Vapor Intrusion of Toxic Chemicals:

An Emerging Public Health Concern

Final Report
January 2006

Assemblyman Thomas P. DiNapoli, Chairman
New York State Assembly
Committee on Environmental Conservation

Acknowledgements

On behalf of the members of the Assembly Standing Committee on Environmental Conservation, the Chair would like to thank all those persons who attended and contributed to the Committee's hearings on vapor intrusion in New York State.

Representatives from the New York State Departments of Environmental Conservation and Health attended both the Endicott and Ithaca hearings. In addition to submitting testimony, they answered many detailed questions, remaining in front of the Committee for a considerable amount of time (in the case of the Ithaca hearing, for over two hours). Representatives from the U.S. Environmental Protection Agency (EPA) attended both the Endicott and Hopewell Junction hearings and likewise submitted testimony and responded graciously to lengthy questioning.

Each of the agency representatives who testified also stayed until the end of the hearings to hear all the testimony submitted by technical experts and concerned citizens. This was greatly appreciated by the Committee as well as by community members, and demonstrated the professionalism and commitment of each agency's staff. EPA is to be particularly commended for bringing a team of staff to the Hopewell hearing and making those staff available to answer questions from the public and the Committee before, during, and after the hearing.

National experts on vapor intrusion traveled from as far away as California to attend the hearings. Others who could not be present in person submitted written testimony. The Committee is grateful for the time and effort these busy and knowledgeable people contributed to the policy discussion regarding vapor intrusion in New York State.

Concerned citizens also traveled long distances to attend more than one hearing. Each one who testified exhibited great courage and poise in sharing their private fears and struggles. They also offered invaluable insights into how vapor intrusion should be addressed in the state.

The substance and value of this Report is owed to these participants. I thank you all for your valuable and generous contributions.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

BACKGROUND

Vapor intrusion occurs when toxic volatile organic chemicals (VOCs) from contaminated soil and groundwater vaporize and rise through cracks, gaps, or pores in soil and foundations into homes and other buildings. A national effort to better understand and revisit sites with a potential for vapor intrusion has been underway since the late 1990s, when the potential for significant human exposure was first recognized.

In New York, this effort has led to the discovery of vapor contamination at several Superfund sites, including the IBM Facility site in Endicott, the federal Hopewell Precision Area Contamination site in Hopewell Junction, and the Emerson Power Transmission site in Ithaca. Vapor intrusion also has the potential to be a problem at brownfield sites.

The most common chemicals of concern at vapor intrusion sites are trichloroethene (TCE), tetrachloroethylene (PCE), and trichloroethane (TCA). Each is highly volatile and associated with serious negative health impacts, such as cancer, organ damage, and/or birth defects.

Policies to address vapor intrusion are still in the development stage. The New York State Departments of Environmental Conservation (DEC) and Health (DOH), as well as the United States Environmental Protection Agency (EPA), have all issued draft guidance on the evaluation of vapor intrusion at contaminated sites, but none has been finalized.

One of the most controversial issues associated with vapor intrusion is the toxicity of TCE. EPA issued a draft TCE Health Risk Assessment in 2001. In response to concerns raised by the Department of Defense and other members of the regulated community, an external peer review by the National Academy of Sciences was initiated in December 2004 and is not expected to be completed until the summer of 2006.

In October of 2003, DOH established an air guideline for TCE of 5.0 mcg/m^3. In August 2005, it issued a draft "Trichloroethylene Air Criteria Document" which provides background information on how the guideline was derived. In late August, DOH convened a Peer Review Panel to review the Criteria Document. While the Panel generally praised DOH staff for presenting a thorough review of the scientific literature, it made a number of recommendations that, if adopted, would extend the lower end of the range of scientifically supported potential guideline values.

Also in August 2005, DOH released a Health Statistics Review for the Endicott site that documented elevated rates of testicular cancer, kidney cancer and heart birth defects in the Endicott area. The review found that these elevated rates were statistically significant, meaning they are unlikely to be due to chance alone.

FINDINGS

The five most important findings from the Committee's hearings are discussed below. Additional findings are listed in the body of the report.

1. Significant barriers hamper our ability to assess the toxic effects of chemicals on human health. As a result, the toxic effects of the majority of chemicals used in commerce are unknown and debate persists over the toxicity of the small number of chemicals, like TCE, that have been well studied. Because it is unethical to give humans measured doses of a toxic chemical as part of a scientific experiment, it is difficult, if not impossible, for human epidemiologic studies, which evaluate exposures after they have occurred, to definitively measure the relationship between disease rate and dose. Environmental epidemiologic studies also suffer from a high potential for false negatives due to the small size of most study populations and a long-standing scientific convention which places greater weight on avoiding false positives than avoiding false negatives. Such studies are further limited by the presence of possible confounding factors, while animal toxicological studies are limited by the need to extrapolate from one species to another. Both types of studies are costly and time consuming. As a result, debate over the toxicity of TCE has persisted due to differing judgments regarding the strength, applicability and interpretation of both human and animal studies.

2. The New York State air guideline for TCE of 5.0 mcg/m^3 is not based on the most protective assumptions supported by science. In developing its guideline for TCE, DOH made a number of choices that resulted in a less protective standard, including the choice not to consider the epidemiologic studies used by EPA in its 2001 draft assessment; the choice not to use a new and stronger epidemiologic study as a source of quantitative values; and the choice not to consider animal studies which show an association between exposure to TCE and testicular cancer, lymphoma and lung cancer based on a lack of human evidence. As a result, DOH's guideline is two orders of magnitude higher than the most protective risk-based concentrations for TCE in air developed by California, Colorado, New Jersey and several EPA regional offices, which range from 0.016 to 0.02 mcg/m^3 and are based on the most conservative assumptions about TCE toxicity presented in EPA's 2001 draft assessment.

3. The movement of VOCs is difficult to predict accurately, and seasonal and day-to-day variation in the factors that influence vapor intrusion make it difficult to accurately measure the true concentration of VOCs under foundations and in indoor air. Factors that influence the movement of VOCs include underlying geologic conditions; the type and condition of a building's foundation; the operation of heating and cooling systems; and variable soil and weather conditions, including barometric pressure and wind. Based on this complexity, experts in geology, hydrogeology, and ecotoxicology submitted testimony to the Committee recommending that sampling for VOCs under foundations and in indoor air be done in different seasons and over a long enough period of time to accurately account for variation.

4. The costs of monitoring and mitigation are comparable. In those cases where installation is straightforward, the cost of mitigation for one building is between $1,000 and $2,000. If conditions at a building make installation complex, mitigation can cost as much as $30,000. In

one instance to date, mitigation has cost $80,000. In comparison, testing one building costs between $2,000 and $3,000. If testing is performed annually in order to monitor contaminant levels, the costs of monitoring will quickly exceed the cost of straightforward mitigation under normal circumstances. The cost of more expensive mitigation actions is comparable to the cost of monitoring over ten years, and even the most expensive mitigation action to date is comparable to the cost of monitoring over 25 years.

5. A number of responsible parties and agencies have made site-specific risk management decisions to install mitigation systems in all buildings where VOC contamination is measured and is plausibly due to site contamination. One example is the first round of mitigation in Endicott, where IBM offered mitigation systems to any building located over the 300-acre plume linked to its former manufacturing facility whenever TCE was detected. Many homes that were not even tested also received systems. EPA made a similar risk management decision to install mitigation systems in all homes at the Hopewell Precision site with sub-slab levels of TCE above 2.7 mcg/m^3 and detectable levels of TCE (above 0.38 mcg/m^3) in indoor air. At the Fort Edward site in Washington County**,** GE offered mitigation systems to all structures located over a TCE-contaminated groundwater plume. In conversations with Committee staff, both DEC and DOH have predicted that many responsible parties in the future will choose to mitigate at detect in order to save money and protect themselves from liability.

RECOMMENDATIONS

In response to the uncertainty associated with many aspects of vapor intrusion, government should err on the side of caution. We must use the knowledge we have today to take a preventive approach to eliminating exposures from vapor intrusion. In addition, the decision making process at vapor intrusion sites should be equitable and transparent, and provide opportunities for meaningful public participation. The five most important recommendations from the Committee's hearings are discussed below.

1. DOH should revise its current indoor air guideline for TCE to reflect the most protective assumptions about toxicity and exposure supported by science. In the face of uncertainty regarding the threat of harm to human health posed by vapor intrusion, DOH should err on the side of caution and adopt a guideline for TCE similar to those developed by a number of other states and regional offices based on more protective assumptions, which range from 0.016 to 0.02 mcg/m^3.

2. DEC and DOH should adopt a general presumption that mitigation will be implemented for any structure where detectable VOC contamination is measured under the sub-slab or in indoor air and evidence exists that such contamination may be caused by vapor intrusion. A large number of findings from the Committee's hearings support this recommendation, including the difficulty of accurately predicting and measuring the contamination caused by vapor intrusion; the limits of science and the fact that the most protective risk-based concentrations for TCE are equal to or below detection limits; and the comparable cost of mitigation and monitoring.

3. The indoor air of any structure located near a contaminated site with a potential for vapor intrusion should be tested whenever a resident or occupant requests such a test. Given the difficulty of accurately predicting and measuring the contamination caused by vapor intrusion, potentially affected residents have legitimate reason to be concerned. At a cost of $2,000 or more, testing represents a large cost to many residents but only a small percentage of the overall cost of cleaning up a contaminated site.

4. Accelerated and aggressive cleanup of the contamination causing vapor intrusion, including the pulling back of groundwater plumes, should become routine practice at all vapor intrusion sites. Such measures are the only way to ensure that mitigation systems will not have to be employed into the future and to protect the economy of communities impacted by vapor intrusion. DEC's view of mitigation as a short term solution, and commitment to aggressively cleaning up underlying contamination, deserve the strongest praise and support. A similar policy should be adopted by EPA.

5. DOH should make every effort to educate communities about the limitations of health studies and increase the ability of science to measure the negative health impacts caused by vapor intrusion, including the expansion of its VOC registry to include vapor intrusion sites. The high potential for false negatives in health studies should be disclosed, and negative results in studies with low statistical power should be characterized as inconclusive. DOH's VOC registry should be expanded to include all sites where there is evidence of human exposure due to vapor intrusion, and New York should develop a comprehensive, statewide environmental health tracking system that includes all contaminated sites and periodic health monitoring for current and former residents.

The report makes a number of additional recommendations including:

- DOH should revise its current air guideline for TCE to correspond to an excess cancer risk of one-in-one million.
- DOH should retain the protective protocols for investigation presented in their draft Guidance for Evaluating Soil Vapor Intrusion, and ensure that testing be of long enough duration to reflect varied conditions and include measurements of the lower air space frequently occupied by children.
- DOH should retain its proposed approach of defining the contamination caused by vapor intrusion as an environmental rather than occupational exposure.
- DEC, DOH and EPA should invest more staff time and resources in public participation activities at vapor intrusion sites and develop a proactive policy regarding the public release of testing results that addresses privacy concerns while encouraging more widespread disclosure of information.
- Landlords should be required to disclose vapor intrusion problems to their tenants, including offers to sample or mitigate and any sampling results.
- DEC and DOH should be commended for leading the nation in the effort to screen existing contaminated sites for potential vapor intrusion problems.
- New York State should significantly increase its investment in pollution prevention programs and consider the enactment of legislation that would promote the adoption of effective and safer alternatives to TCE and PCE.

INTRODUCTION

Vapor intrusion occurs when toxic volatile chemicals from contaminated soil and groundwater vaporize and rise up through cracks, gaps, or pores in soil and foundations into homes and other buildings. The contamination of indoor air caused by vapor intrusion is an emerging area of public health concern.

Vapor intrusion is known to have occurred at several Superfund sites in New York State and has the potential to be a problem at brownfield sites as well. The New York State Departments of Environmental Conservation (DEC) and Health (DOH), as well as the United States Environmental Protection Agency (EPA), have issued draft guidance pertaining to various aspects of vapor intrusion, but none have been finalized.

Starting in the fall of 2004, the New York State Assembly Standing Committee on Environmental Conservation convened a series of public hearings on the problem of vapor intrusion in New York State. The primary purpose of the hearings was to determine what lessons can be learned from past experience in order to properly address vapor intrusion in the future. The first hearing was held in Endicott, New York on November 15, 2004; the second in Ithaca, New York on April 21, 2005; and the third in Hopewell Junction, New York on May 19, 2005. At the hearings, the Committee received testimony from panels of witnesses including federal, state, and local government officials; public health and environmental experts; and citizens representing affected communities. This report provides a summary of testimony from each hearing as well as findings and recommendations based on the Committee's investigations. (For hearing notices, witness lists, and summaries of testimony see appendices.)

BACKGROUND

While federal and state agencies have been aware of the potential for vaporized contaminants to enter into homes and buildings for over a decade, conventional wisdom held that levels of indoor air contamination would not be of concern due to dilution and attenuation. Experts in environmental health and engineering have only recently come to realize the true potential for vapor intrusion to result in widespread human exposures. Indoor air sampling performed at a site in Colorado in the late 1990s found significant levels of the contaminant trichloroethylene (TCE) in homes where the computer model recommended by EPA had predicted little or no contamination. As a result, EPA and state agencies began a national effort to understand vapor intrusion and to revisit sites where cleanup has occurred but the potential for vapor intrusion remains high.

In New York, this effort led to the discovery of widespread vapor contamination around the IBM Corporation Endicott Facility state Superfund site in Broome County, where mitigation systems have been installed at 441 properties. Vapor intrusion has also been discovered around the Hopewell Precision Area federal Superfund site in Hopewell Junction, Dutchess County, where

mitigation systems have been installed in 46 homes. Vapor intrusion problems have also been identified at the Emerson Power Transmission state Superfund site in Ithaca; the CAE Electronics site in Hillcrest, Broome County; the Jackson Steel site on Long Island; and the GE site in Fort Edward, Washington County; as well as at other sites around the state.

Many chemicals have the potential to vaporize and intrude into indoor air. Although all of these chemicals are of concern, three chemicals—trichloroethene (TCE or trichloroethylene), tetrachloroethylene (PCE), and trichloroethane (TCA)—have gained particular attention due to their common occurrence at vapor intrusion sites. TCE has been found at 852 out of 1,540 federal Superfund sites and is the chemical of greatest concern at many contaminated sites in New York State, including the Endicott, Emerson, and Hopewell Junction sites. TCE is considered to be a probable human carcinogen by the International Agency for Research on Cancer and has been found to adversely affect the central nervous and immune systems, organs such as the liver and kidney, and fetus development. PCE has been identified at approximately 771 federal Superfund sites and is also considered to be a probable human carcinogen. Exposure to PCE can cause dizziness, headache, sleepiness, and confusion, and it has also been shown to cause damage to the skin, liver, and kidneys. TCA has been found at 809 federal Superfund sites and, although not considered a carcinogen, can cause damage to the liver, skin, and nervous and circulatory systems.

Vapor intrusion is an extremely complex phenomenon and poses serious challenges for sound public policy making in New York State and the country as a whole. One of the biggest challenges is the lack of legally enforceable cleanup standards for contaminants in residential indoor air. Other challenges include the difficulty of accurately determining which sites and/or buildings have the potential to be contaminated by vapor intrusion and should be tested; the numerous factors that must be considered following initial testing when determining whether to proceed with mitigation, monitor the problem, or take no action; and how to ensure the protection of public health over the long term, including the proper maintenance of mitigation systems and achieving full cleanup of the contamination which is causing the problem.

STATUS OF CURRENT REGULATIONS, STANDARDS, AND STATUTES

The EPA and many state environmental and health departments have begun to develop policies and guidance to address the issue of vapor intrusion. At the federal level, EPA released a draft vapor intrusion guidance in 2002. The intent of the guidance is to help regulators and responsible parties conduct a screening evaluation of whether or not the vapor intrusion exposure pathway is complete and, if so, whether it poses an unacceptable risk to human health. The draft guidance recommends that sub-slab and indoor air sampling be conducted when the possibility of vapor intrusion at levels of concern can't be ruled out. Three technical sessions were held with the states, academia, and external stakeholders to review the guidance. The draft guidance drew strong criticism from industry groups, who raised concerns that the screening test was overly protective.

EPA announced proposed changes to the draft guidance on March 5, 2005 at the Association for Environmental Health and Sciences meeting in San Diego. These changes include lowering

estimates (known as attenuation factors) of the amount of vapor that will seep inside buildings; increasing the number of variables regulators must consider in assessing the likelihood that vapors will enter a structure; and allowing regulators to consider a site's future use when assessing potential vapor intrusion risks. These changes would raise the threshold for concluding that vapor intrusion represents a likely threat to human health. EPA hopes to finalize the guidance sometime in 2006; an additional meeting is scheduled for March in San Diego. In the meantime, the draft 2002 guidance may still be used to evaluate sites with potential vapor intrusion issues, along with consideration of these potential changes.

In New York State, both DEC and DOH have issued draft guidance pertaining to vapor intrusion. DEC's draft guidance, titled "Evaluating the Potential for Vapor Intrusion at Past, Current, and Future Sites," was released in late 2004. The guidance makes a commitment to review all sites where remedial decisions have already been made (known as "legacy" sites) to determine their potential for vapor intrusion. Under the guidance, sites will be identified and prioritized for further action based on a number of criteria, including the total concentration of chlorinated volatile organic chemicals (VOCs), depth to contamination, soil characteristics, and land use adjacent to the site.

Although the draft guidance has not yet been finalized, DEC expects to complete the initial site characterization work needed to prioritize all legacy sites by December 2006. On-site investigations of legacy sites are expected to commence in October 2007. Sites where the perceived likelihood of exposure is great will be scheduled for vapor intrusion evaluations sooner than sites where the perceived likelihood of exposure is small. (See Appendix D for the full text of Assemblyman DiNapoli's comments on DEC's draft policy.)

In February 2005, DOH issued a draft "Guidance for Evaluating Soil Vapor Intrusion in the State of New York," which sets forth procedures on how site investigations and mitigation will be conducted at all potential vapor intrusion sites, including legacy sites and sites where remedial decisions have yet to be made. The policy requires that vapor intrusion be evaluated as part of the remedial investigation at all contaminated sites.

One major aspect of DOH's guidance is the use of chemical-specific matrices as tools for decision making at vapor intrusion sites. The guidance establishes two draft matrices. The first matrix was originally developed for TCE and the second was originally developed for PCE. DOH states that "Because the matrices are risk management tools and consider a number of factors, the NYSDOH intends to assign chemicals to one of these two matrices, if possible." Each matrix has four columns and three or four rows. The cells of the matrices describe which of three types of action – no further action, monitoring, or mitigation – will be triggered by specific levels of indoor air and sub-slab vapor concentrations. (See Appendix E for the full text of Assemblyman DiNapoli's comments on DOH's draft policy.)

A new Superfund and brownfield statute was enacted in New York State in October 2003 that should help to guide the development of policies to address vapor intrusion at contaminated sites. Sponsored by Assemblyman DiNapoli in the New York State Assembly, the law provides for the voluntary cleanup of brownfield sites, refinancing of the state Superfund program, and the creation of a comprehensive program for the long-term restoration of groundwater.

Under the new Brownfield Cleanup Program statute, DEC and DOH are charged with developing generic soil cleanup objectives that must be protective of indoor air. The first draft of those objectives was released in November 2005 and is currently undergoing a public comment period until the end of March 2006. The new statutory Groundwater Protection and Remediation Program, which provides for the long-term pursuit and remediation of off-site groundwater contamination, should help to ensure that the contamination causing vapor intrusion is addressed properly. The new law also establishes a Technical Assistance Grants Program for both Superfund and brownfield sites, a particularly important resource for citizens at complex vapor intrusion sites.

Status of TCE Guidelines

TCE is the primary contaminant of concern at most of the vapor intrusion sites that have been identified in New York State to date. The toxicity of TCE, in particular its potency as a carcinogen, is currently the subject of much debate. In 1989, EPA withdrew the TCE cancer toxicity values from its Integrated Risk Information System (IRIS) database. This database contains toxicity information, such as cancer potency factors (estimates of a chemical's ability to cause cancer), for hundreds of chemicals. At the same time, EPA's Office of Research and Development (ORD) began a reassessment of TCE's toxicity and health effects, including a review of the most recent scientific studies. In the absence of a formal toxicity value, EPA and state environmental agencies continued to use the withdrawn cancer potency factor of 0.006 $(mg/kg\text{-}d)^{-1}$ until ORD's reassessment was completed in 2001.

Based on this reassessment, EPA published a Draft TCE Health Risk Assessment in 2001. The draft assessment found, among other things, that children are more susceptible to TCE exposure than adults and that TCE is five to 65 times more toxic than previously believed. The reassessment proposed a range of cancer potency factors from 0.4 to 0.02 $(mg/kg\text{-}d)^{-1}$ for TCE, which are significantly more stringent than the old withdrawn value**.**

The draft TCE assessment was peer reviewed by EPA's Science Advisory Board, which recommended finalization of the assessment with some revisions. In response to concerns raised by the Department of Defense, however, EPA requested additional external peer review by the National Academy of Sciences. The academy officially initiated its review of the draft assessment in December 2004. The review is expected to take about 18 months.

Over fifteen years after the TCE values were first removed from IRIS, there is still no agreement on TCE's potency as a carcinogen. As a result, state and federal agencies across the country are utilizing different cancer potency factors for TCE that vary by as much as two orders of magnitude. Some states and EPA Regions use the most conservative factor provided in the draft assessment ($0.4\ (mg/kg\text{-}d)^{-1}$), while others use the less conservative factor provided ($0.02\ (mg/kg\text{-}d)^{-1}$), and still others use the old withdrawn factor ($0.006\ (mg/kg\text{-}d)^{-1}$). California's Office of Environmental Health Hazard Assessment developed their own cancer potency factor for TCE of $0.007\ (mg/kg\text{-}d)^{-1}$. New York's Department of Health (DOH) has calculated a range of TCE concentrations associated with an excess lifetime cancer risk of one-in-one million that

correspond to cancer potency factors ranging from 0.0175 to 0.000875 $(mg/kg\text{-}d)^{-1}$. (See Appendix F for a table of the cancer potency values used by different jurisdictions.)

Based on these different cancer potency factors for TCE, a number of EPA Regions and states have developed risk-based concentrations for TCE in indoor air that vary by an order of magnitude or more. In its draft 2002 vapor intrusion guidance, EPA provides tables with target indoor air concentrations at various risk levels. The target indoor air concentration listed for TCE associated with a cancer risk of one-in-one million is 0.022 mcg/m^3, which corresponds to the most conservative cancer potency factor (0.4) in EPA's draft risk assessment. EPA Regions 2, 3, 6, and 9, as well as the States of Colorado and New Jersey, have also developed risk-based indoor air concentrations for TCE (associated with a cancer risk of one-in-one million) based on the most conservative cancer potency factor provided in the draft risk assessment. Region 3 and Colorado have a value of 0.016 mcg/m^3; Regions 6 and 9 have a value of 0.017 mcg/m3; Region 2 has a value of 0.05 mcg/m^3; and New Jersey has a value of 0.02 mcg/m^3. Although these concentrations differ slightly due to minor variations in exposure assumptions, they are all based on the most conservative assumptions regarding TCE's potency as a carcinogen.

The State of California has developed a TCE concentration (associated with a cancer risk of one-in-one million) of 1.22 mcg/m^3 based on its cancer potency factor of 0.007. In addition to the more conservative value noted above, EPA Region 9 has developed a second risk-based concentration for TCE (associated with a cancer risk of one-in-one million and based on the same cancer potency factor as California) of 0.96 mcg/m^3. Both of Region 9's risk-based concentrations are presented in a table with the following explanation: "Region 9 has shown both [TCE guidelines] on this Table, rather than choosing one over the other to give table users as much information as possible in the absence of a final EPA toxicity value." (See Appendix F for a table of the TCE risk based concentrations developed by different jurisdictions.)

It is far from clear how any of these risk-based concentrations are actually being used by agencies to make site investigation, mitigation and remediation decisions. They are variously labeled as "screening levels," "remediation goals," and "target indoor air concentrations." New Jersey's "immediate action level" for TCE in indoor air is based on the higher of the state's health based value and its analytical reporting limit, which is currently 3.0 mcg/m^3. It is hard to get a true picture of the role these concentrations play in site decisions, in part because decisions are largely being made on a site-by-site basis, and in part because decisions to take action, including the decision to mitigate, are being triggered not by contaminant concentrations alone but by a number of additional site specific considerations, including the costs of monitoring versus the costs of mitigation.

Adding to the debate and confusion surrounding the development of risk-based concentrations to guide decision making at vapor intrusion sites is the fact that different jurisdictions operate under different definitions of what constitutes acceptable risk. For example, under the federal Superfund program, the acceptable level of cancer risk ranges from one-in-one million to one-in-ten thousand. In New York, the historical target risk for cancer at Superfund sites has been one-in-one million; this is also the target risk established in statute for brownfield sites and the risk level that must be met by the new generic brownfield soil cleanup standards currently being developed by DEC and DOH.

In October of 2003, the New York State DOH established an air guideline for TCE of 5.0 mcg/m^3. This value is substantially higher than the most conservative risk-based concentrations developed by California, Colorado, and several EPA Regions, and exceeds DOH's own estimate of the range of concentrations associated with an excess lifetime cancer risk of one-in-one million.

During the Committee's hearings, DOH repeatedly emphasized that their TCE guideline is not an action level or cleanup level. However, the guideline is presented in DOH's draft decision matrix for TCE as one level that will be used, in conjunction with sub-slab concentrations, as a trigger for site decision making.

DOH's draft TCE matrix has four columns and four rows. The columns represent indoor air contaminant concentrations of less than 0.25 mcg/m^3; 0.25 to less than 2.5 mcg/m^3; 2.5 to less than 5.0 mcg/m^3; and 5.0 mcg/m^3 and above. The rows represent sub-slab concentrations of less than 5.0 mcg/m^3; 5 to less than 50 mcg/m^3; 50 to less than 250 mcg/m^3; and 250 mcg/m^3 and above.

The matrix directs decision makers to mitigate or monitor if the indoor air concentration of TCE is 5.0 mcg/m^3 or above and the sub-slab concentration is less than 5.0 mcg/m^3. It directs decision makers to mitigate if the indoor air concentration is 5.0 mcg/m^3 or above and the sub-slab concentration is above 5.0; the indoor air concentration is 2.5 to less than 5.0 and the sub-slab concentration is between 50 and 250; or the sub-slab concentration is 250 or above. All other cells direct decision makers to either monitor, identify alternative sources of contamination, or take no further action.

New York's TCE guideline is the subject of much debate. In August 2005, DOH issued a draft "Trichloroethene Air Criteria Document" which provides a detailed overview of the scientific literature and a discussion of how DOH's guideline of 5.0 mcg/m^3 was derived. On August 29-30, 2005, DOH convened a Peer Review Panel to review the Criteria Document. The Panel's charge was limited by DOH to reviewing the validity of the scientific information used by DOH to develop the guideline value, as distinct from the reasonableness or advisability of the value itself.

The Committee was also asked by DOH to consider whether a Health Statistics Review conducted by DOH for the Endicott site and released on August 23, 2005 would affect the Document's conclusions about TCE toxicity in a substantive manner. The review documented elevated rates of testicular cancer, kidney cancer and heart birth defects in the Endicott area. These elevated rates were statistically significant, meaning they are unlikely to be due to chance alone.

While the Peer Review Panel generally praised DOH staff for presenting a thorough review of the scientific literature, it made a number of recommendations that, if adopted, would extend the lower end of the range of scientifically supported potential guideline values. These include the use of a child's body weight and inhalation rate in evaluating central nervous system and other effects; the use of an uncertainty factor of 10 rather than 3 in estimating a "no effect level" for central nervous system effects; using mouse lymphoma data to develop a potential air criteria

value based on carcinogenic effects; and taking exposure to multiple sources and multiple chemicals, through multiple routes, into account.

In addition, the Panel raised concerns about DOH's decision not to use human epidemiologic studies to quantify carcinogenic risks, the cornerstone of EPA's more conservative approach to deriving cancer potency values in its 2001 Assessment. In verbal discussion, Panel members made it clear that DOH's decision not to use these studies was not dictated by science, but was a professional judgment or 'philosophical' decision. In a written consensus response to the six questions posed to the Panel by DOH, the Panel states that while using animal studies as the primary source for quantitative cancer risk assessment is appropriate, "DOH may want to consider the human studies to a greater extent when weighting the cancer evidence to establish a guideline."[1]

According to the draft DOH Criteria Document, cancer potency factors derived from the human epidemiologic studies used by EPA in its 2001 assessment correspond to air criteria ranging from 0.009 to 0.2 mcg/m^3 for an excess cancer risk of one-in-one million (pp. 292-293). DOH declined to use these studies to quantify cancer risk because, according to DOH, they fail to adequately describe the duration or magnitude of exposure to TCE experienced by individuals. A new, stronger study published in 2001 (and so not used in EPA's assessment) was determined by DOH to provide sufficient dose-response data to check the plausibility of potential air criteria derived from animal studies but not to quantify risk itself. This study, referred to as the Hansen study, provides an upper estimate for an excess cancer risk of one-in-one million that corresponds to an air criteria ranging between 0.062 to 1.2 mcg/m^3 with a geometric mean of 0.27 mcg/m^3. (Draft Criteria Document, pp. 132-133.)

The Peer Review Panel concluded the following regarding the use of human epidemiologic studies:

> "Because the analyses are being used to support a TCE inhalation guideline, it is most appropriate to utilize the human epidemiologic studies which evaluate TCE inhalation exposures. The Hansen et al. (2001) study meets all the NYSDOH selection parameters and is a strong and appropriate choice." (Anderson letter, p. 8-9.)

While the Panel did not make a formal recommendation regarding the advisability of DOH's chosen guideline value, some Panel members verbally expressed their belief that the value should be lower (Anderson letter, p. 9). No Panel member stated that the value should be higher.

In regard to the Endicott Health Statistics Review, a number of Panel members stated that the study raised concerns, but all members agreed that the study could not and would not play a substantive role in the development of a quantitative guideline value for TCE. The rationale provided for this conclusion was that the study provides no information regarding exposure levels and does not correct for confounding factors, such as smoking, income or employment history. These weaknesses make it even less useful than the human epidemiologic studies rejected by DOH in their development of a quantitative guideline for TCE.

[1] Letter from Henry Anderson, M.D., Chair of the TCE Peer Review Panel, to Nancy K. Kim, Ph.D., Director, Division of Environmental Health Assessment, NYS DOH, dated November 1, 2005; p. 8.

MITIGATION DECISIONS AT NEW YORK SITES

The complexity of the issues involved in decision making at vapor intrusion sites and the lack of clear health-based standards have led to widespread confusion about what levels of contamination will trigger mitigation at such sites. The perception of discrepancies between sites has created confusion and became a major focus of questions posed to the agencies and testimony presented by concerned citizens at the hearings held by this Committee. The following descriptions present our best understanding of the decision-making process at three of the sites most closely examined during the hearings.[2]

Endicott – IBM Corporation Endicott Facility site

In 1979, a 4,100-gallon methyl chloroform release occurred at the IBM facility in the Village of Endicott in Broome County. IBM began an investigation and discovered concentrations of TCE, TCA, methyl chloroform, methylene chloride, Freon and other chemicals in the aquifer below its facility and extending into residential and commercial areas. Groundwater remediation and monitoring began in 1980 and continues today.

The discovery of vapor contamination in Colorado in the late 1990s led to a review of sites previously believed to have little potential for vapor intrusion. The IBM Endicott site was the first of these sites in New York at which it became clear that vapor intrusion from contamination was impacting residential homes and other buildings.

Indoor air sampling was initially performed at the site in 2001 by IBM as part of state implementation of EPA's RCRA Environmental Indicators Initiative, and included concurrent sampling and analysis of groundwater, soil, and subsurface soil vapor. Subsequently, in the spring of 2002, DEC and DOH required IBM to evaluate the potential for vapor intrusion into buildings over the roughly 300-acre plume of solvents linked to the former IBM campus.

An approach to evaluate the potential for vapor intrusion was developed by IBM in consultation with DEC and DOH and finalized in December 2002. The sampling plan for structures was designed to identify, during the 2002 – 2003 heating season, the extent of the area where ventilation (mitigation) systems would be offered. In order to accomplish that objective, IBM elected to sample approximately 20-25 % of the structures above the 300-acre plume rather than every structure.

When the plan was developed, DOH had not established a guideline for the presence of TCE in air. Consequently, IBM proposed to take a conservative approach and mitigate all structures above the plume where vapor intrusion had a discernible impact to indoor air. DEC and DOH

[2] The data presented in the descriptions for Endicott and Ithaca were verified by DEC and DOH. The data presented in the description for Hopewell Junction were verified by EPA Region 2. On behalf of the Committee, the Chair thanks these agencies for their cooperation and assistance. Any error in presentation or interpretation is ours alone.

approved this approach. At that time, 0.22 mcg/m^3 was the analytical limit the environmental laboratory used by IBM was capable of achieving. Mitigation systems were initially installed in every building where TCE was detected at 0.22 mcg/m^3 or higher and could be attributed to vapor intrusion. Nearby buildings that had not been tested (but were assumed to have similar contaminant levels) were also offered mitigation systems. By the end of the 2003 sampling season, more than 230 structures had been sampled by IBM, and the extent of the area requiring mitigation had essentially been established. IBM extended an offer to install mitigation systems to the owners of 481 properties at that time.

Beginning in January 2004, confirmation testing was begun around the perimeter of the impacted area that had been established during the 2003 heating season. At that time, DOH was working to develop its draft matrices for decision making at vapor intrusion sites. The draft matrix for TCE integrates information regarding the toxicity of TCE used by DOH to develop its air guideline for TCE of 5.0 mcg/m^3 (which was issued in October 2003), as well as the potential for exposure based on sub-slab and indoor air contaminant concentrations. DOH's assessment of the relationship between sub-slab contamination and indoor air contamination (also known as an attenuation factor) initially relied heavily on data from the Endicott site, but, according to the agency, has since been verified at other sites.

