EXHIBIT S5 TO DECLARATION OF STEPHEN G. SCHWARZ IN SUPPORT OF PLAINTIFFS' MOTION FOR CLASS CERTIFICATION

UNITED STATES DISTRICT COURT
FOR THE
DISTRICT OF VERMONT

JAMES D. SULLIVAN, LESLIE ADDISON, WILLIAM S. SUMNER, JR., RONALD S. HAUSTHOR, GORDON GARRISON, LINDA CRAWFORD, TED CRAWFORD, and BILLY J. KNIGHT, individually, and on behalf of a Class of persons similarly situated, Plaintiffs v. SAINT-GOBAIN PERFORMANCE PLASTICS CORPORATION, Defendant.	)	Case No. 5:16-cv-125

DECISION ON DEFENDANT'S *DAUBERT* MOTION
(Doc. 218)

The court heard testimony from expert witnesses from both sides in this groundwater contamination case on April 15–18, 22–23, and 29–30, 2019. The testimony was offered both with respect to the motion for class certification (Doc. 107) and to a *Daubert* motion filed by the defense (Doc. 218). The *Daubert* motion seeks to preclude the testimony of three experts concerning the source of contamination (Hopke, Yoder and Siegel), two experts concerning the proposed remedy of medical monitoring (Ducatman and Grandjean), one expert concerning alleged regulatory violations (Mears), and one expert on economic loss (Unsworth). The court will decide both the *Daubert* motion and the class certification motion on this common record, which includes multiple exhibits outlining the history of the case; the development, use and regulation of the chemical known as PFOA; the history of its use in Bennington, Vermont; and

the efforts of all the experts to understand different aspects of the case. This decision concerns the *Daubert* issues only.

FACTS

I. PFOA

Perflourooctanoic acid or PFOA is an industrial chemical prized for its qualities in the presence of water.[1] It was developed in the 1950s by 3M Co. as a dispersant or surfactant. In a water-based solution, it assists in spreading a non-soluble compound evenly throughout the solution as an emulsion. The family of compounds that are marketed as "Teflon" were frequently dispersed on fabric, metal, or other surfaces through the use of PFOA. Without a dispersant, the Teflon might bead up or in other ways resist an even dispersion.

PFOA was used for more than four decades in the manufacture of consumer and commercial products such as "Scotchguard" water repellent sprays, toothpaste, ski wax, food service paper, firefighting foam, and a host of other products. Manufacturers frequently added PFOA to a solution containing Teflon or some other compound. The end product such as a bolt of cloth or a line of non-stick cookware would be dipped in the solution or sprayed and then subjected to a drying process. Having served its purpose as a dispersant, the PFOA either evaporated in a process called sublimation, broke down into constituent compounds at relatively high temperatures, or remained in trace amounts in the product.

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[1] PFOA is the chemical salt of a similar compound commonly called "APFO." APFO is one of a group of industrial chemicals known as "PFAS" or "C-8." DuPont, 3M, and other companies sold APFO to manufacturers as a dispersant in aqueous solutions containing Teflon. The solution can be applied to fabric and other materials. APFO commonly changes into PFOA in the course of the manufacturing process. PFOA can escape as a gas in the course of manufacturing and enter the atmosphere where it condenses into a solid in the form of airborne particulate.

For ease of reference, the court will refer to APFO and PFOA as "PFOA."

In addition to its qualities as a dispersant, PFOA has a second unusual characteristic. It is highly resistant to degradation in the natural environment. It is readily transported by wind in the form of airborne particles as well as by ground and surface water. It can be found in drinking water. It enters the food chain and accumulates in the bodies of people and animals. It is now detectable at low levels throughout the world.

The average concentration of PFOA in the U.S. population in 2012 was 2.08 nanograms per liter of blood. (Ex. X (Feb. 2015 CDC report on Human Exposure to Environmental Chemicals).) This figure has fallen from 5.21 nanograms in 2000, probably as a result of the voluntary withdrawal of PFAS products from the American market in the years after 2000. (Ex. Y (ATSDR PFAS Information for Clinicians).) PFOA has been associated with an increased incidence of certain health conditions. Research and understanding of these health risks are incomplete.

II. Use of PFOA in Bennington and North Bennington

In 1969, a company called Chem-Fab Corporation opened a plant in Bennington, Vermont where it produced Teflon-coated fabrics and other products. (Siegel Ex. D. (Barr Engineering report).) Chem-Fab purchased Teflon in water-based solution from DuPont and applied it to fabric to improve water resistance. Its principal product was fiberglass cloth impregnated with Teflon. The cloth was used in construction. Chem-Fab's first plant was located on Northside Drive in Bennington. It operated for ten years. Chem-Fab opened a new plant on Water Street in North Bennington in 1978. It continued to produce fabric in the same manner. In 2000, defendant St. Gobain acquired Chem-Fab and continued to operate in the same manner at the North Bennington plant. In 2002, St. Gobain closed the North Bennington plant and moved the fabric-coating process to a plant in Merrimack, New Hampshire. (Ex. D.)

The essential elements of the manufacturing process used within the two Chem-Fab plants are simple to describe in general terms. (Ex. 58) Fiberglass cloth and other fabrics were soaked in a water-based solution containing Teflon (PFTE). The PFTE solution contained PFOA as a dispersant. The wet fabric passed on rollers through a series of drying ovens. Steam from the drying process entered the atmosphere through smokestacks, which in some cases were equipped with "scrubber" technology to reduce emissions. The amount of PFOA purchased by Chem-Fab and St. Gobain in the Teflon solution can be determined through plant records.

The parties disagree about what happened to the PFOA in the course of the manufacturing process.

Plaintiffs' expert Dr. Philip Hopke has concluded that the PFOA sublimated directly from its suspension as a solid in the PFTE solution into a gas form and then cooled into airborne particulates that left the plant through the stacks. Dr. Hopke believes this process took place at the relatively low temperatures in place in the early stage of the drying process (200–300 degrees Fahrenheit). (Ex. 38.) Estimating a 0.5% concentration of PFOA in the Teflon solution, he reached estimates ranging from 1,000 pounds per year for the Northside Drive Plant and over 7,000 pounds per year for the Water Street plant. (*Id.* at 4.) In a report prepared by the consultants Amec Foster Wheeler for the Vermont Department of Environmental Conservation in May 2018, the state's experts used a concentration of .3 % and noted that the Dupont manufacturers safety data sheet for the product specified a .5 % concentration of PFOA. (Hopke Ex. N, p. A-17).

The defense experts who completed the Barr report (Siegel Ex. D) have concluded that the PFOA was broken down by much higher temperatures in the late fusion stage of the manufacturing process. They believe that relatively low levels of PFOA left the plant in the

stack exhaust. Assuming a 0.2% concentration (2,000 parts per million), significantly lower than Dr. Hopke's estimate, the Barr report estimates annual releases of PFOA of 26 to 307 pounds per year from the Water Street plant (47 pounds on average) and 13 to 104 pounds per year from the Northside Drive plant (145 pounds on average.) (Ex. D at 27.)

There is scant evidence of other industrial use of PFOA in Bennington County. Products containing PFOA such as Scotchguard or ski wax were available in Bennington in the same manner that they were available throughout the state. The Barr report identifies other manufacturers who used products containing PFAS. But no other entity is known to have purchased or used large quantities of PFOA in Bennington and North Bennington.

III. Discovery of PFOA in Drinking Water

Due to concern at the Environmental Protection Agency ("EPA") and among state regulators about the presence of PFOA in the natural environment, the Vermont Department of Environmental Conservation ("DEC") began to test residential wells in and around Bennington in 2016. The results ranged from non-detectable levels to nearly 3,000 parts per trillion. (Ex. 134.) The contaminated wells were primarily located in a "zone of contamination" within the towns of Bennington and North Bennington.

The DEC and Department of Health took prompt regulatory action. Residents whose wells were contaminated by PFOA received bottled water or were placed on individual filtration systems. St. Gobain joined in the effort to provide potable water to all residents. In the course of a separate proceeding in Vermont Superior Court, St. Gobain has agreed to pay most of the cost of extending the municipal water supply to all but a handful of residences with elevated groundwater levels. The remaining households receive on-site water purification or point-of-

entry treatment ("POET") systems. St. Gobain has also agreed to fund continuing well testing and to provide municipal water to additional households as needed in the future.

IV. Claims in this Case

Plaintiffs are Bennington and North Bennington residents whose wells have been contaminated. They seek class certification in order to present two categories of claims. They seek to establish a system of medical monitoring to detect medical conditions such as certain cancers, high blood pressure in pregnant women, elevated cholesterol, and other conditions that they claim are strongly associated with exposure to PFOA. They also seek to recover money damages on behalf of the class for the contamination of their groundwater. As individuals, they also seek to recover damages for lost property value and for emotional harm.

