July 23, 2019

The Honorable Tom Wolf
Governor of Pennsylvania
225 Main Capitol Building
Harrisburg, PA 17120

Dear Governor Wolf:

As you know, several recent *Pittsburgh Post-Gazette* articles are reporting an inaccurate narrative around strongly regulated natural gas development in Pennsylvania.

The stories misrepresent the efforts of tens-of-thousands of hardworking Pennsylvanians who work diligently to protect the environment and communities in which they work, live and proudly contribute to the natural gas industry – including many in our union building trades and countless other small family-owned businesses. While this inaccurate reporting is disappointing, the record can be corrected.

Pennsylvanians deserve fair and objective information based on independent research and science. This is especially true on matters related to the scientific evidence associating potential health outcomes in communities living near natural gas and oil operations.

Unfortunately, the *Post-Gazette* continues to lack the important fact-based information required to make science-led and weight-of-evidence determinations for causality.

To be clear, our industry is deeply committed to protecting the health, safety and environment of our communities and our workforce. We support your administration's efforts for further, objective scientific research. Health and safety are core values of this industry. We are committed to protecting the safety and health of our employees, our contractors and the people of the communities in which we operate. The combination of proven engineering technologies, industry risk management practices and world class standards, coupled with a comprehensive matrix of federal and state regulatory programs, ensure that operations are performed and managed effectively.

Particularly on matters involving public health, a strong combination of unbiased science, robust research, active air and water monitoring, and health surveillance data trends demonstrate that natural gas development is well-regulated, well-managed, and conducted in a responsible way. State regulatory programs have protocols requiring operators to identify all fresh water zones, provide for casing and cementing (zonal isolation) of those zones and well construction requirements that provide assurance that the targeted production zones will not impact shallow potable water supplies.

It is important for the public to hear the conclusions and findings of unbiased, independent science and numerous in-depth reports and analysis from the career professionals and experts within both the Department of Environmental Protection (DEP) and Department of Health (DOH).

The *Post-Gazette* series may support the agenda of anti-natural gas activists, but it is a disservice to the career and professional regulators within your administration, as well as the tens-of-thousands of hardworking women and men who help produce clean, affordable Pennsylvania energy.

"*We have very good oil and gas regulations,*" DEP Sec. Patrick McDonnell confirmed last year, and reinforced the fact that Pennsylvania has "*some of the most protective regulations in the nation [that] ensure safe development of this important resource.*"

As evidence of our commitment to environmental protection, unconventional operators demonstrated a 98.3 percent regulatory compliance rate last year, following a record 19,617 DEP inspections.

Importantly, comprehensive literature reviews, public health surveillance data trends of cancer cases, asthma and birth effects do not support the narrative that the paper and anti-energy activists are promoting.

- In June of 2019, the DOH, along with the Colorado Department of Public Health and Environment, released a comprehensive systematic review of existing epidemiologic literature and concluded that the majority of studies claiming to link health impacts to oil and gas development were rated "*low certainty*" and limited in study design. Most of the studies, the state health agencies concluded, had "*conflicting evidence (mixed), insufficient evidence, or in some cases, a lack of evidence of the possibility for harmful health effects.*"

- Further, an April 2019 DOH investigation into cases of rare childhood cancers concluded that "*incidence rates for the Ewing's family of tumors and childhood cancers in Washington County and Canon-McMillan School District were not consistently and statistically significantly higher than expected in all three time periods analyzed.*"

  Further, Dr. Kelly Bailey – an expert in Ewing Sarcoma with UPMC Children's Hospital – has said that "*it is important to remember that at this time, nothing could have been done to prevent these cancers*," adding: "*We have no data right now showing that there's any environmental exposure…that would leave to one developing Ewing Sarcoma.*" This expert medical analysis reflects the views held by the American Cancer Society, National Institutes of Health and the Mayo Clinic, among others.

- Asthma hospitalization rates in the counties with the most shale wells, according to state health data, declined as shale development significantly increased. Statewide, asthma prevalence in children dropped 4.2 percent from 2013-2015, the most recently available year.

- In response to a study funded by the Heinz Endowments (an organization that finances anti-energy activism, as the Associated Press reported) that attempted to link natural gas development to low-infant birth weights, the Magee Women's Research Institute stated that such studies "*are not rigorous enough to generate firm, action-guiding scientific conclusions.*"

- The globally-recognized children's and women's health institute within UPMC's network continued:

  - "*The study found no significant and consistent associations between residence near unconventional gas development wells and either preterm birth or fetal abnormalities. … The results do not rely on the most stringent criteria for clinically relevant fetal growth abnormality, and do not support a conclusion that the proximity to the unconventional gas development wells caused reduced birth weights or a higher incidence of small for gestational age fetuses.*"

These opinions from professional medical experts and conclusions from objective and thorough research aligns with the progress tied to the rigorous air and water quality monitoring by state regulators, reflecting the well-understood fact that natural gas development is well-managed and does not threaten public health. Among those examples:

- DEP's long-term ambient air monitoring project of facilities in Washington County, released in 2018, found "*few health risks*" and noted "*little risk of healthy residents getting sick from breathing the air nearby.*" A recent comprehensive air quality analysis conducted by Gradient, a Boston-based environmental and risk sciences consulting firm, found that natural gas operations in the Ft. Cherry School District "*do not pose any acute or chronic health concerns*" and the data – which was taken from three site monitors over a two-year period and encompassed all stages of well development – "*showed no air quality impacts of public health concern.*"

- Air monitoring results from a 2015 Drexel University study and a separate 2016 Ft. Cherry School District air quality study came to similar conclusions.

