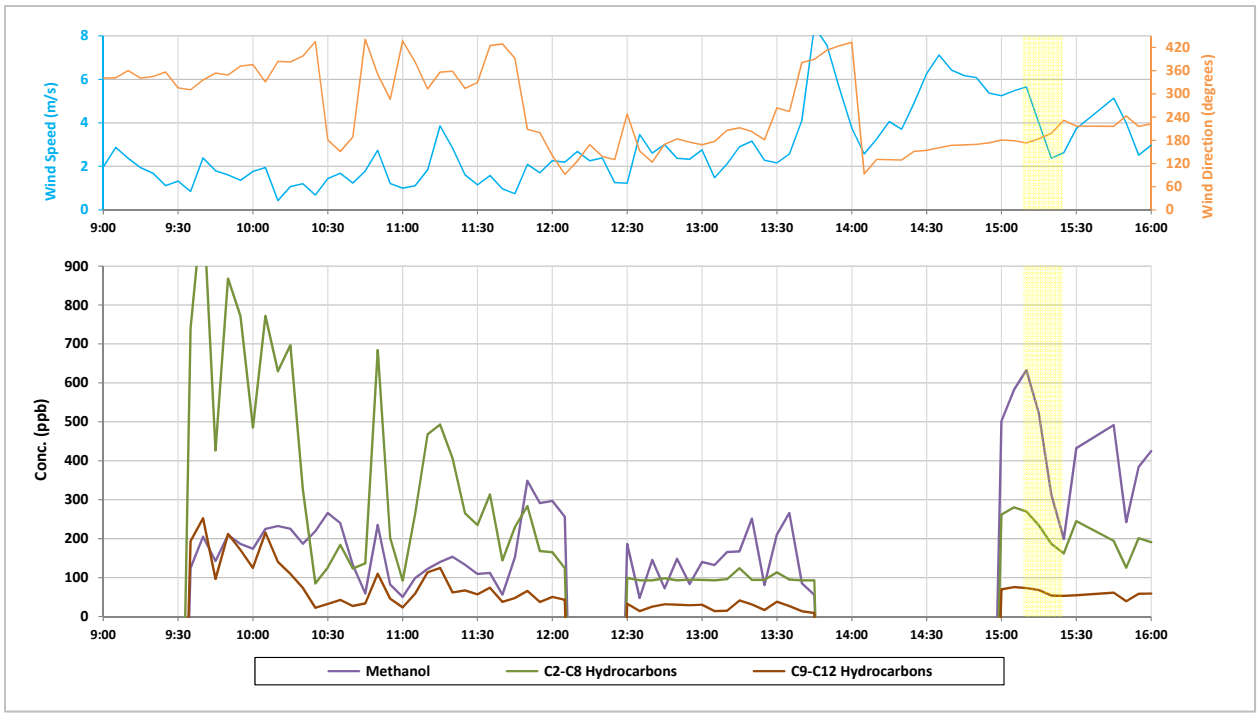
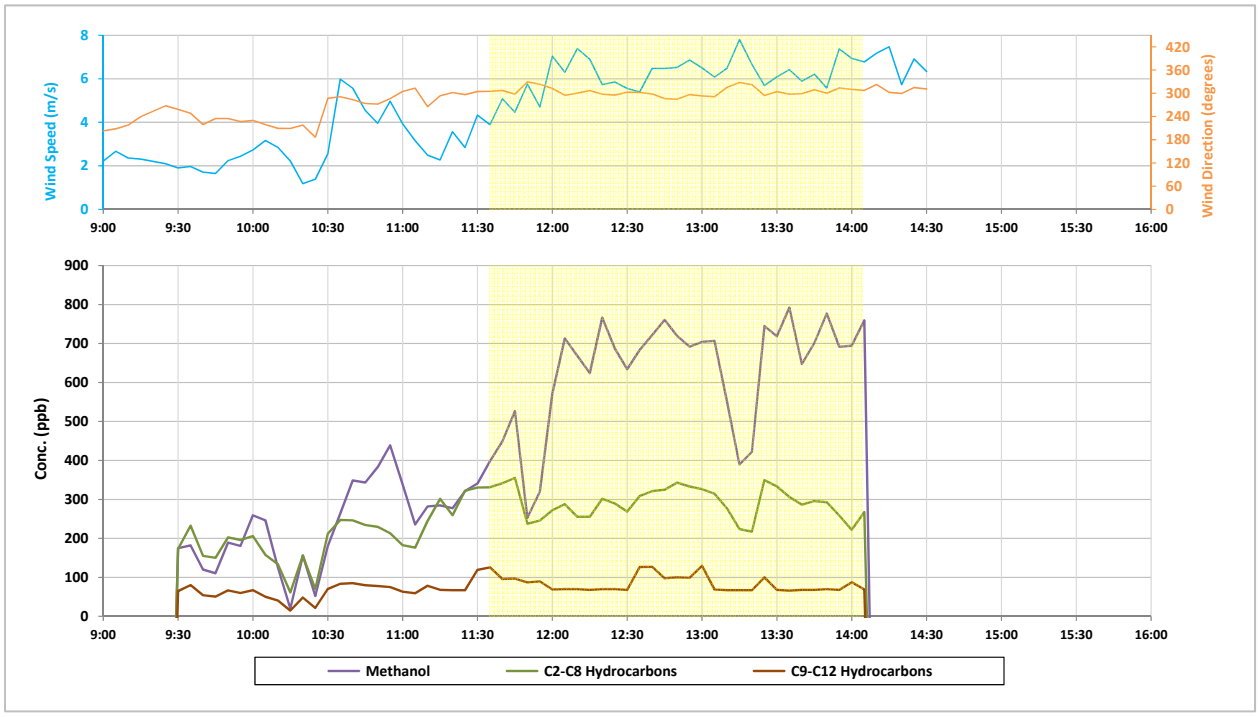


Chart 3. OP-FTIR Measured Concentration vs. Time: Pond C, 5 April 2017.



3.2.4 Inverse Modeling to Estimate Pond-Wide Emission Rates

Dr. Rich Grant, a micrometeorologist and researcher at Purdue University, was contracted to calculate pond emission rates using an inverse dispersion, Backward Lagrangian Stochastic (bLS) model (WindTrax®, Thunder Beach Scientific, Edmonton, Alberta, Canada) (Grant and Boehm, 2015a,b) for 13 discrete 15-minute intervals (highlighted in yellow in Charts 2 and 3). This model was selected over another inverse model (HEGADAS-S) that has been previously used in this study due to advantages it provided, including the ability to produce more results, with equal confidence and equal resources, over a more time intervals, as compared to the previously used model.

The bLS modeling was based on point-specific air canister sampling results for two 15-minute intervals and path-integrated OP-FTIR results for elven 15-minute intervals, including the 2 intervals for which the canister data were modeled independent of the OP-FTIR data. Combined canister emission estimates were individually modeled for all hydrocarbon species based on the measured concentrations of all canisters (upwind and downwind) combined. Here the estimated emissions of each analyte were determined based on a best fit of a set of simultaneous equations relating the measured analyte concentrations in each canister. With the OP-FTIR results, emissions were modeled based on the measured line-integrated concentrations of total hydrocarbons and methanol.

Comparing classified emission categories between the OP-FTIR and the combined canister estimates can provide a means of: (i) correcting the categorical emissions for bulk hydrocarbon ranges measured by the OP-FTIR, which depend on assumed average molecular weights, based on the effective emission-weighted molecular weights from the combined canister analysis, and (ii) approximating emissions of individual hydrocarbon species not measureable by the relatively low sensitivity of the OP-FTIR but measured in the canister samples. It is assumed that the emissions estimates from the line-integrated OP-FTIR are more accurate than those of the point canister samples, based on the higher consistency of the emission results and higher touchdown fractions (an acceptance criterion used to validate bLS modeling) when modeling the OP-FTIR versus the canister data. However, modeling of the canister data provides emissions of individual hydrocarbon species, compared to the OP-FTIR. The combined modeling of two time intervals using both approaches was used to apportion the speciation of total hydrocarbon emissions calculated from the OP-FTIR data based on the relative proportions of speciated emissions in the corresponding canister estimates. Emissions of n-octane, n-heptane, and dodecane were treated as proxies for the C2-C8 and C9-C12+ hydrocarbon ranges emissions, respectively, as these were indicated as the predominant species in the OP-FTIR results.

3.2.5 Air Emissions Estimation Results

The emissions-weighted molecular weight for the proxies in the OP-FTIR C2-C8 category (n-octane at 114.23 g/mol and n-heptane at 100.21 g/mol) was 113.66 for both 4-April and 5-April-2017. The OP-FTIR proxy for C9-C12+ was dodecane (170.34 g/mol). After correction for molecular weights, the classified canister C2-C8 hydrocarbon emissions were approximately equal to the OP-FTIR analyzed emissions on 4-April-2017 and approximately three times less

than the OP-FTIR emissions on 5-April-2017. The C9-C12+ hydrocarbon emissions estimated from the OP-FTIR were about two times greater than estimated from the canisters during both measurement periods. Methanol emissions estimated from the OP-FTIR were greater than estimated from the combined canisters by about three times on 4-April-2017 and by about 6 times on 5-April-2017. These emission differences further support the contention that the pond is not a homogeneous source for emissions, a finding that is confirmed flux chamber sampling results for Pond C (see **Table 1**).

4.0 WATER SAMPLING

A total of 12 water samples plus two duplicate samples were collected from Ponds A, C, and D at the locations shown on **Figure 2**. One of the twelve samples was collected directly from the influent pipeline (via sampling port) that discharges into Pond C as a means to compare initial influent versus residing water concentrations. In general, all other samples were collected at the pond surface at the same time and location as flux chamber measurements. All water sample collection and analysis was conducted in accordance with the procedures described in Appendix D of the SAP/QAPP, issued 11 August 2016.

4.1 Field Measurements

At each water sample location, key water quality parameters including temperature, dissolved oxygen, total dissolved solids (TDS), and specific conductance were measured. Due to an instrument malfunction, pH could not be measured in the field. Other significant observations such as any color, odor, or the presence of oily liquids on the water surface or within samples were also recorded. Pond D had the lowest water temperature with an average of 6.4 °C (44 °F), while Ponds A and C had average water temperatures of 9.0 °C (49 °F) and 9.8 °C (50 °F), respectively. Specific conductivity was relatively similar between the three ponds, with average values ranging from 17.3 to 17.7 mS/cm. Dissolved oxygen (DO) saturation in Ponds A, C, and D had average values of 80.7%, 3.5%, and 21.1%, respectively. The elevated DO in Pond A is consistent with its function as an active aeration pond. There was no observable presence of oily liquids in any of the three ponds where samples were collected.

4.2 Analytical Results

Analytical results from the water sampling program are presented in **Table 3**. All water samples were analyzed by Test America, Inc., laboratories in Denver, Colorado, Nashville, Tennessee, and Buffalo, New York according to standard USEPA methods: 8260B (for BTEX), RSK 175 (for dissolved gases), 8015B (for alcohols and GRO), 8315A (for formaldehyde and acetaldehyde).

With the exception of ethene, analytical results of the water sampling program showed detections for all constituents. In general, Pond C exhibited the highest concentrations for most constituents, with the exception of methane. Pond C and D exhibited comparable formaldehyde concentrations, whereas Pond D generally exhibited non-detect or low level concentrations for all other constituents. This observation could be attributed to reduced use of Pond D during the winter season and dilution from recent ice and snow melt, per anecdotal information from facility personnel. As expected, the highest water concentrations for nearly all constituents were

observed in the influent to Pond C, at which the water has had minimal exposure to the atmosphere for volatilization and other processes (e.g. degradation, chemical transformation) occurring within the ponds.

Chart 4 below compares the measured concentrations for each target analyte in each pond, These results include approximated values (flagged with a "J" on Table 3), which are measured in the laboratory above a constituent's method detection limit but below its required reporting limit.

Chart 4. April 2017 Measured Water Concentrations, Anticline Disposal facility

4.3 QA/QC Procedures and Outcomes

Two field duplicates were collected in accordance with the QA/QC requirements specified in the SAP/QAPP. Relative Percent Difference (RPD), a QA/QC measure of precision (or repeatability) calculated by determining the difference in results between analytical runs of a parent sample and its duplicate, were calculated for each duplicate pair. RPDs for all constituents detected above reporting limits were below 30%, the acceptable range for duplicate sample pairs. In addition, no VOC were detected in trip blanks shipped with each water sample shipment.

5.0 WATER PREDICTIVE TOOL UPDATE

5.1 Overview

A modified model based on processes simulated in the USEPA regulatory model *Water9* was used as a baseline platform to develop a spreadsheet-based predictive tool for estimating and correlating air emissions to source water concentrations. *Water9* estimates air emissions of individual constituents in waste water mixtures based on the properties of the constituent and its concentration in water for various types of hazardous waste treatment, storage, and disposal facilities (USEPA, 1994). The predictive tool developed for this project consists of a user-friendly, project-specific modification of the *Water9* model developed in the Microsoft Excel© spreadsheet environment. It efficiently computes average air emission rates for multiple chemicals in units of mg/m^2/hr, g/s, or U.S. tons/yr using minimal key inputs, including:

- Pond identification and periods of interest.
- Constituents of concern (temperature-dependent chemical coefficients and partition coefficients for each constituent).
- For each period of interest:
  - Pond surface area occupied by water or ice
  - Average wind speed
  - Average daily high and low ambient air temperatures
  - Average water temperature
  - Water concentration of each constituent of concern (mg/L).

The predictive tool was initially calibrated using the results of summer and winter emissions measurement at two commercial OWDs in the Upper Green River Basin and further calibrated and refined with additional summer data collected at two OWDs in eastern and southern Wyoming. Details of these efforts and the technical modeling basis for customized spreadsheet tool are provided in two previous reports: i) *Upper Green River Basin Disposal Pit Emission Study,* issued 14 September 2016; and ii) *Southeast Wyoming Disposal Pit Emissions Study*, issued 10 March 2017.