V. Plaintiffs' Experts

In support of these claims, Plaintiffs have disclosed the following experts:

A. Experts Concerning the Deposit of PFOA in Groundwater

1. Philip Hopke, Ph.D. is a chemist. He has offered an opinion that PFOA was emitted by the Chem-Fab and St. Gobain plants in large quantities over three decades.
2. Gary Yoder is a meteorologist. He has offered an opinion that PFOA from the two plants was spread by wind and weather in the form of small particulate solids over the Bennington and North Bennington region over the same period of time.
3. Donald Siegel, Ph.D. is a hydrogeologist. He has offered an opinion that PFOA which was deposited on the ground passed through the surface soil into the groundwater and is the cause of the contamination levels of wells in Bennington and North Bennington.

4. David Mears is an environmental attorney and former Vermont Commissioner of Environmental Conservation. He has offered testimony about the history of efforts by the State of Vermont to regulate emissions from the Chem-Fab plants.

B. Experts Concerning Medical Monitoring

1. Alan Ducatman, M.D. is a medical doctor with a specialization in public health. He has offered an opinion about the potential health risks presented by PFOA. He has proposed a program of medical monitoring intended to provide annual blood tests and other health services to residents of Bennington and North Bennington who have elevated blood serum levels for PFOA.
2. Philippe Grandjean, M.D. is a medical doctor with a specialization in public health. He has offered an opinion rebutting opinions from defense experts Philip Guzelian, M.D. and Sorell Schwartz, Ph.D. that medical monitoring is neither necessary nor beneficial. In Dr. Grandjean's opinion, PFOA presents a risk to human health which requires the type of monitoring proposed by Dr. Ducatman.

C. Economic Experts

1. Robert Unsworth is an economist who has offered an opinion that compensation for the loss to the public of the natural resource of uncontaminated groundwater may be provided through the funding of three capital improvement projects designed to safeguard the Bennington municipal water supply.

St. Gobain has filed *Daubert* motions seeking to exclude the testimony of each of these witnesses, both for purposes of the motion to certify a class and for purposes of trial. Having heard testimony from each of the witnesses (and some of the opposing experts) and reviewed

their reports and supporting materials on which they relied, the court is in a position to rule on the *Daubert* issues for both class certification and a merits trial.

ANALYSIS

The court starts with the *Daubert* standard. The search for an effective way to screen proposed expert testimony goes back at least as far as a law review article written by Judge Learned Hand in 1901.

> The trouble with all this is that it is setting the jury to decide, where doctors disagree. The whole object of the expert is to tell the jury, not facts, as we have seen, but general truths derived from his specialized experience. But how can the jury judge between two statements each founded upon an experience confessedly foreign in kind to their own? It is just because they are incompetent for such a task that the expert is necessary at all.

L. Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 Har. L. Rev. 40, 54 (1901). Twenty years later in *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923), the D.C. Circuit adopted the "general acceptance" standard as the basis for admissibility of expert testimony:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, 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.

Id. at 1014.

In 1972, the test for admissibility changed again with the adoption of Rule 702. In its original version, the rule permitted the admission of testimony by an expert in the form of an opinion or otherwise if scientific or technical knowledge would assist the trier of fact. An expert's qualifications were based on his or her knowledge, skill, experience, training or education.

Both the *Frye* test and the original version of Rule 702 suffered from the same shortcoming: expertise was measured by standards set by other experts, either through a process of "general acceptance" or through a course of training and experience leading to the acquisition of knowledge and skill. The courts were not expected to consider directly the reliability of the expert's methodology. Instead, the expert's professional qualifications and the views of other scientists expressed as acceptance were the two criteria.

The *Daubert* trilogy of cases required the courts to consider the qualifications of the expert, the reliability of the opinion, and its "fit" or relevance to the issues in dispute. Determining reliability "entails a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid." *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 592–93 (1993). The list of non-exclusive factors available to test methodology includes testing, peer review and publication, error rate, the existence of standards for its application, and acceptance within the relevant scientific community. "Fit" or relevance requires an assessment of "whether that reasoning or methodology properly can be applied to the facts in issue." *Id.* at 593. The majority opinion expressed a preference for resolving disputed issues through admission of contrary evidence and cross-examination, not through rigid exclusion. "Vigorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence." *Id.* at 596.

In *General Electric Co. v. Joiner*, 522 U.S. 136 (1997), the Court refined its requirement that trial judges evaluate the reliability of expert opinions without ruling on the merits of the parties' positions. The majority decision recognized the need for the court to consider the strength of the logical connection between data and opinion.

> But conclusions and methodology are not entirely distinct from one another. Trained experts commonly extrapolate from existing data. But nothing in either *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert. A court may conclude that there is simply too great an analytical gap between the data and the opinion proffered.

Id. at 146. In a concurring and dissenting opinion, Justice Stevens placed his finger on a potential weakness of the emerging *Daubert* test. Judges are gatekeepers—but they are not deciders of the truth of testimony. He wrote, "*Daubert* quite clearly forbids trial judges to assess the validity or strength or an expert's scientific conclusions, which is a matter for the jury." *Id.* at 154. Admissibility is a lower threshold than demonstrable truth.

The third case in the trilogy, *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), is most frequently cited for its holding that *Daubert* applies to practical and technical experts such as engineers and economists in the same manner as research scientists. But it is the mode of analysis employed by Justice Breyer in *Kumho* that is relevant to the dispute in this case. In dissenting and concurring in *Daubert*, Chief Justice Rehnquist had expressed concern about the trial courts' ability to evaluate the strength of scientific evidence except through the lens of general acceptance by other members of the scientific community.

> I do not doubt that Rule 702 confides to the judge some gatekeeping responsibility in deciding questions of the admissibility of proffered expert testimony. But I do not think it imposes on them either the obligation or the authority to become amateur scientists in order to perform that role.

Daubert, 509 U.S. at 600–01 (Rehnquist, C.J., concurring in part and dissenting in part). In *Joiner*, writing for the majority, Chief Justice Rehnquist showed more appetite for the work. "[It] was within the District Court's discretion to conclude that the studies upon which the experts relied were not sufficient, whether individually or in combination, to support their

conclusions that Joiner's exposure to PCB's contributed to his cancer . . . ." *Joiner*, 522 U.S. at 146–47.

In *Kumho*, Justice Breyer discussed the merits of the tire failure analysis in depth. He rejected the expert's four-point checklist for signs of product failure. Justice Breyer did not question the initial observations or the final conclusion. Instead, it was the lack of a known, validated, measurable connection between observed data and conclusion that doomed the tire expert's testimony. *Kumho* requires by example that the trial court evaluate the deductive process by which the expert derives a conclusion from data and observation.

The court describes the evolution of the *Daubert* test to emphasize the distinction between evaluating methodology (required) and deciding whether the opinion is correct (forbidden). With this review of the test in mind, the court will consider the proffered testimony of each witness in turn. Consistent with the example of *Kumho*, the court summarizes the data relied upon by the expert and then seeks to identify and evaluate the method by which the data leads by inference to a conclusion. The court will also address the witness's qualifications and the "fit" or relevance of his opinions.

I. Philip Hopke, Ph.D.

Dr. Hopke is a distinguished chemist who has taught and published widely in the area of airborne environmental pollution. (Ex. 36.) His assignment was to calculate the amount of PFOA discharged into the atmosphere from the two Chem-Fab plants.

A. Qualifications

Dr. Hopke is fully qualified to investigate the chemical reactions that occurred within the Chem-Fab plants resulting in the release of PFOA. He holds a Ph.D. in chemistry from

Princeton. He has taught and published in the fields of environmental chemistry and airborne contamination. He is clearly qualified to provide an expert opinion.

B. Method

Neither Chemfab nor St. Gobain monitored stack exhaust for PFOA during three decades of operations. In the absence of direct observation of emission levels, Dr. Hopke used a "mass balance approach." (Tr. 4/16/19, Doc. 275 at 207.) This approach requires a determination of the amount of PFOA entering the plant and a calculation of how much was released into the air. The Barr experts, acting on behalf of St. Gobain, performed the same type of calculation after examining records of the purchase of the dispersion solution. In 2017, Barr produced a report for St. Gobain showing the total amount of dispersion solution purchased each year from 1969 (33,573 pounds) through 2001 (777,280 pounds). (Ex. 42.) Dr. Hopke accepted these quantities as reasonable.

The next step was to calculate the amount of PFOA in the dispersion. The Barr report used a .2 percent concentration of PFOA in the dispersion. Dr. Hopke used a .5 percent figure based on information in material safety data sheets for the dispersion, which showed the higher concentration as well as evidence that plant workers sometimes added more PFOA to the dispersion in the course of the manufacturing process. (Tr. 4/16/19, Doc. 275 at 208.) The .5 percent concentration figure resulted in an average input of 7,000 pounds of PFOA into the plants. The 7,000 pound figure was also consistent with estimates St. Gobain provided to New Hampshire regulators when it moved its manufacturing facilities to Merrimac in 2001. (Tr. 4/17/19, Doc. 281 at 47–49; *see also* Ex. 47.)

