North Carolina Department of Environment and Natural Resources
Division of Air Quality

Beverly Eaves Perdue
Governor

Sheila C. Holman
Director

Dee Freeman
Secretary

December 11, 2012

Mr. Lorenzo Carmon
County Manager
Edgecombe County Landfill
P. O. Box 10 – 201 St. Andrew Street
Tarboro, North Carolina 27886

Re: Permitting Applicability Request – Non-hazardous Secondary Material Determination
Air Permit No. 10196R00
Edgecombe County Landfill
Tarboro, Edgecombe County, North Carolina
Permit Fee Class: Small
Facility ID# 3300191

Dear Mr. Carmon:

The North Carolina Department of Environment and Natural Resources (NCDENR) Division of Air Quality (DAQ) received your letter dated November 13, 2012 requesting a Non-Hazardous Secondary Material (NHSM) determination for a landfill gas to energy (LFGTE) project owned and operated by Edgecombe County. This memorandum summarizes the Non-Hazardous Secondary Material (NHSM) determination for the landfill gas to energy project to be located at the Edgecombe County Landfill in Tarboro, North Carolina. The project includes the installation of two 2G CENERGY Cogeneration generators burning landfill gas (LFG) from the Edgecombe County Landfill. This determination is being made pursuant to the federal Environmental Protection Agency's (EPA' s) March 11, 2011 NHSM regulation. That rule states that any NHSM that is burned is a solid waste unless it qualifies for an exception under the rule.[1] Based on the information provided by the applicant in this case, Edgecombe County Landfill, the LFG to be burned does qualify for an exception and therefore is not considered solid waste under this rule.

Background

It is important to note that this determination is limited to review of the LFG as represented by Edgecombe County and under the NHSM rule. The NHSM rule did not redefine the current definition of "solid waste"

[1] 40 CFR §241.3 (2011).

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at 40 CFR §258.2[2] The EPA, through the NSHM rule, provided a method to determine whether NHSM materials that were burned would qualify as solid waste for the purpose of § 129 of the Clean Air Act (CAA). The EPA has issued several policy interpretation letters since promulgating the NHSM rule in an attempt to clarify any possible confusion regarding the relationship between the existing definition of solid waste and the NHSM rule.[3] More specifically, these letters address the issue of "contained gas" as it relates to the 40 CFR §258.2 "solid waste" definition. The letters confirm that, consistent with the NHSM rule, LFG is not a "traditional fuel," but may be considered a "processed commodity fuel" by meeting all of the requirements presumably given in the NHSM rule. Significantly, the August 11, 2011 letter quotes the EPA's response to comments document on the critical question of whether LFG is a traditional fuel.[4] The NHSM rule states that traditional fuels are not secondary materials or solid waste. Interestingly, on the question of whether LFG is a contained gas, none of the EPA letters cite another EPA response to that question found in the same document referenced above. The EPA did respond to a commenter who asked that the "EPA should make clear that "contained gaseous material" is only meant to cover gas in a container when that container and its contents are combusted."[5] The EPA stated that it was

> "...unable to find any Agency reasoning supporting previous EPA interpretations that only gases in containers may be considered "contained." Based on the facts of this case, EPA cannot see how gaseous secondary material that is generated in any particular system and is somehow sent to a gas-fired boiler, even through a pipeline, can be considered an "uncontained gas." This even assumes that "uncontained gas" is not covered under the definition of solid waste, which EPA does not concede in this rulemaking. This would mean that a clean gas-fired boiler could still burn under CAA 112 secondary material that is handled through a seriously leaking pipeline, has little to no real fuel value, and is full of dirty contamination, simply because the material is not a "contained gas" under the definition of solid waste. EPA rejects any such formulation."[6]

From these comments, and from the fact that the EPA has never stated that LFG is not a NHSM, the NC DAQ proceeded to apply the NHSM procedure to ascertain whether LFG is a solid waste.

Analysis under NHSM

Under the EPA rule *Non-hazardous secondary material* means a secondary material that, when discarded, would not be identified as a hazardous waste under Part 261 of this chapter. In turn, secondary material means "... any material that is not the primary product of a manufacturing or commercial process, and can

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[2] In the Resource Conservation and Recovery Act, Congress defined "Solid waste" as any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923). The EPA has adopted a nearly identical definition at 40 CFR 258 .2.