The draft matrix for TCE establishes minimum thresholds for proceeding with mitigation, which are 250 mcg/m^3 under the sub-slab, 5.0 mcg/m^3 in indoor air, or a range of 50-250 mcg/m^3 under the sub-slab if associated with a range of 2.5 to 5.0 mcg/m^3 in indoor air. IBM was aware of the new air guideline for TCE and the draft matrix being developed by DOH, and with the approval of the department they incorporated the guideline into a decision matrix for the site that was very similar to the draft matrix developed by DOH.

Starting in January 2004, IBM sampled 119 structures and five were offered mitigation systems. The indoor air concentration of TCE in the structures offered mitigation ranged from 0.25 to 7.6 mcg/m^3 in indoor air and 260 to 4,400 mcg/m^3 under the sub-slab**.** Of the 144 samples taken roughly 90% (130) had indoor air concentrations of less than 0.22 mcg/m^3. No structure that was not offered mitigation had an indoor air level above 0.67 mcg/m^3 or a sub-slab level above 250. During the 2004 - 2005 heating season, IBM sampled an additional 24 structures. TCE was not detected in any of those structures.

The new approach to mitigation in Endicott generated concern among residents and criticism in the press, which characterized the situation as one where one set of residents would receive a protective level of cleanup and one would not. As of December 2005, DEC and IBM estimate that 496 mitigation systems have been installed at 441 properties. Of the roughly 45 additional properties offered mitigation, ten are now in the process of having systems designed and installed; five have structural issues; 25 have either not responded or refused the offer; and five, mostly commercial properties, have been identified as sources of environmental contamination in themselves and are subject to ongoing evaluation by DEC.

In the 2003-2004 heating season and continuing through the 2004-2005 heating season, DEC and DOH investigated a 250-acre section of the village west of the 300-acre plume of solvents linked to the former IBM campus. A smaller area east of Arthur Blvd. was also investigated. While

levels of PCE and/or TCE were detected in some of the more than 68 structures tested, only three structures exceeded the minimum levels for mitigation set forth in DOH's draft decision matrices. Mitigation systems were offered and accepted for those three structures. During the 2005-2006 heating season, DEC plans to re-test a number of these structures as well as additional structures not previously tested, both in these areas and in a new area directly north of the IBM campus.

In February and March of 2005, DEC and DOH collected air and soil vapor samples on the Huron Campus (the former IBM Endicott Facility). A total of 259 indoor, outdoor and sub-slab air samples were collected and tested for VOCs. According to DOH, the majority of indoor air results for routinely occupied areas fell into two categories: "…air levels consistent with background indoor air levels and are not of concern" and "…levels [that] are below or slightly above NYSDOH guidelines." DOH concluded that the "possibility of health effects in workers exposed to these levels is low." They further stated: "NYSDOH does not expect to be able to associate health effects from any chemicals at the levels measured in indoor air." However, the agencies did conclude that the soil vapor data "clearly" supports continuing IBM's ongoing on-site investigation.

In January of 2004, DOH, working with the Agency for Toxic Substances and Disease Registry (ATSDR) and the Broome County Health Department, released a draft Public Health Response Plan (PHRP). The purpose of the PHRP is to "prioritize and evaluate the public health impact of environmental contamination in the Village of Endicott." It also includes community outreach and education for health care providers. In October of 2004 ATSDR and DOH released a report titled "Health Consultation: Public Health Implications of Exposures to Low-Level VOCs in Drinking Water, Village of Endicott." The study concluded that Endicott's drinking water is of "high quality and is suitable for both drinking and bathing."

In August of 2005 DOH, working with ATSDR, released for public comment a draft study titled "Health Statistics Review: Cancer and Birth Outcome Analysis, Endicott Area." The study found statistically significant elevated levels of testicular and kidney cancer as well as heart birth defects (see discussion earlier in this report). The agencies state: "Although this type of study cannot prove whether there is a casual relationship between VOC exposure in the study area and the increased risk of several health outcomes observed, it does serve as a first step in providing guidance for further health studies and interventions." To date, similar studies have not been initiated in Ithaca or Hopewell.

The Endicott site is listed on New York State's Inactive Hazardous Waste site registry as a Class 2 site. Class 2 sites have been determined to pose a significant threat to human health or the environment—action is required. The site was initially listed as a Class 2 site in 1984, then downgraded to a Class 4 in 1986. Class 4 sites have been determined to be properly closed—continued management required. However, upon appeal by several parties including Congressman Hinchey and Assemblyman DiNapoli, the site was reclassified as a Class 2 in February 2004.

Ithaca – Emerson Power Transmission site (formerly Morse Chain)

The Emerson Power Transmission site located in the City of Ithaca encompasses approximately 94 acres. A manufacturing company currently operates on a portion of the site, which has been the location of factory operations since 1906. The company and factory were owned by Borg Warner from 1928-1983 (when the site was known as Morse Chain). In 1983, the facility changed hands and became Emerson Power Transmission, which manufactures steel roller chain. Manufacturing activities include metal stamping, heat-treating, oil quenching, degreasing, plating, and parts assembly. TCE was reportedly used as a degreasing solvent from sometime after March 1969 until 1983. An environmental investigation in and around the facility began in the late 1980s. Groundwater was found to contain various VOCs including TCE and TCA.

In July of 1988, Emerson signed a Consent Order requiring a Remedial Investigation/Feasibility Study (RI/FS) and a full remedial program. In 1989, TCE was reportedly measured at one of the site's groundwater monitoring wells at 1,100,000 parts per billion (ppb) or 220,000 times the New York drinking water standard of 5.0 ppm**.** In 1990, a final RI with a proposed Interim Remedial Measure (IRM) was submitted. The IRM consisted of a low volume pump and treat system that was started in the spring of 1991.

In 1991, DOH monitored indoor air at 14 homes near the site. Four of the homes were tested as controls. At three out of the other ten homes, TCE concentrations were reported above background levels. A Record of Decision (ROD) was signed in 1995 that called for the installation of a two-phase treatment system to remove volatile solvents from soil and groundwater, the cleanup of selected petroleum contaminated soils, and a study of volatile contaminants in the vadose zone (i.e. aerated soil layer).

DEC's Inactive Hazardous Waste Disposal Sites Database indicates that remedial work began at the site in October 1995 and that:

> "All contaminated soils have been removed and disposed off-site. Construction work was completed in December of 1996. The remedy (operation of the two phase extraction system) is performing properly and is effective."

In March of 1998, the site was reclassified from a Class 2 to a Class 4 (properly closed, continuing management needed).

A soil gas vapor study required in the ROD was never completed due to the flooding of four monitoring wells between 1996 and 2003. In January 2004, Emerson's consultant proposed a new work plan to investigate soil gas vapor. The plan was approved by DEC in May 2004. The investigation consisted of sampling nine shallow vadose zone points. The sampling was conducted on June 17, 2004 and elevated levels of several chemical compounds were detected. At five of the wells, TCE was detected above laboratory reporting limits.

According to DEC, the presence of elevated levels of these compounds warranted further investigation both near and inside residences. DEC asked Emerson to provide a proposal for additional cleanup measures and indoor air quality testing in area homes. Emerson submitted a

proposal to DEC and DOH in September 2004. The approved work plan required concurrent sub-slab, basement, first floor, and ambient air samples be taken at each location. Where there were no slabs or the basement had a partial dirt floor, it was assumed that the basement air sample was representative of vadose conditions as no barrier was present.

The interpretation of results from homes without a sub-slab is difficult as there is less information upon which to base conclusions as to the source of chemicals detected. Chemicals present in indoor air may be associated with household products, and while such sources are required to be recorded on the household survey that is part of the sampling protocol, not all product labels are complete.

In October and November of 2004, 43 homes were tested (Phase I). The target area for these tests was chosen based on an analysis of the results from the June soil vapor tests. At least one home from Phase I was found to have indoor air concentrations of TCE exceeding DOH's TCE air guideline of 5.0 mg/m^3. Emerson installed a vapor mitigation system in that home. Two other homes were offered mitigation systems for high levels of PCE, however the owners have requested additional testing before systems are installed. In January 2005, the test area was expanded to include twelve more homes (Phase II). DEC has scheduled a public meeting to discuss the results of that testing on January 25, 2006.

At a public meeting held in March 2005, DEC discussed the results of testing from Phase I and laid out steps for a third round of testing (Phase III) which will include the testing of 26 additional homes as well as the re-sampling of 18 homes that had been previously tested. While a time line for completion of Phase III has not yet been provided, testing began in October 2005 and is expected to be on going through the 2005-2006 heating season. Two additional rounds of testing were completed in the fall of 2005 on groundwater flowing from the site to determine if contaminant pathways were complete. Although no final conclusions have been made, DEC has indicated that additional testing may be needed. In April of 2005 the site was reclassified from a Class 4 to a Class 2.

Community residents and their representatives, including Assemblymember Lifton, have requested that DOH undertake a health study. The department has not made a determination regarding the performance of a health study at this time, however they are offering consultations to the residents and their physicians.

Hopewell Junction – Hopewell Precision Area Contamination site

The Hopewell Precision Area Contamination site is located in Hopewell Junction, Dutchess County. Hopewell Precision Inc. is an active manufacturer of sheet metal parts and assemblies. Activities at this site have resulted in a groundwater contamination plume beneath and downgradient of the current and former Hopewell Precision properties. The combined size of the properties is approximately 5.7 acres and the plume extends approximately 1.5 miles. The area surrounding the site consists mostly of residences, all of which are served by private wells and septic systems.

In 2003, EPA Region 2 initiated a Superfund Removal Action in response to the identification of several contaminated residential wells in close proximity to Hopewell Precision Inc. Significantly elevated levels of VOCs, including TCE and TCA, were detected in drinking wells downgradient from the property. Out of 450 wells sampled by EPA, 37 were found to exceed State and federal drinking water standards for TCE, and 14 were found to exceed the state drinking water standard for TCA. Drinking water treatment systems have also been installed at 37 properties to date, with an additional three systems planned at this time.

In April and November of 2003, EPA collected air samples from residences in the vicinity of the Hopewell Precision properties. In January and February 2004, EPA used their "Mobile Trace Atmospheric Gas Analyzer" (TAGA) unit to collect both sub-slab and indoor air samples in 36 homes which confirmed that the Hopewell Precision plume was causing the vapor intrusion problems. In July and August of 2004, sub-slab ventilation systems were installed in the 17 homes where the TAGA detected a sub-slab concentration of TCE over 50 mg/m^3.

In a second phase of testing, subsequent to EPA's confirmation that the TCE plume was creating the vapor intrusion problems at the site, the investigation was expanded to include the 170 additional homes overlying the TCE groundwater plume. This expanded investigation was undertaken during June 2004 and only included the collection of sub-slab samples. A sub-slab air concentration of greater than 50 mg/m^3 of TCE was measured in 26 homes, which were then equipped with sub-slab ventilation systems.

Based on the sampling done both in January-February of 2004 and June 2004, and the subsequent sampling of one newly constructed residence, 15 residences were identified with sub-slab concentrations of TCE between 2.7 and 50 mcg/m^3. In a third phase of testing during January 2005, indoor air sampling was undertaken at these residences. At that time, 0.38 mcg/m^3 was the lowest concentration at which TCE could be detected by the laboratories used by Region 2. Three residences with measured indoor air levels of TCE above 0.38 mcg/m^3 were equipped with mitigation systems in July 2005.

Of the remaining 12 properties, mitigation systems were not installed at 2 because indoor air samples were not greater than 0.38 mcg/m^3; at 3 because contamination was caused by a source inside the home; and at 5 because sampling could not be completed due to the absence of the owner or other similar reasons. At one property the owner refused to allow sampling, and one was a commercial establishment. EPA is planning to carry out sampling at the 5 properties where sampling could not be completed in the near future. To date, no commercial properties have been mitigated at the Hopewell site.

As of December 2005, EPA Region 2 has taken a total of 207 air samples and installed mitigation systems in a total of 46 homes. EPA plans to test an additional 96 homes located over an area of the plume contaminated with TCA during the early months of 2006. On April 27, 2005, the Hopewell Precision site was added to EPA's National Priorities List.

According to EPA, the mitigation decision-making process at Hopewell Junction was based on a number of factors. First, like DOH, Region 2 utilizes a matrix for mitigation decision making at vapor intrusion sites. Region 2's matrix, however, is a generic matrix based on risk. It has three

columns and three rows. The columns represent indoor air contaminant concentrations that correspond to the cancer risk of one-in-one million, one-in-one-hundred thousand, and one-in-ten thousand, which is consistent with the excess lifetime cancer risk range presented in the federal Superfund regulations. (For a copy of EPA's matrix, see Appendix G.)

Region 2 developed risk-based indoor air concentrations for the three columns using standard risk assessment protocols and applied site-specific exposure information when available. The concentration of TCE in indoor air that was estimated to be at the one-in-one million cancer risk level is 0.05 mcg/m^3. The indoor air concentration that corresponds to the one-in-one hundred thousand cancer risk level is 0.5 mcg/m^3, and the concentration that corresponds to the one-in-ten thousand cancer risk level is 5.0 mcg/m^3. Region 2 staff developed these concentrations with consideration of the DOH guideline of 5.0 mcg/m^3, EPA's earlier cancer potency values for TCE, and the cancer potency values from EPA's draft 2001 Risk Assessment. They believe that it is unlikely that the re-evaluation of the 2001 assessment underway at the National Academy of Sciences will result in more conservative cancer potency values.

The matrix also contains three rows, which correspond to sub-slab vapor concentrations. These concentrations are higher than the indoor air concentrations by a factor of ten, which is the attenuation rate used in EPA's draft 2002 vapor intrusion guidance. As a result, the highest value for sub-slab concentrations in the matrix is 50 mcg/m^3 and the lowest is 0.5 mcg/m^3. Overall, Region 2 is confident that the ranges presented in their matrix for indoor air and sub-slab vapors are both conservative and flexible, allowing the Region, as EPA representative William McCabe explained at the Hopewell hearing, "...to do what makes sense in any situation."[3]

Region 2 staff emphasized that sub-slab and indoor air concentrations are not considered in isolation when making mitigation decisions. In fact, staff emphasized that their decision matrix has never been formally published and is not treated even as a guidance document – it is not that firm. Instead, it is used as a flexible, internal decision making tool. In addition, the matrix itself offers more than one decision option in four out of nine of its cells, and explicitly refers to additional factors that should be taken into consideration when making mitigation decisions, such as the lower cost of mitigation compared to monitoring.

A number of important factors in addition to sub-slab and indoor air concentrations influenced decision making at the Hopewell site. The most important factor emphasized by Region 2 staff is that they have a tremendous amount of groundwater data at the Hopewell site. Both the extent and nature of the plume are very well defined. As McCabe explained:

> ". . . [I]f we're over 50 at Hopewell in the sub-slab, knowing that we're on top of a plume, even if the indoor comes up pretty low, unless it's just totally non-detect, perhaps, we're going to put a system in. Because we know we've got a plume; we know that all the homes around it – I mean, if one home in the middle of all this doesn't have vapors in

[3] NYS Assembly Standing Committee on Environmental Conservation, Public Hearing on Vaporization of Contamination from Soil and Groundwater into Indoor Air, Hopewell Junction, New York (May 19, 2005) transcript, p. 54.

> it, but the sub-slab does, we're going to – we're going to be conservative and we're going to put one in. It just makes sense." (Hopewell transcript, pp. 51-52.)

Second, the cost of mitigation and continued monitoring are so similar that EPA has generally erred on the side of mitigation at the Hopewell site. Again, McCabe explained:

> "For instance, we have put systems in places where if the cost to monitor were far less, we'd probably monitor a few more times, just to make absolutely sure what was going on there. But given that the costs of monitoring are so similar to just putting this system in, we're just going to put the system in." (Hopewell transcript, pp. 54-55.)

Region 2 staff noted that their approach to mitigation at vapor intrusion sites may change when an official EPA determination regarding the toxicity of TCE is completed, although, as previously stated, they believe it is unlikely that the re-evaluation currently underway will result in more conservative toxicity values for TCE. In addition, they emphasized that when evaluating the potential for vapor intrusion at other Region 2 sites, site-specific information may lead to different actions at these other sites, due to the complex nature vapor intrusion.

Hopewell Junction residents have requested that a community health study be undertaken at the site. DOH has not made a determination regarding the performance of such a study at this time.

FINDINGS

The Committee learned a great deal from the three public hearings held on this issue across the state. The following points summarize the major findings from the hearings.

HEALTH EFFECTS OF VAPOR INTRUSION

Human exposure to low levels of the chemicals found at vapor intrusion sites has the potential to make people sick.

While acute health effects may be unlikely to result from the low levels of contamination commonly found in buildings contaminated by vapor intrusion, long-term exposure to these levels has the potential to result in serious adverse health effects, including cancer. Low levels of TCE, PCE and TCA can damage the liver, and TCE and PCE are both potential human carcinogens. Adverse effects associated with one or more of these chemicals include central nervous system, immune system, and circulatory system damage; kidney damage; and birth defects.

The mechanisms by which TCE causes disease are particularly well understood. Its solvent properties make it easy for TCE to enter cells. Once there, it changes the way DNA works, causing it to make huge errors when it duplicates itself, resulting in mutations. In a process known as biological amplification, these mutations then lead to cancer, birth defects and other diseases. Because of amplification, adverse health effects can result from even low exposures.

Newborns and children are more vulnerable to exposure to volatile chemicals than adults.

Newborns and small children breathe two and a half times more air per pound of body weight than adults and drink more water than adults. Children also occupy a different breathing zone than adults. TCE is heavier than air and settles closer to where children play and live. Young children also tend to spend more time at home than adults.

In addition, children have more years ahead of them in which to develop chronic diseases and may be developmentally more susceptible than adults to early exposures. Many diseases of adult life, including cancer, Parkinson's disease and dementia, are now thought to arise through a series of stages that span years or even decades. Carcinogenic and toxic exposures sustained early in life, including prenatal exposures, appear more likely to lead to disease than similar exposures encountered later.

Significant barriers hamper our ability to adequately assess the toxic effects of chemicals on human health.

Over the last three decades, government regulatory agencies, businesses, academic institutions and non-profit foundations have invested a large amount of time and resources into research on the negative impacts of toxic chemicals on human health. While progress has been made in some areas (for example our understanding of the toxic effects of lead on childhood development) researching the toxic effects of chemicals has proven to be expensive, time consuming, and imprecise. Understanding the limits on our ability to understand the toxic effect of chemicals, illuminates the controversy surrounding the establishment of an indoor air standard for TCE as well as the evaluation of health impacts at vapor intrusion sites. The most important of these limits are discussed below.

Direct experimentation on humans is unethical.

It is clearly unethical to give humans measured doses of a toxic chemical as part of a controlled laboratory experiment. In the absence of such studies, society's knowledge of the health impacts of toxic chemicals must be derived from human exposures that have already occurred. The study of such exposures and potentially associated disease is called epidemiology. The main approach of epidemiology is to compare groups (populations) of people based on exposure or rates of disease. "Cohort" studies try to determine whether disease occurs more frequently among a group of people which has been exposed to a contaminant than among those who have not been exposed. "Case control" studies examine whether exposure to a contaminant occurred more frequently in people who have a particular disease than in persons who do not have that disease. While epidemiology has provided us with extremely important insights into the toxic impacts of some chemicals, such as the ability of asbestos to cause cancer, it has severe limitations that hamper its ability to provide definitive information on chemical toxicity. A number of the specific limitations of epidemiology are discussed below.

It is difficult, if not impossible, for epidemiologic studies to provide definitive information regarding the relationship between disease rate and dose.

Because epidemiology investigates exposures after they have already occurred, the actual amount of the chemical (or dose) to which individuals have been exposed must be estimated. Geographic location alone (for example residence near a vapor intrusion site) is an imprecise indicator of dose because it is unlikely that everyone in the same geographic area was exposed to the same level of contamination, and the duration of exposure is likely to vary due to variation in how long a person lived in the neighborhood and their daily routine.

In recent years, scientists have emphasized the importance of obtaining firm individual dose estimates, but obtaining such estimates through dose reconstruction is expensive and time-consuming and also prone to controversy. The New York State Department of Health rejected the use of quantitative data from human epidemiologic studies to establish an indoor air criteria for TCE precisely because such studies failed to provide dose-response data DOH deemed adequate for quantitative risk assessment. DOH determined that a number of such studies,

however, did provide qualitative evidence in support of the findings of animal studies, which is a common use of epidemiologic studies in risk assessment.

Environmental epidemiologic studies suffer from a high potential for false negatives.

This potential is due to a long-standing bias in the way scientific studies are designed and a number of factors intrinsic to the study of the impact of environmental contaminants on human populations. The most important of these are a built-in bias against false positive errors, the need to evaluate low dose effects on small populations, and the unavoidability of confounding factors.

"Statistical significance" is the likelihood that a positive association between exposure to environmental contamination and disease found by a study could not have occurred by chance alone. Since the early 20th Century, strong scientific convention has dictated that a positive association should only be declared "significant" when a study is designed in such a way that there is less than a 5% chance that such an association *does not*, in reality, exist. This is also known as the rate of false positives, false alarms, or "type I" error. A 5% rate for significance is used both in traditional hypothesis studies and in more recent studies which calculate 95% confidence limits.

Conversely, "statistical power" is the ability of a study to obtain "statistically significant" results. The chance that a positive association will be overlooked when such an association *does*, in reality, exist is directly proportional to statistical power and is known as the rate of false negatives, failed alarms, or "type II" error. Historically, it has been deemed much more important to avoid false positives than false negatives. While the rate of false positives has been arbitrarily set at 5%, a rate of false negatives of 20% (or a statistical power of 80%) is considered quite acceptable and indeed is not achieved by many studies.

The statistical power of a given study is determined by three factors: the sample size, or number of people in the study population; the effect size, which is influenced both by the dose of contaminant received and the strength of the contaminant's negative impact on human health; and the level that is chosen as significant, i.e. the chosen rate for false positives, or "type I" error.

Environmental epidemiologic studies are particularly prone to low statistical power because the size of the study population is pre-determined by historical patterns of exposure and is often quite small. For example, the number of people with documented exposures to contamination living near a state Superfund site is often very low, in the low hundreds or less than one hundred. Endicott, with a documented exposure of roughly 1,300 people, has one of the largest if not the largest sample population of any contaminated site in the state, and yet that number is still considered small for the detection of low-dose effects. Small population size increases the rate of false negatives or "type II" errors because the normal rate of variability (or "standard deviation" in statistical parlance), creates more "noise" in a small population and makes it harder to see a positive effect. During a discussion of the Endicott study by the TCE Peer Review Panel, Dr. Daniel Wartenberg emphasized that the danger of false negatives is very high when population numbers are small, as they are in the Endicott study.

Environmental epidemiologic studies also frequently lack power because they are searching for effects at low doses and/or are trying to determine associations with subtle effects, such as developmental disorders. These factors lower the effect size, which in turn lowers statistical power. Delayed effects or those with long latency periods, such as cancer, may not be detected at all using such studies.

Increasing the acceptable rate for false positives can increase power and may be the only way for an environmental epidemiologic study with a limited, predetermined population to accurately identify low-dose or subtle effects. Indeed, Dr. Michael Gochfeld, Professor of Environmental and Community Medicine at the Robert Wood Johnson Medical School in New Jersey, claims that with small sample sizes and low power, setting the rate for false positives at 5% "is an invitation to a false-negative study."[4] Under current practice, avoiding false positives is considered at least four times as important as avoiding false negatives. Gochfeld argues that this bias effectively stacks the deck against detecting effects that are real. He and other experts believe that avoiding false negatives is equally as important as avoiding false positives in the fields of environmental epidemiology and toxicology, and that the acceptable rate of false positives should be adjusted accordingly.

The potential for false negatives is not consistently considered or reported in epidemiologic and toxicological studies.

According to Gochfeld, "far too many" epidemiologic studies lack the power to perceive positive results, and the majority of studies fail to report their power (pp. 2,525 and 2,528). In a review of ecotoxicological studies published in the peer-reviewed journal Ecotoxicology and Environmental Safety in 1985-1986, John P. Hayes, a researcher at Cornell University, found that out of 1,360 statistical tests reported, only 1.4% had the power to accurately detect a positive association 80% of the time, and less than 20% had the power to accurately detect a positive association 50% of the time.[5] This means that over 80% of the published studies had greater than a 50% chance of failing to detect a positive association when such an association did, in reality, exist.

More recent surveys of the scientific literature in a number of fields have documented similar rates of low power and lack of reporting on power. In 1994, the Journal of the American Medical Association (JAMA) published a survey of statistical power and its reporting in randomized controlled trials. The survey found that out of 102 trials with negative results reported in JAMA, Lancet, and the New England Journal of Medicine between 1975 and 1990, most did not have enough statistical power to detect a 25% or 50% relative difference between the study population and the control group, and that the level of power in such studies had not improved over time. In addition, less than 50% of trials reported sample size calculations or statistical power.[6] In 2004, the British Medical Journal published a survey of 73 epidemiologic

[4] Michael Gochfeld, "Why Epidemiology of Endocrine Disruptors Warrants the Precautionary Principle," Pure Applied Chemistry 75 (2003):2521-2529.
[5] John P. Hayes, "The Positive Approach to Negative Results in Toxicology Studies," Ecotoxicology and Environmental Safety 14 (1987):73-77.
[6] D. Moher *et al.*, "Statistical Power, Sample Size, and their Reporting in Randomized Controlled Trials," Journal of the American Medical Association 272, no. 2 (1994):122-124.

articles published in 20 English language epidemiology and medical journals in January 2001. The survey found that few studies gave any power calculation to justify their size and that the median sample size of both cohort and case control studies (roughly 400 and 350 respectively) suggests that many are underpowered and could detect only large effects.[7]

Given the general lack of attention paid to statistical power, there is a high potential for negative results to be misinterpreted. In the fields of both environmental epidemiology and toxicology, negative results can support a conclusion that a contaminant does not cause negative health impacts at the dose level measured or estimated in a study. Depending on the power of the study, such a conclusion might be erroneous. If power is low, below 80%, the only appropriate conclusion to be drawn from negative results is that under the conditions of the study, there is insufficient evidence to conclude that a positive association exists. As Hayes puts it, "the results can only be considered inconclusive."[8]

The presence of confounders makes it hard for epidemiologic studies to definitively establish cause-and-effect relationships between environmental contamination and disease.

Confounding factors are any pattern of behavior or susceptibility present in a population that, in addition to exposure to environmental contamination, may contribute to the disease or diseases which are the focus of an epidemiologic investigation. Socioeconomic status is a frequent confounder in environmental epidemiologic studies, as are smoking and occupational exposure. Lower socioeconomic status is associated with lower birth weight in infants, smoking is associated with cancer and other negative health impacts, and people can be exposed to significant levels of chemical contamination through their work or hobbies. If large numbers of people in a study population have lower socioeconomic status, smoke, or are exposed to the same chemical of concern at work or during special activities, the results of an investigation may be skewed toward the finding of a stronger association between environmental exposure and disease than does, in reality, exist.

On the other hand, as discussed in more detail below, exposure to the same chemical or chemicals with similar health impacts from different sources may increase the risk of developing disease from the exposures associated with vapor intrusion. In addition, some chemicals have the potential to cause greater negative impacts when combined. Such "additive" and "synergistic" effects also warrant consideration in risk assessment.

When a study population is large and resources are unlimited, researchers can identify individuals whose behavior and status may serve as confounding factors and correct for confounding either by removing them from the study or assigning less (or more) weight to the data associated with them. In reality, however, many studies do not have the resources to interview each member of a study population in order to address or eliminate confounders. In addition, due to the small size of the study population in most environmental epidemiologic

[7] Stuart J. Pocock *et al.*, "Issues in the Reporting of Epidemiological Studies: A Survey of Recent Practice," British Medical Journal 329 (2004):883-887.

[8] Hayes, p. 74. Moher *et al.* share this concern, p. 123; and Douglas G. Altman and J. Martin Bland discuss it at length in a widely cited article, "Absence of Evidence is Not Evidence of Absence," British Medical Journal 311 (1995):485.

studies, the weeding out of members due to confounding may lower the study's statistical power to the point where it would be unable to detect a positive association between environmental exposure and disease even if one did, in reality, exist. The inability to correct for confounding factors is one of the major weaknesses of the Endicott Health Statistics Review study, as discussed in more detail below.

Toxicological studies involving animals also suffer from important limitations, including the need to extrapolate effects on one species to another.

As compared to human epidemiologic studies, animal studies are better able to establish dose-response relationships because study animals can be given measured doses of a toxic chemical as part of a carefully controlled laboratory experiment. Given adequate resources, the population size of the animals involved in the study can also be increased to ensure adequate statistical power.

The strengths of animal studies are offset by a number of limitations, however. The most important of these is the necessity of extrapolating from one species to another. Humans may be more or less sensitive to contaminants than laboratory mice or rats, or the systems or organs affected may be entirely different. During the course of deliberations by the TCE Peer Review Panel, for example, a question was raised about the validity of extrapolating from the rate of liver cancer associated with TCE in mice to humans since the physiology of liver cancer is different in the two species.

While DOH determined that only animal studies provide strong enough dose-response information on cancer to use in the development of a range of quantitative potential air criteria for TCE, it further limited its use of animal studies to only those involving cancers with a high potential to occur in humans as a result of TCE exposure, as supported by epidemiologic studies. Thus the only "recommended" criteria used to develop the final guideline were derived from animal studies showing an association between TCE exposure and liver and kidney cancer, while criteria derived from animal studies showing an association between TCE exposure and lung cancer, lymphoma and testicular cancer were not used. Despite the evidence provided in the Endicott study for an association between testicular cancer and TCE exposure, DOH rejected the use of potential criteria based on testicular cancer in animals because "the limited epidemiological data have not suggested that TCE exposure is a risk factor for testicular tumors in humans."

All epidemiologic and toxicological research is costly and time consuming.

The cost of epidemiologic studies ranges from $1.5 million for an ecological study of a small community of less than 100 individuals surrounding a contaminated site (e.g. Nassau Lake in Rensselaer County), to tens of millions of dollars for a long-term prospective study of puberty and breast cancer being carried out by the federally funded Breast Cancer Research Centers. The smallest studies take three to five years to complete, while long-term studies can take decades.[9]

[9] Personal communication with Andy Carlson, Ph.D., Director, Division of Environmental Health Investigation, NYS DOH (December 2005), regarding the Nassau Lake study, which was considered in 2001-2002 but never carried out for various reasons; and personal communication with Susan Snedeker, Ph.D., Associate Director for

Two-year rodent bioassays as performed by the National Toxicology Program (NTP) cost between $3 and $4 million depending on the complexity of the study, and take at least three years to complete. The NTP starts between eight and ten of these studies each year, and has conducted 350 since it was established in 1978.[10]

Due to the limitations discussed above, the toxic effects of the majority of chemicals used in commerce are unknown, and debate persists over the toxicity of the small number of chemicals that have been well studied, like TCE.

Health and safety information is available for only 20% of the over 80,000 different chemicals used in commerce. Of that 20%, no chemicals are fully characterized for their ability to cause toxic effects.[11] A recent survey by EPA of the 3,000 high production volume chemicals imported or produced in the U.S. at more than 1 million lbs/yr found that 43% of such chemicals have no testing data on basic toxicity and only 7% have a full set of basic test data.[12] Significant data gaps exist for most chemicals regarding developmental, reproductive, low-dose and chronic effects, and impacts on children.[13]

TCE is one of the best studied chemicals in commerce. Yet even for TCE, debate over its potency as a carcinogen and its ability to cause a number of non-cancer effects has persisted due to differing judgments regarding the strength, applicability and interpretation of human epidemiologic and animal studies.

In the face of the uncertainty caused by these data gaps, risk assessors are put in the position of making a policy choice between erring on the side of overestimating risk or underestimating it. That choice determines the underlying protectiveness of any environmental standard.

TCE TOXICITY

The New York State air guideline for TCE of 5.0 mcg/m^3 is not based on the most protective assumptions supported by science.

DOH's indoor air guideline for TCE of 5.0 mcg/m^3 is significantly higher than the risk-based concentrations for TCE developed by a number of other EPA regions and states based on more protective assumptions regarding TCE toxicity. Specifically, the guideline is two orders of magnitude higher than those concentrations, which range from 0.016 to 0.02 mcg/m^3 and are based on the most conservative cancer potency factor of 0.4 (mg.kg-d)$^{-1}$ presented in EPA's 2001

Translational Research, Program on Breast Cancer and Environmental Risk Factors, Cornell University (December, 2005), regarding the study on puberty and breast cancer.

[10] Personal communication with Mary Wolfe, Director of the National Toxicology Program Office of Liaison and Scientific Review (December 2005).

[11] NYS Assembly Legislative Commission on Toxic Substances and Hazardous Waste, Using Comparative Risk to Set Pollution Prevention Priorities in New York State: A Formula for Inaction (May, 2001) pp. 7-8.

[12] US EPA, Chemical Hazard Data Availability Study (2004) available at www.epa.gov/opptintr/chemtest/hazchem.htm.

[13] NYS Assembly, Using Comparative Risk, pp. 7-10.

draft Risk Assessment. (See Appendix F for a table of the cancer potency factors used and the TCE risk based concentrations developed by different jurisdictions.)

The differences in these levels are largely due to differences in the use and interpretation of available studies, most notably human epidemiological studies; and differences in the protectiveness of underlying assumptions, most notably those regarding the unique susceptibility of children. In developing their guideline for TCE, DOH could have taken a number of approaches that would have resulted in a lower guideline value. Using the epidemiologic studies used by EPA in 2001 to develop quantitative criteria would have provided a set of potential criteria associated with an excess cancer risk of one-in-one million ranging from 0.009 to 0.2 mcg/m^3. Using the newer and stronger Hansen epidemiologic study would have provided a set of such criteria ranging between 0.062 to 1.2 mcg/m^3. Using the animal studies which show an association between exposure to TCE and lymphoma, testicular cancer, and lung cancer would have provided such criteria as low as 0.3, 0.9 and 1.3 mcg/m^3 respectively.[14]

Following the recommendations provided by the TCE Peer Review Panel might also result in a lower range of potential criteria and thus a lower guideline value. These include taking a child's body weight and inhalation rate into account, using a higher uncertainty factor for central nervous system effects, and taking multiple sources and routes of exposure into account.

