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## What We Can Learn From Pennsylvania DEP's Marcellus Air Monitoring Studies

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On January 31, the Pennsylvania Department of Environmental Protection released a study<sup>1</sup> of air quality around Marcellus Shale operations in northeastern Pennsylvania. Here are some typical headlines from articles on the study: "Pa. DEP study finds Marcellus air emissions OK,"<sup>2</sup> "DEP Says Air Near Marcellus Drilling Sites Is Safe,"<sup>3</sup> or even "DEP finds no health threat from Marcellus air emissions."<sup>4</sup>

If those headlines are accurate, why do GASP and other environmental organizations keep going on and on<sup>5</sup> about



<sup>1</sup> PADEP, NORTHEASTERN PENNSYLVANIA MARCELLUS SHALE SHORT-TERM AMBIENT AIR SAMPLING REPORT (Jan. 12, 2011), *available at*: [http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus\\_NE\\_01-12-11.pdf](http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_NE_01-12-11.pdf) [hereinafter PADEP NE REPORT].

<sup>2</sup> WJAC-TV, Pa. DEP Study Finds Marcellus Air Emissions OK (Jan. 31, 2011) *available at*: <http://www.wjactv.com/news/26679878/detail.html>.

<sup>3</sup> WBNG, DEP Says Air Near Marcellus Drilling Sites Is Safe (Jan. 31, 2011) *available at*: <http://www.wbng.com/news/local/DEP-Says-Air-Near-Marcellus-Drilling-Sites-Is-Safe-114951289.html>.

<sup>4</sup> Scranton Times Tribune, DEP finds no health threat from Marcellus air emissions (Feb. 1, 2011), *available at*: <http://thetimes-tribune.com/news/dep-finds-no-health-threat-from-marcellus-air-emissions-1.1098111>

<sup>5</sup> See e.g., Pittsburgh Post-Gazette, Shale gas can pollute the air, too (Nov. 1, 2010) *available at*: <http://www.post-gazette.com/pg/10305/1099670-109.stm>; GASP Presentation, Addressing Air Emissions from Marcellus Shale Natural Gas Production (Jan. 30, 2011) *available at*: <http://gasp-pgh.org/wp-content/uploads/2011/01/GASP-marcellus-presentation-1-30-2011.pdf>; Wildearth Guardians, Clean Air at Risk from Expanded Oil and Gas Drilling Along Colorado's Front Range (Jan. 19, 2011) *available at*: [http://www.wildearthguardians.org/site/News2?page=NewsArticle&id=6493&news\\_iv\\_ctrl=1194](http://www.wildearthguardians.org/site/News2?page=NewsArticle&id=6493&news_iv_ctrl=1194);

the massive quantities of air pollution that result from natural gas production? Both can't be true, right? So what explains the discrepancy?

## *Limitations of the DEP Studies*

First, as DEP acknowledges, the data collected during this study simply is not sufficient to support the bold, sweeping claims found in headlines like those I listed above. This study, as well as a similar study<sup>6</sup> from southwestern Pennsylvania DEP released last fall, selected a few sites where natural gas activity was occurring and conducted air monitoring at each of these sites on no more than 4 days.<sup>7</sup> The goal was to determine if any of 44 specific pollutants DEP selected<sup>8</sup> were present in the atmosphere in sufficient concentrations that breathing that air for a short period (generally somewhere between 1 hour and 24 hours) would pose a threat to human health.<sup>9</sup> So already some of the studies' limitations are clear: between these two studies DEP has conducted monitoring at only 8 natural gas sites, never monitored at any one site for more than 4 days, and ignored the risks of long-term exposure to these pollutants. Are these studies useful? Absolutely, but they don't justify a sweeping conclusion that natural gas operations pose no risk to our air.

In fairness to the journalists who reported on the DEP's study, I should also note that the majority of news stories on the DEP's studies also mention these limitations, but you have to make it most of the way through the typical article before they're mentioned. And while I'm being fair, I should also mention that DEP acknowledges these limitations in the executive summaries to both of these studies (though press releases and public statements are another matter, which I'll get to in a moment):

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Al Armendariz, Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements (Jan. 26, 2009), *available at*:  
[http://www.edf.org/documents/9235\\_Barnett\\_Shale\\_Report.pdf](http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf).

