PSE Healthy Energy
Physicists Scientists & Engineers

22 March 2017

**RE: House Bill 17-1256**

Dear Representative Foote,

We write to express our support for House Bill 17-1256, which clarifies that the minimum distance that oil and gas facilities must be located 1,000 feet from school property lines rather than school buildings. The science clearly supports the implementation of greater setback distances from schools and other sensitive receptors.

As you know, there has been much discussion concerning the potential impacts of oil and gas development to the environment and human health. While there is still a limited amount of epidemiological research, there is a growing body of peer-reviewed science that provides evidence of hazards, elevated risks, and associated health outcomes [1–4]. These hazards are of particular concern to our most vulnerable populations, including children, who may be disproportionately exposed and adversely affected [5].

The peer-review process is the cornerstone of scientific inquiry. Our energy science and policy institute, 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 shale/tight 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 several very important points about the environmental and public health implications of oil and gas development in the creation and review of this collection of scientific literature.

First, there are clear, well-defined pathways of exposure from oil and gas operations to human populations, including air, water, and soil. Numerous investigations have linked modern natural gas operations to surface and groundwater contamination; this is well documented in the peer-reviewed literature [6–9] and in state agency reporting [10]. Emissions of health damaging air pollutants such as aromatic hydrocarbons, nitrogen oxides ($NO_x$), volatile organic compounds (VOCs) and other ground-level ozone (smog) precursors occur throughout the life cycle of oil and gas development. Research has shown that at least five air pollutants associated with oil and gas (benzene, formaldehyde, ozone, particulate matter, silica dust) produce well known respiratory health effects in children [11].

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. Although a well pad may not be directly adjacent to a particular population, air pollutant emissions can extend beyond its immediate vicinity. Studies suggest trucking and other activities deliver significant impacts on both local [12] and 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 human populations living near natural gas operations [14–16]. Benzene has been identified as a major contributor to elevated cancer risks from air pollutant emissions

associated with the development of natural gas [14]. Previous studies have identified an association between this hazardous air pollutant and childhood leukemia [17].

There are a number of other considerations as well. Besides air and water pollution, the oil and gas industry also brings heavy truck traffic, noise and light pollution, and a number of other probable ramifications that influence community wellness, such as traffic accidents, social stress, and anxiety [18]. Noise pollution is a 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 [19,20]. A recent review of the scientific literature indicates that natural gas operations produce noise at levels that may increase the risk of adverse health outcomes, including annoyance, sleep disturbance, and cardiovascular disease [21].

The science has grown tremendously in the past several years and the research community is now beginning to understand the implications of this industry for the environment and human populations. Of the nearly 1200 peer-reviewed journal papers contained in the aforementioned database, nearly 700 (>50%) have been published since the beginning of 2015 and over 100 papers have already been published this year. There are still significant information gaps that would provide better evidence on the relative safety of modern oil and gas development and new data will continue to emerge. However, based on the available evidence, precautionary measures are justifiable with regard to the permitting of new wells in close proximity to where people live, play and learn, and in particular to our more vulnerable populations including young children, the elderly and those with existing respiratory conditions.

The epidemiological literature is still limited and it is difficult to draw firm conclusions about causality and the extent of health burdens attributable to oil and gas development. Most research efforts to date have used electronic health records and self-reported data and relied on proximity to natural gas operations as a surrogate for exposure [22]. Randomized control trials and other highly controlled study designs are either unrealistic or unethical in this type of setting. It would take decades to bring the epidemiological literature to a point where we could make causal claims that connect oil and gas development with adverse health outcomes. However, the current body of epidemiology does help identify hazards and risks, which is more than sufficient to provide an empirically justifiable foundation for policy decisions. Indeed, in the case of lead, regulations to protect childhood exposure were promulgated when the scientific literature was in its infancy. They were then modified over time as the literature became more sophisticated and scientists' understanding of the interactions between lead, bone growth and cognitive development became more complete.

Despite its inherent limitations, the epidemiological evidence cannot be ignored. Of the more than thirty original research publications that consider human health, roughly 85% contain findings that suggest that there are public health hazards, elevated risks, or adverse health outcomes associated with the development of shale gas [4]. Several studies suggest a greater prevalence of some adverse birth outcomes for neonates born to mothers living in areas of higher density and in closer proximity to the development of oil and gas [23–25]. An analysis of over 35,000 electronic health records suggest that asthma patients with greater exposure to

unconventional gas development in Pennsylvania are more likely to experience exacerbations, including hospitalizations and emergency department visits [26]. Qualitative case studies have also suggested harm to human and animals populations [27,28].

Research provides evidence of dose-response relationships between oil and gas development and adverse health outcomes that have biological plausibility. There are a number of pollutants associated with various stages of oil and gas development as well as clear pathways of exposure. In addition, numerous reports of common health symptoms have been independently surfacing throughout the United States in areas with active natural gas development. Unfortunately, some of these reports have involved children, who effectively serve as sentinels for adverse health outcomes in the general population.

Children are a vulnerable population who may exhibit different health outcomes from adults when exposed to environmental pollution [29,30]. 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.

The issue of determining a safe distance to develop oil and gas from sensitive receptors is complex. Many people argue that states should require greater setback distances between well pads and sensitive receptors, such as schools and hospitals, to mitigate potential risks. This is logical since evidence does suggest elevated health risks for populations living in closer proximity to well pads. However, increasing the distance from well pads will not eliminate all of these risks, as air pollutant emissions come from a variety of activities beyond the well pad (e.g., truck traffic) and can emanate from sources beyond the setback distance. Haley et al. (2016), the first and only peer-reviewed publication focused explicitly on evaluating the effectiveness of setback distances, found that current setbacks may leave populations vulnerable to various hazards, including explosions and air pollution, and may be inadequate in several states, including Colorado. The authors in this study explicitly write the following statement, with which we agree:

> "...Colorado should consider adopting more generous setback distances, particularly in reference to vulnerable populations; however, distance is not an absolute measure of protection. Unfortunately, there is no defined setback distance that assures safety [31]."

Finally, it is worth bearing in mind that there is no scientific way to determine the optimal distance between oil and gas operations and schools; this is ultimately a question that involves a complex set of value judgments [32]. Science can, however, inform our decisions by identifying hazards and quantifying risks, creating an empirical foundation from which rational decisions can be made. Simply put, a greater quantity of well pads surrounding a particular population will elevate their risk of adverse health outcomes.

PSE Healthy Energy
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Our organization, PSE Healthy Energy, is dedicated to supplying evidence-based, scientific information and resources on unconventional shale oil and gas development, renewable energy, 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 the University of California, Berkeley, Lawrence Berkeley National Laboratory, Cornell University, Weill Cornell Medicine, University of Pennsylvania, and Stanford University. We invite you to visit our website at www.psehealthyenergy.org, where we provide high-quality resources and analyses on oil and gas development and other forms of energy production.

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

Sincerely,

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