The controversy surrounding the development of indoor air guidelines for TCE and the deliberations of DOH's TCE Peer Review Panel make it clear that the scientific evidence regarding TCE supports a range of toxicity estimates. The choice between those estimates is largely a policy choice, not one of science alone. While there may be plausible arguments for rejecting the use of epidemiologic studies in the development of quantitative standards, there are equally plausible arguments for using them, such as the importance of effects on humans and the ability of such studies to provide reasonably accurate, if not definitive, estimates of individual exposure. There is no hard and fast rule that regulators must, as a matter of scientific practice, limit the use of evidence from epidemiologic studies.

Likewise, the Peer Review Panel concluded that while site concordance between animal and human studies is informative and useful, it should not be a limiting requirement for consideration of a cancer endpoint. The lack of such concordance was the main reason for DOH's decision to reject the use of the animal studies discussed above.

Each of the different risk-based concentrations for TCE developed by EPA regional offices and states was developed by professional and respected scientific staff. This provides strong evidence that the analysis underlying each of these levels is scientifically plausible and sound. The TCE Peer Review panel made it clear that DOH used 'scientific judgment' both in determining what studies to include and exclude in their delineation of the range of potential indoor air criteria for TCE and in the choice of the final criteria value from within that range. Other jurisdictions have similarly exercised 'scientific judgment' with distinctly different and more protective results.

[14] These values can all be found in DOH's draft "Trichloroethene Air Criteria Document," at pp. 292-293 (EPA); 132-133 (Hansen); 150 (lymphoma); 149 (testicular); and 147 (lung).

Members of DOH's Peer Review Panel and other experts recommend that the DOH's TCE guideline be made more stringent.

Dr. David Ozonoff, Professor of Environmental Health at the Boston University School of Public Health and a national expert on TCE toxicity, submitted testimony to the Committee stating that the dose-response model used by DOH to develop the TCE guideline was significantly less protective than other models supported by science. Dr. Daniel Wartenberg, Director of the Division of Environmental Epidemiology at the Robert Wood Johnson Medical School, who conducted a comprehensive review of the epidemiological evidence regarding the cancer risk posed by TCE as part of EPA's reassessment, urged state policy makers to err on the side of protection and limit exposure to TCE to the minimum amounts reasonably achievable. Dr. Nathan Graber, an expert in children's environmental health with the Mount Sinai School of Medicine, raised questions about whether DOH's TCE guideline adequately protects the special vulnerabilities of children and recommended that the guideline be made more stringent.

Both Drs. Wartenberg and Graber served on DOH's TCE Peer Review Panel, where they and other members of the Panel, including Dr. James Dix with the Department of Chemistry at the State University of New York at Binghamton, Dr. Peter Infante with the School of Public Health at George Washington University, and Dr. George Lucier, formerly with the National Institute of Environmental Health Sciences expressed the belief that DOH's current guideline of 5.0 mcg/m^3 should be lowered. No panel member present at the meeting expressed a belief that the value should be higher.

The New York State guideline for TCE exceeds DOH's own estimate of the concentration associated with a cancer risk of one-in-one million.

DOH's guideline of 5.0 mcg/m^3 is less protective than the range of potential criteria estimated by DOH to be associated with an excess lifetime cancer risk of one-in-one million. This range, of 0.2 mcg/m^3 to 4.0 mcg/m^3, was reported in the same October 2003 letter from Dr. Nancy Kim of DOH to Dale Desnoyers, Director of DEC's Division of Environmental Remediation, which established 5.0 mcg/m^3 as the indoor air guideline for TCE in New York. DOH's new draft Air Criteria Document for TCE, released in August 2005, does not explicitly provide an estimate of the range of potential air criteria associated with an excess lifetime cancer risk of one-in-one million, but the same studies are used to derive potential air criteria in the new document as in the 2003 letter.

In presenting DOH's approach to deriving the TCE indoor air criteria to the Peer Review Committee in August 2005, Dr. Kim verbally estimated that 5.0 mcg/m^3 falls somewhere between a one-in-one million and a one-in-one hundred thousand excess lifetime risk of cancer. The criteria document itself states that the estimated excess human cancer risk associated with a lifetime of continuous exposure to 5.0 mcg/m^3 is in "the lower end of the risk range [of one-in-one million to one-in-ten thousand] that is generally used by regulatory agencies when setting guidelines or standards." Risk assessors with EPA Region 2 estimate that DOH's guideline corresponds to an excess lifetime cancer risk of one-in-ten thousand.

New York has an historical and statutory preference for cleanup standards that correspond to a cancer risk of one-in-one million.

New York State has historically shown a preference for the establishment of cleanup standards that correspond to an excess cancer risk of one-in-one million. The state Superfund program's Technical and Administrative Guidance Memorandum (TAGM) 4046, which has guided the establishment of soil cleanup objectives for over a decade, requires the development of objectives that correspond to an excess cancer risk of one-in-one million for known and probable carcinogens.

In addition, New York recently established in statute the new Brownfield Cleanup Program (BCP). Under the BCP the target risk level for site remediation is an excess cancer risk of one-in-one million (ECL §27-1415(1)). In addition, the statute establishes an excess cancer risk of one-in-one million as the required risk level for the development of soil cleanup objectives under the BCP (ECL §27-1415(6)(b)).

While the federal Superfund program allows remedial goals to fall between an excess cancer risk of one-in-ten thousand and one-in-one million for known or suspected carcinogens, it also establishes that one-in-one million should be used "as the point of departure" for determining such goals when an already established standard is unavailable or "not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure" (40 CFR §300.430 (e)(2)(i)(A)(2)).

INVESTIGATION AND TESTING

The movement of VOCs is difficult to accurately predict.

Many factors can influence the movement of volatile organic contaminants through soil, groundwater and bedrock and into structures. DOH's draft Guidance for Evaluating Soil Vapor Intrusion lists eight categories of environmental factors and six categories of building factors that can affect vapor intrusion, including soil and weather conditions, fractures in bedrock or tight clay soils, preferential pathways such as sewer and utility lines, and the type and condition of a building's foundation. The number and diversity of these factors make the movement of VOCs challenging and complicated to predict.

Seasonal and day-to-day variation in the factors that influence vapor intrusion make it difficult to accurately measure the true concentration of VOCs under foundations and in indoor air.

Seasonal variation in climatic conditions; the use of home heating or cooling systems; and daily fluctuations in weather conditions, including barometric pressure, soil moisture, temperature and wind can all cause sub-slab and indoor air contaminant levels to vary considerably. Limited sampling provides a snapshot at the time of sample collection, but may not be an adequate characterization of long-term exposure and risk. One example of this type of variation is

illustrated by samples taken at the home of Debra Hall in Hopewell Junction in the winter of 2004. On January 26, 2005, EPA's mobile testing or TAGA unit measured an indoor air concentration of 107.4 mcg/m^3 of TCE in Debra's basement, while a second measurement taken on February 4, 2005 in the same location was less than half that, or 50.48 mcg/m^3.[15]

Based on the high potential for variation, experts in geology, hydrogeology, and ecotoxicology submitted testimony to the Committee recommending that sampling for VOCs under foundations and in indoor air be done in different seasons and over a long enough period of time to accurately account for such variation.

Dr. Tammo Steenhuis, Professor of Biological and Environmental Engineering, Dr. Lawrence Cathles, Professor of Earth and Atmospheric Sciences, and Dr. James Gillette, Professor of Ecotoxicology, all from Cornell University, testified that the 24-hour samples typically collected in residential settings may not be adequate to measure long term exposure. Dr. Gillette testified that it may take weeks to accumulate a representative sample. Dr. Joseph Graney, an Assistant Professor of Geology from the State University of New York at Binghamton, recommended that sampling be carried out during all seasons of the year to document the trends in VOC contamination associated with climatic conditions in New York State.

Testing for VOC contamination is frequently performed in an iterative manner.

Due to the challenges associated with testing for vapor intrusion, agency staff described the decision making process associated with investigation and testing as iterative. After a first round of testing is performed in structures located within the area most likely to be affected, and depending upon the results, a wider circle may be drawn and additional testing performed. Eventually, based on test results, the responsible parties and agencies determine that testing has been adequate and no further incidences of contamination will be found.

Many people living near vapor intrusion sites wish to have their homes tested but fall outside the perimeter of the area designated for testing by the responsible party and the state.

Many of the citizens who testified at the hearings described the anxiety and frustration experienced by residents who live adjacent to or very close to the perimeter of the area designated for testing but who are not eligible for testing themselves. These residents are aware of how difficult it is to accurately predict and measure the contamination caused by vapor intrusion, and have legitimate cause for concern.

Currently, testing one building costs $2,000 to $3,000. This is a large cost to many potentially impacted residents but represents only a small percentage of the overall cost of cleaning up a contaminated site.

The average cost of cleaning up a state Superfund site is roughly $2.5 million. The cleanup of a large, complex site with a potential for widespread vapor intrusion, like Endicott, is likely to cost

[15] Personal communication with Debra Hall, Hopewell Junction resident, December 2005.

even more.[16] Testing 100 additional homes would cost $200,000 to $300,000, less than 9% of the cost of cleaning up an average Superfund site, and even less of the cost at a more complex site.

DOH has established a number of protective protocols for the investigation of vapor intrusion sites.

These include the requirement that indoor air sampling be conducted in the area most likely to be impacted by vapor intrusion; that indoor and sub-slab contaminant levels must be measured directly instead of extrapolated from soil vapor samples taken outside a structure; that modeling cannot be used to rule out exposure; that measurements must be taken during the heating season to rule out exposure; and that the potential for exposure in the future must be assessed in addition to current exposures. All of these requirements are supported by testimony gathered during the hearings regarding the difficulty of accurately measuring the contamination caused by vapor intrusion. However, members of the regulated community have criticized many of these requirements and recommended substantial relaxation of the investigation protocols.

EPA's mobile testing TAGA unit is an effective method for testing contamination at vapor intrusion sites.

According to both EPA officials and residents, the TAGA unit used by Region 2 at the Hopewell Precision site is an effective measurement tool because the results are available immediately and can provide real time data regarding the source of contamination in indoor air. It is particularly useful in identifying and pinpointing contamination that is emanating from products being used in the home. The accuracy and cost of TAGA measurements is comparable to that of the most common testing method, Summa canisters.

MITIGATION

The costs of monitoring and mitigation are comparable.

In those cases where installation is straightforward, the cost of mitigation for one building is between $1,000 and $2,000. If conditions at a building make installation complex, mitigation can cost as much as $30,000. In one instance to date, mitigation has cost $80,000. In comparison, testing one building costs between $2,000 and $3,000. If testing is performed annually in order to monitor contaminant levels, the costs of monitoring will quickly exceed the cost of straightforward mitigation under normal circumstances. The cost of more expensive mitigation actions is comparable to the cost of monitoring over ten years, and even the most expensive mitigation action to date is comparable to the cost of monitoring over 25 years.

[16] Governor's Superfund Working Group, Recommendations to Reform and Finance New York's Remedial Programs (NYS DEC, June 1999) p. A-4.

In some cases, the most protective risk-based concentrations for TCE are equal to or below the detection limits for TCE.

Detection limits vary among sites due to differences in the methods used to collect samples and the laboratories used to evaluate those samples. The current level of detect for TCE in indoor air ranges from as low as 0.017 mcg/m^3 through the 0.25 mcg/m^3 required in DOH's draft Guidance for Evaluating Soil Vapor Intrusion to the 0.38 mcg/m^3 which is currently the limit at the Hopewell site. These numbers are equal to or above the most protective risk-based concentrations for TCE developed by some EPA regions and other states, which range from 0.016 to 0.02 mcg/m^3.

A number of responsible parties and agencies have made site-specific risk management decisions to install mitigation systems in all buildings where VOC contamination is measured and is plausibly due to site contamination.

DOH testified at the Ithaca hearing that at some sites around the state where the Department has been working with responsible parties, those parties have chosen to install mitigation systems in any structure where contamination is measured and is plausibly due to site contamination. According to DOH, this choice is most often based on a number of considerations, including cost, liability and community relations.[17]

One example is the first round of mitigation in Endicott, where IBM offered mitigation systems to any building located over the roughly 300-acre plume linked to its former manufacturing facility whenever TCE was detected. Many buildings that were not even tested also received systems. In conversations with Committee staff, both DEC and DOH have predicted that many responsible parties in the future will choose to mitigate at detect in order to save money and protect themselves from liability.

Based on testimony received by the Committee at the Hopewell Junction hearing and subsequent conversations with Region 2 staff, EPA made a similar risk management decision to install mitigation systems in all homes at the Hopewell Precision site with sub-slab levels of TCE above 2.7 mcg/ m^3 and detectable levels of TCE (above 0.38 mcg/m^3) in indoor air. EPA's decision at Hopewell was based on a number of factors, including the agency's confidence in the accuracy of its knowledge regarding the movement of VOCs at the site, the shallow depth of groundwater, the large size of the plume, and the higher cost of monitoring compared with mitigation.

At the Fort Edward site in Washington County, GE offered mitigation systems to all structures located over a groundwater plume contaminated with TCE. Of 76 properties offered such systems, 45 residential and 3 commercial properties accepted. As of November 2005, 44 residential and 2 commercial systems had been installed. GE expects that the remaining 2 systems will be completed before the beginning of the New Year. According to DEC, only 2 systems would have been required to be installed at the site based on DOH's draft matrix for TCE, and an additional 22 would have required monitoring.[18]

[17] NYS Assembly Standing Committee on Environmental Conservation, Public Hearing on Vaporization of Contamination from Soil and Groundwater Into Indoor Air, Ithaca, New York (April 21, 2005) transcript, pp. 70.
[18] Personal communication with DEC staff, Division of Environmental Remediation (December 2005).

The level of indoor air contamination associated with a decision to install mitigation systems has varied among sites and sometimes even at the same site. This variation has raised concerns among the public regarding the safety and fairness of mitigation decisions.

In the first round of testing in Endicott, mitigation systems were offered to all buildings located over the 300-acre plume in which TCE contamination was measured at levels above detect for the site, which was 0.22 mcg/m^3. In subsequent rounds of testing, an approach similar to DOH's draft matrix, which requires mitigation whenever sub-slab levels exceed 250 mcg/m^3, indoor air levels exceed 5.0 mcg/m^3, or sub-slab levels are between 50 and 250 mcg/m^3 and indoor air levels are between 2.5 and 5.0 mcg/m^3, was used.

At the Emerson Power Transmission site in Ithaca, mitigation systems were offered to homes in which TCE was measured in indoor air at levels above DOH's TCE guideline of 5.0 mcg/m^3. At the Hopewell Precision site, mitigation systems were offered to all homes with sub-slab levels of TCE above 2.7 mcg/m^3 and indoor air levels above detect for the site, which is 0.38 mcg/m^3.

Much public and media attention has been focused on the levels of contamination associated with mitigation decisions at different sites. Many citizens at the hearings expressed concern that residents exposed to the same level of contamination are being treated differently; some have been offered mitigation systems while their neighbors or residents at a different site have not. These citizens are well aware of the controversy surrounding the development of an air standard for TCE, and their lack of confidence in DOH's guideline for TCE adds to their concerns. There is a strong interest among local elected officials and citizens in ensuring that all exposed residents receive the same level of protection. The perception that different action levels have been adopted at different sites has also raised concerns about fairness and equity.

The basis for mitigation decision making in New York is not fully transparent, and this lack of transparency has led to much confusion among the public.

In response to public concerns and the widespread perception that different action levels are being used at different sites, representatives of DEC and DOH made a great effort to explain, at the hearings, that the TCE guideline of 5.0 mcg/m^3 is not a "bright line" that defines a decision point to mitigate or not mitigate. Instead, the use of DOH's draft decision matrix for TCE may result in mitigation being initiated when the indoor air concentration is as low as 0.25 mcg/m^3 if the sub-slab concentration is high, specifically 250 mcg/m^3 or higher. This indoor air concentration is close to the detection level in New York State.

In addition, agency officials took pains to emphasize that factors other than indoor air and sub-slab concentrations are also considered in mitigation decision-making, including the nature of the source, local geology, and foundation and building characteristics. DOH's draft "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" contains a useful list of these factors.

The decision matrices presented in the draft guidance do not mention any of these factors, however, and the guidance fails to describe the role played by each factor and how each should be weighed when making mitigation decisions. As a result, the importance of these other factors is played down while the matrices themselves appear to establish "bright lines" between the indoor air and sub-slab concentration thresholds that form their cells.

In addition, the list of factors contained in the draft guidance fails to list several important factors that should play a part in mitigation decision making, including the relative cost of mitigation compared to monitoring; the degree of uncertainty associated with fully characterizing the nature and migration of soil and groundwater contamination; the degree of uncertainty associated with measuring contaminant concentrations, both indoors and under the sub-slab; the potential for exposure through multiple pathways, from multiple sources and to multiple contaminants; community acceptance; and the potential for inequitable outcomes.

EPA Region 2 uses a decision matrix for vapor intrusion sites that is more multi-dimensional than those proposed by DOH.

Five out of nine cells in EPA Region 2's matrix present more than one option for taking action. In addition, while the main focus of the matrix is still the concentration of contaminants in indoor air and under the sub-slab, the matrix also discusses additional considerations, such as cost, and provides some indications of how they may influence site decision making.

Experts in human toxicology, ecotoxicology and geology all testified at the Committee's hearings on the wisdom of mitigating even low-level exposures to TCE.

Dr. Daniel Wartenberg of the Robert Wood Johnson Medical School stressed the importance of limiting exposure to TCE to the minimum amounts reasonably achievable. Drs. James Gillette, Tammo Steenhuis and Lawrence Cathles of Cornell University testified that money is better spent on mitigation than on extensive and expensive monitoring programs. They recommended that any structure with a potential to be affected by vapor intrusion be mitigated. Dr. Kathy Burns, a private consultant and former risk assessor with EPA, recommended that State and Federal agencies mitigate any home where TCE is detected and is plausibly associated with vapor intrusion.

REMEDIATION

It is important to distinguish between the type of contamination that causes vapor intrusion and the type of contamination commonly referred to as "source" at contaminated sites.

The term "source" has traditionally been used at federal and state Superfund sites to refer to the highly concentrated pools or masses of liquid or solid contamination frequently found in the immediate vicinity of the activity, dumping, leak or spill that caused the site to be contaminated in the first place. The term "source" is also used to refer to soil that is so grossly contaminated that the contamination can be detected through sight, smell, or simple field instrumentation.

The contamination that results in vapor intrusion, however, can be, and commonly is, much more dilute. At most of the sites identified in New York to date, the majority of vapor intrusion problems have been caused by contamination that has migrated from a "source" area through groundwater, soil or bedrock to areas outside the legal boundary of the site.

This type of contamination can be quite extensive, and may be much more expensive and challenging to clean up than more concentrated "source" contamination. For example, it frequently involves the cleanup of contaminated groundwater that has migrated off-site, also known as "chasing plumes."

Mitigation is not adequate to protect public health over the long term. Aggressive cleanup of the contamination that is causing vapor intrusion to occur is necessary.

Prior to the emergence of vapor intrusion as a serious problem, conventional wisdom held that due to dilution and attenuation, off-site groundwater contamination was unlikely to result in dangerous exposures as long as alternative sources of water were provided. Historically, groundwater remediation focused on halting the further migration of contamination off-site by cleaning up "source" areas and installing pump-and-treat systems at the perimeter of the site. It did not necessarily involve removing contamination from off-site groundwater which had already been impacted.

Vapor intrusion has changed all that. It is now clear that at vapor intrusion sites, the cleanup of underlying off-site contamination must be accelerated and pursued more aggressively than in the past. Without such aggressive remediation, mitigation systems may have to operate for decades or longer, ambient air exposures will not be addressed, property values will remain depressed, and the economy of communities impacted by vapor intrusion may be irreparably damaged.

At the Endicott Hearing, DEC made a strong and unequivocal statement that the agency views mitigation as a short-term solution and is committed to ensuring that steps are taken to remediate the soil and groundwater contamination which is causing vapor intrusion. That commitment is reflected in actions the agency has taken at the Endicott site, where DEC and IBM have a plan in place to extract contaminated groundwater at a faster rate. The goal is not simply to halt the migration of contamination but to pull back the plume, which DEC hopes will lead to a commensurate reduction in vapor intrusion.

EPA's commitment to aggressively cleaning up the contamination which is causing vapor intrusion is less clear. At the Hopewell Junction Hearing, EPA testified that the best approach to cleaning up groundwater is to get rid of the source of the material going into groundwater (the traditional sense of "source") and that once that is done, the contamination, "even by itself" will attenuate. The agency added that in 95% of the cases, they will also pump and treat the groundwater to pull out contamination. On its face, this language fails to indicate that EPA has adopted a more aggressive approach to cleaning up groundwater contamination at vapor intrusion sites.

COMMUNITY HEALTH STUDIES

People living in residences where vapor intrusion has been detected want to know the health impacts of their exposure.

Since the discovery of Love Canal marked the beginning of the state and federal Superfund programs, the major concern of people living near contaminated sites has been, "What affect has this site had on my family and me?" This concern was expressed by citizens at each of the hearings held by the Committee across the state.

It is very hard for studies involving small populations and low-dose effects to detect statistically significant impacts on human health, and even harder to establish a cause-and-effect relationship between increased disease and environmental contamination.

One of the most important points for the public to be aware of is that community health studies are very limited in their ability to both detect patterns of disease and link those patterns to contamination. At the Ithaca hearing, Assemblymember Barbara Lifton (D-Tompkins County) asked: "Can the Department of Health come in and do a study and find out what the real impact is here on us, on real people that are being affected?" Andy Carlson, the DOH representative responded by saying:

> "…I think one of the most important things is having the folks that do these studies sit down and talk with [people] and say this is what we have available, and this is what they can do with it, and this is what it can tell us and what it can't tell us. Because I think historically we learned that people's expectations of health studies vastly exceeded the reality of what they can do. And that's a problem because we don't want to raise expectations, but we want to do as much as we can that is appropriately responsible to the community."[19]

While DOH, often working with the federal government, has conducted health surveys at several contaminated sites across the state, they have usually been inconclusive, leaving many questions of the affected public unanswered.

The limitations of health studies are well illustrated by the Health Statistics Review for the Endicott Area performed by the Agency for Toxic Substances and Disease Registry (ATSDR) and DOH. As discussed above, the Review documented statistically significant elevated incidences of testicular and kidney cancer as well as birth defects in the Endicott area. The ability of the study to detect this increase in disease in Endicott may be due to the unusually large size of the exposed population for a hazardous waste site – roughly 1,300 people. The

[19] NYS Assembly Standing Committee on Environmental Conservation, Public Hearing on Vaporization of Contamination from Soil and Groundwater into Indoor Air, Ithaca, New York (April 21, 2005) transcript, pp. 101-102.

identification of statistically significant clusters of disease is rare. Roughly five such clusters had been identified in New York State prior to the Endicott study.

Even so, DOH has concluded that the study in itself is unable to provide conclusive evidence of a cause-and-effect relationship between elevated disease levels and contamination from the site. This is because confounding factors, such as the rate of smoking in the community, socio-economic status and employment history were not accounted for in the study. Smoking can be a trigger for kidney cancer, and birth defects increase as income levels decrease. In the Endicott area, there is also the possibility that some of the increase in disease is due to work place exposures. For example a significant number of individuals who live in the neighborhood may have also been employed by IBM.

The possibility of correcting for these confounding factors in a more rigorous follow-up study was discussed at length by the TCE Peer Review Panel in August 2005. While performing such a study might provide a clearer link between vapor intrusion exposures and disease, every person excluded from the study due to a confounding factor, will lower the overall size of the population being considered and weaken the power of the study to detect a positive association between exposure and disease. One approach would be to include residents who have moved away from the area in the study, thus increasing the study population and capturing people who may have received significant exposures who are not included now. Another would be to combine data from multiple vapor intrusion sites. However, the possibility that people at different sites may have been exposed to different chemicals, and that different sites may have different patterns of confounding factors, could make the synthesis of multiple studies quite challenging.

Dr. Daniel Wartenberg expressed strong concern during the deliberations of the Peer Review Panel that performing health studies involving small populations with low sensitivity can actually be detrimental to a community because if nothing is found, people will conclude that nothing is going on. All members of the Panel emphasized that it is important to discuss the limitations of health studies honestly with the community and involve them in any decision regarding how to proceed.

DOH has established a voluntary registry for people who have been exposed to drinking water contaminated by VOCs.

At the Ithaca hearing, DOH testified that they had established a voluntary registry of persons who have been exposed to contamination at various sites in the State. This registry, however, appears limited to persons who have been exposed to drinking water contaminated by VOCs. DOH is considering expanding the registry to include persons exposed as result of vapor intrusion.

There are efforts occurring at the national and state level to better track and monitor exposure to environmental contamination and possible associated negative health impacts.

In January 2001, The PEW Environmental Health Commission addressed the environmental public health capacity of the United States in its report, *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network.* The report described a lack of

information with which to document possible links between environmental exposures and chronic and other diseases. Following up on the report, the Centers for Disease Control and Prevention (CDC) and ATSDR have proposed a plan to establish such a network.

One of these efforts is the National Children's Study undertaken by a consortium of federal agencies. The study resulted from a directive from Congress in 2000 to undertake a national, long-term study of children's health and their subsequent development in relation to environmental exposures. The Study will follow a representative sample of children to assess the effects of environmental factors on children in order to prevent and treat health problems such as autism, birth defects, diabetes, heart disease and obesity. Recently grants were awarded to six Vanguard Centers to pilot and complete the first phases of the study. One of the Centers is the Center for Children's Health and the Environment at the Mount Sinai School of Medicine in New York City.

DOH and New York City's Department of Health and Mental Hygiene (NYC DOH) have also received funding from CDC for a number of Environmental Public Health Tracking (EPHT) Projects including an evaluation of the feasibility and usefulness of linking health-effects data with human-exposure data and environmental hazard data. CDC is also funding DOH and NYC DOH to conduct demonstration projects for the national EPHT Network and has entered into a cooperative agreement with NYC DOH to assess, evaluate and enhance the city's surveillance systems that track health effects, exposure and hazard surveillance data.

Biomonitoring is another aspect of environmental health tracking that is being pursued by state and federal agencies but is under-funded.

Biomonitoring is the collection of human biospecimens (urine, blood, breast milk, hair, etc.) in order to test for levels and concentrations of chemicals. While there have been many research studies using this methodology, biomonitoring does not appear to be widely used by public health agencies at contaminated sites where there has been human exposure. DOH has undertaken a biomonitoring project which has three themes: 1) urban air pollution problems, 2) exposure to persistent organic pollutants, especially in vulnerable populations, and 3) the need to measure exposure to individuals to support public health practices. DOH has selected 10-12 feasibility studies based on these themes. However, these projects appear to be languishing due to funding constraints and lack of priority.

There is concern regarding the ability of doctors to respond adequately to diseases that may be triggered or exacerbated by environmental contamination.

Following the release of the Health Statistics Review, Endicott residents were advised to consult their doctors with any concerns they might have regarding their health. Most doctors, however, are not trained in how to identify symptoms and treat diseases that may be related to environmental exposures. Exposure to environmental contamination has been linked to many chronic diseases, and research is continuing to provide new evidence. Many of these chronic diseases are prevalent in children including asthma, lead poisoning, cancer, birth defects, autism, and other behavioral and learning disabilities. Well trained health care providers could be an important source of assistance to both children and adults who have experienced environmental

exposures, offering such services as thorough examinations, health monitoring, proper diagnoses, and education.

AMBIENT AIR

There is a legitimate concern that ambient air at vapor intrusion sites may be directly contaminated by soil vapor. There is also a related concern that ambient air may be adversely impacted by the venting of mitigation systems.

To address these concerns, DEC has developed and is beginning implementation of an ambient air monitoring and modeling plan that will measure the concentrations of eleven VOCs in Endicott's air. Citizens from the Endicott area have generally praised this plan and believe it may be a good template for the investigation of ambient air at vapor intrusion sites across the State.

MULTIPLE CONTAMINANTS, ROUTES AND SOURCES OF EXPOSURE

At many vapor intrusion sites, people are exposed to a chemical of concern through more than one route of exposure.

Frequently, more than one route of exposure exists for chemicals of concern at a vapor intrusion site. For example, at the Hopewell site, residents are exposed to TCE both in their drinking water and indoor air. Additional routes of exposure may include, but may not be limited to, exposure to contaminants in water through showering and bathing; the incidental ingestion of soil and dust; eating vegetables grown in contaminated soil, and dermal contact.

Many vapor intrusion sites involve exposure to more than one toxic chemical of concern.

Frequently, the intrusion of contaminated vapors into buildings from a contaminated site involves more than one chemical of concern. For example, at the Emerson Power Transmission site in Ithaca, some structures are contaminated with both TCE and PCE, and at the Hopewell Precision Area Contamination site, some drinking wells are contaminated with both TCE and TCA.

Multiple sources of contamination may contribute to exposure in addition to the contaminated site.

In addition to the chemicals emanating from a contaminated site, it is likely that people will be exposed to the same chemicals from sources other than the site. These sources may include, but are not be limited to, dry cleaners, gasoline stations, and other local commercial or industrial sources of contamination; products used both inside and outside a building by its occupants; and workplace exposures. Household products containing volatile organic chemicals include paint strippers and thinners, glues and solvents. Exposure can also arise from the presence of the chemicals in food, cosmetics, drugs and ambient air to which the general population is

commonly exposed, known as "background levels." Each of these factors increases the risk of developing disease from the exposures associated with vapor intrusion.

BACKGROUND LEVELS

The data samples used to generate the databases that DOH relies upon as representative samples of VOC background contamination levels are deficient.

DOH uses background levels as screening tools in determining when to take action to address exposure to contamination. The databases the department relies upon to make these determinations are dated, they also do not represent New York States climatic conditions nor do they represent residential exposures. Additionally the data is limited by the small size of the sampled population. Due to these shortcomings, background levels being used by DOH to help in determining if mitigation should be initiated cannot be assumed to be representative of the actual background levels of VOC that may be present at a site being investigated.

OCCUPATIONAL EXPOSURES

DOH has made a protective determination that any contamination caused by vapor intrusion is an environmental rather than an occupational exposure.

DOH defines occupational exposures as "exposures that result from current commercial or industrial processes within the building." This definition means that for contamination caused by vapor intrusion, the same indoor air standards for contamination will apply to industrial and commercial buildings as apply to residential buildings.

This decision has been criticized by members of the regulated community, who argue that indoor air quality standards established by the Occupational Safety and Health Administration (OSHA) should apply to any commercial or industrial exposures caused by vapor intrusion. The current OSHA Permissible Exposure Limit (PEL) standard for TCE is that indoor air shall not exceed 537,000 mcg/m^3 for longer than five minutes during any two hour period. There has been widespread community support for DOH's approach to this issue at the former IBM facility in Endicott.

IMPACTS OF UNCERTAINTY

Living with uncertainty is one of the most difficult aspects of living at or near a contaminated site.

The evidence gathered at the hearings documented the high level of uncertainty, even controversy, associated with many of the issues raised by vapor intrusion, from site screening and initial testing through the setting of indoor air quality standards, to mitigation and remediation. While this uncertainty and controversy creates challenges for the agency staff who

must determine what actions to take at a contaminated site, it is the residents who are most directly and negatively affected. Residents living outside but near to the perimeter of an area targeted for testing must live with the uncertainty of not knowing whether they are being exposed to indoor air contamination. If a home is tested but contaminants are not found, or are found at levels below the thresholds for mitigation, residents must live with the uncertainty of not knowing if the testing was accurate or whether the level of contamination they are exposed to is safe. If contaminants are found at higher levels, and a mitigation system is installed, residents must live with the uncertainty of not knowing if those levels have already impacted their health or the health of their children.

Residents must also cope with the length of time it can take to perform testing and obtain test results – from months to more than a year. They must live with the challenges associated with getting timely information and clear answers from agency staff who, despite their best efforts and hard work, are almost never provided with the time and resources needed for intensive public outreach and are themselves struggling with the uncertainty associated with health impacts and evolving approaches to investigation, mitigation and remediation. Finally, residents must face the potential for a decrease in the value of their homes. Living with all these sources of uncertainty causes incredible stress and frustration that can adversely affects residents' health and quality of life.

PUBLIC PARTICIPATION AND COMMUNICATION

Vapor intrusion sites pose unique challenges and require a significant investment of time and resources to ensure adequate communication and citizen participation.

One of the most important challenges to good communication at vapor intrusion sites is the emerging nature of the issue and the commensurate level of complexity and uncertainty associated with health studies, investigation, mitigation and remedial decision-making. This complexity and uncertainty requires agency staff to adopt an iterative decision-making style, which in turn makes it hard for them to explain their decisions to the public and adequately include the public in the decision-making process. Additional challenges include the potential for widespread direct human exposure, the need to enter private homes in order to perform investigations and install mitigation systems, and the need for long-term monitoring and maintenance of those systems. Together, all these factors increase the time and resources needed to ensure adequate public communication and participation.

DEC, DOH and EPA have expended considerable time and resources trying to keep the public informed and include them in the decision-making process at vapor intrusion sites. These efforts have often been exemplary and are to be commended. The level of investment required is very high, however, and testimony received at the hearings indicates that even greater effort is needed to adequately respond to citizen concerns. While the highest number of complaints regarding poor communication were associated with the Emerson site in Ithaca, citizens at all sites expressed a desire for greater transparency, speedier responses to citizen requests, better access to technical staff and more direct lines of communication between decision makers and the public.

People who live in communities where there is any chance of vapor intrusion in their homes need access to the same quality of information used by agency staff and responsible parties to make investigation and mitigation decisions.

A number of residents expressed a desire for accurate, clear and transparent information regarding the pattern of contamination found in their community, and expressed frustration about the inability of state agencies to provide such information. DEC and DOH follow a privacy policy that keeps publicly released test results from being associated with any individual property. Maps that keep the identity of individual properties anonymous have been released to the public, with the location of some of the data points randomized by moving them or exchanging them with neighboring data points. As a result, the presentation of data points on the map does not necessarily correlate to the actual pattern of contamination found in the community. This lack of clarity prevents residents from adequately assessing possible patterns of contamination and the relative risk posed to their properties.