5.2 Additional Calibration and Refinement

The predictive spreadsheet tool has been further calibrated to include the results of the April 2017 sampling program in the UGRB. The goal of calibration efforts is to match, as reasonably as possible, pairs of predicted and measured VOC emission rate fluxes for all evaluated pond constituents from all current and previous air and water sampling campaigns.

Charts 5 through 8 illustrate predicted vs. measured VOC emission fluxes. On these charts, a data point on the diagonal represents a perfect match of the modeled vs. measured result. Points above and to the left of the diagonal represent predictions that are greater than corresponding measurements. Points lying below and to the right of the diagonal show model predictions that are less than corresponding measurements.

Chart 5 shows that the previous calibration performed reasonably well in matching predicted vs. measured emission fluxes measured in April 2017 at the Anticline Disposal facility. Clusters of points represented by orange squares indicate results for separate chemical species, which exhibited comparably low variability among both predicted and measured emissions during the ten consecutive 15-minute intervals on April 5 for which OP-FTIR results were modeled using bLS.

Chart 5. Previous Calibration, April 2017 Results Only

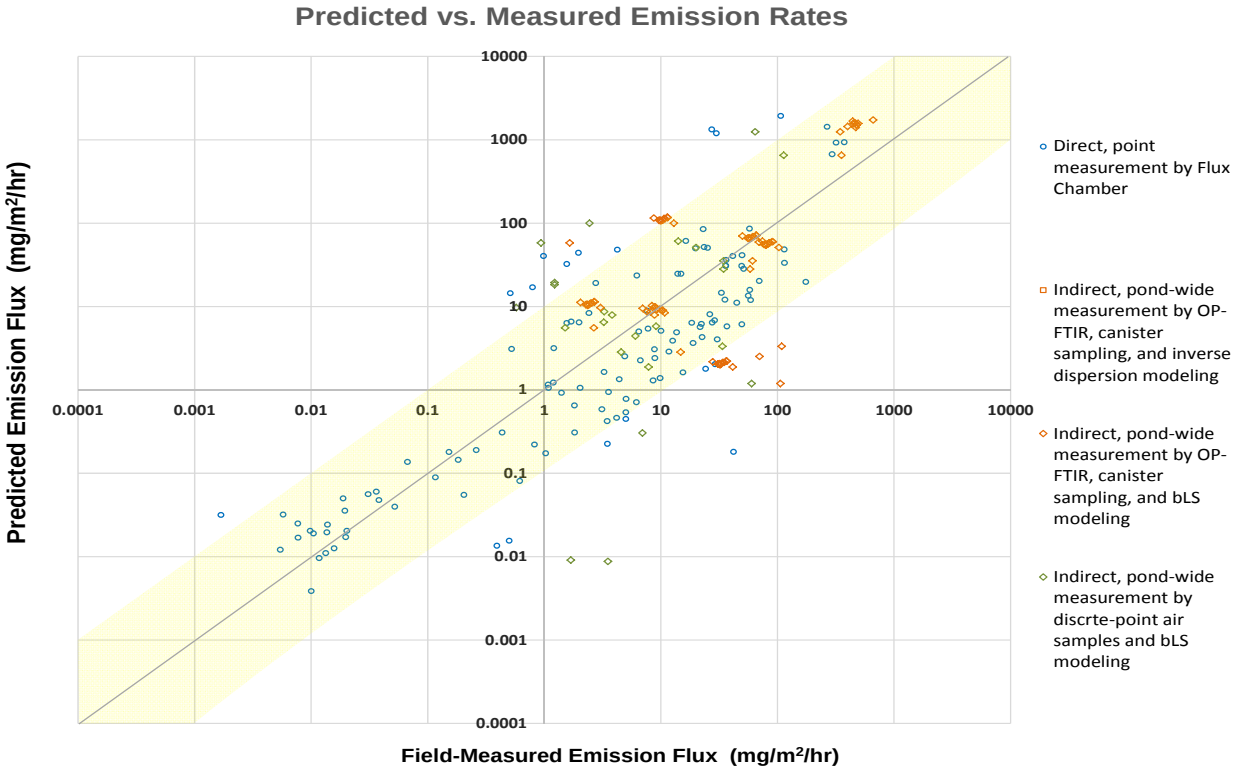
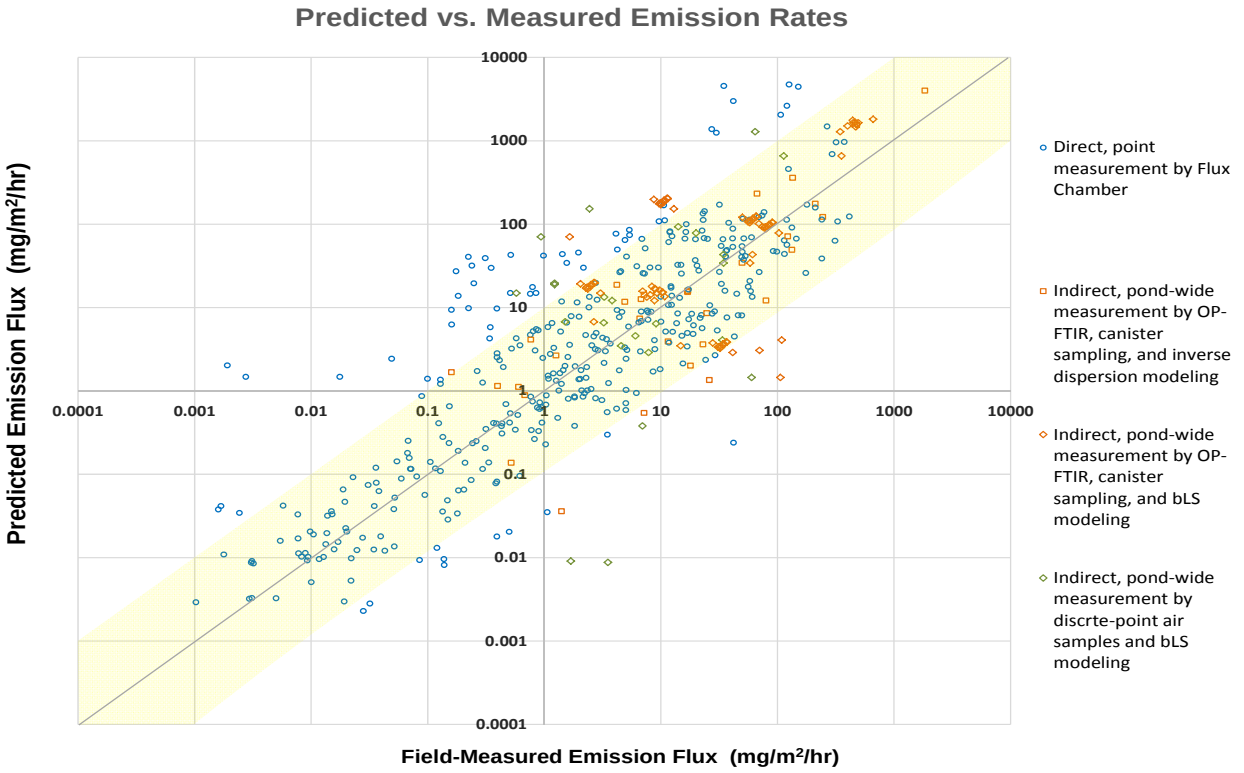


Chart 6. Refined Calibration, Combined Studies

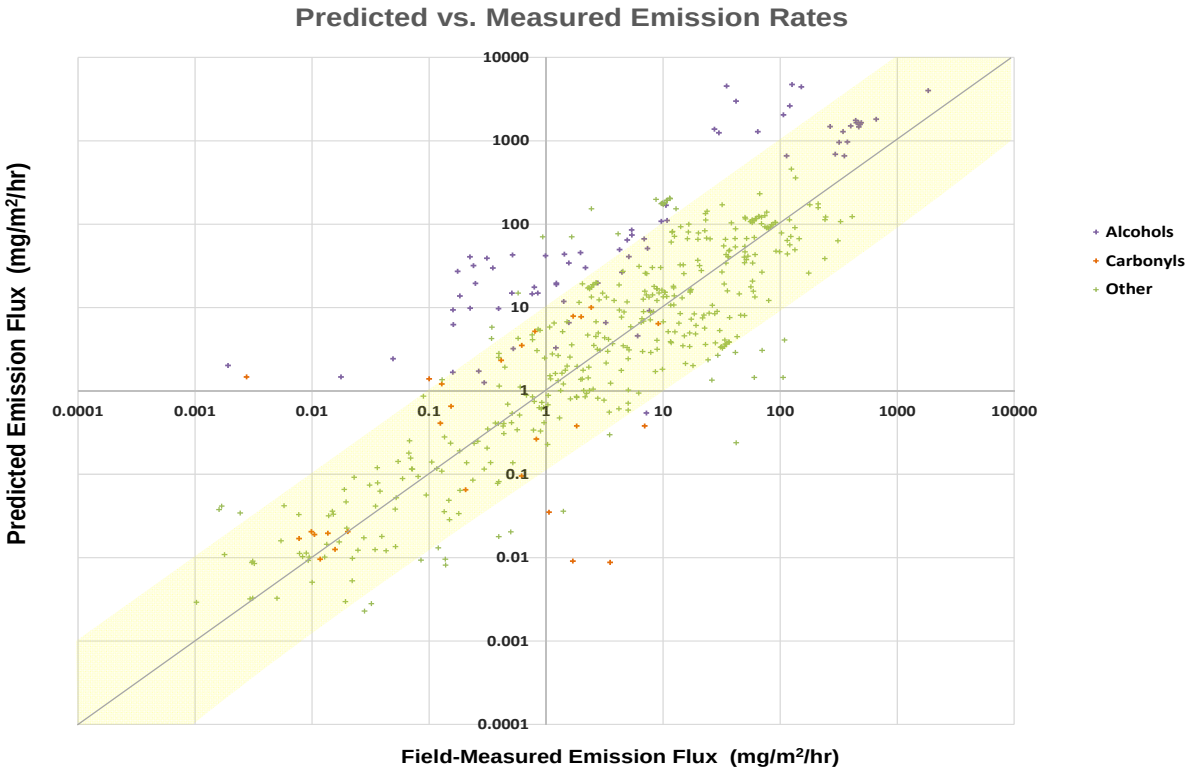


Following validation, the tool was further calibrated to incorporate the results of the April 2017 sampling campaign. Additionally, the present recalibration includes corrected flux chamber results for carbonyls from the previous field studies (August 2015 through August 2016), which were discovered to have originally been reported incorrectly by the laboratory. **Chart 6** presents results of the refined model after minimizing the difference in predicted vs. measured results from the combined studies to date.

5.1 Interpretation and Implications of Results

Chart 7 presents the same results as Chart 6 sorted by chemical class instead of measurement type. As with previous calibrations, the model continues to systematically predict emissions greater than were measured for alcohols. Similarly, but to a lesser extent, the model also generally over or under predicts emissions of other specific hydrocarbon species. Such effects could be addressed by future research by varying the Henry's Law parameters for each chemical within appropriate ranges, based on published values and considering possible dependencies of those values on the water composition in a given pond. The model predictions depend highly on chemical-specific values of the Henry's Law coefficient (i.e., the ratio of a compound's solubility to its vapor pressure in solution with water), as well as this coefficient's dependence on temperature.

Chart 7. Refined Calibration by Chemical Class, Combined Studies



Currently, the model assumes that Henry's Law parameters are the same for every pond and equal to values reported in the scientific literature. However, published Henry's Law values themselves exhibit large variability for the compounds of interest in this study and, in many cases, represent values for compounds present singularly in dilute solution with fresh water (Sander, 2015). Further research—for example, multiple laboratory experiments on waters collected from a variety of Wyoming OWD ponds under range of expected conditions—could yield more representative Henry's Law parameters for each compound of interest and possibly shed light on other currently unknown aspects of their volatilization from the highly complex mixtures of many hydrocarbons, alcohols, carbonyls, and other compounds in saline waters encountered in OWD ponds.

Presently, the tool's accuracy in predicting emissions remains greater than an order of magnitude (factor of 10) in under- or over-predicting individual emissions measurements for some compounds, depending on the specific species of VOC, season, and meteorological characteristics, for compounds that can be analyzed in both air and water samples by standard methods. The table below summarizes the average over or under prediction for each modeled compound for the current calibration, where the reported factor gives the average number of times difference between predicted vs. observed emission rates over all phases of this study. On average, the model is accurate to within a factor of three for carbonyls, BTEX, trimethylbenzenes, and dissolved gases except ethene. Alcohols tend to be over predicted, on average, by 10 to 20 times, and ethene is under predicted by nearly 30 times. The "confidence interval factor" represents the uncertainty in the model's ability to match specific pairs of

observed and predicted emission rates for each chemical and generally corresponds to the degree of scatter among the points for each chemical on plot such as Chart 7. For example, on average the model is expected to over predict emissions of benzene by a factor of 1.4x with a spread of 1.3x; this means that a predicted emission rate of 9.5 mg/m^2/hr of benzene likely corresponds to an average measurable emission rate between (9.5/1.4)/1.3=5.2 and (9.5/1.4)*1.3=8.8 mg/m^2/hr. Similarly, on average ethene is under predicted by a factor of 28x with a spread of 2.5x; therefore, a predicted ethene emission rate of 0.011 mg/m^2/hr corresponds to an expected average measurable emission rate between (0.011*28)/1.6=0.12 and (0.011*28)*1.6=0.77 mg/m^2/hr.