[3] Letter from Suzanne Rudzinski (US EPA) to Tim Hunt (AFPA) dated May 13, 2011, letter from Suzanne Rudzinski (US EPA) to Sue Briggum (Waste Management) dated August 5, 2011, and letter from Mathy Stanislaus, (US EPA) to Paul Noe (AFPA) dated June 25, 2012.

[4] The specific comment was 3b-13-2 in EPA-HQ-RCRA-2008-0329 in response to a comment that asked EPA to clarify that landfill gas and sewage digester gas are unequivocally traditional fuels" and are not solid wastes if they are comb usted in any type of boiler. The term "traditional fuels" is a term defined in the NHSM rule.

[5] Id at 212.

[6] Id at 213.

include post-consumer material, off-specification commercial chemical products or manufacturing chemical intermediates, postindustrial material, and scrap."

The EPA's definition of NHSM is quite broad as evidenced by the phrase "any material that is not the primary product..." In the case of landfills, LFG is unquestionably not the primary product of a landfill and therefore is considered a NHSM.[7]

Exceptions
As noted earlier, the rule provides that any NHSM that is burned is a solid waste unless it qualifies for an exception under the NHSM rule. Generally, the rule provides four exceptions:

> (l) Non-hazardous secondary materials used as a fuel in a combustion unit that remain within the control of the generator and that meet the legitimacy criteria.[8]
>
> (2) Scrap tires managed under the oversight of an established tire collection program and resinated wood provided the materials that have not been discarded and meet the legitimacy criteria.
>
> (3) Non-hazardous secondary materials used as an ingredient in a combustion unit that meet the legitimacy criteria specified in paragraph (d)(2) of this section.
>
> (4) Fuel or ingredient products that are used in a combustion unit, and are produced from the processing of discarded non-hazardous secondary materials and that meet the legitimacy criteria.

For the purposes of this determination, exceptions (2) and (3) are not relevant. However exceptions (1) and (4) are relevant to the current application and therefore each element of the exceptions are discussed below:

Control of the Generator - 40 CFR 241.3(b)(l)
The NHSM rule provides that "Within control of the generator" means that the non-hazardous secondary material is generated and burned in combustion units at the generating facility; or that such material is generated and burned in combustion units at different facilities, provided the facility combusting the non-hazardous secondary material is controlled by the generator; or both the generating facility and the facility combusting the nonhazardous secondary material are under the control of the same person as defined in this section. 40 CFR § 241.2

The term "generating facility" means all contiguous property owned, leased, or otherwise controlled by the NHSM generator. 40 CFR §241.2

The applicant, Edgecombe County Landfill, proposes to burn the LFG in combustion units (gensets) at the site where the landfill gas is being generated. Edgecombe County owns the LFG gensets, as well as the infrastructure used to extract, treat, and convey the LFG to the LFG gensets that will be situated on the Landfill's property located at 2872 Colonial Road in Tarboro. Therefore, Edgecombe County controls all

[7] Were it not for the explicit statement by the EPA that landfill gas and sewage digester gas are "extracted from landfills, which contain wastes" and that they can only "be considered commodity fuels that have been processed from waste materials" if these gases met "all the requirements necessary to be considered a processed commodity fuel" an argument might be made that LFG is the primary product of the landfill.
[8] The legitimacy criteria are provided in the NHSM rule at 40 CFR §241.3(d)(l) and (2) for fuels and ingredients respectively.

aspects of the LFGTE project and satisfies the EPA's definition of "Within the control of the generator" requirement.[9]

Legitimacy Criteria – 40 CFR §241.3(d)(1)

Managed as a Valuable Commodity – 40 CFR 241.3(d)(1)(i)
There is no definition of the phrase "manage as a valuable commodity," however in the preamble to the March 2011 NHSM rule, the EPA provided several factors that could be considered. The EPA stated that "[w]here there is an analogous fuel, the non-hazardous secondary material used as a fuel must be managed in a manner consistent with the management of the analogous fuel or otherwise be adequately contained so as to prevent releases to the environment."[10] In this case natural gas can be considered an analogous fuel and the LFG is managed and contained like the analogous fuel. In addition, Edgecombe County, both the landfill gas generator and combustor is motivated by economics to maximize collection and containment of LFG for combustion in the energy recovery unit. The benefits of this project include reduction in the release of methane into the atmosphere, and the eligibility for both renewable energy credits (RECs) associated with the generation of power; and carbon credits relating to the combustion of methane, which is a significant constituent of LFG; thus, Edgecombe County demonstrates their intent to manage the LFG as a valuable commodity and satisfies this part of the EPA's legitimacy criteria.

