Environmental and Planning Consultants

440 Park Avenue South
7th Floor
New York, NY 10016
tel: 212 696-0670
fax: 212 213-3191
www.akrf.com

Memorandum

To: File

From: Hillel Hammer

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Re: Marcellus Shale DSGEIS: Summary of Comments on Air Quality and Greenhouse Gas Analyses

The following sections summarize our comments regarding air quality and greenhouse gasses. Overall, both air quality and greenhouse gas sections include extensive and high quality analysis. NYSDEC is especially commended on the extensive greenhouse gas analysis. However, the DSGEIS does not require adequate mitigation for the potential significant adverse impacts, and permit limitations which would ensure that the impacts disclosed indeed represent the reasonable worst case were not included in the DSGEIS.

A. AIR QUALITY

Some of the assumptions used to model the emissions and dispersion of pollutants in the DSGEIS underestimate the potential emissions and resulting concentrations. In some cases, the difference between what was assumed in the DSGEIS and a reasonable worst-case assumption is significant. As a result, emissions and concentrations could be significantly higher and, based on the current results, this would likely result in undisclosed significant adverse impacts.

Furthermore, since the DSGEIS does not specify permit conditions setting operating or emissions limits for air pollution sources, there are no enforceable air pollution limits set. Therefore, air quality impacts could be substantially higher if actual pollutant sources are used in excess of the estimated durations or if actual equipment type and quantity exceed the estimates.

Equipment:

1. The reasonable worst-case air pollution emissions would be the operation of two concurrent drilling rigs,[1] not just one, unless simultaneous operation of two drilling rigs on a single pad is prohibited.
2. Engine Tiers:
    a. Since NYSDEC has not proposed limiting the engines by certification, assuming Tier 1 for the worst-case short-term emissions is not a reasonable worst-case, since any given site could employ uncertified ('Tier 0) engines. Uncertified engines have extremely high emission rates for criteria pollutants such as particulate matter.
    b. Similarly, using Tier 2 for typical average long-term (e.g., annual average) modeling is inappropriate, since any given site may use uncertified or Tier 1 engines.

[1] DSGEIS at Section 5.2.2 states:"*One operator has stated that on a well pad where six or more wells are needed, it is possible that two triple-style rigs may operate concurrently*."

c. While Tier 2 may be a reasonable estimate for region-wide emissions (e.g., NOx, VOC, regional $PM_{2.5}$), there is no calculation to demonstrate this. A better estimate would include a 'fleet average' emission (similar to those produced by EPA's NONROAD model).

As set forth below ("Mitigation"), given the results of the analyses, NYSDOT should require engines with higher Tier certification. If those requirements are included, the modeling could use the required higher-Tier assumptions as a worst-case.

3. It is not clear whether the modeling used the largest rig for the entire duration or a combination of small and large rig. While some operators may use a smaller rig for the upper section of the well, and then transition to a larger rig to drill the horizontal section of the well bore, the text of the DSGEIS states that sometimes the larger rig would be used for the full duration.

4. Shallow gas diverter valves are used to vent gas to atmosphere while drilling the first part of the well. Vented gas estimates should be included in the analysis.

5. The emissions factors used for modeling (listed in the ALL 2009 report, Table 5) are cited as "EPA Tier emissions factors" but no source is cited. If the reference indicates the use of EPA regulation levels as emission factors, this would not include engine deterioration, which results in higher emissions over time.

Duration, Production Rates, and Other Emissions Assumptions:

6. NYS has not set any limit, in the DSGEIS or elsewhere, on the type of chemicals that can be used in fracture treatment; therefore, there is no assurance that the air quality impact analysis in section 6.5.2, based on an assumed representative set of chemicals, represents a worst case scenario or is even representative of the emissions that will actually occur in the field.