Difference between Predicted and Observed Emissions, Combined Studies

	No. of air-water sample pairs	Average over(+) or under(-) prediction factor	Confidence Interval Factor*
Carbonyls			
Acetaldehyde	18	1.6	1.9
Formaldehyde	13	-1.1	5.0
Alcohols			
Methanol	53	9.7	1.4
Ethanol	41	15	1.6
Isopropanol	32	17	1.6
Dissolved Gases			
Methane	46	-1.3	1.4
Ethane	43	-2.8	1.5
Propane	20	1.1	1.5
Butane, n-	21	-1.6	1.7
Ethene	29	-28	2.5
Other VOCs			
Benzene	52	1.4	1.3
Toluene	55	2.5	1.4
Ethylbenzene	38	-1.9	1.4
Xylene, o-	57	1.5	1.4
Xylenes, m & p-	54	2.0	3.2
1,2,3-Trimethylbenzene	9	-2.1	1.6
1,2,4-Trimethylbenzene	21	-1.7	1.7
1,3,5-Trimethylbenzene	20	-1.4	1.6

**Antilog of 95% confidence interval of logged residuals.*

Based on these findings, additional study is recommended to further evaluate the field data collected to date and the tool's prediction capability by way of detailed statistical uncertainty analyses with the ultimate goal of improving the tool prediction performance to a point where it

can be confidently used for the WDEQ-AQD's New Source Review and Emission Inventory Programs.

6.0 REFERENCES

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TABLES

GSI ENVIRONMENTAL

TABLE 1: POND EMISSION RATE ESTIMATES BY FLUX CHAMBER METHOD

Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:	ANTW17-D1-1	ANTW17-D1-2	ANTW17-D1-3	ANTW17-D1-4	ANTW17-A2-1	ANTW17-C2-1
Map Reference (Fig. 2):	1	4	5	8	30	12
Date and Time	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/4/2017	4/4/2017
Start Time (MST)	8:50:40 AM	10:35:40 AM	12:20:40 PM	2:05:40 PM	9:00:40 AM	11:00:40 AM
End Time (MST)	9:49:20 AM	11:34:20 AM	1:19:20 PM	3:04:20 PM	9:59:20 AM	11:59:20 AM
Duration (min)	59	59	59	59	59	59
Analyte	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$
Methane	5.78E+01	4.15E+01	6.25E+00	1.40E+01	3.50E+00	7.00E+01
Carbon Dioxide	1.06E+02	1.05E+02	2.92E+01	6.90E+01	1.64E+02	1.27E+02
Ethane	3.38E-02	-3.20E-02	-1.78E-02	-1.88E-02	5.01E-01	1.08E+00
Propane	1.50E-02	-3.14E-02	-7.30E-03	-8.14E-03	3.50E-01	9.08E-01
Iso-butane	1.75E-02	-1.56E-02	-6.48E-03	-2.64E-03	3.97E-01	1.99E+00
N-butane	2.02E-02	-1.10E-02	-3.70E-03	-3.59E-03	4.49E-01	2.04E+00
Acetylene	6.73E-03	-9.44E-03	-1.78E-02	5.16E-03	3.19E+00	1.68E-03
Trans-2-Butene	5.36E-03	1.79E-03	0.00E+00	1.84E-03	1.75E-03	1.74E-03
1-Butene	3.57E-03	-1.76E-03	-1.79E-03	3.51E-05	3.53E-03	3.48E-03
Cis-2-butene	-1.80E-03	1.18E-05	1.79E-03	-1.80E-03	1.75E-03	7.03E-03
isopentane	2.51E-02	-9.04E-03	-2.30E-03	1.81E-04	8.59E-01	4.56E+00
n-pentane	1.48E-02	-3.35E-03	-1.15E-03	-1.07E-03	7.66E-01	5.55E+00
trans-2-pentene	4.47E-03	-2.20E-03	-2.23E-03	4.39E-05	2.19E-03	2.18E-03
cis-2-pentene	2.22E-03	-2.20E-03	2.23E-03	-2.25E-03	4.41E-03	6.57E-03
2,2-dimethylbutane	2.74E-03	-2.72E-03	-2.75E-03	2.70E-05	1.29E-01	8.19E-01
cyclopentane/2,3-dimethylbutane	9.94E-03	-1.98E-02	-9.96E-03	4.89E-05	3.34E-01	2.34E+00
2-methylpentane	1.09E-02	-5.40E-03	-5.49E-03	5.39E-05	1.06E+00	7.78E+00
3-methylpentane	1.10E-02	-1.09E-02	1.10E-18	2.88E-03	7.20E-01	5.70E+00
Isoprene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1-Hexene	2.68E-03	-5.33E-03	2.68E-03	0.00E+00	5.29E-03	2.61E-03
n-Hexane	1.92E-02	-2.64E-03	-8.24E-03	5.65E-03	6.91E-01	1.43E+01
Methylcyclopentane	1.61E-02	-1.06E-02	-5.36E-03	7.90E-05	8.92E-01	8.86E+00
2,4-Dimethylpentane	6.38E-03	-4.75E-03	-3.19E-03	-1.58E-03	2.28E-01	1.27E+00
Benzene	3.10E-02	-2.09E-02	-1.12E-02	-2.11E-02	2.24E+01	3.63E+01
Cyclohexane	2.41E-02	1.06E-04	-2.68E-03	2.91E-03	1.87E+00	2.12E+01
2-Methylhexane	1.27E-02	-9.44E-03	0.00E+00	6.60E-03	1.42E+00	1.11E+01
2,3-Dimethylpentane	6.37E-03	3.15E-05	0.00E+00	3.31E-03	3.42E-01	3.01E+00
3-Methylhexane	1.28E-02	1.16E-04	-3.19E-03	-3.13E-03	1.31E+00	1.05E+01
2,2,4-Trimethylpentane	3.63E-03	1.20E-05	0.00E+00	3.57E-05	2.69E-02	4.20E-01

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TABLE 1: POND EMISSION RATE ESTIMATES BY FLUX CHAMBER METHOD

Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:	ANTW17-D1-1	ANTW17-D1-2	ANTW17-D1-3	ANTW17-D1-4	ANTW17-A2-1	ANTW17-C2-1
Map Reference (Fig. 2):	1	4	5	8	30	12
Date and Time	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/4/2017	4/4/2017
Start Time (MST)	8:50:40 AM	10:35:40 AM	12:20:40 PM	2:05:40 PM	9:00:40 AM	11:00:40 AM
End Time (MST)	9:49:20 AM	11:34:20 AM	1:19:20 PM	3:04:20 PM	9:59:20 AM	11:59:20 AM
Duration (min)	59	59	59	59	59	59
Analyte	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$
n-Heptane	1.75E-02	-1.38E-03	-1.12E-02	-8.05E-03	5.19E-01	2.90E+01
Methylcyclohexane	1.02E-01	6.74E-02	-4.69E-03	2.44E-02	6.88E+00	9.59E+01
2,3,4-Trimethylpentane	0.00E+00	-3.62E-03	0.00E+00	7.15E-05	1.44E-02	3.43E-01
Toluene	1.83E-01	-3.70E-03	-3.96E-02	-4.22E-02	4.49E+01	1.15E+02
2-Methylheptane	1.09E-02	-7.16E-03	-1.09E-02	7.55E-03	1.09E+00	1.34E+01
3-Methylheptane	1.45E-02	-3.54E-03	-3.64E-03	3.81E-03	1.66E+00	1.03E+01
n-Octane	2.17E-02	7.56E-03	-1.45E-02	1.14E-02	9.47E-01	3.50E+01
Ethylbenzene	5.24E-02	-1.49E-02	-1.69E-03	5.45E-03	3.47E+00	1.55E+01
m/p-Xylene	4.36E-01	1.53E-01	1.76E-17	6.74E-02	3.70E+01	1.75E+02
Styrene	3.32E-03	-2.14E-02	0.00E+00	8.53E-03	1.15E-02	-3.30E-03
o-Xylene	1.17E-01	1.89E-02	1.69E-03	1.96E-02	8.59E+00	3.06E+01
n-Nonane	2.86E-02	1.65E-02	-2.86E-02	4.42E-04	1.51E+00	3.84E+01
Isopropylbenzene	5.74E-03	-5.71E-03	-1.91E-03	2.08E-03	2.91E-01	1.59E+00
n-Propbylbenzene	3.83E-03	-3.80E-03	0.00E+00	-3.86E-03	4.61E-01	2.47E+00
m-Ethyltoluene	2.68E-02	5.04E-05	-3.83E-03	1.19E-02	2.99E+00	1.53E+01
p-Ethyltoluene	9.57E-03	1.93E-03	-5.74E-03	2.01E-03	9.71E-01	6.01E+00
1,3,5-Trimethylbenzene	3.64E-02	5.78E-03	-1.91E-03	1.39E-02	5.02E+00	2.43E+01
o-Ethyltoluene	5.74E-03	-5.71E-03	-1.91E-03	9.88E-03	6.73E-01	2.63E+00
1,2,4-Trimethylbenzene	3.83E-02	7.71E-03	0.00E+00	1.98E-02	6.18E+00	2.93E+01
n-Decane	4.08E-02	1.37E-02	-1.36E-02	5.34E-04	1.97E+00	3.66E+01
1,2,3-Trimethylbenzene	1.34E-02	-5.67E-03	-5.74E-03	1.01E-02	1.03E+00	5.04E+00
m-Diethylbenzene	3.84E-02	8.78E-03	-1.71E-02	1.41E-02	7.67E-01	7.06E+00
p-Diethylbenzene	5.55E-02	4.54E-03	-1.71E-02	2.28E-02	1.90E+00	1.75E+01
n-Undecane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E+00	7.07E+01
Methanol	7.66E+00	1.57E+00	5.25E-01	1.21E+00	2.96E+02	3.76E+02
Ethanol	2.61E-01	3.09E-02	8.81E-03	2.74E-02	4.25E+00	9.89E-01
formaldehyde	0.00E+00	0.00E+00	1.05E-02	1.37E-02	1.17E-02	7.75E-03
acetaldehyde	0.00E+00	0.00E+00	1.46E-02	1.36E-02	2.06E-01	2.43E+00

TABLE 1: POND EMISSION RATE ESTIMATES BY FLUX CHAMBER METHOD

Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:	ANTW17-C2-2	ANTW17-C2-3	ANTW17-A3-1	ANTW17-C3-1	ANTW17-C3-2	ANTW17-C3-3
Map Reference (Fig. 2):	15	17	29	24	22	19
Date and Time	4/4/2017	4/4/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Start Time (MST)	1:05:40 PM	2:55:40 PM	8:40:40 AM	10:00:40 AM	11:30:40 AM	1:30:40 PM
End Time (MST)	2:04:20 PM	3:54:20 PM	9:39:20 AM	10:59:20 AM	12:29:20 PM	2:29:20 PM
Duration (min)	59	59	59	59	59	59
Analyte	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$
Methane	5.64E+01	3.33E+01	4.22E+01	5.82E+01	3.56E+01	1.52E+02
Carbon Dioxide	1.27E+02	2.52E+02	2.63E+02	2.82E+02	1.98E+02	9.55E+02
Ethane	1.09E+00	2.04E+00	3.94E-01	3.27E+00	1.41E+00	4.44E-01
Propane	8.61E-01	1.25E+00	3.76E-01	2.00E+00	8.42E-01	6.54E+00
Iso-butane	1.46E+00	1.56E+00	3.58E-01	1.57E+00	1.38E+00	1.76E+01
N-butane	1.47E+00	1.51E+00	3.47E-01	2.35E+00	1.19E+00	2.98E+01
Acetylene	-8.84E-03	-2.02E-02	8.28E-01	2.86E-02	8.29E-03	0.00E+00
Trans-2-Butene	5.21E-03	0.00E+00	-3.62E-03	1.69E-03	-3.57E-03	0.00E+00
1-Butene	5.21E-03	-5.88E-05	-1.81E-03	3.50E-03	-5.88E-05	8.50E-02
Cis-2-butene	0.00E+00	1.73E-03	0.00E+00	0.00E+00	-3.57E-03	0.00E+00
isopentane	2.98E+00	2.13E+00	4.85E-01	3.60E+00	1.75E+00	5.05E+01
n-pentane	3.50E+00	2.41E+00	6.17E-01	4.65E+00	1.91E+00	5.73E+01
trans-2-pentene	0.00E+00	2.16E-03	-4.53E-03	6.49E-03	-7.35E-05	1.09E-01
cis-2-pentene	-2.22E-03	2.16E-03	-2.26E-03	-2.26E-03	-7.35E-05	0.00E+00
2,2-dimethylbutane	4.67E-01	2.74E-01	5.03E-02	5.17E-01	2.36E-01	7.82E+00
cyclopentane/2,3-dimethylbutane	1.58E+00	1.27E+00	-6.56E-02	2.19E+00	9.90E-01	1.45E+01
2-methylpentane	4.26E+00	2.37E+00	8.23E-01	5.41E+00	1.90E+00	6.40E+01
3-methylpentane	3.14E+00	1.75E+00	7.31E-01	3.62E+00	1.43E+00	4.05E+01
Isoprene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1-Hexene	1.05E-02	5.27E-03	1.31E-01	5.25E-03	5.27E-03	-2.70E-03
n-Hexane	7.61E+00	4.21E+00	3.07E-01	9.10E+00	3.43E+00	9.47E+01
Methylcyclopentane	5.58E+00	3.68E+00	1.02E+00	7.65E+00	2.53E+00	5.34E+01
2,4-Dimethylpentane	6.07E-01	3.20E-01	2.09E-01	7.76E-01	2.53E-01	1.03E+01
Benzene	3.64E+01	4.95E+01	2.90E+01	2.35E+01	3.60E+01	1.50E+01
Cyclohexane	1.14E+01	7.34E+00	2.01E+00	1.54E+01	5.18E+00	9.22E+01
2-Methylhexane	4.34E+00	2.34E+00	1.62E+00	5.12E+00	1.72E+00	6.15E+01
2,3-Dimethylpentane	1.19E+00	6.22E-01	6.52E-01	1.54E+00	4.57E-01	1.66E+01
3-Methylhexane	4.14E+00	2.23E+00	1.54E+00	5.17E+00	1.66E+00	5.72E+01
2,2,4-Trimethylpentane	1.44E-01	8.04E-02	-1.29E-02	1.97E-01	5.50E-02	1.93E+00

