UNIVERSITY OF CALIFORNIA
SANTA CRUZ

MODELING NITROGEN FERTILIZER LITIGATION ON TORT-BASED CLIMATE CHANGE LAWSUITS IN THE UNITED STATES

A dissertation submitted in partial satisfaction
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

ENVIRONMENTAL STUDIES

by Marnie E. Riddle

December 2020

The Dissertation of Marnie E. Riddle is approved:

_____
Professor Andrew Szasz, chair

_____
Professor Carol Shennan

_____
Professor Madeleine Fairbairn

_____
Quentin Williams
Interim Vice Provost and Dean of Graduate Studies

Table of Contents

List of Figures

Abstract

Modeling nitrogen fertilizer litigation on tort-based climate change lawsuits in the United States

Marnie E. Riddle

The Clean Air Act and Clean Water Act are major environmental statutes that aim to control air and water pollution using federal standards and state implementation programs. Although these laws have succeeded in reducing some forms of pollution, they have not been effective against two types of environmental harm: greenhouse gases, resulting from fossil fuel use, and nitrogen runoff, resulting from agricultural fertilizer use. Greenhouse gases lead to climate change, and nitrogen runoff can lead to nitrate contamination of drinking water, hypoxia in surface water bodies, and harmful algal blooms. States, cities, counties, and others affected by climate change have recently filed lawsuits against fossil fuel manufacturers that do not allege Clean Air Act violations, instead framing the issues primarily in tort law terms. A case study of this set of lawsuits reveals shared features that inform a possible approach to the nitrogen runoff problem, and common challenges that may arise while using this model. The scientific and legal issues arising from nitrogen runoff bear substantial similarities to those that arose in the climate change lawsuits. Using the model presented by the climate change suits, municipal drinking water utilities and others affected by nitrogen runoff may be able to sue fertilizer manufacturers, framing their cases in tort law terms rather than alleging Clean Water Act violations.

Acknowledgments

I am grateful to my family for their support.

I appreciate the financial support provided by the UCSC Chancellor's and Regents' Fellowships, Annie's Sustainable Agriculture Scholarship, Gliessman Fellowship, John A. Knauss NOAA Sea Grant Fellowship, CONCUR Inc., and the UCSC Environmental Studies Department.

Without the patience, encouragement and intellectual support of my committee members, Andrew Szasz, Carol Shennan, and Madeleine Fairbairn, this would not have been possible. This work has also been inspired by the mentorship of three exceptional litigators: Steve Volker, Vic Sher, and Todd Robins.

Finally, I am deeply thankful for the colleagues and friends who have provided comments, feedback, and emotional support at crucial moments during this process, including Andrew Blumberg, Alicia Calle, Sarah Carvill, Tom Colvin, Masha Dabiza, Sarah Gollust, and Veronica Yovovich.

Chapter 1: Tort litigation as a strategy when regulation fails

Introduction and overview

This work addresses the potential advantages and challenges of a novel approach to the problem of agricultural nitrogen pollution. Chapter 1 offers an overview of the tort law approach (claims based in nuisance, negligence, trespass, and products liability) and the statutory approach (claims based in regulatory violations) and discusses their comparative strengths. This overview is followed by a discussion of the methods used in this research. Chapter 2 discusses the harms caused by agricultural nutrient pollution, existing attempts to mitigate them, and the failures of regulation to address them. Chapter 3 addresses the failure to regulate greenhouse gas emissions and the tort-based litigation approach that has arisen as a response. Chapter 4 discusses the prospect of tort litigation in the context of nonpoint source agricultural nitrogen pollution. Finally, Chapter 5 contextualizes this work and addresses some of its limitations. The scope of this research is limited to the United States, which experiences both nitrogen pollution problems and climate change impacts, and which features a federal-state partnership regime (cooperative federalism) for implementing environmental statutes and a robust history of state common law jurisprudence.

The problem of climate change highlights the failure of the existing regulatory process to protect environmental quality. Legislation and associated administrative actions have not proven adequate to the task of preventing or mitigating the effects of climate change, so new approaches that leverage the existing legal system have arisen. Tort litigation over climate change is premised on the theory that the effects of

climate change are harms for which the manufacturers of fossil fuel products are ultimately responsible. Although early cases employing this approach tested strategies that were ultimately unsuccessful in the courtroom, several city, county, and state governments have recently begun to sue fossil fuel manufacturers in state courts using nuisance, trespass, and products liability causes of action. The strategy requires prospective plaintiffs to identify potential defendants who caused their injuries and persuade a jury that those defendants should either cease the harmful activity or compensate plaintiffs for the harm done. States and municipalities are obliged to protect their residents and property from threats that are created or exacerbated by climate change – potentially an expensive proposition. If these entities themselves are not primarily responsible for climate change impacts like sea level rise or the ensuing damage, and they can identify those who are, they may try to sue to recover those costs.

From a tort law perspective, the nitrogen runoff problem is analogous to the climate change problem in some important ways. The use of fossil fuels has led to increased greenhouse gas emissions, while the use of synthetic fertilizer in agriculture to increase crop yields has led to an excess of nitrogen in the environment. Greenhouse gases trap heat, changing the climate and contributing to sea level rise, extreme weather, and other hazards. In surface water, nitrogen compounds promote the growth of harmful algal blooms; in groundwater, they contaminate drinking water wells and adversely affect human health. The Clean Air Act has not been enforced against greenhouse gas emitters, while the main federal statute protecting water

quality, the Clean Water Act, exempts agricultural operations and nonpoint source pollution (i.e., diffuse runoff from areas of land) from regulation. Tort litigation in state courts, following the model described in Chapter 3, could offer a path to mitigating the adverse impacts of nitrogen pollution.

Background

Fundamentals of environmental torts

In the United States, law can be approximately divided into two categories. State and federal legislatures create "public law," which consists of governing rules codified in statutes and regulations that are implemented by executive agencies. "Common law" is precedent-based law, created over time as judges rule on the merits of specific controversies brought before them by plaintiffs, using principles established in prior rulings in similar cases – i.e., the doctrine of *stare decisis* (lit. "let it stand") under which similar cases are decided alike. (Green, 1997).

In the parlance of common law, a tort is a wrongful act or omission that harms or injures another, giving rise to civil legal liability. Tort law compensates those who have been harmed by the activities of others (Grossman, 2003; Peñalver, 1998; Perillo, 2004). Many tortious activities are negligent: "conduct which falls below the standard established by law for the protection of others against unreasonable risk of harm." Restatement (Second) of Torts (American Law Institute, 1965). The elements of negligent acts are duty, breach, causation, and harm: a negligent defendant is one who owed a *duty* of care (an obligation to do or not do something) to another person

and *breached* that duty, thereby *causing* that person *harm.* But other activities can give rise to strict liability: if harm resulted from particularly dangerous actions, that defendant could be liable no matter how careful it has been. Restatement (Second) of Torts § 402A (American Law Institute, 1965).

The two "classic" environmental torts are trespass and nuisance. Trespass is the physical invasion of property, whether by a human being or by molecules of a water pollutant. *Sterling v. Velsicol Chemical Corp.,* 24 E.R.C. 2017 (W.D.Tenn. 1986) (well water contaminated by hazardous runoff from neighboring land could give rise to a claim for trespass). There is no reasonableness test, no risk-benefit test, and the trespass itself is the compensable harm (Keeton, 1984).

The tort of nuisance is usually defined as an unreasonable interference in the use and enjoyment of property. See, e.g., *Georgia v. Tenn. Copper Co*., 206 U.S. 230, 238 (1907) (emissions from copper smelters in Tennessee were held to be a nuisance when they drifted to and destroyed crops and forests in Georgia); *Copart Indus., Inc. v. Consol. Edison Co. of N.Y., Inc.,* 362 N.E.2d 968, 971 (N.Y. 1977). Much environmental law is nuisance law; *William Aldred's Case* was an early and archetypal case highlighting the friction that can arise when economic activities impact the human environment. 77 Eng. Rep. 816 (K.B. 1611). The defendant raised pigs, an activity that created odors that drifted into the plaintiff's vicinity, to which the plaintiff objected. Although the defendant argued that his work was "necessary for the sustenance of man" and thus "one ought not to have so delicate a nose" as the plaintiff (*id.* at 817), the court found in the plaintiff's favor, relying on the principle

sic utere tuo ut alienum non laedas – one should use his own property in such a manner as not to injure that of another (*id.* at 821). This principle underlies and has evolved into the modern common law of nuisance (McRae, 1948), though not without substantial extension and modification.

Over time, urbanization and industrialization created pressure on courts to soften this rule and create more room for economic development, sometimes at the expense of individual (or public) comfort. In *Radcliff's Executors v. Mayor of Brooklyn*, an urban development case, the Court of Appeals rejected the idea of *sic utere tuo,* saying "a city could not be built under such a doctrine." 4 N.Y. 195, 203 (1850). Instead, the court held that an act that would otherwise be a nuisance, "done under lawful authority, if done in a proper manner, can never subject the party to an action, whatever consequences may follow." *Id.* at 200. Later, in *Losee v. Buchanan,* the court went further, completely discarding the original *sic utere tuo* rule in favor of one "much modified by the exigencies of the social state. We must have factories, machinery, dams, canals and railroads." 51 N.Y. 476, 484 (1873). The court posited that individuals inconvenienced by industrial activity were adequately compensated by the benefits of living in a society where all suffered similarly for the sake of industrialization and its comforts. "[B]y becoming a member of civilized society, I am compelled to give up many of my natural rights, but I receive more than a compensation from the surrender by every other man of the same rights, and the security, advantage and protection which the laws give me." *Id.* at 484. These cases, among others, illustrated the evolution of nuisance law from a predominantly strict

liability framework to a reasonableness framework under which harms may not be compensable unless the putative defendant (or tortfeasor) has been negligent in some way.

The Restatement of Torts[1] articulated this balancing of interests first by adding a reasonableness/negligence test to the definition of nuisance, describing it as "a non-trespassory invasion of another's interest in the private use and enjoyment of land" that is either "(i) intentional and unreasonable; or (ii) unintentional and otherwise actionable under the rules governing liability for negligent, reckless or ultrahazardous conduct." Restatement (Second) of Torts at §822 (American Law Institute, 1979). Reasonableness is defined in risk-benefit terms: "[a]n intentional invasion of another's interest in the use and enjoyment of land is unreasonable under the rule, unless the utility of the actor's conduct outweighs the gravity of the harm," after considering the "extent" and "character" of the harm, "the social value which the law attaches to the type of use or enjoyment invaded," and "the burden on the person harmed of avoiding the harm." Restatement (Second) of Torts at §826-828 (American Law Institute, 1979). This is a high bar to clear for modern cases involving harms that stem from commonly accepted forms of economic activity and useful services and products (Meiners & Yandle, 1999).

[1] The American Law Institute periodically attempts to capture and distill the common law of the United States by identifying patterns in the reasoning of state court decisions that purport to apply common law principles. The first Restatement of Torts was published in the 1930s, followed by the Restatement (Second) in 1965-1979 and the Restatement (Third), which is not yet complete.

Nuisances can be either permanent or temporary. Temporary nuisances can be enjoined by the court; in other words, the court can remedy the harm by ordering the defendant to stop engaging in the activity that has caused the nuisance. Permanent nuisances are those that cannot be enjoined, sometimes because the activity giving rise to the nuisance is deemed too valuable to stop, and the plaintiff is compensated with the loss in value of the affected property (Meiners & Yandle, 1999). The concept of permanent nuisance is relatively new: in 1970, the court in *Boomer v. Atlantic Cement Co.* put forth a novel remedy in answer to a dispute between a cement plant and its neighbors, who objected to the dust and noise that the plant produced and asked the court to close the plant entirely. Instead of granting their request, the court compensated the plaintiffs for the ongoing dust and noise with an award of damages proportional to that harm – in this way, the court supposed, motivating the defendant to minimize its emissions and therefore minimize the amounts it would have to pay its neighbors. 257 N.E.2d 870, 875 (1970).

The moral hazard created by this approach is apparent: under this framework, industries with enough money to do so are permitted by the courts to purchase plaintiffs' rights to be free from nuisance, whether or not the plaintiffs wish to sell. Courts recognized this risk in earlier nuisance cases, noting that "[i]f the smaller interest must yield to the larger, all small property rights... would sooner or later be absorbed by the large, more powerful few" (*Hulbert v. California Portland Cement Co*., 118 P. 928, 933 (Cal. 1911)) and "if followed to its logical conclusion [the rule]

would deprive the poor litigant of his little property by giving it to those already rich" (*Whalen v. Union Bag & Paper Co*., 101 N.E. 805, 806 (N.Y. 1913)).

Public nuisance is a variation of nuisance defined by the Restatement as "an unreasonable interference with a right common to the general public." Restatement (Second) of Torts § 821B (American Law Institute, 1979). For this type of nuisance, interference may be deemed "unreasonable" if it "involves a substantial interference with the public health, the public safety, the public peace, the public comfort or the public convenience, or … is of a continuing nature or has produced a permanent or long-lasting effect and, to the actor's knowledge, has a substantial detrimental effect upon the public right." Restatement (Second) of Torts § 821B (American Law Institute, 1979). Examples include river pollution that interferes with the public's right to fish; lake pollution that interferes with public recreation; or hazardous wastes that interfere with public health and safety (Russo, 2018).

State governments have standing to bring public nuisance actions on the public's behalf (Abate, 2008; Lin & Burger, 2018; Russo, 2018). Private plaintiffs can bring actions for public nuisance if they can show particularized damage that is not shared with the general public – in other words, although the nuisance affects everyone, the plaintiff has been damaged differently from everyone else. Restatement (Second) of Torts § 821C (American Law Institute, 1979).

The common-law/regulation pendulum

The law and economics perspective on property rights, pollution, and nuisance must be addressed because it is the prevailing paradigm in modern American environmental law, the lens through which many practitioners have learned to view environmental disputes, particularly nuisance (Pasquale et al., 2019). In "The Problem of Social Cost" (1960), Ronald Coase theorized that "socially optimal" levels of pollution could be obtained more effectively by conceptualizing the problem in terms of property rights (to pollute or be free of pollution) and their assignment to persons, rather than in normative terms. Litigating the correct assignment of these property rights creates an opportunity to internalize the externalized costs of pollution, or to reassign the right to avoid the costs of pollution from the polluter to the affected downstream property right owners (Lusk, 2013). In reassigning these rights, tort liability both deters potentially hazardous activities and administers justice by compensating the injured (Perillo, 2004). Abelkop (2013) summarizes the role of courts in making this reassignment:

> The parties must rely on the court to settle disputes because in general, neither party has access to full information, there are transaction costs, and entitlements may be unclear as to the parties. The resolution of a nuisance suit in favor of the plaintiff, then, is designed to internalize the external costs associated with pollution by simulating a market exchange between the defendant producing the externality and the plaintiff who must bear the cost. (Abelkop, 2013, p. 393).

Under a Coasian analysis, an injunction against polluting activity recognizes the plaintiff's right to be free from nuisance, and the refusal to grant an injunction recognizes the defendant's right to use plaintiff's property as a pollution sink (Green, 1997).

As long as property conflicts are relatively infrequent and involve a limited number of parties, litigating nuisance suits individually is a reasonably effective solution. As Professor Geistfeld explains, "[t]he tort system's reliance on case-by-case adjudication is well suited for isolated instances of wrongdoing, like occasional collisions at railroad crossings, but tort cases in an increasingly interdependent economy often involve complex decisions in mass markets…" (Geistfeld, 2014, p. 959). As the use of tort to solve widespread problems increases, litigation tends to become increasingly expensive and unpredictable, and common law may begin to seem "too narrow a confine for the exercise of a regulatory power in a complex and interdependent society." *Lucas v. South Carolina Coastal Commission*, 505 U.S. 1003 (1992) (Kennedy, J. concurring). Furthermore, when large numbers of people are only moderately affected by a nuisance, it may become difficult to assemble a coalition to take action (Sivas, 1987).

The *Boomer* court highlighted this quandary in the environmental context, writing "that the judicial establishment is neither equipped . . . nor prepared to lay down and implement an effective policy for the elimination of air pollution." 257 N.E.2d 870, 871 (N.Y. 1970). Ongoing issues that affect large numbers of people may therefore become targets of regulation, so that rules become more clear and the outcomes of environmental conflicts become more predictable. Professor Joseph Sax argued that environmental legislation proliferated because most people had come to understand the following:

> the traditional common law remedies were utterly inadequate to deal with contemporary environmental problems, and a whole new body of law—indeed

> a new conception of law—was needed. The reasons were many. Tort law basically dealt with after-the-fact remediation of harm, but environmental threats had to be addressed before they did their dirty work. Actions like private nuisance and trespass basically protected private property rights, while hazards like pesticides threatened public resources such as wildlife populations. Tort remedies demanded proof of causation of a sort that was poorly fitted to problems like contaminated groundwater and hazardous waste sites to which many industries had contributed over many decades. (Sax, 2007, p. xvii).

The "Environmental Law Revolution" took place in the *Boomer* era – a wave of federal environmental legislation that passed six major statutes with "overwhelming, bipartisan support": the Clean Air Act, Clean Water Act, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), National Environmental Policy Act (NEPA), and Endangered Species Act (ESA) (Aagaard, 2014). The factors leading to the rise of durable national environmental legislation and the creation of the Environmental Protection Agency in the 1970s are not completely clear (Percival, 1998), but some scholars have noted a correlation between nationwide sentiment in support of regulation and the growing severity of environmental problems (Schroeder, 1998). Others trace the turn to wider understanding of ecological problems and their connection to our well-being, spread in part through the writings of Barry Commoner, Rachel Carson, Paul Ehrlich, and others; the first view of the earth from space; and even creative lawyers who were already engaged in the process of leveraging existing laws to protect the environment (Ruhl & Salzman, 2013).

Water pollution is a unique environmental policy problem, for several reasons. Economic activity relies on the availability of water that meets certain standards of usability, water contamination can affect people's health and well-being (a matter of state oversight), and many surface waters are navigable waterways (a matter of federal interest). Before the mid-twentieth century, the control of water pollution was relegated solely to state and local governments (Glicksman & Batzel, 2010). By 1965, however, federal legislation required states to develop water quality standards that met or exceeded a federally-set minimum (Percival, Schroeder, Miller, & Leape, 2009). Federal intervention was intended to correct poor enforcement of the water quality laws developed by the states, which had led to rampant pollution (Glicksman & Batzel, 2010). The Clean Water Act balances state and federal interests in clean water by giving the federal government primary responsibility for regulating surface-water discharges from point sources, and giving the states the responsibility for regulating nonpoint sources.

Following the passage of the Clean Water Act in 1972, in *Weyerheuser Co. v. Costle*, the D.C. Circuit noted that the Act served to codify a shift of rights: from the polluter's right to pollute, to the public's right to a clean environment. 590 F.2d 1011, 1043 (D.C. Cir. 1978). Doremus and Tarlock (2012) conclude from this "that the pre-1972 'right to pollute' was based more on government inaction and the limitations of common law litigation than the existence of any legally protected property right" – implying that the property rights protected by nuisance and trespass law have always

had primacy, even when poorly defended in practice (Doremus & Tarlock, 2012, p. 47 n.14).

Another potential impetus for the passage of the Clean Water Act was a series of lawsuits in the 1960s, brought under obscure provisions of the 1899 Refuse Act, that demonstrated industrial polluters' vulnerability to liability for any polluting surface water discharge in the absence of a national permitting program (Potter, 1972). Liability under a common law system was sometimes viewed as the "unpredictable product of the caprices of individual juries," giving industry no way to predict what activities would be afforded social sanction and what would give rise to a damages judgment (Posner, 1972, p. 73). Environmental laws and standards, in contrast, create a uniform, stable liability regime that encourages economic activity within well-understood bounds – at least in theory (Weiland, 2000). This is especially true for federal, as opposed to state, environmental legislation; state regulation can be inconsistent and sometimes more rigorous than federal (Elliott, Ackerman, & Millian, 1985).

But several decades of experience with the federal environmental statutory regime have illuminated some of its faults. The literature is replete with critiques of the existing regulatory structure:

> [I]t is unduly rigid, cumbersome, and costly; fails to accommodate and stimulate innovation in resource-efficient means of pollution prevention; fails to prioritize risk management wisely; is patchwork in character, focusing in an uncoordinated fashion on different environmental problems in different environmental media and often ignoring functional and ecosystem interdependencies; and relies on a remote centralized bureaucratic apparatus that lacks adequate democratic accountability. (Stewart, 2001, p. 21).

Hylton argues that nuisance law has the potential to do a better job of enforcing environmental protection than administrative law because of what he calls the agency cost problem: public enforcers of private rights may not align their interests and incentives with those whose rights they ostensibly protect (Hylton, 2008). Professor Butler (2008) sees strength in the common law's incentivizing of factual discovery and offers a combined approach that allows for the coexistence of common law and federal regulation. In short, neither public regulation nor tort law is always the best answer to any difficult environmental problem. Both respond to social and political trends and pressures, and their relative power and usefulness can shift over time and over a range of issues. This research addresses the possibilities presented by tort law for solving the agricultural nitrogen pollution problem.

Methods

> How is a Greek chorus like a lawyer
> they're both in the business of searching for a precedent
> finding an analogy
> locating an example
> so as to be able to say
> this terrible thing we're witnessing now is
> not unique you know it happened before
> or something much like it
> we're not at a loss how to think about this
> we're not without guidance
> there is a pattern
> we can find an historically parallel case
> and file it away under
>
> ANTIGONE BURIED ALIVE FRIDAY AFTERNOON
> compare case histories 7, 17 and 49
>
> – Anne Carson, *Antigonick*

The lawsuits described in the next chapter illustrate one possible tort-based approach to a seemingly intractable environmental problem that has not been met with sufficient regulatory and political response to fully mitigate the harm. A careful examination of the choices made by actors with a material interest in the outcome of these suits may shed light on useful approaches to another similarly intractable problem – agricultural nitrogen pollution and harmful algal blooms.

Legal research

This analysis is methodologically rooted in both legal research and the case study technique – which are closely related. As Paul Chynoweth (2008) notes, "[l]egal researchers have always struggled to explain the nature of their activities to colleagues in other disciplines;" he subsequently bemoans the "dearth of theoretical literature on the nature of legal scholarship and a consequent lack of awareness about what legal scholars actually do" (Chynoweth, 2008, p. 28). Edward Rubin (1997) phrased the same problem more colorfully: "For the last few dark and stormy decades, ever since it irreversibly dismantled its formalist home, legal scholarship has been traipsing from door to door, looking for a methodological refuge" (Rubin, 1997, p. 521). It may be that the idea of "legal research" is like "the law of the horse" (Ruhl & Salzman, 2013) – there may be no such subfield, just broadly-applicable laws applied to horses and broadly-useful methods applied to legal questions.

Chynoweth describes a taxonomy of legal research styles on two perpendicular axes, *doctrinal* to *interdisciplinary* and *pure* to *applied*. As matters outside the law (e.g., historical or social context, technological influences) are taken

into account, the legal researcher moves leftward from a more doctrinal to a more interdisciplinary methodology – motion that "might involve, for example, an evaluation of the effectiveness of a particular piece of legislation in achieving particular social goals or an examination of the extent to which it is being complied with" (Chynoweth, 2008, p. 30). "Applied" research is shorthand for that which is useful to practitioners, whereas "pure" research delves into the conceptual underpinnings beneath legal theories and the contexts in which law is applied. This research attempts to occupy the approximate center of the plane; conscious of existing doctrine, informed by other disciplines and the context in which law arises, vitally interested in existing cases with a practical purpose, and exploring the theoretical extensions of these cases into analogous circumstances.

American law is built on the idea of precedent, and legal research often amounts to the practice of analogical reasoning. The similarities have been noted in the literature – for instance, "the case-based method of establishing the law through analysis of precedent is in fact a form of qualitative research using documents as source material" (Webley, 2010). Chynoweth (2008) highlights the use of analogy in legal research, defining it in that context as "a process of reasoning from one specific case to another specific case" (Chynoweth, 2008, p. 33). "Analogical reasoning can thus be understood as an existing approach to legal scholarship, and our conclusions about the nature of analogical reasoning in law should be understood to apply, mutatis mutandis, to analogical reasoning about law" (Schauer & Spellman, 2017, p. 103).

The practice of law could be said to consist in abstracting principles from concrete cases and applying them to novel circumstances. One *must* generalize from individual cases in order to adjudicate any. However, as Ruddin (2006) notes, "the later court … must decide whether in fact a particular decision generalizes to its own case. Thus, it is the receiver of the information who determines the applicability of a finding to a new situation" (Ruddin, 2006, p. 805). This is precisely in line with Stake's (1995) observation that the user of the generalization produced by a case study has the final say as to its usefulness.

Case studies

Case studies are among the most frequently used qualitative research methods (Yazan, 2015). Broadly defined, a case study "engages in intensive analysis of one or several phenomena, outcomes, or processes and is aimed at gaining as full and complete an understanding as possible of the object under study" (Miller, 2018, p. 382). All case studies share certain characteristics: they seek insights into a particular phenomenon, studying it in its natural context rather than manipulating that context and observing changes, and exploring many sources of information (Hancock & Algozzine 2006, pp. 15-16). By increasing our understanding of the context and relevant features of the case under study, I intend to shed light on the potential utility of a similar approach in a somewhat different context that nonetheless shares many of the same pertinent characteristics – in other words, I will generalize, inferring "applicability to far more cases beyond the data or the study" (Ruddin, 2006, p. 799).

Three common approaches to the case study method are set forth by Yin, Stake, and Merriam. In *Case Study Research: Design and Methods* (1994), Yin describes a positivist approach, an empirical, in-depth investigation focused on the "how" and "why" questions that can be explanatory, exploratory, or descriptive (Yin 1994, p. 13; Webley 2010; Yazan 2015). In this view, case studies are useful when the researcher does not control the situation of interest or wants to test a theory-based hypothesis where the theoretical foundation of the hypothesis is already broadly-accepted and not being tested by the case study (Webley, 2010). The approach emphasizes rigor, strict design, and the determination of questions to be answered as a threshold matter; it is distinct in this way from grounded-theory and ethnographic methods that allow for the evolution of hypotheses as the investigation proceeds (Yazan, 2015; Yin, 1994).

In contrast, Stake's *The Art of Case Study Research* (1995) emphasizes the importance of context and the flexibility of the investigation as the case unfolds (Stake, 1995, pp. 2, 22; Yazan, 2015). Stake's attitude toward appropriate data to inform a case study is flexible as well; "[a] considerable proportion of all data is impressionistic, picked up informally as the researcher first becomes acquainted with the case" (Stake, 1995, p. 49). But without experience in the subject matter, "impressionistic" data "picked up informally" may be difficult for a researcher to identify. Merriam's approach in *Qualitative Research and Case Study Applications in Education* (1998) adds to this constructivist approach some more deliberate familiarization with the literature as a first step, as well as more explicit strategies for

managing and analyzing the data (Merriam, 1998, pp. 155, 178, 199). Stake's approach requires the ability to recognize the relevant details, identify good sources of data, and test one's own interpretations of the data (Stake, 1995, p. 50).

Why use case studies? "[C]ase studies will often be the preferred method of research because they may be epistemologically in harmony with the reader's experience and thus to that person a natural basis for generalization" (Stake, 1978, p. 5). In the legal research context, case study can be a particularly attractive method. Systematic hypothesis testing that allows for elimination or control of variables is often impossible, and the analogizing/generalizing component of a case study often feels natural to scholars who are accustomed to working with and applying legal precedent. In other words,

> although in formal terms law purports to treat like cases alike, no two cases are ever exactly alike, and this contributes to scholarly skepticism that hundreds or even dozens of cases can be lumped together to produce meaningful conclusions … Indeed, a concern for the conflation of theoretical categories and data categories, and the necessity of teasing them apart, is sometimes an impetus for case study work in law and social science. In addition, some law and social science scholars are less interested in the effect of a specific legal form on a legal outcome than in gaining a full understanding of those forms and the modes of transmission, explaining extreme or outlier cases, or observing multiple and interactive causal pathways. (Miller, 2018, p. 385).

The value of case studies is even greater in the legal context where it may be one of the few methods of understanding "the processes, relations, and pathways to specific legal outcomes" (Miller, 2018, p. 386). Yin considers case studies pertinent when addressing "either a descriptive question – 'What is happening or has happened?' or an explanatory question – 'How or why did something happen?'" (Yin,

2012, p. 5). This research addresses both *what* and *how* questions about tort-based climate change litigation and then analyzes their relevance to a similar situation, much as legal researchers and practitioners "perceive[] a relevant similarity between the situation involved in some previous decision and the situation at issue in the instant case" and use that similarity to argue for a similar outcome (Schauer & Spellman, 2017, p. 103). Yin describes this process as analytic generalization; in contrast to statistical generalizations, applicable to populations, analytic generalizations "establish a logic that might be applicable to other situations." (Yin, 2012, p. 18). Similarly, "qualitative generalization is a matter of applying the facts of one case to another case instead of attempting to sum them up" (Ruddin, 2006, p. 805).

What is the "case" under study or unit of analysis here? Yin suggests a case that "covers some distinctive if not extreme, unique, or revelatory event or subject" (Yin, 2012, p. 7); here, the choice of municipalities and states to undertake tort-based climate change litigation is distinctive and unusual. The explanatory power of a detailed examination of these climate change lawsuits is greater in part because they are such a unique example (Ruddin, 2006). The individual lawsuits in this category differ in minor respects that are nonetheless interesting, as they have led to some important differences in outcomes and shed light on the possible wisdom of making similar choices in another context. The lawsuits themselves are not each "cases" in this sense; they are iterations of and minor variations on the "case" of state and local tort-based climate change litigation.

The tort-based approach and the representative suits that make up the case under study are not by any means in a final state, but as will become clear in the next chapter, it would be difficult to say when such a final state has arrived. Each year brings a changing legal, political, and scientific milieu; more cases are filed, the public attitude shifts, the scientific evidence and the harms continue to accumulate. Each case will likely take years to resolve. More importantly, the outcome of any one of these cases is not dispositive as to the potential utility of the approach in other contexts. The course of complex litigation can be imagined as a set of random variables – the judge drawn; the success or failure of motions to dismiss, change venue, admit or exclude certain evidence; the persuasiveness of certain testimony; the inclinations of jurors and their dynamics as a jury; the inclinations of parties to settle, or not, for particular amounts offered. Each of these can tip either way and determine the eventual outcome of the case without indicating anything about its overall merit. The lawsuits under study are best understood as exemplars of what Clifford Geertz called "vehicles of meaning" (Geertz, 1995, p. 114); the outcomes of the cases are less enlightening than the "further understanding, further insight, further meaning" that issue from them to "widen their implications and deepen their hold" (Harcourt, 2016, quoting Geertz, 1995, p. 19).

Researcher perspective and approach

This dissertation combines a constructivist/contextualist approach to the case study method with analogical reasoning that extends salient aspects of the case to an existing situation with relevant similarities. Why study this case and why posit this

hypothetical extension? As we will see in Chapter 2, the conventional approaches to nitrogen pollution are focused on a de facto right to pollute: regulation assumes that pollution will occur unless it is expressly forbidden, voluntary programs and incentives assume that pollution will occur unless polluters are asked or paid not to do so. Unlike these, tort law assumes the existence of a right to be free from pollution as well and offers the holders of that right a mechanism for exercising it. As we will also see in Chapter 2, regulatory and voluntary approaches have not worked well in the context of nitrogen pollution; a new approach is worthy of study. Tort-based climate change litigation is one of the very few current, large-scale examples available, it does not conform to the conventional wisdom of federal statutory environmental law, and as I will show in Chapters 3 and 4, the phenomenon of climate change shares many legally-relevant features with nitrogen pollution, making climate change litigation an illuminating model.

I approach this research with a J.D. and several years of experience as an environmental litigator. I worked closely with Vic Sher, one of the lead attorneys on several of the climate change cases discussed in Chapter 3, for several years; although our working relationship came to an end about five years before any of those cases were filed, I remained aware of his ongoing work through press accounts. During that time I contributed to litigation concerning MTBE, PCE, DBCP, and perchlorate, among others, and learned and practiced the essentials of the tort-centered approach to environmental harms that I discuss here. I believe that this background has given me some of the perspective needed, under the Stakian approach to case study

research, to recognize, integrate, and form useful impressions of the relevant data. I have not relied on this background to support my conclusions or to generate data, but I am aware that it affects my perceptions of the data and context and has pointed my research in particular directions and not others.

I do not proffer recommendations or legal advice, nor do I take a normative position here. To analyze this case I have examined publicly available filings in the cases of interest, press accounts and transcripts of hearings and other events in these cases, judicial opinions in these cases and others, minutes and other records held by municipal plaintiffs, and federal data about environmental impacts including sea level rise and nitrogen pollution. Material in Chapter 3 has been organized chronologically as a first step of analysis, to reveal the evolution of legal strategies over time, with additional levels of organization imposed as the analysis progressed to reveal relevant thematic issues.

Chapter 2: The problem of nitrogen pollution

> "Fertilizer is good for the father and bad for the sons."
> –Dutch saying

Anthropogenic nitrogen in agriculture

Nitrogen is a major limiting factor for plant growth (Bloom, 1997; Vitousek et al., 1997). Agricultural crop performance largely depends on the ability of crop plants to absorb available forms of nitrogen (Bloom, 1997). Most nitrogen is found in the form of atmospheric nitrogen gas (N_2), inert and unavailable to plants but converted by soil bacteria in relatively small amounts to more accessible forms (nitrate and ammonium), which then cycle throughout and among ecosystems (Hoeft, 2004; Vitousek et al., 1997).

Because the addition of nitrogen can boost crop yields, demand for agriculturally usable nitrogen is consistently high. Animal wastes and some mineral deposits were the main sources of agricultural nitrogen until the early 20th century. The Haber-Bosch process was the first efficient method of synthetic ammonia production; the German company BASF began industrial-scale production of ammonia using this method in 1913. This method combines hydrogen derived from natural gas (CH_4) with nitrogen from the air (N_2) to form ammonia (NH_3) in an energy- and carbon-intensive process, incidentally generating about 0.7 tons of carbon dioxide per ton of ammonia produced (Jenkinson, 2001). The Haber process consumes 2-5% of global natural gas supplies and 1-3% of electrical energy worldwide (Yang, Ding, Zhang, & Zhang, 2020).

In 2019, the Haber-Bosch process generated over 235 million metric tons of anhydrous ammonia globally, with about 70% used as nitrogen fertilizer in the form of ammonia or after conversion to ammonium nitrate (NH_4NO_3) or urea ($CO(NH_2)_2$), which are more stable than ammonia (Garside, 2020; TechSci Research, 2020). Since 1900, human activity in the United States has increased the amount of reactive nitrogen present in the environment by more than tenfold, from approximately 2 teragrams per year via cultivated biological fixation, to 29 teragrams in 2002 via synthetic nitrogen manufacture and other industrial pathways (U.S. EPA, 2011). Meanwhile, over the same time period, nitrate concentrations in U.S. surface waters increased three- to tenfold (Matson, Parton, Power, & Swift, 1997; USDA NRCS, 1997).

The inputs for nitrogen fertilizer manufacture are relatively inexpensive and easily accessible; barriers to entry are low (Apodaca, 2012; The Economist, 2010). Natural gas represents 70-90% of the variable production costs (Bekkerman, Brester, & Ripplinger, 2020). In contrast, the phosphate and potash fertilizer industries rely on less-accessible mineral deposits. The largest nitrogen fertilizer manufacturers worldwide are Nutrien, Koch Industries, Yara International, OCI Nitrogen, and CF Industries Holdings, Inc. Other major manufacturers include ICL Fertilizers, EuroChem Group AG, Sinofert Holdings Limited, and Coromandel International Ltd. (Grand View Research, 2019). The U.S. nitrogen fertilizer industry has consolidated substantially over time, from 57 companies producing ammonia domestically in 1976

to fewer than 20 today (Bekkerman et al., 2020; Paul, Kilmer, Altobello, & Harrington, 1977).

The largest three companies are responsible for over 75% of domestic production (Bekkerman et al., 2020). CF (Central Farmers) Industries is the largest of these; it has produced nitrogen fertilizer since 1954. CF was organized as a cooperative until it became publicly traded in 2005, after which it sold its potash and phosphate operations to focus on nitrogen. CF owns the largest nitrogen plant in the country, with a capacity of five million tons of nitrogen per year; it is located in Donaldsonville, Louisiana, a major petrochemical region with access to natural gas and shipping facilities – including the Gulf Central Pipeline, an ammonia pipeline built in the late 1960s that connects production plants with agricultural areas in the Midwest (Center for Land Use Interpretation (CLUI), 2019).

The other large domestic producers include Nutrien and Koch. Nutrien, a Canadian company with plants in the U.S., was formed in 2018 when the Potash Corporation of Saskatchewan (PCS) and Agrium Corp. merged. Its plants are also located in petrochemical regions in Louisiana and Texas, both with ready supplies of natural gas and ammonia pipelines to the Midwest (CLUI, 2019). Koch Fertilizer, a subsidiary of the privately-held Koch Industries, operates plants in the Midwest that are connected to ammonia pipelines (some of which it also owns) linking petrochemical and agricultural regions (CLUI, 2019). Some smaller companies specialize in ammonium nitrate production, which can also be used as an explosive for mining, quarrying, and other applications; these companies include Apache

Nitrogen (formerly known as the Apache Powder Company), Trademark Nitrogen Corporation, and Dyno Nobel (CLUI, 2019).

Nitrogen-based fertilizer plants operate in the following U.S. states (CLUI, 2019; The Fertilizer Institute, n.d.):

Alabama:	LSB Industries (as Cherokee Nitrogen LLC) – Cherokee
Arkansas:	LSB Industries (as El Dorado Chemical Co.) – Eldorado
Arizona:	Apache Nitrogen Products, Inc. - Benson
California:	Yara International - West Sacramento
	Simplot – Lathrop-Helm
Florida:	Trade Mark Nitrogen Corp. -Tampa
Georgia:	Nutrien – Augusta
	Augusta Sulfate Co. – Augusta
Iowa:	Green Valley Chemical Corp. – Creston
	Koch Nitrogen Co. - Fort Dodge
	CF Industries - Port Neal
	OCI Industries (as Iowa Fertilizer Company) – Wever
Idaho:	Simplot – Pocatello
Illinois:	CVR Partners - East Dubuque
Kansas:	CVR Partners – Coffeyville
	Koch Nitrogen Co. - Dodge City
Louisiana:	CF Industries - Donaldsonville
	Nutrien – Geismar
	Dyno Nobel – Waggaman
	The Mosaic Company – Faustina
Missouri:	Dyno Nobel, Inc. – Louisiana
Mississippi:	CF Industries - Yazoo City
North Dakota:	Dakota Gasification Co. – Beulah
Nebraska:	Koch Nitrogen Co. - Homestead (Beatrice)
	Fortigen Geneva – Geneva
Ohio:	Trammo - North Bend
	Nutrien – Lima
Oklahoma:	Koch Nitrogen Co. – Enid
	LSB Industries (as Pryor Chemical Co.) – Pryor
	CF Industries – Verdigris
	CF Industries – Woodward
Oregon:	Dyno Nobel, Inc. - St. Helens
Texas:	Nutrien – Borger
	LSB Industries (as El Dorado Nitrogen) – Bayport
	PCI Nitrogen – Pasadena
	Yara International (with BASF) – Freeport

Virginia:	Honeywell International Inc. – Hopewell
Washington:	Nutrien – Kennewick
Wyoming:	Dyno Nobel, Inc. – Cheyenne
	Simplot – Rock Springs

In 2015, the latest year for which USDA has published figures, the U.S. consumed almost 28 million tons of nitrogen fertilizer compounds(USDA ERS, 2019). The proportion of nitrogen fertilizer that is imported has fluctuated over the past several decades, but has been declining steadily from a recent high of 43% in 2007, and in 2020 will likely be close to zero (Bekkerman et al. 2020), suggesting that U.S. production is increasing.

