Deborah Rogers/HDLA, LLC
(d.b.a. Deborah's Farmstead)

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The City of Westworth Village, Texas

Ambient Air Monitoring Analysis Project

Final Report

May 25, 2009

- **Executive Summary**

Wolf Eagle Environmental Engineers and Consultants, LLC ("Wolf Eagle") was retained by Ms. Deborah Rogers and HDLA, LLC (d.b.a. Deborah's Farmstead, "Client"), to perform an

Ambient Air Monitoring Analysis (Test 1) The City of Westworth Village, Texas. The purpose of the Ambient Air Monitoring Analysis was to characterize the ambient air quality on the farmstead owned and operated by Ms. Rogers. Deborah's Farmstead is an all natural farming operation known nationally for their award winning goat cheese. In addition to the dairy operation, free range laying hens produce eggs and cut flowers that are sold by Client to local markets. Recent proposed gas well development on an adjacent property raised concerns as to the potential environmental impact to Client's quality of grazing land, dairy operation and cheese production business and natural farming operation. Additional concern arose for the potential for impact to the deep water well and the water quality of the region by gas exploration and mining. Water quality and the deep water well water that supports the cheese production business are essential to Client's unique cheese product. Industrial operations in a residential or agricultural setting has the potential to cause great impact to the overall quality of life (QOL) as well as the potential for air, noise and vibration, water and soil pollution typical to industrial processes. Natural gas exploration and production adjacent to the dairy farm has the potential to impact the health of the goats, milk production of the dairy, egg production as well as human health impact to the residential community.

- **Background Information**

Deborah's Farmstead is one of only three completely pasture based goat dairy operations within the continental United States. It is an all natural dairy farm based on open pasture foraging on organically managed pastures located in the City of Westworth Village on property that has been in Ms. Rogers' family for three generations. The City of Westworth Village is a quiet residential community approximately two square miles in area within Tarrant County. It is located on the banks of the Trinity River and surrounded by a long established residential community amid natural vegetation and landscape features unique to the region. Wolf Eagle was contacted by Client after Chesapeake Energy ("Chesapeake") began clear cutting land on an adjacent property

3.0 Weather Conditions

Weather conditions on 25 May, 2009, were confirmed at the Fort Worth Meacham International Airport (13961), Fort Worth, Texas. Sky conditions were clear with temperatures ranging from a low of 64 degrees Farenheit to a high of 86 degrees Farenheit. Winds were reported calm out of the north northwest at an average wind speed of 3.8 miles per hour.

- **Ambient Air Sampling**

On 25 May, 2009, with favorable weather conditions for ambient air testing Wolf Eagle began ambient air monitoring on Client's property. The intent was to characterize ambient air concentrations. Upon arrival at the City of Westworth, at 9:26 am, on the 25 May, 2009, Wolf Eagle technicians noticed gas well operational flaring occurring at Chesapeake Operating Inc. Shady Oaks 1H,2H,3H well sites adjacent to Highway 183. Wolf Eagle discussed with Client the location of the air monitoring devices and the potential for air emissions from flaring to be

picked up by the air monitoring canisters. The decision was made to proceed despite flaring operations nearby. The decision was made to monitor the eastern section of Client's grazing land due to the potential for impact to the grazing quality of pasture land from the proposed drilling operations.

Wolf Eagle performed whole air emissions sampling for volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) as well as Tentatively Identified Compounds (TICs) on Client's property. Sampling procedures followed ASTM Method D31357 using certified sterilized evacuated pressurized stainless steel Summa canisters with 24 hour flow regulators (certified mass flow 24- hour meters) obtained from a certified air testing laboratory (GD Air Testing, Inc., 551 N. Plano Parkway #429, Richardson, Texas). All canisters were certified with both a canister number and canister batch from the laboratory verifying proper evacuation and pressurization. All canister locations were verified by GPS coordinates. The initial time of can depressurization (opening) was noted and recorded on chain of custody. Upon completion of sampling the hand valve was closed, brass cap secured and time of closure noted. Canisters were collected, inspected for damage or dents that could impact quality of samples. No dents or damage to either canisters or flow meters were noted. The canisters were returned to the certified testing laboratory in a timely fashion to insure quality of sample with proper chain of custody. A TO-14[1] (Toxic Organic Compounds) VOC analysis or multiple volatile organic compounds and a Tentatively Identified Compounds (TIC) analysis was requested and subsequent report characterizing compounds produced by the laboratory.

[1] The TO-14 is the original and most common method used to test ambient air for toxic organic compounds. TO-14 covers the widest range of volatile organic compounds reporting 40-different species.