7. The maximum number of drilling days appears to be underestimated. Section 6.5.2.3, p. 6-72, states the worst case air modeling was completed at a maximum of 250 days of operations for drilling engines, maximum of 20 days for hydraulic fracturing engines, and maximum of 30 days of flaring in a given year. Yet the operating assumptions found elsewhere in the document show that this is not a worst-case scenario:

   Page 6-53 states 10 wells per drill site per year, drilled and completed. Page 5-22 states that each well takes approximately one month to drill (4 weeks = 28 days). Ten wells times 28 days = 280 days not 250. Page 5-23 says that "*In summary, the rig work for a single horizontal well – including drilling, casing and cementing—would generally last about* ***four to five weeks, subject to extension*** *for slow drilling or other unexpected problems or delays.*" (emphasis added), while page 5-126 says that each well will take at least 4 weeks, explaining that it could be **2 weeks for vertical section and up to an additional 30 days** for the horizontal section—that would be 44 days per well maximum. Therefore, the maximum drill and completion timeframe is 44 days per well not 28. Ten wells per drill site equates to 440 days of drilling per rig. That could put an annual worst case drilling day estimate at 365 days per year, and more if multiple rigs are employed simultaneously.

8. Page 6-120 states that "*A flaring period of three days was considered for this analysis although the actual period could be either shorter or longer.*" The modeling needs to represent a reasonable worst case. The longest reasonable expected flare period should be used.

9. Page 6-61 states that venting was only considered for short term impacts. Since there is no requirement listed which would preclude venting, this would not seem to represent the reasonable worst case.

10. Section 6.5.1.2 concludes that production is estimated to be below 3 MMSCFD. This contradicts the ICF International August 2009 report, Subtask 2.5 (p. 26), that concludes: "*Information gathered by NYSERDA and NYS DEC field trips to Marcellus Shale well sites indicate a potential production rate of 7 to 10 MMscf per day.*"

Dispersion Modeling and Concentrations:

11. Only 2 years of meteorological data were used. Due to the high variability, the standard modeling procedure is to use 5 years of meteorology to determine the worst-case dispersion conditions (EPA, 40 CFR Part 51 Appendix W, §8.3.1.2, November 2005). Data for all stations is readily available. Although the total set included data for 6 locations, and therefore a total of 12 data sets, since these were all from the same two actual meteorological years, they are connected and therefore do not represent a full range of annual and short-term conditions as would be represented in data from 5 separate years.

12. The use of the 98th percentile value for $PM_{2.5}$ increments is incorrect. Incremental values are normally calculated for the highest value, and may be combined with the 98th percentile background to estimate total

values. Alternatively, if the modeled increments dominate (i.e., are much higher than the background), the 98th percentile increment may be used to calculate total concentrations in combination with the highest background. However, the use of 98th percentile increment for the purpose of comparison with incremental thresholds such as the NYSDEC annual and 24-hour average values of 0.3 and 5 $\mu g/m^3$, respectively, is incorrect regardless of the total concentrations.

REGION-WIDE EMISSIONS ANALYSIS

The air quality analysis does not disclose the expected total region-wide criteria pollutant emissions for the various nonattainment areas. The SGEIS will represent a generic analysis of individual potential sites, but is also required to examine the total cumulative impacts of all of these potential sites. An obvious potential cumulative impact is the combined regional criteria pollutant emissions from all potential sites in all relevant nonattainment areas. The total potential emissions in each nonattainment area should be disclosed and discussed in the context of existing or future SIP emission budgets.

A best estimate of the reasonable worst-case overall operations likely to occur per year is required under SEQRA to evaluate the region-wide implications and determine the need for mitigation. The difficulty in "accurately" predicting the unique nature of the New York play does not absolve NYSDEC of its obligation to present a best estimate. This requirement is not covered under the "regulatory analysis" provided in the DSGEIS.

The State is likely to encourage natural gas usage while discouraging higher-carbon fuels in order to meet its greenhouse gas goals (as stated in Executive Order 24 of 2009 and in the State Energy Plan, 2009), through the Climate Action Plan it is currently developing. Therefore, the regional estimates should include an assumption regarding the price signal associated with those future policies and its impact on the annual production rate. The DSGEIS includes one estimate of the establishment of 2,000 wells per year (Section 6.13.2.1, Regional Cumulative Impacts), and indicates that over 1,100 permits were issued in 9 months in 2009 (through the end of August). These estimates are prior to the above mentioned future policy considerations, but these policies would likely result in higher production rates in future years.

In addition, the State will need to address the regional emissions via the State Implementation Plan (SIP) process for existing and future SIPs. As such, the State should disclose, in this SGEIS, how it will offset these emissions or otherwise meet its emissions targets while including these emissions.

