E. Christopher Abruzzo
Secretary, Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101

12 August 2014

Via e-mail and hard copy cabruzzo@pa.gov

**RE: Shale Gas Development and Mars Area School Permitting Decision**

Dear Secretary Abruzzo,

We write to you and other representatives of the Pennsylvania Department of Environmental Protection (PA DEP) in regard to shale gas development and the Mars Area School permitting decision. As you know, there has been much discussion concerning the potential impacts of shale gas development to the environment and human health. While there is still a dearth of quantitative epidemiology that assesses associations between risk factors and health outcomes, there is a growing body of peer-reviewed science that provides significant evidence of public health risks [1,2]. These risks are of particular concern to our most vulnerable populations (e.g., children), who may be disproportionately exposed and adversely affected by these health hazards [3].

The peer-review process is the cornerstone of scientific inquiry. Our organization, PSE Healthy Energy (www.psehealthyenergy.org), is committed to providing citizens and policymakers with objective, evidence-based information on energy production methods. Towards this end we have compiled a near exhaustive database of *all* the peer-reviewed articles on unconventional oil and gas development. This library is open to the public and can be accessed at http://www.psehealthyenergy.org/site/view/1180. We have learned two very important points about shale gas development in the creation and review of this collection of scientific literature.

First, there are clear, well-defined pathways of exposure (e.g., air, water) from shale gas operations to human populations. There are numerous investigations that have linked modern natural gas operations to surface and groundwater contamination and this is well documented in the peer-reviewed literature [4–8] and in PA DEP reporting [9]. Emissions of health damaging air pollutants such as nitrogen oxides ($NO_X$), volatile organic compounds (VOCs), aromatic hydrocarbons, particulate matter (PM), and ground level ozone (smog) precursors including methane ($CH_4$) and VOCs occur throughout the life cycle of shale gas development. While the issue of determining a safe distance to develop unconventional gas from sensitive receptors is complex, evidence suggests that populations located within a mile of unconventional oil and gas development are subject to a statistically significantly elevated hazard from air pollution exposure than those

populations located further away [10]. The Mars Area School is located ~0.6 miles from the proposed shale gas development site and this should be a cause for concern and pause.

It is important to understand that air pollution is caused not only from activities in and around the wellhead, but also from the transportation of water, sand, and chemicals to and from the well pads, from separator tanks, compressor stations, and other ancillary processes. Thus, while a well pad may not be directly adjacent to a population in question, the air pollution impacts of shale gas development can be regional in nature [11]. Studies suggest trucking and other activities deliver significant impacts not only on local air quality [12], but also on regional air quality [13]. Air pollutants known to be health damaging have been measured in concentrations elevated enough to contribute to an excess public health burden for nearby human populations [10,14,15]. Benzene has been identified as a major contributor to elevated cancer risks from air emissions associated with the development of unconventional natural gas [10]. Previous studies have identified an association between this hazardous air pollutant and childhood leukemia [16].

Second, while the science has grown tremendously in the past year, there are still significant data gaps that would provide evidence on the relative safety of shale gas development. Of the 349 peer-reviewed journal articles contained in the aforementioned database, 231 (~66%) have been published since the beginning of 2013 and 100 (~29%) have already been published this year. What this suggests is that studies are underway and the scientific community is now playing catch-up with the rapid growth of this industry. We are only now beginning to understand the implications of this industry for the environment and human populations. Until better data emerges on the potential risks, precautionary measures are surely warranted with regard to the permitting of new wells in close proximity to schools.

There are a number of other considerations as well. Besides the more studied forms of air and water pollution, the shale gas industry also brings heavy truck traffic (over 1,000 truck trips for each well for a high-volume hydraulic fracturing event), noise and light pollution, and a number of other probable ramifications that affect community wellness, such as traffic accidents, social stress, and anxiety [17]. Noise pollution is particularly relevant concern for schools, as evidence has suggested that noise can impact children's cognitive function in a number of ways and can be detrimental to comprehension, memory, and attention/perception [18,19].