In some instances, landlords have not informed tenants of vapor intrusion problems and in at least one case have refused to allow mitigation systems to be installed.

In Endicott and Ithaca, landlords appear to have failed to inform tenants of vapor intrusion problems resulting from contamination. In both Endicott and Ithaca state agencies were refused access to properties by some landlords for testing. In at least one instance in Endicott, a landlord refused to accept a mitigation system even though it was offered. As discussed in the previous finding, there appears to be some confusion over state policy concerning disclosure. In testimony received at the Ithaca hearing, DOH cited property owner confidentiality concerns. However, there does not appear to be any of official policy in statute or regulation regarding the disclosure of test results. In fact, DOH's draft "Guidance for Evaluating Soil Vapor Intrusion in New York State" recommends that the site contact list be used to contact building owners and tenants to "arrange sampling dates and times and to transmit sampling results (in written form and or verbally)." The draft Guidance also discusses what information packages should be given to building owners and tenants once a mitigation system is installed. In a November 2, 2005 news report from the Binghamton Press & Sun Bulletin it was stated, "…there was no clear answer about whether the state could require property owners to install the vents or notify tenants exposed to chemicals." In the article, a DOH spokesperson said it was a matter for the attorney general's office, and a spokesperson for the attorney general said it was a matter for DOH or DEC. The end result is that the public is not always properly protected.

SITE SCREENING

New York State is one of the few states with a plan to screen all legacy sites for potential vapor intrusion problems.

DEC has undertaken an ambitious initiative to screen all former and current Superfund sites for potential vapor intrusion problems. Where the screening process indicates that a high potential for vapor intrusion exists, DEC and DOH have committed to going back to those sites and

conducting further investigations. To our knowledge, this is the most comprehensive review of existing contaminated sites being undertaken in the country.

CONTINUING USE OF TCE AND PCE

TCE and PCE are still widely used in commerce and in residential products.

TCE was first synthesized in 1864. Since the adoption of vapor degreasing in the 1930s, it has been widely used for the cleaning of metals. Currently, it has two primary uses. According to the Halogenated Solvents Industry Alliance (HSIA), 54% percent of the TCE used in the U.S. in 1999 was used as a chemical intermediate in the production of hydrofluorocarbon refrigerants, polyvinyl chloride (PVC), and flame retardants; 42% was used as a metal cleaning and degreasing agent; and 4% was used for miscellaneous applications, including textile solvents, paint removers, and coatings. It can be found in such consumer products as paint removers and strippers, adhesives, spot removers, rug cleaners and typewriter correction fluids. The use of TCE as a general and obstetrical anesthetic, grain fumigant, pet food additive and for the decaffeination of coffee was banned by the U.S. Food and Drug Administration in 1977.

TCE is produced in the United States by the Dow Chemical Company and PPG Industries, Inc. It is a high production volume chemical, with well over 1 million pounds produced annually in the U.S. According to HSIA, U.S. demand for TCE in 1998 was about 171 million pounds, of which about 15 million were imported. About 84 million pounds were exported, indicating a national production level of roughly 240 million pounds.

PCE was first introduced to commerce in 1934. According to the HSIA, 66% of the PCE used in the U.S. in 2004 was used as a chemical intermediate in the production of hydrofluorocarbon refrigerants; 12% was used for dry cleaning and textile processing; 12% was used as a solvent in automotive aerosols like brake cleaners; 8% was used as a metal cleaning and degreasing agent; and 2% was used for miscellaneous applications, including as an insulating fluid in transformers as a substitute for PCBs, as a water repellant and suede protector, as a paint remover, and in printing inks, adhesives, rug cleaners and shoe polish. PCE is still used by over 70% of commercial drycleaners.

PCE is produced in the United States by the Dow Chemical Company, PPG Industries, Inc., and the Basic Chemicals Company, a subsidiary of Occidental Chemical Corporation. A high production volume chemical, U.S. demand for PCE in 2004 was about 355 million pounds, of which about 36 million pounds were imported. About 41 million pounds were exported, indicating a national production level of roughly 360 million pounds, up from 310 million in 1991.

Effective and safer alternatives to TCE and PCE are available.

According to the Massachusetts Toxic Use Reduction Institute (TURI), there are many alternatives to TCE and PCE in metal cleaning and dry cleaning operations. TURI's Surface

Solutions Laboratory has been aiding companies in the search for safer and cost effective cleaning alternatives for over ten years and has performed over 1,000 cleaning trials.

For TCE alone, the lab has conducted over 100 experiments testing metal cleaning alternatives under conditions that closely match the specific operating conditions found in a wide variety of industries, including aircraft and general manufacturing, electronics, metal working and plating. Successful replacements for TCE have been identified by the lab for the removal of eleven categories of materials, including abrasives, buffing compounds, coatings, fluxes, greases, inks, paints, cutting fluids, lubricants, oils and waxes.

Alternatives to the use of PCE as a metal cleaning agent include aqueous and semi-aqueous systems, non-chlorinated solvent systems, mechanical cleaning processes (e.g. abrasive blasting) and other emerging technologies (e.g. laser cleaning). The need for cleaning can also be eliminated through modifications to the manufacturing process. Safer alternatives to PCE for dry cleaning include multi-process wet cleaning and machine wet cleaning, both of which are competitive with PCE cleaning in terms of cost and quality. The use of PCE can also be substantially reduced by updating cleaning equipment and improving operation and maintenance. In July 2005 the Massachusetts legislature issued a mandate and provided $250,000 in funding for TURI to conduct an assessment of viable alternatives to five specific chemicals, one of which is PCE. The study is expected to take approximately one year to complete.

On-site technical assistance for small companies, mandated pollution prevention planning for large companies and the establishment of regulatory limits—all supported by cutting edge research and development and financial assistance--have the potential to result in significant reductions in TCE and PCE use as well as significant cost savings for business.

A recent study conducted by the National Pollution Prevention Roundtable documents that pollution prevention assistance programs across the country resulted in the avoidance of more than 167 billion pounds of pollution in the ten years between 1990-2000. Experience in New York State has shown that for every dollar government spends on technical assistance, small businesses save six dollars.

Following the enactment of a comprehensive toxics use reduction planning and assistance program in Massachusetts in 1991, firms in Massachusetts have reduced their use of TCE by over 60% from 1993 to 2000. PCE use was also drastically reduced.

In 2003, TURI and the Massachusetts Office of Technology began implementation of a new, targeted program to reduce the use of TCE by small businesses in Massachusetts. Under the program, current users of TCE are identified and offered assistance to reduce their use of TCE or substitute less toxic alternatives. Initial outreach is followed up by site visits and the testing of alternative cleaners for each company's specific applications at the Surface Solutions Lab.

A case study reported by the International Finance Corporation documents that one company eliminated its use of TCE and saved approximately $100,000 annually by changing to a water-based method of labeling parts and replacing its degreasing system with a two-step aqueous cleaner. Another case study by Environment Canada documents that a company with 65

employees reduced TCE use by 68% and saved roughly $60,000 per year through such simple measures as improving seals in the degreaser, eliminating the release of fumes during filling and refilling, and using non-absorbent materials to hold metal parts in place.

In 1997, DEC promulgated regulations that require the adoption of cleaner and more efficient machines by dry cleaners. Over the past eight years, the use of these machines has been phased in across the state, with help from the NYS Environmental Facilities Corporation's (EFC) Financial Assistance to Business Program, which provided over $6.4 million dollars to upgrade 1485 machines to either 4th generation PCE, wet cleaning or alternative solvents. At least 98% of all PCE machines currently used in New York are 4th generation machines, which use approximately 80% less PCE than 3rd generation machines and even less than 1st and 2nd generation machines.

In 2002, California's South Coast Air Quality Management District passed a rule prohibiting the use of PCE and other chlorinated solvents in vapor degreasers after January 2003. Following passage of the rule, the California Institute for Research and Technical Assistance worked with five plating companies to adopt viable alternatives. Four companies implemented water-based cleaners and one substituted acetone hand wiping for vapor degreasing. A cost comparison for three of the companies for which data were available documented that it is less costly to use the alternative system.

New York's efforts to promote pollution prevention are lacking compared to many other states.

In 2003, the New York State Assembly Commission on Toxic Substances and Hazardous Waste released a report which found that New York offers very little in the way of on-site technical assistance for small businesses, and has no comprehensive research and development program. Per capita, New York spends considerably less on pollution prevention than eight other states, and New York's investment in pollution prevention is small compared to other environmental spending – representing only 2% of what the state spends on traditional regulatory programs and the cleanup of already contaminated sites.[20]

[20] NYS Assembly Legislative Commission on Toxic Substances and Hazardous Waste, Helping Small Businesses Succeed Through Pollution Prevention (March 2003); available at http://hawkeye.assembly.state.ny.us/comm/Toxic/20030310/.

RECOMMENDATIONS

An overarching principle to remember as New York proceeds to address the challenges posed by vapor intrusion is that the uncertainty associated with these challenges is an issue in itself. This uncertainty is a given, at least for the foreseeable future. In the face of such uncertainty, government must strive to take a precautionary and transparent approach.

A precautionary approach holds that where threats of harm to human health or the environment exist, lack of full scientific certainty about cause and effect should not be viewed as sufficient reason for government to postpone precautionary measures to protect public health and the environment. We must use the knowledge we have today to take a preventive approach to eliminating exposures from vapor intrusion.

Government must also provide citizens with complete and accurate information on the potential health and environmental impacts associated with different policy choices. The decision-making process at vapor intrusion sites should be open and transparent, and provide citizens with opportunities for meaningful public participation. Decisions regarding investigation and mitigation must also be as fair and equitable as possible.

The following recommendations are informed by these principles and are based on the Committee's findings described above.

TCE TOXICITY

DOH should revise its current indoor air guideline for TCE to reflect the most protective assumptions about toxicity and exposure supported by science.

In the face of uncertainty regarding the threat of harm to human health posed by vapor intrusion, DOH should err on the side of caution. Specifically, DOH should adopt a guideline for TCE that is based on the most conservative cancer potency factor for TCE ($0.4\ (mg,kg\text{-}d)^{-1}$) presented in EPA's 2001 draft risk assessment, which would correspond to an air guideline value of between 0.016 and 0.022 mcg/m^3. Caution is warranted based on the evidence available to us regarding the association of exposure to low levels of TCE with cancer and serious non-cancer health impacts, such as birth defects.

Given the inherent limitations on our ability to gather definitive data on the health impacts associated with toxic chemicals, human epidemiologic studies that have detected cancer risks at very low levels of exposure to TCE and community health studies, such as the Endicott Health Statistics Review, should be afforded substantial weight. In addition, the support that the Endicott study provides for the findings of animal studies should not be discounted. The special vulnerabilities of children and the high potential for exposure from multiple sources and pathways also warrant a cautious approach.

DOH should revise its current indoor air guideline to correspond to an excess cancer risk of one-in-one million.

One-in-one million is the target cancer risk level for site remediation established in statute for the new Brownfield Cleanup Program (BCP), and the required risk level for the development of soil cleanup objectives under the same statute. Moreover, experience under the New York State Superfund program has established an historical preference for cleanup to levels that pose equal to or less than a one-in-one million risk of cancer.

DOH's policy choice to establish their TCE guideline at a level that poses a higher risk raises concerns that their decision making process was driven by economic considerations rather than health protection. Decisions regarding acceptable risk should not be made on the basis of financial burden or the number of sites that would qualify for remediation. It should be based solely on public health protection.

INVESTIGATION AND TESTING

The testing and investigation of potential vapor intrusion sites should include the sampling of structures during all seasons of the year and under different weather conditions; be of long enough duration to accurately reflect actual conditions; take preferential pathways into account; and include measurements of the lower air space frequently occupied by children.

DOH and DEC should revise their sampling protocol to address the concerns about testing raised by experts at the hearings and ensure that both sub-slab and indoor air concentrations are measured as accurately as possible. The goal of thorough testing should be to ensure that unacceptable human exposures are not being overlooked. If initial testing indicates that unacceptable exposures may be occurring, mitigation should not be delayed in order to complete further testing.

The indoor air of any structure located near a contaminated site with a potential for vapor intrusion should be tested whenever a resident or occupant requests such a test.

Given the difficulty of accurately predicting and measuring the contamination caused by vapor intrusion, potentially affected residents have legitimate reason to be concerned. Those concerns can only be addressed by testing their homes. At a cost of two thousand dollars or more, testing represents a large cost to many residents but only a small percentage of the overall cost of cleaning up the site by the responsible party or the state.

In addition to protecting the health of residents, expanded testing will relieve some of the anxiety and stress experienced by those who live near vapor intrusion sites. It will also provide useful information regarding site exposures and the pattern of site contamination.

DOH should retain the protective protocols for investigation presented in their draft Guidance for Evaluating Soil Vapor Intrusion.

As discussed above, these include sampling in the area most likely to be affected by contamination; direct measurement of indoor air and under the sub-slab; seasonal sampling; and taking potential future exposures into account. All of these protocols are strongly supported by the difficulties associated with accurately measuring the contamination caused by vapor intrusion, all of which were well documented in testimony submitted during the hearings.

DEC and DOH should consider the procurement of a TAGA unit for use at vapor intrusion and other contaminated sites.

Experience at the Hopewell site has shown such units to be particularly effective at identifying the source of contaminants in indoor air. Such a tool has the potential to help the agencies gain a better understanding of the likelihood of contamination being associated with a source outside the home, information that can be crucial in deciding whether to mitigate or take other actions.

MITIGATION

DOH and DEC should adopt a general presumption that mitigation will be implemented for any structure where detectable VOC contamination is measured under the sub-slab or in indoor air, and evidence exists that such contamination may be caused by vapor intrusion.

A large number of findings from the Committee's hearings support this recommendation. These include: 1) the difficulty of accurately predicting and measuring the contamination caused by vapor intrusion; 2) the limits of epidemiology and toxicology and the fact that the most protective risk-based concentrations for TCE are equal to or below detection limits; 3) the comparable cost of mitigation and monitoring; 4) the decision by a number of responsible parties and agencies to mitigate at detect based on cost and other risk management considerations; 5) the importance of ensuring that site decisions are fair and equitable; 6) the support of scientific experts for mitigation wherever there is a potential for vapor intrusion or whenever contamination associated with vapor intrusion is detected; and 7) the anxiety and stress experienced by residents living near a vapor intrusion site. Taken together, these considerations provide strong evidence that establishing a presumption for mitigation at detect would be a reasonable and cost effective response to the uncertainty associated with vapor intrusion.

While a preference for mitigation at detect is desirable, it should only be applied in those situations where plausible evidence exists that the contamination may be caused by vapor intrusion. In addition, it is important to note that the adoption of a preference for mitigation may not result in taking action to mitigate every time contamination is detected. The preference could be superseded by substantial evidence that such contamination is not being caused by vapor intrusion; or in a situation where the costs of mitigation are extremely high, the measured levels of contamination are extremely low, and a high degree of uncertainty exists regarding the accuracy of such measurements. In other words, the adoption of a presumption for mitigation at detect would not eliminate the need to consider the numerous factors that do and should play a part in mitigation decision making.

DOH should revise its draft Guidance for Evaluating Soil Vapor Intrusion to de-emphasize the importance of sub-slab and indoor air concentrations and more accurately reflect the crucial role played by other factors in site decision making.

The final guidance released by DOH must be transparent and fully describe all the factors that are considered when making site screening, testing and mitigation decisions. The list of factors already provided in the draft guidance should be expanded to include the following considerations, many of which are well established as factors to be considered under the existing federal and state Superfund programs and the new state Brownfield Cleanup Program: overall protectiveness of human health and the environment; the potential for multiple pathways and sources of exposure; the potential for exposure to multiple contaminants; short-term and long-term effectiveness; the degree of uncertainty associated with characterizing the migration of contamination and measuring contamination under the sub-slab and in indoor air; ability to implement; cost effectiveness, including the relative cost of mitigation compared to monitoring; the potential for inequitable outcomes; and community acceptance.

In addition to describing each factor, DOH should provide a more substantive description of how each factor will be weighed in the decision-making process. For example, as done in the decision matrix used by EPA Region 2, the agency could state that if the cost of mitigation is less than or equal to the cost of monitoring, mitigation is more likely to be implemented. Where a great deal of uncertainty is associated with testing results, the agency should state that it is more likely to err on the side of caution and mitigate whenever contamination is detected. The current matrices that exclusively focus on sub-slab vs. indoor air concentrations should be abandoned altogether, or redrafted in such a way that the bright lines between cells are blurred and the importance of other factors is emphasized.

To be consistent with a preference for mitigation at detect, any decision matrix used by DOH should include "mitigation" as an option in any cell where sub-slab or indoor air concentrations are at or above detect. Site managers should be required to transparently explain and justify a decision not to mitigate based on other factors described in the guidance.

If contaminant levels are detected but are not believed to be caused by vapor intrusion, efforts should be made to identify the source.

This is particularly important for contamination detected under the sub-slab, where contamination from products used inside the home is unlikely. Since VOCs of concern at vapor intrusion sites are not naturally occurring materials, exposed residents need the best information possible in order to adequately address exposures not associated with a contaminated site.

REMEDIATION

Accelerated and aggressive cleanup of the contamination causing vapor intrusion should be pursued at all vapor intrusion sites.

Once direct exposures have been mitigated, government agencies and responsible parties should act to cleanup the cause of vapor intrusion, i.e. underlying soil and groundwater contamination, as quickly and aggressively as possible. Aggressive cleanup is the only way to restore property values, ensure that mitigation systems will not have to be employed well into the future, and protect the economy of communities impacted by vapor intrusion. It is also the best way to protect ambient air from the impacts of contamination and the operation of indoor air mitigation systems.

DEC's view of mitigation as a short-term solution and commitment to aggressively cleaning up underlying contamination deserve the strongest praise and support.

EPA's commitment to aggressive cleanup is less clear and should be strengthened. Accelerated groundwater cleanup and the pulling back of plumes should become a routine practice at all vapor intrusion sites, and soil should be cleaned up to levels low enough to ensure that vapor intrusion will not occur.

COMMUNITY HEALTH STUDIES

DOH should make every effort to accurately characterize and educate communities about the limitations of health studies, including the high potential for false negatives.

The public should be provided with full and accurate information regarding the limitations of health studies, including the disclosure and discussion of statistical power. The high potential for false negatives should be disclosed, and negative results in studies with low statistical power (less than an 80% chance of accurately identifying a positive association) should be characterized as inconclusive. State and federal public health officials need to do a better job explaining the resources that are available to communities concerning the potential health impacts of their exposure to contaminants due to vapor intrusion. When there is evidence of human exposure, a community-wide Public Health Response Plan (PHRP) should be developed.

DOH should make every effort to increase the ability of science to measure the negative health impacts of exposure to the contamination caused by vapor intrusion, including the expansion of its VOC registry to include vapor intrusion sites.

While we commend DOH and NYC DOH for their participation in developing a national Environmental Public Health Tracking Network, clearly more needs to need done. New York should develop is own environmental health tracking system that includes the documentation of human exposure at all contaminated sites; periodic health monitoring, particularly for occupants of homes with vapor intrusion problems; and tracking of the health of former residents. The Assembly passed legislation in 2005 (A.969-A, Koon, DiNapoli) that would take the first steps toward establishing such a system.

One of the most promising of health tracking initiatives in the state is the establishment of the voluntary VOC registry by DOH. The registry should be expanded to include all sites where there is evidence of human exposure due to VOC contamination, including vapor intrusion sites. In addition, consideration should be given to combining statistical surveys carried out at individual sites in order to perform a meta-analysis with increased statistical power and ability to accurately detect associations between environmental exposures and disease. Consideration should also be given to increasing the acceptable rate of false positives in community health studies in order to increase their power and ability to accurately detect such associations.

A statewide environmental health tracking system should include biomonitoring.

The tissue and bodily fluids of individuals who have been exposed to chemicals due to vapor intrusion should be collected and tested for contamination as part of a voluntary biomonitoring program. While such testing may prove inconclusive, it has the potential to provide health care professionals and researchers with valuable information in their efforts to better respond to and understand possible human health outcomes. New York State should consider broadening the range of persons authorized to order such tests and receive results to include non-health care professionals such as state and local health officials.

Health monitoring should be provided for all residents with documented exposure to contaminants caused by vapor intrusion.

Occupants of all residential buildings where mitigation systems have been installed should be offered periodic health monitoring at no cost to them. Health monitoring should also be provided for the former residents of such structures.

Funding should be provided for regional environmental health centers.

The Center for Children's Health and the Environment at the Mt. Sinai School of Medicine and several other public health advocacy organizations have recommended the establishment of a statewide environmental health system for children. Regionalized centers would increase the accuracy of diagnosis and improve the treatment of children's disease caused by environmental factors. These centers also would better quantify and describe children's diseases of environmental origin and provide educational programs for health care professionals. Seed money to study this proposal was provided in this year's state budget at the request of Assemblyman DiNapoli. This concept should be expanded to include exposed adults.

AMBIENT AIR

DEC should take steps to protect ambient air quality at vapor intrusion sites.

Implementation of DEC's ambient air monitoring and modeling plan in Endicott should provide useful information regarding the potential for vapor intrusion and vapor intrusion mitigation systems to impact ambient air. Monitoring ambient air quality should become a routine practice at all vapor intrusion sites.

Ambient air can best be protected by moving quickly and aggressively to cleanup the contamination that is causing vapor intrusion to occur (see recommendation above). Even accelerated remediation can take a considerable amount of time, however. As long as mitigation systems are needed, DEC should require the use of filters or other methods to limit the emission of contaminants to ambient air from such systems.

BACKGROUND LEVELS

A comprehensive statewide study should be conducted that measures actual background levels of volatile organic compounds that exist in New York State.

If background levels of VOCs are to be used in the decision-making process, as is proposed in DOH's draft guidance, then such levels should be based upon a comprehensive study of actual VOC background levels in New York State. The current studies being used by DOH are limited both in size and the geographic location they represent, and are not likely to present a representative sample of actual background levels across the state.

OCCUPATIONAL EXPOSURES

DOH should retain its proposed approach of defining the contamination caused by vapor intrusion as an environmental rather than occupational exposure.

Exposure to indoor air contamination caused by vapor intrusion is fundamentally different from exposure to chemicals in the course of commercial or industrial activities. OSHA standards are based on the exposure of workers over a specific period of time (e.g. no more than five minutes over two hours). When such activities cease, exposures cease also. In comparison, exposures from vapor intrusion are ongoing and constant, and will remain whatever the future use of a building might be. DOH should be commended for making this important and protective distinction between environmental and occupational exposures.

PUBLIC PARTICIPATION AND COMMUNICATION

DEC, DOH and EPA should develop a strategic master plan for citizen participation at vapor intrusion sites and invest more staff time and resources in communication and participation activities.

In order to address the unique challenges posed by vapor intrusion sites, a consistent community response plan tailored to such sites is needed. The plan should acknowledge and directly address the complexity and uncertainty associated with decision making at vapor intrusion sites, and suggest measures to counteract the tendency for agency decision making to become less transparent in the face of such uncertainty.

Practical and helpful suggestions coming out of the hearings include: the establishment of a special liaison to facilitate the sharing of information with local government officials, who can serve as an important partner in public communication; establishing site citizen advisory groups that have direct access to and frequent contact with technical experts and site decision makers; and providing greater opportunities for citizens to meet with agency staff apart from responsible parties. In addition, citizens should be actively encouraged to seek a technical assistance grant (TAG), which can provide up to $50,000 to an affected community for the review and interpretation of investigation plans, data, and other site cleanup issues. These grants are now available at state Superfund and brownfield sites as well as at federal Superfund sites.

DEC, DOH and EPA should develop a proactive policy regarding the public release of testing results that addresses privacy concerns while encouraging more widespread disclosure of information.

Residents need access to the same information used by decision makers to make site investigation, mitigation and remediation decisions. A solution is needed that adequately addresses privacy concerns while encouraging disclosure. One option would be for government agencies to routinely ask property owners for permission to publicly release their test results. This would result in better access to test results than citizens can obtain surveying the community on their own. In discussions with the agencies they indicate that they may need some statutory direction.

Landlords should be required to disclose vapor intrusion problems to their tenants, including offers to sample or mitigate and any sampling results.

Such disclosure is crucial to protecting the public health of tenants. In addition, DEC and DOH should be granted the right to enter properties in order to conduct testing for vapor intrusion, as currently provided in statute for on-site access to Superfund and brownfield sites. Assemblymember Donna Lupardo, working with Assemblymembers DiNapoli and Lifton, is in the process of developing legislation to provide for tenant notification and agency right of access to all contaminated sites, including vapor intrusion sites.

SITE SCREENING

DEC and DOH are to be commended for leading the nation in the effort to screen existing contaminated sites for potential vapor intrusion problems.

Experience with vapor intrusion to date, indicates that the screening of old sites, where cleanup is currently considered complete, is extremely important to eliminating the exposures caused by vapor intrusion. Some of the most extensive and serious exposures to date, including those at the Endicott and Emerson sites, have been at sites where remediation was formally determined to be complete under the state Superfund program. DEC and DOH should be commented for undertaking the most comprehensive review of existing contaminated sites in the country.

CONTINUING USE OF TCE AND PCE

New York State should significantly increase its investment in pollution prevention technical assistance and research and development programs and consider the enactment of legislation that would promote the adoption of effective and safer alternatives to TCE and PCE.

New York should significantly increase the amount of pollution prevention assistance, including on-site assistance, it offers to businesses. Such assistance should be integrated into all of DEC's traditional regulatory programs, including permitting, inspection and enforcement efforts, and the state's existing but limited small business compliance assistance program, operated by the Environmental Facilities Corporation (EFC) and Empire State Development (ESD), should be expanded to include pollution prevention and cover all environmental media. In addition, ESD's Environmental Investment Program, which provides grants for solid waste secondary market development and pollution prevention, should be increased and refocused to provide considerably more funding to private sector on-site technical assistance providers. Finally, the state should establish a Pollution Prevention Institute modeled on Massachusetts' TURI to identify effective and safer alternatives to toxic chemicals and help companies test those alternatives under real-life conditions.

Chairman DiNapoli and Assemblyman David Koon, Chair of the Assembly Toxics Commission, have been working over the past few years to promote these initiatives, but additional effort is needed to achieve full implementation. Legislation that explicitly grants DEC the authority to integrate pollution prevention into all agency activities and expands the small business compliance assistance program was passed by both houses of the Legislature during the 2005 Legislative Session and signed by the Governor in October 2005. While the new law is an important first step, increased financial investment will be needed to hire the staff necessary to successfully implement these initiatives.

For the past three years, Assemblymen Koon and DiNapoli have successfully secured significant increases in the Governor's appropriation for the Environmental Investment Program and supported efforts by program staff to increase the disbursement of funds to municipal and private sector technical assistance providers. In 2005, the Assemblymen supported a proposal by the Rochester Institute of Technology to establish a Pollution Prevention Institute at its Center for Integrated Manufacturing Studies (CIMS) that would provide the same types of services to New York businesses that are currently available in Massachusetts through TURI. As in Massachusetts, each of these programs could, and should, undertake targeted initiatives to assist businesses in identifying and adopting effective and safer alternatives to TCE and PCE.

The success of Massachusetts' mandatory toxics use reduction planning law supports the adoption of a similar law in New York State. New York should also consider enactment of a law similar to a bill introduced in Massachusetts in 2005 that would require TURI to evaluate whether there are feasible, safer alternatives to the most toxic and widely used chemicals. If such an alternative is identified, businesses would be required to adopt the alternative, propose a different alternative, or show that the alternative is not technically or economically feasible for their specific use. The bill targets ten toxic chemicals, including TCE and PCE, for initial action.

CONCLUSION

New York State is in the beginning stages of developing policies to address vapor intrusion. The Committee's hearings have been undertaken with the goal of assisting in that effort, providing transparency, and encouraging participation. Many challenges lie ahead. As we move forward to address those challenges, government should strive to prevent harm and make transparent and equitable decisions. I look forward to continuing to work with citizens and policy makers to address the threat to public health posed by vapor intrusion.

APPENDIX A.1 – ENDICOTT HEARING NOTICE

ASSEMBLY STANDING COMMITTEE ON
ENVIRONMENTAL CONSERVATION

NOTICE OF PUBLIC HEARING
Oral Testimony by Invitation Only

SUBJECT: Vaporization of contamination from soil and groundwater into indoor air

PURPOSE: To examine the human health impact of vapor intrusion stemming from soil and groundwater contamination

ENDICOTT
Monday, November 15, 2004
11:00 a.m.
Endicott Visitor Center
Community Meeting Hall
300 Lincoln Avenue
Endicott, NY

Chapter 1 of the Laws of 2003 establishing the Brownfield Cleanup Program (BCP) provided for the refinancing of the State Superfund program and a comprehensive program for the long-term restoration of groundwater. The groundwater provisions of the new program are based on experience at various sites under New York's Superfund and Oil Spill cleanup programs. The intent was to address the shortcomings of those programs by providing for the investigation and pursuit of off-site migration of contamination, particularly through groundwater plumes, in order to eliminate human exposure.

The vaporization of contaminants from soil and groundwater impacting indoor air has occurred at several State Superfund sites and has the potential to be a problem at brownfield sites. While both the New York State Department of Environmental Conservation and United States Environmental Protection Agency are considering draft guidance that sets standards for vapor intrusion, neither agency have issued final guidance. Vapor intrusion should also be considered during the development of generic soil cleanup standards under the BCP.

The purpose of this hearing is to examine issues concerning the vaporization of contamination from soil and groundwater and resulting human exposure, and to determine what lessons can be learned from experience in order to properly address vapor intrusion in the future. The Committee will take testimony from various witnesses including panels of Federal, State and local government officials, public health and environmental experts and citizens representing affected communities.

Oral testimony will be accepted by invitation only and limited to 5 minutes duration. 10 copies of any prepared testimony should be submitted at the hearing registration desk. The Committee would appreciate advance receipt of prepared statements. Written testimony will also be accepted and may be sent to the contact person listed on the reply form. In order to further publicize the hearing, please inform interested parties of the Committee's interest in receiving written testimony from all sources.

In order to meet the needs of those who may have a disability, the Assembly, in accordance with its policy of non-discrimination on the basis of disability, as well as the 1990 Americans with Disabilities Act (ADA), has made its facilities and services available to all individuals with disabilities. For individuals with disabilities, accommodations will be provided, upon reasonable request, to afford such individuals access and admission to Assembly facilities and activities.

APPENDIX A.2 – ENDICOTT WITNESS LIST

WITNESS LIST

Honorable Maurice Hinchey
Congressman, 22nd District
Honorable Joan Pulse
Mayor, Village of Endicott

PANEL

Carl Johnson, Deputy Commissioner
Office of Air and Waste Management
NYS Department of Environmental Conservation
Dr. Nancy Kim, Director
Division of Environmental Health Assessment
NYS Department of Health
Matthew Hale, Director
Office of Solid Waste
US Environmental Protection Agency

PANEL

Joseph Graney, Assistant Professor
Dept. of Geological Sciences and Environmental Studies
State University of New York at Binghamton
Lenny Siegel, Director
Center for Public Environmental Oversight
Theodore J. Henry, Toxicologist and Community Involvement Specialist
Henry and Associates, LLC

PANEL

Bernadette Patrick
Citizens Acting to Restore Endicott's Environment
Alan Turnbull, Coordinator
Resident Action Group of Endicott
Donna Lupardo
Resident Action Group of Endicott
Bruce K. Oldfield, Member
Hillcrest Environmental Action Team
Debra Hall, Member
Hopewell Junction Citizens for Clean Water

ADDITIONAL EXPERT TESTIMONY WAS SUBMITTED BY

Leonardo Trasande, M.D.
Center for Children's Health and the Environment, Mount Sinai School of Medicine
Philip J. Landrigan, M.D.
Center for Children's Health and the Environment, Mount Sinai School of Medicine
David Ozonoff, M.D., M.P.H.
Boston University School of Public Health
Daniel Wartenberg, Director
Division of Environmental Epidemiology, Robert Wood Johnson Medical School

APPENDIX A.3 – SUMMARY OF TESTIMONY, ENDICOTT HEARING

The following are summaries of testimony presented at the hearing or submitted for the record. These summaries were prepared either by the witness or by staff using their written testimony.

Honorable Maurice Hinchey, Congressman, 22nd District
This hearing is an important step towards assessing how regulatory agencies have dealt with Endicott's toxic contamination and how to improve procedures for dealing with the emerging threat that vapor intrusion presents in communities statewide.

As I learned of the extensive toxic plume beneath Endicott, I immediately pushed for a comprehensive health study as well as expedited remedial action. While progress has been made on both these fronts -- a health study is underway and the site has been reclassified from Class 4 (site which has been properly closed but requires continued management) to Class 2 (site which poses a significant threat to public health or the environment and requires action) on the New York State Registry of Inactive Hazardous Waste Sites -- there is more to be done.

Some of the unresolved issues concerning this site include:

Shoddy regulatory record keeping, particularly the absence of a consent order between IBM and DEC -- which should have been established in the 1980s;
The positive identification of the polluter primarily responsible for releasing toxic chemicals. To date, some 80,000 gallons of toxic chemicals have been removed, yet IBM has admitted to releasing only 4,100 gallons;
The status of the historical records reportedly maintained by IBM which track employee mortality rates; and
The remediation time line and whether the Consent Order entered in August 2004 will serve as the guiding document, or will be superseded by a Record of Decision.

TCE inhalation and drinking water standards are presently under review by the Federal government. The progress of this review should be followed closely and may have a profound impact on remediation efforts in Endicott and elsewhere.

Honorable Joan Pulse, Mayor, Village of Endicott (Edited by staff)

The Village of Endicott has encountered numerous trials and tribulations throughout the years. Although we have faced challenges, we were still able to seize and capitalize on every opportunity that was presented before us.