Corn production relies heavily on nitrogen fertilizer. Over 90 million acres of U.S. cropland is devoted to corn production (USDA NASS, 2017, Table 35). In 2017, farmers spent over $23 billion on fertilizers, lime and soil conditioners, and applied 22 million tons of fertilizer to over 250 million acres (Hellerstein, Vilorio, & Ribaudo, 2019; USDA ERS, 2019; USDA NASS, 2017, Table 46). Nitrogen use in the U.S. has steeply increased over time from 17.0 lb/acre/yr in 1960 to a peak of 83.6 lb/acre/yr in 2013, rising from 37 percent of total fertilizer use to 59 percent (USDA ERS, 2019). Corn, cotton, soy, and wheat account for the majority of both crop acreage and nitrogen consumption (USDA ERS, 2019; USDA NASS, 2017, Table 35). Corn alone has historically consumed over 40 percent of fertilizer used in the United States (Daberkow & Huang, 2006).

Traditionally, farmers apply nitrogen to the soil after harvest in the fall or just before planting in the spring. Ideally, nitrogen should be applied during the growing season and just before maximum crop uptake, since applying it too early or too late

leads to nitrogen loss (Culman et al., 2020; Scharf, 2015). The proportion of applied nitrogen that is absorbed by crop plants can range from under 40% to around 70% (Cassman, Dobermann, & Walters, 2002; Hellerstein et al., 2019). Uptake depends on fertilizer characteristics, timing, and environmental conditions. Conservation practices like aerial application, splitting applications, or adding fertilizer stabilizers can decrease nitrogen losses, but add expense (Gramig, Massey, & Yun, 2017). Excess nitrogen application (more than a given crop can use) can be reduced by using what is referred to as the 4Rs: "the right source of nutrients (matching fertilizer type to crop needs), at the right rate (matching amount of required fertilizer(s) to crop needs), at the right time (making nutrients available when crops need them most), and in the right place (applying nutrients where crops can use them)" (Hellerstein et al., 2019). Adoption of these practices has gradually increased over time, but millions of acres of corn still receive excess nitrogen every year.

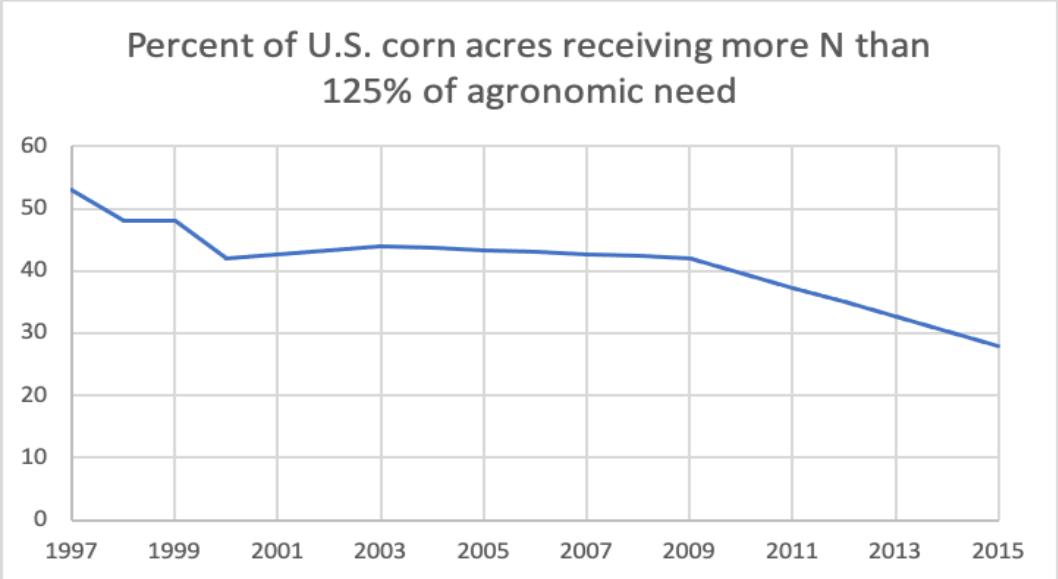

Figure 1: Percent of U.S. corn acres receiving excess nitrogen (Hellerstein et al., 2019; USDA ERS, 2020).

Although nitrogen fluxes can be difficult to quantify, mass balance studies suggest that nitrogen fertilizer is used inefficiently in agriculture-heavy watersheds, resulting in a nitrogen surplus (Van Meter, Basu, Veenstra, & Burras, 2016). Nitrogen that is not incorporated into crop mass can be lost to the environment. Nitrogen fertilizer compounds can be denitrified by soil bacteria to form N_2O and N_2 or nitrified to form NO_x (Hoeft, 2004). Volatilized NH_3 is a much more significant atmospheric loss, particularly when fertilizers are not incorporated into soil quickly; when urea is spread on flooded rice fields, losses can be as high as 70% (Smil, 2002). The majority of surplus nitrogen ends up either as nitrate, which is highly soluble and runs off into surface waters with precipitation or irrigation, or percolates into the vadose zone (subsurface saturated soils) or stationary aquifers; or as organic nitrogen sequestered in the soil (Dowd, Press, & Huertos, 2008; Van Meter et al., 2016).

Environmental impacts of excess nitrogen

Commercial fertilizers are the primary nonpoint (i.e., mobile in diffuse runoff rather than emitted from a single end-of-pipe) source of nitrate in surface water and groundwater (Kershen, 1995; Matson et al., 1997; Pennino, Leibowitz, Compton, Hill, & Sabo, 2020; USDA NRCS, 1997). EPA's 1994 National Water Inventory listed agriculture as the leading source of water quality impairment in lakes and rivers and the third leading cause of impairment in estuaries (U.S. EPA, 1995). Although "[a] long-standing paradigm in aquatic science is that primary production in freshwater systems typically is limited by phosphorus, whereas the primary limiting nutrient in marine systems is nitrogen" (Granéli & Turner, 2006, p. 343), two factors

have rendered nitrogen at least as important a pollutant as nitrogen in both freshwater and marine systems today. First, the sources of phosphorus pollution (primarily wastewater and septic systems, in addition to agricultural fertilizers) have proven more amenable to regulatory control (Paerl & Paul, 2012; Stainton, Salki, Hendzel, & Kling, 2003). But even as phosphorus loads have been actively maintained or reduced, nitrogen fertilizer applications have continued to increase in parallel with watershed human populations (Vitousek et al., 1997; Vitousek, Mooney, Lubchenco, & Melillo, 2008).

Nitrate is highly water soluble and can percolate through permeable soils into underground drinking water sources. Nitrate in water easily converts to nitrite; both are acutely toxic at high concentrations, and are suspected carcinogens even at lower concentrations (Lichtenberg & Shapiro, 1997; Pennino et al., 2020; Zaring, 1996). EPA's maximum contaminant level (MCL) for nitrate, 10 mg/L, guards primarily against methemoglobinemia ("blue baby syndrome"), which occurs when nitrate bonds to hemoglobin, blocking its ability to transport oxygen and harming infant development (Moore et al., 2011; Pennino et al., 2020; Ward & Brender, 2019). Nitrate contamination in excess of this level poses particular risks to children and pregnant women, as nitrate exposure through drinking water has been linked to birth defects including spina bifida and cleft palate (Brender et al., 2013). Nitrate pollution in drinking water has also been linked to cancer of the bladder and thyroid, and may cause up to 12,594 cases of cancer a year in the United States, with a price tag of $1.5 billion (Temkin, Evans, Manidis, Campbell, & Naidenko, 2019; Ward et al., 2018).

The figure below shows the high risk of nitrate contamination for aquifers in the agriculture-intensive Mississippi River watershed, Central Valley of California, and southern Chesapeake Bay watershed, among other areas. The areas most at risk tend to share the following characteristics: high agricultural nitrogen use, permeable soils, and a high ratio of cropland to woodland (Helsel, 1995).

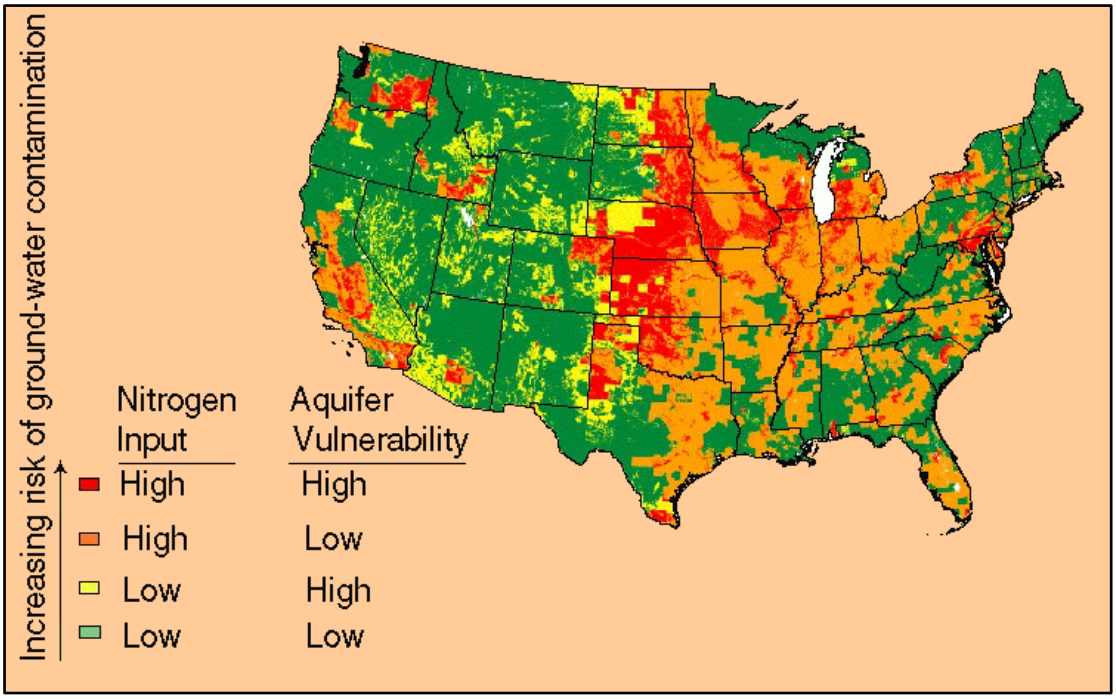

Figure 2: Four levels of groundwater contamination risk, depending on nitrogen input and aquifer vulnerability (USGS, 1998).

Over 97% of the rural U.S., and over 50% of the population as a whole, depends on underground aquifers for drinking water (Lichtenberg & Shapiro, 1997). Nitrate has been one of the top three contaminants in public drinking water supplies for many years (Pennino et al., 2020). A USGS survey of groundwater wells in the U.S. found that one in five had nitrate levels exceeding the EPA's maximum contaminant level of 10 ppm (Dubrovsky et al., 2010). According to the USGS,

nitrate contamination in groundwater is highest near cultivated row crops, and surface water contamination is highest downstream of agricultural areas (Mueller & Helsel, 1996). Between 2005 and 2008, ninety-two drinking water systems in Central California's heavily-agricultural San Joaquin Valley had nitrate levels exceeding EPA standards (Moore et al., 2011).

In surface waters, excess nitrogen can promote the rapid growth of algae (eutrophication), which then block light to deeper waters and deplete dissolved oxygen levels when they die and decompose (National Research Council, 2000; Paerl & Paul, 2012). The lowered oxygen levels (hypoxia) can result in fish kills and other, less obvious and longer-term losses in aquatic biodiversity (Deng et al., 2014; Paerl & Paul, 2012). "Dead zones" – areas of coastal waters with greatly reduced populations of fish and shellfish due to eutrophication-induced hypoxia – have been increasing in number over the past several decades; the dead zone in the Gulf of Mexico at the mouth of the Mississippi River is one of the largest, of over 500 worldwide (Turner & Rabalais, 2019). Harmful algal blooms in lakes and coastal waters smell and look unpleasant, discouraging recreational uses and tourism and potentially reducing property values (National Science and Technology Council, 2017; Zhang & Sohngen, 2018). Agricultural runoff is the most significant pollution source for streams and rivers in 33 states and for freshwater lakes in 42 states, and accounts for 43 percent of pollution in U.S. estuaries (Zaring, 1996). In some states, agricultural pollution is the sole or near-sole cause of freshwater pollution (Ruhl, 2000; Zaring, 1996). As of 2018, over 80 percent of freshwater lake acres were reportedly impaired by nutrient

pollution in eight states: Delaware, Florida, Hawaii, Illinois, Kansas, Nebraska, Oregon, and Utah (Association of Clean Water Administrators, 2018).

Some algal species also produce toxins, such as microcystin and other hepatotoxins and neurotoxins, that can injure people and animals who come into contact with them (Hilborn et al., 2014). Ingesting these toxins via drinking water can cause headaches, fever, muscle and joint pain, stomach cramps, vomiting, and diarrhea, as well as liver failure, seizures, and respiratory arrest in severe cases (Backer, 2002). Cyanobacterial contaminants can overwhelm the treatment capabilities of drinking water providers. A recent study of a two-year period in New York, Ohio, and Washington found eleven outbreaks and sixty-one illnesses resulting from algal blooms in freshwater lakes (Hilborn et al., 2014). A notorious recent example was Toledo, Ohio's August 2014 do-not-drink order, issued to half a million water customers for three days after a harmful algal bloom occurred in Lake Erie near the city's drinking water intake. That algal bloom was believed to have been caused by agricultural fertilizers washing into Lake Erie via the Maumee River (Kozacek, 2014; Philpott, 2015). The cost of the shutdown was estimated at $65 million (Bingham, Sinha, & Lupi, 2015).

Examples from the Mississippi River Watershed

All of the above concerns are featured in the Mississippi River watershed. The Mississippi River originates in northern Minnesota and flows south to the Gulf of Mexico, joined by hundreds of tributaries to form a system of over 12,000 river miles, and draining a watershed that occupies over 1,245,000 square miles (3.2 million

square km) and part or all of 31 states, or over 40% of the land area of the continental U.S. (National Park Service, 2018; U.S. EPA, 2016; USDA NRCS, 2010). The average discharge rate at the mouth of the River is 16,792 cubic meters (593,003 cubic feet) of water per second into the Gulf of Mexico (National Park Service, 2018).

The watershed is dominated by agricultural land uses. USDA's Economic Research Service (ERS) estimates there are almost 250 million acres of corn, soy, wheat and cotton crops in the watershed, and that nitrogen fertilizers are applied to 69 percent of that acreage (Ribaudo, et al., 2011); estimates of tile-drained acres in the watershed range from 50 to 70 million, meaning that irrigation water carrying excess nitrogen is quickly channeled away via ceramic-lined drains installed under the tilled acres (Royer, David and Gentry, 2006; Petrolia and Gowda, 2006). The vast majority of the nitrate that reaches the Gulf originated from agricultural land uses (Coppess, 2016); see Figure 3 below.

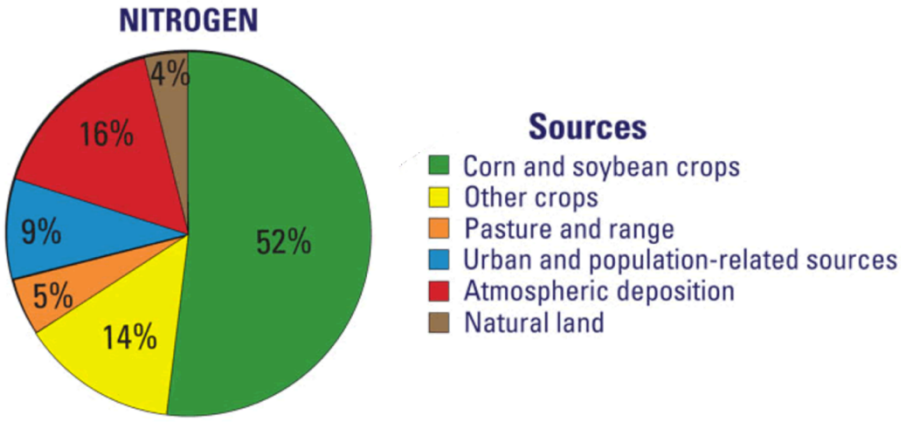

Figure 3: Approximate proportions of nitrogen load to the Mississippi River attributable to each of the listed sources (USGS, 2008).

The seventeen states with the highest percentage of agricultural land area in the basin[2] applied 7.5 million metric tons (8.26 million short tons) of nitrogen as fertilizer in 2011 (a recent year for which EPA has compiled data), up from an average of around 7 million metric tons per year over the reporting period of 2003-2011 (U.S. EPA, 2020a). Farms in the Mississippi River watershed apply approximately 65 percent of the total fertilizer used in the lower 48 states (Tian et al., 2020). Figure 3, below, shows the estimated per-acre loss of agricultural nitrogen via all pathways, averaging about 40 pounds per acre per year (USDA NRCS, 2006). Researchers at the USDA who have modeled this loss estimate that about half is lost to waterborne transport pathways (sediment transport, 21%; leachate, 17%; surface runoff, 10%; lateral sub-surface flow, 1%), and about half is lost to airborne transport pathways (volatilization, 47%; windborne sediment, 4%) (USDA NRCS, 2006). Waterborne nitrate losses from a corn-intensive area in the upper Mississippi watershed where tile drainage systems are common (from southern Minnesota through Iowa, northern Illinois, northern Indiana, and western Ohio) contribute a very high proportion of the total nitrogen reaching the Gulf of Mexico (David, Drinkwater, & McIsaac, 2010). The Mississippi River conveys almost 1.6 million metric tons of nitrogen per year to the Gulf of Mexico, the majority (about 60—70%) from nonpoint sources (Alexander et al., 2008; Tian et al., 2020).

[2] Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Minnesota, Missouri, Montana, Nebraska, Ohio, Oklahoma, South Dakota, Tennessee, West Virginia, Wisconsin.

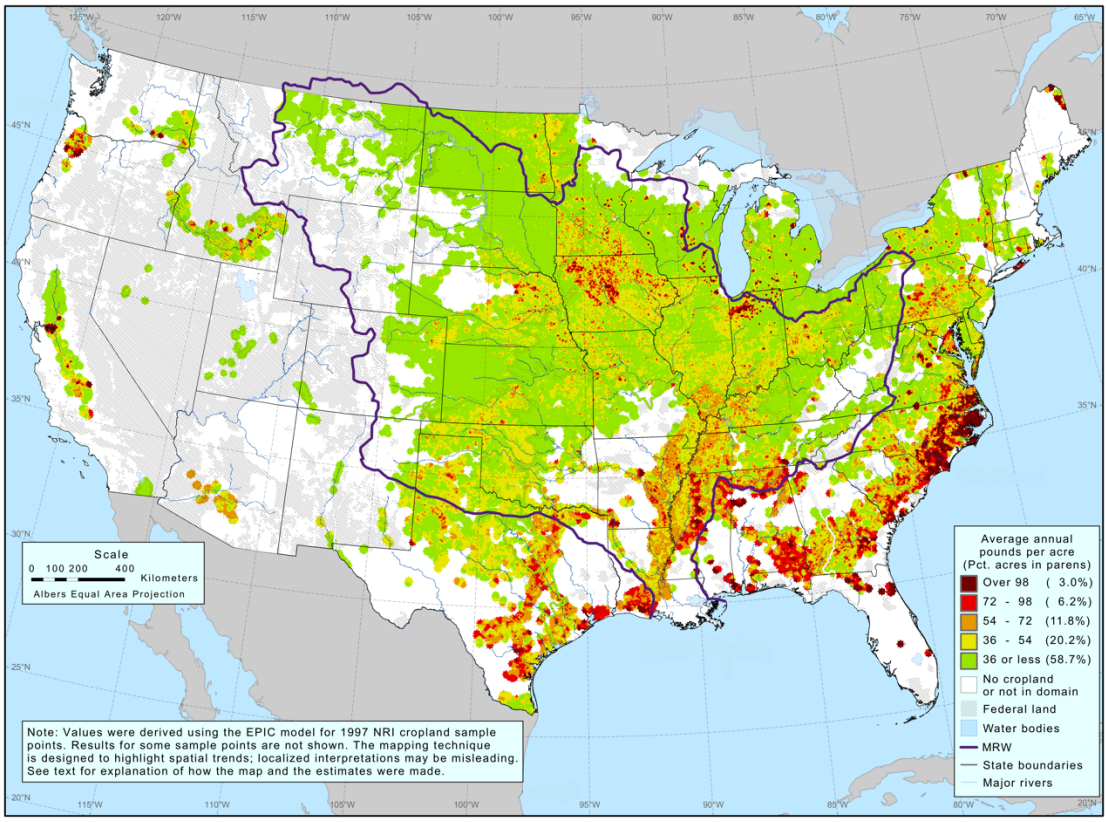

Figure 3: Estimated average annual per-acre nitrogen loss via all loss pathways, with the Mississippi River Watershed (MRW) outlined. (U.S. EPA, 2016; USDA NRCS, 2006).

The Gulf of Mexico hosts both a $2.8 billion fishing industry and one of the largest "dead zones" in the world at the mouth of the Mississippi River (Porter, Mitchell, & Moore, 2015). At 8,776 square miles, the 2017 dead zone was the largest ever measured at that site, and in 2015 it was larger than the states of Connecticut and Rhode Island combined (NOAA, 2015, 2017); see Figure 4, below. The severity of this dead zone has not decreased over time, despite many attempts to reduce nitrogen runoff through regulation, economic incentives, and voluntary conservation measures. These measures were laid out in a 2001 Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico, developed by the Mississippi

River/ Gulf of Mexico Watershed Nutrient Task Force set up by the EPA in 1988 (Turner & Rabalais, 2019).

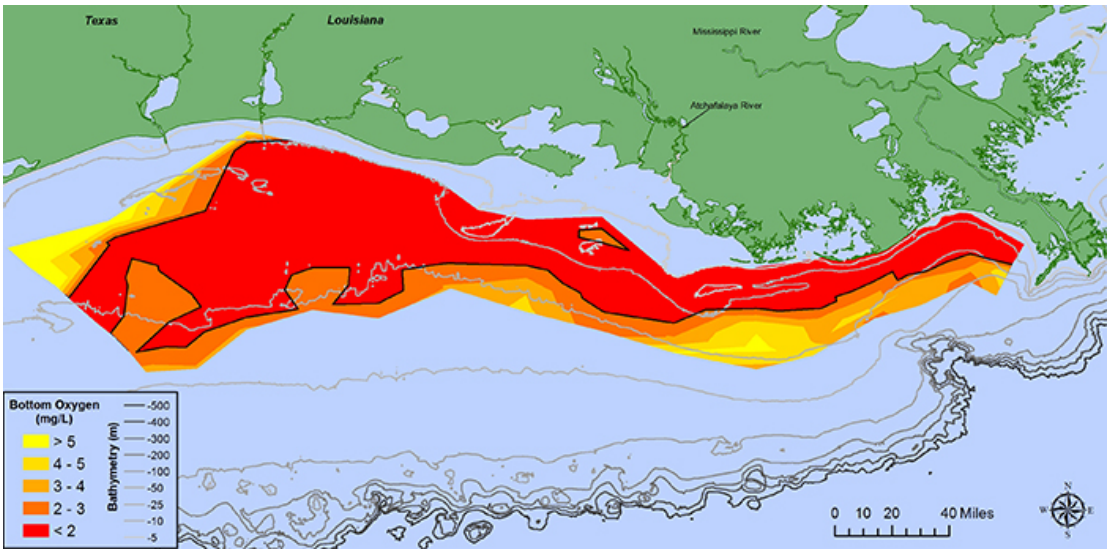

Figure 4: The 2017 extent of the "dead zone" off the Louisiana Coast in the Gulf of Mexico, color-coded by oxygen level. (NOAA, 2017)

States in the watershed have not been successful in their attempts to reduce nitrate pollution. For example, Iowa drafted a Nutrient Reduction Strategy in 2013, designed to cut nitrogen runoff by 45 percent through a combination of voluntary conservation strategies and incentives (Conrad, Osterberg, & Burkart, 2016). Five years later, Iowa's nitrogen problem had only worsened (Eller, 2018). Runoff from land in Iowa contributes almost 12 percent of the water entering the Missouri River (the Mississippi's largest tributary) but 55 percent of the nitrate (Jones, Nielsen, Schilling, & Weber, 2018). The Raccoon River and Des Moines River, from which Des Moines draws its drinking water supply, have been experiencing nitrate levels above the EPA's limits for drinking water hundreds of times per year (Vedachalam, Mandelia, & Heath, 2018). Toxic algal bloom reports at Iowa state-owned and -

monitored beaches in 2016 were nearly double the ten-year average (Conrad et al., 2016).

Regulating nitrogen pollution

Clean Water Act

The regulatory system for managing nitrogen impacts is a patchwork of federal and state water pollution regulation and drinking water quality regulation, and implementation plans that divide responsibility between state governments, federal regulatory agencies, and polluters. The primary federal statute governing surface water quality in the United States is the 1972 Amendments to the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), which nominally prohibits the discharge of any pollutant into U.S. waters (33 U.S.C. § 1311(a)). Preexisting water quality legislation was state-centric: the 1948 Federal Water Pollution Control Act (FWPCA) provided states with technical grants and loans to build wastewater treatment plants, and the 1965 Water Quality Act required states to set water quality standards limiting industrial and municipal discharges (Anderson, 1999; Houck, 2002). But under these statutes, water quality failed to improve. Few states took any action to set water quality standards, and those that did faced both practical enforcement difficulties and pressure from industry to relax discharge limits (Anderson, 1999). In fact, states competed with each other in a race to the bottom to attract industrial investment with weak regulation and lax enforcement (Glicksman & Batzel, 2010; Kerr, 2014). Oliver Houck asserts that:

> We have a federal CWA for one reason: programs run by the states with federal assistance had failed utterly for 25 years. . . . By 1972, few states had even bothered to set water quality standards, much less enforce them. The playing field was not only uneven, it was untenable. It was time for a new approach, a national one premised on a dominant federal role. (Houck, 2014)

Like the Clean Air Act, the Clean Water Act engages the federal and state governments in a regulatory partnership with delineated roles for each, usually referred to as "cooperative federalism" (Glicksman, 2018). State and local governments would retain their usual authorities, but "subject to minimum federal standards — both substantive and procedural — as well as federal judicial review." *City of Rancho Palo Verdes, California v. Abrams,* 544 U.S. 113, 127-28 (2005) (Breyer, J., concurring). At the time the CWA was passed, the Nixon Administration was promoting a "New Federalism" doctrine, offering state and local governments more regulatory control in response to concerns that unique, place-specific environmental quality problems "were not amenable to inflexible federal standards." (Guercio, 2011). The CWA divides the responsibilities of the federal and state governments along lines that match their respective traditional authorities: the federal government is responsible for discharges directly into navigable waterways, which were traditionally considered a medium of interstate commerce, and the states retain authority[3] over any discharges arising from activities on land (Glicksman, 2018;

[3] In practice, states delegate many aspects of land use control to municipalities and other state subdivisions through zoning laws. The constitutionality of states and municipalities to exert authority over land uses was affirmed by the Supreme Court in *Village of Euclid v. Ambler Realty Co.,* 272 U.S. 365 (1926), holding zoning ordinances constitutional under the police power of local governments as long as they have some relation to public health, safety, morals, or general welfare.

Houck, 2014; Kerr, 2014; Loo, 1977); see *Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers*, 531 US 159, 174 (2001) (calling land use management "the States' traditional and primary power"). This division maps neatly to the split between point sources of water pollution, which are often industrial dischargers that deposit effluents directly into water at a single site, and nonpoint sources, which are areas of land from which pollutants diffuse by traveling in precipitation or irrigation water (runoff, in other words). In the Mississippi River watershed context, the federal-state division has caused difficulties in coordinating a multi-state effort to collect and analyze water quality data and plan reductions in discharges from the watershed, since states tend to view water quality in the River as a federal responsibility (National Research Council, 2008).

Point sources are defined in 33 U.S.C. § 1362(14) as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged." But this category "does *not* include agricultural stormwater discharges and return flows from irrigated agriculture,"[4] which are defined and

[4] Ruhl (2000) describes the history and reasoning behind this exemption as follows:

> Many wastewater discharges from agriculture, such as the collected return flow from irrigated fields, appear to fit within the NPDES permit program as generally described. Indeed, EPA knew that this interpretation was inescapable under the CWA as it was originally enacted. Awed by the prospect of issuing NPDES permits to two million farms, EPA thus promulgated an administrative exemption from the statute's unambiguous terms. The courts struck down that exemption as contrary to the clear intent and meaning of the CWA, but in 1977 Congress overruled the courts and

regulated as nonpoint sources. (*Id.*, emphasis added). Point sources are regulated through the National Pollutant Discharge Elimination System ("NPDES"), which requires discharge permits. 33 U.S.C. §§ 1311(a), 1342, 1344. The NPDES program limits the amount and concentration of pollutants that can be discharged under such permits (Angelo & Morris, 2014) by capping pollutant concentrations in each water body via the state TMDL program described below (R. W. Adler, 1999). Individual permittees may also need to adopt feasible and best-available pollution control technologies (R. W. Adler, 1999).

Under the cooperative federalism structure of the Clean Water Act, Congress vested authority in states, rather than the EPA, with the authority to regulate their own intrastate waters by developing water quality standards. 33 U.S.C. § 1313. These water quality standards consist of three elements:

> [F]irst, each water body must be given a 'designated use,' such as recreation or the protection of aquatic life. Second, the standards must specify for each body of water the amounts of various pollutants or pollutant parameters that may be present without impairing the designated use. Finally, each state must adopt an antidegradation review policy which will allow the state to assess activities that may lower the water quality of the water body. 33 U.S.C. § 1313(c)(2)(A); 40 C.F.R. §§ 130.3, 130.10(d)(4), 131.6, 131.10, 131.11.

Am. Wildlands v. Browner, 260 F.3d 1192, 1194 (10th Cir. 2001); see also Angelo and

---

> codified EPA's farm exemption. The original version of the CWA defined discharge of a pollutant as 'any addition of any pollutant to navigable waters from any point source.' To exempt farm irrigation return flows from the reach of NPDES wastewater discharge permits, Congress adopted the fiction that 'these sources were practically indistinguishable from any other agricultural runoff' and simply redefined 'point source' to exclude 'return flows from irrigated agriculture.' Congress drove home the point in Section 402 as well, dictating that EPA may not 'require a permit under this section for discharges composed entirely of return flows from irrigated agriculture.'

Morris 2014. These state-established water quality standards must "protect the public health or welfare, enhance the quality of water and serve the purposes of this chapter." 33 U.S.C. § 1313(c)(2)(A).

Each state is required to establish "total maximum daily loads" (TMDLs) for pollutants in its surface waters (33 U.S.C. § 1313(d)), though the process for doing so is left up to the state (Houck, 2011). A TMDL specifies the maximum amount of a pollutant which can be discharged into a body of water from all sources combined, while still satisfying state water quality standards. 40 C.F.R. § 130.2 (2003); *Dioxin/Organochlorine Ctr. v. Clarke,* 57 F.3d 1517, 1520 (9th Cir.1995). If a state fails to set these standards, EPA can promulgate its own TMDLs for that state. 33 U.S.C. § 1313(d)(2). After calculating TMDLs for a given pollutant, states are expected to allocate any needed reductions in total discharges among both point and nonpoint dischargers – although there is no specific enforcement mechanism in the CWA for making sure reductions take place. 33 U.S.C. § 1313(d). Even TMDLs that are set by EPA cannot be enforced for nonpoint sources (Garovoy 2003, citing *Pronsolino v. Nastri*, 291 F.3d 1123 (9th Cir. 2002); *Am. Wildlands v. Browner,* 260 F.3d 1192, 1194 (10th Cir. 2001); *Or. Natural Desert Ass'n v. Domback*, 172 F.3d 1092, 1096 (9th Cir. 1998)).

The only mechanism in the Clean Water Act specifically designed to help states reduce nonpoint source discharges is the Section 319 program, added in 1987 (Ruhl, 2000). This program required states to identify navigable waterways that could not maintain water quality standards without additional control of nonpoint sources,

and to identify nonpoint sources that harm water quality. 33 U.S.C. § 1329(a)(1)(A)-(B). States are also required to identify ways of reducing nonpoint source pollution "to the maximum extent practicable," best management practices (BMPs) that will do so, programs for implementing BMPs, and schedules for implementation. 33 U.S.C. § 1329(a)(1)(C). In practice, these state programs address nonpoint source pollution only indirectly by encouraging land use planning and best practices (Pollans, 2016).

But states have shown little interest in directly engaging with the agricultural, timber, or development interests responsible for most nonpoint source pollution (Garovoy, 2003; Ruhl, 2000). As a result, Craig and Roberts (2015) characterize this situation as "a de facto fifty-state experiment in regulation-or, often, non-regulation--of [nonpoint source] water pollution" (p. 2). Similarly, Linda Malone (2002) stated that "the only insurmountable problem with the TMDL program is the lack of political will, at the state and federal levels, to implement it with mandatory controls on nonpoint source pollution" (Malone, 2002, p. 63). In short, the CWA has not provided the necessary tools for managing nonpoint sources of nitrogen, and the states have failed to exercise the regulatory authorities available to them (R. W. Adler, 2013; Glicksman, 1993; Tzankova, 2013).

There are a few state programs that take a more aggressive approach to nonpoint pollution than the rest. California's water quality law, the Porter-Cologne Water Quality Control Act (PCA) gives state agencies substantial power to regulate nonpoint sources, including agriculture, and to require the adoption of BMPs, particularly stream monitoring (Nelson, 2011). Delaware, among other states, requires

agricultural operations of a certain size to develop nutrient management plans – although enforcement is notoriously spotty (Tzankova, 2013). Other state programs are weakened by broad exemptions and other loopholes (McElfish, Austin, & Bernstein, 1998).

And in the Mississippi River watershed, states have been slow to develop their own enforceable standards for nitrogen and phosphorus. Oliver Houck summarized their status in 2014, reporting that Illinois had not yet begun to develop a work plan for stream nutrient criteria, and Iowa had no plan to develop them for any category of water bodies. Instead, Iowa submitted a plan for nutrient reduction to EPA that contained no numeric nutrient criteria and only voluntary conservation measures (Houck, 2014). Likewise, Indiana, Missouri, and Kentucky appeared to abandon their efforts to develop nutrient criteria, despite deteriorating water quality in intrastate lakes and streams (Houck, 2014). In 2008, the National Research Council recommended a nutrient TMDL for the entire Mississippi watershed, which has never been developed (Houck, 2014). These failures have, unfortunately, been more typical than aberrant. In 2002, Professor Malone summarized the CWA's effectiveness as follows:

> Despite thirty years of technological controls, many water bodies and segments fail to meet basic, reasonable goals for their water quality. The largest single source of contamination by discharge is nonpoint source pollution. Nonpoint source pollution continues to be the largest source of contamination, despite section 201 waste treatment planning, sections 106 and 303(e) water management planning, area-wide management plans under section 208, section 209 basin planning, the nonpoint source pollution planning program under 319, and general watershed planning. A significant amount of state, federal and local money has gone into these programs. There has been a lot of planning. There are still no federally imposed mandatory

> controls on nonpoint source pollution. Agricultural pollution, point source as well as nonpoint source, has been largely unregulated. (Malone, 2002, p. 76).

Safe Drinking Water Act

The Safe Drinking Water Act of 1974 (SDWA) instructs the U.S. EPA to identify harmful drinking water contaminants and establish standards (maximum contaminant levels, or MCLs) for those contaminants that will protect human health, taking achievability and feasibility into account. Pub. L. No. 93-523, 88 Stat. 1160 (codified as amended passim in 42 U.S.C. § 300g-1 (2012)). The states administer and enforce these drinking water standards, and may establish their own standards as long as they are at least as strict as the federal standards. 40 C.F.R. § 142.10(a). States must also evaluate and map drinking water sources and inventory potential contamination sources. 40 C.F.R. § 140.16.

Utilities that furnish drinking water to the public are required to provide water that meets the standards, and must notify customers of any violations that might have health consequences, as well as prepare an annual report detailing all contaminants found in the system. 42 U.S.C. § 300g-3(c)(2)(C)(i); § 300g-3(c)(4)(A). When source waters become contaminated, utilities will decide whether to invest in treatment infrastructure and filtration equipment. SDWA includes programs aimed at protecting source water and groundwater so that utilities with adequately protected sources can forgo filtration. 40 C.F.R. § 141.70(b).

The federal MCL for nitrate is 10 mg/L, although this is lifted to 20 mg/L for certain systems (usually private and/or rural). There are no MCLs for microcystin or

other cyanotoxins, but EPA recently published Health Advisories for children under 6 of no more than 0.3 micrograms per liter (µg/L) for microcystins and 0.7 µg/L for cylindrospermopsin, and 1.6 µg/L for microcystins and 3.0 µg/L for cylindrospermopsin for older children and adults (U.S. EPA, 2019).

Under the SDWA, drinking water utilities – not polluters – can be sued for failure to comply with the law's requirements, and the EPA can be sued for failure to perform its statutory obligations (42 U.S.C. § 300j-8). The EPA, and only the EPA, can sue over "imminent and substantial endangerment" of drinking water, "upon receipt of information that a contaminant which is present in or is likely to enter a public water system or an underground source of drinking water" (42 U.S.C. § 300i(a)) – although when it comes to agricultural activities, such suits are very rare (Pollans, 2016).

