Air Modeling as a Tool in Environmental Law and Policy: A Guide for Communities and Environmental Groups

Part II:

Practical Uses of Air Modeling in Litigation and Regulatory Contexts

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Authors and Purpose

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Disclaimer

This paper is intended as a general introduction to the law and policy of air modeling under the Clean Air Act. Nothing in this paper is intended, nor shall it be construed as creating an attorney-client relationship or providing legal advice.

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Introduction

In recent years, the scientific community has developed a better understanding of the effects of various air pollutants on human health and the environment. Increasingly, this has included concerns about potentially harmful impacts to the health of large groups of residents living near sources of air pollution.[1] At the same time, the scientific and engineering tools for evaluating the relationship between air emissions and exposure have become more sophisticated. In various contexts, litigants are increasingly seeking to use those tools to estimate levels of exposure to residents from a proposed source of air pollution, or to reconstruct past exposure to determine causes of health impacts and property damage.[2] At the vanguard of developing technology is air dispersion modeling.[3] An air dispersion model is a computer simulation that uses mathematical formulations to characterize the way a plume of air emissions will behave after it is emitted from a source. Specifically, it addresses how the plume will disperse and move downwind from its source.[4]

This white paper will explore various ways in which litigants can use air modeling to establish tort claims, under reported judicial decisions. It will then discuss ways in which litigants can use air modeling to challenge the issuance of air pollution permits in the Clean Air Council's (Council) home state of Pennsylvania. Finally, it will describe a specific air modeling project that the Council has undertaken, as well as its results and implications. The Council modeled air emissions from a compressor station located along a natural gas pipeline in Pennsylvania. The proliferation of the fracking industry in Pennsylvania has raised questions

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[1] Jose A. Berlanga & Nancy J. Brown, Establishing Tort Liability With Regulatory Tools? The Utility of Air Modeling as a Surrogate for Monitoring Data, 3 ENVTL. & ENERGY L. & POL'Y J., 1, 2 (2008).
[2] *Id.* at 3.
[3] *Id.*
[4] *Id.*; *see also* U.S. Envt'l Prot. Agency, Dispersion Modeling, https://www3.epa.gov/ttn/scram/dispersionindex.htm (last visited September 15, 2016).

and concerns regarding the release of harmful air pollutants, including hazardous air pollutants. The Clean Air Council's modeling was intended for gathering and evaluating data regarding emissions from one source.

1. Use of Air Modeling to Support Tort Claims

Some federal courts have directly examined the issue of whether particular uses of air modeling are sufficiently reliable for demonstrating causation in tort claims. This has arisen in the context of motions for summary judgment (motions for judgment without a trial), motions *in limine* (motions to exclude or admit expert testimony), and motions for class certification (motions to designate a class in class action cases).

Challenges to the use of air modeling in tort cases typically involve a particular modeling software and the reliability of its assumptions. Such challenges tend to be resolved in favor of admissibility. It is rare that air modeling expert testimony is excluded before trial. Courts tend to hold that challenges to experts with respect to the appropriate air modeling software or its assumptions go to the credibility of the experts and the weight of their opinions, rather than to the admissibility of those opinions.

a. Challenges to the Use of Particular Modeling Software or to Underlying Assumptions

Much litigation over air pollution occurs in federal court, rather than state court. Federal courts have jurisdiction over cases involving federal questions, including those arising under a federal law.[5] Under the federal Clean Air Act, there is federal jurisdiction for citizen suits and actions challenging state implementation plans.[6] In addition, federal courts have jurisdiction over actions involving diversity of parties (actions by a citizen of one state against a citizen of

[5] 28 U.S.C. §1331.
[6] 42 U.S.C. §7604 (citizen suits), §7607 (actions challenging state implementation plans).

another state), where the matter in controversy involves more than $75,000.[7] Environmental tort claims in federal court are typically based on diversity jurisdiction, rather than federal question jurisdiction.

The starting point in any analysis of the admissibility of expert testimony in federal court is the Federal Rules of Evidence. Rule 702 allows the admission of expert testimony if four conditions are met:

> A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:
> (a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
> (b) the testimony is based on sufficient facts or data;
> (c) the testimony is the product of reliable principles and methods; and
> (d) the expert has reliably applied the principles and methods to the facts of the case.

Rule 702, Federal Rules of Evidence.

For the past several decades, there has been a proliferation of federal litigation involving complex issues of scientific and technical knowledge. As a result, federal courts have developed extensive case law regarding the admissibility of expert testimony. The landmark case is *Daubert v. Merrell Dow Pharmaceuticals*.[8] In interpreting Rule 702, the U.S. Supreme Court rejected the longstanding "general acceptance" test, requiring instead that expert evidence merely be reliable, for it to be admissible.[9] This holding applies to all expert testimony of any nature.

The United States Court of Appeals for the Third Circuit has appellate jurisdiction over federal district courts in Pennsylvania, Delaware, and New Jersey. Interpreting Rule 702 and

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[7] 28 U.S.C. §1332.
[8] *Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 597 (1993).
[9] *Id.* at 579 ("General acceptance" is not a necessary precondition to the admissibility of scientific evidence under the Federal Rules of Evidence, but the Rules of Evidence – especially Rule 702 – do assign to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand. Pertinent evidence based on scientifically valid principles will satisfy those demands.").

Daubert, the Court has developed three requirements for the admissibility of expert testimony: (1) qualification, (2) reliability, and (3) fit.[10] With respect to qualification, the expert must have substantive qualification to testify as an expert, and the courts will interpret this liberally in favor of admissibility.[11] With respect to reliability, the opinion must be based on the methods and procedures of science, rather than subjective belief or unsupported speculation.[12] The Court has recognized a list of eight factors to be considered in evaluating whether a particular scientific methodology is reliable.[13] The requirement of fit is based on the premise that the testimony must assist the trier of fact, either the jury or the judge (in a bench trial).[14] This means that there must be a connection between the scientific research or test result and the particular disputed issues in the case.[15]

A series of decisions from the United States District Court for the Western District of Pennsylvania in *Hartle v. First Energy Generation Corp.* provides guidance for the applicability of these principles in federal courts in Pennsylvania.[16] Property owners and other plaintiffs brought three consolidated actions against the owner and operator of the Bruce Mansfield Power Plant, a coal-fired power plant located along the Ohio River in Shippingport, Pennsylvania.[17] The plaintiffs alleged that in 2006 and 2007 they were harmed by air pollution from the plant, in the form of "white rain," a chronically discharged corrosive material, and

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[10] *In re Paoli R.R. Yard Pcb Litig.*, 35 F.3d 717, 741-743 (3rd Cir. 1994).
[11] *Id.* at 741 (noting the Court's rejection of overly rigorous requirements in favor of more generalized qualifications, and noting that the level of expertise may relate to the second requirement, reliability).
[12] *Id.* at 742.
[13] *Id.*, fn. 8 ("Thus, the factors *Daubert* and *Downing* have already deemed important include: (1) whether a method consists of a testable hypothesis; (2) whether the method has been subject to peer review; (3) the known or potential rate of error; (4) the existence and maintenance of standards controlling the technique's operation; (5) whether the method is generally accepted; (6) the relationship of the technique to methods which have been established to be reliable; (7) the qualifications of the expert witness testifying based on the methodology; and (8) the non-judicial uses to which the method has been put.")
[14] *Id.* at 742-743.
[15] *Id.* at 743.
[16] *Hartle v. First Energy Generation Corp.*, 7 F.Supp.3d 510 (W.D. Pa. 2014).
[17] *Id.*

