Mason Conservation Commission
16 Darling Hill Road
Mason, N.H. 03048

August 28, 2015

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

Dear Ms. Bose:

The enclosed letter expressing concerns about the Northeast Energy Direct natural gas pipeline project (FERC docket PF14-22-000) was written jointly by a group of conservation commissions in New Hampshire. Thirty-five New Hampshire conservation commissions signed the letter. The Mason Conservation Commission agreed to distribute the letter on their behalf, and will act as liaison to this group should you wish to communicate on this matter. We agreed to serve in this role solely for logistical reasons, to provide a single point of contact. The letter itself is very much a collective effort, and the Mason Conservation Commission is but a single signatory.

Respectfully,

Robert Dillberger
Mason Conservation Commission

August 28, 2015

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

Dear Ms Bose:

As conservation commissions for the state of New Hampshire, we are dedicated to protecting the natural resources of our towns, and have taken an oath to that effect. New Hampshire state law (RSA 36-A:2) authorizes the creation of conservation commissions "for the proper utilization and protection of the natural resources and for the protection of watershed resources" within their respective towns. We, the undersigned, find that the Northeast Energy Direct (NED) pipeline project (FERC docket PF14-22-000) threatens to damage these resources in many ways. Furthermore, if approved in its current form, the project threatens our ability to perform our duties in the future. We therefore believe our responsibility requires that we oppose the project for the reasons described herein.

**Impact on Future Conservation Efforts.** As currently proposed, the NED pipeline will cross at least 34 conservation properties in 15 New Hampshire towns. Most of the land being crossed by this project was acquired either by gift or by fee purchase authorized by the relevant towns. The protection of this land was made possible by citizens, voters, and donors who believe strongly that New Hampshire's natural environment is worth protecting now and for future generations.

In many cases, money used to protect these lands came in part from state funds created for this purpose. In particular, the Land Conservation Investment Program (LCIP, established by RSA 221-A, since repealed) and the Land and Community Heritage Investment Program (LCHIP, established by RSA 227-M) have both provided public matching funds without which some of these lands would have been lost to development. The intent of these laws is clear, as illustrated by this excerpt from RSA 227-M (emphasis added):

> The general court finds that **in order to maintain New Hampshire's quality of life and economic vitality for its citizens**, growth and development should be balanced with careful protection of the state's most important natural, cultural, and historical resources. **Permanent protection of these resources**, through acquisition of lands, buildings, and other physical assets, or interests in these assets, must be accomplished along with their planned long-term stewardship. ... The intent...is to conserve and preserve this state's most important natural, cultural, and historical resources...**for the primary purposes of protecting and ensuring the perpetual contribution of these resources to the state's economy, environment, and overall quality of life.**

Going still further, both programs create a public trust that bestows upon the State of New Hampshire the responsibility to protect these lands in perpetuity (emphasis added):

> Resource assets acquired under this chapter through the use of the trust fund for the program **shall be held in public trust and used and applied for the purposes of this chapter.** Notwithstanding any other provision of law relating to the disposal of publicly-owned real estate, **no deviation in the uses of any resource asset so acquired to uses or purposes not consistent with the purposes of this chapter shall be permitted.** —RSA 227-M:14

It's worth noting that the law does provide for an exception to this mandate. Specifically, RSA 227-M:13 allows for these lands to be used for *minor* adjustments to state highways. However, the exception includes a strong qualifier: "Approval shall not be granted if reasonable and prudent alternatives exist nor if individual or cumulative approvals are likely to materially impair the conservation or preservation purposes for which the parcel was originally protected." This wording makes clear that even in the case of an allowed exception, conservation concerns take priority.

Also germane is Article 12-a of the New Hampshire State Constitution which states:

> No part of a person's property shall be taken by eminent domain and transferred, directly or indirectly, to another person if the taking is for the purpose of private development or other private use of the property.

Because NED is a private development project, Article 12-a applies. This article is not specific to conservation land but rather applies to all real property within the state. Thus, unlike the LCIP and LCHIP programs, it provides some protection for lands currently being considered for conservation, or for which conservation plans are underway but not yet finalized. Several properties along the pipeline route fall into one of these two categories.

Citizens of New Hampshire have a right to expect these commitments to be upheld, and could lose faith in such protections if NED is allowed to proceed as planned.