- Importantly, Pennsylvania – as confirmed by independent environmental organizations – has modern below-ground regulations regarding well construction to protect freshwater resources. Natural gas development in the Susquehanna River Basin, an area with significant active operations, has had no impact on water quality or quantity, according to continuous water monitoring.

Objective, science-based evidence reflects the well-understood fact that natural gas development and strong environmental and public health protection are not mutually exclusive.

Like virtually all industries, we recognize there are risks associated with natural gas development – and continue to work with all stakeholders, including regulators, to ensure these risks are effectively managed.

We constantly strive to improve operations, become more efficient, and deploy the latest technology that allows us to continue safely unlocking more of America's natural gas that is demonstrably improving our environment and the quality of life for all Pennsylvanians.

We have no higher responsibility than the protection and improvement of our environment and the health and safety of all Pennsylvanians. The natural gas industry's workforce is overwhelmingly comprised of Pennsylvanians, and our commitment is exceptionally personal to us in order to ensure our kids and grandkids, and fellow community members, are safe and healthy.

We appreciate your support for the safe, responsible development of clean Pennsylvania energy, and look forward to continuing to work closely with your administration on achieving that shared goal.

Sincerely,

Stephanie Catarino Wissman
Executive Director
Associated Petroleum Industries of Pa.

David J. Spigelmyer
President
Marcellus Shale Coalition

Daniel J. Weaver
President & Executive Director
Pa. Independent Oil & Gas Association

cc: Dr. Rachel Levine
Secretary, Department of Health

Patrick McDonnell
Secretary, Department of Environmental Protection

Safe, Well-Regulated

Pa. DEP Secretary McDonnell (2018): *"we have very good oil and gas regulations."*

- **Safe, Tightly-Regulated**: Shale development is a safe, tightly-regulated process that's governed by nearly 70 federal, state and local regulations and monitored by 30 state and federal agencies.
    - New regulations, which took effect in 2016, "*create some of the most protective regulations in the nation and ensure safe development of this important resource*," DEP Secretary Patrick McDonnell said. (Post-Gazette)
- **State Review of Oil and Natural Gas Environmental Regulations report on Pa. oversight:** "*DEP is commended for its hydraulic fracturing program. Standards for well casing and cementing require that the operator conduct those activities to control the well at all times, prevent migration of gas or other fluids into sources of fresh groundwater; and prevent pollution of fresh groundwater. In February of 2011, DEP amended its regulations regarding well design and construction requirements to provide enhanced casing and cementing standards for new well construction. The requirements include standards for casing and cementing to meet anticipated pressures and protect resources and the environment. These standards address internal pressure rating, pressure testing of casing, centralization, and certification of joint welders. The program requires that cement used in the surface casing meet certain compressive strength and free water specifications and isolate the wellbore from fresh groundwater; contain pressures from drilling, completion, and production; protect the casing from the geochemical effects of the subsurface; and prevent gas flow in the annulus*."
- **Annual DEP Inspections:** In 2018, DEP conducted 19,617 inspections of unconventional well sites – the highest number of inspections on record, and a near 60% increase from 2013. Pennsylvania's unconventional industry had a 98.3% compliance rate, demonstrating a clear commitment to environmental protection. (Pa. DEP)
- **Pa.'s Modern Regulations on Air Emissions:** Pa. has adopted aggressive permitting standards with a key component of Pa.'s requirements covering a robust Leak Detection and Repair program. This initiative, included as part of Pa.'s 2018 revisions to its air quality permits, GP5A, requires all unconventional natural gas producers that exceed emission thresholds to implement a quarterly LDAR program. Similarly, under GP5 midstream operators are required to implement a quarterly LDAR program for pipelines and compressor facilities. If natural gas producers fall under the mandated PA DEP emission thresholds, they must implement an annual LDAR program.
- **Strong Setbacks**: Act 13 specifically enhanced setback requirements from 300 to 1,000 feet from water wells and springs and 500 feet from structures. While the Pa. Supreme Court ruled these provisions unconstitutional, industry remains committed to adhering to the more stringent setbacks.