“black rain,” a dark-colored sooty residue.[18] The plaintiffs alleged that the pollution was causing property damage as well as negative health impacts.[19] They brought claims for negligence, battery, trespass, and private nuisance.[20] To show the extent of the white rain and black rain events, the parties sought to introduce testimony from air modeling experts.[21] The plaintiffs’ expert relied primarily on a model known as AERMOD (American Meteorological Society/Environmental Protection Agency Regulatory Model).[22] The defendants sought to exclude the testimony of the plaintiffs’ expert, arguing that AERMOD was not an appropriate model for measuring liquid stack discharge and that a different model known as AGDISP (the Agricultural Dispersal model of the U.S. Forest Service) would be more appropriate.[23] The court held that these objections went to the weight of the experts’ testimonies, and not to their admissibility.[24] Accordingly, the Court rejected plaintiffs’ and defendant’s opposing motions to exclude each other’s primary expert.

A review of the Court’s reasoning is helpful. The battle of experts centered around the inability of the AERMOD model to address the role of evaporation. With respect to the plaintiffs’ expert, the Court held that the expert could make adaptations to the AERMOD model to address evaporation, and that this did not change the soundness of the underlying methodology of the model.[25] In response to the defendant’s objections that field observations were inconsistent with the expert’s testimony, and that there were inherent rates of error, the Court held that the objections went to the weight of the evidence rather than to its

[18] *Id.* at 513.
[19] *Id.*
[20] *Id.*
[21] *Id.* at 516.
[22] *Id.*
[23] *Id.*
[24] *Id.* (“Which of the competing models better reflects the facts of these cases is for the jury to decide.”).
[25] *Id.* at 518.

admissibility.[26] Disputes about the conclusions to be drawn from the expert testimony (that is, whether every property must be considered affected by the pollution) were also for the trier of fact.[27] The fact that the plaintiffs' expert used a method that was not approved by the U.S. Environmental Protection Agency (EPA) for measuring particulates from stacks with liquid droplets did not necessarily establish that the methodology was not reliable.[28]

With respect to the defendant's expert, the Court held that the use of a different model (AGDISP) for evaporation was not unreliable, even though AGDISP was not a preferred model for measuring wet stack emissions with a stationary smoke stack.[29] Where the expert had considered the limitations of the model and had logical grounds for concluding that it did not affect the accuracy of the model, the plaintiffs' objection went to weight, rather than admissibility.[30]

In contrast to its approach for the parties' primary experts, the Court excluded the expert opinion of a third expert offered by the defendant. That expert was a chemical engineer and not an air modeler, and he simply presented his interpretation of the other expert's evidence, and attacked the credibility of the opposing expert's testimony.[31] Consequently, if the testimony of an expert is intended solely as supplemental testimony to attack the credibility of an opposing expert, it is more likely to be excluded.

Air modeling evidence that clearly demonstrates exposure to pollutants through an air pathway is important to effectively establishing a tort claim. For example, in *South Camden Citizens in Action v. New Jersey Department of Environmental Protection*, plaintiffs asserted a

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[26] *Id.*
[27] *Id.* at 521-522.
[28] *Id.* at 522-523.
[29] *Id.* at 524-525.
[30] *Id.* at 525.
[31] *Id.* at 525.

private nuisance claim. The claim alleged that "dust, soot, vapors and fumes" from a granulated blast furnace slag grinding facility, along with noise, vibration, and traffic associated with that facility, were unreasonably interfering with their use and enjoyment of their property.[32] Plaintiffs submitted a report from an air modeling expert. However, he did not clearly tie the facility to the plaintiffs' homes, and did not rule out other potential sources of the air pollution. Instead, "he is silent on the issue of the levels of particulate matter attributable to [the facility], as opposed to that caused by the other industrial operations that Plaintiffs have acknowledged to exist and to cause such impacts."[33] Because the plaintiffs did not submit modeling evidence to support their assertion that the facility was exposing them to air pollution above the background levels to which they were already exposed, the court found the report to be unhelpful. While the court acknowledged that the issue of proximate causation is usually one that is left to a jury to decide,[34] the court found the evidence on causation so lacking that it granted summary judgment on the nuisance claim, in favor of the defendants.[35]

Most of the other reported cases in the federal courts in Pennsylvania involving the admissibility of expert testimony relate to the testimony of medical professionals regarding exposure, as opposed to the testimony of engineering experts regarding dispersion of air pollutants. Nevertheless, they may be relevant in a particular dispute relating to the admissibility of the testimony of an air modeling expert.

Federal courts outside Pennsylvania and the Third Circuit have addressed the admissibility of expert testimony on air modeling. In *Abarca v. Franklin County Water District*

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[32] *S. Camden Citizens in Action v. New Jersey Dep't of Envtl. Prot.*, No. Civ.A. 01-702 (FLW), 2006 U.S. Dist. LEXIS 45765, at *44 (D.N.J. Mar. 31, 2006).
[33] *Id.* at *64.
[34] *Id.* at *48 ("Ordinarily, issues of proximate cause are considered jury questions") (citing *Perez v. Wyeth Labs, Inc.*, 161 N.J. 1, 27 (1999)).
[35] *S. Camden Citizens in Action*, at *64-65.

the plaintiffs brought various claims relating to alleged leaks from a cooling tower facility, including claims for negligence, trespass, nuisance, and wrongful death.[36] The plaintiffs alleged that they were exposed to contaminants from the defendants' cooling tower through multiple pathways, including migration through the air.[37] The defendants moved for summary judgment on the tort claims, asserting that there was no evidence of exposure through any pathway, including air. The plaintiffs opposed the motion, arguing that they had presented expert evidence showing that "contaminants from the [facility] have historically migrated from the facility via groundwater, surface water, and air pathways to locations where plaintiffs were exposed to them and at levels which could cause harm."[38]

To meet their burden on their claims for exposure to hexavalent chromium and arsenic through wind and other airborne pathways, the plaintiffs submitted testimony from an expert air modeler.[39] The defendants attempted to exclude the testimony from consideration on the summary judgment motion, arguing that the model was based on a flawed methodology.[40] The court held that the model's use of a different algorithm to calculate fugitive air emissions did not render the emissions scenario invalid.[41] The court found that "a disagreement over methodology is left to the adversary process and the trier of fact,"[42] and held that the expert's emission scenario was "relevant, admissible, and can be challenged through cross-examination and presentation of contrary evidence."[43]

One case indicates that expert testimony on air dispersion modeling need not be limited to specific, identifiable air pollutants, and can be addressed to odors. In *Powell v. Tosh*, a group

