By U.S. Mail and Email

Chatham Township Committee
Planning Board
58 Meyersville Road
Chatham, NJ 07928
committee@chathamtownship.org

Re: Ordinance 2015-10 (An Ordinance Amending Chapter XXX, Article 7, Titled "Zoning Regulations", Section 30-96.9, Titled "Prohibited Uses", of the Revised General Ordinances of the Township of Chatham Prohibiting Unregulated Pipelines in Any Zoning District)

Dear Members of the Township Committee and Planning Board:

I am a resident of the Township of Chatham, as well as a board-certified internist. I treat patients across a spectrum of healthcare settings from acute inpatient care at Morristown Medical Center to various post acute/ skilled nursing and rehabilitation centers in the area. In addition to being an active member of the Morristown medical staff and Atlantic Health Accountable Care Organization (ACO), I also sit on the Atlantic Health ACO Post Acute Care Division Physician Panel and serve as the medical director at multiple post acute care/ skilled nursing facilities, including Chatham Hills Subacute Care Center (f/k/a King James), Pine Acres Healthcare and Rehabilitation Center, Morris View Healthcare Center, and CareOne at Morris, Madison, and Hanover. I completed my medical residency from 1999-2002 in lower Manhattan (including after the events of September 11, 2001), and therefore have some experience in the medical assessment and care of patients with acute and sub-acute/ chronic exposure to various known and suspected toxins.

Having recently reviewed pertinent research on the toxic effects of chemicals found in petroleum products, it is my view that it is in the best interests of the health and welfare of Chatham residents to continue to prohibit "pipelines that are not public utilities that distribute services to end users and are unregulated by the State of New Jersey Board of Public Utilities." I therefore support, and urge you to vote in favor of, Ordinance 2015-10.

The toxic effects of chemicals present in crude oil and refined petroleum products have been documented and reported in numerous medical journals, which in turn form the basis of recommendations made regarding these substances by government agencies and organizations, including the Centers for Disease Control and Prevention (CDC), the Department of Health and Human Services (DOH), the National Institutes of Health (NIH), the Environmental Protection Agency (EPA), and the International Agency for Research on Cancer (IARC), which is part of the World Health Organization (WHO). I have included with this letter some relevant resources for your consideration, and I outline some of the relevant research findings below.

Monocyclic Aromatic Hydrocarbons

Petroleum fuels, from crude oil to its refined derivatives, are a mixture of compounds, with toxic properties typically studied by chemical groups. One of the earliest discovered, and hence best studied chemical groups, is the hydrocarbons -- more specifically, the unsaturated or aromatic hydrocarbons. Monocyclic aromatic hydrocarbons (MAH), which include benzene, toluene, ethylbenzene, and xylene, are a subset of hydrocarbons with a single aromatic ring.

Benzene is a component of crude oil and is also added during the refining process for fuels to improve octane ratings. It was initially discovered as a chemical compound in 1825 by an English scientist named Michael Faraday, who isolated benzene from an oil resin, and found it to have a variety of valuable properties as a solvent and degreasing compound. By 1849, chemist Charles Mansfield was able to successfully isolate benzene from coal tar leading to the first industrial scale production of benzene. Since then, benzene has been found to be more efficiently produced from petroleum fuels than from coal and ranks in the top 20 chemicals for production volume used extensively in variety of industries from the production of styrene, to phenol and acetone for resins and adhesives, to the manufacture of textiles and engineering plastics, to rubbers, lubricants, dyes, detergents, drugs, explosives and pesticides.

However, benzene is also highly toxic to humans and has been identified as a cause of cancer in humans by multiple safety and regulatory agencies including the CDC Agency for Toxic Substances and Disease Registry (ATSDR), HHS, EPA, IARC, and others. A major source of benzene exposure to humans comes from benzene emissions into water. Benzene—via its major metabolites, including phenol, hydroquinone, catechol, muconaldehyde—contributes to observed mutagenic, carcinogenic, and teratogenic effects, including mylotoxicity (damage in bone marrow) and genotoxicity (damage in genes). Molecular targets for the action of these metabolites include tubulin, histone proteins, topoisomerase II, and other DNA-associated proteins. Damage to these proteins would cause DNA strand breakage, mitotic recombination, chromosomal translocations, and malsegregation of chromosomes to produce aneuploidy.