No Credible Link to Cancer, Public Health Concerns

- **Pa. Dept. of Health (April 2019):** "Overall, there were no conclusive findings indicating that the incidence rates of Ewing's family of tumors In Washington County and Canon-McMillan School District for female and male populations were consistently and statistically significantly higher than the rest of the state over the time periods reviewed."
- **Magee Women's Research Institute Responds to Heinz Endowments-Funded Study:** "The study found no significant and consistent association between residence near UGD wells and either preterm births or fetal anomalies. The results do not rely on the most stringent criteria for clinically relevant fetal growth abnormality, and do not support a conclusion that the proximity to the UGD wells caused reduced birth weights or higher incidence of SGA." (Source)
    - **Study researchers:** "A number of unknown factors" limit the research and that "associations do not imply causation."
    - **Study Didn't Account for Known Risk Factors:** According to the Center for Disease Control and the Pa. Dept. of Health, these risk factors – which were not accounted for in the researchers' paper – may increase a pregnant woman's chances of having a LBW baby in her lifetime (*not just exclusively during the pregnancy*): drinking alcohol and drug use, including over-the-counter medications; domestic violence or other abuse; unmarried; previous preterm birth; secondhand smoke exposure; stress; taking a daily multivitamin containing 400 micrograms of folic acid before and throughout pregnancy; as well as others.
    - **MORE FACTS ON HEINZ-FUNDED ADVOCACY PAPER:** http://marcelluscoalition.org/2015/06/fact-checking-heinz-funded-advocacy-paper/
- **MacArthur Foundation-Funded Low-Infant Birth Weight Study:** A 2017 study funded by the "juggernaut in the environmental community," the MacArthur Foundation, included significant methodological issues and failed to consider crucial issues linked to low-birth weights like smoking, alcohol and drug use in making their conclusions.

- **Doesn't Measure Actual Exposure:** According to the researchers, "A limitation of our study is that given the nature of the available data, we are constrained to focus on potential exposure to pollution (which is determined by the mother's residential location) rather than actual exposure that could be measured with personal monitoring devices."
- **MORE FACTS:** http://marcelluscoalition.org/2017/12/fact-check-5-key-facts-on-new-study/

- **Medical Experts on Cases of Ewing Sarcoma, Childhood Cancer in southwest Pa.**
  - **Mayo Clinic:** "The cause of Ewing sarcoma is unknown" and "can't be prevented." (Source)
  - **American Cancer Society:** "There are no known lifestyle-related or environmental causes of Ewing tumors." (Source)
    - "The gene changes that lead to Ewing tumors are now fairly well known, but it's still not clear what causes these changes. It might just be a random event that sometimes happens inside a cell, without having an outside cause. **So it is important to remember that at this time, nothing could have been done to prevent these cancers.**"
  - **UPMC's Dr. Kelly Bailey:** "We have no data right now showing that there's any environmental exposure, anything like that, that would lead to one developing Ewing sarcoma."
  - Top Medical Experts: "No Known Lifestyle or Environmental Causes" for Rare Childhood Cancer
  - Post-Gazette's Claims on Childhood Cancer Unsupported by Medical Experts, Science
- **Pa. Health Dept. "Not Aware of Any Evidence" of Fracking's Negative Impact on Health**: "The Department of Health is not aware of any evidence to suggest that hydraulic fracturing practices have a negative impact on our residents' health." (Chambersburg Public Opinion Letter, April 2012)
- **National Bureau of Economic Research (2019): U.S. Energy Abundance Saves Thousands of Lives Annually**
  - "We find that **lower heating prices reduce mortality in winter months**. The estimated effect size implies that the drop in natural gas prices in the late 2000s, induced largely by the boom in shale gas production, **averted 11,000 winter deaths per year in the US**. We also find that the effect does not just represent short-run hastening of mortality. … **This effect size is large enough that it should not be ignored when assessing the net health effects of shale production of natural gas**. The findings also highlight the health benefits of other policies to reduce home energy costs, particularly for low-income households."

******Compendium of Studies Demonstrating the Safety & Health Benefits of Fracking******
https://eidhealth.org/wp-content/uploads/2017/04/Positive-Health-Compendium.pdf

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Air Quality Progress

Clean Air Progress
EPA Administrator Andrew Wheeler: *"We are global leader in clean air progress."* (*Oct. 2018*)

- **Pa.'s Top Environmental Regulator, DEP Secretary Patrick McDonnell (Jan. 2019):** "We've seen for example, the Clean Power Plan proposal that the Obama administration put forward, we were already well on our way in large part – and actually since met what were proposed goals – primarily because of the shift towards cleaner natural gas. ***We've seen improvements on ozone, we've seen improvements in those asthma precursors, those VOCs and nitrogen oxides***." (Source)
- **Critical Air Pollutants Plummet:** According to Pa. DEP air monitoring, since 1990 critical air pollutants like NOx (72% decrease) and SOx (82% decrease) have plummeted, and since 1995 VOCs (51% decrease) have fallen thanks in large part to the greater production and use of clean natural gas. (Pa. DEP Stationary Source Emission Inventory, 2012-2015)
- **Pa. GHG Emissions from Power Generation Decline:** Since 2005, the use of natural gas in power generation has increased 27% alongside a 30% decline in power-sector greenhouse gas emissions. (Pa. DEP, Greenhouse Gas Inventory, 2018)
  - **Carnegie Mellon Univ. Study (2018):** Thanks to the expanded use of local, clean natural gas in power generation, the United States "*has already come quite far in reducing carbon dioxide emissions*."
  - "The biggest driver of lower carbon dioxide emissions has been declining natural gas prices, which has allowed the industry to replace coal-fired power plants economically with cleaner natural gas power plants—and without a costly regulatory mandate," said Jeffrey J. Anderson, a doctoral candidate in the Department of Engineering and Public Policy.
  - **MORE:** http://marcelluscoalition.org/2018/02/u-s-natural-gas-consumer-savings-clean-air-progress-energy-security/