[36] *Abarca v. Franklin County Water District*, 761 F. Supp. 2d 1007 (E.D. Cal. 2011).
[37] *Id.* at 1012, 1018.
[38] *Id.* at 1020.
[39] *Id.*
[40] *Id.* at 1031.
[41] *Id.*
[42] *Id.*
[43] *Id.*

of property owners sued a group of swine farmers, alleging that the farmers' use of barns to store hog waste caused a noxious odor, and asserting various tort claims including nuisance and negligence.[44] The defendants sought to introduce the testimony of an expert witness, Kirk Winges, who had used AERMOD to conduct a study of the odors from the hog barns.[45] The plaintiffs challenged the admissibility of that testimony on a variety of grounds, including the assertion that AERMOD is not a sufficiently reliable method for estimating odor dispersion and impact.[46] The court declined to exclude Winges' testimony. Because EPA had designated AERMOD as a preferred model and other courts had found expert testimony based on AERMOD sufficiently reliable to be admissible, the court held that the requirements of *Daubert* were satisfied.[47] The court in *Powell* found that "[t]o the extent Plaintiffs wish to challenge Winges' conclusions or selection of the AERMOD model, these challenges go more appropriately to the weight of Winges' opinions and are properly reserved for cross-examination.[48]

While courts tend to admit air modeling evidence and let the factfinder (typically a jury) resolve disputes about the appropriateness of the model and its assumptions, there are limits to what courts will allow. In *In re Voluntary Purchasing Groups, Inc.*, the plaintiffs sought to introduce the testimony of an air dispersion modeling expert to establish the atmospheric dispersion of arsenic from sources at and around the facility.[49] The court granted motions to strike the plaintiffs' air modeling expert's testimony, holding that the modeling did not meet the standards of Rule 702 and *Daubert*. One reason was that the expert's testimony was attempting

[44] *Powell v. Tosh*, 942 F. Supp. 2d 678 (W.D. Ky. 2013).
[45] *Id.* at 715.
[46] *Id.* at 716.
[47] *Id.* at 717-18.
[48] *Id.* at 718.
[49] *In re Voluntary Purchasing Groups, Inc.*, Nos. Civ. A. 3:94 CV 2477H *et al.*, 2000 U.S. Dist. LEXIS 18561 (N.D. Tex. Dec. 14, 2000).

to establish arsenic exposure over a long period of time in the past.[50] While the model the expert was using was generally accepted and had been peer-reviewed for short-term modeling (the ISCST3 model, Industrial Source Complex, Short Term), the court held that the plaintiffs' failure to establish that the model was "even minimally reliable" for long-term and historic air dispersion modeling was fatal to its admissibility for plaintiffs' purposes.[51] Notably, the assertions of the expert who did the modeling that it would be reliable in this context were insufficient to persuade the court of its admissibility. Reasoning that the use of the model for this particular purpose was not peer-reviewed or tested by the relevant scientific community, the Court held that the expert testimony did not meet the *Daubert* standard.[52]

b. Challenges to the Qualifications of an Air Modeling Expert

Another common approach of litigants seeking to exclude air modeling evidence is to attack the qualifications of the particular expert. As with disagreements over the appropriateness of modeling software, courts are generally inclined to let questions relating to the qualifications of an air modeling expert go to the weight of the testimony, rather than to completely bar the testimony.[53] In *Abarca*, in addition to challenging the modeling software, the defendants also challenged the qualifications of the plaintiffs' air modeling expert.[54] The expert had substantial experience in the air emissions field, having worked for over twenty years calculating fugitive air emissions for public and private employers.[55] The defendants challenged her qualifications with

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[50] *Id.* at *15-17.
[51] *Id.*
[52] *Id.* at *17.
[53] *See Robinson v. GEICO General Ins. Co.*, 447 F.3d 1096, 1100 (8th Cir. 2006) (admitting testimony of defendant's medical expert, even though he did not have the same medical specialty as plaintiff's expert, because "[g]aps in an expert witness's qualifications or knowledge generally go to the weight of the witness's testimony, not its admissibility.").
[54] *Abarca*, 761 F. Supp. 2d at 1024.
[55] *Id.* at 1028.

respect to air modeling, arguing that she needed to have a "sub-specialty" or advanced degree in chemistry or soil science, in order to be properly qualified.[56]

The court disagreed. It held that Rule 702 "only requires that an expert possess 'knowledge, skill, experience, training, or education' sufficient to 'assist' the trier of fact, which is 'satisfied where expert testimony advances the trier of fact's understanding to any degree.'"[57] The court held that there was no authority supporting the proposition that a heightened degree of expertise was necessary for a person to have sufficient qualifications to perform air emissions modeling, and found that the expert's education and substantial experience in the air emissions field were sufficient to allow her to be helpful to the trier of fact, and therefore qualified to testify as an expert.[58] The court explained that "[h]er calculations can be challenged through cross-examination and presentation of contrary evidence."[59]

c. Use of Air Modeling to Establish Boundaries of a Class for a Class Action

Another context in which air modeling can play an important role in tort litigation is in establishing who can be a member of a class or a subclass, in a class action lawsuit. For example, in *Citgo Refining and Marketing, Inc. v. Garza,* property owners brought a class action suit against a refining company and others for property damage allegedly caused by long-term emissions of airborne toxic contaminants, claiming negligence, trespass, and nuisance.[60] The trial court certified the class, composed of various subclasses, based in part on the location of a class member's property in relation to the defendant's facility.[61]

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[56] *Id.*
[57] *Id.* at 1028-29 (citing *Lauria v. Nat'l R.R. Passenger Corp.*, 145 F.3d 593, 598 (3rd Cir. 1998).
[58] *Id.*
[59] *Id.*
[60] *Citgo Refining and Marketing, Inc. v. Garza*, 187 S.W.3d 45 (Tex. App. 2005), *on reh'g* (Mar. 23, 2006).
[61] *Id.* at 51.

In support of their motion for class certification, the plaintiffs partly relied on reports from expert air dispersion modelers.[62] The defendants opposed certification of the class, and submitted reports from their own experts challenging the plaintiffs' air dispersion modeling, both in theory and in application.[63] The defendants "contended that plaintiff experts had made incorrect assumptions with respect to amounts of [air emissions] and drift characteristics that were fatal to the models relied upon to establish class-wide characteristics."[64] The defendants argued that the plaintiffs' proposed class boundaries were therefore invalid.[65] The trial court certified the class and subclasses as to property damage and diminution of value claims, distinguishing between air pollution and water pollution, based on the evidence tendered at the certification hearing by the plaintiffs' experts, including a modeling expert.[66] The defendants appealed the trial court's certification, which was upheld by the Texas Court of Appeals.[67] The Court of Appeals held that the trial court based the class and subclass structures on "concrete evidence" presented at the certification hearing, including modeling, and there was no abuse of discretion.[68]

There is some suggestion in the case law that courts tend to analyze air modeling techniques more critically when they are being used to support class certification, than they do when modeling is being used for other purposes, such as to establish causation in an individual tort claim. For example, in *Coleman v. Union Carbide Corporation*, the plaintiffs were seeking the certification of a medical monitoring class for more than thirty diseases allegedly resulting

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[62] *Id.* at 72.
[63] *Id.*
[64] *Id.*, n.8.
[65] *Id.* at 72.
[66] *Id.* at 75.
[67] *Id.*
[68] *Id.*

from exposure to air emissions from an alloy plant.[69] The plaintiffs sought to introduce the testimony of multiple experts in support of a class certification, including the testimony of an air monitoring expert.[70] The plaintiffs' air modeling expert was "charged with identifying the probable radius of impact resulting from the alloy plant over time,"[71] to establish the geographic range of the class.