Meaningful Heating Value – 40 CFR 241.3(d)(1)(ii)
In the preamble to the final NHSM definitional rule, US EPA stated that materials with a heat content of at least 5,000 Btu/lb presumptively satisfy this criterion.[11] However, materials with lower heat contents may also satisfy the criterion on a case-by-case basis by showing that "the energy recovery unit can cost-effectively recover meaningful energy from the non-hazardous secondary materials used as fuels."[12] Factors that may be considered in this case-by-case analysis include "whether the facility encounters a cost savings due to not having to purchase significant amounts of traditional fuels they otherwise would need, whether they are purchasing the non-hazardous secondary materials to use as a fuel, whether the non-hazardous secondary materials they are burning can self-sustain combustion, and whether their operation produces energy that is sold for a profit...."[13]

Based on DAQ's July 5, 2012 NHSM determination for CII Methane Management IV, LLC LFGTE project located in Johnston County LFG was determined to have a heating value of approximately 500 British Thermal Units (Btu) per cubic foot which is approximately half of that of natural gas. However, the heat content of LFG on a Btu per pound (lb) basis is approximately 8,000-10,000 Btu/lb which is well above the EPA's presumptive meaningful heating value threshold.[14] Data submitted as part of Edgecombe County Landfill Air Quality Permit Modification Application received by DAQ's Raleigh Regional Office (RRO) on February 28, 2012 indicates the LFG higher heating value (HHV) based on a methane content of 50

[9] EPA's definition of "within the control of the generator" is designed to allow two scenarios. The first scenario "that the non-hazardous secondary material is generated and burned in combustion units at the generating facility" limits the inquiry to the geographic location of the combustion unit relevant to the generation of the NHSM. The second scenario allows geographic disparity only in instances where there is common control between the generator and facility burning the material.
[10] 76 Fed. Reg. 15520 (March 21, 2011).
[11] 76 Fed. Reg. 15,523 (Mar. 11, 2011).
[12] *Id.*
[13] *Id.*
[14] The heating value of natural gas is approximately 20,000 Btu/lb. The density of LFG is greater than natural gas as landfill gas contains approximately 50 percent methane (0.0447 lb/ft3) and 50 percent CO2 (0.1234 lb/ft3).

percent is approximately 506 Btu per standard cubic foot (scf) of gas, which equates to 11,962 Btu/lb utilizing the density of methane as provided in equation HH-4 of EPA's Greenhouse Gas Mandatory Reporting Rule[15]; hence meeting the meaningful heating value criterion.

Comparable Contaminant Concentrations – 40 CFR 241.3(d)(1)(iii)
In order for a NHSM to be classified as not a solid waste, it must "contain contaminants at levels comparable in concentration to or lower than those in traditional fuels which the combustion unit is designed to burn."[16] The current rule is silent as to whether the traditional fuels used in the comparison should include all fuels that the combustion unit is capable of burning, or whether it is limited to those fuels that the combustion unit is legally allowed to burn. However, the EPA has subsequently made it clear both through communications with the NCDAQ and in subsequent proposed rulemaking, that the contaminant comparison should be based on what the combustion unit is simply capable of burning.[17]

In this instance, the combustion units are two 370 kilowatt (kW) – 570 horsepower (hp) 2G-CENERGY Power Systems Technologies, Inc. cogeneration gensets designed with lean burn technology. The units can be purchased with the capability of burning either natural gas or biogas. The natural gas fired technical specification sheet submitted as part of this applicability determination (See Attachment 3) contains a statement *"For all other Gas Types: Weak Gases, e.g. Biogas, Landfill Gas, Sewage Gas, Coal Mine Gas, and other Special Gases (Wood Gas, Syngas, Coke Gas, Pyrolysis Gas) see Biogas Spec Sheets and consult 2G-CENERGY."* 2G-CENERGY gas gensets are designed and built for high Btu natural gas fuel, operating those engines on biogas requires downgrading the engine and generator rating; therefore, it would appear that these units are generally designed and capable of burning natural gas.[18] Thus, the NCDAQ considers the units to be capable of burning both LFG and natural gas and therefore natural gas will be the traditional fuel that will be used for comparison purposes.