The immediate destruction of this land, and the effects on adjacent land, watersheds, and wildlife habitat is bad in itself; we describe these effects in the remainder of this letter. Beyond that, we expect that the loss of even part of this land to a private (i.e., non-governmental) for-profit project by a private company (Kinder Morgan and its affiliate Tennessee Gas Pipeline) will undermine the towns' and state's ability to acquire such protected lands in the future. It seems reasonable to ask why anyone would give such a gift, or authorize such a purchase, if a key justification for such acts—perpetual protection—can be so easily dismissed in direct violation of state law?

Completion of this project as currently planned will send the strong message to the conservation-minded public that state laws can be ignored and protected land taken for private use if a private corporation wishes to use that land for a profit-making venture.

**Impact on Water Resources.** NED has the potential to adversely affect groundwater and surface water along the proposed route. Both resources are of great concern.

Groundwater is a vital resource in all areas of human habitation, and particularly so in southern New Hampshire where a large proportion of citizens rely on private wells as their sole water supply. Some towns do have public water, but those public supplies are themselves fed from in-ground wells.

Approximately 18 miles of the planned pipeline route (25% of the total length in New Hampshire) lie within known stratified drift aquifers, yielding 320 acres of pipeline right-of-way (ROW) within aquifer boundaries[1]. Approximately 9 miles of the pipeline route (13%) is planned to pass through soils where blasting is likely to be required.[1,2] Some of these potential blasting zones are near or within these stratified drift aquifers. The remainder of the likely blasting zones are equally troubling, lying within or near the bedrock aquifers from which many private wells derive their water.

Surface waters too are at risk. The pipeline ROW will directly disturb approximately 440 acres[1] of known[3] wetlands across southern New Hampshire. Among their many irreplaceable environmental services, these wetlands collect rainwater that ultimately contributes to aquifer recharge. Additionally, 70 water bodies (streams, brooks, rivers, ponds, and lakes) of varying size will be crossed.

The potential impacts from NED to water resources within these critical and sensitive areas include:

- Well contamination from nitrites or nitrates introduced during blasting.[4]
- Well contamination from previously bound naturally occurring pollutants (such as arsenic and radon) released by blasting.[4]
- Loss or reduction of well output through changes in bedrock channels caused by blasting. (Many private wells are bedrock wells, although the exact proportion of wells fed from bedrock aquifers and stratified drift aquifers is unknown.)
- Contamination through prolonged herbicide use to control vegetation in certain parts of the ROW.[5]
- Contamination through fluids leaked from construction vehicles operating in wetlands and above aquifers, or fluids spilled during fueling or maintenance.[6]
- Direct disruption of hydrology through soil disturbance (dig and fill), particularly in wetlands where necessary soil layering takes centuries to develop and is difficult to recreate once disturbed.
- Direct disruption of hydrology through changes in topology, affecting runoff patterns and rainwater accumulation needed to recharge aquifers.
- Direct drawdown of aquifers due to hydrostatic testing that might require more water than many of these aquifers normally produce.[7]
- Erosion and sedimentation during construction of water crossings affecting fish and stream life.[8,9] Of special concern is the time period between when construction ends and vegetative cover is re-established. With personnel no longer regularly on-site, the beginnings of erosion can go unnoticed and develop into serious problems that could have been prevented if caught early.
- Increased ground temperature in the vicinity of the pipeline, changing the thermal characteristics of traversed water bodies and potentially affected associated biological communities.

In summary, the cumulative effect on groundwater and surface waters of temporary (during construction) and permanent (post-construction) disruption within these areas is potentially great, yet difficult if not impossible to predict. In our view, the potential (and unproven) benefits of the project are insufficient to justify the risk involved.

**Impact on Wildlife Habitat.** Twenty-four miles of the proposed pipeline route, nearly one-third of its total length in New Hampshire, passes through wildlife habitat rated by the New Hampshire Wildlife Action Plan as "highest ranked" within New Hampshire or our biological region.[10] This habitat is outstanding for its high-quality streams, productive wetlands, and unfragmented forests that sustain a great variety of wildlife species, some of them rare, others threatened or endangered. Healthy fish and wildlife populations that support traditional activities such as fishing and hunting depend on New Hampshire's highest-ranked wildlife habitat.