- Total U.S. greenhouse gas emissions reach lowest level since 1992, according to the EPA Greenhouse Gas Inventory released in April. Asthma-inducing and ozone-harming air pollutants have plummeted during the same period

Methane Emissions Flat, Decline

- **Industry Best Practices, Innovations:** Since Methane is the very product that our members market and sell, operators have every incentive to minimize losses. As such, the industry continues to identify and implement new technologies and procedures designed to reduce methane emissions. Improvements include the following:
  - Eliminating venting and flaring by directing the gas that flows back during well competition activities directly into pipelines;
  - Using vapor recovery systems, collecting vapors from dehydrators, water trucks and tanks;
  - Using air instead of gas for pumps and pneumatic controllers;
  - Employing Leak Detection and Repair (LDAR) equipment on a recurring basis to identify and eliminate leaks. (MSC testimony)
- **Peer-Reviewed NOAA Study – Methane Emissions Flat, Other Studies Overestimate (May 2019):** "We analyzed a decade's worth of data and while we do find some increase in methane downwind of oil and gas activity, we do not find a statistically significant trend in the U.S. for total methane emissions."
  - **MORE:** The new NOAA analysis shows that ethane-to-methane ratios are increasing, and that has led to major overestimations of oil and gas emission trends in some previous studies. "What this means is if you want to track methane, you have to measure methane," said the researcher. (NOAA release, 5/15/19)
- **EPA Data:** Total methane emissions have fallen 19 percent since 1990 alongside a 51% increase in U.S. natural gas production. (Source)
- **Falling Methane Emissions:** a more recent analysis demonstrates that despite the significant production increases in the Appalachian Basin between 2011 and 2017, methane emissions fell from 5.3 MMT to 4.7 MMT, resulting in an emissions intensity reduction of 82 percent.4 In short, while production increased, pollutants decreased at a significant rate. (Energy InDepth, 4/25/19)
  - **Tribune-Review (May 2019):** *Appalachian Basin's methane emissions fall despite increase in gas production*
- **PSU Researchers (2017):** "A methane emission inventory was developed for the Marcellus region to be used as input for an atmospheric transport model," stated PSU's Zachary R. Barkley. "Spatial methane concentration maps were then created by the model to be compared to values observed from the aircraft campaign. Results from the study ***show emissions from natural gas production in the northeastern Marcellus region to be much smaller compared to values found from studies performed in other shale gas regions***."
- **2016 NOAA Study:** "Currently increasing methane levels **are caused not by fossil fuel production** but rather by wetlands or, more likely, agriculture." (Journal Science, 3/10/16)
- **Univ. of Colorado Study:** A 2015 study found relatively low emissions of methane from major US gas fields. Specifically for the **Marcellus, the study found the lowest methane release – 0.18%** -- 0.41% -- of the major oil and gas producing formations. This is well below the well-accepted threshold for natural gas to maintain its climate benefits of 3.2% (Journal of Geophysical Research, 2/18/15)

Emissions Below Health Protective Levels

- **2019 Gradient Study:** "This air quality and public health evaluation of December 2016 to October 2018 ambient air quality data collected at three sites in proximity to the Yonker well pad in Mount Pleasant Township showed that measured PM2.5 and VOC concentrations were consistently below health-based air comparison values and thus are not expected to pose acute or chronic health concerns."
  - **KDKA-TV:** "A study of a well site near a local school found no air quality issues that would affect people's health."
  - **Observer-Reporter:** "Air-quality study finds no health risks from natural gas development"
  - **Business-Times:** "A nearly two-year study of the air quality surrounding a well near a Washington County school campus finds levels of fine particulate matter or volatile organic compounds were below health safety limits from just before drilling through hydraulic fracturing and into production of the controversial well pad."
- **Wash. Co. Air Quality Monitoring "Well-Below Health-Protective Levels":** An air quality study in Washington Co. PA, sponsored by Ft. Cherry School District, concluded that the presence and operation of a hydraulic fracturing well pad "did not substantially affect local air concentrations of total and individual VOCs" and "all individual VOC concentrations in the monitored area were well below health-protective levels." (PubMed, June 2016)
  - **MORE – VOC Levels Consistent with Background Baseline Tests:** When volatile compounds were detected, they were consistent with background levels measured at the school and in other areas in

Washington County. Furthermore, a basic yet conservative screening level evaluation shows that the detected volatile compounds were below health-protective levels. (ChemRisk, 2/3/12)