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TABLE 1: POND EMISSION RATE ESTIMATES BY FLUX CHAMBER METHOD

Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:	ANTW17-C2-2	ANTW17-C2-3	ANTW17-A3-1	ANTW17-C3-1	ANTW17-C3-2	ANTW17-C3-3
Map Reference (Fig. 2):	15	17	29	24	22	19
Date and Time	4/4/2017	4/4/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Start Time (MST)	1:05:40 PM	2:55:40 PM	8:40:40 AM	10:00:40 AM	11:30:40 AM	1:30:40 PM
End Time (MST)	2:04:20 PM	3:54:20 PM	9:39:20 AM	10:59:20 AM	12:29:20 PM	2:29:20 PM
Duration (min)	59	59	59	59	59	59
Analyte	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$	$mg/m^2/h$
n-Heptane	1.10E+01	6.10E+00	-9.21E-02	1.46E+01	4.51E+00	1.38E+02
Methylcyclohexane	5.11E+01	2.24E+01	7.79E+00	1.85E+01	1.65E+01	3.97E+02
2,3,4-Trimethylpentane	2.47E-02	1.42E-02	-7.37E-03	3.91E-02	-2.39E-04	6.78E-01
Toluene	1.64E+01	1.99E+01	5.92E+01	2.31E+01	2.52E+01	7.03E+01
2-Methylheptane	5.66E+00	3.12E+00	4.68E-01	5.67E+00	2.11E+00	5.56E+01
3-Methylheptane	4.30E+00	2.27E+00	1.30E+00	4.02E+00	1.57E+00	4.00E+01
n-Octane	1.52E+01	8.13E+00	1.54E-01	1.54E+01	5.69E+00	1.26E+02
Ethylbenzene	8.85E+00	6.68E+00	4.19E+00	1.26E+01	4.92E+00	9.02E+00
m/p-Xylene	1.16E+02	1.49E+01	4.97E+01	5.00E+01	5.14E+01	1.78E+02
Styrene	-3.30E-03	-1.33E-02	-3.36E-03	6.50E-03	-6.63E-03	-1.67E-03
o-Xylene	1.85E+01	1.37E+01	9.89E+00	2.64E+01	1.01E+01	2.49E+01
n-Nonane	1.67E+01	8.91E+00	-4.93E-02	2.61E+01	5.91E+00	1.09E+02
Isopropylbenzene	1.03E+00	5.47E-01	-4.46E-02	1.16E+00	3.74E-01	1.84E+00
n-Propbylbenzene	1.76E+00	8.58E-01	-5.82E-02	2.13E+00	6.46E-01	2.04E+00
m-Ethyltoluene	1.18E+01	5.83E+00	2.26E+00	1.38E+01	4.39E+00	1.44E+01
p-Ethyltoluene	4.27E+00	2.24E+00	4.89E-01	2.81E+01	1.57E+00	5.63E+00
1,3,5-Trimethylbenzene	1.89E+01	8.90E+00	3.13E+00	2.18E+01	6.48E+00	2.11E+01
o-Ethyltoluene	2.23E+00	1.14E+00	-7.56E-02	2.74E+00	7.91E-01	2.57E+00
1,2,4-Trimethylbenzene	2.27E+01	1.18E+01	5.06E+00	2.77E+01	7.79E+00	2.07E+01
n-Decane	1.56E+01	9.79E+00	-8.39E-03	3.52E+01	5.83E+00	5.99E+01
1,2,3-Trimethylbenzene	3.57E+00	1.82E+00	2.61E-01	4.40E+00	1.20E+00	3.90E+00
m-Diethylbenzene	3.84E+00	1.52E+00	-6.50E-02	6.52E+00	1.37E+00	1.73E+00
p-Diethylbenzene	9.29E+00	4.11E+00	-2.88E-01	1.39E+01	2.90E+00	1.31E+01
n-Undecane	2.15E+01	1.25E+01	0.00E+00	5.48E+01	7.61E+00	7.13E+01
Methanol	2.67E+02	3.00E+01	3.20E+02	2.75E+01	1.07E+02	1.43E+01
Ethanol	2.77E+00	1.97E+00	5.12E-01	7.95E-01	1.57E+00	-2.23E-01
formaldehyde	1.58E-02	9.86E-03	0.00E+00	-1.09E-02	2.03E-02	3.65E-02
acetaldehyde	1.71E+00	2.00E+00	6.19E-01	8.26E-01	1.83E+00	-8.45E-02

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TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	04032017 0940/1A	04032017 0940/1B	04032017 0940/2A	04032017 0940/2B	04032017 0940/3	04032017 0940/4	04032017 0940/5	04032017 1305/1A
	Location:	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D
	Map Reference (Fig. 2):	6	6	7	7	9	2	3	6
	Sample Date:	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-11A	Acetaldehyde	4.07 J	3.36 J	4.47	3.06 J	3.27 J	4.6	4.33 J	3.73 J
TO-11A	Formaldehyde	1.78 J	1.55 J	2.04 J	2.43 J	1.67 J	1.53 J	1.69 J	1.72 J
TO-15	Acetylene	<0.64	<0.7	<0.74	<0.8	<0.73	<0.82	<0.76	1.81 J
TO-15	Benzene	0.82 J	0.8 J	0.85 J	1 J	1.06 J	1.01 J	0.98 J	5.32
TO-15	Butane, i-	<0.32	1.3	<0.37	<0.4	<0.36	0.92 J	1.76	<0.32
TO-15	Butane, n-	0.49 J	3.09	0.7 J	0.52 J	0.53 J	0.53 J	1.01 J	0.65 J
TO-15	Butene, 1-	<0.32	<0.35	<0.37	<0.4	<0.36	<0.41	<0.38	<0.32
TO-15	Butene, cis-2-	<0.32	<0.35	<0.37	<0.4	<0.36	<0.41	<0.38	<0.32
TO-15	Butene, trans-2-	<0.32	<0.35	<0.37	<0.4	<0.36	<0.41	<0.38	<0.32
TO-15	Butylbenzene, i-	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	<0.85
TO-15	Butylbenzene, tert-	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	<0.85
TO-15	Cyclohexane	<0.21	<0.23	<0.25	<0.27	<0.24	<0.27	<0.25	<0.21
TO-15	Cyclopentane	<0.26	<0.28	<0.29	<0.32	<0.29	<0.33	<0.3	<0.25
TO-15	Decane, n-	0.29 J	0.32 J	0.24 J	<0.2	<0.18	<0.21	0.48 J	4.4
TO-15	Diethylbenzene, 1,3-	<0.16	0.32 J	<0.19	<0.2	<0.18	<0.21	<0.19	<0.16
TO-15	Diethylbenzene, 1,4-	<0.16	0.43 J	<0.19	<0.2	<0.18	<0.21	<0.19	<0.16
TO-15	Dimethylbutane, 2,2-	<0.21	<0.23	<0.25	<0.27	<0.24	<0.27	<0.25	<0.21
TO-15	Dimethylbutane, 2,3-	<0.21	<0.23	<0.25	<0.27	<0.24	<0.27	<0.25	<0.21
TO-15	Dimethylpentane, 2,3-	<0.18	<0.2	<0.21	<0.23	<0.21	<0.23	<0.22	0.31 J
TO-15	Dimethylpentane, 2,4-	<0.18	<0.2	<0.21	<0.23	<0.21	0.43 J	0.91	0.66
TO-15	Ethane	9.56	10.02	10.9	9.44	10.3	8.48	7.16	8.17

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	04032017 0940/1A	04032017 0940/1B	04032017 0940/2A	04032017 0940/2B	04032017 0940/3	04032017 0940/4	04032017 0940/5	04032017 1305/1A
	Location:	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D
	Map Reference (Fig. 2):	6	6	7	7	9	2	3	6
	Sample Date:	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Ethanol	<1.07	<1.17	<1.23	<1.34	<1.22	<1.37	<1.27	<1.06
TO-15	Ethene	1.32 J	1.3 J	0.81 J	1.35 J	0.99 J	<0.82	0.85 J	4.37
TO-15	Ethylbenzene	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	<0.85
TO-15	Ethyltoluene, 2-	<0.18	<0.2	<0.21	<0.23	<0.21	<0.23	<0.21	1.03
TO-15	Ethyltoluene, 3-	0.49 J	<0.2	<0.21	<0.23	<0.21	<0.23	<0.21	2.06
TO-15	Ethyltoluene, 4-	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	<0.85
TO-15	Heptane, n-	<0.23	<0.25	<0.27	<0.29	<0.26	<0.3	0.6 J	2.87
TO-15	Hexane, n-	0.28 J	0.56 J	<0.25	<0.27	<0.24	0.81 J	4.77	2.11
TO-15	Isoprene	<0.26	<0.28	<0.29	<0.32	<0.29	<0.33	<0.3	<0.25
TO-15	Methanol	<1.07	3.11	3.41	3.37	3.97	3.03	3.24	4.26
TO-15	Methylcyclohexane	<0.23	<0.25	<0.27	<0.29	<0.26	<0.3	<0.28	<0.23
TO-15	Methylcyclopentane	<0.21	<0.23	<0.25	<0.27	<0.24	<0.27	<0.25	<0.21
TO-15	Methylheptane, 2-	<0.2	<0.22	<0.23	<0.25	<0.23	0.47 J	0.46 J	1.61
TO-15	Methylheptane, 3-	<0.2	<0.22	<0.23	<0.25	<0.23	<0.26	<0.24	1.11
TO-15	Methylhexane, 2-	0.3 J	<0.2	0.29 J	<0.23	<0.21	0.3 J	0.38 J	0.55
TO-15	Methylhexane, 3-	0.25 J	0.31 J	0.24 J	<0.23	<0.21	0.46 J	0.65 J	0.66
TO-15	Methylpentane, 2-	0.32 J	0.35 J	<0.25	<0.27	<0.24	0.37 J	0.87	0.69
TO-15	Methylpentane, 3-	0.35 J	0.44 J	<0.25	<0.27	<0.24	2.52	1.2	0.92
TO-15	Nonane, n-	<0.18	<0.2	<0.21	<0.23	<0.21	<0.23	0.26 J	4.69
TO-15	Octane, n-	<0.2	<0.22	<0.23	<0.25	<0.23	0.31 J	0.25 J	3.84
TO-15	Pentane, i-	<0.26	2.36	0.3 J	<0.32	<0.29	3.41	<0.3	0.89

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	04032017 0940/1A	04032017 0940/1B	04032017 0940/2A	04032017 0940/2B	04032017 0940/3	04032017 0940/4	04032017 0940/5	04032017 1305/1A
	Location:	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D
	Map Reference (Fig. 2):	6	6	7	7	9	2	3	6
	Sample Date:	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017
Method	Analyte	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Pentane, n-	<0.26	2.28	<0.29	<0.32	<0.29	0.61 J	4.21	0.77
TO-15	Pentene, 1-	<0.26	<0.28	<0.29	<0.32	<0.29	<0.33	<0.3	<0.25
TO-15	Pentene, cis-2-	<0.26	<0.28	<0.29	<0.32	<0.29	<0.33	<0.3	<0.25
TO-15	Pentene, trans-2-	<0.26	1.17	<0.29	<0.32	<0.29	<0.33	<0.3	<0.25
TO-15	Propane	2.54	4.16	3.2	2.57	2.53	2.73	4.1	7.72
TO-15	Propanol, i-	<1.07	2.55	<1.23	<1.34	<1.22	<1.37	1.49 J	<1.06
TO-15	Propene	<0.43	<0.47	<0.49	<0.53	<0.49	0.91 J	0.74 J	0.54 J
TO-15	Propylbenzene, i-	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	<0.85
TO-15	Propylbenzene, n-	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	<0.85
TO-15	Styrene	<0.2	<0.22	<0.23	<0.25	<0.23	<0.26	<0.24	<0.2
TO-15	TNMHC (no MeOH)	53.77	34.84 J	25.91 J	<16.02	16.28 J	30.63 J	88.09	207.65
TO-15	Toluene	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	1.65	7.93
TO-15	Trimethylbenzene, 1,2,	<0.18	<0.2	<0.21	<0.23	<0.21	<0.23	<0.21	<0.18
TO-15	Trimethylbenzene, 1,2,	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	1.11 J
TO-15	Trimethylbenzene, 1,3,	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	0.89 J
TO-15	Trimethylpentane, 2,2,4	<0.2	<0.22	<0.23	<0.25	<0.23	<0.26	<0.24	0.7
TO-15	Trimethylpentane, 2,3,4	<0.2	<0.22	<0.23	<0.25	<0.23	<0.26	<0.24	0.29 J
TO-15	Undecane, n-	<0.15	<0.17	<0.18	<0.19	<0.18	<0.2	<0.18	4.46
TO-15	Xylene, o-	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	1.03 J
TO-15	Xylenes, Total	<0.85	<0.94	<0.98	<1.07	<0.97	<1.09	<1.02	5.48