In total, the proposed pipeline will directly (i.e., within the planned ROW) affect 421 acres of this important resource (the area of indirect effect will be much larger), destroying forest buffers that shade trout streams, obliterating vernal pools needed for amphibian reproduction, disrupting natural wildlife corridors that connect feeding with breeding areas, choking streams with sediment from long stretches of exposed soils, diminishing the wetlands' ability to function by compacting wetland soil with heavy equipment, threatening the health of wetland species with the use of herbicides for ROW maintenance, and introducing invasive species that out-compete native wildlife foods.

**Impact on Air Quality.** Potential adverse effects on air quality come in two forms:

1. Direct release of methane into the atmosphere, and
2. Additional air pollutants released at compressor stations as a side effect of burning hydrofractured gas to provide power.

Regarding the first point, methane is a potent greenhouse gas. When burned it produces about half as much carbon dioxide as coal or oil, but when released in its raw form, the effect is far from benign. According to the Environmental Protection Agency, methane has a "global warming potential" twenty times that of carbon dioxide over 100 years[11]. Methane loss has been measured in distribution systems, and at compressor stations (via leaks and deliberate "blow downs"), valve stations, and metering stations along supply lines. Methane loss from leaks in production, storage, and transmission systems is well documented, and recent studies show the amount lost due to leaks is greater than previously thought.[12, 13, 14, 15, 16]

The exact amount of methane lost to "fugitive emissions" remains an elusive figure but no study of the problem finds the amount is zero. On the contrary, estimates on the high end approach 8% of total annual shale gas production volume[17], and loss from a single compressor station blow-down releases on average 15,000 cubic feet of methane[18]. Of course, predicting how much gas will escape from the NED pipeline in particular is almost impossible. But given what is known about gas leaks in general, it is unrealistic to think that NED will not contribute to this problem.

As a charter participant in the Regional Greenhouse Gas Initiative (RGGI), New Hampshire has a demonstrated commitment to addressing this issue. Supporting projects like NED would contradict the fundamental principle underlying RGGI.

Regarding the second point (air pollution at compressor stations), numerous reports exist of air pollution near compressor stations (where "near" means as far away as one to two miles). Some pollutants (most notably nitrogen dioxide, which contributes to ground-level ozone production) are produced by burning natural gas. Others (known as "air toxics", some of which are known carcinogens) such as benzene, toluene, ethylbenzene and xylene are presumed to be mixed with the methane as a byproduct of hydraulic fracturing[19] and are released along with fugitive emissions of methane. Collectively, these and other pollutants contribute directly to adverse health effects such as asthma and other respiratory illnesses, eye, ear, and throat irritation, headaches, cognitive complaints, and many other maladies.[20, 21, 22, 23]

Adding to our concern is the fact that a portion of the proposed pipeline route lies within a region already identified as a "nonattainment area" (NAA) which fails to meet ambient air quality standards defined by the U.S. Environmental Protection Agency.[24] Introducing a known source of air pollution—one that could release measurable quantities of a significant greenhouse gas[25]— would undermine the very standard that established this area as an NAA and under these circumstances seems unconscionable.

Given these data, we think it's clear that NED has the potential to adversely and measurably affect air quality at both a local and a global level. As with our previously stated concerns about impacts on water quality, the precise degree of

impact is impossible to predict—although we know it won't be zero—but the lack of proven benefit from NED to potentially affected communities seems poor reason indeed to proceed with the project given these very real risks.

## Other Impacts

**Construction Impacts.** In addition to the construction-related issues already described, construction activities can trigger additional adverse effects including:

- Removal of biological material along the ROW leaving bare mineral soil, a habitat conducive to establishing invasive plants such as Japanese knotweed and oriental bittersweet. These invasive species outcompete native species and reduce the biodiversity essential to a healthy ecosystem.
- Introduction of invasive plants through plant materials inadvertently brought to the site on construction equipment or within fill material. That is, not only will this project create sites conducive to establishing invasive plants, it has the potential to deliver those plants to the sites.
- Fugitive dust and diesel exhaust from trucks and heavy equipment on roadways (southern New Hampshire has many miles of dirt roads which are often the only means of access to planned construction sites). Both pollutants contribute to or exacerbate respiratory problems.[26, 27] Indeed, according to the U.S. Environmental Protection Agency, diesel exhaust is already a concern in New England: "Pollution from diesel engines is a widespread problem across New England and it significantly contributes to air pollution...".[28]

**Farmland Impacts**. Some evidence suggests that soil disturbance and increased ground temperature in the vicinity of natural gas pipelines (gases in general release heat when pressurized) contributes to long-term yield reductions.[29] The proposed pipeline route includes almost 28 miles that cross important farmland soils within New Hampshire.[30] Although a small percentage of this land is currently under cultivation, the degradation of these soils will have long-lasting effects on agricultural potential.