<sup>6</sup> PADEP, Southwestern Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report (Nov. 1, 2010), *available at*:  
[http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus\\_SW\\_11-01-10.pdf](http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_SW_11-01-10.pdf) [hereinafter PADEP SW REPORT].

<sup>7</sup> PADEP NE REPORT, *supra* note 1, Appendices A & B; PADEP SW REPORT, *supra* note 6, Appendices A & B.

<sup>8</sup> PADEP NE REPORT, *supra* note 1, at 6; PADEP SW REPORT, *supra* note 6, at 6.

<sup>9</sup> PADEP NE REPORT, *supra* note 1, at 18; PADEP SW REPORT, *supra* note 6, at 17.

*“Due to the limited scope and duration of the sampling and the limited number of sources and facilities sampled, the findings only represent conditions at the time of the sampling and do not represent a comprehensive study of emissions. While this short-term sampling effort does not address the cumulative impact of air emissions from natural gas operations . . . the sampling results do provide basic information on the type of pollutants emitted to the atmosphere during selected phases of gas extraction operations in the Marcellus Shale formation.”<sup>10</sup>*

There are also problems with these studies that DEP does not acknowledge.

DEP used several different types of monitoring equipment to detect these pollutants: gas chromatography/mass spectrometry, open path FTIR, infrared cameras, and canister sampling.<sup>11</sup> I won't get in to all the technical details of each of these technologies, but each has its strengths and weaknesses in terms of accuracy, sensitivity, length of sampling time, and the types of pollutants it is capable of detecting. For around a dozen of the 44 pollutants DEP looked at, pollutant concentration data was provided only by the FTIR, meaning that for those pollutants, any conclusions about their air concentrations near well sites are entirely subject to the limitations of the FTIR.

The FTIR monitor detects pollutants by shooting an infrared beam through the open air at the site where monitoring is occurring. The beam bounces off a carefully placed reflector and travels back to the monitor to be analyzed. However, as the DEP studies note, a “tradeoff exists between the length of the open path and detection limits; the longer the path, the higher the detection limits.”<sup>12</sup> In other words, the longer the beam, the higher the pollution levels in the air must be before the monitor can detect them. Any pollution concentrations lower than the detection limit essentially register as zero.



*summa canisters*

<sup>10</sup> PADEP NE REPORT, *supra* note 1, at ii; PADEP SW REPORT, *supra* note 6, at ii.

<sup>11</sup> PADEP NE REPORT, *supra* note 1, at 5-7; PADEP SW REPORT, *supra* note 6, at 5-7.

<sup>12</sup> PADEP NE REPORT, *supra* note 1, at 5; PADEP SW REPORT, *supra* note 6, at 5.

For instance, the pollutant nitrogen dioxide (NO<sub>2</sub>) is associated with respiratory problems and can transform into dangerous ozone or particle pollution in the atmosphere.<sup>13</sup> Compressor stations are by far the largest source of NO<sub>2</sub> associated with natural gas production, but amazingly, DEP detected absolutely no NO<sub>2</sub> near a compressor station in DEP's northeastern PA study. How can that be? It's because the FTIR's minimum detection limit was far too high to detect NO<sub>2</sub> at concentrations ever realistically found in the atmosphere.

DEP listed its FTIR detection limits in the appendices to each study. These limits changed with each 7-hour monitoring period due to variations in equipment placement and environmental conditions. During compressor station monitoring for the northeastern PA study, during its most sensitive monitoring session, the FTIR was only capable of detecting NO<sub>2</sub> at concentrations of 198 parts per billion (ppb) and above.<sup>14</sup>

To put that 198 ppb figure in perspective, consider that as I write this, the highest hourly average NO<sub>2</sub> concentration recorded in Allegheny County in the last 48 hours was 42 ppb.<sup>15</sup> As of 2007, the annual average statewide NO<sub>2</sub> concentration was right around 11 ppb.<sup>16</sup> The federal health-based standard for one hour of exposure to NO<sub>2</sub> is 100 ppb.<sup>17</sup>