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040320171305 /1B	040320171305 /2A	040320171305 /2B	040320171305 /2B DUP	040320171305 /3	040320171305 /4	040320171305 /5	040420170930 /1A
Location:		Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond C
Map Reference (Fig. 2):		6	7	7	7	9	2	3	11
Sample Date:		4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/4/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-11A	Acetaldehyde	3.3 J	4.16 J	2.37 J	4.16 J	3.03 J	3.96 J	2.87 J	6.03
TO-11A	Formaldehyde	3.11 J	2.45 J	2.1 J	2.18 J	1.66 J	1.71 J	1.91 J	1.51 J
TO-15	Acetylene	1.03 J	1.92 J	1.66 J	1.76 J	<0.74	<0.78	<0.85	<0.77
TO-15	Benzene	3.13	2.46	1.99	2.33	1.02 J	0.89 J	0.65 J	2.64
TO-15	Butane, i-	1.57	0.43 J	<0.39	<0.37	<0.37	<0.39	<0.43	<0.38
TO-15	Butane, n-	2.6	1.14 J	0.54 J	0.51 J	<0.37	<0.39	<0.43	1.18
TO-15	Butene, 1-	<0.3	<0.38	<0.39	<0.37	<0.37	<0.39	<0.43	<0.38
TO-15	Butene, cis-2-	<0.3	<0.38	<0.39	<0.37	<0.37	<0.39	<0.43	<0.38
TO-15	Butene, trans-2-	<0.3	<0.38	<0.39	<0.37	<0.37	<0.39	<0.43	<0.38
TO-15	Butylbenzene, i-	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Butylbenzene, tert-	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Cyclohexane	<0.2	<0.26	<0.26	<0.25	<0.25	<0.26	<0.28	<0.26
TO-15	Cyclopentane	0.38 J	0.52 J	<0.31	<0.3	<0.29	<0.31	<0.34	<0.31
TO-15	Decane, n-	0.41 J	2.66	2.41	2.47	2.08	<0.2	<0.22	1.55
TO-15	Diethylbenzene, 1,3-	<0.15	<0.19	<0.2	<0.19	<0.19	<0.2	<0.22	<0.19
TO-15	Diethylbenzene, 1,4-	<0.15	<0.19	<0.2	<0.19	<0.19	<0.2	<0.22	<0.19
TO-15	Dimethylbutane, 2,2-	0.28 J	<0.26	<0.26	<0.25	<0.25	<0.26	<0.28	<0.26
TO-15	Dimethylbutane, 2,3-	<0.2	<0.26	<0.26	<0.25	<0.25	<0.26	<0.28	<0.26
TO-15	Dimethylpentane, 2,3-	0.41 J	0.22 J	<0.22	0.25 J	0.22 J	<0.22	<0.24	<0.22
TO-15	Dimethylpentane, 2,4-	0.19 J	0.39 J	1.46	0.35 J	0.43 J	<0.22	<0.24	0.3 J
TO-15	Ethane	9.95	7.07	6.75	7.02	7.26	4.29	4.9	12.94

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040320171305 /1B	040320171305 /2A	040320171305 /2B	040320171305 /2B DUP	040320171305 /3	040320171305 /4	040320171305 /5	040420170930 /1A
	Location:	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond C
	Map Reference (Fig. 2):	6	7	7	7	9	2	3	11
	Sample Date:	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/4/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Ethanol	<1.01	<1.28	<1.31	<1.25	<1.23	<1.31	<1.42	<1.28
TO-15	Ethene	4.26	3.62	3.34	2.97	0.79 J	<0.78	<0.85	1.04 J
TO-15	Ethylbenzene	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Ethyltoluene, 2-	<0.17	0.72	0.63 J	0.6 J	0.37 J	<0.22	<0.24	<0.22
TO-15	Ethyltoluene, 3-	0.22 J	0.77	0.73	0.99	0.56 J	<0.22	<0.24	<0.22
TO-15	Ethyltoluene, 4-	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Heptane, n-	2.82	2.02	1.86	1.83	1.83	<0.28	<0.31	1.3
TO-15	Hexane, n-	4.49	1.53	1.09	1.11	1.42	<0.26	<0.28	0.95
TO-15	Isoprene	<0.24	<0.31	<0.31	<0.3	<0.29	<0.31	<0.34	<0.31
TO-15	Methanol	6.35	10.08	10.5	9.51	4.68	<1.31	1.92 J	15.85
TO-15	Methylcyclohexane	<0.22	<0.28	<0.28	<0.27	<0.27	<0.28	<0.31	<0.28
TO-15	Methylcyclopentane	<0.2	<0.26	<0.26	<0.25	<0.25	<0.26	<0.28	<0.26
TO-15	Methylheptane, 2-	1.36	0.77	0.95	0.98	1.05	<0.25	<0.27	0.75
TO-15	Methylheptane, 3-	0.91	0.9	0.61 J	0.62 J	0.76	<0.25	<0.27	0.48 J
TO-15	Methylhexane, 2-	0.63	0.27 J	0.48 J	0.74	0.93	<0.22	<0.24	0.46 J
TO-15	Methylhexane, 3-	0.77	0.52 J	0.46 J	0.49 J	0.96	<0.22	<0.24	0.4 J
TO-15	Methylpentane, 2-	0.81	0.39 J	0.39 J	0.37 J	0.88	<0.26	<0.28	0.38 J
TO-15	Methylpentane, 3-	0.79	<0.26	<0.26	<0.25	0.58 J	<0.26	<0.28	<0.26
TO-15	Nonane, n-	1.56	2.89	2.69	2.72	2.23	<0.22	<0.24	1.67
TO-15	Octane, n-	2.69	0.84	0.74 J	0.84	2.95	<0.25	<0.27	1.45
TO-15	Pentane, i-	3.69	0.85 J	0.35 J	<0.3	0.85 J	0.36 J	<0.34	0.44 J

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040320171305 /1B	040320171305 /2A	040320171305 /2B	040320171305 /2B DUP	040320171305 /3	040320171305 /4	040320171305 /5	040420170930 /1A
	Location:	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond D	Pond C
	Map Reference (Fig. 2):	6	7	7	7	9	2	3	11
	Sample Date:	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/4/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Pentane, n-	2.64	0.91 J	0.61 J	0.59 J	0.54 J	0.4 J	<0.34	0.78 J
TO-15	Pentene, 1-	<0.24	<0.31	<0.31	<0.3	<0.29	<0.31	<0.34	<0.31
TO-15	Pentene, cis-2-	<0.24	<0.31	<0.31	<0.3	<0.29	<0.31	<0.34	<0.31
TO-15	Pentene, trans-2-	<0.24	<0.31	<0.31	<0.3	<0.29	<0.31	<0.34	<0.31
TO-15	Propane	6.68	2.08	1.64	1.64	5.6	1.24 J	1.65 J	3.97
TO-15	Propanol, i-	<1.01	<1.28	<1.31	<1.25	<1.23	<1.31	<1.42	<1.28
TO-15	Propene	0.46 J	<0.51	<0.52	<0.5	<0.49	<0.52	<0.57	<0.51
TO-15	Propylbenzene, i-	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Propylbenzene, n-	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Styrene	<0.19	<0.24	<0.25	<0.24	<0.23	<0.25	<0.27	<0.24
TO-15	TNMHC (no MeOH)	110.68	118.22	109.97	105.6	93.71	<15.66	<17.04	90.47
TO-15	Toluene	4.01	2.81	2.47	2.86	0.99 J	<1.04	<1.14	3.53
TO-15	Trimethylbenzene, 1,2,	<0.17	<0.22	<0.22	<0.21	<0.21	<0.22	<0.24	<0.22
TO-15	Trimethylbenzene, 1,2,	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Trimethylbenzene, 1,3,	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Trimethylpentane, 2,2,4	0.74	0.47 J	0.44 J	0.46 J	0.37 J	<0.25	0.81	0.37 J
TO-15	Trimethylpentane, 2,3,4	0.26 J	<0.24	<0.25	<0.24	<0.23	<0.25	<0.27	<0.24
TO-15	Undecane, n-	<0.15	<0.19	<0.19	<0.18	<0.18	<0.19	<0.21	<0.19
TO-15	Xylene, o-	<0.81	<1.02	<1.05	<1	<0.98	<1.04	<1.14	<1.02
TO-15	Xylenes, Total	1.1	2.05	2.03	2.06	1.34	<1.04	<1.14	1.85

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040420170930 /1B	040420170930 /1B DUP	040420170930 /2A	040420170930 /2B	040420170930 /3	040420170930 /4	040420170930 /5	040420171510 /1A
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		11	11	14	14	20	21	26	11
Sample Date:		4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-11A	Acetaldehyde	4.16 J	2.79 J	5.89	6.4	6.36	4.77	5.43	7.36
TO-11A	Formaldehyde	1.65 J	1.7 J	1.73 J	1.74 J	1.75 J	<1.36	1.45 J	3.75 J
TO-15	Acetylene	<0.8	<0.59	<0.81	<0.77	<0.74	<0.8	<0.81	1.52 J
TO-15	Benzene	2.55	2.27	4.22	3.98	5	0.95 J	0.84 J	14.93
TO-15	Butane, i-	<0.4	<0.29	<0.4	<0.38	<0.37	<0.4	<0.41	2.47
TO-15	Butane, n-	1.22	0.8 J	1.28	1.88	1.65	0.75 J	0.76 J	6.34
TO-15	Butene, 1-	<0.4	<0.29	<0.4	<0.38	<0.37	<0.4	<0.41	<0.38
TO-15	Butene, cis-2-	<0.4	<0.29	<0.4	<0.38	<0.37	<0.4	<0.41	<0.38
TO-15	Butene, trans-2-	<0.4	<0.29	<0.4	<0.38	<0.37	<0.4	<0.41	<0.38
TO-15	Butylbenzene, i-	<1.06	<0.78	<1.08	<1.02	<0.98	<1.06	<1.08	<1
TO-15	Butylbenzene, tert-	<1.06	<0.78	<1.08	<1.02	<0.98	<1.06	<1.08	<1
TO-15	Cyclohexane	<0.27	<0.2	<0.27	<0.26	<0.25	<0.27	<0.27	<0.25
TO-15	Cyclopentane	<0.32	<0.23	<0.32	<0.31	<0.3	<0.32	<0.32	0.68 J
TO-15	Decane, n-	1.59	1.84	3.77	<0.19	8.4	<0.2	0.23 J	3.72
TO-15	Diethylbenzene, 1,3-	<0.2	<0.15	<0.2	0.28 J	<0.19	<0.2	<0.21	0.38 J
TO-15	Diethylbenzene, 1,4-	<0.2	<0.15	<0.2	0.35 J	<0.19	<0.2	<0.21	0.41 J
TO-15	Dimethylbutane, 2,2-	<0.27	<0.2	<0.27	<0.26	<0.25	<0.27	<0.27	<0.25
TO-15	Dimethylbutane, 2,3-	<0.27	<0.2	<0.27	<0.26	<0.25	<0.27	<0.27	<0.25
TO-15	Dimethylpentane, 2,3-	<0.23	<0.17	<0.23	0.38 J	<0.21	<0.23	<0.23	0.65
TO-15	Dimethylpentane, 2,4-	0.36 J	0.65	0.65 J	0.88	0.48 J	<0.23	<0.23	2.89
TO-15	Ethane	11.46	8.59	12.24	13.14	13.2	10.12	10.63	88.32

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040420170930 /1B	040420170930 /1B DUP	040420170930 /2A	040420170930 /2B	040420170930 /3	040420170930 /4	040420170930 /5	040420171510 /1A
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		11	11	14	14	20	21	26	11
Sample Date:		4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Ethanol	<1.33	<0.98	<1.35	2.94 J	<1.23	<1.33	<1.35	1.55 J
TO-15	Ethene	1.19 J	0.8 J	1.49 J	<0.77	1.27 J	0.92 J	1.24 J	47.95
TO-15	Ethylbenzene	<1.06	<0.78	<1.08	<1.02	<0.98	<1.06	<1.08	1.09 J
TO-15	Ethyltoluene, 2-	<0.22	<0.16	0.69	<0.22	2.05	<0.22	<0.23	1.81
TO-15	Ethyltoluene, 3-	<0.22	<0.16	0.35 J	<0.22	3.55	<0.22	<0.23	0.74
TO-15	Ethyltoluene, 4-	<1.06	<0.78	<1.08	<1.02	1.02 J	<1.06	<1.08	<1
TO-15	Heptane, n-	1.39	1.73	2.84	3.93	6.48	0.38 J	<0.29	8.79
TO-15	Hexane, n-	1.05	0.76	2.11	3.31	4.26	0.27 J	<0.27	6.67
TO-15	Isoprene	<0.32	<0.23	<0.32	<0.31	<0.3	<0.32	<0.32	<0.3
TO-15	Methanol	12.96	8.78	23.13	26.72	17.15	3.15	2.58 J	62.42
TO-15	Methylcyclohexane	<0.29	<0.21	<0.29	<0.28	<0.27	<0.29	<0.29	<0.27
TO-15	Methylcyclopentane	<0.27	<0.2	<0.27	<0.26	<0.25	<0.27	<0.27	<0.25
TO-15	Methylheptane, 2-	0.74 J	0.86	1.38	1.74	3.15	<0.25	<0.26	4.08
TO-15	Methylheptane, 3-	0.42 J	0.54 J	0.91	1.11	2.05	<0.25	<0.26	2.42
TO-15	Methylhexane, 2-	0.24 J	0.21 J	0.54 J	0.68	1.2	<0.23	<0.23	2.02
TO-15	Methylhexane, 3-	0.36 J	0.34 J	0.55 J	0.74	0.78	<0.23	<0.23	1.88
TO-15	Methylpentane, 2-	0.37 J	0.51 J	0.65 J	0.9	1.14	<0.27	<0.27	3.07
TO-15	Methylpentane, 3-	<0.27	<0.2	0.58 J	1.5	1.15	<0.27	<0.27	1.91
TO-15	Nonane, n-	1.67	1.92	3.7	5.18	8	<0.22	0.26 J	8.88
TO-15	Octane, n-	1.48	2.23	3.14	4.17	6.96	0.37 J	<0.26	8.6
TO-15	Pentane, i-	0.57 J	0.58 J	0.74 J	1.29	1.24	<0.32	<0.32	4.88