The final step was to determine what happened to the PFOA. The manufacturing process exposed the rolls of cloth which had been soaked in the dispersion unit to increasing levels of

heat. Rolls of cloth were immersed in a water-based solution containing Teflon, also known as PTFE, and PFOA. The cloth passed on rollers through three stages. First, the cloth was dried at a temperature of 200–300°F. The drying zone removes the water, which is released as vapor. The cloth then passes through a baking zone at 300–500°F. In this zone, the PTFE that remains after evaporation of the water solution is melted onto the fabric. In a final stage, the PTFE particles are fused together ("sintered") at temperatures of 600–700°F. (Ex. 37, 38.)

Dr. Hopke compared the three stages of manufacturing with what is known about the behavior of PFOA when exposed to heat. The form of the chemical in the dispersion is APFO, which is the chemical salt of PFOA. The salt form of the compound contains ammonia. At temperatures between 266 and 392 degrees F., sublimation occurs. At this point, the ammonia separates from the compound which becomes PFOA. (Tr. 4/17/19, Doc. 281 at 32, 40.) At these temperatures, PFOA move from a solid state to a gas in the same way that dry ice changes from a solid to carbon dioxide (CO_2) gas. At temperatures above 392 F, PFOA loses its CO_2 and becomes hydrofluoric acid and CO_2 in a process called decarboxylation. (Tr. 4/17/19, Doc. 281 at 40.)

In Dr. Hopke's view, conditions at the early drying stage were hot enough to achieve complete sublimation of the PFOA before the fabric reached the hotter baking and sintering zones where decarboxylation would start to convert PFOA into hydrofluoric acid. He concluded that all of the PFOA that entered the plant was discharged with water vapor in the course of the drying process.

Dr. Hopke's methodology meets *Daubert* criteria. He calculated the amount of APFO in the dispersions by using a .5 percent concentration, which appears in manufacturers' safety data sheets. That was a reasonable source for the information. He used the figures prepared by

St. Gobain's consulting engineers to determine the total amount of the dispersion purchased by ChemFab and St. Gobain. He used published sources in peer reviewed chemistry journals to determine the temperatures at which APFO sublimated into PFOA and at which PFOA decarboxylated into hydrofluoric acid.[2]

The methodological criticism by the defense chiefly concerns the basis for Dr. Hopke's inference that the PFOA left the plants in the course of the initial drying process. The method on which Dr. Hopke relied in reaching this conclusion depends upon a determination of the temperature at which PFOA sublimates from its suspension in solid form within the water-based dispersion solution directly into a short-lived gaseous form. Dr. Hopke determined from published sources in the field of chemistry that PFOA sublimates freely at temperatures lower than the temperature at which the substance degrades. The PFOA would encounter temperatures sufficient for sublimation in the drying stage. He described the chemical change from APFO to PFOA that permits sublimation to occur. In his view, the heat conditions in the initial drying stage were sufficient to result in complete sublimation before the fabric was exposed to the higher temperature at which degradation of the APFO into its constituent elements could be expected. Since the evaporation of water, which comprises the great majority of the dispersion solution, occurs at 212 degrees Fahrenheit or lower and since sublimation is active at the same temperature range, Dr. Hopke concluded that the water vapor and the PFOA left the plant at the same point.

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[2] These sources are Barton, C.A., *Dissertation Submitted on the Measurement, Partitioning and Near-Field Modeling of Perfluorooctanoate (PFO) in Air*, University of Delaware 2008; Barton, C.A.. *Solid vapor pressure and enthalpy of sublimation for ammonium perfluorooctanoate*, Journal of Chemical and Engineering Data (2009) and other journals listed as references to his rebuttal report (Ex. 41).

The defense criticizes Dr. Hopke for not considering actual emissions data or industry claims that a significant amount of the APFO input to the glass cloth process decomposes. It also criticizes him for not considering a "material balance report" produced by the defense in discovery which stated that 87% of the APFO was destroyed in the manufacturing process. The defense also criticizes Dr. Hopke for overstating the pH of the dispersant solution and for relying on the 2009 Barton paper which established the rate of sublimation at various temperatures.

These are reasonable grounds for cross-examination. These questions go primarily to the truth of Dr. Hopke's conclusions. They do not require the exclusion of Dr. Hopke's report because they do not contradict his methodology, which was to establish the temperatures at which PFOA sublimates and the higher temperature at which it degrades (decarboxylation). There is no dispute that these processes are different and occur at different temperatures. The analytical core of Dr. Hopke's study is to consider the point in the manufacturing process when each could be expected to take place. Since these points are different and depend upon increase in temperatures within the manufacturing process, it is reasonable to develop a thesis that sublimation precedes decarboxylation as temperatures increase during the various stages of manufacturing.

The court is satisfied that the methodology by which Dr. Hopke has reached his conclusion meets *Daubert* criteria for reliability. It depends upon peer reviewed literature. Although Dr. Hopke did not perform laboratory testing to determine the temperatures at which sublimation and decarboxylation occurred, he relied upon the published work of others who have considered the issue. The issue of error rate does not apply to this type of opinion. Dr. Hopke seeks to explain the consequences of a manufacturing process that has been shut down for almost twenty years. There is no way to restart the process and test his calculation that the PFOA exited

the plant with the water vapor created by drying the fabric. Similarly, there are few "standards or controls" for explaining the effects of a manufacturing process. The principles that explain the process of sublimation are commonly accepted within the scientific community.

C. The Issue of "Fit"

The defense argues that Dr. Hopke's opinion (and that of the other experts proposed by the plaintiffs) lack "fit" with the requirements of Fed. R. Civ. P. 23 because "he is unable to state where the PFOA at any given property in the proposed class area came from." (Doc. 218 at 28.) The defense accuses Dr. Hopke of using improper modeling or averaging techniques without proving the causal connection between estimated annual discharges of PFOA from the defendant's smokestacks and the exposure levels experienced by individual plaintiffs.

The court has reviewed the cases cited by Defendant in support of the proposition that modeling or estimating techniques are improper in class action cases. The cases are more limited in their holdings than suggested. In *LifeWise Master Funding v. Telebank*, 374 F.3d 917 (10th Cir. 2004), the proponent of expert testimony excluded under *Daubert* did not challenge the trial court's exclusion of the testimony except on the limited basis that the court improperly weighed the testimony. The determination that the expert's methodology and expertise were deficient was not in dispute. *Broussard v. Meineke Disc. Muffler Shops*, 155 F.3d 331 (4th Cir. 1998), is a case concerning the merits of class action treatment, not the method or qualifications of the expert.

In a case in which no records exist of day-to-day discharges of PFOA, some form of modeling and estimation is necessary to describe the discharge of PFOA. Experts from both sides have employed these methods. Defendants identify no rule or body of case law prohibiting an expert from evaluating the release of a chemical on the basis of a model describing average

rates of release. Such cases almost always involve descriptions of underground plumes or airborne dispersion that were undetected and unmeasured when the release occurred. Modeling in some form is the only way an individual or a class can describe the process of dispersion and deposition of the chemical.

The injury alleged in this case of contamination from airborne sources lends itself to an inquiry founded on common facts which apply to the proposed classes of residents. There is no way that an individual plaintiff can identify which of the two plants deposited PFOA on her property or when it occurred. If Plaintiffs are correct in their claims, it happened over three decades, gradually and invisibly. The same evidence concerning the factory processes that permitted the discharge of some amount of PFOA "fits" each class member's claim equally. The motion to exclude Dr. Hopke's testimony as unreliable under Fed. R. Evid. 702 and *Daubert* is DENIED.

II. Gary Yoder

Mr. Yoder is an expert in the use of the AERMOD program, which is a widely used computer simulation of weather and geographical features used to model the dispersion of emissions from fixed sources such as smokestacks. Mr. Yoder holds a master's degree in meteorology. He has 26 years of experience in air dispersion modeling. The AERMOD program has been in use since 1991 after its development by the American Meteorological Society and scientists at the Environmental Protection Agency. (Tr. 4/17/19, Doc. 281 at 154.)

A. Qualification

Mr. Yoder is clearly a qualified expert in the use of the AERMOD program, which is one of the most widely-used methods of measuring the plume of airborne contaminants from a smokestack or other fixed source.