The court undertook a rigorous and detailed analysis of the strengths and weaknesses of the air modeling testimony. It analyzed very closely what was necessary to create an accurate air model, and whether the expert had taken those necessary steps. The court expressed a number of concerns about the expert evidence, including the expert's choice of a regulatory-based model rather than an exposure-based model, the use of emissions rate estimates representing the highest emission rate from various sources and years, rather than estimates reflecting actual emissions from the plant, the air dispersion model's positioning of emission sources at the wrong location within the plant, potential errors in emission calculation, reliance upon an outdated standard for exposure to relevant pollutants, and choice of time intervals.[72] Based on these concerns about the sufficiency of the modeling evidence, the court ultimately denied the plaintiffs' motion for class certification.[73]

2. Air Modeling in the Regulatory Context

In addition to its use in tort litigation, dispersion air modeling is also being increasingly used in the regulatory context. Applicants for air pollution permits, the regulatory agencies who make decisions on permit applications, and the judicial bodies that review those decisions all increasingly rely upon air modeling.

[69] *Coleman v. Union Carbide Corporation*, No. 2:11-0366, 2013 WL 5461855 (S.D. W.Va. Sept. 30, 2013).
[70] *Id.* at 25.
[71] *Id.* at 35.
[72] *Id.* at 23-33.
[73] *Id.* at 42.

In Pennsylvania, the state regulatory agency responsible for issuing air pollution permits is the Pennsylvania Department of Environmental Protection ("DEP"). Under the Pennsylvania Air Pollution Control Act,[74] DEP is responsible for implementing the provisions of the federal Clean Air Act within the Commonwealth. All appeals from appealable DEP actions, including the issuance of permits, are heard and determined by an administrative court known as the Environmental Hearing Board ("EHB"). We will now examine the evidentiary standards of the Pennsylvania state courts, which EHB uses when parties seek to introduce air dispersion modeling evidence in challenging or defending a permit.

a. The Frye Standard Governs Admissibility of Expert Air Modeling Testimony in the Pennsylvania State Courts

Legal actions based on claims for trespass, negligence, nuisance, and toxic tort claims are typically based on state common law, and tend to be brought in state court, rather than federal court. In Pennsylvania, the trial court is the Court of Common Pleas. Pennsylvania has Rules of Evidence that govern the admissibility of evidence for proving such claims. Rule 702 governs "testimony by experts":

> If scientific, technical or other specialized knowledge beyond that possessed by a layperson will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training or education may testify thereto in the form of an opinion or otherwise.

Pa. R.E. 702. While this language is similar to the language of the Federal Rules of Evidence, Pennsylvania courts apply a different standard of admissibility. Rather than following the standard of reliability set forth in the *Daubert* decision, Pennsylvania follows the "general

[74] 35 P.S. § 4001 *et seq.*

acceptance" test, which was recognized in the 1923 decision of the United States Court of Appeals for the District of Columbia Circuit in *Frye v. United States*.[75]

In 2003, the Supreme Court of Pennsylvania held that the state courts would continue to follow the *Frye* test, rather than the *Daubert* test.[76] The party offering the expert testimony has the burden of proving that the methodology is generally accepted by scientists in the relevant field as a method for arriving at the expert's conclusion.[77] The expert must also be qualified, by knowledge, skill, experience, training, or education.[78] Decisions of trial courts are subject to limited review, under an "abuse of discretion" standard.[79] Applying this test in a consumer's personal injury case involving a claim for damages based on an esophageal tear, the Pennsylvania Supreme Court held that the trial court properly excluded the testimony of the plaintiff's expert, who concluded that Doritos chips were dangerous and defective because they broke into smaller chips that were too sharp, thick, and hard for safe passage in the esophagus.[80] The expert evidence included testimony regarding the compressive strength of dry Doritos, and the expert's measurement of time for human saliva to soften Doritos.[81] The Supreme Court held that the plaintiff's expert failed to submit evidence that scientists generally accept his methodology as a means for arriving at a conclusion that Doritos remain too hard and sharp as they are chewed and swallowed, to be eaten safely.[82]

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[75] *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923) ("the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs").
[76] *Grady v. Frito-Lay*, 839 A.2d 1038, 1043-44 (Pa. 2003).
[77] *Id.* at 558.
[78] *Id.*
[79] *Id.* at 559.
[80] *Id.* at 550.
[81] *Id.* at 549-550.
[82] *Id.* at 560-561.

Extrapolation is an example of a disputed methodology that has gained general acceptance in the scientific community in Pennsylvania, in certain limited circumstances.[83] Traditionally, the extrapolation methodology has been applied in the context of environmental exposure, where environmental exposure is not detected until the onset of illness, making it difficult to study the effects of exposure in controlled settings.[84] In such a context, medical experts might testify based on an extrapolation of data from similar, but not identical studies, to arrive at a conclusion regarding causation of harm.[85] It was accepted by a Pennsylvania court in 2002, when the Superior Court (the intermediate court between the Court of Common Pleas and the Supreme Court) held that a plaintiff's medical expert could use extrapolation to support a conclusion that a massive overdose of a medication could result in permanent side effects.[86] The Court recognized that "the scientist may extrapolate from this sound scientific basis when it is either impossible or unethical to perform the sorts of clinical trials that would yield definitive results."[87] While this case arose in the context of medical evidence, it is possible that the same general principles could apply to the engineering discipline of air dispersion modeling.

b. Challenging the Credibility of an Air Modeling Expert Before the Environmental Hearing Board

Challenges to air permits granted by the DEP go to the EHB. As a preliminary matter, it is important to understand the distinction between lay testimony and expert testimony, and the nature of evidence sufficient to establish standing to make such a challenge. A layperson is qualified to testify about personal observations about the weather and emissions from an industrial facility, including opinions and inferences that are rationally based on the person's

[83] *Trach v. Fellin*, 817 A.2d 1102, 1104 (Pa. Super. 2003).
[84] *Id.* at 1115.
[85] *Id.*
[86] *Id.* at 1114-1118.
[87] *Id.* at 1118 (citing *Donaldson v. Central Illinois Public Service Co.*, 199 Ill.2d 63 (2002).

perception and that are helpful to a clear understanding of the testimony or a fact in issue in the case.[88] This may include testimony about clouds, fog, and smoke.[89] It may also include observations about the weather or about stack plumes leveling off and traveling down a valley.[90] On the other hand, only an expert may testify as to the recognition and identification of the nature, quality, behavior, characteristics, or impact or effects of a "thermal inversion" or "atmospheric inversion."[91] These are matters that call for specialized scientific and technical education, training, expertise, and experience.[92] In addition, testimony that a phenomenon results in a greater risk to public health or the environment requires a witness trained in a field such as risk analysis or risk assessment.[93]

Finally, it is not necessary for an individual to perform air modeling as a condition for establishing standing in a challenge to an air permit.[94] Rather, it is sufficient if a person lives in the community and has observed emissions from an industrial plant coming directly down the valley and actually going by his house, and he was therefore exposed to and came into contact with pollutants from the industrial plant.[95] The EHB rejected the company's apparent argument that the party challenging an air permit must have expensive and complex air dispersion modeling combined with expert testimony, in order to demonstrate standing.[96] A contrary result