In laymen's terms, benzene poses both cancer and non-cancer health risks. Benzene is classified as a known human carcinogen which causes acute myeloid leukemia (acute non-lymphocytic leukemia) and there is evidence that benzene may also cause acute lymphocytic leukemia, chronic lymphocytic leukemia, multiple myeloma, and non-Hodgkin lymphoma. Acute effects from inhalation include neurologic symptoms (drowsiness, dizziness, headaches, and unconsciousness); from external exposure include blistering and irritation to the skin, eyes, and upper respiratory tract; and from ingestion include vomiting, dizziness, and convulsions. Chronic non-cancer effects from benzene exposure include blood disorders due to its direct effects on bone marrow, including aplastic anemia, excessive bleeding, and damage to the immune system. In addition, benzene crosses the human placenta and its metabolites are linked to both structural and numerical chromosomal aberrations, leading to some evidence of reproductive and developmental effects, such as low birth weight, delayed bone formation, bone marrow damage, neural tube defects, and problems with central nervous system development. Because gene mutations affecting mitotic division take time to manifest in overt clinical morbidity or mortaliy, the latency period from the time of exposure to the development of cancer

could be years. Moreover, mutations affecting meiosis and gametogenesis may remain unrealized or masked until exposed individuals attempt to start a family.

Toluene, ethylbenzene, and xylene are also found in crude oil. Toluene is also added to gasoline to produce more benzene. Although toluene, ethylbenzene, and xylene are not known carcinogens, they are directly toxic to the central nervous system and have similar effects to one another. The acute effects from inhalation are fatigue, sleepiness, headaches, nausea, and even death at high exposures, while the chronic effects include drowsiness, ataxia (lack of coordination), tremors, cerebral atrophy, nystagmus, and impaired speech, hearing, and vision. Cardiac arrhythmia has also been reported in humans who have been acutely exposed to toluene. Acute effects from ingestion include central nervous system depression, constriction and necrosis of myocardial fibers, swollen liver, congestion and hemorrhage of the lungs and tubular kidney necrosis. These chemicals can also affect reproduction and development, with observation of central nervous system dysfunction, attention deficits, minor craniofacial and limb anomalies, and developmental delay in children of exposed pregnant women.

Even though not all of these MAHs are known to cause cancer, the other adverse health effects should also be avoided. In my experience, a person's quality of life can be greatly, negatively impacted by acute or chronic symptoms, such as the ones described above.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAH) are a second set of chemicals encompassing the vast majority of hydrocarbons that are composed of multiple aromatic rings that are found in fossil fuels and are produced during incomplete combustion of organic matter. PAHs have been identified as carcinogenic, mutagenic, as well as teratogenic. However, much less is known about the specific mechanism of action, molecular targets, or metabolic intermediates for PAHs as compared to the MAHs, such as benzene.

The EPA has classified seven PAH compounds as probable human carcinogens: benz[*a*]anthracene, benzo[*a*]pyrene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, and considers the potential health hazards to be serious enough to warrant further study. For instance, in September 2014, the EPA submitted a draft assessment for the "Toxicological Review of Benzo[*a*]pyrene" for peer review of the scientific basis supporting the human health hazard assessment for inclusion in the Integrated Risk Information System (IRIS) database. The agencies that have commented on the EPA draft include the ATSDR, the CDC National Institute for Occupational Safety and Health (NIOSH), the Council on Environmental Quality (CEQ), the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and the National Institute of Environmental Health Sciences (NIEHS).

Perchlorate

Perchlorate is a component of jet fuel. Perchlorates are salts derived from perchloric acid. They are rarely produced by natural processes, but are mostly produced commercially. They are used for their explosive properties for use in explosives, flares, fireworks and fuels.

Exposure to the general public occurs primarily by drinking water, milk, or ingesting plants with high water content that were grown in water containing perchlorate.

Though perchlorate has not been found to be mutagenic, it can affect thyroid function. As a negatively charged anion, perchlorate acts through competitive inhibition of the transport of iodine into the thyroid. Iodine, also a negatively charged anion, is an important component of thyroid hormones T4 and T3, with the transfer of iodine from the circulation into the thyroid as an essential step in the synthesis of these two hormones. This sustained competitive inhibition of iodine transport can cause an imbalance in the normal regulatory feedback system leading to potential changes in the thyroid cytoarchitecture, including hypertrophy and/or hyperplasia possibly followed by hypothyroidism. Hypothyroidism would require medical evaluation and treatment likely requiring thyroid supplements until the perchlorates have been purged from the system.