**Noise Impacts**. Federal guidelines establish a maximum day-night *average* noise level for compressor stations of 55 dB at the closest noise-sensitive area[31] and we have no doubt that NED compressor stations will comply with this nominal statutory requirement. However, averages can be misleading. For this particular impact, we believe that peak noise level is a more relevant and important metric because the loudest noises at compressor stations occur sporadically (such as during blow downs), not continually.

Peak noise levels of 100 dB have been measured in the vicinity of compressor stations.[32] For comparison, the nominal requirement of 55 dB is roughly equivalent to the sound produced by a modern dishwasher. In contrast, 100 dB is about as loud as a jackhammer.

Noise alone is sufficient to cause health problems including hearing impairment, cardiovascular and other physiological effects, mental health effects, and sleep disturbance.[34] Here, sleep disturbance is of particular concern. Because compressor stations operate 24 hours a day, the potential exists for nighttime sleep disruption. Inadequate sleep is a proven cause of many health problems, and chronic sleep loss "has serious consequences for health, performance, and safety."[33]

Evidence suggests that the difference between a loud noise and the ambient noise level is a more important factor in sleep disturbance than the absolute magnitude of the loud noise[34, 35, 36] This fact is another reason we believe peak noise is more important than average noise in this case. Much of the pipeline route in New Hampshire passes through decidedly rural areas where the typical nighttime noise level is around 35 dB. In these circumstances, a nighttime noise of 100 dB would be jarring indeed (being perceived as roughly 90 times louder than the background noise) and is easily loud enough to disturb sleep in most people.[35, 36]

Also of concern is the low-frequency noise (LFN) produced by compressor stations.[37] Low-frequency noise (below 100 Hz) has been linked to numerous psychological, emotional, and physiological complaints.[34, 38, 39] In some ways, LFN can be worse than noise at higher frequencies. In particular, LFN need not be considered "loud" to cause annoyance and irritation, and is found to be more difficult to ignore than higher frequency noise.[40]

In addition to the potential psychological and physiological effects of loud noise on humans, evidence suggests that wildlife might also be adversely affected by loud noise. Laboratory experiments show reactions in some animals similar to those of humans after prolonged exposure to loud noise. Other studies show that anthropogenic noise can interfere with vocalization and communication in some species, leading one author to conclude that "The inability of creatures to

successfully communicate or otherwise employ their auditory senses is detrimental to the long-term survival of these displaced creatures and the overall biological integrity of the environment."[41]

## In Conclusion

Perhaps it's true that New England needs more energy. However, New Hampshire, as a net exporter of electricity, does not. New Hampshire's recently completed Ten Year Energy Strategy identifies what the state *does* need to prepare for the future, that being (among other things) electric grid improvements (including increased use of sustainable energy sources such as wind and solar power) and improved energy efficiency. Efficiency improvements in particular yield the cheapest, cleanest, most plentiful energy source with no adverse environmental effects. And New Hampshire has much room for improvement here; it lags behind neighboring states in adopting energy efficiency measures.[42]

What New Hampshire does *not* need is an expensive, short-term fossil-fuel fix that diverts us from energy efficiency and energy alternatives and simultaneously destroys wetlands and wildlife habitat, disrupts farmlands, degrades water quality, adds to air and noise pollution, and directly contradicts the legal mandate to hold above all else our precious conservation lands in the public trust.

We the undersigned conservation commissions of New Hampshire believe that the protection of our natural resources is a fundamental right, and that this private taking of these natural resources not only violates this right but is an egregious act against our constitutional guarantee to be protected by the State for the "enjoyment of...life, liberty, and property."[43]

In closing, we acknowledge that energy unquestionably contributes to our quality of life. But the natural environment is the source of that life. Surely nothing is more important than protecting the source.