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[88] *Smedley v. Commonwealth*, 2000 Pa. Envirn. LEXIS 120, *14-15 (Pa .Env. Hrg. Bd.), EHB Docket No. 1997-253-K, February 15, 2000.
[89] *Id.* at *9.
[90] *Id.* at *12-13.
[91] *Id.* at *15.
[92] *Id.* at *10.
[93] *Id.* at *13.
[94] *Smedley v. Commonwealth*, 2001 Pa. Envirn. LEXIS 8, *43-47 (Pa. Env. Hrg. Bd.), EHB Docket No. 1997-253-K, February 8, 2001.
[95] *Id.* at *46-47.
[96] *Id.*

would prevent citizens from exercising their right of appeal, due to inability to afford such costs.[97]

The EHB follows the state courts' "general acceptance" test.[98] The *Frye* standard applies "to proffered expert testimony involving novel science,"[99] including expert testimony on air dispersion modeling. The *Frye* test is not applied to all scientific testimony, only expert testimony involving the alleged "novel" use of science.[100] Such testimony meets the *Frye* standard if "the [scientific] technique, as well as its application to the particular situation at hand, are generally accepted as reliable in the relevant scientific community."[101] The proponent of the testimony bears the burden of demonstrating that the expert's opinion will meet this "general acceptance" standard.[102]

The "general acceptance" test does not require the proponent of the expert testimony to prove that the scientific community generally accepts the expert's *conclusion*. Rather, it requires proof only that the expert's *methodology* is "generally accepted by scientists in the relevant field as a method for arriving at the conclusion the expert will testify to at trial."[103] The EHB's application of the *Frye* standard requires "weighing the credibility" of experts' methodology and determining if the experts' application of that methodology to the situation at hand is generally accepted.[104] Whether or not a particular scientific method and its application in a particular case

[97] *Id*.
[98] *See Pine Creek Valley Watershed Ass'n v. Commonwealth*, 2011 Pa. Envirn. LEXIS 67, *26 (Pa .Env. Hrg. Bd.), EHB Docket No. 2009-168-L, November 10, 2011 (stating that Pennsylvania follows the *Frye* standard "when determining whether expert testimony may be offered on a particular scientific subject").
[99] *Id.*
[100] *Id*.
[101] *Id*. (citing *Grady*, 839 A.2d at 1044, 1047).
[102] *Id*. (citing *Grady*, 839 A.2d at 1045).
[103] *Grady v. Frito-Lay*, 839 A.2d at 1045.
[104] *Pine Creek Valley Watershed Ass'n*, 2011 Pa. Envirn. LEXIS 67, *30.

are accepted by the relevant scientific community "is actually a question of fact as much as opinion."[105]

The EHB interprets the rules liberally in favor of, rather than against the admissibility of expert evidence. The EHB deals with scientific evidence every day, which makes its judges "less inclined than judges presiding over a jury trial to exclude expert opinion altogether."[106] The EHB's technical background makes it less "impressionable" to unaccepted science than layperson jurors.[107] As a result, as in the context of tort litigation, expert testimony on air modeling is rarely excluded in response to a motion *in limine*.[108] This is because applying the *Frye* test itself involves a "battle of experts," with experts testifying that a scientific methodology is or is not "generally accepted."[109] In essence, the EHB has concluded that it has a better chance of making a fully informed decision if facts have not been preemptively excluded from trial.

Therefore, when there is a legitimate dispute between experts in an EHB proceeding, the focus of the "battle of the experts" analysis is on which competing expert's opinion should be afforded greater weight and credibility. The weight given to an expert's opinion depends on "such factors as the expert's qualifications, presentation and demeanor, preparation, knowledge of the field in general and the facts and circumstances of the case in particular, and the quality of the expert's data and other sources."[110] More generally, the court examines the expert's opinion

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[105] *Id*. at *27.
[106] *Id*. at *28.
[107] *Id*.
[108] *Pine Creek Valley Watershed Ass'n v. Commonwealth*, 2011 Pa. Envirn. LEXIS 12, *8 (Pa. Env. Hrg. Bd.), EHB Docket No. 2009-168-L, February 15, 2011 ("While we do not wish to entirely rule out the possibility of a *Frye* motion in limine being an appropriate vehicle for resolving [questions of admissibility] in an EHB appeal, *we suspect that resolving such questions at the hearing itself will almost always be the better approach*.") (emphasis added). A motion *in limine*, filed pursuant to 25 Pa. Code § 1021.121, is the proper mechanism "for addressing matters in advance" of hearing. *Id*. at *2-3.
[109] *Id*. at *5-6.
[110] *Pine Creek Valley Watershed Ass'n*, 2011 Pa. Envirn. LEXIS 67, *30.

"to assess the extent to which it is coherent, cohesive, objective, persuasive, and well grounded in the relevant facts of the case."[111] At trial, parties use cross-examination to challenge the credibility and conclusions of the opposing party's expert and seek to establish their own expert's conclusions as more credible.[112]

c. The Need for Expert Testimony on Air Modeling Before the Environmental Hearing Board, Even for Pro Se Appellants

An examination of the EHB's case law reveals that a challenge to an air permit based on inaccurate or insufficient air modeling is most likely to be successful if the challenger presents an air modeling expert of its own. This is because "simply making unsupported assertions" that different data or a different model should have been used is insufficient to rebut a company that supports its modeling with "affidavits from witnesses and other evidence."[113] In addition, a *Frye* admissibility determination necessarily requires a "battle of experts," and the EHB tends not to exclude expert testimony. The EHB will consider "the degree of acceptance of the underlying science in deciding how much weight to accord" an expert opinion when making a credibility determination.[114] In order to get to this credibility determination stage, having an expert is critical.

One case highlights the difficulties of *pro se* appellants (individuals bringing legal actions without legal counsel), when they challenge air permits without the support of expert testimony. In *Matusinski v. DEP*, one *pro se* appellant challenged the DEP's grant of an air permit to an ethanol plant, alleging that the model was based on incorrect data inputs and that the modeling

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[111] *Id*. (citing *Bethayres Reclamation Corp. v. DER*, 1990 EHB 570, 580-81).
[112] *Grady*, 839 A.2d at 1042.
[113] *Matusinski v. DEP*, 2008 Pa. Envirn. LEXIS 48, *7 (Pa. Env. Hrg. Bd.), EHB Docket No. 2007-278-MG (Consolidated with 2007-279-MG), September 12, 2008.
[114] *Kiskadden v. Commonwealth*, 2014 Pa. Envirn. LEXIS 47, *9-10 (Pa. Env. Hrg. Bd.), EHB Docket No. 2011-149-R, September 12, 2014 ("The judges of the Environmental Hearing Board have a level of expertise far above that of the average jury and can more easily determine how much credibility should be given to expert testimony presented at trial.").

results were therefore inaccurate.[115] The appellant did not challenge the use of the model itself—only the underlying data inputs.[116] However, the appellant did not offer any expert air modeling testimony of his own to support his claim that the underlying data were inaccurate.[117] The Board determined that the appellant's unsupported assertions that "different weather data should have been used" were "insufficient to rebut the Permittee's claim that the air quality modeling was properly performed using appropriate data, which the Permittee supports by affidavits from witnesses and other evidence."[118]