B. Method

Mr. Yoder used the AERMOD program to assemble the "in-puts" for his air dispersion model. These included five years of weather data (2006–2010) from the Bennington airport, geographical terrain, and the details of the buildings and stacks at the two Chem-Fab cites. He ordered the program to map the expected deposition rates of PFOA for three rates of discharge from the stacks. The lower limit was 100 pounds per year and the upper limit was 10,000 pounds per year. He also modeled the deposition rate at 1,000 pounds per year. Mr. Yoder concluded that the AERMOD program depicts the deposition pattern of PFOA in a shape and dimensions which are consistent with the "zone of contamination" determined by the Vermont Department of Environmental Conservation through well testing. (Tr. 4/17/19, Doc. 281 at 187.)

The primary criticism of Mr. Yoder's work by the defense is that it relies upon Dr. Hopke's calculations of stack emissions. Since the court has determined that Dr. Hopke's opinions meet *Daubert* standards, this criticism does not lead to the exclusion of Mr. Yoder's opinions. The defense does not attack the AERMOD program itself which has been widely used by environmental scientists for more than 25 years.

The defense criticized Mr. Yoder for not including a calculation of the background sources of PFOA, unrelated to the Chem-Fab plants. Mr. Yoder did not include these for two reasons. First, there is no evidence of any other airborne source of PFOA in the Bennington area. (As a scientist concerned with measuring airborne deposition, he would not consider St. Gobain's claims that PFOA may have leached out of the Bennington landfill and spread across the zone of contamination through groundwater.) Second, the worldwide atmospheric deposition of PFOA is in amounts too tiny to account for the concentrations found in Bennington. Mr.

Yoder's opinion that alternative airborne sources for PFOA have not been identified provides no basis for the exclusion of his testimony.

Mr. Yoder's opinions meet *Daubert* criteria. The AERMOD technique has been tested by EPA and by users in the field over many years. (Tr. 4/17/19, Doc. 281 at 189.) It is published widely and is available to all scientists in an open format manner. It has an error rate that is on the conservative side in the sense that it tends to underestimate the rate of deposition of airborne material. The issue of "standards and controls" is addressed by the widespread use of AERMOD. The AERMOD program has achieved wide acceptance among research scientists and government regulators at agencies such as the EPA. Investigators for the Vermont Department of Environmental Conservation used it in this case with similar results. Investigators do not seek to duplicate AERMOD tests by collecting particulate material on the ground. (Tr. 4/18/19, Doc. 282, at 37.)

C. Fit

As with Dr. Hopke, the defense questions the "fit" of Mr. Yoder's opinion. He does not calculate the rate of deposition of PFOA at any individual plaintiff's home. He could locate an address on the maps of deposition rates produced by AERMOD, but he has not done so. (Tr. 4/18/19, Doc. 282 at 29.) Instead, he sought to provide the probable off-site footprint of PFOA deposition from the two Chem-Fab locations. As in the case of Dr. Hopke, he would have no basis for tracing emissions in any given year to a particular address.

What Mr. Yoder has done is to explain where prevailing weather conditions (the "in-puts" in to the AERMOD program) would tend to deposit airborne particulates. Using Dr. Hopke's calculation of the amount of PFOA released into the air, he calculated the amount of PFOA that would reach the ground in the Bennington area. The resulting plume is sufficiently

consistent with the outlines of the zone of contamination as to go to the fact-finder for a decision about whether it is more likely than not that the Chem-Fab plants are the source of the contamination. As in the case of Dr. Hopke's conclusions, Mr. Yoder's observations are broadly applicable to the residents within the contaminated zone. They "fit" with a class-wide determination of the question of how the contamination was deposited across the zone.

The methodology used by Mr. Yoder meets *Daubert* criteria. The motion to exclude his testimony is DENIED.

III. Donald Siegel, Ph.D.

Dr. Siegel is an experienced hydrogeologist and a leader within the field. He has served as a full professor at Syracuse University since 1993. He served as chair of the Earth Sciences Department from 2012–2017. He has published extensively within his field.

A. Qualifications

Dr. Siegel is clearly qualified to provide an opinion within the field of hydrogeology.

B. Method

Dr. Siegel undertook a study of the hydrogeology of Bennington and North Bennington. He reviewed the zone of contamination identified by the Vermont Department of Environmental Conservation. He agreed that the zone of contamination identified the area where groundwater was contaminated as a result of operations at the two Chem-Fab plants. He concluded that Mr. Yoder's air model of the deposition of PFOA is consistent with his opinion that air to water contamination explains the high readings within the zone of contamination. He noted that no one has identified an alternative source of contamination. He disagreed with the theory in the Barr report that surface water contamination at the Bennington landfill accounts for the PFOA contamination. In Dr. Siegel's view, the location of the landfill in a separate watershed from the

zone of contamination rules out the theory that contaminated water flowed from the landfill over the watershed and into the zone of contamination. The landfill is located at the extreme eastern end of the zone of contamination and the test values are lower on average than the values closer to the two plant locations.

Dr. Siegel's method of inquiry has three principal steps. First, he examined the subsurface geology of the zone of contamination from existing sources. He noted that the flow of water is from east to west, following the course of the Walloomsac River towards the Hoosick River. Subsurface water occurs in a gravel bed overlying the bedrock and a system of fractures within the bedrock at a depth of 100 to 400 feet. Most drilled wells draw from water in the bedrock.

Second, he calculated the time it would take for PFOA to move from the surface into the groundwater. Because PFOA does not adhere ("sorb") to organic material at a high rate, it tends to move at the same rate as the water that carries it. He calculated this rate using a method published by Dr. Rao in 1985 and used for predicting the movement of pesticides and other contaminates through the earth. He assumed that the bedrock lay about 35 feet below the surface. The Rao calculations predicted a maximum transport time of 5–10 years depending on the composition of the soil. Water moves more slowly through soils dense with organic content and faster through sand and gravel. He calculated the time required to "flush out" the PFOA at 140 years.

Finally, he applied Mr. Yoder's calculation of 3 mg of PFOA deposited per square meter per year to estimate the likely concentration of PFOA in bedrock groundwater. He determined that an emissions rate of 1,000 pounds per year would result in groundwater contamination rates

of 1,000 nanograms per liter in 2016. These were consistent with actual measurements east of the Water Street plant of 1,000 to 2,500 ng/L.

St. Gobain criticizes Dr. Siegel's opinions on the ground that they were developed for litigation and lack the rigor he would apply to his academic research. St. Gobain points to an article Dr. Siegel wrote in 2001 in which he proposed a scale of certainty for various models and methods used in hydrogeology. The "solute transport model" used in this case fell somewhere between 50% certainty and "dead wrong." (Ex. B.) St. Gobain also criticizes the use of Dr. Rao's pesticide formula for predicting the movement of PFOA. St. Gobain complains that Dr. Siegel was too quick to rule out alternate sources of PFOA contamination such as car washes and consumer and industrial products which contain small amounts of PFOA.

In his hearing testimony, Dr. Siegel provided context for the statement in his article that the solute transport model was less than 50% reliable. He admitted that he had "different standards and a different scale about the chance of success in academia versus litigation." (Tr. 4/16/19, Doc. 275 at 108.) He explained that the reason for this difference is that the work is done for different purposes. "In the academic world there's no timeframe. You could just go on and on and study things like you've done for 40 years. In the nonacademic world, whether it's for litigation or regulatory purposes, there's a timeframe within which you have to answer questions." (*Id.* at 107.) He also directed attention to the difference between the highly complex three-dimensional computer models, which he criticized in his article in 2001, and the simpler linear model designed by Dr. Rao, which seeks to determine how long it takes for an organic contaminant to pass vertically through different types of soils.

The criticism of Dr. Siegel for not taking into account background levels of PFOA from worldwide atmospheric distribution of the chemical do not disqualify him under *Daubert*

principles. Dr. Siegel explained that the background levels are miniscule in comparison with the concentrations of PFOA found within the zone of contamination. Since the zone is bounded by areas of non-detectable levels of PFOA, the background levels cannot reasonably account for the elevated levels found close to the Chem-Fab factories.

St. Gobain also criticized Dr. Siegel for not conducting field work of his own in Bennington. Dr. Siegel's response was sufficient to establish the factual basis for his opinions.

> But we have a very rich data array here. We have hundreds and hundreds of wells that were sampled multiple times in many cases, and the kind of soils are not unusual from what I've seen in other topographic regions of similar kind . . . I didn't have to take samples.

(Tr. 4/16/19, Doc. 275 at 178.)

Dr. Siegel's opinions meet *Daubert* criteria. The field of hydrogeology is well-established. The principles employed by Dr. Siegel are long-standing. These include the principles that surface water tends to flow downhill; that ground water collects in gravel deposits and in fractures; that ground water moves in response to pressure; that relatively thin, rocky soils permit water to move more freely than heavier soils; and that ground water movement tends to follow watersheds. These basic principles were not questioned.