While specific cases of human health impacts associated with shale gas development remain largely anecdotal, some population health studies suggest an increased risk of health impacts in nearby human populations. For instance, recent evidence suggests a greater prevalence of some adverse birth outcomes including congenital heart disease and neural tube defects for neonates born to mothers that live in higher densities of unconventional oil and gas development compared with those living in lower densities of oil and gas development or none at all [20]. Qualitative case studies have suggested harm

to human and animals populations as well [21,22]. Regardless of the strength and quantity of health data at this time, a dearth of quantitative epidemiological investigation does not signify an absence of harm. As the scientific literature suggests, there are clear pathways of exposure. Furthermore, numerous reports of common health symptoms have been independently surfacing throughout the United States in areas with active oil and gas development.

Children are a particularly vulnerable population who may exhibit different health outcomes from adults when exposed to environmental pollution [23,24]. From an exposure perspective, children drink more water, breath more air per unit body weight than adults, and often put objects and their hands into their mouths more frequently than adults. For this reason, children can be more exposed to environmental pollution. Additionally, children are less able to metabolize and excrete environmental chemicals and their young ages provide longer durations for diseases with long latency periods to develop. Because of these differences children are a vulnerable population that warrants greater protection from environmental risks and therefore greater precaution in oil and gas development permitting decisions.

Finally, it is worth bearing in mind that there is no scientific way to determine the optimal distance between shale gas operations and schools; this is ultimately a question of values [25]. Science can, of course, identify risks, inform our decisions, and create an empirical foundation from which rational decisions can be made. However, permitting wells near schools is ultimately a matter of balancing the goals of safety with the perceived benefits of developing natural gas. Given the number of documented cases of well contamination and the PA DEP's inadequate preparedness for the shale gas boom [26], it is clear that policy makers should exercise the utmost precaution when making decisions that could potentially impact our most vulnerable populations.

Our organization, PSE Healthy Energy, is dedicated to supplying evidence-based, scientific information and resources on unconventional shale oil and gas development and other novel energy technologies to a variety of stakeholders. PSE's mission is to bring scientific transparency to important public policy issues surrounding such methods by generating, organizing, translating, and disseminating objective, evidence-based information.

In addition to the bibliography mentioned earlier in this letter, we are more than willing to offer our own research and expertise on this subject. We maintain formal affiliations and partnerships with faculty members across a range of disciplines at a number of national institutions, including Cornell University, Weill Cornell Medical College, Stanford University, George Washington University, and The University of California, Berkeley. We invite you to visit our website at www.psehealthyenergy.org, where we provide high-quality resources and analyses on shale gas development and other forms of novel energy production.

If you have any questions, please do not hesitate to contact us. Thank you for your time.

Sincerely,

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References

1 Adgate JL, Goldstein BD, McKenzie LM. Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development. *Environ Sci Technol* Published Online First: 24 February 2014. doi:10.1021/es404621d

2 Shonkoff SB, Hays J, Finkel ML. Environmental Public Health Dimensions of Shale and Tight Gas Development. *Environmental Health Perspectives* 2014;**122**. doi:10.1289/ehp.1307866

3 Landrigan PJ, Goldman LR. Children's Vulnerability To Toxic Chemicals: A Challenge And Opportunity To Strengthen Health And Environmental Policy. *Health Aff* 2011;**30**:842–50. doi:10.1377/hlthaff.2011.0151

4 Fontenot BE, Hunt LR, Hildenbrand ZL, *et al.* An evaluation of water quality in private drinking water wells near natural gas extraction sites in the Barnett Shale Formation. *Environ Sci Technol* Published Online First: 25 July 2013. doi:10.1021/es4011724

5 Gross SA, Avens HJ, Banducci AM, *et al.* Analysis of BTEX groundwater concentrations from surface spills associated with hydraulic fracturing operations. *J Air Waste Manag Assoc* 2013;**63**:424–32.

6 Jackson RB, Vengosh A, Darrah TH, *et al.* Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction. *PNAS* Published Online First: 24 June 2013. doi:10.1073/pnas.1221635110

7 Kassotis CD, Tillitt DE, Wade Davis J, *et al.* Estrogen and Androgen Receptor Activities of Hydraulic Fracturing Chemicals and Surface and Ground Water in a Drilling-Dense Region. *Endocrinology* Published Online First: 16 December 2013. doi:10.1210/en.2013-1697

8 Osborn SG, Vengosh A, Warner NR, *et al.* Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. *PNAS* Published Online First: 9 May 2011. doi:10.1073/pnas.1100682108

9 Legere L. *DEP: Oil and gas operations damaged water supplies 209 times since end of '07.* Pittsburgh Post-Gazette. 2014. http://powersource.post-gazette.com/powersource/policy-powersource/2014/07/22/DEP-Oil-and-gas-endeavors-have-damaged-water-supply-209-times-since-07/stories/201407220069 (accessed 12 Aug2014).