Comparison of Contaminants
A contaminant is defined as "any constituent in a non-hazardous secondary material *that will result in emissions of the air pollutants* identified in the Clean Air Act section 112(b) or the nine pollutants listed under Clean Air Act section 129(a)(4) when such non-hazardous secondary material are burned as fuel or used as an ingredient, including those constituents that could generate products of incomplete combustion."[19] This definition could be interpreted to include (1) chemical pollutants that are present within the NHSM that may be emitted as regulated air pollutants during the combustion process[20], (2) chemicals that are not regulated air pollutants, but which may form air pollutants during the combustion process[21], and (3) chemicals that are not regulated pollutants, but which may promote the formation of air

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[15] 40 CFR Part 98 – Subpart HH – Municipal Solid Waste Landfills.
[16] 40 CFR 241.3(d)(1)(iii) (March 23, 2011).
[17] E-mail from George Faison (US EPA) to Donald van der Vaart (NC DAQ), dated May 2, 2012 (indicating that the contaminant levels in the NHSM "should be compared to what traditional fuel the unit is [burning] or CAN burn, not what it is permitted for."; 76 Fed. Reg. 80530 (Dec. 23, 2011) (proposing to revise 40 CFR 241.3(d)(1)(ii) to indicate that, "In determining which traditional fuel(s) a unit is designed to burn, persons can choose a traditional fuel that can be or is burned in the particular type of boiler, whether or not the combustion unit is permitted to burn that traditional fuel."
[18] http://www.2g-cenergy.com/faq.html
[19] 40 CFR 241.1 (March 23, 2011) (*emphasis added*).
[20] *Example*: Regulated toxic metals in the NHSM may be emitted in the form of particulate matter. Toxic metals include antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium.
[21] *Example*: Sulfur in the NHSM may be emitted as sulfur dioxide (SO_2), which is a pollutant listed under CAA § 129(a)(4).

pollutants during the combustion process.[22] While the EPA does draw a distinction between comparing "emissions" and comparing "constituents that will result in emissions" they have advocated evaluating combustion emissions as part of the comparability analysis.[23] According to EPA, this distinction between contaminant levels and emissions becomes particularly important when looking at constituents that are defined as contaminants based solely on the fact that they are precursors to Section 112/129 pollutants. For example, nitrogen is one such constituent. If unit designs are selected and combustion conditions are managed such that nitrogen does not form NO_x (no consideration of add-on controls), EPA would not consider it a contaminant.[24]

Since the time the final rule was promulgated the US EPA has indicated that it did not intend for the definition of contaminants to be so broadly interpreted. On December 23, 2011, the US EPA proposed a revision to the definition "to clarify what will be considered contaminants for the purposes of the legitimacy criteria."[25] The US EPA proposed including a specific list of pollutants and precursors that fall within the definition of "contaminants" in place of the existing definition that includes constituents that would result in emissions of air pollutants.[26] In the preamble to the proposed rulemaking, US EPA repeatedly asserts that the revised language is only intended to clarify the intent of the final rule and that the Agency does "not expect this change to affect any of the decisions previously made on whether NHSMs are solid wastes when burned as fuels."[27]

The EPA has indicated that a variety of comparisons could be made. For example, the upper contaminant levels in the NHSM should be compared against the upper end of the statistical range of contaminant levels in the relevant traditional fuels. Alternatively, the average values of the NHSM should be compared with the average values of the traditional fuels. "Anything less could result in 'traditional fuel' samples being considered solid waste if burned in the very combustion units designed to burn them – not the Agency's intent in either the 2011 NHSM final rule or today's proposed rule."[28] However, using different bases for comparison could lead to different results. The EPA warned that "[i]t would not be appropriate to compare

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[22] *Example*: Copper "significantly enhance[s] the yield of [dioxins]" (see references below). Therefore, the presence of copper in the NHSM may result in the emission of these pollutants, which are listed under CAA § 129(a)(4). For information on the efficacy of copper in catalyzing the formation of Dioxin/Furnas, see for example, http://www.epa.gov/ncea/pdfs/dioxin/2k-update/pdfs/Dioxin_Chapter_2.pdf .