Other policy approaches

Agricultural nutrient pollution is an intractable and multi-faceted problem that may appear in different guises in different watersheds, suggesting the need for individualized approaches – one reason states, rather than the federal government, have tended to retain control. The suite of policy tools oriented toward managing or reducing the problem has been well-studied, but none have emerged as a clearly effective choice. These potential policy solutions include nitrogen fertilizer taxes, financial assistance to support (or farm program benefits conditioned on) nitrogen management and retention practices, and emissions markets such as water quality trading. Water quality trading "allow[s] the various parties that contribute pollution to

a water body, using their particular and specialized knowledge of their activities, to remedy the problem themselves by using a market approach that encourages the party with the lowest pollution abatement costs to reduce its pollution loading" (Ruppert, 2016). Success requires the participation of parties with great differences in pollution control costs, so those with lower marginal costs of abatement can be paid to abate even more in place of parties with higher costs (Ruppert, 2016), eliminating the need for EPA or state agencies to specify the allocation of reductions (Shortle & Horan, 2006). Nelson (2010) notes that several U.S. states allow water quality trades between point sources and nonpoint sources and describes several; however, such trading programs often focus on phosphorus rather than nitrogen, because phosphorus reductions are often more feasible for point source dischargers.

The Minnesota Sugar Beet Cooperative's phosphorous reduction trading program, for example, covers almost 600 nonpoint source sites and 58,000 acres, though only one point source participates in trades, and the nutrient reductions it achieves are relatively small (Nelson, 2011). Beet growers in the program reduce field runoff by implementing BMPs, financed by a trust fund; the reduction in runoff is not directly quantified, but third party auditors verify that BMPs have been implemented (Nelson, 2011). The Tampa Bay Estuary Program, a nitrogen trading program that was established as a special district under Florida law to facilitate interagency agreements, has been more successful in reducing algal blooms and assisting seagrass habitat recovery (Nelson, 2011). Members from electric utilities, industry, agriculture, local government and regulatory agencies share load reductions

by undertaking nitrogen management projects ranging from public and commercial landscaping, agricultural BMPs, and reducing non-agricultural fertilizer use (Nelson, 2011).

Best practices come in many different forms. Virginia and Maryland require local governments to adopt land use regulations that will ultimately limit nonpoint runoff in the Chesapeake Bay watershed, including "the delineation of resource protection and management areas, the designation of development concentration areas, and vegetation cover requirements" (Tarlock, 2002, p. 167). Nitrate runoff can be reduced to some extent by simply rearranging the timing of fertilizer application, not reducing the total (Grandy, Kallenbach, Loecke, Snapp, & Smith, 2012). Cover cropping can significantly reduce the need for fertilizer, although it is not completely costless (Groff, 2015).

In order for these practices to adequately and effectively control nitrogen runoff, however, these BMPs must be mandated to a degree "tantamount to land use controls" (Glicksman & Batzel, 2010). One potential barrier to doing so is the Fifth Amendment's prohibition on takings. Although some local governments have conditioned development or use permits on specific environmental measures like agricultural BMPs, courts sometimes find that these conditions constitute an impermissible taking. For example, in *Dolan v. City of Tigard*, 512 U.S. 687 (1994), the Supreme Court struck down the City of Tigard's attempt to require Dolan to dedicate a portion of her land to a greenway that would support flood control and traffic improvements as an unconstitutional taking. Regulations imposing buffer zone

requirements, which could slow the progress of excess nitrogen to water bodies but could also take farmland out of production, may run afoul of this prohibition.

Voluntary programs to mitigate runoff have also been attempted, though there are few empirical studies of their usefulness in the nonpoint source water pollution context (Lyon & Maxwell, 2002). These programs generally fall into one of three categories: (a) polluters develop and implement their own pollution reduction program, (b) stakeholders negotiate the terms of a pollution production program, or (c) the program is developed or sponsored by a government, which establishes participation criteria (Dowd et al., 2008). Incentives to participate can be personal commitments to stewardship, improved profit margins, or government incentives such as subsidies conditioned on participation (Alberini & Segerson, 2002). But to be successful, voluntary environmental programs often require one or more other features: (a) the threat of regulatory enforcement if the voluntary program fails, (b) a third-party monitoring program, and (c) peer sanctions for poor performance (Dowd et al., 2008).

After systematically evaluating the efficacy of the existing regulatory and policy approaches to nutrient pollution, the State-EPA Nutrient Innovations Task Group (2009) concluded that they were not working, setting forth the following findings:

- The nutrient pollution problem is nationally significant, expanding, and likely to substantially accelerate.
- Existing efforts are not succeeding at improving water quality.

- Knowledge, collaboration and financial incentives will fail without a common framework of responsibility and accountability for all point and nonpoint sources.
- TMDL implementation, while an effective tool for point sources, has not been able to fully address the larger problem of nonpoint sources.
- Current tools such as numeric nutrient criteria, water quality assessments and listings, urban stormwater controls, POTW nutrient limits, and animal feedlot controls are underused and poorly coordinated.
- Other broadly applicable tools, such as CZARA, antidegradation, 40 CFR part 122.4 limitations on discharges to impaired waters, and compliance with downstream water quality standards, are rarely used.
- Current regulations disproportionately address certain sources (e.g., municipal sewage treatment) at the exclusion of others (e.g., row crop agriculture).
- Uneven responsibility between point and nonpoint sources continues to be a major barrier to coordinated and collaborative multi-sector partnerships.
- Specific aspects of state nonpoint source programs have been highly successful in addressing individual sources of nutrients, but their broader application has been undercut by the absence of a common multistate framework of mandatory point and nonpoint source accountability within and across watersheds. (State-EPA Nutrient Innovations Task Group, 2009, p. 31)

In short, nonpoint source nitrogen pollution has proven intractable, existing legislation has not been effective, and the harms caused by nitrogen pollution are considerable.

Chapter 3: Climate change tort litigation as an evolving strategy for mitigating environmental harm

> "Avoiding climate breakdown will require cathedral thinking. We must lay the foundation while we may not know exactly how to build the ceiling."
>
> –Greta Thunberg, April 23, 2019

Anthropogenic climate change

Like nitrogen, greenhouse gas emissions have proven difficult to regulate in a way that protects downstream bystanders from harm. The system includes billions of small, globally distributed sites of emission, both stationary and mobile; a market dominated by a few very large companies who manufacture the products generating emissions; and injuries that are often far removed, in both space and time, from the activities that caused them. The first-order impacts of greenhouse gas emissions – increases in global average temperature – are readily observable. These lead to a range of adverse consequences, among them "rising sea levels, ocean warming and acidification, melting sea ice, thawing permafrost, increases in the frequency and severity of extreme events, and a variety of impacts on people, communities, and ecosystems" (Burger, Horton, & Wentz, 2020). The link between these consequences and human activity is supported by many forms of evidence. The Intergovernmental Panel on Climate Change (IPCC) documents these impacts globally, and also summarizes research on attribution science (Burger et al., 2020). In the United States, the U.S. Global Change Research Group (USGCRP) publishes the National Climate Assessment (NCA) every four years, as required by the Global Change Research Act

of 1990. The Fourth National Climate Assessment was issued in two parts; Volume 1 addressed climate science and our current state of knowledge about the attributability of climate change to anthropogenic greenhouse gas emissions, and Volume 2 described the impacts and risks of climate change to the United States, as well as potential adaptation and mitigation activities (U.S. Global Change Research Group, 2017, 2018).

In short, the widespread use of fossil fuels has emitted carbon dioxide into the atmosphere far faster than natural cycles can remove it, leading to a build-up of carbon dioxide into the atmosphere, a consequent greenhouse effect that traps heat, and a range of harmful consequences. Carbon dioxide concentrations in the atmosphere have increased by more than 40 percent since the Industrial Revolution, to levels not seen in at least 3 million years. Global surface air temperature has increased by approximately 1.8° F (U.S. Global Change Research Group, 2017). Sea levels have risen by approximately 1 foot, due to thermal expansion of ocean waters and freshwater runoff from melting ice sheets. The frequency of both droughts and floods is increasing worldwide, due in part to increases in atmospheric moisture and changes in the distribution of atmospheric moisture. Floods, due in part to rising sea levels on the coast and to increasingly frequent extreme rainfall events, increase erosion and damage property and infrastructure (IPCC, 2014; U.S. Global Change Research Group, 2017). Extreme heat events are increasing in frequency and intensity worldwide as a result of increased greenhouse gas concentrations trapping heat(Horton, Mankin, Lesk, Coffel, & Raymond, 2016). These heatwaves cause

ecosystem damage, habitat destruction, and loss of human life. (Burger et al., 2020). Drought, in part a product of increased heat, raises the risk of forest fires and crop failure (U.S. Global Change Research Group, 2017).

These impacts impose substantial costs worldwide, although the dollar figures are complex and difficult to calculate. The probabilistic nature of climate change impacts, and the possibility of nonlinear increases in impacts as temperatures increase, add additional layers of difficulty to any projections of future costs. Economist William Nordhaus recently attempted to model the cost of climate change using the "social cost of carbon," or the amount per ton of carbon dioxide that approximates the externality imposed by fossil fuel use. He identified a range of figures from $36/ton to $250/ton, depending on the policy outcome desired – of course, "[t]he actual global carbon price is at most one-tenth of that" (Nordhaus, 2019).

As with fertilizer, the fossil fuel industry is dominated by several large multinational companies. The major players include a number of oil and gas conglomerates: ExxonMobil, Chevron Texaco, and Conoco Phillips in the U.S., and Royal Dutch/Shell, Total Fina Elf, BP Amoco, and Eni worldwide, as well as several national companies, including SinoPec, Saudi Aramco, and Gazprom. The largest coal companies in the world include Arch Coal, Cloud Peak Energy, and Peabody Energy in the U.S., as well as Anglo American, BHP Billiton, Coal India Limited, China National Coal Group and ShenHua Group. The 90 largest oil, natural gas, coal, and cement production companies are allegedly responsible for 63 percent of the

greenhouse gases emitted between 1751 and 2010 – over half of those after 1986 (Andres et al., 2012; Heede, 2014). The scientific evidence linking emissions to changes in the climate and physical world is improving over time. A Union of Concerned Scientists study published in 2017 found that almost half the rise in global average temperature, and almost 30 percent of global sea level rise, could be attributed to the heat trapped by emissions from the manufacture, extraction, and consumption of products made by those 90 companies (Ekwurzel et al., 2017).

Regulating greenhouse gas emissions

The United Nations Framework Convention on Climate Change (UNFCCC), ratified in 1994, defined its objective as "stabilization of greenhouse-gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Under the Kyoto Protocol of 1997, the first step in implementing the UNFCCC, high-income countries agreed to limit their emissions to 5 percent below 1990 levels and adhere to greenhouse gas reporting requirements. The Kyoto Protocol also developed an international cap-and-trade system for carbon that was intended to cohere policies of different countries in service of an agreed-upon common goal. By 2012, lack of participation (particularly by the United States, a major emitter) and lack of cooperation had substantially reduced its impact, without significant reduction in emissions (Nordhaus, 2019).

The Kyoto Protocol was largely supplanted by the 2015 Paris Agreement, which asked signatories to make their countries' best efforts to limit climate change to 2°C. During the Obama Administration, the United States said that it would

participate by reducing its greenhouse gas emissions to 26-28 percent below 2005 levels in 2025. The Paris Agreement imposes no penalties for noncompliance or withdrawal, and would not have the desired effect of limiting global warming to the targeted increase, even if all signatories complied with their commitments. Since 2017, the United States has stated that it will withdraw from the Paris Agreement, although some state and local governments have expressed the desire to continue operating in the Agreement's spirit (Tabuchi & Fountain, 2017).

In the United States, there is no comprehensive federal environmental statute that directly addresses climate change. The Clean Air Act, however, allows the EPA to regulate "hazardous air pollutants." As evidence linking carbon dioxide to climate change accumulated and EPA took no action, a group of private organizations filed a rulemaking petition in 1999, asking EPA to regulate "greenhouse gas emissions from new motor vehicles under §202 of the Clean Air Act," given that 1998 had been the warmest year recorded and that the IPCC had warned in 1995 that carbon dioxide was forcing anthropogenic climate change, which would have serious adverse effects on human health. *Massachusetts v. EPA*, 549 U.S. 497, 500 (2007). EPA denied the rulemaking petition in 2003, stating that it was not actually authorized to regulate carbon dioxide emissions by the Clean Air Act and that it would be "unwise" to do so, given the regulatory challenges and residual scientific uncertainty. *Id.* The State of Massachusetts, among other state and local governments, joined the petitioners in a suit that reached the Supreme Court, which ruled in 2007 that EPA did have the discretion to regulate greenhouse gases. *Id.* EPA subsequently issued a determination

that several greenhouse gases could indeed be considered hazardous air pollutants, given their contributions to climate change. 81 Fed. Reg. 54421.

As a result of this determination, the EPA issued standards in 2015 limiting carbon emissions from new and existing (newly modified) fossil fuel-fired power plants, finding that their contributions to greenhouse gas pollution endangered public health and welfare. 80 Fed. Reg. 64510, 64529-30. Similar standards and findings followed in 2016 for oil and gas sector sources of methane, greenhouse gas emissions from aircraft engines, and CAFE standards for automobiles. 81 Fed. Reg. 35824; 81 Fed. Reg. 54422. These standards, however, were promptly rolled back in 2017, after a change of presidential administrations. By then, the Supreme Court had already blocked implementation of the new source rule, pending the resolution of lower court challenges, and the EPA issued a replacement rule in 2019, substantially scaling back the prior limitations on power plant emissions (Nuccitelli, 2019).

Given the vulnerability of regulation to shifts in the political winds, some economists have identified the reservation of regulatory power over greenhouse gases to the EPA as "inferior to new legislation from Congress, especially over the long term," for the purpose of controlling climate change impacts (Burtraw, Fraas, & Richardson, 2011). Other than the Endangerment Finding and related regulations, the federal government has not taken any other major regulatory action to reduce greenhouse gas emissions (Drabick, 2005), and substantial reductions in U.S. greenhouse gas emissions have not occurred – as the below chart shows.

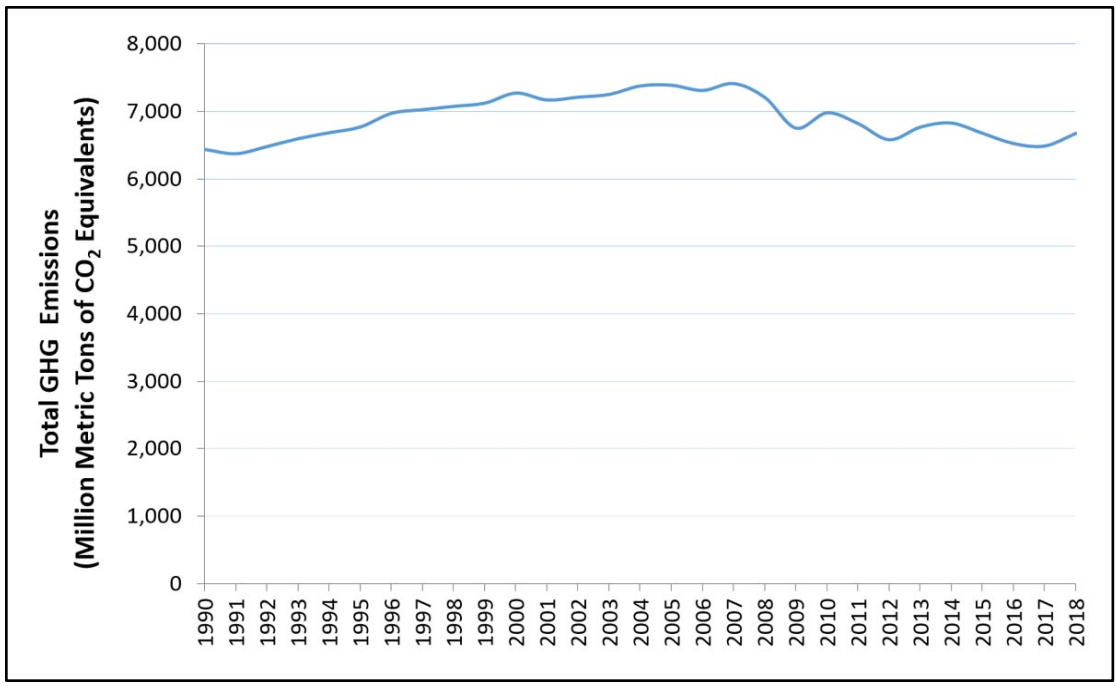

Figure 5: Total Annual U.S. Greenhouse Gas Emissions, 1990-2018. (U.S. EPA, 2020b)

In response to this regulatory failure, some have called for a strategic turn to litigation against those responsible for the harm. Among them is James Hansen, a scientist who was among the first and most prominent to draw attention to the harmful effects of climate change. A recent article in The Guardian described his recommendation: "the key is to make the 100 big 'carbon majors' – corporations like ExxonMobil, BP and Shell that are, by one account, responsible for more than 70% of emissions – pay for the transition to cleaner energy and greater forests. Until governments make them do so by introducing carbon fees or taxes, [Hansen] says, the best way to hold them to account and generate funds is to sue them for the damage they are doing to the climate, those affected and future generations." (Watts, 2017).

Legal scholars have been discussing the use of common law tort suits to address climate change for some time. An early analysis by David Hodas (2000) addressed the threshold issue of standing for climate change plaintiffs, concluding that standing challenges could be overcome under the right circumstances. David Grossman's in-depth analysis previewed likely plaintiffs, likely defendants, and promising causes of action, as well as some possible defenses and pitfalls (2003). Here, he explains why tort law is uniquely suited to address an environmental issue like climate change:

> In deciding who should bear the costs of global warming, it is helpful to look at two of tort law's basic goals: (1) reducing the costs of accidents, and (2) providing corrective justice. Consider first which allocation of costs will best reduce the costs of climate change "accidents." Leaving the costs of climate change on its victims ensures that climate-changing activities occur at higher than optimal levels, resulting in higher "accident" costs. This is true because victims and potential victims, for three principal reasons, cannot effectively organize to bargain with or to force producers of fossil fuels to reduce fossil fuel use. First, climate change has global effects, so in that regard, the transaction costs involved in organizing the vast numbers of potential victims are immense. Second, as noted, the effects of climate change are unevenly distributed. While the transaction costs of organizing victims are lower in more localized areas, it is likely that any such local organization would have insufficient economic clout to bargain meaningfully with fossil fuel companies. Third, the lack of public knowledge about climate change, caused by the evolving and complicated science of climate change and compounded by some fossil fuel companies' efforts to encourage public uncertainty and inaction on global warming, further hinders fruitful organization and collective action. Lack of organization and imperfect knowledge therefore enable producers to continue producing their climate-changing products at higher than optimal levels and to keep externalizing the costs of climate change. Fossil fuel prices thus do not accurately reflect climate change's costs when these costs are left on victims. (Grossman, 2003, p. 4).

Shi-Ling Hsu (2008) concluded that "seeking direct civil liability against those responsible for [greenhouse gas] emissions" is the only strategy "that holds out any

promise of being a magic bullet" (p. 116). Although some promising lawsuits, like *Massachusetts v. EPA*, were oriented toward pushing governmental action to reduce greenhouse gases, Hsu pointed out that "[t]he incremental effect of these strategies, however, can always be undermined by the politics of the day and the policy stance of the President…. it will be the President, and not the outcome of litigation, that bends the will of federal agencies to engage in the problem of regulating and reducing greenhouse gases" (Hsu, 2008, pp. 115-16). However, because litigation is so risky and the chances of success are so mixed, he eventually concluded that "climate change litigation is unlikely to play a significant role in arresting global climate change. In the end, the bulk of the work in reducing greenhouse gases must be undertaken by nation-states and international agreements" (Hsu, 2008, pp. 101-102).

Hari Osofsky situates climate change tort proposals in the context of regulatory failure, noting that "[c]limate change poses a multidimensional regulatory problem because addressing it involves many levels of government and a wide range of governmental and nongovernmental actors" that involves "(1) scientific, technical, and legal uncertainty; (2) simultaneously overlapping and fragmented legal regimes; (3) difficulties of balancing inclusion and efficiency; and (4) inequality and resulting injustice," calling for simultaneous strategies including litigation (Osofsky, 2012, p. 448). As early as 2007, scholars were evaluating the strength of potential tort claims against climate change emitters and working through potential challenges they might face. Hunter and Salzman observed that the causation and injury elements of negligence claims had been much discussed in the climate change context – injury

being fairly straightforward to establish, causation less so, particularly at the time given the state of the science – and turned their attention to the questions of duty and breach (Hunter & Salzman, 2007). And in 2011 Maxine Burkett refined the strategy further, focusing on the public nuisance theory that was being advanced at the time in the *Kivalina* litigation discussed below (Burkett, 2011).

Dena Adler has tracked and sorted ongoing climate change litigation by functional category (D. P. Adler, 2018). She identified five tactical categories for current litigation: (1) defending Obama Administration policies and decisions; (2) demanding transparency and scientific integrity; (3) integrating consideration of climate change into environmental review; (4) advancing additional climate change protections through the court system; and (5) deregulating or undermining climate change protections (D. P. Adler, 2018). Similarly, Setzer and Vanhala (2019) recently performed a systematic review of research on climate change litigation in order to highlight emerging strategic trajectories. They found that although most climate litigation activity is routine and undertaken to push government and regulatory action, high-profile judgments like *Massachusetts v. EPA* tend to inspire more research and scholarly attention. They also note some recurring phenomena and themes: the two-way relationship between litigation and legislation in the climate change context, the geographic scale and time frame of climate litigation (including the state and local litigation discussed below), the role of science in the courtroom, and the relationship between climate change and litigation.

The case studied here represents a practical implementation and a test of the tort-oriented theories that have been discussed in the literature. Although the lawsuits at issue have not yet been fully resolved, the strategies employed illustrate the potential utility of public nuisance and other common-law-based litigation as a climate change lever.

Early climate change tort litigation

From 2005 to 2015, several preliminary tort cases, positing a variety of common law theories, were filed partly in response to slow regulatory action on climate change.[5] These suits named fossil fuel companies, power companies, and automobile manufacturers as defendants, and based liability on those defendants' roles in greenhouse gas emissions, promoting greenhouse gas emitting products, and concealing their own contributions to dangerous climate change. See *Am. Elec. Power Co*., 564 U.S. at 418 (naming as defendants the Tennessee Valley Authority and four private companies that operate fossil-fuel fired power plants); *Kivalina*, 696 F.3d at

[5] These cases included *People of the State of California v General Motors Corp.,* No C06-05755 (ND Cal, 17 September 2007); *American Electrical Power Co (AEP) v Connecticut*, [2005 cite to district court op] *Kivalina v ExxonMobil Corporation et al.,* 696 F.3d 849 (9th Cir 2012); *Comer v Murphy Oil USA Inc*., 607 F.3d 1049 (5th Cir 2010). See also *Oakland*, 325 F. Supp. 3d at 1024-26 (dismissing federal common law nuisance claims on displacement and separation of powers grounds); *Sanders-Reed*, 350 P.3d at 1225-27 (holding state public trust claim displaced by state statute); *Kanuk*, 335 P.3d at 1096-1103 (affirming dismissal of state public trust claims either for lack of justiciability or on prudential grounds); *Alec L. v. McCarthy*, 561 F. App'x. 7, 7 (D.C. Cir. 2014) (affirming dismissal of climate change suit based on federal public trust doctrine, on grounds that public trust doctrine is a matter of state law).) The U.S. Court of Appeals panel in *Connecticut v. Am. Elec. Power Co.,* 582 F.3d 309, 392 (2d Cir. 2009) held that there was no such threshold bar to plaintiffs' claims, though the suit failed on other grounds (Lin & Burger, 2018).

853 n.1 (naming as defendants multiple oil companies and power companies); *Comer*, 585 F.3d at 859 (naming as defendants companies engaged in energy, fossil fuels, and chemical industries); and *General Motors Corp.,* 2007 WL 2726871, at *1 (noting that six defendant automakers produce vehicles that emit over 20% of U.S. anthropogenic carbon dioxide emissions) (Lin & Burger, 2018). These and other important preliminary tort suits over climate change are detailed below.

Connecticut v. American Electric Power

Connecticut v. Am. Elec. Power Corp. ("*AEP*") was filed on July 21, 2004, by eight state attorneys general and the City of New York, along with three environmental advocacy groups. Defendants were six large electric power generation companies, who were collectively responsible for about 10% of U.S. carbon dioxide emissions. Plaintiffs sought to limit the generators' greenhouse gas emissions by asking the court to find that these emissions contributed to the public nuisance of climate change, requesting that the court order limits and phased reductions of defendants' carbon dioxide emissions. In 2005, the district court dismissed the lawsuit on political question grounds – that regulating greenhouse gases was a question for Congress, not the courts. Four years later, the Second Circuit reversed, and the U.S. Supreme Court granted *certiorari* in late 2010. Ruling for the defendants, the Court explained that "the Clean Air Act and the EPA actions it authorizes displace any federal common-law right to seek abatement" of carbon emissions. 564 U.S. 410, 424 (2011). The Court found that Congress had entrusted EPA with the authority to decide how greenhouse gases should be regulated, and the

judicial branch lacked similar power to address climate change. 564 U.S. at 426. The court would have had "to balance health and environmental concerns with economic concerns to set and implement emissions caps, which involved a range of policy issues unresolved by the political branches" (Lin & Burger, 2018; Vallejo & Gloppen, 2013). However, the Supreme Court did *not* foreclose the possibility of a public nuisance claim based on state law, expressly leaving the matter open. 564 U.S. at 429.

Comer v. Murphy Oil

In 2005, private plaintiffs in Mississippi alleged that a range of defendants, including a number of fossil fuel producers, caused the emission of greenhouse gases that contributed to climate change, added to the severity of Hurricane Katrina, and ultimately damaged plaintiffs' property. The causes of action included public and private nuisance, trespass and negligence. 839 F. Supp. 2d at 852-53. For technical reasons, the Fifth Circuit never addressed the merits of the public or private nuisance claims, but did determine that the plaintiffs had standing to bring their claims – though warning of the "daunting evidentiary problems" in store. In 2011 the Supreme Court rejected the writ of mandamus petition. *Comer I*, 562 U.S. at 1133. The plaintiffs re-filed their case in district court, and it was dismissed based on res judicata grounds – though, again, not on the merits. (*Comer II*, 839 F. Supp. 2d at 855-57; see Lin & Burger, 2018; Merrill, 2011).

California v. General Motors, Inc.

In 2006, the State of California filed a lawsuit in federal court against a group of car manufacturers, alleging that the companies' vehicles were a substantial source

of greenhouse gas emissions and had caused millions of dollars in climate-related damages to the State – specifically, a substantial reduction in Sierra snowpack, which provides 35% of the state's water (Peel & Osofsky, 2013). The district court granted defendants' motion to dismiss on political question grounds, while also questioning whether available scientific methods could ever possibly determine defendants' contribution to climate change with enough specificity to assign liability (id.). California appealed the district court's decision to the Ninth Circuit, but dropped the appeal in 2009, citing progress on increasing fuel economy standards and the EPA's recent endangerment finding.

Native Village of Kivalina v. ExxonMobil

Plaintiffs filed suit in 2008 in federal court[6] alleging federal public nuisance, state public and private nuisance. The Alaskan village where plaintiffs lived was threatened by rising seas, melting permafrost, and loss of the sea ice that ordinarily shielded the village from seasonal storms. The U.S. Army Corps of Engineers had already made a determination that the village was in danger and needed immediate relocation (Frank, 2011). As damages, plaintiffs sought the estimated cost of relocating the village ($400 million) and an injunction to reduce defendants' greenhouse gas emissions. Plaintiffs also raised claims for conspiracy and concert of action against the fossil fuel manufacturer defendants, alleging that they had conspired to mislead the public about the existence and impacts of climate change. In September 2009, the court dismissed the Kivalina lawsuit, acknowledging that "the

[6] CV 08-1138 N.D. Cal. (2008)

lack of a federal remedy may be a factor to be considered in determining whether Congress has displaced federal common law," but holding that "if a cause of action is displaced, displacement is extended to all remedies." 696 F.3d at 857. It did not rule on the question of whether state common law was similarly displaced, however (696 F.3d at 866; Vallejo and Gloppen 2013).

Climate change nuisance litigation since 2017

After the failure of *Kivalina*, a decade passed without any significant coordinated effort to leverage common law in the climate change context. A number of plaintiffs pursued Clean Air Act claims in an effort to pressure EPA to enforce the Act against greenhouse gas emitters, but none proved effective. Some alleged the failure to evaluate climate change impacts in NEPA suits, in an effort to force regulatory attention to the issue.[7]

In 2017, several city and county governments in California filed suit against major fossil fuel manufacturers to recover their costs of coping with the harmful effects of climate change. These initial forays were followed by a handful of others across the country, from the city of Boulder, Colorado to the State of Rhode Island. All of the cases allege roughly the same set of facts and resulting harms. The *Rhode Island v. Chevron Corp.* court summarized the strategy as follows, in its opinion granting remand to state court:

[7] Instead, in 2020, the Council on Environmental Quality revised the NEPA Guidelines to state explicitly that cumulative climate change impacts need not be considered in determining whether to issue permits under NEPA.

> Climate change is expensive, and the State wants help paying for it. Specifically from Defendants in this case, who together have extracted, advertised, and sold a substantial percentage of the fossil fuels burned globally since the 1960s. This activity has released an immense amount of greenhouse gas into the Earth's atmosphere, changing its climate and leading to all kinds of displacement, death (extinctions, even), and destruction. What is more, Defendants understood the consequences of their activity decades ago, when transitioning from fossil fuels to renewable sources of energy would have saved a world of trouble. But instead of sounding the alarm, Defendants went out of their way to becloud the emerging scientific consensus and further delay changes—however existentially necessary—that would in any way interfere with their multibillion-dollar profits….
>
> Pleading eight state-law causes of action, the State prays in law and equity to relieve the damage Defendants have and will inflict upon all the non-federal property and natural resources in Rhode Island. Casualties are expected to include the State's manmade infrastructure, its roads, bridges, railroads, dams, homes, businesses, and electric grid; the location and integrity of the State's expansive coastline, along with the wildlife who call it home; the mild summers and the winters that are already barely tolerable; the State fisc, as vast sums are expended to fortify before and rebuild after the increasing and increasingly severe weather events; and Rhode Islanders themselves, who will be injured or worse by these events. The State says it will have more to bear than most: Sea levels in New England are increasing three to four times faster than the global average, and many of the State's municipalities lie below the floodplain. 393 F.Supp.2d at 146-47.

These cases are worthy of study because, taken as a body, these seventeen lawsuits illustrate a novel strategy of using state tort law to hold fossil fuel producers liable for the negative environmental impacts and externalities imposed by their products. The small number of firms pursuing these cases[8] have made a range of strategic choices in aspects of the case ranging from the number of defendants to the causes of action to the remedy sought, adding texture and illuminating nuance to the case study. This

[8] State and local governments as well as corporate law departments often retain outside counsel to perform specialized legal work, including litigation (Seamans, 1960; Sebok, 2016).

section will detail the salient characteristics of each case.

Table 1: Extant climate change tort cases.

CASE TITLE	DATE FILED	OUTSIDE COUNSEL[9]
City of Imperial Beach v. Chevron	July 17, 2017	Sher Edling
County of Marin v. Chevron	July 17, 2017	
County of San Mateo v. Chevron	July 17, 2017	
City of San Francisco v. BP	September 19, 2017	Hagens Berman Sher Edling[10]
City of Oakland v. BP	September 19, 2017	
City of Santa Cruz v. Chevron	December 20, 2017	Sher Edling
County of Santa Cruz v. Chevron	December 20, 2017	
City of New York v. BP	January 9, 2018	Hagens Berman Seeger Weiss
City of Richmond v. Chevron	January 22, 2018	Sher Edling
Boulder County v. Suncor	April 17, 2018	The Hannon Law Firm EarthRights International Niskanen Center
King County v. BP	May 9, 2018	Hagens Berman
Rhode Island v. Chevron	July 2, 2018	Sher Edling
Baltimore v. Chevron	July 20, 2018	Sher Edling
PCFFA v. Chevron	November 14, 2018	Sher Edling
Honolulu v. Sunoco	March 9, 2020	Sher Edling
Minnesota v. API	June 24, 2020	No outside counsel
Hoboken v. ExxonMobil	September 2, 2020	Emery Celli Brinckerhoff Abady Ward Maazel LLP
Charleston v. Brabham Oil Co.	September 9, 2020	Sher Edling
Delaware v. BP America	September 10, 2020	Sher Edling
Maui v. Sunoco	October 12, 2020	Sher Edling

[9] Each governmental plaintiff is co-represented by its own attorneys or legal department and by the outside firm listed. In some cases, where outside counsel does not hold a local state bar membership, the outside counsel has associated with a local firm or practitioner who does. In general, the local associated counsel appears on filings but does not usually provide substantial strategic input.

[10] Following the dismissal of the cases by the district court and before briefing and arguing the appeal of the dismissal to the Ninth Circuit, plaintiffs San Francisco and Oakland hired Sher Edling as new outside counsel.

Cases filed by Sher Edling

The first group of California governments to file suit – San Mateo County, Marin County, and the City of Imperial Beach – chose as their outside representation San Francisco-based Sher Edling LLP, co-led by Vic Sher, an environmental litigator with experience in a range of groundwater contamination cases involving methyl tert-butyl-ether (MTBE), perchloroethylene (PCE), trichloropropane (TCP) and other pollutants.[11] Sher represented the City of New York in an MTBE suit, winning a $104 million verdict at trial. Sher practiced with Earthjustice (formerly known as the Sierra Club Legal Defense Fund) from 1986 to 1997, serving as its president for three years and playing a major role in actions to protect the endangered northern spotted owl from logging of old-growth forests in the Pacific Northwest. Michael Burger, the Executive Director of the Sabin Center for Climate Change Law, works with Sher Edling in an of-counsel role.[12]

This group filed their complaints simultaneously on July 17, 2017.[13] The complaints alleged that coal, oil, and natural gas companies' "production, promotion, marketing, and use of fossil fuel products, simultaneous concealment of the known

[11] I worked with Mr. Sher as an attorney employed by his former firm, Sher Leff LLP, and assisted with the groundwater contamination cases in the 2007-2012 timeframe. We have not collaborated on the climate change suits that are the subject of this work.
[12] https://www.sheredling.com/team/michael-burger/ (last accessed April 30, 2020).
[13] Complaint, County of Marin v. Chevron, No. CV 1702586 (Cal. Super. Ct. Jul. 17, 2017) [hereinafter Marin Compl.]; Complaint, County of San Mateo v. Chevron, No. 17CIV03222 (Cal. Super. Ct. Jul. 17, 2017) [hereinafter San Mateo Compl.]; Complaint, Imperial Beach v. Chevron, No. C17-01227 (Cal. Super. Ct. Jul. 17, 2017) [hereinafter Imperial Beach Compl.].

hazards of those products, and their championing of anti-regulation and anti-science campaigns, actually and proximately caused" injuries to the plaintiffs, including more frequent and more severe flooding, as well as sea level rise that jeopardized infrastructure, beaches, schools, and communities.[14] Their complaints included claims for public nuisance, strict liability, failure to warn, design defect, private nuisance, negligence, and trespass.[15] The relief sought by the local governments includes compensatory damages, abatement of the alleged nuisance, attorneys' fees, punitive damages, and disgorgement of profits.[16] These cases were removed to federal court on August 24, 2017.[17] Judge Chhabria remanded the cases on March 16, 2018, deeming the issues suitable for state court.[18] The remand was appealed to the 9th Circuit, and the appeals in these and Santa Cruz/Richmond cases were consolidated.

The City and County of Santa Cruz filed their complaints on December 20, 2017 in California Superior Court against 29 fossil fuel companies,[19] alleging that greenhouse gas pollution from production and use of the defendants' products had played "a direct and substantial role in the unprecedented rise in emissions of

---

[14] Marin Compl. at 4; San Mateo Compl. at 4; Imperial Beach Compl. at 4.
[15] Marin Compl. At 79-98; San Mateo Compl. at 78-97; Imperial Beach Compl. at 75-94.
[16] Marin Compl. at 99; San Mateo Compl. at 98; Imperial Beach Compl. at 95.
[17] "Removal" of a case from state to federal court occurs when defendants file a notice of removal. Removal jurisdiction exists when the federal district court has a basis for subject-matter jurisdiction over the dispute, such as a claim under federal law. 28 U.S.C. § 1441 et seq.
[18] *County of San Mateo v. Chevron Corp.,* 294 F. Supp. 3d 934, 939 (N.D. Cal. 2018)
[19] Complaint, City of Santa Cruz v. Chevron, No. 17CV03243 (Cal. Super. Ct. Dec. 20, 2017) [hereinafter City of Santa Cruz Compl.]; Complaint, County of Santa Cruz v. Chevron, No. 17CV03242 (Cal. Super. Ct. Dec. 20, 2017) [hereinafter County of Santa Cruz Compl.].

greenhouse gas pollution and increased atmospheric CO2 concentrations since the mid-20th century" and that the companies' production, promotion, and marketing of their products, along with their concealment of the products' known hazards and "championing of anti-regulation and anti-science campaigns," had caused injuries to the City and County. The City and County alleged that the defendants were directly responsible for 17.5% of total global emissions of carbon dioxide between 1965 and 2015. The climate change-related injuries alleged by the City and County included drought, extreme precipitation and landslides, heat waves, wildfires, and sea level rise.[20] The causes of action asserted in the complaint were public nuisance, strict liability based on failure to warn and design defect, private nuisance, negligence, and trespass.[21] The City and County sought compensatory damages, equitable relief including abatement of the nuisance, punitive damages, and disgorgement of profits, as well as attorneys' fees and other costs.[22] Like the cases above, these suits were removed to federal court, remanded, and the remand was stayed pending appeal.

The City of Richmond filed its complaint on January 22, 2018 in California Superior Court against 29 fossil fuel companies.[23] The City seeks damages and other relief for climate change-related injuries allegedly resulting from the defendants' "production, promotion, marketing of fossil fuel products, simultaneous concealment of the known hazards of those products, and their championing of anti-science

---

[20] City of Santa Cruz Compl. at 34-40; County of Santa Cruz Compl. 34-40.
[21] City of Santa Cruz Compl. at 95-118; County of Santa Cruz Compl. at 99-122.
[22] City of Santa Cruz Compl. at 119; County of Santa Cruz Compl. at 123.
[23] Complaint, *City of Richmond v. Chevron*, No. C18-00055 (Cal. Super. Ct. Jan. 22, 2018) [hereinafter Richmond Compl.].

campaigns." The complaint alleged that the defendants were directly responsible for 17.5% of global carbon dioxide emissions between 1965 and 2015, and that during the past 50 years the defendants had taken steps to protect their own assets from climate change effects while simultaneously promoting use of their products and working to undermine support for greenhouse gas regulation. The climate change-related injuries alleged by the City included sea level rise, more frequent and more severe flooding and storms, drought, and heatwaves. The City alleged that it had already spent significant funds to study, mitigate, and adapt to the effects of climate change. The causes of action asserted by the City are public nuisance, strict liability based on both design defect and failure to warn, private nuisance, negligence, negligent failure to warn, and trespass.[24] The City seeks compensatory damages, equitable relief including abatement of the nuisance, punitive damages, and disgorgement of profits, as well as attorneys' fees and other costs.[25] Like the cases above, this case was removed, remanded, and the remand appealed.