10 McKenzie LM, Witter RZ, Newman LS, *et al.* Human health risk assessment of air emissions from development of unconventional natural gas resources. *Sci Total Environ* 2012;**424**:79–87. doi:10.1016/j.scitotenv.2012.02.018

11 Roy AA, Adams PJ, Robinson AL. Air pollutant emissions from the development, production, and processing of Marcellus Shale natural gas. *Journal of the Air & Waste Management Association* 2014;**64**:19–37. doi:10.1080/10962247.2013.826151

12 Colborn T, Schultz K, Herrick L, *et al.* An Exploratory Study of Air Quality near Natural Gas Operations. *Human and Ecological Risk Assessment: An International Journal* 2014;**0**:null. doi:10.1080/10807039.2012.749447

13 Kemball-Cook S, Bar-Ilan A, Grant J, *et al.* Ozone Impacts of Natural Gas Development in the Haynesville Shale. *Environ Sci Technol* 2010;**44**:9357–63. doi:10.1021/es1021137

14 Gentner DR, Ford TB, Guha A, *et al.* Emissions of organic carbon and methane from petroleum and dairy operations in California's San Joaquin Valley. *Atmos Chem Phys* 2014;**14**:4955–78. doi:10.5194/acp-14-4955-2014

15 Pétron G, Frost G, Miller BR, *et al.* Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study. *Journal of Geophysical Research: Atmospheres* 2012;**117**:n/a–n/a. doi:10.1029/2011JD016360

16 Whitworth KW, Symanski E, Coker AL. Childhood Lymphohematopoietic Cancer Incidence and Hazardous Air Pollutants in Southeast Texas, 1995-2004. *Environ Health Perspect* 2008;**116**:1576–80. doi:10.1289/ehp.11593

17 Witter RZ, McKenzie L, Stinson KE, *et al.* The use of health impact assessment for a community undergoing natural gas development. *Am J Public Health* 2013;**103**:1002–10. doi:10.2105/AJPH.2012.301017

18 Haines MM, Stansfeld SA, Brentnall S, *et al.* The West London Schools Study: the effects of chronic aircraft noise exposure on child health. *Psychol Med* 2001;**31**:1385–96.

19 Haines MM, Stansfeld SA, Job RF, *et al.* Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children. *Psychol Med* 2001;**31**:265–77.

20 McKenzie LM, Guo R, Witter RZ, *et al.* Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado. *Environmental Health Perspectives* Published Online First: 28 January 2014. doi:10.1289/ehp.1306722

21 Bamberger M, Oswald RE. Impacts of Gas Drilling on Human and Animal Health. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy* 2012;**22**:51–77. doi:10.2190/NS.22.1.e

22 Steinzor N, Subra W, Sumi L. Investigating Links between Shale Gas Development and Health Impacts Through a Community Survey Project in Pennsylvania. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy* 2013;**23**:55–83. doi:10.2190/NS.23.1.e

23 Suwanwaiphatthana W, Ruangdej K, Turner-Henson A. Outdoor air pollution and children's health. *Pediatr Nurs* 2010;**36**:25–32.

24 Tzivian L. Outdoor air pollution and asthma in children. *J Asthma* 2011;**48**:470–81. doi:10.3109/02770903.2011.570407

25 Briggle A. Let Politics, Not Science, Decide the Fate of Fracking. *Slate* Published Online First: 12 March 2012.http://www.slate.com/blogs/future_tense/2013/03/12/fracking_bans_let_politics_not_science_decide.html

26 DePasquale E. DEP's performance in monitoring potential impacts to water quality from shale gas development, 2009 - 2012. 2014.http://www.auditorgen.state.pa.us/reports/performance/special/speDEP072114.pdf