**Acworth Conservation Commission**

Deborah O. Hinman, Chair

Carole A. Wallace

Daniel Goodwin

Lillie K. Hilliard

Beverly M. Buxton

Helen H. Frink

**Amherst Conservation Commission**

John Harvey, Chairman

William Wichman

Anne Krantz

Rob Clemens

Paul Indeglia, Ph.D, P.E.

**Belmont Conservation Commission**

Laurel Day, Chairman

Paul Schmidt, Vice Chairmain

Denise Naiya

Scott Rolfe

Ken Knowlton

Benjamin Crawford

**Bethlehem Conservation Commission**

Cheryl Jensen, Chair

**Brookfield Conservation Commission**

THOMAS HILL - CHAIRMAN
JULY 15, 2015

**Brookline Conservation Commission**

Francis "Buddy" Dougherty, Chairman

**Campton Conservation Commission**

Tammy Wooster
Alison Hodge
Rebecca Reeves
Jessica T. Halm

**Cornish Conservation Commission**

James Barker, Chair

**Deerfield Conservation Commission**

Senta Frey, Chair

**Dorchester Conservation Commission**

Ryan J. Hung, Chairman
Maria Weick, Secretary

**Exeter Conservation Commission**

Margaret J Malick
Carlos K Lindon
Cyn Mia Field
Robert M. Field
Peter H Richardson

**Fitzwilliam Conservation Commission**

Paul M. Kotila
**Paul M. Kotila, Chair**

Hiel E Lindquist
**Hiel Lindquist**

Dorothy Zug
**Dorothy Zug**

Cheryl M. Norskey
**Cheryl Norskey**

Barbara Green
**Barbara Green**

Jeanne Sable
**Jeanne Sable, Secretary**

**Greenfield Conservation Commission**

Carol V. Davis, Chair
J. Renaud
Conrad B. Dumas
Neal C. Brown
Karen Day

**Greenville Conservation Commission**

Stacy DelVal
Barbara J Larrabee-Guay

**Hudson Conservation Commission**

Ken Dickinson
Kenneth Dickinson, Chairman

James Battis
James Battis

Randy Brownrigg
Randy Brownrigg

**Jaffrey Conservation Commission**

Carolyn D Garretson
Carolyn D Garretson, Chair

**Kensington Conservation Commission**

Joan Keeves
Sydney M Goldenl

**Lyndeborough Conservation Commission**

Sharon Akers, Lyndeborough Con Com Chair

**Mason Conservation Commission**

Robert B. Leraliette CHAIR MASON CC

Robert Dillberger

Barbara B. DeVore

L G Fitchen

Rosanna M. Kadeau

Lindy Lewis

Anna M Faiello

**Merrimack Conservation Commission**

Timothy Tenhave, Chairperson

by unanimous vote of the Commission, 7/20/2015

**Middleton Conservation Commission**

Kathryn Buzard, CHAIR

**Milford Conservation Commission**

Janet Urquhart

Les V. [illegible]

Rodney Della Felici

Hale Seward

Chris Collins

Andy Hughes

**Nottingham Conservation Commission**

Samuel P.M. Demerett, Chair
Susan P. Mooney
Caroline Shepper, Vice
[illegible]
Kristen E. [illegible]
Paul Miliatis

**Pelham Conservation Commission**

Paul L. Dadak
Paul Dadak

Louise Delahanty
Louise Delahanty

Paul Gagnon
Paul Gagnon

Mike Gendreau
Mike Gendreau

Kaela Law
Kaela Law

Lisa Loosigian
Lisa Loosigian

Karen MacKay
Karen MacKay

**Peterborough Conservation Commission**

Frances Von Mertens, Co-chair
Peterborough (NH) Conservation Commission

July 21, 2015

At its July 16, 2015, the Peterborough Conservation Commission voted unanimously to sign this letter.

Jo Anne Carr
Swift Corwin, Alternate
Bryn Dumas
John Kerrick
Matt Lundsted
Cynthia Nichols, Alternate
John Patterson, Co-chair
Robert Wood, Vice Chair

**Piermont Conservation Commission**

Helga Mueller, Chairman

**Rindge Conservation Commission**

David G. Drouin, CHAIR.
William C. Preston
Philip Simeone
Jan A. Griska
Richard Mellor
Albert C. Lefebvre

DAVID G. DROUIN
William C. Preston
Philip Simeone
JAN A. GRISKA
Richard Mellor
ALBERT C. LEFEBVRE

**Sullivan Conservation Commission**

THE SULLIVAN CONSERVATION COMMISSION ENDORES THIS LETTER.