[23] See Letter from James R. Berlow (EPA) to Fadi K. Mourad (DTE Energy) dated March 16, 2012. In this case the EPA considered the affect of the design of the combustion unit on the formation of NO_x from N contained in the NHSM.

[24] E-mail from George Faison (US EPA) to Donald van der Vaart (NC DAQ), dated June 15, 2012. (As a delegatee of this regulatory program the NC DAQ does not comment on this interpretation of the rule but does note that EPA's interpretation herein provides that the design of the combustion unit is a consideration in the determination of whether the material to be burned is a NHSM.)

[25] 76 Fed. Reg. 80470 (Dec. 23, 2011).

[26] The proposed definition is as follows: "*Contaminants* means all pollutants listed in Clean Air Act sections 112(b) and 129(a)(4), with modifications outlined in this definition to reflect constituents found in non-hazardous secondary materials prior to combustion. The definition includes the following elemental contaminants that commonly form Clean Air Act section 112(b) and 129(a)(4) pollutants: Antimony, arsenic, beryllium, cadmium, chlorine, chromium, cobalt, fluorine, lead, manganese, mercury, nickel, nitrogen, selenium, and sulfur. The definition does not include the following Clean Air Act section 112(b) and 129(a)(4) pollutants that are either unlikely to be found in non-hazardous secondary materials prior to combustion or are adequately measured by other parts of this definition: Hydrogen chloride (HCl), chlorine gas (Cl_2), hydrogen fluoride (HF), nitrogen oxides (NO_x), sulfur dioxide (SO_2), fine mineral fibers, particulate matter, coke oven emissions, diazomethane, white phosphorus, titanium tetrachloride, m-cresol, o-cresol, p-cresol, m-xylene, o-xylene, and p-xylene." See 76 Fed. Reg. 80529 (Dec. 23, 2011).

[27] 76 Fed. Reg. 80470 (Dec. 23, 2011). At this point, however, this can only be considered as guidance from the EPA.

[28] 76 Fed. Reg. 80481 (Dec. 23, 2011).

an average NHSM contaminant value to the high end of a traditional fuel range, as the existence of an average implies multiple data points from which a more suitable statistic (*e.g.,* range or standard deviation) could have been calculated. Finally, the EPA warned that "in the context of an inspection or enforcement action, the Agency will evaluate the appropriateness of alternative methodologies and data sources on a case-by-case basis when determining whether the legitimacy criteria have been met."[29]

A Contaminant Comparison Table (CCT) is attached to this determination that provides a comparison between contaminants in the Edgecombe County LFG and natural gas (see Attachment). One area where comparisons were difficult was for those contaminants that were identified to be present in LFG but for which there was little or no data available to quantify the concentration of those same contaminants in natural gas.[30] As discussed above, the "comparison" test is not limited to the ultimate analysis of the as-fired material, but rather considered the emission rates of pollutants generated from the combustion of the NHSM.[31] Because EPA has acknowledged that emission rates can be considered as one factor of the comparison test, the NCDAQ employed a de minimis emissions-based approach for those compounds present in LFG but for which there was limited information for natural gas.[32] The de minimis approach consisted of estimating the potential emission rate of each contaminant and comparing that rate to the federal EPA's de minimis emission rates developed during the CAA §112(g) program.[33] The EPA's de minimis values were developed using air dispersion modeling and ambient health based data to establish emission rates that EPA considers trivial for regulatory purposes. The contaminants for which the EPA de minimis approach was used were acetonitrile, chloroethane (ethyl chloride), dichloromethane (methylene chloride), hydrogen sulfide, acetaldehyde, carbon disulfide, formaldehyde, methyl isobutyl ketone, and ethylbenzene. In all cases the expected emission rates of these contaminants from the combustion of this landfill gas were below their respective EPA de minimis emission rates.

Nitrogen is one contaminant that is present in LFG greater than ten times the concentration of natural gas (262,000 ppmv in LFG compared with a range between 3, 100 and 25,000 ppmv in natural gas). As EPA noted in their response to questions, they recommend comparing the emission rates of NOx. In this case, the NOx emission rate from the proposed engines while burning LFG is <0.99 grams per brake horsepower-hour (g/bhp-hr) which is equivalent to the NOx emission rate of the engine when burning natural gas. The

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[29] 76 Fed. Reg. 80482-3. (Dec. 23, 2011).