Sher Edling also represents several groups of non-California plaintiffs – the State of Rhode Island, the City of Baltimore, the Pacific Coast Federation of Fisherman's Associations (PCFFA), the City and County of Honolulu, the City of Charleston, and the State of Delaware. Rhode Island filed its complaint on 7/2/18 in state court, asserting that 21 fossil fuel companies should be held liable for climate change impacts that the State has experienced and will experience in the future.

[24] Richmond Compl. at 90-112.
[25] Richmond Compl. at 112.

Alleged harms include substantial sea level rise; more frequent and severe flooding, extreme precipitation events, and drought; and a warmer and more acidic ocean. Rhode Island asserted that the defendants were directly responsible for 182.9 gigatons of carbon dioxide emissions between 1965 and 2015, representing 14.81% of total carbon dioxide emissions during that time period. The complaint alleges that the defendants' production, promotion, and marketing of fossil fuel products, along with their "simultaneous concealment of the known hazards of these products, and their championing of anti-science campaigns" actually and proximately caused Rhode Island's injuries. The complaint asserts claims of public nuisance, strict liability for failure to warn, strict liability for design defect, negligent design defect, negligent failure to warn, trespass, impairment of public trust resources, and violations of the State Environmental Rights Act. Rhode Island seeks compensatory damages, equitable relief (including abatement of nuisances), punitive damages, disgorgement of profits, and attorneys' fees and costs of suit. Like the other cases above, the case was removed, remanded, and the remand appealed.

The City of Baltimore filed its complaint on July 20, 2018 in state court, seeking to hold 26 fossil fuel companies liable for injuries resulting from climate change. Like other municipalities, Baltimore alleged that the defendants' conduct—the production, promotion, and marketing of fossil fuel products; the simultaneous concealment of the products' known hazards; and their "championing of anti-science campaigns"—directly and proximately cause adverse climate change impacts. The alleged injuries included more frequent and more severe storms and flooding in the

city and substantial increases in average sea level, as well as heatwaves, disruptions of the hydrologic cycle (including extreme precipitation and drought), and associated public health impacts. Baltimore asserted that it was particularly vulnerable to sea level rise and flooding due to 60 miles of waterfront land and that climate change impacts already adversely affected the City's infrastructure. Baltimore asserted causes of action for public nuisance, private nuisance, strict liability failure to warn, strict liability design defect, negligent design defect, negligent failure to warn, and trespass, as well as a cause of action under Maryland's Consumer Protection Act. This case was also removed to federal court, remanded, and the appeal remanded; in March of 2020, the Fourth Circuit denied the remand appeal, meaning that the case will stay in state court for now.

The single non-government plaintiff in this group of cases, Pacific Coast Federation of Fishermen's Associations, filed its complaint on November 14, 2018 in California Superior Court[26] seeking to hold fossil fuel companies liable for adverse climate change impacts to the ocean off the coasts of California and Oregon that resulted in "prolonged closures" of Dungeness crab fisheries. The plaintiff alleged that the companies had known for decades that use of their products could be "catastrophic" and that "only a narrow window existed" for action before consequences would be irreversible. The plaintiff asserted the companies took actions to obscure the harms and avoid regulation, while still acknowledging and planning for

[26] Complaint, *Pacific Coast Federation of Fishermen's Associations, Inc. v. Chevron Corp*., No. C18-571285 (Cal. Super. Ct. Nov. 14, 2018) [hereinafter Pacific Coast Compl.].

climate change's consequences internally. The plaintiff contended that the companies' actions prevented the development of alternatives that could have eased the transition to a less fossil fuel-dependent economy. The complaint contains five causes of action: nuisance, strict liability for failure to warn, strict liability for design defect, negligence, and negligent failure to warn.[27] The plaintiff seeks compensatory damages, equitable relief including abatement of the nuisance, punitive damages, disgorgement of profits, and attorneys' fees and costs.[28] The case was removed, but not yet remanded.

The City and County of Honolulu filed its complaint on March 9, 2020 in Hawai'i state court, alleging that the actions of fossil fuel company defendants directly and proximately caused "a substantial portion of the climate crisis-related impacts in the City," including sea level rise, extreme weather, ocean warming and acidification, impacts on freshwater supplies, loss of habitat for endemic species, and "the cascading social, economic, and other consequences of those environmental changes." The City alleged that these consequences would include injury to and destruction of critical City-owned or -operated facilities and would require the City to incur costs for adaptation and resiliency, while also reducing tax revenue due to impacts on the tourism- and ocean-based economy. The alleged wrongful conduct by the defendants included "concealing the dangers of, promoting false and misleading information about, and engaging in massive campaigns to promote increasing use of

[27] Pacific Coast Compl. at 76-90.
[28] Pacific Coast Compl. at 90.

their fossil fuel products," which the complaint alleged had "contributed substantially to the buildup of CO2 in the atmosphere that drives global warming." Honolulu asserted claims of public nuisance, private nuisance, strict liability for failure to warn, negligent failure to warn, and trespass. The City seeks compensatory damages; equitable relief, including abatement of the nuisance; punitive damages; disgorgement of profits; attorneys' fees; and costs of suit. The case was removed to federal court on April 15, 2020, and stayed as of May 1, 2020 pending the outcome of the appeals in other cases in the Ninth Circuit.

Cases filed by Hagens Berman

To litigate their climate change nuisance cases, San Francisco and Oakland hired the Seattle-based firm Hagens Berman Sobol Shapiro LLP ("Hagens Berman"), which had just been joined by Matt Pawa as co-chair of the firm's environmental practice group.[29] Pawa's environmental litigation experience included representing the plaintiffs in *Native Village of Kivalina v. ExxonMobil* and *Connecticut v. American Electric Power Co.,* discussed in the previous section, as well as the State of New Hampshire in litigation over groundwater contamination caused by the gasoline additive MTBE, winning the largest jury verdict ($236 million) in New Hampshire history. Before Pawa joined the firm, Hagens Berman had represented the

[29] Pawa's former firm, Pawa Law Group P.C., merged with Hagens Berman in September 2017 and its three attorneys formed the new environmental practice group at Hagens Berman. See https://www.hbsslaw.com/cases/closed-case/pressrelease/closed-case-hagens-berman-doubles-down-on-environmental-law-adding-three-environmental-law-trailblazers-to-firm-roster (last accessed March 22, 2020).

Gulf coast fishing industry in litigation against BP over the *Deepwater Horizon* oil spill;[30] another partner at the firm had played a key role in the *Exxon Valdez* oil spill litigation.[31]

The two cities filed their complaints just two months after San Mateo, Marin, and Imperial Beach, on September 19, 2017 in California Superior Court. The suit named as defendants the "five largest investor-owned fossil fuel corporations in the world as measured by their historic production of fossil fuels,"[32] alleging that the carbon emissions from their fossil fuel production had created an unlawful public nuisance under both state and federal nuisance law. The complaint alleged that the defendants had produced and promoted the use of "massive amounts" of fossil fuels despite having been aware since the 1950s, based on information from the American Petroleum Institute, that emissions from fossil fuels would cause severe and even catastrophic climate change impacts -- engaging in sophisticated public relations "campaigns to promote pervasive fossil fuel usage" and downplaying the risks even as they knew that their fossil fuels were contributing to global warming.[33] The complaint alleged that San Francisco/Oakland was already experiencing impacts from

---

[30] *Brian Howard's Charter Fishing LLC and Laurence Emory Walker Jr. v. Transocean Ltd., et al.,* No. 1:10-cv-00207-HSO-JMR, S.D. Miss.
[31] https://www.bizjournals.com/seattle/stories/2005/02/14/daily23.html (last accessed March 25, 2020)
[32] First Amended Complaint at 2, City of San Francisco v. BP, No. 3:17-cv-06012-WHA (N.D. Cal. Apr. 3, 2018) [SF Am. Compl.] (naming BP, Chevron, ConocoPhillips, Exxon Mobil, and Royal Dutch Shell as defendants); First Amended Complaint at 2, City of Oakland v. BP, No. 3:17-cv-06011-WHA (N.D. Cal. Apr. 3, 2018) [Oakland Am. Compl.] (naming BP, Chevron, ConocoPhillips, Exxon Mobil, and Royal Dutch Shell as defendants). 5.
[33] SF Am. Compl. at 3; Oakland Am. Compl. At 2-3. 6.

accelerated sea level rise due to climate change and incurring costs for planned and current abatement projects.[34] Rather than liability for damages or an injunction, the cities asked the court to require the companies to create an abatement fund – a remedy sometimes used to mitigate the harm of a public nuisance – that would fund a climate adaptation program to build sea walls and other infrastructure necessary to protect public and private property from sea level rise and other climate impacts.[35] Defendants removed the cases to federal court on October 20, 2017; Judge Alsup denied remand, on the ground that the claims were "necessarily governed by federal common law."[36] The cases were then dismissed entirely on June 25, 2018;[37] the district court held that the Clean Air Act displaced plaintiffs' claims as to domestic greenhouse gas emissions, and any international greenhouse gas emissions were within the purview of the legislative or executive branches, not the courts.[38] The dismissal has been appealed to the Ninth Circuit.[39] In fall of 2018, San Francisco and

---

[34] SF Am. Compl. at 1, 5, 58-61; Oakland Am. Compl. at 5, 49-55.
[35] SF Am. Compl. at 1, 5, 58-61; Oakland Am. Compl. at 5, 49-55.
[36] *California v. BP*, No. C 16-06011 WHA, No. C 17-06012 WHA, 2018 WL 1064293, at *2 (N.D. Cal. Feb. 27, 2018).
[37] *City of Oakland v. BP P.L.C. (SF/OAK II*), 325 F. Supp. 3d 1017, 1028-29 (N.D. Cal. 2018) (granting motions to dismiss under FRCP 12(b)(6)), appeal docketed, No. 18-16663 (9th Cir. 2018); *California v. BP P.L.C. (SF/OAK I),* Nos. C 17-06011 WHA & C 17-06012 WHA, 2018 WL 1064293 (N.D. Cal. Feb. 27, 2018) (addressing cases brought by San Francisco and Oakland, California and denying motions to remand), appeal docketed sub. nom*. City of Oakland v. BP P.L.C.,* No. 18-16663 (9th Cir. 2018).
[38] *City of Oakland v. BP*, 325 F. Supp. 3d 1017, 1024-26 (N.D. Cal. 2018), appeal filed, Case No. 18-16663; see also *City of New York v. BP*, 325 F. Supp. 3d 466 (S.D.N.Y. 2018), appeal filed, Case No. 18-2188 (finding New York City could not pursue nuisance and trespass claims against oil and gas companies for injuries arising from greenhouse gases).
[39] Notice of Appeal, *City of Oakland v. BP*, No. 18-16663 (N.D. Cal. Aug. 24, 2018).

Oakland switched their outside counsel from Hagens Berman to Sher Edling. The appeal was briefed and argued in February 2020, and the parties are awaiting a decision.

Hagens Berman also represents the City of New York, which filed its complaint on January 9, 2018 in federal court against the five largest fossil fuel companies globally, alleging that their activities were responsible for more frequent and more intense heat waves, extreme precipitation, and sea level rise and bringing federal common law claims for private nuisance, public nuisance, and trespass.[40] The district court dismissed the case on July 19, 2018, holding that federal common law governed the City's claims because the claims were "ultimately based on the 'transboundary' emission of greenhouse gas emissions" and thus they require a uniform standard of decision. *City of New York v. BP, p.l.c. et al.,* 325 F.Supp.3d 466, 472 (2018). The court also concluded that the Clean Air Act displaced any federal common law claims, noting that Congress had "expressly delegated to the EPA the determination as to what constitutes a reasonable amount of greenhouse gas emission under the Clean Air Act." 325 F.Supp.3d at 473. The court rejected the City's argument that state common law claims should become available if their federal common law claims were displaced by the Clean Air Act, saying such a result would be "illogical … when courts have found that these matters are areas of federal concern that have been delegated to the Executive Branch as they require a uniform,

[40] Complaint, *City of New York v. BP, p.l.c. et al.,* Case 1:18-cv-00182-JFK (S.D.N.Y., 1/09/18) [hereinafter New York Compl.]

national solution," and "[g]lobal warming and solutions thereto must be addressed by the two other branches of government." 325 F.Supp.3d at 474-475. Similarly, the court held that the lawsuit implicated foreign policy, since greenhouse gas emissions were global: "To litigate such an action for injuries from foreign greenhouse gas emissions in federal court would severely infringe upon the foreign-policy decisions that are squarely within the purview of the political branches of the U.S. Government." 325 F.Supp.3d at 476. Plaintiff appealed to the 2nd Circuit to reverse the dismissal; the appeal was argued on November 22, 2019, but no ruling has yet been issued.

King County, Washington, also hired Hagens Berman and filed its complaint on May 9, 2018 in Washington state court, against the world's five largest investor-owned fossil fuel companies. The County asserted that the companies' "production and promotion of massive quantities of fossil fuels, and their promotion of those fossil fuels' pervasive use" created a public nuisance of "global warming-induced sea level rise and other climate change hazards."[41] The County contended that the companies were individually and collectively "substantial contributors" to global warming who promoted the use of fossil fuels despite knowing "for many years that global warming threatened severe and ever catastrophic harms to coastal areas like King County."[42] The County also contended that the companies knew that their actions would cause invasions of King County property due to sea level rise and

[41] Complaint, *King County v. BP p.l.c. et al.,* Docket No. 18-2-11859-0 (Washington Superior Court, May 9, 2018) [King Cty. Compl.] at p. 68.
[42] King Cty. Compl. at p. 69.

storm surge. The County alleged that it was already experiencing climate change impacts, including "warming temperatures, acidifying marine waters, rising seas, increasing flooding risk, decreasing mountain snowpack, and less water in the summer," that rising sea levels posed an imminent threat of storm surge flooding that could inundate portions of the county, and that the County would be required to spend hundreds of millions of dollars to build infrastructure to protect King County and its residents.[43] The County sought an order of abatement requiring the companies to fund a climate change adaptation program for the County as well as compensatory damages for the costs the County had already incurred. The case was removed to federal court, and stayed pending the resolution of the Ninth Circuit appeal of the San Francisco/Oakland lawsuit dismissals.

Cases handled by other firms

Three local Colorado governments – Boulder County, San Miguel County, and the City of Boulder – hired Colorado-based The Hannon Law Firm, headed by Kevin Hannon, a litigator with experience in contaminated groundwater, toxic torts, and product liability suits, to represent them. Joining Hannon *pro bono* (i.e., without charging a fee for representation) are EarthRights International, a nonprofit organization with a focus on international human rights cases involving fossil fuel

[43]King Cty. Compl. at 55-67.

companies[44], and the Niskanen Center, a libertarian-leaning think tank with a focus on climate change among other topics.[45]

Although climate change is currently seen as an issue of concern primarily for organizations on the left end of the political spectrum, the libertarian-leaning Niskanen Center has framed this and other environmental issues as a property rights concern (Dolan, 2020). David Bookbinder, a litigator with Niskanen, has emphasized the fossil fuel companies' extensive knowledge and understanding of the consequences of fossil fuel use along with their investment in misinformation campaigns to conceal that understanding from the public: "'They knew this was going to happen, and our taxpayers did not…. So why should we have to bear the burden of it?'" (Schwartz, 2018).

The Colorado actions were filed on April 18, 2020 in Colorado state court, alleging that defendants' actions had changed the climate of Colorado and causing harm.[46] The three local governments alleged they had incurred expenses responding to climate change-related harms that resulted from intensifying heat waves, wildfires, droughts, and floods. They asserted that the defendants "knowingly and substantially contributed to the climate crisis by producing, promoting and selling a substantial portion of the fossil fuels that are causing and exacerbating climate change, while

---

[44] See https://earthrights.org/wp-content/uploads/041020_ERI_StrategicPlan_RGB_pages_sm.pdf (last accessed June 1, 2020).
[45] See https://www.climateunplugged.com/ (last accessed June 1, 2020).
[46] Complaint, *Board of County Commissioners of Boulder County, et al. v. Suncor Energy, et al.*, Case No. 2018CV030349 (District Court of Colorado, Boulder County, April 17, 2018) [Boulder Compl.] at 24-90.

concealing and misrepresenting the dangers associated with their intended use."[47] The plaintiffs asserted causes of action for public nuisance, private nuisance, trespass, and unjust enrichment, as well as a claim of deceptive trade practices under the Colorado Consumer Protection Act. The case was removed to federal court, remanded to state court, and the remand was appealed by defendants to the Tenth Circuit; oral argument was held telephonically on May 6, 2020. Like the Fourth and Ninth Circuits, the Tenth Circuit upheld the remand order, deeming the cases suitable for state court jurisdiction.

Without hiring outside counsel, the state of Minnesota filed a lawsuit in state court against the American Petroleum Institute, Exxon Mobil Corporation (Exxon), Koch Industries, Inc. (Koch), and Exxon and Koch subsidiaries, alleging that the defendants caused a "climate-change crisis" in the state through a "campaign of deception."[48] The State sought "to hold Defendants accountable for deliberately undermining the science of climate change, purposefully downplaying the role that the purchase and consumption of their products played in causing climate change and the potentially catastrophic consequences of climate change, and for failing to fully inform the consumers and the public of their understanding that without swift action, it would be too late to ward off the devastation."[49] In addition to strict liability and negligent liability for failure to warn, and common law fraud and misrepresentation,

---

[47] Boulder Compl. at 1.
[48] Complaint, *State of Minnesota v. American Petroleum Institute, et al.*, Case No. 62-CV-20-3837 (Minnesota Dist. Ct., 2d Judicial Dist., June 24, 2020) [Minnesota Compl.] at p. 2.
[49] Minnesota Compl. at p. 3.

the complaint asserted claims under the Minnesota Consumer Fraud Act, deceptive trade practices under Minnesota Statutes § 325D.44; and Minnesota's False Statements in Advertising Act. As a remedy, Minnesota asked the court to order defendants to publish all of their research related to climate change and to "fund a corrective public education campaign in Minnesota relating to the issue of climate change," as well as compensatory damages and disgorgement of profits.[50] The case was removed to federal court on July 27, 2020, and has not yet been remanded.

Case strategy

The above cases follow a tried-and-true playbook for litigating large-scale public nuisances that threaten public health and the environment but are not readily susceptible to regulation, based on the tobacco lawsuits of the 1980s and 90s (Olszynski, Mascher, & Doelle, 2018). Faced with an industry that had sown doubt about the deleterious impacts of its products – but luckily obtaining a trove of documents demonstrating the cigarette industry's complete awareness of those deleterious impacts – attorneys succeeded in persuading the courts that the industry had defrauded both the public and the regulators. The climate change cases share similar features: a misinformation campaign by the product manufacturers, intended to suppress public awareness of the consequences of using their product; widespread impacts to health and safety; and insufficient regulation of the problem.

[50] Minnesota Complaint at p. 82-84.

In order to succeed, the plaintiffs must make several choices correctly. First, they must be the right plaintiffs – in other words, they must have standing to sue. They must sue in the right place – state court rather than federal court. They must choose the right defendants, who must be subject to the jurisdiction of the state courts, not bankrupt, and not owned by foreign governments. They must choose the right causes of action; they cannot be federal claims in disguise. And, if possible, they should try to choose the right facts, which will persuade a court (and a jury, eventually) that the plaintiffs' injuries were caused by defendants' actions and defendants should therefore compensate plaintiffs for the harm.

Plaintiffs and standing

The bulk of the tobacco litigation was brought by governments suing to protect the interests and welfare of their citizens using *parens patriae* power – the power of governments to sue on behalf of their citizens and recover damages on their behalf (Thomas, 2016). Since the tobacco litigation era, many jurisdictions have codified *parens patriae*, expressly conferring on prosecutors the power to bring such cases on behalf of constituents (Savit, 2019). Because *parens patriae* actions are not class actions, which have faced an increasing degree of judicial skepticism in recent years, they remain a potentially powerful tool for litigating environmental problems affecting large numbers of people.

Courts may only hear cases or controversies where: (i) the plaintiff has suffered an injury in fact (ii) that is fairly traceable to the defendant's misconduct and

(iii) can be redressed by the court.[51] If all three of these conditions are met, a plaintiff has "standing" to sue. The plaintiffs in these cases are cities, counties, states, and one trade association. Cities, counties, and states ("government plaintiffs") often own and manage things like "property and structures that are currently impacted and threatened by global warming."[52] Counties and cities are responsible for zoning and planning for future land uses, urban development and economic health;[53] they provide "health and human services, emergency services, wildfire mitigation, and other necessary governmental functions"[54] and are "responsible for the public health, safety, and welfare" of their residents.[55] Many cities are also water utilities, maintaining water acquisition, treatment and distribution infrastructure.[56] The trade association plaintiff represents fishermen who have suffered economic losses due to climate-change-associated impacts to the West Coast crab fishery.[57]

Rhode Island is the only State plaintiff in this set of cases. States hold a special power in the court room: they have standing to sue as *parens patriae* to remedy injuries affecting the well-being of their people. See *Alfred L. Snapp & Son, Inc. v. Puerto Rico ex rel. Barez*, 458 U.S. 592, 602 (1982). In *Massachusetts v EPA*, the court found that the governmental plaintiffs, because they were states, were

[51] U.S. Constitution, Article III.
[52] King County Complaint at 4; see also Boulder Complaint at 8, Imperial Beach Complaint at 5
[53] Boulder Complaint at 6-10.
[54] Boulder Complaint at 6-10 .
[55] New York Complaint at 7-8.
[56] Boulder Complaint at 10-11.
[57] PCFFA Complaint at 9.

entitled to “special solicitude” - special consideration afforded by the US Supreme Court to the states, given their special, quasi-sovereign interests in protecting their lands, the air and the citizens’ health, a shortcut to standing – and found that EPA’s failure to regulate greenhouse gas emissions presented an actual, imminent risk of harm to the state (Ganguly, Setzer, & Heyvaert, 2018). In recent decades, in the wake of the tobacco litigation, and as the courts become less friendly to mass torts, states have come to rely on this power more frequently. As Professor Thomas (2016) writes,

> *parens patriae* went through a remarkable transformation in the multi-state tobacco litigation in the 1990s, in which many states brought novel tort claims to sue cigarette manufacturers for harm to the common good, through aggregated harm to their citizen smokers resulting in increased health costs for the states themselves. In this model, the physical harm that was sustained by the smokers then transmitted to the state through financial costs. Causation requirements often make recovery for individual victims of products like cigarettes impossible - indeed, individual plaintiffs lost virtually every personal injury case brought against tobacco companies prior to the states' *parens patriae* litigation. The states were fairly successful suing to recover financial costs incurred from smokers' addiction though. Professors Ieyoub and Eisenberg have argued that the states' involvement in tobacco litigation turned the tide against the defendants, resulting in the first plaintiff-verdicts in California, Oregon, and Florida. (Thomas, 2016, pp. 787-788)

Cities and counties, though political subdivisions of the state, have not been granted the same power by the federal courts. State courts have occasionally allowed cities to sue on behalf of their residents, but this is rare (see, e.g., City of New York v. Wyman, 321 N.Y.S.2d 695 (Sup. Ct. 1971), rev’d on other grounds, 281 N.E.2d 180 (N.Y. 1972). For an examination of cities and problems with putative *parens patriae* standing, see generally Savit, 2019). Sarah Swan points out the unique vantage point of cities when it comes to public harms: “Because they are the level of government closest to the people and ‘interact with their residents each day,’ cities and municipal

governments have 'an excellent vantage point for recognizing patterns of harm affecting their communities,'" and are motivated to take action on behalf of their residents in response to harms like public nuisance (Swan, 2018, p. 1251). Swan goes on to describe grounds less controversial than *parens patriae* under which cities may sue, including direct property ownership, "generally the least controversial basis for city litigation;" associational or quasi-corporate standing, allowing cities to assert their residents' rights and sue on their behalf; and the special standing of municipalities to bring public nuisance claims (Swan, 2018).

The Pacific Coast Federation of Fishermen's Associations, the only non-governmental plaintiff in this group, filed suit "in its own name; as a representative of its members that are and will continue to be injured financially and otherwise by Defendants' conduct and consequent domoic acid incidents and domoic acid-induced crab fishery closures; and as assignee of claims assigned to it by individuals and businesses that derive income from the California and Oregon Dungeness crab fisheries that have suffered and will continue to suffer financial and other injuries because of Defendants' conduct and consequent domoic acid blooms and domoic acid-induced crab fishery closures."[58] In other words, PCFFA asserts direct harm to its members' property interests and asserts that it has associational standing to bring its members' claims before the court.

[58] PCFFA Complaint at 6.

Defendants and jurisdiction

Tort law holds responsible those parties who are shown to have caused the harm; that is, but for their actions, the harm would not have occurred. In the case of climate change, the chain of causation includes many contributors, from fossil fuel producers, to refiners who turn raw materials into useful intermediates, to power plants who burn fuel to make energy, to automobile manufacturers who produce machines that generate greenhouse gases when used, to consumers who use electricity and drive cars in the course of their everyday lives. Liability may be found when a defendant's conduct is at least a "substantial factor" in causing the harm. Restatement (Second) of Torts § 431 (American Law Institute, 1965).

Earlier nuisance litigation was directed at automobile manufacturers (*California v. General Motors*) and power plants (*Connecticut v. AEP*). Power plants have sometimes been named as defendants because, as Shi-Ling Hsu (2008) points out, "the idea of a polluter billowing out some emittant comports with traditional notions of nuisance law, harkening to the landmark air pollution cases of *Boomer v. Atlantic Cement Co., Georgia v. Tennessee Copper Co., Madison v. Ducktown Sulphur, Copper & Iron*. While the emittants, the science, and the parties have changed, it must be reassuring for a judge to have a mental analog in mind when attempting to understand a complex problem like greenhouse gas emissions." (Hsu, 2008, p. 125). Moreover, the U.S. electricity generation industry is one of the biggest greenhouse gas emitters in the world, accounting for over 30% of U.S. carbon dioxide emissions (Hsu, 2008).

As the *Kivalina* plaintiffs realized, however, evidence implicating fossil fuel manufacturers in efforts to suppress public awareness of the dangers of greenhouse gas emissions[59] made for an even stronger case against those defendants, much as analogous allegations of mendacity had strengthened the tobacco litigation against manufacturers years earlier (Olszynski et al., 2018). Furthermore, a traditional, "pure" nuisance case, like the ones cited by Hsu above, posed a risk of dragging plaintiffs into a balancing-of-the-equities contest that would almost certainly place substantial weight on the social utility of electricity production, as in *Boomer*, without the counterbalancing weight of defendant malfeasance. Restatement (Second) of Torts §§ 821B, 826 (American Law Institute, 1979). A nuisance case based on the continuing manufacture of a problematic product with knowledge of its potential to cause harm, however, could be enough to support a finding that such conduct was unreasonable.

The choice of defendant matters not only to the cause of action but to the choice of court. Courts must have *jurisdiction* over the parties in order to hear matters. "The inquiry whether a forum State may assert specific jurisdiction over a nonresident defendant focuses on the relationship among the defendant, the forum, and the litigation." *Walden v. Fiore,* 571 U.S. 277, 283–84 (2014). "The proper question is not where the plaintiff experienced a particular injury or effect but whether the defendant's conduct connects him to the forum in a meaningful way." *Id*.

[59] Complaint for Damages and Demand for Jury Trial ¶¶ 5, 189-190, Kivalina v. ExxonMobil, No. CV 08-1138-SBA (N.D. Calif.), available at https://insideclimatenews.org/sites/default/files/Kivalina%20Complaint-1.pdf (last accessed November 14, 2018)

at 290. If the defendant is not a "resident" of the State, three requirements must be met: (1) the defendant must either purposefully direct his activities toward the forum or purposefully avail himself of the privileges of conducting activities in the forum; (2) the claim must be one which "arises out of or relates to" the defendant's forum-related activities; and (3) the exercise of jurisdiction must comport with fair play and substantial justice, i.e., it must be reasonable. *Axiom Foods, Inc. v. Acerchem Int'l, Inc*., 874 F.3d 1064, 1068 (9th Cir. 2017). In the case of corporations, courts of states other than the company's home state (the state in which the company is incorporated or has its principal place of business) may still exercise specific personal jurisdiction over corporations that have continuous, systematic, and purposeful transactions or activities within the state, if the injury arises out of or is related to those transactions or activities. *Bristol-Myers Squibb Co. v. Superior Court*, 137 S. Ct. 1773, 1779–80 (2017).

The San Francisco and Oakland suits initially filed by Hagens Berman, followed by the King County suit, named only the five largest investor-owned oil companies: BP, Chevron, ConocoPhillips, ExxonMobil, and Royal Dutch Shell. All five either do business and engage in activities contributing to climate change in all of the states where cases were filed, or have their principal places of business in the forum state; for example, Chevron's principal place of business is currently San Ramon, California.[60] All of these cases were filed in state court save the City of New York's, which was filed in federal court under diversity jurisdiction – that is, the

[60] See Oakland Complaint and New York Complaint at __.

plaintiff is a citizen of New York and none of the defendants are, so the federal court has jurisdiction to hear the case (28 U.S.C. § 1332). The Boulder County plaintiffs elected to sue only ExxonMobil, which owns a subsidiary (XTO Energy Inc.) that is engaged in fossil fuel development in Colorado, and Suncor Energy and its subsidiaries, a company that predominantly mines tar sands and operates the only refinery in Colorado.[61]

The Imperial Beach, Marin, and San Mateo suits[62] named all of these and the U.S. subsidiaries of foreign companies BP and Royal Dutch Shell, as well as the U.S. subsidiaries of other foreign companies including Total and Citgo; other U.S. oil companies; oil company subsidiary refinery companies; coal and natural gas companies; and mining companies with fossil fuel subsidiaries – a group collectively responsible for about 20% of total emissions (Heede, 2014). When the Santa Cruz city and county cases were filed, followed shortly thereafter by the City of Richmond and PCFFA, several defendants had been dropped. Peabody Energy and Arch Coal had previously filed for bankruptcy, which meant that the Bankruptcy Court – a

[61] See Boulder Complaint at 11-18.

[62] Defendants in Imperial Beach included: Chevron Corporation and Chevron USA Inc.; ExxonMobil Corporation; BP PLC and BP America, Inc.; Royal Dutch Shell and Shell Oil Products Company LLC; Citgo Petroleum Corporation; ConocoPhillips, ConocoPhillips Company and Phillips 66; Peabody Energy Corporation; Total E&P USA and Total Specialties USA, Arch Coal Inc.; Eni S.p.A., Eni Oil & Gas Inc., and other Eni holding companies; Rio Tinto PLC, Rio Tinto Limited, Rio Tinto Energy America, Rio Tinto Minerals, and Rio Tinto Services; Statoil ASA; Anadarko Petroleum Corporation; Occidental Petroleum Corporation and Occidental Chemical Corporation; Repsol S.A., Repsol Energy North America, and Repsol Trading USA; Marathon Oil Company, Marathon Oil Corporation, and Marathon Petroleum Corp.; Hess Corporation; Devon Energy Corp. and Devon Energy Production Company; Encana Corporation; and Apache Corporation (Imperial Beach Complaint at 1-2).

federal court – had jurisdiction over matters involving them. On October 24, 2017, the Bankruptcy Court for the Eastern District of Missouri granted Peabody's request for an injunction barring the plaintiffs from pursuing their claims.[63] Statoil is majority-owned by the Norwegian government, and thus likely entitled to sovereign immunity defenses and a hearing in federal court; the initial three plaintiffs voluntarily dismissed their suit against Statoil (Bookbinder, 2017; Hester, 2018). In addition to these, the Rhode Island complaint dropped Total, Eni, Repsol, Devon, Encana, and Apache, and added Motiva Enterprises (a Shell subsidiary), Speedway (a Marathon subsidiary), Lukoil Pan Americas (a company with gas stations in Rhode Island), and Getty Petroleum Marketing (a Lukoil subsidiary). The Baltimore case added a number of Crown Central entities (incorporated and headquartered in Maryland), Louisiana Land & Exploration Co. (a ConocoPhillips subsidiary), and Consol entities (a group with a coal export terminal in Baltimore). The most recent case to be filed, by the City and County of Honolulu, covered a slightly different set of defendants with contacts in Hawai'i: Sunoco, Exxon, Shell, Chevron, BHP, BP, Marathon, and ConocoPhillips, and their subsidiaries.

Both of these approaches carry risk. Suing fewer defendants than the facts of a case might conceivably render liable reduces the number of potential settlors or contributors to an eventual judgment, and opens the door to complicating third-party litigation as named defendants sue those not named for contribution – which, in a

[63] http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2017/20171024_docket-16-42529-399_memorandum-opinion.pdf

case like this with a complex chain of causation, could include parties like the power plants and automobile companies sued in the earlier cases. But a large number of defendants, each with their own particular set of defenses and competitive interests, can make cases unwieldy as well.

Causes of action

The San Francisco and Oakland lawsuits filed by Hagens Berman stated a single cause of action: public nuisance.[64] As the plaintiffs described it, "[t]his case does not seek to hold Defendants liable for their own emissions of greenhouse gases or to restrain Defendants from engaging in their businesses. This case seeks only to hold Defendants liable for the cost of abating a public nuisance caused by their massive and ongoing fossil fuel production and promotion activities."[65]

The King County complaint added trespass, while the New York complaint added both private nuisance and trespass.[66] The Hannon Law Firm filed a suit on behalf of Boulder County with five causes of action: public nuisance, private nuisance, trespass, unjust enrichment, and a violation of a Colorado state civil statute, the Colorado Consumer Protection Act.[67]

---

[64] Oakland Complaint at 32; San Francisco Complaint at 37.
[65] Case 3:17-cv-06011-WHA, Document 121, Joint Case Management Statement (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2018/20180201_docket-317-cv-06011_statement-1.pdf).
[66] New York Complaint at 58-62; King County Complaint at 68-73.
[67] Boulder Complaint at 91-103.

Of the Sher Edling cases, the San Mateo and Santa Cruz groups of complaints included claims for public nuisance, private nuisance, and trespass, plus strict liability for failure to warn and design defect, negligence, and negligent failure to warn. The Rhode Island complaint stated public nuisance and trespass claims, negligent failure to warn and design defect, and strict liability failure to warn and design defect, as well as a violation of the state Environmental Rights Act. The Baltimore complaint included claims for public and private nuisance, trespass, negligent failure to warn and design defect, strict liability failure to warn and design defect, and the Maryland Consumer Protection Act. The Pacific Coast Federation of Fishermen's Associations, which has no governmental authority or real property to be trespassed upon, limited its claims to private nuisance, strict liability for failure to warn and design defect, negligence, and negligent failure to warn. Finally, the City and County of Honolulu included claims for public and private nuisance, trespass, negligent failure to warn, and strict liability failure to warn.

In sum, all of the municipal and state governments with public interest concerns, except the District of Columbia, included public nuisance causes of action. Most included trespass as well; the two governments that did not, San Francisco and Oakland, did not allege a physical invasion – yet. Unlike the City of New York, for example, which suffered flooding during Hurricane Sandy, those two cities have not yet experienced marquee events connected to climate change. Other California coastal plaintiffs, like San Mateo County, included the effects of sea level rise on

their civil infrastructure in their complaints, and alleged that rising sea levels constitute a physical invasion giving rise to their trespass claim.

A public nuisance is generally defined as an unreasonable interference with a right common to the general public. Restatement (Second) of Torts, § 821B (American Law Institute, 1979). The plaintiffs stating a public nuisance cause of action (i.e., all but PCFFA) have included roughly similar allegations to support this claim, like these from the City of San Francisco's Complaint:

> 96. Defendants' production and promotion of massive quantities of fossil fuels, and their promotion of those fossil fuels' pervasive use, has caused, created, assisted in the creation of, contributed to, and/or maintained and continues to cause, create, assist in the creation of, contribute and/or maintain to global warming-induced sea level rise, a public nuisance in San Francisco. Defendants, both individually and collectively, are substantial contributors to the global warming- induced sea level rise and the People's attendant injuries and threatened injuries. The People's injuries and threatened injuries from each Defendant's contributions to global warming are indivisible injuries. Each Defendant's past and ongoing conduct is a direct and proximate cause of the People' injuries and threatened injuries. Defendants each should have known that this dangerous global warming with its attendant harms on coastal cities like San Francisco would occur before it even did occur, and each Defendant in fact did have such knowledge. Each Defendant has at all relevant times been aware, and continues to be aware, that the inevitable emissions of greenhouse gases from the fossil fuels it produces combines with the greenhouse gas emissions from fossil fuels produced by the other Defendants, among others, to result in dangerous levels of global warming with grave harms for coastal cities like San Francisco. Defendants were aware of this dangerous global warming, and of its attendant harms on coastal cities like San Francisco, even before those harms began to occur. Defendants' conduct constitutes a substantial and unreasonable interference with and obstruction of public rights and property, including, *inter alia,* the public rights to health, safety and welfare of San Francisco residents and other citizens whose safety and lives are at risk from increased storm surge flooding and whose public and private property, is threatened with widespread damage from global warming-induced sea level rise, greater storm surges, and flooding.

CASE/ CAUSE OF ACTION	Public Nuisance	Private Nuisance	Trespass	Negligence	Negligent Failure to warn	Negligent Design defect	Strict liability-Failure to warn	Strict liability-Design defect	Public Trust	Unjust enrichment	State statutes
San Mateo, Imperial Beach, Marin	X	X	X	X	X		X	X			
San Francisco, Oakland	X										
Santa Cruz City/County, Richmond	X	X	X	X	X		X	X			
New York	X	X	X								
Boulder Cnty.	X	X	X							X	X
King Cnty.	X		X								
Rhode Island	X		X		X	X	X	X	X		X
Baltimore	X	X	X		X	X	X	X			X
PCFFA		X		X	X		X	X			
Honolulu	X	X	X		X		X				
Delaware	X		X		X						X

Table 2: Causes of action by climate change tort case or case group

> 97. Defendants, individually and collectively, are substantial contributors to global warming and to the injuries and threatened injuries suffered by the People. Defendants have caused or contributed to accelerated sea level rise from global warming, which has and will continue to injure public property and land located in the City of San Francisco, through increased inundation, storm surges, and flooding, and which threatens the safety and lives of San Francisco residents. Defendants have inflicted and continue to inflict injuries upon the People that require the People to incur extensive costs to protect public and private property, against increased sea level rise, inundation, storm surges, and flooding. (San Francisco Compl. at 96-97).

Only governmental plaintiffs have standing to bring public nuisance claims on behalf of their constituents; thus, public nuisance was not a cause of action that was available to PCFFA.