ERIC J. WHITE
CHAIR

**Temple Conservation Commission**

Hunter Repah
Catherine K Joly
Sean Rodchlff
Lincoln Geiger
H Hastings

Temple Conservation Commission
by unanimous vote 14 July 2015

**Troy Conservation Commission**

Sheila Ames _____
Marty Barry, Ph.D. _____
Warren Davis _____
Darline Harris _____
Melvin Pierce _____
Julie Reekie _____
Marianne Salcetti, Ph.D. _____

**Walpole Conservation Commission**

Tom Beaudry - Chair
Myra Manesaire
Kelli Wilson
Elaine Helen
Sharon Tullar
Alicia Flammia
Gary Sweet
[illegible]
[illegible]

**Washington Conservation Commission**

[illegible]
JED SCHWARTZ CHAIR

**Wilmot Conservation Commission**

Brian Faughnan

**Winchester Conservation Commission**

Gustav A. Rutt (chair)
John H Hamm
Ben Kutner
Bonnie Leveillo, Secretary
Miriam "Mim" Johnson
Paul M Hubner Jr.
Joseph Malaretti
Jon D. Bar

**Windham Conservation Commission**

Wayne Morris

Wayne Morris, Chairman

## Notes

[1] Derived from publicly available GIS data obtained from GRANIT at the University of New Hampshire (UNH).

[2] Blasting is expected to be required in any soil of type Lyman-Tunbridge-Rock outcrop complex as identified in the Soil Survey Geographic (SSURGO) database for New Hampshire available at UNH GRANIT.

[3] Rick Van de Poll, Ph.D., a wetlands scientist currently with Ecosystem Management Consultants, estimates that National Wetlands Inventory (NWI) data accounts for only 50-70% of actual wetlands. Personal communication, June 29, 2015.

[4] "Rock Blasting and Water Quality Measures That Can Be Taken To Protect Water Quality and Mitigate Impacts," New Hampshire Department of Environmental Services, 2010.

[5] "Tennessee Gas Pipeline Company Commonwealth of Massachusetts Five-Year Vegetation Management Plan 2011-2015", Tennessee Gas Pipeline Co., 2010.

[6] "Best Management Practices for Fueling and Maintenance of Excavation and Earthmoving Equipment", WD-DWGB-22-6, New Hampshire Department of Environmental Services, 2010.

[7] As it does for many critical statistics, Tennessee Gas Pipeline Company's "Resource Report 2: Water Use and Quality" lists the exact amount of groundwater withdrawal for hydrostatic testing as "TBD" so it is not yet possible to predict the exact impact of this activity on groundwater supplies. Transmissivity of affected aquifers is available in the Natural Services Network dataset at UNH GRANIT.

[8] "Senator calls for rehearing on pending pipeline project in West Milford, Ringwood," David Zimmer, NorthJersey.com, 2012, describes a particular example of issues with sedimentation from pipeline construction by Tennessee Gas Pipeline Co.

[9] "AFS Policy Statement #12: Construction and Operation of Oil and Gas Pipelines," American Fisheries Society, available at http://fisheries.org/docs/policy_statements/policy_12f.pdf.

[10] "New Hampshire Wildlife Action Plan," New Hampshire Fish & Game Department, 2010.

[11] From information available at http://www.epa.gov.

[12] "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013," EPA 430-R-15-004, United States Environmental Protection Agency, 2015.

[13] "Methane Emissions from Natural Gas Systems," Robert Howarth *et al*, Cornell University, 2012.

[14] "Into Thin Air - How Leaking Natural Gas Infrastructure is Harming our Environment and Wasting a Valuable Resource," Conservation Law Foundation.

[15] "Thousands of gas leaks in Boston Area," Boston Globe, August 17, 2011.

[16] "Methane Leaks from North American Natural Gas Systems," A.R. Brandt *et al*, Science, Vol. 343, No. 6172, 2014.

[17] "Methane and the greenhouse-gas footprint of natural gas from shale formations", Robert W. Howarth, Renee Santoro, and Anthony Ingraffea, Climate Change, 2011.

[18] "Reducing Emissions When Taking Compressors Off-Line," United States Environmental Protection Agency, 2006, available at http://www.epa.gov/gasstar/documents/ll_compressorsoffline.pdf.