- **Drexel Univ. Study:** "We did not observe elevated levels of any of the light aromatic compounds (benzene, toluene, etc.)" and "there are few emissions of nonalkane VOCs (as measured by PTR-MS) from Marcellus Shale development." (4/21/15)
- **PG: DEP's overdue Marcellus Shale air study finds few health risks:** "A much-delayed state air monitoring study meant to gauge the long-term health risks of living near Marcellus Shale operations found limited impacts to the air quality around the sites it examined and little risk of healthy residents getting sick from breathing the air nearby." (7/20/18)
    - **DEP report:** http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Monitoring%20Topics/Toxic%20Pollutants/Docs/FINAL_Long-Term_Marcellus_Project_Report_071018.pdf
    - **More:** https://eidhealth.org/pa-agencies-find-shale-development-has-little-risk-of-harming-public-health/

Water Protection, Recycling & Reuse, NORM / TENORM

Well Integrity, Groundwater Protection
Marcellus Shale well casing design: http://marcelluscoalition.org/marcellus-shale/production-processes/casing-the-well/

- **Pa. Department of Environmental Protection**: "*there is no evidence that hydraulic fracturing has resulted in a direct impact to water supply in Pennsylvania.*"
- **Pa. DEP Comprehensive Well Integrity Report:** In 2018, DEP released an in-depth, comprehensive report on the integrity of unconventional natural gas wells, concluding that more than 99% of wells were structurally sound and "*operated in a manner that greatly reduces the risk for groundwater impacts*." Commenting on the report, DEP Secretary Patrick McDonnell said we have "*the most rigorous routine well integrity assessment program to protect groundwater in the United States.*" (2018)
- **Susquehanna River Basin Continuous Water Quality Monitoring:** The SRBC actively monitors waterways across the basin, where significant natural gas development has occurred, and, according to its report, there have been "no discernable" impacts to water quality or quantity as a result of shale development activities.
    - Last year a Penn State peer-reviewed study identified, "an overall trend of improving water quality," in Bradford County, one of Pennsylvania's top natural gas producing counties.
    - A 2018 Yale study of sampled nearby water well supplies before, during and after unconventional natural gas drilling and hydraulic fracturing and attributed any rising levels of methane to natural variability, not to shale related activities.
    - **MORE**: http://marcelluscoalition.org/wp-content/uploads/2018/06/DRBC-MSC-Letter-June-2118.pdf
- **Department of Conservation and Natural Resources:** A report released last year concluded natural gas development in and under state forests has had no impact on the quality of waterways.
- **Industry-Supported Baseline Water Testing Expansions:** Pennsylvania has established, under [Act 13], that operators who drill gas wells within 2,500 feet of private or public water supply are presumed to be responsible for impacting these water supplies should a complaint arise from the land owner or water purveyor. This encourages the operator to prepare third party baseline testing of all water supplies within 2,500 feet to illustrate the existing conditions of the water supplies. The operator is fully responsible for completing pre and post testing to prove that no impact on water supplies has occurred. (10/12/12)
- **Exhaustive EPA Fracking Study:** A multi-year EPA study on hydraulic fracturing determined that the highly-regulated technology has "*not led to widespread, systemic impacts on drinking water resources.*"
- **Nat'l Ground Water Assoc.:** The NGWA – the largest association of groundwater professionals in world – reported "no widespread water quality or quantity issues have been definitely documented that are attributable to the hydraulic fracturing process." (NGWA, 2/19/14)
- **2016 University of Cincinnati study:** A three-year study by the University of Cincinnati has determined that natural gas drilling has had no effect on the quality of water coming from wells in Carroll County. … "*The good news is that our study did not document that fracking was directly linked to water contamination*," said Dr. Amy Townsend-Small of the University of Cincinnati, who presented the findings Thursday at a meeting of Carroll Concerned Citizens. (Times Reporter, 2/5/16)
    - Full report: http://www.artsci.uc.edu/departments/geology/research-and-scholarship/UCGWResearchofOhio/GROQuestions.html
- **AP: DOE study: Fracking chemicals didn't taint water:** A landmark federal study on hydraulic fracturing, or fracking, shows no evidence that chemicals from the natural gas drilling process moved up to contaminate drinking water aquifers at a western Pennsylvania drilling site, the Department of Energy told The Associated Press. After a year of monitoring, the researchers found that the chemical-laced fluids used to free gas trapped

deep below the surface stayed thousands of feet below the shallower areas that supply drinking water, geologist Richard Hammack said. (AP, 7/19/13)
    - Full study: http://energy.gov/fe/articles/netl-releases-hydraulic-fracturing-study
- **"Studies Show Naturally Occurring Methane in Northeast Pa. Water":** A pair of studies released today by the U.S Geological Survey found low-to-moderate concentrations of naturally occurring methane in private water wells in Wayne and Pike Counties– a region of the state without Marcellus Shale drilling. … "In the case of Wayne and Pike counties, the methane we're measuring is all naturally occurring," says [USGS' Ronald] Sloto. (StateImpact, 11/13/14)
- **2015 Syracuse Univ. study:** "An extensive study conducted by a Syracuse University professor has shown that central New York water quality has not been negatively affected by intense "fracking" operations in northern Pennsylvania and southeastern Ohio. … [Don] Siegel's study falls in line with similar studies on the matter performed by the EPA and USGS. Siegel and his team tested more than 21,000 samples of groundwater over the course of their study with some of the samples coming from depths that exceeded federal requirements by more than 500 feet. … Siegel's study found that "natural geological formations" in the area were responsible for the anomalies. Siegel explained that the results from the study were "neither unusual nor surprising and are consistent with previous results in both areas…taken both before and after unconventional gas development began." (Daily Orange, 9/27/15)