MOBILE-SOURCE ANALYSIS

Mobile-source emissions are not addressed at all in the DSGEIS. Potential emissions should be screened at an intersection level to determine if there is a need for dispersion analysis and if there is potential for local impacts. In addition, the total region-wide emissions from mobile sources should be included in a regional emissions analysis, also missing (see above).

MITIGATION

1. Permit Operational Limits

The analysis and its conclusions are based on estimated operations levels, rather than on potential to emit, but there is no commitment to restricting operations via permit specifications. In order to ensure that the impacts do not exceed the disclosed levels, permit limits must be set for operations—hours and duration of operations, and equipment types and quantities at any given site.

In general, the mitigation section for Air Quality does not require any mitigation. Instead, it simply lists measures "*possible mitigation measures*". Currently, the DSGEIS does not identify any required mitigation or mitigation level, and therefore, does not demonstrate in any way that mitigation will be implemented, as required by SEQRA. As discussed above, the DSGEIS does not even acknowledge potential significant adverse impacts, underestimates the impacts disclosed, and does not demonstrate the effectiveness of mitigation or include many available mitigation measures (detailed below).

The Proposed Supplementary Permit Conditions (Appendix 10, §32) states that "*Fracturing products **other than those identified in the well permit application** materials may not be used without specific approval from this office. The Department will require submission and review of chemical information for any product which has not previously been reviewed, and **may** require a site-specific environmental assessment and SEQRA determination*

prior to approving commencement of hydraulic fracturing operations based on a change in fracturing products." (emphasis added). The conditions should state that if any substances identified in the well permit application were not included or would exceed the quantities identified in the FSGEIS analysis, and may result in the emission of toxic or criteria pollutant emissions, a site-specific environmental assessment and SEQRA determination would be required prior to approval.

2. Restricting Public Access and Stack Heights:

Since the definition of "ambient air" includes any area to which the public would have continuous access, the DSGEIS proposes to significantly enlarge sites to include any areas where potential significant adverse air quality impacts were predicted in order to restrict public access to these areas—in some instances to as much as a 1,000 meter distance. Note that the DGEIS identifies the need for a 500 **meter** buffer for particulate matter (p. 6-85, 7-88), and then requires a buffer of only 500 **feet** for mitigations (p. 7-89).

This type of "mitigation" would require additional land use, and result in impacts associated with disturbing those lands for fencing and creating access to those areas—an action which is not reviewed in the DSGEIS and which could result in additional undisclosed impacts, and would contribute nothing to reducing region-wide emissions. Since the preferred approach is always to mitigate potential impacts on-site to the extent practicable, and since practicable methods are available and commonly used elsewhere, it is not reasonable to rely on restricting public access to these areas and increasing stack heights as the preferred and only solution. Instead, proper mitigation can and should be required, as detailed in the sections below. The old adage "dilution is not the solution to pollution" is quite apt in this case.

3. Green Completions and Prohibition of Venting:

Section 6.5.1.3 of the DSGEIS states that green completions are not required in NY State. Although oil and gas exploration may not have been a major focus in the past, this action will enable large scale natural gas drilling operations throughout the state, and natural gas is likely to be encouraged further in the coming years due to its low-carbon and low-emissions properties when used as a fuel.

Therefore, we strongly advocate that state regulations require green completions once the first well on a pad is drilled and a pipeline is in place, and allow venting only in case of emergency, as is common in current operations of many industry members. For example, many industry members reporting to the EPA Natural Gas STAR program are voluntarily instituting this procedure and report substantial profits related to recovering the gas and selling it to market instead of venting to the atmosphere (http://www.epa.gov/gasstar). In cases where sales lines exist nearby, or where the likelihood of the first site producing marketable gas is high, green completions should be required prior to the first well being established. However, since such regulations are not yet in place, the FSGEIS must make green completions and the prohibition on venting a strict requirement for any drilling operation permitted under this action.

4. Dehydrators:

Section 6.5.1.2 concludes that dehydration units used for the gas development will be exempt from EPA's NESHAP requirements since production is estimated to be below 3 MMSCFD or benzene below 1 tpy. This conclusion conflicts with ICF International's August 2009 Report, Subtask 2.5 (p. 26), that concludes: *"Information gathered by NYSERDA and NYS DEC field trips to Marcellus Shale well sites indicate a potential production rate of 7 to 10 MMscf per day."*

5. Flowback Emissions:

Section 6.5.1.8 concludes that *"Based on an assumed installation of ten wells per wellsite in a given year, an annual methanol air emission* [estimate] *of **32.5 tons** (i.e., "**major" quantity of HAP**) is theoretically possible at a central impoundment."* (emphasis added).