- **Location of the Monitors**

In total, three (3) canisters were placed on Client's property, (See Appendix 1 – Map). Placement of the canisters was on the eastern boundary line in the pasture impacted greatest by gas exploration activities. Placement began at 1114 hours (11:14am CST) on 25 May 2009, ending at approximately 1038 hours (10:38 am CST) on 26 May 2009. (GPS Coordinates and canister information can be reviewed in Appendix 2 – Canister Locations).

- **Laboratory Results**

Thousands of chemicals have been classified by the International Agency for Research on Cancer (IARC) and the US National Toxicology Program (NTP) as *Recognized Human Carcinogens* or *Suspected Carcinogens* based on decades of laboratory and epidemiological studies confirming the chemicals capability to cause cancer in humans or animals. In addition, the U.S. Environmental Protection Agency (E.P.A.) has developed a system that ranks chemicals based on their chronic toxicity to human health. The E.P.A. has determined acceptable risk levels of exposure to humans in an effort to establish industry standards for safe exposure.

E.P.A.'s Risk Screening Environmental Indicators (RSEI) project is used to evaluate the potential health impacts of chemicals releases reported to the Toxic Release Inventory. The RSEI assigns a "toxicity weight" to a chemical relative to how its risk assessment values for cancer and non-cancer health effects compare to other chemicals. Within each category, limits of chemical exposure to humans are identified and separate toxicity weights assigned for ingestion and inhalation exposures. The limits have become the basis for establishing regulatory standards. The categories are defined as the following:

- Recognized Human Carcinogen
- Suspected Human Carcinogen

State regulations may adopt risk levels more restrictive to the Federal guidelines or at their choosing may adopt existing risk levels identified by the E.P.A. The Texas Commission on Environmental Quality in a February 13, 2009, Memorandum Identified the latest updated list of Effects Screening Levels (ESLs) now currently in use by the TCEQ Toxicology Division for air permitting. This list is the commonly referred to database to evaluate the potential for adverse human health effects to occur as a result of exposure to concentrations of compounds in air. ESLs are based on research data that indicates concern for health effects, odor/nuisance potential and effects on vegetation. Weighted toxicity levels are identified as both Short-term ESLs and Long-term ESLs. Short term ESLs indicate a 1-hour averaging period and Long-term ESLs indicate an annual averaging period. Both values are identified as micrograms per cubic meter (ug/m3) and parts per billion (ppb). All compounds are identified with a CAS Number to insure consistency and proper identification due to numerous chemicals with multiple names. An additional note is made of a double asterisk (**) after the constituent name which indicates the constituent has a disaster potential. Disaster potential as identified by TCEQ guidance document present in draft form defines disaster potential as chemicals with:

- high toxicity to human life
- moderate to high vapor pressure, or easily volatilized
- high vapor density that causes the vapor to resist dispersion or hug the ground
- chemical is to be stored, in high pressure operating areas, or otherwise handled in sufficient quantity to support a dangerous off-plant impact
- chemical with an IDLH value, or one that could reasonably be expected to have impacts immediately dangerous to life and health

Laboratory results confirmed the presence of multiple Recognized and Suspected Human Carcinogens in fugitive air emissions present on Client's property commonly known to emanate from industrial processes directly related to the natural gas industrial processes of exploration, drilling, flaring and compression. In addition, laboratory results confirmed the presence of two (2) chemicals with disaster potential. (See Appendix 3 for a Summary of TCEQ exceedences and Laboratory Analytical Results).

Fugitive emission sources of hazardous air pollutants emanating from the oil and gas sector include emissions from pumps, compressors, engine exhaust and oil/condensate tanks, pressure relief devices, sampling connections systems, well drilling and fracing (hydraulic fracturing), engines, well completions, gas processing and transmission, as well as mobile vehicle transportation emissions. Along with hazardous air pollutants (HAPs) and known carcinogenic compounds; smog forming compounds (NOx and VOCs) as well as air toxic compounds is a known result of gas industrial exploration, compression, processing and distribution.

6.0 Discussion

The chemicals found to exceed TCEQ's ESL's identified as present on Client's property include Chloroform**, Carbon disulfide**, Methyl disulfide, Methyl ethyl disulphide with the potential for exceedences by Methyl propyl disulfide, Diethyl disulfide, Dimethyl trisulfide and Ethyl n-propyl disulfide. In addition, methane was detected at levels above ambient background levels (2.0 ppmv [parts per million by volume]) and provide indication of presence of constituents from gas drilling operations.

Chloroform** – CAS Number 67663

Chloroform ($CHCL_3$, trichloromethane) is produced by heating a mixture of chlorine and chloromethane, or chlorine and methane. It is known as one of the first inhalation anesthetics. Use was discontinued due to its hepatotoxic (liver toxicity) and nephrotoxic (kidney toxicity) potential. Trichlormethane's status as a rodent carcinogen is indisputable according to laboratory research. The EPA classifies Trichloromethane as a probable human carcinogen (group B2) with sufficient supporting evidence for carcinogenicity in animals.