[19] The content of liquids used in hydrofracturing is not public knowledge due to the "Halliburton Loophole" that exempts the oil and gas industry from reporting the content of fracturing fluids. As Earthworks reports "The oil and gas industry is the only industry in America that is allowed by EPA to inject known hazardous materials—unchecked—directly into or adjacent to underground drinking water supplies." ("The Halliburton Loophole" at www.earthworks.org).

[20] "Summary on Compressor Stations and Health Impacts," Southwest Pennsylvania Environmental Health Project, February 24, 2015.

[21] "Human Health Impacts Associated with Chemicals & Pathways of Exposure from the Development of Shale Gas Plays," Wilma Subra, Subra Company, 2012.

[22] "Marcellus Shale Compressor Station Exceeding Pollution Standard by Nearly Three Times the Allowable Limit," Clean Air Council, 2013.

[23] Environmental Protection Agency web site, Oil and Natural Gas Pollution Standards, Basic Information (http://www.epa.gov/airquality/oilandgas/basic.html), 2014.

[24] "Metropolitan Planning Organization Air Quality Conformity Analysis," Nashua Regional Planning Commission, 2012.

[25] The four chief greenhouse gases are carbon dioxide ($C0_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and fluorinated gases according to "Overview of Greenhouse Gases" at http://www.epa.gov/climatechange/ghgemissions/gases.html.

[26] "Particle Pollution and Your Health," United States Environmental Protection Agency, EPA-452/F-03-001, 2003.

[27] "Region 1: EPA New England, Diesel Exhaust and Your Health", U.S. Environmental Protection Agency, available at http://www.epa.gov/region1/eco/diesel/health_effects.html.

[28] "Region 1: EPA New England, Diesel Exhaust" , U.S. Environmental Protection Agency, available at http://www.epa.gov/region1/eco/diesel/index.html.

[29] "Lancaster County farmer says crop yields never the same after gas pipelines," Ad Crable, Lancaster Online, 2014, available at http://lancasteronline.com/.

[30] "Important farmland" includes all soils identified in the Soil Survey Geographic (SSURGO) database for New Hampshire (available at UNH GRANIT) as having a farmland classification of "All areas are prime farmland, "Farmland of local importance, "Farmland of statewide importance," or "Prime farmland if protected from flooding".

[31] 18 CFR 380.12.

[32] "Reducing the Impact of Natural Gas Compressor Noise," United States Department of Agriculture, 2014, available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/pa/home/?cid=nrcseprd330242.

[33] Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem, H.R. Colten and B.M. Altevogt, editors, Institute of Medicine (US) Committee on Sleep Medicine and Research, 2006.

[34] "World Health Organization: Guidelines for Community Noise", B. Berglund *et al*, World Health Organization, 1999.

[35] "Noise and Its Effects," Dr. Alice H. Suter, Administrative Conference of the United States, 1991.

[36] "Development of Criteria to Minimize Noise Annoyance from Industrial Applications," David C. DeGagne (Noise Solutions, Calgary, Alberta, Canada) and Anita Lewis (Energy Resources Conservation Board, Calgary, Alberta, Canada).

[37] "Proposed Criteria for Low Frequency Noise from Combustion Turbine Power Plants," George F. Hessler Jr., Institute of Noise Control Engineering, 2004.

[38] "Low frequency noise and annoyance," H.G. Leventhall, Noise and Health, 2004.

[39] "Noise Pollution: A Modern Plague," Lisa Goines, RN and Louis Hagler, MD, Southern Medical Journal, 2007.

[40] "Incorporating Low Frequency Noise Legislation for the Energy Industry in Alberta, Canada,", David C. DeGagne (Noise Solutions, Calgary, Alberta, Canada) and Stephanie D. Lapka (Energy Resources Conservation Board, Calgary, Alberta, Canada), 2008.

[41] "The Affect of Noise on Wildlife: A Literature Review," Autumn Lynn Radle, 2007, available at http://wfae.proscenia.net/library/articles/radle_effect_noise_wildlife.pdf.

[42] "New Hampshire 10 Year State Energy Strategy," New Hampshire Office of Energy and Planning, 2014.

[43] Article 12 ("Taxation and Protection Reciprocal") of the New Hampshire State Constitution Bill of Rights.