******Additional, peer-reviewed studies concluding hydraulic fracturing is not a major threat to groundwater******
https://www.ipaa.org/fracking/#studies

Pa. Operators Pioneer Water Recycling & Reuse

- A Bloomberg News editorial writes this about the Commonwealth's forward-leaning water management regulations: *"**Pennsylvania has the right approach**. Before withdrawing water in that state, drillers must win approval for a water-use plan that discloses how much water a well will use, from where and what effect that will have on local sources. To be approved, these plans must include wastewater recycling. … **Other states…should follow Pennsylvania's lead**."*
    - **Post-Gazette (2011):** Gas drillers recycling more water, using fewer chemicals
- **Water Recycling Rates:** In 2017, about 94 percent of all produced fluids was recycled and/or reused in the production/hydraulic fracturing of other natural gas wells, according to the DEP's 2017 Oil and Gas Report.
    - **MORE:** http://marcelluscoalition.org/marcellus-shale/production-processes/water/
    - http://marcelluscoalition.org/2013/09/what-happens-to-the-brine/
- **2011 MSC Letter on Water Management:** On behalf of the Board of Directors of the MSC, I write to you today to express our commitment to meet the call of the DEP to halt the delivery of flowback and produced water from shale gas extraction to the facilities that currently accept it under special provisions of last year's TDS regulations. … This decision is a further reflection of our Guiding Principles for responsible natural gas production – including our focus on state-of-the-art environmental protections and increased transparency in our operations throughout the Commonwealth. (MSC letter, 4/20/11)
- **DEP Study: Shale Presents "Little Potential" Radon Risk:** In January 2015, the DEP announced results of its TENORM study, which analyzed naturally occurring levels of radioactivity associated with oil and gas development. It found that there is little potential for harm to workers or the public from radiation exposure due to oil and gas development.

NORM / TENORM

- **2015 DEP Peer-Reviewed Study Shows There is Little Potential for Radiation Exposure from Oil and Gas Development**
    - "The study report is the culmination of a multi-year effort and represents what we believe to be the most comprehensive radiological study of the oil and gas industry ever conducted," Vince Brisini, DEP Deputy Secretary for Waste, Air, Radiation and Remediation said.
    - There is little potential for additional radon exposure to the public due to the use of natural gas extracted from geologic formations located in Pennsylvania.
    - There is little or limited potential for radiation exposure to the public and workers from the development, completion, production, transmission, processing, storage, and end use of natural gas.
    - There is little potential for radiation exposure to workers and the public at facilities that treat oil and gas wastes.
    - There is little potential for radiation exposure to the public and workers from landfills receiving waste from the oil and gas industry.

- **MORE:** https://www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/Oil-and-Gas-Related-Topics/Pages/Radiation-Protection.aspx

- **In Pennsylvania, depending on predicted radiation dose levels from TENORM waste, protective actions and regulations include:**
  - Sampling waste and determining radionuclide levels, using these to determine proper protection and disposal;
  - Monitoring truckloads of waste when it leaves the well site and when it arrives at a landfill;
  - Performing work area surveys to determine radiation exposure levels;
  - Performing contamination surveys of personnel and equipment prior to leaving work areas;
  - Segregating TENORM to a holding area to limit exposures; and
  - Preparing and implementing a radiation action plan.
  - **MORE:** http://marcelluscoalition.org/wp-content/uploads/2018/02/NORM-and-TENORM-Fact-Sheet_FINAL.pdf

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Economic Driver, Job-Creator