In the same case, another *pro se* appellant alleged that the project lacked sufficient monitoring controls for odors, opacity, and fugitive particulate emissions.[119] But he did not produce any expert testimony in support of his technical and scientific claims that ethanol plants generate odors and emissions, and that the restrictions in the plan approval were insufficient to control the odors and emissions.[120] The Board explained that it "certainly underst[ood] the difficult situation that *pro se* appellants have in appealing Department actions" in cases which require "expert testimony to prove the scientific and technical objections" made by appellants.[121] Despite recognizing this difficulty, the Board granted summary judgment to the agency and permit holder on appellant's claim.[122]

In a similar case, the EHB held that a landfill's engineering expert satisfied the *Frye* test, even though its line-of-sight analysis study was novel, because it was based on sound

[115] *Matusinski v. DEP*, 2008 Pa. Envirn. LEXIS 48, *2.
[116] *Id.*
[117] *Id.* at *3.
[118] *Id.*
[119] *Id.*
[120] *Id.* at *4.
[121] *Id*. at *4.
[122] *Id.*

engineering practices.[123] The appellant introduced no testimony to contradict the validity of the methods used (topographic mapping, surveying, digital elevation levels from the United States Geological Service, and geometric calculations.[124]

3. Air Modeling Case Study

This portion of the paper will discuss the results of air modeling the Council itself conducted, as well as provide the context for understanding those findings. The Council modeled air emissions from a compressor station in Pennsylvania. Compressor stations are located at regular intervals along a natural gas pipeline, keeping the gas sufficiently pressurized so that it will continue to flow through the pipeline. Compressor stations emit a large number of volatile organic compounds ("VOCs"), hazardous air pollutants ("HAPs"), and other harmful air pollutants, including benzene, ethyl benzene, n-hexane, carbon monoxide, nitrogen oxides ("NOx"), formaldehyde, and methyl tert-butyl ether ("MTBE").[125] Many of these chemicals are known or suspected human carcinogens, or are known to cause significant human health problems, including serious respiratory problems and nerve damage.

In its air modeling, the Council looked specifically at emissions of nitrogen dioxide ("NO_2"), one of a highly reactive group of gases known as nitrogen oxides or NOx.[126] Because nitrogen oxides form as a result of fossil fuel combustion,[127] they result from emissions from cars, trucks, and other equipment using fossil fuel burning engines, including compressor

[123] *Exeter Citizens' Action Committee v. Commonwealth*, 2005 Pa. Envirn. LEXIS 22, *37-39 (Pa. Env. Hrg. Bd.), EHB Docket No. 2002-156-MG, March 31, 2005.
[124] *Id.* at 39.
[125] Southwest Pennsylvania Environmental Health Project, Summary on Compressor Stations and Health Impacts, 2-3, February 24, 2015, http://www.environmentalhealthproject.org/files/Summary%20Compressor-station-emissions-and-health-impacts-02.24.2015.pdf.
[126] U.S. Environmental Protection Agency, *Basic Information About NO2*, https://www.epa.gov/no2-pollution/basic-information-about-no2#What is NO2 (last visited Sep. 15, 2016).
[127] National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474, 6479 (February 9, 2010).

engines.[128] Nitrogen oxides contribute to the formation of ozone and particulate matter,[129] and they are also harmful by themselves, causing adverse respiratory effects.[130]

Short-term nitrogen dioxide exposure is linked to adverse respiratory effects, including airway inflammation and aggravation of asthma symptoms.[131] Nitrogen oxides also react with ammonia, moisture and other compounds to form small particles.[132] These small particles can cause or aggravate various respiratory diseases, including emphysema and bronchitis, and can also exacerbate existing heart disease, leading to increased hospital admissions and in some cases, premature death.[133] In addition, nitrogen oxides react with volatile organic compounds (VOCs) in the presence of heat and sunlight to form ground-level ozone.[134] Ozone has many adverse health effects, including reduced lung function and increased respiratory symptoms.[135]

The Council's modeling shows that current regulatory requirements do not adequately control the emissions of nitrogen dioxide from compressor stations.

The next section contains a brief discussion of the federal standards for emissions of nitrogen oxides and why exceedances of the standards matter, followed by a discussion of air modeling and how it differs from air monitoring. The final section is a review of the findings from the modeling report.

[128] U.S. Environmental Protection Agency, *Basic Information About NO2*, https://www.epa.gov/no2-pollution/basic-information-about-no2#What is NO2 (last visited Sep. 15, 2016); U.S. Environmental Protection Agency, AP-42, Vol. I, 3:2 Natural Gas-fired Reciprocating Engines, https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf (last visited July 26, 2016).
[129] U.S. Environmental Protection Agency, *Basic Information About NO2*, https://www.epa.gov/no2-pollution/basic-information-about-no2#What is NO2 (last visited Sep. 15, 2016).
[130] 75 Fed. Reg. 6479-6482; U.S. Environmental Protection Agency, *Basic Information About NO2*, https://www.epa.gov/no2-pollution/basic-information-about-no2#What is NO2 (last visited Sep. 15, 2016).
[131] *Id.*
[132] *Id.*
[133] *Id.*
[134] *Id.*
[135] *Id.*

a. National Ambient Air Quality Standards for NO_2

The Clean Air Act requires the EPA to set national ambient air quality standards ("NAAQS") for pollutants considered harmful to public health and the environment.[136] EPA has set standards for six principal pollutants, referred to as "criteria pollutants." There are primary and secondary standards for criteria pollutants.[137] Primary standards must be set at levels protective of public health, with an adequate margin of safety.[138] Secondary standards must be designed to protect public welfare, which includes "impacts on plants, wildlife and biota, property damage, aesthetic concerns such as reductions in visibility, and other non-health-related impacts."[139] The standards involve setting pollution levels based on ambient air concentration, with varying averaging times. There are two nitrogen dioxide standards. First, the annual average concentrations may not exceed 53 parts per billion (ppb). Second, a one-hour average concentration may not exceed 100 ppb.[140] The one-hour standard is a relatively new standard, having been first established in 2010.[141]

b. Air Modeling and Air Monitoring

The Council used air dispersion modeling to assess the emissions of the Barto Compressor Station in Penn Township, Lycoming County. The modeling was performed using the AERMOD model, which was developed by EPA and the American Meteorological Society, and which is EPA's recommended model.[142]

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[136] 40 C.F.R. part 50. *See also* U.S. Environmental Protection Agency, NAAQS Table, https://www.epa.gov/criteria-air-pollutants/naaqs-table (last visited May 19, 2016).
[137] 42 U.S.C. § 7409.
[138] *Id.*
[139] *See* 42 U.S.C. § 7409(b)(2), § 7602(h) (definition of "effects on welfare").
[140] 40 C.F.R. § 50.11.
[141] Primary National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474, 6531 (Feb. 9, 2010).
[142] U.S. Environmental Protection Agency, *Technology Transfer Network: Support Center for Regulatory Atmospheric Modeling: Preferred/Recommended Models*, https://www3.epa.gov/scram001/dispersion_prefrec.htm (last visited Sep. 15, 2016).