[30] As noted in the CCT, there was a dearth of information on concentrations of metals in as-fired natural gas. While the EPA's Survey Results included concentration ranges for metals in natural gas, these values were based on AP-42 factors that were developed from testing of dual fuel boilers (e.g. oil and natural gas). The NCDAQ concluded that the metals measured were not from the combustion of natural gas but rather the result of residual metals remaining on boiler surfaces from burning oil. There is no reason to expect any appreciable concentrations of metals in pipeline quality as-fired natural gas and therefore, unless otherwise noted, it was assumed that there were no metals in as-fired natural gas. Because metals were present in the landfill gas, as discussed above, the NCDAQ used the EPA de minimis approach for comparability purposes.

[31] E-mail from George Faison (US EPA) to Donald van der Vaart (NC DAQ), dated June 15, 2012 "We [EPA] draw a distinction between comparing "emissions" and comparing "constituents that will result in emissions." This distinction becomes particularly important when looking at constituents that are defined as contaminants based solely on the fact that they are precursors to 112/129 pollutants. Nitrogen is one such constituent. If unit designs are selected and combustion conditions are managed such that nitrogen doesn't form NOx, our logic for considering it as a contaminant falls apart."

[32] EPA stated in the proposed CAA §112(g) rulemaking, "In general, the concept of de minimis has been used by the courts for providing authority to regulatory agencies to make exceptions for regulation when the regulatory burdens of those affected by the rule would "yield a gain of trivial or no value." The EPA then described the proposed de minimis values as "levels of emission increases that would result in a trivial risk to the public health." See EPA-453\R-93-035.

[33] EPA-453\R-93-035, Documentation of De minimis Emission Rates – Proposed 40 CFR Part 63, Subpart B Background Document. The develop of the De minimis values was not affected by EPA's decision to abandon the modification provisions of the §112(g) program.

NOx emission rate is also compliant with New Source Performance Standards (NSPS), 40 CFR Part 60, Subpart JJJJ—Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, as well as with the National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 63, Subpart ZZZZ—National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (RICE MACT).

Based on the data provided the NCDAQ has concluded that the Edgecombe County LFG being burned in the 2G CENERGY gensets contains contaminants at levels comparable in concentration to or lower than those in natural gas (the traditional fuel the engine is designed to burn).

Conclusion

Because the LFG being burned remains within the control of the generator and because the LFG meets the legitimacy criteria (managed as valuable commodity, meaningful heating value, and has comparable or lower contaminant concentrations) the NCDAQ has determined that the Edgecombe County landfill gas proposed to be burned in the proposed gensets is not a solid waste pursuant to 40 CFR §241.3. If you have any questions regarding this NHSM determination, please contact me at (919) 707-8475.