- **PwC Economic Analysis:** Natural gas development in Pennsylvania supports more than 320,000 jobs and contributes more than $45 billion to the Commonwealth's economy, a new PricewaterhouseCoopers study confirms. (PwC, 7/17/17)
- **Revenue to Pennsylvania from Oil & Natural Gas:** Oil and natural gas development has generated $6 billion in new revenue for Pennsylvania since 2008.
  - **$1.7 Billion in Impact Fee Collections:** Since 2012, Pennsylvania's tax on natural gas – the impact fee – is on track to generate nearly $1.7 billion in new revenue, including a record $247 million in 2018. These revenues directly benefit communities in all 67 counties and the tax is levied on top of all other Pennsylvania business taxes.
  - **$3+ Billion in Tax Revenue:** Since 2008, oil and natural gas development has generated more than $3 billion (and counting) in capital stock & franchise, corporate net income, sales & use, business, and personal income tax revenue for Pennsylvania.
  - **$1.1 Billion in Bonus & Lease Royalty Payments to DCNR:** From 2008-2017, oil and natural gas development under state lands has generated $1.1 billion in lease bonus and annual royalty payments.
- **Forge the Future:** A recent report by McKinsey & Co. demonstrates Pennsylvania can add $60 billion in gross domestic product, 100,000 new jobs and billions of dollars in tax revenue over the next decade if policies are enacted to leverage the region's shale energy abundance for downstream, manufacturing use. (Forge the Future)
- **Univ. of Pennsylvania Expert – "shale gas has been a clear win for consumers":** After ten years of gas production in the shale fields, a new study from the Kleinman Center for Energy Policy at the University of Pennsylvania takes a closer look—demonstrating that Pennsylvania's residential consumers enjoy gas bills that are on average 40 percent lower (than 2007 bills) and that the electric power sector is now the nation and state's largest gas consumer. (UPenn, 10/27/17)
  - **Consumer Savings:** Thanks to affordable, abundant natural gas, Pennsylvania households are experiencing average annual home energy savings of $1,100-$2,200.
    - Natural gas prices for end-use consumers are down 51-78% since 2008
    - Wholesale electric prices down 41% since 2008.
    - **MORE:** http://marcelluscoalition.org/2019/01/pennsylvanians-stay-warm-with-affordable-natural-gas-during-brutal-cold-snap/
- **Univ. of Chicago – Study Shows Hydraulic Fracturing Boosts Local Economies:** Research "makes clear that on net there are benefits to local economies – which we believe is useful information for leaders in the U.S. and abroad who are deciding whether to allow fracing in their communities." (Univ. of Chicago, 12/22/16)
- **London School of Economics – Shale "has made U.S. manufacturing more competitive":** "That the cost advantage due to the shale gas boom may have helped the US economy recover significantly faster than it would otherwise have done after the financial crisis of 2007/08." (London School of Economics, 12/16/16)
- **Harvard Study: Shale the "Single Largest Opportunity to Improve Trajectory of U.S. Economy":** The U.S. energy revolution is delivering an "unprecedented, once-in-a-generation opportunity to all Americans," according to Harvard University experts. According to the Harvard experts' analysis, in 2014 American energy development contributed $430 billion to U.S. GDP; supported 2.7 million jobs; saved of the average household $800 through lower energy costs; and improved our geopolitical positioning by reducing America's trade deficit all while improving energy security. (Harvard Business School, 6/12/15)
- **National Bureau of Economic Research / Univ. of Pennsylvania – Shale Development Is Key Driver of Economic Growth:** "In the aggregate, we estimate that during the shale oil period 4,600,000 (net) new jobs are linked with the development of shale oil technology. This represents a 4.2% increase in the number of jobs across

the industries in our study, compared to the aggregate number of jobs at the beginning of the shale oil period. … We find that…shale oil is an important contributor to the future U.S. economic growth." (NBER, 12/16)

- **National Bureau of Economic Research / Dartmouth Univ. – Regional Economies Reap Benefits From Fracking:** Commenting on the study's findings, Dartmouth economics professor Bruce Sacerdote notes that "*It's surprising just how much of the revenue, how large the benefits are in the county and within 100 miles of the county.*" (Dartmouth Univ., 11/6/15)

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Sample of available studies

	ARTICLE	RESEARCHER	ABSTRACT/CONCLUSION
Screening Risk Assessments			
Air	Health Consultation -Public Health Evaluation of Long-Term Air Sampling Data Collected in the Vicinity of Natural Gas Operations. **Washington County, Pennsylvania** https://www.atsdr.cdc.gov/HAC/pha/marcellusShale/Air_Marcellus_Shale_HC-508.pdf	Agency of Toxic Disease Registry	Seven chemicals (acetaldehyde, benzene, carbon tetrachloride, chloroform, formaldehyde, hydrogen sulfide, and ozone) and PM2.5 exceeded health-based comparison levels in ambient air. However, except for ozone, hydrogen sulfide, and PM2.5, the detected concentrations for these chemicals are not expected to result in adverse health effects from short- or long-term exposures.
	Public Health Evaluation of Ambient Air Near a Shale Gas Well Site and School Campus: Results from Long-term Air Monitoring at the Yonker Well Site Nearby the Fort Cherry School Campus in **Washington County, Pennsylvania**	Gradient Inc. AECOM Technical Services	The measured PM2.5 and VOC concentrations do not provide evidence of elevated long-term average concentrations relative to other parts of Washington County that are more distant from local natural gas development. The measured concentrations reflect the cumulative contributions of both air emissions from the Yonker well pad as well as from other local and regional air emission sources such as area well pad sites, and include concentrations during all phases of well pad construction and operation.
	Maskrey, J. R., Insley, A. L., Hynds, E. S., & Panko, J. M. (2016). Air monitoring of volatile organic compounds at relevant receptors during hydraulic fracturing operations in **Washington County, Pennsylvania.** Environmental monitoring and assessment, 188(7),	Cadno ChemRisk	Several individual volatile compounds were detected in the 24-hour samples, but they were consistent with background atmospheric levels measured previously at nearby sampling sites and in other areas in Washington County. Furthermore, a basic yet conservative screening level evaluation demonstrated that the detected volatile organic compounds were well below health-protective levels. The primary finding