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It should be noted that, by design, medical research on the human effects of these chemicals attempts to isolate exposure to a single agent to eliminate confounding variables that may affect outcomes. In a real world oil spill, however, exposure to multiple chemicals (either simultaneously or sequentially) is inevitable, and the cumulative effect on humans is impossible to model. The "best case" scenario is that the health effects from exposure to several chemicals are merely additive. A "worse case" is that the effects are exponential, while the "worst case" is that people develop diseases that were previously unknown.

It is impossible to know with 100% certainty whether residents exposed to the toxic chemicals in crude oil or refined petroleum products would suffer adverse health outcomes. The amount and timing of exposure, the method of exposure, and individual risk factors can affect whether someone will suffer acute symptoms, go on to manifest chronic symptoms, or ultimately develop disease.

In light the present medical and scientific research, which shows that the chemicals commonly found in petroleum pose significant health risks and the immeasurable potential for additional synergistic harm, the Planning Board and Township Committee should absolutely confirm that pipelines that could carry such products are "prohibited uses" in the Township's Zoning Ordinances because they are contrary to the public health and welfare.

Sincerely,

Michael S. Leung, M.D.

cc: Township Pipeline Advisory Committee

Encl. (electronic)

Appendix

Tab	Title
1	Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Gasoline* (June 1995)
2	Agency for Toxic Substances and Disease Registry, *Chemical Identity of Gasoline*
3	Agency for Toxic Substances and Disease Registry, *Public Health Statement: Benzene CAS# 71-43-2* (Aug. 2007)
4	Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Benzene* (Aug. 2007)
5	Agency for Toxic Substances and Disease Registry, *Public Health Statement: Toluene* (Sept. 2000)
6	Agency for Toxic Substances and Disease Registry, *Toluene CAS# 108-88-3 – ToxFAQs*
7	Agency for Toxic Substances and Disease Registry, *Public Health Statement: Ethylbenzene* (Nov. 2010)
8	Agency for Toxic Substances and Disease Registry, *Ethylbenzene - ToxFAQs* (Sept. 2007)
9	Agency for Toxic Substances and Disease Registry, *Public Health Statement: Xylenes* (Aug. 2007)
10	Agency for Toxic Substances and Disease Registry, *Xylenes – ToxFAQs* (Aug. 2007)
11	Agency for Toxic Substances and Disease Registry, *Polycyclic Aromatic Hydrocarbons (PAHs) – ToxFAQs*
12	Agency for Toxic Substances and Disease Registry, *Public Health Statement: Polycyclic Aromatic Hydrocarbons (PAHs)* (Aug. 1995)
13	International Agency for Research on Cancer, *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Chemical Agents and Related Occupations*, Vol. 100F, pp. 249-285 (Benzene) (2012)
14	International Agency for Research on Cancer, *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Some Industrial Chemicals and Dyestuffs*, Vol. 29, pp. 93-148 (Benzene) (1982)

15	International Agency for Research on Cancer, *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Re-evaluation of Some Organic Compounds, Hydrazine and Hydrogen Peroxide*, Vol. 71, pp. 829-864 (Toluene) (1999)
16	International Agency for Research on Cancer, *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Re-evaluation of Some Organic Compounds, Hydrazine and Hydrogen Peroxide*, Vol. 71, pp. 1189-1208 (Xylene) (1999)
17	International Agency for Research on Cancer, *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Some Industrial Chemicals*, Vol. 77, pp. 227-265 (Ethylbenzene) (2000)
18	Environmental Protection Agency, Integrated Risk Information System, *Benzene* (CASRN 71-43-2), II.A.2 Supporting data for Carcinogenicity
19	Environmental Protection Agency, Integrated Risk Information Systems, *Perchlorate and Perchlorate Salts* (Feb. 18, 2005)
20	Environmental Protection Agency, *Carcinogenic Effects of Benzene: An Update*, EPA/600/P-97/001F (April 1998)
21	W.F. von Oettingen, "The Toxicity and Potential Dangers of Aliphatic and Aromatic Hydrocarbons," YALE JOURNAL OF BIOLOGY AND MEDICINE, Vol. 15, pp. 167-184 (1942)
22	New Jersey Department of Health, *Benzene – Right to Know Hazardous Substance Fact Sheet* (Oct. 2008)