The test that the defense questioned was the Rao model that Dr. Siegel used to estimate the ten years needed for PFOA to reach the ground water. The Rao formula was published in 1985 in a peer-reviewed journal. (Tr. 4/16/19, Doc. 275 at 148.) Dr. Siegel's use of the model in this case to evaluate the transport of PFOA was untested and unpublished, but the model is widely used by scientists to evaluate the transport of organic contamination through soil. It has been subjected to testing and adopted by earth scientists in the case of pesticides, nutrients, and the "evaluation of transports of organic contamination through soils." (*Id.* at 151.) There was no

testimony about whether the Rao model is subject to a particular error rate. It has not been used before to measure the length of time it takes PFOA to move down through different soil types.

The court concludes that Dr. Siegel's opinion satisfies *Daubert* standards for methodology. He has applied conventional principles from the field of hydrogeology to reach the conclusion that PFOA deposited on the ground in the airborne plume modeled by Mr. Yoder would make its way in 5 or 10 years time into the groundwater. He concluded that the rate of recharge would take about 150 years to remove the PFOA from the groundwater. He ruled out alternative sources of contamination. The Bennington landfill is not likely to be the source of the contamination because it is located at the extreme eastern edge of the plume in a different watershed. Neither the worldwide dispersal of PFOA in trace amounts nor its use by individual consumers and other businesses explains the concentrated nature of the Bennington plume within the groundwater. The methodology used to reach these opinions is widely accepted in the profession and subject to peer review through the publication of the Rao paper as well as basic hydrology textbooks.

C. Fit

In a manner similar to Dr. Hopke and Mr. Yoder, Dr. Siegel has not sought to measure the concentration of PFOA in any individual well or to trace the contamination back to a particular time or plant. He has described the final stage in a gradual dispersion of PFOA over the zone of contamination. His calculations are directed at explaining why the zone of contamination is present and why some wells test negative while others are positive. These are explanations that apply to all property within the zone of contamination. The "fit" between his observations of the hydrogeology of the region and the claims made on behalf of the property class that contamination fell across the two towns over a period of three decades is very close.

In leaving the three liability experts, the court returns again to the question of "fit" raised in each case by St. Gobain. It is true that none of the three experts has examined the property of any individual plaintiff or can trace a particular amount of PFOA from the St. Gobain plants to the plaintiffs' wells. Whether a particular plaintiff has PFOA in his or her well water is a separate question and is resolved through a test. It is not the subject of these expert's opinions.

These three experts are answering a different question, which is whether there is a credible explanation for how PFOA could have traveled from the two plants to the well water. Their answer would be the same even if they appeared in a case involving one plaintiff. The alleged dispersion of PFOA from the Chem-Fab plants occurred gradually over 30 years, ending approximately 15 years ago. Whether these cases are tried in a single class trial or in single trials the expert testimony is equally relevant in providing an explanation of the mechanism of injury.

The court makes no judgment about whether the testimony of the three "transport" experts is credible or accurate. That is an issue for the jury as fact-finder. But for purposes of *Daubert*, the testimony of the three experts "fits" the case regardless of the manner of trial. It is equally relevant to a class trial as to an individual nuisance action.

IV. Alan Ducatman, M.D.

The court turns to the two medical monitoring experts: Alan Ducatman, M.D. and Philippe Grandjean, M.D.

Whether medical monitoring is a form of damages recoverable under Vermont law is a legal issue that the court and the parties will take up later in the context of summary judgment. It is not an issue for expert testimony. In considering the *Daubert* issues, the court assumes for the sake of argument that medical monitoring is a remedy available under Vermont law. The

evidentiary issue is whether these witnesses have provided admissible opinions about whether the remedy should be ordered in this case and in what form.

Alan Ducatman. M.D. is a medical doctor who specializes in the field of public health and occupational medicine. He has held faculty positions at multiple medical schools since 1983. Since 1992, he has served as a professor of public health and medicine at West Virginia University.

A. Qualification

Dr. Ducatman is highly qualified in the field of public health and particularly in the area of environmental health. In his testimony at the *Daubert* hearing, he identified himself as an expert in the health effects of perfluorocarbon compounds (a category which includes PFOA) as well as in the design and implementation of medical monitoring programs. He helped to design a very large medical surveillance program run by the U.S. Navy concerning exposure to asbestos. (Tr. 4/22/19, Doc. 279 at 166–67.) He worked on medical monitoring projects at MIT concerning exposure too beryllium, lead, and other potentially harmful substances. He helped the state of West Virginia establish a medical monitoring program for lead. He assisted the lead scientist in the "C-8" medical monitoring program in Ohio, which concerned perfluorocarbon compounds. (*Id.* at 168–170.) He has published extensively about both PFOA and medical monitoring. (Plaintiffs' Ex. 17 at 2.)

B. Method

Dr. Ducatman has provided expert witness reports in this case that support Plaintiffs' claim for medical monitoring. He offers the following opinions:

- As a result of the contamination of drinking water wells by PFOA, hundreds of Bennington residents have PFOA levels that exceed average levels found in the general population.
- The presence of PFOA in the bloodstream increases the risk of development of certain illnesses.
- These illnesses include kidney and testicular cancer, hypertension and thyroid disease during pregnancy and problems with breast-feeding, thyroid disease without pregnancy, liver disease, hyperlipidemia, gout, and ulcerative colitis.
- Primary care physicians and other clinicians are commonly unfamiliar with the effects of environmental toxins in general and the class of PFAS of which PFOA is a member.
- Increased testing and examination known as medical monitoring will increase the likelihood of early detection and improved outcomes for these conditions.
- The creation of a clinic staffed by doctors and nurses with special training in the potential health consequences of exposure to PFOA is an effective way to conduct medical monitoring.

These opinions are set forth in much greater detail in Dr. Ducatman's reports dated September 1, 2017, December 15, 2017, and August 1, 2018. (Ex. 136, 138,139).

St. Gobain criticizes Dr. Ducatman's report on several grounds. The defense contends that in recommending a monitoring program for all members of the "exposure class" (individuals whose blood serum test shows above-average concentrations of PFOA), Dr. Ducatman overlooks the individual differences between class members. These differences include different levels of exposure to PFOA, blood test results, susceptibilities to PFOA as well as different ages,

physiology, water consumption, diet, drug and alcohol use, body mass index, health, and occupational history. (Doc. 218 at 16–17.)

Building on this observation, St. Gobain accuses Dr. Ducatman of fashioning a remedy for a non-existent "hypothetical resident." The defense argues that Dr. Ducatman's recommendation is at odds with the advice of the U.S. Center for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry. St. Gobain argues that Dr. Ducatman failed to review the medical records of the individual plaintiffs. Because the proposed remedy is over-inclusive, it runs the risk of harming class members by exposing healthy people to the risk of false positives, false negatives, and over-diagnosis.

These criticisms tend to go to the credibility and empirical basis for Dr. Ducatman's opinions. They illustrate the essential difference between the two sides' experts on the issue of medical monitoring. Dr. Ducatman is an advocate for monitoring *before* a person is identified as ill and without regard to whether their individual characteristics make it more or less likely that they will become ill. He also includes conditions that may be associated with exposure to PFOA in some studies but have not been demonstrated to be caused by PFOA. St. Gobain's experts set the bar higher and demand proof of causality and an individualized scrutiny of risk factors and health history before they would support testing above the level recommended for everyone, including those with no exposure to PFOA.

The advice of governmental agencies that have examined these issues has been more guarded than Dr. Ducatman's strong endorsement of increased scrutiny. In its report issued in September 2017 entitled "Exposure to Perfluorooctanoic Acid (PFOA) in Bennington and North Bennington, Vermont," the Vermont Department of Health summarized the health concerns resulting from exposure to PFOA.

> Why is PFOA contamination a health concern?
> Prior studies, such as those conducted by the C8 Science Panel in the Mid-Ohio Valley, have shown an association between PFOA in blood and the following adverse health outcomes:
> - High cholesterol
> - Ulcerative colitis
> - Thyroid disease
> - Kidney cancer
> - Testicular cancer
> - High blood pressure during pregnancy
>
> The associations found in these studies are not proof a cause-and-effect relationship between exposure to PFOA and the above adverse health outcomes. More research is needed before scientists will be able to determine whether there is a definitive cause-and-effect relationship between PFOA and any adverse health outcomes – such as the cause-and-effect relationship between smoking and lung cancer. However, the Health Department does not require such definitive causal relationships to be established in order to take action to protect public health.

(Plaintiffs' Ex. 130.) The results of the Health Department's study of 472 individuals with high blood levels of PFOA led it to conclude that there was an association between PFOA concentrations in blood and the adverse conditions of high cholesterol and hypertension during pregnancy. The Department's assessment did not indicate an association between PFOA concentrations and other conditions such as kidney, liver, and thyroid disease and gout and ulcerative colitis. This second finding was limited by the small sample size, which makes it unlikely that many of these outcomes would have been detected in a population of 472. The Health Department has recommended that drinking water not exceed 20 parts per trillion. (Ex. 130 at 2.)