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040420170930 /1B	040420170930 /1B DUP	040420170930 /2A	040420170930 /2B	040420170930 /3	040420170930 /4	040420170930 /5	040420171510 /1A
	Location:	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
	Map Reference (Fig. 2):	11	11	14	14	20	21	26	11
	Sample Date:	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Pentane, n-	0.85 J	0.87	1.12	1.49	3.01	<0.32	<0.32	4.62
TO-15	Pentene, 1-	<0.32	<0.23	<0.32	<0.31	<0.3	<0.32	<0.32	<0.3
TO-15	Pentene, cis-2-	<0.32	<0.23	<0.32	<0.31	<0.3	<0.32	<0.32	<0.3
TO-15	Pentene, trans-2-	<0.32	<0.23	<0.32	<0.31	0.3 J	<0.32	<0.32	<0.3
TO-15	Propane	4.59	6.03	4.42	5.9	4.36	3.35	3.22	15.95
TO-15	Propanol, i-	<1.33	<0.98	<1.35	<1.28	<1.23	<1.33	<1.35	<1.26
TO-15	Propene	<0.53	<0.39	<0.54	<0.51	<0.49	<0.53	<0.54	2.57
TO-15	Propylbenzene, i-	<1.06	<0.78	<1.08	<1.02	<0.98	<1.06	<1.08	<1
TO-15	Propylbenzene, n-	<1.06	<0.78	<1.08	<1.02	<0.98	<1.06	<1.08	<1
TO-15	Styrene	<0.25	<0.19	<0.26	<0.24	<0.23	<0.25	<0.26	<0.24
TO-15	TNMHC (no MeOH)	94.13	133.97	177.43	261.28	377.45	<15.9	20.72 J	504.4
TO-15	Toluene	3.78	4.13	6.51	7.33	10.1	1.29 J	<1.08	21.94
TO-15	Trimethylbenzene, 1,2,	<0.22	<0.16	<0.23	<0.22	<0.21	<0.22	<0.23	<0.21
TO-15	Trimethylbenzene, 1,2,	<1.06	<0.78	<1.08	1.19 J	1.92 J	<1.06	<1.08	1.27 J
TO-15	Trimethylbenzene, 1,3,	<1.06	<0.78	<1.08	<1.02	1.62	<1.06	<1.08	1.14 J
TO-15	Trimethylpentane, 2,2,4	0.34 J	0.44 J	0.71 J	0.93	0.72	<0.25	<0.26	0.78
TO-15	Trimethylpentane, 2,3,4	<0.25	<0.19	0.26 J	0.32 J	0.5 J	<0.25	<0.26	0.55 J
TO-15	Undecane, n-	<0.19	<0.14	<0.2	<0.19	<0.18	<0.19	<0.2	<0.18
TO-15	Xylene, o-	<1.06	<0.78	<1.08	<1.02	1.52	<1.06	<1.08	2.09
TO-15	Xylenes, Total	2.1	2.04	4.15	5.1	8.65	<1.06	<1.08	13

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040420171510 /1B	040420171510 /1B DUP	040420171510 /2A	040420171510 /2B	040420171510 /3	040420171510 /4	040420171510 /5	040520170910 /1A
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		11	11	14	14	20	21	26	16
Sample Date:		4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-11A	Acetaldehyde	8.45	7.25	9.11	2.54 J	4.88	4.82	5.03	3.72 J
TO-11A	Formaldehyde	4.72 J	3.92 J	2.86 J	<1.36	3.87 J	5.27 J	4.43 J	1.78 J
TO-15	Acetylene	<0.81	<0.73	<0.79	<0.73	<0.76	2.11 J	<0.8	<0.8
TO-15	Benzene	15.66	16.31	13.1	12.9	3.96	2.64	39.75	9.57
TO-15	Butane, i-	1.99	1.89	1.13 J	0.97 J	1.33	1.05 J	2.15	0.56 J
TO-15	Butane, n-	2.09	5.96	3.4	3.27	3.95	3.07	5.59	2.19
TO-15	Butene, 1-	<0.4	<0.36	<0.4	<0.37	<0.38	<0.4	<0.4	<0.4
TO-15	Butene, cis-2-	<0.4	<0.36	<0.4	<0.37	<0.38	<0.4	<0.4	<0.4
TO-15	Butene, trans-2-	<0.4	<0.36	<0.4	<0.37	<0.38	<0.4	<0.4	<0.4
TO-15	Butylbenzene, i-	<1.08	<0.97	<1.06	<0.98	<1.02	<1.07	<1.07	<1.07
TO-15	Butylbenzene, tert-	<1.08	<0.97	<1.06	<0.98	<1.02	<1.07	<1.07	<1.07
TO-15	Cyclohexane	<0.27	<0.24	<0.26	<0.24	<0.25	<0.27	<0.27	<0.27
TO-15	Cyclopentane	0.57 J	0.5 J	0.47 J	<0.29	<0.3	<0.32	0.69 J	<0.32
TO-15	Decane, n-	1.43	0.75	7.39	8.79	4.56	0.82	4.29	8.72
TO-15	Diethylbenzene, 1,3-	0.57 J	0.68	0.49 J	0.67	<0.19	<0.2	<0.2	<0.2
TO-15	Diethylbenzene, 1,4-	1.05	0.67	0.53 J	1.09	<0.19	<0.2	<0.2	<0.2
TO-15	Dimethylbutane, 2,2-	<0.27	<0.24	<0.26	<0.24	<0.25	<0.27	<0.27	<0.27
TO-15	Dimethylbutane, 2,3-	<0.27	<0.24	<0.26	<0.24	<0.25	<0.27	<0.27	<0.27
TO-15	Dimethylpentane, 2,3-	1.25	0.72	0.55 J	0.61 J	0.67	<0.23	0.75	0.78
TO-15	Dimethylpentane, 2,4-	1.94	1.93	1.73	1.44	1.65	0.45 J	0.37 J	0.32 J
TO-15	Ethane	79.49	92.07	41.04	36.23	32.36	40.63	352.79	15.5

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
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3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040420171510 /1B	040420171510 /1B DUP	040420171510 /2A	040420171510 /2B	040420171510 /3	040420171510 /4	040420171510 /5	040520170910 /1A
	Location:	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
	Map Reference (Fig. 2):	11	11	14	14	20	21	26	16
	Sample Date:	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Ethanol	1.63 J	<1.22	1.93 J	2.91 J	<1.27	<1.34	1.87 J	<1.34
TO-15	Ethene	52.68	52.4	10.2	8.76	3.26	1.42 J	270.7	1.09 J
TO-15	Ethylbenzene	<1.08	1.32	1.15 J	1.12 J	<1.02	<1.07	1.97	<1.07
TO-15	Ethyltoluene, 2-	<0.23	<0.21	<0.22	<0.21	<0.21	<0.23	<0.23	<0.23
TO-15	Ethyltoluene, 3-	1.81	3.72	<0.22	<0.21	<0.21	<0.23	<0.23	<0.23
TO-15	Ethyltoluene, 4-	<1.08	1.13 J	<1.06	1.03 J	<1.02	<1.07	1.23 J	<1.07
TO-15	Heptane, n-	7.02	7.5	4.87	5.6	6.11	0.96	4.38	6.79
TO-15	Hexane, n-	5.77	5.51	6.95	3.11	5.82	1.01	5.02	6.49
TO-15	Isoprene	<0.32	<0.29	<0.32	<0.29	<0.3	<0.32	<0.32	<0.32
TO-15	Methanol	77.77	68.45	144.43	162.54	23.97	19.66	173.08	17.8
TO-15	Methylcyclohexane	<0.29	<0.26	<0.29	<0.26	<0.28	<0.29	<0.29	<0.29
TO-15	Methylcyclopentane	<0.27	<0.24	<0.26	<0.24	<0.25	<0.27	<0.27	<0.27
TO-15	Methylheptane, 2-	3.95	3.91	2.98	0.94	2.78	0.61 J	3.8	3.48
TO-15	Methylheptane, 3-	2.52	2.46	1.9	2.35	1.79	0.35 J	2.56	2.26
TO-15	Methylhexane, 2-	2.07	1.38	0.94	0.64	1.42	0.29 J	1.35	1.68
TO-15	Methylhexane, 3-	2.02	1.46	1.05	1.77	1.29	0.42 J	1.48	1.42
TO-15	Methylpentane, 2-	2.79	1.79	1.22	1.93	1.64	0.51 J	1.75	1.65
TO-15	Methylpentane, 3-	2.27	1.09	1.17	1.17	4.38	0.34 J	1.11	1.08
TO-15	Nonane, n-	4.47	10.57	7.47	8.52	6.14	0.99	5.41	9.58
TO-15	Octane, n-	7.28	8.93	6.43	9.93	6.37	0.98	4.74	8.17
TO-15	Pentane, i-	3	2.87	3.5	3.26	2.8	1.07	1.06	1.88

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040420171510 /1B	040420171510 /1B DUP	040420171510 /2A	040420171510 /2B	040420171510 /3	040420171510 /4	040420171510 /5	040520170910 /1A
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		11	11	14	14	20	21	26	16
Sample Date:		4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Pentane, n-	4.11	4.27	2.76	2.48	4.28	1.13	5.47	3.44
TO-15	Pentene, 1-	<0.32	<0.29	<0.32	<0.29	<0.3	<0.32	<0.32	<0.32
TO-15	Pentene, cis-2-	<0.32	<0.29	<0.32	<0.29	<0.3	<0.32	<0.32	<0.32
TO-15	Pentene, trans-2-	<0.32	<0.29	<0.32	<0.29	<0.3	<0.32	<0.32	<0.32
TO-15	Propane	14.94	15.9	11.68	10.01	8.79	12.64	23.18	5.15
TO-15	Propanol, i-	2.4 J	<1.22	1.59 J	2.42 J	2.23 J	<1.34	1.42 J	<1.34
TO-15	Propene	1.27 J	1.18 J	<0.53	0.53 J	<0.51	<0.53	4.64	<0.53
TO-15	Propylbenzene, i-	<1.08	<0.97	<1.06	<0.98	<1.02	<1.07	<1.07	<1.07
TO-15	Propylbenzene, n-	<1.08	<0.97	<1.06	<0.98	<1.02	<1.07	<1.07	<1.07
TO-15	Styrene	<0.26	<0.23	<0.25	<0.23	<0.24	<0.25	<0.25	<0.25
TO-15	TNMHC (no MeOH)	491.33	586.21	470.48	555.72	278.54	87.46	923.13	411.38
TO-15	Toluene	21.52	23.82	20.25	21.26	9.85	3.45	51.71	13.98
TO-15	Trimethylbenzene, 1,2,	<0.23	<0.21	<0.22	<0.21	<0.21	<0.23	<0.23	<0.23
TO-15	Trimethylbenzene, 1,2,	<1.08	1.65 J	1.54 J	1.89 J	<1.02	<1.07	2.06 J	1.36 J
TO-15	Trimethylbenzene, 1,3,	<1.08	1.46	1.26 J	1.48	<1.02	<1.07	1.58	1.09 J
TO-15	Trimethylpentane, 2,2,4	1.92	1.77	1.26	1.38	1.43	0.29 J	1.76	1.56
TO-15	Trimethylpentane, 2,3,4	0.72 J	0.64 J	0.39 J	0.55 J	0.45 J	<0.25	0.57 J	0.57 J
TO-15	Undecane, n-	<0.2	<0.18	<0.19	<0.18	<0.18	<0.19	<0.19	<0.19
TO-15	Xylene, o-	1.39	2.24	2.03	2.04	1.06 J	<1.07	3.53	1.41
TO-15	Xylenes, Total	7.98	12.58	12.19	11.19	7.35	1.6	19.45	8.25

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040520170910 /1B	040520170910 /1B DUP	040520170910 /2A	040520170910 /2B	040520170910 /3	040520170910 /4	040520170910 /5	040520171150 /1A
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		16	16	18	18	25	28	10	16
Sample Date:		4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-11A	Acetaldehyde	3.59 J	4.87	6.36	7.56	4.07 J	4.43 J	3.3 J	5.93
TO-11A	Formaldehyde	1.57 J	1.39 J	1.58 J	2.02 J	1.69 J	1.86 J	3.01 J	3.49 J
TO-15	Acetylene	-	0.83 J	0.96 J	<0.74	<0.75	1.9 J	<0.58	<0.82
TO-15	Benzene	-	10.41	9.64	9.21	1.89	14.53	150.55	4.8
TO-15	Butane, i-	-	<0.38	1.25	<0.37	0.63 J	3.16	6.76	<0.41
TO-15	Butane, n-	-	0.52 J	1.42	1.77	1.84	2.36	74.61	1.51
TO-15	Butene, 1-	-	<0.38	<0.39	<0.37	<0.38	<0.33	<0.29	<0.41
TO-15	Butene, cis-2-	-	<0.38	<0.39	<0.37	<0.38	<0.33	<0.29	<0.41
TO-15	Butene, trans-2-	-	<0.38	<0.39	<0.37	<0.38	<0.33	<0.29	<0.41
TO-15	Butylbenzene, i-	-	<1.01	<1.04	<0.99	<1	<0.89	<0.78	<1.09
TO-15	Butylbenzene, tert-	-	<1.01	<1.04	<0.99	<1	<0.89	0.96 J	<1.09
TO-15	Cyclohexane	-	<0.25	<0.26	<0.25	<0.25	<0.22	<0.19	<0.27
TO-15	Cyclopentane	-	<0.3	<0.31	<0.3	<0.3	<0.27	<0.23	<0.33
TO-15	Decane, n-	-	3.53	7.69	4.05	1.67	<0.17	24.01	9.69
TO-15	Diethylbenzene, 1,3-	-	<0.19	<0.2	<0.19	0.51 J	0.7	13.68	4.07
TO-15	Diethylbenzene, 1,4-	-	<0.19	<0.2	<0.19	0.57	0.59	3.45	0.62 J
TO-15	Dimethylbutane, 2,2-	-	<0.25	<0.26	<0.25	<0.25	<0.22	0.35 J	<0.27
TO-15	Dimethylbutane, 2,3-	-	<0.25	<0.26	<0.25	<0.25	<0.22	<0.19	<0.27
TO-15	Dimethylpentane, 2,3-	-	0.31 J	0.67	0.58 J	0.73	1.26	15.06	0.76
TO-15	Dimethylpentane, 2,4-	-	0.26 J	2.41	0.94	1.22	0.55 J	2.23	4.51
TO-15	Ethane	-	14.79	14.72	12.82	22.93	22.11	333.38	12.29