It is important to draw some key distinctions between air *modeling* and air *monitoring*. Air monitoring is largely present or forward-looking. It involves the ongoing collection and use of data to assess actual air quality or emissions. Samples can be taken of ambient air or from a stationary source of air emissions. On the other hand, air modeling can be used to estimate air pollution levels in an area surrounding an operating or proposed facility in the past, present, or future. Thus, while it is true that air modeling can be used as a forecasting tool – for example, when it is used for the purpose of demonstrating compliance with the national ambient air quality standards – it need not be only forward-looking. To a large degree, the pollution levels estimated by an air model will be a function of model inputs, such as emission rates, topography, and meteorological data. By choosing to input accurate historical emission rates and meteorological data, a modeler can generate a model of how a given facility affected local air quality at a particular time in the past.

A second important difference between modeling and monitoring is that modeling can provide a more comprehensive view of air pollution from a given source. While the particular models discussed here only looked at one pollutant (nitrogen dioxide), models are capable of simultaneously providing information for a wide range of air pollutants. By contrast, air monitors are typically much less capable of providing data about multiple pollutants simultaneously, at least not without significant expense. For example, a sensor in an air monitor that detects particulate matter will not be able to measure volatile organic compounds. Therefore, collecting air monitoring data on multiple pollutants simultaneously often involves an expensive process of purchasing additional sensors and more sophisticated equipment. For this reason, air monitoring studies are often limited to a small subset of pollutants emitted by a facility.

There is another important difference between air modeling and air monitoring. Because air modeling can account for factors such as changes in weather conditions over time and movements and dispersions of plumes of air pollution, it can provide information about air pollution levels at multiple times and places. For example, the Council's modeling for the Barto Compressor Station used 5 years of meteorological data and 16,733 "receptors," with each receptor representing a particular location within a 5 kilometer radius of the facility. By contrast, air monitoring can only show air pollution levels at the exact locations where air monitors are placed, and only during the time when the air monitors are used. Air monitors are expensive to purchase and expensive to deploy. As a result, monitoring studies generally do not utilize many monitors, and therefore involve fewer receptors than in an air model. In addition, they are often conducted over relatively short periods of time. For example, when DEP monitored air emissions at the Barto Compressor Station, it deployed a single air monitor that took measurements at two locations, over a four-day period.[143]

The potential shortcomings of using air monitoring to estimate exposure to air pollutants from shale gas development are outlined well in *Understanding Exposure from Natural Gas Drilling Puts Current Air Standards to the Test*.[144] Because air emissions can be variable, air monitoring that uses periodic sampling or averaging instead of real-time measurements can miss emission peaks that can cause acute exposures.[145] Even agencies that conduct air monitoring appear to recognize its limitations. The Agency for Toxic Substances and Disease Registry

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[143] Pennsylvania Department of Environmental Protection, *Ambient NO2 Sampling near the BARTO Compressor Station*, August 29, 2013, http://files.dep.state.pa.us/air/AirQuality/AQPortalFiles/Regulations%20and%20Clean%20Air%20Plans/BARTO%20Sampling%20Report%20Final%202013-08-29.pdf.
[144] David Brown, Beth Weinberger, et al., *Understanding Exposure from Natural Gas Drilling Puts Current Air Standards to the Test*, Rev Environ Health 2014; 29(4): 277-92.
[145] *See id.* at 3, 11.

("ATSDR") recently conducted air monitoring at the Brigich Compressor Station.[146] As part of its findings, ATSDR recommended that air modeling based on sufficient representative data be conducted "as it may provide a more generalized understanding of ambient air quality near these types of facilities."[147]

However, air modeling is not without shortcomings. Air modeling can only provide estimates. The accuracy of the estimates will depend on the quality of the inputs and the model assumptions. By contrast, air monitoring can provide an actual reading of air quality at a particular location, at a particular point in time (or time interval, where averaging is used). Air monitoring demonstrating compliance with national ambient air quality standards or otherwise showing legally acceptable levels of air pollution is not necessarily proof that residents throughout a community are breathing safe air. However, air monitoring showing unsafe levels of air pollution demonstrates with certainty that an air pollution problem exists.

c. Compressor Station Air Modeling Results

Compressors are powered by engines which are frequently fired by burning some of the natural gas that is moving through the pipeline. This combustion produces a significant portion of compressor station air pollution. While nitrogen dioxide emissions from compressor engines were the primary focus of the Council's modeling, there are often many other sources of air emissions at compressor stations, such as tanks, dehydrators, and separators, which can produce a large array of harmful air pollutants.[148]

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[146] U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, *Exposure Investigation – Natural Gas Ambient Air Quality Monitoring Initiative – Brigich Compressor Station* (2016), http://www.atsdr.cdc.gov/HAC/pha/Brigich_Compressor_Station/Brigich_Compressor_Station_EI_HC_01-29-2016_508.pdf.
[147] *Id.* at iv.
[148] *See* Southwest Environmental Health Project, *Summary on Compressor Stations and Health Impacts*, February 24, 2015, http://www.environmentalhealthproject.org/files/Summary%20Compressor-station-emissions-and-health-impacts-02.24.2015.pdf; Gregg Macey, et al., *Air Concentrations of Volatile Compounds near Oil and Gas Production: A Community-based Exploratory Study*, Environ Health 2014, 13:82; Nadia Steinzor, et al.,

Compressor stations can be found throughout Pennsylvania.[149] There are as many as seven hundred compressor stations in the state,[150] with many found near sensitive populations, such as schools, child care providers, hospitals, and nursing care facilities.[151] Typically compressor stations claim that due to their size, their potential emissions are below the threshold of 100 tons per year (either naturally or due to a permit limitation), and are therefore considered "minor sources" of air pollution,[152] and therefore undergo only limited regulatory review.[153] The Barto Compressor Station is subject to an individual air pollution permit, avoiding major source status by agreeing to accept certain emission limitations in its permit, essentially being regulated as a "synthetic" minor source.[154]

As a consequence of being regulated as a minor source, the Barto Compressor station was not required to undergo the air modeling that is required by the New Source Review program for major sources.[155] Despite the "minor" label, compressor stations can be significant sources of air pollutants, including nitrogen oxides. Because industry is often not required to model compressor station emissions, there is little reliable information available about whether compressor stations are contributing to violations of applicable air quality standards. To fill this data gap, the Council conducted air dispersion modeling of the Barto Compressor Station.

Investigating Links between Shale Gas Development and Health Impacts through a Community Survey Project in Pennsylvania New Solutions, New Solutions, 2013; 23(1): 55-84.

[149] *See* Clean Air Council, *Gas Infrastructure Map of Pennsylvania*, http://wikimapping.net/wikimap/gas.html (last visited Mar. 3, 2016). The Council inventory draws on data from Pennsylvania DEP regions and crowd-sourced reports.

[150] *Id.*

[151] PennEnvironment, *Dangerous and Close: Fracking Near Pennsylvania's Most Vulnerable Residents* (2015), http://www.pennenvironment.org/sites/environment/files/reports/PA_Close_Fracking_scrn.pdf.

[152] Whether a source is "minor" or "major" is determined by estimates of a facility's emissions. A "major facility" is defined to include a facility with a potential to emit of 100 tons per year of a regulated New Source Review pollutant, but this threshold is lowered for certain types of nonattainment areas. 25 Pa Code § 121.1.