During my campaign and since election, I have had three primary goals for the Village of Endicott: fiscal responsibility, economic development (which will create and secure the future for our children), and safety (specifically addressing any and all environmental concerns in our community). Protecting our community and holding accountable those responsible for the contamination, is fundamental to my beliefs-THOSE WHO DID IT; CLEAN IT UP!

Five years ago, no one had ever heard of vapor intrusion. A situation in Colorado shed new light on our understanding of vapor intrusion. EPA continues to work diligently to help others understand the environmental impacts of this emerging issue.

State and local agencies have met with residents on numerous occasions, provided information, conducted investigations, and where appropriate, ensured that responsible parties are held accountable for cleanup. I, and the residents of the Village of Endicott, would accept no less. I would argue that Endicott, from the environmental perspective, is one of the most highly scrutinized municipalities in the State, if not the Nation.

I welcome and endorse the need to protect our citizens. I personally have said and will continue to say, "I will hold IBM's feet to the fire" when it comes to protecting our environment – but I refuse to accept the portrayal by the media that every effort isn't being made to address the situation. Yes, there are environmental concerns in Endicott and they do need to be resolved. There needs to be oversight, to ensure the protection of citizens – and that is being done by the DEC and the state and county DOH.

I rely on and thank the DEC and the state and county DOH. Moving forward, protecting residents, improving the quality of life, and providing opportunities are the responsibilities of my administration. I encourage those present to join me in accomplishing these goals, and I again thank the committee for taking up this issue.

Carl Johnson, Deputy Commissioner, Office of Air and Waste Management, NYS Department of Environmental Conservation (Edited by staff)

Along with the New York State Department of Health (DOH), the Department of Environmental Conservation (DEC) is committed to protecting public health and environmental quality from the potentially serious effects of vapor intrusion into homes and businesses.

Vapor intrusion is a rapidly developing field of science and policy. While chemical concentrations of vapors are typically low, in some instances they can accumulate to levels which pose safety hazards, including the potential for explosions or acute health effects. Even in low concentrations, these vapors may lead to chronic health effects.

Determining the exact concentrations of contaminants in a building resulting from vapor intrusion may be difficult. For example, the use of other substances (including gasoline and cleaning solvents) in or around a building may complicate our ability to effectively determine the precise level and source of contaminants stemming from vapor intrusion. Through modeling and direct measurements, DEC makes the best possible estimate of actual contamination levels resulting from vapor intrusion. In partnership with DOH, we then search for means to resolve the problem.

DEC recognizes that vapor intrusion cannot be resolved simply through ventilation at the buildings where hazardous or potentially hazardous levels of vapors are discovered. Elimination of the source is our ultimate objective. We view the use of vapor mitigation systems as a short-term solution to the vapor intrusion problem. By addressing the source of the contamination, and

ensuring that steps are taken to remediate and monitor the soil and groundwater which provides a pathway for the migration of these chemicals, DEC can provide effective long-term protection of the public health from vapor migration.

At the Endicott site, we have a commitment from IBM to extract contaminated groundwater at a faster rate. We are going to pull back the plume, which we hope will lead to a commensurate reduction in vapor intrusion.

The standards with which cleanups must comply are determined by DOH, not DEC. Our responsibility involves establishing a cleanup plan which ensures that contamination is cleaned up to the level established by DOH.

DEC has developed a program policy to deal with all sites in all the remedial programs where vapor intrusion may be an issue. The strategy in the policy divides the universe of sites into two groups: 1) sites where remedial decisions have already been made (legacy sites) and 2) sites where remedial decisions have yet to be made. The guidance in this document primarily applies to the first group – sites where decisions have already been made – and outlines a process to be used to identify and prioritize those sites for further action. A prioritization approach has been developed to focus efforts on evaluation of legacy sites with the greatest potential for vapor intrusion first. DEC is in the process of working through the universe of legacy sites in order to identify the sites of concern. The sites in group 2 have already been evaluated and, where necessary, vapor intrusion is being added as part of a routine investigation. All future sites will include a vapor intrusion investigation component.

The remediation of vapor intrusion sites is complex, and these comments only provide a brief synopsis of the actions which DEC undertakes.

Nancy Kim, Ph.D., Director, Division of Environmental Health Assessment, NYS Department of Health (Edited by staff)

The New York State Department of Health (DOH), in conjunction with other state and federal agencies, is carrying out a number of activities related to vapor intrusion, including the performance of environmental health investigations and health studies; the development of remedial guidance, guidelines for chemicals in air, and soil cleanup objectives for brownfields; and the provision of public health information.

Environmental health investigations at vapor intrusion sites follow an approach consistent with that for other environmental media. Since no two sites are exactly alike, the approach is dependent on site specific conditions, including site use history, geological and other physical characteristics, and potentially exposed populations. Existing information is reviewed and new data is gathered until questions regarding current and potential exposures and the actions needed to prevent or mitigate exposures and remediate the source of vapor contamination can be answered.

DEC and DOH are drafting guidance right now for investigating and evaluating exposure pathways, an early draft of which is attached to our testimony.

DOH is also developing an approach to making remedial decisions based on soil vapor and indoor air concentrations. The approach is outlined in a matrix and to date, matrices have been developed for trichloroethylene and tetrachloroethylene. Drafts are being provided with our testimony for you to comment on however you want to. The form of the matrix is evolving as we learn more and apply it at different sites.

In addition, DOH has developed indoor air guidelines for the dry-cleaning chemical tetrachloroethylene (also known as perc), dioxin, PCBs and TCE. The TCE guideline was established after an extensive evaluation of scientific information using methods consistent with those used by other agencies and scientific bodies. We looked at both cancer and non-cancer effects and focused most on inhalation studies. We developed potential guidelines or criteria for evaluating TCE toxicity for all the different health effects, and in general, those guidelines range from one to ten micrograms per cubic meter of air. The guideline adopted is five micrograms per cubic meter of air.

We developed the TCE guideline based on our understanding of the science. We reviewed EPA's draft Health Risk Assessment for TCE and the Science Advisory Board's review, which provided many recommendations for improving the document and many more details about the uncertainties involved in estimating TCE's cancer risks. Depending on the various aspects of TCE at issue, we came up with a slightly different answer than the Assessment. We also looked at critiques of the Assessment by some other EPA scientists who are aware of California's work on TCE.

Some EPA regions have taken a lower figure and some reference concentrations are higher. It depends on which guideline you look at. For example, the cancer potency factor for TCE in air recommended by EPA Region 3 is the highest recommended by EPA in the draft Assessment. It is based on an epidemiological study with the following limitations: the study did not have individual exposure measurements; the study population was exposed to other chemicals besides TCE; and the routes of exposure for the study were ingestion, and probably dermal absorption and inhalation, as compared to inhalation alone.

Our guideline corresponds to an excess cancer risk of between one-in-one million and one-in-one hundred thousand, depending on the risk extrapolation relied upon. But it is generally probably a little bit greater than one-in-one million.

We have committed to a peer review process for the TCE guideline and expect to ask various stakeholders to recommend scientists for the peer review. For the peer review, we are completing an extensive scientific document about the key issues related to TCE toxicity and risks. We also recognize the need to continue to update, review and refine our evaluation of the potential health risks associated with TCE using good science.

Matthew Hale, Director, Office of Solid Waste, US Environmental Protection Agency
(Edited by Staff)

EPA considers vapor intrusion from contaminated soils or groundwater into homes and other buildings to be a significant environmental concern and one where the science is still evolving. We have long recognized that volatile organics contaminating soils or groundwater can migrate into nearby buildings, resulting in indoor air levels that may present a human health threat. Within recent years, however, we have come to recognize that the occurrence of vapor intrusion into buildings is more widespread than previously thought. For example, in some cases, volatile organics have migrated further from their source than was expected; in others, vapor intrusion was not originally identified as an exposure pathway of concern, but later proved to be one.

Because we now recognize the potential for vapor intrusion to be a significant exposure pathway at certain remediation sites, EPA and state environmental agencies have paid increased attention to indoor air concerns at cleanup sites where soil or groundwater is contaminated with volatile organics. For example, in the Resource Conservation and Recovery Act (RCRA) corrective action cleanup program, we routinely screen sites for potential vapor intrusion where there is a possible concern. Where concerns are identified, EPA (or more frequently under RCRA, the authorized state agency) requires corrective action – for example, the installation of vapor removal systems beneath a building.

Perhaps the most difficult challenge relating to vapor intrusion is determining with reasonable certainty whether there is likely to be a problem or not when buildings are in the vicinity of soil or groundwater contaminated with volatile organics. A complicating factor in evaluating vapor intrusion and the risks it may pose is the potential presence of some of the same chemicals at or above background concentrations from the ambient (outdoor) air and/or emission sources in the building e.g., household solvents, gasoline, cleaners. Because of the large number of sites where vapor intrusion could potentially be a concern, because the science is still evolving in this area, and because of the technical difficulties in determining whether there actually is a problem at a given location, the EPA Office of Solid Waste and Emergency Response developed draft screening guidance, which it published for comment on November 29, 2002 (Federal Register November 29, 2002: 67 FR 71169-71172).

In this draft guidance, EPA recommends a tiered approach to screening sites for vapor intrusion potential – that is, to determine whether vapor from volatile organics is likely to be entering buildings, and if so whether it would likely be a health concern. The guidance recommends that regulators and responsible parties use a conservative modeling approach in determining whether there is likely concern at a given location, and that they conduct sub-slab and indoor air sampling when the possibility of vapor intrusion at levels of concern can't be ruled out. The guidance also notes that when indoor air sampling is conducted, that it be conducted more than once and the sampling program be designed to identify ambient and indoor air emission sources of contaminants.

EPA received numerous comments on this guidance, which it is now reviewing. We have held technical working sessions with the states, academia, and external stakeholders to discuss this guidance in San Diego, California and Amherst, Massachusetts, and will be returning to San

Diego next March for our third technical working session. After that meeting, we will determine how best and over what time period to finalize the guidance.

When it published this draft guidance, EPA recommended its use at RCRA, Superfund, and brownfield cleanup sites. However, we emphasize that it is only guidance and is still in draft form, and that other approaches may also be appropriate. Furthermore, the state of New York is authorized to run the RCRA cleanup program in lieu of EPA, and therefore the New York State Department of Environmental Conservation is generally responsible for overseeing and regulating RCRA cleanups within the state. New York—like any authorized state under RCRA—may choose to follow this guidance, or may adopt other approaches that achieve protective results.

Joseph Graney, Ph.D., Assistant Professor, Dept. of Geological Sciences and Environmental Studies, State University of New York at Binghamton (Edited by staff)

I have been fortunate to have been involved in some of the scientific research related to the Hillcrest problems. Much of my work at Hillcrest has been related to the emission and transport of vapor phase mercury. I believe that similarities in the chemical and physical properties of mercury to volatile organic compounds (VOCs) may allow findings from mercury monitoring studies to act as a potential surrogate for designing future studies of VOCs in brownfields as well as residential exposure studies.

The methods for detecting indoor air concentrations of organic compounds such as trichloroethylene (TCE) and other VOCs typically require use of Summa canisters and relatively long sampling times (typically 24 hours). Collection and analysis of such samples is expensive, but needed for regulatory purposes including exposure assessments. However, short-term monitoring times and in situ sampling methods would be of major benefit to better determine shorter term variation in VOC concentrations from exposure perspectives. Such instrumentation is available for monitoring low level mercury concentrations in indoor air exposure settings, and further development of similar instrumentation for low level VOCs is needed. Such instrumentation could be used to quickly screen large numbers of residences in a cost effective manner.

The times of year when samples should be collected for indoor and ambient air exposure assessments need further study. I am not convinced that the major indoor air exposure to contaminants associated with vapor intrusion occurs during the winter months (i.e. during the heating season when forced air furnaces are in operation). Sampling during all seasons should be carried out to document temporal trends in VOC concentrations specific to the climatic conditions in the Southern Tier of New York State.

The complex terrain of the Southern Tier (characterized by incised river valleys and surrounding hilltops) may make ambient air quality from venting of VOCs in residential areas a concern, due to the likelihood of pollutants being preferentially channeled within the river valleys. Methods should be devised and tested to lower the VOC emissions to ambient air. For example, the installation of in-situ VOC vapor adsorption cartridges inside ventilation ductwork may lower emissions to ambient air.

Groundwater contamination problems are proving to be difficult to rectify. There may be need for a further evaluation of innovative groundwater remediation approaches above and beyond conventional pump and treat methods. The study of preferential pathways of groundwater and vapor phase pollutant transport in relation to underground utility services (gas, sewer, cable, electric, telephone) is also in need of further study.

Lenny Siegel, Executive Director, Center for Public Environmental Oversight

U.S. EPA's 2001 draft toxicity assessment found that TCE is five to sixty-five times more toxic than previously believed, largely because of the risk to children. Consequently, most EPA Regions have adopted a new "provisional" standard of .017 micrograms per cubic meter (mcg/m3). However, New York has no clear plan for responding at concentrations below 5 mcg/m3. Because people who live and work above volatile pollution cannot replace the air they breathe, policy makers should take a more precautionary approach.

Vapor intrusion is usually viewed as the rise of toxic fumes directly into structures. However, contamination may escape over a large area, elevating ambient concentrations above the screening level. Therefore, investigations should be based upon conceptual site models that consider all sources, pathways and receptors.

Cleanup should be accelerated to ensure that mitigation measures will remain effective in the long run, reduce outdoor exposures, and enable safe reuse of vapor-impacted properties. Today there are cheaper, faster technologies that can protect against vapor intrusion and restore groundwater resources.

1. Environmental regulators should use 0.017 mcg/m3 as a screening level in their investigations.

2. Soil and groundwater cleanup goals should be strong enough to protect the air.

3. Mitigation—such as sub-slab depressurization systems—should be considered wherever sampling shows TCE exposures above 0.17 mcg/m3.

4. Development should be restricted wherever soil gas studies suggest that future indoor concentrations may exceed the screening level. Where housing is approved, mitigation and notification should be required.

5. The remedy should be reconsidered at any site where vapor intrusion is recognized.

Theodore J. Henry, M.S., Toxicologist and Community Involvement Specialist, Henry and Associates, LLC

Trichloroethylene (TCE) is one of the top 8 percent most toxic compounds based on EPA Region 3 data. The data available show that the current national debate over adequate vapor intrusion criteria is economic and not the result of a lack of data. This is unfortunate given America's past

lessons involving lead and smoking, where we ignored science for decades at the cost of many lives and young minds.

EPA has started addressing vapor intrusion, but investigation of this pathway is in its infancy. Furthermore, the financial and technical expertise limitations at the state and local level will impact the nation's ability to protect communities from TCE. Nevertheless, community members will try to apply political pressure where they can to get adequate testing and remediation despite a regulatory process that is financially strapped, technically challenged and conflicted. Some policies and regulations will be implemented to help, but this will take years and will differ drastically from state to state. While communities work hard to bring this change, they will need the support from political leadership to allow them to participate effectively. All participating agencies must involve communities through HEART (Honesty, Empathy, Accessibility, Responsiveness and Transparency). Technical issues needing to be addressed include: source definition, correlation of known contamination with records, groundwater flow, soil gas data, indoor air data over time, biomonitoring, etc.

In the end, science must prove itself with empirical data from the affected communities, not just with modeling and risk assessment. If the affected communities do not get this type of community involvement and technical support, contamination will be missed, misjudgments will be made regarding true exposure levels, and the remedial actions selected will fall short of protecting neighborhoods.

Bernadette Patrick, Citizens Acting to Restore Endicott's Environment (Edited by staff)

I am a resident in the Town of Union and co-founder of the citizens' action group C.A.R.E. On October 31, 2002 my daughter at the age of 17 during her senior year of High School was diagnosed with Hodgkin's Lymphoma.

On that same day in October the DEC, DOH, and IBM representatives agreed upon a mitigation decision matrix to be protective of public health and to be used to determine which houses in my neighborhood, located in a 300-acre toxic plume, will be eligible for a mitigation system. To date, there are 480 properties with mitigation systems installed.

What about those properties that did not meet the criteria? People continue to live in their homes and work in buildings that are contaminated with VOCs. They have chemical vapors inside and under their homes but the levels are not high enough to warrant a mitigation system.

What about the family with small children living next door to a vented home? They are told they don't need testing because they are not in the plume, they just border it.

What about the home in the plume that has been tested, and VOCs are detected in the sub slab and indoor air. They are denied a system, but their neighbors all have them.

What about the people that live within 100 feet of the plume, that are just plain scared? What type of standard is available to protect them? They have every reason to be concerned. They are not eligible for testing.

There are hundreds of people in this community that share these same stories. What is worse, knowing or not knowing? The level of fear and anxiety is the same for everyone living within this plume. Test or no test, system or no system.

Think about the scenarios I just mentioned. They are real. There are about 200 more homes in the area near the mapped plume that have TCE under them. They are not qualifying for testing or mitigation systems. The only way we can ensure the safety of the people in this designated area is to lower the acceptable levels of TCE vapor intrusion and vent their homes.

Based on this testimony I am here today asking that the EPA set a standard for TCE at nothing greater than .017 micrograms per cubic meter. It is your fiduciary duty to ensure that this community and every community nationwide be protected from vapor intrusion stemming from soil and groundwater contamination caused by industries that jeopardize our health and well being.

Alan Turnbull, Coordinator, Resident Action Group of Endicott (Edited by staff)

Some two years ago, my wife was diagnosed with squamous cell carcinoma, a cancer of the throat. Oncologists will never venture any statement as to its cause, but it is generally thought to have origins by inhalation of air or drinking of liquids (water). In an effort to determine what may have caused this illness, I began to ask questions from a multitude of sources, such as the Cancer Society, the NYS-DOH and private oncologists. Needless to say, I was confronted with more questions than answers. To my dismay, I found that there were no safe guidelines or standards that addressed residential indoor air standards for toxic intrusions. Therefore, safe guidelines and standards must be established to protect the citizenship of our community as well as other communities around the country. These guidelines and standards must be put into place as soon as possible to ensure productive and healthy lives for all.

It is crucial that a commission of scientists and medical personnel undertake extended studies for low-dose ingestion of toxins in humans without delay. Results of this toxic/human hypothesis of low-dose exposure must be made available to the general public at the earliest time frame possible.

Pressure should be placed on EPA to have their science committees present the lowest possible threshold level for remediation. While some scientists admit that any air/vapor TCE reading qualifies to institute remediation, we must not accept any guideline threshold level higher than .175 micrograms per cubic meter (a guideline of .017 micrograms per cubic meter would be preferable).

Remediation must be vigorously undertaken by any and all means at our disposal. However, mitigation via venting systems installed in homesteads is, at best, only a temporary “stopgap” measure.

Last, and most importantly, I request that the following be given serious consideration: That in order to expedite residential VOC/toxic testing by the NYS-DOH/NYS-DEC to determine toxicology levels:

Sub-slab testing alone be done to determine "hot spots" of TCE/PCE within a given area, and that a reasonable guideline be determined as a threshold of concern.

Readings over and above the established sub-slab threshold be scheduled for further comprehensive testing during the heating season.

As it now stands, a team of technicians must take an inventory of any and all items within a basement to remove anything that would possibly influence air sampling. This elimination process alone takes approximately four hours. Thus the team is able to test approximately two residences per day. However, by performing sub-slab sampling, approximately six houses could be accomplished per day. By reducing time, costs would likewise be reduced, and overall area testing would be accelerated.

Donna Lupardo, Resident Action Group of Endicott (Edited by staff)

The residents of the Village of Endicott and surrounding entities have been exposed to contaminants from multiple exposure routes including air pollution, contaminated drinking and bathing water, soil gas and vapor intrusion. Health studies need to take into consideration the combined effects of these various exposure routes. In looking at places like Endicott, there is a need to create models that take all of these routes into consideration.

As far back as 1989, reports were being published indicating that the IBM facility led the United States in chlorofluorocarbon emissions and other pollutants. Most of us here are interested in knowing what the current emission levels are from the plant; how the current ambient air is affected by hundreds of venting units; and what we can learn from historic air emission levels. After much delay, the Agency for Toxic Substances and Disease Registry (ATSDR) is now in the process of surveying residents to gather information about the historic pre-1987 air emission levels where there seems to be some kind of information gap.

We've now been witness to the evolution of the science of vapor intrusion. Communities around the state are grappling with the reality of this new exposure route. I join my friends in saying that we want the state to thoroughly examine the issue of putting in place stricter TCE air standards, which should be stricter than the current standard of five micrograms per cubic meter.

Many of these standards are set for adults over short exposure time periods. We're especially concerned that the standards also take into consideration young children who are more sensitive to contaminants of this kind.

I'd like to point your attention to something that our Press and Sun Bulletin reported back in August. They reported that water samples from a well installed in the IBM cafeteria building back in 1963 showed evidence of pollution in the bedrock 250 feet below the site, and evidence suggests industrial solvents may have reached a deep aquifer that feeds a network of wells along

the Susquehanna River Valley. Collectively, these wells serve at least 80,000 residents in Vestal, Johnson City and in Endicott. Obviously, there could be a potential need for more aggressive remediation efforts given the sheer number of people affected.

Finally, we are grateful that ATSDR has a mixtures work group investigating the water contamination issue. While we've been assured that there are low levels of various compounds in the water, what is not clear is what happens when these low levels interact with one another. Further scientific inquiry may show that such commingling of these contaminants represents a potential threat to public health.

Bruce K. Oldfield, Hillcrest Environmental Action Team (edited by staff)

I am a resident in Hillcrest, NY and part of a citizens' action group, the Hillcrest Environmental Action Team, HEAT.

In 1992, a discharge of TCE into a dry well at the former Singer-Link facility (now owned by CAE Electronics) was mapped, indicating movement of this material into the surrounding neighborhood. Since then, TCE has spread throughout portions of the residential area and even shows up in a monitoring well 1700 feet from the source, on a direct path towards our drinking water well field.

Recently, the DEC began monitoring TCE levels in our homes. Levels above 5 micrograms/cubic meter were discovered. I had been following a similar problem in Endicott and was told that the standard for mitigation there was 0.22 micrograms/cubic meter. In Endicott, just under 500 homes were vented. In Hillcrest, only three homes were vented, although many more were above the .22 micrograms/cubic meter action level used in Endicott.

The EPA proposed guideline for TCE in residential buildings is 0.017 micrograms/cubic meter. This is roughly 300 times lower, that is, more stringent, than the standard set by New York's DOH. Although the DOH acknowledges the range of estimates for TCE (for one excess cancer per million persons) is 0.2 to 4 micrograms/cubic meter, our standard was set arbitrarily higher at 5 micrograms/cubic meter. The orders of magnitude difference between the provisional EPA standard and DOH standard concerns me and many of my fellow residents.

I am also concerned that the venting of TCE from the sub-slab of our homes is moving the pollutant from one area to the next. When temperature inversions form in these valleys, the air that we are venting from the ground is trapped in the valley, so not only are we breathing it in our homes, we are breathing it in the outdoor air also. We find this unacceptable.

I would like the NYS Assembly to consider using its influence on the NYS Department of Health to change the NYS standards for TCE in our homes to match the EPA provisional guidelines. I would also like to see outdoor air standards set that are going to insure that breathing this air is safe for our children.

Debra Hall, Hopewell Junction Citizens for Clean Water

All I know is that living in the United States, paying my taxes and living an honest life, the least my family and I deserve is clean air to breath and clean water to drink. Imagine knowing that your water and air are contaminated. You go to the health agencies, the so called experts, who are there to help you. But instead of getting the help you need, you get untruths and false information. And then you ask why? Is it financial? Is it that if the person tells you what they know, they will get in trouble? Is it that they really do not know?

Whatever the reason is, my family should not be at risk of getting cancer or some other deadly disease. I see it all around me, so many sick people, especially children. It has been known that my site was contaminated since 1979, but the correct investigation never took place. The Hopewell Junction Citizens for Clean Water ask to stop making us victims. Give us air standards that will protect us. It can be done. It's possible. No more excuses. The technology is here. It's only common sense that this issue gets dealt with correctly and morally.

Philip J. Landrigan, M.D., M.P.P, Director, Center for Children's Health and the Environment, Mount Sinai School of Medicine
and
Leonardo Trasande, M.D., M.S., Assistant Director, Center for Children's Health and the Environment, Mount Sinai School of Medicine (Edited by staff)

TCE is an organic chemical that has been used for dry cleaning, metal degreasing and as a solvent for oils and resins. It evaporates easily in the open air but can stay in the soil and groundwater for years afterwards. In the body, TCE may break down into multiple other chemicals such as dichloroacetic acid, trichloroacetic acid, chloral hydrate, and 2-chloroacetaldehyde. These products have been shown to be toxic to animals and are probably toxic to humans, especially young children with developing bodies.

The most well-studied and significant health effect of TCE is its link to cancer. Studies of workers exposed to TCE are sometimes complicated to interpret because many of these workers are exposed to other solvents that also can cause health effects. However, TCE has been found to cause cancer in both mice and rats, which suggests that it also causes cancer in humans. The World Health Organization has classified TCE as a Class IIA carcinogen, meaning that TCE is probably carcinogenic to humans. The EPA has also stated that TCE may have the potential to cause cancer in humans, and has set a maximum contaminant level for TCE of five parts per million in drinking water.

Other effects that can result from heavy TCE exposure include damage to the liver, kidneys, gastrointestinal system and skin. TCE has been linked to birth defects. Chronic exposure to TCE can also affect the human central nervous system. Case reports of intermediate and chronic occupational exposures included effects such as dizziness, headache, sleepiness, nausea, confusion, blurred vision, facial numbness and weakness.

For all of these reasons, all occupational exposures to TCE should be thoroughly investigated. Not only do the workers who have been exposed to TCE deserve to know the potential health

effects they have suffered, but further research into the health effects of TCE will help clarify important questions that remain about its health effects.

In addition, we also need to consider the effects of TCE contamination on people in the broader community. For example, children are especially vulnerable to the health effects of TCE, just as they are to many other chemicals. The health and economic consequences of children's present-day exposures to environmental toxicants will be experienced by our society throughout much of the 21st century.

Unfortunately, we have learned this lesson the hard way, in part because of exposures to chemicals such as TCE. A very high rate of childhood cancers in Toms River, New Jersey was found to be linked to the amount of drinking water that women ingested during their pregnancies. Even though the water was never found to have levels higher than EPA's contamination standard for TCE, the researchers' analysis demonstrated that exposure to TCE in the fetus was associated with cancer, especially leukemia, in these children. The epidemiologists who studied this cluster of cancer suggested that the developing fetus might be especially vulnerable to TCE and other chemicals that were found in the drinking water in Toms River. As the exposure to TCE was removed, researchers found that the cancer rates in Toms River decreased significantly.

One way to prevent and treat children's exposures to environmental contaminants, such as TCE, is through the development of a statewide system of Children's Environmental Health Centers of Excellence.

David Ozonoff, M.D., M.P.H., Professor of Environmental Health, Boston University School of Public Health (Edited by staff)

I have had a long interest in the health effects of the chlorinated ethylenes TCE and its very close relative, tetrachloroethylene (PCE), and have authored numerous peer-reviewed epidemiological studies on these chemicals. TCE has been implicated in at least four kinds of adverse health effects: effects on the central nervous system; cancer; birth defects; and autoimmune disease, such as lupus. For historical reasons and force of circumstance, much of our knowledge of the effects of TCE are based on occupational exposures. While it is not easy to determine what effects might be expected, if any, at the substantially lower levels normally encountered from vapor intrusion, I am concerned about effects even at these levels for two main reasons.

First, we have been studying the effects of TCE in drinking water for almost 15 years and have seen substantial increased cancer risks at exposures orders of magnitude lower than occupational exposures. Residential exposures to drinking water come from a combination of ingestion, inhalation (from air stripping) and dermal absorption, with the latter two being of roughly the same order of magnitude as ingestion. The current maximum contaminant limit (MCL) for drinking water is 5 micrograms per liter. This corresponds (roughly) to an indoor air exposure of 1 microgram per cubic meter of air. The MCL is an old standard based on outdated cancer estimates. Thus, the level of 5 micrograms per cubic meter proposed by the NYS DOH is not consistent with the current (now fairly old) water standard.

In addition, there is reason to believe that the exposure level corresponding to an excess cancer risk of one-in-one million is considerably lower than previously thought. To be health protective one normally chooses the most conservative estimates. Considerable uncertainty in the correct parameter estimates for important physiological processes, like the rate of absorption between species, can lead to very large differences in dose-response modeling. W.J. Cronin and colleagues use Monte Carlo analysis in conjunction with physiologically-based pharmacokinetic (PBPK) modeling to determine the impact of different parameter values on estimates of the risks posed by TCE. There is a wide range of legitimate estimates using PBPK models when coupled with the linearized multistage model used by DOH. Cronin, for example, has estimates as low as 0.02 micrograms per cubic meter as the one in one million risk for TCE in air.

The choice of a linearized multistage model, as used by DOH, is not the only possible choice, and choosing a different biologically plausible model can result in a large variation in estimated risks. C.R. Cothern and colleagues investigated the variations between four different dose-response function models, including the model chosen by DOH. The difference in estimated risks among the models was almost a factor of 10,000, i.e. the most protective model (the Weibull model) predicted risks from TCE in drinking water to be 10,000 times higher than the risks from the least protective model (the multistage model chosen by DOH). There are no biologically based criteria for choosing one model over another.

My second concern is that adverse health effects can be expected to result from extremely tiny exposures where some kind of biological amplification of damage occurs. The classic example is cancer, where a tiny alteration in DNA makes a cell into a cancer cell. The original damage is biologically reproduced and the offending tiny amount of chemical no longer need be present. This is essentially the reason we believe there is some cancer risk at every level of exposure.

There are other biological systems where such intrinsic amplification might be expected, including the immune system (e.g. bee stings and the dramatic, sometimes fatal effect of tiny exposures); the nervous system (where tiny signals are amplified into large responses); and human reproduction (where an entire organism comes from a single fertilized egg). Thus the health effects seen in occupational environments are plausibly present, although at a much lesser frequency, at much lower exposures as well.

Daniel Wartenberg, Ph.D., M.S., Director, Division of Environmental Epidemiology, Robert Wood Johnson Medical School (Edited by staff)

I have been studying the health effects of TCE for about 8 years and am increasingly concerned about the likely carcinogenicity of TCE and its impact on the health of those exposed to even low levels of this chemical.

In 1997, I was awarded a grant by the EPA to evaluate the epidemiologic evidence for making inferences of cancer hazards and risks for exposure to TCE. With colleagues, I conducted a detailed review of more than 80 relevant scientific publications. We concluded that evidence of excess cancer rates among occupational cohorts with the most rigorous exposure assessment is found for kidney cancer, liver cancer, non-Hodgkin's lymphoma, cervical cancer, Hodgkin's disease and multiple myeloma. In 2000, I again summarized the data and made similar

conclusions. One notable report published since my review in 2000, was on a new cohort in Denmark that uses measures of biological material to document exposure to TCE. In general, the results of that study provided additional support for the findings we presented in 2000, which suggested that TCE exposure causes cancer in humans.

I acknowledge the limitations of some of these studies, and imprecision of the assessments of exposures, but I believe that the evidence points strongly towards carcinogenicity and that we should err on the side of overprotection rather than under protection. On the basis of the available evidence, I urge you to limit exposures to the minimum amounts reasonably achievable. In short, based on the evidence, we believe that TCE should be considered a human carcinogen until proven otherwise.

In general, any exposure to a carcinogen increases an individual's risk of developing cancer. Therefore, on the basis of the available evidence, and in the interest of preventing unnecessary cases of cancer, I urge you to limit exposures to the minimum amounts reasonably achievable. Because the studies conducted did not collect sufficient data on length and magnitude of exposures for rigorous modeling of the likely carcinogen, we should err on the side of overprotection rather than under protection. In addition, the research on other outcomes is somewhat limited, again suggesting the need for more stringent rather than less stringent exposure limits.

APPENDIX B.1 – ITHACA HEARING NOTICE

ASSEMBLY STANDING COMMITTEE ON ENVIRONMENTAL CONSERVATION

NOTICE OF PUBLIC HEARING
Oral Testimony by Invitation Only

SUBJECT: Vaporization of contamination from soil and groundwater into indoor air

PURPOSE: To examine the human health impact of vapor intrusion stemming from soil and groundwater contamination

ITHACA
Thursday, April 21, 2005
10:30 a.m.
Shirley A. Raffensperger Meeting Room
Town Hall
215 North Tioga Street
Ithaca, NY

Contamination of indoor air by volatile chemicals from contaminated soil and groundwater is an emerging area of public health concern. Vapor intrusion is known to have occurred at Superfund sites in New York State and has occurred at brownfield sites as well. While the New York State Department of Environmental Conservation and the Department of Health, as well as the United States Environmental Protection Agency, have issued draft guidance pertaining to various aspects of vapor intrusion, none of these agencies have issued final guidance.

Chapter 1 of the Laws of 2003 established the Brownfield Cleanup Program (BCP) as well as refinancing the State Superfund program and providing for a comprehensive program for the long-term restoration of groundwater. The BCP requires, at all brownfield sites, the "elimination of volatilization into buildings: provided however if such elimination is not feasible such exposure shall be eliminated to the greatest extent feasible." Vapor intrusion should be considered in remediation of all contaminated sites.

The purpose of this hearing, the second in a series, is to examine issues concerning the vaporization of contamination and to determine what can be learned to address vapor intrusion in the future. The Committee will take testimony from various witnesses including panels of government officials, public health and environmental experts and citizens representing affected communities.

Oral testimony will be accepted by invitation only and limited to 5 minutes duration. 10 copies of any prepared testimony should be submitted at the hearing registration desk. The Committee would appreciate advance receipt of prepared statements. Written testimony will also be accepted and may be sent to the contact person listed on the reply form. In order to further publicize the hearing, please inform interested parties of the Committee's interest in receiving written testimony from all sources.

In order to meet the needs of those who may have a disability, the Assembly, in accordance with its policy of non-discrimination on the basis of disability, as well as the 1990 Americans with Disabilities Act (ADA), has made its facilities and services available to all individuals with disabilities. For individuals with disabilities, accommodations will be provided, upon reasonable request, to afford such individuals access and admission to Assembly facilities and activities.