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040520170910 /1B	040520170910 /1B DUP	040520170910 /2A	040520170910 /2B	040520170910 /3	040520170910 /4	040520170910 /5	040520171150 /1A
	Location:	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
	Map Reference (Fig. 2):	16	16	18	18	25	28	10	16
	Sample Date:	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Ethanol	-	<1.26	<1.31	<1.24	6.6	9.33	<0.97	<1.37
TO-15	Ethene	-	1.41 J	1.15 J	1.51 J	0.86 J	1.2 J	2.06	1.3 J
TO-15	Ethylbenzene	-	<1.01	<1.04	<0.99	<1	<0.89	16.16	<1.09
TO-15	Ethyltoluene, 2-	-	<0.21	2.02	<0.21	0.44 J	<0.19	14.25	2.15
TO-15	Ethyltoluene, 3-	-	<0.21	3.89	<0.21	0.9	<0.19	26	0.52 J
TO-15	Ethyltoluene, 4-	-	<1.01	<1.04	<0.99	<1	<0.89	7.65	<1.09
TO-15	Heptane, n-	-	2.45	8.53	4.49	2.88	4.34	189.39	16.62
TO-15	Hexane, n-	-	1.64	9.69	3.61	5.22	13.04	157.5	6.33
TO-15	Isoprene	-	<0.3	<0.31	<0.3	<0.3	<0.27	<0.23	<0.33
TO-15	Methanol	-	18.97	74.11	83.16	18.13	142.13	29.03	40.15
TO-15	Methylcyclohexane	-	<0.27	<0.28	<0.27	<0.27	<0.24	<0.21	<0.3
TO-15	Methylcyclopentane	-	<0.25	<0.26	<0.25	<0.25	<0.22	<0.19	<0.27
TO-15	Methylheptane, 2-	-	1.82	3.71	2.65	1.24	1.46	4.31	4.56
TO-15	Methylheptane, 3-	-	1.06	2.4	1.71	0.64 J	0.92	37.65	3.27
TO-15	Methylhexane, 2-	-	0.36 J	1.71	1.04	1.34	1.82	31.73	6.01
TO-15	Methylhexane, 3-	-	0.43 J	1.6	1	0.79	1.38	28.03	0.52 J
TO-15	Methylpentane, 2-	-	0.26 J	2.5	0.91	4.11	4.19	43.83	7.89
TO-15	Methylpentane, 3-	-	1.85	6.53	0.54 J	4.87	7.69	23.51	5
TO-15	Nonane, n-	-	3.42	9.14	6.65	1.89	0.22 J	87.47	10.23
TO-15	Octane, n-	-	2.96	8.24	5.86	2.34	1.11	154.18	13.42
TO-15	Pentane, i-	-	<0.3	5.24	1.11	1.52	8.1	40.34	4.15

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040520170910 /1B	040520170910 /1B DUP	040520170910 /2A	040520170910 /2B	040520170910 /3	040520170910 /4	040520170910 /5	040520171150 /1A
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		16	16	18	18	25	28	10	16
Sample Date:		4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Pentane, n-	-	<0.3	6.01	2.05	0.96	10.54	106.3	1.37
TO-15	Pentene, 1-	-	<0.3	<0.31	<0.3	<0.3	<0.27	<0.23	<0.33
TO-15	Pentene, cis-2-	-	<0.3	<0.31	<0.3	<0.3	<0.27	<0.23	<0.33
TO-15	Pentene, trans-2-	-	<0.3	<0.31	<0.3	<0.3	<0.27	<0.23	<0.33
TO-15	Propane	-	1.39 J	6.16	4.42	6.88	10.9	116.94	6.01
TO-15	Propanol, i-	-	<1.26	<1.31	<1.24	5.76	6.27	<0.97	<1.37
TO-15	Propene	-	1.13 J	<0.52	<0.49	0.67 J	<0.44	<0.39	<0.55
TO-15	Propylbenzene, i-	-	<1.01	<1.04	<0.99	<1	<0.89	2.79	<1.09
TO-15	Propylbenzene, n-	-	<1.01	<1.04	<0.99	<1	<0.89	1.4	<1.09
TO-15	Styrene	-	<0.24	<0.25	<0.23	<0.24	<0.21	<0.18	<0.26
TO-15	TNMHC (no MeOH)	-	180.7	488.61	312.19	201.05	342.71	5118.52	439.93
TO-15	Toluene	-	17.72	17.61	18.8	3.3	9.02	202.43	7.85
TO-15	Trimethylbenzene, 1,2,	-	<0.21	<0.22	<0.21	<0.21	<0.19	<0.16	<0.23
TO-15	Trimethylbenzene, 1,2,	-	1.53 J	1.07 J	1.11 J	<1	<0.89	9.51	1.41 J
TO-15	Trimethylbenzene, 1,3,	-	1.26	<1.04	<0.99	<1	<0.89	8.83	1.21 J
TO-15	Trimethylpentane, 2,2,4	-	0.9	1.38	1.2	0.36 J	0.95	17.71	1.51
TO-15	Trimethylpentane, 2,3,4	-	0.38 J	0.5 J	0.45 J	<0.24	0.44 J	0.75	0.48 J
TO-15	Undecane, n-	-	<0.18	<0.19	<0.18	<0.18	<0.16	<0.14	<0.2
TO-15	Xylene, o-	-	1.67	1.35	1.28	<1	<0.89	22.87	1.26 J
TO-15	Xylenes, Total	-	9.56	7.64	8.2	1.31	<0.89	108.88	6.84

Notes:

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3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

Sample ID:		040520171150 /1B	040520171150 /1B DUP	040520171150 /2A	040520171150 /2B	040520171150 /3	040520171150 /4	040520171150 /5
Location:		Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
Map Reference (Fig. 2):		16	16	18	18	25	28	10
Sample Date:		4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-11A	Acetaldehyde	6.52	6.85	8.54	11.95	5.74	3.01 J	3.69 J
TO-11A	Formaldehyde	1.77 J	1.96 J	3.28 J	2.3 J	3.63 J	<1.36	<1.36
TO-15	Acetylene	<0.74	<0.73	<0.75	1.06 J	<0.72	<0.75	<0.44
TO-15	Benzene	8.17	7.26	11.84	17.44	10.73	1.18 J	2.21
TO-15	Butane, i-	<0.37	<0.36	3.08	0.57 J	0.81 J	<0.38	24.33
TO-15	Butane, n-	1.45	1.88	2.35	4.13	2.31	5.85	42.78
TO-15	Butene, 1-	<0.37	<0.36	<0.38	<0.36	<0.36	<0.38	<0.22
TO-15	Butene, cis-2-	<0.37	<0.36	<0.38	<0.36	<0.36	<0.38	<0.22
TO-15	Butene, trans-2-	<0.37	<0.36	<0.38	<0.36	<0.36	<0.38	<0.22
TO-15	Butylbenzene, i-	<0.98	<0.97	<1	<0.97	<0.96	<1	<0.59
TO-15	Butylbenzene, tert-	<0.98	<0.97	<1	<0.97	<0.96	<1	<0.59
TO-15	Cyclohexane	<0.25	<0.24	<0.25	<0.24	<0.24	<0.25	<0.15
TO-15	Cyclopentane	<0.3	<0.29	<0.3	<0.29	<0.29	<0.3	<0.18
TO-15	Decane, n-	15.13	14.24	11.49	3.56	23.75	<0.19	9.69
TO-15	Diethylbenzene, 1,3-	0.93	1.28	1.17	<0.18	<0.18	<0.19	8.1
TO-15	Diethylbenzene, 1,4-	1	1.9	0.89	<0.18	<0.18	<0.19	1.93
TO-15	Dimethylbutane, 2,2-	<0.25	<0.24	<0.25	<0.24	<0.24	<0.25	<0.15
TO-15	Dimethylbutane, 2,3-	<0.25	<0.24	<0.25	<0.24	<0.24	<0.25	<0.15
TO-15	Dimethylpentane, 2,3-	4.58	1.24	0.91	1.09	1.43	<0.22	0.39
TO-15	Dimethylpentane, 2,4-	2.62	1.77	1.87	2.18	2.41	0.5 J	1.18
TO-15	Ethane	12.32	11.44	17.69	19.11	31.81	81.93	11.44

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040520171150 /1B	040520171150 /1B DUP	040520171150 /2A	040520171150 /2B	040520171150 /3	040520171150 /4	040520171150 /5
	Location:	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
	Map Reference (Fig. 2):	16	16	18	18	25	28	10
	Sample Date:	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Ethanol	2 J	5.6	5.27	2.35 J	1.67 J	<1.26	1.89 J
TO-15	Ethene	0.97 J	0.83 J	<0.75	<0.73	1.31 J	<0.75	1.34
TO-15	Ethylbenzene	<0.98	1.13 J	1.05 J	<0.97	1.43	<1	0.68 J
TO-15	Ethyltoluene, 2-	<0.21	1.04	2.34	<0.2	<0.2	<0.21	<0.12
TO-15	Ethyltoluene, 3-	<0.21	3.56	3.37	<0.2	<0.2	<0.21	<0.12
TO-15	Ethyltoluene, 4-	1.18 J	1.18 J	<1	<0.97	1.88	<1	<0.59
TO-15	Heptane, n-	11.62	6.31	6.64	7.93	13.29	1.4	1.45
TO-15	Hexane, n-	4.75	9.03	6.54	5.16	7.6	1.38	2.44
TO-15	Isoprene	<0.3	<0.29	<0.3	<0.29	<0.29	<0.3	<0.18
TO-15	Methanol	122.28	124.27	165.04	124.12	111.91	39.82	11.41
TO-15	Methylcyclohexane	<0.27	<0.26	<0.27	<0.26	<0.26	<0.27	<0.16
TO-15	Methylcyclopentane	<0.25	<0.24	<0.25	<0.24	<0.24	<0.25	<0.15
TO-15	Methylheptane, 2-	6.04	3.4	4.03	4.1	7.44	0.43 J	1.09
TO-15	Methylheptane, 3-	3.66	2.31	2.35	2.33	4.75	0.39 J	0.62
TO-15	Methylhexane, 2-	0.99	1.99	3.1	3.32	3.89	1.04	0.75
TO-15	Methylhexane, 3-	0.99	1.8	2.44	2.97	3.68	1.04	0.7
TO-15	Methylpentane, 2-	4.68	1.91	2.45	2.85	3.39	1.17	1.84
TO-15	Methylpentane, 3-	4.57	10.38	6.89	3.73	2.1	0.75 J	3.39
TO-15	Nonane, n-	15.36	11.65	9.92	4.45	22.3	0.4 J	2.58
TO-15	Octane, n-	14.51	8.39	8.36	5.19	18.17	1.31	1.83
TO-15	Pentane, i-	2.42	7.48	5.46	2.28	2.26	1.42	24.53

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

TABLE 2: SUMMA AIR SAMPLE RESULTS - WINTER 2017 SAMPLING EVENT
Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	040520171150 /1B	040520171150 /1B DUP	040520171150 /2A	040520171150 /2B	040520171150 /3	040520171150 /4	040520171150 /5
	Location:	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C	Pond C
	Map Reference (Fig. 2):	16	16	18	18	25	28	10
	Sample Date:	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017	4/5/2017
Method	**Analyte**	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV	ppbV
TO-15	Pentane, n-	1.94	6.22	5.13	2.86	3.58	2.02	23.25
TO-15	Pentene, 1-	<0.3	<0.29	<0.3	<0.29	<0.29	<0.3	<0.18
TO-15	Pentene, cis-2-	<0.3	<0.29	<0.3	<0.29	<0.29	<0.3	<0.18
TO-15	Pentene, trans-2-	<0.3	<0.29	<0.3	<0.29	<0.29	<0.3	<0.18
TO-15	Propane	6.69	8.17	8.31	6.87	9.34	27.62	33.85
TO-15	Propanol, i-	1.76 J	3.31	7.33	10.93	1.69 J	<1.26	71.14
TO-15	Propene	<0.49	<0.48	<0.5	1.63	<0.48	<0.5	4.62
TO-15	Propylbenzene, i-	<0.98	<0.97	<1	<0.97	<0.96	<1	<0.59
TO-15	Propylbenzene, n-	<0.98	<0.97	<1	<0.97	<0.96	<1	<0.59
TO-15	Styrene	<0.23	<0.23	<0.24	<0.23	<0.23	<0.24	<0.14
TO-15	TNMHC (no MeOH)	607.09	603.48	606.44	570.87	5142.91	159.06	576.04
TO-15	Toluene	13.18	13.22	20.97	24.3	17.39	<1	10.72
TO-15	Trimethylbenzene, 1,2,	<0.21	<0.2	<0.21	<0.2	<0.2	<0.21	<0.12
TO-15	Trimethylbenzene, 1,2,	2.24	2.23	1.87 J	1.08 J	3.25	<1	<0.59
TO-15	Trimethylbenzene, 1,3,	1.85	1.72	1.4	<0.97	2.6	<1	<0.59
TO-15	Trimethylpentane, 2,2,4	3.56	1.48	1.28	2.16	2.85	<0.24	0.56
TO-15	Trimethylpentane, 2,3,4	0.75	0.56 J	0.41 J	0.66 J	1.09	<0.24	0.15 J
TO-15	Undecane, n-	<0.18	<0.18	<0.18	<0.18	<0.17	<0.18	<0.11
TO-15	Xylene, o-	1.8	1.92	1.98	<0.97	3.16	<1	0.75
TO-15	Xylenes, Total	10.25	10.1	9.71	5.74	16.36	<1	2.89