All of the cases filed by Sher Edling included failure to warn and design defect claims, in strict liability and some in negligence as well. These are product liability claims traditionally brought against manufacturers of products that turn out to cause harm; the manufacturer of a "defective" product is liable for injuries to people or property caused by that product. Restatement (Second) of Torts § 402 (American Law Institute, 1965). There are three kinds of defects: failure to warn of a product's danger, defects in the design of a product, and defects in manufacturing. *Caterpillar Tractor Co. v. Beck,* 593 P.2d 871, 878 n. 15 (Alaska 1979). (Manufacturing defects are not an issue in these cases.) Some jurisdictions support claims in strict liability for these defects, meaning that the manufacturer need not have been negligent to be liable; instead, liability attaches upon a showing of the defect and the harm. Restatement (Second) of Torts § 402A (1965). Professors Cupp & Polage (2002) have argued that the distinction between strict liability and negligence in product defect cases is swiftly becoming one without a difference, and that judges are likely

to use risk/utility balancing tests to determine the reasonableness of a manufacturer or product design no matter how a cause of action is styled.

To prevail on a design defect claim, a plaintiff must generally show that the design of the product was not "reasonably safe" and that the "foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design." Restatement (Third) of Products Liability § 2(b) (1998). The complaints alleging defective design of fossil fuels leverage the "reasonably safe" idea, stating that such products "have not performed as safely as an ordinary consumer would expect them to" given the climate change risks associated with their use.[68] They also allege that the risks and costs of using fossil fuels outweigh their benefits to society.[69]

Failure-to-warn claims focus on the manufacturer's conduct, specifically its duty to warn consumers (and sometimes third parties who might foreseeably be harmed) of unreasonably dangerous products and failure to adequately do so. *In re Methyl Tertiary Butyl Ether (MBTE) Prod. Liab. Litig.,* 175 F. Supp. 2d 593, 625 (S.D.N.Y. 2001). Here, plaintiffs argue that fossil fuel manufacturers "knew or should have known, in light of the scientific knowledge generally accepted at the time, that fossil fuel products, whether used as intended or misused in a foreseeable manner, release greenhouse gases into the atmosphere that inevitably cause *inter alia* global warming, increased mean sea surface temperature, marine heatwaves, and harmful

[68] See, e.g., PCFFA Complaint at 83.
[69] Id. at 84-85.

algal blooms with a capacity for producing marine toxins," and that ordinary consumers would *not* have known these things.[70] Plaintiffs also allege that the defendants actively worked to *prevent* the public from understanding the risks associated with fossil fuel use, instead of warning about them.[71]

In sketching the likely features of a climate change suit relying on common law, Professor Hsu (2008) dismissed the prospect of a trespass claim out of hand, saying:

> A trespass cause of action would require some physical invasion of a property interest. While a few isolated cases find a trespass from the invasion of sufficiently severe air pollutants or gases, the general proposition is that such marginally physical offenses are better covered under the law of nuisance. Greenhouse gases, especially carbon dioxide, would certainly not be considered sufficiently physical invasions to warrant a trespass action. It might be argued that the consequent rise in sea levels that would flood coastal property could be considered a trespassory invasion, but even then intent and causation problems would likely bar a trespass action. (Hsu, 2008, pp. 130-131)

And in fact, the trespassory invasion claimed in all of the complaints is not a literal or straightforward invasion of greenhouse gases themselves, but of weather events and excess precipitation, fires, floodwaters and saltwater/storm surges – even invasive species – all exacerbated by climate change. [72]

Rhode Island's public trust claim is unique because it is one of a handful of states that has enshrined the protection of public resources in its state constitution (English & Carroll, 2015). As a coastal state known for unspoiled beaches and

---

[70] See, e.g., PCFFA Complaint at 81.
[71] PCFFA Complaint at 81.
[72] Baltimore Complaint at 126; Imperial Beach Complaint at 94; Richmond Complaint at 110; Honolulu Complaint at 111; Santa Cruz City Complaint at 117

saltwater fishing, Rhode Island included in its constitution a guarantee that its citizens "shall continue to enjoy and freely exercise all the rights of fishery and the privileges of the shore to which they have been heretofore entitled under the charter and usages of the State … and they shall be secure in their rights to the use and enjoyment of the natural resources of the state with due regard for the preservation of their values." R.I. Const., Art. I, § 17. Moreover, that constitution gives the state power to "regulate and control the use of land and waters in the furtherance of the preservation, regeneration, and restoration of the natural environment, and in furtherance of the protection of the rights of the people to enjoy and freely exercise the rights of fishery and the privileges of the shore." R.I. Const., Art. I, § 16. In keeping with this protective stance, Rhode Island has passed a state Environmental Rights Act that entitles each person "to the protection, preservation, and enhancement of air, water, land, and other natural resources located within the state … it is in the public interest to provide an adequate civil remedy to protect air, water, land and other natural resources located within the state from pollution, impairment, or destruction." R.I. Gen. Laws § 10-20-1.

The San Francisco and Oakland cases included a single cause of action, public nuisance. Although the definition varies slightly by state, liability is only imposed for public nuisance in cases where "defendant was in control of the instrumentality alleged to have created the nuisance when the damage occurred." *State v. Lead Indus. Assoc.,* 951 A.2d 428, 450 (R.I. 2008).

Complaints with multiple technical causes of action on several different grounds (the "kitchen sink" approach) increase the complexity of cases, but in some ways increase their resilience as well, in that the loss or dismissal of a single cause of action does not necessarily kill the lawsuit. Illustrating this point, in the San Francisco/Oakland cases, defendants successfully argued that the public nuisance claim was not actually a state law claim but a federal one.[73] In ruling on defendants' removal to federal court, the district court found that:

> Plaintiffs' claims for public nuisance, though pled as state-law claims, depend on a global complex of geophysical cause and effect involving all nations of the planet (and the oceans and atmosphere). It necessarily involves the relationships between the United States and all other nations. It demands to be governed by as universal a rule of apportioning responsibility as is available. .. [P]laintiffs' claims, if any, are governed by federal common law.[74]

Even though this ruling merely kept the cases in federal court and did not yet dismiss them entirely, it highlights the risk of pinning a case on a single cause of action. And as Lin and Burger (2018) point out, "[a]t the core of the argument against the existence of state public nuisance claims is the notion that common law has no proper role to play when it comes to climate change - whether it be in addressing the sources of GHG emissions or the adverse impacts that result from them - because all of it is wrapped up in federal policies pertaining to energy, economy, security, and appropriate levels of air pollution control, a complex web of national and foreign affairs concerns governed by congressional statutes and executive branch authority" (Lin & Burger, 2018). To prevail against this line of reasoning, plaintiffs' lawyers

[73] 2018 WL 1064293, at 2.
[74] Id. at 5.

will need to simplify this complex web to the elements of each tort: duty, breach, and causation.

Procedural history and case events

What follows is an annotated timeline of important milestones in this set of climate change tort cases:[75]

July 2017

On July 17, the City of Imperial Beach, the County of Marin, and the County of San Mateo filed similar lawsuits in Contra Costa County Superior Court, Marin County Superior Court, and San Mateo County Superior Court, respectively. Imperial Beach, which is not in Contra Costa County, filed in that court because one of the defendants, Chevron, is headquartered there.

September 2017

On September 12, the Imperial Beach, Marin, and San Mateo cases were related to each other (i.e., combined for purposes of filings on issues common to all of the cases) and assigned to the Honorable Vince Chhabria.

On September 19, the City of Oakland and the City of San Francisco filed similar lawsuits in Alameda County Superior Court and San Francisco County Superior Court, respectively.

[75] Supporting documents are available at http://climatecasechart.com/case-category/common-law-claims/, last accessed December 12, 2020.

October 2017

On October 20, defendants removed the San Francisco and Oakland cases to federal court, the Northern District of California, where they were assigned to the Honorable William Alsup. On October 26, plaintiffs moved to relate the two cases to each other, and the motion was granted on October 31.[76]

November 2017

On November 20, the San Francisco and Oakland plaintiffs moved to remand the two cases back to state court.[77]

December 2017

On December 14, Chevron Corporation filed a third-party complaint against Statoil Corporation (majority-owned by the Norwegian government) in the San Francisco/Oakland suits, claiming entitlement to indemnity from Statoil for contribution to any judgment Chevron might eventually pay.[78]

On December 20, the City and County of Santa Cruz filed similar lawsuits in Santa Cruz County Superior Court.

---

[76] Case 3:17-cv-04929-VC, Document 170, Administrative Motion to Relate Cases at 2 (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2017/20171102_docket-317-cv-06011_motion.pdf)

[77] Case 3:17-cv-06012-WHA, Document 64, Notice of Motion and Motion to Remand (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2017/20171120_docket-317-cv-06011_motion.pdf)

[78]Case 3:17-cv-06011-WHA, Document 84, Third-Party Complaint (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2017/20171214_docket-317-cv-06011_complaint.pdf)

January 2018

On January 9, the City of New York filed a complaint in federal court, the Southern District of New York.

On January 22, the City of Richmond filed its lawsuit in Contra Costa County Superior Court.

February 2018

On February 23, some of the defendants in *City of New York v. BP* filed motions to dismiss. ExxonMobil moved to dismiss on the ground that the court lacked jurisdiction,[79] and Chevron, ConocoPhillips, and ExxonMobil moved to dismiss on several independent grounds: (1) the City's common law claims are actually federal common law claims, not state, and have therefore been displaced by federal statutory law; (2) the claims are barred by federal legal doctrines including the federal foreign affairs power; the commerce, due process, and takings clauses; and preemption doctrine; (3) the state law claims were not adequately pled; and (4) the controversy is not justiciable because it presents a political question and plaintiffs lack standing.[80]

On February 27, Judge Alsup denied San Francisco and Oakland's motion to remand to state court and asked for a "tutorial" on climate change, giving each side an

---

[79] No. 18 Civ. 182 (JFK), Memorandum of Law ISO Exxon Mobil Corporation's Motion to Dismiss for Lack of Personal Jurisdiction, 6-12 (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2018/20180223_docket-118-cv-00182_motion-to-dismiss.pdf)

[80] Case No. 18 Civ. 182 (JFK), Memorandum of Law Addressing Common Grounds ISO Motions to Dismiss (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2018/20180223_docket-118-cv-00182_motion-to-dismiss-1.pdf)

hour to "trace the history of scientific study of climate change" and an hour to "set forth the best science now available on global warming, glacier melt, sea rise, and coastal flooding."[81]

March 2018

On March 6, Judge Alsup asked the San Francisco and Oakland parties to answer the following questions in the climate change tutorial scheduled for March 21:

> 1. What caused the various ice ages (including the "little ice age" and prolonged cool periods) and what caused the ice to melt? When they melted, by how much did sea level rise?
>
> 2. What is the molecular difference by which CO2 absorbs infrared radiation but oxygen and nitrogen do not?
>
> 3. What is the mechanism by which infrared radiation trapped by CO2 in the atmosphere is turned into heat and finds its way back to sea level?
>
> 4. Does CO2 in the atmosphere reflect any sunlight back into space such that the reflected sunlight never penetrates the atmosphere in the first place?
>
> 5. Apart from CO2, what happens to the collective heat from tailpipe exhausts, engine radiators, and all other heat from combustion of fossil fuels? How, if at all, does this collective heat contribute to warming of the atmosphere?
>
> 6. In grade school, many of us were taught that humans exhale CO2 but plants absorb CO2 and return oxygen to the air (keeping the carbon for fiber). Is this still valid? If so, why hasn't plant life turned the higher levels of CO2 back into oxygen? Given the increase in human population on Earth (four billion), is human respiration a contributing factor to the buildup of CO2?
>
> 7. What are the main sources of CO2 that account for the incremental buildup of CO2 in the atmosphere?

[81] Case 3:17-cv-06012-WHA, Document 117, Notice Re Tutorial (blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2018/20180227_docket-317-cv-06011_notice-1.pdf)

8. What are the main sources of heat that account for the incremental rise in temperature on Earth?[82]

On March 16, the City of New York filed an amended complaint to address some of the issues raised in defendants' motions to dismiss; this was followed on March 30 by a new set of motions to dismiss, raising largely the same issues as before and adding a motion to dismiss by ConocoPhillips on the ground that its actions were not the proximate cause of the City's injuries.

April 2018

On April 17, the Board of County Commissioners of Boulder County, the Board of County Commissioners of San Miguel County, and the City of Boulder filed suit as co-plaintiffs in the District Court for the County of Boulder.

May 2018

On May 9, King County filed a complaint in the King County Superior Court. On May 25, defendants removed the case to federal court (W.D. Wash.).

On May 30, several U.S. states[83] filed an *amicus curiae* brief with the Southern District of New York in support of the New York defendants' motion to dismiss the case, arguing that the claims were not justiciable (as political questions) and were displaced by federal statutes, among other arguments.

---

[82] Case 3:17-cv-06011-WHA Document 138 (http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2018/20180306_docket-317-cv-06011_order-1.pdf)

[83] *Amici* states who signed onto the brief include Indiana, Alabama, Arkansas, Colorado, Georgia, Kansas, Louisiana, Nebraska, Oklahoma, South Carolina, Texas, Utah, West Virginia, Wisconsin, and Wyoming

June 2018

On June 1, the Niskanen Center filed an *amicus curiae* brief in support of the City of New York, arguing that applying state common law to defendants' actions would not violate the federal interest in uniform regulation of defendants' conduct.

On June 11, the Boulder plaintiffs filed an amended complaint that added a civil conspiracy claim.

On June 29, the Boulder defendants removed the case to federal court (D. Colo.).

July 2018

On July 2, Rhode Island filed its lawsuit in the Providence County Superior Court; on July 13, defendants removed the case to federal court (D.R.I.).

On July 19, the federal court dismissed plaintiff City of New York's lawsuit, holding that the City's claims were governed by federal common law, not state common law, because greenhouse gas emissions cross boundaries, and that the Clean Air Act already displaced the federal common law claims. Further, the court noted that to the extent the City's injuries arose from foreign greenhouse gas emissions, its claims were barred because extraterritorial matters were not justiciable. On July 26, the City filed a notice of appeal to the Second Circuit.

On July 20, the Mayor and City Council of Baltimore filed a lawsuit in the Circuit Court for Baltimore City; on July 31, defendants removed the case to federal court (D. Md.).

On July 27, the King County defendants moved to dismiss for lack of personal jurisdiction and for failure to state a claim.

On July 30, the Boulder plaintiffs moved for remand of their case back to state court.

August 2018

On August 17, King County amended its complaint to strengthen its allegations regarding defendants' connections to the State of Washington. On August 31, defendants re-filed their motions to dismiss the amended complaint.

Also on August 17, Rhode Island moved to remand its case from federal court back to state court.

On August 24, San Francisco and Oakland appealed the denial of remand to the Ninth Circuit.

September 2018

On September 11, Baltimore moved to remand its case back to state court.

On September 13, King County moved to stay proceedings in its case, pending the outcome of San Francisco/Oakland's appeal of the dismissal of their cases.

October 2018

On October 13, twelve states (Indiana, Alabama, Arkansas, Colorado, Georgia, Louisiana, Nebraska, Oklahoma, South Carolina, Texas, Utah, and Wisconsin) filed a brief as *amici curiae* urging dismissal of King County's suit

against the fossil fuel defendants, arguing against the justiciability of plaintiffs' climate change claims.

On October 17, the court granted King County's request for a stay pending the outcome of the appeal of San Francisco and Oakland's dismissal.

November 2018

On November 9, the City of New York filed its appeal brief with the Second Circuit. It was joined on November 15 by several sets of *amici curiae.* Several U.S. states[84] and the District of Columbia filed an *amicus* brief primarily arguing that dismissal of the City's case was not consistent with the reservation of authority to states to deal with environmental harms. Professor Catherine M. Sharkey, a tort law expert, filed an *amicus* brief arguing that nuisance law was a doctrinally appropriate approach to the problem of climate change impacts. Several environmental groups[85] filed an *amicus* brief emphasizing the inequitable impacts of climate change. A group of legal scholars[86] specializing in foreign relations and conflict of laws filed an *amicus* brief arguing that New York state common law was appropriate for the case and that it did not implicate foreign affairs. Finally, the National League of Cities, the U.S. Conference of Mayors, and the International Municipal Lawyers Association

[84] *Amici* included New York, California, Maryland, New Jersey, Oregon, Rhode Island, Vermont, and Washington, along with D.C.
[85] Environmental *amici* included Natural Resources Defense Council, New York City Environmental Justice Alliance, The Point, and Uprose.
[86] This group of *amici* included Professors Sarah H. Cleveland, Zachary D. Clopton, William S. Dodge, Harold Hongju Koh, Kermit Roosevelt III, and Christopher A. Whytock.

filed a brief arguing that state law claims would be available to address local injuries due to climate change.

On November 14, the Pacific Coast Federation of Fishermen's Associations filed a complaint in San Francisco County Superior Court.

December 2018

On December 12, the PCFFA case was removed to federal court (N.D.Cal.) and assigned to Judge Chhabria on December 24.

January 2019

On January 2, the PCFFA case was stayed pending the resolution of proceedings in the San Mateo group of cases and San Francisco/Oakland group.

February 2019

On February 7, the New York defendants filed their appeal brief in support of the dismissal of the City's case in the Second Circuit.

March 2019

On March 7, the United States filed an *amicus curiae* brief in support of the defendants in the City of New York case, reiterating defendants' arguments that the City's claims are preempted by the Clean Air Act, properly characterized as federal common law claims, displaced by federal statute, and not justiciable.

June 2019

On June 10, the federal court for the District of Maryland remanded Baltimore's case back to state court, finding that federal jurisdiction did not exist, and stayed the order pending appeal. Defendants filed a notice of appeal on June 13.

July 2019

On July 22, the federal district court found in Rhode Island's favor and remanded its case back to state court, but stayed the remand order for 60 days to allow for the possibility of appeal (a stay which was then extended after the appeal was filed).

August 2019

On August 9, the Rhode Island defendants appealed the district court's remand order to the First Circuit.

September 2019

On September 5, the District of Colorado federal court remanded the Boulder plaintiffs' case back to state court, concluding that the complaint, on its face, did not raise federal issues, and that jurisdiction did not automatically attach solely because plaintiffs' state law claims might be preempted by federal law. The following day, defendants filed a notice of appeal of the remand order to the Tenth Circuit.

November 2019

On November 18, the Boulder defendants filed their appeal brief with the Tenth Circuit, arguing that the case should not have been remanded to state court but should stay in federal court; they were joined on November 25 by the U.S. Chamber of Commerce with an *amicus curiae* brief in support of defendants' position.

On November 20, the Rhode Island defendants filed their appeal brief with the First Circuit, arguing against remand; they were joined on November 27 by the U.S. Chamber of Commerce as *amicus curiae*.

December 2019

On December 20, the Boulder plaintiffs filed their appeal brief in the Tenth Circuit, arguing that remand was proper.

On December 19 (corrected version filed December 23), Rhode Island was joined by a number of former federal officials[87] as *amici curiae* who were formerly "U.S. diplomats or United States government officials who have worked under presidents from both major political parties on diplomatic missions to mitigate the dangers of climate change," arguing that – contrary to defendants' assertions – addressing Rhode Island's climate change claims would not interfere with or disrupt U.S. foreign policy. On December 26, U.S. Senators Sheldon Whitehouse, Jack Reed, and Edward Markey filed an *amicus curiae* brief in support of Rhode Island, addressing arguments made by the U.S. Chamber of Commerce in their *amicus* brief in support of defendants. On December 31, Public Citizen filed an *amicus* brief in support of Rhode Island.

January 2020

On January 2, several groups of *amici curiae* filed briefs in support of Rhode Island's case. Several U.S. states[88] argued that Rhode Island's claims were not preempted and that the claims arose under federal law. A group of climate scientists

[87] *Amici* included Susan Biniaz, Antony Blinken, Carol M. Browner, William J. Burns, Stuart E. Eizenstat, Avril D. Haines, John F. Kerry, Gina McCarthy, Jonathan Pershing, John Podesta, Susan E. Rice, Wendy R. Sherman, and Todd D. Stern.
[88] State *amici* included Massachusetts, California, Connecticut, Delaware, Hawai'i, Maine, Maryland, Minnesota, New Jersey, New York, Oregon, Vermont, and Washington.

and scholars[89] filed an *amicus* brief linking Rhode Island's injuries to climate change and fossil fuel emissions. Another group of scientists[90] filed an *amicus* brief arguing that defendants had knowledge of the risks of fossil fuel use and deceived the public about those risks. *Amicus* Public Citizen argued that the federal officer removal statute (which defendants argued applied, because some of their activities involved contracts with the federal government) does not apply here. *Amicus* Natural Resources Defense Council argued that Rhode Island's claims were not preempted by the Clean Air Act nor federal common law. Finally, on January 7, *amici* The National League of Cities, the U.S. Conference of Mayors, and the International Municipal Lawyers Association filed a brief in support of Rhode Island's case returning to state court.

On January 6, the Boulder plaintiffs' appeal was joined by *amici curiae* Natural Resources Defense Council, Colorado Communities for Climate Action, Public Citizen, the National League of Cities, the U.S. Conference of Mayors, and the International Municipal Lawyers Association.

March 2020

On March 9, the City and County of Honolulu filed a complaint in the Circuit Court of the First Circuit, Hawai'i.

---

[89] Scientists in this group included Mario J. Molina, Michael Oppenheimer, Robert E. Kopp, Friederike Otto, Susanne C. Moser, Donald J. Wuebbles, Gary B. Griggs, Peter C. Frumhoff, and Kristina Dahl.

[90] Scientists in this group included Robert Brulle, the Center for Climate Integrity, Justin Farrell, Benjamin Franta, Stephan Lewandowsky, Naomi Oreskes, Geoffrey Supran, and the Union of Concerned Scientists.

April 2020

On April 15, the Honolulu case was removed to federal court.

June 2020

On June 24, the Minnesota Attorney General, Keith Ellison, filed suit in state court.

July 2020

On July 27, the Minnesota case was removed to federal court.

September 2020

On September 2, the City of Hoboken filed a complaint in state court.

On September 10, the State of Delaware filed a complaint in state court.

October 2020

On October 9, the Hoboken case was removed to federal court, and on October 23, the Delaware case was removed as well.

On October 12, the County of Maui filed a case against several oil companies, which was subsequently removed to federal court on October 30.

November 2020

On November 4, the Honolulu remand was stayed pending resolution of a similar question in the Maui case.

Proving causation

Tort plaintiffs must prove that the defendant's actions caused the plaintiff harm, an element that proves to be a particular challenge in climate change litigation (Grossman, 2003). In most tort cases, the connection between a defendant’s putative

actions and the harm suffered by the plaintiff is relatively straightforward. But demonstrating the straight-line connection between fossil-fuel manufacturers' decisions about product development, marketing, and sale – their business model, in other words – and climate change, global warming, sea level rise, and real financial costs, has not been so simple. In the *Kivalina* case, for example, the district court found that the connection between the plaintiffs' injury and defendant's greenhouse gas emissions was too tenuous to serve as the basis of a claim. *Kivalina* at 881-882.

One challenge has been the disjunction between many scientists' conceptions of causation and the traditional conception of direct, but-for cause-and-effect in tort law as understood by laypeople. Restatement (Third) of Torts § 26 (American Law Institute, 1998). A "cause" of harm is often described in the traditional legal sense as a necessary antecedent to the harm. Restatement (Third) of Torts § 26, cmt. b. In contrast, causation can sometimes be viewed by climate scientists as a probabilistic, stochastic question of whether one event has made others in a chain significantly more likely. This schism has been described in detail in the climate change context by Michael Duffy (2009) as well as David Grossman (2003). Duffy describes four categories of environmental effects resulting from global warming: Arctic ice and snow melting, sea level rise, heat waves, and hurricanes (Duffy, 2009). Each of these raises particular issues of causal proof; for example, it can be difficult to distinguish natural variability in sea level at a particular coastal location from warming-induced sea level rise, and more difficult still to state that coastal erosion or other injuries are caused more by one than the other. (Duffy, 2009). Similarly, the relatively short

history of hurricane records makes it difficult to ascribe changes in hurricane trends to climate change with the degree of certainty, and in the terms, that courts might demand. (Duffy, 2009).

Vallejo and Gloppen (2013) present the difficulty in similar terms:

> From a theoretical perspective a challenge for tort-based climate litigation is to demonstrate injury in fact and a linear chain of causality. Nuisance or damages cases point at wrongful actions that cause harm or injury to persons or their property. Damages can be caused intentionally or due to negligence. Plaintiffs of nuisance cases need to prove a) that they have suffered 'injury in fact'; b) that their injuries have been caused by the defendant, and c) that the injuries can be redressed by a court decision. Given the global nature of GHG emissions and the billions of contributors to climate change, it is not an easy case to make. In climate change, there is no clear chain of causation from a particular defendant's actions to the plaintiffs' injury and a plaintiff could sue any emitter of their choosing. The lack of linear causation has been seen to count against a legal solution: Unlike traditional pollution cases, where discrete lines of causation can be drawn from individual polluters to their individual victims, climate change results only from the non-linear, collective impact of millions of fungible, climatically indistinguishable, and geographically dispersed emitters.

Several of the early climate litigation cases failed because the link between fossil fuel use and the harmful impacts of climate change was too tenuous to be accepted by judges. Now, however, the scientific evidence has advanced to a point that brings courtroom proof potentially within reach.

> Strategic private climate litigation today looks significantly different from private climate litigation 10 years ago as a result of (i) the growth and consolidation of climate science released by the Intergovernmental Panel on Climate Change (IPCC), and better and up-to-date localised data; (ii) the increased possibility of quantifying the proportional contribution of the world's largest emitters to climate change; and (iii) developments in attribution science. (Ganguly et al., 2018, p. 851)

Heede (2014) has assembled "a quantitative analysis of the historic fossil fuel and cement production records of the 50 leading investor-owned, 31 state-owned, and

9 nation-state producers of oil, natural gas, coal, and cement from as early as 1854 to 2010" (p. 229). And Burger et al. (2020) have created a helpful guide to the current state of attribution science, with definitions and guideposts. These advances have brought scientific and legal causation closer together in the climate change context, and may have implications for the future success of these suits.

Over time, tort law has adapted to incorporate a number of alternative theories of causation in response to particular circumstances where requiring the plaintiff to prove causation in the traditional way would lead to an unjust outcome (Duffy, 2009). One such alternative is collective liability, where multiple defendants have engaged in independent tortious acts to produce the harm, but no single act can be proved a necessary antecedent to the harm. The classic example comes from *Summers v. Tice*, 199 P.2d 1, 5 (Cal. 1948); two defendants negligently fired their guns and plaintiff was hit with one bullet, but it was impossible for the plaintiff to determine whose it was. Similarly, when multiple defendants manufacture a harmful product – diethylstilbestrol, for example – that injures a plaintiff, but the product is fungible so that the plaintiff cannot determine who manufactured the specific pill that she took, the theory of market share liability allows the plaintiff to assign liability to every manufacturer according to its share of the relevant market. A variation on market share liability, commingled-product liability, applies in situations where harm is caused by a product manufactured by multiple defendants but mixed together in the course of commerce, such that each manufacturer has likely contributed in some part to the product that caused a single injury. As the *In re MTBE* court put it, "[w]hen a

plaintiff can prove that certain gaseous or liquid products (e.g., gasoline, liquid propane, alcohol) of many suppliers were present in a completely commingled or blended state at the time and place that the risk of harm occurred, and the commingled product caused a single indivisible injury, then each of the products should be deemed to have caused the harm." *In re Methyl Tertiary Butyl Ether (MTBE) Prods. Liab. Litig.,* 379 F. Supp. 2d 348, 277-78 (S.D.N.Y. 2005).

This case study sheds light on one approach to environmental litigation over an extremely commonplace product that causes both diffuse and concentrated harms when used in reasonably foreseeable ways, in the context of regulation that has not substantially solved the problem. Although the litigation has not yet concluded and it is difficult to predict what the practical outcome will be, a close examination of the parties' (and their attorneys') choices and responses at this stage provides data that can help inform similarly situated entities on both sides. The next chapters will describe a similar context of product, harm, and regulatory environment, and analyze the potential for a similar approach in that context.

Chapter 4: Strategic nitrogen litigation using tort causes of action

> "Litigation is the pursuit of practical ends, not a game of chess."
> –Felix Frankfurter

Agriculture is a large and powerful regulated community, dispersed throughout the nation ("few federal, state, or local politicians can escape pressure from the farm constituencies, and in farming areas, politicians are dominated by them") (Ruhl, 2000). The attempt to regulate agricultural discharges thus "matches a large and diverse 'public' interest group of other water users who would benefit from decreased agricultural pollution against a concentrated 'private' group of farmers threatened with potentially expensive pollution regulation" (Zaring, 1996, p. 542), a classic case of diffuse costs and concentrated benefits (Waldner, 2009). "That states ... facing threats to their own water resources, soaring costs of water treatment, plunging property values, and lost recreation and tourism are so resistant to cleaning them up is some testament to the power of nutrient dischargers in the equation" (Houck, 2014, p. 10430). In sum, the agriculture industry views regulation of nonpoint source pollution as a major threat to its livelihood, to be vigorously defended against; or, as Jim Chen put it, "[t]raditional agriculture quakes at the idea that environmental law will come to the farm" (Chen, 1995, p. 351). After reviewing regulatory programs in states with both strong agricultural sectors and marked nitrogen problems, Professors Craig and Roberts (2015) concluded the following:

> Generally, in politically powerful agricultural states, there needs to be a countervailing and prominent water quality concern to motivate states to regulate nonpoint source pollution in general and agricultural nonpoint source pollution in particular. In the Pacific Northwest states, protection of culturally, economically, and recreationally important salmon has often prompted strong

> nonpoint source protection. In other states, nitrate contamination of groundwater—which causes "blue baby syndrome"—has motivated more stringent regulation. In the Chesapeake Bay states, concern from both Congress and the U.S. Environmental Protection Agency (EPA) about the increasingly degraded condition of the Bay has prompted increased management of nonpoint sources. In contrast, the Gulf of Mexico's long-term "dead zone" has yet to generate either state or federal action to address the nonpoint source nutrient pollution that contributes to the problem. (Craig & Roberts 2015, pp. 2-3).

For agricultural nitrogen pollution, therefore, there appear to be few effective regulatory avenues, and little recourse for those harmed. As discussed in Chapter 2, the cooperative-federalism structure of the Clean Water Act has proven inadequate to the task of managing nonpoint source pollution like nitrogen-laden runoff (Malone, 2002). Regulatory reform of the CWA has sometimes been suggested as a solution – e.g., setting consistent nationwide minimum water quality standards, creating better (or better-enforced) state programs à la California's Porter-Cologne Act, or removing the Clean Water Act's exemption for agricultural runoff (Williams, 2002). But these types of changes would require the cooperation of a Congress that has not demonstrated an appetite for significant changes to the major federal environmental statutes in recent decades, and of state legislatures in states like Iowa, where agricultural interests hold substantial political power.

Some scholars have investigated the possibilities presented by litigation, however. In an examination of the options available to those affected by agricultural nonpoint source pollution, Professor Pollans (2016) describes four types of possible suits and their shortcomings: (1) endangerment suits brought by the EPA under the Safe Drinking Water Act, (2) Clean Water Act citizen suits that attempt to enforce the

act's TMDL requirements, (3) Resource Conservation and Recovery Act (RCRA) or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or the Superfund law) cases that treat manure and other agricultural pollution sources as solid or hazardous waste, and (4) state nuisance and trespass actions (Pollans, 2016).

The Safe Drinking Water Act gives the EPA (and no others) the authority to sue agricultural operations that are directly endangering drinking water sources, and it has been used on occasion to enforce better management practices at CAFOs that were allowing manure to contaminate drinking water aquifers[91]. But each of these suits demands substantial resources from an agency with limited resources, and the SDWA solution is ill-suited to a problem as widespread as fertilizer runoff, where relatively minor changes in farming practices are unlikely to eliminate the problem (Pollans, 2016). RCRA, which regulates solid waste, can sometimes be stretched to encompass excessive manure application that plainly serves as *de facto* waste disposal,[92] but likely not ordinary fertilizer use, while CERCLA expressly exempts "normal application of fertilizer" from the activities it regulates (Pollans, 2016).

The Clean Water Act allows private parties to sue states to force them to develop TMDLs, but does not provide for the subsequent enforcement of those

[91] See, e.g., Administrative Order on Consent, *In re Yakima Valley Dairies*, No. SDWA-10-2013-0080 (U.S. E.P.A. Region 10, Mar. 19, 2013)

[92] See *Community Association for Restoration of the Environment, Inc. v. Cow Palace, LLC,* 80 F. Supp. 3d 1180, 1225 (E.D. Wash. 2015) (holding that excessive application of manure leading to nitrate pollution rendered it waste, rather than fertilizer).

TMDLs.[93] As with climate change, this was a major early strategy for nutrient pollution plaintiffs – lawsuits pushing state and federal agencies to use their statutory authority to reduce pollution. TMDL litigation beginning in the early 1990s attempted to accelerate the pace of TMDL development and approval for impaired water bodies.[94] Most of these suits resulted in consent decrees or court orders directing the EPA to establish TMDLs, unless it could show that they were not needed.[95] But this has been a long and slow process. For example, after years of waiting for TMDLs to be set for rivers in the Mississippi Basin, a group of environmental organizations called the Gulf Restoration Network petitioned the EPA to force Mississippi watershed states to adopt numeric standards for nutrients and thereby create the authority to limit discharges. The EPA denied their petition, and the Fifth Circuit agreed that EPA had the discretionary authority to decline to enforce provisions of the Clean Water Act if it so chose (*Gulf Restoration Network v. EPA*, 783 F.3d 227 (2015); Houck, 2014; Kerr, 2014). Similarly, EPA's failure to promulgate numeric nutrient criteria for Florida waterways prompted a suit from Florida Wildlife Federation, a coalition of environmental groups, in 2008.[96] The EPA did determine

---

[93] See, e.g, *Am. Farm Bureau Fed'n v. U.S. Envtl. Prot. Agency,* 792 F.3d 281, 291 & n.4 (3d Cir. 2015) (TMDLs provide information, not regulation), *cert. den.,* 136 S. Ct. 1246 (2016).

[94] See Litigation Status: Summary of Litigation on Pace of TMDL Establishment, U.S. ENVTL. PROTECTION AGENCY (Mar. 2009), http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/lawsuit.cfm

[95] Id.

[96] Second Amended Complaint for Declaratory and Injunctive Relief at 1, Fla. Wildlife Fed'n v. Jackson, No. 4:08CV324, 2009 WL 494581 (N.D. Fla., Jan. 6, 2009).

that Florida needed a new numeric standard,[97] and entered into a consent decree with the plaintiffs that required either Florida or the EPA to promulgate one by January 2010.[98] Florida did not, and EPA published its own, which were promptly challenged by Florida itself (Weiss, 2012). EPA eventually yielded to Florida's alternative (and far less stringent) proposal, after political pressure came to bear (Kerr, 2014). Overall, as of 2020, the only jurisdictions with completed numeric nutrient water quality criteria (precursors to TMDLs) were Pacific islands: Hawaii, Guam, the Northern Marianas, and American Samoa (U.S. EPA, 2020c). Twenty-seven other jurisdictions had not developed any nutrient criteria at all, and of those, twenty had also failed to develop criteria for chlorophyll-a – a proxy for nutrient pollution, since it reflects the degree of algal growth and thus eutrophication in a surface water body (U.S. EPA, 2020c).

Another important case for water utilities coping with nonpoint source pollution was *Des Moines Water Works v. Sac County, et al.*[99] The plaintiff articulated a novel approach to the problem of nonpoint pollution under the Clean Water Act, arguing that agricultural tile drains, because they channel runoff directly into water bodies, should be treated as point sources (and therefore subject to NPDES permitting requirements) for purposes of the law (Crawford, 2016; Dirth, 2018; Vos,

---

[97] Florida Wildlife Fed'n, Inc. v. Jackson, No. 4:08cv324-RH/WCS, 2009 WL 5217062, at *2
(N.D. Fla. Dec. 30, 2009).
[98] 33 U.S.C. § 1313(c)(4).
[99] *Board of Water Works Trustees of the City of Des Moines v. Sac County Board of Supervisors, et al*., 2015 WL 1191173 (N.D. Iowa Mar. 16, 2015) (No. 5:15-cv-04020).

2017). Des Moines Water Works thus sued a group of Iowa drainage districts – the governmental bodies responsible for overseeing tile drainage systems – for discharging nutrient pollution from a *point source* without a NPDES permit, in contravention of the CWA.[100] It claimed that it had suffered compensable financial harm as a result of these discharges because it was obligated to provide customers with clean water (less than 10 mg nitrate per liter), and the Raccoon River, the utility's main water supply, had become contaminated with fertilizer runoff (Gannon, 2016). The eventual ruling, which was not appealed and is therefore final, granted Des Moines Water Works no relief, largely because the drainage district defendants lacked the power or authority to either control farmers' use of fertilizer or to manage the operation of tile drain systems beyond keeping them in basic working order. Because the plaintiff's claims were not redressable by defendants in the first place, therefore, the court did not reach the question of whether tile drain outlets should be considered point sources under the CWA. *Bd. of Water Works Trs. of Des Moines v. Sac Cnty. Bd. of Supervisors of Drainage Districts 32, 42, 65, 79, 81, 83,* No. C15-4020-LTS (N.D. Iowa Mar. 17, 2017)).

The failure of these and many other ultimately unsuccessful attempts to accomplish reductions in nonpoint-source water pollution using existing regulatory structures points to the need for a different approach. The climate change litigation described in Chapter 3, which arose after decades of frustratingly ineffective attempts

[100] Complaint, *Board of Water Works Trustees of the City of Des Moines v. Sac County Board of Supervisors, et al*., 2015 WL 1191173 (N.D. Iowa Mar. 16, 2015) (No. 5:15-cv-04020).

to address greenhouse gas emissions through regulation, suggests that a return to common-law tort principles could yield better results. As a step in this direction, Pollans mentions two important, but rare, actions implicating state tort law that were settled before decisions were rendered on their merits (Pollans, 2016).

City of Tulsa v. Tyson Foods, Inc. 258 F.Supp.2d 1263 (N.D.Okla. 2003) was a decision on a motion for summary judgment (i.e., an early stage of the proceedings). The city's water utility sued poultry farms over applications of phosphorus-rich poultry manure, runoff from which was causing eutrophication in freshwater lakes from which Tulsa's drinking water was drawn. Although the case was filed in federal court and chiefly raised a number of CERCLA claims, the plaintiffs also brought nuisance and trespass claims under Oklahoma state law (258 F.Supp.2d at 1288). Defendants argued that the water utility had a license, rather than a right, to use the groundwater and thus had no property interest that could support one of those tort claims (258 F.Supp.2d at 1289). The court ruled that the water utility did in fact have a sufficient property interest in its drinking water source, citing Oklahoma law holding that the water is subject to "appropriation for the benefit and welfare of the people of the state" and that the Oklahoma Water Resource Board "is entitled to appropriate water to municipalities," like Tulsa, for any beneficial use (258 F.Supp.2d at 1289-90, citations omitted). A settlement by the parties obviated the need for the court to rule on the merits, but it is worth noting that manure application by CAFOs is subject to its own body of regulation defining "reasonable" manure application

practices; see 40 C.F.R. § 122.23(e) (2009); *Waterkeeper Alliance, Inc. v. EPA*, 399 F.3d 486, 511 (2d Cir. 2005) (Centner, 2010).