The federal authorities have also considered the possible health effects of PFOA. These are summarized in a presentation for physicians dated January 18, 2017 published by the Agency for Toxic Substances and Disease Registry ("ATSDR"). (Defendant's Ex. L.) The presentation notes that the EPA recommends that PFOA and related chemicals not exceed 70 parts per trillion in drinking water. It described a range of serious health effects seen in animal studies. It

described the associations found in the C8 study on which the Vermont Health Department also relied. It surveyed the limited number of studies available concerning the link between PFOA and specific diseases. The evidence was inconclusive with respect to bladder and pancreatic cancer. Studies showed evidence of an association between PFOA and kidney cancer. There was limited or inconclusive evidence of a link with prostate and thyroid cancer. There was an association between PFOA and high cholesterol. The ATSDR concluded that "[m]anagement of patients exposed to PFAS should be guided solely by patient symptoms and findings derived from a thorough health history and physical examination." The agency stated that "there are no official guidelines supporting health screening for individuals exposed to PFAS." (Ex. L.)

In 1995 the ATSDR promulgated regulations that guide that agency in determining whether medical monitoring is appropriate in cases subject to the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601 et seq. This is not a CERCLA case and the regulations are not directly applicable. They provide a model, however, of the analytical basis on which a court or agency could evaluate a proposed medical monitoring plan. The ATSDR proposes the following criteria:

- "[E]vidence of contaminant levels in environmental media that would suggest the high likelihood of environmental exposure to a hazardous substance and subsequent adverse health outcomes."
- "[A] well-defined, identifiable target population of concern in which exposure to a hazardous substance at a sufficient level has occurred."
- "[D]ocumented human health research that demonstrates a scientific basis for a reasonable association between an exposure to a hazardous substance and a

specific adverse health effect (such as an illness or change in a biological marker of effect)."

- "[M]onitoring . . . directed at detecting adverse health effects that are consistent with the existing body of knowledge and amenable to prevention or intervention measures."
- "[A]dverse health effects (disease process, illness, or biomarkers of effect) should be such that early detection and treatment or intervention interrupts the progress to symptomatic disease . . . ."
- "There should be an accepted screening test that meets the requirements for validity, reliability, estimates of yield, sensitivity, specificity, and acceptable cost."
- "The accuracy [of the test(s)] is measured using four indices: sensitivity, specificity, positive predictive value and negative predictive value."
- "The screening program should be one that is feasible and acceptable to individuals and the community."
- "An accepted treatment, intervention, or both, for the condition . . . must exist and a referral system should be in place prior to the initiation of a medical monitoring program."

(Ex. L.) These excerpts illustrate the complexity of the medical monitoring decision. The court will use these in considering the reliability and helpfulness of Dr. Ducatman's opinions.

In considering the effects of PFOA contamination in Bennington, Dr. Ducatman relied on the Vermont Department of Health report, which issued in September 2017. (Plaintiffs' Ex. 130.) This report studied the results of 472 blood tests of residents. The results varied from

0.3 to 1125.6 micrograms per liter. The geometric mean was 10.1 micrograms per liter. This average was approximately five times the national background average of 2.1 micrograms per liter. The cause of the exposure was primarily due to contaminated drinking water. (Sixty-five cases were attributed to occupational exposure.) Dr. Ducatman noted that the Department of Health had already completed the first step in a medical monitoring program which is to advise the community members of their blood levels for PFOA. (Tr. 4/22/19, Doc. 279 at 189.)

With this information in hand, Dr. Ducatman reached two conclusions. The first is that Bennington residents with elevated blood levels of PFOA are subject to an increased risk of PFOA-related disease. (*Id.* at 207-208) The second is that these residents would benefit from increased medical testing in an effort to detect conditions associated with PFOA exposure. (*Id.* at 194.)

Because there are very few clinical studies of the effects of PFOA on humans, Dr. Ducatman relied on a literature search of epidemiological studies of which there are many examples. From these he drew a conclusion that PFOA is associated with increased incidence of certain cancers and other conditions. He used a "weight of the evidence" approach to consider multiple studies. He then relied on the ATSDR regulations to conclude that medical monitoring would be an appropriate way to reduce the danger of these conditions through early detection. (*Id.* at 24–25.)

Dr. Ducatman's approach to these questions satisfies *Daubert* criteria:

1. Testing

A public health recommendation such as medical monitoring cannot be "tested" in the sense that two or more populations are compared with some people receiving medical monitoring and others not. But Dr. Ducatman is familiar with other medical monitoring

programs such as the successful efforts to monitor children for the effects of lead poisoning and his own involvement in monitoring for occupational exposure to harmful substances such as asbestos. His familiarity with the successes and shortcomings of these efforts provides reasonable assurance that medical monitoring has been "tested" in the real world.

2. Peer review

Dr. Ducatman has published extensively in peer reviewed journals on the subject of medical monitoring. His opinion that exposure to PFOA is dangerous to human health is derived from the peer-reviewed work of other researchers. The defense disagrees with his choice of articles and accuses him of "cherry-picking" the literature. But *Daubert* does not require that both sides agree of on a particular scientific method. It requires instead that other experts recognize the method by agreeing to publish about it in a peer-reviewed setting. Dr. Ducatman meets this criterion.

3. Error rate

As in the case of testing, it is difficult to measure the error rate for a public health recommendation. It is especially difficult to do this before the recommendation is put into effect. This is not a criterion which the court applies in this case.

4. Standards and controls

Dr. Ducatman has relied on the ATSDR regulations concerning medical monitoring as a source for standards. The parties disagree about whether the ATSDR factors would support medical monitoring. The question clearly has two sides. In the context of the *Daubert* motion, however, Dr. Ducatman has identified an independent authoritative source to guide his analysis.

5. General acceptance

Medical monitoring is recognized as appropriate in some circumstances. Monitoring for lead poisoning is an example that both sides recognize as an acceptable public health measure. Medical monitoring is not a frivolous or radical suggestion. Whether it is the appropriate choice in this case is an issue that the court will decide on the merits at a future date. But general acceptance of the concept has been in place at least since promulgation of the ATSDR regulations in 1995.

These traditional *Daubert* factors support the admissibility of Dr. Ducatman's testimony. The principal criticism that St. Gobain directs against Dr. Ducatman's testimony concerns his decision to recommend monitoring for all Bennington residents with elevated PFOA levels and not just for those who exhibit signs of illness or injury. The defense criticizes him for not examining the medical records and history of the named plaintiffs. As the ATSDR model demonstrates, however, evidence of the effect of medical monitoring on an exposed population—in contrast to the symptoms of an individual—is recognized by epidemiologists as relevant to the decision about whether medical monitoring is appropriate. The court will consider Dr. Ducatman's analysis when the time arrives to answer that question on the merits.

C. Fit

The defense criticizes Dr. Ducatman for not undertaking an individual assessment of the health concerns of the individual plaintiffs. St. Gobain argues that every person is different and that a health recommendation for medical monitoring cannot be advanced in favor of a group or class.

The court disagrees. For purposes of the question of "fit," the named plaintiffs and the members of the proposed exposure class share two important qualities. All have levels of PFOA above the national average. And none currently exhibit symptoms of disease. Dr. Ducatman's

testimony "fits" their case because he is not testifying about compensation for an "average" case of cancer or high blood pressure associated with PFOA exposure. The remedy he proposes is testing, not payment. The members of the class are alike in their relative "wellness," not because they have unique patterns of illness. Whether Plaintiffs can prove an increased risk requiring extra testing is an open question on the merits, but their chosen method of proving a risk of future onset of disease based on epidemiological research rather than clinical presentation is not barred by *Daubert*.

The court DENIES the motion to exclude Dr. Ducatman.

V. Philippe Grandjean, M.D., DMSc

Dr. Grandjean is a highly distinguished public health researcher. Originally from Denmark, he has joint appointments at the University of Southern Denmark and the Harvard School of Public Health. He has published about 500 scientific papers and serves as an advisor to governmental agencies in Europe and the United States on issues of environmental health and risk assessment. He is offered in this case as a rebuttal witness on the health risks of PFOA and the early detection of serious disease through existing diagnostic procedures. (Ex. 20 at 1–2.)

A. Qualification

Dr. Grandjean is highly qualified to testify in the field of public health and environmental hazard.

B. Method

Because Dr. Grandjean is a rebuttal witness, his opinions address and respond to the opinions offered by the defense experts.

In his rebuttal report, Dr. Grandjean opens with a candid review of the constraints and difficulties that hamper inquiry into the health hazards of PFOA. Because it is unethical to

experiment on humans directly by exposing subjects to toxins, health effects must be measured on a population basis. When these studies are based on occupational exposure, the "healthy worker effect" leads to underreporting of health effects. In other words, the group of men and women who are regularly employed may be healthier and longer-lived than the entire population despite exposure to a dangerous chemical. Studies of potentially more vulnerable populations such as children are relatively scarce. PFOA in particular has received intensive attention from researchers only in the last 10 years.