So, on their best monitoring day at a northeastern Pennsylvania compressor station, DEP was incapable of detecting NO<sub>2</sub> unless those concentrations were 18 times the typical concentrations we see statewide, nearly 5 times the highest hourly concentration we've seen in Allegheny County in the past 48 hours, and double the short-term health-based standard. That means not just that NO<sub>2</sub> may have been elevated near these compressor stations, but that it would have to be sufficiently elevated to be nearly double the short-term health standard before DEP's monitoring would even detect it.

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<sup>13</sup> US EPA, Nitrogen Dioxide – Health, <http://www.epa.gov/oaqps001/nitrogenoxides/health.html>.

<sup>14</sup> PADEP NE REPORT, *supra* note 1, at 29.

<sup>15</sup> Allegheny County Health Dept., Division of Air Quality, Current Air Quality Data, <http://mapps.achd.net/AQ/> (last visited Feb. 6, 2011).

<sup>16</sup> PADEP, 2007 PENNSYLVANIA AMBIENT AIR QUALITY REPORT at 19, *available at*:<http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/aqreport.htm>.

<sup>17</sup> US EPA, National Ambient Air Quality Standards, <http://www.epa.gov/air/criteria.html>.

And keep in mind, that was by far DEP's best NO<sub>2</sub> detection limit at a northeastern PA compressor station. Their next lowest is 434 ppb,<sup>18</sup> followed by 448 ppb,<sup>19</sup> 985 ppb,<sup>20</sup> 1015 ppb,<sup>21</sup> and 1041 ppb.<sup>22</sup>

DEP's monitoring for hydrogen sulfide (H<sub>2</sub>S) provides an even more drastic example. Hydrogen sulfide is a potent neurotoxin often associated with natural gas operations.<sup>23</sup> Like NO<sub>2</sub>, H<sub>2</sub>S is a pollutant you'd expect to see some concentration of near natural gas operations, but this is another pollutant DEP has never detected at a natural gas site. Between the southwestern and northeastern studies, the best detection limit DEP ever achieved during a monitoring session was 2528 micrograms per cubic meter (µg/m<sup>3</sup>).<sup>24</sup> The worst was 35,950 µg/m<sup>3</sup>.<sup>25</sup> According to the DEP studies, the maximum safe H<sub>2</sub>S concentration for short-term exposure is 42 µg/m<sup>3</sup>.<sup>26</sup> On its best monitoring day, DEP would have been unable to detect hydrogen sulfide unless it was present in concentrations 60 times the maximum safe short-term exposure concentration DEP cites.

And the problem isn't limited to H<sub>2</sub>S and NO<sub>2</sub> (see charts at right). In both the southwestern and northeastern air studies, formaldehyde and sulfur dioxide minimum detection limits also routinely exceeded the short-term health standard.<sup>27</sup> In DEP's press release<sup>28</sup> announcing the publication of the northeastern Pennsylvania Marcellus Study, the agency states, "DEP's air sampling did not find concentrations of any compound that

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<sup>18</sup> PADEP NE REPORT, *supra* note 1, at 29.

<sup>19</sup> *Id.*

<sup>20</sup> *Id.* at 30.

<sup>21</sup> *Id.* at 29.

<sup>22</sup> *Id.* at 30.

<sup>23</sup> OSHA, Hydrogen Sulfide Fact Sheet, *available at*:

[http://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/hydrogen\\_sulfide\\_fact.pdf](http://www.osha.gov/OshDoc/data_Hurricane_Facts/hydrogen_sulfide_fact.pdf).

<sup>24</sup> PADEP NE REPORT, *supra* note 1, at 36.

<sup>25</sup> *Id.* at 34.