Sincerely,

Donald van der Vaart, Ph.D., P.E., J.D.
Chief, Permits Section

Attachment

c: Charles McEachern

Contaminant Comparison Table Between Edgecombe County LFG and Natural Gas

Contaminant	Natural Gas ppmv (unless otherwise noted)	Source	Landfill Gas ppmv (unless otherwise noted)	Source	MW	SCFM (77°F)	lb/hr	tpy	EPA de minimus (tpy unless otherwise noted)	Notes
Nitrogen	3,100 - 25,000	Perry's Handbook	8,200	Site Test						Within traditional fuel range
Sulfur	0.34 ppmw		Not detected	Site Test						Lower than traditional fuel
Hydrogen Sulfide (H_2S)	1,800	Ohio Raw Gas Sample	Not Detected	Site Test						Lower than traditional fuel
Metals										
Arsenic (As)	35.5 - 86.5	EPA/OAQPS Survey for Final NHSM Rule	0.004	EPA Field Tests (Raw LFG)	74.9	720	3.30E-05	0.0001	0.005	Lower than EPA de minimis
Beryllium (Be)	20.3 - 45.6	EPA/OAQPS Survey for Final NHSM Rule	No data							
Cadmium (Cd)	3.6 - 8.3	EPA/OAQPS Survey for Final NHSM Rule	0.00098	EPA Field Tests (Raw LFG)	112.4	720	1.21E-05	0.0001	0.01	Lower than EPA de minimis
Chlorine (Cl)	2140 - 2870	EPA/OAQPS Survey for Final NHSM Rule	No data							
Chromium (Cr)	164.3 - 274.6	EPA/OAQPS Survey for Final NHSM Rule	0.008	EPA Field Tests (Raw LFG)	52.0	720	4.59E-05	0.0002	0.002	Lower than EPA de minimis
Lead (Pb)	55.3 - 78.3	EPA/OAQPS Survey for Final NHSM Rule	0.005	EPA Field Tests (Raw LFG)	207.19	720	1.14E-04	0.001	0.01	Lower than EPA de minimis
Manganese (Mn)	102.4 - 165.5	EPA/OAQPS Survey for Final NHSM Rule	0.011	EPA Field Tests (Raw LFG)	54.9	720	6.66E-05	0.0003	0.8	Lower than EPA de minimis
Mercury (Hg)	0.022 - 0.051	EPA/OAQPS Survey for Final NHSM Rule	0.00134	EPA Field Tests (Raw LFG)	200.6	720	2.96E-05	0.0001	0.01	Lower than EPA de minimis
Nickel (Ni)	179.5 - 328.6	EPA/OAQPS Survey for Final NHSM Rule	0.0383	EPA Field Tests (Raw LFG)	58.7	720	2.48E-04	0.001	0.04	Lower than EPA de minimis
Organics										
Acetaldehyde (C_2H_4O)	No Data Available		0.0293	EPA Field Tests (Raw LFG)	44	720	1.42E-04	0.001	9	Lower than EPA de minimis
Acetonitrile	No Data Available		0.121	Orange Site Test**	41.1	720	5.48E-04	0.002	4	Lower than EPA de minimis
Acrolein (C_3H_4O	No Data Available		0.01	Orange Site Test**	56.1	720	6.18E-05	0.0003	0.04	Lower than EPA de minimis
Acrylonitrile	No Data Available		0.01	Orange Site Test**	53	720	5.84E-05	0.0003	0.3	Lower than EPA de minimis
Allyl Chloride	No Data Available		0.01	Orange Site Test**	76.5	720	8.44E-05	0.0004	1	Lower than EPA de minimis
Benzene	5.1 - 8.3	Boiler Fuel Sample	0.34	Site Test	--	--	--	--	--	Lower than traditional fuel
Benzyl Chloride	No Data Available		0.001	Site Test*	126.6	720	1.40E-05	0.0001	0.1	Lower than EPA de minimis
1,3 Butadiene	No Data Available		0.01	Orange Site Test**	54.1	720	5.96E-05	0.0003	0.07	Lower than EPA de minimis
t-Butyl Methyl Ether	No Data Available		0.001	Site Test*	88.1	720	9.72E-06	0.00004	10	Lower than EPA de minimis
Carbon Disulfide	No Data Available		0.005	Site Test*	76	720	4.19E-05	0.0002	1	Lower than EPA de minimis
Carbon Tetrachloride	No Data Available		0.001	Site Test*	153.8	720	1.70E-05	0.0001	1	Lower than EPA de minimis
Carbon Tetrachloride	No Data Available		0.081	Site Test	112.56	720	1.01E-03	0.004	10	Lower than EPA de minimis
Chloroethane (ethyl chloride)	No Data Available		0.58	Site Test	64.5	720	4.12E-03	0.02	10	Lower than EPA de minimis
Chloromethane (methyl chloride)	No Data Available		0.002	Site Test*	50	720	1.10E-05	0.00005	10	Lower than EPA de minimis
Chloroform	No Data Available		0.001	Site Test*	119.4	720	1.32E-05	0.0001	0.9	Lower than EPA de minimis
1,2-Dibromoethane (ethylene dibromide)	No Data Available		0.001	Site Test*	187.9	720	2.07E-05	0.0001	0.1	Lower than EPA de minimis
1,4-Dichlorobenzene	No Data Available		0.001	Site Test*	147.0	720	1.62E-05	0.0001	3	Lower than EPA de minimis
1,1-Dichloroethane	No Data Available		0.072	Site Test	99.0	720	7.86E-04	0.003	1	Lower than EPA de minimis
1,2-Dichloroethane (ethylene dichloride)	No Data Available		0.001	Site Test*	99.0	720	1.09E-05	0.00005	0.8	Lower than EPA de minimis
1,2-Dichloroethene	No Data Available		0.61	Site Test	96.9	720	6.52E-03	0.03	NA	Not HAP
Dichlorodifluoromethane	No Data Available		0.19	Site Test	120.9	720	2.53E-03	0.01	NA	Not HAP
1,2-Dichloropropane (propylene dichloride)	No Data Available		0.001	Site Test*	113.0	720	1.25E-05	0.0001	1	Lower than EPA de minimis
1,3-Dichloropropene	No Data Available		0.001	Site Test*	111.0	720	1.22E-05	0.0001	1	Lower than EPA de minimis
Dichloromethane (methylene chloride)	No Data Available		0.083	Site Test	84.9	720	7.77E-04	0.003	10	Lower than EPA de minimis
1,4-Dioxane	No Data Available		0.01	Orange Site Test**	88.1	720	9.71E-05	0.0004	6	Lower than EPA de minimis
1,1-Dichloroethene (vinylidene chloride)	No Data Available		0.001	Site Test*	96.9	720	1.07E-05	0.00005	0.4	Lower than EPA de minimis
Ethylbenzene	1	Johnston County	2.2	Site Test	106.2	720	2.57E-02	0.11	10	Lower than EPA de minimis