Carbon disulfide ** - CAS Number 75150

Carbonyl disulfide (CS_2) is a common solubilizer for waxes and oils. Most often exposures are occupational but according to EPA's National Priority List Carbon disulfide has been identified in over 200 registered waste sites. Epidemiological studies support an association between Carbon disulfide exposure and cardiovascular disease in workers. Research in rats indicates a support role for Carbon disulfide in the elevation of blood cholesterol with the potential to induce early lesions of atherosclerosis. High levels of Carbon disulfide have been known to be

life-threatening due to the interference in the sympathetic nervous system. TCEQ identifies Carbon disulfide as a constituent with a disaster potential.

Dimethyl disulphide – CAS Number 624920

Dimethyl disulphide exceedences occurred in both Short-term and Long-term ESLs according to TCEQ limits. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Dimethyl disulphide is 0.5 ppm, 1.9 mg/m^3 TWA, which is considerably lower than TCEQ limits. Health factors associated with exposure to Dimethyl disulphide include irritation of the respiratory system (nose, throat) as well as eye and skin irritation. Dimethyl disulphide is known to cause nausea and overall weakness. Vapor or air mixtures of Dimethyl disulphide above 24 °C may be explosive.

Methyl ethyl disulphide – CAS Number 20333395

Methyl ethyl disulphide, (methyldisulphanylethane) is known for its highly offensive odor. Although stable it is known to be highly flammable. Like Dimethyl disulphide it is a known eye and skin and respiratory irritant.

Methyl propyl disulfide – CAS Number 2179604

Methyl propyl disulfide (1-methyldisulfanylpropane) like many of the other disulfide metabolites are known to be flammable and should be kept away from any source of ignition. It is a known irritant to the eyes, skin and respiratory system.

Ethyl, methylethyl disulfide, Dimethyl trisulfide, Ethyl n-propyl disulphide

Although these compounds may vary in CAS Number they can be considered metabolites of the same basic chemical with the inference for use of similar Short-term and Long-term exceedences. Laboratory results indicate a presence in levels that exceed ESL for disulfides both at Short-term and Long-term ESLs. This family of compounds is known both for its flammability and potential for offensive odor. They are known eye, skin and respiratory irritants with caution for respiratory exposures.

- **Conclusion**

Although the initial intent of the project was to characterize the ambient air of Client's property high concentrations of carcinogenic constituents in the ambient air were unexpectedly identified.

The presence of these compounds in a residential area indicates a strong correlation to gas flaring from gas exploration in process during the week of air testing. The constituents in the ambient air indicate quantities in excess of what would normally be anticipated in ambient air in an urban, residential or rural area. Many of the compounds verified by laboratory analysis were metabolites of known human carcinogens. Due to the confounding factor present of gas flaring the decision was made to conduct a subsequent ambient air analysis on a later date after gas flaring ceased. See the attached Ambient Air Analysis – June 27, 2009.

7.0 Statement of Confidentiality

This report was prepared exclusively for the use and reliance of Deborah Rogers/HDLA, LLC/Deborah's Farmstead (collectively "Client"). The contents shall not be disseminated, in whole or in part, without the written consent of any authorized representative of same. The findings of this report shall not be used by, or conveyed to any other party without prior written consent of Wolf Eagle Environmental Engineers and Consultants, LLC. The scope of this report is specific to Client, and may not be suitable for other users. Wolf Eagle accepts no responsibility for unauthorized manipulation or misuse of this report, whether intentional or incidental.

Alisa Rich, MPH, PhDc

President

Wolf Eagle Environmental

Engineers and Consultants, LLC

Deborah Rogers/HDLA, LLC/Deborah's Farmstead

Additional Ambient Air Monitoring Analysis Project – June 27, 2009

- **Executive Summary**

Due to the impact of the flaring operations on ambient air conditions on 25 May, 2009, the decision was made to repeat the ambient air monitoring a second time after flaring operations had ceased. On 27 June, 2009, a second ambient air monitoring was performed in absence of operational flaring at the Chesapeake Operating Inc. Shady Oaks IH,2H,3H gas wells. The Additional Ambient Air Monitoring Analysis (Test 2) of 27 June, 2009 was meant as an addendum to the initial testing and subsequent report of 25 May, 2009, and was not intended to stand alone without the support information as noted by reference in the below report.

- **Background Information**

Background information remains the same as previously stated.

- **Weather Conditions**

Weather conditions on 27 June, 2009, were confirmed at the Fort Worth Meacham International Airport, Fort Worth, Texas. Sky conditions were clear with temperatures ranging from a low of 79 degrees Farenheit to a high of 102 degrees Farenheit. Winds were predominately out of the east, southeast with varying winds with an average wind speed of 5.2 miles per hour.