The other case, *City of Greenville v. Syngenta Crop Protection, Inc.,* was a class action brought by a class of 1,930 drinking water systems in several states that had detected atrazine, an agricultural herbicide, in their water supplies. Like fertilizer, atrazine moves with runoff into surface water and ground water used to supply drinking water. *City of Greenville v. Syngenta Crop Protection, Inc.,* No. 11-mc-10, 3 (C.D. Ill. Oct. 27, 2011). Like *Tulsa v. Tyson,* the parties settled the case at an early stage, before any court ruled on the merits of the plaintiffs' claims. *City of Greenville v. Syngenta Crop Protection, Inc.,* 904 F. Supp. 2d 902, 904, 905 (S.D. Ill. 2012). The $105 million settlement was meant to resolve the class members' trespass, negligence, products liability, and nuisance claims related to atrazine in the water that did not come from a point source. *City of Greenville v. Syngenta Crop Prot., Inc.,* Case No.: 3:10-cv-188-JPG-PMF, 4-5 (S.D. Ill. May. 30, 2012).

These two cases lack precedential value with respect to the substantive tort law issues involved, but they represent very early steps on the path to modeling a viable nutrient pollution tort case. The rest of this chapter will continue down this path, identify the main issues that must be considered, and address the major challenges that could stymie potential litigants.

Overview

A lawsuit aimed at the problem of nonpoint agricultural nitrogen pollution and modeled after the climate change litigation described in Chapter 3 will have certain

features, described in greater detail below. First, the plaintiffs must be able to demonstrate a redressable injury to their interests; in other words, they must be the ones harmed. Private organizations like the Pacific Coast Federation of Fishermen's Associations who find that nitrogen pollution has threatened their members' livelihoods (e.g., by harming fishing grounds or discouraging tourism) may fall into this category. Municipal water utilities who must provide their customers with safe drinking water and who incur costs to filter out nitrates and algal toxins also fall into this category.

The climate change defendants are those who manufactured the products ultimately responsible for the harm, rather than those who used the products to make electricity (as in *AEP v. Connecticut*), power vehicles, or heat their homes – even though these end consumers are in some sense "causing" the relevant emissions, by driving or turning up the thermostat. The analogous defendants here are not farmers, who presumably apply fertilizer products approximately as directed in most cases, but fertilizer manufacturers, who are in a better position to know the environmental impacts of ordinary use of their products.

Nuisance and trespass are the classic environmental tort causes of action, joined in product liability cases by failure to warn, defective design, and negligence – particularly where there is evidence that manufacturers concealed their knowledge of the harm their products could cause. Public (governmental) plaintiffs may be able to bring public nuisance claims as well. Defendants are likely to raise two types of argument in response: first, that the Clean Water Act preempts common law suits

over nitrogen pollution because it describes a complete regulatory scheme for managing water pollution, and second, that the question of whether ordinary fertilizer use should give rise to tort liability for anyone, and if so whom, is a question of policy for legislatures to decide, not courts.

Plaintiffs will have to show the chain of events leading from the manufacture of fertilizer to the injury: from sale, to application, to runoff, to water body, to algal bloom or nitrate contamination, to harm done or cost incurred. Defendants are likely to argue that there is no way to link their particular fertilizer product to, say, the dead zone in the Gulf of Mexico; the causal chain is simply too long and tenuous, and there are too many possible intervening causes, to form a basis for liability. Besides, the manufacturers lack the requisite control over the harmful instrumentality to be held liable for the injuries caused thereby; once it leaves the factory, their responsibility for it ends.

Plaintiffs and injury-in-fact

Standing, or the capacity of a potential plaintiff to bring a lawsuit, is determined in state courts by statute. Such statutes generally follow the federal requirement that plaintiffs have sustained or will sustain direct, redressable injury or harm. See *Lujan v. Defenders of Wildlife*, 504 U.S. 555 (1992) (plaintiffs must have suffered an "injury in fact," i.e., an invasion of a legally protected interest that is (a) concrete and particularized, and (b) actual or imminent, not "conjectural" or "hypothetical"). For example, in Iowa, state law requires plaintiffs to 1) have a specific personal or legal interest in the litigation and (2) be injuriously affected.

Citizens for Responsible Choices v. City of Shenandoah, 686 N.W.2d 470, 475 (Iowa 2004). Similarly, Illinois courts are not required to follow the *Lujan* standard, but generally require an "actual or threatened . . . injury in fact to a legally cognizable interest," which must be "distinct and palpable," "fairly traceable" to the defendant's actions, and substantially likely to be redressed by granting the requested relief. *Greer v. Illinois Housing Development Authority,* 122 Ill. 2d 462, 491 (1988).

Since standing depends on the existence of an actual or threatened injury-in-fact, the nature of the injury attributed to agricultural nitrogen pollution is among the first inquiries. In most cases, with the exception of public nuisance for which injunction is usually the only remedy, tort law allows injured plaintiffs to recover their reasonable expenditures made in order to abate, mitigate, or prevent recurrences of those harms (Grossman, 2003). In 2015, the EPA compiled research documenting the localized impacts and costs of nutrient pollution leading to algal blooms in surface waters (U.S. EPA, 2015). These impacts tend to fall into several broad categories:

1. *Tourism and recreation.* Harmful algal blooms can look and smell unattractive, reducing the appeal of lakeside or seaside recreation. This can lead to reductions in restaurant and other local business spending in areas that depend on tourism income. For example, Davenport & Drake (2011) estimated that algal blooms in Grand Lake St. Marys, Ohio, resulted in lost tourism revenues of $37 million to $47 million in 2009 and 2010. Larkin & Adams (2007) estimated that each harmful algal bloom event caused $4.2 million in reduced restaurant revenue and $5.6 million in reduced lodging revenue in the Fort Walton Beach and Destin areas of Florida

(Pittman, 2019).

2. *Commercial fishing.* Algal blooms can reduce commercial fishery harvests or close fisheries entirely; some types of algal blooms can cause a buildup of toxins in shellfish, rendering them unfit for consumption. A single red tide event in Galveston Bay led to economic losses of $240,000 for the decline in shellfish harvests between September and December 2000 (Evans & Jones, 2001). A 2005 red tide event may have caused impacts to the Massachusetts shellfish industry of up to $21 million (Jin, Thurnberg, & Hoagland, 2008). And hypoxia due to nutrient pollution in the Patuxent River in Maryland caused a 49% reduction in crab harvests, corresponding to annual lost revenues of $304,000 (Mistiaen, Strand, & Lipton, 2003).

3. *Property values.* As with tourism impacts, algal blooms look and smell unattractive, decreasing water quality and clarity. Some studies attempted to quantify the reduction in property values associated with these impacts. In Wisconsin, for example, lakefront property values at lakes with severe algal bloom problems were lower by $128 to $402 per shoreline foot, relative to nearby comparable lakes (Kashian & Kasper, 2010).

4. *Human health.* Algal blooms can not only toxify shellfish, but also cause respiratory illnesses and skin disorders. One study found that Sarasota County, Florida, can incur excess health care costs and lost productivity of up to $130,000 per red tide event, due to respiratory illnesses (Hoagland et al., 2009).

5. *Drinking water treatment.* The need to filter out nitrates and algal toxins can lead to increased expenditures by drinking water providers on operation and

maintenance, specialized equipment, and infrastructure (Vedachalam et al., 2018). The federal standard (maximum contaminant limit, or MCL) for nitrate in drinking water is 10 mg/L; drinking water providers whose supplies exceed that standard must filter or dilute until nitrate concentrations reach acceptable levels in the water served. Removing nitrate from drinking water using conventional treatment methods, such as coagulation and filtration, is very difficult; nitrate is highly stable and soluble and does not readily precipitate or adsorb to filtration media (Rezvani, Sarrafzadeh, Ebrahimi, & Oh, 2019). Reverse osmosis and ion exchange are the most effective filtration choices for nitrate contamination, but these techniques are extremely expensive relative to conventional methods (Gerba & Pepper, 2020). Cheaper options include blending nitrate-rich water with other existing sources, drilling new wells, finding alternative surface water sources, purchasing water from nearby utilities (Vedachalam et al., 2018). Sometimes, these measures are only temporary fixes; Des Moines Water Works, for example, was able to alternate water sourcing between the Raccoon River and the Des Moines River only until both rivers were affected by high nitrate concentrations at once.

A 2010 blue-green algae outbreak at Grand Lake St. Mary's, Ohio, necessitated $13.1 million in spending by the municipal water utility serving water from the lake to install treatment controls and set up toxic algae testing, including $3.6 million in increased operation and maintenance costs (Davenport & Drake, 2011). Poor drinking water quality due to excess nutrients caused the City of Waco, Texas, to spend an estimated $70.2 million from 2002 to 2012 on upgrades to the

drinking water treatment process, nutrient-related watershed water quality monitoring, increased treatment chemical usage, influent and treated water monitoring, and increased energy usage (U.S. EPA, 2015). For Des Moines Water Works in Iowa, maintenance of their current nitrate removal facility is expected to cost $72 million, while a new facility to mitigate the effects of increasing nitrate concentrations in the Raccoon River could cost up to $184 million (Canning & Stillwell, 2018). Mosheim and Ribaudo (2017) evaluated the factors that influence the expense of treating drinking water for nitrates and found that "the cost to water utilities of nitrogen removal increases with the percentage of nitrogen pollution attributed to agriculture" and that "smaller water systems have a higher cost of nitrogen abatement" (Mosheim & Ribaudo, 2017, 30-31). Finally, one nationwide study by USDA economists estimated that treating drinking water for nitrate alone (not cyanotoxins) costs billions of dollars[101]:

> Using data from water treatment plants, ERS estimates the cost of removing nitrate from U.S. drinking water supplies is over $4.8 billion per year (see app. 1). Based on the contribution of nitrate loadings from agriculture, agriculture's share of these costs is estimated at about $1.7 billion per year. Most costs are borne by the large utilities, due to the volume of water treated. ERS findings indicate that reducing nitrate concentrations in source waters by 1 percent would reduce water treatment costs in the United States by over $120 million per year. (Ribaudo et al., 2011, p. 4)

6. *Mitigation and restoration.* Water bodies may not recover automatically if the flow of nutrients is turned off. Nutrients accumulate in and re-release from bottom

[101] These figures do not include the expected costs of upgrading water utilities dealing with new or increasing exposure to nitrate pollution, but rather provide a snapshot of costs to the sample of water utilities surveyed by the American Water Works Association in 1996 (Ribaudo et al., 2011).

sediments, contributing to ongoing high concentrations of pollutants in the water. Dredging, alum treatment, and other mitigation measures can be very costly, ranging from thousands to millions of dollars per water body. For example, alum treatment of Spring Lake, Minnesota would cost about $1 million, while dredging Lake Lawrence, Washington, to remove excess nutrients is estimated to cost over $28 million (U.S. EPA, 2015).

The climate change plaintiffs in Chapter 3 are state, county, or municipal governments suing on behalf of their residents and/or to protect their property interests, plus one industry association claiming economic harm to its members. Plaintiffs who could sue over nonpoint source agricultural nitrogen pollution will be similarly positioned. They could include those who have suffered harm to their livelihoods, like those in the fishing, outdoor recreation, or tourism industries; public or private drinking water utilities who have incurred costs in responding to nitrate or algal toxin contamination; and governments suing to protect their own proprietary interests (such as municipal water utilities) or the health and welfare of their citizens.

Kate Fritz (2020) suggests that environmental cases by cities against corporate defendants have better chances of success when public knowledge about the health implications of pollution or other harmful products increases, and cities then attempt to hold manufacturers accountable for the health impacts of their products. Cities in particular are "potent information aggregators," well-positioned to become aware of problems that affect many residents, and motivated to serve their residents well by protecting them from local environmental nuisances and other harms (Caruso, 2014).

Moreover, city charters often authorize cities to file lawsuits (Gavioli, 2004) to protect their proprietary interests – for instance, the City of New York's interest in protecting its property from sea level rise, described in Chapter 3. Some cities own drinking water utilities and may sue in that capacity; others contract with private water utilities, who may sue to protect their property interest in the water they treat and serve to customers. Although water is generally a public trust resource, both municipally-owned and private drinking water providers are granted a usufructuary right to extract, treat, and serve the water to ratepayers (see discussion below under "Causes of action").

As Professor Pollans (2016) points out, the Clean Water Act and the Safe Drinking Water Act together

> assign primary responsibility for nonpoint source contamination of drinking water to water utilities. Water utilities have extremely limited capacity to prevent contamination of drinking source water. With few options at their disposal to mitigate threats to source water, most devote extensive resources to water purification, which itself is an imperfect tool to protect the public health. (Pollans, 2016).

Because they are obligated to filter out nitrate contamination and algal toxins before distributing drinking water, therefore, water utilities currently pay for the damage caused by excessive agricultural nitrogen fertilizer use, not those who manufactured or applied the fertilizer. This cost allocation is not only unfair, but inefficient (in the Coasian sense), because the cost of controlling contamination at the source tends to be less than the cost of filtering contaminated water (Pollans, 2016; Rabotyagov et al., 2010; Ribaudo et al., 2011).

Potential defendants

In a lawsuit alleging tortious injury, the proper defendant is the one who caused the harm. But the chain of causation in the nitrate pollution context, as with greenhouse gases, is long and complicated. In addition to agricultural fertilizer runoff, nitrogen can reach groundwater and surface water via atmospheric deposition, animal manure, decaying organic matter in soils, septic systems, leaking sewer lines, or municipal waste treatment outflows and land application (McMahon et al., 2008; Musgrove et al., 2016; Wang et al., 2017). The nitrogen that can be attributed to synthetic fertilizers was produced in factories, transferred to agrichemical distributors and retailers, sold and shipped to farmers, and applied to crops. Some evaporated, some was taken up by crops, some was transformed by soil bacteria, and some washed away, entered drinking water sources, or flowed downstream to fertilize algal blooms far downstream.

There are several reasons to pursue defendants closer to the beginning of this chain – fertilizer manufacturers, if not also agrichemical distributors – rather than farmers. First, the individual contribution of any one farmer in a watershed is likely to be small, perhaps not rising to the level of a "substantial factor" in causing the harm (see Restatement (Second) of Torts § 834 cmt. d (American Law Institute, 1979)). Second, even if there are few farmers in a given watershed or up-gradient from an affected well, it can be difficult or impossible to trace the nitrate in a well or lake to a specific single farmer. Third, all fifty states have passed right-to-farm laws that protect farms from nuisance liability for ordinary farming activities, codifying the

"coming-to-the-nuisance rule" (Centner, 2006; Noble & Looney, 1994; Ruhl, 2000; Smart, 2016). These laws allow farmers to continue engaging in activities that create harmful impacts, like fertilizing crops, without incurring nuisance liability – but they do not protect other potential defendants, like large agricultural companies, who are also vulnerable to negligence and defective-product claims, unlike farmers. Finally, like fossil fuel manufacturers, fertilizer manufacturers are in a far better position than farmers to understand the environmental consequences of widespread use of their products and act accordingly to prevent the harm; they are, in Coasian terms, the least-cost avoiders. The nuisance suits described at the beginning of this chapter followed this principle. In *City of Tulsa v. Tyson Foods*, the city sued the companies holding the poultry production contracts, not the farms themselves; these companies, not the farmers, controlled the production conditions "on the ground" (Pollans, 2016). *City of Greenville v. Syngenta*, likewise, involved the manufacturer rather than the applicators of atrazine.

Manufacturer knowledge of potential harm is an important feature of the climate change litigation in Chapter 3. The allegation that fossil fuel manufacturers were aware of, and attempted to conceal, the potential harm caused by their products raises the probability of a larger judgment, the imposition of punitive damages, and/or a shift in public opinion. A similar finding of manufacturer knowledge in the nitrogen context – that fertilizer manufacturers knew of the potential for ordinary use of their product to cause drinking water contamination or harmful algal blooms – would be similarly advantageous for plaintiffs, and there is some evidence pointing to early

understanding of the possible consequences of anthropogenic nitrogen loading. In the first half of the twentieth century, some believed that adding nitrogen to coastal ecosystems could make estuarine resources more productive, (Galloway, Leach, Bleeker, & Erisman, 2013). By the 1950s and 60s, however, the impact of algal blooms on marine species and the growth of coastal "dead zones" had become harder to ignore (Galloway et al., 2013). Coastal marine eutrophication increased dramatically in the second half of the 20th century as fertilizer application rates did the same (Howarth, 2008). The causal link between nitrogen fertilizers, hypoxia, and nitrate contamination was well understood by the 1990s (Glibert & Burkholder, 2006).

Jurisdiction and venue

Where a lawsuit implicates "uniquely federal interests," concerned with "the rights and obligations of the United States, interstate and international disputes implicating the conflicting rights of States or our relations with foreign nations, and admiralty cases," it must be in federal court. *Tex. Indus., Inc. v. Radcliff Materials, Inc.,* 451 U.S. 630, 641 (1981). But following the failure of *Kivalina* in federal court, attorney Matt Pawa reportedly said, "The takeaway's pretty clear … It's time to focus on state law" (Drugmand, 2018).

The climate change plaintiffs described in Chapter 3 filed their cases in state court, not federal, since their complaints alleged only violations of state law.

Nevertheless, defendants promptly removed[102] the cases to federal court. In other words, they claimed that the cases actually implicated federal law, not state law, and asked the federal courts to hear them instead. The substance of the argument in the climate change context is that the Clean Air Act "preempts" nuisance law when it comes to air pollution of any kind, meaning that any dispute over air pollution cannot be treated as a state law nuisance case, but falls under the regulatory regime laid out in the Act and is a matter of federal, not state, law. If courts adopt this position, they are likely to reject plaintiffs' claims, as Judge Alsup did with the climate change cases filed by San Francisco and Oakland, reasoning that "[a] patchwork of fifty different answers to the same fundamental global issue would be unworkable."[103]

In *American Electric Power v. Connecticut,* the U.S. Supreme Court held unanimously that the Clean Air Act preempts *federal* common law nuisance claims against a utility for emissions of greenhouse gases. 564 U.S. 410 (2011). This holding has been extended to cases involving *out-of-state* defendants, who cannot be held to the requirements of another state's nuisance law. *North Carolina ex rel. Cooper v. Tennessee Valley Authority,* 615 F. 3d 291 (4th Cir. 2010). However, an Iowa Supreme Court case, *Freeman v. Grain Processing Corp.,* No. 13-0723, 2014 Iowa

---

[102] Removal is the process of transferring a lawsuit from state court to federal court, and happens automatically when defendants file a notice of removal. The case will remain in federal court if there is federal subject matter jurisdiction (a matter of federal law) or diversity jurisdiction (no defendant is a citizen of the state in which the case was filed). If the federal court determines that it lacks subject matter jurisdiction, it will "remand" (return) the case to the state court where it was originally filed.

[103] Order Denying Motion to Remand, Case 3:17-cv-06012-WHA (N.D. Cal), Docket No. 116, filed 02/27/18.

Sup. LEXIS 72 (Iowa Sup. Ct. June 13, 2014), explains that state law nuisance claims (against in-state defendants) are not preempted by the Clean Air Act because the Act contains a "savings clause" which, with language nearly identical to a savings clause in the Clean Water Act (33 U.S.C. § 1365(e)), preserves the right of private plaintiffs to bring state law nuisance claims as long as the state law is at least as stringent as the federal law. The *Freeman* court relied on the U.S. Supreme Court's 1987 holding, concerning the Clean Water Act's savings clause, that some state common law claims are not preempted by the Clean Water Act, as long as the defendant is properly subject to those state laws. *International Paper Co. v. Ouellette*, 479 U.S. 481 (1987).

In one federal appellate court, the Fourth Circuit, the CAA has been held to preempt state law nuisance claims because it occupies the entire field of air emission regulation; in other words, the regulatory scheme is comprehensive and leaves no room for state law when it comes to air emissions. *North Carolina v. Tennessee Valley Authority*, 615 F.3d 291 (4th Cir. 2010), cert. denied, 132 S. Ct. 46 (2011). The Third Circuit, however, noted that the cooperative federalism structure of the CAA gives states an independent role enforcing emission standards, suggesting that federal law does not occupy the entire field. Bell v. Cheswick Generating Station, 734 F.3d 188 (3d Cir. 2013), cert. denied, 134 S. Ct. 2696 (2014). A district court in the Sixth Circuit[104] have also found no preemption of state nuisance claims. *Merrick v. Diageo*

[104] State courts in Texas and Kentucky have also held that state nuisance law should apply. *Sciscoe v.Enbridge Gathering LP*, 2015 WL 3463490, No. 07-13-00391-CV (Ct. App. Tex. June, 1, 2015) (CAA did not preempt a state nuisance claim over emanations from industrial facilities); *Merrick v. Brown-Foreman Corp.,* No. 2013-

Americas Supply, Inc., 5 F. Supp. 3d 865 (W.D. Ky. 2014) (CAA did not preempt a state nuisance claim over ethanol emissions from a whiskey distillery).

In a groundwater contamination case, the Second Circuit held that the imposition of state tort liability for public nuisance "falls well within the state's historic powers to protect the health, safety, and property rights of its citizens" and therefore, "the presumption that Congress did not intend to preempt state tort law verdicts is particularly strong." *In re MTBE Products Liab. Litig.,* 725 F.3d 65, 96 (2d Cir. 2013), cert. den., 134 S. Ct. 1877 (2014). Although the Clean Water Act does not explicitly preempt the common law, the Supreme Court has ruled that it supplants federal common law nuisance claims. In *City of Milwaukee v. Illinois*, 451 U.S. 304 (1981), the State of Illinois sued Milwaukee over discharges of inadequately treated sewage into Lake Michigan, alleging that it had thereby created a public nuisance. (Id. at 311). Milwaukee responded that the federal common law of nuisance had been preempted by the clean water act; it was unsuccessful in the 7th Circuit, but the Supreme Court held that the Clean Water Act was intended to create a comprehensive federal program of water pollution regulation, leaving no room for federal common law. *Illinois v. City of Milwaukee*, 599 F.2d 151, 157, 162 (7th Cir. 1979); 452 U.S. at 318. However, the Supreme Court later ruled in *International Paper Co. v. Ouellette*, 479 U.S. 481 (1987) that the Clean Water Act does *not* preempt state common law. The Act gives states a significant role in protecting their own waters as they see fit;

CA-002048 (Ct. App. Ky. 2014) (CAA did not preempt a state nuisance claim over emissions from a whiskey distillery).

states can enact more stringent water quality regulations than the federal minimums, for example, and the Act's savings clause preserves state actions (Centner, 2010). *Id.* at 489-90, 497-98.

Tort causes of action

Plaintiffs must first establish that they have a defensible property right before raising tort claims that are based in violations of property rights, like nuisance and trespass. Although water resources are generally owned by a state for the benefit of its people, drinking water utilities have a "usufructuary" right to extract, treat, and serve water to customers. Usufructuary rights are not possessory rights, since the water is "owned" by the state in trust for the public, but are rights to use the water for a given purpose. See, e.g., *State of Cal. v. Superior Court,* 78 Cal. App. 4th 1019, 1025 (2000); *Nat'l Audubon Soc'y v. Superior Court,* 33 Cal. 3d 419, 441 (1983). "Whereas real property ownership is defined by a right to exclude others from that property, water ownership is defined by the right to access and use that water." *Estate of Hage v. United States (Hage V),* 82 Fed. Cl. 202 (2008). Tortious conversion – any act asserting control over another's property in denial of that person's rights – can happen for both ownership rights (as in theft) and usufructuary rights (as in depletion or contamination of a resource). This property rights structure offers two alternative paths forward, for two possible sets of plaintiffs. States, which own the water, can base a claim on their possessory property right; drinking water utilities, which have the right to use the water, can base a claim on interference with their usufruct.

Negligence

Negligence is the failure to act with reasonable care. See Restatement (Second) of Torts § 282 (American Law Institute, 1965).[105] Reasonableness depends on several factors: whether it was foreseeable that the conduct would result in harm, the foreseeable severity of that harm, and how burdensome it would have been to reduce the harm. A prima facie case of negligence is established by (a) the existence of a legal duty that the defendant owed to the plaintiff, (b) defendant's breach of that duty, (c) injury to the plaintiff, and (d) proof that the defendant's breach of duty caused the injury. The injury in question must be either bodily harm or property damage, not mere economic loss – but economic loss that results from damage to *public* property can support a claim for negligence. Whether the defendant had a duty to act can be determined in several different ways: if, for example, the defendant created the risk to the plaintiff, or knew or should have known that his actions would cause harm, the defendant owes a legal duty to the plaintiff.

Courts usually use the Hand Formula, created by Judge Learned Hand in *United States v. Carroll Towing*, to determine whether there was a breach of duty: if the burden of taking precautions is less than the probability of harm multiplied by the severity of the harm, then the duty of reasonable care has been breached (Posner, 1972, 33: "When the cost of accidents is less than the cost of prevention, a rational

[105] Although the case law applying them varies from state to state, tort causes of action share common features and definitions. The Restatement of Torts, while not binding in any state's courts, provides a starting point to which decisions in a given state's courts can add nuance and specificity.

profit-maximizing enterprise will pay tort judgments to the accident victims rather than incur the larger cost of avoiding liability.") In the nitrogen fertilizer context, plaintiffs must show that defendants manufactured (or continued to manufacture) fertilizer while knowing that its use was likely to cause groundwater contamination, hypoxia, or harmful algal blooms. In addition, plaintiffs will have to show that the manufacturer defendants could have taken steps to mitigate the damage – reformulating fertilizers, or instructing farmers to minimize application rates, or funding conservation measures that would reduce nitrogen fluxes.

Nuisance and trespass

A public nuisance is an unreasonable interference with a right common to the general public. Restatement (Second) of Torts § 821B (American Law Institute, 1979). Interference with a public right is unreasonable if, for example, it (a) significantly interferes with public health, safety, peace, comfort or convenience; (b) is proscribed by a statute, ordinance or administrative regulation, or (c) is ongoing/permanent and the defendant knows or should know it significantly affects a public right. Public nuisances "are said to emerge when a large number of parties are affected negatively and simultaneously, at the margin, by an action undertaken by an individual or group," or when "public property, such as a navigable stream or state-provided highway, is adversely affected by the action of an economic agent" (Boudreaux & Yandle, 2003, 59-60).

Common law has construed public rights to include unpolluted air and water (Cusack, 1993; see *State v. Lead Indus. Ass'n*, 951 A.2d 428, 453 (R.I. 2008)). Some

scholars (Dana, 2008; Merrill, 2011) have argued that public nuisance in the environmental context is not really a tort but a public action in disguise – i.e., an attempt to create and implement sweeping public policy using the court system rather than the legislature (improperly, in their view). However, accumulating precedent over time has applied public nuisance law in situations where shared public resources have been contaminated by persistent diffuse substances, like MTBE or PCBs, which (unlike asbestos or lead paint) cause harm even without being disturbed (Fritz, 2020). Since nitrogen in fertilizer is unstable and migrates into water without human intervention beyond its initial application, it more closely resembles MTBE and PCBs in this respect than asbestos, which is generally stable unless disturbed.

The loss of livelihood suffered by fishermen and others affected economically by hypoxia and harmful algal blooms is not a property right per se, and this category of potential plaintiffs cannot base a private nuisance or trespass claim on that loss. But because the algal blooms damage a public resource, and because these plaintiffs' loss of livelihood is different from injuries suffered by the public at large as a result of that damage, they can make a public nuisance claim using the special injury rule.[106] A New York case, *Leo v. General Electric*, 145 A.D.2d 291, 294 (N.Y. App. Div. 1989), is analogous: PCB contamination of fish stocks led to a ban on the sale of striped bass, threatening the livelihoods of commercial fishermen, whom the court allowed to pursue a public nuisance claim against the manufacturers of PCBs. The

[106] Private plaintiffs cannot bring public nuisance claims unless they have suffered a "special injury" as a result of the nuisance, or one that is different in kind from the harm suffered from the rest of the public (Merrill, 2011).

court noted its "agreement with the reasoning in numerous decisions of our sister States which have addressed the issue and which have found that commercial fishermen do have standing to complain of the pollution of the waters from which they derive their living." *Id.* at 294-295.[107] In *Leo,* the defendants challenged the standing of plaintiff fishermen's organizations to sue as the representatives of their members. In response, the court noted that the associations sought prospective relief (injunctions against the offending activity), not just money damages, and the prospective relief would presumably "inure to the benefit of the members actually injured." *Id.* at 295. In a nitrogen fertilizer case, not only could those whose livelihoods were threatened allege public nuisance, but they would not necessarily have to sue as individuals.

Large numbers of people can be affected by higher costs of drinking water, including the costs of installing treatment facilities, drilling new wells, and subsidizing the purchase of water from alternate sources, which can lead to higher water rates and taxes (Pollans, 2016). However, since water customers have not suffered a qualitatively different injury from the general public, they cannot pursue a public nuisance claim – but a state or municipality could sue on their behalf as *parens patriae* protecting a public right.

---

[107] *Carson v Hercules Powder Co.,* 240 Ark. 887, 402 S.W.2d 640; *Hampton v North Carolina Pulp Co.,* 223 N.C. 535, 27 S.E.2d 538; *Columbia Riv. Fishermen's Protective Union v City of St. Helens*, 160 Or. 654, 87 P.2d 195, *State of Louisiana ex rel. Guste v M/V Testbank,* 524 F. Supp. 1170; *Pruitt v Allied Chem. Corp.,* 523 F. Supp. 975; *Burgess v M/V Tamano*, 370 F. Supp. 247, aff'd 559 F.2d 1200.

A private nuisance is defined as the invasion of another's interest in the private use and enjoyment of land (or other real property). The invasion must be either (a) intentional and unreasonable, or (b) unintentional and negligent, reckless, or abnormally dangerous. Restatement (Second) of Torts § 822 (American Law Institute, 1979). An intentional invasion is unreasonable if (a) the gravity of the harm outweighs the utility of the conduct, or (b) the harm is serious, and the financial burden of compensating those harmed would not make the conduct infeasible. Restatement (Second) of Torts § 826. The gravity of the harm depends on its extent and character, the social value of the invaded interest, the suitability of the invaded interest to its locality, and the burden to the *plaintiff* of avoiding the harm (plaintiff's duty to avoid preventable injury, in other words). Restatement (Second) of Torts § 827-828. Nitrate and cyanotoxin contamination interferes with the ability of drinking water utilities to use their property as drinking water; to recover damages, plaintiffs would have to show that fertilizer manufacturers acted negligently or recklessly in allowing their products to degrade water supplies.

A claim for trespass will lie if the defendant intentionally (a) enters plaintiff's property (or causes something to do so), (b) remains there, or (c) fails to remove something he has a duty to remove. Restatement (Second) of Torts § 158 (American Law Institute, 1965). There are several significant differences between trespass and other torts, even though they may arise from the same set of actions and circumstance: unlike nuisance, there are no elements of harm, negligence, or cost-benefit analysis in trespass. Thus, defendant's entry onto plaintiff's property

automatically creates liability, whether or not the property was damaged and whether or not the entry was negligent or reasonable; however, courts can be reluctant to award damages or issue injunctions where the trespass has not demonstrably caused any harm (Roisman & Wolff, 2010). In the environmental tort context, contamination of real property by chemicals such as trichloroethylene, gasoline, and drifting pesticide spray have all given rise to trespass liability (Centner, 2014; Rhymes, 2012). But Centner (2014) notes that the modern view of trespass does not tend to find that intangible pollution creates liability unless the pollution also causes "substantial damage" to the property.

Products liability

Section 402A of the Restatement (Second) of Torts described a relatively new tort based on the sale of defective products, stating that sellers could be held liable for harm caused by unreasonably dangerous defective products, even if the seller exercised all possible care in preparing the product, and even if the one harmed was not the original purchaser. Restatement (Second) of Torts § 402A (American Law Institute, 1965). Of note: while nuisance claims require plaintiffs to show that defendants were negligent, defective-product claims do not.

After thirty more years of judicial interpretation of products liability law, the Restatement (Third) of Torts updated this definition: "One engaged in the business of selling or otherwise distributing products who sells or distributes a defective product is subject to liability for harm to persons or property caused by the defect." Restatement (Third) of Torts § 1 (American Law Institute, 1998). The defect giving

rise to liability can be either a manufacturing defect, a design defect, or a failure to warn of a potential danger associated with the product. A product "is defective in design when the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design," and the failure to adopt this alternative renders the product unsafe. Restatement (Third) of Torts § 2(b) (American Law Institute, 1998). A product "is defective because of inadequate instructions or warnings when the foreseeable risks of harm posed by the product could have been reduced or avoided by the provision of reasonable instructions or warnings by the seller," and the failure to include such warnings renders the product unsafe. Restatement (Third) of Torts § 2(c) (American Law Institute, 1998).

> Comment d to § 2 further explains what is meant by defective design:
> A product asserted to have a defective design meets the manufacturer's design specifications but raises the question whether the specifications themselves create unreasonable risks. . . . the test is whether a reasonable alternative design would, at reasonable cost, have reduced the foreseeable risks of harm posed by the product and, if so, whether the omission of the alternative design by the seller or a predecessor in the distributive chain rendered the product not reasonably safe....Under prevailing rules concerning allocation of burden of proof, the plaintiff must prove that such a reasonable alternative was, or reasonably could have been, available at time of sale or distribution.
> Restatement (Third) of Torts § 2, cmt. d (American Law Institute, 1998).

In the climate change cases, some of the plaintiffs have included defective design claims, saying that defendant fossil fuel manufacturers had a reasonable alternative: "in light of their extensive knowledge of the hazards of placing fossil fuel products into the stream of commerce," defendants should have chosen "to pursue and adopt known, practical, and available technologies, energy sources, and business practices that would have mitigated their greenhouse gas pollution and eased the transition to a

lower carbon economy, reduced global CO2 emissions, and mitigated the harms associated with the use and consumption of such products."[108] Courts applying the risk-utility balancing test set out in the Restatement (Third) who have interpreted the "reasonable alternative" requirement have often required the alternative product to be substantially similar to the original. For example, in *Niedner v. Ortho-McNeil Pharmaceutical, Inc.,* 90 Mass. App. Ct. 306 (2016) a teenage girl died from a blood clot potentially attributable to the use of a contraceptive patch. Plaintiff claimed that contraceptives in pill form were a "safer alternative," but the court found that although the two products had similar effects, they had "fundamentally different" mechanisms. In other words,

> [a] plaintiff cannot demonstrate the existence of a safer alternative design by pointing to a substantially different product, even when the other product has the same general purpose as the allegedly defective product. A safer alternative design must be one for the product at issue, not a different product." *Massa v. Genentech, Inc.,* 2012 WL 956192, *7 (S.D. Tex. Mar. 19, 2012).

See also *Torkie-Tork v. Wyeth*, 739 F. Supp.2d 895, 900 (E.D. Va. 2010) ("an alternative design must not be an altogether essentially different product"); *Linsley v. C.R. Bard, Inc*., 2000 WL 343358, *3 (E.D. La. March 30, 2000) (alternative usage techniques are not the same as alternative designs); *Caterpillar v. Shears*, 911 S.W.2d 379, 384-85 (Tex. 1995) ("A motorcycle could be made safer by adding two additional wheels and a cab, but then it is no longer a motorcycle."); *Evans v.*

[108] Santa Cruz City Complaint para. 289(e), Santa Cruz County Complaint 248(g), PCFFA Complaint 211(e), Richmond Complaint 250(e), Marin Complaint 185(g), San Mateo Complaint 184(g), Imperial Beach Complaint 181(g).

Lorillard Tobacco Co., 990 N.E.2d 997, 1017 (Mass. 2013) ("in a case where the allegedly defective product is a cigarette, the reasonable alternative design must also be a cigarette").

But not all courts apply a risk-utility balancing test, under which the existence of an alternative design tends to lower the relative utility of the existing design. Some states instead apply a "consumer expectations" test: a product is defectively designed if the plaintiff can show that the product failed to perform as safely as an ordinary consumer would expect when used in the intended or a reasonably foreseeable manner. The Florida Supreme Court has expressly rejected the reasonable alternative requirement, holding that "in approaching design defect claims, we adhere to the consumer expectations test, as set forth in the Second Restatement, and reject the categorical adoption of the Third Restatement and its [requirement for a] reasonable alternative design." *Aubin v. Union Carbide Corp.,* 177 So.3d 489, 510 (Fla. 2015). Other states that predominantly use the consumer expectations test include Arkansas, Kansas, Nevada, Indiana, and Utah. Some states allow either test (including Alaska, Arizona, California, Connecticut, Florida, Hawaii, Illinois Ohio, Oregon, and Tennessee), but may limit the use of the consumer expectations test to less-complex products (see, e.g., *Soule v. Gen. Motors Corp.,* 8 Cal. 4th 548, 567 (Cal. 1994) ("the consumer expectations test is reserved for cases in which the everyday experience of the product's users permits a conclusion that the product's design violated minimum safety assumptions, and is thus defective regardless of expert opinion about the merits of the design"). Nebraska, Kansas, and Missouri do not hew as closely as other states

to the Restatement in this area, and do not strictly require alternative designs in negligent design defect cases. See *Rahmig v. Mosley Machinery Co.,* 412 N.W.2d 56, 82 (Neb. 1987); *Jenkins v. Amchem Products, Inc.,* 886 P.2d 869, 890 (Kan. 1994); *Bavlsik v. General Motors LLC*, 2016 WL 362512, at *2 (Mag. E.D. Mo. Jan. 29, 2016).

Thus, in states that allow a consumer expectations test for defective design, plaintiffs would only have to show that consumers would not ordinarily expect that using nitrogen fertilizers as intended will lead to contaminated drinking water or algal blooms. Plaintiffs suing in a state that requires a risk-utility balancing test to find defective design, on the other hand, would likely have to persuade a court that there was a reasonably feasible alternative design *for nitrogen fertilizer* that would reduce the risk of nitrate water contamination or harmful algal blooms – a difficult task, but possibly as simple as a more dilute formulation applied in lower amounts. Fertilizer manufacturers would likely argue that this alternative design would be less effective at promoting crop growth. But in *Brochu v. Ortho Pharmaceutical Corp*., 642 F.2d 652 (1st Cir.1981), the court held that the high concentration of estrogen in an oral contraceptive rendered it defectively designed, when a pill with half as much estrogen was marketed by the same defendant manufacturer. Id. at 654-55. There is evidence that applying fertilizer to crops where the soil is already saturated with nitrogen from previous years' applications does not lead to a concomitant increase in productivity (Halvorson, Schweissing, Bartolo, & Reule, 2005). As nitrogen rates increase, the incremental yield increase is reduced until higher nitrogen inputs result in no change

in yield (Franzen, 2015; Sawyer, 2015). New crop varieties with improved nitrogen use efficiency (NUE) do not require as much nitrogen as older varieties (Woli et al., 2016). For some crops, lowering nitrogen inputs leads to very small reductions in yield, but relatively large reductions in nitrogen fluxes to groundwater (Amon-Armah, Yiridoe, Jamieson, & Hebb, 2015).