Notes:

1. Samples analyzed by Environmental Analytical Service, Inc.
2. Less than (<) symbol indicates the analyte was not found at the stated limit.
3. ppbV = parts per billion by volume; TNMHC = total non-methane hydrocarbons.
4. J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

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TABLE 3: WATER SAMPLING RESULTS - WINTER 2017

Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	ANTW17-A2-1	ANTW17-A3-1	ANTW17-C2-1	DUP-1	ANTW17-C2-2	ANTW17-C2-3	ANTW17-C2-INFLUENT	ANTW17-C3-1	DUP-2
	Sample Location:	Pond A	Pond A	Pond C	Pond C	Pond C	Pond C	Pond C Influent	Pond C	Pond C
	Map Ref. (Fig 2):	30	29	12	12	15	17	27	24	24
	Sample Date:	4/4/2017	4/5/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/4/2017	4/5/2017	4/5/2017
Method	**Analyte**	mg/L	mg/L	mg/kg	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
8015B	Ethanol	**39**	**12**	**30**	**29**	**14**	**31**	**59**	**13**	**6.8 J**
8015B	GRO (C6-C10)	**6.7**	**6.9**	**24**	**25**	**41**	**25**	**150**	**53 D**	**47**
8015B	Methanol	**370**	**520**	**480**	**430**	**730**	**590**	**860**	**700**	**730**
8015B	Propanol, i-	**12**	**1.8 J**	**9.2 J**	**6.1 J**	**3.9 J**	**12**	**24**	**3.8 J**	**1.5 J**
8260B	Benzene	**0.68**	**0.75**	**3.4**	**3.8**	**4**	**3.4**	**18**	**5.7**	**4**
8260B	Ethylbenzene	**0.052**	**0.057**	**0.2**	**0.21**	**0.38**	**0.28**	**1.1**	**0.48**	**0.51**
8260B	Toluene	**1.3**	**1.4**	**5.7**	**6.1**	**7.2**	**5.9**	**30**	**10**	**5.4**
8260B	Trimethylbenzene, 1,2,3-	**0.022**	**0.024**	**0.057**	**0.059**	**0.12**	**0.083**	**0.2**	**0.17**	**0.18**
8260B	Trimethylbenzene, 1,2,4-	**0.091**	**0.099**	**0.26**	**0.28**	**0.55**	**0.37**	**0.95**	**0.82**	**0.96**
8260B	Trimethylbenzene, 1,3,5-	**0.069**	**0.075**	**0.23**	**0.25**	**0.47**	**0.31**	**0.79**	**0.73**	**0.86**
8260B	Xylene, o-	**0.16**	**0.17**	**0.5**	**0.5**	**0.79**	**0.61**	**2.1**	**1**	**0.87**
8260B	Xylenes, m & p-	**0.67**	**0.71**	**2.3**	**2.3**	**3.9**	**2.9**	**10**	**4.8**	**4.2**
8260B	Xylenes, Total	**0.83**	**0.88**	**2.8**	**2.8**	**4.7**	**3.5**	**12**	**5.8**	**5.1**
8315A	Acetaldehyde	**0.0081 J**	**0.012 J**	**1.2**	**1.4**	**0.94**	**0.91**	**0.036 J H**	**0.032 J**	**0.032 J**
8315A	Formaldehyde	**0.095**	**0.062**	**0.15**	**0.16**	**0.11**	**0.17**	**0.3 H**	**0.072**	**0.099**
RSK-175	Ethane	**0.0016 J**	**0.0014 J**	**0.12**	**0.1**	**0.11**	**0.11**	**1.1**	**0.17**	**0.17**
RSK-175	Ethene	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
RSK-175	Methane	**0.02**	**0.016**	**1.8**	**1.4**	**1.2**	**1.3**	**3.8**	**1.4**	**1.4**

Notes:

1. Samples analyzed by TestAmerica Laboratories, Inc. Detections are shown in **bold.**
2. GRO = gasoline range organics.
3. Less than (<) symbol indicates the analyte was not found at the stated limit. Dash (-) indicates that compound was not analyzed.
4. Flag Definitions:
   J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.
   H - Sample was prepped or analyzed beyond the specified holding time.
   D - Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples.

TABLE 3: WATER SAMPLING RESULTS - WINTER 2017

Disposal Pit Emission Study - Upper Green River Basin, Sublette County, Wyoming

	Sample ID:	ANTW17-C3-2	ANTW17-D1-1	ANTW17-D1-2	ANTW17-D1-3	ANTW17-D1-4	TRIP BLANK 1	TRIP BLANK 2	TRIP BLANK 3
	Sample Location:	Pond C	Pond D	Pond D	Pond D	Pond D	-	-	-
	Map Ref. (Fig 2):	22	1	4	5	8	-	-	-
	Sample Date:	4/5/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/4/2017	4/5/2017
Method	**Analyte**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
8015B	Ethanol	**15**	<0.14	<0.14	<0.14	<0.14	-	-	-
8015B	GRO (C6-C10)	**37**	**0.25**	**0.13**	**0.091**	**0.087**	-	-	-
8015B	Methanol	**680**	**4.7**	**3.2**	**1.6**	**1.6**	-	-	-
8015B	Propanol, i-	**2.9 J**	<0.12	<0.12	<0.12	<0.12	-	-	-
8260B	Benzene	**3.5**	**0.0062**	**0.0025**	**0.0015**	**0.0015**	<0.00016	<0.00016	<0.00016
8260B	Ethylbenzene	**0.32**	**0.0049**	**0.0025**	**0.0013**	**0.0015**	<0.00016	<0.00016	<0.00016
8260B	Toluene	**6.1**	**0.017**	**0.0067**	**0.0039**	**0.0042**	<0.00017	<0.00017	<0.00017
8260B	Trimethylbenzene, 1,2,3-	**0.16**	**0.0014 J**	**0.00072 J**	**0.00043 J**	**0.00049 J**	<0.00027	<0.00027	<0.00027
8260B	Trimethylbenzene, 1,2,4-	**0.71**	**0.0061**	**0.0032**	**0.002**	**0.0022**	<0.00015	<0.00015	<0.00015
8260B	Trimethylbenzene, 1,3,5-	**0.66**	**0.0077**	**0.0041**	**0.0028**	**0.0031**	<0.00016	<0.00016	<0.00016
8260B	Xylene, o-	**0.65**	**0.011**	**0.0062**	**0.0039**	**0.0044**	<0.00019	<0.00019	<0.00019
8260B	Xylenes, m & p-	**3.4**	**0.036**	**0.021**	**0.014**	**0.016**	<0.00034	<0.00034	<0.00034
8260B	Xylenes, Total	**4.1**	**0.047**	**0.027**	**0.018**	**0.02**	<0.00019	<0.00019	<0.00019
8315A	Acetaldehyde	**0.039 J**	<0.008	<0.008	<0.008	<0.008	-	-	-
8315A	Formaldehyde	**0.1**	**0.058**	**0.11**	**0.17**	**0.17**	-	-	-
RSK-175	Ethane	**0.098**	<0.00057	<0.00057	<0.00057	<0.00057	-	-	-
RSK-175	Ethene	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	-	-	-
RSK-175	Methane	**1.1**	**7.6**	**3.6**	**2.1**	**2.2**	-	-	-

Notes:

1. Samples analyzed by TestAmerica Laboratories, Inc. Detections are shown in **bold.**
2. GRO = gasoline range organics.
3. Less than (<) symbol indicates the analyte was not found at the stated limit. Dash (-) indicates that compound was not analyzed.
4. Flag Definitions:

   J - less than reporting limit (RL) but greater than or equal to method detection limit (MDL). Concentration is an approximate value.

   H - Sample was prepped or analyzed beyond the specified holding time.

   D - Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples.

FIGURES

LEGEND

Topographic contour

Notes

Background Imagery: Microsoft Bing system via ESRI's ArcGIS Online premium services (http://maps.bing.com).

Feet
0 200 400

Projected Coordinate System
Datum: NAD 1983
UTM: Zone 12N

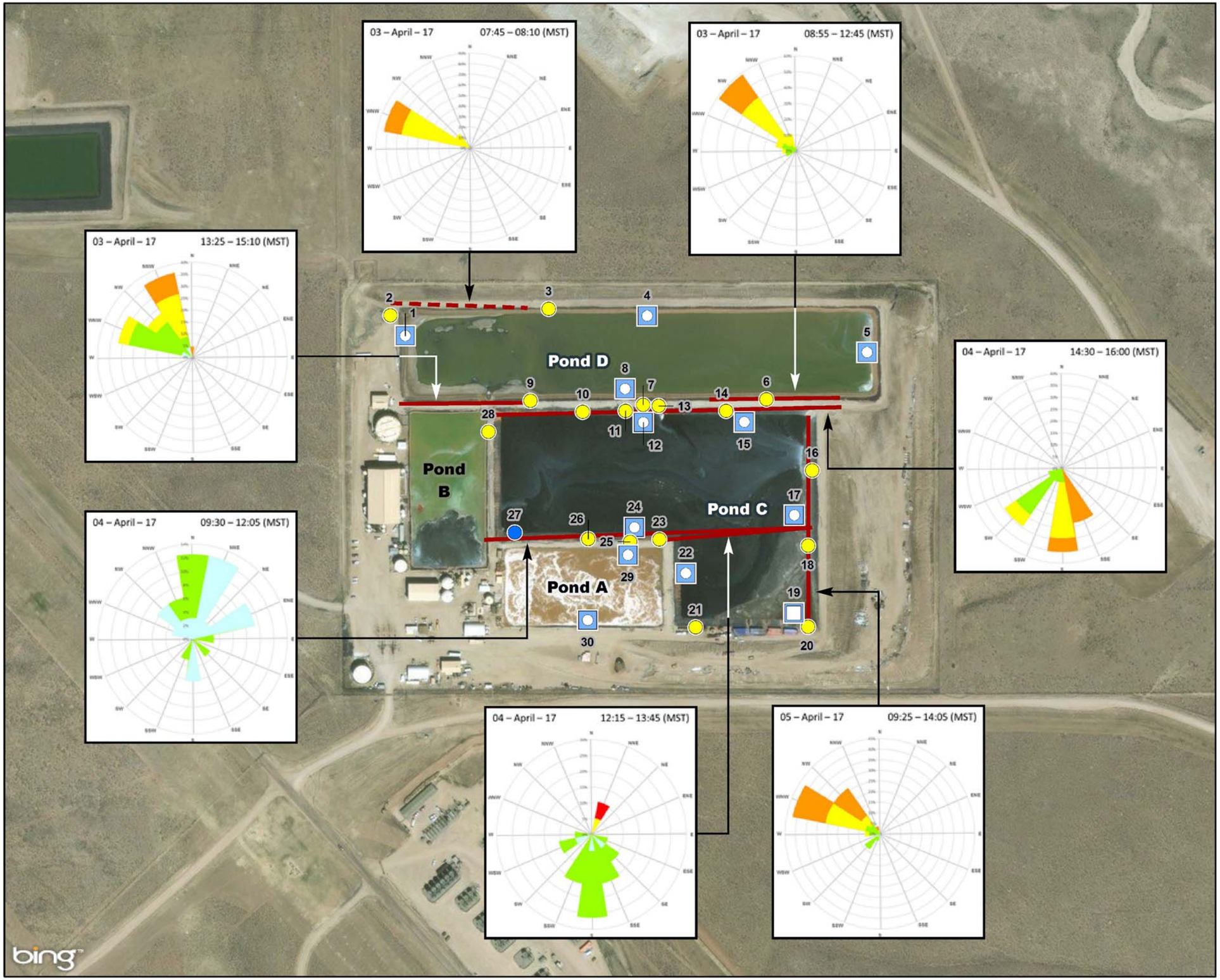
GSI ENVIRONMENTAL

ANTICLINE DISPOSAL, LLC
SITE MAP

Disposal Pit Emission Study
Upper Green River Basin
Sublette County, Wyoming

GSI Job No. G-4194	Drawn By: CDM
Issued: 7-Sept-2017	Chk'd By: JAL
Map ID: **006_01**	Appv'd By: RLB

FIGURE 1



LEGEND

- Air Sample location
- Flux-Chamber and Water Sample location
- Water Sample location
- Flux-Chamber location
- OP-FTIR Beam Path

Wind speed (m/s)

- 8 to 10
- 6 to 8
- 4 to 6
- 2 to 4
- 0 to 2

Notes

1. OP-FTIR = Open-Path Fourier Transform Infrared Spectrometry.
2. Background Imagery: Microsoft Bing system via ESRI's ArcGIS Online premium services (http://maps.bing.com).

Feet
0 150 300

Projected Coordinate System
Datum: NAD 1983
UTM: Zone 12N

GSI ENVIRONMENTAL

APRIL 2017 SAMPLE LOCATIONS: ANTICLINE DISPOSAL FACILITY

Disposal Pit Emission Study
Upper Green River Basin
Sublette County, Wyoming

GSI Job No.	G-4194	Drawn By:	CDM
Issued:	7-Sept-2017	Chk'd By:	CVD
Map ID:	**006_02**	Appv'd By:	RLB

FIGURE 2