The DSGEIS presents inconsistent approaches to mitigating this issue (p. 7-55, 7-88, 7-89, 7-90). It is very unclear what NY State is actually proposing. Is the operator required to eliminate toxic chemicals, stop using impoundments and flow to tankage, complete more site specific modeling, or just build a larger fence?

Flowback into central impoundments should not be allowed. Flowback should be routed to closed/controlled tank/pipeline collection and treatment systems and the use of toxic and bioaccumulating substances should be eliminated. NY State should clearly list the compounds analyzed and their assumed quantities, and include a requirement that any use of other substances not analyzed in the FSGEIS, or larger quantities of the analyzed substances, require full disclosure and analysis of potential adverse impacts as an action not covered in this SGEIS.

6. Dual Fuel and Electricity:

A basic and common mitigation approach, overlooked by the DSGEIS, is the use of cleaner engines and fuels. Specifically, in areas where a connection to the electric power grid is available, electric engines should be used in lieu of diesel wherever practicable. This would eliminate entirely the local diesel exhaust from those engines. Alternatively, if a connection is not available, but a site is producing usable natural gas (where separation and dehydration capability exists on-site), electricity could be provided using fuel cells fueled with natural gas, or, if fuel cells are not practicable, natural gas generator sets could be used.

For engines or situations where electricity is not a practicable option, but where a site is expected to produce usable natural gas, the use of dual fuel engines would enable switching from diesel to natural gas once it is available.

The use of electric and natural gas engines would result in reduced local pollutant emissions and overall greenhouse gas emissions (both grid power and natural gas have a lower carbon footprint than diesel), and would generally have associated cost savings due to the use of the fuel produced on-site, reduced fuel transportation and storage needs (double-wall tanks), and reduced risk of tank leakage and cleanup.

7. Diesel Particle Filters and Engine Tier:

As mentioned above, the DSGEIS identifies unacceptable increases in particulate matter concentrations, but determines that creating larger sites and increasing stack heights will mitigate the significant adverse impacts by making the area not accessible to the public. This solution would create additional problems and does nothing to reduce region-wide emissions. The most common mitigation measure for reducing particulate matter emissions from diesel engines, currently used for many construction projects in New York, is the requirement for best available control technologies, including the use of engines equipped with diesel particle filters (DPFs). This type of control program is legally required for all New York City construction, is routinely required for all large private and public construction projects in New York City including federal and State projects, does not add significant cost to implement, and is readily available. Since diesel particulate matter has been shown to be carcinogenic as well, one of the largest side benefits to such programs is the protection of the health of the workers on-site.

NYSDEC should require that:

- All engines with a power output of 50 horsepower or greater be equipped with a DPF, either original engine manufacturer or retrofit, including active DPF as necessary.
- All diesel engines (of any size) should be certified Tier 2 or higher.

B. GREENHOUSE GASES COMMENTS

MODELING ASSUMPTIONS

Many of the modeling assumptions called out as potentially underestimating criteria pollutant emissions (see "Air Quality", above) would also result in underestimated greenhouse gas (GHG) emissions. The following list indicates items which would impact GHG emissions, and full details can be found above in the air quality section:

1. *Simultaneous multiple drilling rig operations not accounted for*: This would result in higher per-year per-site GHG emissions.
2. *Drilling duration*: If drilling duration is longer than assumed, overall drilling emissions would be underestimated. This would result in higher first-year emissions, and in an overall longer duration of operations per site.
3. *Flaring duration*: A flaring duration of 3 days was assumed, but it is not clear if this represent an average per well. Representative flaring duration data should be obtained and presented.
4. *Venting*: NYSDEC states the importance of avoiding vented methane emissions, but sets no requirement to avoid such events and does not disclose emissions associated with longer events. A strict requirement to avoid venting other than in case of emergency should be enforced.