APPENDIX B.2 – ITHACA WITNESS LIST

ASSEMBLY STANDING COMMITTEE ON ENVIRONMENTAL CONSERVATION

Public Hearing on Vaporization of Contamination from Soil and Groundwater into Indoor Air

Thursday, April 21, 2005, 10:30 a.m.
Shirley A. Raffensperger Meeting Room
Town Hall, 215 North Tioga Street
Ithaca, NY

WITNESS LIST

Honorable Carolyn Peterson, Mayor
City of Ithaca

PANEL

Carl Johnson, Deputy Commissioner
Office of Air and Waste Management
New York State Department of Environmental Conservation

G. Anders Carlson, Director
Division of Environmental Health Investigation
New York State Department of Health

PANEL

Tammo S. Steenhuis, Ph.D
Professor of Hydrology
Cornell University

James W. Gillett, Ph.D
Professor of Ecotoxicology
Cornell University

James A. Dix, Ph.D
Associate Professor, Department of Chemistry
State University of New York at Binghamton

PANEL

Jutta Dotterweich
Ithaca Coal Tar Advisory Committee

Ken Deschere, Local Citizen

Timothy Weber, Local Citizen

Janet Snoyer, Local Citizen

Rick Grossman, Local Citizen

PANEL

Kenneth S. Kamlet, Director of Legal Affairs
Newman Development Group, L.L.C.

Walter Hang, President
Toxics Targeting, Inc.

APPENDIX B.3 - SUMMARY OF TESTIMONY, ITHACA HEARING

*Copies of written testimony may be obtained by contacting the Committee.

Honorable Carolyn Peterson, Mayor, City of Ithaca

As a result of concern over contamination from the Emerson Power Transmission site, the city of Ithaca became involved in the issue about a year ago. In addition to written communication to DEC, EPA, and DOH, we also conducted our own sampling of soil and groundwater on Spencer Street where new road construction was occurring and on South Cayuga Street where road reconstruction was occurring. The city was, at this early stage, concerned about exposing neighboring residents and city workers to dangerous vapors through soil disruption. The city, at its own expense, undertook this testing in an effort to protect the residents and our employees.

Although I do not have expertise in the science of vaporization of contamination, I do have expertise on how contamination and its proposed remediation can and does affect a community. I can address the strength of the feeling regarding the elimination of contamination and the frustration that many residents share regarding waiting for the science before cleanup occurs. I cannot over emphasize the worry and fear that some of our residents have been living with for months and months. Because two of the tenets of good health include clean water and clean air, especially in one's private home, it is understandable that the highest level of cleanup is desired.

I believe that while you are examining the human health impacts, the psychological stress and duress experienced by residents should weigh equally with physical symptoms. Consideration should be given regarding the balance of waiting for the exact science and the very real stresses on the residents who are waiting out the process. In other words, mental health is also a human health impact and takes its toll as well. Performing a more general and faster cleanup than such a precisely targeted one could be a solution. At the same time, the highest level of cleanup should be expected.

The elected city representatives are often the first people that resident's turn to when there is concern about an issue. We are asked to advocate for the residents, to assist residents who are trying to get information from the state, and to assist in expediting contact with offices such as the DEC and DOH. I want to stress that the local government is very much a part of the remediation process. The local government is more easily accessible to the citizens and takes a direct role in helping citizens sort out the issues or contact other officials.

This contamination has required inordinate hours of work and expense from our citizens, as well as from local government officials and employees. We look to the state for clear accessible lines of communication, a speedy remediation, and the highest level of cleanup of the air that people breathe in their own homes. The residents should not have to bear the physical price of breathing contaminated air.

Carl Johnson, Deputy Commissioner, Office of Air and Waste Management, NYS Department of Environmental Conservation

Historically, we thought that vapor intrusion was only an issue where the source of the contaminants was very shallow and the magnitude of the contamination was very great. We now know that our previous assumptions about the mechanisms that could lead to exposure to vapor intrusion were not complete. The result is that additional work may be required to investigate or remediate sites that are in the operational or monitoring phase, or that have already been closed.

The department has developed a document, "Evaluating the Potential for Vapor Intrusion at Past, Present, and Future Sites," which describes the conditions under which the state will conduct vapor intrusion evaluations, and the order in which sites will be addressed. At remedial sites where there are ongoing environmental investigations, we will evaluate the vapor intrusion pathway as part of the remedial investigation. At legacy sites where remedial decisions have already been made which do not address vapor intrusion, we will use various criteria to re-evaluate and rank the sites for the likelihood of current or potential exposures. Because the number of sites at which evaluations for vapor intrusion are expected to be made is quite large, sites where the perceived likelihood of exposure is great will be scheduled for vapor intrusion evaluations sooner than sites where the perceived likelihood of exposure is small.

We should complete our initial site characterization work to prioritize all the legacy sites by December 2006. We expect to commence field work before the beginning of the next heating season. Although some field work, such as soil gas sampling, will begin in the summer, indoor sampling cannot begin until October, when the heating season starts.

The department's evaluation of a vapor intrusion pathway at a specific site will initially involve a review of existing environmental data to see if sufficient information is already available to assess possible vapor impacts. If a vapor intrusion problem is suspected, we may recommend additional sampling, monitoring or mitigation actions. Additional sampling would be used to determine the extent of soil vapor contamination and to verify our initial findings. Monitoring, or sampling on a recurring basis, is typically conducted if there is a significant potential for vapor intrusion to occur if building conditions change. Mitigation steps are intended to prevent exposures associated with soil vapor intrusion. Mitigation may include sealing cracks in the building's foundation; adjusting the building's heating, ventilation, or air-conditioning system to maintain a positive pressure to prevent infiltration of subsurface vapors; or installing a sub-slab depressurization system beneath the building.

Because the state's decisions on mitigation measures will vary from site to site, it may appear that we are applying our vapor intrusion policy and guidance inconsistently. In reality, however, decisions on how to address exposure to vapor intrusion will be made on a site-by-site basis, after a comprehensive review of individual subsurface vapor, indoor air and outdoor air sampling results, and after consideration of additional site-specific parameters, such as sources of volatile chemicals, background levels, and applicable guidelines for volatile chemicals in the air. This is the most appropriate approach to ensure the protection of public health.

Andy Carlson, Director, Division of Environmental Health Investigation, NYS Department of Health

The department's draft "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" is intended to provide a scientifically sound and consistent basis for investigating and remediating vapor intrusion. The general approach is consistent with the process and methods used for investigating any environmental contamination.

DOH has developed air guidelines/criteria for several contaminants, including trichloroethene (TCE). The TCE guideline (5 mcg/m^3) was established after an extensive evaluation of scientific information about its health effects, using methods consistent with those used by other agencies and scientific bodies. We are committed to an expert peer review process for the TCE guideline. We anticipate having a twelve-member panel with a balanced selection from each of the four interest areas: business/industry organizations, public health organizations, other governmental agencies, and citizen groups. We are close to completing the TCE technical document that the scientists will be reviewing, which will be available to the public. Based on the comments from the peer review, we will revise our assessment, including re-evaluating our guideline.

At brownfields, or inactive hazardous waste sites, the air guidelines developed by DOH will be one part of the decision making process used in determining what actions may be required. However, these guidelines are not "bright lines" that define a decision point to mitigate or not mitigate. There have been, and will be in the future, many instances where mitigation systems are installed at levels well below the guideline for the chemical of concern.

DOH has developed two matrices to use as tools in making decisions. The first was originally developed for TCE and the second matrix was originally developed for PCE. Because the matrices are risk management tools and consider a number of factors, DOH intends to assign other chemicals to one of these two matrices, as appropriate. Additional matrices will be developed when a chemical's toxicological properties, background concentrations, or analytical capabilities suggest that major revisions are needed.

The matrices explicitly consider the relationship between indoor air concentrations and sub-slab vapor concentrations, but decisions based on the guidance they provide must consider specific and general aspects of a site or area under investigation. Such considerations may include the nature of the source, the local geology, foundation and building characteristics, indoor and ambient sources and the status of adjacent buildings. We feel that sub-slab concentration is important, because it represents the source where the contamination is coming from. If the concentration in the source is high, but there are low levels in the home, we still feel the need to respond to that, because we can't always be there and know whether or not that source is changing and is getting into the home. That's why the matrix is constructed the way it is—to give us the ability to make decisions site by site, and within the context of the total environment of the source. Based on the relationship between sub-slab vapor concentrations and corresponding indoor air concentrations, the following actions may be recommended: no further action, take reasonable and practical actions to identify source(s) and reduce exposures, monitor or mitigate.

Region 2 of the U.S. EPA uses a very similar matrix. There have, however, been many reports that Region 2 uses a cleanup number for TCE of .38 mcg/m^3. Region 2 found at a particular site that it was more efficient to install vapor mitigation systems than to carry out long-term monitoring, and that when the systems were installed they could expect to achieve levels in the indoor air below the analytical detection limit of .38 mcg/m^3. This number was then stated by the Region 2 program staff as the cleanup goal for the site. The number has come to be commonly reported as the Region 2 response level, leading people to believe that the EPA sets out and responds to anything over their detection limit. This is not the case. Like the state, Region 2 makes its decisions on a case-by-case basis, taking sub-slab concentrations into account.

In a few of the places around the state where we have been working with responsible parties, they are choosing, based on their interpretation of whatever elements they might consider (i.e. costs, liability, community outreach), to install a system wherever they find contamination. An obvious up side of this is that where you have the potential and you mitigate it, you've eliminated the potential.

In addition to environmental investigations and remedial actions, DOH also considers the need to review health outcome data for past or ongoing exposures. The studies that are easiest to conduct use readily available health data to compare health outcome rates in a community with a possible exposure to those of the general population using statewide or national rates. While these types of studies cannot prove whether or not the disease was caused by a particular exposure, they can be useful in identifying communities where a more complex study might be necessary.

The use of a registry is another option. In 1999, DOH established the New York State Volatile Organic Compounds (VOC) Exposure Registry as a tool for health status assessment and long-term follow-up for communities and individuals with documented exposures to VOCs. Individuals and communities are selected for inclusion in the registry if potential exposures from contaminated private wells, public water supplies, or indoor air have been verified by sampling results.

Tammo Steenhuis, Professor, Department of Biological and Environmental Engineering, Cornell University
Lawrence Cathles, Professor, Department of Earth and Atmospheric Sciences, Cornell University

The South Hill area in Ithaca is a unique and complex environment. The hillside consists of some topsoil, soft shale, and hard shale with many cracks (joints). Science tells us that pollutants from the Emerson plant will travel down the hill through the cracks in the shale. However, science cannot predict the exact paths that will be traveled. Ground penetrating radar might be the best way to find dense, non-aqueous phase liquids (DNAPLs) such as TCE and PCE, but will not be effective in finding all the accumulations that can be in almost any crack or pocket in the bedrock. In addition, the radar penetrates only a few meters.

The current testing of both groundwater and indoor air quality is a good start, but it is limited in extent and may not define the location of all the DNAPLs. Indoor air quality can be highly variable and a 24-hour sample is not necessarily a good indication of the long-term exposure.

Even if and when the extent and severity of the pollution is defined, complete cleanup would be an unrealistic and probably undesirable goal. Digging all the soft shale below the Emerson plant would take years to accomplish, destroy the neighborhood, and would likely be ineffective.

We recommend that steps be taken to decrease the anxiety level of the home owners. For instance, each home that could be potentially affected should be mitigated with a basement ventilation system. Money is better spent on mitigation than on extensive air sampling and analysis (at approximately $1,000 per sample). A few of these houses should be monitored to assure that the mitigation is functioning. There should also be a guarantee that houses can be sold at fair market value. The differences between the actual selling price and the fair market value should be made up.

We also recommend that steps be taken to prevent further contamination. All future spills should be prevented by cleaning up all potential sources at the Emerson plant. This will require cooperation and openness.

James Gillett, Professor of Ecotoxicology, Cornell University

The study of the phenomenon of vapor intrusion has revealed effective means of controlling residential exposures to diverse materials. While this approach does not do very much about the source of such intrusion, understanding the physicochemical processes enables decisive intervention. Such an understanding has been fully established, in spite of the so-called cryptic nature of the flow of intrusive materials via the cracks and crannies of soil and rock layers, various basement materials, diverse ways of using the space in households which create temperature and pressure gradients favoring intrusion, and many other activities introducing these same agents into residences. Thus, as a practical matter, we know how to respond to reduce any suspected risk even though we can't always permanently eliminate all sources.

Gases of volatile chemicals tend to absorb to soil organic matter and even clay particles. If capillaries in the soil are dry and are not warmed, then the chemicals will stay right there. If the capillaries are wetted, however, as by rising water levels, then that vapor can be forced off the capillary walls by the thousands of water molecules binding to the same sites. The displaced vapor moves up the soil capillary and sorbs to the next dry zone. But if rain is falling and the soil is saturated, some will stay on the organic matter and a small amount may dissolve. As soon as the soil dries sufficiently, those molecules will find their way back. Over time, however, materials can move quite a distance, moving up and down with the water table, saturated pore flow, and vapor distribution. This whole process is called the "wick effect," because it works like the wick of a candle to bring fuel to the flame.

When vapors in the soil approach the floor or walls of a basement—whether they are poured concrete, cinder block, or rocks—the tiny cracks and pores in these materials create similar pathways for these vapors to slowly seep into the house.

The vapor intrusion process takes time. Therefore, the measurement of it must be time-averaged on a basis which takes into account all the variations in the pathways into the residence and the intermittent use of closed or semi-closed areas in which the intrusion might build up. If you've done a radon survey, then you know that it takes weeks to accumulate a representative sample. It is not much different with TCE, chlordane or petroleum solvents. Moreover, our concern is with the duration and strength of a chronic exposure, typically as some major fraction of a lifetime, at the low doses typically encountered in intrusive episodes.

Many of the intrusions are of chemicals which don't alert us by smell and may not make us perceptibly ill. Still, they can create risks of cancer and other ill effects. So when intrusion is suspected, we often try to set up extensive (and expensive) monitoring programs. I would argue that, given what we already know about the variability of such exposures and the difficulty in locating the actual pathways by which these pollutants are traveling, we are far better off simply working on establishing fast and simple protection programs against the intrusion. These usually take the form of sub-slab vapor removal by venting, sealing of slab and wall surfaces with quality epoxy paint, and otherwise blocking vapor entry at French drains, slab cracks, etc.

For the most part, retrofitting housing to prevent the wick effect is easier than changing building codes or mobilizing the community to remove all the sources, which isn't very easy. Many of the

subject chemicals of concern still have uses which may bring them into some households by other routes on an irregular basis. These are being reduced, but not eliminated.

James Dix, Chemistry Professor, Binghamton University
Bruce Oldfield, Professor of Engineering Science, Broome Community College

I have a somewhat unique perspective on the environmental issues surrounding our legacy of unbridled industrial expansion of the last century. Living on top of a toxic plume in Endicott, NY, I have a vested interest in vapor intrusion, and given my scientific background, I'm able to delve into the technical minutiae associated with vapor intrusion.

Today I'd like to give my comments on the ambient air monitoring and modeling plan recently accepted by DEC to measure the concentrations of eleven VOCs in Endicott's air. We are generally impressed with the technical aspects of the monitoring and modeling plan. However, we do have some questions. For example, why is the downtown Endicott area designated rural for the purposes of the study? Why is the meteorological data used in the study from the airport, eight miles away, rather than from a more central location? Despite these questions, we believe the plan is a good template for Endicott and for other areas in New York State, such as the Ithaca area, that are plagued by VOCs in the air.

If one looks at the data from ambient air sampling collected two years ago as posted on the DEC web site, one can do a "back-of-the-envelope" calculation to conclude that the VOC concentration in ambient air from soil gas emission plus that from sub-slab ventilation will be low. But a low concentration is not synonymous with a safe concentration. We are pleased that DOH is reviewing its guideline of 5 mcg/m^3 for TCE, one of the VOCs. We believe that this level is too high, and that the level should be much lower. We are not alone in this belief. Nearly four years ago, EPA's own scientists, based on a thorough review of recent scientific literature and an acknowledgement of susceptible populations, recommended a level more than an order of magnitude below 5 mcg/m^3.

Why is there still no TCE guideline concentration from EPA and probably won't be one for years to come? In my view, one major factor is that Federal government entities have improperly interfered with the scientific review process. New York State can do better than that. There is a time for politics, but that time is not the time when, for example, one designs scientific studies and collects data on VOCs in ambient air, or when one reviews studies published in peer-reviewed scientific journals.

The history of New York government agencies' involvement in the Southern Tier's bout with VOCs is checkered. The Endicott plume was misclassified by DEC as a Class 4 site for years. EPA Region II, driven by health concerns, mitigated in East Fishkill when there was any detectable indoor TCE level, while DOH mitigated in the Southern Tier at the much higher level of 5 mcg/m^3, claiming EPA's East Fishkill mitigation at any detectable level was driven by economics.

It's time to get this right. We are going in the right direction with the ambient air monitoring and modeling study in Endicott. Let's stay the course.

Jutta Dotterweich, Ithaca Coal Tar Advisory Committee

I am speaking as an Ithaca resident and a member of the Coal Tar Advisory Committee. I would like to focus my remarks on concerns related to the public notification and participation process.

In 1994, NYSEG was named as the responsible party for the cleanup of the contamination at the former gas manufacturing plant operated by the Ithaca Gas and Light Company. A consent decree signed between NYSEG and the DEC outlines a public participation which basically assures that the public is informed at certain times during the cleanup or remediation process and is given time to respond to completed reports and proposed actions. Despite this participation plan, the public, and the neighborhood in particular, was largely unaware of the extent of contamination at the site until 2000. In that year, NYSEG began vacuuming several subsurface containment structures on the original plant site, at which point residents were able to smell the obnoxious odor of coal tar throughout the neighborhood. The lack of notification about the cleanup process and subsequent complaints resulted in a meeting in 2001 between residents, NYSEG, DEC, and DOH. The agencies agreed to a better notification process.

After this initial meeting, residents became very concerned about the extent of the contamination and whether or not it was getting into homes, and what health risks were connected with such exposure. Residents formed the Coal Tar Advisory Committee in 2002 with the goal to get involved and ensure that the cleanup was done properly and comprehensively. Residents asked questions about such issues as cleanup standards, health risks, testing instruments and cleanup methods. In public meetings, answers to those questions remained vague at best. It appeared that NYSEG, DEC, and DOH had already decided upon and mapped out what the plan of action was going to be. The questions we raised did not fit in.

In 2002 and 2003, as part of the remedial investigation, houses and other buildings along the original site were tested for indoor vapors. Complaints came in right away: the notification was insufficient; agents did not have the protocol available; homeowners were not prepared for the inspection; the screening device was not sensitive enough. Improvements were made in a second round of indoor testing: advanced notification including written step-by-step protocol; CTAC endorsed testing encouraging homeowners to participate and how to prepare for it; the use of more sensitive equipment; and the testing of more houses.

The role of DEC and DOH as public monitoring agents has been problematic. Although it has improved over time, we have relied on outside experts, lawyers, and political representatives to make sure that our interests are represented. Based on our experience, I recommend that DEC and DOH rethink and restructure the public participation process—it might be helpful to set up meetings for neighborhood groups and DEC/DOH without the corporation that is responsible for the cleanup, in addition to regular public meetings. I also recommend that DEC and DOH provide more public information and education on contamination sources, pathways, cleanup methods, cleanup standards and health risks. This requires that they translate technical concepts. Furthermore, the public should have real input on the scope of the investigation and remedial action—connecting with an established neighborhood group or association might be an effective strategy to engage the neighborhood from the beginning. Finally, New York State should invest in studies that establish clearer connections between industrial contamination and health risks.

Ken Deschere, Ithaca Resident

I am a resident of the City of Ithaca and have lived about two blocks downhill from the Emerson site for the last 24 years. For about 20 of those years, I worked on computers in an office in the basement of our home. My wife and I brought two sons, now 22 and 20, into this house as newborns. They had a large playroom in the basement.

In October 2003 I was diagnosed with a Stage IV squamous cell cancer. After three surgeries within 15 days, followed by two months of lengthy sessions of radiation, I have recovered enough to resume part-time work and begin exercising to restore my strength and energy. The doctors could not identify a likely cause for my cancer—it was listed simply as "of unknown origin."

In the spring of 2004, our neighborhood became aware of the high levels of TCE and other toxins present at the Emerson plant site. Through research, and with the cooperation of local officials, we found that Emerson had failed to abide by the terms of the 1994 Record of Decision regarding the toxic pollution found on their site. We also found that DEC had failed to properly monitor Emerson's activities in this regard.

At the public information session conducted by DEC, DOH, and Emerson last August, we asked the Emerson representatives present to include our home among those to be tested for toxins and indoor air quality. We signed Emerson's Access Agreement at that time, authorizing them to perform the tests, but our home was not among those selected for the first round of tests, which were performed late in 2004.

Our home was among the very few added for the second phase of tests, and we were tested on February 10 and 11. Nine weeks later, the results of those tests still have not been made available to us. The reason for the delay is unclear. What is clear is that we still don't know what toxins may be present in our home—eight months after the initial meeting and a year after the issue returned to public view. The many people who live in the shadow of the 90-acre Emerson site whose homes have not yet been tested also don't know about the safety of their homes.

We understand that testing and monitoring take time. However, this slow pace is adding to the anxieties in our neighborhood and to the frustrations of those of us who want to know to what level of toxins we, our children, neighbors, and friends, have been exposed.

The slow pace extends to DEC's response to information requests as well. On March 17, we faxed a FOIL request for a copy of a letter DEC had made public at the March 3 information meeting held here in Ithaca. Over a month later, we have yet to receive a copy of the letter we requested.

Both Emerson and DEC have failed to provide the timely answers our neighborhood's residents deserve. I respectfully ask this committee to pressure all parties involved to speed up their efforts, perform meaningful tests, and to provide proper and timely remediation.

Timothy Weber, Ithaca Resident

At present, indoor air testing is the standard way to test for vapor intrusion. For residents, the first concern is getting one's own home tested and obtaining the results. If the tests are positive (contaminants are found), mitigation if offered. If the test results are negative (contaminants are not found, or are found at levels below the remediation thresholds), mitigation is not offered. However, due to the unpredictable nature of subsurface contaminant movement – especially given the particular geology of the Emerson site – a negative result does not necessarily indicate that a property is under no risk of vapor intrusion, or that it could not be at risk in a different season, under different weather conditions, or even on a different day.

Residents need to come to the best understanding they can of the risks, options and costs, to make their own decisions as to the proper course of action. So, in the context of the process as it stands, it is essential that residents know where their homes sit geographically in relation to the pattern of contamination. The state agencies recognize residents' need to understand the spatial distribution of test results. However, the DEC/DOH's privacy policy requires that data points be anonymized – that is, full test results are provided to property owners, but publicly presented test results must not be identifiable to an individual property. So, the DEC presents to the public a map with the following features to help anonymize the values: instead of a city map, a satellite photo is used, with the test region painted over in a flat color; properties are assigned arbitrary numbers instead of addresses; and test values are presented as numbers in boxes, so it's visually difficult to relate them to their origins. DEC also randomizes the location of the result points by moving them or exchanging them with neighboring points. So, if the viewer does pick out a property, it might really be located down the block from the point indicated.

This does effectively anonymize the data. But the question is whether it still allows us to understand the spatial relationships and patterns. In our case, a representative from the DEC presented this map at a public meeting and said "As you can see, there's no discernible pattern." It's certainly true that it's difficult to discern a pattern from this map. But does that mean there is no spatial pattern in the data?

In order to find out, my neighbors and I asked property owners in the test area to voluntarily contribute their results to a public database. By the time of this writing, we've collected more than half the total results in this way. I have constructed a map of those results, without the anonymization the DEC is required to do. To many residents, this map does present a discernible pattern. The pattern appears to point to an area of the site that, to our knowledge, hasn't received attention so far. The mitigation efforts performed so far at the Emerson site itself have centered around the fire reservoir. While the non-anonymized map does suggest some involvement from that part of the site, the R&D lab appears to be much more significantly related to the pattern of contamination.

I conclude that the agencies' privacy policy is, at least in our case, preventing residents from adequately assessing the test results to meet our needs. This is a significant cost. The benefits of the privacy policy, if any, must be measured against that cost, and I believe it's imperative that a better solution is found.

Janet Snoyer, Ithaca Resident

Since June of 2004, my residential community has relied on information provided by DEC and Emerson. Since the first round of testing, I have experienced a progressive shutdown in communication. People who live in communities where there is any chance of vapor intrusion in their homes need information. We are getting information filtered through a lot of self-protective lenses at this point, making the information itself seriously distorted, and we cannot use it to protect our own self-interest. One example of poorly communicated information is the DEC site map, where privacy rationale prevented us from detecting a pattern to indoor test results.

After the indoor air in my home was tested, and high levels of contamination were found, I was offered a mitigation system, which was installed in January 2005. Since the installation of the remediation system, much has gone wrong. For five weeks I have had standing water in my basement for the first time in 21 years. In addition, the fan that provides the vacuum to pull the vapors out from the house has failed after only three months and needs to be replaced. I cannot help but wonder: why did it fail so soon?

Economists have studied the effect of chemical contamination on property values. Housing prices go down and, until the contamination is cleaned up, they stay down. Will any potential economic impact be reflected in an overall NYS assessment of the problem of vapor intrusion?

People don't want to raise families in these houses. They are most likely to sell to people who want to rent them out to others. We have disclosure laws that require me to inform a potential buyer of what I know about contamination problems with the house, but is a landlord required to inform tenants?

I have a 24-year-old daughter. I bought the house when she was three, and she began preschool. Throughout elementary and middle school, her academic reports and evaluations repeated the same theme: smart girl, poor student—although she wants to, it seems she cannot focus, cannot concentrate, does not listen, does not complete assignments, is very slow at her work. In the summer between ninth and tenth grade, she told me that she couldn't continue to participate in school this way, that she loved her artistic pursuits. She begged me to let her apply to a performing arts boarding high school. She was accepted and I used a second mortgage on my house to pay for the school. On her first report card she received a B+ in creative writing and A's in the other subjects. There was no mention of an inability to concentrate. That was the last grade below an A that she would receive in her schooling. She took the most advanced and rigorous academic subjects offered by the school, went on to college at Brandeis University, completed two majors and two minors, and graduated summa cum laude with highest honors.

I never understood the seemingly instant transformation. Then last summer at the DEC's first meeting, which coincided with a visit home by my daughter, where the cognitive impairment effects of TCE exposure were listed, she leaned over and whispered to me, "that was me in elementary and middle school." If I had known that TCE vapors were present in our home, that information certainly would have entered my problem solving process in trying to help my daughter succeed in school.

Richard Grossman, Ithaca Resident

When you look up from our front yard on Park Street, you see a steep hillside with a huge factory atop it—the Emerson Power Transmission site. So, I am still amazed that, until a year ago, I had no idea we were living in the shadow of a massive toxic site that had been declared by the DEC "a significant threat to the public health or environment!" None of our neighbors were aware of this classification either. The fact that many people living near contaminated sites are either uninformed or generally unclear about the situation is a major concern.

Another issue of concern is that there are many people living near contaminated sites who wish to have their homes and the surrounding areas tested, but have no idea when or if the testing will be done. Additionally, people who do have their homes tested and receive testing results from their own home or the surrounding area often interpret those results differently and come to different conclusions.

The following are some suggestions on what needs to be done:

- Additional investigations need to be done promptly to identify all toxic substances used at the site and the locations on the site where they were used.
- Additional investigations need to be done promptly to determine the locations and extent of the contamination.
- The DEC and DOH need to make information widely available to the public and update the information regularly.
- The DEC and DOH need to make experts available to individuals who wish to have questions answered, information explained, etc.
- The owners of all homes in the area need to be offered testing as soon as possible.
- The owners of all homes tested and shown to be contaminated should be offered immediate mitigation. This mitigation should be at no initial cost and have no maintenance cost to the homeowner.
- The owners of all homes tested, regardless of results, should be offered periodic home monitoring at no cost to the homeowner.
- The owners of all homes tested, regardless of results, should be offered periodic health monitoring at no cost to the homeowner.
- Homeowners whose property values are diminished should be offered compensation.

I would be remiss if I did not bring up the issue of the former residents of the areas around these contaminated sites—both homeowners and renters. Many people who were longtime residents in these areas are no longer living nearby. It is very likely that they are completely unaware of their possible long-term exposure to toxic substances. What about the health of those individuals? Once again, there are more questions than answers. Will an effort be made to identify these former residents?

Ken Kamlet, Environmental Attorney

My interest lies in the interface between the Brownfield Cleanup Program (BCP) and the state's emerging Vapor Intrusion Program. While vapor intrusion is an important issue that can only benefit from clearer policies and guidance, I am very concerned that unduly complex evaluation requirements and unduly stringent cleanup endpoints, that are not directly tied to harmful exposures, could have a devastating impact on the new BCP.

While protection of public health and the environment must be a foremost concern, other significant interests and implications must also be considered, especially in the context of brownfields redevelopment where the burden of environmental investigation and cleanup falls primarily on "volunteers" who neither caused nor contributed to contamination of the sites they are seeking to redevelop. To the extent that the costs of environmental investigation and cleanup go beyond what is necessary to limit human exposures to toxic vapors in indoor air, they have the potential to negatively and unfairly impact innocent cleanup volunteers at new and old brownfield sites out of all proportion to resulting public health and environmental benefits. It follows that, especially in the brownfields context, the "rules" governing the control of vapor intrusion need to be both clear and flexible, with an emphasis on minimizing exposure potential, rather than on rigid concentration-based limits or complex evaluation procedures.

The following are some recommendations on how to strike the correct public policy balance between protecting public health from vapor intrusion and preserving the momentum and efficacy of the State's brownfields revitalization efforts:

- Brownfield cleanup volunteers should not be required to investigate or remediate vapor intrusion precursors beyond what is reasonably necessary to protect public health.
- Where "source" removal or treatment of potential vapor intrusion precursors is not feasible, the focus of remediation efforts should be on elimination of exposure.
- Where brownfield cleanups completed prior to the advent of the BCP law are revisited to investigate the presence of vapor intrusion, the costs of follow-up investigations and/or remediation should be borne by Responsible Parties or the State.
- Even where a potential vapor intrusion pathway is being addressed prospectively at a new BCP site, the state should take care not to "punish the innocent" by imposing Superfund-caliber investigation and remediation requirements (and costs) on brownfield volunteers.
- Brownfield certificates of completion should not lightly be reopened at brownfield sites to address belatedly recognized vapor intrusion precursors.
- The State should not impose on private parties more expansive and stringent mitigation or cleanup requirements at Vapor Intrusion sites than it is prepared to assume itself at sites for which it has responsibility.
- The incremental cancer risk threshold of one-in-a-million set forth in the BCP law is tantamount to a zero-risk standard. DOH and DEC should not succumb to "reverse auction" public pressure to enforce everywhere the lowest (most stringent) indoor air standards applied anywhere.
- DOH's emphasis on monitoring and mitigation should be emulated by DEC and given preference over dramatically more costly source removal and treatment approaches—except where significant incremental public health and environmental benefits can be shown to result.

Walter Hang, President, Toxics Targeting

When a citizen contacted me about the chain factory about a year ago, I documented its contamination problems using publicly available data, determined that long-standing hazards had never been remedied, and brought my findings to the public's attention.

In 1987, the metal degreasing solvent TCE was reportedly identified at a concentration of 2,400 ppm in oil partially skimmed from an underground fire reservoir at the old Morse Chain factory. First, the reservoir was cleaned out and sealed. Then efforts were undertaken to identify, investigate, and cleanup the site as a whole.

In 1994, DEC adopted a Record of Decision requiring a two-phase vapor/groundwater treatment system that "should operate for three years, but may reach goals in a shorter time frame." DEC changed the site's classification code from two ("significant threat to the public health or environment—action required) to four ("site properly closed—continued management required").

Monitoring results generated in November 2003 reported up to 28,000 ppb of TCE in groundwater. The cleanup standard for TCE in groundwater is 5 ppb. Despite the long-term inadequacy of the remedial system, no effort was made to determine whether indoor air pollution persisted in nearby homes. A study to assess soil gas vapor migration was ten years overdue.

During the last year, monitoring of indoor air quality in dozens of homes near the site has identified multiple contaminants, notably PCE and TCE, at concentrations exceeding background levels. Even though DEC recently determined that the site poses a significant threat to public health and the environment and action is required, vapor suppression systems have been installed in only a handful of homes, the full range of the site's hazards have yet to be determined, and there is no overall mitigation or remediation agreement in place.

The factory has operated for nearly 100 years and it is imperative to identify the full range of its hazards. In terms of what should be done, first, all of the toxic solvents ever used at the factory must be inventoried. Second, a study must be undertaken to determine the full extent of those solvents in soil and groundwater surrounding the site. Third, all homes located in the impacted area must be monitored for toxic vapor intrusion. Fourth, homes found to be threatened or impacted by toxics must be equipped with vapor suppression systems or otherwise mitigated. The effectiveness of those systems must be verified on an ongoing basis. Finally, property values near the site must be protected. Responsible parties often offer financial settlements or insurance policies to safeguard the interests of local residents. Comprehensive protection should be afforded residents at no cost if they request it.

Cleaning up the plant site, however technically difficult and costly, could be warranted because vapor suppression or other mitigation systems might not protect residents from long-term health risks. In addition, extensive hazards could lie beneath the factory and might threaten plant workers.

James Little, Process Specialist, IBM Manufacturing Plant, Endicott

As a worker and insider, I bring a unique perspective to uncover some of the factors that led to contamination. Such factors include a lack of knowledge early on about the toxicity of these chemicals, lax government standards, complacency, and the fact that chemical companies failed to maintain good accounting practices when underground holding tanks or pipes leaked. In addition, I believe that practices at work are often what lead to spills. Work accountability is lacking, as evidenced by lost training records, machines that are allowed to leak chemicals in favor of production, and employees who are allowed to let chemical safety courses expire.