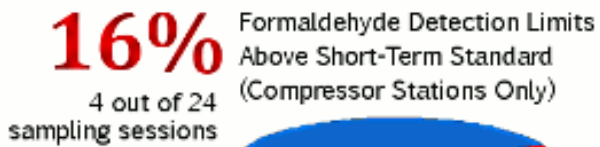
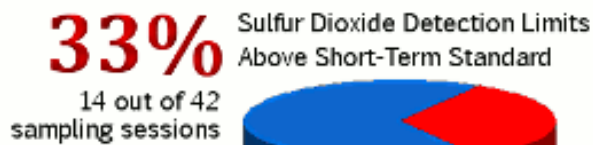
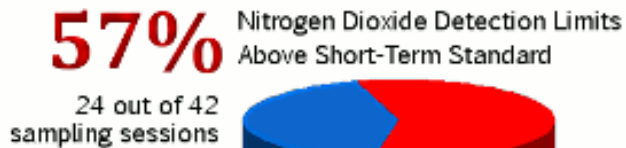
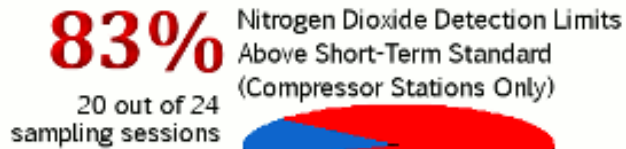
<sup>26</sup> PADEP NE REPORT, *supra* note 1, Appendix C; PADEP SW REPORT, *supra* note 6, Appendix C.

<sup>27</sup> PADEP NE REPORT, *supra* note 1, *compare* Appendix A detection limits *with* Appendix C reference concentrations; PADEP SW REPORT, *supra* note 6, *compare* Appendix A detection limits *with* Appendix C reference concentrations.

<sup>28</sup> PADEP, Press Release: DEP Issues Report on Short-term Air Quality Impacts from Marcellus Shale Operations in Northeast PA (Jan. 31, 2011) *available at*:  
<http://www.portal.state.pa.us/portal/server.pt/community/newsroom/14287?id=16139&typeid=1>.

would likely trigger air-related health issues associated with Marcellus Shale drilling activities.”

What DEP says is technically true, but without knowing about the minimum detection limit problem, one would naturally assume DEP “did not find” unhealthy concentrations because unhealthy concentrations were not present. These studies rarely detected pollutants in concentrations approaching short-term risk levels, but given that DEP’s monitors were incapable of detecting several air pollutants commonly associated with natural gas operations unless they were present at concentrations many times greater than those risk levels, the studies simply don’t provide enough information to conclude the air is safe. And again, we’re only talking about short-term risk levels, not the much lower concentrations that pose a long-term exposure risk.



In future studies, ideally DEP would find a means to ensure minimum detection limits for these pollutants better coincide with DEP’s short-term risk levels. Unless and until that can happen, I hope DEP will keep this study limitation in mind and adopt a more moderate tone when discussing the extent to which these studies indicate air near natural gas operations is safe.

Finally, a central purpose of these studies is to extrapolate from these monitoring sessions to get an idea of what ambient air quality looks like around natural gas operations statewide. These studies have the most predictive power if the activities and equipment at the natural gas sites where sampling occurred were operating normally during the sampling period.

Is there any reason to think these sites weren't operating as normal? DEP's air sampling vehicles, called "mobile analytical units" or MAUs, aren't exactly inconspicuous. These are large, gleaming-white vehicles with DEP logos and the words "mobile analytical unit" boldly printed on their sides. MAU-1, a heavily modified Winnebago, looks particularly billboard-like:



For all I know, operations did not change at all at the natural gas sites when the MAUs were present, but these vehicles are hard to miss, and after spotting them rolling up to the site, it would only be sensible for a gas field worker to double check that all equipment is operating properly, hatches are closed on storage tanks, no unnecessary equipment is running, lower-emitting equipment is used preferentially when possible, etc. If a gas producer were particularly worried about air emissions from their operations, they might even go so far as to cut back production until the MAU leaves, taking its air monitors and infrared cameras along with it.