Theories of causation

For the climate change lawsuits, establishing duty, breach, and causation will be challenging – especially causation (Kysar, 2011; Lin & Burger, 2018). Plaintiffs in any toxic tort case must be able to establish both generic causation (the pollutant at issue is capable of causing the *kind* of harm suffered by plaintiffs) and specific causation (defendant's pollutant actually did cause the specific harm suffered by plaintiffs) (Grossman, 2003). The climate change plaintiffs have alleged at least a probabilistic association between greenhouse gas emissions and the climatic harms they have suffered, and nitrogen plaintiffs would find it similarly straightforward to establish that nitrogen in fertilizer *can* raise nitrate levels in groundwater or promote algal blooms. But demonstrating the unbroken causal chain leading from defendants' actions to plaintiffs' eventual injuries is a tricky proposition for both.

Proving specific causation is especially difficult when the causal chain is long and involves intermediaries. In cases brought by municipalities against handgun manufacturers, for example, the injuries in question are generally caused by criminals, over whom the manufacturers have no control (Grossman, 2003). Courts have sometimes found the link "too attenuated to attribute sufficient control to the

manufacturers" of handguns, since the manufacturers were not in a position to prevent unauthorized owners from causing harm. *Camden County Bd. of Chosen Freeholders v. Beretta, U.S.A. Corp.,* 273 F.3d 536, 541 (3d Cir. 2001). Others have asked whether the end result was, or should have been, reasonably foreseeable to the manufacturer. *Young v. Bryco Arms*, 765 N.E.2d 1, 18-19 (Ill. App. Ct. 2001).

In some jurisdictions, the defendant must have control over the instrumentality causing harm, such that they are in a position to abate the nuisance at the time of plaintiff's complaint. In Rhode Island, for example, lead paint manufacturers were not held liable for lead contamination in buildings because after the paint was sold, they no longer had any control over where or how it was applied and could no longer prevent the harm. *State of Rhode Island v. Lead Industries Association,* 951 A.2d 428, 434, 435, 480 (R.I. 2008). In California, by contrast, "[n]ot only is the party who maintains the nuisance liable but also the party or parties who create or assist in its creation are responsible for the ensuing damages." *Mangini v. Aerojet-General Corp.,* 230 Cal.App.3d 1125, 1137 (1991). In the face of arguments that defendants give up control of their products at the point of sale, plaintiffs in Rhode Island and similar jurisdictions may still be able to bring public nuisance claims by pointing out that defendants continue to promote excessive fertilizer use, and could abate at least some of the nuisance they have caused by stopping (see Lin & Burger, 2018).

Fertilizer manufacturers may point to the actions of farmers in applying fertilizer as an intervening cause that relieves them of responsibility, since farmers

make choices about the timing and amount of fertilizer application over which manufacturers have no control. However, for a case involving an entire watershed's worth of fertilizer application, the contribution of any individual farmer may be insignificant, and therefore would not be the legal cause of a watershed-wide injury. See Restatement (Second) of Torts, § 834 cmt. d (1979). Moreover, farmers do not operate in isolation, but receive information from manufacturers via product labels and advertising, and manufacturers are likely to have information about practices and purchasing habits of farmers in a given market as well.

"Where the acts of a third person intervene between the defendant's conduct and the plaintiff's injury, the causal connection is not automatically severed. In such a case, liability turns upon whether the intervening act is a normal or foreseeable consequence of the situation created by the defendant's negligence." *Derdiarian v. Felix Contracting Corp.,* 51 N.Y.2d 308, 315 (1980); *Higazy v. Templeton*, 505 F.3d 161, 177 (2d Cir. 2007) ("it is not readily apparent why the chain of causation should be considered broken where the initial wrongdoer can reasonably foresee that his misconduct will contribute to an 'independent' decision"). Manufacturers have been held liable for trespasses caused by products that the manufacturer knows are likely to cause harm only after use by third parties. See *In re Methyl Tertiary Butyl Ether Prods. Liab. Litig.,* 725 F.3d 65, 120 (2d Cir. 2013); *State v. Fermenta ASC Corp.,* 238 A.D.2d 400, 404 (2d Dep't 1997) (holding liable a pesticide producer who directed consumers to apply pesticide to soil).

The fate of nitrogen fertilizer after sale is presumably well-understood to the manufacturers. The *In re MTBE* court held that allegations that gasoline refiners "marketed and promoted MTBE knowing that underground storage tanks ... could not safely contain MTBE" were "sufficient to sustain a nuisance claim against the defendants" under California law. *In re Methyl Tertiary Butyl Ether (MTBE) Prods. Liab. Litig.* (S.D.N.Y. 2006) 457 F.Supp.2d 455, 464. The Second Circuit affirmed this interpretation, holding that a defendant producing a product may be held liable for nuisance when it knows that its product will escape into the environment with harmful consequences. *In re Methyl Tertiary Butyl Ether Prods. Liab. Litig.,* 725 F.3d 65, 120-21 (2d Cir. 2013). Simply marketing and promoting a product, while knowing that it would be used in systems that could not keep it contained, could be enough to hold defendants liable for causing the harm (Biber, 2017). Where there are multiple contributors to a single harm—even a very large number of contributors—each may be held liable, but the court need not trace molecules back to defendants. *See, e.g., Cox v. City of Dallas*, 256 F.3d 281, 292 n.19 (5th Cir. 2001) ("[N]uisance liability at common law has been based on actions which 'contribute' to the creation of a nuisance"). As the Restatement provides, "the fact that other persons contribute to a nuisance is not a bar to the defendant's liability for his own contribution." Restatement (Second) of Torts § 840E (1979) cmt. b ("It may, for example, be unreasonable to pollute a stream to only a slight extent, harmless in itself, when the defendant knows that pollution by others is approaching or has reached the point

where it causes or threatens serious interference with the rights of those who use the water.")

However, the courts cannot hold liable defendants who did *not* contribute to the problem. In lead paint and asbestos cases, identifying the legally responsible party – the maker of the *specific* lead paint or asbestos product found in the building in question – can be impossible, because these products, like fertilizer, are essentially generic, manufactured by many different companies in the same way. The problem is compounded in all three cases by the lag between exposure and injury; even if the injury can be traced back to an exposure at a particular moment, records or memories of the manufacturer of the specific product may already be gone (Gerrard, 2011; Perillo, 2004).

In the case of Agent Orange, a defoliant used during the Vietnam War that caused cancer in soldiers exposed to it, the court developed a market share theory of liability to apportion fault among several possible manufacturers, any of whom could have made the Agent Orange that caused a given plaintiff's cancer. Instead of trying to trace each plaintiff's exposure back to the original product sale, each defendant's liability was assigned in proportion to its share of the Agent Orange market. See *In re Agent Orange Prod. Liab. Litig. (Agent Orange 1),* 597 F. Supp. 740, 827-28 (E.D.N.Y. 1984). In another notorious case, diethylstilbestrol (DES) had been marketed to pregnant mothers as a miscarriage preventative, but later shown to cause cancer in their daughters. *Sindell v. Abbott Labs.,* 607 P.2d 924, 925 (Cal. 1980). One such victim, the daughter of a woman who had taken DES during her pregnancy, sued

ten DES manufacturers. *Id.* at 926 n.4. She knew that one of them had likely produced the drug her mother took, but could not know which one. *Id.* at 926. To avoid the injustice of letting all companies off the hook when one had definitely caused the harm, the court developed

> an exception to the usual "causation" requirement: if, through no fault of her own, the plaintiff is unable to identify the manufacturer of the generic product which injured her, she may proceed by joining a "substantial share" of the manufacturers in the relevant market as defendants. Once the plaintiff demonstrates that the product in question caused her injuries, the burden shifts to the individual defendants to show that they could not have been responsible for the injury. If they cannot, liability for the injury will be assessed on the defendants proportional to their share in the relevant market. (Nick, 2008).

Researchers have developed methods of determining each fossil fuel company's contribution to climate change (Heede, 2014); tracing sales data to calculate the market share of fertilizer manufacturers in a given watershed is a simpler proposition.

Of course, the market share of a fertilizer manufacturer does not correspond to the same share of nitrogen in a water body, because many natural and anthropogenic sources may also contribute. "For example, riparian uses such as fishing may be impaired by increased nutrient loading in a stream resulting from land application of animal waste. However, many farmers may be applying the waste, and the pollutant of concern may also be found naturally in the stream." (Noble & Looney, 1994). Under these conditions, fertilizer manufacturers could well complain that not only is the correct proportion of blame in doubt, but question whether they deserve any of the blame at all.

As far as climate change is concerned, carbon dioxide and other greenhouse gases are evenly distributed in the atmosphere, and the relative contribution of any

molecule to an increase in global temperature is independent of where it was released or where it ends up. In contrast, different water bodies can have nitrogen loads that are predominantly, moderately, or only marginally attributable to synthetic[109] fertilizer use; harmful algal blooms and nitrate contamination can be of completely natural origin, though few currently are. Before plaintiffs can reach the question of market share, they must first prove that synthetic fertilizer caused *any* share of the problem.

Nitrate in water is composed of one nitrogen atom and three oxygen atoms. All atoms are made up of electrons, protons, and neutrons; the number of protons determines what element the atom is (nitrogen atoms always have seven protons, and oxygen atoms always have eight protons). Atoms with the same number of protons, but different numbers of neutrons, are called isotopes of that element. Since atomic weight is the sum of the number of protons and number of neutrons, isotopes of the same element will have different atomic weights (Shelley & Love, 2015). For example, two isotopes of nitrogen (N) are ^{14}N (with 7 protons and 7 neutrons) and ^{15}N (with 7 protons and 8 neutrons). The majority of N in the atmosphere is composed of ^{14}N (99.6337%) and the remainder is composed of ^{15}N (0.3663%) (Junk & Svec, 1958). Oxygen (O) has three stable isotopes, ^{16}O (99.759%), ^{17}O (0.037%), and ^{18}O (0.204%); all three have eight protons, but have eight, nine, and ten neutrons, respectively (Cook & Lauer, 1968). Isotopic composition is the ratio of heavier to

[109] That is, fertilizer produced using the Haber-Bosch process or similar, rather than compost or animal manure.

lighter isotopes in a given sample (Mancini, Pence, Kavanaugh, Davidson, & Sherwood, 2017).

Isotopic analysis is an environmental forensics technique that takes advantage of the slightly different isotope ratios of elements in compounds that have undergone certain kinds of processing or transformation. The extremely small differences in mass between different isotopes of the same element can lead to changes in isotopic composition, depending on the compound's source or how it has been processed. For instance, perchlorate, a compound of chlorine and oxygen, features slightly different ratios of chlorine and oxygen isotopes depending on whether its source is an industrial manufacturing process, nitrate deposits in the Chilean desert, or atmospheric deposition (Sturchio, Beloso, Heraty, Wheatcraft, & Schumer, 2014). This difference allowed researchers to determine that the likely source of perchlorate in a municipal drinking water supply was Chilean nitrate, imported for use as fertilizer decades earlier – a determination at issue in *City of Pomona v. SQM North America Corporation,* 750 F.3d 1036 (9th Cir. 2014). The Ninth Circuit held that isotopic analysis could be a reliable scientific methodology for identifying contaminant sources. *Id.* at 1052.

Similarly, the source of nitrate pollution can sometimes be identified using stable isotopes of both nitrogen and oxygen (Burns, Boyer, Elliott, & Kendall, 2009; Puig et al., 2017; Xue et al., 2009). Dual isotope studies have been able to distinguish nitrate derived from atmospheric deposition, animal waste, and fertilizer where direct measurements have not (Burns et al., 2009; Kendall et al., 1995; Mayer, Reynolds,

McCutchen, & Canfield, 2007; Murgulet & Tick, 2013; Zheng, Zhao, Qin, Ma, & Han, 2016). This is because each of these sources tends to produce a different characteristic "mix" of predominant nitrogen and oxygen isotopes, as seen in the table below. For nitrate, $\delta^{15}N$ represents the $^{15}N/^{14}N$ ratio of a sample, and $\delta^{18}O$ is the $^{18}O/^{16}O$ ratio. When δ_{sample} is positive, the heavy isotope is enriched relative to a common standard, and when δ_{sample} is negative, the heavy isotope is depleted relative to a common standard (Xue et al., 2009).

Table __: Isotopic composition of nitrate from various sources.

Source	**Nitrogen Isotope**	**Oxygen Isotope**
Atmospheric deposition	-13‰ to +13‰ $\delta^{15}N$ [110]	>60‰ $\delta^{18}O$ [111]
Microbial nitrification products	[Varies by source][112]	+3.8‰ to +4.3‰ $\delta^{18}O$ [113]
Synthetic fertilizers	-6‰ to +6‰ $\delta^{15}N$ [114]	+17‰ to +25‰ $\delta^{18}O$ [115]
Animal manure	+5‰ to +25‰ $\delta^{15}N$ [116]	-5‰ to +15‰ $\delta^{18}O$ [117]
Sewage	-4‰ to +19‰ $\delta^{15}N$ [118]	-5‰ to +15‰ $\delta^{18}O$ [119]

These isotope ranges are used to distinguish between sources of N in a sample. Specifically, $\delta^{15}N_{NO3}$ values can help to distinguish nitrate from ammonium-

[110] Xue et al. 2009, citing Huebner 1986 and Kendall 1998
[111] Elliott et al. 2007; Michalski et al. 2003 (atmospheric NO_x reacts with ozone (O3) having over 90% $\delta^{18}O$ to form atmospheric HNO_3, so atmospheric NO_3- has a high proportion of $\delta^{18}O$).
[112] Xing & Liu, 2016
[113] Urresti-Estala et al., 2015
[114] Xue et al 2009, citing Flipse and Bonner 1985 (all are produced by fixation of atmospheric nitrogen, without much isotopic fractionation in processing, so there are small differences in $\delta^{15}N$ content among ammonium, nitrate, and urea fertilizers)
[115] Xue et al. 2009, citing Amberger and Schmidt 1987 (oxygen in fertilizer mainly derived from atmospheric oxygen, with a $\delta^{18}O$ of ~23.5‰).
[116] Xue et al., 2009
[117] Xue et al., 2009
[118] Xue et al., 2009
[119] Xue et al., 2009

based fertilizer vs. soil organics vs. animal waste, and $\delta^{18}O_{NO3}$ values can help to distinguish synthetic fertilizer from both atmospheric nitrate and endogenous soil nitrate (Kendall et al., 1995; Mayer et al., 2007) In combination with groundwater flow models, fertilizer sales records, and hydrogeological studies, this information may help plaintiffs identify sources of nitrate contamination and thus allocate responsibility to fertilizer manufacturers.

Isotopic analysis is also part of the causation analysis linking fossil fuel producers to climate change. Graven, Keeling, and Rogelj (2020) have explained how a portion of atmospheric carbon dioxide can be attributed to burning fossil fuels using isotopic analysis. One of the isotopes of carbon, ^{14}C, is a radioisotope that decays relatively quickly (with a half-life of 5,700 years), so that fossil fuels are virtually free of ^{14}C after millions of years underground. The other two major isotopes present in atmospheric carbon dioxide are ^{12}C and ^{13}C. ^{12}C is preferentially absorbed during photosynthesis; since fossil fuel carbon originated in ancient plants, fossil fuels have more ^{12}C and less ^{13}C than pre-industrial atmospheric carbon dioxide (the carbon isotope ratios of which can be measured in ice cores). Thus, burning fossil fuels adds relatively ^{14}C- and ^{13}C-depleted carbon dioxide to the atmosphere, increasing the proportion of ^{12}C (Graven, Keeling, & Rogelj, 2020).

The foregoing chapter catalogs the important elements of a potential lawsuit, modeled after the climate change lawsuits described in Chapter 3, and discusses the approaches plaintiffs might take and challenges they might face. The next chapter takes a broader perspective: why have no such cases yet been filed, what is the

political and practical context, and what impacts beyond the courtroom would a fertilizer lawsuit have?

Chapter 5: Context, challenges, and opportunities

> "The life of the law has not been logic; it has been experience."
> – Oliver Wendell Holmes

A new round of litigation over (a) widespread environmental harm that is seemingly impervious to regulation, brought by (b) plaintiffs who have suffered economic loss or property damage, against (c) the original manufacturers of the offending product, raising (d) tort causes of action, would follow a well-trodden path. Nitrogen fertilizer lawsuits in this mold would share many features with the recent spate of climate change cases described in Chapter 3, which themselves build on older battles over asbestos, lead paint, tobacco, MTBE, Agent Orange, and others. They would also face many of the same challenges: identifying a group of potentially liable defendants, framing their claims as matters of state common law rather than federal regulation, building evidence-based theories of causation, and demonstrating product manufacturers' foreknowledge of the potential harm.

Accomplishing these tasks is no guarantee of success for the plaintiffs: strong cases sometimes fail for unpredictable reasons, and similar cases can meet very different fates in different courtrooms. But the value of nitrogen fertilizer litigation, like the climate change cases, may lie elsewhere. Since the climate change suits were filed, there has been renewed interest in legislation that would tax carbon but relieve fossil fuel producers of tort liability for climate change.

> [L]itigation pressure on the companies could lead to settlements that would include changes in how the companies operate. They could, for example, trade a framework for carbon taxes that could finance infrastructure for protection from legal liability. Exxon, which has publicly acknowledged climate change

> and supported the Paris climate agreement, has already said that it would support a carbon tax. (Schwartz, 2018)

Carbon taxes have been proposed by both Republicans and Democrats, as well as the oil companies themselves, though proposals differ in magnitude across the political spectrum (Schwartz, 2017). This is not a completely surprising outcome; the credible threat of industry-wide litigation can sometimes revive interest in public policy solutions that have stalled. In a similar vein, a coordinated spate of nitrogen fertilizer litigation could stimulate new efforts to give TMDLs real teeth. "Public support for such efforts may also increase in response to high salience contamination events. In Iowa, for instance, 60% of residents support the Des Moines Water Works lawsuit." (Pollans, 2016) Although Professor Pollans views novel litigation over nitrogen as a path to greater regulation of farmers, it may – by highlighting the responsibility of manufacturers – lead to manufacturer-focused policy.

This feedback cycle can also be seen as a natural consequence of weak enforcement against environmental problems with broad impacts. In a story for The Climate Docket, Professor Paul Nolette noted an interaction between the political milieu and plaintiffs' motivation in the context of the climate change cases: "When Obama came in, [plaintiffs] thought the EPA would take more aggressive action, so they held back … I do expect [during the Trump administration] considerably more litigation and attempts in state court to push these innovative claims that have been lying dormant in the years that the Obama administration was taking administrative action . . ."(The Climate Docket, 2018). Future litigation choices, similarly, will be

influenced by potential plaintiffs' beliefs about the likelihood of effective regulation if they do not act.

This is particularly true for drinking water utilities who face real costs in dealing with nitrogen contamination. "As filtration and treatment costs rise for municipalities, water utilities and the state agencies overseeing them will continue to seek alternate approaches, including using litigation to reallocate mitigation costs from municipal ratepayers to farmers." (Pollans, 2016) Lin and Burger (2018), similarly, believe that climate change lawsuits could provide the necessary impetus not only for direct regulatory action of some kind, but could also "encourage an industry shift away from fossil fuels, and shape the narrative on the reality of- and responsibility for-climate change." This narrative-shaping, norm-shifting effect can have a significant impact; as Larry Lessig put it, "[t]he regulatory effect of norms comes not from something physical or behavioral…. [but] from something interpretive." (Lessig, 1998, p. 680). In other words, lawsuits over nitrogen may be seen not just as economic responses to price signals, but may also signal that the social norm of unchecked pollution is no longer acceptable. The language in the climate change complaints, at points, refers explicitly to this moral dimension: "[fossil fuel companies'] conduct was willful, intentional, and in conscious disregard for the rights of others. Defendants' conduct was so vile, base, and contemptible that it would be looked down upon and despised by reasonable people."[120] Litigation

[120] Imperial Beach Complaint at para. 183.

keeps issues like these alive in the mind of the public and can influence public opinion. (Vallejo & Gloppen, 2013)

The availability and strength of scientific evidence that can support a causation analysis is another major influence on litigant's choices. Early climate litigation was unsuccessful in part because plaintiffs could not firmly establish causal links between defendants' conduct and their injuries, but as the connection between fossil fuel consumption and climate-related harms gets stronger, so do these cases (Ganguly et al., 2018). The same is true for potential nitrogen fertilizer litigation. For example, dual isotope analysis of nitrate, which can help plaintiffs eliminate potential alternative sources of the nitrogen causing harm, is relatively new; the earliest scientific papers using the technique date back to the early 1990s (Kendall et al., 1995), and since 2008 there has been a noticeable increase in papers on the topic.

The legal context in which these cases take place also makes a difference. None of the suits discussed in Chapter 3 has arrived at a final disposition in court, and some may be settled by the parties before that happens. But a nitrogen lawsuit filed in the wake of a recent, successful bout of litigation following this model may look very different from one that follows defeat. If appellate courts decide that sweeping litigation against fossil fuel companies is indeed barred by the political question doctrine, fertilizer companies – who make a product to which some say billions of lives are owed (Smil, 2001) – are likely to be similarly immune. Potential plaintiffs may then make different choices about defendants – focusing on distributor messaging about fertilizer application rates, for instance, instead of manufacturers'

knowledge of the possible harms. On the other hand, if the courts take up the task of assigning the costs of externalities like pollution to those who can efficiently avoid the harm, defendants may find themselves more inclined to settle.

Other avenues and models of litigation may emerge as well. On April 23, 2020, the U.S. Supreme Court held in *County of Maui v. Hawaii Wildlife Fund*, 140 S. Ct. 1462 (2020) that unpermitted discharges to groundwater violated the Clean Water Act if they were "functionally equivalent" to direct discharges to surface water – a revision or clarification of the "significant nexus" language of *Rapanos v. United States,* 126 S. Ct. 2208 (2006). In *County of Maui,* a wastewater treatment facility was injecting wastewater into the ground as a form of disposal. Researchers found that a large percentage of this wastewater was seeping into the ocean, but – since it was not discharging directly into a navigable waterway – the facility had not applied for an NPDES permit under the Clean Water Act. The Court limited its holding, however:

> Where a pipe ends a few feet from navigable waters and the pipe emits pollutants that travel those few feet through groundwater (or over the beach), the permitting requirement clearly applies. If the pipe ends 50 miles from navigable waters and the pipe emits pollutants that travel with groundwater, mix with much other material, and end up in navigable waters only many years later, the permitting requirements likely do not apply. *County of Maui,* 126 S. Ct. at 2220.

Whether or not the tile drains at issue in *Des Moines Water Works* – far closer than fifty miles to navigable waterways – would have met this new definition of a point source is unknown. Nonpoint sources are not directly affected by the ruling, but the

decision hints at an evolution toward a more hydrogeologically conscious jurisprudence, recognizing ecophysical realities and interpreting the law accordingly.

In closing, note that none of the foregoing is legal advice, nor is it a policy recommendation. Novel litigation strategies (or common litigation strategies used in novel contexts) involve substantial risk and uncertainty. I have attempted to shed light on some of these uncertainties, but the topic is not readily susceptible to prediction.

References

Aagaard, T. S. (2014). Environmental law outside the canon. *Indiana Law Journal*, *89*(3), 1239–1298.

Abate, R. S. (2008). Automobile emissions and climate change impacts: Employing public nuisance doctrine as part of a "global warming solution" in California. *Conn. L. Rev.*, *40*, 591–630. https://doi.org/10.3868/s050-004-015-0003-8

Adler, D. P. (2018). *U.S. climate change litigation in the age of Trump: Year one*. Retrieved from http://columbiaclimatelaw.com/files/2018/02/Adler-2018-02-Executive-Summary-for-Climate-Change-Litigation-in-the-Age-of-Trump-Year-One.pdf

Adler, R. W. (1999). Integrated approaches to water pollution: Lessons from the Clean Air Act. *Harvard Environmental Law Review*, *23*, 203–295.

Adler, R. W. (2013). The decline and (possible) renewal of aspiration in the Clean Water Act. *Washington Law Review*, *88*, 759–813.

Alberini, A., & Segerson, K. (2002). Assessing voluntary programs to improve environmental quality. *Environmental and Resource Economics*, *22*, 157–184. https://doi.org/10.1023/A:1015519116167

Alexander, R. B., Smith, R. A., Schwarz, G. E., Boyer, E. W., Nolan, J. V., & Brakebill, J. W. (2008). Differences in phosphorus and nitrogen delivery to the Gulf of Mexico from the Mississippi River Basin. *Environmental Science and Technology*, *42*(3), 822–830. https://doi.org/10.1021/es0716103

American Law Institute. (1965). *Restatement of the law of torts, 2d*. St. Paul, Minnesota: American Law Institute Publishers.

American Law Institute. (1979). *Restatement of the law of torts, 2d*. St. Paul, Minnesota: American Law Institute Publishers.

Amon-Armah, F., Yiridoe, E. K., Jamieson, R., & Hebb, D. (2015). Comparison of crop yield and pollution production response to nitrogen fertilization models, accounting for crop rotation effect. *Agroecology and Sustainable Food Systems*, *39*(3), 245–275. https://doi.org/10.1080/21683565.2014.967435

Anderson, S. D. (1999). Watershed management and nonpoint source pollution: The Massachusetts approach. *Boston College Environmental Affairs Law Review*, *26*, 339–386.

Andres, R. J., Boden, T. A., Bréon, F. M., Ciais, P., Davis, S., Erickson, D., … Treanton, K. (2012). A synthesis of carbon dioxide emissions from fossil-fuel combustion. *Biogeosciences*, *9*(5), 1845–1871. https://doi.org/10.5194/bg-9-1845-2012

Angelo, M. J., & Morris, J. (2014). Maintaining a healthy water supply while growing a healthy food supply: Legal tools for cleaning up agricultural water pollution. *Kansas Law Review*, *62*, 1003–1041.

Apodaca, L. E. (2012). Nitrogen. *Mining Engineering*, *64*(6), 78–79.

Association of Clean Water Administrators. (2018). *Nutrient reduction progress tracker, version 1.0*. Retrieved from https://www.acwa-us.org/wp-content/uploads/2018/03/Nutrient-Reduction-Progress-Tracker-Version-1.0-2017-Report.pdf

Backer, L. C. (2002). Cyanobacterial harmful algal blooms (CyanoHABs): Developing a public health response. *Lake and Reservoir Management*, *18*(1), 20–31. https://doi.org/10.1080/07438140209353926

Bekkerman, A., Brester, G., & Ripplinger, D. (2020). The history, consolidation, and future of the U.S. nitrogen fertilizer production industry. *Choices: The Magazine of Food, Farm, and Resource Issues*, *35*(2), 1–7.

Biber, E. (2017). Law in the Anthropocene epoch. *Georgetown Law Journal*, *106*(1), 1–68. https://doi.org/10.2139/ssrn.2834037

Bingham, M., Sinha, S. K., & Lupi, F. (2015). *Economic benefits of reducing harmful algal blooms in Lake Erie*. Environmental Consulting & Technology, Inc., Report.

Bloom, A. J. (1997). Nitrogen as a limiting factor. In L. E. Jackson (Ed.), *Ecology in Agriculture* (pp. 145–162). New York.

Bookbinder, D. (2017, September 28). *Global warming tort litigation: Two very different approaches*. Retrieved from https://www.niskanencenter.org/global-warming-tort-litigation-two-different-approaches/

Boudreaux, K., & Yandle, B. (2003). Public bads and public nuisance: Common law remedies for environmental decline. *Fordham Environmental Law Journal*, *14*(1), 55–88.

Brender, J. D., Weyer, P. J., Romitti, P. a, Mohanty, B. P., Shinde, M. U., Vuong, A. M., … Canfield, M. A. (2013). Prenatal nitrate intake from drinking water and

selected birth defects in offspring of participants in the National Birth Defects Prevention Study. *Environmental Health Perspectives*, *121*(9), 1083–1089.

Burger, M., Horton, R., & Wentz, J. (2020). The law and science of climate change attribution. *Columbia Journal of Environmental Law*, *45*(1), 57–240.

Burkett, M. (2011). Climate justice and the elusive climate tort. *The Yale Law Journal Online*, *121*(115), 115–119.

Burns, D. A., Boyer, E. W., Elliott, E. M., & Kendall, C. (2009). Sources and transformations of nitrate from streams draining varying land uses: Evidence from dual isotope analysis. *Journal of Environmental Quality*, *38*(3), 1149–1159. https://doi.org/10.2134/jeq2008.0371

Burtraw, D., Fraas, A., & Richardson, N. (2011). Greenhouse gas regulation under the Clean Air Act: A guide for economists. *Review of Environmental Economics and Policy*, *5*(2), 293–313. https://doi.org/10.1093/reep/rer009

Butler, H. N. (2008). A defense of common law environmentalism: The discovery of better environmental policy. *Case Western Reserve Law Review*, *58*(3), 705–752.

Canning, J. F., & Stillwell, A. S. (2018). Nutrient reduction in agricultural green infrastructure: An analysis of the Raccoon River Watershed. *Water*, *10*, 749. https://doi.org/10.3390/w10060749

Caruso, K. A. (2014). Associational standing for cities. *Connecticut Law Review*, *47*(1), 59–100.

Cassman, K. G., Dobermann, A., & Walters, D. T. (2002). Agroecosystems, nitrogen-use efficiency, and nitrogen management. *AMBIO: A Journal of the Human Environment*, *31*(2), 132–140. https://doi.org/10.1016/0960-1686(90)90168-M

Center for Land Use Interpretation. (2019). Land Use Database. Retrieved December 12, 2020, from Land Use Database website: https://www.clui.org/ludb

Centner, T. J. (2006). Creating an "Undeveloped Lands Protection Act" for farmlands, forests, and natural areas. *Duke Environmental Law and Policy Forum*, *17*(1), 1–62.

Centner, T. J. (2010). Nutrient pollution from land applications of manure: Discerning a remedy for pollution. *Stanford Law & Policy Review*, *21*, 213.

Centner, T. J. (2014). Damages from pesticide spray drift under trespass law. *Ecology Law Currents*, *41*, 1–17.

Chen, J. (1995). Get green or get out: Decoupling environmental from economic objectives in agricultural regulation. *Oklahoma Law Review*, *48*, 333.

Chynoweth, P. (2008). Legal research. In A. Knight & L. Ruddock (Eds.), *Advanced Research Methods in the Built Environment* (pp. 28–38). Oxford: Wiley-Blackwell.

Coase, R. H. (1960). The problem of social cost. *The Journal of Law and Economics*, *3*, 1–44.

Conrad, S., Osterberg, D., & Burkart, M. R. (2016). *Water quality in Iowa and the Mississippi River Basin*. Iowa City, Iowa.

Cook, G. A., & Lauer, C. M. (1968). *The encyclopedia of the chemical elements*. New York: Reinhold Book Corporation.

Coppess, J. (2016, February 25). Dead zones & drinking water, part 1: RCPP and review. *Farmdoc Daily*, (6), 37. Retrieved from https://farmdocdaily.illinois.edu/2016/02/dead-zones-drinking-water-part1.html

Craig, R. K., & Roberts, A. M. (2015). When will governments regulatenonpoint source pollution? A comparative perspective. *Boston College Environmental Affairs Law Review*, *42*(1), 1–64.

Crawford, A. (2016). Nutrient pollution and the Gulf of Mexico dead zone: Will Des Moines Water Works be a turning point? *Tulane Law Review*, *91*(1), 157.

Culman, S., Fulford, A., Camberato, J., Steinke, K., Lindsey, L., LaBarge, G., … Warncke, D. (2020). *Tri-state fertilizer recommendations for corn, soybeans, wheat and alfalfa. Extension Bulletin E-2567*. College of Food, Agricultural, and Environmental Sciences. Columbus, OH: The Ohio State University.

Cupp, R. L., & Polage, D. (2002). The rhetoric of strict products liability versus negligence: An empirical analysis. *New York University Law Review*, *77*(4), 874–961.

Cusack, M. E. (1993). Judicial interpretation of state constitutional rights to a healthful environment. *Boston College Environmental Affairs Law Review*, *20*(1), 173–202.

Daberkow, S., & Huang, W. (2006). Nutrient management. In *Agricultural Resources and Environmental Indicators* (pp. 117–123). US Department of Agriculture, Economic Research Service.

Dana, D. A. (2008). *The mismatch between public nuisance law and global warming*. Northwestern Law & Econ Research Paper No. 08-05, Northwestern Public Law Research Paper No. 08-16. http://dx.doi.org/10.2139/ssrn.1129838.

Davenport, T., & Drake, W. (2011). Grand Lake St. Marys, Ohio—The case for source water protection: Nutrients and algae blooms. *North American Lake Management Society: LakeLine Magazine*, *31*(3), 41–46.

David, M. B., Drinkwater, L. E., & McIsaac, G. F. (2010). Sources of nitrate yields in the Mississippi River Basin. *Journal of Environmental Quality*, *39*(5), 1657–1667. https://doi.org/10.2134/jeq2010.0115

Deng, J., Qin, B., Paerl, H. W., Zhang, Y., Ma, J., & Chen, Y. (2014). Earlier and warmer springs increase cyanobacterial (Microcystis spp.) blooms in subtropical Lake Taihu, China. *Freshwater Biology*, *59*(5), 1076–1085. https://doi.org/10.1111/fwb.12330

Dirth, E. M. (2018). Successful agriculture and clean water: A workable path forward for regulating drainage districts as point sources under the Clean Water Act. *Iowa Law Review*, *103*(3), 1213–1244.

Dolan, E. (2020, December 10). Taking Locke seriously: Of government, property rights, and climate change. *Niskanen Center*. Retrieved from https://www.niskanencenter.org/taking-locke-seriously-of-government-property-rights-and-climate-change/

Doremus, H., & Tarlock, A. D. (2012). Can the U.S. Clean water act succeed as an ecosystem protection law? *Journal of Water Law*, *23*(1), 3–23.

Dowd, B. M., Press, D., & Huertos, M. L. (2008). Agricultural nonpoint source water pollution policy: The case of California's Central Coast. *Agriculture, Ecosystems and Environment*, *128*, 151–161. https://doi.org/10.1016/j.agee.2008.05.014

Drabick, J. (2005). "Private" public nuisance and climate change: Working within, and around, the special injury rule. *Fordham Environmental Law Review*, *16*(3), 503–541.

Drugmand, D. (2018, February 8). As San Francisco, Oakland press climate cases, they pay homage to tiny Kivalina. *The Climate Docket*. Retrieved from https://www.climatedocket.com/2018/02/08/san-francisco-oakland-climate-lawsuit-kivalina-alaska/

Dubrovsky, N. M., Burow, K. R., Clark, G. M., Gronberg, J. M., Hamilton, P. A., Hitt, K. J., … Rupert, M. G. (2010). The quality of our Nation's waters—

Nutrients in the Nation's streams and groundwater, 1992–2004. *U.S. Geological Survey Circular*, *1350*(2), 174.

Duffy, M. (2009). Climate change causation: Harmonizing tort law and scientific probability. *Temple Journal of Science Technology & Environmental Law*, *28*(2), 185–242.

Ekwurzel, B., Boneham, J., Dalton, M. W., Heede, R., Mera, R. J., Allen, M. R., & Frumhoff, P. C. (2017). The rise in global atmospheric CO2, surface temperature, and sea level from emissions traced to major carbon producers. *Climatic Change*, *144*(4), 579–590. https://doi.org/10.1007/s10584-017-1978-0

Eller, D. (2018, June 22). Iowa nitrogen pollution in the water is getting worse, despite hundreds of millions of dollars in spending, study shows. *Des Moines Register*. Retrieved from https://www.desmoinesregister.com/story/money/agriculture/2018/06/22/iowa-water-pollution-gulf-mexico-dead-zone-nitrogren-missouri-mississippi-river-quality-nirtate/697370002/

Elliott, E. D., Ackerman, B. A., & Millian, J. C. (1985). Toward a theory of statutory evolution: the federalization of environmental law. *Journal of Law, Economics, & Organization*, *1*(2), 313–340.

English, B. A., & Carroll, J. J. (2015). State constitutions and environmental bills of rights. In *The Book of the States 2015* (pp. 18–22). The Council of State Governments.

Evans, G., & Jones, L. (2001). *Economic impact of the 2000 red tide on Galveston County, Texas: A case study.* Texas Parks and Wildlife District: Final Report TPWD No.6662266, FAMIS 403206.

Frank, R. (2011, November 28). Kivalina and the courts: Justice for America's first climate refugees? *Legal Planet*. Retrieved from http://legalplanet.wordpress.com/2011/11/28/kivalina-and-the-courts-justice-for-americas-first-climate-refugees/

Franzen, D. (2015). Economics and nitrogen fertilization for corn and wheat in the Northern Great Plains. *Crops & Soils*, *48*(5), 14–19. https://doi.org/10.2134/cs2015-48-5-3

Fritz, K. (2020). Public pollution/public solution: A framework for city-led toxic tort litigation. *NYU Environmental Law Journal*, *28*(3), 319.

Galloway, J. N., Leach, A. M., Bleeker, A., & Erisman, J. W. (2013). A chronology of human understanding of the nitrogen cycle. *Philosophical Transactions of the*

Royal Society B: Biological Sciences, *368*, 20130120. https://doi.org/10.1098/rstb.2013.0120

Ganguly, G., Setzer, J., & Heyvaert, V. (2018). If at first you don't succeed: Suing corporations for climate change. *Oxford Journal of Legal Studies*, *38*(4), 841–868. https://doi.org/10.1093/ojls/gqy029

Gannon, M. (2016, February 4). Water Works lawsuit started overdue discussion. *Des Moines Register*. Retrieved from http://www.desmoinesregister.com/story/opinion/abetteriowa/ 2%0A2016/0 /04/water-works-lawsuit-started-overdue-discussion/79767154/

Garovoy, J. B. (2003). "A breathtaking assertion of power"? Not quite. Pronsolino v. Nastri and the still limited role of federal regulation of nonpoint source pollution. *Ecology Law Quarterly*, *30*(3), 543–568.

Garside, M. (2020). Ammonia annual production capacity globally 2030. Retrieved December 12, 2020, from Statista website: https://www.statista.com/statistics/1065865/ammonia-production-capacity-globally/

Gavioli, L. L. (2004). Who should pay: Obstacles to cities in using affirmative litigation as source of revenue. *Tulane Law Review*, *78*(3), 941–968.

Geertz, C. (1995). *After the fact: Four decades, two countries, one anthropologist*. Cambridge, Massachusetts: Harvard University Press.

Geistfeld, M. A. (2014). Tort law in the age of statutes. *Iowa Law Review*, *99*(3), 967–1020.

Gerba, C. P., & Pepper, I. L. (2020). Chapter 24: Drinking water treatment. In *Environmental and Pollution Science* (3rd ed., pp. 435–454). https://doi.org/10.1016/B978-0-12-814719-1.00024-0

Gerrard, M. B. (2011). What litigation of climate nuisance suit might look like. *Sustainable Development Law & Policy*, *12*(2), 12–14.