There is a concern at work about the possibility of the plant having some older plumbing and leaking tanks, and that our drainage system (where the chemicals exit the machines) might lead directly into the ground. This concern is backed up by the fact that if you look at some of the DEC plants, all the contamination from TCE and other chemicals seems to emanate directly from the buildings. I propose that DEC look into some type of process where they put a dye into the drainage systems to make sure that we're not continuing to contaminate.

I think emphasis should be on extensive testing of the contaminated sites, thorough cleanups, corporate accountability by establishing stringent standards, and the on-site presence of safety inspectors.

Finally, I am very concerned about chemical standards at the workplace. I know this isn't about work—this is about what the workplace has done to the community—but it's really all tied together. We have called in OSHA and they did a study and told us that we were within OSHA standards. Despite what they said, we knew the reality—we'd go in, come out of there feeling drunk, and wake up in the middle of the nights with cold sweats, and we knew something wasn't right. About a year ago I found out that the standards were outdated, going back to the 1950s and 1960s. What's going on at workplaces as far as outdated chemical standards is a travesty and should be a crime. We have the technology to prevent chemical exposure at work. Reducing workplace exposure is a win/win for companies because it will save money on health care costs, reduce time lost from work, lower workman's compensation costs, and increase productivity.

APPENDIX C.1 – HOPEWELL JUNCTION HEARING NOTICE

ASSEMBLY STANDING COMMITTEE ON ENVIRONMENTAL CONSERVATION

NOTICE OF PUBLIC HEARING
Oral Testimony by Invitation Only

SUBJECT: Vaporization of contamination from soil and groundwater into indoor air

PURPOSE: To examine the human health impact of vapor intrusion stemming from soil and groundwater contamination

Hopewell Junction
Thursday, May 19, 2005
11:00 a.m.
East Fishkill Fire District
Meeting Room
2502 Route 52
Hopewell Junction, NY

Contamination of indoor air by volatile chemicals from contaminated soil and groundwater is an emerging area of public health concern. Vapor intrusion is known to have occurred at Superfund sites in New York State and has occurred at brownfield sites as well. While the New York State Department of Environmental Conservation and the Department of Health, as well as the United States Environmental Protection Agency, have issued draft guidance pertaining to various aspects of vapor intrusion, none of these agencies have issued final guidance.

Chapter 1 of the Laws of 2003 established the Brownfield Cleanup Program (BCP) as well as refinancing the State Superfund program and providing for a comprehensive program for the long-term restoration of groundwater. The BCP requires, at all brownfield sites, the "elimination of volatilization into buildings: provided however if such elimination is not feasible such exposure shall be eliminated to the greatest extent feasible." Vapor intrusion should be considered in remediation of all contaminated sites.

The purpose of this hearing, the third in a series, is to examine issues concerning the vaporization of contamination and to determine what can be learned to address vapor intrusion in the future. The Committee will take testimony from various witnesses including panels of government officials, public health and environmental experts and citizens representing affected communities.

Oral testimony will be accepted by invitation only and limited to 5 minutes duration. 10 copies of any prepared testimony should be submitted at the hearing registration desk. The Committee would appreciate advance receipt of prepared statements. Written testimony will also be accepted and may be sent to the contact person listed on the reply form. In order to further publicize the hearing, please inform interested parties of the Committee's interest in receiving written testimony from all sources.

In order to meet the needs of those who may have a disability, the Assembly, in accordance with its policy of non-discrimination on the basis of disability, as well as the 1990 Americans with Disabilities Act (ADA), has made its facilities and services available to all individuals with disabilities. For individuals with disabilities, accommodations will be provided, upon reasonable request, to afford such individuals access and admission to Assembly facilities and activities.

APPENDIX C.2 – HOPEWELL JUNCTION WITNESS LIST

ASSEMBLY STANDING COMMITTEE ON ENVIRONMENTAL CONSERVATION

Public Hearing on Vaporization of Contamination from Soil and Groundwater into Indoor Air

Thursday, May 19, 2005, 11:00 a.m.
East Fishkill Fire District
Meeting Room
2502 Route 52
Hopewell Junction, NY

WITNESS LIST

PANEL

Margaret J. Horton,
Dutchess County Legislator
Mary M. Swartz
Dutchess County Legislator
Peter Idema
Supervisor, Town of East Fishkill

PANEL

William McCabe
Acting Director, Division of Emergency and Remedial Response
Region 2, United States Environmental Protection Agency

PANEL

Nathan Graber, M.D.
Department of Pediatric Environmental Medicine
Center for Children's Health and the Environment
Mount Sinai School or Medicine
Kathleen Burns, Ph.D.
Member, International Society for Environmental Epidemiology

PANEL

Debra Hall
Hopewell Junction Citizens for Clean Water

William N. Borell
Local citizen

APPENDIX C.3 – SUMMARY OF TESTIMONY, HOPEWELL JUNCTION HEARING

Honorable Sue Kelly, Congresswoman, 19th District

My sincere interest in the topics being discussed today stems from work I have been doing at the federal level on behalf of my constituents living within the Hopewell Precision contamination site. Together, for nearly two years now, we have been working with the EPA to bring federal cleanup aid to our local community. I greatly appreciate the EPA proposing this neighborhood to the National Priorities List last fall and officially naming it a Superfund site last month. It is a credit to the patience and perseverance of cooperative local residents living in the Hopewell Junction community that this federal designation became a reality.

More recently, several of those same constituents in Hopewell Junction contacted me with serious concerns about the current Region 2 guideline levels for TCE. Once again, we worked together with the EPA to lower the guideline level at the Hopewell Precision contamination site. However, the question this left me with—and I'm sure it's a question local residents ask as well—is why not have lower treatment standards already in place to make our fight against vapor intrusion more proactive and effective? We need to work collaboratively at all levels of government to lower the threshold for air contamination in New York and around the country.

TCE has become one of the most common industrial contaminants in the United States. It is widely believed to be carcinogenic, immunotoxic, and neurotoxic—all very frightening terms to any local resident. TCE is being found daily in groundwater, soil, and in the air at more than 850 of the EPA's nearly 1,500 Superfund sites.

In 2001, the EPA conducted a Human Health Risk Assessment, finding that TCE is 5 to 65 times as toxic as previously believed. The EPA's Science Advisory Board conducted a peer review that praised the assessment. But when EPA regions began applying the results of that risk assessment, other Federal agencies pressured EPA to shelve the risk assessment and turn over the question of TCE toxicity to the National Academy of Sciences for a second review. That further review is finally underway, but it will take at least several years to complete. Meanwhile, Americans are being exposed to TCE in their water and air, and the EPA has no clear standard for those exposures—particularly for air exposures.

I have begun a Federal effort in Congress to call upon the EPA to adopt a protective "interim approach" to TCE exposures, based upon the peer-reviewed 2001 risk assessment. We are beyond the point where a "wait-and-see" approach is acceptable, or even feasible. We cannot allow vapor intrusion problems to grow, on the Federal level or at the State level.

Other members of Congress, both Democrat and Republican, are joining me in this effort to urge the EPA to use provisional screening levels based upon the 2001 Assessment until the new risk assessment review is completed. For example, based upon work done by several EPA regions, the screening level for TCE in air would be about .02 mcg/m^3. Vapor exposure investigations should use sampling technologies designed to detect TCE down to those provisional levels.

Margaret Horton, Dutchess County Legislator

Back in 1987, the State of California commissioned a report to find out what TCE was and what the state should do about it. They realized that TCE was a very mobile chemical and that it was an animal carcinogen, but they were not sure what else it was. The final report was issued in 1990 and found that TCE was not only an animal carcinogen, but a human carcinogen as well.

Since then we have learned an incredible amount of information. In 2001, EPA did a risk assessment study. However, that risk assessment study has not been acted on yet. And we need to remember this. There have been too many years gone by, too many more chemicals turning up, and too many people getting ill. These illnesses are not allergic reactions or bronchitis—they are diseases like kidney disease, liver disease, and testicular cancer. I have held a two-year-old in my arms who has such severe neurological damage that she probably will never walk. This can't continue.

Mary Schwartz, Dutchess County Legislator

On April 20th four legislators, including myself, sent a letter to the New York State Department of Health Bureau of Environmental Exposure Investigation. I would like to read that letter now.

> Please allow this letter to serve as our written comments on the proposed guidance for evaluating soil vapor intrusion in the State of New York. As you may be aware, there are a number of residents in Dutchess County whose indoor air quality is affected by soil vapor intrusion. Two high profile sites include Hopewell Precision and Shenandoah Road. It is clear to us that the health of the residents at these sites has been affected by the underlying contamination. Our understanding is that there is no "bright line" to separate safe (the amount of the dose you do not want to exceed) versus unsafe exposure levels and that decision matrices are used as risk management tools to determine whether "action" at a site is warranted. Our further understanding is that variable air quality action levels have been permitted on a site-by-site basis and pre-2003 sites have been separated from newer sites.
>
> Based on the foregoing, we respectfully request that the department protect all of the state's residents equally by demanding remediation at consistent and conservative air quality action levels. While we defer to the department's judgment on the issue of whether or not to use ingestion standards as California has done, we do strongly believe that all citizens deserve the same degree of protection. In other words, we request that the decision matrices be created as conservatively as possible with the best interest of the residents in mind.

William McCabe, Acting Director, Division of Emergency and Remedial Response, Region 2, USEPA

Due to the potentially large number of sites where vapor intrusion could be of concern, and given both the evolving science in this area and the difficulty of relating contamination in the soil and groundwater to indoor air at a given location, EPA developed draft screening guidance in 2002.

The draft guidance for vapor intrusion is to be used for determining whether vapor from VOCs is likely to enter buildings. The guidance recommends that sampling from beneath the slab of a building (sub-slab) and of the indoor air environment be conducted when the possibility of vapor intrusion at levels of concern can't be ruled out.

We all would all like to have a number that we could point to and say 'take action,' but, unfortunately, we don't have that, and we're not going to have it for quite some time. The level at which we take action depends on the sub-slab number and the interior number, as well as other factors. What we've come up with is a flexible matrix, which is very conservative and allows us to take action wherever it makes sense. For example, if the sub-slab number is high enough, we probably won't even have to go with an interior sample—we will probably just put a system in. If we're going to have to keep going back and monitoring, because we are a little nervous about a situation, we're going to put a system in. That's where the cost effectiveness factor comes in, given that the costs of monitoring are so similar to just putting a system in.

Two Superfund sites that the Region 2 office of EPA is addressing here in Dutchess County are the Hopewell Precision site and the Shenandoah Road site. The two chemicals of greatest concern at the Hopewell Precision site are trichloroethylene (TCE) and trichloroethene (TCA). The chemical of greatest concern at the Shenandoah Road site is tetrachloroethylene (PCE).

TCE is a colorless liquid which is used as a solvent for cleaning metal parts. Drinking or breathing high levels of TCE may cause nervous system effects, liver and lung damage, abnormal heartbeat, coma, and death. TCE is also considered a potential human carcinogen by the U.S. Department of Health and Human Services (USDHHS). TCE has been found in at least 852 of the 1,540 National Priorities List (NPL) sites identified by EPA.

TCA is found in building materials, cleaning products, paints, and metal degreasing agents. Inhaling high levels of TCA can cause you to become dizzy and lightheaded. Exposure to much higher levels can cause unconsciousness and other effects, however it is not considered to be a potential human carcinogen by the USDHHS. This substance has been found in at least 809 NPL sites.

PCE is a manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations of PCE can cause serious health problems and it is considered a potential human carcinogen by the USDHHS. PCE has been found in at least 771 NPL sites.

At the Hopewell Precision site, testing of 450 residential drinking water wells revealed that 53 were contaminated with TCE and 100 wells were contaminated with TCA. For the 37 TCE-contaminated wells that were found to exceed the state and federal Maximum Contaminant Level (MCL) for drinking water of 5 ppb, we installed point-of-entry-treatment (POET) systems, which remove VOCs from drinking water. For the 14 TCA-contaminated wells found to exceed the state MCL of 5 ppb, DEC installed similar filtration systems.

Given what we know about the characteristics of the Hopewell Precision site, we were aware that there was the potential for TCE to volatize from groundwater and enter homes. In April 2003, EPA started to collect air samples from a number of residences in the vicinity of the site. Sub-

slab samples were collected at 207 homes and, of these, 65 homes were found to have detectable concentrations of TCE. To date, EPA has installed sub-slab ventilation systems in 43 residences, and, as a result of recent sampling data, ventilation systems will be installed in six additional homes within the next two months. EPA initially addressed all homes with sub-slab TCE vapor levels exceeding 50 mcg/m^3.

Based on our experience with indoor air remediation, the effectiveness of the vapor mitigation systems at Hopewell Precision, the ability of laboratories to detect TCE at lower levels using EPA analytical methods, and the cost of mitigation compared to further sampling, for those homes where-slab system is necessary, we adopted a revised indoor air cleanup goal for the site of 0.38 mcg/m^3 in February 2005. There is a great deal of confusion as to cleanup levels versus action levels. The level of .38 is not an action level—it is our goal to cleanup to.

At the Shenandoah Road site, residential well sampling conducted in 2000 indicated that a total of 60 residential wells were contaminated at or above the MCL of 5 ppb for PCE and/or TCE. Of these, 20 had contamination exceeding the removal action level of 70 ppb for PCE. Following discovery of the contaminated residential wells, EPA initiated emergency response action at the site and began the delivery of bottled water to the affected residents in June 2000. Based on additional sampling, a total of 104 residential well treatment systems have been installed.

EPA conducted a vapor intrusion investigation at the site in April and May of 2004. Unlike the Hopewell Precision Site, the resulting data showed that while at some residences there was contamination present in the sub-slab, indoor air levels were not currently a significant concern. EPA conducted additional vapor intrusion testing in February of this year that confirmed that indoor air levels of VOCs are not now a significant concern. EPA expects to be able to complete its indoor air investigation within a year. Working with the state, we will then make a determination as to where mitigation systems should be installed.

The best thing to do for a groundwater problem is to get rid of the source. If you eliminate the source of material going into groundwater, then the groundwater, even by itself, will attenuate. But in 95% of the cases, we are also going to pump and treat that groundwater to pull out the contamination.

Nathan Graber, M.D., Department of Pediatric Environmental Medicine, Center for Children's Health and the Environment, Mount Sinai School of Medicine

In the body, TCE is broken down by the liver into other chemicals. Most of these leave the body in the urine within a day. However, if the exposure continues for an extended period of time, TCE and its breakdown products can achieve a steady state in the blood and lead to a buildup of stores in the fatty tissues of the body.

Most of the information available on the health effects of TCE is from occupationally exposed adults. At very high levels of exposure, TCE can produce effects on the central nervous system, including headaches, dizziness, lack of coordination, stupor, and coma. At the levels likely to be found in homes contaminated through vapor intrusion, acute health effects are unlikely.

Studies suggest that more birth defects may occur when mothers drink water containing TCE. These include heart defects, rare respiratory and eye defects, neural tube defects, and oral cleft palates. Although these studies are limited by the difficulties inherent in carrying out these types of investigations, enough evidence exists to suggest that TCE exposure, even at low levels, is bad for children.

Newborns and children are more vulnerable to exposure to TCE and other volatile chemicals than adults. For instance, newborns breathe more than two and a half times more air per pound of body weight than adults. Children also occupy a different breathing zone than adults. TCE is heavier than air and settles closer to where children play and live. Young children also tend to spend more time at home than adults. In addition, children drink more water than adults. This is important if the drinking water wells are contaminated with TCE.

In addition, because children have more future years of life than most adults, they have more time to develop chronic diseases that may be triggered by early exposures. Many diseases of adult life, including breast cancer, Parkinson's disease and dementia, are now thought to arise through a series of stages that span years or even decades. Carcinogenic and toxic exposures sustained early in life, including prenatal exposures, appear more likely to lead to disease than similar exposures encountered later.

The setting of appropriate remediation standards is important to protect the health of our children. I am not sure that DOH has taken the special vulnerabilities of children into account in setting their guideline for TCE at 5.0 mcg/m^3. DOH's review of the literature in support of the guideline includes studies that show that levels much lower than 5.0 are associated with an increased risk of cancer, in part due to the special vulnerabilities of children. The scarcity of studies on the health effects of low-level, chronic exposure to TCE, the unique vulnerabilities of children, and the potential for serious health outcomes points to a precautionary approach. The guideline needs to be lowered.

EPA has data on the background indoor and outdoor air levels of TCE in the U.S. From a national sample of 2,132 homes and 3,021 outdoor spaces, 50% of the homes tested had indoor air concentration less than 0.67 mcg/m^3 and 50% of the outdoor air concentrations were less than 0.85 mcg/m^3. The DOH has similar data with levels of <2.7 mcg/m^3 and 1.7 mcg/m^3, respectively. We recommend that the homes in Hopewell Junction have levels in the indoor air that are at least as low as these background levels.

In addition, TCE is not a naturally occurring substance. It is also difficult to predict how levels under the foundations of homes affect the air levels in the homes. Therefore, remediation is advised for any home with a detectable level of TCE in that space.

Kathleen Burns, Ph.D., Environmental Health Scientist, Member of International Society of Environmental Epidemiologists

The damage from TCE varies widely, covering almost every system in the body. Regardless of how people and TCE come together—via water, food, or inhalation—some fairly predictable

things happen and it is these actions that help explain why TCE is as damaging as it is, and why we need to use the best strategies possible to avoid human exposures to this chemical.

As a solvent, TCE is capable of dissolving other substances. Although its solvent properties have made it valuable to industry, the fact that TCE can dissolve fats and proteins means that it can enter cells throughout our bodies. Cells comprise most structures in our bodies and are protected by a membrane of fat and protein molecules, which is one or our major defenses against damage and disease. However, since TCE is expert at dissolving and moving through fats and proteins, the cells' protective layers aren't much of a barrier to TCE.

Inside the cell we have all the mechanics of life, with one of the more interesting being the cell's ability to replicate itself. This is how we grow and stay healthy. We have the famous DNA molecule sitting there waiting to be switched on or off, depending on what is needed. Unfortunately, TCE has the ability to change the way DNA works. It causes DNA to make huge errors when it duplicates itself. These errors are commonly called mutations and are associated with cancer and birth defects.

So we arrive at an understanding that TCE is clearly hazardous. But we are left with the question of when actions should be taken to mitigate vapor intrusion into homes. Although it is popular today to use a risk-based approach, there are so many uncertainties in evaluating vapor intrusion that a precautionary approach is far preferable and I believe it is the only way to adequately protect public health. As a risk assessor for over 25 years, I can conduct a very detailed analysis of every possible exposure route that might occur. I can and use estimates of the average amount of air someone breathes in at age 1, 5, or 12 years of age, how many glasses of water the average 7 year old drinks, and so on. But reality is quite different - people are not average and the variability in their activities is tremendous. The child who drinks gallons of water because they play soccer all day in the summer and then spends their time at home in the basement because it is cooler there may have an exposure level that is off the charts.

Our understanding of exposure also relies on extremely uncertain measurements of TCE. TCE's movement through soil and building materials depends on factors such as barometric pressure that changes as the weather changes, and hydrostatic pressure that can be exerted through increased water flow. Fluctuations can occur over hours or days. It takes time for volatiles to move through basement floors, and up from basements to the first and second floors of homes. Increases or decreases in the entry of TCE into sub-slab areas do not instantaneously result in changes in indoor air concentrations. In addition, the variability in air movement within homes is complex and not very predictable.

This dynamic situation raises two issues. First, because variations between sub-slab and residential levels in a home can occur for many reasons, they do not necessarily indicate a personal source of TCE. Second, measurements taken in homes at a single point in time do not capture either the average or range of exposures possible in that home. They give an indication of the concentration, but are highly unreliable as a way to assess exposure. In the absence of reliable exposure information, it is not possible to do a precise risk assessment of how many cases of cancer A or B will occur, or the rate of birth defects or other health impacts. It is also not possible to establish a safe and acceptable level of TCE in a home.

The reasonable and health-protective approach to take under these circumstances is for the EPA, DOH, and DEC to mitigate in any home where TCE is detected and is plausibly associated with vapor intrusion. Between the known health hazards posed by TCE, and the considerable uncertainty in estimating exposures that will occur in homes, the prudent and protective course of action is to reduce TCE in homes to the degree possible. In the face of some uncertainty, we are obligated as health professionals to take preventive measures and protect the public.

The Department of Health's plan to decline mitigation based on a matrix that employs very uncertain data does not make sense from a public health perspective. For the sake of consistency across sites and to achieve an equitable approach to resolving the vapor intrusion problems that reflects our awareness of the inherent uncertainties in measuring TCE, mitigation should occur at all homes where TCE is linked to vapor intrusion.

Debra Hall, Hopewell Junction Citizens for Clean Water

According the EPA's 2001 Draft Assessment, TCE can be as much as 5 to 65 times more detrimental to human health than previously believed, and it is much worse for growing children than it is for us adults. This is why CalEPA and other state environmental departments began to apply new lower guidelines in assessing health threats. They wanted to protect residents' health. Instead, major polluters lobbied the White House, which then opposed the promulgation of a new standard. The President sent the issue of TCE's toxicity to the National Academy of Sciences for re-review which will now take years to complete. In the interim, the public remains unprotected.

Mitigation, remediation, and standard setting should all take into account that people like those in my neighborhood have been exposed to multiple contaminants via multiple exposure pathways. And since the potentially responsible party here in Hopewell Junction began to contaminate our neighborhood's air about thirty years ago, DOH needs to take that long-term exposure into consideration also. All human exposure is cumulative: it is important for your committee to insist that DOH consider cumulative risk whenever a contamination event is being evaluated.

The DOH guidance, from what I have seen, does not mention the Mobile Trace Atmospheric Gas Analyzer, aka the "TAGA" unit. This air measuring tool is invaluable for evaluating community exposure in a meaningful way. The TAGA unit has the ability to prove in real time precisely where the contaminants in residential air are coming from. Although TCE is still used in some household products, the TAGA unit can find those sources so that contaminant levels caused by actual vapor intrusion can be accurately measured. I note also that TAGA measured concentrations are virtually identical to the measurements obtained with the more common monitoring device, the Summa canister. Testing with Summa canisters is more expensive than testing performed with the TAGA unit. I ask the committee to request that DOH seriously consider investing in a TAGA unit.

DOH is in the process of putting together a 12-member panel of experts to discuss the vapor intrusion issue. I think that is a positive step. However, citizen groups which are in the affected communities should have been notified and asked if they had any recommendations. I found out through the grapevine and sent DOH five very credible experts who would represent the

concerns of the citizens. I am asking the committee to check into making sure the DOH Vapor Intrusion Panel is balanced and that citizen groups directly affected by vapor intrusion are better informed.

TCE is not going to go away in our lifetime. I ask that if a home has vapor intrusion from TCE, or any volatile organic compound, no matter what measurement, the government should consider mitigating instead of monitoring. Data show that it is cheaper in the long run to install a mitigation unit than to monitor. There is also an added benefit—you will actually be protecting humans.

We do not want to be used as guinea pigs, which is exactly what will happen if the state continues to use the "wait and see" approach. TCE and other similar contaminants are known to be dangerous to human health and the ventilation units do work.

William N. Borrell, Local Citizen

My wife and I have lived in the newly designated Hopewell Precision Superfund site for the past 21 years. We built our home, cleared our land, and raised our horse barn with our own hands. Our dream for the future was a simple one—to raise a family and enjoy our home. But when the EPA notified us in early 2003 that our well water had become contaminated, our dream became a nightmare. Unnatural chemicals, which are odorless and tasteless, invaded our home, water, soil, and air. The by-products which these chemicals can degrade into are far worse than the original chemicals themselves. I have over the years so many times questioned why my wife and I were unable to have children; why we lost so many of our beloved pets to pancreatic cancer, liver cancer, and kidney failure. What has broken my heart was to recently learn that my wife now must fight a personal health issue of her own.

The EPA's emergency response to our contamination issue was to install a Point of Entry Treatment System and a sub-slab ventilation/depressurization air system to mitigate our home. What governed this action level for response was a standard established by the EPA for TCE in water of 5 ppb and an indoor air guideline of 5 mcg/m^3 established by DOH. This air guidance level was shortly thereafter reviewed by the EPA and revised for the Hopewell Precision site. The EPA adopted a more aggressive site specific guidance level based on soil atmosphere sub-slab test results. The new guideline was lowered significantly to .38 mcg/m^3. Simply stated, the EPA erred to caution in what is now a daily changing field of science. It is my hope that DOH will revise its current policy guideline of 5 mcg/m^3 and establish a standard that reflects the most conservative protective assumptions that science can support.

Sadly we are presently left to deal with the practices that the twentieth century has left behind for us. But today in the 21st century we are fortunate because we have the science, and the technology. We must now demonstrate that we also have vision. Our vision should be to adopt a policy that enables us to not have to live in fear, to ensure that we have a future and to ensure a future for our next generation.

In closing I would like to state that we shouldn’t debate whether the far-reaching consequences concerning our health and environment caused by vapor intrusion might occur; they are occurring as we speak.

APPENDIX D – COMMENTS SUBMITTED TO DEC ON THE DRAFT SITE SCREENING GUIDANCE

THOMAS P. DiNAPOLI
Member of Assembly
16th District
Nassau County

THE ASSEMBLY
STATE OF NEW YORK
ALBANY

CHAIR
Standing Committee on
Environmental Conservation

CO-CHAIR
Legislative Commission on
Water Resource Needs of
New York and Long Island

COMMITTEES
Ways & Means
Education
Veterans Affairs

January 24, 2005

Commissioner Erin Crotty
Department of Environmental Conservation
625 Broadway
Albany, NY 12233

Dear Commissioner Crotty,

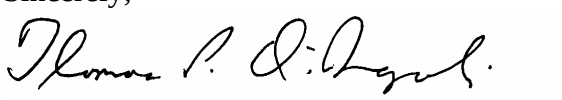
Thank you for the opportunity to comment on the Department's proposed vapor intrusion policy. I appreciate that the Department has acted quickly in drafting this policy in an area that experts in environmental health and engineering have only recently come to realize has significant potential to result in significant risks to human health from exposures.

As you know, the Assembly's Environmental Conservation Committee recently held a hearing on vapor intrusion in Endicott, NY. The difficulty associated with setting indoor air quality standards underscores the need to proceed cautiously, yet to ensure that actions taken protect the health of residents. Testimony from citizens impacted by contaminated sites here in New York made it clear that living with uncertainty is one of the most frustrating and stressful things about living near a contaminated site.

The vapor intrusion policy being formulated by the Department has the potential to ease much of this stress and frustration. To be successful, the vapor intrusion policy that is finally adopted by the Department must be protective of human health and the environment and be transparent. People must be able to see and understand why the Department has made the decisions it has in ranking and investigating contaminated sites.

It is with recognition of the great work being done and tremendous efforts being put forth at the Departments of Environmental Conservation and Health to develop a protective vapor intrusion policy as well soil cleanup program and standards that I offer the following comments. I encourage DEC to consider them and re-issue another draft before finalizing this policy.

Sincerely,



Thomas P. DiNapoli
Chair, NYS Assembly
Environmental Conservation Committee

Assemblyman Thomas P. DiNapoli
Comments on
New York State Department of Environmental Conservation's
Draft Policy
DER-XX/Evaluating the Potential for Vapor Intrusion at Past, Current and Future Sites.

Thank you for this opportunity to comment on the Department of Environmental Conservation's (DEC's) Draft Policy on Vapor Intrusion. DEC's intention to evaluate all contaminated sites to determine whether the vapor intrusion pathway is complete is commendable. I am also looking forward to reviewing the draft "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" when it becomes available.

While I commend DEC for issuing this draft policy is such timely manner, I believe that there is a lack of transparency that makes it impossible to assess fully the adequacy of the policy as a whole and its specific components. I hope that the following comments will be useful in focusing attention on areas that need additional explanation.

The Draft Policy Needs to Clarify How Many Sites will be Investigated and the Timeline for Investigation. Page two of the Draft Policy states that DEC estimated that solvents or other volatile chemicals have been disposed of at over 750 sites resulting in contaminated soil or groundwater. Page three notes that there are more than 400 sites where chlorinated volatile organic compounds (CVOCs) were disposed of or detected in soil or groundwater. The draft report states a "manageable number of sites" will be initially targeted for further study to determine whether impacts associated with vapor intrusion exist. Once initial investigations are complete and any necessary revisions to the procedures are made, DEC will then begin to investigate the remaining sites identified as having potential vapor intrusion impacts. Each year several previously investigated sites will be selected from each Region for further vapor intrusion investigations until all sites requiring further study have been completed.

There is concern that it will take DEC a very long time to investigate all known sites at which public health threats may exist. DEC should state what it believes to be a manageable number of sites that will be targeted initially for further study, and identify how long it estimates it will take to investigate all sites that may be causing vapor intrusion problems.

The Draft Policy needs to state the trigger for actual investigation of contaminated sites. While the summary of the draft policy notes that all past, present and future contaminated sites will be evaluated, the section on screening criteria (p.3) notes that sites will be prioritized based on the ranking and considered for further evaluation. Due to the uncertainties that exist in assessing vapor intrusion, the fact that site characteristics determine how vapors migrate and that understanding of soil vapor migration and intrusion is still evolving, I believe that on-site inspections will be necessary at all sites. In addition, DEC should state clearly whether it intends to investigate all sites or some percentage of sites and what actions will be taken when vapor intrusion impacts are found to exist.

Additional Public Outreach Needed
Sites with vapor intrusion may have a significant public health impact. There should be an opportunity for public input after DEC completes the proposed list for further investigation.

Numerous Questions Remain Concerning Complete Pathways
According to the draft policy, a complete pathway means that humans are being exposed to vapors that originate from site contamination. For sites determined to have a complete pathway, further evaluation is necessary to determine whether the pathway poses a potentially significant risk to human health and whether interim or long-term mitigation or remedial measures are necessary. For sites at which it is determined that a vapor intrusion exposure pathway does not exist under current conditions, a vapor intrusion pathway must be considered if future plans for the site include development that could result in a complete exposure pathway. I commend DEC for planning to incorporate future development plans into this policy.

It is not clear how DEC will determine the current location and extent of the groundwater plumes, which is necessary to determine completed pathways. Without this information, it is impossible to establish a safe distance for measuring adjacent site use or for determining what structures should be evaluated for completed pathways - as is called for in the draft policy. This needs to be clarified.

While this policy deals directly with existing vapor intrusion problems, I am also concerned with how DEC will address situations where no complete pathway is currently identified, but migrating groundwater with levels of contamination exist that may ultimately result in vaporization problems when the plume reaches inhabited areas. If DEC will be relying on existing, dated, information on sites, an additional concern exists as to how DEC will ensure that new pathways have not developed/evolved over time.

As defined, a complete pathway means that humans are exposed to vapors that originate from site contamination. By this definition, vapor intrusion is not limited to indoor air. I support the inclusion of outdoor vapors from contamination being incorporated into DEC's vapor intrusion policy.

Prioritization of Contaminated Sites Needs More Explanation
The draft policy lacks necessary information explaining how and why decisions were made in developing the process for soil and groundwater screening for vapor intrusion and site ranking. This lack of information makes it impossible to evaluate fully the appropriateness of such screening and ranking.

According to the draft policy, prioritization of contaminated sites will drive additional investigation. It is not clear how DEC will determine if impacts associated with vapor intrusion exist. DEC should clarify how many site-specific conditions and what numerical weighting they believe will have to be present to trigger further action. Will one completed pathway be sufficient to trigger additional investigation?

It is Unclear Why Soil and Groundwater Contamination are to be Prioritized Separately
The rationale for DEC's plans to prioritize soil and groundwater contamination separately is not clear. Is there something inherently different about the contaminated soil and contaminated groundwater in relation to vaporization that require separate ranking?

Additivity should be Considered
If DEC proceeds with separate prioritization of soil and groundwater contamination, the methodology should allow for consideration of additive effects at sites that have multiple types of contaminated media. Additivity should also be factored in for cases in which there is more than one type of contaminant known to have adverse health affects. For sites with multiple complete pathways, each known or suspected completed pathway should be counted as additional weight for ranking.

Lack of Information Should Not be Assumed to Mean No Impacts Exist
One of the acknowledged problems associated with vapor intrusion is that it is not possible to know how vapors will travel underground. Preferential pathways can be accorded additional weight if they are known, but many times such pathways are not known or even suspected before indoor air is tested. Consequently, the lack of known preferential pathways should not take away from the ranking of any site.

Screening for Chlorinated Volatile Organic Compound (CVOC) Vapor Intrusion
It is not clear why DEC selected the contaminant concentrations or depth to groundwater levels it did for site screening. An explanation needs to be provided as to why the site-specific conditions to be evaluated were selected, why the contaminant levels and depths to groundwater were determined appropriate, and how the weighting factors were selected.

Concern that Potentially Significant Sites Will Not Triggering Action
In 2003, the Department of Health conducted seminars on the development of soil contamination criteria. At the seminar held in Albany, DOH personnel noted evidence of unacceptable levels of vapor intrusion being experienced at places where groundwater contamination met state standards. In the proposed ranking for groundwater contamination, the lowest level of contamination (<10ppm) in the screening table receives a weight of 1, the lowest weight possible. Many CVOCs and VOCs have an MCL lower than 10 ppm in groundwater. This raises concern that sites posing potential health risks may be ranked in such a way that further site investigation for vaporization impacts is not conducted.

The Trigger for Further Investigation at Sites with Contamination Deep Underground Needs Further Explanation. The background section of the draft policy notes that past assumptions that drove investigation into vapor intrusion were flawed, including the assumption that if an off-site dissolved contaminant plume flowing beneath a home or business was deep, then the concentration of vapors entering buildings above would be so low that they would not represent indoor air concerns. As drafted, this policy places the lowest possible weight on sites where contamination is deep underground. This seems to be inconsistent with DEC's acknowledgement that the potential impacts of such contamination were previously underestimated. It is unclear that the proposed weighting of depth to groundwater proposed in

this policy will provide adequate protections for human health. An explanation of how this determination was made needs to be provided.