[153] For instance, the Barto Compressor Station avoided review as a major source by being just 5.43 tons-per-year below the threshold for NO_2. *See* Clean Air Council, *Re: Chief Gathering LLC, Compressor Station, Plan Approval No. 41-00078C*, Oct. 17, 2011 (on file with author).

[154] Barto's plan approval is 41-00078C. 41 Pa.B. 2704.

[155] By contrast, emissions from major sources must be modeled. 40 C.F.R. § 52.21(l), (m).

The Barto Compressor Station is located in Penn Township, Lycoming County. It relies on nine gas-powered internal combustion engines.[156] The Council's air dispersion modeling was based on the maximum allowable emissions rate for nitrogen dioxide, allowed by the air pollution permit issued by DEP.[157] The Council's model used inputs for stack height, diameter, temperature, and exit velocity. These are critical inputs for an air dispersion model, as they impact the shape and movement of emissions plumes. To illustrate, a stack is like the tailpipe of a car, which being just off the ground would not allow emissions to travel as far as if they were emitted from a stack high off the ground. For the Council's modeling, these parameters were taken from a DEP database.[158] Modeling inputs also included five years of meteorological data collected at the Pittsburgh International Airport,[159] 16,733 receptors that were placed using National Elevation Data, which allowed the model to take the area's specific topography into account,[160] and background air quality data taken from a monitor in State College, Pennsylvania.[161]

The Council's air modeling found that the facility can cause enormous exceedances of the 1-hour national ambient air quality standard for nitrogen dioxide, even when operating at its permitted emissions level. When background concentrations are not incorporated (in other words, when only the permitted emissions from the facility are taken into account) the model estimates levels that are already double the federal standard.[162] When background concentrations are added into the model, it estimates levels that are almost three times (278%)

[156] Clean Air Council, prepared by Khanh Tran, AERMOD Modeling of NO2 Impacts of the Barto Compressor Station, 4, Jan. 24, 2014, http://stopnypipeline.org/wp-content/uploads/2015/05/AERMOD-NO2-Modeling-of-Barto-Compressor-Station-Jan-24-2013-2.pdf.
[157] *Id.*
[158] *Id.*
[159] *Id.* at 4-5.
[160] *Id.* at 4.
[161] *Id.* at 5.
[162] *Id.* at 6.

the level deemed safe by EPA.[163] These unsafe levels are not confined to locations in close proximity to the compressor station. In fact, the model shows that locations up to 1 mile away experience dangerous levels of nitrogen dioxides, due to the facility's pollution.[164] To ensure that the facility does not emit levels that can harm human health, DEP would have to reduce the facility's allowable nitrogen dioxide emissions by 76%.[165]

Clean Air Council shared its air dispersion modeling findings for the Barto Compressor Station with DEP and the public. In response, DEP first criticized the modeling methodology for not taking topography into account and not using an updated version of the air model.[166] However, after reviewing DEP's comments the Council found that many of the criticisms were unfounded because they were rooted in a misreading of the initial modeling report. Khanh Tran, the air modeling expert who prepared the modeling report, responded to each comment. For instance, he noted that his model did indeed take topography into account, contrary to the DEP's criticism. He also refuted DEP's criticism that he did not use a newer version of the model, noting that EPA did not yet recommend the use of the newer version.[167]

Because the Council dispelled DEP's criticisms of the methodology used in the model, DEP next conducted a short air monitoring study at the Barto Compressor Station.[168] Over the course of a four-day air sampling period, DEP did not detect unsafe levels of nitrogen dioxide.[169] However, there are many limitations to DEP's monitoring, some of which are rooted in the

[163] *Id.*
[164] *Id.*
[165] *Id.* at 7.
[166] Pennsylvania Department of Environmental Protection, Letter to Jay Duffy, Re: AERMOD Modeling of NO_2 Impacts of the Barto Compressor Station, May 14, 2013 (on file with author).
[167] Clean Air Council, prepared by Khanh Tran, *Response to DEP Comments on the AERMOD Modeling of NO2 Impacts and Comments on the DEP Sampling of the Barto Compressor Station*, Dec. 20, 2013 (on file with author).
[168] Pennsylvania Department of Environmental Protection, *Ambient NO2 Sampling near the BARTO Compressor Station*, August 29, 2013, http://files.dep.state.pa.us/air/AirQuality/AQPortalFiles/Regulations%20and%20Clean%20Air%20Plans/BARTO%20Sampling%20Report%20Final%202013-08-29.pdf.
[169] *Id.* at 1.

shortcomings described in the discussion above regarding monitoring versus modeling. Mr. Tran reviewed the DEP's air monitoring report and identified multiple flaws.[170] For instance, only one monitor was used, and it was moved to two locations.[171] DEP's failure to detect high levels can be explained by the fact that a single monitor, deployed for only four days, is unlikely to be at the right location at the right time to detect the emission plume with the highest concentration of nitrogen dioxide. This is underscored by the fact that the meteorological data collected on-site by DEP during the sampling period show that the monitor was not in the path of the emission plume for much of the sampling period.[172]

In sum, the air monitoring conducted by DEP around the Barto Compressor Station suffers from exactly the kinds of weaknesses described in this section. The fact that DEP's short-term monitoring did not show unsafe levels of nitrogen dioxide in the vicinity of the facility does not demonstrate that the Council's model is invalid, nor does it demonstrate that the facility is not causing a violation of the national ambient air quality standard. It simply demonstrates that no significant plumes of air pollution from the facility moved through the specific areas sampled during the short period of monitoring. DEP used only one monitor, placed at two locations over the course of four days. By contrast, the Council's model estimated air impacts at 16,733 locations, using five years of meteorological data. With the extremely low spatial and temporal resolution of the agency's monitoring, it is unsurprising that DEP failed to detect air pollution levels in excess of the national ambient air quality standard.

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[170] Clean Air Council, prepared by Khanh Tran, *Response to DEP Comments on the AERMOD Modeling of NO2 Impacts and Comments on the DEP Sampling of the Barto Compressor Station*, Dec. 20, 2013 (on file with author).
[171] *Id.*
[172] *Id.* at 6.

Conclusions

As air modeling technology becomes increasingly sophisticated, it is becoming more and more relevant in a variety of legal contexts. Air modeling is important for companies seeking air permits, regulators examining applications for air permits, and litigants seeking to establish or defend against liability for harm caused by air pollution.

It is increasingly important for communities impacted by air pollution and the environmental organizations who work with them to understand the role air modeling plays in both the regulatory and litigation contexts. As demonstrated by the modeling conducted by the Clean Air Council, air modeling can be a powerful tool in evaluating the contribution of a given facility to local air pollution problems. An examination of the use of air modeling demonstrates that a party seeking to challenge air modeling – whether through the regulatory process or through a lawsuit – is likely to find the most success if that party can present its own competing air modeling evidence to support its position. Furthermore, while the barriers to the admission of such air modeling evidence in a court or administrative tribunal are generally relatively low, it is much more likely to be effective if the proponent of the evidence can provide substantial support for the choice of the specific model used, and for each and every one of the inputs and assumptions used in creating the model.