I see two potential ways to mitigate this problem. First, make the MAUs less conspicuous. Second, after conducting monitoring, PADEP should exercise its authority

under the Pennsylvania Air Pollution Control Act §§ 4(3) & (4)<sup>29</sup> to obtain production and operational records from every site where sampling is performed. If DEP obtains records covering the sampling period and a reasonable period before and after sampling, the Department will be better equipped to judge whether sampling sites were operating under normal conditions while air monitoring was occurring, and the public would have more confidence the air monitoring results are accurate.

## *Conclusion*

To sum up, DEP's Marcellus air studies focus on detecting concentrations of 44 pollutants at concentrations sufficiently elevated that short-term exposure poses a health risk. As described above, for several of the pollutants we would most expect to see near natural gas sites, DEP's monitoring equipment was not sufficiently sensitive to detect these pollutants at even the high concentrations necessary to pose a short-term exposure risk.

For the remaining pollutants for which minimum detection limits were not an issue, we can take more comfort in DEP's sampling results, but they tell us little about the risks posed by long-term, chronic exposure. Further, the measured pollutant concentrations are only reliable to the extent the 8 natural gas sites are representative of routine operation at all PA natural gas sites. Given how conspicuous the DEP's mobile analytical units are, these facilities may have operated with extra care while the MAUs were present—the air pollution equivalent of highway drivers tapping their brakes when they spot a police car on the side of the road.

Finally, as DEP acknowledges, we also can't rely on these studies to estimate the cumulative impact of emissions from natural gas operations. Large portions of Pennsylvania already fail to meet federal health-based standards<sup>30</sup> for ozone and particulate matter. If air emissions from natural gas operations in the Marcellus aren't

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<sup>29</sup> Pennsylvania Air Pollution Control Act, 35 P.S. § 4004(3) & (4).

<sup>30</sup> US EPA, Currently Designated Nonattainment Areas, <http://www.epa.gov/oaqps001/greenbk/ancl.html>



controlled, this industry has the potential to make our existing problems worse. Just ask Wyoming,<sup>31</sup> Utah,<sup>32</sup> Colorado,<sup>33</sup> or Texas.<sup>34</sup>

While I stand by my criticism of DEP's air sampling, I do see value in the Department's studies—as imperfect as they may be. It's easy to forget that as recently as 2008, Marcellus Shale drilling barely existed in Pennsylvania. DEP's air sampling studies are an excellent start to a better understanding of the exact nature of the potential air pollution threat this industry poses. In the next few years I hope we see additional air monitoring performed by environmental organizations, academics, and additional studies by DEP. Future air monitoring efforts can benefit by looking at the DEP Marcellus Shale air studies performed to date, building on what worked well, and correcting what did not.

In the meantime, it's important that we critically evaluate any and all information we come across about this nascent, but fast-growing industry. The newspaper headlines characterizing these DEP's monitoring efforts as proof Marcellus-related air emissions are “OK” or “safe” or “no health threat” are reaching conclusions the DEP's data simply doesn't justify. These DEP studies are not the final word on air emissions from Marcellus Shale activity; they're part of a long a conversation that's just getting started.

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<sup>31</sup> Billings Gazette, Wyoming officials outline ozone area for EPA (Apr. 25, 2009) *available at*:[http://billingsgazette.com/news/state-and-regional/wyoming/article\\_f23f0149-651f-5004-a012-13e7402bfb4d.html](http://billingsgazette.com/news/state-and-regional/wyoming/article_f23f0149-651f-5004-a012-13e7402bfb4d.html).

<sup>32</sup> Salt Lake Tribune, Ozone raises its ugly head in rural Utah (Oct. 22, 2010) *available at*:  
<http://www.sltrib.com/sltrib/home/50516943-76/ozone-county-basin-epa.html.csp>.

<sup>33</sup> Land Letter, OIL AND GAS: Proposed tougher ozone standard worries Intermountain West drillers (Jan. 14, 2010) *available at*: <http://www.eenews.net/public/Landletter/2010/01/14/1>.

<sup>34</sup> Greenwire, AIR POLLUTION: Texans weigh in as EPA considers new oil and gas regs (Aug. 3, 2010) *available at*: <http://www.eenews.net/public/Greenwire/2010/08/03/3>.