Despite these handicaps, Dr. Grandjean reviewed the available research literature as well as court-ordered reports from cases in Ohio and West Virginia. He concluded on the basis of published data and research papers that PFOA is associated with the development of autoimmune diseases such as ulcerative colitis, reproductive disorders in both genders, complications of pregnancy, high cholesterol, and certain cancers. He criticized the defense experts as too dismissive of papers and research results that did not meet their exacting standards for proof of causality. In Dr. Grandjean's view, the evidence of adverse health results is incomplete but strong enough to support a link between PFOA and the onset of certain serious diseases that is sufficient to justify some form of medical monitoring. (Ex. 20.) He finds support for his conclusion in the actions of public agencies, including the Vermont Department of Health, which have set strict limits on the presence of PFOA and related compounds in drinking water. He is not offered as an expert on the terms and duration of a medical monitoring program.

St. Gobain criticizes Dr. Grandjean's report for reasons similar to those advanced against Dr. Ducatman. St. Gobain argues that Dr. Grandjean has applied risk assessment methods more suitable for administrative regulation than the determination of causation for purposes of tort compensation. As in the case of Dr. Ducatman, the court addresses the admissibility of Dr.

Grandjean's testimony through the lens of a court that has already decided that medical monitoring is a legal remedy for exposure to a toxic chemical. That is a question the court has not answered, but if the answer is "yes," then by definition the remedy will be afforded to residents who have not suffered the onset of disease. They cannot prove that an individual case of cancer or some other illness was caused by PFOA because the event has not occurred. They seek a preventive measure, not compensation. While the plaintiffs retain the burden of proving a sufficient causal connection between PFOA and an elevated risk of disease, that burden is qualitatively different when the disease has not occurred. The court is satisfied that Dr. Grandjean's opinion—that "[c]ontrary to the contentions of defense experts, elevated human exposure to PFASs pose a substantial present and potential hazard to human health"—is likely to prove relevant and sufficiently reliable to play a role in guiding the court on the issue of causation. (Ex. 20 at 4.)

Dr. Grandjean's research and report satisfy the *Daubert* criteria.

6. Testing

The papers on which Dr. Grandjean relies are primarily cross-sectional and longitudinal studies of population health. These cannot be reproduced and tested like a chemistry experiment. Consistency in results among these papers functions as a form of test. In considering dozens of papers on the health effects of PFOA, Dr. Grandjean identified results that were similar. He also considered animal studies, which can be duplicated. The court is satisfied that the data on health effects was subjected to as much testing as can be undertaken without experimentation on human subjects.

7. Peer review

Dr. Grandjean relied on studies that were published through a peer review process. He has also published extensively himself. His reports in this case were not peer reviewed because they were submitted to the court through attorneys. The court is satisfied that Dr. Grandjean's work in the area of the effects of human exposure to chemicals in the environment has been subjected to many years of peer review and that his specific work in this case concerning PFOA is built upon data that was subject to peer review.

8. Error rate

As in the case of Dr. Ducatman, it would be difficult to assign a particular error rate to a determination that the weight of the evidence supported an association between PFOA exposure and certain diseases. Dr. Grandjean was both candid in recognizing that research into PFOA toxicity is at a relatively early stage and quite pointed in describing what he saw as the sources of error in the opposing experts' analyses. (Ex. 20 at 4, 22–27.) The court is satisfied that he has considered the problem of error throughout his work and has not unduly exaggerated the strength of his conclusions.

9. Standards and controls

St. Gobain criticizes Dr. Grandjean for failing to describe an objective process by which he weighs research data in forming his opinion that these studies support his opinion about causation. In his report, Dr. Grandjean described his application of the "weight of the evidence" review of relevant scientific research.

> In each of the following subsections [concerning specific diseases] I discuss the epidemiological evidence that I rely on, summarize the supporting toxicological evidence, and lastly discuss possible mechanisms, and additional studies or potential criticisms relating to the endpoint in question. I have made a reasonably comprehensive review of the epidemiological evidence, and have employed a weight of the evidence approach, as is commonly accepted in the scientific community in reviewing studies on a particular topic.

(Ex. 20 at 27.) Dr. Grandjean also favors studies that have been accorded weight by regulatory agencies, which "allows [him] to focus on the key studies that carry the most weight." (*Id.* at 26.) His methods are subjective in the sense that their application to the choice of one paper over another is not documented. But they are objective in the sense that he limits his inquiry to published work that is listed at length in his "cited publications." (Ex. D.) For purposes of *Daubert*, he has provided a description of his source materials and an explanation of the criteria by which he chooses research papers. This documentation—277 papers in all—provides assurance that he is applying a consistent method which can be assessed by the fact-finder. His weight of the evidence review is not a subjective, "black box" opinion that cannot be examined.

In his concurring decision in *General Electric Co. v. Joiner*, 522 U.S. 136 (1997), Justice Stevens addressed similar issues concerning weight-of-the-evidence proof of epidemiological causation. "It is not intrinsically 'unscientific' for experienced professionals to arrive at a conclusion by weighing all available scientific evidence—this is not the sort of 'junk science' with which *Daubert* was concerned." *Id.* at 153 (Stevens, J., concurring in part and dissenting in part). Justice Stevens noted that the *Daubert* ruling "quite clearly forbids trial judges to assess the validity or strength of an expert's scientific conclusions, which is a matter for the jury." *Id.* at 154. The court will follow the concurrence in ruling that the weight of the evidence process through which Dr. Grandjean considered the available scientific evidence is a legitimate and accepted method of arriving at a scientific conclusion. It will be up to the jury to decide whether he has been intellectually fair in his selection and weighing of the evidence concerning causal links between PFOA and health problems.

10. Peer review

Dr. Grandjean is a prolific author. His work in general appears in peer reviewed journals. In examining the health effects of PFOA, he has functioned not as a primary researcher but as a compiler and evaluator of other scientists' work. The studies on which he relied were so far as the record reveals published in serious, peer-reviewed journals. His own work in general has been published at length in peer-reviewed journals over the course of many years. This is not a case in which an expert's work has not been examined and validated by his peers. Instead, Dr. Grandjean has published widely and relies himself on a broad range of published research.

11. General acceptance

Population-based studies and the "weight of the evidence" assessment have achieved wide acceptance in the field of epidemiology. One may agree or not with Dr. Grandjean's conclusion that exposure to PFOA causes health problems, but the methods he employed in reaching his conclusions are generally accepted.

C. Fit

Dr. Grandjean's testimony "fits" the issues raised by plaintiffs for the same reasons discussed above concerning Dr. Ducatman's testimony and with the same reservations concerning the reservation of the legal issue of the availability of a medical monitoring remedy. The motion to exclude Dr. Grandjean's testimony is DENIED.

VI. David Mears, J.D.

David Mears is a leading environmental attorney in Vermont. He served as Commissioner of the Department of Environmental Conservation. He has also served as Associate Dean for Environmental Programs at Vermont Law School.

Mr. Mears has offered a rebuttal opinion in response to the opinion of Felix Flechas submitted by St. Gobain. Mr. Flechas has offered an expert opinion that over the years of operation, Chem-Fab and St. Gobain complied with Vermont regulatory requirements. Mr. Mears disagrees and identifies what he believes to be errors in Mr. Flechas's analysis. In his view, Chem-Fab violated Vermont air pollution requirements for many years.

St. Gobain's objection to Mr. Mears's testimony relates to relevance issues, not to *Daubert* methodology. Mr. Mears is qualified to explain the details of the Clean Air Act and Vermont environmental regulation. He is not a scientific expert. His expertise is in the history and application of environmental regulation to the defendant's operations. As a rebuttal witness, the relevance of his testimony is largely determined by what Mr. Flechas testifies to and the position taken by St. Gobain at trial concerning compliance or violation of environmental regulations. The court reserves decision on issues of relevance and the related concerns of propensity evidence raised by the defense until trial.

VII. Robert Unsworth, M.S.

Mr. Unsworth is an expert in the field of natural resource economics. He holds a Master of Forest Science from Yale University. He is the principal in Industrial Economics, Inc., which provides consultation services concerning the valuation of environmental damage. He has offered an opinion regarding the economic loss created by the contamination of drinking water by PFOA in Bennington and North Bennington.

A. Qualifications

Mr. Unsworth is well-qualified as an economist specializing in the field of natural resources.