Information is Needed for Sites with Source Remediation Complete and Remaining Groundwater Contamination. The section on vapor intrusion investigation does not cover those cases in which the initial source of contamination has been remediated, but contaminated groundwater remains either on or off-site. The draft policy notes (p.5) that if groundwater within 100 feet of or beneath an occupied building is contaminated with VOCs, then a characterization effort will be required. If groundwater quality data is unavailable, a limited groundwater investigation may be required to evaluate current groundwater conditions downgradient of any remaining on-site sources of VOCs in order to make this determination. DEC needs to ensure that sites where the source has been remediated but groundwater remains contaminated are covered in its final policy.

Additionally, for sites at which groundwater contamination has existed for some time, contaminated groundwater plumes may have migrated further than 100 feet from the original source. Provisions for addressing this should be included in the draft policy.

Additional Issues
In addition to the issues raised above, questions and issues remain regarding DEC's draft policy. These include:

- The screening tables each have four levels of contamination. DEC should explain why these levels were selected. Are there different health impacts associated with exposure to VOCs/CVOCs for the different levels selected?

- Is the smallest contamination level selected for weighting associated with lifetime cancer risks of one in a million, or a hazard index of one? If not, what criteria would result in such a measure?

- DEC should explain why it decided to treat all VOCs/CVOCs equally. The MCLs for drinking water differ significantly for various VOCs/CVOCs, and research shows that the health effects differ; some are known carcinogens while others may not to be. An explanation should be provided as to why the proposed policy does not reflect the differences known about various contaminants.

- For different soil types, clay is ranked lowest. On Long Island, it has been shown that contamination may accumulate on top of, or be sorbed into, clay lenses and be a source for vapor migration in soil gasses. Has this scenario been factored into DEC's ranking?

- The groundwater screening allows an additional point for the presence of NAPL. This should be expanded to include potential NAPL. It is very difficult to confirm the presence of NAPL, but the potential for NAPL exists when contamination exists at certain levels. In such cases, DEC should award additional points.

- Sites with sensitive receptors, such as children who are significantly more susceptible to contaminants than adults, should be evaluated more quickly than sites without sensitive receptors and should be remediated accordingly.

- As currently drafted, the middle two categories on both the CVOC table and the Depth to Groundwater ranking table overlap numerically (10 – 100 ppb and 100 – 500ppb, and 15 – 50 feet and 50 – 100 feet). This should be corrected to allow for consistent ranking.

Conclusion

I hope these comments are useful in formulating a final, transparent vapor intrusion policy. If you have any question, please feel free to contact my office.

APPENDIX E – COMMENTS SUBMITTED TO DOH ON THE DRAFT VAPOR INTRUSION GUIDANCE

THOMAS P. DiNAPOLI
Member of Assembly
16th District
Nassau County

THE ASSEMBLY
STATE OF NEW YORK
ALBANY

CHAIR
Standing Committee on
Environmental Conservation

CO-CHAIR
Legislative Commission on
Water Resource Needs of
New York and Long Island

COMMITTEES
Ways & Means
Education
Veterans Affairs

May 31, 2005

Ron Tramontano
Director, Center for Environmental Health
New York State Department of Health
Flanigan Square, Room 300
547 River Street
Troy, New York 12180-2216

Dear Mr. Tramontano,

Thank you for the opportunity to comment on the Department of Health's (DOH's) proposed "Guidance for Evaluating Soil Vapor Intrusion in the State of New York." The vaporization of volatile chemicals from soil and groundwater contamination has the potential to result in widespread human exposure and may pose significant risks to public health. As Chair of the New York State Assembly Standing Committee on Environmental Conservation, I am committed to working with the Department and other key State and Federal agencies to eliminate those risks.

Compared to other jurisdictions across the country, New York State has been a leader in taking swift and comprehensive action to respond to this newly identified health threat. I appreciate that DOH has acted quickly in drafting this guidance, and it is clear that a tremendous amount of work has been invested in its development. I commend everyone involved. New York has also been one of the few jurisdictions to establish and begin implementation of a process to review so-called "legacy" sites: sites that have already been remediated, but where vapor intrusion may pose ongoing problems.

As you know, the Assembly Committee on Environmental Conservation has held a series of hearings on vapor intrusion across New York State. Testimony from State and Federal officials, public health and environmental experts, and concerned citizens has underscored the need for clear guidance on

addressing vapor intrusion in New York, and for the development of conservative, protective public health standards. The guiding principles behind any vapor intrusion policy adopted by New York State should be protectiveness, caution, fairness, and transparency.

The evidence gathered at the public hearings has documented the high level of uncertainty, even controversy, associated with many of the issues raised by vapor intrusion, from site screening and initial testing through the setting of indoor air quality standards, mitigation and remediation. In the face of this uncertainty, Government must err on the side of caution. It is in this spirit that I offer the following recommendations for changes in the draft Guidance.

1. DOH should revise its current Air Guideline Value for trichloroethene (TCE) to reflect the most protective assumptions about toxicity and exposure supported by science. In addition, the Guideline should be changed to correspond to an excess cancer risk of one-in-one million, which is the target risk level for site remediation established under the new Brownfield Cleanup Program (BCP) statute and the required risk level for the development of soil cleanup objectives under the same statute.

DOH's TCE Guideline was developed separately from the draft Guidance, but it plays a key role in DOH's proposed decision matrix for TCE presented in the Guidance. One of the key findings documented by the Committee's vapor intrusion hearings is that the scientific evidence regarding TCE supports a range of toxicity estimates. This has led to the adoption of indoor air guidelines and screening levels for TCE by U.S. Environmental Protection Agency (EPA) Regions and other states that vary significantly, by an order of magnitude or more. A number of EPA Regions and states have guidelines that are significantly more protective than DOH's Guideline.[21]

The differences in these guidelines are largely due to differences in the protectiveness of underlying assumptions, most importantly the potency of TCE as a carcinogen. The fact that these guidelines have been adopted by government jurisdictions with professional and respected scientific staff is evidence that these assumptions are all scientifically plausible and supported by "sound science." The choice between them is largely a policy choice, not one of science alone. In the face of uncertainty regarding the threat of harm to human health posed by vapor intrusion, the New York State Department of Health should err on the side of caution and adopt an Air Guideline Value for TCE that reflects the most protective assumptions about toxicity and exposure supported by science.

In adopting its current Air Guideline for TCE, DOH chose to select a value that poses greater than an excess cancer risk of one-in-one million. In defense of this choice, the Department argues that the estimated increased human cancer risk associated with lifetime continuous exposure to its TCE Guideline level of 5 mcg/m^3 is within the risk range of one-in-one million to one-in-ten thousand that is generally used by regulatory agencies when making decisions. While the Federal Superfund program allows remedial goals to fall between an excess cancer risk of one-in-ten thousand and one-in-one million, it also establishes that one-in-one million should be used "as the point of departure" for determining such goals when an already established standard is unavailable or "not sufficiently

[21] For a full description of the guidelines used by other jurisdictions, see the Committee's first hearing report, "Vapor Intrusion of Contamination from Soil and Groundwater into Indoor Air: Viewpoints from a Public Hearing" (New York State Assembly Committee on Environmental Conservation, Albany, N.Y., March 2005) pp. 2-3, 18-19, and Appendix F.

protective because of the presence of multiple contaminants at a site or multiple pathways of exposure."[22]

Experts in hydrogeology and toxicology submitted testimony at the Committee's hearings documenting that volatile organic chemicals are easily transformed, during their passage through soil or groundwater, into numerous breakdown products. They also established that it is common for multiple contaminants and multiple pathways of exposure to be present at contaminated Superfund or brownfield sites. These findings support the choice of a risk level for the TCE Guideline of one-in-one million.

Further, New York State has historically shown a preference for the establishment of cleanup standards that correspond to an excess cancer risk of one-in-one million. The State Superfund Program's Technical and Administrative Guidance Memorandum (TAGM) 4046, which has guided the establishment of soil cleanup objectives for over a decade, requires the development of objectives that correspond to an excess cancer risk of one-in-one million for known and probable carcinogens.

More importantly, however, New York State recently established in statute that the target risk level for site remediation under the new Brownfield Cleanup Program (BCP) is an excess cancer risk of one-in-one million (ECL §27-1415(1)). In addition, the statute establishes an excess cancer risk of one-in-one million as the required risk level for the development of soil cleanup objectives under the BCP (ECL §27-1415(6)(b)).

As a final note on this subject, I believe it is crucial for DOH to ensure that the peer review committee being convened to review the Department's TCE Guideline is balanced among scientists recommended by government, business, public health and environmental organizations, and affected citizens.

2. DOH and DEC should adopt a general presumption that mitigation will be implemented for any structure where detectable volatile organic chemical (VOC) contamination is measured under the sub-slab or in indoor air, and evidence exists that the source of such contamination is a contaminated site.

The adoption of a general policy of implementing mitigation where detectable VOC contamination can be associated with a contaminated site is supported by a number of findings from the Committee's hearings across the State.

(a) A number of protective guidelines for TCE are equal to or below the detection limit for TCE. The current level of detect for TCE in indoor air ranges from as low as 0.017 mcg/m^3 through the 0.25 mcg/m^3 required in DOH's draft Guidance to the 0.38 mcg/m^3 currently being used by EPA at the Hopewell site. These numbers are equal to or slightly above the most protective guidelines for TCE adopted by other jurisdictions in the country. In 2001, EPA released a draft toxicity assessment for TCE that presented a range of risk estimates based on different assumptions. The most protective estimate corresponding to an excess cancer risk of one-in-one million is equal to a concentration of TCE of approximately 0.021 mcg/m^3. The least protective estimate for the same risk is 0.43 mcg/m^3 of TCE. Based on the draft assessment, EPA Regions 3 and 6 adopted TCE air guidelines corresponding to an excess cancer risk of one-in-one million of 0.016 and 0.017 mcg/m^3 respectively. Colorado has adopted 0.016 mcg/m^3 as the level at which screening will occur and 1.6 as the level at

[22] 40 CFR §300.430 (e)(2)(i)(A)(1).

which cleanup will be required. EPA Region 9 presents two values, 0.017 and 0.96, in their "Preliminary Remediation Goals Table" published in October 2004. Finally, DOH's own estimated range of concentrations corresponding to an excess cancer risk of one-in-one million for TCE is 0.2 to 4.0 mcg/m^3.

Because detect levels and protective guidelines are so comparable, establishing a presumption for mitigation at detect would be comparable to acting on the most protective assumptions about TCE toxicity and exposure supported by science, an approach that I strongly support.

(b) VOCs are difficult to accurately measure, both under the sub-slab and in indoor air.
Experts in geology, hydrogeology and ecotoxicology submitted testimony at the Committee's hearings documenting that in addition to seasonal variation based on the use of home heating systems, sub-slab and indoor air contaminant levels can vary considerably based on fluctuations in weather, including barometric pressure, wind and soil moisture. Microbial soil conditions, fractures in bedrock, and the presence of preferential pathways such as sewer lines or utility pipes can also make it very difficult to predict accurately the movement of contaminated vapor through groundwater, bedrock or soil and into structures. The draft Guidance contains a detailed and useful description of the many environmental and building factors that affect vapor intrusion on pages 3-4.

Testimony submitted to the hearings by these same experts recommended that sampling for VOCs in sub-slab or indoor air must be undertaken over a long enough period of time to account accurately for variation. They did not believe that a 24-hour sample would be adequate to measure long-term exposure. In addition, the experts recommended that given the variability of vapor intrusion and the difficulty inherent in mapping intrusion pathways accurately, it would be better to act quickly to implement mitigation measures in each structure that could potentially be affected. They emphasized that money would be better spent on mitigation than on extensive air sampling and analysis.

(c) The costs of mitigation and monitoring are comparable, and a number of responsible parties and agencies have made risk management decisions at individual sites to mitigate at detect in order to save time and money.
Mitigating at detect is not only the most protective option, it may also be the most practical. In those cases where installation is straightforward, the cost of mitigation can be as low as $1,000 to $2,000. If conditions at a structure make installation complex, mitigation can cost as much as $30,000. Monitoring costs $2,000 to $3,000 per testing event. If monitoring is done on an annual basis, the costs will quickly exceed the cost of straightforward mitigation, and will be comparable to even the most expensive mitigation actions within ten years.

DOH testified at the Ithaca hearing that in a few of the places around the State where the Department has been working with responsible parties, those parties are choosing to install mitigation systems wherever they find contamination. According to the Department, this choice is based on a number of considerations, including cost, liability, and community relations. In conversations with Assembly staff, both DOH and DEC have predicted that many responsible parties in the future will choose to mitigate at detect in order to save money and protect themselves from liability.

Based on testimony at the Committee Hearing in Hopewell Junction, it seems that EPA made a decision to mitigate at the Hopewell Precision site, largely based on risk management considerations, including cost.

(d) Mitigating at detect will reduce the potential for inequitable outcomes, where some residences will have their exposures mitigated but others exposed to the same level of contamination will not.

Testimony at the Committee's hearings has shown that residents are angry and confused when decisions to mitigate are triggered by different levels of contamination – both at the same site, and at different sites. Setting a uniform standard (e.g., the current detect level) would go far toward eliminating this perception of injustice.

(e) Living with uncertainty is one of the most difficult aspects of living at or near a contaminated site.

Living with uncertainty is a source of incredible stress and frustration for those who live near a contaminated site. This uncertainty is a given, at least for the foreseeable future, and government has a responsibility to relieve the distress associated with uncertainty to the extent practicable. Implementing mitigation where measurable levels of contaminants have been detected and can plausibly be associated with a contaminated site is a reasonable and effective approach to addressing the uncertainty associated with vapor intrusion, including that associated with toxic effects and accurate measurement of exposure.

The considerations outlined in this recommendation support the adoption of a policy by DOH and DEC that establishes a presumption for the mitigation of structures wherever measurable levels of VOCs are detected in sub-slab or indoor air and evidence exists that the source of such contamination may be a contaminated site. However, an exception could be made in cases where substantial evidence indicates that such levels are not due to contamination from a site; or the costs of mitigation are unreasonably high, measured levels of contamination are extremely low, and a high degree of certainty exists regarding the accuracy of such measurements. In other words, a presumption for mitigation would not eliminate the need to consider all the various factors described in the draft Guidance that may affect vapor intrusion. In contrast to the draft Guidance, it would require that DOH and DEC fully and transparently document their reasoning behind a decision not to mitigate where contamination has been found.

3. DOH's draft Guidance should be revised to clarify the role of sub-slab and indoor air concentrations and more accurately reflect the crucial role played by other factors in testing and mitigation decisions.

The final Guidance released by DOH must be transparent and fully describe all the factors that are considered when making screening and mitigation decisions, in addition to sub-slab and indoor air concentrations. While the current draft includes a great deal of important information, it is not fully transparent and provides little guidance on how the myriad factors considered by DOH and DEC are weighed when making testing and mitigation decisions.

Most importantly, the draft Guidance must do a better job of fully describing all the factors that are considered when making screening and mitigation decisions, and the role each factor plays in determining whether or not to test or mitigate. The draft Guidance contains a useful list of factors considered by the Department in making testing and mitigation decisions, in addition to contaminant concentrations, on pages 28-35.

I recommend that this list be expanded to include:

(a) Overall protectiveness of public health and the environment, including the potential for impacts on children and other sensitive populations

(b) The potential for multiple pathways of exposure, exposure to multiple sources of contamination, and/or exposure to multiple contaminants with similar and/or additive toxic effects

(c) Short-term and long-term effectiveness

(d) The degree of uncertainty associated with measuring sub-slab and indoor air contamination at a site or in individual homes or other structures potentially impacted by a site

(e) The degree of uncertainty associated with fully characterizing groundwater and soil contamination, the movement of such contamination through groundwater, soil or bedrock, and predicting the impact of such contamination on indoor air

(f) Implementability

(g) Cost effectiveness, including the relative cost of mitigation as compared to monitoring

(h) The potential for inequitable outcomes

(i) Community acceptance

The concentration of contaminants measured in soil vapor, sub-slab vapor and indoor and outdoor air should be treated as one factor to be considered among all these factors and those listed in the Guidance.

The entire set of factors should be used in a fashion similar to the remedy selection criteria used under the National Contingency Plan, the State Superfund Program, and the new Brownfield Cleanup Program. Experience under those programs has proven that a clear list of remedy selection factors can go a long way toward making agency decision making more transparent and readily understandable to the public.

In addition to describing each factor, the Department should provide a more substantive discussion regarding the role each factor plays in deciding whether to test or mitigate at structures. One value of the two-dimensional sub-slab vs. indoor air contaminant concentration matrix proposed by the Department is that it gives a strong indication of how the agency will weigh different contamination levels when making testing and mitigation decisions. The Department should provide similar information for each of the factors it considers in making such decisions. For example, the Department could state that if the cost of mitigation is equal to that of monitoring, mitigation is more likely to be implemented; or if the measurement of sub-slab or indoor air contamination is highly uncertain, the Department would choose to mitigate whenever measurable levels of contamination are detected.

4. If DOH chooses to use "decision matrices" of sub-slab vs. indoor air contamination to guide testing and mitigation decisions, the importance placed upon such matrices should be de-emphasized and the matrices should be characterized as one factor to be considered among many.

One of the weaknesses of the draft Guidance is that the draft decision matrices place too much emphasis on only two factors: sub-slab and indoor air contaminant levels. As drafted, it seems that actions are clearly tied to those levels, and as a result, although additional factors to be considered are listed, those factors are afforded much less importance.

The draft decision matrices also establish artificial and overly "bright" lines between sub-slab and indoor air contamination thresholds. This is proving to be very confusing to the public, and is opening DOH to criticisms that may be undeserved. In actuality, as both Departments have emphasized in their testimony and meetings with Assembly staff, many considerations go into decisions regarding testing and mitigation. Any matrices that are used in the final Vapor Intrusion Guidance should be clearly identified as a flexible decision-making tool that the Department will consider as one factor among many others in evaluating the needs of a site.

This can be achieved by giving more emphasis to the other decision factors, as recommended above. The sub-slab/indoor air decision matrices should either be abandoned altogether, or redrafted in such a way that the bright lines are blurred and the importance of all the other factors is emphasized.

The decision matrix used by EPA Region 2 is one example of the latter approach. While some quadrants clearly require a particular action such as "investigate," "monitor" or "mitigate," others present more than one option, and most discuss additional considerations, such as cost, that might tilt a decision toward a different action.

Consistent with the recommendation to mitigate where contamination is detected and evidence exists that the source is the contaminated site, any matrix used by the Department should include "mitigate" as an option in any quadrant where sub-slab or indoor air contamination levels are at or above detect. Other considerations can then be used to justify those situations where mitigation is not carried out.

5. If DOH chooses to use "decision matrices" of sub-slab vs. indoor air contamination to guide testing and mitigation decisions, the thresholds used in the matrices should be based upon the most conservative assumptions and provide the greatest level of public health protection.

The thresholds used in the Department's matrices for TCE and PCE are too high. EPA Region 2's upper threshold for sub-slab action (for TCE) is 50 mcg/m^3. Matrix 1 in DOH's Draft Guidance provides an upper threshold for action of 250 mcg/m^3 and above. Also see the prior discussion concerning DOH's TCE Guideline.

Furthermore, any matrices utilized by DOH must be transparent. The rationale for selecting all thresholds used must be clearly articulated. For example, if there is information supporting the use of different values on the axes of the matrices (e.g., exposures to 0.25 mcg/m^3 of TCE and 2.5 mcg/m^3 have different health outcomes), this information needs to be provided.

A matrix developed for a specific contaminant (TCE and PCE) being utilized for other contaminants is problematic. There is no evidence that the specific human health risks, data gaps, background concentrations, and analytical capabilities available for these specific contaminants will be

appropriate for use with other contaminants (e.g., fitting toluene into a PCE matrix may be inappropriate).

6. The testing and investigation of potential vapor intrusion sites should include the sampling of structures during all seasons of the year and under different weather conditions; be of long enough duration to accurately reflect actual conditions; take preferential pathways and the potential for chemical transformation into account; and include measurements of the lower air space frequently occupied by children.

As discussed above, experts in geology, hydrogeology and ecotoxicology submitted testimony at the Committee's hearings documenting that in addition to seasonal variation based on the use of home heating systems, sub-slab and indoor air contaminant levels can vary considerably based on fluctuations in weather, barometric pressure, soil conditions, geology and the presence of preferential pathways. These experts recommended that sampling must be undertaken over a sufficient period of time and under differing conditions in order to accurately account for variation due to such factors. They did not believe that a 24-hour sample would be adequate to measure long-term exposure. An expert in children's environmental health testified that TCE is heavier than air and settles toward the floor, increasing the probability that children's exposures will be higher than adults, since they spend more time playing and living in that airspace than adults.

DOH and DEC should revise their sampling protocol to address these concerns and ensure that sub-slab and indoor air contaminant concentrations are measured as accurately as possible.

7. The indoor air of homes adjacent to a contaminated site with a potential for vapor intrusion should be tested whenever a resident requests such a test.

As discussed above, living with uncertainty is one of the most difficult aspects of living near a contaminated site. Government can help relieve that uncertainty by providing concerned citizens with as much information as possible about the risks posed by a site, including the potential for individuals to be exposed to toxic contaminants. At the Committee's hearings, concerned citizens repeatedly testified that they have been unable to secure testing of their homes when those structures lie outside the perimeter of the neighborhood targeted for testing by DOH and DEC. This situation is unacceptable given the high level of uncertainty associated with the mapping of contaminated soil and groundwater and assessment of the potential for vapor intrusion.

Residents living adjacent to or near a contaminated site with a potential for vapor intrusion, but outside the perimeter of the area that has been designated to be tested, have legitimate concerns regarding whether contamination is present in their homes. At a cost of two thousand dollars or more, testing represents a large cost to residents but only a small percentage of the overall cost of cleaning up a site. The indoor air of homes adjacent to or near a contaminated site with potential for vapor intrusion should be tested by DOH and DEC whenever a resident requests such a test.

8. Although the draft guidance provides for the use of easements if a site will not be developed in the foreseeable future, it is not clear what criteria will be utilized for the investigation of such sites when development is pursued.

The current draft Guidance focuses on the relationships between sub-slab vapors and indoor air contamination levels, which will not be applicable at undeveloped sites. The final Guidance should set out the criteria that will be used to determine whether there is a potential for vapor intrusion and,

if so, what actions should be taken. For example, California's Vapor Intrusion Guidance provides engineering controls that need to be installed in any future buildings.

9. The policy for tracking known contamination so that it does not impact on other sites in the future should be identified.

As the issue of vapor intrusion has demonstrated, contaminants continue to migrate through soil and groundwater, resulting in exposures in areas far removed from the origin of the contaminant release. While the preference should be to remediate the source, there remains the potential for vapor intrusion, as has been witnessed at several Federal and State Superfund sites. The final Guidance should include a reference to the measures that will be taken by the State to track and remediate such contamination to minimize future impacts, as provided in the Brownfield Cleanup Program.

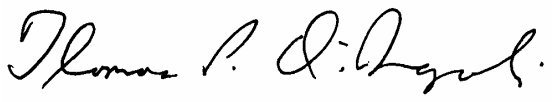
Conclusion

Recommendations regarding DOH's draft vapor intrusion Guidance are based on three basic principles: that decisions regarding the investigation and mitigation of vapor intrusion must be as transparent as possible and provide opportunities for meaningful public participation; that in the face of the high degree of uncertainty associated with vapor intrusion government should err on the side of caution; and that decisions regarding investigation and mitigation must be as fair and equitable as possible.

DOH should revise its draft Guidance to incorporate the most protective assumptions about toxicity and exposure supported by science. The ultimate goal of New York State's vapor intrusion policy should be to reduce the risk to human health to an excess cancer risk of one-in-one million and a hazard index of one for non-cancer end points. Mitigation should be considered for any structure in which VOC contamination is detected and can plausibly be associated with vapor intrusion. The draft Guidance should be revised to describe fully and transparently all the factors and considerations that are taken into account when DOH and DEC make investigation and mitigation decisions. Testing should ensure that contaminants are measured as accurately as possible, and citizens with legitimate concerns regarding the potential for vapor intrusion into their homes should have their homes tested. Finally, the State's vapor intrusion policy must afford every resident the same level of protection.

I look forward to continuing to work with both the Department of Health and the Department of Environmental Conservation to craft a transparent, preventive and equitable approach to eliminating exposures from vapor intrusion.

Sincerely,



Thomas P. DiNapoli
Chair, NYS Assembly
Environmental Conservation Committee

CC: Hon. Denise Sheehan, Acting Commissioner, NYS DEC
Hon. Maurice Hinchey, US Congress
Hon. Sue Kelly, US Congress
Hon. Barbara Lifton, NYS Assembly
Hon. Donna Lupardo, NYS Assembly
Hon. Patrick Manning, NYS Assembly
Carl Johnson, Deputy Commissioner for Air and Waste Management, NYS DEC
Nancy Kim, Director, Division of Environmental Hazard Assessment, NYS DOH

Dale Desnoyers, Director, Division of Environmental Remediation, NYS DEC
Andy Carlson, Director, Division of Environmental Health Investigation, NYS DOH
William McCabe, Acting Director, Division of Emergency Remedial Response, US EPA

APPENDIX F – TABLE OF TCE GUIDELINES

Appendix F							
	Range of TCE Values Cited by NYS DOH and EPA After Reviewing Numerous Scientific Studies				TCE Guidelines Used By Various Agencies		
	DOH*		EPA*		EPA		EPA Region 2
	Less Conservative Value	More Conservative Value	Less Conservative Value	More Conservative Value	"Old Withdrawn" Value*	Proposed Draft Target Indoor Air Concentration*	—
Toxicity Value (Cancer Slope Factor) $(mg/kg\text{-}d)^{-1}$	0.000875	0.0175	0.02	0.40	0.006	0.40	0.40
Concentration of TCE in Indoor Air Corresponding to a One-in-One Million 10^{-6} Cancer Risk (mcg/m^3)	4	0.2	0.43	0.021	1.4	0.022	0.05
Concentration of TCE in Indoor Air Corresponding to a One-in-Ten Thousand 10^{-4} Cancer Risk (mcg/m^3)	-----	-----	43	2.1	140	2.2	5.0
Notes	*DOH states that this range of values is based on published estimates (from animal studies) and DOH-derived estimates (which take the quality of the data in the animal studies into consideration).		*EPA's draft toxicity assessment provides a range of toxicity values (cancer slope factors). These toxicity values are the basis for calculating TCE risk concentrations. However, the draft assessment does not actually provide these risk concentration estimates. The risk concentrations noted here were cited in an EPA Region 8 Technical Publication which states that the estimates were derived using EPA's standard residential exposure assumptions (70-kg individual occupying a residence 24/hours/day, 350 days/year, for 70 years breathing 20 m^3 of air per day)		*This toxicity value (cancer slope factor) was withdrawn from EPA's Integrated Risk Information System (IRIS) in 1989. IRIS presently contains no quantitative toxicity information for TCE. The TCE risk concentrations shown here were cited in an EPA Region 8 Technical Publication which states that the estimates were derived using EPA's standard residential exposure assumptions.	EPA's Draft Vapor Intrusion Guidance provides generic screening levels at cancer risks of 10-4, 10-5, and 10-6. The cancer slope factor is not explicitly stated, but a footnote to the tables states "the target concentration is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for TCE." The footnote also indicates that since the draft assessment is still undergoing review, the slope factor and concentration values may be revised further.	EPA Region 2 has not formally published these values in guidance. In addition to looking at sub-slab and indoor air contaminant levels, Region 2 considers a number of site-specific factors in order to make screening and cleanup decisions.
Source	Letter from Nancy Kim, Director of the Division of Environmental Health Assessment, to Dale Desnoyers, Director of Division of Environmental Remediation (October 31, 2003); cancer potency factors provided in email from Nancy Kim to Assembly staff (June 10, 2005)		EPA Region 8 Technical Publication (January 26, 2005)		EPA Region 8 Technical Publication (January 26, 2005)	EPA's "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils" - Tables 2a, 2b and 2c (November 2002) www.epa.gov/correctiveaction/eis/vapor	Testimony of William McCabe, Acting Director of Emergency and Remedial Response, EPA Region 2, Hopewell Hearing Transcript, pp.54.

Appendix F – Table of TCE Guidelines – Page 2

Appendix F								
	TCE Guidelines Used By Various Agencies							
	EPA Region 3	EPA Region 6	EPA Region 9		California Environmental Protection Agency	Colorado Department of Health and Environment	New Jersey Department of Health and Senior Services	New York State Department of Health
	Risk Based Concentration	Human Health Medium-Specific Levels	Preliminary Remediation Goal*		Target Indoor Air Concentration	Screening and Cleanup Levels*	Residential Health-Based Value	TCE Indoor Air Guideline*
Toxicity Value (Cancer Slope Factor) $(mg/kg-d)^{-1}$	0.40	0.40	0.40	0.007	0.007	-----	-----	
Concentration of TCE in Indoor Air Corresponding to a One-in-One Million 10^{-6} Cancer Risk (mcg/m^3)	0.016	0.017	0.017	0.96	1.22	0.016	0.02	5.0
Concentration of TCE in Indoor Air Corresponding to a One-in-Ten Thousand 10^{-4} Cancer Risk (mcg/m^3)	-----	-----	-----	-----	-----	1.6	-----	
Notes			*The 2004 Region 9 Preliminary Remediation Goal (PRG) Table shows two different values for TCE. One value (.017) is derived from a toxicity factor of 0.4 and is based on conservative toxicity assumptions from the EPA's 2001 draft toxicity assessment. The other value (.96) is derived from a toxicity value of 0.007 and is based on toxicity assumptions used by the State of California.			*Screening for TCE will occur at the level of 0.016 and cleanup would be required at the level of 1.6 mcg/m^3.	This is a lower value than NJ's Residential Screening Level and Indoor Action Level, which are based on the higher of the Residential Health Based Value and the TO-15 Analytical Reporting Limit, which is 3.0 mcg/m^3.	*Adopted in October 2003. DOH states that "the estimated increased human cancer risks associated with lifetime continuous exposure to 5 mcg/m^3 are in the risk range (1*10E-6 to 1*10E-4) that is generally used by regulatory agencies when making decisions."
Source	EPA Region 3 Risk-Based Concentration Table (October 2004) www.epa.gov/reg3hwmd/risk/human/index.htm	EPA Region 6 Human Medium-Specific Screening Levels Table (December 2004) www.epa.gov/correctiveaction/eis/vapor.htm	EPA Region 9 PRG Preliminary Remediation Goals Table (October 2004) www.epa.gov/region09/waste/sfund/prg/index.htm		Cal-EPA report "Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil" (November 2004) www.oehha.ca.gov/risk/pdf/screenreport010405.pdf	Colorado Department of Public Health and Environment. Press Release (August 20, 2004) www.cdphe.state.co.us/release/2004/082004.html	New Jersey Department of Environmental Protection, "Vapor Intrusion Guidance," Tables 2 and G-4 (October 6, 2005) www.nj.gov/dep/srp/guidance/vaporintrusion.	Letter from Nancy Kim, Director of the Division of Environmental Health Assessment, to Dale Desnoyers, Director of Division of Environmental Remediation (October 31, 2003)

Appendix G – USEPA Vapor Intrusion Decision Making Matrix

--- Final Draft ---
July 08, 2004

Table 1. USEPA Vapor Intrusion Matrix For Carcinogenic Chemicals

Sub Slab Soil Gas Concentration (units)	Cancer Risk (CR) of 10^{-4} to CR of 10^{-5} -1) OR < Target Indoor Air Concentration from Table 2c to (Target Indoor Air Concentration from Table 2b-1)	Indoor Air concentration (Units) CR of 10^{-5} to CR of 10^{-4} OR Target Indoor Air Concentration from Table 2b to (Target Indoor Air Concentration from Table 2a-1)	> CR of 10^{-4} OR > Target Indoor Air Concentration from Table 2a
[CR of 10^{-6}/Attenuation Factor] to CR of 10^{-5}/Attenuation Factor]-1 OR < Target Shallow Soil Gas Concentration from Table 2c to (Target Shallow Soil Gas Concentration from Table 2b-1)	1 NO ACTION – Potentially site-related and within acceptable risk range.	2. INVESTIGATE – Potentially site related and within acceptable risk range. Further investigation needed to identify source and preferential pathway(s).	3 INVESTIGATE – Many not be site related. Further investigation needed to identify a source or preferential pathway(s).
[CR of 10^{-5}/Attenuation Factor] to [CR of 10^{-4}/Attenuation Factor}-1 OR Target shallow soil gas concentration from Table 2b to (Target Shallow Soil Gas Concentration from Table 2a-1)	4. MONITOR – probably site-related and within acceptable risk range. Potential for future exposures. Collection of additional data or further investigation may aid decision process, however reliable decisions may be made with the inclusion of other factors, such as cost, which would suggest that pursuing remediation is warranted.	5. MONITOR or PURSUE REMEDIATION Probably site-related with potential for exposures at concentrations approaching the upper-bound of the acceptable risk range. Collection of additional data may aid decision process, however, reliable decisions may be made with the inclusion of other factors, such as cost, which would suggest that pursuing remediation is warranted.	6. INVESTIGATE or PURSUE REMEDIATION – Potentially site-related and above the upper bound of the acceptable risk range. Further investigation needed to identify other potential pathway(s). If none found remediation is the preferred option due to indoor air concentrations exceeding the upper bound of the acceptable risk range.
	7. MONITOR or PURSUE REMEDIATION – probably site-related and within acceptable risk range, however further monitoring may be advisable prior to remediation to determine the future potential for vapor intrusion from elevated soil gas concentrations. Alternatively, remediation could be performed to eliminate the potential for future exposures with potential cost savings by eliminating additional monitoring costs.	8. [CR of 10^{-4}/Attenuation Factor] OR Target Shallow Soil Gas Concentration from Table 2a.	9. PURSUE REMEDIATION – probably site related and above the upper-bound of the acceptable risk range. Elevated soil gas and indoor air could lead to future exposures with risks above the acceptable range.

Note: (a) Target Indoor Air Concentrations and Target Shallow Soil Gas Concentrations for the row and column headings can be found in the November 2002 USEPA draft Vapor Intrusion Guidance document referenced within the text; and (b) Values that are below the range listed in the first column or row should be evaluated by assuming that the lowest value in the range was detected.