Sample of available studies

	ARTICLE	RESEARCHER	ABSTRACT/CONCLUSION
	410 https://www.ncbi.nlm.nih.gov/pubmed/27312253		of this study was that the operation of a hydraulic fracturing well pad in Washington County did not substantially affect local air concentrations of total and individual volatile organic compounds.
Water	National Human Health Risk Evaluation for Hydraulic Fracturing Fluid Additives https://www.energyindepth.org/wp-content/uploads/2013/05/Gradient-Report_2.pdf	Gradient Inc	"we conclude that when used in their intended manner in tight oil and gas formations, i.e., pumped into a subsurface formation to induce fractures in the target formation, HF fluids are not expected to pose adverse risk to human health because wells are designed and constructed to prevent HF fluids in the well from coming in contact with shallow aquifers and it is implausible that the fluids pumped into the target formation would migrate from the target formation through overlying bedrock to reach shallow aquifers. Even in the event of surface spills, inherent environmental dilution mechanisms would, with a high degree of confidence (based on our probabilistic analysis covering wide ranging conditions), reduce concentrations of HF chemical constituents in either groundwater or surface water below levels of human health concern (RBCs), such that adverse human health impacts are not expected to be significant."
Reviews of Literature that take into account study limitations and exposure			
	RFF Health Impacts of Unconventional Oil and Gas Development - Alan J. Krupnick and Isabel Echarte https://media.rff.org/documents/RFF-Rpt-ShaleReviews_Health_0.pdf	Resources for future	We found that though many epidemiological studies used robust statistical methods to estimate changes in health outcomes associated with unconventional oil and gas development, all had shortcomings that were most often significant.
	Bamber et al., A Systematic Review of the Epidemiologic Literature Assessing Health Outcomes in Populations Living	Colorado Department of Health and the	Systematic method was used to review the existing epidemiologic literature and determine the state of the scientific evidence for potential adverse health outcomes in

	ARTICLE	RESEARCHER	ABSTRACT/CONCLUSION
	near Oil and Natural Gas Operations: Study Quality and Future Recommendations https://www.mdpi.com/1660-4601/16/12/2123	Environment/ PA Department of Health	populations living near oil and natural gas (ONG) operations in the United States. The review utilized adapted systematic review frameworks from the medical and environmental health fields, such as Grading of Recommendations, Assessment, Development and Evaluations (GRADE), the Navigation Guide, and guidance from the National Toxicology Program's Office of Health Assessment and Translation (OHAT). The review included 20 epidemiologic studies, with 32 different health outcomes. Studies of populations living near ONG operations provide limited evidence (modest scientific findings that support the outcome, but with significant limitations) of harmful health effects including asthma exacerbations and various self-reported symptoms. Study quality has improved over time and the highest rated studies within this assessment have primarily focused on birth outcomes. Additional high-quality studies are needed to confirm or dispute these correlations
Ambient monitoring data			
Air	Public Health Evaluation of Ambient Air Near a Shale Gas Well Site and School Campus: Results from Long-term Air Monitoring at the Yonker Well Site Nearby the Fort Cherry School Campus in Washington County, PA http://www.rangeresources.com/docs/default-source/files/public-health-evaluation-of-ambient-air-near-a-shale-gas-well-site-and-school-campus.pdf?sfvrsn	Gradient Inc.	"Overall, we found an absence of PM2.5 and VOC concentrations of either acute or chronic health concern, based on the comparison of valid measurements taken at the three Yonker air monitoring sites to health-based air comparison values"

Sample of available studies

	ARTICLE	RESEARCHER	ABSTRACT/CONCLUSION
	Long, Christopher M., Nicole L. Briggs, and Ifeoluwa A. Bamgbose. "Synthesis and health-based evaluation of ambient air monitoring data for the Marcellus Shale region." Journal of the Air & Waste Management Association 69.5 (2019): 527-547. Maskrey et al., Fort Cherry School District https://www.ncbi.nlm.nih.gov/pubmed/27312253	Gradient Inc	"Several individual volatile compounds were detected in the 24-hour samples, but they were consistent with background atmospheric levels measured previously at nearby sampling sites and in other areas in Washington County. Furthermore, a basic yet conservative screening level evaluation demonstrated that the detected volatile organic compounds were well below health-protective levels. The primary finding of this study was that the operation of a hydraulic fracturing well pad in Washington County did not substantially affect local air concentrations of total and individual volatile organic compounds."
Water	Retrospective Case Study in **Southwestern Pennsylvania** EPA 600/R-14/084 | May 2015 | www.epa.gov/hfstudy Study Of The Potential Impacts Of Hydraulic Fracturing On Drinking Water Resources https://www.epa.gov/sites/production/files/2015-06/documents/swpa_508_km.pdf	USEPA	"There were no detections in this study of glycol ethers, GRO compounds, or acetate in ground water and surface samples collected in Washington County. Detections of VOCs and SVOCs were infrequent, below EPA's drinking water MCLs, and did not correlate with other potential indicators of hydraulic fracturing fluids, such as elevated chloride and/or the presence of glycol ethers."