In addition, the following assumption was used only for the GHG analysis:

5. *Assumed only 20 miles for in-state round trip for on-road emissions:* presenting such a trip and the associated emissions as a reasonable low-end estimate, for the purposes of highlighting the potential benefits of local operations, may be reasonable. However, in most cases, this may be a gross underestimate even in-state since many remote locations will require transport for considerably longer distances. In addition to the scenarios presented, a reasonable estimate should be made representing average in-state distances and included in the per-site and statewide emissions totals (see more on total summaries below).

MODELED COMPONENTS

Fugitive emissions

Fugitive emissions were not disclosed. The DSGEIS acknowledges that it is appropriate to analyze fugitive emissions (p. 6-111), but goes on to state "*However, relative to combustion and process emissions, fugitive CH_4 and CO_2 contributions are insignificant*.", citating a 2003 report from the International Petroleum Industry Environmental Conservation Association and the American Petroleum Institute. Page 3-10 of that document states, "*General categories of direct emissions sources that should be included in inventories are … [f]ugitive losses from equipment leaks such as from gas pipeline systems.*" Page 3-15 states that, with respect to indirect emission sources, "*companies are encouraged to be able to account for selected indirect sources including … [t]hird party shipping of … petroleum products … by pipeline up to the point of custody transfer.*", and API provides methods for estimating these emissions, with an update in August 2009. Thus the DSGEIS is misleading in quoting the API as saying that pipeline leakage is insignificant.

Indeed, most greenhouse gas inventories including, for example, the US national inventory and the New York State inventory do include these emissions, precisely because they are not negligible and are mitigable. Distribution losses from natural gas systems are called out explicitly in the 2009 NY State GHG Inventory as 1.85 percent of total state-wide emissions, and are therefore a significant source. This fraction may be larger if large scale production and distribution in the State grows as a consequence of this action.

Since the SGEIS will enable widespread natural gas operations throughout the state, the undisclosed increase in fugitive emissions, if left unmitigated, is likely to be substantial.

Fuel Use

The NYSDEC guidance for GHG analyses in EISs states that "*Project proponents should not be required to include the emissions (either qualitatively or quantitatively) from the use of products that will be produced or sold at the project site, **except where the projects involve fuel production***." (emphasis added, NYSDEC 2009). According to that guidance, the use of the gas produced state-wide should be analyzed, to address—

a. The potential change in net fuel use (e.g., would the production reduce natural gas prices);

b. The fuel use that may be offset by this natural gas (e.g., reduction if replacing oil, increase if replacing other natural gas produced with a lesser carbon footprint).

SUMMARY OF EMISSIONS

Lack of Disclosure of Total Per-Site Emissions

The DSGEIS does not disclose the total GHG emissions expected per site. Unlike criteria pollutants, the annual rate of GHG emissions is only important for continuous emissions (e.g., development projects). There is little or no difference between the impacts associated with one well operating for two years and with two well operating for one year. Table 6.15 (p. 6-126) discloses the annual first-year and subsequent-year emissions, but does not include an estimate of the range and/or average number of years for which production will continue. Although much uncertainty exists, a best-estimate range and average duration and the total associated emissions should be presented.

Lack of Disclosure of Statewide Emissions

The GHG analysis does not disclose the expected state-wide GHG emissions expected for the duration of overall operations throughout the state. The DSGEIS represents a generic analysis of individual potential sites, but is also required to examine the cumulative impacts of all of these potential sites. An obvious potential cumulative impact is the combined state-wide GHG emissions from the sites.

A best estimate of the reasonable worst-case (e.g., assuming the full exploitation of the Marcellus Shale to the extent practicable by year X) is required under SEQRA in order to evaluate the long-term implications and determine appropriate mitigation. The DSGEIS states that "*It is estimated that the entire Marcellus shale may hold between 168 and 516 trillion cubic feet of gas".* (See more in the Air Quality section above, under "Region-Wide Emissions Analysis".)

It is likely that these activities will be included in the current efforts being undertaken by NY State to formulate a Climate Action Plan (CAP) that will identify policies to reduce GHG emissions from all sectors, including the Oil and Gas sector. The emissions associated with this project will need to be included in the State GHG Inventory as well as the potential mitigation programs included in the NY State CAP.