Glibert, P. M., & Burkholder, J. M. (2006). The complex relationships between increases in fertilization of the earth, coastal eutrophication and proliferation of harmful algal blooms. In *The Economic Effects of Harmful Algal Blooms* (pp. 341–354). Springer, Berlin, Heidelberg.

Glicksman, R. L. (1993). Watching the river flow: The prospects for improved interstate water pollution control. *Washington University Journal of Urban & Contemporary Law*, *43*, 119. https://doi.org/10.3868/s050-004-015-0003-8

Glicksman, R. L. (2018). The firm constitutional foundation and shaky political future of environmental cooperative federalism. In C. P. Banks (Ed.), *Controversies in American Federalism and Public Policy* (pp. 132–150). https://doi.org/10.4324/9781315178448

Glicksman, R. L., & Batzel, M. R. (2010). Science, politics, law, and the arc of the Clean Water Act: the role of assumptions in the adoption of a pollution control landmark. *Washington University Journal of Law and Policy*, *32*, 99–138.

Gramig, B. M., Massey, R., & Yun, S. Do. (2017). Nitrogen application decision-making under climate risk in the U.S. Corn Belt. *Climate Risk Management*, *15*, 82–89. https://doi.org/10.1016/j.crm.2016.09.001

Grand View Research. (2019). Nitrogenous fertilizer market size, share & trends analysis report by product, by application, by region, and segment forecasts, 2019-2025 (summary). Retrieved December 12, 2020, from https://www.grandviewresearch.com/industry-analysis/nitrogenous-fertilizer-market

Grandy, A., Kallenbach, C., Loecke, T. D., Snapp, S. S., & Smith, R. G. (2012). The biological basis for nitrogen management in agroecosystems. In *Microbial Ecology in Sustainable Agroecosystems* (pp. 113–132). https://doi.org/doi:10.1201/b12339-7\r10.1201/b12339-7

Granéli, E., & Turner, J. T. (2006). *Ecology of harmful algae*. Ecological Studies Vol. 189. Springer.

Graven, H., Keeling, R. F., & Rogelj, J. (2020). Changes to carbon isotopes in atmospheric CO2 over the industrial era and into the future. *Global Biogeochemical Cycles*, *34*. https://doi.org/10.1029/2019GB006170

Green, H. M. (1997). Common law, property rights and the environment: A comparative analysis of historical developments in the United States and England and a model for the future. *Cornell International Law Journal*, *30*(2), 541–586.

Groff, S. (2015). The past, present, and future of the cover crop industry. *Journal of Soil and Water Conservation*, *70*(6), 130A-133A. https://doi.org/10.2489/jswc.70.6.130A

Grossman, D. A. (2003). Warming up to a not-so-radical idea: tort-based climate change litigation. *Columbia Journal of Environmental Law*, *28*, 1–61. https://doi.org/10.3868/s050-004-015-0003-8

Guercio, L. D. (2011). The struggle between man and nature - agriculture, nonpoint source pollution, and clean water: How to implement the State of Vermont's phosphorous TMDL within the Lake Champlain Basin. *Vermont Journal of Environmental Law*, *12*, 455–545.

Halvorson, A. D., Schweissing, F. C., Bartolo, M. E., & Reule, C. A. (2005). Corn response to nitrogen fertilization in a soil with high residual nitrogen. *Agronomy Journal*, *97*(4), 1222–1229. https://doi.org/10.2134/agronj2004.0279

Hancock, D. R., & Algozzine, B. (2006). *Doing case study research*. New York: Teachers College Press.

Harcourt, B. E. (2000). After the "social meaning turn": Implications for research design and methods of proof in contemporary criminal law policy analysis. *Law & Society Review*, *34*(1), 179–211.

Heede, R. (2014). Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854-2010. *Climatic Change*, *122*(1–2), 229–241. https://doi.org/10.1007/s10584-013-0986-y

Hellerstein, D., Vilorio, D., & Ribaudo, M. (2019). Agricultural resources and environmental indicators, EIB-208. In *Economic Information Bulletin*. U.S. Department of Agriculture, Economic Research Service.

Helsel, D. R. (1995). Nitrate in the nation's waters: A summary of recent studies. *Journal of Contemporary Water Research and Education*, *101*(1), 12–17.

Hester, T. (2018). Climate tort federalism. *FIU Law Review*, *13*(1), 79–101.

Hilborn, E. D., Roberts, V. A., Backer, L., DeConno, E., Egan, J. S., Hyde, J. B., … Hlavsa, M. C. (2014). Algal bloom-associated disease outbreaks among users of freshwater lakes: United States, 2009-2010. *Morbidity and Mortality Weekly Report*, *63*(1), 11–15.

Hoagland, P., Jin, D., Polansky, L. Y., Kirkpatrick, B., Kirkpatrick, G., Fleming, L. E., … Backer, L. C. (2009). The costs of respiratory illnesses arising from Florida gulf coast Karenia brevis blooms. *Environmental Health Perspectives*, *117*(8), 1239–1243. https://doi.org/10.1289/ehp.0900645

Hodas, D. R. (2000). Standing and climate change: Can anyone complain about the weather? *Journal of Transnational Law and Policy*, *9*, 451–488.

Hoeft, R. G. (2004). Environmental and agronomic fate of fertilizer nitrogen. *Environmental Impact of Fertilizer on Soil and Water*, *872*, 235–243. https://doi.org/10.1021/bk-2004-0872.ch017

Horton, R. M., Mankin, J. S., Lesk, C., Coffel, E., & Raymond, C. (2016). A review of recent advances in research on extreme heat events. *Current Climate Change Reports*, *2*(4), 242–259. https://doi.org/10.1007/s40641-016-0042-x

Houck, O. A. (2002). *The Clean Water Act TMDL program: Law, policy, and implementation* (2d ed.). Environmental Law Institute.

Houck, O. A. (2011). The Clean Water Act returns (again): Part I, TMDLs and the Chesapeake Bay. *Environmental Law Reporter*, *41*(3), 10208–10228.

Houck, O. A. (2014). Cooperative federalism, nutrients, and the Clean Water Act: three cases revisited. *Environmental Law Reporter News & Analysis*, *44*, 10426.

Howarth, R. W. (2008). Coastal nitrogen pollution: A review of sources and trends globally and regionally. *Harmful Algae*, *8*(1), 14–20. https://doi.org/10.1016/j.hal.2008.08.015

Hsu, S. (2008). A realistic evaluation of climate change litigation through the lens of a hypothetical lawsuit. *University of Colorado Law Review*, *79*, 701.

Hunter, D., & Salzman, J. (2007). Negligence in the air: The duty of care in climate change litigation. *University of Pennsylvania Law Review*, *155*(6), 1741–1794.

Hylton, K. N. (2008). The economic theory of nuisance law and implications for environmental regulation. *Case Western Reserve Law Review*, *58*(3), 673–704.

Hylton, K. N. (2013). The law and economics of products liability. *Notre Dame Law Review*, *88*(5), 2457.

IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (R. K. Pachauri & L. A. Meyer, Eds.). Geneva, Switzerland.

Jenkinson, D. S. (2001). The impact of humans on the nitrogen cycle, with focus on temperate arable agriculture. *Plant and Soil*, *228*(1), 3–15. https://doi.org/10.1023/A:1004870606003

Jin, D., Thurnberg, E., & Hoagland, P. (2008). Economic impact of the 2005 red tide event on commercial shellfish fisheries in New England. *Ocean & Coastal Management*, *51*, 420–429.

Jones, C. S., Nielsen, J. K., Schilling, K. E., & Weber, L. J. (2018). Iowa stream nitrate and the Gulf of Mexico. *PLoS ONE*, *13*(4), 1–17. https://doi.org/10.1371/journal.pone.0195930

Junk, G., & Svec, H. J. (1958). The absolute abundance of the nitrogen isotopes in the atmosphere and compressed gas from various sources. *Geochimica et Cosmochimica Acta*, *14*(3), 234–243.

Kashian, R., & Kasper, J. (2010). *Tainter Lake and Lake Menomin: The impact of diminishing water quality on value*. Retrieved from https://www.uww.edu/Documents/colleges/cobe/ferc/TainterLakes.pdf

Keeton, P. (1984). *Prosser and Keeton on the Law of Torts*. West Publishing Company.

Kendall, C., Campbell, D. H., Burns, D. a, Shanley, J. B., Silva, S. R., & Chang, C. C. Y. (1995). Tracing sources of nitrate in snowmelt runoff using the oxygen and nitrogen isotopic compositions of nitrate. *Biogeochemistry of Seasonally Snow-Covered Catchments (Proceedings of a Boulder Symposium, July 1995)*, (228), 339–347.

Kerr, L. (2014). Compelling a nutrient pollution solution: How nutrient pollution litigation is redefining cooperative federalism under the Clean Water Act. *Environmental Law*, *44*, 1219–1254. https://doi.org/10.3868/s050-004-015-0003-8

Kershen, D. L. (1995). Agricultural water pollution: From point to nonpoint and beyond. *Natural Resources & Environment*, *9*(3), 3–65.

Kozacek, C. (2014, August 25). Seven Ohio drinking water sources don't meet state water quality standards for toxic algae. *Circle of Blue*. Retrieved from https://www.circleofblue.org/2014/world/seven-ohio-drinking-water-sources-dont-meet-state-water-quality-standards-toxic-algae/

Kysar, D. A. (2011). Lecture: What climate change can do about tort law. *Environmental Law*, *41*, 1–71.

Larkin, S. L., & Adams, C. M. (2007). Harmful algal blooms and coastal business: Economic consequences in Florida. *Society and Natural Resources*, *20*(9), 849–859. https://doi.org/10.1080/08941920601171683

Lessig, L. (1998). The New Chicago School. *Journal of Legal Studies*, *27*, 661–691.

Lichtenberg, E., & Shapiro, L. K. (1997). Agriculture and nitrate concentrations in Maryland community water system wells. *Journal of Environmental Quality*, *26*(1), 145–153.

Lin, A. C., & Burger, M. (2018). State public nuisance claims and climate change adaptation. *Pace Environmental Law Review*, *36*(1), 49–94.

Loo, E. J. T. (1977). State land use statutes: A comparative analysis. *Fordham Law Review*, *45*(6), 1154–1178.

Lusk, J. L. (2013). Lunch with Pigou: Externalities and the "hidden" cost of food. *Agricultural and Resource Economics Review*, *42*(3), 419–435. https://doi.org/10.1017/S1068280500004913

Lyon, T. P., & Maxwell, J. W. . (2002). "Voluntary" approaches to environmental regulation: A survey. In M. Franzini & A. Nicita (Eds.), *Economic Institutions and Environmental Policy* (pp. 142–174). Aldershot, Hampshire, UK: Ashgate Publishing Ltd.

Malone, L. A. (2002). The myths and truths that ended the 2000 TMDLprogram. *Pace Environmental Law Review*, *20*(1), 63–87.

Mancini, S., Pence, W., Kavanaugh, M., Davidson, M., & Sherwood, B. (2017). The "CSI" in environmental forensics: Using compound-specific isotope analysis in legal matters. *Natural Resources & Environment*, *31*, 37.

Matson, P. A., Parton, W. J., Power, A. G., & Swift, M. J. (1997). Agricultural intensification and ecosystem properties. *Science*, *277*(5325), 504–509.

Mayer, P. M., Reynolds, S. K., McCutchen, M. D., & Canfield, T. J. (2007). Meta-analysis of nitrogen removal in riparian buffers. *Journal of Environmental Quality*, *36*(4), 1172–1180. https://doi.org/10.2134/jeq2006.0462

McElfish, J. M. J., Austin, J., & Bernstein, T. (1998). *Almanac of enforceable state laws to control nonpoint source water pollution*. Retrieved from http://www.eli.org/research-report/almanac-enforceable-state-laws-control-nonpoint-source-water-pollution

McMahon, P. B., Böhlke, J. K., Kauffman, L. J., Kipp, K. L., Landon, M. K., Crandall, C. A., … Brown, C. J. (2008). Source and transport controls on the movement of nitrate to public supply wells in selected principal aquifers of the United States. *Water Resources Research*, *44*(4), 1–17. https://doi.org/10.1029/2007WR006252

McRae, W. A. J. (1948). The development of nuisance in the early common law. *University of Florida Law Journal*, *1*, 27.

Meiners, R., & Yandle, B. (1999). Common law and the conceit of modern environmental policy. *George Mason Law Review*, *7*(1), 923. https://doi.org/10.3868/s050-004-015-0003-8

Mergers in the fertiliser industry: A growth business. (2010, February). *The Economist*. Retrieved from https://www.economist.com/business/2010/02/18/a-growth-business

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.

Merrill, T. W. (2011). Is public nuisance a tort? *Journal of Tort Law*, *4*(2), 1. https://doi.org/10.2202/1932-9148.1113

Miller, L. L. (2018). The use of case studies in social science research. *Annual Review of Law and Social Science*, *14*, 381–396. https://doi.org/10.4135/9780857028051

Mistiaen, J. A., Strand, I. E., & Lipton, D. (2003). Effects of environmental stress on blue crab (Callinectes sapidus) harvests in Chesapeake Bay tributaries. *Estuaries*, *26*(2), 316–322. https://doi.org/10.1007/bf02695970

Moore, E., Matalon, E., Balazs, C., Clary, J., Firestone, L., De Anda, S., … Luu, P. (2011). *The human costs of nitrate-contaminated drinking water in the San Joaquin Valley*. Retrieved from http://www.pacinst.org/reports/nitrate_contamination/

Mosheim, R., & Ribaudo, M. (2017). Costs of nitrogen runoff for rural water utilities: A shadow cost approach. *Land Economics*, *93*(1), 12–39. https://doi.org/10.3368/le.93.1.12

Mueller, D. K., & Helsel, D. R. (1996). *Nutrients in the nation's waters: too much of a good thing? U.S. Geological Survey Circular 1136*. U.S. Geological Survey.

Murgulet, D., & Tick, G. R. (2013). Understanding the sources and fate of nitrate in a highly developed aquifer system. *Journal of Contaminant Hydrology*, *155*(3), 69–81. https://doi.org/10.1016/j.jconhyd.2013.09.004

Musgrove, M., Opsahl, S. P., Mahler, B. J., Herrington, C., Sample, T. L., & Banta, J. R. (2016). Source, variability, and transformation of nitrate in a regional karst aquifer: Edwards aquifer, central Texas. *Science of the Total Environment*, *568*, 457–469. https://doi.org/10.1016/j.scitotenv.2016.05.201

National Park Service. (2018). Mississippi River Facts. Retrieved December 12, 2020, from https://www.nps.gov/miss/riverfacts.htm

National Research Council. (2000). *Clean Coastal Waters*. Washington, D.C.: Committee on the Causes and Management of Coastal Eutrophication, Ocean

Studies Board, Water Science & Technology Board Commission on Geosciences Environment and Resources. The National Academies Press.

National Research Council. (2008). *Mississippi River Water quality and the Clean Water Act: Progress, challenges, and opportunities*. Washington, D.C.: The National Academies Press.

National Science and Technology Council. (2017). *Harmful Algal Blooms and Hypoxia Comprehensive Research Plan and Action Strategy: An Interagency Report*. https://doi.org/10.13140/RG.2.2.33266.20167

Nelson, R. (2011). Regulating nonpoint source pollution in the US: A regulatory theory lpproach to Lessons and research paths for Australia. *University of Western Australia Law Review*, *35*, 340.

Nick, A. B. (2008). Market share liability and punitive damages: The case for evolution in tort law. *Columbia Journal of Law and Social Problems*, *42*, 225.

NOAA. (2015, August 4). *2015 Gulf of Mexico dead zone 'above average.'* Retrieved from https://www.noaa.gov/media-release/2015-gulf-of-mexico-dead-zone-above-average

NOAA. (2017, August 2). *Gulf of Mexico 'dead zone' is the largest ever measured*. Retrieved from https://www.noaa.gov/media-release/gulf-of-mexico-dead-zone-is-largest-ever-measured

Noble, M. L., & Looney, J. W. (1994). The emerging legal framework for animal agricultural waste management in Arkansas. *Arkansas Law Review*, *47*, 159.

Nordhaus, W. (2019). Climate change: The ultimate challenge for economics. *American Economic Review*, *109*(6), 1991–2014. https://doi.org/10.1257/aer.109.6.1991

Nuccitelli, D. (2019, June 21). The Trump EPA strategy to undo the Clean Power Plan. *Yale Climate Connections*. Retrieved from https://yaleclimateconnections.org/2019/06/the-trump-epa-strategy-to-undo-the-clean-power-plan/

Olszynski, M., Mascher, S., & Doelle, M. (2018). From smokes to smokestacks: Lessons from tobacco for the future of climate change liability. *The Georgetown Environmental Law Review*, *30*(1), 1–45.

Osofsky, H. (2012). Litigation's role in the path of U.S. federal climate change regulation: Implications of AEP v. Connecticut. *Valparaiso University Law Review*, *46*(2), 447–457.

Paerl, H. W., & Paul, V. J. (2012). Climate change: Links to global expansion of harmful cyanobacteria. *Water Research*, *46*(5), 1349–1363. https://doi.org/10.1016/j.watres.2011.08.002

Pasquale, F., Palladino, L., McCluskey, M. T., Haskell, J. D., Kroncke, J. J., Moudud, J. K., … Dibadj, R. (2019). Eleven things they don't tell you about law & economics: An informal introduction to political economy and law. *Law & Ineq.*, *37*, 97–148.

Paul, D. A., Kilmer, Ri. L., Altobello, M. A., & Harrington, D. N. (1977). *The changing U.S. fertilizer industry. Agricultural Economic Report No. 378*. United States Department of Agriculture, Economic Research Service.

Peel, J., & Osofsky, H. M. (2013). Climate change litigation's regulatory pathways: A comparative analysis of the United States and Australia. *Law & Policy*, *35*(3), 150–183. https://doi.org/10.1111/lapo.12003

Peñalver, E. (1998). Acts of God or toxic torts? Applying tort principles to the problem of climate change. *Natural Resources Journal*, *38*(4), 563–601.

Pennino, M. J., Leibowitz, S. G., Compton, J. E., Hill, R. A., & Sabo, R. D. (2020). Patterns and predictions of drinking water nitrate violations across the conterminous United States. *Science of the Total Environment*, *722*(March), 137661. https://doi.org/10.1016/j.scitotenv.2020.137661

Percival, R. V., Schroeder, C., Miller, A., & Leape, J. (2009). *Environmental regulation: Law,science, and policy*. Aspen Publishers.

Percival, R. V. (1998). Environmental legislation and the problem of collective action. *Duke Environmental Law and Policy Forum*, *9*(1), 9–26.

Perillo, L. A. (2004). Scraping beneath the surface: Finally holding lead-based paint manufacturers liable by applying public nuisance and market-share liability theories. *Hofstra L. Rev*, *32*, 1039. https://doi.org/10.3868/s050-004-015-0003-8

Philpott, T. (2015, August). The big-ag-fueled algae bloom that won't leave Toledo's water supply alone. *Mother Jones*. Retrieved from http://www.motherjones.com/tom-philpott/2015/08/giant-toxic-algae-bloom-haunts-toledo

Pittman, C. (2019, November 30). A decade of environmental traumas hurt Florida industry. *Tampa Bay Times*. Retrieved from https://www.tampabay.com/news/environment/2019/12/30/a-decade-of-environmental-traumas-hurt-florida-industry/

Pollans, M. J. (2016). Drinking water protection and agricultural exceptionalism. *Ohio State Law Journal*, *77*, 1195.

Porter, P. A., Mitchell, R. B., & Moore, K. J. (2015). Reducing hypoxia in the Gulf of Mexico: Reimagining a more resilient agricultural landscape in the Mississippi River Watershed. *Journal of Soil and Water Conservation*, *70*(3), 63A-68A. https://doi.org/10.2489/jswc.70.3.63A

Posner, R. A. (1972). A theory of negligence. *Journal of Legal Studies*, *1*, 29. https://doi.org/10.5840/socphiltoday1992725

Potter, R. L. (1972). Discharging new wine into old wineskins: The metamorphosis of the Rivers and Harbors Act of 1899. *University of Pittsburgh Law Review*, *33*(3), 483–532.

Puig, R., Soler, A., Widory, D., Mas-Pla, J., Domènech, C., & Otero, N. (2017). Characterizing sources and natural attenuation of nitrate contamination in the Baix Ter aquifer system (NE Spain) using a multi-isotope approach. *Science of the Total Environment*, *580*, 518–532. https://doi.org/10.1016/j.scitotenv.2016.11.206

Rabotyagov, S., Campbell, T., Jha, M., Gassman, P. W., Arnold, J., Kurkalova, L., … Kling, C. L. (2010). Least-cost control of agricultural nutrient contributions to the Gulf of Mexico hypoxic zone. *Ecological Applications*, *20*(6), 1542–1555. https://doi.org/10.1890/08-0680.1

Rezvani, F., Sarrafzadeh, M. H., Ebrahimi, S., & Oh, H. M. (2019). Nitrate removal from drinking water with a focus on biological methods: a review. *Environmental Science and Pollution Research*, *26*(2), 1124–1141. https://doi.org/10.1007/s11356-017-9185-0

Rhymes, C. M. (2012). Environmental contamination as continuing trespass. *Environmental Law*, *42*(4), 1381–1400.

Ribaudo, M., Delgado, J., Hansen, L., Livingston, M., Mosheim, R., & Williamson, J. (2011). *Nitrogen in agricultural systems: Implications for conservation policy.* Economic Research Report No. 127. U.S. Department of Agriculture, Economic Research Service.

Roisman, A. Z., & Wolff, A. (2010). Trespass by pollution: Remedy by mandatory injunction. *Fordham Environmental Law Review*, *21*(1), 157–191.

Rubin, E. L. (1997). Law and society & law and economics: Common ground, irreconcilable differences, new directions: Law and the methodology of law. *Wisconsin Law Review*, *1997*, 521.

Ruddin, L. P. (2006). You can generalize stupid! Social scientists, Bent Flyvbjerg, and case study methodology. *Qualitative Inquiry*, *12*(4), 797–812. https://doi.org/10.1177/1077800406288622

Ruhl, J. (2000). Farms, their environmental harms, and environmental law. *Ecology Law Quarterly*, *27*, 263–350.

Ruhl, J., & Salzman, J. (2013). Climate chnage meets the law of the horse. *Duke Law Journal*, *62*(5), 975–1027.

Ruppert, T. K. (2016). Water quality trading and agricultural nonpoint source pollution: An analysis of the effectiveness and fairness of EPA's policy on water quality trading. *Villanova Environmental Law Journal*, *15*, 1–27.

Russo, M. (2018). Productive public nuisance: How private individuals can use public nuisance to achieve environmental objectives. *University of Illinois Law Review*, *2018*(5), 1969.

Savit, E. (2019). States empowering plaintiff cities. *University of Michigan Journal of Law Reform*, *52*, 581.

Sawyer, J. (2015). *Nitrogen use in Iowa corn production*. Extension and Outreach Publications, No. 107. Iowa State University.

Sax, J. (2007). Preface. In C. Rechtschaffen & D. Antolini (Eds.), *Creative common law strategies for protecting the environment*. Environmental Law Institute.

Scharf, P. (2015). *Managing nitrogen in crop production*. American Society of Agronomy.

Schauer, F., & Spellman, B. A. (2017). Analogy, expertise, and experience. *The University of Chicago Law Review*, *84*(1), 249–268.

Schroeder, C. H. (1998). Rational choice versus republican moment-explanations for environmental laws, 1969-73. *Duke Environmental Law & Policy Forum*, *9*(1), 29–60.

Schwartz, J. (2017, February 7). 'A conservative climate solution': Republican group calls for carbon tax. *The New York Times*. Retrieved from https://www.nytimes.com/2017/02/07/science/a-conservative-climate-solution-republican-group-calls-for-carbon-tax.html

Schwartz, J. (2018, June 18). Climate lawsuits, once limited to the coasts, jump inland. *The New York Times*. Retrieved from

https://www.nytimes.com/2018/04/18/climate/exxon-climate-lawsuit-colorado.html

Seamans, F. L. (1960). Relations between corporate legal departments and outside counsel. *Business Lawyer*, *15*(3), 633–637.

Sebok, A. J. (2016). Private dollars for public litigation: An introduction. *NYU Journal of Law & Business*, *12*(3), 813–832.

Shelley, T. M., & Love, A. H. (2015). A question of proof: Using isotope analysis and chemical fingerprinting to identify the source of contamination. *Environmental Claims Journal*, *27*(3), 264–275. https://doi.org/10.1080/10406026.2015.1063382

Shortle, J. S., & Horan, R. D. (2006). Water quality trading. *Penn State Environmental Law Review*, *14*(2), 231–250. https://doi.org/10.1142/9789814675444_0016

Sivas, D. (1987). Groundwater pollution from agricultural activities: policies for protection. *Stanford Environmental Law Journal*, *7*, 117.

Smart, C. M. (2016). The "right to commit nuisance" in North Carolina: A historical analysis of the Right-to-Farm Act. *North Carolina Law Review*, *94*(6), 2097–2154.

Smil, V. (2001). *Enriching the Earth: Fritz Haber, Carl Bosch, and the transformation of world food*. Cambridge, Massachusetts: MIT Press.

Smil, V. (2002). Nitrogen and food production. *Ambio*, *31*(2), 126.

Sophocles, & Carson, A. (2015). *Antigonick*. New York: New Directions.

Stainton, M., Salki, A., Hendzel, L., & Kling, H. (2003). *Ecosystem evidence for the need to remove phosphorus from the City of Winnipeg's wastewater effluents*. Manitoba Clean Environment Commission Public Hearing on the City of Winnipeg Wastewater Collection and Treatment Systems.

Stake, R. E. (1978). The case study method in social inquiry. *Educational Researcher*, *7*(2), 5–8. https://doi.org/10.3102/0013189X007002005

Stake, R. E. (1995). *The art of case study research*. Sage Publications, Inc.

State-EPA Nutrient Innovations Task Group. (2009). *An urgent call to action: Report of the State-EPA Nutrient Innovations Task Group*. Retrieved from https://www.epa.gov/sites/production/files/documents/nitgreport.pdf

Stewart, R. B. (2001). A new generation of environmental regulation. *Capital University Law Review*, *29*(1), 21.

Sturchio, N. C., Beloso, A., Heraty, L. J., Wheatcraft, S., & Schumer, R. (2014). Isotopic tracing of perchlorate sources in groundwater from Pomona, California. *Applied Geochemistry*, *43*, 80–87. https://doi.org/10.1016/j.apgeochem.2014.01.012

Swan, S. L. (2018). Plaintiff cities. *Vanderbilt Law Review*, *71*(4), 1227–1291.

Tabuchi, H., & Fountain, H. (2017, June 1). Bucking Trump, these cities, states and companies commit to Paris Accord. *The New York Times*. Retrieved from https://www.nytimes.com/2017/06/01/climate/american-cities-climate-standards.html

Tarlock, A. D. (2002). The potential role of local governments in watershed management. *Pace Environmental Law Review*, *20*, 149.

TechSci Research. (2020). Global ammonia market, by grade, by application, by manufacturing process, by region, competition, forecast & opportunities, 2025 (Summary). Retrieved December 12, 2020, from Research and Markets website: https://www.researchandmarkets.com/reports/5134805/global-ammonia-market-by-grade-anhydrous

Temkin, A., Evans, S., Manidis, T., Campbell, C., & Naidenko, O. V. (2019). Exposure-based assessment and economic valuation of adverse birth outcomes and cancer risk due to nitrate in United States drinking water. *Environmental Research*, *176*(April), 108442. https://doi.org/10.1016/j.envres.2019.04.009

The Climate Docket. (2018, September 11). Why states may turn the tide in climate liability, led by Rhode Island. *The Climate Docket*. Retrieved from https://www.climatedocket.com/2018/09/11/rhode-island-states-climate-liability/

The Fertilizer Institute. (n.d.). *Operational U.S. Fertilizer Production Facilities - N, P & K*. Retrieved from https://www.tfi.org/sites/default/files/images/usproductionmaps%28updated%29.pdf

Thomas, M. (2016). Parens patriae and the states' historic police power. *SMU Law Review*, *69*(4), 759.

Thunberg, G. (2019, April 23). Speech to Members of Parliament. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2019/apr/23/greta-thunberg-full-speech-to-mps-you-did-not-act-in-time

Tian, H., Xu, R., Pan, S., Yao, Y., Bian, Z., Cai, W. J., … Yang, J. (2020). Long-term trajectory of nitrogen loading and delivery from Mississippi River Basin to the Gulf of Mexico. *Global Biogeochemical Cycles*, *34*(5). https://doi.org/10.1029/2019GB006475

Turner, R. E., & Rabalais, N. N. (2019). *2019 forecast: Summer hypoxic zone size, Northern Gulf of Mexico*. Retrieved from https://www.ngi.msstate.edu/portal/media/docs/2019/LSU_LUMCON_forecast_2019.pdf

Tzankova, Z. (2013). The difficult problem of nonpoint nutrient pollution: Could the Endangered Species Act offer some relief? *William & Mary Environmental Law and Policy Review*, *37*, 709.

U.S. EPA. (1995). *National water quality inventory: 1994 report to Congress* (Vol. 2). U.S. Environmental Protection Agency, Office of Water.

U.S. EPA. (2011). *Reactive nitrogen in the United States: An analysis of inputs, flows, consequences, and management options. EPA-SAB-11-013*. U.S. Environmental Protection Agency, Science Advisory Board, Integrated Nitrogen Committee.

U.S. EPA. (2015). *A compilation of cost data assocated with the impacts and control of nutrient pollution, EPA 820-F-15-096*. U.S. Environmental Protection Agency, Office of Water.

U.S. EPA. (2016). The Mississippi/Atchafalaya River Basin (MARB). Retrieved December 12, 2020, from https://www.epa.gov/ms-htf/mississippiatchafalaya-river-basin-marb

U.S. EPA. (2019). *Cyanobacteria and cyanotoxins: Information for drinking water systems, EPA-810F11001*. Retrieved from https://www.epa.gov/sites/production/files/2014-08/documents/cyanobacteria_factsheet.pdf

U.S. EPA. (2020a). *Commercial fertilizer purchased (Nutrient Indicators Dataset)*. Retrieved from https://www.epa.gov/nutrient-policy-data/commercial-fertilizer-purchased

U.S. EPA. (2020b). *Inventory of greenhouse gas emissions and sinks, 1990-2018. 430-R-20-002*. Retrieved from https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf

U.S. EPA. (2020c). State progress toward developing numeric nutrient water quality criteria for nitrogen and phosphorus. Retrieved from

https://www.epa.gov/nutrient-policy-data/state-progress-toward-developing-numeric-nutrient-water-quality-criteria

U.S. Global Change Research Group. (2017). *Fourth National Climate Assessment, Volume 1: Climate Science Special Report*. Retrieved from https://science2017.globalchange.gov/

U.S. Global Change Research Group. (2018). *Fourth National Climate Asessment, Volume 2: Impacts, Risks, and Adaptation in the United States*. Retrieved from https://nca2018.globalchange.gov/

Urresti-Estala, B., Vadillo-Pérez, I., Jiménez-Gavilán, P., Soler, A., Sánchez-García, D., & Carrasco-Cantos, F. (2015). Application of stable isotopes (δ34S-SO4, δ18O-SO4,δ15N-NO3, δ18O-NO3) to determine natural background and contamination sources in the Guadalhorce River Basin (southern Spain). *Science of the Total Environment*, *506–507*(3), 46–57. https://doi.org/10.1016/j.scitotenv.2014.10.090

USDA ERS. (2019). *U.S. consumption of selected nitrogen materials, fertilizer use and price*. Retrieved from https://www.ers.usda.gov/data-products/fertilizer-use-and-price/

USDA ERS. (2020). Agricultural resource management survey: Farm financial and crop production practices. Retrieved December 12, 2020, from https://www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices.aspx

USDA NASS. (2017). *2017 census of agriculture*. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/index.php

USDA NRCS. (1997). *America's private land: a geography of hope*. U.S. Department of Agriculture, Natural Resource Conservation Service.

USDA NRCS. (2006). *Model simulation of soil loss, nutrient loss, and change in soil organic carbon associated with crop production*. Washington, D.C.: U.S. Dept. of Agriculture, Natural Resources Conservation Service.

USDA NRCS. (2010). *2010 conservation activities: Mississippi River Basin Healthy Watersheds Initiative*. Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcsdev11_023950.pdf

USGS. (1998). A national look at nitrate contamination of drinking water, Nutrients National Synthesis Project. Retrieved December 12, 2020, from https://water.usgs.gov/nawqa/nutrients/pubs/wcp_v39_no12/

USGS. (2008). *Differences in Phosphorus and Nitrogen Delivery to the Gulf of Mexico from the Mississippi River Basin*. Retrieved from https://water.usgs.gov/nawqa/sparrow/gulf_findings/index.html

Vallejo, C., & Gloppen, S. (2013). Red-green lawfare and the context of climate change litigation. In J. Dugard, A. L. St. Clair, & S. Gloppen (Eds.), *Climate Talk: Rights, Poverty and Justice*. Cape Town: Juta & Co. Ltd.

Van Meter, K. J., Basu, N. B., Veenstra, J. J., & Burras, C. L. (2016). The nitrogen legacy: Emerging evidence of nitrogen accumulation in anthropogenic landscapes. *Environmental Research Letters*, *11*(3). https://doi.org/10.1088/1748-9326/11/3/035014

Vedachalam, S., Mandelia, A. J., & Heath, E. A. (2018). *Source water quality and the cost of nitrate treatment in the Mississippi River Basin*. Northeast-Midwest Institute.

Vitousek, P. M., Aber, J. D., Howarth, R. W., Likens, G. E., Matson, P. A., Schindler, D. W., … Tilman, D. G. (1997). Human alteration of the global nitrogen cycle: Sources and consequences. *Ecological Applications*, *7*(3), 737–750. https://doi.org/10.1089/adt.2015.692

Vitousek, P. M., Mooney, H. A., Lubchenco, J., & Melillo, J. M. (2008). Human domination of Earth's ecosystems. In *Urban ecology: An international perspective on the interaction between humans and nature* (pp. 3–13). Springer US.

Vos, N. (2017). Agricultural drainage and the Des Moines Water Works lawsuit. *Drake Journal of Agricultural Law*, *22*(3), 109–134.

Waldner, J. S. (2009). Into the black hole: Do local governments implement their spatial policies? *Land Use Policy*, *26*(3), 818–827.

Wang, S., Zheng, W., Currell, M., Yang, Y., Zhao, H., & Lv, M. (2017). Relationship between land-use and sources and fate of nitrate in groundwater in a typical recharge area of the North China Plain. *Science of the Total Environment*, *609*, 607–620. https://doi.org/10.1016/j.scitotenv.2017.07.176

Ward, M. H., & Brender, J. D. (2019). Drinking water nitrate and human health. *Encyclopedia of Environmental Health*, *15*(7), 173–186. https://doi.org/10.1016/B978-0-12-409548-9.11245-X

Ward, M. H., Jones, R. R., Brender, J. D., de Kok, T. M., Weyer, P. J., Nolan, B. T., … van Breda, S. G. (2018). Drinking water nitrate and human health: An

updated review. *International Journal of Environmental Research and Public Health*, *15*(7), 1–31. https://doi.org/10.3390/ijerph15071557

Watts, J. (2017, November 17). 'We should be on the offensive': James Hansen calls for wave of climate lawsuits. *The Guardian*. Retrieved from www.theguardian.com/environment/2017/nov/17/we-should-be-on-the-offensive-james-hansen-calls-for-wave-of-climate-lawsuits

Webley, L. (2010). Qualitative approaches to empirical legal research. In P. Cane & H. Kritzer (Eds.), *The Oxford Handbook of Empirical Legal Research* (pp. 1–21). https://doi.org/10.1093/oxfordhb/9780199542475.013.0039

Weiland, P. S. (2000). Federal and state preemption of environmental law: a critical analysis. *Harvard Environmental Law Review*, *24*, 237. https://doi.org/10.3868/s050-004-015-0003-8

Weiss, A. (2012). Federal numeric nutrient criteria in Florida: When cooperative federalism goes rogue. *Pace Environmental Law Review*, *30*(1), 299–324.

Williams, D. R. (2002). When Voluntary, Incentive-Based Controls Fail: Structuring a Regulatory Response to Agricultural Nonpoint Source Water Pollution. *Washington University Journal of Law & Policy*, *9*(21), 21–121. Retrieved from http://openscholarship.wustl.edu/law_journal_law_policy/vol9/iss1/3/

Woli, K. P., Boyer, M. J., Elmore, R. W., Sawyer, J. E., Abendroth, L. J., & Barker, D. W. (2016). Corn era hybrid response to nitrogen fertilization. *Agronomy Journal*, *108*(2), 473–486. https://doi.org/10.2134/agronj2015.0314

Xing, M., & Liu, W. (2016). Using dual isotopes to identify sources and transformations of nitrogen in water catchments with different land uses, Loess Plateau of China. *Environmental Science and Pollution Research*, *23*(1), 388–401. https://doi.org/10.1007/s11356-015-5268-y

Xue, D., Botte, J., De Baets, B., Accoe, F., Nestler, A., Taylor, P., … Boeckx, P. (2009). Present limitations and future prospects of stable isotope methods for nitrate source identification in surface- and groundwater. *Water Research*, *43*(5), 1159–1170. https://doi.org/10.1016/j.watres.2008.12.048

Yang, B., Ding, W., Zhang, H., & Zhang, S. (2020). Recent progress on electrochemical synthesis of ammonia from nitrogen: Strategies to improve the catalytic activity and selectivity. *Energy & Environmental Science (Accepted Manuscript)*.

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report*, *20*(2), 134–152.

Yin, R. K. (1994). Case study research: Design and Methods. First release. *Thousand Oaks: Sage*, 221–222. https://doi.org/10.1080/09500790.2011.582317

Yin, R. K. (2012). A (very) brief refresher on the case study method. In *Applications of case study research* (pp. 3–20). Thousand Oaks: Sage Publications, Inc.

Zaring, D. (1996). Agriculture, nonpoint source pollution, and regulatory control: The Clean Water Act's bleak present and future. *Harvard Environmental Law Review*, *20*, 515. https://doi.org/10.3868/s050-004-015-0003-8

Zhang, W., & Sohngen, B. (2018). Do U.S. anglers care about harmful algal blooms? A discrete choice experiment of Lake Erie recreational anglers. *American Journal of Agricultural Economics*, *100*(3), 868–888. https://doi.org/10.1093/ajae/aay006

Zheng, B., Zhao, Y., Qin, Y., Ma, Y., & Han, C. (2016). Input characteristics and sources identification of nitrogen in the three main tributaries of the Three Gorges Reservoir, China. *Environmental Earth Sciences*, *75*(17), 1–10. https://doi.org/10.1007/s12665-016-6028-0