3.0 Ambient Air Sampling

The ambient air testing and analysis was performed redundant to procedures of Test #1 as noted in Section 4.0, of the preceding report. Certified Summa canisters were obtained in the same manner as previously stated. Location of the monitors was similar to the first with all canister locations verified by GPS coordinates. The initial time of can depressurization (opening) was noted on chain of custody. Upon completion of sampling the hand valve was closed, brass cap secured and time of closure noted. Canisters were collected, inspected for damage or dents that could impact quality of samples. No dents or damage to either canisters or flow meters were noted. The canisters were then returned to the certified testing laboratory noted in Section 4.0 in a timely fashion to insure quality of sample with proper chain of custody. A TO-14[1] (Toxic Organic Compounds) VOC analysis and a Tentatively Identified Compounds (TIC) was requested from the laboratory with subsequent report characterizing the captured compounds.

- **Location of the Monitors**

Three (3) canisters were placed on Client's property as previously performed, (See Appendix 1 – Map). Placement of the canisters was on the eastern boundary line in the pasture impacted greatest by gas exploration activities. Placement began at 1102 hours (11:02am CST) on 27 June 2009, ending at approximately 947 hours (9:47am CST) on 28 June, 2009. (GPS Coordinates and canister information can be reviewed in Appendix 2 – Canister Locations).

- **Laboratory Results of Additional Ambient Air Monitoring**

Laboratory results of the additional ambient air monitoring project (Test 2) did not identify the presence of Chloroform as the previous report stated. In addition, only one canister identified Dichlordiflouoromethane (F12) as present in ambient air. Toluene was present in all three canisters. Ethylbenzene and Xylene (m&p) were also present in only one canister. Carbon disulphide, Methyl disulphide and Methyl ethyl disulphide were identified in only one canister.

- **Discussion**

The chemicals found to exceed TCEQ's ESLs present on Client's property include Carbon disulphide**, Methyl disulfide, Methyl ethyl disulphide. However, all amounts of constituents were in levels below what was previously identified in Test 1. Several hydrocarbon categories were identified including C7, C8 and C12 but with the exception of Limonene and 2-Methylhexane (isoheptane, ehtylisobutylmethane) could not be isolated from the constituent in reportable amounts. Methane was also identified as present in ambient air conditions but in range usually identified as consistent with ambient urban air quality (2.2 ppmv).

Carbon disulfide ** - CAS Number 75150

Carbonyl disulfide (CS_2) is a common solubilizer for waxes and oils. Most often exposures are occupational but according to EPA's National Priority List Carbon disulfide has been identified in over 200 registered waste sites. Epidemiological studies support an association between Carbon disulfide exposure and cardiovascular disease in workers. Research in rats indicates a support role for Carbon disulfide in the elevation of blood cholesterol with the potential to induce early lesions of atherosclerosis. High levels of Carbon disulfide have been known to be life-threatening due to the interference in the sympathetic nervous system. TCEQ identifies Carbon disulfide as a constituent with a disaster potential.

Dimethyl disulphide – CAS Number 624920

Dimethyl disulphide exceedences occurred in both Short-term and Long-term ESLs according to TCEQ limits. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Dimethyl disulphide is 0.5 ppm, 1.9 mg/m^3 TWA, which is considerably lower than TCEQ limits. Health factors associated with exposure to Dimethyl disulphide include irritation of the respiratory system (nose, throat) as well as eye and skin irritation. Dimethyl disulphide is known to cause nausea and overall weakness. Vapor or air mixtures of Dimethyl disulphide above 24 °C may be explosive.

Methyl ethyl disulphide – CAS Number 20333395

Methyl ethyl disulphide, (methyldisulphanylethane) is known for its highly offensive odor. Although stable it is known to be highly flammable. Like Dimethyl disulphide it is a known eye and skin and respiratory irritant.

- **Conclusion**

The Additional Ambient Air Monitoring performed on 27 June, 2009, was more consistent with what is considered ambient air conditions in urban areas with the exception of the compounds of disulphides identified above. These compounds are typically found in areas consistent with gas exploration, compression, and distribution, rather than urban residential areas. The fact that these levels were below previous levels indicates continued presence of compounds related to the gas industry present in residential areas. The point of origin, or point of emission could be from numerous wells currently in the process of being drilled in Westworth Village or the neighboring community of Rivercrest. As stated previously, these constituents in the ambient urban air indicate quantities in excess of what would normally be anticipated in ambient air in an urban residential area. Many of these compounds verified by laboratory analysis were known, or recognized carcinogens with the potential for human health impact exceeding TCEQ Short Term and Long Term ESL's. In addition, of high concern are the compounds TCEQ identifies as compounds with the potential for disaster.

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