B. Method

To understand Mr. Unsworth's opinion, it is necessary to recount a little of the history of remediation efforts conducted by St. Gobain and the Vermont Department of Environmental Conservation. In contrast to the views expressed by St. Gobain in this case that some other source shares responsibility for the PFOA contamination, the same company has moved rapidly to address the provision of clean drinking water to homeowners whose wells are contaminated. In recent years, St. Gobain has committed to paying most of the cost of providing municipal water from reservoirs to most homeowners in the contaminated zone. The work of laying water mains and completing the connections is on-going. In the case of about 12 homes that cannot be connected to water service due to their remote location, St. Gobain has agreed to pay the cost of on-site filtering and purification through a POET system. These voluntary measures have greatly reduced the economic loss suffered by homeowners who can no longer make use of their own wells for drinking water.

Plaintiffs have asked Mr. Unsworth to calculate the remaining economic damages. He identifies three areas:

1. the difference in cost to an average homeowner between maintaining a well and paying quarterly water bills;
2. the loss to homeowners served by a POET system based on "their willingness-to-pay to not have a groundwater source that requires treatment"; and
3. the replacement cost incurred by Bennington and North Bennington residents due to increased demand on their municipal water systems.

He calculates these costs at $4,904,276, $257,674, and $12,420,700 respectively.[3]

Defendant argues that Mr. Unsworth did not consider the individual expenses of the named plaintiffs in measuring their damages. According to St. Gobain, "Mr. Unsworth's use of averages, rather than actual data on putative class members leads to a fatal disconnect between his opinion on total class damages and the damages attributable to individual class members." (Doc. 218 at 31.) The defense notes that the use of "replacement costs" drawn from a list of future improvements to the Bennington municipal water supply substitutes damages sustained by a class member to a claim made on behalf of a non-party—the Town of Bennington—or "the public" which includes the proposed class members and other residents. In addition to these objections relating to the "fit" between the expert's report and the damage calculations permitted in the class action setting, the defendant argues that the use of averages for water use and expense figures is inherently unreliable because it masks significant differences in the experiences of individual plaintiffs. (*Id.* at 55–56.)

Plaintiffs respond that statistical evidence is commonly admitted in order to prove damages in class action cases. They maintain that "Mr. Unsworth's use of statistically reliable, common methodology to project such added costs for the class is both relevant and fits class certification, as it is plainly tied to the facts of the case and can be demonstrated by common proof." (Doc. 246 at 49.) With respect to the elements of damage drawn from the Town of

[3] Plaintiffs' claim for loss of value of their property is not part of the proposed class action. They seek an opportunity as individual plaintiffs to make a claim for diminution of value based on their own opinion. Mr. Unsworth is offered as a witness to rebut testimony from defendant's expert that in the context of valuation appraisal, the stigma of contamination does not affect the value of the subject properties. This issue is not really addressed in the parties' memoranda except in passing. After the class certification decision issues, there will be a better opportunity to rule on the admissibility of Mr. Unsworth's rebuttal opinion that stigma affects value in the context of the individual claims. This issue is not decided now.

Bennington's list of planned improvements, Plaintiffs argue without citation to case law that the assurance of clean water supply through these upgrades will effectively compensate members of the Bennington community for the loss of the shared resource of clean groundwater. (*Id.* at 54.)

In addition to these issues, at the hearing itself, St. Gobain criticized Mr. Unsworth for obtaining expense costs for well water systems from casual and unreliable sources such as the internet.

1. Use of average cost figures

In *Tyson Foods, Inc. v. Bouaphakeo*, 136 S. Ct. 1036 (2016), the Supreme Court permitted the use of representative evidence to determine liability on a class basis so long as the same evidence would have been admissible in an individual suit. "In a case where representative evidence is relevant in proving a plaintiff's individual claim, that evidence cannot be deemed improper merely because the claim is brought on behalf of a class." *Id.* at 1046. In *Tyson Foods*, average time spent "doffing and donning" protective clothing was admissible through an expert to prove the number of hours worked by employees. As in the case of household water usage or well costs, the length of time a person needs to put on or remove the clothing varies. The Court permitted the use of averages because it may have been "the only practicable means to collect and present relevant data" on liability. *Id.* (quoting Manual of Complex Litigation § 11.493, p. 102 (4th ed. 2004)). *Tyson Foods* was not a case in which the defense raised a *Daubert* challenge to the use of representative evidence.

The court considers the use of representative evidence from the perspective of relevance or fit. The relative costs of municipal water and well operation vary—but not very much. Water is most commonly metered on a flat-rate basis in Bennington—currently $532 per year—and on the basis of usage in North Bennington—$354 per year. (Ex. 14.) Mr. Unsworth

computed well costs on the basis of annualized costs for each element such as pressure tank replacement or electricity use. The average cost was $419 per year (unless a water softener was used, which would reduce it to $188). The parties are free to argue about the accuracy of each figure, but there is no record evidence that the costs for either system vary greatly from one home to the next. For example, St. Gobain argues that different households use water at different rates but provides no evidence about actual variance in their water bills. (Doc. 218 at 56.)

The court follows *Tyson Foods* in considering whether average costs would be admissible in an individual case. In such a case, the best evidence would be actual costs projected into the future. In *Tyson Foods*, the best evidence of how long an employee takes to doff and don her protective equipment would be the time she actually spends in that manner. But a litigant who did not know, for example, the future costs of operating a well would rely on averages. And while a record exists of municipal water bills for a property, a party might seek to introduce average costs to show that his usage was within normal limits. The court is satisfied that Mr. Unsworth did not violate *Daubert* standards when he measured average costs rather than determining these costs one property at a time.

2. Replacement costs

Plaintiffs seek to recover $12,420,700 which they describe as replacement costs for the loss of potable groundwater within the zone of contamination. This figure is made up of three capital improvement projects to the Bennington municipal water supply, including the purchase of an additional buffer of land around an intake location, modifications to water filtration at the same location, and the replacement of a storage tank and water line. All of these projects are on

a list of future improvements maintained by the Town. North Bennington did not submit any proposed improvements to their system.

The court will not permit Mr. Unsworth to testify concerning these amounts on grounds of relevance. As the citations to his report demonstrate, economists frequently evaluate the social costs of pollution and other harms to the environment. He is qualified to undertake such an inquiry. To the extent a method exists to total such costs, he followed it. But the cost to the Town of Bennington to improve its fresh water supply is irrelevant to the damages sustained by the individual class representatives or the entire class. To award this amount would be more like a gift or a fine than a compensatory remedy.

It is telling that no other cases are cited in support of the remedy. The Restatement (Second) of Torts § 902 defines "damages" as a sum of money awarded to a person injured by the tort of another. The commentary includes a discussion of this circular definition which bears directly on the issue presented by the claim for damage to the community:

> Damages flow from an injury. As stated in § 7, injury denotes the invasion of any legally protected interest. "Injury" is thus distinguished from "harm," which is a nonlegal word implying merely a detriment in fact. The infliction of harm does not always give rise to a cause of action.

Id. § 902 cmt. a. In this case, the extensive contamination of the groundwater is a significant harm. Some aspects of that harm were directly experienced by the individual plaintiffs and by the broader class of residents whose wells are contaminated. But harm to the two municipalities —a group greatly exceeding the two proposed classes—is different from compensable damages suffered by Plaintiffs.

Several features of the proposed remedy illustrate that it falls beyond the bounds of tort recovery. Neither municipality has sought to intervene in this action even though Plaintiffs seek to recover more than 12 million dollars on behalf of Bennington. North Bennington has not even

submitted a list of potential improvements. The great majority of Bennington and North Bennington residents either have no wells, have wells which have not tested positive to date, or have not shown through testing that they have elevated blood levels of PFOA. Plaintiffs seek to have the money held in trust for Bennington which has not asked for it.

Plaintiffs seek to recover future costs of a non-party. If increased demand on the municipal water supply results from well contamination, the municipality may have a claim. The town already has juridical existence—it is in effect its own class, comprised of all residents. It can sue for damages caused by the contamination. It could file a motion to join in this action. That damage claim would be subject to tests of liability, including causation. What tort law does not permit is for the individual plaintiffs or the class of exposed individuals and well owners to sue on behalf of the town.

The Bennington list of future capital improvements is irrelevant to the losses fairly attributable to the named plaintiffs or to the two classes which they seek to represent. The court will not allow testimony on that issue from Mr. Unsworth.

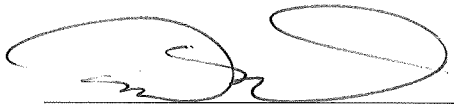
C. Fit

The "fit" of Mr. Unsworth's testimony with the determination of the alleged added costs for municipal water is reasonably close. While water bills and the costs of maintaining an existing drilled well may vary, they do so within relatively narrow limits and are susceptible of common proof. The court has already disallowed the testimony concerning the replacement of the ground water resource by court-ordered capital improvements.

CONCLUSION

The court DENIES the *Daubert* motion (Doc. 218) except with respect to a portion of the proposed testimony from Mr. Unsworth.

Dated at Rutland, in the District of Vermont, this 15 day of July, 2019.



Geoffrey W. Crawford, Chief Judge
United States District Court