Contaminant Comparison Table Between Edgecombe County LFG and Natural Gas

Contaminant	Natural Gas ppmv (unless otherwise noted)	Source	Landfill Gas ppmv (unless otherwise noted)	Source	MW	SCFM (77°F)	lb/hr	tpy	EPA de minimus (tpy unless otherwise noted)	Notes
4-Ethyl Toluene	No Data Available		0.29	Site Test	120.2	720	3.84E-03	0.02	NA	Not HAP
Hexane	No Data Available		21	Site Test	86.2	720	2.00E-01	0.9	10	Lower than EPA de minimis
Methyl Bromide (bromomethane)	No Data Available		0.001	Site Test*	94.9	720	1.05E-05	0.00005	10	Lower than EPA de minimis
Methyl Ethyl Ketone (2-Butanone)	No Data Available		1.7	Site Test	72.1	720	1.35E-02	0.06	10	No longer a HAP
4-Methyl-2-Pentanone (MIBK)	No Data Available		0.001	Site Test*	100.2	720	1.10E-05	0.00005	10	Lower than EPA de minimis
Styrene	No Data Available		0.16	Site Test	104.1	720	1.84E-03	0.01	1	Lower than EPA de minimis
Tetrachloroethene	No Data Available		0.15	Site Test	165.8	720	2.74E-03	0.01	10	Lower than EPA de minimis
Toluene	4.0 - 11.2	Boiler Fuel Sample	8.5	Site Test	92	720	8.62E-02	0.4	10	Lower than EPA de minimis
1,1,1-Trichloroethane (methyl chloroform)	No Data Available		0.001	Site Test*	133.4	720	1.47E-05	0.0001	10	Lower than EPA de minimis
Trichloroethene	No Data Available		0.085	Site Test	131.4	720	1.23E-03	0.01	10	Lower than EPA de minimis
1,3,5-Trimethylbenzene	No Data Available		0.1	Site Test	120.2	720	1.33E-03	0.01	NA	Not HAP
1,2,4-Trimethyl benzene	No Data Available		0.3	Site Test	120.2	720	3.98E-03	0.02	NA	Not HAP
Vinyl Chloride	No Data Available		2.6	Site Test	62.5	720	1.79E-02	0.08	0.2	Lower than EPA de minimis
o-xylene	No Data Available		0.8	Site Test	106.16	720	9.36E-03	0.04	10	Lower than EPA de minimis
m&p-xylene	No Data Available		2.6	Site Test	106.16	720	3.04E-02	0.13	10	Lower than EPA de minimis
Xylene (mixed isomers)	1		3.4	Site Test	106.16	720	3.98E-02	0.17	10	Lower than EPA de minimis

*Actual site test results were non-detectable; therefore, lowest detectable test value was used as a conservative measure.

391.835 scf/lbmole at 77° F

**Results from Orange County Landfill Site Test.