As an agency directly involved in the CAP effort, NYSDEC would do well to identify potentially practicable policies and requirement now, through this EIS process, and thus ensure that the proper requirements are included in drilling permits and enforced, rather than attempt to put restrictions in place after operations have begun and the State has less opportunity to do so, while losing years of sector emissions reductions in the process. By not addressing these issues at this juncture, NYSDEC would be at odds with the various State policies and guidelines regarding energy efficiency and GHG emission reductions.

MITIGATION

In general, the mitigation section for GHG emissions does not require any mitigation. Instead, it simply lists measures that "could be included". Certain mitigation, identified as practicable, should be required of all permit applicants. Failing to do so would be contrary to current state policies and to SEQRA. Currently, the DSGEIS does not identify any required mitigation or mitigation level, and therefore, does not demonstrate in any way that mitigation will be implemented, as required by SEQRA. The Proposed Supplementary Permit Conditions (Appendix 10, §1.c) states that operations must be conducted in accordance with a site specific "*greenhouse gas emissions impacts mitigation plan consistent with the SGEIS*", but since the SGEIS does not require anything, it is not clear what would be required or if any GHG reduction measures would be implemented as a result.

New York State Policy commits the State to achieving an 80 percent reduction in GHG emissions by 2050. This goal poses a significant challenge and cannot be achieved by focusing only on large sources—e.g., ignoring fugitive emissions, not considering the use of biofuels, and more, especially when considering the potential statewide implications of this action. National and state GHG inventories identify these sources precisely for that reason: to enable mitigation.

Furthermore, the exploitation of the shale natural gas reserves is presented as a mid-term solution to reducing GHG emissions by using the lower-carbon natural gas instead of oil and/or coal. The degree to which lifecycle GHG emissions associated with the use of natural gas would be lower than higher-carbon fuels is dictated not only by the nature of the fuel itself, but by the actions taken to avoid emissions during production and delivery of the natural gas. All practicable efforts should be made to ensure that the natural gas produced in NY State will have the lowest practicable carbon footprint.

The mitigation "options" presented in the DSGEIS focused on vented and flared emissions, which are obvious candidates for controls, but the DSGEIS does not require even those measures. Existing control methods for these emissions should be required as a matter of course:

1. *Green Completions and Prohibition of Venting*: see the air quality "Mitigation" section, above.
2. *Natural Gas Star:* Requiring participation in the Natural Gas STAR program would be a positive step toward identifying emissions reduction opportunities and sharing information.

However, focusing on these obvious sources should not serve to minimize the need to examine and require, as appropriate, other more standard GHG reduction measures, as outlined in the NYSDEC GHG EIS analysis guidance and required of all projects now reviewed by NYSDEC. Relevant measures include:

3. *Dual Fuel and Electricity*: see the air quality "Mitigation" section, above. The purchase of renewable electricity should be considered as well.
4. *Biofuels:* In cases where electricity and natural gas cannot be used, the use of biodiesel should be considered. Biodiesel blends of up to 20 percent (B20) can generally be used in diesel engines without any modification, although minor modifications are sometimes required for blends above 5 percent (B5). With the current biodiesel production methods specific to NY State, this would result in the reduction estimated to be between 3-13 percent on an energy basis, on average (based on NY-GREET model, NYSERDA, 2007), and the cost is relatively low. Higher level blends such as B80 or even full biodiesel (B99 or B100) are currently being used for many applications and should be investigated as well. These would achieve much higher GHG reductions, up to 67 percent on average. Note that although some engine manufacturers have stated that their warranty will not cover damage by these higher blends, they would still be required to honor the warranty conditions for any other damage, and a properly implemented program would not cause damage to engines as a result of the use of the fuel. Priority should be given to biodiesel produced from recycled oils and waste products.
5. *Reducing Distribution Losses and Other Fugitive Emissions:* Ensuring tightly sealed flow connections, and performing leak detection and corrective action should be required and an enforcement program implemented. Note that distribution losses from natural gas systems are called out explicitly in the 2009

NY State GHG Inventory as 1.85 percent of total state-wide emissions, and are therefore a significant source. This fraction would be even larger if large scale production and distribution in the State grows as a consequence of this action.

6. *Lighting and Other Electrical Uses:* the choice of energy efficient systems and practices can minimize electricity consumption.

7. *Best Management Practices:* USEPA's Natural Gas STAR Best Management Practices (p. 7-94) should be evaluated for each proposed permit application, and any measures found to be practicable should be required.